Appendix A

Regulatory Background

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This appendix provides regulatory background for the project in terms of Federal, state, and local laws, ordinances, regulations, and planning guidance. This regulatory background indicates approvals that may be required for implementation of the project or contextual information to be considered in environmental analysis. Table A-1 presents a list of acronyms and abbreviations found in this appendix.

Table A-1. List of Acronyms and Abbreviations

AB	Assembly Bill
ACHP	Advisory Council on Historic Preservation
AG	California Attorney General
Alquist-Priolo Act	Alquist-Priolo Earthquake Fault Zoning Act
APE	area of potential effects
ARB	California Air Resources Board
ARPA	Archaeological Resources Protection Act
basin plan	water quality control plan
BCAQMD	Butte County Air Quality Management District
BMP	best management practice
Butte County FMP	Butte County Flood Mitigation Plan
Butte County MHMP	Butte County Multi-Jurisdictional All-Hazard Pre-Disaster Mitigation Plan
Butte Regional HCP/NCCP	Butte Regional Habitat Conservation Plan/Natural Community Conservation Plan
CAA	Clean Air Act
CAFE	Corporate Average Fuel Economy
Cal/EPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
CAPCOA	California Air Pollution Control Officers Association
Carl Moyer Program	Carl Moyer Memorial Air Quality Standards Attainment Program
CBSC	California Building Standards Code
CCA	Community Choice Aggregation
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CERCLA or Superfund	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CGS	California Geological Survey
CNEL	community noise equivalent level
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
CRHR	California Register of Historical Resources

CTR	California Toxics Rule
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CWA	Federal Clean Water Act
dbh	diameter at breast height
DO	dissolved oxygen
DWR	California Department of Water Resources
EFH	essential fish habitat
EIR	environmental impact report
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
ESP	energy service provider
ETL	Engineer Technical Letter
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Studies
FRAQMD	Feather River Air Quality Management District
FRWLP	Feather River West Levee Project
GC	Government Code
General Dewatering Order	General Order for Dewatering and Other Low Threat Discharges to Surface Waters
GHG	greenhouse gas
HCP	habitat conservation plan
ICLEI	International Council of Local Environmental Initiatives
ICW	Inspection of Completed Works
IOU	investor-owned utility
ISR	Indirect Source Review
LCFS	low carbon fuel standard
L_{dn}	day-night average sound level
LGOP	Local Government Operations Protocol
LOS	level of service
MBTA	Migratory Bird Treaty Act
MOA	memorandum of agreement
mpg	miles per gallon
MPO	metropolitan planning organization
MRZ	Mineral Resource Zone
MS4	Municipal Separate Storm Sewer Systems
MS4 Permit	National Pollutant Discharge Elimination System General Permit for Municipal Separate Storm Sewer Systems
MT	metric ton
MW	megawatt
NAGPRA	Native American Graves Protection and Repatriation Act
NAHC	Native American Heritage Commission
NCCP	natural community conservation plan
NCCPA	Natural Community Conservation Planning Act
NEPA	National Environmental Policy Act

NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NISC	National Invasive Species Council
NMFS	National Marine Fisheries Service
NOI	notice of intent
NO_X	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NTR	National Toxics Rule
OHWM	ordinary high water mark
OPR	Office of Planning and Research
PA	programmatic agreement
PL	Public Law
PM	particulate matter
Porter-Cologne Act	Porter-Cologne Water Quality Control Act of 1969
PPMP	pollution prevention and monitoring program
PRC	Public Resources Code
ROG	reactive organic gas
RPS	California's Renewable Portfolio Standard
RTP	regional transportation plan
RWQCB	regional water quality control board
SACOG	Sacramento Area Council of Governments
SAFCA	Sacramento Area Flood Control Agency
SB	Senate Bill
SBFCA	Sutter Butte Flood Control Agency
SCS	sustainable communities strategy
SHPO	State Historic Preservation Officer
SIP	state implementation plan
SMARA	Surface Mining and Reclamation Act of 1975
SOI	sphere of influence
SR	State Route
State Water Board	State Water Resources Control Board
SWMP	stormwater management plan
SWPPP	stormwater pollution prevention plan
TAC	toxic air contaminant
TMDL	Total Maximum Daily Load
ULDC	Urban Levee Design Criteria
Uniform Act	Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended in 1987 (42 USC 4601 et seq.)
USACE	U.S. Army Corps of Engineers
USC	U.S. Government Code
USFWS	U.S. Fish and Wildlife Service
VMT	vehicle miles traveled
WDR	waste discharge requirement

A.1 Federal Plans, Policies, and Regulations

A.1.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) is the nation's broadest environmental law, applying to all Federal agencies and most of the activities they manage, regulate, or fund that have the potential to affect the environment. It requires Federal agencies to disclose and consider the environmental implications of their proposed actions. NEPA establishes environmental policies for the nation, provides an interdisciplinary framework for Federal agencies to prevent environmental damage, and contains action-forcing procedures to ensure that Federal agency decision makers take environmental factors into account.

NEPA requires the preparation of an appropriate document to ensure that Federal agencies accomplish the law's purposes. The Council on Environmental Quality (CEQ) has adopted regulations and other guidance that provide detailed procedures that Federal agencies must follow to implement NEPA.

This document is the instrument for NEPA compliance for the project under U.S. Army Corps of Engineers' (USACE's) authority, as described in Chapter 1, *Introduction*.

A.1.2 Federal Endangered Species Act

Section 7 of the Federal Endangered Species Act (ESA) requires Federal agencies, in consultation with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS), to ensure that their actions do not jeopardize the continued existence of endangered or threatened species, or result in the destruction or adverse modification of the critical habitat of these species. The required steps in the Section 7 consultation process are as follows.

- Agencies must request information from USFWS and/or NMFS on the existence in a project area of special-status species or species proposed for listing.
- Agencies must initiate formal consultation with USFWS and/or NMFS if the proposed action may adversely affect special-status species.

The project may affect special-status species. USACE and the Sutter Butte Flood Control Agency (SBFCA) are in coordination with USFWS and NMFS to initiate consultation under Section 7.

A.1.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) implements a series of international treaties that provide for migratory bird protection. The MBTA authorizes the Secretary of the Interior to regulate the taking of migratory birds; the act provides that it is unlawful, except as permitted by regulations, "to pursue, take, or kill any migratory bird, or any part, nest or egg of any such bird..." (16 U.S. Government Code [USC] 703). This prohibition includes both direct and indirect acts, although harassment and habitat modification are not included unless they result in direct loss of birds, nests, or eggs. The current list of species protected by the MBTA includes several hundred species and essentially includes all native birds. Permits for take of non-game migratory birds can be issued only

for specific activities, such as scientific collecting, rehabilitation, propagation, education, taxidermy, and protection of human health and safety and personal property.

Compliance with the MBTA would be addressed through compliance with the ESA and California Endangered Species Act (CESA). The project would incorporate mitigation measures that would help ensure that construction activities do not result in the take of migratory birds, as discussed in Section 3.9, *Wildlife*.

A.1.4 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act provides for the protection of the bald eagle and the golden eagle by prohibiting, except under certain specified conditions, the take, possession, and commerce of such birds.

The project area does not contain bald eagle or golden eagle nesting habitat, and the project would not result in the take of bald or golden eagles. The project incorporates mitigation measures that would ensure that construction activities do not result in the take of any raptors, as discussed in Section 3.9, *Wildlife*.

A.1.5 Clean Water Act

The Federal Clean Water Act (CWA) is the primary Federal law that protects the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. It operates on the principle that all discharges into the nation's waters are unlawful unless specifically authorized by a permit. Permit review is the CWA's primary regulatory tool. The following sections provide additional details on specific sections of the CWA.

Section 303

California adopts water quality standards to protect beneficial uses of state waters as required by CWA Section 303 and the Porter-Cologne Water Quality Control Act of 1969 (Porter-Cologne Act) (see Section A.2.7). Section 303(d) of the CWA requires the identification of water bodies that do not meet, or are not expected to meet, water quality standards (i.e., impaired water bodies). In California, the State Water Resources Control Board (State Water Board) develops the list of water quality-limited segments and the U.S. Environmental Protection Agency (EPA) approves the state's list. The affected water body, and associated pollutant or stressor, is then prioritized in the 303(d) List. Section 303(d) also requires the development of a Total Maximum Daily Load (TMDL) for each listing. The current list, approved by the EPA, is the 2006 303(d) List.

In addition to the impaired water body list required by CWA Section 303(d), CWA section 305(b) requires states to develop a report assessing statewide surface water quality. Both CWA requirements are being addressed through the development of a 303(d)/305(b) Integrated Report, which will address both an update to the 303(d) list and a 305(b) assessment of statewide water quality. The State Water Board developed a statewide 2010 California Integrated Report based upon the Integrated Reports from each of the nine regional water quality control boards (RWQCBs). The 2010 California Integrated Report was approved by the State Water Board at a public hearing on August 4, 2010, and the report was submitted to the EPA for final approval. Although updates to the 303(d) list must be finalized by the EPA before becoming effective, this updated 303(d) list will be used for this analysis in order to have the most up-to-date information available.

Section 401

Under the CWA Section 401, applicants for a Federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a Federal component and may affect state water quality (including projects that require Federal agency approval [such as issuance of a Section 404 permit]) must also comply with CWA Section 401. In California, the authority to grant water quality certification has been delegated to the State Water Board, and applications for water quality certification under CWA Section 401 are typically processed by the RWQCB with local jurisdiction. Water quality certification requires evaluation of potential impacts in light of water quality standards and CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United States.

The Feather River West Levee Project (FRWLP) is subject to CWA Section 401 certification as a condition of USACE's authority under the CWA Section 404.

Section 402

CWA Section 402 regulates discharges to surface waters through the National Pollutant Discharge Elimination System (NPDES) program, administered by EPA. In California, the State Water Board is authorized by EPA to oversee the NPDES program through the RWQCBs (see related discussion regarding the Porter-Cologne Act under state regulations, Section A.2.7). The NPDES program provides for both general permits (those that cover a number of similar or related activities) and individual permits.

Construction General Permit

Dischargers whose projects disturb 1 or more acres of soil or whose projects disturb less than 1 acre but are part of a larger common plan of development that in total disturbs 1 or more acres are required to file a notice of intent (NOI) to obtain coverage under the NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (General Order No. 2010-0014-DWQ—General Permit). Construction activities subject to this permit include clearing, grading, and disturbances to the ground such as stockpiling or excavation, but do not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility.

The Construction General Permit requires the preparation and implementation of a stormwater pollution prevention plan (SWPPP), which must be completed before construction begins. The SWPPP should contain a site map that shows the construction site perimeter; existing and proposed buildings, lots, roadways, and stormwater collection and discharge points; general topography both before and after construction; and drainage patterns across the project. The SWPPP must list best management practices (BMPs) the discharger will use to protect stormwater runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for non-visible pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment. Section A (or Section XIV) of the Construction General Permit describes the elements that must be contained in a SWPPP.

Municipal Activities

CWA Section 402 mandates permits for municipal stormwater discharges, which are regulated under the NPDES General Permit for Municipal Separate Storm Sewer Systems (MS4) (MS4 Permit). Phase 1 MS4 regulations cover municipalities with populations greater than 100,000, certain industrial processes, or construction activities disturbing an area of 5 acres or more. Phase 2 MS4 regulations require that stormwater management plans be developed by municipalities with populations smaller than 100,000 and construction activities disturbing 1 or more acres of land area.

Several of the cities and counties within the affected area have their own NPDES municipal stormwater permits for the regulation of stormwater discharges. Yuba City and Sutter County (joint program) as well as Butte County are permit holders under the general Phase 2 MS4 Permit (Order No. 2003-0005-DWQ) in the affected area. These permits require that controls are implemented to reduce the discharge of pollutants in stormwater discharges to the maximum extent possible, including management practices, control techniques, system design and engineering methods, and other measures as appropriate. As part of permit compliance, these permit holders have created stormwater management plans for their respective locations. These plans outline the requirements for municipal operations, industrial and commercial businesses, construction sites, and planning and land development. These requirements may include multiple measures to control pollutants in stormwater discharge. During implementation of specific projects, project applicants would be required to follow the guidance contained in the stormwater management plans as defined by the permit holder in that location.

General Dewatering Permit

Although small amounts of construction-related dewatering are covered under the Construction General Permit, the Central Valley RWQCB has also adopted a General Order for Dewatering and Other Low-Threat Discharges to Surface Waters for which a permit is required (General Dewatering Permit). This permit applies to various categories of dewatering activities if construction required dewatering in greater quantities than that allowed by the Construction General Permit and the effluent is discharged to surface waters. The General Dewatering Permit contains waste discharge limitations and prohibitions similar to those in the Construction General Permit. To obtain coverage, the applicant must submit an NOI and pollution prevention and monitoring program (PPMP) to the Central Valley RWQCB. The PPMP must include a description of the discharge location, discharge characteristics, primary pollutants, receiving water, treatment systems, spill prevention plans, and other measures necessary to comply with discharge limits. A representative sampling and analysis program must be prepared as part of the PPMP and implemented by the permittee, along with recordkeeping and quarterly reporting requirements during dewatering activities.

Municipal Separate Storm Sewer System Program (MS4s)

EPA defines an MS4 as any conveyance or system of conveyances (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, human-made channels, and storm drains) owned or operated by a state, city, town, county, or other public body having jurisdiction over stormwater, that is designed or used for collecting or conveying stormwater. As part of the NPDES program, EPA initiated a program requiring that entities having MS4s apply to their local RWQCBs for stormwater discharge permits. The program proceeded through two phases. Under Phase I, the program initiated permit requirements for designated municipalities with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. Phase II expanded the

program to municipalities with populations less than 100,000, as well as small MS4s outside the urbanized areas that are designated by the permitting authority to obtain NPDES permit coverage for their stormwater discharges.

Generally, Phase I MS4s are covered by individual permits and Phase II MS4s are covered by a general permit. Each regulated MS4 is required to develop and implement a stormwater management program to reduce the contamination of stormwater runoff and prohibit illicit discharges.

Section 404

Section 404 of the CWA requires that a permit be obtained from USACE for the discharge of dredged or fill material into "waters of the United States, including wetlands."

Waters of the United States include wetlands and lakes, rivers, streams, and their tributaries. *Wetlands* are defined for regulatory purposes, at 33 Code of Federal Regulations (CFR) § 328.3 as:

> (1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of tide; (2) All interstate waters, including interstate wetlands; (3) All other waters such as intrastate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce; (4) All impoundments of waters otherwise defined as waters of the United States under the definition; (5) Tributaries of waters identified in paragraphs 1–4 in this section; (6) The territorial seas; and (7) Wetlands adjacent to waters identified in paragraphs 1–6 in this section.

CWA Section 404(b) requires that USACE process permits in compliance with guidelines developed by EPA. These guidelines (404[b][1] Guidelines) require that there be an analysis of alternatives available to meet the project purpose and need, including those that avoid and minimize discharges of dredged or fill materials in waters. Once this first test has been satisfied, the project that is permitted must be the least environmentally damaging practicable alternative before USACE may issue a permit for the proposed activity.

Before any actions that may affect surface waters are implemented, a delineation of jurisdictional waters of the United States must be completed following USACE protocols to determine whether the affected area contains wetlands or other waters of the United States that qualify for CWA protection. These areas include:

- Sections within the ordinary high water mark (OHWM) of a stream, including non-perennial streams with a defined bed and bank and any stream channel that conveys natural runoff, even if it has been realigned.
- Seasonal and perennial wetlands, including coastal wetlands.

*[**Note:** Section 404 does not apply to authorities under the Rivers and Harbors Appropriation Act of 1899, except that some of the same waters may be regulated under both statutes; the USACE typically combines the permit requirements of Section 10 and Section 404 into one permitting process.]*

A.1.6 River and Harbors Appropriation Act of 1899

The River and Harbors Appropriation Act of 1899 addresses activities that involve the construction of dams, bridges, dikes, and other structures across any navigable water, or that place obstructions to navigation outside established Federal lines and excavate from or deposit material in such waters.

Such activities require permits from USACE. *Navigable waters* are defined in Section 329.4 of the act as:

> Those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the water body, and is not extinguished by later actions or events which impede or destroy navigable capacity.

Section 9

Section 9 (33 USC 401) prohibits the construction of any bridge, dam, dike, or causeway across any navigable water of the United States in the absence of congressional consent and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the water body lie wholly within the limits of a single state, the structure may be built under authority of the legislature of that state, if the location and plans or any modification thereof are approved by the Chief of Engineers and by the Secretary of the Army.

Section 10

Section 10 (33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section provides that the construction of any structure in or over any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters, is unlawful unless the work has been authorized by the Chief of Engineers.

Section 13

Section 13 (33 USC 407) provides that the Secretary of the Army, whenever the Chief of Engineers determines that anchorage and navigation would not be injured thereby, may permit the discharge of refuse into navigable waters. In the absence of a permit, such discharge of refuse is prohibited. While the prohibition of this section, known as the Refuse Act, is still in effect, the permit authority of the Secretary of the Army has been superseded by the permit authority provided the Administrator, EPA, and the states under Sections 402 and 405 of the CWA, respectively.

As described above, the proposed project may affect waters of the United States under Section 404 and navigable waters under the Rivers and Harbors Appropriation Act of 1899. Consultation with USACE is in progress.

Section 14

Under Section 14 (33 USC 408) temporary or permanent alteration, occupation, or use of any public works, including levees, for any purpose is only allowable with the permission of the Secretary of the Army. Under the terms of 33 USC 408, any proposed levee modification requires a determination by the Secretary that the proposed alteration, permanent occupation, or use of a Federal project is not injurious to the public interest and will not impair the usefulness of the levee. The authority to make this determination and approve modifications to Federal works under 33 USC 408 has been delegated to the Chief of Engineers, USACE. Minor modifications to flood control facilities have been further delegated via Section 208 (33 CFR 208.10) to the District Engineer.

Section 208 (33 CFR 208.10)

While not technically part of the Rivers and Harbors Act, as introduced above, Section 208 (33 CFR 208.10) authorizes the USACE District Engineer to approve relatively minor, low impact alterations/modifications related to the operation and maintenance responsibilities of the non-Federal sponsors, provided these alterations and modifications do not adversely affect the functioning of the project and flood fighting activities. The project is considered to fall under Section 408, as described in the preceding paragraph, the process for which includes and goes beyond the Section 208 District Engineer level to the Chief of Engineers.

A.1.7 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Act establishes a management system for national marine and estuarine fishery resources. This legislation requires that all Federal agencies consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect essential fish habitat (EFH). EFH is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The legislation states that migratory routes to and from anadromous fish spawning grounds are considered EFH. The phrase *adversely affect* refers to the creation of any effect that reduces the quality or quantity of essential fish habitat. Federal activities that occur outside of an essential fish habitat but that may, nonetheless, have an effect on essential fish habitat waters and substrate must also be considered in the consultation process.

Under the Magnuson-Stevens Act, effects on habitat managed under the Pacific Salmon Fishery Management Plan must also be considered. The Magnuson-Stevens Act states that consultation regarding essential fish habitat should be consolidated, where appropriate, with the interagency consultation, coordination, and environmental review procedures required by other Federal statutes, such as NEPA, Fish and Wildlife Coordination Act, CWA, and ESA. EFH consultation requirements can be satisfied through concurrent environmental compliance if the lead agency provides NMFS with timely notification of actions that may adversely affect EFH and if the notification meets requirements for essential fish habitat assessments.

USACE and NMFS are in coordination to determine the EFH compliance documentation appropriate for the FRWLP.

A.1.8 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act in general requires Federal agencies to coordinate with USFWS, NMFS, and state fish and game agencies whenever streams or bodies of water are controlled or modified. This coordination is intended both to promote the conservation of wildlife resources by providing equal consideration for fish and wildlife in water project planning and to provide for the development and improvement of wildlife resources in connection with water projects. Federal agencies undertaking water projects are required to include recommendations made by USFWS and state fish and game agencies in project reports, and give full consideration to these recommendations.

USACE and SBFCA are in coordination with the resource agencies in accordance with the act.

A.1.9 Farmland Protection Policy Act and Memoranda on Farmland Preservation

Two policies require Federal agencies to include assessments of the potential effects of a proposed project on prime and unique farmland. These policies are the Farmland Protection Policy Act and the Memoranda on Farmland Preservation, dated August 30, 1976, and August 11, 1980, respectively, from the CEQ. Under requirements set forth in these policies, Federal agencies must determine these effects before taking any action that could result in converting designated prime or unique farmland for non-agricultural purposes. If implementing a project would adversely affect farmland preservation, the agencies must consider alternative actions to lessen those effects. Federal agencies also must ensure that their programs, to the extent feasible, are compatible with state, local, and private programs to protect farmland. The Natural Resources Conservation Service is the Federal agency responsible for ensuring that these laws and policies are followed.

The project may affect farmland adjacent to the levee, as discussed in Section 3.11, *Agriculture, Land Use, and Socioeconomics*.

A.1.10 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires Federal agencies to evaluate the effects of their undertakings on historic properties, which are those properties listed or eligible for listing on the National Register of Historic Places (NRHP). Implementing regulations at 36 CFR Part 800 require that Federal agencies, in consultation with the State Historic Preservation Officer (SHPO), identify historic properties within the area of potential effects (APE) of the proposed project and make an assessment of adverse effects if any are identified. If the project is determined to have an adverse effect on historic properties, the Federal agency is required to consult further with SHPO and the Advisory Council on Historic Preservation (ACHP) to develop methods to resolve the adverse effects. The Section 106 process has five basic steps.

1. Initiate the Section 106 process, including the identification of consulting parties, such as Native American tribes.
2. Identify and evaluate cultural resources to determine whether they are historic properties.
3. Assess the effects of the undertaking on historic properties within the APE.
4. If historic properties may be subject to an adverse effect, the Federal agency, the SHPO, and any other consulting parties (including Native American tribes and the ACHP) continue consultation to seek ways to avoid, minimize, or mitigate the adverse effect. A memorandum of agreement (MOA) is usually developed to document the measures agreed upon to resolve adverse effects. Alternatively, the Federal agency may prepare and execute a programmatic agreement (PA) with the aforementioned parties to comply with 36 CFR 800, particularly in the context of complex undertakings that entail years of implementation actions or where the undertaking's effects on historic properties cannot be well characterized during the planning phase.
5. Proceed in accordance with the terms of the MOA or PA.

The efforts taken to identify cultural resources within the APE and any potential effects are discussed in Section 3.17, *Cultural Resources*. Consultation with SHPO is in progress.

A.1.11 American Indian Religious Freedom Act

The American Indian Religious Freedom Act of 1978 is also applicable to Federal undertakings. This act established "the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites" (Public Law 95-431).

It is not anticipated that actions related to the project would conflict with the American Indian Religious Freedom Act. Consultation with the Native American Heritage Commission and the Sacred Lands database was negative for findings in the project areas, which is discussed in Section 3.17, *Cultural Resources*.

A.1.12 Wild and Scenic Rivers Act

The Wild and Scenic Rivers Act (16 USC 1271 et seq.) establishes a National Wild and Scenic Rivers System for the protection of rivers with important scenic, recreational, fish and wildlife, and other values. Rivers are classified as wild, scenic, or recreational. The act designates specific rivers for inclusion in the System and prescribes the methods and standards by which additional rivers may be added. The Feather River in the project area is not designated under this act.

A.1.13 Executive Order 11988 (Floodplain Management)

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.

A.1.14 Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 (May 24, 1977) requires Federal agencies to prepare wetland assessments for proposed actions located in or affecting wetlands. Agencies must avoid undertaking new construction in wetlands unless no practicable alternative is available and the proposed action includes all practicable measures to minimize harm to wetlands. Section 3.8, *Vegetation*, describes effects on wetlands and mitigation measures for reducing significant effects for the project.

A.1.15 Executive Order 12898 (Environmental Justice)

Executive Order 12898 (February 11, 1994) requires Federal agencies to identify and address adverse human health or environmental effects of Federal programs, policies, and activities that could be disproportionately high on minority and low-income populations. Federal agencies must ensure that Federal programs or activities do not directly or indirectly result in discrimination on the basis of race, color, or national origin. Federal agencies must provide opportunities for input into the NEPA process by affected communities and must evaluate the potentially significant and adverse environmental effects of proposed actions on minority and low-income communities during environmental document preparation. Even if a proposed Federal project would not result in

significant adverse effects on minority and low-income populations, the environmental document must describe how Executive Order 12898 was addressed during the NEPA process.

Environmental justice issues are discussed in Section 3.12, *Population, Housing, and Environmental Justice*.

A.1.16 Executive Order 13007 (Indian Sacred Sites) and April 29, 1994, Executive Memorandum

Executive Order 13007 (May 24, 1996) requires Federal agencies with land management responsibilities to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites. Among other things, Federal agencies must provide reasonable notice of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. The agencies must comply with the April 29, 1994, Executive Memorandum, *Government-to-Government Relations with Native American Tribal Governments*.

Based on the analysis described in Section 3.17, *Cultural Resources*, no sacred sites would be significantly affected by the implementation of the project.

A.1.17 Federal Clean Air Act

The Federal Clean Air Act (CAA) was enacted to protect and enhance the nation's air quality in order to promote public health and welfare and the productive capacity of the nation's population. The CAA requires an evaluation of any Federal action to determine its potential effects on air quality in the project region. California has a corresponding law, which also must be considered during the environmental impact report (EIR) process.

For specific projects, Federal agencies must coordinate with the appropriate air quality management district as well as with EPA. This coordination would determine whether the project conforms to the CAA and the state implementation plan (SIP).

Section 176 of the CAA prohibits Federal agencies from engaging in or supporting in any way an action or activity that does not conform to an applicable SIP. Actions and activities must conform to a SIP's purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and in attaining those standards expeditiously. EPA promulgated conformity regulations (codified in 40 CFR 93.150 et seq.).

The potential air quality effects of the project resulting from construction (such as equipment emissions and fugitive dust) are discussed in Section 3.5, *Air Quality*, which analyzes and documents compliance with the CAA.

A.1.18 Federal Water Project Recreation Act

The Federal Water Project Recreation Act requires Federal agencies with authority to approve water projects to include recreation development as a condition of approving permits. Recreation development must be considered along with any navigation, flood control, reclamation, hydroelectric, or multi-purpose water resource project. The act states that,

consideration should be given to opportunities for outdoor recreation and fish and wildlife enhancement whenever any such project can reasonably serve either or both purposes consistently.

Recreation effects, such as temporary loss to river access, are described in Section 3.14, *Recreation*.

A.1.19 Resource Conservation and Recovery Act

The Federal Resource Conservation and Recovery Act enables EPA to administer a regulatory program that extends from the manufacture of hazardous materials to their disposal, thus regulating the generation, transportation, treatment, storage, and disposal of hazardous waste at all facilities and sites in the nation.

No materials classified as hazardous are proposed to be used for the project.

A.1.20 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (also known as CERCLA or Superfund) was passed to facilitate the cleanup of the nation's toxic waste sites. In 1986, the act was amended by the Superfund Amendment and Reauthorization Act Title III (community right-to-know laws). Title III states that past and present owners of land contaminated with hazardous substances can be held liable for the entire cost of the cleanup, even if the material was dumped illegally when the property was under different ownership.

Hazardous waste sites are discussed in Section 3.16, *Public Health and Environmental Hazards*.

A.1.21 Wildlife Hazards on or Near Airports

The Federal Aviation Administration addresses control of hazardous wildlife in Advisory Circular 150/5200-33B, *Hazardous Wildlife Attractants on or near Airports*. The Federal Aviation Administration provides direction on where public-use airports should restrict land uses that have the potential to attract hazardous wildlife. The Federal Aviation Administration recommends a distance of 10,000 feet separating wildlife attractants and aircraft movement areas. The area within a 10,000-foot radius of the Airport Operations Area is designated as the Critical Zone. The definition of wildlife attractants in Advisory Circular 150/5200-33A includes human-made or natural areas, such as poorly drained areas, retention ponds, agricultural activities, and wetlands. Advisory Circular 150/5200-33A recommends against the use of airport property for agricultural production within a 5-mile radius of the Airport Operations Area unless the income from the agricultural crops is necessary for the economic viability of the airport.

A.1.22 Sustainable Fisheries Act

In response to growing concern about the status of United States fisheries, Congress passed the Sustainable Fisheries Act of 1996 (Public Law [PL] 104-297) to amend the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265), the primary law governing marine fisheries management in the Federal waters of the United States. Under the Sustainable Fisheries Act, consultation is required by NMFS on any activity that might adversely affect EFH. EFH includes those habitats that fish rely on throughout their life cycles. It encompasses habitats necessary to allow sufficient production of commercially valuable aquatic species to support a long-term

sustainable fishery and contribute to a healthy ecosystem. The Feather River has been designated as EFH by the Pacific Fishery Management Council. As described in Section A.1.2, *Federal Endangered Species Act*, USACE and SBFCA are in coordination with USFWS and NMFS and consultation would be initiated under Section 7 with publication of the Draft EIS/EIR. That process would include consideration of and compliance with the Magnuson-Stevens Act to determine effects on EFH. At this time, it is considered that no EFH would be affected.

A.1.23 Uniform Relocation Assistance and Real Property Acquisition Policies Act

All or portions of parcels within the project footprint may need to be acquired to construct either of the action alternatives. Federal, state, local government agencies, and others receiving Federal financial assistance for public programs and projects that require the acquisition of real property must comply with the policies and provisions set forth in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended in 1987 (42 USC 4601 et seq.) (Uniform Act), and implementing regulation, Title 49 CFR Part 24. Relocation advisory services, moving costs reimbursement, replacement housing, and reimbursement for related expenses and rights of appeal are provided for in the Uniform Act.

If necessary, property acquisition and relocation services, compensation for living expenses for temporarily relocated residents, and negotiations regarding any compensation for temporary loss of business would be accomplished in accordance with the Uniform Act and California Government Code Section 7267 et seq.

A.1.24 Code of Federal Regulations, Title 40, Part 131, Water Quality Standards

This regulation establishes requirements for water quality, including activities related to in-channel construction, dredging, and long-term effects resulting in sediment transport and scouring.

A.1.25 USACE Levee Safety Program

The USACE Rehabilitation and Inspection Program provides for rehabilitation and/or repair of Public Law 84-99 eligible (active status) levees that are damaged during flood events. This authority covers post flood repair of both Federally authorized and/or constructed and non-Federally constructed flood control works. Inspections of Federal levees are funded and conducted under the Inspection of Completed Works (ICW) program. Inspection of non-Federal levees are funded and conducted under the PL 84-99 Rehabilitation and Inspection Program. Because the subject levees in the proposed project area are classified as Federal levees, inspections are funded and conducted under the ICW program.

A.1.26 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act (NAGPRA) defines the ownership of Native American human remains and funerary materials excavated on lands owned or controlled by

the Federal government. This review of NAGPRA is provided because the FRWLP may traverse Federal lands. NAGPRA establishes a hierarchy of ownership as follows (25 USC 3002[a]).

- Where the lineal descendants can be found, the lineal descendants own the remains.
- Where the lineal descendants cannot be found, the remains belong to the Indian tribe or Native Hawaiian organization on whose land the remains were found.
- If the remains are discovered on other lands owned or controlled by the Federal government and the lineal descendants cannot be determined, the remains belong to the Indian tribe or Native Hawaiian organization that is culturally affiliated with the remains, or the tribe that aboriginally occupied the land where the remains were discovered.

Under NAGPRA, intentional excavation of Native American human remains on lands owned or controlled by the Federal government may occur (25 USC 3002[c]) only under the following circumstances.

- With a permit issued under the Archaeological Resources Protection Act (16 USC 470cc).
- After documented consultation with the relevant tribal or Native American groups.

NAGPRA also provides guidance on inadvertent discoveries of Native American or Hawaiian human remains on lands owned or controlled by the Federal government. When an inadvertent discovery on these lands occurs in association with construction, construction must cease. The party that discovers the remains must notify the relevant Federal agency, and the remains must be transferred according to the ownership provisions above (25 USC 3002[d]).

A.1.27 Archaeological Resources Protection Act

The Archaeological Resources Protection Act (ARPA) requires a permit for intentional excavation of archaeological materials on Federal lands (16 USC 470ee[a]). This review of ARPA is provided because the FRWLP may traverse Federal lands. The Federal agency that owns or controls the land may dispense permits for excavation as provided in the ARPA regulations (43 CFR Section 7.5). The permit may require notice to affected Indian tribes (43 CFR Section 7.7), and compliance with the terms and conditions provided in the ARPA regulations (43 CFR Section 7.9).

A.1.28 Executive Order 13112: Prevention and Control of Invasive Species

EO 13112, signed February 3, 1999, directs all Federal agencies to prevent and control the introduction of invasive species in a cost-effective and environmentally sound manner. The EO established the National Invasive Species Council (NISC), which is composed of Federal agencies and departments, and a supporting Invasive Species Advisory Committee composed of state, local, and private entities. In 2008, the NISC released an updated national invasive species management plan that recommends objectives and measures to implement the EO and prevent the introduction and spread of invasive species (National Invasive Species Council 2008). The EO requires consideration of invasive species in NEPA analyses, including their identification and distribution, their potential effects, and measures to prevent or eradicate them.

A.1.29 Engineer Technical Letter (ETL) 1110-2-571 10 April 2009

In 2009, USACE published new Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures for the control of vegetation on levees (ETL 1110-2-571 10 April 2009). These guidelines recommend that a vegetation-free zone be established.

The vegetation-free zone is a three-dimensional corridor surrounding all levees, floodwalls, embankment dams, and critical appurtenant structures in all flood damage reduction systems. The vegetation-free zone applies to all vegetation except perennial, non-irrigated grass. Grass species are permitted. The only grasses permitted are perennial grasses whose primary function is to reliably protect against erosion. The species selected for the project shall be appropriate to local climate, conditions, and surrounding or adjacent land uses. Preference should be given to native species.

The primary purpose of a vegetation-free zone is to provide a reliable corridor of access to, or along, levees, floodwalls, embankment dams, and appurtenant structures. This corridor must be free of obstructions to assure adequate access by personnel and equipment for surveillance, inspection, maintenance, monitoring, and flood-fighting. In the case of flood-fighting, this access corridor must also provide the unobstructed space needed for the construction of temporary flood-control structures. Access is typically by four-wheel-drive vehicle, but for some purposes, such as maintenance and flood-fighting, access is required for larger equipment, such as tractors, bulldozers, dump trucks and helicopters. Accessibility is essential to the reliability of flood damage reduction systems.

The vegetation-free zone must be wide enough and tall enough to accommodate all likely access requirements. The minimum width of the corridor shall be the width of the levee, floodwall, or embankment dam, including all critical appurtenant structures, plus 15 feet on each side, measured from the outer edge of the outermost critical structure. In the case of a landside planting berm, the 15 feet is measured from the point at which the top surface of the planting berm meets the levee section. The minimum height of the corridor shall be 8 feet from any point on the ground.

No vegetation, other than approved grasses, may penetrate the vegetation-free zone, with two exceptions.

- Tree trunks are measured to their centerline, so one half of the tree trunk may be within the vegetation-free zone.
- Newly planted trees, whose crowns can be expected to grow, or be pruned, clear of the vegetation free zone within 10 years may be within the vegetation-free zone. (U.S. Army Corps of Engineers 2009.)

A.1.30 Federal - *Massachusetts et al. v. U.S. Environmental Protection Agency* (2007)

Twelve U.S. states and cities, including California, in conjunction with several environmental organizations, sued to force EPA to regulate greenhouse gases (GHGs) as a pollutant pursuant to the CAA in *Massachusetts et al. v. Environmental Protection Agency 549 US 497* (2007). The court ruled

that the plaintiffs had standing to sue, GHGs fit within the CAA's definition of a pollutant, and EPA's reasons for not regulating GHGs were insufficiently grounded in the CAA.

A.1.31 Energy Independence and Security Act of 2007

The Energy Independence and Security Act of 2007 mandates a host of actions that would aid in the reduction of GHG emissions. These actions include (but are not limited to): fuel economy standard of 35 miles per gallon (mpg) by 2020; improved energy efficiency in lighting and appliances; and investments in efficiency and renewable energy use.

A.1.32 Update to Corporate Average Fuel Economy Standards (2009)

The new Corporate Average Fuel Economy (CAFE) standards incorporate stricter fuel economy standards promulgated by the State of California into one uniform standard. Additionally, automakers are required to cut GHG emissions in new vehicles by roughly 25% by 2016. Rule-making to adopt these new standards is in process, and thus they are not yet in effect. When the national program takes effect, California has committed to allowing automakers who show compliance with the national program also to be deemed in compliance with state requirements (U.S. Environmental Protection Agency 2010a).

A.1.33 EPA Rule: Mandatory Reporting of Greenhouse Gases (2009)

Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons (MT) or more per year of GHGs are required to report annual emissions to the EPA. The first annual reports for the largest emitting facilities, covering calendar year 2010, would be submitted to the EPA in 2011. The mandatory reporting rule does not limit GHG emissions but establishes a standard framework for emissions reporting and tracking of large emitters (U.S. Environmental Protection Agency 2010a).

A.1.34 EPA Endangerment Finding and Cause or Contribute Finding (2009)

In its Endangerment Finding, the Administrator of the EPA found, as described above, that GHGs in the atmosphere threaten the public health and welfare of current and future generations. The Administrator also found that the combined emissions of well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution that threatens public health and welfare. Although the Finding of Endangerment does not place requirements on industry, it is an important step in the EPA's process to develop regulation. This action is a prerequisite to finalizing the EPA's proposed GHG emission standards for light-duty vehicles, which were jointly proposed by EPA and the Department of Transportation's National Highway Safety Administration on September 15, 2009 (U.S. Environmental Protection Agency 2010a).

In its Cause or Contribute Finding the Administrator found that the combined emissions of well-mixed GHG from new motor vehicles and new motor vehicle engines contribute to the GHG pollution that threatens public health and welfare (U.S. Environmental Protection Agency 2010a).

A.1.35 National Global Change Research Plan, 2012–2021 (Published in 2012)

In 2012 the National Science and Technology Council published the most recent update to the *National Global Change Research Plan, 2012-2021* (National Science and Technology Council 2012). The National Science and Technology Council represents 13 Federal agencies which are responsible for developing policies and procedures to research, track and mitigate global change, including sea-level rise, ocean acidification, heat waves and drought, severe storms, floods, and forest fires that pose an ever-growing risk to life, property and agriculture. The Research Plan presented four major goals: Advance Scientific Knowledge; Inform Decisions; Conduct Sustained Assessments; and Communicate and Educate.

A.1.36 Federal Tailpipe Emission Standards

To reduce emissions from off-road diesel equipment, on-road diesel trucks, and harbor craft, EPA established a series of increasingly strict emission standards for new engines. New construction equipment used for the project, including heavy-duty trucks, off-road construction equipment, tugboats, and barges, will be required to comply with the emission standards.

A.2 State Plans, Policies, and Regulations

A.2.1 California Environmental Quality Act

The California Environmental Quality Act (CEQA) requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The environmental review required imposes both procedural and substantive requirements. At a minimum, an initial review of the project and its environmental effects must be conducted. CEQA's primary objectives are listed below.

- Disclose to decision makers and the public the significant environmental effects of proposed activities.
- Identify ways to avoid or reduce environmental damage.
- Prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures.
- Disclose to the public reasons for agency approval of projects with significant environmental effects.
- Foster interagency coordination in the review of projects.
- Enhance public participation in the planning process.

CEQA applies to all discretionary activities proposed to be carried out or approved by California public agencies, including state, regional, county, and local agencies, unless an exemption applies. The act requires that public agencies comply with both procedural and substantive requirements. Procedural requirements include the preparation of the appropriate public notices (including notices of preparation), scoping documents, alternatives, environmental documents (including mitigation measures, mitigation monitoring plans, responses to comments, findings, and statements

of overriding considerations), completion of agency consultation and State Clearinghouse review, and provisions for legal enforcement and citizen access to the courts.

CEQA's substantive provisions require agencies to address environmental impacts disclosed in an appropriate document. When avoiding or minimizing environmental damage is not feasible, CEQA requires agencies to prepare a written statement of overriding considerations when they decide to approve a project that would cause one or more significant effects on the environment that cannot be mitigated. CEQA establishes a series of action-forcing procedures to ensure that agencies accomplish the purposes of the law. In addition, under the direction of CEQA, the California Resources Agency has adopted regulations, known as the State CEQA Guidelines, which provide detailed procedures that agencies must follow to implement the law.

This document is the instrument for CEQA compliance, as described in Chapter 1, *Introduction*.

Cultural Resources Protection under CEQA

CEQA requires the lead agency to consider the effects of a project on cultural resources. Two categories of cultural resources are specifically called out in the State CEQA Guidelines: historical resources (State CEQA Guidelines Section 15064.5[b]) and unique archaeological sites (State CEQA Guidelines 15064.5[c] and Public Resources Code (PRC) Section 21083.2). Different legal rules apply to the two different categories of cultural resources, although the two categories sometimes overlap where a "unique archaeological resource" also qualifies as a "historical resource." In such an instance, the more stringent rules for archaeological resources that are historical resources apply, as explained below. CEQA and other California laws also set forth special rules for dealing with human remains that might be encountered during construction.

Historical resources are those meeting any of the requirements listed below.

- Resources listed in or determined eligible for listing in the California Register of Historical Resources (CRHR) (State CEQA Guidelines Section 15064.5[a][1]).
- Resources included in a local register as defined in California PRC Section 5020.1(k), "unless the preponderance of evidence demonstrates" that the resource "is not historically or culturally significant" (State CEQA Guidelines Section 15064.5[a][2]).
- Resources that are identified as significant in surveys that meet the standards provided in California PRC Section 5024.1[g] (State CEQA Guidelines Section 15064.5[a][3]).
- Resources that the lead agency determines are significant, based on substantial evidence (State CEQA Guidelines Section 15064.5[a][3]).

Cultural resources may be listed in the CRHR if they have significance and integrity. Cultural resources are significant if they meet any of the following criteria.

- Resources that are associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage, or the United States (California Code of Regulations [CCR], Title 14, Section 4852[b][1]).
- Resources that are associated with the lives of persons important in our past (14 CCR 4852[b][2]).

- Resources that embody the distinctive characteristics of a type, period, region, or method of construction, or represent the work of an important creative individual, or possess high artistic values (14 CCR 4852[b][3]).
- Resources that yield, or may be likely to yield, information important in prehistory or history (14 CCR 4852[b][4]).

Integrity for built environment resources means the "survival of characteristics that existed during the resource's period of significance" (14 CCR Section 4852[c]). Integrity must also be assessed in relationship to the particular criterion under which a resource has significance. For example, even where a resource has "lost its historic character or appearance [it] may still have sufficient integrity for the California Register if it maintains the potential to yield significant scientific or historical information or specific data" (14 California Code of Regulations Section 4852[c]). Integrity is further defined as the ability to "convey the reasons" for the significance of the resource (14 CCR Section 4852[c]).

For archaeological sites, this language therefore means that a site must have a likelihood of yielding useful information for research in order to have integrity, if the site is significant for its data potential.

The fact that a resource is not listed in, or determined to be eligible for listing in the California Register of Historical Resources, not included in a local register of historical resources, or identified in a historical resource survey does not preclude a lead agency under CEQA from determining that the resource *may* be a historical resource as defined in California PRC Section 5020.1(j) or 5024.1 (State CEQA Guidelines Section 15064.5[a][4]).

A project that causes a substantial adverse change in the significance of a historical resource is a project that may cause a significant impact under CEQA (State CEQA Guidelines Section 15064.5[b]). A substantial adverse change in the significance of a historical resource means physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historical resource would be materially impaired. The significance of a historical resource is materially impaired if the project demolishes or materially alters any qualities:

- that justify the inclusion or eligibility for inclusion of a resource on the CRHR (State CEQA Guidelines Section 15064.5[b][2][A],[C]); or
- that justify the inclusion of the resource on a local register (State CEQA Guidelines Section 15064.5[b][2][B]).

Unique archaeological resources, on the other hand, are defined in California PRC Section 21083.2 as a resource that meets at least one of the following criteria.

- The resource contains information needed to answer important scientific research questions and there is a demonstrable public interest in that information.
- The resource has a special and particular quality such as being the oldest of its type or the best available example of its type.
- The resource is directly associated with a scientifically recognized important prehistoric or historic event or person. (California PRC Section 21083.2[g])

Mitigation Requirements for Archaeological Resources Qualifying As Historical Resources

As set forth in State CEQA Guidelines Section 15064.5[c], special rules apply where a lead agency is not certain at first whether an archaeological resource qualifies as either a "historical resource" or a "unique archaeological resource." That section provides that "[w]hen a project will impact an archaeological site, a lead agency shall first determine whether the site is a historical resource." "If a lead agency determines that the archaeological site is a historical resource," the resource will be subject to the rules set forth above regarding historical resources. In addition, according to State CEQA Guidelines Section 15126.4[b]:

> [p]ublic agencies should, whenever feasible, seek to avoid damaging effects on any historical resource of an archaeological nature. The following factors shall be considered and discussed in an EIR for a project involving such an archaeological site:
>
> (A) Preservation in place is the preferred manner of mitigating impacts to archaeological sites. Preservation in place maintains the relationship between artifacts and the archaeological context. Preservation may also avoid conflict with religious or cultural values of groups associated with the site.
>
> (B) Preservation in place may be accomplished by, but is not limited to, the following:
>
> 1. Planning construction to avoid archaeological sites;
> 2. Incorporation of sites within parks, greenspace, or other open space;
> 3. Covering the archaeological sites with a layer of chemically stable soil before building tennis courts, parking lots, or similar facilities on the site.
> 4. Deeding the site into a permanent conservation easement.

Thus, although California PRC Section 21083.2, in dealing with "unique archaeological sites," provides for specific mitigation options "in no order of preference," CEQA Guidelines Section 15126.4(b), in dealing with "historical resources of an archaeological nature," provides that "preservation in place is the preferred manner of mitigating impacts to archaeological sites."

For archaeological resources that qualify as historical resources, "data recovery" is a disfavored form of mitigation compared with "preservation in place." Yet "[w]hen data recovery through excavation is the only feasible mitigation, a data recovery plan, which makes provisions for adequately recovering the scientifically consequential information from and about the historical resource, would be prepared and adopted prior to any excavation being undertaken. Such studies would be deposited with the California Historical Resources Regional Information Center." Moreover, "[i]f an artifact must be removed during project excavation or testing, curation may be an appropriate mitigation" (State CEQA Guidelines Section 15126.4[b][3][C]). "Data recovery shall not be required [, however,] for a historical resource [as with a unique archaeological resource] if the lead agency determines that testing or studies already completed have adequately recovered the scientifically consequential information from and about the archaeological or historical resource, provided that the determination is documented in the EIR and that the studies are deposited with the California Historical Resources Regional Information Center" (State CEQA Guidelines Section 15126.4[b][3][D]).

With respect to *both* historical resources and unique archaeological resources:

> a lead agency should make provisions for…resources accidentally discovered during construction. These provisions should include an immediate evaluation of the find by a qualified archaeologist. If the find is determined to be a historical or unique archaeological resource, contingency funding and a time allotment sufficient to allow for implementation of avoidance measures or appropriate

> mitigation should be available. Work could continue on other parts of the building site while historical or unique archaeological resource mitigation takes place (State CEQA Guidelines Section 15064.5[f]).

Mitigation for Unique Archaeological Resources

If a lead agency determines that "an archaeological site does *not* meet the criteria" for qualifying as a historical resource "but does meet the definition of a unique archeological resource…, the site shall be treated in accordance with the provisions of section 21083.2" (described above). Section 21083.2 contains the special rules for mitigation for "unique archaeological resources." These rules do not apply if the archaeological resource is a historical resource (State CEQA Guidelines Section 15064.5[c][1]). The CEQA Statute states:

> [i]f it can be demonstrated that a project will cause damage to a unique archaeological resource, the lead agency may require reasonable efforts to be made to permit any or all of these resources to be preserved in place or left in an undisturbed state. Examples of that treatment, in no order of preference, may include, but are not limited to, any of the following:
>
> 1. Planning construction to avoid archaeological sites.
> 2. Deeding archaeological sites into permanent conservation easements.
> 3. Capping or covering archaeological sites with a layer of soil before building on the sites.
> 4. Planning parks, greenspace, or other open space to incorporate archaeological sites.
>
> Excavation as mitigation shall be restricted to those parts of the unique archaeological resource that would be damaged or destroyed by the project. Excavation as mitigation shall not be required for a unique archaeological resource if the lead agency determines that testing or studies already completed have adequately recovered the scientifically consequential information from and about the resource, if this determination is documented in the environmental impact report (California Public Resources Code Section 21083.2[d]).

If, however, "an archaeological resource is neither a unique archaeological nor a historical resource, the effects of the project on those resources shall not be considered a significant effect on the environment. It shall be sufficient that both the resource and the effect on it are noted in the Initial Study or EIR, if one is prepared to address impacts on other resources, but they need not be considered further in the CEQA process" (State CEQA Guidelines Section 15064.5[c][4]).

Discoveries of Human Remains under CEQA

California law sets forth special rules that apply where *human remains* are encountered during project construction. These rules are set forth in State CEQA Guidelines Section 15064.5[e] as follows:

> In the event of the accidental discovery or recognition of any human remains in any location other than a dedicated cemetery, the following steps should be taken:
>
> (1) There shall be no further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until:
>
> (A) The coroner of the county in which the remains are discovered must be contacted to determine that no investigation of the cause of death is required (as required under California Health and Safety Code Section 7050.5).
>
> (B) If the coroner determines the remains to be Native American:
>
> 1. The coroner shall contact the Native American Heritage Commission within 24 hours.

2. The Native American Heritage Commission shall identify the person or persons it believes to be the most likely descended from the deceased Native American.
3. The most likely descendent may make recommendations to the landowner or the person responsible for the excavation work, for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods (as provided in Public Resources Code Section 5097.98), or

(2) Where the following conditions occur, the landowner or his authorized representative shall rebury the Native American human remains and associated grave goods with appropriate dignity on the property in a location not subject to further subsurface disturbance.

(A) The Native American Heritage Commission is unable to identify a most likely descendent or the most likely descendent failed to make a recommendation within 24 hours after being notified by the commission.

(B) The descendant identified fails to make a recommendation; or

(C) The landowner or his authorized representative rejects the recommendation of the descendant, and the mediation by the Native American Heritage Commission fails to provide measures acceptable to the landowner.

A.2.2 California Register of Historical Resources

The CRHR includes resources that are listed in or formally determined eligible for listing in the NRHP (see Section 3.17, *Cultural Resources*) as well as some California State Landmarks and Points of Historical Interest (PRC Section 5024.1, 14, CCR Section 4850). Properties of local significance that have been designated under a local preservation ordinance (local landmarks or landmark districts) or that have been identified in a local historical resources inventory may be eligible for listing in the CRHR and are presumed to be significant resources for purposes of CEQA unless a preponderance of evidence indicates otherwise (State CEQA Guidelines Section 15064.5[a][2]). The eligibility criteria for listing in the CRHR are similar to those for NRHP listing but focus on the importance of the resources to California history and heritage. A cultural resource may be eligible for listing in the CRHR if it:

1. is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
2. is associated with the lives of person important in our past;
3. embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important individual, or possesses high artistic values; or
4. has yielded, or may be likely to yield, information important in prehistory or history.

A.2.3 Native American Heritage Commission

The Native American Heritage Commission (NAHC) identifies and catalogs places of special religious or social significance to Native Americans and known graves and cemeteries of Native Americans on private lands, and performs other duties regarding the preservation and accessibility of sacred sites and burials and the disposition of Native American human remains and burial items. Consultation with NAHC and the Sacred Lands database was negative for findings in the affected area.

A.2.4 California Native American Graves Protection and Repatriation Act

Sections 8010–8011 of the California Health and Safety Code establish a state repatriation policy that is consistent with and facilitates implementation of NAGPRA. The policy requires that all California Indian human remains and cultural items be treated with dignity and respect, and encourages voluntary disclosure and return of remains and cultural items by publicly funded agencies and museums in California. The policy provides for mechanisms to aid California Indian tribes, including non–Federally recognized tribes, in filing repatriation claims and getting responses to those claims.

A.2.5 California Endangered Species Act

CESA is similar to ESA but pertains only to state-listed endangered and threatened species. CESA requires state agencies to consult with the California Department of Fish and Wildlife (CDFW) when preparing documents under CEQA to ensure that the actions of the state lead agency do not jeopardize the continued existence of listed species. CESA directs agencies to consult with CDFW on projects or actions that could affect listed species, directs CDFW to determine whether there would be jeopardy to listed species, and allows CDFW to identify "reasonable and prudent alternatives" to the project consistent with conserving the species. Agencies can approve a project that affects a listed species if the agency determines that there are "overriding considerations;" however, the agencies are prohibited from approving projects that would cause the extinction of a listed species.

Mitigating impacts on state-listed species involves avoidance, minimization, and compensation (listed in order of preference). Unavoidable effects on state-listed species are typically addressed in a detailed mitigation plan prepared in accordance with CDFW guidelines. CDFW exercises authority over mitigation projects involving state-listed species, including those resulting from CEQA mitigation requirements.

CESA prohibits the "take" of plant and wildlife species state-listed as endangered or threatened. CDFW may authorize take if there is an approved habitat management plan or management agreement that avoids or compensates for effects on listed species.

Effects on wildlife resources are discussed in Section 3.9, *Wildlife*.

A.2.6 California Fish and Game Code

Protection of Fully protected species is described in Sections 3511, 4700, 5050, and 5515 of the California Fish and Game Code. These statutes prohibit take or possession of fully protected species and do not provide for authorization of incidental take of fully protected species. CDFW has informed non-Federal agencies and private parties that their actions must avoid take of any fully protected species.

Section 1600

CDFW regulates work that would substantially affect resources associated with rivers, streams, and lakes in California, pursuant to California Fish and Game Code Sections 1600 to 1607. Any action from a public project that substantially diverts or obstructs the natural flow or changes the bed, channel, or bank of any river, stream, or lake, or uses material from a streambed must be previously

authorized by CDFW in a lake or streambed alteration agreement under Section 1602 of the California Fish and Game Code. This requirement may in some cases apply to any work undertaken within the 100-year floodplain of a body of water or its tributaries, including intermittent streams and desert washes. As a general rule, however, it applies to any work done within the annual high-water mark of a wash, stream, or lake that contains or once contained fish and wildlife, or that supports or once supported riparian vegetation.

Applications for a Streambed Alteration Agreement would be submitted to CDFW to authorize the project under Section 1602.

Section 2800/Natural Community Conservation Planning Act

The Natural Community Conservation Planning Act (NCCPA) (California Fish and Game Code Section 2800 et seq.) was enacted to support broad-based planning for effective protection and conservation of the state's wildlife heritage, while continuing to allow appropriate development and growth. The purpose of natural community conservation planning is to sustain and restore those species and their habitat identified by CDFW that are necessary to maintain the continued viability of biological communities affected by human changes to the landscape. A Natural Community Conservation Plan identifies and provides for those measures necessary to conserve and manage natural biological diversity within the plan area while allowing compatible use of the land. CDFW may authorize the take of any identified species, including listed and non-special-status species, pursuant to Section 2835 of the NCCPA, if the conservation and management of such species is provided for in a Natural Community Conservation Plan (NCCP) approved by CDFW.

The project would not affect the take of state-listed species or substantially degrade habitat, so a Natural Community Conservation Plan is not triggered. Effects on biological resources are discussed in Section 3.8, *Vegetation*, and Section 3.9, *Wildlife*.

Section 3503 and 3503.5

Section 3503 of the California Fish and Game Code states that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird. Section 3503.5 specifically states that it is unlawful to take, possess, or destroy any raptors (i.e., species in the orders *Falconiformes* and *Strigiformes*), including their nests or eggs. Typical violations of these codes include destruction of active nests resulting from removal of vegetation in which the nests are located. Violation of Section 3503.5 could also include failure of active raptor nests resulting from disturbance of nesting pairs by nearby project construction. This statute does not provide for the issuance of any type of incidental take permit.

A.2.7 Porter-Cologne Water Quality Control Act of 1969

In 1967, the Porter-Cologne Act established the State Water Board and nine RWQCBs as the primary state agencies with regulatory authority over California water quality and appropriative surface water rights allocations. Under this act (and the CWA), the state is required to adopt a water quality control policy and waste discharge requirements (WDRs) to be implemented by the State Water Board and nine RWQCBs. The State Water Board also establishes Basin Plans and statewide plans. The RWQCBs carry out State Water Board policies and procedures throughout the state.

Pursuant to the Porter-Cologne Act, the Central Valley RWQCB prepares and updates the Basin Plan for the Sacramento and San Joaquin River Basins every 3 years. The Basin Plan describes the

officially designated beneficial uses for specific surface water and groundwater resources and the enforceable water quality objectives necessary to protect those beneficial uses. The planning area is located within the Central Valley RWQCB jurisdiction and is subject to the Basin Plan.

The Basin Plan includes numerical and narrative water quality objectives for physical and chemical water quality constituents. Numerical objectives are set for temperature, dissolved oxygen (DO, turbidity, and pH; total dissolved solids, electrical conductivity, bacterial content, and various specific ions; trace metals; and synthetic organic compounds. Narrative objectives are set for parameters such as suspended solids, biostimulatory substances (e.g., nitrogen and phosphorus), oil and grease, color, taste, odor, and aquatic toxicity. Narrative objectives are often precursors to numeric objectives. The primary method used by the Central Valley RWQCB to ensure conformance with the Basin Plan's water quality objectives and implementation policies and procedures is to issue WDRs for projects that may discharge wastes to land or water. WDRs specify terms and conditions that must be followed during the implementation and operation of a project.

Basin Plans designate beneficial uses for specific surface water and groundwater resources and establish water quality objectives to protect those uses. The project has the potential to affect water quality in surface water or groundwater within the project area which is governed by the Central Valley RWQCB.

Section 3.2, *Water Quality and Groundwater Resources*, describes water quality effects and mitigation measures for the project.

Central Valley Regional Water Quality Control Board

The Porter-Cologne Water Quality Control Act provides for the development and periodic review of water quality control plans (basin plans) for each region. The Central Valley RWQCB is responsible for implementing its Basin Plan (Central Valley Regional Water Quality Control Board 2009) for the Feather River and its tributaries. The basin plan identifies beneficial uses of the river and its tributaries and water quality objectives to protect those uses. Numerical and narrative criteria are contained in the basin plan for several key water quality constituents, including DO, water temperature, trace metals, turbidity, suspended material, pesticides, salinity, radioactivity, and other related constituents.

Basin plans are implemented primarily by using the NPDES permitting system to regulate waste discharges so that water quality objectives are met (see discussion of the NPDES system under CWA above). Basin plans are supposed to be updated every 3 years and provide the technical basis for determining WDRs and taking enforcement actions. The Central Valley RWQCB Basin Plan was last updated in 2007. Another method the Central Valley RWQCB uses to implement the basin plan criteria is by issuing WDRs. WDRs are issued to any entity that discharges to a surface water body and does not meet certain water quality criteria such as those related to sediment. The WDR/NPDES permit also serves as a Federally required NPDES permit (under the CWA) and incorporates the requirements of other applicable regulations.

State Implementation Plan

In 1994, the State Water Board and EPA agreed to a coordinated approach for addressing priority toxic pollutants in inland surface waters, enclosed bays, and estuaries of California. In March 2000, the State Water Board adopted a SIP for priority toxic pollutant water quality criteria contained in the California Toxics Rule (CTR). The EPA promulgated the CTR in May 2000. The SIP also

implements National Toxics Rule (NTR) criteria and applicable priority pollutant objectives in the basin plans. In combination, the CTR and NTR and applicable basin plan objectives, existing RWQCB beneficial use designations, and SIP compose water quality standards and implementation procedures for priority toxic pollutants in non-ocean surface waters in California, such as the Feather River.

The CTR was promulgated in 2000 in response to requirements of the EPA NTR. The NTR and CTR criteria are regulatory criteria adopted for inland surface waters, enclosed bays, and estuaries in California that are subject to regulation pursuant to Section 303(c) of the CWA. The NTR and CTR include criteria for the protection of aquatic life and human health. Human health criteria (water and organisms) apply to all waters with a Municipal and Domestic Supply beneficial use designation as indicated in the RWQCBs' basin plans. The Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California, also known as the State Implementation Plan, was adopted by the State Water Board in 2000 to establish provisions for translating CTR criteria, NTR criteria, and basin plan water quality objectives for toxic pollutants into the following.

- NPDES permit effluent limits
- Compliance determinations
- Monitoring for dioxin (2,3,7,8-TCDD) equivalents
- Chronic toxicity control provisions
- Initiating site-specific objective development
- Granting exceptions.

See Section 3.2, *Water Quality and Groundwater Resources*, for information related to the project.

A.2.8 California Code of Regulations, Title 23

The Central Valley Flood Protection Board (CVFPB) (formerly the California Reclamation Board) of the State of California regulates the modification and construction of levees and floodways in the Central Valley defined as part of the Sacramento Valley and San Joaquin Valley flood control projects. Rules promulgated in Title 23 of the CCR (Title 23, Division 1, Article 8 [Section 111 through 137]) regulate the modification and construction of levees to ensure public safety. The CVFPB requires an encroachment permit for any non-Federal activity along or near Federal flood damage reduction project levees and floodways or in CVFPB-designated floodways to ensure that proposed local actions or projects do not impair the integrity of existing flood damage reduction systems to withstand flood conditions. The permits are conditioned upon SBFCA's receipt of permission from USACE for alteration of the Federal project works pursuant to Section 408.The rules further state that existing levees may not be excavated or left partially excavated during the flood season, which is generally November 1 through April 15 for the proposed project area levees.

The following CVFPB guidance applies:

> The California Reclamation Board has primary jurisdiction approval of levee design and construction. The Reclamation Board standards are found in Title 23, Division 1, Article 8 (Sections 111 through 137) of the California Code of Regulations (CCR), and constitute the primary state standard. Section 120 of the CCR directs that levee design and construction be in accordance with the USACE's Engineer Manual EM 1110-2-1913, Design and Construction of Levees. This document is the primary

federal standard applicable to this project, as supplemented by additional prescriptive standards contained in Section 120 of the CCR. These additional standards prescribe minimum levee cross-sectional dimensions, construction material types, and compaction levels.

A.2.9 Central Valley Flood Control Act of 2008

The Central Valley Flood Control Act of 2008, passed in 2007, recognizes that the Central Valley of California, which includes the planning area, is experiencing unprecedented development, resulting in the conversion of historically agricultural lands and communities to densely populated residential and urban centers. Because of the potentially catastrophic consequences of flooding, the Act recognizes that the Federal government's current 100-year flood protection standard is not sufficient to protect urban and urbanizing areas within flood-prone areas throughout the Central Valley and declares that the minimum standard for these areas is a 200-year level of flood protection. To continue with urban development, cities and counties must develop and implement plans for achieving this new standard by 2025. With respect to flood risk reduction, the Central Valley Flood Control Act also calls upon the California Department of Water Resources (DWR) to develop a comprehensive Central Valley Flood Protection Plan (CVFPP) by the end of 2012 for protecting the lands currently within the Sacramento–San Joaquin River Flood Management System.

According to California Government Code Sections 65302.9 and 65860.1, every jurisdiction located within the Sacramento–San Joaquin Valley is required to update its General Plan and Zoning Ordinance in a manner consistent with the CVFPP within 24 months after the CVFPP's adoption, which occurred July 1, 2012. In addition, the locations of the state and local flood management facilities, locations of flood hazard zones, and the properties located in these areas must be mapped and consistent with the CVFPP.

The proposed project is intended to be consistent with the CVFPP, as the State seeks to continue to work with SBFCA to develop and implement projects to achieve an urban level of flood protection for Yuba City and other population centers in the affected area. This includes reconstructing and/or improving levees to urban design criteria (see below) along the west bank of the Feather River, adjacent to and upstream from Yuba City, as part of the FRWLP.

Senate Bill 5, Senate Bill 17, and Assembly Bill 162

According to legislation as part of Senate Bill (SB) 5 (Machado and Wolk), SB 17 (Florez) and Assembly Bill (AB) 162 (Wolk), urban and urbanizing areas in the Sacramento Valley and San Joaquin Valley will be required to achieve, or make adequate progress toward achieving, 200-year protection by the year 2015 to continue to have development approved in the floodplain. Specifically, AB 162 requires that each local jurisdiction's Safety Element include 200-year floodplain maps. Maps must be based on the best available data on flood protection, including areas protected by state and Federal project levees, and areas outside of these areas.

California Department of Water Resources Urban Levee Design Criteria

Pursuant to SB 5 (Government Code (GC) §65007(l)), the Urban Levee Design Criteria (ULDC) define the urban level of flood protection as the level of protection that is necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year using criteria consistent with, or developed by, DWR. While cities and counties located outside of the Sacramento–San Joaquin Valley are not required to make findings related to the urban level of flood protection, the ULDC can help inform engineering and local land use decisions for areas at risk of flooding anywhere in California. The

ULDC was developed through a collaborative process with stakeholders from local government (including representatives from the Central Valley, San Francisco Bay Area, and Los Angeles Region), State government, and the Federal government.

The ULDC provide criteria and guidance for design, construction, operation, and maintenance of levees and floodwalls in urban and urbanizing areas. When finalized, the ULDC will supersede Version 4 of the Interim Levee Design Criteria for Urban and Urbanizing Areas in the Sacramento-San Joaquin Valley (Version 4), dated December 15, 2010. The ULDC contain numerous revisions and refinements from Version 4.

A.2.10 California Surface Mining and Reclamation Act

The principal legislation addressing mineral resources in California is the Surface Mining and Reclamation Act of 1975 (SMARA) (PRC Sections 2710–2719), which was enacted in response to land use conflicts between urban growth and essential mineral production. The stated purpose of SMARA is to provide a comprehensive surface mining and reclamation policy that would encourage the production and conservation of mineral resources while ensuring that adverse environmental effects of mining are prevented or minimized; that mined lands are reclaimed and residual hazards to public health and safety are eliminated; and that consideration is given to recreation, watershed, wildlife, aesthetic, and other related values. SMARA governs the use and conservation of a wide variety of mineral resources, although some resources and activities are exempt from its provisions, including excavation and grading conducted for farming, construction, or recovery from flooding or other natural disaster.

Activities subject to SMARA include, but are not limited to, mining of minerals, gravel, and borrow material. The SMARA statute requires mitigation to reduce adverse effects on public health, property, and the environment. Because the Sacramento Area Flood Control Agency (SAFCA) would require borrow material for project construction, SAFCA must comply with SMARA. SMARA applies to an individual or entity that would disturb more than 1 acre or remove more than 1,000 cubic yards of material through surface mining activities, including the excavation of borrow pits for soil material. SMARA is implemented through ordinances for permitting developed by local government "lead agencies" that provide the regulatory framework under which local mining and reclamation activities are conducted. The State Mining and Geology Board reviews the local ordinances to ensure that they meet the procedures established by SMARA.

SMARA provides for the evaluation of an area's mineral resources using a system of Mineral Resource Zone (MRZ) classifications that reflect the known or inferred presence and significance of a given mineral resource. The MRZ classifications are based on available geologic information, including geologic mapping and other information on surface exposures, drilling records, and mine data; and socioeconomic factors such as market conditions and urban development patterns. The MRZ classifications are defined as follows.

- **MRZ-1**—areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- **MRZ-2**—areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists.
- **MRZ-3**—areas containing mineral deposits, the significance of which cannot be evaluated from available data.

- **MRZ-4**—areas where available information is inadequate for assignment into any other MRZ.

Although the state of California is responsible for identifying areas containing mineral resources, the county or city is responsible for SMARA implementation and enforcement by providing annual mining inspection reports and coordinating with California Geological Survey (CGS).

Mining activities that disturb more than 1 acre or 1,000 cubic yards of material require a SMARA permit from the lead agency, which is the county, city, or board that is responsible for ensuring that adverse environmental effects of mining are prevented or minimized. The lead agency establishes its own local regulations and requires a mining applicant to obtain a surface mining permit, submit a reclamation plan, and provide financial assurances, pursuant to SMARA.

Certain mining activities do not require a permit, such as excavation related to farming, grading related to restoring the site of a natural disaster, and grading related to construction. The project is under evaluation for SMARA applicability.

A.2.11 California Important Farmland Inventory System and Farmland Mapping and Monitoring Program

The California Department of Conservation, Office of Land Conservation, maintains a statewide inventory of farmlands. These lands are mapped by the Division of Land Resource Protection as part of the Farmland Mapping and Monitoring Program. The maps are updated every 2 years with the use of aerial photographs, a computer mapping system, public review, and field reconnaissance. Farmlands are divided into the following five categories based on their suitability for agriculture.

- Prime Farmland: land that has the best combination of physical and chemical characteristics for crop production. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when treated and managed.
- Farmland of Statewide Importance: land other than Prime Farmland that has a good combination of physical and chemical characteristics for crop production.
- Unique Farmland: land that does not meet the criteria for Prime Farmland or Farmland of Statewide Importance, but that has been used for the production of specific crops with high economic value.
- Farmland of Local Importance: land that is either currently producing crops or has the capability of production, but that does not meet the criteria of the categories above.
- Grazing Land: land on which the vegetation is suited to the grazing of livestock.

These categories are sometimes referred to as Important Farmland. Other categories used in the mapping system are urban and built-up lands, lands committed to non-agricultural use, and other lands (land that does not meet the criteria of any of the other categories).

Section 3.11, *Agriculture, Land Use, and Socioeconomics,* addresses effects on farmland.

A.2.12 California Land Conservation Act (Williamson Act)

The California Land Conservation Act of 1965, commonly known as the Williamson Act (California Government Code Section 51200 et seq.), enables local governments to enter into contracts with private landowners for the purpose of promoting the continued use of the relevant land in

agricultural or related open space use. In return, landowners receive property tax assessments that are based on farming and open space uses instead of full market value. Local governments receive an annual subvention (subsidy) of forgone property tax revenues from the state via the Open Space Subvention Act of 1971.

The Williamson Act empowers local governments to establish agricultural preserves consisting of lands devoted to agricultural uses and other compatible uses. Upon establishment of such preserves, the locality may offer to owners of included agricultural land the opportunity to enter into annually renewable contracts that restrict the land to agricultural use for at least 10 years (i.e., the contract continues to run for 10 years following the first date upon which the contract is not renewed). In return, the landowner is guaranteed a relatively stable tax rate, based on the value of the land for agricultural/open space use only and unaffected by its development potential.

As a public agency that may acquire lands within agricultural preserves, including lands under contract, SBFCA is exempt from the normal cancellation process for Williamson Act contracts, because the contract is nullified for the portion of the land actually acquired (California Government Code Section 51295). SAFCA must provide notice to the California Department of Conservation prior to acquiring such lands (California Government Code Section 51291[b]). A second notice is required within 10 working days after the land is actually acquired (California Government Code Section 51291 (c J). As the land would be acquired for flood damage reduction measures, SAFCA is exempt from the findings required in California Government Code Section 51292 (California Government Code Section 51293[e][1]) because the proposed project consists of flood control works. The preliminary notice to the California Department of Conservation, provided before lands are actually acquired, would demonstrate the purpose of the project and the exemption from the findings.

Section 3.11, *Agriculture, Land Use, and Socioeconomics*, addresses effects on farmland.

A.2.13 California Climate Solutions Act

In September 2006, Governor Arnold Schwarzenegger signed AB 32, the California Climate Solutions Act of 2006. AB 32 requires that statewide GHG emissions be reduced to 1990 levels by 2020. This reduction would be accomplished through an enforceable statewide cap on GHG emissions that would be phased in starting in 2012. To effectively implement the cap, AB 32 directs the California Air Resources Board (ARB) to develop and implement regulations to reduce statewide GHG emissions from stationary sources. AB 32 specifies that regulations adopted in response to AB 1493 should be used to address GHG emissions from vehicles. However, AB 32 also includes language stating that if the AB 1493 regulations cannot be implemented, then ARB should develop new regulations to control vehicle GHG emissions under the authorization of AB 32.

AB 32 requires that ARB adopt a quantified cap on GHG emissions representing 1990 emissions levels and disclose how it arrives at the cap; institute a schedule to meet the emissions cap; and develop tracking, reporting, and enforcement mechanisms to ensure that the state achieves the reductions in GHG emissions necessary to meet the cap. AB 32 also includes guidance to institute emissions reductions in an economically efficient manner and conditions to ensure that businesses and consumers are not unfairly affected by the reductions.

Contributions of GHG emissions related to the project are discussed in Section 3.6, *Climate Change and Greenhouse Gas*.

A.2.14 California Regulations for Environmental Justice

Most state governments have plans and policies intended to protect and expand the local and regional economies affecting the communities within their jurisdictions. State plans and policies also frequently address other social and economic impact topics, including fiscal conditions and related public services that affect local residents' quality of life.

Within California, SB 115 (Chapter 690, Statutes of 1999) was signed into law in 1999. The legislation established OPR as the coordinating agency for state environmental justice programs (California Government Code, Section 65040.12[a]) and defined environmental justice in statute as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" (Government Code Section 65040.12(e). SB 115 further required the California Environmental Protection Agency (Cal/EPA) to develop a model environmental justice mission statement for boards, departments, and offices within the agency by January 1, 2001 (Public Resources Code, Sections 72000–72001).

In 2000, SB 89 (Chapter 728, Statutes of 2000) was signed, which complemented SB 115 by requiring the creation of an environmental justice working group and an advisory group to assist Cal/EPA in developing an intra-agency environmental justice strategy (PRC Sections 72002–72003). SB 828 (Chapter 765, Statutes of 2001) added and modified due dates for the development of Cal/EPA's intra-agency environmental justice strategy and required each board, department, and office within Cal/EPA to identify and address, no later than January 1,2004, any gaps in its existing programs, policies, and activities that may impede environmental justice (PRC, Sections 71114–71115).

Cal/EPA adopted its environmental justice policy in 2004 (California PRC, Sections 71110–71113). This policy (or strategy) provides guidance to its resource boards, departments, and offices. It is intended to help achieve the state's goal of "achieving fair treatment of people of all races, cultures and incomes with respect to the development, adoption, implementation and enforcement of environmental laws and policies."

AB 1553 (Chapter 762, Statutes of 2001) required OPR to incorporate environmental justice considerations in the General Plan Guidelines. AB 1553 specified that the guidelines should propose methods for local governments to address the following goals.

- Plan for the equitable distribution of new public facilities and services that increase and enhance community quality of life.
- Provide for the location of industrial facilities and uses that pose a significant hazard to human health and safety in a manner that seeks to avoid over-concentrating these uses in proximity to schools or residential dwellings.
- Provide for the location of new schools and residential dwellings in a manner that avoids proximity to industrial facilities and uses that pose a significant hazard to human health and safety.
- Promote more livable communities by expanding opportunities for transit-oriented development.

Although environmental justice is not a mandatory topic in the general plan, OPR is required to provide guidance to cities and counties for integrating environmental justice into their general

plans. The 2003 edition of the *General Plan Guidelines* included the contents required by AB 1553 (see pages 8, 12, 20–27, 40, 114, 142, 144, and 260 of the revised *General Plan Guidelines*).

Environmental justice issues pertaining to the project are discussed in Section 3.12, *Population, Housing, and Environmental Justice*.

A.2.15 Water Use Efficiency

The California Constitution prohibits the waste or unreasonable use of water. Further, Water Code Section 275 directs DWR and the State Water Board to "take all appropriate proceedings or actions before executive, legislative, or judicial agencies to prevent waste or unreasonable use of water." Several legislative acts have been adopted to develop efficient use of water in the state.

- Urban Water Management Planning Act of 1985
- Water Conservation in Landscaping Act of 1992
- Agricultural Water Management Planning Act
- Agricultural Water Suppliers Efficient Management Practices Act of 1990
- Water Recycling Act of 1991
- Agricultural Water Conservation and Management Act of 1992

The purpose of the project is to address flood issues; it would not result in the waste or unreasonable use of water.

A.2.16 Public Trust Doctrine

When planning and allocating water resources, the State of California is required to consider the public trust and preserve for the public interest the uses protected by the trust. The public trust doctrine embodies the principle that certain resources, including water, belong to all and, thus, are held in trust by the state for future generations.

In common law, the public trust doctrine protects navigation, commerce, and fisheries uses in navigable waterways. However, the courts have expanded the doctrine's application to include protecting tideland, wildlife, recreation, and other public trust resources in their natural state for recreational, ecological, and habitat purposes as they affect birds and marine life in navigable waters. *The National Audubon Society v. Superior Court of Alpine County* (1983) 33 Cal 3d 419 decision extended the public trust doctrine's limitations on private rights to appropriative water rights, and also ruled that longstanding water rights could be subject to reconsideration and could possibly be curtailed. The doctrine, however, generally requires the court and the State Water Board to perform a balancing test to weigh the potential value to society of a proposed or existing diversion against its effect on trust resources.

The 1986 Rancanelli decision applied the public trust doctrine to decisions by the State Water Board and held that this doctrine must be applied by the State Water Board in balancing all the competing interests in the uses of Bay-Delta waters (*United States v. State Water Resources Control Board* [1986] 182 Cal. App. 3d 82).

The project is consistent with the public trust doctrine, as the primary goals include improved flood protection.

A.2.17 Davis-Dolwig Act

The Davis-Dolwig Act declares that recreation and fish and wildlife enhancement are among the purposes of state water projects. It specifies that costs for recreation and fish and wildlife enhancement not be included in prices, rates, and charges for water and power to urban and agricultural users. Under the Davis-Dolwig Act, land for recreation and fish and wildlife enhancement must be planned and initiated at the same time as any other land acquisition for the project. Implementation of the project would maintain existing recreation areas and not preclude opportunities for future recreation use or facilities. While the project is not related to water supply, it consistent with this act.

A.2.18 Relocation Assistance and Property Acquisition

The State of California's Government Code Section 7260, et seq. brings the California Relocation Act into conformity with the Federal Uniform Act. In the acquisition of real property by a public agency, both the Federal and state acts seek to (1) ensure consistent and fair treatment of owners of real property, (2) encourage and expedite acquisition by agreement to avoid litigation and relieve congestion in the courts, and (3) promote confidence in public land acquisition.

The Relocation Assistance and Real Property Acquisition Guidelines were established by 25 CCR 1.6. The guidelines were developed to assist public entities with developing regulations and procedures implementing Title 42, Chapter 61 of the USC, the Uniform Act, for Federal and Federally-assisted programs. The guidelines are designed to ensure that uniform, fair, and equitable treatment is given to people displaced from their homes, businesses, or farms as a result of the actions of a public entity. Under the act, persons required to relocate temporarily are not considered displaced, but must be treated fairly. Such persons have a right to temporary housing that is decent, safe, and sanitary, and must be reimbursed for all reasonable out-of-pocket expenses. In accordance with these guidelines, people may not suffer disproportionate injury as a result of action taken for the benefit of the public as a whole. Additionally, public entities must ensure consistent and fair treatment of owners of such property, and encourage and expedite acquisitions by agreement with owners of displaced property to avoid litigation.

Property acquisition and relocation services, compensation for living expenses for temporarily relocated residents, and negotiations regarding any compensation for temporary loss of business would be accomplished in accordance with the Uniform Act (see above) and California Government Code Section 7267 et seq.

A.2.19 Safe, Clean, Reliable Water Supply Act

This act declares that the basic goals of the state are, among other findings, to protect the integrity of the state's water supply system from catastrophic failure attributable to earthquakes and flooding.

A.2.20 Alquist-Priolo Earthquake Fault Zoning Act

California's Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) (PRC Section 2621 et seq.), originally enacted in 1972 as the Alquist-Priolo Special Studies Zones Act and renamed in 1994, is intended to reduce risks to life and property from surface fault rupture during earthquakes. The Alquist-Priolo Act prohibits the location of most types of structures intended for human occupancy across the traces of active faults and strictly regulates construction in the corridors along

active faults (earthquake fault zones). It also defines criteria for identifying active faults, giving legal weight to terms such as active, and establishes a process for reviewing building proposals in and adjacent to earthquake fault zones.

Under the Alquist-Priolo Act, faults are zoned, and construction along or across them is strictly regulated if they are "sufficiently active" and "well defined." A fault is considered sufficiently active if one or more of its segments or strands shows evidence of surface displacement during Holocene time (defined for purposes of the act as referring to approximately the last 11,000 years). A fault is considered well-defined if its trace can be identified clearly by a trained geologist at the ground surface, or in the shallow subsurface using standard professional techniques, criteria, and judgment (Bryant and Hart 2007).

The act directs CGS to establish the regulatory zones, called AP Earthquake Fault Zones, around the known surface traces of active faults and to publish maps showing these zones. Each fault zone extends approximately 200 to 500 feet on each side of the mapped fault trace to account for potential branches of active faults.

CGS Special Publication 42 (Bryant and Hart 2007) states that in the absence of a site-specific faulting study, the areas within 50 feet of the mapped fault should be considered to have the potential for surface faulting and, therefore, no structure for human occupancy should be in these areas. Construction of buildings intended for human occupancy within the fault zone boundaries is strictly regulated, and site-specific faulting investigations are required.

Title 14 of CCR, Section 3601(e), defines buildings intended for human occupancy as those that would be inhabited for more than 2,000 hours per year. If no facilities are to be within AP Earthquake Fault Zones, this act would not apply.

A.2.21 Seismic Hazards Mapping Act

Like the Alquist-Priolo Act, the Seismic Hazards Mapping Act of 1990 (PRC Sections 2690–2699.6) is intended to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong ground shaking, liquefaction, and seismically induced landslides. Its provisions are similar in concept to those of the Alquist-Priolo Act: The state is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards; and cities and counties are required to regulate development within mapped seismic hazard zones.

Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for sites within seismic hazard zones until appropriate site-specific geologic and/or geotechnical investigations have been carried out and measures to reduce potential damage have been incorporated into the development plans.

A.2.22 California Building Standards Code

California's minimum standards for structural design and construction are given in the California Building Standards Code (CBSC) (24 CCR). The CBSC provides standards for various aspects of construction, including excavation, grading, and earthwork construction; fills and embankments; expansive soils; foundation investigations; and liquefaction potential and soil strength loss. In

accordance with California law, certain aspects of the project would be required to comply with all provisions of the CBSC.

A.2.23 Assembly Bill 939, Titles 14, 17, and 27, Chapter 1095, Statutes of 1989

GHG emissions from landfills are regulated under AB 939, Titles 14 and 27. AB 939 mandated local jurisdictions to meet waste diversion goals of 25% by 1995 and 50% by 2000. In addition, AB 939 established an integrated statewide system for compliance and program implementation. Titles 14 and 27 contain detailed rules on daily operations, handling of specific waste types, monitoring, closure, and record-keeping.

At its June 25, 2009, public hearing, ARB approved for adoption CCR Title 17, article 4, sub-article 6, sections 95460 to 95476, Methane Emissions from Municipal Solid Waste Landfills. This regulation is a discrete early action GHG-reduction measure, as described in the California Global Warming Solutions Act of 2006 (AB 32; Stats. 2006, chapter 488). It would reduce methane emissions from landfills primarily by requiring owners and operators of certain uncontrolled landfills to install gas collection and control systems, and by requiring existing and newly installed gas collection and control systems to operate optimally.

A.2.24 Assembly Bill 1493—Pavley Rule (2002)

Known as Pavley I, AB 1493 standards are the nation's first GHG standards for automobiles. AB 1493 requires ARB to adopt vehicle standards that will lower GHG emissions from new light duty autos to the maximum extent feasible beginning in 2009. Additional strengthening of the Pavley standards (Pavley II) has been proposed for vehicle model years 2017–2020. Together, the two standards are expected to increase average fuel economy to roughly 43 mpg by 2020 and reduce GHG emissions from the transportation sector in California by approximately 14%. In June 2009, the EPA granted California's waiver request, enabling the state to enforce its GHG emissions standards for new motor vehicles beginning with the current model year. The new Federal CAFE standards, described above, are the analogous national policy.

A.2.25 Executive Order S-03-05 (2005)

Executive Order S-03-05 established the following GHG emission reduction targets for California's state agencies:

- By 2010, reduce GHG emissions to 2000 levels.
- By 2020, reduce GHG emissions to 1990 levels.
- By 2050, reduce GHG emissions to 80% below 1990 levels.

Executive orders are binding only on state agencies. Accordingly, Executive Order S-03-05 will guide state agencies' efforts to control and regulate GHG emissions but would have no direct binding effect on local efforts. The Secretary of the Cal/EPA is required to report to the Governor and state legislature biannually on the effects of climate change on California, mitigation and adaptation plans, and progress made toward reducing GHG emissions to meet the targets established in this executive order.

A.2.26 Senate Bill 97, Chapter 185 (2007)

SB 97 of 2007 requires that the State's OPR prepare guidelines to submit to the California Resources Agency regarding feasible mitigation of GHG emissions or the effects of GHG emissions as required by CEQA. The Natural Resources Agency adopted Amendments to the State CEQA Guidelines for GHG emissions on December 30, 2009. On February 16, 2010, the State's Office of Administrative Law approved the amendments and filed them with the Secretary of State for inclusion in the California Code of Regulations. The amendments became effective March 18, 2010.

A.2.27 Executive Order S-01-07, Low Carbon Fuel Standard (2007)

Executive Order S-01-07 essentially mandates: (1) that a statewide goal be established to reduce the carbon intensity of California's transportation fuels by at least 10% by 2020, and (2) that a low carbon fuel standard (LCFS) for transportation fuels be established in California. The executive order initiates a research and regulatory process at the ARB. Based on an implementation plan developed by the CEC, ARB will be responsible for implementing the LCFS.

A.2.28 California Air Resources Board Mandatory Greenhouse Gas Reporting Rule (Title 17) (2007)

In December of 2007, ARB approved a rule requiring mandatory reporting of GHG emissions from certain sources, pursuant to AB 32. Facilities subject to the mandatory reporting rule must report their emissions either annually for large facilities or triennially for smaller facilities starting from 2010. In general the rule applies to facilities emitting more than 25,000 MT of carbon dioxide equivalent (CO_2e) in any given calendar year and electricity generating facilities with a nameplate generating capacity greater than 1 megawatt (MW) and/or emitting more than 2,500 MT CO_2e per year. Additional requirements apply to cement plants and entities that buy and sell electricity in the state.

A.2.29 California Air Resources Board Local Government Operations Protocol (2008)

On September 25, 2008, the Local Government Operations Protocol (LGOP) was adopted by ARB. The protocol, prepared by ARB, California Climate Action Registry, International Council of Local Environmental Initiatives (ICLEI), and The Climate Registry, provides methods and techniques for the preparation of GHG emission inventories for local government municipal operations. The adopted protocol does not recommended any particular measures for GHG reductions by local governments (California Air Resources Board 2010a).

A.2.30 Senate Bill 375—Sustainable Communities Strategy, Chapter 728 (2008)

SB 375 provides for a new planning process that coordinates land use planning, regional transportation plans, and funding priorities in order to help California meet the GHG reduction goals established in AB 32. SB 375 requires regional transportation plans (RTPs), developed by metropolitan planning organizations (MPOs), including the Sacramento Area Council of

Governments (SACOG), to incorporate a "sustainable communities strategy" (SCS) in their Regional Transportation Plans. The goal of the SCS is to reduce regional vehicle miles traveled (VMT) through land use planning and consequent transportation patterns. On September 23, 2010, ARB adopted regional GHG reduction targets that will focus each SCS. The target for the Sacramento region specifies a 7% reduction in per capita emissions by 2020 and a 16% reduction by 2035. SACOG is in the process of developing its SCS, pursuant to the regional GHG target. Completion is expected in December 2011. SB 375 also includes provisions for streamlined CEQA review for some infill projects such as transit-oriented development. However, those provisions would not become effective until an SCS is adopted.

A.2.31 Senate Bills 1078/107 and Executive Order S-14-08—Renewable Portfolio Standard (2008)

SBs 1078 and 107, California's Renewable Portfolio Standard (RPS), obligates investor-owned utilities (IOUs), energy service providers (ESPs), and Community Choice Aggregations (CCAs) to procure an additional 1% of retail sales per year from eligible renewable sources until 20% is reached, no later than 2010. The CPUC and CEC are jointly responsible for implementing the program. EO S-14-08 set forth a longer range target of procuring 33% of retail sales by 2020.

A.2.32 California Energy Efficiency Standards for Residential and Non-Residential Buildings (Title 24)(2008)

Energy Conservation Standards for new residential and nonresidential buildings were adopted by the California Energy Resources Conservation and Development Commission in June 1977 and most recently revised in 2008 (24 CCR 6). Title 24 requires that building shells and building components be designed to conserve energy and the standards are updated periodically (roughly every 3 years) to allow consideration and incorporation of new energy efficiency technologies. This program has been partially responsible for keeping California's per capita energy use approximately constant over the past 30 years.

Title 24 standards were most recently updated on July 17, 2008. The new code, adopted by the California Building Standards Commission, represents the nation's first green building standards and went into effect on January 1, 2010. Part 11 of the code established voluntary actions (Tier 1 and 2), designed to achieve a higher level of efficiency and sustainability, including planning and design for sustainable site development, energy efficiency (in excess of the California Energy Code requirements), water conservation, material conservation, and internal air contaminants. The voluntary standards became mandatory on January 1, 2011.

A.2.33 California Cap-and-Trade (2010)

Pursuant to the directives of AB 32, ARB recently approved measures on December 16, 2010, to enact a GHG Cap-and-Trade program for the state of California. The California Cap-and-Trade program would create a CO_2 market system with a GHG emissions cap that will be decreased over time. Building on the data required by the 2007 California Mandatory GHG Reporting rule, only stationary sources that emit more than 25,000 MT of CO_2e per year would be affected by the Cap-and-Trade program. These sources include mostly large operations such as power plants, refineries, cement plants, hydrogen production facilities, and other large, stationary sources. Official

rulemaking associated with achieving this emissions cap was adopted by January 1, 2011, and the actual program is to commence in 2012.

A.2.34 Actions Taken by California Attorney General's Office

The California Attorney General (AG) has filed comment letters under CEQA about a number of proposed projects. The AG also has filed several complaints and obtained settlement agreements for CEQA documents covering general plans and individual programs that the AG found either failed to analyze GHG emissions or failed to provide adequate GHG mitigation. The AG's office prepared a report listing the measures that local agencies should consider under CEQA to offset or reduce global warming effects. The AG's office also has prepared a chart of modeling tools to estimate GHG emissions effects of projects and plans. Information on the AG's actions can be found on the California Department of Justice, Office of Attorney General web site (California Department of Justice 2008).

A.2.35 California Air Pollution Control Officers Association Guidance

The California Air Pollution Control Officers Association (CAPCOA) released a report in January 2008 that describes methods to estimate and mitigate GHG emissions from projects subject to CEQA. The CAPCOA report evaluates several GHG thresholds that could be used to evaluate the significance of a project's GHG emissions. The CAPCOA report, however, does not recommend any one threshold. The report is designed as a resource for public agencies as they establish agency procedures for reviewing GHG emissions from projects subject to CEQA (California Air Pollution Control Officers Association 2008).

In 2010 CAPCOA prepared a supplemental guidance document entitled Quantifying Greenhouse Gas Mitigation Measures (California Air Pollution Control Officers Association 2010). The report is intended to provide a resource for applicants and planners who might be required to mitigate GHG emissions, and provides tools to quantify a wide range of potentially feasible GHG reduction measures. However, the document does not specify GHG significance thresholds, nor does it advocate any policy or specific set of GHG mitigation measures.

A.2.36 Executive Order S-13-08

Executive Order S-13-08, issued November 14, 2008, directs the California Natural Resources Agency, DWR, Office of Planning and Research, Energy Commission, State Water Resources Control Board, State Parks Department, and California's coastal management agencies to participate in a number of planning and research activities to advance California's ability to adapt to the impacts of climate change. The order specifically directs agencies to work with the National Academy of Sciences to initiate the first California Sea Level Rise Assessment and to review and update the assessment every 2 years after completion; to immediately assess the vulnerability of the California transportation system to sea level rise; and to develop a California Climate Change Adaptation Strategy.

A.2.37 Idling Limit Regulation

On June 15, 2008, ARB adopted a regulation for off-road diesel vehicles. The regulation is designed to reduce toxic air contaminants (TACs) from diesel-powered construction and mining vehicles operating in California. Fleet owners are subject to retrofit or accelerated replacement/repower requirements for which ARB must obtain authorization from EPA prior to enforcement.

The regulation also imposes idling limitations on owners, operators, and renters or lessees of off-road diesel vehicles. The idling limits became effective on June 15, 2008, and require an operator of applicable off-road vehicles (self-propelled, diesel-fueled vehicles of 25 horsepower and greater that were not designed for on-road driving) to limit idling to no more than 5 minutes. These requirements are specified in 13 CCR 2449(d)(3).

A.2.38 State Tailpipe Emission Standards

To reduce emissions from off-road diesel equipment, on-road diesel trucks, and harbor craft, ARB established a series of increasingly strict emission standards for new engines. New construction equipment used for the project, including heavy duty trucks, off-road construction equipment, tugboats, and barges, will be required to comply with the standards.

A.2.39 Carl Moyer Memorial Air Quality Attainment Program

The Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer Program) is a voluntary program that offers grants to owners of heavy-duty vehicles and equipment. The program is a partnership between ARB and the local air districts throughout the state. Locally, the air districts administer the Carl Moyer program. The purpose of the program is to reduce air pollution emissions from heavy-duty engines.

A.3 Local Plans, Policies, and Regulations

In addition to Federal and state regulatory requirements, the project may be subject to certain zoning or other ordinances and general plans of Butte and Sutter Counties and cities in the affected area. These are presented below by resource topic for convenience. For more discussion on local plans and requirements applicable to the project, refer to the Regulatory Setting part of the specific resource sections of interest within this document.

A.3.1 Flood Control and Geomorphology

A.3.1.1 Butte County

Butte County General Plan 2030

Both the Water Resources Element and the Health and Safety Element of the Butte County General Plan 2030 (Butte County 2010) contain goals and policies relevant to flood control. These goals and policies focus on minimizing risk and property damage from flooding, protection of surface water and groundwater resources and quality, and management of stormwater runoff.

- **Goal W-6** Improve streambank stability and protect riparian resources.
  - **Policy W-P6.1** Any alteration of natural channels for flood control shall retain and protect riparian vegetation to the extent possible while still accomplishing the goal of providing flood control. Where removing existing riparian vegetation is unavoidable, the alteration shall allow for reestablishment of vegetation without compromising the floodflow capacity.
  - **Policy W-P6.2** Where streambanks are already unstable, as demonstrated by erosion or landslides along banks, tree collapse, or severe in-channel sedimentation, proponents of new development projects shall prepare a hydraulic and/or geomorphic assessment of on-site and downstream drainageways that are affected by project area runoff.
- **Goal HS-2** Protect people and property from flood risk.
  - **Policy HS-P2.1** The County supports the efforts of regional, State and federal agencies to improve flood management facilities along the Sacramento River while conserving the riparian habitat of the river.
  - **Policy HS-P2.2** The County supports the efforts of private landowners and public agencies to maintain existing flood management facilities.
  - **Policy HS-P2.3** The County supports the Flood Mitigation Plan and the Flooding Mitigation Action Plan in the Butte County Multi-Jurisdictional All-Hazard Pre-Disaster Mitigation Plan (MHMP).
  - **Policy HS-P2.4** Development projects on lands within the 100-year flood zone, as identified on the most current available maps from FEMA (the most current available map at the time of the publication of General Plan 2030 is shown on Figure HS-1), shall be allowed only if the applicant demonstrates that it will not:*
    a. Create danger to life and property due to increased flood heights or velocities caused by excavation, fill, roads and intended use.
    b. Create difficult emergency vehicle access in times of flood.
    c. Create a safety hazard due to the height, velocity, duration, rate of rise and sediment transport of the flood waters expected at the site.
    d. Create excessive costs in providing governmental services during and after flood conditions, including maintenance and repair of public facilities.
    e. Interfere with the existing water conveyance capacity of the floodway.
    f. Substantially increase erosion and/or sedimentation.
    g. Require significant storage of material or any substantial grading or substantial placement of fill that is not approved by the County through a development agreement, discretionary permit, or other discretionary entitlement; a ministerial permit that would result in the construction of a new residence; or a tentative map or parcel map.
    h. Conflict with the provisions of the applicable requirements of Government Code Sections 65865.5, 65962 or 66474.5.
  - **Policy HS-P2.5** The lowest floor of any new construction or substantial improvement within Flood Zones A, AE, AH and shaded Zone X, as shown in Figure HS-1 or the most current maps available from FEMA, shall be elevated 1 foot or more above the 100-year

flood elevation. (County Flood Ordinance Sec. 26-22). Within urban or urbanizing areas, as defined in Government Code 65007, the lowest floor of any new construction or substantial improvements shall be elevated a minimum of 1 foot above the 200-year flood elevation.

  - **Policy HS-P2.6** After General Plan 2030 and the Zoning Ordinance are amended to be consistent with the Central Valley Flood Protection Plan, scheduled for adoption in July 2012, the County shall make specific findings prior to approval of a development agreement, subdivision or discretionary permit or other discretionary entitlement, or any ministerial permit that would result in the construction of a new residence. The County shall make findings that it has imposed conditions that will protect the property to the urban level of flood protection, as defined in Government Code Section 65007, in urban and urbanizing areas, or to the national Federal Emergency Management Agency standard of flood protection in nonurbanized areas.

- **Goal HS-3** Prevent and reduce flooding.
  - **Policy HS-P3.1** Watersheds shall be managed to minimize flooding by minimizing impermeable surfaces, retaining or detaining stormwater and controlling erosion.
  - **Policy HS-P3.2** Applicants for new development projects shall provide plans detailing existing drainage conditions and specifying how runoff will be detained or retained on-site and/or conveyed to the nearest drainage facility and shall provide that there shall be no increase in the peak flow runoff to said channel or facility.
  - **Policy HS-P3.3** All development projects shall include stormwater control measures and site design features that prevent any increase in the peak flow runoff to existing drainage facilities.
  - **Policy HS-P3.4** Developers shall pay their fair share for construction of off-site drainage improvements necessitated by their projects.
- **Goal HS-4** Reduce risks from levee failure.
  - **Policy HS-P4.1** The County supports the efforts of regional, State or federal agencies to study levee stability throughout the county, particularly levees that were designed and constructed to provide a minimum 100-year level of protection.
  - **Policy HS-P4.2** The County supports the efforts of levee owners and regional, State, or federal agencies to design and reconstruct levees that do not meet flood protection standards (200-year for urban or urbanizing areas, 100-year for all other areas) to bring them into compliance with adopted State and/or federal standards.
  - **Policy HS-P4.3** New development proposals in levee inundation areas shall consider risk from failure of these levees.

County Ordinance

The delineation of flood boundaries and adoption of County ordinances regulating development within identified floodplains/floodways are the basic flood management tools that the County uses to identify flood hazards and implement its own flood management program. The Federal Emergency Management Agency's (FEMA's) flood mapping program is a critical component of these efforts. A County ordinance adopted in March 1983 enforced flood hazard prevention, as set forth in Article IV in Chapter 26 of the Butte County Code. The Code assigns authority for enforcement of County flood hazard prevention policy to the floodplain administrator, in this case the Director of

Development Services. The Code relies on FEMA and Flood Insurance Studies (FIS) data, although other studies may supplement these data if the floodplain administrator recommends it and the Board of Supervisors approves it. The Flood Hazard Prevention Ordinance appoints the Department of Development Services to review all applications for new construction or subdivisions within flood hazard areas. The ordinance's basic requirement, in order to reduce flood hazards, is that the lowest floor of any new construction or substantial improvement within Flood Zones A, AE, AH, and shaded Zone X be elevated 1 foot or more above the regulatory flood elevation. Also, it must be shown that development within the floodplain will not raise the existing flood level. There are other criteria for building in flood hazard areas, including flood-proofing nonresidential structures and designing structures to withstand hydrostatic pressures and hydrodynamic loads.

In areas subject to flooding that are proposed for subdivision, the County is required to ensure that:

- All such proposed developments are consistent with the need to minimize flood damage,
- Subdivisions and parcel maps must, as a condition of approval, establish regulatory flood elevations and note same on final maps prior to recordation of the final map,
- Adequate drainage is provided to reduce exposure to flood hazards.
- All public utilities and facilities are located so as to minimize or eliminate flood damage.

Butte County Multi-Jurisdictional All-Hazard Pre-Disaster Mitigation Plan

The County's principal emergency response plan is the Butte County Multi-Jurisdictional All-Hazard Pre-Disaster Mitigation Plan (Butte County MHMP) (Butte County 2007), adopted in March 2007. The purpose of the plan is to meet the requirements of the Disaster Mitigation Act and thereby maintain continued eligibility for certain hazard mitigation (or disaster loss reduction) programs from FEMA. The plan lays out the strategy that will enable Butte County to become less vulnerable to future disaster losses. The plan reviews the County's capabilities with regard to reducing impacts of natural hazards (e.g., flooding, dam failure) and identifies recommended action items to reduce vulnerability to these hazards. The most relevant section of the plan with respect to flood control issues is the Flooding Mitigation Action Plan. The Flooding Mitigation Action Plan contains a description of flood hazards, a risk assessment, plans and programs to address the hazards, and mitigation goals and strategies for each jurisdiction in Butte County.

In essence, the main goal of the Butte County MHMP with respect to flood control is to protect infrastructure and agriculture from long-term risks of flood, and this goal is to be achieved by implementation of the Flooding Mitigation Action Plan.

Butte County Flood Mitigation Plan

The County established the Butte County Flood Mitigation Plan (Butte County FMP) (Wood Rodgers 2006) to provide guidance to agencies that protect life, property, and livestock; are involved in land use planning; administer FEMA's National Flood Insurance Program (NFIP); and respond to flood emergencies in Butte County. The Butte County FMP will need to be updated to address new state flood control regulations described above.

City of Biggs

Biggs does not have any FEMA-identified flood hazard areas. The elevation of the city from 96+ feet above sea level in the northeast to 86+ feet above sea level near its westerly boundary generally

prevents water accumulation in depths that create dangerous flooding. However, the city of Biggs is subject to inundation if the Thermalito Afterbay levee or the Oroville Dam fails.

City of Biggs General Plan 1997–2015

Flood mitigation goals, policies, and programs described in the Public Health and Safety Element of the City of Biggs General Plan 1997–2015 (City of Biggs 1998) include the following.

- **Goal 6.2** Minimize the risk of personal injury and property damage resulting from flooding.
  - **Policy 6.2.A** Develop flood control strategies and improvement plans for the City of Biggs in coordination with RD 833.
  - **Policy 6.2.B** New development shall not be approved in areas which are subject to flooding without prior review and approval of plans for improvements which provide a minimum flood protection level equal to the 100 year occurrence storm event.
  - **Policy 6.2.C** Development of structures must be in compliance with FEMA standards. All 100 year flood hazards must be completely mitigated through proper design.
  - **Policy 6.2.D** All new residential development shall be constructed on pads which are at least six inches above the top of curb of the street on which the development fronts.
  - **Policy 6.2.E** New development projects shall be designed to avoid increases in peak storm runoff levels entering RD 833 channels.
  - **Program 6.2.1** Encourage the California Department of Water Resources to determine the maximum flow capacity for the Feather River and to identify portions of the Feather River levees, particularly in the vicinity of Hazelbush Levee, which are subject to failure or overtopping during periods of high water flow.

Also see the discussion above for Butte County MHMP, which is applicable to flood control in the city of Biggs.

City of Gridley

Flooding is a hazard for Gridley, which is in the SBFCA assessment district. The city of Gridley is approximately 1.3 miles west of the 100-year floodplain (as mapped by FEMA) of the Feather River and the levees that exist there. When 200-year floodplain maps for the Gridley area become available from DWR, they must be analyzed to determine whether any areas planned for development under the General Plan are within the 200-year floodplain. If the possibility of flooding does exist from flood levels occurring at intervals of 200 years or less, such measures as necessary must be taken to meet the state law requirements for development in Flood Hazard Zones. Gridley and likely evacuation routes (State Route [SR] 99, SR 70, and SR 162) are located in an area subject to inundation following partial or total failure of Oroville Dam.

City of Gridley 2030 General Plan

Flood hazard safety goals and policies described in the Safety Element of the City of Gridley 2030 General Plan (City of Gridley 2010) include the following.

- **Safety Goal 2:** To reduce risks to people and property from flooding.
  - **Safety Policy 2.1** The City will use the best available flood hazard information and mapping from regional, state, and federal agencies and use this information to inform land use and public facilities investment decisions.
  - **Safety Policy 2.2** The City will regulate development within floodplains in accordance with state and federal requirements.
  - **Safety Policy 2.3** New development shall provide an evaluation of potential flood hazards and demonstrate compliance with state and federal flood standards prior to approval.

Also see the discussion above for Butte County MHMP, which is applicable to flood control in the city of Gridley.

A.3.1.2 Sutter County

Sutter County General Plan

The Public Health and Safety Element of the Sutter County General Plan (Sutter County 2010) contains goals and policies relevant to flood control. These goals and policies focus on minimizing risk and property damage from flooding, protection of surface water and groundwater resources and quality, and stormwater runoff management. They also presently reflect the requirements established by SB 5 pertaining to planning and other efforts necessary ultimately to provide for 200-year flood protection.

- **Goal PHS 1** Minimize the potential for loss of life, personal injury and property damage associated with floods.
  - **PHS 1.1** NFIP. Continue to participate in the National Flood Insurance Program and the Community Rating System.
  - **PHS 1.2** Minimize Risk of Flood Damage. Require a minimum of 100-year flood protection and regulate development in accordance with local, State, and federal requirements to avoid or minimize the risk of flood damage.
  - **PHS 1.3** Flood Protection for New Development. Require new development in urban and/or urbanizing areas to provide 200-year flood protection within three years of adoption of the Central Valley Flood Protection Plan in accordance with state regulations, and require new development outside urban or urbanizing areas to provide 100-year flood protection in accordance with Federal regulations.
  - **PHS 1.4** Development in Dam Inundation Areas. Require new development located in dam inundation areas to consider the risks from dam failure.
  - **PHS 1.5** Essential Facilities. Require that new essential public facilities (e.g., hospitals, health care facilities, emergency shelters, fire stations, etc.) be located, when feasible, outside of flood hazard zones, as defined by FEMA, or designed to maintain the structural and operational integrity of the facility during flooding events.
  - **PHS 1.6** Inter-Agency Coordination. Coordinate efforts with local, regional, State, and federal agencies to maintain and improve the existing levee system to protect life and property.

County Ordinance

As a participant in the NFIP, Sutter County is required to adopt and enforce a floodplain management ordinance that minimizes future flood risks to new or existing construction. The Floodplain Management Ordinance (Chapter 1780 of the Sutter County Codes and Ordinances):

- Restricts land use in flood prone areas.
- Requires flood protection measures at the time of initial construction for uses that are vulnerable to floods.
- Controls the alteration of natural floodplains.
- Controls activities that may increase flood damage.
- Prevents or regulates unnatural diversions of floodwaters that could increase flood hazards in other areas.

The current Floodplain Management Ordinance was adopted in October 2008. The ordinance refers to the revised FIRMs dated December 2, 2008, and all subsequent amendments and/or revisions (1780-320). The ordinance will be amended, as necessary, to reflect minor changes (including referencing the revised FIRMs) sometime between the Letter of Final Determination (August 2011) and the effective date of the new FIRMs (February 2012).

Final Yuba City–Sutter County, California Multi-Hazard Mitigation Plan

The County's principal emergency response plan is the Final Yuba City–Sutter County, California Multi-Hazard Mitigation Plan (AMEC 2007), adopted in January 2008. The purpose of the plan is to meet the requirements of the Disaster Mitigation Act and thereby maintain continued eligibility for certain hazard mitigation (or disaster loss reduction) programs from FEMA. The plan lays out the strategy that will enable Sutter County to become less vulnerable to future disaster losses. The plan reviews the County's capabilities with regard to reducing effects of natural hazards (e.g., flooding, dam failure) and identifies recommended action items to reduce vulnerability to these hazards. The plan addresses the unincorporated county, as well as the cities of Yuba City and Live Oak, and six participating districts: the Gilsizer County Drainage District, Levee District 1, and RDs 1001, 1500, 70, and 1660.

The plan identifies the following goals and objectives related to flood hazard protection, but it does not contain any specific policies.

- **Goal 1:** Improve community awareness about hazards that threaten our communities and identify appropriate actions to minimize their impacts upon people and property.
    - **Objective 1.1:** Increase public awareness about the nature and extent of hazards they are exposed to, where they occur, and recommend responses to identified hazards (create/continue an outreach program, provide educational resources and training)
- **Goal 2:** Minimize Risk and Vulnerability to Flood Hazards
    - **Objective 2.1:** Improve the integrity of the levees to at least 100-year flood protection
    - **Objective 2.2:** Eliminate open drainage ditches within 20' of traveled roadways within urbanized areas
    - **Objective 2.3:** Minimize damage/loss to roads

- **Objective 2.4:** Identify/Protect evacuation routes
- **Objective 2.5:** Reduce localized flooding from storm events
- **Objective 2.6:** Provide Protection for community critical facilities

City of Yuba City

Yuba City General Plan

The Noise and Safety Element of the Yuba City General Plan (City of Yuba City 2004) contains guiding policies and implementing policies relevant to flood control. These guiding and implementing policies focus on minimizing risk and property damage from flooding, protection of surface water and groundwater resources and quality, and management of stormwater runoff.

- **9.3-G-1** Protect the community from risks to lives and property posed by flooding and stormwater runoff.
- **9.3-G-2** Collect and dispose of storm water in a safe and efficient manner.
- **9.3-G-3** Ensure that dams and levees are properly maintained for long-term flood protection.
- **9.3-I-1** Implement the drainage improvements identified in the City's Capital Improvement Program.
- **9.3-I-2** Continue to work with the U.S. Army Corps of Engineers to implement levee improvements on the Feather River. Incorporate features in the levee system to ensure flood protection and at the same time improve the connection between the city and the river.
- **9.3-I-3** When necessary, require new development to prepare hydrologic studies to assess storm runoff impacts on the local and subregional storm drainage systems and, if warranted, require new development to provide adequate drainage facilities and to mitigate increases in storm water flows and/or volume to avoid cumulative increases in downstream flows.

  Developers shall provide an assessment of a project's potential impacts on the local and subregional storm drainage systems, so that the City can determine appropriate mitigation to ensure that system capacity and peak flow restrictions are not exceeded.
- **9.3-I-4** Restrict new development in areas subject to 100 year flooding, as shown in Figure 9-6.
- **9.3-I-5** Provide information to property owners about the availability of flood insurance.

  This policy can be implemented with counter handouts and stories in the City's newsletter and pages on the City's website.
- **9.3-I-6** As new development occurs, work with Sutter County to establish drainage areas that serve the entire Planning Area.

  A new drainage study may be appropriate to determine the best means to establish drainage areas that would safely channel runoff and provide protection from flooding.
- **9.3-I-7** Utilize parks for the secondary purpose of storm water storage.

Final Yuba City–Sutter County, California Multi-Hazard Mitigation Plan

See the Final Yuba City–Sutter County, California Multi-Hazard Mitigation Plan (AMEC 2007) and discussion above under Sutter County for relevant goals adopted by Yuba City that apply to the proposed project area.

City of Live Oak

City of Live Oak 2030 General Plan

The Public Utilities, Services, and Facilities Element and the Public Safety Element of the City of Live Oak 2030 General Plan (City of Live Oak 2010) contain goals, policies, and implementation programs relevant to flood control. These goals, policies, and implementation programs focus on minimizing risk and property damage from flooding, protection of surface water and groundwater resources and quality, and stormwater runoff management.

Within the Public Utilities, Services, and Facilities Element, the following flood protection goal, policies, and implementation program are included.

- **Goal PUBLIC-6.** Protect property and public health through adequate flood protection.
  - **Policy PUBLIC-6.1** The City will coordinate with ongoing regional efforts to verify and improve flood protection for the Planning Area, consistent with state and federal regulations.
  - **Policy PUBLIC-6.2** The City will assess fees for new development on a fair-share basis to fund regional flood protection improvements needed to meet state and federal standards.
  - **Policy PUBLIC-6.3** The City will proactively identify and take advantage of regional, state, and federal funding that may be available for use in flood protection improvements.
    - **Implementation Program PUBLIC-6.1**

      The City will continue its participation with the regional flood protection joint powers authority addressing the assessment and improvement of levees on the west side of the Feather River to meet state and federal standards.

Within the Public Safety Element, the following flood protection goal, policies, and implementation programs are included.

- **Goal PS-2.** Minimize the loss of life and damage to property caused by flood events.
  - **Policy PS-2.1** The City will coordinate with the Sutter Butte Flood Control Agency to ensure that flood control facilities protecting Live Oak's Planning Area from flood risks to the City are well maintained and capable of protecting existing and proposed structures from flooding, in accordance with state law.
  - **Policy PS-2.2** The City will regulate development within floodplains according to state and federal requirements to minimize human and environmental risks and maintain the City's eligibility under the National Flood Insurance Program.
  - **Policy PS-2.3** The City will require evaluation of potential flood hazards before approving development projects.

- **Policy PS-2.4** The City will require applicants for development to submit drainage studies that adhere to City stormwater design requirements and incorporate measures from the City's master drainage plan to prevent on- or off-site flooding.
- **Policy PS-2.5** New development shall be required to be consistent with regional flood control improvement efforts. New development shall contribute on a fair-share basis to regional solutions to improve flood protection to meet state and federal standards.
- **Policy PS-2.6** The City will use the most current flood hazard and floodplain information from state and federal agencies (such as the State Department of Water Resources, the Federal Emergency Management Agency, and the Army Corps of Engineers) as a basis for project review and to guide development in accordance with federal and state regulations.
- **Policy PS-2.7** As feasible, new development should incorporate stormwater treatment practices that allow percolation to the underlying aquifer and minimize off-site surface runoff (and therefore flooding).

  - **Implementation Program PS-1**

    The City will continue its participation with the regional flood protection joint powers authority addressing the assessment and improvement of levees on the west side of the Feather River to meet federal and state standards. The City will implement development impact fees to provide for necessary levee studies and improvement programs in coordination with the regional flood control joint powers authority. The City will proactively identify and take advantage of federal, state, and regional funding that may be available for use in flood protection improvements.

  - **Implementation Program PS-3**

    Consistent with state law, the City will consult with the Central Valley Flood Protection Board and local flood protection agencies serving the Planning Area, to obtain updated floodway and floodplain maps, data, and policies. When this information is available, if necessary, the City will update the General Plan and revise all applicable development standards, including the zoning code. Subdivision approvals, development agreements, permits, and other City entitlements will incorporate these revised City policies and regulations.

  - **Implementation Program PS-4**

    If necessary, the City will update the General Plan to incorporate 200-year floodplain mapping from the California Department of Water Resources and Central Valley Flood Protection Board, once available.

  - **Implementation Program PS-5**

    In review of new development projects, require disclosure of risk where proposed development would occur in flood risk areas. This disclosure may include notifying new residents in these areas and encouraging purchase of appropriate insurance.

A.3.2 Water Quality and Groundwater Resources

A.3.2.1 Butte County

Butte County 2030 General Plan

The Butte County General Plan 2030 was adopted in October 2010 and became effective on November 30, 2010 (Butte County 2010). The plan includes several goals and policies related to water resources. For example, the plan contains the following goal related to water quality.

- **Goal W-1** Maintain and enhance water quality.

The goal is followed by policies, such as integrating county planning and programs with other watershed planning efforts, including BMPs, guidelines, and policies of the Central Valley RWQCB, and identifying and eliminating or minimizing all sources of existing and potential point and non-point sources of pollution to ground and surface waters.

Butte County Stormwater Management Program

Butte County has been covered under an NPDES Phase II MS4 General Permit since 2004. Currently, Butte County's MS4 General Permit covers the urbanized unincorporated areas within and around the City of Chico. As part of permit compliance, the Butte County Department of Public Works implements a stormwater management plan (SWMP).

City of Biggs

City of Biggs General Plan 1997–2015

The City of Biggs is currently involved in the general plan update process. The existing City of Biggs General Plan 1997–2015 was adopted in January 1998 (City of Biggs 1998). This plan contains goals and policies related to water resources. For example, the Open Space and Conservation Element of the plan highlights the following goal related to water resources.

- **GOAL 5.4:** Protect the quantity and quality of community water supplies and avoid degradation of water quality downstream from Biggs.

City of Gridley

City of Gridley 2030 General Plan

The City of Gridley specifies water-related policies in various sections of the City of Gridley 2030 General Plan (City of Gridley 2010). These policies are primarily outlined in the Public Services and Facilities Element. For example, the plan includes the following water resources goal.

- **Public Facilities Goal 1:** To maintain safe and reliable ongoing water supply.

A.3.2.2 Sutter County

Sutter County General Plan—Public Draft

The county is in the process of updating its general plan that was adopted in 1996. The public draft (September 2010) is available on the County's website (Sutter County 2010). The draft general plan

contains a number of goals and related policies related to water resources. For example, the Environmental Resources Element includes the following goal.

- **Goal ER 6:** Preserve and protect the County's surface water and groundwater resources.

The goal is followed by several policies consistent with achieving this goal, such as integrated water management programs, surface water resource protection, groundwater protection and sustainability, and stormwater quality.

Yuba City–Sutter County Stormwater Management Program

Sutter County and the City of Yuba City are co-permittees of the NPDES Phase II MS4 General Permit, which requires the development of a SWMP. Adopted in 2003, the Yuba City-Sutter County SWMP is a combined effort of the city and county, which addresses stormwater discharges to the Sutter Bypass and the Feather River through pumping stations located along several levees. This SWMP describes the approach to reduce stormwater pollution. It includes the required six minimum control measures required under the NPDES Phase II MS4 program: public education and outreach; public participation/involvement; illicit discharge detection and elimination; construction site runoff control; post-construction runoff control; and pollution prevention/good housekeeping (City of Yuba City and Sutter County 2003).

City of Yuba City

Yuba City General Plan

The City of Yuba City General Plan was updated in April 2004 (City of Yuba City 2004). The Environmental Conservation Section has numerous goals, or guiding policies, and implementing policies related to water quality. Guiding policies include protecting and enhancing surface water and groundwater resources and enhancing the natural condition of the Feather River waterway. Related implementing policies include complying with the Central Valley RWQCBs regulations and standards to maintain and improve the quality of both surface water and groundwater resources; continuing to control stormwater pollution and protect the quality of the city's waterways by preventing oil and sediment from entering the river; and requiring new construction to utilize BMPs such as site preparation, grading, and foundation designs for erosion control to prevent sediment runoff into waterways, specifically the Feather River.

City of Live Oak

City of Live Oak 2030 General Plan

The City of Live Oak 2030 General Plan was adopted in May 2010 (City of Live Oak 2010). The city's plan contains several water goals, policies, and implementation programs. For example, the Public Utilities, Services, and Facilities Element of the plan includes the following goal related to water resources.

- **Goal PUBLIC-1:** Provide a safe and reliable water supply and delivery system.

A.3.3 Geology, Soils, Seismicity, and Mineral Resources

A.3.3.1 Butte County

Butte County General Plan 2030

The Health and Safety Element of the Butte County General Plan 2030 (Butte County 2010) includes the following goals and policies related to geologic and seismic hazards.

- **Goal HS-6** Reduce risks from earthquakes.
  - **Policy HS-P6.1** Appropriate detailed seismic investigations shall be completed for all public and private development projects in accordance with the Alquist-Priolo Earthquake Fault Zoning Act.*
  - **Policy HS-P6.2** Geotechnical investigations shall be completed prior to approval of schools, hospitals, fire stations and sheriff stations, as a means to ensure that these critical facilities are constructed in a way that mitigates site-specific seismic hazards.
  - **Action HS-A6.1** Continue to require applicants to seismically retrofit existing homes where required under existing building codes.
- **Goal HS-7** Reduce risks from steep slopes and landslides.
  - **Policy HS-P7.1** Site-specific geotechnical investigations shall be required to assess landslide potential for private development and public facilities projects in areas rated "Moderate to High" and "High" in Figure HS-4 or the most current available mapping.*
- **Goal HS-8** Reduce risks from erosion.
  - **Policy HS-P8.1** Site-specific geotechnical investigations shall be required to assess erosion potential for private development projects and public facilities in areas rated "Very High" in Figure HS-5 or the most current available mapping.*
- **Goal HS-9** Reduce risks from expansive soils.
  - **Policy HS-P9.1** Site-specific geotechnical investigations shall be required to assess risks from expansive soils for private development projects and public facilities in areas rated "High" in Figure HS-6 or the most current available mapping.*
- **Goal HS-10** Avoid subsidence from groundwater withdrawal.
  - **Policy HS-P10.1** Continue to work with water providers and regulatory agencies to ensure that groundwater withdrawals do not lead to subsidence problems.
  - **Policy HS-P10.2** Existing programs to monitor potential subsidence activity shall be supported.

The Agriculture Element and Area and Neighborhood Plans Element of the plan include the following goal, policies, and objectives related to soils.

- **Goal AG-1** Maintain, promote and enhance Butte County's agriculture uses and resources, a major source of food, employment and income in Butte County.
  - **Policy AG-P1.1** The County supports State and federal legislation designed to conserve soil and protect agricultural land.

- **Policy AG-P1.2** The County supports agricultural education and research at Butte County educational institutions.
- **Policy AG-P1.3** Continue to work with landowners in establishing new and maintaining existing Williamson Act contracts.
  - **Objective D2N-O6.2** Protection of soil resources.

    a. To eliminate potential for soil erosion or degradation of its agricultural productivity.
- **Policy D2N-P6.5** Require standard erosion-control measures and construction practices to minimize soil erosion.
- **Policy D2N-P6.6** Protect agricultural lands which currently produce, or have the potential to produce, from encroaching urban uses.

The Conservation and Open Space Element and Area and Neighborhood Plans Element contain the following goals, policies, actions, and objectives related to mineral resources.

- **Goal COS-12** Protect economically viable mineral resources and related industries while avoiding land use conflicts and environmental impacts from mining activities.
  - **Policy COS-P12.1** Sufficient aggregate resources to meet the County's fair share of future regional needs shall be conserved.
  - **Policy COS-P12.2** Mineral resources identified by the State to be of regional or statewide significance for mineral resource extraction shall be conserved.*
  - **Policy COS-P12.3** Permitted uses on lands containing and adjacent to important mineral resources shall be restricted to those compatible with mineral extraction, except in cases where such uses offer public benefits that outweigh those of resource extraction.
  - **Policy COS-P12.4** Prior to approval of any new or expanded mining operation, the applicant shall demonstrate that the operation will not create significant nuisances, hazards or adverse environmental effects.
  - **Policy COS-P12.5** New mineral haul routes shall avoid landslides, highly erodible soils, residential areas and schools, when feasible.
  - **Policy COS-P12.6** Discretionary development projects in the vicinity of permitted mining extraction sites or along existing haul routes shall record a notice of the right to mine against the property for which a discretionary permit is sought. The notice shall advise owners and subsequent interests in ownership that the existing mining operation has a permitted right to continued mining operations.
  - **Policy COS-P12.7** Mined property shall be left in a condition suitable for reuse in conformance with the General Plan land use designations and in accordance with the California Surface Mining and Reclamation Act (SMARA).
    - **Action COS-A12.1** Apply zoning regulations permitting extraction and processing as a conditional use on any lands classified by the State Mining and Geology Board as Mineral Resource Zone 2 (MRZ-2) or Scientific Zone (SZ).
- **Goal D2N-6** Utilize and develop natural resources so as to protect those resources and eliminate exposure of persons and property to environmental hazards.
  - **Objective D2N-O6.1** Management of mineral resources.

a. Efficiently utilize mineral resources and ensure their continued supply.

- **Policy D2N-P6.1** Encourage proper development and management of sand and gravel.
- **Policy D2N-P6.2** Ensure that all commercial development of sand and gravel deposits is compatible with nearby land uses.
- **Policy D2N-P6.3** Ensure that extraction operations of sand and gravel adhere to all environmental quality regulations of the County and State.
- **Policy D2N-P6.4** Locate commercial, industrial, open space and agricultural uses adjacent to prime mineral resource areas to avoid conflicts between mineral production activities and present or planned residential and institutional land uses.

County Ordinance

Many California counties and cities have grading and erosion control ordinances. These ordinances are intended to control erosion and sedimentation caused by construction activities. As part of the grading permit, a project applicant must submit a grading and erosion control plan, project vicinity and site maps, and other supplemental information. Standard conditions in the grading permit include an extensive list of BMPs similar to those contained in a SWPPP.

The purpose of the grading portion of the Butte County Grading and Mining Ordinance is "the control of erosion and siltation, the enhancement of slope stability, the protection of said resources and the prevention of related environmental damage by establishing standards and requiring permits for grading." In general, a grading permit is required for any earthmoving activities involving 50 cubic yards or more of material. Depending on the project, the county may require environmental review, engineering plans and specifications, soils engineering report, and/or an erosion and sediment control plan.

The purpose of the mining portion of the Butte County Grading and Mining Ordinance is to comply with the requirements of SMARA, encourage production and conservation of mineral resources in balance with other beneficial uses, and prevent or minimize damage to the environment. Applicants must file a permit application with the county, submit mining and reclamation plans, and provide financial assurances. The application then goes through a review and public hearing process before a determination is made by the Butte County Planning Commission.

City of Biggs

City of Biggs General Plan

The Public Health and Safety Element of the City of Biggs General Plan (City of Biggs 1998) includes the following goal, policies, and program related to geologic and seismic hazards.

- **Goal 6.5** Minimize the threat of personal injury and property damage due to seismic and geologic hazards.
  - **Policy 6.5.A** Consider the potential for expansive soils and earthquake related hazards when reviewing applications for developments.
  - **Policy 6.5.B** A soils report, prepared by a licensed soils engineer, shall be required for all residential subdivisions and development projects. Soils reports shall evaluate shrink/swell

and liquefaction potential of sites and recommend measures to minimize unstable soil hazards.

- **Policy 6.5.C** Applications for projects which extract groundwater, oil, or gas shall include a report evaluating the potential for resulting subsidence. Reports shall discuss appropriate mitigation measures to reduce the potential for subsidence.
- **Policy 6.5.D** The City encourages owners of buildings which are subject to seismic hazards to pursue structural improvements to remedy seismic related hazards.
- **Program 6.5.E** The City shall pursue funding options to assist property owners with costs related to seismic safety structural improvements.

The Public Health and Safety Element of the plan contains the following policies related to mineral resources.

- **Goal 5.1:** Promote and protect the continued viability of agriculture surrounding Biggs.
  - **Policy 5.1.D** No mineral, gas or other natural resource extraction shall occur within the City limits of Biggs without prior review and approval of the activity by the City.
  - **Policy 5.1.E** Ensure that any mineral extraction activities within the Biggs planning area to conform with the State Mining and Reclamation Act (SMARA) requirements, including financial assurances and reclamation plans.

City of Gridley

City of Gridley 2030 General Plan

The Safety Element of the City of Gridley 2030 General Plan (City of Gridley 2010) includes the following goal, policies, and strategies related to geologic and seismic hazards.

- **Safety Goal 1:** To reduce risks to people and property from geologic hazards and soils conditions.
  - **Safety Policy 1.1** New development shall implement state and local building code requirements, including those related to structural requirements and seismic safety criteria in order to reduce risks associated with seismic events and unstable and expansive soils.
  - **Safety Policy 1.2** New developments that could be adversely affected by geological and/or soil conditions shall include project features that minimize these risks.
  - **Safety Policy 1.3** The City will not allow new water well sites to be located in areas where subsidence could occur as a result of water well operation, or where the potential for subsidence could increase as a result of operation of a water well.
    - **Safety Implementation Strategy 1.1**

      The City will continue to enforce the most recent statewide building code requirements.
    - **Safety Implementation Strategy 1.2**

      The City will require geotechnical evaluation and recommendations before development or construction of buildings meant for public occupancy in geologic hazard areas may proceed. Such evaluations will be required to focus on potential hazards related to liquefaction, erosion, subsidence, seismic activity, and other relevant geologic hazards

and soil conditions for development. New development would be required to incorporate project features that avoid or minimize the identified hazards to the satisfaction of the City.

The City of Gridley 2030 General Plan states that there are no significant mineral resources in the Gridley area and therefore does not address the topic (City of Gridley 2010:6–9).

A.3.3.2 Sutter County

Sutter County General Plan Policy Document

The Sutter County General Plan Policy Document (Sutter County 1996a) includes the following goal, policies, and program related to geologic and seismic hazards.

- **Goal 7.B** To minimize the risk of personal injury and property damage due to seismic and geological hazards.
  - **Policy 7.B-1** Where geologic hazards exist from landslides, the County should designate the land as open space or agriculture.
  - **Policy 7.B-2** The County may require the preparation of a soils engineering and/or geologic-seismic analysis prior to permitting development in areas of geologic or seismic hazards (i.e., ground shaking, landslides, liquefaction, expansive soils).
    - **Implementation Program**

      7.1 The County shall continue to enforce provisions of the Uniform Building Code which address seismic design criteria.

      Responsibility: Community Services Department

This document contains the following goal, policies, and implementation program related to mineral resources.

- **Goal 4.H** To encourage commercial resource extraction activities in locations where environmental, aesthetic, and adjacent land use compatibility impacts can be adequately mitigated.
  - **Policy 4.H-1** The County shall require that the development of gas and mineral resources be designed and conducted in a manner to minimize incompatibility with nearby land uses.
  - **Policy 4.H-2** The County shall prohibit the establishment of any new mining operations in the Sutter Buttes.
  - **Policy 4.H-3** The County shall require that all new gas and mineral extraction projects be designed to provide a buffer between existing and/or likely adjacent uses.
  - **Policy 4.H-4** The County shall require that all mining operations prepare and implement reclamation plans and provide adequate security to guarantee the proposed reclamation.
  - **Policy 4.H-5** The County shall require that gas, and mineral extraction projects incorporate adequate measures to minimize impacts to local residents, county roadways, services and facilities.

- **Implementation Program**

  4.7 The County shall review and revise as necessary its ordinances governing gas and mineral extraction projects.

  Responsibility: Community Services Department

Sutter County General Plan

The *Sutter County General Plan* (Sutter County 2011) includes the following goal and policies related to geologic and seismic hazards.

- **Goal PHS 2** Minimize the risk of personal injury and property damage due to geologic and seismic hazards and adverse soil conditions.
  - **PHS 2.1 Review Standards.** Review and enforce seismic and geologic safety standards and require the use of best management practices in site design and building construction methods. (PHS 2-A)
  - **PHS 2.2 Minimize Exposure to Geologic Hazards.** Minimize development in areas where geologic hazards exist from landslides and erosion.
  - **PHS 2.3 Site-Specific Geotechnical Analysis.** Require the preparation of a County approved site-specific geotechnical analysis prior to approval of development in areas where the potential for geologic or seismic hazards exists (e.g., ground shaking, landslides, liquefaction, expansive soils, steep slopes, subsidence, and erosion) and incorporate recommended project features to avoid or minimize the identified hazards.
  - **PHS 2.4 Essential Facilities.** Promote the upgrade, retrofitting, and/or relocation of existing essential facilities (e.g., hospitals, schools, law enforcement and fire stations, etc.) that do not meet current building code standards and are within areas susceptible to seismic or geologic hazards.

The plan contains the following goal and policies related to mineral resources.

- **Goal ER 5** Encourage commercial resource extraction activities in locations where environmental, aesthetic, and adjacent land use compatibility impacts can be adequately mitigated.
  - **ER 5.1** Significant Resources. Conserve and protect mineral resources that may be identified by the state as a significant resource to allow for their continued use in the economy.
  - **ER 5.2** Compatible Operations. Require that gas and mineral resource extraction activities be designed and operated to minimize incompatibilities with nearby land uses and incorporate features that buffer existing and planned adjacent uses. Extraction activities shall incorporate adequate measures to minimize impacts to local residents, county roadways, services, facilities, and the environment.
  - **ER 5.3** No New Operations in Sutter Buttes. Prohibit the establishment of any new mining operations in the Sutter Buttes, which is defined as the area within the Sutter Buttes Overlay Zone.
  - **ER 5.4** Reclamation. Encourage disturbed mined areas to be reclaimed concurrent with mining (i.e., phased reclamation), and require reclamation that is consistent with an adopted reclamation plan, as appropriate, and in conjunction with the Surface Mining and

Reclamation Act, and County and state standards to a condition that is sensitive to the natural environment and where subsequent, beneficial uses can occur.

County Codes and Ordinances

The purpose of the County of Sutter Land Grading and Erosion Control (Chapter 1770) ordinances is to minimize damage or degradation to waterways caused by excavation-related activities and comply with the provisions of NPDES permits covering the activities of the county issued by the RWQCB.

A grading permit is required in the unincorporated portion of the county for:

> grading to (1) grade, fill, excavate, store or dispose of 350 cubic yards or more of soil or earthly material, or (2) clear and grub one acre or more of land, or (3) grade, fill, or store 50 cubic yards or more of soil or earthly material in a designated floodway, or (4) relocate, reshape, re-route, obstruct, or alter an existing water course.

The purpose of the Sutter County Surface Mining and Reclamation Code is to "provide local procedures, processes and responsibilities for the implementation of SMARA and other State regulations pertaining to surface mining in Sutter County." Applicants must file a permit application with the county, submit mining and reclamation plans, and provide financial assurances. These documents are reviewed by the State Mining and Geology Board and the Sutter County Planning Commission. Approval is granted or denied by the planning commission.

Sutter County and the City of Yuba City adopted the 2010 California Building Code as part of their building standards. The Butte County Building Design Criteria incorporated the 2007 California Building Code.

City of Yuba City

Yuba City General Plan

The City of Yuba City General Plan (City of Yuba City 2004) contains the following policies related to geologic and seismic hazards.

- **Guiding Policy 9.2-G-1** Minimize risks of property damage and personal injury posed by geologic and seismic hazards.
  - **Implementing Policy 9.2-I-1** Review proposed development sites at the earliest stage of the planning process to locate any potential geologic or seismic hazards. Following receipt of a development proposal, engineering staff shall review the plans to determine whether a geotechnical review is required. If the review is required, then the applicant shall be referred to geotechnical experts for further evaluation.
  - **Implementing Policy 9.2-I-2** Prohibit structures intended for human occupancy within 50 feet of an active fault trace. Although no active faults are located within the Planning Area, this policy would apply if a new fault was discovered. It is also the City's intent to discourage homes, offices, hospitals, public buildings, and other similar structures over the trace of an inactive fault and to allow uses within setback areas that could experience displacement without undue risk to people and property.
  - **Implementing Policy 9.2-I-3** Require comprehensive geologic and engineering studies of critical structures regardless of location. Critical structures are those most needed following

a disaster or those that could pose hazards of their own if damaged. They include utility centers and substations, water reservoirs, hospitals, fire stations, police and emergency communications facilities, and bridges and overpasses.

- **Implementing Policy 9.2-I-4** Require preparation of a soils report as part of the development review and/or building permit process for development proposed in the area depicted with expansive soils. The southwest corner of the City is underlain by expansive soils that must be taken into account during building design if cracking and settling of structures are to be minimized. The report would not be necessary when soil characteristics are known, and the City's Building Official or Public Works Director determines it is not needed.
- **Implementing Policy 9.2-I-5** Provide information for property owners to rehabilitate existing buildings using construction techniques to protect against seismic hazards. The City-adopted Uniform Building Code specifies seismic standards for new construction, as well as for additions or expansions to buildings. It is in the community's best interest to do all that is necessary to ensure that all structures meet current seismic standards.

City of Live Oak

City of Live Oak 2030 General Plan

The Public Safety Element of the City of Live Oak 2030 General Plan (City of Live Oak 2010) contains the following goal and policies related to geologic and seismic hazards.

- **Goal PS-1.** Design buildings to prevent property damage and injury from hazards.
  - **Policy PS-1.1** All new buildings in the City shall be built under the seismic requirements of the California Building Code.
  - **Policy PS-1.2** The City will encourage the retrofitting of older buildings to current safety standards, as specified in locally applicable fire and building codes.
  - **Policy PS-1.3** New development shall ensure adequate water flow for fire suppression as required by City Public Works Improvement Standards.

The Conservation and Open Space Element contains the following goal and policy related to mineral resources.

- **Goal MINERAL-1.** Protect soil and mineral resources in the Live Oak Study Area consistent with other environmental, social, and economic goals.
  - **Policy Mineral-1.1** The City will coordinate with the state to incorporate, as necessary, any policies for conservation and possible future extraction of mineral or soil resources of regional or statewide significance.

A.3.3.3 Yuba County

County Ordinance Code

Title X, Buildings and Construction, of the Yuba County Ordinance Code, outlines all provisions relevant to grading and construction within the county. Chapter 10.05 addresses standards of construction, Chapter 10.30 addresses construction in areas of flood hazard, and Chapter 11.25 provides regulations related to grading and excavations. Chapter 11.25 also sets forth means for

controlling soil erosion and problems associated with excavations, grading, and fill. The provisions provided in this chapter apply to the unincorporated areas of Yuba County.

A.3.4 Traffic, Transportation, and Navigation

A.3.4.1 Butte County

Butte County General Plan

The Circulation Element of the *Butte County General Plan*, adopted in 2010, is concerned with the safe and efficient movement of people and goods in and around the County. The element contains background circulation information for a wide range of existing and planned transportation modes, including roads, transit, non-motorized transportation, rail and aviation. To ensure that the county's transportation system can accommodate growth anticipated during the 20-year planning period, the Circulation Element works closely with the Land Use Element of the general plan, as required by Section 65302(b) of the California Government Code. The following goals and policies are applicable to traffic.

- **Goal CIR-6** Support a balanced and integrated road and highway network that maximizes the mobility of people and goods in a safe, efficient manner.
    - **Policy CIR-P6.1** The level of service for County-maintained roads within the unincorporated areas of the county but outside municipalities' sphere of influences (SOI) shall be level of service C or better during the PM peak hour. Within a municipality's SOI, the level of service shall meet the municipality's level of service policy.
    - **Policy CIR-P6.2** The level of service on State Highways should at least match the concept level of service for the facility, as defined by Caltrans.

Butte County roadway level of service (LOS) thresholds are provided in Table A-2, below.

Table A-2. Butte County Roadway Level of Service Thresholds

Facility Type	A	B	C	D	E	F
Minor 2–Lane Highway	0–900	901–2,000	2,001–6,800	6,801–14,100	14,101–17,400	>17,400
Major 2–Lane Highway/ Expressway	0–1,200	1,201–2,900	2,901–7,900	7,901–16,000	16,001–20,500	>20,500
4–Lane, Multi–Lane Highway/ Expressway	0–10,700	10,701–17,600	17,601–25,300	25,301–32,800	32,801–36,500	>36,500
2–Lane Arterial	–	–	0–9,700	9,701–17,600	17,601–18,700	>18,700
4–Lane Arterial, Undivided	–	–	0–17,500	17,501–27,400	27,401–28,900	>28,900
4–Lane Arterial, Divided	–	–	0–19,200	19,201–35,400	35,401–37,400	>37,400
6–Lane Arterial, Divided	–	–	0–27,100	27,101–53,200	53,201–56,000	>56,000
3–Lane Arterial, 1–Way Roadway	–	–	0–13,100	13,101–20,600	20,601–21,700	>21,700
2–Lane Freeway	0–11,110	11,111–20,100	20101–28,800	28,801–35,700	35,701–40,100	>40,100
2–Lane Freeway + Auxiliary Lane	0–14,100	14,101–25,500	25,501–36,400	36,401–44,900	44,901–50,350	>50,350
3–Lane Freeway	0–17,000	17,001–30,800	30,801–44,000	44,001–54,100	54,101–60,600	>60,600
3–Lane Freeway + Auxiliary Lane	0–20,100	20,101–36,400	36,401–51,800	51,801–63,500	63,501–71,000	>71,000
4–Lane Freeway	0–23,200	23,201–42,000	42,001–59,500	59,501–72,800	72,801–81,400	>81,400
Major 2–Lane Collector	–	–	0–5,550	5,551–11,800	11,801–15,200	>15,200

Source: Transportation Research Board, Highway Capacity Manual 2000.

City of Biggs

City of Biggs General Plan

The City of Biggs General Plan 1997–2015 outlines goals, policies, and guidelines that relate to transportation and circulation within the city. The following policy in the Circulation Element is applicable to traffic.

- **Policy 2.1.G** Functional performance of roadways throughout the community shall be maintained at a Level of Service C or better and shall conform with the Roadway Environmental Capacity as defined in Table 2.3 of this Element.

City of Gridley

City of Gridley 2030 General Plan

The *City of Gridley 2030 General Plan* outlines goals, policies, and guidelines that relate to transportation and circulation within the city. The following goals and policies in the Circulation Element are applicable to traffic.

- **Circulation Goal 4**: To improve connectivity in existing developed parts of Gridley.
  - **Circulation Policy 4.2:** The City will increase connectivity in the Highway 99 corridor by requiring new east-west and north-south connections in new developments, to the maximum extent feasible.

- **Circulation Goal 8**: To provide efficient and effective freight systems that serve Gridley's businesses, while avoiding negative impacts to residents
  - **Circulation Policy 8.2:** The City will restrict truck traffic to Highway 99, Magnolia Avenue, West Biggs-Gridley Road, Ord Ranch Road, South Avenue, East Gridley Road, West Liberty Road, and streets in areas designated for Industrial and Agricultural Industrial development (see Exhibit Circulation-7). Trucks may go by direct route to and from restricted streets, where required for the purpose of making pickups and deliveries of goods, but are otherwise restricted to truck routes.

A.3.4.2 Sutter County

2011 Sutter County General Plan and General Plan Technical Background Report

The *2011 Sutter County General Plan* outlines goals, policies, and guidelines that relate to transportation and circulation within the county (Sutter County 2011: 6-9). The following goals and policies are applicable to traffic.

- **Goal M2** Provide for the long-range planning and development of the County's roadway system and the safe, efficient, and reliable movement of people and goods throughout Sutter County.
  - **Policy M 2.1** Plan, design, and regulate roadways in accordance with the circulation diagram contained within this element and the California Road System Functional Classification System as updated and approved by the Federal Highway Administration, unless otherwise addressed in an adopted specific plan or community plan.
  - **Policy M 2.5** Develop and manage the County roadway segments and intersections to maintain LOS D or better during peak hour, and LOS C or better at all other times. Adjust for seasonality. These standards shall apply to all County roadway segments and intersections, unless otherwise addressed in an adopted specific plan or community plan.
  - **Policy M 2.8** Coordinate with the cities of Yuba city and Live Oak to provide acceptable and compatible levels of service on roadways that cross county/City boundaries and when establishing future road alignments within the cities' spheres of influence.
  - **Policy M 2.10** maintain ongoing coordination with Caltrans, SACOG and other jurisdictions to address local and regional transportation issues.
  - **Policy M 2.11** Support projects that will improve traffic flows and safety on State Highways.
  - **Policy M 2.14** Develop local roads parallel to State Highways, where feasible, to reduce congestion and increase traffic safety on state facilities.

In addition to the above policies, the *General Plan Technical Background Report* states that the California Department of Transportation (Caltrans) has adopted LOS D as the minimum acceptable standard for SR 20 west of Humphrey Road and LOS E as the minimum acceptable standard for SR 20 east of Humphrey Road (Sutter County 2008: 3.2-2). SR 99 has a minimum acceptable LOS of E throughout the county.

Sutter County roadway LOS thresholds are provided in Table A-3.

Table A-3. Sutter County Roadway Level of Service Thresholds

Roadway	LOS C	LOS D	LOS E
Rural—Two Lane	7,000–10,600	10,600–16,400	16,400–25,200
Urban—Three Lane	15,330–17,520	17,520–19,700	19,700–21,900
Urban—Five Lane	30,660–35,040	35,040–39,420	39,420–43,800
Expressway—Four Lane	29,100–41,800	41,801–53,500	53,501–59,500
Freeway—Four Lane	33,700–48,400	48,401–60,000	60,001–67,400
Freeway—Six Lane	51,800–73,900	73,901–90,900	90,901–101,800

Source: Sutter County 2008.

City of Yuba City

Yuba City General Plan

The *Yuba City General Plan* outlines goals, policies, and guidelines that relate to transportation and circulation within the city. The following policies in the Transportation Element are applicable to traffic.

- **Policy 5.2-G-4** Coordinate local actions with state and County agencies to ensure consistency.
- **Policy 5.2-G-7** Maximize the carrying capacity of arterial roadways by controlling the number of intersections and driveways, prohibiting residential access, and requiring sufficient offstreet parking to meet the needs of each project.
- **Policy 5.2-I-12** Develop and manage the roadway system to obtain LOS D or better for all major roadways and intersections in the City. This policy does not extend to residential streets (i.e., streets with direct driveway access to homes) or bridges across the Feather River nor does the policy apply to state highways and their intersections, where Caltrans policies apply. Exceptions to LOS D policy may be allowed by the City Council in areas, such as downtown, where allowing a lower LOS would result in clear public benefits. Specific exceptions granted by the Council shall be added to the list of exceptions below:
    - SR 20 (SR 99 to Feather River Bridge) – LOS F is acceptable;
    - SR 20 (Feather River Bridge) – LOS F is acceptable;
    - Bridge Street (Twin Cities Bridge) – LOS F is acceptable; and
    - Lincoln Road (New Bridge across the Feather River) – LOS F is acceptable.
    - No new development will be approved unless it can be shown that required level of service can be maintained on the affected roadways.
- **Policy 5.4-I-2** Develop bicycle routes that provide access to schools, parks, and the Feather River Parkway.
- **Policy 5.6-I-1** In consultation with Sutter County and Caltrans, designate and provide signed truck routes, ensure that adequate pavement depth, lane widths, bridge capacities, loading areas, and turn radii are maintained on the designated truck routes, and prohibit commercial trucks from non-truck routes except for deliveries. Require that a truck route be provided for

any approved development zoned regional commercial, community commercial, business technology and light industrial, or manufacturing, processing, and warehousing.

- **Policy 5.6-I-2** Maintain design standards for industrial streets that incorporate heavier loads associated with truck operations and larger turning radii to facilitate truck movements.
- **Policy 5.6-I-3** Continue to ensure adequate truck access to off-street loading areas in commercial areas.
- **Policy 5.6-I-4** Encourage regional freight movement on freeways and other appropriate routes; evaluate and implement vehicle weight limits as appropriate on arterial, collector, and local roadways to mitigate truck traffic impacts in the community.

The *Yuba City General Plan* does not identify LOS thresholds.

City of Live Oak

City of Live Oak 2030 General Plan

The *City of Live Oak 2030 General Plan* outlines goals and policies that relate to transportation and circulation within the city. The following goal and policy of the Circulation Element are applicable to traffic.

- **Goal CIRC-5** Allow for efficient delivery of materials and shipment of products for Live Oak businesses without adversely affecting residents.
    - **Policy CIRC-5.2** The City will consult with Caltrans, Sutter County, the California Highway Patrol, the California Public Utilities Commission, and the Union Pacific Railroad Company to appropriately regulate the safe movement of truck traffic and hazardous materials throughout the City.

A.3.5 Air Quality

A.3.5.1 Butte County

Butte County Air Quality Management District List of Rules

The Butte County Air Quality Management District (BCAQMD) has adopted local rules to reduce emissions throughout the district. Portions of the project in Butte County may be subject to the following rules and regulations (California Air Resources Board 2010b).

- **Rule 200 (Nuisance)**: Prohibits the discharge of air contaminants or other materials which cause injury, detriment, nuisance, or annoyance.
- **Rule 201 (Visible Emissions)**: Prohibits the discharge of air containments for a period or periods aggregating more than 3 minutes in any 1 hour.
- **Rule 202 (Particulate Matter Concentrations)**: Prohibits the discharge of particulate matter (PM) in excess of 0.3 grain per cubic foot of gas at standard conditions.
- **Rule 205 (Fugitive Dust Emissions)**: Limits the quantity of PM through BMPs.
- **Rule 252 (Stationary Internal Combustion Engines)**: Limits emissions of oxides of nitrogen (NO_X) and carbon monoxide (CO) from stationary internal combustion engines (if construction requires engines rated at more than 50 brake horsepower).

- **Rule 309 (Wildland Vegetation Management Burning)**: Establishes standards for the use of wildland vegetation management burning, range improvement burning, and forest management burning.

A.3.5.2 Sutter County

Feather River Air Quality Management District List of Rules

Similar to the BCAQMD, the Feather River Air Quality Management District (FRAQMD) has developed local rules to reduce emissions throughout the district. The proposed project may be subject to the following FRAQMD rules. Failure to comply with any applicable district rule would be a violation subject to district enforcement action (California Air Resources Board 2009).

- **Rule 2.0 (Open Burning)**: Establishes standards for open burning to be conducted in a manner that minimizes emissions and smoke.
- **Rule 3.0 (Visible Emissions)**: Prohibits the discharge of air containments for a period or periods aggregating more than 3 minutes in any 1 hour.
- **Rule 3.2 (Particulate Matter)**: Prohibits the discharge of PM in excess of 0.3 grains per cubic foot of gas at standard conditions.
- **Rule 3.16 (Fugitive Dust Emissions)**: Limits emissions of fugitive dust from being airborne beyond the property line from which the emission originates.
- **Rule 3.22 (Stationary Internal Combustion Engines)**: Limits emissions of NO_x, reactive organic gases (ROG), and CO from stationary internal combustion engines (if construction requires engines rated at more than 50 brake horsepower).

FRAQMD has established significance thresholds for the evaluation of criteria pollutant emissions. These thresholds are based on the district's Indirect Source Review (ISR) Guidelines (Feather River Air Quality Management District 2010). FRAQMD's main CEQA guidance is found in the ISR guidelines, and additional clarifying language is located on their website (Feather River Air Quality Management District 2010). The district requires construction and operational emissions to be quantified for the determination of mitigation measures.

A.3.6 Vegetation

A.3.6.1 Butte County

Butte County General Plan 2030

The policies below are taken from the Conservation and Open Space Element of the Butte County General Plan 2030, adopted in October 2010 (Butte County 2010:235–240). These policies are designed to guide planning related to and affecting habitat and biological resources, including vegetation and wetlands, within Butte County's jurisdiction.

- **Goal COS-6:** Engage in cooperative planning efforts to protect biological resources.
  - **COS-P6.1** The County shall coordinate with applicable federal, State, regional and local agencies on natural resources and habitat planning.

- **Goal COS-7:** Conserve and enhance habitat for protected species and sensitive biological communities.
  - **COS-P7.1** Conservation easements that protect habitat areas, habitat corridors and sensitive biological resources shall be promoted.
  - **COS-P7-2** Clustered development patterns shall be encouraged in order to conserve habitat for protected species and biological resources.
  - **COS-P7.3** Creeks shall be maintained in their natural state whenever possible, and creeks and floodways shall be allowed to function as natural flood protection features during storms.
  - **COS-P7.6** New development projects shall include setbacks and buffers along riparian corridors and adjacent to habitat for protected species, except where permitted in the Butte Regional Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP) Planning Area and where such development is consistent with the conditions of the HCP/NCCP, upon the future adoption of the [Butte Regional] HCP/NCCP.
  - **COS-P7.7** Construction barrier fencing shall be installed around sensitive resources on or adjacent to construction sites. Fencing shall be installed prior to construction activities and maintained throughout the construction period.
  - **COS-P7.8** Where sensitive on-site biological resources have been identified, construction employees operating equipment or engaged in any development-associated activities involving vegetation removal or ground disturbing activities in sensitive resource areas shall be trained by a qualified biologist and/or botanist who will provide information on the on-site biological resources (sensitive natural communities, special status plant and wildlife habitats, nests of special-status birds, etc.), avoidance of invasive plant introduction and spread, and the penalties for not complying with biological mitigation requirements and other state and federal regulations.
  - **COS-P7.9** A biologist shall be retained to conduct construction monitoring in and adjacent to all habitats for protected species when construction is taking place near such habitat areas.
- **Goal COS-8:** Maintain and promote native vegetation.
  - **COS-P8.1** Native plant species shall be protected and planting and regeneration of native plant species shall be encouraged, wherever possible, in undisturbed portions of development sites.
  - **COS-P8.2** New landscaping shall promote the use of xeriscape and native tree and plant species, including those valued for traditional Native American cultural uses.
- **Goal COS-9:** Protect identified special-status plant and animal species.
  - **COS-P9.1** A biological resources assessment shall be required for any proposed development project where special-status species or critical habitat may be present. Assessments shall be carried out under the direction of Butte County. Additional focused surveys shall be conducted during the appropriate season if necessary. Upon adoption of the Butte Regional Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP), assessment requirements of the [Butte Regional] HCP/NCCP shall be implemented for development projects within the [Butte Regional] HCP/NCCP area.

- **COS-P9.2** If special-status plant or animal species are found to be located within a development site, proponents of the project shall engage in consultation with the appropriate federal, state and regional agencies and mitigate project impacts in accordance with state and federal law. Upon adoption of the Butte Regional Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP), mitigation requirements of the [Butte Regional] HCP/NCCP shall be implemented for development projects within the [Butte Regional] HCP/NCCP area. Examples of mitigation may include:

  a. Design the proposed project to avoid and minimize impacts.

  b. Restrict construction to specific seasons based on project-specific special-status species issues (e.g. minimizing impacts to special-status nesting birds by constructing outside of the nesting season).

  c. Confine construction disturbance to the minimum area necessary to complete the work.

  d. Mitigate for the loss of special-status species by purchasing credits at an approved conservation bank (if a bank exists for the species in question), funding restoration or habitat improvement projects at existing preserves in Butte County, or purchasing or donating mitigation lands of substantially similar habitat.

  e. Maintain a minimum 100-foot buffer on each side of all riparian corridors, creeks and streams for special-status and common wildlife.

  f. Establish setbacks from the outer edge of special-status species habitat areas.

  g. Construct barriers to prevent compaction damage by foot or vehicular traffic.

Butte County Regional Habitat Conservation Plan/Natural Community Conservation Plan

Butte County is currently preparing a Butte Regional Habitat Conservation Plan/Natural Community Conservation Plan (Butte Regional HCP/NCCP) that will provide comprehensive species, wetlands, and ecosystem conservation and contribute to the recovery of endangered species within the plan area while also providing a more streamlined process for environmental permitting. Plan goals that will support the conservation of vegetation and wetland resources include the following.

- Balance open space, habitat, agriculture and urban development.
- Allow for appropriate and compatible growth and development in the Butte County region.
- Preserve aquatic and terrestrial resources and provide habitat for threatened and endangered species through conservation partnerships with local agencies.
- Provide greater conservation values than a project-by-project, species-by-species review.

The first administrative draft is a work-in-progress (available: http://www.buttehcp.com/BRCP-Documents/1st-Admin-Draft-BRCP/index.html) and finalization and adoption of the plan is scheduled for late 2012 or early 2013.

City of Biggs

City of Biggs General Plan 1997–2015

The policies below are taken from the Conservation and Open Space Element of the City of Biggs General Plan 1997–2015, adopted in 1998 (City of Biggs 1998:5-5–5-6). These policies are designed to guide planning related to and affecting habitat and biological and mineral resources within the City of Biggs' jurisdiction.

- **Policy 5.2.A** Apply mitigation measures to development projects to minimize impacts to biological resources during and after construction.
- **Policy 5.2.B** Consider opportunities for habitat preservation and enhancement in conjunction with public facility projects, particularly storm drainage facilities.
- **Policy 5.2.D** If the presence of protected species is determined to be likely, the project applicant shall be responsible for all costs associated with investigating species presence and preparation of any required mitigation plans.
- **Policy 5.2.E** Promote the establishment of an open space reserve along Hamilton Slough in areas southeast and south of the current City limits.

Municipal Code

According to Section 9.15.080 of the City of Biggs Municipal Code, *Tree care, planting, removing, and replacement – Permit required*, it is unlawful and prohibited for any person other than the superintendent or their authorized agent or deputy to cut, trim, prune, spray, brace, plant, move, remove, or replace any tree in any public street within the city.

City of Gridley

City of Gridley 2030 General Plan

The policies below are taken from the Conservation Element of the City of Gridley 2030 General Plan, adopted in December 2009 (City of Gridley 2010:17). These policies are designed to guide planning related to biological resources, including vegetation and wetlands, within the City of Gridley's jurisdiction.

- **Policy 5.1** New developments shall use techniques, such as buffers, setbacks, and clustering of development to protect wetlands, riparian corridors, vernal pools, and sensitive species.
- **Policy 5.3** The City will have former agricultural drainage ditches improved or restored in a way that avoids or improves habitat value and maintains or improves wetland function.
- **Policy 5.4** The City will condition new development, as necessary, to reduce erosion, siltation, and mitigate impacts to wetland, riverine, and riparian habitats.
- **Policy 5.7** The City will ensure consistency of new development with applicable portions of the Butte County Habitat Conservation Plan and Natural Communities Conservation Plan.
- **Policy 5.9** The City will continue to collaborate with the California Department of Fish and Wildlife and the U. S. Fish and Wildlife Service, as appropriate, to ensure the protection and preservation of special-status species and their habitats within the Gridley Planning Area.

A.3.6.2 Sutter County

Yuba-Sutter Habitat Conservation Plan/Natural Community Conservation Plan

Yuba and Sutter Counties are currently preparing a regional HCP, referred to as the Yuba-Sutter HCP/NCCP. The plan will include conservation goals, objectives, and measures that aim to preserve covered plant and wildlife species and important natural and agricultural communities that support these species as well as other local native and migratory wildlife within the plan area.

According to the November 2011 Planning Agreement (available: <http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=39871>), the preliminary conservation objectives for the Plan are as follows.

- Provide for the protection of species and natural communities on an ecosystem or a landscape level.
- Preserve the diversity of plant and animal communities in the Planning Area;
- Assure connectivity to and compatibility with conserved areas within and adjacent to the Planning area boundaries.
- Protect the viability of threatened, endangered or other special status plant and animal species, and minimize and mitigate the take or loss of the Covered Species;
- Identify and designate biologically sensitive habitat areas;
- Preserve habitat and thereby contribute to the recovery of the Covered Species; and
- Reduce the need to list additional species.

Sutter County General Plan—Public Draft

The biological resource and open space policies below are taken from the Environmental Resources chapter of the *Sutter County General Plan—Public Draft*, released for public comment in fall 2010 (Sutter County 2010:9-4–9-7). These policies are designed to guide planning related to biological resources, including vegetation and wetlands, within Sutter County's jurisdiction.

- **Policy ER 1.3** Focus conservation efforts on areas identified as having very high and high habitat value as well as Sutter County's unique natural open space resources, including the Sutter Buttes, Sutter Bypass, Butte Sink, and the Sacramento, Feather, and Bear River corridors.
- **Policy ER 1.4** Emphasize the preservation, enhancement, and creation of sustainable, interconnected habitat and open space areas that highlight unique resources and integrate educational and recreational opportunities as appropriate.
- **Policy ER 1.7** Mitigate biological and open space effects that cannot be avoided in accordance with an applicable Habitat Conservation Plan and federal, state, and local regulations.
- **Policy ER 1.10** Identify and pursue economically viable methods and funding sources for the long-term maintenance and management of significant biological and open space resource areas, including state and federal programs.
- **Policy ER 2.2** Encourage and support the Sutter County Resource Conservation District's programs that facilitate preservation and restoration of natural wetland environments as long as these programs do not significantly affect Sutter County agricultural lands and flood control operations.

- **Policy ER 2.4** Encourage the creation and use of regional wetland mitigation banks to the extent that they do not conflict with Sutter County agricultural lands and flood control operations
- **Policy ER 3.1** Preserve special-status fish, wildlife, and plant species (e.g., rare, threatened, or endangered species) and habitats consistent with an applicable Habitat Conservation Plan and federal, state, and local regulations.
- **Policy ER 3.2** Coordinate with federal, state, and local resource agencies (e.g., California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers) to protect special-status species.
- **Policy ER 3.3** Support the preservation and re-establishment of fisheries in the rivers and streams within Sutter County.
- **Policy ER 3.4** Preserve and protect waterfowl resources along the Pacific Flyway Migration Corridor.
- **Policy ER 3.5** Preserve and enhance wildlife movement corridors between natural habitat areas to maintain biodiversity and prevent the creation of biological islands. Preserve contiguous habitat areas when possible.
- **Policy ER 3.6** Preserve important areas of natural vegetation and the ecological integrity of these habitats, where feasible, including but not limited to riparian, vernal pool, marshes, oak woodlands and annual grasslands.
- **Policy ER 3.7** Preserve native oak trees when possible through the review of discretionary development projects and activities. Reduce the loss of oak trees through consideration of tree mitigation/replanting programs.
- **Policy ER 3.8** Encourage the use of native and drought tolerant plant materials, including native tree species, in all public and private landscaping and revegetation projects.
- **Policy ER 4.1** Preserve natural landforms, natural vegetation, and natural resources as open space to the extent feasible.
- **Policy ER 4.2** Preserve the Sutter Buttes as an important agricultural, cultural, historic, habitat, and open space resource. Promote and support efforts by willing landowners to increase opportunities for public access to the Sutter Buttes and other open space areas.
- **Policy ER 4.3** Preserve the Sacramento, Feather, and Bear River corridors as important habitat, recreation and open space resources. Support efforts to increase public access and recreational uses along the County's river corridors.
- **Policy ER 4.4** Support efforts to acquire additional open space adjoining protected natural resource areas to increase the size, connectivity, and buffering of existing habitat.
- **Policy ER 4.6** Prohibit land mitigation within Sutter County for projects within other jurisdictions unless there is a benefit to Sutter County. Benefits can include, but are not limited to, providing flood protection for Sutter County, providing opportunities for Sutter County projects' use of the area for mitigation, or making the natural resources available for the enjoyment of Sutter County residents.

City of Yuba City

Yuba City General Plan

The guiding and implementation policies below are taken from the Environmental Conservation chapter of the City of Yuba City General Plan, adopted in 2004 (City of Yuba City 2004:8-13–8-14). These policies are designed to guide planning related to biological resources, including vegetation and wetlands, within the City of Yuba City's jurisdiction.

- **Policy 8.4-G-1** Protect special status species, in accordance with State regulatory requirements.
- **Policy 8.4-G-2** Protect and enhance the natural habitat features of the Feather River and new open space corridors within and around the urban growth area.
- **Policy 8.4-G-3** Preserve and enhance heritage oaks in the Planning Area.
- **Policy 8.4-G-4** Where appropriate, incorporate natural, wildlife habitat features into public landscapes, parks, and other public facilities.
- **Policy 8.4-G-5** Support the preservation and enhancement of fisheries in the Feather River.
- **Policy 8.4-I-2** Require preservation of oak trees and other native trees that are of a significant size, by requiring site designs to incorporate these trees to the maximum extent feasible.
- **Policy 8.4-I-3** Require, to the extent feasible, use of drought tolerant plants in landscaping for new development, including private and public projects.
- **Policy 8.4-I-4** Require measures, as part of the Feather River Parkway Plan, to protect and enhance riparian zones, natural areas and wildlife habitat qualities; and establish and maintain protection zone along the river where development shall not occur, except a part of the parkway enhancement (e.g., trails and bikeways). For park improvements, require a buffer zone along the river in which no grading or construction activities will occur, except as needed for shoreline uses such as boat docks.
- **Policy 8.4-I-5** Establish wildlife corridors in conjunction with implementation of the Feather River Parkway Plan to minimize wildlife-urban conflicts.
- **Policy 8.4-I-6** Work with California Department of Fish and Wildlife and other agencies to enhance and preserve fisheries in the Feather River.

Municipal Code

According to municipal code Section 9-2.04, *Care of trees, shrubbery, and lawns*, "it shall be unlawful for any person to damage, cut, carve, transplant, or remove any tree, plant, wood, turf, or grass, or pick the flowers or seeds of any tree or plant, or attach any rope, wire, or other object to any tree or plant located in any park or recreation area." The Feather River bike trail, a recreational facility, falls within the biological study area.

City of Live Oak

City of Live Oak 2030 General Plan

The policies below are taken from the Conservation and Open Space Element of the City of Live Oak 2030 General Plan (City of Live Oak 2010: CO-4–CO-9). These policies are designed to guide

planning related to and affecting habitat and biological resources, including vegetation and wetlands, within the City of Live Oak's jurisdiction.

- **Goal BIOLOGICAL-1**. Protect and enhance habitat suitable for special-status species that can occur in the Study Area.
  - **Policy Biological-1.1** Applicants of projects that have the potential to negatively affect special-status species or their habitat shall conduct a biological resources assessment and identify design solutions that avoid such adverse effects. If adverse effects cannot be avoided, then they shall be mitigated in accordance with guidance from the appropriate state or federal agency charged with the protection of these species.
- **Goal BIOLOGICAL-2**. Protect native oak and other large tree species occurring throughout the Study Area that provide valuable habitat for wildlife species and contribute to the historic and aesthetic character of the city.
  - Policy Biological-2.1 New developments shall preserve all native oaks with a diameter at breast height (dbh) of 6 inches or greater and all other trees that have a dbh of 30 inches or greater, to the maximum extent feasible.
- **Goal BIOLOGICAL-3**. Protect and enhance existing riparian habitat within the Study Area.
  - **Policy Biological-3.1** Where feasible, the City will require that new developments avoid the conversion of existing riparian habitat and require that an adequate buffer of the associated riparian areas be established to protect this resource. Where feasible, the riparian buffers shall be incorporated into open space corridors, public landscapes, and parks. Riparian buffers shall be designed to preserve existing wildlife habitat; restore degraded habitat; provide habitat conditions favorable to native local wildlife; restrict activities that may adversely affect wildlife habitat quality within the established buffer zone; and provide interpretive features educating the public about the beneficial effects of native riparian habitat and activities that adversely affect wildlife.
  - **Policy Biological-3.2** The City will take advantage of opportunities to enhance and restore existing riparian areas along Live Oak Slough and other drainage canals. Where feasible, these resources shall be incorporated into open space corridors, public landscapes, and park during the preparation of the Parks and Recreation Master Plan.
  - **Policy Biological-3.3** The City will require new developments to avoid the loss of federally protected and state-protected wetlands. If loss is unavoidable, the City will require applicants to mitigate the loss on a "no net loss" basis through a combination of avoidance, minimization, and/or compensation in accordance with federal and state law.
  - **Policy Biological-3.4** If development or expansion of the Live Oak Park and Recreation Area on the Feather River occurs, the City will encourage designs, construction, and operation to protect sensitive riparian habitat.

Municipal Code

Section 12.04.030 of the municipal code, *Permit to Plant or Remove*, states that "no trees or shrubs shall be planted in or removed from any public utility strip or other place in the city without a permit from the superintendent of streets. (Ord. 88 § 3, 1957)".

A.3.7 Fish and Wildlife Resources

A.3.7.1 Sutter County

Yuba-Sutter Habitat Conservation Plan/Natural Community Conservation Plan

The Yuba-Sutter NCCP/HCP, currently under development, is a cooperative planning effort initiated by Yuba and Sutter Counties to address the effects of regional proposed transportation projects (SR 99 and SR 70) and any resulting development in the surrounding area. The purpose of the Yuba-Sutter NCCP/HCP is to provide a way to continue economic growth and community development; retain the economic vitality of the area's agricultural community; maintain public uses of open space; simplify and expedite land use and conservation planning in the plan area; protect threatened and endangered species; and preserve plant and wildlife communities.

Sutter County General Plan

The *Sutter County General Plan* update was initiated in fall 2007. The objective of the general plan is to provide guidance for the development of Sutter County. The general plan promotes a balance between strong agricultural traditions, natural resource preservation, and economic growth opportunities. The Environmental Resources chapter of the general plan was updated in 2010. The following goals, objectives, and policies are relevant to fish resources in the study area.

- **Goal ER 1:** Support a comprehensive approach for the conservation, enhancement, and regulation of Sutter County's significant habitat and natural open space resources.
  - **ER 1.3 Conservation Efforts.** Focus conservation efforts on areas identified as having very high and high habitat value as well as Sutter County's unique natural open space resources, including the Sutter Buttes, Sutter Bypass, Butte Sink, and the Sacramento, Feather, and Bear River corridors.
  - **ER 1.5 Resources Assessment.** Require discretionary development proposals that could potentially impact biological resources to conduct a biological resources assessment to determine if any resources will be adversely affected by the proposal and, if so, to identify appropriate measures to avoid or mitigate such effects.
  - **ER 1.6 Avoidance.** Ensure that new development projects avoid, to the extent feasible, significant biological resources (e.g., areas of rare, threatened or endangered species of plants, riparian areas, vernal pools), except where such projects are identified as —Authorized Development within an adopted Habitat Conservation Plan.
  - **ER 1.7 Mitigation.** Mitigate biological and open space effects that cannot be avoided in accordance with an applicable Habitat Conservation Plan and federal, state, and local regulations.
  - **ER 1.9 Buffers.** Ensure that new development incorporates buffers and other measures adequate to protect biological habitats that have been preserved, enhanced, and created.
- **GOAL ER 3:** Conserve, protect, and enhance Sutter County's varied wildlife and vegetation resources.
  - **ER 3.1 Special-Status Species.** Preserve special-status fish, wildlife, and plant species (e.g., rare, threatened, or endangered species) and habitats consistent with an applicable Habitat Conservation Plan and federal, state, and local regulations.

- **ER 3.2 Agency Coordination.** Coordinate with federal, state, and local resource agencies (e.g., California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers) to protect special-status species.
- **ER 3.3 Fisheries.** Support the preservation and re-establishment of fisheries in the rivers and streams within Sutter County.
- **ER 3.6 Natural Vegetation.** Preserve important areas of natural vegetation and the ecological integrity of these habitats, where feasible, including but not limited to riparian, vernal pool, marshes, oak woodlands and annual grasslands (ER 3-A).
- **ER 3.8 Native Plant Use.** Encourage the use of native and drought tolerant plant materials, including native tree species, in all public and private landscaping and revegetation projects (ER 3-D).

A.3.7.2 Butte County

Butte County General Plan 2030

The Butte County General Plan 2030 (Butte County 2010) was adopted in October 2010. The objective of the general plan is to provide direction on how the county will fulfill its community vision and manage its future growth. The general plan addresses all aspects of development, including land use; circulation and transportation; open space, natural resources and conservation; public facilities and services; safety; and noise. The Conservation and Open Space Element chapter of the general plan was updated in 2010. The following goals, objectives, and policies are relevant to fish resources in the study area.

- **Goal COS-9:** Protect identified special-status plant and animal species.
  - **COS-P9.1** A biological resources assessment shall be required for any proposed development project where special-status species or critical habitat may be present. Assessments shall be carried out under the direction of Butte County. Additional focused surveys shall be conducted during the appropriate season if necessary. Upon adoption of the Butte Regional Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP), assessment requirements of the [Butte Regional] HCP/NCCP shall be implemented for development projects within the [Butte Regional]HCP/NCCP area.
  - **COS-P9.2** If special-status plant or animal species are found to be located within a development site, proponents of the project shall engage in consultation with the appropriate federal, State and regional agencies and mitigate project effects in accordance with State and federal law. Upon adoption of the Butte Regional Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP), mitigation requirements of the [Butte Regional]HCP/NCCP shall be implemented for development projects within the [Butte Regional]HCP/NCCP area.

    Examples of mitigation may include:

    a. Design the proposed project to avoid and minimize effects.

    b. Restrict construction to specific seasons based on project specific special-status species issues (e.g. minimizing effects on special-status nesting birds by constructing outside of the nesting season).

    c. Confine construction disturbance to the minimum area necessary to complete the work.

d. Mitigate for the loss of special-status species by purchasing credits at an approved conservation bank (if a bank exists for the species in question), funding restoration or habitat improvement projects at existing preserves in Butte County, or purchasing or donating mitigation lands of substantially similar habitat.

e. Maintain a minimum 100-foot buffer on each side of all riparian corridors, creeks and streams for special-status and common wildlife.

f. Establish setbacks from the outer edge of special-status species habitat areas.

A.3.8 Agriculture, Land Use, and Socioeconomics

A.3.8.1 Butte County

Butte County General Plan

The northern portion of Reach 25 through Reach 41 of the proposed project are located in unincorporated Butte County, and are subject to the goals and policies of the *Butte County General Plan*. Relevant goals and policies of the Agriculture Element follow.

- **Goal AG-1** Maintain, promote, and enhance Butte County's agriculture uses and resources, a major source of food, employment, and income in Butte County.
  - **Policy AG-P1.1** The County supports State and federal legislation designed to conserve soil and protect agricultural land.
  - **Policy AG-P1.3** Continue to work with landowners in establishing new and maintaining existing Williamson Act contracts.
- **Goal AG-2** Protect Butte County's agricultural lands from conversion to non-agricultural uses.
  - **Policy AG-P2.1** The county shall work with the Local Agency Formation Commission to create and maintain a consistent approach to the conservation of agricultural land through the designation of reasonable and logical sphere of influence boundaries.
  - **Policy AG-P2.2** The County supports private conservation organizations that utilize voluntary conservation easements as a tool for agricultural conservation, continued agricultural use, agricultural supportive uses, tax breaks and similar goals.
- **Goal AG-6** Provide adequate infrastructure and services to support agriculture.
  - **Policy AG-P6.1** The County supports the efforts of private landowners and public agencies to protect farmers from catastrophic and uncontrolled flooding of permanent crops, such as orchards, nurseries and other major agricultural investments.

Relevant goals and policies of the Land Use Element follow.

- **Goal LU-1** Continue to uphold and respect the planning principles on which the County's land use map is based.
  - **Policy LU-P1.1** The County shall protect and conserve land that is used for agricultural purposes, including cropland and grazing land.
  - **Policy LU-P1.2** The County shall promote economic development and job-generating industry in unincorporated areas.

  - **Policy LU-P1.6** The County shall conserve important habitat and watershed areas, while protecting the public safety of County residents.
- **Goal LU-6** Provide adequate land for the development of public and quasi-public uses, as a means to provide necessary public services and facilities in support of existing and new residential, commercial, and industrial land uses.
- **Goal LU-12** Coordinate planning efforts within the county and region.
  - **Policy LU-P12.4** The County shall coordinate planning efforts with those of special districts and school districts.

Relevant goals and policies of the Economic Development Element follow.

- **Goal ED-1** Improve the local economy by diversifying the economy, reducing the unemployment rate, increasing business revenues to the county, and increasing wages.
  - **Policy ED-P1.1** The County's priority for future growth is creating sustainable jobs and providing a living wage to families to reduce poverty.
  - **Policy ED-P1.4** Products and services for County operations should be purchased from Butte County locally-owned businesses whenever possible.
  - **Policy ED-P1.5** The County supports education and job training for those county residents currently employed, dislocated, or unemployed in order to enhance existing skill levels and provide for job advancement, and supports removal of impediments to gainful employment for county residents.
- **Goal ED-2** Promote and support the local agricultural economic sector.
  - **Policy ED-P2.2** The County shall encourage development of food processing and other facilities that could support production of "value-added" agriculture products from Butte County.
- **Goal ED-3** Improve the county's fiscal health.

A.3.8.2 Sutter County

Sutter County General Plan

Project Reaches 2 through 10, part of Reach 11, and Reaches 14, 15, and 17 through the southern portion of Reach 25 lie within unincorporated Sutter County, and are subject to the goals and policies of the *Sutter County General Plan*. Relevant goals and policies of the Agriculture Element follow.

- **Goal AG 1** Preserve and protect high-quality agricultural lands for long-term agricultural production.
  - **Policy AG 1.1 Agricultural Land Preservation.** Preserve and maintain agriculturally designated lands for agricultural use and direct urban/suburban and other nonagricultural related development to the cities, unincorporated rural communities, and other clearly defined and comprehensively planned development areas.
  - **Policy AG 1.5 Agricultural Land Conversion.** Discourage the conversion of agricultural land to other uses unless all of the following findings can be made:

    a. The net community benefit derived from conversion of the land outweighs the need to protect the land for long-term agricultural use
    b. There are no feasible alternative locations for the proposed use that would appreciably reduce impacts upon agricultural lands
    c. The use will not have significant adverse effects, or can mitigate such effects, upon existing and future adjacent agricultural lands and operations
  - **Policy AG 1.6 Interrelationship with Habitat Conservation.** Permit agriculturally designated lands to be used for habitat conservation and/or mitigation with approval of a development agreement, provided such use does not interfere or adversely affect existing or planned agricultural uses or impact County flood control operations.
  - **Policy AG 1.9 Williamson Act.** Promote the use of the California Land Conservation Act (Williamson Act) on agricultural lands throughout the County provided the State continues to fund the subvention program to offset the loss of property taxes.
  - **Policy AG 1.10 Transfer of Development Rights.** Explore, and if determined feasible, implement programs to permanently preserve agricultural lands through the use of voluntary transfer of development rights to guide development to more suitable areas.
  - **Policy AG 1.11 Conservation Easements.** Explore, and if determined feasible, identify agricultural mitigation bank areas in which the County will encourage private landowners to voluntarily participate in agricultural conservation easements.
  - **Policy AG 1.12 Land Mitigation Program.** Explore, and if determined feasible, create an Agricultural Land Mitigation Program.
  - **Policy AG 1.13 Cooperation with Other Agencies.** Coordinate with the cities, the Local Agency Formation Commission (LAFCO), local service providers, and other relevant agencies on joint mechanisms to preserve agricultural lands and limit urban encroachment and the extension of urban service and infrastructure into agricultural areas.
- **Goal AG 2** Minimize conflicts between agricultural uses and operations and adjacent non-agricultural uses.
  - **Policy AG 2.1 Minimize Conflicts.** Require that new development adjacent to agricultural areas be designed to minimize conflicts with adjacent agricultural uses and operations.
  - **Policy AG 2.2 Right to Farm.** Affirm and protect the right of agricultural operators in agricultural areas to continue their agricultural practices ("right to farm"). The right to farm shall acknowledge through noticing that landowners and residents adjacent to agriculture should be prepared, accept, and not consider a nuisance the impacts inherent with lawful farming activities. At a minimum, the Right to Farm Notice shall be recorded with the Deed of Trust at the time of transfer of all applicable properties.
  - **Policy AG 2.3 Buffers.** Protect agricultural operations from conflicts with non-agricultural uses by requiring buffers between proposed non-agricultural uses and adjacent agricultural operations:
    a. Buffers should be physically and biologically designed to avoid conflicts between agricultural and nonagricultural uses. The biological design should ensure that the buffer does not provide a host environment for pests or carriers of disease which could potentially impact adjacent farming operations.

b. Buffers shall not be located on the agricultural parcel(s).

c. Buffers should primarily consist of a physical separation (setback) between agricultural and non-agricultural uses. The appropriate width of the buffer shall be determined on a site-by-site basis taking into account the type of existing agricultural uses (i.e. crop type and associated operational requirements); the nature of the proposed non-agricultural development; the natural features of the site; landscaping, walls or other barriers planned by the proposed development; and any other factors that affect the specific situation.

d. In addition to a physical separation, the following buffer options may be considered: greenbelts/open space, limited park and recreation areas, roads, PUE's, waterways, and vegetative screens. These buffering options may be used in any combination to most effectively reduce conflicts arising from adjacent incompatible uses.

e. An ongoing maintenance program for the buffer shall be established and should include vector controls.

f. Buffer restrictions may be removed if all adjacent parcels have been irreversibly converted to nonagricultural uses.

- **Goal AG 3** Protect the natural resources needed to ensure that agriculture remains an essential and sustainable part of Sutter County's future.
- **Goal AG 4** Provide for growth, expansion, and diversification of Sutter County's agricultural industries.
  - **Policy AG 4.1 Transportation Systems.** Maintain existing regional transportation systems to support the local, national, and global movement of agricultural products. Support the extension of freight rail into Sutter County's industrial areas.
  - **Policy AG 4.2 Utility Infrastructure.** Implement mechanisms to provide the utility infrastructure, flood protection, and services necessary to lands designated for industrial use in order to support the growth and expansion of Sutter County's agriculture industries.
  - **Policy AG 4.5 Agricultural Industries.** Promote the growth and expansion of existing agricultural industries as well as the development of new and diverse agricultural production, processing, and distribution industries within Sutter County.
  - **Policy AG 4.6 Local Processing.** Support the local processing and distribution of agricultural products grown in Sutter County and other nearby locations.

Relevant goals and policies of the Land Use Element follow.

- **Goal LU 1** Promote the efficient and sensitive use of lands to protect and enhance Sutter County's quality of life and meet the needs of existing and future residents and businesses.
  - **Policy LU 1.2 Balanced Land Use Pattern.** Maintain a balance of land uses that allows residents the opportunity to live, work, and shop in the County.
  - **Policy LU 1.4 Identification of Floodplains.** Identify the unincorporated areas of Sutter County that are subject to flooding, and evaluate and regulate development within these areas according to state and federal regulations to minimize the loss of life and damage to property caused by potential flood events.

- **Policy LU 1.5 Minimize Land Use Conflicts.** Avoid/minimize conflicts between land uses and ensure that new development maintains the viability of adjacent agricultural, open space, and rural uses and minimizes impacts upon existing residents, businesses, and resources.
- **Policy LU 1.6 Buffers.** Require new development adjacent to agricultural and open space lands to provide buffers and incorporate mitigation to minimize impacts as appropriate. Agricultural buffers shall be in accordance with the Sutter County Design Guidelines and project environmental review.
- **Policy LU 1.7 Growth Inducement.** Locate and size infrastructure to not induce growth within adjacent agricultural and open space areas.
- **Policy LU 1.11 Efficient Land Use Patterns.** Encourage land use patterns that support the efficient use of resources, enhance the timely provision of services and infrastructure, promote a variety of transportation modes, facilitate pedestrian mobility, and support health and wellness.

- **Goal LU 2** Preserve Sutter County's agricultural heritage and natural resources.
  - **Policy LU 2.1 Long-Term Conservation.** Promote the long-term conservation of agricultural and open space lands in accordance with the goals and policies of the Agricultural Resources and Environmental Resources elements.
  - **Policy LU 2.2 Isolated Urban and Rural Uses.** Prohibit the designation of new, and the expansion of existing, isolated rural or urban land uses within agricultural or other resource lands, unless such expansion is compatible with the existing use.
  - **Policy LU 2.5 Commercial Recreation Overlay.** Allow for the allocation of the Commercial Recreation Overlay land use designation within, or "inside" the levees along the Sacramento, Feather, and Bear River corridors. Consider allocation of this land use designation to adjacent areas "outside" the levees when determined to be necessary for the proposed use and if the use will not have an adverse impact on adjacent agricultural operations or natural resources.
- **Goal LU 4** Facilitate orderly, well-planned, sustainable, and efficient growth that balances aesthetic, functional, resource, and economic considerations.
  - **Policy LU 4.1 Growth Areas.** Direct future growth and development to the growth areas identified on Figure 3-1.
  - **Policy LU 4.6 Discontiguous Development.** Prohibit the establishment of new growth areas that are separated from existing cities and/or rural communities.
- **Goal LU 5** Promote a collaborative process for the planning and annexation of the area within the cities spheres of influence.
  - **Policy LU 5.1 Live Oak SOI.** Recognize the sphere of influence identified on the General Plan Land Use Diagrams as Live Oak's boundary of future planned urban growth.
  - **Policy LU 5.2 Yuba City Existing SOI.** Recognize the existing sphere of influence identified on the General Plan Land Use Diagrams as Yuba City's boundary of future planned urban growth.

- **Policy LU 5.3 Yuba City Possible Future SOI.** Consider the possible future expanded sphere of influence identified on the General Plan Land Use Diagrams as Yuba City's possible boundary of future planned urban growth. Enter into a memorandum of understanding (MOU) with Yuba City prior to supporting the City's possible future expanded sphere of influence.
- **Policy LU 5.4 Sphere Expansion.** Discourage the modification or expansion of Yuba City's and Live Oak's spheres of influence beyond the boundaries identified (including the possible future expanded Yuba City sphere of influence) on the General Plan Land Use Diagrams until substantial build out has occurred within the existing spheres, and a clear market demand exists for new uses that cannot be more efficiently accommodated in other defined growth areas in the County.

- **Goal LU 9** Designate adequate and compatible sites for governmental/public uses, and take a lead role when feasible on regional issues of importance to Sutter County, its residents, and businesses.
  - **Policy LU 9.1 Co-Location.** Promote the co-location of parks, schools, police, fire, libraries, community centers and other community facilities to support community interaction, enhance neighborhood identity, support joint use, and leverage resources.
  - **Policy LU 9.4 Impacts to Nearby Uses.** Require public facilities such as wells, pumps, tanks, and yards to be located and designed to ensure that noise, light, odors, and appearance do not adversely affect nearby land uses.
  - **Policy LU 9.5 Regional Planning Efforts.** Support and participate as appropriate in countywide, regional, and other multi-agency planning efforts related to land use, housing, revenue, economic development, tourism, agriculture, natural resources, air quality, habitat conservation, transportation, transit, infrastructure, water supply, flood control, solid waste disposal, emergency preparedness, and other issues relevant to the County.
  - **Policy LU 9.7 Project Consultation.** Encourage early consultation with adjacent jurisdictions on development proposals in Sutter County that may have an impact to them. Respond to and comment on development proposals in other jurisdictions that may have an impact to Sutter County to ensure consistency with the County's General Plan and that appropriate mitigation is incorporated.

Relevant goals and policies of the Economic Development Element follow.

- **Goal ED 1** Maintain and enhance the County's long-term fiscal health.
- **Goal ED 2** Maintain a business-friendly environment for both existing and new companies.
  - **Policy ED 2.1** Infrastructure for New Business. Ensure the provision of adequate infrastructure for business development, including flood control, road and rail networks, telecommunications backbone, sewer, drainage facilities, and water supply.
  - **Policy ED 2.6** Interjurisdiction Coordination. Create alliances with local jurisdictions and agencies to promote economic growth within the county.
- **Goal ED 3** Enhance the desirability of the County for new business and business expansion by supporting investment in the professional skills of the work force.
  - **Policy ED 3.1** Stable Jobs. Encourage future growth that creates stable jobs.

- **Policy ED 3.2** Financial Independence. Support economic opportunities that promote the self-sufficiency of residents and reduce dependence on County programs and services.

City of Yuba City

Yuba City General Plan

The *Yuba City General Plan* outlines land use and zoning policies for the area within the Yuba City limits. Although Reaches 11 through 18 of the proposed project skirt the eastern boundary of Yuba City, the project site lies, with three exceptions, within unincorporated Sutter County. These exceptions are the northernmost portion of Reach 11, Reach 16, and the southernmost portion of Reach 17, which fall within Yuba City limits.

Relevant policies of the Agriculture Element follow.

- **Policy 8.2-G-1** Promote preservation of agriculture outside of the urban growth area.
- **Policy 8.2-I-1** Work with the County to preserve agricultural uses in areas outside the Urban Growth Boundary and within greenbelts established around the exterior of the UGB. *The City should work with Sutter County to encourage the continuation of farming activities outside the City's and Urban Growth Boundary. Programs such as conservation easements and Williamson Act contracts should be pursued.*
- **Policy 8.2-I-2** Facilitate the continuance of agricultural activities within the City's urban growth area until the land is needed to accommodate population and employment growth. During this interim, minimize conflicts between agricultural uses and urban/suburban uses through site design techniques (not necessarily structural barriers).
- **Policy 8.2-I-5** Work with the Economic Development Corporation to assist proponents in continued and new agricultural processing uses in the proposed industrial area in order to support agricultural activities in the County.
- **Policy 8.2-I-6** Work with government agencies and non-profit land trusts to assist owners of undeveloped lands (sufficient in size to allow continued agricultural uses) to remain in agricultural open space on the perimeter of the urban growth area. *Potential programs may include purchase of conservation easements or creation of agricultural land trusts.*

Relevant policies of the Land Use Element follow.

- **Policy 3.4-I-2** Establish standards for urban edges and ensure that designated intensities and uses provide an appropriate transition to rural land at these edges.
- **Policy 3.4-I-4** Support the County's efforts to maintain viable agricultural uses surrounding the city in areas outside the proposed Urban Growth Boundary.
- **Policy 3.9-G-5** Protect the supply of land suitable for employment center uses by not allowing incompatible uses to locate in these areas.

Relevant policies of the Growth and Economic Development Element follow.

- **Policy 2.5-G-1** Foster a climate in which business can prosper and actively promote economic development opportunities and knowledge of Yuba City in the region, state and nation.

- **Policy 2.5-G-5** Encourage agricultural processing and cooperative distribution and marketing of agricultural products.
- **Policy 2.5-G-6** Promote agricultural-related technology and opportunities for "back office" uses and specialty manufacturing.
- **Policy 2.5-G-7** Enhance aspects of the community that help economic development and draw residents to Yuba City, including small-town ambience, educational, cultural, environmental and recreational resources, and affordable housing.

City of Live Oak

City of Live Oak 2030 General Plan

The FRWLP project area lies approximately 1mile east of the Live Oak City limit, but portions of Reaches 22 through 25 fall within the City of Live Oak SOI. The SOI, as designated in the *City of Live Oak 2030 General Plan*, represents the city's probable ultimate physical boundary. Accordingly, the following goals and policies may apply to implementation of the proposed project.

The relevant goal and policies from the Agriculture Element follow.

- **Goal Agriculture-1** Preserve agricultural resources and support the practice of farming.
  - **Policy Agriculture-1.1** Preserve agricultural enterprises by supporting right-to-farm policies.
  - **Policy Agriculture-1.3** As a part of the City's economic development strategy, the City will focus on efforts to attract industries related to, and supportive of, the local agricultural economy.
  - **Policy Agriculture-1.5** The City will work with farmers, property owners, extensions, agencies, and agricultural organizations to enhance the viability of agricultural uses and activities.

The relevant goal of the Land Use Element follows.

- **Goal LU-5** Establish environmentally and economically sustainable land-use patterns.

Relevant goals and policies of the Economic Development Element follow.

- **Goal ED-3** Attract and develop new employment uses in Live Oak that can provide jobs for local workers, enhance the City's tax base, and diversify the local economy.
  - **Policy ED-3.2** The City will coordinate with Sutter County to ensure a mutual City-County benefit from agricultural processing plants that locate near Live Oak.
  - **Policy ED-3.3** The City will identify and proactively engage agricultural service businesses that could locate in Live Oak and support nearby agricultural processing and sales.
  - **Policy ED-3.6** The City will target attracting the types of industries that are not only suited to the assets offered by Live Oak's location, but also industries that will provide viable career ladders for local workers, from entry level through management positions.
- **Goal ED-5** Foster growth and expansion among existing businesses in the community as a primary strategy for improving the economic health of the City.

A.3.9 Population, Housing, and Environmental Justice

A.3.9.1 Butte County

Butte County General Plan 2030

The relevant goals and policies of the Housing Element of the *Butte County General Plan 2030* are listed below.

- **Goal H-1:** Provide for the County's regional share of new housing for all income groups and future residents as identified in the Housing Needs Assessment.
- **Goal H-2:** Encourage the provision of affordable housing in the unincorporated area.
- **Goal H-3:** Partner with property owners to preserve and rehabilitate the existing supply of housing.
- **Goal H-4:** Collaborate with existing service providers to meet the special housing needs of homeless persons, elderly, large families, disabled persons, and farmworkers.
- **Goal H-5:** Ensure equal housing opportunity.
- **Goal H-6:** Promote energy conservation.

City of Biggs

City of Biggs General Plan

The relevant goals and policies of the City of Biggs General Plan Housing Element 2009–2014 (Pacific Municipal Consultants 2010) are listed below.

- **Goal 1—Housing Quality**: Provide an adequate supply of housing which is affordable, safe, sanitary, and desirable for all segments of the community. Housing should be of sufficient quality and quantity to afford all persons regardless of race, age, religion, sex, marital status, ethnic background, or personal disabilities an opportunity of selecting among varying types, designs, quality and value.
- **Goal 2—Housing Quantity and Affordability**: It is the goal of the City of Biggs to encourage the preservation of existing housing and the construction of new housing at a range of costs and in quantities to meet the needs of existing and future residents of the City.
- **Goal 3—Equal Housing opportunity**: It is the goal of the City of Biggs to assure that discrimination is not a factor in the ability of households to obtain housing.
- **Goal 4—Natural Resources and Energy Conservation**: It is the goal of the City to promote the conservation of natural resources and energy in housing production.

City of Gridley

City of Gridley 2030 General Plan

The relevant goals of the *City of Gridley 2030 General Plan* Housing Plan are listed below.

- **Housing Goal 1:** To promote the development of a variety of housing types throughout the city that are safe and built to complement the surrounding neighborhood.

- **Housing Goal 2:** To facilitate the preservation and construction of housing to meet the needs of Gridley residents, including all household types and incomes.
- **Housing Goal 3:** To reduce and remove constraints to development and redevelopment of housing.
- **Housing Goal 4:** To promote development and redevelopment of affordable housing.
- **Housing Goal 5:** To ensure equal opportunity and access to housing for all residents.
- **Housing Goal 6:** To reduce household costs and conserve natural resources and energy in housing production.

A.3.9.2 Sutter County

Sutter County General Plan

The applicable goals and policies of the Sutter County General Plan Housing Element are listed below (Sutter County 2010:5-19 to 5-20).

- **Goal 1:** Remove governmental constraints, address accessibility needs, and provide a regulatory framework to encourage a variety of housing types that accommodate all income groups.
- **Goal 2:** Provide for an adequate supply of new housing to meet the needs of present and future Sutter County residents, incorporating a variety of housing types and densities that accommodate all income groups, including extremely low-income households.
- **Goal 3:** Provide opportunities for agricultural housing while preserving rural land for agricultural uses.
- **Goal 4:** Ensure that new housing in Sutter County is safe and sanitary and that it receives public services that are adequate to support the level of development.
- **Goal 5:** Conserve and improve existing housing in Sutter County to ensure safe and sanitary conditions.
- **Goal 6:** Support the Consolidated Area Housing Authority of Sutter County and other nonprofit and private affordable housing providers in the County.

City of Yuba City

Yuba City Housing Element Update

The City of Yuba City's policies on housing provided in its housing element update (2008–2013) (Stuart and Graham 2009: 56, 57, 63, 65, 71) are listed below.

- **H-A:** Provide incentives and programs to ensure the construction and maintenance of safe and sanitary housing with adequate public services for existing and future residents of the City.
- **H-B:** Provide incentives and programs to ensure the provision of very low, low, and moderate income housing units to meet community needs.
- **H-C:** Continue to work with Sutter County on actions to fulfill Yuba City's fair share of regional housing needs.
- **H-D:** Ensure that new housing will be safe and sanitary and in a livable environment with adequate public services for the level of development.

- **H-E:** Facilitate the production of various housing types and densities to meet the needs of all income groups and ensure that housing opportunities are open to all without regard to race, color, age, sex, religion, national origin, family status, or physical handicap.
- **H-F:** Encourage the use of energy efficient materials and technology in new construction.

City of Live Oak

City of Live Oak 2030 General Plan

The relevant goals and policies of the *City of Live Oak 2030 General Plan* Housing Element are listed below.

- **Goal A:** To accommodate the City's share of the Regional Housing Need.
- **Goal B:** Provide for a variety of housing opportunities and affordability levels within the City of Live Oak.
- **Goal C:** Encourage and assist in the rehabilitation of housing units in need of repair and occupied by extremely low-, very low-, and low-income residents. Strive to enhance the overall quality of the City's existing housing stock.
- **Goal D:** Preserve, and if necessary replace, the City's publicly assisted affordable housing.
- **Goal E.1:** Ensure that no person seeking housing in the City of Live Oak is discriminated against on the basis of race, color, religion, sex, disability, familial status, ancestry, national origin, ancestry, marital status, sexual orientation, source of income, or age.
- **Goal F.1:** To promote energy conservation.

A.3.10 Visual

A.3.10.1 Butte County

Butte County General Plan 2030

The Butte County General Plan 2030 (Butte County 2010) establishes the Thermalito Afterbay as a Water-Based Scenic Area. There are no other county-designated Land- or Water-Based Scenic Areas in the project area. Relevant goals and policies of the Water Resources Element, Conservation and Open Space Element, and Public Facilities and Services Element are listed below.

- **Goal W-6**: Improve streambank stability and protect riparian resources
  - **W-P6.1** Any alteration of natural channels for flood control shall retain and protect riparian vegetation to the extent possible while still accomplishing the goal of providing flood control. Where removing existing riparian vegetation is unavoidable, the alteration shall allow for reestablishment of vegetation without compromising the flood flow capacity.
- **Goal COS-16**: Respect Native American culture and planning concerns.
  - **COS-P16.2** Impacts to the traditional Native American landscape shall be considered during California Environmental Quality Act or National Environmental Policy Act review of development proposals.

- **COS-P17.1** Views of Butte County's scenic resources, including water features, unique geologic features and wildlife habitat areas, shall be maintained.

- **Goal PUB-8:** Coordinate an interconnected multi-use trail system.
  - **PUB-P8.3** The development of abandoned railroad rights-of-way, levee tops, utility easements and waterways for new multi-use trails shall be pursued where appropriate.

A.3.10.2 Sutter County

Sutter County General Plan

Signs are located along North Buttes Road indicating the North Buttes Scenic Route. This route, however, is not included in the Sutter County General Plan (Sutter County 2011) as a county-designated scenic route. The Sutter County General Plan contains the following policies related to visual resources.

Related policies of the Land Use Element are listed below. The policy concerning countywide land use is as follows.

- **LU 1.16** Views from Rural Roadways and Highways. Prohibit new projects and activities that would obscure, detract from, or negatively impact the quality of views from the County's rural roadways and highways. Limit off-site advertising along County roadways and highways. *(LU 1-B)*

The policies concerning agriculture and open space are shown below.

- **LU 2.5** Commercial Recreation Overlay. Allow for the allocation of the Commercial Recreation Overlay land use designation within, or "inside" the levees along the Sacramento, Feather, and Bear River corridors. Consider allocation of this land use designation to adjacent areas "outside" the levees when determined to be necessary for the proposed use and if the use will not have an adverse impact on adjacent agricultural operations or natural resources. *(LU 2-A/LU 2-B)*
- **LU 2.6** Rural Character. Ensure the density, intensity, and design of new development within agricultural areas is consistent with and maintains the County's rural/agricultural character. *(LU 1-B)*

The policy concerning rural communities is shown below.

- **LU 3.8** Landmarks and Resources. Preserve and protect local landmarks and significant natural resources within rural communities. *(LU 1-B/ LU 3-A)*

One policy of the Agricultural Resources Element relates to visitor services (agri-tourism).

- **AG 5.4** Recreational Uses. Support recreational uses on privately owned lands where such uses are compatible with on and off-site agriculture and with scenic and environmentally sensitive resources. *(AG 1-A)*

Several policies of the Environmental Resources Element related to biological resources and open space.

- **ER 3.6** Natural Vegetation. Preserve important areas of natural vegetation and the ecological integrity of these habitats, where feasible, including but not limited to riparian, vernal pool, marshes, oak woodlands and annual grasslands. *(ER 3-A)*

- **ER 3.7** Oak Trees. Preserve native oak trees when possible through the review of discretionary development projects and activities. Reduce the loss of oak trees through consideration of tree mitigation/replanting programs. *(ER 3-B/ER 3C)*
- **ER 4.1** Preserve Natural Resources. Preserve natural landforms, natural vegetation, and natural resources as open space to the extent feasible.
- **ER 4.3** River Corridors. Preserve the Sacramento, Feather, and Bear River corridors as important habitat, recreation and open space resources. Support efforts to increase public access and recreational uses along the County's river corridors.

Other policies of the Environmental Resources Element concern visual resources.

- **ER 7.1** Scenic Resources. Protect views of Sutter County's unique scenic resources including the Sutter Buttes, wildlife and habitat areas, the Sacramento, Feather, and Bear Rivers, and other significant resources. *(ER 7-A)*
- **ER 7.2** Scenic Roadways. Enhance the visual character along the County's key transportation corridors, in particular Highways 99 and 20, through application of consistent design and landscape standards. *(ER 7-B)*
- **ER 7.3** Visually Complimentary Development. Require new development adjacent to the County's scenic resources to be sited and designed to visually complement the natural environment, topography, and aesthetic viewsheds. *(ER 7-A)*
- **ER 7.5** Lighting. Support practices that reduce light pollution and preserve views of the night sky including the design and sighting of light fixtures to minimize glare and light on adjacent properties. *(ER 7-A)*

City of Yuba City

The City of Yuba City General Plan (City of Yuba City 2004) contains the following Growth and Economic Development policy related to visual resources.

- **Guiding Policy 2.5-G-7** Enhance aspects of the community that help economic development and draw residents to Yuba City, including small-town ambience, educational, cultural, environmental and recreational resources, and affordable housing.

Community Design

Sutter Street/Second Street

- **Implementing Policy 4.4-I-10** Provide signage, landscaping, lighting, and other visual features to emphasize the existing and planned pedestrian access to the riverfront.

Parks, Schools, & Community Facilities

The general plan references the 2002 *Feather River Parkway Strategic Plan* that was developed to make use of the existing open space along the river that

> is visually inaccessible due to the existing levee. Proposed uses include a trail system, beaches, river viewing pavilions, boating facilities, and active recreational facilities, such as a golf course. The plan also addresses issues of waterfront accessibility, park space creation, and connections between the waterfront and Yuba City.

- **Implementing Policy 6.1-I-10** Implement the Feather River Parkway Strategic Plan in a manner consistent with the plans and programs put forth in that document and consistent with policies in the Open Space and Conservation Chapter (Chapter 8). Proposed actions include:
  - Improve pedestrian access to the riverfront;
  - Provide a mix of active- and non-active recreational and open space in those areas delineated in the Feather River Parkway Strategic Plan; and
  - Ensure that the open spaces proposed in the Feather River Parkway Strategic Plan be designed in a manner flexible enough to accommodate a variety of activities.

Environmental Conservation

Open Space

- **Guiding Policy 8.1-G-2** Enhance the open space features of the Feather River.
- **Guiding Policy 8.1-G-3** Preserve and enhance the visual and scenic resources of the Planning Area.
- **Implementing Policy 8.1-I-1** Coordinate with Sutter County in the creation of a greenway/open space buffer around the perimeter of the City's urban growth area. Explore regulatory incentives (e.g., Williamson Act) and financing mechanisms necessary to ensure preservation of these lands as open space.
- **Implementing Policy 8.1-I-3** Work with public and private entities to implement open space features of the Feather River Parkway Plan.
- **Implementing Policy 8.1-I-4** Where feasible, encourage restoration of degraded open space areas in the Feather River Parkway planning area to an environmentally valuable and sustainable condition.

Biological Resources

- **Guiding Policy 8.4-G-2** Protect and enhance the natural habitat features of the Feather River and new open space corridors within and around the urban growth area.
- **Guiding Policy 8.4-G-3** Preserve and enhance heritage oaks in the Planning Area.
- **Implementing Policy 8.4-I-2** Require preservation of oak trees and other native trees that are of a significant size, by requiring site designs to incorporate these trees to the maximum extent feasible.

City of Live Oak

City of Live Oak 2030 General Plan

The City of Live Oak 2030 General Plan (City of Live Oak 2010) contains the following policies related to visual resources. One policy concerns community character.

- **Policy Design 3.1** Important visual gateways should be designed to:
  - Provide an attractive streetscape environment for visitors;
  - Preserve vegetation and add new landscaping to enhance aesthetics;

- Preserve or enhance views of the Sutter Buttes, where possible;
- Visually "announce" to the visitor their arrival in Live Oak and the downtown core area; and
- Have attractive civic landmarks and public spaces.

Other policies relate to conservation and open space. Specifically, the following policies concern biological resources.

- **Policy Biological 3.1** Where feasible, the City will require that new developments avoid the conversion of existing riparian habitat and require that an adequate buffer of the associated riparian areas be established to protect this resource. Where feasible, the riparian buffers shall be incorporated into open space corridors, public landscapes, and parks. Riparian buffers shall be designed to preserve existing wildlife habitat; restore degraded habitat; provide habitat conditions favorable to native local wildlife; restrict activities that may adversely affect wildlife habitat quality within the established buffer zone; and provide interpretive features educating the public about the beneficial effects of native riparian habitat and activities that adversely affect wildlife.
- **Policy Biological 3.2** The City will take advantage of opportunities to enhance and restore existing riparian areas along Live Oak Slough and other drainage canals. Where feasible, these resources shall be incorporated into open space corridors, public landscapes, and park during the preparation of the Parks and Recreation Master Plan.
- **Policy Biological 3.4** If development or expansion of the Live Oak Park and Recreation Area on the Feather River occurs, the City will encourage designs, construction, and operation to protect sensitive riparian habitat.

The following policy concerns drainage and flood protection.

- **Policy Public 5.3** Existing Reclamation District 777 and Reclamation District 2056 drainage channels should be improved, to the greatest extent feasible, to create more naturalized swales that provide stormwater conveyance. These channels should be restored with native, low-maintenance landscaping to filter stormwater and enhance neighborhood aesthetics.

The following policy concerns parks and recreation.

- **Policy Parks 4.2** The City will coordinate with the other cities and the county to plan for improvements at Live Oak Park and Recreation Area to support and complement future trails along the Feather River.

A.3.11 Recreation

A.3.11.1 Butte County

Butte County General Plan 2030

The Butte County General Plan 2030 establishes several goals, policies, and actions affecting recreation including bicycle and park facilities (Butte County 2010:191). These appear in the Circulation Element and the Public Facilities and Services Element.

- **Goal CIR-1:** Promote intergovernmental communication and cooperation concerning transportation-related issues.

- **Goal CIR-3:** Design new neighborhoods, and improve existing neighborhoods, to accommodate and promote alternative modes of transportation.
- **Goal CIR-5:** Provide a safe, continuous, integrated, and accessible bicycle system, so as to encourage the use of the bicycle as a viable transportation mode and as a form of recreation and exercise.
- **Goal CIR-9:** Provide a circulation system that supports public safety.
- **Goal PUB-6:** Support a comprehensive and high-quality system of recreational open space and facilities.
- **Goal PUB-7:** Encourage local, regional, and State parks providers to engage in coordinated and cooperative planning efforts.
- **Goal PUB-8:** Coordinate an interconnected multiuse trail system.
    - **Policy PUB-P8.1** The County shall work with the municipalities and park and recreation districts to connect between trails in incorporated and unincorporated regions of Butte County.
    - **Policy PUB-P8.2** The County shall work with local jurisdictions, Lassen and Plumas National Forests, the California Department of Water Resources, and the California Department of Fish and Wildlife to designate additional shared use trails along unpaved County roads, access roads, and fire roads.
    - **Policy PUB-P8.3** The development of abandoned railroad rights-of-way, levee tops, utility easements, and waterways for new multiuse trails shall be pursued where appropriate.
    - **Policy PUB-P8.4** The County supports development of additional equestrian trails, including safe routes along roads.
    - **Policy PUB-P8.5** The County supports development of additional off-road vehicle trails.
    - **Policy PUB-P8.6** The County supports acquisition of appropriate and adequate funding for the creation and ongoing maintenance of trails.
    - **Policy PUB-P8.7** New development shall incorporate multiuse trails and connections to existing trail networks.
        - **Action PUB-A8.2** Cooperate with appropriate agencies to conduct a countywide trails planning study to identify new needed routes and connections to the existing trails network, as well as to address funding and management of trail facilities.

Countywide Bikeway Master Plan

Butte County adopted its Countywide Bikeway Master Plan in 1998 and is updating this plan (Butte County 2010:177). The Countywide Bikeway Master Plan identifies the following goals, objectives, and policies affecting recreation (Butte County 1998:39):

- **Goal 1:** Provide continuous and convenient bicycle access to and between major destinations throughout the County.
    - **Objective:** Develop a bikeway program that identifies interregional bikeway needs.
        - **Policy** Identify and give funding priority to projects which connect existing regional bikeway facilities.

        - **Policy** Encourage linkages between local bikeways to regional bikeways.
        - **Policy** Promote bikeway linkages to regional educational, recreational, shopping, governmental, and other attractions.
- **Goal 2:** Provide a safe and efficient bikeway system.
- **Goal 3:** Promote bicycling as a part of the intermodal transportation system.
- **Goal 5:** Develop a bikeway system that encourages and facilitates commuter use.
- **Goal 6:** Develop a bikeway system that encourages and facilitates recreational use.
    - **Objective:** Encourage recreational bicycling by providing a bikeway system that responds to the riding needs of both the avid cyclist and the "weekend" rider.
        - **Policy** Emphasize connections to regional recreational centers, such as Lake Oroville and Bidwell Park.
        - **Policy** Provide adequate bicycle parking facilities at regional recreation areas where warranted by demand.
- **Goal 7:** Pursue and obtain maximum funding available for bikeway programs.

City of Gridley

City of Gridley 2030 Master Plan

The City of Gridley 2030 General Plan establishes a policy of achieving and maintaining a standard of 5 acres of park land per 1,000 population (City of Gridley 2010:10-22). The Circulation Element and the Open Space Element in the general plan contain several goals, policies, and programs affecting recreation including bicycle and park facilities (City of Gridley 2010:7-19).

- **Circulation Goal 1:** To ensure that new development accommodates safe and pleasant routes for pedestrians, bicyclists, and drivers.
    - **Circulation Implementation Strategy 1.3** The City will update the Bicycle Plan to incorporate the Planned Growth Area and implement policies of the updated 2030 General Plan. The City will incorporate connections to existing and planned regional pedestrian/bicycle routes shown on plans adopted by Butte County. The City will provide potential connections with the City of Biggs and will incorporate planned connections shown on plans adopted by the City of Biggs. The City will consult with BCAG, the County, Butte County Air Quality Management District, and other agencies to obtain funding for improvements described in the Bicycle Plan.
- **Circulation Goal 2:** To retrofit existing development for increased pedestrian, bicycle, and transit access.
- **Open Space Goal 1:** To create high-quality, functional open space corridors.
- **Open Space Goal 2:** To provide visual screening, buffering, trails, and drainage in open space corridors along the railroad and Highway 99 in the Planned Growth Area.
- **Open Space Goal 3:** To provide for drainage, pedestrian and bicycle circulation, and landscaping in open space corridors within neighborhoods.

- **Open Space Goal 4:** To ensure adequate outdoor recreational open space to meet local needs as the City grows.
  - **Open Space Policy 4.1** New developments shall provide for improved, public park land according at a minimum rate of 5 acres per 1,000 residents.
- **Open Space Goal 5:** Maintain, expand, and upgrade facilities in existing recreation areas.
  - **Open Space Policy 5.6** The City will explore opportunities to improve ongoing public access to, and expand recreational opportunities related to the Feather River on property owned by the City and used for wastewater treatment.
  - **Open Space Implementation Strategy 5.1** The City will promote awareness of regional, state, and private parks and recreation planning and facilities development near Gridley, such as Grey Lodge, Lake Oroville Recreation Area, or new facilities. The City will encourage development of uses and facilities within Gridley that would be complementary to these regional recreation opportunities, in order to take best local advantage of these resources. The City will coordinate signage to promote awareness of these regional facilities.
- **Open Space Goal 6:** To provide recreation facilities and programs that meet the needs of existing and future residents.

City of Gridley Bicycle Plan

The City of Gridley Bicycle Plan identifies goals, objectives, and measures for developing a bicycle circulation network that ties into the region beyond the City and provides access to the Gray Lodge Wildlife Area, the City of Biggs, and the Feather River. The plan establishes several goals, objectives, and implementation measures affecting recreation facilities for bikes (City of Gridley 2003:16).

- **Goal:** A safe, effective, and efficient bicycle circulation system
  - **Implementation Measure 3.1:** Participate and comment on the Butte County Bicycle Plan update as it relates to Gridley-area routes, namely access to Feather River along East Gridley Road, and bikeways to Biggs and Gray Lodge Wildlife Area.

A.3.11.2 Sutter County

Sutter County General Plan

Sutter County does not have a park and recreation department and does not provide recreational facilities or opportunities through County programs under such a public agency (Sutter County 2011:8-1). The County does collect developer fees for parks and allocates the fees to one of five sectors. The fees are collected for recreation capital improvements (Sutter County 1996b:7.3). The Sutter County General Plan establishes a policy of achieving and maintaining a standard of 10 acres of park land per 1,000 population (Sutter County 2011:8-7). The plan identifies the following goals and policies affecting recreation, including bicycle and park facilities (Sutter County 2011:8-7–8-9).

- **Goal PS 6:** Ensure that adequate park, recreation, and open space lands and programs are provided to meet the diverse needs of Sutter County's residents.
  - **Policy PS 6.1 Park Facilities.** Support the development of new parks and recreational facilities, and the maintenance and enhancement of existing parks and recreational facilities, to provide for a variety of active and passive recreational needs.

- **Policy PS 6.2 Countywide Parks and Open Space Standard.** Strive to achieve and maintain a standard of 10 acres per 1,000 residents of park and open space lands within the County.
- **Policy PS 6.3 Parks and Open Space Standard for New Large-Scale Development.** Require new large-scale development projects (i.e., Specific Plans, Rural Planned Communities) to provide 10 acres per 1,000 residents of active and passive parks and open space lands. New large-scale development projects shall prepare and implement a County approved Parks and Open Space Master Plan.
- **Policy PS 6.6 Access**. Locate new parks and recreation facilities within walking and bicycling distance of residential areas.
- **Policy PS 6.10 River Recreation.** Support the development of public recreational amenities that enhance public access to and use of the Sacramento, Feather, and Bear River corridors including launch ramps, marinas, camping facilities, picnic areas, vista points, interpretive centers, and commercial recreation and services.
- **Policy PS 6-B** Revise the Zoning Code to allow for and facilitate recreation, commercial recreation, service and related uses along the County's river corridors.

- **Goal PS 7:** Support creation of an interconnected multi-use trail system that enhances Sutter County's recreational opportunities.
  - **Policy PS 7.1 Multi-Use Trails.** Support the development of a network of safe, interconnected multi-use trails that link activity and resource areas, and connect with regional trail systems.
  - **Policy PS 7.3 River Trails.** Support opportunities to create multi-use trails along the Sacramento, Feather, and Bear Rivers, including enhancement of the Feather River Parkway, through collaboration with the cities of Yuba City and Live Oak.
  - **Policy PS 7.4 Trail Opportunities.** Encourage the development of abandoned rights-of-way, levee tops, utility easements, and waterways for new multi-use trails.

Yuba-Sutter Bikeway Master Plan

The Yuba-Sutter Bikeway Master Plan, completed by the FRQAMD, provides comprehensive trail facility planning in Sutter County (Feather River Air Quality Management District 1995:i). The plan identifies the following goals, objectives, and policies for trails that apply to the Sutter Basin Project feasibility study area (Feather River Air Quality Management District 1995:6).

- **Goal 1.0:** Develop a comprehensive regional bikeway system as a viable alternative to the automobile for all trip purposes.
  - **Objective:** Improve on-street and off-street bicycling conditions through the construction and maintenance of bikeway facilities.
    - **Policy 1.2** Encourage the use of existing natural and manmade corridors such as creeks and railroad right of ways for future bike path alignments.
    - **Policy 1.4** Develop a recreational bikeway system that uses lower volume streets, off-street bike paths, and serves regional historic and natural destinations.

    - **Policy 1.8** Develop a network of off-road mountain bicycling facilities that offer variety of experiences for the bicyclist while minimizing conflicts with hikers and equestrians, and environmental impacts.

- **Goal 2.0:** Maximize the amount of State and Federal funding for bikeway improvements that can be received by Yuba and Sutter Counties.
- **Goal 3.0:** Maximize Multi-Modal Connections to the Bikeway System.
- **Goal 4.0:** Improve bicycle safety conditions in Yuba and Sutter Counties.

City of Yuba City

Yuba City General Plan

Yuba City has a policy of achieving and maintaining a standard of 10 acres of park land per 1,000 population (City of Yuba City 2004:6-1). The City of Yuba City General Plan establishes several policies affecting recreation including bicycle and park facilities.

- **Policy 5.4-I-1** Establish a network of on- and off-roadway bicycle routes and encourage their use for commute, recreational, and other trips. Design bike routes with the safety of cyclists as a priority.
- **Policy 5.4-I-2** Develop bicycle routes that provide access to schools, parks, and the Feather River Parkway.
- **Policy 6.1-I-1** Establish and maintain a standard of 10 acres of public parks per 1,000 residents. Specific standards are as follows: 1 acre of Neighborhood Parks, 1.5 acres of Community Parks, 1.5 acres of City Parks, and 6 acres of Specialized Recreation Area per 1,000 residents.
- **Policy 6.1-I-10** Implement the Feather River Parkway Strategic Plan in a manner consistent with the plans and programs put forth in that document and consistent with policies in the Open Space and Conservation Chapter (Chapter 8). Proposed actions include:
    - Improved pedestrian access to the riverfront;
    - Provide a mix of active- and non-active recreational and open space in those areas delineated in the Feather River Parkway Strategic Plan; and
    - Ensure that the open spaces proposed in the Feather River Parkway Strategic Plan be designed in a manner flexible enough to accommodate a variety of activities.

Feather River Parkway Strategic Plan

The Feather River Parkway Strategic Plan is master plan for the space between the western Feather River Levee and the Feather River within Yuba City. The plan calls for an extensive network of bicycle and pedestrian trails, wildlife habitat preserves, campgrounds, water focused recreation facilities, civic and urban plaza elements, beach recreation, and equestrian facilities. The plan divides the space into five distinct sub-areas each with a unique program and master plan (City of Yuba City 2002:III-9).

City of Live Oak

City of Live Oak 2030 General Plan

The City of Live Oak 2010 General Plan establishes a policy of achieving and maintaining a standard of 7 acres of park land per 1,000 population (City of Live Oak 2010). The City of Live Oak 2030 General Plan establishes several goals and policies affecting recreation including bicycle and park facilities (City of Live Oak 2010).

- **Goal CIRC-1:** Develop a highly connected circulation system.
- **Goal CIRC-2:** Improve the convenience and safety for multi-modal travel in existing development.
- **Goal CIRC-3:** Ensure safe and convenient daily travel for pedestrians, bicyclists, transit users, and drivers as Live Oak grows.
- **Goal PARKS-1:** Provide a variety of park land in the existing developed City to meet park standards.
- **Goal PARKS-2:** Ensure that accessible, high-quality park land is planned and developed as the City grows.
- **Goal PARKS-3:** Provide recreation facilities and programs to accommodate the needs of existing and future residents.
- **Goal PARKS-4:** Become a countywide or regional center for recreation.
    - **Policy PARKS-4.1** The City will proactively coordinate with Sutter County and Yuba City to identify regional park and recreation needs, such as regional parks or trails, which could be planned, jointly funded, and developed in Live Oak.
    - **Policy PARKS-4.2** The City will coordinate with the other cities and the county to plan for improvements at Live Oak Park and Recreation Area to support and complement future trails along the Feather River.
    - **Policy PARKS-4.3** The City will coordinate with the California Department of Parks and Recreation on funding opportunities to support local recreational goals and plan for improvements in Live Oak that would complement any future nearby state parks and recreational lands.

A.3.12 Public Health and Environmental Hazards

A.3.12.1 Butte County

Butte County General Plan

The Health and Safety Element in the *Butte County General Plan* outlines goals, policies, and implementation policies that address natural to human-made hazards.

- **Goal HS-14:** Reduce risks from the harmful effects of hazardous materials.
    - **Policy HS-P14.1** The County supports the hazardous materials Emergency Response Plan (Area Plan).

- **Policy HS-P14.2** Hazardous materials carrier routes shall be designated to direct hazardous materials transport away from populated areas.
- **Policy HS-P14.5** Environmental assessment and/or investigation shall be required prior to General Plan Amendment or Rezone approval that would allow uses with sensitive receptors, such as residential developments, schools, or care facilities, on sites previously used for commercial, industrial, agricultural or mining uses to determine whether soils, groundwater and existing structures are contaminated and require remediation. Policies and oversight authority shall follow Health and Safety Code Division 20, Chapters 6.5 and 6.8 when determining jurisdiction.

- **Goal HS-15:** Ensure that Butte County is prepared for emergency situations.
  - **Policy HS-P15.1** The County shall conduct continuous advance planning to anticipate potential threats and improve emergency response effectiveness.
  - **Policy HS-P15.2** Critical emergency response facilities such as fire, police, emergency service facilities and utilities shall be sited to minimize their exposure to flooding, seismic effects, fire, or explosion.
  - **Policy HS-P15.3** Emergency access routes shall be kept free of traffic impediments.
  - **Policy HS-P15.4** Streets and developed properties shall be clearly marked to enable easy identification.
    - **Action HS-A15.1** Seek funding to develop community awareness and education programs for citizens that describe procedures and evacuation routes to be followed in the event of a disaster.

City of Biggs

City of Biggs General Plan

The Public Health and Safety Element of the City of Biggs General Plan establishes goals and policies that address public health and safety, and hazardous materials. These goals and policies address the city's approach to minimizing these hazards and maintaining a safe environment for residents.

- **Goal 6.1:** To ensure that the City and involved local agencies are able to effectively respond to emergency situations which may threaten the people or property of the Biggs community.
  - **Policy 6.1.A**: The City shall continue to participate in emergency preparedness planning with Butte County.
- **Goal 6.3:** Protect people and property within the City of Biggs against fire related loss and damage.
  - **Policy 6.3.A:** At a minimum, maintain current levels of service for fire protection by continuing to require development to provide and/or fund fire protection facilities, personnel, and operations and maintenance.
- **Goal 6.6:** Minimize the risk of personal injury, property damage, and environmental degradation resulting from the use, transport, disposal, and release/discharge of hazardous materials.

City of Gridley

City of Gridley General Plan

The Safety Element of the *City of Gridley General Plan* outlines key safety issues facing Gridley, public health and hazardous materials. Goals and policies in this element describe the city's approach to minimizing these hazards and maintaining a safe environment for residents.

- **Safety Goal 3:** To protect people and resources from hazards posed by hazardous materials, including their extraction, manufacture, storage, use, disposal, and transport.
  - **Safety Policy 3.1**: The City will require that hazardous materials are used, stored, transported, and disposed in a safe manner and in compliance with local, State, and federal safety standards.
  - **Safety Policy 3.7**: The City will review development requests and require that any airborne, waterborne, windborne, and other hazardous materials uses are fully disclosed, analyzed, and mitigated to ensure against any risk relative to any nearby planned or existing land uses and their users.
- **Safety Goal 4:** To reduce risks to people and structures from fires.
  - **Safety Policy 4.1** The City will require setbacks, ignition resistant building materials, or other measures to reduce exposure to potential wildfires in areas designated for natural open space preservation, based on California Department of Forestry and Fire Protection recommendations and Maintenance of Defensible Space Measures, as appropriate.
- **Safety Goal 5:** To minimize the loss of life and damage to property from natural and human-caused hazards by ensuring adequate emergency routes and response.
  - **Safety Policy 5.1** New developments and City investments shall be consistent with the information provided in the Butte County Multi-Jurisdictional All Hazard Pre-Disaster Mitigation Plan.
  - **Safety Policy 5.2** The City will ensure the adequacy of disaster response and coordination with Butte County and the ability of individuals to survive disasters.
  - **Safety Policy 5.4** The City will identify and maintain, in consultation with the Butte County Office of Emergency Services, evacuation routes and operational plans for relevant local hazards.
  - **Safety Policy 5.6** The City will require development and maintenance of a road system that provides adequate access for emergency equipment.

A.3.12.2 Sutter County

Sutter County General Plan

The Hazards and Hazardous Materials Element and Public Services Element of the *Sutter County General Plan* contains goals, policies, and actions aimed at reducing the risk associated with natural and human-made hazards within the county.

- **Goal PHS 3:** Protect health, safety, property, and the environment from the use, transport, disposal, and release/discharge of hazardous materials and waste.

- **Goal PHS 4:** Respond appropriately, effectively, and efficiently to natural and human-made emergencies and disasters.
  - **Policy PHS 4.1 Emergency Operation Plans.** Continue to implement and regularly update countywide emergency operation plans to reduce or eliminate long-term risk to life and property from natural or human-made emergencies and disasters.
  - **Policy PHS 4.2 Evacuation Routes.** Regularly review established evacuation routes to ensure emergency access to and from all parts of the County.
  - **Policy PHS 4.3 Post-Disaster Response.** Plan for the continued function of essential facilities following a major disaster to facilitate post-disaster response.
  - **Policy PHS 4.4 Emergency Access.** Require minimum road and driveway widths and clearances around structures consistent with established requirements in order to ensure emergency access.
  - **Policy PHS 4.5 Emergency and Disaster Preparedness Training.** Coordinate with local and regional agencies to regularly conduct emergency and disaster preparedness training to test operational and emergency plans.
  - **Policy PHS 4.7 Coordination.** Continue to be responsible for planning, preparedness, emergency response, and recovery activities associated with natural and human-made disasters. Provide communication and coordination between local and federal agencies, medical facilities, schools, local radio stations, and special needs service providers.
  - **Policy PHS 4.8 Mutual Aid Agreements.** Continue to participate in mutual aid agreements to ensure adequate resources, facilities, and other support services necessary for emergency response.

City of Yuba City

Yuba City General Plan

The Noise and Safety Element of the *Yuba City General Plan* provides information for the protection of the community from unreasonable risks associated with the effects of hazardous material accidents.

- **Guiding Policy 9.4-G-2** Minimize the risk of personal injury, property damage, and environmental damage from fire, hazardous chemicals releases, natural and human made disasters.
- **Implementing Policy 9.4-I-2** Prepare and disseminate information, including a page on the City's website, about emergency preparedness.
- **Guiding Policy 9.5-G-1** Minimize the risk of property damage and personal injury resulting from the production, use, storage, disposal, or transportation of hazardous materials.
- **Implementing Policy 9.5-I-1** Promote the reduction, recycling, and safe disposal of household hazardous wastes through public education and awareness. Expand collection programs in conjunction with new growth in the city.
- **Implementing Policy 9.5-I-2** Continue to pursue funding to conduct pre-plan visits to hazardous materials sites within the city, as well as major roadway and rail corridors used for hazardous materials transport.

- **Implementing Policy 9.5-I-3** Require the clean-up of sites contaminated with hazardous substances.
- **Implementing Policy 9.5-I-4** Implement policies contained in the Sutter County Hazardous Waste Management Plan that encourage and assist the reduction of hazardous waste from businesses and homes.
- **Implementing Policy 9.5-I-6** Specify routes for transporting hazardous materials, taking into account areas of projected new growth.

City of Live Oak

City of Live Oak 2030 General Plan

The Public Safety Element of the *City of Live Oak 2030 General Plan* contains goals, policies, and implementation measures related to public safety in the city of Live Oak. This element directs the city to evaluate potential hazards, develop policies and procedures to avoid hazards, and create adequate emergency responses.

- **Goal PS-3.** Provide for adequate emergency response.
  - **Policy PS-3.1** The City shall maintain and update the City's emergency response plan, as needed, and ensure ongoing consistency with the General Plan.
  - **Policy PS-3.2** The City will add a section to the emergency response plan on railroad safety to address potential releases related to accidents or spills of hazardous substances, such as gasoline, diesel, or transported hazardous materials/hazardous wastes.
  - **Policy PS-3.3** The City will maintain mutual aid agreements with other agencies in Sutter County.
  - **Safety Implementation Strategy 3.1:** The City will maintain and update a list of hazardous sites, buildings, and uses in the Sphere of Influence or use databases that track the location of hazardous materials sites, buildings, and similar features. The City will use updated lists to evaluate and condition development, as necessary, to protect environmental and public health.
- **Goal PS-4.** Protect the community from the harmful effects of hazardous materials.
  - **Policy PS-4.1:** The City, through its discretionary review authority, will assess potential risks associated with hazardous materials used, stored, transported, and disposed, and ensure they are handled in a safe manner and in compliance with local, state, and federal safety standards.
  - **Policy PS-4.2** The City will require that dumpsites for hazardous materials are cleaned in conformance with applicable federal and state laws before new uses are established.
  - **Policy PS-4.3** The City will coordinate with appropriate federal, state, and regional agencies to address local sources of groundwater and soil contamination, including underground storage tanks, septic tanks, agriculture, and industrial uses.
  - **Policy PS-4.4** New development adjacent to areas of ongoing agricultural development outside the City's Sphere of Influence shall provide agricultural buffers that are adequate to protect future residents from harmful effects of agricultural chemical use (see Conservation and Open Space Element).

- **Policy PS-4.5** The City will support efforts to identify and remediate soils and groundwater contaminated with toxic materials, and to identify and eliminate sources contributing to such contamination.

A.3.13 Cultural Resources

A.3.13.1 Butte County

Butte County General Plan

The Butte County General Plan 2030 (Butte County 2010:253) contains a number of policies governing cultural resources. The following goals and policies of the Conservation and Open Space Element are relevant to review of the FRWLP.

- **Goal COS-14:** Preserve important cultural resources.
  - **Policy COS-P14.2** As part of CEQA and NEPA projects, evaluations of surface and subsurface cultural resources in the county shall be conducted. Such evaluations should involve consultation with the Northeast Information Center.
- **Goal COS-15:** Ensure that new development does not adversely impact cultural resources.
  - **Policy COS-P15.1** Areas found during construction to contain significant historic or prehistoric archaeological artifacts shall be examined by a qualified consulting archaeologist or historian for appropriate protection and preservation. Historic or prehistoric artifacts found during construction shall be examined by a qualified consulting archaeologist or historian to determine their significance and develop appropriate protection and preservation measures.
  - **Policy COS-P15.2** Any archaeological or paleontological resources on a development project site shall be either preserved in their sites or adequately documented as a condition of removal. When a development project has sufficient flexibility, avoidance and preservation of the resource shall be the primary mitigation measure.
- **Goal COS-16** Respect Native American culture and planning concerns.
  - **Policy COS-P16.2** Impacts to the traditional Native American landscape shall be considered during California Environmental Quality Act or National Environmental Protection Act review of development proposals.
  - **Policy COS-P16.3** Human remains discovered during implementation of public and private development projects shall be treated with dignity and respect. Such treatment shall fully comply with the federal Native American Graves Protection and Repatriation Act and other appropriate laws.
  - **Policy COS-P16.4** If human remains are located during any ground disturbing activity, work shall stop until the County Coroner has been contacted, and, if the human remains are determined to be of Native American origin, the NAHC and most likely descendant have been consulted.

A.3.13.2 Sutter County

Sutter County General Plan

The Sutter County General Plan (Sutter County 2011:9-16, 9-17) identifies the following policies.

- **Policy ER-8A:** For projects subject to discretionary approval involving the demolition, relocation, or alteration of a building or structure over 45 years old or that would result in a change to the building or structure's immediate setting, the County shall require an assessment by a professional historic resource consultant to determine if the action would cause a substantial adverse change in the significance of an historical resource pursuant to CEQA Guidelines Section 15064.5.
- **Policy ER-8b:** If the historical resource assessment determines that the proposed action would cause a substantial adverse change in the significance of an historical resource, the County shall require as a condition of project approval the implementation of appropriate and feasible measures to reduce the potential impact, including the appropriate level of written and photographic documentation of significant historical resources that would be demolished.
- **Policy ER 8-C:** For projects subject to discretionary approval, which involve grading, excavation, or construction, require the applicant to hire a professional that meets the Secretary of Interior's professional qualifications standards for archaeology to conduct an archaeological resource investigation. As determined necessary by the archaeologist and the County, updated records search, pre-construction field surveys, research, and testing, and/or other methods that identify whether a substantial adverse impact on significant archaeological resource would occur. If cultural resources are discovered, the resource shall be examined by a qualified archaeologist to determine its significance and develop appropriate protection and preservation measures.
- **Policy ER 8-D:** Require that when any subsurface cultural resources, paleontological resources, or human remains are encountered, all work within 100 feet of the discovery be stopped and the area protected from further disturbance until the discovery is evaluated. The appropriate County personnel shall be notified immediately. The resources shall be examined by qualified personnel to determine their significance and develop appropriate protection and preservation measures. If human remains are discovered, they shall be treated in compliance with applicable state and Federal laws, including notifying the County Coroner and consulting with the California Native American Heritage Commission, as appropriate.

City of Yuba City

Yuba City General Plan

Yuba City's adopted general plan (Yuba City 2004:8-8) provides the following guiding and implementing policies related to cultural resources.

- **Guiding Policy: 8.3-G-1** Identify and preserve the archaeological, paleontological, and historic resources that are found within the Yuba City Planning Area.
- **Implementing Policy 8.3-I-1** Encourage the preservation of historic sites, buildings, and structures.

- **Implementing Policy 8.3-I-3** Promote the registration of historic sites, buildings, and structures in the National Register of Historic Places, and inclusion in the California Inventory of Historic Resources.
- **Implementing Policy 8.3-I-4** Consult with the local Native American community in the cases where new development may result in disturbance to Native American sites.
- **Implementing Policy 8.3-I-5** Require that new development analyze and avoid any potential impacts to archaeological, paleontological, and historic resources by:
  - Requiring a records review for development proposed in areas that are considered archaeologically sensitive;
  - Studying the potential effects of development and construction (as required by CEQA);
  - Requiring pre-construction surveys and monitoring during any ground disturbance for all development in areas of historical and archaeological sensitivity; and
  - Implementing appropriate measures to avoid the identified impacts.
- **Implementing Policy 8.3-I-6** In accordance with CEQA and the State Public Resources Code, require the preparation of a resource mitigation plan and monitoring program by a qualified archaeologist in the event that archaeological resources are discovered.

A.4 References

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Appendix B
Scoping Report

This appendix contains the scoping report that was prepared for and delivered to the U.S. Army Corps of Engineers and Sutter Butte Area Flood Control Agency on July 29, 2011, that documented the preparation and outcomes of the joint environmental scoping process for both the Sutter Basin Project and the Feather River West Levee Project held in June 2011.

Memorandum

Date:	July 29, 2011
To:	Matt Davis, U.S. Army Corps of Engineers
Cc:	Chris Elliott, ICF International, Jennifer Rogers, ICF International
From:	Ingrid Norgaard, ICF International
Subject:	**Public Scoping Meeting Summary for the Sutter Basin Project and Feather River West Levee Project Environmental Scoping Meetings—June 27 and 28, 2011**

Introduction

Two efforts are presently underway to study flood risk reduction improvements in Sutter and Butte Counties, one known as the Sutter Basin Feasibility Study, sponsored by the U.S. Army Corps of Engineers (USACE) to determine federal interest in flood risk reduction project(s), and one known as the Feather River West Levee Project (FRWLP), sponsored by the Sutter Butte Flood Control Agency (SBFCA) as a locally driven flood risk reduction project.

The two projects are being studied in close coordination because they at least partially overlap in their study areas, purpose, potential improvements, potential effects, and involved parties. Therefore, a joint scoping process is being conducted for the two projects to explain the relationship between the two efforts and obtain public input in a manner that is convenient, efficient, and integrated. It is anticipated that the two planning efforts will result in a separate Environmental Impact Study/Environmental Impact Report (EIS/EIR) for each project, in accordance with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA).

Sutter Basin Feasibility Study

USACE initiated the Sutter Basin project in 2001 and is conducting a feasibility study to evaluate flood damage reduction, ecosystem restoration, and recreation opportunities within the study area. The Central Valley Flood Protection Board (CVFPB) and SBFCA, in their roles as non-federal local sponsors, are coordinating with USACE on the feasibility study. USACE, acting as the federal lead agency under NEPA, and SBFCA, acting as the state lead agency under CEQA, have determined that an EIS/EIR will be prepared to describe alternatives, potential environmental effects, and mitigation measures.

FRWLP

SBFCA is planning the FRWLP to address levee deficiencies in the west levee of the Feather River from Thermalito Afterbay to the Sutter Bypass confluence to meet federal, state, and local flood protection criteria and goals. In 2010, an assessment district was enacted to provide local funding toward flood management improvements. These funds will be matched with those from the Disaster Preparedness and Flood Prevention Bond Act of 2006 (Proposition 1E) administered by the California Department of Water Resources (DWR). The purpose of the FRWLP would be to construct improvements as quickly as possible in advance of and compatible with the Sutter Basin Feasibility Study. USACE, acting as the federal lead agency under NEPA, and SBFCA, acting as the state lead agency under the CEQA, have determined that an EIS/EIR will be prepared to describe alternatives, potential environmental effects, and mitigation measures.

Development of the draft EIS/EIR to evaluate the FRWLP is underway and scheduled for public release in early 2012. A public release date for the Sutter Basin Project draft EIS/EIR has yet to be determined.

SBFCA and USACE have been carrying out scoping activities to assist them in determining the scope, and content of the environmental information for these two projects. SBFCA and USACE have had ongoing inter-agency consultation with responsible and interested agencies such as the Central Valley Flood Protection Board, Department of Fish and Game, Department of Water Resources (DWR), and California Regional Water Quality Control Board to name a few. In addition, SBFCA and USACE conducted a total of four public scoping meetings for the public and for federal and state agency staff on June 27th and June 28th, 2011. The following summarizes the outreach conducted to inform responsible and interested agencies and the public of the proposed projects, the scoping meetings, and the public comment received.

Noticing

Notice of Intent/Preparation

In compliance with the requirements set forth in CEQA, SBFCA and USACE prepared a Notice of Preparation (NOP). The NOP contained a brief description of the proposed project, project date, probable environmental effects, the date, time and place of the public scoping meetings, and contact information. The NOP solicited participation in determining the scopes and content of the environmental information of the EIS/EIRs. On May 20, 2011 the NOP was sent to Responsible and Trustee Agencies and involved federal agencies, to the State Clearinghouse, and parties previously requesting notice in writing. The comment period on the NOP was May 20, 2011 to July 08, 2011.

In compliance with the requirements set forth in NEPA, USACE prepared a Notice of Intent (NOI) describing its intent to prepare an EIS/EIR, the proposed action, the possible alternatives, and relevant scoping meeting and contact information. The NOI was posted in the Federal Register, the United States Government's official noticing and reporting publication, on May 20, 2011. The official comment period for the NOI was May 20, 2011 to July 08, 2011.

Mailings

SBFCA utilized a previously developed mailing list of interested stakeholders to send an email notification encouraging attendance at the scoping meetings.

Notifications

Advertisements briefly introducing the lead agencies, the proposed projects and associated environmental review processes, and publicizing the scoping meetings were placed in the Appeal Democrat and the Gridley Herald newspapers. Both newspapers are intended to reach a local and regional public audience that residents routinely rely upon to keep them abreast of Sutter and Butte county issues. The advertisements were published in the Appeal Democrat on June 20 and June 27, 2011. The advertisements were published in the Gridley Herald on June 22 and June 24, 2011. A media release was also emailed out to a number media contacts within the region on June 22, 2011.

Attachment A contains copies of the following:

- Notice of Preparation
- Notice of Intent
- Email Notification
- Appeal Democrat and Gridley Herald Ledger Advertisements
- Media Release

Public Meetings

Four public scoping meetings were held to inform the public of the proposed projects and seek feedback on the range of alternatives, environmental effects, and issues of concern related to the Sutter Basin Project and the FRWLP. The four meetings were held at two different times for two days. On June 27, 2011 the meeting times were from 3:30 to 5:30 p.m. and 6:30 to 8:30 p.m., at the Yuba City Veterans Memorial Community Center. On June 28, 2011 the meeting times were from 3:30 to 5:30 p.m. and 6:30 to 8:30 p.m., at the Gridley Veterans Memorial Hall. The meeting locations were chosen as they are central to the region. The meeting times were chosen to accommodate both the work day schedules of public agency representatives and the general public, including residents and business owners.

The meetings were open-house style workshops in which attendees could read and view the information about the two projects and interact with project staff including SBFCA, USACE, DWR, HDR Engineering consultant staff, and ICF International (ICF) environmental consulting staff.

Twenty-six graphic display boards were on display for attendees to review. The boards described and illustrated the Sutter Basin Project and FRWLP history, purpose, need and objectives, study area, levee deficiencies and potential improvements, environmental considerations, the CEQA/NEPA process and project timeline and were on display for attendees to review. SBFCA, USACE, HDR and

ICF staff were stationed at display boards to interact with public attendees and provide additional detail or answer any questions.

A Power Point presentation was given to provide a brief introduction to the Sutter Basin Project and the FRWLP including objectives, schedule, environmental compliance, and related flood control work in the region.

A fact sheet, providing an overview of the Sutter Basin Project and the FRWLP including purpose and goals, maps of the corresponding study areas, an overview of the environmental compliance process and timeline, was also made available.

Comment cards were prepared so that meeting attendees could provide feedback on the projects. These cards could be filled out during the meeting and given to a project team member.

Attachment B contains copies of the following:

- Display boards
- Power Point presentation
- Fact sheet
- Comment card templates

Public Feedback

There were 36 people in total who attended the two meetings. Twelve people attended the meeting from 3:30 to 5:00 p.m. and four people attended the meeting from 6:30 to 8:00 p.m. on June 27, 2011. Fifteen people attended the meeting from 3:30 to 5:00 p.m. and five people attended the meeting from 6:30 to 8:00 p.m. on June 28, 2011.

Five comments were received from the public regarding the EIS/EIRs during the scoping period. Below is a list summarizing the comments received.

- A request was made to keep the process for the Sutter Basin Feasibility Study on schedule so the state will be able to release EIP funding for the FRWLP.
- A comment was received regarding the importance of coordinating with the Lower Feather River Corridor Management Project so not to have to duplicate efforts on environmental studies.
- A comment was received in favor of the option of putting in a levee setback in the Nelson Slough area.
- A comment was received in opposition of the project.
- A comment addressed two issues. The first comment pertains to the lack of attention to the east levee of the Sutter Bypass. The second comment suggested using a perimeter levee around Yuba City, or a J levee on the south and west side.

Attachment C contains copies of the following:

- Comments received from all interested parties (including those transcribed by court reporter)
- Attendee sign-in sheet templates

Next Steps

The comments received during the scoping period will assist in determining which issues are evaluated in detail in both the Sutter Basin Project and FRWLP EIS/EIRs. Once alternatives have been developed based on the scoping process and preexisting information, they will be analyzed, and draft EIS/EIRs will be developed. Upon the release of the draft EIR/EIS, the public will have 45 days to comment on the document. Additionally, at least one public hearing will be held so the public and agencies can learn more about both of the draft EIR/EISs, ask questions regarding the analysis, and provide comments. At these meetings, the alternatives will be presented and explained.

Development of the draft EIS/EIR to evaluate the FRWLP is underway and scheduled for public release in early 2012. A public release date for the Sutter Basin Project draft EIS/EIR has yet to be determined.

Attachment A

- Notice of Preparation
- Notice of Intent
- Email Notification
- Appeal Democrat and Gridley Herald Ledger Advertisements
- Media Release

STATE OF CALIFORNIA

GOVERNOR'S OFFICE *of* PLANNING AND RESEARCH

STATE CLEARINGHOUSE AND PLANNING UNIT

JERRY BROWN
GOVERNOR

Notice of Preparation

May 20, 2011

To: Reviewing Agencies

Re: Sutter Basin Feasibility Study and Feather River West Levee Project
SCH# 2011052062

Attached for your review and comment is the Notice of Preparation (NOP) for the Sutter Basin Feasibility Study and Feather River West Levee Project draft Environmental Impact Report (EIR).

Responsible agencies must transmit their comments on the scope and content of the NOP, focusing on specific information related to their own statutory responsibility, within 30 days of receipt of the NOP from the Lead Agency. This is a courtesy notice provided by the State Clearinghouse with a reminder for you to comment in a timely manner. We encourage other agencies to also respond to this notice and express their concerns early in the environmental review process.

Please direct your comments to:

Ingrid Norgaard
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

with a copy to the State Clearinghouse in the Office of Planning and Research. Please refer to the SCH number noted above in all correspondence concerning this project.

If you have any questions about the environmental document review process, please call the State Clearinghouse at (916) 445-0613.

Sincerely,

Scott Morgan
Director, State Clearinghouse

Attachments
cc: Lead Agency

Document Details Report
State Clearinghouse Data Base

SCH# 2011052062
Project Title Sutter Basin Feasibility Study and Feather River West Levee Project
Lead Agency Sutter Butte Flood Control Agency

Type NOP Notice of Preparation

Description Two efforts are presently underway to study flood risk reduction improvements in Sutter and Butte Counties, one known as the Sutter Basin Feasibility Study, sponsored by the U.S. Army Corps of Engineers (USACE) to determine federal interest in flood risk reduction project(s), and one known as the Feather River West Levee Project (FRWLP), sponsored by the Sutter Butte Flood Control Agency (SBFCA) as a locally driven flood risk reduction project.

Lead Agency Contact

Name Ingrid Norgaard
Agency Sutter Butte Flood Control Agency
Phone 916 737-3000 **Fax**
email inorgaard@icfi.com
Address c/o ICF International
630 K Street, Suite 400
City Sacramento **State** CA **Zip** 95814

Project Location

County Sutter, Butte
City
Region
Cross Streets
Lat / Long
Parcel No.
Township **Range** **Section** **Base**

Proximity to:

Highways
Airports
Railways
Waterways
Schools
Land Use

Project Issues Aesthetic/Visual; Agricultural Land; Air Quality; Biological Resources; Archaeologic-Historic; Geologic/Seismic; Toxic/Hazardous; Water Quality; Landuse; Other Issues; Minerals; Noise; Population/Housing Balance; Public Services; Recreation/Parks; Economics/Jobs; Traffic/Circulation

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Reviewing Agencies Resources Agency; Department of Conservation; Central Valley Flood Protection Board; Office of Historic Preservation; Department of Parks and Recreation; Department of Water Resources; Department of Fish and Game, Region 2; Office of Emergency Management Agency, California; Native American Heritage Commission; State Lands Commission; Caltrans, District 3; State Water Resources Control Board, Division of Water Quality; Regional Water Quality Control Bd., Region 5 (Sacramento); Regional Water Quality Control Bd., Region 5 (Redding)

Date Received 05/20/2011 **Start of Review** 05/20/2011 **End of Review** 06/20/2011

ources Agency

Resources Agency
Nadell Gayou

Dept. of Boating & Waterways
Mike Sotelo

California Coastal Commission
Elizabeth A. Fuchs

Colorado River Board
Gerald R. Zimmerman

Dept. of Conservation
Rebecca Salazar

California Energy Commission
Eric Knight

Cal Fire
Allen Robertson

Central Valley Flood Protection Board
James Herota

Office of Historic Preservation
Ron Parsons

Dept of Parks & Recreation
Environmental Stewardship Section

California Department of Resources, Recycling & Recovery
Sue O'Leary

S.F. Bay Conservation & Dev't. Comm.
Steve McAdam

Dept. of Water Resources
Resources Agency
Nadell Gayou

Conservancy

and Game

Depart. of Fish & Game
Scott Flint
Environmental Services Division

Fish & Game Region 1
Donald Koch

- ☐ **Fish & Game Region 1E**
  Laurie Harnsberger
- ☐ **Fish & Game Region 2**
  Jeff Drongesen
- ☐ **Fish & Game Region 3**
  Charles Armor
- ☐ **Fish & Game Region 4**
  Julie Vance
- ☐ **Fish & Game Region 5**
  Don Chadwick
  Habitat Conservation Program
- ☐ **Fish & Game Region 6**
  Gabrina Gatchel
  Habitat Conservation Program
- ☐ **Fish & Game Region 6 I/M**
  Brad Henderson
  Inyo/Mono, Habitat Conservation Program
- ☐ **Dept. of Fish & Game M**
  George Isaac
  Marine Region

Other Departments

- ☐ **Food & Agriculture**
  Steve Shaffer
  Dept. of Food and Agriculture
- ☐ **Depart. of General Services**
  Public School Construction
- ☐ **Dept. of General Services**
  Anna Garbeff
  Environmental Services Section
- ☐ **Dept. of Public Health**
  Bridgette Binning
  Dept. of Health/Drinking Water

Independent Commissions,Boards

- ☐ **Delta Protection Commission**
  Linda Flack
- ☐ **Cal EMA (Emergency Management Agency)**
  Dennis Castrillo
- ☐ **Governor's Office of Planning & Research**
  State Clearinghouse

- ☐ **Native American Heritage Comm.**
  Debbie Treadway
- ☐ **Public Utilities Commission**
  Leo Wong
- ☐ **Santa Monica Bay Restoration**
  Guangyu Wang
- ☐ **State Lands Commission**
  Marina Brand
- ☐ **Tahoe Regional Planning Agency (TRPA)**
  Cherry Jacques

Business, Trans & Housing

- ☐ **Caltrans - Division of Aeronautics**
  Philip Crimmins
- ☐ **Caltrans - Planning**
  Terri Pencovic
- ☐ **California Highway Patrol**
  Scott Loetscher
  Office of Special Projects
- ☐ **Housing & Community Development**
  CEQA Coordinator
  Housing Policy Division

Dept. of Transportation

- ☐ **Caltrans, District 1**
  Rex Jackman
- ☐ **Caltrans, District 2**
  Marcelino Gonzalez
- ☐ **Caltrans, District 3**
  Bruce de Terra
- ☐ **Caltrans, District 4**
  Lisa Carboni
- ☐ **Caltrans, District 5**
  David Murray
- ☐ **Caltrans, District 6**
  Michael Navarro
- ☐ **Caltrans, District 7**
  Elmer Alvarez
- ☐ **Caltrans, District 8**
  Dan Kopulsky
- ☐ **Caltrans, District 9**
  Gayle Rosander
- ☐ **Caltrans, District 10**
  Tom Dumas
- ☐ **Caltrans, District 11**
  Jacob Armstrong
- ☐ **Caltrans, District 12**
  Chris Herre

Cal EPA

Air Resources Board

- ☐ Airport Projects
  Jim Lerner
  - ☐ Transportation Projects
    Douglas Ito
  - ☐ Industrial Projects
    Mike Tollstrup
- ☐ **State Water Resources Control Board**
  Regional Programs Unit
  Division of Financial Assistance
- ☐ **State Water Resources Control Board**
  Student Intern, 401 Water Quality Certification Unit
  Division of Water Quality
- ☐ **State Water Resouces Control Board**
  Steven Herrera
  Division of Water Rights
- ☐ **Dept. of Toxic Substances Control**
  CEQA Tracking Center
- ☐ **Department of Pesticide Regulation**
  CEQA Coordinator

Regional Water Quality Control Board (RWQCB)

- ☐ **RWQCB 1**
  Cathleen Hudson
  North Coast Region (1)
- ☐ **RWQCB 2**
  Environmental Document Coordinator
  San Francisco Bay Region (2)
- ☐ **RWQCB 3**
  Central Coast Region (3)
- ☐ **RWQCB 4**
  Teresa Rodgers
  Los Angeles Region (4)
- ☐ **RWQCB 5S**
  Central Valley Region (5)
  - ☐ **RWQCB 5F**
    Central Valley Region (5)
    Fresno Branch Office
  - ☐ **RWQCB 5R**
    Central Valley Region (5)
    Redding Branch Office
- ☐ **RWQCB 6**
  Lahontan Region (6)
  - ☐ **RWQCB 6V**
    Lahontan Region (6)
    Victorville Branch Office
- ☐ **RWQCB 7**
  Colorado River Basin Region (7)
- ☐ **RWQCB 8**
  Santa Ana Region (8)
- ☐ **RWQCB 9**
  San Diego Region (9)

☐ **Other** _____

Last Updated on 01/10/11

POLICY JUSTIFICATION

Kingdom of Saudi Arabia – Night Vision Equipment

The Government of the Kingdom of Saudi Arabia has requested a possible sale of 200 High-performance In-Line Sniper Sight (HISS) Thermal Weapon Sights - 1500 meter, 200 MilCAM Recon III LocatIR Long Range, Light Weight Thermal Binoculars with Geo Location, 7,000 Dual Beam Aiming Lasers (DBAL A2), 6000 AN/PVS-21 Low Profile Night Vision Goggles (LPNVG), spare and repair parts, support equipment, technical documentation and publications, translation services, training, U. S. government and contractor technical and logistics support services, and other related elements of logistical and program support. The estimated cost is $330 million.

This proposed sale will contribute to the foreign policy and national security of the United States by helping to improve the security of a friendly country which has been, and continues to be, an important force for political stability and economic progress in the Middle East.

The proposed sale will augment Saudi Arabia's capability to meet current and future threats from potential adversaries during operations conducted at night and during low visibility conditions. The Royal Saudi Land Forces (RSLF) are responsible for regional, perimeter, and border security operations. This proposed sale meets their defense and counter-terrorism requirements to deter current insurgent activity along their southern border and contributes to their overall military posture. The RSLF already has night vision devices in its inventory and will have no difficulty absorbing this night vision equipment into its inventory.

The proposed sale of this equipment will not alter the basic military balance in the region.

The prime contractors will be FLIR Inc. in Boston, Massachusetts and Laser Devices, Inc. in Monterey, California. There are no known offset agreements proposed in connection with this potential sale.

Implementation of this sale will not require the assignment of any U.S. Government or contractor representatives to recipient.

There will be no adverse impact on U.S. defense readiness as a result of this proposed sale.

[FR Doc. 2011–12405 Filed 5–19–11; 8:45 am]
BILLING CODE 5001–06–C

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Notice of Intent To Prepare Draft Environmental Impact Statements/ Environmental Impact Reports for the Sutter Basin Feasibility Study and the Section 408 Permission for the Feather River West Levee Project, Sutter and Butte Counties, CA

AGENCY: Department of the Army, U.S. Army Corps of Engineers; DoD.

ACTION: Notice of intent.

SUMMARY: Pursuant to the National Environmental Policy Act of 1969, as amended, and the California Environmental Quality Act (CEQA), the U.S. Army Corps of Engineers (USACE) intends to prepare a separate Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) for each of the following related flood risk management study efforts in north-central California: a Feasibility Study of flood risk management and related water resources problems in the Sutter Basin conducted by USACE under the authority of the Flood Control Act of 1962 (Pub. L. 87–874); and under Section 14 of the Rivers and Harbors Act

of 1899 (as amended) (33 U.S.C. 408), and Section 404 of the Clean Water Act (33 U.S.C. 1344), the proposed Feather River West Levee Project (FRWLP), sponsored by the Sutter Butte Flood Control Agency (SBFCA) as a locally driven flood management improvement project. The two projects are being studied in close coordination because they partially overlap in their study areas, purpose, potential improvements, potential effects, and involved parties. Therefore, a joint scoping process is being conducted for the two projects to explain the relationship between the two efforts and obtain public input in a manner that is convenient, efficient, and integrated. Figures of the two project areas can be viewed at the SBFCA *Web site at: http://www.sutterbutteflood.org/index.php/notices_documents.*

Sutter Basin Feasibility Study. On March 20, 2000, the State of California entered into a feasibility cost-sharing agreement (FCSA) with USACE to initiate a feasibility study. An amendment to the FCSA was signed in 2010, which included SBFCA as a non-Federal sponsor. The purpose of the study is to address flood risk, ecosystem restoration and recreation-related issues in the study area. If a Federal interest is determined, the study would result in a decision document, a General Investigation Feasibility Study report and EIS/EIR, which would be the basis for a recommendation to Congress for authorization. The Central Valley Flood Protection Board (CVFPB) and SBFCA are coordinating with USACE on the feasibility study. USACE, as the Federal lead agency under NEPA, and SBFCA, as the state lead agency under CEQA in coordination with CVFPB, have determined that an EIS/EIR will be prepared to describe alternatives, potential environmental effects, and mitigation measures.

FRWLP. SBFCA is planning the FRWLP to construct improvements to the west levee of the Feather River from Thermalito Afterbay to the Sutter Bypass confluence to meet Federal, state, and local flood protection criteria and goals. In 2010, an assessment district was enacted to provide local funding toward flood management improvements. These funds may be matched with those from the Early Implementation Program (funded through previous state bonds) administered by the California Department of Water Resources (DWR). In order to implement the project, the sponsor must acquire permission from USACE to alter the Federal project under Section 14 of the Rivers and Harbors Act of 1899 (as amended) (33 U.S.C. 408 or, Section 408). USACE also has authority under Section 404 of the Clean Water Act (33 U.S.C. 1344) over activities involving the discharge of dredged or fill material to waters of the United States, which are known to be in the project area. The purpose of the FRWLP would be to construct improvements as quickly as possible in advance of and compatible with the Sutter Basin Project. USACE, acting as the Federal lead agency under NEPA, and SBFCA, acting as the state lead agency under the CEQA in coordination with CVFPB, have determined that an EIS/EIR will be prepared to describe alternatives, potential environmental effects, and mitigation measures.

DATES: Public scoping meetings will be held on Monday, June 27 at 3:30 p.m. and 6:30 p.m. at the Veterans Memorial Community Building, 1425 Veterans Memorial Circle, Yuba City, CA and on Tuesday, June 28 at 3:30 p.m. and 6:30 p.m. at the Veterans Memorial Hall, 245 Sycamore Street, Gridley, CA. Send written comments by July 8, 2011 (see **ADDRESSES**).

ADDRESSES: Written comments and suggestions concerning the scope and content of the environmental information may be submitted to Mr. Matt Davis, U.S. Army Corps of Engineers, Sacramento District, Attn: Planning Division (CESPK–PD–R), 1325 J Street, Sacramento, CA 95814. Requests to be placed on the mailing list also should be sent to this address.

FOR FURTHER INFORMATION CONTACT: Questions about the proposed actions and environmental review process should be addressed to Matt Davis at (916) 557–6708, *e-mail: Matthew.G.Davis@usace.army.mil* (see **ADDRESSES**).

SUPPLEMENTARY INFORMATION:

1. *Proposed Action. Sutter Basin Feasibility Study.* USACE is conducting a feasibility study to evaluate structural and non-structural flood-risk-management measures, including re-operation of existing reservoirs; improvements to existing levees; construction of new levees; and other storage, conveyance, and non-structural options. The Sutter Basin study area covers approximately 285 square miles and is roughly bounded by the Feather River, Sutter Bypass, Wadsworth Canal, Sutter Buttes, and Cherokee Canal. Flood waters potentially threatening the study area originate from the Feather River watershed and/or the upper Sacramento River watershed, above Colusa Weir. The study area is essentially encircled by project levees and the high ground of Sutter Buttes. Geotechnical analysis and historical performance during past floods indicates the project levees are at risk of failure due to underseepage. The risk of levee failure coupled with the consequence of deep flooding presents a threat to public safety and property. Considering the collective changes to riparian and aquatic ecosystems brought about by agriculture, urbanization, mining, and flood risk management and water supply infrastructure, and the national concern for environmental quality and protection, every opportunity to restore and protect natural resources should be taken whenever changes in the water management system are being contemplated. Ecosystem restoration measures likely would include restoration of floodplain function and habitat. Recreation measures include those outdoor recreation opportunities associated with sustainable water resource development. The feasibility phase of this project is cost-shared 50% Federal, 50% non-Federal with the project sponsors, the State of California CVFPB and the SBFCA. The study will focus on alternatives in the study area that comprise flood risk management, ecosystem restoration, and recreation management measures. As part of the study, an EIS/EIR will be prepared with USACE as the lead agency under NEPA and SBFCA in cooperation with CVFPB as the lead agency under CEQA.

FRWLP. SBFCA is proposing a levee improvement project along the Feather River west levee under the California DWR's Early Implementation Program to expeditiously complete flood-risk reduction measures in advance of the Sutter Basin Feasibility Study. Known as the FRWLP, the project proposes to construct levee improvements between the Thermalito Afterbay and the Feather River/Sutter Bypass confluence. Primary deficiencies of the levee include through-seepage, under-seepage, and embankment instability (*e.g.,* overly steepened slopes). Alternatives considered may include measures such as slurry cutoff walls, seepage berms, stability berms, internal drains, relief wells, sheet-pile walls, slope flattening, and potential new levee alignments. As part of the project, an EIS/EIR is being prepared. USACE has authority under Section 14 of the Rivers and Harbors Act of 1899 (as amended) (33 U.S.C. 408), over alterations to Federal flood control project levees and any such alterations as proposed by SBFCA are subject to approval by USACE. USACE also has authority under Section 404 of the Clean Water Act (33 U.S.C. 1344) over activities involving the discharge of dredged or fill material to waters of the United States, which are known to be in

the project area. Due to these authorities, USACE is acting as the lead agency for the EIS pursuant to NEPA. SBFCA will be acting as the lead agency for the EIR according to CEQA as an agency of the State of California with delegated authority to approve the project.

2. *Alternatives.* The EIS/EIRs will consider several alternatives for reducing flood damage. Alternatives analyzed during the investigation will consist of a combination of one or more measures to reduce the risk of flooding. These measures include installing cutoff walls, and constructing seepage berms.

3. *Scoping Process.*

a. A series of public scoping meetings will be held on June 27 and 28, 2011, to present information to the public and to receive comments from the public on both the feasibility study and the FRWLP. These meetings are intended to initiate the process to involve concerned individuals, and local, state, and Federal agencies.

b. Significant issues to be analyzed in depth in the environmental documents include effects on hydraulics, wetlands and other waters of the U.S., vegetation and wildlife resources, special-status species, aesthetics, cultural resources, recreation, land use, fisheries, water quality, air quality, transportation, and socioeconomics; and cumulative effects of related projects in the study area.

c. USACE is consulting with the State Historic Preservation Officer to comply with the National Historic Preservation Act and with the U.S. Fish and Wildlife Service and National Marine Fisheries Service to comply with the Endangered Species Act. USACE also is coordinating with the U.S. Fish and Wildlife Service to comply with the Fish and Wildlife Coordination Act.

d. A 45-day public review period will be provided for individuals and agencies to review and comment on the draft environmental documents. All interested parties are encouraged to respond to this notice and provide a current address if they wish to be notified of the draft EIS/EIR circulation.

4. *Availability.* The draft EIS/EIR for the FRWLP is scheduled to be available for public review and comment in late 2011. The draft EIS/EIR for the Sutter Basin Feasibility Study is scheduled to be available for public review and comment in mid 2012.

Dated: May 12, 2011.

Andrew B. Kiger,

LTC, EN, Commanding.

[FR Doc. 2011–12510 Filed 5–19–11; 8:45 am]

BILLING CODE 3720–58–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Notice of Availability of the Final Programmatic Environmental Impact Statement for the Mechanical and Artificial Creation and Maintenance of Emergent Sandbar Habitat in the Riverine Segments of the Upper Missouri River, Missouri River Basin, United States

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of Availability.

SUMMARY: In accordance with the National Environmental Policy Act of 1969, as amended, the U.S. Army Corps of Engineers intends to file a Final Programmatic Environmental Impact Statement (FPEIS) for the Mechanical and Artificial Creation and Maintenance of Emergent Sandbar Habitat on the Riverine Segments of the Upper Missouri River with the U.S. Environmental Protection Agency. The FEIS is available for final public review. Details on the proposed action, location and areas of environmental concern addressed in the FPEIS are provided below under **SUPPLEMENTARY INFORMATION.**

DATES: The review period will be open 30 days from the date of this notice. The Record of Decision is anticipated to be issued in August, 2011.

ADDRESSES: Written comments should be sent to: Department of the Army; Corps of Engineers, Omaha District; CENWO–PM–AC; ATTN: Emergent Sandbar Habitat Programmatic EIS; 1616 Capitol Avenue; Omaha, NE 68102–4901, or e-mailed to: *Cynthia.s.upah@usace.army.mil.* Comments must be postmarked, e-mailed, or otherwise submitted no later than June 13, 2011. Copies of the FPEIS have been sent to all agencies and individuals who participated in the scoping process or public hearings and to those requesting copies. The FEIS is available online at: *http://www.moriverrecovery.org/mrrp/MRRP_PUB_DEV.download_documentation_peis.* To obtain a copy, please contact Ms. Cynthia Upah.

FOR FURTHER INFORMATION CONTACT: Ms. Cynthia Upah, Project Manager, by telephone: (402) 995–2672, by mail: 1616 Capitol Avenue, Omaha, NE 68102–4901, or by e-mail: *Cynthia.s.upah@usace.army.mil.* For inquires from the media, please contact the USACE Omaha District Public Affairs Officer (PAO), Ms. Monique Farmer by telephone: (402) 995–2416, by mail: 1616 Capitol Avenue, Omaha, NE 68102, or by e-mail: *Monique.l.farmer@usace.army.mil.*

SUPPLEMENTARY INFORMATION: 1. *Background.* The Emergent Sandbar Habitat (ESH) program is being implemented by the U.S. Army Corps of Engineers (Corps) for the benefit of the interior population of the Interior least tern (least tern) and the northern Great Plains piping plover (piping plover). This implementation program resulted from a Biological Opinion (BiOp) issued by the U.S. Fish and Wildlife Service (USFWS) in which the Reasonable and Prudent Alternative (RPA) called for the Corps to provide sufficient ESH acreage in order to meet biological metrics (fledge ratios) to avoid jeopardizing continued existence of the species, as defined by the Endangered Species Act (ESA).

The FPEIS is needed to provide National Environmental Policy Act (NEPA) coverage for the mechanical and artificial construction of ESH in the riverine segments of the Upper Missouri River, pursuant to the 2003 BiOp Amendment RPA IV(b) 3, and to compare impacts among a range of alternatives. The goal is to inform the selection of a preferred alternative that allows for the creation and replacement of sufficient habitat to support tern and plover populations on the Missouri River in a safe, efficient and cost-effective manner that minimizes negative environmental consequences.

Alternatives to the proposed project that are considered in the FPEIS include (1) no action, including existing program activities and no action; (2) and 6 action alternatives of various acreage creation. Environmental issues addressed in the FPEIS include hydrology, water quality, aggradation and degradation, biological resources, air quality, noise and recreation.

After detailed consideration of the environmental and social impacts, and cumulative effects, of the Alternatives, the Corps has identified an Adaptive Management Implementation Process (AMIP) as the preferred alternative, and not one of the specific acreage alternatives. The key aspect of the AMIP is that, rather than selecting a specific acreage alternative and pursuing such construction, actions would be progressively implemented with the focus on monitoring a combination of biological and physical metrics (measurements). Implementation of progressively larger acreage amounts of habitat would continue until the desired biological response is attained and sustained.

Join Us To Learn More About Local Flood Risk Reduction Efforts

Join the U.S. Army Corps of Engineers (USACE) and the Sutter Butte Flood Control Agency (SBFCA) for a public scoping meeting to learn about two proposed flood risk reduction efforts in Sutter and Butte counties. USACE's Sutter Basin Feasibility Study will look at potential improvements throughout the Sutter Basin, while SBFCA's Feather River West Levee Project is proposing to repair 44 miles of the river's west levee.

The public is encouraged to attend these meetings to comment on the scope of the proposed projects and the preparation of related environmental documents.

Meeting Dates & Times

June 27 at 3:30 p.m. and 6:30 p.m.
Veterans Memorial Community Building
1425 Veterans Memorial Circle, Yuba City

June 28 at 3:30 p.m. and 6:30 p.m.
Gridley Veterans Memorial Hall
249 Sycamore Street, Gridley

A presentation will begin 30 minutes after the start of each meeting. The same information will be presented at each meeting.

If you have questions or need special assistance or accommodations at a meeting, call 916-231-9618 at least 72 hours in advance of the meeting you plan to attend.

US Army Corps of Engineers.
Sacramento District

www.sutterbutteflood.org • www.spk.usace.army.mil

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US Army Corps of Engineers.
Sacramento District

www.sutterbutteflood.org • www.spk.usace.army.mil

FOR IMMEDIATE RELEASE
CONTACT: INGRID NORGAARD
EMAIL: inorgaard@icfi.com
PHONE: 916-737-3000

Agencies Hosting Public Meetings Related to Proposed Flood Improvements in Sutter and Butte Counties

The public is invited to attend to provide input on environmental process

Yuba City, June 22, 2011—The U.S. Army Corps of Engineers' (USACE) Sacramento District and the Sutter Butte Flood Control Agency (SBFCA) will hold four public scoping meetings on June 27 and 28 to provide the public an opportunity to comment on proposed regional flood risk management projects.

The purpose of the USACE's Sutter Basin Project is to address flood risk management, ecosystem restoration, and recreation issues in the Sutter Basin study area. The project is currently in the feasibility study phase. The study area covers approximately 285 square miles and is roughly bounded by the Feather River, Sutter Bypass, Wadsworth Canal, Sutter Buttes and Cherokee Canal.

SBFCA is planning the Feather River West Levee Project (FRWLP) to address levee deficiencies found along 44 miles of the west levee of the Feather River from the Thermalito Afterbay south to the Sutter Bypass. The west levee provides flood risk management benefits to the cities of Yuba City, Gridley, Live Oak, and Biggs and portions of unincorporated areas of Butte and Sutter counties. Measures are being evaluated to meet Federal, state, and local flood protection criteria and goals.

The Sutter Basin Project and FRWLP are being studied in close coordination because of related study areas, purpose, potential measures and potential effects. It is anticipated that two separate environmental impact statements/environmental impact reports (EIS/EIR) will be developed—one for the Sutter Basin Project and one for FRWLP. The public release of the draft EIS/EIR to evaluate FRWLP is scheduled for early 2012. The release of the Sutter Basin Project's draft EIS/EIR has yet to be determined. The California Department of Water Resources and Central Valley Flood Protection Board are also involved in these two efforts.

Combined and coordinated scoping for the two efforts is being conducted to ensure an efficient process for interested stakeholders. Public input will be solicited about the content of the environmental documents. Please join us at one of four scoping meetings to provide input.

City of Yuba City
June 27 at 3:30 p.m. *and* 6:30 p.m.
Veteran's Memorial Community Bldg.
1425 Veterans Memorial Circle,
Yuba City

City of Gridley
June 28 at 3:30 p.m. *and* 6:30 p.m.
Gridley Veteran's Memorial Hall
249 Sycamore Street, Gridley

-MORE-

A presentation will be given 30 minutes after each meeting begins. The content of all four meetings will be the same. For questions about the meetings or to make special accommodations for attendees, contact Ms. Norgaard at 916-737-3000 or via email at inorgaard@icfi.com.

Learn more about the Sutter Basin Project at www.spk.usace.army.mil and about the FRWLP at www.sutterbutteflood.org.

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Attachment B

- Display boards
- Power Point presentation
- Fact sheet
- Comment card templates

Station 2 - Overview, Purpose, and Objectives 110x13

2A
About the SBP
36x18

2B
SBP Study Area MAP
36x24

2C
SBP Timeline
36x18

2D
Inside Look at a Levee
30x24

2E
Typical Levee Deficiencies
30x24

2F
About the FRWLP
36x18

2G
FRWLP Study Area MAP
36x24

2H
FRWLP Timeline & Funding
36x18

Station 3 - Potential Measures 110x13

3A Slurry Wall 25x20	3B Stability Berm 25x20	3C Seepage Berm 25x20	3D Relief Well 25x20
3E Sheet-Pile Wall 25x20	3F Slope Flattening 25x20	3G Internal Drain 25x20	3H New/Relocated Levee 25x20
3I Re-Operation 25x20	3J Non-Structural 25x20	3K Ecosystem Restoration 25x20	3L Recreation 25x20

Station 4 - Environmental Process 110x13

4A
About NEPA/CEQA
24x32

4B
Scoping
24x32

4C
Enviro Issues
24x32

4D
Regulatory Compliance
24x32

4E
SBP Photo
52x32

4F
FRWLP Photo
52x32

Welcome to the Sutter Basin Project & Feather River West Levee Project Environmental Scoping Meeting

US Army Corps of Engineers®
Sacramento District

Overview, Purpose, and Objectives

About the Sutter Basin Project

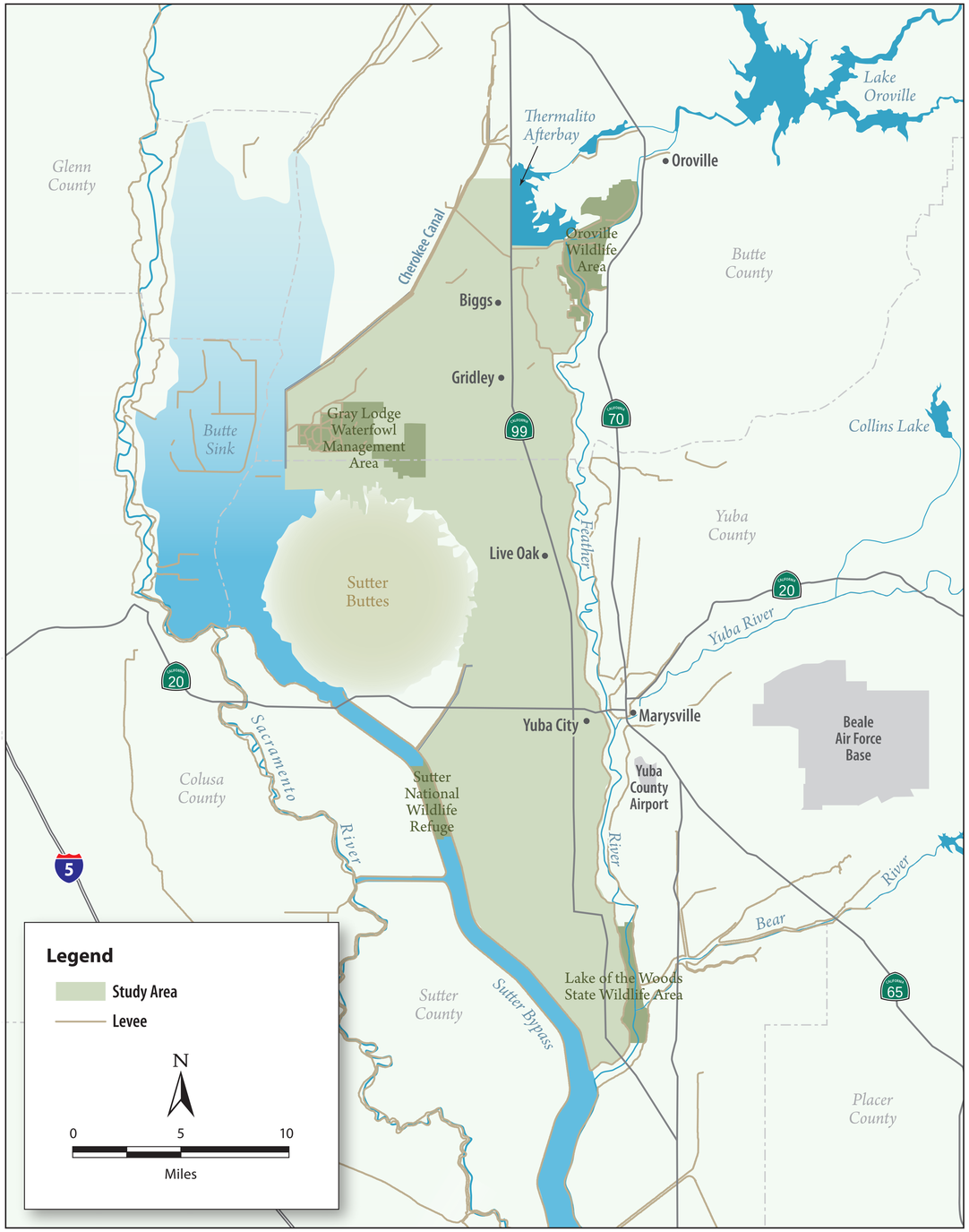
In 2000, the State of California and USACE entered into a cost-sharing agreement to initiate a feasibility study within the Sutter Basin. An amendment of the cost-sharing agreement was signed in July 2010 to include SBFCA as a non-Federal sponsor. The purpose of the feasibility study is to address flood risk management, ecosystem restoration, and recreation issues in the study area.

The Sutter Basin Project feasibility study evaluates approximately 285 square miles that are roughly bounded by the Feather River, Sutter Bypass, Wadsworth Canal, Sutter Buttes, and Cherokee Canal. The study area is essentially encircled by project levees and the high ground of the Sutter Buttes. Past flood events and geotechnical analysis show these levees 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.

As part of the Sutter Basin Project feasibility study, USACE is evaluating a variety of flood risk management measures that could include re-operation of reservoirs; improvements to existing levees; construction of new levees; other storage, conveyance, and non-structural options; and measures that could potentially restore the ecosystem within the study area and develop or expand recreation facilities.

This study will be the basis for a recommendation to Congress to address water resources and related issues within the study area.

Sutter Basin Project Area



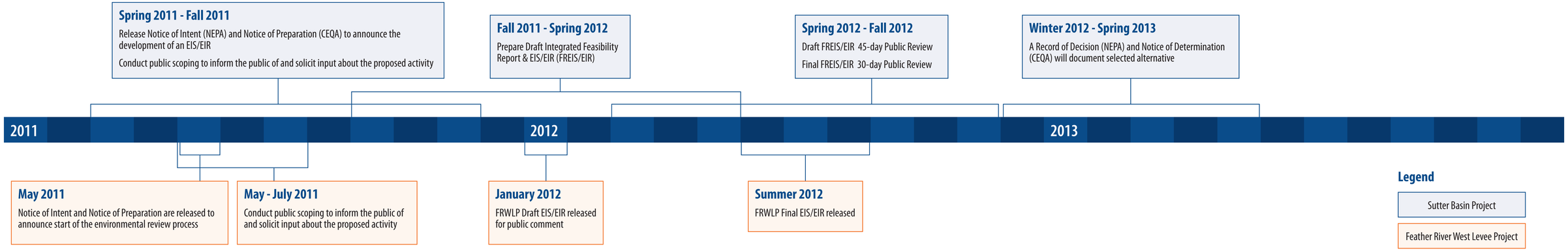
2B - SBP Study Area.indd 1
6/21/11 2:10 PM

Sutter Basin Project Funding and Timeline

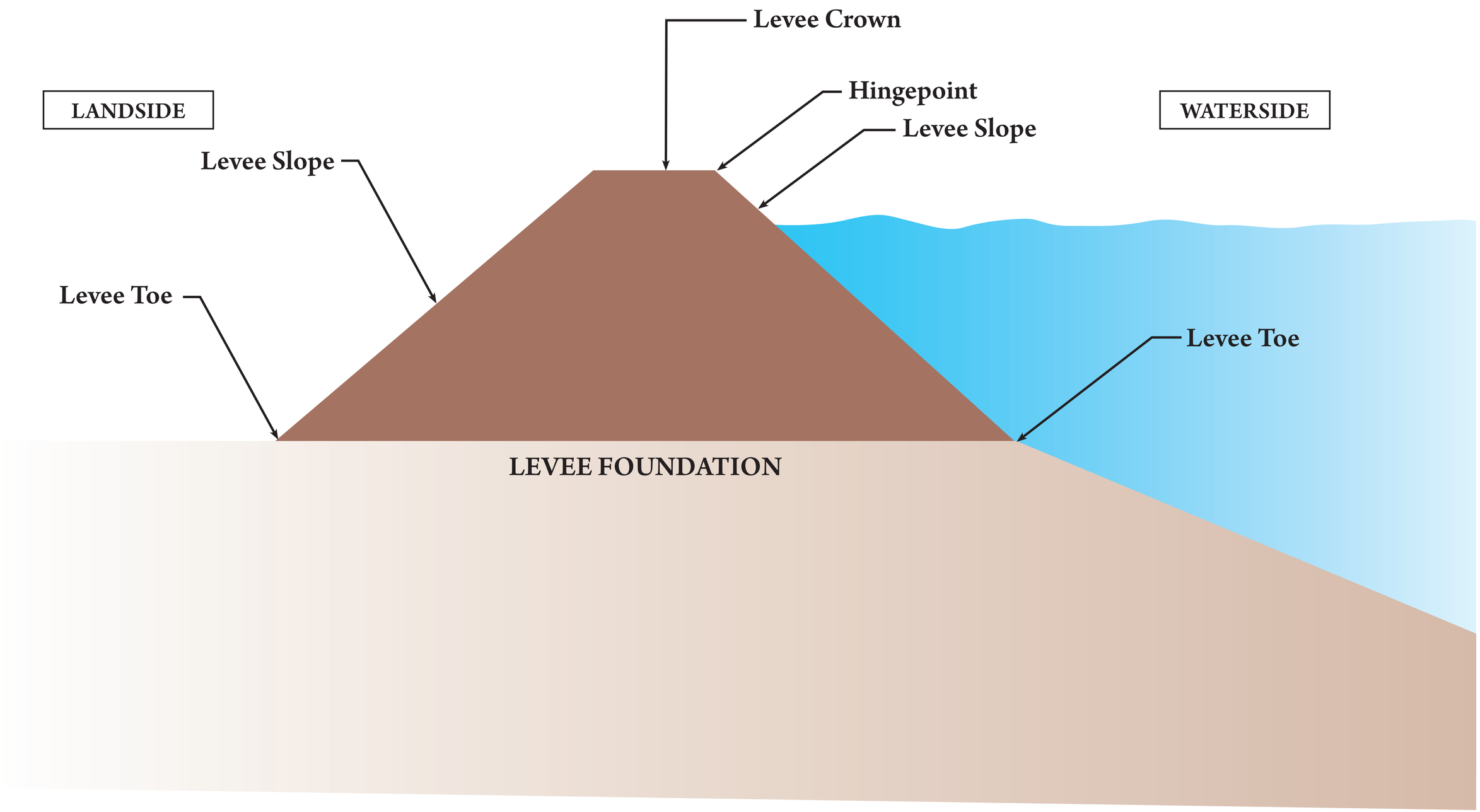
Funding

The feasibility study phase of this project is cost-shared; USACE will fund 50% and SBFCA and the State of California will fund the remaining 50% of the project.

Timeline



An "Inside" Look at a Levee



2D - Inside Look at Levee.indd 1
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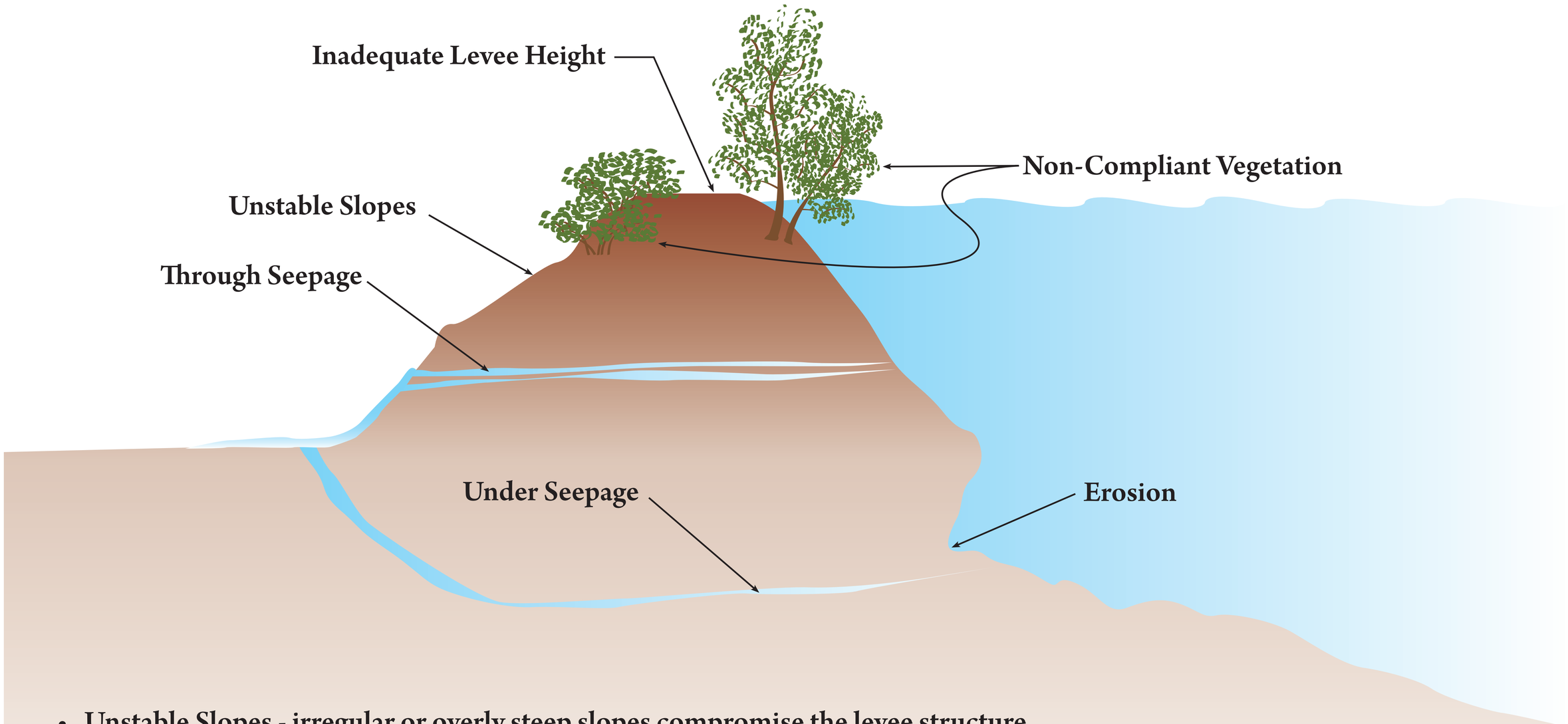
Typical Levee Deficiencies



- Unstable Slopes - irregular or overly steep slopes compromise the levee structure
- Inadequate levee height - levee height may be too low relative to predicted water levels
- Non-Compliant Vegetation - can lead to levee instability and hinder levee monitoring and maintenance
- Erosion - water flow, wakes and waves, remove soil material, damaging the levee
- Seepage

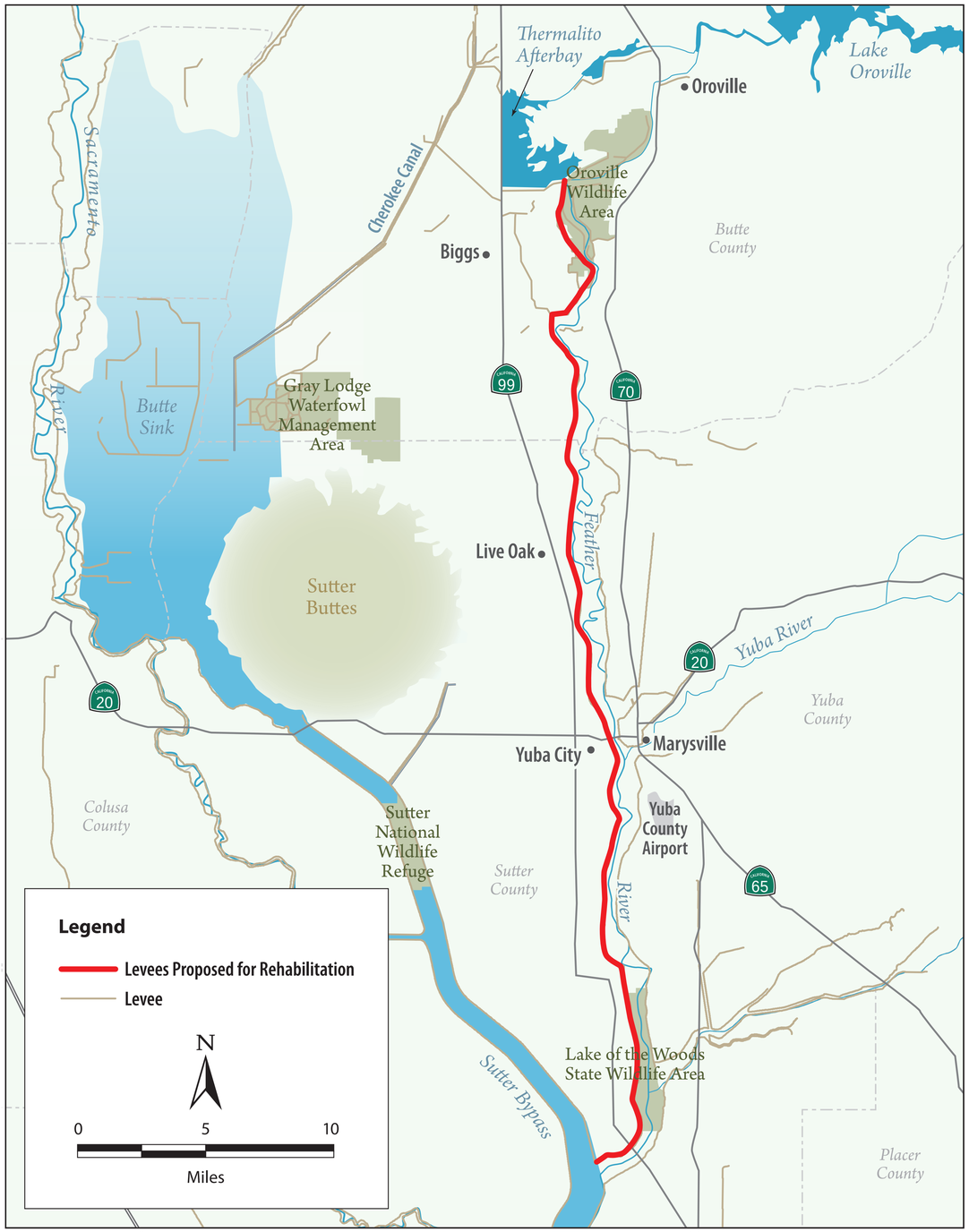
2E - Levee Deficiencies.indd 1 6/21/11 2:13 PM

About the Feather River West Levee Project

Communities in both Butte and Sutter Counties have an unfortunate historical knowledge of devastating flood events within the region. Sutter Butte Flood Control Agency (SBFCA) is planning the Feather River West Levee Project (FRWLP) to address levee deficiencies found along 44 miles of the west levee of the Feather River from the Thermalito Afterbay south to the Sutter Bypass. Measures are being evaluated to meet Federal, state, and local flood protection criteria and goals. The FRWLP is expected to:

- Increase public safety by providing 200-year flood protection from Yuba City north to the Thermalito Afterbay, and the appropriate level of flood protection south of Yuba City (in conjunction with repairs to the Sutter Bypass, which are the responsibility of the state).
- Save property owners millions of dollars annually in flood insurance costs by delaying, preventing, or cutting short FEMA floodplain mapping.
- Allow cities and counties to implement general plans, which will soon be restricted for any urban or urbanizing community without 200-year flood protection. This would not apply to areas with fewer than 10,000 residents.
- Sustain and grow the local economy by creating construction jobs, protecting property values, and allowing for responsible development.

Feather River West Levee Project Area



2G - FRWLP Study Area.indd 1
6/21/11 2:16 PM

Feather River West Levee Project Funding and Timeline

Funding

The FRWLP is estimated at $250 million for construction. A local assessment district enacted in 2010 will pay 29% of the project cost and the State of California is expected to pay the remaining share.

Timeline

Environmental specialists are currently analyzing the effects the FRWLP could have if implemented, to comply with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). This analysis will help engineers finalize the project design, and request Federal and state permits. The goal is to construct the FRWLP as quickly as possible in advance of and compatible with the Sutter Basin Project, potentially beginning construction in 2013.

May 2011
Notice of Intent and Notice of Preparation are released to announce start of the environmental review process

May-July 2011
Sutter Basin Project and FRWLP scoping period

January 2012
FRWLP Draft EIS/EIR released for public comment

Summer 2012
FRWLP Final EIS/EIR released

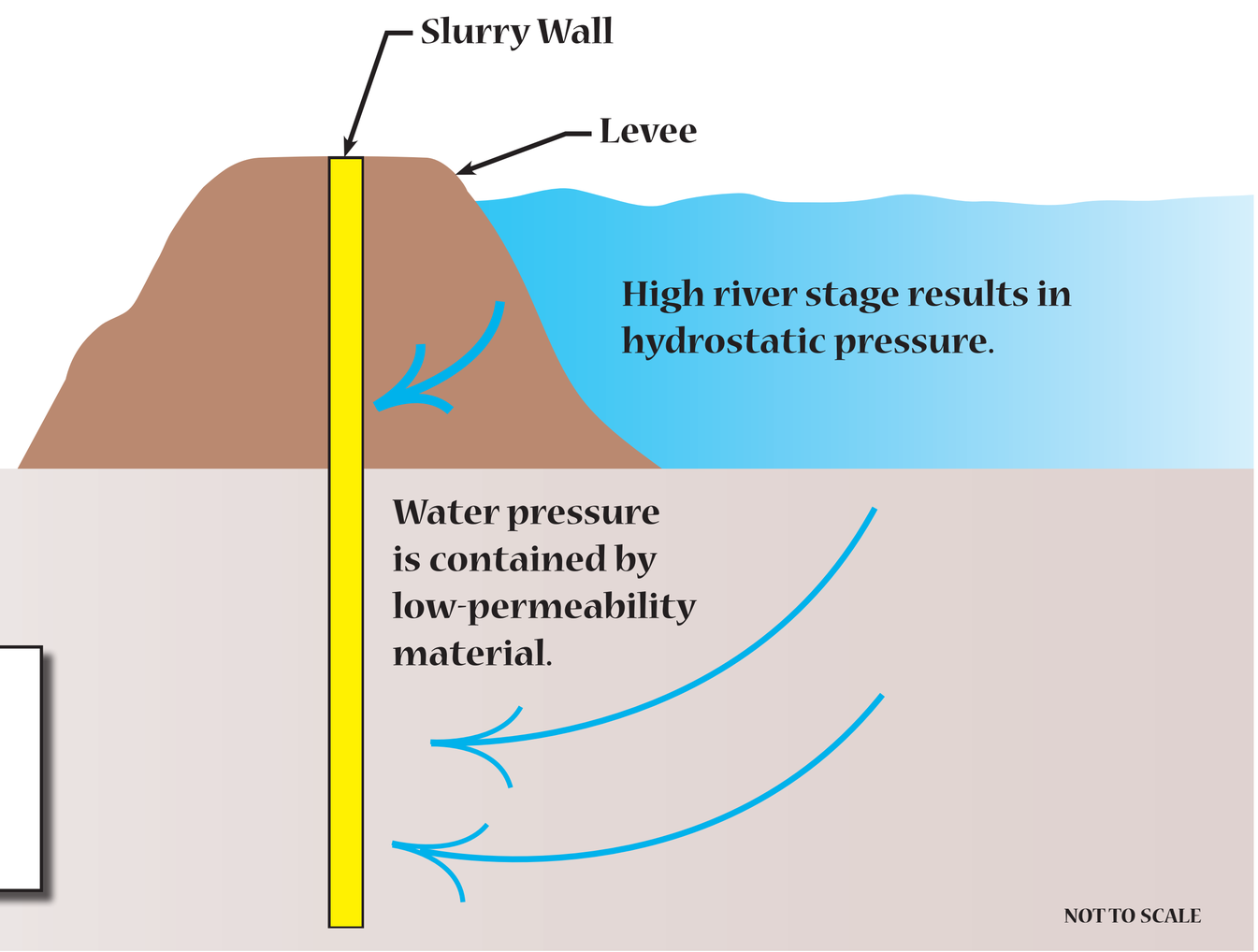
2011 2012

2H - Funding and Timeline.indd 1 6/22/11 1:24 PM

Potential Measures

Slurry Cut-off Wall

Concept:
Water-seepage and through-seepage are controlled by a low-permeability wall constructed within the levee cross section.

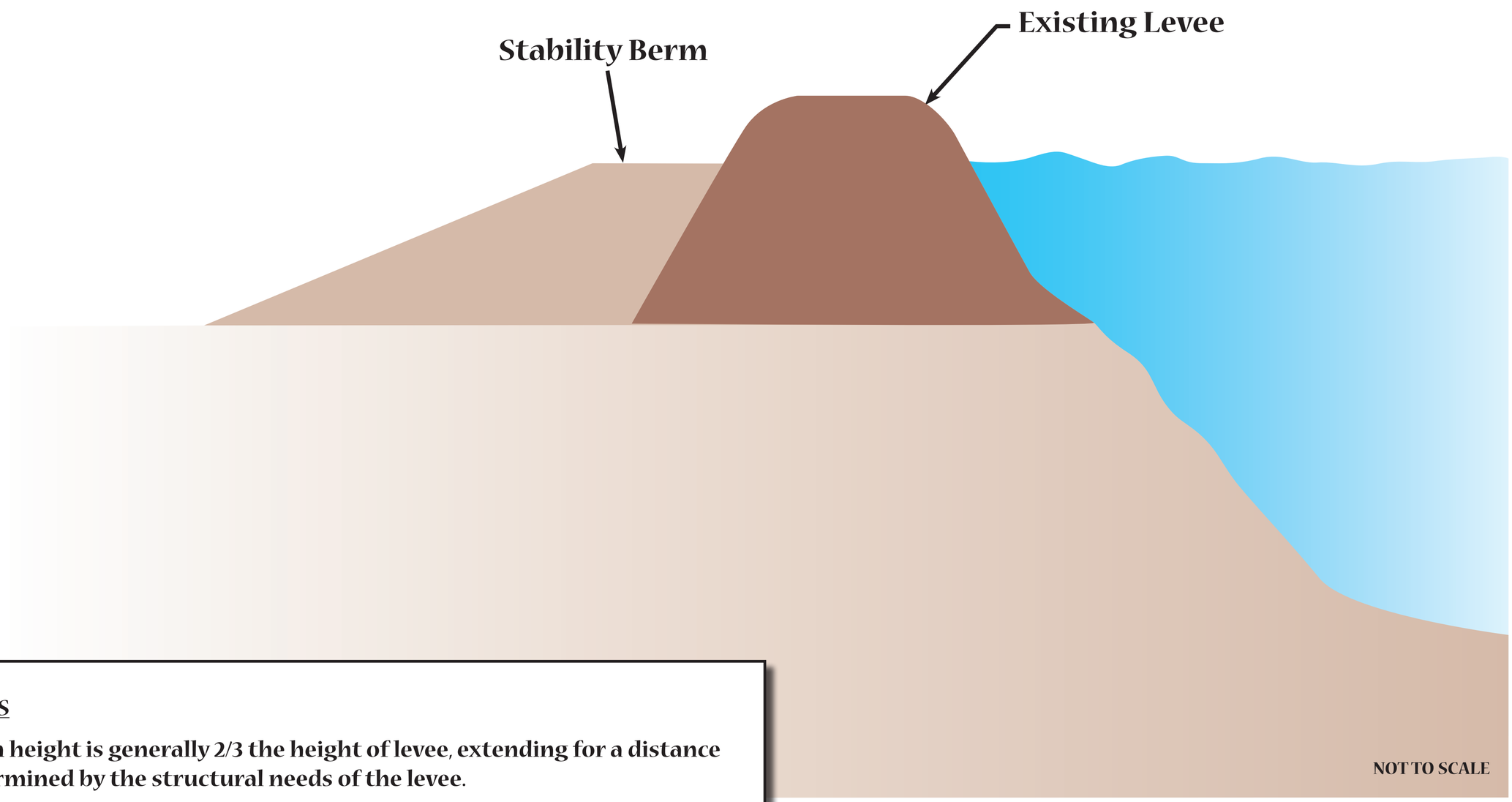


DETAILS

- Constructed via traditional slot trench, deep soil mix method, or jet grouting.
- Wall is approximately 3 ft wide and up to 140 ft deep.

Stability Berm

Concept:
Provides additional support to levee to increase strength.

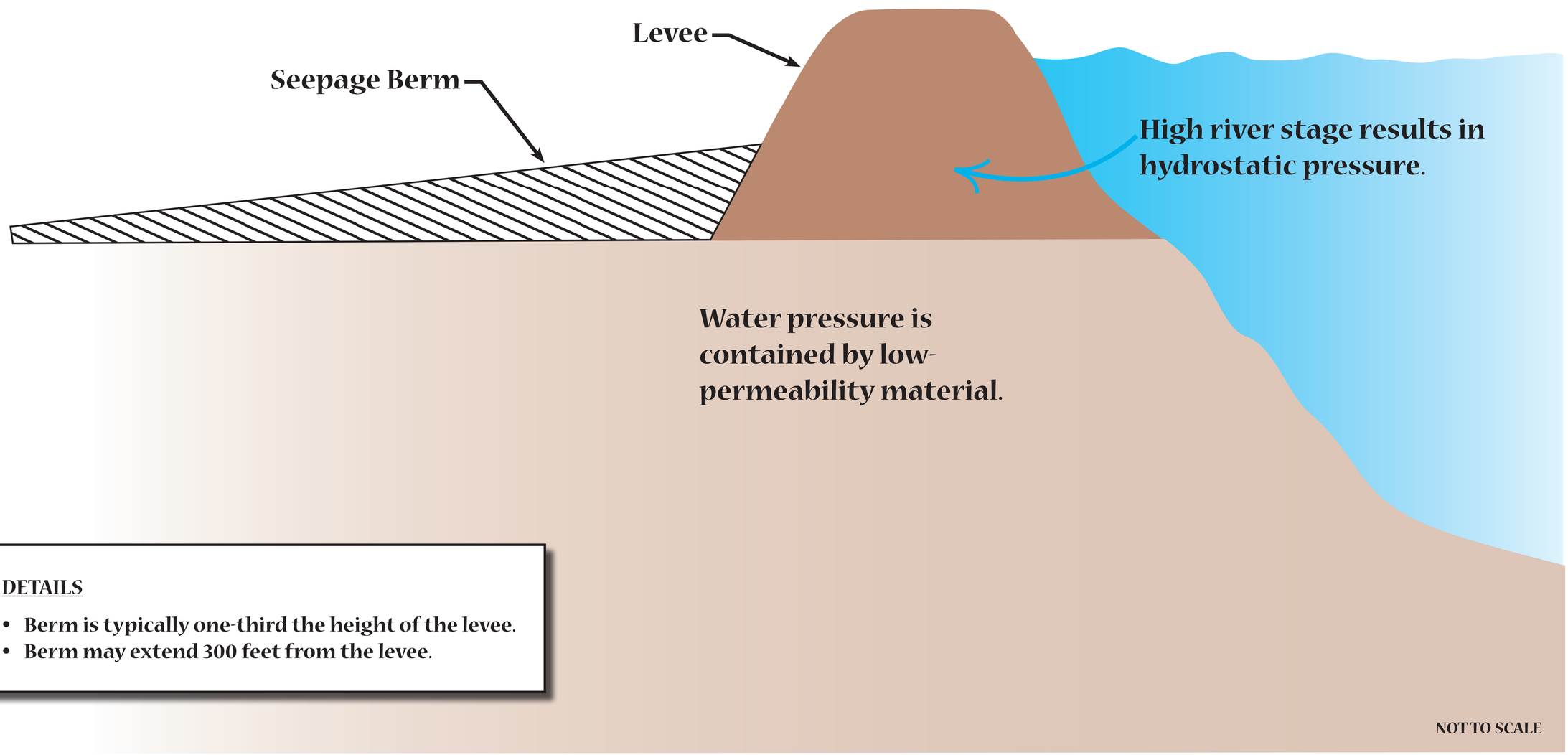


DETAILS

- **Berm height is generally 2/3 the height of levee, extending for a distance determined by the structural needs of the levee.**

Seepage Berm

Concept:
Water pressure is contained and dispersed by a thickened soil layer.

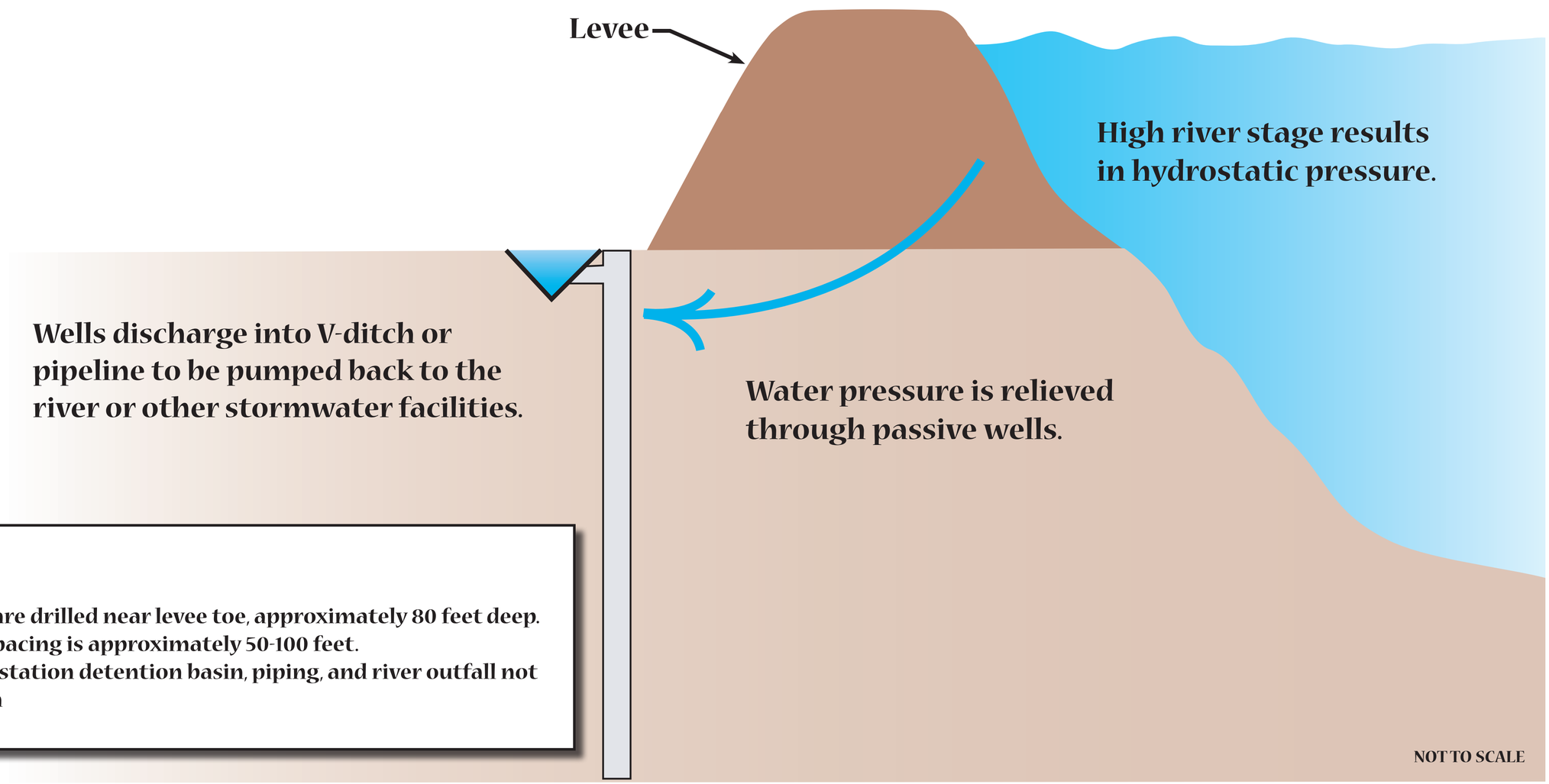


DETAILS

- Berm is typically one-third the height of the levee.
- Berm may extend 300 feet from the levee.

Relief Well

Concept:
Water pressure is relieved via passive wells, which direct water discharge into a collection system.

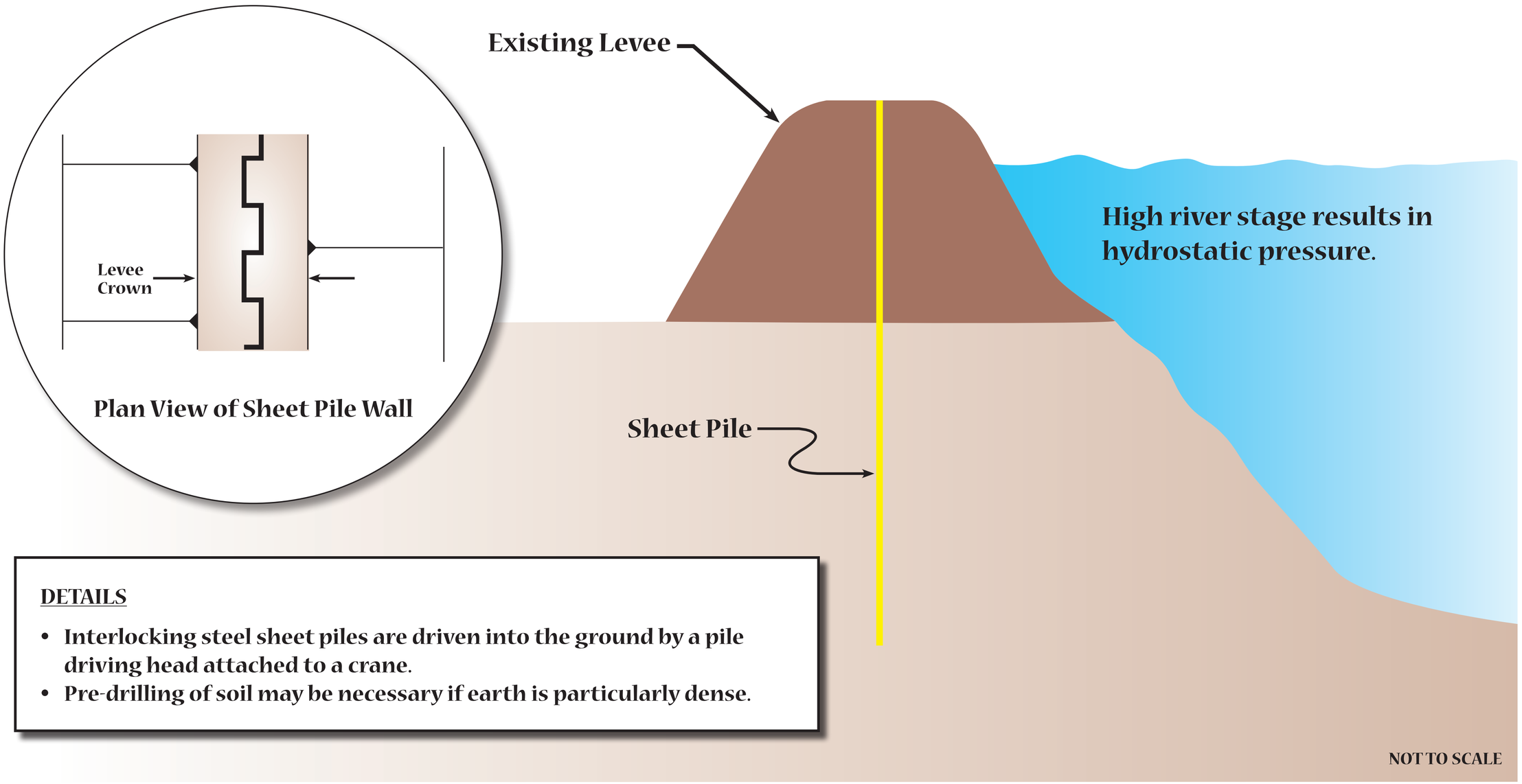


DETAILS

- Wells are drilled near levee toe, approximately 80 feet deep.
- Well spacing is approximately 50-100 feet.
- Pump station detention basin, piping, and river outfall not shown

Sheet Pile Wall

Concept:
Steel panels are driven into the levee core to provide a seepage barrier.

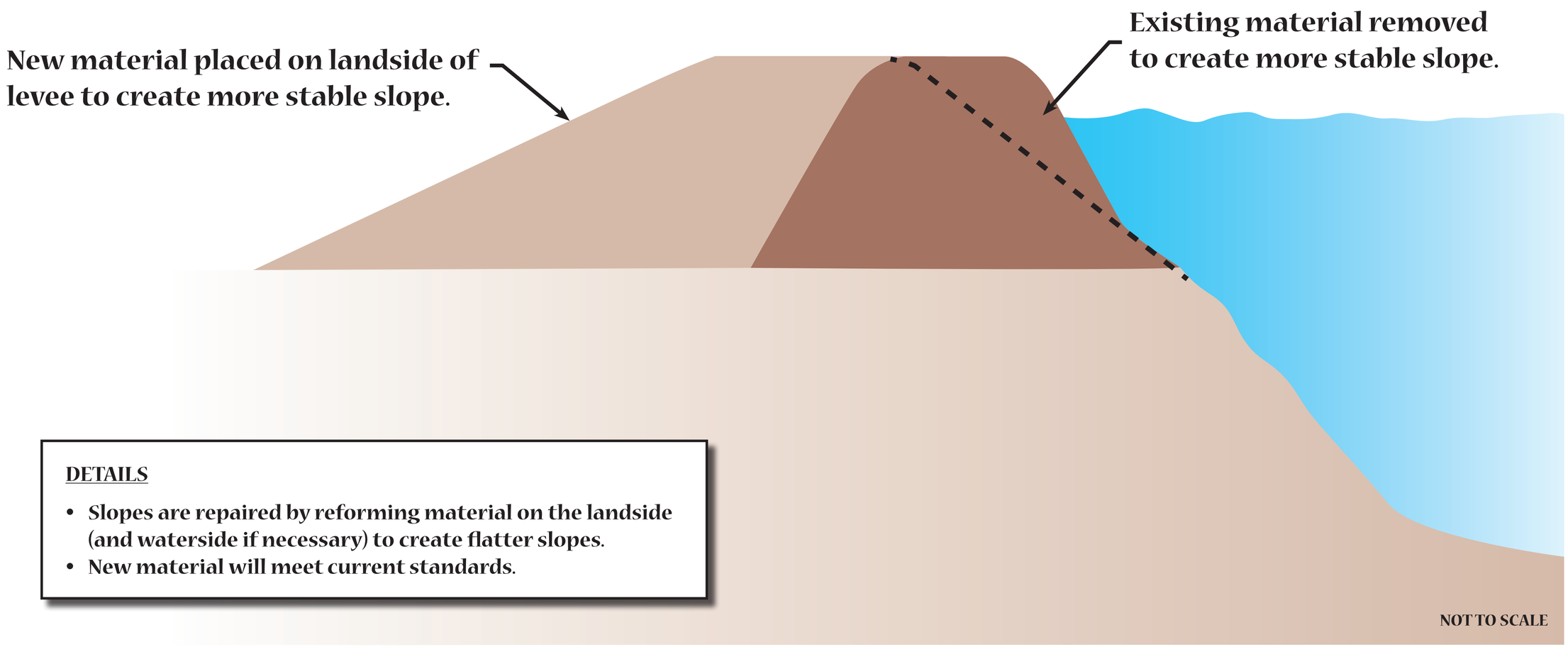


DETAILS

- Interlocking steel sheet piles are driven into the ground by a pile driving head attached to a crane.
- Pre-drilling of soil may be necessary if earth is particularly dense.

Slope Flattening

Concept:
Flatter slopes are more stable and less susceptible to erosion.

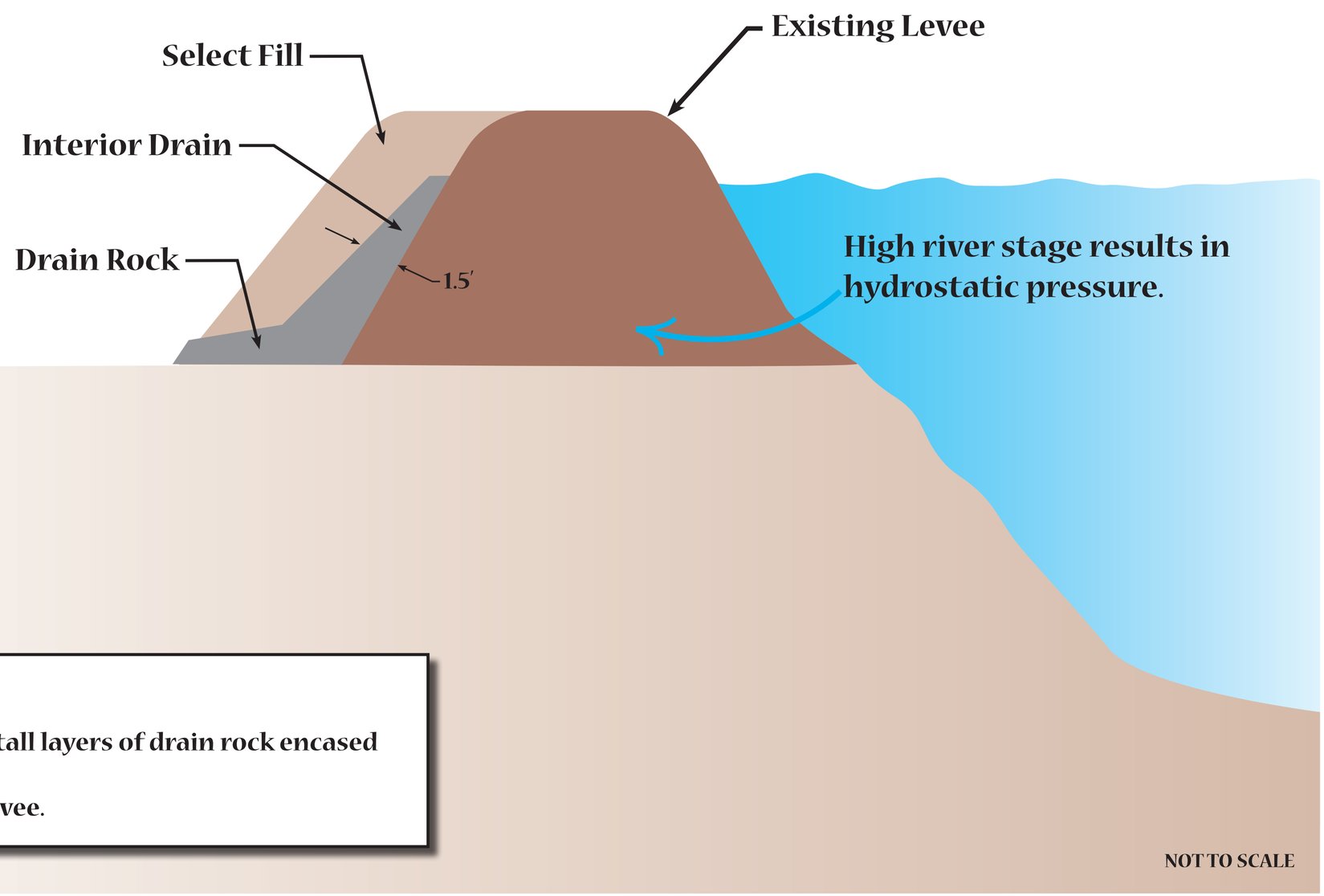


DETAILS

- Slopes are repaired by reforming material on the landside (and waterside if necessary) to create flatter slopes.
- New material will meet current standards.

Internal Drain

Concept:
Capture any through-seepage and
direct it away from the face of the levee.

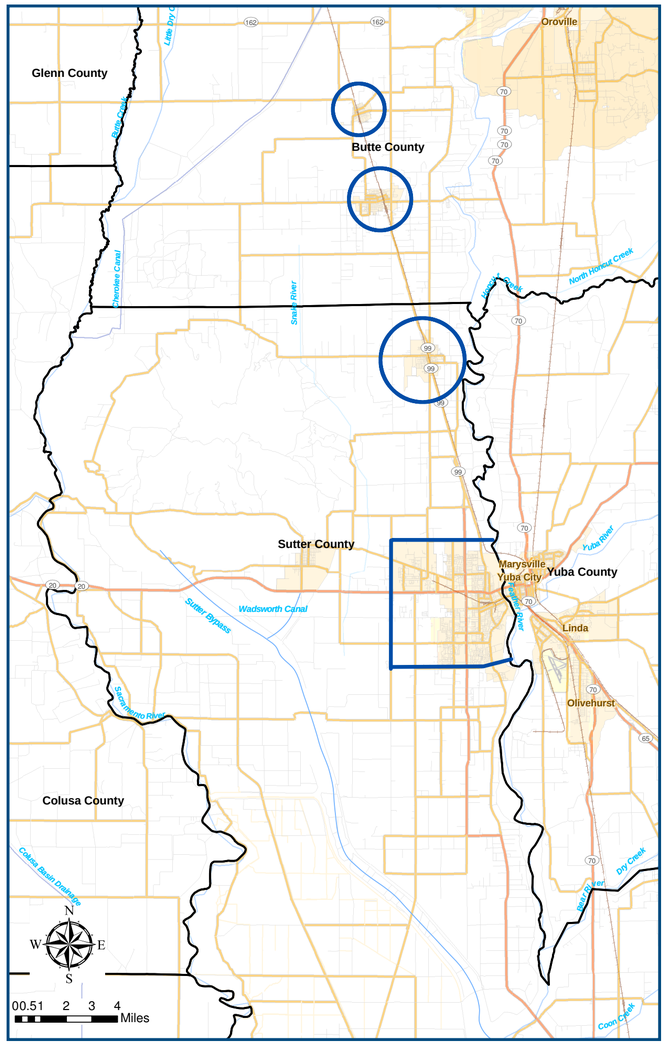


DETAILS

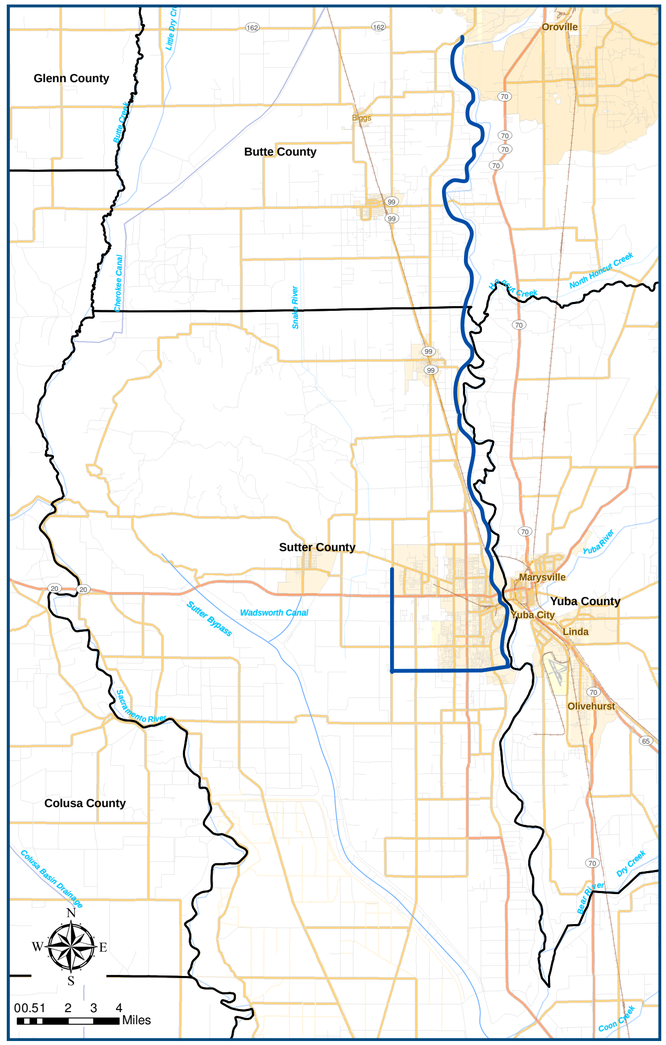
- Levee is partially excavated to install layers of drain rock encased in filter sand.
- Placed on the landside 1/3 of the levee.

New Levee Location

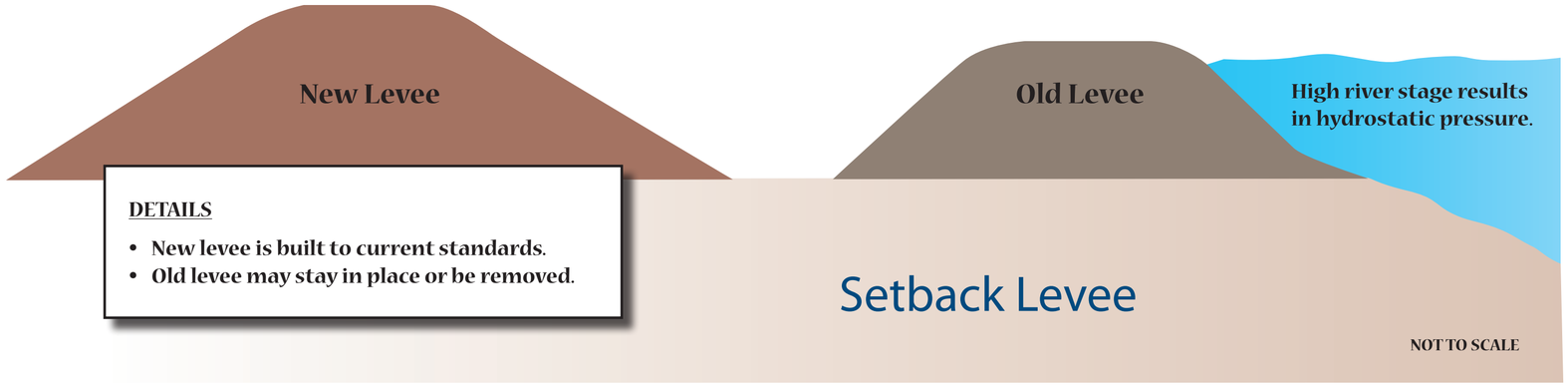
Concept:
A new levee is built where the existing levee is not readily repairable or where a change in the floodplain is an option (such as setback levees, ring levees, J-levees or similar concepts).



Ring Levees



J-Levees



Reservoir Reoperation Flood Risk Management

Reduce flood risk by improving a reservoir's ability to store peak flood flows through a variety of operational or physical modifications.

Examples:

- Reallocate storage for flood risk management purposes.
- Utilize flood forecast based operations to release storage in anticipation of a flood event.

Non-Structural Flood Risk Management

Non-structural measures reduce flood risk without significantly altering the nature or extent of the flooding. They do this by changing the use made of the floodplains, or by accommodating existing uses to the flood hazard.

Examples:

- Flood proofing
- Relocation of structures
- Flood warning/preparedness systems
- Regulation of floodplain uses

Ecosystem Restoration

Existing levees have isolated the floodplains from waterways, thereby eliminating significant floodplain habitats for native species, including Federally-listed species and other special-status species. There is potential to restore these areas in conjunction with flood risk management measures.

Examples:

- Realign levees to restore floodplains and river function
- Establish riparian/wetland habitat in conjunction with detention basins and other storage facilities
- Modify water inflow to select ponds to restore fish production and riparian/wetland habitats
- Convert nonnative habitats to native riparian/wetland habitats
- Eradicate exotic invasive plant species and establish native habitat

Recreation

An opportunity exists to create or enhance recreation features consistent with flood damage reduction and ecosystem restoration project features.

Examples:

- Multi-purpose paved trail on levee crown with access points, highway under crossings, public safety facilities, and appropriate signage
- Provide wildlife viewing platforms
- Picnic areas with associated parking and facilities
- Provide increased river access points

Environmental Process

About NEPA & CEQA

It is anticipated the Sutter Basin Project and FRWLP will result in two separate environmental impact statements/ environmental impact reports (EIS/EIR)—one for each project. Both documents will disclose an activity's potential alternatives, potential effects, and proposed mitigation measures in compliance with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), respectively.

A joint EIS/EIR is prepared when there is both a Federal and state agency interest in an activity, and/or when a state agency needs permission to perform an action under Federal jurisdiction. The development of the draft joint EIS/EIR to evaluate the FRWLP is underway and scheduled for release in early 2012. The release date of USACE's draft joint EIS/EIR for the Sutter Basin Project has yet to be determined.

Scoping and Other Public Engagement

Scoping is a process used to inform the public of a proposed activity and provide an opportunity to give comment, insight, and local information related to the range of alternatives, environmental effects, and/or issues of concern related to the proposed activity.

Because the agencies are working to create two joint, albeit separate, environmental documents for these two projects, a joint scoping period is also being held. During the scoping process public input will be solicited about the scope of the environmental documents and the agencies will communicate with the public about the two efforts.

Scoping is particularly informative in a flood risk management project because the citizens of the effected community could have insight into the performance of a levee that the agencies are unaware of (think locations of under-seepage or boils or areas of general poor levee performance).

The comments received from public scoping will be used to inform development of the alternatives; defining the environment and resources potentially affected by the alternatives; and analysis of effects resulting from the alternatives. The affected environment broadly includes physical, biological, and social topic areas. Effects are identified and analyzed both for project construction and long-term operations and maintenance.

Potential Environmental Issues

The effect of a proposed activity on natural and built resources will be evaluated in the environmental documents for the Sutter Basin Project and the FRWLP. Resources analyzed in the EIS/EIRs will include, but are not limited to:

- Transportation and Navigation
- Vegetation and Wetlands
- Socioeconomics and Environmental Justice
- Wildlife
- Fisheries and Aquatics
- Cultural Resources
- Air Quality, GHG and Climate Change
- Public Health and Environmental Hazards
- Land Use and Agriculture

Other Regulatory Compliance

USACE and SBFCA will need to comply with several regulations to complete the environmental process. Those could include:

Section 404: Establishes regulation of discharges of pollutants

- USACE grants 404 permits. The compliance mechanism is an Individual Permit, including 404(b)(1) alternatives analysis to identify least environmentally damaging practicable alternative (LEDPA)

Section 401: Requires certification that the project will not adversely affect water quality

- Administered by State of California through the Regional Water Quality Control Board

Rivers and Harbors Act

- Section 14 of the Rivers and Harbors Act requires permission from USACE for alterations to Federal flood control projects
    - More commonly referred to as Section 408

Endangered Species Act

- Purpose is to protect species and the ecosystems upon which they depend
- Administered by two Federal agencies: NMFS and USFWS
- Section 7 requires Federal agencies to ensure any action authorized, funded, or carried out is not likely to jeopardize the continued existence of a listed species or modify their habitat
- If a listed species may be present, the agency must conduct a biological assessment (BA)
    - Analyzes the potential effects of the project on listed species and critical habitat
- NMFS/USFWS then determines a need for a biological opinion (BO) or letter of concurrence

National Historic Preservation Act

- Section 106: Requires consideration of resources eligible or potentially eligible for the National Register of Historic Places
    - Administered by California State Historic Preservation Officer (SHPO)

Fish and Game Code

- Section 1600 et seq.: Work on the waterside of the levee will require Streambed Alteration Agreement
- Section 2050 et seq.: Potential effects on listed species will require demonstration that effects have been fully mitigated or incidental take permit

Thank you for your interest in these two public safety projects. Please provide us with your input on the scope of the projects and the environmental analysis here.

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Sacramento District

5A - Comments.indd 1 6/22/11 5:44 AM

Welcome to the

SUTTER BASIN PROJECT FEASIBILITY STUDY
&
FEATHER RIVER WEST LEVEE PROJECT

PUBLIC SCOPING MEETING

JUNE 27 & 28, 2011

US Army Corps of Engineers®
Sacramento District

Presentation Outline

1. Coordinated Flood Management Efforts
2. How Did We Get Here?
3. A Closer Look at Each Project
4. The Environmental Process

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Coordinated Flood Management Efforts

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Sutter Basin Project Feasibility Study

- Led by U.S. Army Corps of Engineers (USACE)
- Initiated in 2001
- Purpose is to evaluate a Federal interest in flood risk management, ecosystem restoration, and recreation projects in study area
- Coordinating with Sutter Butte Flood Control Agency (SBFCA), Central Valley Flood Protection Board (CVFPB), and California Department of Water Resources (DWR)

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Feather River West Levee Project (FRWLP)

- Led by local agency SBFCA
- Initiated upon approval of annual property assessment in 2010
- Purpose is to address levee deficiencies in the Feather River's west levee from Thermalito Afterbay to Sutter Bypass
- Construction start targeted for 2013
- SBFCA is coordinating with USACE, CVFPB, and DWR

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A Joint Approach

- Studied in coordination due to similar study areas, purpose, potential improvements, effects, and parties involved
- Separate but coordinated EIS/EIRs will be developed for each project
- USACE is NEPA lead and SBFCA is CEQA lead agency for environmental process, jointly coordinating with CVFPB and DWR

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How Did We Get Here?

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A Brief Local History

- Before 1850, the Feather and Sacramento Rivers overflowed their banks in high-water periods every few years
- Sediment from hydraulic mining in the mid-1800s caused river beds to rise
- Levees were consequently privately constructed in late 1800s and early 1900s to combat primarily overtopping
- Levees were improved and incorporated under the Sacramento River Flood Control Project by USACE in early 1900s

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A Brief Local History (cont.)

- Oroville Dam and Reservoir were completed in 1967, adding substantial flood storage
- New Bullards Bar Dam and Reservoir completed in 1970, adding substantial flood storage
- Flood risk is still present, with major events
- In 1955, breach on Feather River near Shanghai Bend (38 people killed)
- In 1986, break on Yuba River and slump on Sutter Bypass
- In 1997, breaches on Feather River and Sutter Bypass

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Recent Flood Management Efforts

- Levee evaluation studies by USACE, DWR, and SBFCA have documented deficiencies in the system
- In 2010, property owners of Sutter and Butte Counties approved the formation of an assessment district to provide local funds for flood risk management

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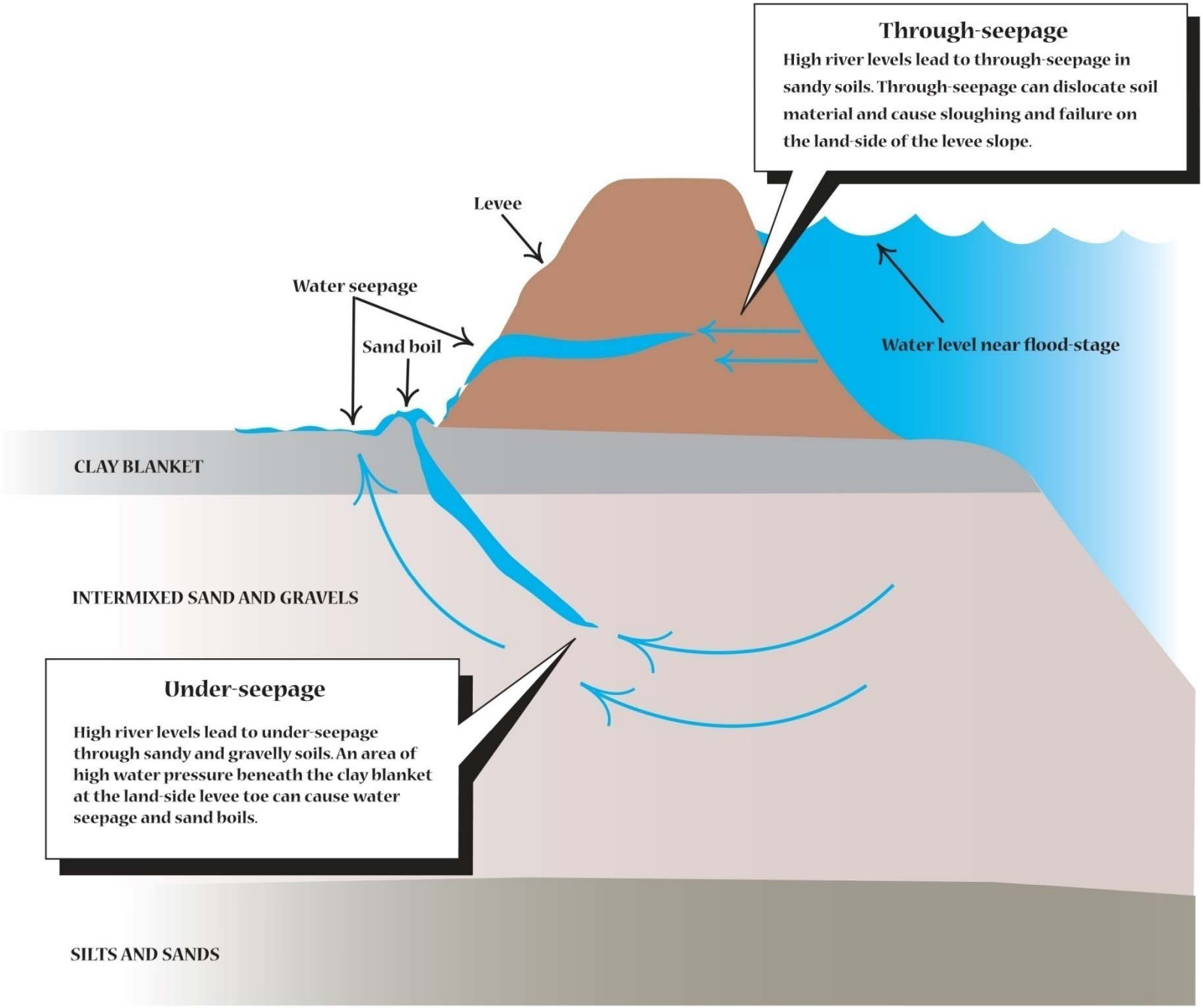
Through-seepage
High river levels lead to through-seepage in sandy soils. Through-seepage can dislocate soil material and cause sloughing and failure on the land-side of the levee slope.
Levee
Water seepage
Sand boil
Water level near flood-stage
CLAY BLANKET
INTERMIXED SAND AND GRAVELS
Under-seepage
High river levels lead to under-seepage through sandy and gravelly soils. An area of high water pressure beneath the clay blanket at the land-side levee toe can cause water seepage and sand boils.
SILTS AND SANDS

A Closer Look at Each Project

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Sutter Basin Project Feasibility Study: Study Area

- Study area encompasses ~284 sq. miles and is nearly encircled by Federal Project levees
- Includes portions of Sutter and Butte Counties
- About 44 miles long and 9 miles wide
- Feather River to the east and the Cherokee Canal, Wadsworth Canal, Sutter Buttes, and Sutter Bypass to the west

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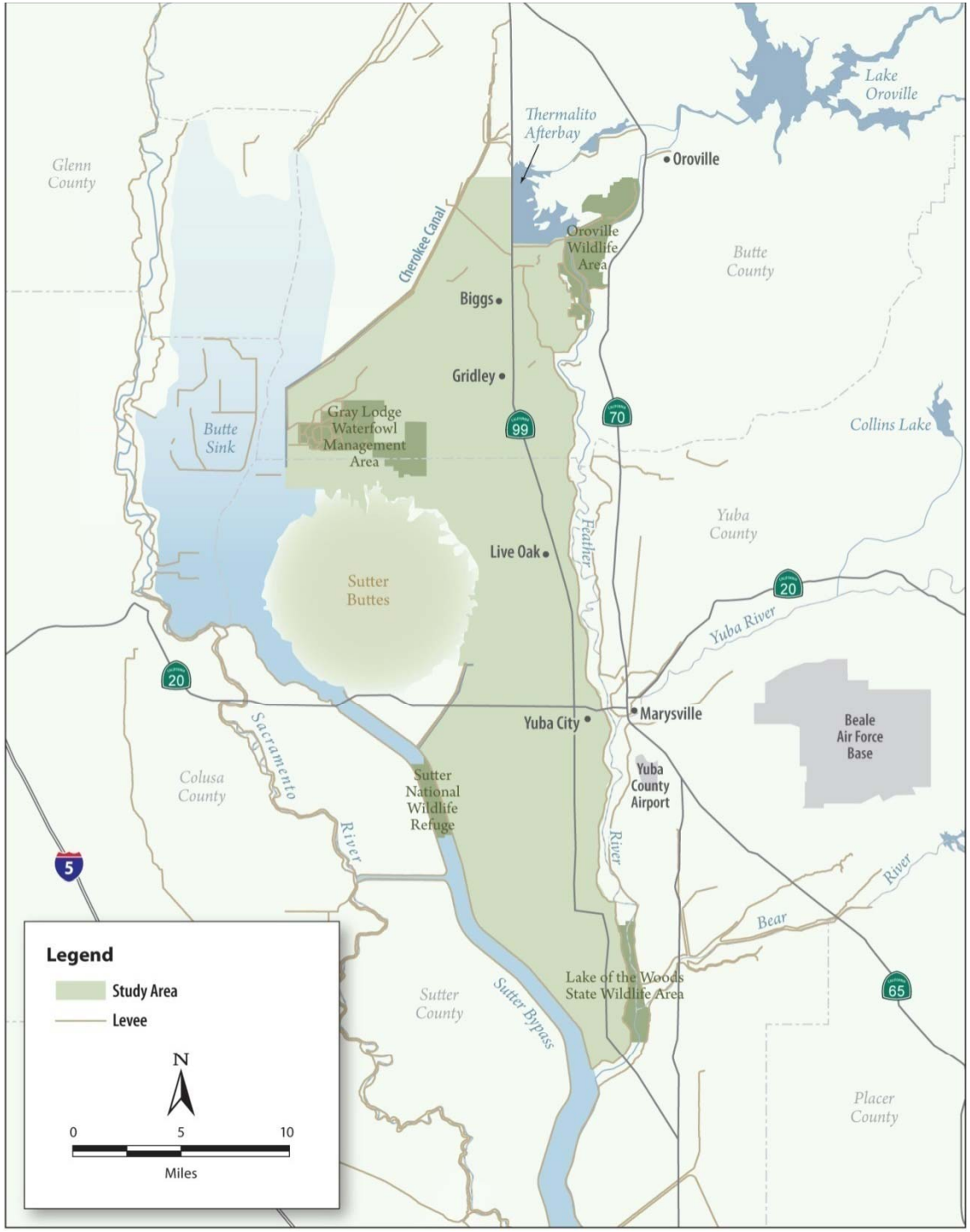
Sutter Basin Project Study Area



Sutter Basin Project Feasibility Study: Problems and Potential Measures

- Levees are at risk due to under- and through-seepage and overtopping
- Study will evaluate measures including: re-operation of reservoirs, improvements to existing levees, building new levees, and other storage & conveyance options
- Ecosystem restoration would include restoration of floodplain function and habitat

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Sutter Basin Project Feasibility Study: Potential Alternatives & Funding

- Potential alternatives include those that comprise flood risk management, ecosystem restoration, and recreation measures
- Funding for the feasibility study phase only is cost-shared, 50% Federal (USACE) and 50% non-Federal (SBFCA and CVFPB)

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Feather River West Levee Project: Study Area

- Will improve 44-miles of levees from the Thermalito Afterbay to the Sutter Bypass
- Provides flood risk management benefits to Live Oak, Biggs, Gridley, and Yuba City and unincorporated areas

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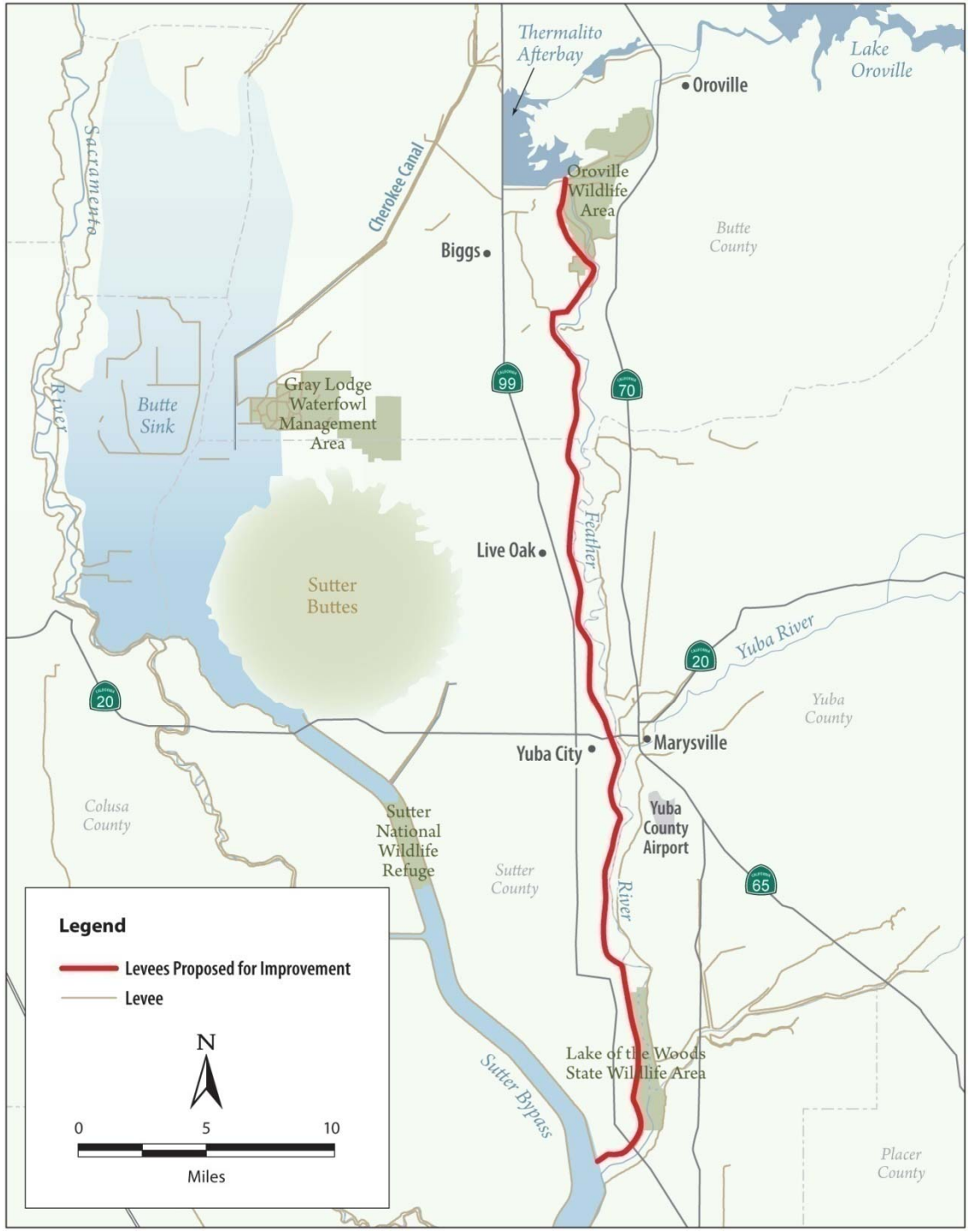
Feather River West Levee Project Study Area



Feather River West Levee Project: Problems and Potential Measures

- Primary deficiencies include through-seepage and under-seepage
- Measures may include slurry walls, seepage berms, stability berms, internal drains, relief wells, sheet-pile walls, slope flattening, and new levee alignments

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Feather River West Levee Project: Funding

- The project cost is estimated at $300 million
- The state is expected to pay as much as 76% of project costs
- Locals (within assessment district) will pay the remaining share through annual assessment (anticipated to be in effect for 33 years)

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THE ENVIRONMENTAL PROCESS

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NEPA & CEQA

- NEPA (Federal) and CEQA (state) are both processes that require:
  - Analysis and disclosure of an activity's potential effect on the natural and built environments
  - Identification of alternatives and mitigation measures to reduce effects
- Processes may necessitate an EIS and EIR depending on potential effects (type and degree)

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JOINT EIS/EIR

- Prepared when there is both a Federal and state agency interest in an activity, and/or
- When a state lead agency needs permission to perform an action under Federal jurisdiction (Section 408 permission & Section 404 permit)
- Agencies partner to analyze effects in a joint EIS/EIR and disclose an activity's potential effects

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WHAT IS *SCOPING*?

- Scoping is a process used to inform the public of the proposed activity and provide an opportunity to give input on the range of alternatives, potential environmental effects, and any issues of concern related to the proposed activity

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Scoping Period

- May 20, 2011 to July 8, 2011
- Comments will be accepted via e-mail, fax, and USPS
- Comments must be postmarked, faxed, or time-stamped (email) before or on July 8, 2011

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Ways to Comment

- Via E-mail
- Facsimile
- Via U.S. Postal Service
- Today via written comment (see comment cards)
- Provide oral comments to court reporter

US Army Corps of Engineers®
Sacramento District

Contact Information

Mail or E-mail comments to:

Matt Davis
U.S Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

Phone: 916-557-6708
Fax: 916-557-7856

Matthew.G.Davis@usace. army.mil

Ingrid Norgaard
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

Phone: 916-737-3000
Fax: 916-737-3030

inorgaard@icfi.com

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Sacramento District

THANK YOU FOR ATTENDING

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Coordinated Environmental Analysis

It is anticipated the Sutter Basin Project and FRWLP will result in two separate environmental impact statements/environmental impact reports (EIS/EIR)—one for each project. Both documents will disclose alternatives, potential effects, and proposed mitigation measures in compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), respectively. A joint EIS/EIR is prepared when there is both a Federal and state agency interest in an activity, and/or when a state agency needs permission to perform an action under Federal jurisdiction.

Development of the draft EIS/EIR to evaluate the FRWLP is underway and scheduled for public release in early 2012. A public release date for the Sutter Basin Project draft EIS/EIR has yet to be determined.

The Scoping Process

USACE and SBFCA are working together to combine and coordinate this public scoping process for their two separate environmental documents.

Scoping is a process in which agencies inform the public of a proposed activity and provide an opportunity for public input on the range of alternatives, environmental effects, and issues of concern related to the proposed activity. It also allows agencies to gather insights and local information from the public related to the activity.

Comments received from this public scoping period will be used to inform development of the alternatives; define the environment and resources potentially affected by the alternatives; and analyze effects resulting from the alternatives. The affected environment broadly includes physical, biological, and social topic areas. Effects will be identified and analyzed both for project construction and long-term operations and maintenance. The scoping period is from May 20, 2011 to July 8, 2011.

For more information on these efforts, visit www.spk.usace.army.mil or www.sutterbutteflood.org.

6/23/11

Sutter Basin Project and Feather River West Levee Project

The U.S. Army Corps of Engineers (USACE) and the Sutter Butte Flood Control Agency (SBFCA), in coordination with the California Department of Water Resources (DWR) and the California Central Valley Flood Protection Board (CVFPB), are undertaking two related efforts to study flood risk management measures in Sutter and Butte Counties. USACE is leading a feasibility study for the Sutter Basin Project to determine Federal interest in flood risk management in conjunction with other related purposes in the Sutter Basin study area, while SBFCA is leading the Feather River West Levee Project (FRWLP) to address deficiencies in 44 miles along the west levee of the Feather River.

USACE and SBFCA are studying these two projects in close coordination because they are related in their study areas, purpose, potential measures, and potential effects.

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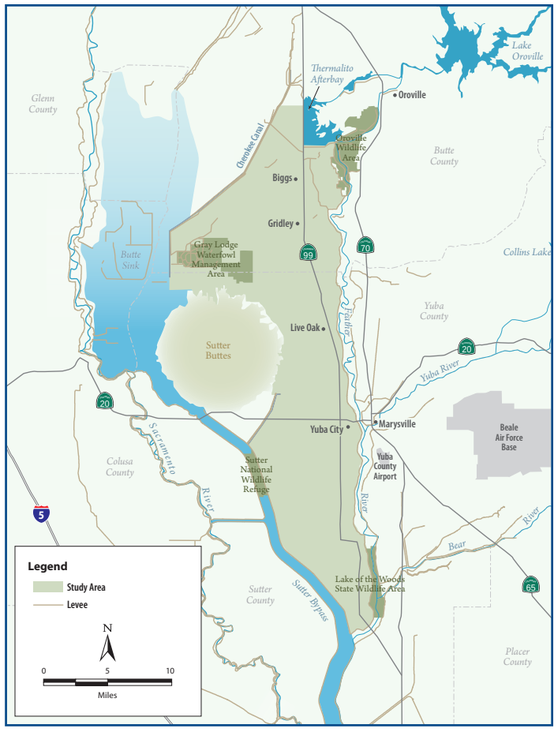
A Closer Look at the Two Projects

The Sutter Basin Project Feasibility Study

In 2000, the State of California and USACE entered into a cost-sharing agreement to initiate a feasibility study within the Sutter Basin. An amendment of the cost-sharing agreement was signed in July 2010 to include SBFCA as a non-Federal sponsor. The purpose of the feasibility study is to address flood risk management, ecosystem restoration, and recreation issues in the study area.

The Sutter Basin Project feasibility study evaluates approximately 285 square miles that are roughly bounded by the Feather River, Sutter Bypass, Wadsworth Canal, Sutter Buttes, and Cherokee Canal. The study area is essentially encircled by project levees and the high ground of the Sutter Buttes. Past flood events and geotechnical analysis show these levees 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.

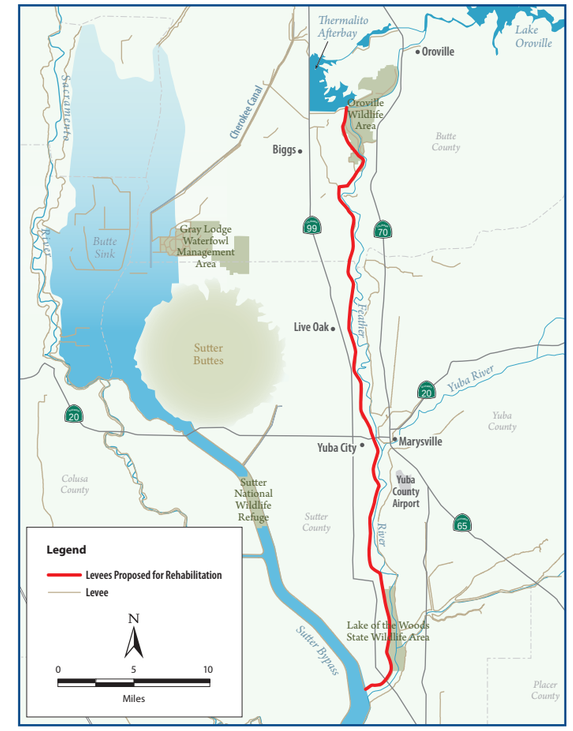


As part of the Sutter Basin Project feasibility study, USACE is evaluating a variety of flood risk management measures that could include re-operation of reservoirs; improvements to existing levees; construction of new levees; other storage, conveyance, and non-structural options; and measures that could potentially restore the ecosystem within the study area and develop or expand recreation facilities. This study will be the basis for a recommendation to Congress to address water resources and related issues within the study area. The feasibility study phase of this project is cost-shared: USACE will fund 50%, and SBFCA and the State of California will fund the remaining 50%.

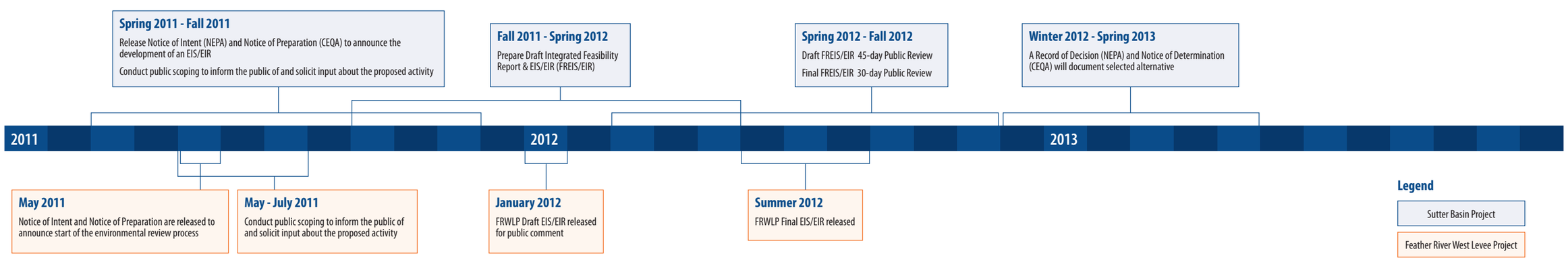
The Feather River West Levee Project

SBFCA is planning the FRWLP to address levee deficiencies found along 44 miles of the Feather River's west levee from the Thermalito Afterbay south to the Sutter Bypass. The west levee provides flood risk management benefits to the cities of Yuba City, Gridley, Live Oak, and Biggs, and portions of Butte and Sutter Counties. Measures are being evaluated to meet Federal, state, and local flood protection criteria and goals.

The west levee is at risk of failure from through- and under-seepage and from overtopping caused by floods greater than the levee is designed to withstand. Alternatives to repair these deficiencies could include slurry walls, seepage berms, stability berms, internal drains, relief wells, sheet-pile walls, slope flattening, and new levee alignments. The goal is to construct the FRWLP as quickly as possible, in advance of and compatible with the Sutter Basin Project, potentially in 2013.



Environmental Review Process Timeline for the Sutter Basin Project and FRWLP



Sutter Basin Project
& Feather River West Levee Project

US Army Corps of Engineers
Sacramento District

June 27, 2011 Scoping Meeting
Comment Card

Date:_____

Name:_____Title:_____

Phone:_____Fax:_____Affiliation:_____

Email:_____Street Address_____

City:_____State:_____Zip:_____

☐ Please add me to the mailing list to receive future updates.

Thank you for attending the Sutter Basin Project and Feather River West Levee Project (FRWLP) scoping meeting. Please provide your input in the space below about the content of the environmental impact statement/environmental impact report (EIS/EIR) for the Sutter Basin Project and/or for the EIS/EIR for the FRWLP. After you've written your comments in the space below, place this card in one of the designated baskets around the room or hand it to a project team member. Please write legibly.

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Sutter Basin Project
& Feather River West Levee Project

US Army Corps of Engineers
Sacramento District

June 28, 2011 Scoping Meeting
Comment Card

Date:_____

Name:_____Title:_____

Phone:_____Fax:_____Affiliation:_____

Email:_____Street Address_____

City:_____State:_____Zip:_____

☐ Please add me to the mailing list to receive future updates.

Thank you for attending the Sutter Basin Project and Feather River West Levee Project (FRWLP) scoping meeting. Please provide your input in the space below about the content of the environmental impact statement/environmental impact report (EIS/EIR) for the Sutter Basin Project and/or for the EIS/EIR for the FRWLP. After you've written your comments in the space below, place this card in one of the designated baskets around the room or hand it to a project team member. Please write legibly.

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Attachment C

- Comments received from all interested parties (including those transcribed by court reporter)
- Attendee sign-in sheet templates

Sutter Basin Project
& Feather River West Levee Project

US Army Corps of Engineers
Sacramento District

June 27, 2011 Scoping Meeting
Comment Card

Date: 6/27/11

Name: Douglas Gault Title: Director of Public Works, Sutter County

Phone: Fax: Affiliation:

Email: Street Address

City: State: Zip:

☐ Please add me to the mailing list to receive future updates.

Thank you for attending the Sutter Basin Project and Feather River West Levee Project (FRWLP) scoping meeting. Please provide your input in the space below about the content of the environmental impact statement/environmental impact report (EIS/EIR) for the Sutter Basin Project and/or for the EIS/EIR for the FRWLP. After you've written your comments in the space below, place this card in one of the designated baskets around the room or hand it to a project team member. Please write legibly.

Meet Spring 2013 scheduled completion of USACE Feasibility study. Do not delay. 104 certification must be issued at that time to allow state to release EIP funding for West Levee Project.

Keep the process for feasibility study on schedule.

ORIGINAL

SUTTER BASIN PROJECT FEASIBILITY STUDY & FEATHER RIVER

WEST LEVEE PROJECT PUBLIC SCOPING MEETING û YUBA CITY, CA

DATE: June 27, 2011

TIME: 3:30 p.m. and 6:30 p.m.

REPORTED BY: Jillian Bassett
Certified Shorthand Reporter No. 13619

NCCR

Northern California Court Reporters

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1325 Howe Avenue, Suite 105 ■ Sacramento, CA 95825

nccr@norcalreporters.com ■ www.norcalreporters.com

STAN CLEVELAND, COUNTY SUPERVISOR:

I was told to repeat the comment I made regarding including the DWR Corridor Management Project, which is called The Lower Feather River Corridor Management Project. And there's a management group, and then there's -- I forgot what the other one is; there's two groups. And Aecom, they're the project, I guess, engineer group for that. And making sure that that is coordinated with this here. Because in that corridor of the Feather River, they're doing a lot of environmental planning and setting a foundation, or a level base, to where everybody won't have to come back and start from scratch on any of their studies -- environmental studies.

1 Certificate

2 of

3 Certified Shorthand Reporter

4 The undersigned certified shorthand reporter of the

5 state of California does hereby certify:

6 That the foregoing deposition was taken before me at

7 the time and place therein set forth, at which time the

8 witness was duly sworn by me;

9 That the testimony of the witness and all objections

10 made at the time of the examination were recorded

11 stenographically by me and thereafter transcribed, said

12 transcript being a true copy of my shorthand notes thereof.

13 In witness whereof, I have subscribed my name this

14 date July 25 2011.

15

16

17 Jill Bessett

18 Certificate number 13619

19

20

21

22

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24

25

ORIGINAL

SUTTER BASIN PROJECT FEASIBILITY STUDY & FEATHER RIVER

WEST LEVEE PROJECT PUBLIC SCOPING MEETING û GRIDLEY, CA

DATE: June 28, 2011

TIME: 3:30 p.m. and 6:30 p.m.

REPORTED BY: Jillian Bassett
Certified Shorthand Reporter No. 13619

NCCR

Northern California Court Reporters

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DAVID NEUBERT:

I live in Sutter County. I was speaking with your colleagues, and they mentioned one of the options they're looking at is a levee setback in the area of Nelson slough along Sacramento Avenue in Sutter County. And this would be the area between the Sacramento bypass and the Feather River, right where the Feather River enters the bypass. There's, I don't know, maybe 900,000 acres there that they could sort of cut the corner on the levee the way it exists now, and pick up 1,000 acres of floodplain.

And I'm just -- I think that's a great idea. There's -- I think there might be one house, and it's probably just a rental in that area. So you probably wouldn't have a lot of homeowners that would be hopping mad. And you'd probably pick up 10 or 15,000 acre-feet of flood storage. So it would be something, I think, that would -- engineering-wise, it would be an interesting levee setback to look at.

So the other thing that I think that as a resident of Sutter County, and I live in the LD-1 area -- I'm not sure if LD-1 has the capacity -- management capacity to pull something like that off. You know, maybe setting up something like

trilla (phonetic) like they did in Yuba County. Or maybe this super agency, the Sutter Butte Agency, could do it.

But I just -- I just don't think management capacity, or I should say the planning capacity of the board level -- I think the management, the managers of LD-1 are fine. But the board, I don't think, has vision for projects like this. So hopefully they do.

RICHARD KUCEK:

I guess it goes back to the building of the levee was our first project for the taxpayers to protect everybody from flooding. Okay. They knew after '55 when they finished the levee and had to break in Yuba City, that that wouldn't solve the problem. So they took -- and I wouldn't say they use -- it had scare tactic. But they got the taxpayers to fund another project which was get the dam at Lake Oroville. And the state of California, at that time, from what I understand, did not have enough money to build it. But the taxpayers voted it in, so it went on their tax board. But Southern California funded most of the money for building that in return for surplus water out at the lake.

And somewhere down the line it got turned around that I guess the water's worth more than the people in the houses. So they keep the lake elevation too high. But if they would keep it down, we would never need these projects that they're proposing today, which would be the third ones the taxpayers are going to pay for just for protection.

And like, the slurry would be the right way to fix this right now. If they went with the berm, that would cause a lot of problems, because there would be

1 maintenance, and they can't maintain the levees that there
2 are right now. You can go out there and look at it; kids
3 drive up and down on it, there's gophers and squirrels on
4 it and everything else. And they don't spray it. They
5 don't kill the weeds. They don't do nothing. So if they
6 do, I guess that setback levee, that wouldn't cause a lot
7 more problems on the east side of it, and then what do you
8 do with that? Because you got to be in the floodplain.
9 But the berm, to me, would be too expensive to keep in
10 33 years.
11 So I don't know how they got as far as they did
12 with this project. But it should never happen because the
13 taxpayers shouldn't have to pay three times for flood
14 protection.
15 So I don't know. I guess we'll just go to the
16 meetings and see how it comes out and, you know, if
17 they're going to do all this, and Southern California has
18 the right to all that water, why don't they pay the bills?
19 I mean, why should we have to pay it? If they want to
20 keep that lake full enough so it enables us from flooding,
21 they should have to pay the bill if it does flood. Not
22 raise our taxes and everything else, and our flood
23 insurance, and they get all the water, and we got the
24 bill.
25

BOB BARKHOUSE:

Two concerns I have is the east levee of the Sutter bypass, because, in my lifetime, on the west side -- I've had to live through two floods -- farmland on the other side -- major floods. Those levees on the west side -- east side are no better than west side, yet we're trying to contain the overflow from the Sacramento River between bypass. And we certainly are subject to flooding if the right condition --

And then my second concern was the maps continuously show a perimeter levee around Yuba City, or a J levee on the south and west side. And I'm concerned about building a levee around Yuba City and putting the city of Yuba City in the same parallel as the city of Marysville. Although Marysville has never flooded, but it's always -- the bowl is likely to fill up someday, and it would be a catastrophe.

But I am concerned about that part. They have a strong levee on the Feather River, and let that take care of itself. So that was my two concerns.

1 Certificate

2 of

3 Certified Shorthand Reporter

4 The undersigned certified shorthand reporter of the

5 state of California does hereby certify:

6 That the foregoing deposition was taken before me at

7 the time and place therein set forth, at which time the

8 witness was duly sworn by me;

9 That the testimony of the witness and all objections

10 made at the time of the examination were recorded

11 stenographically by me and thereafter transcribed, said

12 transcript being a true copy of my shorthand notes thereof.

13 In witness whereof, I have subscribed my name this

14 date July 25 2011.

15

16

17 Jill Bassett

18 Certificate number 13619

19

20

21

22

23

24

25

Sutter Basin Project & Feather River West Levee Project

June 27, 2011 Scoping Meeting

Sign-in Sheet

US Army Corps of Engineers
Sacramento District

Name	Title	Affiliation	Street Address	City	Zip Code	How did you hear about the meeting?

Sutter Basin Project & Feather River West Levee Project

June 28, 2011 Scoping Meeting

Sign-in Sheet

US Army Corps of Engineers
Sacramento District

Name	Title	Affiliation	Street Address	City	Zip Code	How did you hear about the meeting?

Appendix E

Comments Received During the Scoping Period

[Excluding comments received at the scoping meetings. See Appendix D for those comments.]

E.1 Public Feedback

Seventeen comments were received apart from feedback received (comments and transcripts from oral comments) at the two scoping meetings. See Appendix D to view comments received at the scoping meetings.

Below is a list summarizing comments received.

1. Project lead agencies must obtain appropriate water quality/discharge permits including those related to dewatering, discharge, sewer, and construction and land disturbance.
2. The area being studied is located in the planning area of the Yuba/Sutter Habitat Conservation Plan/Natural Community Conservation Plan (HCP/HCCP); therefore please provide the Sutter County Community Services Director's office with all future notices regarding this project.
    a. The applicants currently are the Counties of Yuba and Sutter, the City of Wheatland, the City of Live Oak, and Yuba City. These agencies are available to provide additional information upon request.
3. Project teams need to review the current effective Flood Insurance Rate Maps for all counties and cities in the study area. Please note that these cities and counties are participants in the National Flood Insurance Program (NFIP) and the minimum, basic NFIP floodplain management building requirements are described in 44 Code of Federal Regulations (CFR) §§59–65.
4. General requests for more detailed information about the boundaries of each project and the relationship between the two projects.
5. A request to memorialize, in some way, the unreported deaths in 1955 caused by a levee break at Shanghai Bend.
6. The California State Lands Commission (CSLC) requests that as the Project proceeds, the Sutter Butte Flood Control Agency (SBFCA) submits additional information (e.g., detailed maps) to enable CSLC staff to determine if any components of the Project will require a lease or permit. CLSC additionally requests to be placed on any future distribution mailing list for the Project. A thorough project description should be included in the environmental impact statement/environmental impact report (EIS/EIR) in order to facilitate meaningful environmental review of potential impacts, mitigation measures, and alternatives. A thorough description will facilitate CSLC staff's determination of the extent and location of its leasing jurisdiction, make for a more robust analysis of the work that may be performed, and minimize the potential need for subsequent environmental analysis.
7. The project's EIS/EIR should carefully issues and mitigation alternatives in order to formulate a more comprehensive and sustainable approach to flood management in the Sutter/Butte region, as described below. These include:

a. Growth Inducing Impacts—Consider whether providing 200-year flood protection would increase rather than decrease flood risk by incentivizing development in these flood prone areas.

b. Downstream Flood Impacts—Proposed project could route more floodwater downstream to urban communities.

c. Impacts Under Climate Change—Will levee improvements really provide 100–200 year protection?

d. Evaluate a Broader Range of Alternatives—Levee Setbacks, Ring Levees and Building Modifications, Flood Bypass, Oroville Reservoir, Oroville Wildlife Area Levee Modification.

8. From the Feather River Air Quality Management District (AQMD): Recommends regarding the air quality and climate change for both projects. The EIS/EIR should include a discussion of greenhouse gas emissions and climate change impacts. The following District Rules and Regulations May apply:

   a. Rule 3.0 Visible Emissions.

   b. Rule 3.16 Fugitive Dust Emissions.

   c. Rule 4.1 Permit Requirements.

9. The project should submit a Fugitive Dust Control Plan to the Feather River AQMD prior to beginning work. The California Department of Fish and Game (CDFG) would like to emphasize the critical importance of coordination with CDFG during the California Environmental Quality Act (CEQA) and regulatory processes and asks that SBFCA and the U.S. Army Corps of Engineers (USACE) evaluate CDFG's comments closely to ensure that impacts are avoided, minimized and mitigated pursuant to the CEQA and the appropriate regulations and statutes:

   a. CDFG Authority—Commenting as Trustee Agency, landowner and conservation easement holder within the study area for both projects.

   b. California Endangered Species Act (CESA) Species—CDFG has identified species with potential to occur within the study area that may be affected by the projects. (See Attachment with List of Species.)

   c. Threatened and Endangered Plants—EIS/EIRs should include a full impact assessment.

   d. Other Species Considerations—Emphasis on describing and identifying locations of existing resources within the study area that are rare or unique.

   e. Lake or Streambed Alteration Agreement—Backfilling of a pond could be a solution to reducing levee permeability. EIS/EIRs should identify ponds and measures required to reduce an impact to below a level of significance.

   f. Other Habitat Considerations—Recommends the projects be designed to avoid impacts to wetlands and riparian habitat as much as possible.

   g. CDFG Lands, Restoration Efforts and Public Use—Identify lands subject to conservation easements in the study area and ensure that the projects are implemented consistent with the conservation easement terms.

   h. Other Considerations—Identify clear windows of construction, and other measures to minimize impact to wildlife and the recreating public. Detailed monitoring for all mitigation

measures. CEQA filing fees due at the time of the Notice of Determination (NOD) for final EIS/EIRs.

10. To adequately assess and mitigate project-related impacts to archaeological resources, the Native American Heritage Commission (NAHC) recommends the following actions:
    a. Contact the appropriate regional archaeological Information Center for a record search.
    b. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
    c. Contact the NAHC for sacred lands file check and a list of contacts.
    d. Lack of surface evidence of archeological resources does not preclude their subsurface existence.
    e. Information presented at the scoping meetings and in the Notice of Preparation (NOP) was vague. Support for the development of a levee setback area near the confluence was voiced because this land is currently used for agriculture and USACE could minimize land acquisition costs by simply utilizing a flood easement rather than land purchase if the levee is moved north to widen the flood plan.
    f. The sharing of hydraulic models and other findings of levee setback options and costs as they are developed.
11. Keep the public informed about the following topics:
    a. The legal basis for the construction or improvement of levees, on each segment of levee, and include this in the documents.
    b. The extent to which the levee districts are obligated to provide for cross-levee access for private owners and the public; and, the extent to which the levee districts have a right to exclude underlying owners, owners of land on the water-side of the levee, and the public, from being on or crossing the levees
    c. Address the question of who owns the segments of land the levee sits on; what basis the levee district claims the right to maintain a levee on each segment; what extent the levee district may have the right to exclude land-owners and members of the public; and what extent is the burden of the levee district to build and maintain ramps to allow private owners or the public to cross the levee.
    d. The legal effect of the documents and general law on whether levee deeds are read as fee grants or mere easements; who is obligated to maintain ramps providing access across the levee; under what circumstances might the levee district be obligated to construct or maintain a ramp; when may the levee district exclude the underlying owner, owners inside the levee, or the public from crossing the levee.
    e. The tops of the levees were open for use apparently as public roads. What happened to rights which might have existed by dedication, grant, or county road action?

E.2 Next Steps

All comments received, both those at the scoping meetings and those received during the scoping period, will assist in determining which issues are evaluated in detail in both the Sutter Basin Project and Feather River West Levee Project (FRWLP) EIS/EIRs. Once alternatives have been developed based on the scoping process and preexisting information, they will be analyzed, and draft EIS/EIRs will be developed.

Upon the release of the draft EIS/EIR, the public will have 45 days to comment on the document. Additionally, at least one public hearing will be held so the public and agencies can learn more about both of the draft EIS/EIRs, ask questions regarding the analysis, and provide comments. At these meetings, the alternatives will be presented and explained.

Development of the draft EIS/EIR to evaluate the FRWLP is underway and scheduled for public release in 2012. A public release date for the Sutter Basin Project draft EIS/EIR has yet to be determined.

SUTTER COUNTY
COMMUNITY SERVICES DEPARTMENT

Animal Control
Building Inspection
Environmental Health
Planning

Director – Larry Bagley
Assistant Director – Randy Cagle
Fire Services – Dan Yager
Emergency Services – John DeBeaux

CERTIFIED AND FIRST CLASS MAIL

June 8, 2011

Ingrid Norgaard, Project Manager
Sutter Buttes Flood Control Agency
630 K Street, Suite 400
Sacramento, CA 95814

Matt Davis, Environmental Resources Branch
Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

Re: Response to the Notice of Preparation of an EIS/EIR for the Sutter Basin Feasibility Study and Feather River West Levee Project

Dear Ms. Norgaard and Mr. Davis,

Thank you for the opportunity to comment on the Notice of Preparation for the EIS/EIR on the Sutter Basin Feasibility Study and Feather River West Levee Project. The County of Sutter, County of Yuba, City of Yuba City, City of Live Oak, City of Wheatland, California Department of Fish and Game ("DFG") and the United States Fish and Wildlife Service ("USFWS") are in the process of preparing the Yuba-Sutter Natural Community Conservation Plan and Habitat Conservation Plan ("Yuba-Sutter NCCP/HCP"). The area you are studying is located in the planning area of the Yuba/Sutter NCCP/HCP; therefore please provide our office with all future notices regarding this project.

Sincerely,

Larry Bagley

LARRY BAGLEY
COMMUNITY SERVICES DIRECTOR

LB:tsg

cc: Yuba-Sutter NCCP/HCP Working Group Members

H:\My Doc...\2011 Corr...\NCCP_SBFCA NOP response_6-8-11

U.S. Department of Homeland Security
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA. 94607-4052

FEMA

June 9, 2011

Ingrid Norgaard, Project Manager
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, California 95814

Dear Ms. Norgaard:

This is in response to your request for comments on the Notice of Preparation of Draft Environmental Impact Statements/Environmental Impact Reports for the Sutter Basin Feasibility Study and Feather River West Levee Project.

Please review the current effective Flood Insurance Rate Maps (FIRMs) for the Counties of Butte (Community Number 060017) and Sutter (Community Number 060394), and Cities of Biggs (Community Number 060437), Gridley (Community Number 060019), Yuba City (Community Number 060396), and Live Oak (Community Number 060395). Please note that the above referenced Cities and Counties are participants in the National Flood Insurance Program (NFIP). The minimum, basic NFIP floodplain management building requirements are described in Vol. 44 Code of Federal Regulations (44 CFR), Sections 59 through 65.

A summary of these NFIP floodplain management building requirements are as follows:

- All buildings constructed within a riverine floodplain, (i.e., Flood Zones A, AO, AH, AE, and A1 through A30 as delineated on the FIRM), must be elevated so that the lowest floor is at or above the Base Flood Elevation level in accordance with the effective Flood Insurance Rate Map.

- If the area of construction is located within a Regulatory Floodway as delineated on the FIRM, any ***development*** must not increase base flood elevation levels. **The term *development* means any man-made change to improved or unimproved real estate, including but not limited to buildings, other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, and storage of equipment or materials.** A hydrologic and hydraulic analysis must be performed *prior* to the start of development, and must demonstrate that the development would not cause any rise in base flood levels. No rise is permitted within regulatory floodways.

- Upon completion of any development that changes existing Special Flood Hazard Areas, the NFIP directs all participating communities to submit the appropriate hydrologic and hydraulic data to FEMA for a FIRM revision. In accordance with 44 CFR, Section 65.3, as soon as practicable, but not later than six months after such data becomes available, a community shall notify FEMA of the changes by submitting technical data for a flood map revision. To obtain copies of FEMA's Flood Map Revision Application Packages, please refer to the FEMA website at http://www.fema.gov/business/nfip/forms.shtm.

Please Note:

Many NFIP participating communities have adopted floodplain management building requirements which are more restrictive than the minimum federal standards described in 44 CFR. Please contact the local community's floodplain manager for more information on local floodplain management building requirements. The City of Gridley floodplain manager can be reached by calling Jerry Ann Fichter, Mayor, at (). The City of Biggs floodplain manager can be reached by calling Paul H. Pratt, Public Works Superintendent, at (530) 868-1396. The Sutter County floodplain manager can be reached by calling Douglas R. Gault, Director, Department of Public Works, at (530) 822-7450. The Yuba City floodplain manager can be reached by calling George Musallam, Director, Department of Public Works, at (530) 822-3288. The City of Live Oak floodplain manager can be reached by calling Bruce Nash, City Engineer, at (530) 895-1442. The Butte County floodplain manager can be reached by calling Mike Crump, Director, Department of Public Works, at (530) 538-7681.

If you have any questions or concerns, please do not hesitate to call Cynthia McKenzie (510) 627-7190 and/or Frank Mansell (510) 627-7191 of the Mitigation staff.

Sincerely,

Gregor Blackburn, CFM, Branch Chief
Floodplain Management and Insurance Branch

cc:
Jerry Ann Fichter, Mayor, City of Gridley
Paul H. Pratt, Public Works Superintendent, City of Biggs
Douglas R. Gault, Director, Department of Public Works, Sutter County
George Musallam, Director, Department of Public Works, Yuba City
Bruce Nash, City Engineer, City of Live Oak
Mike Crump, Director, Department of Public Works, Butte County
Raul Barba, State of California, Department of Water Resources, Northern Region Office
Ray Lee, State of California, Department of Water Resources, North Central Region Office
Cynthia McKenzie, Senior Floodplanner, CFM, DHS/FEMA Region IX
Frank Mansell, Floodplanner, DHS/FEMA Region IX
Alessandro Amaglio, Environmental Officer, DHS/FEMA Region IX

July 5, 2011

Ingrid Norgaard, Project Manager
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

Dear Ms. Norgaard,

American Rivers, in its commitment to river conservation, public safety, and sustainable flood management, would like to offer comments with respect to the proposed Feather River West Levee Project (FRWLP). It is American Rivers' concern that the project, as currently proposed, fails to incorporate long-term, sustainable flood management strategies, and places both human and natural communities at increased risk of future catastrophic flooding.

The project's EIR/EIS should examine a broad range of issues and mitigation alternatives in order to formulate a more comprehensive and sustainable approach to flood management in the Sutter/Butte region, as described below.

Growth Inducing Impacts
The report should consider whether providing 200-year flood protection from Thermalito Afterbay to Yuba City north would increase, rather than decrease, flood risk by incentivizing development in these flood-prone areas. Flood risk, as defined by the state of California, equals the probability of flooding multiplied by the consequences of a flood. Although the project will reduce the *probability* of local flooding, the *consequences* of eventual flooding in a heavily developed community would be much more severe. Facilitating development efforts by cities, counties, and property owners in flood-prone regions may substantially increase flood risk over the long term.

Downstream Flood Impacts
In its emphasis on structural levee improvements, the proposed project could route more floodwater downstream to urban communities. By reducing the probability of levee failure in the Yuba City area during a large flood event, the project would necessarily increase the probability that flows would be routed downstream, and this would increase the risk of catastrophic flooding in Sacramento and West Sacramento. The report should consider and select alternative improvement measures that would avoid or mitigate these impacts.

Impacts Under Climate Change
The project should consider whether the proposed levee improvements will actually provide 100-year and 200-year protection under projected future flows assuming climate change.

Evaluate a Broader Range of Alternatives

In order to better advance the state and federal flood management goals, the EIR/EIS must evaluate a broader range of alternatives including:

1. **Levee Setbacks**: Evaluate the potential benefits of levee setbacks, including reduced operations and maintenance costs, improvements to local flood protection in the face of climate change, and benefits for fisheries and wildlife habitat.
2. **Ring Levees and Building Modifications**: Examine the potential that ring levees offer for protecting the existing communities of Gridley, West Gridley, Biggs, and Yuba City as an alternative to the proposed project. Elevate buildings outside the ring levees to protect against flooding.
3. **Flood Bypass**: Evaluate the opportunity to reduce peak flows during extreme flood events by rerouting floodwaters into the Butte Basin through a new flood bypass. Such a bypass could divert water out of Thermalito Afterbay and the Feather River and into the Cherokee Canal.
4. **Oroville Reservoir**: Consider opportunities for reducing extreme flood events by reoperating the Oroville reservoir either to expand the flood reservation or improve real time operations during flood events.
5. **Oroville Wildlife Area Levee Modification**: Explore opportunities for reducing peak flood flows through planned modifications to levees adjacent to the Oroville Wildlife Area that would increase flooding of the OWA. Modifying levees along the OWA is required by Article A106 Riparian and Floodplain Improvement Program in the Settlement Agreement for the Relicensing of the Oroville Facilities, FERC Project 2100, executed by the Department of Water Resources and 52 other parties in March 2006.

The costs and benefits of all alternatives should be evaluated in light of the life cycle costs of maintaining and operating the project.

By examining the aforementioned potential project impacts and considering additional mitigation alternatives, the FRWLP can adopt a sustainable flood management vision and offer long-term public safety as well as ecological benefits to the communities of the Sutter/Butte region.

We hope that, in compiling the EIR/EIS and in moving forward with the project, the Sutter Butte Flood Control Agency and its collaborators will consider our comments and be part of the movement towards a safer, more sustainable future for California's Central Valley.

Respectfully,

John Cain,
Director of Conservation
California Flood Management

Megan Randall,
California Flood Management Fellow

From: Francis Coats [mailto:fecoats@msn.com]
Sent: Tuesday, June 28, 2011 12:34 PM
To: Norgaard, Ingrid; Matthew G. Davis
Subject: FW: Additional deaths in 1955 flood

Information on farmworkers who died on Shanghai Bend levee Christmas eve, 1955.

Date: Mon, 10 Jan 2011 15:44:32 -0800
From: mnewkom@yahoo.com
Subject: RE: Additional deaths in 1955 flood
To: fecoats@msn.com

Frank, I'm sure that Oji could possibily have that info in their "archives" if they still have them. I know I still have my old ranch books and employment records from 1956 on. The early stuff is gone.

--- On **Mon, 1/10/11, Francis Coats <*fecoats@msn.com*>** wrote:

From: Francis Coats <fecoats@msn.com>
Subject: RE: Additional deaths in 1955 flood
To: "Roberta Fletcher" <rlf@syix.com>, "Nelson Anthoine" <nelsonanthoine@sbcglobal.net>, "Joe and Jackie Griffin" <leeann@syix.com>, "Jeet Bajwa" <jeetbaj@hotmail.com>, "Janet Baur" <edbaur@sbcglobal.net>, "Kurt Bonham" <bonhamcpa@citlink.net>, "Dick Boundy" <d.boundy@comcast.net>, "Karna Boyer" <boyerkar@syix.com>, "Stan Cleveland" <frypanman@excite.com>, "Suzanne Connelly" <misuzinca1@juno.com>, "Dan Cucchi" <dancucchi@yahoo.com>, "Bob Harlan" <bob@kubaradio.com>, "Mike Darnell" <mikeagle@yahoo.com>, "Narinder Dhaliwal" <ndhaliwal@sbcglobal.net>, "Angel Diaz" <brooklyngeek@yahoo.com>, "David and Pamela Geitner" <geitner@comcast.net>, "Jack and Maxine Elliott" <maxineelliott1695@yahoo.com>, "Diane Fales" <dfales@live.com>, "Darin Gale" <daringale@hotmail.com>, "James Gallagher" <jmgallagher21@hotmail.com>, "Barbara Gaudreau" <b.bilingual@syix.com>, "Richard von Geldern" <vongeldern_ric@sbcglobal.net>, "Ashley Gebb" <agebb@appealdemocrat.com>, "Roy and Miriam Hatamiya" <hatamiyas@yahoo.com>, "Ray Janssen" <rayjanssen@comcast.net>, "Don Kessel" <meccacol@comcast.net>, "Jeannie Klever" <cinnamongirls@sbcglobal.net>, "Rob Klotz" <rob.klotz@yahoo.com>, "Robert LaHue" <rlahue@appealdemocrat.com>, "Howard Yune" <hyune@appealdemocrat.com>, "Barbara LeVake" <blevake@syix.com>, "Jack Levine" <jlevine@c21selectgroup.com>, "Rick and Jerrie Libby" <rlibby@syix.com>, "Tej Maan" <tejmaan@hotmail.com>, "Bob Mackensen" <rmackensen@sbcglobal.net>, "Russell and Mary Mayfield" <marymay2@sbcglobal.net>, "Dee and Roy

Meli" <dmeli1@comcast.net>, "Eric Meyers" <ericbmeyers@cs.com>, "Elaine Miles" <elaine.miles@att.net>, "Chuck and Pat Miller" <chucknpat@comcast.net>, "Rick Nelson" <rrnels1@aol.com>, "Martin Newkom" <mnewkom@yahoo.com>, "Horacio Paras" <hparassr@hotmail.com>, "Kevin Perkins" <kpatcal@yahoo.com>, "Ron Reavis" <ron859@succeed.net>, "Joan Joaquin Wood" <joanwood@earthlink.net>, "Stephanie Ruscigno" <slruscigno@gmail.com>, "Sarvjit Sangha" <coldaqua01@yahoo.com>, "Gabrial Singh" <usafarm@jps.net>, "Paul Singh" <butter2000p@aol.com>, "Chuck Smith" <chucksmith57@hotmail.com>, "Leo and Marilyn Speth" <lfspeth@sbcglobal.net>, "Robert and Pam Stark" <stark@otnusa.com>, "Sarb Takhar" <sarb@sarb.com>, "Larry and Carla Virga" <emu@syix.com>, "Gregor Blackburn" <gregor.blackburn@dhs.gov>, "Bill Edgar" <bille@eanda.org>, "Kim Floyd" <kim@floydcommunications.com>, "Bill Hampton" <ld1@syix.com>, "Kimberly Hoover" <khoover@sutterbutteflood.org>, "Carlos Lazo" <carlos.j.lazo@usace.army.mil>, "Sean Minard" <sminard@mhm-inc.com>, "Al Montna" <almontna@montnafarms.com>, "Duane Oliveira" <duane@theoliveiralawfirm.com>, "Dan Peterson" <dwpeterson@co.sutter.ca.us>, "Michael Picker" <picker@lincolncrow.com>, "Scott Rice" <srice@water.ca.gov>, "Jeff Twitchell" <jtwitchell@geiconsultants.com>, "Steve Yuhas" <stephen.m.yuhas@usace.army.mil>, "Tyler Stalker" <tyler.m.stalker@usace.army.mil>, "Ron Southard" <ronald_southard@sbcglobal.net>, "Sally Serger" <sallyserger@yahoo.com>
Date: Monday, January 10, 2011, 3:26 PM

It seems likely that Oji Brothers might have their names, at least the ones from the Shanghai Bend crew.

Date: Fri, 7 Jan 2011 16:32:51 -0800
From: rlf@syix.com
To: nelsonanthoine@sbcglobal.net; leeann@syix.com; jeetbaj@hotmail.com; edbaur@sbcglobal.net; bonhamcpa@citlink.net; d.boundy@comcast.net; boyerkar@syix.com; frypanman@excite.com; fecoats@msn.com; misuzinca1@juno.com; dancucchi@yahoo.com; bob@kubaradio.com; mikeagle@yahoo.com; ndhaliwal@sbcglobal.net; brooklyngeek@yahoo.com; geitner@comcast.net; maxineelliott1695@yahoo.com; dfales@live.com; daringale@hotmail.com; jmgallagher21@hotmail.com; b.bilingual@syix.com; vongeldern_ric@sbcglobal.net; agebb@appealdemocrat.com; hatamiyas@yahoo.com; rayjanssen@comcast.net; meccacol@comcast.net; cinnamongirls@sbcglobal.net; rob.klotz@yahoo.com; rlahue@appealdemocrat.com; hyune@appealdemocrat.com; blevake@syix.com; jlevine@c21selectgroup.com; rlibby@syix.com; tejmaan@hotmail.com; rmackensen@sbcglobal.net; marymay2@sbcglobal.net; dmeli1@comcast.net; ericbmeyers@cs.com; elaine.miles@att.net; chucknpat@comcast.net; rrnels1@aol.com; mnewkom@yahoo.com; hparassr@hotmail.com; kpatcal@yahoo.com; ron859@succeed.net; joanwood@earthlink.net; slruscigno@gmail.com; coldaqua01@yahoo.com; usafarm@jps.net; butter2000p@aol.com; chucksmith57@hotmail.com; lfspeth@sbcglobal.net; stark@otnusa.com; sarb@sarb.com; emu@syix.com; gregor.blackburn@dhs.gov; BillE@eanda.org; kim@floydcommunications.com; Ld1@syix.com;

khoover@sutterbutteflood.org; carlos.j.lazo@usace.army.mil; sminard@mhm-inc.com; almontna@montnafarms.com; duane@theoliveiralawfirm.com; dwpeterson@co.sutter.ca.us; Picker@lincolncrow.com; srice@water.ca.gov; jtwitchell@geiconsultants.com; stephen.m.yuhas@usace.army.mil; Tyler.M.Stalker@usace.army.mil; ronald_southard@sbcglobal.net; sallyserger@yahoo.com
Subject: Additional deaths in 1955 flood

Additional unreported deaths in the Yuba City 1955 flood
by Roberta Fletcher

News reports state that thirty-eight people died in the Yuba City 1955 flood. What has not been reported is that many more lives were lost when the levee broke at Shanghai Bend on the Feather River. Burwell Ullrey, Sutter County Coroner at the time, documented thirty-eight flood-related deaths in Sutter County. The deaths of the men who were working on top of the levee at Shanghai Bend where it broke are not documented and are not included in the official count. This is Sutter County history that has never been made public.

In 1955 there were Mexican farm workers at Shanghai Bend and they died when the levee broke. It may seem hard for some people to believe that the deaths were not publicly reported and documented. But the 1950's were before the Civil Rights Movement and apparently no one in authority made the effort to document the deaths. It was easier at the time to just bury them and move on. We accepted the decisions that those in authority made. I believe there was no "conspiracy". It was just that people didn't talk about it.

My sources of information include:

Robert Fletcher (my husband) was volunteering on the levee at Shanghai Bend that night along with my father, Irving Pearce. My father worked a little farther down the levee with the English speaking people. Bob worked with the Mexicans because he knew a little Spanish. He said that Oji farms brought two bus-loads of "green card" Mexicans to work on the levee. He and my father left just before the levee broke. My husband always wondered what happened to the Mexicans.

Gabrial Singh's father and uncles were working that night down the levee from the Mexicans. When the levee broke they could hear the screams of the Mexican workers as they were being washed away.

Elaine Miles's father, after the flood, was working under the 5th Street Bridge. There were several bodies and by the way they were dressed he assumed they were Mexicans. They covered them with concrete.

Ben Mueck was a mechanic for Oji farms at the time and he verified the story of the farm workers.

A booklet on the 1955 flood that was written a year later by a person from the LDS church mentions buses and asks the question about who may have died.

Gerald Arnoldy said that the body of a Mexican worker was in a friend's swimming pool.

Jim Kimerer said his grandmother saw dead Mexicans in trees on Carlson Road. They apparently were washed down Gilsizer Slough. I asked him what happened to their bodies and he doesn't know.

I would like for those workers to be remembered for sacrificing their lives trying to keep the Feather River inside the levee. They will probably never be individually identified, but I want people to know the history.

Roberta Fletcher

From: Francis Coats [mailto:fecoats@msn.com]
Sent: Tuesday, July 05, 2011 9:25 AM
To: Norgaard, Ingrid; Matthew G. Davis
Subject: West (right descending bank) Feather River Levee and Sacramento side, Sutter County Levee project.

Please include me in all notices and disributions under CEQA and NEPA

Francis E. Coats, 3392 Caminito Avenue, Yuba City, CA 95991 (530) 701-6116, fecoats@msn.com

Please figure out and let us know the legal basis for the construction or improvement of levees, on each segment of levee, and include this in the documents.

Please figure out and let us know the extent to which the levee districts are obligated to provide for cross-levee access for private owners and the public; and, the extent to which the levee districts have a right to exclude underlying owners, owners of land on the wet side of the levee, and the public, from being on or crossing the levees.

So far as I know, the levee districts bought right-of-way for levees in the 1880 - 1900 era; and then, a another Valley wide entity bought right-of-way in the 1930's and 1940's.

Particlulary the first generation of acquisitions may not be where the levee sits today. Some of these are mere easements, allowing the construction and maintenance of the levee, but not granting the right to exclude other users. Also, though some of the first generation of deeds may appear to grant the whole ownership of the land, the courts may believe that these are still merely easements.

Most of the second generation documents are clearly on their faces merely easements, not authorizing the grantee to exclude anyone else. It seems likely that the larger entity does have real property records that would be of help in figuring out what the rights are relative to the land and the levee.

My experience with Levee District One is that they say they do not have real property records reflecting the acquisition and ownership of levees, although they assume they own the levee and have a right to exclude the public from travelling across or along the levee.
However, they say they have no records, so they really don't have any idea. I identified, say 30 deeds into LD1 between 1870 and 1906, and these seem to correspond to the published county tax maps, particularly Pennngton (1873??) and Punnett (1895). The records are there and accessible, but some one needs to work them up and do the necessary legal research to see what the effects of those documents are.

The county does not tax land under the levee, on the theory that it is close to worthless, so tax records are not much help in figuring out who owns the land the levee sits on.

As part of the planning process, please address the question of who owns the segments of land the levee sit on, on what basis the levee district claims the right to maintain a levee on each segment, to what extent the levee district may have the right to exclude land-owners and members of the public, to what extent it is the burden of the levee district to build and maintain ramps to allow private owners or the public to cross the levee.

I imagine this come out to a series of reference map identifying the location of each tract and cross eferenced to the instrument creating it, with an evaluation of the effect of the document - what rights granted, what rights retained.

Also, a discussion of the legal effect of the documents and general law on whether levee deeds are read

as fee grants or mere easements; who is obligated to maintain ramps providng access across the levee; under what circumstances might the levee district be obligated to construct or maintain a ramp; when may the levee district exclude the underlying owner, owners inside the levee, or the public from crossing the levee.

Also, within human memory, the tops of the levees were open for use apparently as public roads. What happened to rights which might have existed by dedication, grant, or county road action?

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This would involve both work in the county real property records, and any records held by the levee districts and or the other greater entity that took title to lots of levee land in the 1930s and 1940s. the creation of a map showing the segments of levee right of way acquired and relating them to recorded documents. Evaluation of the documents for legal effect. Legal research to come up with an opinion of the legal effect of the documents.

State of California -The Resources Agency
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EDMUND G. BROWN, Jr. Governor
JOHN McCAMMAN, Director

July 26, 2011

Ingrid Norgaard, Project Manager
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

Matt Davis, Environmental Resources Branch
Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

Dear Ms. Norgaard and Mr. Davis:

The Department of Fish and Game (DFG) has reviewed the Notices of Preparation (NOPs) and associated materials for the Sutter Basin and Feather River West Levee Projects (Projects) to be prepared pursuant to the California Environmental Quality Act (CEQA). Environmental Impact Statement/Environmental Impact Reports (EIS/EIRs) will be prepared for the Projects by the Sutter Butte Flood Control Agency (SBFCA) and the U.S. Army Corps of Engineers (USACE) to evaluate structural and non-structural flood-risk-management measures and address levee deficiencies in the Feather River's west levee. Because the Projects are being studied in coordination due to similar study areas, purpose, potential improvements, effects, and parties involved, the DFG has prepared this letter to comment on both Projects. The DFG appreciates the opportunity to provide initial comments on the Projects, and thanks SBFCA and USACE for granting the DFG's request for additional time to comment pursuant to CEQA Guidelines Section 15103.

The study area for the Projects is located in Butte and Sutter Counties, and encompasses approximately 285 square miles roughly bounded by the Feather River to the East; Sutter Bypass, Sutter Buttes, Wadsworth Canal to the West; and Cherokee Canal and Thermalito Afterbay to the North (study area). The Projects' purposes include evaluating structural and non-structural flood-risk-management measures including re-operation of existing reservoirs; improvements to existing levees; construction of new levees; and other storage, conveyance, and non-structural options. Flood waters potentially threatening the study area originate from the Feather River watershed and/or the upper Sacramento River watershed above Colusa Weir. The study area is essentially encircled by project levees and the high ground of Sutter Buttes. Geotechnical analysis and historical performance during past floods indicate that levees are at risk of failure due to underseepage and through-levee seepage.

Activities from the Projects may have significant impacts to fisheries, wildlife, habitats (both in natural and restoration areas), and to DFG lands which provide hunting, fishing, and other public use opportunities. The DFG is able to provide the recommendations included below based on the information provided in the NOPs and associated materials, and an understanding of the natural resources in the study area. The DFG would like to emphasize the critical importance of coordination with the DFG during the CEQA and regulatory processes and asks that SBFCA and USACE evaluate the DFG's comments closely to ensure that impacts are avoided, minimized and mitigated pursuant to CEQA and the appropriate regulations and statutes.

DFG's Authority

These initial comments are submitted under the DFG's authority as Trustee Agency with regard to the fish and wildlife of the State of California, designated rare or endangered native plants, game refuges, ecological reserves, and other areas administered by the DFG (CEQA Guidelines § 15386, subd. (a)). In addition, the DFG will likely be a Responsible Agency with regards to the Projects due to its discretionary approval power pursuant to the California Endangered Species Act (CESA) and/or Section 1603 of the Fish and Game Code (CEQA Guidelines § 15381). The DFG is also commenting as a landowner and conservation easement holder within the study area for the Projects.

CESA Species

The DFG has regulatory authority pursuant to CESA over projects that will result in the take[1] of any species of wildlife designated by the California Fish and Game Commission as an endangered, threatened, or candidate species. Based upon a preliminary review, the DFG has identified several such species with potential to occur within the study area that may be affected by the Projects. These species include giant garter snake (*Thamnophis gigas*), bank swallow (*Riparia riparia*), Swainson's hawk (*Buteo swainsoni*), and other species listed in the attachment to this letter. Take of species protected pursuant to CESA is prohibited (Fish and Game Code § 2080). The DFG, however, may authorize the take of these species by permit if the conditions set forth in Fish and Game Code Section 2081, subdivisions (b) and (c) are met. (See also Cal. Code Regs., tit. 14, § 783.4). If the Projects could result in the take of any species protected pursuant to CESA, an incidental take permit issued by the DFG should be obtained before the take can occur. If the DFG will issue an incidental take permit, the DFG must rely on the EIS/EIRs as prepared by SBFCA and USACE to prepare and issue its own findings regarding the Projects (CEQA Guidelines §§15096 and 15381). The DFG will use the EIS/EIRs if they adequately address the effects of those project activities which the DFG is required by law to carry out or approve.

If a CESA incidental take permit will be sought from the DFG for the Project(s), the DFG will require the EIS/EIRs to contain a detailed analysis of the take and other potential

[1]Pursuant to Fish and Game Code section 86, "'Take' means hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture or kill."

impacts to the species and its habitat, acreage of habitat affected or potentially affected, avoidance and minimization measures that will be implemented, and a detailed description of the mitigation measures that will be performed to reduce impacts to a level of less than significant and fully mitigate the impacts pursuant to CESA.

The DFG may only issue an incidental take permit if it is determined that impacts associated with the authorized take of the species are minimized, fully mitigated, and that adequate funding has been ensured to implement the mitigation measures (Fish and Game Code § 2081(b)(2) and (4)). Because take must be fully mitigated pursuant to CESA, a standard that is higher than the less than significance standard of CEQA, and because funding must be ensured to DFG standards for the minimization and full mitigation measures, the DFG suggests that if take will occur, SBFCA begin to examine and discuss potential strategies to fully mitigate and ensure adequate funding with the DFG now. The EIS/EIRs should include a discussion of the measures that will be required to minimize, fully mitigate and ensure adequate funding pursuant to CESA. The DFG must also determine that issuance of an incidental take permit will not jeopardize the continued existence of a CESA-listed species. The DFG will make this determination based on the best scientific information available and shall include consideration of the species capability to survive and reproduce, including the species known population trends and known threats to the species. The DFG requests that the EIS/EIRs include scientific information sufficient to justify such a determination if necessary.

Regardless of whether take of CESA-listed species is anticipated to occur or not, the EIS/EIRs should provide a comprehensive discussion of all CESA-listed species with a potential to be impacted by the Projects, their habitat, and a discussion of all species-specific mitigation measures that will reduce impacts to CESA-listed species and their habitat to below the level of significance. Any activity resulting in loss of habitat, decreased reproductive success, or other negative effects on population levels of species protected pursuant to CESA should be addressed. The DFG requests that sufficient technical data, thresholds of significance, best management practices, and similar information be included in the EIS/EIRs to permit a full assessment of all significant environmental impacts (CEQA Guidelines § 15147). Because the study area for the Projects is large, the DFG requests that the EIS/EIRs carefully examine the cumulative and landscape-level effects to CESA-listed species that may occur as a result of changes over such a broad landscape. General and specific plans, regional or local land management plans, as well as other closely related past, present, and reasonably foreseeable probable future projects, should be analyzed relative to their impacts on plant and animal communities, wildlife habitats and corridor use in the Sacramento Valley (CEQA Guidelines § 15130). The DFG also requests a careful examination of how the Projects may affect CESA-listed species dispersal in connection with the natural and artificial barriers in the study area. This analysis should include a discussion of adjacent habitats outside of the study area that support or could support species protected pursuant to CESA that may be impacted as a result of the Projects.

Giant Garter Snake

Giant garter snake is designated as threatened pursuant to CESA and occurs throughout the study area. Giant garter snake utilizes habitats associated with waterways and levees that may be directly altered by the Projects. The EIS/EIRs should include a detailed and careful discussion of the potential effects of the Projects on giant garter snake, particularly from any kind of vegetation removal, ground disturbing activities, temporary and permanent loss of habitat, changes in baseline conditions, and other forms of disturbance. The EIS/EIRs should include mitigation measures that will reduce these potential impacts to giant garter snake to below a level of significance. In addition, if take of giant garter snake is expected to occur as a result of the Projects, the EIS/EIRs should include an analysis of appropriate full mitigation measures, including, if necessary, measures to permanently protect and perpetually manage compensatory habitat. The DFG suggests that SBFCA and USACE begin examining locations that would be appropriate for giant garter snake mitigation.

Bank Swallow

Bank swallow is designated as threatened pursuant to CESA and occurs in the study area. Bank swallow utilizes naturally eroded river banks for nesting. Any loss of bank swallow nesting habitat could be considered a potentially significant impact pursuant to CEQA. The EIS/EIRs should identify all areas of existing and potential bank swallow nesting habitat that has the potential to be affected by the Projects. The EIS/EIRs should identify the Projects' potential impacts to bank swallow, and include mitigation measures that reduce these impacts to below a level of significance.

Swainson's Hawk

Swainson's hawk is designated as threatened pursuant to CESA and occurs throughout the study area. Swainson's hawk often utilizes trees in riparian areas for nesting and open landscapes for foraging. The DFG is concerned with potential impacts to raptor nesting behavior as a result of the Projects' activities, and potential loss of foraging and nesting habitat. The Projects' activities could potentially result in significant impacts to nesting raptors including nest abandonment, starvation of young, and/or reduced health and vigor of eggs or nestlings that could result in death. The EIS/EIRs should identify the Projects' potential impacts to Swainson's hawk, and include mitigation measures that reduce these impacts to below a level of significance, and fully mitigate them if necessary.

Chinook Salmon

The Feather River is located adjacent to the eastern border of the study area. The Feather River supports several fish species that utilize the river for immigration, emigration, spawning and/or rearing. These fish species include runs of Chinook salmon (*Oncorhynchus tshawytscha*). Winter-run Chinook salmon is designated as endangered and Spring-run Chinook salmon is designated as threatened pursuant to

CESA. The EIS/EIRs should analyze any potential impacts to these species that may occur as a result of the Projects, and include mitigation measures that reduce these impacts to below a level of significance.

Threatened and Endangered Plants

The EIS/EIRs should include a full impact assessment for plants that are designated as threatened or endangered pursuant to CESA and have the potential to occur in the study area. Numerous vernal pool endemic plant species that are protected pursuant to CESA are known to occur in the study area. The EIS/EIRs should evaluate, but not limit its evaluation, to impacts to the plant species included in the attachment to this letter. The EIS/EIRs should analyze any potential impacts to CESA-listed species that may occur as a result of the Projects, and include mitigation measures that reduce these impacts to below a level of significance.

Other Species Considerations

The regional setting and baseline habitat conditions are critical to an assessment of environmental impacts of the Projects. Therefore the EIS/EIRs should place special emphasis on describing and identifying the locations of existing resources within the study area that are rare or unique (CEQA Guidelines, § 15125 (a)).

The DFG recommends that appropriate surveys be conducted for CESA-listed and other species using standard protocols at the time of year when the species are both evident and identifiable. Field surveys should be scheduled to coincide with the appropriate breeding or other life history stages of animals, when they are likely to be evident. Full floristic surveys should be conducted for any parts of the study area where ground disturbance will occur or where significant changes such as new inundation will occur. Surveys should be scheduled to coincide with peak flowering periods and/or during periods of phonological development that are necessary to identify the plant species. A list of all plant and animal species encountered should be included with the EIS/EIRs.

In addition to species that are protected pursuant to CESA, the EIS/EIRs should evaluate in a similar manner impacts to species that are protected pursuant to other State or federal statutes or regulations, or that may otherwise be considered rare, endangered, or sensitive. This includes an evaluation of impacts to species protected pursuant to the federal endangered species act (16 U.S.C. § 1531)(ESA), plants that are listed with a California Rare Plant Rank, animals listed as a DFG species of special concern, birds of prey (Fish and Game Code § 3503.5), eagles (16 U.S.C. 668-668c), migratory birds (16 U.S.C. 703-712), species listed in the Fish and Game Code as fully protected (Fish and Game Code §§ 3511, 4700, 5050, and 5515), bird nests and eggs including heron rookeries (Fish and Game Code § 3503), and any species that meets the standard in Section 15380 of the CEQA Guidelines. The DFG suggests that the EIS/EIRs include separate thresholds of significance for each of the different species designations listed above that may be impacted by the Projects. The EIS/EIRs should also consider potentially significant cumulative impacts to other species in a manner similar to that described for CESA-listed species above.

Lake or Streambed Alteration Agreement

Pursuant to Section 1602(a) of the Fish and Game Code an entity may not substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake unless the DFG receives written notification beforehand. If the activity may substantially adversely affect an existing fish or wildlife resource then an agreement with the DFG will be required which includes reasonable measures necessary to protect the resource. In general, potentially significant impacts to the environment that should be addressed pursuant to CEQA result whenever a project involves work undertaken in or near a river, stream, or lake that flows at least intermittently through a bed or channel, including ephemeral streams and water courses. Due to the nature of the Projects, the DFG anticipates that a Lake and Streambed Alteration Agreement (LSAA) will be required for the Projects. If DFG will issue an LSAA, the DFG must rely on the EIS/EIRs as prepared by SBFCA and USACE to prepare and issue its own findings regarding the Projects (CEQA Guidelines §15096 and 15381). The DFG will use the EIS/EIRs if they adequately address the effects of those project activities which the DFG is required by law to carry out or approve.

If a LSAA will be sought from the DFG pursuant to Section 1600 et seq. of the Fish and Game Code, the DFG requests that the EIS/EIRs contain specific and detailed descriptions of all fish[2] and wildlife[3] resources that may be substantially adversely affected by any alteration in the bed, channel, bank, natural flow, and the measures necessary to protect them. The EIS/EIRs should delineate and identify seasonally and permanently wetted channels, sloughs, depressions, ponds, etc. that will be filled and/or modified as a result of the Projects. These areas should be quantified by existing habitat type, management strategies and constraints, species presence, and ownership and/or agency responsible for the management and maintenance of the parcel. The DFG requests that the description and protection measures in the EIS/EIRs be supported by scientific information.

The Feather River EIP Preliminary Identification/Design Report (Kleinfelder 2009) states on page 85 Section 5.18.7 in the third mitigation proposal that the backfilling of a pond could be a solution to reducing levee permeability. If this is considered to be an option, the EIS/EIRs should identify the ponds proposed for filling and the measures that will be required to reduce such an impact to below a level of significance.

Other Habitat Considerations

In addition to potential impacts to the bed, channel, or bank of rivers, streams, or lakes, the Projects could also result in potentially significant impacts to associated riparian habitat and wetlands. The DFG recommends that the Projects be designed to avoid

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[2]Pursuant to Fish and Game Code section 45, "'Fish' means wild fish, mollusks, crustaceans, invertebrates, or amphibians, including in part, spawn, or ova thereof."

[3]Pursuant to Fish and Game Code section 711.2(a), "'Wildlife' means and includes all wild animals, birds, plants, fish, amphibians, reptiles, and related ecological communities, including the habitat upon which the wildlife depends for its continued viability."

impacts to wetlands and riparian habitat as much as possible. Mitigation should be provided for unavoidable impacts to wetland and riparian habitat based upon the concept of no net loss of habitat values or acreage.

The EIS/EIRs should identify where any fill material (borrow) will come from, including who owns the property and/or mineral rights for the extraction, who will have management responsibility for borrow areas, and the management purpose of borrow area properties. The EIS/EIRs should quantify the number of old growth riparian trees that may be removed and or impacted by the Projects, and include appropriate mitigation.

The Projects may also contribute to habitat fragmentation and isolation of plant and animal populations. The EIS/EIRs should identify areas where habitat fragmentation or isolation of populations may occur as a result of the Projects, and discuss alternatives or potentially feasible mitigation measures that will avoid or substantially lessen these potential impacts to less than significant levels. Existing wildlife corridors and movement areas should be maintained, and access to undisturbed habitat in adjacent areas, should be provided or maintained. The EIS/EIRs should also analyze project impacts relative to their effects on off-site habitats, and populations. This should include nearby public lands, open space, adjacent natural habitats and riparian ecosystems.

Due to the collective changes to riparian and aquatic ecosystems brought about by agriculture, urbanization, flood risk management and water supply infrastructure, every opportunity to restore and protect existing natural resources should be taken whenever changes in these systems are being contemplated. Potential ecosystem restoration measures include restoration of floodplain function and habitat, and conserving lands with habitat connected to other protected lands. When considering how to mitigate for any potential impacts that could result from the Projects, the DFG encourages SBFCA and USACE to consider broader conservation efforts and goals in the area.

The EIS/EIRs should contain an evaluation of the Projects' consistency with applicable land use plans, such as General Plans, Specific Plans, Watershed Master Plans, and Habitat Conservation Plans, that are established or under development in the study area. The EIS/EIRs should also contain current information regarding any previous reports of sensitive species and habitats including Significant Natural Areas (Section 1930 et seq. of the Fish and Game Code), Significant Ecological Areas, or Environmentally Sensitive Habitat Areas that have been identified near or adjacent to the study area.

DFG Lands, Restoration Efforts and Public Use

The DFG strives to maintain and enhance hunting, fishing and other appropriate public use opportunities throughout the study area. The DFG owns and manages several wildlife and fishing access areas within the study area including the Feather River Wildlife Area (Nelson Slough, Lake of the Woods, O'Connor Lakes, Abbott Lake, and Shanghai Bend), Oroville Wildlife Area, Sutter Bypass, and Gray Lodge Wildlife Area.

These areas provide recreation opportunities (hunting, fishing, wildlife observation, etc.) and access points for the public. Some of these lands are areas that have been restored (especially along the Feather River), and are areas where creation and preservation of habitat is especially important.

The DFG considers impacts to lands owned or managed by the DFG and to public use opportunities to be potentially significant biological and recreational impacts. The DFG requests that the EIS/EIRs fully address potentially significant impacts to DFG lands and public use and recreation, and include appropriate measures to reduce such impacts to less than significant.

The routes and impact areas of the Projects should be clearly defined in the EIS/EIRs to fully evaluate potentially significant impacts. In Figure 2: "Feather River West Levee Project Study Area", the "Levees Proposed for Improvement" alignment shows the levee route approaching the Feather River and cutting through the southern portion of the Oroville Wildlife Area. The DFG is concerned with possible significant impacts to the Oroville Wildlife Area. The current flood control levee passes to the west of the Oroville Wildlife Area boundary. Any proposed new alignment of the levee system through a Wildlife Area should be discussed with the DFG extensively.

The EIS/EIRs should also identify and quantify the cumulative and other impacts of the Projects on existing restoration efforts, and habitats within inundation zones and floodplains that could potentially be impacted by the Projects.

SBFCA and USACE should work with the DFG to ensure that the Projects are consistent with the current efforts to restore floodplain connectivity and habitat corridors, and do not conflict with or inhibit existing restoration projects (e.g. at O'Connor Lakes, Gray Lodge), Management Plans or the goals of the overall Lower Feather River Corridor Management Strategy.

In addition, the Projects should be planned to avoid effects to existing DFG private lands conservation programs such as The California Waterfowl Habitat Program. This program is one of the few incentive based programs that provide private landowners with technical assistance and financial incentives to manage wetland habitat in a specific way for 10 years, and an easement program where landowners are required to follow a cooperatively developed wetland management plan.

SBFCA and USACE should identify lands subject to conservation easements in the study area and ensure that the Projects are implemented consistent with the conservation easement terms.

Other Considerations

The EIS/EIRs should identify clear windows of construction and other measures that will minimize impacts to wildlife as well as the recreating public.

In order to comply with Public Resources Code Section 21081.6, detailed monitoring programs should be developed for all mitigation measures required in the EIS/EIRs

relevant to DFG's jurisdiction. The monitoring programs should include specific criteria to measure effectiveness of mitigation measures, clear timelines for implementation, identification of responsible parties, annual monitoring of restored areas or mitigation lands if applicable, performance criteria for the mitigation measures, and annual monitoring reports submitted to the lead agency and the DFG which include corrective recommendations that shall be implemented in order to ensure that mitigation efforts are successful.

The EIS/EIRs will also be subject to CEQA filing fees pursuant to Fish and Game Code Section 711.4, which must be paid at the time the Notices of Determination for the final EIS/EIRs are filed.

If you have any questions regarding this letter please contact Jeb Bjerke, Environmental Scientist, at jbjerke@dfg.ca.gov or (916) 358-2956.

Sincerely,

Kent A. Smith
Regional Manager

Attachment

ec: Laura Whitney
United States Army Corps of Engineers

Tina Bartlett
Jeff Drongensen
Jennifer Navicky
Jeb Bjerke
Department of Fish and Game

Attachment

The DFG requests that the EIS/EIRs include, but not be limited to analyzing potentially significant impacts to the following species:

Scientific Name	Common Name
Plants	
Astragalus tener var. *ferrisiae*	Ferris' milk-vetch
Atriplex cordulata	heartscale
Atriplex minuscula	lesser saltscale
Atriplex subtilis	subtle orache
Balsamorhiza macrolepis var. *macrolepis*	big-scale balsamroot
Brasenia schreberi	watershield
California macrophylla	round-leaved filaree
Castilleja rubicundula ssp. *rubicundula*	pink creamsacs
Centromadia parryi ssp. *parryi*	pappose tarplant
Chamaesyce hooveri	Hoover's spurge
Clarkia biloba ssp. *brandegeeae*	Brandegee's clarkia
Delphinium recurvatum	recurved larkspur
Downingia pusilla	dwarf downingia
Fritillaria pluriflora	adobe-lily
Hibiscus lasiocarpos var. *occidentalis*	woolly rose-mallow
Juncus leiospermus var. *ahartii*	Ahart's dwarf rush
Juncus leiospermus var. *leiospermus*	Red Bluff dwarf rush
Layia septentrionalis	Colusa layia
Legenere limosa	legenere
Limnanthes floccosa ssp. *californica*	Butte County meadowfoam
Monardella douglasii ssp. *venosa*	veiny monardella
Navarretia leucocephala ssp. *bakeri*	Baker's navarretia
Neostapfia colusana	Colusa grass
Orcuttia pilosa	hairy Orcutt grass
Orcuttia tenuis	slender Orcutt grass
Paronychia ahartii	Ahart's paronychia
Pseudobahia bahiifolia	Hartweg's golden sunburst
Sagittaria sanfordii	Sanford's arrowhead
Silene verecunda ssp. *Verecunda*	San Francisco campion
Trichocoronis wrightii var. *wrightii*	Wright's trichocoronis
Trifolium jokerstii	Butte County golden clover
Tuctoria greenei	Greene's tuctoria
Wolffia brasiliensis	Brazilian watermeal
Animals	
Acipenser medirostris	green sturgeon
Agelaius tricolor	tricolored blackbird
Ambystoma californiense	California tiger salamander
Antrozous pallidus	pallid bat
Athene cunicularia	burrowing owl
Branchinecta lynchi	vernal pool fairy shrimp
Branta hutchinsii leucopareia	cackling goose

Buteo swainsoni	Swainson's hawk
Charadrius montanus	mountain plover
Circus cyaneus	northern harrier
Coccyzus americanus occidentalis	western yellow-billed cuckoo
Dendroica petechia brewsteri	yellow warbler
Desmocerus californicus dimorphus	Valley elderberry longhorn beetle
Dipodomys californicus eximius	Marysville California kangaroo rat
Elanus leucurus	white-tailed kite
Emys marmorata	western pond turtle
Eumops perotis californicus	western mastiff bat
Grus canadensis tabida	greater sandhill crane
Haliaeetus leucocephalus	bald eagle
Lampetra ayresii	river lamprey
Lanius ludovicianus	loggerhead shrike
Lasiurus blossevillii	western red bat
Laterallus jamaicensis coturniculus	California black rail
Lepidurus packardi	vernal pool tadpole shrimp
Mylopharodon conocephalus	hardhead
Oncorhynchus mykiss irideus	steelhead
Oncorhynchus tshawytscha	chinook salmon
Riparia riparia	bank swallow
Spea hammondii	western spadefoot
Taxidea taxus	American badger
Thamnophis gigas	giant garter snake

-----Original Message-----
From: David Neubert [mailto:dcneubert@gmail.com]
Sent: Tuesday, July 05, 2011 4:35 PM
To: Davis, Matthew G SPK
Subject: Sutter Basin and Feather River West Levee Project - Scoping Meeting Comments

Matthew,

The following are my comments on the 28 June Scoping Meeting that I attended in Gridley, CA, in regards to the Sutter Basin and Feather River West Levee Project.

First, let me say that I am encouraged that the Corps and its partners value the input of local citizens in the project area, and are considering ways to optimize both flood safety and riparian ecosystems under the two new projects.

Regarding the presentation given on the 28th, I (along with other citizens I talked with) found it to be rather vague and lacking enough detail for the audience to generate questions from. The opaque nature of the presentation did not help the people understand what the Corps is planning in the project areas, and what the various options are. In the future, it would be better if the Corps (or its consultants) actually presented ideas on the types of activities that are being planned. For example, the Corps could identify areas where levee setbacks may occur, identify areas where riparian habitat can be improved and conserved, identify areas where levees are weak or strong and specific actions that might take place at weak sites to remedy problems.
The format used at the Gridley meeting was probably not worth the time and money invested.

Following the presentation, I spoke with one of the consultants employed by the Corps (or one of its partners). I asked the consultant specifically where levee setbacks may occur on the Feather River West project. He said that there were four possible sites or sites under consideration. One of them (as I recall) was in Butte County near Almond Avenue. A second area identified was at the confluence of the Feather River and the Sutter Bypass (just south of Sacramento Avenue, Sutter County).

As a resident of south Sutter County, I would support any levee setback near the confluence of the Feather River and Sutter Bypass. By creating a wider floodplain in this area, I would think that peak flood levels could be reduced along the Nicolaus Reach. It is my understanding that this is one of the most flood-threatened reaches of the Feather River at the current time.
I hope the Corps aggressively researches the development of a levee setback area near the confluence. This land is currently only in agriculture and the Corps could minimize land acquisition costs by simply utilizing a flood easement rather than land purchase if the levee is moved north to widen the flood plan.

I look forward to seeing hydraulic models and your other findings of levee setback options and costs as they are developed.

Regards,
David Neubert

Classification: UNCLASSIFIED
Caveats: NONE

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

CURTIS L. FOSSUM, *Executive Officer*
(916) 574-1800 FAX (916) 574-1810
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from Voice Phone **1-800-735-2922**

Contact Phone: **(916) 574-1890**
Contact FAX: **(916) 574-1885**

June 29, 2011

File Ref: SCH #2011052062

Ingrid Norgaard
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street
Sacramento, CA 95814

Subject: Notice of Preparation (NOP) for a Joint Environment Impact Report (EIR)/Environmental Impact Statement (EIS) for the Feather River West Levee Project, Sutter and Butte Counties

Dear Ms. Norgaard:

Staff of the California State Lands Commission (CSLC) have reviewed the subject NOP for a joint EIR/EIS for the Feather River West Levee Project (FRWLP or Project), which is being prepared by the U.S. Army Corps of Engineers (USACE) as the federal lead agency under the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] § 4321 et seq.) and the Sutter Butte Flood Control Agency (SBFCA) as the state lead agency under the California Environmental Quality Act (CEQA) (Public Resources Code [PRC] § 21000 et seq.).

The FRWLP is being sponsored by the SBFCA and Central Valley Flood Protection Board (CVFPB) as a locally driven flood risk reduction project. USACE has authority through the Rivers and Harbors Act of 1899 (as amended) over modifications to federal flood control project levees, and any such alterations proposed by SBFCA are subject to approval by USACE.

The FRWLP is being studied in close coordination with the Sutter Basin Feasibility Study (SBFS), a separate but related project, because the FRWLP and the SBFS at least partially overlap in their study areas, purpose, potential improvements, potential effects, and involved parties.

The CSLC has prepared these comments as a trustee and responsible agency because of its trust responsibility for projects that could directly or indirectly affect sovereign lands, their accompanying Public Trust resources or uses, and the public easement in navigable waters.

CSLC Jurisdiction

The CSLC has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable rivers, sloughs, lakes, etc. The CSLC has certain residual and review authority for tide and submerged lands legislatively granted in trust to local jurisdictions (PRC § 6301, § 6306). All tide and submerged lands, granted or ungranted, as well as navigable rivers, sloughs, etc., are impressed with the Common Law Public Trust.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for fill or artificial accretion. On navigable non-tidal waterways, the State holds fee ownership of the bed landward to the ordinary low water mark and a Public Trust easement landward to the ordinary high water mark. Such boundaries may not be readily apparent from present day site inspections.

The location of the proposed Project may involve sovereign land in the Feather River under the jurisdiction of the Commission. However, information submitted in the NOP is insufficient for CSLC staff to determine the extent and location of the Project with respect to sovereign ownership interests of the State. We request that as the Project proceeds, the SBFCA submit additional information (e.g., detailed maps) to enable CLSC staff to determine if any components of the Project will require a lease or permit. We additionally request to be placed on any future distribution mailing list for the Project.

Proposed Project

The SBFCA proposes the FRWLP under the California Department of Water Resources (DWR) Early Implementation Program (EIP) to expeditiously complete flood risk reduction measures in advance of the Sutter Basin Project.

SPFCA is planning the FRWLP to address levee deficiencies in the west levee of the Feather River between Thermolito Afterbay and the Feather River/Sutter Bypass confluence to meet federal, state and local flood protection criteria and goals. Primary deficiencies of the levee include:

- through-seepage;
- under-seepage; and
- embankment instability (overly steepened slopes).

Alternatives considered for addressing levee deficiencies may include measures such as:

- slurry cut-off walls;
- seepage berms;
- stability berms;
- internal drains;
- relief wells;
- sheet-pile walls;
- slope flattening; and
- potential new levee alignments.

Environmental Review

A thorough Project description should be included in the EIR/EIS in order to facilitate meaningful environmental review of potential impacts, mitigation measures, and alternatives. The Project description should be as precise as possible in describing the details of all proposed activities (e.g., types of equipment or methods that may be used, maximum area of impact, seasonal work windows, locations for material disposal, etc.), as well as the details of the timing and length of activities. A thorough description will facilitate CSLC staff's determination of the extent and location of its leasing jurisdiction, make for a more robust analysis of the work that may be performed, and minimize the potential need for subsequent environmental analysis.

Biological Resources

1. Sensitive Species: SBFCA should conduct queries of the California Department of Fish and Game's (DFG) California Natural Diversity Database (CNDDB) and U.S. Fish and Wildlife Service's (USFWS) Special Status Species Database to identify any special-status plant or wildlife species that may occur in the Project area. Additionally, SBFCA should consult early in the process with appropriate staff at DFG to identify species of concern. The EIR/EIS should analyze the potential for such species to occur in the Project area and, if impacts to special-status species are found to be significant, identify feasible mitigation measures.

2. Invasive Species: One of the major stressors to the Sacramento-San Joaquin River Delta is introduction of non-native species. As the Feather River is a principal tributary of the Sacramento River, the EIR/EIS should consider a plan with a range of alternatives for prevention programs for terrestrial and aquatic invasive species (including quarantine, early detection, and early response) to slow the introduction of invasive species into high-traffic and sensitive areas. In developing these alternatives, the proposed plan should consider using current and proposed aquatic invasive species prevention programs in the area as models. In addition, in light of the recent decline of pelagic organisms and in order to protect at-risk fish species, the EIR/EIS should examine if the objectives of the plan would favor non-native fisheries within the Sacramento and San Joaquin River system and Delta.

3. Construction Noise: The EIR/EIS should evaluate noise and vibration impacts on fish and birds from construction, restoration or flood control activities in the water, on the levees, and for land-side supporting structures. Mitigation measures could include species-specific work windows as defined by DFG, USFWS, and the National Oceanographic and Atmospheric Administration's Fisheries Service (NOAA Fisheries). Again, staff recommends early consultation with these agencies to minimize the impacts of the Project on sensitive species.

Climate Change

A greenhouse gas (GHG) emissions analysis consistent with the California Global Warming Solutions Act (AB 32) and required by section 15064.4 of the State CEQA Guidelines[1] should be included in the EIR/EIS. This analysis should identify a threshold for significance for GHG emissions, calculate the level of GHGs that will be emitted as a result of construction and ultimate build-out of the Project, determine the significance of the impacts of those emissions, and, if impacts are significant, identify mitigation measures that would reduce or minimize them. The analysis should pay particular attention to the possibility of cumulative impacts of GHG emissions.

Cultural Resources

1. Submerged Resources: The EIR/EIS should evaluate the possibility of submerged cultural resources in the Project area. The CSLC maintains a shipwrecks database, available at http://shipwrecks.slc.ca.gov, that can assist with this analysis. The database includes known and potential vessels located on the State's tide and submerged lands; however, the locations of many shipwrecks remain unknown. Please note that any submerged archaeological site or submerged historic resource that has remained in state waters for more than 50 years is presumed to be significant.

2. Title to Abandoned Resources: The EIR/EIS should mention that the title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the State and under the jurisdiction of the CSLC. Mitigation measures should be developed to address any submerged cultural resources that may be affected by the proposed Project and any unanticipated discoveries during the Project's construction. CSLC staff would like to review the proposed mitigation measures and requests that SBFCA consult with CSLC staff, should any cultural resources be discovered during construction of the proposed Project.

Hydrology and Water Quality

SBFCA should disclose and analyze the Project's potential to adversely affect water quality. Such impacts are likely to include increased turbidity and sedimentation from

[1] The "State CEQA Guidelines" are found in Title 14 of the California Code of Regulations, commencing with section 15000.

construction disturbance, dredging, fill, and other in-water construction work, and potential pollution from worksite spills or mobilization of pollutants from the disturbed soils. For any effects found to be potentially significant, the EIR/EIS should identify feasible mitigation measures that would avoid or lessen such effects.

Recreation

As public access and recreation on State lands are key concerns of the Public Trust, CSLC staff requests that the EIR/EIS analyze the Project's short-term and long-term impacts on recreation resources, both during construction and for the life of the project. Any significant impacts will require mitigation measures that either minimize or reduce the impacts or otherwise compensate residents and visitors.

Mitigation and Monitoring

To avoid the improper deferral of mitigation, mitigation measures should either be presented as specific, feasible, enforceable obligations, or should be presented as formulas containing "performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way" (State CEQA Guidelines § 15126.4(b)).

It would also be helpful to provide a summary of the mitigation measures relied upon to avoid or reduce the identified impacts to less than significant, in addition to a monitoring program of these actions to ensure compliance and enforceability through permit conditions, agreements or other measures during Project implementation.

As a potential responsible agency, the CSLC may need to rely on this document for the issuance of a lease, therefore, we request that you consider our comments during preparation of the draft EIR/EIS.

If you have any questions concerning environmental review or where to send copies of future FRWLP-related notices and/or environmental documents, please contact Joan Walter, Environmental Scientist, at (916) 574-1310 or by e-mail at joan.walter@slc.ca.gov. If you have any questions concerning CSLC leasing jurisdiction, please feel free to contact Ninette Lee, Public Land Manager, at (916) 574-1869.

Sincerely,

Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Matt Davis, Environmental Resources Branch
Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

Office of Planning and Research
N. Lee, LMD, CSLC
J. Walter, DEPM, CSLC

From: Megan Randall [mailto:mrandall@americanrivers.org]
Sent: Wednesday, June 22, 2011 3:47 PM
To: Norgaard, Ingrid; Matthew.G.Davis@usace.army.mil
Subject: Feather River West Levee Project Information

Dear Ingrid and Matt,

I am writing to you in hopes of discussing the Feather River West Levee Project. I was hoping that you might be able to help me answer a couple questions or provide me with some helpful materials before the scoping period ends. American Rivers is interested in submitting comments, and we would like to get all the information possible before doing so.

Specifically, I would like to get some more in-depth information on exactly what is being proposed for the Feather River Levee system. Do you have any additional information or reports on the following that might help me become better informed?

a. Background information: Reports detailing the current flaws in the levee system. Technical background information identifying specific flaws and the need for improvements.
b. Details about what is being proposed currently:
    i. Detailed maps of which levees and regions are identified for repair, etc.
    ii. Detailed reports on the proposed design for repair. I am aware that the design process isn't expected to be completed until 2012. Do you know how far along the design process is and if there are any reports which would give insight into the most significant elements of the plan to date?
c. Lastly, are you aware of any information on the project's relationship to expanded urban development in the region? Do you know if there is any literature on proposed development projects, or if there is someone I can contact to get more information on this aspect of the project?

Thanks to both of you for your time and any help you can provide.

Best,
Megan Randall

From: Megan Randall [mailto:mrandall@americanrivers.org]
Sent: Monday, June 27, 2011 3:30 PM
To: Norgaard, Ingrid
Subject: RE: Feather River Levee Scoping Period

Dear Ingrid,

Thanks for your help and insights. I have a couple additional questions.

I am curious as to whether there are any existing maps which identify the location and boundaries of the Reaches outlined by the Preliminary Identification/Design Report. It would be nice to get a visual of the precise location of the proposed improvements.

Also, I am wondering if you (or anyone else) might be able to provide any information as to the relationship between the FRWLP and the Sutter Basin Feasibility Study. Do you know why these two projects were both included in the NOP?

Thanks so much! I really appreciate your time and help.

-Megan

From: Norgaard, Ingrid [mailto:INorgaard@icfi.com]
Sent: Monday, June 27, 2011 6:45 AM
To: admin@sutterbutteflood.org; Megan Randall
Subject: RE: Feather River Levee Scoping Period

Megan, I can see why that title on Attachment 1 is confusing, but the intent of that doc is only to provide additional information related to scoping for the Draft EIS/EIRs under preparation (none have been prepared to date). And to clarify, we are accepting comments through July 8, 2011.

Thanks,
Ingrid

From: SBFCA [mailto:admin@sutterbutteflood.org]
Sent: Friday, June 24, 2011 4:08 PM
To: Norgaard, Ingrid; mrandall@americanrivers.org
Subject: FW: Feather River Levee Scoping Period

Hi, Megan;

I've copied Ingrid Norgaard on this email as she will be able to answer your environmental questions below.

Ingrid;
Please see the email below re: enviro questions. Could you please review and respond to Megan (copied on this email)?

Thank you!
Sarah

Sutter Butte Flood Control Agency
530-755-9859 o

1227 Bridge Street, Suite C
Yuba City, CA 95991

admin@sutterbutteflood.org
www.SutterButteFlood.org

From: Megan Randall [mailto:mrandall@americanrivers.org]
Sent: Wednesday, June 22, 2011 3:37 PM
To: admin@sutterbutteflood.org
Subject: RE: Feather River Levee Scoping Period

Dear Sarah,

Thanks for the information. I have a couple additional questions that perhaps you can answer for me.

1. The PDF of the NOP which was provided on the website also includes a document labeled Attachment 1: DRAFT Environmental Impact Statements/Environmental Impact Reports. I found this a bit confusing since the document does not appear to be a comprehensive EIS/EIR and I wasn't aware that the draft EIR/EIS had been released yet. Could you clarify what Attachment 1 is meant to be?

Sorry for the long e-mail. Any help or insight would be very much appreciated!

Thanks for your time,
Megan Randall

From: SBFCA [mailto:admin@sutterbutteflood.org]
Sent: Wednesday, June 22, 2011 2:30 PM
To: Megan Randall
Subject: RE: Feather River Levee Scoping Period

Hi, Megan;

Thanks for your inquiry – and, good timing! Our public scoping meetings are next week; you can find information on our website here: http://sutterbutteflood.org/index.php/notices_documents and here: http://sutterbutteflood.org/index.php/news_events/events/. I hope this information is helpful to you. Should you have any additional questions, please don't hesitate to email me.

Thanks!
Sarah Modeste

Sutter Butte Flood Control Agency

1227 Bridge Street, Suite C
Yuba City, CA 95991

admin@sutterbutteflood.org
www.SutterButteFlood.org

From: Megan Randall [mailto:mrandall@americanrivers.org]
Sent: Tuesday, June 21, 2011 9:51 AM
To: info@sutterbutteflood.org
Subject: Feather River Levee Scoping Period

I wanted to inquire about the Feather River West Levee Rehabilitation Project. I was wondering if the scoping period for this project has closed, or if there is still time to comment.

Thanks for any insights.

Best,
Megan Randall

From: Megan Randall [mailto:mrandall@americanrivers.org]
Sent: Thursday, June 30, 2011 10:40 AM
To: admin@sutterbutteflood.org
Cc: Norgaard, Ingrid; Matthew.G.Davis@usace.army.mil
Subject: FRWLP Questin

Dear Sarah, Ingrid, and Matthew,

I have one additional question about the FRWLP that perhaps you might be able to help me with.

I have been browsing the Preliminary Problem Identification Report as well as the Preliminary Design Report on the SBFCA website, and I noticed that the levee project identified by these documents is only 27 miles long and runs from Yuba City north to Thermalito Afterbay.

On the website, however, the project maps and the NOP identify the FRWLP as running all the way from Thermalito Afterbay to the Sutter Bypass confluence, a total of 44 miles.

I am just curious as to why the information differs, and how the two projects are related (the levee project from Thermalito after to Yuba City, and then the project from Yuba City to the Sutter Bypass confluence). Will the SBFCA implement both of these projects? Does the approximate $300 million cost estimate cover improvements for the entire stretch, or just the 27 mile stretch? Is there any other information about the proposed Yuba-Sutter Bypass improvements available that might clarify some of my questions?

Thanks so much for all your help!

Best,
Megan

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-4082
(916) 657-5390 - Fax

July 15, 2011

Ingrid Norgaard
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

RE: SCH# 2011052062 Sutter Basin Feasibility Study and Feather River West Levee Project; Sutter and Butte Counties.

Dear Ms. Norgaard:

The Native American Heritage Commission (NAHC) has reviewed the Notice of Preparation (NOP) referenced above. The California Environmental Quality Act (CEQA) states that any project that causes a substantial adverse change in the significance of an historical resource, which includes archeological resources, is a significant effect requiring the preparation of an EIR (CEQA Guidelines 15064(b)). To comply with this provision the lead agency is required to assess whether the project will have an adverse impact on historical resources within the area of project effect (APE), and if so to mitigate that effect. To adequately assess and mitigate project-related impacts to archaeological resources, the NAHC recommends the following actions:

- ✓ Contact the appropriate regional archaeological Information Center for a record search. The record search will determine:
  - If a part or all of the area of project effect (APE) has been previously surveyed for cultural resources.
  - If any known cultural resources have already been recorded on or adjacent to the APE.
  - If the probability is low, moderate, or high that cultural resources are located in the APE.
  - If a survey is required to determine whether previously unrecorded cultural resources are present.
- ✓ If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
  - The final report containing site forms, site significance, and mitigation measurers should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum, and not be made available for public disclosure.
  - The final written report should be submitted within 3 months after work has been completed to the appropriate regional archaeological Information Center.
- ✓ Contact the Native American Heritage Commission for:
  - A Sacred Lands File Check. . **USGS 7.5 minute quadrangle name, township, range and section required.**
  - A list of appropriate Native American contacts for consultation concerning the project site and to assist in the mitigation measures. **Native American Contacts List attached.**
- ✓ Lack of surface evidence of archeological resources does not preclude their subsurface existence.
  - Lead agencies should include in their mitigation plan provisions for the identification and evaluation of accidentally discovered archeological resources, per California Environmental Quality Act (CEQA) §15064.5(f). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American, with knowledge in cultural resources, should monitor all ground-disturbing activities.
  - Lead agencies should include in their mitigation plan provisions for the disposition of recovered artifacts, in consultation with culturally affiliated Native Americans.
  - Lead agencies should include provisions for discovery of Native American human remains in their mitigation plan. Health and Safety Code §7050.5, CEQA §15064.5(e), and Public Resources Code §5097.98 mandates the process to be followed in the event of an accidental discovery of any human remains in a location other than a dedicated cemetery.

Sincerely,

Katy Sanchez

Katy Sanchez
Program Analyst
(916) 653-4040

cc: State Clearinghouse

Native American Contact List
Sutter and Butte Counties
July 15, 2011

Berry Creek Rancheria of Maidu Indians
Cultural Resources Rep
#5 Tyme Way — Tyme Maidu
Oroville , CA 95966
gmix@berrycreekrancheria.com
(530) 534-3859
(530) 534-1151 FAX

Butte Tribal Council
Ren Reynolds
1693 Mt. Ida Road — Maidu
Oroville , CA 95966
(530) 589-1571

Mechoopda Indian Tribe of Chico Rancheria
Dennis E. Ramirez, Chairperson
125 Mission Ranch Blvd — Mechoopda Maidu
Chico , CA 95926 — Concow
dramirez@mechoopda-nsn.gov
(530) 899-8922 ext 215
(530) 899-8517 - Fax

Mooretown Rancheria of Maidu Indians
Gary Archuleta, Chairperson
#1 Alverda Drive — Maidu
Oroville , CA 95966 — KonKow / Concow
frontdesk@mooretown.org
(530) 533-3625
(530) 533-3680 Fax

Greenville Rancheria of Maidu Indians
Kyle Self, Chairperson
PO Box 279 — Maidu
Greenville , CA 95947
kself@greenvillerancheria.com
(530) 284-7990
(530) 284-6612 - Fax

United Auburn Indian Community of the Auburn Rancheria
David Keyser, Chairperson
10720 Indian Hill Road — Maidu
Auburn , CA 95603 — Miwok
530-883-2390
530-883-2380 - Fax

Maidu Nation
Clara LeCompte
P.O Box 204 — Maidu
Susanville , CA 96130

Maidu Cultural and Development Group
Lorena Gorbet
PO Box 426 — Maidu
Greenville , CA 95947
(530) 284-1601

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources for proposed SCH# 2011052062 Sutter Basin Feasibility Study and Feather River West Levee Project; Sutter and Butte Counties.

Native American Contact List
Sutter and Butte Counties
July 15, 2011

KonKow Valley Band of Maidu
Patsy Seek, Chairperson
1706 Sweem Street — KonKow / Concow
Oroville , CA 95965 — Maidu
(530) 533-1504

Berry Creek Rancheria of Maidu Indians
Jim Edwards, Chairperson
#5 Tyme Way — Tyme Maidu
Oroville , CA 95966
gmix@berrycreekrancheria.com
(530) 534-3859
(530) 534-1151 FAX

T si-Akim Maidu
Eileen Moon,Vice Chairperson
760 So. Auburn St. Ste 2-C — Maidu
Grass Valley , CA 95945
(530) 477-0711

Enterprise Rancheria of Maidu Indians
Art Angle, Vice Chairperson
3690 Olive Hwy — Maidu
Oroville , CA 95966
eranch@cncnet.com
(530) 532-9214
(530) 532-1768 FAX

Strawberry Valley Rancheria
Cathy Bishop, Chairperson
PO Box 667 — Maidu
Marysville , CA 95901 — Miwok
catfrmsac2@yahoo.com
916-501-2482

Enterprise Rancheria of Maidu Indians
Glenda Nelson, Chairperson
2133 Monta Vista Ave — Maidu
Oroville , CA 95966
eranch@cncnet.com
(530) 532-9214
(530) 532-1768 FAX

Mooretown Rancheria of Maidu Indians
James Sanders, Tribal Administrator
#1 Alverda Drive — Maidu
Oroville , CA 95966 — KonKow/Concow
(530) 533-3625
(530) 533-3680 FAX

United Auburn Indian Community of the Auburn Rancheria
Marcos Guerrero, Tribal Preservation Committee
10720 Indian Hill Road — Maidu
Auburn , CA 95603 — Miwok
mguerrero@auburnrancheria.com
530-883-2364
530-883-2320 - Fax

This list is current only as of the date of this document.

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This list is only applicable for contacting local Native Americans with regard to cultural resources for proposed SCH# 2011052062 Sutter Basin Feasibility Study and Feather River West Levee Project; Sutter and Butte Counties.

Native American Contact List
Sutter and Butte Counties
July 15, 2011

Mechoopda Indian Tribe of Chico Rancheria
Mike DeSpain, Director - OEPP
125 Mission Ranch Blvd
Chico , CA 95926
mdespain@mechoopda-nsn.gov
(530) 899-8922 ext 219
(530) 899-8517 - Fax

Mechoopda Maidu
Concow

April Wallace Moore
19630 Placer Hills Road
Colfax , CA 95713
530-637-4279

Nisenan - So Maidu
Konkow
Washoe

United Auburn Indian Community of the Auburn Rancheria
Gregory S. Baker, Tribal Administrator
10720 Indian Hill Road
Auburn , CA 95603
gbaker@auburnrancheria.
530-883-2390
530-883-2380 - Fax

Maidu
Miwok

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of the statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native Americans with regard to cultural resources for proposed SCH# 2011052062 Sutter Basin Feasibility Study and Feather River West Levee Project; Sutter and Butte Counties.

Serving Sutter and Yuba Counties

1007 Live Oak Blvd. Suite B-3
Yuba City, CA 95991
(530) **634-7659**
FAX (530) **634-7660**
www.fraqmd.org

David A. Valler, Jr.
Air Pollution Control Officer

June 30, 2011

Ingrid Norgaard, Project Manager
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

Matt Davis, Environmental Resources Branch
Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

Re: Notice of Preparation of Draft Environmental Impact Statements/Environmental Impact Reports for the Sutter Basin Feasibility Study and Feather River West Levee Project.

Dear Ms. Norgaard and Mr. Davis,

The Feather River Air Quality Management District (District) appreciates the opportunity to review and comment on the above referenced project.

The project site is partially located in Sutter County, which is currently designated as nonattainment for Federal $PM_{2.5}$ ambient air quality standards, nonattainment-transitional for State 1-hour and 8-hour ozone standards, and nonattainment for State PM_{10} standards. The District would like to make the following recommendations regarding the scope and content of the environmental information for these two projects in regards to air quality and climate change:

Construction Phase

A project of this type is considered a Type 2 project under the District's CEQA Guidelines (http://www.fraqmd.org/PlanningTools.htm). This size project will likely generate construction-related air quality impacts that exceed the District's adopted thresholds of significance. An air quality analysis should be performed to determine the impact of the project. The District recommends the Roadway Construction Emissions Model (Version 6.3.2, July 2009) developed by the Sacramento Metropolitan Air Quality Management District, available at http://www.airquality.org/ceqa/index.shtml. If the impacts are found to be significant, the District recommends the measures listed on Attachment C Best Available Construction Phase Mitigation Measures, and the construction equipment mitigation measure on Attachment E.

Some special considerations for construction phase of this project may include an analysis of the impacts to sensitive receptors located within 1,000 feet of the project site, compliance with state regulations prohibiting the excessive idling of on-road and off-road diesel-fueled vehicles, and ensuring that all portable engines greater than 50 horsepower be registered with the California Air Resources Board or obtain a District permit. For information on obtaining a District permit, please contact Mr. Timothy Mitro, Air Quality Engineer, at (530) 634-7659 ext 208.

Operational Phase
Any air quality impacts from this project are likely to occur during the construction phase as this is a Type 2 project.

Greenhouse Gas and Climate Change Impacts
The District recommends the EIR/EIS include a discussion of greenhouse gas emissions and climate change impacts. Currently, the District has not adopted thresholds of significance for GHG emissions. However, the California Air Pollution Control Officers Association (CAPCOA) publication CAPCOA CEQA & Climate Change provides guidance on addressing a project's impact on climate change (www.capcoa.org). Other resources for addressing Climate Change under CEQA are listed in Chapter 8 of the District's Guidelines (http://www.fraqmd.org/PlanningTools.htm).

District Rules and Regulations
All projects are subject to District rules and regulations. Some rules and regulations that may apply to this project are:

- Rule 3.0 Visible Emissions
- Rule 3.16 Fugitive Dust Emissions
- Rule 4.1 Permit Requirements

A complete listing of District rules and regulations is available at http://www.arb.ca.gov/drdb/fr/cur.htm.

The project should also submit a Fugitive Dust Control Plan to the District prior to beginning work. The Fugitive Dust Control Plan and supporting documentation are included with this comment letter as Attachments A, B, & D.

If you need further information or assistance, please contact me at (530) 634-7659 x210. Air District staff will be available to assist the project proponent or Lead Agency as needed.

Sincerely,

Sondra Spaethe

Sondra Andersson Spaethe
Air Quality Planner

Enclosures: Attachments A, B, C, D & E

File: Chron

Attachment A:
Feather River Air Quality Management District
Fugitive Dust Control Plan

This plan, upon signature and submittal to the FRAQMD, will serve as an approved Fugitive Dust Control Plan to be implemented at the designated site. This plan must be submitted by the project proponent and received at the air district prior to start of work.

The approved plan serves as an acknowledgment by the project proponent of their duty to address state and local laws governing fugitive dust emissions and the potential for first offense issuance of a Notice of Violation by the air district where violations are substantiated by District staff. This plan (along with standard mitigation measures for all projects and best available mitigation measures where applicable) shall be made available to the contractors and construction superintendent on the project site.

- Site Location: _____

- Project Type (circle all that apply): Residential Commercial Industrial Transportation

- List of responsible persons:

  Company:_____

  Office (name, title, address, phone): _____

  _____

  Field (name, title, phone): _____

- Projected Start and End Dates: _____
  (Day/Month/Year)

Project Proponent: _____ _____
Printed Name Company/Phone

Signature: _____ Title: _____

By signing this document I acknowledge that I have read the accompanying literature regarding state and local fugitive dust emission laws and understand that it is my responsibility as the project proponent to ensure that appropriate materials and instructions are available to site employees to implement fugitive dust mitigation measures (Attachment B) appropriate for each development phase of this project.

I further acknowledge that it is my responsibility to ensure that site employees are made formally aware of fugitive dust control laws, requirements, and available mitigation techniques, and that appropriate measures are to be implemented at the site as necessary to prevent fugitive dust violations.

Please Submit to: FRAQMD, 1007 Live Oak Blvd. Suite B-3, Yuba City, CA 95991 Attn: Planning
Phone: 530-634-7659 x210 FAX: 530-634-7660 Email: sspaethe@fraqmd.org

Attachment B
Feather River Air Quality Management District

Standard Construction Phase Mitigation Measures for All Projects

1. *Mandatory:* Implement the Fugitive Dust Control Plan

2. Construction equipment exhaust emissions shall not exceed FRAQMD Regulation III, Rule 3.0, Visible Emissions limitations (40 percent opacity or Ringelmann 2.0). Operators of vehicles and equipment found to exceed opacity limits shall take action to repair the equipment within 72 hours or remove the equipment from service. Failure to comply may result in a Notice of Violation.

3. The primary contractor shall be responsible to ensure that all construction equipment is properly tuned and maintained prior to and for the duration of onsite operation.

4. Minimize idling time to 5 minutes – saves fuel and reduces emissions. (State idling rule: commercial diesel vehicles- 13 CCR Chapter 10 Section 2485 effective 02/01/2005; off road diesel vehicles- 13 CCR Chapter 9 Article 4.8 Section 2449 effective 05/01/2008)

5. Utilize existing power sources (e.g., power poles) or clean fuel generators rather than temporary power generators.

6. Develop a traffic plan to minimize traffic flow interference from construction activities. The plan may include advance public notice of routing, use of public transportation, and satellite parking areas with a shuttle service. Schedule operations affecting traffic for off-peak hours. Minimize obstruction of through-traffic lanes. Provide a flag person to guide traffic properly and ensure safety at construction sites.

7. Portable engines and portable engine-driven equipment units used at the project work site, with the exception of on-road and off-road motor vehicles, may require California Air Resources Board (ARB) Portable Equipment Registration with the State or a local district permit. The owner/operator shall be responsible for arranging appropriate consultations with the ARB or the District to determine registration and permitting requirements prior to equipment operation at the site.

Attachment C

Feather River Air Quality Management District

FUGITIVE DUST CONTROL - BEST AVAILABLE MITIGATION MEASURES

TO BE USED IN ADDITION TO STANDARD CONSTRUCTION PHASE MITIGATION MEASURES

Sources: FRAQMD Indirect Source Review Guidelines and Best Available Mitigation Measures compiled by the air districts of the Greater Sacramento Region and approved for implementation by the FRAQMD Board of Directors.

All grading operations on a project should be suspended when winds exceed 20 miles per hour or when winds carry dust beyond the property line despite implementation of all feasible dust control measures.

Construction sites shall be watered as directed by the Department of Public Works or Air Quality Management District and as necessary to prevent fugitive dust violations.

An operational water truck should be onsite at all times. Apply water to control dust as needed to prevent visible emissions violations and offsite dust impacts.

Onsite dirt piles or other stockpiled particulate matter should be covered, wind breaks installed, and water and/or soil stabilizers employed to reduce wind blown dust emissions. Incorporate the use of approved non-toxic soil stabilizers according to manufacturer's specifications to all inactive construction areas.

All transfer processes involving a free fall of soil or other particulate matter shall be operated in such a manner as to minimize the free fall distance and fugitive dust emissions.

Apply approved chemical soil stabilizers according to the manufacturers' specifications, to all-inactive construction areas (previously graded areas that remain inactive for 96 hours) including unpaved roads and employee/equipment parking areas.

To prevent track-out, wheel washers should be installed where project vehicles and/or equipment exit onto paved streets from unpaved roads. Vehicles and/or equipment shall be washed prior to each trip. Alternatively, a gravel bed may be installed as appropriate at vehicle/equipment site exit points to effectively remove soil buildup on tires and tracks to prevent/diminish track-out.

Paved streets shall be swept frequently (water sweeper with reclaimed water recommended; wet broom) if soil material has been carried onto adjacent paved, public thoroughfares from the project site.

Provide temporary traffic control as needed during all phases of construction to improve traffic flow, as deemed appropriate by the Department of Public Works and/or Caltrans and to reduce vehicle dust emissions. An effective measure is to enforce vehicle traffic speeds at or below 15 mph.

Reduce traffic speeds on all unpaved surfaces to 15 miles per hour or less and reduce unnecessary vehicle traffic by restricting access. Provide appropriate training, onsite enforcement, and signage.

Reestablish ground cover on the construction site as soon as possible and prior to final occupancy, through seeding and watering.

Disposal by Burning: Open burning is yet another source of fugitive gas and particulate emissions and shall be prohibited at the project site. No open burning of vegetative waste (natural plant growth wastes) or other legal or illegal burn materials (trash, demolition debris, et. al.) may be conducted at the project site. Vegetative wastes should be chipped or delivered to waste to energy facilities (permitted biomass facilities), mulched, composted, or used for firewood. It is unlawful to haul waste materials offsite for disposal by open burning.

Attachment D
Feather River Air Quality Management District
LOCAL AND STATE REGULATIONS APPLICABLE TO FUGITIVE DUST

I. FRAQMD Rules and Regulations

Note: The following District Rules and Regulations are enforced for each project regardless of lead agency or Board approved project CEQA mitigation requirements.

FRAQMD RULE 3.0 - VISIBLE EMISSIONS *(Adopted 6/91)*

As provided by Section 41701 of the California Health and Safety Code, a person shall not discharge into the atmosphere from any single source of emissions whatsoever, any air contaminants for a period or periods aggregating more than three minutes in any one hour which is:

a. As dark or darker in shade as that designated as No. 2 on the Ringlemen Chart, as published by the United States Bureau of Mines; or

b. Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in Subsection 'a' above.

Enforcement: The District has trained staff capable of performing a Visible Emissions Evaluation (VEE). VEE courses are offered to regulators and the regulated community (for a fee) at regular intervals by staff of the California Air Resources Board.

FRAQMD RULE 3.16 - FUGITIVE DUST EMISSIONS *(Adopted 4/11/94)*

A. PURPOSE
The purpose of this Rule is to reasonably regulate operations which periodically may cause fugitive dust emissions into the atmosphere.

B. DEFINITION
For the purpose of this Rule, the following definitions shall apply:

B.1 Fugitive Dust: Solid airborne matter emitted from any non-combustion source.
B.2 Emergency: Any act of God, but only if the owner of the property from which fugitive dust emissions originate establishes for the Feather River Air Quality Management District, by a preponderance of evidence, that he or she took reasonable precautions in light of the relevant facts and circumstances to minimize emissions.
B.3 Property Line: Adjacent properties which are owned by the same person shall be considered the same property for the purpose of determining the property line.

C. REQUIREMENTS
A person shall take every reasonable precaution not to cause or allow the emissions of fugitive dust from being airborne beyond the property line from which the emission originates, from any construction, handling or storage activity, or any wrecking, excavation, grading, clearing of land or solid waste disposal operation.

Reasonable precautions shall include, but are not limited to:

C.1 use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, construction of roadways, or the clearing of land;
C.2 application of asphalt, oil, water, or suitable chemical on dirt roads, material stockpiles, and other surfaces which can give rise to airborne dusts;
C.3 other means approved by the Air Pollution Control Officer.

D. EXEMPTIONS
The provisions of this Rule shall not apply to the following:

D.1 Agricultural Operations
D.2 Currently unworked land designated as reclaimed for agriculture
D.3 An Emergency
D.4 Unpaved roads open to public travel (this inclusion shall not apply to industrial or commercial facilities).

II. State Laws

California Health and Safety Code

Section 41700. Except as otherwise provided in Section 41705, no person shall discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.

Section 41701. Except as otherwise provided in Section 41704, or Article 2 (commencing with Section 41800) of this chapter other than Section 41812, or Article 2 (commencing with Section 42350) of Chapter 4, no person shall discharge into the atmosphere from any source whatsoever any air contaminant, other than uncombined water vapor, for a period or periods aggregating more than three minutes in any one hour which is: (a) As dark or darker in shade as that designated as No. 2 on the Ringelmann Chart, as published by the United States Bureau of Mines, or (b) Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in subdivision (a).

California Vehicle Code

Section 23114 requires: No vehicle shall transport any aggregate material upon a highway unless the material is covered. Exception 23114(e)(4): Vehicles transporting loads of aggregate materials shall not be required to cover their loads if the load, where it contacts the sides, front, and back of the cargo container area, remains six inches from the upper edge of the container area, and if the load does not extend, at its peak, above any part of the upper edge of the cargo container area. For purposes of this section, "aggregate material" means rock fragments, pebbles, sand, dirt, gravel, cobbles, crushed base, asphalt, and other similar materials.

Attachment E:
Reducing ROG, NOx, & PM emissions from off-road diesel powered equipment

This mitigation measure may be used by projects to mitigate emissions of Reactive Organic Gases (ROG), Oxides of Nitrogen (NOx), and/or Particulate Matter (PM). The results of the Construction Mitigation Calculator shall be submitted and approved by the District PRIOR TO BEGINNING WORK.

The proponent shall assemble a comprehensive inventory list (i.e. make, model, engine year, horsepower, emission rates) of all heavy-duty **off-road** (portable and mobile) equipment (50 horsepower and greater) that will be used an aggregate of 40 or more hours for the construction project and apply the following mitigation measure:

The project shall provide a plan for approval by FRAQMD demonstrating that the heavy-duty (equal to or greater than 50 horsepower) **off-road equipment** to be used in the construction project, including owned, leased and subcontractor vehicles, will achieve a project wide fleet-average 5 percent ROG reduction, 20 percent NOx reduction and 45 percent particulate reduction compared to the most recent CARB fleet average at time of construction. A Construction Mitigation Calculator (MS Excel) may be downloaded from the SMAQMD web site to perform the fleet average evaluation http://www.airquality.org/ceqa/index.shtml .

Acceptable options for reducing emissions may include use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology (Carl Moyer Guidelines), after-treatment products, voluntary offsite mitigation projects, provide funds for air district offsite mitigation projects, and/or other options as they become available. The District should be contacted to discuss alternative measures.

Linda S. Adams
Acting Secretary for Environmental Protection

California Regional Water Quality Control Board
Central Valley Region
Katherine Hart, Chair

11020 Sun Center Drive #200, Rancho Cordova, California 95670-6114
(916) 464-3291 • FAX (916) 464-4645
http://www.waterboards.ca.gov/centralvalley

Edmund G. Brown Jr.
Governor

20 June 2011

Ingrid Norgaard
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

CERTIFIED MAIL
7010 1670 0002 0652 8212

COMMENTS TO THE NOTICE OF PREPARATION OF THE DRAFT ENVIRONMENTAL IMPACT REPORT, SUTTER BASIN FEASIBILITY STUDY AND FEATHER RIVER WEST LEVEE PROJECT, SCH NO.2011052062, SUTTER COUNTY

Pursuant to the State Clearinghouse's 20 May 2011 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Notice of Preparation of the Draft Environmental Impact Report* for the Sutter Basin Feasibility Study and Feather River West Levee Project, located in Sutter County.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP).

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]

The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/

Industrial Storm Water General Permit

Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 97-03-DWQ.

For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml.

Clean Water Act Section 404 Permit

If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed for the United States Army Corps of Engineers (USACOE). If a Section 404 permit is required by the USACOE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements.

If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACOE at (916)557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACOE permit, or any other federal permit, is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. Water Quality Certification must be obtained prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications.

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[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

Waste Discharge Requirements

If USACOE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project will require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

For more information on the Water Quality Certification and WDR processes, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/

If you have questions regarding these comments, please contact me at (916) 464-4745 or gsparks@waterboards.ca.gov.

For Genevieve (Gen) Sparks
Environmental Scientist
401 Water Quality Certification Program

cc: State Clearinghouse Unit, Governor's Office of Planning and Research, Sacramento

Linda S. Adams
Acting Secretary for Environmental Protection

California Regional Water Quality Control Board
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Edmund G. Brown Jr.
Governor

6 July 2011

Ingrid Norgaard
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

CERTIFIED MAIL
7010 3090 0001 4843 2695

COMMENTS TO THE NOTICE OF PREPARATION FOR THE DRAFT ENVIRONMENTAL IMPACT REPORT, SUTTER BASIN FEASIBILITY STUDY PROJECT, SCH NO. 2011052085, SUTTER AND BUTTE COUNTIES

Pursuant to the State Clearinghouse's 22 June 2011 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Notice of Preparation for the Draft Environmental Impact Report* for the Sutter Basin Feasibility Study Project, located in Sutter and Butte Counties.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP).

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

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The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
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Clean Water Act Section 404 Permit
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If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACOE at (916)557-5250.

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If USACOE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project will require

[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

For more information on the Water Quality Certification and WDR processes, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/

If you have questions regarding these comments, please contact me at (916) 464-4745 or gsparks@waterboards.ca.gov.

Genevieve (Gen) Sparks
Environmental Scientist
401 Water Quality Certification Program

cc: State Clearinghouse Unit, Governor's Office of Planning and Research, Sacramento

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In reply refer to:
81420-2011-TA-0619-01

JUN 30 2011

Mr. Matt Davis
Environmental Resources Branch
Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

Subject: Yuba-Sutter Habitat Conservation Plan/Natural Community Conservation Plan, Yuba and Sutter Counties, California

Dear Mr. Davis:

The U.S. Fish and Wildlife Service (Service) has received your Notice of Preparation of Draft Environmental Impact Statements/Environmental Impact Reports for the Sutter Basin Feasibility Study and Feather River West Levee Project dated May 20, 2011 (ER 11/464). The Service would like to assist you in your planning efforts, so we are providing this notification that Yuba and Sutter Counties are currently engaged in a Habitat Conservation Plan/Natural Community Conservation Plan (HCP/HCCP). The applicants currently are the counties of Yuba and Sutter, the city of Wheatland, the city of Live Oak, and Yuba City. This is a multi-year planning process that was initiated as a result of indirect effects from the Upgrade of State Route 70 project (Service file numbers 1-1-00-F-0224 and 1-1-02-F-0069) and it includes the majority of Yuba and Sutter Counties. We would be happy to provide you with additional information upon your request.

TAKE PRIDE IN AMERICA

The Service wishes to thank you for your continued efforts and dedication to the conservation of America's wildlife resources. Please contact Ellen R. McBride or Mike Thomas at (916) 414-6630 if you have questions regarding this response. Please refer to Service file number 81420-2011-TA-0619 in any future correspondence.

Sincerely,

Michael Thomas

for Eric Tattersall
Deputy Assistant Field Supervisor

cc:
Ms. Ingrid Norgaard, Sutter Butte Flood Control Agency, Sacramento, CA 95814
Mr. Steve Schoenberg, U.S. Fish and Wildlife Service, Sacramento, CA 95825
Ms. Loretta Sutton, Office of Environmental Policy and Compliance, Washington, DC 20240

California Regional Water Quality Control Board
Central Valley Region
Katherine Hart, Chair

Linda S. Adams
Acting Secretary for Environmental Protection

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Edmund G. Brown Jr.
Governor

31 May 2011

Ingrid Norgaard
Sutter Butte Flood Control Agency
c/o ICF International
630 K Street, Suite 400
Sacramento, CA 95814

COMMENTS ON THE NOTICE OF PREPARATION FOR PROPOSED SUTTER BASIN FEASIBILITY STUDY & FEATHER RIVER WEST LEVEE PROJECT, BUTTE COUNTY

The Central Valley Regional Water Quality Control Board (Central Valley Water Board) is a responsible agency for this project, as defined by the California Environmental Quality Act (CEQA). On 23 May 2011, we received your request for comments on the Notice of Preparation for the Sutter Basin Feasibility Study & Feather River West Levee Project.

Sutter Butte Flood Control Agency has two efforts presently underway to study flood risk reduction improvements in Sutter and Butte Counties, one known as the Sutter Basin Feasibility Study, sponsored by the U.S. Army Corps of Engineers to determine federal interest in flood risk reduction projects, and one known as the Feather River West Levee Project, sponsored by the Sutter Butte Flood Control Agency as a locally driven flood risk reduction project.

USACE initiated the Sutter Basin project in 2001 and is conducting a feasibility study to evaluate flood damage reduction, ecosystem restoration, and recreation opportunities within the study area. The Central Valley Flood Protection Board and SBFCA, in their roles as non-federal local sponsors, are coordinating with USACE on the feasibility study. USACE, acting as the federal lead agency under NEPA, and SBFCA, acting as the state lead agency under CEQA, have determined that an EIS/EIR will be prepared to describe alternative, potential environmental effects, and mitigation measures.

SBFCA is planning the FRWLP to address levee deficiencies in the west levee of the Feather River from Thermalito Afterbay to the Sutter Bypass confluence to meet federal, state, and local flood protection criteria and goals. In 2010, an assessment district was enacted to provide local funding toward flood management improvements. These funds will be matched with those from the Disaster Preparedness and Flood Prevention Bond Act of 2006. The purpose of the FRWLP would be to construct improvements as quickly as possible in advance of and compatible with the Sutter Basin Feasibility Study.

Based on our review of the information submitted for the proposed project, we have the following comments:

Clean Water Act (CWA) Section 401, Water Quality Certification
The Central Valley Water Board has regulatory authority over wetlands and waterways under both the Federal Clean Water Act (CWA) and the California Water Code, Division 7 (CWC). Discharge of dredged or fill material to waters of the United States requires a CWA Section 401 Water Quality Certification from the Central Valley Water Board. Typical activities include any modifications to these waters, such as stream crossings, stream bank modifications, filling of wetlands, etc. 401 Certifications are issued in combination with CWA Section 404 Permits issued by the Army Corps of Engineers. The proposed project must be evaluated for the presence of jurisdictional waters, including wetlands and other waters of the State. Steps must be taken to first avoid and minimize impacts to these waters, and then mitigate for unavoidable impacts. Both the Section 404 Permit and Section 401 Water Quality Certification must be obtained prior to site disturbance.

Isolated wetlands and other waters not covered by the Federal Clean Water Act
Some wetlands and other waters are considered "geographically isolated" from navigable waters and are not within the jurisdiction of the Clean Water Act. (e.g., isolated wetlands, vernal pools, or stream banks above the ordinary high water mark). Discharge of dredged or fill material to these waters may require either individual or general waste discharge requirements from the Central Valley Water Board. If the U.S. Army Corps of Engineers determine that isolated wetlands or other waters exist at the project site, and the project impacts or has potential to impact these non-jurisdictional waters, a Report of Waste Discharge and filing fee must be submitted to the Central Valley Water Board. The Central Valley Water Board will consider the information provided and either issue or waive Waste Discharge Requirements. Failure to obtain waste discharge requirements or a waiver may result in enforcement action.

Any person discharging dredge or fill materials to waters of the State must file a report of waste discharge pursuant to Sections 13376 and 13260 of the CWC. Both the requirements to submit a report of waste discharge and apply for a Water Quality Certification may be met using the same application form, found at:

http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/wqc_application.pdf

General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (CGP)
Construction activity, including demolition, resulting in a land disturbance of one acre or more must obtain coverage under the CGP. The Sutter Basin Feasibility Study & Feather River West Levee Project must be conditioned to implement storm water pollution controls during construction and post-construction as required by the CGP. To apply for coverage under the CGP the property owner must submit Permit Registration Documents electronically prior to construction. Detailed information on the CGP can be found on the State Water Board website: http://www.waterboards.ca.gov/water_issues/programs/stormwater/gen_const.shtml

Dewatering Alternative 1: Discharge to Storm Drains or Waters of the United States
A dewatering permit, *General Order for Dewatering and Other Low Threat Discharges to Surface Waters*, (Central Valley Water Board Order No. R5-2008-0082, adopted 12 June 2008) may be required for pump testing, pipeline dewatering and/or construction activities. This general NPDES (National Pollutant Discharge Elimination System) permit covers the discharge to waters of the United States of clean or relatively pollutant-free wastewater that poses little or no threat to water quality. The following categories are covered by the dewatering permit: well development water; construction dewatering; pump/well testing; pipeline/tank pressure testing; pipeline/tank flushing or dewatering; condensate discharges; water supply system discharges; miscellaneous dewatering/low threat discharges. The dewatering permit applies only to direct discharges to waters of the United States Failure to obtain a dewatering permit, when required, may result in enforcement action. An application form and a copy of the permit are available at this office.

Dewatering Alternative 2: Discharges to Land
Construction and system test dewatering discharges that are contained on land (i.e., will not enter waters of the United States) are allowed under Central Valley Water Board Resolution No. 2003-0003-DWQ provided the following conditions are met: (1) the dewatering discharge is of a quality as good as or better than underlying groundwater; and (2) there is a low risk of nuisance. Examples of dewatering discharges to land include a terminal basin, irrigation (with no return to waters of the United States), and dust control. You may request written confirmation from this office that the waiver is applicable.

If you have any questions or comments regarding this matter please contact me at (530) 224-4784 or by email at szaitz@waterboards.ca.gov.

Scott A. Zaitz

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SAZ: wrb/jmtm

cc: Mr. Will Ness, U.S. Army Corp of Engineers, Sacramento
Department of Fish and Game, Region 2, Rancho Cordova
State Clearing House Number (2011052062), Sacramento
State Water Resources Control Board, Sacramento

Appendix C

Flood Risk Management and Geomorphic Conditions Supplemental Environmental Setting, Flood Risk Management and Geomorphic Reports

Part C.1

Additional environmental setting information in support of Section 3.1, *Flood Risk Management and Geomorphic Conditions*

Parts C.2, C.3, C.4, and C.5

William Lettis and Associate's Surficial Geologic Maps and Geomorphic Assessment of the Sutter Study Area, Urban Levee Geotechnical Evaluation, Sutter and Butte Counties, California

From URS Supplemental Geotechnical Data Report (2010), Appendix O, Volumes 2 through 5

Parts C.6 and C.7

Feather River West Levee Project Design Water Surface Profiles, PBI, March 2012

Feather River West Levee Project Design Water Surface Profiles Addendum #1, PBI, July 2012

Part C.8

'With-Project' Hydraulics Analysis for the Feather River West Levee Project, PBI, October 2012

Part C.1

Supplemental Environmental Setting

Part C.1
Supplemental Environmental Setting

This appendix provides additional environmental setting information in support of Section 3.1, *Flood Risk Management and Geomorphic Conditions.*

C.1.1 Flooding

C.1.1.1 Flood Basins of the Sacramento Valley

The importance of natural flood basins to the Sacramento Valley river system was recognized by Gilbert as early as 1917 (Gilbert 1917; Water Engineering & Technology 1990:32–33). Flood basins in the Sacramento Valley were originally delineated by Gilbert. More recently, Ayres Associates (2008:16–17) divided the entire Sacramento River basin into potential flooded areas, based on the land that would be flooded if a levee failure occurs. The Sacramento River basin was divided into 26 sub-basins (Ayres Associates 2008:16–17, Figures 5 and 6).

Gilbert (1917) and discussed in Water Engineering & Technology (1990:32–33) described these flood basins as being inundated annually by floodwaters. The Sacramento River was separated from the flood basins by natural levees; however, at high water, these levees were easily overtopped. The lower 25 miles of the Feather River (approximately 18 miles of which are in the proposed project area) is also bounded by flood basins (Water Engineering & Technology 1990:32–33).

Hall (1880 as cited in Water Engineering & Technology 1990:32–34) describes the inundation of the flood basins during the flood of 1879:

> During the high water of March 1879, the low lands of the Sacramento Valley, to the extent of about 847 square miles, were covered with water; this area includes all flooded for a short period of time, as well as that upon which the water rested for several months. Above the mouth of the Feather River, in what may be called the upper flood region, the area covered was about 483 square miles; and below that point, in what is called the lower flood region, the flooded area was about 364 square miles in extent.

Gilbert (1917:15) emphasized the hydrologic significance of the natural flood basins:

> The lateral basins affected the channel characters in important ways. They conveyed a large part of the flood discharge and thus left for adjacent portions of the channel only a small part. They acted as reservoirs for the storage of floodwaters and fed them gradually to the lower course of the Sacramento, so that the channels in the delta region were only moderately taxed by the floods. The channels in consequence were adjusted for conveyance of only a fraction of the flood discharge; they were of moderate section and their meanders were of small radius. Between the town of Colusa and the mouth of the Feather River the Sacramento River grows gradually smaller downstream until its estimated capacity is only 10 per cent of the flood discharge.

Because the flood basins have been maintained as topographic lows even though there has been extensive overbank deposition, it is evident that the flood basins have been subsiding at a rate equal to or exceeding that of overbank deposition (Gilbert 1917; Water Engineering & Technology 1990:34; Water Engineering & Technology 1989 as cited in Water Engineering & Technology 1990:34; Harvey 1988 as cited in Water Engineering & Technology 1990:34). Such widespread

subsidence perhaps is driven by ongoing structural deformation of the Sacramento Valley. Offset on the Willows fault could have generated an east-dipping topographic gradient on the eastern, upthrust block. Rotation of the downthrust block could have generated a similar gradient (Water Engineering & Technology 1990:34–35). See Section 3.3, *Geology, Soils, Seismicity, and Mineral Resources*, for further information about land subsidence in the proposed project area.

In brief, the Sacramento Valley flood basins play a key role in the fluvial geomorphology and hydrology of the Feather River. Most importantly, suspended sediment that historically has been deposited in the flood basins has produced a thick, cohesive stratigraphic assemblage, which adds to the bank stability of the lower Feather River. The significance of these flood basin deposits increases downstream as the topographic lows become more prevalent (Water Engineering & Technology 1990:35).

C.1.2 Geomorphic Conditions

C.1.2.1 Channel Network Classification

Valley morphology varies going downstream in most watersheds, such as the Feather River watershed. Because of this variation, watersheds are divided into valley segments and channel reaches. Valley segments are distinctive sections of the valley network that possess geomorphic properties and hydrologic transport characteristics that distinguish them from adjacent reaches (Bisson and Montgomery 1996:26).

Valley segments can be classified into three classes based on their position within the watershed and the relative ratios of transport capacity to sediment supply (Montgomery and Buffington 1998:23–24). Headwater source areas typically are transport-limited (often because of limited channel runoff) but do offer sediment storage that is intermittently initiated under large flow events, debris flows, or other gravitational events (e.g., landslides). Transport segments are composed of morphologically resilient, supply-limited reaches (e.g., bedrock, cascade, step-pool) that rapidly convey increased sediment inputs. Response segments consist of lower-gradient, more transport-limited depositional reaches (e.g., plane-bed, pool-riffle, step-pool sequences) where channel adjustments occur in response to changes in sediment supply delivered from upstream.

Based on field observations, literature review, and the stream classification methodologies described above, the Feather River in the proposed project area is an alluvial valley segment dominated by plane-bed and pool-riffle reaches. Plane-bed and pool-rifle reaches are transport-limited; therefore, the Feather River behaves as a response segment, theoretically adjusting its bed morphology to water and/or sediment. In general, it can be described as a sediment-laden, low-sinuosity stream.

C.1.2.2 Reach-Specific Geomorphic Conditions

From the Feather River's confluence with the Yuba River to river mile (RM) 7, levees confine the river within the Sutter Bypass. During flooding, overflow from the Sacramento River can enter the river through the Bypass and a backwater can form. The bed is made up of moving bars of sand, which can become mobile even during summer irrigation season (Foothill Associates 2010).

From RM 7 to RM 12.5, the Feather River is characterized by the presence of alternate gravel bars on the channel margins and large sand waves within the channel. The frequency of these sand waves increases upstream from Nicolaus. From RM 12.5 to RM 17, near the confluence with the Bear River, the Feather River is relatively wide and straight, and the upper bank sediments are composed of highly erodible, non-cohesive hydraulic mining-derived sands (Water Engineering & Technology 1990:8). For the most part, the bank on one side of the river consists of floodplain silt and sand overlying slickens, while the opposite bank is made up of active point bar deposits of sand with some silt, which indicates that some bank erosion and channel migration is occurring (Foothill Associates 2010). Fluvial entrainment and dry gravel of upper bank sediments are common; however, the resistance of the toe bank, composed of fine-grained hydraulic mining debris (slickens), contributes to planform stability (Water Engineering & Technology 1990:8).

From RM 17 to RM 28, the resistant Pleistocene Modesto Formation commonly forms the channel banks of the Feather River so that channel planform is relatively stable. Several distinct bendways are present within this reach (Water Engineering & Technology 1990:8). These large meanders occur near the bottom of the reach. The banks are made up mostly of floodplain deposits and the beds mostly of sand. The Shanghai Bend, a bench-like outcrop that forms a rapid, with a near-vertical drop of several feet in places, occurs in this reach (Foothill Associates 2010).

Near the confluence with the Yuba River, the Feather River is influenced by backwater effects from the Yuba River, which cause the river to become relatively straight with minimal bank instability and fewer meanders. The floodplain here, confined by older natural levee terrace deposits and built levees, is typically less than 1 mile across. The bed is sand and the banks are made up of floodplain deposits. There are few point bars or other depositional features and only a single channel (Foothill Associates 2010).From RM 29 to RM 61 (near Oroville), the levee embankment system is set back and the river occupies a wide meander belt similar to the Sacramento River upstream of Colusa. In general, the Feather River is a sand- to fine gravel–dominated, high-sinuosity channel upstream of Marysville to about RM 56. Upstream of RM 56, sinuosity decreases, split flow around mid-channel gravel bars is common, and sediment is dominated by coarse gravel to cobble-sized sediment. The river is bordered by gold mining dredge spoils in this upper reach (Water Engineering & Technology 1991:139–140).

More specifically, from RM 29 to RM 45, the Feather River is a sinuous meandering channel whose bed material is dominated by sand to fine gravel–sized sediment. The sediment coarsens gradually upstream through the reach. The river is highly dynamic and contains large point bars and chute channels. Bank erosion is extensive; however, wide levee setback precludes direct levee threat. Where the channel flows close to the levees, the resistant Pleistocene Modesto Formation commonly composes the channel banks (Water Engineering & Technology 1991:139–140). This section of river is unlike the other reaches because of its high sinuosity, active bank erosion, and point bar formation. These point bars are made up primarily of sand and minor gravel and are not armored. Meander cutoffs have occurred here and will likely continue to occur. The instability of this reach is likely related to the relatively fine composition (sand to fine gravel) of the bed and banks (Foothill Associates 2010).

From RM 45 to 54, high-flow sinuosity is low, split flow is common, and bed and bar sediment is dominated by gravel to cobble-sized material. This reach has a very high sediment load because of the presence of dredge spoils upstream. From RM 54 to RM 61, the Feather River flows through gold mining dredge spoils. The channel banks generally are composed of the spoils, which are dominated by sand to cobble-sized sediment. The river has been controlled within linear spoils piles so that the

spoils border the river directly for several miles. As a result, sinuosity is low in this uppermost reach (Water Engineering & Technology 1991:139–140).

C.1.2.2.1 Surficial Geology

Previous geologic mapping in the southern proposed project area along the Feather River and surrounding areas generalize the surficial deposits as: Quaternary Alluvium (map unit Qa) and Quaternary stream channel deposits (map unit Qsc) within and proximal to the modern Feather River channel, (Helley and Harwood 1985). These map units are considered Holocene age (less than 11,000 years old). Late Quaternary Modesto Formation (map units Qmu, Qml) is mapped along the western margin of the floodplain.

Previous geologic mapping along the northern Feather River and surrounding areas generalizes the surficial deposits as: Quaternary alluvium (map unit Qa) and Quaternary stream channel deposits (map unit Qsc), which are mapped within and proximal to the modern Feather River channel (Bussaca et al. 1989 as cited in Appendix O of Volume 4 of URS 2010:3 [included in this report as Appendix C, part C.4]; Creely 1965 as cited in Appendix O of Volume 4 of URS 2010:3; Helley and Harwood 1985). These map units are considered Holocene in age (less than 11,000 years old). Late Pleistocene Modesto Formation (map units Qmu, Qml) is present as an escarpment along the western margin of the floodplain.

These map units were delineated by Helley and Harwood (1985) at a regional scale (1:62,500). A more current analysis of the Feather River area by William Lettis & Associates uses this existing geologic framework as a basis for more detailed mapping of late Holocene alluvium and geomorphic features (see Plate 1 of Appendix O of Volumes 4 and 5 of URS 2010 [included in this report as Appendix C, parts C.4 and C.5, and Plate 3.3-1 of this document).

The surficial geologic map units in and adjacent to the Feather River are described in Appendix O, "Geomorphology Report," in Volumes 4 and 5 of the URS (2010) report (included in this report as Appendix B). Additionally, for a description of surficial geologic units, refer to Section 3.3, *Geology, Soils, Seismicity, and Mineral Resources*.

Lower Feather River

Published geologic maps of the lower Feather River identify a complex series of westward aggrading alluvial fans and terraces derived from the Sierra Nevada, identified as the Riverbank and Modesto Formations. The Riverbank Formation and Modesto Formation are semi-consolidated to unconsolidated deposits characterized by intra-formational paleochannels and lateral and vertical stratigraphic complexity related to past fluvial processes and buried paleo-topography. The Riverbank Formation unconformably overlies the Laguna Formation, which is a deeply dissected alluvial surface (Busacca et al. 1989 as cited in Appendix O of Volume 4 of URS 2010:5) (Appendix O of Volume 4 of URS 2010:5 [included in this report as Appendix B]).

Subsurface deposits about 150 feet beneath the ground surface rest on a resistant volcanic tuff capped by interbedded alluvial gravel, sand, and silt, interpreted as Pliocene-Pleistocene age Laguna Formation that represents a period of relatively stable landscape conditions (Helley and Harwood 1985). The Laguna Formation is overlain by the Pleistocene Riverbank Formation, (very dense gravel deposits), which are, in turn, overlain by a medium dense sand and gravelly sand assemblage of the latest Pleistocene Modesto Formation (Busacca et al. 1989 as cited in Appendix O of Volume 4 of URS 2010:5 [included in this report as Appendix B]). The upper member of the Modesto

Formation is exposed at the ground surface adjacent to the western bank of the Feather River south of Marysville and Yuba City. The Modesto Formation is mantled by unconsolidated deposits of Holocene age that compose most of the surficial geologic deposits along the western side of the Feather River (Plate 1 of Appendix O of Volume 4 of URS 2010 [included in this report as Appendix B] and Plate 3.3-1 of this document) (Appendix O of Volume 4 of URS 2010:5).

Upper Feather River

Published geologic maps of the upper Feather River show a complex series of westward aggrading alluvial fans and terraces derived from erosion of the Sierra Nevada, identified as the Riverbank and Modesto Formations (Bussaca et al. 1989 as cited in Appendix O of Volume 5 of URS 2010:5 [included in this report as Appendix B]; Helley and Harwood 1985; Creely 1965 as cited in Appendix O of Volume 5 of URS 2010:5 [Appendix B]). The Riverbank Formation and Modesto Formation in general are semi-consolidated to unconsolidated deposits characterized by intra-formational paleochannels and lateral and vertical stratigraphic complexity related to past fluvial processes and buried paleo-topography. The oldest map unit, the Riverbank Formation unconformably overlies the Pliocene-Pleistocene age Laguna Formation, which consists of interbedded alluvial gravel, sand and silt (Busacca et al. 1989 as cited in Appendix O of Volume 5 of URS 2010:6 [Appendix B]; Helley and Harwood 1985). The overlying Pleistocene Riverbank Formation consists of very dense gravel deposits that are, in turn, overlain by a medium dense sand and gravelly sand package of the latest Pleistocene Modesto Formation (Busacca et al. 1989 as cited in Appendix O of Volume 5 of URS 2010:6 [included in this report as Appendix B]). The upper member of the Modesto Formation is exposed at the ground surface adjacent to the western bank of the Feather River. The Modesto Formation is locally mantled by unconsolidated, sand-rich Holocene deposits (Plate 1 of Appendix O of Volume 5 of URS 2010 [included in this report as Appendix B] and Plate 3.3-1 of this document). East of the Feather River, the older stratigraphic units are uplifted and dissected and younger deposits are inset into them with older deposits buried beneath younger deposits. West of the Feather River, the stratigraphic units are found in typical succession. This is the result of overall westward tilting and uplift of the Sierra Nevada, incision along the tributary drainages (i.e., Honcut creek), and progradational fan deposition west of the river (Appendix O of Volume 5 of URS 2010:5–6 [Appendix B]).

Surficial geologic mapping (Plate 1 of Appendix O of Volume 5 of URS 2010 [included in this report as Appendix B], and Plate 3.3-1 of this document) shows differences in deposit type and distribution from north to south along the northern Feather River proposed project area that primarily are associated with proximity to the Sierra Nevada mountain front near Thermalito Afterbay. These differences illustrate the diversity of past geomorphic processes along the river and, as a consequence, the type of geologic deposits at and near the ground surface. The surficial geologic map created by William Lettis & Associates allows the delineation of reaches along the river within which geomorphic processes and their associated deposits appear to be relatively consistent (Appendix O of Volume 5 of URS 2010:5–6 [included in this report as Appendix B]).

C.1.2.3 Channel Incision

Thalweg (channel centerline) profiles for the lower Feather River are shown in Figure 5.13 of Water Engineering & Technology (1990:81). The data sets incorporated in this figure represent 1911, 1924, and 1965 surveys. The profiles illustrate a degradational trend from 1911 to 1965, which is expected as channel incision into hydraulic mining debris has been documented (Meade 1982 as

cited in Water Engineering & Technology 1990:80). The profiles show approximately 10 feet of degradation between 1924 and 1965 (Water Engineering & Technology 1990:80–81).

The Sutter Bypass has its confluence with the Feather River at RM 7.5 (the bottom of the proposed project area). From this point downstream, approximately 5 feet of incision occurred between 1911 and 1924 versus about 2 feet upstream during the same period. Increased flows introduced by the Sutter Bypass may have served to increase the rate of incision into hydraulic mining debris along this lower reach (Water Engineering & Technology 1990:80–81).

Thalweg profiles for the upper Feather River are shown in Figure 6.8 of Water Engineering & Technology 1991:155. The data sets incorporated in this figure represent 1909 and 1964 surveys. The profiles illustrate a significant degradational trend during this time period, which is expected as channel incision into hydraulic mining debris has been documented (Meade 1982 as cited in Water Engineering & Technology 1990:80). The profiles show the greatest amount degradation (approximately 10 feet) at the lower end of the upper proposed project area. The reason the Feather River in the upper proposed project area has not degraded in the upper reaches is attributable to the sediment supply that is maintained by lateral erosion of the dredge spoils that border the channels. In addition, flow regulation has affected the rate of incision. As only infrequent flows can entrain coarser material, channel incision into the debris is relatively slow. Farther downstream, the lower reaches have degraded because of the presence of finer materials (Water Engineering & Technology 1991:150–156).

C.1.2.4 Sinuosity, Channel Migration, and Bank Failure

In the lower proposed project area, historical observations and present-day channel sinuosity upstream of the Yuba River confluence suggest that the Feather River was more sinuous prior to hydraulic mining than it is today. In general, sinuosity increases with distance upstream. This increase in sinuosity reflects the increase in the upstream presence of the resistant Pleistocene Modesto Formation, which has helped to maintain the channel planform. Present-day sinuosity on the Feather River is not substantially different from that of the 1920s. The channel has incised into cohesive hydraulic mining debris (slickens), which has helped to maintain the channel planform. Additionally, flow regulation by upstream dams in the watershed has contributed to the maintenance of the channel planform. Whether sinuosity of the Feather River will increase back to pre-mining levels is unclear; such an increase is dependent on the depositional thickness of the cohesive toe sediment (slickens). If the river degrades through the slickens and less cohesive sediments compose the lower bank, channel migration rates and sinuosity may increase rapidly. Further evidence for the current planform stability is provided by the presence of the extensive riparian vegetation that is located near the water's edge (Water Engineering & Technology 1990:77–80).

In the upper proposed project area, modes of bank failure and thus channel migration are highly dependent on bank lithology and stratigraphy. Along the Feather River in the upper proposed project area, coarse-grained point bar deposits are commonly preserved in the channel banks; fluvial entrainment of these sediments is followed by cantilever failure of the more cohesive upper bank vertical accretion sediments. Abandoned channel fill deposits form resistant hard points on the channel bank; where these deposits are located in the lower bank, bank retreat over the top of the resistant abandoned channel fill deposits can occur (Water Engineering & Technology 1991:149).

The greatest concentration of eroding banks is between RM 29 to RM 45, where the Feather River is a sinuous meandering channel whose bed material is dominated by sand to fine gravel–sized sediment. The river in this reach is highly dynamic and contains large point bars and chute channels. Bank erosion is extensive; however, as mentioned above, wide levee setback precludes direct levee threat in many locations.

Migration rates in the upper proposed project area are highly variable, reflecting the heterogeneity of materials present, and the range and stages of channel bend development (Harvey 1988 as cited in Water Engineering & Technology 1991:150). Although lateral migration rates are commonly high in the upper proposed project area, levee setback is sufficient so that very little direct levee threat exists (Water Engineering & Technology 1991:139–140).

C.1.2.4.1 Bank Retreat Rates: Feather River (RM 0–28)

Water Engineering & Technology (1990:172–173) conducted an analysis of migration rates for the lower Feather River bank lines. Bankline migration rates (for the west bank) averaged approximately 6 feet of migration per year, with a minimum value of 0 feet per year and a maximum value of 26.5 feet per year. At the time the study was conducted (1990), based on projected migration rates, the lower Feather River levees on the west bank were not anticipated to be threatened over a 15-year interval (Water Engineering & Technology 1990:172). Current-day field observations support this conclusion that bank retreat is slow on this reach, as erosion appears intermittent, the bank toe is cohesive, and mature vegetation is growing along the water's edge.

C.1.2.4.2 Bank Retreat Rates: Feather River (RM 28–61)

Water Engineering & Technology (1991:150–153) conducted an analysis of migration rates for the upper Feather River bank lines. Bankline migration rates (for the west bank) are commonly high (especially between RM 29 to RM 45), with an average of approximately 5 feet of migration per year, with a minimum value of 1.4 feet per year and a maximum value of 20.3 feet per year.

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Part C.2

URS Supplemental Geotechnical Data Report (2010), Appendix O, Volume 2

APPENDIX O

Geomorphology Report

WILLIAM LETTIS & ASSOCIATES, INC.
1777 Botelho Drive, Suite 262, Walnut Creek, California 94596
tel (925) 256-6070 fax (925) 256-6076

September 8, 2009

Mr. Juan Vargas
URS Corporation
2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833

RE: Surficial geologic mapping and geomorphic assessment, California Department of Water Resources Urban Levees, Wadsworth Canal, Sutter County, California

Dear Mr. Vargas:

This memorandum presents the surficial geologic mapping and preliminary geomorphic assessment of the Wadsworth Canal area, for the California Department of Water Resources (DWR) Urban Project Levees geotechnical characterization. The goal of this mapping and geomorphic assessment is to provide information on the type and distribution of surface and shallow subsurface deposits that likely underlie the project levees along the canal, with respect to potential levee underseepage. This letter presents the technical approach, surficial geologic map, conceptual geomorphic model, and initial results based on map analysis and preliminary review of Phase 1 geotechnical data.

We appreciated the opportunity to provide these geomorphic and geologic data and preliminary interpretations of the shallow stratigraphic conditions in the Wadsworth Canal study area. Please do not hesitate to call either of the undersigned if there are any questions or comments.

Respectfully,

WILLIAM LETTIS & ASSOCIATES, INC.

Justin Pearce, C.E.G. 2421
Senior Project Geologist
(925) 395-2035

Keith Kelson, C.E.G. 1610
Principal Geologist
(925) 395-2032

1.0 Approach

The approach to developing a surficial geologic map of the Wadsworth Canal area (Figure 1, Plate 1) consisted of analysis of the following data: Aerial photography (black and white stereo-pairs taken in 1937, ~1:20,000-scale); early topographic maps (USGS, 1911); published surficial geologic maps (Helley and Harwood, 1985); early and modern soil survey maps (Strahorn et al., 1911; Lytle, et al., 1988); field reconnaissance visit on June, 22, 2007, and other maps and documents (i.e., Chambers, 2002). Synthesis of these data allow for the development of a detailed surficial geologic map that provides an initial understanding of primary geomorphic processes that have acted in the study area during recent geologic and historical time. Through this mapping, primary geomorphic features and associated surficial geologic deposits are identified, such as abandoned paleochannels, marsh and basin deposits, and other features commonly associated with flood basins adjacent to large, active river systems.

The surficial geologic map was developed at the nominal scale of the aerial photography (1:20,000). This scale establishes the resolution of the map (Plate 1). The map unit contacts shown on the surficial geologic map should be considered approximate, and accurate to no more than about 30 feet on either side of the line shown on the map. The 1937 aerial photographs are the primary data set for interpreting the surficial geologic deposits because: (1) they are the oldest high-quality images available and pre-date much of the cultivation and landscape alteration within present-day Sutter County (Figure 2); and, (2) because these data represent a close approximation to the surficial deposits that were likely present at the ground surface prior to construction of the levees. The 1937 photographs generally were taken in later summer or early autumn (i.e., August). By 1937, the area had experienced moderate cultivation that locally obscures geomorphic conditions. However, integration of data from the 1937 photographs, old and recent topography, existing geologic maps, existing soil surveys and historical documents provides sufficient information to delineate many of the pre-historical and historical surficial deposits in detail. Taken together, these data provide key insights to the geomorphic processes and resulting deposits that may affect levee underseepage.

Additional floodplain deposition may have occurred after 1937, due to flood overflows, levee overtopping, or localized levee failure. A time series analysis that interprets successive aerial photographs taken after major flood events (i.e., 1955) or known local levee failures (i.e., 1986) may reveal additional information on surficial deposits in the Wadsworth Canal area. However, such analyses are beyond the scope of this project. The data and interpretations presented herein address the primary goal of characterizing the type and distribution of deposits likely present directly beneath the project levees.

1.1 Report Preparation Quality Control

The surficial geologic map data and geomorphic interpretations presented in this memorandum were subject to quality control and quality assurance procedures as required by the Levee Geotechnical Evaluation Project Management Plan (PMP). The surficial geologic map data developed by this study were reviewed for accuracy and completeness through an internal review and an independent technical review by Dr. Janet Sowers of WLA. Results of QA/QC

review were documented using PMP Exhibit 2.2-3 (Independent Technical Review Report) and are kept on file according filing control plan. Subsurface data shown on diagrams were provided as draft information, and were not verified for accuracy or completeness by this study.

2.0 Geologic Setting

The Wadsworth Canal (WC) study area is southeast of the Sutter Buttes, a presently in-active and dissected rhyolitic and andesitic volcanic neck, and between the Sacrametno River to the west and the Feather River to the east (Figure 1). The WC levee addressed in this study borders the southeastern side of Wadsworth Canal from just north of Butte House Road to the eastern Sutter Bypass levee. The WC levee trends northeast-southwest, and ties in to the eastern Sutter Bypass levee (Figure 1).

The WC levee lies northeast of Sutter Basin, a low-lying area east of the Sacramento River where overflow and floodwaters produce a seasonally marshy area. Except for the Sutter Buttes, the land regional surface is nearly flat, and along the WC area gently slopes southwest at an elevation of about 40 to 50 feet. Construction of the WC levee was completed by 1924, and was subsequently enlarged in 1942 (DWR, 1976). Prior to cultural modification, surface water runoff in the WC area was delivered to the Sutter Basin via intermittent, meandering creeks and sloughs from the northern Central Valley, including: Snake River, Snake Slough, Little Blue Creek, and ephemeral channels emanating from the eastern side of Sutter Buttes. Presently, many of the natural drainages and channels have been replaced by linear ditches, agricultural drains, and canals (Figure 2).

3.0 Surficial Geologic Mapping

Published surficial geologic maps within the WC study area generalized the surficial deposits primarily as Quaternary basin deposits, with localized units of Quaternary alluvium (map unit Qa) and Quaternary Modesto Formation (lower member, map unit Qml) (Helley and Harwood, 1985). These map units were delineated by Helley and Harwood (1985) at a regional scale (i.e., 1:62,500). The current analysis of the WC uses this existing geologic framework as a basis for more detailed mapping of late Holocene alluvium and geomorphic features (Plate 1). The surficial geologic map units in the Wadsworth Canal study area are described below, in order from oldest to youngest.

The oldest map unit exposed in the study area is the Pliocene-Pleistocene tuff breccia (map unit QTm). This rock primarily comprises a peripheral topographic ring around the relatively high relief Sutter Buttes, and consists of consolidated coarse material derived from the volcanic rocks of the Buttes. This bedrock is exposed in the northwest corner of the WC map area (plate 1).

The Quaternary Riverbank Formation (lower and upper members) is exposed at the ground surface adjacent to the tuff breccia (map unit Qrl and Qru, Plate 1). This map unit does not directly underlie the project levees in this study area, but is present in the shallow subsurface as

alluvial-fan deposits derived from the Sutter Buttes during the middle Pleistocene (about 400,000 to 200,000 years ago). The Riverbank Formation is semi-consolidated, and the top of the formation is marked by a hardpan (or, duripan) layer that is a product of soil-forming processes over substantial geologic time. This hardpan layer reflects an ancient land surface that is now buried by younger deposits. In WC area, the upper Riverbank formation is associated with the Sutter clay (Strahorn, et al., 1911), and Marcum clay loam with "siltstone" hardpan (Lytle, 1988).

The late Pleistocene Modesto Formation is exposed at the surface as alluvial-fan deposits emanating from southwestern Sutter Buttes, and is younger than, and inset into, the Riverbank Formation (Plate 1). This unit is divided into two members, a lower (older) unit that is about 42,000 to 29,000 years old (map unit Qml), and an upper member that is about 24,000 to 12,000 years old (map unit Qmu) (Helley and Harwood, 1985). The upper member in the map area is associated with sub-linear low ridges to the east of the WC that have not been completely covered by basin deposits. The Modesto Formation is locally associated with the Sutter sandy loam (Strahorn, et al., 1911), and the Olashes sandy loam (Lytle, et al., 1988); the sand consisting of volcanic lithologies indicating derivation from Sutter Buttes parent material. The latest Pleistocene Modesto Formation, in general, consists of unconsolidated sand, silt, and clay, and is associated with a moderate amount of secondary (pedogenic) clay accumulation that may form laterally continuous zones of low hydraulic conductivity.

Holocene deposits (less than 11,000 years old) in the WC map area consist of basin and alluvial deposits (Qb of Helley and Harwood [1985]; map unit Qn, Plate 1). These widespread basin deposits, about 4 to 8 feet thick, overlie the Modesto Formation. The soils developed on the basin deposits are generally the Gridley clay loam and Oswald clay (Stahorn et al., 1911; Lytle, et al., 1988), immature soils with fine-grained textures. Undifferentiated Quaternary alluvium (map unit Qa) is present near the western margin of the map area, deposited by pre-historic Butte Creek. Holocene alluvium is mapped at the surface as alluvial-fan deposits emanating from southwestern Sutter Buttes, and is younger than, and locally overlies the upper Modesto Formation. These deposits likely consist of poorly sorted mixtures of fine gravel, sand, and silt derived from the volcanic rocks of the Buttes. The Quaternary marsh deposits (map unit Qs, Plate 1) are present between the levees of the Sutter Bypass, and consist of fine grained deposits that are differentiated from basin deposits by generally being underwater or having standing water at the time when the 1937 photographs were taken.

Holocene alluvial channels (map unit Hch, Plate 1) are mapped as a network of moderately sinuous channels with southwesterly orientations. These channels appear to be mostly filled in with sediment on the 1937 photographs, and are not expressed as strong topographic lows in the ground surface. Many of these channels extend beyond, and therefore cross beneath, the eastern Sutter Bypass levee and WC levee (Plate 1). The infilling material in the basal portions of the channel consists of relatively loose, coarse material (i.e., sand), which fines upward into fine-grained, silt and clay. The channel deposits are tentatively associated with the Liveoak series, sandy clay loam soil (Lytle, et al., 1988).

Localized deposits related to the Holocene alluvial channels are in-stream bars (map unit Hb) that typically occur in the medial portions of the channels, and distributary fans (map unit Hdf)

that occur where the channel morphology tapers out and the channel has deposited sediment on the basin floor. These two types of deposits are uncommon in the study area, and have been mapped only distant from the WC levee.

Historical alluvial channels (map unit Rch, Plate 1) also are mapped as a network of moderately sinuous channels that have southwesterly orientations toward Sutter Basin. The term "historical" is applied to deposits that are estimated to be less than 150 years old. The historical channels are differentiated from the slightly older Holocene channels on the basis of cross-cutting relationships, relative degree of geomorphic expression, and correlation with mapped creek positions on the 1911 USGS topographic map. The Wadsworth Canal levee overlies the former locations of these alluvial channels in several locations throughout its length (Plate 1).

4.0 Conceptual Geomorphic Model

Based on synthesis of surficial geologic mapping, early topographic maps, soil surveys, geologic maps, and review of readily available subsurface geotechnical information, this section presents a preliminary conceptual model describing general relationships among surface and subsurface deposits in the Wadsworth Canal area. This conceptual model provides a consistent basis for understanding the type and distribution of surficial geologic deposits, primary geomorphic processes, and shallow subsurface stratigraphy in the area.

The geologic deposits present at the surface and in the shallow subsurface are derived from three general source areas: (1) material eroded from the Sutter Buttes and transported to the adjacent low-lying basin floor forming modest alluvial fans (i.e. Riverbank and Modesto Formations); (2) material deposited on the basin floor as fine silt and clay settled from standing or slow moving floodwaters of large rivers (i.e., basin deposits); and, (3) material transported to the basin by the ephemeral creeks and sloughs that traversed the valley floor prior to present day modification (i.e., channel fill).

The WC project levee trends southwest, and is primarily underlain by clayey basin deposits with some silt and sand (Plate 1, Figure 3). The basin deposits rest directly on the upper Modesto Formation, the upper boundary of which is characterized by a clay hardpan horizon associated with a buried soil. The hard pan layer is generally observed as a very stiff to hard, lean to fat clay, 10YR ¾ colors (Munsell color notation) associated with locally increased density (i.e., blow counts, CPT tip resistance), and likely very low permeability. Thus, the upper Modesto Formation mapped in northwest potion of the map area extends below ground, and dips southeasterly beneath the project levee in the shallow subsurface.

Fine-grained basin deposits overlie the upper Modesto Formation near the WC levees (Figure 3). These deposits accumulated on the valley floor over geologic time resulting from flooding of the major rivers (i.e., Sacramento and/or Feather Rivers), tributaries draining Sutter Buttes, and sheetwash from the generally flat valley floor. This resulted in inundation of the basin with standing water, and subsequent settlement of silt and clay from suspension. The thickness of the basin deposits is about 4 to 8 feet, but locally may be thicker. Review of available Phase 1 and other existing geotechnical data (i.e., Chambers 2002) indicate medium stiff to very stiff

relative density of the basin deposits. However, there is a substantial lateral and vertical variability in the hardness properties of the basin deposits.

Laterally cross-cutting, and vertically inset into the basin deposits, are the Holocene and Historical channel deposits (map units Hch and Rch, Plate 1). These southwest-trending alluvial channel deposits locally underlie the WC levee, and thus result in local differences in material textures beneath the levee (Figure 3). Field reconnaissance on June 22, 2007 reveals that the topographic expression of these channels has been obliterated by cultivation. However, sub-linear to curvilinear differences in ground color (i.e., darker strips) were observed in the cultivated fields in areas that potentially correlate with mapped channels, suggesting a contrast in materials in the shallow subsurface. Review of subsurface geotechnical data indicate that the channel fill deposits include a lower channel fill consisting of relatively loose, coarser material (i.e., sand), fining upward and grading into fine-grained silt and clay. Many of these channels extend across, and therefore continue beneath, the WC levees (Plate 1, Figure 3).

Figure 3 illustrates the relationships between the surficial channels, basin deposits, and shallow stratigraphy that underlie the WC project levee, wherein dense, semi-consolidated Pleistocene deposits are overlain by a layer of fine-grained basin deposits, locally cut by alluvial channel deposits.

5.0 Applications to the Urban Levee Project

Based on synthesis of the surficial geologic map with preliminary Phase 1 boring and cone penetrometer (CPT) data, and historical geotechnical subsurface exploration data (i.e., Chambers, 2002), the WC levee is underlain by relatively young fine-grained clay and sandy clay deposits that are laterally interrupted by local coarser channel fill deposits (Figure 3). Mud rotary borehole WSEWWC-002B penetrates a mapped surficial channel unit (Figure 3, Plate 1), and indicates the channel fill is silty sand that grades upward into clay, with an uncorrected SPT blow count of 5 blows per foot. This suggests locally loose and unconsolidated, and therefore likely permeable, material in the shallow subsurface. Initial review of subsurface boring profiles completed along the eastern landside of the Wadsworth Canal near the tie-in to the Sutter Bypass levee (Chambers, 2002) also shows relatively loose and soft sandy deposits (i.e., blow counts of 0 to 5) that are overlain by a layer of medium stiff clay-rich material.

Synthesis of the surficial mapping and geotechnical data indicate that subsurface stratigraphy the WC area locally may be conducive to levee underseepage. Shallow strata typically include denser and probably semi-cemented material (i.e., Modesto Formation) that likely contains a low-permeability hardpan horizon. The hardpan may or may not be laterally continuous, depending on post-depositional soil formation and erosional processes. The Modesto formation is overlain by about 4 to 6 feet of medium stiff to stiff clay (i.e., basin deposits). Surficial mapping indicates that the basin materials locally are cross-cut by relatively loose, sandy channel deposits; subsurface geotechnical data show lateral and vertical variations in texture and density that are probably related to buried channel deposits. Therefore, this shallow subsurface stratigraphy may promote levee underseepage along certain areas of the WC project

levees where geologically young, loose, sandy channel material lies between the dense Pleistocene deposits and relatively stiff, low-permeability clay-rich surface “blanket” layer.

Lateral and vertical variability in the shallow subsurface deposits has resulted from past geomorphic processes. The conceptual subsurface stratigraphic framework suggests that stratigraphic relationships may promote localized levee underseepage, given certain hydraulic conditions. Further spatial analyses of the surficial geologic mapping and subsurface geotechnical exploration data are needed to better constrain and characterize areas that are most susceptible to underseepage in the study area.

6.0 Limitations

This geomorphic assessment and associated data interpretation have been performed in accordance with the standard of care commonly used as the state-of-practice in the geologic engineering profession. Standard of care is defined as the ordinary diligence exercised by fellow practitioners in this geographic area performing the same services under similar circumstances during the same time period.

Discussions of surface and subsurface conditions summarized in this technical memorandum are based on geologic interpretations of subsurface soil data at limited exploration locations available to this assessment through July of 2007. Variations in subsurface conditions may exist between exploration locations, and the project team may not be able to identify all adverse conditions in the levee and its foundation. This memorandum is for the use and benefit of DWR. Use by any other party is at their own discretion and risk.

7.0 References

California Department of Water Resources (DWR), Northern District, 1976, "Sutter Bypass Study"

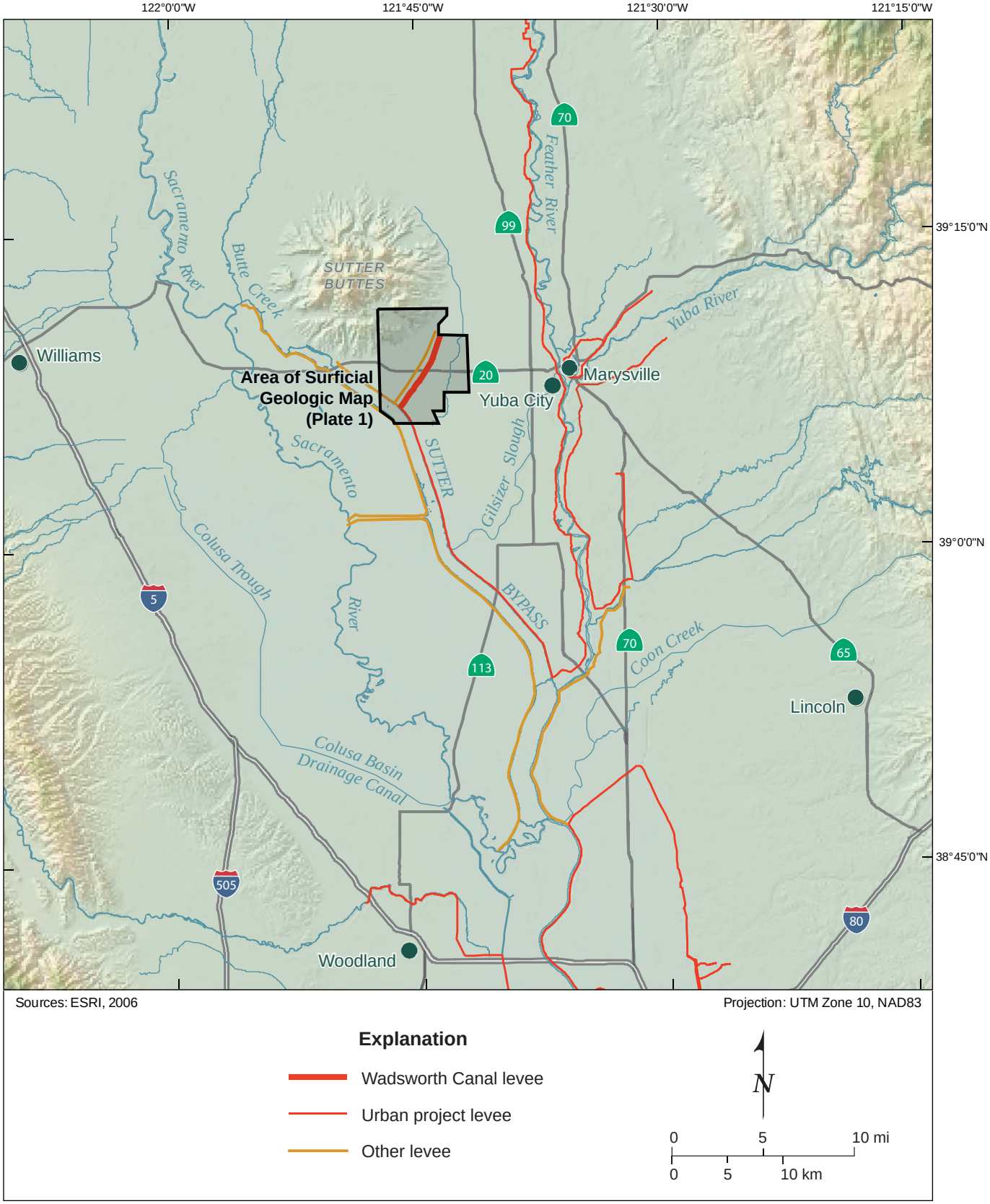
Chambers, J., 2002, US Army Corps of Engineers, Geotechnical Branch, Soil Design Section, "SAC-18 Wadsworth Canal – Dean Property Site"

Helley, E.J., and Harwood, D.S., 1985, Geologic map of the late Cenozoic deposits of the Sacramento Valley and Northern Sierran foothills, California; 1:62,500, USGS Map File MF-1790

Lytle, D.J., Kurowski, R.G., Whiting, M.L., Vinson, E.N., Vonich, P.W., Hansen, R.W., 1988, Soil Survey of Sutter County, California, 1:24,000, USDA Soil Conservation Service

Strahorn, A.T., Mackie, W.W., Holmes, L.C., Westover, H.L., Van Duyne, C., 1911, Soil Survey of the Marysville Area, California; 1:62,500, USDA Bureau of Soils

USGS, Sutter topographic quadrangle, surveyed 1909, published 1911; map scale 1:31,680, five foot contour interval.



WLA

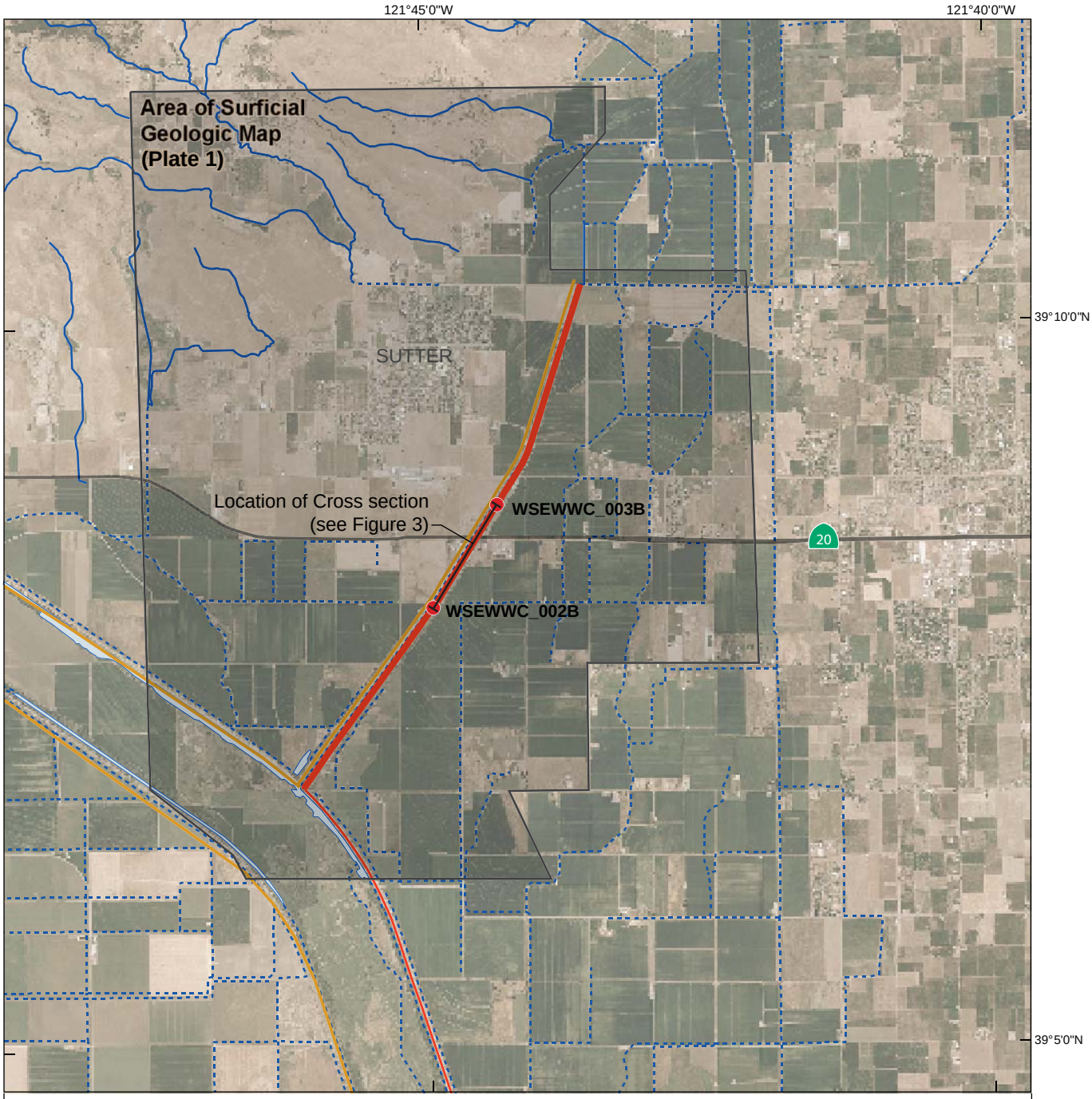
Map of Northern Central Valley, California

DWR URBAN LEVEE PROJECT

Figure 1

1881 Wadsworth Canal

Modified 09.03.09



Sources: ESRI, 2006

Projection: UTM Zone 10, NAD83

Explanation

- Creek, slough
- Canal, drain
- Wadsworth Canal Urban Project levee
- Other Urban Project levee
- Other levee

N

0 1 2 mi

0 1 2 km

WADSWORTH CANAL

Looking Northwest

S36°W

Southwest

Northeast

Approximate levee crest

WSEWWC 002B | WSEWWC 015C | WSEWWC 016C | WSEWWC 017C | WSEWWC 018C | WSEWWC 003B

Holocene channel, surficial map unit Hch, (Plate 1)

Levee fill (AF)

Stiff clay and hard silt (Quaternary Basin Deposits, Qn)

Stiff clay with layers of stiff silt and silty sand (Upper Modesto Formation, Qmu)

Stiff clay with layers of medium dense silty sand and very stiff silt (Lower Modesto Formation, Qml)

Hard sandy clay interbedded with medium dense silty sand (Upper Riverbank Formation, Qru)

Very dense sand interbedded with stiff clay and silt (Lower Riverbank Formation, Qrl)

B.O.H. 65 ft.

B.O.H. 60 ft.

B.O.H. 60 ft.

B.O.H. 60 ft.

B.O.H. 140 ft. below ground surface

B.O.H. 140 ft. below ground surface

Elevation (feet, NAVD 88): 70, 50, 30, 10, 0, -10, -30, -50, -70, -90

Log description from borehole WSEWWC 002B

44.0 to 42.5 feet. Lean CLAY (CL) stiff; dark brown (10YR 3/3); moist; 90% medium plasticity; 10% fine sand

42.5 to 41.0 feet. SILT with SAND (ML) loose, dark yellowish brown (10YR 3/4); moist; 15% fine sand

41.0 to 39.0 feet. SILTY SAND (SM) medium dense; dark yellowish brown (10YR 3/4); moist; 75% fine to medium sand; 25% fines

42.5 to 41.5 SPT = 5 blows/foot

Explanation

- Channel identified on surficial geologic map or as fining upward sequence of sediments in boreholes
- Localized sand and gravel; possible channel; interpreted from suburface borehole data
- Moderate paleosol (hardpan)
- Strong paleosol (hardpan)

Notes:
1. Borehole ground elevation values from Engeo, Inc. draft borehole logs as estimated from map (NAVD 88). Absolute elevations of geologic contacts could change if reported ground elevations of boreholes are revised.
2. CPT borehole surface elevations are approximate, placed on projected ground surface between continuous boreholes WSEWWC-002B and 003B.
3. All depths (vertical axis) shown as elevation values (NAVD88), as shown on Engeo, Inc. borehole logs.
4. Bottom of hole (B.O.H.) values shown as total depth below ground surface.
5. Borehole names and and horizontal distance shown above (from Engeo logs and location maps). Geologic relations could change if borehole locations are revised.
6. Drilling method indicated as last letter in borehole name:
   B = Mud Rotary borehole with SPT
   C = Cone Penetrometer Test
7. See Figure 2 for location of cross section.

20 feet

0

0 — 1000 feet

Scale

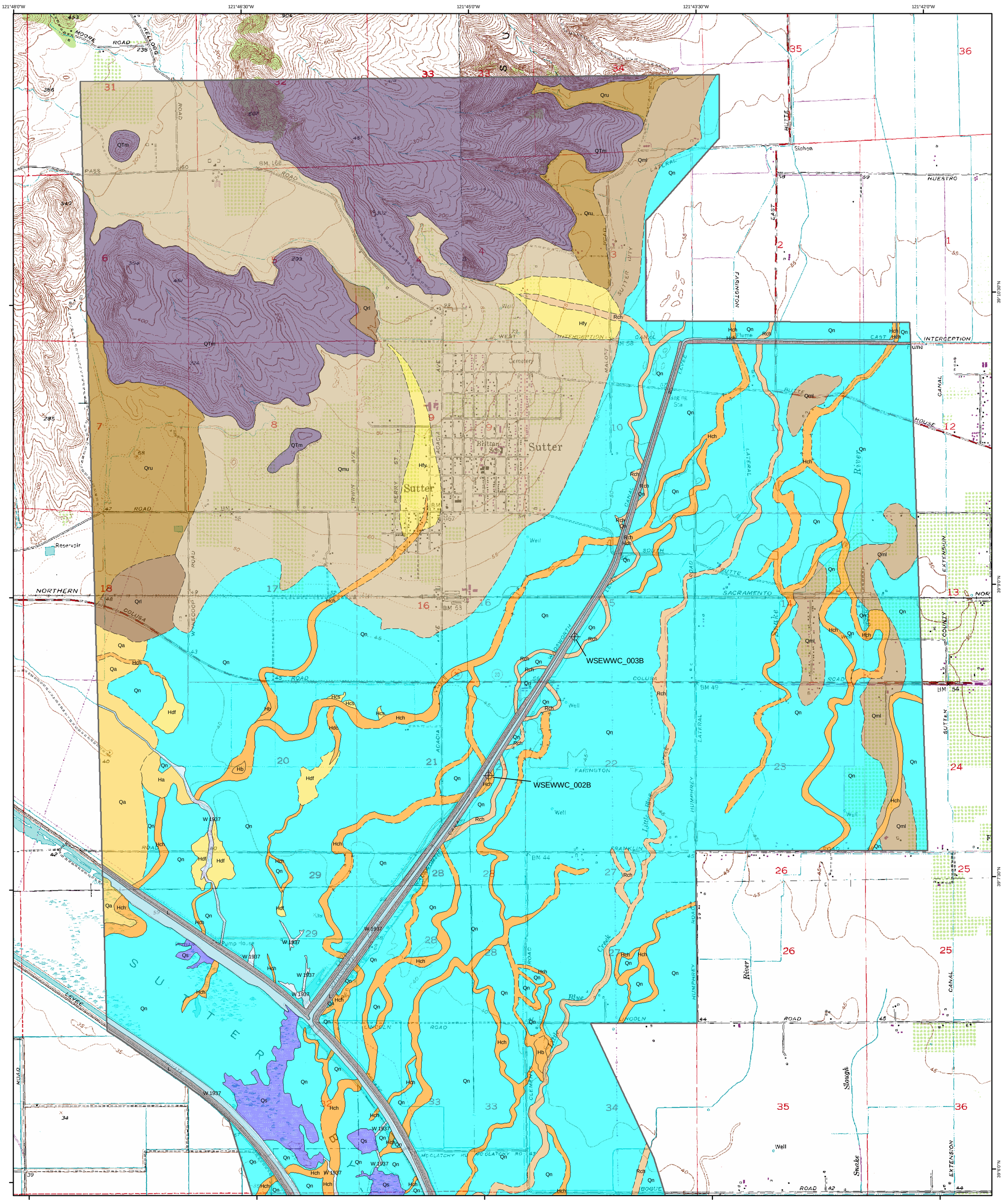
Vertical exaggeration 50X

WLA

Conceptual Cross Section along Eastern Levee Crest Wadsworth Canal

DWR URBAN LEVEE PROJECT

Figure 3



Explanation

Geologic contact; dashed where approximate, dotted where concealed, queried where uncertain; solid contacts have a resolution no better than about 30'.

WSEWWC_003B — Geotechnical borehole, approximately located.

W — Water visible on 1937 aerial photography.

Geologic Units

HISTORICAL

- AF — Artificial fill; visible on 1937 aerial photography.
- Rch — Channel deposits; sorted sands and silty sand; fining upward.

HOLOCENE

- Hcs — Crevasse splay deposits; fine to coarse sand, silt and clay.
- Hdc — Distributary channels, sand, silt, and clay.
- Hdf — Distributary fan deposits; sand, silt and clay.
- Ha — Alluvial deposits; undifferentiated; sand, silt, and minor lenses of gravel; under cultivation in 1937.
- Hch — Channel deposits; sorted sands and silts; fining upward.
- Hb — Channel bar deposits; fine sand, and silt deposited in or along channel lateral margins.
- Hfy — Alluvial fan deposits, well graded gravel, sand, silt and clay; volcanic lithologies.
- Qa — Alluvial deposits, undifferentiated; sand, silt, and minor lenses of gravel; under cultivation in 1937.
- Qn — Basin deposits; fine sand, silt and clay, dark yellow to dark yellowish brown, under cultivation in 1937.
- Qs — Marsh deposits; silt and clay, likely organic-rich; perennially or seasonally submerged on 1937 photography.

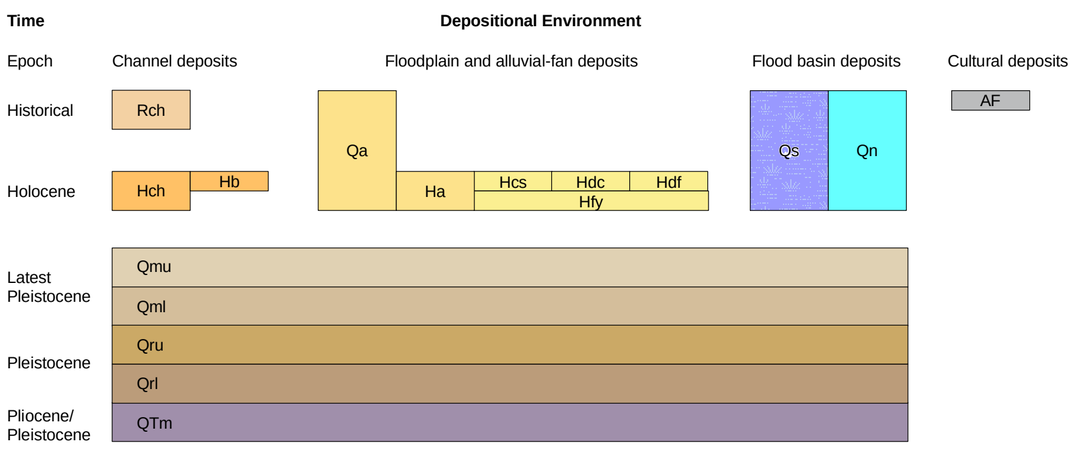
PLEISTOCENE

- Qmu — Modesto Formation; upper member; unconsolidated to semi-consolidated gravel, sand, silt, and clay.
- Qml — Modesto Formation; lower member; unconsolidated gravel, sand, silt and clay.
- Qru — Riverbank Formation; upper member, semi-consolidated to consolidated gravel, sand, silt and minor clay.
- Qrl — Riverbank Formation; lower member; consolidated gravel, sand, silt, and clay, generally associated with strong duripan horizon.

PLIOCENE / PLEISTOCENE

- QTm — Tuff Breccia; Volcanic tuff breccia (andesitic and rhyolitic) from Sutter Buttes, latest Pliocene.

Stratigraphic Correlation Chart



1:20,000

N

0 0.5 1 Miles

0 0.5 1 Kilometers

Map projection: UTM NAD83 Zone 10N
Topo base USGS quadrangles.

Plate 1 - Surficial Geologic Map of the Wadsworth Canal Area

WILLIAM LETTIS & ASSOCIATES, INC.
Walnut Creek, CA

Sutter_MGT_Plate1_Wadsworth.mxd 09/04/2009

Part C.3

URS Supplemental Geotechnical Data Report (2010), Appendix O, Volume 3

APPENDIX O

Geomorphology Report

WILLIAM LETTIS & ASSOCIATES, INC.
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September 8, 2009

Mr. Juan Vargas
URS Corporation
2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833

RE: Surficial geologic mapping and geomorphic assessment, California Department of Water Resources Urban Levees Project, Southern Feather River, Sutter County, California

Dear Mr. Vargas:

This memorandum presents the surficial geologic mapping and preliminary geomorphic assessment of the southern Feather River study area, for the California Department of Water Resources (DWR) Urban Levees Project geotechnical characterization. The goal of this mapping and geomorphic assessment is to provide information on the type and distribution of surface and shallow subsurface deposits that likely underlie the project levees along the western bank of the Feather River. The purpose of this study is to develop spatially-continuous geologic data and a conceptual model that provides a framework for stratigraphic interpretations between widely-spaced subsurface explorations. A primary goal is to provide a geologic framework for the geotechnical assessment of potential levee underseepage. This memo presents the technical approach, surficial geologic map, conceptual geomorphic model, and initial results based on map analysis and preliminary review of Phase 1 geotechnical data.

We appreciated the opportunity to provide these geomorphic and geologic data and preliminary interpretations of the shallow stratigraphic conditions in the southern Feather River study area. Please do not hesitate to call either of the undersigned if there are any questions or comments.

Respectfully,

WILLIAM LETTIS & ASSOCIATES, INC.

Justin Pearce, C.E.G. 2421
Senior Geologist

Ashley Streig
Senior Staff Geologist

Keith Kelson, C.E.G. 1610
Principal Geologist

1.0 Approach

The approach to developing a surficial geologic map of the southern Feather River project area (Figure 1, Plate 1) consisted of analysis of the following data: Aerial photography (black and white stereo-pairs taken in 1937, ~1:20,000-scale); early USGS topographic maps (i.e., 1911); published surficial geologic maps (Helley and Harwood, 1985); early and modern soil survey maps (Strahorn et al., 1909; Lytle, et al., 1988); and other maps and documents (Busacca et al., 1989). Synthesis of these data allow for the development of a detailed surficial geologic map that provides an initial understanding of primary geomorphic processes that have acted in the study area during recent and historical geologic time. Through this mapping, primary geomorphic features and associated surficial geologic deposits are identified, such as abandoned paleochannels, channel deposits, floodplain deposits, basin deposits and other features commonly associated with surficial deposits with large active river systems. Knowledge of fluvial processes and the ability to recognize depositional environments in the geologic record are key to identifying locations along levees where underseepage is most likely to occur (Llopis
et al., 2007).

The surficial geologic map was developed at the nominal scale of the aerial photography (1:20,000). This scale establishes the resolution of the map (Plate 1), such that analysis of the map data at a more detailed scale than 1:20,000 may introduce uncertainties beyond the original resolution of the data. The map unit boundaries shown on the surficial geologic map should be considered approximate, and accurate within 30 feet on either side of the line shown on the map. The 1937 aerial photographs are the primary data set for interpreting the surficial geologic deposits because: (1) they are the oldest high-quality images that pre-date much of the urbanization and landscape alteration within present-day Sutter County (i.e. Figure 2); and, (2) these data represent a close approximation to the surficial deposits that were likely present at the ground surface prior to the construction of the levees. The 1937 photographs generally were taken in late summer or early autumn (i.e., August). By 1937, the area had experienced moderate cultivation that locally obscures geomorphic conditions. However, integration of data from the 1937 photography, old and recent topographic maps, geologic maps, soil surveys and historical documents provides sufficient information to delineate many of the pre-historical and historical surficial deposits in detail. Taken together, these data provide key insights to the characteristics of shallow deposits beneath the levees, as well as the geomorphic processes responsible for their distribution.

Additional floodplain deposition may have occurred after 1937, due to flood overflows, levee overtopping, or localized levee failure. A time series analysis that interprets successive aerial photographs taken after major flood events (i.e., USDA, black and white stereo-pairs taken in 1958, ~1:20,000-scale) or known local levee failures (i.e., 1986) may reveal additional information on surficial deposits in the southern Feather River area. Such analyses are beyond the scope of this study. The data and interpretations presented herein address the primary goal of characterizing the type and distribution of deposits likely present directly beneath the project levees.

1.1 Report Preparation Quality Control

The surficial geologic map data and geomorphic interpretations presented in this memorandum were subject to quality control and quality assurance procedures as required by the Levee Geotechnical Evaluation Project Management Plan (PMP). The surficial geologic map data developed by this study were reviewed for accuracy and completeness through an internal review and an independent technical review by Dr. Janet Sowers of WLA. Results of QA/QC review were documented using PMP Exhibit 2.2-3 (Independent Technical Review Report) and are kept on file according filing control plan. Subsurface data shown on diagrams were provided as draft information, and were not verified for accuracy or completeness by this study.

2.0 Geologic Setting

The southern Feather River study area lies in the Central Sacramento Valley, between the Coast Ranges to the west and the Sierra Nevada foothills to the east. Feather River drains the western slope of the Sierra Nevada, and emerges from the mountains south of the Thermalito Afterbay (Figure 1). The river flows southward from the Thermalito Afterbay, over middle-to late Pleistocene dissected alluvium derived from the Sierra Nevada. The regional land surface is nearly flat, with a gentle west-southwest slope that flattens out south of the Sutter Buttes, in Sutter Basin. The Feather River is entrenched into middle to late Pleistocene semi-consolidated sediments. Holocene alluvium deposited by the Feather River is present between the present-day levees, inset to the older formations, as well as on the western floodplain as subdued natural levees. The river trends roughly south until its confluence with the Bear River, where it curves
to the southwest (Figure 1). The Feather River lies east of, and is a tributary to the Sacramento River, converging near the town of Nicolaus (Figure 1). A primary influence on the historic processes in the river system was the hydraulic mining that began in the 1850's. Mining occurred through the early 1900's in the Feather, Yuba and Bear River watersheds, and abruptly introduced large quantities of sediment, drastically changing the geomorphic characteristics of these river systems (DWR, 2004; Ellis, 1939). Aggradation within the stream channel was a primary response to the introduction of substantial mining debris (James, 1999), consequently young alluvial deposits are common throughout the study area.

3.0 Surficial Geologic Mapping

Previous geologic mapping in the study area along the Feather River and surrounding areas generalize the surficial deposits as: Quaternary Alluvium (Qa) and Quaternary stream channel deposits (Qsc) within and proximal to the modern Feather River channel, (Helley and Harwood, 1985). These map units are considered Holocene age (less than 11,000 years old). Late Quaternary Modesto Formation (Qmu, Qml) is mapped along the western margin of the floodplain. These map units were delineated by Helley and Harwood (1985) at a regional scale (i.e., 1:62,500). The current analysis of the Feather River uses this geologic framework as a basis for more detailed mapping of late Holocene alluvium and geomorphic features (Plate 1).

The surficial geologic map units within the southern Feather River study area are described below, in order from oldest to youngest. Surficial geologic mapping for this study subdivides these map units and delineates individual deposits based on relative age and depositional process or environment (Plate 1). The map units depicted on Plate 1 are based primarily on analysis of 1937-vintage photography, and thus the map essentially is a "snapshot" of geologic conditions at this time.

The oldest unit exposed along the Feather River is the lower member of the Riverbank Formation (Qrl) of Helley and Harwood (1985). This unit is a highly dissected alluvial surface with textures of weathered gravel, sand and silt with strong soil-profile development. The Riverbank Formation is semi-consolidated, and is associated with the presence of a well-developed hardpan (or, duripan) layer that is a product of soil-forming processes over substantial geologic time. This hardpan layer reflects an ancient land surface that locally is buried by younger deposits. The Riverbank Formation is late to middle Pleistocene in age, and is estimated to be 130,000 to 450,000 yrs old (Helley and Harwood, 1985). The upper member is unconsolidated dark brown to red alluvium consisting of gravel, sand, silt and minor clay (Busacca et al., 1989, Helley and Harwood, 1985).

The Modesto Formation is divided into two members, a lower (older) unit that is latest Pleistocene in age (about 29,000 to 49,000 years old), and consists of unconsolidated slightly weathered gravel, sand, silt and clay. The upper member, a younger unit, is latest Pleistocene age (circa 12,000 to 26,000 years old) (Helley and Harwood, 1985). This unit (Qmu) is composed of sand, silt, and some gravel, comprising river channel and floodplain deposits, and is associated with a moderate amount of secondary (pedogenic) clay accumulation. This clay-rich horizon may form laterally continuous zones of low hydraulic conductivity, and may extend across boundaries between coarse and fine-grained strata within the latest Pleistocene alluvium. Soils on the Modesto Formation deposits include the Gridley loam of Strahorn et al. (1909) and the Conejo complex of Lytle et al. (1988).

Latest Holocene deposits overlie or are inset into the Modesto Formation, and are categorized as channel, floodplain, and basin deposits (Plate 1). Channel deposits include Holocene channels (Hch), distributary channels (Hdc), overflow channels (Hofc), sloughs (Hsl), in-stream or lateral bars (Hb), and meander scrolls (Hms). These deposits likely consist of fine to coarse sand, silty sand, and clayey sand, with trace fine gravel. Holocene channel deposits (Hch), which are present along Gilsizer Slough and the western floodplain as secondary channels, contain fining-upward sequences of sand, silt and clay. Overflow channels (Hofc) transport water across the land surface during high flow stages toward Sutter Basin. Networks of sloughs wander across the distal floodplain, and are likely filled with a fining-upward sequence of silt and clay (map unit Hsl). These deposits are associated with former channels, and generally are present landside (outboard) of the present-day human-made levees.

Holocene floodplain deposits include crevasse splays (Hcs), distributary fans (Hdf), and overbank deposits (Hob). Crevasse splays (Hcs) are sandy deposits that form from breaching of river banks or natural levees. Distributary fan deposits (Hdf) occur when water and velocity within a distributary channel decreases, can no longer transport its sediment load, and sediment is laid down on the floodplain. Overbank sediments are formed by localized overtopping of

river banks or natural levees, subsequent deposition from shallow sheet flow or standing water. Basin deposits occur on the distal floodplain and include undifferentiated basin deposits (Qn), and marsh deposits (Qs). Basin and marsh deposits are present in the topographically low areas west of the present-day natural levees along the Feather River. These deposits consist of fine sand, silt, and clay laid down in a relatively low-energy depositional environment. Soils developed on these deposits are the Sacramento series silt loam, fine sandy loam, clay, Alamo clay loam adobe and Stockton clay adobe. Marsh deposits are generally saturated and are often underwater in the present-day environment. Undifferentiated Holocene and Quaternary alluvium (Ha and Qa, respectively) usually are proximal to the river channel, and this map unit is used in areas where geomorphic features are obscured or obliterated by historical (1937-era) agriculture or cultivation. The deposits within these agriculturally modified areas are assigned a relative age (Ha or Qa) based on overlapping and cross cutting relationships with the surrounding deposits as follows: Ha if the agriculture-modified area is mapped within or shown overlying Holocene deposits; or Qa where it is difficult to evaluate the surface age based on the nearby deposits. Soils associated with these, undifferentiated units (Qa) are the Sacramento silt loam and Sacramento fine sandy loam, (Strahorn et al., 1909), and the Columbia fine sandy loam of Lyle et al. (1988), which are weakly developed soils commonly developed on relatively young deposits.

Historical deposits mapped in the area include stream channel and floodplain deposits, as well as artificial fill deposits (L and SP) (Plate 1). Historical deposits are estimated to be less than 150 years old, dating from approximately 1800 to 1937. Historical stream channels (Rch), distributary channels (Rdc), and overflow channels (Rofc) within the floodplain are recently abandoned channels or reflect active channels with low water flow. Lateral bar deposits (Rb) and meander scrolls (Rms) are located adjacent to the present-day Feather River, and are generally present inboard (waterside) of the present-day Feather River levees. When the river overtops its banks, distributary channels (Rdc) and recent overflow channels (Rofc) transport water and sediment across the floodplain. These channel deposits likely consist of silt and sand with traces of gravel. The upper few feet of these deposits probably are filled with debris from upstream hydraulic mining activities. Historical sloughs transport low velocity water flow derived from distributary channels proximal to the Feather River onto the distal floodplain and into the Sutter Basin. Slough deposits (Rsl) likely consist of fining-upward silt and clay.

Historical flood plain deposits include crevasse splay (Rcs), distributary fan (Rdf), and overbank (Rob) deposits, which generally consist of a fining upward or episodic fining upward sequence of sand, silt, and clay. Historical overbank (Rob) deposits are slightly finer grained sand, silt, and clay deposited via sheet flow when the river is at flood-stage and overtops natural and artificial levees. These historical deposits are differentiated based on cross-cutting and superposition relationships relative to existing cultural deposits visible on the 1937 photographs. Historical alluvial deposits (Ra), generally located within the Feather River channel, consist of undifferentiated sand, silt, and minor lenses of gravel. Historical artificial fills (map units L and SP) are culturally-emplaced heterogeneous deposits, with varying amounts of clay, silt, sand, and gravel from local sources. These deposits include levee structures and canal levee systems (L), and some undifferentiated soil piles (SP), and are shown on the surficial geologic map where present and identifiable on the 1937 photography.

Mapping of historical and Holocene deposits shown on Plate 1 generally is consistent with early, less-detailed soil survey mapping along the western banks of the Feather River as areas of Gridley loam, Sacramento Series fine sand, sandy loam and silt loam soils (Strahorn et al., 1909). The Gridley loam occurs along the northern Feather River from Thermalito south to the confluence with the Bear River, and closely corresponds to the Modesto Formation of Helley and Harwood (1985). The relationship between the mapped surficial geologic units and the potential for underseepage is summarized below.

4.0 Geomorphic Conceptual Model

The preliminary conceptual model described here is based on general relationships among surface and subsurface geologic deposits along the Feather River, as described above and shown on Plate 1. This conceptual model provides a consistent basis for understanding the type and stratigraphy in the area.

Published geologic maps of the project area identify a complex series of westward aggrading alluvial fans and terraces derived from the Sierra Nevada, identified as the Riverbank and Modesto formations. The Riverbank Formation and Modesto Formation are semi-consolidated to unconsolidated deposits characterized by intraformational paleochannels and lateral and vertical stratigraphic complexity related to past fluvial processes and buried paleo-topography. The Riverbank Formation unconformably overlies the Laguna Formation, which is a deeply dissected alluvial surface (Busacca et al., 1989).

Subsurface deposits about 150 feet beneath the ground surface rest on a resistant volcanic tuff capped by interbedded alluvial gravel, sand and silt, interpreted as Pliocene-Pleistocene age Laguna Formation that represents a period of relatively stable landscape conditions (Helley and Harwood, 1985). The Laguna Formation is overlain by the Pleistocene Riverbank Formation, (very dense gravel deposits) that are, in turn, overlain by a medium dense sand and gravelly sand package of the latest Pleistocene Modesto Formation (Busacca et al., 1989). The upper member of the Modesto Formation is exposed at the ground surface adjacent to the western bank of the Feather River south of Marysville and Yuba City. The Modesto Formation is mantled by unconsolidated deposits of Holocene age that comprise most of the surficial geologic deposits along the western side of the Feather River (Plate 1).

Geomorphic evidence suggests that the Feather River system south of Yuba City may have been located west of its present course (Figure 3). The present-day Gilsizer Slough diverges from the modern Feather River directly north of Yuba City and trends southwestward toward the Sacramento River. Alluvial deposits of Gilsizer Slough are inset (i.e. incised) into the Modesto Formation from Yuba City southward. The ancestral Gilsizer Slough perhaps extended to as far as the Sacramento River (Figure 3), based on surficial mapping not included in this report, and inspection of topographic maps. The ancestral Gilsizer Slough deposits are related to discharges and sediment loads that were higher than present-day conditions, and perhaps is an ancestral course of the Feather River.

Surficial geologic deposits near the Yuba City airport indicate the Feather River occupied an intermediate position between ancestral and present locations. The river occupied an abandoned channel arm north of Shanghai Bend, located between Gilsizer Slough and the modern Feather River (Figure 3). From this point the river continued southward in nearly its present location. This paleochannel had a sharp, more exaggerated bend than the present-day channel at Shanghai Bend (Figure 2). The channel subsequently moved eastward, laterally backfilling and abandoning the meander above Shanghai Bend, and moved to the rivers' present location closer to Marysville. Today, Gilsizer Slough is a natural bypass for high water flow stages on the Feather River, in the area between Marysville and Yuba City (Ellis, 1939).

Surficial geologic mapping (Plate 1) shows differences in deposit type and distribution from north to south along the Feather River, which is associated with changes in watershed production of water and sediment, related geomorphic processes, soil profile development, and the underlying subsurface hardpan layer. These differences illustrate the diversity of past geomorphic processes along the river and, as a consequence, the type of geologic deposits at and near the ground surface. The surficial geologic map allows the delineation of reaches along the river within which geomorphic processes and their associated deposits appear to be relatively consistent.

Between Yuba City on the north to the confluence with the Sutter Bypass on the south, the southern Feather River consists of four major reaches, each having characteristic deposit types and distributions. The river reaches are numbered Southern Feather one through four (SF-I through SF-IV), sequentially from north to south (Plate 1, Figure 3). This report describes the surficial geologic characteristics of Reach SF-I, SF-II, SF-III and SF-IV of the southern part of the Feather River, extending from Yuba City, south to the confluence with the Sutter Bypass.

Reach SF-I, extends from the north end of Yuba City to the Yuba City airport, and is about 1.15 miles long (Plate 1, Figure 3). The Project levee along Reach SF-I trends roughly north-south, and overlies alluvial sediments deposited by the Feather River. In Yuba City the levee rests on Holocene deposits associated with Gilsizer Slough that are inset into the upper member of the Modesto Formation. The active Feather River channel is east of, and inset to these Holocene channel deposits (Figure 4).

The second reach of south Feather River project area, SF-II, extends from the Yuba City airport south to Shanghai Bend, and is about 2.9 miles long. Near the Yuba City airport, and south of the confluence of the Feather and Yuba Rivers, young channel deposits are inset against the Gilsizer Slough channel deposits (Plate 1). From the Yuba City airport, south to Epley Drive (about 1.5 miles), the levees overlie historical alluvium of mining debris origin, map unit Ra. From Epley Drive south to Shanghai Bend Road the levees (about 1.4 miles) overlie historical meander scrolls, map unit Rms, (Figure 2, Plate 1). The levee along this reach, SF-II, primarily overlies Holocene channel fill, historical alluvium and overbank deposits. These channels are likely filled with a fining-upward sequence of gravel, sand and silt, the upper few feet of these features are probably covered by a veneer of sediment derived from upstream hydraulic mining activities (Figure 4).

River Reach SF-III extends from Shanghai Bend on the north to just south of the confluence with Bear River, and is approximately 12 miles long (Plate 1). Along Reach SF-III, the active river floodplain is inset into the upper member of the Modesto Formation. Over geologic time, flooding has lead to the vertical accretion of overbank and crevasse splay deposits onto the Modesto Formation west of the Feather River. Overflow channels and related deposits (Rofc) are common along this reach of the river. Beginning at Shanghai Bend and continuing southward are seven overflow channels that range from approximately 100 to 200 feet wide. The Project levees overlie these channels in the area around Messick Road (Plate 1). A few overflow channels conduct water flow immediately landside of the levees, across a short distance between Shanghai Bend and Oswald Avenue, then converge with the Feather River. The overflow channels are slightly inset to the Modesto Formation, and based on borehole data from locations where these channels cross the Sutter Bypass, are probably 6 to 15 feet deep. These channels are likely filled with episodic fining upward sequences of silt, sand and gravel, representing multiple flood events on the Feather River. The upper few feet of these channels are probably filled with sediment from upstream historic hydraulic mining activities. The river channel widens considerably between Country Club Road (0.5 mile width) and Obanion Road (1 mile width), (Plate 1). Feather River meanders along the eastern edge of Abbott Lake, swings sharply southward into Star Bend, where the river is deflected eastward by a resistant knob of Modesto Formation (which forms Star Bend). Historical crevasse splay and overbank deposits overlie the Modesto Formation from Abbott Road to Star Bend Road, along the western edge of Abbot Lake (Figure 5). These crevasse splay deposits are likely filled with a fining-upward sequence of fine gravel, sand and silt, The upper few feet of these features are probably covered by a veneer of hydraulic mining sediment.

The southernmost reach, Reach SF-IV, extends from the area south of the confluence with the Bear River to the confluence of the Feather River and Sutter Bypass, and is roughly 4 miles long (Plate 1). The sediments underlying the levee along this reach are geomorphically complex, resulting from depositional convergence between the Feather River and Bear River. The Bear River channel deposits large amounts of sediment across the ground surface adjacent to the confluence. The Modesto and Riverbank Formations are exposed at the ground surface adjacent to natural levees immediately north of the Bear River confluence, and north of this reach (Plate 1). These formations are covered by historical alluvium, sourced from the Feather and Bear Rivers. Much of the historical activity along this reach is located near the levee at Laurel Avenue. Here, consisting eight distributary channels (Rdc), typically 90 feet wide but ranging from 45 to 190 feet wide, cross the floodplain in southwesterly orientations, terminating in geologically young distributary-fan sediments. These sediments, primarily consisting of fine to coarse sand and silt, probably were deposited as a result of increased sediment and water input contributed to the Feather River from the Bear River. Historically, the Feather River and the Bear River have aggraded from substantial mining debris input, thus reducing channel cross sectional area (i.e., James, 1999). This reduction of cross section area, coupled with the trajectory of flood flow from the Bear River watershed, resulted in water overtopping the Feather River channel banks, and depositing sediment onto the floodplain between the confluence of the Feather River and Sutter Bypass (Plate1).

5.0 Applications to the Urban Levee Project

Based on an initial analysis of surface geologic and geomorphic data, the levees bordering the western side of the Feather River from Yuba City to the Sutter Bypass, (Reaches SF-I, SF-II, SFIII and SF-IV) probably are underlain by a veneer of near-surface sandy deposits, or by buried channels that are inset into the Modesto Formation. The preliminary conceptual surface and subsurface geologic relationships as they relate to levee structures and potential underseepage along each reach of the river are described below. This study does not account for any existing seepage mitigation structures, i.e. slurry wall or cutoff wall, which may be present.

Reach SF-I contains the Gilsizer paleochannel deposits, this channel intersects the levees roughly 660 feet south of Lynn Way to Colusa Avenue (Plate 1). Along this length the levees are underlain by coarse channel deposits. These coarse grain deposits are likely laterally continuous and poorly consolidated and relatively highly permeable, and likely are susceptible to underseepage.

Levees along the reach SF-II are underlain by a Holocene paleochannel and historical meander scroll deposits (Figure 2, Plate 1). These deposits are coarse grained, laterally continuous and poorly consolidated, and likely are susceptible to underseepage. The presence of this paleochannel deposit suggests locally permeable material (channel fill) directly underlying the levees. Historical alluvium most likely of mining debris origin, blankets the Yuba City airport paleochannel and meander scroll deposits. The levees along this reach are underlain by a thick sequence of young, permeable alluvium of meander scroll deposits that are highly susceptible to seepage (Glynn and Kuszmaul, 2004).

Reach SF-III consists of coarse-grained avulsion deposits (overbank, crevasse splay and overflow channel deposits) overlying the Modesto Formation. Overflow channels (Rofc) are common along this reach, are relatively thin, slightly inset to the Modesto Formation and are filled with poorly consolidated sediments that may provide local pathways for underseepage. Individual shallow coarse deposits may be laterally discontinuous and may be separated by clayey interbeds (i.e. thin blankets). Local coarse deposits may be associated with higher likelihoods of levee underseepage. Deeper deposits probably consist of consolidated Modesto Formation with occasional small, but unconsolidated, overflow channel deposits incised into resistant strata.

Along Reach SF-IV the levee is underlain by laterally-continuous sandy deposits formed by distributary overbank fans and by the south flowing ancestral Feather River (Gilsizer Slough). These coarse-grained deposits likely are permeable and susceptible to underseepage. Near Laurel Avenue distributary channel deposits underlie the levees and may be relatively coarser than the surrounding alluvium.

6.0 Summary

Lateral and vertical variability in the shallow subsurface deposits has resulted from past geomorphic processes. Surficial geologic mapping along the south Feather River allows reach classifications within which conditions may be relatively consistent. The conceptual subsurface stratigraphic framework suggests that stratigraphic relationships may promote localized levee underseepage, given certain hydraulic conditions, particularly along reach SF-I and II. Further spatial analyses of the surficial geologic mapping and subsurface geotechnical exploration data are needed to better constrain and characterize areas that are most susceptible to underseepage in the study area.

7.0 Limitations

This geomorphic assessment and associated data interpretation have been performed in accordance with the standard of care commonly used as the state-of-practice in the geologic engineering profession. Standard of care is defined as the ordinary diligence exercised by fellow practitioners in this geographic area performing the same services under similar circumstances during the same time period.

Discussions of surface and subsurface conditions summarized in this technical memorandum are based on geologic interpretations of subsurface soil data at limited exploration locations available to this assessment through August of 2007. Variations in subsurface conditions may exist between exploration locations, and the project team may not be able to identify all adverse conditions in the levee and its foundation. This memorandum is for the use and benefit of DWR. Use by any other party is at their own discretion and risk.

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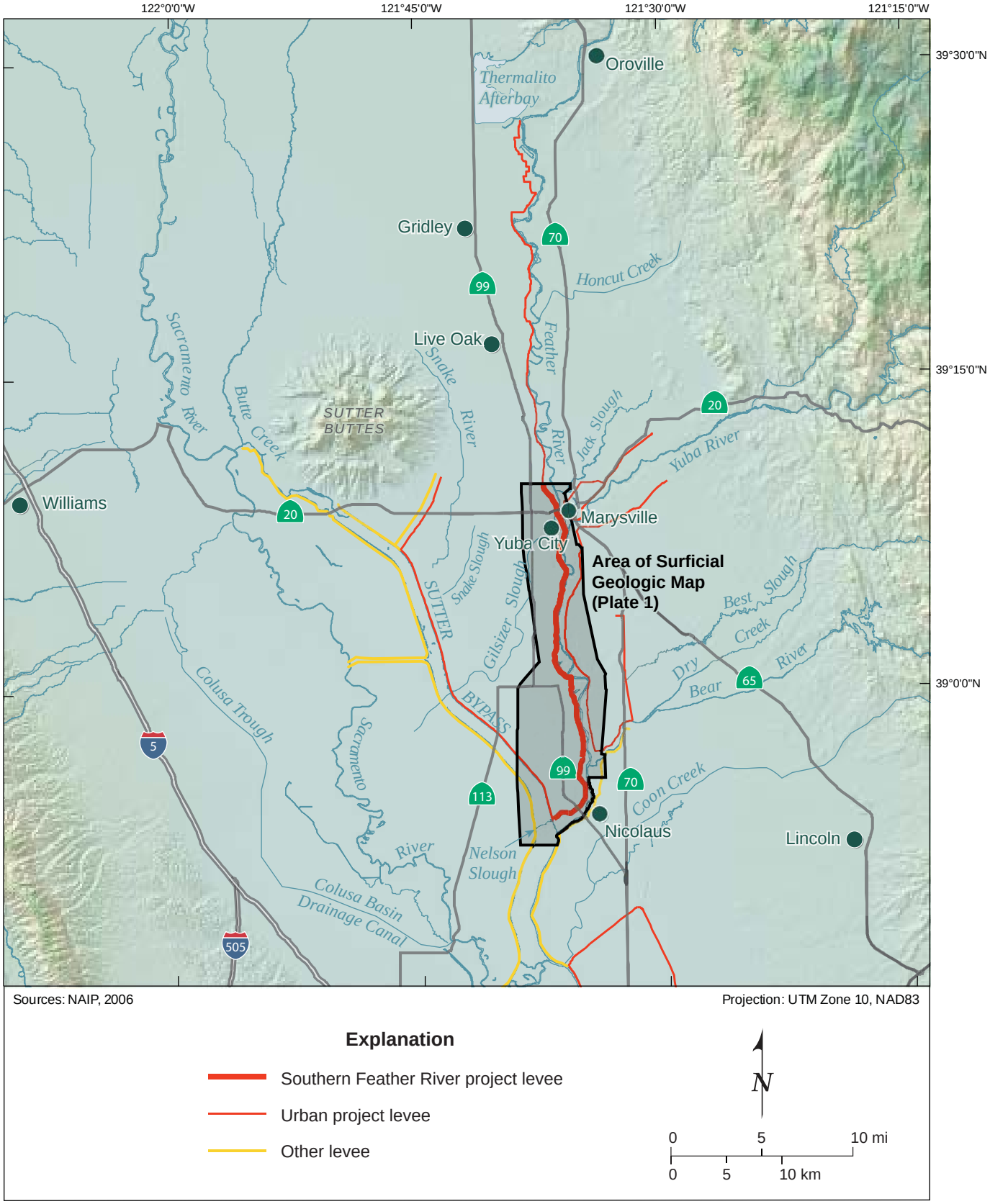


WLA

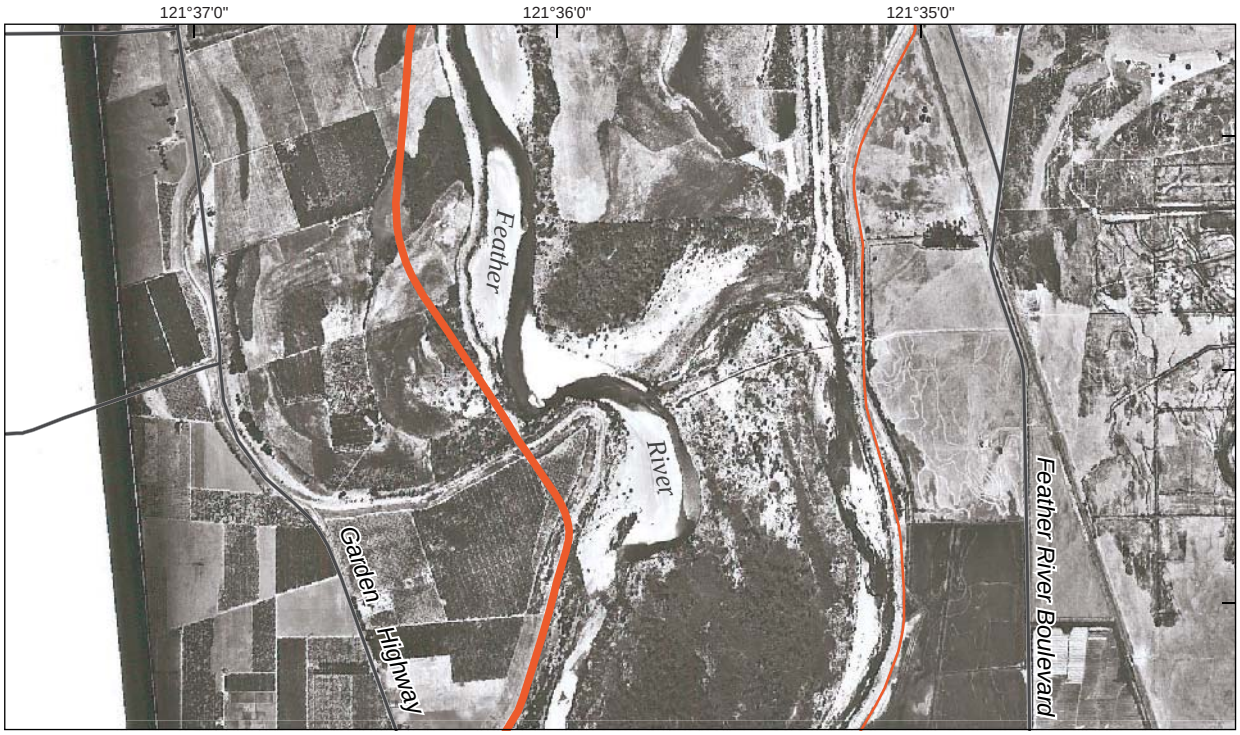
Map of Central Valley near Sutter Buttes, California

DWR URBAN LEVEE PROJECT

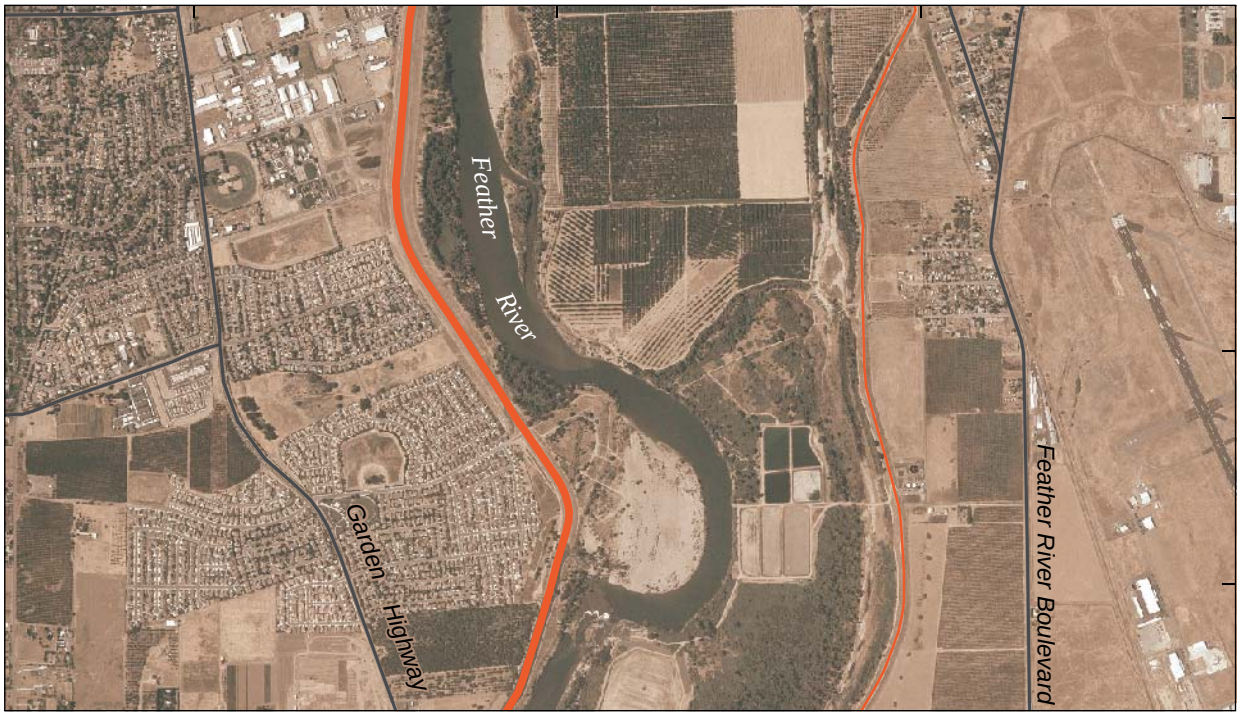
Figure 1

1881 South Feather River

Modified 09.03.09



A. 1937 USDA Air Photo



B. 2006 NAIP Ortho Imagery

Explanation

- Southern Feather River project levee
- Urban project levee
- Major road

N

0 5 10 mi

0 5 10 km

WLA

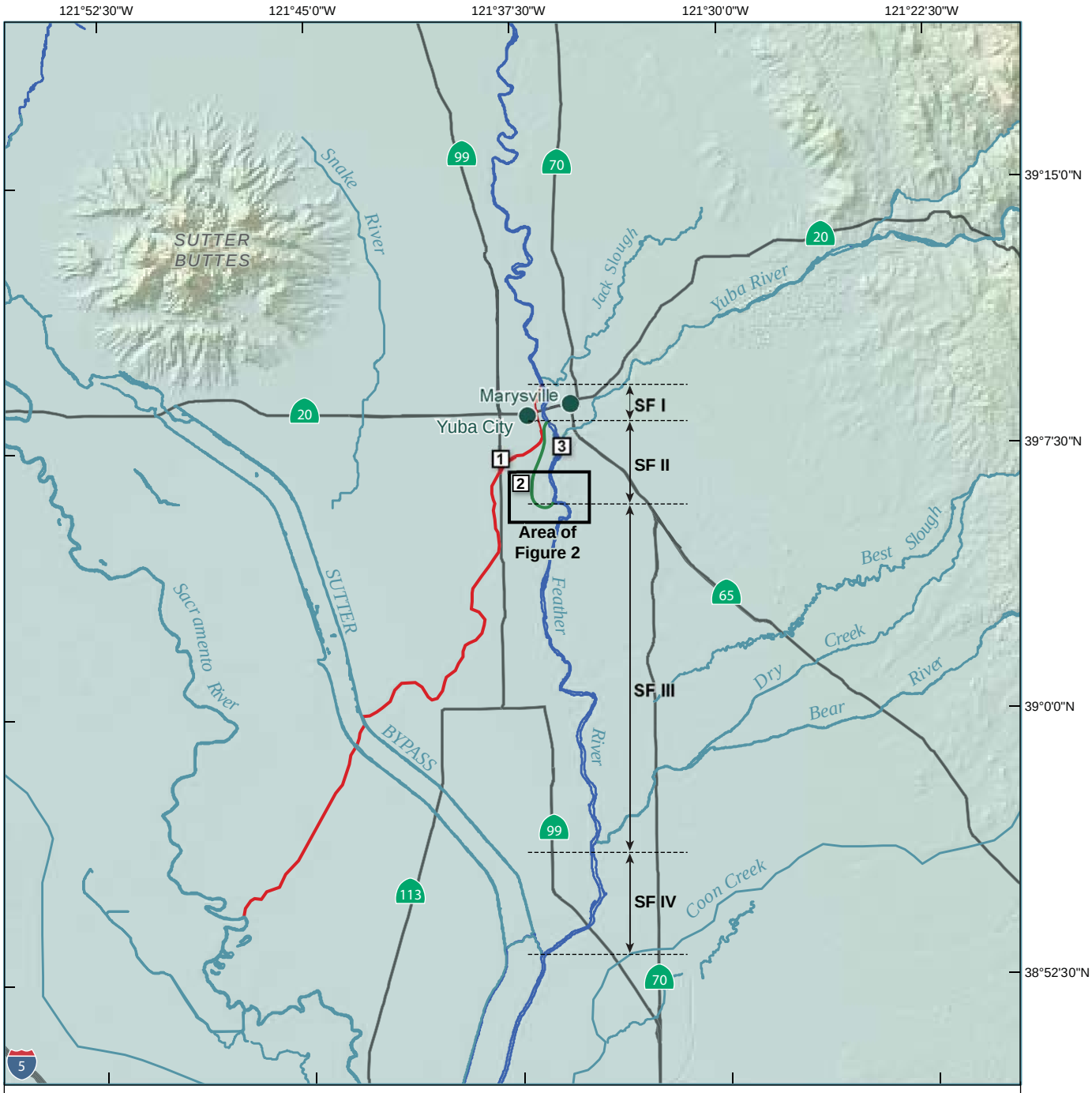
Aerial Imagery of the Feather River at Shanghai Bend

DWR URBAN LEVEE PROJECT

Figure 2

1881 South Feather River

Modified 09.03.09



Source: ESRI, 2006

Projection: UTM Zone 10, NAD83

Explanation

- 3 — Modern Feather River Channel
- 2 — Abandoned arm of the Feather River
- 1 — Ancestral Feather River Channel (Gilsizer Slough)
- SF I — Reach of Southern Feather River Study Area

N

0 — 5 mi

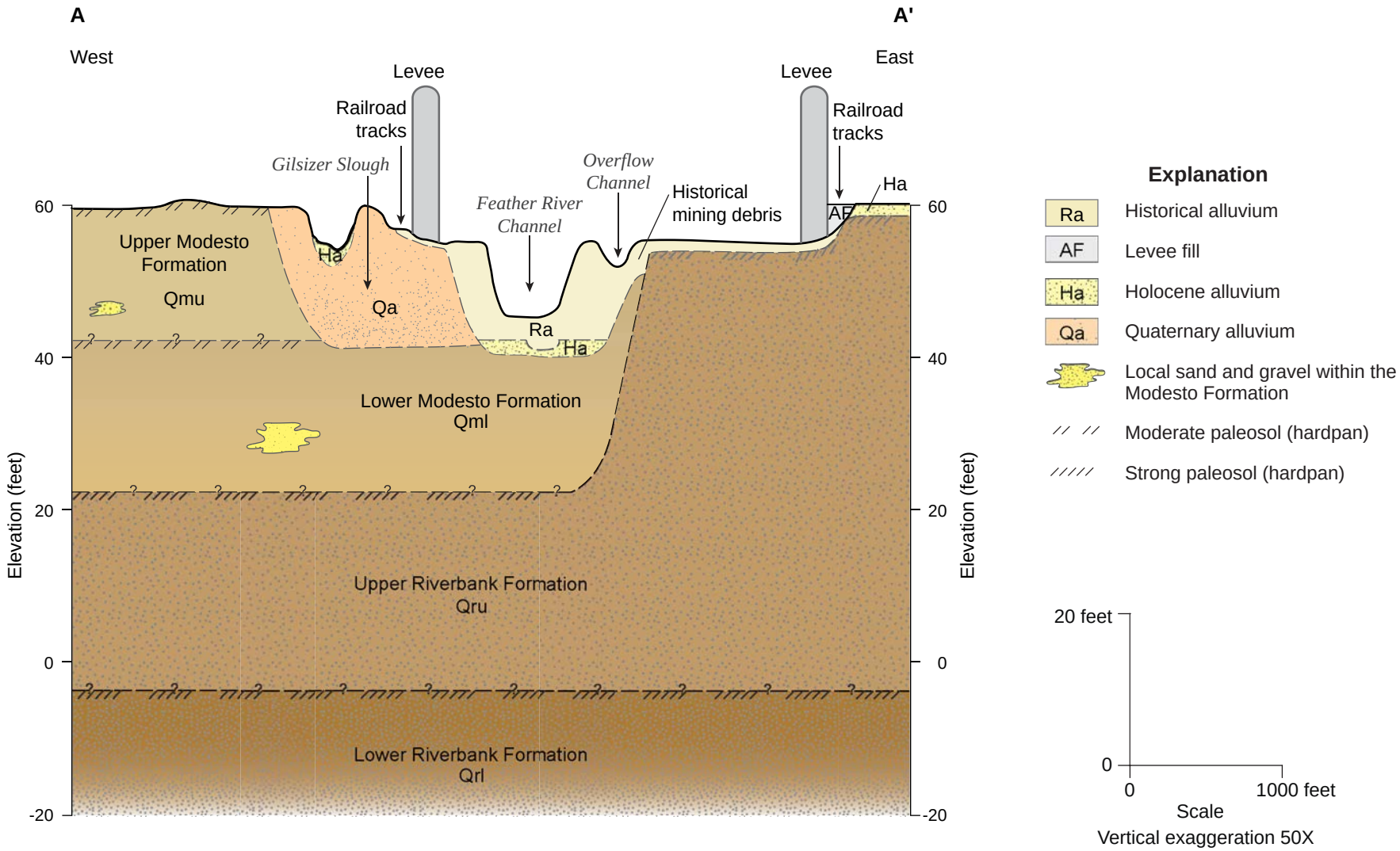
0 — 5 km

WLA

Map Showing the Eastern Migration of the Feather River

DWR URBAN LEVEE PROJECT

Figure 3



WLA

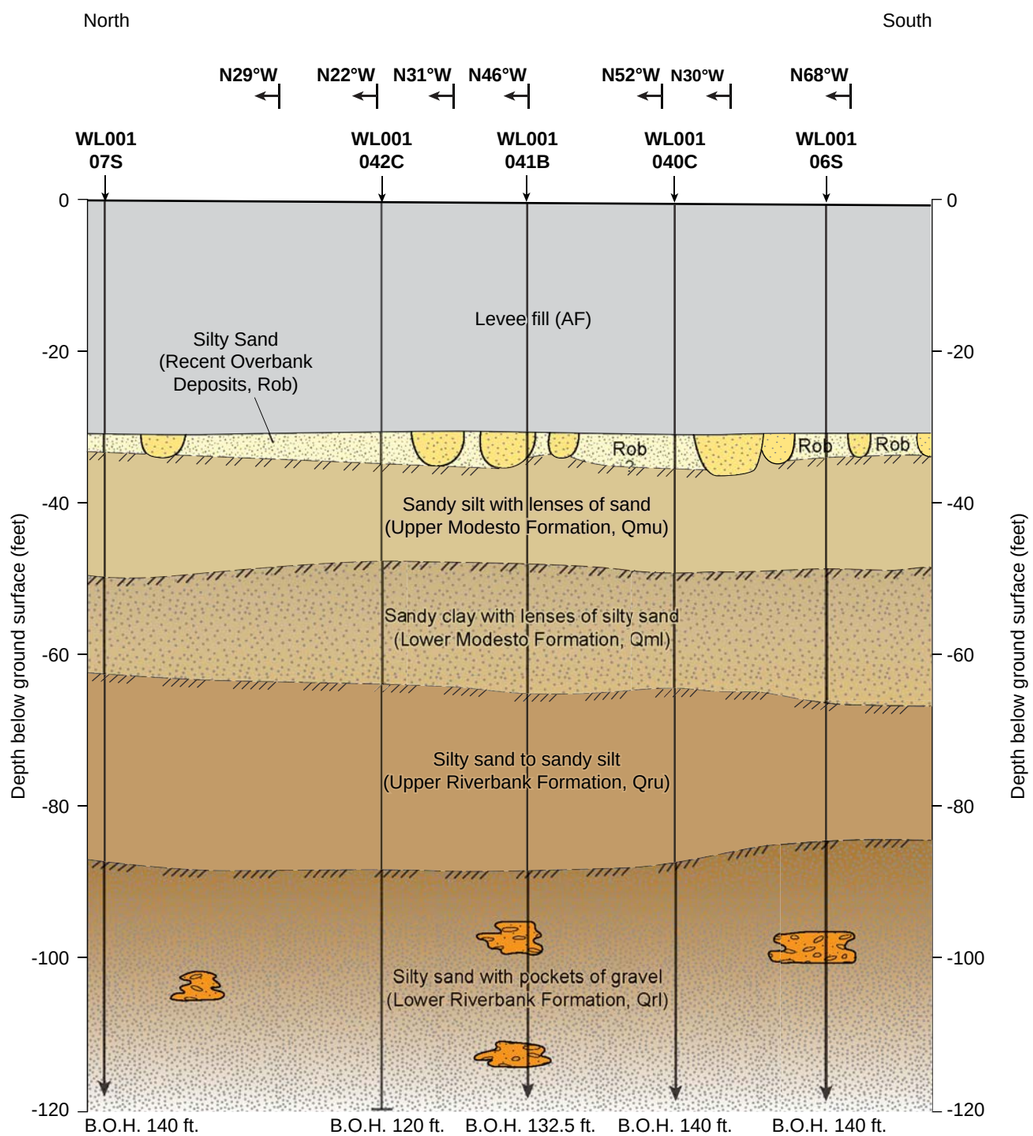
Conceptual Subsurface Diagram across the Feather River at Yuba City

DWR URBAN LEVEE PROJECT

Figure 4

1881 South Feather River

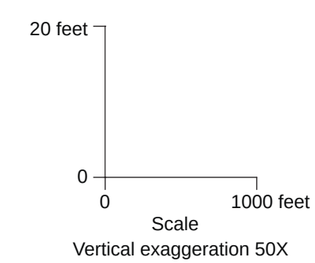
Modified 09.03.09



Explanation

- Recent crevasse splay, surficial geologic map unit Rcs
- Local sand and gravel within the Riverbank Formation
- Moderate paleosol (hardpan)
- Strong paleosol (hardpan)
- N46°W — Bend in Section

Notes:
1. See Plate 1 for location of cross section.
2. Surficial geologic units and contacts from this study and Helley and Harwood (1985).
3. Bottom of hole (BOH) values shown as total depth below ground surface.
4. Borehole names and horizontal distance shown above from draft URS logs and location maps. Geologic relations could change if borehole locations revised
5. Drilling method indicated as last letter in borehole names:
   S = Sonic Vibracore;
   C = Cone Penetrometer Test;
   B = Mud Rotary with SPT



Conceptual Subsurface Diagram, West Levee at Abbott Lake and Star Bend

Figure 5

Plate 1 - Surficial Geologic Map of the Feather River, Southern Section
This map shows surficial geologic deposits and levees as they existed in 1937. Map units and boundaries are drawn by interpretation of historical aerial photography supplemented by data from historical maps and surveys. For reference, the mapping is superimposed on modern U.S. Geological Survey topographic base map prepared in 1952 and photo revised in 1973. See accompanying report for complete descriptions of map units, process descriptions and methodology.
Explanation
Geologic contact; dashed where approximate, dotted where concealed, queried where uncertain; solid contacts within 30' of line shown on map.
SF-II
Geomorphic Reaches Discussed in Text
Project Levees
Cross Section
A
A'
WSL001_006S
Borehole locations from URS, Corp; locations from Sutter P2 Boring Locations, Region 1 Northern Area map.
W 1937
Water bodies, circa 1937.
BP
Borrow pits present in 1937.
Geologic Units
HISTORICAL
L
Levees (artificial fill), circa 1937.
SP
Spoils pile (artificial fill), circa 1937.
Rob
Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks.
Rcs
Crevasse splay deposits; fine to coarse sand, with minor lenses of clay deposited from breaching of natural or artifical levees.
Rdf
Distributary fan deposits; sand, silt and clay.
Rch
Channel deposits; well sorted sands and fine gravels.
Rms
Channel meander scroll deposits; sand, silt and clay from lateral channel migration.
Rb
Channel bar deposits; fine gravel, sand, and silt deposited in or along channel lateral margins.
Rcu
Cut off channel (chute); occurs on insides of meander bends within the river channel; on flood plain – entrenchment of overflow channels into hydraulic mining debris.
Rdc
Distributary channel deposits, trace gravel, sand, silt, and clay; channelized flow conducting sediment to floodplain.
Rofc
Overflow channels; vertically stratified sand, silt, and clay in floodplain channels occupied primarily when high-stage water overtops channel banks.
Rsl
Slough deposits; sand, silt and clay, fining upward facies, low-energy channel deposit.
Ra
Alluvial deposits, undifferentiated; sand, silt, and minor lenses of fine gravel.
HOLOCENE
Hob
Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks.
Hcs
Crevasse splay deposits; fine to coarse sand, with minor lenses of fine gravel deposited from breaching of natural or artifical levees.
Hdf
Distributary fan deposits; sand, silt and clay.
Hofc
Overflow channels; vertically stratified sand, silt, and clay in channels occupied when high-stage water overtops channel banks.
Hch
Channel deposits; sorted sands and silts; fining upward.
Hb
Channel bar deposits; fine sand, and silt deposited in or along channel lateral margins.
Hdc
Distributary channel deposits, sand, silt, and clay.
Hsl
Slough deposits; sand, silt and clay, fining upward facies, low-energy channel deposit.
Ha
Alluvial deposits; undifferentiated; sand, silt, and minor lenses of gravel; under cultivation in 1937.
Qn
Basin deposits; fine sand, silt and clay, dark yellow to dark yellowish brown, under cultivation in 1937.
Qs
Marsh deposits; silt and clay, likely organic-rich; perennially or seasonally submerged on 1937 photography.
PLEISTOCENE
Qmu
Modesto Formation; upper member; unconsolidated gravel, sand, silt, and clay.
Qml
Modesto Formation; lower member; unconsolidated to semi-consolidated gravel, sand, silt and clay.
Qru
Riverbank Formation; upper member, semi-consolidated to consolidated gravel, sand, silt and minor clay.
Qrl
Riverbank Formation; lower member; consolidated gravel, sand, silt, and clay, generally associated with strong duripan horizon.
Stratigraphic Correlation Chart
Time
Depositional Environment
Epoch
Channel deposits
Floodplain and alluvial-fan deposits
Flood basin deposits
Cultural deposits
Historical
Rch
Rdc
Rb
Rsl
Rms
Rofc
Rcu
Qa
Ra
Rcs
Rdf
Rob
Qs
Qn
L
SP
Holocene
Hch
Hdc
Hb
Hsl
Ha
Hdf
Hcs
Hob
Hofc
Latest Pleistocene
Qmu
Qml
Pleistocene
Qru
Qrl
MARYSVILLE
YUBA CITY
YUBA CITY AIRPORT
SF-I
SF-II
SF-III
SF-IV
1:20,000
N
0
0.5
1 Miles
0
0.5
1 Kilometers
Map projection: UTM NAD83 Zone 10N
Topographic base USGS quadrangles:
USGS, Gilsizer Slough topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
USGS, Nicolaus topographic quadrangle, published 1952, remapped 1992; map scale 1:24,000, five foot contour interval.
USGS, Olivehurst topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
USGS, Sutter topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
USGS, Sutter Causeway topographic quadrangle published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
USGS, Yuba City topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
Plate 1 - Surficial Geologic Map of the Feather River, Southern Section
WLA
WILLIAM LETTIS & ASSOCIATES, INC.
Walnut Creek, CA
1881_URS_Feather_South.mxd
09/04/2009
Geologic Mapping by J. Pearce and A. Streig
Digital Cartography by M. Ticci

WILLIAM LETTIS & ASSOCIATES, INC.
1777 Botelho Drive, Suite 262, Walnut Creek, California 94596
tel (925) 256-6070 fax (925) 256-6076

September 8, 2009

Mr. Juan Vargas
URS Corporation
2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833

RE: Surficial geologic mapping and geomorphic assessment, California Department of Water Resources Urban Levees Project, Sutter Bypass, Sutter County, California

Dear Mr. Vargas:

This memorandum presents the surficial geologic mapping and preliminary geomorphic assessment of the eastern Sutter Bypass area, for the California Department of Water Resources (DWR) Urban Levees Project geotechnical characterization. The goal of this mapping and geomorphic assessment is to provide information on the type and distribution of surface and shallow subsurface deposits that likely underlie the project levees along the eastern part of the bypass. The purpose of this study is to develop spatially-continuous geologic data and a conceptual model that allows reasonable stratigraphic interpretations between widely-spaced subsurface explorations, with respect to potential levee underseepage (i.e., Llopis et al., 2007). This letter presents the technical approach, surficial geologic map, conceptual geomorphic model, and initial results based on map analysis and preliminary review of available Phase 1 geotechnical data.

We appreciate the opportunity to provide these geomorphic and geologic data and preliminary interpretations of the shallow stratigraphic conditions in the Sutter Bypass study area. Please do not hesitate to call either of the undersigned if there are any questions or comments.

Respectfully,

WILLIAM LETTIS & ASSOCIATES, INC.

Justin Pearce, C.E.G. 2421
Senior Geologist
(925) 256-6070

Keith Kelson, C.E.G. 1610
Principal Geologist
(925) 256-6070

1.0 Approach

The approach to developing a surficial geologic map of the Sutter Bypass area (Figure 1, Plate 1) consisted of analysis of the following data: Aerial photography (black and white stereo-pairs taken in 1937, ~1:20,000-scale); early USGS topographic maps (i.e., 1911); published surficial geologic maps (Helley and Harwood, 1985); early and modern soil survey maps (Strahorn et al., 1911; Lytle, et al., 1988); field reconnaissance visit on June 22, 2007; and other maps and documents. Synthesis of these data allow for the development of a detailed surficial geologic map that provides an initial understanding of primary geomorphic processes that have acted in the study area during recent and historical geologic time. Through this mapping, we identify primary geomorphic features and associated surficial geologic deposits, such as abandoned paleochannels, marsh and basin deposits, flood-basin deposits, and other features commonly associated with flood-basins adjacent to large, active river systems. Knowledge of fluvial processes and the ability to recognize depositional environments in the geologic record are key to identifying locations along levees where underseepage is most likely to occur (Llopis, 2007).

The surficial geologic map was developed at the nominal scale of the aerial photography (1:20,000). This scale establishes the resolution of the map (Plate 1). The map unit contacts shown on the surficial geologic map should be considered approximate, and accurate to no more than about 30 feet on either side of the line shown on the map. The 1937 aerial photographs are the primary data set for interpreting the surficial geologic deposits because: (1) they are the oldest high-quality images that pre-date much of the urbanization and landscape alteration within present-day Sutter County (Figure 2); and, (2) these data represent a close approximation to the surficial deposits that were likely present at the ground surface prior to the construction of the levees. The 1937 photographs generally were taken in late summer or early autumn (i.e., August). By 1937, the area had experienced moderate cultivation that locally obscures geomorphic conditions. However, integration of data from the 1937 photography, old and recent topographic maps, geologic maps, soil surveys and historical documents provides sufficient information to delineate many of the pre-historic and historic surficial deposits in detail. Taken together, these data provide key insights to the geomorphic processes and resulting deposits that may affect levee underseepage.

Additional flood-basin or floodplain deposition may have occurred after 1937, due to flood overflows, levee overtopping, or localized levee failure. A time series analysis that interprets successive aerial photographs taken after major flood events (i.e., 1955) or known local levee failures (i.e., 1986) may reveal additional information on surficial deposits in the Sutter Bypass area. Such analyses are beyond the scope of this study. The data and interpretations presented herein address the primary goal of characterizing the type and distribution of deposits likely present directly beneath the project levees.

1.1 Report Preparation Quality Control

The surficial geologic map data and geomorphic interpretations presented in this memorandum were subject to quality control and quality assurance procedures as required by the Levee

Geotechnical Evaluation Project Management Plan (PMP). The surficial geologic map data developed by this study were reviewed for accuracy and completeness through an internal review and an independent technical review by Dr. Janet Sowers of WLA. Results of QA/QC review were documented using PMP Exhibit 2.2-3 (Independent Technical Review Report) and are kept on file according filing control plan. Subsurface data shown on diagrams were provided as draft information, and were not verified for accuracy or completeness by this study.

2.0 Geologic Setting

The Sutter Bypass (Bypass) study area lies southeast of the volcanic Sutter Buttes, between the Sacramento and Feather Rivers. The project levee addressed in this study borders the eastern side of the Sutter Bypass, extending from the Wadsworth Canal southeast to the Feather River (Figure 1). The Bypass levee generally trends northwest-southeast, and ties in to the Feather River west bank levee.

The Bypass levee lies northeast of Sutter Basin, a low-lying area east of the Sacramento River and west of the Feather River, where overflow and floodwaters from Butte Basin (located northwest of the Sutter Buttes), the Sacramento River, and the Feather River produced a seasonally marshy area. Except for the Sutter Buttes area, the regional land surface is nearly flat, and along the Bypass area gently slopes southwest at an elevation of about 30 to 40 feet. Construction of the Sutter Bypass was completed in 1924 to serve as an overflow for Sacramento River floods in the winter, and a source of irrigation in the summer (DWR, 1976). The eastern levee was enlarged in 1942 (Corps of Engineers, 1953). Prior to cultural modification, surface water runoff in the Bypass area was delivered to the Sutter Basin via intermittent, meandering creeks and sloughs from the northern Central Valley, including: Snake River, Snake Slough, Gilsizer Slough, Nelson Slough, and flood overflow channels emanating from the western side of the Feather River. The construction of the Bypass levee blocks water from the east that normally drains to the Sutter Basin and Sacramento River (DWR, 1976). Presently, many of the natural drainages and channels have been replaced by linear ditches, agricultural drains, and canals (Figure 2).

3.0 Surficial Geologic Mapping

Published surficial geologic maps of the Sutter Bypass study area generalized the surficial deposits primarily as late Quaternary basin (map unit Qb) deposits, with localized units of late Quaternary alluvium, Quaternary Modesto Formation (lower member), and Quaternary Riverbank Formation (lower member) (Helley and Harwood, 1985). These map units were delineated at a regional scale (i.e., 1:62,500). The current analysis of the Bypass uses this geologic framework as a basis for more detailed mapping of late Holocene alluvium and geomorphic features (Plate 1). The surficial geologic map units within the Sutter Bypass study area are described below, in order from oldest to youngest.

The oldest map unit exposed in the study area is the late Quaternary Riverbank Formation (lower member), and is mapped in the south portion of the study area east of Nelson Slough,

where it likely directly underlies the project levee near the latitude of Laurel Avenue (Plate 1). This formation (map unit Qrl) is present in the shallow subsurface beneath much of the bypass area, and consists of alluvial-fan deposits derived from the Sierra Nevada during the middle Pleistocene (about 400,000 to 200,000 years ago). The Riverbank Formation is semi-consolidated, and is associated with the presence of a well-developed hardpan (or, duripan) layer that is a product of soil-forming processes over substantial geologic time. This hardpan layer reflects an ancient land surface that locally is buried by younger deposits. Soils developed on the Riverbank Formation in the Bypass area include the San Joaquin loam of Strahorn et al. (1911) and the Yuvas loam (Lytle et al., 1988), both of which document a strongly cemented hardpan at depths of about 1.5 to 3 feet below ground surface.

The late Pleistocene Modesto Formation is younger than the Riverbank Formation and is present in the map area primarily along the margin of Gilsizer Slough and directly east of Highway 113 (Plate 1). This unit is divided into two members, a lower (older) unit that is about about 42,000 to 29,000 years old (Qml), and an upper member that is about 24,000 to 12,000 years old (Qmu) (Helley and Harwood, 1985). The Modesto Formation, in general, consists of unconsolidated sand, silt, and clay, and is associated with a moderate amount of secondary (pedogenic) clay accumulation. This clay-rich horizon may form laterally continuous zones of low hydraulic conductivity. These soil horizons may extend across boundaries between coarse and fine-grained strata within the latest Pleistocene alluvium, and may form relatively continuous zones of low vertical hydraulic conductivity within the Modesto Formation. Soils developed on the Modesto Formation include the Gridley loam of Strahorn et al. (1911) and the Marcum clay loam with “siltstone” hardpan (Lytle, 1988).

Younger surficial deposits overlying the Riverbank and Modesto Formation include late Quaternary marsh, basin, and alluvial deposits (map units Qs, Qn, and Qa, respectively), which are considered Holocene age (i.e., less than 11,000 years old). The widespread basin deposits are about 4 to 8 feet thick and bury the gently southwest dipping Modesto Formation (Figure 3). The thickness of the basin deposits increases to the southwest, in the direction of Sutter Basin (Figure 3). The soils developed on the basin deposits generally are associated with the Stockton clay adobe and Marcuse clay of Strahorn et al. (1911) and the Oswald clay (Lytle et al., 1988), and thus represent immature soils with overall fine-grained textures. Undifferentiated alluvial deposits (map Qa, Plate 1) are present along Gilsizer Slough, and are inset (i.e., topographically lower) into the adjacent Modesto Formation. The Quaternary marsh deposits (map unit Qs, Plate 1) are present between the Sutter Bypass levees northwest of Gilsizer Slough, and are also fine-grained deposits that are differentiated from basin deposits by usually being underwater or having standing water at the time when the 1937 photographs were taken (usually late summer to early autumn).

Inset into the units described above are deposits of Holocene alluvial channels (map unit Hch, Plate 1), which are a network of moderately sinuous channels with southwesterly orientations. These channels appear to be mostly filled with sediment by the time of 1937 photographs, and are expressed only locally as subtle topographic lows in the ground surface. Many of these channels extend west of, and therefore cross beneath, the eastern Sutter Bypass levee (Plate 1). The alluvial channels west of Gilsizer Slough start on the alluvial plain as intermittent creeks, and are not directly connected to the Feather River (USGS Tisdale Weir quadrangle, 1911).

The channel deposits are tentatively associated with the Liveoak series, sandy clay loam soil (Lytle et al., 1988), and consist of a lower, sandy unit that fines-upward into an upper, silt and clay layer.

Subdivisions of the Holocene channels include sloughs (map unit Hsl, Plate 1), distributary channels (map unit Hdc), and overflow channels (map unit Hofc). These deposits, in general, also consist of a fining-upward sequence of sand, silt, and clay. The sloughs are present primarily east of Highway 113 (Plate 1) and have southwesterly orientations. The sloughs are ephemeral channels that drain the alluvial plain between Gilsizer Slough and the Feather River. The term "slough" in this study does not mean tidally-influenced channels, but instead channels that likely conveyed relatively slow-moving water from direct precipitation and sheet-flow runoff. The overflow channels convey flood flows that overtop the banks of the Feather River onto the floodplain, and are interpreted as higher-energy channel systems relative to the sloughs. The distributary channels route flow from and sediment onto the floodplain, and end at distributary-fan deposits. The overflow and distributary channel deposits are present in the southeastern portion of the Bypass area, south of the latitude of Laurel Avenue (Plate 1).

Localized deposits related to the Holocene alluvial channels are bars (map unit Hb) that typically occur in the medial and lateral portions of the channels, and distributary fan deposits (map unit Hdf) that occur where the channel becomes unconfined and has deposited sediment on the basin floor. Channel bars are relatively uncommon in the Sutter Bypass study area. Distributary fans are common in the southeast portion of the Bypass area, south of the latitude of Sacramento Avenue (Plate 1). The distributary-fan deposits likely consist of unconsolidated fine sand and silt (i.e., Strahorn et al., 1911).

Historical geologic deposits are present along the length of the Bypass study area (i.e., map unit Rch, map unit Rdf). The term "historical" is applied to deposits that are estimated to be less than 150 years old. These deposits share the same genetic origin as the Holocene deposits described above. The historical channel deposits are differentiated from the Holocene channel deposits on the basis of cross-cutting relationships with other map units, relative degree of geomorphic expression and/or dissection, and correlation with land surface expression on the early and modern topographic maps. The Bypass eastern levee overlies the former locations of Holocene and historical alluvial channels in several locations throughout its length (Plate 1).

Undifferentiated Holocene and historical alluvium (map units Ha and Ra) is mapped in the southeastern Bypass area, near the confluence of the Sutter Bypass and the Feather River, generally east of Sawtelle Road (Plate 1). The undifferentiated map unit is delineated where the morphology of these deposits is indistinguishable on 1937 photographs as a result of cultural modifications (i.e., agriculture). The soils developed on the undifferentiated historical alluvium generally correspond with the Sacramento series fine sandy loam and silt loam of Strahorn et al. (1911) and the Shanghai silt loam (Lytle et al., 1988). There is no hardpan layer associated with these soils, supporting the interpretation of geologically young deposits.

4.0 Conceptual Geomorphic Model

Based on synthesis of surficial geologic mapping, topographic maps, soil surveys, geologic maps, and review of readily available subsurface geotechnical information, we present a preliminary conceptual geomorphic model describing general relationships among surface and subsurface deposits along the Sutter Bypass study area. This conceptual model provides a consistent basis for understanding the type and distribution of surficial geologic deposits, primary geomorphic processes, and shallow subsurface stratigraphy in the area. Identification of subsurface stratigraphic formations is challenging, primarily because of a lack of distinctive and laterally extensive stratigraphic marker beds within late Quaternary deposits of the northern Central Valley (i.e., Page, 1986), and because there is little apparent difference in lithology between the late Quaternary formations (i.e., Helley and Harwood, 1985). This study relies heavily on the identification and local correlation of hardpan horizons and deposit color and density changes to delineate subsurface formations.

In a general sense, the Sutter Bypass levees traverse across the distal portions of ancient alluvial-fan deposits that were derived from the Sierra Nevada, and prograded westward onto the valley floor (i.e., Riverbank and Modesto Formations). These Pleistocene deposits are exposed at the ground surface northeast of the Bypass study area (Helley and Harwood, 1985; Page, 1986), dip to the southwest and are mantled by younger fine-grained basin deposits (Figure 3). In contrast, the Modesto Formation is exposed at the ground surface along Gilsizer Slough and directly east of Highway 113 (Plate 1). The surficial map pattern of the Modesto deposits in these locations suggests depositional lobes from an ancestral Gilsizer Slough. These deposits may have been related to discharges and sediment loads that were higher than present-day conditions. These deposits may, perhaps, represent an ancestral Feather River channel location that occupied the present-day Gilsizer Slough during the latest Pleistocene and was subsequently abandoned.

The surficial geologic mapping (Plate 1) shows differences in deposit type and distribution from northwest to southeast along the Bypass, which are associated with changes in watershed production of water and sediment, related geomorphic processes, soil profile development, and the underlying subsurface hardpan layer. These differences illustrate the diversity of past geomorphic processes along and near the Bypass and, as a consequence, the type of geologic deposits at and near the ground surface. The surficial geologic map allows the interpretation of "reaches" along the Bypass within which geomorphic processes and their associated deposits are likely to be relatively consistent. The Bypass study area consists of four general reaches, from northwest to southeast, each having characteristic deposit types and distributions (Plate 1).

The westernmost reach of the Bypass study area extends from the junction with the Wadsworth Canal to directly south of the Tisdale Weir ("Reach I", Plate 1). The levee along this reach, about 8.1 miles long, primarily overlies fine grained basin deposits accumulated on the valley floor over geologic time. This deposition resulted from flooding of the Sacramento and Feather Rivers, tributaries draining Sutter Buttes, and sheet flow from the generally flat valley floor. Holocene and historical channel deposits (map units Hch and Rch, Plate 1) are inset into the basin deposits. These southwest-trending alluvial channel deposits locally underlie the Bypass

levee, and result in local differences in material textures beneath the levee (Figure 4). About 27 abandoned channels traverse the levee along this reach (approximately 3 channels per levee mile). The channels are about 250 feet wide, but range from about 100 to 300 feet wide (Plate 1). In this area, the channels are about 6 to 8 feet deep, and are typically filled with sand, silt, and clay in a fining-upward sequence, i.e., coarser-grained sand overlain by about one to two feet of silt and clay. This sedimentary sequence may be conducive to seepage where relatively more-permeable channel sands are overlain by a relatively thin, fine-grained "blanket" layer.

The second reach along the Bypass, about 1.1 miles long, extends across Gilsizer Slough ("Reach II", Plate 1), where Modesto Formation deposits are present at the ground surface. Undifferentiated alluvium (map unit Qa, Plate 1) is present along the historically-active Gilsizer channel floor, and is inset to the Modesto Formation (Figure 5). The Gilsizer Slough alluvium extends beneath the eastern and western Bypass levee, and thus represents the progradation of younger deposits with respect to the Modesto Formation. Along this reach, the Bypass levee is underlain by younger Gilsizer Slough alluvium flanked by the relatively denser, semi-consolidated late Pleistocene Modesto deposits (Figure 5). Areas where the levee directly overlies the Modesto Formation may be relatively less conducive to underseepage, as the associated hardpan layer may form locally continuous zones of low hydraulic conductivity.

The third reach along the Bypass extends from the Gilsizer Slough to the latitude directly south of Laurel Avenue, and is about 6.6 miles long ("Reach III", Plate 1). This reach is generally similar to Reach I, except Reach III has Pleistocene deposits (i.e., lower Modesto and Riverbank Formations) exposed at or very near the ground surface, and has a sparser channel density (about 2 channels per levee mile) compared to Reach I. About 14 southerly-oriented sloughs are mapped across this reach and locally underlie the Bypass levee (Plate 1). The sloughs originate from the Feather River, near Star Bend and Shanghai Bend, extending southward toward the Bypass. The sloughs along Reach III are about 250 feet wide, but range from about 100 to 300 feet wide, similar to Reach I (Plate 1). In this area, the channels are also probably about 6 to 8 feet deep, and probably filled with sand fining-upward to silt and clay. These channel deposits may be conducive to underseepage because of the deposit stratigraphy that has coarser-grained sand overlain by about one to two feet of silt and clay. Late Quaternary Riverbank Formation is at the ground surface along the southwestern end of Reach III (Plate 1), and likely is not conducive to seepage due to the dense and strongly-developed hardpan clay layer that is usually at about 1.5 to 4 feet depth below ground surface.

The fourth reach along the Bypass extends from directly south of the latitude of Laurel Avenue to the confluence with the Feather River west bank levee ("Reach IV", Plate 1). Reach IV, about 1.9 miles long, has Holocene and historical alluvium at the ground surface along this reach of the Bypass, primarily because of the proximity to the Feather and Bear Rivers (Plate 1). About 8 distributary channels, usually 90 feet wide but ranging from 45 to 190 feet wide, cross the floodplain in southwesterly orientations, leading to geologically young distributary-fan sediments. These sediments, primarily consisting of fine to coarse sand and silt, probably were deposited as a result of increased sediment and water input contributed to the Feather River from the Bear River; the confluence located directly upstream from this reach of the Bypass (Figure 1). Historically, the Feather River and the Bear River have aggraded from substantial mining debris input, thus reducing channel cross sectional area (i.e., James, 1999).

This reduction of cross section area, coupled with the trajectory of floodflow from the Bear River watershed, resulted in water overtopping the Feather River channel banks, and depositing sediment onto the western floodplain where the Bypass levee is located (Plate 1).

5.0 Applications to the Urban Levee Project

Based on synthesis of the surficial geologic map with preliminary Phase 1 borehole and cone penetrometer (CPT) data, the Bypass levee generally is underlain by relatively young fine-grained clay and sandy clay deposits that are laterally interrupted by local coarser channel fill deposits (i.e., Figures 3, 4, 5, and 6).

The northernmost reach of the Bypass levee ("Reach I") is predominantly underlain in the shallow subsurface by relatively young fine-grained clay and sandy clay deposits. These basin deposits are laterally interrupted by coarser-grained deposits filling abandoned channels that are about 250 wide (Plate 1, Figure 4). Mud rotary borehole WSESBP_011B, which penetrated channel unit Rch norths of Gilsizer Slough (Plate 1), indicates the channel deposit is about four-feet thick, consisting of about 60% fine to coarse sand (medium dense) with clayey sand. The clayey sand grades upward into clay, of about 45% sand fraction. This suggests locally coarse and unconsolidated, and therefore likely permeable, material in the channel fill. Based on review of adjacent borehole data, the basin deposits (Figure 4) generally consist of stiff clay, with less than 10% fine sand. It is likely that most or all of the small channels mapped herein as unit Rch are similar in textural characteristics and depths, because of similar genetic origin and geomorphic process of channel development and infilling. These deposits underlie Reach I in at least 27 places between Wadsworth Canal and Gilsizer Slough (Plate 1).

Reach II crosses late Pleistocene and Holocene geologic deposits associated with Gilsizer Slough (Plate 1). Review of subsurface borehole and CPT data indicate that the basin deposits north of the slough consist of medium stiff to stiff clays (Figure 5). The channel fill deposits within Gilsizer Slough (map unit Qa, Plate 1) consist of alternating beds of sandy gravel and clay. These channel deposits are inset into the lower Modesto Formation which, in this area, consists of very stiff sandy clay interbedded with silty sand and localized dense sand. Directly south of Gilsizer Slough, the lower Modesto Formation is at the ground surface (Plate 1). Subsurface data suggest that a hardpan horizon is encountered at about 3 to 4 feet below the ground surface. The uppermost deposit above the hardpan consists of sand and silty sand, and probably is weathered and/or culturally re-worked materials of the lower Modesto Formation. Thus, north of Gilsizer Slough, potentially low-permeability basin materials blanket the Modesto, and are locally cut by channel deposits, whereas at and south of Gilsizer Slough the local channel deposits are inset directly into the dense Modesto Formation. Where the Bypass levee rests on the unconsolidated Qa deposits within Gilsizer Slough, these coarse deposits may be associated with higher probabilities of levee underseepage. In constrast, the sections of the levee underlain directly by the Modesto Formation containing consolidated (hardpan) horizons are much less likely to experience underseepage.

Reach III is similar in geomorphic nature to Reach I, except it has a lower frequency of channels as compared to Reach I (Plate 1). It is probable that the composition of these deposits

generally will be consistent with those along Reach I (i.e., coarse-grained channel fill with upper fine-grained layers). These channels are more likely to promote seepage beneath the levee compared to the basin deposits. Additionally, the Pleistocene materials that likely directly underlie the project levees along this reach (Plate 1) are relatively dense and the associated hardpan layer may form a relatively continuous zone of lower hydraulic conductivity. Where the levee directly overlies Modesto formation (NW ¼, Section 20; southeast of the Sutter Causeway), there is a lower likelihood of underseepage. There is also a lower likelihood of underseepage where the levee rests on the Riverbank Formation in lower length of Reach III (SW ½, Section 34).

Along Reach IV, geologically young Holocene and historical alluvium is beneath the Bypass levee (Plate 1). This uppermost layer, about five-feet thick, is locally cross-cut by channel deposits that also consist of silt and sand (Figure 6). Quaternary basin deposits do not directly underlie the Bypass levee along this reach. Review of Phase 1 subsurface geotechnical data indicates that these alluvial deposits consist of silty sand and sandy silt textures. Based on review of Phase 1 data in other Project areas (i.e., Marysville), the uppermost alluvium generally has low densities (i.e. loose to medium dense), and consequently relatively high permeability. The surficial mapping indicates that essentially all of this reach of the levee (about1.9 miles) is underlain by loose, unconsolidated sandy alluvium, which may be susceptible to substantial underseepage. The local recent channels (map units Ra and Rdc; Plate 1) may contain coarser deposits and may be more susceptible to underseepage.

Synthesis of the surficial mapping and geotechnical data indicate that subsurface stratigraphy along the Sutter Bypass area locally may be conducive to levee underseepage. Shallow strata typically include denser and probably semi-consolidated material (i.e., Modesto Formation) that likely contains a moderately developed low-permeability hardpan horizon. The hardpan may or may not be laterally continuous, depending on post-depositional soil formation and erosional processes. Along Reach I and III, the Modesto formation is overlain by about 4 to 6 feet of medium stiff to stiff clay (i.e., basin deposits). The basin materials locally are cross-cut by relatively loose, sandy channel deposits that have a thin fine-grained upper “blanket” layer. Therefore, this shallow subsurface stratigraphy may promote levee underseepage along certain areas of the Bypass project levees that overlie geologically young, loose, sandy channel material lies between the dense Pleistocene deposits and relatively thin, low-permeability clay-rich “blanket” layer. Along Reach IV, a layer Holocene and historical alluvium from the Feather River mantles the Modesto Formation, and also may promote levee underseepage.

Lateral and vertical variability in the shallow subsurface deposits has resulted from past geomorphic processes. The conceptual subsurface stratigraphic framework suggests that stratigraphic relationships may promote localized levee underseepage, given certain hydraulic conditions. Further spatial analyses of the surficial geologic mapping and subsurface geotechnical exploration data are needed to better constrain and characterize areas that are most susceptible to underseepage in the study area.

6.0 Limitations

This geomorphic assessment and associated data interpretation have been performed in accordance with the standard of care commonly used as the state-of-practice in the geologic engineering profession. Standard of care is defined as the ordinary diligence exercised by fellow practitioners in this geographic area performing the same services under similar circumstances during the same time period.

Discussions of surface and subsurface conditions summarized in this technical memorandum are based on geologic interpretations of subsurface soil data at limited exploration locations available to this assessment through August of 2007. Variations in subsurface conditions may exist between exploration locations, and the project team may not be able to identify all adverse conditions in the levee and its foundation. This memorandum is for the use and benefit of DWR. Use by any other party is at their own discretion and risk.

7.0 References

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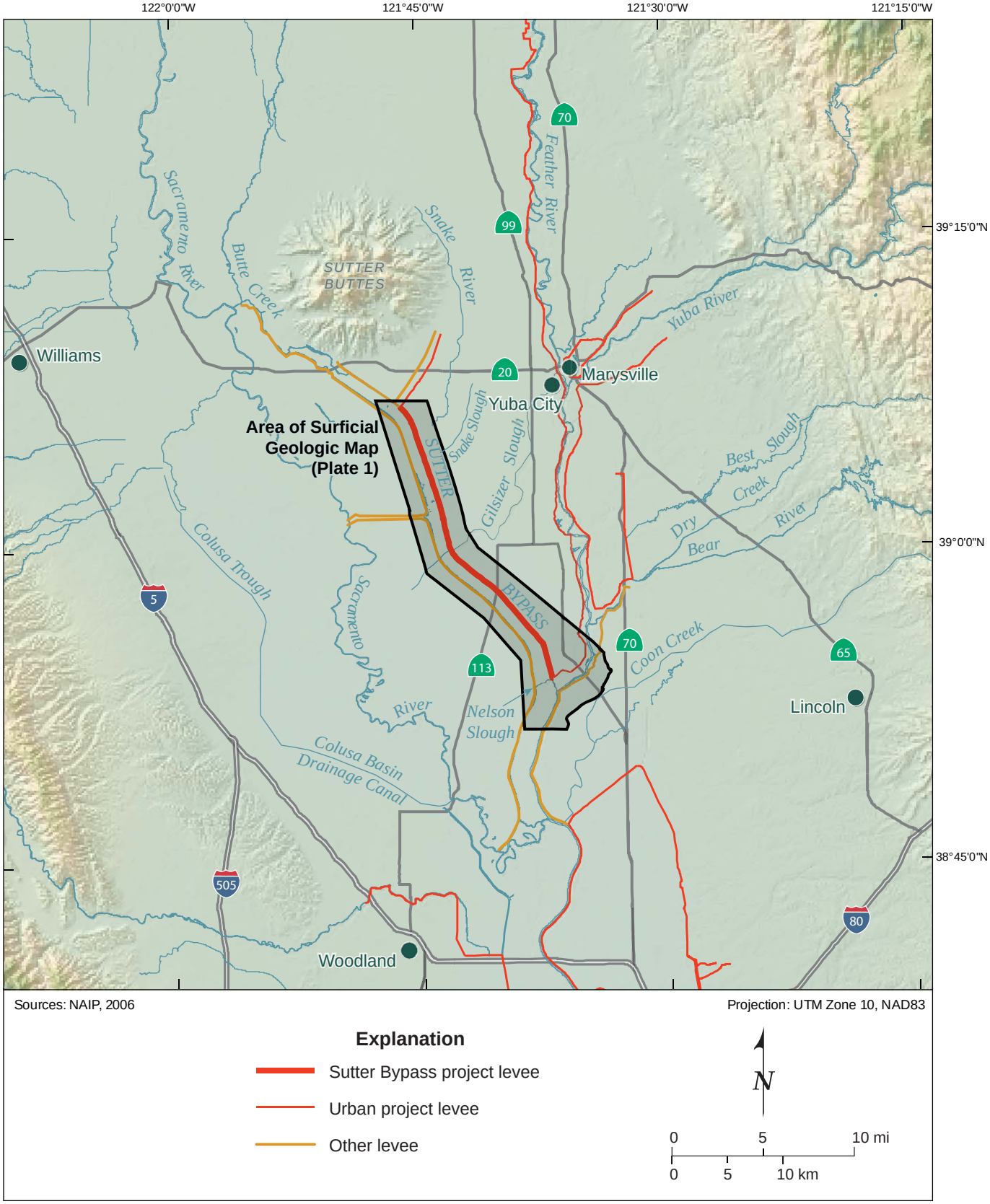
USGS, Marcuse topographic quadrangle, surveyed 1909, published 1911; map scale 1:31,680, five foot contour interval.

USGS, Nicolaus topographic quadrangle, surveyed 1908, published 1910; map scale 1:31,680, five foot contour interval.

USGS, Tisdale Weir topographic quadrangle, surveyed 1909, published 1911; map scale 1:31,680, five foot contour interval.



WLA

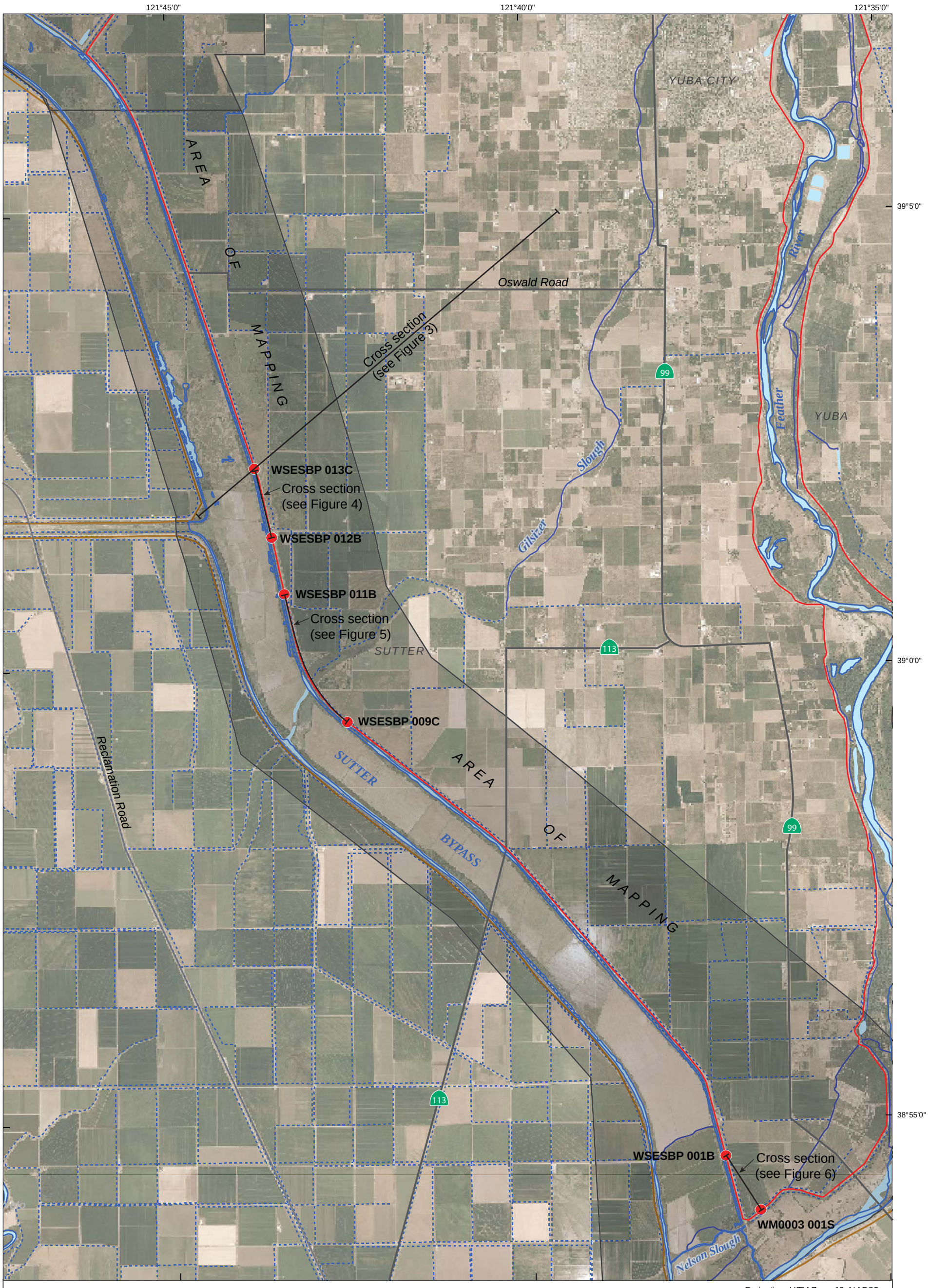
Map of Northern Central Valley, California

DWR URBAN LEVEE PROJECT

Figure 1

1881 Sutter Bypass

Modified 09.03.09



WLA

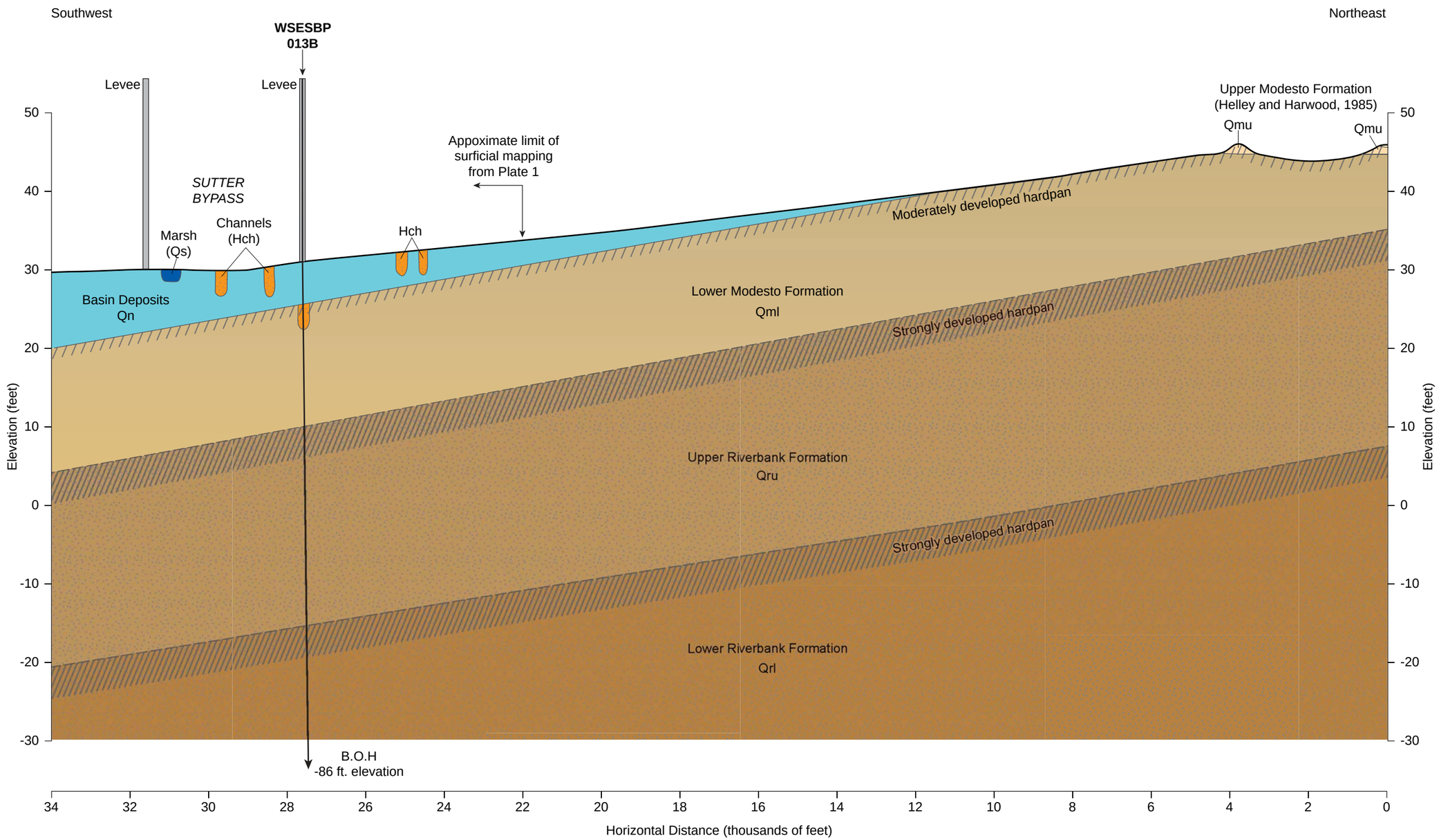
Sutter Bypass

DWR URBAN LEVEE PROJECT

Figure 2

1881 Sutter Bypass

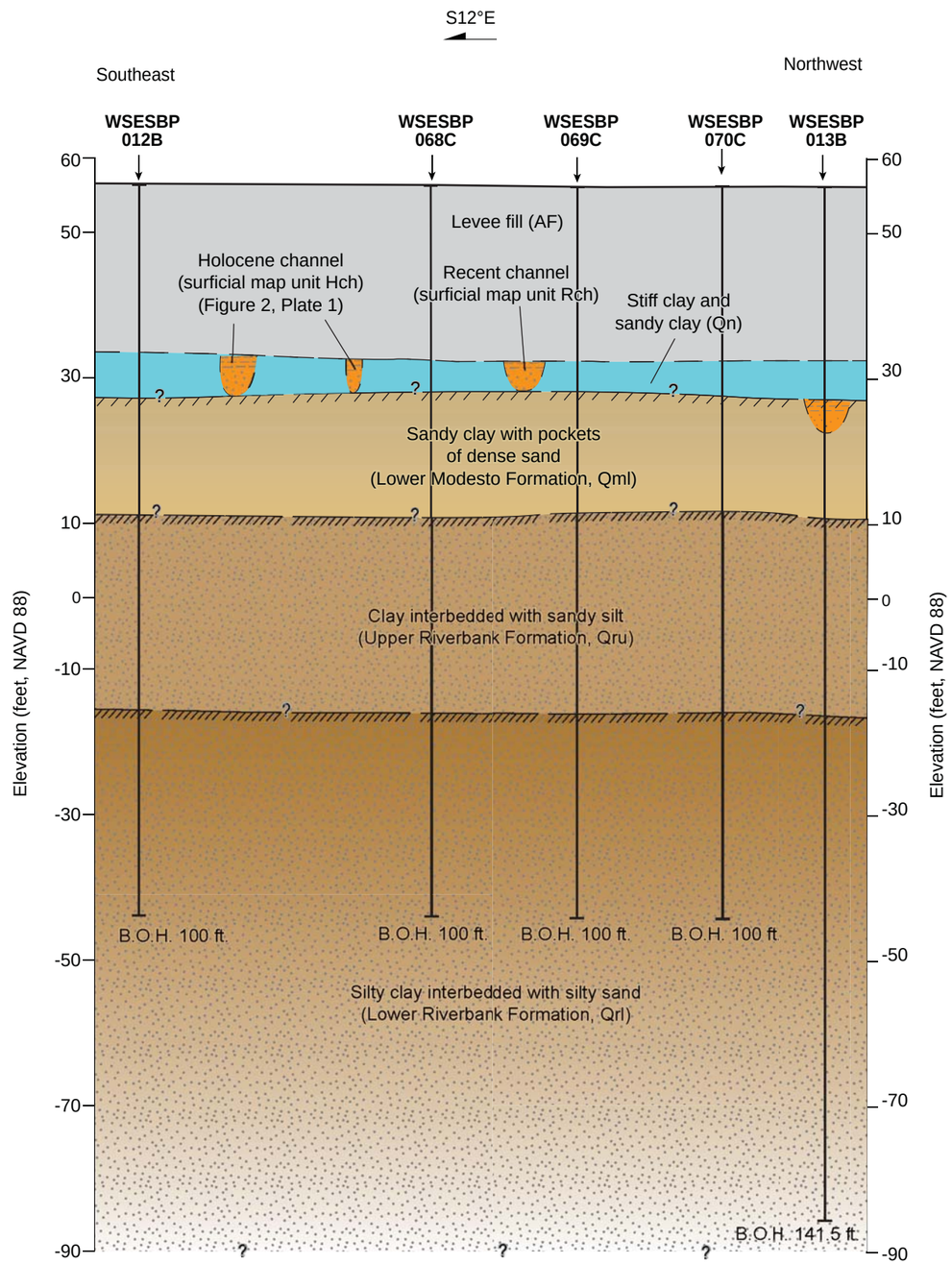
Modified 09.03.09



Notes: 1. See Figure 2 for location of cross section.
2. Surficial geologic units and contacts from this study and Helley and Harwood (1985).
3. Ground surface elevation from USGS Gilsizer Slough topographic map, 5-foot contour interval.

Conceptual Cross Section Transverse to Sutter Bypass

TISDALE WEIR



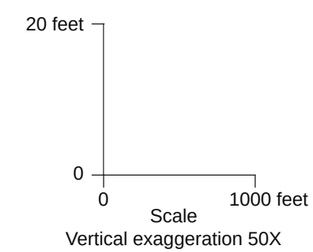
Explanation

Channel identified on surficial geologic map or as fining upward sequence of sediments in boreholes

Moderate paleosol (hardpan)

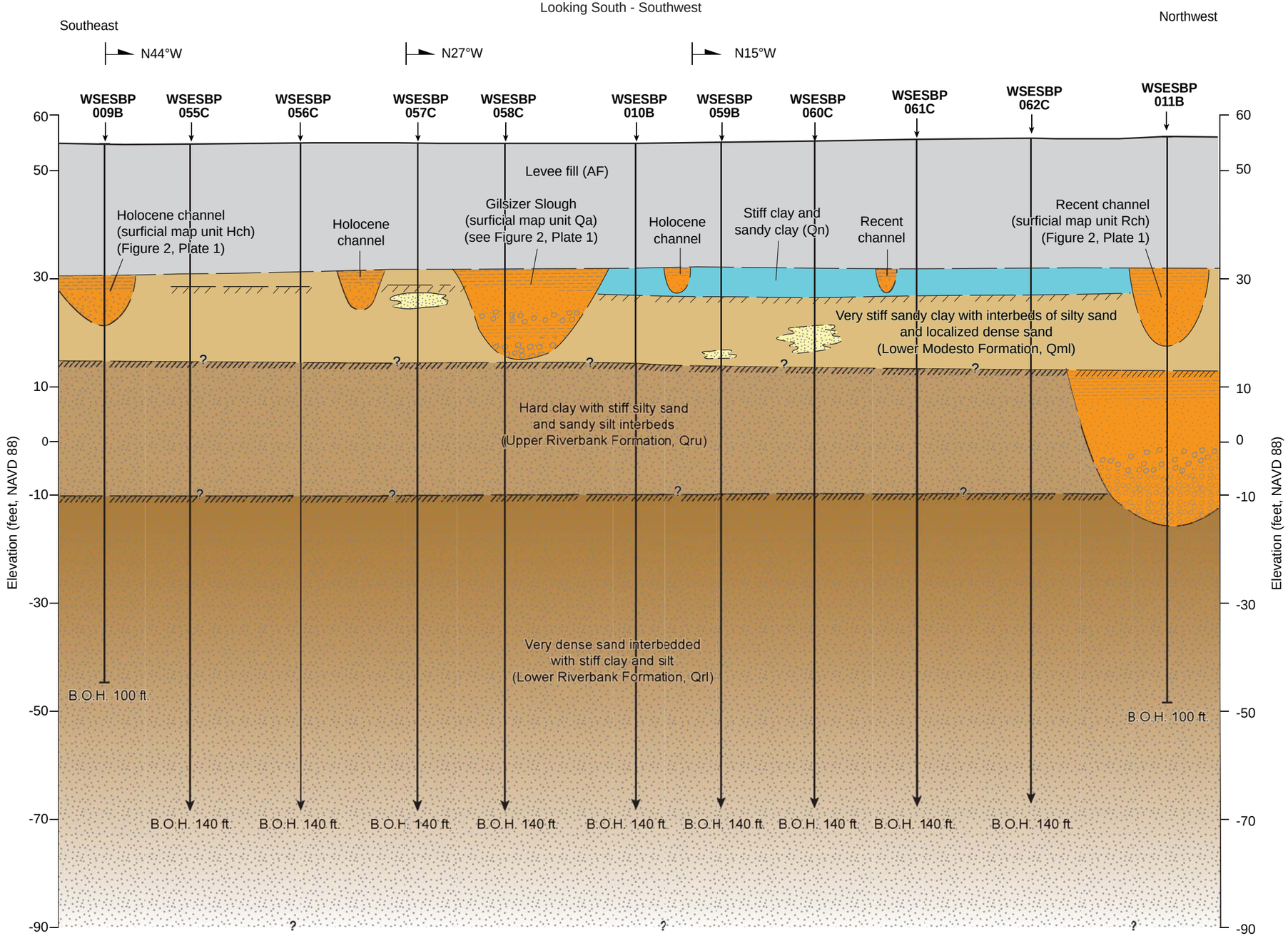
Strong paleosol (hardpan)

Notes:
1. Borehole ground elevation values from URS Corp., and reported in the Boring Location Survey, DWR task #10. (NAVD 88).
2. CPT borehole surface elevations are approximate, placed on projected ground surface between boreholes WSESBP_012B and WSESBP_013B.
3. Bottom of hole (B.O.H.) values shown as total depth below ground surface.
4. Borehole names and horizontal distance shown above from draft URS logs and location maps. Geologic relations could change if borehole locations are revised.
5. Drilling method indicated as last letter in borehole names.
   B = Mud Rotary unit with SPT
   C = Cone Penetrometer Test.



GILSIZER SLOUGH

Looking South - Southwest



Explanation

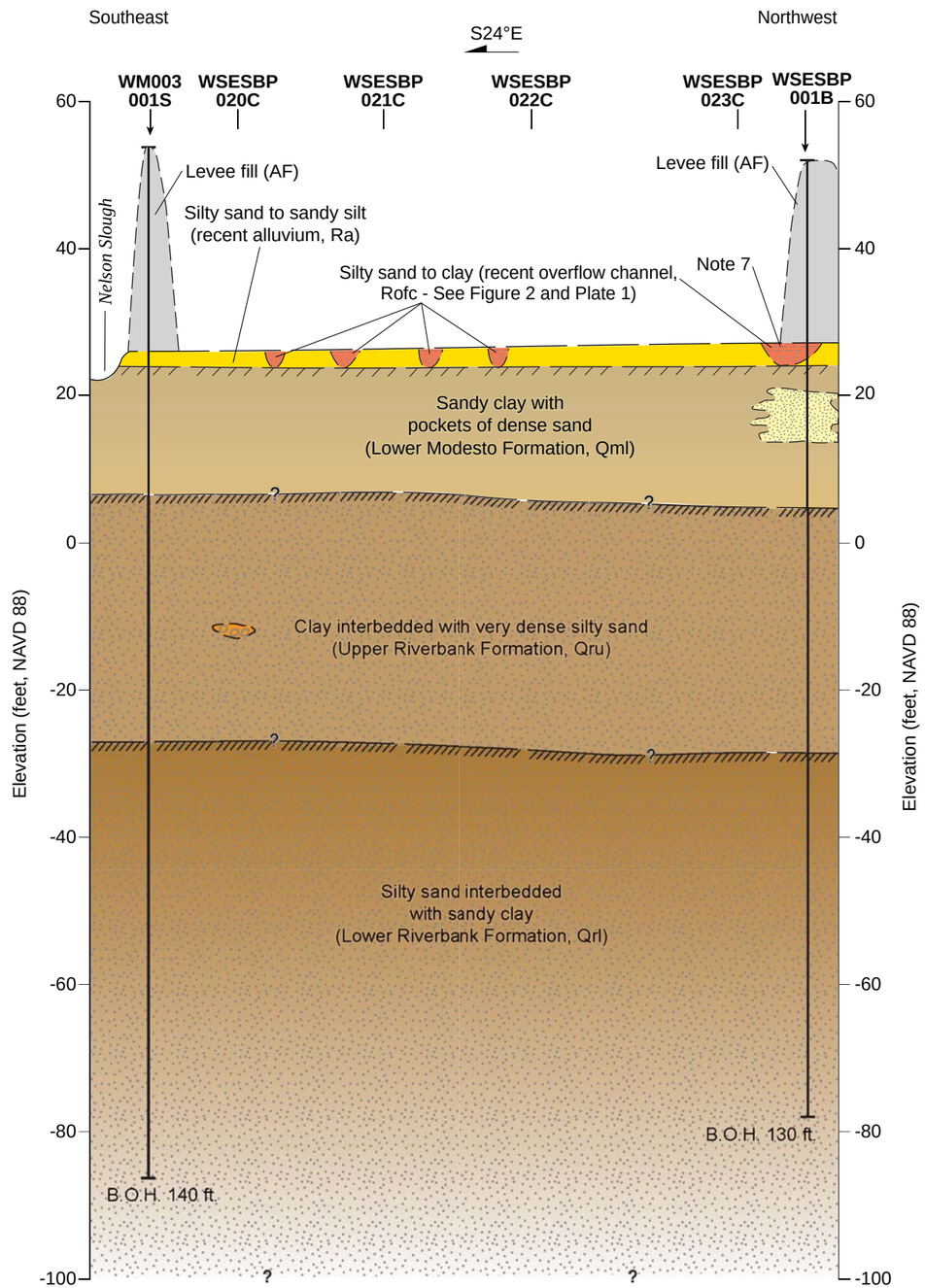
- Channel identified on surficial geologic map or as fining upward sequence of sediments in boreholes
- Localized sand and gravel; possible channel interpreted from borehole logs
- Moderate paleosol (hardpan)
- Strong paleosol (hardpan)
- Bend in levee
- N16°W Azimuth of levee segment

Notes:
1. Borehole ground elevation values from URS Corp., and reported in the Boring Location Survey, DWR task #10.(NAVD 88).
2. CPT borehole surface elevations are approximate, placed on projected ground surface between continuous boreholes WSESBP-009B, WSESBP-010B, and WSESBP-011B.
3. Bottom of hole (B.O.H.) values shown as total depth below ground surface.
4. Borehole names and horizontal distance shown above (from draft URS logs and location maps). Geologic relations could change if borehole locations are revised.
5. Drilling method indicated as last letter in borehole names.
   B = Mud Rotary unit with SPT
   C = Cone Penetrometer

20 feet
0
0 1000 feet
Scale
Vertical exaggeration 50X

SOUTHERN SUTTER BYPASS

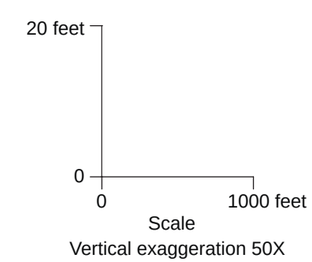
Looking Southwest

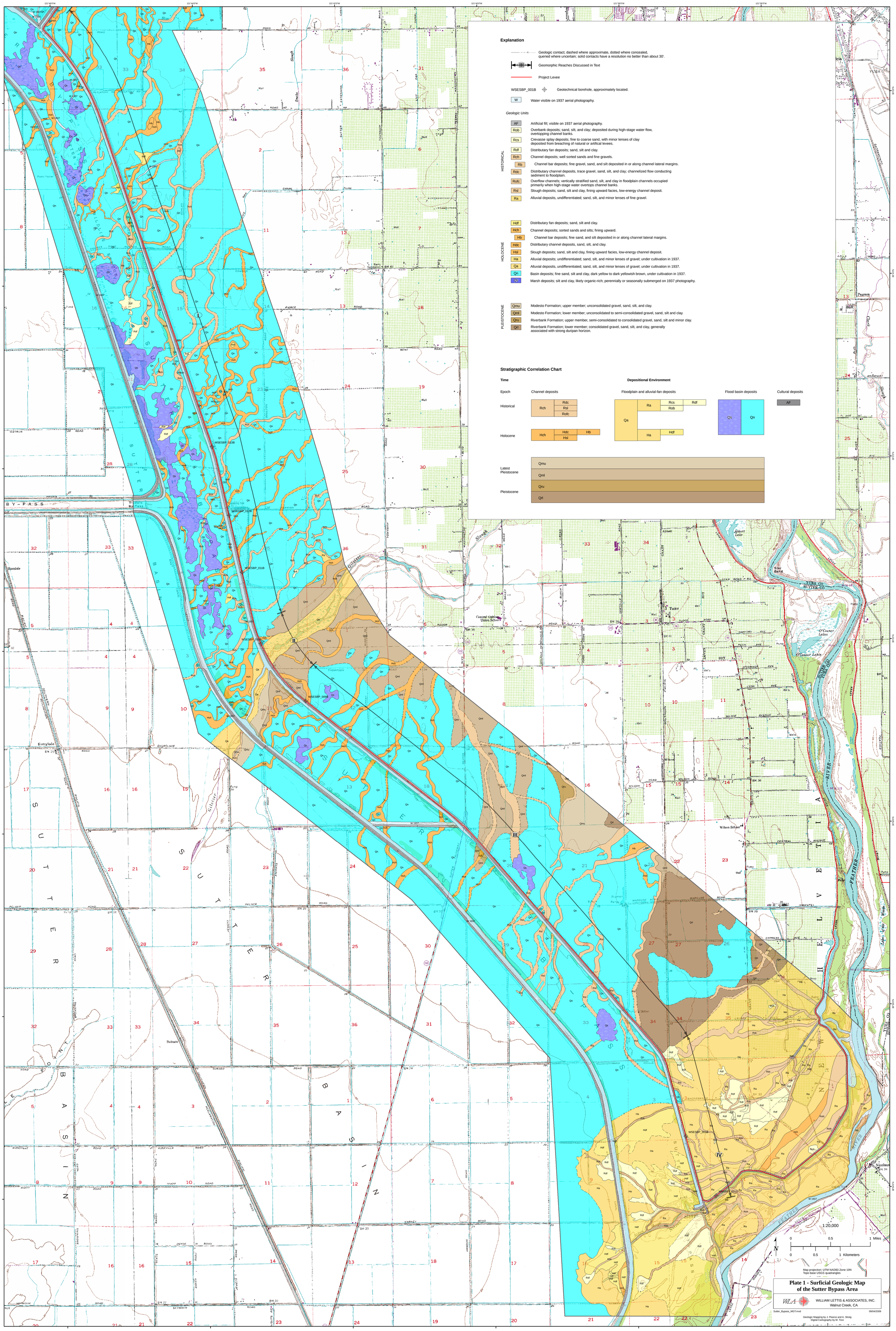


Explanation

- Channel identified on surficial geologic map or as fining upward sequence of sediments in boreholes
- Localized sand and gravel; possible channel interpreted from borehole logs
- Moderate paleosol (hardpan)
- Strong paleosol (hardpan)
- Levee widths and side slopes are schematically shown

Notes:
1. Borehole ground elevation values from URS Corp., and reported in the Boring Location Survey, DWR task #10. (NAVD 88).
2. CPT borehole surface elevations are approximate, placed on projected ground surface between boreholes WM00_001S and WSESBP_001B.
3. Bottom of hole (B.O.H.) values shown as total depth below ground surface.
4. Borehole names and horizontal distance shown above from draft URS logs and location maps. Geologic relations could change if borehole locations are revised.
5. Drilling method indicated as last letter in borehole names.
   - B = Mud Rotary unit with SPT
   - S = Sonic vibracore
   - C = Cone Penetrometer Test.
6. Cone penetrometer borehole locations projected to the trend of this cross section.
7. Recent over flow channel shown beneath the northwestern levee intersects the levee at a sub-orthogonal angle. This conceptual cross section intersects the levee and the over flow channel at an oblique angle, as shown in the channel asymmetry.




Explanation
Geologic contact; dashed where approximate, dotted where concealed, queried where uncertain; solid contacts have a resolution no better than about 30'.
Geomorphic Reaches Discussed in Text
Project Levee
WSESBP_001B
Geotechnical borehole, approximately located.
W
Water visible on 1937 aerial photography.
Geologic Units
HISTORICAL
AF
Artificial fill; visible on 1937 aerial photography.
Rob
Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks.
Rcs
Crevasse splay deposits; fine to coarse sand, with minor lenses of clay deposited from breaching of natural or artifical levees.
Rdf
Distributary fan deposits; sand, silt and clay.
Rch
Channel deposits; well sorted sands and fine gravels.
Rb
Channel bar deposits; fine gravel, sand, and silt deposited in or along channel lateral margins.
Rdc
Distributary channel deposits, trace gravel, sand, silt, and clay; channelized flow conducting sediment to floodplain.
Rofc
Overflow channels; vertically stratified sand, silt, and clay in floodplain channels occupied primarily when high-stage water overtops channel banks.
Rsl
Slough deposits; sand, silt and clay, fining upward facies, low-energy channel deposit.
Ra
Alluvial deposits, undifferentiated; sand, silt, and minor lenses of fine gravel.
HOLOCENE
Hdf
Distributary fan deposits; sand, silt and clay.
Hch
Channel deposits; sorted sands and silts; fining upward.
Hb
Channel bar deposits; fine sand, and silt deposited in or along channel lateral margins.
Hdc
Distributary channel deposits, sand, silt, and clay.
Hsl
Slough deposits; sand, silt and clay, fining upward facies, low-energy channel deposit.
Ha
Alluvial deposits; undifferentiated; sand, silt, and minor lenses of gravel; under cultivation in 1937.
Qa
Alluvial deposits, undifferentiated; sand, silt, and minor lenses of gravel; under cultivation in 1937.
Qn
Basin deposits; fine sand, silt and clay, dark yellow to dark yellowish brown, under cultivation in 1937.
Qs
Marsh deposits; silt and clay, likely organic-rich; perennially or seasonally submerged on 1937 photography.
PLEISTOCENE
Qmu
Modesto Formation; upper member; unconsolidated gravel, sand, silt, and clay.
Qml
Modesto Formation; lower member; unconsolidated to semi-consolidated gravel, sand, silt and clay.
Qru
Riverbank Formation; upper member, semi-consolidated to consolidated gravel, sand, silt and minor clay.
Qrl
Riverbank Formation; lower member; consolidated gravel, sand, silt, and clay, generally associated with strong duripan horizon.
Stratigraphic Correlation Chart
Time
Depositional Environment
Epoch
Channel deposits
Floodplain and alluvial-fan deposits
Flood basin deposits
Cultural deposits
Historical
Rch
Rdc
Rsl
Rofc
Ra
Rcs
Rdf
Rob
Qa
Qs
Qn
AF
Holocene
Hch
Hdc
Hsl
Hb
Ha
Hdf
Latest Pleistocene
Pleistocene
Qmu
Qml
Qru
Qrl
1:20,000
0
0.5
1 Miles
0
0.5
1 Kilometers
N
Map projection: UTM NAD83 Zone 10N
Topo base USGS quadrangles
Plate 1 - Surficial Geologic Map of the Sutter Bypass Area
WILLIAM LETTIS & ASSOCIATES, INC.
Walnut Creek, CA
Sutter_Bypass_MGT.mxd
09/04/2009
Geologic Mapping by J. Pearce and A. Streig
Digital Cartography by M. Ticci

Part C.4

URS Supplemental Geotechnical Data Report (2010), Appendix O, Volume 4

APPENDIX O

Geomorphology Report

WILLIAM LETTIS & ASSOCIATES, INC.
1777 Botelho Drive, Suite 262, Walnut Creek, California 94596
tel (925) 256-6070 fax (925) 256-6076

September 8, 2009

Mr. Juan Vargas
URS Corporation
2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833

RE: Surficial geologic mapping and geomorphic assessment, California Department of Water Resources Urban Levees Project, Southern Feather River, Sutter County, California

Dear Mr. Vargas:

This memorandum presents the surficial geologic mapping and preliminary geomorphic assessment of the southern Feather River study area, for the California Department of Water Resources (DWR) Urban Levees Project geotechnical characterization. The goal of this mapping and geomorphic assessment is to provide information on the type and distribution of surface and shallow subsurface deposits that likely underlie the project levees along the western bank of the Feather River. The purpose of this study is to develop spatially-continuous geologic data and a conceptual model that provides a framework for stratigraphic interpretations between widely-spaced subsurface explorations. A primary goal is to provide a geologic framework for the geotechnical assessment of potential levee underseepage. This memo presents the technical approach, surficial geologic map, conceptual geomorphic model, and initial results based on map analysis and preliminary review of Phase 1 geotechnical data.

We appreciated the opportunity to provide these geomorphic and geologic data and preliminary interpretations of the shallow stratigraphic conditions in the southern Feather River study area. Please do not hesitate to call either of the undersigned if there are any questions or comments.

Respectfully,

WILLIAM LETTIS & ASSOCIATES, INC.

Justin Pearce, C.E.G. 2421
Senior Geologist

Ashley Streig
Senior Staff Geologist

Keith Kelson, C.E.G. 1610
Principal Geologist

1.0 Approach

The approach to developing a surficial geologic map of the southern Feather River project area (Figure 1, Plate 1) consisted of analysis of the following data: Aerial photography (black and white stereo-pairs taken in 1937, ~1:20,000-scale); early USGS topographic maps (i.e., 1911); published surficial geologic maps (Helley and Harwood, 1985); early and modern soil survey maps (Strahorn et al., 1909; Lytle, et al., 1988); and other maps and documents (Busacca et al., 1989). Synthesis of these data allow for the development of a detailed surficial geologic map that provides an initial understanding of primary geomorphic processes that have acted in the study area during recent and historical geologic time. Through this mapping, primary geomorphic features and associated surficial geologic deposits are identified, such as abandoned paleochannels, channel deposits, floodplain deposits, basin deposits and other features commonly associated with surficial deposits with large active river systems. Knowledge of fluvial processes and the ability to recognize depositional environments in the geologic record are key to identifying locations along levees where underseepage is most likely to occur (Llopis
et al., 2007).

The surficial geologic map was developed at the nominal scale of the aerial photography (1:20,000). This scale establishes the resolution of the map (Plate 1), such that analysis of the map data at a more detailed scale than 1:20,000 may introduce uncertainties beyond the original resolution of the data. The map unit boundaries shown on the surficial geologic map should be considered approximate, and accurate within 30 feet on either side of the line shown on the map. The 1937 aerial photographs are the primary data set for interpreting the surficial geologic deposits because: (1) they are the oldest high-quality images that pre-date much of the urbanization and landscape alteration within present-day Sutter County (i.e. Figure 2); and, (2) these data represent a close approximation to the surficial deposits that were likely present at the ground surface prior to the construction of the levees. The 1937 photographs generally were taken in late summer or early autumn (i.e., August). By 1937, the area had experienced moderate cultivation that locally obscures geomorphic conditions. However, integration of data from the 1937 photography, old and recent topographic maps, geologic maps, soil surveys and historical documents provides sufficient information to delineate many of the pre-historical and historical surficial deposits in detail. Taken together, these data provide key insights to the characteristics of shallow deposits beneath the levees, as well as the geomorphic processes responsible for their distribution.

Additional floodplain deposition may have occurred after 1937, due to flood overflows, levee overtopping, or localized levee failure. A time series analysis that interprets successive aerial photographs taken after major flood events (i.e., USDA, black and white stereo-pairs taken in 1958, ~1:20,000-scale) or known local levee failures (i.e., 1986) may reveal additional information on surficial deposits in the southern Feather River area. Such analyses are beyond the scope of this study. The data and interpretations presented herein address the primary goal of characterizing the type and distribution of deposits likely present directly beneath the project levees.

1.1 Report Preparation Quality Control

The surficial geologic map data and geomorphic interpretations presented in this memorandum were subject to quality control and quality assurance procedures as required by the Levee Geotechnical Evaluation Project Management Plan (PMP). The surficial geologic map data developed by this study were reviewed for accuracy and completeness through an internal review and an independent technical review by Dr. Janet Sowers of WLA. Results of QA/QC review were documented using PMP Exhibit 2.2-3 (Independent Technical Review Report) and are kept on file according filing control plan. Subsurface data shown on diagrams were provided as draft information, and were not verified for accuracy or completeness by this study.

2.0 Geologic Setting

The southern Feather River study area lies in the Central Sacramento Valley, between the Coast Ranges to the west and the Sierra Nevada foothills to the east. Feather River drains the western slope of the Sierra Nevada, and emerges from the mountains south of the Thermalito Afterbay (Figure 1). The river flows southward from the Thermalito Afterbay, over middle-to late Pleistocene dissected alluvium derived from the Sierra Nevada. The regional land surface is nearly flat, with a gentle west-southwest slope that flattens out south of the Sutter Buttes, in Sutter Basin. The Feather River is entrenched into middle to late Pleistocene semi-consolidated sediments. Holocene alluvium deposited by the Feather River is present between the present-day levees, inset to the older formations, as well as on the western floodplain as subdued natural levees. The river trends roughly south until its confluence with the Bear River, where it curves
to the southwest (Figure 1). The Feather River lies east of, and is a tributary to the Sacramento River, converging near the town of Nicolaus (Figure 1). A primary influence on the historic processes in the river system was the hydraulic mining that began in the 1850's. Mining occurred through the early 1900's in the Feather, Yuba and Bear River watersheds, and abruptly introduced large quantities of sediment, drastically changing the geomorphic characteristics of these river systems (DWR, 2004; Ellis, 1939). Aggradation within the stream channel was a primary response to the introduction of substantial mining debris (James, 1999), consequently young alluvial deposits are common throughout the study area.

3.0 Surficial Geologic Mapping

Previous geologic mapping in the study area along the Feather River and surrounding areas generalize the surficial deposits as: Quaternary Alluvium (Qa) and Quaternary stream channel deposits (Qsc) within and proximal to the modern Feather River channel, (Helley and Harwood, 1985). These map units are considered Holocene age (less than 11,000 years old). Late Quaternary Modesto Formation (Qmu, Qml) is mapped along the western margin of the floodplain. These map units were delineated by Helley and Harwood (1985) at a regional scale (i.e., 1:62,500). The current analysis of the Feather River uses this geologic framework as a basis for more detailed mapping of late Holocene alluvium and geomorphic features (Plate 1).

The surficial geologic map units within the southern Feather River study area are described below, in order from oldest to youngest. Surficial geologic mapping for this study subdivides these map units and delineates individual deposits based on relative age and depositional process or environment (Plate 1). The map units depicted on Plate 1 are based primarily on analysis of 1937-vintage photography, and thus the map essentially is a "snapshot" of geologic conditions at this time.

The oldest unit exposed along the Feather River is the lower member of the Riverbank Formation (Qrl) of Helley and Harwood (1985). This unit is a highly dissected alluvial surface with textures of weathered gravel, sand and silt with strong soil-profile development. The Riverbank Formation is semi-consolidated, and is associated with the presence of a well-developed hardpan (or, duripan) layer that is a product of soil-forming processes over substantial geologic time. This hardpan layer reflects an ancient land surface that locally is buried by younger deposits. The Riverbank Formation is late to middle Pleistocene in age, and is estimated to be 130,000 to 450,000 yrs old (Helley and Harwood, 1985). The upper member is unconsolidated dark brown to red alluvium consisting of gravel, sand, silt and minor clay (Busacca et al., 1989, Helley and Harwood, 1985).

The Modesto Formation is divided into two members, a lower (older) unit that is latest Pleistocene in age (about 29,000 to 49,000 years old), and consists of unconsolidated slightly weathered gravel, sand, silt and clay. The upper member, a younger unit, is latest Pleistocene age (circa 12,000 to 26,000 years old) (Helley and Harwood, 1985). This unit (Qmu) is composed of sand, silt, and some gravel, comprising river channel and floodplain deposits, and is associated with a moderate amount of secondary (pedogenic) clay accumulation. This clay-rich horizon may form laterally continuous zones of low hydraulic conductivity, and may extend across boundaries between coarse and fine-grained strata within the latest Pleistocene alluvium. Soils on the Modesto Formation deposits include the Gridley loam of Strahorn et al. (1909) and the Conejo complex of Lytle et al. (1988).

Latest Holocene deposits overlie or are inset into the Modesto Formation, and are categorized as channel, floodplain, and basin deposits (Plate 1). Channel deposits include Holocene channels (Hch), distributary channels (Hdc), overflow channels (Hofc), sloughs (Hsl), in-stream or lateral bars (Hb), and meander scrolls (Hms). These deposits likely consist of fine to coarse sand, silty sand, and clayey sand, with trace fine gravel. Holocene channel deposits (Hch), which are present along Gilsizer Slough and the western floodplain as secondary channels, contain fining-upward sequences of sand, silt and clay. Overflow channels (Hofc) transport water across the land surface during high flow stages toward Sutter Basin. Networks of sloughs wander across the distal floodplain, and are likely filled with a fining-upward sequence of silt and clay (map unit Hsl). These deposits are associated with former channels, and generally are present landside (outboard) of the present-day human-made levees.

Holocene floodplain deposits include crevasse splays (Hcs), distributary fans (Hdf), and overbank deposits (Hob). Crevasse splays (Hcs) are sandy deposits that form from breaching of river banks or natural levees. Distributary fan deposits (Hdf) occur when water and velocity within a distributary channel decreases, can no longer transport its sediment load, and sediment is laid down on the floodplain. Overbank sediments are formed by localized overtopping of

river banks or natural levees, subsequent deposition from shallow sheet flow or standing water. Basin deposits occur on the distal floodplain and include undifferentiated basin deposits (Qn), and marsh deposits (Qs). Basin and marsh deposits are present in the topographically low areas west of the present-day natural levees along the Feather River. These deposits consist of fine sand, silt, and clay laid down in a relatively low-energy depositional environment. Soils developed on these deposits are the Sacramento series silt loam, fine sandy loam, clay, Alamo clay loam adobe and Stockton clay adobe. Marsh deposits are generally saturated and are often underwater in the present-day environment. Undifferentiated Holocene and Quaternary alluvium (Ha and Qa, respectively) usually are proximal to the river channel, and this map unit is used in areas where geomorphic features are obscured or obliterated by historical (1937-era) agriculture or cultivation. The deposits within these agriculturally modified areas are assigned a relative age (Ha or Qa) based on overlapping and cross cutting relationships with the surrounding deposits as follows: Ha if the agriculture-modified area is mapped within or shown overlying Holocene deposits; or Qa where it is difficult to evaluate the surface age based on the nearby deposits. Soils associated with these, undifferentiated units (Qa) are the Sacramento silt loam and Sacramento fine sandy loam, (Strahorn et al., 1909), and the Columbia fine sandy loam of Lyle et al. (1988), which are weakly developed soils commonly developed on relatively young deposits.

Historical deposits mapped in the area include stream channel and floodplain deposits, as well as artificial fill deposits (L and SP) (Plate 1). Historical deposits are estimated to be less than 150 years old, dating from approximately 1800 to 1937. Historical stream channels (Rch), distributary channels (Rdc), and overflow channels (Rofc) within the floodplain are recently abandoned channels or reflect active channels with low water flow. Lateral bar deposits (Rb) and meander scrolls (Rms) are located adjacent to the present-day Feather River, and are generally present inboard (waterside) of the present-day Feather River levees. When the river overtops its banks, distributary channels (Rdc) and recent overflow channels (Rofc) transport water and sediment across the floodplain. These channel deposits likely consist of silt and sand with traces of gravel. The upper few feet of these deposits probably are filled with debris from upstream hydraulic mining activities. Historical sloughs transport low velocity water flow derived from distributary channels proximal to the Feather River onto the distal floodplain and into the Sutter Basin. Slough deposits (Rsl) likely consist of fining-upward silt and clay.

Historical flood plain deposits include crevasse splay (Rcs), distributary fan (Rdf), and overbank (Rob) deposits, which generally consist of a fining upward or episodic fining upward sequence of sand, silt, and clay. Historical overbank (Rob) deposits are slightly finer grained sand, silt, and clay deposited via sheet flow when the river is at flood-stage and overtops natural and artificial levees. These historical deposits are differentiated based on cross-cutting and superposition relationships relative to existing cultural deposits visible on the 1937 photographs. Historical alluvial deposits (Ra), generally located within the Feather River channel, consist of undifferentiated sand, silt, and minor lenses of gravel. Historical artificial fills (map units L and SP) are culturally-emplaced heterogeneous deposits, with varying amounts of clay, silt, sand, and gravel from local sources. These deposits include levee structures and canal levee systems (L), and some undifferentiated soil piles (SP), and are shown on the surficial geologic map where present and identifiable on the 1937 photography.

Mapping of historical and Holocene deposits shown on Plate 1 generally is consistent with early, less-detailed soil survey mapping along the western banks of the Feather River as areas of Gridley loam, Sacramento Series fine sand, sandy loam and silt loam soils (Strahorn et al., 1909). The Gridley loam occurs along the northern Feather River from Thermalito south to the confluence with the Bear River, and closely corresponds to the Modesto Formation of Helley and Harwood (1985). The relationship between the mapped surficial geologic units and the potential for underseepage is summarized below.

4.0 Geomorphic Conceptual Model

The preliminary conceptual model described here is based on general relationships among surface and subsurface geologic deposits along the Feather River, as described above and shown on Plate 1. This conceptual model provides a consistent basis for understanding the type and stratigraphy in the area.

Published geologic maps of the project area identify a complex series of westward aggrading alluvial fans and terraces derived from the Sierra Nevada, identified as the Riverbank and Modesto formations. The Riverbank Formation and Modesto Formation are semi-consolidated to unconsolidated deposits characterized by intraformational paleochannels and lateral and vertical stratigraphic complexity related to past fluvial processes and buried paleo-topography. The Riverbank Formation unconformably overlies the Laguna Formation, which is a deeply dissected alluvial surface (Busacca et al., 1989).

Subsurface deposits about 150 feet beneath the ground surface rest on a resistant volcanic tuff capped by interbedded alluvial gravel, sand and silt, interpreted as Pliocene-Pleistocene age Laguna Formation that represents a period of relatively stable landscape conditions (Helley and Harwood, 1985). The Laguna Formation is overlain by the Pleistocene Riverbank Formation, (very dense gravel deposits) that are, in turn, overlain by a medium dense sand and gravelly sand package of the latest Pleistocene Modesto Formation (Busacca et al., 1989). The upper member of the Modesto Formation is exposed at the ground surface adjacent to the western bank of the Feather River south of Marysville and Yuba City. The Modesto Formation is mantled by unconsolidated deposits of Holocene age that comprise most of the surficial geologic deposits along the western side of the Feather River (Plate 1).

Geomorphic evidence suggests that the Feather River system south of Yuba City may have been located west of its present course (Figure 3). The present-day Gilsizer Slough diverges from the modern Feather River directly north of Yuba City and trends southwestward toward the Sacramento River. Alluvial deposits of Gilsizer Slough are inset (i.e. incised) into the Modesto Formation from Yuba City southward. The ancestral Gilsizer Slough perhaps extended to as far as the Sacramento River (Figure 3), based on surficial mapping not included in this report, and inspection of topographic maps. The ancestral Gilsizer Slough deposits are related to discharges and sediment loads that were higher than present-day conditions, and perhaps is an ancestral course of the Feather River.

Surficial geologic deposits near the Yuba City airport indicate the Feather River occupied an intermediate position between ancestral and present locations. The river occupied an abandoned channel arm north of Shanghai Bend, located between Gilsizer Slough and the modern Feather River (Figure 3). From this point the river continued southward in nearly its present location. This paleochannel had a sharp, more exaggerated bend than the present-day channel at Shanghai Bend (Figure 2). The channel subsequently moved eastward, laterally backfilling and abandoning the meander above Shanghai Bend, and moved to the rivers' present location closer to Marysville. Today, Gilsizer Slough is a natural bypass for high water flow stages on the Feather River, in the area between Marysville and Yuba City (Ellis, 1939).

Surficial geologic mapping (Plate 1) shows differences in deposit type and distribution from north to south along the Feather River, which is associated with changes in watershed production of water and sediment, related geomorphic processes, soil profile development, and the underlying subsurface hardpan layer. These differences illustrate the diversity of past geomorphic processes along the river and, as a consequence, the type of geologic deposits at and near the ground surface. The surficial geologic map allows the delineation of reaches along the river within which geomorphic processes and their associated deposits appear to be relatively consistent.

Between Yuba City on the north to the confluence with the Sutter Bypass on the south, the southern Feather River consists of four major reaches, each having characteristic deposit types and distributions. The river reaches are numbered Southern Feather one through four (SF-I through SF-IV), sequentially from north to south (Plate 1, Figure 3). This report describes the surficial geologic characteristics of Reach SF-I, SF-II, SF-III and SF-IV of the southern part of the Feather River, extending from Yuba City, south to the confluence with the Sutter Bypass.

Reach SF-I, extends from the north end of Yuba City to the Yuba City airport, and is about 1.15 miles long (Plate 1, Figure 3). The Project levee along Reach SF-I trends roughly north-south, and overlies alluvial sediments deposited by the Feather River. In Yuba City the levee rests on Holocene deposits associated with Gilsizer Slough that are inset into the upper member of the Modesto Formation. The active Feather River channel is east of, and inset to these Holocene channel deposits (Figure 4).

The second reach of south Feather River project area, SF-II, extends from the Yuba City airport south to Shanghai Bend, and is about 2.9 miles long. Near the Yuba City airport, and south of the confluence of the Feather and Yuba Rivers, young channel deposits are inset against the Gilsizer Slough channel deposits (Plate 1). From the Yuba City airport, south to Epley Drive (about 1.5 miles), the levees overlie historical alluvium of mining debris origin, map unit Ra. From Epley Drive south to Shanghai Bend Road the levees (about 1.4 miles) overlie historical meander scrolls, map unit Rms, (Figure 2, Plate 1). The levee along this reach, SF-II, primarily overlies Holocene channel fill, historical alluvium and overbank deposits. These channels are likely filled with a fining-upward sequence of gravel, sand and silt, the upper few feet of these features are probably covered by a veneer of sediment derived from upstream hydraulic mining activities (Figure 4).

River Reach SF-III extends from Shanghai Bend on the north to just south of the confluence with Bear River, and is approximately 12 miles long (Plate 1). Along Reach SF-III, the active river floodplain is inset into the upper member of the Modesto Formation. Over geologic time, flooding has lead to the vertical accretion of overbank and crevasse splay deposits onto the Modesto Formation west of the Feather River. Overflow channels and related deposits (Rofc) are common along this reach of the river. Beginning at Shanghai Bend and continuing southward are seven overflow channels that range from approximately 100 to 200 feet wide. The Project levees overlie these channels in the area around Messick Road (Plate 1). A few overflow channels conduct water flow immediately landside of the levees, across a short distance between Shanghai Bend and Oswald Avenue, then converge with the Feather River. The overflow channels are slightly inset to the Modesto Formation, and based on borehole data from locations where these channels cross the Sutter Bypass, are probably 6 to 15 feet deep. These channels are likely filled with episodic fining upward sequences of silt, sand and gravel, representing multiple flood events on the Feather River. The upper few feet of these channels are probably filled with sediment from upstream historic hydraulic mining activities. The river channel widens considerably between Country Club Road (0.5 mile width) and Obanion Road (1 mile width), (Plate 1). Feather River meanders along the eastern edge of Abbott Lake, swings sharply southward into Star Bend, where the river is deflected eastward by a resistant knob of Modesto Formation (which forms Star Bend). Historical crevasse splay and overbank deposits overlie the Modesto Formation from Abbott Road to Star Bend Road, along the western edge of Abbot Lake (Figure 5). These crevasse splay deposits are likely filled with a fining-upward sequence of fine gravel, sand and silt, The upper few feet of these features are probably covered by a veneer of hydraulic mining sediment.

The southernmost reach, Reach SF-IV, extends from the area south of the confluence with the Bear River to the confluence of the Feather River and Sutter Bypass, and is roughly 4 miles long (Plate 1). The sediments underlying the levee along this reach are geomorphically complex, resulting from depositional convergence between the Feather River and Bear River. The Bear River channel deposits large amounts of sediment across the ground surface adjacent to the confluence. The Modesto and Riverbank Formations are exposed at the ground surface adjacent to natural levees immediately north of the Bear River confluence, and north of this reach (Plate 1). These formations are covered by historical alluvium, sourced from the Feather and Bear Rivers. Much of the historical activity along this reach is located near the levee at Laurel Avenue. Here, consisting eight distributary channels (Rdc), typically 90 feet wide but ranging from 45 to 190 feet wide, cross the floodplain in southwesterly orientations, terminating in geologically young distributary-fan sediments. These sediments, primarily consisting of fine to coarse sand and silt, probably were deposited as a result of increased sediment and water input contributed to the Feather River from the Bear River. Historically, the Feather River and the Bear River have aggraded from substantial mining debris input, thus reducing channel cross sectional area (i.e., James, 1999). This reduction of cross section area, coupled with the trajectory of flood flow from the Bear River watershed, resulted in water overtopping the Feather River channel banks, and depositing sediment onto the floodplain between the confluence of the Feather River and Sutter Bypass (Plate1).

5.0 Applications to the Urban Levee Project

Based on an initial analysis of surface geologic and geomorphic data, the levees bordering the western side of the Feather River from Yuba City to the Sutter Bypass, (Reaches SF-I, SF-II, SFIII and SF-IV) probably are underlain by a veneer of near-surface sandy deposits, or by buried channels that are inset into the Modesto Formation. The preliminary conceptual surface and subsurface geologic relationships as they relate to levee structures and potential underseepage along each reach of the river are described below. This study does not account for any existing seepage mitigation structures, i.e. slurry wall or cutoff wall, which may be present.

Reach SF-I contains the Gilsizer paleochannel deposits, this channel intersects the levees roughly 660 feet south of Lynn Way to Colusa Avenue (Plate 1). Along this length the levees are underlain by coarse channel deposits. These coarse grain deposits are likely laterally continuous and poorly consolidated and relatively highly permeable, and likely are susceptible to underseepage.

Levees along the reach SF-II are underlain by a Holocene paleochannel and historical meander scroll deposits (Figure 2, Plate 1). These deposits are coarse grained, laterally continuous and poorly consolidated, and likely are susceptible to underseepage. The presence of this paleochannel deposit suggests locally permeable material (channel fill) directly underlying the levees. Historical alluvium most likely of mining debris origin, blankets the Yuba City airport paleochannel and meander scroll deposits. The levees along this reach are underlain by a thick sequence of young, permeable alluvium of meander scroll deposits that are highly susceptible to seepage (Glynn and Kuszmaul, 2004).

Reach SF-III consists of coarse-grained avulsion deposits (overbank, crevasse splay and overflow channel deposits) overlying the Modesto Formation. Overflow channels (Rofc) are common along this reach, are relatively thin, slightly inset to the Modesto Formation and are filled with poorly consolidated sediments that may provide local pathways for underseepage. Individual shallow coarse deposits may be laterally discontinuous and may be separated by clayey interbeds (i.e. thin blankets). Local coarse deposits may be associated with higher likelihoods of levee underseepage. Deeper deposits probably consist of consolidated Modesto Formation with occasional small, but unconsolidated, overflow channel deposits incised into resistant strata.

Along Reach SF-IV the levee is underlain by laterally-continuous sandy deposits formed by distributary overbank fans and by the south flowing ancestral Feather River (Gilsizer Slough). These coarse-grained deposits likely are permeable and susceptible to underseepage. Near Laurel Avenue distributary channel deposits underlie the levees and may be relatively coarser than the surrounding alluvium.

6.0 Summary

Lateral and vertical variability in the shallow subsurface deposits has resulted from past geomorphic processes. Surficial geologic mapping along the south Feather River allows reach classifications within which conditions may be relatively consistent. The conceptual subsurface stratigraphic framework suggests that stratigraphic relationships may promote localized levee underseepage, given certain hydraulic conditions, particularly along reach SF-I and II. Further spatial analyses of the surficial geologic mapping and subsurface geotechnical exploration data are needed to better constrain and characterize areas that are most susceptible to underseepage in the study area.

7.0 Limitations

This geomorphic assessment and associated data interpretation have been performed in accordance with the standard of care commonly used as the state-of-practice in the geologic engineering profession. Standard of care is defined as the ordinary diligence exercised by fellow practitioners in this geographic area performing the same services under similar circumstances during the same time period.

Discussions of surface and subsurface conditions summarized in this technical memorandum are based on geologic interpretations of subsurface soil data at limited exploration locations available to this assessment through August of 2007. Variations in subsurface conditions may exist between exploration locations, and the project team may not be able to identify all adverse conditions in the levee and its foundation. This memorandum is for the use and benefit of DWR. Use by any other party is at their own discretion and risk.

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USGS, Ostrom topographic quadrangle, surveyed 1909, published 1911; map scale 1:31,680, five foot contour interval.

USGS, Sutter topographic quadrangle, surveyed 1909, published 1911; map scale 1:31,680, five foot contour interval.

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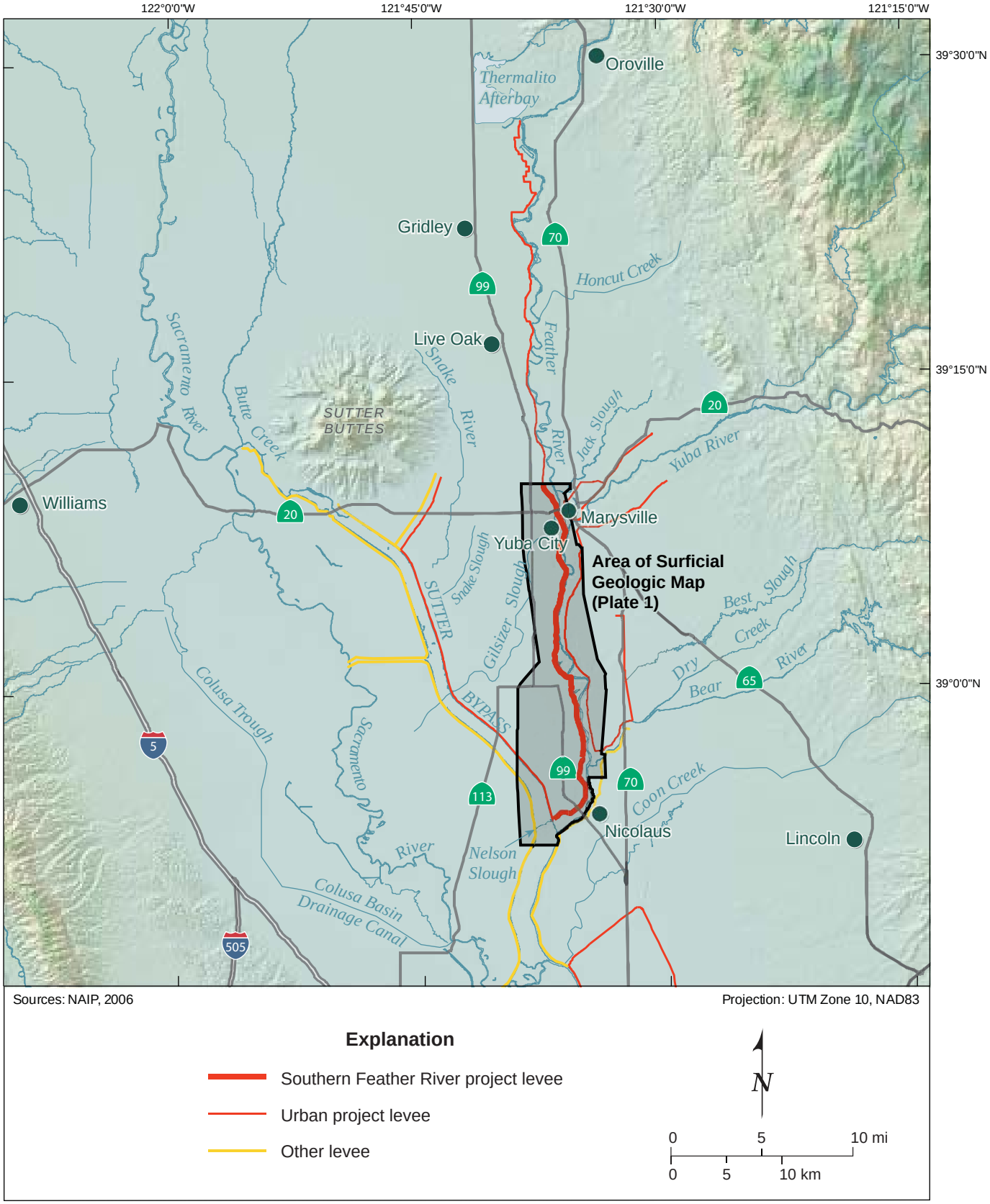


WLA

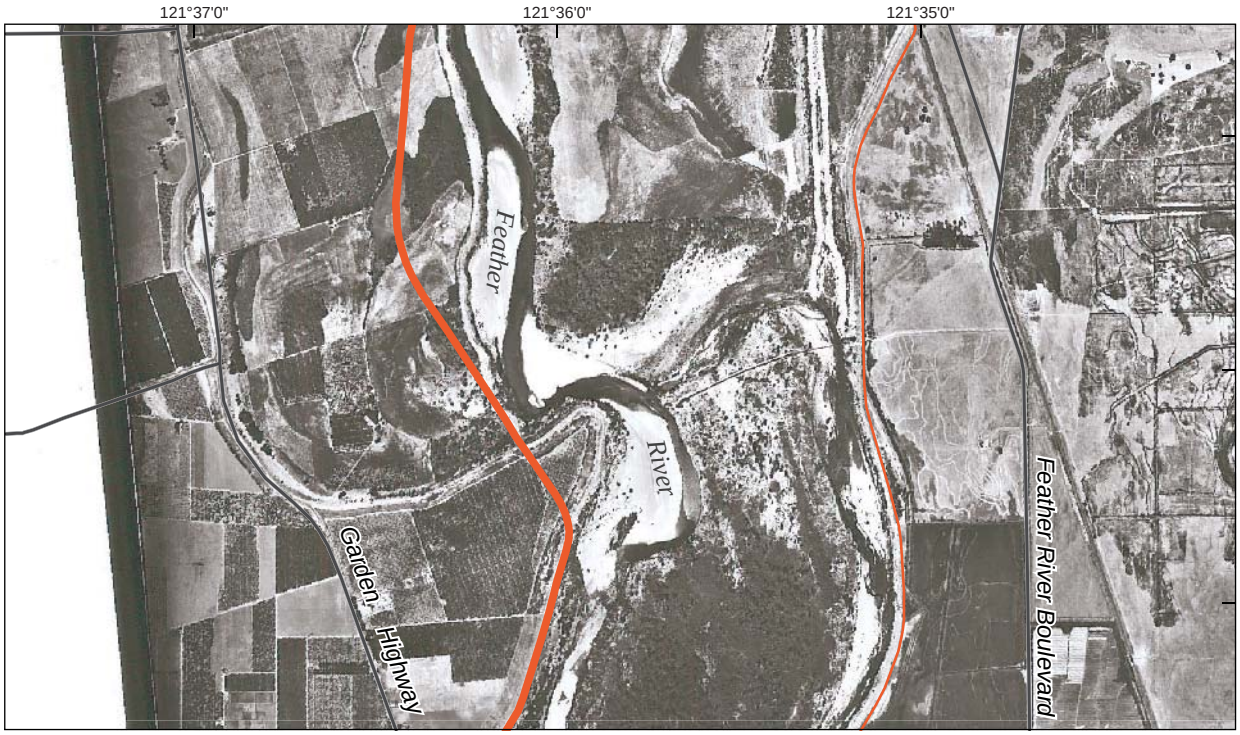
Map of Central Valley near Sutter Buttes, California

DWR URBAN LEVEE PROJECT

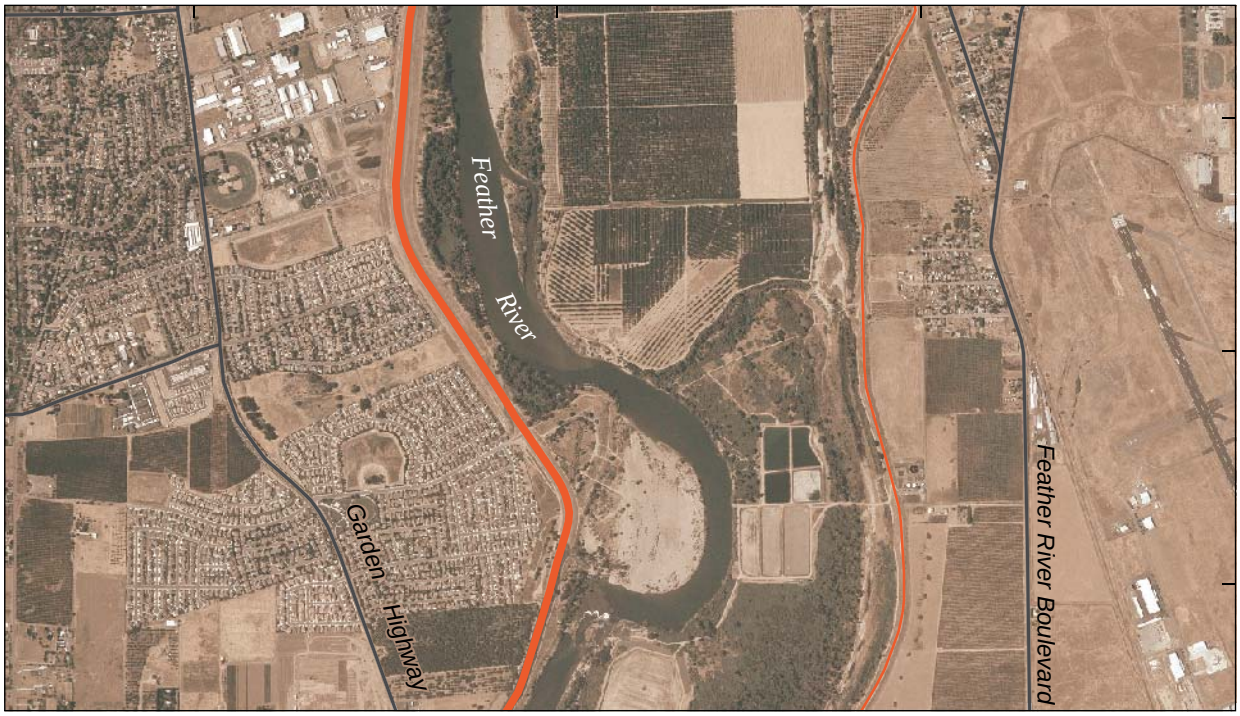
Figure 1

1881 South Feather River

Modified 09.03.09



A. 1937 USDA Air Photo



B. 2006 NAIP Ortho Imagery

Explanation

- Southern Feather River project levee
- Urban project levee
- Major road

N

0 5 10 mi

0 5 10 km

WLA

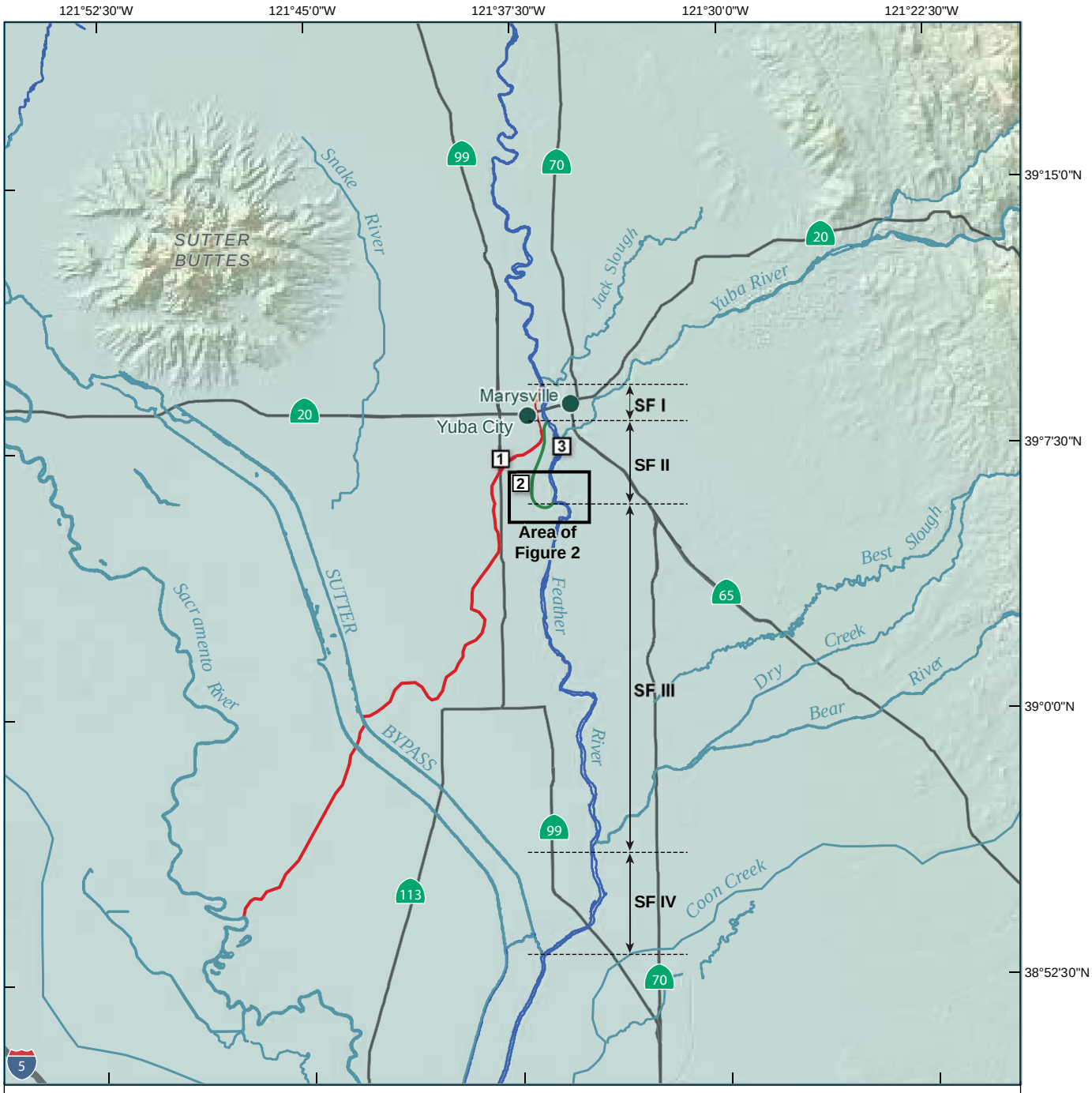
Aerial Imagery of the Feather River at Shanghai Bend

DWR URBAN LEVEE PROJECT

Figure 2

1881 South Feather River

Modified 09.03.09



Source: ESRI, 2006

Projection: UTM Zone 10, NAD83

Explanation

- 3 — Modern Feather River Channel
- 2 — Abandoned arm of the Feather River
- 1 — Ancestral Feather River Channel (Gilsizer Slough)
- SF I — Reach of Southern Feather River Study Area

N

0 — 5 mi

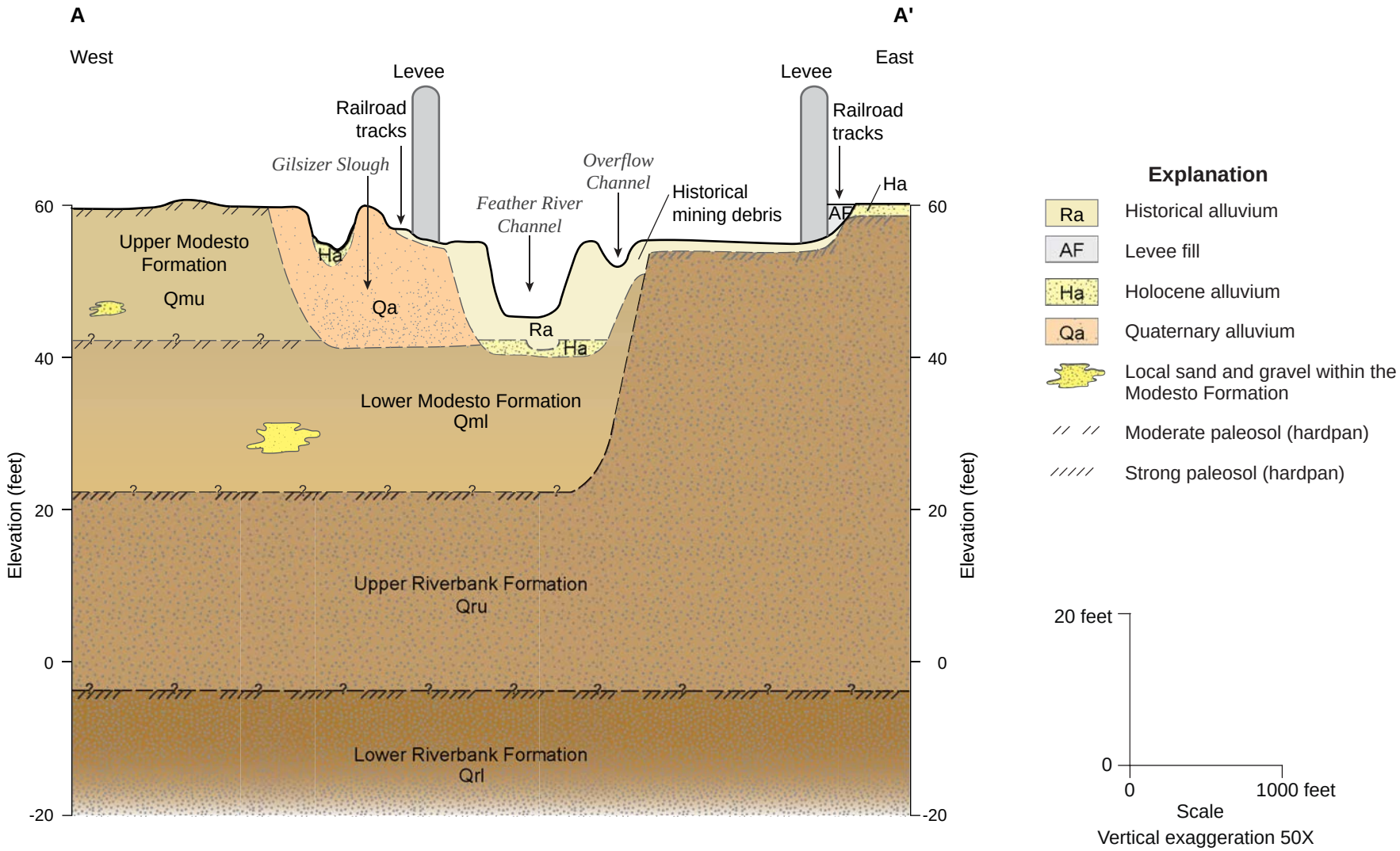
0 — 5 km

WLA

Map Showing the Eastern Migration of the Feather River

DWR URBAN LEVEE PROJECT

Figure 3



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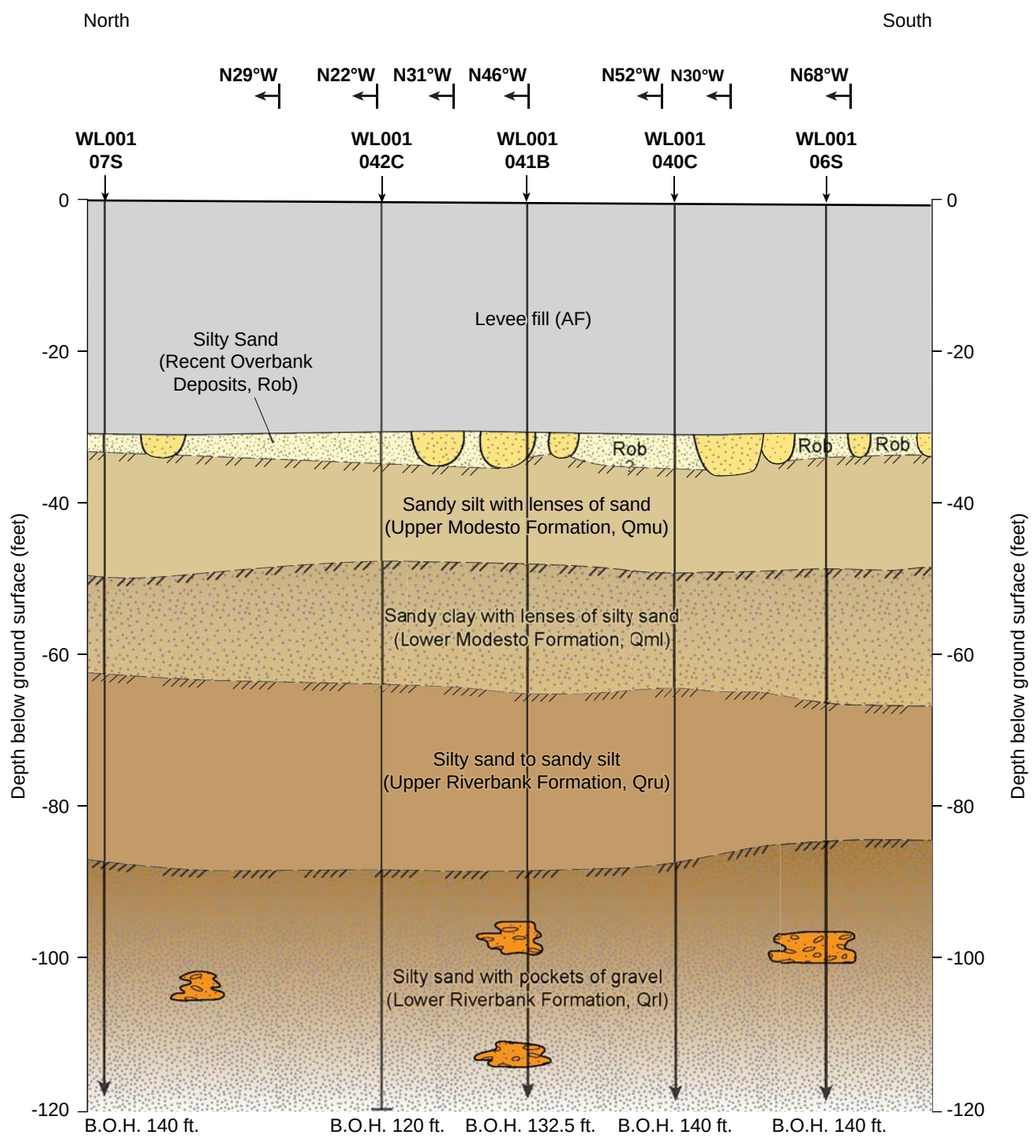
Conceptual Subsurface Diagram across the Feather River at Yuba City

DWR URBAN LEVEE PROJECT

Figure 4

1881 South Feather River

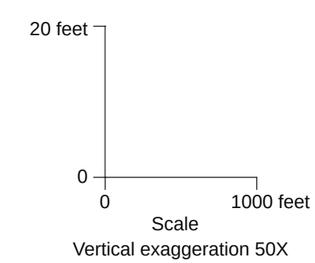
Modified 09.03.09



Explanation

- Recent crevasse splay, surficial geologic map unit Rcs
- Local sand and gravel within the Riverbank Formation
- Moderate paleosol (hardpan)
- Strong paleosol (hardpan)
- N46°W — Bend in Section

Notes:
1. See Plate 1 for location of cross section.
2. Surficial geologic units and contacts from this study and Helley and Harwood (1985).
3. Bottom of hole (BOH) values shown as total depth below ground surface.
4. Borehole names and horizontal distance shown above from draft URS logs and location maps. Geologic relations could change if borehole locations revised
5. Drilling method indicated as last letter in borehole names:
   S = Sonic Vibracore;
   C = Cone Penetrometer Test;
   B = Mud Rotary with SPT



Conceptual Subsurface Diagram, West Levee at Abbott Lake and Star Bend

Figure 5

Plate 1 - Surficial Geologic Map of the Feather River, Southern Section
This map shows surficial geologic deposits and levees as they existed in 1937. Map units and boundaries are drawn by interpretation of historical aerial photography supplemented by data from historical maps and surveys. For reference, the mapping is superimposed on modern U.S. Geological Survey topographic base map prepared in 1952 and photo revised in 1973. See accompanying report for complete descriptions of map units, process descriptions and methodology.
Explanation
Geologic contact; dashed where approximate, dotted where concealed, queried where uncertain; solid contacts within 30' of line shown on map.
SF-II
Geomorphic Reaches Discussed in Text
Project Levees
Cross Section
A
A'
WSL001_006S
Borehole locations from URS, Corp; locations from Sutter P2 Boring Locations, Region 1 Northern Area map.
W 1937
Water bodies, circa 1937.
BP
Borrow pits present in 1937.
Geologic Units
HISTORICAL
L
Levees (artificial fill), circa 1937.
SP
Spoils pile (artificial fill), circa 1937.
Rob
Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks.
Rcs
Crevasse splay deposits; fine to coarse sand, with minor lenses of clay deposited from breaching of natural or artifical levees.
Rdf
Distributary fan deposits; sand, silt and clay.
Rch
Channel deposits; well sorted sands and fine gravels.
Rms
Channel meander scroll deposits; sand, silt and clay from lateral channel migration.
Rb
Channel bar deposits; fine gravel, sand, and silt deposited in or along channel lateral margins.
Rcu
Cut off channel (chute); occurs on insides of meander bends within the river channel; on flood plain – entrenchment of overflow channels into hydraulic mining debris.
Rdc
Distributary channel deposits, trace gravel, sand, silt, and clay; channelized flow conducting sediment to floodplain.
Rofc
Overflow channels; vertically stratified sand, silt, and clay in floodplain channels occupied primarily when high-stage water overtops channel banks.
Rsl
Slough deposits; sand, silt and clay, fining upward facies, low-energy channel deposit.
Ra
Alluvial deposits, undifferentiated; sand, silt, and minor lenses of fine gravel.
HOLOCENE
Hob
Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks.
Hcs
Crevasse splay deposits; fine to coarse sand, with minor lenses of fine gravel deposited from breaching of natural or artifical levees.
Hdf
Distributary fan deposits; sand, silt and clay.
Hofc
Overflow channels; vertically stratified sand, silt, and clay in channels occupied when high-stage water overtops channel banks.
Hch
Channel deposits; sorted sands and silts; fining upward.
Hb
Channel bar deposits; fine sand, and silt deposited in or along channel lateral margins.
Hdc
Distributary channel deposits, sand, silt, and clay.
Hsl
Slough deposits; sand, silt and clay, fining upward facies, low-energy channel deposit.
Ha
Alluvial deposits; undifferentiated; sand, silt, and minor lenses of gravel; under cultivation in 1937.
Qn
Basin deposits; fine sand, silt and clay, dark yellow to dark yellowish brown, under cultivation in 1937.
Qs
Marsh deposits; silt and clay, likely organic-rich; perennially or seasonally submerged on 1937 photography.
PLEISTOCENE
Qmu
Modesto Formation; upper member; unconsolidated gravel, sand, silt, and clay.
Qml
Modesto Formation; lower member; unconsolidated to semi-consolidated gravel, sand, silt and clay.
Qru
Riverbank Formation; upper member, semi-consolidated to consolidated gravel, sand, silt and minor clay.
Qrl
Riverbank Formation; lower member; consolidated gravel, sand, silt, and clay, generally associated with strong duripan horizon.
Stratigraphic Correlation Chart
Time
Depositional Environment
Epoch
Channel deposits
Floodplain and alluvial-fan deposits
Flood basin deposits
Cultural deposits
Historical
Rch
Rdc
Rb
Rsl
Rms
Rofc
Rcu
Qa
Ra
Rcs
Rdf
Rob
Qs
Qn
L
SP
Holocene
Hch
Hdc
Hb
Hsl
Ha
Hdf
Hcs
Hob
Hofc
Latest Pleistocene
Qmu
Qml
Pleistocene
Qru
Qrl
SF-I
SF-II
SF-III
SF-IV
MARYSVILLE
YUBA CITY
YUBA CITY AIRPORT
COLUSA ROAD
GARDEN HIGHWAY
EPLEY DRIVE
OSWALD ROAD
MESSICK ROAD
O'BANION ROAD
LAUREL AVENUE
ABBOTT LAKE
FEATHER RIVER
Trowbridge
1:20,000
N
0
0.5
1 Miles
0
0.5
1 Kilometers
Map projection: UTM NAD83 Zone 10N
Topographic base USGS quadrangles:
USGS, Gilsizer Slough topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
USGS, Nicolaus topographic quadrangle, published 1952, remapped 1992; map scale 1:24,000, five foot contour interval.
USGS, Olivehurst topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
USGS, Sutter topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
USGS, Sutter Causeway topographic quadrangle published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
USGS, Yuba City topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.
Plate 1 - Surficial Geologic Map
of the Feather River, Southern Section
WILLIAM LETTIS & ASSOCIATES, INC.
Walnut Creek, CA
1881_URS_Feather_South.mxd
09/04/2009
Geologic Mapping by J. Pearce and A. Streig
Digital Cartography by M. Ticci

Part C.5

URS Supplemental Geotechnical Data Report (2010), Appendix O, Volume 5

APPENDIX O

Geomorphology Report

Surficial Geologic Maps and Geomorphic Assessment of the Sutter Study Area, Urban Levee Geotechnical Evaluation, Sutter and Butte Counties, California

Prepared for:

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September 8, 2009

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September 8, 2009

Mr. Juan Vargas
URS Corporation
2870 Gateway Oaks Drive, Suite 150
Sacramento, CA 95833

RE: Surficial geologic mapping and geomorphic assessment, California Department of Water Resources Urban Levees Project, Northern Feather River, Sutter County, California

Dear Mr. Vargas:

This letter presents the surficial geologic mapping and preliminary geomorphic assessment of the northern Feather River study area, for the California Department of Water Resources (DWR) Urban Levees Project geotechnical characterization. The goal of this mapping and geomorphic assessment is to provide information on the type and distribution of surface and shallow subsurface deposits that likely underlie the project levees along the western bank of the Feather River between Thermalito Afterbay and Yuba City. The purpose of this study is to develop spatially continuous geologic map data and a conceptual model for stratigraphic interpretations between shallow boreholes. A primary goal is to provide a geologic framework for the geotechnical assessment of potential levee underseepage. This letter presents the technical approach, surficial geologic map, conceptual geomorphic model, and initial results based on map analysis and preliminary review of available Phase 1 geotechnical data.

We appreciated the opportunity to provide these geomorphic and geologic data and preliminary interpretations of the shallow stratigraphic conditions in the northern Feather River study area. Please do not hesitate to call any of the undersigned if there are any questions or comments.

Respectfully,

WILLIAM LETTIS & ASSOCIATES, INC.

Justin Pearce, C.E.G. 2421
Senior Geologist

Ashley Streig
Senior Staff Geologist

Keith Kelson, C.E.G. 1610
Principal Geologist

1.0 Introduction

This technical memorandum presents the results of surficial geologic mapping and geomorphic assessment along the north Feather River between Thermalito Afterbay and Yuba City, for the California Department of Water Resources Urban Levee program. The purpose of this study is to provide detailed information on the type and distribution of surface and shallow subsurface deposits that likely underlie the project levees, with respect to levee underseepage. This study involved integration and analysis of aerial photography, topographic, geologic, and soil maps, other historical documents, and review of readily available geotechnical exploration data. Synthesis of these data allowed us to assess the geomorphic processes responsible for the distribution of surficial deposits within the project area, and construct a preliminary conceptual model for stratigraphic interpretations. This technical memorandum is accompanied by the "Surficial Geologic Map of the Feather River, Northern Section".

1.1 Map and Report Preparation Quality Control

The surficial geologic map data and geomorphic interpretations presented in this memorandum were subject to quality control and quality assurance procedures as required by the Levee Geotechnical Evaluation Project Management Plan (PMP). The surficial geologic map data developed by this study were reviewed for accuracy and completeness through an internal review and an independent technical review by Dr. Janet Sowers of WLA. Results of QA/QC review were documented using PMP Exhibit 2.2-3 (Independent Technical Review Report) and are kept on file according filing control plan. Subsurface data shown on diagrams were provided as draft information, and were not verified for accuracy or completeness by this study.

2.0 Approach

The approach to developing a surficial geologic map of the northern Feather River project area (Figure 1, Plate 1) consisted of analysis of the following data:

- Aerial photography (black and white stereo-pairs taken in 1937, ~1:20,000-scale);
- early USGS topographic maps (i.e., 1911);
- published surficial geologic maps (Bussaca et al., 1989; Helley and Harwood, 1985; Creely, 1965);
- early and modern soil survey maps (Strahorn et al., 1909; Lytle, et al., 1988);
- other maps and documents (Page, 1985).

Synthesis of these data allow for the development of a detailed surficial geologic map that provides an initial understanding of primary geomorphic processes that have acted in the study area during recent and historical geologic time. Through this mapping, primary geomorphic features and associated surficial geologic deposits are identified, such as abandoned paleochannels, channel deposits, splay and overbank deposits and other deposits commonly associated with large active river systems. Knowledge of fluvial processes and the ability to recognize depositional environments in the geologic record are key to identifying locations along levees where underseepage is most likely to occur (Llopis et al., 2007).

The surficial geologic map was developed at the nominal scale of the aerial photography (1:20,000). This scale establishes the resolution of the map (Plate 1), such that display or analysis of the map data at a more detailed scale than 1:20,000 may introduce uncertainties beyond the original resolution of the data. The map unit boundaries shown on the surficial geologic map should be considered approximate, and accurate within 30 feet on either side of the line shown on the map. The 1937 aerial photographs are the primary data set for interpreting the surficial geologic deposits because: (1) they are the oldest high-quality images that pre-date much of the urbanization and landscape alteration within present-day Sutter and Butte Counties and, (2) these data represent a close approximation to the surficial deposits that were likely present at the ground surface prior to the construction of the levees. The 1937 photographs generally were taken in late summer or early autumn (i.e., August). By 1937, the area had experienced moderate cultivation that locally obscures geomorphic conditions. However, integration of data from the 1937 photography, old and recent topographic maps, geologic maps, soil surveys and historical documents provides sufficient information to delineate many of the pre-historical and historical surficial deposits in detail. Taken together, these data provide key insights to the characteristics of shallow deposits beneath the levees, as well as the geomorphic processes responsible for their distribution.

Additional floodplain deposition may have occurred after 1937, due to flood overflows, levee overtopping, or localized levee failure. A time series analysis that interprets successive aerial photographs taken after major flood events (i.e., USDA, black and white stereo-pairs taken in 1958, ~1:20,000-scale) or known local levee failures (i.e., 1986) may reveal additional information on surficial deposits in the northern Feather River area. Such analyses are beyond the scope of this study. The data and interpretations presented herein address the primary goal of characterizing the type and distribution of deposits likely present directly beneath the project levees that may be conducive to underseepage.

3.0 Geologic Setting

The northern Feather River study area lies in the central Sacramento Valley, between the Coast Ranges to the west and the Sierra Nevada foothills to the east. The Feather River drains the western slope of the Sierra Nevada, and emerges from the mountains south of Thermalito Afterbay (Figure 1). The river flows southward from Thermalito Afterbay, over middle –to late Pleistocene alluvium derived from the Sierra Nevada. The regional land surface is nearly flat, with a gentle west-southwest slope that flattens south of the Sutter Butte. The Feather River is entrenched into middle-to-late Pleistocene semi-consolidated sediments (i.e. Modesto Formation). Historical alluvium deposited by the Feather River is present between the modern levees, inset to the older geologic formations, and is present on the western floodplain as subdued natural levees that mantle the older geologic formations. In this study reach, west-flowing Honcut Creek is the only drainage tributary to the northern Feather River, with a confluence east of the town of Live Oak (Figure 1).

A primary influence on the historical processes in the river system was the hydraulic mining that began in the 1850's. Mining continued through the early 1900's in the Feather, Yuba and

Bear River watersheds, and abruptly introduced large quantities of sediment and drastically changed the geomorphic characteristics of these river systems (DWR, 2004; Ellis, 1939). Aggradation within the stream channels was a primary response to the introduction of substantial mining debris (James, 1999); consequently, post-1850 alluvial deposits are common throughout the study area.

4.0 Surficial Geologic Mapping

Previous geologic mapping along the northern Feather River and surrounding areas generalize the surficial deposits as: Quaternary alluvium (Qa) and Quaternary stream channel deposits (Qsc) are mapped within and proximal to the modern Feather River channel, (Bussaca et al., 1989; Helley and Harwood, 1985; Creely, 1965). These map units are considered Holocene in age (less than 11,000 years old). Late Pleistocene Modesto Formation (Qmu, Qml) is present as an escarpment along the western margin of the floodplain. These map units were delineated by Helley and Harwood (1985) at a regional scale (i.e., 1:62,500). The current analysis of the northern Feather River uses this geologic framework as a basis for more detailed mapping of Quaternary deposits and geomorphic features (Plate 1). The surficial geologic map units within the northern Feather River study area are described below, in order from oldest to youngest. Surficial geologic mapping for this study subdivides these general map units and delineates individual deposits based on relative age and depositional process or environment. The map units depicted on Plate 1 are primarily based on analysis of 1937 aerial photography, and thus the map essentially is a “snapshot” of geologic conditions at this time.

The oldest unit exposed along the Feather River is the lower member of the Riverbank Formation (Qrl) of Helley and Harwood (1985). The Riverbank Formation is a semi-consolidated, highly-dissected alluvial surface with textures of weathered gravel, sand and silt, and is associated with the presence of a well-developed hardpan (or, duripan) layer. This hardpan layer is a product of soil-forming processes over substantial geologic time, and reflects an ancient land surface that locally is buried by younger deposits. The Riverbank Formation is late to middle Pleistocene in age, and is estimated to be 130,000 to 450,000 yrs old (Helley and Harwood, 1985). The upper member (map unit Qru; Plate 1) is poorly consolidated dark brown to red alluvium consisting of gravel, sand, silt and minor clay (Busacca et al., 1989, Helley and Harwood, 1985). West of the Feather River, the Riverbank Formation is present near the town of East Biggs (Plate 1). Soils developed on the Riverbank formation are the Gridley clay loam and the Redding gravelly sandy loam (Carpenter et al., 1926).

The latest Pleistocene Modesto Formation is informally divided into two members: a lower (older) unit that is (about 29,000 to 49,000 years old), and consists of unconsolidated slightly weathered gravel, sand, silt and clay; and an upper member, a younger unit, that is about 12,000 to 26,000 years old (Helley and Harwood, 1985). The upper Modesto (map unit Qmu) consists of sand, silt, and some gravel, and is associated with a moderate amount of secondary (pedogenic) clay accumulation. This clay-rich horizon may form laterally continuous zones of low hydraulic conductivity, and may extend across boundaries between coarse and fine-grained strata within the latest Pleistocene alluvium. Soils developed on the Modesto Formation

include the Gridley loam of Strahorn et al. (1909) and the Conejo complex of Lytle et al. (1988), both of which are associated with a shallow "siltstone" horizon, or duripan (hardpan).

Latest Holocene deposits overlie or are inset into the Modesto Formation, and are categorized as channel, floodplain, and basin deposits (stratigraphic correlation chart; Plate 1). Channel deposits include Holocene channels (Hch), sloughs (Hsl), in-stream or lateral bars (Hb), and meander scrolls (Hms). These deposits likely consist of fine to coarse sand, silty sand, and clayey sand, with trace fine gravel. Holocene channel deposits (Hch) present along the western map area as secondary channels, contain fining-upward sequences of sand, silt and clay. These sloughs (map unit Hsl) are former channels associated with Live Oak and Morrison Sloughs (Plate 1), and are likely filled with a fining upward sequence of silt and clay.

Holocene floodplain deposits include crevasse splays (Hcs), and overbank deposits (Hob) and are typically deposited by non-channelized flow. Crevasse splays (Hcs) are from breaching of river banks or natural levees and are usually sand rich. Overbank deposits form by localized overtopping of river banks or natural levees, and subsequent deposition from shallow sheet flow or standing water.

Undifferentiated Holocene and Quaternary alluvium (Ha and Qa, respectively) usually occur proximal to or within the river channel, (Plate 1). The undifferentiated map unit is used in areas where geomorphic features are obscured or obliterated by historical (1937-era) agriculture. The deposits within these agriculturally modified areas are assigned a relative age (Ha or Qa) based on overlapping and cross cutting relationships with the surrounding deposits as follows: Ha if the agriculture-modified area is mapped within or shown overlying Holocene deposits; Qa where it is difficult to evaluate the age based on the relationship with nearby deposits. Soils associated with these undifferentiated units (Qa) are the Sacramento silt loam and Sacramento fine sandy loam, (Strahorn et al., 1909), and the Columbia fine sandy loam of Lyle et al. (1988), which are poorly-developed soils commonly associated with relatively young deposits (i.e. Shlemon, 1967).

Historical deposits mapped in the Northern Feather Study area include channel and floodplain deposits, as well as artificial fill deposits (Plate 1). Historical deposits are estimated to be less than about 150 years old, dating from approximately 1800 to 1937. Historical stream channels (Rch), and overflow channels (Rofc) transport high stage water flow across the ground surface outboard of the levees. These channel deposits likely consist of silt and sand with traces of gravel. The upper few feet of these deposits probably are filled with debris derived from upstream hydraulic mining activities. Lateral bar deposits (Rb) and meander scrolls (Rms) are located adjacent to the present-day Feather River, and are generally present inboard (waterside) of the present-day Feather River levees. In the northern part of the study area, directly south of Thermalito, are multiple anastomosing chutes (map unit Rcu; Plate 1). These chutes are similar to overflow channels in that they transport water flow during high river stage across the ground surface outboard of the levees. These chutes are entrenched into fluvially deposited hydraulic mining debris, and likely have filled with re-worked mining debris. Historical sloughs transport water collected from sheet flow and overland flow west of the Feather River southerly toward the Sutter Basin (i.e., Live Oak and Morrison Slough). Slough deposits (Rsl) likely consist of fining-upward silt and clay. Historical flood plain deposits include crevasse

splay (Rcs), and overbank (Rob) deposits, which generally consist of a gradational or abrupt fining upward sequence of sand, silt, and clay. Historical overbank (Rob) deposits are slightly finer grained sand, silt, and clay deposited via sheet flow. These historical deposits are differentiated from older deposits based on cross-cutting and superposition relationships relative to cultural features visible on the 1937 photographs.

Historical alluvial deposits (Ra), generally located between the Feather River channel levees, and on the land side of the levees in the area directly south of the Thermalito Afterbay, consist of undifferentiated sand, silt, and minor lenses of gravel. Soils associated with this sandy alluvium are the Columbia very fine sandy loam and Columbia loam, as shown on the Soil Survey Map of the Oroville Area (Carpenter et al., 1926). This series of soils has been correlated with Holocene age deposits by Shlemon (1967). Historical artificial fills are culturally-emplaced heterogeneous deposits, with varying amounts of clay, silt, sand, and gravel from local sources. These deposits include levee structures and canal levee systems (map unit L; Plate 1) and dredge tailings (map unit DT).

The distribution of historical and Holocene deposits shown on Plate 1 generally is consistent with early, less-detailed soil survey mapping along the western banks of the Feather River as areas of Marcuse clay loam, Gridley loam, Sacramento Series fine sand, sandy loam and silt loam and the Columbia very fine sandy loam soils (Strahorn et al., 1909; Carpenter et al., 1926). The Gridley loam occurs along the northern Feather River from the Thermalito Afterbay south to the confluence with the Bear River, and closely corresponds to the Modesto Formation of Helley and Harwood (1985). The relationship between the mapped surficial geologic units and the potential for underseepage is summarized below.

5.0 Geomorphic Conceptual Model

This section provides a preliminary geomorphic conceptual model based on general relationships among surface and subsurface geologic deposits along the western side of the Feather River, as described above and shown on Plate 1. This conceptual model provides a consistent basis for understanding the type and distribution surficial geologic deposits, primary geomorphic processes, and shallow subsurface stratigraphy in the study reach. This conceptual model does not address planform or gradient changes of the Feather River itself, nor the susceptibility of stream banks to erosion. Future studies of these changes would be valuable in understanding process response of the Feather River, and provide key data for estimating rates of channel changes (i.e. lateral migration). However, these analyses are not directly relevant to evaluating the possibility of underseepage with respect to levee stability.

Published geologic maps of the project area show a complex series of westward aggrading alluvial fans and terraces derived from erosion of the Sierra Nevada, identified as the Riverbank and Modesto Formations (Bussaca et al., 1989; Helley and Harwood, 1985; Creely, 1965). The Riverbank Formation and Modesto Formation in general are semi-consolidated to unconsolidated deposits characterized by intraformational paleochannels and lateral and vertical stratigraphic complexity related to past fluvial processes and buried paleo-topography. The oldest map unit, the Riverbank Formation unconformably overlies the Pliocene-Pleistocene

age Laguna Formation, which consists of interbedded alluvial gravel, sand and silt (Busacca et al., 1989; Helley and Harwood, 1985). The overlying Pleistocene Riverbank Formation consists of very dense gravel deposits that are, in turn, overlain by a medium dense sand and gravelly sand package of the latest Pleistocene Modesto Formation (Busacca et al., 1989). The upper member of the Modesto Formation is exposed at the ground surface adjacent to the western bank of the Feather River. The Modesto Formation is locally mantled by unconsolidated, sand rich Holocene deposits (Plate 1). East of the Feather River the older stratigraphic units are uplifted and dissected and younger deposits are inset into them with older deposits buried beneath younger deposits. West of the Feather River, the stratigraphic units are found in typical succession. This is the result of overall westward tilting and uplift of the Sierra Nevada, incision along the tributary drainages (i.e. Honcut creek), and progradational fan deposition west of the river.

Surficial geologic mapping (Plate 1) shows differences in deposit type and distribution from north to south along the northern Feather River study area, which are primarily associated with proximity to the Sierra Nevada mountain front near Thermalito Afterbay. These differences illustrate the diversity of past geomorphic processes along the river and, as a consequence, the type of geologic deposits at and near the ground surface. The surficial geologic map allows the delineation of reaches along the river within which geomorphic processes and their associated deposits appear to be relatively consistent.

The northern Feather River project area is divided into three reaches based on characteristic deposit types and distributions. The levee reaches are numbered Northern Feather one through three (NF-I through NF-III), sequentially from north to south (Figure 2, Plate 1). This section describes the surficial geologic characteristics of Reach NF-I, NF-II, and NF-III of the Feather River between Thermalito Afterbay and Yuba City.

5.1 Reach NF-I

Reach NF-I extends from the Thermalito Afterbay to Reimer Road and is about 11.1 levee miles long (Plate 1). Widespread deposits of historical alluvium (map unit Ra) blanket the area adjacent to the Feather River along the length of this reach where the river flows in the Sacramento Valley. Much of this unconsolidated historical alluvium contains clasts from many source lithologies and is derived from hydraulic mining debris (James, 1999). A complex pattern of anastomosing chutes or cut-off channels (map unit Rcu) eroded the historical alluvium by 1937 (Ra). These chutes underlie the project levees along the length of this reach (Plate 1). Project levees were built after 1937 along NF-I, from Thermalito Afterbay south to Ord Ranch Road.

Hardpan horizons were not identified in subsurface data along this reach, suggesting a substantial thickness of unconsolidated alluvial deposits unconformably overlying the Modesto Formation. Three alluvial units were identified in subsurface data overlying a semi-consolidated alluvial unit that we identified as the lower member of the Modesto Formation. Boreholes revealed an approximately 20-foot-thick package of young, unconsolidated silty sands and sandy clays, above a 10 to 16 foot thick silty sand, and 15-to 20-foot-thick gravel bed (Figure 3).

Hydraulic mining debris was dredged for its gold content along the northern half of the river banks along this reach, from Lapkin Road at Thermalito Afterbay to the area just south of Almond Avenue (Plate 1). Some dredge tailing spoils were apparent in 1937 aerial photography, though the majority of dredge tailing spoils post-date these air photos. The full extent of dredging tailing is apparent in modern USGS topographic maps (i.e. USGS, Biggs topographic quadrangle, 1:24,000 scale, 1970) and is shown on this surficial geologic map (map unit DT). Chutes (map unit Rcu) present in 1937 aerial images, though now obliterated by dredge operations are shown as dotted contacts in the Surficial Geologic Map (Plate 1). In this area project levees either overlie or bound the western edge of the Dredge Tailings (map unit DT). South of the dredged areas, the levee along Ord Ranch Road overlies deposits that fill an abandoned channel meander, map unit Hch (Plate 1). This abandoned meander matches the present river geometry and possibly reflects a southward migration of this meander within the active channel.

5.2 Reach NF-II

The second reach of the north Feather River project area, NF-II, extends from Reimer Road to Sanders Road, and has a length of about 9.4 levee miles. In this reach the project levee is typically perched at the top of a 5- to 15-foot-high east-facing escarpment cut into the Modesto Formation. The active meander belt of the Feather River with its flood plain, meander scrolls, and channel deposits, lies to the east of the levee at the base of the escarpment. West of the escarpment, historical overbank (Rob) and crevasse splay (Rcd) deposits locally overlie the Modesto. They represent locations where flooding of the Feather River overtopped the escarpment in the past and are assumed to pre-date the construction of the levee. An extensive continuous Holocene natural levee deposit has not built up along reach II, in contrast to reach I. The river may be incised too deeply below the surface of the Modesto Formation for floods to regularly overtop the escarpment.

Most of the Reach II levee sits directly on Modesto Formation with about 3.5 of the 9.4 miles of the levee sitting on the above-mentioned Holocene overbank and crevasse splay deposits that overlie Modesto Formation. Borehole WL0009_004S (Plate 1), located in the southern portion of this reach, shows project levee fill directly above the hard, consolidated Modesto Formation.

5.3 Reach NF-III

Levee reach NF-III extends from Sanders Road at the north to Yuba City at the south, and is about 4 miles in length (Plate 1). Along this reach the project levee almost entirely overlies Historical alluvial deposits that mantle, or crosscut the Modesto Formation. Crevasse splay (Rcs), overflow channels (Rofc), historical alluvium (Ra), channel deposits (Rch), and overbank deposits (Rob) are present along this reach. Crevasse splay deposits are present at the northern end of NF-III (Sanders Road, Plate 1), directly adjacent to a westerly bend of the Feather River. Aerial photography from 1937 shows multiple generations of crevasse splay deposits at this location. The levee appears to be constructed overtop these deposits. A pump station is noted on the 1970's topographic map, suggesting this location may have had seepage problems.

Immediately south of Sanders Road, an overflow channel (map unit Rofc) diverges from the Feather River, transporting flow outboard of the levees, and flowing back into the river about 1.5 miles south at Rednall Road (Plate 1). The overflow channel likely consists of a fining upward sequence of sand, silt, clay and some gravel, and could be slightly incised into the Modesto Formation. Undifferentiated historical alluvium (map unit Ra) underlies the levees within the area directly east of these overflow channels. This alluvium was laid down over the surface of the Modesto Formation by unchannelized flow of the Feather River (Plate 1). Historical channel deposits (map unit Rch) from the Feather River underlie about 0.7 miles of the levees north of Rednall Road (Plate 1). Overbank deposits are present near Pease Road (Plate 1) and continue along the levee for about 0.5 miles. Historical crevasse splay and overbank deposits likely consist of a massive to fining upward sequence of sand and silt derived from upstream hydraulic mining activities.

6.0 Applications to the Urban Levee Project

Based on an initial analysis of surface and subsurface geologic and geomorphic data, the levee bordering the western side of the Feather River from the Thermalito Afterbay to Yuba City, overlies three different types of deposits, Reach NF-I overlies a thick package of historical alluvium, NF-II directly overlies the Modesto Formation with local areas of historical alluvium, and Reach NF-III directly overlies a continuous blanket of sediment derived from historical crevasse splay (Rcs), overflow channel (Rofc), alluvium (Ra), channel (Rch) and overbank (Rob) deposits, above the Modesto Formation. The preliminary conceptual surface and subsurface geologic relationships as they relate to levee structures and potential underseepage along each reach of the river are described below. This study does not account for any existing seepage mitigation structures (i.e. cutoff walls) that may be present.

Along Reach NF-I the levees are underlain by a package of young coarse-grained fluvial sediment, most likely of mining debris origin, and chutes filled with coarse grained fining upward sequences of sediment also derived from hydraulic mining debris (Figure 3). This material is laterally extensive and poorly consolidated, with localized chute deposits (map unit Rcu). The chutes extend beneath the levee with an orientation that is roughly orthogonal to the levee crest, and may provide relatively high conductivity pathways for levee underseepage within the already very permeable fluvial sediments. The sediments along the northern half of reach NF-I were dredged for gold during the first half of the 20th century, well-graded dredge tailings remain in these areas. Dredge tailings are unconsolidated and consist of silt, sand, and gravel. At the north near Vance Avenue the project levees appear to overlie these highly permeable tailings, and everywhere else bound the western edge of the tailing spoils. Levees along this entire reach are judged to be highly susceptible to underseepage.

Levee reach NF-II is likely underlain by a combination of coarse grained, semi-consolidated alluvium of the Modesto Formation and localized areas of historical, poorly consolidated coarse-grained avulsion deposits (overbank and crevasse splay deposits) overlying the Modesto Formation. These avulsion deposits likely are permeable and may provide localized areas susceptible to underseepage. Project levees underlain by the Modesto Formation likely are less

susceptible to underseepage problems, however the natural variability within the Modesto may also provide local pathways for underseepage.

Levee reach NF-III generally consists of westward aggrading avulsion deposits overlying the Modesto Formation. The levee is underlain by coarse-grained, poorly consolidated silt, sand and gravel, blanketing the consolidated Modesto Formation and in some places incised into the Modesto Formation. These deposits likely are permeable and susceptible to underseepage.

In summary, lateral and vertical variabilities in the shallow subsurface deposits have resulted from past fluvial geomorphic processes. Surficial geologic mapping along the north Feather River allows reach classifications within which conditions may be relatively similar. The conceptual geomorphic framework suggests that stratigraphic relationships may promote localized levee underseepage, given certain hydraulic conditions throughout the Northern Feather River Study area, particularly along reach NF-I. Areas where levees may overlie historical or Holocene-age coarse grained deposits are of special concern. Further spatial analyses of the surficial geologic mapping and subsurface geotechnical exploration data are needed to better constrain and characterize areas that are most susceptible to underseepage in the study area. We anticipate that this conceptual model will be revised and updated as new information becomes available.

7.0 Limitations

This geomorphic assessment and associated data interpretation have been performed in accordance with the standard of care commonly used as the state-of-practice in the geologic engineering profession. Standard of care is defined as the ordinary diligence exercised by fellow practitioners in this geographic area performing the same services under similar circumstances during the same time period.

Discussions of surface and subsurface conditions summarized in this technical memorandum are based on geologic interpretations of subsurface soil data at limited exploration locations available to this assessment through September of 2007. Variations in subsurface conditions may exist between exploration locations, and the project team may not be able to identify all adverse conditions in the levee and its foundation. This memorandum is for the use and benefit of DWR. Use by any other party is at their own discretion and risk.

8.0 References

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USGS, Gridley topographic quadrangle, surveyed 1909-1910, published 1912; map scale 1:31,680, five foot contour interval.

USGS, Honcut topographic quadrangle, surveyed 1909-1910, published 1912; map scale 1:31,680, five foot contour interval.

USGS, Oroville topographic quadrangle, surveyed 1910, published 1912; map scale 1:31,680, five foot contour interval.

USGS, Palermo topographic quadrangle, surveyed 1910, published 1912; map scale 1:31,680, five foot contour interval.

USGS, Sutter topographic quadrangle, surveyed 1909, published 1911; map scale 1:31,680, five foot contour interval.

USGS, Yuba City topographic quadrangle, surveyed 1909, published 1911; map scale 1:31,680, five foot contour interval.

USGS, Biggs topographic quadrangle, published 1952, remapped 1970; map scale 1:24,000, five foot contour interval.

USGS, Gridley topographic quadrangle, published 1952, remapped 1973; map scale 1:24,000, five foot contour interval.

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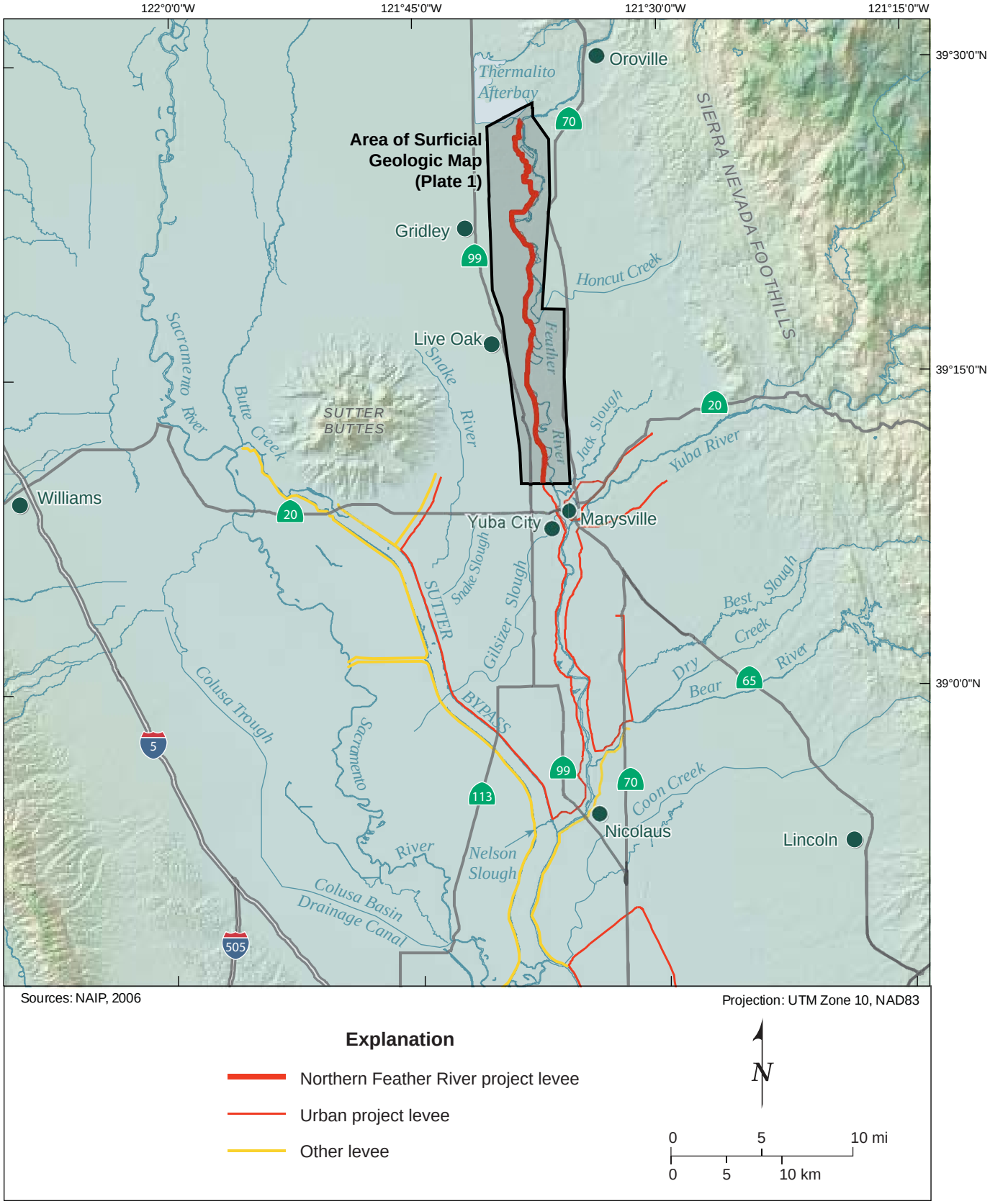
USGS, Palermo topographic quadrangle published 1952, remapped 1970; map scale 1:24,000, five foot contour interval.

USGS, Sutter topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.

USGS, Yuba City topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000, five foot contour interval.



WLA

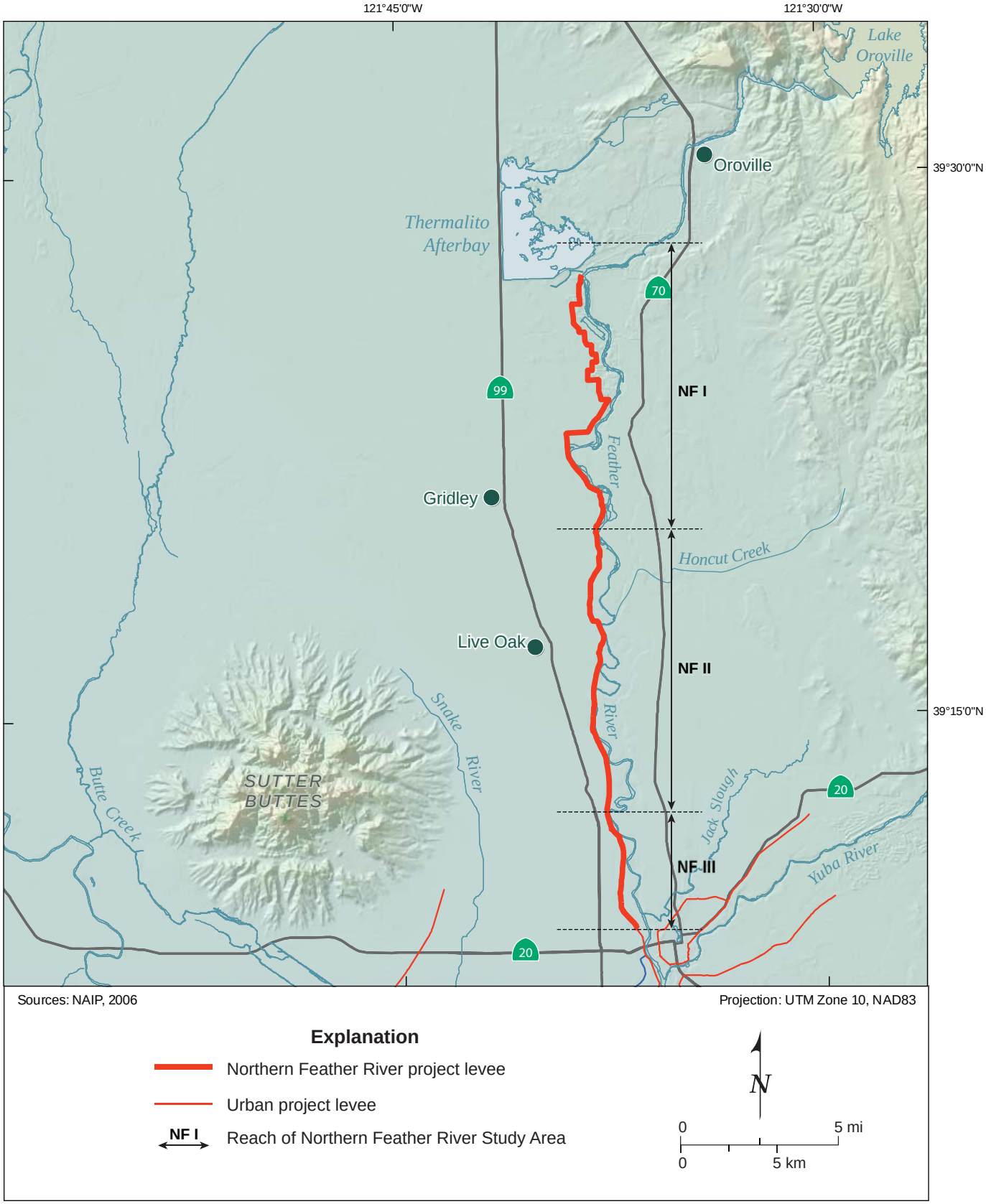
Map of Central Valley near Sutter Buttes, California

DWR URBAN LEVEE PROJECT

Figure 1

1881 North Feather River

Modified 09.03.09



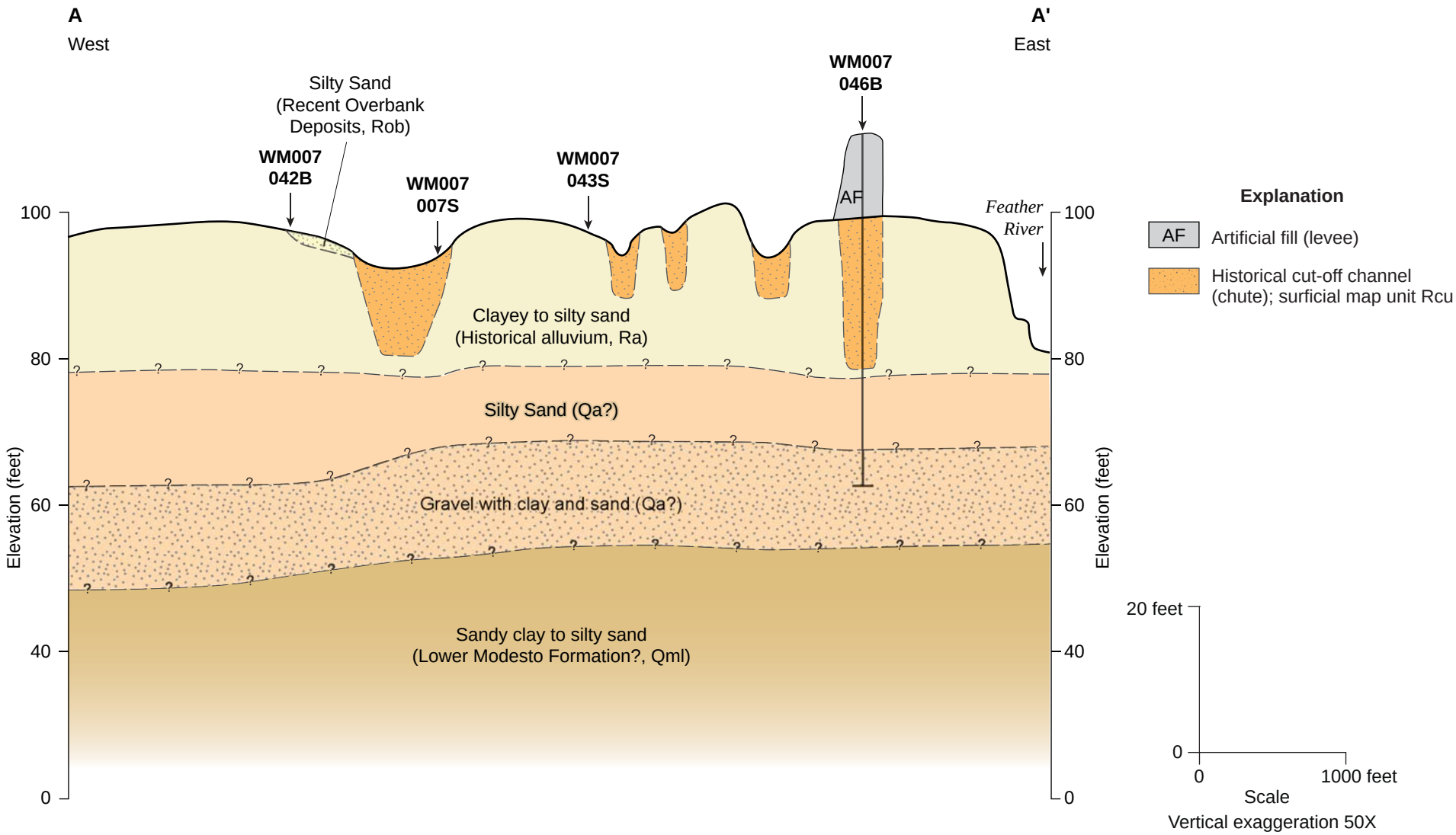
Map of the Reaches Identified along the Northern Feather River Study Area

DWR URBAN LEVEE PROJECT

Figure 2

1881 North Feather River

Modified 09.03.09



WLA

Conceptual Subsurface Diagram across the Northern Feather River, A-A'

DWR URBAN LEVEE PROJECT

Figure 3

1881 North Feather River

Modified 09.03.09

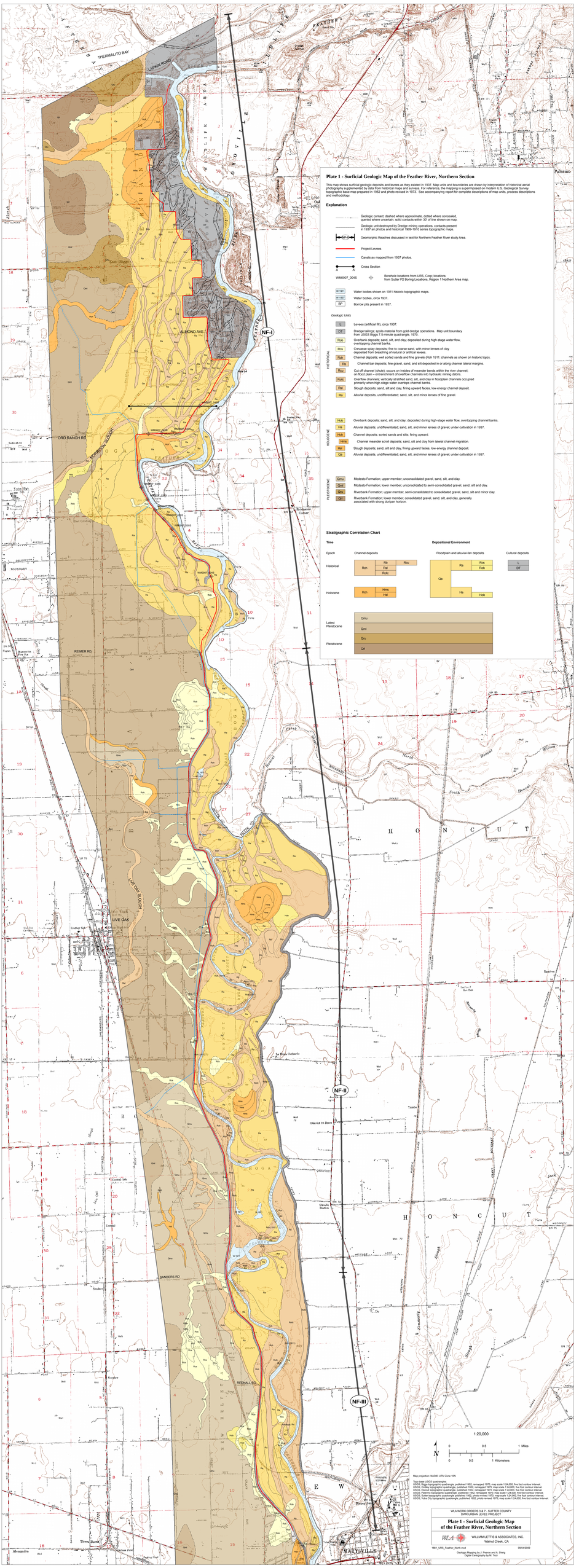


Plate 1 - Surficial Geologic Map of the Feather River, Northern Section
This map shows surficial geologic deposits and levees as they existed in 1937. Map units and boundaries are drawn by interpretation of historical aerial photography supplemented by data from historical maps and surveys. For reference, the mapping is superimposed on modern U.S. Geological Survey topographic base map prepared in 1952 and photo revised in 1973. See accompanying report for complete descriptions of map units, process descriptions and methodology.
Explanation
Geologic contact; dashed where approximate, dotted where concealed, queried where uncertain; solid contacts within 30' of line shown on map.
Geologic unit destroyed by Dredge mining operations, contacts present in 1937 air photos and historical 1909-1910 series topographic maps.
NF-I
Geomorphic Reaches discussed in text for Northern Feather River study Area.
Project Levees
Canals as mapped from 1937 photos.
A
A'
Cross Section
WM0007_004S
Borehole locations from URS, Corp; locations from Sutter PZ Boring Locations, Region 1-Northern Area map.
W 1911
Water bodies shown on 1911 historic topographic maps.
W 1937
Water bodies, circa 1937.
BP
Borrow pits present in 1937.
Geologic Units
HISTORICAL
L
Levees (artificial fill), circa 1937.
DT
Dredge tailings; spoils material from gold dredge operations. Map unit boundary from USGS Biggs 7.5-minute quadrangle, 1970.
Rob
Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks.
Rcs
Crevasse splay deposits; fine to coarse sand, with minor lenses of clay deposited from breaching of natural or artificial levees.
Rch
Channel deposits; well sorted sands and fine gravels (Rch 1911: channels as shown on historic topo).
Rb
Channel bar deposits; fine gravel, sand, and silt deposited in or along channel lateral margins.
Rcu
Cut-off channel (chute); occurs on insides of meander bends within the river channel; on flood plain — entrenchment of overflow channels into hydraulic mining debris.
Roh
Overflow channels; vertically stratified sand, silt, and clay in floodplain channels occupied primarily when high-stage water overtops channel banks.
Rsl
Slough deposits; sand, silt and clay, fining upward facies, low-energy channel deposit.
Ra
Alluvial deposits, undifferentiated; sand, silt, and minor lenses of fine gravel.
HOLOCENE
Hob
Overbank deposits; sand, silt, and clay; deposited during high-stage water flow, overtopping channel banks.
Ha
Alluvial deposits; undifferentiated; sand, silt, and minor lenses of gravel; under cultivation in 1937.
Hch
Channel deposits; sorted sands and silts; fining upward.
Hms
Channel meander scroll deposits; sand, silt and clay from lateral channel migration.
Hsl
Slough deposits; sand, silt and clay, fining upward facies, low-energy channel deposit.
Qa
Alluvial deposits, undifferentiated; sand, silt, and minor lenses of gravel; under cultivation in 1937.
PLEISTOCENE
Qmu
Modesto Formation; upper member; unconsolidated gravel, sand, silt, and clay.
Qml
Modesto Formation; lower member; unconsolidated to semi-consolidated gravel, sand, silt and clay.
Qrs
Riverbank Formation; upper member; semi-consolidated to consolidated gravel, sand, silt and minor clay.
Qrl
Riverbank Formation; lower member; consolidated gravel, sand, silt, and clay, generally associated with strong duripan horizon.
Stratigraphic Correlation Chart
Time
Depositional Environment
Epoch
Channel deposits
Floodplain and alluvial-fan deposits
Cultural deposits
Historical
Holocene
Latest Pleistocene
Pleistocene
1:20,000
0 0.5 1 Miles
0 0.5 1 Kilometers
Map projection: NAD83 UTM Zone 10N
Topo base USGS quadrangles:
USGS: Nicolaus topographic quadrangle, published 1952, remapped 1970; map scale 1:24,000; five foot contour interval.
USGS: Grafton topographic quadrangle, published 1952, remapped 1973; map scale 1:24,000; five foot contour interval.
USGS: Honcut topographic quadrangle, published 1952, remapped 1973; map scale 1:24,000; five foot contour interval.
USGS: Oroville topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000; five foot contour interval.
USGS: Sutter topographic quadrangle, published 1952, photo revised 1973; map scale 1:24,000; five foot contour interval.
USGS: Yuba City topographic quadrangle, published 1952; photo revised 1973; map scale 1:24,000; five foot contour interval.
WLA WORK ORDERS 3 & 7 - SUTTER COUNTY
DWR URBAN LEVEE PROJECT
Plate 1 - Surficial Geologic Map of the Feather River, Northern Section
WILLIAM LETTIS & ASSOCIATES, INC.
Walnut Creek, CA
1911_URS_Feather_North.mxd
09/04/2009
Geologic Mapping by J. Pierce and A. Streig
Digital Cartography by M. Tozo
NF-I
NF-II
NF-III
THERMALITO BAY
LAPHON ROAD
ALMOND AVE
ORD RANCH RD
NORTHAM SLOUGH
REIMER RD
LIVE OAK SLOUGH
LIVE OAK
SANDERS RD
REENALL RD
MARYSVILLE
H O N C U T
B O G A
E W
Alexandra
Thorn Slough

Part C.6

Feather River West Levee Project
Design Water Surface Profiles, PBI, March 2012

Design Water Surface Profiles for the Feather River West Levee Project

March 2012

Prepared for:

Sutter Butte Flood Control Agency

Prepared By:

PETERSON . BRUSTAD . INC
ENGINEERING . CONSULTING

1180 Iron Point Rd., Suite 260, Folsom, CA, 95630
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Design Water Surface Profiles for the Feather River West Levee Project

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TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 BACKGROUND 1
1.2 DATUM 4
1.3 TOPOGRAPHY 4
1.4 COMPARISON TO CVFED LIDAR 4

2 HYDROLOGY 12

3 HYDRAULICS 16

3.1 UPDATE #1 (JUNE 2011) 16
3.2 UPDATE #2 (SEPTEMBER 2011) 20
3.3 UPDATE #3 (DECEMBER 2011) 20
3.4 UPDATE #4 (MARCH 2012) 21
3.5 FINAL CALIBRATION RESULTS 21

4 FINAL DESIGN WATER SURFACE PROFILES 35

5 FREEBOARD ANALYSIS 51

6 REFERENCES 85

7 ATTACHMENTS 87

A. PBI DATUM CONVERSION FOR SELECT GAGES
B. VERTICAL DATUM CONVERSION TM
C. DWR 1957 PROFILE
D. OCTOBER 2010 WATER SURFACE PROFILES
E. JUNE 2011 WATER SURFACE PROFILES
F. SEPTEMBER 2011 WATER SURFACE PROFILES
G. DECEMBER 2011 WATER SURFACE PROFILES
H. USACE TECHNICAL REVIEW COMMENTS
I. MBK TECHNICAL REVIEW COMMENTS

LIST OF FIGURES

FIGURE 1-1. SBFCA FEATHER RIVER WEST LEVEE PROJECT 2
FIGURE 1-2. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 57.7 5
FIGURE 1-3. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 49.58 5
FIGURE 1-4. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 47.55 6
FIGURE 1-5. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 45.26 6
FIGURE 1-6. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 43.28 7
FIGURE 1-7. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 37.29 7
FIGURE 1-8. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 33.0 8
FIGURE 1-9. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 31.25 8
FIGURE 1-10. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 29.75 9
FIGURE 1-11. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 25.25 9
FIGURE 1-12. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 20.5 10
FIGURE 1-13. CROSS SECTION TOPOGRAPHY COMPARISON AT HEC-RAS RIVER STA 14.25 10
FIGURE 1-14. TOP OF LEVEE TOPOGRAPHY COMPARISON 11
FIGURE 2-1. PBI SUTTER BASIN HEC-RAS MODEL 13
FIGURE 3-1. UPDATED RATING CURVE FOR SACRAMENTO RIVER AT VERONA GAGE 17
FIGURE 3-2. REVISED RATING CURVE FOR YOLO BYPASS AT WOODLAND GAGE 17
FIGURE 3-3. 1997 CALIBRATION WATER SURFACE PROFILE FOR UPPER REACH OF FEATHER RIVER 22
FIGURE 3-4. 1997 CALIBRATION WATER SURFACE PROFILE FOR HONCUT-JACK REACH OF FEATHER RIVER 22
FIGURE 3-5. 1997 CALIBRATION WATER SURFACE PROFILE FOR JACK-BEAR REACH OF FEATHER RIVER 23
FIGURE 3-6. 1997 CALIBRATION WATER SURFACE PROFILE FOR BEAR-SAC REACH OF FEATHER RIVER 23
FIGURE 3-7. 1997 CALIBRATION WATER SURFACE PROFILE FOR BUTTE-TISDALE REACH OF SUTTER BYPASS 24
FIGURE 3-8. 1997 CALIBRATION WATER SURFACE PROFILE FOR TISDALE-YOLO REACH OF SUTTER BYPASS 24
FIGURE 3-9. 2006 CALIBRATION WATER SURFACE PROFILE FOR BUTTE-TISDALE REACH OF SUTTER BYPASS 25
FIGURE 3-10. 2006 CALIBRATION WATER SURFACE PROFILE FOR TISDALE-YOLO REACH OF SUTTER BYPASS 25
FIGURE 4-1. FRWL DESIGN WATER SURFACE PROFILES 43
FIGURE 4-2. COMPARISON OF JUNE 2011 VS. MARCH 2012 DESIGN WATER SURFACE PROFILES 44
FIGURE 5-1. FEATHER RIVER WEST LEVEE PROJECT FREEBOARD ANALYSIS 84

LIST OF TABLES

TABLE 2-1. SHANGHAI STORM CENTERING PEAK INFLOW VALUES PRIOR TO MARCH 2012 14
TABLE 2-2. FINAL SHANGHAI STORM CENTERING PEAK INFLOW VALUES 14
TABLE 2-3. SOURCES OF SHANGHAI STORM CENTERING HYDROLOGY FOR THE FRWLP HEC-RAS MODEL 14
TABLE 2-4. SACRAMENTO STORM CENTERING PEAK INFLOW VALUES PRIOR TO MARCH 2012 15
TABLE 2-5. FINAL SACRAMENTO STORM CENTERING PEAK INFLOW VALUES 15
TABLE 2-6. SOURCES OF SACRAMENTO STORM CENTERING HYDROLOGY FOR THE FRWLP HEC-RAS MODEL 15
TABLE 3-1. LATERAL DIVERSION RATING CURVE FOR TISDALE WEIR 18
TABLE 3-2. SUMMARY OF THE JUNE 2011 RE-CALIBRATION RESULTS; COMPARISON OF PEAK STAGES AT GAGES 19
TABLE 3-3. SUMMARY OF THE FINAL RE-CALIBRATION RESULTS; COMPARISON OF PEAK STAGES AT GAGES 21
TABLE 3-4. FEATHER RIVER MANNING'S N-VALUES UTILIZED FOR THE PBI SUTTER BASIN MODEL 26
TABLE 4-1. FRWLP MAXIMUM WATER SURFACE PROFILES 35
TABLE 4-2. COMPARISON OF JUNE 2011 VS. MARCH 2012 DESIGN WATER SURFACE PROFILES (NAVD88-FT) 40
TABLE 4-3. FEATHER RIVER AVERAGE VELOCITY INFORMATION 45
TABLE 4-4. FEATHER RIVER SHEAR STRESS INFORMATION 48
TABLE 5-1. FEATHER RIVER WEST LEVEE PROJECT FREEBOARD ANALYSIS 51

1 INTRODUCTION

This report documents the development of the design water surface profiles for the Sutter-Butte Flood Control Agency's (SBFCA) Feather River West Levee Project (FRWLP). The goal of the FRWLP is to provide 200-year flood protection for the urban and urbanizing northern portion of the Sutter-Yuba City Basin, and 100-year protection south of Yuba City. The FRWLP includes rehabilitation of the entire 44-mile west Feather River levee from the Thermalito Afterbay downstream to the Sutter Bypass (see Figure 1-1).

The original design water surface profiles for the FRWLP were developed in October, 2010. Following the original October profiles, there were three additional updates in order to improve the HEC-RAS model and to address independent technical review comments. Four Technical Memorandums (TM) were developed at each different stage to document the specific updates incorporated into the design profiles:

1. October 2010 TM – Original Design Water Surface Profiles
2. June 2011 TM – Update #1
3. September 2011 – Update #2
4. December 2011 – Update #3

In addition to the four TM's listed above, the United States Army Corps of Engineers (USACE) recently provided updates to the inflow hydrology for the n-year storm events. This report documents the recent improvements to the inflow hydrology and compiles all four of the above model development TM's into a single comprehensive document.

1.1 BACKGROUND

For the FRWLP, Peterson Brustad Inc. (PBI) utilized the HEC-RAS model that is currently being prepared for the USACE as part of the Sutter Basin Feasibility Study (SBFS). The USACE, in conjunction with SBFCA and California Department of Water Resources (DWR), is currently preparing the SBFS in order to evaluate flood damage reduction, ecosystem restoration, and recreation projects within the Sutter-Yuba City basin. To aid in this evaluation, extensive hydraulic modeling and floodplain mapping is being conducted in order to evaluate and determine the extent of flood inundation damages that would occur within the basin in the event of levee overtopping and/or levee failure. PBI has been assisting the USACE with the SBFS since 2009.

The Feather 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*[12] and versions of this model have since been updated independently by both the USACE and MBK Engineers (MBK). The USACE model was updated to support the *American River Watershed Common Features General Reevaluation Report*[11] and the MBK model was updated to support the levee improvement projects that were constructed by the *Three Rivers Levee Improvement Authority* (TRLIA)[4].

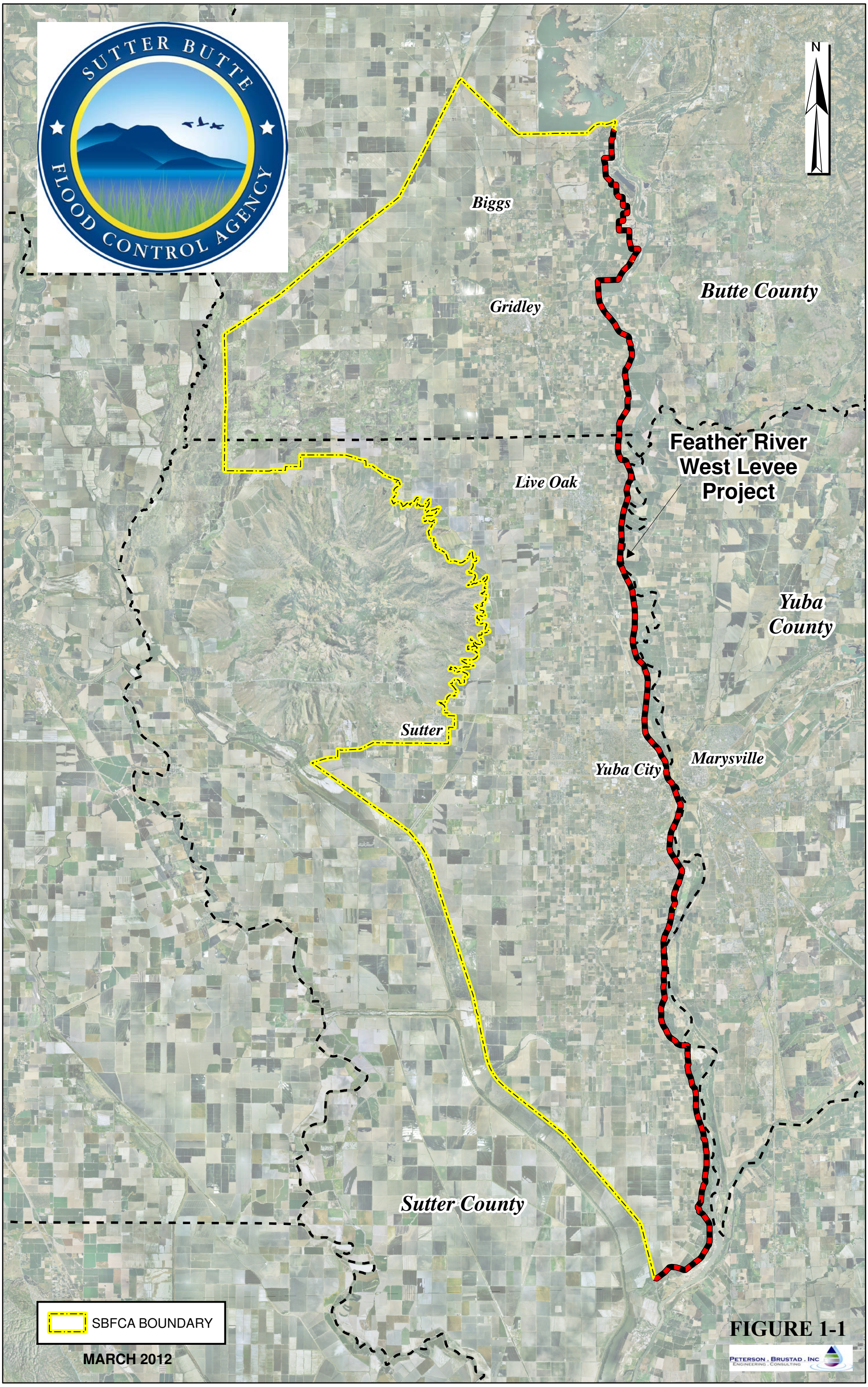

SUTTER BUTTE FLOOD CONTROL AGENCY
N
Biggs
Gridley
Butte County
Feather River
West Levee
Project
Live Oak
Yuba
County
Sutter
Yuba City
Marysville
Sutter County
SBFCA BOUNDARY
MARCH 2012
PETERSON . BRUSTAD . INC
ENGINEERING . CONSULTING

FIGURE 1-1

A summary timeline of events regarding the development of the FRWLP HEC-RAS model is as follows:

OCTOBER 2010: PBI published the original design water surface profiles based upon an interim version of the SBFS HEC-RAS model. For the SBFS, PBI obtained the USACE Common Features model[13] 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 FRWLP analysis, the model's vertical datum was updated from the National Geodetic Vertical Datum of 1929 (NGVD29) to the North American Vertical Datum of 1988 (NAVD88).

APRIL 2011: The USACE released an updated version of the SBFS model (Release 3)[14].

MAY 2011: PBI updated the FRWLP design water surface profiles (Update #1) using an improved version of the USACE Release 3 model.

JUNE 2011: PBI sent the FRWLP model to the USACE for technical review.

SEPTEMBER 2011: PBI updated the FRWLP design water surface profiles (Update #2) to incorporate the technical review comments provided by USACE.

OCTOBER 2011: PBI sent the FRWLP model to MBK for independent technical review.

DECEMBER 2011: PBI updated the FRWLP design water surface profiles (Update #3) to incorporate the technical review comments provided by MBK.

MARCH 2012: USACE released improvements to the inflow hydrology for the n-year storm events.

MARCH 2012: PBI updated the FRWLP design water surface profiles to incorporate the recent inflow hydrology updates provided by the USACE.

Details regarding the specific improvements that were incorporated into the HEC-RAS model at each update can be found in Section 3. The final water surface profiles are shown in Section 4.

1.2 DATUM

The FRWLP HEC-RAS model and all results and calculations presented in this report reference the California State Plane Coordinate System (CCS), Zone 2 – NAD83 horizontal datum and the North American Vertical Datum of 1988 (NAVD88). All units are in U.S. Survey feet.

1.3 TOPOGRAPHY

The ground surface topography included with the base USACE Release 3 model is based upon USACE Sacramento and San Joaquin River Basins Comprehensive Study mapping[(1)(10)], which was provided by the USACE at a contour interval of 2 feet. No new topography was obtained for the development of the FRWLP model. In early 2010, the base USACE model was converted from the National Geodetic Vertical Datum of 1929 (NGVD 29) to the North American Vertical Datum of 1988 (NAVD 88). The conversion was completed by PBI for the USACE as part of the SBFS. PBI converted the HEC-RAS geometry to NAVD88 based upon a conversion surface provided by the USACE. Levee crowns, weirs and stream gages were input directly from NAVD88 surveys. Details regarding PBI's role in the vertical datum conversion are included in the *Vertical Datum Conversion TM* (see Attachment A).

Levee elevations within the FRWLP HEC-RAS model are based upon top of levee (TOL) data from the USACE National Levee Database (NLDB)[(9)]. The NLDB contains an elevation every 100-ft for the top of levee. The elevations for the NLDB were obtained via ground surveys based in NAVD 88.

1.4 COMPARISON TO CVFED LIDAR

PBI compared the converted HEC-RAS model components to CVFED LiDAR[(2)] data in order to verify that the HEC-RAS model datum conversion matches the recent NAVD88 LiDAR surveys which are being used for the design of the FRWLP. PBI compared both cross section data (converted Comprehensive Study Topography) and Top of Levee data (NLDB) to the LiDAR. The results show that the while the cross sections are not exact overlays, the datum adjustment used to convert the Release 3 HEC-RAS model from NGVD29 to NAVD88 was within the precision of the modeling effort. It is important to note that the LiDAR data does not include bathymetric data for the river channel or any overbank areas containing water.

The 12 cross section comparisons are shown in Figure 1-2 thru Figure 1-13. The TOL comparison profile is shown in Figure 1-14.

Figure 1-2. Cross Section Topography Comparison at HEC-RAS River STA 57.7

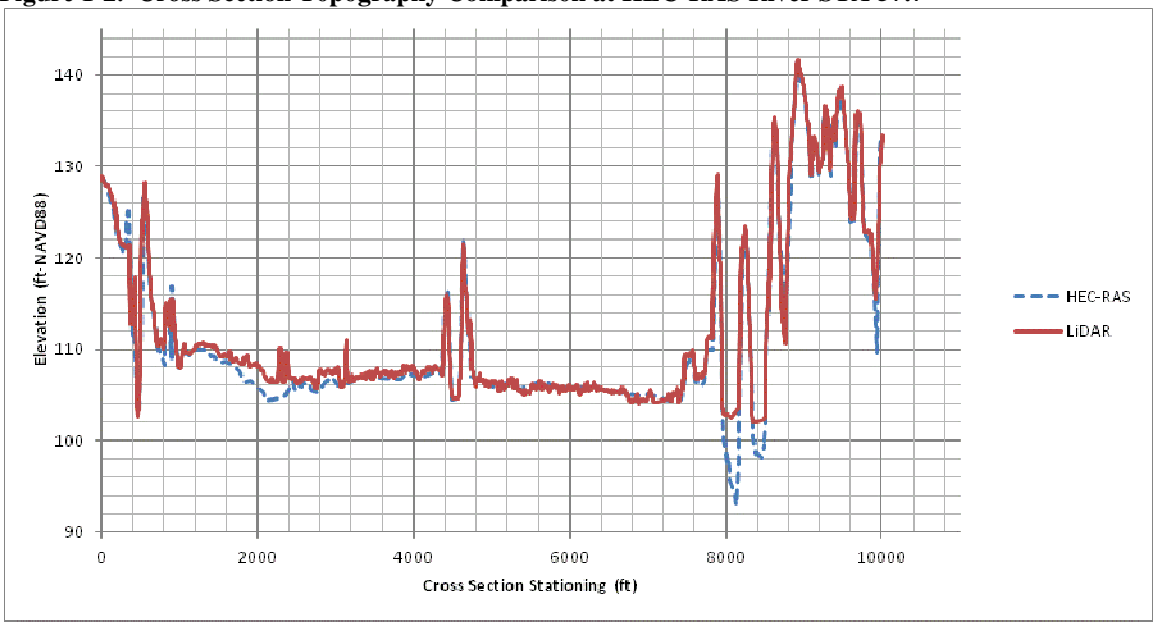


Figure 1-3. Cross Section Topography Comparison at HEC-RAS River STA 49.58

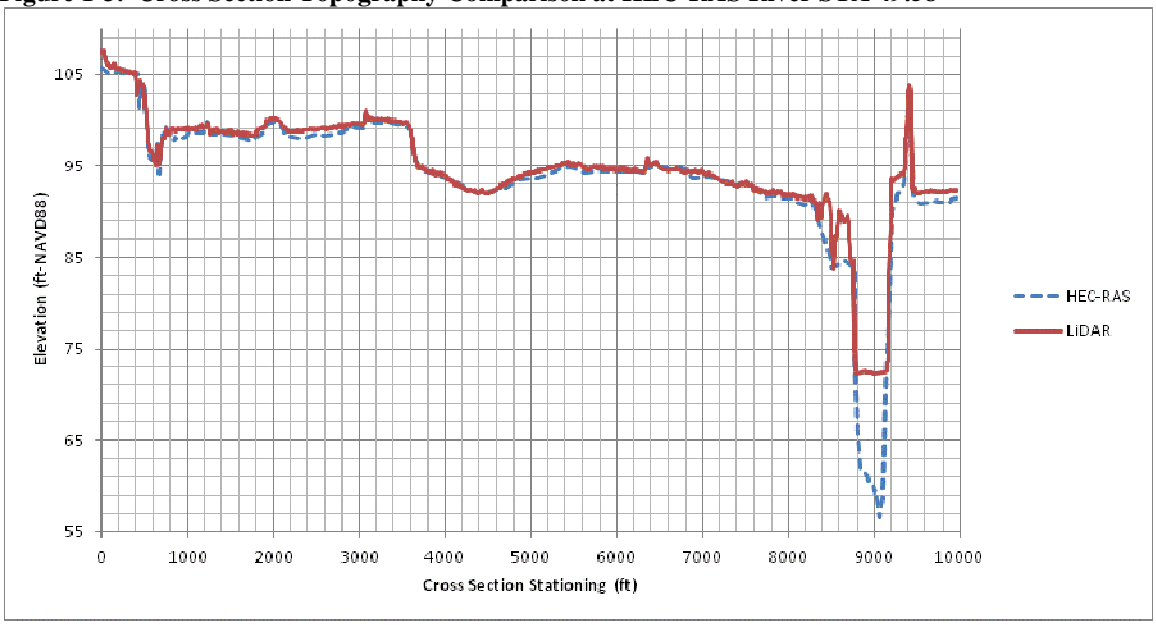


Figure 1-4. Cross Section Topography Comparison at HEC-RAS River STA 47.55

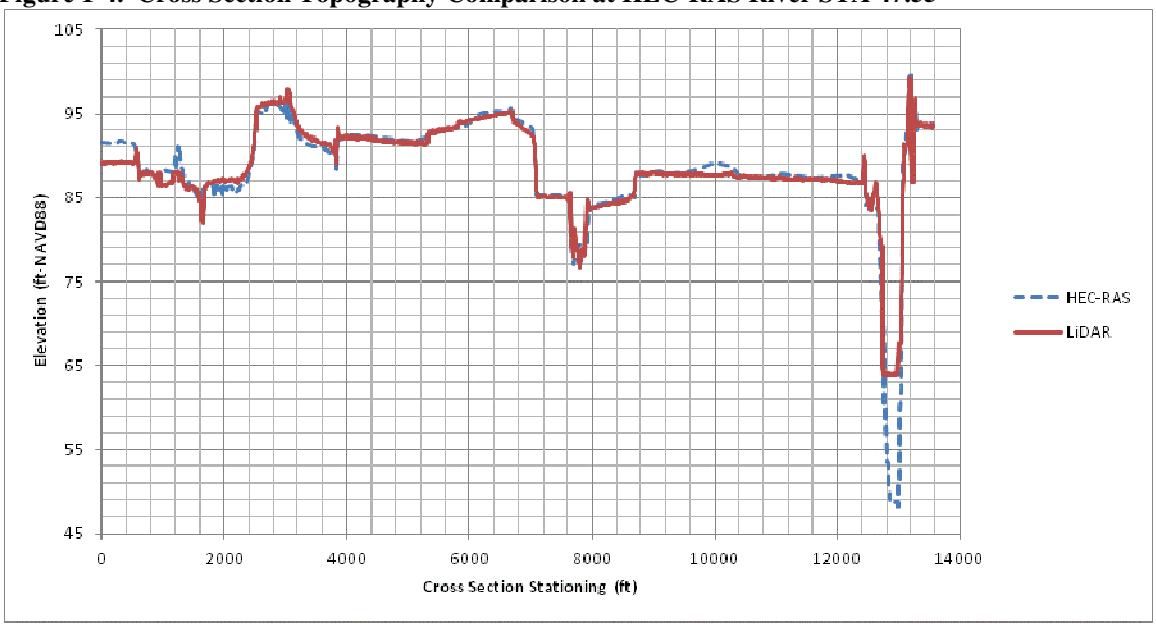


Figure 1-5. Cross Section Topography Comparison at HEC-RAS River STA 45.26

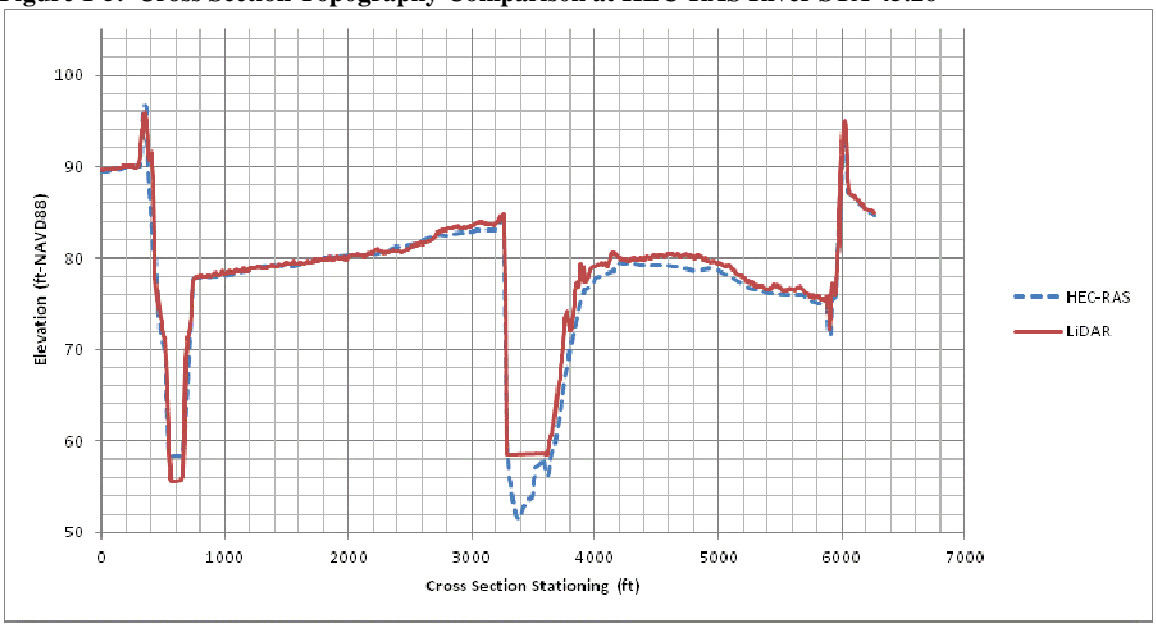


Figure 1-6. Cross Section Topography Comparison at HEC-RAS River STA 43.28

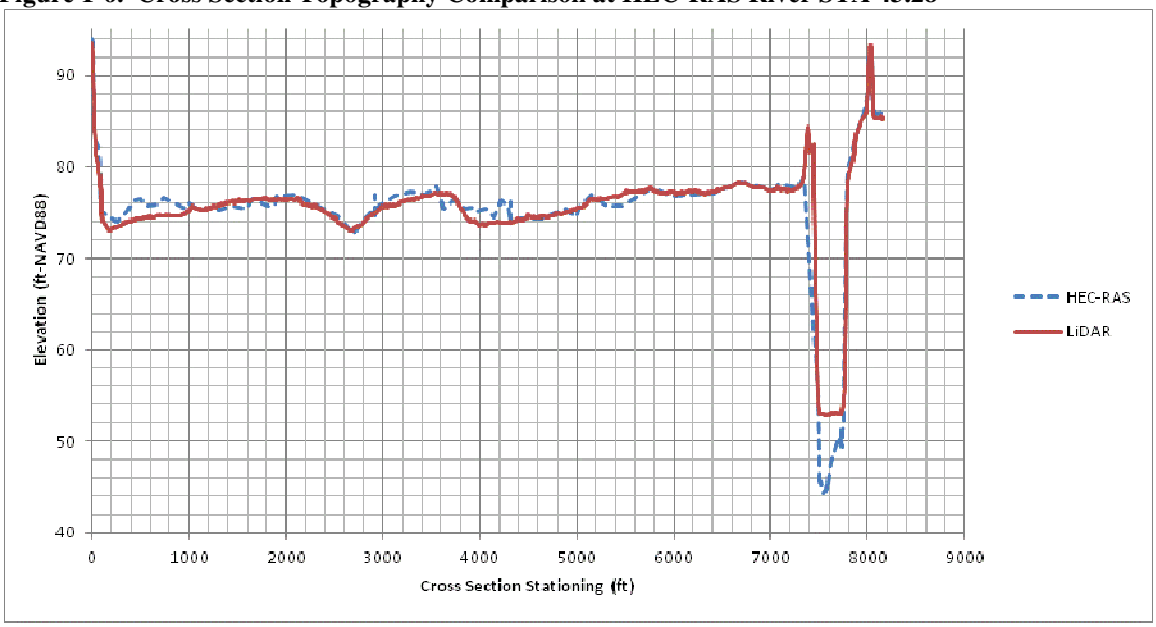


Figure 1-7. Cross Section Topography Comparison at HEC-RAS River STA 37.29

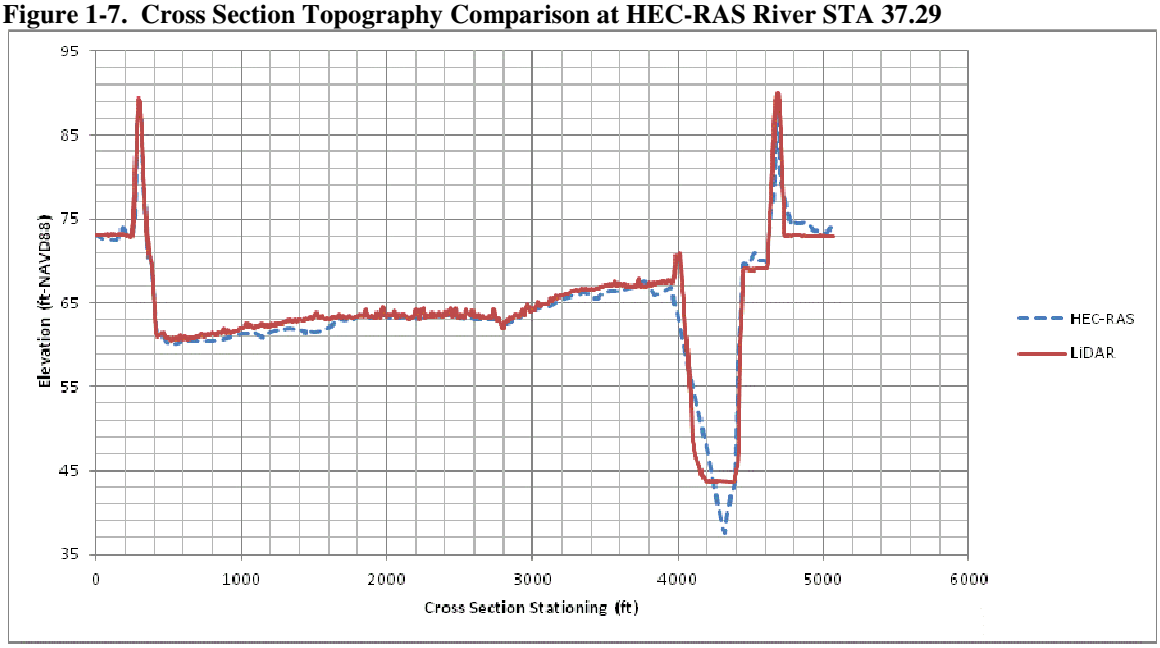


Figure 1-8. Cross Section Topography Comparison at HEC-RAS River STA 33.0

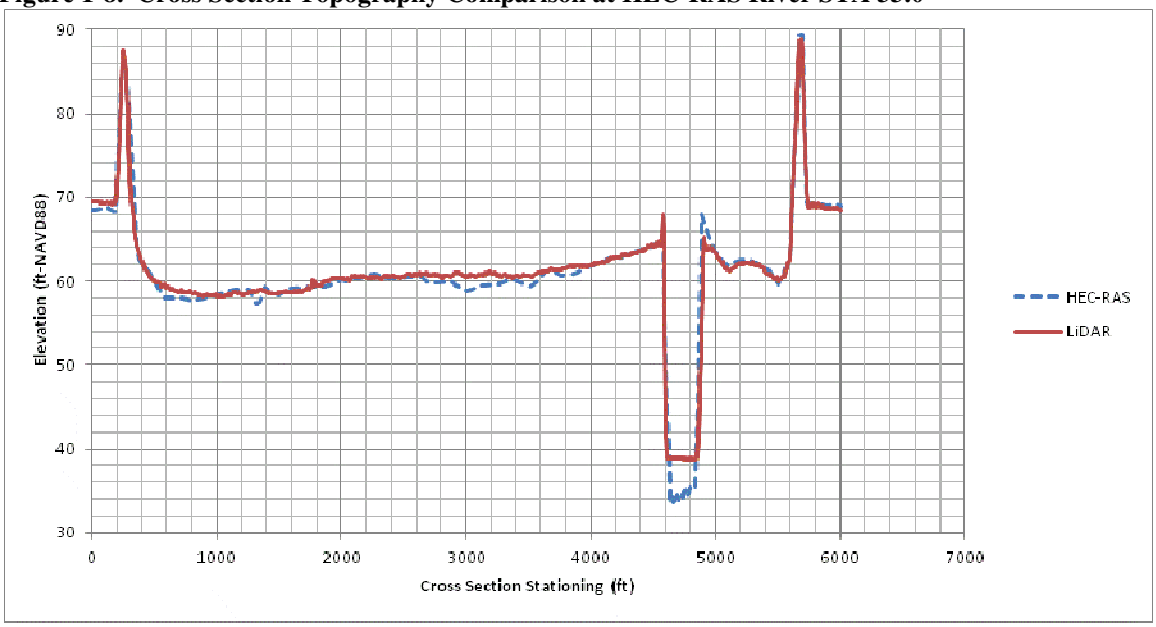


Figure 1-9. Cross Section Topography Comparison at HEC-RAS River STA 31.25

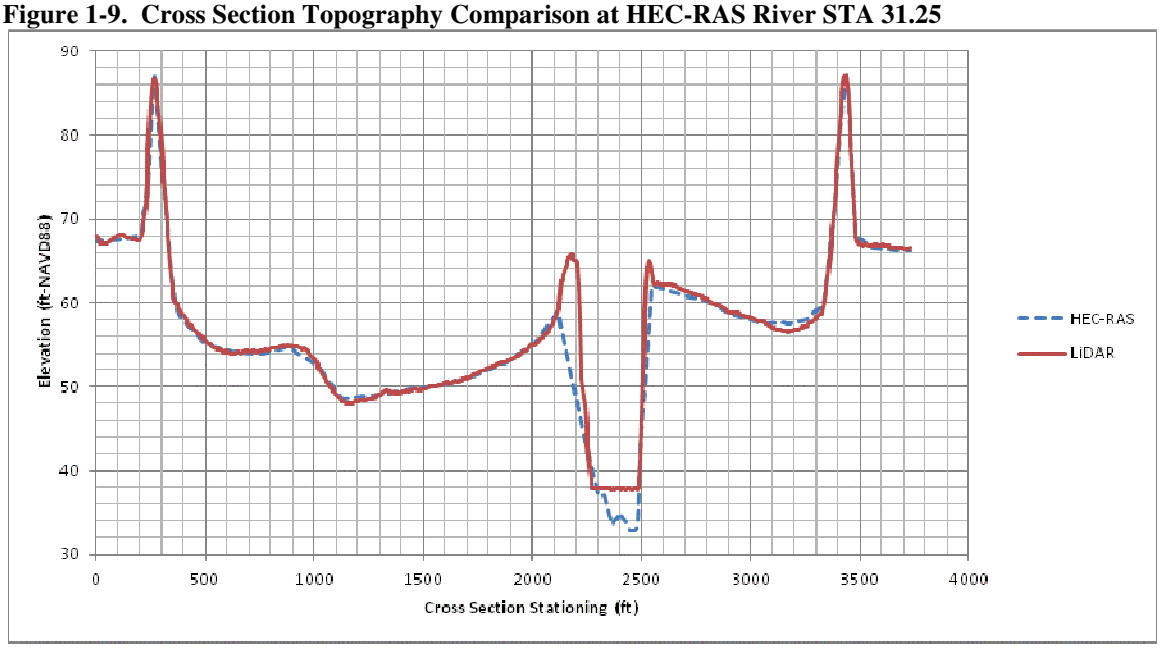


Figure 1-10. Cross Section Topography Comparison at HEC-RAS River STA 29.75

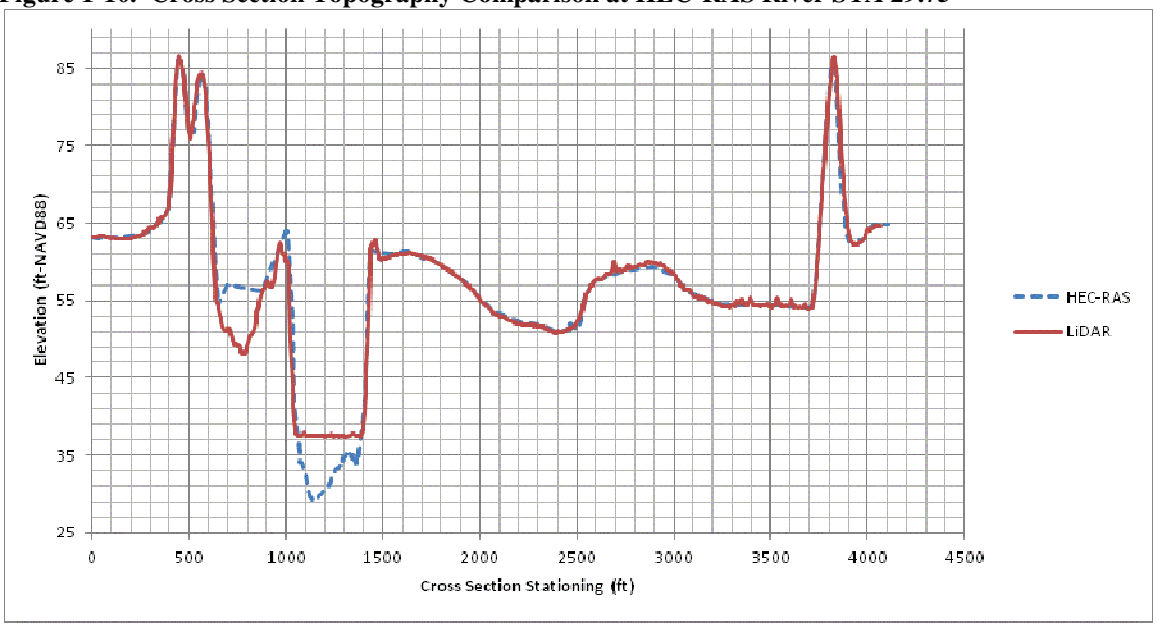


Figure 1-11. Cross Section Topography Comparison at HEC-RAS River STA 25.25

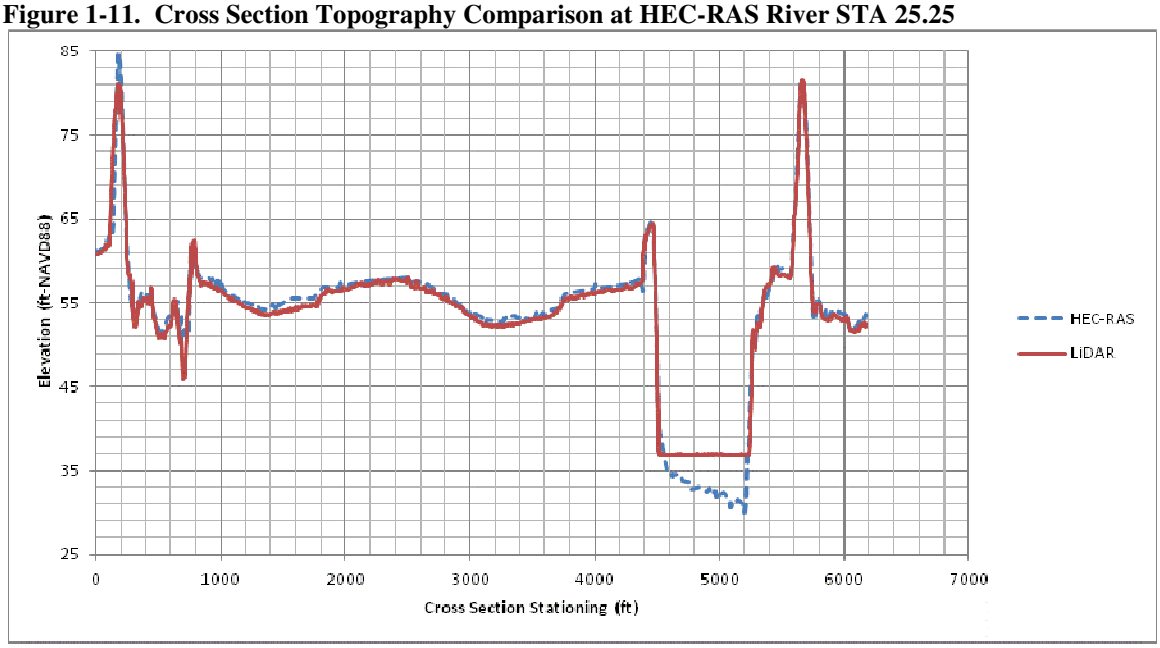


Figure 1-12. Cross Section Topography Comparison at HEC-RAS River STA 20.5

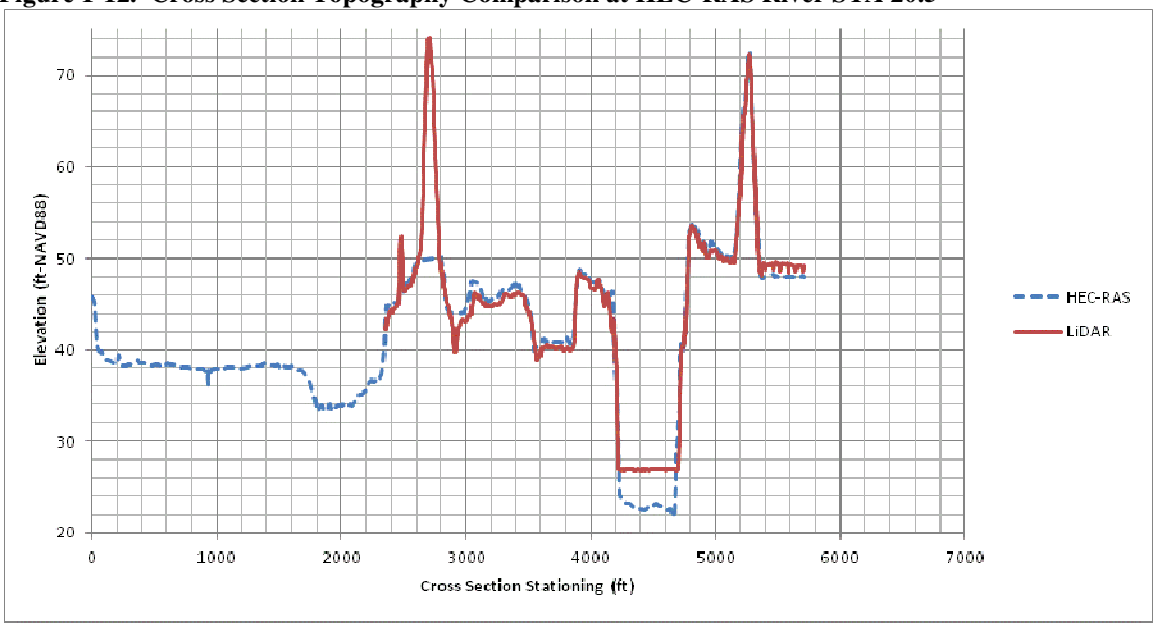
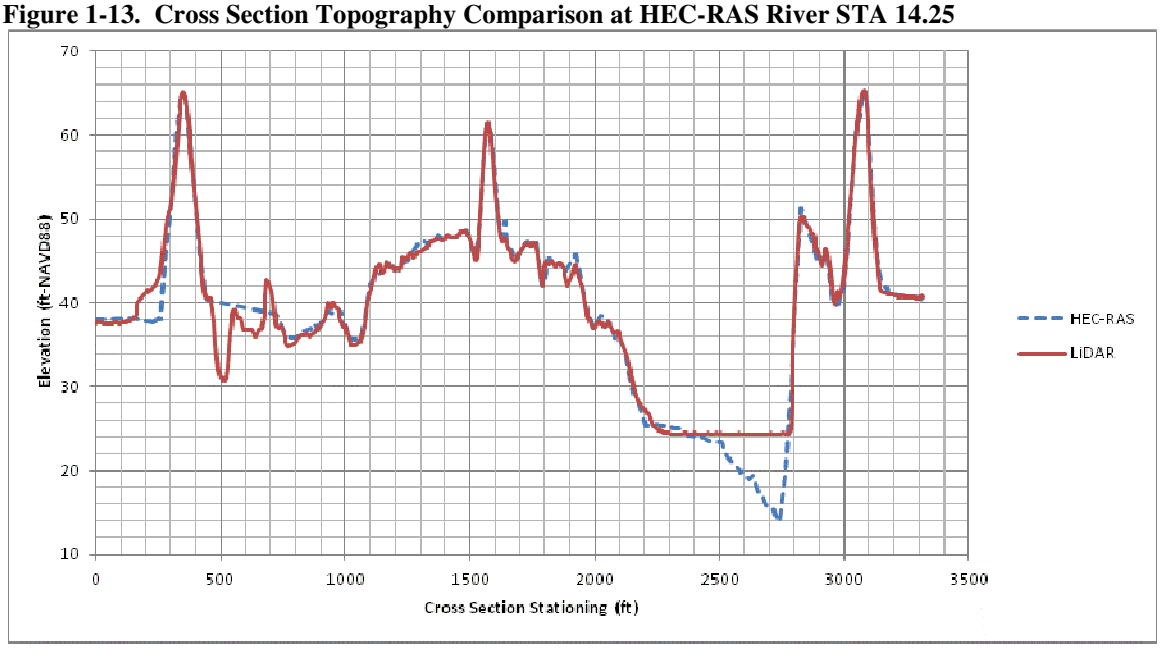


Figure 1-13. Cross Section Topography Comparison at HEC-RAS River STA 14.25



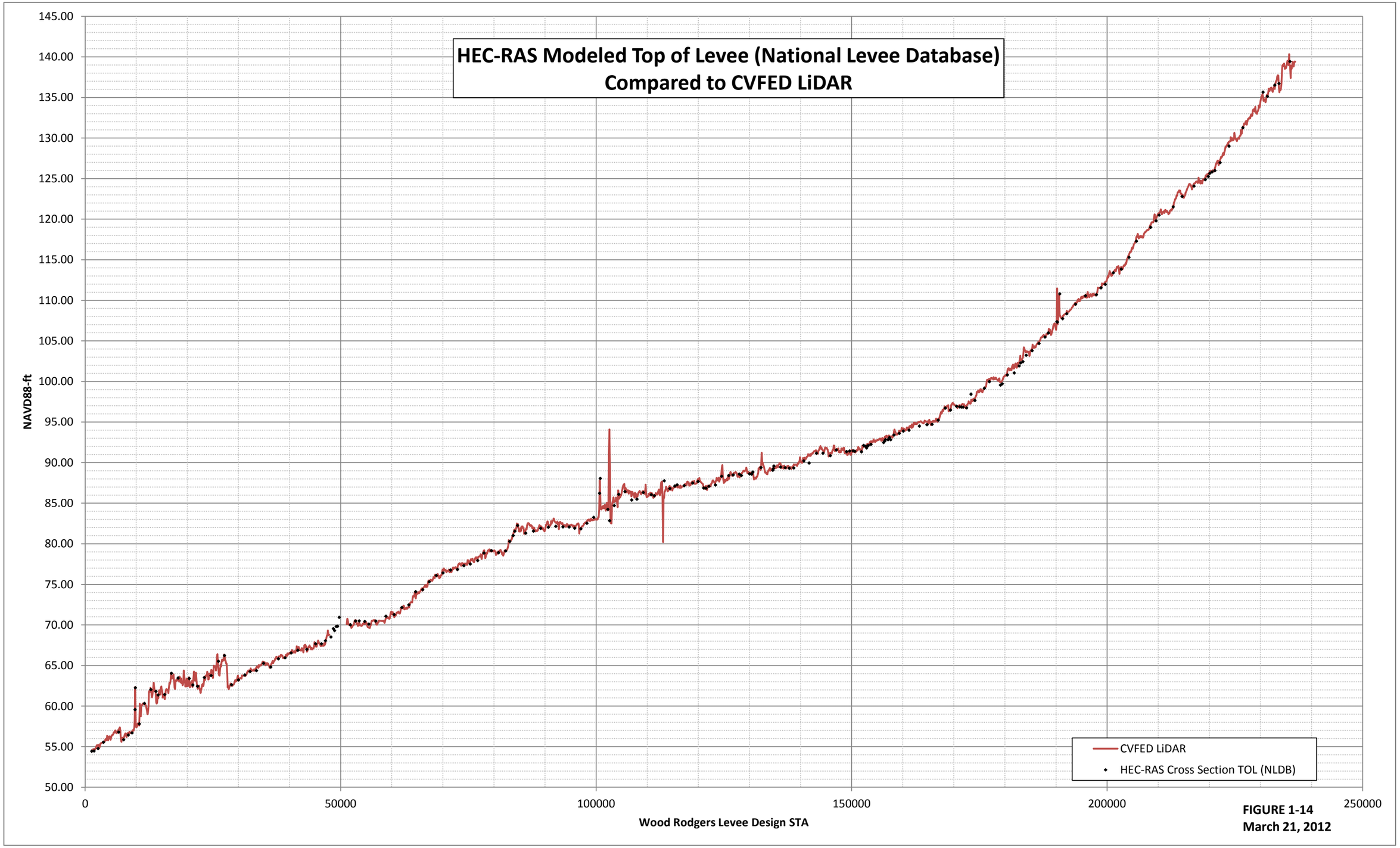


FIGURE 1-14
March 21, 2012

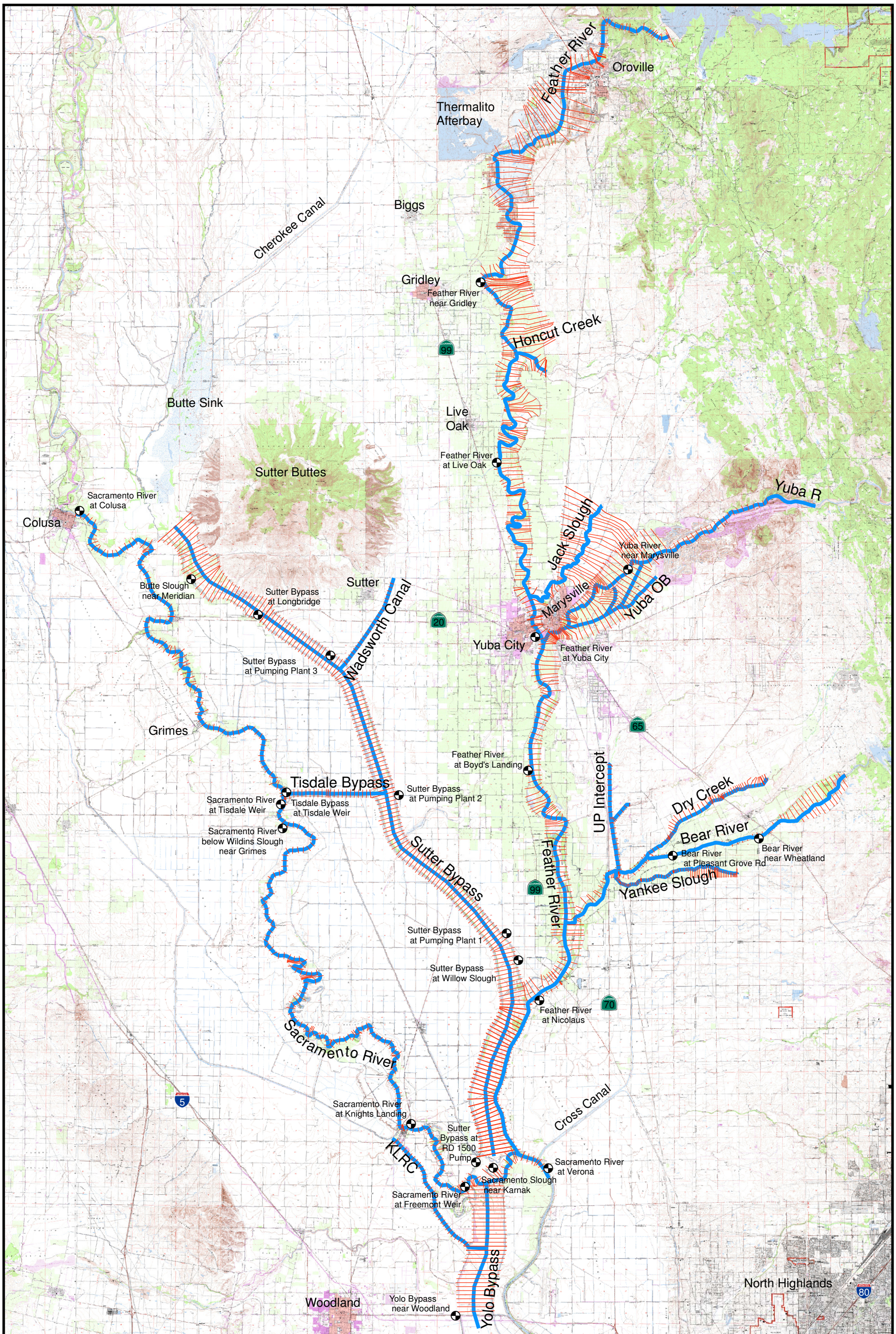
2 HYDROLOGY

For the HEC-RAS model inflow parameters, PBI utilized 1/100, 1/200 and 1/500 annual exceedance probability (AEP) 30-day storm event hydrographs provided by the USACE. The inflows were applied to the most upstream cross sections of the HEC-RAS model, which is shown in Figure 2-1. In developing the n-year hydrographs the USACE used two different storm centerings: 1) the Sacramento River storm centering and 2) the Shanghai Bend storm centering. The Shanghai Bend storm centering produces higher stages in the Feather River for the 200-year event. For the 100-year event, the Sacramento storm centering produces higher stages in the Feather River downstream of HEC-RAS River Station (RS) 47.04 and the Shanghai storm centering produces higher stages in the Feather River upstream of RS 47.04. For the 500-year storm event, the Sacramento storm centering produces higher stages for the lower Feather River (downstream of RS 15.25) and the Shanghai storm centering produces higher stages for the Feather River at and above RS 15.25.

In March 2012, the USACE made several improvements to the inflow hydrology for the n-year events. As part of the improvements, the USACE refined the inflows for the minor tributaries and verified that the inflow hydrographs input into the HEC-RAS model match their referenced study source. The March improvements included:

- Wadsworth Canal: Replaced the constant inflow of 1,500 cubic feet per second (cfs) with n-year hydrographs
- Best Slough: Updated the n-year hydrographs to include all of the AEP events
- UP Interceptor Canal: Updated the n-year hydrographs to include all of the AEP events
- Yankee Slough: Updated the n-year hydrographs to include all of the AEP events
- Honcut Creek: Revised the inflow hydrographs to account for flows that should be routed to Jack Slough
- Jack Slough: Updated the n-year hydrographs to include all of the AEP events
- Feather River: Revised the n-year hydrographs for the Shanghai storm centering to match the *Lower Feather River Floodplain Mapping Study*
- Bear River: Revised the n-year hydrographs to match the *Sacramento and San Joaquin Basins Comprehensive Study*
- Yuba River: Revised the n-year hydrographs for the Shanghai storm centering to match the *Lower Feather River Floodplain Mapping Study* and combined the n-year hydrographs from Englebright and Deer Creek at HEC-RAS River STA 13.84

Table 2-1 and Table 2-4 summarize the peak inflow values that were used for the FRWLP prior to March 2012. Table and Table 2-5 summarize the final peak inflow values after the March USACE improvements. All inflow hydrographs were provided by the USACE in HEC-DSS format. The sources of the inflow hydrographs are summarized in Table 2-3 and Table 2-6. The hydrology sources were provided by the USACE as part of the March update.



N

0 1.25 2.5 5 Miles

MARCH 2012

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SUTTER BUTTE FLOOD CONTROL AGENCY

PBI SUTTER BASIN HEC-RAS MODEL

FIGURE

2-1

Table 2-1. Shanghai Storm Centering Peak Inflow Values Prior to March 2012

Description	1/100 AEP Storm Event (cfs)	1/200 AEP Storm Event (cfs)	1/500 AEP Storm Event (cfs)
Bear River	41,500	47,700	55,300
Best Slough	820	820	820
Dry Creek	7,000	8,100	9,400
Feather River	150,000	174,000	327,000
Jack Slough	6,800	6,800	6,800
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
Wadsworth Canal	1,500	1,500	1,500
UP Interceptor Canal	7,300	7,300	7,300
Yankee Slough	2,800	2,800	2,800

Table 2-2. Final Shanghai Storm Centering Peak Inflow Values

Description	1/100 AEP Storm Event (cfs)	1/200 AEP Storm Event (cfs)	1/500 AEP Storm Event (cfs)
Bear River	40,600	46,800	54,200
Best Slough	3,900	4,600	5,500
Dry Creek	7,000	8,100	9,400
Feather River	150,000	174,000	320,000
Jack Slough	4,500	5,400	6,600
Sacramento River	52,900	58,200	62,600
Sutter Bypass	156,000	218,000	273,000
Yuba (Englebright)	141,000	208,000	294,000
Yuba (Deer Creek)	9,500	10,700	12,400
Yuba (Dry Creek)	8,900	10,100	11,600
Honcut Creek	27,900	33,400	41,500
Wadsworth Canal	1,500	1,550	1,600
UP Interceptor Canal	5,700	7,300	9,500
Yankee Slough	2,100	2,800	3,800

Table 2-3. Sources of Shanghai Storm Centering Hydrology for the FRWLP HEC-RAS Model

Inflow Hydrograph	Source of Data
Bear River - Dry Creek at Jasper Lane	Lower Feather River Floodplain Mapping Study
Bear River below Camp Far West	Sacramento and San Joaquin Basins Comprehensive Study
Best Slough at Forty Mile Road	Lower Feather River Floodplain Mapping Study
Sutter Bypass at West Butte Road	Sacramento and San Joaquin Basins Comprehensive Study
Feather River at Oroville	Lower Feather River Floodplain Mapping Study
Honcut Creek at Hwy 70	Lower Feather River Floodplain Mapping Study
Sacramento River at Colusa Bridge	Sacramento and San Joaquin Basins Comprehensive Study
UP Interceptor Canal	Lower Feather River Floodplain Mapping Study
Wadsworth Canal at Hwy 20	Sutter County 2004 Feasibility Study
Yankee Slough at Swetzer Road	Lower Feather River Floodplain Mapping Study
Yuba River - Dry Creek at Hwy 20	Lower Feather River Floodplain Mapping Study
Yuba River below Englebright Dam	Lower Feather River Floodplain Mapping Study
Yuba River - Deer Creek	Lower Feather River Floodplain Mapping Study

Table 2-4. Sacramento Storm Centering Peak Inflow Values Prior to March 2012

Description	1/100 AEP Storm Event (cfs)	1/200 AEP Storm Event (cfs)	1/500 AEP Storm Event (cfs)
Bear River	49,200	54,700	62,000
Best Slough	820	820	820
Dry Creek	8,300	9,300	10,500
Feather River	150,000	150,000	292,000
Jack Slough	6,800	6,800	6,800
Sacramento River	55,500	59,300	67,900
Sutter Bypass	184,000	229,000	327,000
Yuba (Englebright)	124,000	170,000	244,000
Yuba (Deer Creek)	11,100	12,200	13,700
Yuba (Dry Creek)	10,400	11,400	12,900
Honcut Creek	31,200	37,300	46,500
Wadsworth Canal	1,500	1,500	1,500
UP Interceptor Canal	7,300	7,300	7,300
Yankee Slough	2,800	2,800	2,800

Table 2-5. Final Sacramento Storm Centering Peak Inflow Values

Description	1/100 AEP Storm Event (cfs)	1/200 AEP Storm Event (cfs)	1/500 AEP Storm Event (cfs)
Bear River	48,200	53,600	60,700
Best Slough	4,700	5,300	6,200
Dry Creek	8,300	9,300	10,500
Feather River	150,000	150,000	292,000
Jack Slough	4,300	5,100	6,400
Sacramento River	55,500	59,300	67,900
Sutter Bypass	184,000	229,000	327,000
Yuba (Englebright)	124,000	170,000	244,000
Yuba (Deer Creek)	11,100	12,200	13,700
Yuba (Dry Creek)	10,400	11,400	12,900
Honcut Creek	26,900	32,100	40,100
Wadsworth Canal	1,500	1,550	1,600
UP Interceptor Canal	6,800	8,400	10,600
Yankee Slough	2,500	3,200	4,300

Table 2-6. Sources of Sacramento Storm Centering Hydrology for the FRWLP HEC-RAS Model

Inflow Hydrograph	Source of Data
Bear River - Dry Creek at Jasper Lane	Sacramento and San Joaquin Basins Comprehensive Study
Bear River below Camp Far West	Sacramento and San Joaquin Basins Comprehensive Study
Best Slough at Forty Mile Road	Lower Feather River Floodplain Mapping Study
Sutter Bypass at West Butte Road	Sacramento and San Joaquin Basins Comprehensive Study
Feather River at Oroville	Sacramento and San Joaquin Basins Comprehensive Study
Honcut Creek at Hwy 70	Sacramento and San Joaquin Basins Comprehensive Study
Sacramento River at Colusa Bridge	Sacramento and San Joaquin Basins Comprehensive Study
UP Interceptor Canal	Lower Feather River Floodplain Mapping Study
Wadsworth Canal at Hwy 20	Sutter County 2004 Feasibility Study
Yankee Slough at Swetzer Road	Lower Feather River Floodplain Mapping Study
Yuba River - Dry Creek at Hwy 20	Sacramento and San Joaquin Basins Comprehensive Study
Yuba River below Englebright Dam	Sacramento and San Joaquin Basins Comprehensive Study
Yuba River - Deer Creek	Sacramento and San Joaquin Basins Comprehensive Study

3 HYDRAULICS

The final FRWLP HEC-RAS model was developed from Release 3 of the USACE Sacramento River Basin HEC-RAS Model (NAVD88 version), which was released by the USACE in February 2011. As part of Release 3, the USACE made several improvements to the input hydrology for both the 1997 and 2006 storm events. The USACE also made significant updates to the stream gage data based upon additional research and new field surveys. The following sections summarize the additional updates that were incorporated into the USACE Release 3 HEC-RAS model and provide the final calibration results for the FRWLP.

3.1 UPDATE #1 (JUNE 2011)

Subsequent to development of the preliminary design water surface profiles in PBI's October 2010 TM, both PBI and the USACE made significant improvements to the HEC-RAS hydraulic model. The major improvements included:

- Modifications to the hydrologic input used for the calibration storm events
- Updated stream gage data and stream gage rating curves
- Updates to the Tisdale Weir flow split
- Updates to the Fremont Weir coding
- Modifications to the coding of the Sutter Bypass/Feather River confluence
- Various minor topographic updates

These improvements necessitated a re-calibration of the HEC-RAS model and PBI therefore revised the design water surface profiles in June 2011 using this updated model version. The June update generally raised the water surface profile along the entire reach of the Feather River by an average of 0.5 feet. The most significant change occurred at the upper end near reach 34, where the water surface experienced a raise of plus 3 feet. HDR's 65% design is based upon the June 2011 water surface profiles.

A summary of the June updates that PBI incorporated into the modeling is provided below, along with a summary of the results of the June re-calibration. Information regarding the calibration inflow hydrographs, along with information regarding the updated stream gage data, will be published by the USACE at a later date. No modifications were made to the n-year design flow hydrology as part of the June 2011 update.

Based upon the new information, the HEC-RAS model was updated at each of its two downstream boundary locations: Sacramento River at Verona Gage and Yolo Bypass at Woodland Gage. The USACE discovered that the USGS Yolo Bypass Woodland gage rating curve incorporates an adjustment for Sacramento Weir inflow into the Yolo Bypass. The gage, however, is located upstream of the confluence with the Sacramento Bypass. As a result, the USGS rating curve does not accurately represent the stage-flow relationship at the gage. Therefore, the Woodland gage rating curve was revised by the USACE. The Sacramento River at Verona gage was also updated based upon new field survey data. Figure 3-1 and Figure 3-2 show the updated rating curves at each of these locations.

Figure 3-1. Updated Rating Curve for Sacramento River at Verona Gage

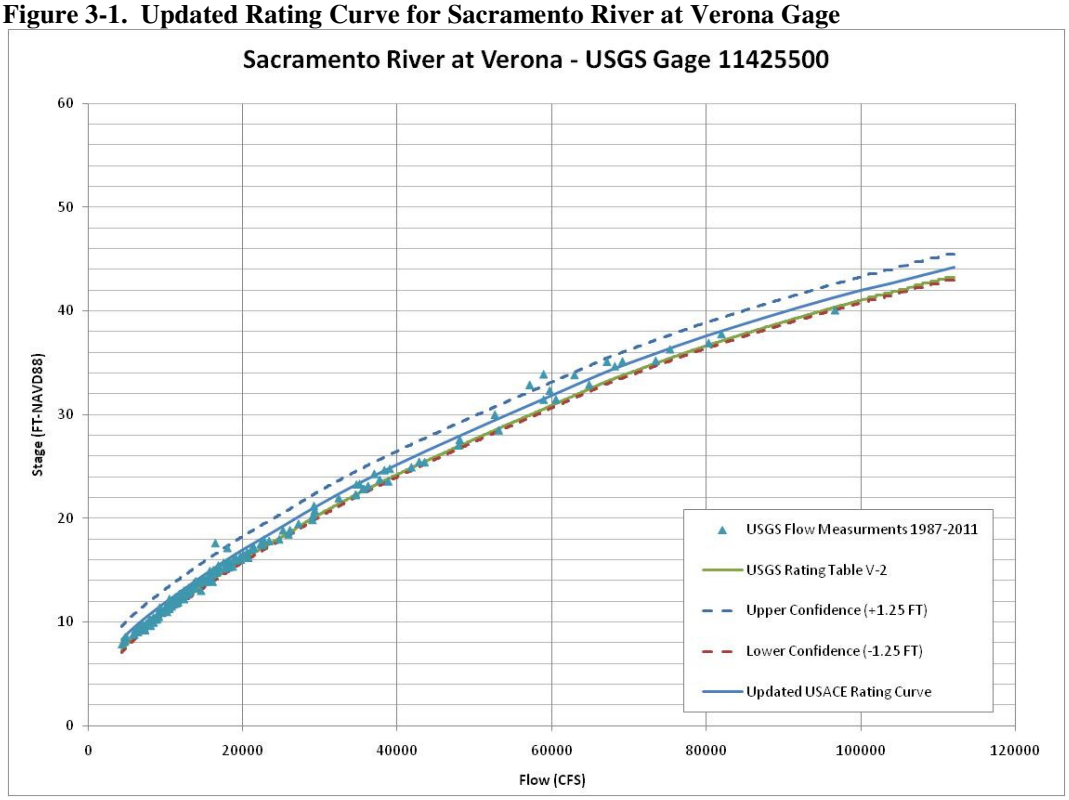
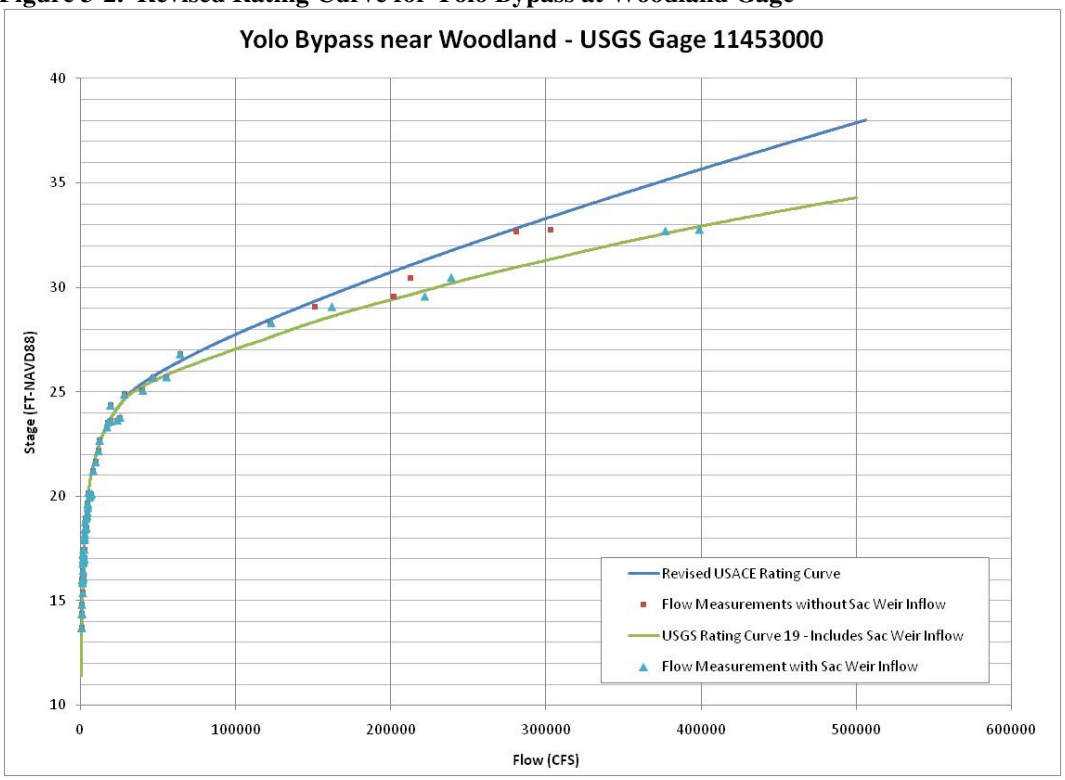


Figure 3-2. Revised Rating Curve for Yolo Bypass at Woodland Gage



The Tisdale Weir coding was also modified during the June 2011 update in order to better represent historic conditions and to stabilize HEC-RAS computations. The updated weir utilizes a user-input stage-discharge flow split provided by the USACE in lieu of a flow split calculated by HEC-RAS based on weir flow calculations. It is important to note that the updated rating curve is based upon historical data and that it does not incorporate the new bridge at Tisdale weir (completed in the Spring of 2010) or the DWR Tisdale Bypass sediment removal project (completed in 2008). These improvements are likely to modify the flow split table, but the modifications would have no appreciable effect on the Feather River water surface profiles, and very little effect on the outflow breach hydrographs utilized for the SBFS; therefore, it was deemed that the historic flow split table is appropriate for use in this study. However, it is recommended that this area of the HEC-RAS model be reviewed and updated in conjunction with future modeling focused on the Tisdale Bypass, Sutter Bypass and Sacramento River. The Tisdale Weir lateral diversion rating curve is shown in Table 3-1.

Table 3-1. Lateral Diversion Rating Curve for Tisdale Weir

Sacramento River Flow Upstream of Weir (cfs)	Diverted Flow to Tisdale Bypass (cfs)
0	0
2,400	0
22,300	0
22,500	10
22,800	100
23,700	500
24,500	1,000
26,000	2,000
28,650	4,050
33,250	7,950
37,950	12,050
42,500	15,000
52,400	20,000
60,000	23,300
66,800	26,000
69,600	27,000

As part of the June update, PBI re-calibrated the model to both the 1997 and 2006 storm events by adjusting the channel Manning's n-values in order to match observed stream gage data and surveyed high water marks. While performing the calibration, PBI made several structural modifications to the model to improve the topography and assist in the calibration, including:

- Removed the right bank blocked obstruction at Feather River Mile (RM) 7.55 (downstream of the Feather River Highway 99 crossing)
- Deleted the flow-based roughness factors for the upper Yuba River reach and incorporated the factors directly into the cross section Manning's n-values
- Further refined the ineffective flow areas for the upper Feather River (RM 63.73 thru 53.84)

- Added a blocked obstruction in the left overbank at Feather River (FR) RM 56.02 (Design STA 2200+58) to represent the top elevation of a road
- Raised the blocked obstructions along the Sutter Bypass, the Tisdale Bypass and Wadsworth Canal in order to correctly model levee overtopping
- Verified and refined the locations of the observed high water marks by incorporating the downstream distance relative to each cross section (completed for all of the Feather River and Sutter Bypass reaches)
- Added blocked obstructions and updated the lateral weir topography for Highway 70 (FR RM 56.43 thru 46.53)
- Added observed stage data for the DWR Feather River at Live Oak (FLO) gage, Feather River at Boyd's Landing (FBL) gage, and the Sutter Bypass at Longbridge (LNB) gage (see Attachment A for details regarding PBI's gage datum conversion to NAVD88)
- Various minor edits to the cross section hydraulic tables in order to eliminate model instabilities

Manning's n-values were adjusted (within reason) to duplicate stages for the 2006 storm event. The 1997 storm event was then simulated using the revised friction factors. In some locations, adjustments were made to achieve a compromise in stage errors between the two calibration events. It should be noted that the differences in the physical configuration of the Feather River between 1997 and 2006 (such as the Shanghai Bend Setback Levee completed in 1999) were taken into account in the calibration process. Table 3-2 shows a summary of the results of the June 2011 PBI re-calibration.

Table 3-2. Summary of the June 2011 Re-Calibration Results; Comparison of Peak Stages at Gages

GAGE	1997 Peak Stage (ft-NAVD88)			2006 Peak Stage (ft-NAVD88)		
	Observed	Computed	Difference (ft)	Observed	Computed	Difference (ft)
FEATHER RIVER NEAR GRIDLEY (#11407150)	99.66	99.21	-0.45	92.29	93.11	0.82
FEATHER RIVER AT LIVE OAK* (FLO) (FEATHER)	-	-	-	75.08	75.16	0.08
FEATHER RIVER AT YUBA CITY (#A05135)	77.51	77.13	-0.38	67.71	68.68	0.97
FEATHER RIVER AT BOYDS LANDING* (FBL) (FEATHER)	-	-	-	58.54	59.05	0.51
FEATHER RIVER AT NICOLAUS (#A05103)	49.33	49.22	-0.11	44.70	44.55	-0.15
BUTTE SLOUGH NR MERIDIAN (#A02972)	60.91	61.33	0.42	58.19	58.18	-0.01
SUTTER BYPASS AT LONGBRIDGE* (LNB) (BYPASS)	-	-	-	53.61	53.33	-0.28
SUTTER BYPASS AT PUMPING PLANT 3 (SB3) (BYPASS)	54.32	55.44	1.12	51.84	51.25	-0.59
SUTTER BYPASS AT PUMPING PLANT 2 (SB2) (BYPASS)	50.64	50.86	0.22	46.85	46.48	-0.37

GAGE	1997 Peak Stage (ft-NAVD88)			2006 Peak Stage (ft-NAVD88)		
	Observed	Computed	Difference (ft)	Observed	Computed	Difference (ft)
SUTTER BYPASS AT PUMPING PLANT 1 (SB1) (BYPASS)	47.01	48.57	1.56	44.71	44.02	-0.69
WILLOW SLOUGH NR NICOLAUS (#A02943)	46.91	48.42	1.51	43.49	43.73	0.24
SUTTER BYPASS AT RD 1500 NEAR KARNAK (#A02927)	42.50	42.83	0.33	39.00	38.75	-0.25

* This gage data should be considered provisional; the gage datum has not been verified and was converted from NGVD29 to NAVD88 using Corpscon.

3.2 UPDATE #2 (SEPTEMBER 2011)

PBI updated the June 2011 TM to incorporate technical review comments provided by the USACE (Attachment H). A summary of the USACE's comments is as follows:

- Yolo Bypass/Woodland gage corrections
- Junction reach length corrections
- Blocked obstruction modifications along the Bear River
- Various description field (text) modifications
- Modifications to the Honcut Creek inflow for the 1997 event

The September update raised the design water surface profiles by about 0.1 feet at the downstream end of the lower Feather River. The September update had no impacts to the design water surface profiles north of the Bear River confluence.

3.3 UPDATE #3 (DECEMBER 2011)

PBI updated the September 2011 TM to incorporate technical review comments provided by MBK (Attachment I). A summary of MBK's comments is as follows:

- Sutter Bypass and lower Feather River n-value adjustments
- Sutter Bypass/Feather River blocked obstruction modifications
- Lateral structure improvements
- Various report revisions
- 1997 surveyed high water mark review
- Tisdale Weir: rating curve vs. sharp crested weir

The December review comments were addressed by both PBI and the USACE as part of the December update. The comments necessitated a revision of the June 2011 re-calibration. The December calibration results are shown in Section 3.5. The December 2011 update lowered the design water surface profiles by about 0.5 feet at the downstream end of the lower Feather River and had no impacts to the water surface profiles north of Star Bend.

3.4 UPDATE #4 (MARCH 2012)

PBI updated the December 2011 TM to incorporate the updated n-year inflow hydrology provided by the USACE (see Section 2). The March update raised the 200-year design water surface profiles by about 0.3 feet at the Bear River and Feather River confluence, by about 0.2 feet at the Feather River and Sutter Bypass confluence, and by about 0.2 feet upstream of Highway 20. The March update had no impacts to the 200-year design water surface profiles north of Honcut Creek.

3.5 FINAL CALIBRATION RESULTS

Table 3-3 shows a summary of the results of the December 2011 re-calibration. The calibration water surface profiles are shown in Figure 3-3 thru Figure 3-10 (note that the shaded areas represent the right bank levee). Table 3-4 includes a complete list of the re-calibrated Manning's n-values. Table 3-4 also shows the additional n-values that were incorporated into the design to account for the 2009 Feather River Setback Levee.

Table 3-3. Summary of the Final Re-Calibration Results; Comparison of Peak Stages at Gages

GAGE	1997 Peak Stage (ft-NAVD88)			2006 Peak Stage (ft-NAVD88)		
	Observed	Computed	Difference (ft)	Observed	Computed	Difference (ft)
FEATHER RIVER NEAR GRIDLEY (#11407150)	99.66	99.22	-0.44	92.29	93.11	0.82
FEATHER RIVER AT LIVE OAK* (FLO) (FEATHER)	-	-	-	75.08	75.16	0.08
FEATHER RIVER AT YUBA CITY (#A05135)	77.51	77.36	-0.15	67.71	68.68	0.97
FEATHER RIVER AT BOYDS LANDING* (FBL) (FEATHER)	-	-	-	58.54	59.04	0.50
FEATHER RIVER AT NICOLAUS (#A05103)	49.33	49.48	0.15	44.70	44.96	0.26
BUTTE SLOUGH NR MERIDIAN (#A02972)	60.91	61.39	0.48	58.19	58.19	0.00
SUTTER BYPASS AT LONGBRIDGE* (LNB) (BYPASS)	-	-	-	53.61	53.41	-0.20
SUTTER BYPASS AT PUMPING PLANT 3 (SB3) (BYPASS)	54.32	55.65	1.33	51.84	51.38	-0.46
SUTTER BYPASS AT PUMPING PLANT 2 (SB2) (BYPASS)	50.64	51.36	0.72	46.85	46.89	0.04
SUTTER BYPASS AT PUMPING PLANT 1 (SB1) (BYPASS)	47.01	48.84	1.83	44.71	44.27	-0.44
WILLOW SLOUGH NR NICOLAUS (#A02943)	46.91	48.69	1.78	43.49	43.95	0.46
SUTTER BYPASS AT RD 1500 NEAR KARNAK (#A02927)	42.50	42.92	0.42	39.00	38.74	-0.26

* This gage data should be considered provisional; the gage datum has not been verified and was converted from NGVD29 to NAVD88 using Corpscon.

Figure 3-3. 1997 Calibration Water Surface Profile for Upper Reach of Feather River

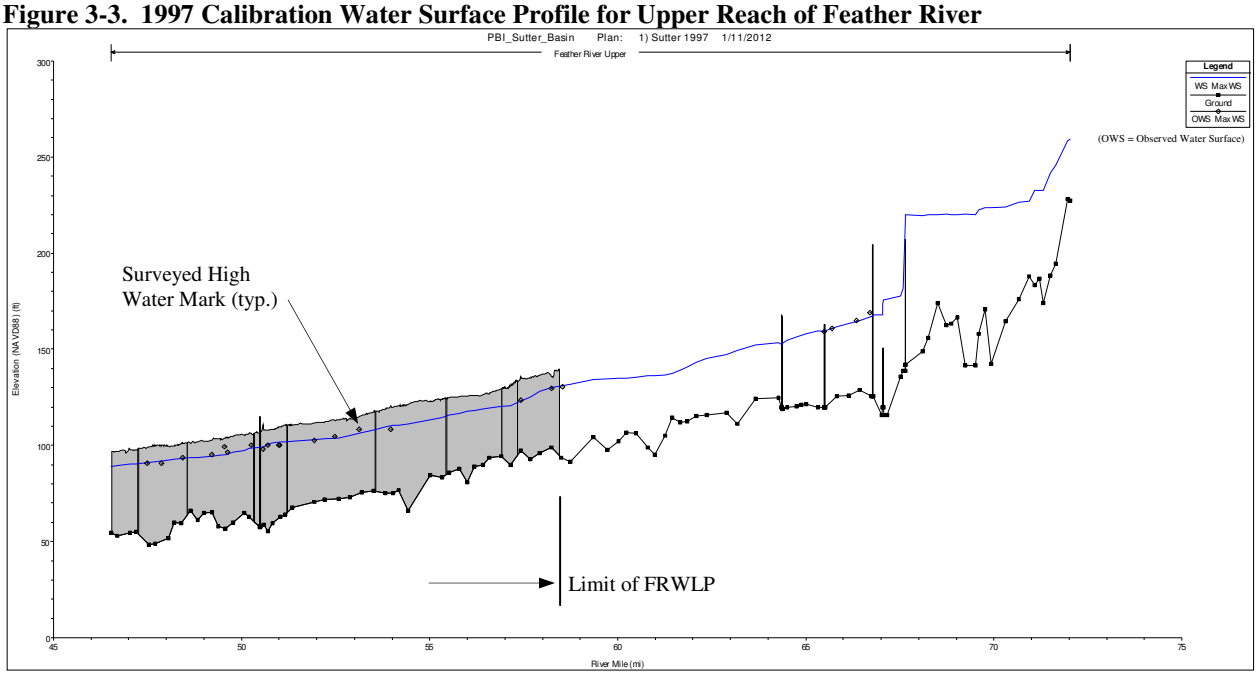


Figure 3-4. 1997 Calibration Water Surface Profile for Honcut-Jack Reach of Feather River

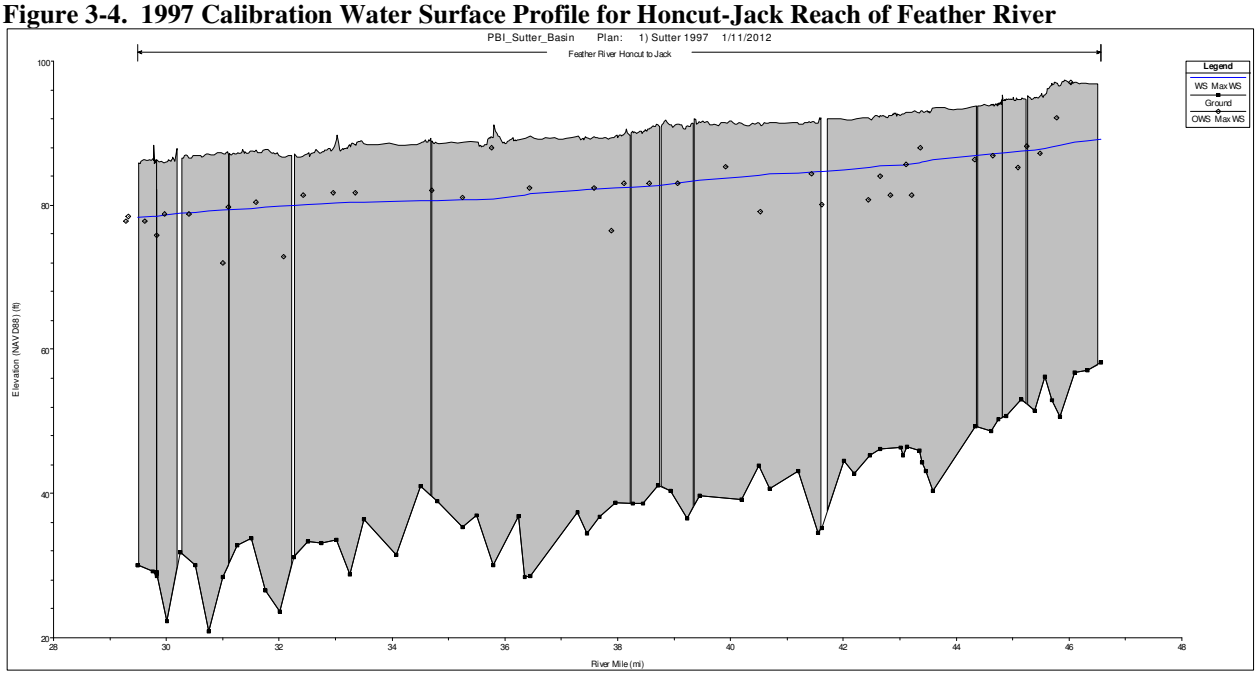


Figure 3-5. 1997 Calibration Water Surface Profile for Jack-Bear Reach of Feather River

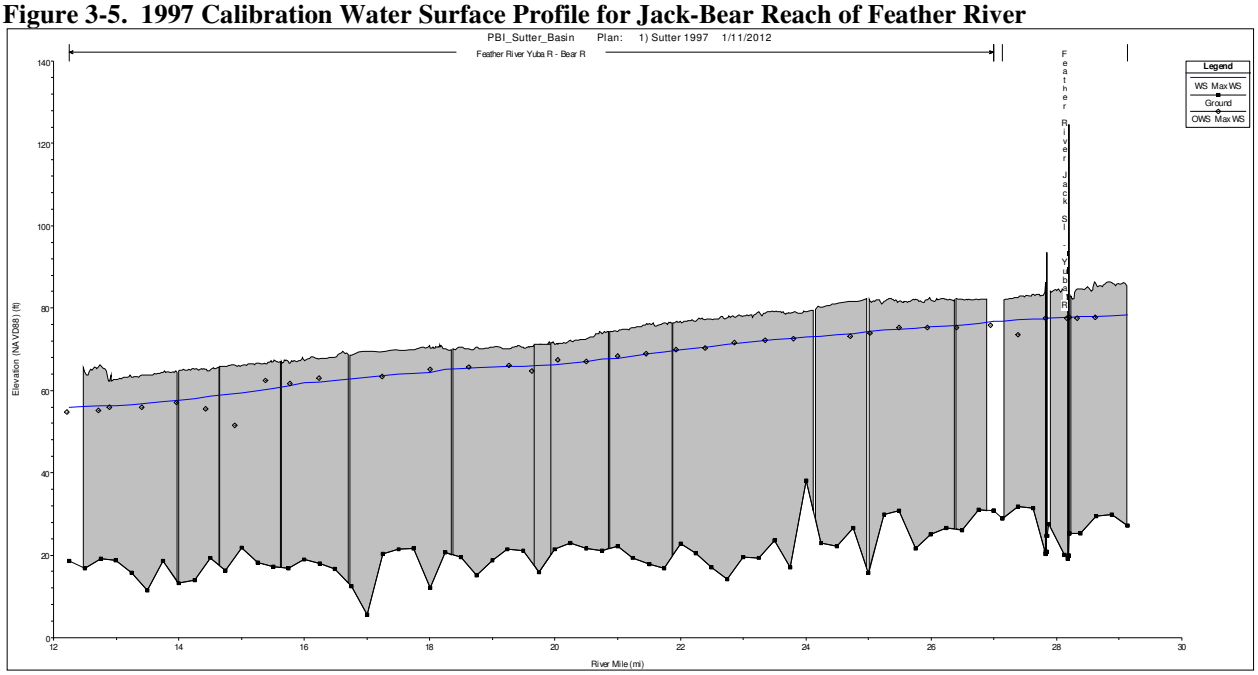


Figure 3-6. 1997 Calibration Water Surface Profile for Bear-Sac Reach of Feather River

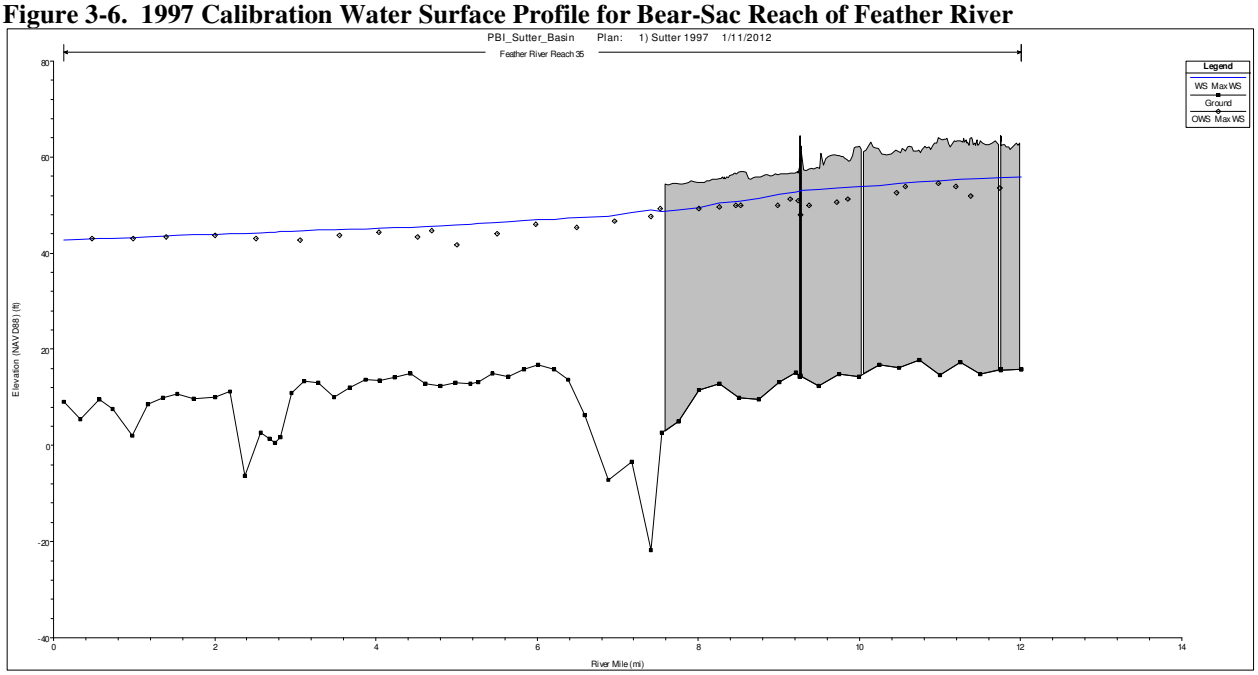


Figure 3-7. 1997 Calibration Water Surface Profile for Butte-Tisdale Reach of Sutter Bypass

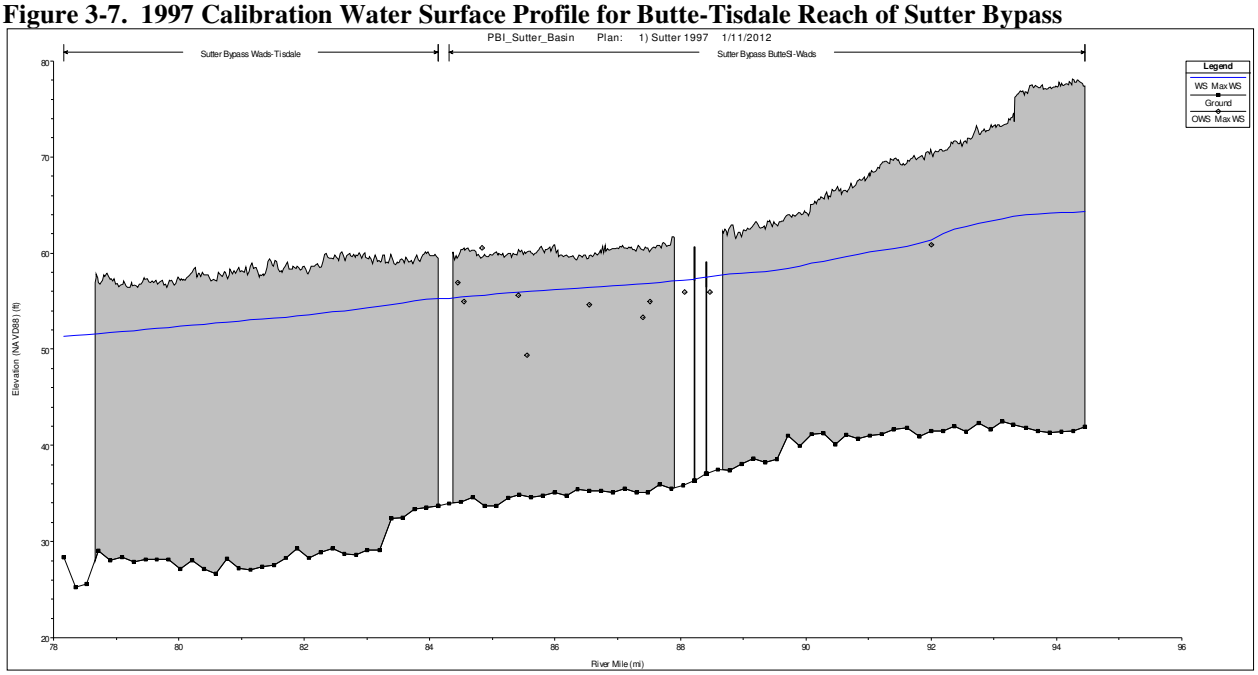


Figure 3-8. 1997 Calibration Water Surface Profile for Tisdale-Yolo Reach of Sutter Bypass

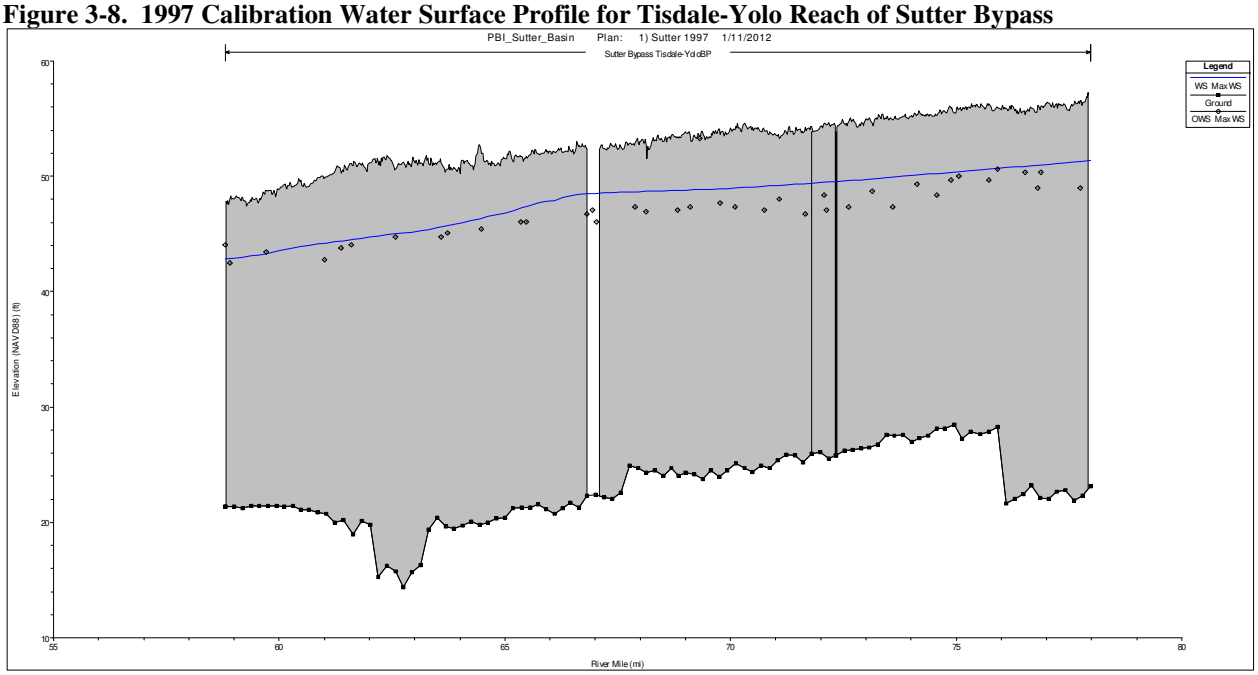


Figure 3-9. 2006 Calibration Water Surface Profile for Butte-Tisdale Reach of Sutter Bypass

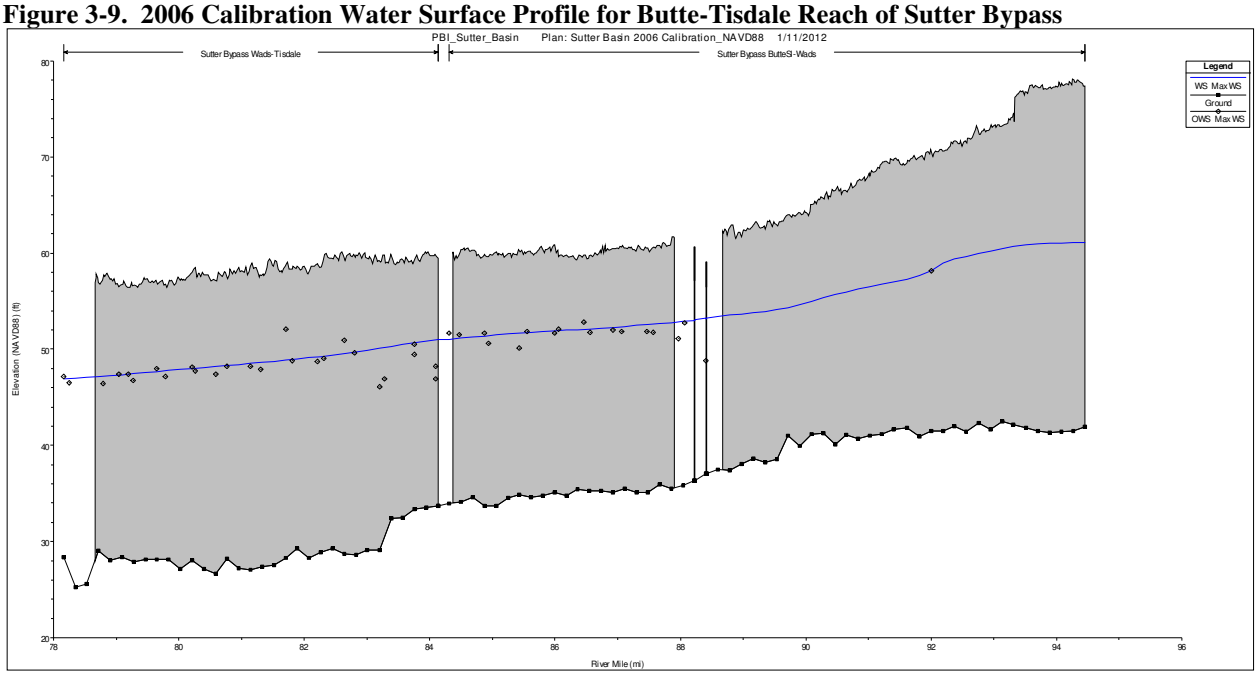


Figure 3-10. 2006 Calibration Water Surface Profile for Tisdale-Yolo Reach of Sutter Bypass

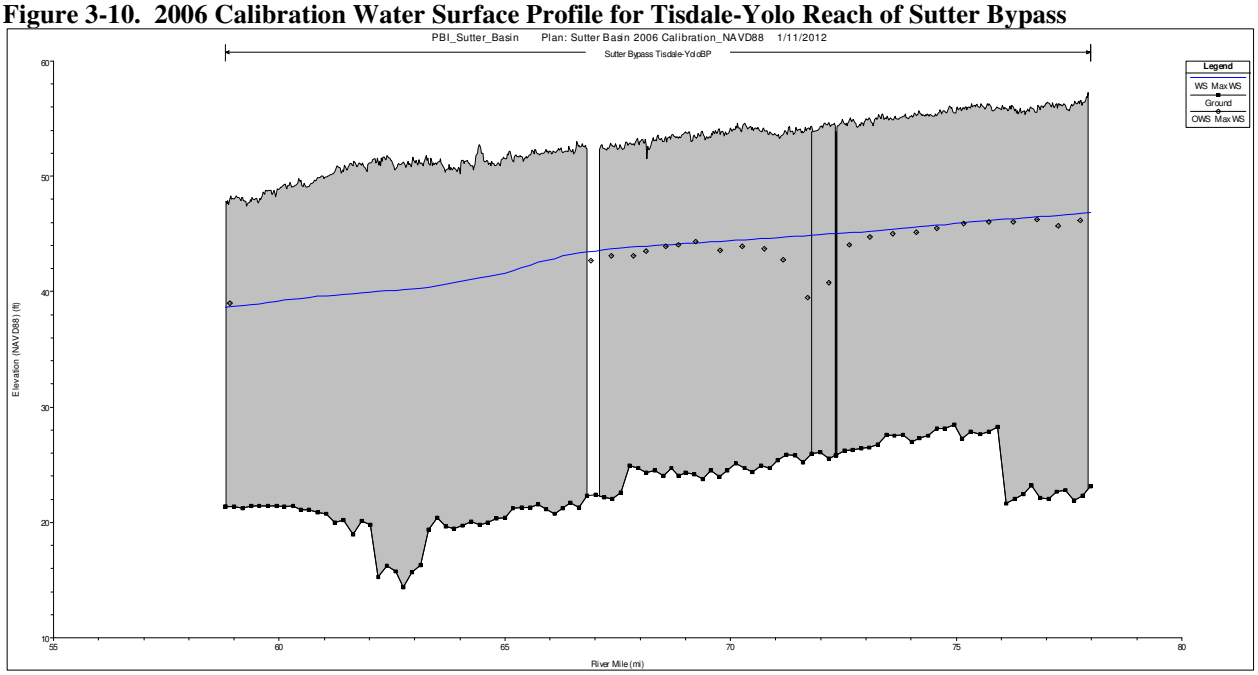


Table 3-4. Feather River Manning's n-Values Utilized for the PBI Sutter Basin Model

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Upper	71.45	n	0.07	0.07	0.07		
Upper	71.4	n	0.07	0.07	0.07		
Upper	71.09	n	0.07	0.07	0.07		
Upper	70.95	n	0.07	0.07	0.07		
Upper	70.74	n	0.07	0.07	0.07		
Upper	70.65	n	0.065	0.04	0.065		
Upper	70.53	n	0.065	0.04	0.065		
Upper	70.38	n	0.065	0.04	0.065		
Upper	70.1	n	0.065	0.04	0.065		
Upper	69.73	n	0.065	0.04	0.065		
Upper	69.37	n	0.065	0.04	0.065		
Upper	69.2	n	0.065	0.04	0.065		
Upper	69.04	n	0.065	0.04	0.065		
Upper	68.95	n	0.065	0.04	0.065		
Upper	68.67	n	0.065	0.04	0.065		
Upper	68.46	n	0.065	0.04	0.065		
Upper	68.29	n	0.065	0.04	0.065		
Upper	68.17	n	0.065	0.04	0.065		
Upper	67.94	n	0.065	0.04	0.065		
Upper	67.7	n	0.065	0.04	0.065		
Upper	67.54	n	0.065	0.04	0.065		
Upper	67.08	n	0.065	0.04	0.065		
Upper	67.07	Inl Struct					
Upper	67.03	n	0.065	0.04	0.065		
Upper	66.95	n	0.065	0.04	0.065		
Upper	66.61	n	0.065	0.04	0.065		
Upper	66.4889	n	0.055	0.04	0.055		
Upper	66.472	n	0.055	0.04	0.055		
Upper	66.469	Inl Struct					
Upper	66.4637	n	0.055	0.04	0.055		
Upper	66.4448	n	0.055	0.04	0.055		
Upper	66.2317	n	0.055	0.04	0.055		
Upper	66.2162	n	0.055	0.04	0.055		
Upper	66.2149	Bridge					
Upper	66.212	n	0.055	0.04	0.055		
Upper	66.19	n	0.055	0.04	0.055		
Upper	65.88	n	0.055	0.04	0.055		
Upper	65.58	n	0.055	0.04	0.055		
Upper	65.28	n	0.055	0.04	0.055		
Upper	64.954	n	0.055	0.04	0.055		
Upper	64.952	n	0.055	0.04	0.055		
Upper	64.95	Bridge					
Upper	64.916	n	0.055	0.04	0.055		
Upper	64.914	n	0.055	0.04	0.055		
Upper	64.76	n	0.055	0.04	0.055		
Upper	64.46	n	0.055	0.04	0.055		
Upper	64.34	n	0.055	0.04	0.055		
Upper	64.2	n	0.055	0.04	0.055		
Upper	63.95	n	0.055	0.04	0.055		
Upper	63.826	n	0.055	0.04	0.055		
Upper	63.824	n	0.055	0.04	0.055		
Upper	63.82	Bridge					

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Upper	63.816	n	0.055	0.04	0.055		
Upper	63.814	n	0.055	0.04	0.055		
Upper	63.73	n	0.055	0.04	0.055		
Upper	63.43	n	0.055	0.04	0.055		
Upper	62.93	n	0.055	0.04	0.055		
Upper	62.65	n	0.055	0.04	0.055		
Upper	62.38	n	0.055	0.04	0.055		
Upper	62.12	n	0.055	0.04	0.07		
Upper	61.86	n	0.055	0.04	0.07		
Upper	61.67	n	0.055	0.04	0.07		
Upper	61.46	n	0.055	0.04	0.07		
Upper	61.28	n	0.055	0.04	0.07		
Upper	61	n	0.055	0.04	0.07		
Upper	60.81	n	0.055	0.04	0.07		
Upper	60.49	n	0.055	0.04	0.07		
Upper	60.25	n	0.055	0.04	0.07		
Upper	60.04	n	0.055	0.04	0.07		
Upper	59.74	n	0.055	0.04	0.07		
Upper	59.35	n	0.055	0.04	0.07		
Upper	58.75	n	0.055	0.04	0.07		
Upper	58.51	n	0.07	0.04	0.055		
Upper	58.45	Lat Struct					
Upper	58.26	n	0.07	0.04	0.055		
Upper	57.95	n	0.07	0.04	0.055		
Upper	57.7	n	0.07	0.04	0.055		
Upper	57.45	n	0.07	0.04	0.055		
Upper	57.3	Lat Struct					
Upper	57.17	n	0.07	0.04	0.055		
Upper	56.99	Lat Struct					
Upper	56.94	n	0.07	0.04	0.055		
Upper	56.61	n	0.07	0.04	0.055		
Upper	56.43	n	0.07	0.04	0.055		
Upper	56.42	Lat Struct					
Upper	56.2	n	0.07	0.04	0.055		
Upper	56.02	n	0.07	0.04	0.055		
Upper	55.8	n	0.055	0.04	0.055		
Upper	55.55	n	0.055	0.04	0.055		
Upper	55.4	Lat Struct					
Upper	55.35	n	0.055	0.04	0.055		
Upper	55.03	n	0.055	0.04	0.055		
Upper	54.45	n	0.05	0.04	0.05		
Upper	54.2	n	0.05	0.04	0.05		
Upper	54.04	n	0.05	0.04	0.05		
Upper	54.039	Lat Struct					
Upper	53.84	n	0.05	0.04	0.05		
Upper	53.56	Lat Struct					
Upper	53.52	n	0.05	0.04	0.05		
Upper	53.22	n	0.05	0.04	0.05		
Upper	52.89	n	0.065	0.04	0.065		
Upper	52.6	n	0.065	0.045	0.065		
Upper	52.21	n	0.065	0.045	0.065		
Upper	51.95	n	0.065	0.045	0.065		
Upper	51.35	n	0.055	0.04	0.055		

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Upper	51.2	Lat Struct					
Upper	51.1777	n	0.06	0.038	0.06		
Upper	51.04	n	0.06	0.038	0.06		
Upper	50.84	n	0.06	0.038	0.06		
Upper	50.7	n	0.065	0.038	0.065		
Upper	50.59	n	0.065	0.038	0.065		
Upper	50.498	n	0.065	0.038	0.065		
Upper	50.496	n	0.07	0.038	0.07		
Upper	50.493	Bridge					
Upper	50.489	n	0.07	0.038	0.07		
Upper	50.487	n	0.07	0.038	0.07		
Upper	50.486	Lat Struct					
Upper	50.48	Lat Struct					
Upper	50.31	Lat Struct					
Upper	50.2	n	0.065	0.038	0.065		
Upper	50.06	n	0.065	0.038	0.065		
Upper	49.78	n	0.065	0.038	0.065		
Upper	49.58	n	0.065	0.038	0.065		
Upper	49.38	n	0.065	0.038	0.065		
Upper	49.21	n	0.065	0.038	0.065		
Upper	48.99	n	0.055	0.04	0.055		
Upper	48.85	n	0.055	0.04	0.055		
Upper	48.66	n	0.055	0.04	0.055		
Upper	48.55	Lat Struct					
Upper	48.47	Lat Struct					
Upper	48.39	n	0.055	0.04	0.055		
Upper	48.21	n	0.055	0.04	0.055		
Upper	48.07	n	0.055	0.04	0.055		
Upper	47.7	n	0.055	0.04	0.055		
Upper	47.55	n	0.055	0.04	0.055		
Upper	47.25	Lat Struct					
Upper	47.2	n	0.055	0.04	0.055		
Upper	47.04	n	0.055	0.04	0.055		
Upper	46.69	n	0.055	0.04	0.055		
Upper	46.53	n	0.055	0.04	0.055		
Honcut to Jack	46.45	n	0.06	0.04	0.06		
Honcut to Jack	46.449	n	0.06	0.04	0.06		
Honcut to Jack	46.44	Lat Struct					
Honcut to Jack	46.43	Lat Struct					
Honcut to Jack	46.2	n	0.06	0.04	0.06		
Honcut to Jack	45.98	n	0.06	0.04	0.06		
Honcut to Jack	45.71	n	0.06	0.04	0.06		
Honcut to Jack	45.58	n	0.06	0.04	0.06		
Honcut to Jack	45.55	Lat Struct					
Honcut to Jack	45.44	n	0.06	0.04	0.06		
Honcut to Jack	45.26	n	0.06	0.04	0.06		
Honcut to Jack	45.14	Lat Struct					
Honcut to Jack	45.1	Lat Struct					
Honcut to Jack	45.03	n	0.06	0.04	0.06		
Honcut to Jack	44.76	n	0.06	0.04	0.06		
Honcut to Jack	44.71	Lat Struct					
Honcut to Jack	44.6326	n	0.06	0.04	0.06		
Honcut to Jack	44.6	Lat Struct					

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Honcut to Jack	44.5	n	0.06	0.04	0.06		
Honcut to Jack	44.24	Lat Struct					
Honcut to Jack	44.23	n	0.06	0.05	0.06		
Honcut to Jack	44.2	Lat Struct					
Honcut to Jack	43.46	n	0.06	0.05	0.06		
Honcut to Jack	43.34	n	0.06	0.05	0.06		
Honcut to Jack	43.28	n	0.06	0.05	0.06		
Honcut to Jack	43.27	Lat Struct					
Honcut to Jack	43.23	n	0.06	0.05	0.06		
Honcut to Jack	43.12	n	0.06	0.05	0.06		
Honcut to Jack	43.06	n	0.06	0.05	0.06		
Honcut to Jack	43.01	n	0.06	0.05	0.06		
Honcut to Jack	42.65	n	0.06	0.05	0.06		
Honcut to Jack	42.62	Lat Struct					
Honcut to Jack	42.47	n	0.065	0.05	0.065		
Honcut to Jack	42.19	n	0.065	0.05	0.065		
Honcut to Jack	42.01	n	0.065	0.05	0.065		
Honcut to Jack	41.61	n	0.065	0.05	0.065		
Honcut to Jack	41.6	Lat Struct					
Honcut to Jack	41.59	Lat Struct					
Honcut to Jack	41.55	n	0.065	0.05	0.065		
Honcut to Jack	41.2	n	0.065	0.05	0.065		
Honcut to Jack	40.7	n	0.065	0.05	0.065		
Honcut to Jack	40.49	n	0.065	0.05	0.065		
Honcut to Jack	40.19	n	0.065	0.05	0.065		
Honcut to Jack	39.45	n	0.07	0.05	0.07		
Honcut to Jack	39.35	Lat Struct					
Honcut to Jack	39.3	Lat Struct					
Honcut to Jack	39.23	n	0.07	0.05	0.07		
Honcut to Jack	38.94	n	0.07	0.05	0.07		
Honcut to Jack	38.75	Lat Struct					
Honcut to Jack	38.73	Lat Struct					
Honcut to Jack	38.71	n	0.07	0.05	0.07		
Honcut to Jack	38.45	n	0.07	0.05	0.07		
Honcut to Jack	38.27	n	0.07	0.05	0.07		
Honcut to Jack	38.2	Lat Struct					
Honcut to Jack	38.1	Lat Struct					
Honcut to Jack	37.95	n	0.07	0.05	0.07		
Honcut to Jack	37.68	n	0.07	0.05	0.07		
Honcut to Jack	37.45	n	0.08	0.05	0.08		
Honcut to Jack	37.29	n	0.08	0.05	0.08		
Honcut to Jack	36.45	n	0.08	0.05	0.08		
Honcut to Jack	36.35	n	0.08	0.05	0.08		
Honcut to Jack	36.24	n	0.08	0.05	0.08		
Honcut to Jack	35.78	n	0.08	0.05	0.08		
Honcut to Jack	35.5	n	0.08	0.05	0.08		
Honcut to Jack	35.25	n	0.088	0.056	0.088		
Honcut to Jack	34.8	n	0.088	0.056	0.088		
Honcut to Jack	34.7	Lat Struct					
Honcut to Jack	34.6	Lat Struct					
Honcut to Jack	34.5	n	0.088	0.056	0.088		
Honcut to Jack	34.07	n	0.088	0.056	0.088		
Honcut to Jack	33.5	n	0.088	0.056	0.088		

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Honcut to Jack	33.25	n	0.088	0.056	0.088		
Honcut to Jack	33	n	0.088	0.056	0.088		
Honcut to Jack	32.75	n	0.088	0.056	0.088		
Honcut to Jack	32.5	n	0.088	0.056	0.088		
Honcut to Jack	32.25	n	0.088	0.056	0.088		
Honcut to Jack	32.23	Lat Struct					
Honcut to Jack	32.2	Lat Struct					
Honcut to Jack	32	n	0.088	0.056	0.088		
Honcut to Jack	31.75	n	0.088	0.056	0.088		
Honcut to Jack	31.5	n	0.088	0.056	0.088		
Honcut to Jack	31.25	n	0.088	0.056	0.088		
Honcut to Jack	31.1	Lat Struct					
Honcut to Jack	31.05	Lat Struct					
Honcut to Jack	31	n	0.088	0.056	0.088		
Honcut to Jack	30.75	n	0.088	0.056	0.088		
Honcut to Jack	30.5	n	0.088	0.056	0.088		
Honcut to Jack	30.25	n	0.085	0.056	0.085		
Honcut to Jack	30.21	Lat Struct					
Honcut to Jack	30.2	Lat Struct					
Honcut to Jack	30	n	0.085	0.056	0.085		
Honcut to Jack	29.828	n	0.085	0.056	0.085		
Honcut to Jack	29.826	n	0.085	0.056	0.085		
Honcut to Jack	29.824	Bridge					
Honcut to Jack	29.822	n	0.072	0.056	0.072		
Honcut to Jack	29.821	n	0.072	0.056	0.072		
Honcut to Jack	29.82	Lat Struct					
Honcut to Jack	29.75	n	0.07	0.05	0.07		
Honcut to Jack	29.741	Lat Struct					
Honcut to Jack	29.501	n	0.065	0.045	0.065		
Honcut to Jack	29.5	n	0.065	0.045	0.065		
Jack Sl - Yuba R	29.25	n	0.065	0.045	0.065		
Jack Sl - Yuba R	29.249	n	0.065	0.045	0.065		
Jack Sl - Yuba R	29.241	Lat Struct					
Jack Sl - Yuba R	29.2	Lat Struct					
Jack Sl - Yuba R	29.00	n	0.065	0.045	0.065		
Jack Sl - Yuba R	28.75	n	0.065	0.045	0.065		
Jack Sl - Yuba R	28.74	Lat Struct					
Jack Sl - Yuba R	28.50	n	0.065	0.045	0.065		
Jack Sl - Yuba R	28.324	n	0.065	0.045	0.065		
Jack Sl - Yuba R	28.322	n	0.065	0.045	0.065		
Jack Sl - Yuba R	28.321	Bridge					
Jack Sl - Yuba R	28.309	n	0.065	0.045	0.065		
Jack Sl - Yuba R	28.307	n	0.065	0.045	0.065		
Jack Sl - Yuba R	28.3	Lat Struct					
Jack Sl - Yuba R	28.255	Lat Struct					
Jack Sl - Yuba R	28.25	n	0.06	0.04	0.06		
Jack Sl - Yuba R	28.00	n	0.06	0.04	0.06		
Jack Sl - Yuba R	27.971	n	0.06	0.04	0.06		
Jack Sl - Yuba R	27.97	Bridge					
Jack Sl - Yuba R	27.963	n	0.06	0.04	0.06		
Jack Sl - Yuba R	27.956	n	0.06	0.04	0.06		
Jack Sl - Yuba R	27.955	Bridge					
Jack Sl - Yuba R	27.952	n	0.06	0.04	0.06		

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Jack Sl - Yuba R	27.95	Lat Struct					
Jack Sl - Yuba R	27.94	Lat Struct					
Jack Sl - Yuba R	27.75	n	0.06	0.04	0.06		
Jack Sl - Yuba R	27.50	n	0.06	0.04	0.06		
Jack Sl - Yuba R	27.251	n	0.06	0.045	0.06		
Jack Sl - Yuba R	27.25	n	0.06	0.045	0.06		
Yuba R - Bear R	27	n	0.06	0.055	0.06		
Yuba R - Bear R	26.999	n	0.06	0.055	0.06		
Yuba R - Bear R	26.95	Lat Struct					
Yuba R - Bear R	26.9	Lat Struct					
Yuba R - Bear R	26.75	n	0.06	0.055	0.06		
Yuba R - Bear R	26.5	n	0.06	0.055	0.06		
Yuba R - Bear R	26.4	Lat Struct					
Yuba R - Bear R	26.3	Lat Struct					
Yuba R - Bear R	26.25	n	0.06	0.055	0.06		
Yuba R - Bear R	26	n	0.06	0.055	0.06		
Yuba R - Bear R	25.75	n	0.06	0.055	0.06		
Yuba R - Bear R	25.5	n	0.06	0.055	0.06		
Yuba R - Bear R	25.25	n	0.06	0.055	0.06		
Yuba R - Bear R	25	n	0.06	0.055	0.06		
Yuba R - Bear R	24.99	Lat Struct					
Yuba R - Bear R	24.95	Lat Struct					
Yuba R - Bear R	24.75	n	0.06	0.055	0.06		
Yuba R - Bear R	24.5	n	0.06	0.055	0.06		
Yuba R - Bear R	24.25	n	0.06	0.055	0.06		
Yuba R - Bear R	24.12	Lat Struct					
Yuba R - Bear R	24	n	0.1	0.06	0.039	0.06	The n-values for the calibration scenario do not include the 0.1 left overbank values. The 0.1 left overbank values were incorporated into the design scenario in order to account for the 2009 Feather River Setback Levee Project.
Yuba R - Bear R	23.75	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	23.5	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	23.25	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	23	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	22.75	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	22.5	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	22.25	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	22	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	21.89	Lat Struct					
Yuba R - Bear R	21.75	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	21.5	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	21.25	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	21	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	20.85	Lat Struct					
Yuba R - Bear R	20.75	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	20.5	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	20.25	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	20	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	19.91	Lat Struct					
Yuba R - Bear R	19.9	Lat Struct					
Yuba R - Bear R	19.75	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	19.5	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	19.25	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	19	n	0.1	0.06	0.039	0.06	
Yuba R - Bear R	18.75	n	0.1	0.088	0.039	0.088	
Yuba R - Bear R	18.5	n	0.1	0.088	0.039	0.088	

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Yuba R - Bear R	18.3	Lat Struct					
Yuba R - Bear R	18.25	n	0.1	0.088	0.039	0.088	
Yuba R - Bear R	18	n	0.1	0.088	0.039	0.088	
Yuba R - Bear R	17.75	n	0.1	0.088	0.039	0.088	
Yuba R - Bear R	17.5	n	0.1	0.088	0.039	0.088	
Yuba R - Bear R	17.25	n	0.088	0.042	0.088		
Yuba R - Bear R	17.2	Lat Struct					
Yuba R - Bear R	17	n	0.088	0.042	0.088		
Yuba R - Bear R	16.75	n	0.08	0.042	0.08		
Yuba R - Bear R	16.7	Lat Struct					
Yuba R - Bear R	16.69	Lat Struct					
Yuba R - Bear R	16.5	n	0.08	0.042	0.08		
Yuba R - Bear R	16.25	n	0.08	0.042	0.08		
Yuba R - Bear R	16	n	0.08	0.042	0.08		
Yuba R - Bear R	15.75	n	0.08	0.042	0.08		
Yuba R - Bear R	15.61	Lat Struct					
Yuba R - Bear R	15.6	Lat Struct					
Yuba R - Bear R	15.5	n	0.08	0.042	0.08		
Yuba R - Bear R	15.25	n	0.08	0.035	0.08		
Yuba R - Bear R	15	n	0.08	0.035	0.08		
Yuba R - Bear R	14.75	n	0.055	0.035	0.055		
Yuba R - Bear R	14.68	Lat Struct					
Yuba R - Bear R	14.67	Lat Struct					
Yuba R - Bear R	14.5	n	0.055	0.035	0.055		
Yuba R - Bear R	14.25	n	0.055	0.035	0.055		
Yuba R - Bear R	14	n	0.055	0.031	0.055		
Yuba R - Bear R	13.95	Lat Struct					
Yuba R - Bear R	13.9	Lat Struct					
Yuba R - Bear R	13.75	n	0.055	0.031	0.055		
Yuba R - Bear R	13.5	n	0.055	0.031	0.055		
Yuba R - Bear R	13.25	n	0.05	0.031	0.05		
Yuba R - Bear R	13.24	Lat Struct					
Yuba R - Bear R	13	n	0.055	0.035	0.055		
Yuba R - Bear R	12.75	n	0.055	0.035	0.055		
Yuba R - Bear R	12.74	Lat Struct					
Yuba R - Bear R	12.5	n	0.055	0.035	0.055		
Yuba R - Bear R	12.25	n	0.055	0.035	0.055		
Reach 35	12	n	0.045	0.031	0.045		
Reach 35	11.999	n	0.045	0.031	0.045		
Reach 35	11.95	Lat Struct					
Reach 35	11.93	Lat Struct					
Reach 35	11.75	n	0.045	0.031	0.045		
Reach 35	11.599	n	0.045	0.031	0.045		
Reach 35	11.59	Lat Struct					
Reach 35	11.57	Lat Struct					
Reach 35	11.5	n	0.045	0.031	0.045		
Reach 35	11.25	n	0.045	0.031	0.045		
Reach 35	11	n	0.045	0.031	0.045		
Reach 35	10.75	n	0.045	0.031	0.045		
Reach 35	10.5	n	0.045	0.031	0.045		
Reach 35	10.25	n	0.045	0.031	0.045		
Reach 35	10.07	Lat Struct					
Reach 35	10.05	Lat Struct					

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Reach 35	10	n	0.045	0.031	0.045		
Reach 35	9.75	n	0.045	0.031	0.045		
Reach 35	9.5	n	0.045	0.031	0.045		
Reach 35	9.278	n	0.045	0.031	0.045		
Reach 35	9.27	Bridge					
Reach 35	9.265	n	0.045	0.031	0.045		
Reach 35	9.261	Lat Struct					
Reach 35	9.22	Lat Struct					
Reach 35	9.2	n	0.05	0.031	0.05		
Reach 35	9	n	0.05	0.035	0.05		
Reach 35	8.75	n	0.05	0.035	0.05		
Reach 35	8.5	n	0.05	0.035	0.05		
Reach 35	8.25	n	0.05	0.035	0.05		
Reach 35	8	n	0.05	0.035	0.05		
Reach 35	7.75	n	0.05	0.035	0.05		
Reach 35	7.55	n	0.05	0.035	0.05		
Reach 35	7.52	Lat Struct					
Reach 35	7.41	n	0.05	0.035	0.05		
Reach 35	7.17	n	0.05	0.035	0.05		
Reach 35	6.88	n	0.05	0.035	0.05		
Reach 35	6.59	n	0.05	0.035	0.05		
Reach 35	6.39	n	0.05	0.035	0.05		
Reach 35	6.21	n	0.05	0.035	0.05		
Reach 35	6.02	n	0.05	0.035	0.05		
Reach 35	5.83	n	0.05	0.035	0.05		
Reach 35	5.64	n	0.05	0.035	0.05		
Reach 35	5.45	n	0.05	0.035	0.05		
Reach 35	5.27	n	0.05	0.035	0.05		
Reach 35	5.17	n	0.05	0.035	0.05		
Reach 35	4.98	n	0.05	0.035	0.05		
Reach 35	4.95	Lat Struct					
Reach 35	4.8	n	0.055	0.04	0.055		
Reach 35	4.62	n	0.055	0.04	0.055		
Reach 35	4.42	n	0.055	0.04	0.055		
Reach 35	4.23	n	0.055	0.04	0.055		
Reach 35	4.05	n	0.055	0.04	0.055		
Reach 35	3.87	n	0.055	0.04	0.055		
Reach 35	3.67	n	0.055	0.04	0.055		
Reach 35	3.47	n	0.055	0.04	0.055		
Reach 35	3.29	n	0.055	0.04	0.055		
Reach 35	3.1	n	0.055	0.04	0.055		
Reach 35	2.95	n	0.055	0.04	0.055		
Reach 35	2.82	n	0.055	0.04	0.055		
Reach 35	2.74	n	0.055	0.04	0.055		
Reach 35	2.68	n	0.055	0.04	0.055		
Reach 35	2.57	n	0.055	0.04	0.055		
Reach 35	2.55	Lat Struct					
Reach 35	2.37	n	0.055	0.04	0.055		
Reach 35	2.19	n	0.055	0.04	0.055		
Reach 35	2	n	0.055	0.04	0.055		
Reach 35	1.74	n	0.055	0.04	0.055		
Reach 35	1.54	n	0.055	0.04	0.055		
Reach 35	1.36	n	0.055	0.04	0.055		

(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Reach 35	1.17	n	0.055	0.04	0.055		
Reach 35	0.98	n	0.055	0.04	0.055		
Reach 35	0.73	n	0.055	0.04	0.055		
Reach 35	0.56	n	0.055	0.04	0.055		
Reach 35	0.33	n	0.055	0.04	0.055		
Reach 35	0.13	n	0.055	0.04	0.055		

4 FINAL DESIGN WATER SURFACE PROFILES

The Feather River West Levee Project design water surface profiles include the 1/100, 1/200, and 1/500 annual exceedance probability (AEP) storm events. The design water surface profiles are a composite of the Shanghai and Sacramento storm centerings as described in Section 2. The simulations utilized to compute the n-year design profiles assume no levee breaches and the levees act as weirs if they are overtopped.

The HEC-RAS model results for each of the AEP events are shown in Table 4-1 and Figure 4-1. Table 4-2 and Figure 4-2 compares the final design water surface profiles to the profiles used for HDR's 65% design (June 2011 profiles). Velocity and shear stress information is included in Table 4-3 and Table 4-4. Similar to the design water surface profiles, the shear stress and velocity information is a composite of both the Sacramento and Shanghai storm centerings, with the larger of the two selected at each location. All results are referenced to both the Wood Rodgers FRWLP 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 (see Attachment C). No details were provided regarding its development. 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 03.27.2012".

Table 4-1. FRWLP Maximum Water Surface Profiles

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Upper	58.75	131.09	132.96	137.96	-	-
Upper	-	130.74	132.53	137.58	-	236800.00
Upper	58.51	130.32	132.03	137.14	132.14	235748.95
Upper	58.26	129.25	131.01	136.03	130.88	233625.38
Upper	57.95	127.30	128.94	134.46	129.32	232796.18
Upper	57.7	124.59	126.04	132.60	128.05	231347.46
Upper	57.45	122.54	123.89	130.41	126.84	230491.75
Upper	57.17	120.27	121.48	127.39	125.70	226547.44
Upper	56.94	119.72	121.02	126.81	124.95	223836.90
Upper	56.61	119.04	120.36	126.18	123.87	222092.63
Upper	56.43	118.70	120.04	125.79	123.28	221068.16
Upper	56.2	117.82	119.19	124.92	122.52	220516.06
Upper	56.02	117.18	118.55	124.13	121.93	220057.97
Upper	55.8	115.95	117.20	122.24	121.18	219786.54
Upper	55.55	115.34	116.58	121.42	120.17	219191.24
Upper	55.35	114.23	115.38	119.72	119.31	216984.11
Upper	55.03	112.90	113.96	117.87	117.92	214664.25
Upper	54.45	110.87	111.90	115.86	115.41	212925.66
Upper	54.2	110.15	111.17	115.02	114.33	210158.47
Upper	54.04	109.82	110.86	114.74	113.64	209562.52
Upper	53.84	109.01	110.08	113.99	112.77	208499.74

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Upper	53.52	107.58	108.54	112.31	111.39	205714.05
Upper	53.22	106.33	107.26	110.78	110.18	204265.70
Upper	52.89	104.81	105.71	109.17	109.40	202757.11
Upper	52.6	103.63	104.49	107.82	108.90	201183.88
Upper	52.21	102.99	103.81	107.01	108.23	199618.97
Upper	51.95	102.73	103.54	106.68	107.78	198775.45
Upper	51.35	101.83	102.74	106.02	106.73	197882.65
Upper	51.1777	101.65	102.54	105.80	106.00	195736.74
Upper	51.04	101.54	102.42	105.65	105.38	193817.41
Upper	50.84	100.98	101.90	105.18	104.23	192085.50
Upper	50.7	100.23	101.32	104.79	103.61	191278.99
Upper	50.59	98.83	100.21	104.18	102.93	190705.90
Upper	50.498	98.73	99.99	103.98	102.55	190230.79
Upper	50.496	98.67	99.94	103.90	102.54	190218.72
Upper	50.489	98.64	99.86	103.75	102.52	190176.83
Upper	50.487	98.69	99.91	103.77	102.51	190166.78
Upper	50.2	97.95	98.92	102.75	101.47	188470.72
Upper	50.06	97.10	98.12	102.03	100.96	187822.66
Upper	49.78	95.96	96.97	100.93	99.97	186662.60
Upper	49.58	95.11	96.12	100.18	99.36	185293.60
Upper	49.38	94.51	95.49	99.53	98.77	184138.90
Upper	49.21	94.12	95.11	99.22	98.27	183514.21
Upper	48.99	93.86	94.86	99.01	97.62	183056.49
Upper	48.85	93.54	94.54	98.74	97.21	182753.69
Upper	48.66	93.34	94.33	98.53	96.65	181801.88
Upper	48.39	93.02	94.02	98.24	95.85	180454.16
Upper	48.21	92.70	93.69	97.92	95.32	179460.20
Upper	48.07	92.25	93.26	97.61	95.00	179109.34
Upper	47.7	91.39	92.43	97.02	94.57	176933.60
Upper	47.55	90.83	91.92	96.72	94.39	175967.91
Upper	47.2	90.24	91.36	96.31	93.85	174102.82
Upper	47.04	90.01	91.14	96.16	93.54	173345.89
Upper	46.69	89.45	90.55	95.84	92.86	172499.41
Upper	46.53	89.16	90.22	95.66	92.55	171792.00
Honcut to Jack	46.45	89.16	90.22	95.66	92.40	171454.59
Honcut to Jack	46.2	88.94	90.02	95.46	92.00	171127.62
Honcut to Jack	45.98	88.71	89.80	95.24	91.82	170521.00
Honcut to Jack	45.71	88.22	89.34	94.85	91.60	169330.99
Honcut to Jack	45.58	87.96	89.10	94.64	91.49	168312.33
Honcut to Jack	45.44	87.79	88.94	94.49	91.37	166923.76
Honcut to Jack	45.26	87.57	88.73	94.29	91.22	165726.12
Honcut to Jack	45.03	87.39	88.57	94.12	91.03	164732.57
Honcut to Jack	44.76	87.19	88.38	93.95	90.81	163250.84
Honcut to Jack	44.6326	87.11	88.29	93.86	90.70	161213.76
Honcut to Jack	44.5	86.96	88.15	93.71	90.59	160088.12
Honcut to Jack	44.23	86.74	87.94	93.51	90.35	159311.39
Honcut to Jack	43.46	86.15	87.43	93.10	89.56	158271.13
Honcut to Jack	43.34	85.88	87.19	92.91	89.38	157627.58
Honcut to Jack	43.28	85.77	87.09	92.88	89.38	157373.66
Honcut to Jack	43.23	85.62	86.96	92.82	89.32	157104.73
Honcut to Jack	43.12	85.32	86.70	92.70	89.21	156612.83
Honcut to Jack	43.06	85.25	86.64	92.67	89.15	156460.24
Honcut to Jack	43.01	85.19	86.59	92.62	89.10	156249.06

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	42.65	85.05	86.47	92.52	88.73	153765.90
Honcut to Jack	42.47	84.85	86.29	92.36	88.55	153202.55
Honcut to Jack	42.19	84.56	86.03	92.16	88.27	152912.23
Honcut to Jack	42.01	84.50	85.98	92.12	88.13	152695.48
Honcut to Jack	41.61	84.26	85.78	91.97	87.81	152341.44
Honcut to Jack	41.55	84.16	85.69	91.90	87.76	151907.71
Honcut to Jack	41.2	83.90	85.47	91.74	87.49	150600.52
Honcut to Jack	40.7	83.73	85.33	91.64	87.09	150271.92
Honcut to Jack	40.49	83.49	85.11	91.46	86.93	149590.33
Honcut to Jack	40.19	83.28	84.93	91.33	86.71	148995.18
Honcut to Jack	39.45	82.75	84.47	90.97	86.23	147001.01
Honcut to Jack	39.23	82.42	84.20	90.73	86.09	145807.70
Honcut to Jack	38.94	82.02	83.89	90.45	85.90	144368.14
Honcut to Jack	38.71	81.77	83.69	90.26	85.75	143106.13
Honcut to Jack	38.45	81.60	83.55	90.13	85.58	141664.04
Honcut to Jack	38.27	81.47	83.45	90.03	85.46	140631.21
Honcut to Jack	37.95	81.29	83.31	89.88	85.28	138661.68
Honcut to Jack	37.68	81.13	83.18	89.74	85.13	137779.55
Honcut to Jack	37.45	80.95	83.04	89.59	85.00	136973.90
Honcut to Jack	37.29	80.80	82.91	89.44	84.91	136058.20
Honcut to Jack	36.45	80.20	82.48	89.00	84.43	134783.46
Honcut to Jack	36.35	80.01	82.34	88.86	84.37	134645.65
Honcut to Jack	36.24	79.77	82.18	88.72	84.30	134561.14
Honcut to Jack	35.78	79.22	81.79	88.34	83.99	132247.58
Honcut to Jack	35.5	79.07	81.67	88.20	83.88	130647.35
Honcut to Jack	35.25	78.97	81.60	88.12	83.77	130422.24
Honcut to Jack	34.8	78.89	81.54	88.05	83.58	129991.41
Honcut to Jack	34.5	78.80	81.47	87.97	83.46	128407.23
Honcut to Jack	34.07	78.72	81.41	87.90	83.28	127995.61
Honcut to Jack	33.5	78.63	81.34	87.82	83.03	126794.65
Honcut to Jack	33.25	78.50	81.25	87.72	82.90	125934.45
Honcut to Jack	33	78.37	81.15	87.61	82.77	124547.32
Honcut to Jack	32.75	78.21	81.03	87.46	82.65	123335.94
Honcut to Jack	32.5	78.09	80.93	87.34	82.52	122068.05
Honcut to Jack	32.25	77.98	80.85	87.24	82.39	121462.67
Honcut to Jack	32	77.82	80.73	87.09	82.26	121023.94
Honcut to Jack	31.75	77.62	80.57	86.88	82.13	119945.84
Honcut to Jack	31.5	77.43	80.42	86.68	81.98	118882.16
Honcut to Jack	31.25	77.25	80.28	86.49	81.80	117232.05
Honcut to Jack	31	77.06	80.13	86.30	81.63	115835.54
Honcut to Jack	30.75	76.88	80.00	86.12	82.65	115369.28
Honcut to Jack	30.5	76.67	79.84	85.92	82.03	114410.61
Honcut to Jack	30.25	76.45	79.67	85.70	81.08	113317.84
Honcut to Jack	30	76.13	79.42	85.35	80.84	111356.97
Honcut to Jack	29.828	75.84	79.20	85.27	80.67	110812.54
Honcut to Jack	29.826	75.86	79.21	85.27	80.67	110802.45
Honcut to Jack	29.822	75.87	79.23	85.26	80.67	110784.75
Honcut to Jack	29.821	75.88	79.24	85.25	80.66	110774.66
Honcut to Jack	29.75	75.83	79.21	85.16	80.60	109217.11
Honcut to Jack	29.5	75.72	79.13	85.06	80.36	107965.48
Jack Sl - Yuba R	29.25	75.72	79.13	85.06	80.12	106938.36
Jack Sl - Yuba R	29	75.59	78.98	84.86	79.88	105627.60
Jack Sl - Yuba R	28.75	75.35	78.71	84.50	79.65	104417.55

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Jack Sl - Yuba R	28.5	75.21	78.54	84.27	79.33	103521.79
Jack Sl - Yuba R	28.324	75.07	78.39	84.07	78.95	102627.46
Jack Sl - Yuba R	28.322	75.07	78.39	84.06	78.94	102615.67
Jack Sl - Yuba R	28.309	75.05	78.37	84.05	78.91	102537.51
Jack Sl - Yuba R	28.307	75.05	78.37	84.04	78.91	102527.14
Jack Sl - Yuba R	28.25	75.01	78.32	83.97	78.79	102281.40
Jack Sl - Yuba R	28	74.85	78.13	83.70	78.51	100798.76
Jack Sl - Yuba R	27.971	74.75	77.99	83.48	78.49	100749.02
Jack Sl - Yuba R	27.963	74.73	77.96	83.42	78.48	100696.07
Jack Sl - Yuba R	27.956	74.70	77.92	83.36	78.48	100684.10
Jack Sl - Yuba R	27.952	74.63	77.82	83.17	78.47	100652.33
Jack Sl - Yuba R	27.75	74.64	77.83	83.19	78.31	99512.10
Jack Sl - Yuba R	27.5	74.36	77.48	82.66	78.10	98174.47
Jack Sl - Yuba R	27.251	73.93	76.91	81.77	77.90	97016.29
Jack Sl - Yuba R	27.25	73.92	76.91	81.76	77.90	97011.08
Yuba R - Bear R	27	73.92	76.91	81.76	77.71	95787.83
Yuba R - Bear R	26.999	73.92	76.91	81.76	77.71	95782.80
Yuba R - Bear R	26.75	73.42	76.39	81.23	77.55	94705.78
Yuba R - Bear R	26.5	72.85	75.85	80.72	77.39	93495.05
Yuba R - Bear R	26.25	72.42	75.45	80.36	77.23	92095.83
Yuba R - Bear R	26	72.06	75.13	80.06	77.07	90634.01
Yuba R - Bear R	25.75	71.74	74.83	79.78	76.91	89136.87
Yuba R - Bear R	25.5	71.49	74.59	79.54	76.74	87728.16
Yuba R - Bear R	25.25	71.23	74.32	79.26	76.49	86208.17
Yuba R - Bear R	25	70.68	73.80	78.76	76.17	84613.00
Yuba R - Bear R	24.75	70.08	73.24	78.20	75.86	84085.03
Yuba R - Bear R	24.5	69.64	72.81	77.77	75.55	83744.43
Yuba R - Bear R	24.25	69.21	72.39	77.35	75.23	83076.25
Yuba R - Bear R	24	68.89	72.09	77.05	74.92	82269.01
Yuba R - Bear R	23.75	68.49	71.71	76.67	74.61	80891.65
Yuba R - Bear R	23.5	68.23	71.45	76.41	74.25	79494.60
Yuba R - Bear R	23.25	67.85	71.09	76.04	73.87	78032.72
Yuba R - Bear R	23	67.46	70.70	75.62	73.49	76810.25
Yuba R - Bear R	22.75	67.15	70.39	75.28	73.11	75345.95
Yuba R - Bear R	22.5	66.70	69.94	74.79	72.73	74107.24
Yuba R - Bear R	22.25	66.32	69.55	74.36	72.35	72852.32
Yuba R - Bear R	22	66.05	69.27	74.06	71.97	71497.68
Yuba R - Bear R	21.75	65.67	68.90	73.67	71.41	70018.45
Yuba R - Bear R	21.5	65.35	68.59	73.33	70.82	68712.35
Yuba R - Bear R	21.25	64.98	68.22	72.94	70.23	67330.45
Yuba R - Bear R	21	64.69	67.93	72.61	69.77	66047.23
Yuba R - Bear R	20.75	64.47	67.71	72.36	69.30	64675.51
Yuba R - Bear R	20.5	64.29	67.51	72.12	68.83	63332.45
Yuba R - Bear R	20.25	64.11	67.31	71.89	68.37	61977.06
Yuba R - Bear R	20	63.93	67.13	71.67	67.90	60460.00
Yuba R - Bear R	19.75	63.76	66.95	71.48	67.74	58852.41
Yuba R - Bear R	19.5	63.63	66.82	71.33	67.58	56862.66
Yuba R - Bear R	19.25	63.52	66.71	71.20	67.37	55516.59
Yuba R - Bear R	19	63.43	66.61	71.10	67.15	54713.04
Yuba R - Bear R	18.75	63.27	66.45	70.91	66.93	53622.77
Yuba R - Bear R	18.5	63.18	66.35	70.81	66.71	52897.52
Yuba R - Bear R	18.25	63.07	66.24	70.68	66.45	51890.28
Yuba R - Bear R	18	62.88	66.03	70.44	66.19	49704.43

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Yuba R - Bear R	17.75	62.73	65.87	70.26	65.93	49399.72
Yuba R - Bear R	17.5	62.57	65.70	70.06	65.67	49114.25
Yuba R - Bear R	17.25	62.37	65.51	69.85	65.41	48794.83
Yuba R - Bear R	17	61.95	65.08	69.39	65.16	48556.49
Yuba R - Bear R	16.75	61.67	64.79	69.07	64.90	48094.20
Yuba R - Bear R	16.5	61.37	64.47	68.71	64.39	47013.16
Yuba R - Bear R	16.25	61.15	64.23	68.45	63.87	46228.38
Yuba R - Bear R	16	60.83	63.89	68.06	63.36	45101.47
Yuba R - Bear R	15.75	60.22	63.19	67.26	62.85	43356.36
Yuba R - Bear R	15.5	59.65	62.55	66.50	62.33	41613.14
Yuba R - Bear R	15.25	59.13	61.97	65.83	61.82	40305.41
Yuba R - Bear R	15	58.73	61.50	65.26	61.31	39102.69
Yuba R - Bear R	14.75	58.35	61.10	64.84	60.60	37817.10
Yuba R - Bear R	14.5	57.98	60.67	64.34	59.88	36319.37
Yuba R - Bear R	14.25	57.44	60.03	63.58	59.24	34904.17
Yuba R - Bear R	14	57.11	59.65	63.15	58.89	33507.55
Yuba R - Bear R	13.75	56.82	59.30	62.72	58.53	32270.43
Yuba R - Bear R	13.5	56.44	58.85	62.18	58.17	31239.13
Yuba R - Bear R	13.25	56.21	58.60	61.90	57.82	29977.40
Yuba R - Bear R	13	56.15	58.53	61.85	57.46	28644.35
Yuba R - Bear R	12.75	55.99	58.35	61.65	57.11	27255.90
Yuba R - Bear R	12.5	55.91	58.28	61.58	56.82	26065.40
Yuba R - Bear R	12.25	55.66	58.04	61.32	56.59	24642.20
Reach 35	12	55.66	58.04	61.32	56.37	23313.05
Reach 35	11.75	55.53	57.90	61.19	56.15	21993.69
Reach 35	11.599	55.49	57.86	61.15	56.02	21069.77
Reach 35	11.5	55.37	57.74	61.03	55.93	20354.66
Reach 35	11.25	55.16	57.52	60.77	55.71	18182.41
Reach 35	11	54.86	57.20	60.40	55.44	16871.48
Reach 35	10.75	54.72	57.05	60.23	55.01	15547.88
Reach 35	10.5	54.48	56.79	59.92	54.57	14278.44
Reach 35	10.25	54.03	56.29	59.31	54.13	13850.18
Reach 35	10	53.83	56.07	59.06	53.69	12847.13
Reach 35	9.75	53.52	55.73	58.65	53.27	11597.74
Reach 35	9.5	53.18	55.35	58.20	52.91	10595.55
Reach 35	9.278	53.12	55.30	58.15	52.59	9814.09
Reach 35	9.265	52.82	54.94	57.69	52.56	9758.91
Reach 35	9.2	52.70	54.81	57.52	52.39	9164.29
Reach 35	9	52.35	54.42	57.06	51.55	8445.84
Reach 35	8.75	51.56	53.54	55.99	50.44	7531.76
Reach 35	8.5	51.07	53.03	55.39	49.34	6548.71
Reach 35	8.25	50.71	52.66	54.97	48.23	3573.02
Reach 35	8	49.98	51.88	53.99	47.12	2528.45
Reach 35	7.75	49.55	51.41	53.36	46.02	1733.43
Reach 35	7.55	49.33	51.16	53.03	44.98	1275.43

Table 4-2. Comparison of June 2011 vs. March 2012 Design Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE (JUN 2011)	100yr Max WSE (MAR 2012)	Diff. (ft)	200yr Max WSE (JUN 2011)	200yr Max WSE (MAR 2012)	Diff. (ft)	500yr Max WSE (JUN 2011)	500yr Max WSE (MAR 2012)	Diff. (ft)
Upper	58.51	130.32	130.32	0	131.97	132.03	0.06	137.27	137.14	-0.13
Upper	58.26	129.25	129.25	0	130.96	131.01	0.05	136.17	136.03	-0.14
Upper	57.95	127.3	127.3	0	128.89	128.94	0.05	134.60	134.46	-0.14
Upper	57.7	124.59	124.59	0	125.99	126.04	0.05	132.74	132.60	-0.14
Upper	57.45	122.54	122.54	0	123.85	123.89	0.04	130.54	130.41	-0.13
Upper	57.17	120.27	120.27	0	121.44	121.48	0.04	127.48	127.39	-0.09
Upper	56.94	119.72	119.72	0	120.97	121.02	0.05	126.88	126.81	-0.07
Upper	56.61	119.04	119.04	0	120.31	120.36	0.05	126.24	126.18	-0.06
Upper	56.43	118.7	118.7	0	120	120.04	0.04	125.86	125.79	-0.07
Upper	56.2	117.82	117.82	0	119.14	119.19	0.05	124.99	124.92	-0.07
Upper	56.02	117.18	117.18	0	118.5	118.55	0.05	124.19	124.13	-0.06
Upper	55.8	115.95	115.95	0	117.16	117.2	0.04	122.29	122.24	-0.05
Upper	55.55	115.34	115.34	0	116.54	116.58	0.04	121.47	121.42	-0.05
Upper	55.35	114.23	114.23	0	115.34	115.38	0.04	119.76	119.72	-0.04
Upper	55.03	112.9	112.9	0	113.93	113.96	0.03	117.90	117.87	-0.03
Upper	54.45	110.87	110.87	0	111.86	111.9	0.04	115.89	115.86	-0.03
Upper	54.2	110.15	110.15	0	111.13	111.17	0.04	115.05	115.02	-0.03
Upper	54.04	109.82	109.82	0	110.82	110.86	0.04	114.77	114.74	-0.03
Upper	53.84	109.01	109.01	0	110.03	110.08	0.05	114.02	113.99	-0.03
Upper	53.52	107.58	107.58	0	108.5	108.54	0.04	112.34	112.31	-0.03
Upper	53.22	106.33	106.33	0	107.23	107.26	0.03	110.81	110.78	-0.03
Upper	52.89	104.81	104.81	0	105.68	105.71	0.03	109.20	109.17	-0.03
Upper	52.6	103.63	103.63	0	104.46	104.49	0.03	107.84	107.82	-0.02
Upper	52.21	102.99	102.99	0	103.78	103.81	0.03	107.04	107.01	-0.03
Upper	51.95	102.73	102.73	0	103.51	103.54	0.03	106.70	106.68	-0.02
Upper	51.35	101.83	101.83	0	102.7	102.74	0.04	106.04	106.02	-0.02
Upper	51.1777	101.65	101.65	0	102.51	102.54	0.03	105.82	105.80	-0.02
Upper	51.04	101.54	101.54	0	102.39	102.42	0.03	105.67	105.65	-0.02
Upper	50.84	100.98	100.98	0	101.86	101.9	0.04	105.21	105.18	-0.03
Upper	50.7	100.23	100.23	0	101.28	101.32	0.04	104.82	104.79	-0.03
Upper	50.59	98.83	98.83	0	100.16	100.21	0.05	104.20	104.18	-0.02
Upper	50.498	98.73	98.73	0	99.94	99.99	0.05	104.00	103.98	-0.02
Upper	50.496	98.68	98.67	-0.01	99.89	99.94	0.05	103.93	103.90	-0.03
Upper	50.489	98.65	98.64	-0.01	99.82	99.86	0.04	103.78	103.75	-0.03
Upper	50.487	98.69	98.69	0	99.87	99.91	0.04	103.80	103.77	-0.03
Upper	50.2	97.95	97.95	0	98.89	98.92	0.03	102.77	102.75	-0.02
Upper	50.06	97.11	97.1	-0.01	98.09	98.12	0.03	102.06	102.03	-0.03
Upper	49.78	95.96	95.96	0	96.94	96.97	0.03	100.96	100.93	-0.03
Upper	49.58	95.12	95.11	-0.01	96.1	96.12	0.02	100.21	100.18	-0.03
Upper	49.38	94.52	94.51	-0.01	95.46	95.49	0.03	99.56	99.53	-0.03
Upper	49.21	94.13	94.12	-0.01	95.09	95.11	0.02	99.25	99.22	-0.03
Upper	48.99	93.87	93.86	-0.01	94.84	94.86	0.02	99.05	99.01	-0.04
Upper	48.85	93.55	93.54	-0.01	94.52	94.54	0.02	98.78	98.74	-0.04
Upper	48.66	93.35	93.34	-0.01	94.32	94.33	0.01	98.57	98.53	-0.04
Upper	48.39	93.03	93.02	-0.01	94	94.02	0.02	98.28	98.24	-0.04
Upper	48.21	92.71	92.7	-0.01	93.67	93.69	0.02	97.96	97.92	-0.04
Upper	48.07	92.27	92.25	-0.02	93.25	93.26	0.01	97.65	97.61	-0.04
Upper	47.7	91.41	91.39	-0.02	92.42	92.43	0.01	97.07	97.02	-0.05
Upper	47.55	90.85	90.83	-0.02	91.92	91.92	0	96.78	96.72	-0.06
Upper	47.2	90.27	90.24	-0.03	91.37	91.36	-0.01	96.37	96.31	-0.06
Upper	47.04	90.04	90.01	-0.03	91.15	91.14	-0.01	96.23	96.16	-0.07
Upper	46.69	89.38	89.45	0.07	90.56	90.55	-0.01	95.91	95.84	-0.07
Upper	46.53	89.03	89.16	0.13	90.24	90.22	-0.02	95.74	95.66	-0.08
Honcut to Jack	46.45	89.03	89.16	0.13	90.24	90.22	-0.02	95.74	95.66	-0.08
Honcut to Jack	46.2	88.82	88.94	0.12	90.04	90.02	-0.02	95.53	95.46	-0.07
Honcut to Jack	45.98	88.6	88.71	0.11	89.81	89.8	-0.01	95.31	95.24	-0.07
Honcut to Jack	45.71	88.11	88.22	0.11	89.35	89.34	-0.01	94.92	94.85	-0.07
Honcut to Jack	45.58	87.85	87.96	0.11	89.11	89.1	-0.01	94.71	94.64	-0.07
Honcut to Jack	45.44	87.69	87.79	0.1	88.95	88.94	-0.01	94.55	94.49	-0.06
Honcut to Jack	45.26	87.47	87.57	0.1	88.74	88.73	-0.01	94.36	94.29	-0.07
Honcut to Jack	45.03	87.3	87.39	0.09	88.57	88.57	0	94.19	94.12	-0.07
Honcut to Jack	44.76	87.1	87.19	0.09	88.38	88.38	0	94.01	93.95	-0.06
Honcut to Jack	44.6326	87.02	87.11	0.09	88.3	88.29	-0.01	93.92	93.86	-0.06
Honcut to Jack	44.5	86.87	86.96	0.09	88.15	88.15	0	93.77	93.71	-0.06
Honcut to Jack	44.23	86.65	86.74	0.09	87.94	87.94	0	93.57	93.51	-0.06
Honcut to Jack	43.46	86.07	86.15	0.08	87.42	87.43	0.01	93.15	93.10	-0.05
Honcut to Jack	43.34	85.81	85.88	0.07	87.18	87.19	0.01	92.96	92.91	-0.05
Honcut to Jack	43.28	85.7	85.77	0.07	87.08	87.09	0.01	92.93	92.88	-0.05
Honcut to Jack	43.23	85.55	85.62	0.07	86.95	86.96	0.01	92.87	92.82	-0.05
Honcut to Jack	43.12	85.25	85.32	0.07	86.68	86.7	0.02	92.74	92.70	-0.04
Honcut to Jack	43.06	85.18	85.25	0.07	86.62	86.64	0.02	92.72	92.67	-0.05
Honcut to Jack	43.01	85.12	85.19	0.07	86.57	86.59	0.02	92.66	92.62	-0.04
Honcut to Jack	42.65	84.99	85.05	0.06	86.45	86.47	0.02	92.57	92.52	-0.05
Honcut to Jack	42.47	84.79	84.85	0.06	86.26	86.29	0.03	92.40	92.36	-0.04
Honcut to Jack	42.19	84.5	84.56	0.06	86	86.03	0.03	92.20	92.16	-0.04
Honcut to Jack	42.01	84.44	84.5	0.06	85.95	85.98	0.03	92.16	92.12	-0.04

Table 4-2. Comparison of June 2011 vs. March 2012 Design Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE (JUN 2011)	100yr Max WSE (MAR 2012)	Diff. (ft)	200yr Max WSE (JUN 2011)	200yr Max WSE (MAR 2012)	Diff. (ft)	500yr Max WSE (JUN 2011)	500yr Max WSE (MAR 2012)	Diff. (ft)
Honcut to Jack	41.61	84.21	84.26	0.05	85.74	85.78	0.04	92.01	91.97	-0.04
Honcut to Jack	41.55	84.11	84.16	0.05	85.65	85.69	0.04	91.94	91.90	-0.04
Honcut to Jack	41.2	83.85	83.9	0.05	85.42	85.47	0.05	91.78	91.74	-0.04
Honcut to Jack	40.7	83.68	83.73	0.05	85.28	85.33	0.05	91.68	91.64	-0.04
Honcut to Jack	40.49	83.43	83.49	0.06	85.05	85.11	0.06	91.50	91.46	-0.04
Honcut to Jack	40.19	83.23	83.28	0.05	84.87	84.93	0.06	91.36	91.33	-0.03
Honcut to Jack	39.45	82.7	82.75	0.05	84.41	84.47	0.06	91.00	90.97	-0.03
Honcut to Jack	39.23	82.36	82.42	0.06	84.15	84.2	0.05	90.76	90.73	-0.03
Honcut to Jack	38.94	81.97	82.02	0.05	83.84	83.89	0.05	90.47	90.45	-0.02
Honcut to Jack	38.71	81.71	81.77	0.06	83.63	83.69	0.06	90.28	90.26	-0.02
Honcut to Jack	38.45	81.53	81.6	0.07	83.5	83.55	0.05	90.15	90.13	-0.02
Honcut to Jack	38.27	81.41	81.47	0.06	83.4	83.45	0.05	90.05	90.03	-0.02
Honcut to Jack	37.95	81.22	81.29	0.07	83.25	83.31	0.06	89.90	89.88	-0.02
Honcut to Jack	37.68	81.06	81.13	0.07	83.12	83.18	0.06	89.76	89.74	-0.02
Honcut to Jack	37.45	80.88	80.95	0.07	82.98	83.04	0.06	89.60	89.59	-0.01
Honcut to Jack	37.29	80.72	80.8	0.08	82.85	82.91	0.06	89.45	89.44	-0.01
Honcut to Jack	36.45	80.11	80.2	0.09	82.41	82.48	0.07	89.01	89.00	-0.01
Honcut to Jack	36.35	79.9	80.01	0.11	82.27	82.34	0.07	88.88	88.86	-0.02
Honcut to Jack	36.24	79.66	79.77	0.11	82.1	82.18	0.08	88.73	88.72	-0.01
Honcut to Jack	35.78	79.08	79.22	0.14	81.71	81.79	0.08	88.34	88.34	0.00
Honcut to Jack	35.5	78.92	79.07	0.15	81.59	81.67	0.08	88.21	88.20	-0.01
Honcut to Jack	35.25	78.82	78.97	0.15	81.51	81.6	0.09	88.13	88.12	-0.01
Honcut to Jack	34.8	78.73	78.89	0.16	81.45	81.54	0.09	88.06	88.05	-0.01
Honcut to Jack	34.5	78.64	78.8	0.16	81.38	81.47	0.09	87.98	87.97	-0.01
Honcut to Jack	34.07	78.55	78.72	0.17	81.32	81.41	0.09	87.90	87.90	0.00
Honcut to Jack	33.5	78.45	78.63	0.18	81.25	81.34	0.09	87.83	87.82	-0.01
Honcut to Jack	33.25	78.32	78.5	0.18	81.15	81.25	0.1	87.72	87.72	0.00
Honcut to Jack	33	78.18	78.37	0.19	81.05	81.15	0.1	87.61	87.61	0.00
Honcut to Jack	32.75	78	78.21	0.21	80.93	81.03	0.1	87.46	87.46	0.00
Honcut to Jack	32.5	77.87	78.09	0.22	80.83	80.93	0.1	87.34	87.34	0.00
Honcut to Jack	32.25	77.76	77.98	0.22	80.75	80.85	0.1	87.24	87.24	0.00
Honcut to Jack	32	77.58	77.82	0.24	80.62	80.73	0.11	87.08	87.09	0.01
Honcut to Jack	31.75	77.37	77.62	0.25	80.46	80.57	0.11	86.88	86.88	0.00
Honcut to Jack	31.5	77.16	77.43	0.27	80.31	80.42	0.11	86.67	86.68	0.01
Honcut to Jack	31.25	76.97	77.25	0.28	80.16	80.28	0.12	86.48	86.49	0.01
Honcut to Jack	31	76.76	77.06	0.3	80.01	80.13	0.12	86.29	86.30	0.01
Honcut to Jack	30.75	76.56	76.88	0.32	79.88	80	0.12	86.11	86.12	0.01
Honcut to Jack	30.5	76.33	76.67	0.34	79.71	79.84	0.13	85.90	85.92	0.02
Honcut to Jack	30.25	76.1	76.45	0.35	79.55	79.67	0.12	85.68	85.70	0.02
Honcut to Jack	30	75.84	76.13	0.29	79.29	79.42	0.13	85.33	85.35	0.02
Honcut to Jack	29.828	75.6	75.84	0.24	79.06	79.2	0.14	85.24	85.27	0.03
Honcut to Jack	29.826	75.62	75.86	0.24	79.08	79.21	0.13	85.24	85.27	0.03
Honcut to Jack	29.822	75.63	75.87	0.24	79.09	79.23	0.14	85.23	85.26	0.03
Honcut to Jack	29.821	75.64	75.88	0.24	79.11	79.24	0.13	85.23	85.25	0.02
Honcut to Jack	29.75	75.6	75.83	0.23	79.07	79.21	0.14	85.13	85.16	0.03
Honcut to Jack	29.5	75.51	75.72	0.21	78.99	79.13	0.14	85.03	85.06	0.03
Jack Sl - Yuba R	29.25	75.51	75.72	0.21	78.99	79.13	0.14	85.03	85.06	0.03
Jack Sl - Yuba R	29	75.39	75.59	0.2	78.85	78.98	0.13	84.83	84.86	0.03
Jack Sl - Yuba R	28.75	75.18	75.35	0.17	78.58	78.71	0.13	84.47	84.50	0.03
Jack Sl - Yuba R	28.5	75.05	75.21	0.16	78.41	78.54	0.13	84.24	84.27	0.03
Jack Sl - Yuba R	28.324	74.93	75.07	0.14	78.26	78.39	0.13	84.03	84.07	0.04
Jack Sl - Yuba R	28.322	74.92	75.07	0.15	78.26	78.39	0.13	84.03	84.06	0.03
Jack Sl - Yuba R	28.309	74.91	75.05	0.14	78.24	78.37	0.13	84.02	84.05	0.03
Jack Sl - Yuba R	28.307	74.91	75.05	0.14	78.24	78.37	0.13	84.01	84.04	0.03
Jack Sl - Yuba R	28.25	74.87	75.01	0.14	78.19	78.32	0.13	83.94	83.97	0.03
Jack Sl - Yuba R	28	74.72	74.85	0.13	78	78.13	0.13	83.67	83.70	0.03
Jack Sl - Yuba R	27.971	74.63	74.75	0.12	77.87	77.99	0.12	83.45	83.48	0.03
Jack Sl - Yuba R	27.963	74.61	74.73	0.12	77.84	77.96	0.12	83.39	83.42	0.03
Jack Sl - Yuba R	27.956	74.58	74.7	0.12	77.79	77.92	0.13	83.33	83.36	0.03
Jack Sl - Yuba R	27.952	74.52	74.63	0.11	77.7	77.82	0.12	83.14	83.17	0.03
Jack Sl - Yuba R	27.75	74.53	74.64	0.11	77.71	77.83	0.12	83.16	83.19	0.03
Jack Sl - Yuba R	27.5	74.27	74.36	0.09	77.36	77.48	0.12	82.62	82.66	0.04
Jack Sl - Yuba R	27.251	73.87	73.93	0.06	76.8	76.91	0.11	81.73	81.77	0.04
Jack Sl - Yuba R	27.25	73.87	73.92	0.05	76.8	76.91	0.11	81.73	81.76	0.03
Yuba R - Bear R	27	73.87	73.92	0.05	76.8	76.91	0.11	81.73	81.76	0.03
Yuba R - Bear R	26.999	73.87	73.92	0.05	76.8	76.91	0.11	81.72	81.76	0.04
Yuba R - Bear R	26.75	73.37	73.42	0.05	76.29	76.39	0.1	81.20	81.23	0.03
Yuba R - Bear R	26.5	72.79	72.85	0.06	75.74	75.85	0.11	80.68	80.72	0.04
Yuba R - Bear R	26.25	72.35	72.42	0.07	75.34	75.45	0.11	80.32	80.36	0.04
Yuba R - Bear R	26	71.99	72.06	0.07	75.01	75.13	0.12	80.03	80.06	0.03
Yuba R - Bear R	25.75	71.67	71.74	0.07	74.72	74.83	0.11	79.75	79.78	0.03
Yuba R - Bear R	25.5	71.41	71.49	0.08	74.47	74.59	0.12	79.50	79.54	0.04
Yuba R - Bear R	25.25	71.15	71.23	0.08	74.2	74.32	0.12	79.22	79.26	0.04
Yuba R - Bear R	25	70.59	70.68	0.09	73.69	73.8	0.11	78.72	78.76	0.04
Yuba R - Bear R	24.75	69.98	70.08	0.1	73.12	73.24	0.12	78.17	78.20	0.03
Yuba R - Bear R	24.5	69.54	69.64	0.1	72.69	72.81	0.12	77.74	77.77	0.03
Yuba R - Bear R	24.25	69.1	69.21	0.11	72.27	72.39	0.12	77.32	77.35	0.03
Yuba R - Bear R	24	68.77	68.89	0.12	71.97	72.09	0.12	77.02	77.05	0.03

Table 4-2. Comparison of June 2011 vs. March 2012 Design Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE (JUN 2011)	100yr Max WSE (MAR 2012)	Diff. (ft)	200yr Max WSE (JUN 2011)	200yr Max WSE (MAR 2012)	Diff. (ft)	500yr Max WSE (JUN 2011)	500yr Max WSE (MAR 2012)	Diff. (ft)
Yuba R - Bear R	23.75	68.36	68.49	0.13	71.58	71.71	0.13	76.63	76.67	0.04
Yuba R - Bear R	23.5	68.1	68.23	0.13	71.33	71.45	0.12	76.38	76.41	0.03
Yuba R - Bear R	23.25	67.72	67.85	0.13	70.97	71.09	0.12	76.01	76.04	0.03
Yuba R - Bear R	23	67.31	67.46	0.15	70.58	70.7	0.12	75.59	75.62	0.03
Yuba R - Bear R	22.75	67	67.15	0.15	70.26	70.39	0.13	75.25	75.28	0.03
Yuba R - Bear R	22.5	66.54	66.7	0.16	69.81	69.94	0.13	74.76	74.79	0.03
Yuba R - Bear R	22.25	66.15	66.32	0.17	69.42	69.55	0.13	74.34	74.36	0.02
Yuba R - Bear R	22	65.88	66.05	0.17	69.15	69.27	0.12	74.04	74.06	0.02
Yuba R - Bear R	21.75	65.49	65.67	0.18	68.78	68.9	0.12	73.65	73.67	0.02
Yuba R - Bear R	21.5	65.16	65.35	0.19	68.46	68.59	0.13	73.30	73.33	0.03
Yuba R - Bear R	21.25	64.78	64.98	0.2	68.09	68.22	0.13	72.92	72.94	0.02
Yuba R - Bear R	21	64.48	64.69	0.21	67.8	67.93	0.13	72.59	72.61	0.02
Yuba R - Bear R	20.75	64.26	64.47	0.21	67.58	67.71	0.13	72.34	72.36	0.02
Yuba R - Bear R	20.5	64.08	64.29	0.21	67.38	67.51	0.13	72.10	72.12	0.02
Yuba R - Bear R	20.25	63.88	64.11	0.23	67.19	67.31	0.12	71.87	71.89	0.02
Yuba R - Bear R	20	63.71	63.93	0.22	67	67.13	0.13	71.65	71.67	0.02
Yuba R - Bear R	19.75	63.53	63.76	0.23	66.83	66.95	0.12	71.46	71.48	0.02
Yuba R - Bear R	19.5	63.4	63.63	0.23	66.69	66.82	0.13	71.31	71.33	0.02
Yuba R - Bear R	19.25	63.28	63.52	0.24	66.58	66.71	0.13	71.19	71.20	0.01
Yuba R - Bear R	19	63.19	63.43	0.24	66.48	66.61	0.13	71.08	71.10	0.02
Yuba R - Bear R	18.75	63.03	63.27	0.24	66.32	66.45	0.13	70.90	70.91	0.01
Yuba R - Bear R	18.5	62.93	63.18	0.25	66.23	66.35	0.12	70.79	70.81	0.02
Yuba R - Bear R	18.25	62.82	63.07	0.25	66.12	66.24	0.12	70.66	70.68	0.02
Yuba R - Bear R	18	62.62	62.88	0.26	65.91	66.03	0.12	70.42	70.44	0.02
Yuba R - Bear R	17.75	62.47	62.73	0.26	65.75	65.87	0.12	70.25	70.26	0.01
Yuba R - Bear R	17.5	62.3	62.57	0.27	65.58	65.7	0.12	70.05	70.06	0.01
Yuba R - Bear R	17.25	62.1	62.37	0.27	65.39	65.51	0.12	69.84	69.85	0.01
Yuba R - Bear R	17	61.66	61.95	0.29	64.96	65.08	0.12	69.38	69.39	0.01
Yuba R - Bear R	16.75	61.37	61.67	0.3	64.67	64.79	0.12	69.06	69.07	0.01
Yuba R - Bear R	16.5	61.06	61.37	0.31	64.35	64.47	0.12	68.70	68.71	0.01
Yuba R - Bear R	16.25	60.84	61.15	0.31	64.12	64.23	0.11	68.44	68.45	0.01
Yuba R - Bear R	16	60.52	60.83	0.31	63.78	63.89	0.11	68.05	68.06	0.01
Yuba R - Bear R	15.75	59.9	60.22	0.32	63.08	63.19	0.11	67.26	67.26	0.00
Yuba R - Bear R	15.5	59.32	59.65	0.33	62.44	62.55	0.11	66.50	66.50	0.00
Yuba R - Bear R	15.25	58.8	59.13	0.33	61.87	61.97	0.1	65.83	65.83	0.00
Yuba R - Bear R	15	58.39	58.73	0.34	61.4	61.5	0.1	65.26	65.26	0.00
Yuba R - Bear R	14.75	58.01	58.35	0.34	61	61.1	0.1	64.83	64.84	0.01
Yuba R - Bear R	14.5	57.64	57.98	0.34	60.58	60.67	0.09	64.32	64.34	0.02
Yuba R - Bear R	14.25	57.09	57.44	0.35	59.95	60.03	0.08	63.55	63.58	0.03
Yuba R - Bear R	14	56.75	57.11	0.36	59.58	59.65	0.07	63.11	63.15	0.04
Yuba R - Bear R	13.75	56.47	56.82	0.35	59.24	59.3	0.06	62.67	62.72	0.05
Yuba R - Bear R	13.5	56.08	56.44	0.36	58.79	58.85	0.06	62.13	62.18	0.05
Yuba R - Bear R	13.25	55.86	56.21	0.35	58.54	58.6	0.06	61.84	61.90	0.06
Yuba R - Bear R	13	55.79	56.15	0.36	58.48	58.53	0.05	61.79	61.85	0.06
Yuba R - Bear R	12.75	55.62	55.99	0.37	58.31	58.35	0.04	61.59	61.65	0.06
Yuba R - Bear R	12.5	55.55	55.91	0.36	58.23	58.28	0.05	61.52	61.58	0.06
Yuba R - Bear R	12.25	55.32	55.66	0.34	58	58.04	0.04	61.29	61.32	0.03
Reach 35	12	55.32	55.66	0.34	58	58.04	0.04	61.29	61.32	0.03
Reach 35	11.75	55.19	55.53	0.34	57.88	57.9	0.02	61.16	61.19	0.03
Reach 35	11.599	55.16	55.49	0.33	57.84	57.86	0.02	61.12	61.15	0.03
Reach 35	11.5	55.04	55.37	0.33	57.73	57.74	0.01	61.01	61.03	0.02
Reach 35	11.25	54.84	55.16	0.32	57.52	57.52	0	60.76	60.77	0.01
Reach 35	11	54.55	54.86	0.31	57.21	57.2	-0.01	60.42	60.40	-0.02
Reach 35	10.75	54.42	54.72	0.3	57.07	57.05	-0.02	60.25	60.23	-0.02
Reach 35	10.5	54.19	54.48	0.29	56.82	56.79	-0.03	59.97	59.92	-0.05
Reach 35	10.25	53.77	54.03	0.26	56.34	56.29	-0.05	59.39	59.31	-0.08
Reach 35	10	53.57	53.83	0.26	56.14	56.07	-0.07	59.16	59.06	-0.10
Reach 35	9.75	53.29	53.52	0.23	55.82	55.73	-0.09	58.78	58.65	-0.13
Reach 35	9.5	52.97	53.18	0.21	55.47	55.35	-0.12	58.37	58.20	-0.17
Reach 35	9.278	52.91	53.12	0.21	55.41	55.3	-0.11	58.33	58.15	-0.18
Reach 35	9.265	52.63	52.82	0.19	55.08	54.94	-0.14	57.90	57.69	-0.21
Reach 35	9.2	52.51	52.7	0.19	54.95	54.81	-0.14	57.75	57.52	-0.23
Reach 35	9	52.19	52.35	0.16	54.6	54.42	-0.18	57.36	57.06	-0.30
Reach 35	8.75	51.26	51.56	0.3	53.6	53.54	-0.06	56.22	55.99	-0.23
Reach 35	8.5	50.58	51.07	0.49	52.91	53.03	0.12	55.47	55.39	-0.08
Reach 35	8.25	50.04	50.71	0.67	52.37	52.66	0.29	54.90	54.97	0.07
Reach 35	8	49.07	49.98	0.91	51.42	51.88	0.46	53.82	53.99	0.17
Reach 35	7.75	48.4	49.55	1.15	50.76	51.41	0.65	53.03	53.36	0.33
Reach 35	7.55	48.04	49.33	1.29	50.4	51.16	0.76	52.58	53.03	0.45
			MAX:	**1.29**		**MAX:**	**0.76**		**MAX:**	**0.45**
			MIN:	**-0.03**		**MIN:**	**-0.18**		**MIN:**	**-0.3**
			AVG:	**0.15**		**AVG:**	**0.07**		**AVG:**	**-0.01**

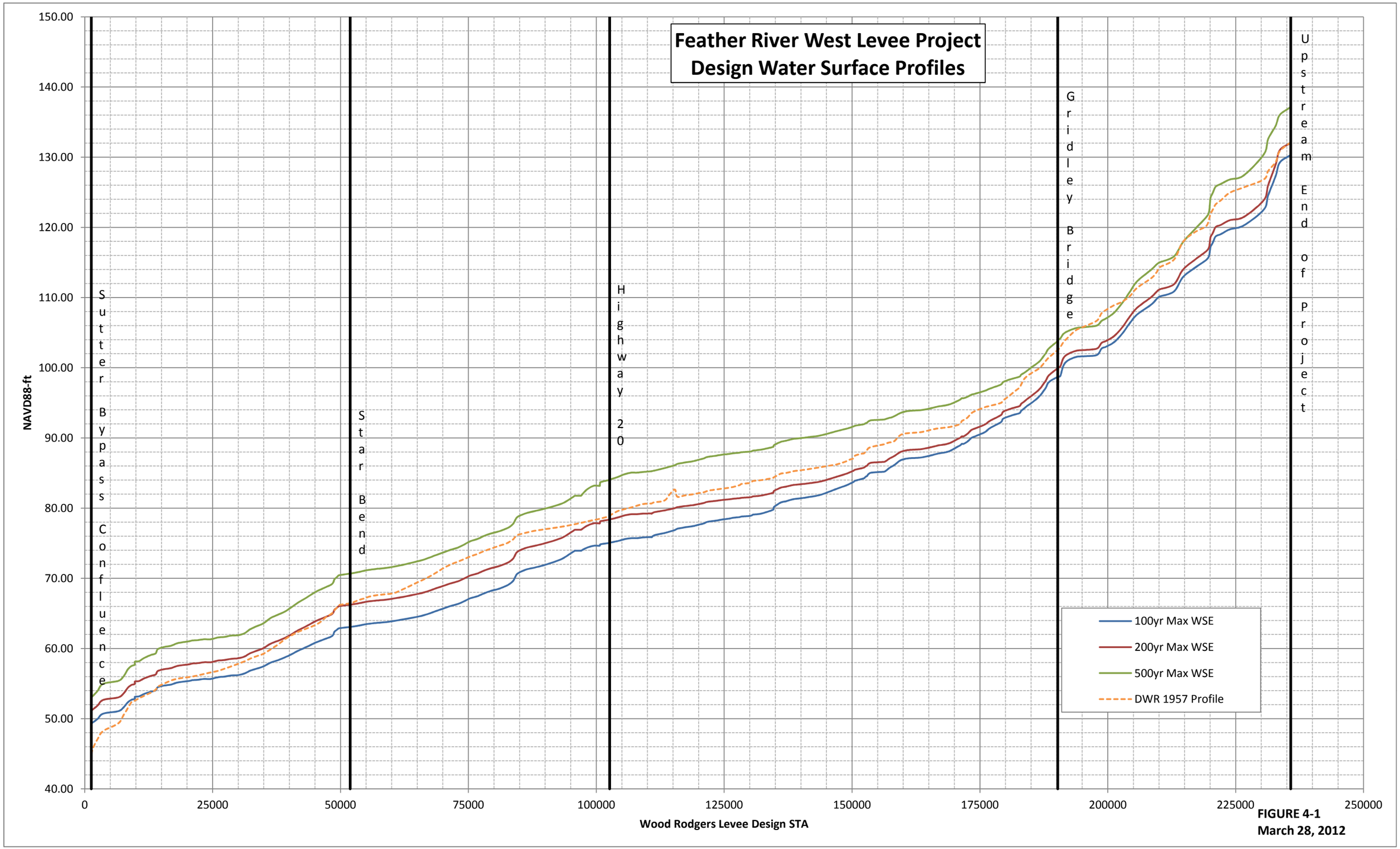


FIGURE 4-1
March 28, 2012

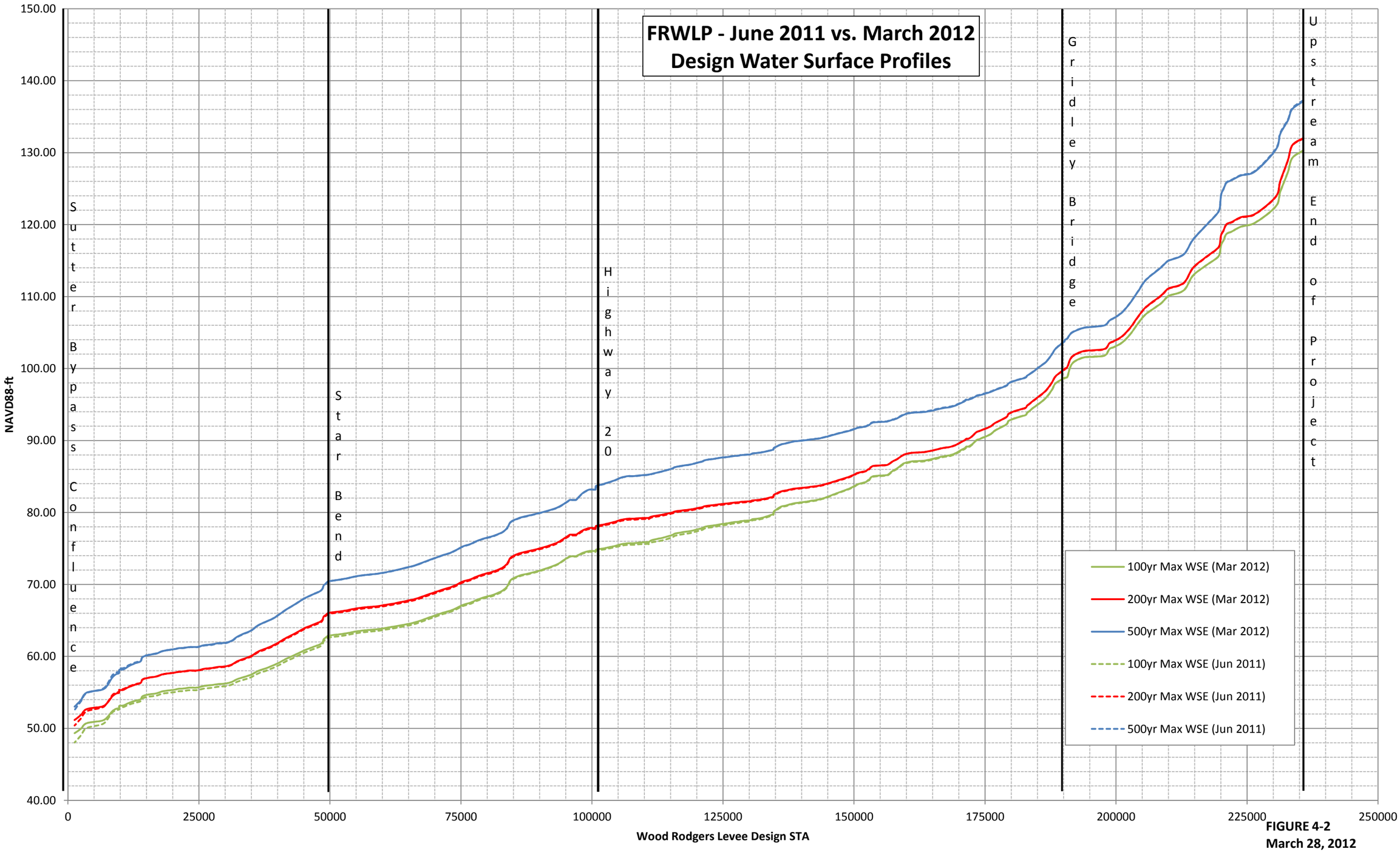


FIGURE 4-2
March 28, 2012

Table 4-3. Feather River Average Velocity Information

Feather River Reach	HEC-RAS River STA	500YR LOB Velocity (ft/s)	200YR LOB Velocity (ft/s)	100YR LOB Velocity (ft/s)	500YR Channel Velocity (ft/s)	200YR Channel Velocity (ft/s)	100YR Channel Velocity (ft/s)	500YR ROB Velocity (ft/s)	200YR ROB Velocity (ft/s)	100YR ROB Velocity (ft/s)	Wood Rodgers Design STA
Upper	58.51	1.78	0.29	0	7.97	7.55	7.32	1.84	2.25	2.03	235748.95
Upper	58.26	1.52	0	0	8.34	7	6.74	2.18	2.18	2.18	233625.38
Upper	57.95	1.97	0	0	11.21	9.86	9.18	4.99	5.04	5.04	232796.18
Upper	57.7	2.25	0	0	12.15	12.14	11.42	4.02	3.84	3.47	231347.46
Upper	57.45	1.99	0	0	11.98	10.92	10.24	2.39	0	0	230491.75
Upper	57.17	1.61	0	0	13.13	10.42	9.72	0	0	0	226547.44
Upper	56.94	1.22	0	0	7.74	6.39	6.18	3.44	3.26	3.02	223836.90
Upper	56.61	0.99	0	0	6.52	5.68	5.52	2.95	2.65	2.45	222092.63
Upper	56.43	0.74	0	0	5.77	5.04	4.95	2.69	2.37	2.21	221068.16
Upper	56.2	0	0	0	7.63	6.87	6.72	3.67	3.02	2.78	220516.06
Upper	56.02	0	0	0	8.19	6.83	6.57	3.55	2.65	2.36	220057.97
Upper	55.8	0	0	0	10.82	8.41	7.91	3.53	3.04	2.61	219786.54
Upper	55.55	0	0	0	9.18	6.83	6.39	2.91	2.18	1.85	219191.24
Upper	55.35	0	0	0	11.52	8.8	8.26	4.61	2.75	2.31	216984.11
Upper	55.03	0	0	0	10.71	8.19	7.64	2.98	1.49	1.07	214664.25
Upper	54.45	2.67	1.21	0.67	8.45	7.21	6.78	2.41	1.88	1.88	212925.66
Upper	54.2	2.89	1.74	1.4	7.86	6.6	6.32	2.1	1.43	1.11	210158.47
Upper	54.04	2.51	1.56	1.27	6.36	5.6	5.45	1.92	1.15	0.91	209562.52
Upper	53.84	2.75	1.78	1.47	8.42	7.58	7.44	2.44	1.76	1.56	208499.74
Upper	53.52	3.04	2.63	2.33	9.96	8.58	8.18	4.6	3.41	3.08	205714.05
Upper	53.22	2.7	2.21	1.87	9.46	7.77	7.42	4.04	2.75	2.43	204265.70
Upper	52.89	2.23	1.34	1.08	9.38	8.09	7.72	2.86	1.9	1.62	202757.11
Upper	52.6	2.15	1.35	1.04	8.53	7.22	6.88	3.24	2.3	2.05	201183.88
Upper	52.21	1.14	0.58	0.4	5.1	3.93	3.64	1.82	1.18	1.02	199618.97
Upper	51.95	1.27	0.81	0.72	4.75	3.81	3.56	1.61	1.05	0.91	198775.45
Upper	51.35	2	1.72	1.61	6.88	6.66	6.66	2.29	1.68	1.51	197882.65
Upper	51.1777	1.29	0.92	0.81	4.93	4.37	4.24	1.79	1.37	1.26	195736.74
Upper	51.04	1.24	0.82	0.7	4.54	3.83	3.64	0.84	0.4	0.23	193817.41
Upper	50.84	1.81	1.32	1.12	7.16	6.72	6.71	0	0	0	192085.50
Upper	50.7	2.16	1.73	1.54	7.28	8.2	8.2	0	0	0	191278.99
Upper	50.59	2.25	1.46	1.2	10.38	11.72	11.72	0	0	0	190705.90
Upper	50.498	2.13	1.39	1.35	8.86	9.71	9.71	1.2	0.7	0.36	190230.79
Upper	50.496	2.06	1.26	1.08	9.08	9.61	9.61	0.86	0	0	190218.72
Upper	50.489	1.93	1.19	1.01	8.93	9.39	9.35	0.79	0	0	190176.83
Upper	50.487	1.92	1.27	1.15	8.87	9.25	9.25	0.89	0.14	0	190166.78
Upper	50.2	2.04	2.61	2.61	9.31	8.9	7.18	1.43	1.11	0.78	188470.72
Upper	50.06	1.97	1.79	1.69	9.61	8.89	8.53	1.7	1.17	0.98	187822.66
Upper	49.78	1.81	1.44	1.23	9.4	8.48	8.16	2.98	2.28	2.05	186662.60
Upper	49.58	1.9	1.24	0.9	8.83	8.25	8	2.31	1.66	1.41	185293.60
Upper	49.38	1.64	1.04	0.72	8.06	7.28	6.99	1.71	1.05	0.79	184138.90
Upper	49.21	1.66	1	0.74	6.85	6.39	6.21	1.99	1.36	1.14	183514.21
Upper	48.99	1.81	1.18	0.96	5.26	4.98	4.9	1.93	1.33	1.13	183056.49
Upper	48.85	1.99	1.5	1.32	5.47	5.29	5.28	1.97	1.41	1.22	182753.69
Upper	48.66	1.71	1.4	1.28	4.05	3.63	3.54	2.26	1.93	1.85	181801.88
Upper	48.39	1.61	1.49	1.38	4.13	3.68	3.56	0	0	0	180454.16
Upper	48.21	1.73	1.65	1.54	5.43	4.85	4.71	2.24	1.69	1.54	179460.20
Upper	48.07	1.94	1.87	1.66	7.57	7.38	7.28	2.84	2.3	2.12	179109.34
Upper	47.7	2.02	2.03	1.78	6.72	7.1	7.22	1.09	0	0	176933.60
Upper	47.55	2.04	2.05	1.87	6.72	7.61	7.72	1.59	0.81	0.5	175967.91
Upper	47.2	1.58	1.61	1.46	4.74	4.67	4.62	1.76	1.24	1.15	174102.82
Upper	47.04	1.58	1.65	1.54	4.55	4.62	4.57	1.77	1.36	1.23	173345.89
Upper	46.69	1.68	1.91	1.78	5.86	6.67	6.75	1.86	1.46	1.26	172499.41
Upper	46.53	1.62	2.01	1.93	4.97	6.03	6.2	1.79	1.54	1.37	171792.00
Honcut to Jack	46.45	1.81	1.77	1.77	4.64	4.55	4.54	1.65	1.19	1.07	171454.59
Honcut to Jack	46.2	1.65	1.57	1.56	4.16	3.62	3.57	1.52	0.99	0.89	171127.62
Honcut to Jack	45.98	1.88	1.77	1.7	5.35	4.66	4.6	1.94	1.35	1.24	170521.00
Honcut to Jack	45.71	2.59	2.29	2.21	6.15	6.24	6.22	2.63	2.04	1.94	169330.99
Honcut to Jack	45.58	2.38	1.89	1.81	6.23	6.08	6.06	2.39	1.87	1.78	168312.33
Honcut to Jack	45.44	2.28	1.8	1.72	5.67	5.33	5.31	2.39	1.93	1.86	166923.76
Honcut to Jack	45.26	2.22	1.71	1.63	5.31	4.84	4.85	2.33	1.85	1.78	165726.12
Honcut to Jack	45.03	1.89	1.44	1.37	4.16	3.56	3.51	1.67	1.18	1.1	164732.57
Honcut to Jack	44.76	2.03	1.58	1.51	4.78	4.27	4.26	2	1.53	1.45	163250.84
Honcut to Jack	44.6326	2.1	1.67	1.61	4.6	4.1	4.08	2.08	1.65	1.6	161213.76
Honcut to Jack	44.5	2.38	2.02	1.97	4.96	4.36	4.32	2.27	1.75	1.66	160088.12
Honcut to Jack	44.23	1.96	1.58	1.49	4	3.45	3.43	2.39	1.87	1.8	159311.39
Honcut to Jack	43.46	2.44	2.05	2.01	4.7	4.67	4.85	1.24	0.32	0	158271.13
Honcut to Jack	43.34	2.18	1.82	1.78	4.46	4.44	4.61	1.41	0.98	0.87	157627.58
Honcut to Jack	43.28	1.92	1.96	1.91	3.7	4.48	4.61	1.13	0.83	0.72	157373.66
Honcut to Jack	43.23	1.83	1.9	1.86	3.67	4.56	4.74	1.24	1.06	1	157104.73
Honcut to Jack	43.12	1.77	1.91	1.87	3.51	4.56	4.75	1.47	1.43	1.35	156612.83
Honcut to Jack	43.06	1.82	2.01	1.99	3.35	4.38	4.6	1.52	1.52	1.44	156460.24
Honcut to Jack	43.01	2	1.85	1.82	3.81	4.17	4.33	1.64	1.36	1.3	156249.06
Honcut to Jack	42.65	2.02	1.69	1.66	3.79	3.66	3.76	1.91	1.58	1.53	153765.90
Honcut to Jack	42.47	2.22	1.89	1.86	4.1	3.9	3.98	2.03	1.65	1.59	153202.55
Honcut to Jack	42.19	2.24	1.91	1.88	4.44	4.33	4.45	2.05	1.67	1.6	152912.23
Honcut to Jack	42.01	1.69	1.39	1.35	3.13	2.93	2.96	1.91	1.68	1.66	152695.48
Honcut to Jack	41.61	2.11	1.8	1.75	4.53	4.59	4.76	1.56	1.24	1.14	152341.44
Honcut to Jack	41.55	2.22	1.93	1.89	4.68	4.78	4.97	1.66	1.32	1.26	151907.71

Table 4-3. Feather River Average Velocity Information

Feather River Reach	HEC-RAS River STA	500YR LOB Velocity (ft/s)	200YR LOB Velocity (ft/s)	100YR LOB Velocity (ft/s)	500YR Channel Velocity (ft/s)	200YR Channel Velocity (ft/s)	100YR Channel Velocity (ft/s)	500YR ROB Velocity (ft/s)	200YR ROB Velocity (ft/s)	100YR ROB Velocity (ft/s)	Wood Rodgers Design STA
Honcut to Jack	41.2	1.94	1.72	1.7	3.76	3.79	3.93	1.75	1.47	1.41	150600.52
Honcut to Jack	40.7	2.04	1.84	1.83	3.55	3.49	3.59	1.81	1.54	1.49	150271.92
Honcut to Jack	40.49	2.05	1.83	1.8	3.82	3.75	3.83	1.85	1.55	1.49	149590.33
Honcut to Jack	40.19	1.84	1.58	1.53	3.91	3.93	4.06	1.96	1.73	1.71	148995.18
Honcut to Jack	39.45	2.34	2.01	1.96	5.14	5.12	5.31	1.75	1.53	1.45	147001.01
Honcut to Jack	39.23	2.43	1.99	2.02	5.33	4.99	5.37	1.77	1.28	1.23	145807.70
Honcut to Jack	38.94	2.21	1.82	1.89	4.34	3.96	4.3	1.68	1.23	1.2	144368.14
Honcut to Jack	38.71	2.07	1.66	1.73	4.3	3.88	4.22	1.12	0.63	0.57	143106.13
Honcut to Jack	38.45	1.77	1.41	1.47	3.5	3.07	3.32	1.45	1.12	1.15	141664.04
Honcut to Jack	38.27	1.76	1.39	1.45	3.41	2.97	3.2	1.26	1	1.02	140631.21
Honcut to Jack	37.95	1.77	1.42	1.49	3.04	2.58	2.78	1.67	1.32	1.37	138661.68
Honcut to Jack	37.68	1.92	1.5	1.55	3.74	3.17	3.41	1.77	1.35	1.39	137779.55
Honcut to Jack	37.45	1.95	1.52	1.57	4.51	3.85	4.15	1.78	1.36	1.4	136973.90
Honcut to Jack	37.29	2.03	1.58	1.64	4.18	3.46	3.7	1.5	1.1	1.1	136058.20
Honcut to Jack	36.45	1.69	1.31	1.34	5.05	4.47	4.98	2	1.54	1.6	134783.46
Honcut to Jack	36.35	1.85	1.45	1.49	5.15	4.65	5.28	2.18	1.73	1.83	134645.65
Honcut to Jack	36.24	2.01	1.68	1.76	5.87	5.37	6.16	2.25	1.74	1.82	134561.14
Honcut to Jack	35.78	1.68	1.28	1.34	3.97	3.31	3.65	1.81	1.39	1.47	132247.58
Honcut to Jack	35.5	1.48	1.13	1.18	3.29	2.67	2.91	1.56	1.19	1.25	130647.35
Honcut to Jack	35.25	1.41	1.09	1.14	3.02	2.47	2.69	1.45	1.11	1.17	130422.24
Honcut to Jack	34.8	1.34	1.03	1.08	2.78	2.28	2.5	1.37	1.07	1.13	129991.41
Honcut to Jack	34.5	1.36	1.04	1.1	2.4	1.88	2.01	1.38	1.07	1.14	128407.23
Honcut to Jack	34.07	1.12	0.85	0.88	2.12	1.66	1.78	1.23	0.96	1.02	127995.61
Honcut to Jack	33.5	1.29	1.01	1.07	2.63	2.17	2.4	1.4	1.15	1.26	126794.65
Honcut to Jack	33.25	1.56	1.22	1.3	3.43	2.9	3.24	1.2	0.9	0.93	125934.45
Honcut to Jack	33	1.61	1.25	1.33	3.57	3.01	3.37	1.47	1.13	1.2	124547.32
Honcut to Jack	32.75	1.57	1.19	1.26	3.37	2.73	2.98	1.26	0.92	0.95	123335.94
Honcut to Jack	32.5	1.75	1.33	1.41	3.75	3.04	3.35	1.43	1.05	1.08	122068.05
Honcut to Jack	32.25	1.7	1.3	1.39	3.49	2.83	3.12	1.58	1.19	1.25	121462.67
Honcut to Jack	32	1.93	1.45	1.53	4.26	3.44	3.78	1.98	1.5	1.59	121023.94
Honcut to Jack	31.75	1.99	1.47	1.53	4.4	3.47	3.79	2.15	1.62	1.72	119945.84
Honcut to Jack	31.5	1.97	1.45	1.52	4	3.09	3.33	1.83	1.33	1.39	118882.16
Honcut to Jack	31.25	2.31	1.72	1.83	4.37	3.36	3.65	1.97	1.42	1.47	117232.05
Honcut to Jack	31	2.14	1.6	1.72	4.32	3.37	3.71	1.89	1.37	1.43	115835.54
Honcut to Jack	30.75	1.72	1.3	1.39	4.67	3.67	4.07	2.11	1.55	1.63	115369.28
Honcut to Jack	30.5	1.7	1.23	1.28	4.75	3.73	4.15	2.2	1.63	1.73	114410.61
Honcut to Jack	30.25	1.94	1.44	1.54	3.84	2.96	3.28	1.97	1.45	1.54	113317.84
Honcut to Jack	30	2.55	1.84	1.93	5.51	4.21	4.64	2.7	1.94	2.03	111356.97
Honcut to Jack	29.828	2.17	2.28	2.43	4.56	4.99	5.48	2.14	2.18	2.25	110812.54
Honcut to Jack	29.826	2.18	2.18	2.33	4.58	4.77	5.27	2.15	2.08	2.16	110802.45
Honcut to Jack	29.822	2.26	2.34	2.51	4.05	4.36	4.84	2.25	2.25	2.35	110784.75
Honcut to Jack	29.821	2.26	2.21	2.39	4.05	4.14	4.62	2.25	2.11	2.21	110774.66
Honcut to Jack	29.75	1.85	1.5	1.59	4.47	3.41	3.79	2.29	1.64	1.73	109217.11
Honcut to Jack	29.5	1.56	1.11	1.13	3.42	2.67	3.01	2.08	1.58	1.76	107965.48
Jack Sl - Yuba R	29.25	2.25	1.58	1.29	5.42	4.28	3.91	2.99	2.28	2.03	106938.36
Jack Sl - Yuba R	29	2.61	1.87	1.56	5.63	4.43	4.02	3.18	2.44	2.16	105627.60
Jack Sl - Yuba R	28.75	2.92	2.1	1.73	6.68	5.27	4.7	3.36	2.57	2.2	104417.55
Jack Sl - Yuba R	28.5	2.73	1.96	1.61	5.7	4.36	3.76	3.12	2.4	2.06	103521.79
Jack Sl - Yuba R	28.324	3.07	2.31	1.93	5.8	4.54	3.96	2.48	1.87	1.58	102627.46
Jack Sl - Yuba R	28.322	3.07	2.31	1.93	5.81	4.55	3.97	2.53	1.91	1.62	102615.67
Jack Sl - Yuba R	28.309	3.46	2.62	2.21	5.62	4.45	3.91	2.38	1.83	1.55	102537.51
Jack Sl - Yuba R	28.307	3.46	2.62	2.21	5.65	4.47	3.94	2.38	1.82	1.55	102527.14
Jack Sl - Yuba R	28.25	3.14	2.32	1.94	6.24	4.85	4.22	2.03	1.67	1.38	102281.40
Jack Sl - Yuba R	28	3.6	2.67	2.22	7.14	5.53	4.78	2.04	1.5	1.32	100798.76
Jack Sl - Yuba R	27.971	3.85	2.79	2.29	8.07	6.14	5.23	2.44	1.76	1.39	100749.02
Jack Sl - Yuba R	27.963	3.85	2.79	2.29	8.08	6.14	5.23	2.45	1.76	1.4	100696.07
Jack Sl - Yuba R	27.956	3.91	2.82	2.3	8.41	6.41	5.46	2.6	1.77	1.55	100684.10
Jack Sl - Yuba R	27.952	3.94	2.84	2.31	8.51	6.47	5.5	2.51	1.71	1.54	100652.33
Jack Sl - Yuba R	27.75	4.17	3.05	2.53	5.78	4.29	3.59	1.95	1.45	1.18	99512.10
Jack Sl - Yuba R	27.5	2.67	1.73	1.26	7.03	5.29	4.46	1.69	1.19	0.9	98174.47
Jack Sl - Yuba R	27.251	4.2	2.81	2.14	9.12	6.78	5.69	3.79	2.57	1.95	97016.29
Jack Sl - Yuba R	27.25	4.2	2.81	2.14	9.12	6.78	5.69	3.78	2.57	1.95	97011.08
Yuba R - Bear R	27	3.98	3.16	2.64	7.47	6.61	6.06	2.12	1.35	1.14	95787.83
Yuba R - Bear R	26.999	3.96	3.16	2.64	7.48	6.61	6.06	2.12	1.35	1.14	95782.80
Yuba R - Bear R	26.75	3.82	3.1	2.64	6.88	6.18	5.76	1.86	1.3	1.04	94705.78
Yuba R - Bear R	26.5	3.61	3.03	2.65	6.7	6.29	6.08	1.72	1.02	1.01	93495.05
Yuba R - Bear R	26.25	3.22	2.76	2.46	5.76	5.48	5.36	2.65	2.34	2.13	92095.83
Yuba R - Bear R	26	2.89	2.49	2.23	4.8	4.53	4.41	2.85	2.52	2.31	90634.01
Yuba R - Bear R	25.75	2.9	2.5	2.25	4.54	4.22	4.08	2.98	2.63	2.42	89136.87
Yuba R - Bear R	25.5	2.73	2.3	2.03	4.55	4.12	3.89	3.16	2.78	2.56	87728.16
Yuba R - Bear R	25.25	3.06	2.59	2.31	4.75	4.31	4.08	2.42	2.03	1.78	86208.17
Yuba R - Bear R	25	3.7	3.2	2.91	6.05	5.72	5.62	3.59	3.1	2.81	84613.00
Yuba R - Bear R	24.75	3.34	2.69	2.26	6.48	5.98	5.72	3.69	3.1	2.72	84085.03
Yuba R - Bear R	24.5	3.53	2.95	2.61	5.44	4.92	4.65	3.36	2.78	2.41	83744.43
Yuba R - Bear R	24.25	3.55	3.01	2.7	5.02	4.47	4.19	2.8	2.26	1.91	83076.25
Yuba R - Bear R	24	3.17	2.76	2.53	6.17	5.58	5.32	2.97	2.47	2.15	82269.01
Yuba R - Bear R	23.75	3.02	2.55	2.28	7.13	6.42	6.08	1.6	1.14	0.91	80891.65
Yuba R - Bear R	23.5	2.75	2.33	2.1	6.2	5.52	5.18	1.3	0.91	0.67	79494.60

Table 4-3. Feather River Average Velocity Information

Feather River Reach	HEC-RAS River STA	500YR LOB Velocity (ft/s)	200YR LOB Velocity (ft/s)	100YR LOB Velocity (ft/s)	500YR Channel Velocity (ft/s)	200YR Channel Velocity (ft/s)	100YR Channel Velocity (ft/s)	500YR ROB Velocity (ft/s)	200YR ROB Velocity (ft/s)	100YR ROB Velocity (ft/s)	Wood Rodgers Design STA
Yuba R - Bear R	23.25	3.19	2.73	2.47	7.77	7.07	6.78	3.58	3.19	2.96	78032.72
Yuba R - Bear R	23	2.98	2.49	2.22	8.28	7.41	7	2.38	1.9	1.59	76810.25
Yuba R - Bear R	22.75	2.98	2.49	2.21	8.39	7.46	7.01	2.6	2.09	1.79	75345.95
Yuba R - Bear R	22.5	3.13	2.63	2.35	9.22	8.28	7.86	2.99	2.45	2.13	74107.24
Yuba R - Bear R	22.25	3	2.5	2.22	8.73	7.76	7.3	2.85	2.36	2.06	72852.32
Yuba R - Bear R	22	2.44	2.01	1.78	6.86	6.03	5.63	2.47	2.04	1.78	71497.68
Yuba R - Bear R	21.75	2.55	2.09	1.82	8.29	7.43	7.07	2.91	2.43	2.16	70018.45
Yuba R - Bear R	21.5	2.45	2.03	1.79	7.06	6.28	5.95	1.65	1.09	0.68	68712.35
Yuba R - Bear R	21.25	2.52	2.07	1.82	7.57	6.72	6.36	1.96	1.41	1.02	67330.45
Yuba R - Bear R	21	2.43	1.98	1.73	7.42	6.48	6.05	1.47	0.97	0.61	66047.23
Yuba R - Bear R	20.75	2.44	2.01	1.77	6.91	5.98	5.57	2.61	2.09	1.81	64675.51
Yuba R - Bear R	20.5	2.36	1.92	1.69	6.26	5.3	4.82	2.33	1.81	1.54	63332.45
Yuba R - Bear R	20.25	2.21	1.8	1.59	6.17	5.24	4.79	2.51	2.06	1.77	61977.06
Yuba R - Bear R	20	2.13	1.74	1.54	5.81	4.93	4.49	2.57	2.06	1.8	60460.00
Yuba R - Bear R	19.75	1.81	1.5	1.33	5.65	4.88	4.51	2.36	1.89	1.63	58852.41
Yuba R - Bear R	19.5	1.63	1.37	1.22	5.37	4.72	4.43	2.39	1.99	1.76	56862.66
Yuba R - Bear R	19.25	1.27	1.05	0.92	4.42	3.86	3.57	2.24	1.89	1.69	55516.59
Yuba R - Bear R	19	1.3	1.08	0.96	4.08	3.53	3.26	2.2	1.86	1.66	54713.04
Yuba R - Bear R	18.75	1.68	1.41	1.25	5.55	4.84	4.47	1.88	1.58	1.41	53622.77
Yuba R - Bear R	18.5	1.68	1.42	1.26	5.35	4.66	4.3	1.78	1.49	1.32	52897.52
Yuba R - Bear R	18.25	1.78	1.49	1.31	5.93	5.16	4.74	1.97	1.66	1.47	51890.28
Yuba R - Bear R	18	2.05	1.73	1.53	6.51	5.7	5.26	1.94	1.6	1.39	49704.43
Yuba R - Bear R	17.75	1.92	1.61	1.43	6.17	5.39	4.96	1.89	1.56	1.36	49399.72
Yuba R - Bear R	17.5	2.03	1.73	1.54	6.44	5.61	5.18	1.89	1.55	1.34	49114.25
Yuba R - Bear R	17.25	2.29	1.99	1.79	6.83	6.1	5.76	2.06	1.7	1.49	48794.83
Yuba R - Bear R	17	1.81	1.47	1.22	8.44	7.65	7.3	2.62	2.21	1.95	48556.49
Yuba R - Bear R	16.75	0	0	0	7.21	6.42	6.04	2.81	2.38	2.11	48094.20
Yuba R - Bear R	16.5	2.02	1.65	1.37	7.19	6.3	5.79	2.76	2.31	2.04	47013.16
Yuba R - Bear R	16.25	2.28	1.88	1.61	7.08	6.23	5.7	2.7	2.28	2.02	46228.38
Yuba R - Bear R	16	2.54	2.12	1.83	7.64	6.76	6.22	2.87	2.44	2.15	45101.47
Yuba R - Bear R	15.75	3.37	2.82	2.39	9.82	8.7	7.86	3.07	2.64	2.53	43356.36
Yuba R - Bear R	15.5	3.68	3.06	2.65	10.35	9.06	8.19	3.52	2.96	2.56	41613.14
Yuba R - Bear R	15.25	3.17	2.62	2.24	10.68	9.28	8.35	3.21	2.69	2.34	40305.41
Yuba R - Bear R	15	2.81	2.28	1.92	9.83	8.44	7.53	3	2.49	2.12	39102.69
Yuba R - Bear R	14.75	4.08	3.39	2.91	9.72	8.55	7.8	4.22	3.57	3.13	37817.10
Yuba R - Bear R	14.5	4.11	3.39	2.9	9.72	8.44	7.61	4.12	3.48	3.05	36319.37
Yuba R - Bear R	14.25	4.38	3.6	3.07	10.77	9.31	8.36	3.7	3.06	2.55	34904.17
Yuba R - Bear R	14	4.11	3.37	2.86	11.29	9.72	8.72	4.55	3.81	3.32	33507.55
Yuba R - Bear R	13.75	4.03	3.32	2.84	10.03	8.51	7.51	3.56	2.87	2.43	32270.43
Yuba R - Bear R	13.5	4.3	3.61	3.1	10.45	9.04	8.04	3.78	3.1	2.59	31239.13
Yuba R - Bear R	13.25	4.46	3.74	3.23	9.75	8.46	7.55	4.05	3.36	2.85	29977.40
Yuba R - Bear R	13	3.58	3.03	2.63	6.97	6.03	5.37	2.91	2.39	2.01	28644.35
Yuba R - Bear R	12.75	3.34	2.83	2.47	6.63	5.76	5.16	2.81	2.33	1.97	27255.90
Yuba R - Bear R	12.5	2.87	2.42	2.1	5.81	5.04	4.51	2.34	1.91	1.6	26065.40
Yuba R - Bear R	12.25	2.9	2.5	2.26	6.32	5.67	5.29	2.42	2.03	1.77	24642.20
Reach 35	12	2.76	2.38	2.14	5.71	5.19	4.91	2.78	2.41	2.18	23313.05
Reach 35	11.75	2.71	2.35	2.13	5.37	4.88	4.62	2.69	2.35	2.14	21993.69
Reach 35	11.599	2.78	2.4	2.15	5.75	5.24	4.96	2.8	2.43	2.19	21069.77
Reach 35	11.5	2.66	2.31	2.09	5.51	5.02	4.75	2.54	2.19	1.97	20354.66
Reach 35	11.25	3.01	2.57	2.3	6.26	5.61	5.23	2.98	2.57	2.31	18182.41
Reach 35	11	3.75	3.22	2.9	7.68	6.9	6.46	3.39	2.89	2.57	16871.48
Reach 35	10.75	3.44	2.93	2.61	7.04	6.24	5.78	3.58	3.1	2.79	15547.88
Reach 35	10.5	3.86	3.31	2.97	7.46	6.58	6.07	3.52	3.01	2.68	14278.44
Reach 35	10.25	4.3	3.63	3.21	8.95	7.83	7.19	4.22	3.54	3.12	13850.18
Reach 35	10	4.36	3.7	3.29	8.63	7.54	6.91	4.35	3.68	3.27	12847.13
Reach 35	9.75	3.98	3.39	3.02	7.66	6.64	6.04	4.1	3.46	3.08	11597.74
Reach 35	9.5	4.95	4.19	3.73	9.73	8.41	7.64	4.33	3.6	3.14	10595.55
Reach 35	9.278	0	0	0	6.09	5.26	4.77	0	0	0	9814.09
Reach 35	9.265	2.08	1.62	1.32	8.08	6.94	6.27	3.83	3.16	2.74	9758.91
Reach 35	9.2	1.86	1.36	1.14	8.61	7.41	6.7	3.54	2.91	2.51	9164.29
Reach 35	9	2.28	1.75	1.28	9.43	8.16	7.43	4.25	3.52	3.05	8445.84
Reach 35	8.75	2.95	2.12	1.52	11.97	10.36	9.57	5.24	4.33	3.77	7531.76
Reach 35	8.5	3.57	2.81	2.31	11.16	9.68	9.05	4.99	4.13	3.64	6548.71
Reach 35	8.25	2.18	1.92	1.97	9.46	8.19	7.74	4.2	3.47	3.09	3573.02
Reach 35	8	3.38	2.79	2.56	11.71	10.03	9.68	4.59	3.71	3.29	2528.45
Reach 35	7.75	1.96	1.46	1.15	11.17	9.33	8.95	4.42	3.51	3.12	1733.43
Reach 35	7.55	2	1.56	1.32	10.15	8.35	7.99	4.09	3.22	2.87	1275.43

Table 4-4. Feather River Shear Stress Information

Feather River Reach	HEC-RAS River STA	500YR LOB Shear Stress (lb/sq ft)	200YR LOB Shear Stress (lb/sq ft)	100YR LOB Shear Stress (lb/sq ft)	500YR Channel Shear Stress (lb/sq ft)	200YR Channel Shear Stress (lb/sq ft)	100yr Channel Shear Stress (lb/sq ft)	500YR ROB Shear Stress (lb/sq ft)	200YR ROB Shear Stress (lb/sq ft)	100YR ROB Shear Stress (lb/sq ft)	Wood Rodgers Design STA
Upper	58.51	0.25	0.02	0	1.03	1	0.97	0.18	0.26	0.23	235748.95
Upper	58.26	0.2	0	0	1.11	0.85	0.81	0.22	0.19	0.19	233625.38
Upper	57.95	0.33	0	0	1.94	1.56	1.38	0.68	0.73	0.62	232796.18
Upper	57.7	0.42	0	0	2.27	2.46	2.22	0.5	0.62	0.49	231347.46
Upper	57.45	0.36	0	0	2.33	2.06	1.84	0.32	0	0	230491.75
Upper	57.17	0.27	0	0	2.76	1.89	1.67	0	0	0	226547.44
Upper	56.94	0.14	0	0	0.94	0.7	0.67	0.45	0.41	0.37	223836.90
Upper	56.61	0.09	0	0	0.66	0.54	0.52	0.32	0.28	0.25	222092.63
Upper	56.43	0.05	0	0	0.52	0.43	0.42	0.27	0.22	0.2	221068.16
Upper	56.2	0	0	0	0.94	0.8	0.78	0.46	0.37	0.33	220516.06
Upper	56.02	0	0	0	1.02	0.76	0.72	0.4	0.3	0.25	220057.97
Upper	55.8	0	0	0	1.87	1.19	1.07	0.39	0.42	0.33	219786.54
Upper	55.55	0	0	0	1.26	0.74	0.66	0.36	0.21	0.17	219191.24
Upper	55.35	0	0	0	2.08	1.29	1.15	0.85	0.36	0.27	216984.11
Upper	55.03	0	0	0	1.8	1.1	0.97	0.42	0.14	0.08	214664.25
Upper	54.45	0.29	0.09	0.04	1.16	0.89	0.8	0.24	0.16	0.16	212925.66
Upper	54.2	0.3	0.14	0.1	0.97	0.73	0.68	0.18	0.1	0.07	210158.47
Upper	54.04	0.23	0.11	0.08	0.66	0.54	0.53	0.14	0.06	0.04	209562.52
Upper	53.84	0.27	0.14	0.1	1.06	0.9	0.88	0.22	0.13	0.11	208499.74
Upper	53.52	0.36	0.24	0.22	1.55	1.21	1.12	0.68	0.43	0.36	205714.05
Upper	53.22	0.3	0.21	0.17	1.43	1.02	0.94	0.56	0.3	0.25	204265.70
Upper	52.89	0.34	0.14	0.11	1.4	1.1	1.02	0.49	0.26	0.2	202757.11
Upper	52.6	0.32	0.16	0.1	1.47	1.11	1.02	0.6	0.35	0.29	201183.88
Upper	52.21	0.09	0.03	0.02	0.51	0.31	0.27	0.19	0.09	0.07	199618.97
Upper	51.95	0.11	0.04	0.04	0.44	0.3	0.26	0.15	0.07	0.06	198775.45
Upper	51.35	0.18	0.13	0.11	0.73	0.72	0.72	0.23	0.15	0.12	197882.65
Upper	51.1777	0.08	0.05	0.04	0.34	0.27	0.26	0.15	0.1	0.08	195736.74
Upper	51.04	0.08	0.04	0.03	0.29	0.21	0.2	0.04	0.01	0.01	193817.41
Upper	50.84	0.18	0.11	0.09	0.72	0.67	0.67	0	0	0	192085.50
Upper	50.7	0.3	0.23	0.21	0.82	1.14	1.15	0	0	0	191278.99
Upper	50.59	0.33	0.19	0.15	1.48	2.01	2.01	0	0	0	190705.90
Upper	50.498	0.29	0.17	0.14	1.12	1.46	1.46	0.12	0.06	0.02	190230.79
Upper	50.496	0.32	0.17	0.13	1.2	1.47	1.47	0.09	0	0	190218.72
Upper	50.489	0.29	0.15	0.12	1.15	1.38	1.38	0.08	0	0	190176.83
Upper	50.487	0.28	0.15	0.12	1.12	1.31	1.31	0.09	0.01	0	190166.78
Upper	50.2	0.27	0.17	0.11	1.17	1.12	0.74	0.16	0.11	0.06	188470.72
Upper	50.06	0.27	0.18	0.16	1.3	1.17	1.1	0.22	0.13	0.1	187822.66
Upper	49.78	0.24	0.15	0.1	1.24	1.07	1	0.5	0.33	0.28	186662.60
Upper	49.58	0.21	0.13	0.08	1.1	1.02	0.98	0.33	0.21	0.16	185293.60
Upper	49.38	0.19	0.1	0.06	0.94	0.81	0.76	0.21	0.1	0.07	184138.90
Upper	49.21	0.18	0.09	0.05	0.67	0.62	0.6	0.24	0.14	0.11	183514.21
Upper	48.99	0.14	0.08	0.06	0.44	0.42	0.41	0.16	0.09	0.07	183056.49
Upper	48.85	0.16	0.11	0.09	0.47	0.47	0.47	0.16	0.1	0.08	182753.69
Upper	48.66	0.11	0.09	0.08	0.26	0.23	0.22	0.18	0.14	0.13	181801.88
Upper	48.39	0.11	0.09	0.09	0.28	0.24	0.23	0	0	0	180454.16
Upper	48.21	0.13	0.1	0.09	0.45	0.38	0.36	0.19	0.12	0.11	179460.20
Upper	48.07	0.17	0.17	0.14	0.82	0.81	0.8	0.3	0.23	0.2	179109.34
Upper	47.7	0.19	0.19	0.17	0.7	0.81	0.85	0.07	0	0	176933.60
Upper	47.55	0.18	0.18	0.18	0.68	0.93	0.97	0.13	0.05	0.03	175967.91
Upper	47.2	0.11	0.12	0.1	0.35	0.36	0.36	0.13	0.08	0.07	174102.82
Upper	47.04	0.11	0.11	0.11	0.32	0.35	0.36	0.13	0.09	0.08	173345.89
Upper	46.69	0.12	0.14	0.15	0.48	0.66	0.68	0.14	0.11	0.09	172499.41
Upper	46.53	0.11	0.16	0.17	0.36	0.57	0.61	0.13	0.12	0.1	171792.00
Honcut to Jack	46.45	0.14	0.14	0.14	0.32	0.34	0.34	0.13	0.08	0.07	171454.59
Honcut to Jack	46.2	0.12	0.09	0.09	0.26	0.21	0.21	0.11	0.06	0.05	171127.62
Honcut to Jack	45.98	0.16	0.14	0.14	0.41	0.33	0.33	0.16	0.09	0.08	170521.00
Honcut to Jack	45.71	0.29	0.24	0.24	0.57	0.62	0.62	0.29	0.21	0.2	169330.99
Honcut to Jack	45.58	0.24	0.17	0.16	0.54	0.55	0.55	0.24	0.17	0.16	168312.33
Honcut to Jack	45.44	0.21	0.15	0.14	0.45	0.43	0.43	0.23	0.17	0.16	166923.76
Honcut to Jack	45.26	0.2	0.14	0.13	0.41	0.36	0.37	0.22	0.16	0.15	165726.12
Honcut to Jack	45.03	0.14	0.09	0.09	0.25	0.2	0.19	0.12	0.07	0.06	164732.57
Honcut to Jack	44.76	0.16	0.11	0.11	0.32	0.28	0.28	0.16	0.11	0.1	163250.84
Honcut to Jack	44.6326	0.17	0.12	0.12	0.3	0.25	0.25	0.17	0.12	0.11	161213.76
Honcut to Jack	44.5	0.23	0.17	0.17	0.37	0.31	0.31	0.21	0.14	0.13	160088.12
Honcut to Jack	44.23	0.16	0.11	0.11	0.36	0.28	0.28	0.22	0.15	0.14	159311.39
Honcut to Jack	43.46	0.24	0.2	0.2	0.49	0.51	0.56	0.09	0.01	0	158271.13
Honcut to Jack	43.34	0.19	0.15	0.15	0.43	0.45	0.49	0.1	0.06	0.05	157627.58
Honcut to Jack	43.28	0.15	0.18	0.17	0.3	0.46	0.5	0.07	0.05	0.04	157373.66
Honcut to Jack	43.23	0.13	0.17	0.17	0.29	0.48	0.52	0.08	0.07	0.07	157104.73
Honcut to Jack	43.12	0.12	0.17	0.17	0.26	0.47	0.52	0.09	0.11	0.1	156612.83
Honcut to Jack	43.06	0.13	0.19	0.19	0.25	0.45	0.51	0.1	0.12	0.12	156460.24
Honcut to Jack	43.01	0.16	0.15	0.15	0.31	0.39	0.43	0.12	0.1	0.09	156249.06
Honcut to Jack	42.65	0.16	0.12	0.12	0.31	0.3	0.32	0.14	0.11	0.11	153765.90
Honcut to Jack	42.47	0.22	0.18	0.18	0.37	0.36	0.38	0.19	0.15	0.14	153202.55
Honcut to Jack	42.19	0.23	0.19	0.19	0.43	0.43	0.46	0.2	0.15	0.15	152912.23
Honcut to Jack	42.01	0.13	0.1	0.1	0.22	0.21	0.22	0.16	0.13	0.14	152695.48
Honcut to Jack	41.61	0.2	0.17	0.17	0.43	0.47	0.52	0.13	0.1	0.09	152341.44

Table 4-4. Feather River Shear Stress Information

Feather River Reach	HEC-RAS River STA	500YR LOB Shear Stress (lb/sq ft)	200YR LOB Shear Stress (lb/sq ft)	100YR LOB Shear Stress (lb/sq ft)	500YR Channel Shear Stress (lb/sq ft)	200YR Channel Shear Stress (lb/sq ft)	100yr Channel Shear Stress (lb/sq ft)	500YR ROB Shear Stress (lb/sq ft)	200YR ROB Shear Stress (lb/sq ft)	100YR ROB Shear Stress (lb/sq ft)	Wood Rodgers Design STA
Honcut to Jack	41.55	0.23	0.2	0.2	0.47	0.52	0.57	0.15	0.11	0.11	151907.71
Honcut to Jack	41.2	0.17	0.15	0.15	0.31	0.33	0.36	0.14	0.12	0.12	150600.52
Honcut to Jack	40.7	0.18	0.16	0.17	0.28	0.29	0.31	0.15	0.13	0.12	150271.92
Honcut to Jack	40.49	0.18	0.16	0.16	0.31	0.32	0.34	0.16	0.13	0.12	149590.33
Honcut to Jack	40.19	0.15	0.13	0.13	0.32	0.34	0.37	0.17	0.15	0.15	148995.18
Honcut to Jack	39.45	0.28	0.24	0.24	0.56	0.59	0.64	0.18	0.16	0.15	147001.01
Honcut to Jack	39.23	0.3	0.23	0.25	0.59	0.55	0.64	0.19	0.12	0.12	145807.70
Honcut to Jack	38.94	0.24	0.19	0.21	0.4	0.36	0.43	0.16	0.1	0.11	144368.14
Honcut to Jack	38.71	0.21	0.15	0.17	0.38	0.33	0.39	0.08	0.04	0.03	143106.13
Honcut to Jack	38.45	0.15	0.11	0.12	0.25	0.21	0.25	0.11	0.08	0.08	141664.04
Honcut to Jack	38.27	0.15	0.1	0.12	0.24	0.2	0.23	0.09	0.06	0.07	140631.21
Honcut to Jack	37.95	0.15	0.11	0.12	0.2	0.16	0.19	0.14	0.1	0.11	138661.68
Honcut to Jack	37.68	0.18	0.12	0.13	0.29	0.22	0.26	0.15	0.1	0.11	137779.55
Honcut to Jack	37.45	0.23	0.16	0.17	0.41	0.31	0.37	0.2	0.13	0.15	136973.90
Honcut to Jack	37.29	0.25	0.17	0.19	0.37	0.27	0.32	0.16	0.1	0.1	136058.20
Honcut to Jack	36.45	0.21	0.14	0.16	0.53	0.44	0.56	0.27	0.18	0.2	134783.46
Honcut to Jack	36.35	0.25	0.18	0.2	0.57	0.5	0.66	0.32	0.23	0.27	134645.65
Honcut to Jack	36.24	0.29	0.23	0.27	0.72	0.64	0.86	0.34	0.24	0.28	134561.14
Honcut to Jack	35.78	0.18	0.12	0.13	0.32	0.24	0.3	0.2	0.13	0.15	132247.58
Honcut to Jack	35.5	0.13	0.09	0.1	0.22	0.15	0.19	0.14	0.09	0.11	130647.35
Honcut to Jack	35.25	0.15	0.09	0.11	0.23	0.16	0.2	0.15	0.1	0.11	130422.24
Honcut to Jack	34.8	0.13	0.09	0.1	0.2	0.14	0.18	0.14	0.09	0.11	129991.41
Honcut to Jack	34.5	0.13	0.08	0.1	0.15	0.1	0.12	0.13	0.09	0.1	128407.23
Honcut to Jack	34.07	0.09	0.06	0.07	0.12	0.08	0.1	0.11	0.07	0.08	127995.61
Honcut to Jack	33.5	0.12	0.08	0.1	0.18	0.13	0.16	0.14	0.1	0.12	126794.65
Honcut to Jack	33.25	0.18	0.12	0.14	0.29	0.22	0.28	0.12	0.07	0.08	125934.45
Honcut to Jack	33	0.19	0.12	0.15	0.32	0.24	0.3	0.16	0.11	0.13	124547.32
Honcut to Jack	32.75	0.18	0.11	0.13	0.28	0.19	0.24	0.13	0.07	0.08	123335.94
Honcut to Jack	32.5	0.22	0.14	0.16	0.34	0.24	0.3	0.16	0.09	0.11	122068.05
Honcut to Jack	32.25	0.2	0.13	0.15	0.31	0.21	0.26	0.18	0.11	0.13	121462.67
Honcut to Jack	32	0.27	0.17	0.19	0.45	0.3	0.38	0.28	0.17	0.2	121023.94
Honcut to Jack	31.75	0.28	0.17	0.19	0.48	0.31	0.38	0.32	0.19	0.23	119945.84
Honcut to Jack	31.5	0.28	0.16	0.18	0.4	0.25	0.3	0.25	0.14	0.16	118882.16
Honcut to Jack	31.25	0.36	0.22	0.25	0.48	0.3	0.36	0.29	0.16	0.18	117232.05
Honcut to Jack	31	0.31	0.19	0.23	0.46	0.29	0.36	0.26	0.15	0.17	115835.54
Honcut to Jack	30.75	0.24	0.15	0.17	0.54	0.35	0.44	0.32	0.19	0.22	115369.28
Honcut to Jack	30.5	0.24	0.13	0.15	0.56	0.36	0.46	0.35	0.2	0.24	114410.61
Honcut to Jack	30.25	0.26	0.15	0.19	0.39	0.24	0.31	0.27	0.16	0.19	113317.84
Honcut to Jack	30	0.45	0.25	0.29	0.76	0.46	0.58	0.49	0.27	0.31	111356.97
Honcut to Jack	29.828	0.32	0.37	0.44	0.52	0.65	0.8	0.31	0.35	0.39	110812.54
Honcut to Jack	29.826	0.32	0.34	0.41	0.52	0.59	0.74	0.31	0.32	0.36	110802.45
Honcut to Jack	29.822	0.25	0.28	0.34	0.41	0.49	0.63	0.25	0.27	0.31	110784.75
Honcut to Jack	29.821	0.25	0.25	0.31	0.41	0.45	0.57	0.25	0.24	0.28	110774.66
Honcut to Jack	29.75	0.17	0.11	0.14	0.39	0.24	0.3	0.24	0.13	0.16	109217.11
Honcut to Jack	29.5	0.11	0.06	0.07	0.2	0.13	0.17	0.16	0.1	0.13	107965.48
Jack Sl - Yuba R	29.25	0.22	0.12	0.09	0.47	0.3	0.26	0.33	0.21	0.17	106938.36
Jack Sl - Yuba R	29	0.28	0.16	0.12	0.52	0.34	0.29	0.38	0.24	0.2	105627.60
Jack Sl - Yuba R	28.75	0.36	0.2	0.15	0.71	0.46	0.38	0.44	0.27	0.21	104417.55
Jack Sl - Yuba R	28.5	0.3	0.17	0.12	0.52	0.32	0.24	0.37	0.23	0.17	103521.79
Jack Sl - Yuba R	28.324	0.36	0.23	0.17	0.57	0.37	0.29	0.28	0.17	0.13	102627.46
Jack Sl - Yuba R	28.322	0.36	0.23	0.17	0.58	0.37	0.29	0.29	0.18	0.13	102615.67
Jack Sl - Yuba R	28.309	0.33	0.21	0.16	0.54	0.35	0.28	0.26	0.16	0.12	102537.51
Jack Sl - Yuba R	28.307	0.33	0.21	0.16	0.54	0.36	0.29	0.26	0.16	0.12	102527.14
Jack Sl - Yuba R	28.25	0.33	0.19	0.14	0.51	0.32	0.25	0.17	0.12	0.09	102281.40
Jack Sl - Yuba R	28	0.42	0.25	0.18	0.64	0.4	0.31	0.18	0.1	0.08	100798.76
Jack Sl - Yuba R	27.971	0.49	0.28	0.19	0.82	0.49	0.36	0.25	0.14	0.09	100749.02
Jack Sl - Yuba R	27.963	0.5	0.28	0.19	0.82	0.49	0.37	0.25	0.14	0.09	100696.07
Jack Sl - Yuba R	27.956	0.52	0.29	0.2	0.89	0.54	0.4	0.28	0.14	0.1	100684.10
Jack Sl - Yuba R	27.952	0.53	0.29	0.2	0.91	0.55	0.41	0.27	0.14	0.11	100652.33
Jack Sl - Yuba R	27.75	0.28	0.15	0.11	0.42	0.24	0.17	0.15	0.09	0.06	99512.10
Jack Sl - Yuba R	27.5	0.28	0.13	0.08	0.66	0.39	0.29	0.14	0.08	0.05	98174.47
Jack Sl - Yuba R	27.251	0.68	0.33	0.21	1.4	0.81	0.59	0.58	0.29	0.18	97016.29
Jack Sl - Yuba R	27.25	0.68	0.33	0.21	1.41	0.81	0.59	0.58	0.29	0.18	97011.08
Yuba R - Bear R	27	0.6	0.41	0.31	1.35	1.1	0.95	0.23	0.12	0.09	95787.83
Yuba R - Bear R	26.999	0.6	0.41	0.31	1.36	1.1	0.95	0.23	0.12	0.09	95782.80
Yuba R - Bear R	26.75	0.55	0.4	0.31	1.17	0.98	0.88	0.19	0.11	0.08	94705.78
Yuba R - Bear R	26.5	0.5	0.39	0.32	1.1	1.01	0.97	0.16	0.07	0.07	93495.05
Yuba R - Bear R	26.25	0.39	0.31	0.27	0.82	0.77	0.76	0.29	0.24	0.22	92095.83
Yuba R - Bear R	26	0.31	0.25	0.22	0.59	0.55	0.54	0.31	0.26	0.23	90634.01
Yuba R - Bear R	25.75	0.31	0.25	0.22	0.53	0.49	0.47	0.32	0.27	0.24	89136.87
Yuba R - Bear R	25.5	0.26	0.2	0.17	0.5	0.43	0.39	0.33	0.27	0.24	87728.16
Yuba R - Bear R	25.25	0.33	0.26	0.22	0.57	0.49	0.45	0.24	0.18	0.15	86208.17
Yuba R - Bear R	25	0.51	0.42	0.37	0.93	0.87	0.87	0.49	0.4	0.35	84613.00
Yuba R - Bear R	24.75	0.44	0.32	0.25	1.05	0.93	0.88	0.51	0.4	0.33	84085.03
Yuba R - Bear R	24.5	0.46	0.35	0.3	0.78	0.67	0.62	0.43	0.32	0.26	83744.43
Yuba R - Bear R	24.25	0.45	0.35	0.29	0.66	0.55	0.5	0.31	0.22	0.18	83076.25
Yuba R - Bear R	24	0.39	0.32	0.28	0.52	0.45	0.43	0.27	0.2	0.17	82269.01

Table 4-4. Feather River Shear Stress Information

Feather River Reach	HEC-RAS River STA	500YR LOB Shear Stress (lb/sq ft)	200YR LOB Shear Stress (lb/sq ft)	100YR LOB Shear Stress (lb/sq ft)	500YR Channel Shear Stress (lb/sq ft)	200YR Channel Shear Stress (lb/sq ft)	100yr Channel Shear Stress (lb/sq ft)	500YR ROB Shear Stress (lb/sq ft)	200YR ROB Shear Stress (lb/sq ft)	100YR ROB Shear Stress (lb/sq ft)	Wood Rodgers Design STA
Yuba R - Bear R	23.75	0.37	0.28	0.24	0.64	0.55	0.51	0.13	0.08	0.06	80891.65
Yuba R - Bear R	23.5	0.33	0.25	0.21	0.5	0.42	0.38	0.09	0.05	0.03	79494.60
Yuba R - Bear R	23.25	0.46	0.35	0.3	0.77	0.66	0.63	0.46	0.38	0.35	78032.72
Yuba R - Bear R	23	0.44	0.32	0.27	0.82	0.69	0.63	0.24	0.17	0.13	76810.25
Yuba R - Bear R	22.75	0.45	0.33	0.27	0.83	0.68	0.62	0.28	0.19	0.15	75345.95
Yuba R - Bear R	22.5	0.53	0.39	0.33	1.02	0.86	0.79	0.36	0.26	0.21	74107.24
Yuba R - Bear R	22.25	0.47	0.35	0.28	0.91	0.74	0.68	0.32	0.24	0.19	72852.32
Yuba R - Bear R	22	0.35	0.26	0.21	0.59	0.48	0.43	0.24	0.18	0.14	71497.68
Yuba R - Bear R	21.75	0.41	0.3	0.25	0.83	0.69	0.64	0.33	0.25	0.21	70018.45
Yuba R - Bear R	21.5	0.4	0.3	0.26	0.65	0.54	0.5	0.14	0.07	0.04	68712.35
Yuba R - Bear R	21.25	0.41	0.31	0.26	0.72	0.59	0.55	0.18	0.11	0.07	67330.45
Yuba R - Bear R	21	0.38	0.28	0.23	0.67	0.53	0.48	0.11	0.06	0.03	66047.23
Yuba R - Bear R	20.75	0.38	0.27	0.22	0.59	0.46	0.41	0.26	0.18	0.14	64675.51
Yuba R - Bear R	20.5	0.35	0.25	0.2	0.48	0.36	0.31	0.21	0.14	0.11	63332.45
Yuba R - Bear R	20.25	0.34	0.24	0.2	0.47	0.36	0.31	0.23	0.17	0.13	61977.06
Yuba R - Bear R	20	0.31	0.22	0.18	0.42	0.32	0.27	0.24	0.16	0.13	60460.00
Yuba R - Bear R	19.75	0.26	0.19	0.16	0.39	0.3	0.27	0.2	0.14	0.11	58852.41
Yuba R - Bear R	19.5	0.21	0.16	0.13	0.35	0.28	0.25	0.2	0.15	0.12	56862.66
Yuba R - Bear R	19.25	0.15	0.11	0.09	0.25	0.19	0.17	0.17	0.13	0.11	55516.59
Yuba R - Bear R	19	0.15	0.11	0.09	0.22	0.17	0.15	0.16	0.12	0.1	54713.04
Yuba R - Bear R	18.75	0.26	0.19	0.16	0.39	0.3	0.27	0.26	0.19	0.16	53622.77
Yuba R - Bear R	18.5	0.24	0.17	0.14	0.35	0.28	0.25	0.23	0.17	0.14	52897.52
Yuba R - Bear R	18.25	0.26	0.19	0.15	0.43	0.34	0.29	0.28	0.21	0.17	51890.28
Yuba R - Bear R	18	0.34	0.25	0.21	0.52	0.41	0.36	0.28	0.21	0.17	49704.43
Yuba R - Bear R	17.75	0.3	0.22	0.18	0.46	0.37	0.32	0.27	0.19	0.16	49399.72
Yuba R - Bear R	17.5	0.34	0.26	0.21	0.51	0.4	0.35	0.27	0.2	0.16	49114.25
Yuba R - Bear R	17.25	0.39	0.31	0.26	0.66	0.54	0.5	0.33	0.24	0.2	48794.83
Yuba R - Bear R	17	0.31	0.22	0.17	1.03	0.87	0.82	0.54	0.41	0.34	48556.49
Yuba R - Bear R	16.75	0	0	0	0.76	0.62	0.56	0.49	0.37	0.31	48094.20
Yuba R - Bear R	16.5	0.29	0.2	0.15	0.73	0.58	0.5	0.46	0.34	0.28	47013.16
Yuba R - Bear R	16.25	0.34	0.24	0.19	0.7	0.56	0.48	0.43	0.32	0.26	46228.38
Yuba R - Bear R	16	0.42	0.31	0.24	0.83	0.67	0.58	0.5	0.38	0.31	45101.47
Yuba R - Bear R	15.75	0.73	0.54	0.41	1.37	1.11	0.93	0.63	0.49	0.45	43356.36
Yuba R - Bear R	15.5	0.86	0.63	0.49	1.54	1.22	1.03	0.8	0.6	0.47	41613.14
Yuba R - Bear R	15.25	0.64	0.46	0.35	1.14	0.89	0.74	0.65	0.48	0.38	40305.41
Yuba R - Bear R	15	0.52	0.36	0.27	0.97	0.74	0.61	0.57	0.41	0.31	39102.69
Yuba R - Bear R	14.75	0.51	0.38	0.29	0.96	0.77	0.66	0.54	0.41	0.33	37817.10
Yuba R - Bear R	14.5	0.51	0.37	0.28	0.95	0.73	0.61	0.51	0.38	0.31	36319.37
Yuba R - Bear R	14.25	0.6	0.43	0.33	1.18	0.91	0.75	0.47	0.34	0.25	34904.17
Yuba R - Bear R	14	0.52	0.37	0.28	1	0.76	0.63	0.6	0.44	0.35	33507.55
Yuba R - Bear R	13.75	0.48	0.34	0.26	0.8	0.59	0.47	0.4	0.27	0.21	32270.43
Yuba R - Bear R	13.5	0.55	0.41	0.31	0.89	0.68	0.56	0.46	0.32	0.24	31239.13
Yuba R - Bear R	13.25	0.49	0.36	0.28	0.77	0.59	0.48	0.42	0.3	0.23	29977.40
Yuba R - Bear R	13	0.37	0.28	0.22	0.51	0.4	0.32	0.27	0.2	0.15	28644.35
Yuba R - Bear R	12.75	0.32	0.24	0.19	0.46	0.36	0.29	0.25	0.18	0.14	27255.90
Yuba R - Bear R	12.5	0.24	0.18	0.14	0.35	0.27	0.22	0.18	0.12	0.09	26065.40
Yuba R - Bear R	12.25	0.25	0.19	0.16	0.41	0.34	0.3	0.19	0.14	0.11	24642.20
Reach 35	12	0.16	0.13	0.11	0.28	0.24	0.22	0.17	0.13	0.11	23313.05
Reach 35	11.75	0.15	0.12	0.11	0.25	0.21	0.2	0.15	0.12	0.11	21993.69
Reach 35	11.599	0.17	0.13	0.11	0.28	0.24	0.22	0.17	0.13	0.12	21069.77
Reach 35	11.5	0.15	0.12	0.1	0.25	0.22	0.2	0.14	0.11	0.09	20354.66
Reach 35	11.25	0.19	0.14	0.12	0.32	0.27	0.24	0.18	0.14	0.12	18182.41
Reach 35	11	0.29	0.23	0.19	0.49	0.4	0.36	0.25	0.19	0.16	16871.48
Reach 35	10.75	0.24	0.18	0.15	0.4	0.33	0.29	0.26	0.2	0.17	15547.88
Reach 35	10.5	0.3	0.23	0.19	0.45	0.36	0.32	0.26	0.2	0.16	14278.44
Reach 35	10.25	0.38	0.29	0.23	0.66	0.52	0.45	0.37	0.28	0.22	13850.18
Reach 35	10	0.38	0.29	0.24	0.61	0.48	0.41	0.38	0.29	0.24	12847.13
Reach 35	9.75	0.33	0.25	0.21	0.51	0.4	0.34	0.35	0.26	0.21	11597.74
Reach 35	9.5	0.48	0.35	0.29	0.75	0.57	0.48	0.39	0.28	0.22	10595.55
Reach 35	9.278	0	0	0	0.34	0.26	0.22	0	0	0	9814.09
Reach 35	9.265	0.12	0.08	0.06	0.54	0.41	0.34	0.31	0.22	0.17	9758.91
Reach 35	9.2	0.13	0.08	0.06	0.62	0.47	0.39	0.33	0.24	0.18	9164.29
Reach 35	9	0.19	0.12	0.07	0.94	0.72	0.61	0.49	0.35	0.27	8445.84
Reach 35	8.75	0.32	0.18	0.11	1.52	1.16	1.02	0.75	0.54	0.43	7531.76
Reach 35	8.5	0.41	0.27	0.2	1.32	1.02	0.91	0.67	0.48	0.4	6548.71
Reach 35	8.25	0.18	0.14	0.15	0.95	0.73	0.67	0.48	0.34	0.29	3573.02
Reach 35	8	0.38	0.27	0.24	1.44	1.07	1.02	0.6	0.41	0.35	2528.45
Reach 35	7.75	0.16	0.1	0.07	1.28	0.91	0.86	0.54	0.36	0.3	1733.43
Reach 35	7.55	0.16	0.1	0.08	1.05	0.72	0.68	0.46	0.3	0.25	1275.43

5 FREEBOARD ANALYSIS

For the freeboard analysis, PBI compared the final FRWLP design water surface profiles to both the CVFED LiDAR Top of Levee and the November 2011 Wood Rodgers field survey[16]. The results of the analysis are shown in Table 5-1 and Figure 5-1. The results show that there are no freeboard deficiencies for the 100-year event. However, for the 200-year event, the following sections do not have 3 feet of available freeboard:

- At STA 1,131+00 (railroad crossing)
- STA 555+00 to 557+00 (up to 0.1' deficient)
- STA 70+00 to 106+00 (includes Hwy 99)
- STA 34+00 to 38+00
- STA 27+00 to 29+00

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
236800.00		139.41	130.74	132.53	137.58				8.67	6.88	1.83
236700.00		139.43	130.70	132.48	137.54				8.73	6.94	1.89
236600.00		139.21	130.66	132.43	137.50				8.55	6.78	1.72
236500.00	138.91	138.82	130.62	132.39	137.45	8.29	6.52	1.46	8.20	6.44	1.37
236400.00		139.05	130.58	132.34	137.41				8.47	6.71	1.64
236300.00		139.42	130.54	132.29	137.37				8.88	7.13	2.05
236200.00		138.85	130.50	132.24	137.33				8.35	6.60	1.52
236100.00		138.53	130.46	132.20	137.29				8.07	6.33	1.24
236000.00	139.28	138.92	130.42	132.15	137.25	8.86	7.13	2.04	8.50	6.77	1.67
235900.00		137.38	130.38	132.10	137.20				7.00	5.28	0.18
235800.00		138.85	130.34	132.05	137.16				8.51	6.80	1.69
235700.00		139.01	130.30	132.01	137.11				8.72	7.01	1.90
235600.00		140.34	130.24	131.96	137.06				10.10	8.38	3.28
235500.00	138.84	138.98	130.19	131.91	137.01	8.64	6.93	1.83	8.79	7.07	1.97
235400.00		139.32	130.14	131.86	136.96				9.18	7.46	2.37
235300.00		139.52	130.09	131.81	136.91				9.42	7.70	2.61
235200.00		139.30	130.04	131.77	136.85				9.25	7.53	2.44
235100.00		138.91	129.99	131.72	136.80				8.91	7.19	2.10
235000.00	138.40	138.61	129.94	131.67	136.75	8.45	6.73	1.65	8.67	6.94	1.87
234900.00		138.64	129.89	131.62	136.70				8.75	7.02	1.94
234800.00		138.51	129.84	131.57	136.64				8.67	6.94	1.87
234700.00		138.91	129.79	131.53	136.59				9.11	7.38	2.31
234600.00		139.18	129.74	131.48	136.54				9.44	7.70	2.64
234500.00		138.85	129.69	131.43	136.49				9.16	7.42	2.36
234400.00		139.04	129.64	131.38	136.43				9.40	7.66	2.60
234300.00		138.93	129.59	131.33	136.38				9.34	7.59	2.55
234200.00		138.12	129.54	131.29	136.33				8.58	6.83	1.79
234100.00		136.70	129.49	131.24	136.28				7.21	5.46	0.42
234000.00	135.80	136.03	129.44	131.19	136.23	6.36	4.61	-0.42	6.60	4.84	-0.19
233900.00		135.89	129.39	131.14	136.17				6.50	4.75	-0.28
233800.00		136.06	129.34	131.09	136.12				6.72	4.96	-0.06
233700.00		135.63	129.29	131.05	136.07				6.35	4.59	-0.43
233600.00		136.18	129.19	130.95	135.98				6.99	5.23	0.20
233500.00	137.57	137.70	128.96	130.70	135.79	8.62	6.88	1.78	8.74	7.00	1.90
233400.00		137.74	128.72	130.45	135.60				9.02	7.30	2.14
233300.00		137.61	128.48	130.20	135.41				9.12	7.41	2.19
233200.00		137.16	128.25	129.95	135.22				8.91	7.21	1.93
233100.00		137.07	128.01	129.70	135.04				9.05	7.37	2.03
233000.00	136.79	136.88	127.78	129.45	134.85	9.01	7.35	1.95	9.10	7.43	2.04
232900.00		136.62	127.54	129.20	134.66				9.08	7.42	1.97
232800.00		136.05	127.31	128.95	134.47				8.74	7.10	1.58
232700.00		136.55	127.12	128.75	134.34				9.43	7.80	2.21
232600.00		136.22	126.93	128.55	134.21				9.29	7.68	2.02
232500.00	135.82	136.14	126.75	128.35	134.08	9.07	7.47	1.74	9.39	7.79	2.06
232400.00		135.68	126.56	128.15	133.95				9.12	7.54	1.73
232300.00		135.82	126.37	127.95	133.82				9.45	7.87	2.00
232200.00		136.08	126.18	127.75	133.69				9.90	8.33	2.39

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
232100.00		136.22	126.00	127.55	133.57				10.22	8.67	2.65
232000.00	136.11	136.17	125.81	127.35	133.44	10.30	8.76	2.67	10.36	8.83	2.74
231900.00		136.01	125.62	127.15	133.31				10.39	8.86	2.70
231800.00		135.82	125.44	126.95	133.18				10.38	8.87	2.64
231700.00		135.80	125.25	126.75	133.05				10.55	9.05	2.75
231600.00		136.06	125.06	126.55	132.92				11.00	9.52	3.14
231500.00		135.45	124.88	126.35	132.80				10.58	9.11	2.66
231400.00		135.26	124.69	126.15	132.67				10.57	9.11	2.59
231300.00		135.35	124.48	125.92	132.48				10.88	9.43	2.88
231200.00		135.20	124.24	125.67	132.22				10.96	9.53	2.98
231100.00		134.76	124.00	125.42	131.97				10.76	9.34	2.79
231000.00		134.39	123.76	125.17	131.71				10.64	9.23	2.68
230900.00		134.71	123.52	124.92	131.45				11.20	9.80	3.26
230800.00		134.76	123.28	124.66	131.20				11.49	10.10	3.57
230700.00		134.66	123.04	124.41	130.94				11.62	10.24	3.71
230600.00		134.57	122.80	124.16	130.69				11.77	10.40	3.88
230500.00		135.11	122.56	123.91	130.43				12.55	11.19	4.67
230400.00		135.43	122.49	123.83	130.34				12.94	11.59	5.09
230300.00		135.25	122.43	123.77	130.26				12.82	11.48	4.99
230200.00		135.12	122.37	123.71	130.19				12.75	11.41	4.93
230100.00		134.82	122.31	123.65	130.11				12.50	11.17	4.71
230000.00	134.36	134.50	122.26	123.59	130.03	12.10	10.77	4.32	12.25	10.92	4.47
229900.00		133.96	122.20	123.53	129.96				11.76	10.43	4.00
229800.00		133.75	122.14	123.47	129.88				11.61	10.29	3.87
229700.00		134.02	122.08	123.41	129.80				11.93	10.61	4.21
229600.00		133.54	122.03	123.35	129.73				11.51	10.20	3.81
229500.00	133.20	133.32	121.97	123.28	129.65	11.23	9.91	3.55	11.35	10.04	3.67
229400.00		133.19	121.91	123.22	129.57				11.28	9.97	3.62
229300.00		132.97	121.85	123.16	129.50				11.12	9.81	3.48
229200.00		133.05	121.80	123.10	129.42				11.26	9.95	3.63
229100.00		133.21	121.74	123.04	129.34				11.47	10.17	3.86
229000.00	133.52	133.85	121.68	122.98	129.27	11.83	10.54	4.25	12.16	10.87	4.58
228900.00		133.24	121.62	122.92	129.19				11.62	10.33	4.05
228800.00		133.58	121.57	122.86	129.11				12.01	10.72	4.46
228700.00		133.33	121.51	122.80	129.04				11.82	10.53	4.29
228600.00		133.54	121.45	122.73	128.96				12.08	10.80	4.57
228500.00	133.09	133.37	121.39	122.67	128.88	11.70	10.42	4.21	11.98	10.70	4.49
228400.00		132.76	121.34	122.61	128.81				11.42	10.14	3.95
228300.00		132.73	121.28	122.55	128.73				11.45	10.18	4.00
228200.00		132.91	121.22	122.49	128.66				11.69	10.43	4.26
228100.00		132.82	121.16	122.43	128.58				11.66	10.39	4.24
228000.00	132.44	132.41	121.11	122.37	128.50	11.33	10.07	3.93	11.30	10.04	3.91
227900.00		132.52	121.05	122.31	128.43				11.47	10.22	4.10
227800.00		132.51	120.99	122.25	128.35				11.52	10.26	4.16
227700.00		132.32	120.93	122.18	128.27				11.39	10.14	4.05
227600.00		132.37	120.88	122.12	128.20				11.50	10.25	4.18
227500.00	132.08	132.16	120.82	122.06	128.12	11.26	10.02	3.96	11.34	10.10	4.04
227400.00		131.97	120.76	122.00	128.04				11.21	9.97	3.93
227300.00		131.64	120.70	121.94	127.97				10.93	9.70	3.67
227200.00		132.10	120.65	121.88	127.89				11.45	10.22	4.21
227100.00		131.98	120.59	121.82	127.81				11.39	10.16	4.17
227000.00	131.75	131.71	120.53	121.76	127.74	11.22	9.99	4.01	11.17	9.95	3.97
226900.00		131.72	120.47	121.70	127.66				11.25	10.02	4.06
226800.00		131.80	120.42	121.63	127.58				11.38	10.16	4.21
226700.00		131.42	120.36	121.57	127.51				11.07	9.85	3.92
226600.00		131.46	120.30	121.51	127.43				11.16	9.95	4.03
226500.00	131.20	131.20	120.26	121.47	127.38	10.94	9.73	3.82	10.94	9.73	3.82
226400.00		130.93	120.24	121.45	127.36				10.69	9.48	3.57
226300.00		130.52	120.22	121.44	127.34				10.30	9.09	3.19
226200.00		131.00	120.20	121.42	127.32				10.80	9.58	3.68
226100.00		130.30	120.18	121.40	127.29				10.12	8.89	3.00
226000.00	130.28	130.25	120.16	121.39	127.27	10.12	8.89	3.00	10.09	8.87	2.98
225900.00		130.21	120.14	121.37	127.25				10.07	8.84	2.96
225800.00		129.89	120.12	121.35	127.23				9.77	8.54	2.66
225700.00		130.02	120.10	121.34	127.21				9.92	8.68	2.81
225600.00		129.99	120.08	121.32	127.19				9.91	8.67	2.80
225500.00	129.82	129.85	120.06	121.30	127.17	9.76	8.52	2.66	9.79	8.55	2.68
225400.00		129.61	120.04	121.29	127.14				9.58	8.33	2.47
225300.00		129.70	120.02	121.27	127.12				9.69	8.44	2.58
225200.00		129.90	120.00	121.25	127.10				9.91	8.65	2.80
225100.00		129.89	119.98	121.23	127.08				9.92	8.66	2.81
225000.00	130.06	130.13	119.96	121.22	127.06	10.10	8.84	3.00	10.18	8.91	3.07
224900.00		130.64	119.94	121.20	127.04				10.70	9.44	3.60
224800.00		129.92	119.92	121.18	127.02				10.01	8.74	2.91

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
224700.00		129.72	119.90	121.17	126.99				9.82	8.55	2.73
224600.00		129.89	119.87	121.15	126.97				10.02	8.74	2.92
224500.00	129.62	129.99	119.85	121.13	126.95	9.77	8.49	2.67	10.13	8.86	3.04
224400.00		129.67	119.83	121.12	126.93				9.84	8.55	2.74
224300.00		129.75	119.81	121.10	126.91				9.94	8.65	2.84
224200.00		130.09	119.79	121.08	126.89				10.30	9.01	3.21
224100.00		129.61	119.77	121.06	126.87				9.84	8.55	2.74
224000.00	129.46	129.55	119.75	121.05	126.84	9.71	8.41	2.62	9.80	8.51	2.71
223900.00		129.58	119.73	121.03	126.82				9.85	8.55	2.76
223800.00		129.54	119.71	121.01	126.80				9.84	8.54	2.74
223700.00		129.28	119.67	120.97	126.76				9.61	8.31	2.51
223600.00		129.37	119.63	120.93	126.72				9.74	8.43	2.64
223500.00	128.97	129.15	119.59	120.89	126.69	9.38	8.08	2.28	9.56	8.26	2.46
223400.00		129.09	119.55	120.85	126.65				9.54	8.24	2.44
223300.00		128.93	119.51	120.82	126.62				9.42	8.12	2.32
223200.00		128.93	119.47	120.78	126.58				9.46	8.15	2.35
223100.00		128.72	119.43	120.74	126.54				9.29	7.98	2.18
223000.00	128.34	128.41	119.39	120.70	126.51	8.95	7.64	1.84	9.02	7.71	1.91
222900.00		128.20	119.35	120.67	126.47				8.85	7.54	1.73
222800.00		127.90	119.32	120.63	126.44				8.58	7.27	1.46
222700.00		128.15	119.28	120.59	126.40				8.87	7.56	1.75
222600.00		127.92	119.24	120.55	126.36				8.68	7.36	1.55
222500.00	127.76	127.74	119.20	120.51	126.33	8.56	7.24	1.43	8.55	7.23	1.42
222400.00		127.59	119.16	120.48	126.29				8.43	7.12	1.30
222300.00		127.68	119.12	120.44	126.25				8.56	7.24	1.43
222200.00		127.43	119.08	120.40	126.22				8.35	7.03	1.22
222100.00		127.33	119.04	120.36	126.18				8.29	6.97	1.15
222000.00	126.93	126.92	119.01	120.33	126.14	7.92	6.60	0.78	7.91	6.59	0.78
221900.00		126.77	118.98	120.30	126.11				7.79	6.47	0.66
221800.00		126.66	118.94	120.27	126.07				7.72	6.39	0.59
221700.00		127.22	118.91	120.24	126.03				8.31	6.98	1.19
221600.00		127.20	118.88	120.21	125.99				8.33	7.00	1.21
221500.00	126.83	127.10	118.84	120.17	125.95	7.99	6.66	0.88	8.25	6.92	1.14
221400.00		126.85	118.81	120.14	125.92				8.04	6.71	0.93
221300.00		126.83	118.78	120.11	125.88				8.06	6.72	0.96
221200.00		126.51	118.74	120.08	125.84				7.76	6.42	0.66
221100.00		126.32	118.71	120.05	125.80				7.60	6.27	0.51
221000.00	126.02	126.10	118.59	119.94	125.68	7.43	6.08	0.34	7.51	6.17	0.42
220900.00		125.86	118.43	119.78	125.53				7.43	6.08	0.34
220800.00		125.87	118.27	119.63	125.37				7.60	6.25	0.51
220700.00		126.04	118.11	119.47	125.21				7.93	6.57	0.83
220600.00		125.84	117.95	119.32	125.05				7.88	6.52	0.79
220500.00	125.78	125.89	117.80	119.17	124.89	7.99	6.62	0.89	8.10	6.73	1.00
220400.00		125.88	117.66	119.03	124.72				8.22	6.85	1.16
220300.00		125.90	117.52	118.89	124.55				8.38	7.01	1.35
220200.00		125.98	117.38	118.75	124.37				8.60	7.23	1.61
220100.00		125.97	117.24	118.61	124.20				8.73	7.36	1.77
220000.00	125.55	125.80	116.92	118.26	123.73	8.64	7.29	1.83	8.89	7.54	2.08
219900.00		125.65	116.46	117.76	123.03				9.19	7.89	2.62
219800.00		125.49	116.01	117.27	122.33				9.48	8.22	3.15
219700.00		125.40	115.86	117.11	122.12				9.54	8.29	3.28
219600.00		125.57	115.76	117.01	121.98				9.82	8.57	3.59
219500.00	125.18	125.32	115.66	116.90	121.85	9.52	8.27	3.33	9.66	8.42	3.47
219400.00		125.21	115.55	116.80	121.71				9.66	8.41	3.50
219300.00		125.41	115.45	116.69	121.57				9.96	8.71	3.84
219200.00		125.19	115.35	116.59	121.43				9.84	8.60	3.75
219100.00		124.99	115.29	116.53	121.35				9.70	8.46	3.64
219000.00	124.67	124.90	115.24	116.48	121.27	9.42	8.19	3.40	9.65	8.42	3.62
218900.00		124.84	115.19	116.42	121.20				9.64	8.41	3.64
218800.00		124.94	115.14	116.37	121.12				9.79	8.57	3.82
218700.00		124.80	115.09	116.31	121.04				9.71	8.49	3.76
218600.00		124.40	115.04	116.26	120.96				9.35	8.14	3.43
218500.00	124.41	124.62	114.99	116.20	120.89	9.42	8.20	3.52	9.62	8.41	3.73
218400.00		124.73	114.94	116.15	120.81				9.79	8.58	3.92
218300.00		124.39	114.89	116.10	120.73				9.50	8.30	3.66
218200.00		124.55	114.84	116.04	120.66				9.71	8.51	3.90
218100.00		124.79	114.79	115.99	120.58				10.00	8.80	4.21
218000.00		124.49	114.74	115.93	120.50				9.75	8.56	3.99
217900.00		125.12	114.69	115.88	120.43				10.43	9.24	4.69
217800.00		124.58	114.64	115.82	120.35				9.94	8.76	4.24
217700.00		124.46	114.59	115.77	120.27				9.87	8.69	4.19
217600.00		124.62	114.54	115.71	120.19				10.08	8.90	4.42
217500.00		124.66	114.49	115.66	120.12				10.17	9.00	4.54
217400.00		124.63	114.44	115.61	120.04				10.19	9.02	4.59

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
217300.00		124.53	114.39	115.55	119.96				10.14	8.98	4.57
217200.00		124.39	114.34	115.50	119.89				10.06	8.90	4.51
217100.00		124.40	114.29	115.44	119.81				10.11	8.96	4.59
217000.00		124.40	114.24	115.39	119.73				10.17	9.01	4.67
216900.00		124.27	114.18	115.33	119.65				10.09	8.94	4.62
216800.00		124.11	114.12	115.27	119.57				9.98	8.84	4.54
216700.00		123.95	114.07	115.21	119.49				9.88	8.74	4.46
216600.00		123.66	114.01	115.14	119.41				9.65	8.52	4.25
216500.00		123.96	113.95	115.08	119.33				10.01	8.88	4.63
216400.00		124.17	113.90	115.02	119.25				10.28	9.15	4.92
216300.00		124.27	113.84	114.96	119.17				10.44	9.31	5.10
216200.00		124.33	113.78	114.90	119.09				10.55	9.43	5.23
216100.00		124.35	113.72	114.84	119.01				10.63	9.51	5.34
216000.00		124.28	113.67	114.78	118.94				10.62	9.50	5.35
215900.00		124.03	113.61	114.72	118.86				10.42	9.31	5.17
215800.00		123.94	113.55	114.66	118.78				10.38	9.28	5.16
215700.00		123.82	113.49	114.59	118.70				10.32	9.22	5.12
215600.00		123.63	113.44	114.53	118.62				10.19	9.10	5.02
215500.00		123.46	113.38	114.47	118.54				10.08	8.99	4.93
215400.00		123.30	113.32	114.41	118.46				9.98	8.89	4.84
215300.00		123.10	113.26	114.35	118.38				9.84	8.75	4.73
215200.00		122.89	113.21	114.29	118.30				9.69	8.60	4.60
215100.00		122.78	113.15	114.23	118.22				9.63	8.56	4.57
215000.00		122.63	113.09	114.17	118.14				9.54	8.46	4.49
214900.00		122.71	113.04	114.10	118.06				9.67	8.60	4.65
214800.00		122.97	112.98	114.04	117.98				9.99	8.93	4.99
214700.00		123.06	112.92	113.98	117.90				10.14	9.08	5.16
214600.00		122.84	112.82	113.88	117.80				10.02	8.96	5.04
214500.00		123.14	112.71	113.77	117.68				10.43	9.37	5.46
214400.00		123.15	112.59	113.65	117.56				10.56	9.51	5.59
214300.00		123.51	112.47	113.53	117.45				11.03	9.98	6.06
214200.00		123.35	112.36	113.41	117.33				11.00	9.94	6.02
214100.00		123.55	112.24	113.29	117.22				11.31	10.26	6.33
214000.00		123.34	112.12	113.17	117.10				11.21	10.17	6.24
213900.00		123.36	112.01	113.05	116.99				11.35	10.30	6.37
213800.00		123.29	111.89	112.94	116.87				11.40	10.36	6.42
213700.00		122.90	111.77	112.82	116.76				11.13	10.09	6.15
213600.00		122.94	111.66	112.70	116.64				11.28	10.24	6.30
213500.00	122.63	122.65	111.54	112.58	116.52	11.09	10.05	6.11	11.11	10.07	6.13
213400.00		122.52	111.42	112.46	116.41				11.09	10.05	6.11
213300.00		122.48	111.31	112.34	116.29				11.17	10.14	6.19
213200.00		122.21	111.19	112.23	116.18				11.02	9.98	6.03
213100.00		122.09	111.07	112.11	116.06				11.02	9.98	6.03
213000.00	121.65	121.65	110.96	111.99	115.95	10.70	9.66	5.71	10.69	9.66	5.71
212900.00		121.68	110.86	111.89	115.85				10.82	9.79	5.83
212800.00		121.26	110.84	111.87	115.82				10.42	9.40	5.44
212700.00		121.26	110.81	111.84	115.79				10.45	9.42	5.47
212600.00		121.07	110.79	111.81	115.76				10.28	9.25	5.31
212500.00	121.14	121.18	110.76	111.79	115.73	10.38	9.35	5.41	10.42	9.40	5.45
212400.00		121.09	110.73	111.76	115.70				10.35	9.33	5.39
212300.00		121.07	110.71	111.73	115.67				10.36	9.34	5.40
212200.00		120.74	110.68	111.71	115.64				10.06	9.03	5.10
212100.00		120.76	110.66	111.68	115.61				10.11	9.08	5.15
212000.00	120.56	120.59	110.63	111.66	115.58	9.93	8.90	4.98	9.96	8.94	5.01
211900.00		120.81	110.60	111.63	115.55				10.21	9.18	5.26
211800.00		120.92	110.58	111.60	115.52				10.35	9.32	5.40
211700.00		121.04	110.55	111.58	115.49				10.48	9.46	5.55
211600.00		120.89	110.53	111.55	115.46				10.36	9.34	5.43
211500.00	120.88	121.04	110.50	111.52	115.43	10.38	9.35	5.45	10.54	9.52	5.61
211400.00		121.14	110.47	111.50	115.40				10.66	9.64	5.74
211300.00		121.09	110.45	111.47	115.37				10.64	9.61	5.72
211200.00		120.77	110.42	111.44	115.34				10.35	9.33	5.43
211100.00		120.79	110.39	111.42	115.31				10.40	9.38	5.49
211000.00	120.69	120.95	110.37	111.39	115.28	10.32	9.30	5.41	10.58	9.56	5.68
210900.00		120.90	110.34	111.37	115.25				10.55	9.53	5.65
210800.00		120.75	110.32	111.34	115.21				10.43	9.41	5.54
210700.00		120.61	110.29	111.31	115.18				10.32	9.30	5.43
210600.00		120.79	110.26	111.29	115.15				10.52	9.50	5.63
210500.00	120.88	121.21	110.24	111.26	115.12	10.64	9.62	5.76	10.97	9.95	6.09
210400.00		121.00	110.21	111.23	115.09				10.78	9.76	5.90
210300.00		120.81	110.19	111.21	115.06				10.62	9.60	5.74
210200.00		120.77	110.16	111.18	115.03				10.61	9.59	5.74
210100.00		120.65	110.12	111.14	114.99				10.53	9.51	5.66
210000.00	120.42	120.72	110.06	111.09	114.95	10.36	9.33	5.47	10.66	9.63	5.77

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
209900.00		120.60	110.01	111.04	114.90				10.59	9.56	5.70
209800.00		120.38	109.95	110.98	114.85				10.43	9.40	5.53
209700.00		120.25	109.90	110.93	114.80				10.35	9.32	5.44
209600.00		120.08	109.84	110.88	114.76				10.24	9.20	5.32
209500.00	119.70	119.98	109.77	110.81	114.70	9.92	8.88	5.00	10.21	9.17	5.28
209400.00		120.12	109.70	110.74	114.63				10.42	9.37	5.49
209300.00		120.60	109.62	110.67	114.55				10.98	9.93	6.04
209200.00		120.37	109.54	110.59	114.48				10.82	9.77	5.88
209100.00		119.76	109.47	110.52	114.41				10.30	9.24	5.35
209000.00	119.24	119.60	109.39	110.45	114.34	9.85	8.79	4.90	10.21	9.15	5.26
208900.00		119.60	109.32	110.37	114.27				10.29	9.23	5.33
208800.00		119.62	109.24	110.30	114.20				10.38	9.32	5.42
208700.00		119.61	109.16	110.23	114.13				10.45	9.39	5.48
208600.00		119.42	109.09	110.15	114.06				10.33	9.26	5.35
208500.00	118.97	119.24	109.01	110.08	113.99	9.96	8.89	4.98	10.23	9.16	5.25
208400.00		119.25	108.96	110.02	113.93				10.29	9.23	5.32
208300.00		118.98	108.91	109.97	113.87				10.07	9.01	5.11
208200.00		118.81	108.86	109.91	113.81				9.96	8.90	5.01
208100.00		118.69	108.80	109.86	113.75				9.88	8.83	4.94
208000.00	118.50	118.65	108.75	109.80	113.69	9.75	8.70	4.81	9.90	8.85	4.96
207900.00		118.69	108.70	109.75	113.63				9.98	8.94	5.06
207800.00		118.60	108.65	109.69	113.57				9.95	8.91	5.04
207700.00		118.60	108.60	109.64	113.51				10.00	8.96	5.09
207600.00		118.51	108.55	109.58	113.45				9.96	8.93	5.07
207500.00	118.20	118.37	108.50	109.53	113.39	9.70	8.67	4.81	9.87	8.84	4.98
207400.00		118.42	108.45	109.47	113.33				9.98	8.95	5.09
207300.00		118.30	108.39	109.42	113.27				9.90	8.88	5.03
207200.00		118.20	108.34	109.36	113.21				9.85	8.84	4.99
207100.00		117.86	108.29	109.31	113.15				9.56	8.55	4.71
207000.00	117.40	117.71	108.24	109.25	113.09	9.16	8.15	4.32	9.47	8.46	4.63
206900.00		117.85	108.19	109.20	113.03				9.66	8.65	4.82
206800.00		117.92	108.14	109.14	112.96				9.78	8.78	4.95
206700.00		117.75	108.09	109.09	112.90				9.66	8.66	4.84
206600.00		117.82	108.03	109.03	112.84				9.79	8.79	4.98
206500.00	117.99	117.95	107.98	108.97	112.78	10.01	9.02	5.21	9.96	8.97	5.16
206400.00		117.77	107.93	108.92	112.72				9.84	8.85	5.04
206300.00		117.72	107.88	108.86	112.66				9.84	8.85	5.06
206200.00		117.63	107.83	108.81	112.60				9.80	8.82	5.03
206100.00		117.88	107.78	108.75	112.54				10.10	9.13	5.34
206000.00	117.71	118.20	107.73	108.70	112.48	9.98	9.01	5.22	10.47	9.50	5.71
205900.00		118.00	107.68	108.64	112.42				10.32	9.35	5.58
205800.00		117.76	107.62	108.59	112.36				10.14	9.18	5.40
205700.00		117.81	107.57	108.53	112.30				10.24	9.28	5.51
205600.00		117.30	107.48	108.44	112.19				9.82	8.86	5.11
205500.00	116.95	117.20	107.40	108.35	112.08	9.56	8.60	4.87	9.80	8.85	5.12
205400.00		117.03	107.31	108.26	111.98				9.73	8.77	5.06
205300.00		116.97	107.22	108.17	111.87				9.75	8.80	5.10
205200.00		116.83	107.14	108.09	111.77				9.70	8.75	5.07
205100.00		116.59	107.05	108.00	111.66				9.54	8.59	4.92
205000.00	116.29	116.34	106.96	107.91	111.56	9.32	8.38	4.73	9.38	8.44	4.79
204900.00		116.53	106.88	107.82	111.45				9.65	8.71	5.08
204800.00		116.33	106.79	107.73	111.34				9.54	8.60	4.99
204700.00		116.04	106.70	107.64	111.24				9.34	8.40	4.81
204600.00		115.92	106.62	107.56	111.13				9.30	8.36	4.79
204500.00	115.85	115.97	106.53	107.47	111.03	9.32	8.39	4.83	9.44	8.51	4.95
204400.00		115.83	106.45	107.38	110.92				9.38	8.45	4.90
204300.00		115.68	106.36	107.29	110.82				9.32	8.39	4.86
204200.00		115.46	106.26	107.19	110.71				9.19	8.26	4.75
204100.00		115.46	106.16	107.09	110.60				9.30	8.37	4.86
204000.00	114.96	115.14	106.06	106.99	110.50	8.90	7.98	4.47	9.08	8.15	4.65
203900.00		115.12	105.96	106.88	110.39				9.16	8.24	4.73
203800.00		114.76	105.86	106.78	110.28				8.90	7.98	4.48
203700.00		114.48	105.76	106.68	110.18				8.72	7.81	4.31
203600.00		114.58	105.66	106.58	110.07				8.92	8.01	4.51
203500.00	114.06	114.30	105.56	106.47	109.96	8.50	7.58	4.09	8.75	7.83	4.34
203400.00		114.24	105.46	106.37	109.86				8.78	7.86	4.38
203300.00		114.33	105.36	106.27	109.75				8.97	8.06	4.58
203200.00		114.23	105.26	106.17	109.64				8.97	8.06	4.58
203100.00		113.96	105.16	106.06	109.54				8.80	7.90	4.42
203000.00	113.62	113.80	105.05	105.96	109.43	8.57	7.66	4.19	8.75	7.84	4.37
202900.00		113.87	104.95	105.86	109.32				8.91	8.01	4.54
202800.00		114.10	104.85	105.75	109.22				9.25	8.35	4.89
202700.00		114.02	104.77	105.67	109.12				9.25	8.35	4.89
202600.00		114.05	104.69	105.59	109.04				9.36	8.47	5.02

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
202500.00	113.34	113.68	104.62	105.51	108.95	8.72	7.83	4.39	9.06	8.17	4.73
202400.00		113.26	104.54	105.43	108.86				8.72	7.83	4.40
202300.00		113.73	104.47	105.36	108.78				9.27	8.38	4.95
202200.00		114.23	104.39	105.28	108.69				9.83	8.95	5.53
202100.00		114.18	104.32	105.20	108.61				9.86	8.98	5.57
202000.00	113.80	114.03	104.24	105.12	108.52	9.55	8.67	5.27	9.79	8.90	5.51
201900.00		114.13	104.17	105.05	108.43				9.97	9.09	5.70
201800.00		113.93	104.09	104.97	108.35				9.83	8.96	5.58
201700.00		113.60	104.02	104.89	108.26				9.58	8.71	5.34
201600.00		113.68	103.94	104.81	108.18				9.74	8.87	5.50
201500.00	113.48	113.74	103.87	104.74	108.09	9.61	8.74	5.39	9.88	9.01	5.65
201400.00		113.64	103.79	104.66	108.01				9.85	8.99	5.64
201300.00		113.43	103.72	104.58	107.92				9.71	8.85	5.51
201200.00		113.49	103.64	104.50	107.83				9.85	8.99	5.65
201100.00		113.34	103.60	104.45	107.78				9.75	8.89	5.57
201000.00	112.90	113.09	103.55	104.41	107.72	9.35	8.49	5.18	9.53	8.68	5.36
200900.00		113.20	103.51	104.37	107.67				9.68	8.83	5.52
200800.00		112.99	103.47	104.32	107.62				9.52	8.67	5.37
200700.00		113.30	103.43	104.28	107.57				9.87	9.02	5.73
200600.00		113.42	103.39	104.24	107.52				10.03	9.18	5.90
200500.00	113.50	113.61	103.35	104.19	107.47	10.15	9.31	6.03	10.26	9.42	6.14
200400.00		113.36	103.31	104.15	107.41				10.06	9.22	5.95
200300.00		112.99	103.27	104.11	107.36				9.72	8.88	5.63
200200.00		112.81	103.23	104.06	107.31				9.58	8.75	5.50
200100.00		112.98	103.19	104.02	107.26				9.79	8.96	5.72
200000.00	112.55	112.60	103.15	103.98	107.21	9.41	8.58	5.35	9.45	8.62	5.39
199900.00		112.38	103.10	103.93	107.16				9.27	8.45	5.22
199800.00		112.31	103.06	103.89	107.10				9.24	8.42	5.20
199700.00		112.33	103.02	103.85	107.05				9.31	8.49	5.28
199600.00		112.26	102.98	103.80	107.00				9.28	8.46	5.26
199500.00	112.07	112.12	102.95	103.77	106.96	9.11	8.29	5.10	9.17	8.35	5.16
199400.00		112.01	102.92	103.74	106.92				9.09	8.27	5.09
199300.00		112.05	102.89	103.71	106.89				9.15	8.34	5.16
199200.00		112.04	102.86	103.68	106.85				9.18	8.36	5.19
199100.00		111.92	102.83	103.64	106.81				9.09	8.27	5.11
199000.00	111.97	112.08	102.80	103.61	106.77	9.17	8.36	5.20	9.29	8.47	5.32
198900.00		111.67	102.77	103.58	106.73				8.90	8.09	4.94
198800.00		111.64	102.74	103.55	106.69				8.90	8.09	4.95
198700.00		111.60	102.65	103.47	106.62				8.94	8.12	4.97
198600.00		111.54	102.55	103.38	106.55				8.99	8.16	4.99
198500.00	111.43	111.51	102.45	103.29	106.48	8.98	8.14	4.95	9.06	8.22	5.04
198400.00		111.52	102.35	103.20	106.40				9.17	8.32	5.12
198300.00		111.50	102.25	103.11	106.33				9.25	8.39	5.18
198200.00		111.58	102.15	103.02	106.25				9.43	8.55	5.32
198100.00		111.13	102.05	102.93	106.18				9.08	8.20	4.95
198000.00	110.82	110.87	101.95	102.85	106.11	8.87	7.97	4.71	8.92	8.03	4.77
197900.00		110.74	101.85	102.76	106.03				8.90	7.99	4.71
197800.00		110.76	101.82	102.73	106.01				8.94	8.03	4.75
197700.00		110.59	101.81	102.72	106.00				8.78	7.87	4.59
197600.00		110.64	101.81	102.71	105.99				8.83	7.92	4.64
197500.00	110.58	110.66	101.80	102.70	105.98	8.78	7.87	4.60	8.86	7.95	4.67
197400.00		110.83	101.79	102.70	105.97				9.04	8.14	4.86
197300.00		110.60	101.78	102.69	105.96				8.82	7.91	4.64
197200.00		110.76	101.77	102.68	105.95				8.99	8.09	4.81
197100.00		110.78	101.76	102.67	105.94				9.02	8.12	4.84
197000.00		110.46	101.76	102.66	105.93				8.70	7.80	4.53
196900.00		110.53	101.75	102.65	105.92				8.79	7.89	4.61
196800.00		110.69	101.74	102.64	105.91				8.95	8.05	4.79
196700.00		110.78	101.73	102.63	105.90				9.04	8.15	4.88
196600.00		110.71	101.72	102.62	105.89				8.99	8.09	4.82
196500.00	110.39	110.39	101.71	102.61	105.88	8.67	7.78	4.51	8.68	7.78	4.51
196400.00		110.55	101.71	102.60	105.87				8.84	7.94	4.68
196300.00		110.58	101.70	102.59	105.86				8.89	7.99	4.73
196200.00		111.03	101.69	102.58	105.85				9.34	8.45	5.18
196100.00		110.40	101.68	102.57	105.84				8.72	7.83	4.57
196000.00	110.31	110.32	101.67	102.56	105.83	8.64	7.75	4.49	8.65	7.76	4.50
195900.00		110.74	101.66	102.56	105.82				9.07	8.18	4.92
195800.00		110.56	101.66	102.55	105.81				8.90	8.01	4.75
195700.00		110.37	101.65	102.54	105.80				8.72	7.83	4.57
195600.00		110.59	101.64	102.53	105.79				8.95	8.06	4.80
195500.00	110.55	110.55	101.64	102.53	105.78	8.92	8.03	4.77	8.91	8.02	4.77
195400.00		110.47	101.63	102.52	105.77				8.84	7.96	4.70
195300.00		110.49	101.62	102.51	105.77				8.87	7.98	4.72
195200.00		110.27	101.62	102.51	105.76				8.65	7.77	4.51

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
195100.00		110.23	101.61	102.50	105.75				8.62	7.73	4.48
195000.00	110.47	110.44	101.61	102.49	105.74	8.86	7.98	4.73	8.83	7.94	4.70
194900.00		110.38	101.60	102.49	105.73				8.78	7.89	4.64
194800.00		110.14	101.60	102.48	105.73				8.54	7.66	4.41
194700.00		109.96	101.59	102.48	105.72				8.37	7.49	4.24
194600.00		109.87	101.58	102.47	105.71				8.29	7.40	4.16
194500.00	109.88	110.07	101.58	102.46	105.70	8.30	7.42	4.18	8.49	7.61	4.37
194400.00		110.17	101.57	102.46	105.70				8.60	7.71	4.47
194300.00		109.89	101.57	102.45	105.69				8.32	7.44	4.20
194200.00		110.02	101.56	102.44	105.68				8.46	7.58	4.34
194100.00		109.75	101.56	102.44	105.67				8.19	7.31	4.07
194000.00	109.72	109.65	101.55	102.43	105.66	8.17	7.29	4.05	8.10	7.22	3.99
193900.00		109.72	101.54	102.43	105.66				8.18	7.30	4.07
193800.00		109.69	101.53	102.41	105.65				8.15	7.27	4.04
193700.00		109.65	101.50	102.38	105.62				8.15	7.27	4.03
193600.00		109.54	101.47	102.35	105.59				8.07	7.18	3.95
193500.00	109.36	109.41	101.44	102.32	105.56	7.92	7.03	3.79	7.98	7.09	3.85
193400.00		109.40	101.41	102.29	105.54				8.00	7.11	3.87
193300.00		109.25	101.37	102.26	105.51				7.87	6.98	3.74
193200.00		109.16	101.34	102.23	105.48				7.82	6.93	3.68
193100.00		109.10	101.31	102.20	105.46				7.79	6.89	3.64
193000.00	108.93	108.98	101.28	102.17	105.43	7.66	6.76	3.50	7.71	6.81	3.55
192900.00		108.86	101.24	102.14	105.40				7.62	6.72	3.46
192800.00		108.80	101.21	102.11	105.37				7.59	6.68	3.42
192700.00	108.73	108.79	101.18	102.08	105.35	7.55	6.65	3.39	7.61	6.70	3.44
192600.00		108.68	101.15	102.05	105.32				7.53	6.62	3.36
192500.00	108.60	108.61	101.11	102.02	105.29	7.49	6.58	3.31	7.49	6.58	3.32
192400.00	108.63	108.57	101.08	101.99	105.27	7.54	6.63	3.36	7.49	6.58	3.31
192300.00		108.56	101.05	101.96	105.24				7.51	6.60	3.32
192200.00		108.62	101.02	101.93	105.21				7.60	6.68	3.41
192100.00		108.70	100.98	101.90	105.18				7.72	6.80	3.52
192000.00	108.45	108.41	100.90	101.84	105.14	7.55	6.62	3.32	7.51	6.57	3.27
191900.00	108.24	108.33	100.81	101.77	105.09	7.43	6.47	3.15	7.52	6.56	3.24
191800.00		108.30	100.71	101.69	105.04				7.58	6.60	3.25
191700.00		108.31	100.62	101.62	104.99				7.68	6.68	3.31
191600.00		108.25	100.53	101.55	104.95				7.72	6.70	3.31
191500.00	108.22	108.17	100.44	101.48	104.90	7.78	6.74	3.32	7.73	6.69	3.27
191400.00		108.11	100.34	101.41	104.85				7.77	6.71	3.26
191300.00		107.81	100.25	101.34	104.80				7.56	6.48	3.01
191200.00		107.91	100.04	101.17	104.71				7.87	6.74	3.20
191100.00		107.87	99.79	100.97	104.60				8.08	6.90	3.27
191000.00	107.87	107.81	99.55	100.78	104.49	8.32	7.09	3.38	8.27	7.04	3.32
190900.00		107.91	99.30	100.59	104.39				8.61	7.32	3.52
190800.00		108.12	99.06	100.39	104.28				9.06	7.73	3.84
190700.00		108.18	98.83	100.21	104.18				9.35	7.98	4.00
190600.00		110.66	98.81	100.16	104.14				11.85	10.50	6.52
190500.00	108.02	108.25	98.79	100.11	104.09	9.23	7.90	3.93	9.46	8.14	4.16
190400.00		107.73	98.77	100.07	104.05				8.96	7.66	3.68
190300.00	107.30	107.05	98.74	100.02	104.01	8.56	7.28	3.29	8.31	7.03	3.05
190200.00		111.48	98.66	99.90	103.83				12.82	11.58	7.65
190100.00		106.90	98.66	99.87	103.73				8.24	7.03	3.17
190000.00	106.15	106.35	98.62	99.81	103.67	7.53	6.34	2.48	7.74	6.54	2.68
189900.00		106.66	98.57	99.75	103.61				8.08	6.90	3.05
189800.00		106.94	98.53	99.70	103.55				8.41	7.24	3.39
189700.00		107.16	98.49	99.64	103.49				8.67	7.52	3.67
189600.00		107.09	98.44	99.58	103.43				8.65	7.51	3.66
189500.00		107.01	98.40	99.52	103.37				8.61	7.49	3.64
189400.00		106.54	98.36	99.46	103.31				8.18	7.08	3.23
189300.00		106.36	98.31	99.40	103.25				8.05	6.96	3.11
189200.00		106.17	98.27	99.35	103.19				7.90	6.83	2.98
189100.00		105.81	98.22	99.29	103.13				7.59	6.53	2.69
189000.00	105.56	105.74	98.18	99.23	103.07	7.38	6.34	2.50	7.55	6.51	2.67
188900.00		106.00	98.14	99.17	103.01				7.87	6.83	3.00
188800.00		106.40	98.09	99.11	102.95				8.31	7.29	3.45
188700.00		106.20	98.05	99.05	102.89				8.15	7.14	3.31
188600.00		106.49	98.01	99.00	102.83				8.48	7.49	3.66
188500.00	106.01	105.98	97.96	98.94	102.77	8.05	7.07	3.24	8.02	7.04	3.21
188400.00		106.02	97.86	98.83	102.67				8.16	7.18	3.35
188300.00		105.82	97.73	98.71	102.56				8.10	7.11	3.26
188200.00		105.83	97.59	98.59	102.45				8.24	7.25	3.38
188100.00		105.86	97.46	98.46	102.34				8.40	7.40	3.52
188000.00	105.65	105.60	97.33	98.34	102.23	8.31	7.31	3.42	8.27	7.27	3.38
187900.00		105.52	97.20	98.22	102.12				8.32	7.30	3.40
187800.00		105.52	97.08	98.10	102.01				8.45	7.43	3.52

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
187700.00		105.52	96.98	98.00	101.91				8.54	7.52	3.61
187600.00		105.75	96.88	97.90	101.82				8.87	7.85	3.93
187500.00	105.55	105.59	96.78	97.80	101.72	8.76	7.74	3.82	8.81	7.79	3.87
187400.00		105.61	96.68	97.70	101.63				8.93	7.91	3.98
187300.00		105.46	96.59	97.60	101.53				8.87	7.85	3.92
187200.00		105.45	96.49	97.50	101.44				8.96	7.94	4.01
187100.00		105.45	96.39	97.40	101.34				9.06	8.04	4.10
187000.00	105.37	105.36	96.29	97.30	101.25	9.08	8.07	4.12	9.07	8.06	4.11
186900.00		105.07	96.19	97.21	101.16				8.87	7.86	3.91
186800.00		105.04	96.10	97.11	101.06				8.95	7.94	3.98
186700.00		104.86	96.00	97.01	100.97				8.86	7.85	3.90
186600.00		104.73	95.92	96.93	100.90				8.81	7.80	3.84
186500.00	104.81	104.86	95.86	96.87	100.84	8.95	7.94	3.97	9.00	7.99	4.02
186400.00		104.62	95.80	96.81	100.79				8.83	7.82	3.84
186300.00		104.66	95.73	96.74	100.73				8.93	7.92	3.93
186200.00		104.57	95.67	96.68	100.68				8.90	7.89	3.89
186100.00		104.41	95.61	96.62	100.62				8.80	7.79	3.79
186000.00	104.20	104.22	95.55	96.56	100.57	8.65	7.64	3.63	8.67	7.66	3.65
185900.00		104.27	95.49	96.50	100.51				8.79	7.78	3.76
185800.00	104.07	104.15	95.42	96.43	100.46	8.65	7.64	3.61	8.73	7.72	3.69
185700.00		104.36	95.36	96.37	100.40				9.00	7.99	3.96
185600.00		104.32	95.30	96.31	100.35				9.02	8.01	3.98
185500.00	103.91	104.13	95.24	96.25	100.29	8.67	7.66	3.61	8.89	7.88	3.84
185400.00		104.53	95.18	96.19	100.24				9.36	8.35	4.29
185300.00	103.87	103.93	95.11	96.12	100.18	8.75	7.74	3.68	8.81	7.80	3.74
185200.00		103.99	95.06	96.07	100.13				8.93	7.92	3.86
185100.00		103.82	95.01	96.01	100.07				8.81	7.81	3.75
185000.00	103.46	103.79	94.96	95.96	100.01	8.51	7.50	3.45	8.83	7.83	3.77
184900.00		103.56	94.91	95.91	99.96				8.66	7.66	3.60
184800.00		103.15	94.85	95.85	99.90				8.30	7.30	3.25
184700.00		103.68	94.80	95.80	99.85				8.87	7.88	3.83
184600.00		103.52	94.75	95.74	99.79				8.77	7.78	3.73
184500.00	103.26	103.66	94.70	95.69	99.73	8.57	7.58	3.53	8.96	7.97	3.93
184400.00		103.65	94.65	95.63	99.68				9.01	8.02	3.97
184300.00		103.72	94.59	95.58	99.62				9.13	8.14	4.10
184200.00		103.64	94.54	95.52	99.56				9.10	8.11	4.07
184100.00		103.59	94.49	95.47	99.51				9.10	8.12	4.08
184000.00	103.25	103.80	94.42	95.41	99.46	8.83	7.85	3.79	9.37	8.39	4.34
183900.00		103.79	94.36	95.34	99.41				9.43	8.45	4.38
183800.00		104.02	94.30	95.28	99.36				9.72	8.73	4.65
183700.00		104.20	94.24	95.22	99.31				9.97	8.98	4.89
183600.00		103.34	94.17	95.16	99.26				9.16	8.18	4.08
183500.00	102.23	102.90	94.11	95.10	99.21	8.12	7.13	3.02	8.79	7.80	3.69
183400.00		102.78	94.06	95.05	99.17				8.72	7.73	3.61
183300.00		102.67	94.00	94.99	99.12				8.67	7.68	3.55
183200.00		102.61	93.94	94.94	99.08				8.67	7.67	3.53
183100.00		102.63	93.88	94.88	99.03				8.75	7.75	3.60
183000.00	102.66	103.16	93.80	94.80	98.96	8.85	7.85	3.70	9.36	8.36	4.20
182900.00		102.75	93.69	94.69	98.87				9.06	8.06	3.88
182800.00		102.29	93.59	94.59	98.78				8.70	7.70	3.51
182700.00		102.23	93.53	94.53	98.73				8.70	7.70	3.50
182600.00		102.04	93.51	94.51	98.71				8.53	7.53	3.33
182500.00	101.91	102.31	93.49	94.48	98.68	8.42	7.42	3.22	8.83	7.83	3.63
182400.00		101.80	93.47	94.46	98.66				8.33	7.33	3.13
182300.00		101.69	93.44	94.44	98.64				8.24	7.25	3.05
182200.00	101.51	101.78	93.42	94.42	98.62	8.09	7.09	2.89	8.36	7.36	3.16
182100.00		102.22	93.40	94.40	98.60				8.81	7.82	3.62
182000.00	101.91	102.16	93.38	94.37	98.57	8.53	7.53	3.33	8.78	7.79	3.59
181900.00		101.83	93.36	94.35	98.55				8.47	7.48	3.28
181800.00		101.61	93.34	94.33	98.53				8.27	7.28	3.08
181700.00		101.59	93.32	94.31	98.51				8.28	7.29	3.08
181600.00		102.09	93.29	94.28	98.49				8.79	7.80	3.60
181500.00	101.57	101.85	93.27	94.26	98.47	8.30	7.31	3.10	8.59	7.59	3.39
181400.00		101.88	93.24	94.24	98.44				8.64	7.64	3.44
181300.00		101.40	93.22	94.21	98.42				8.18	7.18	2.97
181200.00		101.41	93.20	94.19	98.40				8.22	7.22	3.01
181100.00		101.55	93.17	94.17	98.38				8.38	7.38	3.17
181000.00		101.61	93.15	94.15	98.36				8.46	7.47	3.25
180900.00		101.37	93.13	94.12	98.34				8.25	7.25	3.04
180800.00		101.47	93.10	94.10	98.31				8.37	7.37	3.16
180700.00		101.65	93.08	94.08	98.29				8.57	7.57	3.36
180600.00		101.57	93.05	94.05	98.27				8.52	7.52	3.30
180500.00		101.39	93.03	94.03	98.25				8.36	7.36	3.14
180400.00		100.91	93.00	94.00	98.22				7.91	6.91	2.69

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
180300.00		100.91	92.97	93.97	98.19				7.94	6.94	2.72
180200.00		100.70	92.94	93.94	98.16				7.76	6.76	2.54
180100.00		100.72	92.91	93.90	98.13				7.82	6.82	2.60
180000.00		100.75	92.87	93.87	98.09				7.88	6.88	2.66
179900.00		100.64	92.84	93.84	98.06				7.80	6.81	2.58
179800.00		100.59	92.81	93.80	98.03				7.78	6.79	2.56
179700.00		100.51	92.78	93.77	98.00				7.73	6.74	2.51
179600.00		100.32	92.75	93.74	97.97				7.58	6.59	2.36
179500.00		100.10	92.71	93.70	97.93				7.39	6.40	2.17
179400.00		100.06	92.62	93.62	97.87				7.44	6.45	2.20
179300.00		99.93	92.49	93.49	97.78				7.43	6.44	2.15
179200.00		99.90	92.37	93.37	97.69				7.53	6.53	2.21
179100.00		99.96	92.25	93.26	97.61				7.71	6.70	2.35
179000.00		99.93	92.21	93.22	97.58				7.73	6.71	2.35
178900.00		100.38	92.17	93.18	97.55				8.22	7.20	2.83
178800.00		100.35	92.13	93.14	97.53				8.22	7.21	2.83
178700.00		100.08	92.09	93.10	97.50				7.99	6.97	2.58
178600.00		100.12	92.05	93.07	97.47				8.07	7.05	2.65
178500.00		100.20	92.01	93.03	97.44				8.19	7.17	2.75
178400.00		100.25	91.97	92.99	97.42				8.28	7.26	2.83
178300.00		100.32	91.93	92.95	97.39				8.39	7.37	2.93
178200.00		100.48	91.89	92.91	97.36				8.59	7.57	3.12
178100.00		100.35	91.85	92.87	97.34				8.50	7.47	3.01
178000.00		100.28	91.81	92.84	97.31				8.47	7.44	2.97
177900.00		100.39	91.77	92.80	97.28				8.61	7.59	3.10
177800.00		100.53	91.73	92.76	97.25				8.79	7.76	3.27
177700.00		100.24	91.69	92.72	97.23				8.55	7.52	3.01
177600.00		100.36	91.65	92.68	97.20				8.71	7.68	3.16
177500.00		100.40	91.61	92.65	97.17				8.79	7.76	3.23
177400.00		100.44	91.57	92.61	97.15				8.87	7.83	3.30
177300.00		100.45	91.53	92.57	97.12				8.91	7.88	3.33
177200.00		100.25	91.50	92.53	97.09				8.76	7.72	3.16
177100.00		100.16	91.46	92.49	97.07				8.71	7.67	3.10
177000.00		100.15	91.42	92.46	97.04				8.74	7.70	3.12
176900.00		100.33	91.37	92.41	97.01				8.96	7.92	3.32
176800.00		100.24	91.31	92.36	96.98				8.93	7.88	3.26
176700.00		100.22	91.25	92.31	96.95				8.97	7.92	3.28
176600.00		100.10	91.20	92.25	96.92				8.91	7.85	3.19
176500.00	99.85	100.21	91.14	92.20	96.89	8.71	7.65	2.96	9.07	8.01	3.32
176400.00	99.46	99.85	91.08	92.15	96.85	8.38	7.32	2.61	8.77	7.70	3.00
176300.00		99.38	91.02	92.10	96.82				8.36	7.28	2.56
176200.00		99.30	90.96	92.04	96.79				8.34	7.26	2.51
176100.00		99.21	90.91	91.99	96.76				8.30	7.22	2.44
176000.00	99.09	99.28	90.85	91.94	96.73	8.24	7.15	2.36	8.43	7.34	2.55
175900.00		99.15	90.81	91.90	96.71				8.34	7.25	2.44
175800.00		98.95	90.78	91.87	96.68				8.17	7.08	2.26
175700.00		98.92	90.75	91.84	96.66				8.17	7.08	2.26
175600.00		98.68	90.71	91.81	96.64				7.97	6.87	2.04
175500.00	98.52	98.80	90.68	91.78	96.62	7.84	6.74	1.90	8.12	7.02	2.18
175400.00		98.74	90.65	91.75	96.60				8.09	7.00	2.15
175300.00		99.04	90.62	91.72	96.57				8.42	7.32	2.47
175200.00		99.05	90.59	91.69	96.55				8.46	7.36	2.50
175100.00		98.91	90.56	91.66	96.53				8.36	7.25	2.38
175000.00	98.36	98.70	90.52	91.63	96.51	7.83	6.73	1.85	8.18	7.07	2.19
174900.00		98.67	90.49	91.60	96.49				8.17	7.07	2.18
174800.00		98.89	90.46	91.57	96.46				8.43	7.32	2.43
174700.00	98.37	98.75	90.43	91.54	96.44	7.94	6.83	1.93	8.32	7.21	2.30
174600.00		98.73	90.40	91.51	96.42				8.34	7.22	2.31
174500.00	98.19	98.72	90.37	91.48	96.40	7.82	6.71	1.79	8.35	7.24	2.32
174400.00		98.25	90.33	91.45	96.38				7.92	6.80	1.88
174300.00		98.22	90.30	91.42	96.35				7.91	6.80	1.86
174200.00		98.02	90.27	91.39	96.33				7.75	6.63	1.69
174100.00		97.88	90.24	91.36	96.31				7.64	6.52	1.57
174000.00	97.57	97.87	90.21	91.33	96.29	7.36	6.24	1.28	7.66	6.54	1.58
173900.00		97.76	90.18	91.30	96.27				7.59	6.46	1.49
173800.00		97.86	90.15	91.27	96.25				7.72	6.59	1.61
173700.00		97.57	90.12	91.24	96.23				7.45	6.33	1.34
173600.00		97.71	90.09	91.21	96.21				7.63	6.50	1.50
173500.00	97.28	97.65	90.06	91.18	96.19	7.23	6.10	1.09	7.59	6.46	1.45
173400.00		97.77	90.03	91.16	96.17				7.74	6.61	1.60
173300.00		97.30	89.98	91.11	96.14				7.32	6.19	1.16
173200.00		97.24	89.91	91.04	96.10				7.33	6.20	1.14
173100.00		97.30	89.85	90.97	96.07				7.45	6.33	1.23
173000.00	97.26	97.48	89.78	90.90	96.03	7.47	6.36	1.23	7.70	6.58	1.45

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
172900.00		97.56	89.72	90.83	95.99				7.84	6.73	1.57
172800.00		97.27	89.65	90.76	95.95				7.62	6.51	1.32
172700.00		97.23	89.58	90.69	95.92				7.64	6.54	1.31
172600.00		97.13	89.52	90.62	95.88				7.61	6.51	1.25
172500.00	96.60	96.92	89.45	90.55	95.84	7.15	6.05	0.76	7.47	6.37	1.08
172400.00	96.55	97.01	89.41	90.50	95.81	7.14	6.05	0.74	7.61	6.51	1.20
172300.00		96.71	89.37	90.46	95.79				7.35	6.26	0.93
172200.00		97.00	89.33	90.41	95.76				7.67	6.59	1.23
172100.00		96.94	89.29	90.36	95.74				7.66	6.58	1.20
172000.00	96.72	97.19	89.25	90.32	95.71	7.48	6.41	1.01	7.95	6.87	1.48
171900.00		97.16	89.20	90.27	95.69				7.96	6.89	1.48
171800.00		97.14	89.16	90.22	95.66				7.97	6.91	1.47
171700.00		97.24	89.16	90.22	95.66				8.08	7.02	1.58
171600.00		97.20	89.16	90.22	95.66				8.04	6.98	1.54
171500.00	96.68	97.13	89.16	90.22	95.66	7.52	6.46	1.02	7.97	6.91	1.47
171400.00		96.95	89.12	90.19	95.63				7.82	6.76	1.32
171300.00		96.99	89.06	90.13	95.57				7.93	6.86	1.42
171200.00		96.90	88.99	90.06	95.50				7.91	6.84	1.40
171100.00		97.09	88.93	90.01	95.45				8.16	7.08	1.64
171000.00	96.70	97.00	88.89	89.97	95.41	7.81	6.73	1.29	8.11	7.03	1.59
170900.00		97.01	88.85	89.94	95.38				8.15	7.07	1.63
170800.00		96.98	88.82	89.90	95.34				8.16	7.08	1.64
170700.00		96.72	88.78	89.86	95.30				7.94	6.85	1.41
170600.00		96.95	88.74	89.83	95.27				8.21	7.12	1.68
170500.00	96.63	96.94	88.70	89.79	95.23	7.93	6.84	1.39	8.24	7.15	1.71
170400.00		97.05	88.66	89.75	95.20				8.39	7.29	1.84
170300.00		97.05	88.62	89.71	95.17				8.43	7.33	1.88
170200.00		97.09	88.58	89.68	95.13				8.51	7.42	1.96
170100.00		97.08	88.54	89.64	95.10				8.54	7.44	1.97
170000.00	96.86	97.26	88.50	89.60	95.07	8.37	7.26	1.79	8.76	7.66	2.19
169900.00		97.31	88.45	89.56	95.04				8.86	7.75	2.27
169800.00		97.36	88.41	89.52	95.00				8.94	7.84	2.35
169700.00		97.30	88.37	89.48	94.97				8.93	7.82	2.33
169600.00		97.16	88.33	89.44	94.94				8.83	7.72	2.22
169500.00	97.14	97.11	88.29	89.41	94.91	8.85	7.73	2.23	8.82	7.70	2.20
169400.00		96.63	88.25	89.37	94.87				8.38	7.27	1.76
169300.00		96.48	88.21	89.33	94.84				8.27	7.15	1.64
169200.00		96.42	88.19	89.31	94.82				8.23	7.11	1.60
169100.00		96.54	88.16	89.29	94.80				8.38	7.26	1.74
169000.00	96.98	96.32	88.14	89.26	94.78	8.85	7.72	2.20	8.18	7.06	1.54
168900.00		97.09	88.11	89.24	94.76				8.98	7.85	2.33
168800.00		96.92	88.08	89.21	94.74				8.84	7.71	2.18
168700.00		96.97	88.06	89.19	94.72				8.91	7.78	2.25
168600.00		96.96	88.03	89.17	94.70				8.92	7.79	2.26
168500.00	96.80	96.84	88.01	89.14	94.68	8.79	7.65	2.12	8.83	7.70	2.16
168400.00		96.65	87.98	89.12	94.66				8.67	7.53	1.99
168300.00		96.77	87.96	89.10	94.64				8.81	7.67	2.13
168200.00		96.94	87.95	89.09	94.63				8.99	7.85	2.31
168100.00		96.64	87.93	89.08	94.62				8.70	7.56	2.02
168000.00	96.55	96.59	87.92	89.06	94.61	8.63	7.49	1.94	8.66	7.52	1.98
167900.00		96.36	87.91	89.05	94.60				8.45	7.31	1.77
167800.00		96.54	87.90	89.04	94.58				8.64	7.49	1.95
167700.00		96.23	87.89	89.03	94.57				8.35	7.20	1.66
167600.00		96.04	87.87	89.02	94.56				8.17	7.03	1.48
167500.00	96.17	96.24	87.86	89.01	94.55	8.31	7.16	1.61	8.38	7.24	1.69
167400.00		96.00	87.85	88.99	94.54				8.15	7.01	1.46
167300.00		95.82	87.84	88.98	94.53				7.98	6.83	1.29
167200.00		95.55	87.82	88.97	94.52				7.73	6.58	1.03
167100.00		95.38	87.81	88.96	94.51				7.57	6.42	0.87
167000.00		95.21	87.80	88.95	94.50				7.41	6.26	0.71
166900.00		95.37	87.79	88.94	94.49				7.58	6.43	0.88
166800.00		95.00	87.77	88.92	94.47				7.24	6.08	0.53
166700.00		95.14	87.75	88.90	94.45				7.39	6.24	0.69
166600.00		95.25	87.73	88.88	94.44				7.52	6.37	0.82
166500.00		95.43	87.71	88.87	94.42				7.71	6.56	1.01
166400.00		95.14	87.69	88.85	94.40				7.44	6.29	0.73
166300.00		95.03	87.68	88.83	94.39				7.35	6.20	0.64
166200.00		95.08	87.66	88.81	94.37				7.42	6.27	0.71
166100.00		95.15	87.64	88.80	94.35				7.51	6.35	0.80
166000.00		95.01	87.62	88.78	94.34				7.39	6.23	0.67
165900.00		95.14	87.60	88.76	94.32				7.54	6.38	0.82
165800.00		95.04	87.58	88.74	94.30				7.46	6.30	0.74
165700.00		95.05	87.57	88.73	94.29				7.48	6.32	0.76
165600.00		94.74	87.55	88.71	94.27				7.19	6.03	0.47

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
165500.00		94.62	87.53	88.69	94.25				7.09	5.92	0.37
165400.00		94.98	87.51	88.68	94.23				7.47	6.30	0.75
165300.00		95.00	87.49	88.66	94.22				7.51	6.34	0.78
165200.00		95.29	87.47	88.65	94.20				7.82	6.64	1.09
165100.00		94.88	87.46	88.63	94.18				7.42	6.25	0.70
165000.00		94.85	87.44	88.61	94.17				7.41	6.23	0.68
164900.00		95.06	87.42	88.60	94.15				7.64	6.47	0.91
164800.00		95.09	87.40	88.58	94.13				7.69	6.51	0.96
164700.00		95.00	87.39	88.57	94.12				7.62	6.44	0.89
164600.00		95.05	87.37	88.55	94.10				7.68	6.50	0.95
164500.00		95.10	87.36	88.54	94.09				7.74	6.56	1.00
164400.00		95.07	87.35	88.53	94.08				7.72	6.54	0.99
164300.00		95.19	87.33	88.51	94.07				7.86	6.68	1.12
164200.00		94.97	87.32	88.50	94.06				7.65	6.47	0.91
164100.00		94.85	87.30	88.49	94.05				7.54	6.36	0.80
164000.00		94.96	87.29	88.48	94.04				7.67	6.48	0.92
163900.00		94.89	87.28	88.46	94.02				7.61	6.42	0.86
163800.00		94.91	87.26	88.45	94.01				7.65	6.46	0.90
163700.00		94.98	87.25	88.44	94.00				7.73	6.55	0.98
163600.00		95.08	87.24	88.42	93.99				7.84	6.66	1.09
163500.00		95.09	87.22	88.41	93.98				7.87	6.68	1.12
163400.00		95.05	87.21	88.40	93.97				7.84	6.65	1.08
163300.00		95.04	87.20	88.39	93.96				7.84	6.65	1.08
163200.00		94.96	87.19	88.38	93.95				7.77	6.58	1.01
163100.00		94.95	87.18	88.37	93.94				7.77	6.58	1.01
163000.00		95.00	87.18	88.37	93.94				7.82	6.64	1.07
162900.00		94.89	87.18	88.36	93.93				7.72	6.53	0.96
162800.00		94.76	87.17	88.36	93.93				7.59	6.40	0.83
162700.00		94.85	87.17	88.36	93.93				7.68	6.49	0.92
162600.00		94.73	87.16	88.35	93.92				7.56	6.38	0.81
162500.00		94.77	87.16	88.35	93.92				7.61	6.42	0.85
162400.00		94.94	87.16	88.34	93.91				7.78	6.59	1.02
162300.00		94.72	87.15	88.34	93.91				7.57	6.38	0.81
162200.00		94.93	87.15	88.33	93.90				7.78	6.60	1.03
162100.00		94.72	87.14	88.33	93.90				7.58	6.39	0.82
162000.00	94.12	94.43	87.14	88.32	93.89	6.98	5.80	0.23	7.28	6.10	0.53
161900.00		94.33	87.14	88.32	93.89				7.19	6.01	0.44
161800.00		94.73	87.13	88.32	93.89				7.60	6.42	0.85
161700.00		94.28	87.13	88.31	93.88				7.15	5.97	0.40
161600.00		94.40	87.13	88.31	93.88				7.28	6.10	0.53
161500.00	94.21	94.54	87.12	88.30	93.87	7.09	5.91	0.34	7.42	6.24	0.67
161400.00		94.38	87.12	88.30	93.87				7.26	6.08	0.51
161300.00		94.49	87.11	88.29	93.86				7.37	6.19	0.62
161200.00	94.05	94.21	87.11	88.29	93.86	6.94	5.76	0.19	7.10	5.92	0.35
161100.00		94.10	87.09	88.28	93.84				7.01	5.82	0.26
161000.00	94.00	94.32	87.08	88.26	93.83	6.92	5.74	0.17	7.23	6.05	0.48
160900.00		94.14	87.07	88.25	93.82				7.07	5.89	0.32
160800.00		94.34	87.05	88.24	93.80				7.28	6.10	0.53
160700.00	93.90	94.09	87.04	88.23	93.79	6.86	5.68	0.11	7.05	5.86	0.30
160600.00		93.99	87.03	88.21	93.78				6.96	5.77	0.21
160500.00	93.72	93.93	87.01	88.20	93.76	6.70	5.52	-0.05	6.91	5.72	0.16
160400.00		94.10	87.00	88.19	93.75				7.09	5.91	0.34
160300.00		94.10	86.99	88.18	93.74				7.11	5.92	0.36
160200.00		94.18	86.97	88.16	93.72				7.21	6.02	0.46
160100.00		94.22	86.96	88.15	93.71				7.26	6.07	0.51
160000.00	93.79	94.00	86.94	88.13	93.69	6.85	5.66	0.10	7.07	5.88	0.32
159900.00		93.99	86.91	88.10	93.66				7.09	5.89	0.33
159800.00		94.28	86.88	88.07	93.64				7.40	6.21	0.64
159700.00		93.93	86.85	88.05	93.61				7.08	5.88	0.32
159600.00		93.88	86.82	88.02	93.58				7.06	5.86	0.29
159500.00	93.74	93.81	86.79	87.99	93.56	6.95	5.75	0.18	7.02	5.82	0.25
159400.00		93.93	86.77	87.96	93.53				7.17	5.97	0.40
159300.00		93.96	86.73	87.93	93.51				7.22	6.02	0.45
159200.00		93.67	86.68	87.89	93.47				7.00	5.79	0.21
159100.00		93.63	86.62	87.84	93.43				7.01	5.79	0.20
159000.00	93.40	93.53	86.56	87.79	93.39	6.83	5.61	0.01	6.97	5.75	0.15
158900.00		93.44	86.51	87.74	93.35				6.94	5.71	0.10
158800.00		93.45	86.45	87.69	93.31				7.00	5.76	0.14
158700.00		93.47	86.39	87.64	93.27				7.08	5.83	0.20
158600.00		93.77	86.34	87.59	93.23				7.43	6.18	0.54
158500.00	93.54	93.76	86.28	87.54	93.19	7.26	6.00	0.35	7.48	6.22	0.57
158400.00	93.75	94.08	86.22	87.49	93.15	7.52	6.25	0.59	7.86	6.59	0.93
158300.00		93.89	86.17	87.44	93.11				7.73	6.45	0.78
158200.00		93.51	86.12	87.40	93.08				7.39	6.11	0.43

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
158100.00		93.32	86.08	87.37	93.05				7.24	5.95	0.27
158000.00	92.83	93.08	86.04	87.33	93.02	6.79	5.50	-0.19	7.05	5.75	0.06
157900.00		93.17	85.99	87.29	92.99				7.18	5.88	0.18
157800.00		93.19	85.95	87.25	92.96				7.24	5.93	0.23
157700.00		93.26	85.91	87.22	92.93				7.35	6.04	0.33
157600.00		93.19	85.87	87.18	92.91				7.32	6.01	0.29
157500.00	92.94	93.06	85.82	87.14	92.89	7.11	5.80	0.04	7.24	5.92	0.17
157400.00		93.23	85.78	87.10	92.88				7.45	6.13	0.35
157300.00		93.36	85.73	87.05	92.86				7.63	6.31	0.50
157200.00		93.19	85.67	87.01	92.84				7.52	6.19	0.35
157100.00		93.07	85.62	86.96	92.82				7.45	6.11	0.25
157000.00	92.91	93.17	85.56	86.90	92.79	7.36	6.01	0.12	7.62	6.27	0.38
156900.00		93.28	85.50	86.85	92.77				7.79	6.43	0.51
156800.00		93.31	85.43	86.80	92.75				7.88	6.51	0.57
156700.00		93.10	85.37	86.75	92.72				7.73	6.35	0.38
156600.00		93.23	85.31	86.69	92.70				7.92	6.54	0.54
156500.00	92.77	93.18	85.27	86.66	92.68	7.50	6.11	0.09	7.92	6.53	0.51
156400.00		92.94	85.23	86.63	92.66				7.70	6.31	0.28
156300.00		92.94	85.20	86.60	92.63				7.74	6.34	0.31
156200.00		92.72	85.19	86.59	92.62				7.54	6.14	0.11
156100.00		92.75	85.18	86.58	92.61				7.57	6.16	0.13
156000.00	92.78	93.03	85.18	86.58	92.61	7.60	6.20	0.17	7.86	6.46	0.42
155900.00		92.78	85.17	86.57	92.61				7.61	6.21	0.18
155800.00		92.68	85.16	86.57	92.60				7.52	6.11	0.08
155700.00		92.94	85.16	86.56	92.60				7.78	6.38	0.34
155600.00		92.95	85.15	86.56	92.59				7.80	6.39	0.36
155500.00	92.80	92.97	85.15	86.55	92.59	7.65	6.25	0.21	7.82	6.41	0.38
155400.00		92.84	85.14	86.55	92.59				7.70	6.29	0.25
155300.00		92.86	85.14	86.54	92.58				7.73	6.32	0.28
155200.00		92.77	85.13	86.54	92.58				7.64	6.23	0.20
155100.00		92.79	85.13	86.53	92.57				7.66	6.25	0.21
155000.00	92.51	92.81	85.12	86.53	92.57	7.39	5.98	-0.06	7.69	6.28	0.24
154900.00		92.69	85.11	86.52	92.57				7.58	6.17	0.12
154800.00		92.68	85.11	86.52	92.56				7.57	6.16	0.11
154700.00		92.74	85.10	86.52	92.56				7.64	6.23	0.19
154600.00		92.55	85.10	86.51	92.55				7.45	6.04	-0.01
154500.00	92.22	92.61	85.09	86.51	92.55	7.13	5.72	-0.33	7.52	6.11	0.06
154400.00		92.64	85.09	86.50	92.55				7.56	6.14	0.10
154300.00		92.86	85.08	86.50	92.54				7.78	6.37	0.32
154200.00		92.56	85.07	86.49	92.54				7.48	6.07	0.02
154100.00		92.62	85.07	86.49	92.53				7.55	6.14	0.09
154000.00	92.34	92.58	85.06	86.48	92.53	7.28	5.86	-0.19	7.51	6.09	0.05
153900.00		92.43	85.06	86.48	92.53				7.37	5.95	-0.09
153800.00		92.65	85.05	86.47	92.52				7.59	6.17	0.12
153700.00		92.44	85.03	86.45	92.50				7.42	6.00	-0.06
153600.00	92.40	92.55	84.99	86.42	92.47	7.41	5.99	-0.07	7.56	6.14	0.08
153500.00	92.28	92.38	84.96	86.39	92.44	7.32	5.89	-0.17	7.43	6.00	-0.06
153400.00		92.29	84.92	86.35	92.42				7.37	5.94	-0.13
153300.00	91.77	92.03	84.88	86.32	92.39	6.88	5.44	-0.62	7.14	5.71	-0.36
153200.00		92.20	84.85	86.29	92.36				7.35	5.91	-0.16
153100.00		92.33	84.75	86.20	92.29				7.58	6.13	0.04
153000.00	92.06	92.25	84.65	86.11	92.22	7.42	5.96	-0.16	7.60	6.14	0.03
152900.00		92.03	84.56	86.03	92.16				7.48	6.00	-0.13
152800.00		91.99	84.53	86.00	92.14				7.46	5.98	-0.15
152700.00		91.89	84.50	85.98	92.12				7.39	5.91	-0.23
152600.00		92.01	84.44	85.93	92.08				7.57	6.08	-0.07
152500.00	92.02	92.01	84.37	85.87	92.04	7.65	6.15	-0.02	7.65	6.14	-0.02
152400.00		91.97	84.30	85.81	91.99				7.67	6.16	-0.02
152300.00		92.12	84.25	85.77	91.96				7.87	6.35	0.15
152200.00		91.85	84.23	85.75	91.95				7.62	6.09	-0.10
152100.00		92.08	84.20	85.73	91.93				7.88	6.35	0.15
152000.00	91.48	91.51	84.18	85.71	91.91	7.29	5.77	-0.44	7.33	5.80	-0.41
151900.00		91.30	84.16	85.69	91.90				7.14	5.61	-0.60
151800.00		91.40	84.14	85.67	91.89				7.26	5.73	-0.49
151700.00		91.58	84.12	85.66	91.87				7.46	5.92	-0.30
151600.00		91.70	84.10	85.64	91.86				7.60	6.06	-0.16
151500.00	91.52	91.65	84.08	85.62	91.85	7.44	5.90	-0.33	7.58	6.03	-0.20
151400.00		91.81	84.06	85.60	91.84				7.75	6.21	-0.03
151300.00		91.94	84.04	85.59	91.83				7.90	6.35	0.12
151200.00		91.57	84.02	85.57	91.81				7.55	5.99	-0.25
151100.00		91.49	84.00	85.55	91.80				7.49	5.93	-0.31
151000.00	91.48	91.56	83.98	85.54	91.79	7.50	5.94	-0.31	7.58	6.02	-0.23
150900.00		91.42	83.96	85.52	91.78				7.46	5.90	-0.35
150800.00		91.29	83.94	85.50	91.76				7.35	5.79	-0.47

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
150700.00		91.24	83.92	85.49	91.75				7.32	5.76	-0.51
150600.00		91.48	83.90	85.47	91.74				7.58	6.01	-0.26
150500.00	91.45	91.45	83.85	85.43	91.71	7.60	6.02	-0.26	7.60	6.02	-0.26
150400.00		91.34	83.80	85.38	91.68				7.54	5.96	-0.34
150300.00		91.54	83.74	85.34	91.65				7.80	6.20	-0.11
150200.00		91.54	83.70	85.31	91.62				7.83	6.23	-0.08
150100.00		91.29	83.67	85.27	91.59				7.62	6.02	-0.30
150000.00	91.41	91.58	83.63	85.24	91.57	7.78	6.17	-0.15	7.95	6.34	0.02
149900.00		90.98	83.60	85.21	91.54				7.39	5.77	-0.56
149800.00		90.97	83.56	85.18	91.52				7.41	5.79	-0.55
149700.00		91.11	83.53	85.15	91.49				7.59	5.97	-0.37
149600.00		91.35	83.49	85.11	91.46				7.85	6.24	-0.11
149500.00	91.24	91.29	83.46	85.08	91.44	7.78	6.15	-0.21	7.84	6.21	-0.15
149400.00		91.30	83.42	85.05	91.42				7.88	6.25	-0.12
149300.00		91.02	83.39	85.02	91.40				7.63	5.99	-0.38
149200.00		90.95	83.35	84.99	91.37				7.59	5.95	-0.43
149100.00		90.95	83.32	84.96	91.35				7.63	5.98	-0.41
149000.00	91.30	91.24	83.28	84.93	91.33	8.02	6.37	-0.03	7.95	6.31	-0.09
148900.00		91.40	83.25	84.91	91.31				8.15	6.49	0.09
148800.00		91.33	83.23	84.88	91.29				8.10	6.44	0.03
148700.00		91.13	83.20	84.86	91.28				7.93	6.27	-0.15
148600.00		91.22	83.17	84.84	91.26				8.05	6.38	-0.04
148500.00	91.72	91.85	83.15	84.82	91.24	8.58	6.91	0.48	8.70	7.04	0.61
148400.00		91.82	83.12	84.79	91.22				8.70	7.03	0.60
148300.00		91.54	83.10	84.77	91.20				8.45	6.77	0.34
148200.00		91.63	83.07	84.75	91.19				8.57	6.89	0.45
148100.00		91.74	83.04	84.72	91.17				8.70	7.02	0.58
148000.00	91.30	91.77	83.02	84.70	91.15	8.29	6.60	0.15	8.75	7.07	0.62
147900.00		91.30	82.99	84.68	91.13				8.31	6.62	0.17
147800.00		91.28	82.96	84.65	91.11				8.32	6.62	0.16
147700.00		91.45	82.94	84.63	91.10				8.52	6.82	0.36
147600.00		91.26	82.91	84.61	91.08				8.36	6.66	0.19
147500.00	91.17	91.31	82.88	84.59	91.06	8.29	6.59	0.11	8.43	6.72	0.25
147400.00		91.75	82.86	84.56	91.04				8.90	7.19	0.71
147300.00		91.52	82.83	84.54	91.02				8.69	6.98	0.50
147200.00		91.71	82.80	84.52	91.01				8.91	7.20	0.71
147100.00		91.63	82.78	84.49	90.99				8.85	7.14	0.64
147000.00	91.50	91.63	82.75	84.47	90.97	8.75	7.03	0.53	8.88	7.16	0.66
146900.00		91.52	82.72	84.45	90.95				8.80	7.08	0.57
146800.00		91.43	82.69	84.42	90.93				8.74	7.01	0.50
146700.00		91.45	82.67	84.40	90.91				8.78	7.05	0.54
146600.00		92.10	82.64	84.38	90.89				9.46	7.72	1.21
146500.00	91.85	92.11	82.61	84.36	90.87	9.24	7.49	0.98	9.49	7.75	1.24
146400.00		91.57	82.58	84.33	90.85				8.99	7.24	0.72
146300.00		91.55	82.56	84.31	90.83				9.00	7.24	0.73
146200.00		91.38	82.53	84.29	90.81				8.85	7.09	0.57
146100.00		91.12	82.50	84.27	90.79				8.62	6.86	0.33
146000.00	90.90	91.10	82.47	84.24	90.77	8.43	6.66	0.14	8.63	6.85	0.33
145900.00		91.20	82.45	84.22	90.75				8.76	6.98	0.45
145800.00		91.23	82.42	84.20	90.73				8.81	7.03	0.50
145700.00		91.01	82.39	84.18	90.71				8.62	6.84	0.31
145600.00		91.06	82.36	84.16	90.69				8.70	6.91	0.37
145500.00	90.55	90.76	82.33	84.13	90.67	8.22	6.42	-0.12	8.43	6.63	0.09
145400.00		91.29	82.31	84.11	90.65				8.99	7.18	0.64
145300.00		91.60	82.28	84.09	90.63				9.32	7.51	0.96
145200.00		91.69	82.25	84.07	90.61				9.44	7.62	1.08
145100.00		91.83	82.22	84.05	90.59				9.61	7.78	1.24
145000.00	91.27	91.80	82.20	84.03	90.57	9.08	7.25	0.70	9.60	7.77	1.23
144900.00		91.82	82.17	84.00	90.55				9.66	7.82	1.27
144800.00		91.87	82.14	83.98	90.53				9.73	7.89	1.33
144700.00		91.54	82.11	83.96	90.51				9.43	7.58	1.02
144600.00		91.28	82.08	83.94	90.50				9.19	7.34	0.78
144500.00	90.99	91.39	82.06	83.92	90.48	8.93	7.07	0.51	9.34	7.47	0.92
144400.00		91.51	82.03	83.90	90.46				9.48	7.61	1.05
144300.00		91.54	82.01	83.88	90.44				9.53	7.66	1.10
144200.00		91.64	81.99	83.86	90.42				9.65	7.78	1.22
144100.00		91.83	81.97	83.85	90.41				9.87	7.99	1.42
144000.00	91.40	91.70	81.95	83.83	90.39	9.45	7.57	1.00	9.75	7.87	1.31
143900.00		92.04	81.93	83.82	90.38				10.11	8.22	1.66
143800.00		91.92	81.91	83.80	90.36				10.01	8.12	1.56
143700.00		91.70	81.89	83.78	90.35				9.81	7.91	1.35
143600.00		91.54	81.87	83.77	90.33				9.67	7.77	1.20
143500.00	91.04	91.42	81.85	83.75	90.32	9.19	7.29	0.72	9.57	7.67	1.10
143400.00		91.11	81.83	83.74	90.30				9.28	7.37	0.80

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
143300.00		91.28	81.81	83.72	90.29				9.47	7.56	0.99
143200.00		91.40	81.79	83.70	90.27				9.61	7.69	1.12
143100.00		91.50	81.77	83.69	90.26				9.73	7.81	1.24
143000.00	91.28	91.52	81.76	83.68	90.25	9.52	7.60	1.03	9.76	7.84	1.27
142900.00		91.36	81.75	83.67	90.24				9.62	7.69	1.12
142800.00		91.40	81.73	83.66	90.23				9.67	7.74	1.17
142700.00		91.45	81.72	83.65	90.22				9.72	7.79	1.22
142600.00		91.39	81.71	83.64	90.21				9.68	7.75	1.18
142500.00	90.66	91.21	81.70	83.63	90.21	8.96	7.03	0.45	9.51	7.58	1.00
142400.00		91.15	81.69	83.62	90.20				9.46	7.53	0.95
142300.00		91.19	81.67	83.61	90.19				9.51	7.58	1.00
142200.00		91.01	81.66	83.60	90.18				9.35	7.41	0.83
142100.00		90.99	81.65	83.59	90.17				9.34	7.40	0.82
142000.00	90.32	90.84	81.64	83.58	90.16	8.68	6.73	0.15	9.20	7.25	0.68
141900.00		91.08	81.63	83.57	90.15				9.45	7.51	0.93
141800.00		90.83	81.62	83.56	90.14				9.21	7.27	0.69
141700.00		90.86	81.60	83.55	90.13				9.25	7.30	0.72
141600.00		90.89	81.59	83.54	90.12				9.30	7.35	0.77
141500.00	90.38	91.06	81.58	83.53	90.11	8.80	6.85	0.27	9.48	7.53	0.95
141400.00		90.78	81.57	83.52	90.10				9.21	7.25	0.67
141300.00		90.72	81.55	83.51	90.09				9.17	7.21	0.63
141200.00		90.73	81.54	83.51	90.09				9.19	7.22	0.64
141100.00		90.47	81.53	83.50	90.08				8.94	6.98	0.40
141000.00	89.91	90.45	81.52	83.49	90.07	8.39	6.42	-0.16	8.93	6.97	0.39
140900.00		90.38	81.50	83.48	90.06				8.88	6.91	0.33
140800.00		90.61	81.49	83.47	90.05				9.12	7.15	0.57
140700.00		90.39	81.48	83.46	90.04				8.91	6.93	0.35
140600.00		90.55	81.47	83.45	90.03				9.08	7.10	0.52
140500.00	90.30	90.57	81.46	83.44	90.02	8.84	6.86	0.28	9.11	7.13	0.55
140400.00		90.07	81.45	83.43	90.01				8.62	6.63	0.06
140300.00		89.98	81.44	83.43	90.00				8.54	6.55	-0.03
140200.00		90.03	81.43	83.42	90.00				8.60	6.61	0.03
140100.00		90.02	81.42	83.41	89.99				8.59	6.60	0.03
140000.00	89.97	90.27	81.41	83.41	89.98	8.56	6.57	-0.01	8.86	6.86	0.29
139900.00		90.66	81.40	83.40	89.97				9.26	7.26	0.68
139800.00		90.22	81.39	83.39	89.97				8.82	6.83	0.25
139700.00		90.06	81.38	83.38	89.96				8.67	6.67	0.10
139600.00		89.87	81.38	83.38	89.95				8.49	6.49	-0.08
139500.00	89.77	89.96	81.37	83.37	89.94	8.41	6.40	-0.17	8.60	6.59	0.02
139400.00		89.73	81.36	83.36	89.94				8.37	6.37	-0.21
139300.00		89.59	81.35	83.36	89.93				8.24	6.23	-0.34
139200.00		89.78	81.34	83.35	89.92				8.44	6.44	-0.14
139100.00		89.73	81.33	83.34	89.91				8.40	6.38	-0.19
139000.00	89.62	89.78	81.32	83.33	89.91	8.30	6.28	-0.29	8.45	6.44	-0.13
138900.00		89.73	81.31	83.33	89.90				8.42	6.41	-0.17
138800.00		89.70	81.30	83.32	89.89				8.40	6.38	-0.19
138700.00		89.80	81.29	83.31	89.88				8.50	6.48	-0.09
138600.00		89.58	81.28	83.30	89.87				8.30	6.28	-0.29
138500.00	89.50	89.58	81.26	83.29	89.85	8.24	6.21	-0.36	8.32	6.29	-0.27
138400.00		89.38	81.24	83.27	89.84				8.14	6.11	-0.46
138300.00		89.39	81.22	83.26	89.82				8.17	6.14	-0.43
138200.00		89.20	81.21	83.24	89.81				8.00	5.96	-0.60
138100.00		89.46	81.19	83.23	89.79				8.27	6.23	-0.33
138000.00	89.39	89.38	81.17	83.21	89.77	8.22	6.18	-0.38	8.21	6.17	-0.39
137900.00		89.47	81.15	83.20	89.76				8.32	6.27	-0.29
137800.00		89.42	81.13	83.18	89.74				8.29	6.24	-0.32
137700.00		89.43	81.11	83.17	89.73				8.32	6.27	-0.29
137600.00		89.61	81.09	83.15	89.71				8.52	6.46	-0.09
137500.00	89.49	89.55	81.07	83.13	89.69	8.43	6.36	-0.19	8.48	6.42	-0.14
137400.00		89.56	81.05	83.11	89.67				8.52	6.45	-0.11
137300.00		89.35	81.02	83.10	89.65				8.33	6.25	-0.30
137200.00		89.27	81.00	83.08	89.63				8.27	6.19	-0.36
137100.00		89.41	80.98	83.06	89.61				8.44	6.35	-0.20
137000.00	89.34	89.38	80.96	83.04	89.59	8.39	6.30	-0.25	8.42	6.33	-0.22
136900.00		89.53	80.94	83.03	89.58				8.60	6.50	-0.04
136800.00		89.62	80.92	83.02	89.56				8.70	6.61	0.06
136700.00		89.27	80.91	83.00	89.55				8.36	6.26	-0.28
136600.00		89.37	80.89	82.99	89.53				8.48	6.39	-0.16
136500.00	89.34	89.57	80.87	82.97	89.51	8.46	6.36	-0.18	8.70	6.60	0.06
136400.00		89.36	80.86	82.96	89.50				8.50	6.40	-0.14
136300.00		89.30	80.84	82.94	89.48				8.46	6.36	-0.18
136200.00		89.63	80.82	82.93	89.46				8.81	6.70	0.17
136100.00		89.87	80.81	82.92	89.45				9.07	6.96	0.43
136000.00	89.55	89.96	80.77	82.89	89.42	8.78	6.66	0.13	9.18	7.07	0.54

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
135900.00		89.97	80.73	82.86	89.39				9.24	7.11	0.58
135800.00		89.80	80.68	82.82	89.35				9.12	6.98	0.45
135700.00		89.71	80.63	82.79	89.32				9.08	6.92	0.40
135600.00		89.44	80.58	82.76	89.28				8.85	6.68	0.16
135500.00	89.30	89.54	80.54	82.72	89.25	8.76	6.58	0.05	9.01	6.82	0.30
135400.00		89.67	80.49	82.69	89.21				9.18	6.98	0.46
135300.00		89.36	80.44	82.65	89.18				8.92	6.71	0.18
135200.00		89.49	80.40	82.62	89.14				9.09	6.87	0.34
135100.00		89.31	80.35	82.59	89.11				8.96	6.72	0.20
135000.00	89.27	89.34	80.30	82.55	89.07	8.96	6.71	0.19	9.04	6.79	0.27
134900.00		89.36	80.25	82.52	89.04				9.10	6.84	0.32
134800.00		89.61	80.21	82.49	89.01				9.40	7.13	0.61
134700.00		89.63	80.08	82.40	88.92				9.55	7.24	0.72
134600.00		89.10	79.88	82.25	88.78				9.22	6.84	0.31
134500.00	89.14	89.14	79.76	82.17	88.71	9.38	6.97	0.43	9.39	6.98	0.43
134400.00		89.17	79.73	82.15	88.69				9.44	7.01	0.47
134300.00		89.16	79.71	82.14	88.68				9.45	7.03	0.49
134200.00		89.19	79.68	82.12	88.66				9.50	7.07	0.53
134100.00		89.00	79.66	82.10	88.64				9.34	6.90	0.36
134000.00	89.45	89.34	79.64	82.09	88.63	9.81	7.36	0.82	9.71	7.26	0.72
133900.00		89.19	79.61	82.07	88.61				9.57	7.12	0.58
133800.00		89.01	79.59	82.05	88.59				9.43	6.96	0.42
133700.00		89.05	79.57	82.03	88.58				9.49	7.02	0.47
133600.00		88.85	79.54	82.02	88.56				9.31	6.83	0.29
133500.00	88.67	88.57	79.52	82.00	88.55	9.15	6.66	0.12	9.05	6.57	0.02
133400.00		88.58	79.49	81.98	88.53				9.09	6.60	0.06
133300.00		88.73	79.47	81.97	88.51				9.26	6.76	0.21
133200.00		88.81	79.45	81.95	88.50				9.36	6.86	0.31
133100.00		88.76	79.42	81.93	88.48				9.34	6.83	0.28
133000.00	88.95	88.95	79.40	81.92	88.46	9.55	7.03	0.49	9.55	7.03	0.48
132900.00		89.32	79.38	81.90	88.45				9.95	7.42	0.88
132800.00		89.59	79.35	81.88	88.43				10.24	7.71	1.16
132700.00		89.61	79.33	81.87	88.41				10.28	7.74	1.19
132600.00		90.02	79.30	81.85	88.40				10.72	8.17	1.62
132500.00	90.13	90.07	79.28	81.83	88.38	10.85	8.30	1.75	10.79	8.23	1.69
132400.00		91.23	79.26	81.82	88.37				11.97	9.41	2.87
132300.00		89.82	79.23	81.80	88.35				10.59	8.02	1.47
132200.00		89.09	79.22	81.79	88.34				9.87	7.30	0.75
132100.00		89.39	79.21	81.78	88.33				10.18	7.61	1.06
132000.00	89.40	89.45	79.20	81.77	88.32	10.20	7.63	1.08	10.25	7.68	1.13
131900.00		89.16	79.19	81.76	88.31				9.97	7.39	0.85
131800.00		89.29	79.18	81.76	88.30				10.11	7.53	0.99
131700.00		88.74	79.17	81.75	88.29				9.57	6.99	0.45
131600.00		88.46	79.16	81.74	88.28				9.30	6.72	0.18
131500.00	88.26	88.26	79.15	81.73	88.27	9.11	6.52	-0.02	9.11	6.53	-0.01
131400.00		88.26	79.14	81.73	88.27				9.12	6.54	0.00
131300.00		88.03	79.13	81.72	88.26				8.90	6.31	-0.23
131200.00		88.16	79.12	81.71	88.25				9.04	6.45	-0.08
131100.00		88.03	79.11	81.70	88.24				8.92	6.33	-0.21
131000.00	88.11	88.10	79.10	81.70	88.23	9.00	6.41	-0.12	9.00	6.41	-0.13
130900.00		87.93	79.09	81.69	88.22				8.83	6.24	-0.30
130800.00		88.31	79.08	81.68	88.21				9.22	6.63	0.09
130700.00		88.84	79.07	81.67	88.20				9.77	7.17	0.64
130600.00		88.79	79.05	81.66	88.18				9.75	7.14	0.61
130500.00	88.72	88.72	79.00	81.62	88.15	9.71	7.09	0.57	9.72	7.10	0.58
130400.00		88.71	78.97	81.60	88.12				9.74	7.11	0.59
130300.00		88.72	78.95	81.58	88.10				9.77	7.14	0.62
130200.00		88.78	78.93	81.57	88.08				9.85	7.21	0.69
130100.00		88.68	78.91	81.56	88.07				9.77	7.12	0.61
130000.00	88.56	88.73	78.89	81.54	88.05	9.66	7.01	0.50	9.84	7.19	0.68
129900.00		88.72	78.88	81.54	88.05				9.83	7.18	0.67
129800.00		88.87	78.88	81.53	88.04				9.99	7.34	0.83
129700.00		88.78	78.87	81.53	88.04				9.91	7.25	0.74
129600.00		88.72	78.87	81.52	88.03				9.85	7.19	0.69
129500.00	88.89	89.06	78.86	81.52	88.03	10.03	7.37	0.86	10.20	7.54	1.03
129400.00		89.39	78.86	81.51	88.02				10.53	7.87	1.37
129300.00		89.01	78.85	81.51	88.02				10.16	7.50	0.99
129200.00		89.04	78.85	81.51	88.01				10.20	7.54	1.03
129100.00		88.93	78.84	81.50	88.00				10.10	7.43	0.93
129000.00	88.83	88.92	78.83	81.50	88.00	9.99	7.33	0.83	10.08	7.42	0.92
128900.00		89.02	78.83	81.49	87.99				10.19	7.53	1.02
128800.00		88.97	78.82	81.49	87.99				10.15	7.49	0.98
128700.00		88.84	78.82	81.48	87.98				10.02	7.36	0.86
128600.00		88.73	78.81	81.48	87.98				9.92	7.25	0.75

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
128500.00	88.79	88.73	78.81	81.47	87.97	9.98	7.31	0.81	9.92	7.25	0.75
128400.00		88.55	78.80	81.47	87.97				9.75	7.08	0.58
128300.00		88.50	78.78	81.45	87.95				9.72	7.05	0.55
128200.00		88.34	78.76	81.44	87.93				9.58	6.90	0.40
128100.00		88.18	78.74	81.43	87.92				9.44	6.76	0.27
128000.00	88.24	88.27	78.72	81.41	87.90	9.52	6.83	0.34	9.55	6.86	0.37
127900.00		88.59	78.71	81.40	87.89				9.88	7.19	0.70
127800.00		88.31	78.71	81.40	87.89				9.60	6.91	0.42
127700.00		88.24	78.70	81.39	87.88				9.54	6.85	0.36
127600.00		88.44	78.69	81.39	87.87				9.75	7.05	0.57
127500.00	88.79	88.73	78.68	81.38	87.87	10.10	7.40	0.92	10.04	7.35	0.86
127400.00		88.77	78.68	81.38	87.86				10.10	7.40	0.91
127300.00		88.87	78.67	81.37	87.85				10.20	7.50	1.02
127200.00		88.78	78.66	81.36	87.85				10.12	7.42	0.93
127100.00		88.66	78.65	81.36	87.84				10.01	7.31	0.82
127000.00	88.83	88.76	78.65	81.35	87.83	10.18	7.47	0.99	10.12	7.41	0.93
126900.00		88.68	78.64	81.35	87.83				10.04	7.33	0.85
126800.00		88.61	78.63	81.34	87.82				9.98	7.27	0.79
126700.00		88.37	78.62	81.33	87.81				9.76	7.04	0.57
126600.00		88.38	78.60	81.32	87.80				9.78	7.06	0.58
126500.00	88.43	88.55	78.59	81.31	87.79	9.85	7.12	0.65	9.96	7.24	0.76
126400.00		88.64	78.57	81.30	87.77				10.07	7.34	0.86
126300.00		88.86	78.56	81.29	87.76				10.30	7.57	1.09
126200.00		88.64	78.54	81.28	87.75				10.10	7.37	0.89
126100.00		88.28	78.53	81.27	87.74				9.76	7.01	0.54
126000.00	87.99	87.99	78.51	81.26	87.73	9.48	6.74	0.26	9.48	6.73	0.26
125900.00		88.45	78.50	81.25	87.72				9.96	7.21	0.74
125800.00		88.25	78.49	81.24	87.71				9.76	7.01	0.54
125700.00		87.83	78.48	81.23	87.70				9.35	6.59	0.12
125600.00		88.03	78.47	81.23	87.69				9.56	6.80	0.33
125500.00	87.85	87.83	78.46	81.22	87.69	9.39	6.63	0.16	9.37	6.61	0.14
125400.00	87.88	87.82	78.45	81.21	87.68	9.43	6.66	0.20	9.37	6.60	0.14
125300.00		87.67	78.44	81.20	87.67				9.23	6.47	0.00
125200.00		87.89	78.43	81.20	87.66				9.45	6.69	0.22
125100.00		87.56	78.42	81.19	87.65				9.13	6.37	-0.10
125000.00	87.48	87.50	78.41	81.18	87.65	9.06	6.29	-0.17	9.09	6.32	-0.15
124900.00		87.80	78.40	81.18	87.64				9.39	6.62	0.16
124800.00		88.34	78.39	81.17	87.63				9.95	7.18	0.71
124700.00		89.69	78.38	81.16	87.62				11.31	8.53	2.07
124600.00		89.35	78.37	81.15	87.61				10.98	8.20	1.74
124500.00	88.54	88.62	78.36	81.15	87.60	10.17	7.39	0.93	10.26	7.48	1.02
124400.00		88.24	78.35	81.14	87.59				9.89	7.10	0.65
124300.00		87.98	78.34	81.13	87.58				9.64	6.86	0.40
124200.00		87.85	78.32	81.12	87.57				9.53	6.74	0.28
124100.00	87.50	87.65	78.31	81.11	87.55	9.19	6.39	-0.06	9.34	6.55	0.10
124000.00	88.04	88.16	78.30	81.10	87.54	9.74	6.94	0.49	9.86	7.06	0.61
123900.00		87.95	78.28	81.09	87.53				9.66	6.86	0.42
123800.00		87.82	78.27	81.08	87.52				9.54	6.74	0.30
123700.00		88.01	78.26	81.07	87.51				9.76	6.95	0.51
123600.00		88.13	78.24	81.06	87.49				9.88	7.07	0.64
123500.00	87.52	87.78	78.23	81.05	87.48	9.29	6.48	0.04	9.54	6.73	0.30
123400.00		87.74	78.22	81.04	87.47				9.52	6.70	0.27
123300.00		87.47	78.21	81.03	87.46				9.26	6.44	0.01
123200.00		87.45	78.20	81.02	87.45				9.25	6.43	0.00
123100.00		87.55	78.19	81.01	87.44				9.36	6.54	0.11
123000.00	87.55	87.70	78.18	81.00	87.43	9.37	6.54	0.12	9.52	6.69	0.27
122900.00		87.80	78.17	81.00	87.42				9.64	6.81	0.39
122800.00		87.81	78.16	80.99	87.41				9.65	6.82	0.40
122700.00		87.60	78.15	80.98	87.40				9.45	6.62	0.20
122600.00		87.44	78.14	80.97	87.39				9.30	6.47	0.05
122500.00	87.28	87.38	78.13	80.96	87.38	9.15	6.32	-0.10	9.25	6.42	0.00
122400.00		87.06	78.12	80.96	87.37				8.94	6.11	-0.31
122300.00		87.22	78.11	80.95	87.36				9.11	6.27	-0.14
122200.00		87.21	78.10	80.94	87.35				9.11	6.27	-0.14
122100.00		87.14	78.09	80.93	87.34				9.04	6.20	-0.21
122000.00	86.99	87.08	78.08	80.92	87.33	8.92	6.07	-0.33	9.01	6.16	-0.24
121900.00		87.18	78.06	80.91	87.31				9.12	6.27	-0.14
121800.00		86.91	78.04	80.89	87.30				8.87	6.02	-0.38
121700.00		86.63	78.02	80.88	87.28				8.61	5.75	-0.65
121600.00	86.96	86.88	78.00	80.87	87.26	8.95	6.09	-0.30	8.87	6.01	-0.39
121500.00	87.09	87.14	77.99	80.85	87.25	9.11	6.24	-0.15	9.15	6.28	-0.11
121400.00		86.92	77.96	80.83	87.22				8.97	6.09	-0.29
121300.00		86.99	77.92	80.81	87.18				9.07	6.19	-0.19
121200.00		86.78	77.88	80.78	87.15				8.89	6.00	-0.37

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
121100.00		86.81	77.85	80.75	87.12				8.96	6.06	-0.31
121000.00	86.92	86.99	77.82	80.73	87.09	9.10	6.19	-0.17	9.18	6.27	-0.09
120900.00		87.34	77.80	80.71	87.07				9.54	6.63	0.27
120800.00		87.40	77.78	80.70	87.05				9.62	6.70	0.35
120700.00		87.45	77.76	80.68	87.03				9.69	6.77	0.42
120600.00		87.56	77.74	80.67	87.01				9.81	6.89	0.55
120500.00	87.31	87.59	77.72	80.65	86.99	9.58	6.65	0.32	9.87	6.94	0.60
120400.00		87.69	77.70	80.64	86.97				9.99	7.05	0.72
120300.00		87.72	77.69	80.62	86.95				10.03	7.10	0.77
120200.00		88.11	77.67	80.61	86.93				10.44	7.50	1.18
120100.00		87.82	77.65	80.59	86.91				10.17	7.23	0.91
120000.00	87.81	87.95	77.63	80.58	86.89	10.18	7.23	0.92	10.32	7.37	1.06
119900.00		87.98	77.61	80.56	86.87				10.37	7.41	1.11
119800.00		87.74	77.59	80.55	86.85				10.14	7.19	0.88
119700.00		87.45	77.58	80.54	86.83				9.88	6.92	0.62
119600.00		87.48	77.56	80.52	86.81				9.92	6.96	0.67
119500.00	87.27	87.40	77.54	80.51	86.80	9.73	6.76	0.47	9.86	6.89	0.60
119400.00		87.38	77.52	80.49	86.78				9.86	6.89	0.60
119300.00		87.39	77.50	80.48	86.76				9.88	6.91	0.63
119200.00		87.76	77.49	80.46	86.74				10.27	7.30	1.02
119100.00		87.51	77.47	80.45	86.72				10.04	7.06	0.79
119000.00	87.55	87.58	77.45	80.44	86.70	10.10	7.12	0.85	10.13	7.15	0.88
118900.00		87.67	77.43	80.42	86.68				10.24	7.25	0.99
118800.00		87.69	77.42	80.41	86.67				10.27	7.28	1.02
118700.00		87.50	77.41	80.40	86.66				10.09	7.10	0.84
118600.00		87.53	77.40	80.40	86.65				10.13	7.13	0.88
118500.00	87.35	87.26	77.39	80.39	86.64	9.96	6.96	0.72	9.87	6.87	0.62
118400.00		87.39	77.38	80.38	86.62				10.01	7.01	0.76
118300.00		87.16	77.37	80.37	86.61				9.79	6.79	0.54
118200.00		87.18	77.36	80.36	86.60				9.83	6.82	0.58
118100.00		87.56	77.34	80.35	86.59				10.22	7.21	0.97
118000.00	87.59	87.55	77.33	80.35	86.58	10.25	7.24	1.01	10.22	7.21	0.97
117900.00		87.67	77.32	80.34	86.57				10.35	7.33	1.10
117800.00		87.65	77.31	80.33	86.56				10.34	7.32	1.09
117700.00		87.19	77.30	80.32	86.54				9.89	6.87	0.65
117600.00		87.35	77.29	80.31	86.53				10.06	7.03	0.81
117500.00	87.32	87.38	77.28	80.30	86.52	10.04	7.01	0.80	10.10	7.08	0.86
117400.00		87.22	77.27	80.29	86.51				9.95	6.93	0.71
117300.00		87.33	77.26	80.29	86.50				10.07	7.04	0.83
117200.00		87.20	77.25	80.28	86.49				9.95	6.92	0.71
117100.00		87.09	77.23	80.27	86.47				9.86	6.82	0.62
117000.00	87.05	87.07	77.22	80.26	86.46	9.84	6.80	0.60	9.85	6.81	0.61
116900.00		87.06	77.20	80.24	86.44				9.85	6.81	0.61
116800.00		87.07	77.19	80.23	86.43				9.88	6.84	0.64
116700.00		86.94	77.18	80.22	86.42				9.76	6.72	0.52
116600.00		86.90	77.16	80.21	86.40				9.73	6.68	0.49
116500.00	87.19	87.19	77.15	80.20	86.39	10.04	6.99	0.80	10.04	6.99	0.80
116400.00		86.88	77.14	80.19	86.38				9.74	6.69	0.50
116300.00		87.07	77.12	80.18	86.36				9.95	6.89	0.71
116200.00		87.10	77.11	80.17	86.35				9.99	6.93	0.75
116100.00		86.96	77.10	80.16	86.34				9.87	6.81	0.63
116000.00	87.08	86.94	77.08	80.15	86.32	9.99	6.93	0.75	9.85	6.79	0.61
115900.00		87.10	77.07	80.14	86.31				10.03	6.96	0.79
115800.00		87.25	77.05	80.12	86.29				10.21	7.13	0.97
115700.00		87.28	77.01	80.09	86.25				10.27	7.18	1.03
115600.00		86.99	76.97	80.06	86.21				10.02	6.93	0.78
115500.00	86.91	86.97	76.93	80.04	86.17	9.98	6.88	0.74	10.04	6.93	0.80
115400.00		87.01	76.89	80.01	86.13				10.12	7.00	0.88
115300.00		87.06	76.86	79.99	86.11				10.19	7.07	0.95
115200.00		86.88	76.84	79.97	86.08				10.04	6.91	0.80
115100.00		86.91	76.82	79.96	86.06				10.09	6.95	0.85
115000.00	86.77	86.77	76.80	79.94	86.04	9.97	6.83	0.73	9.97	6.83	0.73
114900.00		86.56	76.78	79.92	86.02				9.78	6.64	0.54
114800.00		86.83	76.76	79.90	86.00				10.07	6.92	0.83
114700.00		86.96	76.73	79.89	85.98				10.23	7.07	0.98
114600.00		86.85	76.71	79.87	85.96				10.14	6.98	0.89
114500.00	86.80	86.64	76.69	79.85	85.94	10.11	6.94	0.86	9.95	6.78	0.70
114400.00		87.13	76.67	79.84	85.92				10.46	7.29	1.21
114300.00		87.08	76.65	79.82	85.90				10.43	7.26	1.18
114200.00		86.80	76.63	79.81	85.88				10.17	6.99	0.92
114100.00		86.55	76.61	79.79	85.86				9.94	6.76	0.69
114000.00	86.53	86.45	76.59	79.78	85.84	9.94	6.75	0.69	9.86	6.67	0.61
113900.00		86.80	76.57	79.76	85.82				10.23	7.04	0.98
113800.00		86.84	76.55	79.75	85.80				10.29	7.09	1.04

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
113700.00		87.03	76.53	79.73	85.78				10.51	7.31	1.26
113600.00		86.73	76.51	79.71	85.76				10.22	7.01	0.97
113500.00	86.43	86.48	76.49	79.70	85.74	9.95	6.73	0.70	9.99	6.78	0.74
113400.00		86.40	76.47	79.68	85.72				9.93	6.72	0.68
113300.00		85.74	76.45	79.67	85.70				9.29	6.07	0.04
113200.00		85.52	76.43	79.65	85.68				9.09	5.86	-0.16
113100.00		80.21	76.41	79.64	85.66				3.79	0.57	-5.45
113000.00	85.72	85.49	76.40	79.63	85.64	9.32	6.09	0.07	9.09	5.86	-0.15
112900.00		87.68	76.38	79.62	85.63				11.30	8.06	2.06
112800.00		87.64	76.37	79.60	85.61				11.27	8.04	2.03
112700.00		87.46	76.35	79.59	85.59				11.11	7.87	1.87
112600.00		86.27	76.33	79.58	85.57				9.94	6.69	0.70
112500.00	86.08	85.97	76.32	79.57	85.55	9.77	6.52	0.53	9.65	6.40	0.41
112400.00		86.16	76.30	79.55	85.54				9.86	6.60	0.62
112300.00		86.70	76.28	79.54	85.52				10.41	7.15	1.18
112200.00		86.55	76.27	79.53	85.50				10.28	7.02	1.05
112100.00		86.40	76.25	79.51	85.48				10.14	6.88	0.91
112000.00	86.27	86.08	76.23	79.50	85.46	10.04	6.77	0.81	9.85	6.58	0.62
111900.00		86.04	76.22	79.49	85.45				9.82	6.55	0.60
111800.00		86.11	76.20	79.48	85.43				9.91	6.64	0.68
111700.00		86.25	76.19	79.46	85.41				10.07	6.79	0.84
111600.00		86.09	76.17	79.45	85.39				9.92	6.64	0.70
111500.00	86.08	85.86	76.15	79.44	85.38	9.92	6.64	0.70	9.71	6.42	0.49
111400.00		85.77	76.14	79.43	85.36				9.64	6.35	0.42
111300.00		85.73	76.10	79.40	85.34				9.63	6.33	0.39
111200.00		85.65	76.05	79.36	85.33				9.61	6.30	0.33
111100.00		85.93	75.99	79.32	85.31				9.94	6.61	0.62
111000.00	86.06	86.11	75.94	79.28	85.30	10.12	6.78	0.76	10.17	6.84	0.82
110900.00		86.26	75.89	79.24	85.28				10.37	7.02	0.98
110800.00		86.18	75.86	79.21	85.27				10.32	6.97	0.91
110700.00		86.25	75.88	79.24	85.25				10.37	7.01	1.00
110600.00		86.30	75.87	79.24	85.24				10.43	7.07	1.06
110500.00	86.04	85.95	75.87	79.23	85.23	10.16	6.80	0.80	10.07	6.71	0.71
110400.00		85.97	75.87	79.23	85.23				10.11	6.74	0.75
110300.00		86.15	75.86	79.23	85.22				10.29	6.92	0.93
110200.00		85.92	75.86	79.23	85.22				10.06	6.70	0.71
110100.00		85.81	75.86	79.23	85.21				9.95	6.58	0.60
110000.00	85.80	85.76	75.86	79.23	85.21	9.95	6.58	0.60	9.91	6.54	0.56
109900.00		85.73	75.85	79.22	85.20				9.88	6.51	0.53
109800.00		85.98	75.85	79.22	85.19				10.13	6.76	0.79
109700.00		87.29	75.85	79.22	85.19				11.44	8.07	2.10
109600.00		86.52	75.84	79.22	85.18				10.68	7.30	1.34
109500.00	86.38	86.15	75.84	79.22	85.18	10.54	7.17	1.21	10.31	6.93	0.97
109400.00		86.45	75.84	79.21	85.17				10.61	7.24	1.28
109300.00	86.44	86.30	75.83	79.21	85.16	10.60	7.22	1.27	10.46	7.08	1.13
109200.00		86.49	75.83	79.21	85.16				10.66	7.28	1.33
109100.00		86.47	75.82	79.20	85.15				10.65	7.26	1.32
109000.00	86.43	86.35	75.81	79.20	85.14	10.61	7.23	1.28	10.53	7.15	1.20
108900.00		86.23	75.80	79.19	85.13				10.42	7.04	1.09
108800.00		86.10	75.79	79.18	85.13				10.31	6.92	0.97
108700.00		86.34	75.78	79.18	85.12				10.55	7.16	1.22
108600.00		86.32	75.78	79.17	85.11				10.54	7.15	1.21
108500.00	86.36	86.54	75.77	79.16	85.10	10.60	7.20	1.26	10.77	7.37	1.43
108400.00		86.37	75.76	79.16	85.09				10.61	7.21	1.27
108300.00		86.34	75.75	79.15	85.09				10.59	7.18	1.25
108200.00		86.09	75.74	79.14	85.08				10.35	6.94	1.01
108100.00		85.84	75.73	79.14	85.07				10.11	6.70	0.77
108000.00	85.89	85.90	75.72	79.13	85.06	10.16	6.75	0.82	10.18	6.77	0.84
107900.00		85.71	75.72	79.13	85.06				9.99	6.58	0.65
107800.00		86.16	75.72	79.13	85.06				10.44	7.03	1.10
107700.00		86.10	75.72	79.13	85.06				10.38	6.97	1.04
107600.00		86.29	75.72	79.13	85.06				10.57	7.16	1.23
107500.00	85.46	85.67	75.72	79.13	85.06	9.74	6.33	0.40	9.95	6.54	0.61
107400.00		85.98	75.72	79.13	85.06				10.26	6.85	0.92
107300.00	85.79	86.09	75.72	79.13	85.06	10.07	6.66	0.73	10.37	6.96	1.03
107200.00		86.24	75.72	79.13	85.06				10.52	7.11	1.18
107100.00		86.40	75.72	79.13	85.06				10.68	7.27	1.34
107000.00	85.69	86.02	75.72	79.13	85.06	9.97	6.56	0.63	10.30	6.89	0.96
106900.00		85.85	75.72	79.13	85.05				10.13	6.72	0.79
106800.00		86.45	75.71	79.11	85.04				10.74	7.33	1.41
106700.00		86.40	75.70	79.10	85.02				10.70	7.30	1.38
106600.00		86.34	75.69	79.09	85.01				10.65	7.25	1.33
106500.00	86.07	86.54	75.68	79.08	84.99	10.39	6.99	1.08	10.86	7.46	1.54
106400.00		86.18	75.67	79.07	84.98				10.51	7.11	1.20

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
106300.00		86.32	75.66	79.06	84.96				10.66	7.26	1.36
106200.00		86.60	75.65	79.05	84.95				10.95	7.55	1.65
106100.00		86.59	75.64	79.03	84.93				10.95	7.55	1.66
106000.00	85.59	86.43	75.63	79.02	84.92	9.96	6.57	0.67	10.80	7.41	1.51
105900.00		86.34	75.62	79.01	84.90				10.72	7.32	1.43
105800.00		86.83	75.61	79.00	84.89				11.23	7.83	1.95
105700.00		86.90	75.60	78.99	84.87				11.30	7.91	2.03
105600.00		86.66	75.58	78.97	84.85				11.07	7.68	1.80
105500.00	86.49	87.37	75.56	78.95	84.82	10.92	7.53	1.66	11.81	8.42	2.55
105400.00		87.26	75.54	78.93	84.79				11.72	8.33	2.47
105300.00		87.19	75.53	78.91	84.76				11.67	8.28	2.43
105200.00		86.96	75.51	78.88	84.73				11.46	8.08	2.23
105100.00		86.60	75.49	78.86	84.70				11.11	7.73	1.89
105000.00	85.65	86.33	75.47	78.84	84.67	10.19	6.81	0.98	10.87	7.49	1.66
104900.00		85.94	75.45	78.82	84.64				10.49	7.12	1.29
104800.00		86.04	75.43	78.80	84.61				10.61	7.24	1.42
104700.00		85.73	75.41	78.77	84.58				10.33	6.96	1.15
104600.00		85.79	75.39	78.75	84.55				10.41	7.04	1.24
104500.00	85.27	85.55	75.37	78.73	84.52	9.90	6.54	0.75	10.19	6.83	1.03
104400.00		86.28	75.35	78.71	84.50				10.93	7.57	1.79
104300.00		86.58	75.33	78.69	84.47				11.25	7.89	2.11
104200.00		84.51	75.32	78.67	84.44				9.20	5.84	0.07
104100.00		85.02	75.30	78.65	84.42				9.72	6.37	0.60
104000.00	85.18	85.62	75.28	78.63	84.39	9.89	6.55	0.78	10.34	6.99	1.23
103900.00		85.70	75.27	78.61	84.37				10.43	7.09	1.33
103800.00		85.24	75.25	78.59	84.34				9.99	6.65	0.90
103700.00		85.25	75.24	78.57	84.32				10.02	6.68	0.94
103600.00		85.19	75.22	78.55	84.29				9.97	6.64	0.90
103500.00	84.68	85.14	75.21	78.54	84.27	9.47	6.14	0.41	9.93	6.60	0.87
103400.00		85.71	75.19	78.52	84.24				10.52	7.19	1.47
103300.00		85.31	75.18	78.50	84.22				10.13	6.81	1.09
103200.00		85.15	75.16	78.49	84.20				9.99	6.67	0.96
103100.00		84.53	75.14	78.47	84.18				9.39	6.06	0.36
103000.00	82.21	82.50	75.13	78.45	84.15	7.08	3.76	-1.94	7.38	4.05	-1.65
102900.00		82.52	75.11	78.44	84.13				7.41	4.08	-1.61
102800.00		83.24	75.10	78.42	84.11				8.14	4.82	-0.87
102700.00		88.83	75.08	78.40	84.09				13.75	10.43	4.74
102600.00		94.10	75.07	78.39	84.06				19.04	15.72	10.04
102500.00	90.55	91.42	75.05	78.36	84.03	15.51	12.19	6.52	16.38	13.06	7.39
102400.00		84.14	75.03	78.34	84.00				9.11	5.80	0.14
102300.00		85.02	75.01	78.32	83.98				10.01	6.70	1.05
102200.00		84.79	75.00	78.31	83.96				9.79	6.48	0.83
102100.00		85.07	74.99	78.30	83.94				10.08	6.77	1.13
102000.00	84.02	84.49	74.98	78.28	83.92	9.04	5.74	0.10	9.51	6.21	0.57
101900.00		84.08	74.97	78.27	83.90				9.11	5.81	0.18
101800.00		84.76	74.96	78.26	83.88				9.80	6.50	0.87
101700.00		84.80	74.95	78.25	83.86				9.85	6.55	0.94
101600.00		84.36	74.94	78.23	83.85				9.42	6.12	0.51
101500.00	84.16	84.41	74.93	78.22	83.83	9.24	5.94	0.34	9.49	6.19	0.58
101400.00		84.67	74.91	78.21	83.81				9.75	6.46	0.86
101300.00		84.36	74.90	78.19	83.79				9.45	6.16	0.56
101200.00		84.57	74.89	78.18	83.77				9.67	6.39	0.79
101100.00		84.32	74.88	78.17	83.75				9.44	6.15	0.57
101000.00		84.23	74.87	78.16	83.74				9.35	6.07	0.49
100900.00		84.29	74.86	78.14	83.72				9.42	6.14	0.57
100800.00		86.18	74.85	78.13	83.70				11.33	8.05	2.48
100700.00		87.83	74.73	77.96	83.42				13.09	9.86	4.40
100600.00		84.19	74.63	77.82	83.17				9.56	6.37	1.02
100500.00	83.28	83.26	74.63	77.82	83.17	8.65	5.46	0.10	8.63	5.44	0.09
100400.00		83.30	74.63	77.82	83.17				8.67	5.48	0.12
100300.00		83.02	74.63	77.82	83.18				8.39	5.20	-0.16
100200.00		82.97	74.63	77.82	83.18				8.33	5.14	-0.21
100100.00		82.97	74.63	77.82	83.18				8.33	5.14	-0.21
100000.00	83.14	83.05	74.64	77.83	83.18	8.50	5.31	-0.04	8.42	5.23	-0.13
99900.00		82.99	74.64	77.83	83.18				8.35	5.16	-0.20
99800.00		83.06	74.64	77.83	83.18				8.42	5.23	-0.13
99700.00		82.95	74.64	77.83	83.19				8.31	5.12	-0.24
99600.00		83.13	74.64	77.83	83.19				8.49	5.30	-0.06
99500.00	83.04	83.06	74.64	77.83	83.19	8.40	5.21	-0.15	8.42	5.23	-0.13
99400.00		82.91	74.62	77.80	83.15				8.29	5.11	-0.24
99300.00		82.89	74.60	77.77	83.11				8.30	5.12	-0.21
99200.00		82.95	74.57	77.75	83.07				8.38	5.20	-0.12
99100.00		82.90	74.55	77.72	83.03				8.34	5.18	-0.13
99000.00	82.85	83.10	74.53	77.70	82.99	8.31	5.15	-0.14	8.57	5.40	0.11

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
98900.00		82.98	74.51	77.67	82.95				8.47	5.31	0.03
98800.00		82.78	74.49	77.64	82.91				8.29	5.14	-0.13
98700.00		82.90	74.47	77.62	82.87				8.43	5.28	0.03
98600.00		83.00	74.45	77.59	82.83				8.55	5.41	0.17
98500.00	82.76	82.86	74.43	77.57	82.79	8.34	5.20	-0.02	8.43	5.30	0.07
98400.00		82.86	74.41	77.54	82.75				8.46	5.33	0.12
98300.00		82.93	74.39	77.51	82.71				8.54	5.41	0.22
98200.00		82.75	74.37	77.49	82.67				8.38	5.26	0.08
98100.00		82.61	74.33	77.44	82.60				8.28	5.17	0.01
98000.00	82.62	82.65	74.30	77.39	82.53	8.32	5.22	0.09	8.35	5.25	0.12
97900.00		82.63	74.26	77.34	82.45				8.37	5.28	0.18
97800.00		82.58	74.22	77.30	82.37				8.36	5.28	0.21
97700.00		82.45	74.18	77.25	82.30				8.27	5.21	0.16
97600.00		82.46	74.15	77.20	82.22				8.31	5.26	0.24
97500.00	82.28	82.24	74.11	77.15	82.14	8.17	5.13	0.13	8.13	5.09	0.09
97400.00		82.20	74.07	77.10	82.06				8.13	5.10	0.14
97300.00		82.19	74.04	77.05	81.99				8.15	5.14	0.20
97200.00		82.13	74.00	77.00	81.91				8.13	5.13	0.22
97100.00		81.96	73.96	76.95	81.83				8.00	5.01	0.12
97000.00	81.99	81.99	73.92	76.91	81.76	8.07	5.08	0.23	8.07	5.08	0.23
96900.00		81.86	73.92	76.91	81.76				7.94	4.95	0.10
96800.00		81.80	73.92	76.91	81.76				7.88	4.89	0.04
96700.00		81.27	73.92	76.91	81.76				7.35	4.36	-0.49
96600.00	82.17	82.42	73.92	76.91	81.76	8.25	5.26	0.41	8.50	5.51	0.66
96500.00	82.57	82.53	73.92	76.91	81.76	8.65	5.66	0.81	8.61	5.62	0.77
96400.00		82.37	73.92	76.91	81.76				8.45	5.46	0.61
96300.00		82.48	73.92	76.91	81.76				8.56	5.57	0.72
96200.00		82.37	73.92	76.91	81.76				8.45	5.46	0.61
96100.00		82.25	73.92	76.91	81.76				8.33	5.34	0.49
96000.00	82.08	82.21	73.92	76.91	81.76	8.16	5.17	0.32	8.29	5.30	0.45
95900.00		82.07	73.92	76.91	81.76				8.15	5.16	0.31
95800.00		82.11	73.92	76.91	81.76				8.19	5.20	0.35
95700.00		82.23	73.88	76.87	81.72				8.35	5.36	0.51
95600.00		82.22	73.84	76.82	81.67				8.38	5.40	0.55
95500.00	81.96	82.08	73.79	76.77	81.62	8.17	5.19	0.34	8.29	5.30	0.46
95400.00		82.29	73.74	76.73	81.57				8.54	5.56	0.72
95300.00		82.26	73.70	76.68	81.52				8.57	5.59	0.74
95200.00		82.26	73.65	76.63	81.47				8.61	5.63	0.79
95100.00		82.37	73.60	76.58	81.42				8.77	5.79	0.95
95000.00		82.24	73.56	76.53	81.37				8.68	5.71	0.86
94900.00		82.22	73.51	76.48	81.33				8.71	5.74	0.90
94800.00		82.28	73.46	76.44	81.28				8.82	5.85	1.01
94700.00		82.11	73.42	76.39	81.23				8.69	5.72	0.88
94600.00		82.12	73.37	76.34	81.19				8.75	5.78	0.93
94500.00		82.32	73.32	76.30	81.14				8.99	6.02	1.17
94400.00		82.16	73.28	76.25	81.10				8.89	5.91	1.06
94300.00		82.45	73.23	76.21	81.06				9.22	6.24	1.39
94200.00		82.20	73.18	76.16	81.02				9.01	6.03	1.18
94100.00		82.08	73.13	76.12	80.97				8.95	5.96	1.11
94000.00		82.11	73.09	76.08	80.93				9.02	6.04	1.18
93900.00		82.30	73.04	76.03	80.89				9.26	6.27	1.41
93800.00		82.28	72.99	75.99	80.85				9.28	6.29	1.43
93700.00		82.27	72.95	75.94	80.81				9.33	6.33	1.47
93600.00		82.34	72.90	75.90	80.76				9.44	6.44	1.57
93500.00		82.19	72.85	75.85	80.72				9.34	6.34	1.47
93400.00		82.57	72.82	75.82	80.70				9.75	6.75	1.87
93300.00		82.43	72.79	75.79	80.67				9.63	6.63	1.76
93200.00		82.52	72.76	75.77	80.64				9.76	6.76	1.88
93100.00		82.57	72.73	75.74	80.62				9.84	6.83	1.95
93000.00		82.71	72.70	75.71	80.59				10.01	7.00	2.12
92900.00		82.68	72.67	75.68	80.57				10.01	7.00	2.12
92800.00		82.33	72.64	75.65	80.54				9.69	6.68	1.79
92700.00		81.80	72.61	75.62	80.52				9.19	6.18	1.28
92600.00		82.59	72.57	75.59	80.49				10.02	7.00	2.11
92500.00	81.91	82.37	72.54	75.57	80.46	9.37	6.35	1.45	9.83	6.81	1.91
92400.00		82.74	72.51	75.54	80.44				10.23	7.20	2.30
92300.00		82.54	72.48	75.51	80.41				10.06	7.03	2.13
92200.00		82.57	72.45	75.48	80.39				10.11	7.09	2.18
92100.00		82.59	72.42	75.45	80.36				10.17	7.14	2.23
92000.00	82.20	82.65	72.40	75.43	80.34	9.80	6.77	1.86	10.25	7.22	2.30
91900.00		82.78	72.37	75.41	80.32				10.41	7.37	2.46
91800.00		82.93	72.35	75.39	80.30				10.59	7.55	2.63
91700.00		83.12	72.32	75.36	80.28				10.79	7.75	2.84
91600.00		82.92	72.30	75.34	80.26				10.62	7.58	2.66

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
91500.00	82.15	82.80	72.27	75.32	80.24	9.88	6.83	1.91	10.52	7.48	2.56
91400.00		82.69	72.25	75.30	80.22				10.44	7.39	2.47
91300.00		82.49	72.22	75.28	80.20				10.27	7.21	2.29
91200.00		82.79	72.20	75.25	80.18				10.60	7.54	2.62
91100.00		82.39	72.17	75.23	80.16				10.22	7.16	2.24
91000.00	81.64	82.20	72.15	75.21	80.14	9.49	6.43	1.50	10.05	6.99	2.07
90900.00		82.24	72.13	75.19	80.11				10.11	7.05	2.12
90800.00		82.30	72.10	75.17	80.09				10.20	7.14	2.21
90700.00		82.14	72.08	75.14	80.07				10.07	7.00	2.07
90600.00		82.53	72.05	75.12	80.05				10.48	7.41	2.47
90500.00	82.44	82.76	72.03	75.10	80.03	10.41	7.33	2.40	10.73	7.66	2.73
90400.00		82.60	72.01	75.08	80.02				10.59	7.51	2.58
90300.00		82.39	71.99	75.06	80.00				10.40	7.32	2.39
90200.00		82.36	71.97	75.04	79.98				10.39	7.32	2.38
90100.00		81.99	71.95	75.02	79.96				10.05	6.97	2.03
90000.00	81.48	81.69	71.92	75.00	79.94	9.56	6.48	1.54	9.76	6.68	1.75
89900.00		81.52	71.90	74.98	79.92				9.61	6.53	1.59
89800.00		81.64	71.88	74.96	79.90				9.76	6.67	1.73
89700.00		81.68	71.86	74.94	79.89				9.82	6.74	1.80
89600.00		81.93	71.84	74.92	79.87				10.09	7.01	2.07
89500.00	81.67	81.82	71.82	74.90	79.85	9.85	6.77	1.82	10.00	6.92	1.97
89400.00		82.01	71.80	74.88	79.83				10.22	7.13	2.18
89300.00		81.98	71.77	74.86	79.81				10.21	7.12	2.17
89200.00		82.17	71.75	74.84	79.79				10.42	7.33	2.38
89100.00		82.07	71.73	74.82	79.77				10.33	7.24	2.29
89000.00	82.20	82.13	71.72	74.81	79.76	10.48	7.39	2.44	10.42	7.33	2.38
88900.00		82.30	71.70	74.79	79.74				10.61	7.51	2.56
88800.00		82.09	71.68	74.77	79.72				10.41	7.32	2.37
88700.00		81.94	71.66	74.76	79.71				10.28	7.19	2.24
88600.00		81.68	71.64	74.74	79.69				10.04	6.94	1.99
88500.00	81.45	81.59	71.63	74.72	79.67	9.83	6.73	1.78	9.96	6.87	1.92
88400.00		81.54	71.61	74.70	79.65				9.93	6.83	1.88
88300.00		81.65	71.59	74.69	79.64				10.06	6.96	2.01
88200.00	81.60	81.67	71.57	74.67	79.62	10.02	6.93	1.98	10.10	7.00	2.05
88100.00		81.52	71.56	74.65	79.60				9.96	6.86	1.91
88000.00	81.50	81.55	71.54	74.64	79.59	9.96	6.86	1.91	10.01	6.91	1.96
87900.00		81.94	71.52	74.62	79.57				10.42	7.32	2.37
87800.00		82.00	71.50	74.60	79.55				10.50	7.40	2.45
87700.00		82.02	71.49	74.58	79.53				10.53	7.43	2.48
87600.00		81.86	71.47	74.57	79.52				10.39	7.29	2.34
87500.00	81.67	81.95	71.45	74.55	79.50	10.22	7.12	2.17	10.50	7.40	2.46
87400.00		82.23	71.43	74.53	79.48				10.79	7.69	2.75
87300.00		82.27	71.42	74.51	79.46				10.86	7.76	2.81
87200.00		82.31	71.40	74.50	79.44				10.91	7.81	2.87
87100.00		82.18	71.38	74.48	79.42				10.80	7.70	2.76
87000.00	82.15	82.27	71.37	74.46	79.41	10.78	7.68	2.74	10.90	7.81	2.86
86900.00		82.49	71.35	74.44	79.39				11.14	8.05	3.10
86800.00		82.51	71.33	74.43	79.37				11.18	8.09	3.14
86700.00		82.57	71.31	74.41	79.35				11.25	8.16	3.22
86600.00		82.52	71.30	74.39	79.33				11.22	8.13	3.19
86500.00	82.18	82.24	71.28	74.37	79.31	10.90	7.80	2.86	10.96	7.87	2.93
86400.00		81.80	71.26	74.35	79.30				10.53	7.44	2.50
86300.00		81.87	71.25	74.34	79.28				10.62	7.53	2.59
86200.00		81.70	71.23	74.32	79.26				10.47	7.38	2.44
86100.00		81.36	71.19	74.28	79.23				10.17	7.08	2.14
86000.00	81.08	81.23	71.16	74.25	79.19	9.92	6.83	1.89	10.07	6.97	2.03
85900.00		81.22	71.12	74.22	79.16				10.10	7.00	2.06
85800.00		81.89	71.09	74.19	79.13				10.80	7.70	2.76
85700.00		81.92	71.05	74.15	79.10				10.87	7.77	2.82
85600.00		82.14	71.02	74.12	79.07				11.12	8.02	3.07
85500.00	81.94	82.00	70.99	74.09	79.04	10.95	7.85	2.90	11.02	7.92	2.97
85400.00		82.14	70.95	74.06	79.01				11.18	8.08	3.13
85300.00		81.59	70.92	74.02	78.98				10.67	7.57	2.61
85200.00		81.92	70.88	73.99	78.94				11.03	7.93	2.97
85100.00		81.51	70.85	73.96	78.91				10.66	7.55	2.60
85000.00	81.47	81.51	70.81	73.93	78.88	10.66	7.54	2.59	10.70	7.59	2.63
84900.00		81.53	70.78	73.89	78.85				10.75	7.64	2.68
84800.00		81.86	70.74	73.86	78.82				11.12	8.00	3.04
84700.00		82.43	70.71	73.83	78.79				11.72	8.60	3.64
84600.00		82.42	70.67	73.79	78.75				11.76	8.64	3.68
84500.00	82.28	82.50	70.55	73.68	78.64	11.73	8.60	3.64	11.95	8.82	3.86
84400.00		81.97	70.44	73.57	78.53				11.54	8.40	3.44
84300.00		81.88	70.32	73.47	78.43				11.55	8.41	3.45
84200.00		81.57	70.21	73.36	78.32				11.36	8.21	3.25

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
84100.00		81.78	70.10	73.26	78.22				11.68	8.52	3.56
84000.00		81.75	69.97	73.13	78.09				11.78	8.62	3.66
83900.00		81.44	69.84	73.01	77.97				11.60	8.43	3.47
83800.00		81.27	69.71	72.88	77.84				11.55	8.39	3.43
83700.00		81.00	69.61	72.78	77.74				11.39	8.22	3.26
83600.00		80.96	69.55	72.72	77.68				11.42	8.24	3.28
83500.00		80.58	69.48	72.66	77.62				11.10	7.93	2.97
83400.00		80.54	69.42	72.59	77.55				11.12	7.95	2.99
83300.00		80.36	69.35	72.53	77.49				11.01	7.83	2.87
83200.00		80.34	69.29	72.47	77.43				11.05	7.87	2.91
83100.00		80.17	69.23	72.40	77.36				10.94	7.76	2.80
83000.00	80.35	80.19	69.18	72.36	77.32	11.17	7.99	3.03	11.01	7.83	2.87
82900.00		80.45	69.14	72.32	77.28				11.31	8.13	3.17
82800.00		79.77	69.10	72.29	77.25				10.67	7.48	2.52
82700.00		79.49	69.06	72.25	77.21				10.43	7.24	2.28
82600.00		79.31	69.02	72.21	77.17				10.29	7.10	2.14
82500.00	79.40	79.23	68.98	72.18	77.14	10.41	7.22	2.26	10.25	7.05	2.09
82400.00		79.16	68.94	72.14	77.10				10.22	7.02	2.06
82300.00		79.07	68.90	72.10	77.06				10.17	6.97	2.01
82200.00		79.11	68.87	72.07	77.03				10.24	7.04	2.08
82100.00		79.18	68.84	72.04	77.00				10.34	7.14	2.18
82000.00	78.97	78.92	68.81	72.02	76.98	10.15	6.95	1.99	10.11	6.90	1.94
81900.00		78.69	68.78	71.99	76.95				9.90	6.70	1.74
81800.00		78.53	68.75	71.96	76.92				9.78	6.57	1.61
81700.00		78.83	68.72	71.93	76.89				10.10	6.89	1.93
81600.00		78.70	68.70	71.91	76.87				10.01	6.80	1.84
81500.00	78.99	79.00	68.67	71.88	76.84	10.32	7.11	2.15	10.34	7.12	2.16
81400.00		79.03	68.64	71.85	76.81				10.39	7.18	2.22
81300.00		79.24	68.61	71.82	76.78				10.63	7.42	2.46
81200.00		79.21	68.58	71.80	76.76				10.63	7.41	2.45
81100.00		79.15	68.55	71.77	76.73				10.60	7.38	2.42
81000.00	79.02	79.00	68.52	71.74	76.70	10.50	7.28	2.32	10.47	7.26	2.30
80900.00		78.80	68.49	71.71	76.67				10.31	7.09	2.13
80800.00		79.06	68.47	71.69	76.65				10.59	7.37	2.41
80700.00		78.79	68.45	71.67	76.63				10.34	7.12	2.16
80600.00		78.90	68.44	71.66	76.62				10.46	7.24	2.28
80500.00	78.66	78.68	68.42	71.64	76.60	10.24	7.02	2.06	10.26	7.04	2.08
80400.00		78.62	68.40	71.62	76.58				10.22	7.00	2.04
80300.00		79.07	68.38	71.60	76.56				10.69	7.47	2.51
80200.00		79.05	68.36	71.58	76.54				10.69	7.47	2.51
80100.00		79.19	68.34	71.56	76.52				10.84	7.62	2.66
80000.00	79.16	79.16	68.32	71.54	76.50	10.84	7.62	2.66	10.83	7.61	2.65
79900.00		79.04	68.31	71.53	76.49				10.74	7.52	2.56
79800.00		79.11	68.29	71.51	76.47				10.82	7.60	2.64
79700.00		79.12	68.27	71.49	76.45				10.85	7.63	2.67
79600.00		79.12	68.25	71.47	76.43				10.87	7.65	2.69
79500.00	79.24	79.04	68.23	71.45	76.41	11.01	7.79	2.83	10.81	7.59	2.63
79400.00		79.21	68.21	71.43	76.39				11.00	7.78	2.82
79300.00		79.24	68.18	71.40	76.36				11.06	7.84	2.88
79200.00		79.04	68.15	71.38	76.34				10.89	7.66	2.70
79100.00		79.31	68.13	71.35	76.31				11.18	7.96	3.00
79000.00	79.16	79.26	68.10	71.33	76.28	11.06	7.84	2.88	11.16	7.93	2.98
78900.00		79.16	68.08	71.30	76.26				11.09	7.86	2.90
78800.00		79.16	68.05	71.28	76.23				11.11	7.88	2.93
78700.00		78.83	68.02	71.25	76.21				10.81	7.58	2.62
78600.00		78.73	68.00	71.23	76.18				10.74	7.50	2.55
78500.00	78.85	78.87	67.97	71.21	76.16	10.88	7.64	2.69	10.90	7.66	2.71
78400.00		78.38	67.95	71.18	76.13				10.43	7.20	2.25
78300.00		78.22	67.92	71.16	76.11				10.30	7.06	2.11
78200.00		78.69	67.89	71.13	76.08				10.79	7.56	2.60
78100.00		79.21	67.87	71.11	76.06				11.34	8.10	3.15
78000.00	79.14	79.17	67.84	71.08	76.03	11.30	8.06	3.11	11.34	8.10	3.15
77900.00		78.93	67.81	71.05	75.99				11.12	7.88	2.93
77800.00		78.74	67.78	71.02	75.96				10.96	7.72	2.78
77700.00		78.61	67.74	70.98	75.93				10.87	7.63	2.69
77600.00		78.13	67.71	70.95	75.89				10.42	7.18	2.24
77500.00	78.24	78.56	67.68	70.92	75.86	10.56	7.32	2.38	10.88	7.64	2.70
77400.00		78.72	67.65	70.89	75.82				11.07	7.83	2.90
77300.00		78.41	67.62	70.86	75.79				10.79	7.55	2.62
77200.00		78.45	67.58	70.82	75.75				10.87	7.63	2.70
77100.00		78.45	67.55	70.79	75.72				10.90	7.66	2.73
77000.00	78.27	78.40	67.52	70.76	75.69	10.75	7.51	2.59	10.88	7.64	2.71
76900.00		78.36	67.49	70.73	75.65				10.87	7.63	2.71
76800.00		77.99	67.46	70.70	75.62				10.53	7.29	2.37

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
76700.00		78.15	67.44	70.68	75.59				10.72	7.48	2.56
76600.00		78.16	67.42	70.66	75.57				10.74	7.50	2.59
76500.00	78.16	78.36	67.39	70.63	75.55	10.77	7.53	2.62	10.96	7.72	2.81
76400.00		78.30	67.37	70.61	75.52				10.93	7.69	2.78
76300.00		78.18	67.35	70.59	75.50				10.83	7.59	2.68
76200.00		77.93	67.33	70.57	75.48				10.60	7.36	2.45
76100.00		77.73	67.31	70.55	75.46				10.42	7.18	2.27
76000.00	77.74	77.78	67.29	70.53	75.43	10.45	7.21	2.31	10.49	7.25	2.35
75900.00		77.94	67.27	70.51	75.41				10.67	7.43	2.53
75800.00		78.17	67.25	70.49	75.39				10.93	7.69	2.79
75700.00		77.96	67.22	70.46	75.36				10.74	7.50	2.60
75600.00		77.99	67.20	70.44	75.34				10.79	7.55	2.65
75500.00	78.05	78.11	67.18	70.42	75.32	10.87	7.63	2.74	10.92	7.68	2.79
75400.00		77.90	67.16	70.40	75.29				10.73	7.49	2.60
75300.00		77.51	67.13	70.37	75.26				10.37	7.13	2.24
75200.00		77.55	67.10	70.34	75.22				10.45	7.21	2.33
75100.00		77.61	67.06	70.30	75.18				10.55	7.31	2.43
75000.00	77.85	77.95	67.02	70.26	75.14	10.83	7.59	2.71	10.93	7.69	2.81
74900.00		78.00	66.99	70.23	75.10				11.01	7.77	2.90
74800.00		77.77	66.95	70.19	75.06				10.81	7.57	2.70
74700.00		77.39	66.92	70.16	75.02				10.48	7.24	2.37
74600.00		77.48	66.88	70.12	74.98				10.60	7.36	2.50
74500.00	77.32	77.57	66.84	70.08	74.95	10.48	7.24	2.37	10.72	7.48	2.62
74400.00		77.54	66.81	70.05	74.91				10.73	7.49	2.63
74300.00		77.56	66.77	70.01	74.87				10.79	7.55	2.70
74200.00		77.31	66.73	69.97	74.83				10.58	7.34	2.49
74100.00		77.54	66.70	69.94	74.79				10.84	7.60	2.75
74000.00	77.29	77.46	66.67	69.91	74.75	10.62	7.38	2.53	10.79	7.56	2.71
73900.00		77.56	66.64	69.88	74.72				10.92	7.68	2.84
73800.00		77.62	66.61	69.84	74.68				11.01	7.77	2.93
73700.00		77.62	66.58	69.81	74.65				11.04	7.80	2.97
73600.00		77.30	66.55	69.78	74.62				10.76	7.52	2.69
73500.00	77.19	77.43	66.52	69.75	74.58	10.67	7.43	2.60	10.91	7.68	2.85
73400.00		77.50	66.49	69.72	74.55				11.01	7.77	2.95
73300.00		77.60	66.46	69.69	74.51				11.14	7.91	3.09
73200.00		77.46	66.43	69.66	74.48				11.04	7.80	2.98
73100.00		77.51	66.39	69.63	74.44				11.12	7.89	3.07
73000.00	77.39	77.43	66.36	69.60	74.41	11.03	7.80	2.98	11.07	7.83	3.02
72900.00		77.11	66.33	69.56	74.38				10.77	7.54	2.73
72800.00		76.75	66.31	69.54	74.35				10.44	7.22	2.41
72700.00		76.81	66.29	69.52	74.33				10.52	7.29	2.49
72600.00		77.04	66.27	69.50	74.30				10.77	7.54	2.73
72500.00	77.12	77.13	66.25	69.48	74.28	10.87	7.64	2.83	10.88	7.65	2.84
72400.00		77.09	66.23	69.46	74.26				10.86	7.63	2.83
72300.00		76.99	66.21	69.44	74.24				10.78	7.55	2.75
72200.00		77.05	66.19	69.42	74.22				10.86	7.63	2.83
72100.00		76.88	66.17	69.39	74.19				10.71	7.49	2.69
72000.00	76.96	77.10	66.15	69.37	74.17	10.81	7.58	2.78	10.95	7.72	2.93
71900.00		76.86	66.13	69.35	74.15				10.73	7.50	2.71
71800.00		76.76	66.11	69.33	74.13				10.65	7.43	2.64
71700.00		76.54	66.09	69.31	74.10				10.45	7.22	2.43
71600.00		76.49	66.07	69.29	74.08				10.42	7.20	2.41
71500.00	76.82	76.85	66.05	69.27	74.06	10.77	7.55	2.76	10.80	7.58	2.79
71400.00		76.69	66.02	69.25	74.03				10.67	7.45	2.66
71300.00		76.50	66.00	69.22	74.01				10.50	7.28	2.49
71200.00		76.81	65.97	69.20	73.98				10.83	7.61	2.83
71100.00		76.72	65.95	69.17	73.96				10.77	7.55	2.76
71000.00	76.58	76.64	65.92	69.15	73.93	10.66	7.43	2.65	10.72	7.50	2.71
70900.00		76.68	65.90	69.12	73.90				10.79	7.56	2.78
70800.00		76.66	65.87	69.10	73.88				10.79	7.57	2.79
70700.00		76.49	65.85	69.07	73.85				10.64	7.42	2.64
70600.00		76.76	65.82	69.05	73.82				10.94	7.71	2.94
70500.00	76.46	76.72	65.79	69.02	73.80	10.66	7.44	2.66	10.92	7.70	2.92
70400.00		76.80	65.77	69.00	73.77				11.03	7.80	3.03
70300.00		76.66	65.74	68.97	73.74				10.92	7.69	2.92
70200.00		76.95	65.72	68.95	73.72				11.23	8.01	3.23
70100.00		76.74	65.69	68.92	73.69				11.05	7.82	3.05
70000.00	76.54	76.82	65.67	68.90	73.67	10.87	7.64	2.87	11.16	7.93	3.16
69900.00		76.76	65.64	68.87	73.64				11.12	7.89	3.12
69800.00		76.26	65.62	68.85	73.61				10.64	7.41	2.64
69700.00		76.11	65.59	68.82	73.59				10.52	7.28	2.52
69600.00		76.10	65.57	68.80	73.56				10.54	7.30	2.54
69500.00	75.96	75.87	65.54	68.78	73.54	10.42	7.18	2.43	10.33	7.10	2.34
69400.00		75.85	65.52	68.75	73.51				10.33	7.10	2.34

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
69300.00		75.76	65.49	68.73	73.48				10.27	7.03	2.28
69200.00		76.05	65.47	68.71	73.46				10.58	7.34	2.59
69100.00		76.03	65.44	68.68	73.43				10.58	7.35	2.60
69000.00	76.39	76.27	65.42	68.66	73.40	10.97	7.73	2.99	10.85	7.61	2.87
68900.00		75.97	65.40	68.63	73.38				10.58	7.34	2.60
68800.00		75.97	65.37	68.61	73.35				10.60	7.36	2.62
68700.00		76.07	65.35	68.59	73.33				10.72	7.48	2.74
68600.00		76.06	65.32	68.56	73.30				10.74	7.50	2.76
68500.00	76.26	76.19	65.29	68.53	73.27	10.97	7.73	2.99	10.90	7.66	2.92
68400.00		75.78	65.27	68.51	73.24				10.51	7.27	2.53
68300.00		75.91	65.24	68.48	73.21				10.67	7.43	2.69
68200.00		75.89	65.21	68.45	73.19				10.68	7.44	2.71
68100.00		75.67	65.19	68.43	73.16				10.48	7.24	2.51
68000.00	75.64	75.53	65.16	68.40	73.13	10.48	7.24	2.51	10.37	7.13	2.40
67900.00		75.43	65.13	68.37	73.10				10.30	7.06	2.33
67800.00		75.50	65.11	68.35	73.07				10.39	7.15	2.42
67700.00		75.47	65.08	68.32	73.04				10.39	7.15	2.43
67600.00		75.58	65.05	68.29	73.02				10.53	7.29	2.57
67500.00	75.54	75.48	65.03	68.27	72.99	10.51	7.27	2.55	10.46	7.22	2.49
67400.00		75.29	65.00	68.24	72.96				10.29	7.05	2.33
67300.00		75.45	64.97	68.21	72.93				10.47	7.23	2.52
67200.00		75.48	64.95	68.19	72.91				10.53	7.29	2.58
67100.00		75.21	64.93	68.17	72.88				10.28	7.04	2.33
67000.00	75.07	74.78	64.91	68.15	72.86	10.16	6.92	2.21	9.87	6.63	1.92
66900.00		74.69	64.88	68.12	72.83				9.81	6.57	1.86
66800.00		74.92	64.86	68.10	72.80				10.06	6.82	2.12
66700.00		74.65	64.84	68.08	72.78				9.81	6.57	1.87
66600.00		74.92	64.81	68.05	72.75				10.10	6.86	2.17
66500.00	75.04	74.85	64.79	68.03	72.73	10.25	7.01	2.31	10.06	6.82	2.13
66400.00		74.78	64.77	68.01	72.70				10.01	6.77	2.08
66300.00		74.64	64.75	67.99	72.68				9.89	6.65	1.96
66200.00		74.59	64.72	67.96	72.65				9.87	6.63	1.95
66100.00		74.28	64.70	67.94	72.62				9.58	6.34	1.66
66000.00	74.34	74.21	64.68	67.92	72.60	9.66	6.42	1.74	9.52	6.28	1.61
65900.00		74.52	64.67	67.91	72.58				9.85	6.61	1.93
65800.00		74.42	64.65	67.89	72.56				9.77	6.53	1.86
65700.00		74.28	64.63	67.87	72.55				9.64	6.40	1.73
65600.00		74.19	64.62	67.86	72.53				9.58	6.34	1.67
65500.00	74.51	74.06	64.60	67.84	72.51	9.90	6.66	2.00	9.46	6.22	1.55
65400.00		73.94	64.59	67.83	72.49				9.35	6.11	1.44
65300.00		73.87	64.57	67.81	72.47				9.30	6.06	1.40
65200.00		74.05	64.55	67.79	72.46				9.50	6.26	1.59
65100.00		74.00	64.54	67.78	72.44				9.46	6.22	1.56
65000.00	74.29	73.83	64.52	67.76	72.42	9.77	6.53	1.87	9.31	6.07	1.41
64900.00		73.91	64.51	67.75	72.40				9.41	6.17	1.51
64800.00		73.68	64.49	67.73	72.38				9.19	5.95	1.29
64700.00		73.28	64.47	67.71	72.36				8.80	5.56	0.91
64600.00		74.08	64.46	67.70	72.35				9.62	6.38	1.74
64500.00	74.31	74.02	64.45	67.68	72.33	9.86	6.62	1.98	9.57	6.33	1.69
64400.00		73.49	64.43	67.67	72.31				9.06	5.82	1.18
64300.00		73.58	64.42	67.65	72.29				9.16	5.92	1.29
64200.00		73.57	64.41	67.64	72.28				9.17	5.93	1.30
64100.00		73.40	64.39	67.62	72.26				9.00	5.77	1.14
64000.00	73.11	72.77	64.38	67.61	72.24	8.73	5.50	0.87	8.39	5.16	0.53
63900.00		72.76	64.37	67.59	72.22				8.40	5.17	0.54
63800.00		72.82	64.35	67.58	72.20				8.47	5.24	0.61
63700.00		72.78	64.34	67.56	72.19				8.44	5.22	0.60
63600.00		72.74	64.33	67.55	72.17				8.41	5.19	0.57
63500.00	72.89	72.41	64.31	67.53	72.15	8.58	5.36	0.74	8.09	4.87	0.26
63400.00		72.15	64.30	67.52	72.13				7.85	4.63	0.02
63300.00		72.24	64.29	67.51	72.11				7.95	4.73	0.12
63200.00		72.15	64.27	67.49	72.10				7.87	4.66	0.05
63100.00		72.13	64.26	67.48	72.08				7.87	4.66	0.05
63000.00	72.42	71.98	64.25	67.46	72.06	8.18	4.96	0.36	7.73	4.52	-0.09
62900.00		72.14	64.23	67.45	72.05				7.91	4.69	0.09
62800.00		72.08	64.22	67.43	72.03				7.86	4.65	0.05
62700.00		72.02	64.21	67.42	72.01				7.82	4.61	0.01
62600.00		71.96	64.19	67.40	72.00				7.77	4.56	-0.03
62500.00	72.30	71.92	64.18	67.39	71.98	8.12	4.91	0.32	7.74	4.53	-0.06
62400.00		72.32	64.17	67.37	71.96				8.15	4.94	0.36
62300.00		72.39	64.15	67.36	71.94				8.23	5.03	0.44
62200.00		72.03	64.14	67.34	71.93				7.89	4.69	0.11
62100.00		72.08	64.13	67.33	71.91				7.96	4.76	0.17
62000.00	72.29	72.11	64.11	67.31	71.89	8.18	4.98	0.40	8.00	4.80	0.22

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
61900.00		72.15	64.10	67.30	71.88				8.05	4.85	0.27
61800.00		71.99	64.09	67.29	71.86				7.90	4.70	0.12
61700.00		71.65	64.08	67.28	71.85				7.57	4.37	-0.20
61600.00		71.41	64.07	67.27	71.84				7.35	4.15	-0.42
61500.00	71.66	71.40	64.05	67.25	71.82	7.60	4.40	-0.17	7.35	4.15	-0.42
61400.00		71.49	64.04	67.24	71.81				7.45	4.25	-0.31
61300.00		71.65	64.03	67.23	71.79				7.62	4.42	-0.15
61200.00		71.56	64.02	67.22	71.78				7.55	4.35	-0.21
61100.00		71.49	64.01	67.21	71.76				7.48	4.28	-0.27
61000.00	71.55	71.53	63.99	67.19	71.75	7.56	4.36	-0.20	7.54	4.34	-0.22
60900.00		71.47	63.98	67.18	71.73				7.49	4.29	-0.26
60800.00		71.18	63.97	67.17	71.72				7.21	4.01	-0.54
60700.00		71.14	63.96	67.16	71.70				7.18	3.98	-0.57
60600.00		71.13	63.95	67.15	71.69				7.18	3.98	-0.56
60500.00	71.19	70.95	63.93	67.13	71.68	7.26	4.06	-0.48	7.01	3.81	-0.73
60400.00		71.20	63.92	67.12	71.66				7.28	4.08	-0.46
60300.00		71.24	63.91	67.11	71.65				7.33	4.13	-0.41
60200.00		71.58	63.90	67.10	71.64				7.68	4.48	-0.06
60100.00		71.30	63.89	67.09	71.63				7.41	4.21	-0.32
60000.00	71.68	71.40	63.88	67.08	71.62	7.80	4.60	0.07	7.52	4.32	-0.21
59900.00		71.65	63.87	67.07	71.60				7.78	4.58	0.05
59800.00		71.54	63.86	67.06	71.59				7.68	4.49	-0.05
59700.00		71.13	63.85	67.04	71.58				7.28	4.09	-0.45
59600.00		70.78	63.84	67.03	71.57				6.94	3.74	-0.79
59500.00	71.06	70.75	63.83	67.02	71.56	7.23	4.04	-0.49	6.92	3.73	-0.81
59400.00		70.93	63.82	67.01	71.54				7.12	3.92	-0.61
59300.00		70.83	63.81	67.00	71.53				7.02	3.83	-0.71
59200.00		70.88	63.80	66.99	71.52				7.08	3.89	-0.65
59100.00		70.99	63.79	66.98	71.51				7.20	4.01	-0.52
59000.00	71.24	70.86	63.78	66.97	71.50	7.46	4.27	-0.26	7.09	3.90	-0.63
58900.00		70.84	63.77	66.96	71.49				7.08	3.89	-0.64
58800.00		70.78	63.76	66.95	71.48				7.02	3.83	-0.69
58700.00		70.47	63.75	66.94	71.47				6.72	3.53	-1.00
58600.00		70.24	63.74	66.93	71.46				6.50	3.31	-1.22
58500.00	70.83	70.41	63.74	66.93	71.45	7.09	3.90	-0.63	6.67	3.48	-1.05
58400.00		70.52	63.73	66.92	71.45				6.79	3.60	-0.93
58300.00		70.51	63.72	66.91	71.44				6.79	3.60	-0.92
58200.00		70.46	63.72	66.91	71.43				6.75	3.56	-0.97
58100.00		70.51	63.71	66.90	71.42				6.80	3.61	-0.92
58000.00	70.91	70.48	63.70	66.89	71.42	7.20	4.01	-0.51	6.78	3.59	-0.94
57900.00		70.53	63.70	66.89	71.41				6.83	3.64	-0.88
57800.00		70.50	63.69	66.88	71.40				6.81	3.62	-0.90
57700.00		70.50	63.68	66.87	71.39				6.82	3.63	-0.89
57600.00		70.54	63.68	66.87	71.39				6.86	3.67	-0.85
57500.00	70.75	70.55	63.67	66.86	71.38	7.07	3.88	-0.63	6.88	3.69	-0.83
57400.00		70.30	63.67	66.86	71.37				6.63	3.44	-1.07
57300.00		70.32	63.66	66.85	71.36				6.66	3.47	-1.04
57200.00		70.13	63.65	66.84	71.36				6.47	3.28	-1.23
57100.00		70.02	63.65	66.84	71.35				6.37	3.18	-1.33
57000.00	70.25	70.08	63.64	66.83	71.34	6.61	3.42	-1.09	6.44	3.25	-1.27
56900.00		70.27	63.63	66.82	71.33				6.64	3.45	-1.06
56800.00		70.34	63.62	66.81	71.32				6.72	3.53	-0.98
56700.00		70.48	63.62	66.81	71.31				6.86	3.67	-0.84
56600.00		70.60	63.61	66.80	71.30				6.99	3.80	-0.71
56500.00	70.94	70.57	63.60	66.79	71.29	7.34	4.15	-0.35	6.97	3.78	-0.72
56400.00		70.58	63.59	66.78	71.29				6.98	3.79	-0.71
56300.00		70.50	63.58	66.77	71.28				6.92	3.73	-0.77
56200.00		70.47	63.58	66.77	71.27				6.90	3.71	-0.79
56100.00		70.53	63.57	66.76	71.26				6.96	3.77	-0.73
56000.00	70.77	70.27	63.56	66.75	71.25	7.21	4.02	-0.48	6.71	3.52	-0.98
55900.00		69.95	63.55	66.74	71.24				6.40	3.21	-1.29
55800.00		69.83	63.54	66.73	71.23				6.28	3.09	-1.40
55700.00		69.61	63.53	66.72	71.22				6.07	2.88	-1.61
55600.00		69.67	63.53	66.72	71.21				6.15	2.96	-1.53
55500.00	70.19	69.68	63.52	66.71	71.20	6.67	3.48	-1.01	6.16	2.97	-1.52
55400.00		69.70	63.51	66.70	71.19				6.19	3.01	-1.48
55300.00		69.73	63.50	66.68	71.17				6.24	3.05	-1.44
55200.00		69.94	63.48	66.67	71.16				6.46	3.27	-1.22
55100.00		70.20	63.47	66.66	71.15				6.73	3.54	-0.95
55000.00	70.91	70.32	63.46	66.65	71.14	7.45	4.26	-0.23	6.86	3.68	-0.81
54900.00		70.42	63.45	66.63	71.12				6.97	3.78	-0.71
54800.00		70.16	63.44	66.62	71.11				6.72	3.54	-0.95
54700.00		70.10	63.43	66.61	71.10				6.67	3.49	-1.00
54600.00		70.25	63.41	66.59	71.08				6.84	3.66	-0.83

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
54500.00	70.60	70.26	63.40	66.58	71.06	7.20	4.02	-0.46	6.86	3.68	-0.80
54400.00		70.07	63.38	66.56	71.05				6.69	3.51	-0.97
54300.00		70.13	63.37	66.55	71.03				6.76	3.58	-0.90
54200.00		69.90	63.35	66.53	71.01				6.55	3.37	-1.11
54100.00		69.88	63.34	66.52	70.99				6.54	3.36	-1.12
54000.00	70.38	69.97	63.33	66.51	70.98	7.06	3.88	-0.59	6.64	3.46	-1.01
53900.00		69.94	63.31	66.49	70.96				6.62	3.44	-1.02
53800.00		69.92	63.30	66.48	70.94				6.62	3.44	-1.02
53700.00		70.22	63.28	66.46	70.92				6.94	3.76	-0.70
53600.00		70.31	63.27	66.45	70.91				7.05	3.87	-0.59
53500.00	70.22	69.99	63.25	66.43	70.89	6.96	3.78	-0.68	6.74	3.56	-0.90
53400.00		69.87	63.24	66.42	70.88				6.63	3.45	-1.01
53300.00		70.08	63.23	66.41	70.87				6.85	3.67	-0.79
53200.00		70.23	63.22	66.39	70.85				7.01	3.83	-0.63
53100.00		70.12	63.21	66.38	70.84				6.92	3.74	-0.72
53000.00	70.56	70.58	63.19	66.36	70.82	7.37	4.20	-0.26	7.39	4.22	-0.24
52900.00		70.54	63.18	66.35	70.81				7.36	4.19	-0.27
52800.00		70.57	63.17	66.34	70.80				7.41	4.24	-0.22
52700.00		70.39	63.16	66.33	70.78				7.23	4.06	-0.39
52600.00		70.07	63.15	66.32	70.77				6.92	3.75	-0.71
52500.00	70.23	69.99	63.14	66.31	70.76	7.10	3.93	-0.53	6.86	3.69	-0.77
52400.00		69.97	63.13	66.30	70.75				6.84	3.67	-0.78
52300.00		69.83	63.11	66.28	70.73				6.71	3.54	-0.91
52200.00		69.69	63.10	66.27	70.72				6.58	3.41	-1.03
52100.00		69.63	63.09	66.26	70.71				6.53	3.36	-1.08
52000.00	70.24	69.97	63.08	66.25	70.69	7.15	3.98	-0.46	6.89	3.72	-0.73
51900.00		70.14	63.07	66.24	70.68				7.07	3.90	-0.54
51800.00		69.99	63.06	66.23	70.67				6.93	3.76	-0.68
51700.00		69.98	63.05	66.22	70.66				6.93	3.76	-0.68
51600.00		70.05	63.04	66.21	70.65				7.00	3.83	-0.60
51500.00	71.20	70.07	63.04	66.20	70.64	8.16	5.00	0.56	7.04	3.87	-0.56
51400.00		70.59	63.03	66.19	70.63				7.56	4.40	-0.03
51300.00		70.76	63.02	66.18	70.62				7.74	4.57	0.14
51200.00		70.09	63.01	66.17	70.60				7.08	3.92	-0.51
51100.00			63.00	66.16	70.59						
51000.00			62.99	66.15	70.58						
50900.00			62.98	66.14	70.57						
50800.00			62.98	66.14	70.56						
50700.00			62.97	66.13	70.55						
50600.00			62.96	66.12	70.54						
50500.00			62.95	66.11	70.53						
50400.00			62.94	66.10	70.52						
50300.00			62.93	66.09	70.51						
50200.00			62.92	66.08	70.49						
50100.00			62.91	66.07	70.48						
50000.00			62.91	66.06	70.47						
49900.00			62.90	66.05	70.46					STAR	
49800.00			62.89	66.04	70.45					BEND	
49700.00			62.88	66.03	70.44					AREA	
49600.00			62.83	65.98	70.38						
49500.00			62.78	65.92	70.32						
49400.00			62.73	65.87	70.26						
49300.00			62.67	65.81	70.19						
49200.00			62.62	65.75	70.12						
49100.00			62.56	65.69	70.05						
49000.00			62.50	65.63	69.98						
48900.00			62.44	65.57	69.92						
48800.00			62.37	65.51	69.85						
48700.00			62.20	65.34	69.67						
48600.00			62.03	65.16	69.47						
48500.00			61.92	65.04	69.35						
48400.00			61.86	64.98	69.28						
48300.00			61.79	64.92	69.21						
48200.00			61.73	64.86	69.14						
48100.00			61.67	64.79	69.07						
48000.00			61.64	64.76	69.04						
47900.00			61.62	64.73	69.01						
47800.00		68.78	61.59	64.70	68.97				7.19	4.07	-0.19
47700.00		68.75	61.56	64.67	68.94				7.19	4.08	-0.19
47600.00		68.74	61.53	64.64	68.91				7.21	4.10	-0.16
47500.00	70.15	69.31	61.51	64.61	68.87	8.65	5.54	1.28	7.81	4.70	0.44
47400.00		68.72	61.48	64.58	68.84				7.24	4.13	-0.12
47300.00		68.64	61.45	64.55	68.81				7.19	4.09	-0.16
47200.00		68.39	61.42	64.53	68.77				6.97	3.87	-0.38

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
47100.00		68.09	61.39	64.50	68.74				6.70	3.60	-0.65
47000.00	68.41	67.75	61.37	64.47	68.71	7.04	3.94	-0.30	6.38	3.28	-0.96
46900.00		67.53	61.34	64.44	68.67				6.19	3.09	-1.14
46800.00		67.76	61.31	64.40	68.64				6.45	3.35	-0.88
46700.00		67.45	61.28	64.37	68.61				6.17	3.07	-1.16
46600.00		67.43	61.25	64.34	68.57				6.17	3.08	-1.15
46500.00	67.87	67.50	61.23	64.31	68.54	6.65	3.56	-0.67	6.28	3.19	-1.04
46400.00		67.46	61.20	64.28	68.51				6.26	3.17	-1.05
46300.00	67.97	67.41	61.17	64.25	68.47	6.80	3.72	-0.50	6.24	3.16	-1.07
46200.00		67.43	61.14	64.22	68.44				6.29	3.21	-1.01
46100.00		67.41	61.11	64.19	68.41				6.29	3.22	-1.00
46000.00	68.11	67.60	61.09	64.16	68.37	7.02	3.95	-0.26	6.51	3.44	-0.77
45900.00		67.63	61.06	64.13	68.34				6.58	3.50	-0.70
45800.00		67.75	61.03	64.10	68.30				6.72	3.65	-0.55
45700.00		67.89	61.00	64.07	68.27				6.89	3.82	-0.38
45600.00		68.07	60.97	64.04	68.23				7.10	4.03	-0.17
45500.00	68.05	67.71	60.94	64.01	68.20	7.11	4.04	-0.14	6.77	3.70	-0.48
45400.00		67.61	60.91	63.98	68.16				6.69	3.63	-0.56
45300.00		67.31	60.89	63.95	68.13				6.42	3.36	-0.82
45200.00		67.39	60.86	63.92	68.09				6.54	3.47	-0.70
45100.00		67.36	60.83	63.89	68.06				6.53	3.47	-0.70
45000.00	67.91	67.78	60.79	63.85	68.01	7.12	4.06	-0.10	6.98	3.93	-0.23
44900.00		67.87	60.76	63.81	67.97				7.11	4.06	-0.10
44800.00		67.37	60.72	63.77	67.92				6.65	3.60	-0.55
44700.00		67.13	60.69	63.73	67.88				6.44	3.40	-0.74
44600.00		67.11	60.65	63.69	67.83				6.45	3.42	-0.72
44500.00	67.26	66.98	60.62	63.65	67.78	6.64	3.61	-0.52	6.36	3.33	-0.81
44400.00		67.02	60.58	63.61	67.74				6.43	3.41	-0.72
44300.00		67.19	60.55	63.57	67.69				6.64	3.62	-0.51
44200.00		66.97	60.51	63.53	67.65				6.46	3.45	-0.67
44100.00		67.23	60.48	63.49	67.60				6.75	3.75	-0.37
44000.00	67.43	67.38	60.44	63.45	67.56	6.98	3.98	-0.13	6.93	3.93	-0.18
43900.00		67.47	60.41	63.41	67.51				7.06	4.07	-0.04
43800.00		67.25	60.38	63.37	67.46				6.88	3.88	-0.21
43700.00		67.29	60.34	63.33	67.42				6.95	3.96	-0.13
43600.00		66.96	60.31	63.29	67.37				6.65	3.67	-0.41
43500.00	66.95	66.79	60.27	63.25	67.33	6.68	3.71	-0.37	6.52	3.54	-0.53
43400.00		66.71	60.24	63.21	67.28				6.47	3.50	-0.57
43300.00		67.21	60.20	63.17	67.24				7.01	4.04	-0.02
43200.00		67.41	60.17	63.13	67.19				7.24	4.28	0.22
43100.00		67.55	60.14	63.10	67.15				7.41	4.45	0.40
43000.00	67.39	67.22	60.10	63.06	67.10	7.29	4.33	0.29	7.11	4.16	0.11
42900.00		67.49	60.07	63.02	67.06				7.42	4.47	0.43
42800.00		66.99	60.04	62.99	67.02				6.95	4.00	-0.03
42700.00		66.60	60.01	62.95	66.97				6.60	3.65	-0.37
42600.00		66.93	59.97	62.91	66.93				6.96	4.02	0.00
42500.00	67.17	66.98	59.94	62.88	66.89	7.23	4.30	0.29	7.04	4.11	0.10
42400.00		67.15	59.91	62.84	66.84				7.24	4.31	0.30
42300.00		66.84	59.87	62.80	66.80				6.96	4.03	0.04
42200.00		66.82	59.84	62.77	66.76				6.98	4.06	0.07
42100.00		66.95	59.81	62.73	66.71				7.14	4.23	0.24
42000.00	67.06	66.90	59.78	62.69	66.67	7.28	4.36	0.39	7.12	4.21	0.23
41900.00		67.00	59.74	62.66	66.63				7.26	4.35	0.38
41800.00		67.30	59.71	62.62	66.58				7.59	4.68	0.72
41700.00		67.09	59.68	62.58	66.54				7.41	4.50	0.55
41600.00		66.90	59.64	62.54	66.49				7.26	4.36	0.41
41500.00	67.05	66.92	59.61	62.50	66.44	7.44	4.55	0.60	7.32	4.42	0.48
41400.00		67.37	59.57	62.46	66.39				7.80	4.91	0.98
41300.00		66.75	59.53	62.41	66.34				7.23	4.34	0.41
41200.00		66.80	59.49	62.37	66.29				7.31	4.43	0.51
41100.00		66.57	59.45	62.32	66.24				7.12	4.24	0.33
41000.00	66.65	66.63	59.41	62.28	66.19	7.24	4.37	0.46	7.22	4.35	0.44
40900.00		66.77	59.37	62.23	66.13				7.41	4.54	0.64
40800.00		66.74	59.33	62.19	66.08				7.41	4.55	0.66
40700.00		66.59	59.29	62.15	66.03				7.30	4.44	0.56
40600.00		66.62	59.25	62.10	65.98				7.37	4.52	0.64
40500.00	66.82	66.90	59.21	62.06	65.93	7.61	4.76	0.89	7.69	4.85	0.97
40400.00		66.77	59.17	62.01	65.88				7.60	4.76	0.89
40300.00		66.73	59.13	61.97	65.83				7.60	4.76	0.90
40200.00		66.56	59.09	61.93	65.78				7.46	4.63	0.78
40100.00		66.46	59.06	61.89	65.73				7.40	4.57	0.73
40000.00	66.60	66.58	59.03	61.85	65.69	7.57	4.75	0.92	7.55	4.73	0.90
39900.00		66.52	59.00	61.81	65.64				7.52	4.71	0.88
39800.00		66.42	58.96	61.77	65.59				7.46	4.65	0.83

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
39700.00		66.36	58.93	61.73	65.54				7.43	4.63	0.82
39600.00		66.51	58.90	61.69	65.50				7.61	4.81	1.01
39500.00	66.22	66.19	58.86	61.66	65.45	7.36	4.56	0.77	7.32	4.53	0.74
39400.00		66.35	58.83	61.62	65.40				7.52	4.74	0.95
39300.00		66.31	58.80	61.58	65.35				7.52	4.74	0.96
39200.00		66.10	58.76	61.54	65.31				7.34	4.56	0.79
39100.00		66.03	58.73	61.50	65.26				7.30	4.53	0.77
39000.00	66.10	65.97	58.70	61.47	65.23	7.40	4.63	0.87	7.28	4.51	0.75
38900.00		65.99	58.67	61.44	65.19				7.32	4.55	0.79
38800.00		65.92	58.64	61.41	65.16				7.28	4.51	0.76
38700.00		65.92	58.61	61.37	65.13				7.31	4.55	0.79
38600.00		66.20	58.58	61.34	65.10				7.61	4.85	1.10
38500.00	66.23	66.27	58.55	61.31	65.06	7.68	4.92	1.17	7.72	4.96	1.21
38400.00		66.22	58.52	61.28	65.03				7.70	4.94	1.19
38300.00		66.32	58.49	61.25	65.00				7.82	5.07	1.32
38200.00		66.06	58.46	61.22	64.97				7.59	4.84	1.09
38100.00		66.12	58.43	61.19	64.93				7.69	4.94	1.19
38000.00	66.13	66.13	58.40	61.16	64.90	7.73	4.98	1.23	7.73	4.97	1.23
37900.00		66.12	58.37	61.13	64.87				7.75	5.00	1.25
37800.00		65.95	58.35	61.10	64.83				7.61	4.86	1.12
37700.00		65.81	58.32	61.07	64.80				7.49	4.74	1.01
37600.00		65.91	58.30	61.04	64.77				7.61	4.87	1.14
37500.00	66.07	66.03	58.27	61.01	64.73	7.80	5.06	1.33	7.76	5.02	1.30
37400.00		66.07	58.25	60.98	64.70				7.83	5.09	1.37
37300.00		65.82	58.22	60.95	64.67				7.60	4.87	1.15
37200.00		65.87	58.20	60.92	64.63				7.67	4.94	1.23
37100.00		65.64	58.17	60.89	64.60				7.47	4.75	1.04
37000.00	65.62	65.56	58.15	60.87	64.57	7.47	4.75	1.05	7.41	4.70	0.99
36900.00		65.49	58.12	60.84	64.53				7.37	4.65	0.95
36800.00		65.29	58.10	60.81	64.50				7.19	4.48	0.79
36700.00		65.56	58.07	60.78	64.47				7.48	4.78	1.09
36600.00		65.42	58.05	60.75	64.43				7.37	4.67	0.98
36500.00	65.22	65.22	58.02	60.72	64.40	7.20	4.50	0.82	7.20	4.50	0.82
36400.00		65.18	58.00	60.69	64.37				7.18	4.48	0.81
36300.00		64.85	57.97	60.66	64.33				6.88	4.19	0.52
36200.00		64.82	57.93	60.62	64.28				6.89	4.20	0.54
36100.00		64.72	57.90	60.57	64.22				6.82	4.15	0.49
36000.00	65.00	65.00	57.86	60.53	64.17	7.14	4.47	0.83	7.14	4.48	0.83
35900.00		65.03	57.82	60.48	64.11				7.21	4.55	0.91
35800.00		65.24	57.78	60.44	64.06				7.46	4.81	1.18
35700.00		65.29	57.74	60.39	64.01				7.55	4.90	1.29
35600.00		65.15	57.71	60.34	63.95				7.45	4.81	1.20
35500.00	65.28	65.30	57.67	60.30	63.90	7.61	4.98	1.38	7.63	5.00	1.40
35400.00		65.19	57.63	60.25	63.85				7.56	4.94	1.35
35300.00		65.01	57.59	60.21	63.79				7.42	4.80	1.21
35200.00		65.32	57.55	60.16	63.74				7.77	5.16	1.58
35100.00		65.42	57.51	60.12	63.69				7.91	5.30	1.73
35000.00	65.30	65.37	57.48	60.07	63.63	7.82	5.23	1.67	7.90	5.30	1.74
34900.00		65.36	57.44	60.03	63.58				7.92	5.33	1.78
34800.00		65.50	57.42	60.00	63.55				8.09	5.50	1.95
34700.00		65.44	57.39	59.97	63.52				8.05	5.46	1.92
34600.00		65.20	57.37	59.95	63.49				7.83	5.25	1.71
34500.00	65.16	65.16	57.34	59.92	63.46	7.82	5.24	1.71	7.82	5.24	1.71
34400.00		64.99	57.32	59.89	63.42				7.67	5.10	1.56
34300.00		65.02	57.30	59.87	63.39				7.73	5.16	1.63
34200.00		64.97	57.27	59.84	63.36				7.70	5.13	1.61
34100.00		64.89	57.25	59.81	63.33				7.64	5.07	1.55
34000.00	65.17	65.07	57.23	59.78	63.30	7.94	5.38	1.86	7.84	5.29	1.77
33900.00		64.72	57.20	59.76	63.27				7.51	4.96	1.45
33800.00		64.90	57.18	59.73	63.24				7.72	5.17	1.66
33700.00		64.81	57.16	59.70	63.21				7.66	5.11	1.60
33600.00		64.89	57.13	59.68	63.18				7.75	5.21	1.71
33500.00	64.79	64.66	57.11	59.65	63.15	7.68	5.14	1.64	7.56	5.02	1.52
33400.00		64.64	57.08	59.62	63.11				7.56	5.02	1.53
33300.00		64.55	57.06	59.59	63.08				7.48	4.95	1.47
33200.00		64.45	57.04	59.56	63.04				7.41	4.89	1.41
33100.00		64.35	57.01	59.53	63.01				7.33	4.81	1.34
33000.00	64.54	64.52	56.99	59.51	62.97	7.55	5.03	1.57	7.53	5.01	1.55
32900.00		64.38	56.97	59.48	62.94				7.42	4.91	1.44
32800.00		64.35	56.94	59.45	62.90				7.41	4.90	1.45
32700.00		64.39	56.92	59.42	62.87				7.47	4.97	1.52
32600.00		64.44	56.90	59.39	62.83				7.54	5.05	1.61
32500.00	64.39	64.35	56.87	59.36	62.80	7.52	5.03	1.59	7.47	4.98	1.55
32400.00		64.64	56.85	59.34	62.77				7.79	5.30	1.87

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
32300.00		64.41	56.83	59.31	62.73				7.59	5.10	1.68
32200.00	64.40	64.40	56.79	59.27	62.68	7.60	5.13	1.71	7.60	5.13	1.71
32100.00		64.26	56.76	59.23	62.63				7.51	5.04	1.63
32000.00		64.37	56.72	59.18	62.58				7.65	5.19	1.79
31900.00		64.39	56.68	59.14	62.53				7.71	5.25	1.87
31800.00		64.15	56.65	59.09	62.47				7.51	5.06	1.68
31700.00	64.06	64.18	56.61	59.05	62.42	7.45	5.01	1.64	7.57	5.13	1.76
31600.00		63.91	56.57	59.01	62.37				7.34	4.90	1.54
31500.00	63.84	63.85	56.54	58.96	62.32	7.30	4.87	1.52	7.32	4.89	1.54
31400.00		63.73	56.50	58.92	62.26				7.23	4.81	1.47
31300.00		63.69	56.46	58.88	62.21				7.23	4.82	1.48
31200.00		63.83	56.43	58.84	62.17				7.40	4.99	1.66
31100.00		63.77	56.41	58.82	62.15				7.35	4.94	1.62
31000.00	63.82	63.75	56.40	58.80	62.13	7.42	5.02	1.69	7.35	4.95	1.62
30900.00		63.72	56.38	58.78	62.10				7.34	4.94	1.61
30800.00		63.77	56.36	58.76	62.08				7.41	5.01	1.69
30700.00		63.79	56.34	58.74	62.06				7.45	5.05	1.73
30600.00		63.37	56.32	58.72	62.04				7.05	4.65	1.34
30500.00	63.33	63.45	56.31	58.70	62.02	7.03	4.63	1.32	7.14	4.74	1.43
30400.00		63.47	56.29	58.68	61.99				7.19	4.79	1.48
30300.00		63.44	56.27	58.66	61.97				7.17	4.78	1.47
30200.00		63.39	56.25	58.64	61.95				7.14	4.75	1.44
30100.00		63.14	56.23	58.62	61.93				6.91	4.52	1.21
30000.00	63.21	63.24	56.21	58.60	61.91	7.00	4.61	1.31	7.03	4.64	1.34
29900.00		63.75	56.21	58.60	61.90				7.55	5.16	1.86
29800.00		63.57	56.20	58.59	61.89				7.37	4.98	1.68
29700.00		63.14	56.20	58.59	61.89				6.94	4.55	1.25
29600.00		63.09	56.19	58.58	61.89				6.89	4.51	1.20
29500.00	63.22	63.03	56.19	58.57	61.88	7.03	4.64	1.33	6.84	4.46	1.15
29400.00		63.22	56.18	58.57	61.88				7.04	4.65	1.34
29300.00		63.08	56.18	58.56	61.87				6.90	4.52	1.21
29200.00		62.80	56.18	58.56	61.87				6.63	4.24	0.93
29100.00		62.67	56.17	58.55	61.87				6.50	4.12	0.81
29000.00	62.89	62.62	56.17	58.55	61.86	6.72	4.34	1.03	6.46	4.07	0.76
28900.00		62.66	56.16	58.54	61.86				6.49	4.11	0.80
28800.00		62.49	56.16	58.54	61.86				6.34	3.96	0.64
28700.00		62.66	56.15	58.53	61.85				6.50	4.12	0.80
28600.00		62.51	56.14	58.52	61.84				6.37	3.99	0.67
28500.00	62.75	62.80	56.13	58.51	61.83	6.61	4.24	0.92	6.66	4.29	0.97
28400.00		62.55	56.12	58.50	61.81				6.43	4.05	0.74
28300.00		62.51	56.11	58.49	61.80				6.40	4.03	0.71
28200.00		62.31	56.10	58.47	61.79				6.21	3.84	0.52
28100.00		62.09	56.09	58.46	61.77				6.00	3.63	0.31
28000.00	62.52	62.49	56.08	58.45	61.76	6.44	4.07	0.76	6.42	4.05	0.74
27900.00		62.28	56.06	58.43	61.74				6.22	3.85	0.54
27800.00		64.02	56.05	58.42	61.73				7.97	5.60	2.29
27700.00		65.23	56.04	58.41	61.71				9.19	6.82	3.52
27600.00		65.22	56.03	58.39	61.70				9.19	6.82	3.52
27500.00	65.37	65.59	56.02	58.38	61.69	9.35	6.99	3.69	9.57	7.21	3.90
27400.00		65.61	56.01	58.37	61.67				9.61	7.25	3.94
27300.00		66.25	56.00	58.36	61.66				10.26	7.90	4.59
27200.00		66.35	55.99	58.35	61.65				10.36	8.00	4.70
27100.00		65.69	55.98	58.34	61.64				9.71	7.35	4.05
27000.00	65.35	65.63	55.97	58.33	61.63	9.37	7.01	3.71	9.66	7.29	3.99
26900.00		65.53	55.97	58.33	61.63				9.57	7.20	3.90
26800.00		65.74	55.96	58.32	61.62				9.78	7.42	4.12
26700.00		65.37	55.95	58.32	61.62				9.42	7.06	3.76
26600.00		64.88	55.95	58.31	61.61				8.94	6.57	3.27
26500.00	65.16	65.13	55.94	58.31	61.61	9.22	6.85	3.55	9.19	6.83	3.53
26400.00		64.48	55.93	58.30	61.60				8.55	6.18	2.88
26300.00		63.75	55.93	58.29	61.59				7.82	5.46	2.16
26200.00		63.82	55.92	58.29	61.59				7.90	5.54	2.24
26100.00		64.34	55.91	58.28	61.58				8.43	6.06	2.76
26000.00	65.06	65.03	55.90	58.27	61.57	9.16	6.79	3.49	9.13	6.76	3.46
25900.00		66.41	55.88	58.25	61.55				10.53	8.16	4.86
25800.00		66.16	55.86	58.24	61.53				10.30	7.93	4.63
25700.00		64.85	55.85	58.22	61.51				9.00	6.63	3.33
25600.00		64.38	55.83	58.20	61.49				8.55	6.18	2.88
25500.00	65.01	64.93	55.81	58.18	61.48	9.20	6.83	3.53	9.12	6.74	3.45
25400.00		64.90	55.79	58.17	61.46				9.11	6.74	3.44
25300.00		64.83	55.78	58.15	61.44				9.06	6.68	3.39
25200.00		64.98	55.76	58.13	61.42				9.22	6.84	3.56
25100.00		64.19	55.74	58.12	61.40				8.45	6.08	2.79
25000.00	63.56	63.45	55.72	58.10	61.39	7.84	5.46	2.17	7.73	5.35	2.07

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
24900.00		64.37	55.71	58.08	61.37				8.67	6.29	3.01
24800.00		64.38	55.69	58.07	61.35				8.69	6.31	3.03
24700.00		64.47	55.67	58.05	61.33				8.80	6.42	3.14
24600.00		63.98	55.66	58.04	61.32				8.32	5.94	2.66
24500.00	63.79	63.73	55.66	58.04	61.32	8.13	5.75	2.47	8.07	5.69	2.41
24400.00		63.98	55.66	58.04	61.32				8.32	5.94	2.66
24300.00		64.02	55.66	58.04	61.32				8.36	5.98	2.70
24200.00		63.31	55.66	58.04	61.32				7.65	5.27	1.99
24100.00		63.27	55.66	58.04	61.32				7.61	5.23	1.95
24000.00	63.93	63.96	55.66	58.04	61.32	8.27	5.89	2.61	8.30	5.92	2.64
23900.00		64.23	55.66	58.04	61.32				8.57	6.19	2.91
23800.00		63.75	55.66	58.04	61.32				8.09	5.71	2.43
23700.00		63.78	55.66	58.04	61.32				8.12	5.74	2.46
23600.00		63.77	55.66	58.04	61.32				8.11	5.73	2.45
23500.00	63.46	63.27	55.66	58.04	61.32	7.80	5.42	2.14	7.61	5.23	1.95
23400.00		63.17	55.66	58.04	61.32				7.51	5.13	1.85
23300.00		63.35	55.66	58.04	61.32				7.69	5.31	2.03
23200.00		62.65	55.65	58.03	61.31				7.00	4.62	1.34
23100.00		62.45	55.64	58.02	61.30				6.81	4.43	1.15
23000.00	62.88	62.73	55.63	58.01	61.29	7.25	4.87	1.59	7.10	4.72	1.44
22900.00		62.63	55.62	58.00	61.28				7.01	4.63	1.35
22800.00		62.28	55.61	57.99	61.27				6.67	4.29	1.01
22700.00		61.98	55.60	57.97	61.26				6.38	4.01	0.72
22600.00		61.63	55.59	57.96	61.25				6.04	3.66	0.38
22500.00	62.07	61.92	55.58	57.95	61.24	6.49	4.12	0.83	6.34	3.96	0.68
22400.00		62.10	55.57	57.94	61.23				6.53	4.16	0.87
22300.00		62.52	55.56	57.93	61.22				6.96	4.59	1.30
22200.00		62.41	55.55	57.92	61.21				6.86	4.49	1.20
22100.00		62.40	55.54	57.91	61.20				6.86	4.49	1.20
22000.00	62.10	62.14	55.53	57.90	61.19	6.57	4.20	0.91	6.61	4.24	0.95
21900.00		62.59	55.53	57.90	61.19				7.07	4.70	1.41
21800.00		63.15	55.52	57.89	61.18				7.63	5.26	1.97
21700.00		64.11	55.52	57.89	61.18				8.59	6.22	2.93
21600.00		63.80	55.51	57.88	61.17				8.28	5.91	2.62
21500.00	62.98	63.12	55.51	57.88	61.17	7.47	5.10	1.81	7.61	5.24	1.95
21400.00		63.72	55.50	57.87	61.16				8.21	5.84	2.55
21300.00		64.26	55.50	57.87	61.16				8.76	6.39	3.10
21200.00		63.58	55.50	57.87	61.16				8.09	5.72	2.43
21100.00		62.82	55.49	57.86	61.15				7.33	4.96	1.67
21000.00	62.20	62.37	55.48	57.85	61.14	6.72	4.35	1.06	6.89	4.52	1.23
20900.00		63.10	55.46	57.83	61.12				7.63	5.26	1.97
20800.00		63.07	55.44	57.81	61.10				7.62	5.25	1.96
20700.00		62.70	55.43	57.80	61.09				7.27	4.90	1.61
20600.00		62.51	55.41	57.78	61.07				7.10	4.73	1.44
20500.00	62.20	62.31	55.39	57.76	61.05	6.80	4.43	1.14	6.91	4.54	1.25
20400.00		62.94	55.38	57.75	61.04				7.57	5.20	1.91
20300.00		63.54	55.36	57.73	61.02				8.18	5.81	2.52
20200.00		62.72	55.36	57.72	61.01				7.37	5.00	1.71
20100.00		62.43	55.35	57.71	61.00				7.08	4.72	1.43
20000.00		63.01	55.34	57.70	60.99				7.67	5.31	2.02
19900.00		63.40	55.33	57.69	60.98				8.07	5.71	2.42
19800.00		62.42	55.32	57.68	60.96				7.10	4.74	1.46
19700.00		62.68	55.31	57.67	60.95				7.38	5.01	1.73
19600.00		62.42	55.30	57.66	60.94				7.12	4.76	1.48
19500.00		63.21	55.29	57.65	60.93				7.92	5.56	2.28
19400.00		63.81	55.28	57.64	60.92				8.53	6.17	2.90
19300.00		64.38	55.27	57.63	60.90				9.11	6.75	3.48
19200.00		62.94	55.26	57.62	60.89				7.69	5.32	2.05
19100.00		62.56	55.25	57.61	60.88				7.31	4.95	1.68
19000.00		63.02	55.24	57.60	60.87				7.78	5.42	2.15
18900.00		62.82	55.23	57.59	60.86				7.59	5.23	1.96
18800.00		63.41	55.22	57.58	60.84				8.19	5.83	2.57
18700.00		62.92	55.21	57.57	60.83				7.71	5.35	2.09
18600.00		63.52	55.20	57.56	60.82				8.32	5.96	2.70
18500.00		63.65	55.19	57.55	60.81				8.46	6.10	2.84
18400.00		63.00	55.18	57.54	60.80				7.82	5.46	2.21
18300.00		63.34	55.17	57.53	60.78				8.17	5.81	2.56
18200.00		63.30	55.16	57.52	60.77				8.14	5.78	2.53
18100.00		63.20	55.14	57.50	60.75				8.06	5.70	2.46
18000.00		63.32	55.12	57.48	60.72				8.20	5.84	2.60
17900.00		63.10	55.10	57.45	60.69				8.01	5.65	2.41
17800.00		63.22	55.07	57.43	60.66				8.15	5.79	2.56
17700.00		63.07	55.05	57.40	60.63				8.03	5.67	2.44
17600.00		62.11	55.03	57.38	60.61				7.09	4.73	1.51

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
17500.00		62.27	55.00	57.35	60.58				7.26	4.91	1.69
17400.00		63.22	54.98	57.33	60.55				8.24	5.89	2.67
17300.00		63.90	54.96	57.30	60.52				8.95	6.60	3.38
17200.00		63.65	54.94	57.28	60.49				8.72	6.37	3.16
17100.00		63.66	54.91	57.26	60.46				8.75	6.41	3.20
17000.00		63.37	54.89	57.23	60.44				8.48	6.14	2.94
16900.00		63.66	54.87	57.21	60.41				8.79	6.45	3.25
16800.00		63.99	54.85	57.19	60.39				9.13	6.79	3.59
16700.00		63.07	54.84	57.18	60.38				8.23	5.89	2.69
16600.00		62.73	54.83	57.17	60.37				7.90	5.56	2.36
16500.00		62.86	54.82	57.16	60.35				8.04	5.70	2.51
16400.00		62.25	54.81	57.15	60.34				7.44	5.11	1.91
16300.00		61.60	54.80	57.14	60.33				6.80	4.47	1.28
16200.00		61.85	54.79	57.12	60.31				7.06	4.73	1.54
16100.00		62.03	54.78	57.11	60.30				7.25	4.92	1.73
16000.00		61.99	54.77	57.10	60.29				7.22	4.89	1.70
15900.00		62.10	54.76	57.09	60.28				7.35	5.01	1.83
15800.00		61.93	54.75	57.08	60.26				7.18	4.85	1.66
15700.00		61.41	54.74	57.07	60.25				6.67	4.34	1.16
15600.00		60.84	54.73	57.06	60.24				6.12	3.79	0.61
15500.00		61.40	54.71	57.04	60.22				6.69	4.36	1.18
15400.00		61.23	54.69	57.02	60.19				6.54	4.21	1.04
15300.00		61.35	54.67	57.00	60.17				6.68	4.36	1.19
15200.00		61.04	54.65	56.98	60.15				6.38	4.06	0.89
15100.00		61.87	54.64	56.96	60.12				7.24	4.92	1.75
15000.00		61.98	54.62	56.94	60.10				7.36	5.04	1.88
14900.00		62.42	54.60	56.92	60.07				7.82	5.51	2.35
14800.00		62.21	54.58	56.90	60.05				7.63	5.32	2.17
14700.00		61.42	54.56	56.88	60.02				6.86	4.55	1.40
14600.00		61.55	54.54	56.86	60.00				7.01	4.69	1.55
14500.00		61.95	54.52	56.84	59.97				7.43	5.12	1.98
14400.00		61.52	54.50	56.81	59.95				7.02	4.70	1.57
14300.00		60.95	54.48	56.79	59.93				6.47	4.16	1.02
14200.00		61.32	54.40	56.70	59.81				6.92	4.62	1.51
14100.00		60.39	54.29	56.58	59.67				6.10	3.81	0.73
14000.00		60.31	54.19	56.46	59.52				6.12	3.84	0.79
13900.00		60.48	54.08	56.35	59.38				6.39	4.13	1.10
13800.00		61.67	54.02	56.28	59.30				7.65	5.39	2.38
13700.00		61.80	54.00	56.26	59.27				7.80	5.54	2.52
13600.00		61.90	53.98	56.24	59.25				7.92	5.67	2.66
13500.00		62.40	53.96	56.21	59.22				8.44	6.18	3.17
13400.00		62.86	53.94	56.19	59.20				8.92	6.67	3.66
13300.00		62.03	53.92	56.17	59.17				8.11	5.86	2.86
13200.00		61.54	53.90	56.15	59.15				7.64	5.40	2.40
13100.00		61.09	53.88	56.13	59.12				7.20	4.96	1.96
13000.00		61.28	53.86	56.10	59.10				7.42	5.18	2.18
12900.00		62.08	53.84	56.08	59.07				8.24	6.00	3.01
12800.00		62.25	53.82	56.06	59.04				8.43	6.19	3.20
12700.00		61.75	53.79	56.03	59.01				7.96	5.72	2.74
12600.00		61.88	53.77	56.00	58.98				8.11	5.88	2.90
12500.00		61.72	53.74	55.98	58.95				7.98	5.75	2.78
12400.00		60.02	53.72	55.95	58.91				6.30	4.07	1.10
12300.00		59.19	53.69	55.92	58.88				5.50	3.27	0.31
12200.00		58.98	53.67	55.89	58.85				5.31	3.09	0.14
12100.00		59.47	53.64	55.87	58.81				5.83	3.60	0.66
12000.00		59.74	53.62	55.84	58.78				6.12	3.90	0.95
11900.00		60.07	53.59	55.81	58.75				6.48	4.26	1.32
11800.00		60.18	53.57	55.79	58.72				6.61	4.39	1.46
11700.00		60.25	53.55	55.76	58.68				6.70	4.49	1.57
11600.00		60.22	53.52	55.73	58.65				6.70	4.49	1.57
11500.00		60.23	53.49	55.69	58.61				6.74	4.53	1.62
11400.00		60.33	53.45	55.66	58.56				6.88	4.67	1.77
11300.00		60.32	53.42	55.62	58.52				6.90	4.70	1.80
11200.00		60.20	53.39	55.58	58.47				6.81	4.62	1.73
11100.00		60.11	53.35	55.54	58.43				6.75	4.56	1.68
11000.00		60.02	53.32	55.50	58.38				6.70	4.52	1.64
10900.00		58.74	53.28	55.47	58.34				5.46	3.28	0.41
10800.00		58.81	53.25	55.43	58.29				5.56	3.38	0.52
10700.00		60.29	53.22	55.39	58.25				7.08	4.90	2.05
10600.00		57.60	53.18	55.35	58.20				4.42	2.25	-0.60
10500.00		57.90	53.17	55.34	58.19				4.72	2.55	-0.30
10400.00		57.68	53.16	55.34	58.19				4.52	2.35	-0.50
10300.00		57.85	53.16	55.33	58.18				4.70	2.52	-0.33
10200.00		57.54	53.15	55.32	58.17				4.39	2.21	-0.64

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
10100.00		57.41	53.14	55.32	58.17				4.27	2.09	-0.76
10000.00		57.40	53.13	55.31	58.16				4.27	2.09	-0.76
9900.00		57.87	53.13	55.31	58.16				4.75	2.57	-0.28
9800.00		62.36	53.04	55.21	58.03				9.32	7.16	4.33
9700.00		58.26	52.81	54.93	57.67				5.45	3.33	0.59
9600.00		57.35	52.79	54.91	57.64				4.56	2.44	-0.30
9500.00		56.96	52.77	54.88	57.62				4.19	2.08	-0.66
9400.00		56.97	52.75	54.86	57.59				4.23	2.11	-0.61
9300.00		57.03	52.73	54.84	57.56				4.30	2.19	-0.53
9200.00		56.94	52.71	54.82	57.53				4.23	2.12	-0.59
9100.00		56.73	52.67	54.78	57.48				4.06	1.95	-0.75
9000.00		56.73	52.62	54.72	57.41				4.11	2.01	-0.69
8900.00		56.67	52.57	54.67	57.35				4.10	2.00	-0.68
8800.00		56.69	52.52	54.61	57.29				4.17	2.08	-0.59
8700.00		56.84	52.47	54.56	57.22				4.37	2.28	-0.38
8600.00		56.61	52.43	54.50	57.16				4.18	2.10	-0.55
8500.00		56.75	52.38	54.45	57.09				4.37	2.30	-0.35
8400.00		56.53	52.31	54.38	57.01				4.22	2.16	-0.47
8300.00		56.65	52.22	54.28	56.89				4.42	2.37	-0.24
8200.00		56.52	52.14	54.18	56.77				4.38	2.34	-0.25
8100.00		56.18	52.05	54.09	56.66				4.13	2.09	-0.47
8000.00		56.40	51.96	53.99	56.54				4.43	2.41	-0.14
7900.00		56.63	51.88	53.89	56.42				4.75	2.73	0.21
7800.00		56.54	51.79	53.80	56.30				4.75	2.75	0.24
7700.00		56.38	51.71	53.70	56.19				4.67	2.68	0.19
7600.00		56.12	51.62	53.61	56.07				4.50	2.52	0.05
7500.00		56.07	51.54	53.52	55.97				4.53	2.55	0.10
7400.00		56.10	51.49	53.47	55.91				4.60	2.62	0.19
7300.00		56.10	51.44	53.42	55.85				4.65	2.68	0.25
7200.00		56.07	51.39	53.37	55.79				4.68	2.71	0.29
7100.00		55.60	51.34	53.32	55.73				4.25	2.28	-0.13
7000.00		55.93	51.29	53.26	55.67				4.63	2.66	0.26
6900.00		56.92	51.25	53.21	55.60				5.68	3.71	1.32
6800.00		57.37	51.20	53.16	55.54				6.17	4.21	1.82
6700.00		57.22	51.15	53.11	55.48				6.08	4.11	1.74
6600.00		57.17	51.10	53.06	55.42				6.07	4.11	1.75
6500.00		56.90	51.06	53.02	55.38				5.83	3.87	1.52
6400.00		57.00	51.05	53.01	55.37				5.95	3.99	1.63
6300.00		56.75	51.04	53.00	55.35				5.71	3.76	1.40
6200.00		56.66	51.03	52.99	55.34				5.63	3.67	1.32
6100.00		56.67	51.02	52.97	55.33				5.66	3.70	1.35
6000.00		56.89	51.00	52.96	55.31				5.89	3.93	1.58
5900.00		57.00	50.99	52.95	55.30				6.01	4.05	1.70
5800.00		56.89	50.98	52.94	55.28				5.91	3.95	1.60
5700.00		56.70	50.97	52.92	55.27				5.74	3.78	1.43
5600.00		56.76	50.96	52.91	55.26				5.80	3.85	1.50
5500.00		56.53	50.94	52.90	55.24				5.59	3.63	1.29
5400.00		56.43	50.93	52.89	55.23				5.50	3.54	1.20
5300.00		56.43	50.92	52.87	55.21				5.51	3.56	1.22
5200.00		56.38	50.91	52.86	55.20				5.47	3.52	1.18
5100.00		56.18	50.89	52.85	55.19				5.29	3.33	1.00
5000.00		55.86	50.88	52.84	55.17				4.98	3.02	0.69
4900.00		56.04	50.87	52.82	55.16				5.17	3.22	0.88
4800.00		56.26	50.86	52.81	55.14				5.40	3.45	1.11
4700.00		56.23	50.85	52.80	55.13				5.39	3.43	1.11
4600.00		56.03	50.83	52.79	55.11				5.20	3.24	0.92
4500.00		55.78	50.82	52.78	55.10				4.96	3.01	0.68
4400.00		56.09	50.81	52.76	55.09				5.28	3.33	1.00
4300.00		56.35	50.80	52.75	55.07				5.56	3.60	1.28
4200.00		55.82	50.79	52.74	55.06				5.04	3.08	0.76
4100.00		55.79	50.77	52.73	55.04				5.01	3.06	0.74
4000.00		55.92	50.76	52.71	55.03				5.16	3.21	0.89
3900.00		55.73	50.75	52.70	55.02				4.98	3.02	0.71
3800.00		55.64	50.74	52.69	55.00				4.91	2.96	0.64
3700.00		55.60	50.73	52.68	54.99				4.87	2.92	0.61
3600.00		55.57	50.71	52.66	54.97				4.85	2.90	0.59
3500.00		55.61	50.66	52.61	54.90				4.95	3.00	0.70
3400.00		55.52	50.59	52.53	54.81				4.93	2.99	0.71
3300.00		55.48	50.52	52.46	54.71				4.96	3.02	0.76
3200.00		55.46	50.45	52.38	54.62				5.01	3.08	0.84
3100.00		55.38	50.38	52.31	54.53				5.00	3.07	0.86
3000.00		55.38	50.31	52.23	54.43				5.07	3.15	0.95
2900.00		55.13	50.24	52.16	54.34				4.89	2.97	0.79
2800.00		54.88	50.17	52.08	54.24				4.71	2.80	0.64

Table 5-1. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
2700.00		54.87	50.10	52.01	54.15				4.77	2.86	0.72
2600.00		55.23	50.03	51.93	54.06				5.20	3.29	1.17
2500.00		55.01	49.96	51.86	53.97				5.05	3.15	1.04
2400.00		55.02	49.91	51.80	53.89				5.11	3.21	1.13
2300.00		55.19	49.86	51.74	53.81				5.33	3.44	1.38
2200.00		55.06	49.80	51.69	53.73				5.26	3.38	1.33
2100.00		54.84	49.75	51.63	53.65				5.10	3.22	1.19
2000.00		54.69	49.69	51.57	53.57				5.00	3.12	1.12
1900.00		54.74	49.64	51.51	53.49				5.10	3.23	1.25
1800.00		54.61	49.59	51.45	53.41				5.03	3.16	1.20
1700.00		54.58	49.53	51.39	53.34				5.04	3.19	1.24
1600.00		54.70	49.49	51.34	53.26				5.21	3.36	1.43
1500.00		54.53	49.44	51.28	53.19				5.09	3.25	1.34
1400.00		54.42	49.39	51.23	53.12				5.03	3.19	1.30
1300.00		54.58	49.34	51.17	53.05				5.24	3.41	1.53

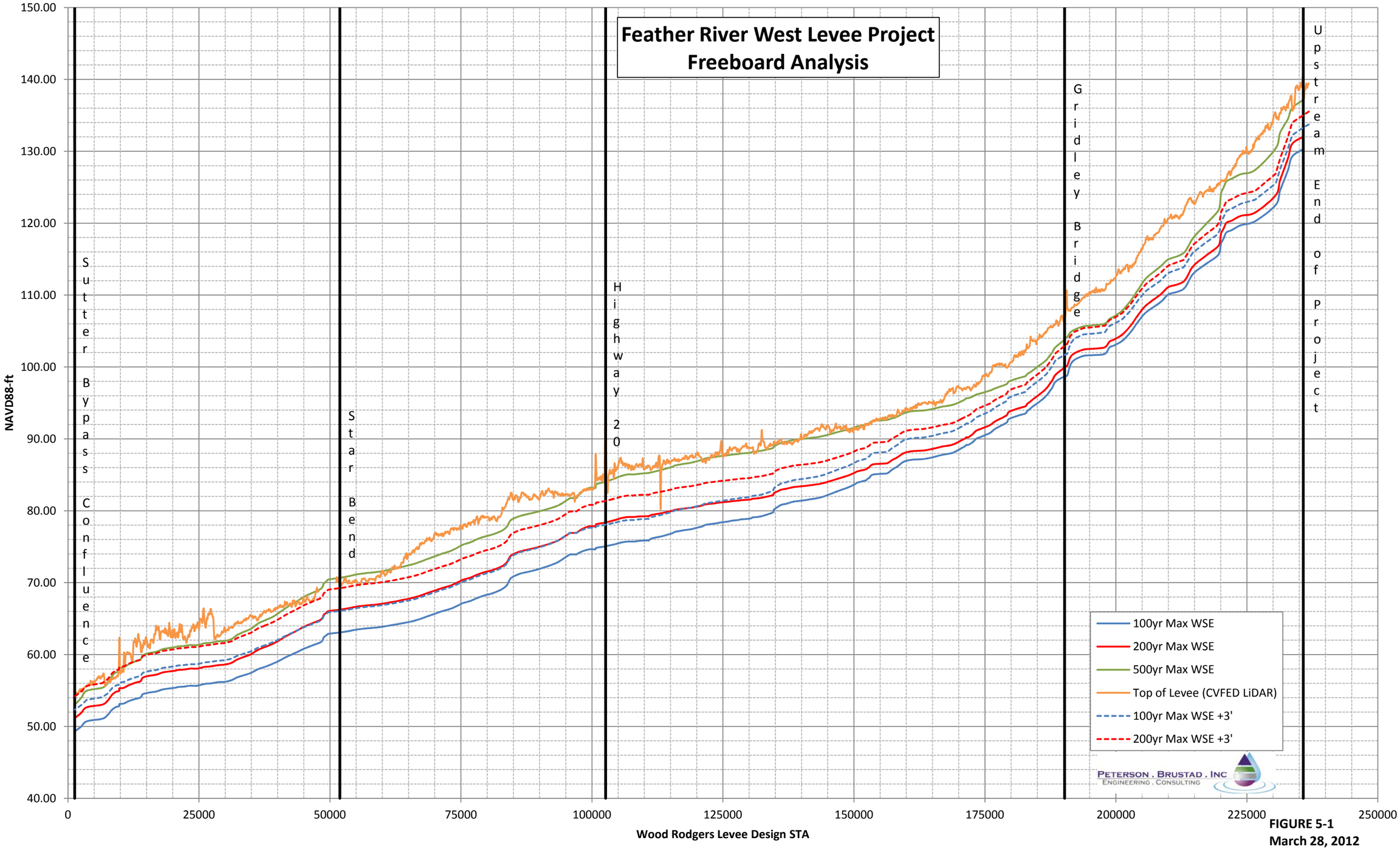


FIGURE 5-1
March 28, 2012

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7 ATTACHMENTS

A. PBI Datum Conversion for Select Gages

B. Vertical Datum Conversion TM

C. DWR 1957 Profile

D. October 2010 Water Surface Profiles

E. June 2011 Water Surface Profiles

F. September 2011 Water Surface Profiles

G. December 2011 Water Surface Profiles

H. USACE Technical Review Comments

I. MBK Technical Review Comments

ATTACHMENT A

PBI Datum Conversion for Select Gages

Additional Gages Inserted into PBI Calibration for reference:

Gage	NGVD29 to NAVD88 Corpscon Conversion Value	Comments Regarding Conversion from Reported Gage Datum to NAVD88
FR at Live Oak (FLO)	2.274	No Gage Datum information on CDEC; Per NHC report, subtract 3.0-ft to get Gage Datum to NGVD29. To convert: take reported CDEC stage and subtract 0.70-ft (subtract 3.0' then add 2.3') for NAVD88 values.
FR at Boyd's Landing (FBL)	2.293	Per CDEC, subtract 3.0-ft to get Gage Datum to NGVD29. To convert: take reported CDEC stage and subtract 0.70-ft (subtract 3.0' then add 2.3') for NAVD88 values.
SB at Longbridge (LNB)	2.375	Per CDEC, subtract 3.0 to get Gage Datum to NGVD29. To convert: take the reported CDEC stage and subtract 0.70-ft (subtract 3.0' then add 2.3') for NAVD88 values.
YR at Marysville (#11421000)	2.264	No Gage Datum information on CDEC; Per NHC report, subtract 2.95-ft to get Gage Datum to NGVD29. To convert: take reported CDEC stage and subtract 0.65-ft (subtract 2.95' then add 2.3') for NAVD88 values.
YR at Simpson Lane Bridge (SIM)	2.274	No Gage Datum information on CDEC; Per NHC report, subtract 3.0-ft to get Gage Datum to NGVD29. To convert: take reported CDEC stage and subtract 0.70-ft (subtract 3.0' then add 2.3') for NAVD 88 values.

NOTE: THIS DATA SHOULD ONLY BE USED AS REFERENCE; DO NOT USE WITHOUT SCRUTINY.
This data was converted based upon unverified information from past studies and CDEC. Elevations were converted to NAVD88 using Corpscon.
The Referenced NHC Report refers to the report titled "Common Features GRR: Data Gathering for Model Calibration" dated July 2008, prepared for the USACE by Northwest Hydraulic Consultants Inc. (NHC).

ATTACHMENT B

Vertical Datum Conversion TM

VERTICAL DATUM CONVERSION
of the
SUTTER BYPASS-FEATHER RIVER HEC-RAS MODEL

Hydraulic Design Support for USACE Feasibility Study
F3 Phase

Prepared for: Sutter-Butte Flood Control Agency ***July 14, 2010***

Prepared by: Chris Fritz, PE

Reviewed by: Barry O'Regan, PE

1. INTRODUCTION

The Peterson Brustad Inc. (PBI) Sutter Bypass-Feather River ver.1 HEC-RAS model (Sutter Basin model) was developed using the National Geodetic Vertical Datum of 1929 (NGVD 29). This Technical Memorandum (TM) documents the process and procedures utilized in converting the vertical datum of the Sutter Basin model from NGVD 29 to the North American Vertical Datum of 1988 (NAVD 88).

The datum conversion factors used in the conversion process described below were developed by the U.S. Army Corps of Engineers (USACE) and provided to PBI. The USACE is in the process of documenting how the conversion factors referred to below were developed. This documentation will be included in the final Feasibility Report.

2. CONVERSION PROCESS

The process used for converting each of the HEC-RAS model components was as follows:

2.1 Cross Sections

Cross sections were converted using electronic conversion surfaces that were provided to PBI by the USACE on June 3, 2010. The conversion surfaces specify the conversion factor value to apply to each cross section depending on the location of the cross section. Two conversion surfaces were provided by USACE; conversion surface 1 was used for the Lower Feather River Mapping conducted by Towill (see Figure 3) and conversion surface 2 was used for all other remaining areas. A list of the conversion factors that were applied to the PBI Sutter Basin model cross sections is contained in Table 1.

Table 1: Conversion Factors Utilized for the PBI Sutter Basin HEC-RAS Cross Sections

Description	Station Range			Conversion Factor	Conversion Surface
Sacramento River	139.75	-	143.24	1.8	2
	137.00	-	139.50	1.7	2
	134.25	-	136.75	1.8	2
	130.00	-	134.00	1.9	2
	124.25	-	129.75	2	2
	123.75	-	124.00	2.1	2
	122.75	-	123.50	2	2
	120.00	-	122.50	2.1	2
	116.25	-	119.75	2.2	2
	115.25	-	116.00	2.3	2
	111.75	-	115.00	2.2	2
	103.25	-	111.50	2.1	2
	97.75	-	103.00	2	2
	93.50	-	97.50	2.1	2
	86.50	-	93.25	2	2
	84.25	-	86.25	1.9	2
	81.26	-	84.00	2	2
	78.756	-	80.75	2.1	2
Wadsworth Canal	2.24	-	4.29	2.1	2
	0	-	2.06	2	2
Yuba OB	All			2.3	2
Feather River	68.46	-	71.45	2.2	2
	67.70	-	68.29	2.3	2
	65.88	-	67.54	2.2	2
	64.20	-	65.58	2.3	2
	59.35	-	63.95	2.2	2
	58.75			2.3	2
	55.35	-	58.51	2.2	2
	52.60	-	55.03	2.3	2
	35.78	-	52.21	2.2	2
	35.25	-	35.50	2.3	2
	32.50	-	34.80	2.2	2
	31.50	-	32.25	2.3	2
	30.25	-	31.25	2.2	2
	23.75	-	30.00	2.2	1
	7.55	-	23.50	2.1	1

Description	Station Range			Conversion Factor	Conversion Surface
	5.64	-	7.41	2.3	2
	3.10	-	5.45	2.2	2
	0.13	-	2.95	2.1	2
Dry Creek	All			2.1	1
Best Slough	All			2.1	1
Tisdale Bypass	0.21	-	4.36	2.2	2
	0.04			2.3	2
KLRC	5.13	-	6.25	2.0	2
	1.19	-	4.95	1.9	2
	0.26	-	1.0	1.8	2
Sutter Bypass	91.02	-	94.45	1.7	2
	89.53	-	90.84	1.8	2
	88.41	-	89.35	1.9	2
	86.18	-	88.23	2	2
	77.79	-	85.99	2.1	2
	75.91	-	77.61	2.2	2
	75.72			2.1	2
	73.63	-	75.53	2.2	2
	73.45			2.3	2
	73.07	-	73.26	2.4	2
	72.71	-	72.89	2.5	2
	67.20	-	72.52	2.4	2
	64.63	-	67.01	2.3	2
	62.01	-	64.44	2.2	2
	58.81	-	61.82	2.1	2
Yolo Bypass	56.57	-	57.15	2	2
	54.33	-	56.38	1.9	2
	51.284	-	53.626	1.8	2
	51.097			1.9	2
	50.911			2	2
	50.697			2	2
Honcut Creek	All			2.2	2
Yankee Slough	All			2.1	1
Bear River	13.37	-	16.35	2.2	Extrapolated*
	0.67	-	13.09	2.1	1
UPIC	4.939	-	4.94	2.2	1
	0.06	-	4.75	2.1	1
Jack Slough	2.250	-	7.50	2.3	2
	1.250	-	2.13	2.2	1
Yuba River	2.830	-	13.84	2.3	2
	1.479	-	2.60	2.2	2
	0.19	-	1.35	2.2	1

*Note – The conversion surfaces did not extend into the upper portion of Bear Creek. Therefore a conversion factor of 2.2 was applied by extrapolating the values of Conversion Surface 1.

2.2 Lateral Structures

Lateral structures in the PBI Sutter Basin model represent levees. The top of levee elevations used for the lateral structures are based upon data obtained from the USACE National Levee Database (NLDB) which was developed using NAVD 88. However, top of levee elevations

from the NLDB were converted to NGVD 29 (via Corpscon) when utilized for the USACE ver.3 model (which is the basis of the PBI Sutter Basin model). Three methods were specified by USACE to be used in converting the lateral structures from NGVD 29 to NAVD 88: (i) Lateral structures for the west bank of the Feather River and the east bank of the Sutter Bypass were re-coded into the model based upon the NLDB NAVD 88 values, (ii) certain lateral structures were re-converted back to NAVD 88 using the original conversion values that were provided by the USACE on June 9, 2010, and (iii) the remaining lateral structures were converted using the conversion surfaces referred to in Section 2.1. A list of the conversion values applied to the lateral structures in the PBI Sutter Basin model is contained in Table 2.

Table 2: Conversion Factors Utilized for the PBI Sutter Basin HEC-RAS Lateral Structures

Description	Lateral Structure Stations			Conversion Factor	Source
Feather River	56.99	-	58.45		Coded in from NLDB
	56.01			2.29	USACE Conversion Value
	55.4				Coded in from NLDB
	54.039			2.29	USACE Conversion Value
	50.31	-	53.56		Coded in from NLDB
	50.17			2.27	USACE Conversion Value
	48.55				Coded in from NLDB
	48.47			2.27	USACE Conversion Value
	47.25				Coded in from NLDB
	46.44			2.27	USACE Conversion Value
	29.82	-	46.43		Coded in from NLDB
	29.241	-	29.741	2.27	USACE Conversion Value
	20.85	-	29.2		Coded in from NLDB
	19.91			2.1	Conversion Surface
	13.9	-	19.9		Coded in from NLDB
	12.74	-	13.24	2.1	Conversion Surface
	2.55	-	11.95		Coded in from NLDB
Sacramento River	128.4	-	143.23	2.4	USACE Conversion Value
	122.4	-	125.49	2.38	USACE Conversion Value
	118.24	-	118.97	2.39	USACE Conversion Value
	90.35	-	111.49	2.42	USACE Conversion Value
	90.21	-	90.219	2.44	USACE Conversion Value
	84.74			1.9	Conversion Surface
	83.74			2	Conversion Surface
	79.2	-	79.99	2.1	Conversion Surface
Sutter Bypass	94.44			2.39	USACE Conversion Value
	88.03	-	88.191	2.37	USACE Conversion Value
	84.131			2.35	USACE Conversion Value
	81.23	-	84.13		Coded in from NLDB
	77.96	-	77.97	2.35	USACE Conversion Value
	73.84	-	77.2		Coded in from NLDB
	72.31			2.35	USACE Conversion Value

Description	Lateral Structure Stations			Conversion Factor	Source
	72.2	-	72.3		Coded in from NLDB
	71.97			2.35	USACE Conversion Value
	68.95	-	71.43		Coded in from NLDB
	66.81			2.39	USACE Conversion Value
	64.45	-	66.80	2.3	Conversion Surface
	62.02	-	64.26	2.2	Conversion Surface
	59.01	-	61.83	2.1	Conversion Surface
Best Slough	1.24			2.1	Conversion Surface
Dry Creek	1.948	-	7.58	2.27	USACE Conversion Value
Jack Slough	2.24	-	7.49	2.27	USACE Conversion Value
Wadsworth Canal	4.28	-	4.281	2.33	USACE Conversion Value
Tisdale Bypass	1.949	-	3.941	2.37	USACE Conversion Value
Yankee Slough	0.7	-	5.14	2.27	USACE Conversion Value
Yuba OB	1.781	-	1.921	2.3	Conversion Surface
Bear River	2.24	-	12.491	2.27	USACE Conversion Value
Honcut Creek	3.316			2.2	Conversion Surface
Yuba River	0.639	-	8.0	2.27	USACE Conversion Value
KLRC	1.18	-	6.24	Varies from 2.45-2.47	USACE Conversion Value
Yolo Bypass	56.7			1.9	Conversion Surface
	53.45	-	56.5	Varies from 2.44-2.53	USACE Conversion Value
	51.9			2.0	Conversion Surface
UPIC	2.24	-	4.93	2.27	USACE Conversion Value

2.3 Storage Areas

Storage areas within the PBI Sutter Basin model were converted using conversion factors provided by the USACE. A list of the conversion factors utilized is contained in Table 3.

Table 3: Conversion Factors Utilized for the PBI Sutter Basin HEC-RAS Storage Areas

Storage Area	Conversion Factor
SA - Grasshopper	2.24
SA - Yankee	2.24
SA - Reeds Cr	2.25
SA - N Best Sl	2.25
SA - Camp Beale	2.26
SARobinsons	2.26
SA - S Best Sl	2.27
SA - Olivehurst	2.27
SAHoncut	2.27
SA - N Tri	2.27
MarysvilleSA	2.27
SABOGA	2.28
SA - Yankee low	2.28
SAFernandez1	2.29

Storage Area	Conversion Factor
SAFernandez2	2.29
SA - Arboga	2.29
SA - Gilsizer	2.31
SA Gridley	2.33
SA - Coon Creek	2.33
SA Live Oak	2.34
SA-Sutter	2.37
SA94	2.39
SA-RD70&1660	2.39
SA96	2.40
SA92	2.40
SA-RD1500	2.41
SA86	2.41
SA100	2.42
SA89	2.42
SA98	2.43
SA93	2.43
SA87	2.43
SA90	2.43
SA88	2.44
sac-sutter	2.44
SA102	2.44
SA91	2.44
SA95	2.45
SA97	2.45
SA166	2.46
SA106	2.46
SA107	2.46
SA103	2.46
SA105	2.46
SA108	2.47
SA101	2.47
SA99	2.48
SA104	2.48
Cache Set Basin	2.49
SA 109	2.49
SA 110	2.51
SA 111	2.53
SA 112	2.53

2.4 Storage Area Connections

Storage area connections within the PBI Sutter Basin model were converted using conversion factors provided by the USACE. A list of the conversion factors utilized is contained in Table 4.

Table 4: Conversion Factors Utilized for the PBI Sutter Basin HEC-RAS Storage Area Connections

Storage Area Connection	Conversion Factor
SC - overland2	2.25
SC - overland1	2.26
SC - overland Ya	2.26
SC - overland3	2.26
SC - RTE 70 A	2.26
Robinsons-Honcut	2.27
SC - N Beale Rd	2.27
SC - RR Bridge	2.27
SC - levee notch	2.27
SC - FR Blvd	2.28
SC - RR A	2.28
SC - RR at Erle	2.28
SC - RR B	2.28
SAC122_125	2.29
SACGridl_LiveOak	2.29
SC - overland YS	2.29
Fern1toFern2	2.29
SACGridley_125	2.31
SACLiveOak_125	2.31
SACGridley_122	2.31
94-95	2.32
SACLiveOak_Gilsi	2.33
92-94	2.40
94-96	2.40
86-92	2.41
93-94	2.41
86-89	2.42
92-93	2.42
96-98	2.42
86-87	2.42
86-90	2.42
RD1500-Sutter	2.42
87-89	2.43
89-90	2.43
95-96	2.43
96-97	2.43
98-100	2.43
87-90	2.43
90-93	2.43
87-88	2.44
87-91	2.44
90-91	2.44
88-91	2.44
97-98	2.44
100-101	2.45
91-95	2.45
102-105	2.45
102-106	2.45
95-97	2.45
98-101	2.45

Storage Area Connection	Conversion Factor
98-99	2.46
105-106	2.46
105-107	2.46
106-107	2.46
101-103	2.47
105-108	2.47
107-108	2.47
97-99	2.47
103-104	2.47
101-104	2.48
99-101	2.48
SA104 to Cache	2.49
Cache to SA109	2.49
Cache to SA110	2.50
SA109 to SA111	2.51
SA110 to SA111	2.52
SA110 to SA112	2.52
SA111 to SA112	2.53

2.5 Bridges & Inline Structures

The bridges and inline structures within the PBI Sutter Basin model were converted using the conversion surface value for their associated river stationing. The bridges and inline structures utilize the same conversion factors that were applied to the cross sections (see Section 2.1 of this TM).

2.6 Flood Relief Structures

The PBI Sutter Basin HEC-RAS model contains two flood relief structures; the Fremont Weir and the Tisdale Bypass. These structures were converted to NAVD 88 based upon record drawing information provided by the USACE. A summary of the converted flood relief structure elevations is shown in Table 6.

Table 6: Conversion Factors Utilized for the HEC-RAS Flood Relief Structures

Flood Relief Structure	Weir Crest Elevation (ft-NAVD 88)
Tisdale Bypass	44.21
Freemont Weir (@ East End)	32.61

2.7 Downstream Boundary Conditions

Two rating curves are utilized as the downstream boundary condition for the PBI Sutter Basin model; 1) Yolo Bypass at Woodland and 2) Sacramento River at Verona. The rating curves were adjusted to NAVD 88 based upon data provided by the USACE (see Table 7).

Table 7: Gage Datum Relationships Utilized for the Downstream Rating Curves

Rating Curve Location	NAVD 88 Gage Datum Relationship
Yolo Bypass at Woodland	USGS Gage Datum minus 1.21’
Sacramento River at Verona	USGS Gage Datum minus 0.77’

2.8 Conversion Results

The water surface elevation profiles for the Feather River and Sutter Bypass resulting from the conversion of the PBI Sutter Basin HEC-RAS model from NGVD 29 to NAVD 88 are shown in Figures 1 and 2.

Figure 1: Model Conversion Results for the Feather River

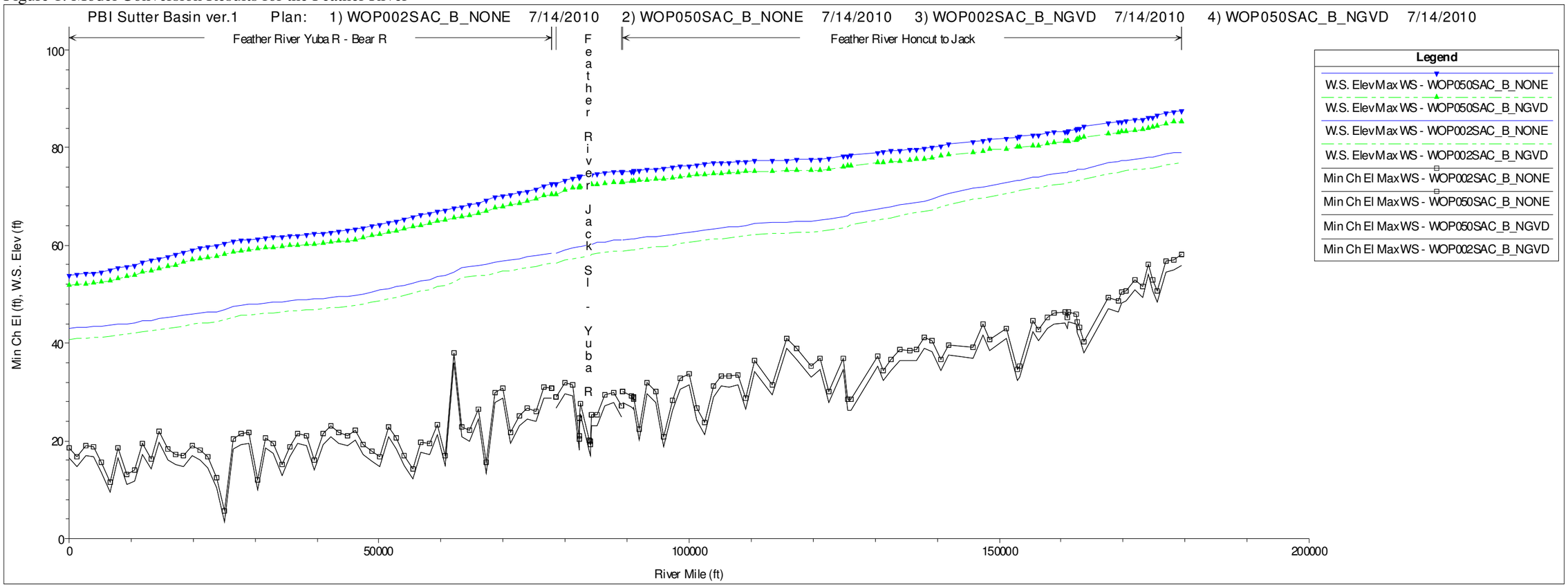
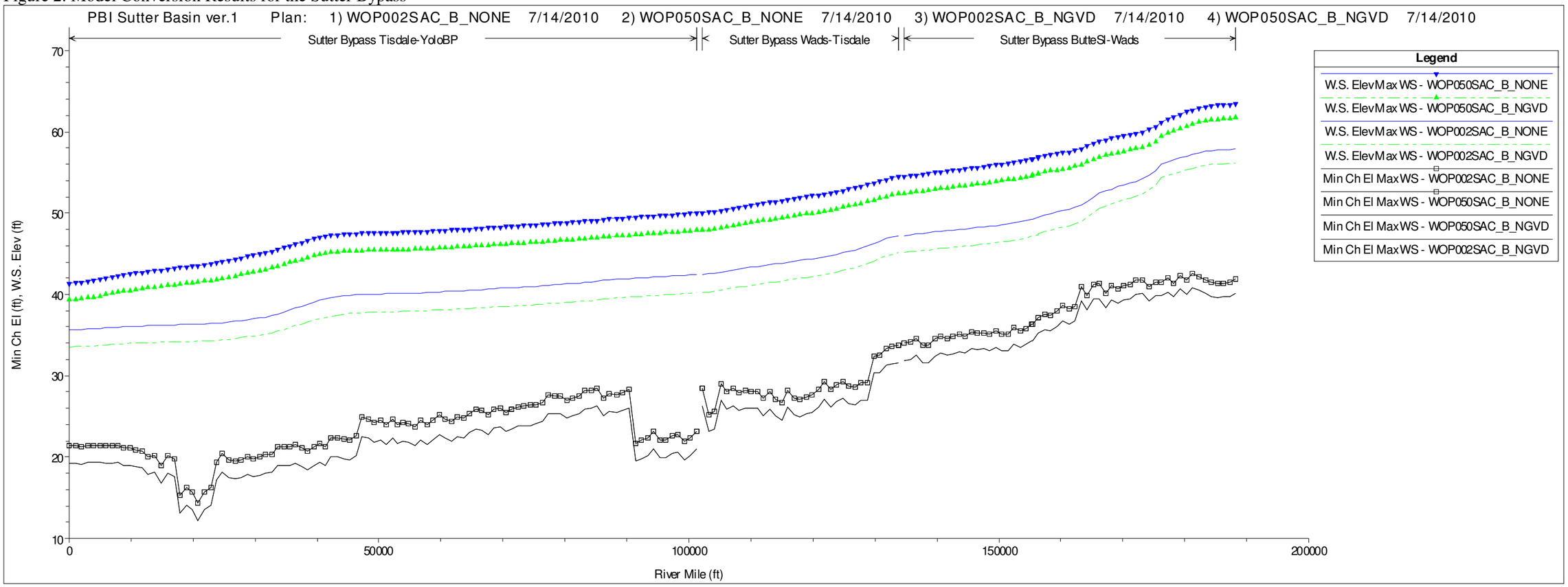
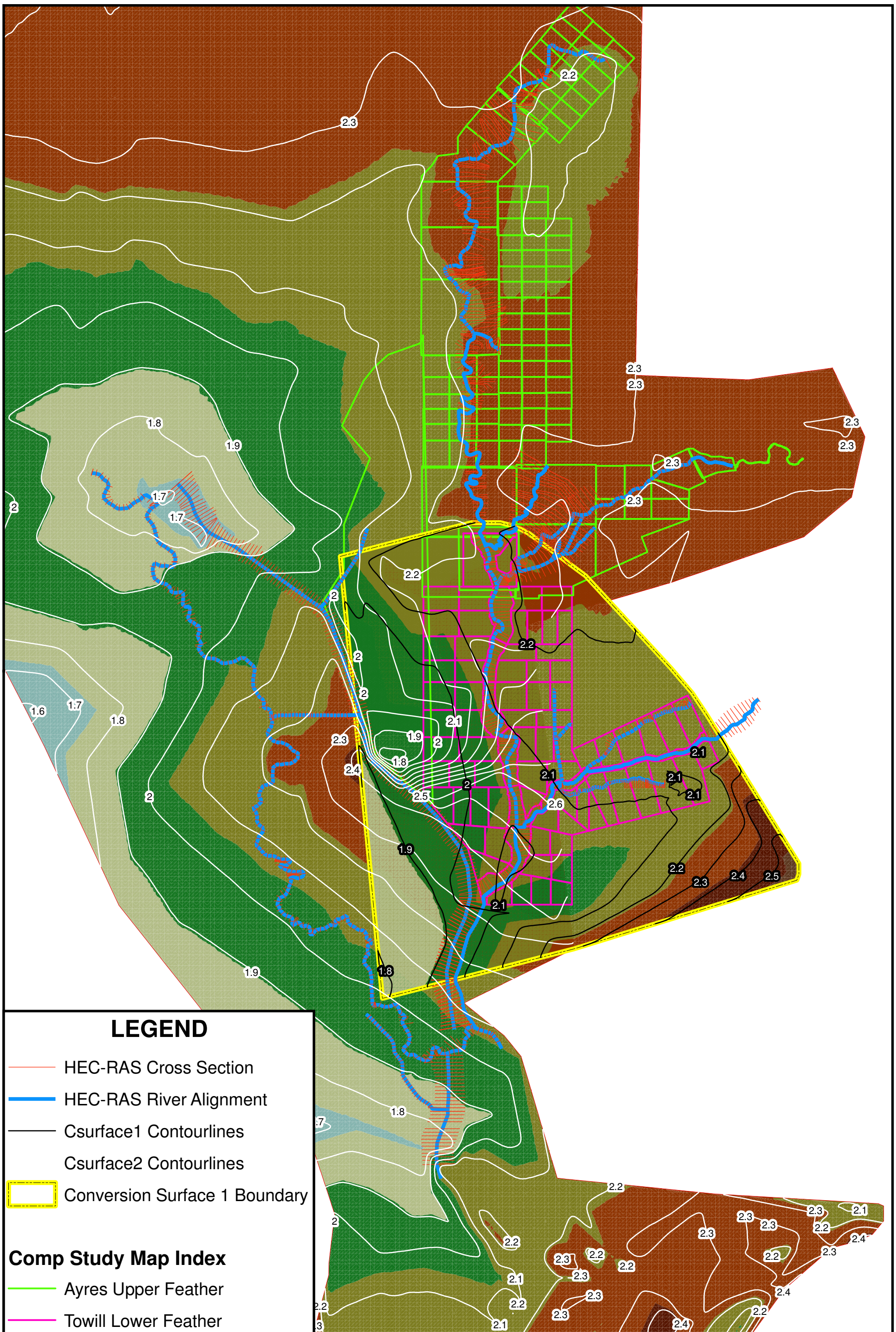


Figure 2: Model Conversion Results for the Sutter Bypass





N

JUNE 7, 2010

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SUTTER BUTTE FLOOD CONTROL AGENCY

TO2 CONVERSION SURFACE
PBI SUTTER BASIN HEC-RAS MODEL

FIGURE

3

ATTACHMENT C

DWR 1957 Profile

FEATHER RIVER
1957 PROFILE

	A	B	C	D	E
3		River Mile	1957 Design Profile	Design Elevation	
4			1929 Feet	1929 Feet	1988 Feet
5		58.560	130.09	130.09	**132.39**
6		58.310	128.83	128.83	**131.13**
7		58.000	127.27	127.27	**129.57**
8		57.750	126.01	126.01	**128.31**
9		57.500	124.75	124.75	**127.05**
10		57.220	123.57	123.57	**125.87**
11		56.990	122.82	122.82	**125.11**
12		56.660	121.74	121.74	**124.03**
13		56.480	121.15	121.15	**123.44**
14		56.250	120.40	120.40	**122.69**
15		56.070	119.81	119.81	**122.10**
16		55.850	119.09	119.09	**121.38**
17		55.600	118.11	118.11	**120.39**
18		55.400	117.24	117.24	**119.53**
19		55.080	115.86	115.86	**118.14**
20		54.500	113.35	113.35	**115.63**
21		54.250	112.27	112.27	**114.54**
22		54.090	111.58	111.58	**113.85**
23		53.890	110.71	110.71	**112.99**
24		53.570	109.33	109.33	**111.60**
25		53.270	108.03	108.03	**110.31**
26		52.940	107.20	107.20	**109.48**
27		52.650	106.71	106.71	**108.98**
28		52.260	106.04	106.04	**108.31**
29		52.000	105.59	105.59	**107.87**
30		51.400	104.56	104.56	**106.83**
31		51.090	103.38	103.38	**105.66**
32		50.890	102.24	102.24	**104.52**
33		50.750	101.44	101.44	**103.71**
34		50.548	100.45	100.45	**102.73**
35		50.546	100.45	100.45	**102.72**
36		50.539	100.42	100.42	**102.70**
37		50.537	100.41	100.41	**102.69**
38		50.250	99.37	99.37	**101.65**
39		50.110	98.86	98.86	**101.14**
40		49.830	97.85	97.85	**100.12**
41		49.630	97.23	97.23	**99.50**
42		49.430	96.64	96.64	**98.92**
43		49.260	96.14	96.14	**98.42**
44		49.040	95.49	95.49	**97.76**
45		48.900	95.08	95.08	**97.35**
46		48.710	94.52	94.52	**96.79**
47		48.440	93.73	93.73	**96.00**
48		48.260	93.20	93.20	**95.47**
49		48.120	92.79	92.79	**95.06**

FEATHER RIVER
1957 PROFILE

	A	B	C	D	E
3		River Mile	1957 Design Profile	Design Elevation	
4			1929 Feet	1929 Feet	1988 Feet
50		47.750	92.34	92.34	**94.62**
51		47.600	92.19	92.19	**94.46**
52		47.250	91.67	91.67	**93.94**
53		47.090	91.36	91.36	**93.63**
54		46.740	90.69	90.69	**92.96**
55		46.580	90.38	90.38	**92.65**
56		46.500	90.22	90.22	**92.49**
57		46.250	89.78	89.78	**92.05**
58		46.030	89.59	89.59	**91.86**
59		45.760	89.37	89.37	**91.64**
60		45.630	89.26	89.26	**91.53**
61		45.490	89.15	89.15	**91.42**
62		45.310	89.00	89.00	**91.27**
63		45.080	88.81	88.81	**91.08**
64		44.810	88.58	88.58	**90.85**
65		44.550	88.37	88.37	**90.64**
66		44.280	88.13	88.13	**90.40**
67		43.510	87.34	87.34	**89.61**
68		43.390	87.22	87.22	**89.49**
69		43.280	87.11	87.11	**89.38**
70		43.060	86.88	86.88	**89.15**
71		42.700	86.51	86.51	**88.78**
72		42.520	86.33	86.33	**88.60**
73		42.240	86.04	86.04	**88.31**
74		41.600	85.53	85.53	**87.80**
75		41.250	85.25	85.25	**87.53**
76		40.750	84.86	84.86	**87.13**
77		40.540	84.70	84.70	**86.97**
78		40.240	84.47	84.47	**86.74**
79		39.500	83.99	83.99	**86.26**
80		39.280	83.84	83.84	**86.12**
81		38.990	83.66	83.66	**85.93**
82		38.760	83.51	83.51	**85.78**
83		38.500	83.34	83.34	**85.61**
84		38.320	83.22	83.22	**85.49**
85		38.000	83.04	83.04	**85.31**
86		37.730	82.88	82.88	**85.16**
87		37.500	82.75	82.75	**85.02**
88		37.340	82.66	82.66	**84.94**
89		36.500	82.18	82.18	**84.46**
90		36.290	82.06	82.06	**84.34**
91		35.780	81.72	81.72	**83.99**
92		35.500	81.60	81.60	**83.88**
93		35.250	81.50	81.50	**83.77**
94		34.800	81.31	81.31	**83.58**

FEATHER RIVER
1957 PROFILE

	A	B	C	D	E
3		River Mile	1957 Design Profile	Design Elevation	
4			1929 Feet	1929 Feet	1988 Feet
95		34.500	81.18	81.18	**83.46**
96		34.070	81.00	81.00	**83.28**
97		33.500	80.75	80.75	**83.03**
98		33.250	80.62	80.62	**82.90**
99		33.000	80.49	80.49	**82.77**
100		32.750	80.37	80.37	**82.65**
101		32.500	80.24	80.24	**82.52**
102		32.250	80.11	80.11	**82.39**
103		32.000	79.98	79.98	**82.26**
104		31.750	79.86	79.86	**82.13**
105		31.500	79.70	79.70	**81.98**
106		31.250	79.53	79.53	**81.80**
107		31.000	79.35	79.35	**81.63**
108		30.750	80.38	80.38	**82.65**
109		30.500	79.75	79.75	**82.03**
110		30.250	78.80	78.80	**81.08**
111		30.000	78.56	78.56	**80.84**
112		29.828	78.39	78.39	**80.67**
113		29.826	78.39	78.39	**80.67**
114		29.822	78.39	78.39	**80.67**
115		29.821	78.39	78.39	**80.66**
116		29.750	78.32	78.32	**80.60**
117		29.500	78.08	78.08	**80.36**
118		29.250	77.84	77.84	**80.12**
119		29.000	77.61	77.61	**79.88**
120		28.750	77.37	77.37	**79.65**
121		28.500	77.05	77.05	**79.33**
122		28.324	76.67	76.67	**78.95**
123		28.322	76.66	76.66	**78.94**
124		28.309	76.64	76.64	**78.91**
125		28.307	76.63	76.63	**78.91**
126		28.250	76.51	76.51	**78.79**
127		28.000	76.24	76.24	**78.51**
128		27.973	76.21	76.21	**78.49**
129		27.971	76.21	76.21	**78.49**
130		27.954	76.20	76.20	**78.48**
131		27.952	76.20	76.20	**78.47**
132		27.750	76.03	76.03	**78.31**
133		27.500	75.83	75.83	**78.10**
134		27.250	75.62	75.62	**77.90**
135		27.000	75.44	75.44	**77.71**
136		26.750	75.27	75.27	**77.55**
137		26.500	75.11	75.11	**77.39**
138		26.250	74.95	74.95	**77.23**
139		26.000	74.79	74.79	**77.07**

FEATHER RIVER
1957 PROFILE

	A	B	C	D	E
3		River Mile	1957 Design Profile	Design Elevation	
4			1929 Feet	1929 Feet	1988 Feet
140		25.750	74.63	74.63	**76.91**
141		25.500	74.46	74.46	**76.74**
142	v	25.250	74.21	74.21	**76.49**
143		25.000	73.90	73.90	**76.17**
144		24.750	73.58	73.58	**75.86**
145		24.500	73.27	73.27	**75.55**
146		24.250	72.95	72.95	**75.23**
147		24.000	72.64	72.64	**74.92**
148		23.890	72.50	72.50	**74.78**
149		23.750	72.33	72.33	**74.61**
150		23.500	71.97	71.97	**74.25**
151		23.250	71.59	71.59	**73.87**
152		23.000	71.21	71.21	**73.49**
153		22.750	70.82	70.82	**73.11**
154		22.500	70.44	70.44	**72.73**
155		22.250	70.06	70.06	**72.35**
156		22.000	69.68	69.68	**71.97**
157		21.750	69.12	69.12	**71.41**
158		21.500	68.53	68.53	**70.82**
159		21.250	67.94	67.94	**70.23**
160		21.000	67.48	67.48	**69.77**
161		20.750	67.01	67.01	**69.30**
162		20.500	66.54	66.54	**68.83**
163		20.250	66.07	66.07	**68.37**
164		20.000	65.60	65.60	**67.90**
165		19.750	65.44	65.44	**67.74**
166		19.500	65.28	65.28	**67.58**
167		19.250	65.07	65.07	**67.37**
168		19.000	64.85	64.85	**67.15**
169		18.750	64.63	64.63	**66.93**
170		18.500	64.41	64.41	**66.71**
171		18.250	64.15	64.15	**66.45**
172		18.000	63.89	63.89	**66.19**
173		17.750	63.63	63.63	**65.93**
174		17.500	63.38	63.38	**65.67**
175		17.250	63.12	63.12	**65.41**
176		17.000	62.86	62.86	**65.16**
177		16.750	62.60	62.60	**64.90**
178		16.500	62.09	62.09	**64.39**
179		16.250	61.57	61.57	**63.87**
180		16.000	61.06	61.06	**63.36**
181		15.750	60.54	60.54	**62.85**
182		15.500	60.03	60.03	**62.33**
183		15.250	59.51	59.51	**61.82**
184		15.000	59.00	59.00	**61.31**

FEATHER RIVER
1957 PROFILE

	A	B	C	D	E
3		River Mile	1957 Design Profile	Design Elevation	
4			1929 Feet	1929 Feet	1988 Feet
185		14.750	58.29	58.29	**60.60**
186		14.500	57.57	57.57	**59.88**
187		14.250	56.93	56.93	**59.24**
188		14.000	56.57	56.57	**58.89**
189		13.750	56.21	56.21	**58.53**
190		13.500	55.86	55.86	**58.17**
191		13.250	55.50	55.50	**57.82**
192		13.000	55.14	55.14	**57.46**
193		12.750	54.79	54.79	**57.11**
194		12.500	54.49	54.49	**56.82**
195		12.250	54.27	54.27	**56.59**
196		12.000	54.05	54.05	**56.37**
197		11.750	53.82	53.82	**56.15**
198		11.500	53.60	53.60	**55.93**
199		11.250	53.38	53.38	**55.71**
200		11.000	53.11	53.11	**55.44**
201		10.750	52.67	52.67	**55.01**
202		10.500	52.23	52.23	**54.57**
203		10.250	51.79	51.79	**54.13**
204		10.000	51.35	51.35	**53.69**
205		9.750	50.93	50.93	**53.27**
206		9.500	50.57	50.57	**52.91**
207		9.278	50.25	50.25	**52.59**
208		9.276	50.24	50.24	**52.58**
209		9.267	50.22	50.22	**52.56**
210		9.265	50.21	50.21	**52.56**
211		9.200	50.05	50.05	**52.39**
212		9.000	49.20	49.20	**51.55**
213		8.750	48.09	48.09	**50.44**
214		8.500	46.99	46.99	**49.34**
215		8.250	45.88	45.88	**48.23**
216		8.000	44.77	44.77	**47.12**
217		7.750	43.66	43.66	**46.02**
218		7.550	42.62	42.62	**44.98**
219		7.410	42.55	42.55	**44.90**
220		7.170	42.41	42.41	**44.77**
221		6.880	42.26	42.26	**44.62**
222		6.590	42.10	42.10	**44.46**
223		6.390	41.99	41.99	**44.35**
224		6.210	41.89	41.89	**44.26**
225		6.020	41.79	41.79	**44.16**
226		5.830	41.68	41.68	**44.05**
227		5.640	41.58	41.58	**43.95**
228		5.450	41.48	41.48	**43.85**
229		5.270	41.38	41.38	**43.75**

FEATHER RIVER
1957 PROFILE

	A	B	C	D	E
3		River Mile	1957 Design Profile	Design Elevation	
4			1929 Feet	1929 Feet	1988 Feet
230		5.170	41.32	41.32	**43.70**
231		4.980	41.22	41.22	**43.60**
232		4.800	41.12	41.12	**43.50**
233		4.620	41.02	41.02	**43.40**
234		4.420	40.91	40.91	**43.30**
235		4.230	40.81	40.81	**43.19**
236		4.050	40.71	40.71	**43.10**
237		3.870	40.61	40.61	**43.00**
238		3.670	40.50	40.50	**42.90**
239		3.470	40.39	40.39	**42.79**
240		3.290	40.30	40.30	**42.69**
241		3.100	40.19	40.19	**42.59**
242		2.950	40.11	40.11	**42.51**
243		2.820	40.04	40.04	**42.44**
244		2.740	40.00	40.00	**42.40**
245		2.680	39.96	39.96	**42.37**
246		2.570	39.90	39.90	**42.31**
247		2.370	39.79	39.79	**42.20**
248		2.190	39.70	39.70	**42.10**
249		2.000	39.59	39.59	**42.00**
250		1.740	39.45	39.45	**41.86**
251		1.540	39.34	39.34	**41.75**
252		1.360	39.24	39.24	**41.66**
253		1.170	39.14	39.14	**41.55**
254		0.980	39.04	39.04	**41.45**
255		0.730	38.90	38.90	**41.32**
256		0.560	38.81	38.81	**41.23**
257		0.330	38.68	38.68	**41.10**
258		0.130	38.57	38.57	**40.99**

ATTACHMENT D

October 2010 Water Surface Profiles

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
October 26, 2010

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Upper	58.51	129.82	131.48	139.08	132.14	235748.95
Upper	58.26	129.39	131.08	139.07	130.88	233625.38
Upper	57.95	127.43	128.91	137.19	129.32	232796.18
Upper	57.7	124.99	126.24	132.7	128.05	231347.46
Upper	57.45	122.63	123.71	129.69	126.84	230491.75
Upper	57.17	120.24	121.32	127.59	125.70	226547.44
Upper	56.94	118.97	120.1	126.56	124.95	223836.90
Upper	56.61	117.66	118.82	125.38	123.87	222092.63
Upper	56.43	116.96	118.15	124.81	123.28	221068.16
Upper	56.2	115.55	116.82	123.65	122.52	220516.06
Upper	56.02	114.65	115.95	122.78	121.93	220057.97
Upper	55.8	113.07	114.25	120.24	121.18	219786.54
Upper	55.55	112.34	113.53	119.33	120.17	219191.24
Upper	55.35	110.94	112.04	117.07	119.31	216984.11
Upper	55.03	110.1	111.1	115.62	117.92	214664.25
Upper	54.45	109.02	109.95	114.44	115.41	212925.66
Upper	54.2	108.67	109.64	114.11	114.33	210158.47
Upper	54.04	108.63	109.61	114.11	113.64	209562.52
Upper	53.84	107.98	108.97	113.5	112.77	208499.74
Upper	53.52	107.21	108.13	112.38	111.39	205714.05
Upper	53.22	106.24	107.13	111.06	110.18	204265.70
Upper	52.89	104.42	105.32	109.34	109.40	202757.11
Upper	52.6	102.76	103.63	107.63	108.90	201183.88
Upper	52.21	101.94	102.79	106.71	108.23	199618.97
Upper	51.95	101.7	102.54	106.39	107.78	198775.45
Upper	51.35	100.89	101.83	105.93	106.73	197882.65
Upper	51.1777	100.97	101.87	105.89	106.00	195736.74
Upper	51.04	100.94	101.83	105.81	105.38	193817.41
Upper	50.84	100.54	101.47	105.57	104.23	192085.50
Upper	50.7	100.18	101.22	105.41	103.61	191278.99
Upper	50.59	99.34	100.57	105.08	102.93	190705.90
Upper	50.498	99.27	100.41	104.89	102.55	190230.79
Upper	50.496	99.26	100.39	104.85	102.54	190218.72
Upper	50.489	99.28	100.31	104.82	102.52	190176.83
Upper	50.487	99.33	100.35	104.84	102.51	190166.78
Upper	50.2	98.53	99.52	104.02	101.47	188470.72
Upper	50.06	97.9	98.86	103.41	100.96	187822.66
Upper	49.78	96.68	97.63	102.33	99.97	186662.60
Upper	49.58	95.64	96.6	101.37	99.36	185293.60
Upper	49.38	94.78	95.72	100.55	98.77	184138.90
Upper	49.21	94.19	95.15	100.06	98.27	183514.21
Upper	48.99	93.73	94.7	99.68	97.62	183056.49
Upper	48.85	93.24	94.22	99.24	97.21	182753.69
Upper	48.66	92.89	93.85	98.86	96.65	181801.88
Upper	48.39	92.46	93.42	98.44	95.85	180454.16
Upper	48.21	92.02	92.97	97.98	95.32	179460.20
Upper	48.07	91.42	92.38	97.49	95.00	179109.34
Upper	47.7	90.59	91.6	96.91	94.57	176933.60
Upper	47.55	89.97	91.06	96.62	94.39	175967.91
Upper	47.2	89.51	90.61	96.25	93.85	174102.82
Upper	47.04	89.29	90.4	96.14	93.54	173345.89
Upper	46.69	88.57	89.75	95.85	92.86	172499.41
Upper	46.53	88.22	89.45	95.69	92.55	171792.00
Honcut to Jack	46.45	88.22	89.45	95.69	92.40	171454.59
Honcut to Jack	46.2	88.02	89.25	95.48	92.00	171127.62
Honcut to Jack	45.98	87.77	89.01	95.26	91.82	170521.00
Honcut to Jack	45.71	87.22	88.5	94.86	91.60	169330.99
Honcut to Jack	45.58	86.95	88.25	94.64	91.49	168312.33

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
October 26, 2010

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	45.44	86.78	88.09	94.49	91.37	166923.76
Honcut to Jack	45.26	86.55	87.87	94.28	91.22	165726.12
Honcut to Jack	45.03	86.39	87.71	94.13	91.03	164732.57
Honcut to Jack	44.76	86.17	87.51	93.94	90.81	163250.84
Honcut to Jack	44.6326	86.09	87.43	93.86	90.70	161213.76
Honcut to Jack	44.5	85.92	87.27	93.7	90.59	160088.12
Honcut to Jack	44.23	85.7	87.05	93.49	90.35	159311.39
Honcut to Jack	43.46	85.1	86.54	93.12	89.56	158271.13
Honcut to Jack	43.34	84.85	86.32	92.95	89.38	157627.58
Honcut to Jack	43.28	84.75	86.22	92.93	89.38	157373.66
Honcut to Jack	43.23	84.61	86.1	92.87	89.32	157104.73
Honcut to Jack	43.12	84.32	85.86	92.76	89.21	156612.83
Honcut to Jack	43.06	84.26	85.81	92.74	89.15	156460.24
Honcut to Jack	43.01	84.21	85.76	92.68	89.10	156249.06
Honcut to Jack	42.65	84.09	85.66	92.58	88.73	153765.90
Honcut to Jack	42.47	83.88	85.46	92.4	88.55	153202.55
Honcut to Jack	42.19	83.58	85.2	92.18	88.27	152912.23
Honcut to Jack	42.01	83.56	85.18	92.17	88.13	152695.48
Honcut to Jack	41.61	83.28	84.94	91.98	87.81	152341.44
Honcut to Jack	41.55	83.17	84.85	91.91	87.76	151907.71
Honcut to Jack	41.2	82.92	84.67	91.76	87.49	150600.52
Honcut to Jack	40.7	82.75	84.54	91.65	87.09	150271.92
Honcut to Jack	40.49	82.5	84.34	91.46	86.93	149590.33
Honcut to Jack	40.19	82.3	84.19	91.32	86.71	148995.18
Honcut to Jack	39.45	81.77	83.81	90.95	86.23	147001.01
Honcut to Jack	39.23	81.47	83.59	90.71	86.09	145807.70
Honcut to Jack	38.94	81.15	83.35	90.47	85.90	144368.14
Honcut to Jack	38.71	80.92	83.18	90.29	85.75	143106.13
Honcut to Jack	38.45	80.77	83.08	90.17	85.58	141664.04
Honcut to Jack	38.27	80.66	82.99	90.07	85.46	140631.21
Honcut to Jack	37.95	80.5	82.88	89.93	85.28	138661.68
Honcut to Jack	37.68	80.34	82.76	89.79	85.13	137779.55
Honcut to Jack	37.45	80.18	82.64	89.64	85.00	136973.90
Honcut to Jack	37.29	80.05	82.54	89.49	84.91	136058.20
Honcut to Jack	36.45	79.52	82.17	89.07	84.43	134783.46
Honcut to Jack	36.35	79.36	82.07	88.96	84.37	134645.65
Honcut to Jack	36.24	79.17	81.95	88.84	84.30	134561.14
Honcut to Jack	35.78	78.72	81.66	88.5	83.99	132247.58
Honcut to Jack	35.5	78.59	81.56	88.38	83.88	130647.35
Honcut to Jack	35.25	78.51	81.51	88.3	83.77	130422.24
Honcut to Jack	34.8	78.44	81.46	88.25	83.58	129991.41
Honcut to Jack	34.5	78.39	81.42	88.2	83.46	128407.23
Honcut to Jack	34.07	78.32	81.38	88.14	83.28	127995.61
Honcut to Jack	33.5	78.25	81.33	88.08	83.03	126794.65
Honcut to Jack	33.25	78.15	81.26	87.99	82.90	125934.45
Honcut to Jack	33	78.04	81.18	87.89	82.77	124547.32
Honcut to Jack	32.75	77.91	81.09	87.77	82.65	123335.94
Honcut to Jack	32.5	77.82	81.03	87.67	82.52	122068.05
Honcut to Jack	32.25	77.74	80.97	87.6	82.39	121462.67
Honcut to Jack	32	77.57	80.85	87.43	82.26	121023.94
Honcut to Jack	31.75	77.33	80.68	87.19	82.13	119945.84
Honcut to Jack	31.5	77.12	80.52	86.95	81.98	118882.16
Honcut to Jack	31.25	76.91	80.37	86.74	81.80	117232.05
Honcut to Jack	31	76.68	80.21	86.51	81.63	115835.54
Honcut to Jack	30.75	76.49	80.09	86.32	82.65	115369.28
Honcut to Jack	30.5	76.36	80	86.19	82.03	114410.61
Honcut to Jack	30.25	76.25	79.92	86.08	81.08	113317.84
Honcut to Jack	30	76.03	79.76	85.83	80.84	111356.97

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
October 26, 2010

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	29.828	75.84	79.62	85.83	80.67	110812.54
Honcut to Jack	29.826	75.86	79.64	85.83	80.67	110802.45
Honcut to Jack	29.822	75.8	79.62	85.81	80.67	110784.75
Honcut to Jack	29.821	75.82	79.64	85.81	80.66	110774.66
Honcut to Jack	29.75	75.83	79.65	85.72	80.60	109217.11
Honcut to Jack	29.5	75.74	79.6	85.67	80.36	107965.48
Jack Sl - Yuba R	29.25	75.74	79.6	85.67	80.12	106938.36
Jack Sl - Yuba R	29	75.72	79.59	85.68	79.88	105627.60
Jack Sl - Yuba R	28.75	75.45	79.31	85.31	79.65	104417.55
Jack Sl - Yuba R	28.5	75.26	79.11	85.02	79.33	103521.79
Jack Sl - Yuba R	28.324	75.14	78.96	84.82	78.95	102627.46
Jack Sl - Yuba R	28.322	75.14	78.95	84.82	78.94	102615.67
Jack Sl - Yuba R	28.309	75.15	78.97	84.86	78.91	102537.51
Jack Sl - Yuba R	28.307	75.15	78.97	84.85	78.91	102527.14
Jack Sl - Yuba R	28.25	75.09	78.89	84.74	78.79	102281.40
Jack Sl - Yuba R	28	74.88	78.61	84.35	78.51	100798.76
Jack Sl - Yuba R	27.971	74.78	78.46	84.11	78.49	100749.02
Jack Sl - Yuba R	27.963	74.76	78.42	84.04	78.48	100696.07
Jack Sl - Yuba R	27.956	74.73	78.37	83.98	78.48	100684.10
Jack Sl - Yuba R	27.952	74.71	78.33	83.96	78.47	100652.33
Jack Sl - Yuba R	27.75	74.59	78.17	83.75	78.31	99512.10
Jack Sl - Yuba R	27.5	74.2	77.62	82.95	78.10	98174.47
Jack Sl - Yuba R	27.251	73.59	76.7	81.56	77.90	97016.29
Jack Sl - Yuba R	27.25	73.58	76.7	81.56	77.90	97011.08
Yuba R - Bear R	27	73.58	76.7	81.56	77.71	95787.83
Yuba R - Bear R	26.999	73.58	76.7	81.56	77.71	95782.80
Yuba R - Bear R	26.75	73.14	76.24	81.07	77.55	94705.78
Yuba R - Bear R	26.5	72.53	75.66	80.51	77.39	93495.05
Yuba R - Bear R	26.25	72.06	75.21	80.1	77.23	92095.83
Yuba R - Bear R	26	71.68	74.85	79.75	77.07	90634.01
Yuba R - Bear R	25.75	71.33	74.53	79.44	76.91	89136.87
Yuba R - Bear R	25.5	71.04	74.24	79.14	76.74	87728.16
Yuba R - Bear R	25.25	70.73	73.92	78.81	76.49	86208.17
Yuba R - Bear R	25	70.08	73.3	78.2	76.17	84613.00
Yuba R - Bear R	24.75	69.5	72.7	77.59	75.86	84085.03
Yuba R - Bear R	24.5	69.17	72.34	77.22	75.55	83744.43
Yuba R - Bear R	24.25	68.81	71.94	76.81	75.23	83076.25
Yuba R - Bear R	24	68.54	71.7	76.59	74.92	82269.01
Yuba R - Bear R	23.75	68.12	71.3	76.21	74.61	80891.65
Yuba R - Bear R	23.5	67.85	71.04	75.95	74.25	79494.60
Yuba R - Bear R	23.25	67.45	70.67	75.58	73.87	78032.72
Yuba R - Bear R	23	67.03	70.26	75.17	73.49	76810.25
Yuba R - Bear R	22.75	66.71	69.94	74.83	73.11	75345.95
Yuba R - Bear R	22.5	66.24	69.47	74.35	72.73	74107.24
Yuba R - Bear R	22.25	65.83	69.07	73.93	72.35	72852.32
Yuba R - Bear R	22	65.55	68.79	73.63	71.97	71497.68
Yuba R - Bear R	21.75	65.14	68.4	73.24	71.41	70018.45
Yuba R - Bear R	21.5	64.8	68.07	72.9	70.82	68712.35
Yuba R - Bear R	21.25	64.39	67.68	72.52	70.23	67330.45
Yuba R - Bear R	21	64.08	67.38	72.2	69.77	66047.23
Yuba R - Bear R	20.75	63.85	67.15	71.95	69.30	64675.51
Yuba R - Bear R	20.5	63.65	66.94	71.72	68.83	63332.45
Yuba R - Bear R	20.25	63.45	66.74	71.49	68.37	61977.06
Yuba R - Bear R	20	63.27	66.54	71.27	67.90	60460.00
Yuba R - Bear R	19.75	63.08	66.36	71.08	67.74	58852.41
Yuba R - Bear R	19.5	62.94	66.22	70.94	67.58	56862.66
Yuba R - Bear R	19.25	62.82	66.1	70.81	67.37	55516.59
Yuba R - Bear R	19	62.72	66	70.7	67.15	54713.04

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
October 26, 2010

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Yuba R - Bear R	18.75	62.55	65.83	70.52	66.93	53622.77
Yuba R - Bear R	18.5	62.45	65.73	70.41	66.71	52897.52
Yuba R - Bear R	18.25	62.33	65.61	70.28	66.45	51890.28
Yuba R - Bear R	18	62.12	65.39	70.03	66.19	49704.43
Yuba R - Bear R	17.75	61.95	65.23	69.85	65.93	49399.72
Yuba R - Bear R	17.5	61.78	65.05	69.66	65.67	49114.25
Yuba R - Bear R	17.25	61.56	64.83	69.43	65.41	48794.83
Yuba R - Bear R	17	61.1	64.39	68.97	65.16	48556.49
Yuba R - Bear R	16.75	60.82	64.11	68.67	64.90	48094.20
Yuba R - Bear R	16.5	60.54	63.81	68.33	64.39	47013.16
Yuba R - Bear R	16.25	60.34	63.6	68.1	63.87	46228.38
Yuba R - Bear R	16	60.04	63.28	67.73	63.36	45101.47
Yuba R - Bear R	15.75	59.47	62.64	66.99	62.85	43356.36
Yuba R - Bear R	15.5	58.98	62.1	66.34	62.33	41613.14
Yuba R - Bear R	15.25	58.59	61.67	65.85	61.82	40305.41
Yuba R - Bear R	15	58.17	61.2	65.28	61.31	39102.69
Yuba R - Bear R	14.75	57.78	60.8	64.84	60.60	37817.10
Yuba R - Bear R	14.5	57.4	60.37	64.33	59.88	36319.37
Yuba R - Bear R	14.25	56.83	59.73	63.55	59.24	34904.17
Yuba R - Bear R	14	56.51	59.38	63.17	58.89	33507.55
Yuba R - Bear R	13.75	56.15	58.96	62.64	58.53	32270.43
Yuba R - Bear R	13.5	55.68	58.44	62.01	58.17	31239.13
Yuba R - Bear R	13.25	55.32	58.05	61.55	57.82	29977.40
Yuba R - Bear R	13	55.19	57.92	61.43	57.46	28644.35
Yuba R - Bear R	12.75	55.01	57.73	61.21	57.11	27255.90
Yuba R - Bear R	12.5	54.93	57.65	61.14	56.82	26065.40
Yuba R - Bear R	12.25	54.68	57.4	60.89	56.59	24642.20
Reach 35	12	54.68	57.4	60.89	56.37	23313.05
Reach 35	11.75	54.54	57.27	60.76	56.15	21993.69
Reach 35	11.599	54.5	57.23	60.71	56.02	21069.77
Reach 35	11.5	54.37	57.1	60.59	55.93	20354.66
Reach 35	11.25	54.15	56.87	60.32	55.71	18182.41
Reach 35	11	53.82	56.51	59.93	55.44	16871.48
Reach 35	10.75	53.67	56.36	59.76	55.01	15547.88
Reach 35	10.5	53.41	56.08	59.44	54.57	14278.44
Reach 35	10.25	52.96	55.57	58.83	54.13	13850.18
Reach 35	10	52.74	55.34	58.59	53.69	12847.13
Reach 35	9.75	52.51	55.08	58.29	53.27	11597.74
Reach 35	9.5	52.1	54.62	57.74	52.91	10595.55
Reach 35	9.278	52.19	54.75	57.93	52.59	9814.09
Reach 35	9.265	51.71	54.16	57.16	52.56	9758.91
Reach 35	9.2	51.61	54.05	57.04	52.39	9164.29
Reach 35	9	51.26	53.66	56.58	51.55	8445.84
Reach 35	8.75	50.5	52.84	55.61	50.44	7531.76
Reach 35	8.5	50.14	52.48	55.23	49.34	6548.71
Reach 35	8.25	49.89	52.25	55	48.23	3573.02
Reach 35	8	49.11	51.46	54.1	47.12	2528.45
Reach 35	7.75	47.97	50.32	52.72	46.02	1733.43
Reach 35	7.55	46.82	49.11	51.05	44.98	1275.43

ATTACHMENT E

June 2011 Water Surface Profiles

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
June 10, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Upper	58.51	130.32	131.97	137.27	132.14	235748.95
Upper	58.26	129.25	130.96	136.17	130.88	233625.38
Upper	57.95	127.3	128.89	134.6	129.32	232796.18
Upper	57.7	124.59	125.99	132.74	128.05	231347.46
Upper	57.45	122.54	123.85	130.54	126.84	230491.75
Upper	57.17	120.27	121.44	127.48	125.70	226547.44
Upper	56.94	119.72	120.97	126.88	124.95	223836.90
Upper	56.61	119.04	120.31	126.24	123.87	222092.63
Upper	56.43	118.7	120	125.86	123.28	221068.16
Upper	56.2	117.82	119.14	124.99	122.52	220516.06
Upper	56.02	117.18	118.5	124.19	121.93	220057.97
Upper	55.8	115.95	117.16	122.29	121.18	219786.54
Upper	55.55	115.34	116.54	121.47	120.17	219191.24
Upper	55.35	114.23	115.34	119.76	119.31	216984.11
Upper	55.03	112.9	113.93	117.9	117.92	214664.25
Upper	54.45	110.87	111.86	115.89	115.41	212925.66
Upper	54.2	110.15	111.13	115.05	114.33	210158.47
Upper	54.04	109.82	110.82	114.77	113.64	209562.52
Upper	53.84	109.01	110.03	114.02	112.77	208499.74
Upper	53.52	107.58	108.5	112.34	111.39	205714.05
Upper	53.22	106.33	107.23	110.81	110.18	204265.70
Upper	52.89	104.81	105.68	109.2	109.40	202757.11
Upper	52.6	103.63	104.46	107.84	108.90	201183.88
Upper	52.21	102.99	103.78	107.04	108.23	199618.97
Upper	51.95	102.73	103.51	106.7	107.78	198775.45
Upper	51.35	101.83	102.7	106.04	106.73	197882.65
Upper	51.1777	101.65	102.51	105.82	106.00	195736.74
Upper	51.04	101.54	102.39	105.67	105.38	193817.41
Upper	50.84	100.98	101.86	105.21	104.23	192085.50
Upper	50.7	100.23	101.28	104.82	103.61	191278.99
Upper	50.59	98.83	100.16	104.2	102.93	190705.90
Upper	50.498	98.73	99.94	104	102.55	190230.79
Upper	50.496	98.68	99.89	103.93	102.54	190218.72
Upper	50.489	98.65	99.82	103.78	102.52	190176.83
Upper	50.487	98.69	99.87	103.8	102.51	190166.78
Upper	50.2	97.95	98.89	102.77	101.47	188470.72
Upper	50.06	97.11	98.09	102.06	100.96	187822.66
Upper	49.78	95.96	96.94	100.96	99.97	186662.60
Upper	49.58	95.12	96.1	100.21	99.36	185293.60
Upper	49.38	94.52	95.46	99.56	98.77	184138.90
Upper	49.21	94.13	95.09	99.25	98.27	183514.21
Upper	48.99	93.87	94.84	99.05	97.62	183056.49
Upper	48.85	93.55	94.52	98.78	97.21	182753.69
Upper	48.66	93.35	94.32	98.57	96.65	181801.88
Upper	48.39	93.03	94	98.28	95.85	180454.16
Upper	48.21	92.71	93.67	97.96	95.32	179460.20
Upper	48.07	92.27	93.25	97.65	95.00	179109.34
Upper	47.7	91.41	92.42	97.07	94.57	176933.60
Upper	47.55	90.85	91.92	96.78	94.39	175967.91
Upper	47.2	90.27	91.37	96.37	93.85	174102.82
Upper	47.04	90.04	91.15	96.23	93.54	173345.89
Upper	46.69	89.38	90.56	95.91	92.86	172499.41
Upper	46.53	89.03	90.24	95.74	92.55	171792.00
Honcut to Jack	46.45	89.03	90.24	95.74	92.40	171454.59
Honcut to Jack	46.2	88.82	90.04	95.53	92.00	171127.62
Honcut to Jack	45.98	88.6	89.81	95.31	91.82	170521.00
Honcut to Jack	45.71	88.11	89.35	94.92	91.60	169330.99
Honcut to Jack	45.58	87.85	89.11	94.71	91.49	168312.33

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
June 10, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	45.44	87.69	88.95	94.55	91.37	166923.76
Honcut to Jack	45.26	87.47	88.74	94.36	91.22	165726.12
Honcut to Jack	45.03	87.3	88.57	94.19	91.03	164732.57
Honcut to Jack	44.76	87.1	88.38	94.01	90.81	163250.84
Honcut to Jack	44.6326	87.02	88.3	93.92	90.70	161213.76
Honcut to Jack	44.5	86.87	88.15	93.77	90.59	160088.12
Honcut to Jack	44.23	86.65	87.94	93.57	90.35	159311.39
Honcut to Jack	43.46	86.07	87.42	93.15	89.56	158271.13
Honcut to Jack	43.34	85.81	87.18	92.96	89.38	157627.58
Honcut to Jack	43.28	85.7	87.08	92.93	89.38	157373.66
Honcut to Jack	43.23	85.55	86.95	92.87	89.32	157104.73
Honcut to Jack	43.12	85.25	86.68	92.74	89.21	156612.83
Honcut to Jack	43.06	85.18	86.62	92.72	89.15	156460.24
Honcut to Jack	43.01	85.12	86.57	92.66	89.10	156249.06
Honcut to Jack	42.65	84.99	86.45	92.57	88.73	153765.90
Honcut to Jack	42.47	84.79	86.26	92.4	88.55	153202.55
Honcut to Jack	42.19	84.5	86	92.2	88.27	152912.23
Honcut to Jack	42.01	84.44	85.95	92.16	88.13	152695.48
Honcut to Jack	41.61	84.21	85.74	92.01	87.81	152341.44
Honcut to Jack	41.55	84.11	85.65	91.94	87.76	151907.71
Honcut to Jack	41.2	83.85	85.42	91.78	87.49	150600.52
Honcut to Jack	40.7	83.68	85.28	91.68	87.09	150271.92
Honcut to Jack	40.49	83.43	85.05	91.5	86.93	149590.33
Honcut to Jack	40.19	83.23	84.87	91.36	86.71	148995.18
Honcut to Jack	39.45	82.7	84.41	91	86.23	147001.01
Honcut to Jack	39.23	82.36	84.15	90.76	86.09	145807.70
Honcut to Jack	38.94	81.97	83.84	90.47	85.90	144368.14
Honcut to Jack	38.71	81.71	83.63	90.28	85.75	143106.13
Honcut to Jack	38.45	81.53	83.5	90.15	85.58	141664.04
Honcut to Jack	38.27	81.41	83.4	90.05	85.46	140631.21
Honcut to Jack	37.95	81.22	83.25	89.9	85.28	138661.68
Honcut to Jack	37.68	81.06	83.12	89.76	85.13	137779.55
Honcut to Jack	37.45	80.88	82.98	89.6	85.00	136973.90
Honcut to Jack	37.29	80.72	82.85	89.45	84.91	136058.20
Honcut to Jack	36.45	80.11	82.41	89.01	84.43	134783.46
Honcut to Jack	36.35	79.9	82.27	88.88	84.37	134645.65
Honcut to Jack	36.24	79.66	82.1	88.73	84.30	134561.14
Honcut to Jack	35.78	79.08	81.71	88.34	83.99	132247.58
Honcut to Jack	35.5	78.92	81.59	88.21	83.88	130647.35
Honcut to Jack	35.25	78.82	81.51	88.13	83.77	130422.24
Honcut to Jack	34.8	78.73	81.45	88.06	83.58	129991.41
Honcut to Jack	34.5	78.64	81.38	87.98	83.46	128407.23
Honcut to Jack	34.07	78.55	81.32	87.9	83.28	127995.61
Honcut to Jack	33.5	78.45	81.25	87.83	83.03	126794.65
Honcut to Jack	33.25	78.32	81.15	87.72	82.90	125934.45
Honcut to Jack	33	78.18	81.05	87.61	82.77	124547.32
Honcut to Jack	32.75	78	80.93	87.46	82.65	123335.94
Honcut to Jack	32.5	77.87	80.83	87.34	82.52	122068.05
Honcut to Jack	32.25	77.76	80.75	87.24	82.39	121462.67
Honcut to Jack	32	77.58	80.62	87.08	82.26	121023.94
Honcut to Jack	31.75	77.37	80.46	86.88	82.13	119945.84
Honcut to Jack	31.5	77.16	80.31	86.67	81.98	118882.16
Honcut to Jack	31.25	76.97	80.16	86.48	81.80	117232.05
Honcut to Jack	31	76.76	80.01	86.29	81.63	115835.54
Honcut to Jack	30.75	76.56	79.88	86.11	82.65	115369.28
Honcut to Jack	30.5	76.33	79.71	85.9	82.03	114410.61
Honcut to Jack	30.25	76.1	79.55	85.68	81.08	113317.84
Honcut to Jack	30	75.84	79.29	85.33	80.84	111356.97

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
June 10, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	29.828	75.6	79.06	85.24	80.67	110812.54
Honcut to Jack	29.826	75.62	79.08	85.24	80.67	110802.45
Honcut to Jack	29.822	75.63	79.09	85.23	80.67	110784.75
Honcut to Jack	29.821	75.64	79.11	85.23	80.66	110774.66
Honcut to Jack	29.75	75.6	79.07	85.13	80.60	109217.11
Honcut to Jack	29.5	75.51	78.99	85.03	80.36	107965.48
Jack Sl - Yuba R	29.25	75.51	78.99	85.03	80.12	106938.36
Jack Sl - Yuba R	29	75.39	78.85	84.83	79.88	105627.60
Jack Sl - Yuba R	28.75	75.18	78.58	84.47	79.65	104417.55
Jack Sl - Yuba R	28.5	75.05	78.41	84.24	79.33	103521.79
Jack Sl - Yuba R	28.324	74.93	78.26	84.03	78.95	102627.46
Jack Sl - Yuba R	28.322	74.92	78.26	84.03	78.94	102615.67
Jack Sl - Yuba R	28.309	74.91	78.24	84.02	78.91	102537.51
Jack Sl - Yuba R	28.307	74.91	78.24	84.01	78.91	102527.14
Jack Sl - Yuba R	28.25	74.87	78.19	83.94	78.79	102281.40
Jack Sl - Yuba R	28	74.72	78	83.67	78.51	100798.76
Jack Sl - Yuba R	27.971	74.63	77.87	83.45	78.49	100749.02
Jack Sl - Yuba R	27.963	74.61	77.84	83.39	78.48	100696.07
Jack Sl - Yuba R	27.956	74.58	77.79	83.33	78.48	100684.10
Jack Sl - Yuba R	27.952	74.52	77.7	83.14	78.47	100652.33
Jack Sl - Yuba R	27.75	74.53	77.71	83.16	78.31	99512.10
Jack Sl - Yuba R	27.5	74.27	77.36	82.62	78.10	98174.47
Jack Sl - Yuba R	27.251	73.87	76.8	81.73	77.90	97016.29
Jack Sl - Yuba R	27.25	73.87	76.8	81.73	77.90	97011.08
Yuba R - Bear R	27	73.87	76.8	81.73	77.71	95787.83
Yuba R - Bear R	26.999	73.87	76.8	81.72	77.71	95782.80
Yuba R - Bear R	26.75	73.37	76.29	81.2	77.55	94705.78
Yuba R - Bear R	26.5	72.79	75.74	80.68	77.39	93495.05
Yuba R - Bear R	26.25	72.35	75.34	80.32	77.23	92095.83
Yuba R - Bear R	26	71.99	75.01	80.03	77.07	90634.01
Yuba R - Bear R	25.75	71.67	74.72	79.75	76.91	89136.87
Yuba R - Bear R	25.5	71.41	74.47	79.5	76.74	87728.16
Yuba R - Bear R	25.25	71.15	74.2	79.22	76.49	86208.17
Yuba R - Bear R	25	70.59	73.69	78.72	76.17	84613.00
Yuba R - Bear R	24.75	69.98	73.12	78.17	75.86	84085.03
Yuba R - Bear R	24.5	69.54	72.69	77.74	75.55	83744.43
Yuba R - Bear R	24.25	69.1	72.27	77.32	75.23	83076.25
Yuba R - Bear R	24	68.77	71.97	77.02	74.92	82269.01
Yuba R - Bear R	23.75	68.36	71.58	76.63	74.61	80891.65
Yuba R - Bear R	23.5	68.1	71.33	76.38	74.25	79494.60
Yuba R - Bear R	23.25	67.72	70.97	76.01	73.87	78032.72
Yuba R - Bear R	23	67.31	70.58	75.59	73.49	76810.25
Yuba R - Bear R	22.75	67	70.26	75.25	73.11	75345.95
Yuba R - Bear R	22.5	66.54	69.81	74.76	72.73	74107.24
Yuba R - Bear R	22.25	66.15	69.42	74.34	72.35	72852.32
Yuba R - Bear R	22	65.88	69.15	74.04	71.97	71497.68
Yuba R - Bear R	21.75	65.49	68.78	73.65	71.41	70018.45
Yuba R - Bear R	21.5	65.16	68.46	73.3	70.82	68712.35
Yuba R - Bear R	21.25	64.78	68.09	72.92	70.23	67330.45
Yuba R - Bear R	21	64.48	67.8	72.59	69.77	66047.23
Yuba R - Bear R	20.75	64.26	67.58	72.34	69.30	64675.51
Yuba R - Bear R	20.5	64.08	67.38	72.1	68.83	63332.45
Yuba R - Bear R	20.25	63.88	67.19	71.87	68.37	61977.06
Yuba R - Bear R	20	63.71	67	71.65	67.90	60460.00
Yuba R - Bear R	19.75	63.53	66.83	71.46	67.74	58852.41
Yuba R - Bear R	19.5	63.4	66.69	71.31	67.58	56862.66
Yuba R - Bear R	19.25	63.28	66.58	71.19	67.37	55516.59
Yuba R - Bear R	19	63.19	66.48	71.08	67.15	54713.04

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
June 10, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Yuba R - Bear R	18.75	63.03	66.32	70.9	66.93	53622.77
Yuba R - Bear R	18.5	62.93	66.23	70.79	66.71	52897.52
Yuba R - Bear R	18.25	62.82	66.12	70.66	66.45	51890.28
Yuba R - Bear R	18	62.62	65.91	70.42	66.19	49704.43
Yuba R - Bear R	17.75	62.47	65.75	70.25	65.93	49399.72
Yuba R - Bear R	17.5	62.3	65.58	70.05	65.67	49114.25
Yuba R - Bear R	17.25	62.1	65.39	69.84	65.41	48794.83
Yuba R - Bear R	17	61.66	64.96	69.38	65.16	48556.49
Yuba R - Bear R	16.75	61.37	64.67	69.06	64.90	48094.20
Yuba R - Bear R	16.5	61.06	64.35	68.7	64.39	47013.16
Yuba R - Bear R	16.25	60.84	64.12	68.44	63.87	46228.38
Yuba R - Bear R	16	60.52	63.78	68.05	63.36	45101.47
Yuba R - Bear R	15.75	59.9	63.08	67.26	62.85	43356.36
Yuba R - Bear R	15.5	59.32	62.44	66.5	62.33	41613.14
Yuba R - Bear R	15.25	58.8	61.87	65.83	61.82	40305.41
Yuba R - Bear R	15	58.39	61.4	65.26	61.31	39102.69
Yuba R - Bear R	14.75	58.01	61	64.83	60.60	37817.10
Yuba R - Bear R	14.5	57.64	60.58	64.32	59.88	36319.37
Yuba R - Bear R	14.25	57.09	59.95	63.55	59.24	34904.17
Yuba R - Bear R	14	56.75	59.58	63.11	58.89	33507.55
Yuba R - Bear R	13.75	56.47	59.24	62.67	58.53	32270.43
Yuba R - Bear R	13.5	56.08	58.79	62.13	58.17	31239.13
Yuba R - Bear R	13.25	55.86	58.54	61.84	57.82	29977.40
Yuba R - Bear R	13	55.79	58.48	61.79	57.46	28644.35
Yuba R - Bear R	12.75	55.62	58.31	61.59	57.11	27255.90
Yuba R - Bear R	12.5	55.55	58.23	61.52	56.82	26065.40
Yuba R - Bear R	12.25	55.32	58	61.29	56.59	24642.20
Reach 35	12	55.32	58	61.29	56.37	23313.05
Reach 35	11.75	55.19	57.88	61.16	56.15	21993.69
Reach 35	11.599	55.16	57.84	61.12	56.02	21069.77
Reach 35	11.5	55.04	57.73	61.01	55.93	20354.66
Reach 35	11.25	54.84	57.52	60.76	55.71	18182.41
Reach 35	11	54.55	57.21	60.42	55.44	16871.48
Reach 35	10.75	54.42	57.07	60.25	55.01	15547.88
Reach 35	10.5	54.19	56.82	59.97	54.57	14278.44
Reach 35	10.25	53.77	56.34	59.39	54.13	13850.18
Reach 35	10	53.57	56.14	59.16	53.69	12847.13
Reach 35	9.75	53.29	55.82	58.78	53.27	11597.74
Reach 35	9.5	52.97	55.47	58.37	52.91	10595.55
Reach 35	9.278	52.91	55.41	58.33	52.59	9814.09
Reach 35	9.265	52.63	55.08	57.9	52.56	9758.91
Reach 35	9.2	52.51	54.95	57.75	52.39	9164.29
Reach 35	9	52.19	54.6	57.36	51.55	8445.84
Reach 35	8.75	51.26	53.6	56.22	50.44	7531.76
Reach 35	8.5	50.58	52.91	55.47	49.34	6548.71
Reach 35	8.25	50.04	52.37	54.9	48.23	3573.02
Reach 35	8	49.07	51.42	53.82	47.12	2528.45
Reach 35	7.75	48.4	50.76	53.03	46.02	1733.43
Reach 35	7.55	48.04	50.4	52.58	44.98	1275.43

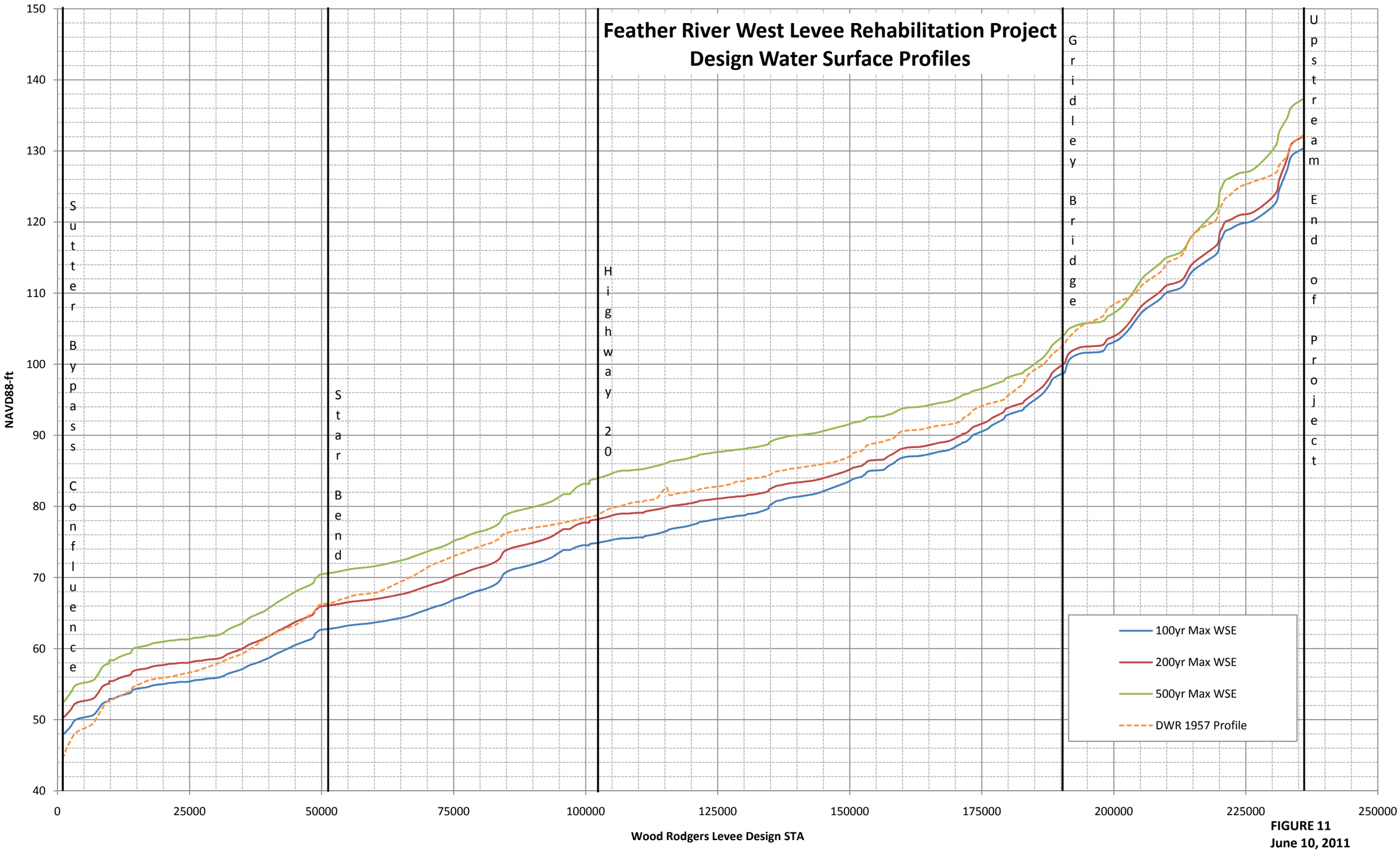


FIGURE 11
June 10, 2011

ATTACHMENT F

September 2011 Water Surface Profiles

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
September 30, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Upper	58.51	130.32	131.97	137.27	132.14	235748.95
Upper	58.26	129.25	130.96	136.17	130.88	233625.38
Upper	57.95	127.30	128.89	134.60	129.32	232796.18
Upper	57.7	124.59	125.99	132.74	128.05	231347.46
Upper	57.45	122.54	123.85	130.54	126.84	230491.75
Upper	57.17	120.27	121.44	127.48	125.70	226547.44
Upper	56.94	119.72	120.97	126.88	124.95	223836.90
Upper	56.61	119.04	120.31	126.24	123.87	222092.63
Upper	56.43	118.70	120.00	125.86	123.28	221068.16
Upper	56.2	117.82	119.14	124.99	122.52	220516.06
Upper	56.02	117.18	118.50	124.19	121.93	220057.97
Upper	55.8	115.95	117.16	122.29	121.18	219786.54
Upper	55.55	115.34	116.54	121.47	120.17	219191.24
Upper	55.35	114.23	115.34	119.76	119.31	216984.11
Upper	55.03	112.90	113.93	117.90	117.92	214664.25
Upper	54.45	110.87	111.86	115.89	115.41	212925.66
Upper	54.2	110.15	111.13	115.05	114.33	210158.47
Upper	54.04	109.82	110.82	114.77	113.64	209562.52
Upper	53.84	109.01	110.03	114.02	112.77	208499.74
Upper	53.52	107.58	108.50	112.34	111.39	205714.05
Upper	53.22	106.33	107.23	110.81	110.18	204265.70
Upper	52.89	104.81	105.68	109.20	109.40	202757.11
Upper	52.6	103.63	104.46	107.84	108.90	201183.88
Upper	52.21	102.99	103.78	107.04	108.23	199618.97
Upper	51.95	102.73	103.51	106.70	107.78	198775.45
Upper	51.35	101.83	102.70	106.04	106.73	197882.65
Upper	51.1777	101.65	102.51	105.82	106.00	195736.74
Upper	51.04	101.54	102.39	105.67	105.38	193817.41
Upper	50.84	100.98	101.86	105.21	104.23	192085.50
Upper	50.7	100.23	101.28	104.82	103.61	191278.99
Upper	50.59	98.83	100.16	104.20	102.93	190705.90
Upper	50.498	98.73	99.94	104.00	102.55	190230.79
Upper	50.496	98.68	99.89	103.93	102.54	190218.72
Upper	50.489	98.65	99.82	103.78	102.52	190176.83
Upper	50.487	98.69	99.87	103.80	102.51	190166.78
Upper	50.2	97.95	98.89	102.77	101.47	188470.72
Upper	50.06	97.11	98.09	102.06	100.96	187822.66
Upper	49.78	95.96	96.94	100.96	99.97	186662.60
Upper	49.58	95.12	96.10	100.21	99.36	185293.60
Upper	49.38	94.52	95.46	99.56	98.77	184138.90
Upper	49.21	94.13	95.09	99.25	98.27	183514.21
Upper	48.99	93.87	94.84	99.05	97.62	183056.49
Upper	48.85	93.55	94.52	98.78	97.21	182753.69
Upper	48.66	93.35	94.32	98.57	96.65	181801.88
Upper	48.39	93.03	94.00	98.28	95.85	180454.16
Upper	48.21	92.71	93.67	97.96	95.32	179460.20
Upper	48.07	92.27	93.25	97.65	95.00	179109.34
Upper	47.7	91.41	92.42	97.07	94.57	176933.60
Upper	47.55	90.85	91.92	96.78	94.39	175967.91
Upper	47.2	90.27	91.37	96.37	93.85	174102.82
Upper	47.04	90.04	91.15	96.23	93.54	173345.89
Upper	46.69	89.38	90.56	95.91	92.86	172499.41
Upper	46.53	89.03	90.24	95.74	92.55	171792.00
Honcut to Jack	46.45	89.03	90.24	95.74	92.40	171454.59
Honcut to Jack	46.2	88.82	90.04	95.53	92.00	171127.62
Honcut to Jack	45.98	88.60	89.81	95.31	91.82	170521.00
Honcut to Jack	45.71	88.11	89.35	94.92	91.60	169330.99
Honcut to Jack	45.58	87.85	89.11	94.71	91.49	168312.33

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
September 30, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	45.44	87.69	88.95	94.55	91.37	166923.76
Honcut to Jack	45.26	87.47	88.74	94.36	91.22	165726.12
Honcut to Jack	45.03	87.30	88.57	94.19	91.03	164732.57
Honcut to Jack	44.76	87.10	88.38	94.01	90.81	163250.84
Honcut to Jack	44.6326	87.02	88.30	93.92	90.70	161213.76
Honcut to Jack	44.5	86.87	88.15	93.77	90.59	160088.12
Honcut to Jack	44.23	86.65	87.94	93.57	90.35	159311.39
Honcut to Jack	43.46	86.08	87.42	93.15	89.56	158271.13
Honcut to Jack	43.34	85.81	87.18	92.96	89.38	157627.58
Honcut to Jack	43.28	85.70	87.08	92.93	89.38	157373.66
Honcut to Jack	43.23	85.55	86.95	92.87	89.32	157104.73
Honcut to Jack	43.12	85.25	86.68	92.74	89.21	156612.83
Honcut to Jack	43.06	85.18	86.62	92.72	89.15	156460.24
Honcut to Jack	43.01	85.12	86.57	92.66	89.10	156249.06
Honcut to Jack	42.65	84.99	86.45	92.57	88.73	153765.90
Honcut to Jack	42.47	84.79	86.26	92.40	88.55	153202.55
Honcut to Jack	42.19	84.50	86.00	92.20	88.27	152912.23
Honcut to Jack	42.01	84.44	85.95	92.16	88.13	152695.48
Honcut to Jack	41.61	84.21	85.74	92.01	87.81	152341.44
Honcut to Jack	41.55	84.11	85.65	91.94	87.76	151907.71
Honcut to Jack	41.2	83.85	85.43	91.78	87.49	150600.52
Honcut to Jack	40.7	83.68	85.28	91.67	87.09	150271.92
Honcut to Jack	40.49	83.43	85.05	91.50	86.93	149590.33
Honcut to Jack	40.19	83.23	84.87	91.36	86.71	148995.18
Honcut to Jack	39.45	82.70	84.42	91.00	86.23	147001.01
Honcut to Jack	39.23	82.36	84.15	90.76	86.09	145807.70
Honcut to Jack	38.94	81.97	83.84	90.47	85.90	144368.14
Honcut to Jack	38.71	81.71	83.64	90.28	85.75	143106.13
Honcut to Jack	38.45	81.53	83.50	90.15	85.58	141664.04
Honcut to Jack	38.27	81.41	83.40	90.05	85.46	140631.21
Honcut to Jack	37.95	81.22	83.25	89.90	85.28	138661.68
Honcut to Jack	37.68	81.06	83.12	89.76	85.13	137779.55
Honcut to Jack	37.45	80.88	82.98	89.60	85.00	136973.90
Honcut to Jack	37.29	80.72	82.85	89.45	84.91	136058.20
Honcut to Jack	36.45	80.11	82.41	89.01	84.43	134783.46
Honcut to Jack	36.35	79.90	82.27	88.88	84.37	134645.65
Honcut to Jack	36.24	79.66	82.11	88.73	84.30	134561.14
Honcut to Jack	35.78	79.08	81.71	88.34	83.99	132247.58
Honcut to Jack	35.5	78.92	81.59	88.21	83.88	130647.35
Honcut to Jack	35.25	78.82	81.51	88.13	83.77	130422.24
Honcut to Jack	34.8	78.73	81.45	88.06	83.58	129991.41
Honcut to Jack	34.5	78.64	81.38	87.98	83.46	128407.23
Honcut to Jack	34.07	78.55	81.32	87.90	83.28	127995.61
Honcut to Jack	33.5	78.45	81.25	87.83	83.03	126794.65
Honcut to Jack	33.25	78.32	81.15	87.72	82.90	125934.45
Honcut to Jack	33	78.18	81.05	87.61	82.77	124547.32
Honcut to Jack	32.75	78.00	80.93	87.46	82.65	123335.94
Honcut to Jack	32.5	77.87	80.83	87.34	82.52	122068.05
Honcut to Jack	32.25	77.76	80.75	87.24	82.39	121462.67
Honcut to Jack	32	77.58	80.62	87.08	82.26	121023.94
Honcut to Jack	31.75	77.37	80.46	86.88	82.13	119945.84
Honcut to Jack	31.5	77.16	80.31	86.67	81.98	118882.16
Honcut to Jack	31.25	76.97	80.16	86.48	81.80	117232.05
Honcut to Jack	31	76.76	80.01	86.29	81.63	115835.54
Honcut to Jack	30.75	76.56	79.88	86.11	82.65	115369.28
Honcut to Jack	30.5	76.33	79.71	85.90	82.03	114410.61
Honcut to Jack	30.25	76.10	79.55	85.69	81.08	113317.84
Honcut to Jack	30	75.84	79.30	85.33	80.84	111356.97

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
September 30, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	29.828	75.60	79.06	85.24	80.67	110812.54
Honcut to Jack	29.826	75.62	79.08	85.24	80.67	110802.45
Honcut to Jack	29.822	75.63	79.09	85.23	80.67	110784.75
Honcut to Jack	29.821	75.64	79.11	85.23	80.66	110774.66
Honcut to Jack	29.75	75.60	79.07	85.13	80.60	109217.11
Honcut to Jack	29.5	75.51	78.99	85.03	80.36	107965.48
Jack Sl - Yuba R	29.25	75.51	78.99	85.03	80.12	106938.36
Jack Sl - Yuba R	29	75.39	78.85	84.83	79.88	105627.60
Jack Sl - Yuba R	28.75	75.18	78.58	84.47	79.65	104417.55
Jack Sl - Yuba R	28.5	75.05	78.42	84.24	79.33	103521.79
Jack Sl - Yuba R	28.324	74.93	78.26	84.04	78.95	102627.46
Jack Sl - Yuba R	28.322	74.92	78.26	84.03	78.94	102615.67
Jack Sl - Yuba R	28.309	74.91	78.24	84.02	78.91	102537.51
Jack Sl - Yuba R	28.307	74.91	78.24	84.01	78.91	102527.14
Jack Sl - Yuba R	28.25	74.87	78.19	83.94	78.79	102281.40
Jack Sl - Yuba R	28	74.72	78.00	83.67	78.51	100798.76
Jack Sl - Yuba R	27.971	74.63	77.87	83.45	78.49	100749.02
Jack Sl - Yuba R	27.963	74.61	77.84	83.39	78.48	100696.07
Jack Sl - Yuba R	27.956	74.58	77.79	83.33	78.48	100684.10
Jack Sl - Yuba R	27.952	74.52	77.70	83.14	78.47	100652.33
Jack Sl - Yuba R	27.75	74.53	77.71	83.16	78.31	99512.10
Jack Sl - Yuba R	27.5	74.27	77.36	82.62	78.10	98174.47
Jack Sl - Yuba R	27.251	73.87	76.80	81.73	77.90	97016.29
Jack Sl - Yuba R	27.25	73.87	76.80	81.73	77.90	97011.08
Yuba R - Bear R	27	73.87	76.80	81.73	77.71	95787.83
Yuba R - Bear R	26.999	73.87	76.80	81.72	77.71	95782.80
Yuba R - Bear R	26.75	73.37	76.29	81.20	77.55	94705.78
Yuba R - Bear R	26.5	72.79	75.74	80.68	77.39	93495.05
Yuba R - Bear R	26.25	72.35	75.34	80.32	77.23	92095.83
Yuba R - Bear R	26	71.99	75.02	80.03	77.07	90634.01
Yuba R - Bear R	25.75	71.67	74.72	79.75	76.91	89136.87
Yuba R - Bear R	25.5	71.42	74.47	79.50	76.74	87728.16
Yuba R - Bear R	25.25	71.15	74.21	79.22	76.49	86208.17
Yuba R - Bear R	25	70.59	73.69	78.72	76.17	84613.00
Yuba R - Bear R	24.75	69.99	73.12	78.17	75.86	84085.03
Yuba R - Bear R	24.5	69.54	72.70	77.74	75.55	83744.43
Yuba R - Bear R	24.25	69.11	72.28	77.32	75.23	83076.25
Yuba R - Bear R	24	68.78	71.97	77.02	74.92	82269.01
Yuba R - Bear R	23.75	68.36	71.59	76.64	74.61	80891.65
Yuba R - Bear R	23.5	68.10	71.34	76.38	74.25	79494.60
Yuba R - Bear R	23.25	67.72	70.97	76.01	73.87	78032.72
Yuba R - Bear R	23	67.32	70.58	75.59	73.49	76810.25
Yuba R - Bear R	22.75	67.01	70.27	75.25	73.11	75345.95
Yuba R - Bear R	22.5	66.55	69.82	74.77	72.73	74107.24
Yuba R - Bear R	22.25	66.16	69.43	74.34	72.35	72852.32
Yuba R - Bear R	22	65.88	69.16	74.04	71.97	71497.68
Yuba R - Bear R	21.75	65.49	68.79	73.65	71.41	70018.45
Yuba R - Bear R	21.5	65.17	68.47	73.31	70.82	68712.35
Yuba R - Bear R	21.25	64.78	68.10	72.92	70.23	67330.45
Yuba R - Bear R	21	64.49	67.81	72.59	69.77	66047.23
Yuba R - Bear R	20.75	64.27	67.59	72.34	69.30	64675.51
Yuba R - Bear R	20.5	64.08	67.39	72.11	68.83	63332.45
Yuba R - Bear R	20.25	63.89	67.19	71.87	68.37	61977.06
Yuba R - Bear R	20	63.71	67.01	71.66	67.90	60460.00
Yuba R - Bear R	19.75	63.54	66.84	71.46	67.74	58852.41
Yuba R - Bear R	19.5	63.40	66.71	71.32	67.58	56862.66
Yuba R - Bear R	19.25	63.29	66.59	71.19	67.37	55516.59
Yuba R - Bear R	19	63.19	66.49	71.08	67.15	54713.04

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
September 30, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Yuba R - Bear R	18.75	63.03	66.33	70.90	66.93	53622.77
Yuba R - Bear R	18.5	62.94	66.24	70.80	66.71	52897.52
Yuba R - Bear R	18.25	62.83	66.13	70.67	66.45	51890.28
Yuba R - Bear R	18	62.63	65.92	70.43	66.19	49704.43
Yuba R - Bear R	17.75	62.48	65.76	70.25	65.93	49399.72
Yuba R - Bear R	17.5	62.31	65.59	70.05	65.67	49114.25
Yuba R - Bear R	17.25	62.11	65.40	69.85	65.41	48794.83
Yuba R - Bear R	17	61.67	64.97	69.38	65.16	48556.49
Yuba R - Bear R	16.75	61.38	64.68	69.07	64.90	48094.20
Yuba R - Bear R	16.5	61.07	64.36	68.70	64.39	47013.16
Yuba R - Bear R	16.25	60.85	64.13	68.44	63.87	46228.38
Yuba R - Bear R	16	60.53	63.79	68.06	63.36	45101.47
Yuba R - Bear R	15.75	59.91	63.10	67.27	62.85	43356.36
Yuba R - Bear R	15.5	59.33	62.46	66.51	62.33	41613.14
Yuba R - Bear R	15.25	58.82	61.89	65.84	61.82	40305.41
Yuba R - Bear R	15	58.41	61.42	65.27	61.31	39102.69
Yuba R - Bear R	14.75	58.04	61.03	64.84	60.60	37817.10
Yuba R - Bear R	14.5	57.66	60.61	64.34	59.88	36319.37
Yuba R - Bear R	14.25	57.11	59.98	63.56	59.24	34904.17
Yuba R - Bear R	14	56.78	59.61	63.13	58.89	33507.55
Yuba R - Bear R	13.75	56.50	59.27	62.69	58.53	32270.43
Yuba R - Bear R	13.5	56.12	58.83	62.15	58.17	31239.13
Yuba R - Bear R	13.25	55.89	58.58	61.86	57.82	29977.40
Yuba R - Bear R	13	55.82	58.52	61.82	57.46	28644.35
Yuba R - Bear R	12.75	55.66	58.34	61.62	57.11	27255.90
Yuba R - Bear R	12.5	55.58	58.27	61.55	56.82	26065.40
Yuba R - Bear R	12.25	55.36	58.04	61.31	56.59	24642.20
Reach 35	12	55.36	58.04	61.31	56.37	23313.05
Reach 35	11.75	55.23	57.92	61.19	56.15	21993.69
Reach 35	11.599	55.19	57.88	61.15	56.02	21069.77
Reach 35	11.5	55.07	57.77	61.03	55.93	20354.66
Reach 35	11.25	54.88	57.56	60.79	55.71	18182.41
Reach 35	11	54.60	57.26	60.45	55.44	16871.48
Reach 35	10.75	54.46	57.11	60.28	55.01	15547.88
Reach 35	10.5	54.23	56.86	60.00	54.57	14278.44
Reach 35	10.25	53.82	56.39	59.43	54.13	13850.18
Reach 35	10	53.62	56.19	59.20	53.69	12847.13
Reach 35	9.75	53.34	55.87	58.82	53.27	11597.74
Reach 35	9.5	53.02	55.52	58.41	52.91	10595.55
Reach 35	9.278	52.97	55.47	58.37	52.59	9814.09
Reach 35	9.265	52.69	55.14	57.93	52.56	9758.91
Reach 35	9.2	52.57	55.01	57.79	52.39	9164.29
Reach 35	9	52.25	54.67	57.40	51.55	8445.84
Reach 35	8.75	51.34	53.68	56.27	50.44	7531.76
Reach 35	8.5	50.67	53.00	55.53	49.34	6548.71
Reach 35	8.25	50.14	52.47	54.96	48.23	3573.02
Reach 35	8	49.20	51.54	53.90	47.12	2528.45
Reach 35	7.75	48.56	50.90	53.12	46.02	1733.43
Reach 35	7.55	48.21	50.56	52.67	44.98	1275.43

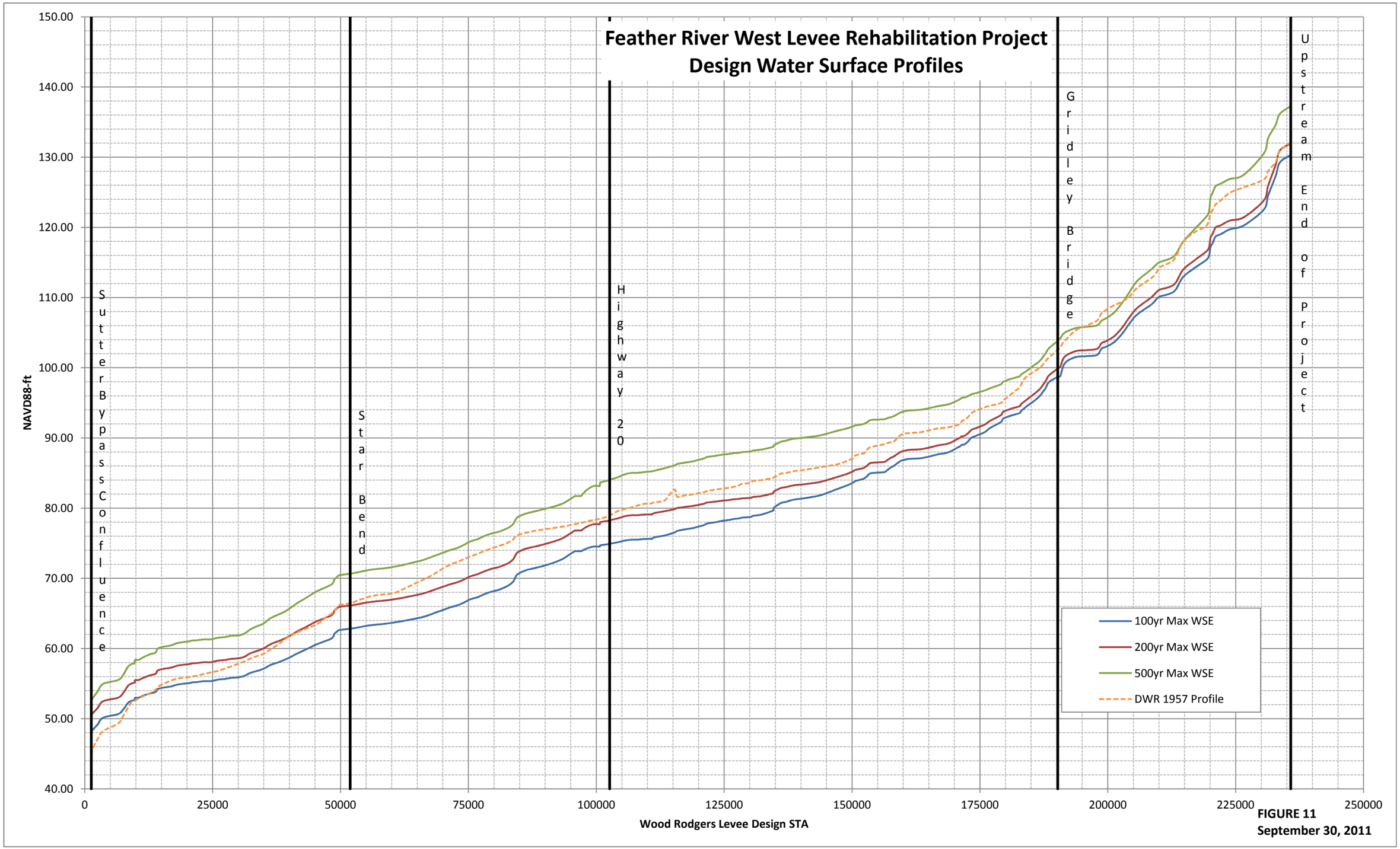


FIGURE 11
September 30, 2011

ATTACHMENT G

December 2011 Water Surface Profiles

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
December 29, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Upper	58.75	131.09	132.91	138.10	-	-
Upper	-	130.74	132.48	137.72	-	236800.00
Upper	58.51	130.32	131.97	137.27	132.14	235748.95
Upper	58.26	129.25	130.96	136.17	130.88	233625.38
Upper	57.95	127.30	128.89	134.60	129.32	232796.18
Upper	57.7	124.59	125.99	132.74	128.05	231347.46
Upper	57.45	122.54	123.85	130.54	126.84	230491.75
Upper	57.17	120.27	121.44	127.48	125.70	226547.44
Upper	56.94	119.72	120.97	126.88	124.95	223836.90
Upper	56.61	119.04	120.31	126.24	123.87	222092.63
Upper	56.43	118.70	120.00	125.86	123.28	221068.16
Upper	56.2	117.82	119.14	124.99	122.52	220516.06
Upper	56.02	117.18	118.50	124.19	121.93	220057.97
Upper	55.8	115.95	117.16	122.29	121.18	219786.54
Upper	55.55	115.34	116.54	121.47	120.17	219191.24
Upper	55.35	114.23	115.34	119.76	119.31	216984.11
Upper	55.03	112.90	113.93	117.90	117.92	214664.25
Upper	54.45	110.87	111.86	115.89	115.41	212925.66
Upper	54.2	110.15	111.13	115.05	114.33	210158.47
Upper	54.04	109.82	110.82	114.77	113.64	209562.52
Upper	53.84	109.01	110.03	114.02	112.77	208499.74
Upper	53.52	107.58	108.50	112.34	111.39	205714.05
Upper	53.22	106.33	107.23	110.81	110.18	204265.70
Upper	52.89	104.81	105.68	109.20	109.40	202757.11
Upper	52.6	103.63	104.46	107.84	108.90	201183.88
Upper	52.21	102.99	103.78	107.04	108.23	199618.97
Upper	51.95	102.73	103.51	106.70	107.78	198775.45
Upper	51.35	101.83	102.70	106.04	106.73	197882.65
Upper	51.1777	101.65	102.51	105.82	106.00	195736.74
Upper	51.04	101.54	102.39	105.67	105.38	193817.41
Upper	50.84	100.98	101.86	105.21	104.23	192085.50
Upper	50.7	100.23	101.28	104.82	103.61	191278.99
Upper	50.59	98.83	100.16	104.20	102.93	190705.90
Upper	50.498	98.73	99.94	104.00	102.55	190230.79
Upper	50.496	98.68	99.89	103.93	102.54	190218.72
Upper	50.489	98.65	99.82	103.78	102.52	190176.83
Upper	50.487	98.69	99.87	103.80	102.51	190166.78
Upper	50.2	97.95	98.89	102.77	101.47	188470.72
Upper	50.06	97.11	98.09	102.06	100.96	187822.66
Upper	49.78	95.96	96.94	100.96	99.97	186662.60
Upper	49.58	95.12	96.10	100.21	99.36	185293.60
Upper	49.38	94.52	95.46	99.56	98.77	184138.90
Upper	49.21	94.13	95.09	99.25	98.27	183514.21
Upper	48.99	93.87	94.84	99.05	97.62	183056.49
Upper	48.85	93.54	94.52	98.78	97.21	182753.69
Upper	48.66	93.35	94.32	98.57	96.65	181801.88
Upper	48.39	93.03	94.00	98.28	95.85	180454.16
Upper	48.21	92.71	93.67	97.96	95.32	179460.20
Upper	48.07	92.27	93.24	97.65	95.00	179109.34
Upper	47.7	91.41	92.42	97.07	94.57	176933.60
Upper	47.55	90.85	91.92	96.78	94.39	175967.91
Upper	47.2	90.27	91.37	96.37	93.85	174102.82
Upper	47.04	90.04	91.15	96.23	93.54	173345.89
Upper	46.69	89.38	90.56	95.91	92.86	172499.41
Upper	46.53	89.03	90.24	95.74	92.55	171792.00
Honcut to Jack	46.45	89.03	90.24	95.74	92.40	171454.59
Honcut to Jack	46.2	88.82	90.03	95.53	92.00	171127.62
Honcut to Jack	45.98	88.59	89.81	95.31	91.82	170521.00

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
December 29, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	45.71	88.11	89.35	94.92	91.60	169330.99
Honcut to Jack	45.58	87.85	89.11	94.71	91.49	168312.33
Honcut to Jack	45.44	87.68	88.95	94.55	91.37	166923.76
Honcut to Jack	45.26	87.47	88.74	94.36	91.22	165726.12
Honcut to Jack	45.03	87.30	88.57	94.19	91.03	164732.57
Honcut to Jack	44.76	87.10	88.38	94.01	90.81	163250.84
Honcut to Jack	44.6326	87.02	88.29	93.92	90.70	161213.76
Honcut to Jack	44.5	86.87	88.15	93.77	90.59	160088.12
Honcut to Jack	44.23	86.65	87.94	93.57	90.35	159311.39
Honcut to Jack	43.46	86.07	87.42	93.15	89.56	158271.13
Honcut to Jack	43.34	85.81	87.18	92.96	89.38	157627.58
Honcut to Jack	43.28	85.70	87.07	92.93	89.38	157373.66
Honcut to Jack	43.23	85.55	86.94	92.87	89.32	157104.73
Honcut to Jack	43.12	85.25	86.68	92.74	89.21	156612.83
Honcut to Jack	43.06	85.18	86.62	92.72	89.15	156460.24
Honcut to Jack	43.01	85.12	86.56	92.66	89.10	156249.06
Honcut to Jack	42.65	84.99	86.44	92.57	88.73	153765.90
Honcut to Jack	42.47	84.79	86.26	92.40	88.55	153202.55
Honcut to Jack	42.19	84.50	86.00	92.20	88.27	152912.23
Honcut to Jack	42.01	84.44	85.94	92.16	88.13	152695.48
Honcut to Jack	41.61	84.21	85.74	92.01	87.81	152341.44
Honcut to Jack	41.55	84.11	85.65	91.94	87.76	151907.71
Honcut to Jack	41.2	83.85	85.42	91.78	87.49	150600.52
Honcut to Jack	40.7	83.68	85.28	91.67	87.09	150271.92
Honcut to Jack	40.49	83.43	85.05	91.50	86.93	149590.33
Honcut to Jack	40.19	83.23	84.86	91.36	86.71	148995.18
Honcut to Jack	39.45	82.70	84.41	91.00	86.23	147001.01
Honcut to Jack	39.23	82.36	84.14	90.76	86.09	145807.70
Honcut to Jack	38.94	81.96	83.83	90.47	85.90	144368.14
Honcut to Jack	38.71	81.70	83.63	90.28	85.75	143106.13
Honcut to Jack	38.45	81.53	83.49	90.15	85.58	141664.04
Honcut to Jack	38.27	81.40	83.39	90.05	85.46	140631.21
Honcut to Jack	37.95	81.22	83.25	89.90	85.28	138661.68
Honcut to Jack	37.68	81.05	83.12	89.76	85.13	137779.55
Honcut to Jack	37.45	80.88	82.98	89.60	85.00	136973.90
Honcut to Jack	37.29	80.71	82.85	89.45	84.91	136058.20
Honcut to Jack	36.45	80.10	82.40	89.01	84.43	134783.46
Honcut to Jack	36.35	79.90	82.26	88.87	84.37	134645.65
Honcut to Jack	36.24	79.65	82.10	88.73	84.30	134561.14
Honcut to Jack	35.78	79.07	81.70	88.34	83.99	132247.58
Honcut to Jack	35.5	78.91	81.58	88.21	83.88	130647.35
Honcut to Jack	35.25	78.81	81.50	88.13	83.77	130422.24
Honcut to Jack	34.8	78.72	81.44	88.06	83.58	129991.41
Honcut to Jack	34.5	78.63	81.37	87.98	83.46	128407.23
Honcut to Jack	34.07	78.54	81.31	87.90	83.28	127995.61
Honcut to Jack	33.5	78.44	81.24	87.83	83.03	126794.65
Honcut to Jack	33.25	78.31	81.14	87.72	82.90	125934.45
Honcut to Jack	33	78.17	81.04	87.61	82.77	124547.32
Honcut to Jack	32.75	77.99	80.92	87.45	82.65	123335.94
Honcut to Jack	32.5	77.86	80.82	87.33	82.52	122068.05
Honcut to Jack	32.25	77.75	80.74	87.24	82.39	121462.67
Honcut to Jack	32	77.57	80.61	87.08	82.26	121023.94
Honcut to Jack	31.75	77.36	80.45	86.87	82.13	119945.84
Honcut to Jack	31.5	77.15	80.30	86.67	81.98	118882.16
Honcut to Jack	31.25	76.96	80.15	86.48	81.80	117232.05
Honcut to Jack	31	76.75	80.00	86.29	81.63	115835.54
Honcut to Jack	30.75	76.55	79.86	86.11	82.65	115369.28
Honcut to Jack	30.5	76.32	79.70	85.90	82.03	114410.61

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
December 29, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	30.25	76.10	79.53	85.68	81.08	113317.84
Honcut to Jack	30	75.83	79.28	85.33	80.84	111356.97
Honcut to Jack	29.828	75.60	79.05	85.24	80.67	110812.54
Honcut to Jack	29.826	75.61	79.07	85.24	80.67	110802.45
Honcut to Jack	29.822	75.62	79.08	85.23	80.67	110784.75
Honcut to Jack	29.821	75.63	79.09	85.23	80.66	110774.66
Honcut to Jack	29.75	75.59	79.06	85.13	80.60	109217.11
Honcut to Jack	29.5	75.50	78.98	85.03	80.36	107965.48
Jack Sl - Yuba R	29.25	75.50	78.98	85.03	80.12	106938.36
Jack Sl - Yuba R	29	75.38	78.83	84.83	79.88	105627.60
Jack Sl - Yuba R	28.75	75.17	78.57	84.47	79.65	104417.55
Jack Sl - Yuba R	28.5	75.04	78.40	84.23	79.33	103521.79
Jack Sl - Yuba R	28.324	74.92	78.25	84.03	78.95	102627.46
Jack Sl - Yuba R	28.322	74.92	78.25	84.03	78.94	102615.67
Jack Sl - Yuba R	28.309	74.90	78.23	84.01	78.91	102537.51
Jack Sl - Yuba R	28.307	74.90	78.23	84.01	78.91	102527.14
Jack Sl - Yuba R	28.25	74.86	78.18	83.94	78.79	102281.40
Jack Sl - Yuba R	28	74.71	77.99	83.66	78.51	100798.76
Jack Sl - Yuba R	27.971	74.62	77.85	83.44	78.49	100749.02
Jack Sl - Yuba R	27.963	74.60	77.82	83.38	78.48	100696.07
Jack Sl - Yuba R	27.956	74.57	77.78	83.32	78.48	100684.10
Jack Sl - Yuba R	27.952	74.51	77.69	83.13	78.47	100652.33
Jack Sl - Yuba R	27.75	74.52	77.69	83.15	78.31	99512.10
Jack Sl - Yuba R	27.5	74.26	77.34	82.62	78.10	98174.47
Jack Sl - Yuba R	27.251	73.86	76.79	81.72	77.90	97016.29
Jack Sl - Yuba R	27.25	73.86	76.78	81.72	77.90	97011.08
Yuba R - Bear R	27	73.86	76.78	81.72	77.71	95787.83
Yuba R - Bear R	26.999	73.86	76.78	81.71	77.71	95782.80
Yuba R - Bear R	26.75	73.36	76.27	81.19	77.55	94705.78
Yuba R - Bear R	26.5	72.77	75.72	80.67	77.39	93495.05
Yuba R - Bear R	26.25	72.33	75.32	80.31	77.23	92095.83
Yuba R - Bear R	26	71.98	74.99	80.02	77.07	90634.01
Yuba R - Bear R	25.75	71.65	74.69	79.73	76.91	89136.87
Yuba R - Bear R	25.5	71.40	74.45	79.49	76.74	87728.16
Yuba R - Bear R	25.25	71.13	74.18	79.21	76.49	86208.17
Yuba R - Bear R	25	70.57	73.66	78.71	76.17	84613.00
Yuba R - Bear R	24.75	69.96	73.09	78.15	75.86	84085.03
Yuba R - Bear R	24.5	69.51	72.66	77.72	75.55	83744.43
Yuba R - Bear R	24.25	69.08	72.24	77.30	75.23	83076.25
Yuba R - Bear R	24	68.74	71.93	77.01	74.92	82269.01
Yuba R - Bear R	23.75	68.33	71.54	76.62	74.61	80891.65
Yuba R - Bear R	23.5	68.07	71.29	76.36	74.25	79494.60
Yuba R - Bear R	23.25	67.68	70.92	75.99	73.87	78032.72
Yuba R - Bear R	23	67.27	70.53	75.57	73.49	76810.25
Yuba R - Bear R	22.75	66.96	70.21	75.23	73.11	75345.95
Yuba R - Bear R	22.5	66.50	69.76	74.74	72.73	74107.24
Yuba R - Bear R	22.25	66.11	69.36	74.32	72.35	72852.32
Yuba R - Bear R	22	65.83	69.09	74.01	71.97	71497.68
Yuba R - Bear R	21.75	65.44	68.71	73.62	71.41	70018.45
Yuba R - Bear R	21.5	65.11	68.39	73.28	70.82	68712.35
Yuba R - Bear R	21.25	64.71	68.02	72.89	70.23	67330.45
Yuba R - Bear R	21	64.42	67.73	72.57	69.77	66047.23
Yuba R - Bear R	20.75	64.19	67.50	72.31	69.30	64675.51
Yuba R - Bear R	20.5	64.01	67.30	72.07	68.83	63332.45
Yuba R - Bear R	20.25	63.81	67.10	71.84	68.37	61977.06
Yuba R - Bear R	20	63.63	66.92	71.62	67.90	60460.00
Yuba R - Bear R	19.75	63.46	66.74	71.43	67.74	58852.41
Yuba R - Bear R	19.5	63.32	66.61	71.28	67.58	56862.66

FEATHER RIVER WEST LEVEE REHABILITATION PROJECT
MAXIMUM WATER SURFACE PROFILES
December 29, 2011

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 (NAVD88-ft)	Wood Rodgers Design STA
Yuba R - Bear R	19.25	63.20	66.49	71.16	67.37	55516.59
Yuba R - Bear R	19	63.11	66.39	71.05	67.15	54713.04
Yuba R - Bear R	18.75	62.95	66.23	70.87	66.93	53622.77
Yuba R - Bear R	18.5	62.85	66.13	70.76	66.71	52897.52
Yuba R - Bear R	18.25	62.74	66.02	70.63	66.45	51890.28
Yuba R - Bear R	18	62.53	65.81	70.39	66.19	49704.43
Yuba R - Bear R	17.75	62.38	65.65	70.21	65.93	49399.72
Yuba R - Bear R	17.5	62.21	65.48	70.01	65.67	49114.25
Yuba R - Bear R	17.25	62.01	65.28	69.80	65.41	48794.83
Yuba R - Bear R	17	61.55	64.84	69.33	65.16	48556.49
Yuba R - Bear R	16.75	61.26	64.55	69.01	64.90	48094.20
Yuba R - Bear R	16.5	60.94	64.23	68.65	64.39	47013.16
Yuba R - Bear R	16.25	60.72	63.99	68.38	63.87	46228.38
Yuba R - Bear R	16	60.39	63.64	67.99	63.36	45101.47
Yuba R - Bear R	15.75	59.76	62.94	67.18	62.85	43356.36
Yuba R - Bear R	15.5	59.17	62.28	66.41	62.33	41613.14
Yuba R - Bear R	15.25	58.64	61.70	65.73	61.82	40305.41
Yuba R - Bear R	15	58.22	61.22	65.14	61.31	39102.69
Yuba R - Bear R	14.75	57.83	60.81	64.70	60.60	37817.10
Yuba R - Bear R	14.5	57.45	60.38	64.18	59.88	36319.37
Yuba R - Bear R	14.25	56.88	59.73	63.38	59.24	34904.17
Yuba R - Bear R	14	56.54	59.35	62.93	58.89	33507.55
Yuba R - Bear R	13.75	56.25	59.00	62.48	58.53	32270.43
Yuba R - Bear R	13.5	55.85	58.54	61.91	58.17	31239.13
Yuba R - Bear R	13.25	55.62	58.28	61.62	57.82	29977.40
Yuba R - Bear R	13	55.54	58.22	61.57	57.46	28644.35
Yuba R - Bear R	12.75	55.37	58.03	61.36	57.11	27255.90
Yuba R - Bear R	12.5	55.30	57.96	61.29	56.82	26065.40
Yuba R - Bear R	12.25	55.06	57.72	61.04	56.59	24642.20
Reach 35	12	55.06	57.72	61.04	56.37	23313.05
Reach 35	11.75	54.92	57.59	60.90	56.15	21993.69
Reach 35	11.599	54.88	57.55	60.86	56.02	21069.77
Reach 35	11.5	54.76	57.43	60.74	55.93	20354.66
Reach 35	11.25	54.55	57.21	60.49	55.71	18182.41
Reach 35	11	54.26	56.89	60.12	55.44	16871.48
Reach 35	10.75	54.11	56.74	59.95	55.01	15547.88
Reach 35	10.5	53.87	56.48	59.65	54.57	14278.44
Reach 35	10.25	53.44	55.99	59.05	54.13	13850.18
Reach 35	10	53.23	55.77	58.80	53.69	12847.13
Reach 35	9.75	52.93	55.44	58.40	53.27	11597.74
Reach 35	9.5	52.60	55.07	57.95	52.91	10595.55
Reach 35	9.278	52.54	55.01	57.90	52.59	9814.09
Reach 35	9.265	52.24	54.66	57.45	52.56	9758.91
Reach 35	9.2	52.12	54.53	57.29	52.39	9164.29
Reach 35	9	51.78	54.15	56.83	51.55	8445.84
Reach 35	8.75	50.98	53.29	55.78	50.44	7531.76
Reach 35	8.5	50.47	52.78	55.20	49.34	6548.71
Reach 35	8.25	50.09	52.41	54.79	48.23	3573.02
Reach 35	8	49.31	51.64	53.85	47.12	2528.45
Reach 35	7.75	48.85	51.17	53.25	46.02	1733.43
Reach 35	7.55	48.62	50.94	52.93	44.98	1275.43

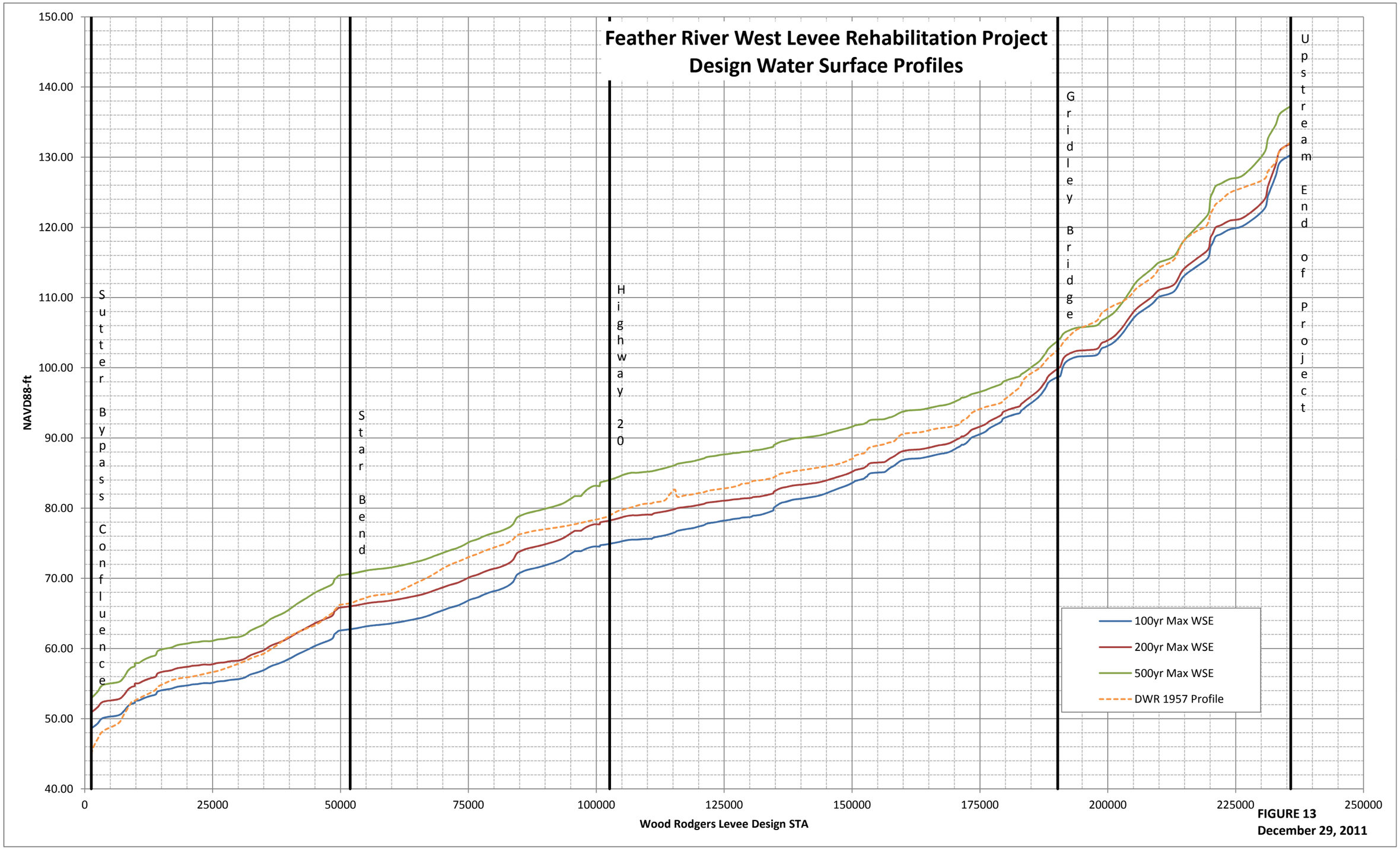


FIGURE 13
December 29, 2011

ATTACHMENT H

USACE Technical Review Comments

SUTTER BASIN FEASILITY STUDY

SPK HYDRAULIC DESIGN SECTION
DISTRICT QUALITY CONTROL REVIEW

SUTTER BASIN
PBI HEC-RAS HYDRAULIC MODEL 06.10.2011

Reviewer: Peter Blodgett, P.E. SPK Hydraulic Analysis Section
Review Date: 10 September 2011
Response Date: 16 September 2011
Backcheck Date: 14 December 2011

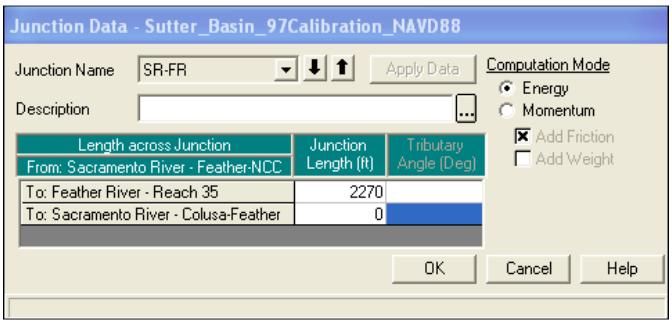
Review of 1997 and 2006 flood calibration/verification and 1/n-AEP event models.

Comment 1) Rating curve for Yolo Bypass at Woodland gage (downstream boundary) is not the same between calibration and 1/n aep runs. The calibration version seems to be correct.

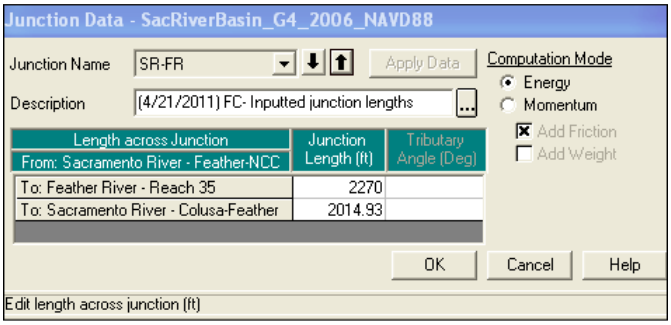
Response : Agree
Backcheck - Comment Resolved.

Comment 2) Junction SR-FR. Reach length is not correct.

In Model:



Should Be:

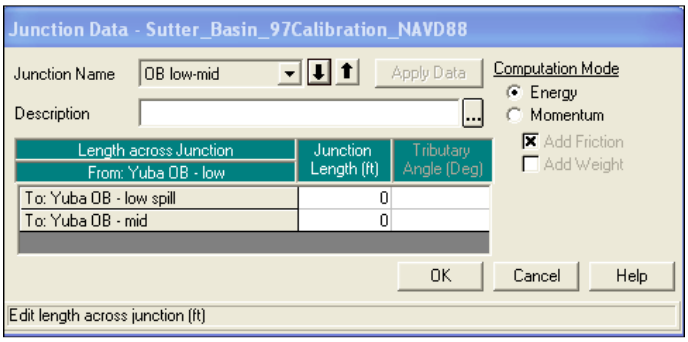


Response : Agree

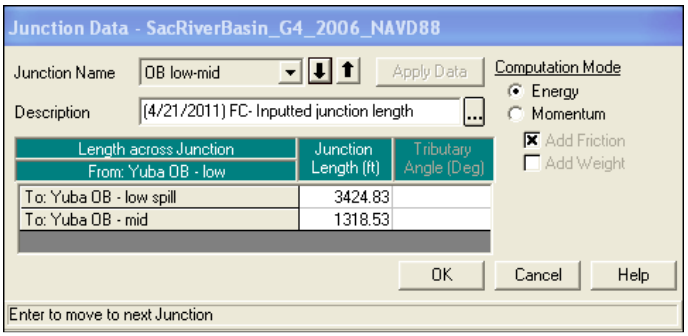
Backcheck - Comment Resolved.

Comment 3) Junction OB Low-Mid. Reach length is not correct

In Model:



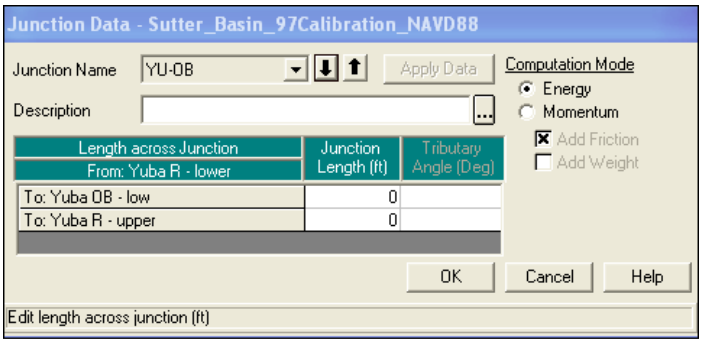
Should Be:

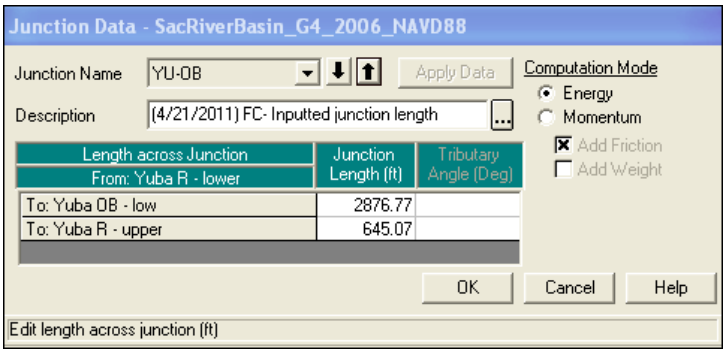


Response : Agree.

Backcheck - Comment Resolved.

Comment 4) Junction YU-OB. Reach length is not correct





Response : Agree.

Backcheck - Comment Resolved.

Comment 5) Recommend adding artificial obstructions to contain flow between levees at Bear River 6.50, 6.25, 6.0, 5.91.

Response: Agree.

Backcheck - Comment Resolved.

Comment 6) Please review description fields in the Bear River Lower cross sections. Do these comments apply?

Response: Most of the descriptions apply. However, there were a few comments with ambiguous meaning that appear to be left over from previous model versions. The ambiguous comments were deleted.

Backcheck - Comment Resolved.

Comment 7) Honcut Creek inflow for 1997 flood is multiplied by 0.50. Please check.

Response – This multiplier should not be there and has been deleted.
Backcheck - Comment Resolved.

ATTACHMENT I

MBK Technical Review Comments

REVIEW COMMENT/RESPONSE LOG

PROJECT: **Feather River West Levee Rehabilitation Project**

REVIEW DOCUMENT(S): **Revised Design Water Surface Profiles for the Feather River West Levee Rehabilitation Project (September 2011), September 30, 2011; HEC-RAS model and analysis dated 9/14/2011**

DATE: **1/19/2012**

SUBMITTAL:

REVIEWER: **MBK Engineers**

REFERENCE			COMMENT Comment Codes: **M**=Mandatory Response; **S**=Suggested Correction; **Q**=Question; **G**=General Comment;				RESPONSE Response Codes: **A**=Agree, will revise; **D**=Disagree, see explanation; **F**=Follow up required; **G**=General Response					
Comment No.	Dwg/Sec	Page/Sht	Code	Description	By	Date	Code	Explanation	By	Date	Backcheck By/Date	Backcheck Comment
1		Page 2 (2nd paragraph)	**S**	The report states "After PBI converted the HEC-RAS model's vertical datum from NGVD29 to NAVD88...". It appears from review that the model was developed from Release 3 of the USACE Sacramento River HEC-RAS model, which was converted from NGVD29 to NAVD88 by the USACE. If this is the case then the text needs to be revised to reflect this. Also, some discussion on how the model was converted from NGVD29 to NAVD88 should be included.	MBK	11/16/11	**A**	The report text was revised to include reference to Release 3. The text was also revised to include some discussion on how the model was converted from NGVD29 to NAVD88.	PBI	01/09/12	MBK 1/18/12	
2		Page 4 (1st paragraph)	**G**	It is our opinion that the use of a rating curve is not appropriate for the Tisdale Weir in that it does not reflect the reduction in flow that would occur due to submergence caused by high tailwater from the Sutter Bypass. It is our opinion that the Tidale Weir would be better represented as a weir with the "sharp crested" shape option. We provided this opinion to the USACE as part of a review of the Sacramento River HEC-RAS model. We agree with PBI that this is unlikely to have any appreciable effect on the Feather River, but recommend doing a sensitivity analysis to verify this.	MBK	11/16/11	**D**	Neither methods are appropriate for the high flows. The diversion method uses the DWR rating curve and USGS rating curves to estimate the diversion at the weir. At submergence, both of these approaches have higher and probably equal levels of uncertainty. However, at lower more common flows, diversions based on ratings developed from flow measurements would be more accurate. (PBI NOTE: We have verified that this issue has no appreciable effect on the Feather River and therefore request that MBK approve this backcheck for the FRWLRP.)	USACE	12/07/11	MBK 1/18/12 with comment	It is our opinion that the sharp-crested weir option is a better representation for Tisdale Weir than the rating curve option, especially for the large events which are the focus of the hydraulic model. However, since it has been demonstrated that the study area is not sensitive to the modeling method at Tisdale Weir, the model and analysis are acceptable for the study purposes.
3		Page 4 (2nd paragraph)	**G**	Recommend further review of 1997 surveyed high water marks. Review of the Feather River and Sutter Bypass high water mark elevations carried over from the USACE HEC-RAS model indicates that they were converted from NGVD29 to NAVD88 by adding 2.7 ft., which is not consistent with the conversion used for the model geometry, which is more in the 2.2 to 2.3 ft. range.	MBK	11/16/11	**G**	The conversion of 1997 HWM data to NAVD88 were based on a comparison of the vertical control used at the time of the survey. The conversions varied throughout the data set and were based on a comparison of the value used in the 1997 survey relative to a survey or GPS readjustment to establish the NAVD88 value. The reason the values are different is they used different vertical control values. It is important to note that all the NAVD88 GPS measurements have an estimated network uncertainty +/-0.3 feet (relative uncertainty is better) and the NGVD29 values probably have a higher degree of uncertainty.	USACE	12/07/11	MBK 1/18/12	

REVIEW COMMENT/RESPONSE LOG

PROJECT: **Feather River West Levee Rehabilitation Project**

REVIEW DOCUMENT(S): **Revised Design Water Surface Profiles for the Feather River West Levee Rehabilitation Project (September 2011), September 30, 2011; HEC-RAS model and analysis dated 9/14/2011**

DATE: **1/19/2012**

SUBMITTAL:

REVIEWER: **MBK Engineers**

REFERENCE			COMMENT				RESPONSE					
			Comment Codes: **M**=Mandatory Response; **S**=Suggested Correction; **Q**=Question; **G**=General Comment;				Response Codes: **A**=Agree, will revise; **D**=Disagree, see explanation; **F**=Follow up required; **G**=General Response					
Comment No.	Dwg/Sec	Page/Sht	Code	Description	By	Date	Code	Explanation	By	Date	Backcheck By/Date	Backcheck Comment
4		Page 5 (first bullet) & Model	**S**	A portion of the right bank in section 7.55 is represented by Sutter Bypass lateral structure 66.80. This portion should be a blocked obstruction. Without the blocked obstruction it is essentially represented twice: 1) in the cross-section as flow area that conveyed flow from section 7.55 to section 7.17, and 2) as connection that shares flow between section 7.55 and Sutter Bypass sections 66.80 to 66.10. Also, lateral structure 66.8, which is modeled with a single elevation of 37.8 ft NAVD88 should be refined to represent the actual topography.	MBK	11/16/11	**D**	We understand that the coding of the Sutter Bypass/Feather River confluence (by others) stretches the capabilities of the 1D HEC-RAS model. When we add a blocked obstruction at 7.55, it results in a accelerated flume effect in the Feather River at section 7.55 (lowered stages and high velocities) which we do not believe is what physically occurs during a major flood. While imperfect, removing the blocked obstruction smoothes out the transition and eliminates the flume effect. It also results in slightly higher stages in the lower Feather River, which is conservative for levee design purposes. We have revised lateral structure 66.8 to represent the actual topography.	PBI	01/09/12	MBK 1/18/12 with comment	It is understood that due to the complexity of the confluence and its 2-D nature, any representation in the 1-D HEC-RAS is going to be very approximate. Since the methodology used appears to be conservative (i.e. tends to overstimate water surface elevation), and the affected range represents only a small percentage of the study area, the model and analysis are acceptable for the study purposes. However, it is our recommendation that if the model is to be used for defining design water surfaces near the confluence, results from available 2-D hydraulic model simulations should be used to refine the 1-D model representation.
5		Page 5 (3rd paragraph) & Model	**G**	The Sutter Bypass n-values of 0.031 and 0.032 from section 76.86 downstream are too low in our opinion. This may be driven by attempting to calibrate to 1997 using the Butte Slough near Meridian observed flow. It is our opinion that the reported 1997 flow at the Meridian gage is too high. This is based on review of other gages: computed peak flow at Verona gage (102,000 cfs) calibrates well with observed (102,000 cfs) but computed peak flow in Yolo Bypass at Woodland gage (397,200 cfs) exceeds the reported peak flow (357,000 cfs) by 40,200 cfs. This is further supported that n-values based on 2006 calibration, where the reported Meridian flow is less uncertain, result in significantly over estimated water surface elevations in Sutter Bypass for the 1997 event when the reported Meridian flow is used. This is also demonstrated in Table 2, which shows understimated 2006 peak stages at Sutter Bypass gages and corresponding overestimated 1997 peak stages.	MBK	11/16/11	**G**	We have re-calibrated the Sutter Bypass to the 2006 event. This has resulted in higher Sutter Bypass n-values of 0.035 and 0.033. The report text has also been updated to reflect the changes.	PBI	01/09/12	MBK 1/18/12	
6		Page 11	**S**	It should be stated that the simulations used to compute the n-year profiles assumed no levee breaches and that levees would act as weirs if overtopped.	MBK	11/16/11	**A**	The report text was revised to include this statement.	PBI	01/09/12	MBK 1/18/12	
7			**S**	The report should include a location map and a project site map.	MBK	11/16/11	**A**	These maps have been added to the report as Figures 1 and 2.	PBI	01/09/12	MBK 1/18/12	
8			**S**	The DWR draft Urban Levee Design Criteria (ULDC) state that hydraulic analysis for design of urban and urbanizing levees should assume that system levees protecting urban areas are at a minimum height of 200-year water surface plus 3 feet and that non-urban levees satisfy there authorized design profile. Some discussion of the analysis in relation to the ULDC should be included in the report.	MBK	11/16/11	**G**	This information is included in the Pre-Design Formulation Report developed by HDR Inc. The objective of this TM is to document the hydraulic modeling utilized for the design WS profiles. Discussions regarding the application of the WS profiles is included in other project documentation.	PBI	01/09/12	MBK 1/18/12	

REVIEW COMMENT/RESPONSE LOG

PROJECT: **Feather River West Levee Rehabilitation Project**

REVIEW DOCUMENT(S): **Revised Design Water Surface Profiles for the Feather River West Levee Rehabilitation Project (September 2011), September 30, 2011; HEC-RAS model and analysis dated 9/14/2011**

DATE: **1/19/2012**

SUBMITTAL:

REVIEWER: **MBK Engineers**

REFERENCE			COMMENT Comment Codes: **M**=Mandatory Response; **S**=Suggested Correction; **Q**=Question; **G**=General Comment;				RESPONSE Response Codes: **A**=Agree, will revise; **D**=Disagree, see explanation; **F**=Follow up required; **G**=General Response					
Comment No.	Dwg/Sec	Page/Sht	Code	Description	By	Date	Code	Explanation	By	Date	Backcheck By/Date	Backcheck Comment
9		Model	**S**	Lateral Structure Yuba River upper 8.0 elevations have not been converted to NAVD88 from NGVD29.	MBK	11/16/11	**D**	The lateral structure was converted using a conversion factor of 2.27. For the YR Lateral Structure 8.0, station 0 has an elevation of 98.44' in the NAVD88 model version, and 96.17' in the NGVD29 model version. All other station elevations for LS 8.0 include the same relative difference between NGVD29 and NAVD88.	PBI	01/09/12	MBK 1/18/12 with comment	Our review has indicated that the 98.44' value at station 0 is actually NGVD29. The original USACE Feather River HEC-RAS model developed in 2003, with NGVD29 vertical datum, had the same lateral structure with the station 0 elevation of 98.44'. Review of the model shows that the weir elevations were derived from the model cross-sections, and the weir elevations in Rel. 3 (NAVD88 version) correspond to cross-section elevations in Rel. 2 (NGVD29 version). Review of CVFED LiDAR elevation data (NAVD88) also verifies this. Water that flows over this weir still ends up in the Feather River via Jack Slough, so the net effect on the Feather River is likely minimal. Therefore, the model and analysis are acceptable for the study purposes.

Part C.7

Feather River West Levee Project
Design Water Surface Profiles Addendum #1,
PBI, July 2012

PETERSON . BRUSTAD . INC .
ENGINEERING . CONSULTING

DESIGN WATER SURFACE PROFILES for the FEATHER RIVER WEST LEVEE PROJECT

ADDENDUM #1 (July 2012)

Prepared for: Sutter-Butte Flood Control Agency ***July 26, 2012***

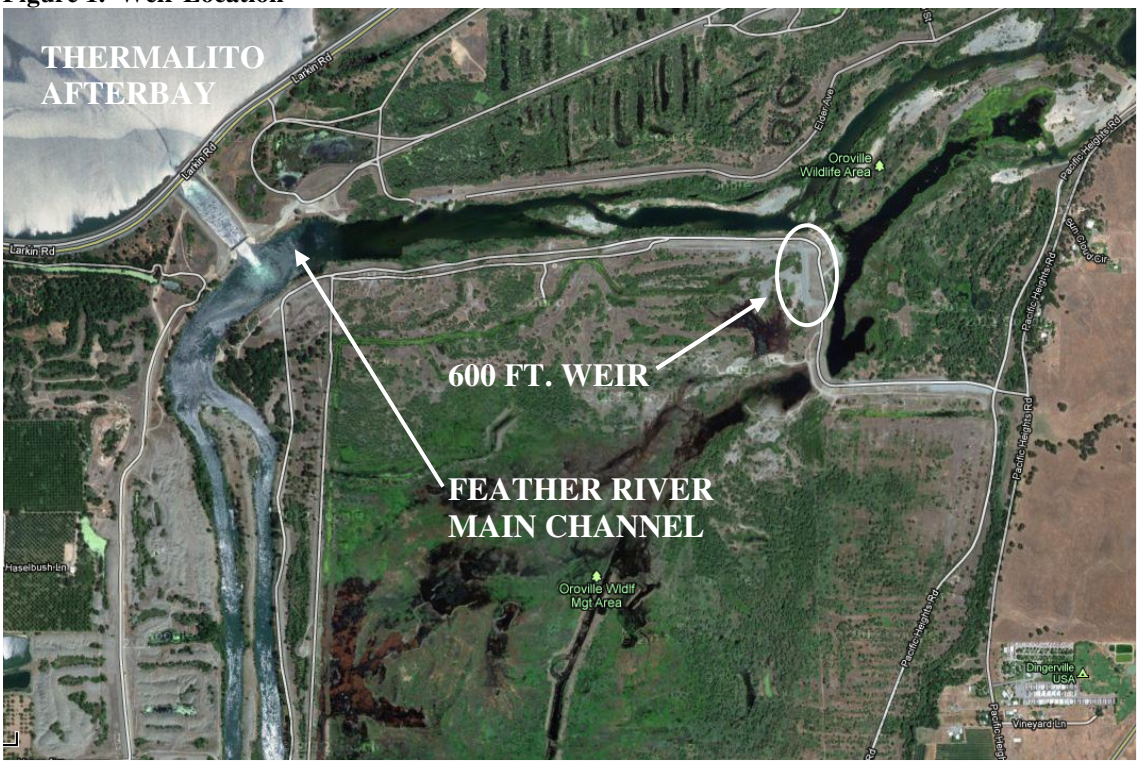
Prepared by: Chris Fritz, PE

Reviewed by: Dave Peterson, PE

INTRODUCTION

This Technical Memorandum (TM) documents the first Addendum to the March 2012 design water surface profiles for the Sutter Butte Flood Control Agency's (SBFCA) Feather River West Levee Project (FRWLP). This July 2012 version of Addendum #1 supersedes the previous May 2012 version of Addendum #1 and incorporates the June 2012 independent technical review (ITR) comments provided by MBK Engineers. The purpose of Addendum #1 is to address the 600 ft. weir in the State of California's Oroville Wildlife Area (see Figures 1 & 2), which was discovered after the previous modeling of the design profiles. The weir diverts higher flows from the main Feather River channel into the Oroville Wildlife Area (OWA). Addendum #1 primarily affects only the uppermost reaches of the FRWLP, from levee design stationing 2,368+00 to 2,200+58. However, minor changes are also observed downstream due to the changes in hydrograph routing.

Figure 1. Weir Location

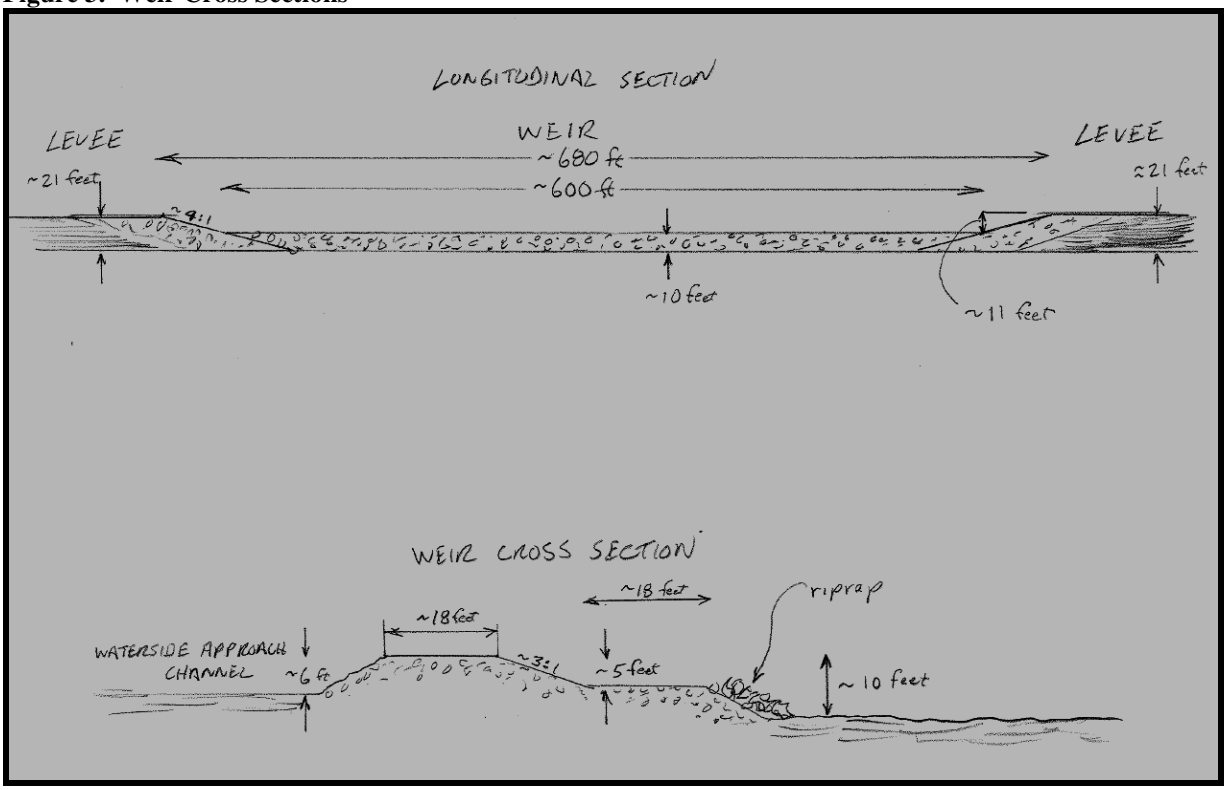


Imagery ©2012 DigitalGlobe

Figure 2. Photo of Weir

Photo Courtesy HDR, Inc.

Figure 3. Weir Cross Sections



Sketch Courtesy HDR, Inc.

Figure 4. Aerial View of Weir

Figure Courtesy HDR, Inc.

HEC-RAS MODEL IMPROVEMENTS

The overflow of water into the OWA was modeled in HEC-RAS using a system of storage areas and lateral weirs. The following summarizes the improvements that were incorporated into the upper Feather River reach of the HEC-RAS model in order to model the hydraulic effects of the OWA weir:

- Added storage areas 'Orov Wdlf SA6'and 'Orov Wdlf SA7'
- Added Lateral Structures 60.7678, 59.8175, 58.7854, 56.5755 & 56.1938
- Added storage area connections 'SAC6-7' and 'SA6 – Robinsons'
- Added left overbank blocked obstructions to cross sections 56.2 thru 60.49

All of the added components, with the exception of the OWA weir crest elevations, were input using Comp Study topography[1]. The Comp Study topography was utilized due to the fact that it is the topography that was used to develop the existing cross sections within the HEC-RAS model. The Comp Study topography is based in NGVD29 datum, therefore, the HEC-RAS features were converted to NAVD88 using the methods and conversion factors previously provided by the USACE[2]. Elevations and dimensions for the OWA weir crest elevations were obtained from CVFED LiDAR data[3] and coded into the HEC-RAS model without any conversion.

In addition to the OWA improvements, the elevations for the upper Yuba River lateral structure 8.0 were also adjusted as part of the Addendum #1 update. The elevations were adjusted by a factor of +2.27' in order to correctly convert the lateral structure to NAVD88 vertical datum. This change was originally identified in a previous ITR comment and PBI has since confirmed its validity with the USACE.

ADDENDUM #1 HEC-RAS RE-CALIBRATION

During the independent technical review process, it was recommended that the 1997 calibration be re-visited for the section of the upper Feather River near the Oroville Wildlife Area. As part of the re-calibration effort, the California Department of Water Resources Oroville Field Division provided first-hand accounts of the flooding that occurred within the OWA. The new key pieces of information include the dates, locations and dimensions of the various dike breaches that occurred within the OWA during the 1997 event (see Attachment # B). The Oroville Field Division also provided photographs taken near the peak of the 1997 event.

Using the newly obtained information for the 1997 event, the HEC-RAS model was re-calibrated by adjusting the Manning's n-values and ineffective flow areas for the upper Feather River reach

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[1] *Final Report, Topographic and Hydrographic Surveys of the Feather River System for the Sacramento and San Joaquin River Basin Comprehensive Study,* Ayres Associates, Prepared for the U.S. Army Corps of Engineers Sacramento District, May 2003

[2] *Vertical Datum Conversion of the Sutter Bypass-Feather River HEC-RAS Model, Hydraulic Design Support for USACE Feasibility Study F3 Phase,* Peterson Brustad, Inc., July 14, 2010

[3] California Department of Water Resources, LiDAR Datasets for the Sacramento River Basin, Central Valley Floodplain Evaluation and Delineation Program (CVFED), March 2010 Deliverable

near the OWA (cross sections 56.02 thru 62.12). The in-effective flow area adjustments include updates near the area of one-mile pond, based upon the recent insight received from DWR staff.

A key calibration issue for the OWA is the occurrence of the three different dike breaches that occur on the rising limb of the upper Feather River hydrograph for the 1997 event. These dike breaches are included in the HEC-RAS model for the 1997 event, but are not included in the model for the 2006 event or the n-year design simulations. The timing of these breaches plays a key role in the flood dynamics for the 1997 event since they essentially limit the maximum flow that is conveyed through the main channel of the Feather River downstream of the Thermalito Afterbay outlet. It is important to note that the breach timings input into the HEC-RAS model are based solely upon personal recollections that are nearly 15 years old, so some uncertainty still remains. In addition, the post-flood repairs that occurred after the 1997 event leave a system today that is unlike both the pre-flood and during-flood condition. The drawings for the post-1997 dike repairs and weir modifications are included in Attachment C.

Following the re-calibration to the 1997 event, the 2006 event was then simulated to verify the re-calibration efforts. The results of the Addendum #1 re-calibration are shown in Table 1 and Figures 5 thru 8 (note that the shaded areas represent the right bank levee). Only re-calibration figures for the Feather River are shown since the re-calibration did not result in any changes to the Sutter Bypass. The re-calibrated Manning's n-values for the upper Feather River are listed in Table 2. The ITR comments log for Addendum #1 is included in Attachment A.

Table 1. Summary of the Final Re-Calibration Results; Comparison of Peak Stages at Gages

GAGE	1997 Peak Stage (ft-NAVD88)			2006 Peak Stage (ft-NAVD88)		
	Observed	Computed	Difference (ft)	Observed	Computed	Difference (ft)
FEATHER RIVER NEAR GRIDLEY (#11407150)	99.66	99.36	-0.30	92.29	93.11	0.82
FEATHER RIVER AT LIVE OAK* (FLO) (FEATHER)	-	-	-	75.08	75.18	0.10
FEATHER RIVER AT YUBA CITY (#A05135)	77.51	77.38	-0.13	67.71	68.74	1.03
FEATHER RIVER AT BOYDS LANDING* (FBL) (FEATHER)	-	-	-	58.54	59.11	0.57
FEATHER RIVER AT NICOLAUS (#A05103)	49.33	49.57	0.24	44.70	44.99	0.29
BUTTE SLOUGH NR MERIDIAN (#A02972)	60.91	61.39	0.48	58.19	58.19	0.00
SUTTER BYPASS AT LONGBRIDGE* (LNB) (BYPASS)	-	-	-	53.61	53.41	-0.20
SUTTER BYPASS AT PUMPING PLANT 3 (SB3) (BYPASS)	54.32	55.65	1.33	51.84	51.38	-0.46
SUTTER BYPASS AT PUMPING PLANT 2 (SB2) (BYPASS)	50.64	51.35	0.71	46.85	46.88	0.03
SUTTER BYPASS AT PUMPING PLANT 1 (SB1) (BYPASS)	47.01	48.93	1.92	44.71	44.26	-0.45
WILLOW SLOUGH NR NICOLAUS (#A02943)	46.91	48.78	1.87	43.49	43.94	0.45
SUTTER BYPASS AT RD 1500 NEAR KARNAK (#A02927)	42.50	43.00	0.50	39.00	38.74	-0.26

* This gage data should be considered provisional; the gage datum has not been verified and was converted from NGVD29 to NAVD88 using Corpscon.

Figure 5. 1997 Calibration Water Surface Profile for Upper Reach of Feather River

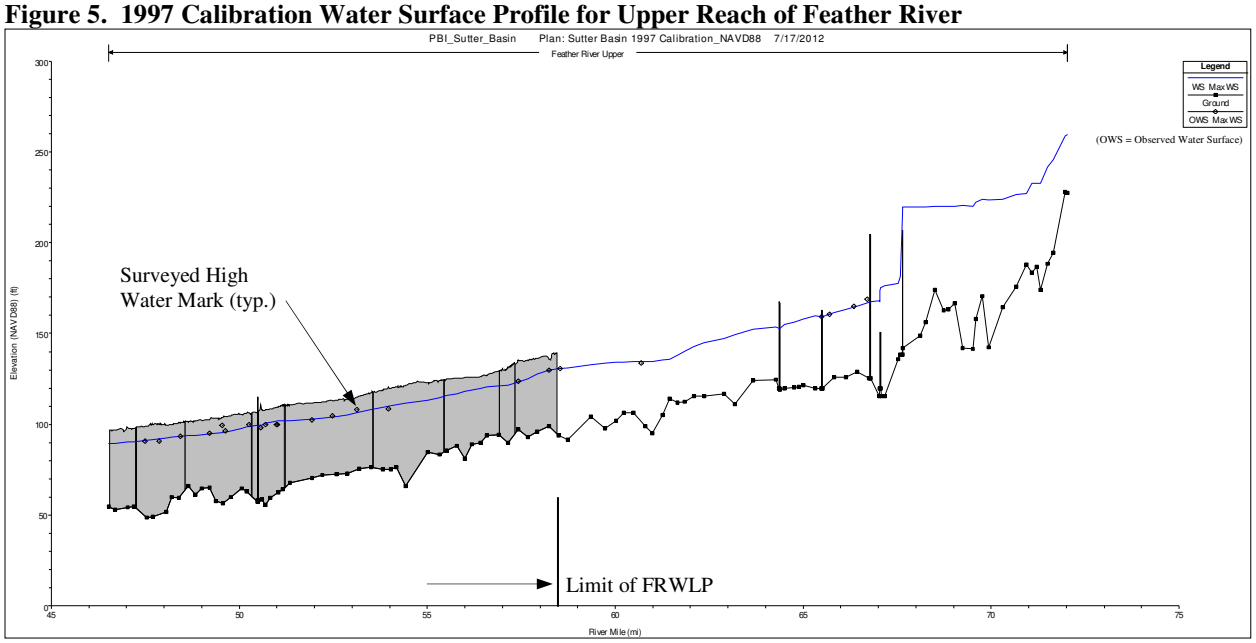

Figure 6. 1997 Calibration Water Surface Profile for Honcut-Jack Reach of Feather River

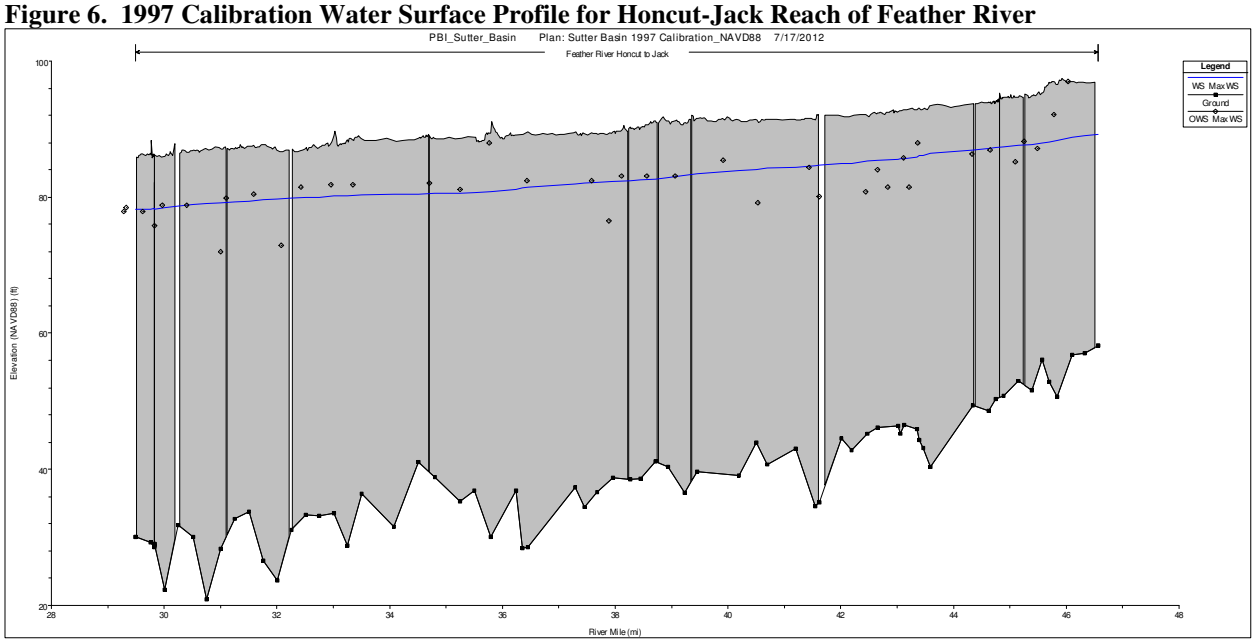

Figure 7. 1997 Calibration Water Surface Profile for Jack-Bear Reach of Feather River

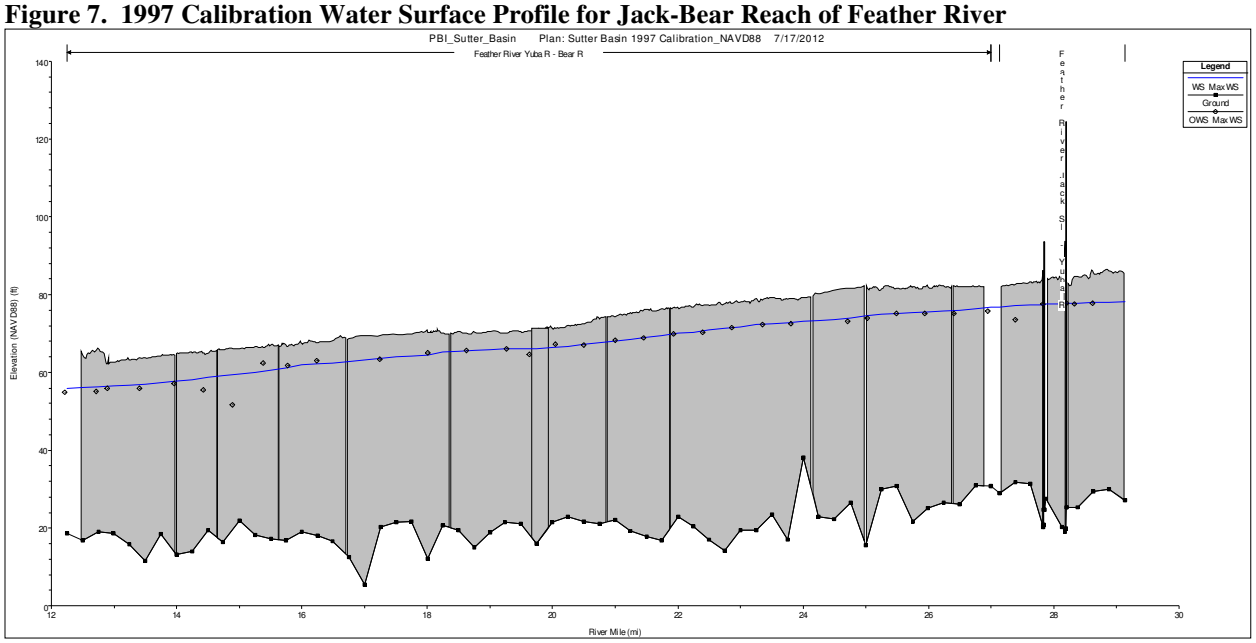

Figure 8. 1997 Calibration Water Surface Profile for Bear-Sac Reach of Feather River

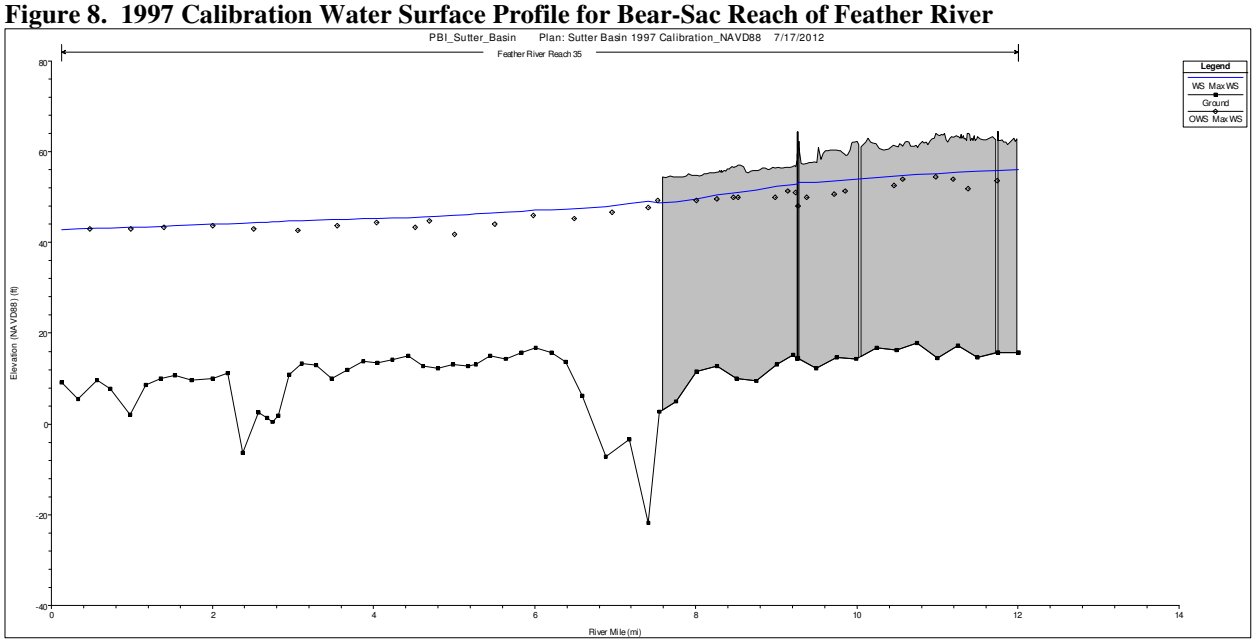

Table 2. Re-Calibrated Feather River Manning's n-Values Utilized for the PBI Sutter Basin Model
(Note: N-values are numbered from left overbank to right overbank; Channel n-values are highlighted)

Reach	River Station	Friction (n/K)	n #1	n #2	n #3	n #4	COMMENTS
Upper	62.12	n	0.055	0.04	0.065		
Upper	61.86	n	0.055	0.04	0.065		
Upper	61.67	n	0.055	0.04	0.065		
Upper	61.46	n	0.055	0.04	0.065		
Upper	61.28	n	0.055	0.04	0.065		
Upper	61	n	0.055	0.04	0.065		
Upper	60.81	n	0.055	0.04	0.065		
Upper	60.7678	Lat Struct					
Upper	60.49	n	0.055	0.04	0.065		
Upper	60.25	n	0.055	0.04	0.065		
Upper	60.04	n	0.055	0.04	0.065		
Upper	59.8175	Lat Struct					
Upper	59.74	n	0.055	0.04	0.065		
Upper	59.35	n	0.055	0.04	0.065		
Upper	58.7854	Lat Struct					
Upper	58.75	n	0.055	0.04	0.065		
Upper	58.51	n	0.07	0.04	0.065		
Upper	58.45	Lat Struct					
Upper	58.26	n	0.07	0.045	0.065		
Upper	57.95	n	0.07	0.048	0.065		
Upper	57.7	n	0.07	0.048	0.065		
Upper	57.45	n	0.07	0.05	0.065		
Upper	57.3	Lat Struct					
Upper	57.17	n	0.07	0.05	0.065		
Upper	56.99	Lat Struct					
Upper	56.94	n	0.07	0.04	0.065		
Upper	56.61	n	0.07	0.04	0.065		
Upper	56.5755	Lat Struct					
Upper	56.43	n	0.07	0.04	0.065		
Upper	56.42	Lat Struct					
Upper	56.2	n	0.07	0.04	0.065		
Upper	56.1938	Lat Struct					
Upper	56.02	n	0.07	0.04	0.065		

ADDENDUM #1 DESIGN WATER SURFACE PROFILES

The Addendum #1 HEC-RAS model results for the 1/100, 1/200, and 1/500 AEP events are shown in Table 3 and Figure 9. The design water surface profiles are a composite of the Shanghai and Sacramento storm centerings as described in the previous March 2012[4] design water surface profiles report. The simulations utilized to compute the n-year design profiles assume no levee breaches and the levees act as weirs if they are overtopped. Table 4 and Figure 10 compares the Addendum #1 updates to the previous March 2012 profiles. The updated velocity and shear stress information is included in Table 5. An updated freeboard analysis is included in Table 6 and Figure 11. The Addendum #1 results show that there are no freeboard deficiencies for the 100-year event. However, for the 200-year event, the following sections do not have 3 feet of available freeboard:

- At STA 1,131+00 (railroad crossing) [no change from March 2012]
- STA 553+00 to 558+00 (up to 0.2' deficient) [minor change from March 2012]
- STA 70+00 to 106+00 (includes Hwy 99) [no change from March 2012]
- STA 34+00 to 38+00 [no change from March 2012]
- STA 27+00 to 29+00 [no change from March 2012]

The HEC-RAS model files that were used in this analysis are titled "PBI Sutter Basin Model 07.09.2012".

Table 3. FRWLP Maximum Water Surface Profiles

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Upper	58.75	130.90	132.06	134.09	-	-
Upper	-	130.67	131.87	134.02	-	236800.00
Upper	58.51	130.40	131.65	133.93	132.14	235748.95
Upper	58.26	129.63	130.93	133.27	130.88	233625.38
Upper	57.95	127.58	128.84	131.18	129.32	232796.18
Upper	57.7	125.43	126.75	129.78	128.05	231347.46
Upper	57.45	123.70	125.06	129.32	126.84	230491.75
Upper	57.17	121.83	123.23	128.92	125.70	226547.44
Upper	56.94	120.56	122.09	128.43	124.95	223836.90
Upper	56.61	119.58	121.22	128.12	123.87	222092.63
Upper	56.43	119.16	120.70	127.29	123.28	221068.16
Upper	56.2	118.12	119.62	126.03	122.52	220516.06
Upper	56.02	117.50	119.03	125.23	121.93	220057.97
Upper	55.8	116.16	117.54	123.26	121.18	219786.54
Upper	55.55	115.43	116.71	121.94	120.17	219191.24
Upper	55.35	114.16	115.29	119.49	119.31	216984.11
Upper	55.03	112.90	113.98	118.03	117.92	214664.25
Upper	54.45	110.87	111.92	116.03	115.41	212925.66
Upper	54.2	110.15	111.19	115.19	114.33	210158.47
Upper	54.04	109.82	110.88	114.91	113.64	209562.52
Upper	53.84	109.01	110.10	114.17	112.77	208499.74
Upper	53.52	107.58	108.55	112.49	111.39	205714.05

[4] *Design Water Surface Profiles for the Feather River West Levee Project,* Peterson Brustad, Inc., March 2012

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Upper	53.22	106.33	107.27	110.96	110.18	204265.70
Upper	52.89	104.81	105.73	109.34	109.40	202757.11
Upper	52.6	103.63	104.51	107.98	108.90	201183.88
Upper	52.21	102.99	103.83	107.18	108.23	199618.97
Upper	51.95	102.73	103.56	106.84	107.78	198775.45
Upper	51.35	101.83	102.75	106.19	106.73	197882.65
Upper	51.1777	101.65	102.55	105.97	106.00	195736.74
Upper	51.04	101.54	102.43	105.82	105.38	193817.41
Upper	50.84	100.98	101.91	105.35	104.23	192085.50
Upper	50.7	100.23	101.34	104.97	103.61	191278.99
Upper	50.59	98.83	100.24	104.35	102.93	190705.90
Upper	50.498	98.73	100.01	104.15	102.55	190230.79
Upper	50.496	98.68	99.96	104.08	102.54	190218.72
Upper	50.489	98.65	99.88	103.93	102.52	190176.83
Upper	50.487	98.69	99.93	103.95	102.51	190166.78
Upper	50.2	97.95	98.93	102.93	101.47	188470.72
Upper	50.06	97.11	98.14	102.21	100.96	187822.66
Upper	49.78	95.96	96.98	101.12	99.97	186662.60
Upper	49.58	95.12	96.13	100.35	99.36	185293.60
Upper	49.38	94.52	95.50	99.70	98.77	184138.90
Upper	49.21	94.13	95.12	99.39	98.27	183514.21
Upper	48.99	93.87	94.87	99.18	97.62	183056.49
Upper	48.85	93.54	94.55	98.91	97.21	182753.69
Upper	48.66	93.34	94.34	98.70	96.65	181801.88
Upper	48.39	93.03	94.03	98.40	95.85	180454.16
Upper	48.21	92.70	93.70	98.09	95.32	179460.20
Upper	48.07	92.26	93.26	97.78	95.00	179109.34
Upper	47.7	91.40	92.43	97.21	94.57	176933.60
Upper	47.55	90.84	91.92	96.93	94.39	175967.91
Upper	47.2	90.25	91.37	96.53	93.85	174102.82
Upper	47.04	90.02	91.15	96.38	93.54	173345.89
Upper	46.69	89.46	90.55	96.07	92.86	172499.41
Upper	46.53	89.17	90.23	95.90	92.55	171792.00
Honcut to Jack	46.45	89.17	90.23	95.90	92.40	171454.59
Honcut to Jack	46.2	88.96	90.02	95.70	92.00	171127.62
Honcut to Jack	45.98	88.72	89.80	95.47	91.82	170521.00
Honcut to Jack	45.71	88.23	89.35	95.08	91.60	169330.99
Honcut to Jack	45.58	87.97	89.10	94.86	91.49	168312.33
Honcut to Jack	45.44	87.80	88.94	94.70	91.37	166923.76
Honcut to Jack	45.26	87.57	88.74	94.50	91.22	165726.12
Honcut to Jack	45.03	87.40	88.57	94.33	91.03	164732.57
Honcut to Jack	44.76	87.20	88.38	94.14	90.81	163250.84
Honcut to Jack	44.6326	87.11	88.30	94.05	90.70	161213.76
Honcut to Jack	44.5	86.96	88.15	93.90	90.59	160088.12
Honcut to Jack	44.23	86.74	87.94	93.69	90.35	159311.39
Honcut to Jack	43.46	86.15	87.43	93.26	89.56	158271.13
Honcut to Jack	43.34	85.89	87.19	93.07	89.38	157627.58
Honcut to Jack	43.28	85.77	87.09	93.04	89.38	157373.66
Honcut to Jack	43.23	85.62	86.96	92.97	89.32	157104.73
Honcut to Jack	43.12	85.32	86.70	92.85	89.21	156612.83
Honcut to Jack	43.06	85.25	86.64	92.82	89.15	156460.24
Honcut to Jack	43.01	85.19	86.59	92.76	89.10	156249.06

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Honcut to Jack	42.65	85.05	86.47	92.67	88.73	153765.90
Honcut to Jack	42.47	84.85	86.29	92.50	88.55	153202.55
Honcut to Jack	42.19	84.56	86.03	92.29	88.27	152912.23
Honcut to Jack	42.01	84.50	85.98	92.26	88.13	152695.48
Honcut to Jack	41.61	84.27	85.77	92.10	87.81	152341.44
Honcut to Jack	41.55	84.17	85.69	92.03	87.76	151907.71
Honcut to Jack	41.2	83.90	85.46	91.87	87.49	150600.52
Honcut to Jack	40.7	83.73	85.32	91.76	87.09	150271.92
Honcut to Jack	40.49	83.49	85.10	91.59	86.93	149590.33
Honcut to Jack	40.19	83.29	84.92	91.45	86.71	148995.18
Honcut to Jack	39.45	82.77	84.46	91.09	86.23	147001.01
Honcut to Jack	39.23	82.44	84.16	90.84	86.09	145807.70
Honcut to Jack	38.94	82.06	83.81	90.55	85.90	144368.14
Honcut to Jack	38.71	81.81	83.58	90.36	85.75	143106.13
Honcut to Jack	38.45	81.64	83.43	90.23	85.58	141664.04
Honcut to Jack	38.27	81.52	83.32	90.12	85.46	140631.21
Honcut to Jack	37.95	81.34	83.16	89.97	85.28	138661.68
Honcut to Jack	37.68	81.18	83.02	89.83	85.13	137779.55
Honcut to Jack	37.45	81.01	82.87	89.68	85.00	136973.90
Honcut to Jack	37.29	80.86	82.73	89.52	84.91	136058.20
Honcut to Jack	36.45	80.27	82.27	89.08	84.43	134783.46
Honcut to Jack	36.35	80.08	82.12	88.95	84.37	134645.65
Honcut to Jack	36.24	79.85	81.95	88.80	84.30	134561.14
Honcut to Jack	35.78	79.30	81.53	88.42	83.99	132247.58
Honcut to Jack	35.5	79.15	81.41	88.28	83.88	130647.35
Honcut to Jack	35.25	79.05	81.33	88.20	83.77	130422.24
Honcut to Jack	34.8	78.97	81.26	88.13	83.58	129991.41
Honcut to Jack	34.5	78.88	81.19	88.05	83.46	128407.23
Honcut to Jack	34.07	78.80	81.13	87.98	83.28	127995.61
Honcut to Jack	33.5	78.71	81.05	87.90	83.03	126794.65
Honcut to Jack	33.25	78.58	80.95	87.79	82.90	125934.45
Honcut to Jack	33	78.45	80.85	87.68	82.77	124547.32
Honcut to Jack	32.75	78.28	80.72	87.53	82.65	123335.94
Honcut to Jack	32.5	78.16	80.62	87.41	82.52	122068.05
Honcut to Jack	32.25	78.05	80.53	87.32	82.39	121462.67
Honcut to Jack	32	77.89	80.40	87.16	82.26	121023.94
Honcut to Jack	31.75	77.69	80.23	86.96	82.13	119945.84
Honcut to Jack	31.5	77.49	80.07	86.76	81.98	118882.16
Honcut to Jack	31.25	77.31	79.92	86.57	81.80	117232.05
Honcut to Jack	31	77.11	79.77	86.38	81.63	115835.54
Honcut to Jack	30.75	76.93	79.62	86.20	82.65	115369.28
Honcut to Jack	30.5	76.70	79.45	86.00	82.03	114410.61
Honcut to Jack	30.25	76.48	79.27	85.78	81.08	113317.84
Honcut to Jack	30	76.14	79.01	85.44	80.84	111356.97
Honcut to Jack	29.828	75.83	78.76	85.35	80.67	110812.54
Honcut to Jack	29.826	75.85	78.78	85.35	80.67	110802.45
Honcut to Jack	29.822	75.86	78.79	85.34	80.67	110784.75
Honcut to Jack	29.821	75.88	78.81	85.34	80.66	110774.66
Honcut to Jack	29.75	75.83	78.77	85.24	80.60	109217.11
Honcut to Jack	29.5	75.70	78.68	85.14	80.36	107965.48
Jack Sl - Yuba R	29.25	75.70	78.68	85.14	80.12	106938.36
Jack Sl - Yuba R	29	75.57	78.57	84.97	79.88	105627.60

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Jack Sl - Yuba R	28.75	75.32	78.36	84.66	79.65	104417.55
Jack Sl - Yuba R	28.5	75.17	78.23	84.45	79.33	103521.79
Jack Sl - Yuba R	28.324	75.03	78.12	84.28	78.95	102627.46
Jack Sl - Yuba R	28.322	75.02	78.12	84.28	78.94	102615.67
Jack Sl - Yuba R	28.309	75.01	78.10	84.26	78.91	102537.51
Jack Sl - Yuba R	28.307	75.00	78.10	84.26	78.91	102527.14
Jack Sl - Yuba R	28.25	74.96	78.06	84.20	78.79	102281.40
Jack Sl - Yuba R	28	74.80	77.92	83.96	78.51	100798.76
Jack Sl - Yuba R	27.971	74.69	77.82	83.77	78.49	100749.02
Jack Sl - Yuba R	27.963	74.67	77.79	83.72	78.48	100696.07
Jack Sl - Yuba R	27.956	74.64	77.76	83.67	78.48	100684.10
Jack Sl - Yuba R	27.952	74.57	77.69	83.49	78.47	100652.33
Jack Sl - Yuba R	27.75	74.58	77.70	83.51	78.31	99512.10
Jack Sl - Yuba R	27.5	74.31	77.44	83.06	78.10	98174.47
Jack Sl - Yuba R	27.251	73.90	77.03	82.33	77.90	97016.29
Jack Sl - Yuba R	27.25	73.90	77.03	82.32	77.90	97011.08
Yuba R - Bear R	27	73.90	77.03	82.32	77.71	95787.83
Yuba R - Bear R	26.999	73.90	77.03	82.32	77.71	95782.80
Yuba R - Bear R	26.75	73.40	76.52	81.78	77.55	94705.78
Yuba R - Bear R	26.5	72.83	75.97	81.27	77.39	93495.05
Yuba R - Bear R	26.25	72.40	75.58	80.91	77.23	92095.83
Yuba R - Bear R	26	72.04	75.25	80.61	77.07	90634.01
Yuba R - Bear R	25.75	71.73	74.96	80.33	76.91	89136.87
Yuba R - Bear R	25.5	71.47	74.71	80.08	76.74	87728.16
Yuba R - Bear R	25.25	71.21	74.45	79.79	76.49	86208.17
Yuba R - Bear R	25	70.66	73.93	79.28	76.17	84613.00
Yuba R - Bear R	24.75	70.06	73.36	78.71	75.86	84085.03
Yuba R - Bear R	24.5	69.62	72.94	78.28	75.55	83744.43
Yuba R - Bear R	24.25	69.20	72.52	77.84	75.23	83076.25
Yuba R - Bear R	24	68.87	72.22	77.54	74.92	82269.01
Yuba R - Bear R	23.75	68.47	71.83	77.14	74.61	80891.65
Yuba R - Bear R	23.5	68.21	71.58	76.88	74.25	79494.60
Yuba R - Bear R	23.25	67.83	71.22	76.50	73.87	78032.72
Yuba R - Bear R	23	67.44	70.83	76.07	73.49	76810.25
Yuba R - Bear R	22.75	67.13	70.51	75.72	73.11	75345.95
Yuba R - Bear R	22.5	66.68	70.06	75.21	72.73	74107.24
Yuba R - Bear R	22.25	66.30	69.67	74.76	72.35	72852.32
Yuba R - Bear R	22	66.03	69.40	74.45	71.97	71497.68
Yuba R - Bear R	21.75	65.65	69.03	74.04	71.41	70018.45
Yuba R - Bear R	21.5	65.34	68.71	73.68	70.82	68712.35
Yuba R - Bear R	21.25	64.96	68.34	73.28	70.23	67330.45
Yuba R - Bear R	21	64.67	68.05	72.94	69.77	66047.23
Yuba R - Bear R	20.75	64.46	67.82	72.67	69.30	64675.51
Yuba R - Bear R	20.5	64.28	67.63	72.42	68.83	63332.45
Yuba R - Bear R	20.25	64.09	67.43	72.17	68.37	61977.06
Yuba R - Bear R	20	63.92	67.24	71.94	67.90	60460.00
Yuba R - Bear R	19.75	63.75	67.07	71.74	67.74	58852.41
Yuba R - Bear R	19.5	63.62	66.93	71.59	67.58	56862.66
Yuba R - Bear R	19.25	63.51	66.82	71.46	67.37	55516.59
Yuba R - Bear R	19	63.41	66.72	71.35	67.15	54713.04
Yuba R - Bear R	18.75	63.26	66.56	71.16	66.93	53622.77
Yuba R - Bear R	18.5	63.17	66.47	71.05	66.71	52897.52

Feather River Reach	HEC-RAS River STA	100yr Max WSE (NAVD88-ft)	200yr Max WSE (NAVD88-ft)	500yr Max WSE (NAVD88-ft)	DWR 1957 Profile (NAVD88-ft)	Wood Rodgers Design STA
Yuba R - Bear R	18.25	63.06	66.35	70.92	66.45	51890.28
Yuba R - Bear R	18	62.86	66.14	70.67	66.19	49704.43
Yuba R - Bear R	17.75	62.71	65.98	70.49	65.93	49399.72
Yuba R - Bear R	17.5	62.55	65.81	70.29	65.67	49114.25
Yuba R - Bear R	17.25	62.36	65.62	70.07	65.41	48794.83
Yuba R - Bear R	17	61.93	65.19	69.60	65.16	48556.49
Yuba R - Bear R	16.75	61.65	64.90	69.28	64.90	48094.20
Yuba R - Bear R	16.5	61.35	64.57	68.91	64.39	47013.16
Yuba R - Bear R	16.25	61.14	64.34	68.64	63.87	46228.38
Yuba R - Bear R	16	60.82	63.99	68.25	63.36	45101.47
Yuba R - Bear R	15.75	60.21	63.29	67.45	62.85	43356.36
Yuba R - Bear R	15.5	59.63	62.64	66.68	62.33	41613.14
Yuba R - Bear R	15.25	59.12	62.06	66.01	61.82	40305.41
Yuba R - Bear R	15	58.72	61.58	65.42	61.31	39102.69
Yuba R - Bear R	14.75	58.35	61.18	64.99	60.60	37817.10
Yuba R - Bear R	14.5	57.98	60.75	64.49	59.88	36319.37
Yuba R - Bear R	14.25	57.43	60.10	63.72	59.24	34904.17
Yuba R - Bear R	14	57.10	59.73	63.28	58.89	33507.55
Yuba R - Bear R	13.75	56.82	59.37	62.84	58.53	32270.43
Yuba R - Bear R	13.5	56.43	58.92	62.29	58.17	31239.13
Yuba R - Bear R	13.25	56.21	58.66	62.01	57.82	29977.40
Yuba R - Bear R	13	56.14	58.60	61.97	57.46	28644.35
Yuba R - Bear R	12.75	55.98	58.42	61.76	57.11	27255.90
Yuba R - Bear R	12.5	55.90	58.34	61.69	56.82	26065.40
Yuba R - Bear R	12.25	55.66	58.10	61.43	56.59	24642.20
Reach 35	12	55.66	58.10	61.43	56.37	23313.05
Reach 35	11.75	55.52	57.96	61.30	56.15	21993.69
Reach 35	11.599	55.49	57.93	61.25	56.02	21069.77
Reach 35	11.5	55.36	57.81	61.13	55.93	20354.66
Reach 35	11.25	55.16	57.58	60.87	55.71	18182.41
Reach 35	11	54.86	57.26	60.50	55.44	16871.48
Reach 35	10.75	54.71	57.10	60.33	55.01	15547.88
Reach 35	10.5	54.47	56.84	60.02	54.57	14278.44
Reach 35	10.25	54.03	56.34	59.40	54.13	13850.18
Reach 35	10	53.82	56.12	59.15	53.69	12847.13
Reach 35	9.75	53.52	55.77	58.73	53.27	11597.74
Reach 35	9.5	53.18	55.39	58.28	52.91	10595.55
Reach 35	9.278	53.12	55.34	58.23	52.59	9814.09
Reach 35	9.265	52.82	54.98	57.76	52.56	9758.91
Reach 35	9.2	52.70	54.84	57.59	52.39	9164.29
Reach 35	9	52.35	54.46	57.13	51.55	8445.84
Reach 35	8.75	51.56	53.57	56.04	50.44	7531.76
Reach 35	8.5	51.07	53.05	55.44	49.34	6548.71
Reach 35	8.25	50.71	52.67	55.01	48.23	3573.02
Reach 35	8	49.98	51.88	54.03	47.12	2528.45
Reach 35	7.75	49.55	51.41	53.39	46.02	1733.43
Reach 35	7.55	49.33	51.16	53.05	44.98	1275.43

Table 4. Comparison of Mar 2012 vs. July 2012 Design Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE (MAR 2012)	100yr Max WSE (JUL 2012)	Diff. (ft)	200yr Max WSE (MAR 2012)	200yr Max WSE (JUL 2012)	Diff. (ft)	500yr Max WSE (MAR 2012)	500yr Max WSE (JUL 2012)	Diff. (ft)
Upper	58.51	130.32	130.40	0.08	132.03	131.65	-0.38	137.14	133.93	-3.21
Upper	58.26	129.25	129.63	0.38	131.01	130.93	-0.08	136.03	133.27	-2.76
Upper	57.95	127.30	127.58	0.28	128.94	128.84	-0.10	134.46	131.18	-3.28
Upper	57.7	124.59	125.43	0.84	126.04	126.75	0.71	132.60	129.78	-2.82
Upper	57.45	122.54	123.70	1.16	123.89	125.06	1.17	130.41	129.32	-1.09
Upper	57.17	120.27	121.83	1.56	121.48	123.23	1.75	127.39	128.92	1.53
Upper	56.94	119.72	120.56	0.84	121.02	122.09	1.07	126.81	128.43	1.62
Upper	56.61	119.04	119.58	0.54	120.36	121.22	0.86	126.18	128.12	1.94
Upper	56.43	118.70	119.16	0.46	120.04	120.70	0.66	125.79	127.29	1.50
Upper	56.2	117.82	118.12	0.30	119.19	119.62	0.43	124.92	126.03	1.11
Upper	56.02	117.18	117.50	0.32	118.55	119.03	0.48	124.13	125.23	1.10
Upper	55.8	115.95	116.16	0.21	117.20	117.54	0.34	122.24	123.26	1.02
Upper	55.55	115.34	115.43	0.09	116.58	116.71	0.13	121.42	121.94	0.52
Upper	55.35	114.23	114.16	-0.07	115.38	115.29	-0.09	119.72	119.49	-0.23
Upper	55.03	112.90	112.90	0.00	113.96	113.98	0.02	117.87	118.03	0.16
Upper	54.45	110.87	110.87	0.00	111.90	111.92	0.02	115.86	116.03	0.17
Upper	54.2	110.15	110.15	0.00	111.17	111.19	0.02	115.02	115.19	0.17
Upper	54.04	109.82	109.82	0.00	110.86	110.88	0.02	114.74	114.91	0.17
Upper	53.84	109.01	109.01	0.00	110.08	110.10	0.02	113.99	114.17	0.18
Upper	53.52	107.58	107.58	0.00	108.54	108.55	0.01	112.31	112.49	0.18
Upper	53.22	106.33	106.33	0.00	107.26	107.27	0.01	110.78	110.96	0.18
Upper	52.89	104.81	104.81	0.00	105.71	105.73	0.02	109.17	109.34	0.17
Upper	52.6	103.63	103.63	0.00	104.49	104.51	0.02	107.82	107.98	0.16
Upper	52.21	102.99	102.99	0.00	103.81	103.83	0.02	107.01	107.18	0.17
Upper	51.95	102.73	102.73	0.00	103.54	103.56	0.02	106.68	106.84	0.16
Upper	51.35	101.83	101.83	0.00	102.74	102.75	0.01	106.02	106.19	0.17
Upper	51.1777	101.65	101.65	0.00	102.54	102.55	0.01	105.80	105.97	0.17
Upper	51.04	101.54	101.54	0.00	102.42	102.43	0.01	105.65	105.82	0.17
Upper	50.84	100.98	100.98	0.00	101.90	101.91	0.01	105.18	105.35	0.17
Upper	50.7	100.23	100.23	0.00	101.32	101.34	0.02	104.79	104.97	0.18
Upper	50.59	98.83	98.83	0.00	100.21	100.24	0.03	104.18	104.35	0.17
Upper	50.498	98.73	98.73	0.00	99.99	100.01	0.02	103.98	104.15	0.17
Upper	50.496	98.67	98.68	0.01	99.94	99.96	0.02	103.90	104.08	0.18
Upper	50.489	98.64	98.65	0.01	99.86	99.88	0.02	103.75	103.93	0.18
Upper	50.487	98.69	98.69	0.00	99.91	99.93	0.02	103.77	103.95	0.18
Upper	50.2	97.95	97.95	0.00	98.92	98.93	0.01	102.75	102.93	0.18
Upper	50.06	97.10	97.11	0.01	98.12	98.14	0.02	102.03	102.21	0.18
Upper	49.78	95.96	95.96	0.00	96.97	96.98	0.01	100.93	101.12	0.19
Upper	49.58	95.11	95.12	0.01	96.12	96.13	0.01	100.18	100.35	0.17
Upper	49.38	94.51	94.52	0.01	95.49	95.50	0.01	99.53	99.70	0.17
Upper	49.21	94.12	94.13	0.01	95.11	95.12	0.01	99.22	99.39	0.17
Upper	48.99	93.86	93.87	0.01	94.86	94.87	0.01	99.01	99.18	0.17
Upper	48.85	93.54	93.54	0.00	94.54	94.55	0.01	98.74	98.91	0.17
Upper	48.66	93.34	93.34	0.00	94.33	94.34	0.01	98.53	98.70	0.17
Upper	48.39	93.02	93.03	0.01	94.02	94.03	0.01	98.24	98.40	0.16
Upper	48.21	92.70	92.70	0.00	93.69	93.70	0.01	97.92	98.09	0.17
Upper	48.07	92.25	92.26	0.01	93.26	93.26	0.00	97.61	97.78	0.17
Upper	47.7	91.39	91.40	0.01	92.43	92.43	0.00	97.02	97.21	0.19
Upper	47.55	90.83	90.84	0.01	91.92	91.92	0.00	96.72	96.93	0.21
Upper	47.2	90.24	90.25	0.01	91.36	91.37	0.01	96.31	96.53	0.22
Upper	47.04	90.01	90.02	0.01	91.14	91.15	0.01	96.16	96.38	0.22
Upper	46.69	89.45	89.46	0.01	90.55	90.55	0.00	95.84	96.07	0.23
Upper	46.53	89.16	89.17	0.01	90.22	90.23	0.01	95.66	95.90	0.24
Honcut to Jack	46.45	89.16	89.17	0.01	90.22	90.23	0.01	95.66	95.90	0.24
Honcut to Jack	46.2	88.94	88.96	0.02	90.02	90.02	0.00	95.46	95.70	0.24
Honcut to Jack	45.98	88.71	88.72	0.01	89.80	89.80	0.00	95.24	95.47	0.23
Honcut to Jack	45.71	88.22	88.23	0.01	89.34	89.35	0.01	94.85	95.08	0.23
Honcut to Jack	45.58	87.96	87.97	0.01	89.10	89.10	0.00	94.64	94.86	0.22
Honcut to Jack	45.44	87.79	87.80	0.01	88.94	88.94	0.00	94.49	94.70	0.21
Honcut to Jack	45.26	87.57	87.57	0.00	88.73	88.74	0.01	94.29	94.50	0.21
Honcut to Jack	45.03	87.39	87.40	0.01	88.57	88.57	0.00	94.12	94.33	0.21
Honcut to Jack	44.76	87.19	87.20	0.01	88.38	88.38	0.00	93.95	94.14	0.19
Honcut to Jack	44.6326	87.11	87.11	0.00	88.29	88.30	0.01	93.86	94.05	0.19
Honcut to Jack	44.5	86.96	86.96	0.00	88.15	88.15	0.00	93.71	93.90	0.19
Honcut to Jack	44.23	86.74	86.74	0.00	87.94	87.94	0.00	93.51	93.69	0.18
Honcut to Jack	43.46	86.15	86.15	0.00	87.43	87.43	0.00	93.10	93.26	0.16
Honcut to Jack	43.34	85.88	85.89	0.01	87.19	87.19	0.00	92.91	93.07	0.16
Honcut to Jack	43.28	85.77	85.77	0.00	87.09	87.09	0.00	92.88	93.04	0.16
Honcut to Jack	43.23	85.62	85.62	0.00	86.96	86.96	0.00	92.82	92.97	0.15
Honcut to Jack	43.12	85.32	85.32	0.00	86.70	86.70	0.00	92.70	92.85	0.15
Honcut to Jack	43.06	85.25	85.25	0.00	86.64	86.64	0.00	92.67	92.82	0.15
Honcut to Jack	43.01	85.19	85.19	0.00	86.59	86.59	0.00	92.62	92.76	0.14
Honcut to Jack	42.65	85.05	85.05	0.00	86.47	86.47	0.00	92.52	92.67	0.15
Honcut to Jack	42.47	84.85	84.85	0.00	86.29	86.29	0.00	92.36	92.50	0.14
Honcut to Jack	42.19	84.56	84.56	0.00	86.03	86.03	0.00	92.16	92.29	0.13

Table 4. Comparison of Mar 2012 vs. July 2012 Design Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE (MAR 2012)	100yr Max WSE (JUL 2012)	Diff. (ft)	200yr Max WSE (MAR 2012)	200yr Max WSE (JUL 2012)	Diff. (ft)	500yr Max WSE (MAR 2012)	500yr Max WSE (JUL 2012)	Diff. (ft)
Honcut to Jack	42.01	84.50	84.50	0.00	85.98	85.98	0.00	92.12	92.26	0.14
Honcut to Jack	41.61	84.26	84.27	0.01	85.78	85.77	-0.01	91.97	92.10	0.13
Honcut to Jack	41.55	84.16	84.17	0.01	85.69	85.69	0.00	91.90	92.03	0.13
Honcut to Jack	41.2	83.90	83.90	0.00	85.47	85.46	-0.01	91.74	91.87	0.13
Honcut to Jack	40.7	83.73	83.73	0.00	85.33	85.32	-0.01	91.64	91.76	0.12
Honcut to Jack	40.49	83.49	83.49	0.00	85.11	85.10	-0.01	91.46	91.59	0.13
Honcut to Jack	40.19	83.28	83.29	0.01	84.93	84.92	-0.01	91.33	91.45	0.12
Honcut to Jack	39.45	82.75	82.77	0.02	84.47	84.46	-0.01	90.97	91.09	0.12
Honcut to Jack	39.23	82.42	82.44	0.02	84.20	84.16	-0.04	90.73	90.84	0.11
Honcut to Jack	38.94	82.02	82.06	0.04	83.89	83.81	-0.08	90.45	90.55	0.10
Honcut to Jack	38.71	81.77	81.81	0.04	83.69	83.58	-0.11	90.26	90.36	0.10
Honcut to Jack	38.45	81.60	81.64	0.04	83.55	83.43	-0.12	90.13	90.23	0.10
Honcut to Jack	38.27	81.47	81.52	0.05	83.45	83.32	-0.13	90.03	90.12	0.09
Honcut to Jack	37.95	81.29	81.34	0.05	83.31	83.16	-0.15	89.88	89.97	0.09
Honcut to Jack	37.68	81.13	81.18	0.05	83.18	83.02	-0.16	89.74	89.83	0.09
Honcut to Jack	37.45	80.95	81.01	0.06	83.04	82.87	-0.17	89.59	89.68	0.09
Honcut to Jack	37.29	80.80	80.86	0.06	82.91	82.73	-0.18	89.44	89.52	0.08
Honcut to Jack	36.45	80.20	80.27	0.07	82.48	82.27	-0.21	89.00	89.08	0.08
Honcut to Jack	36.35	80.01	80.08	0.07	82.34	82.12	-0.22	88.86	88.95	0.09
Honcut to Jack	36.24	79.77	79.85	0.08	82.18	81.95	-0.23	88.72	88.80	0.08
Honcut to Jack	35.78	79.22	79.30	0.08	81.79	81.53	-0.26	88.34	88.42	0.08
Honcut to Jack	35.5	79.07	79.15	0.08	81.67	81.41	-0.26	88.20	88.28	0.08
Honcut to Jack	35.25	78.97	79.05	0.08	81.60	81.33	-0.27	88.12	88.20	0.08
Honcut to Jack	34.8	78.89	78.97	0.08	81.54	81.26	-0.28	88.05	88.13	0.08
Honcut to Jack	34.5	78.80	78.88	0.08	81.47	81.19	-0.28	87.97	88.05	0.08
Honcut to Jack	34.07	78.72	78.80	0.08	81.41	81.13	-0.28	87.90	87.98	0.08
Honcut to Jack	33.5	78.63	78.71	0.08	81.34	81.05	-0.29	87.82	87.90	0.08
Honcut to Jack	33.25	78.50	78.58	0.08	81.25	80.95	-0.30	87.72	87.79	0.07
Honcut to Jack	33	78.37	78.45	0.08	81.15	80.85	-0.30	87.61	87.68	0.07
Honcut to Jack	32.75	78.21	78.28	0.07	81.03	80.72	-0.31	87.46	87.53	0.07
Honcut to Jack	32.5	78.09	78.16	0.07	80.93	80.62	-0.31	87.34	87.41	0.07
Honcut to Jack	32.25	77.98	78.05	0.07	80.85	80.53	-0.32	87.24	87.32	0.08
Honcut to Jack	32	77.82	77.89	0.07	80.73	80.40	-0.33	87.09	87.16	0.07
Honcut to Jack	31.75	77.62	77.69	0.07	80.57	80.23	-0.34	86.88	86.96	0.08
Honcut to Jack	31.5	77.43	77.49	0.06	80.42	80.07	-0.35	86.68	86.76	0.08
Honcut to Jack	31.25	77.25	77.31	0.06	80.28	79.92	-0.36	86.49	86.57	0.08
Honcut to Jack	31	77.06	77.11	0.05	80.13	79.77	-0.36	86.30	86.38	0.08
Honcut to Jack	30.75	76.88	76.93	0.05	80.00	79.62	-0.38	86.12	86.20	0.08
Honcut to Jack	30.5	76.67	76.70	0.03	79.84	79.45	-0.39	85.92	86.00	0.08
Honcut to Jack	30.25	76.45	76.48	0.03	79.67	79.27	-0.40	85.70	85.78	0.08
Honcut to Jack	30	76.13	76.14	0.01	79.42	79.01	-0.41	85.35	85.44	0.09
Honcut to Jack	29.828	75.84	75.83	-0.01	79.20	78.76	-0.44	85.27	85.35	0.08
Honcut to Jack	29.826	75.86	75.85	-0.01	79.21	78.78	-0.43	85.27	85.35	0.08
Honcut to Jack	29.822	75.87	75.86	-0.01	79.23	78.79	-0.44	85.26	85.34	0.08
Honcut to Jack	29.821	75.88	75.88	0.00	79.24	78.81	-0.43	85.25	85.34	0.09
Honcut to Jack	29.75	75.83	75.83	0.00	79.21	78.77	-0.44	85.16	85.24	0.08
Honcut to Jack	29.5	75.72	75.70	-0.02	79.13	78.68	-0.45	85.06	85.14	0.08
Jack Sl - Yuba R	29.25	75.72	75.70	-0.02	79.13	78.68	-0.45	85.06	85.14	0.08
Jack Sl - Yuba R	29	75.59	75.57	-0.02	78.98	78.57	-0.41	84.86	84.97	0.11
Jack Sl - Yuba R	28.75	75.35	75.32	-0.03	78.71	78.36	-0.35	84.50	84.66	0.16
Jack Sl - Yuba R	28.5	75.21	75.17	-0.04	78.54	78.23	-0.31	84.27	84.45	0.18
Jack Sl - Yuba R	28.324	75.07	75.03	-0.04	78.39	78.12	-0.27	84.07	84.28	0.21
Jack Sl - Yuba R	28.322	75.07	75.02	-0.05	78.39	78.12	-0.27	84.06	84.28	0.22
Jack Sl - Yuba R	28.309	75.05	75.01	-0.04	78.37	78.10	-0.27	84.05	84.26	0.21
Jack Sl - Yuba R	28.307	75.05	75.00	-0.05	78.37	78.10	-0.27	84.04	84.26	0.22
Jack Sl - Yuba R	28.25	75.01	74.96	-0.05	78.32	78.06	-0.26	83.97	84.20	0.23
Jack Sl - Yuba R	28	74.85	74.80	-0.05	78.13	77.92	-0.21	83.70	83.96	0.26
Jack Sl - Yuba R	27.971	74.75	74.69	-0.06	77.99	77.82	-0.17	83.48	83.77	0.29
Jack Sl - Yuba R	27.963	74.73	74.67	-0.06	77.96	77.79	-0.17	83.42	83.72	0.30
Jack Sl - Yuba R	27.956	74.70	74.64	-0.06	77.92	77.76	-0.16	83.36	83.67	0.31
Jack Sl - Yuba R	27.952	74.63	74.57	-0.06	77.82	77.69	-0.13	83.17	83.49	0.32
Jack Sl - Yuba R	27.75	74.64	74.58	-0.06	77.83	77.70	-0.13	83.19	83.51	0.32
Jack Sl - Yuba R	27.5	74.36	74.31	-0.05	77.48	77.44	-0.04	82.66	83.06	0.40
Jack Sl - Yuba R	27.251	73.93	73.90	-0.03	76.91	77.03	0.12	81.77	82.33	0.56
Jack Sl - Yuba R	27.25	73.92	73.90	-0.02	76.91	77.03	0.12	81.76	82.32	0.56
Yuba R - Bear R	27	73.92	73.90	-0.02	76.91	77.03	0.12	81.76	82.32	0.56
Yuba R - Bear R	26.999	73.92	73.90	-0.02	76.91	77.03	0.12	81.76	82.32	0.56
Yuba R - Bear R	26.75	73.42	73.40	-0.02	76.39	76.52	0.13	81.23	81.78	0.55
Yuba R - Bear R	26.5	72.85	72.83	-0.02	75.85	75.97	0.12	80.72	81.27	0.55
Yuba R - Bear R	26.25	72.42	72.40	-0.02	75.45	75.58	0.13	80.36	80.91	0.55
Yuba R - Bear R	26	72.06	72.04	-0.02	75.13	75.25	0.12	80.06	80.61	0.55
Yuba R - Bear R	25.75	71.74	71.73	-0.01	74.83	74.96	0.13	79.78	80.33	0.55
Yuba R - Bear R	25.5	71.49	71.47	-0.02	74.59	74.71	0.12	79.54	80.08	0.54
Yuba R - Bear R	25.25	71.23	71.21	-0.02	74.32	74.45	0.13	79.26	79.79	0.53
Yuba R - Bear R	25	70.68	70.66	-0.02	73.80	73.93	0.13	78.76	79.28	0.52
Yuba R - Bear R	24.75	70.08	70.06	-0.02	73.24	73.36	0.12	78.20	78.71	0.51
Yuba R - Bear R	24.5	69.64	69.62	-0.02	72.81	72.94	0.13	77.77	78.28	0.51

Table 4. Comparison of Mar 2012 vs. July 2012 Design Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE (MAR 2012)	100yr Max WSE (JUL 2012)	Diff. (ft)	200yr Max WSE (MAR 2012)	200yr Max WSE (JUL 2012)	Diff. (ft)	500yr Max WSE (MAR 2012)	500yr Max WSE (JUL 2012)	Diff. (ft)
Yuba R - Bear R	24.25	69.21	69.20	-0.01	72.39	72.52	0.13	77.35	77.84	0.49
Yuba R - Bear R	24	68.89	68.87	-0.02	72.09	72.22	0.13	77.05	77.54	0.49
Yuba R - Bear R	23.75	68.49	68.47	-0.02	71.71	71.83	0.12	76.67	77.14	0.47
Yuba R - Bear R	23.5	68.23	68.21	-0.02	71.45	71.58	0.13	76.41	76.88	0.47
Yuba R - Bear R	23.25	67.85	67.83	-0.02	71.09	71.22	0.13	76.04	76.50	0.46
Yuba R - Bear R	23	67.46	67.44	-0.02	70.70	70.83	0.13	75.62	76.07	0.45
Yuba R - Bear R	22.75	67.15	67.13	-0.02	70.39	70.51	0.12	75.28	75.72	0.44
Yuba R - Bear R	22.5	66.70	66.68	-0.02	69.94	70.06	0.12	74.79	75.21	0.42
Yuba R - Bear R	22.25	66.32	66.30	-0.02	69.55	69.67	0.12	74.36	74.76	0.40
Yuba R - Bear R	22	66.05	66.03	-0.02	69.27	69.40	0.13	74.06	74.45	0.39
Yuba R - Bear R	21.75	65.67	65.65	-0.02	68.90	69.03	0.13	73.67	74.04	0.37
Yuba R - Bear R	21.5	65.35	65.34	-0.01	68.59	68.71	0.12	73.33	73.68	0.35
Yuba R - Bear R	21.25	64.98	64.96	-0.02	68.22	68.34	0.12	72.94	73.28	0.34
Yuba R - Bear R	21	64.69	64.67	-0.02	67.93	68.05	0.12	72.61	72.94	0.33
Yuba R - Bear R	20.75	64.47	64.46	-0.01	67.71	67.82	0.11	72.36	72.67	0.31
Yuba R - Bear R	20.5	64.29	64.28	-0.01	67.51	67.63	0.12	72.12	72.42	0.30
Yuba R - Bear R	20.25	64.11	64.09	-0.02	67.31	67.43	0.12	71.89	72.17	0.28
Yuba R - Bear R	20	63.93	63.92	-0.01	67.13	67.24	0.11	71.67	71.94	0.27
Yuba R - Bear R	19.75	63.76	63.75	-0.01	66.95	67.07	0.12	71.48	71.74	0.26
Yuba R - Bear R	19.5	63.63	63.62	-0.01	66.82	66.93	0.11	71.33	71.59	0.26
Yuba R - Bear R	19.25	63.52	63.51	-0.01	66.71	66.82	0.11	71.20	71.46	0.26
Yuba R - Bear R	19	63.43	63.41	-0.02	66.61	66.72	0.11	71.10	71.35	0.25
Yuba R - Bear R	18.75	63.27	63.26	-0.01	66.45	66.56	0.11	70.91	71.16	0.25
Yuba R - Bear R	18.5	63.18	63.17	-0.01	66.35	66.47	0.12	70.81	71.05	0.24
Yuba R - Bear R	18.25	63.07	63.06	-0.01	66.24	66.35	0.11	70.68	70.92	0.24
Yuba R - Bear R	18	62.88	62.86	-0.02	66.03	66.14	0.11	70.44	70.67	0.23
Yuba R - Bear R	17.75	62.73	62.71	-0.02	65.87	65.98	0.11	70.26	70.49	0.23
Yuba R - Bear R	17.5	62.57	62.55	-0.02	65.70	65.81	0.11	70.06	70.29	0.23
Yuba R - Bear R	17.25	62.37	62.36	-0.01	65.51	65.62	0.11	69.85	70.07	0.22
Yuba R - Bear R	17	61.95	61.93	-0.02	65.08	65.19	0.11	69.39	69.60	0.21
Yuba R - Bear R	16.75	61.67	61.65	-0.02	64.79	64.90	0.11	69.07	69.28	0.21
Yuba R - Bear R	16.5	61.37	61.35	-0.02	64.47	64.57	0.10	68.71	68.91	0.20
Yuba R - Bear R	16.25	61.15	61.14	-0.01	64.23	64.34	0.11	68.45	68.64	0.19
Yuba R - Bear R	16	60.83	60.82	-0.01	63.89	63.99	0.10	68.06	68.25	0.19
Yuba R - Bear R	15.75	60.22	60.21	-0.01	63.19	63.29	0.10	67.26	67.45	0.19
Yuba R - Bear R	15.5	59.65	59.63	-0.02	62.55	62.64	0.09	66.50	66.68	0.18
Yuba R - Bear R	15.25	59.13	59.12	-0.01	61.97	62.06	0.09	65.83	66.01	0.18
Yuba R - Bear R	15	58.73	58.72	-0.01	61.50	61.58	0.08	65.26	65.42	0.16
Yuba R - Bear R	14.75	58.35	58.35	0.00	61.10	61.18	0.08	64.84	64.99	0.15
Yuba R - Bear R	14.5	57.98	57.98	0.00	60.67	60.75	0.08	64.34	64.49	0.15
Yuba R - Bear R	14.25	57.44	57.43	-0.01	60.03	60.10	0.07	63.58	63.72	0.14
Yuba R - Bear R	14	57.11	57.10	-0.01	59.65	59.73	0.08	63.15	63.28	0.13
Yuba R - Bear R	13.75	56.82	56.82	0.00	59.30	59.37	0.07	62.72	62.84	0.12
Yuba R - Bear R	13.5	56.44	56.43	-0.01	58.85	58.92	0.07	62.18	62.29	0.11
Yuba R - Bear R	13.25	56.21	56.21	0.00	58.60	58.66	0.06	61.90	62.01	0.11
Yuba R - Bear R	13	56.15	56.14	-0.01	58.53	58.60	0.07	61.85	61.97	0.12
Yuba R - Bear R	12.75	55.99	55.98	-0.01	58.35	58.42	0.07	61.65	61.76	0.11
Yuba R - Bear R	12.5	55.91	55.90	-0.01	58.28	58.34	0.06	61.58	61.69	0.11
Yuba R - Bear R	12.25	55.66	55.66	0.00	58.04	58.10	0.06	61.32	61.43	0.11
Reach 35	12	55.66	55.66	0.00	58.04	58.10	0.06	61.32	61.43	0.11
Reach 35	11.75	55.53	55.52	-0.01	57.90	57.96	0.06	61.19	61.30	0.11
Reach 35	11.599	55.49	55.49	0.00	57.86	57.93	0.07	61.15	61.25	0.10
Reach 35	11.5	55.37	55.36	-0.01	57.74	57.81	0.07	61.03	61.13	0.10
Reach 35	11.25	55.16	55.16	0.00	57.52	57.58	0.06	60.77	60.87	0.10
Reach 35	11	54.86	54.86	0.00	57.20	57.26	0.06	60.40	60.50	0.10
Reach 35	10.75	54.72	54.71	-0.01	57.05	57.10	0.05	60.23	60.33	0.10
Reach 35	10.5	54.48	54.47	-0.01	56.79	56.84	0.05	59.92	60.02	0.10
Reach 35	10.25	54.03	54.03	0.00	56.29	56.34	0.05	59.31	59.40	0.09
Reach 35	10	53.83	53.82	-0.01	56.07	56.12	0.05	59.06	59.15	0.09
Reach 35	9.75	53.52	53.52	0.00	55.73	55.77	0.04	58.65	58.73	0.08
Reach 35	9.5	53.18	53.18	0.00	55.35	55.39	0.04	58.20	58.28	0.08
Reach 35	9.278	53.12	53.12	0.00	55.30	55.34	0.04	58.15	58.23	0.08
Reach 35	9.265	52.82	52.82	0.00	54.94	54.98	0.04	57.69	57.76	0.07
Reach 35	9.2	52.70	52.70	0.00	54.81	54.84	0.03	57.52	57.59	0.07
Reach 35	9	52.35	52.35	0.00	54.42	54.46	0.04	57.06	57.13	0.07
Reach 35	8.75	51.56	51.56	0.00	53.54	53.57	0.03	55.99	56.04	0.05
Reach 35	8.5	51.07	51.07	0.00	53.03	53.05	0.02	55.39	55.44	0.05
Reach 35	8.25	50.71	50.71	0.00	52.66	52.67	0.01	54.97	55.01	0.04
Reach 35	8	49.98	49.98	0.00	51.88	51.88	0.00	53.99	54.03	0.04
Reach 35	7.75	49.55	49.55	0.00	51.41	51.41	0.00	53.36	53.39	0.03
Reach 35	7.55	49.33	49.33	0.00	51.16	51.16	0.00	53.03	53.05	0.02
			MAX:	**1.56**		**MAX:**	**1.75**		**MAX:**	**1.94**
			MIN:	**-0.07**		**MIN:**	**-0.45**		**MIN:**	**-3.28**
			AVG:	**0.03**		**AVG:**	**0.00**		**AVG:**	**0.17**

Table 5. Feather River Average Velocity and Shear Stress Information

Feather River Reach	HEC-RAS River STA	Event	Channel Velocity (ft/s)	LOB Velocity (ft/s)	ROB Velocity (ft/s)	Channel Shear Stress (lb/sq ft)	LOB Shear Stress (lb/sq ft)	ROB Shear Stress (lb/sq ft)	Wood Rodgers Design STA
Upper	58.51	100yr	5.95	-	-	0.64	-	-	235748.95
		200yr	6.09	-	-	0.66	-	-	
		500yr	7.19	-	-	0.88	-	-	
Upper	58.26	100yr	5.43	-	-	0.66	-	-	233625.38
		200yr	5.54	-	-	0.67	-	-	
		500yr	6.24	-	-	0.82	-	-	
Upper	57.95	100yr	8.22	-	-	1.58	-	-	232796.18
		200yr	8.5	-	-	1.67	-	-	
		500yr	9.15	-	-	1.9	-	-	
Upper	57.7	100yr	9.08	-	-	2	-	-	231347.46
		200yr	9.25	-	-	2.04	-	-	
		500yr	9.06	-	-	1.9	-	-	
Upper	57.45	100yr	7.83	-	-	1.66	-	-	230491.75
		200yr	7.86	-	0.35	1.7	-	0.02	
		500yr	6.45	-	1.08	1.08	-	0.1	
Upper	57.17	100yr	7.26	-	-	1.42	-	-	226547.44
		200yr	7.26	-	-	1.42	-	-	
		500yr	4.83	-	0.47	0.58	-	0.03	
Upper	56.94	100yr	7.04	-	-	0.85	-	-	223836.90
		200yr	7.04	-	-	0.85	-	-	
		500yr	4.87	-	0.95	0.37	-	0.07	
Upper	56.61	100yr	6.44	-	-	0.7	-	-	222092.63
		200yr	6.44	-	-	0.7	-	-	
		500yr	4.58	-	0.89	0.32	-	0.06	
Upper	56.43	100yr	5.98	-	-	0.62	-	-	221068.16
		200yr	6.27	-	-	0.66	-	-	
		500yr	6.8	-	1.6	0.71	-	0.17	
Upper	56.2	100yr	7.18	-	-	0.89	-	-	220516.06
		200yr	7.54	-	-	0.95	-	-	
		500yr	9.05	-	1.55	1.3	-	0.19	
Upper	56.02	100yr	6.43	-	-	0.68	-	-	220057.97
		200yr	6.66	-	-	0.72	-	-	
		500yr	8.23	-	1.39	1.03	-	0.15	
Upper	55.8	100yr	8.11	-	-	1.13	-	-	219786.54
		200yr	8.68	-	-	1.27	-	-	
		500yr	11.19	-	2.35	1.97	-	0.31	

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
236800.00		139.41	130.67	131.87	134.02				8.74	7.54	5.39
236700.00		139.43	130.64	131.85	134.01				8.78	7.58	5.41
236600.00		139.21	130.62	131.83	134.00				8.59	7.39	5.21
236500.00	138.91	138.82	130.59	131.81	133.99	8.32	7.10	4.92	8.23	7.02	4.83
236400.00		139.05	130.57	131.79	133.99				8.48	7.26	5.06
236300.00		139.42	130.54	131.77	133.98				8.88	7.65	5.44
236200.00		138.85	130.52	131.74	133.97				8.33	7.10	4.88
236100.00		138.53	130.49	131.72	133.96				8.04	6.81	4.57
236000.00	139.28	138.92	130.46	131.70	133.95	8.82	7.58	5.33	8.45	7.21	4.97
235900.00		137.38	130.44	131.68	133.94				6.94	5.70	3.44
235800.00		138.85	130.41	131.66	133.93				8.44	7.19	4.92
235700.00		139.01	130.38	131.63	133.91				8.63	7.38	5.10
235600.00		140.34	130.35	131.60	133.88				10.00	8.74	6.46
235500.00	138.84	138.98	130.31	131.57	133.85	8.53	7.27	4.98	8.67	7.41	5.13
235400.00		139.32	130.27	131.53	133.82				9.05	7.79	5.50
235300.00		139.52	130.24	131.50	133.79				9.28	8.02	5.73
235200.00		139.30	130.20	131.46	133.76				9.09	7.83	5.54
235100.00		138.91	130.16	131.43	133.73				8.74	7.48	5.18
235000.00	138.40	138.61	130.13	131.40	133.70	8.27	7.00	4.70	8.49	7.22	4.92
234900.00		138.64	130.09	131.36	133.67				8.55	7.28	4.97
234800.00		138.51	130.06	131.33	133.64				8.46	7.18	4.88
234700.00		138.91	130.02	131.29	133.60				8.89	7.61	5.30
234600.00		139.18	129.98	131.26	133.57				9.20	7.92	5.61
234500.00		138.85	129.95	131.23	133.54				8.90	7.62	5.31
234400.00		139.04	129.91	131.19	133.51				9.13	7.85	5.53
234300.00		138.93	129.87	131.16	133.48				9.05	7.77	5.45
234200.00		138.12	129.84	131.12	133.45				8.28	6.99	4.67

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
234100.00		136.70	129.80	131.09	133.42				6.90	5.61	3.28
234000.00	135.80	136.03	129.77	131.06	133.39	6.04	4.75	2.42	6.27	4.98	2.65
233900.00		135.89	129.73	131.02	133.36				6.16	4.87	2.53
233800.00		136.06	129.69	130.99	133.32				6.36	5.07	2.73
233700.00		135.63	129.66	130.96	133.29				5.98	4.68	2.34
233600.00		136.18	129.57	130.87	133.21				6.61	5.31	2.97
233500.00	137.57	137.70	129.32	130.61	132.95	8.25	6.96	4.62	8.38	7.08	4.74
233400.00		137.74	129.07	130.36	132.70				8.67	7.38	5.04
233300.00		137.61	128.83	130.11	132.45				8.78	7.50	5.16
233200.00		137.16	128.58	129.86	132.20				8.58	7.30	4.96
233100.00		137.07	128.33	129.61	131.95				8.73	7.46	5.12
233000.00	136.79	136.88	128.08	129.35	131.69	8.71	7.44	5.10	8.80	7.53	5.19
232900.00		136.62	127.84	129.10	131.44				8.79	7.52	5.18
232800.00		136.05	127.59	128.85	131.19				8.46	7.20	4.86
232700.00		136.55	127.44	128.70	131.09				9.11	7.85	5.46
232600.00		136.22	127.29	128.56	130.99				8.93	7.67	5.23
232500.00	135.82	136.14	127.14	128.41	130.89	8.68	7.41	4.92	9.00	7.73	5.25
232400.00		135.68	126.99	128.27	130.80				8.69	7.41	4.89
232300.00		135.82	126.84	128.12	130.70				8.98	7.70	5.12
232200.00		136.08	126.70	127.98	130.60				9.39	8.10	5.48
232100.00		136.22	126.55	127.84	130.51				9.67	8.38	5.71
232000.00	136.11	136.17	126.40	127.69	130.41	9.71	8.42	5.70	9.78	8.48	5.76
231900.00		136.01	126.25	127.55	130.31				9.76	8.46	5.70
231800.00		135.82	126.10	127.40	130.22				9.72	8.42	5.60
231700.00		135.80	125.95	127.26	130.12				9.85	8.54	5.68
231600.00		136.06	125.80	127.11	130.02				10.26	8.95	6.04
231500.00		135.45	125.66	126.97	129.93				9.80	8.48	5.53
231400.00		135.26	125.51	126.83	129.83				9.75	8.43	5.43
231300.00		135.35	125.33	126.66	129.75				10.02	8.70	5.60
231200.00		135.20	125.13	126.46	129.70				10.07	8.74	5.50
231100.00		134.76	124.93	126.26	129.65				9.83	8.50	5.11
231000.00		134.39	124.73	126.06	129.59				9.67	8.33	4.80
230900.00		134.71	124.53	125.87	129.54				10.19	8.85	5.17
230800.00		134.76	124.32	125.67	129.49				10.44	9.10	5.28
230700.00		134.66	124.12	125.47	129.43				10.53	9.18	5.22
230600.00		134.57	123.92	125.27	129.38				10.65	9.29	5.19
230500.00		135.11	123.72	125.08	129.32				11.39	10.03	5.78
230400.00		135.43	123.66	125.02	129.31				11.77	10.41	6.11
230300.00		135.25	123.61	124.97	129.30				11.64	10.28	5.95
230200.00		135.12	123.56	124.92	129.29				11.56	10.20	5.83
230100.00		134.82	123.51	124.88	129.28				11.31	9.94	5.54
230000.00	134.36	134.50	123.47	124.83	129.27	10.89	9.52	5.08	11.04	9.67	5.23
229900.00		133.96	123.42	124.79	129.26				10.54	9.17	4.70
229800.00		133.75	123.37	124.74	129.25				10.38	9.01	4.50
229700.00		134.02	123.32	124.69	129.24				10.69	9.32	4.78
229600.00		133.54	123.28	124.65	129.23				10.26	8.89	4.31
229500.00	133.20	133.32	123.23	124.60	129.22	9.97	8.60	3.98	10.09	8.72	4.10
229400.00		133.19	123.18	124.55	129.21				10.01	8.64	3.98
229300.00		132.97	123.13	124.51	129.20				9.84	8.47	3.77
229200.00		133.05	123.09	124.46	129.19				9.97	8.59	3.86
229100.00		133.21	123.04	124.41	129.18				10.17	8.79	4.03
229000.00	133.52	133.85	122.99	124.37	129.17	10.52	9.15	4.35	10.85	9.48	4.68
228900.00		133.24	122.95	124.32	129.16				10.30	8.92	4.08
228800.00		133.58	122.90	124.28	129.15				10.68	9.30	4.43
228700.00		133.33	122.85	124.23	129.14				10.48	9.10	4.19
228600.00		133.54	122.80	124.18	129.13				10.73	9.35	4.41
228500.00	133.09	133.37	122.76	124.14	129.12	10.34	8.96	3.97	10.62	9.24	4.25
228400.00		132.76	122.71	124.09	129.11				10.05	8.67	3.65
228300.00		132.73	122.66	124.04	129.10				10.07	8.69	3.63
228200.00		132.91	122.61	124.00	129.09				10.30	8.92	3.83
228100.00		132.82	122.57	123.95	129.08				10.25	8.87	3.74
228000.00	132.44	132.41	122.52	123.90	129.07	9.92	8.53	3.37	9.89	8.50	3.34
227900.00		132.52	122.47	123.86	129.06				10.05	8.67	3.47
227800.00		132.51	122.42	123.81	129.05				10.08	8.70	3.46
227700.00		132.32	122.38	123.76	129.04				9.95	8.56	3.29
227600.00		132.37	122.33	123.72	129.03				10.05	8.66	3.35
227500.00	132.08	132.16	122.28	123.67	129.02	9.80	8.41	3.06	9.88	8.49	3.14
227400.00		131.97	122.23	123.63	129.01				9.74	8.34	2.96
227300.00		131.64	122.19	123.58	129.00				9.45	8.06	2.64
227200.00		132.10	122.14	123.53	128.99				9.96	8.56	3.11
227100.00		131.98	122.09	123.49	128.98				9.89	8.49	3.00
227000.00	131.75	131.71	122.04	123.44	128.97	9.71	8.31	2.79	9.66	8.27	2.74
226900.00		131.72	122.00	123.39	128.96				9.72	8.32	2.76
226800.00		131.80	121.95	123.35	128.95				9.85	8.45	2.85

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
226700.00		131.42	121.90	123.30	128.94				9.52	8.12	2.49
226600.00		131.46	121.85	123.25	128.93				9.60	8.20	2.53
226500.00	131.20	131.20	121.81	123.21	128.91	9.39	7.99	2.29	9.40	7.99	2.29
226400.00		130.93	121.76	123.17	128.89				9.17	7.76	2.04
226300.00		130.52	121.71	123.13	128.88				8.81	7.40	1.65
226200.00		131.00	121.67	123.08	128.86				9.33	7.91	2.14
226100.00		130.30	121.62	123.04	128.84				8.68	7.26	1.46
226000.00	130.28	130.25	121.57	123.00	128.82	8.70	7.28	1.46	8.68	7.25	1.43
225900.00		130.21	121.53	122.96	128.80				8.68	7.25	1.41
225800.00		129.89	121.48	122.92	128.78				8.41	6.98	1.11
225700.00		130.02	121.43	122.87	128.77				8.58	7.14	1.25
225600.00		129.99	121.39	122.83	128.75				8.60	7.16	1.24
225500.00	129.82	129.85	121.34	122.79	128.73	8.48	7.03	1.09	8.51	7.06	1.12
225400.00		129.61	121.29	122.75	128.71				8.32	6.87	0.90
225300.00		129.70	121.25	122.71	128.69				8.46	7.00	1.01
225200.00		129.90	121.20	122.66	128.68				8.70	7.24	1.23
225100.00		129.89	121.15	122.62	128.66				8.74	7.27	1.23
225000.00	130.06	130.13	121.10	122.58	128.64	8.95	7.48	1.42	9.03	7.55	1.49
224900.00		130.64	121.06	122.54	128.62				9.58	8.10	2.02
224800.00		129.92	121.01	122.50	128.60				8.91	7.43	1.32
224700.00		129.72	120.96	122.45	128.59				8.76	7.27	1.13
224600.00		129.89	120.92	122.41	128.57				8.97	7.48	1.32
224500.00	129.62	129.99	120.87	122.37	128.55	8.75	7.25	1.07	9.12	7.62	1.44
224400.00		129.67	120.82	122.33	128.53				8.85	7.34	1.14
224300.00		129.75	120.78	122.28	128.51				8.97	7.47	1.24
224200.00		130.09	120.73	122.24	128.50				9.36	7.85	1.60
224100.00		129.61	120.68	122.20	128.48				8.93	7.41	1.13
224000.00	129.46	129.55	120.64	122.16	128.46	8.82	7.30	1.00	8.92	7.40	1.09
223900.00		129.58	120.59	122.12	128.44				8.99	7.46	1.14
223800.00		129.54	120.54	122.07	128.42				9.00	7.47	1.12
223700.00		129.28	120.48	122.02	128.41				8.79	7.25	0.87
223600.00		129.37	120.43	121.97	128.39				8.94	7.39	0.98
223500.00	128.97	129.15	120.37	121.92	128.37	8.60	7.05	0.60	8.78	7.23	0.78
223400.00		129.09	120.31	121.87	128.35				8.78	7.22	0.74
223300.00		128.93	120.26	121.82	128.33				8.67	7.11	0.60
223200.00		128.93	120.20	121.77	128.32				8.73	7.16	0.62
223100.00		128.72	120.15	121.72	128.30				8.58	7.00	0.42
223000.00	128.34	128.41	120.09	121.67	128.28	8.25	6.67	0.06	8.32	6.74	0.13
222900.00		128.20	120.03	121.62	128.26				8.17	6.58	-0.06
222800.00		127.90	119.98	121.57	128.25				7.92	6.32	-0.35
222700.00		128.15	119.92	121.52	128.23				8.22	6.62	-0.08
222600.00		127.92	119.87	121.47	128.21				8.05	6.44	-0.29
222500.00	127.76	127.74	119.81	121.42	128.19	7.95	6.33	-0.44	7.94	6.32	-0.45
222400.00		127.59	119.75	121.37	128.17				7.84	6.22	-0.58
222300.00		127.68	119.70	121.32	128.16				7.99	6.36	-0.47
222200.00		127.43	119.64	121.27	128.14				7.79	6.16	-0.70
222100.00		127.33	119.58	121.22	128.12				7.75	6.11	-0.79
222000.00	126.93	126.92	119.54	121.17	128.04	7.39	5.76	-1.12	7.38	5.75	-1.12
221900.00		126.77	119.50	121.12	127.96				7.27	5.65	-1.19
221800.00		126.66	119.46	121.07	127.88				7.20	5.59	-1.22
221700.00		127.22	119.42	121.02	127.80				7.80	6.20	-0.58
221600.00		127.20	119.38	120.97	127.72				7.83	6.23	-0.52
221500.00	126.83	127.10	119.34	120.92	127.64	7.49	5.91	-0.81	7.76	6.18	-0.54
221400.00		126.85	119.30	120.87	127.56				7.56	5.98	-0.71
221300.00		126.83	119.26	120.82	127.48				7.58	6.02	-0.64
221200.00		126.51	119.21	120.77	127.40				7.29	5.74	-0.89
221100.00		126.32	119.17	120.72	127.32				7.14	5.60	-1.00
221000.00	126.02	126.10	119.03	120.57	127.13	6.99	5.45	-1.12	7.07	5.53	-1.03
220900.00		125.86	118.84	120.37	126.91				7.02	5.49	-1.05
220800.00		125.87	118.65	120.18	126.68				7.22	5.70	-0.80
220700.00		126.04	118.47	119.98	126.45				7.58	6.06	-0.41
220600.00		125.84	118.28	119.78	126.22				7.56	6.05	-0.38
220500.00	125.78	125.89	118.10	119.60	126.00	7.68	6.18	-0.22	7.80	6.29	-0.11
220400.00		125.88	117.96	119.47	125.83				7.92	6.41	0.05
220300.00		125.90	117.83	119.34	125.65				8.07	6.56	0.25
220200.00		125.98	117.69	119.21	125.48				8.29	6.77	0.50
220100.00		125.97	117.56	119.08	125.30				8.41	6.88	0.66
220000.00	125.55	125.80	117.21	118.71	124.81	8.34	6.84	0.74	8.59	7.09	0.99
219900.00		125.65	116.72	118.16	124.08				8.93	7.49	1.57
219800.00		125.49	116.23	117.61	123.36				9.26	7.87	2.13
219700.00		125.40	116.05	117.42	123.07				9.35	7.98	2.33
219600.00		125.57	115.93	117.28	122.85				9.64	8.29	2.73
219500.00	125.18	125.32	115.81	117.14	122.62	9.37	8.03	2.55	9.51	8.18	2.69
219400.00		125.21	115.69	117.00	122.40				9.52	8.21	2.81

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
219300.00		125.41	115.56	116.86	122.18				9.84	8.55	3.23
219200.00		125.19	115.44	116.72	121.96				9.75	8.46	3.23
219100.00		124.99	115.38	116.65	121.84				9.61	8.34	3.15
219000.00	124.67	124.90	115.32	116.59	121.73	9.35	8.08	2.94	9.58	8.31	3.17
218900.00		124.84	115.26	116.52	121.62				9.57	8.31	3.22
218800.00		124.94	115.20	116.46	121.51				9.73	8.48	3.43
218700.00		124.80	115.15	116.39	121.39				9.65	8.41	3.41
218600.00		124.40	115.09	116.33	121.28				9.31	8.07	3.11
218500.00	124.41	124.62	115.03	116.27	121.17	9.38	8.14	3.24	9.58	8.35	3.44
218400.00		124.73	114.97	116.20	121.06				9.76	8.53	3.67
218300.00		124.39	114.92	116.14	120.95				9.48	8.26	3.44
218200.00		124.55	114.86	116.07	120.84				9.69	8.48	3.71
218100.00		124.79	114.80	116.01	120.73				9.99	8.78	4.06
218000.00		124.49	114.74	115.94	120.62				9.75	8.55	3.87
217900.00		125.12	114.69	115.88	120.51				10.43	9.24	4.61
217800.00		124.58	114.63	115.81	120.40				9.95	8.77	4.19
217700.00		124.46	114.57	115.75	120.28				9.89	8.71	4.18
217600.00		124.62	114.51	115.69	120.17				10.10	8.93	4.44
217500.00		124.66	114.46	115.62	120.06				10.20	9.03	4.59
217400.00		124.63	114.40	115.56	119.95				10.23	9.07	4.68
217300.00		124.53	114.34	115.49	119.84				10.19	9.04	4.69
217200.00		124.39	114.28	115.43	119.73				10.11	8.97	4.67
217100.00		124.40	114.23	115.36	119.62				10.17	9.04	4.78
217000.00		124.40	114.17	115.30	119.51				10.23	9.10	4.90
216900.00		124.27	114.11	115.24	119.44				10.15	9.03	4.83
216800.00		124.11	114.06	115.19	119.37				10.05	8.92	4.74
216700.00		123.95	114.01	115.13	119.31				9.94	8.82	4.64
216600.00		123.66	113.95	115.07	119.25				9.71	8.59	4.42
216500.00		123.96	113.90	115.02	119.19				10.07	8.95	4.78
216400.00		124.17	113.84	114.96	119.12				10.33	9.21	5.05
216300.00		124.27	113.79	114.90	119.06				10.49	9.37	5.21
216200.00		124.33	113.73	114.85	119.00				10.59	9.48	5.33
216100.00		124.35	113.68	114.79	118.93				10.67	9.56	5.42
216000.00		124.28	113.63	114.73	118.87				10.66	9.55	5.41
215900.00		124.03	113.57	114.68	118.81				10.46	9.35	5.22
215800.00		123.94	113.52	114.62	118.74				10.42	9.31	5.19
215700.00		123.82	113.46	114.56	118.68				10.35	9.25	5.13
215600.00		123.63	113.41	114.51	118.62				10.22	9.12	5.01
215500.00		123.46	113.35	114.45	118.56				10.11	9.01	4.91
215400.00		123.30	113.30	114.40	118.49				10.00	8.91	4.81
215300.00		123.10	113.25	114.34	118.43				9.86	8.76	4.67
215200.00		122.89	113.19	114.28	118.37				9.70	8.61	4.53
215100.00		122.78	113.14	114.23	118.30				9.65	8.56	4.48
215000.00		122.63	113.08	114.17	118.24				9.55	8.46	4.39
214900.00		122.71	113.03	114.11	118.18				9.68	8.59	4.53
214800.00		122.97	112.97	114.06	118.12				10.00	8.91	4.85
214700.00		123.06	112.92	114.00	118.05				10.14	9.06	5.01
214600.00		122.84	112.82	113.90	117.96				10.02	8.94	4.88
214500.00		123.14	112.71	113.79	117.84				10.43	9.35	5.30
214400.00		123.15	112.59	113.67	117.73				10.56	9.49	5.43
214300.00		123.51	112.47	113.55	117.61				11.03	9.96	5.90
214200.00		123.35	112.36	113.43	117.50				11.00	9.92	5.86
214100.00		123.55	112.24	113.31	117.38				11.31	10.24	6.17
214000.00		123.34	112.12	113.19	117.27				11.21	10.15	6.07
213900.00		123.36	112.01	113.07	117.15				11.35	10.28	6.20
213800.00		123.29	111.89	112.96	117.04				11.40	10.34	6.26
213700.00		122.90	111.77	112.84	116.92				11.13	10.07	5.98
213600.00		122.94	111.66	112.72	116.81				11.28	10.22	6.14
213500.00	122.63	122.65	111.54	112.60	116.69	11.09	10.03	5.94	11.11	10.05	5.96
213400.00		122.52	111.42	112.48	116.58				11.09	10.03	5.94
213300.00		122.48	111.31	112.36	116.46				11.17	10.12	6.02
213200.00		122.21	111.19	112.25	116.35				11.02	9.96	5.86
213100.00		122.09	111.07	112.13	116.23				11.02	9.96	5.86
213000.00	121.65	121.65	110.96	112.01	116.12	10.70	9.64	5.54	10.69	9.64	5.54
212900.00		121.68	110.86	111.91	116.02				10.82	9.77	5.66
212800.00		121.26	110.84	111.89	115.99				10.42	9.38	5.27
212700.00		121.26	110.81	111.86	115.96				10.45	9.40	5.30
212600.00		121.07	110.79	111.83	115.93				10.28	9.23	5.14
212500.00	121.14	121.18	110.76	111.81	115.90	10.38	9.33	5.24	10.42	9.38	5.28
212400.00		121.09	110.73	111.78	115.87				10.35	9.31	5.22
212300.00		121.07	110.71	111.75	115.84				10.36	9.32	5.23
212200.00		120.74	110.68	111.73	115.81				10.06	9.01	4.93
212100.00		120.76	110.66	111.70	115.78				10.11	9.06	4.98
212000.00	120.56	120.59	110.63	111.68	115.75	9.93	8.88	4.81	9.96	8.92	4.84

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
211900.00		120.81	110.60	111.65	115.72				10.21	9.16	5.09
211800.00		120.92	110.58	111.62	115.69				10.35	9.30	5.23
211700.00		121.04	110.55	111.60	115.66				10.48	9.44	5.38
211600.00		120.89	110.53	111.57	115.63				10.36	9.32	5.26
211500.00	120.88	121.04	110.50	111.54	115.60	10.38	9.33	5.28	10.54	9.50	5.44
211400.00		121.14	110.47	111.52	115.57				10.66	9.62	5.57
211300.00		121.09	110.45	111.49	115.54				10.64	9.59	5.55
211200.00		120.77	110.42	111.46	115.51				10.35	9.31	5.26
211100.00		120.79	110.39	111.44	115.48				10.40	9.36	5.32
211000.00	120.69	120.95	110.37	111.41	115.45	10.32	9.28	5.24	10.58	9.54	5.51
210900.00		120.90	110.34	111.39	115.42				10.55	9.51	5.48
210800.00		120.75	110.32	111.36	115.38				10.43	9.39	5.37
210700.00		120.61	110.29	111.33	115.35				10.32	9.28	5.26
210600.00		120.79	110.26	111.31	115.32				10.52	9.48	5.46
210500.00	120.88	121.21	110.24	111.28	115.29	10.64	9.60	5.59	10.97	9.93	5.92
210400.00		121.00	110.21	111.25	115.26				10.78	9.74	5.73
210300.00		120.81	110.19	111.23	115.23				10.62	9.58	5.57
210200.00		120.77	110.16	111.20	115.20				10.61	9.57	5.57
210100.00		120.65	110.12	111.16	115.16				10.53	9.49	5.49
210000.00	120.42	120.72	110.06	111.11	115.12	10.36	9.31	5.30	10.66	9.61	5.60
209900.00		120.60	110.01	111.06	115.07				10.59	9.54	5.53
209800.00		120.38	109.95	111.00	115.02				10.43	9.38	5.36
209700.00		120.25	109.90	110.95	114.97				10.35	9.30	5.27
209600.00		120.08	109.84	110.90	114.93				10.24	9.18	5.15
209500.00	119.70	119.98	109.77	110.83	114.87	9.92	8.86	4.83	10.21	9.15	5.11
209400.00		120.12	109.70	110.76	114.80				10.42	9.35	5.32
209300.00		120.60	109.62	110.69	114.73				10.98	9.91	5.87
209200.00		120.37	109.54	110.61	114.66				10.82	9.75	5.71
209100.00		119.76	109.47	110.54	114.59				10.30	9.22	5.18
209000.00	119.24	119.60	109.39	110.47	114.52	9.85	8.77	4.72	10.21	9.13	5.08
208900.00		119.60	109.32	110.39	114.45				10.29	9.21	5.15
208800.00		119.62	109.24	110.32	114.38				10.38	9.30	5.24
208700.00		119.61	109.16	110.25	114.31				10.45	9.37	5.30
208600.00		119.42	109.09	110.17	114.24				10.33	9.24	5.18
208500.00	118.97	119.24	109.01	110.10	114.17	9.96	8.87	4.80	10.23	9.14	5.07
208400.00		119.25	108.96	110.04	114.11				10.29	9.21	5.14
208300.00		118.98	108.91	109.99	114.05				10.07	8.99	4.93
208200.00		118.81	108.86	109.93	113.99				9.96	8.88	4.83
208100.00		118.69	108.80	109.88	113.93				9.88	8.81	4.76
208000.00	118.50	118.65	108.75	109.82	113.87	9.75	8.68	4.63	9.90	8.83	4.78
207900.00		118.69	108.70	109.77	113.81				9.98	8.92	4.88
207800.00		118.60	108.65	109.71	113.75				9.95	8.89	4.86
207700.00		118.60	108.60	109.66	113.69				10.00	8.94	4.91
207600.00		118.51	108.55	109.60	113.63				9.96	8.91	4.89
207500.00	118.20	118.37	108.50	109.54	113.57	9.70	8.65	4.63	9.87	8.83	4.80
207400.00		118.42	108.45	109.49	113.51				9.98	8.93	4.91
207300.00		118.30	108.39	109.43	113.45				9.90	8.87	4.85
207200.00		118.20	108.34	109.38	113.39				9.85	8.82	4.81
207100.00		117.86	108.29	109.32	113.33				9.56	8.54	4.53
207000.00	117.40	117.71	108.24	109.27	113.27	9.16	8.14	4.14	9.47	8.45	4.45
206900.00		117.85	108.19	109.21	113.21				9.66	8.64	4.64
206800.00		117.92	108.14	109.15	113.14				9.78	8.76	4.77
206700.00		117.75	108.09	109.10	113.08				9.66	8.65	4.66
206600.00		117.82	108.03	109.04	113.02				9.79	8.78	4.80
206500.00	117.99	117.95	107.98	108.99	112.96	10.01	9.00	5.03	9.96	8.96	4.98
206400.00		117.77	107.93	108.93	112.90				9.84	8.84	4.86
206300.00		117.72	107.88	108.88	112.84				9.84	8.84	4.88
206200.00		117.63	107.83	108.82	112.78				9.80	8.81	4.85
206100.00		117.88	107.78	108.76	112.72				10.10	9.11	5.16
206000.00	117.71	118.20	107.73	108.71	112.66	9.98	9.00	5.04	10.47	9.49	5.53
205900.00		118.00	107.68	108.65	112.60				10.32	9.34	5.40
205800.00		117.76	107.62	108.60	112.54				10.14	9.17	5.22
205700.00		117.81	107.57	108.54	112.48				10.24	9.27	5.33
205600.00		117.30	107.48	108.45	112.37				9.82	8.85	4.93
205500.00	116.95	117.20	107.40	108.36	112.26	9.56	8.59	4.69	9.80	8.84	4.94
205400.00		117.03	107.31	108.27	112.16				9.73	8.76	4.88
205300.00		116.97	107.22	108.18	112.05				9.75	8.79	4.92
205200.00		116.83	107.14	108.10	111.95				9.70	8.74	4.89
205100.00		116.59	107.05	108.01	111.84				9.54	8.58	4.74
205000.00	116.29	116.34	106.96	107.92	111.74	9.32	8.37	4.55	9.38	8.43	4.61
204900.00		116.53	106.88	107.83	111.63				9.65	8.70	4.90
204800.00		116.33	106.79	107.74	111.52				9.54	8.59	4.81
204700.00		116.04	106.70	107.65	111.42				9.34	8.39	4.63
204600.00		115.92	106.62	107.57	111.31				9.30	8.35	4.61

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
204500.00	115.85	115.97	106.53	107.48	111.21	9.32	8.38	4.65	9.44	8.50	4.77
204400.00		115.83	106.45	107.39	111.10				9.38	8.44	4.72
204300.00		115.68	106.36	107.30	111.00				9.32	8.38	4.68
204200.00		115.46	106.26	107.20	110.89				9.19	8.25	4.57
204100.00		115.46	106.16	107.10	110.78				9.30	8.36	4.68
204000.00	114.96	115.14	106.06	107.00	110.67	8.90	7.97	4.29	9.08	8.14	4.47
203900.00		115.12	105.96	106.90	110.57				9.16	8.23	4.56
203800.00		114.76	105.86	106.79	110.46				8.90	7.97	4.30
203700.00		114.48	105.76	106.69	110.35				8.72	7.79	4.13
203600.00		114.58	105.66	106.59	110.25				8.92	7.99	4.34
203500.00	114.06	114.30	105.56	106.49	110.14	8.50	7.57	3.92	8.75	7.82	4.17
203400.00		114.24	105.46	106.39	110.03				8.78	7.85	4.21
203300.00		114.33	105.36	106.28	109.92				8.97	8.05	4.41
203200.00		114.23	105.26	106.18	109.82				8.97	8.04	4.41
203100.00		113.96	105.16	106.08	109.71				8.80	7.88	4.25
203000.00	113.62	113.80	105.05	105.98	109.60	8.57	7.64	4.02	8.75	7.83	4.20
202900.00		113.87	104.95	105.88	109.49				8.91	7.99	4.37
202800.00		114.10	104.85	105.77	109.39				9.25	8.33	4.72
202700.00		114.02	104.77	105.69	109.29				9.25	8.33	4.73
202600.00		114.05	104.69	105.61	109.20				9.36	8.45	4.85
202500.00	113.34	113.68	104.62	105.53	109.12	8.72	7.81	4.22	9.06	8.15	4.56
202400.00		113.26	104.54	105.45	109.03				8.72	7.81	4.23
202300.00		113.73	104.47	105.38	108.94				9.27	8.36	4.79
202200.00		114.23	104.39	105.30	108.86				9.83	8.93	5.37
202100.00		114.18	104.32	105.22	108.77				9.86	8.96	5.41
202000.00	113.80	114.03	104.24	105.14	108.69	9.55	8.65	5.11	9.79	8.88	5.34
201900.00		114.13	104.17	105.07	108.60				9.97	9.07	5.53
201800.00		113.93	104.09	104.99	108.51				9.83	8.94	5.41
201700.00		113.60	104.02	104.91	108.43				9.58	8.69	5.17
201600.00		113.68	103.94	104.83	108.34				9.74	8.85	5.34
201500.00	113.48	113.74	103.87	104.76	108.25	9.61	8.72	5.22	9.88	8.99	5.49
201400.00		113.64	103.79	104.68	108.17				9.85	8.97	5.48
201300.00		113.43	103.72	104.60	108.08				9.71	8.83	5.35
201200.00		113.49	103.64	104.52	107.99				9.85	8.97	5.49
201100.00		113.34	103.60	104.47	107.94				9.75	8.87	5.40
201000.00	112.90	113.09	103.55	104.43	107.89	9.35	8.47	5.02	9.53	8.66	5.20
200900.00		113.20	103.51	104.39	107.83				9.68	8.81	5.36
200800.00		112.99	103.47	104.34	107.78				9.52	8.65	5.20
200700.00		113.30	103.43	104.30	107.73				9.87	9.00	5.57
200600.00		113.42	103.39	104.26	107.68				10.03	9.16	5.74
200500.00	113.50	113.61	103.35	104.21	107.63	10.15	9.29	5.87	10.26	9.40	5.98
200400.00		113.36	103.31	104.17	107.58				10.06	9.20	5.79
200300.00		112.99	103.27	104.13	107.53				9.72	8.86	5.46
200200.00		112.81	103.23	104.08	107.48				9.58	8.73	5.33
200100.00		112.98	103.19	104.04	107.43				9.79	8.94	5.55
200000.00	112.55	112.60	103.15	104.00	107.37	9.41	8.56	5.18	9.45	8.60	5.22
199900.00		112.38	103.10	103.95	107.32				9.27	8.43	5.06
199800.00		112.31	103.06	103.91	107.27				9.24	8.40	5.03
199700.00		112.33	103.02	103.87	107.22				9.31	8.47	5.11
199600.00		112.26	102.98	103.82	107.17				9.28	8.44	5.09
199500.00	112.07	112.12	102.95	103.79	107.13	9.11	8.27	4.93	9.17	8.33	4.99
199400.00		112.01	102.92	103.76	107.09				9.09	8.25	4.92
199300.00		112.05	102.89	103.73	107.05				9.15	8.32	4.99
199200.00		112.04	102.86	103.70	107.01				9.18	8.34	5.03
199100.00		111.92	102.83	103.66	106.97				9.09	8.25	4.95
199000.00	111.97	112.08	102.80	103.63	106.93	9.17	8.34	5.04	9.29	8.45	5.15
198900.00		111.67	102.77	103.60	106.89				8.90	8.07	4.78
198800.00		111.64	102.74	103.57	106.85				8.90	8.07	4.79
198700.00		111.60	102.65	103.49	106.79				8.94	8.11	4.81
198600.00		111.54	102.55	103.40	106.71				8.99	8.14	4.83
198500.00	111.43	111.51	102.45	103.31	106.64	8.98	8.12	4.79	9.06	8.20	4.87
198400.00		111.52	102.35	103.22	106.57				9.17	8.30	4.95
198300.00		111.50	102.25	103.13	106.49				9.25	8.38	5.01
198200.00		111.58	102.15	103.04	106.42				9.43	8.54	5.16
198100.00		111.13	102.05	102.95	106.35				9.08	8.19	4.79
198000.00	110.82	110.87	101.95	102.86	106.28	8.87	7.96	4.54	8.92	8.02	4.60
197900.00		110.74	101.85	102.77	106.20				8.90	7.98	4.54
197800.00		110.76	101.82	102.74	106.18				8.94	8.02	4.58
197700.00		110.59	101.81	102.73	106.17				8.78	7.86	4.42
197600.00		110.64	101.81	102.72	106.16				8.83	7.91	4.47
197500.00	110.58	110.66	101.80	102.71	106.15	8.78	7.86	4.43	8.86	7.94	4.50
197400.00		110.83	101.79	102.71	106.14				9.04	8.13	4.69
197300.00		110.60	101.78	102.70	106.13				8.82	7.90	4.47
197200.00		110.76	101.77	102.69	106.12				8.99	8.08	4.64

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
197100.00		110.78	101.76	102.68	106.11				9.02	8.11	4.67
197000.00		110.46	101.76	102.67	106.10				8.70	7.79	4.36
196900.00		110.53	101.75	102.66	106.09				8.79	7.88	4.44
196800.00		110.69	101.74	102.65	106.08				8.95	8.04	4.62
196700.00		110.78	101.73	102.64	106.07				9.04	8.14	4.71
196600.00		110.71	101.72	102.63	106.06				8.99	8.08	4.65
196500.00	110.39	110.39	101.71	102.62	106.05	8.67	7.77	4.34	8.68	7.77	4.34
196400.00		110.55	101.71	102.61	106.04				8.84	7.93	4.51
196300.00		110.58	101.70	102.60	106.03				8.89	7.98	4.56
196200.00		111.03	101.69	102.59	106.02				9.34	8.44	5.01
196100.00		110.40	101.68	102.58	106.01				8.72	7.82	4.40
196000.00	110.31	110.32	101.67	102.57	106.00	8.64	7.74	4.32	8.65	7.75	4.33
195900.00		110.74	101.66	102.57	105.99				9.07	8.17	4.75
195800.00		110.56	101.66	102.56	105.98				8.90	8.00	4.58
195700.00		110.37	101.65	102.55	105.97				8.72	7.82	4.40
195600.00		110.59	101.64	102.54	105.96				8.95	8.05	4.63
195500.00	110.55	110.55	101.64	102.54	105.95	8.92	8.02	4.60	8.91	8.01	4.60
195400.00		110.47	101.63	102.53	105.94				8.84	7.95	4.53
195300.00		110.49	101.62	102.52	105.94				8.87	7.97	4.55
195200.00		110.27	101.62	102.52	105.93				8.65	7.76	4.34
195100.00		110.23	101.61	102.51	105.92				8.62	7.72	4.31
195000.00	110.47	110.44	101.61	102.50	105.91	8.86	7.97	4.56	8.83	7.93	4.53
194900.00		110.38	101.60	102.50	105.90				8.78	7.88	4.47
194800.00		110.14	101.60	102.49	105.90				8.54	7.65	4.24
194700.00		109.96	101.59	102.49	105.89				8.37	7.48	4.07
194600.00		109.87	101.58	102.48	105.88				8.29	7.39	3.99
194500.00	109.88	110.07	101.58	102.47	105.87	8.30	7.41	4.01	8.49	7.60	4.20
194400.00		110.17	101.57	102.47	105.87				8.60	7.70	4.30
194300.00		109.89	101.57	102.46	105.86				8.32	7.43	4.03
194200.00		110.02	101.56	102.45	105.85				8.46	7.57	4.17
194100.00		109.75	101.56	102.45	105.84				8.19	7.30	3.90
194000.00	109.72	109.65	101.55	102.44	105.83	8.17	7.28	3.88	8.10	7.21	3.82
193900.00		109.72	101.54	102.44	105.83				8.18	7.29	3.90
193800.00		109.69	101.53	102.42	105.82				8.15	7.26	3.87
193700.00		109.65	101.50	102.39	105.79				8.15	7.26	3.86
193600.00		109.54	101.47	102.36	105.76				8.07	7.17	3.78
193500.00	109.36	109.41	101.44	102.33	105.73	7.92	7.02	3.62	7.98	7.08	3.68
193400.00		109.40	101.41	102.30	105.71				8.00	7.10	3.70
193300.00		109.25	101.37	102.27	105.68				7.87	6.97	3.57
193200.00		109.16	101.34	102.24	105.65				7.82	6.92	3.51
193100.00		109.10	101.31	102.21	105.63				7.79	6.88	3.47
193000.00	108.93	108.98	101.28	102.18	105.60	7.66	6.75	3.33	7.71	6.80	3.38
192900.00		108.86	101.24	102.15	105.57				7.62	6.71	3.29
192800.00		108.80	101.21	102.12	105.54				7.59	6.67	3.25
192700.00	108.73	108.79	101.18	102.09	105.52	7.55	6.64	3.22	7.61	6.69	3.27
192600.00		108.68	101.15	102.06	105.49				7.53	6.61	3.19
192500.00	108.60	108.61	101.11	102.03	105.46	7.49	6.57	3.14	7.49	6.57	3.15
192400.00	108.63	108.57	101.08	102.00	105.44	7.54	6.62	3.19	7.49	6.57	3.14
192300.00		108.56	101.05	101.97	105.41				7.51	6.59	3.15
192200.00		108.62	101.02	101.94	105.38				7.60	6.67	3.24
192100.00		108.70	100.98	101.91	105.35				7.72	6.79	3.35
192000.00	108.45	108.41	100.90	101.85	105.31	7.55	6.60	3.14	7.51	6.56	3.10
191900.00	108.24	108.33	100.81	101.78	105.26	7.43	6.46	2.97	7.52	6.55	3.07
191800.00		108.30	100.71	101.71	105.22				7.58	6.59	3.08
191700.00		108.31	100.62	101.64	105.17				7.68	6.67	3.14
191600.00		108.25	100.53	101.57	105.12				7.72	6.68	3.13
191500.00	108.22	108.17	100.44	101.50	105.07	7.78	6.72	3.14	7.73	6.67	3.09
191400.00		108.11	100.34	101.43	105.03				7.77	6.69	3.09
191300.00		107.81	100.25	101.35	104.98				7.56	6.46	2.83
191200.00		107.91	100.04	101.19	104.88				7.87	6.72	3.02
191100.00		107.87	99.79	101.00	104.78				8.08	6.88	3.10
191000.00	107.87	107.81	99.55	100.80	104.67	8.32	7.07	3.20	8.27	7.01	3.15
190900.00		107.91	99.30	100.61	104.56				8.61	7.30	3.35
190800.00		108.12	99.06	100.42	104.45				9.06	7.70	3.67
190700.00		108.18	98.83	100.24	104.35				9.35	7.95	3.83
190600.00		110.66	98.81	100.19	104.31				11.85	10.47	6.35
190500.00	108.02	108.25	98.79	100.14	104.26	9.23	7.88	3.76	9.46	8.11	3.99
190400.00		107.73	98.77	100.09	104.22				8.96	7.64	3.51
190300.00	107.30	107.05	98.74	100.04	104.18	8.56	7.26	3.12	8.31	7.01	2.88
190200.00		111.48	98.67	99.92	104.01				12.81	11.56	7.47
190100.00		106.90	98.66	99.89	103.91				8.24	7.01	2.99
190000.00	106.15	106.35	98.62	99.83	103.85	7.53	6.32	2.30	7.74	6.52	2.50
189900.00		106.66	98.57	99.77	103.79				8.08	6.88	2.87
189800.00		106.94	98.53	99.71	103.73				8.41	7.23	3.21

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
189700.00		107.16	98.49	99.65	103.67				8.67	7.50	3.49
189600.00		107.09	98.44	99.60	103.61				8.65	7.49	3.48
189500.00		107.01	98.40	99.54	103.55				8.61	7.47	3.46
189400.00		106.54	98.36	99.48	103.49				8.18	7.06	3.05
189300.00		106.36	98.31	99.42	103.43				8.05	6.94	2.93
189200.00		106.17	98.27	99.36	103.37				7.90	6.81	2.80
189100.00		105.81	98.22	99.30	103.31				7.59	6.51	2.51
189000.00	105.56	105.74	98.18	99.24	103.25	7.38	6.32	2.32	7.55	6.49	2.49
188900.00		106.00	98.14	99.18	103.19				7.87	6.82	2.82
188800.00		106.40	98.09	99.12	103.13				8.31	7.27	3.27
188700.00		106.20	98.05	99.07	103.07				8.15	7.13	3.13
188600.00		106.49	98.01	99.01	103.01				8.48	7.48	3.48
188500.00	106.01	105.98	97.96	98.95	102.95	8.05	7.06	3.06	8.02	7.03	3.03
188400.00		106.02	97.86	98.84	102.85				8.16	7.17	3.17
188300.00		105.82	97.73	98.72	102.74				8.09	7.10	3.08
188200.00		105.83	97.60	98.60	102.63				8.23	7.23	3.20
188100.00		105.86	97.47	98.48	102.52				8.39	7.38	3.34
188000.00	105.65	105.60	97.34	98.36	102.41	8.31	7.29	3.24	8.26	7.25	3.20
187900.00		105.52	97.21	98.23	102.30				8.31	7.29	3.22
187800.00		105.52	97.09	98.12	102.19				8.44	7.41	3.34
187700.00		105.52	96.99	98.02	102.09				8.53	7.50	3.43
187600.00		105.75	96.89	97.92	102.00				8.86	7.83	3.75
187500.00	105.55	105.59	96.79	97.82	101.91	8.75	7.73	3.64	8.80	7.78	3.69
187400.00		105.61	96.69	97.72	101.81				8.92	7.89	3.80
187300.00		105.46	96.59	97.62	101.72				8.86	7.84	3.74
187200.00		105.45	96.49	97.52	101.62				8.95	7.93	3.82
187100.00		105.45	96.39	97.42	101.53				9.05	8.03	3.92
187000.00	105.37	105.36	96.29	97.32	101.44	9.08	8.05	3.93	9.07	8.04	3.92
186900.00		105.07	96.20	97.22	101.34				8.87	7.85	3.72
186800.00		105.04	96.10	97.12	101.25				8.95	7.92	3.79
186700.00		104.86	96.00	97.02	101.16				8.86	7.84	3.71
186600.00		104.73	95.92	96.94	101.08				8.81	7.79	3.65
186500.00	104.81	104.86	95.86	96.88	101.03	8.95	7.93	3.78	9.00	7.98	3.83
186400.00		104.62	95.80	96.82	100.97				8.82	7.81	3.65
186300.00		104.66	95.74	96.75	100.92				8.92	7.91	3.74
186200.00		104.57	95.68	96.69	100.86				8.89	7.88	3.71
186100.00		104.41	95.61	96.63	100.80				8.80	7.78	3.61
186000.00	104.20	104.22	95.55	96.57	100.75	8.65	7.63	3.45	8.67	7.65	3.47
185900.00		104.27	95.49	96.51	100.69				8.78	7.77	3.58
185800.00	104.07	104.15	95.43	96.44	100.63	8.64	7.63	3.44	8.72	7.71	3.52
185700.00		104.36	95.37	96.38	100.58				8.99	7.98	3.78
185600.00		104.32	95.31	96.32	100.52				9.02	8.00	3.80
185500.00	103.91	104.13	95.25	96.26	100.47	8.66	7.65	3.44	8.89	7.87	3.67
185400.00		104.53	95.19	96.20	100.41				9.35	8.34	4.12
185300.00	103.87	103.93	95.12	96.13	100.35	8.74	7.73	3.51	8.80	7.79	3.57
185200.00		103.99	95.07	96.08	100.30				8.92	7.91	3.69
185100.00		103.82	95.02	96.02	100.24				8.80	7.80	3.58
185000.00	103.46	103.79	94.97	95.97	100.18	8.50	7.49	3.28	8.82	7.82	3.60
184900.00		103.56	94.92	95.92	100.13				8.65	7.65	3.43
184800.00		103.15	94.86	95.86	100.07				8.29	7.29	3.08
184700.00		103.68	94.81	95.81	100.02				8.86	7.87	3.66
184600.00		103.52	94.76	95.75	99.96				8.76	7.77	3.56
184500.00	103.26	103.66	94.71	95.70	99.90	8.56	7.57	3.36	8.95	7.96	3.76
184400.00		103.65	94.66	95.64	99.85				9.00	8.01	3.80
184300.00		103.72	94.60	95.59	99.79				9.12	8.13	3.93
184200.00		103.64	94.55	95.53	99.73				9.09	8.10	3.90
184100.00		103.59	94.50	95.48	99.68				9.09	8.11	3.91
184000.00	103.25	103.80	94.43	95.42	99.63	8.82	7.84	3.62	9.36	8.38	4.17
183900.00		103.79	94.37	95.35	99.58				9.42	8.44	4.21
183800.00		104.02	94.31	95.29	99.53				9.71	8.72	4.48
183700.00		104.20	94.25	95.23	99.48				9.96	8.97	4.72
183600.00		103.34	94.18	95.17	99.43				9.15	8.17	3.91
183500.00	102.23	102.90	94.12	95.11	99.38	8.11	7.12	2.85	8.78	7.79	3.52
183400.00		102.78	94.07	95.06	99.34				8.71	7.72	3.44
183300.00		102.67	94.01	95.00	99.29				8.66	7.67	3.38
183200.00		102.61	93.95	94.95	99.25				8.66	7.66	3.36
183100.00		102.63	93.89	94.89	99.20				8.74	7.74	3.43
183000.00	102.66	103.16	93.81	94.81	99.13	8.85	7.84	3.53	9.35	8.35	4.03
182900.00		102.75	93.70	94.70	99.04				9.05	8.05	3.71
182800.00		102.29	93.59	94.60	98.95				8.70	7.69	3.34
182700.00		102.23	93.53	94.54	98.90				8.70	7.69	3.33
182600.00		102.04	93.51	94.52	98.88				8.53	7.52	3.16
182500.00	101.91	102.31	93.49	94.49	98.85	8.42	7.41	3.05	8.83	7.82	3.46
182400.00		101.80	93.47	94.47	98.83				8.33	7.32	2.96

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
182300.00		101.69	93.44	94.45	98.81				8.24	7.24	2.88
182200.00	101.51	101.78	93.42	94.43	98.79	8.09	7.08	2.72	8.36	7.35	2.99
182100.00		102.22	93.40	94.41	98.77				8.81	7.81	3.45
182000.00	101.91	102.16	93.38	94.38	98.74	8.53	7.52	3.16	8.78	7.78	3.42
181900.00		101.83	93.36	94.36	98.72				8.47	7.47	3.11
181800.00		101.61	93.34	94.34	98.70				8.27	7.27	2.91
181700.00		101.59	93.32	94.32	98.68				8.28	7.28	2.92
181600.00		102.09	93.29	94.29	98.66				8.79	7.79	3.43
181500.00	101.57	101.85	93.27	94.27	98.63	8.30	7.30	2.93	8.58	7.58	3.22
181400.00		101.88	93.25	94.25	98.61				8.63	7.63	3.27
181300.00		101.40	93.22	94.22	98.59				8.17	7.17	2.81
181200.00		101.41	93.20	94.20	98.57				8.21	7.21	2.85
181100.00		101.55	93.18	94.18	98.54				8.37	7.37	3.01
181000.00		101.61	93.16	94.16	98.52				8.46	7.46	3.09
180900.00		101.37	93.13	94.13	98.50				8.24	7.24	2.87
180800.00		101.47	93.11	94.11	98.48				8.36	7.36	3.00
180700.00		101.65	93.09	94.09	98.45				8.56	7.56	3.19
180600.00		101.57	93.06	94.06	98.43				8.51	7.51	3.14
180500.00		101.39	93.04	94.04	98.41				8.35	7.35	2.98
180400.00		100.91	93.01	94.01	98.38				7.90	6.90	2.52
180300.00		100.91	92.98	93.98	98.35				7.93	6.93	2.55
180200.00		100.70	92.95	93.95	98.32				7.75	6.75	2.38
180100.00		100.72	92.91	93.91	98.29				7.81	6.81	2.43
180000.00		100.75	92.88	93.88	98.26				7.87	6.87	2.49
179900.00		100.64	92.85	93.85	98.23				7.80	6.80	2.42
179800.00		100.59	92.81	93.81	98.20				7.78	6.78	2.39
179700.00		100.51	92.78	93.78	98.16				7.73	6.73	2.34
179600.00		100.32	92.75	93.75	98.13				7.58	6.58	2.19
179500.00		100.10	92.71	93.71	98.10				7.39	6.39	2.00
179400.00		100.06	92.62	93.62	98.04				7.44	6.44	2.03
179300.00		99.93	92.50	93.50	97.95				7.43	6.43	1.98
179200.00		99.90	92.37	93.37	97.86				7.53	6.53	2.04
179100.00		99.96	92.26	93.26	97.78				7.70	6.70	2.18
179000.00		99.93	92.22	93.22	97.75				7.72	6.71	2.18
178900.00		100.38	92.18	93.18	97.73				8.21	7.20	2.66
178800.00		100.35	92.14	93.14	97.70				8.21	7.21	2.65
178700.00		100.08	92.10	93.10	97.67				7.98	6.97	2.41
178600.00		100.12	92.06	93.07	97.65				8.06	7.05	2.47
178500.00		100.20	92.02	93.03	97.62				8.18	7.17	2.58
178400.00		100.25	91.98	92.99	97.59				8.27	7.26	2.66
178300.00		100.32	91.94	92.95	97.57				8.38	7.37	2.75
178200.00		100.48	91.90	92.91	97.54				8.58	7.57	2.94
178100.00		100.35	91.86	92.87	97.52				8.49	7.47	2.83
178000.00		100.28	91.82	92.84	97.49				8.46	7.44	2.79
177900.00		100.39	91.78	92.80	97.46				8.60	7.59	2.92
177800.00		100.53	91.74	92.76	97.44				8.78	7.76	3.09
177700.00		100.24	91.70	92.72	97.41				8.54	7.52	2.83
177600.00		100.36	91.66	92.68	97.38				8.70	7.68	2.98
177500.00		100.40	91.62	92.65	97.36				8.78	7.76	3.04
177400.00		100.44	91.58	92.61	97.33				8.86	7.83	3.11
177300.00		100.45	91.54	92.57	97.31				8.90	7.88	3.14
177200.00		100.25	91.51	92.53	97.28				8.75	7.72	2.97
177100.00		100.16	91.47	92.49	97.25				8.70	7.67	2.91
177000.00		100.15	91.43	92.46	97.23				8.73	7.70	2.93
176900.00		100.33	91.38	92.41	97.20				8.95	7.92	3.13
176800.00		100.24	91.32	92.36	97.17				8.92	7.88	3.07
176700.00		100.22	91.26	92.31	97.14				8.96	7.92	3.08
176600.00		100.10	91.21	92.25	97.11				8.90	7.85	2.99
176500.00	99.85	100.21	91.15	92.20	97.08	8.70	7.65	2.76	9.06	8.01	3.12
176400.00	99.46	99.85	91.09	92.15	97.06	8.37	7.32	2.41	8.76	7.70	2.80
176300.00		99.38	91.03	92.10	97.03				8.35	7.28	2.35
176200.00		99.30	90.97	92.04	97.00				8.33	7.26	2.30
176100.00		99.21	90.92	91.99	96.97				8.29	7.22	2.24
176000.00	99.09	99.28	90.86	91.94	96.94	8.23	7.15	2.15	8.42	7.34	2.34
175900.00		99.15	90.82	91.90	96.92				8.33	7.25	2.23
175800.00		98.95	90.79	91.87	96.89				8.16	7.08	2.05
175700.00		98.92	90.76	91.84	96.87				8.16	7.08	2.05
175600.00		98.68	90.72	91.81	96.85				7.96	6.87	1.83
175500.00	98.52	98.80	90.69	91.78	96.83	7.83	6.74	1.69	8.11	7.02	1.97
175400.00		98.74	90.66	91.75	96.81				8.08	6.99	1.94
175300.00		99.04	90.63	91.72	96.79				8.41	7.32	2.25
175200.00		99.05	90.60	91.69	96.77				8.45	7.35	2.28
175100.00		98.91	90.57	91.66	96.74				8.35	7.25	2.17
175000.00	98.36	98.70	90.53	91.63	96.72	7.82	6.72	1.64	8.17	7.06	1.98

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
174900.00		98.67	90.50	91.61	96.70				8.16	7.06	1.97
174800.00		98.89	90.47	91.58	96.68				8.42	7.32	2.21
174700.00	98.37	98.75	90.44	91.55	96.66	7.93	6.83	1.71	8.31	7.20	2.09
174600.00		98.73	90.41	91.52	96.64				8.33	7.22	2.10
174500.00	98.19	98.72	90.38	91.49	96.62	7.81	6.70	1.57	8.34	7.23	2.10
174400.00		98.25	90.34	91.46	96.59				7.91	6.79	1.66
174300.00		98.22	90.31	91.43	96.57				7.90	6.79	1.64
174200.00		98.02	90.28	91.40	96.55				7.74	6.62	1.47
174100.00		97.88	90.25	91.37	96.53				7.63	6.51	1.35
174000.00	97.57	97.87	90.22	91.34	96.51	7.35	6.23	1.06	7.65	6.53	1.36
173900.00		97.76	90.19	91.31	96.49				7.58	6.45	1.27
173800.00		97.86	90.16	91.28	96.47				7.71	6.58	1.39
173700.00		97.57	90.13	91.25	96.45				7.44	6.32	1.12
173600.00		97.71	90.10	91.22	96.43				7.62	6.49	1.28
173500.00	97.28	97.65	90.07	91.19	96.41	7.22	6.09	0.87	7.58	6.45	1.23
173400.00		97.77	90.04	91.17	96.39				7.73	6.60	1.38
173300.00		97.30	89.99	91.12	96.36				7.31	6.18	0.94
173200.00		97.24	89.92	91.05	96.33				7.32	6.19	0.91
173100.00		97.30	89.86	90.98	96.29				7.44	6.32	1.01
173000.00	97.26	97.48	89.79	90.90	96.25	7.46	6.35	1.00	7.69	6.57	1.22
172900.00		97.56	89.73	90.83	96.22				7.83	6.72	1.34
172800.00		97.27	89.66	90.76	96.18				7.61	6.51	1.09
172700.00		97.23	89.59	90.69	96.14				7.63	6.53	1.08
172600.00		97.13	89.53	90.62	96.11				7.60	6.51	1.02
172500.00	96.60	96.92	89.46	90.55	96.07	7.14	6.05	0.53	7.46	6.37	0.85
172400.00	96.55	97.01	89.42	90.51	96.05	7.13	6.05	0.50	7.60	6.51	0.97
172300.00		96.71	89.38	90.46	96.02				7.34	6.25	0.69
172200.00		97.00	89.34	90.41	96.00				7.66	6.58	1.00
172100.00		96.94	89.30	90.37	95.97				7.65	6.57	0.97
172000.00	96.72	97.19	89.26	90.32	95.95	7.47	6.40	0.77	7.94	6.87	1.24
171900.00		97.16	89.21	90.28	95.93				7.95	6.88	1.24
171800.00		97.14	89.17	90.23	95.90				7.96	6.90	1.23
171700.00		97.24	89.17	90.23	95.90				8.07	7.01	1.34
171600.00		97.20	89.17	90.23	95.90				8.03	6.97	1.30
171500.00	96.68	97.13	89.17	90.23	95.90	7.51	6.45	0.78	7.96	6.90	1.23
171400.00		96.95	89.13	90.19	95.87				7.81	6.75	1.08
171300.00		96.99	89.07	90.13	95.81				7.92	6.86	1.18
171200.00		96.90	89.01	90.07	95.74				7.90	6.84	1.16
171100.00		97.09	88.95	90.01	95.69				8.14	7.08	1.40
171000.00	96.70	97.00	88.91	89.97	95.65	7.79	6.73	1.05	8.10	7.03	1.35
170900.00		97.01	88.87	89.94	95.61				8.14	7.07	1.39
170800.00		96.98	88.83	89.90	95.58				8.15	7.08	1.40
170700.00		96.72	88.79	89.86	95.54				7.93	6.85	1.18
170600.00		96.95	88.75	89.83	95.50				8.20	7.12	1.45
170500.00	96.63	96.94	88.71	89.79	95.46	7.92	6.84	1.16	8.23	7.15	1.48
170400.00		97.05	88.67	89.75	95.43				8.38	7.29	1.61
170300.00		97.05	88.63	89.72	95.40				8.42	7.33	1.65
170200.00		97.09	88.59	89.68	95.36				8.50	7.41	1.73
170100.00		97.08	88.55	89.64	95.33				8.53	7.43	1.74
170000.00	96.86	97.26	88.51	89.60	95.30	8.36	7.26	1.56	8.75	7.66	1.96
169900.00		97.31	88.46	89.57	95.27				8.85	7.74	2.04
169800.00		97.36	88.42	89.53	95.23				8.93	7.83	2.12
169700.00		97.30	88.38	89.49	95.20				8.92	7.81	2.10
169600.00		97.16	88.34	89.45	95.17				8.82	7.71	1.99
169500.00	97.14	97.11	88.30	89.41	95.14	8.84	7.73	2.00	8.81	7.69	1.97
169400.00		96.63	88.26	89.38	95.10				8.37	7.26	1.53
169300.00		96.48	88.22	89.34	95.07				8.26	7.14	1.41
169200.00		96.42	88.20	89.32	95.05				8.22	7.10	1.37
169100.00		96.54	88.17	89.29	95.03				8.37	7.25	1.51
169000.00	96.98	96.32	88.15	89.27	95.01	8.84	7.71	1.97	8.17	7.05	1.31
168900.00		97.09	88.12	89.24	94.99				8.97	7.84	2.10
168800.00		96.92	88.09	89.22	94.97				8.83	7.70	1.96
168700.00		96.97	88.07	89.20	94.94				8.90	7.78	2.03
168600.00		96.96	88.04	89.17	94.92				8.91	7.78	2.03
168500.00	96.80	96.84	88.02	89.15	94.90	8.78	7.65	1.90	8.82	7.69	1.94
168400.00		96.65	87.99	89.12	94.88				8.66	7.53	1.77
168300.00		96.77	87.97	89.10	94.86				8.80	7.67	1.91
168200.00		96.94	87.96	89.09	94.85				8.98	7.85	2.09
168100.00		96.64	87.94	89.08	94.84				8.69	7.56	1.80
168000.00	96.55	96.59	87.93	89.06	94.82	8.62	7.49	1.73	8.65	7.52	1.76
167900.00		96.36	87.92	89.05	94.81				8.44	7.31	1.55
167800.00		96.54	87.91	89.04	94.80				8.63	7.49	1.73
167700.00		96.23	87.90	89.03	94.79				8.34	7.20	1.44
167600.00		96.04	87.88	89.02	94.78				8.16	7.03	1.27

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
167500.00	96.17	96.24	87.87	89.01	94.77	8.30	7.16	1.40	8.37	7.24	1.48
167400.00		96.00	87.86	88.99	94.75				8.14	7.01	1.25
167300.00		95.82	87.85	88.98	94.74				7.97	6.83	1.07
167200.00		95.55	87.83	88.97	94.73				7.72	6.58	0.82
167100.00		95.38	87.82	88.96	94.72				7.56	6.42	0.66
167000.00		95.21	87.81	88.95	94.71				7.40	6.26	0.50
166900.00		95.37	87.80	88.94	94.70				7.57	6.43	0.67
166800.00		95.00	87.78	88.92	94.68				7.23	6.08	0.32
166700.00		95.14	87.76	88.90	94.66				7.38	6.24	0.48
166600.00		95.25	87.74	88.89	94.65				7.52	6.37	0.61
166500.00		95.43	87.72	88.87	94.63				7.71	6.56	0.80
166400.00		95.14	87.70	88.85	94.61				7.44	6.28	0.52
166300.00		95.03	87.68	88.84	94.60				7.35	6.19	0.43
166200.00		95.08	87.66	88.82	94.58				7.42	6.26	0.50
166100.00		95.15	87.64	88.80	94.56				7.51	6.35	0.59
166000.00		95.01	87.62	88.79	94.55				7.39	6.22	0.46
165900.00		95.14	87.60	88.77	94.53				7.54	6.37	0.61
165800.00		95.04	87.58	88.75	94.51				7.46	6.29	0.53
165700.00		95.05	87.57	88.74	94.50				7.48	6.31	0.55
165600.00		94.74	87.55	88.72	94.48				7.19	6.02	0.26
165500.00		94.62	87.53	88.70	94.46				7.09	5.92	0.16
165400.00		94.98	87.51	88.68	94.44				7.47	6.30	0.54
165300.00		95.00	87.50	88.67	94.43				7.50	6.33	0.57
165200.00		95.29	87.48	88.65	94.41				7.81	6.64	0.88
165100.00		94.88	87.46	88.63	94.39				7.42	6.25	0.49
165000.00		94.85	87.45	88.62	94.38				7.40	6.23	0.47
164900.00		95.06	87.43	88.60	94.36				7.63	6.46	0.70
164800.00		95.09	87.41	88.58	94.34				7.68	6.51	0.75
164700.00		95.00	87.40	88.57	94.33				7.61	6.44	0.68
164600.00		95.05	87.38	88.55	94.31				7.67	6.50	0.74
164500.00		95.10	87.37	88.54	94.30				7.73	6.56	0.80
164400.00		95.07	87.36	88.53	94.29				7.71	6.54	0.78
164300.00		95.19	87.34	88.51	94.27				7.85	6.68	0.92
164200.00		94.97	87.33	88.50	94.26				7.64	6.47	0.71
164100.00		94.85	87.31	88.49	94.25				7.53	6.36	0.60
164000.00		94.96	87.30	88.48	94.24				7.66	6.48	0.72
163900.00		94.89	87.29	88.46	94.22				7.60	6.42	0.66
163800.00		94.91	87.27	88.45	94.21				7.64	6.46	0.70
163700.00		94.98	87.26	88.44	94.20				7.72	6.55	0.79
163600.00		95.08	87.25	88.42	94.18				7.83	6.66	0.90
163500.00		95.09	87.23	88.41	94.17				7.86	6.68	0.92
163400.00		95.05	87.22	88.40	94.16				7.83	6.65	0.89
163300.00		95.04	87.21	88.39	94.15				7.83	6.65	0.89
163200.00		94.96	87.20	88.38	94.14				7.76	6.58	0.82
163100.00		94.95	87.19	88.37	94.13				7.76	6.58	0.82
163000.00		95.00	87.19	88.37	94.13				7.82	6.63	0.88
162900.00		94.89	87.18	88.37	94.12				7.71	6.53	0.77
162800.00		94.76	87.18	88.36	94.12				7.58	6.40	0.64
162700.00		94.85	87.18	88.36	94.12				7.67	6.49	0.73
162600.00		94.73	87.17	88.35	94.11				7.56	6.37	0.62
162500.00		94.77	87.17	88.35	94.11				7.60	6.42	0.66
162400.00		94.94	87.16	88.35	94.10				7.77	6.59	0.83
162300.00		94.72	87.16	88.34	94.10				7.56	6.38	0.62
162200.00		94.93	87.15	88.34	94.09				7.78	6.59	0.84
162100.00		94.72	87.15	88.33	94.09				7.57	6.39	0.63
162000.00	94.12	94.43	87.14	88.33	94.08	6.98	5.79	0.04	7.28	6.09	0.34
161900.00		94.33	87.14	88.33	94.08				7.19	6.00	0.25
161800.00		94.73	87.14	88.32	94.08				7.60	6.41	0.66
161700.00		94.28	87.13	88.32	94.07				7.15	5.96	0.21
161600.00		94.40	87.13	88.32	94.07				7.28	6.09	0.34
161500.00	94.21	94.54	87.12	88.31	94.06	7.09	5.90	0.15	7.42	6.23	0.48
161400.00		94.38	87.12	88.31	94.06				7.26	6.07	0.32
161300.00		94.49	87.11	88.30	94.05				7.37	6.18	0.43
161200.00	94.05	94.21	87.11	88.30	94.05	6.94	5.75	0.00	7.10	5.91	0.16
161100.00		94.10	87.09	88.28	94.03				7.01	5.82	0.07
161000.00	94.00	94.32	87.08	88.27	94.02	6.92	5.73	-0.02	7.23	6.04	0.29
160900.00		94.14	87.07	88.26	94.01				7.07	5.88	0.13
160800.00		94.34	87.05	88.24	93.99				7.28	6.09	0.34
160700.00	93.90	94.09	87.04	88.23	93.98	6.86	5.67	-0.08	7.05	5.86	0.11
160600.00		93.99	87.03	88.22	93.97				6.96	5.77	0.02
160500.00	93.72	93.93	87.01	88.20	93.95	6.70	5.51	-0.24	6.91	5.72	-0.03
160400.00		94.10	87.00	88.19	93.94				7.09	5.90	0.15
160300.00		94.10	86.99	88.18	93.93				7.11	5.92	0.17
160200.00		94.18	86.97	88.16	93.91				7.21	6.02	0.27

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
160100.00		94.22	86.96	88.15	93.90				7.26	6.07	0.32
160000.00	93.79	94.00	86.94	88.13	93.88	6.85	5.66	-0.09	7.07	5.88	0.13
159900.00		93.99	86.91	88.10	93.85				7.09	5.89	0.14
159800.00		94.28	86.88	88.07	93.82				7.40	6.21	0.46
159700.00		93.93	86.85	88.05	93.80				7.08	5.88	0.13
159600.00		93.88	86.82	88.02	93.77				7.06	5.86	0.11
159500.00	93.74	93.81	86.79	87.99	93.74	6.95	5.75	0.00	7.02	5.82	0.07
159400.00		93.93	86.77	87.96	93.71				7.17	5.97	0.22
159300.00		93.96	86.73	87.93	93.69				7.22	6.02	0.27
159200.00		93.67	86.68	87.89	93.64				7.00	5.79	0.03
159100.00		93.63	86.62	87.84	93.60				7.01	5.79	0.02
159000.00	93.40	93.53	86.56	87.79	93.56	6.83	5.61	-0.16	6.97	5.75	-0.03
158900.00		93.44	86.51	87.74	93.52				6.94	5.71	-0.08
158800.00		93.45	86.45	87.69	93.48				7.00	5.76	-0.03
158700.00		93.47	86.39	87.64	93.44				7.08	5.83	0.03
158600.00		93.77	86.34	87.59	93.40				7.43	6.18	0.37
158500.00	93.54	93.76	86.28	87.54	93.35	7.26	6.00	0.18	7.48	6.22	0.40
158400.00	93.75	94.08	86.22	87.49	93.31	7.52	6.25	0.43	7.86	6.59	0.77
158300.00		93.89	86.17	87.44	93.27				7.73	6.45	0.62
158200.00		93.51	86.12	87.40	93.24				7.39	6.11	0.27
158100.00		93.32	86.08	87.37	93.21				7.23	5.95	0.11
158000.00	92.83	93.08	86.04	87.33	93.18	6.79	5.50	-0.35	7.04	5.75	-0.10
157900.00		93.17	86.00	87.29	93.15				7.17	5.88	0.02
157800.00		93.19	85.96	87.25	93.12				7.23	5.93	0.07
157700.00		93.26	85.92	87.22	93.09				7.34	6.04	0.17
157600.00		93.19	85.88	87.18	93.07				7.32	6.01	0.13
157500.00	92.94	93.06	85.83	87.14	93.05	7.11	5.80	-0.12	7.23	5.92	0.01
157400.00		93.23	85.78	87.10	93.04				7.45	6.13	0.19
157300.00		93.36	85.73	87.05	93.02				7.63	6.31	0.34
157200.00		93.19	85.67	87.01	92.99				7.52	6.19	0.20
157100.00		93.07	85.62	86.96	92.97				7.45	6.11	0.10
157000.00	92.91	93.17	85.56	86.90	92.94	7.36	6.01	-0.03	7.62	6.27	0.23
156900.00		93.28	85.50	86.85	92.92				7.79	6.43	0.36
156800.00		93.31	85.43	86.80	92.90				7.88	6.51	0.42
156700.00		93.10	85.37	86.75	92.87				7.73	6.35	0.23
156600.00		93.23	85.31	86.69	92.85				7.92	6.54	0.39
156500.00	92.77	93.18	85.27	86.66	92.83	7.50	6.11	-0.06	7.92	6.53	0.36
156400.00		92.94	85.23	86.63	92.80				7.70	6.31	0.13
156300.00		92.94	85.20	86.60	92.77				7.74	6.34	0.17
156200.00		92.72	85.19	86.59	92.76				7.54	6.14	-0.03
156100.00		92.75	85.18	86.58	92.75				7.57	6.16	-0.01
156000.00	92.78	93.03	85.18	86.58	92.75	7.60	6.20	0.03	7.86	6.46	0.28
155900.00		92.78	85.17	86.57	92.75				7.61	6.21	0.04
155800.00		92.68	85.16	86.57	92.74				7.52	6.11	-0.06
155700.00		92.94	85.16	86.56	92.74				7.78	6.38	0.20
155600.00		92.95	85.15	86.56	92.74				7.80	6.39	0.22
155500.00	92.80	92.97	85.15	86.55	92.73	7.65	6.25	0.07	7.82	6.41	0.23
155400.00		92.84	85.14	86.55	92.73				7.70	6.29	0.11
155300.00		92.86	85.14	86.54	92.73				7.73	6.32	0.14
155200.00		92.77	85.13	86.54	92.72				7.64	6.23	0.05
155100.00		92.79	85.13	86.53	92.72				7.66	6.25	0.07
155000.00	92.51	92.81	85.12	86.53	92.71	7.39	5.98	-0.20	7.69	6.28	0.09
154900.00		92.69	85.11	86.52	92.71				7.58	6.17	-0.02
154800.00		92.68	85.11	86.52	92.71				7.57	6.16	-0.03
154700.00		92.74	85.10	86.52	92.70				7.64	6.23	0.04
154600.00		92.55	85.10	86.51	92.70				7.45	6.04	-0.15
154500.00	92.22	92.61	85.09	86.51	92.70	7.13	5.72	-0.47	7.52	6.11	-0.08
154400.00		92.64	85.09	86.50	92.69				7.56	6.14	-0.05
154300.00		92.86	85.08	86.50	92.69				7.78	6.37	0.18
154200.00		92.56	85.07	86.49	92.69				7.48	6.07	-0.13
154100.00		92.62	85.07	86.49	92.68				7.55	6.14	-0.06
154000.00	92.34	92.58	85.06	86.48	92.68	7.28	5.86	-0.34	7.51	6.09	-0.10
153900.00		92.43	85.06	86.48	92.67				7.37	5.95	-0.24
153800.00		92.65	85.05	86.47	92.67				7.59	6.17	-0.03
153700.00		92.44	85.03	86.45	92.65				7.42	6.00	-0.21
153600.00	92.40	92.55	84.99	86.42	92.62	7.41	5.99	-0.22	7.56	6.14	-0.07
153500.00	92.28	92.38	84.96	86.39	92.59	7.32	5.89	-0.31	7.43	6.00	-0.21
153400.00		92.29	84.92	86.35	92.56				7.37	5.94	-0.27
153300.00	91.77	92.03	84.88	86.32	92.53	6.88	5.44	-0.76	7.14	5.71	-0.50
153200.00		92.20	84.85	86.29	92.50				7.35	5.91	-0.30
153100.00		92.33	84.75	86.20	92.43				7.58	6.13	-0.10
153000.00	92.06	92.25	84.65	86.11	92.35	7.42	5.96	-0.29	7.60	6.14	-0.10
152900.00		92.03	84.56	86.03	92.29				7.48	6.00	-0.26
152800.00		91.99	84.53	86.00	92.27				7.46	5.98	-0.29

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
152700.00		91.89	84.50	85.98	92.26				7.39	5.91	-0.37
152600.00		92.01	84.44	85.92	92.22				7.57	6.09	-0.21
152500.00	92.02	92.01	84.37	85.86	92.17	7.65	6.16	-0.15	7.64	6.15	-0.16
152400.00		91.97	84.31	85.80	92.13				7.66	6.17	-0.16
152300.00		92.12	84.26	85.76	92.09				7.86	6.36	0.02
152200.00		91.85	84.24	85.74	92.08				7.61	6.10	-0.23
152100.00		92.08	84.21	85.73	92.06				7.87	6.35	0.02
152000.00	91.48	91.51	84.19	85.71	92.04	7.28	5.77	-0.57	7.32	5.80	-0.54
151900.00		91.30	84.17	85.69	92.03				7.13	5.61	-0.73
151800.00		91.40	84.15	85.67	92.02				7.25	5.73	-0.62
151700.00		91.58	84.13	85.65	92.00				7.45	5.92	-0.43
151600.00		91.70	84.11	85.64	91.99				7.59	6.06	-0.29
151500.00	91.52	91.65	84.09	85.62	91.98	7.43	5.90	-0.46	7.57	6.04	-0.33
151400.00		91.81	84.07	85.60	91.97				7.75	6.21	-0.16
151300.00		91.94	84.04	85.58	91.96				7.90	6.36	-0.01
151200.00		91.57	84.02	85.57	91.94				7.54	6.00	-0.38
151100.00		91.49	84.00	85.55	91.93				7.49	5.94	-0.44
151000.00	91.48	91.56	83.98	85.53	91.92	7.50	5.95	-0.44	7.58	6.03	-0.36
150900.00		91.42	83.96	85.51	91.91				7.46	5.91	-0.48
150800.00		91.29	83.94	85.50	91.89				7.35	5.80	-0.60
150700.00		91.24	83.92	85.48	91.88				7.32	5.76	-0.64
150600.00		91.48	83.90	85.46	91.87				7.58	6.02	-0.39
150500.00	91.45	91.45	83.85	85.42	91.84	7.60	6.03	-0.39	7.60	6.03	-0.38
150400.00		91.34	83.80	85.37	91.80				7.54	5.97	-0.46
150300.00		91.54	83.74	85.33	91.77				7.80	6.21	-0.23
150200.00		91.54	83.70	85.30	91.74				7.83	6.24	-0.20
150100.00		91.29	83.67	85.26	91.72				7.62	6.03	-0.42
150000.00	91.41	91.58	83.63	85.23	91.69	7.78	6.18	-0.28	7.95	6.35	-0.11
149900.00		90.98	83.60	85.20	91.67				7.39	5.78	-0.68
149800.00		90.97	83.56	85.17	91.64				7.41	5.80	-0.67
149700.00		91.11	83.53	85.14	91.62				7.59	5.98	-0.50
149600.00		91.35	83.49	85.10	91.59				7.85	6.25	-0.24
149500.00	91.24	91.29	83.46	85.07	91.57	7.78	6.16	-0.33	7.83	6.22	-0.28
149400.00		91.30	83.43	85.04	91.55				7.87	6.26	-0.25
149300.00		91.02	83.39	85.01	91.52				7.62	6.00	-0.50
149200.00		90.95	83.36	84.98	91.50				7.59	5.96	-0.55
149100.00		90.95	83.33	84.95	91.47				7.62	5.99	-0.53
149000.00	91.30	91.24	83.29	84.92	91.45	8.01	6.38	-0.15	7.95	6.32	-0.21
148900.00		91.40	83.27	84.90	91.43				8.14	6.50	-0.03
148800.00		91.33	83.24	84.87	91.41				8.09	6.45	-0.09
148700.00		91.13	83.21	84.85	91.40				7.92	6.28	-0.27
148600.00		91.22	83.19	84.83	91.38				8.04	6.39	-0.16
148500.00	91.72	91.85	83.16	84.81	91.36	8.56	6.92	0.36	8.69	7.05	0.49
148400.00		91.82	83.13	84.78	91.34				8.69	7.04	0.48
148300.00		91.54	83.11	84.76	91.32				8.43	6.78	0.22
148200.00		91.63	83.08	84.74	91.31				8.55	6.90	0.33
148100.00		91.74	83.06	84.71	91.29				8.69	7.03	0.46
148000.00	91.30	91.77	83.03	84.69	91.27	8.27	6.61	0.03	8.74	7.08	0.50
147900.00		91.30	83.00	84.67	91.25				8.30	6.63	0.05
147800.00		91.28	82.98	84.64	91.23				8.30	6.63	0.04
147700.00		91.45	82.95	84.62	91.22				8.50	6.83	0.24
147600.00		91.26	82.93	84.60	91.20				8.34	6.67	0.07
147500.00	91.17	91.31	82.90	84.58	91.18	8.27	6.60	-0.01	8.41	6.73	0.13
147400.00		91.75	82.87	84.55	91.16				8.88	7.20	0.59
147300.00		91.52	82.85	84.53	91.14				8.67	6.99	0.38
147200.00		91.71	82.82	84.51	91.13				8.89	7.21	0.59
147100.00		91.63	82.80	84.48	91.11				8.83	7.15	0.52
147000.00	91.50	91.63	82.77	84.46	91.09	8.73	7.04	0.41	8.86	7.17	0.54
146900.00		91.52	82.74	84.43	91.07				8.78	7.09	0.46
146800.00		91.43	82.71	84.41	91.05				8.72	7.02	0.39
146700.00		91.45	82.69	84.38	91.03				8.76	7.07	0.42
146600.00		92.10	82.66	84.36	91.01				9.44	7.74	1.09
146500.00	91.85	92.11	82.63	84.33	90.99	9.22	7.51	0.86	9.47	7.77	1.12
146400.00		91.57	82.60	84.31	90.96				8.97	7.26	0.61
146300.00		91.55	82.58	84.28	90.94				8.98	7.27	0.61
146200.00		91.38	82.55	84.26	90.92				8.83	7.12	0.46
146100.00		91.12	82.52	84.23	90.90				8.60	6.89	0.22
146000.00	90.90	91.10	82.49	84.21	90.88	8.41	6.70	0.02	8.61	6.89	0.22
145900.00		91.20	82.47	84.18	90.86				8.74	7.02	0.34
145800.00		91.23	82.44	84.16	90.84				8.79	7.07	0.39
145700.00		91.01	82.41	84.13	90.82				8.60	6.88	0.20
145600.00		91.06	82.39	84.11	90.80				8.68	6.95	0.27
145500.00	90.55	90.76	82.36	84.09	90.78	8.19	6.47	-0.23	8.41	6.68	-0.01
145400.00		91.29	82.33	84.06	90.76				8.96	7.23	0.54

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
145300.00		91.60	82.31	84.04	90.74				9.29	7.56	0.86
145200.00		91.69	82.28	84.01	90.72				9.41	7.68	0.97
145100.00		91.83	82.25	83.99	90.70				9.58	7.84	1.13
145000.00	91.27	91.80	82.23	83.96	90.68	9.05	7.31	0.60	9.57	7.83	1.12
144900.00		91.82	82.20	83.94	90.66				9.62	7.89	1.17
144800.00		91.87	82.17	83.91	90.64				9.69	7.95	1.23
144700.00		91.54	82.15	83.89	90.62				9.39	7.65	0.92
144600.00		91.28	82.12	83.87	90.60				9.15	7.41	0.68
144500.00	90.99	91.39	82.09	83.84	90.58	8.89	7.14	0.41	9.30	7.55	0.82
144400.00		91.51	82.07	83.82	90.56				9.44	7.69	0.95
144300.00		91.54	82.05	83.80	90.54				9.49	7.74	1.00
144200.00		91.64	82.03	83.78	90.52				9.61	7.86	1.12
144100.00		91.83	82.01	83.76	90.51				9.83	8.07	1.32
144000.00	91.40	91.70	81.99	83.74	90.49	9.41	7.66	0.90	9.71	7.96	1.21
143900.00		92.04	81.97	83.72	90.48				10.07	8.31	1.56
143800.00		91.92	81.95	83.71	90.46				9.97	8.22	1.46
143700.00		91.70	81.93	83.69	90.45				9.77	8.01	1.25
143600.00		91.54	81.91	83.67	90.43				9.63	7.87	1.10
143500.00	91.04	91.42	81.89	83.65	90.42	9.15	7.39	0.62	9.53	7.77	1.00
143400.00		91.11	81.87	83.63	90.40				9.24	7.47	0.70
143300.00		91.28	81.85	83.62	90.39				9.43	7.66	0.89
143200.00		91.40	81.83	83.60	90.37				9.57	7.80	1.02
143100.00		91.50	81.81	83.58	90.36				9.69	7.92	1.14
143000.00	91.28	91.52	81.80	83.57	90.35	9.48	7.71	0.93	9.72	7.95	1.17
142900.00		91.36	81.79	83.56	90.34				9.58	7.80	1.02
142800.00		91.40	81.77	83.55	90.33				9.63	7.86	1.07
142700.00		91.45	81.76	83.54	90.32				9.68	7.91	1.12
142600.00		91.39	81.75	83.53	90.31				9.64	7.87	1.08
142500.00	90.66	91.21	81.74	83.52	90.31	8.92	7.14	0.35	9.47	7.69	0.90
142400.00		91.15	81.73	83.51	90.30				9.42	7.64	0.85
142300.00		91.19	81.71	83.50	90.29				9.47	7.69	0.90
142200.00		91.01	81.70	83.49	90.28				9.31	7.52	0.73
142100.00		90.99	81.69	83.48	90.27				9.30	7.52	0.72
142000.00	90.32	90.84	81.68	83.46	90.26	8.64	6.85	0.05	9.16	7.37	0.58
141900.00		91.08	81.67	83.45	90.25				9.41	7.63	0.83
141800.00		90.83	81.66	83.44	90.24				9.17	7.39	0.59
141700.00		90.86	81.64	83.43	90.23				9.21	7.42	0.62
141600.00		90.89	81.63	83.42	90.22				9.26	7.47	0.67
141500.00	90.38	91.06	81.62	83.41	90.21	8.76	6.97	0.17	9.44	7.65	0.85
141400.00		90.78	81.61	83.40	90.20				9.17	7.37	0.57
141300.00		90.72	81.60	83.39	90.19				9.13	7.33	0.53
141200.00		90.73	81.59	83.38	90.18				9.14	7.35	0.55
141100.00		90.47	81.57	83.37	90.17				8.90	7.10	0.30
141000.00	89.91	90.45	81.56	83.36	90.16	8.34	6.55	-0.25	8.89	7.09	0.29
140900.00		90.38	81.55	83.35	90.15				8.83	7.04	0.24
140800.00		90.61	81.54	83.34	90.14				9.08	7.28	0.48
140700.00		90.39	81.53	83.33	90.13				8.86	7.06	0.26
140600.00		90.55	81.52	83.32	90.12				9.03	7.23	0.43
140500.00	90.30	90.57	81.51	83.31	90.11	8.79	6.99	0.19	9.06	7.26	0.46
140400.00		90.07	81.50	83.30	90.10				8.57	6.77	-0.03
140300.00		89.98	81.49	83.29	90.09				8.49	6.69	-0.12
140200.00		90.03	81.48	83.28	90.09				8.55	6.75	-0.06
140100.00		90.02	81.47	83.28	90.08				8.54	6.74	-0.06
140000.00	89.97	90.27	81.46	83.27	90.07	8.51	6.71	-0.10	8.81	7.00	0.20
139900.00		90.66	81.45	83.26	90.06				9.21	7.40	0.59
139800.00		90.22	81.44	83.25	90.06				8.77	6.96	0.16
139700.00		90.06	81.43	83.24	90.05				8.62	6.81	0.01
139600.00		89.87	81.43	83.24	90.04				8.44	6.63	-0.17
139500.00	89.77	89.96	81.42	83.23	90.03	8.36	6.55	-0.26	8.55	6.74	-0.07
139400.00		89.73	81.41	83.22	90.03				8.32	6.51	-0.30
139300.00		89.59	81.40	83.21	90.02				8.19	6.38	-0.43
139200.00		89.78	81.39	83.20	90.01				8.39	6.58	-0.23
139100.00		89.73	81.38	83.20	90.00				8.35	6.53	-0.28
139000.00	89.62	89.78	81.37	83.19	90.00	8.25	6.43	-0.38	8.40	6.59	-0.22
138900.00		89.73	81.36	83.18	89.99				8.37	6.55	-0.26
138800.00		89.70	81.35	83.17	89.98				8.35	6.53	-0.28
138700.00		89.80	81.34	83.16	89.97				8.45	6.63	-0.18
138600.00		89.58	81.33	83.15	89.96				8.25	6.43	-0.38
138500.00	89.50	89.58	81.31	83.13	89.94	8.19	6.36	-0.45	8.27	6.45	-0.36
138400.00		89.38	81.29	83.12	89.93				8.09	6.26	-0.55
138300.00		89.39	81.27	83.10	89.91				8.12	6.29	-0.52
138200.00		89.20	81.26	83.09	89.90				7.95	6.12	-0.69
138100.00		89.46	81.24	83.07	89.88				8.22	6.39	-0.42
138000.00	89.39	89.38	81.22	83.05	89.86	8.17	6.34	-0.47	8.16	6.33	-0.48

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
137900.00		89.47	81.20	83.04	89.85				8.27	6.43	-0.38
137800.00		89.42	81.18	83.02	89.83				8.24	6.40	-0.41
137700.00		89.43	81.16	83.01	89.82				8.27	6.43	-0.38
137600.00		89.61	81.14	82.99	89.80				8.47	6.63	-0.18
137500.00	89.49	89.55	81.12	82.97	89.78	8.37	6.53	-0.28	8.43	6.58	-0.23
137400.00		89.56	81.10	82.95	89.76				8.46	6.61	-0.20
137300.00		89.35	81.08	82.93	89.74				8.27	6.42	-0.39
137200.00		89.27	81.06	82.91	89.72				8.21	6.36	-0.45
137100.00		89.41	81.04	82.89	89.70				8.38	6.52	-0.29
137000.00	89.34	89.38	81.02	82.87	89.68	8.33	6.47	-0.34	8.36	6.50	-0.31
136900.00		89.53	81.00	82.86	89.67				8.54	6.68	-0.13
136800.00		89.62	80.98	82.84	89.65				8.64	6.78	-0.03
136700.00		89.27	80.97	82.83	89.63				8.30	6.44	-0.37
136600.00		89.37	80.95	82.81	89.61				8.42	6.56	-0.24
136500.00	89.34	89.57	80.93	82.80	89.60	8.40	6.54	-0.26	8.64	6.77	-0.03
136400.00		89.36	80.92	82.78	89.58				8.44	6.58	-0.22
136300.00		89.30	80.90	82.77	89.56				8.40	6.54	-0.26
136200.00		89.63	80.88	82.75	89.54				8.75	6.88	0.09
136100.00		89.87	80.87	82.74	89.53				9.01	7.14	0.35
136000.00	89.55	89.96	80.83	82.71	89.50	8.72	6.84	0.05	9.12	7.25	0.46
135900.00		89.97	80.79	82.67	89.47				9.18	7.29	0.50
135800.00		89.80	80.74	82.64	89.43				9.06	7.16	0.37
135700.00		89.71	80.69	82.60	89.40				9.02	7.11	0.32
135600.00		89.44	80.65	82.56	89.36				8.79	6.87	0.08
135500.00	89.30	89.54	80.60	82.53	89.33	8.70	6.77	-0.03	8.94	7.02	0.22
135400.00		89.67	80.56	82.49	89.29				9.12	7.18	0.38
135300.00		89.36	80.51	82.46	89.26				8.85	6.91	0.10
135200.00		89.49	80.46	82.42	89.22				9.02	7.07	0.26
135100.00		89.31	80.42	82.38	89.19				8.89	6.93	0.12
135000.00	89.27	89.34	80.37	82.35	89.15	8.89	6.92	0.11	8.97	6.99	0.19
134900.00		89.36	80.32	82.31	89.12				9.03	7.04	0.24
134800.00		89.61	80.28	82.28	89.09				9.33	7.34	0.53
134700.00		89.63	80.15	82.18	89.00				9.48	7.45	0.63
134600.00		89.10	79.96	82.03	88.87				9.14	7.07	0.23
134500.00	89.14	89.14	79.84	81.94	88.79	9.30	7.20	0.35	9.31	7.21	0.35
134400.00		89.17	79.81	81.92	88.77				9.36	7.25	0.39
134300.00		89.16	79.79	81.90	88.76				9.37	7.26	0.41
134200.00		89.19	79.76	81.88	88.74				9.42	7.30	0.45
134100.00		89.00	79.74	81.87	88.72				9.26	7.14	0.28
134000.00	89.45	89.34	79.72	81.85	88.71	9.73	7.60	0.74	9.63	7.50	0.64
133900.00		89.19	79.69	81.83	88.69				9.49	7.36	0.50
133800.00		89.01	79.67	81.81	88.67				9.35	7.20	0.34
133700.00		89.05	79.65	81.79	88.66				9.41	7.26	0.39
133600.00		88.85	79.62	81.78	88.64				9.23	7.08	0.21
133500.00	88.67	88.57	79.60	81.76	88.63	9.07	6.91	0.04	8.97	6.81	-0.06
133400.00		88.58	79.57	81.74	88.61				9.01	6.85	-0.02
133300.00		88.73	79.55	81.72	88.59				9.18	7.01	0.13
133200.00		88.81	79.53	81.70	88.58				9.28	7.11	0.23
133100.00		88.76	79.50	81.68	88.56				9.26	7.08	0.20
133000.00	88.95	88.95	79.48	81.67	88.54	9.47	7.28	0.41	9.47	7.28	0.40
132900.00		89.32	79.46	81.65	88.53				9.87	7.67	0.80
132800.00		89.59	79.43	81.63	88.51				10.16	7.96	1.08
132700.00		89.61	79.41	81.61	88.49				10.20	7.99	1.11
132600.00		90.02	79.38	81.59	88.48				10.64	8.43	1.54
132500.00	90.13	90.07	79.36	81.58	88.46	10.77	8.56	1.67	10.71	8.49	1.61
132400.00		91.23	79.34	81.56	88.45				11.89	9.67	2.79
132300.00		89.82	79.31	81.54	88.43				10.51	8.28	1.39
132200.00		89.09	79.30	81.53	88.42				9.79	7.56	0.67
132100.00		89.39	79.29	81.52	88.41				10.10	7.87	0.98
132000.00	89.40	89.45	79.28	81.51	88.40	10.12	7.89	1.00	10.17	7.94	1.05
131900.00		89.16	79.27	81.50	88.39				9.89	7.65	0.77
131800.00		89.29	79.26	81.50	88.38				10.03	7.79	0.91
131700.00		88.74	79.25	81.49	88.37				9.49	7.25	0.37
131600.00		88.46	79.24	81.48	88.36				9.22	6.98	0.10
131500.00	88.26	88.26	79.23	81.47	88.35	9.03	6.78	-0.10	9.03	6.79	-0.09
131400.00		88.26	79.22	81.47	88.35				9.04	6.80	-0.08
131300.00		88.03	79.21	81.46	88.34				8.82	6.57	-0.31
131200.00		88.16	79.20	81.45	88.33				8.96	6.71	-0.16
131100.00		88.03	79.19	81.44	88.32				8.84	6.59	-0.29
131000.00	88.11	88.10	79.18	81.44	88.31	8.92	6.67	-0.20	8.92	6.67	-0.21
130900.00		87.93	79.17	81.43	88.30				8.75	6.50	-0.38
130800.00		88.31	79.16	81.42	88.29				9.14	6.89	0.01
130700.00		88.84	79.15	81.41	88.28				9.69	7.43	0.56
130600.00		88.79	79.13	81.39	88.26				9.67	7.40	0.53

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
130500.00	88.72	88.72	79.08	81.36	88.23	9.63	7.36	0.49	9.64	7.37	0.50
130400.00		88.71	79.05	81.33	88.20				9.66	7.38	0.51
130300.00		88.72	79.03	81.31	88.18				9.69	7.41	0.54
130200.00		88.78	79.01	81.29	88.16				9.77	7.48	0.61
130100.00		88.68	78.99	81.28	88.15				9.69	7.40	0.53
130000.00	88.56	88.73	78.97	81.26	88.13	9.58	7.29	0.42	9.76	7.47	0.60
129900.00		88.72	78.96	81.26	88.13				9.75	7.46	0.59
129800.00		88.87	78.96	81.25	88.12				9.91	7.62	0.75
129700.00		88.78	78.95	81.25	88.12				9.83	7.53	0.66
129600.00		88.72	78.95	81.24	88.11				9.77	7.47	0.61
129500.00	88.89	89.06	78.94	81.24	88.11	9.95	7.65	0.78	10.12	7.82	0.95
129400.00		89.39	78.94	81.23	88.10				10.45	8.15	1.29
129300.00		89.01	78.93	81.23	88.10				10.08	7.78	0.91
129200.00		89.04	78.93	81.23	88.09				10.12	7.82	0.95
129100.00		88.93	78.92	81.22	88.08				10.02	7.71	0.85
129000.00	88.83	88.92	78.91	81.22	88.08	9.91	7.61	0.75	10.00	7.70	0.84
128900.00		89.02	78.91	81.21	88.07				10.11	7.81	0.94
128800.00		88.97	78.90	81.21	88.07				10.07	7.77	0.90
128700.00		88.84	78.90	81.20	88.06				9.94	7.64	0.78
128600.00		88.73	78.89	81.20	88.06				9.84	7.53	0.67
128500.00	88.79	88.73	78.89	81.19	88.05	9.90	7.59	0.73	9.84	7.53	0.67
128400.00		88.55	78.88	81.19	88.05				9.67	7.36	0.50
128300.00		88.50	78.86	81.17	88.03				9.64	7.33	0.47
128200.00		88.34	78.84	81.16	88.01				9.50	7.18	0.32
128100.00		88.18	78.82	81.15	88.00				9.36	7.04	0.19
128000.00	88.24	88.27	78.80	81.13	87.98	9.44	7.11	0.26	9.47	7.14	0.29
127900.00		88.59	78.79	81.12	87.97				9.80	7.47	0.62
127800.00		88.31	78.79	81.12	87.97				9.52	7.19	0.34
127700.00		88.24	78.78	81.11	87.96				9.46	7.13	0.28
127600.00		88.44	78.77	81.10	87.95				9.67	7.34	0.49
127500.00	88.79	88.73	78.76	81.10	87.95	10.02	7.69	0.84	9.96	7.63	0.78
127400.00		88.77	78.76	81.09	87.94				10.02	7.68	0.83
127300.00		88.87	78.75	81.08	87.93				10.12	7.79	0.94
127200.00		88.78	78.74	81.08	87.93				10.04	7.70	0.85
127100.00		88.66	78.73	81.07	87.92				9.93	7.59	0.74
127000.00	88.83	88.76	78.73	81.06	87.91	10.10	7.76	0.91	10.04	7.70	0.85
126900.00		88.68	78.72	81.06	87.91				9.96	7.62	0.77
126800.00		88.61	78.71	81.05	87.90				9.90	7.56	0.71
126700.00		88.37	78.70	81.04	87.89				9.68	7.34	0.49
126600.00		88.38	78.68	81.03	87.88				9.70	7.35	0.50
126500.00	88.43	88.55	78.67	81.02	87.86	9.77	7.42	0.57	9.88	7.53	0.69
126400.00		88.64	78.65	81.00	87.85				9.99	7.63	0.79
126300.00		88.86	78.64	80.99	87.84				10.22	7.86	1.02
126200.00		88.64	78.62	80.98	87.82				10.02	7.66	0.82
126100.00		88.28	78.61	80.97	87.81				9.68	7.31	0.47
126000.00	87.99	87.99	78.59	80.96	87.80	9.40	7.03	0.19	9.40	7.03	0.19
125900.00		88.45	78.58	80.95	87.79				9.88	7.51	0.67
125800.00		88.25	78.57	80.94	87.78				9.68	7.31	0.47
125700.00		87.83	78.56	80.93	87.77				9.27	6.89	0.05
125600.00		88.03	78.55	80.93	87.76				9.48	7.10	0.26
125500.00	87.85	87.83	78.54	80.92	87.76	9.31	6.93	0.09	9.29	6.91	0.07
125400.00	87.88	87.82	78.53	80.91	87.75	9.35	6.96	0.13	9.29	6.90	0.07
125300.00		87.67	78.52	80.90	87.74				9.15	6.77	-0.07
125200.00		87.89	78.51	80.90	87.73				9.37	6.99	0.15
125100.00		87.56	78.50	80.89	87.72				9.05	6.67	-0.17
125000.00	87.48	87.50	78.49	80.88	87.72	8.98	6.59	-0.24	9.01	6.62	-0.22
124900.00		87.80	78.48	80.88	87.71				9.31	6.92	0.09
124800.00		88.34	78.47	80.87	87.70				9.87	7.48	0.64
124700.00		89.69	78.46	80.86	87.69				11.23	8.83	2.00
124600.00		89.35	78.45	80.85	87.68				10.90	8.50	1.67
124500.00	88.54	88.62	78.44	80.84	87.67	10.09	7.69	0.86	10.18	7.78	0.95
124400.00		88.24	78.43	80.83	87.66				9.81	7.40	0.58
124300.00		87.98	78.42	80.82	87.65				9.57	7.16	0.33
124200.00		87.85	78.40	80.81	87.64				9.45	7.04	0.21
124100.00	87.50	87.65	78.39	80.80	87.62	9.11	6.69	-0.13	9.27	6.85	0.03
124000.00	88.04	88.16	78.37	80.79	87.61	9.66	7.24	0.42	9.78	7.36	0.54
123900.00		87.95	78.36	80.78	87.60				9.59	7.16	0.35
123800.00		87.82	78.35	80.77	87.59				9.47	7.05	0.23
123700.00		88.01	78.33	80.76	87.58				9.68	7.25	0.44
123600.00		88.13	78.32	80.75	87.56				9.81	7.38	0.57
123500.00	87.52	87.78	78.30	80.74	87.55	9.22	6.79	-0.03	9.47	7.04	0.23
123400.00		87.74	78.29	80.73	87.54				9.45	7.01	0.20
123300.00		87.47	78.28	80.72	87.53				9.19	6.75	-0.06
123200.00		87.45	78.27	80.71	87.52				9.18	6.74	-0.07

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
123100.00		87.55	78.26	80.70	87.51				9.29	6.85	0.04
123000.00	87.55	87.70	78.25	80.69	87.50	9.30	6.85	0.05	9.45	7.00	0.20
122900.00		87.80	78.24	80.69	87.49				9.57	7.12	0.32
122800.00		87.81	78.23	80.68	87.48				9.58	7.13	0.33
122700.00		87.60	78.22	80.67	87.47				9.38	6.93	0.13
122600.00		87.44	78.21	80.66	87.46				9.23	6.78	-0.02
122500.00	87.28	87.38	78.20	80.65	87.45	9.08	6.63	-0.17	9.18	6.73	-0.07
122400.00		87.06	78.19	80.65	87.44				8.87	6.42	-0.38
122300.00		87.22	78.18	80.64	87.43				9.04	6.58	-0.21
122200.00		87.21	78.17	80.63	87.42				9.04	6.58	-0.21
122100.00		87.14	78.16	80.62	87.41				8.97	6.51	-0.28
122000.00	86.99	87.08	78.15	80.61	87.40	8.85	6.38	-0.41	8.94	6.47	-0.32
121900.00		87.18	78.13	80.60	87.39				9.05	6.58	-0.21
121800.00		86.91	78.11	80.58	87.37				8.80	6.33	-0.46
121700.00		86.63	78.09	80.57	87.36				8.54	6.06	-0.73
121600.00	86.96	86.88	78.07	80.55	87.34	8.88	6.41	-0.38	8.80	6.33	-0.46
121500.00	87.09	87.14	78.06	80.54	87.33	9.04	6.56	-0.23	9.08	6.60	-0.19
121400.00		86.92	78.03	80.51	87.30				8.90	6.41	-0.37
121300.00		86.99	77.99	80.48	87.26				9.00	6.51	-0.27
121200.00		86.78	77.95	80.45	87.22				8.82	6.33	-0.45
121100.00		86.81	77.92	80.42	87.19				8.89	6.38	-0.38
121000.00	86.92	86.99	77.89	80.40	87.16	9.03	6.52	-0.24	9.11	6.60	-0.16
120900.00		87.34	77.87	80.38	87.14				9.47	6.96	0.20
120800.00		87.40	77.85	80.36	87.12				9.55	7.03	0.28
120700.00		87.45	77.83	80.35	87.10				9.62	7.10	0.35
120600.00		87.56	77.81	80.33	87.08				9.74	7.22	0.47
120500.00	87.31	87.59	77.79	80.32	87.06	9.51	6.99	0.24	9.80	7.27	0.53
120400.00		87.69	77.77	80.30	87.04				9.92	7.39	0.65
120300.00		87.72	77.76	80.29	87.03				9.96	7.43	0.69
120200.00		88.11	77.74	80.27	87.01				10.37	7.84	1.10
120100.00		87.82	77.72	80.25	86.99				10.10	7.57	0.83
120000.00	87.81	87.95	77.70	80.24	86.97	10.11	7.57	0.84	10.25	7.71	0.98
119900.00		87.98	77.68	80.22	86.95				10.30	7.75	1.03
119800.00		87.74	77.66	80.21	86.93				10.07	7.53	0.80
119700.00		87.45	77.64	80.19	86.91				9.81	7.26	0.54
119600.00		87.48	77.62	80.18	86.89				9.86	7.30	0.59
119500.00	87.27	87.40	77.61	80.16	86.88	9.66	7.11	0.39	9.79	7.23	0.52
119400.00		87.38	77.59	80.15	86.86				9.79	7.23	0.52
119300.00		87.39	77.57	80.13	86.84				9.82	7.25	0.55
119200.00		87.76	77.55	80.12	86.82				10.21	7.64	0.94
119100.00		87.51	77.53	80.10	86.80				9.98	7.41	0.71
119000.00	87.55	87.58	77.51	80.09	86.78	10.04	7.47	0.77	10.07	7.49	0.80
118900.00		87.67	77.49	80.07	86.76				10.18	7.60	0.91
118800.00		87.69	77.48	80.06	86.75				10.21	7.63	0.94
118700.00		87.50	77.47	80.05	86.74				10.03	7.45	0.76
118600.00		87.53	77.46	80.04	86.73				10.07	7.49	0.80
118500.00	87.35	87.26	77.45	80.04	86.72	9.90	7.32	0.64	9.81	7.22	0.54
118400.00		87.39	77.44	80.03	86.70				9.95	7.36	0.68
118300.00		87.16	77.43	80.02	86.69				9.73	7.14	0.46
118200.00		87.18	77.42	80.01	86.68				9.77	7.17	0.50
118100.00		87.56	77.40	80.00	86.67				10.16	7.56	0.89
118000.00	87.59	87.55	77.39	79.99	86.66	10.19	7.60	0.93	10.16	7.56	0.89
117900.00		87.67	77.38	79.98	86.65				10.29	7.69	1.02
117800.00		87.65	77.37	79.97	86.64				10.28	7.68	1.01
117700.00		87.19	77.36	79.96	86.62				9.83	7.23	0.57
117600.00		87.35	77.35	79.95	86.61				10.00	7.39	0.73
117500.00	87.32	87.38	77.34	79.94	86.60	9.98	7.37	0.72	10.04	7.44	0.78
117400.00		87.22	77.33	79.94	86.59				9.89	7.29	0.63
117300.00		87.33	77.32	79.93	86.58				10.01	7.40	0.75
117200.00		87.20	77.31	79.92	86.57				9.89	7.28	0.63
117100.00		87.09	77.29	79.91	86.55				9.80	7.18	0.54
117000.00	87.05	87.07	77.28	79.90	86.54	9.78	7.16	0.52	9.79	7.17	0.53
116900.00		87.06	77.26	79.88	86.52				9.79	7.17	0.53
116800.00		87.07	77.25	79.87	86.51				9.82	7.20	0.56
116700.00		86.94	77.23	79.86	86.50				9.71	7.08	0.44
116600.00		86.90	77.22	79.85	86.48				9.68	7.04	0.41
116500.00	87.19	87.19	77.21	79.84	86.47	9.98	7.35	0.72	9.98	7.35	0.72
116400.00		86.88	77.19	79.83	86.46				9.69	7.05	0.42
116300.00		87.07	77.18	79.82	86.44				9.89	7.25	0.63
116200.00		87.10	77.16	79.81	86.43				9.94	7.29	0.67
116100.00		86.96	77.15	79.80	86.42				9.82	7.17	0.55
116000.00	87.08	86.94	77.13	79.79	86.40	9.94	7.29	0.67	9.80	7.15	0.53
115900.00		87.10	77.12	79.78	86.39				9.98	7.32	0.71
115800.00		87.25	77.10	79.76	86.37				10.16	7.50	0.89

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
115700.00		87.28	77.06	79.73	86.33				10.22	7.55	0.95
115600.00		86.99	77.02	79.69	86.29				9.97	7.30	0.70
115500.00	86.91	86.97	76.98	79.66	86.25	9.93	7.25	0.66	9.99	7.30	0.72
115400.00		87.01	76.94	79.63	86.21				10.07	7.38	0.80
115300.00		87.06	76.91	79.61	86.19				10.14	7.45	0.87
115200.00		86.88	76.89	79.59	86.16				9.99	7.29	0.72
115100.00		86.91	76.87	79.57	86.14				10.04	7.34	0.77
115000.00	86.77	86.77	76.84	79.55	86.12	9.93	7.22	0.65	9.93	7.22	0.65
114900.00		86.56	76.82	79.54	86.10				9.74	7.02	0.46
114800.00		86.83	76.79	79.52	86.08				10.04	7.31	0.75
114700.00		86.96	76.77	79.50	86.06				10.19	7.46	0.90
114600.00		86.85	76.75	79.48	86.04				10.11	7.37	0.81
114500.00	86.80	86.64	76.72	79.47	86.02	10.08	7.33	0.78	9.92	7.17	0.62
114400.00		87.13	76.70	79.45	86.00				10.43	7.68	1.13
114300.00		87.08	76.68	79.43	85.98				10.40	7.65	1.10
114200.00		86.80	76.66	79.42	85.96				10.14	7.39	0.84
114100.00		86.55	76.64	79.40	85.94				9.91	7.15	0.61
114000.00	86.53	86.45	76.62	79.38	85.92	9.91	7.15	0.61	9.83	7.07	0.53
113900.00		86.80	76.60	79.37	85.90				10.20	7.43	0.90
113800.00		86.84	76.58	79.35	85.88				10.26	7.49	0.96
113700.00		87.03	76.56	79.33	85.86				10.48	7.70	1.18
113600.00		86.73	76.54	79.32	85.84				10.19	7.41	0.89
113500.00	86.43	86.48	76.52	79.30	85.82	9.92	7.13	0.62	9.96	7.18	0.66
113400.00		86.40	76.50	79.28	85.80				9.90	7.11	0.60
113300.00		85.74	76.48	79.27	85.78				9.26	6.47	-0.04
113200.00		85.52	76.46	79.25	85.76				9.06	6.26	-0.24
113100.00		80.21	76.44	79.24	85.74				3.77	0.97	-5.53
113000.00	85.72	85.49	76.42	79.23	85.72	9.29	6.49	-0.01	9.07	6.26	-0.23
112900.00		87.68	76.41	79.21	85.71				11.27	8.47	1.97
112800.00		87.64	76.39	79.20	85.69				11.25	8.44	1.95
112700.00		87.46	76.37	79.19	85.67				11.09	8.27	1.79
112600.00		86.27	76.36	79.17	85.66				9.92	7.10	0.62
112500.00	86.08	85.97	76.34	79.16	85.64	9.74	6.92	0.44	9.63	6.81	0.33
112400.00		86.16	76.32	79.15	85.62				9.84	7.01	0.54
112300.00		86.70	76.30	79.14	85.60				10.39	7.56	1.09
112200.00		86.55	76.29	79.12	85.59				10.27	7.43	0.97
112100.00		86.40	76.27	79.11	85.57				10.13	7.29	0.83
112000.00	86.27	86.08	76.25	79.10	85.55	10.02	7.18	0.72	9.83	6.99	0.53
111900.00		86.04	76.23	79.08	85.53				9.81	6.96	0.51
111800.00		86.11	76.22	79.07	85.52				9.89	7.04	0.59
111700.00		86.25	76.20	79.06	85.50				10.05	7.20	0.75
111600.00		86.09	76.18	79.04	85.48				9.91	7.05	0.61
111500.00	86.08	85.86	76.16	79.03	85.46	9.91	7.05	0.61	9.70	6.83	0.40
111400.00		85.77	76.15	79.02	85.45				9.63	6.76	0.33
111300.00		85.73	76.11	78.98	85.43				9.62	6.74	0.30
111200.00		85.65	76.05	78.94	85.41				9.60	6.72	0.24
111100.00		85.93	75.99	78.89	85.40				9.94	7.04	0.53
111000.00	86.06	86.11	75.94	78.85	85.38	10.12	7.21	0.68	10.18	7.27	0.73
110900.00		86.26	75.88	78.80	85.36				10.38	7.46	0.90
110800.00		86.18	75.85	78.78	85.35				10.33	7.40	0.83
110700.00		86.25	75.88	78.81	85.34				10.37	7.44	0.91
110600.00		86.30	75.87	78.81	85.33				10.43	7.50	0.97
110500.00	86.04	85.95	75.87	78.80	85.32	10.16	7.23	0.71	10.07	7.14	0.62
110400.00		85.97	75.87	78.80	85.32				10.11	7.17	0.66
110300.00		86.15	75.86	78.80	85.31				10.29	7.35	0.84
110200.00		85.92	75.86	78.80	85.30				10.06	7.13	0.62
110100.00		85.81	75.86	78.79	85.30				9.95	7.01	0.51
110000.00	85.80	85.76	75.86	78.79	85.29	9.95	7.01	0.51	9.91	6.97	0.47
109900.00		85.73	75.85	78.79	85.28				9.88	6.95	0.45
109800.00		85.98	75.85	78.78	85.28				10.13	7.19	0.70
109700.00		87.29	75.85	78.78	85.27				11.44	8.50	2.01
109600.00		86.52	75.84	78.78	85.26				10.68	7.74	1.26
109500.00	86.38	86.15	75.84	78.78	85.26	10.54	7.61	1.13	10.31	7.37	0.89
109400.00		86.45	75.84	78.77	85.25				10.61	7.67	1.20
109300.00	86.44	86.30	75.83	78.77	85.25	10.60	7.66	1.19	10.46	7.52	1.05
109200.00		86.49	75.83	78.77	85.24				10.66	7.72	1.25
109100.00		86.47	75.82	78.76	85.23				10.65	7.70	1.24
109000.00	86.43	86.35	75.81	78.75	85.22	10.62	7.67	1.20	10.54	7.59	1.12
108900.00		86.23	75.80	78.75	85.21				10.43	7.48	1.01
108800.00		86.10	75.79	78.74	85.21				10.31	7.36	0.89
108700.00		86.34	75.78	78.73	85.20				10.56	7.61	1.14
108600.00		86.32	75.77	78.73	85.19				10.55	7.59	1.13
108500.00	86.36	86.54	75.76	78.72	85.18	10.61	7.64	1.18	10.78	7.82	1.35
108400.00		86.37	75.75	78.71	85.17				10.62	7.66	1.19

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
108300.00		86.34	75.73	78.70	85.17				10.60	7.63	1.17
108200.00		86.09	75.72	78.70	85.16				10.36	7.39	0.93
108100.00		85.84	75.71	78.69	85.15				10.13	7.15	0.69
108000.00	85.89	85.90	75.70	78.68	85.14	10.18	7.20	0.74	10.20	7.22	0.76
107900.00		85.71	75.70	78.68	85.14				10.01	7.03	0.57
107800.00		86.16	75.70	78.68	85.14				10.46	7.48	1.02
107700.00		86.10	75.70	78.68	85.14				10.40	7.42	0.96
107600.00		86.29	75.70	78.68	85.14				10.59	7.61	1.15
107500.00	85.46	85.67	75.70	78.68	85.14	9.76	6.78	0.32	9.97	6.99	0.53
107400.00		85.98	75.70	78.68	85.14				10.28	7.30	0.84
107300.00	85.79	86.09	75.70	78.68	85.14	10.09	7.11	0.65	10.39	7.41	0.95
107200.00		86.24	75.70	78.68	85.14				10.54	7.56	1.10
107100.00		86.40	75.70	78.68	85.14				10.70	7.72	1.26
107000.00	85.69	86.02	75.70	78.68	85.14	9.99	7.01	0.55	10.32	7.34	0.88
106900.00		85.85	75.70	78.68	85.14				10.15	7.17	0.71
106800.00		86.45	75.69	78.67	85.12				10.76	7.78	1.32
106700.00		86.40	75.68	78.66	85.11				10.72	7.74	1.29
106600.00		86.34	75.67	78.65	85.10				10.67	7.69	1.24
106500.00	86.07	86.54	75.66	78.64	85.08	10.41	7.43	0.99	10.88	7.89	1.45
106400.00		86.18	75.65	78.63	85.07				10.53	7.54	1.11
106300.00		86.32	75.64	78.63	85.06				10.68	7.69	1.26
106200.00		86.60	75.63	78.62	85.04				10.97	7.98	1.55
106100.00		86.59	75.62	78.61	85.03				10.97	7.98	1.56
106000.00	85.59	86.43	75.61	78.60	85.02	9.98	6.99	0.57	10.82	7.83	1.41
105900.00		86.34	75.60	78.59	85.01				10.74	7.74	1.33
105800.00		86.83	75.59	78.58	84.99				11.25	8.25	1.84
105700.00		86.90	75.58	78.58	84.98				11.32	8.32	1.92
105600.00		86.66	75.56	78.57	84.96				11.09	8.09	1.69
105500.00	86.49	87.37	75.54	78.55	84.94	10.94	7.94	1.55	11.83	8.83	2.44
105400.00		87.26	75.52	78.53	84.91				11.74	8.73	2.35
105300.00		87.19	75.50	78.51	84.89				11.69	8.68	2.31
105200.00		86.96	75.48	78.50	84.86				11.48	8.47	2.10
105100.00		86.60	75.46	78.48	84.83				11.13	8.12	1.76
105000.00	85.65	86.33	75.44	78.46	84.81	10.21	7.19	0.84	10.89	7.87	1.52
104900.00		85.94	75.42	78.44	84.78				10.52	7.49	1.15
104800.00		86.04	75.40	78.43	84.76				10.64	7.61	1.28
104700.00		85.73	75.38	78.41	84.73				10.35	7.32	1.00
104600.00		85.79	75.36	78.39	84.71				10.44	7.40	1.09
104500.00	85.27	85.55	75.34	78.37	84.68	9.93	6.90	0.59	10.22	7.18	0.87
104400.00		86.28	75.32	78.36	84.66				10.96	7.92	1.63
104300.00		86.58	75.30	78.34	84.63				11.28	8.24	1.95
104200.00		84.51	75.28	78.33	84.61				9.23	6.18	-0.10
104100.00		85.02	75.27	78.31	84.59				9.76	6.71	0.44
104000.00	85.18	85.62	75.25	78.30	84.56	9.93	6.88	0.61	10.37	7.32	1.06
103900.00		85.70	75.23	78.28	84.54				10.46	7.41	1.16
103800.00		85.24	75.22	78.27	84.52				10.02	6.97	0.72
103700.00		85.25	75.20	78.26	84.49				10.05	7.00	0.76
103600.00		85.19	75.18	78.24	84.47				10.01	6.95	0.72
103500.00	84.68	85.14	75.17	78.23	84.45	9.51	6.45	0.23	9.97	6.91	0.69
103400.00		85.71	75.15	78.22	84.43				10.56	7.50	1.28
103300.00		85.31	75.14	78.20	84.41				10.17	7.11	0.90
103200.00		85.15	75.12	78.19	84.39				10.03	6.96	0.76
103100.00		84.53	75.10	78.18	84.37				9.43	6.35	0.16
103000.00	82.21	82.50	75.09	78.17	84.35	7.12	4.04	-2.14	7.42	4.34	-1.85
102900.00		82.52	75.07	78.15	84.33				7.45	4.36	-1.81
102800.00		83.24	75.06	78.14	84.31				8.18	5.10	-1.08
102700.00		88.83	75.04	78.13	84.29				13.79	10.70	4.53
102600.00		94.10	75.02	78.12	84.28				19.08	15.99	9.83
102500.00	90.55	91.42	75.00	78.10	84.25	15.56	12.46	6.30	16.43	13.33	7.17
102400.00		84.14	74.98	78.08	84.23				9.16	6.06	-0.09
102300.00		85.02	74.96	78.06	84.20				10.06	6.96	0.82
102200.00		84.79	74.95	78.05	84.19				9.84	6.74	0.60
102100.00		85.07	74.94	78.04	84.17				10.13	7.02	0.90
102000.00	84.02	84.49	74.93	78.03	84.15	9.09	5.99	-0.13	9.56	6.46	0.33
101900.00		84.08	74.92	78.02	84.14				9.16	6.06	-0.05
101800.00		84.76	74.91	78.01	84.12				9.85	6.74	0.63
101700.00		84.80	74.90	78.01	84.11				9.90	6.79	0.69
101600.00		84.36	74.89	78.00	84.09				9.47	6.36	0.27
101500.00	84.16	84.41	74.88	77.99	84.07	9.29	6.18	0.09	9.54	6.43	0.34
101400.00		84.67	74.86	77.98	84.06				9.80	6.69	0.61
101300.00		84.36	74.85	77.97	84.04				9.50	6.39	0.31
101200.00		84.57	74.84	77.96	84.02				9.72	6.61	0.54
101100.00		84.32	74.83	77.95	84.01				9.49	6.37	0.31
101000.00		84.23	74.82	77.94	83.99				9.40	6.29	0.23

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
100900.00		84.29	74.81	77.93	83.98				9.47	6.36	0.31
100800.00		86.18	74.80	77.92	83.96				11.38	8.26	2.22
100700.00		87.83	74.67	77.79	83.72				13.15	10.03	4.10
100600.00		84.19	74.57	77.69	83.49				9.62	6.50	0.70
100500.00	83.28	83.26	74.57	77.69	83.49	8.71	5.59	-0.22	8.69	5.57	-0.23
100400.00		83.30	74.57	77.69	83.49				8.73	5.61	-0.20
100300.00		83.02	74.57	77.69	83.50				8.45	5.33	-0.48
100200.00		82.97	74.57	77.69	83.50				8.39	5.27	-0.53
100100.00		82.97	74.57	77.69	83.50				8.39	5.27	-0.53
100000.00	83.14	83.05	74.58	77.70	83.50	8.56	5.44	-0.36	8.48	5.36	-0.45
99900.00		82.99	74.58	77.70	83.50				8.41	5.29	-0.52
99800.00		83.06	74.58	77.70	83.50				8.48	5.36	-0.45
99700.00		82.95	74.58	77.70	83.51				8.37	5.25	-0.56
99600.00		83.13	74.58	77.70	83.51				8.55	5.43	-0.38
99500.00	83.04	83.06	74.58	77.70	83.51	8.46	5.34	-0.47	8.48	5.36	-0.45
99400.00		82.91	74.56	77.68	83.47				8.35	5.23	-0.56
99300.00		82.89	74.54	77.66	83.44				8.36	5.23	-0.54
99200.00		82.95	74.52	77.64	83.41				8.43	5.31	-0.45
99100.00		82.90	74.50	77.62	83.37				8.40	5.28	-0.47
99000.00	82.85	83.10	74.48	77.60	83.34	8.37	5.24	-0.49	8.62	5.50	-0.24
98900.00		82.98	74.46	77.58	83.30				8.53	5.40	-0.32
98800.00		82.78	74.44	77.56	83.27				8.34	5.22	-0.49
98700.00		82.90	74.42	77.54	83.24				8.49	5.36	-0.33
98600.00		83.00	74.40	77.52	83.20				8.60	5.48	-0.20
98500.00	82.76	82.86	74.38	77.50	83.17	8.39	5.26	-0.41	8.49	5.36	-0.31
98400.00		82.86	74.36	77.48	83.14				8.51	5.38	-0.27
98300.00		82.93	74.34	77.46	83.10				8.59	5.46	-0.17
98200.00		82.75	74.32	77.44	83.07				8.43	5.30	-0.32
98100.00		82.61	74.28	77.41	83.01				8.33	5.20	-0.40
98000.00	82.62	82.65	74.25	77.38	82.95	8.37	5.24	-0.33	8.40	5.27	-0.30
97900.00		82.63	74.21	77.34	82.89				8.41	5.28	-0.26
97800.00		82.58	74.18	77.31	82.82				8.40	5.27	-0.24
97700.00		82.45	74.14	77.27	82.76				8.31	5.18	-0.31
97600.00		82.46	74.11	77.24	82.70				8.35	5.22	-0.24
97500.00	82.28	82.24	74.07	77.20	82.63	8.20	5.07	-0.36	8.16	5.03	-0.40
97400.00		82.20	74.04	77.17	82.57				8.17	5.04	-0.37
97300.00		82.19	74.00	77.13	82.51				8.19	5.06	-0.32
97200.00		82.13	73.97	77.10	82.45				8.16	5.03	-0.32
97100.00		81.96	73.93	77.06	82.38				8.03	4.90	-0.43
97000.00	81.99	81.99	73.90	77.03	82.32	8.09	4.96	-0.33	8.09	4.96	-0.33
96900.00		81.86	73.90	77.03	82.32				7.96	4.83	-0.46
96800.00		81.80	73.90	77.03	82.32				7.90	4.77	-0.52
96700.00		81.27	73.90	77.03	82.32				7.37	4.24	-1.05
96600.00	82.17	82.42	73.90	77.03	82.32	8.27	5.14	-0.15	8.52	5.39	0.10
96500.00	82.57	82.53	73.90	77.03	82.32	8.67	5.54	0.25	8.63	5.50	0.21
96400.00		82.37	73.90	77.03	82.32				8.47	5.34	0.05
96300.00		82.48	73.90	77.03	82.32				8.58	5.45	0.16
96200.00		82.37	73.90	77.03	82.32				8.47	5.34	0.05
96100.00		82.25	73.90	77.03	82.32				8.35	5.22	-0.07
96000.00	82.08	82.21	73.90	77.03	82.32	8.18	5.05	-0.24	8.31	5.18	-0.11
95900.00		82.07	73.90	77.03	82.32				8.17	5.04	-0.25
95800.00		82.11	73.90	77.03	82.32				8.21	5.08	-0.21
95700.00		82.23	73.86	76.99	82.28				8.37	5.24	-0.05
95600.00		82.22	73.82	76.94	82.23				8.40	5.27	-0.01
95500.00	81.96	82.08	73.77	76.90	82.18	8.19	5.06	-0.22	8.31	5.18	-0.10
95400.00		82.29	73.72	76.85	82.13				8.56	5.44	0.16
95300.00		82.26	73.68	76.80	82.08				8.59	5.46	0.18
95200.00		82.26	73.63	76.75	82.03				8.63	5.51	0.23
95100.00		82.37	73.58	76.71	81.98				8.79	5.67	0.40
95000.00		82.24	73.54	76.66	81.93				8.70	5.58	0.31
94900.00		82.22	73.49	76.61	81.88				8.73	5.61	0.34
94800.00		82.28	73.44	76.56	81.83				8.84	5.72	0.45
94700.00		82.11	73.40	76.52	81.78				8.71	5.59	0.33
94600.00		82.12	73.35	76.47	81.74				8.77	5.65	0.38
94500.00		82.32	73.30	76.43	81.69				9.01	5.89	0.62
94400.00		82.16	73.26	76.38	81.65				8.91	5.78	0.51
94300.00		82.45	73.21	76.34	81.61				9.24	6.11	0.84
94200.00		82.20	73.16	76.29	81.57				9.03	5.91	0.63
94100.00		82.08	73.11	76.24	81.52				8.97	5.84	0.56
94000.00		82.11	73.07	76.20	81.48				9.04	5.91	0.63
93900.00		82.30	73.02	76.15	81.44				9.28	6.14	0.86
93800.00		82.28	72.97	76.11	81.40				9.30	6.17	0.88
93700.00		82.27	72.93	76.06	81.36				9.35	6.21	0.92
93600.00		82.34	72.88	76.02	81.31				9.46	6.32	1.02

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
93500.00		82.19	72.83	75.97	81.27				9.36	6.22	0.92
93400.00		82.57	72.80	75.94	81.25				9.77	6.63	1.32
93300.00		82.43	72.77	75.92	81.22				9.65	6.51	1.21
93200.00		82.52	72.74	75.89	81.19				9.78	6.64	1.33
93100.00		82.57	72.71	75.86	81.17				9.86	6.71	1.40
93000.00		82.71	72.68	75.83	81.14				10.03	6.88	1.57
92900.00		82.68	72.65	75.80	81.12				10.03	6.88	1.57
92800.00		82.33	72.62	75.78	81.09				9.71	6.55	1.24
92700.00		81.80	72.59	75.75	81.07				9.21	6.05	0.73
92600.00		82.59	72.55	75.72	81.04				10.04	6.87	1.56
92500.00	81.91	82.37	72.52	75.69	81.01	9.39	6.22	0.90	9.85	6.68	1.36
92400.00		82.74	72.49	75.66	80.99				10.25	7.08	1.75
92300.00		82.54	72.46	75.64	80.96				10.08	6.90	1.58
92200.00		82.57	72.43	75.61	80.94				10.13	6.96	1.63
92100.00		82.59	72.40	75.58	80.91				10.19	7.01	1.68
92000.00	82.20	82.65	72.38	75.56	80.89	9.82	6.64	1.31	10.27	7.09	1.75
91900.00		82.78	72.35	75.54	80.87				10.43	7.25	1.91
91800.00		82.93	72.33	75.51	80.85				10.61	7.42	2.08
91700.00		83.12	72.30	75.49	80.83				10.81	7.63	2.29
91600.00		82.92	72.28	75.47	80.81				10.64	7.45	2.11
91500.00	82.15	82.80	72.25	75.45	80.79	9.90	6.71	1.36	10.54	7.35	2.01
91400.00		82.69	72.23	75.42	80.77				10.46	7.27	1.92
91300.00		82.49	72.20	75.40	80.75				10.29	7.09	1.74
91200.00		82.79	72.18	75.38	80.73				10.62	7.42	2.07
91100.00		82.39	72.15	75.36	80.71				10.24	7.04	1.69
91000.00	81.64	82.20	72.13	75.33	80.69	9.51	6.30	0.95	10.07	6.87	1.52
90900.00		82.24	72.11	75.31	80.66				10.13	6.93	1.57
90800.00		82.30	72.08	75.29	80.64				10.22	7.02	1.66
90700.00		82.14	72.06	75.26	80.62				10.09	6.88	1.52
90600.00		82.53	72.03	75.24	80.60				10.50	7.29	1.92
90500.00	82.44	82.76	72.01	75.22	80.58	10.43	7.21	1.85	10.75	7.54	2.18
90400.00		82.60	71.99	75.20	80.57				10.61	7.39	2.03
90300.00		82.39	71.97	75.19	80.55				10.42	7.20	1.84
90200.00		82.36	71.95	75.17	80.53				10.41	7.19	1.83
90100.00		81.99	71.93	75.15	80.51				10.06	6.85	1.48
90000.00	81.48	81.69	71.91	75.13	80.49	9.57	6.35	0.99	9.78	6.56	1.20
89900.00		81.52	71.89	75.11	80.47				9.63	6.41	1.04
89800.00		81.64	71.87	75.09	80.45				9.77	6.55	1.18
89700.00		81.68	71.85	75.07	80.44				9.84	6.61	1.25
89600.00		81.93	71.83	75.05	80.42				10.11	6.88	1.52
89500.00	81.67	81.82	71.81	75.03	80.40	9.87	6.64	1.27	10.01	6.79	1.42
89400.00		82.01	71.78	75.01	80.38				10.23	7.00	1.63
89300.00		81.98	71.76	74.99	80.36				10.22	6.99	1.62
89200.00		82.17	71.74	74.97	80.34				10.43	7.20	1.83
89100.00		82.07	71.72	74.95	80.32				10.34	7.11	1.74
89000.00	82.20	82.13	71.70	74.94	80.31	10.49	7.26	1.89	10.43	7.20	1.83
88900.00		82.30	71.69	74.92	80.29				10.62	7.39	2.02
88800.00		82.09	71.67	74.90	80.27				10.42	7.19	1.82
88700.00		81.94	71.65	74.88	80.25				10.29	7.06	1.69
88600.00		81.68	71.63	74.86	80.23				10.05	6.82	1.45
88500.00	81.45	81.59	71.61	74.85	80.22	9.84	6.61	1.24	9.98	6.74	1.37
88400.00		81.54	71.59	74.83	80.20				9.94	6.71	1.34
88300.00		81.65	71.58	74.81	80.18				10.07	6.84	1.47
88200.00	81.60	81.67	71.56	74.79	80.16	10.04	6.80	1.43	10.11	6.88	1.51
88100.00		81.52	71.54	74.78	80.15				9.98	6.74	1.37
88000.00	81.50	81.55	71.52	74.76	80.13	9.98	6.74	1.37	10.03	6.79	1.42
87900.00		81.94	71.50	74.74	80.11				10.43	7.20	1.83
87800.00		82.00	71.48	74.72	80.09				10.52	7.28	1.91
87700.00		82.02	71.47	74.71	80.07				10.55	7.31	1.94
87600.00		81.86	71.45	74.69	80.06				10.41	7.17	1.80
87500.00	81.67	81.95	71.43	74.67	80.04	10.24	7.00	1.63	10.52	7.28	1.92
87400.00		82.23	71.41	74.65	80.02				10.81	7.57	2.21
87300.00		82.27	71.40	74.64	80.00				10.88	7.64	2.28
87200.00		82.31	71.38	74.62	79.98				10.93	7.69	2.33
87100.00		82.18	71.36	74.60	79.96				10.82	7.58	2.22
87000.00	82.15	82.27	71.35	74.59	79.94	10.80	7.56	2.20	10.92	7.68	2.33
86900.00		82.49	71.33	74.57	79.92				11.16	7.92	2.57
86800.00		82.51	71.31	74.55	79.90				11.20	7.96	2.61
86700.00		82.57	71.29	74.53	79.88				11.27	8.03	2.68
86600.00		82.52	71.28	74.52	79.86				11.24	8.00	2.65
86500.00	82.18	82.24	71.26	74.50	79.85	10.92	7.68	2.33	10.98	7.74	2.40
86400.00		81.80	71.24	74.48	79.83				10.55	7.31	1.97
86300.00		81.87	71.23	74.47	79.81				10.64	7.40	2.06
86200.00		81.70	71.21	74.45	79.79				10.49	7.25	1.91

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
86100.00		81.36	71.17	74.41	79.76				10.19	6.95	1.61
86000.00	81.08	81.23	71.14	74.38	79.72	9.94	6.70	1.36	10.09	6.84	1.50
85900.00		81.22	71.10	74.35	79.69				10.12	6.87	1.53
85800.00		81.89	71.07	74.32	79.66				10.82	7.57	2.23
85700.00		81.92	71.03	74.28	79.63				10.89	7.64	2.30
85600.00		82.14	71.00	74.25	79.60				11.14	7.89	2.55
85500.00	81.94	82.00	70.97	74.22	79.56	10.97	7.72	2.37	11.04	7.79	2.44
85400.00		82.14	70.93	74.19	79.53				11.20	7.95	2.60
85300.00		81.59	70.90	74.15	79.50				10.69	7.44	2.09
85200.00		81.92	70.86	74.12	79.47				11.05	7.80	2.45
85100.00		81.51	70.83	74.09	79.44				10.68	7.42	2.08
85000.00	81.47	81.51	70.79	74.06	79.40	10.68	7.41	2.07	10.72	7.46	2.11
84900.00		81.53	70.76	74.02	79.37				10.77	7.51	2.16
84800.00		81.86	70.72	73.99	79.34				11.14	7.87	2.52
84700.00		82.43	70.69	73.96	79.31				11.74	8.47	3.12
84600.00		82.42	70.65	73.92	79.27				11.78	8.51	3.16
84500.00	82.28	82.50	70.53	73.81	79.16	11.75	8.47	3.12	11.97	8.69	3.34
84400.00		81.97	70.42	73.70	79.05				11.56	8.27	2.92
84300.00		81.88	70.30	73.59	78.94				11.57	8.29	2.94
84200.00		81.57	70.19	73.48	78.83				11.38	8.08	2.73
84100.00		81.78	70.08	73.38	78.73				11.70	8.40	3.05
84000.00		81.75	69.95	73.26	78.60				11.80	8.49	3.15
83900.00		81.44	69.82	73.13	78.48				11.62	8.31	2.96
83800.00		81.27	69.69	73.01	78.35				11.57	8.26	2.92
83700.00		81.00	69.59	72.91	78.25				11.41	8.09	2.75
83600.00		80.96	69.53	72.85	78.18				11.43	8.11	2.78
83500.00		80.58	69.47	72.79	78.12				11.12	7.80	2.47
83400.00		80.54	69.40	72.72	78.05				11.14	7.82	2.49
83300.00		80.36	69.34	72.66	77.99				11.02	7.70	2.38
83200.00		80.34	69.28	72.60	77.92				11.06	7.74	2.42
83100.00		80.17	69.21	72.53	77.86				10.95	7.63	2.31
83000.00	80.35	80.19	69.17	72.49	77.81	11.18	7.86	2.54	11.02	7.70	2.38
82900.00		80.45	69.13	72.45	77.77				11.32	8.00	2.68
82800.00		79.77	69.09	72.42	77.74				10.68	7.35	2.03
82700.00		79.49	69.05	72.38	77.70				10.44	7.11	1.79
82600.00		79.31	69.01	72.34	77.66				10.31	6.97	1.65
82500.00	79.40	79.23	68.96	72.31	77.63	10.43	7.09	1.77	10.26	6.92	1.60
82400.00		79.16	68.92	72.27	77.59				10.24	6.89	1.57
82300.00		79.07	68.88	72.23	77.55				10.19	6.84	1.52
82200.00		79.11	68.85	72.20	77.52				10.26	6.91	1.59
82100.00		79.18	68.82	72.17	77.49				10.36	7.01	1.69
82000.00	78.97	78.92	68.79	72.14	77.46	10.17	6.82	1.50	10.13	6.78	1.46
81900.00		78.69	68.76	72.12	77.43				9.92	6.57	1.25
81800.00		78.53	68.73	72.09	77.40				9.80	6.44	1.13
81700.00		78.83	68.70	72.06	77.37				10.12	6.77	1.45
81600.00		78.70	68.68	72.03	77.35				10.03	6.67	1.36
81500.00	78.99	79.00	68.65	72.00	77.32	10.34	6.99	1.67	10.36	7.00	1.69
81400.00		79.03	68.62	71.97	77.29				10.41	7.06	1.74
81300.00		79.24	68.59	71.95	77.26				10.65	7.30	1.98
81200.00		79.21	68.56	71.92	77.23				10.65	7.29	1.98
81100.00		79.15	68.53	71.89	77.20				10.62	7.26	1.95
81000.00	79.02	79.00	68.50	71.86	77.17	10.52	7.16	1.85	10.49	7.14	1.82
80900.00		78.80	68.47	71.83	77.14				10.33	6.97	1.66
80800.00		79.06	68.45	71.81	77.12				10.61	7.25	1.94
80700.00		78.79	68.43	71.80	77.10				10.36	7.00	1.69
80600.00		78.90	68.42	71.78	77.09				10.48	7.12	1.81
80500.00	78.66	78.68	68.40	71.76	77.07	10.26	6.90	1.59	10.28	6.92	1.61
80400.00		78.62	68.38	71.74	77.05				10.24	6.87	1.57
80300.00		79.07	68.36	71.72	77.03				10.71	7.34	2.04
80200.00		79.05	68.34	71.71	77.01				10.71	7.35	2.04
80100.00		79.19	68.32	71.69	76.99				10.86	7.50	2.19
80000.00	79.16	79.16	68.30	71.67	76.97	10.86	7.49	2.19	10.85	7.49	2.18
79900.00		79.04	68.29	71.65	76.96				10.76	7.39	2.09
79800.00		79.11	68.27	71.63	76.94				10.84	7.48	2.17
79700.00		79.12	68.25	71.62	76.92				10.87	7.51	2.20
79600.00		79.12	68.23	71.60	76.90				10.89	7.52	2.22
79500.00	79.24	79.04	68.21	71.58	76.88	11.03	7.66	2.36	10.83	7.46	2.16
79400.00		79.21	68.19	71.56	76.86				11.02	7.65	2.35
79300.00		79.24	68.16	71.53	76.83				11.08	7.71	2.41
79200.00		79.04	68.13	71.51	76.80				10.91	7.53	2.24
79100.00		79.31	68.11	71.48	76.78				11.20	7.83	2.53
79000.00	79.16	79.26	68.08	71.46	76.75	11.08	7.71	2.41	11.18	7.80	2.51
78900.00		79.16	68.06	71.43	76.73				11.11	7.73	2.44
78800.00		79.16	68.03	71.41	76.70				11.13	7.75	2.46

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
78700.00		78.83	68.00	71.38	76.67				10.83	7.45	2.16
78600.00		78.73	67.98	71.36	76.65				10.76	7.37	2.09
78500.00	78.85	78.87	67.95	71.34	76.62	10.90	7.51	2.23	10.92	7.53	2.25
78400.00		78.38	67.93	71.31	76.60				10.45	7.07	1.78
78300.00		78.22	67.90	71.29	76.57				10.32	6.93	1.65
78200.00		78.69	67.87	71.26	76.54				10.81	7.43	2.14
78100.00		79.21	67.85	71.24	76.52				11.36	7.97	2.69
78000.00	79.14	79.17	67.82	71.21	76.49	11.32	7.93	2.65	11.36	7.97	2.69
77900.00		78.93	67.79	71.18	76.45				11.14	7.75	2.47
77800.00		78.74	67.76	71.15	76.42				10.98	7.59	2.32
77700.00		78.61	67.72	71.11	76.38				10.89	7.50	2.23
77600.00		78.13	67.69	71.08	76.35				10.44	7.05	1.78
77500.00	78.24	78.56	67.66	71.05	76.31	10.58	7.19	1.93	10.90	7.51	2.24
77400.00		78.72	67.63	71.02	76.28				11.09	7.70	2.45
77300.00		78.41	67.60	70.99	76.24				10.81	7.42	2.17
77200.00		78.45	67.56	70.95	76.21				10.89	7.50	2.24
77100.00		78.45	67.53	70.92	76.17				10.92	7.53	2.28
77000.00	78.27	78.40	67.50	70.89	76.14	10.77	7.38	2.14	10.90	7.51	2.26
76900.00		78.36	67.47	70.86	76.10				10.89	7.50	2.26
76800.00		77.99	67.44	70.83	76.07				10.55	7.16	1.92
76700.00		78.15	67.42	70.81	76.04				10.74	7.35	2.11
76600.00		78.16	67.40	70.78	76.02				10.76	7.37	2.14
76500.00	78.16	78.36	67.37	70.76	76.00	10.79	7.40	2.17	10.98	7.60	2.36
76400.00		78.30	67.35	70.74	75.97				10.95	7.56	2.33
76300.00		78.18	67.33	70.72	75.95				10.85	7.46	2.23
76200.00		77.93	67.31	70.70	75.92				10.62	7.23	2.00
76100.00		77.73	67.29	70.67	75.90				10.44	7.05	1.83
76000.00	77.74	77.78	67.27	70.65	75.88	10.47	7.09	1.86	10.51	7.13	1.90
75900.00		77.94	67.25	70.63	75.85				10.69	7.31	2.09
75800.00		78.17	67.23	70.61	75.83				10.95	7.56	2.34
75700.00		77.96	67.20	70.59	75.80				10.76	7.37	2.16
75600.00		77.99	67.18	70.57	75.78				10.81	7.43	2.21
75500.00	78.05	78.11	67.16	70.54	75.76	10.89	7.51	2.30	10.94	7.56	2.35
75400.00		77.90	67.14	70.52	75.73				10.75	7.37	2.16
75300.00		77.51	67.11	70.49	75.70				10.39	7.01	1.80
75200.00		77.55	67.08	70.46	75.66				10.47	7.09	1.89
75100.00		77.61	67.04	70.42	75.62				10.57	7.19	1.99
75000.00	77.85	77.95	67.00	70.38	75.58	10.85	7.47	2.27	10.95	7.57	2.37
74900.00		78.00	66.97	70.35	75.54				11.03	7.65	2.47
74800.00		77.77	66.93	70.31	75.50				10.83	7.45	2.27
74700.00		77.39	66.90	70.28	75.45				10.50	7.12	1.94
74600.00		77.48	66.86	70.24	75.41				10.62	7.24	2.07
74500.00	77.32	77.57	66.82	70.20	75.37	10.50	7.12	1.95	10.74	7.36	2.19
74400.00		77.54	66.79	70.17	75.33				10.75	7.37	2.21
74300.00		77.56	66.75	70.13	75.29				10.81	7.43	2.27
74200.00		77.31	66.71	70.09	75.25				10.60	7.22	2.07
74100.00		77.54	66.68	70.06	75.21				10.86	7.48	2.33
74000.00	77.29	77.46	66.65	70.03	75.17	10.64	7.26	2.11	10.81	7.44	2.29
73900.00		77.56	66.62	70.00	75.14				10.94	7.56	2.42
73800.00		77.62	66.59	69.96	75.10				11.03	7.65	2.52
73700.00		77.62	66.56	69.93	75.06				11.06	7.68	2.55
73600.00		77.30	66.53	69.90	75.03				10.78	7.40	2.27
73500.00	77.19	77.43	66.50	69.87	74.99	10.69	7.31	2.19	10.93	7.56	2.44
73400.00		77.50	66.47	69.84	74.96				11.03	7.65	2.54
73300.00		77.60	66.44	69.81	74.92				11.16	7.79	2.68
73200.00		77.46	66.41	69.78	74.88				11.06	7.68	2.58
73100.00		77.51	66.37	69.75	74.85				11.14	7.77	2.67
73000.00	77.39	77.43	66.34	69.72	74.81	11.05	7.68	2.58	11.09	7.71	2.62
72900.00		77.11	66.31	69.68	74.78				10.79	7.42	2.33
72800.00		76.75	66.29	69.66	74.75				10.46	7.09	2.01
72700.00		76.81	66.27	69.64	74.73				10.54	7.17	2.09
72600.00		77.04	66.25	69.62	74.70				10.79	7.42	2.33
72500.00	77.12	77.13	66.23	69.60	74.68	10.89	7.52	2.44	10.90	7.53	2.45
72400.00		77.09	66.21	69.58	74.66				10.88	7.51	2.43
72300.00		76.99	66.19	69.56	74.63				10.80	7.43	2.35
72200.00		77.05	66.17	69.54	74.61				10.88	7.51	2.44
72100.00		76.88	66.15	69.52	74.59				10.73	7.36	2.30
72000.00	76.96	77.10	66.13	69.50	74.56	10.83	7.46	2.39	10.97	7.60	2.53
71900.00		76.86	66.11	69.48	74.54				10.75	7.38	2.32
71800.00		76.76	66.09	69.46	74.52				10.67	7.30	2.24
71700.00		76.54	66.07	69.44	74.50				10.47	7.10	2.04
71600.00		76.49	66.05	69.42	74.47				10.44	7.07	2.02
71500.00	76.82	76.85	66.03	69.40	74.45	10.79	7.42	2.37	10.82	7.45	2.40
71400.00		76.69	66.00	69.38	74.42				10.69	7.32	2.27

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
71300.00		76.50	65.98	69.35	74.40				10.52	7.15	2.11
71200.00		76.81	65.95	69.33	74.37				10.85	7.48	2.44
71100.00		76.72	65.93	69.30	74.34				10.79	7.42	2.38
71000.00	76.58	76.64	65.90	69.28	74.31	10.68	7.30	2.27	10.74	7.37	2.33
70900.00		76.68	65.88	69.25	74.28				10.81	7.43	2.40
70800.00		76.66	65.85	69.23	74.26				10.81	7.44	2.41
70700.00		76.49	65.83	69.20	74.23				10.66	7.29	2.26
70600.00		76.76	65.80	69.18	74.20				10.96	7.58	2.56
70500.00	76.46	76.72	65.77	69.15	74.17	10.68	7.31	2.28	10.94	7.57	2.54
70400.00		76.80	65.75	69.13	74.15				11.05	7.67	2.65
70300.00		76.66	65.72	69.10	74.12				10.94	7.56	2.54
70200.00		76.95	65.70	69.08	74.09				11.25	7.88	2.86
70100.00		76.74	65.67	69.05	74.06				11.07	7.69	2.68
70000.00	76.54	76.82	65.65	69.03	74.03	10.89	7.51	2.50	11.18	7.80	2.79
69900.00		76.76	65.62	69.00	74.01				11.14	7.76	2.75
69800.00		76.26	65.60	68.98	73.98				10.66	7.28	2.28
69700.00		76.11	65.57	68.95	73.95				10.53	7.16	2.16
69600.00		76.10	65.55	68.93	73.92				10.55	7.18	2.18
69500.00	75.96	75.87	65.53	68.90	73.90	10.43	7.06	2.06	10.35	6.97	1.98
69400.00		75.85	65.50	68.88	73.87				10.35	6.97	1.98
69300.00		75.76	65.48	68.85	73.84				10.28	6.91	1.92
69200.00		76.05	65.46	68.83	73.81				10.59	7.22	2.24
69100.00		76.03	65.43	68.80	73.79				10.60	7.22	2.24
69000.00	76.39	76.27	65.41	68.78	73.76	10.98	7.61	2.63	10.86	7.49	2.51
68900.00		75.97	65.38	68.76	73.73				10.59	7.22	2.24
68800.00		75.97	65.36	68.73	73.70				10.61	7.24	2.26
68700.00		76.07	65.34	68.71	73.68				10.73	7.36	2.39
68600.00		76.06	65.31	68.68	73.65				10.75	7.38	2.42
68500.00	76.26	76.19	65.28	68.65	73.62	10.98	7.61	2.65	10.91	7.54	2.57
68400.00		75.78	65.25	68.63	73.59				10.52	7.15	2.19
68300.00		75.91	65.23	68.60	73.56				10.68	7.31	2.35
68200.00		75.89	65.20	68.57	73.53				10.70	7.32	2.36
68100.00		75.67	65.17	68.55	73.50				10.50	7.12	2.17
68000.00	75.64	75.53	65.14	68.52	73.47	10.50	7.12	2.17	10.38	7.01	2.05
67900.00		75.43	65.12	68.49	73.44				10.31	6.94	1.98
67800.00		75.50	65.09	68.47	73.42				10.41	7.03	2.08
67700.00		75.47	65.06	68.44	73.39				10.41	7.03	2.09
67600.00		75.58	65.03	68.41	73.36				10.55	7.17	2.22
67500.00	75.54	75.48	65.01	68.39	73.33	10.53	7.15	2.21	10.47	7.10	2.15
67400.00		75.29	64.98	68.36	73.30				10.31	6.93	1.99
67300.00		75.45	64.95	68.33	73.27				10.49	7.11	2.18
67200.00		75.48	64.93	68.31	73.25				10.55	7.17	2.24
67100.00		75.21	64.91	68.29	73.22				10.30	6.92	1.99
67000.00	75.07	74.78	64.89	68.27	73.19	10.18	6.80	1.87	9.89	6.51	1.58
66900.00		74.69	64.86	68.24	73.17				9.83	6.45	1.52
66800.00		74.92	64.84	68.22	73.14				10.08	6.70	1.78
66700.00		74.65	64.82	68.20	73.11				9.83	6.45	1.54
66600.00		74.92	64.79	68.17	73.09				10.12	6.74	1.83
66500.00	75.04	74.85	64.77	68.15	73.06	10.27	6.89	1.98	10.08	6.70	1.79
66400.00		74.78	64.75	68.13	73.03				10.03	6.65	1.74
66300.00		74.64	64.73	68.11	73.01				9.91	6.53	1.63
66200.00		74.59	64.70	68.08	72.98				9.89	6.51	1.61
66100.00		74.28	64.68	68.06	72.95				9.60	6.22	1.33
66000.00	74.34	74.21	64.66	68.04	72.93	9.68	6.30	1.41	9.54	6.16	1.28
65900.00		74.52	64.65	68.03	72.91				9.87	6.49	1.60
65800.00		74.42	64.63	68.01	72.89				9.79	6.41	1.53
65700.00		74.28	64.62	67.99	72.87				9.66	6.29	1.41
65600.00		74.19	64.60	67.98	72.85				9.59	6.22	1.34
65500.00	74.51	74.06	64.59	67.96	72.83	9.92	6.55	1.67	9.48	6.10	1.23
65400.00		73.94	64.57	67.94	72.81				9.37	5.99	1.12
65300.00		73.87	64.56	67.92	72.79				9.32	5.95	1.08
65200.00		74.05	64.54	67.91	72.77				9.51	6.14	1.28
65100.00		74.00	64.52	67.89	72.75				9.47	6.11	1.24
65000.00	74.29	73.83	64.51	67.87	72.73	9.78	6.41	1.55	9.32	5.95	1.09
64900.00		73.91	64.49	67.86	72.71				9.42	6.05	1.20
64800.00		73.68	64.48	67.84	72.69				9.20	5.83	0.98
64700.00		73.28	64.46	67.82	72.67				8.81	5.45	0.60
64600.00		74.08	64.45	67.81	72.66				9.63	6.27	1.43
64500.00	74.31	74.02	64.44	67.80	72.64	9.87	6.51	1.67	9.58	6.22	1.38
64400.00		73.49	64.42	67.78	72.62				9.07	5.71	0.87
64300.00		73.58	64.41	67.77	72.60				9.17	5.81	0.98
64200.00		73.57	64.40	67.75	72.58				9.18	5.82	0.99
64100.00		73.40	64.38	67.74	72.56				9.01	5.66	0.83
64000.00	73.11	72.77	64.37	67.72	72.54	8.74	5.39	0.57	8.40	5.05	0.23

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
63900.00		72.76	64.36	67.71	72.53				8.41	5.05	0.24
63800.00		72.82	64.34	67.70	72.51				8.48	5.12	0.31
63700.00		72.78	64.33	67.68	72.49				8.45	5.10	0.29
63600.00		72.74	64.32	67.67	72.47				8.42	5.07	0.27
63500.00	72.89	72.41	64.30	67.65	72.45	8.59	5.24	0.44	8.10	4.75	-0.05
63400.00		72.15	64.29	67.64	72.43				7.86	4.51	-0.28
63300.00		72.24	64.28	67.63	72.41				7.96	4.61	-0.18
63200.00		72.15	64.26	67.61	72.40				7.89	4.54	-0.25
63100.00		72.13	64.25	67.60	72.38				7.88	4.54	-0.24
63000.00	72.42	71.98	64.23	67.58	72.36	8.19	4.84	0.06	7.74	4.40	-0.38
62900.00		72.14	64.22	67.57	72.34				7.92	4.57	-0.20
62800.00		72.08	64.21	67.55	72.32				7.87	4.53	-0.24
62700.00		72.02	64.19	67.54	72.30				7.83	4.49	-0.28
62600.00		71.96	64.18	67.52	72.28				7.78	4.44	-0.32
62500.00	72.30	71.92	64.16	67.51	72.27	8.13	4.79	0.03	7.76	4.41	-0.35
62400.00		72.32	64.15	67.49	72.25				8.17	4.82	0.07
62300.00		72.39	64.14	67.48	72.23				8.25	4.91	0.16
62200.00		72.03	64.12	67.46	72.21				7.91	4.57	-0.18
62100.00		72.08	64.11	67.45	72.19				7.98	4.64	-0.11
62000.00	72.29	72.11	64.09	67.43	72.17	8.20	4.86	0.12	8.02	4.68	-0.06
61900.00		72.15	64.08	67.42	72.16				8.07	4.73	-0.01
61800.00		71.99	64.07	67.41	72.14				7.92	4.58	-0.16
61700.00		71.65	64.06	67.40	72.13				7.59	4.25	-0.48
61600.00		71.41	64.05	67.38	72.11				7.36	4.03	-0.70
61500.00	71.66	71.40	64.04	67.37	72.10	7.62	4.28	-0.44	7.36	4.03	-0.70
61400.00		71.49	64.03	67.36	72.08				7.47	4.14	-0.59
61300.00		71.65	64.01	67.35	72.07				7.63	4.30	-0.42
61200.00		71.56	64.00	67.33	72.05				7.56	4.23	-0.49
61100.00		71.49	63.99	67.32	72.04				7.50	4.17	-0.55
61000.00	71.55	71.53	63.98	67.31	72.02	7.57	4.24	-0.47	7.55	4.22	-0.49
60900.00		71.47	63.97	67.30	72.01				7.50	4.18	-0.54
60800.00		71.18	63.96	67.28	71.99				7.23	3.90	-0.81
60700.00		71.14	63.95	67.27	71.98				7.19	3.87	-0.84
60600.00		71.13	63.94	67.26	71.96				7.19	3.87	-0.83
60500.00	71.19	70.95	63.92	67.25	71.95	7.27	3.95	-0.75	7.02	3.70	-1.00
60400.00		71.20	63.91	67.23	71.93				7.29	3.97	-0.73
60300.00		71.24	63.90	67.22	71.92				7.34	4.02	-0.68
60200.00		71.58	63.89	67.21	71.91				7.69	4.37	-0.32
60100.00		71.30	63.88	67.20	71.90				7.42	4.10	-0.59
60000.00	71.68	71.40	63.87	67.19	71.88	7.81	4.49	-0.20	7.53	4.21	-0.48
59900.00		71.65	63.86	67.18	71.87				7.79	4.47	-0.22
59800.00		71.54	63.85	67.17	71.86				7.69	4.37	-0.32
59700.00		71.13	63.84	67.16	71.85				7.29	3.97	-0.71
59600.00		70.78	63.83	67.15	71.83				6.95	3.63	-1.05
59500.00	71.06	70.75	63.82	67.14	71.82	7.24	3.92	-0.76	6.93	3.61	-1.07
59400.00		70.93	63.81	67.13	71.81				7.13	3.81	-0.87
59300.00		70.83	63.80	67.12	71.80				7.03	3.71	-0.97
59200.00		70.88	63.79	67.11	71.78				7.09	3.77	-0.91
59100.00		70.99	63.78	67.10	71.77				7.21	3.89	-0.79
59000.00	71.24	70.86	63.77	67.09	71.76	7.47	4.15	-0.52	7.10	3.78	-0.89
58900.00		70.84	63.76	67.08	71.75				7.09	3.77	-0.90
58800.00		70.78	63.75	67.07	71.74				7.03	3.72	-0.95
58700.00		70.47	63.74	67.06	71.73				6.73	3.41	-1.26
58600.00		70.24	63.73	67.05	71.72				6.51	3.19	-1.48
58500.00	70.83	70.41	63.73	67.05	71.71	7.10	3.78	-0.89	6.68	3.36	-1.31
58400.00		70.52	63.72	67.04	71.71				6.80	3.48	-1.19
58300.00		70.51	63.71	67.03	71.70				6.80	3.48	-1.18
58200.00		70.46	63.71	67.02	71.69				6.76	3.44	-1.23
58100.00		70.51	63.70	67.02	71.68				6.81	3.49	-1.18
58000.00	70.91	70.48	63.69	67.01	71.68	7.21	3.90	-0.77	6.79	3.47	-1.20
57900.00		70.53	63.69	67.00	71.67				6.84	3.52	-1.14
57800.00		70.50	63.68	67.00	71.66				6.82	3.51	-1.16
57700.00		70.50	63.67	66.99	71.65				6.83	3.52	-1.15
57600.00		70.54	63.67	66.98	71.65				6.87	3.56	-1.11
57500.00	70.75	70.55	63.66	66.97	71.64	7.08	3.77	-0.89	6.89	3.57	-1.09
57400.00		70.30	63.66	66.97	71.63				6.64	3.33	-1.33
57300.00		70.32	63.65	66.96	71.62				6.67	3.36	-1.30
57200.00		70.13	63.64	66.95	71.62				6.48	3.17	-1.49
57100.00		70.02	63.64	66.95	71.61				6.38	3.07	-1.59
57000.00	70.25	70.08	63.63	66.94	71.60	6.62	3.31	-1.35	6.45	3.14	-1.53
56900.00		70.27	63.62	66.93	71.59				6.65	3.34	-1.32
56800.00		70.34	63.61	66.92	71.58				6.73	3.42	-1.24
56700.00		70.48	63.61	66.92	71.57				6.87	3.56	-1.10
56600.00		70.60	63.60	66.91	71.56				7.00	3.69	-0.97

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
56500.00	70.94	70.57	63.59	66.90	71.55	7.35	4.04	-0.61	6.98	3.67	-0.98
56400.00		70.58	63.58	66.89	71.55				6.99	3.68	-0.97
56300.00		70.50	63.57	66.88	71.54				6.93	3.62	-1.03
56200.00		70.47	63.57	66.88	71.53				6.91	3.60	-1.05
56100.00		70.53	63.56	66.87	71.52				6.97	3.66	-0.99
56000.00	70.77	70.27	63.55	66.86	71.51	7.22	3.91	-0.74	6.72	3.41	-1.24
55900.00		69.95	63.54	66.85	71.50				6.41	3.10	-1.55
55800.00		69.83	63.53	66.84	71.49				6.29	2.98	-1.66
55700.00		69.61	63.52	66.83	71.48				6.08	2.77	-1.87
55600.00		69.67	63.52	66.83	71.47				6.16	2.85	-1.79
55500.00	70.19	69.68	63.51	66.82	71.46	6.68	3.37	-1.27	6.17	2.86	-1.78
55400.00		69.70	63.50	66.81	71.44				6.21	2.90	-1.74
55300.00		69.73	63.48	66.79	71.43				6.25	2.94	-1.70
55200.00		69.94	63.47	66.78	71.42				6.47	3.16	-1.47
55100.00		70.20	63.46	66.77	71.40				6.74	3.43	-1.20
55000.00	70.91	70.32	63.45	66.76	71.39	7.46	4.15	-0.48	6.88	3.57	-1.07
54900.00		70.42	63.43	66.74	71.38				6.98	3.67	-0.96
54800.00		70.16	63.42	66.73	71.36				6.74	3.43	-1.20
54700.00		70.10	63.41	66.72	71.35				6.69	3.38	-1.25
54600.00		70.25	63.39	66.70	71.33				6.86	3.55	-1.08
54500.00	70.60	70.26	63.38	66.69	71.31	7.22	3.91	-0.71	6.88	3.57	-1.05
54400.00		70.07	63.37	66.67	71.30				6.70	3.40	-1.22
54300.00		70.13	63.35	66.66	71.28				6.78	3.47	-1.15
54200.00		69.90	63.34	66.64	71.26				6.56	3.26	-1.36
54100.00		69.88	63.33	66.63	71.24				6.55	3.25	-1.37
54000.00	70.38	69.97	63.31	66.62	71.23	7.07	3.77	-0.84	6.65	3.35	-1.26
53900.00		69.94	63.30	66.60	71.21				6.64	3.33	-1.27
53800.00		69.92	63.28	66.59	71.19				6.63	3.33	-1.27
53700.00		70.22	63.27	66.57	71.17				6.95	3.65	-0.95
53600.00		70.31	63.26	66.56	71.16				7.06	3.76	-0.84
53500.00	70.22	69.99	63.24	66.54	71.14	6.97	3.67	-0.93	6.75	3.45	-1.15
53400.00		69.87	63.23	66.53	71.13				6.64	3.34	-1.26
53300.00		70.08	63.22	66.52	71.11				6.86	3.56	-1.03
53200.00		70.23	63.21	66.51	71.10				7.02	3.72	-0.87
53100.00		70.12	63.20	66.50	71.08				6.93	3.63	-0.96
53000.00	70.56	70.58	63.18	66.48	71.07	7.38	4.08	-0.50	7.40	4.10	-0.48
52900.00		70.54	63.17	66.47	71.05				7.37	4.07	-0.51
52800.00		70.57	63.16	66.46	71.04				7.42	4.12	-0.46
52700.00		70.39	63.15	66.45	71.02				7.24	3.95	-0.63
52600.00		70.07	63.14	66.43	71.01				6.93	3.63	-0.95
52500.00	70.23	69.99	63.13	66.42	71.00	7.11	3.81	-0.77	6.87	3.57	-1.01
52400.00		69.97	63.12	66.41	70.99				6.85	3.56	-1.02
52300.00		69.83	63.10	66.40	70.97				6.72	3.43	-1.15
52200.00		69.69	63.09	66.39	70.96				6.59	3.30	-1.27
52100.00		69.63	63.08	66.37	70.95				6.54	3.25	-1.32
52000.00	70.24	69.97	63.07	66.36	70.93	7.16	3.87	-0.70	6.90	3.60	-0.97
51900.00		70.14	63.06	66.35	70.92				7.08	3.79	-0.78
51800.00		69.99	63.05	66.34	70.91				6.94	3.65	-0.92
51700.00		69.98	63.04	66.33	70.90				6.94	3.65	-0.92
51600.00		70.05	63.03	66.32	70.89				7.01	3.72	-0.84
51500.00	71.20	70.07	63.02	66.31	70.88	8.17	4.89	0.32	7.05	3.76	-0.80
51400.00		70.59	63.02	66.30	70.86				7.58	4.29	-0.27
51300.00		70.76	63.01	66.29	70.85				7.75	4.46	-0.10
51200.00		70.09	63.00	66.28	70.84				7.09	3.81	-0.75
51100.00			62.99	66.27	70.83						
51000.00			62.98	66.26	70.82						
50900.00			62.97	66.25	70.81						
50800.00			62.96	66.25	70.80						
50700.00			62.95	66.24	70.78						
50600.00			62.94	66.23	70.77						
50500.00			62.93	66.22	70.76						
50400.00			62.92	66.21	70.75						
50300.00			62.91	66.20	70.74						
50200.00			62.91	66.19	70.73						
50100.00			62.90	66.18	70.72						
50000.00			62.89	66.17	70.70						
49900.00			62.88	66.16	70.69						
49800.00			62.87	66.15	70.68						
49700.00			62.86	66.14	70.67						
49600.00			62.81	66.09	70.61						
49500.00			62.76	66.03	70.55						
49400.00			62.71	65.98	70.49						
49300.00			62.65	65.92	70.42						
49200.00			62.60	65.86	70.35						

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Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
49100.00			62.54	65.80	70.28						
49000.00			62.48	65.74	70.21						
48900.00			62.42	65.68	70.14						
48800.00			62.36	65.62	70.07						
48700.00			62.19	65.45	69.88						
48600.00			62.01	65.27	69.69						
48500.00			61.90	65.15	69.56						
48400.00			61.84	65.09	69.49						
48300.00			61.77	65.03	69.42						
48200.00			61.71	64.97	69.35						
48100.00			61.65	64.90	69.28						
48000.00			61.62	64.87	69.25						
47900.00			61.60	64.84	69.21						
47800.00		68.78	61.57	64.81	69.18				7.21	3.97	-0.40
47700.00		68.75	61.54	64.78	69.15				7.21	3.97	-0.39
47600.00		68.74	61.51	64.75	69.11				7.23	3.99	-0.37
47500.00	70.15	69.31	61.49	64.72	69.08	8.67	5.44	1.08	7.83	4.59	0.24
47400.00		68.72	61.46	64.69	69.04				7.26	4.03	-0.32
47300.00		68.64	61.43	64.66	69.01				7.21	3.98	-0.37
47200.00		68.39	61.40	64.63	68.97				6.99	3.77	-0.58
47100.00		68.09	61.37	64.60	68.94				6.72	3.50	-0.85
47000.00	68.41	67.75	61.35	64.57	68.91	7.06	3.84	-0.50	6.40	3.18	-1.16
46900.00		67.53	61.32	64.54	68.87				6.21	2.99	-1.34
46800.00		67.76	61.29	64.51	68.84				6.46	3.25	-1.08
46700.00		67.45	61.27	64.48	68.80				6.18	2.97	-1.35
46600.00		67.43	61.24	64.45	68.77				6.19	2.98	-1.34
46500.00	67.87	67.50	61.21	64.42	68.73	6.66	3.45	-0.86	6.29	3.08	-1.23
46400.00		67.46	61.19	64.39	68.70				6.27	3.07	-1.24
46300.00	67.97	67.41	61.16	64.36	68.66	6.81	3.61	-0.69	6.25	3.05	-1.26
46200.00		67.43	61.13	64.33	68.63				6.30	3.10	-1.20
46100.00		67.41	61.10	64.30	68.60				6.30	3.11	-1.19
46000.00	68.11	67.60	61.08	64.27	68.56	7.03	3.84	-0.45	6.52	3.33	-0.96
45900.00		67.63	61.05	64.24	68.53				6.59	3.40	-0.89
45800.00		67.75	61.02	64.21	68.49				6.73	3.54	-0.74
45700.00		67.89	60.99	64.18	68.46				6.90	3.71	-0.57
45600.00		68.07	60.96	64.14	68.42				7.11	3.92	-0.36
45500.00	68.05	67.71	60.93	64.11	68.39	7.12	3.94	-0.33	6.78	3.60	-0.67
45400.00		67.61	60.90	64.08	68.35				6.70	3.52	-0.75
45300.00		67.31	60.88	64.05	68.32				6.43	3.26	-1.01
45200.00		67.39	60.85	64.02	68.28				6.55	3.37	-0.89
45100.00		67.36	60.82	63.99	68.25				6.54	3.37	-0.89
45000.00	67.91	67.78	60.78	63.95	68.20	7.13	3.96	-0.29	6.99	3.83	-0.42
44900.00		67.87	60.75	63.91	68.16				7.12	3.96	-0.29
44800.00		67.37	60.71	63.87	68.11				6.66	3.50	-0.74
44700.00		67.13	60.68	63.83	68.07				6.45	3.30	-0.93
44600.00		67.11	60.64	63.79	68.02				6.46	3.32	-0.91
44500.00	67.26	66.98	60.61	63.75	67.97	6.65	3.51	-0.71	6.37	3.23	-1.00
44400.00		67.02	60.57	63.71	67.93				6.44	3.31	-0.91
44300.00		67.19	60.54	63.67	67.88				6.65	3.52	-0.70
44200.00		66.97	60.50	63.63	67.84				6.47	3.35	-0.86
44100.00		67.23	60.47	63.59	67.79				6.76	3.65	-0.56
44000.00	67.43	67.38	60.43	63.55	67.75	6.99	3.88	-0.32	6.94	3.83	-0.37
43900.00		67.47	60.40	63.51	67.70				7.07	3.97	-0.23
43800.00		67.25	60.37	63.47	67.65				6.89	3.78	-0.40
43700.00		67.29	60.33	63.43	67.61				6.96	3.86	-0.32
43600.00		66.96	60.30	63.39	67.56				6.66	3.57	-0.60
43500.00	66.95	66.79	60.26	63.35	67.52	6.69	3.61	-0.56	6.53	3.44	-0.72
43400.00		66.71	60.23	63.31	67.47				6.48	3.40	-0.76
43300.00		67.21	60.19	63.27	67.43				7.02	3.94	-0.21
43200.00		67.41	60.16	63.23	67.38				7.25	4.18	0.03
43100.00		67.55	60.12	63.19	67.34				7.42	4.35	0.21
43000.00	67.39	67.22	60.09	63.16	67.29	7.30	4.23	0.10	7.12	4.06	-0.08
42900.00		67.49	60.06	63.12	67.25				7.43	4.37	0.24
42800.00		66.99	60.02	63.08	67.20				6.96	3.90	-0.22
42700.00		66.60	59.99	63.05	67.16				6.61	3.56	-0.56
42600.00		66.93	59.96	63.01	67.12				6.97	3.92	-0.19
42500.00	67.17	66.98	59.93	62.97	67.07	7.25	4.20	0.10	7.06	4.01	-0.09
42400.00		67.15	59.89	62.93	67.03				7.25	4.21	0.12
42300.00		66.84	59.86	62.90	66.98				6.98	3.94	-0.15
42200.00		66.82	59.83	62.86	66.94				7.00	3.97	-0.11
42100.00		66.95	59.79	62.82	66.90				7.16	4.13	0.06
42000.00	67.06	66.90	59.76	62.78	66.85	7.30	4.27	0.20	7.14	4.11	0.05
41900.00		67.00	59.73	62.75	66.81				7.28	4.25	0.19
41800.00		67.30	59.69	62.71	66.76				7.61	4.59	0.54

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
41700.00		67.09	59.66	62.67	66.72				7.43	4.41	0.37
41600.00		66.90	59.62	62.63	66.67				7.28	4.27	0.23
41500.00	67.05	66.92	59.59	62.59	66.62	7.46	4.46	0.42	7.33	4.33	0.30
41400.00		67.37	59.55	62.55	66.57				7.82	4.82	0.80
41300.00		66.75	59.51	62.50	66.52				7.25	4.25	0.23
41200.00		66.80	59.47	62.46	66.47				7.33	4.34	0.33
41100.00		66.57	59.43	62.41	66.42				7.14	4.15	0.15
41000.00	66.65	66.63	59.39	62.37	66.37	7.26	4.28	0.28	7.23	4.26	0.26
40900.00		66.77	59.35	62.32	66.31				7.42	4.45	0.46
40800.00		66.74	59.31	62.28	66.26				7.43	4.46	0.48
40700.00		66.59	59.27	62.24	66.21				7.31	4.35	0.38
40600.00		66.62	59.23	62.19	66.16				7.39	4.43	0.46
40500.00	66.82	66.90	59.20	62.15	66.11	7.62	4.67	0.71	7.71	4.76	0.79
40400.00		66.77	59.16	62.10	66.06				7.61	4.67	0.71
40300.00		66.73	59.12	62.06	66.01				7.61	4.67	0.72
40200.00		66.56	59.08	62.02	65.96				7.47	4.54	0.60
40100.00		66.46	59.05	61.98	65.91				7.41	4.48	0.55
40000.00	66.60	66.58	59.02	61.94	65.86	7.58	4.66	0.74	7.56	4.64	0.72
39900.00		66.52	58.99	61.90	65.81				7.53	4.62	0.71
39800.00		66.42	58.95	61.86	65.76				7.47	4.57	0.66
39700.00		66.36	58.92	61.82	65.71				7.44	4.54	0.65
39600.00		66.51	58.89	61.78	65.66				7.62	4.73	0.84
39500.00	66.22	66.19	58.85	61.74	65.61	7.37	4.48	0.61	7.33	4.45	0.57
39400.00		66.35	58.82	61.70	65.57				7.53	4.65	0.79
39300.00		66.31	58.79	61.66	65.52				7.53	4.66	0.80
39200.00		66.10	58.75	61.62	65.47				7.35	4.48	0.63
39100.00		66.03	58.72	61.58	65.42				7.31	4.45	0.61
39000.00	66.10	65.97	58.69	61.55	65.39	7.41	4.55	0.71	7.28	4.43	0.59
38900.00		65.99	58.66	61.52	65.35				7.33	4.47	0.64
38800.00		65.92	58.63	61.49	65.32				7.28	4.43	0.60
38700.00		65.92	58.60	61.45	65.29				7.32	4.47	0.64
38600.00		66.20	58.58	61.42	65.25				7.62	4.77	0.94
38500.00	66.23	66.27	58.55	61.39	65.22	7.68	4.84	1.01	7.73	4.88	1.05
38400.00		66.22	58.52	61.36	65.18				7.70	4.86	1.03
38300.00		66.32	58.49	61.33	65.15				7.83	4.99	1.16
38200.00		66.06	58.46	61.30	65.12				7.60	4.76	0.94
38100.00		66.12	58.43	61.27	65.08				7.69	4.86	1.04
38000.00	66.13	66.13	58.40	61.24	65.05	7.73	4.90	1.08	7.73	4.89	1.08
37900.00		66.12	58.37	61.21	65.02				7.75	4.92	1.10
37800.00		65.95	58.35	61.18	64.98				7.61	4.78	0.97
37700.00		65.81	58.32	61.15	64.95				7.49	4.66	0.86
37600.00		65.91	58.30	61.12	64.92				7.61	4.79	0.99
37500.00	66.07	66.03	58.27	61.09	64.88	7.80	4.98	1.18	7.76	4.94	1.15
37400.00		66.07	58.25	61.06	64.85				7.83	5.01	1.22
37300.00		65.82	58.22	61.03	64.82				7.60	4.79	1.00
37200.00		65.87	58.20	61.00	64.78				7.67	4.86	1.08
37100.00		65.64	58.17	60.97	64.75				7.47	4.67	0.89
37000.00	65.62	65.56	58.15	60.95	64.72	7.47	4.67	0.90	7.41	4.62	0.84
36900.00		65.49	58.12	60.92	64.68				7.37	4.57	0.80
36800.00		65.29	58.10	60.89	64.65				7.19	4.40	0.64
36700.00		65.56	58.07	60.86	64.62				7.48	4.70	0.94
36600.00		65.42	58.05	60.83	64.58				7.37	4.59	0.83
36500.00	65.22	65.22	58.02	60.80	64.55	7.20	4.42	0.67	7.20	4.42	0.67
36400.00		65.18	58.00	60.77	64.52				7.18	4.40	0.66
36300.00		64.85	57.97	60.74	64.48				6.88	4.11	0.37
36200.00		64.82	57.93	60.70	64.43				6.89	4.12	0.39
36100.00		64.72	57.89	60.65	64.37				6.82	4.07	0.35
36000.00	65.00	65.00	57.86	60.60	64.32	7.14	4.39	0.68	7.15	4.40	0.69
35900.00		65.03	57.82	60.56	64.26				7.21	4.47	0.77
35800.00		65.24	57.78	60.51	64.21				7.47	4.73	1.04
35700.00		65.29	57.74	60.47	64.15				7.55	4.83	1.14
35600.00		65.15	57.70	60.42	64.10				7.45	4.73	1.05
35500.00	65.28	65.30	57.66	60.37	64.04	7.62	4.90	1.23	7.64	4.93	1.26
35400.00		65.19	57.62	60.33	63.99				7.57	4.86	1.20
35300.00		65.01	57.58	60.28	63.94				7.42	4.72	1.07
35200.00		65.32	57.54	60.24	63.88				7.77	5.08	1.44
35100.00		65.42	57.51	60.19	63.83				7.91	5.23	1.59
35000.00	65.30	65.37	57.47	60.14	63.77	7.83	5.15	1.53	7.91	5.23	1.60
34900.00		65.36	57.43	60.10	63.72				7.93	5.26	1.64
34800.00		65.50	57.41	60.07	63.69				8.10	5.43	1.81
34700.00		65.44	57.38	60.05	63.66				8.06	5.39	1.78
34600.00		65.20	57.36	60.02	63.62				7.84	5.18	1.57
34500.00	65.16	65.16	57.33	59.99	63.59	7.83	5.17	1.57	7.83	5.17	1.57
34400.00		64.99	57.31	59.97	63.56				7.68	5.02	1.43

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
34300.00		65.02	57.29	59.94	63.53				7.74	5.08	1.49
34200.00		64.97	57.26	59.91	63.50				7.71	5.06	1.47
34100.00		64.89	57.24	59.89	63.47				7.65	5.00	1.42
34000.00	65.17	65.07	57.22	59.86	63.44	7.95	5.30	1.73	7.85	5.21	1.63
33900.00		64.72	57.19	59.83	63.40				7.52	4.88	1.31
33800.00		64.90	57.17	59.81	63.37				7.73	5.09	1.53
33700.00		64.81	57.15	59.78	63.34				7.67	5.03	1.47
33600.00		64.89	57.12	59.75	63.31				7.76	5.13	1.58
33500.00	64.79	64.66	57.10	59.73	63.28	7.69	5.06	1.51	7.57	4.94	1.39
33400.00		64.64	57.08	59.70	63.24				7.57	4.95	1.40
33300.00		64.55	57.05	59.67	63.21				7.49	4.88	1.34
33200.00		64.45	57.03	59.64	63.17				7.42	4.81	1.28
33100.00		64.35	57.01	59.61	63.14				7.34	4.73	1.21
33000.00	64.54	64.52	56.99	59.58	63.10	7.55	4.96	1.44	7.54	4.94	1.42
32900.00		64.38	56.96	59.55	63.06				7.42	4.83	1.32
32800.00		64.35	56.94	59.52	63.03				7.41	4.83	1.32
32700.00		64.39	56.92	59.50	62.99				7.47	4.89	1.39
32600.00		64.44	56.89	59.47	62.96				7.55	4.97	1.48
32500.00	64.39	64.35	56.87	59.44	62.92	7.52	4.95	1.47	7.48	4.91	1.43
32400.00		64.64	56.85	59.41	62.89				7.79	5.23	1.75
32300.00		64.41	56.83	59.38	62.85				7.59	5.03	1.56
32200.00	64.40	64.40	56.79	59.34	62.80	7.60	5.06	1.59	7.60	5.06	1.59
32100.00		64.26	56.76	59.30	62.75				7.51	4.97	1.52
32000.00		64.37	56.72	59.25	62.70				7.65	5.12	1.67
31900.00		64.39	56.68	59.21	62.64				7.71	5.18	1.75
31800.00		64.15	56.64	59.16	62.59				7.51	4.99	1.57
31700.00	64.06	64.18	56.60	59.12	62.54	7.45	4.94	1.52	7.58	5.06	1.64
31600.00		63.91	56.57	59.08	62.48				7.35	4.83	1.43
31500.00	63.84	63.85	56.53	59.03	62.43	7.31	4.80	1.41	7.33	4.82	1.42
31400.00		63.73	56.49	58.99	62.38				7.24	4.74	1.35
31300.00		63.69	56.45	58.95	62.32				7.24	4.75	1.37
31200.00		63.83	56.42	58.91	62.28				7.41	4.92	1.55
31100.00		63.77	56.41	58.89	62.26				7.36	4.87	1.51
31000.00	63.82	63.75	56.39	58.87	62.24	7.43	4.95	1.58	7.36	4.88	1.51
30900.00		63.72	56.37	58.85	62.21				7.35	4.87	1.50
30800.00		63.77	56.35	58.83	62.19				7.42	4.94	1.58
30700.00		63.79	56.34	58.81	62.17				7.45	4.98	1.62
30600.00		63.37	56.32	58.79	62.15				7.05	4.58	1.23
30500.00	63.33	63.45	56.30	58.77	62.13	7.03	4.56	1.21	7.15	4.68	1.32
30400.00		63.47	56.28	58.75	62.10				7.19	4.73	1.37
30300.00		63.44	56.27	58.73	62.08				7.17	4.71	1.36
30200.00		63.39	56.25	58.71	62.06				7.14	4.69	1.33
30100.00		63.14	56.23	58.69	62.04				6.91	4.45	1.10
30000.00	63.21	63.24	56.21	58.66	62.02	7.00	4.55	1.20	7.03	4.58	1.23
29900.00		63.75	56.21	58.66	62.01				7.55	5.10	1.74
29800.00		63.57	56.20	58.65	62.00				7.37	4.92	1.57
29700.00		63.14	56.20	58.65	62.00				6.94	4.49	1.13
29600.00		63.09	56.19	58.64	62.00				6.90	4.44	1.09
29500.00	63.22	63.03	56.18	58.64	62.00	7.03	4.58	1.22	6.85	4.39	1.04
29400.00		63.22	56.18	58.63	61.99				7.04	4.59	1.23
29300.00		63.08	56.17	58.63	61.99				6.91	4.45	1.09
29200.00		62.80	56.17	58.63	61.99				6.63	4.18	0.82
29100.00		62.67	56.16	58.62	61.98				6.51	4.05	0.69
29000.00	62.89	62.62	56.16	58.62	61.98	6.73	4.27	0.91	6.46	4.01	0.64
28900.00		62.66	56.15	58.61	61.98				6.50	4.04	0.68
28800.00		62.49	56.15	58.61	61.97				6.35	3.89	0.52
28700.00		62.66	56.14	58.60	61.97				6.51	4.05	0.69
28600.00		62.51	56.13	58.59	61.96				6.38	3.92	0.55
28500.00	62.75	62.80	56.12	58.58	61.95	6.62	4.17	0.80	6.67	4.22	0.85
28400.00		62.55	56.11	58.57	61.93				6.44	3.98	0.62
28300.00		62.51	56.10	58.56	61.92				6.41	3.96	0.60
28200.00		62.31	56.09	58.54	61.90				6.22	3.77	0.41
28100.00		62.09	56.08	58.53	61.89				6.01	3.56	0.20
28000.00	62.52	62.49	56.07	58.52	61.87	6.45	4.00	0.64	6.43	3.98	0.62
27900.00		62.28	56.05	58.50	61.86				6.23	3.78	0.42
27800.00		64.02	56.04	58.49	61.84				7.98	5.53	2.18
27700.00		65.23	56.03	58.48	61.83				9.20	6.75	3.40
27600.00		65.22	56.02	58.46	61.81				9.20	6.75	3.40
27500.00	65.37	65.59	56.01	58.45	61.80	9.36	6.92	3.57	9.58	7.14	3.79
27400.00		65.61	56.00	58.44	61.78				9.62	7.18	3.83
27300.00		66.25	55.99	58.43	61.77				10.27	7.83	4.48
27200.00		66.35	55.98	58.42	61.76				10.37	7.93	4.59
27100.00		65.69	55.97	58.41	61.75				9.72	7.28	3.94
27000.00	65.35	65.63	55.96	58.40	61.74	9.38	6.94	3.60	9.67	7.23	3.88

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
26900.00		65.53	55.96	58.40	61.74				9.58	7.14	3.79
26800.00		65.74	55.95	58.39	61.73				9.79	7.35	4.01
26700.00		65.37	55.94	58.38	61.73				9.43	6.99	3.65
26600.00		64.88	55.94	58.38	61.72				8.95	6.51	3.16
26500.00	65.16	65.13	55.93	58.37	61.72	9.23	6.79	3.44	9.20	6.76	3.42
26400.00		64.48	55.92	58.36	61.71				8.56	6.12	2.77
26300.00		63.75	55.92	58.36	61.70				7.83	5.39	2.05
26200.00		63.82	55.91	58.35	61.70				7.91	5.47	2.13
26100.00		64.34	55.90	58.34	61.69				8.44	6.00	2.65
26000.00	65.06	65.03	55.89	58.33	61.68	9.17	6.73	3.38	9.14	6.70	3.35
25900.00		66.41	55.87	58.31	61.66				10.54	8.10	4.75
25800.00		66.16	55.86	58.30	61.64				10.31	7.87	4.52
25700.00		64.85	55.84	58.28	61.62				9.01	6.57	3.22
25600.00		64.38	55.82	58.26	61.60				8.56	6.12	2.77
25500.00	65.01	64.93	55.80	58.24	61.59	9.21	6.77	3.42	9.12	6.68	3.34
25400.00		64.90	55.79	58.23	61.57				9.12	6.68	3.33
25300.00		64.83	55.77	58.21	61.55				9.06	6.62	3.28
25200.00		64.98	55.75	58.19	61.53				9.22	6.78	3.45
25100.00		64.19	55.74	58.18	61.51				8.46	6.02	2.68
25000.00	63.56	63.45	55.72	58.16	61.50	7.84	5.40	2.06	7.73	5.29	1.96
24900.00		64.37	55.70	58.14	61.48				8.67	6.23	2.90
24800.00		64.38	55.69	58.13	61.46				8.69	6.25	2.92
24700.00		64.47	55.67	58.11	61.44				8.80	6.36	3.03
24600.00		63.98	55.66	58.10	61.43				8.32	5.88	2.55
24500.00	63.79	63.73	55.66	58.10	61.43	8.13	5.69	2.36	8.07	5.63	2.30
24400.00		63.98	55.66	58.10	61.43				8.32	5.88	2.55
24300.00		64.02	55.66	58.10	61.43				8.36	5.92	2.59
24200.00		63.31	55.66	58.10	61.43				7.65	5.21	1.88
24100.00		63.27	55.66	58.10	61.43				7.61	5.17	1.84
24000.00	63.93	63.96	55.66	58.10	61.43	8.27	5.83	2.50	8.30	5.86	2.53
23900.00		64.23	55.66	58.10	61.43				8.57	6.13	2.80
23800.00		63.75	55.66	58.10	61.43				8.09	5.65	2.32
23700.00		63.78	55.66	58.10	61.43				8.12	5.68	2.35
23600.00		63.77	55.66	58.10	61.43				8.11	5.67	2.34
23500.00	63.46	63.27	55.66	58.10	61.43	7.80	5.36	2.03	7.61	5.17	1.84
23400.00		63.17	55.66	58.10	61.43				7.51	5.07	1.74
23300.00		63.35	55.66	58.10	61.43				7.69	5.25	1.92
23200.00		62.65	55.65	58.09	61.42				7.00	4.56	1.23
23100.00		62.45	55.64	58.08	61.41				6.81	4.37	1.04
23000.00	62.88	62.73	55.63	58.07	61.40	7.25	4.81	1.48	7.10	4.66	1.33
22900.00		62.63	55.62	58.06	61.39				7.01	4.57	1.24
22800.00		62.28	55.61	58.05	61.38				6.67	4.23	0.90
22700.00		61.98	55.59	58.03	61.37				6.39	3.95	0.61
22600.00		61.63	55.58	58.02	61.36				6.04	3.60	0.27
22500.00	62.07	61.92	55.57	58.01	61.35	6.50	4.06	0.72	6.34	3.90	0.57
22400.00		62.10	55.56	58.00	61.34				6.54	4.10	0.76
22300.00		62.52	55.55	57.99	61.33				6.97	4.53	1.19
22200.00		62.41	55.54	57.98	61.32				6.87	4.43	1.09
22100.00		62.40	55.53	57.97	61.31				6.87	4.43	1.09
22000.00	62.10	62.14	55.52	57.96	61.30	6.58	4.14	0.80	6.62	4.18	0.84
21900.00		62.59	55.52	57.96	61.29				7.07	4.63	1.30
21800.00		63.15	55.51	57.95	61.29				7.64	5.20	1.86
21700.00		64.11	55.51	57.95	61.28				8.59	6.15	2.82
21600.00		63.80	55.51	57.95	61.28				8.29	5.85	2.52
21500.00	62.98	63.12	55.50	57.94	61.27	7.48	5.04	1.71	7.62	5.18	1.85
21400.00		63.72	55.50	57.94	61.27				8.21	5.77	2.45
21300.00		64.26	55.50	57.94	61.26				8.76	6.32	2.99
21200.00		63.58	55.49	57.93	61.26				8.09	5.65	2.33
21100.00		62.82	55.49	57.93	61.25				7.33	4.89	1.57
21000.00	62.20	62.37	55.48	57.92	61.24	6.72	4.28	0.96	6.89	4.45	1.13
20900.00		63.10	55.46	57.90	61.22				7.64	5.19	1.87
20800.00		63.07	55.44	57.88	61.20				7.62	5.18	1.86
20700.00		62.70	55.42	57.87	61.19				7.27	4.83	1.51
20600.00		62.51	55.40	57.85	61.17				7.11	4.66	1.34
20500.00	62.20	62.31	55.39	57.83	61.15	6.81	4.36	1.04	6.92	4.47	1.15
20400.00		62.94	55.37	57.82	61.14				7.58	5.13	1.81
20300.00		63.54	55.35	57.80	61.12				8.19	5.74	2.42
20200.00		62.72	55.35	57.79	61.11				7.38	4.93	1.61
20100.00		62.43	55.34	57.78	61.10				7.09	4.65	1.33
20000.00		63.01	55.33	57.77	61.09				7.68	5.24	1.92
19900.00		63.40	55.32	57.76	61.08				8.08	5.64	2.32
19800.00		62.42	55.31	57.75	61.06				7.11	4.67	1.36
19700.00		62.68	55.30	57.74	61.05				7.38	4.94	1.63
19600.00		62.42	55.29	57.73	61.04				7.13	4.69	1.38

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
19500.00		63.21	55.28	57.72	61.03				7.93	5.49	2.18
19400.00		63.81	55.27	57.71	61.02				8.54	6.10	2.80
19300.00		64.38	55.26	57.70	61.00				9.12	6.68	3.38
19200.00		62.94	55.25	57.69	60.99				7.69	5.26	1.95
19100.00		62.56	55.24	57.68	60.98				7.32	4.88	1.58
19000.00		63.02	55.24	57.67	60.97				7.78	5.35	2.05
18900.00		62.82	55.23	57.66	60.96				7.59	5.16	1.86
18800.00		63.41	55.22	57.65	60.94				8.19	5.76	2.47
18700.00		62.92	55.21	57.63	60.93				7.71	5.29	1.99
18600.00		63.52	55.20	57.62	60.92				8.32	5.90	2.60
18500.00		63.65	55.19	57.61	60.91				8.46	6.04	2.74
18400.00		63.00	55.18	57.60	60.90				7.82	5.40	2.11
18300.00		63.34	55.17	57.59	60.88				8.17	5.75	2.46
18200.00		63.30	55.16	57.58	60.87				8.14	5.72	2.43
18100.00		63.20	55.14	57.56	60.85				8.06	5.64	2.36
18000.00		63.32	55.12	57.54	60.82				8.20	5.78	2.50
17900.00		63.10	55.10	57.51	60.79				8.01	5.59	2.31
17800.00		63.22	55.07	57.49	60.76				8.15	5.73	2.46
17700.00		63.07	55.05	57.46	60.73				8.03	5.61	2.34
17600.00		62.11	55.03	57.44	60.71				7.09	4.67	1.41
17500.00		62.27	55.00	57.41	60.68				7.26	4.85	1.59
17400.00		63.22	54.98	57.39	60.65				8.24	5.83	2.57
17300.00		63.90	54.96	57.36	60.62				8.95	6.54	3.28
17200.00		63.65	54.94	57.34	60.59				8.72	6.31	3.06
17100.00		63.66	54.91	57.32	60.56				8.75	6.35	3.10
17000.00		63.37	54.89	57.29	60.54				8.48	6.08	2.84
16900.00		63.66	54.87	57.27	60.51				8.79	6.39	3.15
16800.00		63.99	54.85	57.25	60.49				9.13	6.73	3.49
16700.00		63.07	54.84	57.24	60.48				8.23	5.83	2.59
16600.00		62.73	54.83	57.23	60.47				7.90	5.50	2.26
16500.00		62.86	54.82	57.22	60.45				8.04	5.64	2.41
16400.00		62.25	54.81	57.20	60.44				7.45	5.05	1.81
16300.00		61.60	54.80	57.19	60.43				6.81	4.41	1.18
16200.00		61.85	54.78	57.18	60.41				7.07	4.67	1.44
16100.00		62.03	54.77	57.17	60.40				7.26	4.86	1.63
16000.00		61.99	54.76	57.15	60.39				7.23	4.84	1.60
15900.00		62.10	54.75	57.14	60.38				7.35	4.96	1.73
15800.00		61.93	54.74	57.13	60.36				7.19	4.80	1.56
15700.00		61.41	54.73	57.12	60.35				6.68	4.29	1.06
15600.00		60.84	54.72	57.11	60.34				6.13	3.74	0.51
15500.00		61.40	54.70	57.09	60.32				6.70	4.31	1.08
15400.00		61.23	54.68	57.07	60.29				6.55	4.16	0.94
15300.00		61.35	54.66	57.05	60.27				6.69	4.31	1.09
15200.00		61.04	54.64	57.03	60.25				6.39	4.01	0.79
15100.00		61.87	54.63	57.01	60.22				7.25	4.87	1.65
15000.00		61.98	54.61	56.99	60.20				7.37	4.99	1.78
14900.00		62.42	54.59	56.97	60.17				7.83	5.46	2.25
14800.00		62.21	54.57	56.95	60.15				7.64	5.27	2.07
14700.00		61.42	54.55	56.93	60.12				6.87	4.50	1.30
14600.00		61.55	54.53	56.91	60.10				7.02	4.64	1.45
14500.00		61.95	54.51	56.89	60.07				7.44	5.07	1.88
14400.00		61.52	54.49	56.86	60.05				7.03	4.65	1.47
14300.00		60.95	54.47	56.84	60.03				6.48	4.11	0.92
14200.00		61.32	54.39	56.75	59.91				6.93	4.57	1.41
14100.00		60.39	54.29	56.63	59.76				6.11	3.76	0.63
14000.00		60.31	54.18	56.51	59.62				6.12	3.79	0.69
13900.00		60.48	54.08	56.40	59.47				6.40	4.08	1.00
13800.00		61.67	54.02	56.33	59.39				7.65	5.34	2.29
13700.00		61.80	54.00	56.31	59.36				7.80	5.49	2.43
13600.00		61.90	53.98	56.29	59.34				7.93	5.62	2.57
13500.00		62.40	53.96	56.26	59.31				8.44	6.13	3.08
13400.00		62.86	53.94	56.24	59.29				8.92	6.62	3.57
13300.00		62.03	53.91	56.22	59.26				8.12	5.81	2.77
13200.00		61.54	53.89	56.20	59.24				7.65	5.35	2.31
13100.00		61.09	53.87	56.18	59.21				7.21	4.91	1.87
13000.00		61.28	53.85	56.15	59.19				7.43	5.13	2.09
12900.00		62.08	53.83	56.13	59.16				8.25	5.95	2.92
12800.00		62.25	53.81	56.11	59.13				8.44	6.14	3.11
12700.00		61.75	53.78	56.08	59.10				7.97	5.67	2.65
12600.00		61.88	53.76	56.05	59.07				8.12	5.83	2.81
12500.00		61.72	53.74	56.02	59.03				7.99	5.70	2.69
12400.00		60.02	53.71	55.99	59.00				6.31	4.02	1.02
12300.00		59.19	53.69	55.97	58.97				5.51	3.23	0.23
12200.00		58.98	53.66	55.94	58.93				5.32	3.04	0.05

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
12100.00		59.47	53.64	55.91	58.90				5.83	3.56	0.57
12000.00		59.74	53.62	55.88	58.87				6.12	3.85	0.87
11900.00		60.07	53.59	55.85	58.83				6.48	4.22	1.24
11800.00		60.18	53.57	55.83	58.80				6.61	4.35	1.38
11700.00		60.25	53.54	55.80	58.76				6.71	4.45	1.49
11600.00		60.22	53.52	55.77	58.73				6.70	4.45	1.49
11500.00		60.23	53.49	55.73	58.69				6.74	4.49	1.54
11400.00		60.33	53.45	55.70	58.64				6.88	4.63	1.69
11300.00		60.32	53.42	55.66	58.60				6.90	4.66	1.72
11200.00		60.20	53.39	55.62	58.55				6.81	4.58	1.65
11100.00		60.11	53.35	55.58	58.51				6.75	4.52	1.60
11000.00		60.02	53.32	55.54	58.46				6.70	4.48	1.56
10900.00		58.74	53.28	55.51	58.42				5.46	3.24	0.33
10800.00		58.81	53.25	55.47	58.37				5.56	3.34	0.44
10700.00		60.29	53.22	55.43	58.33				7.08	4.86	1.97
10600.00		57.60	53.18	55.39	58.28				4.42	2.21	-0.68
10500.00		57.90	53.17	55.38	58.27				4.72	2.51	-0.38
10400.00		57.68	53.16	55.38	58.27				4.52	2.31	-0.58
10300.00		57.85	53.16	55.37	58.26				4.70	2.48	-0.41
10200.00		57.54	53.15	55.36	58.25				4.39	2.17	-0.72
10100.00		57.41	53.14	55.36	58.25				4.27	2.05	-0.84
10000.00		57.40	53.13	55.35	58.24				4.27	2.05	-0.84
9900.00		57.87	53.13	55.35	58.24				4.75	2.53	-0.36
9800.00		62.36	53.04	55.25	58.11				9.32	7.12	4.25
9700.00		58.26	52.81	54.97	57.74				5.45	3.30	0.52
9600.00		57.35	52.79	54.94	57.71				4.56	2.41	-0.37
9500.00		56.96	52.77	54.92	57.69				4.19	2.04	-0.73
9400.00		56.97	52.75	54.90	57.66				4.23	2.08	-0.68
9300.00		57.03	52.73	54.87	57.63				4.30	2.16	-0.60
9200.00		56.94	52.71	54.85	57.60				4.23	2.09	-0.66
9100.00		56.73	52.67	54.81	57.55				4.06	1.92	-0.82
9000.00		56.73	52.62	54.75	57.48				4.11	1.97	-0.76
8900.00		56.67	52.57	54.70	57.42				4.10	1.97	-0.75
8800.00		56.69	52.52	54.65	57.36				4.17	2.05	-0.66
8700.00		56.84	52.47	54.59	57.29				4.37	2.25	-0.45
8600.00		56.61	52.43	54.54	57.23				4.18	2.06	-0.62
8500.00		56.75	52.38	54.49	57.16				4.37	2.26	-0.42
8400.00		56.53	52.31	54.42	57.08				4.22	2.12	-0.54
8300.00		56.65	52.22	54.32	56.96				4.42	2.33	-0.31
8200.00		56.52	52.14	54.22	56.84				4.38	2.30	-0.32
8100.00		56.18	52.05	54.12	56.72				4.13	2.06	-0.54
8000.00		56.40	51.96	54.03	56.60				4.43	2.37	-0.20
7900.00		56.63	51.88	53.93	56.48				4.75	2.70	0.15
7800.00		56.54	51.79	53.83	56.36				4.75	2.71	0.18
7700.00		56.38	51.71	53.73	56.24				4.67	2.64	0.14
7600.00		56.12	51.62	53.64	56.12				4.50	2.49	0.00
7500.00		56.07	51.54	53.55	56.02				4.53	2.52	0.05
7400.00		56.10	51.49	53.50	55.96				4.60	2.60	0.14
7300.00		56.10	51.44	53.45	55.90				4.65	2.65	0.20
7200.00		56.07	51.39	53.39	55.84				4.68	2.68	0.24
7100.00		55.60	51.34	53.34	55.78				4.25	2.26	-0.18
7000.00		55.93	51.29	53.29	55.72				4.63	2.64	0.21
6900.00		56.92	51.25	53.24	55.65				5.68	3.68	1.27
6800.00		57.37	51.20	53.18	55.59				6.17	4.18	1.77
6700.00		57.22	51.15	53.13	55.53				6.08	4.09	1.69
6600.00		57.17	51.10	53.08	55.47				6.07	4.09	1.70
6500.00		56.90	51.06	53.04	55.43				5.83	3.85	1.47
6400.00		57.00	51.05	53.03	55.42				5.95	3.97	1.58
6300.00		56.75	51.04	53.02	55.40				5.71	3.74	1.35
6200.00		56.66	51.03	53.01	55.39				5.63	3.65	1.27
6100.00		56.67	51.02	52.99	55.38				5.66	3.68	1.30
6000.00		56.89	51.00	52.98	55.36				5.89	3.91	1.53
5900.00		57.00	50.99	52.97	55.35				6.01	4.03	1.66
5800.00		56.89	50.98	52.95	55.33				5.91	3.93	1.56
5700.00		56.70	50.97	52.94	55.32				5.74	3.76	1.39
5600.00		56.76	50.96	52.93	55.30				5.80	3.83	1.46
5500.00		56.53	50.94	52.92	55.29				5.59	3.62	1.24
5400.00		56.43	50.93	52.90	55.27				5.50	3.52	1.15
5300.00		56.43	50.92	52.89	55.26				5.51	3.54	1.17
5200.00		56.38	50.91	52.88	55.25				5.47	3.50	1.14
5100.00		56.18	50.89	52.86	55.23				5.29	3.32	0.95
5000.00		55.86	50.88	52.85	55.22				4.98	3.01	0.64
4900.00		56.04	50.87	52.84	55.20				5.17	3.20	0.84
4800.00		56.26	50.86	52.83	55.19				5.40	3.43	1.07

Table 6. Feather River West Levee Project Freeboard Analysis

						Field Survey Elevations			CVFED Elevations		
LEVEE DESIGN STATION	Survey Elevation @ Control Line	CVFED Elevation @ Control Line	100YR WSE	200YR WSE	500YR WSE	100YR Freeboard	200YR Freeboard	500YR Freeboard	100YR Freeboard	200YR Freeboard	500YR Freeboard
4700.00		56.23	50.85	52.81	55.17				5.39	3.42	1.06
4600.00		56.03	50.83	52.80	55.16				5.20	3.23	0.87
4500.00		55.78	50.82	52.79	55.14				4.96	2.99	0.64
4400.00		56.09	50.81	52.78	55.13				5.28	3.32	0.96
4300.00		56.35	50.80	52.76	55.12				5.56	3.59	1.24
4200.00		55.82	50.79	52.75	55.10				5.04	3.07	0.72
4100.00		55.79	50.77	52.74	55.09				5.01	3.05	0.70
4000.00		55.92	50.76	52.72	55.07				5.16	3.20	0.85
3900.00		55.73	50.75	52.71	55.06				4.98	3.01	0.67
3800.00		55.64	50.74	52.70	55.04				4.91	2.94	0.60
3700.00		55.60	50.73	52.69	55.03				4.87	2.91	0.57
3600.00		55.57	50.71	52.67	55.01				4.85	2.89	0.55
3500.00		55.61	50.66	52.61	54.94				4.95	2.99	0.66
3400.00		55.52	50.59	52.54	54.85				4.93	2.98	0.67
3300.00		55.48	50.52	52.46	54.75				4.96	3.01	0.72
3200.00		55.46	50.45	52.39	54.66				5.01	3.07	0.80
3100.00		55.38	50.38	52.31	54.57				5.00	3.07	0.82
3000.00		55.38	50.31	52.24	54.47				5.07	3.15	0.91
2900.00		55.13	50.24	52.16	54.38				4.89	2.96	0.75
2800.00		54.88	50.17	52.09	54.28				4.71	2.80	0.60
2700.00		54.87	50.10	52.01	54.19				4.77	2.86	0.68
2600.00		55.23	50.03	51.93	54.10				5.20	3.29	1.13
2500.00		55.01	49.96	51.86	54.01				5.05	3.15	1.00
2400.00		55.02	49.91	51.80	53.93				5.11	3.21	1.09
2300.00		55.19	49.86	51.74	53.85				5.33	3.44	1.34
2200.00		55.06	49.80	51.69	53.77				5.26	3.38	1.30
2100.00		54.84	49.75	51.63	53.69				5.10	3.22	1.16
2000.00		54.69	49.69	51.57	53.60				5.00	3.12	1.09
1900.00		54.74	49.64	51.51	53.52				5.10	3.23	1.21
1800.00		54.61	49.59	51.45	53.44				5.03	3.16	1.17
1700.00		54.58	49.53	51.39	53.37				5.04	3.19	1.21
1600.00		54.70	49.49	51.34	53.29				5.21	3.36	1.41
1500.00		54.53	49.44	51.28	53.22				5.09	3.25	1.31
1400.00		54.42	49.39	51.23	53.14				5.03	3.19	1.27
1300.00		54.58	49.34	51.17	53.07				5.24	3.41	1.51

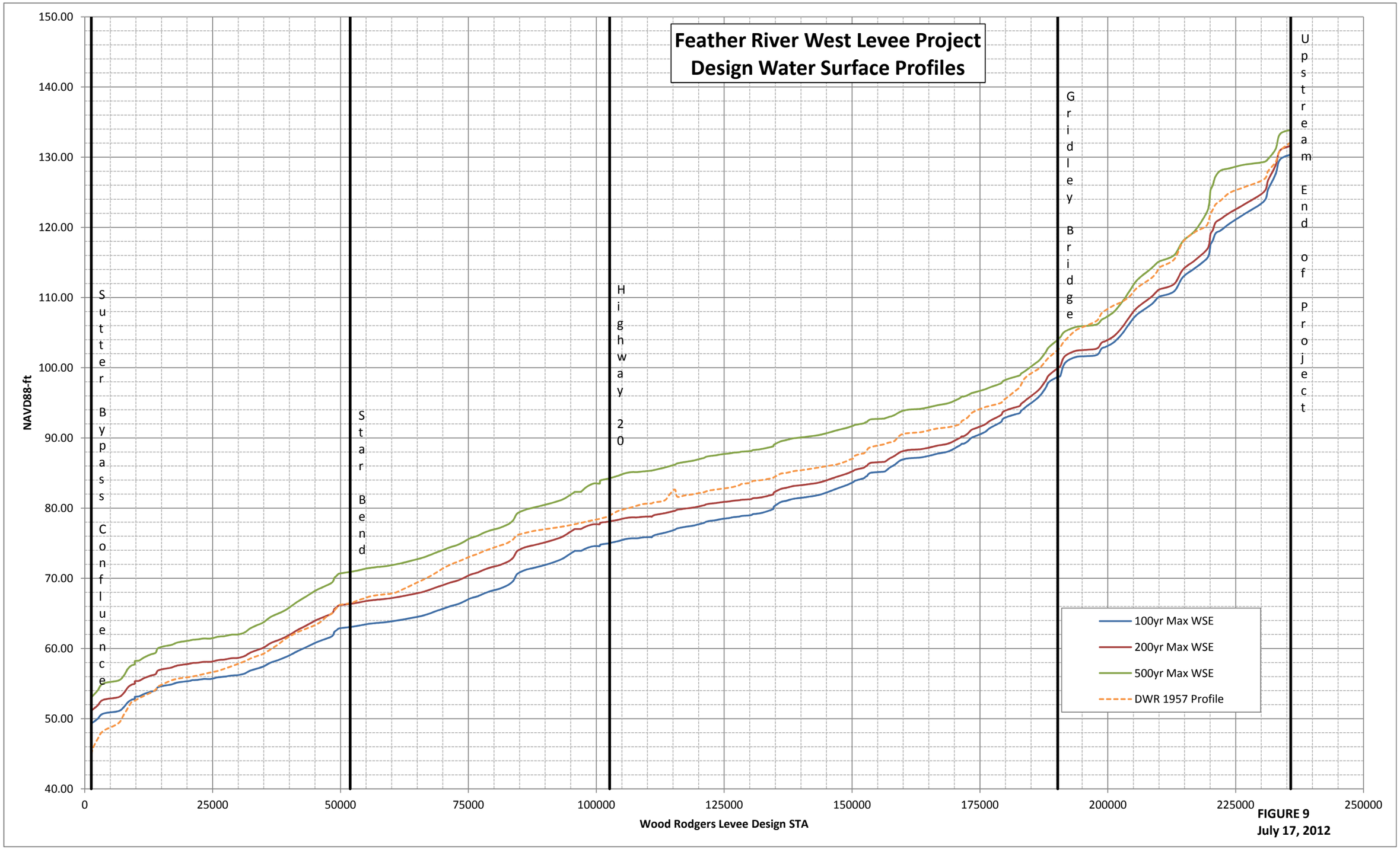


FIGURE 9
July 17, 2012

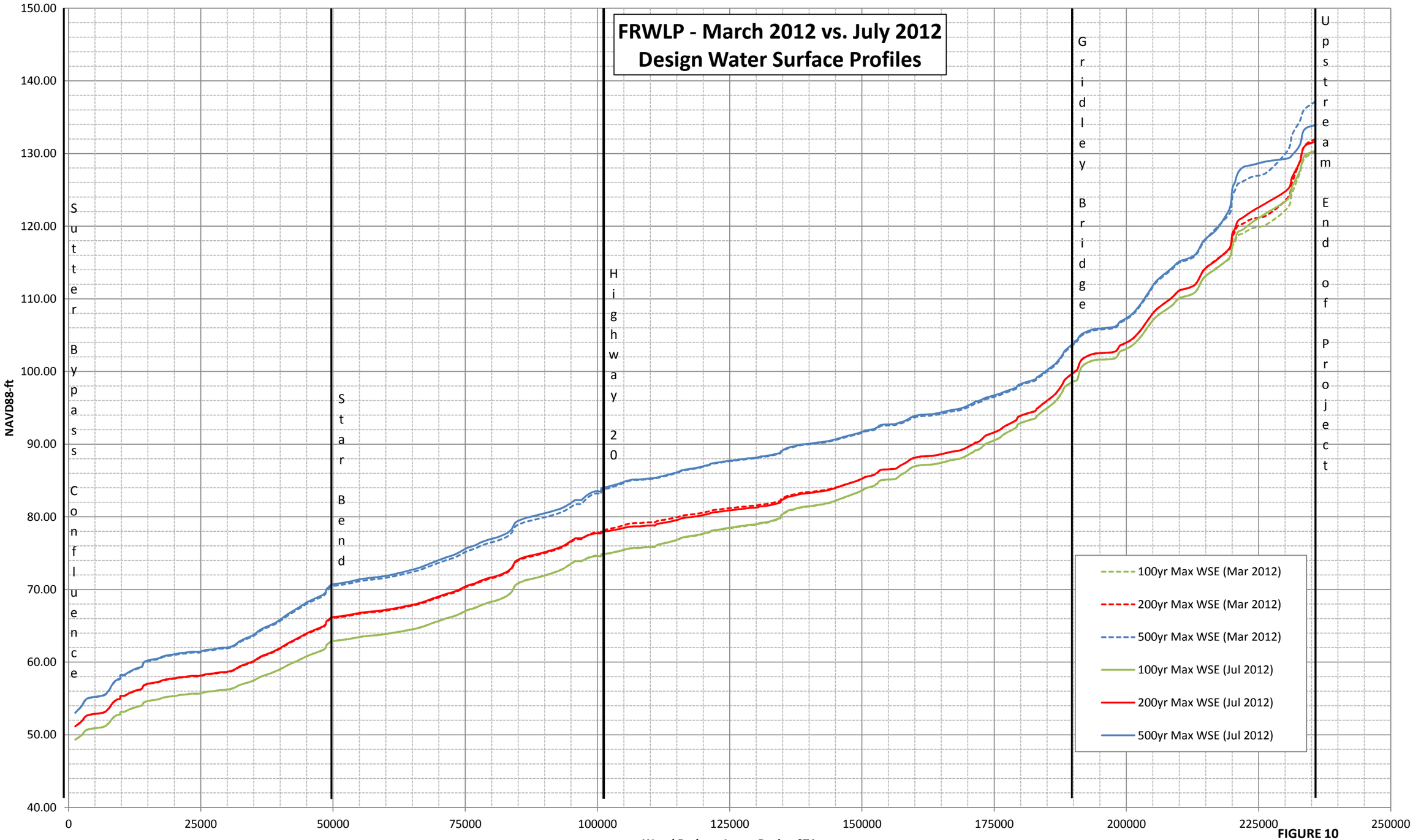


FIGURE 10
July 17, 2012

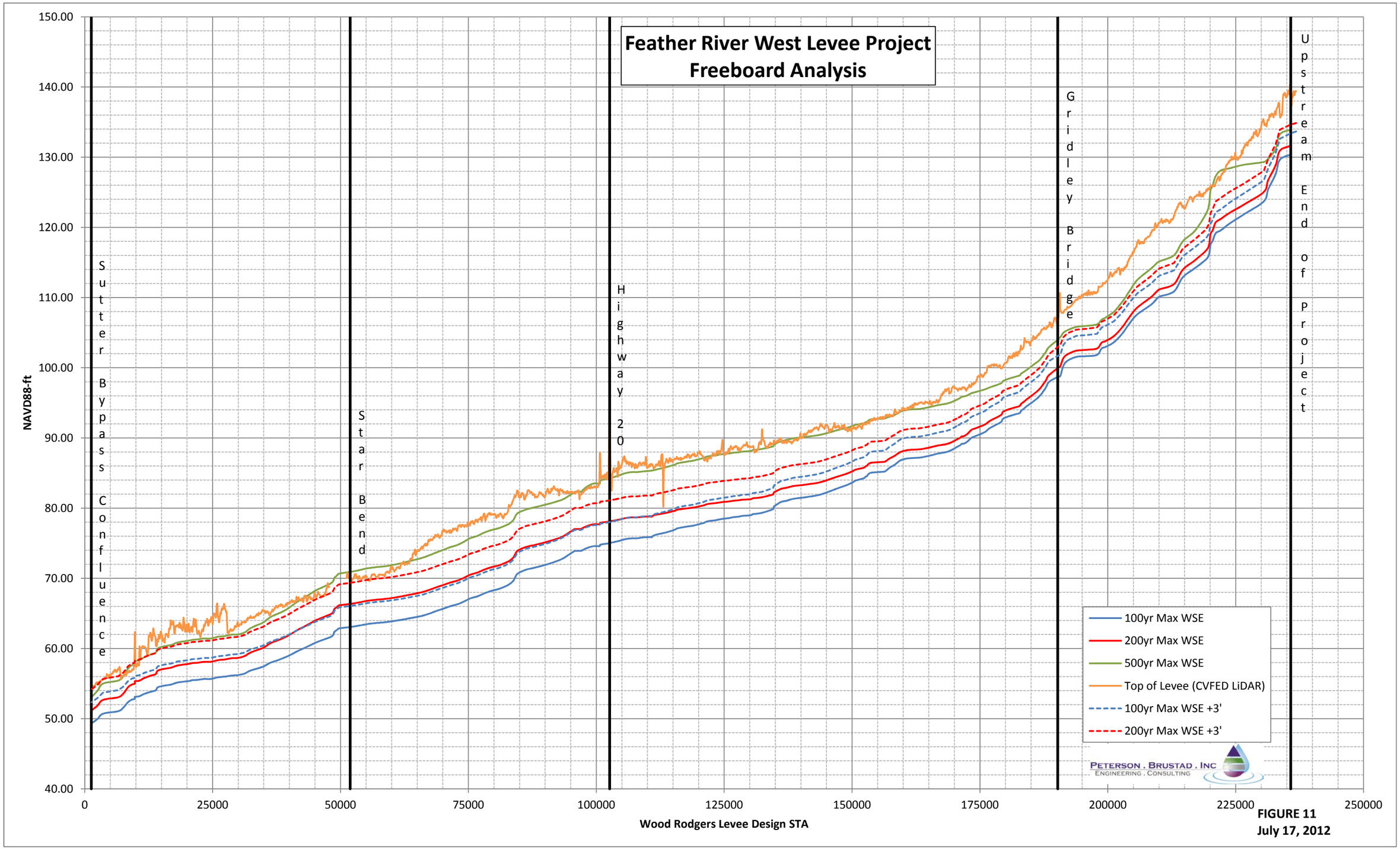


FIGURE 11
July 17, 2012

ATTACHMENT A

ITR COMMENTS LOG

REVIEW COMMENT/RESPONSE LOG

PROJECT: **Feather River West Levee Project**

REVIEW DOCUMENT(S): **Design Water Surface Profiles Addendum #1; HEC-RAS model and TM dated May 2012**

DATE: **7/21/2012**

SUBMITTAL:

REVIEWER: **MBK Engineers**

REFERENCE			COMMENT Comment Codes: **M**=Mandatory Response; **S**=Suggested Correction; **Q**=Question; **G**=General Comment;				RESPONSE Response Codes: **A**=Agree, will revise; **D**=Disagree, see explanation; **F**=Follow up required; **G**=General Response				
Comment No.	Dwg/Sec	Page/Sht	Code	Description	By	Date	Code	Explanation	By	Date	Backcheck By/Date
1			**G**	The addition of the storage areas, lateral weirs, and storage area connection to represent the overflow into the Oroville Wildlife Area is an appropriate methodology to simulate this in HEC-RAS.	MBK	6/8/12					
2			**S**	The TM should document the changes in the HEC-RAS model.	MBK	6/8/12	**A**	The TM has been updated to include this information.	PBI	07/21/12	A - 7/25/12
3			**S**	The TM should document the source of topographic information used to derive the elevations used in the lateral weirs and storage area connections.	MBK	6/8/12	**A**	The TM has been updated to include this information.	PBI	07/21/12	A - 7/25/12
4			**S**	The TM should document the source of topographic information used to derive the volume elevation curves used for the storage areas.	MBK	6/8/12	**A**	The TM has been updated to include this information.	PBI	07/21/12	A - 7/25/12
5			**S**	The addition of the Oroville Wildlife Area may affect the calibration of the HEC-RAS model. Suggest re-running the January 1997 calibration with the new features to check the calibration of the model. Adjustments to model parameters may be needed to re-calibrate the model which could potentially change the design water surface profiles.	MBK	6/8/12	**A**	The model has been re-calibrated to the January 1997 event. The TM has also been updated to include information regarding the calibration updates.	PBI	07/21/12	A - 7/25/12

ATTACHMENT B

1997 FLOOD EVENT PHOTOGRAPHS

1995/1997
Fish Weir
Road Breach
Weir Notch Road
1995/1997 Breach
1997 Breach
Elder Ave
Pacific Heights Rd
Sun Cloud Ct
1
2
3
4
5
6
7
8
9
10
11
Oroville Wildlife Area
1997 High Water Photo Locations:
L:\Staff Folders\Shelby Nadin\1997 FR HW @ OWA

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

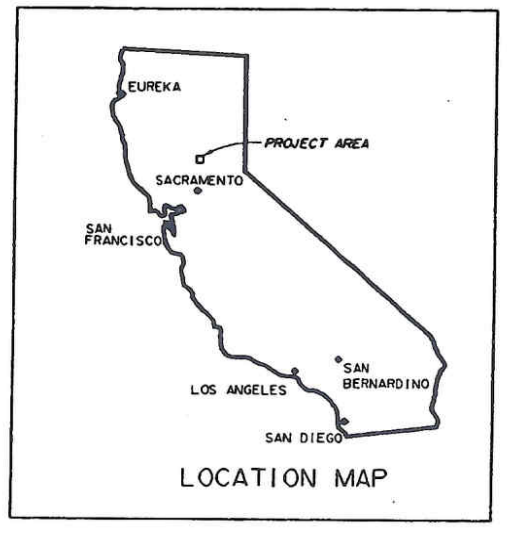
Photo 9

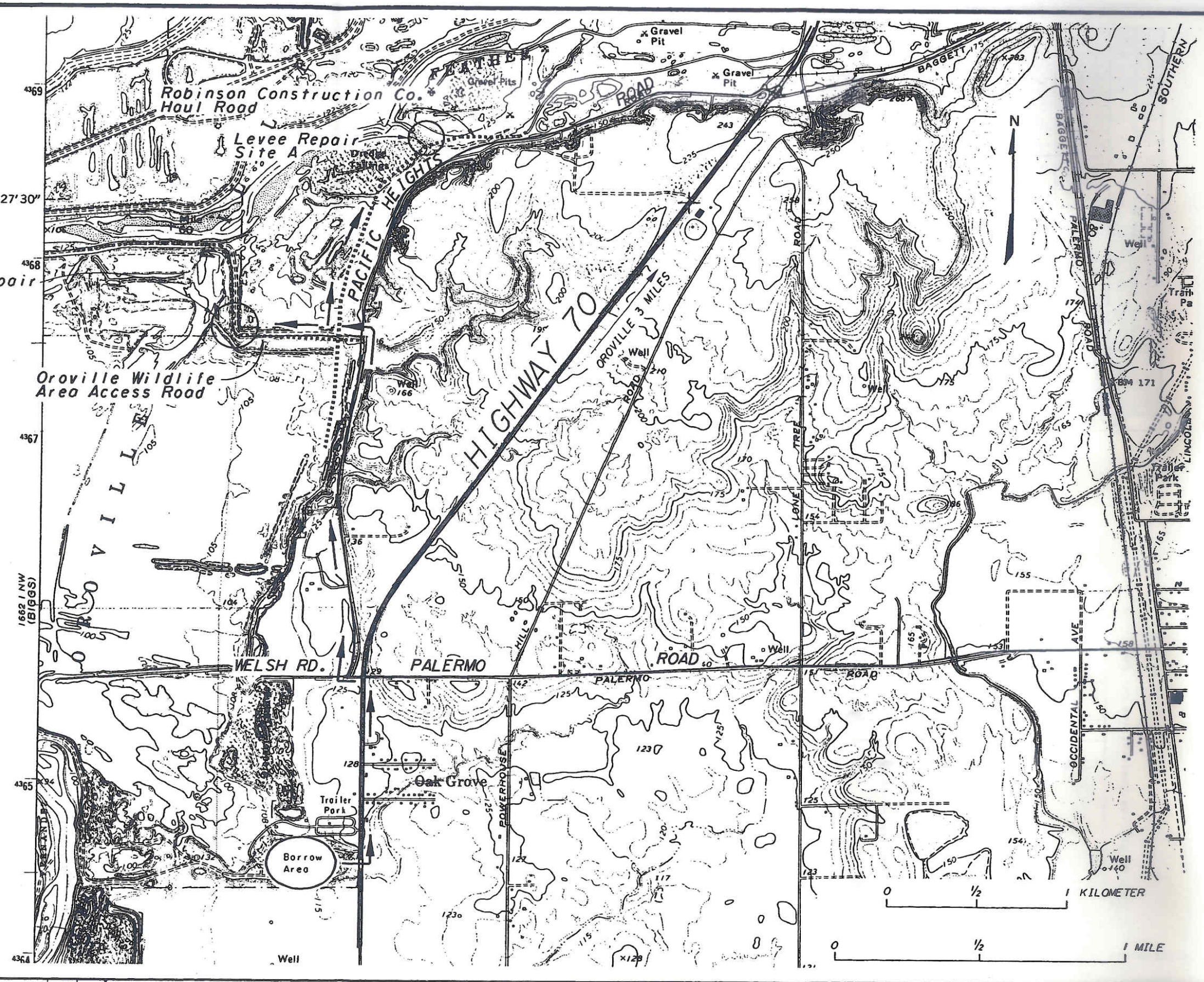
Photo 10

Photo 11

ATTACHMENT C

POST-1997 BREACH REPAIRS AND WEIR MODIFICATIONS





REV.	DATE	DESCRIPTION	SUB.	APP'D

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF ENGINEERING
STATE WATER FACILITIES

OROVILLE FIELD DIVISION
OROVILLE WILDLIFE AREA

LEVEE REPAIR WORK SITE MAP

SPEC. No.
DRAWING No.
REV. SHEET No. 12-2

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29-JUN-1997
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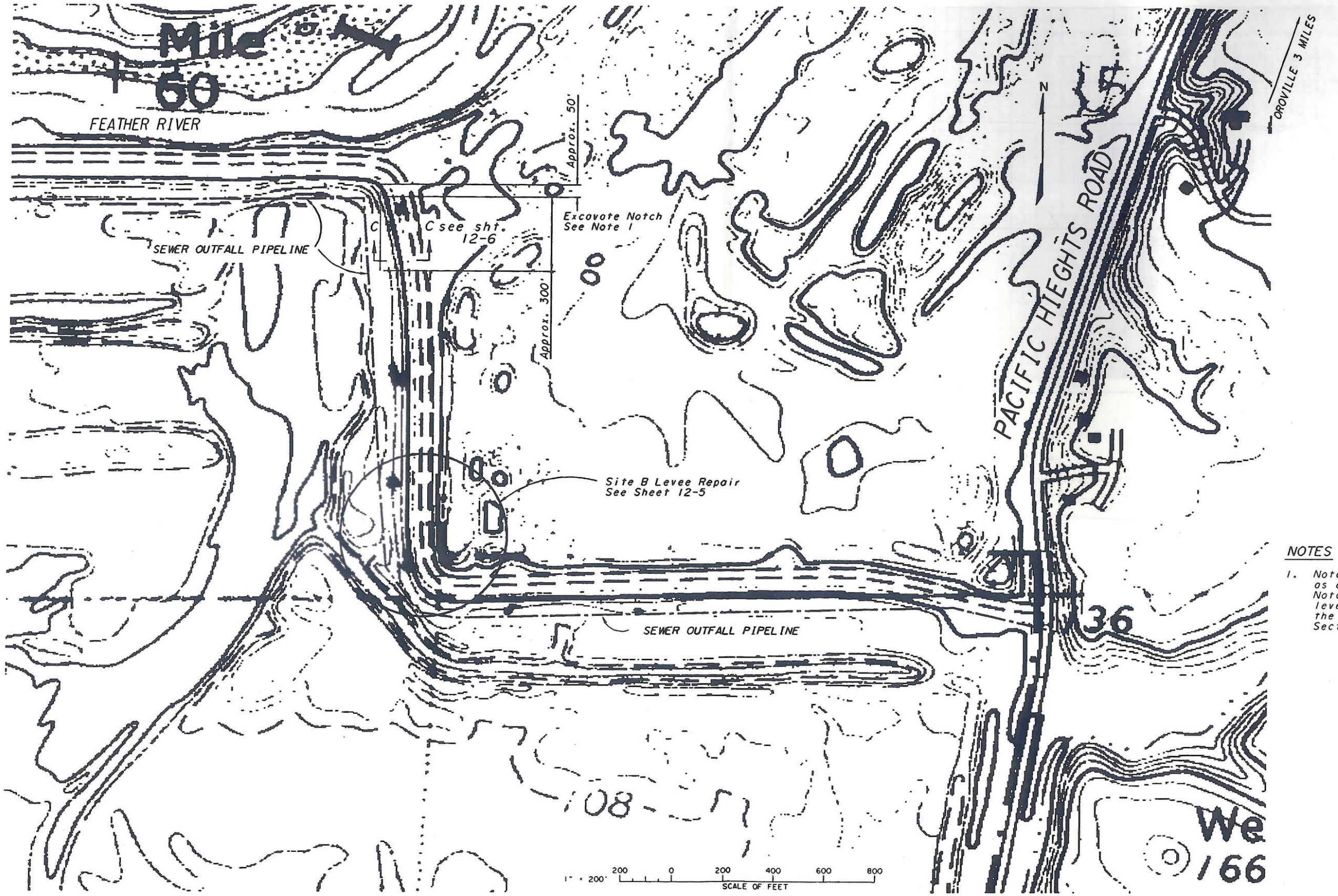


NOTES

1. Notch levee for approx. 300 feet, as directed by the Engineer. Start Notch approx. 50' from east-west levee toe. Use Material as borrow for the Embankment Levee. See Section C-C, Sheet 12-6.

REV.	DATE	DESCRIPTION	SUB.	APP'D

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF ENGINEERING
STATE WATER FACILITIES

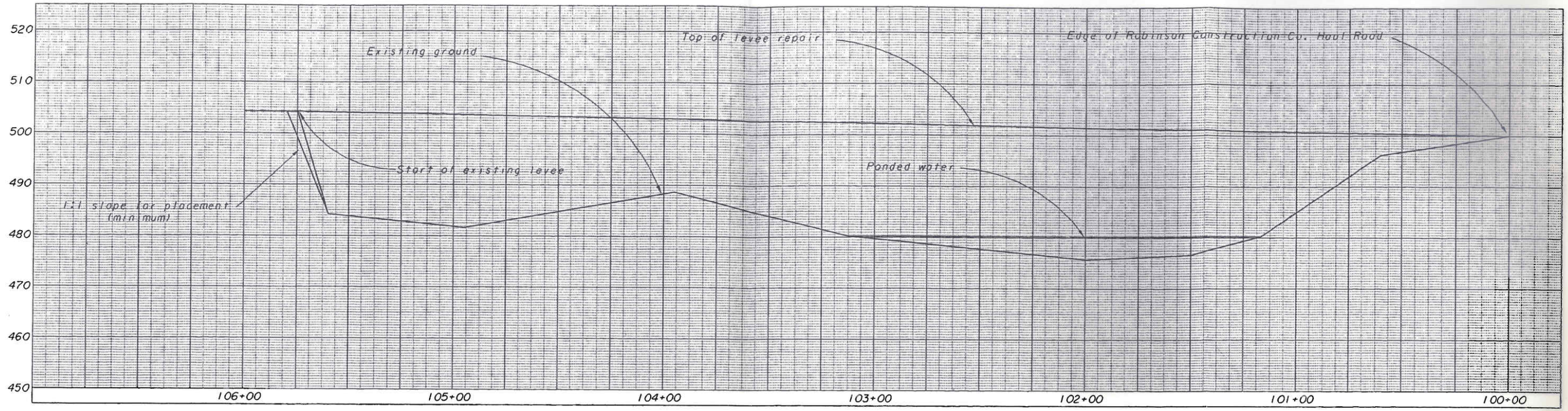
OROVILLE FIELD DIVISION
OROVILLE WILDLIFE AREA

WORK SITE MAP
SITE B AND NOTCH AREA

SPEC. No.
DRAWING No.
REV. SHEET No. 12-3

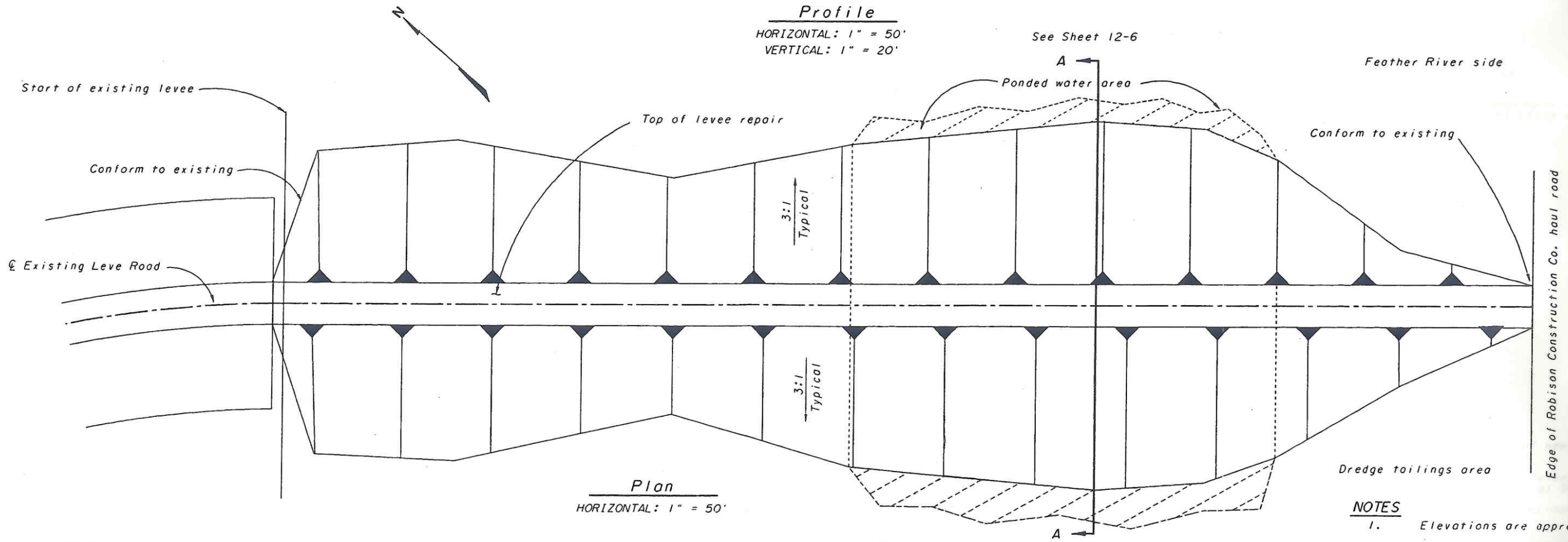
A B C D E F G

29-JUN-1997



Profile

HORIZONTAL: 1" = 50'
VERTICAL: 1" = 20'



Plan

HORIZONTAL: 1" = 50'

NOTES

1. Elevations are approximate.

REV.	DATE	DESCRIPTION	SUB.	APP'D

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF ENGINEERING
STATE WATER FACILITIES

OROVILLE FIELD DIVISION
OROVILLE WILDLIFE AREA
LEVEE REPAIR
SITE A

SPEC. No.
DRAWING No.
REV. SHEET No. 12-4

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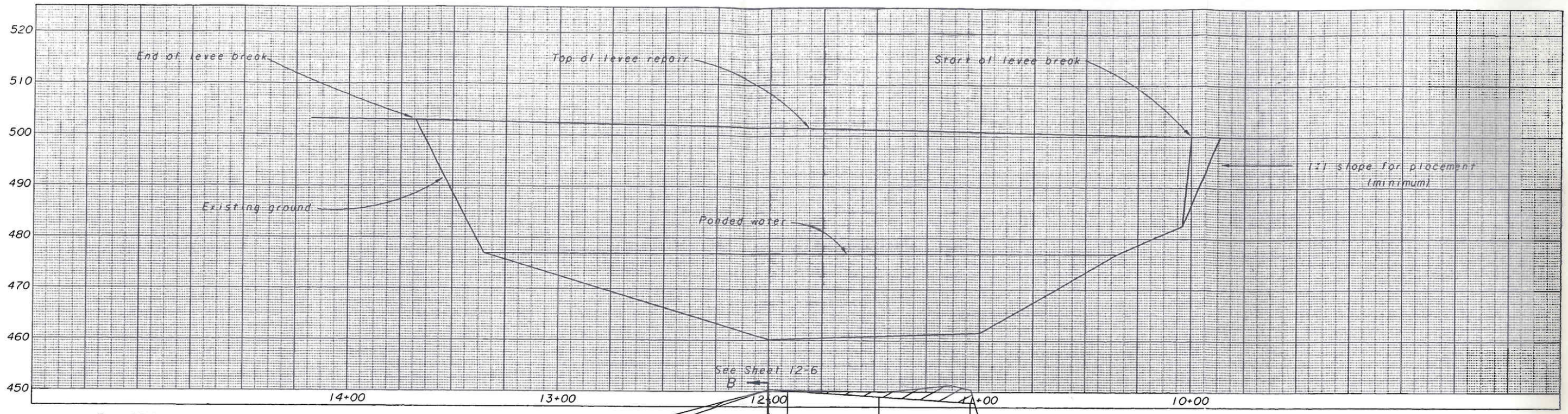
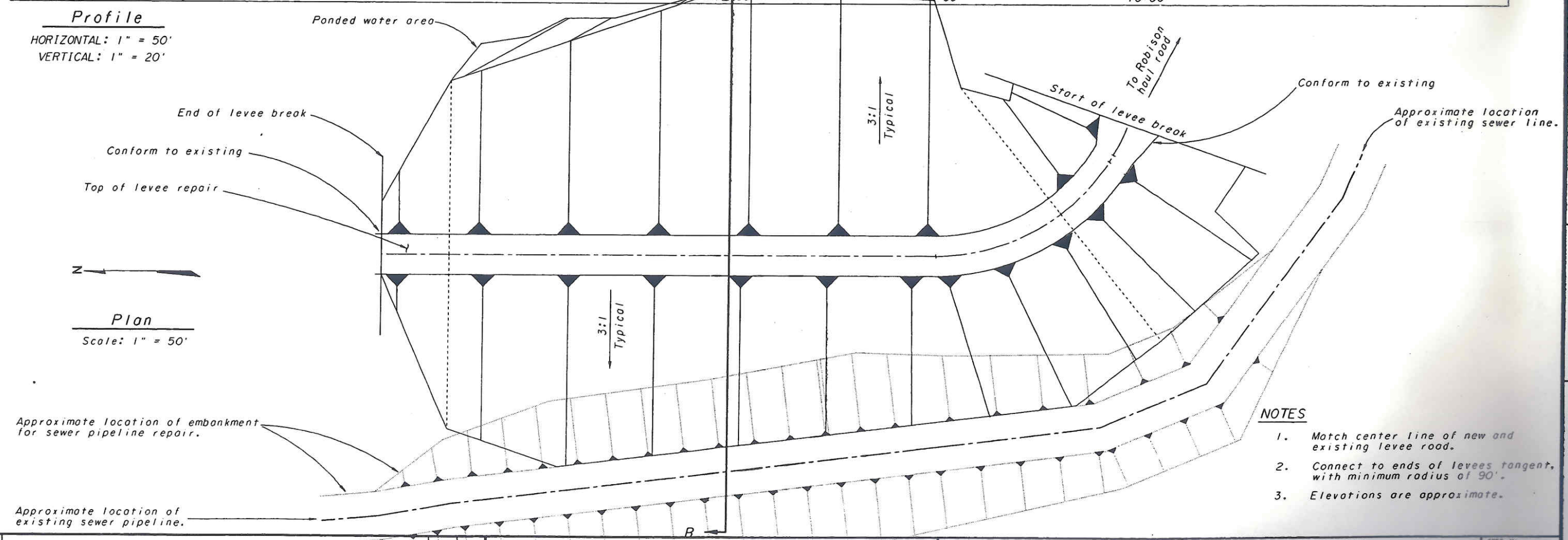


Profile

HORIZONTAL: 1" = 50'
VERTICAL: 1" = 20'



Plan

Scale: 1" = 50'

NOTES

1. Match center line of new and existing levee road.
2. Connect to ends of levees tangent, with minimum radius of 90'.
3. Elevations are approximate.

REV.	DATE	DESCRIPTION	SUB.	APP'D

STATE OF CALIFORNIA
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STATE WATER FACILITIES

OROVILLE FIELD DIVISION
OROVILLE WILDLIFE AREA
LEVEE REPAIR
SITE B

SPEC. No.
DRAWING No.
REV. | SHEET No. 12-5

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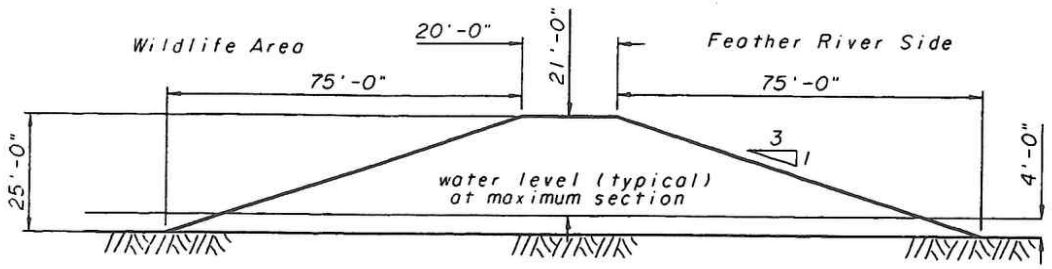
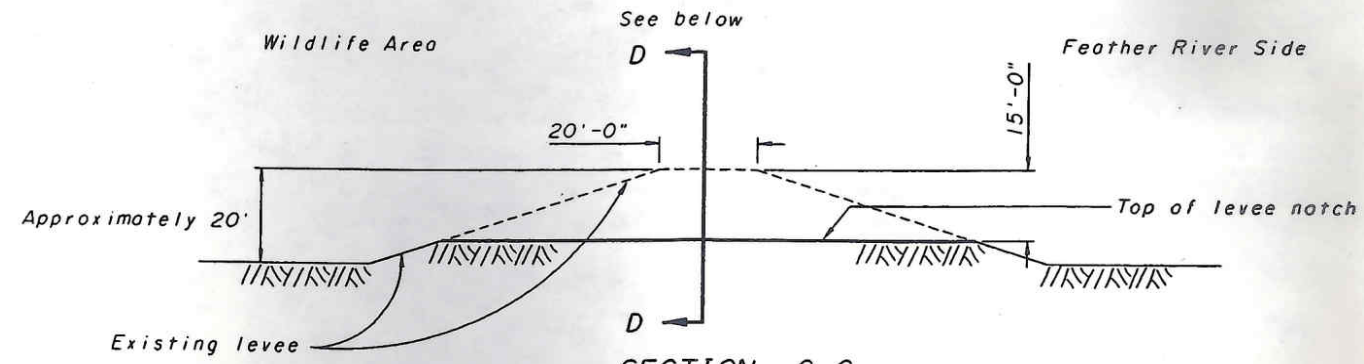


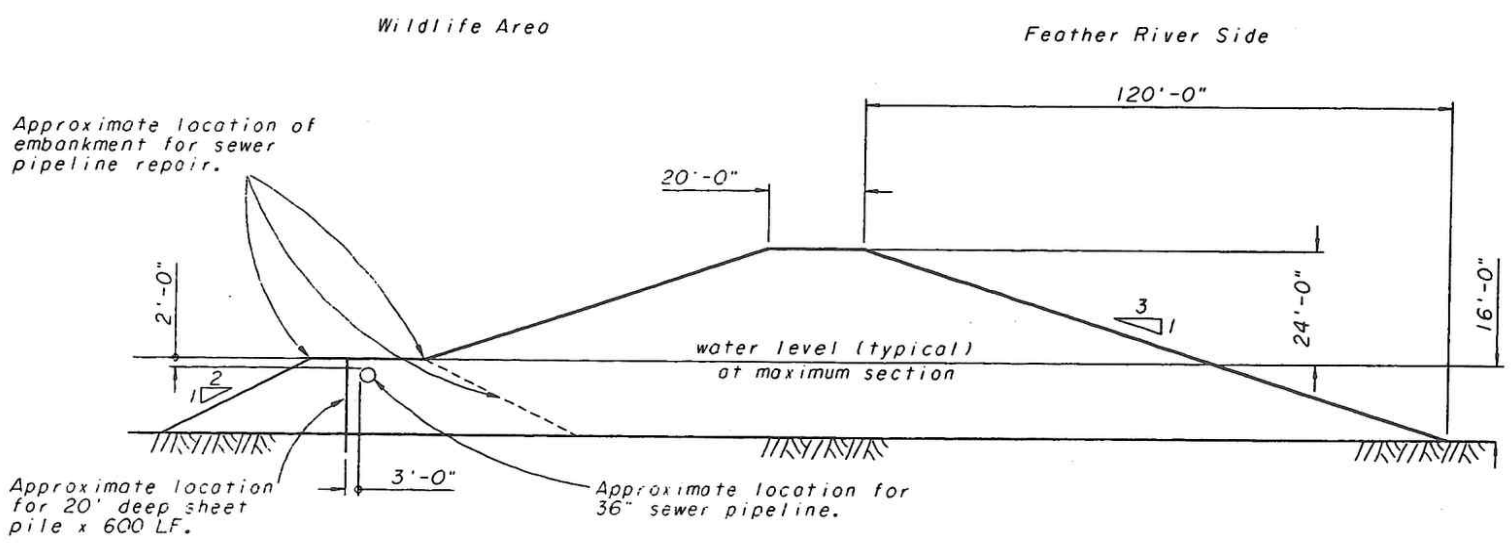
SECTION A-A

SCALE: 1" = 40'
SITE A NORTH LEVEE
See Sheet 12-4



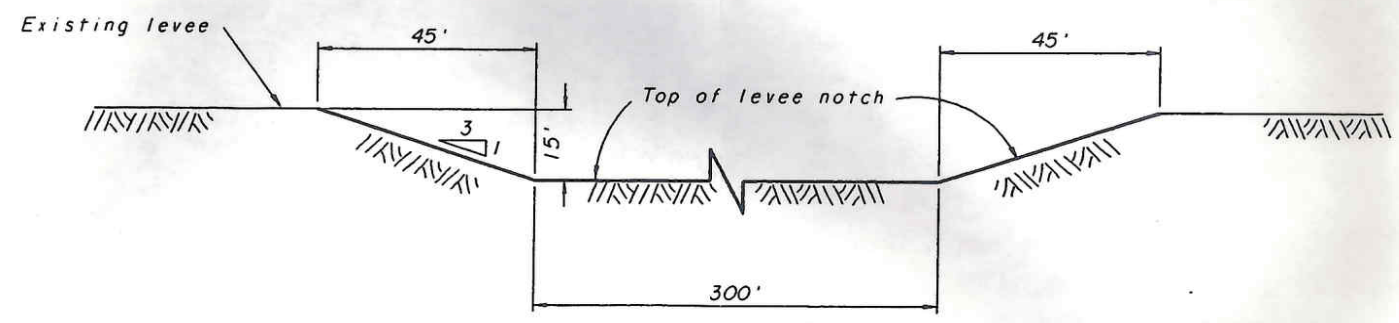
SECTION C-C

SCALE: 1" = 40'
LEVEE NOTCH
See Sheet 12-3



SECTION B-B

SCALE: 1" = 40'
SITE B SOUTH LEVEE
See Sheet 12-5



SECTION D-D

SCALE: 1" = 40'
NOTCH PROFILE

NOTES

1. Maximum water level surface as of 5/97. Water level may have changed.

REV.	DATE	DESCRIPTION	SUB.	APP'D

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OROVILLE FIELD DIVISION
OROVILLE WILDLIFE AREA
LEVEE REPAIR
SECTIONS

SPEC. No.
DRAWING No.
REV. SHEET No. 12-6

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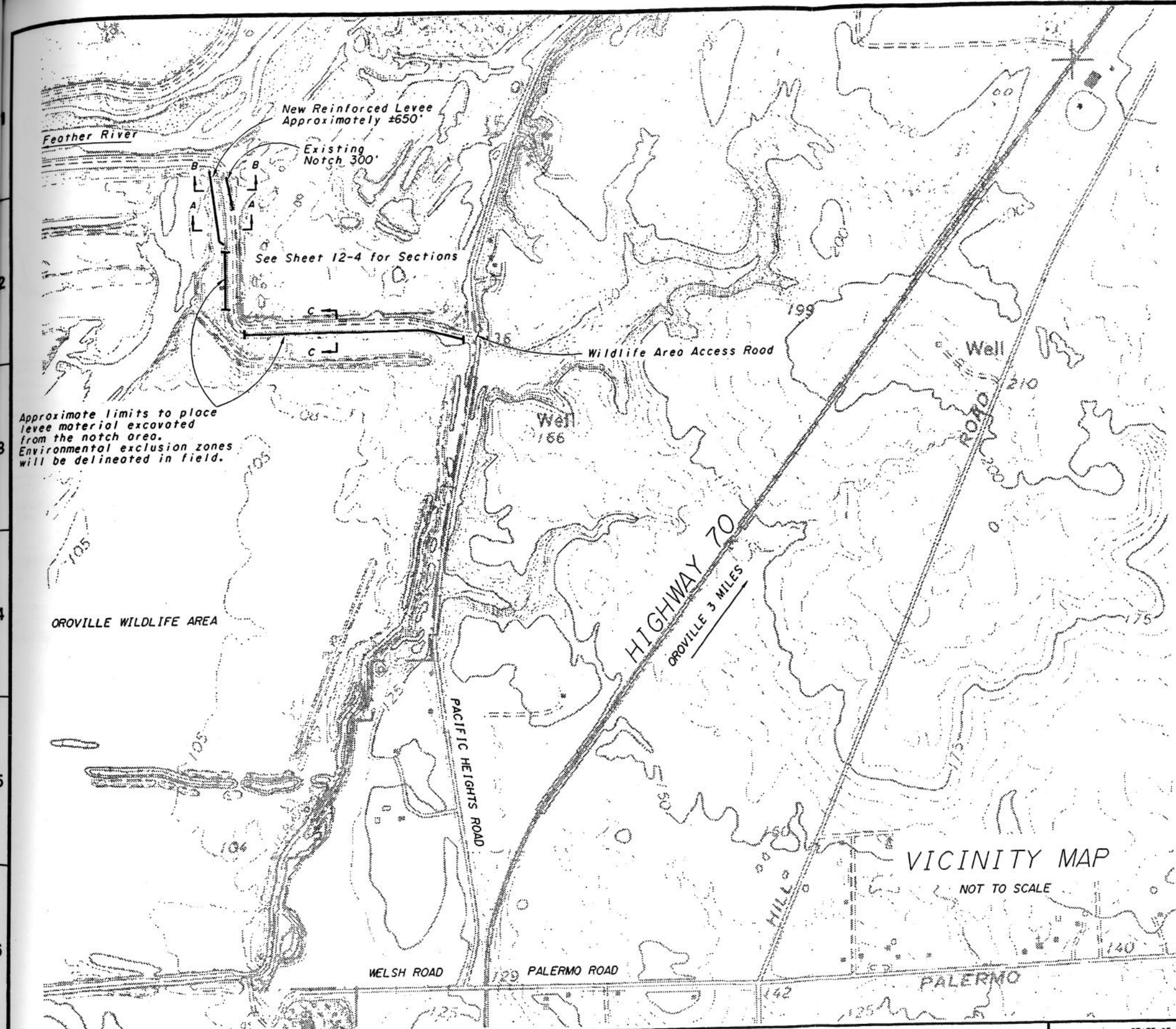

LOCATION MAP
NOT TO SCALE

REV.	DATE	DESCRIPTION	SUB.	APP'D

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF ENGINEERING
STATE WATER FACILITIES

OROVILLE FIELD DIVISION
OROVILLE WILDLIFE AREA

LOCATION AND VICINITY MAP
REINFORCED LEVEE NOTCH

SPEC. No. 98-11 (99-07)
DRAWING No.
REV.
SHEET No. 12-2

23-JUN-1998
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VI-HALFCIVB.PEN

OROVILLE WILDLIFE AREA

Abandonded power poles and line

Typical edge of road

Limits of reinforced levee notch (±650')

Approximate location of existing SC-OR pipeline

Approximate limit of new sheet pile for existing SC-OR pipeline (±320')

A

B

3:1 Typical

130

120

110

Main Feather River Channel

Feather River

Fill corner to existing top of levee. Approximate elevation 136'

Reinforce new 3:1 slope face with 9" revet mattresses

Leading edge of reinforcement shall be anchored with 3' gabion

Reinforce 3:1 slope face with 9" revet mattresses

Leading edge of reinforcement shall be anchored with 3' gabion

Existing tree not to be damaged

Limits of excavation for existing 300' notch and existing levee

Excavation of existing levee and notch to approximate Elevation 120'

Approximate location of existing 300' notch. Does not show existing topography.

N

NOTES

1. Topographic data shown taken Spring 1997. Actual conditions will vary.
2. Water elevation may vary during construction from those shown.
3. Power poles shown are abandoned.
4. Environmentally sensitive area will be delineated in the field.
5. New sheet piling to tie into exsisting (Bethlehem PL223).

LEGEND

Excavation area.

Fill area.

1" = 100'

100 0 100 200 300

SCALE OF FEET

99-07

REV.	DATE	DESCRIPTION	SUB.	APP'D

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OROVILLE FIELD DIVISION
OROVILLE WILDLIFE AREA

WORK SITE
REINFORCED LEVEE NOTCH

SPEC. No. ~~98-11~~
DRAWING No.
REV.
SHEET No. 12-3

VI-HALFCIVB.PEN

23-JUN-1998
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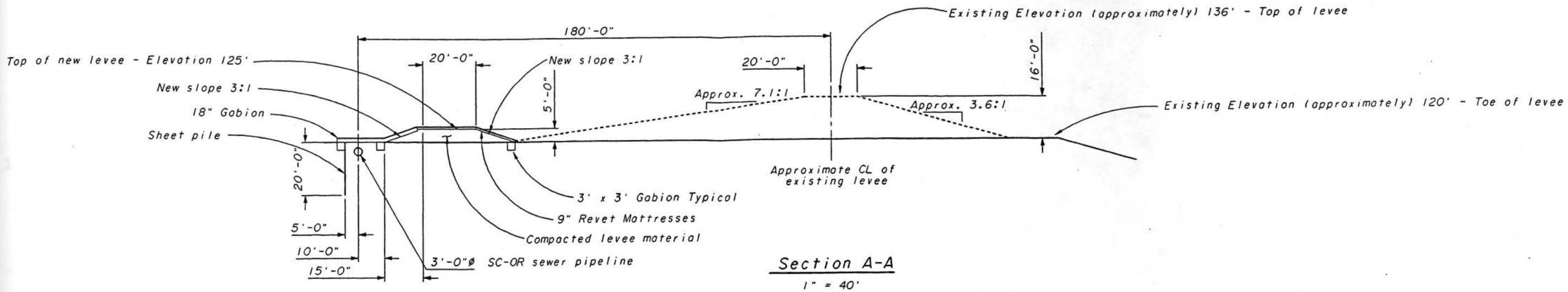
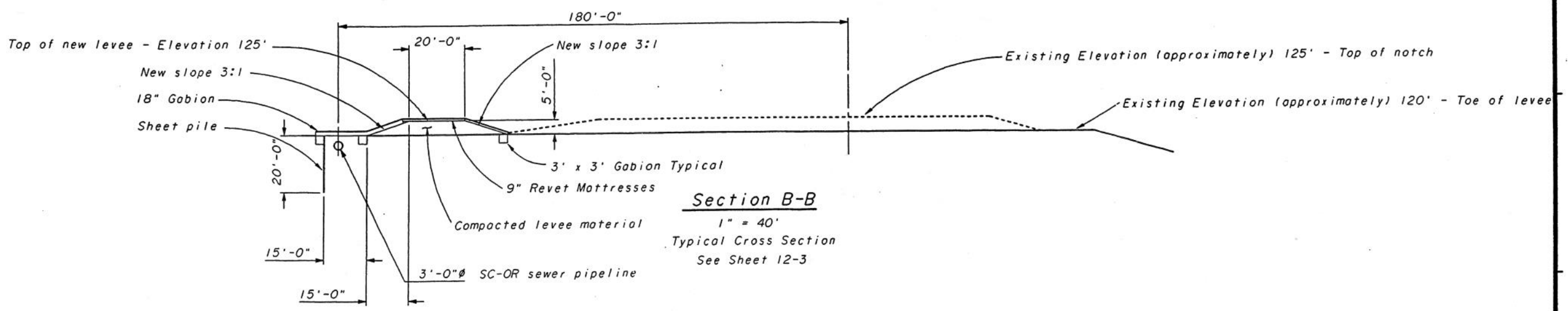


Section A-A

1" = 40'

Typical Cross Section

See Sheet 12-3

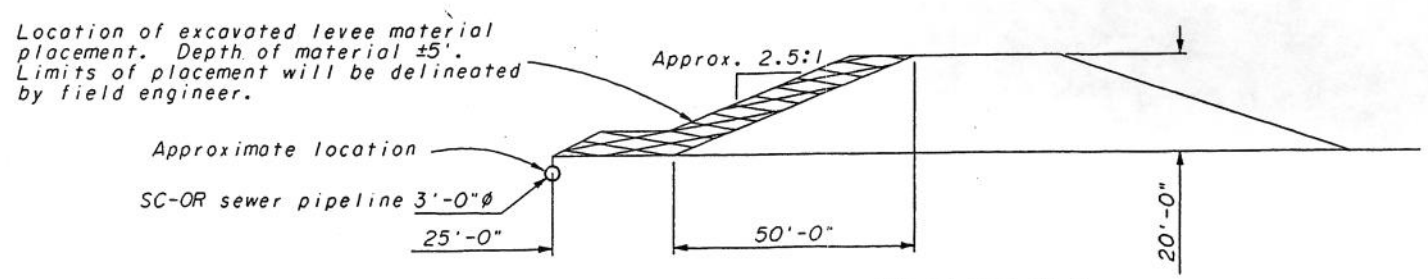


Section B-B

1" = 40'

Typical Cross Section

See Sheet 12-3



Section C-C

1" = 40'

Typical Buttress Section

See Sheet 12-2

NOTES

1. All revet mattrasses and gabions have geotextile under each item.
2. Water elevation may vary during construction.

99-07

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OROVILLE WILDLIFE AREA

SECTIONS
REINFORCED LEVEE NOTCH

SPEC. No. ~~98-11~~
DRAWING No.
REV. SHEET No. 12-4

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Part C.8

‘With-Project’ Hydraulics Analysis for the Feather River West Levee Project, PBI, October 2012

Technical Memorandum

PETERSON . BRUSTAD . INC .
ENGINEERING . CONSULTING

'WITH-PROJECT' HYDRAULICS ANALYSIS for the FEATHER RIVER WEST LEVEE PROJECT

REGISTERED PROFESSIONAL ENGINEER
CHRISTOPHER R. FRITZ
No. 75004
Exp. 12/31/13
CIVIL
STATE OF CALIFORNIA

Prepared for: Sutter Butte Flood Control Agency ***October 9, 2012***

Prepared by: Chris Fritz, PE

Reviewed by: Dave Peterson, PE

INTRODUCTION

This Technical Memorandum (TM) documents the 'With-Project' hydraulics analysis that was developed for the Sutter Butte Flood Control Agency's (SBFCA) Feather River West Levee Project (FRWLP). The analysis utilizes the latest PBI Sutter Basin HEC-RAS model[1] to compare the pre- and post-project water surface profiles (WSP) for the Feather River. The analysis was requested by the California Central Valley Flood Protection Board staff at the August 9, 2012 65% Design Review Meeting.

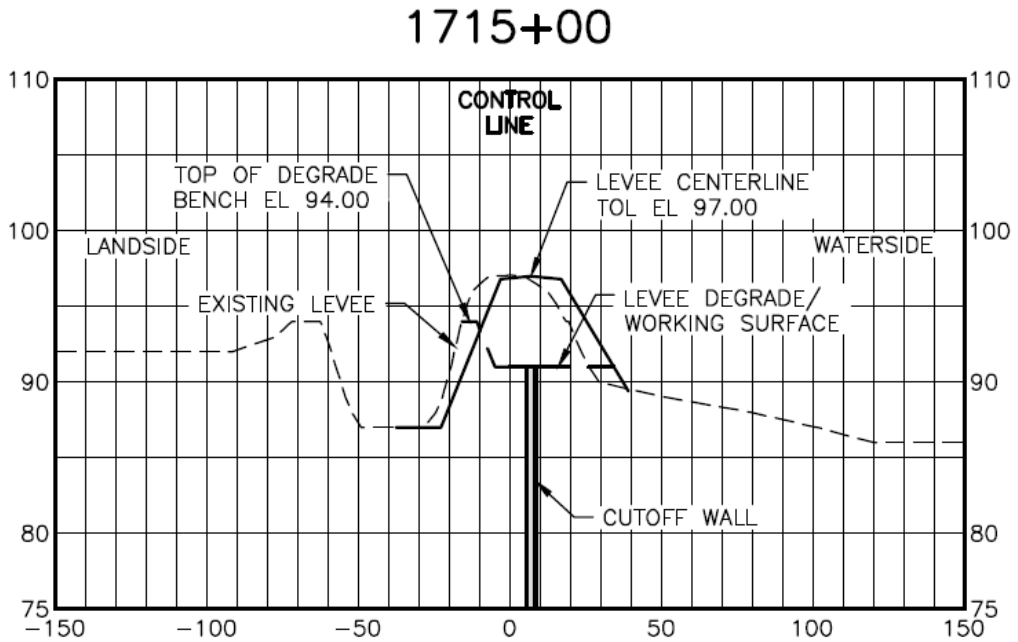
'WITH-PROJECT' HYDRAULICS ANALYSIS

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 (see Figure 1). The 'With-Project' hydraulics analysis was

[1] *Design Water Surface Profiles for the Feather River West Levee Project Addendum #1,* Peterson Brustad Inc., July 26, 2012

therefore completed in order to provide justification that the proposed levee shift does not alter the river channel hydraulics of the Feather River.

Figure 1. Levee Improvement Cross Section (looking North) at STA 1715+00 (typical for reaches 26 – 28)



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

1. 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 (see Figures 2 and 3).
2. 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.
3. 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, the 'With-Project' and 'Existing Conditions' water surface profiles will be exactly the same for both the 100-year and 200-year events.

Figure 2. 'Existing Conditions' HEC-RAS Cross Section at RS 46.53 (typical for reaches 26 thru 28)

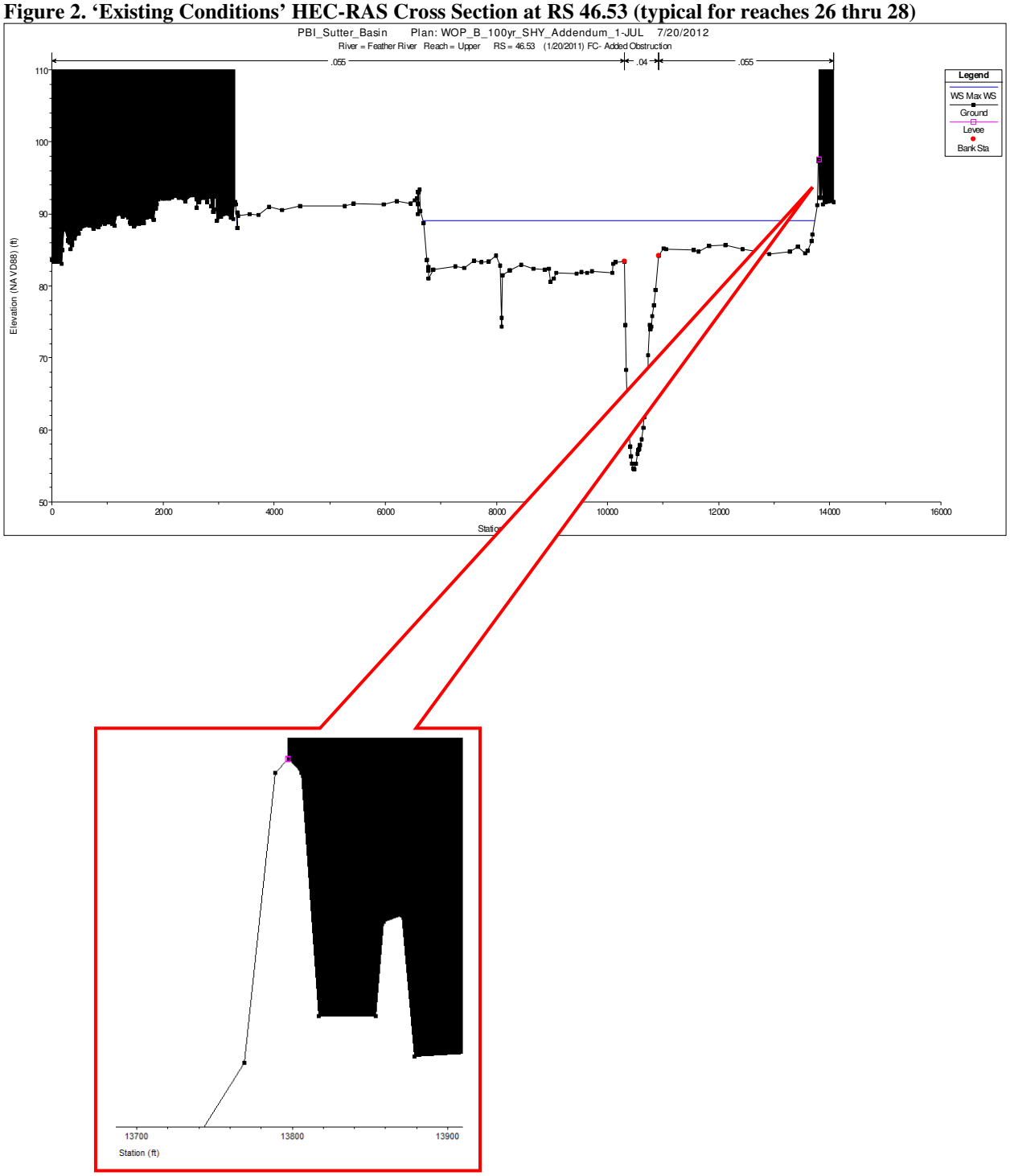
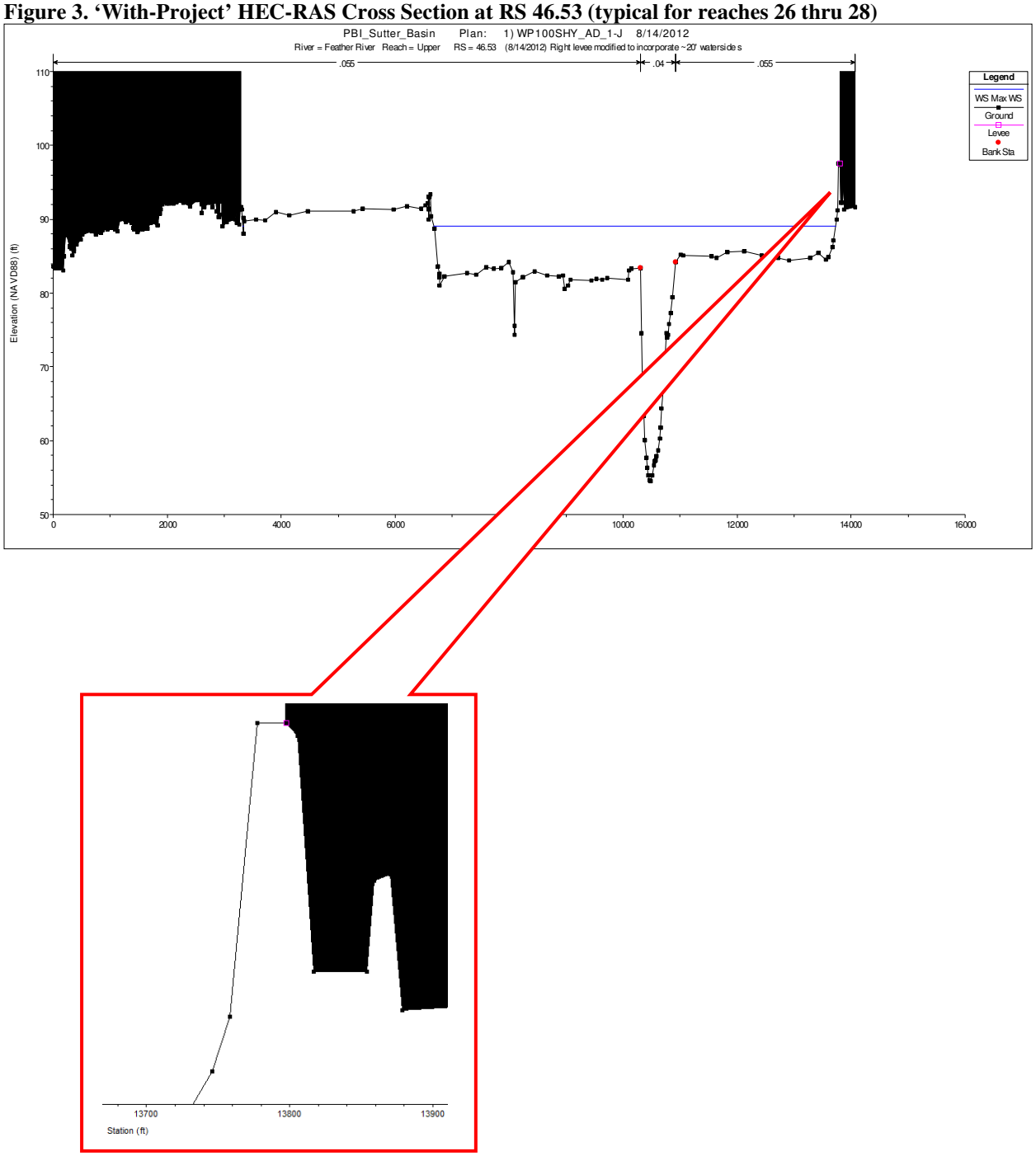


Figure 3. 'With-Project' HEC-RAS Cross Section at RS 46.53 (typical for reaches 26 thru 28)



RESULTS

The results of the analysis show that the FRWLP has no hydraulic impacts to the Feather River (see Table 1).

Table 1. Comparison of July 2012 (Existing Conditions) vs. 'With Project' Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE Existing Conditions	100yr Max WSE With Project	100yr Diff. (ft)	200yr Max WSE Existing Conditions	200yr Max WSE With Project	200yr Diff. (ft)	500yr Max WSE Existing Conditions	500yr Max WSE With Project	500yr Diff. (ft)
Upper	58.51	130.40	130.40	0.00	131.65	131.65	0.00	133.93	133.93	0.00
Upper	58.26	129.63	129.63	0.00	130.93	130.93	0.00	133.27	133.27	0.00
Upper	57.95	127.58	127.58	0.00	128.84	128.84	0.00	131.18	131.18	0.00
Upper	57.7	125.43	125.43	0.00	126.75	126.75	0.00	129.78	129.78	0.00
Upper	57.45	123.70	123.70	0.00	125.06	125.06	0.00	129.32	129.32	0.00
Upper	57.17	121.83	121.83	0.00	123.23	123.23	0.00	128.92	128.92	0.00
Upper	56.94	120.56	120.56	0.00	122.09	122.09	0.00	128.43	128.43	0.00
Upper	56.61	119.58	119.58	0.00	121.22	121.22	0.00	128.12	128.12	0.00
Upper	56.43	119.16	119.16	0.00	120.70	120.70	0.00	127.29	127.29	0.00
Upper	56.2	118.12	118.12	0.00	119.62	119.62	0.00	126.03	126.03	0.00
Upper	56.02	117.50	117.50	0.00	119.03	119.03	0.00	125.23	125.23	0.00
Upper	55.8	116.16	116.16	0.00	117.54	117.54	0.00	123.26	123.26	0.00
Upper	55.55	115.43	115.43	0.00	116.71	116.71	0.00	121.94	121.94	0.00
Upper	55.35	114.16	114.16	0.00	115.29	115.29	0.00	119.49	119.49	0.00
Upper	55.03	112.90	112.90	0.00	113.98	113.98	0.00	118.03	118.03	0.00
Upper	54.45	110.87	110.87	0.00	111.92	111.92	0.00	116.03	116.03	0.00
Upper	54.2	110.15	110.15	0.00	111.19	111.19	0.00	115.19	115.19	0.00
Upper	54.04	109.82	109.82	0.00	110.88	110.88	0.00	114.91	114.91	0.00
Upper	53.84	109.01	109.01	0.00	110.10	110.10	0.00	114.17	114.17	0.00
Upper	53.52	107.58	107.58	0.00	108.55	108.55	0.00	112.49	112.49	0.00
Upper	53.22	106.33	106.33	0.00	107.27	107.27	0.00	110.96	110.96	0.00
Upper	52.89	104.81	104.81	0.00	105.73	105.73	0.00	109.34	109.34	0.00
Upper	52.6	103.63	103.63	0.00	104.51	104.51	0.00	107.98	107.98	0.00
Upper	52.21	102.99	102.99	0.00	103.83	103.83	0.00	107.18	107.18	0.00
Upper	51.95	102.73	102.73	0.00	103.56	103.56	0.00	106.84	106.84	0.00
Upper	51.35	101.83	101.83	0.00	102.75	102.75	0.00	106.19	106.19	0.00
Upper	51.1777	101.65	101.65	0.00	102.55	102.55	0.00	105.97	105.97	0.00
Upper	51.04	101.54	101.54	0.00	102.43	102.43	0.00	105.82	105.82	0.00
Upper	50.84	100.98	100.98	0.00	101.91	101.91	0.00	105.35	105.35	0.00
Upper	50.7	100.23	100.23	0.00	101.34	101.34	0.00	104.97	104.97	0.00
Upper	50.59	98.83	98.83	0.00	100.24	100.24	0.00	104.35	104.35	0.00
Upper	50.498	98.73	98.73	0.00	100.01	100.01	0.00	104.15	104.15	0.00
Upper	50.496	98.68	98.68	0.00	99.96	99.96	0.00	104.08	104.08	0.00
Upper	50.489	98.65	98.65	0.00	99.88	99.88	0.00	103.93	103.93	0.00
Upper	50.487	98.69	98.69	0.00	99.93	99.93	0.00	103.95	103.95	0.00
Upper	50.2	97.95	97.95	0.00	98.93	98.93	0.00	102.93	102.93	0.00
Upper	50.06	97.11	97.11	0.00	98.14	98.14	0.00	102.21	102.21	0.00
Upper	49.78	95.96	95.96	0.00	96.98	96.98	0.00	101.12	101.12	0.00
Upper	49.58	95.12	95.12	0.00	96.13	96.13	0.00	100.35	100.35	0.00
Upper	49.38	94.52	94.52	0.00	95.50	95.50	0.00	99.70	99.70	0.00
Upper	49.21	94.13	94.13	0.00	95.12	95.12	0.00	99.39	99.39	0.00
Upper	48.99	93.87	93.87	0.00	94.87	94.87	0.00	99.18	99.18	0.00
Upper	48.85	93.54	93.54	0.00	94.55	94.55	0.00	98.91	98.91	0.00
Upper	48.66	93.34	93.34	0.00	94.34	94.34	0.00	98.70	98.70	0.00
Upper	48.39	93.03	93.03	0.00	94.03	94.03	0.00	98.40	98.40	0.00
Upper	48.21	92.70	92.70	0.00	93.70	93.70	0.00	98.09	98.09	0.00
Upper	48.07	92.26	92.26	0.00	93.26	93.26	0.00	97.78	97.78	0.00
Upper	47.7	91.40	91.40	0.00	92.43	92.43	0.00	97.21	97.21	0.00
Upper	47.55	90.84	90.84	0.00	91.92	91.92	0.00	96.93	96.93	0.00
Upper	47.2	90.25	90.25	0.00	91.37	91.37	0.00	96.53	96.53	0.00
Upper	47.04	90.02	90.02	0.00	91.15	91.15	0.00	96.38	96.38	0.00
Upper	46.69	89.46	89.46	0.00	90.55	90.55	0.00	96.07	96.07	0.00
Upper	46.53	89.17	89.17	0.00	90.23	90.23	0.00	95.90	95.90	0.00
Honcut to Jack	46.45	89.17	89.17	0.00	90.23	90.23	0.00	95.90	95.90	0.00
Honcut to Jack	46.2	88.96	88.95	-0.01	90.02	90.02	0.00	95.70	95.70	0.00
Honcut to Jack	45.98	88.72	88.72	0.00	89.80	89.80	0.00	95.47	95.47	0.00
Honcut to Jack	45.71	88.23	88.23	0.00	89.35	89.35	0.00	95.08	95.08	0.00
Honcut to Jack	45.58	87.97	87.97	0.00	89.10	89.10	0.00	94.86	94.86	0.00
Honcut to Jack	45.44	87.80	87.80	0.00	88.94	88.94	0.00	94.70	94.70	0.00
Honcut to Jack	45.26	87.57	87.57	0.00	88.74	88.74	0.00	94.50	94.50	0.00
Honcut to Jack	45.03	87.40	87.40	0.00	88.57	88.57	0.00	94.33	94.33	0.00
Honcut to Jack	44.76	87.20	87.20	0.00	88.38	88.38	0.00	94.14	94.14	0.00
Honcut to Jack	44.6326	87.11	87.11	0.00	88.30	88.30	0.00	94.05	94.05	0.00
Honcut to Jack	44.5	86.96	86.96	0.00	88.15	88.15	0.00	93.90	93.90	0.00
Honcut to Jack	44.23	86.74	86.74	0.00	87.94	87.94	0.00	93.69	93.69	0.00
Honcut to Jack	43.46	86.15	86.15	0.00	87.43	87.43	0.00	93.26	93.26	0.00

Table 1. Comparison of July 2012 (Existing Conditions) vs. 'With Project' Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE Existing Conditions	100yr Max WSE With Project	100yr Diff. (ft)	200yr Max WSE Existing Conditions	200yr Max WSE With Project	200yr Diff. (ft)	500yr Max WSE Existing Conditions	500yr Max WSE With Project	500yr Diff. (ft)
Honcut to Jack	43.34	85.89	85.89	0.00	87.19	87.19	0.00	93.07	93.07	0.00
Honcut to Jack	43.28	85.77	85.77	0.00	87.09	87.09	0.00	93.04	93.04	0.00
Honcut to Jack	43.23	85.62	85.62	0.00	86.96	86.96	0.00	92.97	92.97	0.00
Honcut to Jack	43.12	85.32	85.32	0.00	86.70	86.70	0.00	92.85	92.85	0.00
Honcut to Jack	43.06	85.25	85.25	0.00	86.64	86.64	0.00	92.82	92.82	0.00
Honcut to Jack	43.01	85.19	85.19	0.00	86.59	86.59	0.00	92.76	92.76	0.00
Honcut to Jack	42.65	85.05	85.05	0.00	86.47	86.47	0.00	92.67	92.67	0.00
Honcut to Jack	42.47	84.85	84.85	0.00	86.29	86.29	0.00	92.50	92.50	0.00
Honcut to Jack	42.19	84.56	84.56	0.00	86.03	86.03	0.00	92.29	92.29	0.00
Honcut to Jack	42.01	84.50	84.50	0.00	85.98	85.98	0.00	92.26	92.26	0.00
Honcut to Jack	41.61	84.27	84.27	0.00	85.77	85.78	0.01	92.10	92.10	0.00
Honcut to Jack	41.55	84.17	84.17	0.00	85.69	85.69	0.00	92.03	92.03	0.00
Honcut to Jack	41.2	83.90	83.90	0.00	85.46	85.46	0.00	91.87	91.87	0.00
Honcut to Jack	40.7	83.73	83.73	0.00	85.32	85.32	0.00	91.76	91.76	0.00
Honcut to Jack	40.49	83.49	83.49	0.00	85.10	85.10	0.00	91.59	91.59	0.00
Honcut to Jack	40.19	83.29	83.29	0.00	84.92	84.92	0.00	91.45	91.45	0.00
Honcut to Jack	39.45	82.77	82.77	0.00	84.46	84.46	0.00	91.09	91.09	0.00
Honcut to Jack	39.23	82.44	82.44	0.00	84.16	84.16	0.00	90.84	90.84	0.00
Honcut to Jack	38.94	82.06	82.06	0.00	83.81	83.81	0.00	90.55	90.55	0.00
Honcut to Jack	38.71	81.81	81.81	0.00	83.58	83.58	0.00	90.36	90.36	0.00
Honcut to Jack	38.45	81.64	81.64	0.00	83.43	83.43	0.00	90.23	90.23	0.00
Honcut to Jack	38.27	81.52	81.52	0.00	83.32	83.32	0.00	90.12	90.12	0.00
Honcut to Jack	37.95	81.34	81.34	0.00	83.16	83.16	0.00	89.97	89.97	0.00
Honcut to Jack	37.68	81.18	81.18	0.00	83.02	83.02	0.00	89.83	89.83	0.00
Honcut to Jack	37.45	81.01	81.01	0.00	82.87	82.87	0.00	89.68	89.68	0.00
Honcut to Jack	37.29	80.86	80.86	0.00	82.73	82.73	0.00	89.52	89.52	0.00
Honcut to Jack	36.45	80.27	80.27	0.00	82.27	82.27	0.00	89.08	89.08	0.00
Honcut to Jack	36.35	80.08	80.08	0.00	82.12	82.12	0.00	88.95	88.95	0.00
Honcut to Jack	36.24	79.85	79.85	0.00	81.95	81.95	0.00	88.80	88.80	0.00
Honcut to Jack	35.78	79.30	79.30	0.00	81.53	81.53	0.00	88.42	88.42	0.00
Honcut to Jack	35.5	79.15	79.15	0.00	81.41	81.41	0.00	88.28	88.28	0.00
Honcut to Jack	35.25	79.05	79.05	0.00	81.33	81.33	0.00	88.20	88.20	0.00
Honcut to Jack	34.8	78.97	78.97	0.00	81.26	81.26	0.00	88.13	88.13	0.00
Honcut to Jack	34.5	78.88	78.88	0.00	81.19	81.19	0.00	88.05	88.05	0.00
Honcut to Jack	34.07	78.80	78.80	0.00	81.13	81.13	0.00	87.98	87.98	0.00
Honcut to Jack	33.5	78.71	78.71	0.00	81.05	81.06	0.01	87.90	87.90	0.00
Honcut to Jack	33.25	78.58	78.58	0.00	80.95	80.95	0.00	87.79	87.79	0.00
Honcut to Jack	33	78.45	78.45	0.00	80.85	80.85	0.00	87.68	87.68	0.00
Honcut to Jack	32.75	78.28	78.28	0.00	80.72	80.72	0.00	87.53	87.53	0.00
Honcut to Jack	32.5	78.16	78.16	0.00	80.62	80.62	0.00	87.41	87.41	0.00
Honcut to Jack	32.25	78.05	78.05	0.00	80.53	80.53	0.00	87.32	87.32	0.00
Honcut to Jack	32	77.89	77.89	0.00	80.40	80.40	0.00	87.16	87.16	0.00
Honcut to Jack	31.75	77.69	77.69	0.00	80.23	80.23	0.00	86.96	86.96	0.00
Honcut to Jack	31.5	77.49	77.49	0.00	80.07	80.07	0.00	86.76	86.76	0.00
Honcut to Jack	31.25	77.31	77.31	0.00	79.92	79.92	0.00	86.57	86.57	0.00
Honcut to Jack	31	77.11	77.11	0.00	79.77	79.77	0.00	86.38	86.38	0.00
Honcut to Jack	30.75	76.93	76.92	-0.01	79.62	79.62	0.00	86.20	86.20	0.00
Honcut to Jack	30.5	76.70	76.70	0.00	79.45	79.45	0.00	86.00	86.00	0.00
Honcut to Jack	30.25	76.48	76.48	0.00	79.27	79.27	0.00	85.78	85.79	0.01
Honcut to Jack	30	76.14	76.14	0.00	79.01	79.01	0.00	85.44	85.44	0.00
Honcut to Jack	29.828	75.83	75.83	0.00	78.76	78.76	0.00	85.35	85.35	0.00
Honcut to Jack	29.826	75.85	75.85	0.00	78.78	78.78	0.00	85.35	85.35	0.00
Honcut to Jack	29.822	75.86	75.86	0.00	78.79	78.79	0.00	85.34	85.34	0.00
Honcut to Jack	29.821	75.88	75.88	0.00	78.81	78.81	0.00	85.34	85.34	0.00
Honcut to Jack	29.75	75.83	75.83	0.00	78.77	78.77	0.00	85.24	85.24	0.00
Honcut to Jack	29.5	75.70	75.70	0.00	78.68	78.68	0.00	85.14	85.14	0.00
Jack Sl - Yuba R	29.25	75.70	75.70	0.00	78.68	78.68	0.00	85.14	85.14	0.00
Jack Sl - Yuba R	29	75.57	75.57	0.00	78.57	78.57	0.00	84.97	84.97	0.00
Jack Sl - Yuba R	28.75	75.32	75.32	0.00	78.36	78.37	0.01	84.66	84.66	0.00
Jack Sl - Yuba R	28.5	75.17	75.17	0.00	78.23	78.24	0.01	84.45	84.45	0.00
Jack Sl - Yuba R	28.324	75.03	75.03	0.00	78.12	78.12	0.00	84.28	84.28	0.00
Jack Sl - Yuba R	28.322	75.02	75.02	0.00	78.12	78.12	0.00	84.28	84.27	-0.01
Jack Sl - Yuba R	28.309	75.01	75.01	0.00	78.10	78.10	0.00	84.26	84.26	0.00
Jack Sl - Yuba R	28.307	75.00	75.00	0.00	78.10	78.10	0.00	84.26	84.26	0.00
Jack Sl - Yuba R	28.25	74.96	74.96	0.00	78.06	78.06	0.00	84.20	84.20	0.00
Jack Sl - Yuba R	28	74.80	74.80	0.00	77.92	77.92	0.00	83.96	83.96	0.00
Jack Sl - Yuba R	27.971	74.69	74.69	0.00	77.82	77.82	0.00	83.77	83.77	0.00
Jack Sl - Yuba R	27.963	74.67	74.67	0.00	77.79	77.79	0.00	83.72	83.72	0.00
Jack Sl - Yuba R	27.956	74.64	74.64	0.00	77.76	77.76	0.00	83.67	83.67	0.00
Jack Sl - Yuba R	27.952	74.57	74.57	0.00	77.69	77.69	0.00	83.49	83.49	0.00
Jack Sl - Yuba R	27.75	74.58	74.58	0.00	77.70	77.70	0.00	83.51	83.51	0.00
Jack Sl - Yuba R	27.5	74.31	74.31	0.00	77.44	77.44	0.00	83.06	83.06	0.00
Jack Sl - Yuba R	27.251	73.90	73.90	0.00	77.03	77.03	0.00	82.33	82.32	-0.01
Jack Sl - Yuba R	27.25	73.90	73.90	0.00	77.03	77.03	0.00	82.32	82.32	0.00

Table 1. Comparison of July 2012 (Existing Conditions) vs. 'With Project' Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE Existing Conditions	100yr Max WSE With Project	100yr Diff. (ft)	200yr Max WSE Existing Conditions	200yr Max WSE With Project	200yr Diff. (ft)	500yr Max WSE Existing Conditions	500yr Max WSE With Project	500yr Diff. (ft)
Yuba R - Bear R	27	73.90	73.90	0.00	77.03	77.03	0.00	82.32	82.32	0.00
Yuba R - Bear R	26.999	73.90	73.90	0.00	77.03	77.03	0.00	82.32	82.32	0.00
Yuba R - Bear R	26.75	73.40	73.40	0.00	76.52	76.52	0.00	81.78	81.78	0.00
Yuba R - Bear R	26.5	72.83	72.83	0.00	75.97	75.97	0.00	81.27	81.27	0.00
Yuba R - Bear R	26.25	72.40	72.40	0.00	75.58	75.58	0.00	80.91	80.90	-0.01
Yuba R - Bear R	26	72.04	72.04	0.00	75.25	75.25	0.00	80.61	80.61	0.00
Yuba R - Bear R	25.75	71.73	71.73	0.00	74.96	74.96	0.00	80.33	80.32	-0.01
Yuba R - Bear R	25.5	71.47	71.47	0.00	74.71	74.71	0.00	80.08	80.07	-0.01
Yuba R - Bear R	25.25	71.21	71.21	0.00	74.45	74.44	-0.01	79.79	79.79	0.00
Yuba R - Bear R	25	70.66	70.66	0.00	73.93	73.93	0.00	79.28	79.28	0.00
Yuba R - Bear R	24.75	70.06	70.06	0.00	73.36	73.36	0.00	78.71	78.71	0.00
Yuba R - Bear R	24.5	69.62	69.62	0.00	72.94	72.94	0.00	78.28	78.27	-0.01
Yuba R - Bear R	24.25	69.20	69.20	0.00	72.52	72.52	0.00	77.84	77.84	0.00
Yuba R - Bear R	24	68.87	68.87	0.00	72.22	72.22	0.00	77.54	77.54	0.00
Yuba R - Bear R	23.75	68.47	68.47	0.00	71.83	71.83	0.00	77.14	77.14	0.00
Yuba R - Bear R	23.5	68.21	68.21	0.00	71.58	71.58	0.00	76.88	76.87	-0.01
Yuba R - Bear R	23.25	67.83	67.83	0.00	71.22	71.22	0.00	76.50	76.50	0.00
Yuba R - Bear R	23	67.44	67.44	0.00	70.83	70.83	0.00	76.07	76.07	0.00
Yuba R - Bear R	22.75	67.13	67.13	0.00	70.51	70.51	0.00	75.72	75.71	-0.01
Yuba R - Bear R	22.5	66.68	66.68	0.00	70.06	70.06	0.00	75.21	75.20	-0.01
Yuba R - Bear R	22.25	66.30	66.30	0.00	69.67	69.67	0.00	74.76	74.76	0.00
Yuba R - Bear R	22	66.03	66.03	0.00	69.40	69.40	0.00	74.45	74.45	0.00
Yuba R - Bear R	21.75	65.65	65.65	0.00	69.03	69.03	0.00	74.04	74.04	0.00
Yuba R - Bear R	21.5	65.34	65.34	0.00	68.71	68.71	0.00	73.68	73.68	0.00
Yuba R - Bear R	21.25	64.96	64.96	0.00	68.34	68.34	0.00	73.28	73.27	-0.01
Yuba R - Bear R	21	64.67	64.67	0.00	68.05	68.05	0.00	72.94	72.93	-0.01
Yuba R - Bear R	20.75	64.46	64.46	0.00	67.82	67.82	0.00	72.67	72.66	-0.01
Yuba R - Bear R	20.5	64.28	64.28	0.00	67.63	67.63	0.00	72.42	72.42	0.00
Yuba R - Bear R	20.25	64.09	64.09	0.00	67.43	67.43	0.00	72.17	72.17	0.00
Yuba R - Bear R	20	63.92	63.92	0.00	67.24	67.24	0.00	71.94	71.94	0.00
Yuba R - Bear R	19.75	63.75	63.75	0.00	67.07	67.07	0.00	71.74	71.74	0.00
Yuba R - Bear R	19.5	63.62	63.62	0.00	66.93	66.93	0.00	71.59	71.59	0.00
Yuba R - Bear R	19.25	63.51	63.51	0.00	66.82	66.82	0.00	71.46	71.46	0.00
Yuba R - Bear R	19	63.41	63.41	0.00	66.72	66.72	0.00	71.35	71.35	0.00
Yuba R - Bear R	18.75	63.26	63.26	0.00	66.56	66.56	0.00	71.16	71.16	0.00
Yuba R - Bear R	18.5	63.17	63.17	0.00	66.47	66.47	0.00	71.05	71.05	0.00
Yuba R - Bear R	18.25	63.06	63.06	0.00	66.35	66.35	0.00	70.92	70.92	0.00
Yuba R - Bear R	18	62.86	62.86	0.00	66.14	66.14	0.00	70.67	70.67	0.00
Yuba R - Bear R	17.75	62.71	62.72	0.01	65.98	65.98	0.00	70.49	70.49	0.00
Yuba R - Bear R	17.5	62.55	62.55	0.00	65.81	65.81	0.00	70.29	70.29	0.00
Yuba R - Bear R	17.25	62.36	62.36	0.00	65.62	65.62	0.00	70.07	70.07	0.00
Yuba R - Bear R	17	61.93	61.93	0.00	65.19	65.19	0.00	69.60	69.60	0.00
Yuba R - Bear R	16.75	61.65	61.65	0.00	64.90	64.90	0.00	69.28	69.28	0.00
Yuba R - Bear R	16.5	61.35	61.35	0.00	64.57	64.57	0.00	68.91	68.91	0.00
Yuba R - Bear R	16.25	61.14	61.14	0.00	64.34	64.34	0.00	68.64	68.64	0.00
Yuba R - Bear R	16	60.82	60.82	0.00	63.99	63.99	0.00	68.25	68.25	0.00
Yuba R - Bear R	15.75	60.21	60.21	0.00	63.29	63.29	0.00	67.45	67.45	0.00
Yuba R - Bear R	15.5	59.63	59.64	0.01	62.64	62.64	0.00	66.68	66.68	0.00
Yuba R - Bear R	15.25	59.12	59.12	0.00	62.06	62.06	0.00	66.01	66.00	-0.01
Yuba R - Bear R	15	58.72	58.72	0.00	61.58	61.58	0.00	65.42	65.42	0.00
Yuba R - Bear R	14.75	58.35	58.35	0.00	61.18	61.18	0.00	64.99	64.99	0.00
Yuba R - Bear R	14.5	57.98	57.98	0.00	60.75	60.75	0.00	64.49	64.49	0.00
Yuba R - Bear R	14.25	57.43	57.43	0.00	60.10	60.10	0.00	63.72	63.72	0.00
Yuba R - Bear R	14	57.10	57.10	0.00	59.73	59.73	0.00	63.28	63.28	0.00
Yuba R - Bear R	13.75	56.82	56.82	0.00	59.37	59.37	0.00	62.84	62.84	0.00
Yuba R - Bear R	13.5	56.43	56.43	0.00	58.92	58.92	0.00	62.29	62.29	0.00
Yuba R - Bear R	13.25	56.21	56.21	0.00	58.66	58.66	0.00	62.01	62.01	0.00
Yuba R - Bear R	13	56.14	56.14	0.00	58.60	58.60	0.00	61.97	61.97	0.00
Yuba R - Bear R	12.75	55.98	55.98	0.00	58.42	58.42	0.00	61.76	61.76	0.00
Yuba R - Bear R	12.5	55.90	55.90	0.00	58.34	58.34	0.00	61.69	61.69	0.00
Yuba R - Bear R	12.25	55.66	55.66	0.00	58.10	58.10	0.00	61.43	61.43	0.00
Reach 35	12	55.66	55.66	0.00	58.10	58.10	0.00	61.43	61.43	0.00
Reach 35	11.75	55.52	55.52	0.00	57.96	57.96	0.00	61.30	61.30	0.00
Reach 35	11.599	55.49	55.49	0.00	57.93	57.93	0.00	61.25	61.25	0.00
Reach 35	11.5	55.36	55.36	0.00	57.81	57.81	0.00	61.13	61.13	0.00
Reach 35	11.25	55.16	55.16	0.00	57.58	57.58	0.00	60.87	60.87	0.00
Reach 35	11	54.86	54.86	0.00	57.26	57.26	0.00	60.50	60.50	0.00
Reach 35	10.75	54.71	54.71	0.00	57.10	57.11	0.01	60.33	60.33	0.00
Reach 35	10.5	54.47	54.47	0.00	56.84	56.84	0.00	60.02	60.02	0.00
Reach 35	10.25	54.03	54.03	0.00	56.34	56.34	0.00	59.40	59.40	0.00
Reach 35	10	53.82	53.82	0.00	56.12	56.12	0.00	59.15	59.15	0.00
Reach 35	9.75	53.52	53.52	0.00	55.77	55.77	0.00	58.73	58.73	0.00
Reach 35	9.5	53.18	53.18	0.00	55.39	55.39	0.00	58.28	58.28	0.00
Reach 35	9.278	53.12	53.12	0.00	55.34	55.34	0.00	58.23	58.23	0.00

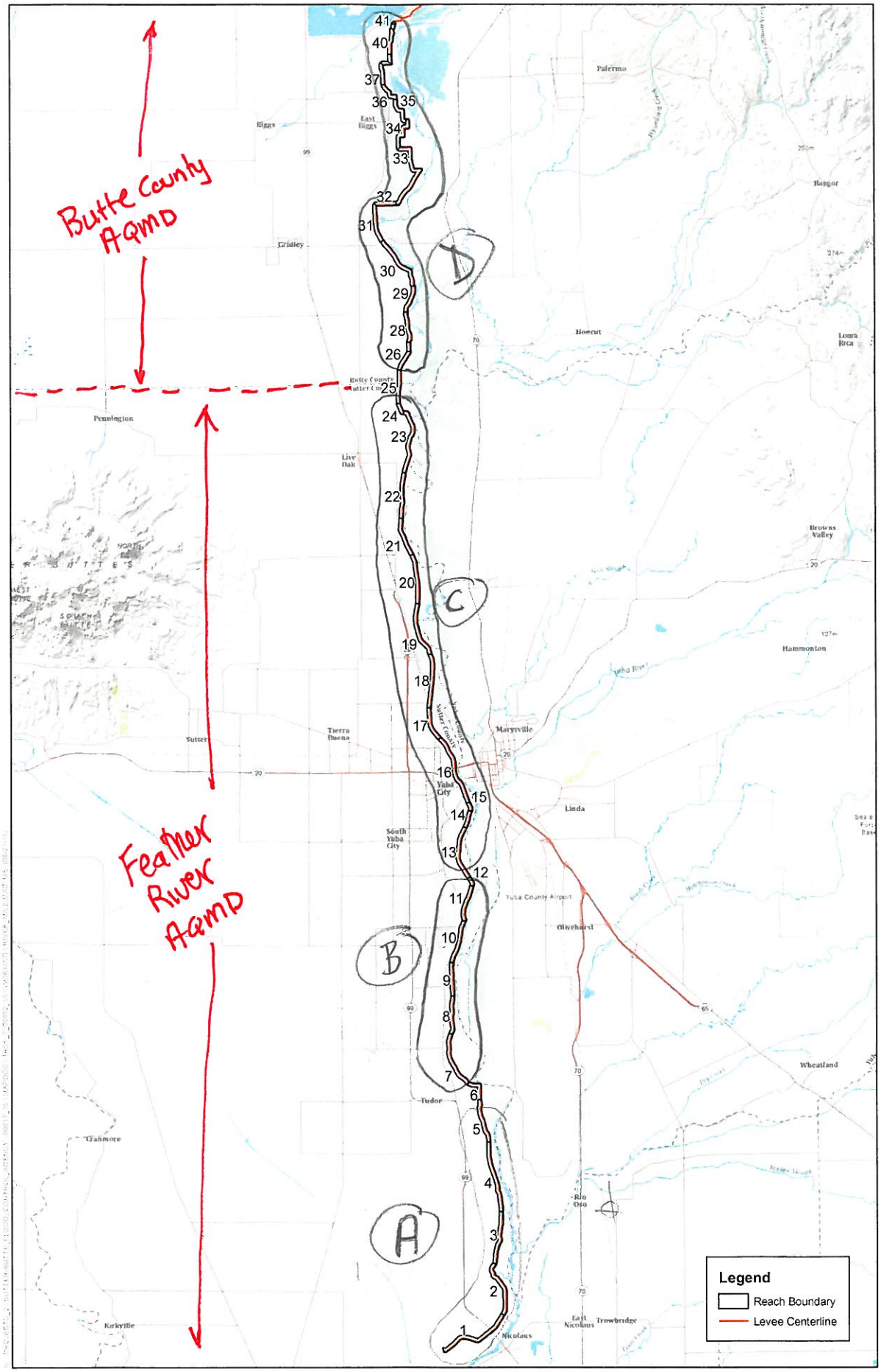
Table 1. Comparison of July 2012 (Existing Conditions) vs. 'With Project' Water Surface Profiles (NAVD88-ft)

Feather River Reach	HEC-RAS River STA	100yr Max WSE Existing Conditions	100yr Max WSE With Project	100yr Diff. (ft)	200yr Max WSE Existing Conditions	200yr Max WSE With Project	200yr Diff. (ft)	500yr Max WSE Existing Conditions	500yr Max WSE With Project	500yr Diff. (ft)
Reach 35	9.265	52.82	52.82	0.00	54.98	54.98	0.00	57.76	57.76	0.00
Reach 35	9.2	52.70	52.70	0.00	54.84	54.84	0.00	57.59	57.59	0.00
Reach 35	9	52.35	52.35	0.00	54.46	54.46	0.00	57.13	57.13	0.00
Reach 35	8.75	51.56	51.56	0.00	53.57	53.57	0.00	56.04	56.04	0.00
Reach 35	8.5	51.07	51.07	0.00	53.05	53.05	0.00	55.44	55.44	0.00
Reach 35	8.25	50.71	50.71	0.00	52.67	52.67	0.00	55.01	55.01	0.00
Reach 35	8	49.98	49.98	0.00	51.88	51.88	0.00	54.03	54.03	0.00
Reach 35	7.75	49.55	49.55	0.00	51.41	51.41	0.00	53.39	53.39	0.00
Reach 35	7.55	49.33	49.32	-0.01	51.16	51.16	0.00	53.05	53.05	0.00
			MAX:	**0.01**		**MAX:**	**0.01**		**MAX:**	**0.01**
			MIN:	**-0.01**		**MIN:**	**-0.01**		**MIN:**	**-0.01**
			AVG:	**0.00**		**AVG:**	**0.00**		**AVG:**	**0.00**

Appendix D

Final Air Quality Calculation Spreadsheets and Supporting Information

AIR QUALITY APPENDIX
CALCULATION SPREADSHEETS AND SUPPORTING INFORMATION



ICF INTERNATIONAL

Project Reach Boundaries

MEMORANDUM

TO: Mr. Mike Inamine, Sutter Butte Flood Control Agency

FROM: HDR/Wood Rodgers Design Team

DATE: January 17, 2012

SUBJECT: SBFCA, Feather River West Levee Project, Project Description for CEQA/NEPA Analysis, Version 2.0

INTRODUCTION

In 2010, the Sutter Butte Flood Control Agency (SBFCA) embarked on the Feather River West Levee (FRWL) Project. The project seeks to rehabilitate 44 miles of existing levee along the west bank of the Feather River through Sutter and Butte Counties. A geotechnical assessment of the levees has been completed and the potential mitigation measures to address the deficiencies in each reach has been analyzed by the design team. These alternatives are outlined in detail in the Project Pre-design Formulation Report (Reference 1). The design of the project is currently approaching the 60-percent level.

The purpose of this Memorandum is to provide the information requested by ICF International (Reference 3), for the purpose of preparing project CEQA/NEPA Analyses. Estimates of the quantity and duration of equipment usage, labor workforce, and materials necessary to construct each of the three project alternatives are provided within this Memorandum. Other information, including power consumption, estimate of the disturbed area, and other information requested in Reference No. 3 is also included. Version 2.0 of this project description addresses additional information requested by ICF/Jones and Stokes as discussed on Monday, January 9, 2012.

REFERENCES

1. HDR, Wood Rodgers, URS, and MHM, "Pre-design Formulation Report, Feather River West Levee – Segments 1 through 7, Sutter Butte Levee Rehabilitation Program, Sutter and Butte Counties, California," February 2011.

2. PBI, "Technical Memorandum, SBFCA Feather River West Levee Project, Preliminary Construction Project Prioritization Analysis," July 11, 2011.

3. ICF International, "Revised Data Requests for the Feather River West Levee Project EIS/EIR," September 30, 2011.

4. Wood Rodgers, Inc., SBFCA, "Feather River West Levee Project, Preliminary Assessment of Borrow Requirements and Potential Borrow Sites," August 12, 2011.

CONSTRUCTION PHASING

Outlined in Reference 2 are four projects corresponding to the likely construction contracts for construction of the overall project. The four projects, or Construction Contracts as referenced herein, and their respective areas for construction of the FRWL project, are identified in Table 1 below.

Table 1 – Construction Contracts and FRWL Reaches

Construction Contract	FRWL Reaches
A	2 Through 5
B	7 Through 11
C	13 Through 24
D	26 Through 41

It is noted that Reaches 6, 12, and 25 are no work reaches on the project. At the south end of the project, the work begins at Station 202+50, within Reach 2. Reach 1 is not currently a part of the Phase 1 Project.

ALTERNATIVES DESCRIPTION

For each of the Construction Contracts identified, there are three alternatives under consideration. The first alternative (Alternative 1) rehabilitates the levee primarily using cutoff walls such that the overall footprint of the levee is not expanded. This alternative is referred to within this memorandum as the "Minimized Footprint" alternative. The second alternative (Alternative 2) rehabilitates the levee using primarily seepage and stability berms, expanding the overall footprint of the existing levee. This alternative is referred to as the "Expanded Footprint" alternative. The third alternative (Alternative 3), rehabilitates the levee by selecting the lowest cost rehabilitation measure (whether a cutoff wall or a seepage berm) such that the overall cost of the project is minimized. This alternative is referred to in this memorandum as the "Optimized Footprint" alternative.

CONSTRUCTION SCHEDULE

Construction of the Project is anticipated to occur beginning in 2013 and continue through 2015. A total of four construction contracts are anticipated, issued in a sequence to match the priority ranking identified in Reference 2. Each of the contracts will be two years in duration. Table 2 below outlines the construction priority and years identified for construction.

Table 2 – Construction Priority and Years of Construction

Construction Contract	Years for Construction
C	2013 through 2014
D	2013 through 2014
B	2014 through 2015
A	2014 through 2015

For each construction season, the maximum window of work is anticipated to be May 1st through November 1st. This start date of construction corresponds to the end of the Giant Garter Snake (GGS) activity period, while November 1st marks the beginning of the flood season for the Sacramento River Flood Control Project. It may be the case that additional construction window restrictions on account of nesting raptors or early season (October) GGS activity may occur and are not accounted for in this analysis.

The construction of each contract is anticipated to occur in single 10 hour shifts, six days a week. An exception to this schedule is cutoff wall construction, which is anticipated to occur in two 10 hour shifts, (24-hour construction) six days a week. While production work will not occur between the two 10 hour shifts, equipment maintenance and preparations for the upcoming work shift will occur.

A construction schedule for each of the alternatives relating of each construction contract is included in Appendix A.

EQUIPMENT AND MANPOWER ESTIMATES

Within each project description outlined below, there are summary Tables for the equipment type, duration, and sequencing for each construction project alternative. The supporting calculations for these estimates are included as Appendix B of this memorandum.

POTENTIAL BORROW SITES

Up to eight potential borrow sites are identified within Reference 4 above for the Project. Location maps for the borrow areas within Yuba City and Live Oak are provided as Figures 1 and 2. It may be the case that additional borrow sites not currently identified are eventually identified and used as sources of borrow for this Project. For the purposes of this memorandum, it is assumed any additional sites are a similar distance to the work areas and require similar equipment and manpower to excavate, borrow, and haul material to the levee rehabilitation sites. The acreage of the primary borrow sites included in Reference 4, are as follows in Table 3 below:

Table 3 – Borrow Site Acreage

Borrow Site	Area, Acres
Yuba City North	28
Yuba City South	70
Live Oak North	34
Live Oak South	28
Live Oak East	13
Live Oak West	7
Caltrans Property	26

RIGHT-OF-WAY AND EASEMENTS

Throughout the project length, the State and/or local levee maintaining agencies hold various easements and fee rights to the land beneath and adjacent to the Feather River West Levee. Due to the age of the system, and the numerous projects to upgrade the levee system over the years, the land right vary significantly throughout the project. One objective of the project is to upgrade these rights so that the State and local maintaining agencies have appropriate and consistent land rights throughout the length to operate and maintain the levee system. To this end, SBFCA has coordinated with the Central Valley Flood Protection Board (CVFPB) and Department of Water Resources (DWR) to acquire the following rights-of-way for the project:

- Waterside: 15 feet
- Landside: 30 feet minimum, 40 feet where orchards or other continuous obstructions are not present.

Where the current rights beneath or adjacent to the levee are currently owned as an easement, the project will upgrade the rights to fee ownership.

For the waterside right-of-way, and the first 20 feet of the 30 feet to be obtained landward of the levee, existing trees and encroachments will be removed to the extent necessary to facilitate construction of the project and to support long term operation and maintenance of the project. It may be the case that some trees, structures, and other encroachments are not removed from the rights-of-way. These encroachments will be addressed on a case by case basis during final design of the project.

The outer ten feet of the landside easement will be granted in easement back to the existing landowner and will be allowed to be used for agricultural purposes following construction of the project.

Staging areas will only be provided within the right-of-way and easement limits described above. The contractor may reach agreements with landowners for additional staging locations outside of

these limits. Staging areas may be used by the contractor for storage of equipment and materials, project offices, employee parking, and other uses needed for construction of the project.

Cutoff wall construction requires temporary establishment of an on-site slurry batch plant that would occupy about 1 to 2 acres. Batch plants will be located at approximately 1-mile intervals along the levee. The batch plant site would likely contain tanks for water storage, bulk bag supplies of bentonite, bentonite and cement storage silos, a cyclone mixer, pumps, and two generators that meet air quality requirements. The site would also accommodate slurry tanks to store the blended slurries temporarily until they are pumped to the work sites. Slurry ingredients would be mixed with water at the batch plant and the mixture would be pumped from the tanks through pipes to the cutoff wall construction work sites. The batch plant would produce two different slurry mixes, one for trench stabilization and one for the soil backfill mix. Therefore, two slurry pipes or hoses, typically 4- or 6-inch high-density polyethelene pipes, would be laid on the ground and would extend to all work sites. An additional pipe may be used to supply water to the work sites.

MATERIALS DELIVERY AND OFF HAULING

Typical deliveries and off hauling for each project includes bentonite powder, used for making cutoff wall trench slurry and backfill, pipe delivery for irrigation pipe relocation and replacement, aggregate road surfacing, and demolition debris off hauling. For backfill of new pipelines crossing the levee, Controlled Low Strength Material (CLSM), otherwise referred to as light-weight concrete, is required to be placed to the pipeline's spring line. A table is included for each project alternative summarizing the total number of materials deliveries and off hauling associated with the project. The calculations for deliveries and debris hauling for encroachments is included as Appendix C.

PROJECT A, REACHES 1 THROUGH 5

Project A of the FRWL begins at Levee Station 202+50 near the intersection of the FRWL and Laurel Road, and continues north to the beginning of the improvements constructed, as part of the Star Bend Setback Levee project, Levee Station 478+68. The total length of the levee in this portion of the FRWL project is 27,618 linear feet.

Alternative 1 would construct a cutoff wall ranging between 30 feet and 127 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded approximately 50% of its overall height with 2,900 feet of the levee being fully degraded. The cutoff wall would be constructed of soil-bentonite by either the conventional, long-reach excavator or the deep soil mixing (DSM) method. After installation of the cutoff wall, the levee will be reconstructed to its original configuration. In addition to the cutoff wall, Alternative 1 would construct a 200-foot wide seepage berm for 2,268 feet. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction and seepage berm

construction, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 1, including staging and construction easement areas, is 137.1 acres.

The crew size for Alternative 1 during the peak is estimated at 115-125 people working on two fronts, 10-hour shifts, 2 shifts per day, six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 4. The anticipated material quantities associated with this alternative is included in Table 5. The total number of anticipated trucks for materials delivery and off hauling is included in Table 6.

Table 4
Anticipated Equipment and Durations for Project A
Alternative 1 – Minimized Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(8) Elevating Scrapers	20 Days
	(2) Water Trucks	20 Days
	(4) Front-End Loaders	20 Days
	(2) Haul Trucks	20 Days
	(5) Pickup Trucks	20 Days
2. Borrow Site Preparation (Concurrent with 1.)	(2) Tractors with Discing Equipment	20 Days
	(2) Elevating Scrapers	20 Days
	(1) Water Truck	20 Days
3. Levee Degrading/ Work Surface Construction (Lags 1. by 15 days)	(3) Excavators	40 Days
	(15) Scrapers	40 Days
	(5) Vibratory Rollers	40 Days
	(3) Water Trucks	40 Days
	(7) Haul Trucks	40 Days
4. Cutoff Wall Construction (Lags 3. by 22 days)	(4) Hydraulic Excavators	60 Days
	(2) Front-End Loaders	60 Days
	(1) DSM Auger	60 Days
	(1) Extended Boom Pallet Loader	60 Days
	(3) 300 kW Generators	60 Days
	(2) Slurry Pumps	60 Days
	(5) Pickup Trucks	60 Days
	(3) Haul Trucks	60 Days
	(2) Water Trucks	60 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
5. Levee Reconstruction/ Seepage Berm Construction (Lags 4. by 25 days)	(20) Scrapers	60 Days
	(2) Motor Graders	60 Days
	(5) Vibratory Rollers	60 Days
	(3) Water Trucks	60 Days
6. Borrow Site Excavation (Concurrent with 5.)	(2) Front-End Loaders	60 Days
	(2) Excavators	60 Days
	(2) Water Trucks	60 Days
	(50) Haul Trucks	60 Days
7. Utility Reconstruction	(2) Backhoes	100 Days
	(2) Front End Loaders	100 Days
	(2) Rubber Tire Crane	100 Days
	(3) Pickup trucks	100 Days
	(2) Water Trucks	100 Days
8. Levee Resurfacing (Follows 5.)	(2) Motor Graders	22 Days
	(2) Vibratory Rollers	22 Days
	(2) Haul Trucks	22 Days
	(1) Water Truck	22 Days
	(2) Motor Graders	22 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	18 Days
10. Demobilization/Cleanup (Lags 9. by 5 days)	(1) Extended Boom Pallet Loader	18 Days
	(2) Haul Trucks	18 Days

Table 5
Anticipated Major Materials Quantities for Project A
Alternative 1 – Minimized Footprint Alternative

Description	Quantity
Clearing and Grubbing	83.5 Acres
Levee Embankment Degrade	602,400 Cubic Yards
SB Cutoff Wall	1,457,000 Square Feet
Levee Embankment Fill	782,000 Cubic Yards
Borrow Site Excavation	244,000 Cubic Yards
Unsuitable Material Export	31,500 Cubic Yards
Class 2 Aggregate Surfacing	13,100 Tons

Table 6
Number of Trucks for Materials Delivery and Off Hauling – Project A, Alternative 1

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
89	425	8	60	26

Alternative 2 would construct an undrained seepage berm ranging between 100 feet and 300 feet in width along the landside toe of the levee. Additionally, an 8-foot high stability berm would be constructed along 20,817 feet of the project. Also, a shallow cutoff wall 20 feet in depth would be constructed along the levee centerline for 1,616 feet of the project. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded approximately 50% of its overall height. The cutoff wall would be constructed of soil-bentonite by the conventional, long-reach excavator method. After installation of the cutoff wall, the levee will be reconstructed to its original configuration. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction, seepage and stability berm construction, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 2, including staging and construction easement areas, is 259.1 acres.

The crew size for Alternative 2 during the peak is estimated at 195-205 people working one 10-hour shift, 2 shifts per day, six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 7. For a listing of the anticipated material quantities associated with this alternative, see Table 8. The total number of anticipated trucks for materials delivery and off hauling is included in Table 9.

Table 7
Anticipated Equipment and Durations for Project A,
Alternative 2 – Expanded Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(8) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(4) Front-End Loaders	40 Days
	(2) Haul Trucks	40 Days
	(5) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(4) Tractors with Discing Equipment	22 Days
	(4) Elevating Scrapers	22 Days
	(2) Water Truck	22 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
3. Levee Degrading/ Work Surface Construction (Follows 1.)	(1) Excavators	10 Days
	(2) Scrapers	10 Days
	(2) Vibratory Rollers	10 Days
	(1) Water Trucks	10 Days
	(2) Haul Trucks	10 Days
4. Cutoff Wall Construction (Follows 3.)	(2) Hydraulic Excavators	10 Days
	(1) Front-End Loaders	10 Days
	(1) Extended Boom Pallet Loader	10 Days
	(2) 300 kW Generators	10 Days
	(1) Slurry Pumps	10 Days
	(3) Pickup Trucks	10 Days
	(2) Haul Trucks	10 Days
	(1) Water Trucks	10 Days
5. Levee Reconstruction/ Seepage and Stability Berm Construction (Lags 2. by 15 days)	(25) Scrapers	180 Days
	(5) Motor Graders	180 Days
	(2) Hydraulic Excavators	180 Days
	(5) Vibratory Rollers	180 Days
	(4) Water Trucks	180 Days
6. Borrow Site Excavation (Concurrent with 5.)	(4) Front-End Loaders	170 Days
	(4) Excavators	170 Days
	(4) Water Trucks	170 Days
	(85) Haul Trucks	170 Days
7. Utility Reconstruction	(2) Backhoes	115 Days
	(2) Rubber Tire Crane	115 Days
	(2) Front End Loaders	115 Days
	(3) Pickup trucks	115 Days
	(2) Water Trucks	115 Days
8. Levee Resurfacing (Follows 5.)	(1) Motor Graders	5 Days
	(1) Vibratory Rollers	5 Days
	(2) Haul Trucks	5 Days
	(1) Water Truck	5 Days
9. Hydroseeding (Follows 5.)	(2) Hydroseeding Trucks	20 Days
10. Demobilization/Cleanup (Lags 9. by 5 days)	(1) Extended Boom Pallet Loader	22 Days
	(2) Haul Trucks	22 Days

Table 8
Anticipated Major Materials Quantities for Project A, Alternative 2 – Expanded Footprint Alternative

Description	Quantity
Clearing and Grubbing	183.1 Acres
Levee Embankment Degrade	16,500 Cubic Yards
SB Cutoff Wall	13,500 Square Feet
Levee Embankment Fill	1,373,000 Cubic Yards
Borrow Site Excavation	1,628,000 Cubic Yards
Unsuitable Material Export	75 Cubic Yards
Class 2 Aggregate Surfacing	1,425 Tons

Table 9
Number of Trucks for Materials Delivery and Off Hauling – Project A, Alternative 2

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
1	50	8	60	26

Alternative 3 would construct a cutoff wall ranging between 20 feet and 127 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded approximately 50% of its overall height. The cutoff wall would be constructed of soil-bentonite by either the conventional, long-reach excavator or the deep soil mixing (DSM) method. After installation of the cutoff wall, the levee will be reconstructed to its original configuration. In addition to the cutoff wall, Alternative 3 would construct a 100-foot wide seepage berm for 1,616 feet and a 200-foot wide seepage berm for 2,268 feet. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction and seepage berm construction, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 3, including staging and construction easement areas, is 142.4 acres.

The crew size for Alternative 3 during the peak is estimated at 115-125 people working on two fronts, 10-hour shifts, 2 shifts per day, six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 10. For a listing of the anticipated material quantities associated with this alternative, see Table 11. The total number of anticipated trucks for materials delivery and off hauling is included in Table 12.

Table 10
Anticipated Equipment and Duration for Project A,
Alternative 3 – Optimized Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(8) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(4) Front-End Loaders	40 Days
	(5) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(2) Tractors with Discing Equipment	60 Days
	(2) Elevating Scrapers	60 Days
	(1) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (Lags 1. by 15 days)	(3) Excavators	100 Days
	(15) Scrapers	100 Days
	(5) Vibratory Rollers	100 Days
	(3) Water Trucks	100 Days
	(7) Haul Trucks	100 Days
4. Cutoff Wall Construction (Lags 3. by 15 days)	(5) Hydraulic Excavators	60 Days
	(2) Front-End Loaders	60 Days
	(1) DSM Auger	30 Days
	(1) Extended Boom Pallet Loader	60 Days
	(4) 300 kW Generators	60 Days
	(2) Slurry Pumps	60 Days
	(5) Pickup Trucks	60 Days
	(3) Haul Trucks	60 Days
	(2) Water Trucks	60 Days
5. Levee Reconstruction/ Seepage and Stability Berm Construction (Lags 4. by 25 days)	(20) Scrapers	60 Days
	(2) Motor Graders	60 Days
	(5) Vibratory Rollers	60 Days
	(3) Water Trucks	60 Days
6. Borrow Site Excavation (Concurrent with 5.)	(2) Front-End Loaders	50 Days
	(2) Hydraulic Excavators	50 Days
	(2) Water Trucks	50 Days
	(50) Haul Trucks	50 Days
7. Utility Reconstruction	(2) Backhoes	130 Days
	(2) Rubber Tire Crane	130 Days
	(2) Front End Loaders	130 Days
	(3) Pickup trucks	130 Days
	(2) Water Trucks	130 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
8. Levee Resurfacing (Follows 5.)	(2) Motor Graders	24 Days
	(2) Vibratory Rollers	24 Days
	(2) Haul Trucks	24 Days
	(1) Water Truck	24 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	24 Days
10. Demobilization/Cleanup (Lags 9. by 5 days)	(1) Extended Boom Pallet Loader	24 Days
	(2) Haul Trucks	24 Days

Table 11
Anticipated Major Materials Quantities for Project A, Alternative 3 – Optimized Footprint Alternative

Description	Quantity
Clearing and Grubbing	87.2 Acres
Levee Embankment Degrade	548,000 Cubic Yards
SB Cutoff Wall	1,272,000 Square Feet
Levee Embankment Fill	759,700 Cubic Yards
Borrow Site Excavation	276,250 Cubic Yards
Unsuitable Material Export	25,750 Cubic Yards
Class 2 Aggregate Surfacing	10,000 Tons

Table 12
Number of Trucks for Materials Delivery and Off Hauling – Project A, Alternative 3

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
78	350	8	60	26

PROJECT B, REACHES 7 THROUGH 11

Project B of the FRWL begins at Levee Station 510+37, the end of the improvements constructed as part of the Star Bend Setback Levee project, and continues north Levee Station 830+00. The total length of the levee in this portion of the FRWL project is 31,963 linear feet. Three alternatives have been reviewed as part of the Feather River West Levee Pre-Design Formulation Report. Alternative 1 would construct a cutoff wall along the centerline of the existing levee to a varying depth and a seepage berm along a portion of the landside levee toe. Alternative 2 would construct seepage and stability berms along the landside toe of the levee and a shallow cutoff wall along a portion of the centerline of the levee. Alternative 3 is an optimized alternative, combining mitigation measures from both Alternative 1 and Alternative 2 to produce the most economically feasible project. For Project B, the most economically feasible project is

to construct a cutoff wall along the centerline of the existing levee. Therefore, Alternative 1 and Alternative 3 are the same for this project.

Alternative 1 would construct a cutoff wall ranging between 39 feet and 124 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded approximately 50% of its overall height with 1,900 feet of the levee being fully degraded. The cutoff wall would be constructed of soil-bentonite by either the conventional, long-reach excavator or the deep soil mixing (DSM) method. After installation of the cutoff wall, the levee will be reconstructed to its original configuration. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up. SBFCA will acquire a temporary construction easement equal to 50 feet from the existing levee toe or toe of the proposed seepage berm for construction of the levee improvements. An additional 20-foot easement will be obtained where required for the relocation of existing utilities. The total disturbed area for Alternative 1, including staging and construction easement areas, is 155.1 acres.

The crew size for Alternative 1 during the peak is estimated at 110-120 people working on two fronts, 10-hour shifts, 2 shifts per day, six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 13. For a listing of the anticipated material quantities associated with this alternative, see Table 14. The total number of anticipated trucks for materials delivery and off hauling is included in Table 15.

Table 13
Anticipated Equipment and Duration for Project B,
Alternative 1 – Minimized Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(8) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(4) Front-End Loaders	40 Days
	(5) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(2) Tractors with Discing Equipment	60 Days
	(2) Elevating Scrapers	60 Days
	(1) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (Lags 1. by 14 days)	(3) Excavators	80 Days
	(15) Scrapers	80 Days
	(5) Vibratory Rollers	80 Days
	(3) Water Trucks	80 Days
	(7) Haul Trucks	80 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
4. Cutoff Wall Construction (Lags 3. by 14 days)	(4) Hydraulic Excavators	50 Days
	(2) Front-End Loaders	50 Days
	(2) DSM Auger	50 Days
	(1) Extended Boom Pallet Loader	50 Days
	(4) 300 kW Generators	50 Days
	(2) Slurry Pumps	50 Days
	(5) Pickup Trucks	50 Days
	(3) Haul Trucks	50 Days
	(2) Water Trucks	50 Days
5. Levee Reconstruction (Follows 4.)	(20) Scrapers	80 Days
	(2) Motor Graders	80 Days
	(5) Vibratory Rollers	80 Days
	(3) Water Trucks	80 Days
6. Borrow Site Excavation (Concurrent with 5.)	(2) Front-End Loaders	80 Days
	(2) Hydraulic Excavators	80 Days
	(2) Water Trucks	80 Days
	(50) Haul Trucks	80 Days
7. Utility Reconstruction	(2) Backhoes	130 Days
	(2) Rubber Tire Crane	130 Days
	(2) Front End Loaders	130 Days
	(3) Pickup trucks	130 Days
	(2) Water Trucks	130 Days
8. Levee Resurfacing (Follows 5.)	(2) Motor Graders	20 Days
	(2) Vibratory Rollers	20 Days
	(2) Haul Trucks	20 Days
	(1) Water Truck	20 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	20 Days
10. Demobilization/Cleanup (Lags 9. by 10 days)	(1) Extended Boom Pallet Loader	15 Days
	(2) Haul Trucks	15 Days

Table 14
Anticipated Major Materials Quantities for FRWL, Project B, Alternative 1 – Minimized Footprint Alternative

Description	Quantity
Clearing and Grubbing	94.1 Acres
Levee Embankment Degrade	931,900 Cubic Yards
SB Cutoff Wall	1,948,500 Square Feet
Levee Embankment Fill	1,086,500 Cubic Yards

Description	Quantity
Borrow Site Excavation	796,750 Cubic Yards
Unsuitable Material Export	520,250 Cubic Yards
Class 2 Aggregate Surfacing	12,000 Tons

Table 15
Number of Trucks for Materials Delivery and Off Hauling – Project B, Alternative 1

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
119	400	17	36	36

Alternative 2 would construct an undrained seepage berm ranging between 110 feet and 300 feet in width along the landside toe of the levee. Additionally, a stability berm approximately 9.5 feet tall would be constructed along 14,163 feet of the project. Also, a shallow cutoff wall ranging between 23 feet and 35 feet in depth would be constructed along the levee centerline for 17,800 feet of the project. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded approximately 50% of its overall height. The cutoff wall would be constructed of soil-bentonite by the conventional, long-reach excavator method. After installation of the cutoff wall, the levee will be reconstructed to its original configuration. A portion of the existing Garden Highway will need to be removed and reconstructed to allow construction of the seepage berm. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction, seepage and stability berm construction, borrow site excavation, utility relocation and reconstruction, roadway reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 2, including staging and construction easement areas, is 331.8 acres.

The crew size for Alternative 2 during the peak is estimated at 190-200 people working one 10-hour shift, 2 shifts per day, six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 16. For a listing of the anticipated material quantities associated with this alternative, see Table 17. The total number of anticipated trucks for materials delivery and off hauling is included in Table 18.

Table 16
Anticipated Equipment and Duration for Project B,
Alternative 2 – Expanded Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(8) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(4) Front-End Loaders	40 Days
	(5) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(4) Tractors with Discing Equipment	50 Days
	(4 Elevating Scrapers	50 Days
	(2) Water Truck	50 Days
3. Levee Degrading/ Work Surface Construction (Follows 1.)	(1) Excavators	22 Days
	(2) Scrapers	22 Days
	(2) Vibratory Rollers	22 Days
	(1) Water Trucks	22 Days
	(6) Haul Trucks	22 Days
4. Cutoff Wall Construction (Lags 3. by 15 days)	(4) Hydraulic Excavators	50 Days
	(1) Front-End Loaders	50 Days
	(1) Extended Boom Pallet Loader	50 Days
	(2) 300 kW Generators	50 Days
	(2) Slurry Pumps	50 Days
	(3) Pickup Trucks	50 Days
	(2) Haul Trucks	50 Days
	(1) Water Trucks	50 Days
5. Levee Reconstruction/ Seepage and Stability Berm Construction (Lags 2. by 15 days)	(25) Scrapers	145 Days
	(5) Motor Graders	145 Days
	(5) Vibratory Rollers	145 Days
	(4) Water Trucks	145 Days
6. Borrow Site Excavation (Concurrent with 5.)	(4) Front-End Loaders	145 Days
	(2) Hydraulic Excavators	145 Days
	(4) Water Trucks	145 Days
	(85) Haul Trucks	145 Days
7. Utility Reconstruction	(2) Backhoes	130 Days
	(2) Rubber Tire Crane	130 Days
	(2) Front End Loaders	130 Days
	(3) Pickup trucks	130 Days
	(2) Water Trucks	130 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
8. Roadway Reconstruction (Follows 5.)	(2) Motor Graders	40 Days
	(1) Paving Machine	40 Days
	(2) Vibratory Rollers	40 Days
	(4) Haul Trucks	40 Days
	(1) Water Truck	40 Days
9. Levee Resurfacing (Follows 5.)	(2) Motor Graders	20 Days
	(1) Vibratory Rollers	20 Days
	(1) Haul Trucks	20 Days
	(1) Water Truck	20 Days
10. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	20 Days
11. Demobilization/Cleanup (Lags 9. by 10 days)	(1) Extended Boom Pallet Loader	15 Days
	(2) Haul Trucks	15 Days

Table 17
Anticipated Major Materials Quantities for Project B, Alternative 2 – Expanded Footprint Alternative

Description	Quantity
Clearing and Grubbing	272.3 Acres
Levee Embankment Degrade	484,000 Cubic Yards
SB Cutoff Wall	504,500 Square Feet
Levee Embankment Fill	2,406,000 Cubic Yards
Borrow Site Excavation	2,334,500 Cubic Yards
Unsuitable Material Export	22,000 Cubic Yards
Class 2 Aggregate Surfacing	6,500 Tons

Table 18
Number of Trucks for Materials Delivery and Off Hauling – Project B, Alternative 2

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
31	225	17	36	36

Alternative 3 would construct a cutoff wall ranging between 39 feet and 124 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded approximately 50% of its overall height with 1,900 feet of the levee being fully degraded. The cutoff wall would be constructed of soil-bentonite by either the conventional, long-reach excavator or the deep soil mixing (DSM) method. After installation of the cutoff wall, the levee will be reconstructed to its original configuration. Work

for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 3, including staging and construction easement areas, is 155.1 acres.

The crew size for Alternative 3 during the peak is estimated at 110-120 people working on two fronts, 10-hour shifts, 2 shifts per day, six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 19. For a listing of the anticipated material quantities associated with this alternative, see Table 20. The total number of anticipated trucks for materials delivery and off hauling is included in Table 21.

Table 19
Anticipated Equipment and Duration for Project B,
Alternative 3 – Optimized Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(8) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(4) Front-End Loaders	40 Days
	(5) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(2) Tractors with Discing Equipment	60 Days
	(2) Elevating Scrapers	60 Days
	(1) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (Lags 1. by 14 days)	(3) Excavators	45 Days
	(15) Scrapers	45 Days
	(5) Vibratory Rollers	45 Days
	(3) Water Trucks	45 Days
	(7) Haul Trucks	45 Days
4. Cutoff Wall Construction (Lags 3. by 14 days)	(4) Hydraulic Excavators	80 Days
	(2) Front-End Loaders	80 Days
	(2) DSM Augers	30 Days
	(1) Extended Boom Pallet Loader	80 Days
	(4) 300 kW Generators	80 Days
	(2) Slurry Pumps	80 Days
	(5) Pickup Trucks	80 Days
	(3) Haul Trucks	80 Days
	(2) Water Trucks	80 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
5. Levee Reconstruction (Lags 4. by 21 days)	(20) Scrapers	85 Days
	(2) Motor Graders	85 Days
	(5) Vibratory Rollers	85 Days
	(3) Water Trucks	85 Days
6. Borrow Site Excavation (Concurrent with 5.)	(2) Hydraulic Excavators	95 Days
	(2) Front-End Loaders	95 Days
	(2) Water Trucks	95 Days
	(50) Haul Trucks	95 Days
7. Utility Reconstruction	(2) Backhoes	130 Days
	(2) Rubber Tire Crane	130 Days
	(2) Front End Loaders	130 Days
	(5) Pickup trucks	130 Days
	(2) Water Trucks	130 Days
8. Levee Resurfacing (Lags 5. by 96 days)	(2) Motor Graders	22 Days
	(2) Vibratory Rollers	22 Days
	(2) Haul Trucks	22 Days
	(1) Water Truck	22 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	20 Days
10. Demobilization/Cleanup (Lags 9. by 10 days)	(1) Extended Boom Pallet Loader	18 Days
	(2) Haul Trucks	18 Days

Table 20
Anticipated Major Materials Quantities for Project B, Alternative 3 – Optimized Footprint Alternative

Description	Quantity
Clearing and Grubbing	94.1 Acres
Levee Embankment Degrade	931,900 Cubic Yards
SB Cutoff Wall	1,948,500 Square Feet
Levee Embankment Fill	1,086,500 Cubic Yards
Borrow Site Excavation	796,750 Cubic Yards
Unsuitable Material Export	520,250 Cubic Yards
Class 2 Aggregate Surfacing	12,000 Tons

Table 21
Number of Trucks for Materials Delivery and Off Hauling – Project B, Alternative 3

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
119	400	17	36	36

PROJECT C, REACHES 13 THROUGH 24

Project C begins at Levee Station 845+00, near the north end of the Shanghai Bend Setback Levee, and continues north to Levee Station 1623+86 (corresponding to Reaches 13 through 24). The total length of the levee in this portion of the FRWL project is 77,886 linear feet.

Three alternatives have been reviewed as part of the Feather River West Levee Pre-Design Formulation Report. Alternative 1 would include the flattening of the waterside levee slope, the construction of a cutoff wall along the centerline of the existing levee to a varying depth, and the infilling of depressions and ditches at the landside levee toe. Alternative 2 would include a combination of seepage and stability berms along the landside toe of the levee, relief wells along the landside toe of the levee and shallow cutoff walls along the centerline of the levee for portions of the project. Alternative 3 is an optimized alternative, combining mitigation measures from both Alternative 1 and Alternative 2 to produce the most economically feasible project.

All three alternatives will require special consideration at the locations where the 5th Street bridge, State Highway 20 bridge, and the Union Pacific Railroad (UPRR) cross the levee. At these locations, soil-cement-bentonite cutoff walls will be constructed by either the Trench Remixing, Deep (TRD), jet grouting, or steel sheet pile method to a depth of approximately 31 to 53 feet. All three methods have similar crew sizes and equipment impacts, which are summarized in the cutoff wall section of the estimated equipment and duration table below.

Alternative 1 would construct a cutoff wall ranging between 21 and 105 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded approximately 50% of its overall height with approximately 2,600 feet of the levee being fully degraded. The cutoff wall would be constructed of soil-bentonite by either the conventional long-reach excavator or the deep mix method (DMM). After installation of the cutoff wall, the levee will be reconstructed to its original configuration. In addition to the cutoff wall, Alternative 1 would include approximately 11,150 feet of waterside slope flattening, approximately 5,100 feet of depression infill and approximately 1,500 feet of ditch lining. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction and seepage berm construction, relief well installation, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 1, including staging and construction easement areas, is 187.3 acres.

The crew size for Alternative 1 during the peak is estimated at 150-160 people working on three to four fronts, 10-hour shifts, 2 shifts per day for cutoff wall construction, and six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 22. For a listing of the anticipated material quantities associated with this alternative, see Table 23. The total number of anticipated trucks for materials delivery and off hauling is included in Table 24.

Table 22
Anticipated Equipment and Duration for Project C,
Alternative 1 – Minimized Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(4) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(2) Front-End Loaders	40 Days
	(4) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(2) Tractors with Discing Equipment	60 Days
	(2) Elevating Scrapers	60 Days
	(1) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (Lags 1. by 7 days)	(3) Excavators	35 Days
	(14) Scrapers	35 Days
	(5) Vibratory Rollers	35 Days
	(4) Water Trucks	35 Days
	(7) Haul Trucks	35 Days
4. Cutoff Wall Construction (Lags 3. by 7 days)	(8) Hydraulic Excavators	60 Days
	(4) Front-End Loaders	60 Days
	(2) DSM Auger	60 Days
	(1) Extended Boom Pallet Loader	60 Days
	(6) 300 kW Generators	60 Days
	(4) Slurry Pumps	60 Days
	(6) Pickup Trucks	60 Days
	(3) Haul Trucks	60 Days
	(2) Water Trucks	60 Days
5. Levee Reconstruction/ Seepage Berm Construction (Lags 4. by 22 days)	(10) Scrapers	130 Days
	(2) Motor Graders	130 Days
	(5) Tractors with Discing Equipment	130 Days
	(5) Vibratory Rollers	130 Days
	(3) Water Trucks	130 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
6. Borrow Site Excavation (Concurrent with 5.)	(2) Front-End Loaders	130 Days
	(2) Water Trucks	130 Days
	(75) Haul Trucks	130 Days
7. Utility Reconstruction	(1) Hydraulic Excavator	130 Days
	(1) Haul Trucks	130 Days
	(2) Pickup Trucks	130 Days
	(1) Water Trucks	130 Days
8. Levee Resurfacing (Follows 5.)	(2) Motor Graders	24 Days
	(2) Vibratory Rollers	24 Days
	(2) Haul Trucks	24 Days
	(1) Water Truck	24 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	24 Days
	(2) Pickup Trucks	24 Days
10. Demobilization/Cleanup (Follows 9.)	(1) Extended Boom Pallet Loader	20 Days
	(2) Haul Trucks	20 Days

Table 23
Anticipated Major Materials Quantities for Project C, Alternative 1 – Minimized Footprint Alternative

Description	Quantity
Clearing and Grubbing	187.3 Acres
Levee Embankment Degrade	882,800 Cubic Yards
SB Cutoff Wall	3,137,100 Square Feet
Levee Embankment Fill	1,410,000 Cubic Yards
Borrow Site Excavation	531,300 Cubic Yards
Unsuitable Material Export	253,100 Cubic Yards
Class 2 Aggregate Surfacing	40,600 Tons

Table 24
Number of Trucks for Materials Delivery and Off Hauling – Project C, Alternative 1

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
191	1500	31	160	104

Alternative 2 would construct an undrained seepage berm ranging between 70 feet and 300 feet in width along the landside toe of the levee. An 8- to 10-foot high stability berm would be constructed along approximately 24,200 feet of the project. A shallow cutoff wall 20 feet in depth would be constructed along the levee centerline for approximately 14,700 feet of the

project. Relief wells will be installed for approximately 37,400 feet of the project. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded by approximately 50% of its overall height. The cutoff wall would be constructed of soil-bentonite by the conventional, long-reach excavator method. After installation of the cutoff wall, the levee will be reconstructed to its original configuration. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction, seepage and stability berm construction, relief well construction, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 2, including staging and construction easement areas, is 344.9 acres.

The crew size for Alternative 2 during the peak is estimated at 200-210 people working on two fronts, 10-hour shifts, 2 shifts per day for cutoff wall construction, and six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 25. For a listing of the anticipated material quantities associated with this alternative, see Table 26. The total number of anticipated trucks for materials delivery and off hauling is included in Table 27.

Table 25
Anticipated Equipment and Duration for Project C,
Alternative 2 – Expanded Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(13) Elevating Scrapers	30 Days
	(7) Water Trucks	30 Days
	(7) Front-End Loaders	30 Days
	(13) Pickup Trucks	30 Days
2. Borrow Site Preparation (Concurrent with 1.)	(4) Tractors with Discing Equipment	60 Days
	(4) Elevating Scrapers	60 Days
	(2) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (Lags 1. by 4 days)	(3) Excavators	20 Days
	(14) Scrapers	20 Days
	(5) Vibratory Rollers	20 Days
	(4) Water Trucks	20 Days
	(7) Haul Trucks	20 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
4. Cutoff Wall Construction (Lags 3. by 7 days)	(4) Hydraulic Excavators	25 Days
	(2) Front-End Loaders	25 Days
	(1) DSM Auger	25 Days
	(1) Extended Boom Pallet Loader	25 Days
	(3) 300 kW Generators	25 Days
	(2) Slurry Pumps	25 Days
	(3) Pickup Trucks	25 Days
	(2) Haul Trucks	25 Days
	(1) Water Trucks	25 Days
5. Levee Reconstruction/ Seepage and Stability Berm Construction (Lags 4. by 2 days)	(10) Scrapers	180 Days
	(5) Motor Graders	180 Days
	(5) Tractors with Discing Equipment	180 Days
	(5) Vibratory Rollers	180 Days
	(3) Water Trucks	180 Days
6. Borrow Site Excavation (Concurrent with 5.)	(4) Front-End Loaders	180 Days
	(4) Water Trucks	180 Days
	(75) Haul Trucks	180 Days
7. Utility Reconstruction	(1) Hydraulic Excavator	130 Days
	(1) Haul Trucks	130 Days
	(2) Pickup Trucks	130 Days
	(1) Water Trucks	130 Days
8. Levee Resurfacing (Follows 5.)	(4) Motor Graders	24 Days
	(4) Vibratory Rollers	24 Days
	(2) Haul Trucks	24 Days
	(2) Water Truck	24 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	24 Days
	(2) Pickup Trucks	24 Days
10. Demobilization/Cleanup (Follows 9.)	(1) Extended Boom Pallet Loader	20 Days
	(2) Haul Trucks	20 Days

Table 26
Anticipated Major Materials Quantities for Project C, Alternative 2 – Expanded Footprint Alternative

Description	Quantity
Clearing and Grubbing	344.9 Acres
Levee Embankment Degrade	385,000 Cubic Yards
SB Cutoff Wall	451,200 Square Feet
Levee Embankment Fill	2,518,400 Cubic Yards
Borrow Site Excavation	2,681,200 Cubic Yards

Description	Quantity
Unsuitable Material Export	322,900 Cubic Yards
Class 2 Aggregate Surfacing	35,900 Tons

Table 27
Number of Trucks for Materials Delivery and Off Hauling – Project C, Alternative 2

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
28	1,200	31	160	104

Alternative 3 would construct a cutoff wall ranging between 21 and 105 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded by approximately 50% of its overall height with approximately 2,600 feet of the levee being fully degraded. The cutoff wall would be constructed of soil-bentonite by either the conventional long-reach excavator or the deep mix method (DMM). After installation of the cutoff wall, the levee will be reconstructed to its original configuration. In addition to the cutoff wall, Alternative 3 would include relief wells for approximately, 8200 feet, approximately 11,150 feet of waterside slope flattening, approximately 5,100 feet of depression infill and approximately 1,500 feet of ditch lining. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction and seepage berm construction, relief well installation, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 3, including staging and construction easement areas, is 187.3 acres.

The crew size for Alternative 3 during the peak is estimated at 150-160 people working on three to four fronts, 10-hour shifts, 2 shifts per day for cutoff wall construction, and six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 28. For a listing of the anticipated material quantities associated with this alternative, see Table 29. The total number of anticipated trucks for materials delivery and off hauling is included in Table 30.

Table 28
Anticipated Equipment and Duration for Project C,
Alternative 3 – Optimized Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(4) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(2) Front-End Loaders	40 Days
	(4) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(2) Tractors with Discing Equipment	60 Days
	(2) Elevating Scrapers	60 Days
	(1) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (Lags 1. by 7 days)	(3) Excavators	35 Days
	(14) Scrapers	35 Days
	(5) Vibratory Rollers	35 Days
	(4) Water Trucks	35 Days
	(7) Haul Trucks	35 Days
4. Cutoff Wall Construction (Lags 3. by 7 days)	(8) Hydraulic Excavators	60 Days
	(4) Front-End Loaders	60 Days
	(2) DSM Auger	60 Days
	(1) Extended Boom Pallet Loader	60 Days
	(6) 300 kW Generators	60 Days
	(4) Slurry Pumps	60 Days
	(6) Pickup Trucks	60 Days
	(3) Haul Trucks	60 Days
	(2) Water Trucks	60 Days
5. Levee Reconstruction/ Seepage Berm Construction (Lags 4. by 22 days)	(10) Scrapers	130 Days
	(2) Motor Graders	130 Days
	(5) Tractors with Discing Equipment	130 Days
	(5) Vibratory Rollers	130 Days
	(3) Water Trucks	130 Days
6. Borrow Site Excavation (Concurrent with 5.)	(2) Front-End Loaders	130 Days
	(2) Water Trucks	130 Days
	(75) Haul Trucks	130 Days
7. Utility Reconstruction	(1) Hydraulic Excavator	130 Days
	(1) Haul Trucks	130 Days
	(2) Pickup Trucks	130 Days
	(1) Water Trucks	130 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
8. Levee Resurfacing (Follows 5.)	(2) Motor Graders	24 Days
	(2) Vibratory Rollers	24 Days
	(2) Haul Trucks	24 Days
	(1) Water Truck	24 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	24 Days
	(2) Pickup Trucks	24 Days
10. Demobilization/Cleanup (Follows 9.)	(1) Extended Boom Pallet Loader	20 Days
	(2) Haul Trucks	20 Days

Table 29
Anticipated Major Materials Quantities for Project C, Alternative 3 – Optimized Footprint Alternative

Description	Quantity
Clearing and Grubbing	187.3 Acres
Levee Embankment Degrade	882,800 Cubic Yards
SB Cutoff Wall	3,175,000 Square Feet
Levee Embankment Fill	1,410,000 Cubic Yards
Borrow Site Excavation	531,300 Cubic Yards
Unsuitable Material Export	253,100 Cubic Yards
Class 2 Aggregate Surfacing	40,600 Tons

Table 30
Number of Trucks for Materials Delivery and Off Hauling – Project C, Alternative 3

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
193	1,500	31	160	104

PROJECT D, REACHES 26 THROUGH 41

Project D begins at Levee Station 1674+37 and continues north Levee Station 2368+00. The total length of the levee in this portion of the FRWL project is 69,363 linear feet.

Three alternatives have been reviewed as part of the Feather River West Levee Pre-Design Formulation Report. Alternative 1 would include the flattening of the waterside levee slope, the construction of a cutoff wall along the centerline of the existing levee to a varying depth, and the infilling of depressions and ditches at the landside levee toe. Alternative 2 would include a combination of seepage and stability berms along the landside toe of the levee, relief wells along the landside toe of the levee and shallow cutoff walls along the centerline of the levee for

portions of the project. In addition, Alternative 2 will include the filling of the existing canal adjacent to the levee in Reaches 26, 27, and 28 with water. This will require the construction of regulating structures within the canal to maintain the water level within the canal. Alternative 3 is an optimized alternative, combining mitigation measures from both Alternative 1 and Alternative 2 to produce the most economically feasible project.

All three alternatives will require construction of a cutoff wall at the East Gridley Road crossing. A 70-foot deep soil-cement-bentonite cutoff wall constructed by either the Trench Remixing, Deep (TRD), jet grouting, or steel sheet pile method. All three methods have similar crew sizes and equipment impacts, which are summarized in the cutoff wall section of the estimated equipment and duration table below.

Alternative 1 would construct a cutoff wall ranging between 18 feet and 97 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded by approximately 50% of its overall height. The cutoff wall would be constructed of soil-bentonite by either the conventional, long-reach excavator or the deep mix method (DSM). After installation of the cutoff wall, the levee will be reconstructed to its original configuration, with some areas including the flattening of the landside slope. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 1, including staging and construction easement areas, is 145.4 acres.

The crew size for Alternative 1 during the peak is estimated at 150-160 people working on three fronts, 10-hour shifts, 2 shifts per day for cutoff wall construction, and six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 31. For a listing of the anticipated material quantities associated with this alternative, see Table 32. The total number of anticipated trucks for materials delivery and off hauling is included in Table 33.

Table 31
Anticipated Equipment and Duration for Project D,
Alternative 1 – Minimized Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(3) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(2) Front-End Loaders	40 Days
	(3) Pickup Trucks	40 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
2. Borrow Site Preparation (Concurrent with 1.)	(4) Tractors with Discing Equipment	60 Days
	(4) Elevating Scrapers	60 Days
	(2) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (Follows 1.)	(3) Excavators	25 Days
	(14) Scrapers	25 Days
	(5) Vibratory Rollers	25 Days
	(3) Water Trucks	25 Days
	(7) Haul Trucks	25 Days
4. Cutoff Wall Construction (Lags 3. by 14 days)	(6) Hydraulic Excavators	75 Days
	(3) Front-End Loaders	75 Days
	(2) DSM Auger	75 Days
	(1) Extended Boom Pallet Loader	75 Days
	(5) 300 kW Generators	75 Days
	(3) Slurry Pumps	75 Days
	(5) Pickup Trucks	75 Days
	(3) Haul Trucks	75 Days
	(2) Water Trucks	75 Days
5. Levee Reconstruction (Lags 4. by 22 days)	(10) Scrapers	90 Days
	(5) Motor Graders	90 Days
	(5) Tractors with Discing Equipment	90 Days
	(5) Vibratory Rollers	90 Days
	(3) Water Trucks	90 Days
6. Borrow Site Excavation (Concurrent with 5.)	(3) Front-End Loaders	90 Days
	(3) Water Trucks	90 Days
	(75) Haul Trucks	90 Days
7. Utility Reconstruction	(1) Hydraulic Excavator	130 Days
	(1) Haul Trucks	130 Days
	(2) Pickup Trucks	130 Days
	(1) Water Trucks	130 Days
8. Levee Resurfacing (Follows 5.)	(2) Motor Graders	24 Days
	(2) Vibratory Rollers	24 Days
	(2) Haul Trucks	24 Days
	(1) Water Truck	24 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	24 Days
	(2) Pickup Trucks	24 Days
10. Demobilization/Cleanup (Follows 9.)	(1) Extended Boom Pallet Loader	20 Days
	(2) Haul Trucks	20 Days

Table 32
Anticipated Major Materials Quantities for Project D, Alternative 1 – Minimized Footprint Alternative

Description	Quantity
Clearing and Grubbing	145.4 Acres
Levee Embankment Degrade	433,200 Cubic Yards
SB Cutoff Wall	3,239,100 Square Feet
Levee Embankment Fill	1,065,300 Cubic Yards
Borrow Site Excavation	330,100 Cubic Yards
Unsuitable Material Export	14,000 Cubic Yards
Class 2 Aggregate Surfacing	43,300 Tons

Table 33
Number of Trucks for Materials Delivery and Off Hauling – Project D, Alternative 1

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
197	1,500	44	275	76

Alternative 2 would construct an undrained seepage berm ranging between 50 feet and 300 feet in width along the landside toe of the levee. A 4- to 10-foot-tall stability berm would be constructed along approximately 38,600 feet of the project. Approximately 1,300 feet of the existing levee will need to be removed and reconstructed with a zoned filter at the base in combination with a seepage berm. Approximately 15,100 feet of canal will be infilled. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction, seepage and stability berm construction, borrow site excavation, utility relocation and reconstruction, roadway reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 2, including staging and construction easement areas, is 241.1 acres.

The crew size for Alternative 2 during the peak is estimated at 150-160 people working one 10-hour shift, six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 34. For a listing of the anticipated material quantities associated with this alternative, see Table 35. The total number of anticipated trucks for materials delivery and off hauling is included in Table 36.

Table 34
Anticipated Equipment and Duration for Project D,
Alternative 2 – Expanded Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(5) Elevating Scrapers	40 Days
	(3) Water Trucks	40 Days
	(3) Front-End Loaders	40 Days
	(5) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(4) Tractors with Discing Equipment	60 Days
	(4) Elevating Scrapers	60 Days
	(2) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (N/A	No Task	No Task
4. Cutoff Wall Construction (N/A)	No Task	No Task
5. Levee Reconstruction/ Seepage and Stability Berm Construction (Follows 2.)	(10) Scrapers	185 Days
	(2) Motor Graders	185 Days
	(2) Tractors with Discing Equipment	185 Days
	(5) Vibratory Rollers	185 Days
	(3) Water Trucks	185 Days
6. Borrow Site Excavation (Concurrent with 5.)	(2) Front-End Loaders	185 Days
	(2) Water Trucks	185 Days
	(75) Haul Trucks	185 Days
7. Utility Reconstruction	(1) Hydraulic Excavator	130 Days
	(1) Haul Trucks	130 Days
	(2) Pickup Trucks	130 Days
	(1) Water Trucks	130 Days
8. Levee Resurfacing (Follows 6.)	(2) Motor Graders	24 Days
	(2) Vibratory Rollers	24 Days
	(2) Haul Trucks	24 Days
	(1) Water Truck	24 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	24 Days
	(2) Pickup Trucks	24 Days
10. Demobilization/Cleanup (Follows 9.)	(1) Extended Boom Pallet Loader	15 Days
	(2) Haul Trucks	15 Days

Table 35
Anticipated Major Materials Quantities for Project D, Alternative 2 – Expanded Footprint Alternative

Description	Quantity
Clearing and Grubbing	241.1Acres
Levee Embankment Degrade	0 Cubic Yards
SB Cutoff Wall	0 Square Feet
Levee Embankment Fill	1,363,700 Cubic Yards
Borrow Site Excavation	601,500 Cubic Yards
Unsuitable Material Export	29,000 Cubic Yards
Class 2 Aggregate Surfacing	43,300 Tons

Table 36
Number of Trucks for Materials Delivery and Off Hauling – Project D, Alternative 2

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
89	1,500	44	275	76

Alternative 3 would construct a cutoff wall ranging between 18 feet and 97 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee will be degraded by approximately 50% of its overall height. The cutoff wall would be constructed of soil-bentonite by either the conventional, long-reach excavator or the deep mix method (DSM). After installation of the cutoff wall, the levee will be reconstructed to its original configuration except in those locations where the levee slopes will be flattened. Approximately 1,300 feet of levee would be degraded and reconstructed with a 5 to 1 slope (horizontal to vertical). Approximately 9,500 feet of the landside levee slope will be flattened where the existing canal is adjacent to the levee. Work for this alternative is to include levee stripping, clearing and grubbing, borrow site preparation, levee degrading, cutoff wall installation, levee reconstruction, borrow site excavation, utility relocation and reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 3, including staging and construction easement areas, is 145.4 acres.

The crew size for Alternative 3 during the peak is estimated at 150-160 people working on three fronts, 10-hour shifts, 2 shifts per day cutoff wall construction only, and six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 37. For a listing of the anticipated material quantities associated with this alternative, see Table 38. The total number of anticipated trucks for materials delivery and off hauling is included in Table 39.

Table 37
Anticipated Equipment and Duration for Project D,
Alternative 3 – Optimized Footprint Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(3) Elevating Scrapers	40 Days
	(2) Water Trucks	40 Days
	(2) Front-End Loaders	40 Days
	(3) Pickup Trucks	40 Days
2. Borrow Site Preparation (Concurrent with 1.)	(4) Tractors with Discing Equipment	60 Days
	(4) Elevating Scrapers	60 Days
	(2) Water Truck	60 Days
3. Levee Degrading/ Work Surface Construction (Follows 1.)	(3) Excavators	25 Days
	(14) Scrapers	25 Days
	(5) Vibratory Rollers	25 Days
	(3) Water Trucks	25 Days
	(7) Haul Trucks	25 Days
4. Cutoff Wall Construction (Lags 3. by 14 days)	(6) Hydraulic Excavators	75 Days
	(3) Front-End Loaders	75 Days
	(2) DSM Auger	75 Days
	(1) Extended Boom Pallet Loader	75 Days
	(5) 300 kW Generators	75 Days
	(3) Slurry Pumps	75 Days
	(5) Pickup Trucks	75 Days
	(3) Haul Trucks	75 Days
	(2) Water Trucks	75 Days
5. Levee Reconstruction (Lags 4. by 22 days)	(10) Scrapers	90 Days
	(5) Motor Graders	90 Days
	(5) Tractors with Discing Equipment	90 Days
	(5) Vibratory Rollers	90 Days
	(3) Water Trucks	90 Days
6. Borrow Site Excavation (Concurrent with 5.)	(3) Front-End Loaders	90 Days
	(3) Water Trucks	90 Days
	(75) Haul Trucks	90 Days
7. Utility Reconstruction	(1) Hydraulic Excavator	130 Days
	(1) Haul Trucks	130 Days
	(2) Pickup Trucks	130 Days
	(1) Water Trucks	130 Days

Construction Phase	Number of Each Equipment Type	Duration of Use
8. Levee Resurfacing (Follows 5.)	(2) Motor Graders	24 Days
	(2) Vibratory Rollers	24 Days
	(2) Haul Trucks	24 Days
	(1) Water Truck	24 Days
9. Hydroseeding (Concurrent with 8.)	(2) Hydroseeding Trucks	24 Days
	(2) Pickup Trucks	24 Days
10. Demobilization/Cleanup (Follows 9.)	(1) Extended Boom Pallet Loader	20 Days
	(2) Haul Trucks	20 Days

Table 38
Anticipated Major Materials Quantities for Project D, Alternative 3 – Optimized Footprint Alternative

Description	Quantity
Clearing and Grubbing	145.4 Acres
Levee Embankment Degrade	433,200 Cubic Yards
SB Cutoff Wall	3,239,100 Square Feet
Levee Embankment Fill	1,065,300 Cubic Yards
Borrow Site Excavation	330,100 Cubic Yards
Unsuitable Material Export	14,000 Cubic Yards
Class 2 Aggregate Surfacing	43,300 Tons

Table 39
Number of Trucks for Materials Delivery and Off Hauling – Project D Alternative 3

Bentonite	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
197	1,500	44	275	76

CUTOFF WALL GAP CLOSURES AND SPECIAL CROSSINGS

Three reaches of the Feather River West Levee, Reaches 14, 15, and 16, have had cutoff walls constructed along the approximate levee centerline. However, the projects skipped two major bridge crossings, the 5th Street bridge at Station 1007+00 and State Highway 20 bridge at Station 1025+20, creating gaps in the cutoff wall. In addition, there are two other crossings that require special consideration for the cutoff wall construction, the Union Pacific Railroad (UPRR) crossing at Station 1131+00 and the East Gridley Road at Station 1902+00.

As part of the technical memorandum titled "SBFCA, Fether River West Levee Rehabilitation Project, Alternatives Cost Analysis for Cutoff Walls at 5th Street, State Highway 20, UPRR, and

East Gridley Road," three alternatives have been reviewed for these locations. Alternative 1 would construct an SCB cutoff wall by the Trench Remixing, Deep (TRD) Method. Alternative 2 would construct a cutoff wall by jet grouting using a mixture of cement and bentonite. Alternative 3 would construct a cutoff wall utilizing sheet piling.

Alternative 1 would construct a cutoff wall ranging between 40 feet and 70 feet in depth along the centerline of the levee. To facilitate construction of the cutoff wall, the levee would be degraded to create an adequate working platform for the TRD machine. Additionally, the existing roadways and railroad tracks would be removed and the existing bases would be graded to provide a working platform. The cutoff wall would be constructed of soil-cement-bentonite utilizing the TRD machine. After installation of the cutoff wall, the existing levee, roadway, and railroad tracks would be reconstructed to their original configuration. Work for this alternative is to include levee stripping, clearing and grubbing, roadway demolition, railroad track removal, levee degrading, cutoff wall installation, levee reconstruction, roadway reconstruction, railroad track replacement, utility reconstruction, levee resurfacing, hydroseeding, and demobilization and clean-up.

The total disturbed area for Alternative 1, including staging and construction easement areas, is 1.1 acres.

The crew size for Alternative 1 during the peak is estimated at 25-30 people working on one front, 12-hour shift, 1 shift per day, and six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 40. For a listing of the anticipated material quantities associated with this alternative, see Table 41. The total number of anticipated trucks for materials delivery and off hauling is included in Table 42.

Table 40
Anticipated Equipment and Duration for Cutoff Wall Gap Closures and Special Crossings, Alternative 1 – SCB Cutoff Wall by TRD Method Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Clearing and Grubbing/ Stripping	(2) Elevating Scrapers	4 Days
	(1) Water Trucks	4 Days
	(1) Front-End Loaders	4 Days
	(4) Haul Trucks	4 Days
	(2) Pickup Trucks	4 Days
2. Borrow Site Preparation (Concurrent with 1.)	(1) Tractors with Discing Equipment	1 Day
	(1) Elevating Scrapers	1 Day
	(1) Water Truck	1 Day

Construction Phase	Number of Each Equipment Type	Duration of Use
3. Levee Degrading/ Work Surface Construction (Lags 1. by 1 day)	(1) Excavators	4 Days
	(1) Scrapers	4 Days
	(2) Vibratory Rollers	4 Days
	(1) Water Trucks	4 Days
	(4) Haul Trucks	4 Days
4. Cutoff Wall Construction (Lags 3. by 1 day)	(1) Front-End Loaders	15 Days
	(1) TRD Machine	15 Days
	(1) Extended Boom Pallet Loader	15 Days
	(1) 300 kW Generators	15 Days
	(2) Pickup Trucks	15 Days
	(2) Haul Trucks	15 Days
	(1) Water Trucks	15 Days
5. Levee Reconstruction (Lags 4. by 25 days)	(1) Scrapers	15 Days
	(2) Motor Graders	15 Days
	(2) Vibratory Rollers	15 Days
	(1) Water Trucks	15 Days
6. Borrow Site Excavation (Concurrent with 5.)	(1) Scrapers	4 Days
	(1) Front-End Loaders	4 Days
	(1) Water Trucks	4 Days
	(4) Haul Trucks	4 Days
7. Utility Reconstruction	(2) Backhoes	10 Days
	(2) Front End Loaders	10 Days
	(2) Rubber Tire Crane	10 Days
	(3) Pickup trucks	10 Days
	(1) Water Trucks	10 Days
8. Levee Resurfacing (Follows 5.)	(2) Motor Graders	15 Days
	(2) Vibratory Rollers	15 Days
	(2) Haul Trucks	15 Days
	(1) Water Truck	15 Days
9. Hydroseeding (Follows 8.)	(1) Hydroseeding Trucks	1 Day
10. Demobilization/Cleanup (Follows 9.)	(1) Extended Boom Pallet Loader	1 Day
	(2) Haul Trucks	1 Day

Table 41
Anticipated Major Materials Quantities for
Cutoff Wall Gap Closures and Special Crossings,
Alternative 1 – SCB Cutoff Wall by TRD Method Alternative

Description	Quantity
Clearing and Grubbing	1.1 Acres
Levee Embankment Degrade	7,420 Cubic Yards
SB Cutoff Wall	58,140 Square Feet
Levee Embankment Fill	8,900 Cubic Yards
Borrow Site Excavation	1,490 Cubic Yards
Class 2 Aggregate Base	210 Tons
Asphalt Concrete Paving	50 Tons

Table 42
Number of Trucks for Materials Delivery and Off Hauling
Cutoff Wall Gap Closures and Special Crossings Alternative 1

Bentonite	Asphalt Concrete	Aggregate Surfacing	Pipe Material	Demolition Debris	CLSM Backfill
4	3	10	3	10	3

Alternative 2 would construct a cutoff wall ranging between 40 feet and 85 feet in depth along the centerline of the levee by jet grouting. A trench would be excavated to handle grouting spoils brought to the surface during the operation requiring removal of the existing roadway surfaces. The cutoff wall would be constructed using a mixture of cement and bentonite. After installation of the cutoff wall, the spoils trench would be backfilled and the existing roadway surface reconstructed. Work for this alternative is to include roadway demolition, trenching, cutoff wall installation, trench backfilling and compacting, roadway reconstruction, levee resurfacing, and demobilization and clean-up.

The total disturbed area for Alternative 2, including staging and construction easement areas, is 1.0 acres.

The crew size for Alternative 2 during the peak is estimated at 10-15 people working on one front, 12-hour shift, 1 shift per day, and six days a week. For a listing of the anticipated equipment and construction durations for this work, see Table 43. For a listing of the anticipated material quantities associated with this alternative, see Table 44. The total number of anticipated trucks for materials delivery and off hauling is included in Table 45.

Table 43
Anticipated Equipment and Duration for Cutoff Wall Gap Closures and Special Crossings, Alternative 2 – Jet Grouting Method Alternative

Construction Phase	Number of Each Equipment Type	Duration of Use
1. Roadway Demolition/ Levee Trenching	(1) Excavator	4 Days
	(1) Water Trucks	4 Days
	(2) Haul Trucks	4 Days
	(2) Pickup Trucks	4 Days
2. Cutoff Wall Construction (Lags 1. by 1 day)	(1) Front-End Loaders	50 Days
	(1) Jet Grouting Machine	50 Days
	(1) Extended Boom Pallet Loader	50 Days
	(1) 300 kW Generators	50 Days
	(2) Pickup Trucks	50 Days
	(2) Haul Trucks	50 Days
	(1) Water Trucks	50 Days
3. Levee Reconstruction (Lags 2. by 5 days)	(1) Excavator	4 Days
	(1) Pickup Truck	4 Days
	(1) Water Trucks	4 Days
4. Levee Resurfacing (Follows 3.)	(1) Vibratory Roller	4 Days
	(1) Water Trucks	4 Days
	(2) Haul Trucks	4 Days
5. Demobilization/Cleanup (Follows 4.)	(1) Extended Boom Pallet Loader	1 Day
	(2) Haul Trucks	1 Day

Table 44
Anticipated Major Materials Quantities for Cutoff Wall Gap Closures and Special Crossings, Alternative 1 – SCB Cutoff Wall by TRD Method Alternative

Description	Quantity
Levee Trenching	1,140 Feet
Jet Grout Cutoff Wall	65,320 Square Feet
Trench Backfill	460 Cubic Yards
Class 2 Aggregate Base	170 Tons
Asphalt Concrete Paving	20 Tons

Table 45
Number of Trucks for Materials Delivery and Off Hauling
Cutoff Wall Gap Closures and Special Crossings Alternative 2

Bentonite	Asphalt Concrete	Aggregate Surfacing
4	1	1

Alternative 1 Equipment Assumptions

Equipment	Project A										Project B										Project C										Project D									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Aerial Lifts																																								
Air Compressors																																								
Bore/Drill Rigs				1										1										2										2						
Cement and Mortar Mixers				2										2										4										3						
Concrete/Industrial Saws																																								
Cranes							2										2																							
Crawler Tractors																																								
Crushing/Proc. Equipment																																								
Excavators			3	4		2							3	4		2							3	8			1						3	6			1			
Forklifts																																								
Generator Sets				3										4										6										5						
Graders					2			4							2			2							2			2							5			2		
Off-Highway Tractors		2										2										2			5							4			5					
Off-Highway Trucks									2										2										2										2	
Other Construction Equipment				1																																				
Other General Industrial Equipment																																								
Other Material Handling Equipment																																								
Pavers																																								
Paving Equipment																																								
Plate Compactors																																								
Pressure Washers																																								
Pumps																																								
Rollers			5		5			2					5		5			2					5		4			2					5		5			2		
Rough Terrain Forklifts										1				1						1				1						1				1						1
Rubber Tired Dozers																																								
Rubber Tired Loaders	4			2	0	2	2				4			2		2	2				2			4		2					2			3		3				
Scrapers	8	2	15		20						8	2	15		20						4	2	14		10						3	4	14		10					
Signal Boards																																								
Skid Steer Loaders																																								
Surfacing Equipment																																								
Sweepers/Scrubbers																																								
Tractors/Loaders/Backhoes							2										2																							
Trenchers																																								
Welders																																								
Water Trucks	2	1	3	2	3	2	2	1	0	0	2	1	3	2	3	2	2	1	0	0	2	1	4	2	3	2	1	1	0	0	2	2	3	2	3	3	1	1	0	0

Workers (trips/day)	**A**	**B**	**C**	**D**	**P?**
Number	79.2	75.9	102.3	102.3	All
Distance (mi)	30	30	30	30	All

						Per Year				Per Day (yr 1)				Per Day (yr 2)			
Trucks (trips/2 years)	**A**	**B**	**C**	**D**	**P?**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Unsuitable Soil Disposal	2625	43354	21083	1166.7	1, 3	1312.5	21677	10542	583.33	33	361	264	17	33	361	301	19
Bentonite	89	119	191	197	4	44.5	59.5	95.5	98.5	1.3	1.2	2.7	2.2	1.8	1.7	3.8	3.3
Aggregate Surfacing	425	400	1500	1500	8	212.5	200	750	750	18	20	63	63	21	25	63	63
Pipe Material	8	17	31	44	5	4	8.5	15.5	22	0.1	0.2	0.2	0.5	0.2	0.2	0.2	0.5
Demolition Debirs	60	36	160	275	10	30	18	80	137.5	3	3	8	14	3	2	8	14
CLSM Backfill	26	36	104	76	5	13	18	52	38	0.4	0.5	1	1	1	0.5	1	1
Borrow Fill	20333	66396	44250	27500	6	10167	33198	22125	13750	290	830	340	306	407	830	340	306
Distance (mi)	7	7	7	7													

Grading	**A**	**B**	**C**	**D**
Acres (2 years)	84	94	187	145
Acres (1 year)	42	47	94	73
Acres (1 year Clearing Phase)	35	40	80	62
Acres (1 year Clearing Phase/day)	2	2	4	3

Acres (1 year Borrow Ex Phase)	6	7	14	11
Acres (1 year Borrow Ex Phase/day)	0.2	0.2	0.2	0.2

Alternative 2 Equipment Assumptions

Equipment	Project A										Project B											Project C										Project D									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	Road	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Aerial Lifts																																										
Air Compressors																																										
Bore/Drill Rigs				1																					1																	
Cement and Mortar Mixers				1										2											2																	
Concrete/Industrial Saws																																										
Cranes							2																																			
Crawler Tractors																																										
Crushing/Proc. Equipment																																										
Excavators			1	2	2	4							1	4		2	2							3	4			1											1			
Forklifts																																										
Generator Sets				2										2											3																	
Graders					5										5			2								5			4							5						
Off-Highway Tractors		4										4											4			5							4			2						
Off-Highway Trucks									2											2										2											2	
Other Construction Equipment				1																																						
Other General Industrial Equipment																																										
Other Material Handling Equipment																																										
Pavers																																										
Paving Equipment																		1																								
Plate Compactors																																										
Pressure Washers																																										
Pumps																																										
Rollers			2		5								2		5			2						5		5			4						5						
Rough Terrain Forklifts										1				1							1				1						1										1
Rubber Tired Dozers											4																															
Rubber Tired Loaders	4	0		1		4	2							1		4	2					7			2		4					3					2				
Scrapers	8	4	2		25						8	4	2		25							13	4	14		10						5	4			10					
Signal Boards																																										
Skid Steer Loaders																																										
Surfacing Equipment																																										
Sweepers/Scrubbers																																										
Tractors/Loaders/Backhoes							2										2																								
Trenchers																																										
Welders																																										
Water Trucks	2	2	2	1	4	4	2		0	0	2	2	1	1	4	4	2	1		0	0	7	2	4	1	3	4	1	2	0	0	3	2			3	2	1		0	0

Workers (trips/day)	**A**	**B**	**C**	**D**	**P?**
Number	132	128.7	135.3	102.3	All
Distance (mi)	30	30	30	30	All

Trucks (trips/2 years)	**A**	**B**	**C**	**D**	**P?**	Per Year **A**	**B**	**C**	**D**	Per Day (yr 1) **A**	**B**	**C**	**D**	Per Day (yr 2) **A**	**B**	**C**	**D**	
Unsuitable Soil Disposal	6.25	1833.3	26908	2416.7	1, 3	3	917	13454	1208	0.1	29	673	60	0	31	448	60	
Bentonite	1	31	28	197	4	0	16	14	0		0.5	0.9			0.8	1.4		
Aggregate Surfacing	50	225	1200	1500	8	0	113	600	0		6	50			6	50		Assigned to roadway
Pipe Material	8	17	31	44	5	4	9	16	22	0.0	0.1	0.1	0.2	0.0	0.2	0.2	0.2	
Demolition Debirs	60	36	160	275	10	30	18	80	138	3	2	8	14	3	2	8	14	
CLSM Backfill	26	36	104	76	5	13	18	52	38	0.1	0.2	0.5	0.4	0.1	0.3	1	0.4	
Borrow Fill	135667	194542	223433	50125	6	67833.3	97270.8	111717	25062.5	754	1057	1016	269	848	1769	1596	272	
Distance (mi)	7	7	7	7														

Grading	**A**	**B**	**C**	**D**
Acres (2 years)	183.1	272.3	344.9	241.1
Acres (1 year)	91.55	136.15	172.45	120.55
Acres (1 year Clearing Phase)	78	116	147	102
Acres (1 year Clearing Phase/day)	4	6	15	5

Acres (1 year Borrow Ex Phase)	14	20	26	18
Acres (1 year Borrow Ex Phase/day)	0.2	0.2	0.2	0.2

Alternative 3 Equipment Assumptions

Equipment	Project A										Project B										Project C										Project D									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Aerial Lifts																																								
Air Compressors																																								
Bore/Drill Rigs				1										2										2										2						
Cement and Mortar Mixers				2										2										4										3						
Concrete/Industrial Saws																																								
Cranes							2										2																							
Crawler Tractors																																								
Crushing/Proc. Equipment																																								
Excavators			3	5		2							3	4		2							3	8			1						3	6			1			
Forklifts																																								
Generator Sets				4										4										6										5						
Graders					2			2							2			2							2			2							5			2		
Off-Highway Tractors		2										2										2			5							4			5					
Off-Highway Trucks									2										2										2										2	
Other Construction Equipment				0																																				
Other General Industrial Equipment																																								
Other Material Handling Equipment																																								
Pavers																																								
Paving Equipment																																								
Plate Compactors																																								
Pressure Washers																																								
Pumps																																								
Rollers			5		5			2					5		5			2					5		5			2					5		5			2		
Rough Terrain Forklifts				1						1				1						1				1						1				1						1
Rubber Tired Dozers											4																													
Rubber Tired Loaders	4			2		2	2							2		2	2				2			4		2					2			3		3				
Scrapers	8	2	15		20						8	2	15		20						4	2	14		10	0					3	4	14		10					
Signal Boards																																								
Skid Steer Loaders																																								
Surfacing Equipment																																								
Sweepers/Scrubbers																																								
Tractors/Loaders/Backhoes							2										2																							
Trenchers																																								
Welders																																								
Water Trucks	2	1	3	2	3	2	2	1	0	0	2	1	3	2	3	2	2	1	0	0	2	1	4	2	3	2	1	1	0	0	2	2	3	2	3	3	1	1	0	0

Workers (trips/day)	**A**	**B**	**C**	**D**	**P?**
Number	79.2	75.9	102.3	102.3	All
Distance (mi)	30	30	30	30	All

		Per Year				Per Day (yr 1)				Per Day (yr 2)			
Trucks (trips/2 years)	**P?**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Unsuitable Soil Disposal	1, 3	1072.9	21677	10546	583.33	15	482	264	29	15	542	301	29
Bentonite	4	39	59.5	96.5	98.5	1	1	3	2	2	2	4	4
Aggregate Surfacing	8	175	200	750	750	15	17	63	63	15	20	63	63
Pipe Material	5	4	8.5	15.5	22	0.1	0.2	0.2	0.4	0.2	0.2	0.2	0.4
Demolition Debirs	10	30	18	80	137.5	2	2	8	14	2	2	8	14
CLSM Backfill	5	13	18	52	38	0.4	0.4	1	1	1	0.5	1	1
Borrow Fill	6	11510	33198	22138	13754	460	604	341	229	460	830	341	229
Distance (mi)		7	7	7	7								

Grading	**A**	**B**	**C**	**D**
Acres (2 years)	87.2	94.1	187.3	145.4
Acres (1 year)	43.6	47.05	93.65	72.7
Acres (1 year Clearing Phase)	37	40	80	62
Acres (1 year Clearing Phase/day)	2	2	4	6

Acres (1 year Borrow Ex Phase)	7	7	14	11
Acres (1 year Borrow Ex Phase/day)	0.3	0.1	0.2	0.2

Alternative 1 Construction Schedule and Daily Output

Construction Phase	Project A																											
	2014														2015													
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5			
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2014	6/4/2014	20	0.9	14.8	71.9	192.1	27.4	7.4	20.0	10.9	6.7	4.2	17314.0	5/15/2015	6/4/2015	20	0.9	14.57	71.67	186.8	27.2	7.211	20.0	10.7	6.577	4.2	17290
2. Borrow Site Preparation	5/15/2014	6/14/2014	30	1.4	6.3	46.4	50.8	2.5	2.5	0.0	2.1	2.1	0.0	8940.3	5/15/2015	6/14/2015	30	1.4	5.934	43.34	48.99	2.46	2.46	0	2.017	2.017	0	8939.98
3. Levee Degrading/ Work Surface Construction	6/12/2014	7/2/2014	20	0.9	26.7	126.2	330.7	13.9	13.9	0.0	12.7	12.7	0.0	29072.8	6/12/2015	7/2/2015	20	0.9	26.27	126	321.9	13.54	13.54	0	12.4	12.4	0	29045.5
4. Cutoff Wall Construction	7/14/2014	8/18/2014	35	1.6	6.0	34.7	63.6	3.1	3.1	0.0	2.9	2.9	0.0	6914.7	7/14/2015	8/8/2015	25	1.1	5.804	34.57	61.09	2.972	2.972	0	2.73	2.73	0	6938.25
5. Levee Reconstruction/ Seepage Berm Construction	8/13/2014	9/17/2014	35	1.6	35.0	159.8	422.7	18.0	18.0	0.0	16.5	16.5	0.0	35040.6	8/13/2015	9/7/2015	25	1.1	34.53	159.8	413.3	17.59	17.59	0	16.18	16.18	0	35065.2
6. Borrow Site Excavation	8/13/2014	9/17/2014	35	1.6	4.5	23.1	117.7	5.2	3.2	2.0	2.9	2.5	0.4	17846.0	8/13/2015	9/7/2015	25	1.1	5.05	25.48	141.8	5.8	3.774	2	3.2	2.787	0.4	23792.5
7. Utility Reconstruction	7/14/2014	9/17/2014	65	3.0	5.3	42.2	37.9	1.9	1.9	0.0	1.5	1.5	0.0	7961.5	7/14/2015	9/17/2015	65	3.0	5.491	39.16	40.91	2.308	2.308	0	1.876	1.876	0	7962.9
8. Levee Resurfacing	10/1/2014	10/13/2014	12	0.5	5.4	17.7	56.6	3.1	3.1	0.0	2.8	2.8	0.0	4225.8	9/17/2015	9/27/2015	10	0.5	5.37	17.69	56.39	3.091	3.091	0	2.807	2.807	0	4370.57
9. Hydroseeding	10/1/2014	10/13/2014	12	0.5	4.6	35.3	28.1	1.5	1.5	0.0	1.1	1.1	0.0	7548.1	9/17/2015	9/23/2015	6	0.3	4.268	32.33	26.93	1.427	1.427	0	1.067	1.067	0	7550.13
10. Demobilization/Cleanup	10/17/2014	10/27/2014	10	0.5	0.3	2.1	4.1	0.2	0.2	0.0	0.2	0.2	0.0	531.0	9/25/2015	10/5/2015	10	0.5	0.274	2.127	3.915	0.197	0.197	0	0.176	0.176	0	529.348

Construction Phase	Project B																											
	2014														2015													
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5			
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2014	6/4/2014	20	0.9	17.7	84.7	297.6	29.9	9.9	20.0	12.7	8.5	4.2	34654.3	5/15/2015	6/4/2015	20	0.9	17.06	82.67	282	29.5	9.482	20.0	12.3	8.115	4.2	34441.3
2. Borrow Site Preparation	5/15/2014	6/14/2014	30	1.4	6.2	45.2	50.7	2.5	2.5	0.0	2.1	2.1	0.0	8744.1	5/15/2015	6/14/2015	30	1.4	5.847	42.35	48.89	2.439	2.439	0	2.008	2.008	0	8743.77
3. Levee Degrading/ Work Surface Construction	6/12/2014	7/22/2014	40	1.8	29.6	139.0	436.2	16.4	16.4	0.0	14.5	14.5	0.0	46413.1	6/12/2015	7/22/2015	40	1.8	28.75	137	417.1	15.81	15.81	0	13.94	13.94	0	46196.7
4. Cutoff Wall Construction	7/14/2014	9/2/2014	50	2.3	6.2	36.1	63.2	3.2	3.2	0.0	3.0	3.0	0.0	7114.7	7/14/2015	8/18/2015	35	1.6	5.879	35.99	60.36	3.034	3.034	0	2.787	2.787	0	7138.32
5. Levee Reconstruction/ Seepage Berm Construction	8/13/2014	9/22/2014	40	1.8	35.0	159.9	422.8	18.0	18.0	0.0	16.5	16.5	0.0	35051.2	8/13/2015	9/22/2015	40	1.8	34.52	159.8	413.2	17.59	17.59	0	16.18	16.18	0	35039.1
6. Borrow Site Excavation	8/13/2014	9/22/2014	40	1.8	9.3	44.2	291.4	9.4	7.4	2.0	5.9	5.4	0.4	46376.7	8/13/2015	9/22/2015	40	1.8	8.253	39.66	264.5	6.7	6.7	2	5.2	4.769	0.4	45897.9
7. Utility Reconstruction	7/14/2014	9/17/2014	65	3.0	5.2	41.0	37.8	1.9	1.9	0.0	1.5	1.5	0.0	7765.4	7/14/2015	9/17/2015	65	3.0	5.403	38.17	40.8	2.287	2.287	0	1.867	1.867	0	7766.69
8. Levee Resurfacing	10/8/2014	10/18/2014	10	0.5	3.2	10.8	35.3	1.9	1.9	0.0	1.7	1.7	0.0	2986.8	10/8/2015	10/16/2015	8	0.4	3.177	10.85	35.81	1.896	1.896	0	1.702	1.702	0	3235.66
9. Hydroseeding	10/8/2014	10/18/2014	10	0.5	4.5	34.2	28.0	1.4	1.4	0.0	1.1	1.1	0.0	7352.0	10/8/2015	10/16/2015	8	0.4	4.181	31.34	26.83	1.406	1.406	0	1.059	1.059	0	7353.92
10. Demobilization/Cleanup	10/22/2014	10/28/2014	6	0.3	0.4	2.6	7.7	0.3	0.3	0.0	0.2	0.2	0.0	1112.2	10/20/2015	10/28/2015	8	0.4	0.357	2.495	7.105	0.273	0.273	0	0.228	0.228	0	1104.19

Construction Phase	Project C																											
	2013														2014													
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5			
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2013	6/4/2013	20	0.9	10.8	49.8	187.3	46.6	6.6	40.0	13.9	5.6	8.3	21795.4	5/15/2014	6/4/2014	20	0.9	9.894	47.04	187.7	45.91	5.915	40	13.25	4.934	8.32	23720.1
2. Borrow Site Preparation	5/15/2013	6/14/2013	30	1.4	7.5	58.5	54.7	2.8	2.8	0.0	2.3	2.3	0.0	10312.1	5/15/2014	6/14/2014	30	1.4	6.936	54.15	51.67	2.677	2.677	0	2.145	2.145	0	10313.3
3. Levee Degrading/ Work Surface Construction	5/24/2013	6/13/2013	20	0.9	29.2	132.2	408.0	16.4	16.4	0.0	14.6	14.6	0.0	39738.9	5/26/2014	6/10/2014	15	0.7	27.5	129.4	397.9	15.19	15.19	0	13.47	13.47	0	41659.8
4. Cutoff Wall Construction	6/4/2013	7/9/2013	35	1.6	11.7	64.4	123.1	6.2	6.2	0.0	5.7	5.7	0.0	12857.2	6/4/2014	6/29/2014	25	1.1	10.84	64.14	114.5	5.611	5.611	0	5.154	5.154	0	12903.8
5. Levee Reconstruction/ Seepage Berm Construction	7/4/2013	9/7/2013	65	3.0	36.3	160.0	441.8	18.8	18.8	0.0	17.3	17.3	0.0	35086.4	7/3/2014	9/6/2014	65	3.0	34.99	159.9	422.9	17.97	17.97	0	16.53	16.53	0	35077.6
6. Borrow Site Excavation	7/4/2013	9/7/2013	65	3.0	5.3	25.0	133.7	6.1	4.1	2.0	3.2	3.2	0.4	19379.3	7/3/2014	9/6/2014	65	3.0	5.344	24.95	133.7	6.146	4.146	2	3.658	3.242	0.416	19379.3
7. Utility Reconstruction	6/25/2013	8/29/2013	65	3.0	3.9	41.7	10.0	0.9	0.9	0.0	0.5	0.5	0.0	6678.1	6/25/2014	8/29/2014	65	3.0	3.467	37.33	8.989	0.897	0.897	0	0.507	0.507	0	6679.53
8. Levee Resurfacing	10/3/2013	10/15/2013	12	0.5	3.9	13.5	51.6	2.5	2.5	0.0	2.2	2.2	0.0	5267.2	10/2/2014	10/14/2014	12	0.5	3.562	12.47	49.12	2.229	2.229	0	1.944	1.944	0	5258.74
9. Hydroseeding	10/3/2013	10/15/2013	12	0.5	5.7	47.4	31.5	1.7	1.7	0.0	1.3	1.3	0.0	8918.8	10/2/2014	10/14/2014	12	0.5	5.234	43.12	28.97	1.609	1.609	0	1.163	1.163	0	8921.11
10. Demobilization/Cleanup	10/21/2013	10/31/2013	10	0.5	0.4	2.5	6.3	0.3	0.3	0.0	0.3	0.3	0.0	796.1	10/20/2014	10/30/2014	10	0.5	0.331	2.337	5.75	0.248	0.248	0	0.215	0.215	0	795.193

Construction Phase	Project D																											
	2013														2014													
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5			
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2013	6/4/2013	20	0.9	6.1	29.0	81.0	33.1	3.1	30.0	9.1	2.8	6.2	7108.7	5/15/2014	6/4/2014	20	0.9	5.879	28.8	77.9	32.95	2.949	30	8.92	2.68	6.24	7211.14
2. Borrow Site Preparation	5/15/2013	6/14/2013	30	1.4	11.6	78.1	105.1	5.0	5.0	0.0	4.2	4.2	0.0	14545.3	5/15/2014	6/14/2014	30	1.4	10.86	73.77	99.6	4.711	4.711	0	4.016	4.016	0	14546.2
3. Levee Degrading/ Work Surface Construction	6/12/2013	6/27/2013	15	0.7	26.1	118.6	321.6	13.7	13.7	0.0	12.6	12.6	0.0	26635.7	6/12/2014	6/22/2014	10	0.5	25.02	118.4	307.1	13	13	0	11.92	11.92	0	26734

4. Cutoff Wall Construction	7/2/2013	8/16/2013	45	2.0	9.4	52.3	99.4	5.0	5.0	0.0	4.6	4.6	0.0	10477.3	7/2/2014	8/1/2014	30	1.4	8.717	52.05	92.28	4.52	4.52	0	4.151	4.151	0	10524.1
5. Levee Reconstruction/ Seepage Berm Construction	8/1/2013	9/15/2013	45	2.0	25.9	110.5	300.4	13.9	13.9	0.0	12.8	12.8	0.0	23488.8	7/31/2014	9/14/2014	45	2.0	25.03	110.4	287.9	13.3	13.3	0	12.23	12.23	0	23482.2
6. Borrow Site Excavation	8/1/2013	9/15/2013	45	2.0	5.5	26.2	129.3	6.0	4.0	2.0	3.2	3.2	0.4	18268.7	7/31/2014	9/14/2014	45	2.0	4.324	21.32	119.9	5.104	3.104	2	2.756	2.34	0.416	18235
7. Utility Reconstruction	7/13/2013	9/16/2013	65	3.0	3.9	41.7	10.0	0.9	0.9	0.0	0.5	0.5	0.0	6678.1	7/14/2014	9/17/2014	65	3.0	3.467	37.33	8.989	0.897	0.897	0	0.507	0.507	0	6679.53
8. Levee Resurfacing	10/3/2013	10/15/2013	12	0.5	3.9	13.5	51.6	2.5	2.5	0.0	2.2	2.2	0.0	5267.2	10/2/2014	10/14/2014	12	0.5	3.467	37.33	8.989	0.897	0.897	0	0.507	0.507	0	6679.53
9. Hydroseeding	10/3/2013	10/15/2013	12	0.5	5.7	47.4	31.5	1.7	1.7	0.0	1.3	1.3	0.0	8918.8	10/2/2014	10/14/2014	12	0.5	5.234	43.12	28.97	1.609	1.609	0	1.163	1.163	0	8921.11
10. Demobilization/Cleanup	10/21/2013	10/31/2013	10	0.5	0.5	2.8	8.4	0.4	0.4	0.0	0.3	0.3	0.0	1113.7	10/20/2014	10/30/2014	10	0.5	0.384	2.571	7.679	0.295	0.295	0	0.247	0.247	0	1112.2

Alternative 2 Construction Schedule and Daily Output

Construction Phase	Project A																												
	2014														2015														
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5				
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2014	6/4/2014	20	0.9	14.5	70.6	181.6	47.1	7.1	40.0	14.9	6.6	8.3	15581.0	5/15/2015	6/4/2015	20	0.9	14.32	70.57	177.3	46.98	6.984	40	14.7	6.424	8.3	15576
2. Borrow Site Preparation	5/15/2014	6/6/2014	22	1.0	7.8	39.2	95.9	4.1	4.1	0.0	3.7	3.7	0.0	8465.8	5/15/2015	6/14/2015	30	1.4	7.666	39.22	92.89	3.929	3.929	0	3.6134	3.613	0.0	8462.1
3. Levee Degrading/ Work Surface Construction	6/12/2014	6/22/2014	10	0.5	4.3	20.4	50.6	2.3	2.3	0.0	2.1	2.1	0.0	4409.3													0.0	
4. Cutoff Wall Construction	6/26/2014	7/6/2014	10	0.5	3.9	22.5	41.0	2.0	2.0	0.0	1.9	1.9	0.0	4466.4													0.0	
5. Levee Reconstruction/ Seepage Berm Construction	6/12/2014	9/10/2014	90	4.1	46.9	212.2	561.6	24.2	24.2	0.0	22.2	22.2	0.0	46256.5	6/12/2015	9/10/2015	90	4.1	46.33	212.1	549.1	23.68	23.68	0	21.786	21.79	0.0	46241
6. Borrow Site Excavation	6/16/2014	9/14/2014	90	4.1	10.6	53.1	291.6	9.8399	7.8	2.0	6.4	5.9	0.4	44898.3	6/26/2015	9/14/2015	80	3.6	10.36	52.1	293.5	7.783	7.783	0	6.1	5.733	0.4	49362
7. Utility Reconstruction	7/14/2014	9/17/2014	65	3.0	3.0	15.4	35.1	1.4	1.4	0.0	1.3	1.3	0.0	3254.2	7/14/2015	9/12/2015	60	2.7	3.39	15.43	38.36	1.813	1.813	0	1.6658	1.666	0	3254
8. Levee Resurfacing																												
9. Hydroseeding	10/20/2014	10/30/2014	10	0.5	2.2	8.6	25.2	1.0	1.0	0.0	0.9	0.9	0.0	2840.8	10/16/2015	10/26/2015	10	0.5	2.167	8.602	24.39	0.932	0.932	0	0.857	0.857	0	2841.2
10. Demobilization/Cleanup	10/16/2014	10/28/2014	12	0.5	0.3	2.1	4.1	0.2	0.2	0.0	0.2	0.2	0.0	531.0	10/16/2015	10/26/2015	10	0.5	0.274	2.127	3.915	0.197	0.197	0	0.176	0.176	0	529.35

Construction Phase	Project B																												
	2014														2015														
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5				
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2014	6/4/2014	20	0.9	17.9	76.9	220.3	69.1	9.1	60.0	20.8	8.3	12.5	18242.1	5/15/2015	6/4/2015	20	0.9	17.67	76.83	215.8	519.7	8.921	60	20.6	8.153	12.5	18324
2. Borrow Site Preparation	5/15/2014	6/4/2014	20	0.9	7.8	39.2	95.9	4.1	4.1	0.0	3.7	3.7	0.0	8465.8	5/15/2015	6/14/2015	30	1.4	7.666	39.22	92.89	3.929	3.929	0	3.6134	3.613	0.0	8462.1
3. Levee Degrading/ Work Surface Construction	6/12/2014	6/24/2014	12	0.5	4.6	21.5	59.7	2.5	2.5	0.0	2.3	2.3	0.0	5909.8	6/12/2015	6/22/2015	10	0.5	4.478	21.38	58.13	2.469	2.469	0	2.2182	2.218	0.0	5996.3
4. Cutoff Wall Construction	6/30/2014	7/30/2014	30	1.4	4.0	23.1	40.5	2.1	2.1	0.0	2.0	2.0	0.0	4469.1	6/26/2015	7/16/2015	20	0.9	3.808	23.04	38.89	2.016	2.016	0	1.8523	1.852	0.0	4484.3
5. Levee Reconstruction/ Seepage Berm Construction	6/12/2014	9/5/2014	85	3.9	46.0	206.6	551.0	23.7	23.7	0.0	21.8	21.8	0.0	45042.3	6/12/2015	8/6/2015	55	2.5	45.44	206.5	539	23.19	23.19	0	21.336	21.34	0.0	45038
6. Borrow Site Excavation	6/12/2014	9/12/2014	92	4.2	12.4	59.4	378.8	11.695	9.7	2.0	7.6	7.1	0.4	59761.6	6/26/2015	8/20/2015	55	2.5	16.45	77.4	550.8	13.67	13.67	0	10.0	9.603	0.4	96346
7. Utility Reconstruction	7/14/2014	9/17/2014	65	3.0	2.3	15.0	27.2	1.1	1.1	0.0	1.0	1.0	0.0	3196.2	7/14/2015	9/7/2015	55	2.5	2.725	14.99	30.67	1.498	1.498	0	1.3761	1.376	0	3196
X. Roadway Construction	9/20/2014	10/10/2014	20	0.9	3.4	12.9	35.1	2.0	2.0	0.0	1.8	1.8	0.0	2673.3	9/11/2015	10/1/2015	20	0.9	3.385	12.9	34.36	1.963	1.963	0	1.7949	1.795	0	2668.9
8. Levee Resurfacing																												
9. Hydroseeding	10/20/2014	10/28/2014	8	0.4	2.2	8.6	25.2	1.0	1.0	0.0	0.9	0.9	0.0	2840.8	9/11/2015	9/21/2015	10	0.5	2.167	8.602	24.39	0.932	0.932	0	0.857	0.857	0	2841.2
10. Demobilization/Cleanup	10/9/2014	10/19/2014	10	0.5	0.3	2.1	3.8	0.2	0.2	0.0	0.2	0.2	0.0	478.2	8/28/2015	9/7/2015	10	0.5	0.267	2.093	3.625	0.19	0.19	0	0.1713	0.171	0	477.09

Construction Phase	Project C																												
	2013														2014														
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5				
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2013	5/25/2013	10	0.5	33.0	153.4	547.9	169.5	19.5	150.0	48.0	16.8	31.2	61385.5	5/15/2014	6/4/2014	20	0.9	27.78	133.8	443.2	165.2	15.22	150	44.4	13.25	31.2	49419
2. Borrow Site Preparation	5/15/2013	6/14/2013	30	1.4	8.2	39.3	100.9	4.3	4.3	0.0	4.0	4.0	0	8466.5	5/15/2014	6/14/2014	30	1.4	7.84	39.24	95.87	4.069	4.069	0	3.7418	3.742	0	8465.8
3. Levee Degrading/ Work Surface Construction	5/21/2013	5/31/2013	10	0.5	34.2	154.7	550.8	20.7	20.7	0.0	17.9	17.9	0	61392.3	6/12/2014	6/22/2014	10	0.5	28.79	135.1	445.2	16.34	16.34	0	14.273	14.27	0	49426
4. Cutoff Wall Construction	5/30/2013	6/14/2013	15	0.7	6.0	33.2	63.2	3.2	3.2	0.0	2.9	2.9	0	6591.0	6/26/2014	7/6/2014	10	0.5	5.546	33.07	58.66	2.894	2.894	0	2.6595	2.659	0	6611.8
5. Levee Reconstruction/ Seepage Berm Construction	5/23/2013	9/10/2013	110	5.0	25.9	110.5	300.1	13.9	13.9	0.0	12.8	12.8	0	23441.2	6/12/2014	8/21/2014	70	3.2	25.03	110.4	287.8	13.3	13.3	0	12.232	12.23	0	23466
6. Borrow Site Excavation	5/23/2013	9/10/2013	110	5.0	14.9	68.3	384.8	11.885	11.9	0.0	9.6	9.2	0.416	56547.1	6/26/2014	9/4/2014	70	3.2	16.21	74.77	541.9	15.38	13.38	2	10.0	9.63	0.416	87094
7. Utility Reconstruction	6/24/2013	8/28/2013	65	3.0	0.5	2.8	5.7	0.3	0.3	0.0	0.3	0.3	0.0	599.2	7/14/2014	9/17/2014	65	3.0	0.451	2.808	5.259	0.254	0.254	0	0.2333	0.233	0	599.19
8. Levee Resurfacing	10/3/2013	10/15/2013	12	0.5	6.8	22.8	76.5	4.1	4.1	0.0	3.7	3.7	0.0	6484.3	10/2/2014	10/14/2014	12	0.5	6.453	21.96	73.64	3.864	3.864	0	3.4701	3.47	0	6475.6
9. Hydroseeding	10/3/2013	10/15/2013	12	0.5	2.4	8.6	27.3	1.1	1.1	0.0	1.0	1.0	0.0	2839.9	10/2/2014	10/14/2014	12	0.5	2.218	8.601	25.24	0.967	0.967	0	0.8896	0.89	0	2840.8
10. Demobilization/Cleanup	10/21/2013	10/31/2013	10	0.5	0.4	2.5	6.3	0.3	0.3	0.0	0.3	0.3	0.0	796.1	10/20/2014	10/30/2014	10	0.5	0.331	2.337	5.75	0.248	0.248	0	0.2146	0.215	0	795.19

Construction Phase	Project D																												
	2013														2014														
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5				
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2013	6/4/2013	20	0.9	8.1	32.7	89.0	53.733	3.7	50.0	13.7	3.3	10.4	8872.9	4/29/2014	5/19/2014	20	0.9	7.416	31.43	84.37	53.38	3.382	50	13.4	3.008	10.4	8865.4
2. Borrow Site Preparation	5/15/2013	6/4/2013	20	0.9	8.2	39.3	100.9	4.3	4.3	0.0	4.0	4.0	0.0	8466.5	4/29/2014	5/29/2014	30	1.4	7.84	39.24	95.87	4.069	4.069	0	3.7418	3.742	0	8465.8

3. Levee Degrading/ Work Surface Construction																												
4. Cutoff Wall Construction																												
5. Levee Reconstruction/ Seepage Berm Construction	6/12/2013	9/13/2013	93	4.2	24.6	102.8	284.8	13.1	13.1	0.0	12.1	12.1	0.0	21960.8	5/27/2014	8/27/2014	92	4.2	23.77	102.8	273.5	12.57	12.57	0	11.559	11.56	0	21954
6. Borrow Site Excavation	6/12/2013	9/13/2013	93	4.2	4.5	21.1	108.9	3.387	3.4	0.0	3.1	2.7	0.4	15620.4	6/10/2014	9/10/2014	92	4.2	3.495	16.94	101.9	4.607	2.607	2	2.4	1.94	0.416	15763
7. Utility Reconstruction	7/12/2013	9/15/2013	65	3.0	0.5	2.8	5.7	0.3	0.3	0.0	0.3	0.3	0.0	599.2	6/26/2014	8/30/2014	65	3.0	0.451	2.808	5.259	0.254	0.254	0	0.2333	0.233	0	599.19
8. Levee Resurfacing																												
9. Hydroseeding	10/21/2013	11/2/2013	12	0.5	2.4	8.6	27.3	1.1	1.1	0.0	1.0	1.0	0.0	2839.9	10/16/2014	10/28/2014	12	0.5	2.218	8.601	25.24	0.967	0.967	0	0.8896	0.89	0	2840.8
10. Demobilization/Cleanup	10/21/2013	10/31/2013	10	0.5	0.5	2.8	8.4	0.4	0.4	0.0	0.3	0.3	0.0	1113.7	10/2/2014	10/12/2014	10	0.5	0.384	2.571	7.679	0.295	0.295	0	0.2474	0.247	0	1112.2

Alternative 3 Construction Schedule and Daily Output

Construction Phase	Project A																											
	2014														2015													
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5			
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2014	6/4/2014	20	0.9	14.6	71.2	186.4	27.3	7.3	20.0	10.8	6.7	4.2	16373.5	5/15/2015	6/4/2015	20	0.9	14.44	71.08	181.6	27.1	7.088	20.0	10.7	6.494	4.2	16359.8
2. Borrow Site Preparation	5/15/2014	6/14/2014	30	1.4	3.9	19.6	47.9	2.0	2.0	0.0	1.9	1.9	0.0	4232.9	5/15/2015	6/14/2015	30	1.4	3.833	19.61	46.45	2.2	1.965	0.0	2.0	1.807	0.0	4231.04
3. Levee Degrading/ Work Surface Construction	6/12/2014	8/1/2014	50	2.3	26.5	125.5	325.0	13.7	13.7	0.0	12.6	12.6	0.0	28132.3	6/12/2015	8/1/2015	50	2.3	26.13	125.4	316.8	16.4	13.42	0.0	14.6	12.32	0.0	28115.2
4. Cutoff Wall Construction	7/14/2014	8/18/2014	35	1.6	6.6	38.9	68.2	3.5	3.5	0.0	3.2	3.2	0.0	7676.9	7/14/2015	8/8/2015	25	1.1	6.321	38.79	65.35	6.2	3.279	0.0	5.7	3.011	0.0	7726.8
5. Levee Reconstruction/ Seepage Berm Construction	8/13/2014	9/17/2014	35	1.6	35.0	159.8	422.7	18.0	18.0	0.0	16.5	16.5	0.0	35040.6	8/13/2015	9/7/2015	25	1.1	34.53	159.8	413.3	12.0	17.59	0.0	11.1	16.18	0.0	35065.2
6. Borrow Site Excavation	8/13/2014	9/7/2014	25	1.1	6.0	29.9	172.6	7.6	4.6	3.0	4.1	3.4	0.6	26847.5	8/13/2015	9/7/2015	25	1.1	5.451	27.26	157.2	7.1	4.14	3.0	3.7	3.035	0.6	26562.2
7. Utility Reconstruction	7/14/2014	9/17/2014	65	3.0	3.0	15.4	35.1	1.4	1.4	0.0	1.3	1.3	0.0	3254.2	7/14/2015	9/17/2015	65	3.0	3.39	15.43	38.36	1.8125	1.813	0	1.666	1.666	0	3253.96
8. Levee Resurfacing	10/1/2014	10/13/2014	12	0.5	3.1	10.6	33.7	1.9	1.9	0.0	1.7	1.7	0.0	2722.7	9/17/2015	9/29/2015	12	0.5	3.141	10.6	33.69	1.8562	1.856	0	1.682	1.682	0	2722.67
9. Hydroseeding	9/17/2014	9/29/2014	12	0.5	2.2	8.6	25.2	1.0	1.0	0.0	0.9	0.9	0.0	2840.8	9/17/2015	9/29/2015	12	0.5	2.167	8.602	24.39	0.9315	0.932	0	0.857	0.857	0	2841.18
10. Demobilization/Cleanup	10/3/2014	10/18/2014	15	0.7	0.3	2.1	3.8	0.2	0.2	0.0	0.2	0.2	0.0	478.2	10/5/2015	10/20/2015	15	0.7	0.267	2.093	3.625	0.1898	0.19	0	0.171	0.171	0	477.089

Construction Phase	Project B																											
	2014														2015													
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5			
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	4/29/2014	5/19/2014	20	0.9	21.8	94.6	365.9	32.6	12.6	20.0	15.0	10.8	4.2	42176.1	4/29/2015	5/19/2015	20	0.9	21.54	93.95	364	32.5	12.46	20.0	14.7	10.55	4.2	45027.9
2. Borrow Site Preparation	4/29/2014	5/29/2014	30	1.4	3.9	19.6	47.9	2.0	2.0	0.0	1.9	1.9	0.0	4232.9	4/29/2015	5/29/2015	30	1.4	3.833	19.61	46.45	2.2	1.965	0.0	2.0	1.807	0.0	4231.04
3. Levee Degrading/ Work Surface Construction	5/27/2014	6/21/2014	25	1.1	30.6	143.7	475.1	17.4	17.4	0.0	15.2	15.2	0.0	52806.1	5/27/2015	6/16/2015	20	0.9	30.12	143	469.6	16.4	17.06	0.0	14.6	14.78	0.0	55655.6
4. Cutoff Wall Construction	6/10/2014	7/30/2014	50	2.3	6.6	39.9	69.5	3.4	3.4	0.0	3.1	3.1	0.0	8049.3	6/26/2015	7/26/2015	30	1.4	6.288	39.8	66.5	6.2	3.218	0.0	5.7	2.955	0.0	8098.07
5. Levee Reconstruction/ Seepage Berm Construction	7/10/2014	8/24/2014	45	2.0	35.0	159.8	422.7	18.0	18.0	0.0	16.5	16.5	0.0	35045.9	7/28/2015	9/6/2015	40	1.8	34.53	159.8	413.3	12.0	17.59	0.0	11.1	16.18	0.0	35065.2
6. Borrow Site Excavation	7/10/2014	9/3/2014	55	2.5	7.3	35.4	218.8	6.7	5.7	1.0	4.4	4.2	0.2	34442.6	7/28/2015	9/6/2015	40	1.8	8.253	39.66	264.5	7.7	6.7	1.0	5.0	4.769	0.2	45897.9
7. Utility Reconstruction	6/26/2014	8/30/2014	65	3.0	3.0	15.4	35.1	1.4	1.4	0.0	1.3	1.3	0.0	3254.2	6/26/2015	8/30/2015	65	3.0	3.39	15.43	38.36	1.8125	1.813	0	1.666	1.666	0	3253.96
8. Levee Resurfacing	9/11/2014	9/23/2014	12	0.5	3.2	10.7	34.3	1.9	1.9	0.0	1.7	1.7	0.0	2828.3	9/22/2015	10/2/2015	10	0.5	3.139	10.68	34.36	1.8617	1.862	0	1.678	1.678	0	2974.36
9. Hydroseeding	9/25/2014	10/5/2014	10	0.5	2.2	8.6	25.2	1.0	1.0	0.0	0.9	0.9	0.0	2840.8	9/22/2015	10/2/2015	10	0.5	2.167	8.602	24.39	0.9315	0.932	0	0.857	0.857	0	2841.18
10. Demobilization/Cleanup	10/9/2014	10/19/2014	10	0.5	0.3	2.1	3.8	0.2	0.2	0.0	0.2	0.2	0.0	478.2	10/6/2015	10/14/2015	8	0.4	0.267	2.093	3.625	0.1898	0.19	0	0.171	0.171	0	477.089

Construction Phase	Project C																											
	2013														2014													
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5			
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2013	6/4/2013	20	0.9	10.8	49.8	187.3	46.6	6.6	40	13.9	5.6	8.32	21795.4	5/15/2014	6/4/2014	20	0.9	9.894	47.04	187.7	45.915	5.915	40	13.25	4.934	8.32	23720.1
2. Borrow Site Preparation	5/15/2013	6/14/2013	30	1.4	4.1	19.6	50.4	2.2	2.2	0	2.0	2.0	0	4233.2	5/15/2014	6/14/2014	30	1.4	3.92	19.62	47.93	2.0345	2.035	0	1.871	1.871	0	4232.91
3. Levee Degrading/ Work Surface Construction	5/24/2013	6/13/2013	20	0.9	29.2	132.2	408.0	16.4	16.4	0	14.6	14.6	0	39738.9	5/26/2014	6/10/2014	15	0.7	27.5	129.4	397.9	15.193	15.19	0	13.47	13.47	0	41659.8
4. Cutoff Wall Construction	6/4/2013	7/9/2013	35	1.6	11.7	64.4	123.2	6.2	6.2	0	5.7	5.7	0	12873.0	6/4/2014	6/29/2014	25	1.1	10.84	64.15	114.5	5.6121	5.612	0	5.155	5.155	0	12914.4
5. Levee Reconstruction/ Seepage Berm Construction	7/4/2013	9/7/2013	65	3.0	22.6	100.0	267.0	12.0	12.0	0	11.1	11.1	0	21454.3	7/3/2014	9/6/2014	65	3.0	21.68	99.95	255	11.457	11.46	0	10.54	10.54	0	21449.4
6. Borrow Site Excavation	7/4/2013	9/7/2013	65	3.0	5.4	25.0	134.1	6.2	4.2	2	3.7	3.3	0.416	19432.2	7/3/2014	9/6/2014	65	3.0	4.1	19.62	124.1	5.1431	3.143	2	2.733	2.317	0.416	19408.1
7. Utility Reconstruction	6/25/2013	8/29/2013	65	3.0	0.5	2.8	5.7	0.3	0.3	0.0	0.3	0.3	0.0	599.2	6/25/2014	8/29/2014	65	3.0	0.451	2.808	5.259	0.2545	0.254	0	0.233	0.233	0	599.187
8. Levee Resurfacing	10/3/2013	10/15/2013	12	0.5	3.9	13.5	51.6	2.5	2.5	0.0	2.2	2.2	0.0	5267.2	10/2/2014	10/14/2014	12	0.5	3.562	12.47	49.12	2.2294	2.229	0	1.944	1.944	0	5258.74
9. Hydroseeding	10/3/2013	10/15/2013	12	0.5	2.4	8.6	27.3	1.1	1.1	0.0	1.0	1.0	0.0	2839.9	10/2/2014	10/14/2014	12	0.5	2.218	8.601	25.24	0.967	0.967	0	0.89	0.89	0	2840.77
10. Demobilization/Cleanup	10/21/2013	10/31/2013	10	0.5	0.4	2.5	6.3	0.3	0.3	0.0	0.3	0.3	0.0	796.1	10/20/2014	10/30/2014	10	0.5	0.331	2.337	5.75	0.2479	0.248	0	0.215	0.215	0	795.193

Construction Phase	Project D																											
	2013														2014													
	Schedule							PM10			PM2.5				Schedule							PM10			PM2.5			
	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2	Start	End	Days	Mo	ROG	CO	NOx	Tot	Ex	FD	Tot	Ex	FD	CO2
1. Clearing and Grubbing/ Stripping	5/15/2013	5/25/2013	10	0.5	6.3	29.7	85.2	63.3	3.3	60	15.4	2.9	12.48	7744.0	5/15/2014	5/25/2014	10	0.5	5.967	29.19	81.11	63.027	3.027	60	15.21	2.735	12.48	7739.48
2. Borrow Site Preparation	5/15/2013	6/14/2013	30	1.4	8.2	39.3	100.9	4.3	4.3	0	4.0	4.0	0	8466.5	5/15/2014	6/14/2014	30	1.4	7.84	39.24	95.87	4.069	4.069	0	3.742	3.742	0	8465.81
3. Levee Degrading/ Work Surface Construction	5/29/2013	6/8/2013	10	0.5	26.2	119.3	325.8	13.8	13.8	0	12.7	12.7	0	27271.0	5/29/2014	6/8/2014	10	0.5	25.1	118.8	310.3	13.074	13.07	0	11.98	11.98	0	27262.4

4. Cutoff Wall Construction	6/12/2013	7/27/2013	45	2.0	9.4	52.2	99.3	5.0	5.0	0	4.6	4.6	0	10466.7	6/12/2014	7/7/2014	25	1.1	8.723	52.08	92.5	4.5256	4.526	0	4.155	4.155	0	10561.1
5. Levee Reconstruction/ Seepage Berm Construction	7/11/2013	9/9/2013	60	2.7	25.9	110.5	300.4	13.9	13.9	0	12.8	12.8	0	23483.5	7/10/2014	9/8/2014	60	2.7	25.03	110.4	287.9	13.302	13.3	0	12.23	12.23	0	23476.9
6. Borrow Site Excavation	7/11/2013	9/9/2013	60	2.7	4.5	22.0	102.5	5.2	3.2	2	3.0	2.6	0.416	14192.1	7/10/2014	9/8/2014	60	2.7	3.663	18.4	95.26	4.5141	2.514	2	2.342	1.926	0.416	14179.8
7. Utility Reconstruction	6/28/2013	9/1/2013	65	3.0	0.5	2.8	5.7	0.3	0.3	0.0	0.3	0.3	0.0	599.2	6/30/2014	9/3/2014	65	3.0	0.451	2.808	5.259	0.2545	0.254	0	0.233	0.233	0	599.187
8. Levee Resurfacing	10/3/2013	10/15/2013	12	0.5	3.9	13.5	51.6	2.5	2.5	0.0	2.2	2.2	0.0	5267.2	10/2/2014	10/14/2014	12	0.5	3.562	12.47	49.12	2.2294	2.229	0	1.944	1.944	0	5258.74
9. Hydroseeding	10/3/2013	10/15/2013	12	0.5	2.4	8.6	27.3	1.1	1.1	0.0	1.0	1.0	0.0	2839.9	10/2/2014	10/14/2014	12	0.5	2.218	8.601	25.24	0.967	0.967	0	0.89	0.89	0	2840.77
10. Demobilization/Cleanup	10/21/2013	10/31/2013	10	0.5	0.5	2.8	8.4	0.4	0.4	0.0	0.3	0.3	0.0	1113.7	10/20/2014	10/30/2014	10	0.5	0.384	2.571	7.679	0.2945	0.295	0	0.247	0.247	0	1112.2

Appendix E

Greenhouse Gas Calculation Spreadsheets and Supporting Information

GREENHOUSE GAS APPENDIX

CACULATION SPREADSHEETS AND

SUPPORTING INFORMATION

Comparison of Project Total GHG Emissions

Emission Category	GHG Constituent Tons			GHG, CO2-Eq Tons			
	CO2	CH4	N2O	CO2	CH4	N2O	CO2-EQ
ALTERNATIVE 1							
Off-Road Equipment	15,076	3.0	0.20	15,076	63	0.20	15,139
On-Road Vehicles	9,131	0	--	9,131	7	--	9,137
Total	24,206	3.3	0.20	24,206	70	0.20	24,276
Levee Project Lifetime, years							50
Annualized GHG Emissions, tons CO2-eq per year							486
ALTERNATIVE 2							
Off-Road Equipment	18,930	3.8	0.25	18,930	79	0.25	19,010
On-Road Vehicles	19,022	1	--	19,022	12	--	19,034
Total	37,952	4.4	0.25	37,952	92	0.25	38,044
Levee Project Lifetime, years							50
Annualized GHG Emissions, tons CO2-eq per year							761
ALTERNATIVE 3							
Off-Road Equipment	16,788	3.4	0.22	16,788	71	0.22	16,859
On-Road Vehicles	9,547	0	--	9,547	7	--	9,554
Total	26,335	3.7	0.22	26,335	78	0.22	26,413
Levee Project Lifetime, years							50
Annualized GHG Emissions, tons CO2-eq per year							528

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Default Construction Equipment Factors from Sacramento Roadway Construction Emission Model

Equipment	d Factor Default Values			g/hp-hr	Vehicle	
	HP	Load Factor	Hrs/Day		CO2	CH4
Bore/Drill Rigs	291	0.75	8	427	N/A	N/A
Cement and Mortar Mixers	10	0.56	8	319	N/A	N/A
Cranes	399	0.43	8	245	N/A	N/A
Excavators	168	0.57	8	324	N/A	N/A
Generator Sets	549	0.74	8	421	N/A	N/A
Graders	174	0.61	8	347	N/A	N/A
Off-Highway Tractors	267	0.65	8	370	N/A	N/A
Off-Highway Trucks	479	0.57	8	324	N/A	N/A
Rollers	95	0.56	8	319	N/A	N/A
Rough Terrain Forklifts	93	0.60	8	336	N/A	N/A
Rubber Tired Dozers	357	0.59	8	336	N/A	N/A
Rubber Tired Loaders	157	0.54	8	307	N/A	N/A
Scrapers	313	0.72	8	410	N/A	N/A
Water Trucks	120	0.75	8	324	N/A	N/A
Commute Vehicles	N/A	N/A	N/A	N/A	426.7	0.018
Heavy Duty Trucks	N/A	N/A	N/A	N/A	1880	0.038

Alternative 1: Off-Road Equipment GHG Emissions and Annual Fuel Usage

	Project A										Project B										Project C										Project D																Project-Wide Fuel Usage					
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10					Project	Project	CO2 EF	Project CO2	BSFC	Project
Equipment	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	Days	Pieces*Days	HP-hr	g/hp-hr	Tons/yr	hp-hr/gal	Gallons
Aerial Lifts			0																																									20	0	0			20	0
Air Compressors																																												20	0	0			20	0
Bore/Drill Rigs				1										1										2										2										20	380	663,919	426.6	312	20	33,196
Cement and Mortar Mixers				2										2										4										3										20	685	31,674	318.5	11	20	1,584
Cranes							2										2																											20	460	631,535	244.6	170	20	31,577
Excavators			3	5		2	2						3	4		2	2						3	8			1							3	6			1						20	2,970	2,276,378	324.2	813	20	113,819
Generator Sets				4										4										6										5										20	1,175	3,820,263	420.9	1,771	20	191,013
Graders					2			2							2			2							2			2							5			2						20	1,170	991,817	346.9	379	20	49,591
Off-Highway Tractors		2										2										2			5							4			5									20	1,620	2,249,067	369.7	916	20	112,453
Off-Highway Trucks			7	3										3									7	3				2					7	3			1	2					20	1,661	3,627,557	324.2	1,295	20	181,378
Other Construction Equipment				1																																								20	60	22,228	352.7	9	20	1,111
Rollers			5		5			2					5		5			2					5		4			2					5		5			2					20	2,750	1,175,307	318.5	412	20	58,765
Rough Terrain Forklifts										1				1						1				1						1				1								1	20	258	115,676	335.6	43	20	5,784
Rubber Tired Dozers											2																																	20	80	134,825	335.6	50	20	6,741
Rubber Tired Loaders	4	0		2		2	2							2		2	2				2			4		2					2			3		3							20	2,195	1,488,723	307.1	504	20	74,436
Scrapers	8	2	15		20						8	2	15		20						4	2	14		10	0					3	4	14		10								20	8,920	16,056,152	409.5	7,241	20	802,808
Water Trucks	2	1	3	2	3	2	2	1	2		2	1	3	2	3	2	2	1	2		2	1	4	2	3	2	1	1	2		2	2	3	2	3	3	1	1	2		20	4,477	3,223,440	324.2	1,151	20	161,172
Construction Days	20	20	40	60	60	60	100	22	18	18	40	60	80	50	80	80	130	20	20	15	40	60	35	60	130	130	130	24	24	20	40	60	25	75	90	90	130	24	24	20								15,076		1,825,428

Activity Codes:

1 - Clearing/Grubbing

2 - Borrow Site Preparation

3 - Levee Degrading

4 - Cutoff Wall Construction

5 - Levee Reconstruction

6 - Borrow Site Excavation and Hauling

7 - Utility Reconstruction

8 - Levee Resurfacing

9 - Hydorseeding

10 - Demobilization/Cleanup

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ALTERNATIVE 1: ON-ROAD VEHICLE EMISSIONS

Trip Type	Project A				Project B				Project C				Project D				Combined Projects				
Workers	79				76				102				102								
Duration, Days	418				575				653				578								
Round Trip Dist., miles	60				60				60				60								
Worker Vehicle Miles	1,986,336				2,618,550				4,008,114				3,547,764								
Vehicle Type	Total CY	Truck Load	Trips	Round Trip Miles	Total CY	Truck Load	Trips	Round Trip Miles	Total CY	Truck Load	Trips	Round Trip Miles	Total CY	Truck Load	Trips	Round Trip Miles	VMT	CO2 EF, g/mi	CO2 Tons	CH4 EF, g/mi	CH4 Tons
Worker Commute																	12,160,764	426.7	5,715	0.018	0.241
Unsuitable Soil Disposal, cy	31500	12	2625	3	520,250	12	43,354	3	253,000	12	21,083	3	14,000	12	1,167	3	204,688	1880	424	0.038	0.009
Bentonite			89	26			119	16			191	12			197	36	13,602	1880	28	0.038	0.001
Aggregate Surfacing			425	36			400	26			1,500	20			1,500	28	97,700	1880	202	0.038	0.004
Pipe Material			8	36			17	16			31	12			44	28	2,164	1880	4	0.038	0.000
Demolition Debris			60	36			36	16			160	12			275	28	12,356	1880	26	0.038	0.001
CLSM Backfill			26	36			36	16			104	12			76	28	4,888	1880	10	0.038	0.000
Borrow Fill, cy	244,000	12	20,333	6	796,750	12	66,396	6	531,000	12	44,250	8	330,000	12	27,500	16	1,314,375	1880	2,721	0.038	0.055
TOTALS																			9,131		0.310

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Alternative 2: OffRoad Equipment GHG Emissions and Fuel Usage

	Project A										Project B										Project C										Project D										Combined Projects GHG Emissions and Fuel Usage					
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	Project	Project	CO2 EF	Project CO2	Avg BSFC	Project
Equipment	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No*Days	HP-hr	g/hp-hr	Tons/yr	hp-hr/gal	Gallons
Bore/Drill Rigs				1																				1										0							35	61,150	426.6	29	20	3,058
Cement and Mortar Mixers				1										2										2										0							160	7,398	318.5	3	20	370
Cranes							2										2																								490	672,722	244.6	181	20	33,636
Excavators			1	2	2	4	2						1	4		2	2						3	4			1						0	0			1				2,492	1,910,012	324.2	682	20	95,501
Generator Sets				2										2										3										0							195	634,001	420.9	294	20	31,700
Graders					5			1							5			2	2						2			4							5			2			3,179	2,694,860	346.9	1,030	20	134,743
Off-Highway Tractors		4										4										4			5							4			2						2,038	2,829,382	369.7	1,152	20	141,469
Off-Highway Trucks			7	2									6	2					1				7	2			1	2				0	0			1	2				888	1,939,356	324.2	692	20	96,968
Other Construction Equipment				1																																					10	3,705	352.7	1	20	185
Rollers			2		5			1					2		5			3	1				5		5			4				0		5			2			3,903	1,668,081	318.5	585	20	83,404
Rough Terrain Forklifts										1				1						1				1						1				0						1	147	65,909	335.6	24	20	3,295
Rubber Tired Dozers											4																														160	269,650	335.6	100	20	13,483
Rubber Tired Loaders	4	0		1		4	2							1		4	2				7			2		4					3			0		2					3,510	2,380,600	307.1	805	20	119,030
Scrapers	8	4	2		25						8	4	2		25						13	4	14		10	0					5	4	0		10						14,247	25,644,843	409.5	11,566	20	1,282,242
Water Trucks	2	2	2	1	4	4	2	1	2		2	2	1	1	4	4	2	1	1	2	7	2	4	1	3	4	1	2	2		3	2	0	0	3	2	1	1	2		6,949	5,003,280	324.2	1,786	20	250,164
Construction Days	40	22	10	10	180	170	115	5	20	22	40	50	22	50	145	145	130	40	20	15	40	60	20	25	180	180	130	24	24	20	40	60	0	0	185	185	130	24	24	15				18,930		2,289,247

Activity Codes:

1 - Clearing/Grubbing

2 - Borrow Site Preparation

3 - Levee Degrading

4 - Cutoff Wall Construction

5 - Levee Reconstruction

6 - Borrow Site Excavation and Hauling

7 - Utility Reconstruction

8 - Levee Resurfacing

9 - Hydorseeding

10 - Demobilization/Cleanup

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ALTERNATIVE 2: ON-ROAD VEHICLE EMISSIONS

Trip Type	Project A					Project B					Project C					Project D					Combined Projects				
Workers	132					129					135					102									
Duration, Days	594					657					693					663									
Round Trip Dist., miles	60					60					60					60									
Worker Vehicle Miles	4,704,480					5,073,354					5,625,774					4,069,494									
Vehicle Type	Total CY	Truck Load	Trips	Round Trip Miles	Vehicle Miles	Total CY	Truck Load	Trips	Round Trip Miles	Vehicle Miles	Total CY	Truck Load	Trips	Round Trip Miles	Vehicle Miles	Total CY	Truck Load	Trips	Round Trip Miles	Vehicle Miles	VMT	2014 CO2 EF, g/mi	CO2 Tons	CH4 EF, g/mi	CH4 Tons
Worker Commute					4704480					5,073,354					5,625,774					4,069,494	19,473,102	426.7	9,151	0.018	0.386
Unsuitable Soil Disposal, cy	75	12	6.25	3	19	22,000	12	1,833	3	5,500	322,900	12	26,908	3	80,725	29,000	12	2,417	3	7,250	93,494	1880	194	0.038	0.004
Bentonite			1	26	26			31	16	496			28	12	336			197	36	7,092	7,950	1880	16	0.038	0.000
Aggregate Surfacing			50	18	900			225	26	5,850			1,200	20	24,000			1,500	28	42,000	72,750	1880	151	0.038	0.003
Pipe Material			8	36	288			17	16	272			31	12	372			44	36	1,584	2,516	1880	5	0.038	0.000
Demolition Debris			60	36	2,160			36	16	576			160	12	1,920			275	36	9,900	14,556	1880	30	0.038	0.001
CLSM Backfill			26	36	936			36	16	576			104	12	1,248			76	36	2,736	5,496	1880	11	0.038	0.000
Borrow Fill, cy	1,628,000	12	135,667	6	814,000	2,334,500	12	194,542	6	1,167,250	2,681,200	12	223,433	8	1,787,467	601,500	12	50,125	16	802,000	4,570,717	1880	9,464	0.038	0.191
TOTALS																							19,022		0.586

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Off-Road Equipment GHG Emissions: Alternative 3

	Project A										Project B										Project C										Project D										Project-Wide GHG Emissions					
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	Equipment	Project	Equip CO2 EF	Project CO2	Avg BSFC	Project
Equipment	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	Pieces*Days	HP-hr	g/hp-hr	Tons/yr	hp-hr/gal	Gallons
Bore/Drill Rigs				1										2										2										2							490	856,106	426.6	402	20	42,805
Cement and Mortar Mixers				2										2										4										3							745	34,449	318.5	12	20	1,722
Cranes							2										2																								520	713,909	244.6	192	20	35,695
Excavators			3	2		2	2						3	4		2	2						3	8			1						3	6			1				3,055	2,341,527	324.2	836	20	117,076
Generator Sets				4										4										6										5							1,295	4,210,417	420.9	1,952	20	210,521
Graders					2			2							2			2							2			2							5			2			1,188	1,007,076	346.9	385	20	50,354
Off-Highway Tractors		2										2										2			5							4			5						1,700	2,360,132	369.7	961	20	118,007
Off-Highway Trucks			7	3										3				2					7	3			1	2					7	3			1	2			2,345	5,121,385	324.2	1,829	20	256,069
Rollers			5		5			2					5		5			2					5		5			2					5		5			2			3,038	1,298,394	318.5	455	20	64,920
Rough Terrain Forklifts				1						1				1						1				1						1				1						1	357	160,064	335.6	59	20	8,003
Rubber Tired Dozers											4																														160	269,650	335.6	100	20	13,483
Rubber Tired Loaders	4	0		2		2	2							2		2	2				2			4		2					2			3		3					2,405	1,631,152	307.1	552	20	81,558
Scrapers	8	2	15		20						8	2	15		20						4	2	14		10	0					3	4	14		10						9,635	17,343,164	409.5	7,822	20	867,158
Water Trucks	2	1	3	2	3	2	2	1	2		2	1	3	2	3	2	2	1	2		2	1	4	2	3	2	1	1	2		2	2	3	2	3	3	1	1	2		4,793	3,450,960	324.2	1,232	20	172,548
Construction Period, Days	40	60	100	60	60	50	130	24	24	24	40	60	45	80	85	95	130	22	20	18	40	60	35	60	130	130	130	24	24	20	40	60	25	75	90	90	130	24	24	20	Project Total Emissions			16,788		2,039,919

Activity Codes:

1 - Clearing/Grubbing

2 - Borrow Site Preparation

3 - Levee Degrading

4 - Cutoff Wall Construction

5 - Levee Reconstruction

6 - Borrow Site Excavation and Hauling

7 - Utility Reconstruction

8 - Levee Resurfacing

9 - Hydorseeding

10 - Demobilization/Cleanup

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ON-ROAD VEHICLE EMISSIONS, ALTERNATIVE 3

Trip Type	Project A					Project B					Project C					Project D					Combined Project				
Workers	79.2					75.9					102.3					102.3									
Duration, Days	572					595					653					578									
Round Trip Dist., miles	60					60					60					60									
Worker Vehicle Miles	2,718,144					2,709,630					4,008,114					3,547,764									
Vehicle Type	Total CY	Truck Load	Trips	Round Trip Miles	Vehicle Miles	Total CY	Truck Load	Trips	Round Trip Miles	Vehicle Miles	Total CY	Truck Load	Trips	Round Trip Miles	Vehicle Miles	Total CY	Truck Load	Trips	Round Trip Miles	Vehicle Miles	VMT	2014 CO2 EF, g/mi	CO2 Tons	CH4 EF, g/mi	CH4 Tons
Worker Commute					2,718,144					2,709,630					4,008,114					3,547,764	12,983,652	426.7	6,101	0.018	0.26
Unsuitable Soil Disposal, cy	25,750	12	2,146	3	6,438	520,250	12	43,354	3	130,063	253,100	12	21,092	3	63,275	14,000	12	1,167	3	3,500	203,275	1880	421	0.038	0.009
Bentonite			78	26	2,028			119	16	1,904			193	12	2,316			197	36	7,092	13,340	1880	28	0.038	0.001
Aggregate Surfacing			350	36	12,600			400	26	10,400			1,500	20	30,000			1,500	28	42,000	95,000	1880	197	0.038	0.004
Pipe Material			8	26	208			17	16	272			31	12	372			44	36	1,584	2,436	1880	5	0.038	0.000
Demolition Debris			60	26	1,560			36	16	576			160	12	1,920			275	36	9,900	13,956	1880	29	0.038	0.001
CLSM Backfill			26	26	676			36	16	576			104	12	1,248			76	36	2,736	5,236	1880	11	0.038	0.000
Borrow Fill, cy	276,250	12	23,021	6	138,125	796,750	12	66,396	6	398,375	531,300	12	44,275	8	354,200	330,100	12	27,508	16	440,133	1,330,833	1880	2,755	0.038	0.056
TOTALS																							9,547		0.33

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Appendix F

Additional Resource Information for the Biological Study Area

Part F.1 U.S. Fish and Wildlife Service Biological Opinion

Part F.2 National Marine Fisheries Service Concurrence Letter

Part F.3 Feather River West Levee Project Final 408 Permission Mitigation and Monitoring Plan

Part F.4 Fish and Wildlife Coordination Act Report

Part F.5 U.S. Fish and Wildlife Service Special-Status Species List

Part F.6 California Natural Diversity Database Special-Status Species List—Plants

Part F.7 California Natural Diversity Database Special-Status Species List—Wildlife

Part F.8 California Native Plant Society Inventory of Rare and Endangered Plants List

Part F.9 USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Part F.10 Soil Map Units in the Biological Study Area

Part F.11 National Wetlands Inventory Mapping in the Biological Study Area

Part F.1

U.S. Fish and Wildlife Service Biological Opinion

Note: The EIS analysis assumes project completion in 2015. The ESA consultation documents assume a longer duration to 2017 to characterize a maximum habitat disturbance scenario and to provide implementation flexibility within the ESA authorization.

Note: Total aquatic temporary acreages for giant garter snake in Table 3.9-10 have been updated to reflect the project description change to remove the Nevis borrow site from the biological study area. This change reduced the acreages stated in the BO from 42.52 to 6.81 of temporary aquatic habitat that SBFCA will need to restore to pre-project conditions.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer To:
08ESMF00-2013-F-0342-1

MAY 02 2013

Ms. Alicia Kirchner
Chief, Planning Division
U.S. Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814

Subject: Formal Consultation on the Feather River West Levee Project, Sutter County, California

Dear Ms. Kirchner:

This is in response to your March 22, 2013, request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the Feather River West Levee Project (FRWLP) (proposed project) in Sutter County, California. Your request was received on March 28, 2013. You requested our concurrence that the proposed project may affect, and is likely to adversely affect the federally-listed as threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)(beetle) and the giant garter snake (*Thamnophis gigas*)(snake). The Service concurs with your determination and this biological opinion addresses the effects of the proposed project on these two species. Critical habitat has been designated for the beetle; however, the proposed project is not located within any designated or proposed critical habitat. Critical habitat has not been designated for the snake; therefore, none will be affected. This response is in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

This biological opinion is based on information provided in the U.S. Army Corps of Engineers' (Corps) letter requesting consultation and their biological assessment. A complete administrative record is on file at the Sacramento Fish and Wildlife Office.

CONSULTATION HISTORY

July 13, 2012. The Service, ICF International, HDR Inc., consultants to Sutter Butte Flood Control Agency (SBFCA), SBFCA, California Department of Fish and Wildlife (CDFW), California Department of Water Resources, and the Corps participated in a site visit to the proposed project. Potential effects to giant garter snake were discussed on the trip.

September 27, 2012. The Service, Corps, HDR, and ICF met to discuss the biological opinion and the level of detail that will be available in order to initiate consultation. The applicant determined that they will have sufficient information to initiate consultation at the project level.

December 18, 2012. The Service, Corps, SBFCA, ICF, and HDR met to discuss effects to giant garter snake. Permanent and temporary effects were discussed as well as the Service providing suggestions on conservation measures that could be incorporated.

February 12, 2013. The Service, Corps, ICF, CDFW, and HDR met to discuss long-term operations and maintenance (O&M). The outcome of this meeting was that the SBFCA FRWLP will not include operations and maintenance in their project description because their project will not be changing O&M. However, the Corps will be initiating consultation on the Sutter Feasibility Study in the next 6 months and this project description will include O&M activities.

March 22, 2013. The Corps initiated section 7 consultation with the Sacramento Fish and Wildlife Office.

BIOLOGICAL OPINION

DESCRIPTION OF ACTION AREA

North to south, the Action Area consists of the 41-mile corridor along the west levee of the Feather River from the Thermalito Afterbay to a point about 4 miles north of the Sutter Bypass. The Action Area includes the project construction area and a 100-foot buffer around this area which includes staging and spoils areas. The project construction area was defined as the area in which levee improvements—such as seepage berms, stability berms, relief wells, sheet-pile walls, and slurry cutoff walls—are likely to be constructed. All direct and indirect effects will occur within this area and the 100-foot buffer around this area.

The corridor is divided into 41 relatively homogeneous reaches for ease of describing existing conditions, project components, land cover-types, and potential effects (note that this number is coincidental and one reach does not correspond to a length of 1 mile; additionally, Reach 1 is not part of the FRWLP) (Figure 1).

The Action Area also includes six potential borrow sites that could supply the borrow material necessary for levee construction and upgrades, and routes from the project construction area to the borrow sites. It is not anticipated that all six sites will be used over the multi-year phased construction period, but until additional geotechnical and soil samplings are completed, all sites will be available for use and are included in the Action Area.

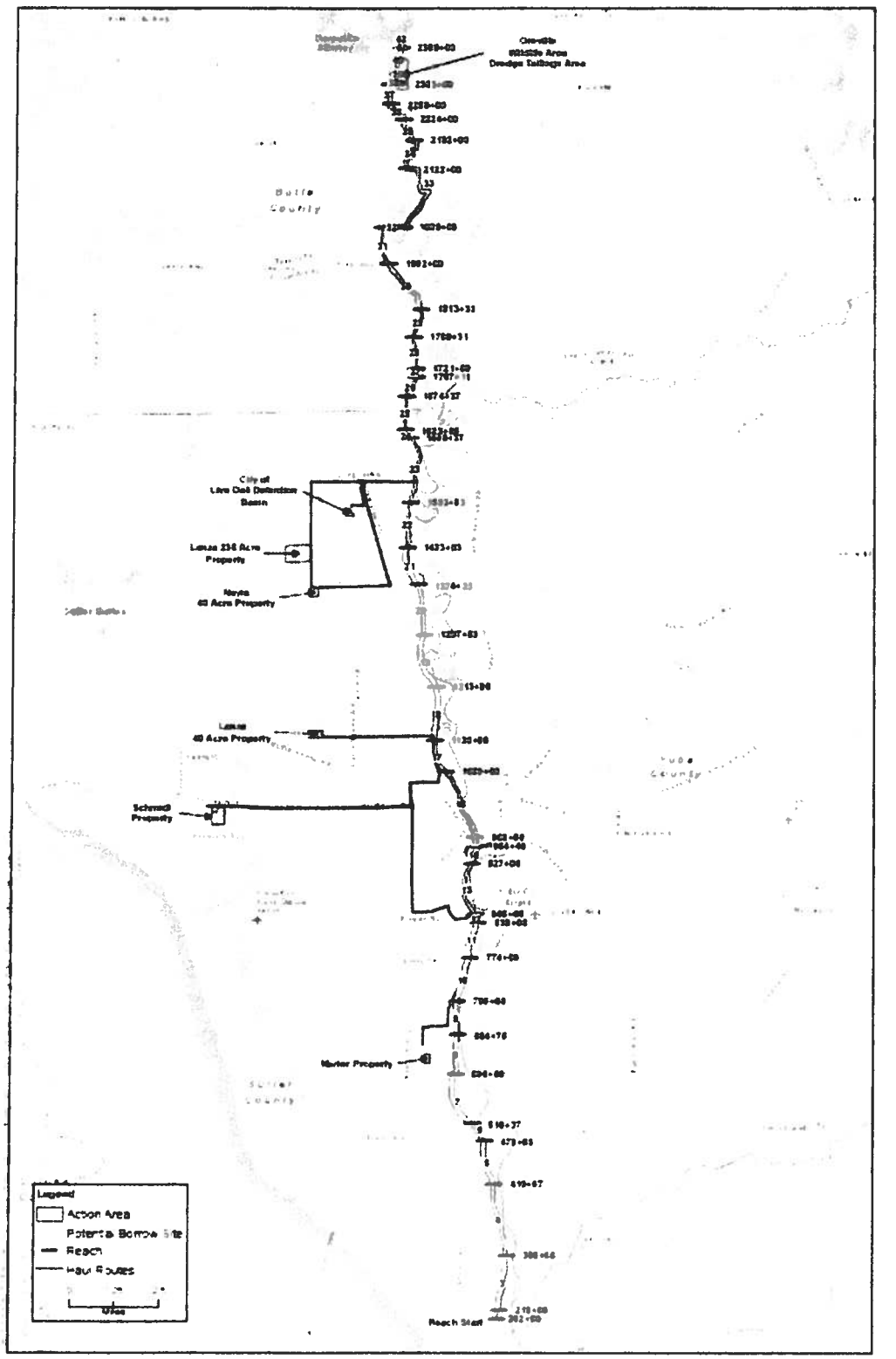

Figure 1. Proposed Project

Finally, the Action Area includes the existing 48.5-acre Star Bend Conservation Area, located on the west levee of the Feather River, about 6 miles south of Yuba City. Compensation for the Proposed Action's effects on the beetle is proposed to occur in a portion of this conservation area, which is discussed below under Conservation Measure 5.

Description of Proposed Action

The primary purpose of the FRWLP is to reduce flood risk in the Sutter Basin by addressing known levee deficiencies along the Feather River West Levee from Thermalito Afterbay downstream to a point about 4 miles upstream of the Feather River's confluence with the Sutter Bypass. While the FRWLP will not by itself reduce all flood risks affecting the Sutter Basin, it will address the most immediate risks based on the following.

- The proximity of the Feather River to population centers and key infrastructure.
- The nature of the Feather River West Levee being the longest and most contiguous portion of the planning area perimeter.
- The location of known levee deficiencies and the clarity and feasibility of available measures to address them.

The construction of the FRWLP will be divided into four separate construction contracts. Contract A begins near the intersection of the Feather River West Levee and Laurel Road. It continues north to the beginning of the improvements constructed as part of the Star Bend Setback Levee Project. The total length of the levee in this portion of the FRWLP is 27,618 linear feet. Contract B begins at the end of the improvements constructed as part of the Star Bend Setback Levee Project, and continues north for 31,963 linear feet. Contract C begins near the north end of the Shanghai Bend Setback Levee, and continues north for a total of 77,886 linear feet. Contract D then begins and continues north for 69,363 linear feet.

For Contract A, a cutoff wall ranging between 10 and 35 feet deep will be constructed along the centerline of the levee for the entire length of levee. The overall height of the levee will be degraded by about 50%. In addition to the cutoff wall, a portion of the levee will have a 9,816-foot-long; 100-foot-wide seepage berm installed.

For Contract B, a cutoff wall ranging between 5 and 25 feet deep will be constructed along the centerline of the levee for 31,600 linear feet. The overall height of the levee will be degraded by about 50%. Relief wells 60 feet apart and 50 feet deep will be installed along a 2,500 linear foot section. Finally, two small sections will involve pipe crossing work.

For Contract C, a cutoff wall ranging between 5 and 65 feet deep will be constructed along the centerline of the levee for 62,117 linear feet. The overall height of the levee will be degraded by about 50%, with about 5,900 linear feet of the levee needing to be fully degraded. A 7-foot tall

and 50-foot-wide seepage berm will be placed near the 10th Street bridge and extend through the existing abandoned railroad tunnel. Finally, there will be a few storm drain pipes replaced within the levee.

For Contract D, a cutoff wall ranging between 10 and 90 feet deep will be constructed along the centerline of the levee for 57,361 linear feet. For all but 317 linear feet of levee, the levee will be degraded by about 50%. The remaining 317 linear feet will have a full levee degrade and reconstruction. A canal runs adjacent to the landside of the levee for 4,723 feet. The landside levee will require reconstruction to the bottom of the canal. Six storm drain and irrigation pipes will need to be replaced along a section of the levee. About 4,800 linear feet of seepage berm will be constructed at the northern end of the proposed project. The berm will very in width between 100 and 170 feet. Additionally, a waterside pit located in this area will be filled.

Materials imported to the construction site will include water, bentonite, cement, incidental construction support materials, aggregate base rock, hydroseed, and up to 1,500,000 cubic yards of embankment fill material for the new levee surfaces from offsite commercial borrow sites or local landowners willing to sell borrow material. For backfill of new pipelines crossing the levee, controlled low strength material (CLSM) (otherwise known as lightweight concrete) will be placed to the pipeline's spring line.

Construction methods for the flood management measures are described in detail below.

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 three methods for constructing a slurry cutoff wall: (1) conventional slot trench, (2) deep soil mixing (DSM), and (3) jet grouting. The first two are the primary methods for application over longer areas, while jet grouting is a spot application based on limiting conditions. A slurry cutoff wall addresses the deficiency of seepage (through- and under-seepage).

Conventional Slot Trench Method - To begin construction, the construction site and any necessary construction staging or slurry mixing areas are cleared, grubbed, and stripped. In the conventional slot trench method, a trench is excavated at the top center of the levee and into subsurface materials. The size of the trench is based on the severity of the seepage but can be typically 3 feet wide and up to 80–90 feet deep. As the trench is excavated, it is filled temporarily with bentonite water slurry to prevent cave-in. The soil from the excavated trench is hauled to a nearby location where it is mixed with hydrated bentonite to reduce permeability and cement in some applications where increased strength is desired. The soil-bentonite mixture then is returned to the levee and backfilled into the trench. This mixture hardens and creates the impermeable barrier wall in the levee.

In most cases, degradation of the levee crown is necessary to create a large enough working platform to reduce the risk of hydraulic fracturing from the insertion of slurry fluids, and allowing greater depths to be reached. Dependent on the conditions of the particular levee, it may be necessary to degrade the levee by one- to two-thirds its existing height. The material

from degrading the levee is hauled to a nearby stockpile area. Following completion of the slurry cutoff wall, the material is hauled back to the levee to restore the levee to its original dimensions. The material may need to be hauled offsite to a local landfill, and borrow material may need to be imported if the in-situ levee material is found to be unsuitable for current levee standards.

One construction crew typically is able to construct 75–100 linear feet of slurry wall (about 70–80 feet deep) in an 8-hour shift. Equipment needed for the crew includes a long-reach track hoe, three or four dump trucks (15 cubic yard capacity each), two loaders at the mixing location, bulldozers, excavators, loaders, a rough terrain forklift, compactors, maintainers, and a water truck. Vertical clearance of about 40 feet is needed for the excavator boom. Horizontal clearance of about 30 feet beyond the levee crest may be required for excavator swing when loading dump trucks.

A mixing area is located at the construction staging area. The mixing area is to prepare the soil-bentonite mixture and supply bentonite-water slurry. The mixing area is contained to avoid inadvertent dispersal of the mixing materials. Dump trucks haul material between the excavator and the mixing area along the levee.

An access road made of aggregate base rock is constructed on the levee crown to enable regular levee inspections. Post-construction, areas used for construction staging, mixing, the levee crown, slopes, and any other disturbed areas are hydroseeded.

Deep Soil Mixing Method - The DSM method of constructing a slurry cutoff wall uses a crane-supported set of two to four mixing augers (typically 36 inches in diameter) set side by side. These augers are drilled through the levee crown and foundation to the required depth (capable of a maximum depth of about 200 feet). As the augers are inserted and withdrawn, a soil-bentonite grout is injected through the augers and mixed with the native soil. An overlapping series of mixed columns is drilled to create a continuous seepage cutoff barrier.

To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee requires excavation with a paddle wheel scraper. Material is scraped and stockpiled at a nearby stockpile area. Dependent on the depth of the wall required, vertical clearance for the crane also may be needed. An excavator manipulates injector return spoils near the DSM rig, and transport trucks are used to haul spoils offsite. A crane is used for in-place sampling of DSM material and also for loading bentonite into the batch plant hopper. A mobile batch plant (diesel-powered) is required near each DSM rig at the work area to prepare the cement-bentonite grout. The grout is transported to the DSM rig through flexible hoses. Each batch plant requires a pad of 50 by 100 feet. Hauling at the work area involves scraper runs along the levee to the staging area and cement and bentonite deliveries to the batch plant.

During DSM slurry wall construction, one DSM rig typically can construct 50 linear feet of DSM wall per 8-hour shift (for wall depths up to 135 feet). Post-construction, areas used for construction staging, the levee slopes, and any other disturbed areas are hydroseeded.

Jet Grouting Method - Jet grouting involves injecting fluids or binders into the soil at very high pressure. The injected fluid can be grout; grout and air; or grout, air, and water. Jet grouting breaks up soil and, with the aid of a binder, forms a homogenous mass that solidifies over time to create a mass of low permeability. Jet grouting typically is used in constructing a slurry cutoff wall to access areas other methods cannot. In this regard, it is typically a spot application rather than a treatment to be applied on a large scale along an entire reach.

Equipment required for jet grouting consists of a drill rig fitted with a special drill string; a high pressure, high flow pump; and an efficient batching plant with sufficient capacity for the required amount of grout and water. The high-pressure pump conveys the grout, air, and/or water through the drill string to a set of nozzles located just above the drill bit. The diameter of the jet grout column is dependent on site-specific variables such as soil conditions, grout mix, nozzle diameter, rotation speed, withdrawal rate, and grout pressure. Jet grouted columns range from 1 to 16 feet in diameter and are typically interconnected to form cutoff barriers or structural sections. Under ideal conditions, one construction crew—consisting of a site supervisor, pump operator, batch plant operator, chuck tender, and driller—can construct two 6-foot diameter, 50-foot columns per day consisting of about 100 cubic yards of grout injected per 8-hour shift. Ideal conditions will be characterized by no technical issues occurring at either the batch plant or the drilling site, such as loss of fluid pressure, breakdown of equipment, or subsurface obstructions to drilling operations.

To initiate jet grouting, a borehole is drilled through the levee crown and foundation to the required depth (to a maximum depth of about 130 feet) by rotary or rotary-percussive methods using water, compressed air, bentonite, or a binder as the flushing medium. When the required depth is reached, the grout is injected at a very high pressure as the drill string is rotated and slowly withdrawn. Use of the double, triple, and superjet systems create eroded spoil materials that are expelled out of the top of the borehole, this material is frequently used as a construction fill.

To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee may require degradation with a paddle wheel scrapper. Material is scraped and stockpiled at a nearby stockpile area. Hauling at the work area involves scraper runs along the levee to the staging area and grout, bentonite, and water deliveries to the batch plant.

Batch plants are typically centrally located to the injection site, with pipelines for mixed grout that run the length of the work. Grout mixing and injection equipment consists of grout mixers, high powered grout pumps and supporting generators and air compressors, holding tanks, and water tanks, with bulk silos of grout typically used to feed large mixers. Smaller equipment can be used in combination with the single phase-fluid system and can be permanently trailer-mounted to permit efficient mobilization and easy movement at the job site.

Prior to commencing production jet grouting, a field test program is typically completed to evaluate injection parameters and to assess jet grout column geometries, and mechanical and permeability properties. Where possible, jet grout test elements are exposed by excavation and properties are obtained by direct measurement. Where excavation is not possible, core drilling is employed to obtain samples from the jet grout test columns for strength testing.

Areas used for construction staging, the levee slope, and any other disturbed areas are restored and hydroseeded following construction.

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 a standard of 3:1 (horizontal to vertical), but this may vary based on site-specific conditions and supporting engineering analysis. Slope flattening addresses the deficiency of slope stability and geometry. To begin slope flattening activities, the area is cleared, grubbed, and stripped to provide space for construction and reshaping of slopes. Additional embankment fill material may be necessary to achieve slope flattening—if so, bulldozers excavate and stockpile borrow material from a nearby permitted borrow site. Front-end loaders load haul trucks with the borrow material. The haul trucks transport the material to slope flattening site. Motor graders spread material evenly according to levee design plans, and sheepsfoot rollers compact the material. Water trucks distribute water over the material to ensure proper moisture for compaction.

To reshape a waterside slope, the existing crown of the levee is shifted farther landward and the waterside slope is trimmed and reshaped to a 3:1 slope. The shifted levee crown will be a minimum of 20 feet wide, with a 3:1 slope on the landward side. An access road made of aggregate base rock is constructed on the levee crown. Post-construction, the construction staging areas, levee slopes, and any other disturbed areas will be hydroseeded.

Stability Berm

A stability berm will 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. To begin the construction of a stability berm, the site is cleared, grubbed, and stripped to provide space for construction and shaping of the berm. Embankment fill material necessary to construct the berm is excavated by a bulldozer from a nearby borrow site. Front-end loaders load haul trucks with the borrow material, and the haul trucks transport the material to the stability berm site. Motor graders spread the material evenly according to design specifications, and a sheepsfoot roller compacts the material. Water trucks distribute water over the material to ensure proper moisture for compaction.

Stability berms may be drained or undrained. An undrained berm consists of embankment fill only. A drained berm includes a layer of drain rock placed along the ground surface underneath the fill material, separated by a casing of filter fabric. Drainage water seeping from the berm will sheetflow on the adjacent landside surface.

Levee Reconstruction

Levee reconstruction will 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. The existing levee is first cleared, grubbed, and stripped to the desired surface to allow a working platform for other measures (such as a slurry cutoff wall), to remove an encroachment, or to remove substandard material. Embankment fill material necessary to construct the new levee is excavated by a bulldozer from a nearby borrow site. Front-end loaders load haul trucks with the borrow material and the haul trucks transport the material to the stability berm site. Motor graders spread the material evenly according to design specifications, and a sheepsfoot roller compacts the material. Water trucks distribute water over the material to ensure proper moisture for compaction. The new levee will be built in cross section to meet current engineering standards.

Sheet-Pile Wall

A sheet-pile wall is a series of vertical panels of interlocking steel that is placed parallel to the levee, typically through the center of the levee crown to provide an impermeable barrier. A sheet-pile wall addresses the deficiencies of seepage and will be used only as a site-specific treatment (rather than applied on a reach-wide basis) such as at roadway or railroad crossings. The site where sheet piles are to be installed is cleared, grubbed, and stripped to allow for construction activities, including removal of the roadway or railroad. A hydraulic- or pneumatically-operated pile-driving head attached to a crane drives the sheet pile into the levee crown to the desired depth (up to 135 feet). If the levee material is particularly solid, pre-drilling may be necessary. The conditions of the site and the desired life of the project determine the thickness and configuration of the sheet piles.

Post-construction, construction staging areas, the levee crown, slopes, and any other disturbed areas are hydroseeded and the roadway or railroad will be replaced in-kind to the pre-project condition.

Seepage Berm

Seepage berms are wide embankment structures made up of low-permeability materials that resist accumulated water pressure and safely release seeping water. A seepage berm is typically one-third the height of the levee, extending outward from the landside levee toe for 300–400 feet, and laterally along the levee as needed relative to the seepage conditions. A seepage berm addresses the deficiency of under-seepage. A seepage berm can vary in width, from a minimum of four times the levee height to a maximum of 300 feet. Berm heights can also vary but are typically a minimum of 5 feet tall at the landside toe of the levee and generally taper down to 3 feet at the end of the berm.

Construction consists of clearing, grubbing, and stripping the ground surface. Bulldozers then excavate and stockpile borrow material from a nearby borrow site. Front-end loaders load haul trucks, and the haul trucks subsequently transport the borrow material to the berm site. The haul trucks dump the material and motor graders spread it evenly, placing 3–5 feet of embankment fill material. Sheepsfoot rollers compact the material, and water trucks distribute water over the material to ensure proper moisture for compaction.

Seepage berms may have an optional feature of a drainage relief trench under the toe of the berm. Drained seepage berms include the installation of a drainage layer (gravel or clean sand) beneath the seepage berm backfill and above the native material at the levee landside toe. A drained seepage berm does not increase the overall footprint of the berm. Post-construction, areas used for construction staging, the levee, the berm, and any other disturbed areas are hydroseeded.

Relief Wells

Relief wells are passive systems that are constructed near the levee landside toe to provide a 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 constructed using soil-boring equipment to drill a hole vertically through the fine-grained blanket layer (sand) into the coarse-grained aquifer layer (gravel) beneath. Pipe casings and gravel/sand filters are installed to allow water to flow freely to the ground surface, relieving the pressure beneath the clay blanket without transporting fine materials to the surface, which can undermine the levee foundation. Relief wells will be designed to discharge onto a cobble splash, and the water will then sheet flow into adjacent agricultural fields. In areas where sheet flow is not feasible, a swale will be excavated and connected to a drainage canal.

Relief wells generally are spaced at 50- to 100-foot intervals, dependent upon the amount of under-seepage, and extend to depths of 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. The drill rig likely will be an all-terrain, track-mounted rig that could access the well locations from the levee toe.

Piezometers, also called monitoring wells, could be installed between relief wells to allow monitoring of groundwater levels to ensure the wells are relieving the pressure within the aquifer.

Areas along the levee toe may be used to store equipment and supplies during construction of each well. Construction of each well and the lateral drainage system typically takes 10–20 days. Additional time may be required for site restoration. Post-construction, areas used for construction staging, the levee slopes, and any other disturbed areas are hydroseeded.

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 surrounding soil mass. This measure involves placing fill soil in such depressions and ditches to remove localized susceptibility to seepage. Construction consists of clearing, grubbing, and stripping the ditch or depression surface to remove vegetative material. Bulldozers then excavate and stockpile borrow material from a nearby borrow site.

Front-end loaders load haul trucks, and the haul trucks subsequently transport the borrow material to the fill site. The depression or ditch may be further excavated to provide a surface that the fill soil may be keyed into. The haul trucks dump the material and motor graders or bulldozers smooth the material level with the surrounding land surface. An excavator may also be used for placement. Sheepsfoot rollers compact the material, and water trucks distribute water over the material to ensure proper moisture for compaction.

Removal and Relocation of Pacific Gas & Electric Facilities

Prior to and/or concurrent with levee rehabilitation construction, Pacific Gas and Electric Company (PG&E) will need to remove and relocate facilities located within the footprint of the FRWLP. PG&E's utility relocations will need to occur in advance of SBFCA's construction activities at any given location. Construction sequencing for SBFCA's work will be dynamic throughout SBFCA's project planning and design. PG&E's construction schedule will be determined by further engineering to clarify and determine efficacy of site-specific measures; the availability of funding for FRWLP; easement and right-of-way acquisition; availability of borrow material for the levee improvement activities; and/or environmental clearances based on wildlife presence, lifecycle activity, and location of habitats. PG&E's construction schedule will be further influenced by utility operation and maintenance constraints, particularly for relocation activities that require taking existing facilities temporarily out of service. As necessary, geotechnical mitigation measures will be incorporated into construction design to ensure that utility facilities effectively co-exist with the FRWLP, relocation will be done where this is not feasible.

For PG&E's electrical transmission and distribution activities, PG&E will install and remove new electrical transmission and distribution poles. Electrical transmission and distribution pole removal is conducted by a line crew, who typically access each pole site with a line truck and trailer or a boom truck, except in those instances when the pole is located on the levee crown (a crane may be used in those instances). On average, removal of vegetation up to 50 feet from the toe of the levee will need to occur to accommodate pole installation activities; this distance may be greater in instances where the installation activity is located further than 30 feet from the levee toe. After vegetation is cleared, PG&E will remove and replace the existing wood distribution and power poles and related equipment.

For PG&E's natural gas transmission and distribution activities, PG&E will install gas transmission and distribution steel pipe. This also typically includes the removal and disposal of existing pipe. Other typical types of gas transmission and distribution equipment that may be installed include Electric Test System/ Gas Cathodic Test System meter stations for future pipe monitoring purposes, and pipeline markers at angle points and at levee crossing locations. Clearing and grading operations in support of installation of natural gas facilities typically involve preparation of the right-of-way, including vegetation removal, debris disposal, and land leveling. Installation sites are backfilled using sand to create a 6-inch insulation zone around the pipe and then covered by native soil from the project area. In some instances, a crane may be required to place pipe at crossing sites located at the crowns of the levees. Dump trucks will be used to transport sand and soil materials. Spoil piles may be temporarily placed onsite while the installation activities are occurring.

Hydrostatic testing associated with installation of natural gas facilities will be performed to test the strength of the new pipeline. Test water intake and discharge will be performed in accordance with all regulations and permit requirements.

Typical electrical and natural gas transmission and distribution project work schedules are comprised of an average 9-hour day, at an average of 6 days per week per crew. Typical crews consist of 3 to 5 members.

PG&E work areas will be about 125 feet by 125 feet in diameter and located in close proximity to installation activity locations. On average, PG&E will require up to 10 work areas per contract phase. PG&E will utilize the work areas identified by SBFCA whenever possible. Typically, PG&E project access is achieved through existing public and private roads. Removal of vegetation to utilize access roads by PG&E equipment and transport of facilities may be required. PG&E currently owns easements along the entire project corridor. However, temporary and/or permanent easements as required for construction and maintenance of these facilities are being acquired by SBFCA.

Encroachment and Vegetation Removal

Encroachments - Existing facilities found within the footprint of an alternative may require removal and replacement nearby, abandonment, or relocation. Encroachments are numerous (over 400 identified) along the Feather River West Levee and may need to be addressed if they present a threat to the stability of the levee, do not currently comply with the levee encroachment criteria, or will be disrupted or otherwise impacted by construction activities. Typical encroachments include pressure pipelines (water supply pipelines from waterside pump stations and drainage pipelines from landside drainage pump stations), gravity drainage pipes, gas lines, telephone utilities, overhead utilities, structural encroachments, and other types and variations. Debris from structure and embankment fill material of poor quality will be hauled offsite to a permitted disposal site within 20 miles of the removal location.

Vegetation Removal - Vegetation removal will involve stripping of herbaceous (non-woody) vegetation by bulldozer. Vegetation will be removed only from within the direct construction footprint and the minimum areas necessary for staging and access. Consistent with the Central Valley Flood Protection Plan guidance for levee repair or improvement, vegetation will be removed to meet specific project objectives. Any vegetation removed as part of direct construction activities will not be replaced at that location, but will involve offsite, in-kind mitigation, to be determined in consultation with the appropriate resource agencies.

In accordance with the State of California's Urban Levee Design Criteria, at a minimum, all roots larger than 1.5 inches in diameter that are within 3 feet of the perimeter of the tree trunk will be removed. Immature trees less than 4 inches in diameter at breast height that will be removed may be cut off at or below ground level, generally without root removal. Any excavation will be

backfilled with engineered fill using appropriate placement, moisture conditioning, and compaction methods. Additional measures for removing non-compliant vegetation are listed below.

- Ensure that the resulting void is free of organic debris.
- Cut poles to salvage propagation materials for replanting, such as willows and cottonwoods.
- Conduct hand clearing using chainsaws and trimmers.
- Conduct mass clearing using bulldozers.

Debris from vegetation removal will be hauled offsite to a permitted disposal site within 20 miles of the removal location.

Construction Staging, Access, and Temporary Facilities

Staging areas will only be provided within the Action Area. Staging areas will be used for staging construction activities and to provide space to house construction equipment and materials, offices, employee parking, and other uses needed for construction of the proposed project.

To facilitate construction, temporary earthen ramps will be constructed for equipment access between the levee crown and the staging area(s). The earthen ramps will be removed when construction is complete.

Cutoff wall construction requires temporary establishment of an onsite slurry batch plant that will occupy about 1–2 acres. Batch plants will be located at about 1-mile intervals along the levee. The batch plant site will likely contain tanks for water storage, bulk bag supplies of bentonite, bentonite storage silos, a cyclone mixer, pumps, and two generators that meet air quality requirements. Slurry ingredients will be mixed with water and the mixture will be pumped from tanks through pipes to the construction work sites. The batch plant will produce two different slurry mixes, one for trench stabilization and one for the soil backfill mix. Therefore, two slurry pipes or hoses, typically 4- or 6-inch high-density polyethelene pipes, will be laid on the ground and will extend to all work sites. An additional pipe may be used to supply water to the work sites.

Staging, access, and other temporary construction areas will be located away from wetlands, woody vegetated areas, wildlife species habitat, known cultural resources, or other sensitive areas and will be limited to disturbed or ruderal grasslands subject to review by Corps and resource agencies.

Material Importation, Reuse, and Borrow

Materials imported to the FRWLP construction area will include water, bentonite, cement, incidental construction support materials, aggregate base rock, asphalt, concrete, hydroseed, and embankment fill soil. Large quantities of fill soil, or borrow will be required. To meet borrow demands, embankment fill material excavated as part of construction will be evaluated for reuse. Embankment fill material deemed suitable will be used as part of levee reconstruction and berms. The total volume of material required is 1,500,000 cubic yards.

SBFCA has explored the option of purchasing fill or borrow material from a local commercial quarry or other permitted source; however, there are not currently any sites near the Action Area that could supply the volume and type of material required. Consequently, SFBCA plans to purchase fill from local landowners willing to sell borrow material.

Six borrow sites have been identified in the Action Area. Each site was investigated to determine the quantity of available material, hauling distance, material composition, groundwater elevation, and prospects for acquisition. Sufficient fill volume is estimated to be present within an approximate 10-mile, one-way haul distance from the area of construction.

SBFCA will maximize the potential borrow sites' use through gradation, placement, and treatment so that they could continue to be used for their current use or otherwise returned to their pre-project condition. As part of borrow operations, the upper 4–6 inches of topsoil will be set aside and replaced after construction in each construction season. After the FRWLP is completed, the borrow site will be re-contoured and reclaimed.

Through outreach efforts, SBFCA identified a number of sites owned by individuals or government agencies willing to sell their property or provide material on a cubic yard basis. Each borrow site is described below.

North Valley Property - The North Valley property is owned by North Valley Properties, LLC and is located south of Ella Road between Feather River Boulevard and Arboga Road. The Wheeler Ranch housing development is proposed at the site. Borrow for the FRWLP will be taken from the northeast corner of the property to create a 24.5 acre detention pond (referred to as the Drainage Basin C Regional Detention Pond, but commonly referred to as the South Ella Detention Pond). The Ella Basin is being constructed as part of Reclamation District No. 784's Master Drainage Plan. Historically, the site was cultivated for agricultural purposes. Currently, the site is disked ruderal grassland with some roads cut in the southern portion of the property for the Wheeler Ranch development. The depth of excavation is anticipated to be 15–20 feet and the yield of material from this site could be 400,000–500,000 cubic yards. Borrow material from this site will be used for work in Contracts B and C. If borrow material is remaining, it may also be used for Contract D. The haul route to Contract C will use existing roads. The post-project land use of the site will be a regional detention pond for Reclamation District No. 784.

Marler Property - The Marler property is a 10-acre property at Johnson Road near Messick Road, north of Star Bend and south of Shanghai Bend. The site is currently an orchard. The depth of

excavation could be upwards of 6 feet. The yield of material from this site could be 75,000 cubic yards. The haul route will use existing roads. The post-project land use for the property will be agricultural production, likely row crops or orchard.

Lanza Property - The Lanza property is 40 acres in size and is currently farmed in field/row crops. It is located at North Township Road and Pease Road south of Live Oak and north of Yuba City. The site has not yet been investigated to determine the types of materials present. Excavation of the site to a depth of 6 feet may occur. The yield of material from this site could be 200,000 cubic yards. The likely haul route will be along Pease Road directly east to the levee. The post-project land use for the property will be rice production.

City of Live Oak Detention Basin - Live Oak owns the property formerly known as the Caltrans Detention Basin Site located west of SR 99 and south of Paseo Avenue. The site is currently fallow. Live Oak intends to construct soccer fields and a stormwater detention basin at the site in 2013 or later. Although the site will require hauling for a short distance through a residential neighborhood, it is anticipated the residents will be amenable to the hauling as it will be a part of the public amenity constructed by Live Oak. This site is about 25 acres, and the depth of excavation is anticipated to be 3–6 feet. The yield of material from this site could be 125,000 cubic yards, and will likely be used for Contract C. Haul routes will use existing roads.

Live Oak (2012) reports that land at this location has historically been cultivated for agricultural purposes and reported that there was no evidence of any wetland or other sensitive plant or wildlife areas remaining onsite. No wetland features were identified during a preliminary wetland delineation of the area in December 2012. The previous agricultural use has displaced native species of plants and animals except those varieties capable of co-existing with humans in urban settings. The post-project use of the site will be a community park and stormwater detention basin facility.

Oroville Wildlife Area Dredge Tailings Area - This site is within the Oroville Wildlife Area and consists of several mounds of dredge tailings waterside of the existing levee. The material is suitable for use in seepage berms in Contract D. The availability of tailings in the area should be sufficient to meet the total deficit for berm material in these reaches. The excavation of the material will be coordinated to maximize hydraulic benefits from the reshaping of the overbank area. The site also represents an opportunity to provide waterside habitat enhancements. The useful area of this site could be about 75 acres and the depth of excavation could be upwards of 10 feet. The yield of material from this site could be 375,000 cubic yards. Hauling from this site will not take place on public roads. It is anticipated the contractor will use an existing waterside levee ramp (or create one), directly accessing the levee patrol road. The future land use for this site will be similar to its present day use (managed habitat area).

Construction Timing

Specific sequencing of construction will be dynamic throughout planning and design of the FRWLP, subject to change based on factors including the following.

- Further engineering in determining the clarity and efficacy of site-specific measures.

- Easement and right-of-way acquisition (where necessary).
- Availability of proximate, suitable, and cost-effective borrow material.
- Environmental clearances based on wildlife presence, lifecycle activity, and location of habitats.

Based on current planning analysis for the FRWLP, construction will occur in more than one annual construction season (typically April 15 to November 30, subject to conditions). Although subject to change, the four contracts and their respective areas for construction of the FRWLP are identified below.

- Contract A, 2016 – 2017
- Contract B, 2014 – 2015
- Contract C, 2013 – 2014
- Contract D, 2014 – 2015

Construction is anticipated to occur in single 10-hour shifts, 6 days per week. An exception to this schedule is slurry cutoff wall construction, which is anticipated to occur in two 10-hour shifts (essentially 24-hour construction), 6 days per week. While actual construction will not occur between the two 10-hour shifts, equipment maintenance and preparations for the upcoming work shift will occur.

Conservation Measures

SBFCA will implement the following conservation measures to avoid and minimize effects on federally listed species. To ensure their implementation, the measures listed below will be included in the project specifications.

General

Conservation Measure 1: Conduct Mandatory Biological Resources Awareness Training for All Project Personnel and Implement General Requirements

Before any ground-disturbing work (including vegetation clearing and grading) occurs in the Action Area, a Service-approved biologist will conduct a mandatory biological resources awareness training for all construction personnel about federally-listed species that could potentially occur onsite (beetle and snake). The training will include the natural history, representative photographs, and legal status of each federally-listed species and avoidance and minimization measures to be implemented. Proof of personnel attendance will be provided to the Service within 1 week of the training. If new construction personnel are added to the project, the contractor will ensure that the new personnel receive the mandatory training before starting work. The subsequent training of personnel can include videotape of the initial training and/or the use of written materials rather than in-person training by a biologist. Requirements that will be followed by construction personnel are listed below.

- Where suitable habitat is present for listed species, SBFCA will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other means, and prohibit any construction-related traffic outside these boundaries.
- Project-related vehicles will observe the posted speed limit on hard-surfaced roads and a 10-mile-per-hour speed limit on unpaved roads during travel in the project construction area. Project-related vehicles and construction equipment will restrict off-road travel to the designated construction areas.
- All food-related trash will be disposed of in closed containers and removed from the project construction area at least once per week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the project site.
- No pets or firearms will be allowed in the project construction area.
- To prevent possible resource damage from hazardous materials such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.
- Any worker who inadvertently injures or kills a federally-listed species or finds one dead, injured, or entrapped will immediately report the incident to the biological monitor and construction foreman. The construction foreman will immediately notify SBFCA, who will provide verbal notification to the Sacramento Fish and Wildlife Office and the local CDFW warden or biologist within 1 working day. SBFCA will follow up with written notification to Service and CDFW within 5 working days. The biological monitor will follow up with SBFCA to ensure that the wildlife agencies were notified.
- The biological monitor will record all observations of federally-listed species on California Natural Diversity Database (CNDDB) field sheets and submit to CDFW.

Valley Elderberry Longhorn Beetle

Conservation measures for the beetle are based on Service's 1999 *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (Conservation Guidelines) (U.S. Fish and Wildlife Service 1999a).

Conservation Measure 2: Fence Elderberry Shrubs to be Protected and Monitor Fencing during Construction

Elderberry shrubs/clusters within 100 feet of the construction area that will not be removed will be protected during construction. A qualified biologist (i.e., with elderberry/beetle experience), under contract to SBFCA, will mark the elderberry shrubs and clusters that will be protected during construction. Orange construction barrier fencing will be placed at the edge of the respective buffer areas. The buffer area distances will be proposed by the biologist and approved by the Service. No construction activities will be permitted within the buffer zone other than those activities necessary to erect the fencing. Signs will be posted every 50 feet (15.2 meters) along the perimeter of the buffer area fencing. The signs will contain the following information:

This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment.

In some cases, where the elderberry shrub dripline is within 10 feet of the work area, k-rails will be placed at the shrub's dripline to provide additional protection to the shrub from construction equipment and activities. Temporary fences around the elderberry shrubs and k-rails at shrub driplines will be installed as the first order of work. Temporary fences will be furnished, constructed, maintained, and later removed, as shown on the plans, as specified in the special provisions, and as directed by the project engineer. Temporary fencing will be 4 feet (1.2 meters) high, commercial-quality woven polypropylene, orange in color.

Buffer area fences around elderberry shrubs will be inspected weekly by a qualified biological monitor during ground-disturbing activities and monthly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around elderberry shrubs throughout construction. Biological inspection reports will be provided to the project lead and the Service.

Conservation Measure 3: Conduct Beetle Surveys Prior to Elderberry Shrub Transplantation

Surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. Surveys will be conducted in accordance with the Conservation Guidelines (U.S. Fish and Wildlife Service 1999a). The biologist will survey the area surrounding the shrub to be transplanted to ensure that there are not additional elderberry shrubs that need to be removed. Surveys will consist of counting and measuring the diameter of each stem, and examining elderberry shrubs for the presence of beetle exit holes. Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to the Service. SBFCA plans to plant elderberry seedlings/cuttings and associated native plants prior to transplantation of elderberry shrubs. The data collected during the surveys prior to transplantation will be used to determine if SFBCA is exceeding their compensation needs or if additional plantings are necessary. Because the Proposed Action will be constructed in four separate contracts, elderberry survey data for each contract will be used to rectify any discrepancies in compensation for the previous contract and to ensure that SBFCA has minimized effects to the beetle.

Conservation Measure 4: Water Down Construction Area to Control Dust

SFBCA or the contractor will ensure that the project construction area will be watered down as necessary to prevent dirt from becoming airborne and accumulating on elderberry shrubs within the 100–foot buffer.

Conservation Measure 5: Compensate for Direct and Indirect Effects on Valley Elderberry Longhorn Beetle Habitat

Before construction begins, SBFCA will compensate for direct effects on elderberry shrubs by transplanting shrubs that cannot be avoided to a Service-approved conservation area (described below). Elderberry seedlings or cuttings and associated native species will also be planted in the conservation area. Each elderberry stem measuring 1 inch or greater in diameter at ground level that is adversely affected (i.e., transplanted or destroyed) will be replaced, in the conservation

area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). The numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether the shrub lies in a riparian or non-riparian area. Stock of either seedlings or cuttings will be obtained from local sources (including the Action Area if acceptable to the Service).

At the discretion of the Service, shrubs that are unlikely to survive transplantation because of poor condition or location, or a plant that will be extremely difficult to move because of access problems, may be exempted from transplantation. In cases where transplantation is not possible, compensation ratios will be increased to offset the additional habitat loss.

The relocation of the elderberry shrubs will be conducted according to Service-approved procedures outlined in the Conservation Guidelines (U. S. Fish and Wildlife Service 1999a). Elderberry shrubs within the project construction area that cannot be avoided will be transplanted during the plant's dormant phase (November through the first 2 weeks of February). A qualified biological monitor will remain onsite while the shrubs are being transplanted.

Property inaccessibility and the high density of vegetation along portions of the Feather River riparian corridor limited the number of elderberry shrubs that could be surveyed (73 shrubs were surveyed). For this reason, compensation for the removal of 91 shrubs was estimated based on the average number of stems in each stem diameter range for the 73 shrubs that could be surveyed. Those average shrub stem counts are as follows.

- Number of stems $\geq$1 inch and $\leq$3 inches = 4.
- Number of stems >3 inches and <5 inches = 1.
- Number of stems $\geq$5 inches = 1.

Table 1 shows the estimated compensation. Because the shrubs are located in riparian habitat and did not have exit holes, the compensation ratios for these conditions were used. As noted in Table 1, one elderberry shrub will need to be transplanted prior to the start of work in 2013 (in Reach 13) and outside of the elderberry dormancy period.

Based on the information in Table 1, the conservation area will be at least 12.15 acres in size to accommodate about 91 elderberry shrubs, 1,470 elderberry cuttings or seedlings, and 1,470 native plants. The conservation area in which the transplanted elderberry shrubs and seedlings are planted will be protected in perpetuity as habitat for the beetle.

Evidence of beetle occurrence in the conservation area, the condition of the elderberry shrubs in the conservation area, and the general condition of the conservation area itself will be monitored over a period of 10 consecutive years or for 7 years over a 15-year period from the date of transplanting. SBFCA will be responsible for funding and providing monitoring reports to the Service in each of the years in which a monitoring report is required. As specified in the Conservation Guidelines, the report will include information on timing and rate of irrigation, growth rates, and survival rates and mortality.

Table 1. Elderberry Stem Sizes and Compensation

Location	Stems (maximum diameter at ground level)	Exit Hole on Shrub (Yes or No)	Elderberry Seedling Ratio	Associated Native Plant Ratio	Multiplier for transplanting between June 15 – August 15	Number of Stems	Required Elderberry Plantings	Required Associated Native Plant Plantings
Riparian	stems ≥1" & ≤3"	No	2:1	1:1	No	360	720	720
Riparian	stems > 3" & <5"	No	3:1	1:1	No	90	270	270
Riparian	stems > 5"	No	4:1	1:1	No	90	360	360
2013 Construction - Reach 13								
Riparian	stems ≥1" & ≤3"	No	2:1	1:1	2.5	1	5	5
Riparian	stems > 3" & <5"	No	3:1	1:1	2.5	2	15	15
Riparian	stems > 5"	No	4:1	1:1	2.5	10	100	100
Total replacement plantings							1,470	1,470
Total elderberry shrubs to be transplanted								91
2940 /10 = 294 valley elderberry longhorn beetle credits or 12.15 acres								

To meet the success criteria specified in the Conservation Guidelines, a minimum survival rate of 60% of the original number of elderberry replacement plantings and associated native plants must be maintained throughout the monitoring period.

Proposed Conservation Area

SBFCA proposes to transplant elderberry shrubs to the existing 48.5-acre Star Bend Conservation Area, located on the west levee of the Feather River, about 6 miles south of Yuba City. In 2009, Levee District 1 of Sutter County proposed to construct the Feather River Setback Levee and Habitat Enhancement Project at Star Bend to replace a portion of existing levee that poses a high risk of failure in order to decrease the flood stage, velocity, and scour potential; increase and improve floodplain habitat; and improve habitat connectivity between the Abbot Lake and O'Connor Lakes Units of CDFW's Feather River Wildlife Area. The Star Bend project created 48.5 acres of floodplain habitat, which included habitat enhancement and onsite compensation for impacted elderberry shrubs.

In 2009, River Partners and Stillwater Sciences prepared a *Habitat Enhancement Plan for the Feather River Setback Levee and Habitat Enhancement Project at Star Bend* to be implemented by Levee District 1. It provides further information on the conditions at the time the site was proposed. About 20 acres have been used for elderberry transplants and associated native plants. In early 2012, a fire at the Star Bend site damaged portions of the site; however, elderberry shrub

planting losses were minimal. The remaining 28.5 acres are available at the conservation area for compensating for impacts on elderberry shrubs from construction of the FRWLP. The long-term goal of the conservation area is to merge this area with CDFW's adjoining O'Conner Lakes and Abbott Lakes Wildlife Units. SBFCA will prepare a mitigation and monitoring plan for the 28.5 acres that are available and will be used as a conservation area for effects to the beetle, as well as riparian impacts. This plan is currently being coordinated with the Service, Corps, and CDFW. Additionally, SBFCA will obtain a conservation easement for the 28.5 acre conservation area.

Giant Garter Snake

Conservation Measure 6: Conduct Construction Activities during the Active Period for Giant Garter Snake

Construction activity within giant garter snake aquatic and upland habitat (200 feet of aquatic habitat) will be conducted during the snake's active period (May 1–October 1). During this timeframe, potential for injury and mortality are lessened because snakes are actively moving and avoiding danger. The only work that will be conducted outside of the active season is levee slope flattening within the Sutter-Butte Canal in Reaches 26–28 (scheduled for 2016) and pipe reconstruction at two sites in the same reaches because these activities must be conducted when the canal is dry (February–March). Additional protective measures will be implemented at these locations (see Conservation Measure 14 below).

Conservation Measure 7: Install and Maintain Exclusion and Construction Barrier Fencing around Suitable Giant Garter Snake Habitat

To reduce the likelihood of giant garter snakes entering the construction area, SBFCA will install exclusion fencing and orange construction barrier fencing along the portions of the construction area that are within 200 feet of suitable aquatic and upland habitat. The exclusion and construction barrier fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during this activity.

The construction specifications will require that SBFCA or its contractor retain a qualified biologist to identify the areas that are to be avoided during construction. Areas adjacent to the directly affected area required for construction, including staging and access, will be fenced off to avoid disturbance in these areas. Before construction, the contractor will work with the qualified biologist to identify the locations for the barrier fencing and will place flags or flagging around the areas to be protected to indicate the locations of the barrier fences. The protected area will be clearly identified on the construction specifications. The fencing will be installed the maximum distance practicable from the aquatic habitat areas and will be in place before construction activities are initiated.

The exclusion fencing will consist of 3-foot-tall silt fencing buried 6 inches below ground level. The exclusion fencing will ensure that giant garter snakes are excluded from the construction area and that suitable upland and aquatic habitat is protected throughout construction. The construction barrier fencing will be commercial-quality, woven polypropylene, orange in color,

and 4 feet high (Tensor Polygrid or equivalent). The fencing will be tightly strung on posts with a maximum of 10-foot spacing.

Barrier and exclusion fences will be inspected daily by a qualified biological monitor during ground-disturbing activities and weekly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around giant garter snake habitat throughout construction. Biological inspection reports will be provided to the project lead and the Service.

Conservation Measure 8: Minimize Potential Impacts on Giant Garter Snake Habitat

SBFCA will implement the following measures to minimize potential impacts on giant garter snake habitat.

- Staging areas will be located at least 200 feet from suitable giant garter snake habitat.
- Any dewatered habitat will remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.
- Vegetation clearing within 200 feet of the banks of suitable giant garter snake aquatic habitat will be limited to the minimum area necessary. Avoided giant garter snake habitat within or adjacent to the Action Area will be flagged and designated as an environmentally sensitive area, to be avoided by all construction personnel.
- The movement of heavy equipment within 200 feet of the banks of suitable giant garter snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance.

Conservation Measure 9: Prepare and Implement a Stormwater Pollution Prevention Plan

SBFCA will prepare a stormwater pollution prevention plan (SWPPP) that describes the BMPs that will be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP will be prepared prior to commencing earth-moving construction activities. This will also comply with the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) general construction activity stormwater permit.

The specific BMPs that will be incorporated into the erosion and sediment control plan and SWPPP will be site-specific and will be prepared by the construction contractor in accordance with the California Regional Water Quality Control Board Field Manual. However, the plan likely will include, but not be limited to, one or more of the following standard erosion and sediment control BMPs.

- **Timing of construction.** The construction contractor will conduct all construction activities during the typical construction season to avoid ground disturbance during the rainy season.
- **Staging of construction equipment and materials.** To the extent possible, equipment and materials will be staged in areas that have already been disturbed.

- **Minimize soil and vegetation disturbance.** The construction contractor will minimize ground disturbance and the disturbance/destruction of existing vegetation. This will be accomplished in part through the establishment of designated equipment staging areas, ingress and egress corridors, and equipment exclusion zones prior to the commencement of any grading operations.
- **Stabilize grading spoils.** Grading spoils generated during the construction will be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If necessary, temporary stockpiles may be covered with an appropriate geotextile to increase protection from wind and water erosion.
- **Install sediment barriers.** The construction contractor may install silt fences, fiber rolls, or similar devices to prevent sediment-laden runoff from leaving the construction area. Natural/biodegradable erosion control measures (i.e., coir rolls, straw wattles or hay bales) will be used. Plastic monofilament netting (erosion control matting) will not be allowed because animals can become caught in this type of erosion control material.
- **Stormwater drain inlet protection.** The construction contractor may install silt fences, drop inlet sediment traps, sandbag barriers, and/or other similar devices.
- **Permanent site stabilization.** The construction contractor will install structural and vegetative methods to permanently stabilize all graded or otherwise disturbed areas once construction is complete. Structural methods may include the installation of biodegradable fiber rolls and erosion control blankets. Vegetative methods may involve the application of organic mulch and tackifier and/or the application of an erosion control seed mix. Implementation of a SWPPP will substantially minimize the potential for project-related erosion and associated adverse effects on water quality.

Conservation Measure 10: Prepare and Implement a Bentonite Slurry Spill Contingency Plan (Frac-Out Plan)

Before excavation begins, SBFCA will ensure the contractor will prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). The plan will be subject to approval by the Corps, Service, and SBFCA before excavation can begin. The BSSCP will include measures intended to minimize the potential for a frac-out (short for "fracture-out event") associated with excavation and tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and "minimum-effect" response in the event of a frac-out and release of excavation fluid (i.e., bentonite). The BSSCP will require, at a minimum, the following measures.

- If a frac-out is identified, all work will stop, including the recycling of the bentonite fluid. In the event of a frac-out into water, the location and extent of the frac-out will be determined, and the frac-out will be monitored for 4 hours to determine whether the fluid congeals (bentonite will usually harden, effectively sealing the frac-out location).
- NMFS, the Service, CDFW, and the RWQCB will be notified immediately of any spills and will be consulted regarding clean-up procedures. A Brady barrel will be onsite and used if a frac-out occurs. Containment materials, such as straw bales, also will be onsite prior to and during all operations, and a vacuum truck will be on

retainer and available to be operational onsite within notice of 2 hours. The site supervisor will take any necessary follow-up response actions in coordination with agency representatives. The site supervisor will coordinate the mobilization of equipment stored at staging areas (e.g., vacuum trucks) as needed.

- If the frac-out has reached the surface, any material contaminated with bentonite will be removed by hand to a depth of 1-foot, contained, and properly disposed of, as required by law. The drilling contractor will be responsible for ensuring that the bentonite is either properly disposed of at an approved Class II disposal facility or properly recycled in an approved manner.
- If the bentonite fluid congeals, no other actions, such as disturbance of the streambed, will be taken that will potentially suspend sediments in the water column.
- The site supervisor has overall responsibility for implementing this BSSCP. The site supervisor will be notified immediately when a frac-out is detected. The site supervisor will be responsible for ensuring that the biological monitor is aware of the frac-out, coordinating personnel, response, cleanup, regulatory agency notification and coordination to ensure proper clean-up, disposal of recovered material, and timely reporting of the incident. The site supervisor will ensure all waste materials are properly containerized, labeled, and removed from the site to an approved Class II disposal facility by personnel experienced in the removal, transport, and disposal of drilling mud.
- The site supervisor will be familiar with the contents of this BSSCP and the conditions of approval under which the activity is permitted to take place. The site supervisor will have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan. The site supervisor will ensure that a copy of this plan is available (onsite) and accessible to all construction personnel. The site supervisor will ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out, prior to commencement of excavation operations.

Conservation Measure 11: Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan

A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable water or adjoining shorelines. SBFCA or its contractor will develop and implement an SPCCP to minimize the potential for and effects from spills of hazardous, toxic, or petroleum substances during construction and operation activities. The SPCCP will be completed before any construction activities begin. Implementation of this measure will comply with State and Federal water quality regulations. The SPCCP will describe spill sources and spill pathways in addition to the actions that will be taken in the event of a spill (e.g., an oil spill from engine refueling will be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as doubled-walled tanks, containment berms, emergency shut-offs, drip pans, fueling procedures and spill response kits. It will also describe how and when employees are trained in proper handling procedure and spill prevention and response procedures.

SBFCA will review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. SBFCA will notify its contractors immediately if there is a non-compliance issue and will require compliance.

The Federal reportable spill quantity for petroleum products, as defined in 40 CFR 110, is any oil spill that results in one or more of the following.

- Violates applicable water quality standards.
- Causes a film or sheen on or discoloration of the water surface or adjoining shoreline.
- Causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.

If a spill is reportable, the contractor's superintendent will notify SBFCA, and SBFCA will take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. A written description of reportable releases must be submitted to the Central Valley RWQCB. This submittal must contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases will be documented on a spill report form.

Conservation Measure 12: Conduct Preconstruction Surveys and Monitoring for Giant Garter Snake

Prior to ground-disturbing activities within 200 feet of suitable habitat, a Service-approved biological monitor will conduct a preconstruction survey of suitable aquatic and upland habitat and inspect exclusion and orange barrier fencing to ensure they are both in good working order each morning. If any snakes are observed within the construction area at any other time during construction the Service-approved biological monitor will be contacted to survey the site for giant garter snakes. The biological monitor will have the authority to stop construction activities until appropriate corrective measures have been completed or it is determined that the snake will not be harmed. Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own. If unable to move away on their own, trapped or injured giant garter snakes will be only be removed by a biologist with a federal 10(a)1(a) permit which allows them to handle the snake and will be placed in a location determined through discussions with the Service. The biological monitor will immediately report the finding of a snake to Service by phone and will provide a written account of the details of the incident within 24 hours.

Once all initial ground-disturbing activities are completed, the biological monitor will perform weekly checks of the site for the duration of construction in order to ensure that construction barrier fences and exclusion fences are in good order, trenches are being covered, project personnel are conducting checks beneath parked vehicles prior to their movement, and that all other required biological protection measures are being complied with. The biological monitor will document the results of monitoring on construction monitoring log sheets, which will be provided to the Service within 1 week of each monitoring visit.

Conservation Measure 13: Provide Escape Ramps or Cover Open Trenches at the End of Each Day

To avoid entrapment of giant garter snake, thereby preventing injury or mortality resulting from falling into trenches, all excavated areas more than 1 foot deep will be provided with one or more escape ramps constructed of earth fill or wooden planks at the end of each workday. If escape ramps cannot be provided, then holes or trenches will be covered with plywood or other hard material. The biological monitor or construction personnel designated by the contractor will be responsible for thoroughly inspecting trenches for the presence of giant garter snakes at the beginning of each workday. Capture and relocation of trapped or injured individuals can only be attempted by personnel or individuals with current Service recovery permits pursuant to section 10(a)1(A) of the Act.

Conservation Measure 14: Implement Additional Protective Measures during Work in Suitable Habitat during the Giant Garter Snake Dormant Period

SBFCA will implement additional protective measures during time periods when work must occur during the giant garter snake dormant period (October 2–April 30), when snakes are more vulnerable to injury and mortality. It is expected that these additional measures will be implemented during levee slope flattening within the Sutter-Butte Canal in Reaches 26–28 (scheduled for 2016) and pipe reconstruction adjoining the canal at two sites in the same reaches during February–March, and if construction activities extend to the period between October 2 and November 1. SBFCA will implement additional protective measures when conducting work in suitable giant garter snake habitat between October 2 and April 30.

- A full-time Service-approved biological monitor will be onsite for the duration of construction activities.
- All emergent vegetation within the Sutter-Butte Canal on the levee side, and vegetation within 200 feet of the canal will be cleared prior to the giant garter snake hibernation period (i.e., vegetation clearing must be completed by October 1 for following winter work).
- Exclusion fencing will be installed around the perimeter of the work area and across the Sutter-Butte Canal where construction activities associated with levee slope flattening and pipe reconstruction activities will occur. The fencing should enclose the work area to the maximum extent possible to prevent giant garter snakes from entering the work area. Fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during fence installation. The Service-approved biological monitor will work with the contractor to determine where fencing should be placed and will monitor fence installation. The exclusion fencing will consist of 3-foot-tall erosion fencing buried 4– 6 inches below ground level. The exclusion fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area (between canal and existing levee).
- Portions of the Sutter-Butte Canal that are temporarily disturbed during construction will be revegetated with emergent vegetation and adjacent disturbed upland habitat will be revegetated with native grasses and forbs after construction is complete.

Conservation Measure 15: Restore Temporarily Disturbed Aquatic and Upland Habitat to Pre-Action Conditions

Upon completion of the proposed project, SBFCA will restore 42.52 acres of suitable aquatic habitat and 118.80 acres of suitable upland habitat for the giant garter snake to pre-project conditions. Restoration of aquatic vegetation and annual grassland will be detailed in a mitigation and monitoring plan that will be reviewed and approved by the Corps and Service prior to the start of construction. Habitat will be restored within one season (defined as May 1–October 1) and providing vegetative cover within 1 year of construction beginning in that area.

Conservation Measure 16: Compensate for Permanent Loss of Aquatic Habitat for Giant Garter Snake

SBFCA will compensate for the permanent loss of 0.004 acre of suitable aquatic habitat for giant garter snake by purchasing preservation credits equal to 0.012 acre of giant garter snake habitat at Westervelt Ecological Services' Sutter Basin Conservation Bank in Sutter County. This bank has available giant garter snake credits and is approved by both the Service and CDFW.

The 0.012 acre of habitat at the conservation bank will be protected in perpetuity for giant garter snake. Prior to the start of construction (excluding Reach 13, as there is no giant garter snake habitat in this reach), SBFCA will provide funding to Westervelt Ecological Services for preservation credits equivalent to 0.012 acre of giant garter snake habitat at the Sutter Basin Conservation Bank. The transaction will take place through a purchase and sale agreement, and funds must be transferred within 30 days, and before any construction activities are initiated. SBFCA will provide the Service and CDFW with copies of the credit sale agreement and fund transfer.

Analytical Framework for the Jeopardy Analysis

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the beetle's and snake's range-wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the beetle and the snake in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the beetle and snake; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the beetle and snake; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the beetle and snake.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the beetle's and snake's current status, taking into account any cumulative effects, to determine if implementation of the proposed

action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the beetle and snake.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the beetle and snake and the role of the action area in the survival and recovery of the beetle and snake as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Status of the Species

Valley Elderberry Longhorn Beetle

Please refer to the *Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus) 5-year Review: Summary and Evaluation* (Service 2006) for the current status of the species.

Giant Garter Snake

Please refer to the *Giant Garter Snake (Thamnophis gigas) 5-year Review: Summary and Evaluation* (Service 2012) for the current status of the species.

Environmental Baseline

Valley Elderberry Longhorn Beetle

The closest beetle occurrence in the CNDDB (2013) is about 0.5 mile from the proposed project. Suitable habitat for the beetle (in the form of elderberry shrubs) exists in numerous places along the 41 miles of proposed levee repair. A total of 267 elderberry shrubs were mapped within the action area. Many others exist at various locations between the levee and the river. Of these SBFCA is proposing to avoid 175 elderberry shrubs and transplant 91 elderberry shrubs. Because the action area is within the range of the species, there are known occurrences from the vicinity of the action area, and suitable habitat is present, the Service concludes that it is reasonably likely for the beetle to occupy the action area.

Giant Garter Snake

The *Draft Recovery Plan for the Giant Garter Snake* subdivides the range of the species into four recovery units (Service 1999b). The action area for the proposed project is located within the Sacramento Valley Recovery Unit. There are 20 records of the snake within 5 miles of the action area. The closest occurrence documented in the CNDDB is 2 miles from the action area. Snakes have the potential to occur within the action area because suitable aquatic and upland habitat is present as it is hydrologically connected to areas that support rice agriculture and areas where the snake has previously been detected. The action area is a long corridor that occasionally has irrigation ditches, which run parallel to the levee for limited stretches. The main threat to the snake in the action area is loss of habitat or connectivity due to channel and levee maintenance.

Effects of the Proposed Action

Valley Elderberry Longhorn Beetle

Ninety-one elderberry shrubs will be removed and transplanted. The 91 affected shrubs have 361 stems between 1 and 3 inches, 92 stems between 3 and 5 inches and 100 stems greater than 5 inches at ground level.

Loss of an elderberry shrub or even a stem can affect the beetle breeding and feeding because adult beetles rely solely on elderberry foliage and flowers for food and must lay their eggs on elderberry stems to successfully reproduce.

Transplantation of elderberry shrubs that are or could be used by beetle larvae is expected to adversely affect the beetle. Beetle larvae will be killed or the beetle's life cycle will be interrupted during or after the transplanting process. For example:

1. Transplanted elderberry shrubs may experience stress or become unhealthy due to changes in soil, hydrology, microclimate, or associated vegetation. This may reduce their quality as habitat for the valley elderberry longhorn beetle, or impair their production of habitat-quality stems in the future.

2. Elderberry shrubs may die as a result of transplantation.

3. Branches containing larvae may be cut, broken, or crushed as a result of the transplantation process.

SBFCA has proposed to transplant one shrub outside of the elderberry shrub's dormant season (November 1 to February 15). To offset the increased risk of the transplantation not being successful SBFCA has proposed to plant 2.5 times the number of elderberry seedlings at the Star Bend Conservation Area.

Temporal loss of habitat will occur. Although conservation measures for effects on the beetle will involve creation or restoration of habitat, it generally takes 5 or more years for elderberry plants to become large enough to support beetles, and it may take 25 years or longer for riparian habitats to reach their full value. Temporal loss of habitat may cause fragmentation of habitat and isolation of subpopulations.

Permanent and temporary habitat loss adversely affects the beetles breeding and foraging requirements. Habitat creation and transplantation of the shrubs will minimize these effects. Success of a restoration site has been linked to presence of transplanted elderberry shrubs that have served to colonize a newly created riparian habitat. Transplants that survive also provide diversity within the conservation area as they are older, larger shrubs within the plantings of young small elderberry seedlings. The Star Bend Conservation Area will be protected with a conservation easement and managed in perpetuity for riparian habitat including valley elderberry longhorn beetle habitat, through development of the *Feather River West Levee Project Mitigation and Monitoring Plan.*

Giant garter snake

Aquatic habitat for the snake near the levee construction varies along the 41 miles of the proposed project. Small areas of aquatic habitat are present in Contract A and C and they are hydrologically connected to areas that support habitat for the snake (rice). Contract D has the largest amount of snake aquatic habitat as the Sutter Butte Canal parallels the levee for longer lengths. Canal filling due to cutoff wall construction will permanently fill 0.004 acre of snake aquatic habitat. Upland habitat around this aquatic habitat will be temporarily disturbed but returned to pre-project condition within one year. Temporary effects will result from temporary fill of aquatic habitat for construction access, reshaping the slope of the Sutter Butte Canal and adjacent levee, and degradation and reconstruction of the levee. These activities will temporarily affect 6.81 acres of aquatic habitat. Levee degradation and reconstruction will temporarily affect 112.47 acres of upland habitat. All temporarily affected areas will be restored to pre-project conditions within the same year the disturbance will occur. This will minimize effects to giant garter snakes because the amount of time the habitat will be unavailable to the snake will be minimized. Permanently affected habitat, such as the canals that will be made smaller will be offset by purchasing 0.012 acre of giant garter snake habitat at Westervelt Ecological Services' Sutter Basin Conservation Bank in Sutter County. None of the borrow sites in the project description have upland or aquatic giant garter snake habitat.

The majority of the construction work will occur during the giant garter snake active season (May 1 to October 1). Increased construction activity in areas where snakes are known to occur could expose snakes to increased risks of injury and mortality from predation, exposure, vehicular traffic, and construction equipment. Because snakes are more mobile during the active season, these effects should be lessened. There are a few activities which SBFCA could not construct during the active season. Because of cooler temperatures in the inactive season (October 1 to May 1), the snake is not as mobile and is most frequently found within burrows. Ground disturbing activities during this timeframe will increase the likelihood of snake mortality when the burrows are disturbed with heavy equipment. SBFCA has proposed to disturb (clear and grub) the out of season work area and place exclusion fencing around the work area during the active season which will create an area that will not support overwintering snakes (lack of burrows). This will minimize the chance of injuring or killing an overwintering snake during out of season construction. This will only occur on one side of the canal, leaving the other side of the canal available as overwintering habitat for the snake.

Temporary effects within the action area will affect both aquatic and upland snake habitat. In some locations degradation of the levee could cause soil to fall into the aquatic habitat or fuel or oil leaks could also adversely affect the habitat and the snake. Placement of sediment fencing and implementing sediment and contaminant BMPs will lessen this effect. Levee degradation will temporarily make upland habitat unavailable to the snake during the active season. Snakes use upland habitat for thermoregulation both as a place to bask and as a place to escape extreme heat (burrows) and cover for shedding and giving birth to young. While snakes are more active during the summer months and more likely to move away from construction, some snakes may choose to remain where they are and therefore will be subject to mortality when construction activities are occurring. In addition to direct mortality, the upland habitat will be temporarily unavailable to the snake during construction. Even once construction is completed it will take a

year or two for the upland habitat to become completely functional for the snake, with burrows or crevices available for them to use. This is likely to result in disturbance, displacement, injury, and/or mortality of snakes. To lessen these effects SBFCA is implementing the conservation measures described above as well as affecting only one side of the canal. This will leave the other side of the canal intact and available to the snake for use, minimizing displacement of snakes. Additionally, because of the staging of construction not all of the upland habitat will be unavailable for use at one time. It will be staged as construction progresses through the various contracts.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed project are not considered in this section, because they require separate consultation pursuant to section 7 of the Act. Any future land use conversions and routine agricultural practices are not subject to Federal authorization or funding and may alter the habitat or result in take of listed valley elderberry longhorn beetle or giant garter snake and are, therefore, cumulative to the proposed project.

Conclusion

After reviewing the current status of the valley elderberry longhorn beetle and giant garter snake, the environmental baselines for these species, the effects of the proposed project, and the cumulative effects on this species, it is the Service's biological opinion that the proposed FRWLP, as described herein, is not likely to jeopardize the continued existence of these species. Although critical habitat has been designated for the beetle, the proposed action will not affect critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary for listed species of this biological opinion and must be implemented by the Corps and SBFCA in order for the exemption in section 7(o)(2)

to apply. The Corps has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Federal agency (1) fails to adhere to the terms and conditions of the incidental take statement, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Valley Elderberry Longhorn Beetle

The Service expects that incidental take of the valley elderberry longhorn beetle will be difficult to detect or quantify. The cryptic nature of this species and their relatively small body size make the finding of an injured or dead specimen unlikely. The species occurs in habitats that make them difficult to detect. Due to the difficulty in quantifying the number of beetles that will be taken as a result of the proposed action, the Service is quantifying take incidental to the project as the number of elderberry stems one inch or greater in diameter at ground level (beetle habitat) that will become unsuitable for beetles due to direct or indirect effects as a result of levee construction. Therefore, the Service estimates that all beetles inhabiting 91 elderberry plants containing stems 1 inch or greater at ground level (361 stems between 1-3 inches, 92 stems between 3 and 5 inches and 100 stems $\geq$5 inches; see Table 1 in the text) will be taken as a result of the proposed action.

Giant Garter Snake

The Service anticipates that incidental take of the snake will be difficult to detect or quantify for the following reasons: the snake is cryptically colored, secretive, and known to be sensitive to human activities. Snakes may avoid detection by retreating to burrows, soil crevices, vegetation, or other cover. Individual snakes are difficult to detect unless they are observed, undisturbed, at a distance. Most close-range observations represent chance encounters that are difficult to predict. It is not possible to make an accurate estimate of the number of snakes that will be harassed, harmed or killed during construction activities (staging areas, work on canal banks, levee degradation and reconstruction, soil borrow areas, and vehicle traffic to and from borrow areas). In instances when take is difficult to detect, the Service may use the quantification of acreage as a surrogate for the individuals that will be taken. Therefore, the Service anticipates take incidental to this project as the 0.004 acre of suitable habitat that will be permanently lost and the 119.28 acres (6.81 acres aquatic and 112.47 acres upland) of suitable snake habitat that will be temporarily lost. Upon implementation of the Reasonable and Prudent Measure, Terms and Conditions, and the Proposed Conservation Measures considered herein, incidental take within this acreage for the proposed project, will be exempt from the prohibitions described under Section 9 of the Act.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the beetle or snake.

Reasonable and Prudent Measures

The Service has determined that the following reasonable and prudent measure is necessary and appropriate to minimize the adverse effects of the Feather River West Levee Project to the beetle and snake and their habitat in the action area.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps and SBFCA must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

The following Terms and Conditions implement the Reasonable and Prudent Measure:

1. All the conservation measures as described in the project description, and as restated here in this biological opinion, must be fully implemented and adhered to.

2. The Corps, SBFCA, and PG&E shall include full implementation and adherence to the conservation measures as outlined in the biological opinion as a condition of any permit or contract issued for the project.

3. In order to monitor whether the amount or extent of take anticipated from implementation of the proposed project is approached or exceeded, the Corps and SBFCA shall adhere to the following reporting requirement. Should this anticipated amount or extent of incidental take be exceeded, the Corps must immediately reinitiate formal consultation as per 50 CFR 402.16.

    a. For those components of the proposed project that will result in habitat degradation or modification whereby incidental take in the form of harm or mortality is anticipated, the Corps and SBFCA will provide weekly updates to the Service with a precise accounting of the total acreage of habitat effected or number of elderberry shrubs and size of stems at ground level transplanted. Updates shall also include any information about changes in the Project Description and not analyzed in this biological opinion.

4. SBFCA shall provide a photo documentation report showing pre- and post-project area conditions for giant garter snake.

Salvage and Disposition of Individuals

The Sacramento Fish and Wildlife Office will be notified within 1 day of the finding of any dead or injured snake or beetle to determine the appropriate measures for salvage and disposition. The Service contact person is the Habitat Conservation Division Chief. In addition, the Recovery Division Chief shall also be notified within 1 day of the procedures implemented for salvage and disposition of the snake or beetle. The applicant must report to the Service immediately any information about take or suspected take of listed species not authorized in this biological

opinion. Notification must include the date, time, and location of the incident or of the finding of a dead or injured listed species. The Habitat Conservation and Recovery Divisions Chiefs can be contacted at (916) 414-6600. The California Department of Fish and Wildlife should also be contacted at (916)358-2900.

CONSERVATION RECOMMENDATIONS

Conservation recommendations are suggestions of the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of new information. These measures may serve to further minimize or avoid the adverse effects of a proposed action on listed, proposed, or candidate species, or on designated critical habitat. They may also serve as suggestions on how action agencies can assist species conservation in furtherance of their responsibilities under section 7(a)(1) of the Act, or recommend studies improving an understanding of a species' biology or ecology. Wherever possible, conservation recommendations should be tied to tasks identified in recovery plans. The Service is providing you with the following conservation recommendations:

1. The Corps and SBFCA should assist in the implementation of the draft, and when published, the final Recovery Plan for the snake.

2. The Corps and SBFCA should provide funding to researchers studying topics identified by the Service in the draft, and when published, the final Recovery Plan for the snake.

3. The Corps should use environmental restoration authorities to acquire and restore beetle and snake habitat.

To be kept informed of actions minimizing or avoiding adverse effects or benefiting listed and proposed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation with the Corps on the Feather River West Levee Project. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the proposed action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this opinion; or (4) a new species or critical habitat is designated that may be affected by the proposed action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

If you have any questions regarding this Feather River West Levee Project biological opinion, please contact Jennifer Hobbs, at (916) 414-6541 or Doug Weinrich, Deputy Assistant Field Supervisor, at (916) 414-6563.

Sincerely,

Roberta Gerson

for Jan C. Knight
Acting Field Supervisor

cc:
Jeff Koschak, Corps, Sacramento, CA
Jenny Marr, CDFW, Chico, CA
Jennifer Haire, ICF, Sacramento, CA

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Part F.2

National Marine Fisheries Service Concurrence Letter

Note: The EIS analysis assumes project completion in 2015. The ESA consultation documents assume a longer duration to 2017 to characterize a maximum habitat disturbance scenario and to provide implementation flexibility within the ESA authorization.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

APR 10 2013

In response refer to:
2013/9542

Alicia E. Kirchner
Chief, Planning Division
Department of Army
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2833

Dear Ms. Kirchner:

This letter is in response to your March 22, 2013, request for initiation of section 7 consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), concerning the Feather River West Levee Project (FRWLP). The proposed project includes modifying approximately 41 miles of a U.S. Army Corps of Engineers (Corps) levee to reduce the potential for flooding, flood damage, and public risk in the Yuba City area. The proposed project is currently scheduled to be constructed by the Sutter Butte Flood Control Agency (SBFCA), in five construction seasons from 2013 to 2017. To construct the FRWLP, SBFCA is requesting permission from the Corps pursuant to Section 14 of the Rivers and Harbors Act of 1899 (Title 33 of the U.S. Government Code [USC], Section 408, [33 USC 408]), for the alteration of a levee as part of the Sacramento River Flood Control Project.

The Corps has determined that the proposed project may affect, but is not likely to adversely affect federally listed as threatened Central Valley (CV) spring-run Chinook salmon (*Oncorhynchus tshawytscha)* evolutionarily significant unit (ESU), endangered Sacramento River winter-run Chinook salmon (*O. tshawytscha)* ESU, threatened California CV (CCV) steelhead (*O. mykiss*) distinct population segment (DPS), threatened Southern DPS of North American green sturgeon (*Acipenser medirostris*), and their designated critical habitats. In addition, the Corps has determined that the proposed project will not adversely affect essential fish habitat (EFH) of Pacific salmon and thus fulfills section 305 (b)(2) of the Magnuson – Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). This letter also serves as consultation under the authority of, and in accordance with, the provisions of the Fish and Wildlife Coordination Act of 1934 (FWCA), as amended.

Consultation to Date

The following is a summary of the NMFS consultation activities on the proposed project:

(1) On December 28, 2012, SBFCA submitted a letter to NMFS via email to request technical assistance regarding potential effects of the proposed project on listed fish species and their designated critical habitat, identify additional data needs, and determine needs for consultation. The letter included a summary of waterside riparian impacts and a map of the project footprint in relation to the ordinary high water mark (OHWM).

(2) On February 5, 2013, the Corps and SBFCA held a meeting with Michael Hendrick of NMFS to provide an overview of the proposed project and discuss proposed project effects on ESA-listed fish species, proposed conservation measures, consultation requirements, and schedule.

(3) In response to the SBFCA's December 28, 2012, letter, NMFS provided a list of federally listed fish species that could occur in the proposed project area and designated critical habitat occurring in the proposed project area (letter to SBFCA dated March 4, 2013).

Project Description

SBFCA is proposing the FRWLP to reduce flood risk in the Sutter Basin, which includes portions of Sutter and Butte counties in California's Sacramento Valley. Communities in the basin include Yuba City, Biggs, Gridley, Live Oak, and Sutter. Floodwaters that potentially threaten the basin originate from the Feather River watershed or the upper Sacramento River watershed.

The FRWLP will reduce flood risk in the Sutter Basin by addressing known levee deficiencies along the Feather River West Levee from Thermalito Afterbay downstream to a point approximately 4 miles upstream of the Feather River's confluence with the Sutter Bypass. The proposed project includes modifying approximately 41 miles of a Corps levee to reduce the potential for flooding, flood damage, and public risk in the Yuba City area. The levee modification will involve: (1) installing approximately 34 miles of soil and bentonite cutoff walls into the levee core, (2) constructing 0.72 miles of seepage berms on the landside of the levee, (3) placing 0.42 miles of ditch fill, (4) dredging 1.8 miles of canal, and (5) relocating or removing encroachments along approximately 3.44 miles of the Feather River west levee. When completed, the work will reduce levee deficiencies, including through- and under-seepage, slope stability, erosion, and encroachments, within the construction footprint. Materials imported to the construction site will include water, bentonite, cement, incidental construction support materials, aggregate base rock, hydroseed, and up to 1,500,000 cubic yards of embankment fill material. While the specific sequencing of construction will be dynamic throughout the planning and design of the FRWLP, the construction will occur from 2013 to 2017.

Action Area

The regulations governing consultations under the ESA define *action area* as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (51 FR 19957). The action area should be determined based on all direct and indirect effects of the proposed action (50 CFR 402.02 and 402.14(b)(2)).

The proposed action area consists of the 41-mile corridor along the west levee of the Feather River from the Thermalito Afterbay to approximately 4 miles north of the Sutter Bypass. The proposed action area includes the project construction area and a 100-foot buffer around this area. The proposed construction area is defined as the area in which levee improvements (seepage berms, stability berms, relief wells, and slurry cutoff walls) are likely to be constructed. All of the potential direct and indirect effects will occur within this area and the 100-foot buffer around this area.

The proposed action area also includes six potential borrow sites that could supply the borrow material necessary for levee construction and upgrades, and routes from the project construction area to the borrow sites. The proposed action area also includes the existing 48.5-acre Star Bend Conservation Area, located within the setback area adjacent to the west levee of the Feather River, approximately 6 miles south of Yuba City.

Effects of Proposed Action

All federally listed fish species potentially found in the area of the proposed project, the CV spring-run Chinook salmon ESU, CCV steelhead DPS, and Southern DPS of North American green sturgeon, have life histories, biological and habitat requirements that may be impacted by the proposed project. The Sacramento River winter-run Chinook salmon ESU is not found within the proposed project's action area; therefore there will be no impacts.

The proposed action area of the FRWLP provides migratory habitat for adult CV spring-run Chinook salmon, and migratory and rearing habitat for juveniles. Based on observations in the Feather River, adults are likely to be present in the proposed action area between February and July as they migrate to summer holding habitat. The proposed action area of the FRWLP borders the designated critical habitat of CV spring-run Chinook salmon in the Feather River. Primary constituent elements (PCEs) of critical habitat in the adjacent reaches of the Feather River include: (1) freshwater rearing sites that have adequate water quality and quantity, floodplain connectivity, and natural cover that supports juvenile growth and mobility, and (2) freshwater migration corridors that support adequate water quantity and quality as well as natural cover to provide food and migration pathways for juveniles as well as adults. Critical habitat includes the river channel and lateral extent as defined by the ordinary high water line. In areas where the ordinary high water line has not been defined, the lateral extent is defined by the bankfull elevation or the elevation at which water begins to leave the channel and move on to the floodplain (this generally corresponds to a discharge that generally has a recurrence interval of one to two years on the annual flood series) (70 FR 52488).

The proposed action area of the FRWLP provides migratory habitat for adult steelhead, and migratory and rearing habitat for juveniles. Adult steelhead immigration in the Feather River occurs from September through March (SWRI 2003). The proposed action area of the FRWLP borders the designated critical habitat of CV steelhead in the Feather River, which includes the river channel and lateral extent as defined by the ordinary high water line. The PCEs of critical habitat are as described for spring-run Chinook salmon.

The proposed action area provides migratory and foraging habitat and likely spawning habitat for green sturgeon (Beamesderfer et al. 2004; Seesholtz pers. comm.). Historical sightings of adult green sturgeon in the Feather River have been in the spring during the general period of upstream migration in the Sacramento River. The proposed action area of the FRWLP borders designated critical habitat of the Southern DPS of North American green sturgeon, which includes the Feather River upstream to Oroville Dam.

Freshwater PCEs for the Southern DPS of North American green sturgeon include sufficient food resources for juvenile foraging, growth, and development; suitable substrates for egg incubation and development; suitable water quantity and quality for normal behavior, growth, and survival of all life stages; suitable passage conditions for adults, larvae, and juveniles; suitable holding pools and water depths for adults; and sediments free of elevated levels of contaminants capable of adversely affecting green sturgeon (74 FR 52300).

The Corps has determined that there will be no direct effect on the designated critical habitat for federally listed fish species, because all work on the waterside slope will stay above the OHWM and at least 50 feet from the top of the bank of the Feather River. All vegetation loss will be confined to the construction footprint, and there will be no additional removal of vegetation to comply with the Corps vegetation policies. As a result, there will be no modification of riparian vegetation or shaded riverine aquatic cover within designated critical habitat of federally listed fish species.

Direct effect to riparian vegetation will be limited to approximately 27 acres of riparian forest and scrub-shrub above the OHWM. Approximately 135 trees (mixed native and non-native riparian and orchard tress) will be removed from the waterside levee slope and toe. In addition, approximately 27 acres of orchard trees (344 trees) will be removed from the permanent and temporary footprints adjacent to the waterside levee slope. These areas are set well back from the river, ranging from approximately 50 to 5,600 feet from the Feather River during typical summer base flows. To compensate for permanent and temporary loss of woody riparian vegetation, SBFCA developed a mitigation and monitoring plan (MMP) to ensure no net loss of habitat functions and values.

Proposed construction and levee repair activities are not likely to result in adverse turbidity- or sedimentation-related effects on winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon or their critical habitat. For the FRWLP, no in-river construction activities are proposed and all activities that will result in physical disturbance or removal of soil or vegetation on the waterside slope of the levee will be limited to areas above the OHWM. With implementation of the stormwater pollution prevention plan (SWPPP) and the associated erosion and sediment control best management practices (BMPs), exposed or imported soil will be largely contained within the immediate project footprint and stabilized using structural or vegetative methods. Any increases in turbidity and sedimentation attributable to the proposed project are expected to be well below levels associated with injury or reduced growth of juvenile salmonids, and will not likely result in significant disruption of normal feeding, sheltering, and migratory behavior of Chinook salmon, steelhead, or green sturgeon.

Contaminants used at construction sites, including gasoline, diesel fuel, lubricants, and hydraulic fluid, could enter the Feather River as result of spills or leakage from machinery or storage containers and injure or kill listed salmon, steelhead, and sturgeon. These substances can kill aquatic organisms through exposure to lethal concentrations or exposure to non-lethal levels that cause physiological stress and increased susceptibility to other sources of mortality such as predation. There is also a slight risk of the release of bentonite into the Feather River during jet grouting or deep soil mixing used to construct slurry cut off walls. Implementation of a spill prevention, control, and countermeasure plan (SPCCP) and bentonite slurry spill contingency plan as part of the environmental commitments of the project is anticipated to minimize the potential for toxic or hazardous spills or discharges into the Feather River. Adherence to all preventative, contingency, and reporting measures in the approved plans will reduce the risk of injury or mortality of listed fish species to negligible levels.

For the FRWLP, sheet piles will be used only as a site-specific treatment at roadway or railroad crossings, and will be restricted to the levee crown above the OHWM where sound waves will be expected to attenuate quickly before reaching the Feather River. Consequently, pile driving activities will have negligible noise and vibration effects on fish in the Feather River.

Potential utilization of the Oroville Wildlife Area dredge tailing site for borrow material could increase the potential for stranding of listed fish species. Based on current estimates, the area identified as a potential source of borrow material is approximately 75 acres and could be lowered up to 10 feet. The proposed elevation of the tailings will remain above the OHWM but will increase the frequency of overbank flows from the Feather River. Following periods of inundation, the tailings could retain surface water or direct surface water to isolated depressions, resulting in fish stranding and high mortality rates due to lethal water temperatures, low dissolved oxygen, predation, and desiccation. If this site is selected as a source of borrow material, SBFCA proposes to re-contour the area to completely drain to the river and reduce the risk of stranding from current levels. The design will be developed in consultation with NMFS, U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), and the Corps, and submitted to the agencies for approval prior to the start of excavation. A monitoring plan will be developed and implemented to evaluate the effectiveness of the design in minimizing fish stranding and will include provisions for remediation should the design fail to meet established performance or success criteria. The net effect may be beneficial in terms of alleviating current stranding risk while also making more floodplain surface available to fish at lower water surface elevations.

ESA Section 7 Consultation

Based on our review of the material provided with your request and the best scientific and commercial information currently available, NMFS concurs that the Corps determination that the proposed project as described is not likely to adversely affect federally listed CV spring-run Chinook salmon ESU (*O. tshawytscha*), Sacramento River winter-run Chinook salmon ESU (*O. tshawytscha),* CCV steelhead DPS (*O. mykiss*), Southern DPS of North American green sturgeon (*Acipenser medirostris*), or their designated critical habitats. No construction activities are proposed in-river or below the OHWM; all activities that will result in physical disturbance and removal of vegetation on the waterside slope of the levee will be limited to areas above OHWM.

The proposed project is not likely to result in adverse water quality or noise effects on listed fish species or their critical habitat. The proposed project is not likely adversely affect PCEs of critical habitat of winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and green sturgeon. There will be no direct physical impacts to riparian vegetation or SRA cover within the designated critical habitat of these species. Therefore, no physical modification of critical habitat for ESA-listed fish species will be expected because all proposed construction activities will occur above the OHWM of the Feather River.

In addition to the above, NMFS reached this determination based on the incorporation of the following measures into the project description:

(1) Construction personnel will receive worker environmental awareness training. This training will instruct workers to recognized sensitive species and their habitats.
(2) Erosion control BMPs and a SWPPP will be implemented to address and minimize water quality issues.
(3) Where suitable habitat is present for listed species, SBFCA will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other means, and prohibit any construction-related traffic outside these boundaries.
(4) If a sensitive species is encountered by a biological monitor during construction, activities will cease until appropriate corrective measures have been completed or it has been determined that the species will not be harmed.
(5) Implementation of a spill prevention, control, and countermeasure plan and bentonite slurry spill contingency plan is anticipated to minimize the potential for toxic or hazardous spills or discharges into the Feather River.
(6) To prevent possible resource damage from hazardous materials such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas unless it is done offsite.
(7) The biological monitor will record all observations of federally listed species on California Natural Diversity Database field sheets and submit to the Corps, NMFS, USFWS, and CDFW.
(8) Because ground disturbance for the proposed project will be greater than one acre, SBFCA will obtain coverage under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System general construction activity stormwater permit.
(9) The specific BMPs that will be incorporated into the erosion and sediment control plan and SWPPP will be site-specific and will be prepared by the construction contractor in accordance with the California Regional Water Quality Control Board Field Manual.
(10) Compensation for permanent and temporary losses of woody riparian vegetation will be achieved through a combination of onsite and offsite compensation. To the extent feasible, SBFCA proposes to conduct onsite compensation in floodplain areas within the proposed project footprint or in the proposed project vicinity. SBFCA proposes to conduct offsite compensation for riparian impacts in the existing 48.5-acre Star Bend Conservation Area, located within the setback area adjacent to the west levee of the Feather River, approximately 6 miles south of Yuba City.
(11) SBFCA prepared an MMP for compensation of riparian impacts with the goal of ensuring no net loss of habitat functions and values. The MMP has been submitted to the

agencies for review and approval. The MMP identifies the compensation ratios and describes how riparian habitat will be restored, monitored, and reported upon over a specified period of time.

(12) To help ensure that there is limited temporal habitat damage to riparian habitat, the mitigation project will be implemented during the fall of 2013.

This concludes ESA section 7 consultation for the proposed project. This concurrence does not provide incidental take authorization pursuant to section 7(b)(4) and section 7(o)(2) of the ESA. Re-initiation of the consultation is required where discretionary Federal agency involvement or control over the proposed project has been retained (or is authorized by law), and if: (1) new information reveals effects of any of the proposed projects that may affect listed species or critical habitat in a manner or to an extent not considered; (2) any of the proposed projects are subsequently modified in a manner that causes adverse effects to listed species or critical habitat; or (3) a new species is listed or critical habitat designated that may be affected by any of the proposed projects.

EFH Consultation

With regards to EFH consultation, the proposed action area has been identified as EFH for Pacific salmon in Amendment 14 of the Pacific Salmon Fishery Management Plan pursuant to the MSA. Federal action agencies are mandated by the MSA (section 305(b)(2)) to consult with NMFS on all actions that may adversely affect EFH, and NMFS must provide EFH conservation recommendations to those agencies (section 305(b)(4)(A)). Based on our review of the material provided, and the best scientific and commercial information currently available, NMFS has determined that the proposed action will adversely affect EFH for Pacific salmon. However, the proposed action includes adequate measures (described in the ESA section 7 Consultation above) to avoid, minimize, or otherwise offset the adverse effects to EFH. Therefore, additional EFH Conservation Recommendations are not being provided at this time and written response as required under section 305(b)(4)(B) of the MSA and Federal regulations (50 CFR 600.920(k)) will not be required. However, if there are substantial revisions to the project description that could result in adverse effects to EFH, the lead Federal agency will need to re-initiate EFH consultation

FWCA Consultation

The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration and is coordinated with other aspects of water resources development (16 U.S.C. 661). The FWCA establishes a consultation requirement for Federal departments and agencies that undertake any action that proposes to modify any stream or other body of water for any purpose, including navigation and drainage (16 U.S.C. 662(a)). Consistent with this consultation requirement, NMFS provides recommendations and comments to Federal action agencies for the purpose of conserving fish and wildlife resources. The FWCA provides the opportunity to offer recommendations for the conservation of species and habitats beyond those currently managed under the ESA and MSA. Because the proposed project is designed to avoid environmental impacts to aquatic habitat within the action area, NMFS has no additional FWCA comments to provide.

Please contact Michael Hendrick at (916) 930-3605, or via e-mail at Michael.Hendrick@noaa.gov, if you have any questions or require additional information concerning this project.

Sincerely,

for Rodney R. McInnis
Regional Administrator

cc: Copy to File ARN 151422SWR2013SA00015
NMFS-PRD, Long Beach, CA

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Part F.3

Feather River West Levee Project Final 408 Permission Mitigation and Monitoring Plan

Note: The EIS analysis assumes project completion in 2015. The ESA consultation documents assume a longer duration to 2017 to characterize a maximum habitat disturbance scenario and to provide implementation flexibility within the ESA authorization.

FEATHER RIVER WEST LEVEE PROJECT
FINAL 408 PERMISSION
MITIGATION AND MONITORING PLAN

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Contents

List of Tables iv
List of Figures v
List of Abbreviated Terms vii

Page

Chapter 1 Responsible Parties 1-1
1.1 California Department of Fish and Wildlife Compliance 1-1
1.1.1 CDFW Guidelines for Implementing Mitigation on Department Owned or Conserved Lands 1-2
1.2 Lead Agency 1-3

Chapter 2 Project Requiring Mitigation 2-1
2.1 Project Location 2-1
2.2 Summary of Overall Project 2-3
2.2.1 Project Purpose 2-3
2.2.2 Project Objectives 2-4
2.2.3 Project Schedule 2-5
2.2.4 Project Description 2-6
2.2.5 Conservation Measures 2-16
2.3 Site Characteristics 2-24
2.3.1 Biological Resources in the Project Area 2-24
2.3.2 Special-Status Plants 2-27
2.3.3 Special-Status Wildlife Species 2-27
2.3.4 Special-Status Fish Species 2-38
2.3.5 Riparian Trees 2-39
2.3.6 Non-Riparian Native Trees 2-40
2.3.7 USACE Section 404 Jurisdictional Areas 2-40

Chapter 3 Mitigation Design 3-1
3.1 Basis for Design 3-1
3.2 Characteristics of Design Reference Site 3-1
3.2.1 Previous Work Credit 3-1
3.3 Proposed Mitigation Site 3-2
3.3.1 Location 3-2
3.3.2 Ownership Status 3-2
3.3.3 Jurisdictional Areas 3-3
3.3.4 Aquatic Functions 3-3
3.3.5 Hydrology and Topography 3-3
3.3.6 Soils and Substrate 3-3
3.3.7 Vegetation 3-4
3.3.8 Present and Historical Uses of the Mitigation Areas 3-5
3.3.9 Present and Proposed Uses of All Adjacent Areas 3-6
3.4 Created/Restored Habitats 3-6
3.4.1 Compensation Ratios 3-6
3.4.2 Long-Term Goal(s) 3-8

3.4.3 Aquatic Functions 3-9
3.4.4 Hydrology and Topography 3-9
3.4.5 Soils and Substrate 3-9
3.4.6 Vegetation 3-10

Chapter 4 Success Criteria and Monitoring 4-1
4.1 Success Criteria 4-1
4.2 Monitoring 4-1
4.2.1 Methods 4-1
4.2.2 Monitoring Schedule 4-3
4.2.3 Photo-Documentation 4-3

Chapter 5 Implementation Plan 5-1
5.1 Site Preparation 5-1
5.1.1 Avoidance Measures 5-1
5.1.2 Pest Plant Removal 5-2
5.1.3 Construction Monitor 5-2
5.2 Planting/Seeding 5-2
5.2.1 Planting Plan 5-2
5.2.2 Nature and Source of Propagules 5-4
5.3 Irrigation 5-4
5.4 Implementation Schedule 5-5

Chapter 6 Maintenance during Monitoring Period 6-1
6.1 Maintenance Activities 6-1
6.1.1 Overall 6-1
6.1.2 Irrigation 6-1
6.1.3 Invasive Plant Control 6-1
6.1.4 Irrigation System Maintenance 6-1
6.1.5 Reporting and Record Keeping 6-2

Chapter 7 Proposed Monitoring Reports 7-1
7.1 Due Dates 7-1
7.2 As-Builts 7-1
7.3 Annual Reports 7-1
7.3.1 File Number 7-1
7.3.2 Contents 7-1

Chapter 8 Potential Contingency Measures 8-1
8.1 Initiating Procedures 8-1
8.2 Contingency Funding Mechanism 8-1

Chapter 9 Completion of Mitigation Responsibilities 9-1
9.1 Notification 9-1
9.2 USACE Confirmation 9-1

Chapter 10 Long-Term Management 10-1
10.1 Property Ownership 10-1
10.2 Management Plan 10-1
10.2.1 Purpose 10-1
10.2.2 Resource Manager 10-1

10.2.3 Management Approach 10-1
10.2.4 Long-Term Management Needs 10-2
10.2.5 Management Responsibilities and Plan Modification 10-3
10.2.6 Funding 10-4
10.2.7 Long-Term Conservation Mechanism 10-4

Chapter 11 References 11-1

11.1 Printed References 11-1
11.2 Personal Communication 11-3

List of Tables

Tables **Page**

Table 2-1. Summary of Reaches in the Project Area 2-2
Table 2-2. Construction Contracts, FRWLP Reaches, and Years for Construction 2-5
Table 2-3. FRWLP Action Alternatives by Reach 2-8
Table 2-4. Criteria Used to Rate the Health, Vigor, Structure and Form of Surveyed Trees 2-26
Table 2-5. Approximate Number of Elderberry Shrubs/Clusters to be Removed and Protected 2-31
Table 2-6. Suitability of Aquatic Habitat for Giant Garter Snake in the Levee Construction Portion of the Project Area 2-35
Table 2-7. Habitat Suitability of Potential Borrow Sites for Giant Garter Snake 2-36
Table 2-8. Effects on Giant Garter Snake Habitat in the Project Area 2-37
Table 2-9. Acreages of Fill of Wetlands and Other Waters 2-40
Table 2-10. Characteristics of Soils in the Impacted Areas 2-43
Table 3-1. Estimated Compensation for Elderberry Shrubs Removed 3-7
Table 3-2. Anticipated Project Impacts to Sensitive Resources and Proposed Compensatory Mitigation 3-8
Table 3-3. Woody Planting Species for the SBCA and FRFCRP site 3-10
Table 4-1. Monitoring Success Criteria for Planted Areas at the SBCA and FRFCRP site 4-1
Table 5-1. Plant Palette for Elderberry Mitigation Areas 5-3
Table 5-2. Plant Palette for Riparian Mitigation Areas 5-3
Table 5-3. Plant Palette for Non-Riparian Native Tree Mitigation Areas 5-3
Table 5-4. Upland Seed Mix 5-4
Table 5-5. Irrigation Goals for the SBCA and FRFCRP site 5-5

List of Figures

All figures are at the end of the document

1	Feather River West Levee Project Action Area
2-1	Land Cover Types and Impacts to Potential Waters of the United States
2-2	Land Cover Types and Impacts to Potential Waters of the United States
2-3	Land Cover Types and Impacts to Potential Waters of the United States
2-4	Land Cover Types and Impacts to Potential Waters of the United States
2-5	Land Cover Types and Impacts to Potential Waters of the United States
2-6	Land Cover Types and Impacts to Potential Waters of the United States
2-7	Land Cover Types and Impacts to Potential Waters of the United States
2-8	Land Cover Types and Impacts to Potential Waters of the United States
2-9	Land Cover Types and Impacts to Potential Waters of the United States
2-10	Land Cover Types and Impacts to Potential Waters of the United States
2-11	Land Cover Types and Impacts to Potential Waters of the United States
2-12	Land Cover Types and Impacts to Potential Waters of the United States
2-13	Land Cover Types and Impacts to Potential Waters of the United States
2-14	Land Cover Types and Impacts to Potential Waters of the United States
2-15	Land Cover Types and Impacts to Potential Waters of the United States
2-16	Land Cover Types and Impacts to Potential Waters of the United States
2-17	Land Cover Types and Impacts to Potential Waters of the United States
2-18	Land Cover Types and Impacts to Potential Waters of the United States
2-19	Land Cover Types and Impacts to Potential Waters of the United States
2-20	Land Cover Types and Impacts to Potential Waters of the United States
2-21	Land Cover Types and Impacts to Potential Waters of the United States
2-22	Land Cover Types and Impacts to Potential Waters of the United States
2-23	Land Cover Types and Impacts to Potential Waters of the United States
2-24	Land Cover Types and Impacts to Potential Waters of the United States
2-25	Land Cover Types and Impacts to Potential Waters of the United States
2-26	Land Cover Types and Impacts to Potential Waters of the United States
2-27	Land Cover Types and Impacts to Potential Waters of the United States
2-28	Land Cover Types and Impacts to Potential Waters of the United States
3-1	Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-2	Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-3	Effects on Giant Garter Snake Habitat in the Levee Construction Area

3-4 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-5 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-6 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-7 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-8 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-9 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-10 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-11 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-12 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-13 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-14 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-15 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-16 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-17 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-18 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-19 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-20 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-21 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-22 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-23 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-24 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-25 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-26 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-27 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-28 Effects on Giant Garter Snake Habitat in the Levee Construction Area
3-29 Effects on Giant Garter Snake Habitat at Potential Borrow Sites
3-30 Effects on Giant Garter Snake Habitat at Potential Borrow Sites
3-31 Effects on Giant Garter Snake Habitat at Potential Borrow Sites
3-32 Effects on Giant Garter Snake Habitat at Potential Borrow Sites
3-33 Effects on Giant Garter Snake Habitat at Potential Borrow Sites
4 Star Bend Conservation Area
5 Star Bend Conservation Area Conceptual Planting Plan
6 Star Bend Conservation Area Conceptual Planting Plan

List of Abbreviated Terms

AEP	annual exceedance probability
BA	Biological Assessment
BSSCP	bentonite slurry spill contingency plan
CAPP	Conceptual Area Protection Plans
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CH	fat clay
CL	lean clay
CLSM	controlled low strength material
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CWA	Clean Water Act
DBH	diameter at breast height
DSM	deep soil mixing
DWR	California Department of Water Resources
EIP	Early Implementation Program
EIR	environmental impact report
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESAs	Environmentally Sensitive Areas
FEMA	Federal Emergency Management Agency
FR	Federal Register
FRFCRP	Feather River Floodway Cooridor Restoration Project
FRWLP	Feather River West Levee Project
GGS	giant garter snake
GPS	global positioning system
ICF	ICF International
LAE	Land Acquisition Evaluations
LD	Levee District
LL	Liquid Limit
ML	silt
MMP	mitigation and monitoring plan
MOU	Memorandum of Understanding

NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OHWM	ordinary high water mark
PG&E	Pacific Gas & Electric Company
PI	Plasticity Index
project	Feather River West Levee Project
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SBCA	Star Bend Conservation Area
SBFCA	Sutter Butte Flood Control Agency
SC	clayey sand
SM	silty sand
SPCCP	spill prevention, control, and counter-measure plan
SR	State Route
SRFCP	Sacramento River Flood Control Project
SWPPP	stormwater pollution prevention plan
TRLIA	Three Rivers Levee Improvement Authority
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USC	U.S. Government Code
USFWS	U.S. Fish and Wildlife Service
VELB	valley elderberry longhorn beetle

Chapter 1
Responsible Parties

This document describes the mitigation and monitoring plan (MMP) for effects associated with implementation of the Feather River West Levee Project (project). Project implementation will create permanent and unavoidable impacts to habitats and species that require mitigation. This document identifies responsible parties for the mitigation project, describes the location and nature of the project, and discusses the types, functions, and values of U.S. Army Corps of Engineers (USACE) jurisdictional wetlands and other waters of the United States.

In addition to the mitigation plan for impacted Section 404 jurisdictional features, this MMP also includes impacts and mitigation for riparian and non-riparian native trees, and special status species habitat for valley elderberry longhorn beetle (VELB) and permanent impacts to giant garter snake (GGS), for which compensatory mitigation is required.

Compensatory mitigation for riparian forest, non-riparian native trees and VELB will occur at the Star Bend site on the Feather River. Mitigation for GGS and Section 404 jurisdictional features will occur at off-site private banking lands.

1.1 California Department of Fish and Wildlife Compliance

This document follows the format and contains the elements described in the USACE report *Mitigation and Monitoring Proposal Guidelines, December 30, 2004* (USACE 2004). Because this report also includes mitigation for non-Section 404 jurisdictional features and will utilize land at the Star Bend Conservation Area (SBCA), the document also complies with the California Department of Fish and Wildlife's (CDFW) own guidelines outlined in *Policy for Mitigation on Publicly Owned, Department Owned, and Conserved Lands* (CDFW 2012). The policy statement contained within the CDFW's report states:

> *Mitigation for impacts to fish and wildlife resources may occur on publicly owned, Department owned, and conserved lands if it has been determined by the Department that: 1) the mitigation is consistent with requirements of the law under which the mitigation is being sought; 2) its relative value as mitigation is equal to or greater than it would be if the same mitigation were situated on non-public or non-conserved lands; 3) it results in a clear and quantifiable improvement or positive change above that currently present or reasonably expected to exist under current conditions on the site; 4) the future uses of the land, including encumbrances or easements, will not preclude or diminish the mitigation; 5) the mitigation will not preclude, diminish or interfere with the funding or purpose of acquisition, encumbrances, or management plan for the property; and 6) it will not result in a net loss of existing conservation values.*

1.1.1 CDFW Guidelines for Implementing Mitigation on Department Owned or Conserved Lands

The following guidelines are addressed throughout the MMP below. Items 1 through 4 have been fully addressed in this MMP. Item 5 is addressed in the project's incremental cost analysis. The Memorandum of Understanding described in item 6 below is still a work in progress and will be finalized before the MMP is complete.

1. Mitigation is consistent with the current and future uses of the land including any encumbrances, easements or public use values.
    a. To find information on encumbrances, easements or public use values the following documents should be checked:
        i. Management plan for the property
        ii. Any Conceptual Area Protection Plans (CAPP) or Land Acquisition Evaluations (LAE) written for the property
        iii. Easements can be found on the California Natural Resources Agency website and at the County Recorders office. The Lands Program should also be checked.
        iv. Title search – this should be performed by the entity proposing the mitigation
        v. Site visits should be performed
2. Mitigation is consistent with the purpose for which the land was acquired and the funding source used for acquisition.
3. Mitigation will not preclude, diminish or interfere with encumbrances, or the management plan for the property.
4. Mitigation maintains and or enhances the current ecological and public use values of the land.
    a. Entity proposing the mitigation needs to provide documentation of how placing the mitigation on the land is going to maintain or enhance the ecological and public use values of the land.
5. The full cost of the mitigation is accounted for (this includes but is not limited to all capital improvements, restoration, enhancement, monitoring, long term management and maintenance and reimbursement for any Department staff time including enforcement, on all lands).
6. A Memorandum of Understanding (MOU) is in place prior to the project sponsors undertaking the project. The MOU will be developed in cooperation with the land manager, reviewed for statewide consistency by the Department's Lands Program in the Wildlife Branch and signed by the District Assistant Chief and the Department Regional Manager, the land management agency or non-profit (if other than the Department), and the project sponsor. The MOU will define the mitigation purpose, permit requirements, agreement term, scope of work, schedule, management and/or maintenance requirements, monitoring, and responsibilities of the parties to the agreement.

1.2 Lead Agency

The Sutter Butte Flood Control Agency (SBFCA) is the lead agency and implementing agency and will construct the project. The USACE is preparing the Environmental Impact Statement (EIS) for the purposes of compliance with the National Environmental Policy Act (NEPA) due to its authority over alteration of Federal project levees. The USACE is also completing Section 7 Endangered Species Act consultation with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) for the project. SBFCA is the applicant and party with financial responsibility for implementing the MMP and satisfying the success criteria.

The project proponent is:

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Chapter 2
Project Requiring Mitigation

2.1 Project Location

North to south, the project area is located in the 41-mile corridor along the west levee of the Feather River that begins at the Thermalito Afterbay and ends approximately 4 miles north of the Sutter Bypass (Figure 1). The project area consists of the project construction area plus a 100-foot-wide buffer zone. The project construction area was defined as the area in which levee improvements—such as seepage berms, stability berms, relief wells, and slurry cutoff walls—are likely to be constructed. All direct and indirect effects would occur within the project area.

The project area corridor is divided into 41 relatively homogeneous reaches for ease of describing existing conditions, project components, land cover types, and potential effects (note that this number is coincidental and one reach does not correspond to a length of 1 mile; additionally, Reach 1 is not part of the Feather River West Levee Project [FRWLP]) (Figures 2-1 to 2-28). The levee stations, lengths, landmarks, and dominant land uses for the reaches are listed in Table 2-1.

The project area also includes five potential borrow sites that could supply the borrow material necessary for levee construction and upgrades, and access routes from the project construction area to the borrow sites. It is not anticipated that all five sites would be used over the phased, multi-year construction period, but until additional geotechnical and soil samplings are completed, all sites would be available for use and are included in the project area (Figure 1).

Table 2-1. Summary of Reaches in the Project Area

Reach	Beginning Station	Ending Station	Length (feet)	Landmark(s)	Dominant Land Uses
1	0+00	202+50	Not part of the project at this time.		
2	202+50	218+66	1,616		Ruderal grassland; open space
3	218+66	300+66	8,200	Cypress Avenue	Ruderal grassland; open space
4	300+66	410+67	11,001	Central Street; Wilkie Avenue	Orchard; ruderal grassland; riparian forest
5	410+67	478+68	6,801	Wilkie Avenue	Orchard
6	478+68	510+37	3,169	Star Bend	Orchard
7	510+37	596+00	8,563	Abbott Lake	Ruderal grassland; open space
8	596+00	654+75	5,875		Ruderal grassland; open space
9	654+75	706+50	5,175	Boyd's Boat Launch; Nursery	Ruderal grassland; open space
10	706+50	774+00	6,750	Barry Road	Ruderal grassland; open space
11	774+00	830+00	5,600		Ruderal grassland; open space
12	830+00	845+00	1,500	Shanghai Bend	Ruderal grassland; open space
13	845+00	927+00	8,200		Ruderal grassland; open space
14	927+00	954+40	2,740	Airport	Ruderal grassland; open space
15	954+40	968+50	1,410	Airport	Developed; ruderal grassland
16	968+50	1080+00	11,150	Garden Highway, 2nd Street; Twin Cities Memorial Bridge; Colusa Avenue	Developed; ruderal grassland
17	1080+00	1130+86	5,086	Live Oak Boulevard; Union Pacific Railroad	Developed; ruderal grassland
18	1130+86	1213+85	8,299	Live Oak Boulevard; Union Pacific Railroad; Rednall Road	Orchard
19	1213+85	1297+83	8,398		Orchard
20	1297+83	1374+33	7,650		Orchard; ruderal grassland
21	1374+33	1433+83	5,950		Ruderal grassland
22	1433+83	1503+83	7,000		Riparian forest; ruderal grassland
23	1503+83	1609+37	10,554		Orchard
24	1609+37	1623+86	1,449		Riparian forest; ruderal grassland
25	1623+86	1674+37	5,051		Orchard; ruderal grassland
26	1674+37	1707+11	3,274		Orchard
27	1707+11	1721+60	1,449		Ruderal grassland
28	1721+60	1769+31	4,771		Orchard
29	1769+31	1813+33	4,402		Orchard; riparian forest
30	1813+33	1902+00	8,867		Orchard
31	1902+00	1958+00	5,600		Orchard; ruderal grassland
32	1958+00	1989+00	3,100		Orchard
33	1989+00	2122+00	13,300		Orchard
34	2122+00	2182+00	6,000		Orchard
35	2182+00	2224+00	4,200		Orchard; ruderal grassland
36	2224+00	2259+00	3,500		Orchard; ruderal grassland
37	2259+00	2290+00	3,100		Orchard; ruderal grassland
38	2290+00	2303+00	1,300		Ruderal grassland
39	2303+00	2319+00	1,600		Ruderal grassland
40	2319+00	2359+00	4,000		Ruderal grassland
41	2359+00	2368+00	900	Thermalito Afterbay	Ruderal grassland

Note: Certain planning and engineering studies for the project make reference to segments within the planning area under which the reaches above are grouped. These segment designations do not have substantial bearing on the alternatives descriptions, environmental setting, or determination of effects and thus for simplicity are not used in this document.

2.2 Summary of Overall Project

SBFCA proposed the project to reduce flood risk in the Sutter Basin, which includes portions of Sutter and Butte Counties in the Sacramento Valley of California. 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).

In partnership with the State of California (through the California 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 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.

The USACE is conducting a feasibility study (the Sutter Basin Pilot Feasibility Study or Sutter Basin Feasibility Study). The FRWLP is being advanced by SBFCA to expeditiously reduce flood risk before the feasibility study is completed. USACE plans to release for public review a draft integrated study report and supplemental environmental impact statement (EIS)/environmental impact report (EIR) in April 2013. Because the FRWLP and the USACE study may affect the same general area, have similar purposes, and share potential measures and effects, the EIS/EIR prepared for the feasibility study is expected to incorporate by reference much of the information, analyses, and conclusions contained within this document. The EIS/EIR would supplement this EIS/EIR focusing on additional alternatives, their effects, or new information not addressed in this document.

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 U.S. Government Code [USC], Section 408, [33 USC 408]), hereinafter referred to as *Section 408*, for the alteration of a levee as part of the Sacramento River Flood Control Project (SRFCP), a Federal work.

2.2.1 Project Purpose

SBFCA's goal is to achieve a minimum of 200-year flood protection for the more urbanized areas with population centers (as mandated by SB 5) and 100-year 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 target of 100-year protection for the more rural, agriculture parts of the planning area, specifically the southern portion of the basin downstream of Yuba City, is driven by the goal to maintain viability and sustainability of agriculture by avoiding Federal Emergency Management Agency (FEMA) restrictions that would hinder construction or upgrade of agricultural infrastructure (such as farm residences, barns, silos, dryers, seasonal worker housing) and supporting business.

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. While the FRWLP would not by itself reduce all flood risks affecting the planning area, it would address the most immediate risk based on the following.

- The proximity of the Feather River to population centers and key infrastructure.
- The nature of Feather River West Levee being the longest and most contiguous portion of the planning area perimeter.
- The location of known levee deficiencies and the clarity and feasibility of available measures to address them.

Future phases may be implemented by SBFCA in coordination with the State of California and USACE based on available funding, the outcome of the Sutter Basin Feasibility Study, and implementation of the Central Valley Flood Protection Plan (CVFPP) and other flood management programs (or multi-objective programs that include flood management).

2.2.2 Project Objectives

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 Senate Bill (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 economically, environmentally, politically, and socially acceptable.
- Facilitate compatibility with the CVFPP and Sutter Basin Feasibility Study such that proposed activities would be “no regrets” and not inconsistent with any future plans.
- Facilitate compatibility with recreation and restoration goals in the planning area.

This MMP is being prepared because the project will have unavoidable effects on Section 404 jurisdictional features and special-status species habitat for which compensatory mitigation is required.

- Project implementation would result in permanent loss of vegetation and wetlands. Compensation for vegetation and wetlands losses with a no-net-loss goal will mitigate those effects.
- Construction of the project would result in the injury, mortality, or disturbance of special-status and common species during construction, which could affect local populations. Implementation of mitigation measures would minimize or avoid these effects and reduce them to a less-than-significant level.
- The project would have no effect on SRA cover and critical habitat; however, there may be effects on Federal Endangered Species Act (ESA)-listed fish species due to loss of floodplain riparian vegetation. Vegetation loss would be minimized and all activities would occur above the ordinary high water mark on the waterside levee slopes and toe. Thus, the project is not expected to contribute to significant effects on fish and aquatic resources.

2.2.3 Project Schedule

Specific sequencing of construction would be dynamic throughout planning and design of the FRWLP, subject to change based on factors including the following.

- Further engineering in determining the clarity and efficacy of site-specific measures.
- Easement and right-of-way acquisition (where necessary).
- Availability of proximate, suitable, and cost-effective borrow material.
- Environmental clearances based on wildlife presence, lifecycle activity, and location of habitats.

Based on current planning analysis for the FRWLP, construction would occur over the course of multiple construction seasons (typically April 15 to November 30, subject to conditions) and would proceed as noted below.

As discussed above, it is anticipated the construction of the FRWLP would be divided into four separate construction contracts (i.e., A, B, C, and D). Although subject to change, the most current information for the four contracts and their respective areas is provided in Table 2-2.

Table 2-2. Construction Contracts, FRWLP Reaches, and Years for Construction

Construction Contract	FRWLP Reaches	Years
A	2–5	2016–2017
B	6–12	2014–2015
C	13–25	2013–2014
D	26–41	2014–2015

It should be noted that 2015 is the presently anticipated year for completion and is consistently used throughout the analysis as presenting the conditions that would result in the greatest severity effect magnitude and disclosure of maximum effects (e.g., for air quality, 2015 represents the most conservative basis for analysis because it is the most aggressive feasible schedule in determining daily and annual emissions). The one exception is that 2017 is used for the consultations with USFWS and NMFS because the longer construction duration represents maximum effects based on habitat disturbance.

Construction is anticipated to occur in single 10-hour shifts, 6 days per week. An exception to this schedule is slurry cutoff wall construction, which is anticipated to occur in two 10-hour shifts (essentially 24-hour construction), 6 days per week. While actual construction would not occur between the two 10-hour shifts, equipment maintenance and preparations for the upcoming work shift would occur. Maintenance work is also anticipated on Sundays.

Contract A begins at Levee Station 202+50 near the intersection of the Feather River West Levee and Laurel Road. It continues north to the beginning of the improvements constructed as part of the Star Bend Setback Levee Project, Levee Station 478+68. The total length of the levee in this portion of the FRWLP is 27,618 linear feet. Contract B begins at Levee Station 478+66, the end of the improvements constructed as part of the Star Bend Setback Levee Project, and continues north to Levee Station 832+30. The total length of the levee in this portion of the FRWLP is 31,963 linear feet. Contract C begins at Levee Station 845+00, near the north end of the Shanghai Bend Setback Levee, and continues north to Levee Station 1674+37. The total length of the levee in this portion of the

FRWLP is 77,886 linear feet. Contract D begins at Levee Station 1674+37 and continues north to Levee Station 2368+00. The total length of the levee in this portion of the FRWLP is 69,363 linear feet.

Reach 1 is not currently part of the FRWLP.

2.2.4 Project Description

Table 2-3 identifies the construction activities that would occur with each reach. For Reaches 2–11, a cutoff wall ranging between 10–25 feet deep would be constructed along the centerline of the levee. The overall height of the levee would be degraded by approximately 50%. In addition to the cutoff wall, two seepage berms would be constructed. One seepage berm would be 100 feet wide and 1,616 feet long, and the other would be 200 feet wide and 2,268 feet long.

Fifty-foot-deep relief wells would be installed 60 feet apart in Reach 7.

For Reaches 13–24, a cutoff wall ranging between 21 and 105 feet in depth would be constructed along the centerline of the levee. The overall height of the levee would be degraded by approximately 50%, with approximately 2,600 feet of the levee being fully degraded.

At Reach 17, a seepage berm beneath the State Route (SR) 20 crossing would be constructed in addition to the description of the flood management measures for the remainder of the reach. The seepage berm would be 7 feet tall and approximately 50 feet wide. It would extend through the existing abandoned railroad tunnel at the levee landside toe.

For Reaches 26–38, a cutoff wall ranging between 10 and 90 feet in depth would be constructed along the centerline of the levee. The overall height of the levee would be degraded approximately 50%. In Reach 38, an 11-foot-high seepage berm would be constructed. The new levee would be constructed using the tailings materials located along the landside of the existing levee.

In Reach 41, a 100-foot-wide drained seepage berm would be constructed. The seepage berm would include a 1-foot thick filter drain along the bottom. The filter drain would provide drainage for seepage through the levee. The existing concrete outfall structure located at the south end of this reach would remain in place and would be backfilled with earth materials. A 30-foot-wide construction access area would be provided at the toe of the seepage berm.

As a special site-specific treatment for the project, a through-seepage barrier would be constructed at four locations where the levee is crossed by a roadway or railroad: the 5th Street Bridge at Station 1007+00 (Reach 16), SR 20 Bridge at Station 1131+00 (Reach 18), East Gridley Road at Station 1902+00 (transition between Reaches 30 and 31), and the Union Pacific Railroad (UPRR) crossing at station 1131+00 (Reach 18). The barrier would be constructed as a cutoff wall through deep soil mixing (DSM), jet grouting, a sheet-pile wall, or a combination thereof.

Materials imported to the construction site would include water, bentonite, cement, incidental construction support materials, aggregate base rock, hydroseed, and up to 1,500,000 cubic yards of embankment fill material for the new levee surfaces from offsite commercial borrow sites or local landowners willing to sell borrow material. For backfill of new pipelines crossing the levee, controlled low strength material (CLSM) (otherwise known as lightweight concrete) would be placed to the pipeline's spring line.

Major activities associated with the project are described below.

Encroachments

Existing facilities found within the footprint of an alternative may require removal and replacement nearby, abandonment, or relocation. Encroachments are numerous (over 400 identified) along the Feather River West Levee and may need to be addressed if they present a threat to the stability of the levee, do not currently comply with the levee encroachment criteria, or would be disrupted or otherwise impacted by construction activities. Typical encroachments include pressure pipelines (water supply pipelines from waterside pump stations and drainage pipelines from landside drainage pump stations), gravity drainage pipes, gas lines, telephone utilities, overhead utilities, structural encroachments, and other types and variations. Debris from structure and embankment fill material of poor quality would be hauled offsite to a permitted disposal site within 20 miles of the removal location.

Vegetation Removal

Bulldozers would be used to remove woody and herbaceous vegetation from the direct construction footprint and the minimum areas needed for project staging and access routes. Vegetation removal to meet project objectives would be consistent with the CVFPP guidance for levee repair or improvement activities. Any vegetation removed as part of direct construction activities would not be replaced at that location and would require offsite, in-kind mitigation, to be determined in consultation with the appropriate resource agencies.

In accordance with the State of California's Urban Levee Design Criteria, at a minimum, all roots larger than 1.5 inches in diameter that are within 3 feet of the perimeter of the tree trunk would be removed. Immature trees less than 4 inches in diameter at breast height (DBH) that would be removed may be cut off at or below ground level, generally without root removal. More extensive root removal may be required, depending upon the location, size, and type of tree; the quantity, orientation, and size of the roots; the dimensions of the levee (or floodwall); the composition of the levee and foundation; and the levee features that address seepage and underseepage. Less extensive root removal may be justified where roots from adjacent trees would be unduly damaged. Any excavation resulting from the above actions would be backfilled with engineered fill using appropriate placement, moisture conditioning, and compaction methods. Additional measures for removing non-compliant vegetation are listed below.

- Ensure that the resulting void is free of organic debris.
- Cut poles to salvage propagation materials for replanting, such as willows and cottonwoods.
- Conduct hand clearing using chainsaws and trimmers.
- Conduct mass clearing using bulldozers.

Debris from vegetation removal would be hauled offsite to a permitted disposal site within 20 miles of the removal location.

Table 2-3. FRWLP Action Alternatives by Reach

Contract	Reach	Length (feet)	project Flood Management Measure
A	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.
A	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'.
A	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'.
A	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' wide undrained seepage berm. Seepage berm 5' thick at berm toe. 475+35 to 478+68 no flood management required.
B	6	3,169	510+00 to 510+50, potential pipe crossing work to install positive closure device and correct pipe size.
B	7	8,563	510+37 to 514+37, no flood management required. 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' 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'.
B	8	5,875	596+00 to 654+75, cutoff wall tip elevation 15'.
B	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'.
B	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'
B	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'
B	12	1,500	832+30, relocate two 24-inch sewer pipes.
C	13	8,200	844+50 to 923+75: cutoff wall tip elevation (-)38'. Full levee degrade from 844+50 to 897+50.
C	14	2,740	952+00 investigation of 12 kV cable to determine if it meets Title 23 requirements.
C	15	1,410	No flood management measures required.
C	16	11,150	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, by using a seepage berm within the abandoned railroad tunnel. 1077+85 to 1080+00, cutoff wall tip elevation 30' and backfill landside toe depression. Miscellaneous landside encroachment relocations/removals.

Contract	Reach	Length (feet)	project Flood Management Measure
C	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'.
C	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'.
C	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'.
C	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'.
C	21	5,950	1374+33 to 1386+00 cutoff wall tip elevation 32'. 1386+00 to 1408+00: cutoff wall tip elevation 55'. 1408+00 to 1433+00: cutoff wall tip elevation 40'.
C	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'.
C	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'.
C	24	1,449	1608+75 to 1623+86, cutoff wall tip elevation 28'
C	25	5,051	1623+86 to 1625+00, cutoff wall tip elevation 28'.
D	26	3,274	1639+00, replace two 24-inch steel storm drain pipes. 1673+00 to 1674+37, cutoff wall tip elevation 65'. 1674+37 to 1707+11, cutoff wall tip elevation 65'. Reconstruction of landside slope extends down to elevation of bottom of canal.
D	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.
D	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.
D	29	4,402	1770+00, 1785+24, 1785+55, 1792+96, 1799+44, 1809+65, storm drain and irrigation pipe replacements.

Contract	Reach	Length (feet)	project Flood Management Measure
D	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'.
D	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'.
D	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'.
D	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'.
D	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'.
D	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'.
D	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'.
D	37	3,100	2259+00 to 2277+00, cutoff wall tip elevation 42'. 2277+00 to 2290+00, cutoff wall tip elevation 45'.
D	38	1,300	2290+00 to 2292+00 cutoff wall to elevation +45'. 2290+00 to 2303+00 construct 11' high seepage berm, 50' wide at the top and 170' wide from levee centerline.
D	39	1,600	2312+10, remove 24" storm drain pipe.
D	40	4,000	2331+00 to 2335+00, construct 120'-wide seepage berm. 2335+00 to 2359+00, 100'-wide seepage berm. Berms are 9' thick at the levee toe and 3' thick at the berm toe.
D	41	900	2359+00 to 2368+00, construct 100'-wide seepage berm with 1'-thick drain layer.

kV=kilovolt.

Construction Staging, Access, and Temporary Facilities

Staging areas would only be provided for the contractor within the project right-of-way and easement limits. The contractor would be responsible for obtaining all required local, state, and Federal permits for any staging areas outside of these limits. Staging areas would be used for equipment staging, storage of equipment and materials, mobile project offices, construction staff parking, etc.

To facilitate project construction, temporary earthen ramps would be constructed for equipment access between the levee crown and the staging area(s). The earthen ramps would be removed when construction is complete.

Cutoff wall construction requires temporary establishment of an onsite slurry batch plant that would occupy approximately 1–2 acres. Batch plants would be located at approximately 1-mile intervals within the project footprint. The batch plant site would likely contain tanks for water storage, bulk bag supplies of bentonite, bentonite storage silos, a cyclone mixer, pumps, and two generators that meet air quality requirements. The site would also accommodate slurry tanks to store the blended slurries temporarily until they are pumped to the work sites. Slurry ingredients would be mixed with water at the batch plant and the mixture would be pumped from the tanks through pipes to the cutoff wall construction work sites. The batch plant would produce two different slurry mixes, one for trench stabilization and one for the soil backfill mix. Therefore, two slurry pipes or hoses, typically 4- or 6-inch high-density polyethylene pipes, would be laid on the ground and would extend to all work sites. An additional pipe may be used to supply water to the work sites.

Staging areas, access routes, and other temporary construction areas would be located away from wetlands, riparian habitat, oak woodlands, special-status wildlife habitat, known cultural resources, or other sensitive areas and would be limited to disturbed or ruderal grasslands subject to review by USACE and Federal and state resource agencies.

Material Importation, Reuse, and Borrow

Materials imported to the project site would include water, bentonite, cement, incidental construction support materials, aggregate base rock, asphalt, concrete, hydroseed, and embankment fill soil. Each alternative would require the use of large quantities of fill soil, or borrow. To meet borrow demands, embankment fill material excavated as part of construction would be evaluated for reuse. Embankment fill material deemed suitable would be used as part of levee reconstruction and berms.

Borrow Volume

The total volume of material required is 1,500,000 cubic yards. The quantities were calculated assuming a 20% shrinkage factor between excavation at the borrow site and placement at the levee. Only material suitable for placement in levee construction may be borrowed (HDR et al. 2012). These materials are identified as low to medium plasticity soils classified in accordance with American Society for Testing and Materials D 2487 as silty sand (SM) and clayey sand (SC), silt (ML), or clay (lean clay [CL] or fat clay [CH]). The materials should have a Liquid Limit (LL) less than or equal to 45 (may be extended up to 55 with justification and approval from the USACE and the CVFPB), a Plasticity Index (PI) greater than or equal to 12 and less than 40, and a fines content

greater than or equal to 30%. The material should be free from visible organics and be no greater than 2 inches in any dimension.

Borrow Site Selection Factors

SBFCA's first choice for fill or borrow material would be from a local commercial quarry or other permitted source. In the event that material is desired from a source that is not presently permitted, for reasons such as quality, proximity, or volume available, SBFCA would implement soil supply protection measures. One such measure would be maximizing on-site use through gradation, placement, and treatment. Another measure would be the preservation and replacements of topsoil at borrow sites, so that they could be continued to be used for their current use or otherwise returned to their pre-project condition. As part of borrow operations, the upper 12 inches of topsoil would be set aside and replaced after project construction in each construction season. After the project is completed, the borrow site would be re-contoured and reclaimed. An additional measure would be independent environmental documentation and regulatory compliance, as required.

Factors determining borrow sources and sites are (followed by a description of each factor and discussion of potential borrow sources).

- Hauling distance and haul route
- Depth to groundwater
- Royalty fees
- Post-construction land use
- Environmental factors

Hauling Distance and Routes. The cost for borrow site excavation and hauling is directly related to the distance required to haul the material and the route by which the materials must be transported. To the extent possible, sites should be selected that minimize haul route length and the use of public roadways (Wood Rodgers 2011).

Depth to Groundwater. Because the top layer of a borrow site must be removed and stockpiled to exclude organics from the borrow material, it is economical to maximize the depth of the excavation. This maximum depth is typically governed by the normal seasonal depth of groundwater. Once excavation extends to within a few feet of the groundwater table, additional expense is incurred to implement dewatering at the site. Groundwater elevations generally fluctuate throughout the year and can be influenced by standing water or irrigation activities on adjacent lands. Typically, groundwater depths are higher at the beginning of spring, and become deeper toward the end of summer (Wood Rodgers 2011).

Royalty Fees. Royalty fees for material excavated directly affect the cost of the borrow and also typically trigger more substantial permitting requirements. It is desirable to find a property owner who wishes to have excavation carried out for his own purposes, such as creating a detention basin to support future development, so that royalty fees and a SMARA permit are avoided (Wood Rodgers 2011).

Post-Construction Land Use. The post-construction use of the property can also effect the depth of excavation. Borrow sites must be free draining after the material is excavated, and therefore cannot be extended deeper than the offsite drainage facilities can accommodate (Wood Rodgers 2011).

Environmental Factors. Environmental factors, including the need for mitigation for special-status species and wetlands encroachments, are also a factor in selecting borrow sites. Consideration should also be given to haul routes when evaluating environmental effects. Routes which could be unavailable during the early months of the construction season due to the presence of nesting raptors should be avoided (Wood Rodgers 2011). If waterside borrow sites outside the construction footprint are needed, only sites that do not impact woody vegetation associated with fish-inhabited waters should be considered. All sites will be surveyed for potential wildlife habitat, jurisdictional waters, cultural resources, and other environmental regulatory triggers prior to use, and environmental documentation and permits will be secured independently or supplemental to the FRWLP documentation and permits.

Borrow Sources and Proposed Borrow Sites

SBFCA has explored the option of purchasing fill or borrow material from a local commercial quarry or other permitted source; however, there are not currently any sites near the project area that would supply the volume and type of material required. Consequently, SFBCA plans to purchase fill from local landowners willing to sell borrow material.

Five borrow sites have been identified in the project area. Each site was investigated to determine the quantity of available material, hauling distance, material composition, groundwater elevation, and prospects for acquisition. The purpose of the investigation was to identify the sites with the greatest potential to economically provide material for the FRWLP. Economical hauling has been determined to be within a 2-miles radius and marginally economic hauling within a 10-mile radius. As a result of the borrow analysis, sufficient fill volume is present within an approximate 10-mile, one-way haul distance from the area of construction.

SBFCA would maximize the potential borrow sites' use through gradation, placement, and treatment so that they could continue to be used for their current use or otherwise returned to their pre-project condition. As part of borrow operations, the upper 4–6 inches of topsoil would be set aside and replaced after construction in each construction season. After the FRWLP is completed, the borrow site would be re-contoured and reclaimed.

Through outreach efforts, SBFCA identified a number of sites owned by individuals or government agencies willing to sell their property or provide material on a cubic yard basis. Figure 1 shows the locations of the five potential borrow sites identified and the proposed haul routes to the construction area.

North Valley Property

The North Valley property is owned by North Valley Properties, LLC and is located south of Ella Road between Feather River Boulevard and Arboga Road. The Wheeler Ranch housing development is proposed at the site. Borrow for the FRWLP would be taken from the northeast corner of the property to create a 24.5 acre detention pond (referred to as referred to as the Drainage Basin C Regional Detention Pond but commonly referred to as the South Ella Detention Pond). The Ella Basin is being constructed as part of Reclamation District No. 784's Master Drainage Plan. Historically, the site was cultivated for agricultural purposes. Currently, the site is disked ruderal grassland with some roads cut in the southern portion of the property for the Wheeler Ranch development. The material at this site is anticipated to be CL from a depth of 18–22 feet, followed by silt-sand material below a depth of 22–25 feet. The depth of excavation is anticipated to be 15–20 feet and the yield of material from this site could be 400,000–500,000 cubic yards. Borrow

material from this site would be used for work in Reach 13 of Contract C (60–70,000 cubic yards needed), Contract B, and the remainder of Contract C. If borrow material is remaining, it may also be used for Contract D.

The haul route to the northern portion of Contract C from the North Valley Property would be west on Ella Avenue to north on Feather River Boulevard to north on SR70 to west on SR20/Colusa Avenue to north on Live Oak Boulevard to north on SR99 to east on Paseo Avenue. Additional access route to the levee along northbound SR99 would be north on Kent Avenue to east on Koch Lane. Additional access routes to the levee along northbound Live Oak Boulevard would be east on Morse Road, east on Rednall Road and east on Market Street to east on Lynn Way. Additional access routes to the levee along westerly SR20/Colusa Avenue would be North on Sutter Street/Market Street to east on Lynn Way.

The haul route to the southern portion of Contract C (and Reach 13) from the North Valley Property would be west on Ella Avenue to north on Feather River Boulevard to north on SR70 to west on SR20/Colusa Avenue to south on Sutter Street to south on 2nd Street to levee access. Additional access route to the levee along westerly SR20/Colusa Avenue would be south on SR99 to east on Bogue Road to south on Garden Highway to east on Shanghai Bend Road.

The post-project land use of the site would be a regional detention pond for Reclamation District No. 784.

Marler Property

The Marler property is a 10-acre property at Johnson Road near Messick Road north of Star Bend and south of Shanghai Bend. The site is currently an orchard. The depth of excavation could be upwards of 6 feet. The yield of material from this site could be up to 75,000 cubic yards. The likely haul route would be Johnson Road to Messick Road to the Garden Highway, accessing the levee near Oswald Road. The post-project land use for the property would be agricultural production, likely row crops or orchard.

Lanza Property

The Lanza property is 40 acres in size and is currently farmed in field/row crops. It is located at North Township Road and Pease Road south of Live Oak and north of Yuba City. The site has not yet been investigated to determine the types of materials present. Excavation of the site to a depth of 6 feet may occur. The yield of material from this site could be up to 200,000 cubic yards. The likely haul route would be along Pease Road directly east to the levee. The post-project land use for the property would be rice production.

City of Live Oak Detention Basin

The City of Live Oak owns the property formerly known as the Caltrans Detention Basin Site located west of SR 99 and south of Paseo Avenue. The site is currently fallow. The City of Live Oak intends to construct soccer fields and a stormwater detention basin at the site in 2013 or later. Although the site would require hauling for a short distance through a residential neighborhood, it is anticipated the residents would be amenable to the hauling as it would be a part of the public amenity constructed by the City of Live Oak. The material at this site is anticipated to be CL from a depth of 1–2.5 feet, followed by more sandy material to a depth of 6 feet. This site is approximately 25 acres, and the depth of excavation is anticipated to be 3–6 feet. The yield of material from this site could be

up to 125,000 cubic yards, and would likely be used for Contract C. The haul route to the northern portion of Contract C from the City of Live Oak Detention Basin would be west crossing the canal to north to Treatment Plant Access road and west on Treatment Plant Access Road to north on Farm Access Road to north on Richards Avenue to east on Pennington Road. Additional access routes to the levee from eastbound on Pennington Road are south on SR99 to east on Paseo Avenue and north on Metteer Road to east on Riviera Road. Additional routes to the levee along northerly Metteer Road would be east on Campbell Road and east on Cooley Road.

The City of Live Oak (Scmidt, pers. comm.) reports that land at this location has historically been cultivated for agricultural purposes and that there was no evidence of any wetland or other sensitive plant or wildlife areas remaining onsite. A preliminary wetland delineation of the area conducted by HDR Engineering in December 2012 did not identify any wetland features. The previous agricultural use has displaced native species of plants and animals except those varieties capable of co-existing with humans in urban settings. The post-project use of the site would be a community park and stormwater detention basin facility.

Oroville Wildlife Area Dredge Tailings Area

This site is within the Oroville Wildlife Area and consists of several mounds of dredge tailings on the waterside of the existing levee. The material is suitable for use in seepage berms at Reaches 40 and 41 and an adjacent levee at Reach 38. The availability of tailings in the area should be sufficient to meet the total deficit for berm material in these reaches. The excavation of the material would be coordinated to maximize hydraulic benefits from the reshaping of the overbank area. The site also represents an opportunity to provide waterside habitat enhancements. The useful area of this site could be approximately 75 acres and the depth of excavation could be upwards of 10 feet. The yield of material from this site could be up to 375,000 cubic yards. Hauling from this site would not take place on public roads. It is anticipated the contractor would use an existing waterside levee ramp (or create one), directly accessing the levee patrol road. The future land use for this site would be similar to its present day use (managed habitat area).

Post-Construction Operations and Maintenance

After construction completion, the levee and staging areas and levee slopes would be hydroseeded for erosion protection, dust abatement, and to prevent colonization of exotic vegetation.

In accordance with Federal Flood Control Regulations (33 CFR 208.10) and State requirements (California Water Code Section 8370), each year the Federal flood control facilities are inspected four times, at intervals not exceeding 90 days. DWR would inspect the system twice per year, and the local maintaining authorities would inspect it twice per year and immediately following major high water events. The findings of these inspections would be reported to the CVFPB's Chief Engineer through DWR's Flood Project Integrity and Inspection Branch.

Permanent facilities associated with relief wells include the wells themselves and surface drainage trenches to control the discharge. Inspection of the relief wells is required at least annually, and observation of flow from the wells is required during high river stages. The wells are test-pumped periodically. The collection ditch is maintained to allow free flow of water.

Because operations and maintenance activities are conducted by DWR and local flood protection districts, the effects of these activities are not part of the proposed project and are not discussed further in this MMP.

2.2.5 Conservation Measures

SBFCA will implement the following conservation measures to avoid and minimize effects on federally listed species. To ensure their implementation, the measures listed below will be included in the project specifications.

General

Conservation Measure 1: Conduct Mandatory Biological Resources Awareness Training for All Project Personnel and Implement General Requirements

Before any ground-disturbing work (including vegetation clearing and grading) occurs in the project area, a biologist approved by USFWS, NMFS, and CDFW will conduct a mandatory biological resources awareness training for all construction personnel about federally listed species that could potentially occur onsite (VELB, giant garter snake, and fish species). The training will include the natural history, representative photographs, and legal status of each federally listed species and avoidance and minimization measures to be implemented. Proof of personnel attendance will be provided to USFWS, NMFS, and CDFW within 1 week of the training. If new construction personnel are added to the project, the contractor will ensure that the new personnel receive the mandatory training before starting work. The subsequent training of personnel can include videotape of the initial training and/or the use of written materials rather than in-person training by a biologist. Requirements that will be followed by construction personnel are listed below.

- Where suitable habitat is present for listed species, SBFCA will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other means, and prohibit any construction-related traffic outside these boundaries.
- Project-related vehicles will observe the posted speed limit on hard-surfaced roads and a 10-mile-per-hour speed limit on unpaved roads during travel in the project construction area.
- Project-related vehicles and construction equipment will restrict off-road travel to the designated construction areas.
- All food-related trash will be disposed of in closed containers and removed from the project construction area at least once per week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the project site.
- No pets or firearms will be allowed in the project construction area.
- To prevent possible resource damage from hazardous materials such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.
- Any worker who inadvertently injures or kills a federally listed species or finds one dead, injured, or entrapped will immediately report the incident to the biological monitor and construction foreman. The construction foreman will immediately notify SBFCA, who will provide verbal notification to the USFWS Sacramento Endangered Species Office and/or the local CDFW warden or biologist within 1 working day. SBFCA will follow up with written notification to USFWS or CDFW within 5 working days. The biological monitor will follow up with SBFCA to ensure that the wildlife agencies were notified.

- The biological monitor will record all observations of federally listed species on CNDDB field sheets and submit to CDFW.

Valley Elderberry Longhorn Beetle

Conservation measures for VELB are based on USFWS's 1999 *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (Conservation Guidelines) (U.S. Fish and Wildlife Service 1999a).

Conservation Measure 2: Fence Elderberry Shrubs to be Protected and Monitor Fencing during Construction

Elderberry shrubs/clusters within 100 feet of the construction area that will not be removed will be protected during construction. A qualified biologist (i.e., with elderberry/VELB experience), under contract to SBFCA, will mark the elderberry shrubs and clusters that will be protected during construction. Orange construction barrier fencing will be placed at the edge of the respective buffer areas. The buffer area distances will be proposed by the biologist and approved by USFWS. No construction activities will be permitted within the buffer zone other than those activities necessary to erect the fencing. Signs will be posted every 50 feet (15.2 meters) along the perimeter of the buffer area fencing. The signs will contain the following information:

This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment.

In some cases, where the elderberry shrub dripline is within 10 feet of the work area, k-rails will be placed at the shrub's dripline to provide additional protection to the shrub from construction equipment and activities. Temporary fences around the elderberry shrubs and k-rails at shrub driplines will be installed as the first order of work. Temporary fences will be furnished, constructed, maintained, and later removed, as shown on the plans, as specified in the special provisions, and as directed by the project engineer. Temporary fencing will be 4 feet (1.2 meters) high, commercial-quality woven polypropylene, orange in color.

Buffer area fences around elderberry shrubs will be inspected weekly by a qualified biological monitor during ground-disturbing activities and monthly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around elderberry shrubs throughout construction. Biological inspection reports will be provided to the project lead and USFWS.

Conservation Measure 3: Conduct VELB Surveys Prior to Elderberry Shrub Transplantation

Surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. Surveys will be conducted in accordance with the Conservation Guidelines for the VELB (U.S. Fish and Wildlife Service 1999a). The biologist will survey the area surrounding the shrub to be transplanted to ensure that there aren't additional elderberry shrubs that need to be removed. Surveys will consist of counting and measuring the diameter of each stem, and examining elderberry shrubs for the presence of VELB exit holes. Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to USFWS. SBFCA plans to plant elderberry seedlings/cuttings and associated native

plants prior to transplantation of elderberry shrubs. The data collected during the surveys prior to transplantation will be used to determine if SFBCA is exceeding their compensation requirements or if additional plantings are necessary. Because the project would be constructed in four separate contracts, elderberry survey data for each contract will be used to rectify any discrepancies in compensation for the previous contract and to ensure that SBFCA has fully mitigated for impacts on VELB.

Conservation Measure 4: Water Down Construction Area to Control Dust

SFBCA or the contractor will ensure that the project construction area will be watered down as necessary to prevent dirt from becoming airborne and accumulating on elderberry shrubs within the 100–foot buffer.

Conservation Measure 5: Compensate for Direct and Indirect Effects on Valley Elderberry Longhorn Beetle Habitat

Project impacts to VELB habitat are discussed in Section 2.3 and compensation ratios are discussed below in Section 3.4.

Giant Garter Snake

Conservation measures for giant garter snake were developed using portions of the *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California* (U.S. Fish and Wildlife Service 1997).

Conservation Measure 6: Conduct Construction Activities during the Active Period for Giant Garter Snake

To the maximum extent possible, all construction activity within giant garter snake aquatic and upland habitat within 200 feet of aquatic habitat will be conducted during the snake's active period (May 1–October 1). During this timeframe, potential for injury and mortality are lessened because snakes are actively moving and avoiding danger. Because levee slope flattening within the Sutter-Butte Canal in Reaches 26–28 (scheduled for 2016) and pipe reconstruction at two sites in the same reaches must be conducted when the canal is dry (February–March), additional protective measures will be implemented at these locations (see Conservation Measure 14 below).

Conservation Measure 7: Install and Maintain Exclusion and Construction Barrier Fencing around Suitable Giant Garter Snake Habitat

To reduce the likelihood of giant garter snakes entering the construction area, SBFCA will install exclusion fencing and orange construction barrier fencing along the portions of the construction area that are within 200 feet of suitable aquatic and upland habitat. The exclusion and construction barrier fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during this activity.

The construction specifications will require that SBFCA or its contractor retain a qualified biologist to identify the areas that are to be avoided during construction. Areas adjacent to the directly affected area required for construction, including staging and access, will be fenced off to avoid disturbance in these areas. Before construction, the contractor will work with the qualified biologist

to identify the locations for the barrier fencing and will place flags or flagging around the areas to be protected to indicate the locations of the barrier fences. The protected area will be clearly identified on the construction specifications. The fencing will be installed the maximum distance practicable from the aquatic habitat areas and will be in place before construction activities are initiated.

The exclusion fencing will consist of 3 foot-tall silt fencing buried at least 4-6 inches below ground level. The exclusion fencing will ensure that giant garter snakes are excluded from the construction area and that suitable upland and aquatic habitat is protected throughout construction. The construction barrier fencing will be commercial-quality, woven polypropylene, orange in color, and 4 feet high (Tensor Polygrid or equivalent). The fencing will be tightly strung on posts with a maximum of 10-foot spacing.

Barrier and exclusion fences will be inspected daily by a qualified biological monitor during ground-disturbing activities and weekly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around giant garter snake habitat throughout construction. Biological inspection reports will be provided to the project lead and USFWS.

Conservation Measure 8: Minimize Potential Impacts on Giant Garter Snake Habitat

SBFCA will implement the following measures to minimize potential impacts on giant garter snake habitat.

- Staging areas will be located at least 200 feet from suitable giant garter snake habitat.
- Any dewatered habitat will remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.
- Vegetation clearing within 200 feet of the banks of suitable giant garter snake aquatic habitat will be limited to the minimum area necessary. Avoided giant garter snake habitat within or adjacent to the project area will be flagged and designated as an environmentally sensitive area, to be avoided by all construction personnel.
- The movement of heavy equipment within 200 feet of the banks of suitable giant garter snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance.

Conservation Measure 9: Prepare and Implement a Stormwater Pollution Prevention Plan

Because ground disturbance for the project would be greater than 1 acre, SBFCA would obtain coverage under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) general construction activity stormwater permit. The Central Valley Regional Water Quality Control Board (RWQCB) administers the NPDES stormwater permit program in Sutter and Butte Counties. Obtaining coverage under the NPDES general construction activity permit generally requires that the project applicant prepare a stormwater pollution prevention plan (SWPPP) that describes the BMPs that would be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP would be prepared prior to commencing earth-moving construction activities.

The specific BMPs that would be incorporated into the erosion and sediment control plan and SWPPP would be site-specific and would be prepared by the construction contractor in accordance with the California RWQCB Field Manual. However, the plan likely would include, but not be limited to, one or more of the following standard erosion and sediment control BMPs.

- **Timing of construction.** The construction contractor will conduct all construction activities during the typical construction season to avoid ground disturbance during the rainy season.
- **Staging of construction equipment and materials.** To the extent possible, equipment and materials will be staged in areas that have already been disturbed.
- **Minimize soil and vegetation disturbance.** The construction contractor will minimize ground disturbance and the disturbance/destruction of existing vegetation. This will be accomplished in part through the establishment of designated equipment staging areas, ingress and egress corridors, and equipment exclusion zones prior to the commencement of any grading operations.
- **Stabilize grading spoils.** Grading spoils generated during the construction will be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If necessary, temporary stockpiles may be covered with an appropriate geotextile to increase protection from wind and water erosion.
- **Install sediment barriers.** The construction contractor may install silt fences, fiber rolls, or similar devices to prevent sediment-laden runoff from leaving the construction area. Natural/biodegradable erosion control measures (i.e., coir rolls, straw wattles or hay bales) will be used. Plastic monofilament netting (erosion control matting) will not be allowed because animals can become caught in this type of erosion control material.
- **Stormwater drain inlet protection**. The construction contractor may install silt fences, drop inlet sediment traps, sandbag barriers, and/or other similar devices.
- **Permanent site stabilization**. The construction contractor will install structural and vegetative methods to permanently stabilize all graded or otherwise disturbed areas once construction is complete. Structural methods may include the installation of biodegradable fiber rolls and erosion control blankets. Vegetative methods may involve the application of organic mulch and tackifier and/or the application of an erosion control seed mix. Implementation of a SWPPP will substantially minimize the potential for project-related erosion and associated adverse effects on water quality.

Conservation Measure 10: Prepare and Implement a Bentonite Slurry Spill Contingency Plan (Frac-Out Plan)

Before excavation begins, SBFCA would ensure the contractor would prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). If the contactor prepares the plan, it would be subject to approval by USACE, NMFS, and SBFCA before excavation can begin. The BSSCP would include measures intended to minimize the potential for a frac-out (short for “fracture-out event”) associated with excavation and tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and “minimum-effect” response in the event of a frac-out and release of excavation fluid (i.e., bentonite). The BSSCP would require, at a minimum, the following measures.

- If a frac-out is identified, all work will stop, including the recycling of the bentonite fluid. In the event of a frac-out into water, the location and extent of the frac-out will be determined, and the frac-out will be monitored for 4 hours to determine whether the fluid congeals (bentonite will usually harden, effectively sealing the frac-out location).
- NMFS, CDFW, and the RWQCB will be notified immediately of any spills and will be consulted regarding clean-up procedures. A Brady barrel will be onsite and used if a frac-out occurs. Containment materials, such as straw bales, also will be onsite prior to and during all operations, and a vacuum truck will be on retainer and available to be operational onsite within notice of 2 hours. The site supervisor will take any necessary follow-up response actions in coordination with agency representatives. The site supervisor will coordinate the mobilization of equipment stored at staging areas (e.g., vacuum trucks) as needed.
- If the frac-out has reached the surface, any material contaminated with bentonite will be removed by hand to a depth of 1-foot, contained, and properly disposed of, as required by law. The drilling contractor will be responsible for ensuring that the bentonite is either properly disposed of at an approved Class II disposal facility or properly recycled in an approved manner.
- If the bentonite fluid congeals, no other actions, such as disturbance of the streambed, will be taken that will potentially suspend sediments in the water column.
- The site supervisor has overall responsibility for implementing this BSSCP. The site supervisor will be notified immediately when a frac-out is detected. The site supervisor will be responsible for ensuring that the biological monitor is aware of the frac-out, coordinating personnel, response, cleanup, regulatory agency notification and coordination to ensure proper clean-up, disposal of recovered material, and timely reporting of the incident. The site supervisor will ensure all waste materials are properly containerized, labeled, and removed from the site to an approved Class II disposal facility by personnel experienced in the removal, transport, and disposal of drilling mud.
- The site supervisor will be familiar with the contents of this BSSCP and the conditions of approval under which the activity is permitted to take place. The site supervisor will have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan. The site supervisor will ensure that a copy of this plan is available (onsite) and accessible to all construction personnel. The site supervisor will ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out, prior to commencement of excavation operations.

Conservation Measure 11: Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan

A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable water or adjoining shorelines. SBFCA or its contractor would develop and implement an SPCCP to minimize the potential for and effects from spills of hazardous, toxic, or petroleum substances during construction and operation activities. The SPCCP would be completed before any construction activities begin. Implementation of this measure would comply with State and Federal water quality regulations. The SPCCP would describe spill sources and spill pathways in addition to the actions that would be taken in the event of a spill (e.g., an oil spill from engine refueling would be immediately cleaned up with oil absorbents). The SPCCP would outline descriptions of containments facilities and practices such as doubled-walled tanks, containment berms, emergency shut-offs, drip pans, fueling procedures and spill response kits. It would also

describe how and when employees are trained in proper handling procedure and spill prevention and response procedures.

SBFCA would review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. SBFCA would notify its contractors immediately if there is a non-compliance issue and would require compliance.

The Federal reportable spill quantity for petroleum products, as defined in 40 CFR 110, is any oil spill that results in one or more of the following.

- Violates applicable water quality standards.
- Causes a film or sheen on or discoloration of the water surface or adjoining shoreline.
- Causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.

If a spill is reportable, the contractor's superintendent would notify SBFCA, and SBFCA would take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. A written description of reportable releases must be submitted to the Central Valley RWQCB. This submittal must contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases would be documented on a spill report form.

Conservation Measure 12: Conduct Preconstruction Surveys and Monitoring for Giant Garter Snake

Prior to ground-disturbing activities within 200 feet of suitable habitat, a USFWS-approved biological monitor will conduct a preconstruction survey of suitable aquatic and upland habitat and inspect exclusion and orange barrier fencing to ensure they are both in good working order each morning. If any snakes are observed within the construction area at any other time during construction the USFWS-approved biological monitor will be contacted to survey the site for giant garter snakes. The biological monitor will have the authority to stop construction activities until appropriate corrective measures have been completed or it is determined that the snake will not be harmed. Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own. If unable to move away on their own, trapped or injured giant garter snakes will be only be removed by the USFWS-approved biological monitor and will be placed in the nearest suitable habitat that is outside of the construction area. The biological monitor will immediately report these activities to USFWS by phone and will provide a written account of the details of the incident within 24 hours.

Once all initial ground-disturbing activities are completed, the biological monitor will perform weekly checks of the site for the duration of construction in order to ensure that construction barrier fences and exclusion fences are in good order, trenches are being covered, project personnel are conducting checks beneath parked vehicles prior to their movement, and that all other required biological protection measures are being complied with. The biological monitor will document the results of monitoring on construction monitoring log sheets, which will be provided to USFWS within 1 week of each monitoring visit.

Conservation Measure 13: Provide Escape Ramps or Cover Open Trenches at the End of Each Day

To avoid entrapment of giant garter snake, thereby preventing injury or mortality resulting from falling into trenches, all excavated areas more than 1 foot deep will be provided with one or more escape ramps constructed of earth fill or wooden planks at the end of each workday. If escape ramps cannot be provided, then holes or trenches will be covered with plywood or other hard material. The biological monitor or construction personnel designated by the contractor will be responsible for thoroughly inspecting trenches for the presence of giant garter snakes at the beginning of each workday. If any individuals have become trapped, the USFWS-approved biological monitor will be contacted to relocate the snake and no work will occur in that area until approved by the biologist.

Conservation Measure 14: Implement Additional Protective Measures during Work in Suitable Habitat during the Giant Garter Snake Dormant Period

SBFCA will implement additional protective measures during time periods when work must occur during the giant garter snake dormant period (October 2–April 30), when snakes are more vulnerable to injury and mortality. It is expected that these additional measures will be implemented during levee slope flattening within the Sutter-Butte Canal in Reaches 26–28 (scheduled for 2016) and pipe reconstruction adjoining the canal at two sites in the same reaches during February–March, and if construction activities extend to the period between October 2 and November 1. SBFCA will implement additional protective measures when conducting work in suitable giant garter snake habitat between October 2 and April 30.

- A full-time USFWS-approved biological monitor will be onsite for the duration of construction activities.
- All emergent vegetation within the Sutter-Butte Canal on the levee side, and vegetation within 200 feet of the canal will be cleared prior to the giant garter snake hibernation period (i.e., vegetation clearing must be completed by October 1 for following winter work).
- Exclusion fencing will be installed around the perimeter of the work area and across the Sutter-Butte Canal where construction activities associated with levee slope flattening and pipe reconstruction activities would occur. The fencing should enclose the work area to the maximum extent possible to prevent giant garter snakes from entering the work area. Fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during fence installation. The USFWS-approved biological monitor will work with the contractor to determine where fencing should be placed and will monitor fence installation. The exclusion fencing will consist of 3 foot-tall erosion fencing buried 4-6 inches below ground level. The exclusion fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area (between canal and existing levee).

  Portions of the Sutter-Butte Canal that are temporarily disturbed during construction will be revegetated with emergent vegetation and adjacent disturbed upland habitat will be revegetated with native grasses and forbs after construction is complete.

Conservation Measure 16: Restore Temporarily Disturbed Aquatic and Upland Habitat to Pre-Project Conditions

Upon completion of the proposed project, SBFCA will restore 6.81 acres of suitable aquatic habitat and 118.80 acres of suitable upland habitat for giant garter snake to pre-project conditions.

Conservation Measure 17: Compensate for Permanent Loss of Aquatic Habitat for Giant Garter Snake

Project impacts to GGS are discussed in Section 2.3 and compensation ratios are discussed below in Section 3.4.

2.3 Site Characteristics

2.3.1 Biological Resources in the Project Area

This section identifies the field surveys conducted to identify biological resources known to occur or having the potential to occur in the project area, special-status wildlife and fish species with potential to occur in the project area, and the effects of the project on sensitive biological resources.

Field Surveys

The field surveys conducted to identify biological resources in the project area consisted of habitat mapping, a delineation of wetlands and other waters of the U.S., special-status wildlife surveys, and a tree survey.

Land Cover Mapping

The information pertaining to land cover types in the project area was derived primarily from the collaborative mapping done in November 2010 by ICF International GIS staff and Galloway Consulting and updated as needed based on the results of the 2011 reconnaissance-level biological assessment conducted by ICF International biologists. These 2010 and 2011 field surveys were conducted by combination of aerial photograph interpretation and walking and driving through the project area.

Land cover types in the project area fall into four broad categories: wildlands, potential wetlands and other waters of the U.S., agricultural lands, and developed/disturbed areas.

Delineation of Wetlands and Other Waters of the U.S.

In June, July, and August 2012, HDR conducted a formal delineation of wetlands and other waters for all areas that may potentially be directly affected by construction of the project. Potential borrow site locations were surveyed for wetlands in winter 2012. An approved Preliminary Jurisdictional Delineation for the Feather River West Levee Project was received on May 1, 2013.

Special-Status Wildlife Surveys

Field surveys to identify habitats for special-status wildlife and elderberry shrub (*Sambucus* spp.) habitat for VELB in the project area were conducted by ICF biologists on July 20–22, July 27, and August 31, 2011. Additional mapping of the elderberry shrubs was conducted by ICF concurrently with arborist surveys in summer 2012. During the 2011 surveys, biologists located elderberry shrubs by driving and walking along the levee in the project area and mapped elderberry shrubs (and shrub clusters) with a sub-meter accuracy global positioning system (GPS). When the bases of shrubs were accessible, stem counts, heights, and widths of shrubs were recorded, and shrubs were

surveyed for VELB exit holes. Where dense poison oak (*Toxicodendron diversilobum*), Himalayan blackberry (*Rubus armeniacus*), and/or other vegetation surrounds elderberry shrubs, stem counts and exit hole surveys could not be conducted. Final stem counts will be conducted on all elderberry shrubs prior to removal for transplanting.

An assessment of habitat for giant garter snake was conducted by ICF and HDR biologists on July 12, 2012, and October 25, 2012. During the assessment, biologists evaluated aquatic and upland habitat for giant garter snake, took representative photographs of habitat present, and recorded all wildlife species observed.

Borrow sites recently have been identified and have not been surveyed yet. Surveys of these sites are planned to occur prior to construction. Any borrow site that contains habitat for listed species will not be utilized.

Tree Survey

ICF arborists assessed trees within the project footprint from July 17 to October 11, 2012. The arborist survey methods followed standard professional practices. Tree location data were collected with a GPS unit. Trees within the defined project footprint, overhanging the project footprint, and greater than 4 inches in DBH were surveyed. Trees were labeled with an aluminum tree tag with unique numbers inscribed on the tags.

The assessment criteria and recorded data from the arborist survey included:

- Identification of the species
- Status of the species
- Number of trunks
- Diameter of trunk 4.5 feet above the ground surface (DBH)
- Tree height
- Canopy dripline radius
- Health, vigor, and structure
- Remarks

For trees with relatively symmetrical canopies, the measurement from the trunk to the end of the longest lateral limb was measured and doubled to determine the diameter of the canopy. For trees with asymmetrical canopies, the diameter of the canopy was determined by adding the distance as measured from the longest lateral limb to the trunk to the distance measured from the trunk to the longest lateral limb on the opposite side of the tree (greater than 90 degrees either side from the first measurement).

Tree health and structure were rated as *good*, *fair*, or *poor*. Table 2-4 provides a general definition of these ratings. Where conditions were between ratings of good and fair or fair and poor, intermediate ratings of fair-good and fair-poor were given.

Table 2-4. Criteria Used to Rate the Health, Vigor, Structure and Form of Surveyed Trees

Rating	Tree Health and Vigor
Good	Overall appearance of the tree is exemplary of the species. No visible wounds or defects, or completely healed. Crown root area displays no signs of wood deterioration. Bark missing from less than 10% of trunk circumference. Trunk does not show any signs of wood decay, cracking, or deterioration. Foliage is exemplary of the species, no sprout growth observed, evenly distributed, and free of pests. No signs of disease symptoms or pests observed. Current annual twig growth is greater than expected for the species. Buds are normal size, viable, abundant, and uniform throughout canopy. Little to no evidence of stress or nutrient deficiency.
Fair	Overall appearance of the tree is representative of the species. Wounds actively healing, but not completely healed. Crown root area displays minor signs of wood deterioration. Bark missing from more than 10% but less than 30% of trunk circumference. Trunk does not show any signs of wood decay, cracking, or deterioration. Foliage is representative of the species, some sprout growth observed, foliage is unevenly distributed yet balanced across whole tree, or only a minor pest problem observed. Disease symptoms or pests observed create an intermittent or temporary nuisance. Current annual twig growth is as expected for the species. Buds are of normal size and viable, but are somewhat sparse or irregular throughout the canopy. Some evidence of minor stress or nutrient deficiency observed.
Poor	Overall appearance of the tree deviates from species representative. Wounds not healing vigorously or are showing signs of decay. Crown root area decayed over more than 30% of tree's cross section. Bark missing from more than 30% of trunk circumference. Trunk shows signs of wood decay, cracking, or deterioration. Foliage deviates from species representative, sprout growth observed, foliage is unevenly distributed, or pest infestation observed. Disease symptoms or pests observed threaten the health and well-being of host and/or adjacent trees. Current annual twig growth is less than expected for the species. Buds are few, or not viable, or sparse, or irregular throughout the canopy. Evidence of stress or nutrient deficiency observed.

Rating	Tree Structure and Form
Good	Tree structure has a low potential for failure. Ample space for tree to grow to mature size characteristic of the species. No visible root defects or damage from roots to infrastructure observed. No anchor roots exposed. Trunk appears solid and free of cavities, decay, or hollowness. No bark inclusion observed. Canopy is full and balanced. Single leader, branch attachment solid, and angle of branch attachment exemplary. No dead limbs observed, all limbs free of defects, and limbs are not overburdened.
Fair	Tree structure has a moderate potential for failure. Adequate space available for tree to grow to a size representative of the species. Roots abutting infrastructure, displacing built objects from normal alignment. Some anchor root exposure. Trunk displays some signs of minor deterioration, but structurally still solid and in process of healing. Bark inclusion observed only on minor branches and away from posing threats to health, safety, and welfare of the public. Canopy is slightly lacking or unbalanced. Leader not clearly defined, but not missing; branch attachment characteristic of species. One minor dead limb observed, but solidly attached, other limbs free of defects, limbs only slightly overburdened.
Poor	Tree structure has a high potential for failure. Inadequate space available for tree to grow to a size representative of the species. Roots lifting sidewalks or built objects from normal grade, extensive portions of root system cut, decay of root crown in excess of 30%, or root zone subject to overwatering. Anchor roots exposed. Trunk decay is affecting 30% or more of the trunk cross section, healing process slow or not evident, or crack observed. Unequal weight distribution within tree structure due to trunk lean. Bark inclusion at branches, involving main trunk, or posing a threat to health, safety, or welfare of the public. Canopy is lacking or unbalanced, or concentrated in the upper 1/3 of tree. Double leader or no leader observed, a branch observed nearly as large as trunk, narrow angles of branch attachment, multiple limb attachments or attachments of limbs not characteristic of species, or decay observed at branch attachment. More than one dead limb observed, a wound in limb observed greater than 30% of cross section, limbs overburdened, or multiple branches sprouting from cuts.

2.3.2 Special-Status Plants

Special-status plant species are plants that are legally protected under California Endangered Species Act (CESA), ESA, or other regulations, and species considered sufficiently rare by the scientific community to qualify for such listing.

Nine special-status plant species have been reported in the seven USGS quadrangles that overlap the project area (California Department of Fish and Game 2010; California Native Plant Society 2012; California Department of Fish and Game 2012; U.S. Fish and Wildlife Service 2012). Two species, slender Orcutt grass (*Orcuttia tenuis*) and Greene's tuctoria (*Tuctoria greenei*) are vernal pool species that lack potential habitat in the project area. No vernal pools were observed in the area during the 2010 and 2011 field surveys. Six species were determined to have low potential for occurrence because the potential habitat (i.e., oak woodland, ruderal areas outside the toe of the levee) constitutes a relatively small portion of the biological study area and has been lowered in quality by past and ongoing disturbance (agricultural activities, dredging). Additionally, suitable microhabitat requirements (subalkaline flats, heavy clay soils, acidic clay soils) for these species may not be met.

Sanford's arrowhead is the only special status species that could occur in jurisdictional habitat, including freshwater marshes, sloughs, canals, and other slow moving habitats. It is neither federally or state listed, but is classified as fairly endangered in California according to the California Rare Plant Rank. For the project area, it was determined to have low potential to occur along the edges of irrigation canals, inundated areas of the river's floodplain within riparian forest, and ponds on the land side of the levee that support a fringe of riparian forest.

2.3.3 Special-Status Wildlife Species

Special-status wildlife species are defined as animals that are legally protected under the ESA, CESA, or other regulations and species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status wildlife species are defined as follows.

- Species that are listed or proposed for listing as threatened or endangered under the ESA (50 CFR 17.11 for listed animals and various notices in the Federal Register (FR) for proposed species).
- Species that are candidates for possible future listing as threatened or endangered under the ESA (77 FR 69993, November 21, 2012).
- Species listed or proposed for listing by the State of California as threatened or endangered under the CESA (14 CCR 670.5).
- Species that meet the definitions of rare or endangered under CEQA (State CEQA Guidelines Section 15380).
- Animals listed as California species of special concern on CDFW's Special Animals List (California Department of Fish and Game 2011).
- Animals that are fully protected in California under the California Fish and Game Code (Sections 3511 [birds], 4700 [mammals], and 5050 [reptiles and amphibians]).

Based on the USFWS (2012) species list and CNDDB (California Department of Fish and Game 2012) records search for the quadrangles overlapping the affected area, 23 special-status wildlife species

were identified as having potential to occur in the affected area. Of these 23 species, four are known to occur in the affected area (western pond turtle, Swainson's hawk, western yellow-billed cuckoo, and bank swallow). Swainson's hawk was observed in the affected area during 2011 field surveys. Though not reported to occur in the affected area, 10 other special-status wildlife species have a moderate or high potential to occur in the affected area given their known range, reports of occurrence, and/or the presence of suitable habitat. These species include Antioch Dunes anthicid beetle (*Anthicus antiochensis*), Sacramento anthicid beetle (*A. sacramento*), Sacramento Valley tiger beetle (*Cicindela hirticollis abrupta*), VELB, giant garter snake, northern harrier, bald eagle, western burrowing owl, tricolored blackbird, and silver-haired bat. The remaining nine species have low or no potential to occur. Seven additional species were added as having at least a moderate potential to occur in the affected area based on species habitat requirements and professional judgment (white-tailed kite, loggerhead shrike, purple martin, yellow warbler, pallid bat, hoary bat, and western red bat).

ESA Consultation to Date

Of the 10 federally listed species considered for inclusion, only VELB and the giant garter snake have the potential to be affected by the project.

The USACE and SBFCA, pursuant to ESA, must consult with USFWS with regard to any proposed actions that may affect the continued existence of a federally listed species.

The Corps has determined that the proposed project may affect, and is likely to adversely affect the federally-listed as threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)(beetle) and the giant garter snake (*Thamnophis gigas*)snake. A Biological Opinion (08ESMF00-2013-F-0342-1) was received from USFWS on May 2, 2013 concurring with the Corps determination and that critical habitat will not be affected concluding ESA section 7 consultation for the proposed project.

Project impacts to VELB and GGS habitat are discussed below.

Valley Elderberry Longhorn Beetle

Status and Distribution

VELB was listed by USFWS as a threatened species on August 8, 1980 (45 FR 52803–52807), due to loss of habitat and inadequate regulatory protection. The current known range of VELB extends from southern Shasta County, south to Fresno County, and from the east side of the Coast Range to the Sierra Nevada foothills (Barr 1991; U.S. Fish and Wildlife Service 2006). The USFWS promulgated the final ruling designating critical habitat for VELB on August 8, 1980 (45 FR 52804). Two critical habitat areas were designated along portions of the American River in Sacramento County (the Sacramento Zone and the American River Parkway Zone). The Proposed Action addressed in this Biological Assessment (BA) is not located within designated critical habitat for VELB. Critical habitat has not been designated for giant garter snake. Accordingly, critical habitat is not discussed further in this BA. In 2006, USFWS released a 5-year review for VELB that recommended delisting the species due to reduction of its primary threats (loss of riparian and inadequacy of regulatory mechanisms) and the increased number of occurrences in the Central Valley (U.S. Fish and Wildlife Service 2006). The report recommended a post-delisting monitoring plan that includes monitoring of the 195 known VELB locations. The purpose of the plan would be to ensure that VELB remains stable after ESA protections are removed.

On August 19, 2011, USFWS announced a 90-day finding on a petition to delist VELB (76 FR 51929–51931). USFWS found that the petition presented substantial scientific or commercial information indicating that delisting may be warranted and requested further scientific and commercial data and other information regarding VELB. Following the review of additional information, USFWS will issue a 12-month finding on the petition, which will address whether the petitioned action is warranted.

Habitat and Biology

VELB is dependent on its host plant, elderberry, which is a common component of riparian corridors and adjacent upland areas in the Central Valley. VELB has four stages of life: egg, larva, pupa, and adult. Females deposit eggs on or adjacent to the host elderberry. Egg production varies and females have been observed to lay between 16 and 180 eggs (U.S. Fish and Wildlife Service 2007). Eggs hatch within a few days of being deposited and larvae emerge. The larvae bore into the wood of the host plant and create a long feeding gallery in the pith of the elderberry stem. The larvae feed on the pith of the plant for 1–2 years. When a larva is ready to pupate, it chews an exit hole to the outside of the stem and then plugs it with frass. The larva then retreats into the feeding gallery and constructs a pupal chamber from wood and frass. The larvae metamorphose between December and April; the pupal stage lasts about a month. The adult remains in the chamber for several weeks after metamorphosis and then emerges from the chamber through the exit hole. Most records for adults show occurrence from late-April to mid-May (U.S. Fish and Wildlife Service 2007). Adults feed on elderberry leaves and mate within the elderberry canopy.

Studies conducted in the American River basin demonstrate that VELB occurs most frequently and is most abundant in significant riparian zones that are well developed. Within significant riparian zones, VELB primarily occurs within the riparian corridor but can occur infrequently in non-riparian scrub habitats adjacent to the riparian corridor. Along the American River, the beetle tends to occupy woodlands dominated by exotic trees (black locust [*Robinia psuedoacacia*]) and black walnut [*Juglans californica*]), and in mixed riparian forests. The beetle less commonly occupies annual grasslands and live oak woodlands. One study showed that the beetle preferentially occupies elderberry shrubs in wooded areas with a relatively dense canopy cover over elderberry shrubs located in open and sparsely wooded areas. Of the occupied shrubs found in wooded areas, about 50% were under a canopy cover of 25–50%, while 25% were under canopies with 50–75% cover and 25% were under canopies with 75–100% cover. The study also demonstrated that VELB appears to be capable of limited dispersal and prefers to remain within contiguous patches of high quality riparian habitat. Clusters of local aggregations of VELB along the American River Parkway were approximately 600–800 meters in diameter (Talley 2005 in Talley et al. 2006).

A variety of branch sizes are utilized for larval development and pupation, although most of those measured in Barr's study (1991) were 2–4 inches (5–10 centimeters) in diameter at the exit hole. Infrequently, smaller branches (less than 1.5 inches [3.8 centimeters] in diameter) that contained exit holes were encountered. Lang et al. (1989) found no current-year exit holes on stems smaller than 1 inch (2.5 centimeters) in diameter. Talley et al. (2007) found that exit holes most frequently occurred in stems that were 0.8–2.8 inches (2–7 centimeters) in diameter and below 3.2 feet (1 meter) (79%). Holes were also found in larger diameter stems (2.8–4.7 inches [7–12 centimeters]) (36% of occurrences) and at heights of 3.2–6.4 feet (1–2 meters) above the ground (19%).

Reasons for Decline

The primary threat to VELB has been attributed to habitat loss and degradation of the riparian forest ecosystem as a result of agricultural and urban development (Barr 1991; Barbour et al. 1993; Eng 1984; Katibah 1984). Colonization by the Argentine ant (*Linepithema humile*) may also pose a biological threat to VELB through egg predation (Huxel 2000).

Occurrence in the Project Area

The closest VELB occurrence in the CNDDB (California Department of Fish and Game 2012) is approximately 0.5 mile from the project area. Numerous other occurrences are located within 10 miles of the project area.

Suitable habitat for VELB is located at numerous places in the project area along the levee construction footprint. There were no elderberry shrubs observed at the seven borrow site locations during the wetlands delineation effort at these sites. A total of 267 shrubs/shrub clusters were mapped in the project area. Because of property inaccessibility and the high density of California grape and Himalayan blackberry along portions of the Feather River riparian corridor, stem counts and examination of shrubs for VELB exit holes could only be conducted for 73 shrubs/shrub clusters in the project area.

Effects of the Project on Valley Elderberry Longhorn Beetle

Direct effects are defined as the direct or immediate effects of a proposed action on a species or its habitat. Direct effects may result from the action and may include the effects of interrelated and interdependent actions. An *interrelated action* is an activity that is part of the proposed action and depends on the proposed action for its justification. An *interdependent action* is an activity that has no independent utility apart from the action under consultation (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998).

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside the area directly affected by the action (U.S. Fish and Wildlife Service and National Marine Fisheries Service 1998).

Direct Effects

Permanent Loss of Elderberry Shrubs and Potential Loss of Individual VELB from Shrub Removal

Removal of habitat (elderberry) and potential injury or mortality of VELB associated with construction of the project would be considered direct effects on VELB. Trimming of elderberry branches that are 1 inch or greater in diameter could also result in injury or mortality of VELB. Because VELB larvae may feed on the roots of elderberries, disturbance of elderberry roots within the shrub dripline could also result in injury or mortality of individuals. Where root damage is expected to be extensive, elderberry shrubs would be removed. Where damage is limited (few roots affected) and roots are expected to grow back, impacts would be considered temporary. Because incidental take of VELB would be difficult to detect or quantify, effects on elderberry shrubs will be used as a proxy for measuring take.

Elderberry shrubs within the construction area that cannot be protected will be removed in accordance with to USFWS-approved procedures outlined in the Conservation Guidelines (U.S. Fish and Wildlife Service 1999a). Shrubs will be transplanted to the Star Bend Conservation Area.

Transplanted shrubs will be moved prior to construction when the plants are dormant, approximately November through the first 2 weeks in February, after they lose their leaves. Transplanting during the dormant period will reduce shock to the plant and increase transplantation success. However, transplanted elderberry shrubs may experience stress, a decline in health, or death due to changes in soil, hydrology, microclimate, or associated vegetation.

Elderberry shrubs that can be avoided at the dripline of the shrub or greater distance will be protected with fencing and/or k-rail as described in Conservation Measure 2. Table 2-5 shows the estimated number of elderberries to be transplanted and to be protected by contract and within Reach 13 (as this is the first portion of the project to be constructed).

Table 2-5. Approximate Number of Elderberry Shrubs/Clusters to be Removed and Protected

Construction Contract	Approximate Number of Elderberries Removed/ Transplanted	Approximate Number of Elderberries Protected/ Fenced
A	3	36
B	10	37
C	43	68
Reach 13	1	16
D	35	34
Oroville Wildlife Area Borrow Site	1	0
Total[a]	91	175

[a] Shrubs in Reach 13 are included in the number of elderberries for Contract C.

As described in Conservation Measure 3, surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. The data collected during the surveys prior to transplantation will be used to determine if SFBCA is exceeding their compensation requirements, or if additional plantings are necessary. Because the project would be constructed in four separate contracts, elderberry survey data for each contract will be used to rectify any discrepancies in compensation for the previous contract, and ensure that SBFCA has fully mitigated for impacts on VELB. Compensation ratios for VELB habitat is discussed below in Section 3.4.

Indirect Effects

As discussed above, *indirect effects* are caused by or result from the project, are later in time, and are reasonably certain to occur. Indirect effects may occur outside the area directly affected by the action.

Loss of Connectivity to Adjacent Habitat

Loss of connectivity between elderberry shrubs may result when elderberries or associated vegetation is removed. Removal of such vegetation could result in gaps in vegetation that are too wide for VELB to travel across due to their fairly limited movement distances (Talley et al. 2006a), resulting in separation of individuals or reducing the possibility of colonization of adjacent areas. Removal of associated vegetation may result in an altered habitat structure or microclimate that could affect behaviors of VELB in response to these changes in unforeseen ways (U.S. Fish and Wildlife Service 2003).

Although more research is needed, VELB has been observed to fly a mile or more in contiguous or fairly contiguous habitat, and exit holes have been observed on isolated shrubs that are a minimum of 0.25 mile (0.4 kilometer) from the next nearest elderberry (Arnold pers. comm. 2011). Within the American River Basin, evidence suggests that local beetle movements are farther within the riparian corridor (141±144 feet [43±44 meters]) than in the adjacent non-riparian scrub (82±52 feet [25±16 meters]) (average±1 standard deviation nearest neighbor distances between recent exit holes) illustrating that VELB population extents may also be habitat-specific (Talley et al. 2006a).

Although approximately 91 elderberry shrubs are expected to be removed as part of the project, 175 elderberry shrubs would be protected in the project area and continue to provide habitat for VELB. Given the distance VELB has been observed to fly, and the amount of elderberry shrubs that will remain in the project area, VELB is not expected to be indirectly affected by a loss of connectivity to adjacent habitat.

Soil Disturbance Adjacent to Roots

Ground disturbance within 20 feet (6.1 meters) of an elderberry shrub's dripline could result in disturbance of roots. Root damage could result in stress or reduced vigor of elderberry shrubs. Because construction of the project may result in disturbance within 20 feet (6.1 meters) of the dripline of elderberry shrubs, indirect effects on these shrubs may result. Elderberry shrubs will be fenced and/or protected with k-rail, as described in Conservation Measure 2, to minimize soil disturbance adjacent to roots. With this measure in place, and because elderberry shrubs are hearty and frequently re-sprout after damage, this indirect effect is not expected to substantially affect VELB.

Dust

Vehicle travel on the levee road adjacent to elderberry shrubs during construction of the project could result in dust becoming airborne and settling on elderberries. The levee road is graveled, and existing shrubs are and have been exposed to dust from vehicles associated with farming and levee maintenance. Construction of the project would increase the amount of dust in the project area as a result of ground-disturbing activities and an increase in the frequency of vehicles driving on the levee road. The amount of dust in the project area would be minimized through dust control measures, as described in Conservation Measure 4. Additionally, according to Talley et al. (2006b), in an experiment along the American River Parkway (Sacramento County) conditions of elderberry shrubs related to dust from nearby trails and roads (paved and dirt) did not affect the presence of VELB. Additional work by Talley and Holyoak (2009) found no effect on elderberries from dust accumulations. Because dust has not been found to greatly affect elderberry shrubs and because dust control measures would be implemented during construction, this indirect effect is not expected to substantially affect VELB.

Altered Hydrology

Reduction of water to elderberry shrubs as a result of altered of hydrology from changes in topography or compaction of soil could result in reduced shrub vigor/vitality and an associated decrease in shoot, leaf, and flower production and ultimately reduce the suitability of the shrubs to provide habitat for VELB. In most portions of the project area, the levee will be degraded and re-built within the same footprint, and would not modify the hydrology of the surrounding area where elderberries may be present. There may be a few instances where the slope is modified or there are other changes that may affect the hydrology in the project area. These situations are expected to be rare. Additionally, a substantial portion of the elderberries are located within riparian woodland

along the Feather River and obtain water from within the river channel, which will not be hydrologically changed as a result of the project. Therefore, altered hydrology as a result of the project is not expected to substantially affect VELB.

Existing Elderberry Shrubs in the Conservation Area

As described in Conservation Measure 5, elderberry shrubs to be removed will be transplanted to the Star Bend Conservation Area, which contains existing elderberry shrubs. Although transplantation activities may occur within 100 feet of existing elderberry shrubs, it is unlikely that they would be indirectly affected by transplantation activities, as the transplantations would be conducted by qualified individuals who would be knowledgeable about elderberry shrubs and the existing conditions within the conservation area.

Temporal Loss of Habitat

It generally takes 5 or more years for newly planted elderberry cuttings/seedlings to become large enough to support beetles, and it generally takes 25 years or longer for riparian habitats to reach their full value (U.S. Fish and Wildlife Service 1994). Because elderberry shrubs within the project area will be transplanted to the Star Bend Conservation Area, which is immediately adjacent to the project area, no temporal loss of habitat for VELB is expected. Additional elderberry plantings in the conservation area will provide additional and/or replacement habitat for VELB in future years.

Giant Garter Snake

Status and Distribution

Giant garter snake was listed as a threatened species by USFWS on October 20, 1993 (58 FR 54033). The species is also State-listed as threatened. Giant garter snake is endemic to the Sacramento and San Joaquin Valleys where it is found in lowland areas (U.S. Fish and Wildlife Service 1999b). Historically, this species was found throughout the Central Valley from Butte County in the north to Kern County in the south. Currently, giant garter snake is only known to occur in 13 discrete populations in the Sacramento and San Joaquin Valleys in Butte, Colusa, Fresno, Glenn, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties (U.S. Fish and Wildlife Service 1999b:9, 11–12).

Habitat and Ecology

Giant garter snakes inhabit agricultural wetlands and other waterways including irrigation and drainage canals, ricelands, marshes, sloughs, ponds, small lakes, and low gradient streams, as well as adjacent upland areas in the Central Valley. Because of the direct loss of natural habitat, giant garter snake relies heavily on rice fields in the Sacramento Valley, but it also uses managed marsh areas in national wildlife refuges and State wildlife areas.

Habitat requirements for giant garter snake consist of the following.

- Adequate water during the snake's active season (early spring through mid-fall) to provide food and cover.
- Emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season.
- Grassy banks and openings in waterside vegetation for basking.

- Higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in the winter.

Giant garter snake can persist in waterbodies that contain predatory fish if sufficient cover is present. It is typically absent from larger rivers because of lack of suitable habitat and emergent vegetative cover; it is also typically absent from wetlands with sand, gravel, or rock substrates. Riparian woodlands typically do not provide suitable habitat because of excessive shade, lack of basking sites, and absence of prey populations.

Giant garter snake inhabits small mammal burrows and other soil crevices above prevailing flood elevations throughout its winter dormancy period (November through mid-March), where it typically selects burrows with sunny exposure along south and west facing slopes. The breeding season extends from March through May and resumes briefly in September. Females give birth to live young from late July through early September. Giant garter snake feeds primarily on small fishes, tadpoles, and frogs (U.S. Fish and Wildlife Service 1999b:12, 13, 22, 24).

Reasons for Decline

Giant garter snake has been extirpated from the southern third of its range as a result of agricultural and flood control activities, which have eliminated the snake's freshwater marsh habitat in the historical Buena Vista, Tulare, and Kern lakebeds. Much of the habitat on the floor of the Central Valley has been lost or degraded by upstream watershed modifications, water storage and diversion projects, and urban and agricultural development. Other negative factors that may be contributing to the decline of giant garter snakes include interrupted water supply, poor water quality, and contaminants (U.S. Fish and Wildlife Service 1999b:25.)

Occurrence in the Project Area

There are no CNDDB records of occurrences of giant garter snake in the project area; however, there are 20 records of occurrences within 5 miles of the project area (California Department of Fish and Game 2012). The information for some of these records is suppressed, but the closest available occurrence is approximately 2 miles from the project area (California Department of Fish and Game 2012).

Within the project area, suitable aquatic habitat for giant garter snake is present within rice fields, irrigation canals, drainage canals, and ponds. Some of the drainage canals and ponds in the project area provide suitable aquatic habitat but do not have connectivity to other water features except the Feather River (which is not considered suitable habitat).

Canals

Canals in the project area consist of the Sutter-Butte Canal and other linear, concrete-lined features that convey water across multiple parcels. Many of these features have no vegetation present, while some have herbaceous emergent (rooted) vegetation and shrubs present in the margins. These canals generally convey water only during the active agricultural periods, which take place between April 15 and February 15.

Suitable upland habitat in the project area is limited to the levee banks and adjacent ruderal areas. Giant garter snakes (if present) are expected primarily to be associated with aquatic habitat in the project area. Table 2-6 provides a summary of the suitability of potential aquatic habitat in the levee construction portion of the project area. Table 2-7 provides a summary of the suitability of potential borrow sites to provide habitat for giant garter snake.

Table 2-6. Suitability of Aquatic Habitat for Giant Garter Snake in the Levee Construction Portion of the Project Area

Approximate Stationing	Aquatic Habitat	Suitability for Giant Garter Snake
208	Perennial ponded area, ditch along levee toe	Suitable aquatic—limited upland, no connectivity to other aquatic.
233	Ditch on land side of levee	Suitable aquatic.
254–258	Pond	Suitable aquatic—limited upland, no connectivity to other aquatic.
280	Canal	Suitable aquatic (low quality) —limited upland, has connectivity to other canals/ditches.
292	Concrete lined canal	Suitable—isolated segment but near other canals.
310	Perennial pond	Suitable aquatic—burrows in grassy hillside and levee side, channel from pond continues north along base of levee and also provides habitat.
336	Perennial pond	Dense willow ring, limited basking areas and upland, limited suitability/low potential for species.
373	Open channel on water side of levee	Suitable aquatic.
396	Canal	Suitable aquatic.
409–410	Cement-lined storage pond	Not suitable—concrete-lined and fenced.
409–410	River backwater, freshwater emergent, and seasonal wetland	Marginal aquatic—area connected to river with marsh.
426	Channel with marsh (seasonal wetlands)	Suitable aquatic—open areas for basking, side of levee may provide upland.
434	Perennial pond	Suitable aquatic—open areas for basking, side of levee provides upland habitat.
512	Canal	Not suitable—canal is concrete-lined, used for drainage, and not connected to other canals/ditches and water not maintained.
544–577	Abbott Lake	Suitable aquatic—open areas for basking, limited upland habitat, connected “channel” along base of levee to the north also provides suitable aquatic.
647–649	Cement-lined storage pond	Not suitable.
689	Canal	Assumed suitable—appears to connect to other canals/ditches, limited suitable upland.
872–880	Seasonal wetland	Wetland feature observed dry during October 25, 2012 site visit. Not suitable—likely does not stay inundated through summer, may not have open water.
1043–1052	Detention pond	Not suitable—unvegetated and unlikely to sustain water through summer.
1043	Stream	Not suitable—stream isolated by river and development.
1060	Stream	Not suitable—stream isolated by river and development.
1375	Unlined canal	Suitable habitat—water present throughout the summer.

Approximate Stationing	Aquatic Habitat	Suitability for Giant Garter Snake
1428	Start of Sutter-Butte Canal	Suitable throughout the project area—water year-round, some patches of suitable emergent vegetation, connectivity to other canals/ditches.
1707	Canal	Similar to the Sutter-Butte Canal, suitable aquatic—connectivity to other canals/ditches.
1761–1766	Ditch	Not suitable—ditch is not very defined and is isolated.
1902	Ditch	Suitable aquatic—ditch had water on October 25, 2012 site visit, ditch is small and isolated but is in close proximity to the Sutter-Butte Canal.
1958	Canal/ditch	Assumed suitable—connected to Sutter-Butte Canal.
2076, 2122, 2217, 2262	Ponds in tailings area	Marginal suitability—aquatic areas appear suitable at base, but are often surrounded by steep mounds of tailings; availability of food is questionable; upland areas are rocky and are unlikely to provide burrows.

Table 2-7. Habitat Suitability of Potential Borrow Sites for Giant Garter Snake

Potential Borrow Site	Habitat Present	Habitat Suitability
Oroville Wildlife Area Dredge Tailings Area	Tailings with emergent vegetation	Not considered suitable—aquatic areas appear suitable at base, but are often surrounded by steep mounds of tailings; availability of food is questionable; upland areas are rocky and are unlikely to provide burrows.
City of Live Oak Detention Basin	Irrigation ditch and grassland	Suitable—irrigation ditch along the edge of the property extends beyond the potential borrow site and provides suitable aquatic habitat; adjacent grassland provides suitable upland habitat.
South Ella Detention Pond	Ruderal grassland	Not suitable—no reported aquatic habitat within 200 feet of potential detention pond borrow site.
Lanza 40-acre property	Agricultural/ row crops	Suitable—irrigation ditch along the edge of the property provides suitable aquatic habitat but adjacent area where borrow would be removed is not suitable (i.e., no impacts to irrigation ditch).
Marler property	Agricultural/ row crops	Not suitable—no aquatic or upland habitat present.

Effects of the Project on Giant Garter Snake

Suitable aquatic habitat for giant garter snake in the project area consists of rice fields, irrigation canals, drainage canals, and ponds. Suitable upland habitat consists of ruderal grassland on the levee banks and adjacent to the levee banks. For the effects discussion below, impacts on ruderal grassland areas were calculated if they occur within 200 feet of suitable aquatic habitat.

Permanent and Temporary Disturbance of Suitable Aquatic and Upland Habitat for Giant Garter Snake

Construction of the Proposed Action would result in the permanent loss of 0.004 acre and the temporary loss of 6.81 acres of suitable aquatic habitat for giant garter snake (Figures 3-1 to 3-34).

Permanent effects to aquatic habitat would result from fill of canals for seepage berms (Reaches 3 and 41). Temporary effects to aquatic habitat would result from temporary fill for construction access along the landside levee toe (Reaches 3 and 7) and from work within the Sutter-Butte Canal (Reaches 26–28; 6.81 acres).

Construction of the Proposed Action would also result in the temporary loss or disturbance of 118.80 acres of suitable upland habitat for giant garter snake. Temporary impacts to suitable upland habitat would mostly occur along the levee and at the City of Live Oak Detention Basin borrow site.

Temporarily affected aquatic and upland habitat would be restored to pre-project conditions within a maximum of one season (a season is defined as the calendar year between May 1 and October 1 [U.S. Fish and Wildlife Service 1997]), as described in Conservation Measure 16. Permanently impacted aquatic habitat for giant garter snake would be compensated for through purchasing preservation credits equal to 0.012 acres of giant garter snake habitat at Westervelt Ecological Services' Sutter Basin Conservation Bank in Sutter County (Conservation Measure 17). Permanent and temporary losses of suitable aquatic and upland habitat for giant garter snake within the project area are summarized in Table 2-8.

If additional impacts to giant garter snake habitat are expected to occur within or outside of the project area as a result of Pacific Gas & Electric Company (PG&E) facility relocation activities, SBFCA would reinitiate consultation to address these additional effects.

Disturbance or degradation of suitable aquatic habitat for giant garter snake in the project area could occur if soil or other materials are sidecast or fall into the habitat. Fuel or oil leaks or spills adjacent to aquatic habitat could also cause degradation of habitat. These potential effects would be avoided by installing sediment and construction barrier fencing (Conservation Measure 7), locating staging areas away from aquatic habitat (Conservation Measure 8), implementing sediment and contaminant BMPs as required by the NPDES permit (SWPPP) (Conservation Measure 9), and preparing a frac-out plan and SPCCP (Conservation Measures 10 and 11).

Table 2-8. Effects on Giant Garter Snake Habitat in the Project Area

Habitat	Total
Aquatic habitat	
Permanent	0.004
Temporary	6.81
Upland habitat (ruderal within 200 feet of aquatic habitat)	
Permanent	0
Temporary	118.80

Potential Injury or Mortality of Giant Garter Snake

Construction activities in suitable habitat could result in the injury, mortality, or disturbance of giant garter snakes. Giant garter snakes could be injured or crushed by construction equipment working in suitable aquatic and upland habitat, or if soil or other materials are side-cast or fall into suitable aquatic habitat. Snakes could also be killed by construction vehicles traveling though the project area. Fuel or oil spills from construction equipment into aquatic habitat could also cause illness or mortality of giant garter snakes. Trenches left open overnight could trap snakes moving through the

construction area during the early morning hours. Noise and vibrations from construction equipment, and presence of human activity during construction activities may also disturb giant garter snakes within the project area. Most construction activities will be limited to the snake's active period (May 1–October 1) when the potential for direct mortality is reduced because snakes can actively move and avoid danger. However, work within the Sutter-Butte Canal (Reaches 26–28) requires construction during February and March when the irrigation canal is dry. Giant garter snakes, if present, in the upland ruderal grassland adjacent to the canal could be injured or killed during work within the snake's dormant period. Conservation Measure 14 would be implemented to reduce the potential for mortality in Reaches 26–28 during this time period.

Potential effects on giant garter snake would be minimized or avoided by conducting biological resources awareness training (Conservation Measure 1), conducting work during the active period (May 1–October 1) (Conservation Measure 6), installing exclusion fencing around suitable habitat (Conservation Measure 7), conducting preconstruction surveys and monitoring (Conservation Measure 12), and providing escape routes or covering open trenches (Conservation Measure 13). If work continued past October 1, additional preconstruction surveys and monitoring would be required (Conservation Measure 14). All of the conservation measures intended to avoid and minimize impacts to giant garter snake would apply to PG&E facility relocations. If these measures cannot be implemented, or the PG&E facility relocation is outside of the project area but would impact giant garter snake or its habitat, SBFCA would reinitiate consultation to address these additional effects.

Indirect Effects

Construction of the project is not expected to have any indirect effects on giant garter snake. Two potential indirect effects on giant garter snake and its habitat were considered but were determined to have no potential to occur as a result of the project. Specifically, the following determinations were made.

- There would be no increase of trash, hazardous waste, or off-road vehicle use due to increased human presence. The project would not result in development or increased access to giant garter snake habitat.
- The project would not result in indirect effects on habitat suitability through changes in the length of inundation or other habitat modifications that would make the habitat less suitable for giant garter snake.

Cumulative Effects

As described above, cumulative effects are future State, local, and private actions not involving a Federal action that are reasonably certain to occur within the action area under consideration. No other actions within the action area are proposed at this time. Therefore, no cumulative effects would result from the proposed action.

Future Federal actions that are unrelated to the project are not considered in this section because they would be subject to separate consultation pursuant to Section 7 of the ESA.

2.3.4 Special-Status Fish Species

Several special-status fish species occur or have the potential to occur in or near the study area. Critical habitat for spring-run Chinook salmon and Central Valley steelhead falls within the study

area in the Feather River. In addition, the Feather River is designated critical habitat for green sturgeon (74 FR 52345 October 9, 2009). While the Feather River is not designated critical habitat for winter-run Chinook salmon, effects on this species were considered as they have the potential to occur in the study area for at least part of their life-cycle.

No construction activities are proposed in-river or below ordinary high water mark (OHWM); all activities that would result in physical disturbance and removal of vegetation on the waterside slope of the levee would be limited to areas above OHWM. Therefore, no physical modification of critical habitat for ESA-listed fish species would be expected because all proposed construction activities would occur above the OHWM of the Feather River. No mitigation measures are required for special-status fish due to project impacts.

2.3.5 Riparian Trees

Riparian forest occurs along the Feather River and its tributaries and forms a fringe around ponds. Riparian forests support an overstory dominated by mature native and nonnative trees. The dominant overstory species are valley oak (*Quercus lobata*), Fremont cottonwood (*Populus fremontii* ssp. *fremontii*), or Goodding's black willow (*Salix gooddingii*). Other trees commonly observed in the riparian forest are box elder (*Acer negundo* var. *californicum*), arroyo willow (*S. lasiolepis*), Oregon ash (*Fraxinus latifolia*), and western sycamore (*Platanus racemosa*). The shrub layer of most of the riparian forest in the biological study area is extremely dense, and species commonly observed are Himalayan blackberry, poison oak, button bush (*Cephalanthus occidentalis*), wild rose (*Rosa* spp.) and blue elderberry (*Sambucus nigra* ssp*. caerulea*). Blue elderberry is the host plant for the valley elderberry longhorn beetle, federally listed as threatened. Many of the trees and shrubs in the riparian forest are covered in California grape (*Vitis californica*). The herbaceous understory of riparian forest contains a mixture of native and introduced species. Representative species observed were horsetails (*Equisetum* spp.), mugwort (*Artemisia douglasiania*), and curly dock (*Rumex crispus*). Several patches of the invasive giant reed (*Arundo donax*) occur along the edges of riparian areas.

Effects of the Project on Riparian Trees

An arborist survey of the project area was conducted during the summer of 2012 to identify riparian trees that would be affected by the project. The project would remove riparian trees on the levees for construction of the proposed cutoff wall and seepage berms. Loss of riparian habitats on the existing levee would be permanent because riparian restoration would not be permitted on the levees or seepage berms to comply with the USACE levee vegetation policy. The policy requires that the crown, slopes, and areas within 15 feet of the waterside and landside levee toes remain free of all woody vegetation. While not proposed for removal by the FRWLP, vegetation would still be subject to USACE levee vegetation policy and may be removed as described under the No Action Alternative.

Riparian communities, including cottonwood riparian woodland and valley oak riparian woodland, are considered sensitive natural communities by the CNDDB (California Department of Fish and Game 2012). These woodlands would be regulated by CDFW and USFWS (46 FR 7644) under no-net-loss policies for existing riparian habitat values.

Construction of the project would impact 23.48 acres of riparian tree canopy. Impacts to riparian trees were generated from data collected during the arborist survey described above in Section 2.3.1.

2.3.6 Non-Riparian Native Trees

The biological study area contains several small patches of oak woodland. The overstory of oak woodlands is predominantly valley oak but some ornamental tree species are also present. The understory of oak woodland contains annual grasses mixed with native and nonnative forbs. Representative understory species are wild oat (*Avena* spp.), soft chess (*Bromus hordeaceus*), ripgut brome (*B. diandrus*), field hedge parsley (*Torilis arvensis*), and the invasive yellow starthistle (*Centaurea solstitialis*).

Construction of the project would impact 0.22 acre of non-riparian native tree. Impacts to non-riparian native trees were generated from data collected during the arborist survey described above in Section 2.3.1.

2.3.7 USACE Section 404 Jurisdictional Areas

The project area contains numerous features that are potential wetlands and other (i.e., non-wetland) waters of the United States that may be subject to USACE jurisdiction under Section 404 of the Clean Water Act (CWA). An approved Preliminary Jurisdictional Delineation for the Feather River West Levee Project was received on May 1, 2013 from the USACE Sacramento District.

Affected Wetland and Other Water Types

The types and acreages of wetlands and other waters that would be affected by the proposed project are listed below in Table 2-9 and mapped in Figures 2-1 to 2-28. A description of each type of affected wetland and other water is provided below.

Table 2-9. Acreages of Fill of Wetlands and Other Waters

	Acreages of Fill		
Waterbodies	Permanent	Temporary	Total
Wetlands			
Forested/shrub wetland	0.03	0.324	0.354
Seasonal wetland	0.026	0.011	0.037
Tailing wetland	0.131	0.074	0.205
Other Waters			
Open water	0.038	none	0.038
Stream/river	none	none	none
Pond/basin	none	none	none
Ditch/canal	0.207	7.195	7.402
Total	0.432	7.604	8.036

Forested/Shrub Wetlands

Forested/shrub wetlands occur on the waterside of the levee along the margins of the Feather River (but are outside the OHWM of the river) and are concentrated in the southern half of the biological study area. The vegetation in riparian forest wetlands is comparable to that of non-wetland riparian

forest and non-wetland riparian scrub-shrub (described above); however, the forested/shrub wetlands exhibit positive indicators of all three Federal wetland criteria.

Seasonal Wetlands

Areas categorized as seasonal wetlands consist of areas that are predominantly vegetated by either floating vegetation or emergent (rooted) vegetation. Common floating vegetation is filamentous algae, common duckweed (*Lemna minor*), and bladderwort (*Utricularia* sp.). Typical emergent vegetation present is floating primrose willow (*Ludwigia peploides*), tall flatsedge (*Cyperus eragrostis*), lady's thumb (*Persicaria maculosa*), and narrowleaf cattail (*Typha angustifolia*), Seasonal wetlands are scattered throughout the southern half of the biological study area. Based on the absence of a plant community with species that are typically found only in vernal pools (e.g., coyote thistle [*Eryngium* sp.]), the seasonal wetlands in the biological study area were determined to not be vernal pools.

Tailing Wetlands

Tailings wetlands occur at the northern end of the biological study area and contain a mixture of floating and emergent vegetation bounded by shrubs and trees. Common floating and emergent species are common rush(*Juncus effusus*), tall flatsedge, lady's thumb, spikerush (*Eleocharis* spp.) floating primrose willow, and common duckweed. Typical trees and shrubs are Pacific willow (*Salix lasiandra*), Goodding's black willow, and valley oak.

Open Water

Areas categorized as open water following the USACE field review of the delineation consist of features where water is flowing or standing that contain sparse, if any, emergent vegetation. Open water features occur in tailings at the northern end of the biological study area and are interspersed with riparian habitats in the southern end of the biological study area.

Stream/River

The area contains two unnamed streams and the Feather River. The unnamed streams are located in the Feather River floodplain within Reach 16 and convey water at least seasonally (i.e., during the wetter winter months). The streams do not have an apparent link to the Feather River but likely have a hydrologic connection during times of high flow. The Feather River connects to the Sacramento River outside the biological study area.

Pond/Basin

Areas categorized as ponds and basins consist of artificial and excavated depressions, some of which contain water year-round.

Ditch/Canal

The drainage ditches and canals scattered within the biological study area are anthropogenic features that drain water from active agricultural lands during the growing season or following a rain event. They consist of the Sutter-Butte Canal, and other linear, concrete-lined features that convey water across multiple parcels. Many of these features are unvegetated; however, some support emergent vegetation or shrubs along their margins.

Soils and Substrate

The Natural Resources Conservation Service (NRCS) Soil Survey shows the permanent impacts to jurisdictional waters are mapped within 10 different soil types. Descriptions of the soil types are listed in Table 2-10. Most of the soils have loamy alluvium parent materials, except for the 118 Xerorthents, which are dredge spoils. The soils are found on low slope floodplain and terrace landorms and range from somewhat poorly drained to somewhat excessively drained.

Hydric soils are formed under saturated conditions (due to flooding or ponding) for sufficiently long enough duration during the growing season to form anaerobic conditions in the upper soil layer. The soils support growth of hydrophytic vegetation. The 7 soils with a hydric rating and criteria are also indicated in Table 2-10. Five of 7 hydric soils listed are described by the NRCS as only containing minor hydric soil components located in only 3–5% of the soil mapping unit, which means that the soils in the impacted areas themselves may not contain any hydric soil layers.

The predominant soil types of the permanently impacted jurisdictional areas (excluding canals) are 118 Xerorthents, tailings, 0 to 50 percent slopes (45% of area) and 124 Conejo loam, 0 to 2 percent slopes (29% of area). Soil type 118 Xerorthents, tailings is derived from dredged spoil piles from gravelly alluvium derived from igneous, metamorphic and sedimentary rock. The texture of the surface layer is very gravelly sandy loam. It is rated as a hydric soil across 80% of its mapping unit with a hydric rating of 4, which refers to soils that are frequently flooded for long or very long duration during the growing season. Soil type 124 Conejo loam, 0 to 2 percent slopes is derived from loamy alluvium derived from mixed sources. Typically, the surface layer is an approximate 7 inch brown loam and the subsoil is brown loam about 23 inches thick. It is not rated as a hydric soil. The third soil type comprising a substantial portion (17%) of the total impacted area is 121 Boga-Loemstone complex, 0 to 1 percent slopes. It's derived from loamy alluvium over dense silty alluvium derived from igneous and metamorphic rock. The surface layer texture is loam and it is not rated as a hydric soil.

Vegetation

The dominant plant communities in the impacted areas are described above in Section 2.3.3.

Threatened and Endangered Species

Discussion of federally–listed and other special status species is described in detail above in Section 2.3.2 and 2.3.3.

VELB was listed by USFWS as a threatened species on August 8, 1980 (45 FR 52803–52807), due to loss of habitat and inadequate regulatory protection (U.S. Fish and Wildlife Service 2011). The current known range of VELB extends from southern Shasta County, south to Fresno County, and from the east side of the Coast Range to the Sierra Nevada foothills (Barr 1991; U.S. Fish and Wildlife Service 2006). Two critical habitat areas have been designated along portions of the American River in Sacramento County (U.S. Fish and Wildlife Service 1984).

The giant garter snake is the only federally listed species occurring in jurisdictional waters requiring ESA consultation. Critical habitat has not been designated for the giant garter snake.

Table 2-10. Characteristics of Soils in the Impacted Areas

Soil Unit	Parent Material	Slope	Drainage Class	Capacity of Limiting Layer to Transmit Water	Landform	Hydric Rating	Hydric Criteria
Sutter County							
124 Conejo loam, 0 to 2 percent slopes	Loamy alluvium derived from mixed sources	0–2%	Well drained	Moderately high or high (0.57–1.98 in/hr)	Terraces		
126 Conejo-Tisdale complex, 0 to 2 percent slopes	Loamy alluvium derived from mixed sources	0–2%	Well Drained	Moderately High (0.2–0.57 in/hr)	Terraces	Yes [a]	2B3, 4
138 Liveoak sandy clay loam, 0 to 2 percent slopes	Loamy alluvium derived from igneous and metamorphic rock	0–2%	Moderately well drained	Moderately high or high (0.57–1.98 in/hr)	Terraces		
143 Marcum-Gridley clay loams, 0 to 1 percent slopes	Loamy alluvium derived from mixed sources	0–1%	Moderately well drained	Very low (0.00–0.00 in/hr)	Terraces	Yes [b]	2B3, 4
165 Shanghai silt loam, frequently flooded, 0 to 2 percent slopes	Alluvium derived from mixed sources	0–2%	Somewhat poorly drained	Moderately high or high (0.57–1.98 in/hr)	Floodplains	Yes	4
Butte County							
118 Xerorthents, tailings, 0 to 50 percent slopes	Dredged spoil piles from gravelly alluvium derived from igneous, metamorphic and sedimentary rock	0–50%	Somewhat Excessively Drained	High (1.98–4.25 in/hr)	Floodplains	Yes	4
121 Boga-Loemstone complex, 0 to 1 percent slopes	Loamy alluvium over dense silty alluvium derived from igneous and metamorphic rock	0–1%	Moderately well drained	Low to moderately low (0.00–0.06 in/hr)	Terraces		
152 Gianella fine sandy loam, 0 to 1 percent slopes, frequently flooded	Stratified coarse-loamy alluvium derived from igneous, metamorphic and sedimentary rock	0–1%	Moderately well drained	Moderately high or high (1.13–5.38 in/hr)	Floodplains	Yes [c]	4
161 Gianella fine sandy loam, 0 to 1 percent slopes, rarely flooded	Stratified coarse-loamy alluvium derived from igneous, metamorphic and sedimentary rock	0–1%	Moderately well drained	Moderately high or high (1.13–5.95 in/hr)	Floodplains	Yes [d]	2B2
162 Gianella loam, 0 to 1 percent slopes, rarely flooded	Stratified coarse-loamy alluvium derived from igneous, metamorphic and sedimentary rock	0–1%	Moderately well drained	Moderately high or high (0.85–1.98 in/hr)	Floodplains	Yes [e]	2B2

[a] Only for the Oswald component, which comprises 3% of the soil mapping unit.
[b] Only for the Oswald and Capay components, which comprise a combined 4% of the soil mapping unit.
[c] Only for the Columbia, frequently flooded component, which comprises 3% of the soil mapping unit.
[d] Only for the Columbia taxadjunct, very fine sandy loam component, which comprises 3% of the soil mapping unit.
[e] Only for the Columbia taxadjunct, very fine sandy loam component, which comprises 5% of the soil mapping unit.
2B2 - A water table at a depth of 0.5 foot or less during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches
2B3 - A water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches.
4 - Soils that are frequently flooded for long or very long duration during the growing season.

Chapter 3
Mitigation Design

3.1 Basis for Design

On-site replacement habitat involves replacement of affected habitat with new habitat of the same type and at the same location as the loss. Because much of the affected habitat (specifically, woody vegetation) is not compliant in its location with USACE levee vegetation policy, this option is not considered feasible. Further, the highly dispersed nature of the impact locations makes efficient replacement infeasible. Therefore, on-site replacement was not considered further as a viable option for this project and off-site, in-kind habitat replacement was selected as the best option for mitigation. It involves replacement of affected habitat with the same type of habitat at a different location off-site. This often allows for consolidation of mitigation at a single or small number of sites, allowing for economy of scale and higher quality habitat due to large patch size.

The project will utilize two sub-types of off-site, in-kind replacement:

- **Permittee-responsible mitigation.** This option involves replacement of in-kind habitat on habitat lands operated by the permittee. Two separate sites are proposed for this mitigation option. The first site is the Star Bend Conservation Area (SBCA) on the west levee of the Feather River near river mile 18 is an existing floodplain habitat restoration site that was created as part of the Star Bend setback levee project. The second site is the proposed 500-acre TRLIA Feather River Floodway Cooridor Restoration Project (FRFCRP) located on the east bank of the Feather River just upstream of the Star Bend site. Together, both sites contain sufficient area to accommodate all of the project's upland compensatory mitigation and will be used for mitigating impacts to: 1) riparian forest; 2) non-riparian, native trees; and 3) VELB.
- **Purchase of credits at commercial mitigation banks.** This option involves replacement of in-kind habitat through purchase of credits issued for habitat lands operated by a commercial mitigation bank. For the aquatic habitat impacts to GGS, the project proposes to purchase credits at the Sutter Basin Conservation Bank, operated by Westervelt Ecological Services in Sutter County, which is the only bank that presently offers giant garter snake credits approved by both the USFWS and CDFW. The project proposes to purchase jurisdictional water credits at the River Ranch Wetland Mitigation Bank, owned and operated by Wildlands, Inc., and located at the confluence of the Sacramento and Feather Rivers in Yolo County. There are currently no mitigation banks that offer oak woodland (non-riparian native tree) credits.

3.2 Characteristics of Design Reference Site

Previous mitigation work was performed at the 48.5-acre SBCA starting in 2009 for the Feather River Setback Levee and Habitat Enhancement Project (Restoration Resources 2010). The work was done as part of a project to replace a portion of the Feather River west levee with a new setback levee approximately 3,400 feet long that begins near the intersection of Star Bend Road and continues southeasterly to the intersection of Tudor Road. For Phase 1A of the project, 37 existing elderberry shrubs were transplanted. For Phase 1B, 20 acres of elderberry and native associate

plants were installed to enhance VELB habitat. For Phase 1C, approximately 2.46 acres of California blackberry (*Rubus ursinus*) and California rose (*Rosa californica*) were planted to protect an area of cultural significance (Restoration Resources 2010). Phase 2 of the SBCA will consistof planting the remaining approximately 24.5 acres. This acreage will be utilized for the mitigation described in this MMP.

The design characteristics used in the initial mitigation work at SBCA will serve as a reference site for the additional VELB mitigation to be performed for this MMP. These characteristics are described in the report *Habitat Enhancement Plan for the Feather River Setback Levee and Habitat Enhancement Project at Star Bend*, prepared by River Partners and Stillwater Sciences in 2009 for Levee District 1 and Wood Rodgers.

Design characteristics for riparian forest and oak woodland will incorporate the species composition and plant spacing found in other natural areas in the project site that will not be disturbed. These areas were field mapped, including field inventories of species composition and size. Additional guidance will be provided by the guidelines for Phase 2 riparian habitat planting outlined in River Partners and Stillwater Sciences (2009).

Design of the FRFCRP has not begun, but the site's ecological setting is similar to that found at the SBCA, and it is likely that design principles used at that site could be applied to the FRFCRP.

As described above, mitigation for USACE jurisdictional habitat and GGS will occur off-site at commercial mitigation and conservation banks.

3.2.1 Previous Work Credit

Much of the design information presented below that is specific to the SBCA is taken from the report *Habitat Enhancement Plan for the Feather River Setback Levee and Habitat Enhancement Project at Star Bend*, prepared by River Partners and Stillwater Sciences in 2009 for Levee District 1 and Wood Rodgers.

3.3 Proposed Mitigation Site

3.3.1 Location

The SBCA mitigation site is located on the water side (east) of the new setback levee that was constructed in 2009 on the Feather River, approximately six miles south of Yuba City, Sutter County, California (Figures 1 and 4). The 48.5-acre site is just upstream of the Star Bend boat ramp (near River Mile 18) and is bounded on the north and east by a sharp bend in the river. Access by road is from the west via Star Bend Road off of Garden Highway (River Partners and Stillwater Sciences 2009). The property to the east is part of the O'Connor Lakes unit of CDFW's Feather River Wildlife Area. The unit is managed by CDFW and DWR to provide wildlife habitat, restore native plant communities, and convey Feather River flood events. The land to the west of the levee is primarily orchards.

In 2009, LD 1 of Sutter County constructed the Feather River Setback Levee and Habitat Enhancement Project at Star Bend to replace a portion of existing levee that poses a high risk of failure in order to decrease the flood stage, velocity, and scour potential; increase and improve

floodplain habitat; and improve habitat connectivity between the Abbot Lake and O'Connor Lakes Units of CDFW's Feather River Wildlife Area. The SBCA project created approximately 48.5 acres of floodplain habitat, which included habitat enhancement and onsite mitigation for impacted elderberry.

Approximately 20 acres have been used for elderberry transplants and associated native plants. In early 2012, a fire at the SBCA damaged portions of the site; however, VELB planting losses were minimal. The remaining approximately 28 acres are available at the conservation area for compensating for impacts on elderberry shrubs, riparian forest, and non-riparian, native trees from construction of the FRWLP.

The FRFCRP site is located on the east side of the Feather River in the levee setback area created by the TRLIA Early Implementation Program (EIP) Feather River Setback Levee project (Figure 1). The FRFCRP is located along a section of the Feather River which currently provides over 3,000 acres of wildlife habitat. Restoration on this site is important because it would add another large block of contiguous habitat (approximately 500 acres) along the lower Feather River; thereby reducing habitat fragmentation.

3.3.2 Ownership Status

The SBCA is under joint control by one of SBFCA's member agencies (Levee District 1) and CDFW. The FRFCRP site is entirely owned by TRLIA.

3.3.3 Jurisdictional Areas

There are no known jurisdictional areas in or near the mitigation activities.

3.3.4 Aquatic Functions

The Feather River Setback Levee and Habitat Enhancement Project at Star Bend constructed in 2009, along with the TRLIA EIP Feather River Setback Levee project, increased the amount of floodplain potentially exposed to inundating flows by approximately 1649 acres. The floodplain restoration allows for higher quality floodplain habitat (better water quality, food inputs, and shelter) for juvenile salmonids and other native species such as Sacramento splittail and steelhead. Organic material produced by native deciduous species restored within the floodplain provides an increased nutrient load for the aquatic environment. This influx of nutrients provides for a greater invertebrate population, thereby creating an abundant food source for fish.

3.3.5 Hydrology and Topography

Both the SBCA and the FRFCRP site were once part of a dynamic system of meandering channels and oxbow lakes that covered an area much wider than the levees of the Feather River Flood Control Project. Levee construction, beginning in the 1860's, confined the channel to its present location, and dams on the Feather and Yuba rivers regulate flows (River Partners and Stillwater Sciences 2009).

To the north of the SBCA, overbank flow from the Feather River periodically (i.e., modeled stage of the 2.5- to 3-year recurrence interval flow [approximately 60,000 cfs]) fills the drainage feature and depressions left by dredger mining (Wood Rodgers, Inc. 2007). In the O'Connor Lakes unit, scour

channels, debris accumulations in trees and shrubs, and deposits of sand are evidence of periodic overbank flow. Periodic maintenance on the O'Connor Lakes Unit is conducted by DWR to increase the conveyance of flood flows and transport sediment (River Partners and Stillwater Sciences 2009).

On the land-side of the existing levee system, rain, flood irrigation and seepage under the levee are the primary sources of surface water. Flooding is used to irrigate the orchard crops, occasionally leaving standing water behind for short periods of time following irrigation. The levee ditch was constructed to contain any water seeping under the toe of the levee, but was only inundated in 1986 and 1997, years in which extremely large flood events occurred (B. Hampton, Manager, LD1, pers. comm., 2007). During those events, water remained for a couple of weeks, generally percolating into soil after flood flows had receded (B. Hampton, Manager, LD1, pers. comm., 2007). In 2006, which had a relatively large flood event, there was no water in the levee ditch (B. Hampton, Manager, LD1, pers. comm., 2007) (River Partners and Stillwater Sciences 2009).

The 2010 initial monitoring report for the Star Bend site (Restoration Resources 2010) stated that surface water was present within the 20 acre habitat area in March 2010 due to low depressions that do not provide sufficient drainage, but began to dry out into April. These areas may have stayed inundated due to the more than average rain received in the regional area during the winter and early spring season.

Elevations of the project area average 45 feet above sea level. Topography is generally flat, with steeper gradients at the river's edge. Several small hills and depressions occur in the O'Connor Lakes Unit as a result of overbank flood scour and deposition, and previous soil excavation and habitat enhancement projects (River Partners and Stillwater Sciences 2009).

Hydrologic function and existing topography of the FRFCRP is likely similar to that found at the SBCA.

3.3.6 Soils and Substrate

The Sutter County Soil Survey (Lytle 1988, NRCS 2008) identifies two soil series within the SBCA. The majority of the site consists of mapping unit 124 Conejo loam, 0 to 2 percent slopes. Conejo soils are very deep, well drained soils formed in alluvium and are observed on alluvial fans and stream terraces. Conejo soils contain about 39.2% sand, 37.3% silt and 23.5% clay. They are classified in hydrologic group B, which have moderately low runoff potential when thoroughly wet and water transmission through the soils is unimpeded.

Mapping unit 134 Holillipah loamy sand, 0 to 2 percent slopes occupies the northern boundary of the site along the Feather River. The Holillipah soils, which contain deep sand to loamy sand derived from mixed alluvium, are frequently flooded, and somewhat excessively well drained (River Partners and Stillwater Sciences 2009).

Detailed soil information for the FRFCRP has not been collected.

3.3.7 Vegetation

Vegetation types at the SBCA were assessed during a September 13, 2006 field survey by EIP Associates (EIP Associates 2007) and were mapped and described during wetland delineation surveys conducted in September 2007 and January 2008 by Stillwater Sciences (Stillwater Sciences 2008b) (River Partners and Stillwater Sciences 2009).

Plant species observed during a September 13, 2006 field survey by EIP Associates included wild oats (*Avena fatua*), ripgut brome (*Bromus diandrus*), soft brome (*Bromus hordeaceus*), turkey mullein (*Eremocarpus setigerus*), wild mustard (*Brassica* sp.), and prickly lettuce (*Lactuca serriola*) (EIP Associates 2007) (River Partners and Stillwater Sciences 2009).

Riparian forest habitat occurs north of the SBCA, throughout much of the levee ditch, and across much of the O'Connor Lakes unit to the southeast. The area north of the existing levee has a dense canopy of native riparian tree species (approximately one acre), including Fremont cottonwood (*Populus fremontii*), Goodding's black willow (*Salix gooddingii*), northern California black walnut (*Juglans californica* var. *hindsii*), Oregon ash (*Fraxinus latifolia*), and valley oak (*Quercus lobata*). There is a sparse to moderately dense shrub layer with arroyo willow (*Salix lasiolepis*), box elder (*Acer negundo*), California button willow (*Cephalanthus occidentalis*), California rose, and narrowleaf willow (*Salix exigua*). The vine layer is thin, containing predominantly California wild grape (*Vitis californica*) and poison oak (*Toxicodendron diversilobum*). The herbaceous layer is generally absent, with small clearings containing black mustard (*Brassica nigra*), oat (*Avena* sp.), perennial pepperweed (*Lepidium latifolium*), seashore vervain (*Verbena littoralis*), and soft brome (River Partners and Stillwater Sciences 2009).

Portions of the Star Bend setback levee ditch (approximately three acres) are predominantly comprised of a mature canopy of valley oak, occasionally shared with blue elderberry (*Sambucus mexicana*). The understory is fairly sparse, with blue wildrye (*Elymus glaucus*), California blackberry, California rose, California wild grape, Goodding's black willow, narrowleaf willow, and poison oak (River Partners and Stillwater Sciences 2009).

The northwest corner of the SBCA includes the recent mitigation work previously described. For Phase 1A of the project, 37 existing elderberry shrubs were transplanted. For Phase 1B, 20 acres of elderberry and native associate plants were installed to enhance VELB habitat. For Phase 1C, approximately 2.46 acres of California blackberry (*Rubus ursinus*) and California rose (*Rosa californica*) were planted to protect an area of cultural significance (Restoration Resources 2010).

The majority of the land west of the SBCA is a plum orchard that is flood irrigated. Annual grass and weedy forb species occur between the rows of trees, but the sparse distribution and short stature of the forbs indicate they are sprayed with herbicides or otherwise controlled on a regular basis (River Partners and Stillwater Sciences 2009).

The FRFCRP is vegetated with non-native annual grasses and forbs and is devoid of any woody vegetation. The site is mostly surrounded by orchards or other agriculture, but there an area of existing riparian vegetation adjacent to the southwest corner.

3.3.8 Present and Historical Uses of the Mitigation Areas

Prior to the arrival of Europeans, Native Americans of the Valley Nisenan populations established villages along the Feather River and its tributaries in the vicinity of the site. The northwest corner of the site is a historic low rise along the river and contains an historic record of an indigenous village site (Bayham 2004) (River Partners and Stillwater Sciences 2009).

John Sutter laid claim to the region when he secured the New Helvetia Land Grant in the 1840s. He promptly built Hock Farm, a rancho in the vicinity of the site, which provided cattle stock that ranged freely along Feather River. W. H. Ashford owned and farmed a section of the west bank as early as 1880, which includes most of the site. In 1880, the O'Connor family owned the parcel to the

south of the site where the lakes are located (Sutter County 1880). The 1912 (U.S. Army Corps of Engineers 1912) geologic survey shows dredging activities to the north and south of the site, but not within the site. The 1912 survey also shows that the site had not been cleared for agriculture (River Partners and Stillwater Sciences 2009).

The SBCA is presently being used for the Phase I and Phase II mitigation work previously described. The SBCA converted 55 acres of former orchard and levee into floodplain habitat. Twenty acres of elderberry shrubs and native associate plants for VELB habitat were planted as part of the initial mitigation. The remaining 35 acres were not planted.

The FRFCRP is currently being managed as open floodplain habitat. Prior to inclusion in the setback area created by the TRLIA EIP Feeather River Setback Levee project, the site was largely planted in orchard trees.

3.3.9 Present and Proposed Uses of All Adjacent Areas

The Feather River and three other properties surround the SBCA (i.e., Churkin, Singh, and CDFW properties). The majority of the area west of the site on the land side of the levee is a plum (*Prunus* sp.) orchard that is flood irrigated. The existing levee, operated by LD1, and the Star Bend pumping plant also are located along the site's western boundary. The pumping plant includes pump station discharge lines and irrigation pipelines that bisect the northern portion of the site and continue to adjacent properties. All the property to the east of the SBCA is part of the O'Connor Lakes unit of CDFW's Feather River Wildlife Area. The unit is managed by CDFW and DWR to provide wildlife habitat, restore native plant communities, and convey Feather River flood events.

The FRFCRP is surrounded by orchards or other agricultural land uses to the north, south, and east. To the west is an area of riparian vegetation.

3.4 Created/Restored Habitats

3.4.1 Compensation Ratios

VELB Habitat

Before construction begins, SFBCA will compensate for direct effects on elderberry shrubs by transplanting shrubs that cannot be avoided to the SBCA. Elderberry seedlings or cuttings and associated native species will also be planted at the mitigation site. For mitigation at the site, each elderberry stem measuring 1 inch or greater in diameter at ground level that is adversely affected (i.e., transplanted) would be replaced with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). The numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether the shrub lies in a riparian or non-riparian area. Stock of either seedlings or cuttings would be obtained from local sources (including the project area if acceptable to USFWS).

At the discretion of USFWS, shrubs that are unlikely to survive transplantation because of poor condition or location, or a plant that would be extremely difficult to move because of access

problems, may be exempted from transplantation. In cases where transplantation is not possible, minimization ratios would be increased to offset the additional habitat loss.

The relocation of the elderberry shrubs will be conducted according to USFWS-approved procedures outlined in the Conservation Guidelines (U.S. Fish and Wildlife Service 1999a). Elderberry shrubs within the project construction area that cannot be avoided will be transplanted during the plant's dormant phase (November through the first 2 weeks of February). A qualified biological monitor will remain onsite while the shrubs are being transplanted.

Property inaccessibility and the high density of vegetation along portions of the Feather River riparian corridor limited the number of elderberry shrubs that could be surveyed (73 shrubs were surveyed). For this reason, compensation for the removal of approximately 91 shrubs was estimated based on the average number of stems in each stem diameter range for the 73 shrubs that could be surveyed (see Table 3-1). Those averages are as follows.

- Number of stems ≥1 inch and ≤3 inches = 4.
- Number of stems >3 inches and <5 inches = 1.
- Number of stems ≥5 inches = 1.

Table 3-1 shows the estimated compensation required for the entire project. Because most of the shrubs are located in riparian habitat and did not have exit holes, the compensation ratios for these conditions were used. As noted in Table 3-1, one elderberry shrub in Reach 13 of Contract C will need to be transplanted prior to the start of work in 2013 and outside of the elderberry dormancy period. Additional compensation will be determined and provided for these shrubs after stem counts are conducted.

Table 3-1. Estimated Compensation for Elderberry Shrubs Removed

Stem Diameter	Number of Stems[1]	Seedling Ratio[2]	Native Plant Ratio[2]	Total Seedlings	Total Native Plants
Stems ≥1" to ≤3"	360	2:1	1:1	720	720
Stems >3" to <5"	90	3:1	1:1	270	270
Stems ≥5"	90	4:1	1:1	360	360
Total	**552**			**1,350**	**1,350**

N/A = not applicable.

[1] The number of stems per shrub was based on the average number of stems in each stem diameter range for the 72 shrubs that could be surveyed. Those averages are as follows: number of stems ≥1" and ≤3" = 4; number of stems >3" and <5" = 1; and number of stems ≥5" = 1.

[2] Ratios are based on shrubs within riparian habitat with no VELB exit holes.

Based on the information in Table 3-1, 270 elderberry units, or 11.16 acres, will be required to fully mitigate for project impacts. All of this mitigation will occur at the SBCA.

Riparian Habitat

The compensation ratios for the project impacts are listed in Table 3-2. The 46.96 acres of compensatory mitigation will be fulfilled at the SBCA and the FRFCRP sites. At the SBCA, the 11.16 acres of elderberry mitigation will be utilized to partially offset the riparian habitat mitigation

obligation, as will 24.5 acres of the riparian mitigation plantings. The remaining 22.46 acres of riparian habitat mitigation will be fulfilled at the FRFCRP site.

Non-Riparian, Native Trees

The compensation ratios for the project impacts are listed in Table 3-2. All 0.44 acre of compensatory mitigation will be fulfilled at the FRFCRP.

Giant Garter Snake

0.012 acre of compensatory giant garter snake mitigation will be purchased from the Sutter Basin Conservation Bank, owned and operated by Westervelt Ecological Services. The bank is located approximately 2.5 miles west of Reach 4.

Jurisdictional Waters

0.87 acre of compensatory wetland mitigation will be purchased from the River Ranch Wetlands Bank, owned and operated by Wildlands Inc. The bank is located approximately 13.5 miles south of Reach 3.

Table 3-2. Anticipated Project Impacts to Sensitive Resources and Proposed Compensatory Mitigation

Impact Type	Impact Unit	Mitigation Ratio	Impact Quantity	Mitigation Need	Mitigation Area
Riparian Tree	acres of canopy	2:1 for canopy	23.48 acres total	46.96 acres	46.96 acres at 10’ o.c. plant spacing
Non-Riparian Native Tree	acres of canopy	2:1 for canopy	0.22 acre total	0.44 acre	0.44 acre at 10’ o.c. plant spacing
Elderberry	individual shrubs and total stem count within each shrub	See Table 3-1	91 shrubs with 540 total stems	91 transplants, 1,350 elderberry seedlings, and 1,350 native associates	11.16 acres (270 elderberry units)
Giant Garter Snake	acres of permanent impact	3:1	0.004 acre aquatic 0.00 acre upland	0.012 acre	0.012 acre
Jurisdictional Waters	acres of permanent impact	2:1	0.432 acre	0.87 acre	0.87 acre

3.4.2 Long-Term Goal(s)

The long-term goal ownership goal for the SBCA is to merge with CDFW’s adjoining O’Conner Lakes and Abbott Lakes Wildlife Units. A similar goal with an appropriate public agency is also envisioned for the FRFCRP.

Given the presence of good soils and potential exposure to frequent flooding, both project areas should sustain rapid growth of restored riparian species throughout the life of the project implementation (approximately 3 years). An “over-planting” approach is used to rapidly establish

native riparian species. Over-planting the project site will eliminate the need for any additional replanting efforts. The ultimate ecological objective for over-planting is that in time the area will thin out and create a complex of open canopy, dense forest, and dead snags, all of which provide benefits to wildlife (River Partners and Stillwater Sciences 2009).

It is anticipated that at the end of the 3-year establishment period, 70% survivorship of woody species will be attained. Over time, mortality based on differences of soil textures and water table depths will create areas of complex, open canopy, dense forest, and dead snags, all of which create habitat for wildlife (River Partners and Stillwater Sciences 2009).

3.4.3 Aquatic Functions

No jurisdictional open water habitat will be created at the either site. The Feather River Setback Levee and Habitat Enhancement Project at Star Bend, together with the TRLIA EIP Feather River Setback Levee project, increased the amount of floodplain potentially exposed to inundating flows by approximately 1649 acres. The floodplain restoration allows for higher quality floodplain habitat (better water quality, food inputs, and shelter) for juvenile salmonids and other native species such as Sacramento splittail and steelhead. Organic material produced by native deciduous species restored within the floodplain provides an increased nutrient load for the aquatic environment. This influx of nutrients also provides for a greater invertebrate population, thereby creating an abundant food source for fish. The additional mitigation plantings for VELB habitat and plantings for riparian forest and non-riparian, native trees proposed for this MMP will further increase the food inputs and shelter for aquatic species by expanding the acreage of floodplain forest and upland habitat at the site (River Partners and Stillwater Sciences 2009).

3.4.4 Hydrology and Topography

The long-term source of water for the new SBCA and FRFCRP mitigation plantings will be groundwater and Feather River flood flows. After the plants have become established enough to discontinue irrigation, groundwater will be the primary source of water. Additional surface water flooding will be provided during when the Feather River flows, most often high during spring and early summer snowmelt. Hydraulic modeling shows that the Feather River overbanks at locations north of the Star Bend site approximately once every 2.5 to 3 years (Wood Rodgers, Inc. 2007, as cited in River Partners and Stillwater Sciences 2009). It is anticipated that flooding will occur at the proposed mitigation site on a similar recurrence interval frequency. The duration of flooding will depend upon water year type. In some years, the river will not overtop its banks and inundate the site. In other years, flooding may occur over a period of several days, while in the wetter years the site could be flooded for several weeks. Flood water that overbanks into the site will generally flow downgradient from the north to south and eventually infiltrate into the ground or recede back into the river when the river's flood stage decreases.

3.4.5 Soils and Substrate

The majority of the SBCA consists of 124 Conejo loam soils, which are very deep, well drained soils formed in alluvium and are observed on alluvial fans and stream terraces. They are classified in hydrologic group B, which have moderately low runoff potential when thoroughly wet and water transmission through the soils is unimpeded. These soils are highly suitable for supporting elderberry shrubs and associated plans for VELB habitat, and for supporting riparian and non-

riparian tree species. The same species that will be planted in the soils at the SBCA are currently growing in the same soils in lands in the site's vicinity.

Detailed soil information has not been collected at the FRFCRP site.

3.4.6 Vegetation

The target plant communities and species at the SBCA will include riparian forest, non-riparian native trees, and elderberry shrubs and associated plans for VELB habitat (Table 3-3).

Table 3-3. Woody Planting Species for the SBCA and FRFCRP site

Common Name	Scientific Name
Coyote brush	*Baccharis pilularis*
Mule fat	*Baccharis salicifolia*
Buttonbush	*Cephalnathus occidentalis*
California Rose	*Rosa californica*
California Blackberry	*Rubus ursinus*
Sandbar willow	*Salix exigua*
Arroyo willow	*Salix lasiolepis*
Blue elderberry	*Sambucus mexicana*
Valley oak	*Quercus lobata*
Interior live oak	*Quercus wislizeni*
Oregon ash	*Fraxinus latifolia*
Fremont cottonwood	*Populus fremontii*
Box elder	*Acer negundo*

The detailed planting plan is described below in Section 5.2.

Chapter 4
Success Criteria and Monitoring

4.1 Success Criteria

For this MMP, a "success criterion" is a measure that indicates whether the mitigation goals have been achieved at the end of the monitoring period. The mitigation will be evaluated annually for the first five years and then every five years until the twentieth year using the annual performance standards. Table 4-1 summarizes the monitoring success criteria for restored and enhanced wetlands, drainages, and upland and riparian areas.

Table 4-1. Monitoring Success Criteria for Planted Areas at the SBCA and FRFCRP site

Monitored Characteristic	Monitoring Year	Success Criteria Standards
Riparian Vegetation		
Plant survival	1–20	Demonstrate at least 60% survival of all riparian vegetation plantings after 20 years.
Non-Riparian Vegetation		
Plant survival	1–20	Demonstrate at least 60% survival of all non-riparian native plant plantings after 20 years.
Valley Elderberry Longhorn Beetle		
Plant survival	1–10 or 1, 2, 3, 5, 7, 10, and 15	Demonstrate at least 60% survival of all elderberry and native associate plantings

A minimum survival rate of at least 60 percent of all of the plantings must be maintained throughout the monitoring period. Within one year of discovery that survival has dropped below 60 percent, the applicant must replace failed plantings to bring survival above this level. The resource agencies will make any determination as to the applicant's replacement responsibilities arising from circumstances beyond its control, such as plants damaged or killed as a result of severe flooding or vandalism.

4.2 Monitoring

4.2.1 Methods

Monitoring will be quantitative and qualitative. The monitoring methods that will be used during the annual performance monitoring are described below by habitat and restoration/mitigation category.

Annual Surveys

At the end of the first growing season, the restoration contractor will conduct a complete census of all woody species planted. The data are best analyzed using a database to calculate survivorship, and to determine any changes to or omissions from the original planting design. During years two and

three, woody species plantings will be sampled to determine survivorship, growth, and coverage. Sampling of native grass and herbaceous understory plantings will also be conducted (River Partners and Stillwater Sciences 2009).

Census

At the end of the first growing season, a census noting survivorship for each location (alive, dead, or missing/not planted) will be conducted. The census allows for pattern analysis to examine the effects of soil, hydrology, or other factors affecting survivorship. During implementation, changes in the planting design are possible (or even desirable) and should be noted. Deviations in planting can also be recorded during the census. Results of the census will be used to determine progress towards performance criteria and replanting, if necessary (River Partners and Stillwater Sciences 2009).

Permanent Plot Sampling

After the initial census, subsequent monitoring (years 2 and 3) utilizes permanent plots to collect data on overall survivorship, height, and cover. The sampling procedure is modified for a restoration setting from protocol developed by Dr. Dave Wood (CSU, Chico) to establish permanent plots in riparian forests (personal communication). Some of the methods have been adapted from Elzinga et al. 1998. Comparison of survivorship between the sampling procedure and census indicates that sampling estimates are within 2% and provide additional information on cover and recruitment (results based on data from field 4 of the Ord Bend Unit, Sacramento River National Wildlife Refuge (River Partners 2003)). The sampling procedure may also be used to compare pre- and post-restoration vegetation, if the permanent plots are installed beforehand (River Partners and Stillwater Sciences 2009).

Plot Location and Size

All samples are based on 20 m x 50 m (1,000 m^2) plots (quadrats) placed with the long axis oriented in a north-south direction. Permanent plot locations will be selected by stratifying the field and using the grid cell method (overlaying each field with a 20 m x 50 m grid) to select sampled plots. Plots that extend past the plantable area are generally rejected. In addition, we exclude locations that are not characteristic of that particular area. In general, a plot should be established every 5–20 acres. The plots serve as areas to collect information on woody, shrub, and herbaceous species (if desired) (River Partners and Stillwater Sciences 2009).

Once each specific plot location is randomly selected, its field location will be permanently recorded at the upstream, inland corner of the plot. The position will be recorded with a GPS unit, and, in subsequent monitoring years, will be reestablished in the same position (River Partners and Stillwater Sciences 2009).

Measurements

At each plot, cover and height measurements of all shrubs and trees inside the 20 m x 50 m plot will be recorded. To assess the survivorship of planted species, we will note their status: alive, dead, or missing (not planted). Because restoration activities often create conditions that favor the survivorship and natural recruitment of native plants, newly recruited native riparian woody species will also be recorded. The estimate of aerial cover of both trees and shrubs will be based on the longest diameter through the horizontal plane of the plant's drip line, a thin line at which a drop

of water would fall from the outward most oriented leaf (River Partners and Stillwater Sciences 2009).

4.2.2 Monitoring Schedule

The riparian tree and non-riparian native tree restoration areas will be monitored annually during Years 1 through 5 following completion of mitigation project implementation. First year monitoring will not be completed until after one full growing season for vegetation has passed since completion of construction. SBFCA will submit an annual report at the end of each monitoring year and a final report to USACE and other resource agencies for review and approval. These areas will be monitored annually during May or June. Additional monitoring of the riparian tree and non-riparian native tree restoration areas will be conducted in the 10th, 15th, and 20th years.

The population of valley elderberry longhorn beetles, the general condition of the conservation area, and the condition of the elderberry and associated native plantings in the conservation area must be monitored over a period of either ten (10) consecutive years or for seven (7) years over a 15-year period. The applicant may elect either 10 years of monitoring, with surveys and reports every year; or 15 years of monitoring, with surveys and reports on years 1, 2, 3, 5, 7, 10, and 15. The conservation plan provided by the applicant must state which monitoring schedule will be followed. No change in monitoring schedule will be accepted after the project is initiated. If conservation planting is done in stages (i.e., not all planting is implemented in the same time period), each stage of conservation planting will have a different start date for the required monitoring time. In any survey year, a minimum of two site visits between February 14 and June 30 of each year must be made by a qualified biologist (USFWS 1999a).

4.2.3 Photo-Documentation

The progress of the restoration areas will be documented photographically. Permanent photo-documentation stations will be established at several points throughout both sites. The locations of photo-documentation stations will be determined during the first year of the monitoring period, and the locations will be identified in the field and mapped, either on a map or by using a GPS receiver.

The number of photographs taken at a given photo-documentation station will vary, depending on the area and habitat. Photos will include panoramic views taken from a high point at the site that will not be obscured in future years by growing vegetation. A sufficient number of stations will be established to ensure that the photographs provide a visual record of the sites. Photographs will be taken during June of each monitoring year. Additional representative photographs may be taken at other times of the year at SBFCA's discretion.

Chapter 5
Implementation Plan

5.1 Site Preparation

5.1.1 Avoidance Measures

Site preparation during the first phase of work will involve implementing the following avoidance measure actions related to preconstruction surveys and construction staking.

- Stake the limits of the work area, including construction, staging, and access areas.
- Perform pre-construction surveys for giant garter snake, western pond turtle, nesting birds/raptors, native bats and valley elderberry longhorn beetle.
- Stake the limits of Environmentally Sensitive Areas (ESAs).
- Place protection fencing around the perimeter of ESAs.
- Place silt fencing, when appropriate, around the perimeter of ESAs.
- Perform preconstruction surveys of affected drainages.

Prior to construction, the construction contractor, under the supervision of SBFCA, will survey and stake the location of the work area and ESAs. These locations will be based on the project construction documents prepared by SBFCA and will be in accordance with this MMP.

The construction contractor will install protective fencing and/or silt fencing according to the specifications in the project construction documents around ESAs to be preserved. Protective fencing will consist of orange plastic-mesh fencing that is secured to metal T-posts. To prevent soil or sediment from entering sensitive areas, silt fencing may be installed around areas to be preserved. Silt fencing may be used in combination with protective fencing and will be installed in accordance with the Stormwater Pollution Prevention Plan that will be prepared by the contractor and the best management practices identified in the project construction documents. This silt fence will also serve as exclusion fencing to aid in preventing wildlife from entering active construction areas.

Prior to initial ground disturbance, preconstruction surveys for giant garter snake, western pond turtle, nesting migratory birds/raptors, and roosting bats will be conducted to ensure that these sensitive species are not directly or indirectly affected by restoration activities. Nesting bird and raptor survey will be conducted no more than 14 days prior to the start of construction to ensure that no active bird nests are present within 50 feet and no raptor nests are present within 300 feet of restoration activities. A bat emergence survey will also be conducted within 14 days prior to construction to ensure that no trees supporting maternal roosts are present within or adjacent to restoration activities.

If a special-status species is identified within or adjacent to restoration activities, appropriate no-disturbance buffers will be established for breeding sites or the individual(s) will be allowed to passively move out of the construction area. Buffers will be determined by a qualified biologist, coordinating with the appropriate regulatory agency, and will depend on the species identified and

one or more of the following factors: season of activity, level of noise or construction activity, level of ambient noise in the vicinity, and line-of-sight.

5.1.2 Pest Plant Removal

Weed control is necessary for the successful establishment of native plants and improvement of habitat. The weeds of greatest concern at the site are black mustard, yellow starthistle and pepperweed (River Partners and Stillwater Sciences 2009).

In areas to be planted with herbaceous species, spraying and mowing for an entire season before planting is recommended. Once the herbaceous species are planted, weed control methods will be mowing, possibly applying 2,4-D to control broad leaf pressure. The restoration contractor will abide by county and state herbicide permitting and reporting requirements. Roundup® (glyphosate) and 2,4-D (for broad-leaf control in native grass planting) are likely to be the most commonly used herbicides on the project. Rodeo® (for areas adjacent to water bodies), Telar® (for pepperweed control), Poast® (for post-emergence control of annual grasses in herbaceous understory planting) and Garlon™ (for woody species control) may also be used (River Partners and Stillwater Sciences 2009). No herbicide will be applied on days when wind speed is high enough to cause drift onto adjacent natural or planting areas.

Planting areas that are within 200 feet of any natural elderberries, elderberry plantings or transplants will not be sprayed with any herbicide during site preparation activities. Only hand or mechanical weed removal methods will be employed in these areas.

5.1.3 Construction Monitor

An individual familiar with this mitigation and monitoring plan will supervise all phases of construction of the project. These phases may include:

- Layout of proposed other waters of the United States boundaries prior to construction.
- Placement and installation of ESA fencing.
- Site preparation/vegetation clearing operations.
- Planting and seeding operations.

The construction monitor will have authority to direct equipment operators and will submit a summary report to the USACE documenting construction observations and any problems that arise.

5.2 Planting/Seeding

5.2.1 Planting Plan

A conceptual planting plan and plant palette for the SBCA is shown in Figures 5 and 6. Planting of the SBCA and FRFCRP site will consist of the following species for Elderberry mitigation (Table 5-1), riparian mitigation (Table 5-2), non-riparian native tree mitigation (Table 5-3) and upland seed mix (Table 5-4):

Table 5-1. Plant Palette for Elderberry Mitigation Areas

Scientific Name	Common Name	Percent of Planting Mix	Plant Spacing (feet on-center)	Container Size
Sambucus mexicana	Blue elderberry	50	10’ O.C.	1-gallon
Baccharis pilularis	Coyote brush	10		1-gallon
Populus fremontii	Fremont cottonwood	10		1-gallon
Rosa californica	California rose	10		1-gallon
Quercus lobata	Valley oak	10		1-gallon
Salix lasiolepis	Arroyo willow	5		1-gallon
Salix exigua	Sandbar willow	5		1-gallon

Table 5-2. Plant Palette for Riparian Mitigation Areas

Scientific Name	Common Name	Percent of Planting Mix	Plant Spacing (feet on-center)	Container Size
Populus fremontii	Fremont cottonwood	25	10’ O.C.	1-gallon
Box elder	Acer negundo	12.5		1-gallon
Oregon ash	Fraxinus latifolia	12.5		1-gallon
Rosa californica	California rose	10		1-gallon
Quercus lobata	Valley oak	10		1-gallon
Salix lasiolepis	Arroyo willow	10		1-gallon
Salix exigua	Sandbar willow	10		1-gallon
Rubus ursinus	California blackberry	5		1-gallon
Cephalanthus occidental	Buttonbush	5		1-gallon

Table 5-3. Plant Palette for Non-Riparian Native Tree Mitigation Areas

Scientific Name	Common Name	Percent of Planting Mix	Plant Spacing (feet on-center)	Container Size
Quercus lobata	Valley oak	75	10’ O.C.	1-gallon
Baccharis pilularis	Coyote brush	15		1-gallon
Quercus wislizeni	Interior live oak	10		1-gallon

Table 5-4. Upland Seed Mix

Botanical Name	Common Name	Pounds Pure Live Seed Per Acre (Slope Measurement)
In-Stream Bench Seeding (Type 1)		
Leymus triticoides	Creeping wild rye	10
Hordeum brachyantherum ssp. *californicum*	Meadow barley	12
Elymus glaucus	Blue wild rye	12
Eschscholizia californica	California poppy	2
Lupinus succulentus	Arroyo lupine	4
Triticum x Elymus	Regreen	25

5.2.2 Nature and Source of Propagules

Container plants will be purchased from a commercial nursery located within two hours of the project site. If possible, container plants will be grown from seeds or cuttings collected at or near the project site in order to populate the site with species ecotypes that are adapted to local ecological conditions.

5.3 Irrigation

Because of the dry summers typical of the climate in the area, irrigation will be required for plant establishment and survival. Irrigation should be applied with the goal that plants will become self-sufficient by the end of the third growing season (River Partners and Stillwater Sciences 2009).

In the first growing season, the rapidly growing seedlings have roots only in the surface (the top 1–2 feet) of the soil profile. The rooting zone must be kept moist through the season to ensure optimum growth and survival. Because of the sandy soils at the site and water table depths of over 20 feet, the soil moisture of the fields planted with woody species will need to be closely monitored. The intervals between irrigations are dependent upon soil texture, depth to water table, the weather conditions, and plant water stress. Because a mixture of species with different water demands is proposed, the plants must be carefully observed to maintain a balance of soil moisture that is acceptable for xeric species like valley oak and elderberry as well as more mesic species like cottonwood and willow (River Partners and Stillwater Sciences 2009).

Prior to project implementation, a more detailed irrigation design will be developed. All irrigation water at the SBCA will be provided by an existing well located in the O'Connor Lakes Unit, near the midpoint of the eastern edge of the project area. The mainline will run west from the well (River Partners and Stillwater Sciences 2009). Irrigation water at the FRFCRP site will be supplied from existing wells on-site.

Based on knowledge of the site and plant design, the following are expected to be the requirements for the system:

- The plant spacing throughout most of the restoration and mitigation areas will be 10-foot-wide rows with a 10-foot distance down the planting rows, and rows planted in an approximate east-west direction.

- Planting rows will curve and run parallel to flood flows. The irrigation system will utilize existing wells as water sources.
- The drip-line emitters will be spaced, with three emitters per plant 12 inches apart. The design flow will be 0.6 gallons per hour per emitter (1.8 gallons per plant per hour).

Within selected areas, soil-moisture sensors will be placed throughout both planting areas. Sensors will be installed at depths of 12 and 36 inches (River Partners and Stillwater Sciences 2009).

In conjunction with these measurements, plant stress observations before and after irrigation periods will be necessary to critically judge the timeliness and effectiveness of irrigation. Measurements provide the most direct assessment of soil moisture. Table 5-5 provides the irrigation goals of the project (River Partners and Stillwater Sciences 2009).

Table 5-5. Irrigation Goals for the SBCA and FRFCRP site

Year	Goal	Frequency
1	Keep the shallow roots (1–2 feet) of young plants moist to ensure optimum growth and survival.	Utilize soil moisture probes to monitor and maintain moisture throughout the soil column.
2	Encourage deep rooting and enhance field access to facilitate weed control.	Deliver less frequent but longer irrigations.
3	Encourage deep rooting and enhance field.	Continue with long irrigations and extend the access to facilitate weed control period between irrigations.

Source: River Partners and Stillwater Sciences 2009.

The strategy for the second and third year is to train the roots to grow deep. Roots at depth (5–15 feet) will need less water and may be able to tap into the water table on the site and outcompete more shallow-rooted weeds. Less frequent, deep watering will encourage roots to grow deeper, well below the roots of the weeds, allowing the tree exclusive use of this deep moisture. As the tree's roots grow deeper, the times between irrigations become longer; this allows the soil surface layers to dry, thereby reducing weed vigor (River Partners and Stillwater Sciences 2009).

We anticipate that the well-drained, sandy soils, and relatively deep groundwater present on the site, will require frequent irrigations and careful observation of water stress. These areas may dictate the frequency of watering on the site. Field managers should use a combination of methods including evapotranspiration estimates, soil probes, gypsum blocks, and plant water stress signs to assess soil moisture and alter the irrigation regime (River Partners and Stillwater Sciences 2009).

5.4 Implementation Schedule

The mitigation project will be implemented during the fall of 2013. Initial elderberry shrub transplant activities will take place during the winter of 2013–2014 and additional transplants will take place in subsequent winters as future phases of the levee project are implemented. Mitigation maintenance will begin immediately following completion of the mitigation activities.

Chapter 6
Maintenance during Monitoring Period

6.1 Maintenance Activities

6.1.1 Overall

Mitigation and riparian vegetation enhancement activities at the SBCA and FRFCRP site will be monitored by LD1 and/or CDFW (or their designee) to determine if mitigation requirements and habitat enhancement goals and performance standards are being met. Annual monitoring of riparian vegetation establishment, including natural native plant recruitment, nonnative plant recruitment, and plant development, will provide guidance to LD1 and/or CDFW (or their designee) to determine if remedial actions are needed. Annual monitoring reports will be submitted by December 31 of each year. If monitoring reveals that performance standards are not being met, remedial activities may be implemented (River Partners and Stillwater Sciences 2009).

6.1.2 Irrigation

All planted areas within the mitigation site will be irrigated during the establishment period. Soil moisture should be checked at least twice weekly and plantings should be qualitatively assessed for signs of drought stress. All planting areas will be irrigated at least twice weekly from May through October. Irrigation event duration should be adjusted depending on soil moisture and prevailing weather conditions but should be of sufficient length to maintain vigorous plant growth and encourage deep root growth.

Between November and April soil moisture at the mitigation site will be checked twice a month, and, if necessary, the irrigation system will be run for approximately ½ hour or long enough to replenish soil moisture around the plantings in the mitigation area.

6.1.3 Invasive Plant Control

Weeding efforts will occur on a monthly basis from April to October of each year for 5 years. Weed control will consist of controlling populations of invasive weeds when they occur in the planting areas. Weed control will consist of mechanical or manual removal only. At no time will herbicides be used in the planted areas. Plant Replacement

Dead of diseased plants will be replaced immediately upon their discovery with new plants of the same size and species. Plant species substitutions will only be permitted with the prior approval of the resource manager.

6.1.4 Irrigation System Maintenance

The resource manager will maintain the irrigation system during the plant establishment maintenance period. Maintenance will include the repair and replacement of parts, ensuring the system is delivering the required amount of water, and ensuring the system is fully operational at all

times. The resource manager will regularly inspect the irrigation system, adjust and replace parts as necessary.

6.1.5 Reporting and Record Keeping

The resource manager will prepare and keep current a record of monthly maintenance performed on the project. The record will identify, at a minimum, project name, mitigation planting zones, current date and establishment period. The record will also identify and discuss weed control performed, irrigation activity and maintenance, plant health, vandalism, site feature conditions, general observations, total precipitation for the month, personnel onsite and any other pertinent information describing site conditions and activities performed during the month.

Chapter 7
Proposed Monitoring Reports

7.1 Due Dates

SBFCA will notify the USACE and other resource agencies of the due date (month and day) for the annual monitoring report.

7.2 As-Builts

As-built planting and irrigation drawings of the mitigation areas will be prepared by SBFCA following completion of the project. The as-built drawings will be prepared on 40-scale or larger-scale maps and will indicate the following features.

- Extent of planting areas (in plan view).
- Location of any permanent markers (e.g., identification stakes, photo documentation stations).
- Seeded areas.
- Other pertinent features.

Any changes from the original mitigation construction plans will be indicated in indelible red ink. The as-built drawings will be submitted to USACE and other resource agencies within 6 weeks of construction completion.

7.3 Annual Reports

7.3.1 File Number

Any appropriate USACE permit/file numbers will be included on correspondence, including the cover and title page of all reports.

7.3.2 Contents

The following text describes the content that will be included in the mitigation monitoring reports.

Years of Full Monitoring

SBFCA will prepare an annual monitoring report in accordance with USACE guidance (U.S. Army Corps of Engineers 2004 and 2006) by December 31 of each monitoring year. Each full-year monitoring report will include the following information.

- Project Information
    - Project name and a summary of the project location and description including date of project commencement and completion.

  - Contact information for the applicant.
  - A list of the names, titles, and companies of the people who prepared the content of the annual report or participated in monitoring activities that year.
  - USACE permit file number.
  - Type and acres of impacted habitat.
  - The monitoring year.
  - Information on any required performance bonds or surety, if applicable.
- Compensatory Mitigation Site Information
  - Location of the mitigation site.
  - Purpose and goals of the mitigation.
  - Dates of mitigation site construction and completion.
  - Dates and summary of maintenance and performance monitoring visits.
  - Contact information for the responsible party for the mitigation site.
  - Summary of remedial actions, if applicable.
- Figures and Graphics
  - Location map.
  - Mitigation site map indicating restored habitats, monitoring locations, photo documentation stations, and any other pertinent site features.
- List of USACE-approved success criteria
- Monitoring Results
  - A summary and analysis of the monitoring results, including an evaluation of site conditions in the context of the performance standards and success criteria, including a comparison with previous monitoring years.
  - Summary of field data taken to determine compliance.
- Problems noted and proposed remedial measures
  - Problems noted during the course of the monitoring surveys or other site visits.
  - Management recommendations, including discussion of areas with inadequate performance and recommendations for remedial action.
- Appendices
  - Original data sheets and technical appendices, as required by the USACE and other resource agencies.
  - Photo-documentation of the planting areas using photographs taken during the monitoring surveys.

Final Monitoring Report

A final monitoring report will be submitted after all performance monitoring at the mitigation sites is complete. The final report will be prepared by a qualified biologist and will evaluate whether the mitigation has achieved the goals and success criteria set forth in the approved MMP. The final report will be submitted within 90 days of the end of the monitoring period to the USACE and other resource agencies for review and approval.

Chapter 8
Potential Contingency Measures

8.1 Initiating Procedures

If the final report indicates that the mitigation project has been unsuccessful, in part or in whole, based on the approved success criteria for physical and ecological functions, the applicant will evaluate the causes for not meeting the criteria and submit a revised or supplemental mitigation plan within 90 days of the end of the monitoring period for the review and approval of USACE to compensate for those portions of the original program that did not meet the approved success criteria. The approved remedial measures will be developed based on the qualitative and quantitative monitoring results to determine the most effective remedy. The revised mitigation plan containing the remedial measures will be processed as an amendment to the original permit unless USACE determines that no permit amendment is required.

If, after all remedial measures have been implemented, it becomes evident that the permit requirements cannot be satisfied according to the proposed mitigation plan, SBFCA will coordinate with the permitting agencies to develop a contingency plan to be approved by all parties.

8.2 Contingency Funding Mechanism

SBFCA will fund any necessary contingency mitigation efforts, including additional planning, implementation, and monitoring. SBFCA will keep funds available for potential contingency measures until final written confirmation from the USACE that all success criteria have been met.

Chapter 9
Completion of Mitigation Responsibilities

9.1 Notification

SBFCA will notify USACE of completion of mitigation responsibilities in conjunction with the final annual report. A minimum of 2 years will be required after the completion of all maintenance activities (e.g., irrigation, replanting, rodent control, fertilization) before final success criteria will be considered met.

9.2 USACE Confirmation

After receiving the final monitoring report, USACE will conduct a site visit and confirm in writing to SBFCA that the mitigation obligations and responsibilities have been met, or if not met, describe additional actions required.

Chapter 10
Long-Term Management

10.1 Property Ownership

The SBCA is owned in part by LD 1 and in part by CDFW. The FRFCRP site is entirely owned by TRLIA.

10.2 Management Plan

10.2.1 Purpose

This section only addresses permittee-responsible mitigation, as compensatory mitigation not addressed below will be deemed satisfied and complete through purchase of credits from a commercial mitigation bank approved by the appropriate resource agencies.

The purpose of this long-term management plan is to ensure the mitigation site is monitored and maintained in perpetuity. This management plan provides management objectives and tasks to monitor, manage, maintain and report on the mitigated natural resources. Routine monitoring and minor maintenance tasks are intended to assure the viability of the mitigation site's functions and values. This long-term management plan will take effect after the completion of the monitoring period, once it has been determined by the appropriate resource agencies that the mitigation project has achieved its project objectives and outlined performance standards for each habitat type have been reached. During the long-term management period the gradual withdrawal of the required support systems (e.g., irrigation and frequency of maintenance) for mitigation resources will begin. The goal for each mitigation site is to become fully self-sustaining. The designated resource manager(s) will oversee all long-term management activities.

10.2.2 Resource Manager

The resources managers are LD1 and CDFW. The resource managers, and subsequent resource managers, upon transfer, shall implement this long-term management plan. Long-term management tasks shall be funded through the mitigation site's endowment fund. The resource manager(s) shall be responsible for providing an annual report, consisting of a description of the management tasks and total funds expended, to the appropriate resource agencies. Any subsequent modification to the mitigation sites by the resource manager(s) or their representatives must be approved by the appropriate resources agencies and the necessary permits obtained.

10.2.3 Management Approach

The general management approach to the long-term maintenance of the mitigation site will be to maintain quality habitat functions and values for each mitigated resource and on-going monitoring and maintenance of the mitigation site. When necessary, adaptive management will be used to adjust management practices, including corrective actions as determined to be appropriate by the

appropriate resources agencies in discussion with the resource manager(s). Adaptive management includes those activities necessary to address the effects of climate change, fire, flood, or other natural events, force majeure, etc. Before considering any adaptive management changes to the long-term management plan, the appropriate resource agencies will consider whether such actions will help ensure the continued viability of the mitigation site's biological resources.

10.2.4 Long-Term Management Needs

The expected long-term management needs and activities necessary to maintain the mitigation site will be resource specific long-term maintenance activities as describe d below and other general maintenance activities such as exotic species elimination, clean-up and trash removal, infrastructure management such as gate, fence, road, culvert, signage and drainage-feature repair, and other maintenance activities necessary to maintain the functions and values of the mitigation site.

Biological Monitoring

Annual field surveys will be conducted to qualitatively assess and record the general conditions of the riparian, non-riparian native trees, and elderberry planting areas. General hydrology, general vegetative cover, structure and native plant diversity, invasive species, and erosion sites will be recorded, evaluated and mapped during site examinations in the spring. Notes to be made will include observations of species encountered, general condition of the planting areas, occurrences of erosion, and presence of significant populations of non-native invasive plants.

Diversity of native plant species will be maintained by replanting native species as specified in the original planting plan, or when appropriate, introduction of additional native species. Native species from various plant communities should be selected to complement natural seral processes that may take place as the mitigation site ages and matures.

Other Site Management Activities

Other site management and maintenance activities are those that may be required on an as-needed basis. Items listed below may be observed, implemented, and/or recorded during annual site observation and included in annual report to the appropriate resource agencies. Funding for these management and maintenance activities will be covered by the mitigation site's endowment fund.

General Inspections: The resource manager(s) will conduct two general site inspections each year. These inspections may take place while conducting other routine site maintenance visits. Photo documentation will be collected. Permanent photo points for taking photographs will be established, and a site map showing the photo point will be prepared for the mitigation project file. Representative photographs will be taken once per year during the same season.

Mosquito Abatement: Potential mosquito abatement issues will be addressed through the development of a plan by the resource manager(s) and the mosquito and vector control district in coordination with and approved by the appropriate resource agencies.

Trash and Trespass: At least once yearly trash will be collected and disposed within the mitigation site. Vandalism and trespass impacts will be repaired and rectified. Sources of trash and trespass will be monitored.

Non-native Invasive Species: The resource manager(s) will monitor and maintain control over non-native invasive species, including but not limited to noxious weeds, that diminish site quality for which the mitigation project was established. The mitigation site currently functions with a number of nonnative species, some of which have become naturalized. They are predominantly annual species that occur in grasslands. It is unreasonable to require or expect eradication of established nonnative species at the site. The required management of nonnative plants therefore will be limited to the management of newly introduced invasive species and controlling the spread of existing invasive species. Methods of removing or controlling these species are outlined below.

Hand/mechanical: Hand removal or use of small hand-powered or handheld equipment (such as a Weed Wrench or a chainsaw) always should be the preferred method of removing invasive species from the mitigation properties. If hand-removal methods are found ineffective, or the problem is too widespread for hand removal to be practical, mechanical methods (use of larger equipment with motors such as mowers) or biological controls as described below can be used.

Biological controls: The county agricultural commissioner would be the point of contact for use of biological controls in the mitigation properties.

At no time will herbicides be utilized at the mitigation site.

Weeding will be done on an as-needed basis starting in March and ending in October.

Each year's annual walk-through survey (or a supplemental survey) will include a qualitative assessment (e.g., visual estimate of cover) of potential or observed noxious weeds or other non-native species invasions, primarily in or around the wetlands. Additional actions to control invasive species will be evaluated and prioritized.

Fire Hazard Reduction: Potential wildfire fuels will be reduced as needed by mowing in areas where approved by the resource agencies. The site will be maintained as required for fire control while limiting impacts to biological values. Vegetation will be mowed in areas required by authority agency(ies), and as approved by the appropriate resource agencies, for fire control.

Reporting and Administration

The resource manager(s) will provide an annual report on all management tasks conducted and general site conditions to appropriate resource agencies and any other appropriate parties. The annual report will be completed and circulated to the appropriate resource agencies and other parties by August 15 of each year. The report will make recommendations with regard to any habitat enhancement measures deemed to be necessary, any problems that need near short and long-term attention (e.g., weed removal, erosion control), and any changes in the monitoring or management program that appear to be warranted based on monitoring results to date.

10.2.5 Management Responsibilities and Plan Modification

Transfer of Management Responsibilities

Any subsequent transfer of management responsibilities under this long-term management plan to a different resource manager shall be requested in writing by the existing resource manager(s). The request shall be made to the appropriate resource agencies, which will issue written approval that shall be incorporated as an amendment into this long-term management plan. Any subsequent

property owner assumes resource manager responsibilities described in this long-term management plan and as required in the conservation easement, unless otherwise amended in writing by the appropriate resource agencies.

Amendment to Management Plan

The resource manager(s), property owner, and the resource agencies may meet and confer from time to time, upon the request of any one of them, to revise the long-term management plan to better meet management objectives and preserve the habitat functions and values of the mitigation site. Any proposed changes to the long-term management plan shall be discussed with the appropriate resource agencies and the resource manager(s). Any proposed changes will be designed with input from all parties. Amendments to the long-term management plan shall be approved by the appropriate resource agencies in writing and implemented by the resource manager(s).

10.2.6 Funding

Long-Term Funding Mechanism

An endowment will be provided by SBFCA to CDFW who will hold the principal and interest monies as required by law in a deposit fund, or subsequent state authorized trustee fund which consists of monies that are paid into it in trust pursuant to law, and will be appropriated to fulfill purposes for which payments into it are made. These interest monies will fund the long-term management, enhancement and monitoring activities set forth by the conservation easement and consistent with this long term management plan.

The resource manager(s) shall consult with CDFW as required to determine the amount of funding available for management and monitoring activities.

10.2.7 Long-Term Conservation Mechanism

Conservation Easement

Conservation easements will be created for the portion of the SBCA owned by LD , and the entire FRFCRP site. They will act as a legal binding agreement to restrict the use of the parcel for the purpose of conserving in perpetuity the mitigated natural resources. The conservation easement will be attached to the property's fee title and apply to present and all future owners and resources managers of the mitigation site should LD1 relinquish or transfer land management responsibilities.

Chapter 11
References

11.1 Printed References

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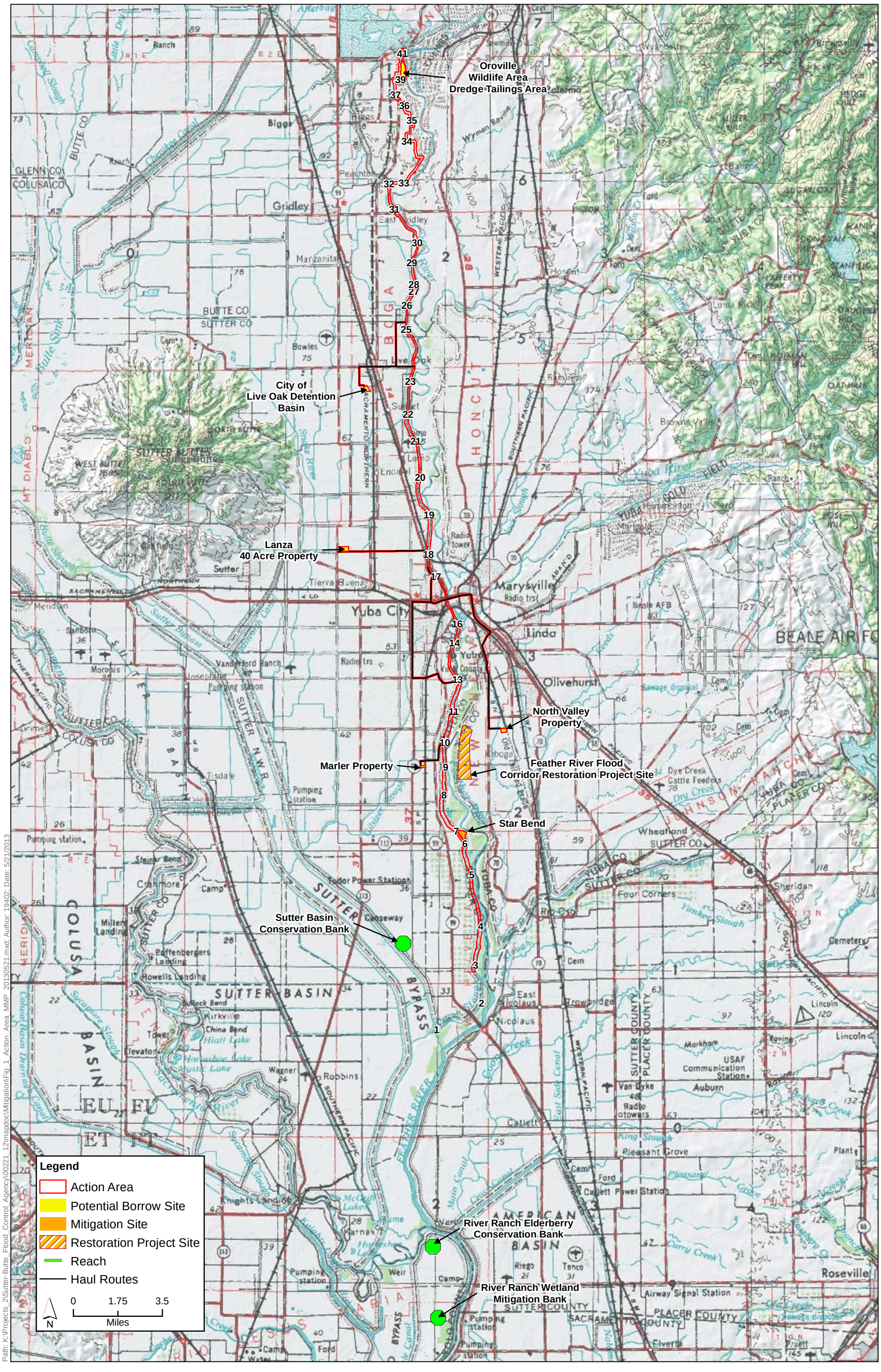

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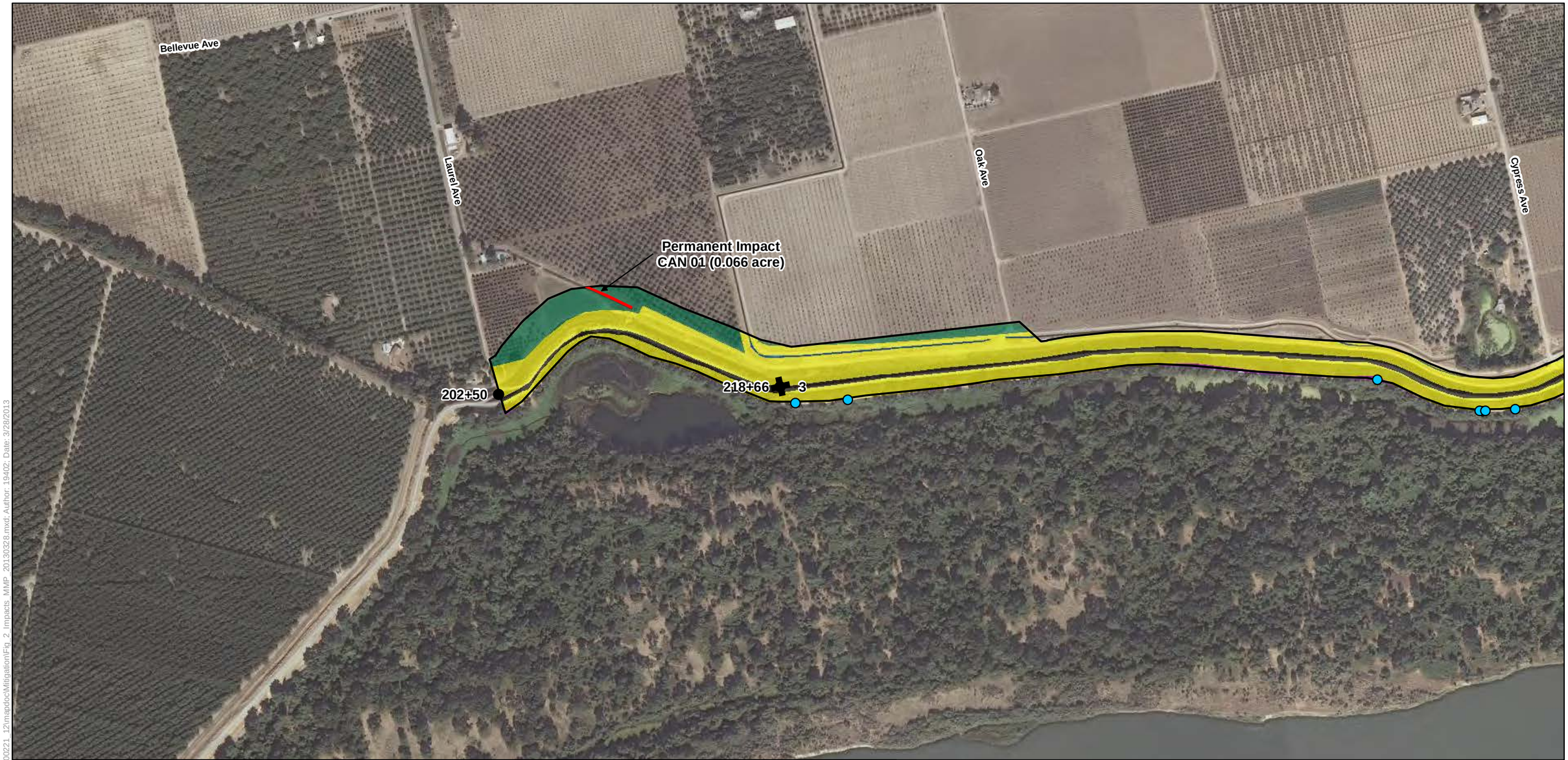
Figure 1
Feather River West Levee Project Action Area



Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-1
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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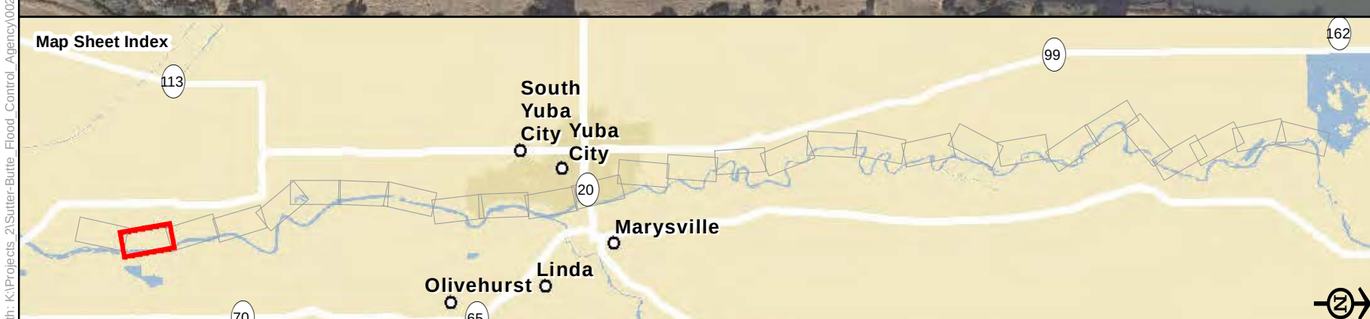

Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-2
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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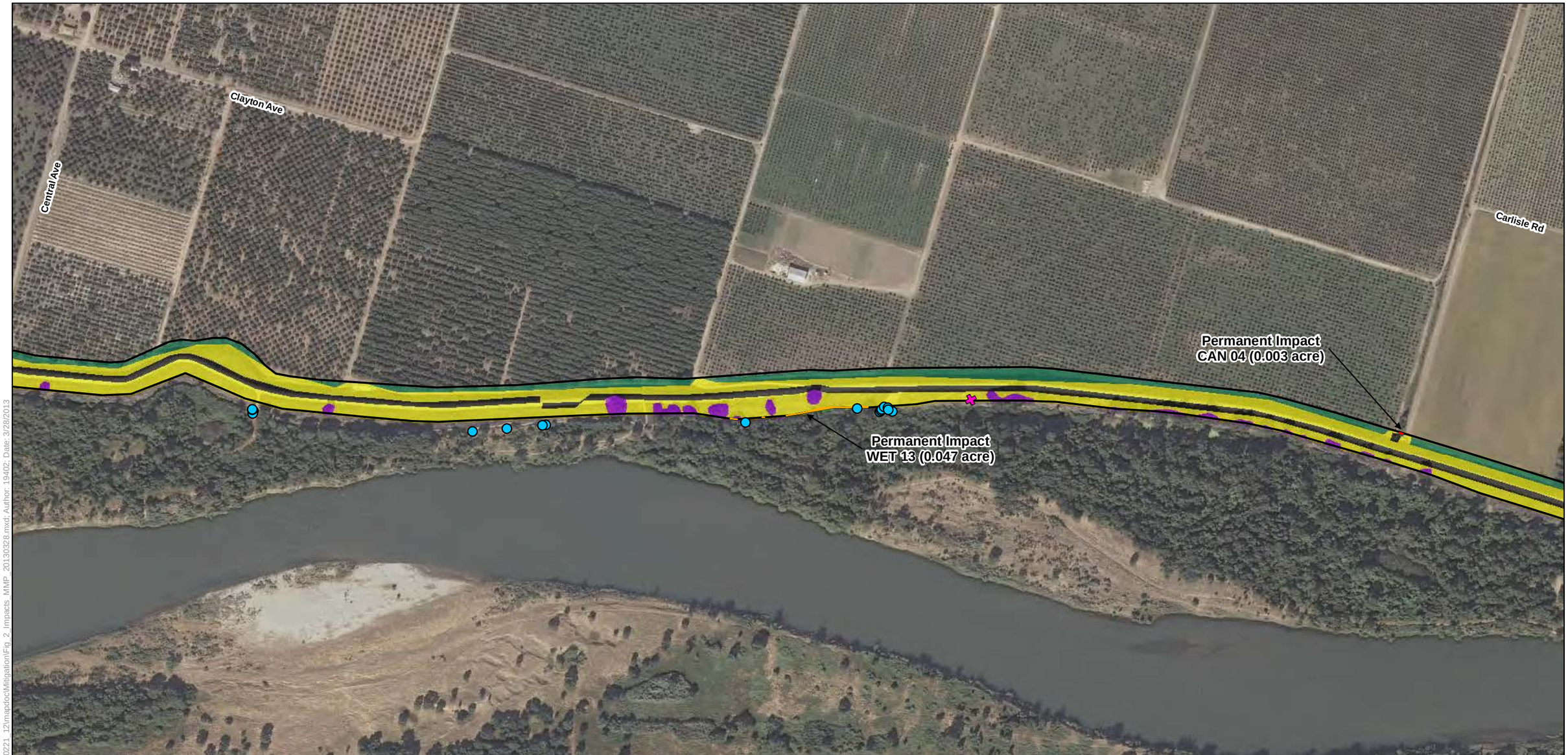

Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-3
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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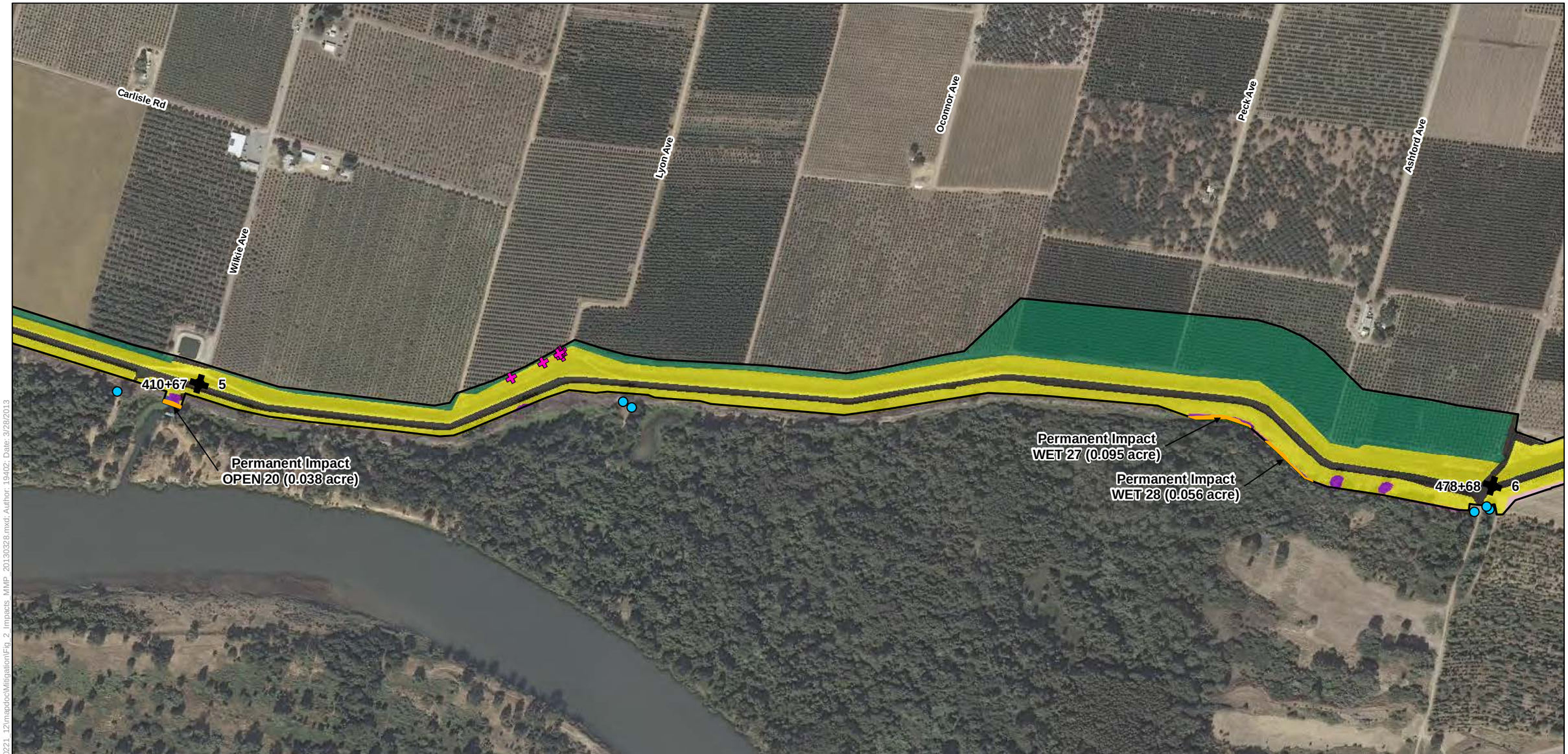

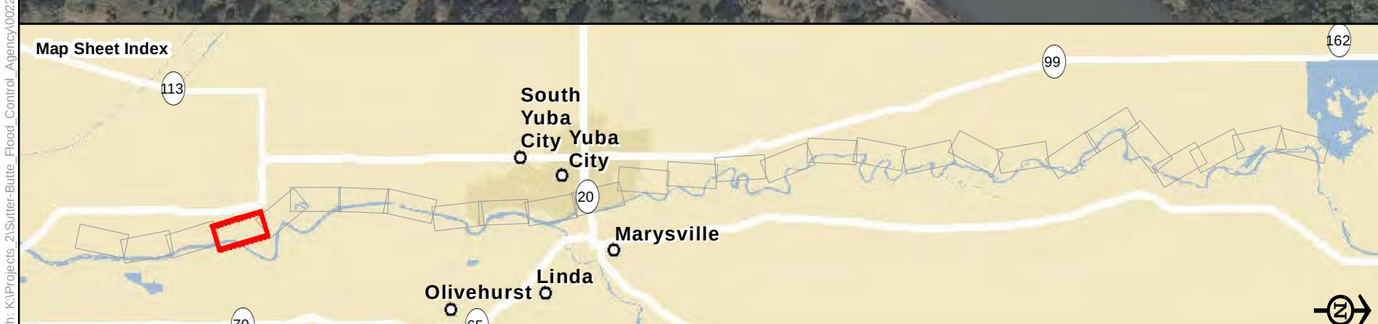

Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-4
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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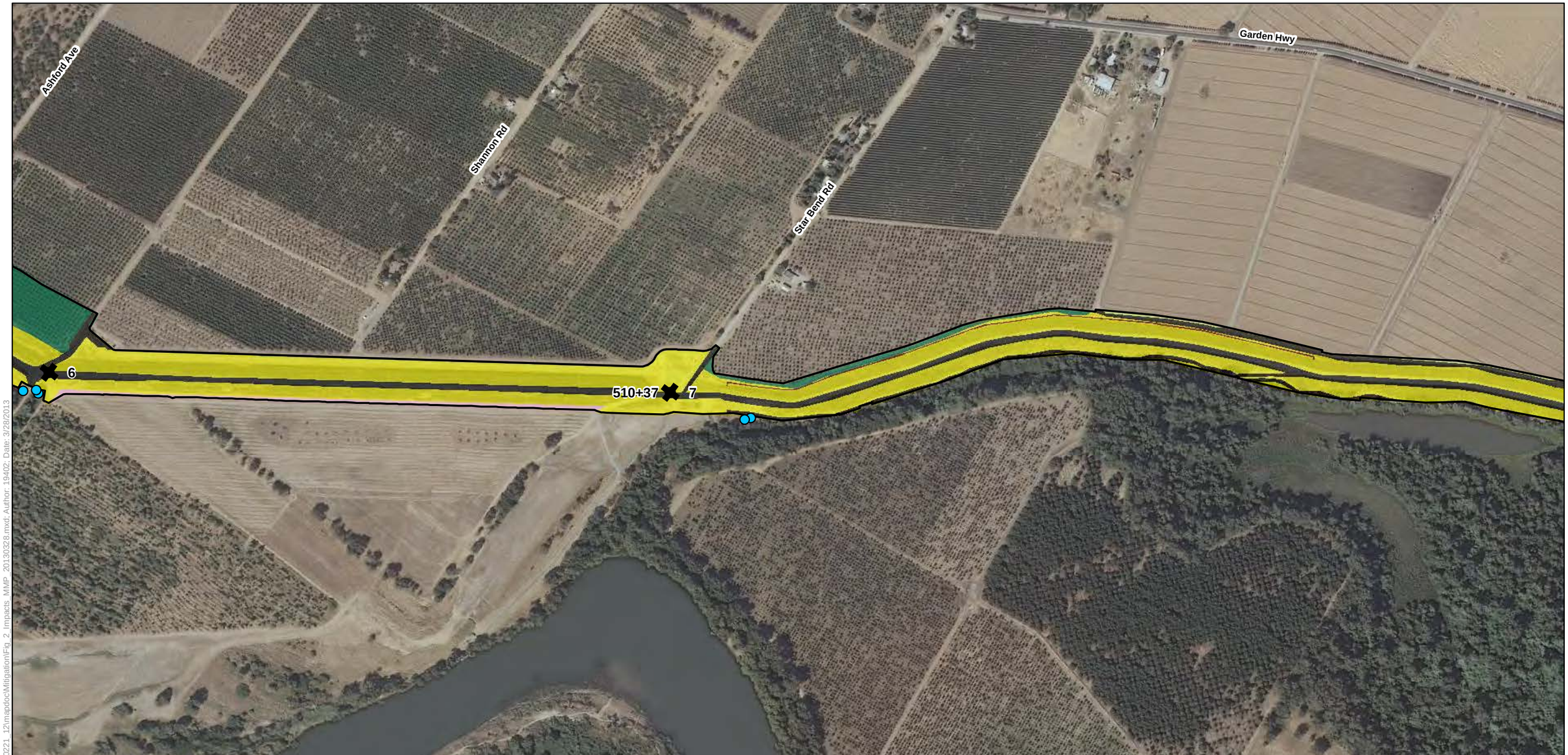

Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-5
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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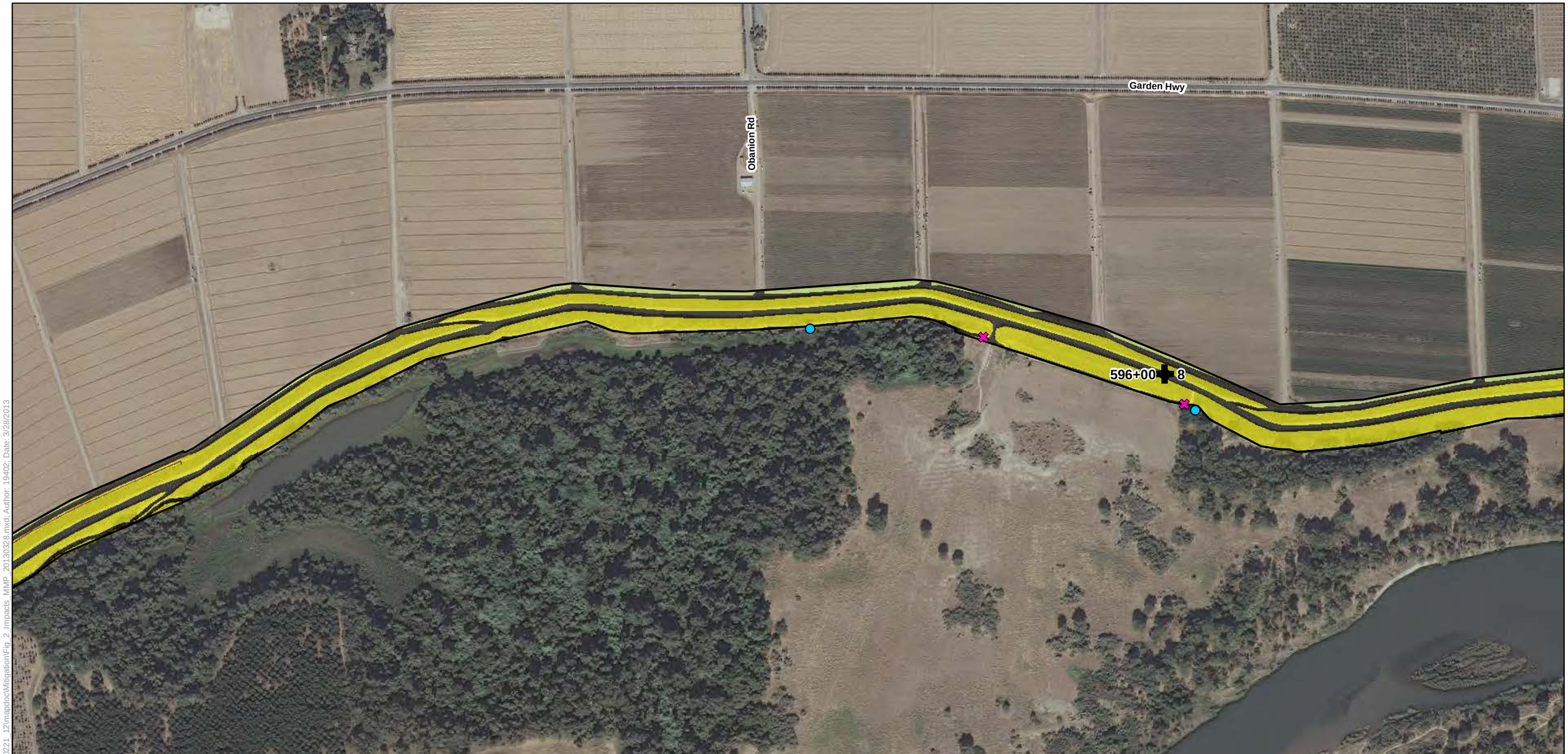

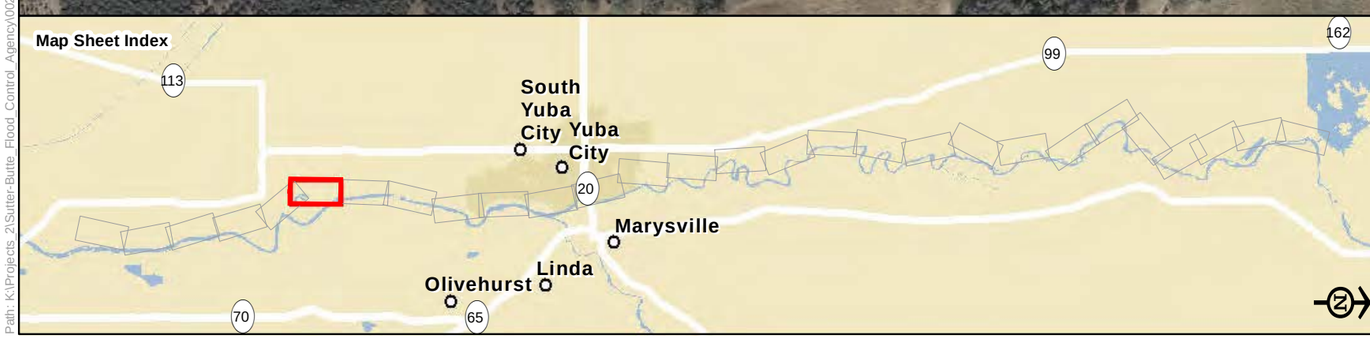

Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-6
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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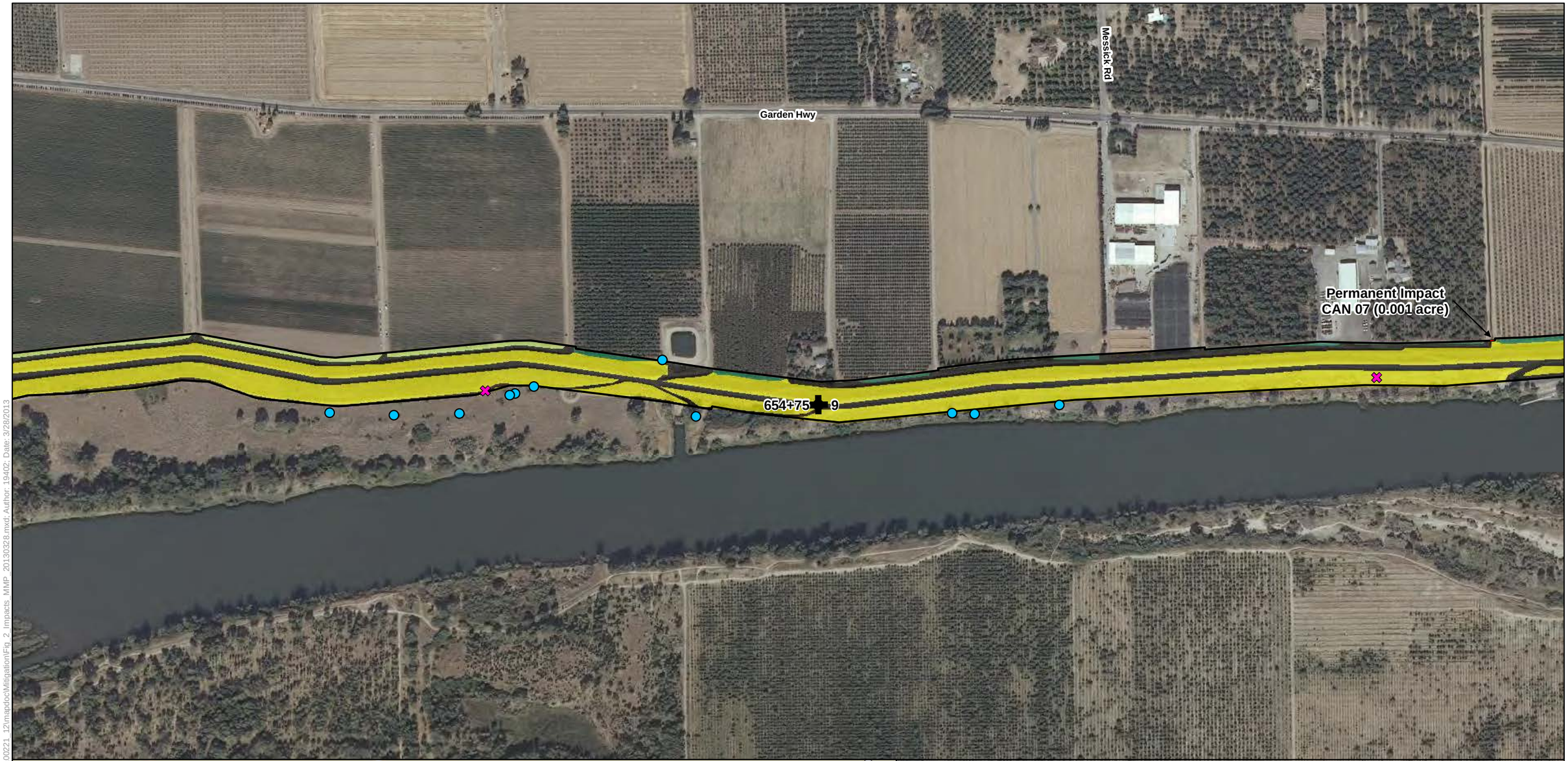

Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-7
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-8
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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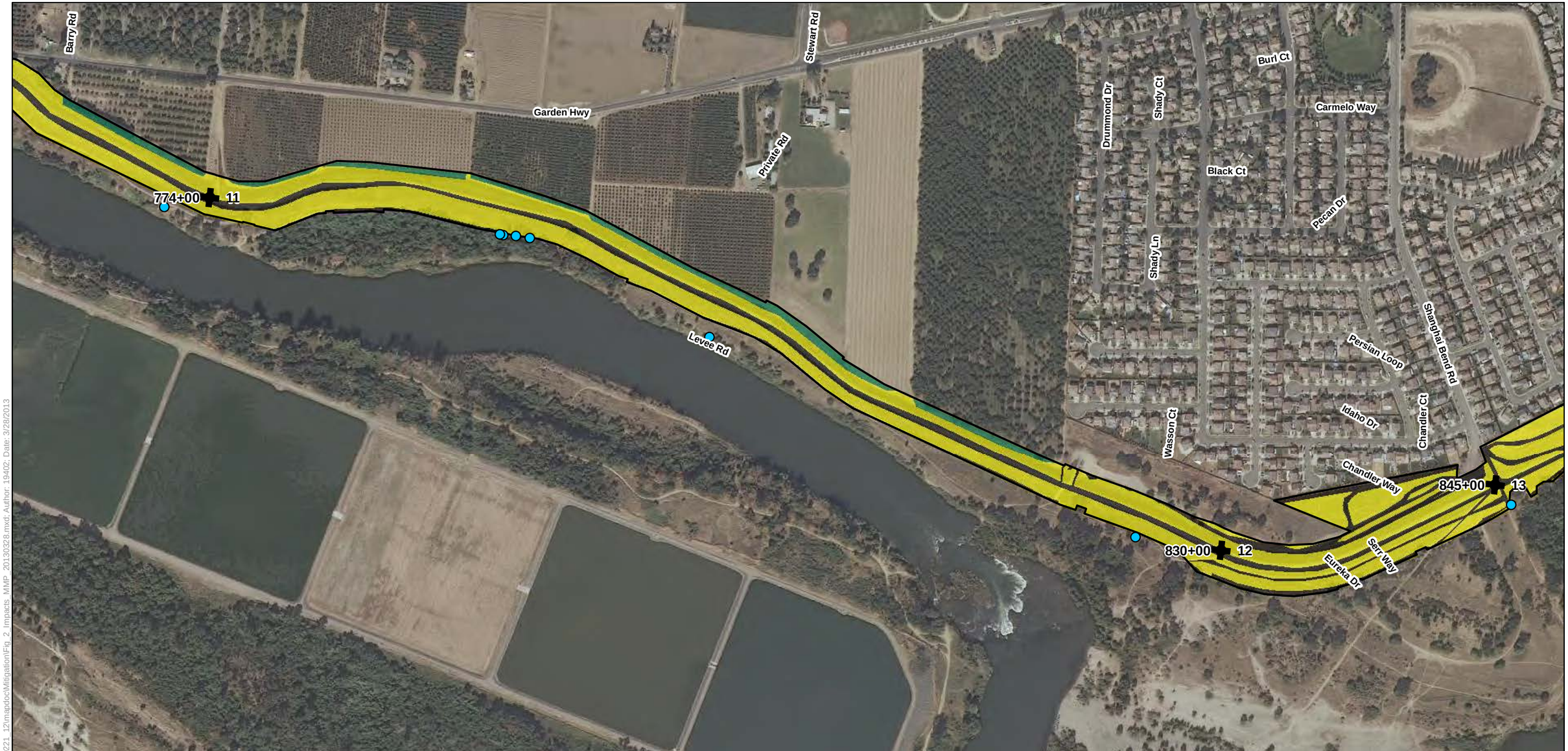

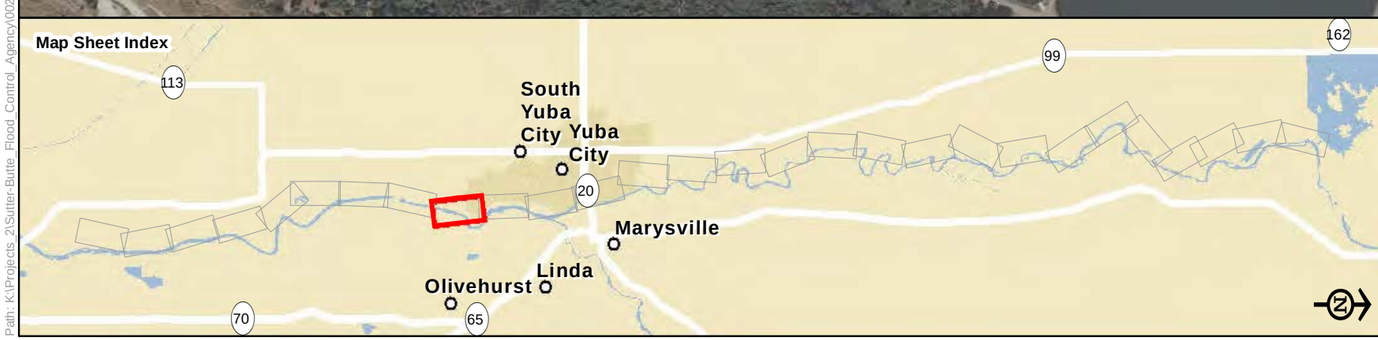

Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-9
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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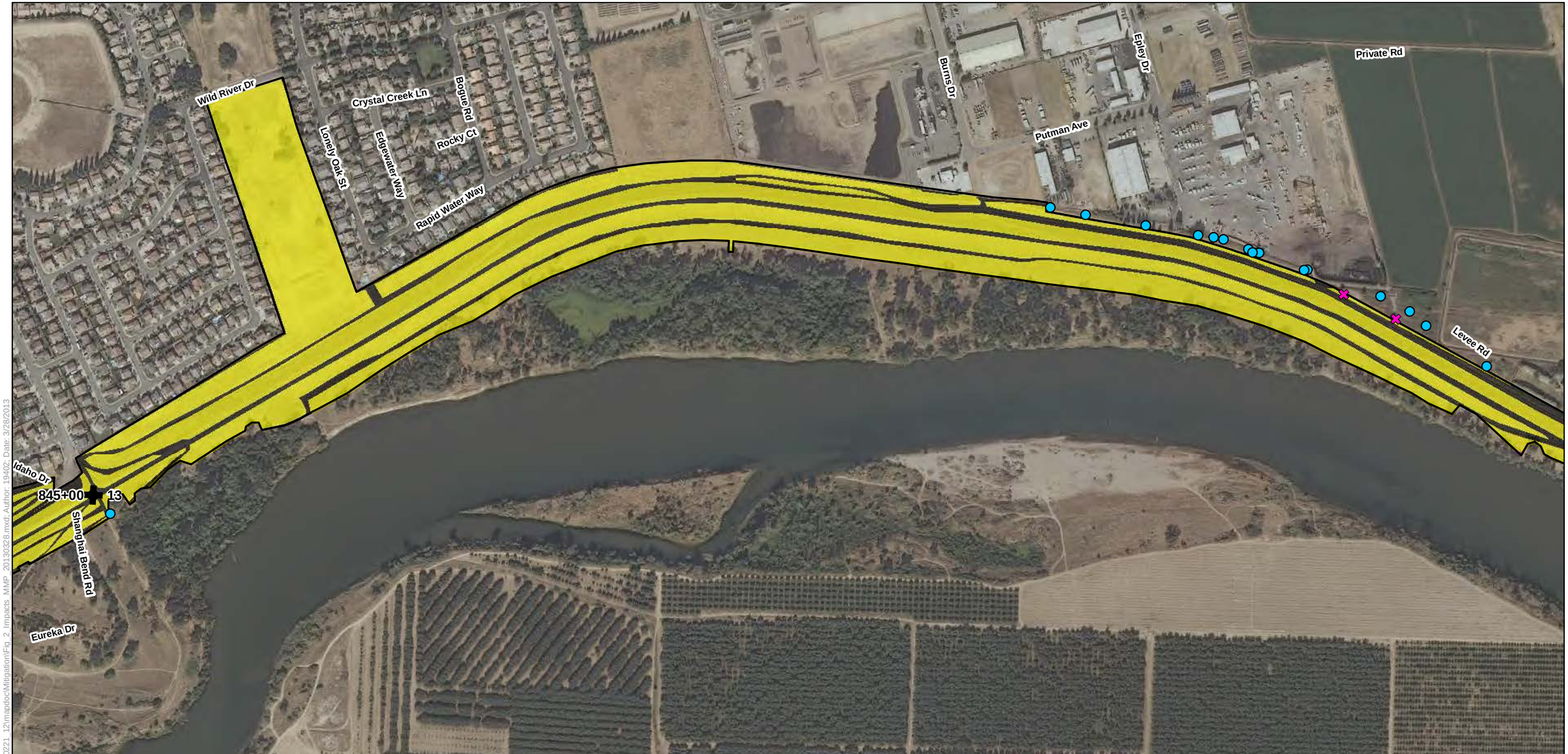

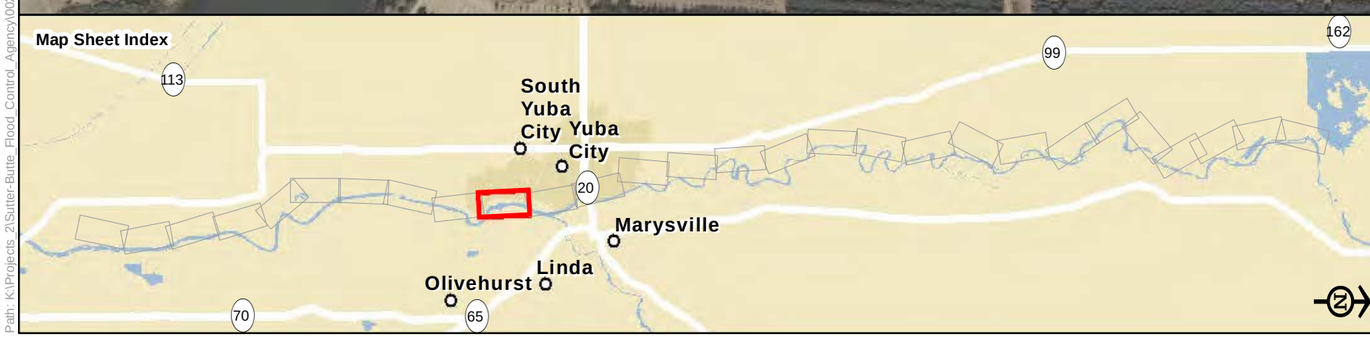

Legend

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- Canal Permanent Impacts (0.969 acre)
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Elderberry Action

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Land Cover Types

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- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-10
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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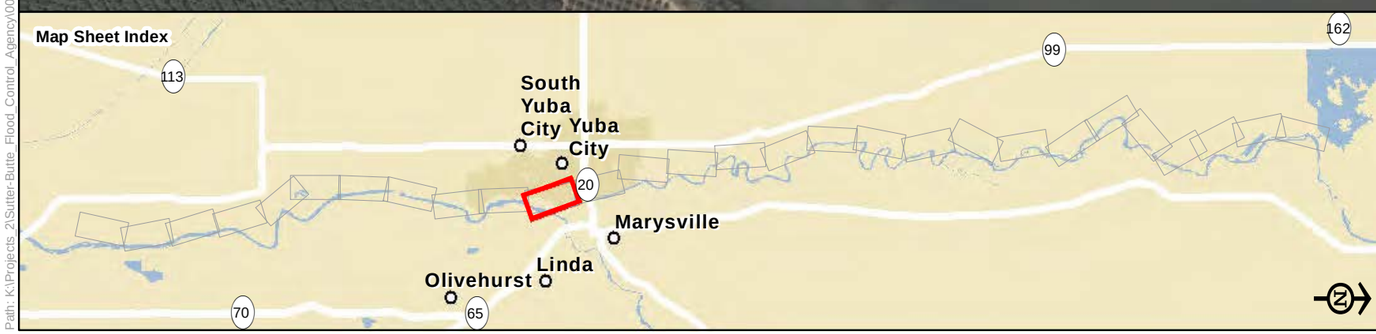

Legend

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Elderberry Action

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Land Cover Types

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- Riparian Scrub-Shrub
- Ruderal
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- Tailings Ponds

Figure 2-11
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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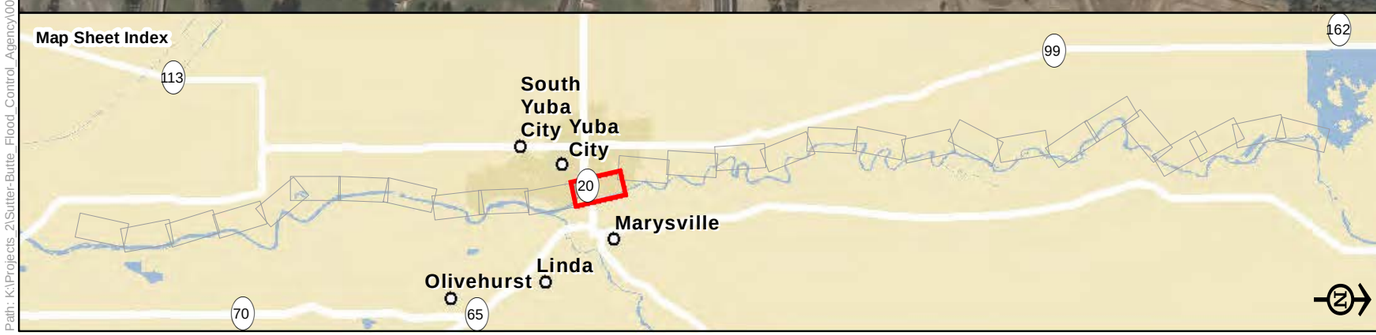

Legend

- Alternative 3
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- Station 202+50

Elderberry Action

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Land Cover Types

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- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-12
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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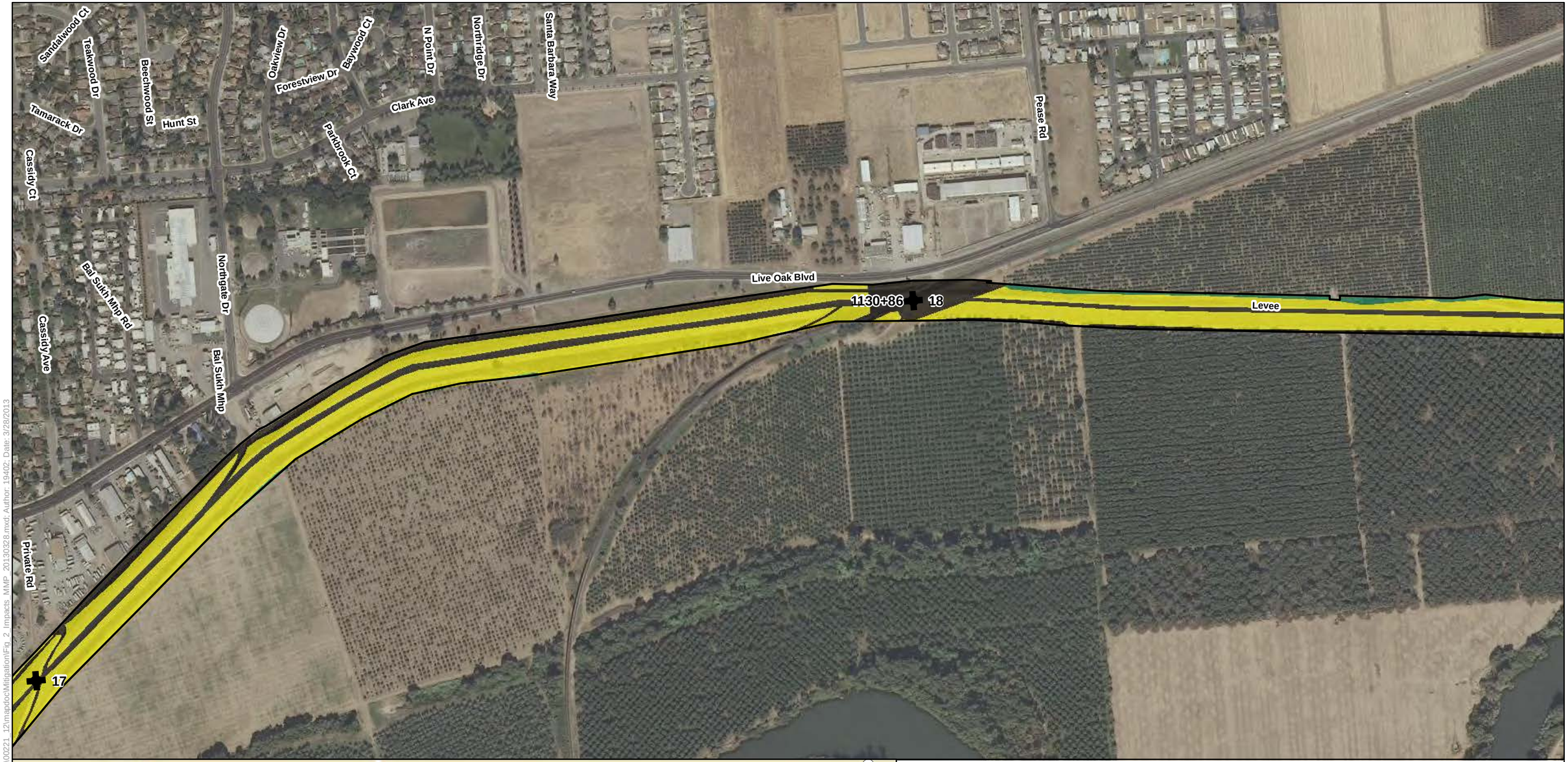

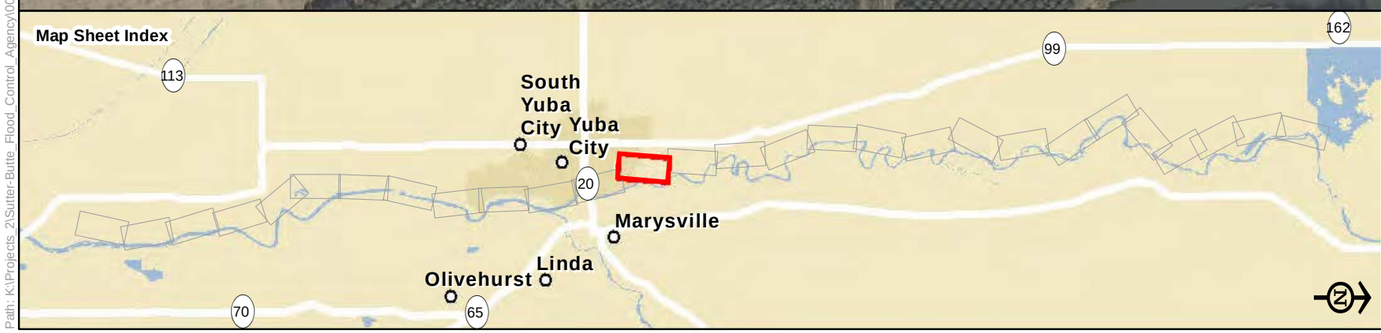

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Elderberry Action

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- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-13
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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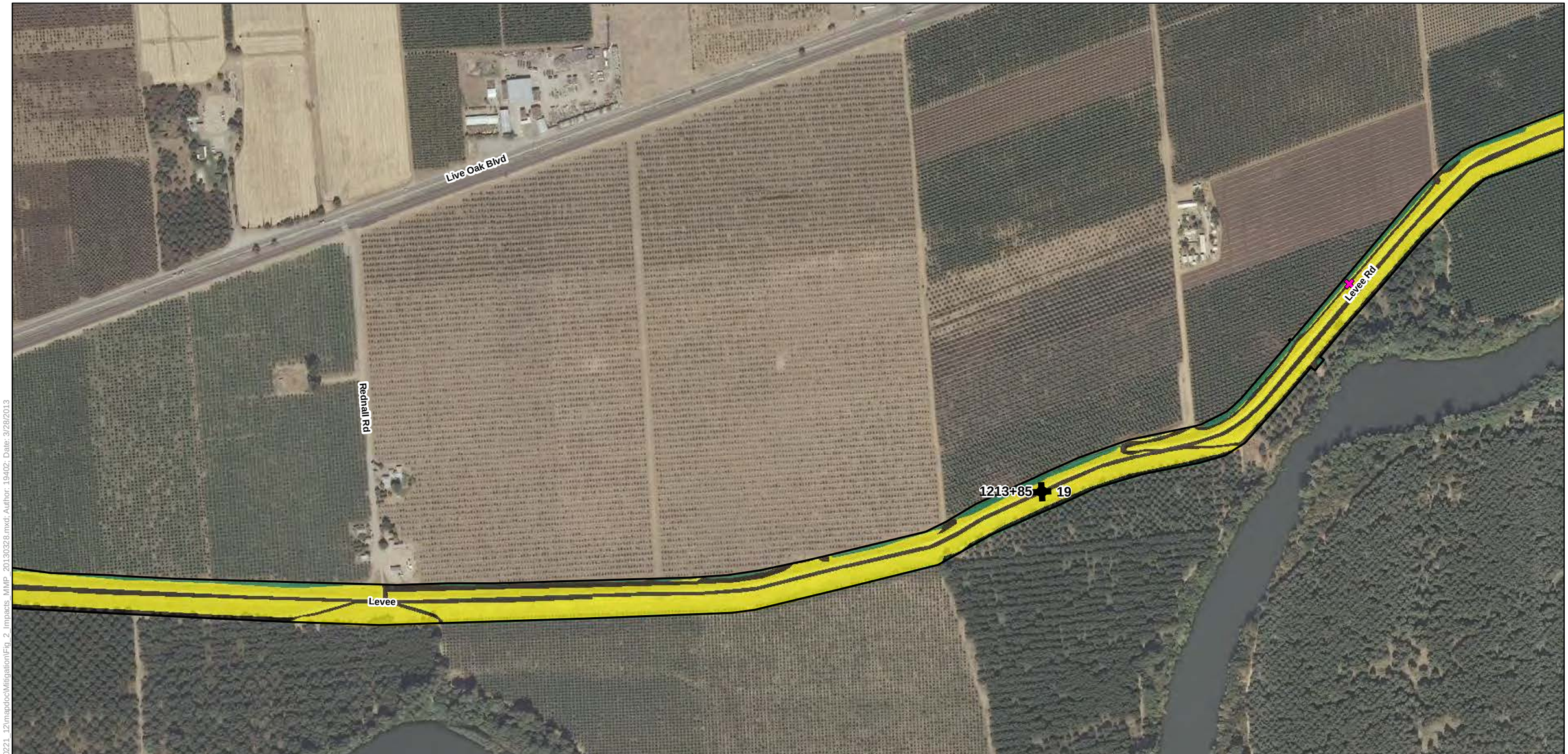

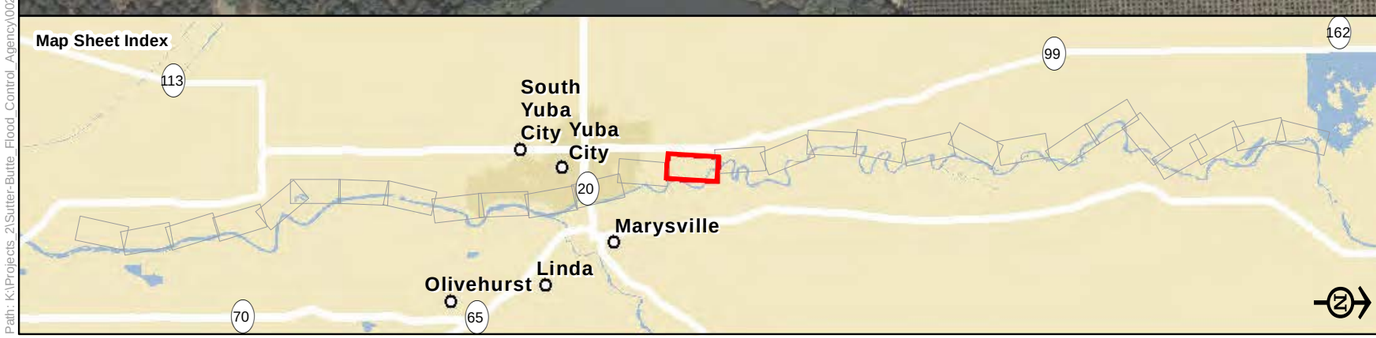

Legend

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- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-14
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

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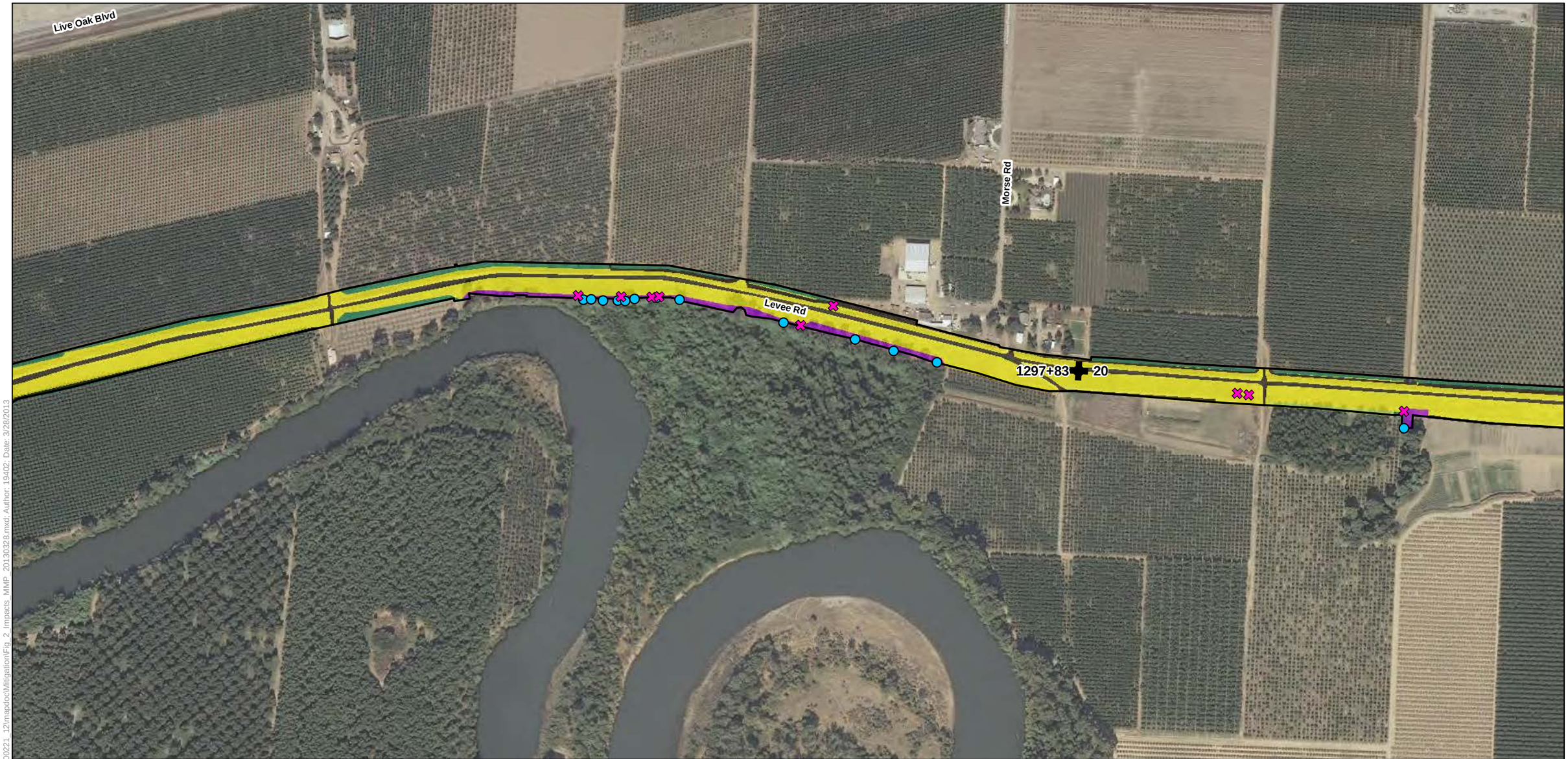
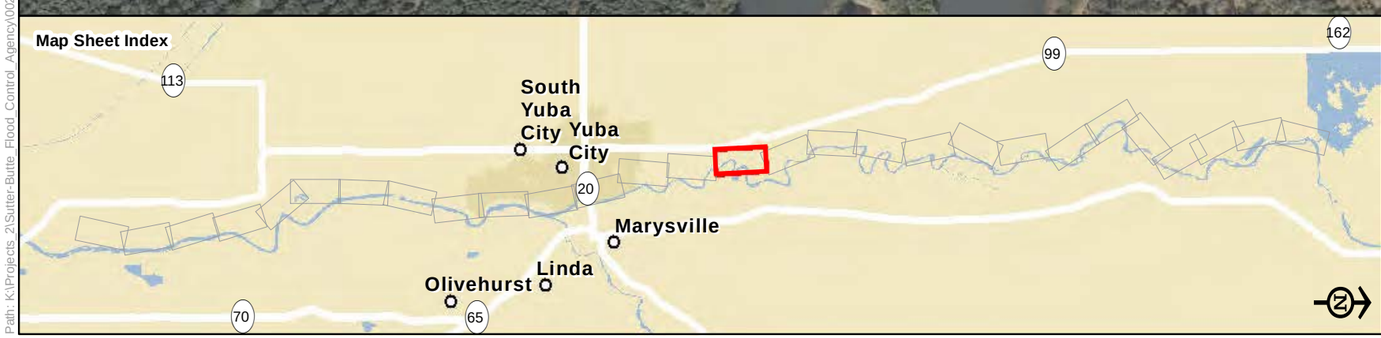




Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

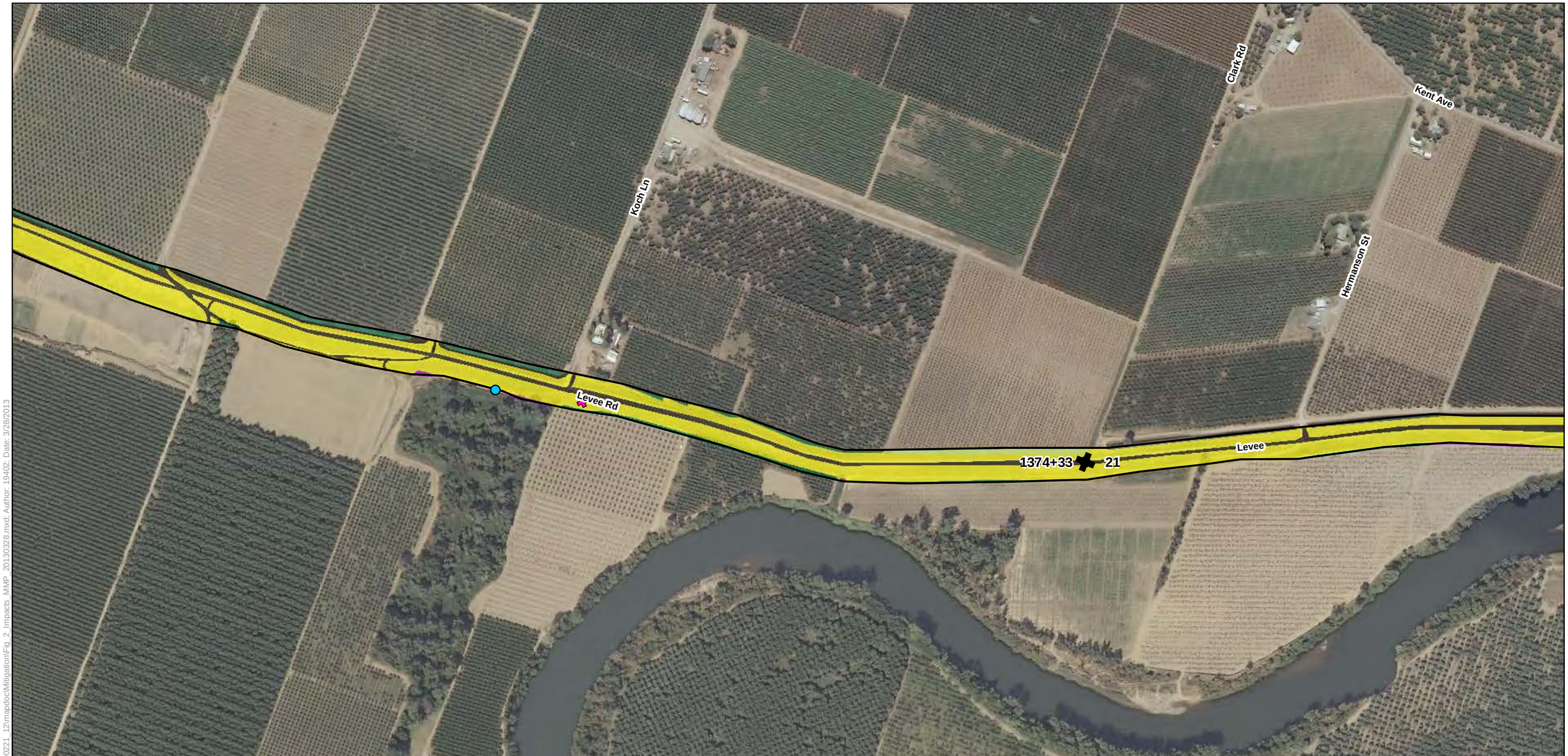
Land Cover Types

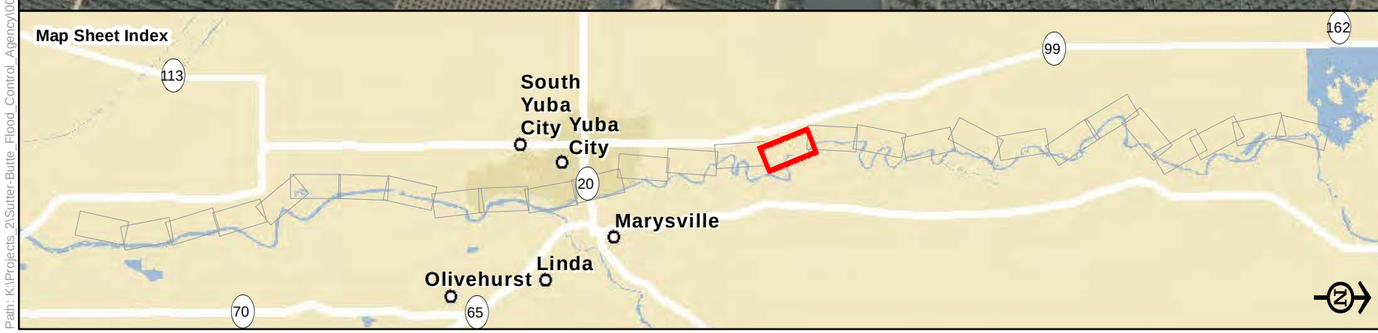
- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-15
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

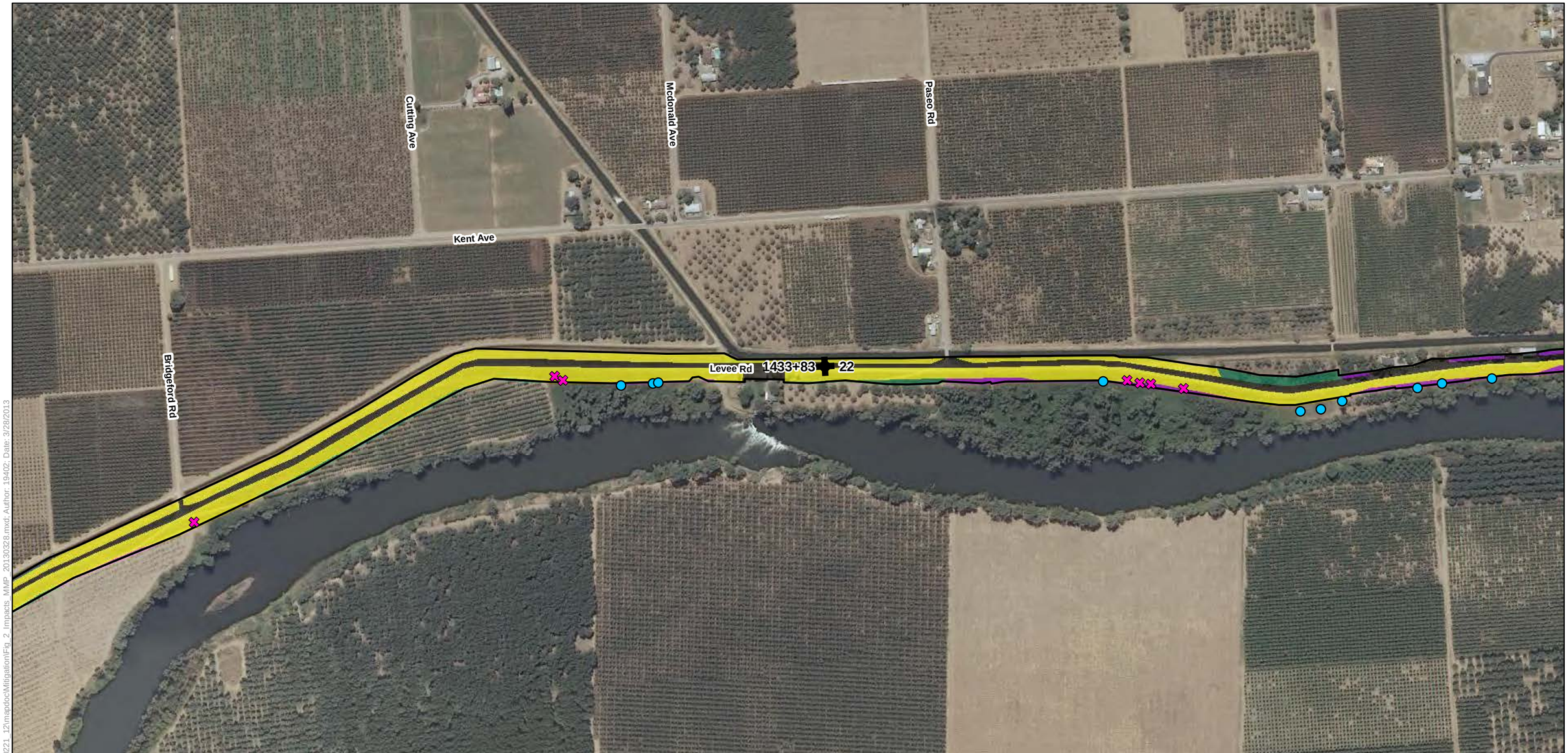
Land Cover Types

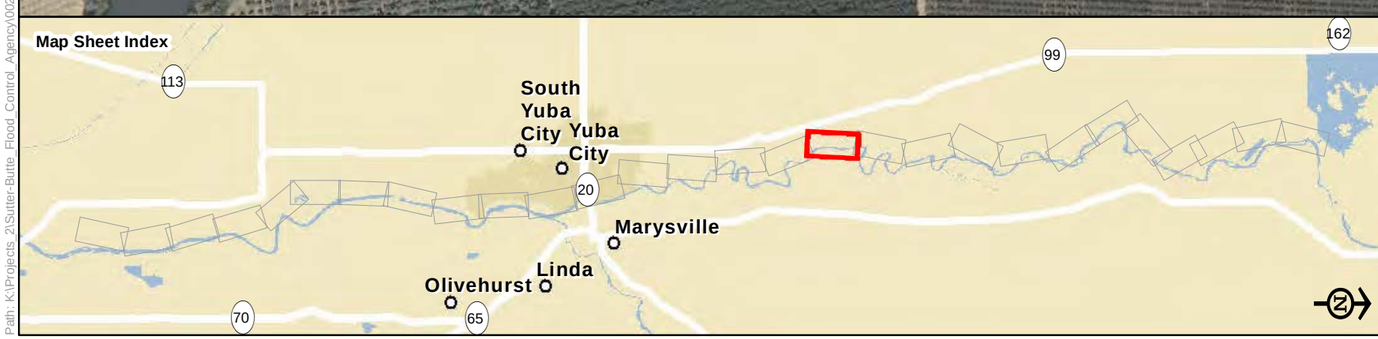
- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-16
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

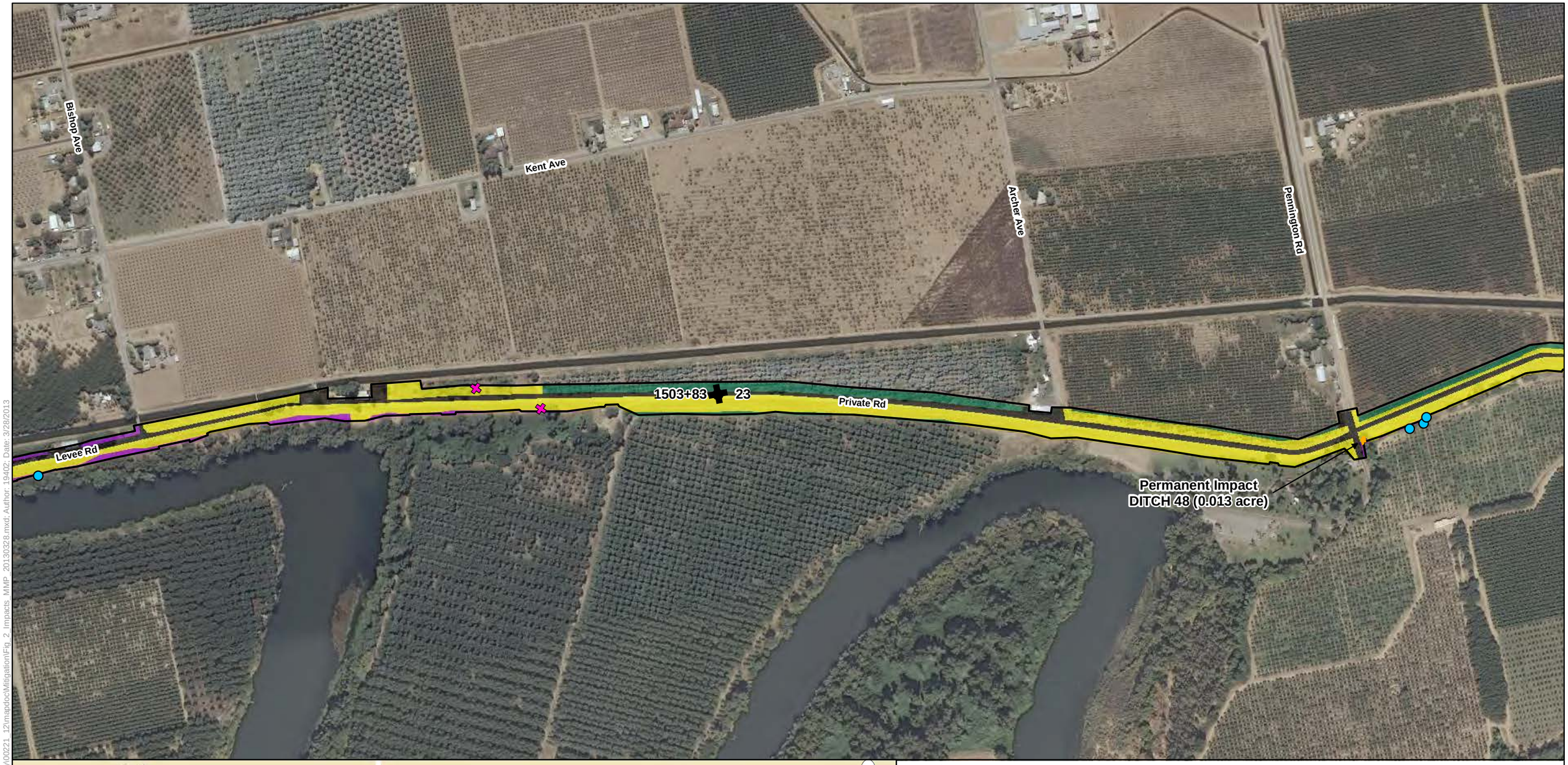
Land Cover Types

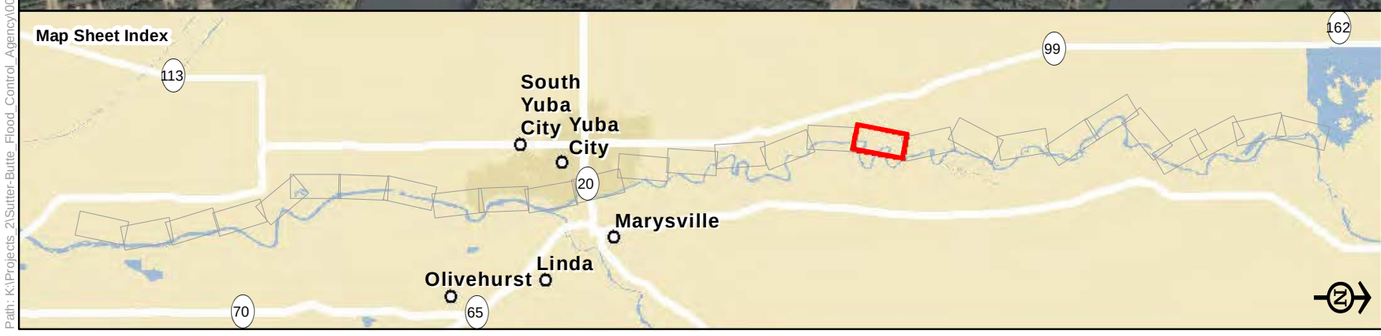
- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-17
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-18
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013

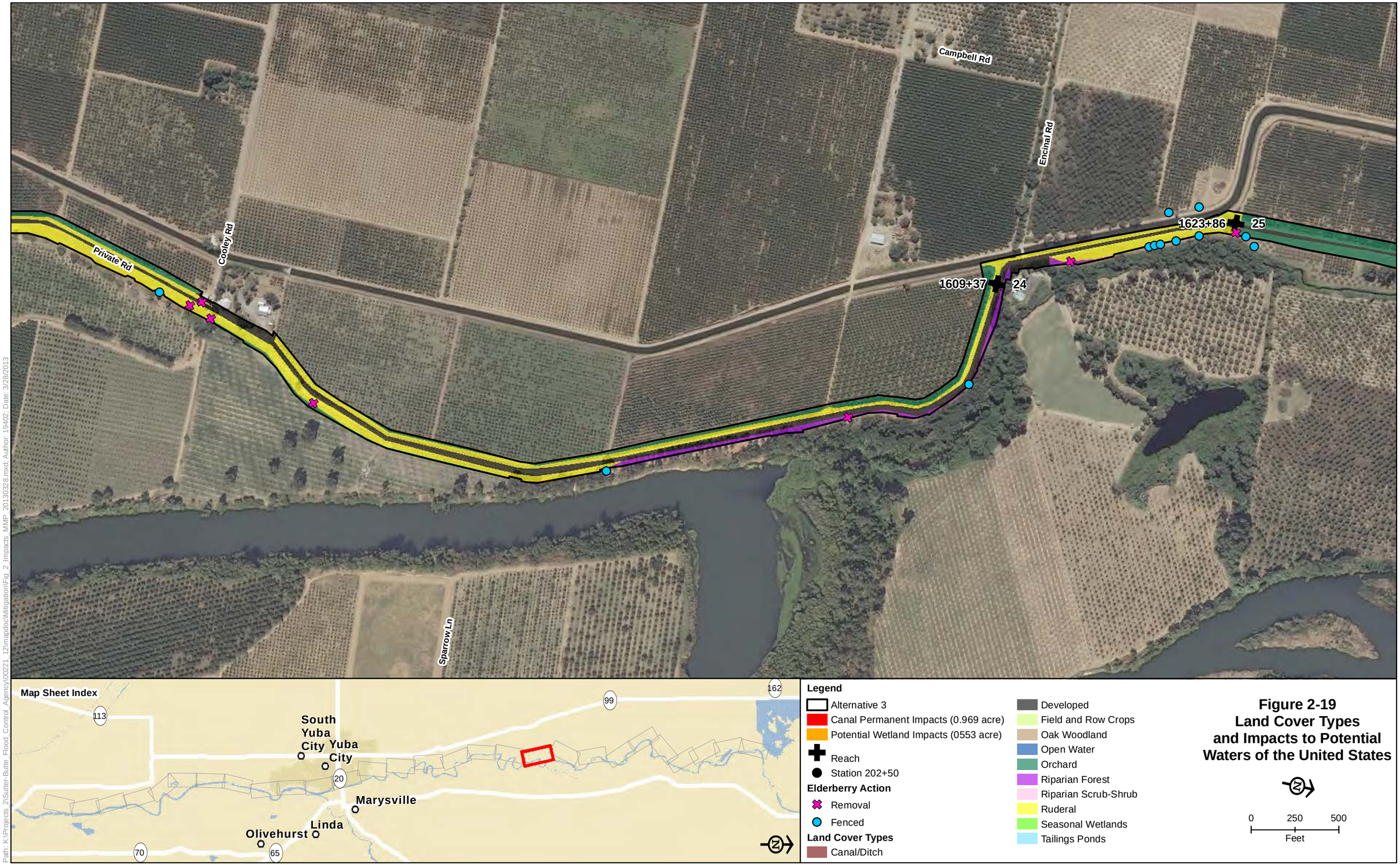
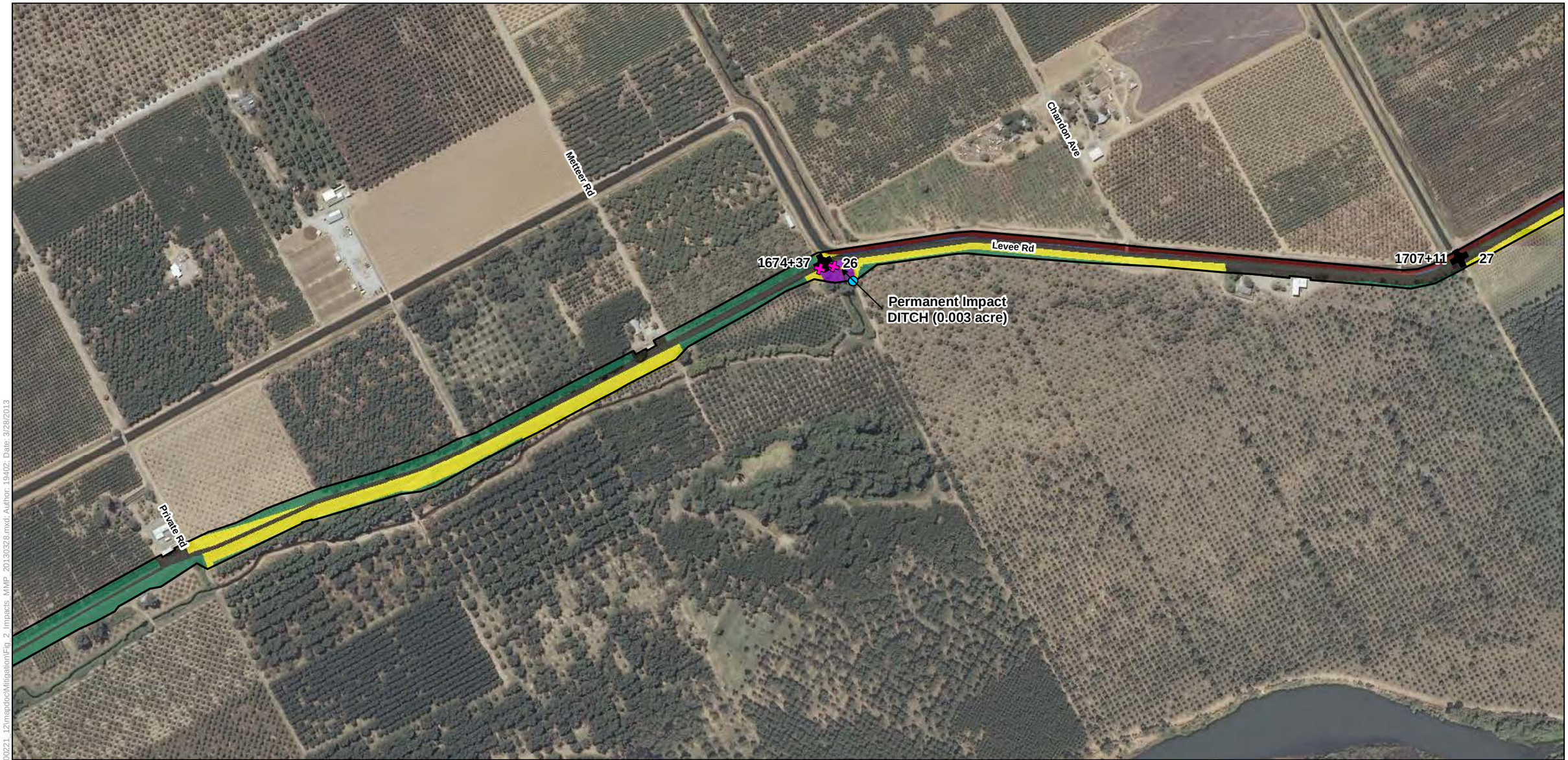
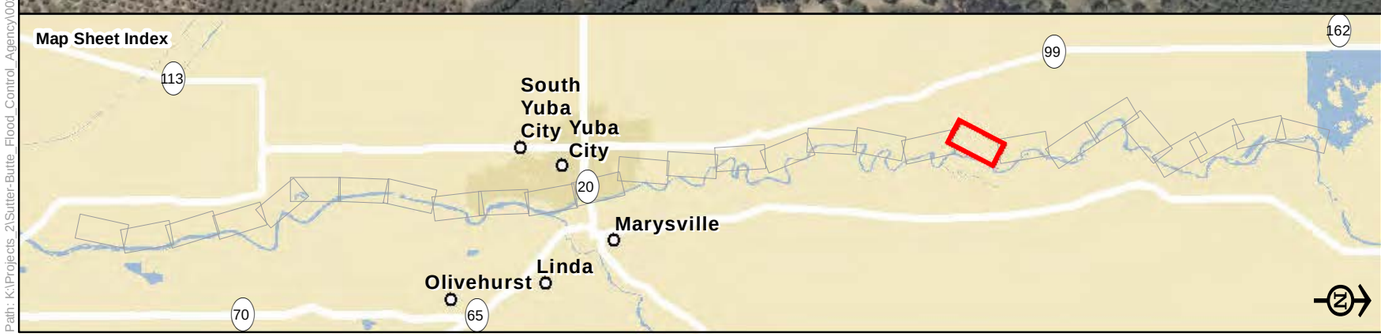


Figure 2-19
Land Cover Types and Impacts to Potential Waters of the United States

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

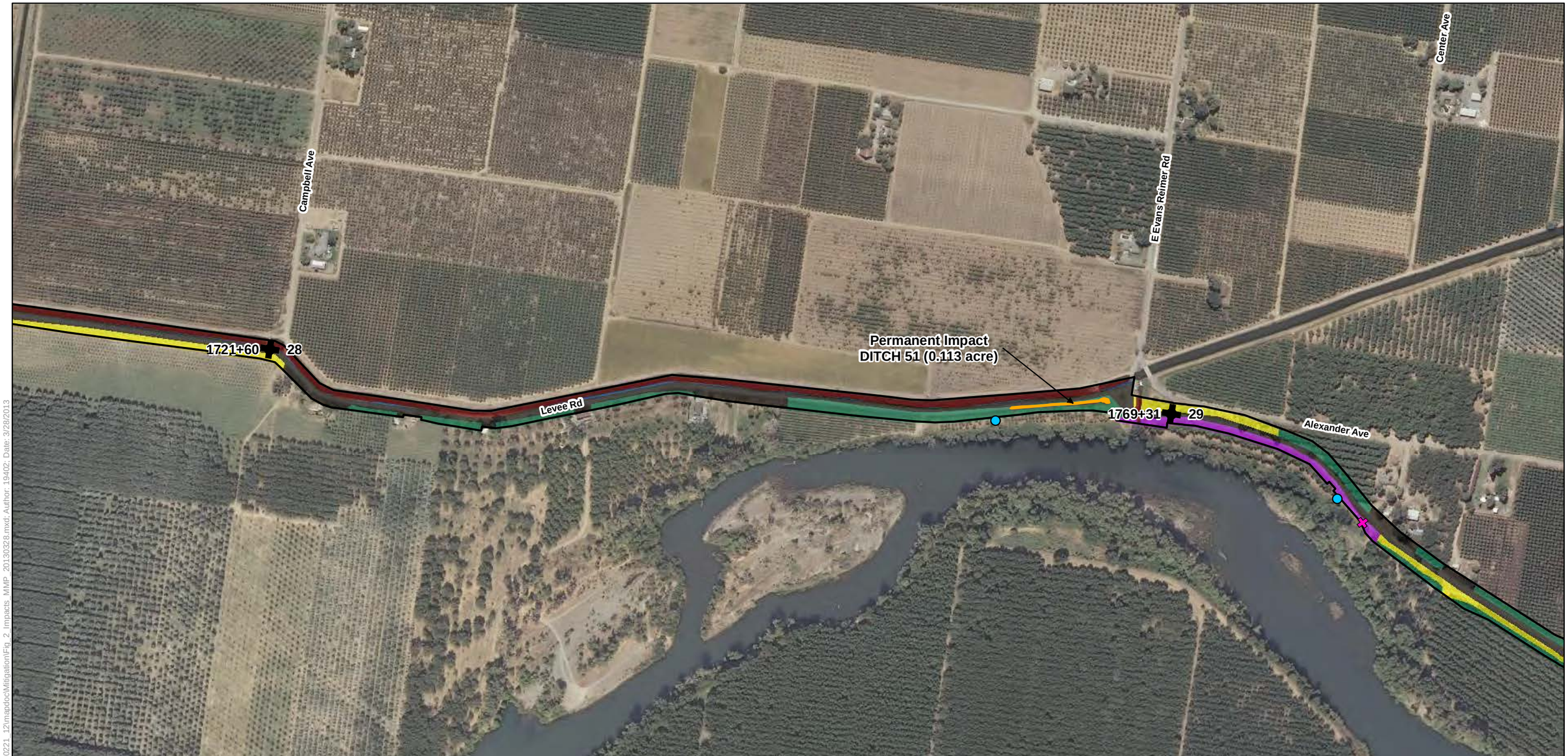
Land Cover Types

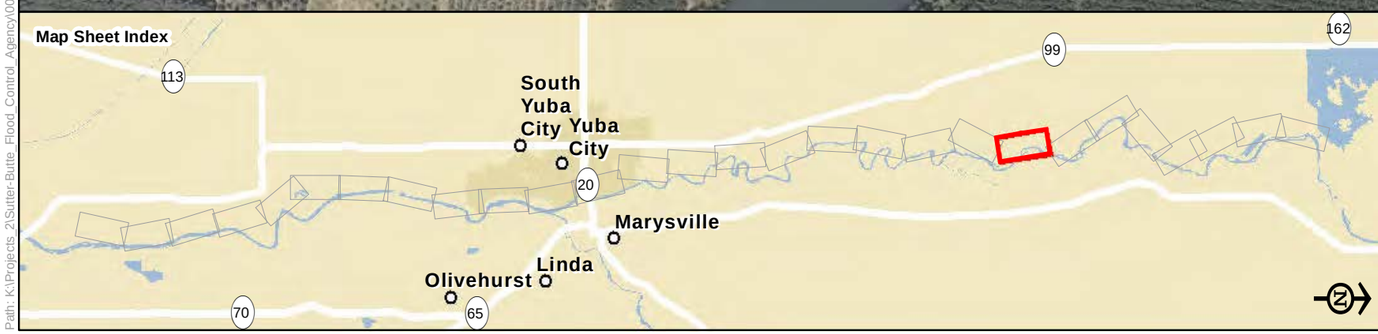
- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-20
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

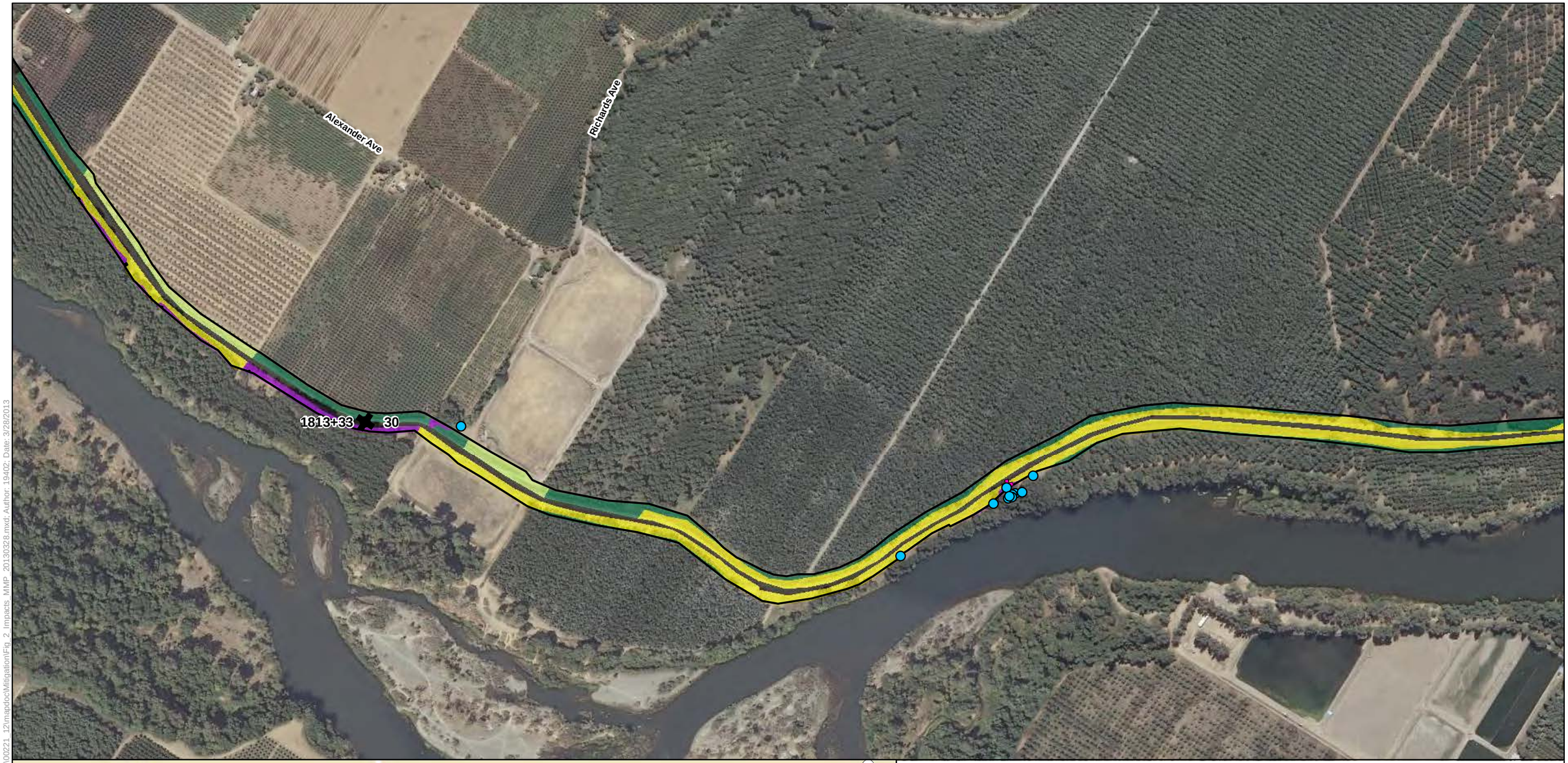
Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-21
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

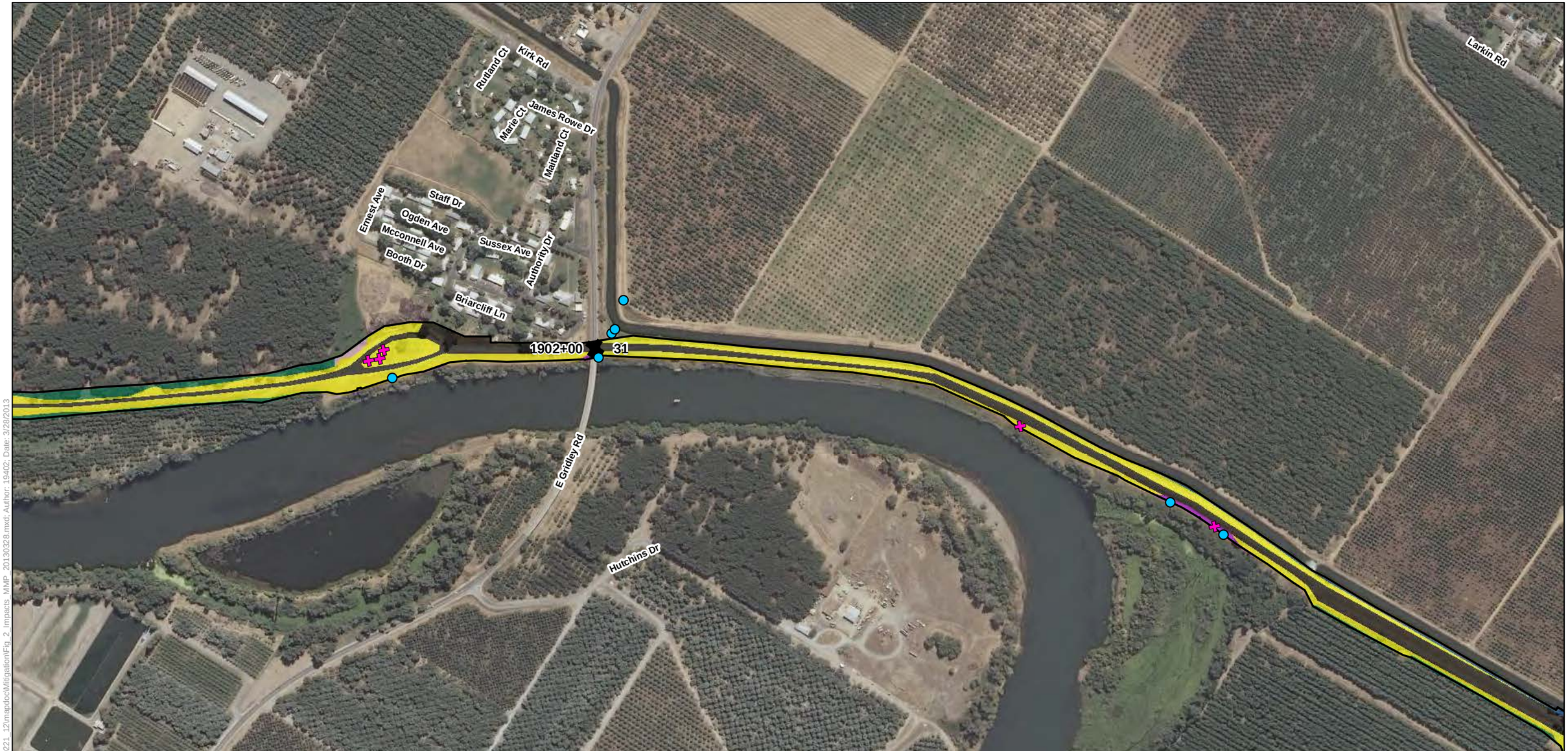
Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-22
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

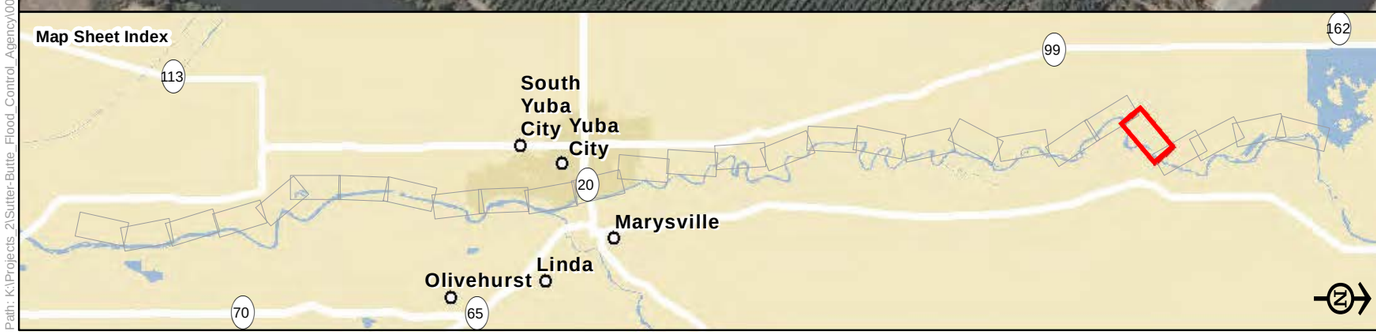
Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-23
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

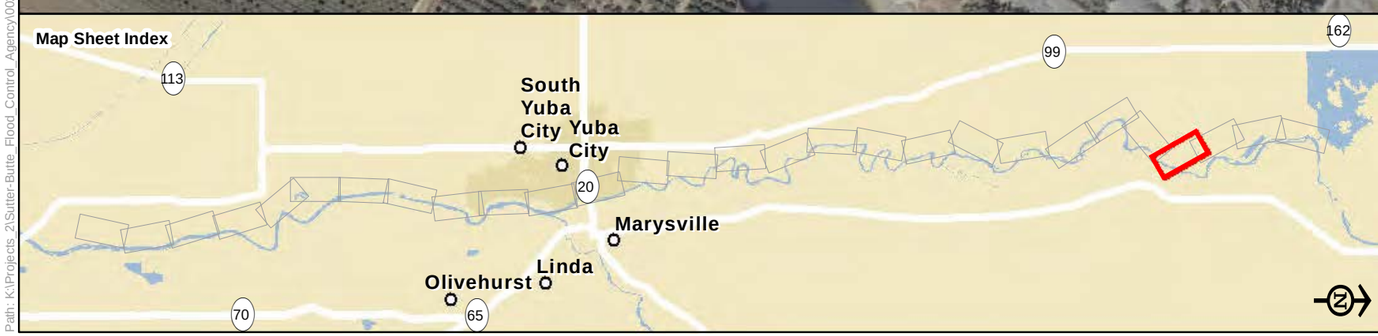
Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-24
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-25
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013

Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

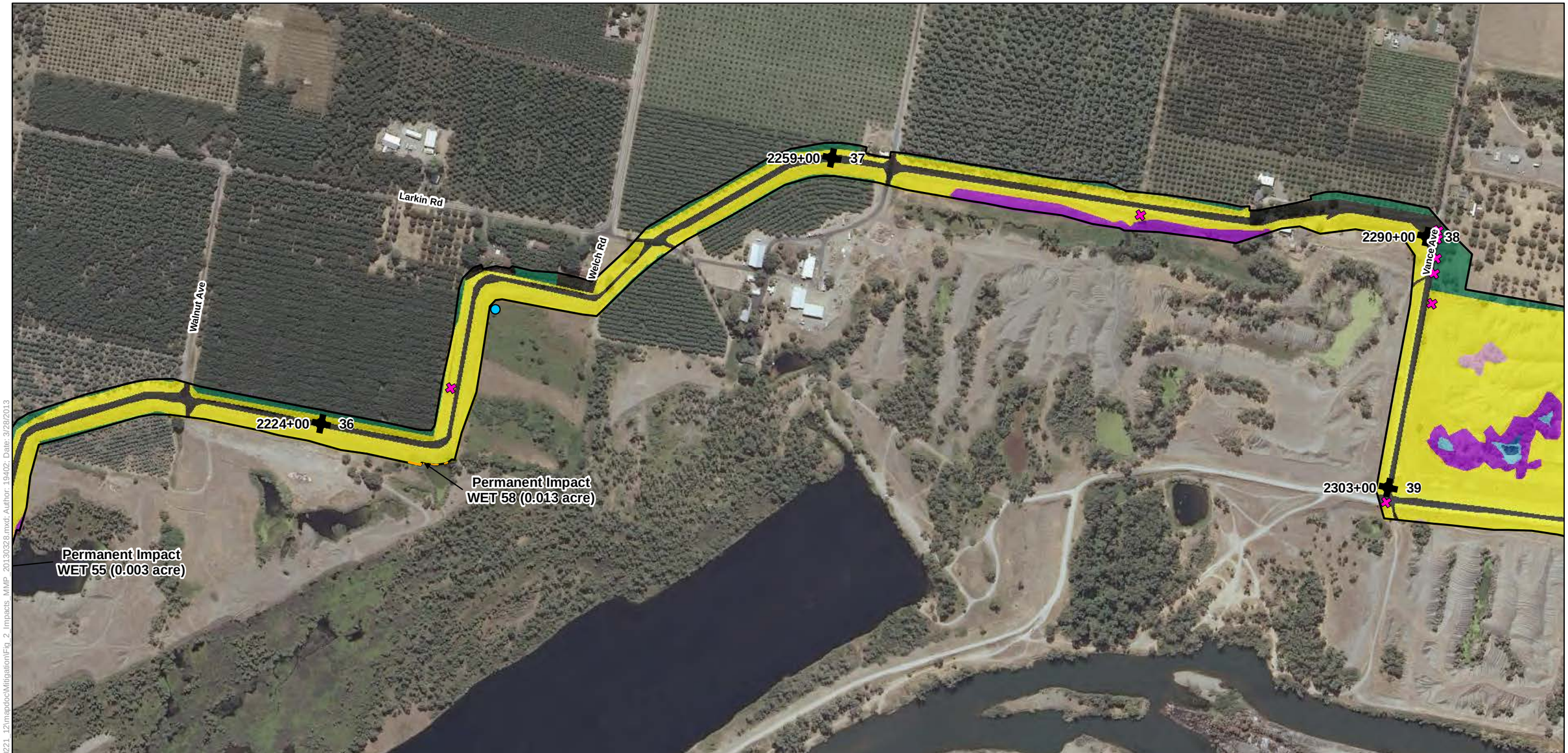
Land Cover Types

- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-26
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

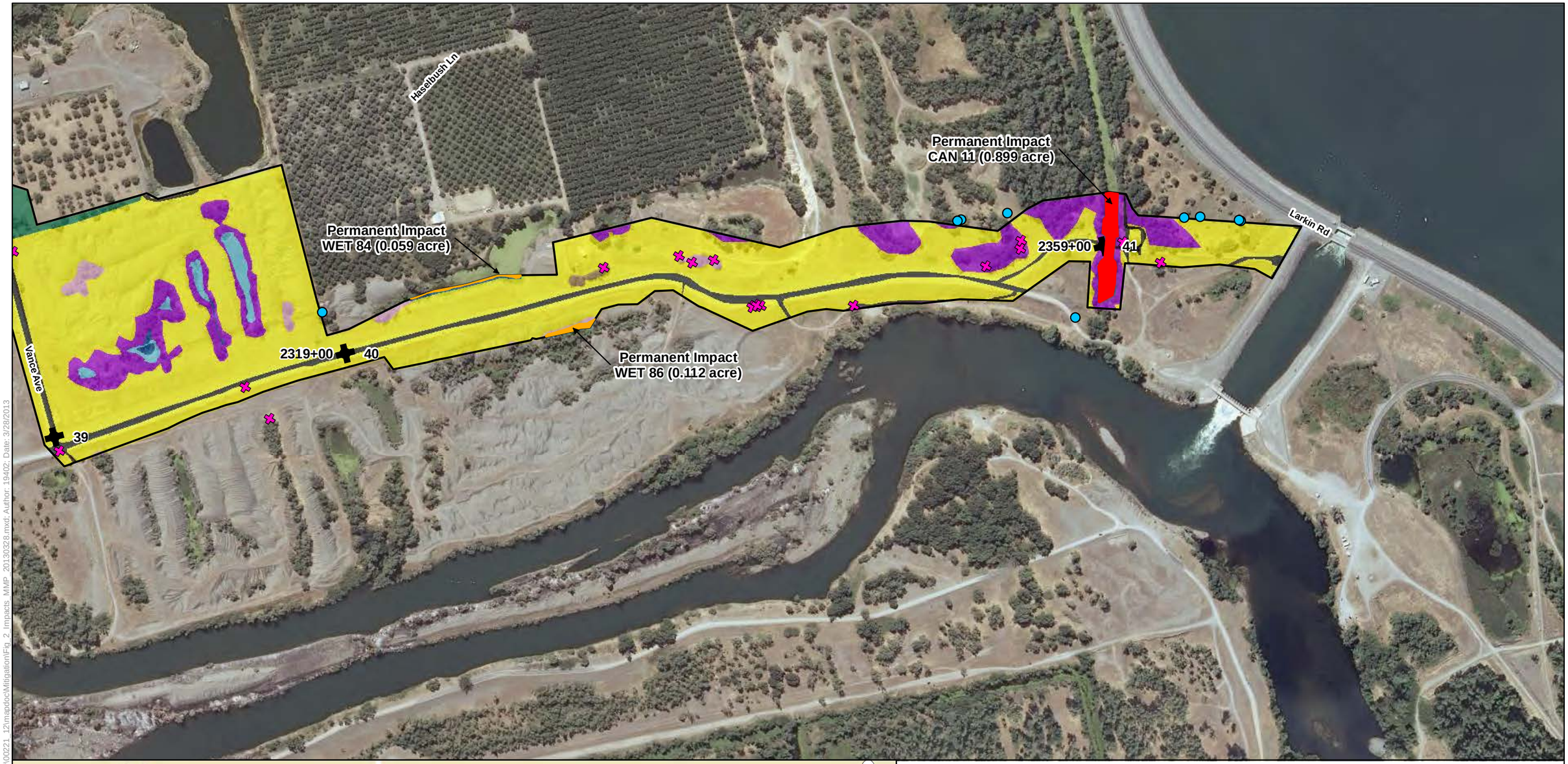
Land Cover Types

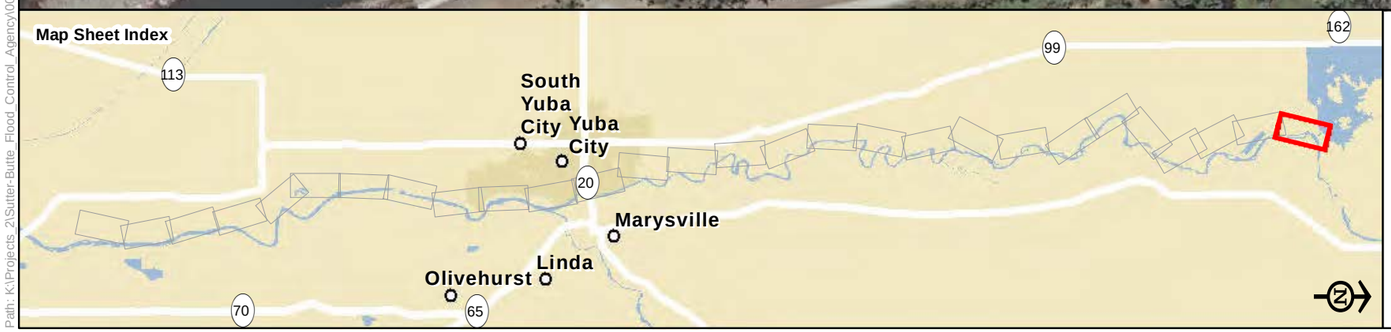
- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-27
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Alternative 3
- Canal Permanent Impacts (0.969 acre)
- Potential Wetland Impacts (0553 acre)
- Reach
- Station 202+50

Elderberry Action

- Removal
- Fenced

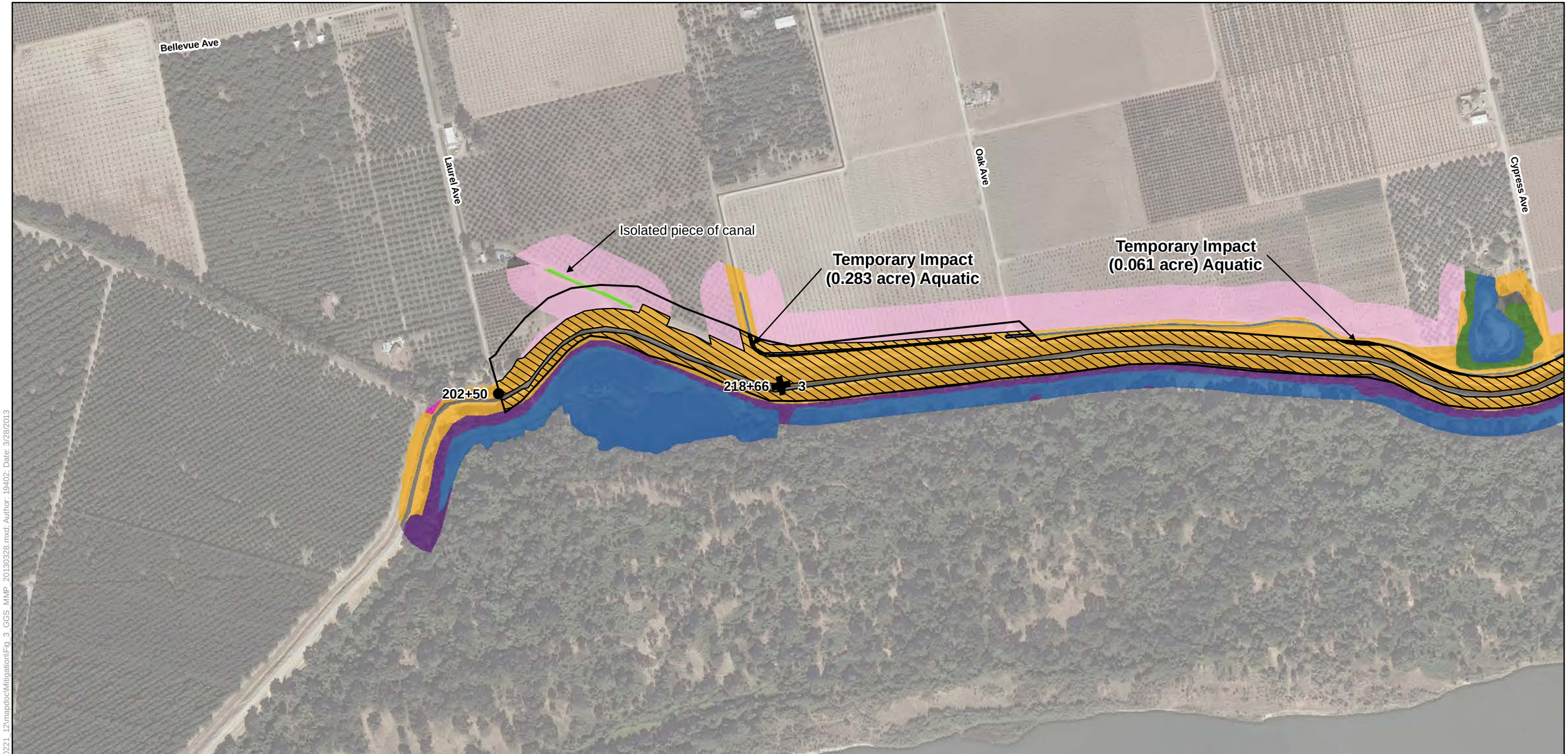
Land Cover Types

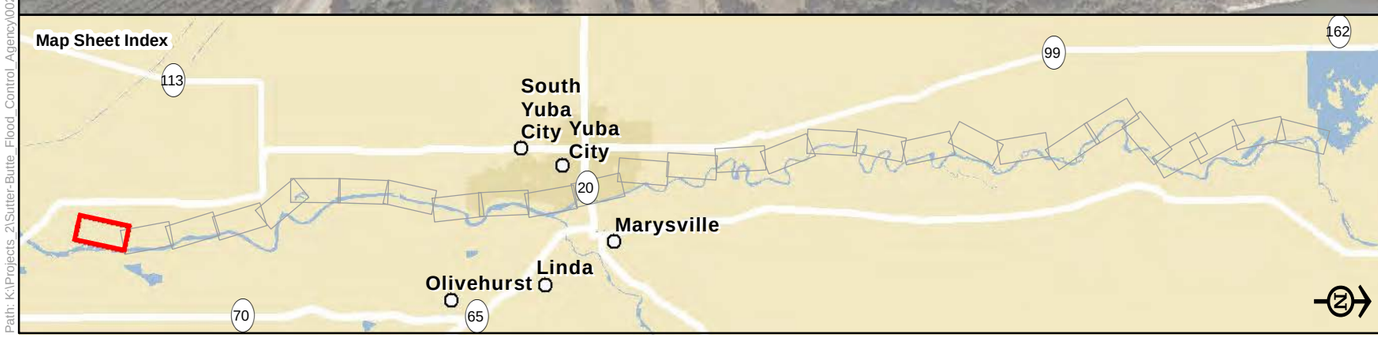
- Canal/Ditch
- Developed
- Field and Row Crops
- Oak Woodland
- Open Water
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Ruderal
- Seasonal Wetlands
- Tailings Ponds

Figure 2-28
Land Cover Types and Impacts to Potential Waters of the United States

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_2_Impacts_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

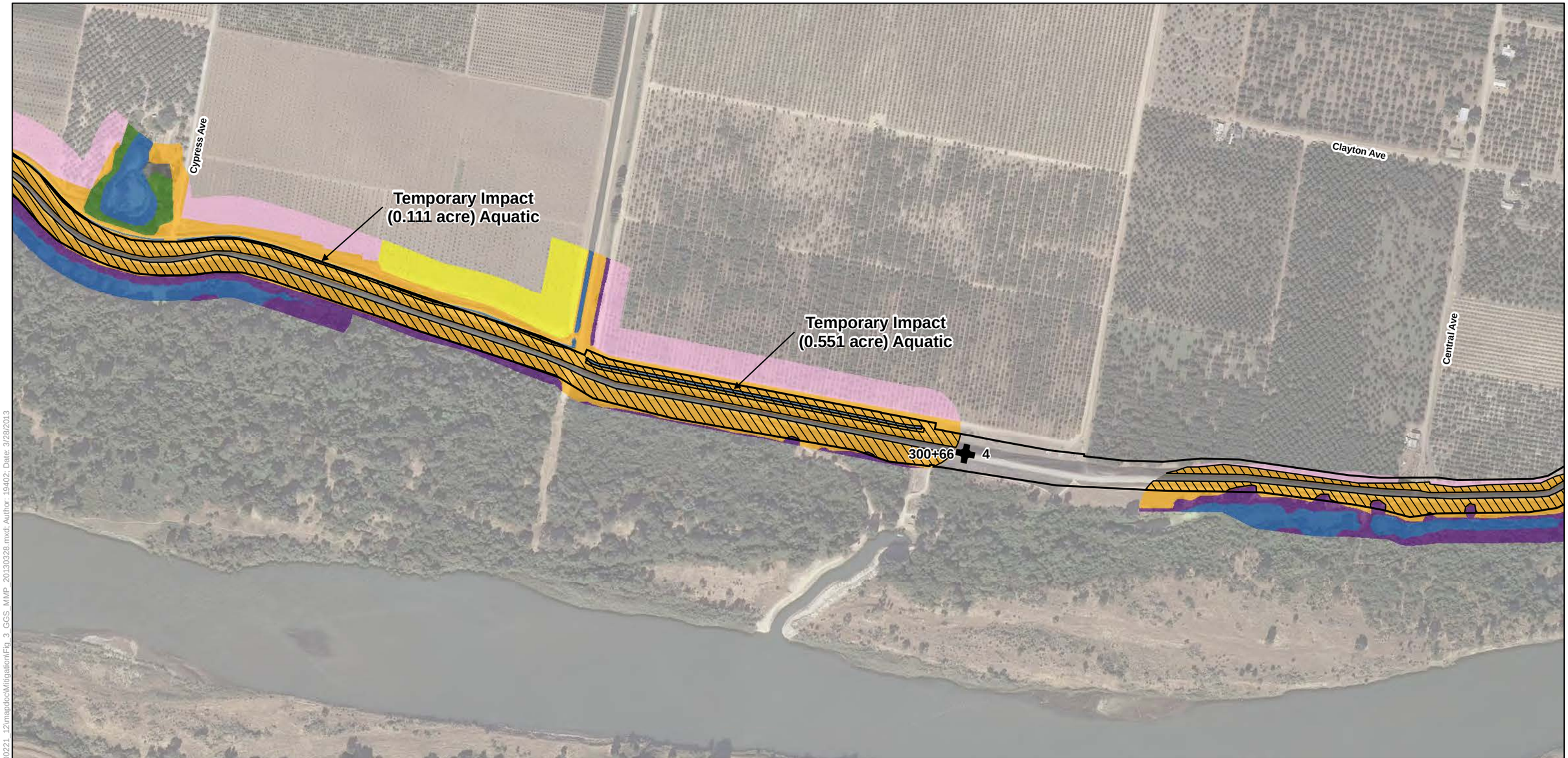
Suitable
- Ruderal Grassland

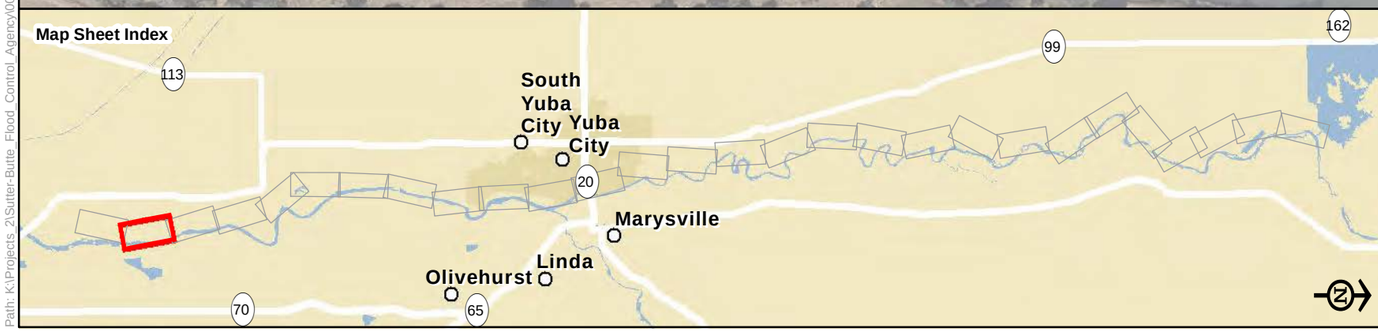
Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-1
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

0 250 500
Feet

Figure 3-2
Effects on Giant Garter Snake Habitat In the Levee Construction Area

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013

Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

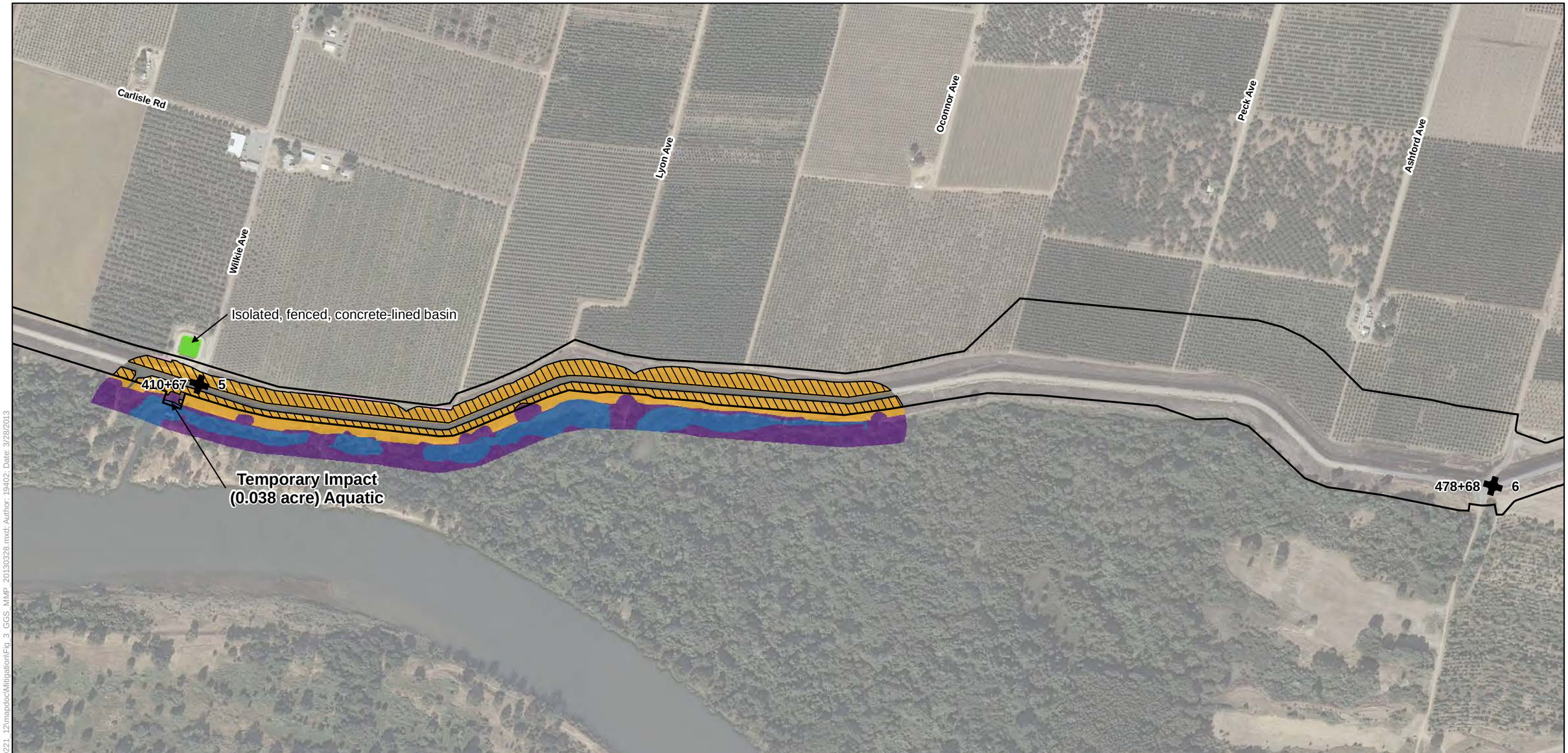
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-3
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

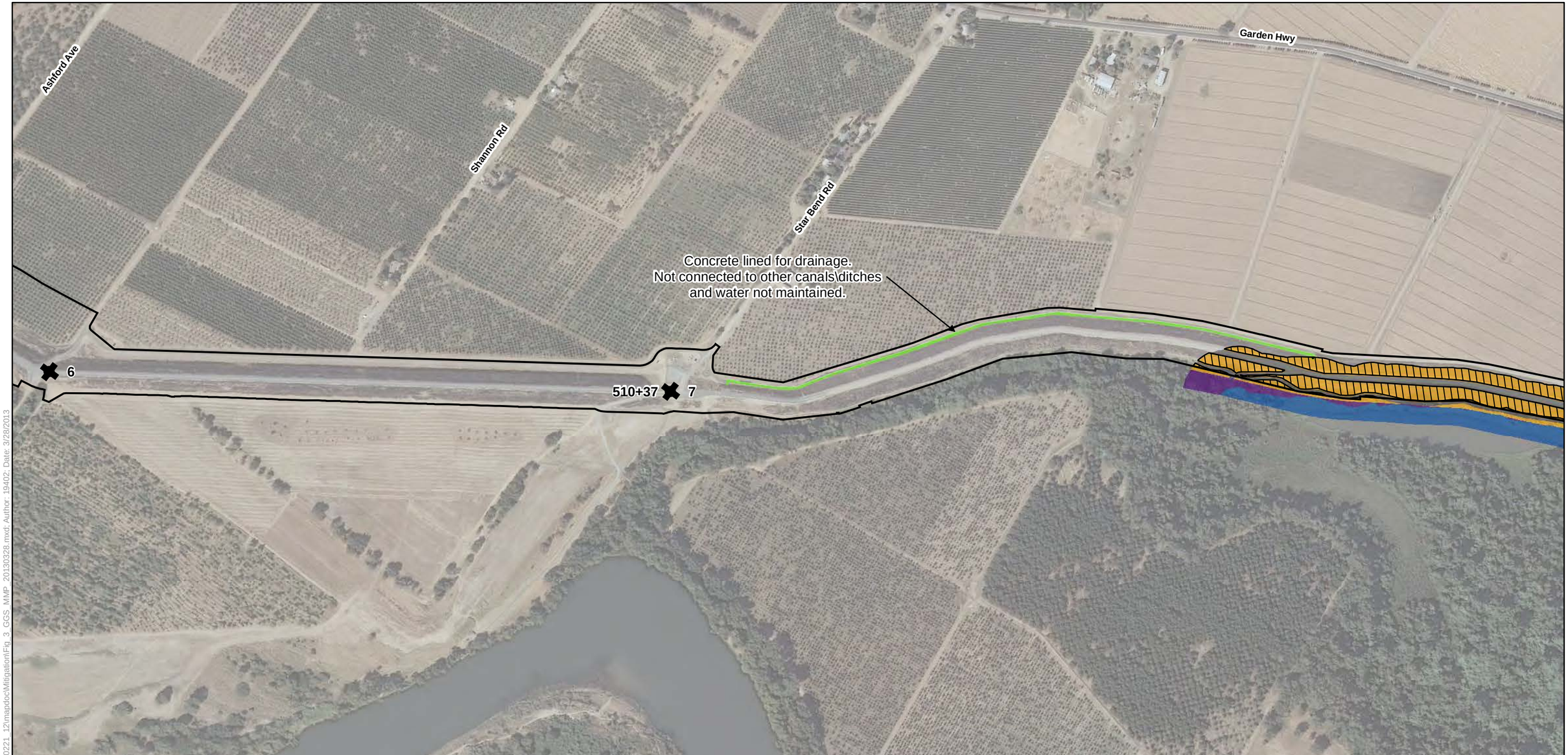
Suitable
- Ruderal Grassland

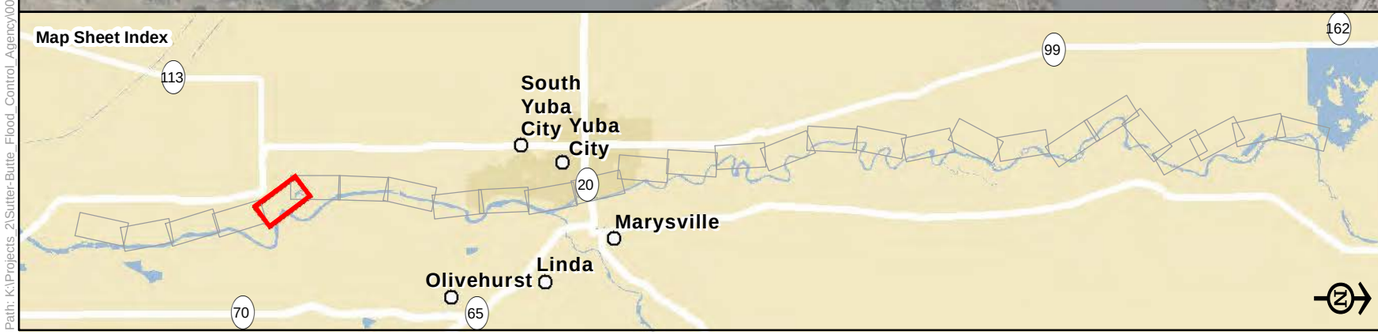
Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-4
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

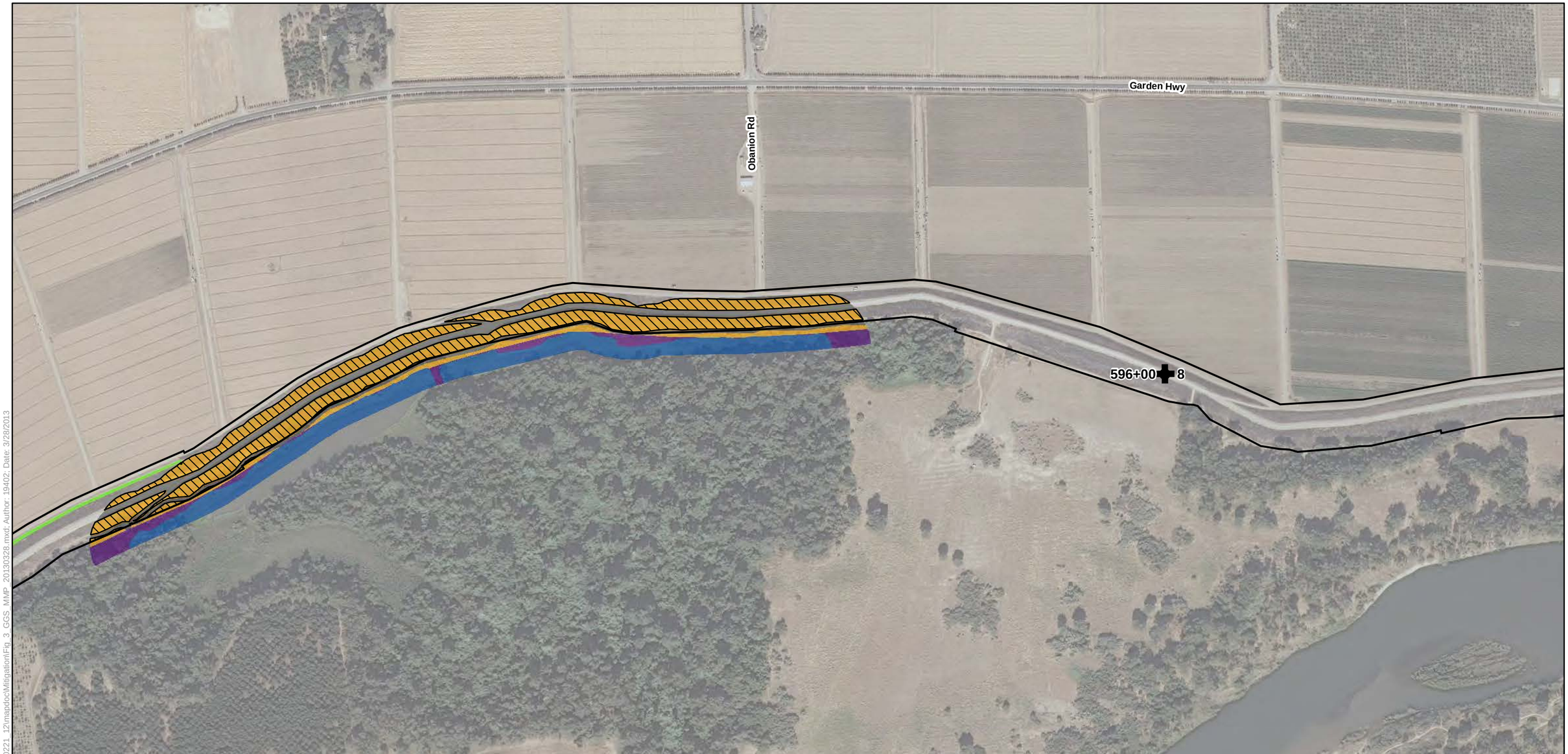
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

0 250 500
Feet

Figure 3-5
Effects on Giant Garter Snake Habitat In the Levee Construction Area

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

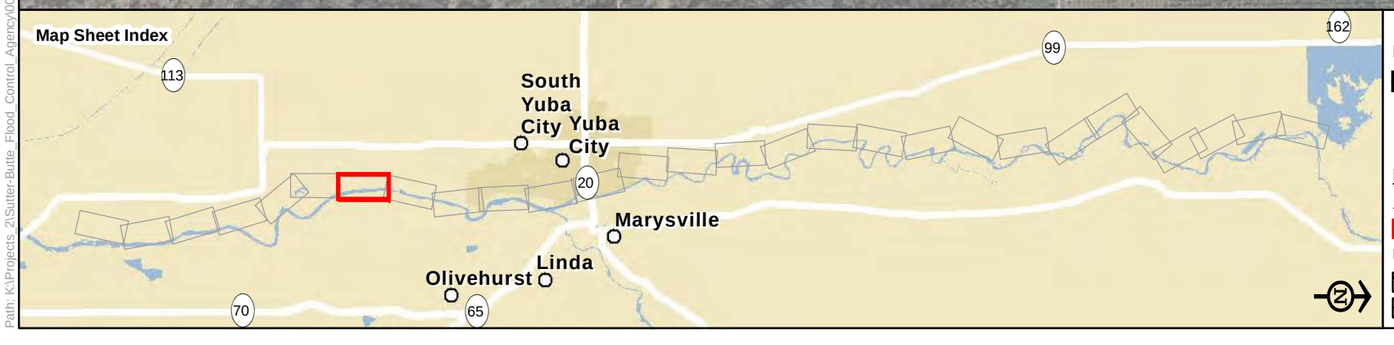
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-6
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

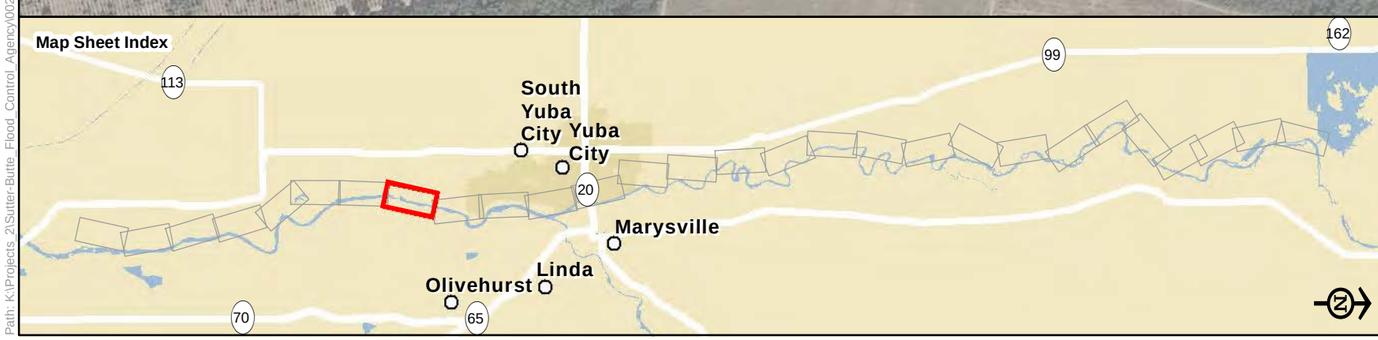
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-7
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

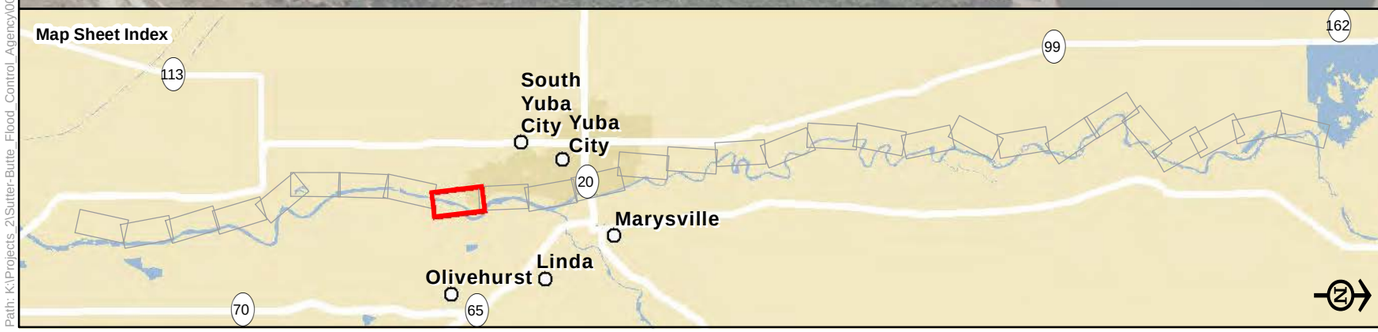
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-8
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

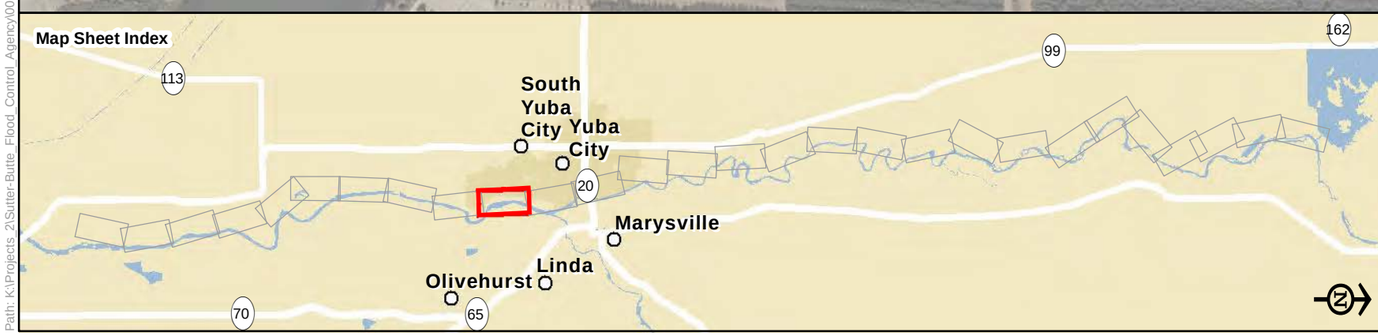
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-9
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

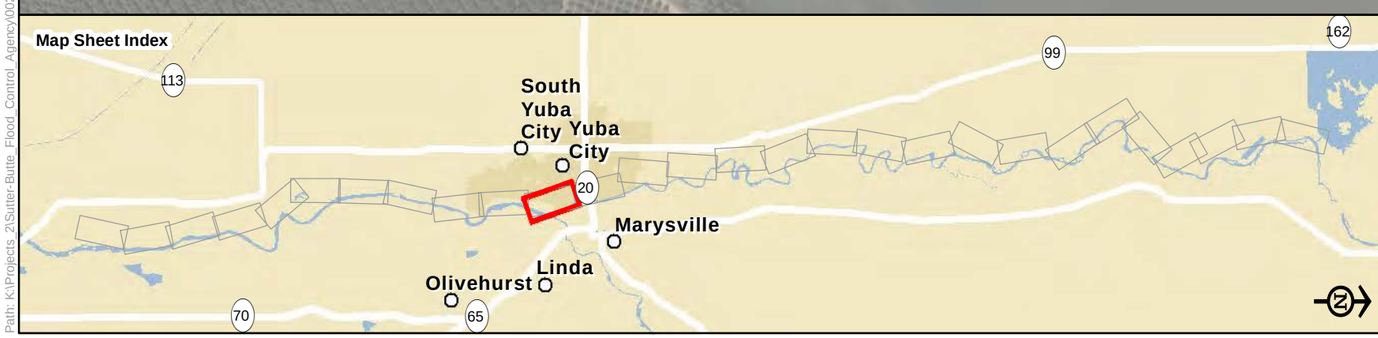
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-10
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

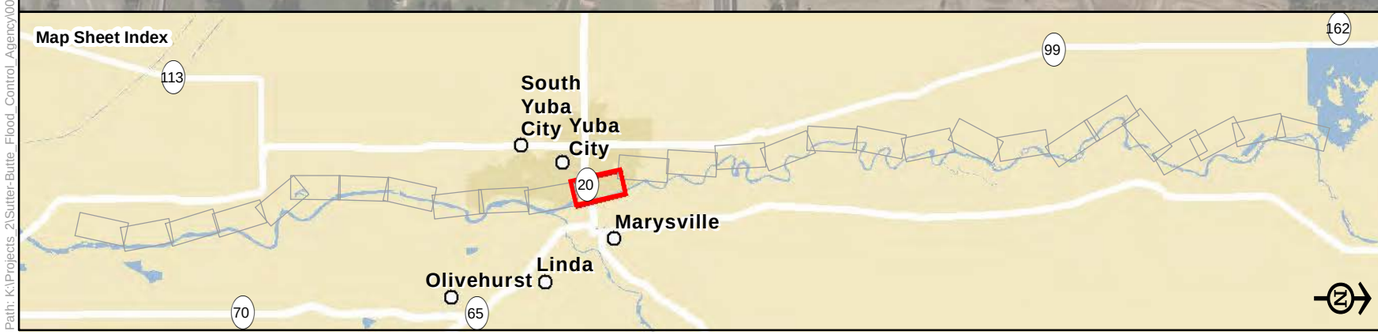
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-11
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

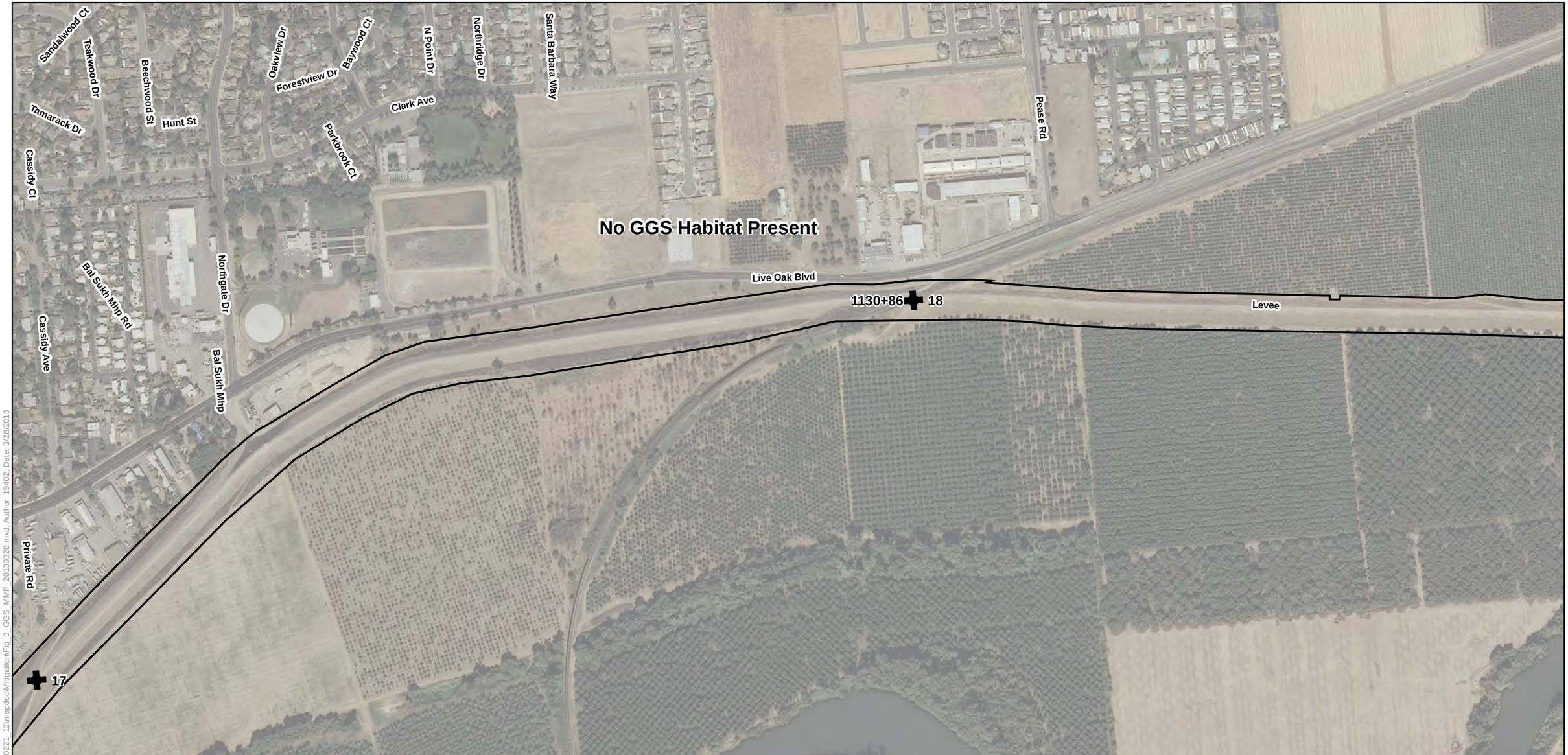
Suitable
- Ruderal Grassland

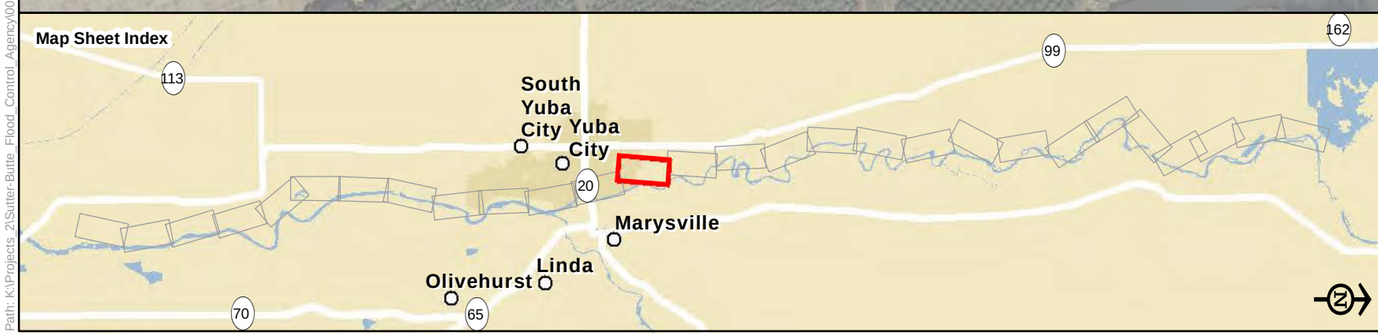
Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-12
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Miligation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

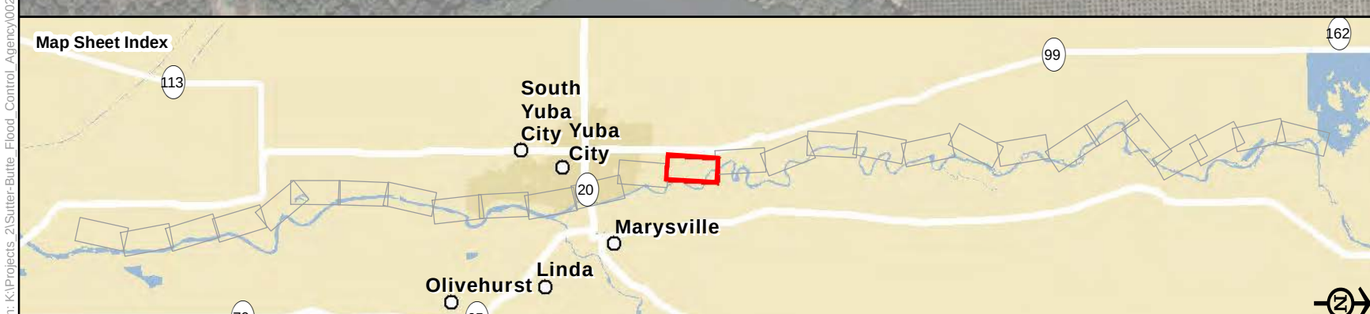
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-13
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

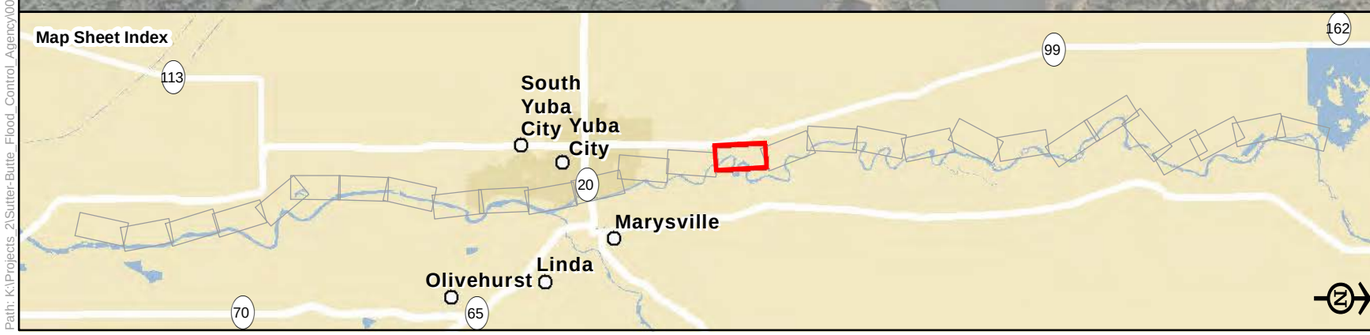
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-14
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

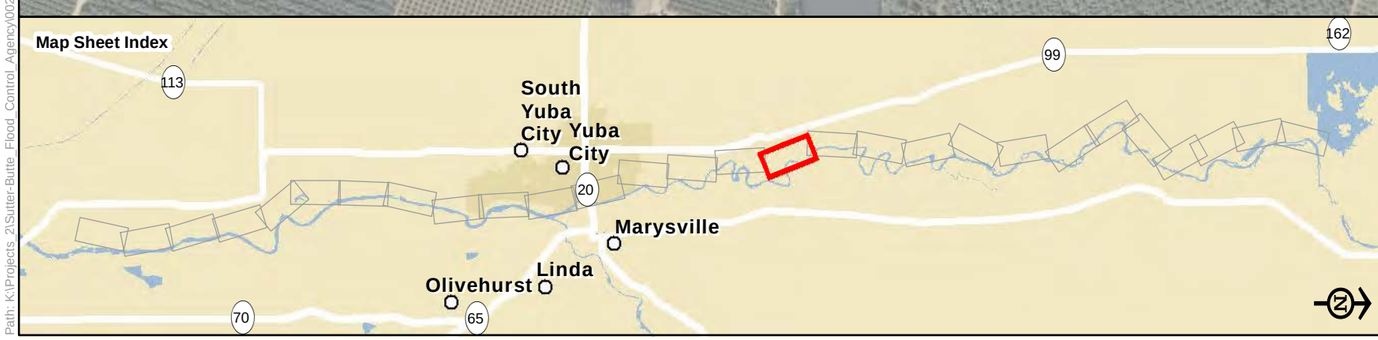
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-15
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-16
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013

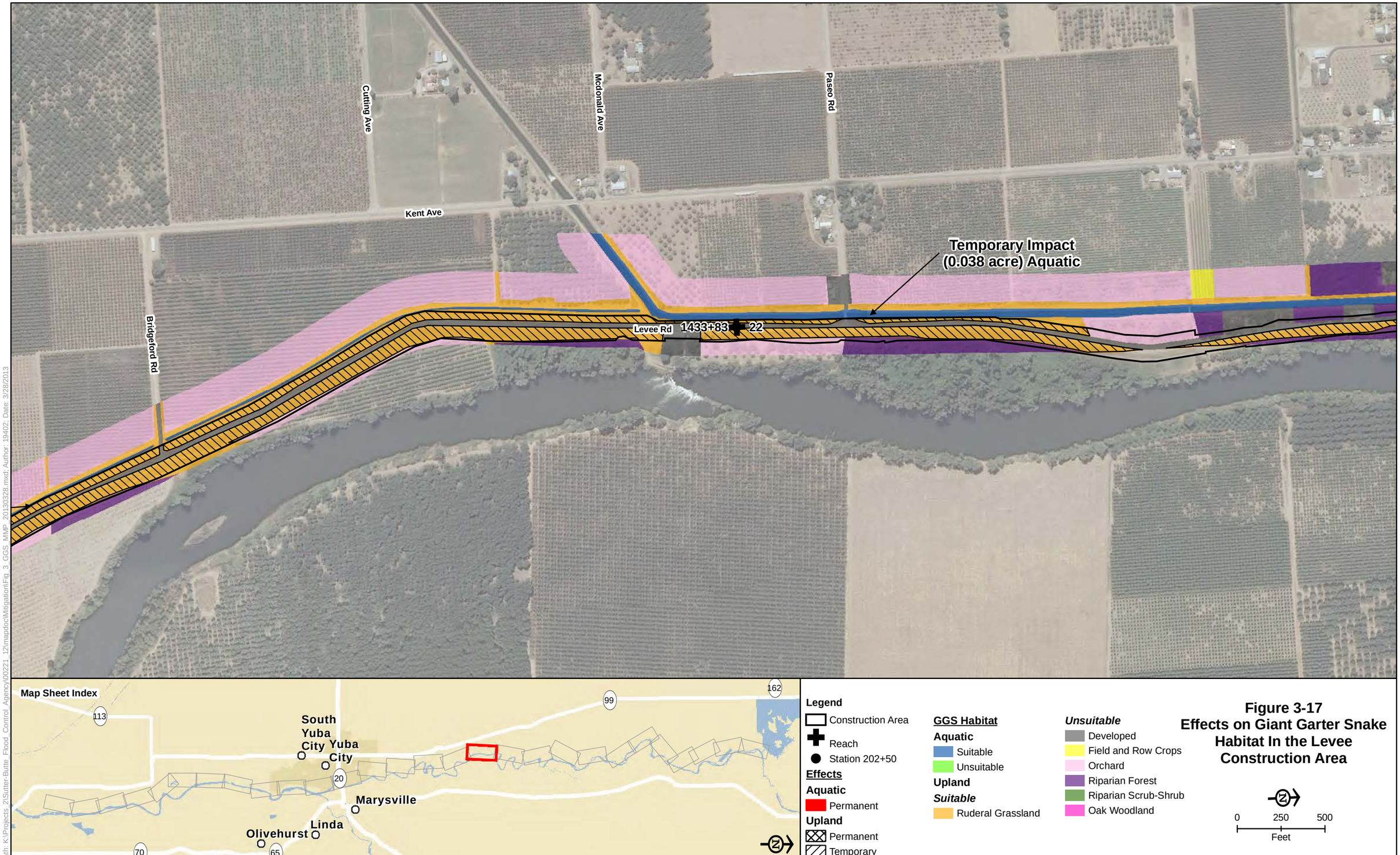
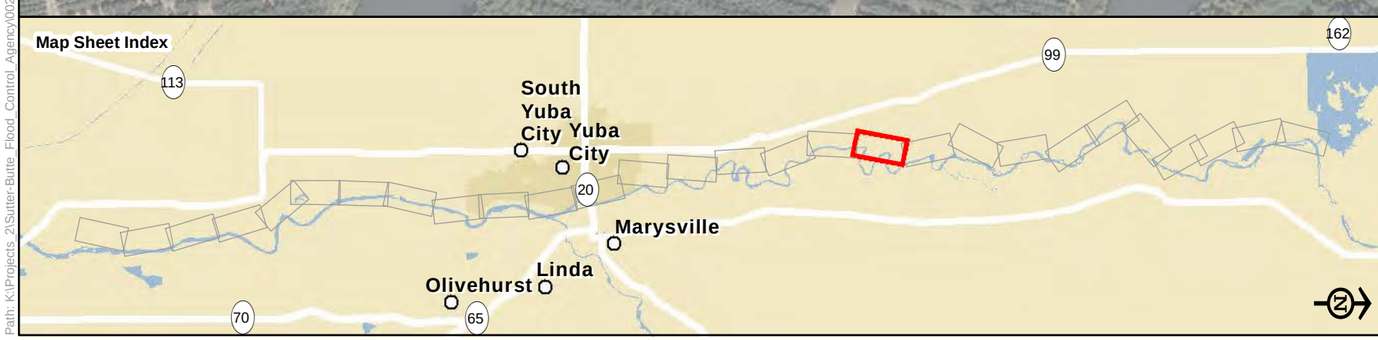


Figure 3-17
Effects on Giant Garter Snake Habitat In the Levee Construction Area

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-18
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013

Campbell Rd

Encinal Rd

Temporary Impact
(0.023 acre) Aquatic

1623+86

25

1609+37

24

Cooley Rd

Private Rd

Sparrow Ln

Map Sheet Index

113

South Yuba City

Yuba City

20

Marysville

Linda

Olivehurst

70

65

99

162

Legend

Construction Area

Reach

Station 202+50

Effects

Aquatic

Permanent

Upland

Permanent

Temporary

GGS Habitat

Aquatic

Suitable

Unsuitable

Upland

Suitable

Ruderal Grassland

Unsuitable

Developed

Field and Row Crops

Orchard

Riparian Forest

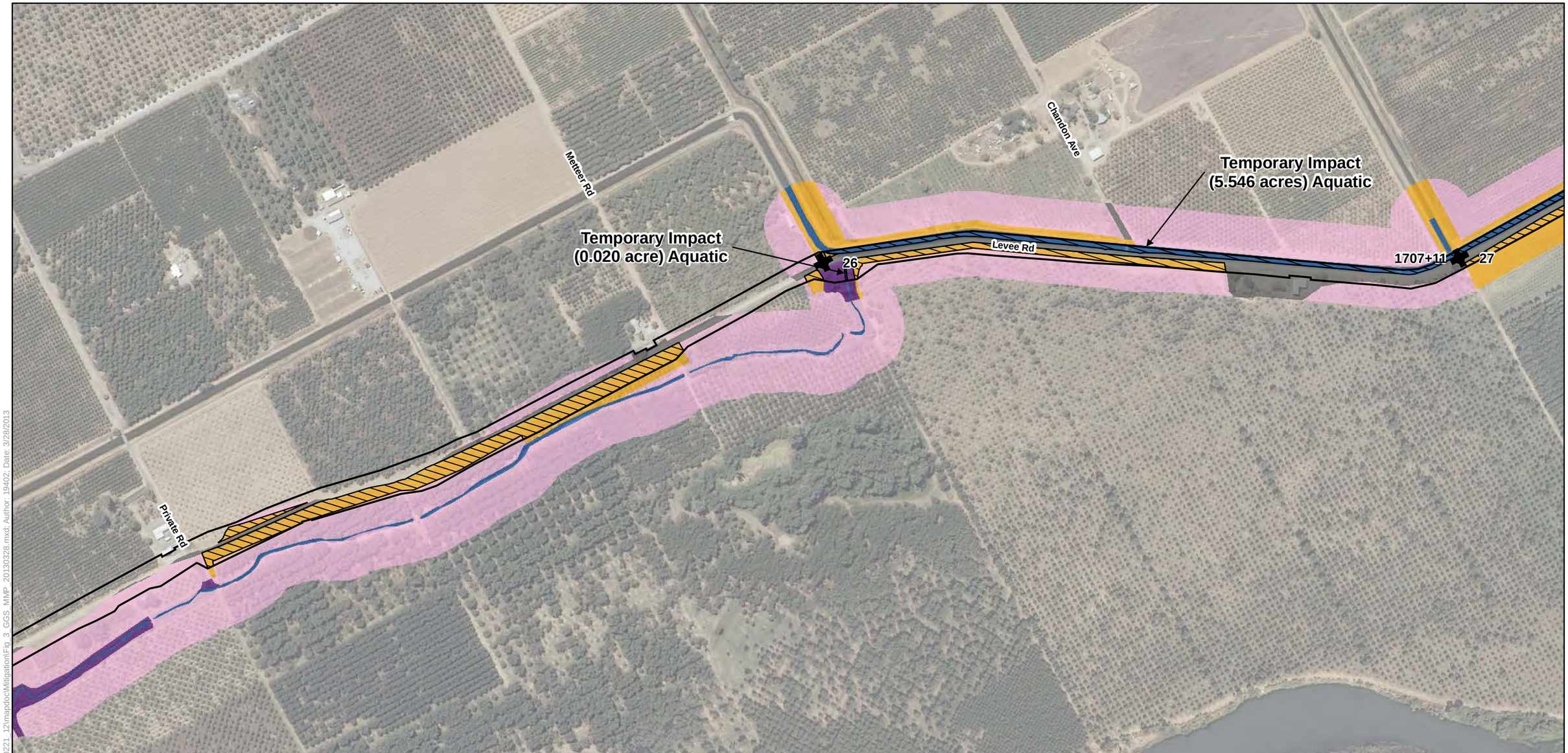
Riparian Scrub-Shrub

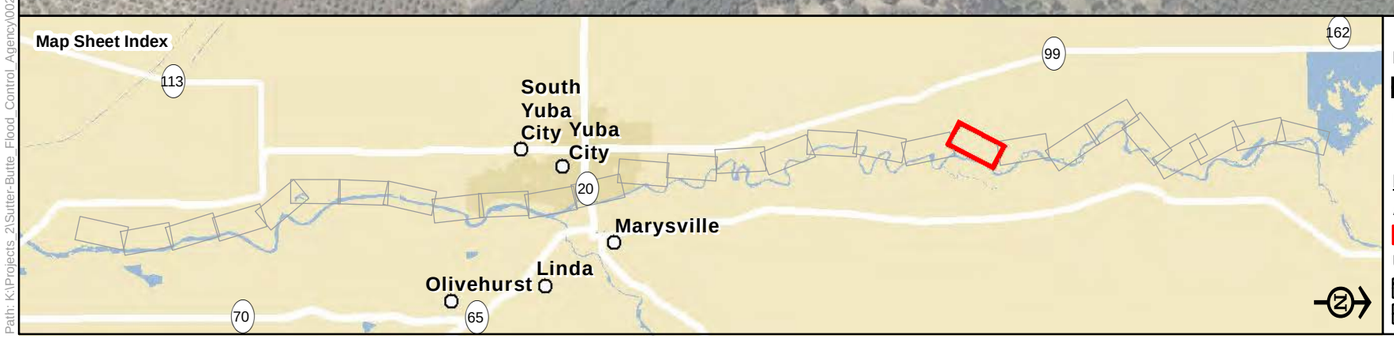
Oak Woodland

Figure 3-19
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013





Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-20
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013

Temporary Impact
(5.546 acres) Aquatic

Temporary Impact
(0.068 acre) Aquatic

Campbell Ave

E Evans Reimer Rd

Center Ave

Levee Rd

Alexander Ave

1721+60

28

1769+31

29

Map Sheet Index

South Yuba City

Yuba City

Marysville

Linda

Olivehurst

113

20

70

65

99

162

Legend

Construction Area

Reach

Station 202+50

Effects

Aquatic

Permanent

Upland

Permanent

Temporary

GGS Habitat

Aquatic

Suitable

Unsuitable

Upland

Suitable

Ruderal Grassland

Unsuitable

Developed

Field and Row Crops

Orchard

Riparian Forest

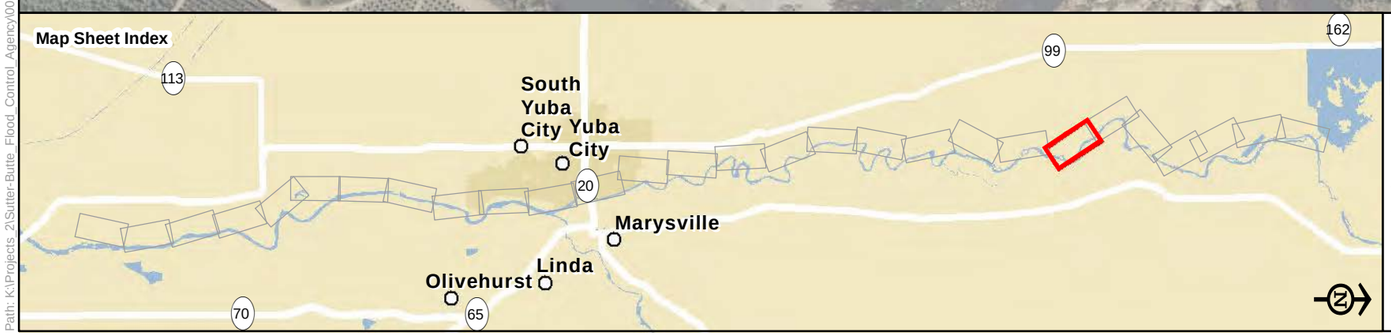
Riparian Scrub-Shrub

Oak Woodland

Figure 3-21
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

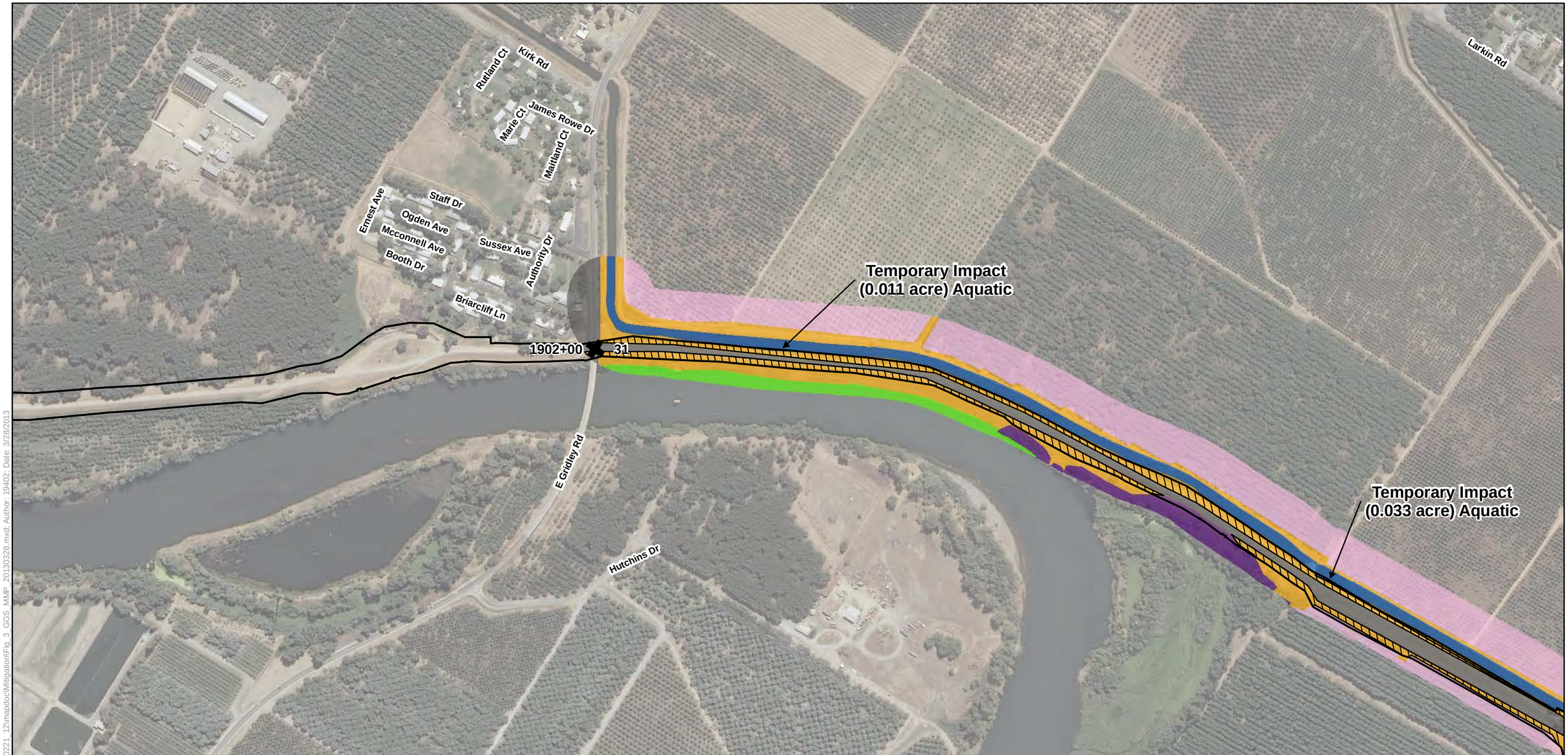
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-22
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

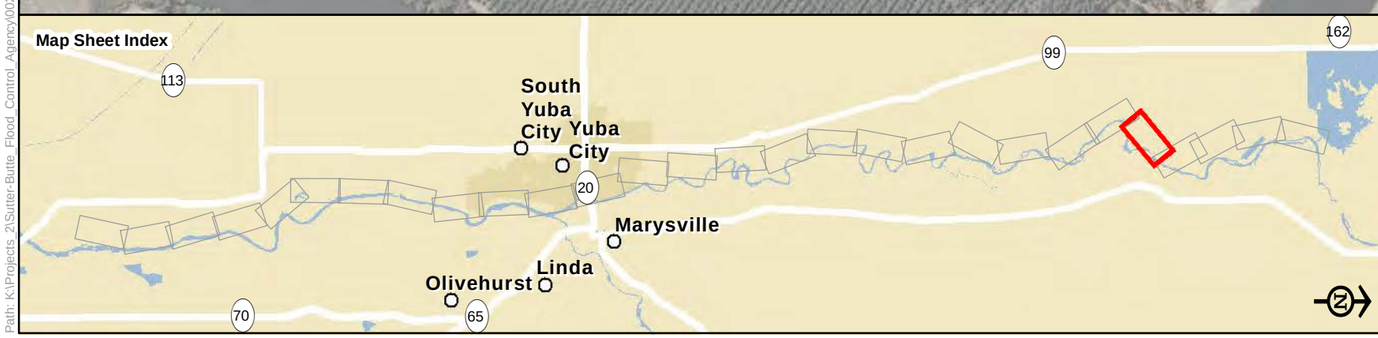
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

0 250 500
Feet

Figure 3-23
Effects on Giant Garter Snake Habitat In the Levee Construction Area

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

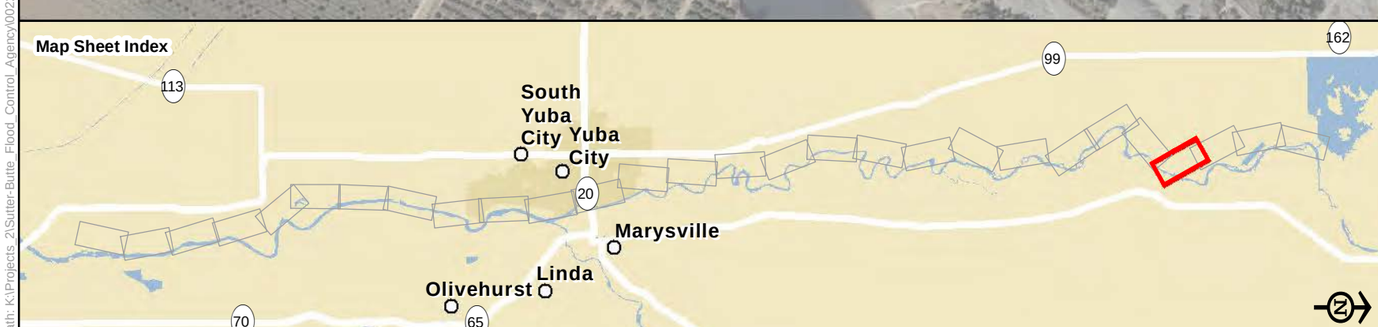
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-24
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

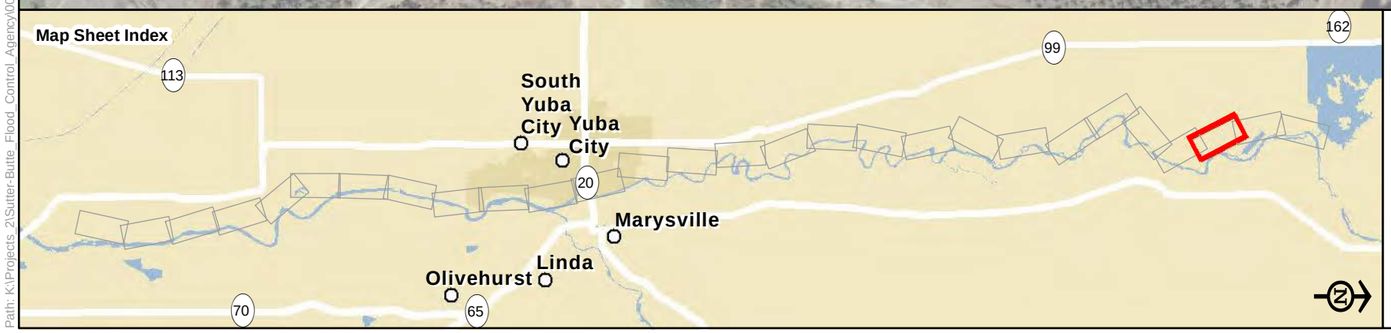
Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

0 250 500
Feet

Figure 3-25
Effects on Giant Garter Snake Habitat In the Levee Construction Area

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

0 250 500
Feet

Figure 3-26
Effects on Giant Garter Snake Habitat In the Levee Construction Area

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013

No GGS Habitat Present

Larkin Rd

Walnut Ave

Welch Rd

Vance Ave

2259+00 37

2290+00 38

2224+00 36

2303+00 39

Tailings Area not considered suitable because of rocky nature of area

Map Sheet Index

113 99 162 20 70 65

South Yuba City

Yuba City

Marysville

Linda

Olivehurst

Legend

Construction Area

Reach

Station 202+50

Effects

Aquatic

Permanent

Upland

Permanent

Temporary

GGS Habitat

Aquatic

Suitable

Unsuitable

Upland

Suitable

Ruderal Grassland

Unsuitable

Developed

Field and Row Crops

Orchard

Riparian Forest

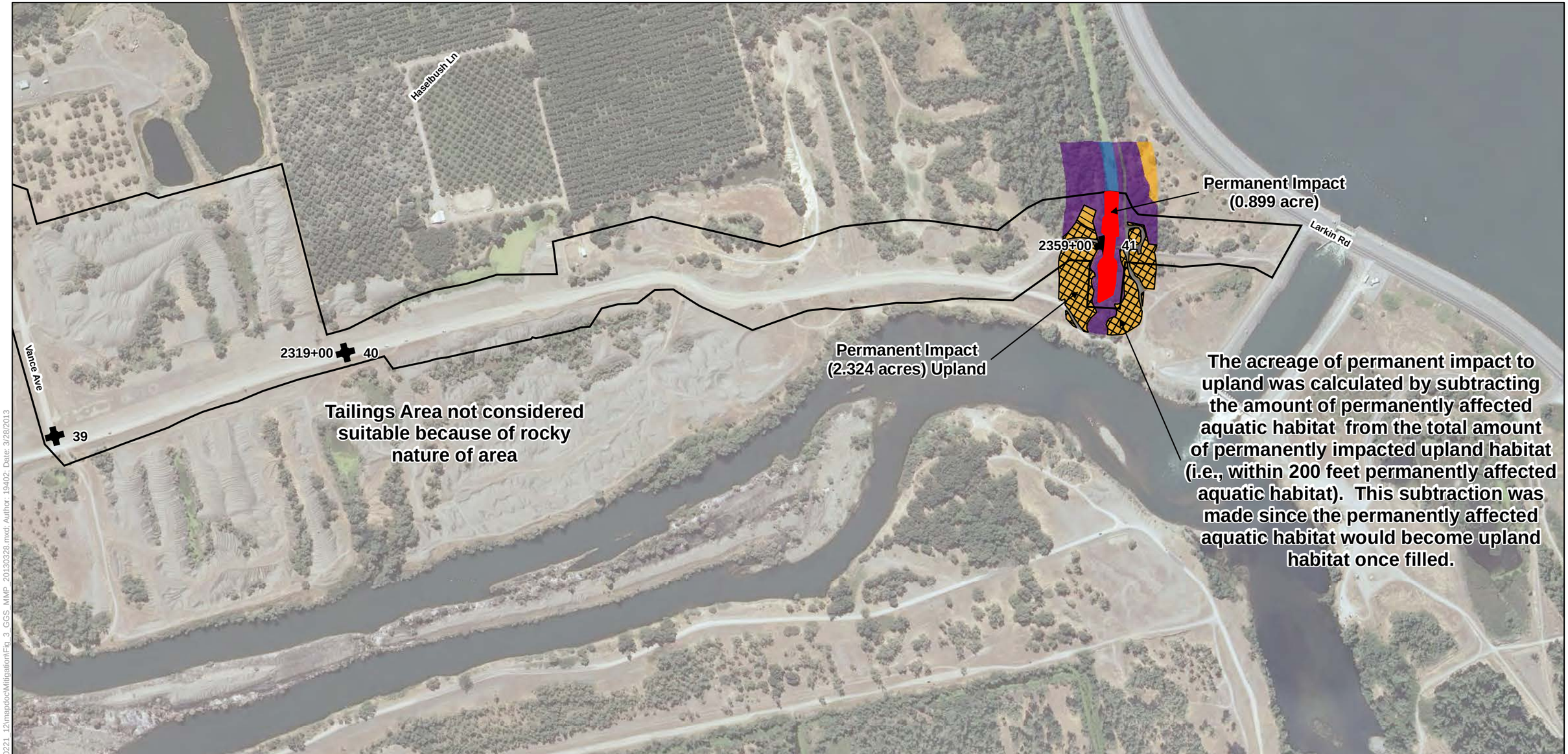
Riparian Scrub-Shrub

Oak Woodland

Figure 3-27
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013



Legend

- Construction Area
- Reach
- Station 202+50

Effects

Aquatic
- Permanent

Upland
- Permanent
- Temporary

GGS Habitat

Aquatic
- Suitable
- Unsuitable

Upland

Suitable
- Ruderal Grassland

Unsuitable
- Developed
- Field and Row Crops
- Orchard
- Riparian Forest
- Riparian Scrub-Shrub
- Oak Woodland

Figure 3-28
Effects on Giant Garter Snake Habitat In the Levee Construction Area

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_MMP_20130328.mxd; Author: 19402; Date: 3/28/2013

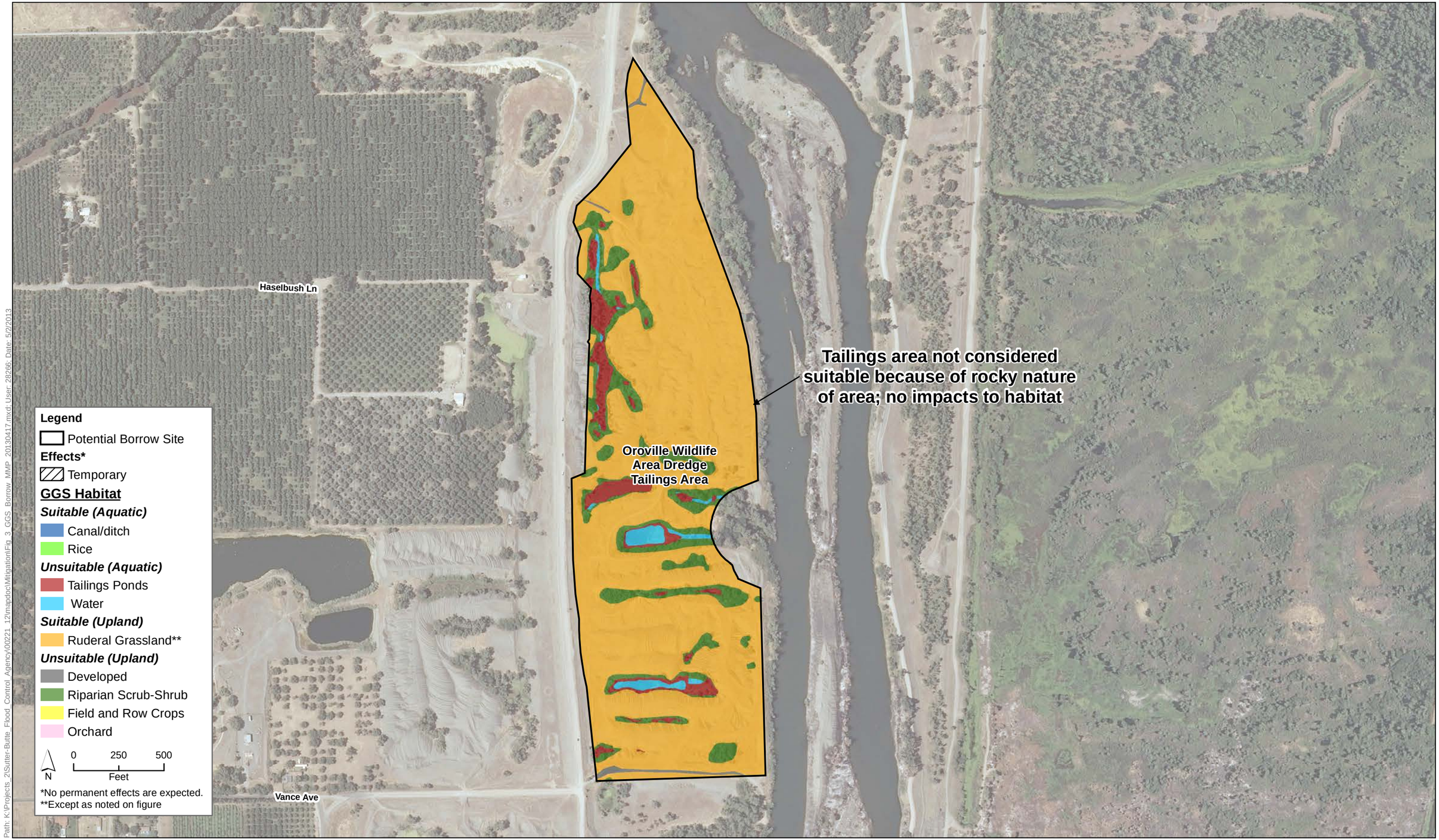


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Figure 3-29
Effects on Giant Garter Snake Habitat at Potential Borrow Sites

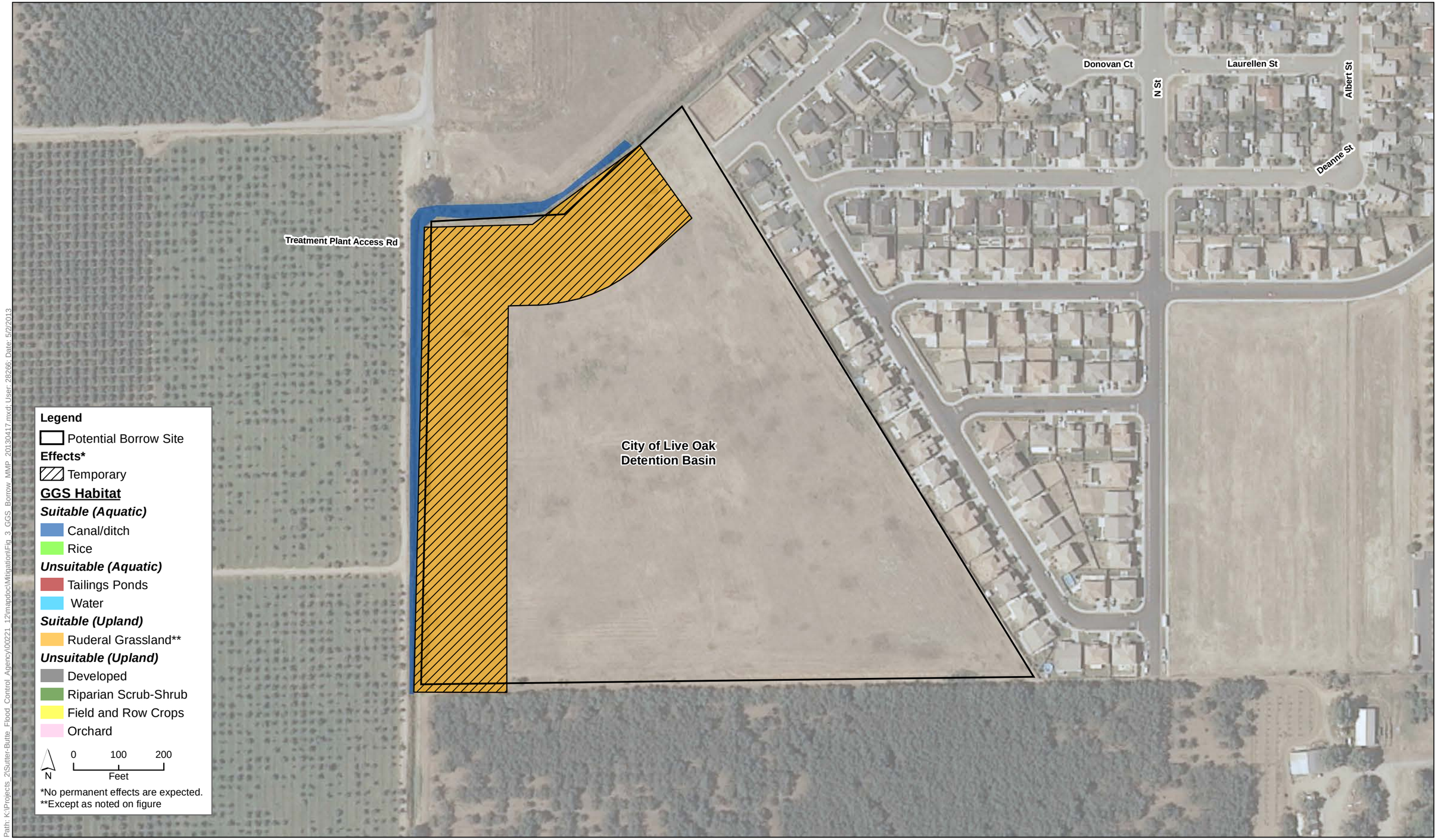

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Figure 3-30
Effects on Giant Garter Snake Habitat at Potential Borrow Sites

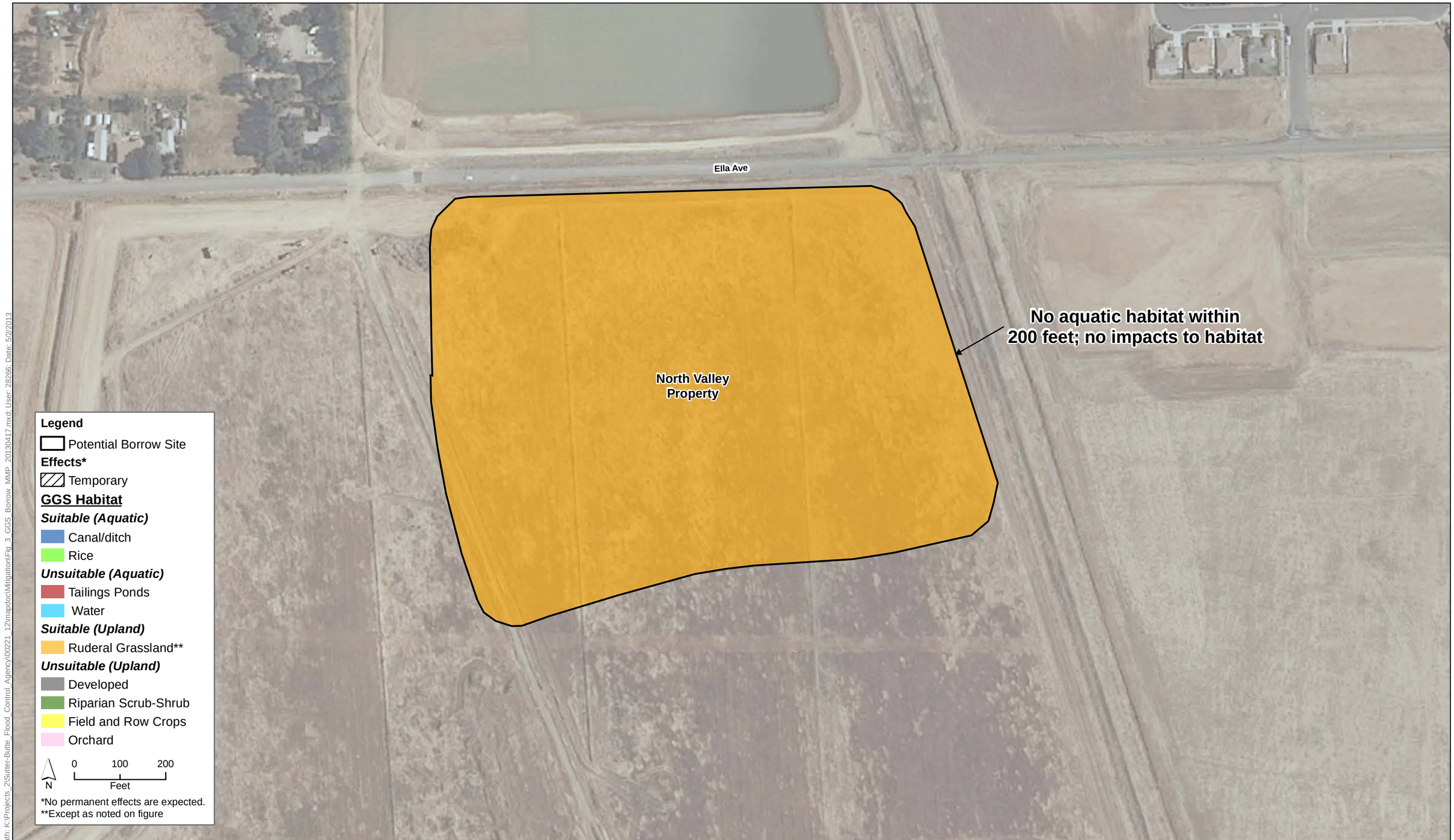

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Figure 3-31
Effects on Giant Garter Snake Habitat at Potential Borrow Sites

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_Borrow_MMP_20130417.mxd; User: 28266; Date: 5/2/2013

Figure 3-32
Effects on Giant Garter Snake Habitat at Potential Borrow Sites

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Mitigation\Fig_3_GGS_Borrow_MMP_20130417.mxd; User: 28266; Date: 5/2/2013

Figure 3-33
Effects on Giant Garter Snake Habitat at Potential Borrow Sites

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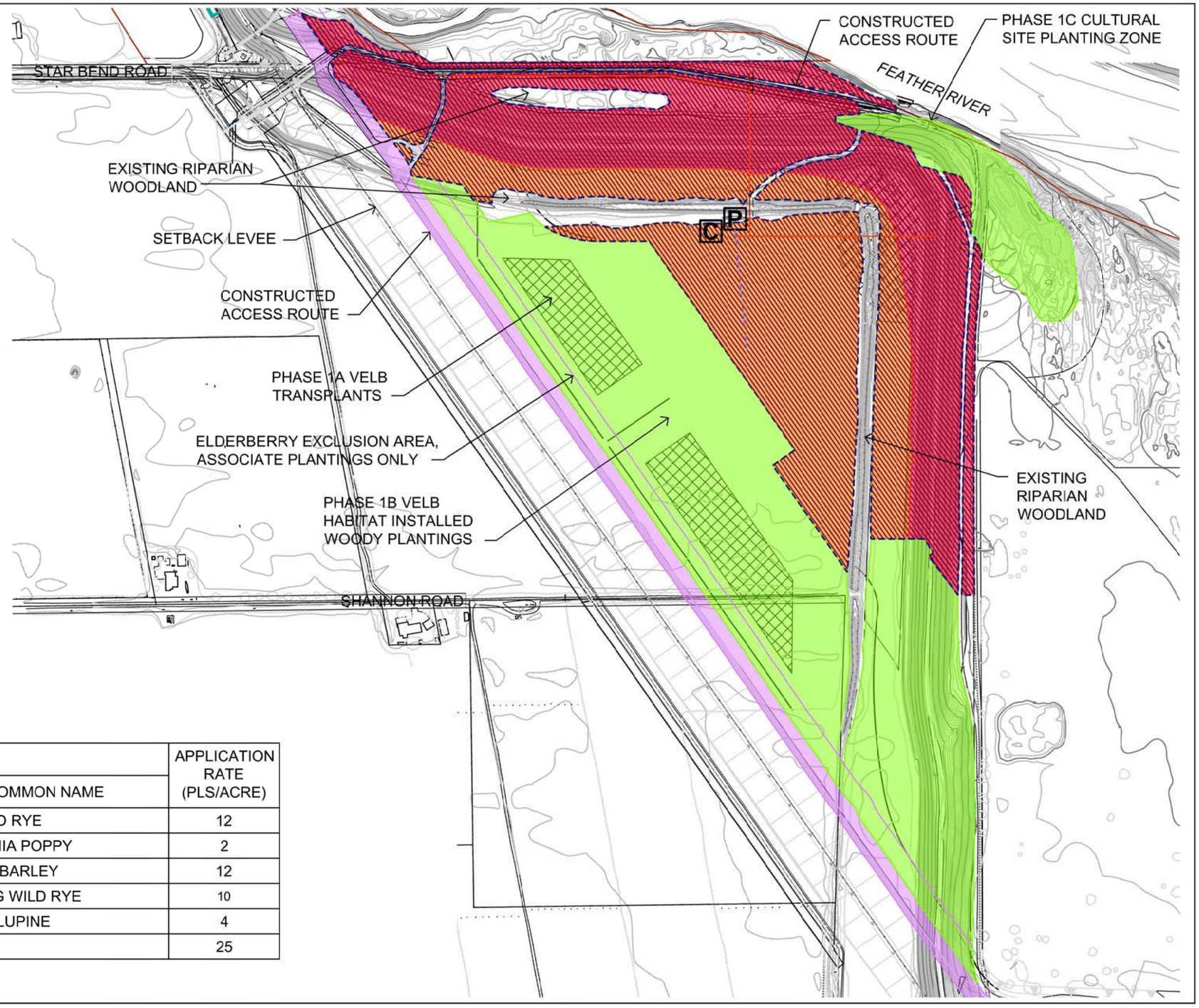
Figure 4
Star Bend Conservation Area

Legend:

- Protection Fencing
- Area of Levee Grading Disturbance
- Area of Mitigation Disturbance
- 50' Vegetation Planting Exclusion Area
- Star Bend Mitigation and Enhancement Habitat Phase 1
- Star Bend Elderberry Mitigation Phase 2 (11.16 acres) (Planting rows 10' apart, plants spaced per Restoration Planting Program)
- Star Bend Riparian Tree Mitigation Phase 2 (13.34 acres) (Planting rows 10' apart, plants spaced per Restoration Planting Program)
- P — Existing Well Pump with Filter, 6CLC 2 Stage Goulds Pump 7.5HP 230 Volt 3 Phase Motor Smartflow 7.5 HP VFD with 900 Series Tornado Filter
- C — Existing Irrigation Controller, Hunter ACC-1200 Controller, Mounted in lockable box adjacent to electric sub-panel
- Existing Mainline Pipe, 4" SCH 40 PVC, On-Grade
- New Mainline Pipe, 4" SCH 40 PVC, On-Grade
- New Mainline Pipe, 4" SCH 40 PVC, Below-Grade
- Sleeve, SCH 40 PVC, Below-Grade



RESTORATION SEED MIX

PLANTING ZONE	SPECIES NAME		APPLICATION RATE (PLS/ACRE)
	BOTANICAL NAME	COMMON NAME	
UPLAND SEED MIX	ELYMUS GLAUCUS	BLUE WILD RYE	12
	ESCHSCHOLIZIA CALIFORNICA	CALIFORNIA POPPY	2
	HORDEUM BRACHYANTHERUM	MEADOW BARLEY	12
	LEYMUS TRITICOIDES	CREEPING WILD RYE	10
	LUPINUS SUCCULENTUS	ARROYO LUPINE	4
	TRITICUM X ELYMUS	REGREEN	25

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0 150 300
Scale 1"=300'

N

Figure 5
SBFCA West Feather River Levee
Star Bend Restoration Phase 2

RESTORATION PLANTING PROGRAM

PLANTING ZONE	SPECIES NAME		AVERAGE PLANT SPACING (FEET ON CENTER)	PERCENTAGE OF PLANT PALETTE	CONTAINER SIZE
	BOTANICAL NAME	COMMON NAME			
ELDERBERRY MITIGATION AREA	BACCHARIS PILULARIS	COYOTE BUSH	10' O.C.	10	1 GALLON
	POPULUS FREMONTII	FREMONT COTTONWOOD	10' O.C.	10	1 GALLON
	ROSA CALIFORNICA	CALIFORNIA WILD ROSE	10' O.C.	10	1 GALLON
	QUERCUS LOBATA	VALLEY OAK	10' O.C.	10	1 GALLON
	SALIX EXIGUA	SANDBAR WILLOW	10' O.C.	5	1 GALLON
	SALIX LASIOLEPIS	ARROYO WILLOW	10' O.C.	5	1 GALLON
	SAMBUCUS MEXICANA	MEXICAN BLUE ELDERBERRY	10' O.C.	50	1 GALLON
	TOTAL PLANT PALETTE FOR ELDERBERRY MITIGATION AREA =			100	
RIPARIAN MITIGATION AREA	ACER NEGUNDO	BOX ELDER	10' O.C.	15	1 GALLON
	CEPHALANTHUS OCCIDENTALIS	BUTTONWILLOW	10' O.C.	15	1 GALLON
	FRAXINUS LATIFOLIA	OREGON ASH	10' O.C.	10	1 GALLON
	PLATANUS RACEMOSA	CALIFORNIA SYCAMORE	12' O.C.	10	1 GALLON
	POPULUS FREMONTII	FREMONT COTTONWOOD	12' O.C.	10	1 GALLON
	QUERCUS LOBATA	VALLEY OAK	12' O.C.	5	1 GALLON
	ROSA CALIFORNICA	CALIFORNIA WILD ROSE	2' O.C. WITHIN CLUSTERS OF 5, 15' O.C. BETWEEN CLUSTERS	10	1 GALLON
	RUBUS URSINUS	CALIFORNIA BLACKBERRY	2' O.C. WITHIN CLUSTERS OF 5, 15' O.C. BETWEEN CLUSTERS	10	1 GALLON
	SALIX EXIGUA	SANDBAR WILLOW	10' O.C.	5	1 GALLON
	SALIX LASIOLEPIS	ARROYO WILLOW	10' O.C.	10	1 GALLON
	VITIS CALIFORNICA	CALIFORNIA WILD GRAPE	2' O.C. WITHIN CLUSTERS OF 5, 15' O.C. BETWEEN CLUSTERS	5	1 GALLON
	TOTAL PLANT PALETTE FOR RIPARIAN MITIGATION AREA =			100	
NON-RIPARIAN NATIVE TREE MITIGATION AREA	BACCHARIS PILULARIS	COYOTE BUSH	10' O.C.	15	1 GALLON
	QUERCUS LOBATA	VALLEY OAK	10' O.C.	75	1 GALLON
	QUERCUS WISLIZENII	INTERIOR LIVE OAK	10' O.C.	10	1 GALLON
	TOTAL PLANT PALETTE FOR NON-RIPARIAN NATIVE TREE MITIGATION AREA =			100	

NOTES:

1. IRRIGATION IS NECESSARY FOR PLANT SURVIVAL AND ESTABLISHMENT. IRRIGATION WILL BE APPLIED TO ACHIEVE SELF-SUFFICIENT PLANTS BY THE END OF THE THIRD DRY SEASON.
2. THE IRRIGATION SYSTEM WILL UTILIZE WELLS AND INFRASTRUCTURE ESTABLISHED IN PHASE 1.
3. SOIL MOISTURE PROBES WILL BE USED TO MONITOR AND MAINTAIN MOISTURE THROUGHOUT THE SOIL COLUMN. DEEP ROOTING WILL BE ENCOURAGED THROUGH DEEP WATERING WITH DIMINISHING FREQUENCY.
4. STAR BEND MITIGATION AND ENHANCEMENT HABITAT PHASE 2 IS COMPRISED OF 11.16 ACRES OF ELDERBERRY MITIGATION AND 13.34 ACRES OF RIPARIAN TREE MITIGATION FOR A TOTAL OF 24.5 ACRES OF MITIGATION. AN ADDITIONAL 22.46 ACRES OF RIPARIAN TREE AND 0.44 ACRES OF NON-RIPARIAN NATIVE TREE MITIGATION WILL BE FULFILLED AT TRLIA'S FEATHER RIVER FLOOD CORRIDOR RESTORATION PROJECT SITE.

2012_Project_Graphics\00221 12 Sutter Butte Flood Control Agency\006 (05/04/13) SS

Figure 6
SBFCA West Feather River Levee
Star Bend Restoration Phase 2

DRAFT FEATHER RIVER WEST LEVEE PROJECT INCREMENTAL COST ANALYSIS

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March 2013

ICF International. 2013. *Draft Feather River West Levee Project Incremental Cost Analysis*. (ICF 00165.12) Sacramento, CA. Prepared for Sutter Butte Flood Control Agency, Yuba City, CA.

Contents

List of Tables and Figures ii
List of Acronyms and Abbreviations iii

Draft Feather River West Levee Project Incremental Cost Analysis 1
Analysis Scope and Objective 1
Project Description, Impacts, and Mitigation Needs 1
Existing Ecological Resources 1
Significant Losses to Ecological Resources, Impact Units and Proposed Mitigation 2
Mitigation Planning Objectives and Potential Mitigation Strategies 3
Summary of Results 5

Appendix A Mitigation Cost Tables

List of Tables and Figures

Tables

Table 1. Acreages of Existing Land Cover Types in the Project Area 2
Table 2. Anticipated Project Impacts to Sensitive Ecological Resources 3
Table 3. Permittee-Responsible Mitigation Costs 4
Table 4. Mitigation Bank Costs 5
Table 5. Unit Cost Comparison 6
Table 6. Most Cost-Effective Mitigation Solution 6

List of Acronyms and Abbreviations

CE/ICA	cost-effectiveness/incremental cost analysis
DFW	California Department of Fish and Wildlife
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
MMP	Mitigation and Monitoring Plan
Project	Feather River West Levee Project applicant-preferred alternative
SBFCA	Sutter Butte Flood Control Agency

Draft Feather River West Levee Project
Incremental Cost Analysis

Analysis Scope and Objective

This section is a cost effectiveness analysis of the options for mitigating habitat and jurisdictional waters impacts associated with Sutter Butte Flood Control Agency's (SBFCA's) Feather River West Levee Project applicant-preferred alternative (Project).

This analysis in presented in compliance with ER 1105-2-100 (April 22, 2000) and its included guidance on cost-effectiveness/incremental cost analysis (CE/ICA). It is intended to determine the least-cost solution for habitat mitigation for the project. As the habitat mitigation needs are directly correlated to the impacts of the project, there are no increments to consider beyond the mitigation requirements. Therefore, incremental cost analysis is not necessary.

Project Description, Impacts, and Mitigation Needs

The project consists of levee improvements in a 41-mile corridor along the west levee of the Feather River from the Thermalito Afterbay downstream to approximately 3 miles north of the confluence with the Sutter Bypass. The levee improvements include mostly slurry cutoff walls with short segments of seepage berms and other location-specific measures like removal or treatment of encroachments.

Potential borrow sites that could supply the soil borrow material necessary for levee construction and upgrades, and routes from the project construction area to the borrow sites, are also included as part of the work. It is not anticipated that all sites would be used over the multi-year phased construction period but would be available for use if the need arises.

Existing Ecological Resources

Table 1 provides a summary of all existing land cover types within the Project area.

Table 1. Acreages of Existing Land Cover Types in the Project Area

Land Cover Type	Permanent Impacts for Which Mitigation Is Required?	Unit	Levee Construction Footprint [a]	Borrow Sites[a]	Total
Terrestrial					
Native riparian tree	Y	dbh	7,833	0	7833
Non-riparian, native tree (oak)	Y	dbh	4,788	0	4788
Non-native tree	N	dbh	36,074	0	36,074
Elderberry shrubs	Y	Each	92	0	92
Field and row crops	N	acre	137.42	41.22	178.64
Developed	N	acre	412.79	2.94	415.73
Ruderal	N	acre	897.96	105.71	1,003.67
Aquatic					
Freshwater emergent wetland	N	acre	0.57	0	0.57
Seasonal wetland	Y	acre	12.23	0	12.23
Open water	Y	acre	44.52	1.21	45.73
Tailing ponds	Y	acre	6.44	3.59	10.03
Stream	N	acre	0.17	0	0.17
Canal/ditch	Y	acre	22.51	0.64	23.15
Wet agriculture (rice)	N	acre	0	35.74	35.74

[a] Accuracy to 0.01 acre is subject to ±5% accuracy depending upon the accuracy of aerial imagery and topographic maps.

Significant Losses to Ecological Resources, Impact Units and Proposed Mitigation

Detailed discussion of the project impacts may be found in the Project's Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) and Biological Assessments. Table 2 summarizes the project's impacts to sensitive ecological resources, impact unit of measure, and the proposed compensatory mitigation ratios and quantities.

Table 2. Anticipated Project Impacts to Sensitive Ecological Resources

Impact Type	Impact Unit	Impact Quantity	Mitigation Need	Mitigation Area
Riparian Tree	diameter at breast height (inches)	1,746 waterside 3,042 landside 4,788 total	4,788 plantings	9.51 acres at 10' o.c. plant spacing
Non-Riparian Native Tree	diameter at breast height (inches)	2,233 waterside 5,600 landside 7,833 total	7,833 plantings	15.57 acres at 10' o.c. plant spacing
Elderberry	individual shrubs and total stem count within each shrub	92 shrubs with 552 total stems	92 transplants, 1,380 elderberry seedlings, and 1,380 native associates	11.4 acres (276 elderberry units)
Giant Garter Snake	acres of permanent impact	0.9 aquatic 2.32 upland	3.22 acres at 3:1 replacement ratio	9.6 acres
Jurisdictional Waters	acres of permanent impact	0.55	1.1 acres at 2:1 replacement ratio	1.1 acres

Mitigation Planning Objectives and Potential Mitigation Strategies

The mitigation planning objective for this project is to provide compensatory mitigation at resource agency approved ratios for all permanent impacts to sensitive ecological resources.

There were four primary habitat mitigation solutions considered, listed below with a statement of applicability.

- **In-lieu fee program.** This option, wherein a permittee/applicant pays the permitting agency to implement mitigation at its discretion, generally has low favorability with the agencies requiring mitigation because it shifts the burden of responsibility for providing replacement habitat from the applicant/permittee to the permitting agency. It is often regarded as a "last resort" and typically applies only to very small projects and impacts where other mitigation options may not be feasible, upon negotiation with the permitting agency. Approved in-lieu fee programs may not exist for all mitigation needs in the project area. For this combination of reasons, in-lieu fee programs were not considered further as a viable solution for this project.
- **Out-of-kind replacement habitat.** This option involves replacement of habitat with a different type than that which was impacted, either on-site or off-site. Because in-kind replacement habitat is not feasible, this option was not considered further as a viable solution for this project.
- **On-site replacement habitat.** This option involves replacement of affected habitat with new habitat of the same type and at the same location as the loss. Because much of the affected habitat (specifically, woody vegetation) is not compliant in its location with USACE levee vegetation policy, this option is not considered feasible. Further, the highly dispersed nature of the impact locations makes efficient replacement infeasible. On-site replacement was not considered further as a viable option for this project.

- **Off-site, in-kind replacement habitat.** This option involves replacement of affected habitat with new habitat of the same type but at a different location than the loss. This often allows for consolidation of mitigation at a single or small number of sites, allowing for economy of scale and higher quality habitat due to large patch size. There are two sub-types:
  - **Permittee-responsible mitigation.** This option involves replacement of in-kind habitat on habitat lands operated by the permittee. Permittee-responsible mitigation is considered viable and is addressed in the Mitigation and Monitoring Plan (MMP) developed for the project.
  - **Purchase of credits at commercial mitigation banks.** This option involves replacement of in-kind habitat through purchase of credits issued for habitat lands operated by a commercial mitigation bank. Purchase of credits is considered viable and is addressed in the MMP developed for the project.

Permittee-Responsible Mitigation. Permittee-responsible offsite mitigation involves securing an appropriate mitigation site, implementing the mitigation plan, monitoring its performance, maintaining the site during the establishment period, developing a conservation mechanism, and arranging a source of funding for long-term protection of the site.

The Star Bend mitigation site is an existing floodplain habitat restoration site that was created as part of the Star Bend setback levee project and contains sufficient area to accommodate all of the project's upland compensatory mitigation, consisting of mostly woody vegetation. Aquatic habitat mitigation, including giant garter snake habitat and jurisdictional waters, could be created through restoration of a rice field used for soil borrow for the project.

Table 3 provides a summary of the permittee-responsible mitigation and the anticipated costs. Appendix A contains detailed construction and establishment cost breakdowns for each category to establish a unit cost for equitable comparison between mitigation solutions (i.e., "apples-to-apples" comparison).

Table 3. Permittee-Responsible Mitigation Costs

Mitigation Type	Location	Quantity	Unit	Cost per Unit	Cost
Riparian Tree	Star Bend and Abbott Lake	9.51	Acres	$36,294	$345,161
Non-Riparian Native Tree	Star Bend	15.57	Acres	$35,192	$568,411
Elderberry (New Plantings)	Star Bend	276	Units	$1,882	$519,572
Elderberry (Transplants)	Star Bend	92	Each	$1,200	$110,400
Giant Garter Snake	Restored rice field	9.6	Acres	$48,342	$464,084
Jurisdictional Waters	Restored rice field	1.1	Acres	$301,242	$331,367
				Total	**$2,338,994**

Mitigation Bank. Purchase of mitigation bank credits involves utilizing a commercial mitigation bank or banks to fulfill the project's compensatory mitigation obligation. The mitigation bank or banks would need to have been approved by the permitting agencies for the habitat types and service area that covers the impact.

Currently there is not one mitigation bank that can solely fulfill all of the credit types needed for the project's mitigation requirements. For the upland habitat impacts, the River Ranch Wetland Mitigation Bank and River Ranch Elderberry Conservation Bank, both owned and operated by Wildlands, Inc., are located at the confluence of the Sacramento and Feather Rivers in Yolo County. These banks can fulfill the riparian and elderberry mitigation requirements of the project. There are currently no mitigation banks that offer oak woodland (non-riparian native tree) credits.

For the aquatic habitat impacts, the Sutter Basin Conservation Bank, owned and operated by Westervelt Ecological Services in Sutter County, is the only bank that presently offers giant garter snake credits approved by both the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife (DFW). Jurisdictional water credits are available at the River Ranch Wetland Mitigation Bank (discussed above).

Table 4 provides a summary of the agency-approved mitigation credits available at the banks in the service area of the impacts.

Table 4. Mitigation Bank Costs

Mitigation Type	Location	Quantity	Unit	Cost per Unit	Total
Riparian Tree	River Ranch Wetlands Mitigation Bank	9.51	acres	$100,000	$951,000
Non-Riparian Native Tree	None	15.57	acres	$50,000*	$778,500
Elderberry (New Plantings)	River Ranch Elderberry Conservation Bank	276	units	$4.000	$1,104,000
Elderberry (Transplants)		92	each	$1200	$110,400
Giant Garter Snake	Sutter Basin Conservation Bank	9.6	acres	$40,000	$384,000
Jurisdictional Waters	River Ranch Wetlands Mitigation Bank	1.1	acres	$100,000	$110,000
				Total	**$4,437,900**

*Estimate; no market credits are available at this time.

Summary of Results

The total cost for the permitted responsible mitigation option is $2,338,994. The total cost for the mitigation bank option is $4,437,900. On a cost per unit basis, the most cost-effective solution would be a blend between the two options, as shown below in Table 5.

Table 5. Unit Cost Comparison

Mitigation Type	Unit	Permittee-Responsible Mitigation Cost per Unit	Mitigation Bank Cost per Unit	Most Cost-Effective Solution
Riparian Tree	acre	$36,294	$100,000	Permittee-responsible
Non-Riparian Native Tree	acre	$35,192	$50,000*	Permittee-responsible
Elderberry (New Plantings)	unit	$1,882	$4,000	Permittee-responsible
Elderberry (Transplants)	each	$1,200	$1,200	Permittee-responsible
Giant Garter Snake	acre	$48,342	$40,000	Mitigation bank
Jurisdictional Waters	acre	$301,242	$100,000	Mitigation bank

* Estimate; no market credits are available at this time.

Therefore, in accordance with ER 1105-2-100 (Appendix E, page 153), the most cost-effective plan is a combination of permittee-responsible mitigation and purchase of credits at a commercial mitigation bank, as no other plan costs less, and no other plan yields more output for less money. This blended solution is detailed in Table 6.

Because of the limited size of the Star Bend mitigation site, it will be necessary to secure a second offsite mitigation location for approximately 8.48 acres of mitigation credit in order to completely fulfill all project mitigation needs. The Abbot Lake site, which is near the Star Bend mitigation site, is owned by DFW and has been tentatively identified as a second suitable mitigation site.

Table 6. Most Cost-Effective Mitigation Solution

Mitigation Type	Location	Quantity/ Unit	Cost per Unit	Total
Riparian Tree	Star Bend and Abbott Lake	9.51 acres	$36,294	$345,161
Non-Riparian Native Tree	Star Bend	15.57 acres	$35,192	$547,939
Elderberry (New Plantings)	Star Bend	276 units	$1,854	$511,704
Elderberry (Transplants)		92 each	$1,200	$110,400
Giant Garter Snake	Sutter Conservation Bank	9.6 acres	$40,000	$384,000
Jurisdictional Waters	River Ranch Wetlands Mitigation Bank	1.1 acres	$100,000	$110,000
Total				**$2,009,204**

There are other factors influencing favorability of this blended solution. One such factor is that non-riparian native tree mitigation is not presently available at a bank, meaning a bank-only solution is not feasible. Moreover, enhancement of the Star Bend restoration area is favored by the permitting agencies to more fully realize the floodplain habitat potential for this area for fish and wildlife. Additionally, the Star Bend site is under joint control by one of SBFCA's member agencies (Levee District 1) and DFW, easing issues with maintenance, ownership, and protective status in conservation. Conversely, these issues are not resolved for a permittee-responsible aquatic mitigation site, increasing the favorability of mitigation bank solution for these impacts.

Appendix A
Mitigation Cost Tables

Table A1. Elderberry Mitigation Costs at Star Bend

Habitat Feature	Task Description	Unit	Unit Cost	Quantity	Total Cost	Assumptions
Elderberry plantings at Star Bend (11.4 acres)	Mobilization	LS	$15,000	1	$15,000	
	Container plant	EA	$20	2,760	$55,200	Assumes 5 elderberry and 5 associates per unit (242 plants/acre)
	Transplants	EA	$1,200	92	$110,400	
	Irrigation system	AC	$8,500	11.4	$96,900	Assumes flood proof drip system
	Irrigation POC	EA	$15,000	1	$15,000	Assumes pumping out of Feather River
	Maintenance Years 1-4	LS	$42,298	1	$67,302	Assumes 20% morality for Years 1-3 and 10% for Year 4
	Monitoring Years 1-10	LS	$92,400	1	$92,000	
	15% Contingency				$67,770	
	Total				**$519,572**	

Table A2. Riparian Mitigation Costs at Star Bend

Habitat Feature	Task Description	Unit	Unit Cost	Quantity	Total Cost	Assumptions
Riparian plantings (1.03 acres at Star Bend, 8.48 acres at Abbot Lake)	Mobilization	LS	$15,000	2	$30,000	
	Container plant	EA	$20	4783	$95,660	Assumes 10' O.C. spacing
	Irrigation system	AC	$8,500	9.51	$80,835	Assumes flood proof drip system
	Maintenance Years 1-4	LS	$16,657	1	$56,445	Assumes 20% morality for Years 1-3 and 10% for Year 4
	Monitoring Years 1-10	LS	$13,950	1	$37,200	
	15% Contingency				$45,021	
	Total				$345,161	

Table A3. Non-Riparian Native Tree Mitigation Costs at Star Bend

Habitat Feature	Task Description	Unit	Unit Cost	Quantity	Total Cost	Assumptions
Oak plantings at Star Bend (15.57 acres)	Mobilization	LS	$15,000	1	$15,000	
	Container plant	EA	$20	7831	$156,620	Assumes 10' O.C. spacing
	Acorn plantings	EA	$3	7785	$23,355	Assumes 500 acorns/acre
	Irrigation system	AC	$8,500	15.57	$132,345	Assumes flood proof drip system
	Maintenance Years 1-4	LS	$54,213	1	$93,353	Assumes 20% morality for Years 1-3 and 10% for Year 4
	Monitoring Years 1-10	LS	$79,050	1	$55,800	
	15% Contingency				$71,470	
	Total				$547,943	

Table A4. GGS Mitigation at Generic Permittee-Responsible Site

Habitat Feature	Task Description	Unit	Unit Cost	Quantity	Total Cost	Assumptions
GGS (3.2 acres aquatic and 6.4 acres upland)	Land cost	AC	$7,500	9.6	$72,000	
	Mobilization	LS	$15,000	1	$15,000	
	Grading	CY	$4	15,488	$61,952	Assumes 3' of cut over 3.2 acres and on-site spoils disposal
	Seeding	AC	$1,000	9.6	$9,600	Assumes 3.2 acres of GGS aquatic habitat and 6.4 acres of GGS upland habitat
	Erosion control	LS	$5,000	1	$5,000	
	GGS monitoring	YR	$8,000	5	$40,000	
	Endowment	LS	$200,000	1	$200,000	Assumes $4,000/year for long term maintenance and monitoring at 2% annual return on principal
	15% Contingency				$60,532	
	Total				$464,084	

Table A5. Jurisdictional Habitat Mitigation at Generic Permittee-Responsible Site

Habitat Feature	Task Description	Unit	Unit Cost	Quantity	Total Cost	Assumptions
Wetlands and waters (1.1 acres)	Land cost	AC	$7,500	1.1	$8,250	
	Mobilization	LS	$15,000	1	$15,000	
	Grading	CY	$4	5,324	$21,296	Assumes 3' of cut over 1.1 acres and on-site spoils disposal
	Seeding	AC	$1,000	1.1	$1,100	Assumes 1.1 acres of wetland habitat
	Erosion control	LS	$2,500	1	$2,500	
	Wetland monitoring	YR	$8,000	5	$40,000	
	Endowment	LS	$200,000	1	$200,000	Assumes $4,000/year for long term maintenance and monitoring at 2% annual return on principal
	15% Contingency				$43,221	
	Total				$331,367	

Part F.4

Fish and Wildlife Coordination Act Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer To
08ESMF00-2013-CPA-0012

MAY 08 2013

Alicia E. Kirchner
Chief, Planning Division
Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95825-2922

Dear Ms. Kirchner:

The U.S. Army Corps of Engineers has requested coordination under the Fish and Wildlife Coordination Act (FWCA) for the Sutter Basin Feasibility Study and the Feather River West Levee Project. The proposed levee modifications would occur on the west levee of the Feather River, in Sutter and Butte Counties, California. This report has been prepared under the authority of, and in accordance with, the provisions of section 2(b) of the FWCA (48 stat.401, as amended; 16 U.S.C. 661 et seq.).

By copy of this letter, this report is being circulated to the agencies and offices listed below for review and comment. We would appreciate receipt of any comments on this report within 30 days of receipt of this report.

If you have any questions regarding this report, please contact Jennifer Hobbs at (916) 414-6541.

Sincerely,

Daniel Welsh
Assistant Field Supervisor

Enclosure

cc:
Mike Hendrick, NMFS, Sacramento, California
Brad Johnson, Corps of Engineers, Sacramento, California
Jeff Koschak, Corps of Engineers, Sacramento, California
Kursten Sheridan, CDFW, Region 2, Rancho Cordova, California
Jenny Marr, CDFW Region 2, Chico, California

FISH AND WILDLIFE COORDINATION ACT REPORT
SUTTER BASIN FEASIBILITY STUDY/ FEATHER RIVER WEST LEVEE PROJECT

This is the U.S. Fish and Wildlife Service's (Service) Fish and Wildlife Coordination Act report on the effects of the proposed Sutter Basin Feasibility Study/Feather River West Levee Project, Sutter and Butte Counties, California. This report has been prepared under the authority of, and in accordance with, the provisions of the Fish and Wildlife Coordination Act (48 stat. 401, as amended: 16 U.S.C. 661 et seq.).

INTRODUCTION

The information presented in this report is based primarily upon project planning information made available by the Sutter Butte Flood Control Agency (SBFCA) and the U.S. Army Corps of Engineers (Corps). The Corps, Central Valley Flood Protection Board, and SBFCA are coordinating on the feasibility study to reduce flood risk within the study area. In a parallel but separate action, SBFCA is planning the Feather River West Levee Project (FRWLP) which would construct improvements along the Feather River from Thermalito Afterbay downstream to Laurel Avenue. The FRWLP is scheduled to begin construction in 2013, prior to the Sutter Basin Feasibility Study being authorized. In order to implement the FRWLP, SBFCA must obtain permission from the Corps to alter the Federal project under Section 14 of the Rivers and Harbors Act of 1899 (as amended) (33 USC §408 or Section 408). Consequently, two environmental impact statement/environmental impact reports (EIS/EIR) are being prepared, one for the feasibility study and one for the FRWLP. Both projects are being closely coordinated as they involve similar actions and the same participants. This FWCA report analyzes the effects to fish and wildlife and their habitats due to each of the projects, recognizing that only one of the alternatives discussed would be constructed and that this report will be used for both the Sutter Basin Feasibility EIS/EIR and the FRWLP EIS/EIR.

Major flood events have occurred along the Feather River, with the more significant events that caused levee failures and flooding occurring in 1955, 1986, and 1997. In December of 1955, the most significant flood event along the Feather River is reported to have occurred. Several levee embankment failures caused major flooding of nearly all of Yuba City, as well as flooding in Nicolaus. About 156 square miles were flooded during this event. In February of 1986, heavy snow pack and warm rains elevated water levels and caused a levee embankment failure on the adjacent segment of the Yuba River near Linda, flooding nearly 30 square miles including Linda and Olivehurst. The winter of 1996/1997, heavy snow pack and warm rains again elevated water levels. All citizens in Yuba City, Marysville, Linda, and Olivehurst were ordered to evacuate. Ultimately, in January of 1997, a levee embankment failure occurred south of Olivehurst flooding nearly 50 square miles including Olivehurst and Arboga.

Over the past two decades, several studies have been conducted by the Department of Water Resources (DWR), the Corps, and more recently SBFCA to evaluate the condition of the levees protecting the planning area relative to criteria for stability, seepage, erosion, geometry, and levee height. These studies have indicated that the levee system deficiencies include seepage,

slope instability, erosion, and encroachment, and that the consequences of levee failure from a major flood event would be significant. An emergency preparedness mapping study analyzed hypothetical levee failures and determined the rate and depth at which water would flood SBFCA's planning area if a levee failure occurred in the studied reaches. This study predicted flooding depths that could range from about 1-foot to more than 20 feet in some areas.

Further evaluation has demonstrated that much of the existing system does not provide protection from the 100-year flood event, the commonly accepted minimum level of flood protection per the Federal Emergency Management Agency's (FEMA's) National Flood Insurance Program as well as being less than the 200-year level targeted by the State of California for urban areas. The Corps' and SBFCA's goal is to reduce the risk of flooding on the population, property, and critical infrastructure. SBFCA's goal is to achieve a minimum of 200-year flood protection for the more urbanized areas and 100-year for the remaining rural agricultural parts of the planning area.

AREA DESCRIPTION

The Sutter Basin is part of the Sacramento River Flood Control Project, located in north-central California in Sutter and Butte Counties. The elongated, irregularly shaped basin covers about 300 square miles and is about 43 miles long north to south, and up to 14 miles wide east to west. The Sutter Basin is roughly bounded by the Feather River, Cherokee Canal, the Sutter Buttes, and Sutter Bypass. Floodwaters potentially threatening the basin originate from the Feather River watershed or the upper Sacramento River watershed, upstream of the 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 Corps and SBFCA have determined that flood risk can be reduced by focusing on the Feather River west levee. Consequently, all of the alternatives that they are pursuing deal with remediation of that levee. This portion of the west Feather River Levee extends from Thermalito Afterbay on the north to where the Feather River enters the Sutter Bypass on the south. This corridor is roughly 500 feet from the land side of the existing levees and 100 feet from the water side. The corridor is about 41 miles long.

PROJECT DESCRIPTION

The Sutter Basin Feasibility Study (SBFS) is evaluating two flood-risk reduction alternatives, while the FRWLP is evaluating three flood-risk reduction alternatives. The no-action alternative describes the project without flood-risk reduction measures. All of the alternatives for the SBFS and FRWLP use very similar flood risk-reduction measures. Rather than restate the entire alternatives for SB-7 and SB-8, the FRWLP alternatives will be discussed first and then the SBFS alternative will follow with the differences between these alternatives defined rather than restating the entire alternative.

No Action Alternative

Under the No Action Alternative, the Corps and SBFCA would not implement flood risk-reduction measures. The levees protecting the Sutter Basin would continue to require risk-reduction measures to meet current levee standards, FEMA's minimum acceptable level of flood protection, and State requirements for 200-year for urbanized areas. In addition, the associated risk to human health and safety, property, and the adverse economic impact that serious flooding could cause would continue, and the risk of a catastrophic flood would remain high.

Because of uncertainties in local, State, and federal funding; future state and federal authorization; and other approvals, it is not reasonable to predict construction of levee improvements in the foreseeable future would be completed in a reasonable timeframe. Therefore, for the purpose of evaluating effects under the No Action Alternative, it is assumed that no levee repair or strengthening would be implemented, the purpose and objectives would not be met, and the current level of flood risk would continue.

Alternative 1 (FRWLP)

This alternative would construct a cutoff wall along the centerline of the existing levee to varying depths and a seepage berm along a portion of the landside levee toe. This alternative would predominately keep within the existing footprint of the levee.

For Reaches 2 through 5, Alternative 1 would construct a cutoff wall ranging between 30 feet and 127 feet deep along the centerline of the levee. The levee would be degraded about 50% of its overall height with 2,900 feet of the levee being fully degraded. In addition to the cutoff wall, Alternative 1 would construct a 200-foot-wide seepage berm for 2,268 feet.

For Reaches 7 through 11, Alternative 1 would construct a cutoff wall ranging between 39 feet and 124 feet deep along the centerline of the levee. The levee would be degraded about 50% of its overall height with 1,900 feet of the levee being fully degraded.

SBFCA would acquire a temporary construction easement equal to 50 feet from the existing levee toe or toe of the proposed seepage berm for construction of the levee improvements. An additional 20-foot easement would be obtained where required for the relocation of existing utilities.

For Reaches 13 through 24, Alternative 1 would construct a cutoff wall ranging between 21 and 105 feet deep along the centerline of the levee. The levee would be degraded about 50% of its overall height with about 2,600 feet of the levee being fully degraded. In addition to the cutoff wall, Alternative 1 would include about 11,150 feet of waterside slope flattening, about 5,100 feet of depression infill, and about 1,500 feet of ditch lining.

For Reaches 26 through 41, a cutoff wall ranging between 18 feet and 97 feet deep along the centerline of the levee would be constructed. The levee would be degraded by about 50% of its overall height.

Materials imported to the project site would include water, bentonite, cement, incidental construction support materials, aggregate base rock, hydroseed, and up to 4,343,800 cubic yards of embankment fill material for the new levee surfaces from off-site commercial borrow sites. For backfill of new pipelines crossing the levee, Controlled Low Strength Material (CLSM) (otherwise known as light-weight concrete) is required to be placed to the pipeline's spring line.

Levee improvements are not required for Reaches 6, 14, 15, 29, and 39.

Alternative 2 (FRWLP)

Alternative 2 would construct seepage and stability berms along the landside toe of the levee and a shallow cutoff wall along a portion of the centerline of the levee. The seepage and stability berms would substantially extend beyond the footprint of the current levee, requiring real estate acquisition. In addition, Alternative 2 would include the filling of the existing canal adjacent to the levee in Reaches 26, 27, and 28 with water during periods of high water surface elevation in the river. This would require the construction of regulating structures within the canal to maintain the water level within the canal and create a resistive force against any under-seepage flows.

For Reaches 2 through 5, Alternative 2 would construct an undrained seepage berm ranging between 100 feet and 300 feet wide along the landside toe of the levee. Additionally, an 8-foot high stability berm would be constructed along 20,817 feet of the project. Also, a shallow cutoff wall 20 feet deep would be constructed along the levee centerline for 1,616 feet of the project. The levee would be degraded about 50% of its overall height.

For Reaches 7 through 11, Alternative 2 would construct an undrained seepage berm ranging between 110 feet and 300 feet wide along the landside toe of the levee. A stability berm about 9.5 feet tall would be constructed along 14,163 feet of the project. Also, a shallow cutoff wall ranging between 23 feet and 35 feet deep would be constructed along the levee centerline for 17,800 feet of the project. A portion of the existing Garden Highway would need to be removed and reconstructed to allow construction of the seepage berm.

For Reaches 13 through 24, Alternative 2 would construct an undrained seepage berm ranging between 70 feet and 300 feet wide along the landside toe of the levee. An 8- to 10-foot high stability berm would be constructed along about 24,200 feet of the project. A shallow cutoff wall 20 feet deep would be constructed along the levee centerline for about 14,700 feet of the project. Relief wells would be installed for about 37,400 feet of the project. To facilitate construction of the cutoff wall and to maintain stability of the levee, the levee would be degraded by about 50% of its overall height.

For Reaches 26 through 41, Alternative 2 would construct an undrained seepage berm ranging between 50 feet and 300 feet wide along the landside toe of the levee. A 4- to 10-foot-tall stability berm would be constructed along about 38,600 feet of the project. About 1,300 feet of the existing levee would need to be removed and reconstructed with a zoned filter at the base in combination with a seepage berm. About 15,100 feet of canal would be in-filled.

Materials imported to the project site would include water, bentonite, cement, incidental construction support materials, aggregate base rock, hydroseed, and up to 7,661,100 cubic yards of embankment fill material for the new levee surfaces from off-site commercial borrow sites. For backfill of new pipelines crossing the levee, CLSM is required to be placed to the pipeline's spring line.

Levee improvements are not required for Reaches 6, 14, 15, 29, and 39.

Alternative 3 (FRWLP)

Alternative 3 is the applicant-preferred alternative, combining measures from both Alternative 1 and Alternative 2 to produce the optimized alternative based on screening criteria. This alternative is optimal due to its effectiveness in addressing levee deficiencies, compatibility with land use, minimization of real estate acquisition, avoidance of effects, and cost.

For Reaches 2 through 5, Alternative 3 would construct a cutoff wall ranging between 20 feet and 127 feet deep along the centerline of the levee. The levee would be degraded by about 50% of its overall height. In addition to the cutoff wall, Alternative 3 would construct a 100-foot wide seepage berm for 1,616 feet and a 200-foot wide seepage berm for 2,268 feet.

For Reaches 7 through 11, Alternative 3 would construct a cutoff wall ranging between 39 feet and 124 feet deep along the centerline of the levee. Relief wells with 60 feet spacing and 50 feet deep would be distributed at various locations in Reach 7.

For Reaches 12 through 24, Alternative 3 would construct a cutoff wall ranging between 21 and 105 feet deep along the centerline of the levee. The levee would be degraded by about 50% of its overall height with about 2,600 feet of the levee being fully degraded. In addition to the cutoff wall, Alternative 3 would include relief wells for about 8,200 feet, about 11,150 feet of waterside slope flattening, about 5,100 feet of depression infill and about 1,500 feet of ditch lining. Reach 16 includes waterside slope flattening or other remedial measures.

At Reach 17, a seepage berm 7 feet tall and about 50 feet wide would be constructed beneath the Highway 20 crossing. It extends through the existing abandoned railroad tunnel at the levee landside toe. Pedestrian access through the tunnel will remain after the berms construction.

For Reaches 26 through 41, Alternative 3 would construct a cutoff wall ranging between 18 feet and 97 feet deep along the centerline of the levee. The levee would be degraded by about 50% of its overall height. About 1,300 feet of levee would be degraded and reconstructed with a 5 to 1 slope (horizontal to vertical). Reach 31 includes cutoff walls in addition to waterside slope flattening or other remedial measures. In Reach 38 an adjacent levee with a 20-ft wide crown will be constructed using the tailings materials located along the landside of the existing levee. In Reach 41, a 150-feet wide drained seepage berm will be constructed with a 1-ft thick filter drain along the bottom. The filter drain would provide drainage for seepage through the levee. The existing concrete outfall structure located at the south end of this reach would remain in place and would be backfilled with earth materials. This alternative would also include filling of the waterside pit located at the south end of this reach. A 30-foot wide construction access area

would be provided at the toe of the seepage berm. About 9,500 feet of canal would be monitored with a Flood Safety Plan.

Materials imported to the project site would include water, bentonite, cement, incidental construction support materials, aggregate base rock, hydroseed, and up to 1,150,000 cubic yards of embankment fill material for the new levee surfaces from off-site commercial borrow sites. For backfill of new pipelines crossing the levee, CLSM is required to be placed to the pipeline's spring line.

Levee improvements are not required for Reaches 6, 14, 15, 29, and 39.

SB-7

This alternative for the feasibility study closely aligns with the FRWLP Alternative 3 alternative description except for the easement that would be acquired and the length of levee that would be repaired. The Corps would only acquire a 20-foot easement on the landside of the levee and a 15-foot easement on the waterside. The Corps would require full compliance with the Corps policy regarding woody vegetation on levees (Engineering Technical Letter 1110-2-571 "Guidelines for Landscape Planting and Vegetation Management on Levees, Floodwalls, Embankment Dams, and Appurtenant Structures") which would result in more vegetation removal with this alternative than with Alternative 3.

SB-7 would only extend through reach 21 of the project area, resulting in a proposed repair length of about 24 miles long. Of this length, 2,250 feet of levee improvement would be made downstream of Laurel Avenue and consist of a 100-foot-wide undrained seepage berm (5-foot thick at berm toe) in combination with a cutoff wall extending to an elevation of 25 feet deep. The additional work is proposed because this area is located in an area that is highly conducive to seepage distress.

SB-8

This alternative for the feasibility study closely aligns with the FRWLP Alternative 3 alternative description. Differences include the reduced easement compared to the FRWLP, as described in SB-7 and the full compliance with Corps' vegetation management standards. Relocation of either the levee or the Sutter-Butte Irrigation Canal (SBIC) would occur where the SBIC is adjacent to the levee. This would provide space for an operations and maintenance road between the canal and levee. The relocation of either the SBIC or levee is described below:

a. Area 1a (Reach 21) would involve 483 linear feet of canal relocation landward into adjacent agricultural land to provide space between the canal and the levee for a landside operations and maintenance road.
b. Area 1b (Reach 22) would move 1,900 linear feet of levee waterward into the floodplain to provide sufficient space for the landside operations and maintenance road.
c. Area 2 (Reach 24) would move 1,200 linear feet of levee waterward into the floodplain to provide sufficient space for the landside operations and maintenance road.
d. Area 3a (Reach 28) would move 7,900 linear feet of levee waterward into the floodplain to provide sufficient space for the landside operations and maintenance road.

e. Area 3b (Reach 28) would move 1,200 linear feet of canal landward into adjacent agricultural area to provide space for the operations and maintenance road.

Canal relocation would occur during the regular construction season. The new canal is offset from the old canal and a berm would separate the two. The greatest distance between the old and new canal would be 81 feet. Plugs would remain at each end of the canal where it ties into the existing canal. In the winter following construction, when the irrigators no longer send water through the canal and it is dry for 2 months, the plugs would be removed and the abandoned canal section would be filled. The small relocation of the canal at the sunset pump station can be accomplished by simply excavating the opposite side of the canal (widening the canal) when the canal is dry and filling the opposite side of the canal.

An additional 2,250 feet of levee improvement would be made downstream of Laurel Avenue and consist of a 100-foot wide undrained seepage berm (5-foot thick at berm toe) in combination with a cutoff wall extending to an elevation of 25 feet deep. The additional work is proposed because this area is located in an area that is highly conducive to seepage distress.

To provide protection in the event of water overtopping the levee the Corps is proposing to use Anchored High Performance Turf Reinforced Mat along two levee sections. This would occur for 5,760 linear feet in Reaches 7 and 8 and 1,900 linear feet in Reach 23.

EXISTING BIOLOGICAL RESOURCES

Vegetation

Seven land cover category types can currently be found in the project area: riparian forest, riparian scrub-shrub, oak woodland, wetland, agricultural lands, ruderal, and developed/disturbed areas.

Riparian Forest habitat occurs along the Feather River and its tributaries, and supports an overstory dominated by mature native and nonnative trees. The dominant overstory species are valley oak, Fremont cottonwood, and Gooding's black willow. Other trees commonly observed within the riparian habitat were box elder, arroyo willow, Oregon ash and western sycamore. Understory species include horsetails, mugwort and curly dock.

California grape covers many of the trees and shrubs in the riparian forest and several patches of the invasive giant reed were found to occur along the edges of the riparian areas.

Riparian Scrub-Shrub habitat within the biological study area consists of shrubs such as willows, blue elderberry, coyote brush, Himalayan blackberry, and button bush.

Oak Woodland habitat is found in two small patches just south of Almond and Laurel Avenues in the study area. The oak woodland are dominated by valley oak and have an understory that includes wild oat, soft chess, ripgut brome, field hedge parsley and invasive yellow starthistle.

Wetland habitat in the study area consists of natural and agricultural waterbodies: irrigation ditches, open water, seasonal wetlands, streams, and tailing wetlands. Irrigation and drainage

canals typically occur along the landside of the levee and service the agricultural fields. There tends to be sparse vegetation growing along the edge of the canals. Seasonal wetlands and tailing wetlands typically have aquatic and/or emergent vegetation such as common duckweed, primrose, or narrowleaf cattail. The tailing wetlands are typically bounded by trees and shrubs. Open water areas consist of standing water with little vegetation. These occur at the northern and southern portions of the project area.

Agricultural lands are a predominant habitat in the project area and are made up largely of orchards and field and row crops. Orchards are the dominant land cover-type and occur throughout the study area. The majority of the orchards consist of walnut, plum and peach trees that are actively maintained. Herbaceous ground cover under the tree rows is highly variable and depends on the type and frequency of maintenance. When present, the herbaceous vegetation is mostly nonnative weedy species. Field and row crops can largely be found in the southern portion of the study area. Both active and fallow fields that showed indicators of tillage were included in this habitat type. Common field and row crops in the area include sweet corn, alfalfa, wheat, and tomatoes.

Developed areas within the study area consist of urban (residential and commercial) centers, ranchettes, rural neighborhoods, agricultural outbuildings, farm equipment storage areas, pumping stations, and a plant nursery.

Ruderal areas within the study area occur as swaths on both sides of the centerline of the levee where the native soil has been substantially altered. The largest ruderal areas are located between Vance Avenue and the northern terminus of the study area. These areas represent past and ongoing disturbance associated with agriculture, levee construction and maintenance, and excavation.

Trees found in ruderal areas include valley oak, Fremont cottonwood, and black willow. Common shrubs found consist of coyote bush, tree tobacco, Himalayan blackberry, and blue elderberry. Herbaceous vegetation is dominated by annual grasses such as wild oat, soft chess, ripgut brome, and foxtail barley. Non-native forbs such as yellow star-thistle, prickly lettuce, field hedge parsley, mustard, and rose clover occur in the study site as well as native forbs, Spanish lotus, California poppy, fireweed, and western verbena.

Wildlife

Riparian habitat communities provide wildlife with dispersal and migration corridors, foraging areas, cover, and breeding habitat. Riparian trees provide nesting habitat for a variety of raptors, egrets, herons, songbirds, and bats. Riparian forest also provides foraging habitat for numerous species of migratory and wintering birds. Typical mammal species that can be found in riparian areas include deer, raccoons, beavers, coyotes, and skunks. Reptiles and amphibians are also associated with a riparian habitat. Species of reptiles and amphibians include the giant garter snake, western fence lizard, western pond turtle, Pacific tree frog, western toad, and bullfrog.

Oak Woodland provides nesting habitat for a variety of raptors and other tree nesting migratory birds. Additionally, great-horned owl, barn owl, and yellow-billed magpie are known to utilize

this habitat as well. Reptiles and mammals that occur in the riparian habitat may also utilize oak woodlands for foraging and cover habitat.

Wetland habitats in the affected area include riverine areas, ponds, canals, and small ditches. In addition to providing habitat for fish, open water habitat provides foraging, cover and reproductive sites for a variety of wildlife species. Open water areas provide foraging habitat for raptors, herons, egrets, waterfowl, water birds, and land birds. Many of the reptiles and amphibians that use riparian habitat use open water habitat for breeding, foraging, and cover.

Canals and ditches that contain water through mid-fall, have suitable prey, and adequate cover have the potential to support giant garter snake. Mammals that use the open water habitats include different species of bats that forage for insects over open water. Terrestrial mammals such as deer, raccoon, skunk, and opossum, use open water habitat for water sources. Semi-aquatic and aquatic mammals that are found within open water habitat include beaver, river otter, mink, and muskrat.

Orchards have limited value for wildlife, although certain birds, such as the red-shouldered hawk, American crow, yellow-billed magpie, mourning dove, European starling, and rock pigeon may nest or forage in these areas.

Row and field crops provide foraging opportunities for a variety of raptors and other migratory and resident birds such as sandhill crane, blackbirds, western meadowlark, and rock pigeon. Similar species are known to use irrigated fields for foraging, and birds such as burrowing owl, northern harrier, and western meadowlark are known to nest in these areas.

Developed lands provide limited habitat for wildlife but are known to support common "urban-dwelling species" such as northern mockingbird, rock pigeon, mourning dove, house sparrow, house finch, western scrub jay, Botta's pocket gopher, California ground squirrel, house mouse, black rat, and coyote. Semi-developed areas with grass, trees, and a water source can provide habitat for additional wildlife species.

Ruderal areas in the project site have a variety of native and non-native trees, shrubs, grasses, and forbs like described in the vegetation section. Similar to developed lands, these areas support mostly common wildlife species, although some elderberry bushes, which support valley elderberry longhorn beetle, were found scattered in the area.

Fisheries

The study area includes over 40 miles of the Feather River's western bank, and the various water bodies in the study area provide spawning, rearing, and migratory habitat for a diverse assemblage of native and non-native fish species. Native species present in these streams can be separated into anadromous and resident species. Native anadromous species include two runs of Chinook salmon, steelhead, green and white sturgeon, Pacific and river lamprey. Native resident species include Sacramento pikeminnow, Sacramento splittail, Sacramento sucker, hardhead, California roach, and rainbow trout. Non-native anadromous species include striped bass and American shad. There are numerous non-native resident species such as catfish, black bass, crappie, sunfish and minnows.

There are many factors affecting the abundance of fish species on the Feather River and its tributaries. Riparian and shaded riverine aquatic habitat has decreased significantly with the building of dams, levees, and water diversions, and floodplain access for spawning and rearing has been diminished from what it once was. In addition to habitat alterations, other factors that limit fish species abundance include non-native fish introductions, food availability, entrainment due to water diversions, and water temperature.

Endangered Species

Appendix A provides the Service's biological opinion for the FRWLP, dated May 2, 2013, pursuant to section 7(a) and (c) of the Endangered Species Act (Act) of 1973, as amended.

In addition, the western yellow-billed cuckoo, a candidate species, may occur in the project area. Although candidate species are not protected under the Act, the 1988 amendments require the Service or NOAA Fisheries to monitor their status. If this species declines precipitously during the planning of this project, it could be listed on an emergency basis.

NOAA Fisheries has responsibility for most marine fish and wildlife, including anadromous salmonids, and should be consulted on activities which may affect any such listed or proposed species in the project area. The Service has consultation responsibility for the remaining species.

The California Department of Fish and Wildlife (CDFW) has responsibility for State listed species and species of concern. The CDFW should be contacted regarding any State listed species or species of concern that may be impacted by project activities.

FUTURE CONDITIONS WITH THE NO ACTION ALTERNATIVE

Vegetation

The No Action Alternative represents the continuation of the existing deficiencies in the levee along the west bank of the Feather River between the Sutter Bypass and Thermalito Afterbay. No levee improvements would be made and no construction related effects on vegetation or wetland would occur. Compliance with the Corps levee vegetation policy could lead to permanent loss of woody vegetation which would result in a significant effect on riparian habitat.

Wildlife

Under the No Action Alternative, the aquatic resources of the project area are not expected to change significantly from existing conditions. Since current levee operations and maintenance activities would continue as is, and there would be no change in the geomorphic or flood control regimes, resident and migratory wildlife would continue to use the area as they do today.

Because no levee improvements would be made under the No Action Alternative, the risk that the levees along the west bank of the Feather River could fail due to seepage or slope stability/geometry issues would continue. A catastrophic levee failure would result in flooding and inundation that could significantly affect wildlife and their upland or wetland habitats. A

major flood event could result in damage to the riparian forest, and given the importance of the riparian corridor to numerous special-status species, loss or fragmentation of this habitat would be a significant effect. Given the uncertainty of the occurrence or magnitude of such an event, potential effects on wildlife and their habitats cannot be quantified based on the available information.

Fisheries

Under the No Action Alternative, the aquatic resources of the project area are not expected to change significantly from existing conditions. Since current levee operations and maintenance activities would continue as is, and there would be no change in the geomorphic or flood control regimes, resident and migratory fishes would continue to use the area as they do today. Compliance with the Corps levee vegetation policy could lead to permanent loss of woody vegetation which would result in a significant effect on riparian habitat.

Because no levee improvements would be made under the No Action Alternative, the risk that the Feather River levee could fail and cause major damage would be greater. If the levees were to fail, it could result in the displacement of fish into flooded areas where the potential for stranding and mortality is high. In addition, flooding could cause adverse water conditions due to hazardous materials being released, which could adversely affect fish populations.

FUTURE CONDITIONS WITH THE PROJECT

Vegetation and Wildlife

Given the similarities in all the alternatives the following discussion on vegetation and wildlife applies to all the alternatives. Where there are substantial differences in the alternatives they are discussed below.

Habitat losses would occur linearly along the 41 miles of levee. Currently the position of the levee varies in distance from the river, with a minimum of the levee and bank of the river being the same to a maximum of about 5,000 feet. Using a GIS layer of the footprint of the various alternatives and measuring the lengths of the levee, the Service calculated that about 11 discontinuous miles of levee would be constructed within 300 feet of the Feather River's edge. Because Alternatives 1, 2, and 3 footprints are almost exactly the same on the waterside of the levee the above number applies to all of these alternatives. The SB-8 alternative is longer by 2,250 linear feet; however, the above number would also apply to this alternative because the additional length of levee is more than 300 feet from the edge of the river. The SB-7 alternative is the shortest of all the alternatives with the total length of levee being about 23 miles. Of this about 7 discontinuous miles of riparian habitat would be removed within 300 feet of the edge of the Feather River. The majority of the riparian forest and riparian scrub shrub that would be removed due to any of the alternatives occurs on the waterside. Removing trees and shrubs along these discontinuous segments of riparian habitat where the stand widths are already narrow is a greater loss of the habitat and therefore a larger effect on the wildlife species that would be using this habitat. Narrowing of riparian corridors decreases the diversity of species and vegetative layers that wildlife species can use. Narrowing of riparian habitat could isolate some species that may require contiguous vegetated areas to move up and down the river course.

All of the alternatives address deficiencies in the levees primarily using cutoff walls and seepage berms which result in potential adverse effects on wildlife resources. Effects of construction on wildlife in the area include disturbance from construction activity and noise. Amphibian and reptile species typically are not as mobile as other types of wildlife. Consequently they have a greater chance of being killed during construction activities. Wildlife such as birds and mammals, typically respond to this type of activity by leaving the construction area. It is likely they would move into adjacent habitat outside of the zone of construction noise and disturbance. However they may be forced to move to less than optimal habitat conditions as other animals may have established territories in the surrounding habitat. Pre-construction nesting bird surveys would avoid disturbing or destroying any nests within the vegetation removal area and comply with the Migratory Bird Treaty Act.

Oak woodland would be minimally affected with SB-8 affecting, at most, 1.3 acres. Effects to species from the loss of this habitat would be similar to what is described above during construction. The loss of wetland types varies with alternative. Small farm canals would be filled for all alternatives due to the construction of the seepage berm adjacent to agricultural lands. The majority of these are small (about 3 feet wide) and only have water in them when the farmers irrigate their fields. While some bird species such as herons and egrets can use this habitat for foraging, the inconsistent water regime and yearly disturbance by the farmers keeps most vegetation out of the canals, thus they tend to not provide much habitat value for wildlife species. Alternative 2 is the only alternative affecting pond habitat. There is a privately owned pond at the lower end of the project area which would be filled due to construction of a seepage berm. The loss of this habitat would likely affect bird species such as herons, egrets, and waterfowl, and amphibian species such as toads and frogs. Given the location is on the landside of the levee and the surrounding landuse is predominately agricultural, this habitat type is not common in the area and would adversely affect native wildlife species.

Seasonal wetlands, open water, and tailing wetlands are affected in almost every alternative. This habitat is scattered along the project area, though the tailing wetlands are at the upper end of the project area near Thermalito Afterbay. These areas typically have frequent bird use as well as serve as habitat for native amphibians such as chorus frogs and spadefoot toad. Construction within and around these areas would adversely affect these wildlife species through the direct loss of habitat as well as effects to species using surrounding areas due to noise and construction activity.

Because the construction would be accomplished over a 4-year period and along a long linear footprint and adjacent habitat in the form of riparian forest and scrub shrub would remain unaffected due to the project, it is likely the birds and mammals not dependent on woody vegetation would move back into the area once construction is completed. Species which rely on riparian vegetation would experience a loss of habitat within the corridor. The Corps and SBFCA would mitigate for the loss of riparian habitat by creating the Star Bend Conservation Area. However, there would be a temporal loss of habitat for all of the alternatives until the habitat grows mature enough to be habitat for certain species. For example raptors require large trees to build nests in; the trees at the Conservation Area may not reach a suitable size until 20 or more years post-planting. Species such as woodpeckers which require snags would not have that habitat available to them for a longer period of time. Once established and maturing, new

riparian habitat at Star Bend Conservation Area would connect existing riparian habitat within the corridor providing better connectivity and dispersal corridors than what currently exist.

Effects to ruderal habitat would be primarily temporary, with the habitat disturbed and replaced within a year. However; with SB-7 and SB-8, the Corps is proposing to place 5,760 linear feet and 7,660 linear feet respectively of erosion protection on the landside of the levee face. This would prevent erosion in the event of a levee overtopping. Placement of this material would prevent this area from being used by ground burrowing animals such as ground squirrels. While much of the surrounding area would still be available for these animals, the animals that depend on these burrows may find this loss detrimental since species such as giant garter snakes and burrowing owls do not create burrows themselves, but rely on other species to create them.

Table 1 summarizes the affected habitat types by Alternative.

Table 1. Acreages of Habitat Types Affected by Alternative

Habitat Type	Alternative 1	Alternative 2	Alternative 3	SB-7	SB-8
Riparian Forest	17.83	26.67	22.19	24.40	42.00
Riparian Scrub Shrub	0.39	3.09	1.29	0.02	0.50
Oak Woodland	0.22	0.24	0.22	1.00	1.30
Canal/Ditch	24.96	27.54	.21	1.4	7.1
Pond/Basin	0.00	1.91	0.00	0.00	0.00
Stream/River	0.00	0.00	0.00	0.02	1.9
Tailing Wetlands	0.14	0.58	0.13	0.00	0.13
Seasonal Wetlands	0.18	0.19	0.03	0.18	0.18
Open Water	0.17	0.62	0.04	0.19	0.19
Orchards	223.38	666.70	101.71	37.80	85.80
Field and Row Crops	17.42	92.03	4.76	0.70	3.80
Ruderal	522.01	559.87	550.80	395.50	552.00
Developed	222.40	259.56	196.00	125.00	199.00

Fisheries

Riparian habitat provides nutrients to the water which supports the feeding of many fish species. When immediately adjacent to the water, riparian habitat can provide shade and structure for fish to use for escaping higher velocity flows and predators. The loss of this type of habitat would adversely affect fish species. Other effects include increases in turbidity and suspended sediment due to construction activities, possible contaminant discharge from the construction equipment, and adverse effects caused by construction noise and vibration. Only certain reaches of the project are immediately adjacent to the river. Over the course of the 41 miles, about 11 miles of levee come within 300 feet of the Feather River. It is at these locations where vegetation loss

and its effects to fishes are most critical. In the other locations the remaining riparian vegetation can serve as a buffer and minimize effects to sediment making its way into the river. Where the buffer is lacking, the loss of vegetation would affect the addition of nutrients through leaf drop to the water. In these locations the vegetation loss would not be replaced by creating habitat at Star Bend Conservation Area. However, Star Bend Conservation area is adjacent to the river and a wider band of riparian habitat would be planted along the 1,250 linear feet which borders the Feather River. Ultimately, at the widest point, a 1,250 wide band of riparian habitat would be created at the Star Bend Conservation Area.

Endangered Species

The Corps and SBFCA have completed section 7 consultation with the Service on Alternative 3 of the FRWLP (Appendix A). Consultation with CDFW under California Endangered Species Act (CESA) needs to be completed to determine the effects of this project on State listed species.

DISCUSSION

The Service would like to comment on the lack of incorporating a setback levee into any of the alternatives. All of the current alternatives consist of fixing the existing levee in place. Setting the levee back in strategic locations would benefit both fish and wildlife species, by creating more floodplain habitat, as well as the flood system by increasing channel capacity and decreasing maintenance by lessening levee erosion. While the Service appreciates the attempts to minimize effects to existing habitat, we would like to see active movement toward creating a sustainable, reliable, and resilient flood and riparian system. Would the current levee alignment that is being improved in place be able to withstand changing future conditions such as climate change? While the EIS/EIR addresses climate change it does not address the ability of the flood control system to adapt to climate change and potentially the different precipitation patterns which may occur. DWR's Central Valley Flood Protection Plan also outlines the goals for flood control projects that DWR participates in. One of the secondary goals is promoting ecosystem restoration. Inclusion of setback levees into this project would help DWR progress on that goal as well as meet DWR's Environmental Stewardship Policy. Both SBFCA and the Corps should consider looking at opportunities to expand the floodway and include these within the selected alternative.

The Service's primary concern with the effects to fish and wildlife is the loss of riparian and wetland habitats. These habitat types would have the largest native habitat loss in each alternative. SBFCA completed section 7 consultation on Alternative 3 for species listed under the Service's jurisdiction. This Alternative avoids as much vegetation removal as possible by working around vegetation when possible. Additionally, it minimizes temporary effects to habitats such as canals/ditches and various waters by limiting the amount of time they are disturbed and restoring them once the construction in the area is completed. Any permanent effects to native habitats, riparian, oak woodland, and seasonal wetlands should be mitigated. To mitigate effects to wetlands SBFCA has proposed to buy credits at a wetland mitigation bank at a ratio of 2:1. The Service concurs this would mitigate the effects to wildlife species due to the loss of wetland habitat.

To offset the loss of riparian forest, riparian scrub, and oak woodland, SBFCA has calculated the total diameter at breast height (dbh) of all native trees which would be removed due to the project. They have proposed to plant a variety of native seedlings at the Star Bend Conservation Area to create a diverse riparian habitat which would restore 28 acres of ruderal floodplain habitat to riparian habitat. Restoration of this area would expand riparian habitat within the area because it is immediately upstream of the O'Connor Lakes Unit of the Feather River Wildlife Area which has had riparian habitat planted within the last 10 years. The Service believes the restoration of this area would mitigate for some of the effects to the loss of riparian and oak woodlands; however, the Service does not agree that the 28 acres adequately mitigates for the entire loss. Many large trees would be removed as a result of the project. The trees planted to mitigate this impact would not reach the size of the some of the affected oak, cottonwood, and sycamore trees for 50 years. To mitigate the loss of this habitat for wildlife species the Service believes that a ratio of at least 2:1 should be used to mitigate the loss of riparian forest, riparian scrub shrub, and oak woodland. Even with the increase in riparian habitat within the Feather River Corridor with the Starbend Conservation Area there will still be a temporal loss to species that use large trees for nesting, foraging, or sheltering. The additional acreages should be found within the 41 mile proposed project area in order to maintain or benefit connectivity of the riparian corridor along the Feather River.

The Service also has concerns about effects to wildlife and fish due to ongoing operation and maintenance (O&M) of the flood control facility. Under the SBFS, the Corps has included O&M as part of the project description. The FRWLP is not proposing to change existing O&M activities and therefore they have not covered these activities in their project description. Currently, effects to federally threatened and endangered species due to O&M activities have not been analyzed. As the Corps is a federal agency that requires DWR and the local maintaining agencies to operate and maintain the flood control structures according to the federal guidelines, the Corps should initiate section 7 on these activities if there are effects to listed species. The Service feels that some of the ongoing O&M activities are likely to adversely affect the valley elderberry longhorn beetle and giant garter snake in this area. Should the Corps reinitiate section 7 consultation for the SBFS, they should include O&M activities in the reinitiation. Additionally, the Corps should provide information regarding O&M to the Service so we can update this Fish and Wildlife Coordination Act report and include effects to fish and wildlife due to O&M activities. Should the Corps not reinitiate section 7 consultation under the SBFS they should initiate section 7 consultation with the Service for ongoing O&M activities given their role as a federal agency and their discretion over the O&M manual.

RECOMMENDATIONS

If the project is constructed, the Service recommends that the Corps implement the following:

1) Mitigate the loss of any natural habitat types (riparian forest, riparian scrub shrub, oak woodland, wetland, pond, canal, stream) at a ratio of at least 2:1.

2) Should the Feasibility Study move forward the Corps should work with DWR and SBFCA to develop a variance to allow vegetation within the Corps' vegetation free zone to remain in place.

3) Work with the Service on the development of the mitigation area.

4) Lands disturbed by construction activities, including the staging areas, should be reseeded with native grasses and forbs. Reseeding should be conducted just prior to the rainy season to enhance germination and plant establishment.

5) Conduct pre-construction surveys for breeding birds including the State listed Swainson's hawk and burrowing owl.

6) Develop and implement a vegetation monitoring program as part of the project. Monitoring the riparian restoration effort should focus on (a) recording tree survival rates, (b) the quantification of improved habitat values for wildlife (primarily bird species) by measuring percent tree and shrub cover, average height of overstory trees, canopy layering, and total woody riparian vegetation, and (c) developing recommendations for alternative methods of riparian restoration should initial efforts fail. A vegetation monitoring report should be submitted annually for the first 5 years after planting activities, and on the 10th, 15th, and 20th year after planting. The monitoring reports should also identify any shortcomings in the restoration effort and include remedial actions on how to improve restoration efforts. All phases of the revegetation, and monitoring programs should be coordinated with, and approved by, the Service, CDFW, and NOAA Fisheries.

7) Comply with the Conservation Measures and Terms and Conditions in the biological opinion (Appendix A).

8) Complete the appropriate consultation with the CDFW regarding impacts to State listed species, and NOAA Fisheries, as required under section 7 of the Endangered Species Act, for potential impacts to anadromous fish under NOAA Fishery's jurisdiction.

9) SB-7 or SB-8 (depending on the alternative selected) should mitigate for the loss of upland habitat lost due to erosion protection. Effects resulting from this action should be discussed both under the FWCA as well as the federal and State endangered species acts.

10) Initiate section 7 consultation with the Service on the effects of O&M activities to federally listed species.

Appendix A

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer To:
08ESMF00-2013-F-0342-1

MAY 02 2013

Ms. Alicia Kirchner
Chief, Planning Division
U.S. Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814

Subject: Formal Consultation on the Feather River West Levee Project, Sutter County, California

Dear Ms. Kirchner:

This is in response to your March 22, 2013, request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the Feather River West Levee Project (FRWLP) (proposed project) in Sutter County, California. Your request was received on March 28, 2013. You requested our concurrence that the proposed project may affect, and is likely to adversely affect the federally-listed as threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)(beetle) and the giant garter snake (*Thamnophis gigas*)(snake). The Service concurs with your determination and this biological opinion addresses the effects of the proposed projec: on these two species. Critical habitat has been designated for the beetle; however, the proposed project is not located within any designated or proposed critical habitat. Critical habitat has not been designated for the snake; therefore, none will be affected. This response is in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

This biological opinion is based on information provided in the U.S. Army Corps of Engineers' (Corps) letter requesting consultation and their biological assessment. A complete administrative record is on file at the Sacramento Fish and Wildlife Office.

CONSULTATION HISTORY

July 13, 2012. The Service, ICF International, HDR Inc., consultants to Sutter Butte Flood Control Agency (SBFCA), SBFCA, California Department of Fish and Wildlife (CDFW), California Department of Water Resources, and the Corps participated in a site visit to the proposed project. Potential effects to giant garter snake were discussed on the trip.

September 27, 2012. The Service, Corps, HDR, and ICF met to discuss the biological opinion and the level of detail that will be available in order to initiate consultation. The applicant determined that they will have sufficient information to initiate consultation at the project level.

December 18, 2012. The Service, Corps, SBFCA, ICF, and HDR met to discuss effects to giant garter snake. Permanent and temporary effects were discussed as well as the Service providing suggestions on conservation measures that could be incorporated.

February 12, 2013. The Service, Corps, ICF, CDFW, and HDR met to discuss long-term operations and maintenance (O&M). The outcome of this meeting was that the SBFCA FRWLP will not include operations and maintenance in their project description because their project will not be changing O&M. However, the Corps will be initiating consultation on the Sutter Feasibility Study in the next 6 months and this project description will include O&M activities.

March 22, 2013. The Corps initiated section 7 consultation with the Sacramento Fish and Wildlife Office.

BIOLOGICAL OPINION

DESCRIPTION OF ACTION AREA

North to south, the Action Area consists of the 41-mile corridor along the west levee of the Feather River from the Thermalito Afterbay to a point about 4 miles north of the Sutter Bypass. The Action Area includes the project construction area and a 100-foot buffer around this area which includes staging and spoils areas. The project construction area was defined as the area in which levee improvements—such as seepage berms, stability berms, relief wells, sheet-pile walls, and slurry cutoff walls—are likely to be constructed. All direct and indirect effects will occur within this area and the 100-foot buffer around this area.

The corridor is divided into 41 relatively homogeneous reaches for ease of describing existing conditions, project components, land cover-types, and potential effects (note that this number is coincidental and one reach does not correspond to a length of 1 mile; additionally, Reach 1 is not part of the FRWLP) (Figure 1).

The Action Area also includes six potential borrow sites that could supply the borrow material necessary for levee construction and upgrades, and routes from the project construction area to the borrow sites. It is not anticipated that all six sites will be used over the multi-year phased construction period, but until additional geotechnical and soil samplings are completed, all sites will be available for use and are included in the Action Area.

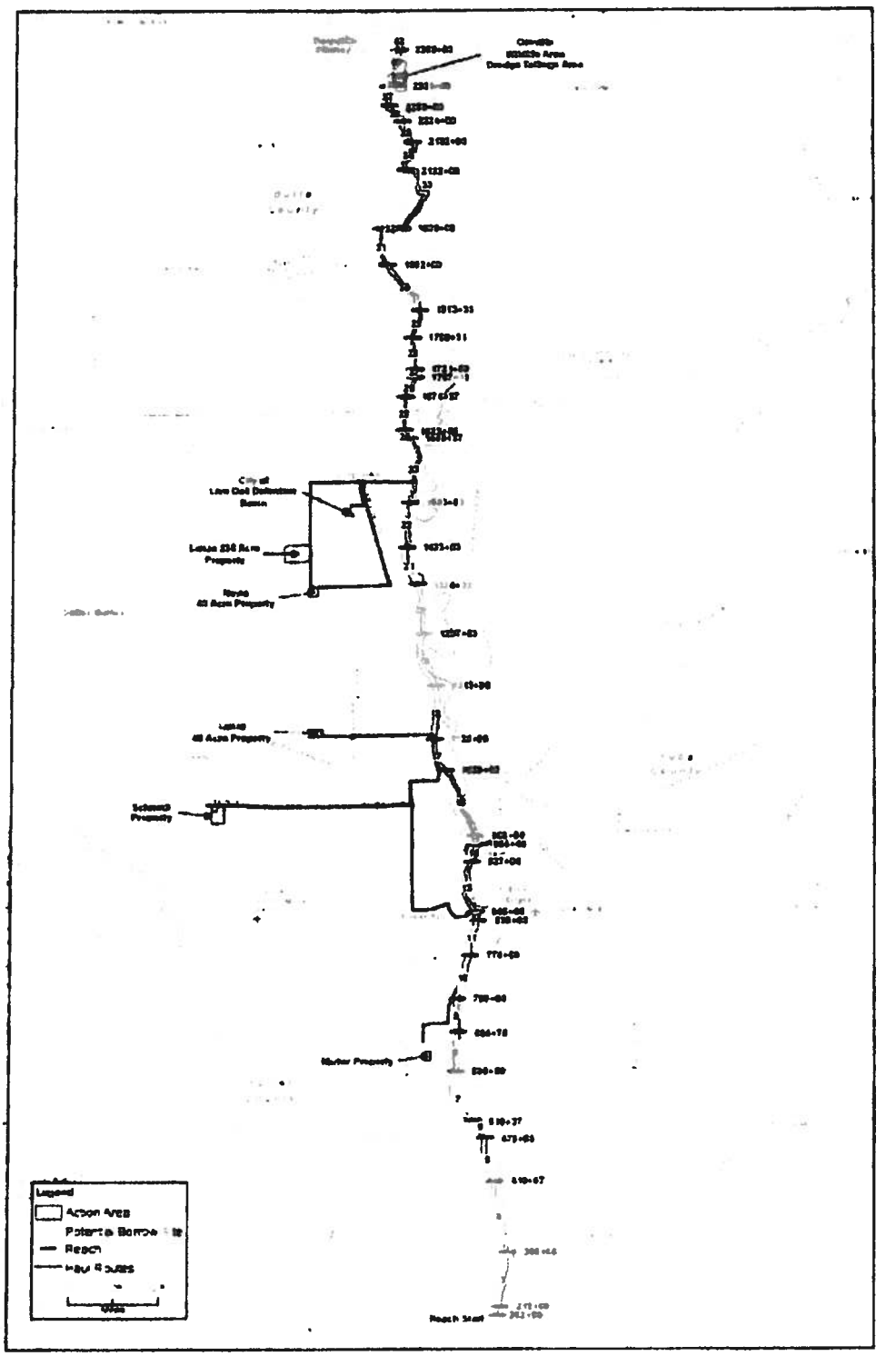


Figure 1. Proposed Project

Finally, the Action Area includes the existing 48.5-acre Star Bend Conservation Area, located on the west levee of the Feather River, about 6 miles south of Yuba City. Compensation for the Proposed Action's effects on the beetle is proposed to occur in a portion of this conservation area, which is discussed below under Conservation Measure 5.

Description of Proposed Action

The primary purpose of the FRWLP is to reduce flood risk in the Sutter Basin by addressing known levee deficiencies along the Feather River West Levee from Thermalito Afterbay downstream to a point about 4 miles upstream of the Feather River's confluence with the Sutter Bypass. While the FRWLP will not by itself reduce all flood risks affecting the Sutter Basin, it will address the most immediate risks based on the following.

- The proximity of the Feather River to population centers and key infrastructure.
- The nature of the Feather River West Levee being the longest and most contiguous portion of the planning area perimeter.
- The location of known levee deficiencies and the clarity and feasibility of available measures to address them.

The construction of the FRWLP will be divided into four separate construction contracts. Contract A begins near the intersection of the Feather River West Levee and Laurel Road. It continues north to the beginning of the improvements constructed as part of the Star Bend Setback Levee Project. The total length of the levee in this portion of the FRWLP is 27,618 linear feet. Contract B begins at the end of the improvements constructed as part of the Star Bend Setback Levee Project, and continues north for 31,963 linear feet. Contract C begins near the north end of the Shanghai Bend Setback Levee, and continues north for a total of 77,886 linear feet. Contract D then begins and continues north for 69,363 linear feet.

For Contract A, a cutoff wall ranging between 10 and 35 feet deep will be constructed along the centerline of the levee for the entire length of levee. The overall height of the levee will be degraded by about 50%. In addition to the cutoff wall, a portion of the levee will have a 9,816-foot-long; 100-foot-wide seepage berm installed.

For Contract B, a cutoff wall ranging between 5 and 25 feet deep will be constructed along the centerline of the levee for 31,600 linear feet. The overall height of the levee will be degraded by about 50%. Relief wells 60 feet apart and 50 feet deep will be installed along a 2,500 linear foot section. Finally, two small sections will involve pipe crossing work.

For Contract C, a cutoff wall ranging between 5 and 65 feet deep will be constructed along the centerline of the levee for 62,117 linear feet. The overall height of the levee will be degraded by about 50%, with about 5,900 linear feet of the levee needing to be fully degraded. A 7-foot tall

and 50-foot-wide seepage berm will be placed near the 10th Street bridge and extend through the existing abandoned railroad tunnel. Finally, there will be a few storm drain pipes replaced within the levee.

For Contract D, a cutoff wall ranging between 10 and 90 feet deep will be constructed along the centerline of the levee for 57,361 linear feet. For all but 317 linear feet of levee, the levee will be degraded by about 50%. The remaining 317 linear feet will have a full levee degrade and reconstruction. A canal runs adjacent to the landside of the levee for 4,723 feet. The landside levee will require reconstruction to the bottom of the canal. Six storm drain and irrigation pipes will need to be replaced along a section of the levee. About 4,800 linear feet of seepage berm will be constructed at the northern end of the proposed project. The berm will very in width between 100 and 170 feet. Additionally, a waterside pit located in this area will be filled.

Materials imported to the construction site will include water, bentonite, cement, incidental construction support materials, aggregate base rock, hydroseed, and up to 1,500,000 cubic yards of embankment fill material for the new levee surfaces from offsite commercial borrow sites or local landowners willing to sell borrow material. For backfill of new pipelines crossing the levee, controlled low strength material (CLSM) (otherwise known as lightweight concrete) will be placed to the pipeline's spring line.

Construction methods for the flood management measures are described in detail below.

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 three methods for constructing a slurry cutoff wall: (1) conventional slot trench, (2) deep soil mixing (DSM), and (3) jet grouting. The first two are the primary methods for application over longer areas, while jet grouting is a spot application based on limiting conditions. A slurry cutoff wall addresses the deficiency of seepage (through- and under-seepage).

Conventional Slot Trench Method - To begin construction, the construction site and any necessary construction staging or slurry mixing areas are cleared, grubbed, and stripped.
In the conventional slot trench method, a trench is excavated at the top center of the levee and into subsurface materials. The size of the trench is based on the severity of the seepage but can be typically 3 feet wide and up to 80–90 feet deep. As the trench is excavated, it is filled temporarily with bentonite water slurry to prevent cave-in. The soil from the excavated trench is hauled to a nearby location where it is mixed with hydrated bentonite to reduce permeability and cement in some applications where increased strength is desired. The soil-bentonite mixture then is returned to the levee and backfilled into the trench. This mixture hardens and creates the impermeable barrier wall in the levee.

In most cases, degradation of the levee crown is necessary to create a large enough working platform to reduce the risk of hydraulic fracturing from the insertion of slurry fluids, and allowing greater depths to be reached. Dependent on the conditions of the particular levee, it may be necessary to degrade the levee by one- to two-thirds its existing height. The material

from degrading the levee is hauled to a nearby stockpile area. Following completion of the slurry cutoff wall, the material is hauled back to the levee to restore the levee to its original dimensions. The material may need to be hauled offsite to a local landfill, and borrow material may need to be imported if the in-situ levee material is found to be unsuitable for current levee standards.

One construction crew typically is able to construct 75–100 linear feet of slurry wall (about 70–80 feet deep) in an 8-hour shift. Equipment needed for the crew includes a long-reach track hoe, three or four dump trucks (15 cubic yard capacity each), two loaders at the mixing location, bulldozers, excavators, loaders, a rough terrain forklift, compactors, maintainers, and a water truck. Vertical clearance of about 40 feet is needed for the excavator boom. Horizontal clearance of about 30 feet beyond the levee crest may be required for excavator swing when loading dump trucks.

A mixing area is located at the construction staging area. The mixing area is to prepare the soil-bentonite mixture and supply bentonite-water slurry. The mixing area is contained to avoid inadvertent dispersal of the mixing materials. Dump trucks haul material between the excavator and the mixing area along the levee.

An access road made of aggregate base rock is constructed on the levee crown to enable regular levee inspections. Post-construction, areas used for construction staging, mixing, the levee crown, slopes, and any other disturbed areas are hydroseeded.

Deep Soil Mixing Method - The DSM method of constructing a slurry cutoff wall uses a crane-supported set of two to four mixing augers (typically 36 inches in diameter) set side by side. These augers are drilled through the levee crown and foundation to the required depth (capable of a maximum depth of about 200 feet). As the augers are inserted and withdrawn, a soil-bentonite grout is injected through the augers and mixed with the native soil. An overlapping series of mixed columns is drilled to create a continuous seepage cutoff barrier.

To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee requires excavation with a paddle wheel scraper. Material is scraped and stockpiled at a nearby stockpile area. Dependent on the depth of the wall required, vertical clearance for the crane also may be needed. An excavator manipulates injector return spoils near the DSM rig, and transport trucks are used to haul spoils offsite. A crane is used for in-place sampling of DSM material and also for loading bentonite into the batch plant hopper. A mobile batch plant (diesel-powered) is required near each DSM rig at the work area to prepare the cement-bentonite grout. The grout is transported to the DSM rig through flexible hoses. Each batch plant requires a pad of 50 by 100 feet. Hauling at the work area involves scraper runs along the levee to the staging area and cement and bentonite deliveries to the batch plant.

During DSM slurry wall construction, one DSM rig typically can construct 50 linear feet of DSM wall per 8-hour shift (for wall depths up to 135 feet). Post-construction, areas used for construction staging, the levee slopes, and any other disturbed areas are hydroseeded.

Jet Grouting Method - Jet grouting involves injecting fluids or binders into the soil at very high pressure. The injected fluid can be grout; grout and air; or grout, air, and water. Jet grouting breaks up soil and, with the aid of a binder, forms a homogenous mass that solidifies over time to create a mass of low permeability. Jet grouting typically is used in constructing a slurry cutoff wall to access areas other methods cannot. In this regard, it is typically a spot application rather than a treatment to be applied on a large scale along an entire reach.

Equipment required for jet grouting consists of a drill rig fitted with a special drill string; a high pressure, high flow pump; and an efficient batching plant with sufficient capacity for the required amount of grout and water. The high-pressure pump conveys the grout, air, and/or water through the drill string to a set of nozzles located just above the drill bit. The diameter of the jet grout column is dependent on site-specific variables such as soil conditions, grout mix, nozzle diameter, rotation speed, withdrawal rate, and grout pressure. Jet grouted columns range from 1 to 16 feet in diameter and are typically interconnected to form cutoff barriers or structural sections. Under ideal conditions, one construction crew—consisting of a site supervisor, pump operator, batch plant operator, chuck tender, and driller—can construct two 6-foot diameter, 50-foot columns per day consisting of about 100 cubic yards of grout injected per 8-hour shift. Ideal conditions will be characterized by no technical issues occurring at either the batch plant or the drilling site, such as loss of fluid pressure, breakdown of equipment, or subsurface obstructions to drilling operations.

To initiate jet grouting, a borehole is drilled through the levee crown and foundation to the required depth (to a maximum depth of about 130 feet) by rotary or rotary-percussive methods using water, compressed air, bentonite, or a binder as the flushing medium. When the required depth is reached, the grout is injected at a very high pressure as the drill string is rotated and slowly withdrawn. Use of the double, triple, and superjet systems create eroded spoil materials that are expelled out of the top of the borehole, this material is frequently used as a construction fill.

To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee may require degradation with a paddle wheel scrapper. Material is scraped and stockpiled at a nearby stockpile area. Hauling at the work area involves scraper runs along the levee to the staging area and grout, bentonite, and water deliveries to the batch plant.

Batch plants are typically centrally located to the injection site, with pipelines for mixed grout that run the length of the work. Grout mixing and injection equipment consists of grout mixers, high powered grout pumps and supporting generators and air compressors, holding tanks, and water tanks, with bulk silos of grout typically used to feed large mixers. Smaller equipment can be used in combination with the single phase-fluid system and can be permanently trailer-mounted to permit efficient mobilization and easy movement at the job site.

Prior to commencing production jet grouting, a field test program is typically completed to evaluate injection parameters and to assess jet grout column geometries, and mechanical and permeability properties. Where possible, jet grout test elements are exposed by excavation and properties are obtained by direct measurement. Where excavation is not possible, core drilling is employed to obtain samples from the jet grout test columns for strength testing.

Areas used for construction staging, the levee slope, and any other disturbed areas are restored and hydroseeded following construction.

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 a standard of 3:1 (horizontal to vertical), but this may vary based on site-specific conditions and supporting engineering analysis. Slope flattening addresses the deficiency of slope stability and geometry. To begin slope flattening activities, the area is cleared, grubbed, and stripped to provide space for construction and reshaping of slopes. Additional embankment fill material may be necessary to achieve slope flattening—if so, bulldozers excavate and stockpile borrow material from a nearby permitted borrow site. Front-end loaders load haul trucks with the borrow material. The haul trucks transport the material to slope flattening site. Motor graders spread material evenly according to levee design plans, and sheepsfoot rollers compact the material. Water trucks distribute water over the material to ensure proper moisture for compaction.

To reshape a waterside slope, the existing crown of the levee is shifted farther landward and the waterside slope is trimmed and reshaped to a 3:1 slope. The shifted levee crown will be a minimum of 20 feet wide, with a 3:1 slope on the landward side. An access road made of aggregate base rock is constructed on the levee crown. Post-construction, the construction staging areas, levee slopes, and any other disturbed areas will be hydroseeded.

Stability Berm

A stability berm will 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. To begin the construction of a stability berm, the site is cleared, grubbed, and stripped to provide space for construction and shaping of the berm. Embankment fill material necessary to construct the berm is excavated by a bulldozer from a nearby borrow site. Front-end loaders load haul trucks with the borrow material, and the haul trucks transport the material to the stability berm site. Motor graders spread the material evenly according to design specifications, and a sheepsfoot roller compacts the material. Water trucks distribute water over the material to ensure proper moisture for compaction.

Stability berms may be drained or undrained. An undrained berm consists of embankment fill only. A drained berm includes a layer of drain rock placed along the ground surface underneath the fill material, separated by a casing of filter fabric. Drainage water seeping from the berm will sheetflow on the adjacent landside surface.

Levee Reconstruction

Levee reconstruction will 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. The existing levee is first cleared, grubbed, and stripped to the desired surface to allow a working platform for other measures (such as a slurry cutoff wall), to remove an encroachment, or to remove substandard material. Embankment fill material necessary to construct the new levee is excavated by a bulldozer from a nearby borrow site. Front-end loaders load haul trucks with the borrow material and the haul trucks transport the material to the stability berm site. Motor graders spread the material evenly according to design specifications, and a sheepsfoot roller compacts the material. Water trucks distribute water over the material to ensure proper moisture for compaction. The new levee will be built in cross section to meet current engineering standards.

Sheet-Pile Wall

A sheet-pile wall is a series of vertical panels of interlocking steel that is placed parallel to the levee, typically through the center of the levee crown to provide an impermeable barrier. A sheet-pile wall addresses the deficiencies of seepage and will be used only as a site-specific treatment (rather than applied on a reach-wide basis) such as at roadway or railroad crossings. The site where sheet piles are to be installed is cleared, grubbed, and stripped to allow for construction activities, including removal of the roadway or railroad. A hydraulic- or pneumatically-operated pile-driving head attached to a crane drives the sheet pile into the levee crown to the desired depth (up to 135 feet). If the levee material is particularly solid, pre-drilling may be necessary. The conditions of the site and the desired life of the project determine the thickness and configuration of the sheet piles.

Post-construction, construction staging areas, the levee crown, slopes, and any other disturbed areas are hydroseeded and the roadway or railroad will be replaced in-kind to the pre-project condition.

Seepage Berm

Seepage berms are wide embankment structures made up of low-permeability materials that resist accumulated water pressure and safely release seeping water. A seepage berm is typically one-third the height of the levee, extending outward from the landside levee toe for 300–400 feet, and laterally along the levee as needed relative to the seepage conditions. A seepage berm addresses the deficiency of under-seepage. A seepage berm can vary in width, from a minimum of four times the levee height to a maximum of 300 feet. Berm heights can also vary but are typically a minimum of 5 feet tall at the landside toe of the levee and generally taper down to 3 feet at the end of the berm.

Construction consists of clearing, grubbing, and stripping the ground surface. Bulldozers then excavate and stockpile borrow material from a nearby borrow site. Front-end loaders load haul trucks, and the haul trucks subsequently transport the borrow material to the berm site. The haul trucks dump the material and motor graders spread it evenly, placing 3–5 feet of embankment fill material. Sheepsfoot rollers compact the material, and water trucks distribute water over the material to ensure proper moisture for compaction.

Seepage berms may have an optional feature of a drainage relief trench under the toe of the berm. Drained seepage berms include the installation of a drainage layer (gravel or clean sand) beneath the seepage berm backfill and above the native material at the levee landside toe. A drained seepage berm does not increase the overall footprint of the berm. Post-construction, areas used for construction staging, the levee, the berm, and any other disturbed areas are hydroseeded.

Relief Wells

Relief wells are passive systems that are constructed near the levee landside toe to provide a 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 constructed using soil-boring equipment to drill a hole vertically through the fine-grained blanket layer (sand) into the coarse-grained aquifer layer (gravel) beneath. Pipe casings and gravel/sand filters are installed to allow water to flow freely to the ground surface, relieving the pressure beneath the clay blanket without transporting fine materials to the surface, which can undermine the levee foundation. Relief wells will be designed to discharge onto a cobble splash, and the water will then sheet flow into adjacent agricultural fields. In areas where sheet flow is not feasible, a swale will be excavated and connected to a drainage canal.

Relief wells generally are spaced at 50- to 100-foot intervals, dependent upon the amount of under-seepage, and extend to depths of 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. The drill rig likely will be an all-terrain, track-mounted rig that could access the well locations from the levee toe.

Piezometers, also called monitoring wells, could be installed between relief wells to allow monitoring of groundwater levels to ensure the wells are relieving the pressure within the aquifer.

Areas along the levee toe may be used to store equipment and supplies during construction of each well. Construction of each well and the lateral drainage system typically takes 10–20 days. Additional time may be required for site restoration. Post-construction, areas used for construction staging, the levee slopes, and any other disturbed areas are hydroseeded.

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 surrounding soil mass. This measure involves placing fill soil in such depressions and ditches to remove localized susceptibility to seepage. Construction consists of clearing, grubbing, and stripping the ditch or depression surface to remove vegetative material. Bulldozers then excavate and stockpile borrow material from a nearby borrow site.

Front-end loaders load haul trucks, and the haul trucks subsequently transport the borrow material to the fill site. The depression or ditch may be further excavated to provide a surface that the fill soil may be keyed into. The haul trucks dump the material and motor graders or bulldozers smooth the material level with the surrounding land surface. An excavator may also be used for placement. Sheepsfoot rollers compact the material, and water trucks distribute water over the material to ensure proper moisture for compaction.

Removal and Relocation of Pacific Gas & Electric Facilities

Prior to and/or concurrent with levee rehabilitation construction, Pacific Gas and Electric Company (PG&E) will need to remove and relocate facilities located within the footprint of the FRWLP. PG&E's utility relocations will need to occur in advance of SBFCA's construction activities at any given location. Construction sequencing for SBFCA's work will be dynamic throughout SBFCA's project planning and design. PG&E's construction schedule will be determined by further engineering to clarify and determine efficacy of site-specific measures; the availability of funding for FRWLP; easement and right-of-way acquisition; availability of borrow material for the levee improvement activities; and/or environmental clearances based on wildlife presence, lifecycle activity, and location of habitats. PG&E's construction schedule will be further influenced by utility operation and maintenance constraints, particularly for relocation activities that require taking existing facilities temporarily out of service. As necessary, geotechnical mitigation measures will be incorporated into construction design to ensure that utility facilities effectively co-exist with the FRWLP, relocation will be done where this is not feasible.

For PG&E's electrical transmission and distribution activities, PG&E will install and remove new electrical transmission and distribution poles. Electrical transmission and distribution pole removal is conducted by a line crew, who typically access each pole site with a line truck and trailer or a boom truck, except in those instances when the pole is located on the levee crown (a crane may be used in those instances). On average, removal of vegetation up to 50 feet from the toe of the levee will need to occur to accommodate pole installation activities; this distance may be greater in instances where the installation activity is located further than 30 feet from the levee toe. After vegetation is cleared, PG&E will remove and replace the existing wood distribution and power poles and related equipment.

For PG&E's natural gas transmission and distribution activities, PG&E will install gas transmission and distribution steel pipe. This also typically includes the removal and disposal of existing pipe. Other typical types of gas transmission and distribution equipment that may be installed include Electric Test System/ Gas Cathodic Test System meter stations for future pipe monitoring purposes, and pipeline markers at angle points and at levee crossing locations. Clearing and grading operations in support of installation of natural gas facilities typically involve preparation of the right-of-way, including vegetation removal, debris disposal, and land leveling. Installation sites are backfilled using sand to create a 6-inch insulation zone around the pipe and then covered by native soil from the project area. In some instances, a crane may be required to place pipe at crossing sites located at the crowns of the levees. Dump trucks will be used to transport sand and soil materials. Spoil piles may be temporarily placed onsite while the installation activities are occurring.

Hydrostatic testing associated with installation of natural gas facilities will be performed to test the strength of the new pipeline. Test water intake and discharge will be performed in accordance with all regulations and permit requirements.

Typical electrical and natural gas transmission and distribution project work schedules are comprised of an average 9-hour day, at an average of 6 days per week per crew. Typical crews consist of 3 to 5 members.

PG&E work areas will be about 125 feet by 125 feet in diameter and located in close proximity to installation activity locations. On average, PG&E will require up to 10 work areas per contract phase. PG&E will utilize the work areas identified by SBFCA whenever possible. Typically, PG&E project access is achieved through existing public and private roads. Removal of vegetation to utilize access roads by PG&E equipment and transport of facilities may be required. PG&E currently owns easements along the entire project corridor. However, temporary and/or permanent easements as required for construction and maintenance of these facilities are being acquired by SBFCA.

Encroachment and Vegetation Removal

Encroachments - Existing facilities found within the footprint of an alternative may require removal and replacement nearby, abandonment, or relocation. Encroachments are numerous (over 400 identified) along the Feather River West Levee and may need to be addressed if they present a threat to the stability of the levee, do not currently comply with the levee encroachment criteria, or will be disrupted or otherwise impacted by construction activities. Typical encroachments include pressure pipelines (water supply pipelines from waterside pump stations and drainage pipelines from landside drainage pump stations), gravity drainage pipes, gas lines, telephone utilities, overhead utilities, structural encroachments, and other types and variations. Debris from structure and embankment fill material of poor quality will be hauled offsite to a permitted disposal site within 20 miles of the removal location.

Vegetation Removal - Vegetation removal will involve stripping of herbaceous (non-woody) vegetation by bulldozer. Vegetation will be removed only from within the direct construction footprint and the minimum areas necessary for staging and access. Consistent with the Central Valley Flood Protection Plan guidance for levee repair or improvement, vegetation will be removed to meet specific project objectives. Any vegetation removed as part of direct construction activities will not be replaced at that location, but will involve offsite, in-kind mitigation, to be determined in consultation with the appropriate resource agencies.

In accordance with the State of California's Urban Levee Design Criteria, at a minimum, all roots larger than 1.5 inches in diameter that are within 3 feet of the perimeter of the tree trunk will be removed. Immature trees less than 4 inches in diameter at breast height that will be removed may be cut off at or below ground level, generally without root removal. Any excavation will be

backfilled with engineered fill using appropriate placement, moisture conditioning, and compaction methods. Additional measures for removing non-compliant vegetation are listed below.

- Ensure that the resulting void is free of organic debris.
- Cut poles to salvage propagation materials for replanting, such as willows and cottonwoods.
- Conduct hand clearing using chainsaws and trimmers.
- Conduct mass clearing using bulldozers.

Debris from vegetation removal will be hauled offsite to a permitted disposal site within 20 miles of the removal location.

Construction Staging, Access, and Temporary Facilities

Staging areas will only be provided within the Action Area. Staging areas will be used for staging construction activities and to provide space to house construction equipment and materials, offices, employee parking, and other uses needed for construction of the proposed project.

To facilitate construction, temporary earthen ramps will be constructed for equipment access between the levee crown and the staging area(s). The earthen ramps will be removed when construction is complete.

Cutoff wall construction requires temporary establishment of an onsite slurry batch plant that will occupy about 1–2 acres. Batch plants will be located at about 1-mile intervals along the levee. The batch plant site will likely contain tanks for water storage, bulk bag supplies of bentonite, bentonite storage silos, a cyclone mixer, pumps, and two generators that meet air quality requirements. Slurry ingredients will be mixed with water and the mixture will be pumped from tanks through pipes to the construction work sites. The batch plant will produce two different slurry mixes, one for trench stabilization and one for the soil backfill mix. Therefore, two slurry pipes or hoses, typically 4- or 6-inch high-density polyethelene pipes, will be laid on the ground and will extend to all work sites. An additional pipe may be used to supply water to the work sites.

Staging, access, and other temporary construction areas will be located away from wetlands, woody vegetated areas, wildlife species habitat, known cultural resources, or other sensitive areas and will be limited to disturbed or ruderal grasslands subject to review by Corps and resource agencies.

Material Importation, Reuse, and Borrow

Materials imported to the FRWLP construction area will include water, bentonite, cement, incidental construction support materials, aggregate base rock, asphalt, concrete, hydroseed, and embankment fill soil. Large quantities of fill soil, or borrow will be required. To meet borrow demands, embankment fill material excavated as part of construction will be evaluated for reuse. Embankment fill material deemed suitable will be used as part of levee reconstruction and berms. The total volume of material required is 1,500,000 cubic yards.

SBFCA has explored the option of purchasing fill or borrow material from a local commercial quarry or other permitted source; however, there are not currently any sites near the Action Area that could supply the volume and type of material required. Consequently, SFBCA plans to purchase fill from local landowners willing to sell borrow material.

Six borrow sites have been identified in the Action Area. Each site was investigated to determine the quantity of available material, hauling distance, material composition, groundwater elevation, and prospects for acquisition. Sufficient fill volume is estimated to be present within an approximate 10-mile, one-way haul distance from the area of construction.

SBFCA will maximize the potential borrow sites' use through gradation, placement, and treatment so that they could continue to be used for their current use or otherwise returned to their pre-project condition. As part of borrow operations, the upper 4–6 inches of topsoil will be set aside and replaced after construction in each construction season. After the FRWLP is completed, the borrow site will be re-contoured and reclaimed.

Through outreach efforts, SBFCA identified a number of sites owned by individuals or government agencies willing to sell their property or provide material on a cubic yard basis. Each borrow site is described below.

North Valley Property - The North Valley property is owned by North Valley Properties, LLC and is located south of Ella Road between Feather River Boulevard and Arboga Road. The Wheeler Ranch housing development is proposed at the site. Borrow for the FRWLP will be taken from the northeast corner of the property to create a 24.5 acre detention pond (referred to as the Drainage Basin C Regional Detention Pond, but commonly referred to as the South Ella Detention Pond). The Ella Basin is being constructed as part of Reclamation District No. 784's Master Drainage Plan. Historically, the site was cultivated for agricultural purposes. Currently, the site is disked ruderal grassland with some roads cut in the southern portion of the property for the Wheeler Ranch development. The depth of excavation is anticipated to be 15–20 feet and the yield of material from this site could be 400,000–500,000 cubic yards. Borrow material from this site will be used for work in Contracts B and C. If borrow material is remaining, it may also be used for Contract D. The haul route to Contract C will use existing roads. The post-project land use of the site will be a regional detention pond for Reclamation District No. 784.

Marler Property - The Marler property is a 10-acre property at Johnson Road near Messick Road, north of Star Bend and south of Shanghai Bend. The site is currently an orchard. The depth of

excavation could be upwards of 6 feet. The yield of material from this site could be 75,000 cubic yards. The haul route will use existing roads. The post-project land use for the property will be agricultural production, likely row crops or orchard.

Lanza Property - The Lanza property is 40 acres in size and is currently farmed in field/row crops. It is located at North Township Road and Pease Road south of Live Oak and north of Yuba City. The site has not yet been investigated to determine the types of materials present. Excavation of the site to a depth of 6 feet may occur. The yield of material from this site could be 200,000 cubic yards. The likely haul route will be along Pease Road directly east to the levee. The post-project land use for the property will be rice production.

City of Live Oak Detention Basin - Live Oak owns the property formerly known as the Caltrans Detention Basin Site located west of SR 99 and south of Paseo Avenue. The site is currently fallow. Live Oak intends to construct soccer fields and a stormwater detention basin at the site in 2013 or later. Although the site will require hauling for a short distance through a residential neighborhood, it is anticipated the residents will be amenable to the hauling as it will be a part of the public amenity constructed by Live Oak. This site is about 25 acres, and the depth of excavation is anticipated to be 3–6 feet. The yield of material from this site could be 125,000 cubic yards, and will likely be used for Contract C. Haul routes will use existing roads.

Live Oak (2012) reports that land at this location has historically been cultivated for agricultural purposes and reported that there was no evidence of any wetland or other sensitive plant or wildlife areas remaining onsite. No wetland features were identified during a preliminary wetland delineation of the area in December 2012. The previous agricultural use has displaced native species of plants and animals except those varieties capable of co-existing with humans in urban settings. The post-project use of the site will be a community park and stormwater detention basin facility.

Oroville Wildlife Area Dredge Tailings Area - This site is within the Oroville Wildlife Area and consists of several mounds of dredge tailings waterside of the existing levee. The material is suitable for use in seepage berms in Contract D. The availability of tailings in the area should be sufficient to meet the total deficit for berm material in these reaches. The excavation of the material will be coordinated to maximize hydraulic benefits from the reshaping of the overbank area. The site also represents an opportunity to provide waterside habitat enhancements. The useful area of this site could be about 75 acres and the depth of excavation could be upwards of 10 feet. The yield of material from this site could be 375,000 cubic yards. Hauling from this site will not take place on public roads. It is anticipated the contractor will use an existing waterside levee ramp (or create one), directly accessing the levee patrol road. The future land use for this site will be similar to its present day use (managed habitat area).

Construction Timing

Specific sequencing of construction will be dynamic throughout planning and design of the FRWLP, subject to change based on factors including the following.

- Further engineering in determining the clarity and efficacy of site-specific measures.

- Easement and right-of-way acquisition (where necessary).
- Availability of proximate, suitable, and cost-effective borrow material.
- Environmental clearances based on wildlife presence, lifecycle activity, and location of habitats.

Based on current planning analysis for the FRWLP, construction will occur in more than one annual construction season (typically April 15 to November 30, subject to conditions). Although subject to change, the four contracts and their respective areas for construction of the FRWLP are identified below.

- Contract A, 2016 – 2017
- Contract B, 2014 – 2015
- Contract C, 2013 – 2014
- Contract D, 2014 – 2015

Construction is anticipated to occur in single 10-hour shifts, 6 days per week. An exception to this schedule is slurry cutoff wall construction, which is anticipated to occur in two 10-hour shifts (essentially 24-hour construction), 6 days per week. While actual construction will not occur between the two 10-hour shifts, equipment maintenance and preparations for the upcoming work shift will occur.

Conservation Measures

SBFCA will implement the following conservation measures to avoid and minimize effects on federally listed species. To ensure their implementation, the measures listed below will be included in the project specifications.

General

Conservation Measure 1: Conduct Mandatory Biological Resources Awareness Training for All Project Personnel and Implement General Requirements

Before any ground-disturbing work (including vegetation clearing and grading) occurs in the Action Area, a Service-approved biologist will conduct a mandatory biological resources awareness training for all construction personnel about federally-listed species that could potentially occur onsite (beetle and snake). The training will include the natural history, representative photographs, and legal status of each federally-listed species and avoidance and minimization measures to be implemented. Proof of personnel attendance will be provided to the Service within 1 week of the training. If new construction personnel are added to the project, the contractor will ensure that the new personnel receive the mandatory training before starting work. The subsequent training of personnel can include videotape of the initial training and/or the use of written materials rather than in-person training by a biologist. Requirements that will be followed by construction personnel are listed below.

- Where suitable habitat is present for listed species, SBFCA will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other means, and prohibit any construction-related traffic outside these boundaries.
- Project-related vehicles will observe the posted speed limit on hard-surfaced roads and a 10-mile-per-hour speed limit on unpaved roads during travel in the project construction area. Project-related vehicles and construction equipment will restrict off-road travel to the designated construction areas.
- All food-related trash will be disposed of in closed containers and removed from the project construction area at least once per week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the project site.
- No pets or firearms will be allowed in the project construction area.
- To prevent possible resource damage from hazardous materials such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.
- Any worker who inadvertently injures or kills a federally-listed species or finds one dead, injured, or entrapped will immediately report the incident to the biological monitor and construction foreman. The construction foreman will immediately notify SBFCA, who will provide verbal notification to the Sacramento Fish and Wildlife Office and the local CDFW warden or biologist within 1 working day. SBFCA will follow up with written notification to Service and CDFW within 5 working days. The biological monitor will follow up with SBFCA to ensure that the wildlife agencies were notified.
- The biological monitor will record all observations of federally-listed species on California Natural Diversity Database (CNDDB) field sheets and submit to CDFW.

Valley Elderberry Longhorn Beetle

Conservation measures for the beetle are based on Service's 1999 *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (Conservation Guidelines) (U.S. Fish and Wildlife Service 1999a).

Conservation Measure 2: Fence Elderberry Shrubs to be Protected and Monitor Fencing during Construction

Elderberry shrubs/clusters within 100 feet of the construction area that will not be removed will be protected during construction. A qualified biologist (i.e., with elderberry/beetle experience), under contract to SBFCA, will mark the elderberry shrubs and clusters that will be protected during construction. Orange construction barrier fencing will be placed at the edge of the respective buffer areas. The buffer area distances will be proposed by the biologist and approved by the Service. No construction activities will be permitted within the buffer zone other than those activities necessary to erect the fencing. Signs will be posted every 50 feet (15.2 meters) along the perimeter of the buffer area fencing. The signs will contain the following information:

This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment.

In some cases, where the elderberry shrub dripline is within 10 feet of the work area, k-rails will be placed at the shrub's dripline to provide additional protection to the shrub from construction equipment and activities. Temporary fences around the elderberry shrubs and k-rails at shrub driplines will be installed as the first order of work. Temporary fences will be furnished, constructed, maintained, and later removed, as shown on the plans, as specified in the special provisions, and as directed by the project engineer. Temporary fencing will be 4 feet (1.2 meters) high, commercial-quality woven polypropylene, orange in color.

Buffer area fences around elderberry shrubs will be inspected weekly by a qualified biological monitor during ground-disturbing activities and monthly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around elderberry shrubs throughout construction. Biological inspection reports will be provided to the project lead and the Service.

Conservation Measure 3: Conduct Beetle Surveys Prior to Elderberry Shrub Transplantation

Surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. Surveys will be conducted in accordance with the Conservation Guidelines (U.S. Fish and Wildlife Service 1999a). The biologist will survey the area surrounding the shrub to be transplanted to ensure that there are not additional elderberry shrubs that need to be removed. Surveys will consist of counting and measuring the diameter of each stem, and examining elderberry shrubs for the presence of beetle exit holes. Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to the Service. SBFCA plans to plant elderberry seedlings/cuttings and associated native plants prior to transplantation of elderberry shrubs. The data collected during the surveys prior to transplantation will be used to determine if SFBCA is exceeding their compensation needs or if additional plantings are necessary. Because the Proposed Action will be constructed in four separate contracts, elderberry survey data for each contract will be used to rectify any discrepancies in compensation for the previous contract and to ensure that SBFCA has minimized effects to the beetle.

Conservation Measure 4: Water Down Construction Area to Control Dust

SFBCA or the contractor will ensure that the project construction area will be watered down as necessary to prevent dirt from becoming airborne and accumulating on elderberry shrubs within the 100–foot buffer.

Conservation Measure 5: Compensate for Direct and Indirect Effects on Valley Elderberry Longhorn Beetle Habitat

Before construction begins, SBFCA will compensate for direct effects on elderberry shrubs by transplanting shrubs that cannot be avoided to a Service-approved conservation area (described below). Elderberry seedlings or cuttings and associated native species will also be planted in the conservation area. Each elderberry stem measuring 1 inch or greater in diameter at ground level that is adversely affected (i.e., transplanted or destroyed) will be replaced, in the conservation

area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). The numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether the shrub lies in a riparian or non-riparian area. Stock of either seedlings or cuttings will be obtained from local sources (including the Action Area if acceptable to the Service).

At the discretion of the Service, shrubs that are unlikely to survive transplantation because of poor condition or location, or a plant that will be extremely difficult to move because of access problems, may be exempted from transplantation. In cases where transplantation is not possible, compensation ratios will be increased to offset the additional habitat loss.

The relocation of the elderberry shrubs will be conducted according to Service-approved procedures outlined in the Conservation Guidelines (U. S. Fish and Wildlife Service 1999a). Elderberry shrubs within the project construction area that cannot be avoided will be transplanted during the plant's dormant phase (November through the first 2 weeks of February). A qualified biological monitor will remain onsite while the shrubs are being transplanted.

Property inaccessibility and the high density of vegetation along portions of the Feather River riparian corridor limited the number of elderberry shrubs that could be surveyed (73 shrubs were surveyed). For this reason, compensation for the removal of 91 shrubs was estimated based on the average number of stems in each stem diameter range for the 73 shrubs that could be surveyed. Those average shrub stem counts are as follows.

- Number of stems $\geq$1 inch and $\leq$3 inches = 4.
- Number of stems >3 inches and <5 inches = 1.
- Number of stems $\geq$5 inches = 1.

Table 1 shows the estimated compensation. Because the shrubs are located in riparian habitat and did not have exit holes, the compensation ratios for these conditions were used. As noted in Table 1, one elderberry shrub will need to be transplanted prior to the start of work in 2013 (in Reach 13) and outside of the elderberry dormancy period.

Based on the information in Table 1, the conservation area will be at least 12.15 acres in size to accommodate about 91 elderberry shrubs, 1,470 elderberry cuttings or seedlings, and 1,470 native plants. The conservation area in which the transplanted elderberry shrubs and seedlings are planted will be protected in perpetuity as habitat for the beetle.

Evidence of beetle occurrence in the conservation area, the condition of the elderberry shrubs in the conservation area, and the general condition of the conservation area itself will be monitored over a period of 10 consecutive years or for 7 years over a 15-year period from the date of transplanting. SBFCA will be responsible for funding and providing monitoring reports to the Service in each of the years in which a monitoring report is required. As specified in the Conservation Guidelines, the report will include information on timing and rate of irrigation, growth rates, and survival rates and mortality.

Table 1. Elderberry Stem Sizes and Compensation

Location	Stems (maximum diameter at ground level)	Exit Hole on Shrub (Yes or No)	Elderberry Seedling Ratio	Associated Native Plant Ratio	Multiplier for transplanting between June 15 – August 15	Number of Stems	Required Elderberry Plantings	Required Associated Native Plant Plantings
Riparian	stems ≥1" & ≤3"	No	2:1	1:1	No	360	720	720
Riparian	stems > 3" & <5"	No	3:1	1:1	No	90	270	270
Riparian	stems > 5"	No	4:1	1:1	No	90	360	360
2013 Construction - Reach 13								
Riparian	stems ≥1" & ≤3"	No	2:1	1:1	2.5	1	5	5
Riparian	stems > 3" & <5"	No	3:1	1:1	2.5	2	15	15
Riparian	stems > 5"	No	4:1	1:1	2.5	10	100	100
Total replacement plantings							1,470	1,470
Total elderberry shrubs to be transplanted								91
2940 /10 = 294 valley elderberry longhorn beetle credits or 12.15 acres								

To meet the success criteria specified in the Conservation Guidelines, a minimum survival rate of 60% of the original number of elderberry replacement plantings and associated native plants must be maintained throughout the monitoring period.

Proposed Conservation Area

SBFCA proposes to transplant elderberry shrubs to the existing 48.5-acre Star Bend Conservation Area, located on the west levee of the Feather River, about 6 miles south of Yuba City. In 2009, Levee District 1 of Sutter County proposed to construct the Feather River Setback Levee and Habitat Enhancement Project at Star Bend to replace a portion of existing levee that poses a high risk of failure in order to decrease the flood stage, velocity, and scour potential; increase and improve floodplain habitat; and improve habitat connectivity between the Abbot Lake and O'Connor Lakes Units of CDFW's Feather River Wildlife Area. The Star Bend project created 48.5 acres of floodplain habitat, which included habitat enhancement and onsite compensation for impacted elderberry shrubs.

In 2009, River Partners and Stillwater Sciences prepared a *Habitat Enhancement Plan for the Feather River Setback Levee and Habitat Enhancement Project at Star Bend* to be implemented by Levee District 1. It provides further information on the conditions at the time the site was proposed. About 20 acres have been used for elderberry transplants and associated native plants. In early 2012, a fire at the Star Bend site damaged portions of the site; however, elderberry shrub

planting losses were minimal. The remaining 28.5 acres are available at the conservation area for compensating for impacts on elderberry shrubs from construction of the FRWLP. The long-term goal of the conservation area is to merge this area with CDFW's adjoining O'Conner Lakes and Abbott Lakes Wildlife Units. SBFCA will prepare a mitigation and monitoring plan for the 28.5 acres that are available and will be used as a conservation area for effects to the beetle, as well as riparian impacts. This plan is currently being coordinated with the Service, Corps, and CDFW. Additionally, SBFCA will obtain a conservation easement for the 28.5 acre conservation area.

Giant Garter Snake

Conservation Measure 6: Conduct Construction Activities during the Active Period for Giant Garter Snake

Construction activity within giant garter snake aquatic and upland habitat (200 feet of aquatic habitat) will be conducted during the snake's active period (May 1–October 1). During this timeframe, potential for injury and mortality are lessened because snakes are actively moving and avoiding danger. The only work that will be conducted outside of the active season is levee slope flattening within the Sutter-Butte Canal in Reaches 26–28 (scheduled for 2016) and pipe reconstruction at two sites in the same reaches because these activities must be conducted when the canal is dry (February–March). Additional protective measures will be implemented at these locations (see Conservation Measure 14 below).

Conservation Measure 7: Install and Maintain Exclusion and Construction Barrier Fencing around Suitable Giant Garter Snake Habitat

To reduce the likelihood of giant garter snakes entering the construction area, SBFCA will install exclusion fencing and orange construction barrier fencing along the portions of the construction area that are within 200 feet of suitable aquatic and upland habitat. The exclusion and construction barrier fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during this activity.

The construction specifications will require that SBFCA or its contractor retain a qualified biologist to identify the areas that are to be avoided during construction. Areas adjacent to the directly affected area required for construction, including staging and access, will be fenced off to avoid disturbance in these areas. Before construction, the contractor will work with the qualified biologist to identify the locations for the barrier fencing and will place flags or flagging around the areas to be protected to indicate the locations of the barrier fences. The protected area will be clearly identified on the construction specifications. The fencing will be installed the maximum distance practicable from the aquatic habitat areas and will be in place before construction activities are initiated.

The exclusion fencing will consist of 3-foot-tall silt fencing buried 6 inches below ground level. The exclusion fencing will ensure that giant garter snakes are excluded from the construction area and that suitable upland and aquatic habitat is protected throughout construction. The construction barrier fencing will be commercial-quality, woven polypropylene, orange in color,

and 4 feet high (Tensor Polygrid or equivalent). The fencing will be tightly strung on posts with a maximum of 10-foot spacing.

Barrier and exclusion fences will be inspected daily by a qualified biological monitor during ground-disturbing activities and weekly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around giant garter snake habitat throughout construction. Biological inspection reports will be provided to the project lead and the Service.

Conservation Measure 8: Minimize Potential Impacts on Giant Garter Snake Habitat

SBFCA will implement the following measures to minimize potential impacts on giant garter snake habitat.

- Staging areas will be located at least 200 feet from suitable giant garter snake habitat.
- Any dewatered habitat will remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat.
- Vegetation clearing within 200 feet of the banks of suitable giant garter snake aquatic habitat will be limited to the minimum area necessary. Avoided giant garter snake habitat within or adjacent to the Action Area will be flagged and designated as an environmentally sensitive area, to be avoided by all construction personnel.
- The movement of heavy equipment within 200 feet of the banks of suitable giant garter snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance.

Conservation Measure 9: Prepare and Implement a Stormwater Pollution Prevention Plan

SBFCA will prepare a stormwater pollution prevention plan (SWPPP) that describes the BMPs that will be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP will be prepared prior to commencing earth-moving construction activities. This will also comply with the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) general construction activity stormwater permit.

The specific BMPs that will be incorporated into the erosion and sediment control plan and SWPPP will be site-specific and will be prepared by the construction contractor in accordance with the California Regional Water Quality Control Board Field Manual. However, the plan likely will include, but not be limited to, one or more of the following standard erosion and sediment control BMPs.

- **Timing of construction.** The construction contractor will conduct all construction activities during the typical construction season to avoid ground disturbance during the rainy season.
- **Staging of construction equipment and materials.** To the extent possible, equipment and materials will be staged in areas that have already been disturbed.

- **Minimize soil and vegetation disturbance.** The construction contractor will minimize ground disturbance and the disturbance/destruction of existing vegetation. This will be accomplished in part through the establishment of designated equipment staging areas, ingress and egress corridors, and equipment exclusion zones prior to the commencement of any grading operations.
- **Stabilize grading spoils.** Grading spoils generated during the construction will be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If necessary, temporary stockpiles may be covered with an appropriate geotextile to increase protection from wind and water erosion.
- **Install sediment barriers.** The construction contractor may install silt fences, fiber rolls, or similar devices to prevent sediment-laden runoff from leaving the construction area. Natural/biodegradable erosion control measures (i.e., coir rolls, straw wattles or hay bales) will be used. Plastic monofilament netting (erosion control matting) will not be allowed because animals can become caught in this type of erosion control material.
- **Stormwater drain inlet protection.** The construction contractor may install silt fences, drop inlet sediment traps, sandbag barriers, and/or other similar devices.
- **Permanent site stabilization.** The construction contractor will install structural and vegetative methods to permanently stabilize all graded or otherwise disturbed areas once construction is complete. Structural methods may include the installation of biodegradable fiber rolls and erosion control blankets. Vegetative methods may involve the application of organic mulch and tackifier and/or the application of an erosion control seed mix. Implementation of a SWPPP will substantially minimize the potential for project-related erosion and associated adverse effects on water quality.

Conservation Measure 10: Prepare and Implement a Bentonite Slurry Spill Contingency Plan (Frac-Out Plan)

Before excavation begins, SBFCA will ensure the contractor will prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). The plan will be subject to approval by the Corps, Service, and SBFCA before excavation can begin. The BSSCP will include measures intended to minimize the potential for a frac-out (short for "fracture-out event") associated with excavation and tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and "minimum-effect" response in the event of a frac-out and release of excavation fluid (i.e., bentonite). The BSSCP will require, at a minimum, the following measures.

- If a frac-out is identified, all work will stop, including the recycling of the bentonite fluid. In the event of a frac-out into water, the location and extent of the frac-out will be determined, and the frac-out will be monitored for 4 hours to determine whether the fluid congeals (bentonite will usually harden, effectively sealing the frac-out location).
- NMFS, the Service, CDFW, and the RWQCB will be notified immediately of any spills and will be consulted regarding clean-up procedures. A Brady barrel will be onsite and used if a frac-out occurs. Containment materials, such as straw bales, also will be onsite prior to and during all operations, and a vacuum truck will be on

retainer and available to be operational onsite within notice of 2 hours. The site supervisor will take any necessary follow-up response actions in coordination with agency representatives. The site supervisor will coordinate the mobilization of equipment stored at staging areas (e.g., vacuum trucks) as needed.

- If the frac-out has reached the surface, any material contaminated with bentonite will be removed by hand to a depth of 1-foot, contained, and properly disposed of, as required by law. The drilling contractor will be responsible for ensuring that the bentonite is either properly disposed of at an approved Class II disposal facility or properly recycled in an approved manner.
- If the bentonite fluid congeals, no other actions, such as disturbance of the streambed, will be taken that will potentially suspend sediments in the water column.
- The site supervisor has overall responsibility for implementing this BSSCP. The site supervisor will be notified immediately when a frac-out is detected. The site supervisor will be responsible for ensuring that the biological monitor is aware of the frac-out, coordinating personnel, response, cleanup, regulatory agency notification and coordination to ensure proper clean-up, disposal of recovered material, and timely reporting of the incident. The site supervisor will ensure all waste materials are properly containerized, labeled, and removed from the site to an approved Class II disposal facility by personnel experienced in the removal, transport, and disposal of drilling mud.
- The site supervisor will be familiar with the contents of this BSSCP and the conditions of approval under which the activity is permitted to take place. The site supervisor will have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan. The site supervisor will ensure that a copy of this plan is available (onsite) and accessible to all construction personnel. The site supervisor will ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out, prior to commencement of excavation operations.

Conservation Measure 11: Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan

A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable water or adjoining shorelines. SBFCA or its contractor will develop and implement an SPCCP to minimize the potential for and effects from spills of hazardous, toxic, or petroleum substances during construction and operation activities. The SPCCP will be completed before any construction activities begin. Implementation of this measure will comply with State and Federal water quality regulations. The SPCCP will describe spill sources and spill pathways in addition to the actions that will be taken in the event of a spill (e.g., an oil spill from engine refueling will be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as doubled-walled tanks, containment berms, emergency shut-offs, drip pans, fueling procedures and spill response kits. It will also describe how and when employees are trained in proper handling procedure and spill prevention and response procedures.

SBFCA will review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. SBFCA will notify its contractors immediately if there is a non-compliance issue and will require compliance.

The Federal reportable spill quantity for petroleum products, as defined in 40 CFR 110, is any oil spill that results in one or more of the following.

- Violates applicable water quality standards.
- Causes a film or sheen on or discoloration of the water surface or adjoining shoreline.
- Causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.

If a spill is reportable, the contractor's superintendent will notify SBFCA, and SBFCA will take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. A written description of reportable releases must be submitted to the Central Valley RWQCB. This submittal must contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases will be documented on a spill report form.

Conservation Measure 12: Conduct Preconstruction Surveys and Monitoring for Giant Garter Snake

Prior to ground-disturbing activities within 200 feet of suitable habitat, a Service-approved biological monitor will conduct a preconstruction survey of suitable aquatic and upland habitat and inspect exclusion and orange barrier fencing to ensure they are both in good working order each morning. If any snakes are observed within the construction area at any other time during construction the Service-approved biological monitor will be contacted to survey the site for giant garter snakes. The biological monitor will have the authority to stop construction activities until appropriate corrective measures have been completed or it is determined that the snake will not be harmed. Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own. If unable to move away on their own, trapped or injured giant garter snakes will be only be removed by a biologist with a federal 10(a)1(a) permit which allows them to handle the snake and will be placed in a location determined through discussions with the Service. The biological monitor will immediately report the finding of a snake to Service by phone and will provide a written account of the details of the incident within 24 hours.

Once all initial ground-disturbing activities are completed, the biological monitor will perform weekly checks of the site for the duration of construction in order to ensure that construction barrier fences and exclusion fences are in good order, trenches are being covered, project personnel are conducting checks beneath parked vehicles prior to their movement, and that all other required biological protection measures are being complied with. The biological monitor will document the results of monitoring on construction monitoring log sheets, which will be provided to the Service within 1 week of each monitoring visit.

Conservation Measure 13: Provide Escape Ramps or Cover Open Trenches at the End of Each Day

To avoid entrapment of giant garter snake, thereby preventing injury or mortality resulting from falling into trenches, all excavated areas more than 1 foot deep will be provided with one or more escape ramps constructed of earth fill or wooden planks at the end of each workday. If escape ramps cannot be provided, then holes or trenches will be covered with plywood or other hard material. The biological monitor or construction personnel designated by the contractor will be responsible for thoroughly inspecting trenches for the presence of giant garter snakes at the beginning of each workday. Capture and relocation of trapped or injured individuals can only be attempted by personnel or individuals with current Service recovery permits pursuant to section 10(a)1(A) of the Act.

Conservation Measure 14: Implement Additional Protective Measures during Work in Suitable Habitat during the Giant Garter Snake Dormant Period

SBFCA will implement additional protective measures during time periods when work must occur during the giant garter snake dormant period (October 2–April 30), when snakes are more vulnerable to injury and mortality. It is expected that these additional measures will be implemented during levee slope flattening within the Sutter-Butte Canal in Reaches 26–28 (scheduled for 2016) and pipe reconstruction adjoining the canal at two sites in the same reaches during February–March, and if construction activities extend to the period between October 2 and November 1. SBFCA will implement additional protective measures when conducting work in suitable giant garter snake habitat between October 2 and April 30.

- A full-time Service-approved biological monitor will be onsite for the duration of construction activities.
- All emergent vegetation within the Sutter-Butte Canal on the levee side, and vegetation within 200 feet of the canal will be cleared prior to the giant garter snake hibernation period (i.e., vegetation clearing must be completed by October 1 for following winter work).
- Exclusion fencing will be installed around the perimeter of the work area and across the Sutter-Butte Canal where construction activities associated with levee slope flattening and pipe reconstruction activities will occur. The fencing should enclose the work area to the maximum extent possible to prevent giant garter snakes from entering the work area. Fencing will be installed during the active period for giant garter snakes (May 1–October 1) to reduce the potential for injury and mortality during fence installation. The Service-approved biological monitor will work with the contractor to determine where fencing should be placed and will monitor fence installation. The exclusion fencing will consist of 3-foot-tall erosion fencing buried 4– 6 inches below ground level. The exclusion fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area (between canal and existing levee).
- Portions of the Sutter-Butte Canal that are temporarily disturbed during construction will be revegetated with emergent vegetation and adjacent disturbed upland habitat will be revegetated with native grasses and forbs after construction is complete.

Conservation Measure 15: Restore Temporarily Disturbed Aquatic and Upland Habitat to Pre-Action Conditions

Upon completion of the proposed project, SBFCA will restore 42.52 acres of suitable aquatic habitat and 118.80 acres of suitable upland habitat for the giant garter snake to pre-project conditions. Restoration of aquatic vegetation and annual grassland will be detailed in a mitigation and monitoring plan that will be reviewed and approved by the Corps and Service prior to the start of construction. Habitat will be restored within one season (defined as May 1–October 1) and providing vegetative cover within 1 year of construction beginning in that area.

Conservation Measure 16: Compensate for Permanent Loss of Aquatic Habitat for Giant Garter Snake

SBFCA will compensate for the permanent loss of 0.004 acre of suitable aquatic habitat for giant garter snake by purchasing preservation credits equal to 0.012 acre of giant garter snake habitat at Westervelt Ecological Services' Sutter Basin Conservation Bank in Sutter County. This bank has available giant garter snake credits and is approved by both the Service and CDFW.

The 0.012 acre of habitat at the conservation bank will be protected in perpetuity for giant garter snake. Prior to the start of construction (excluding Reach 13, as there is no giant garter snake habitat in this reach), SBFCA will provide funding to Westervelt Ecological Services for preservation credits equivalent to 0.012 acre of giant garter snake habitat at the Sutter Basin Conservation Bank. The transaction will take place through a purchase and sale agreement, and funds must be transferred within 30 days, and before any construction activities are initiated. SBFCA will provide the Service and CDFW with copies of the credit sale agreement and fund transfer.

Analytical Framework for the Jeopardy Analysis

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the beetle's and snake's range-wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the beetle and the snake in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the beetle and snake; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the beetle and snake; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the beetle and snake.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the beetle's and snake's current status, taking into account any cumulative effects, to determine if implementation of the proposed

action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the beetle and snake.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the beetle and snake and the role of the action area in the survival and recovery of the beetle and snake as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Status of the Species

Valley Elderberry Longhorn Beetle

Please refer to the *Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus) 5-year Review: Summary and Evaluation* (Service 2006) for the current status of the species.

Giant Garter Snake

Please refer to the *Giant Garter Snake (Thamnophis gigas) 5-year Review: Summary and Evaluation* (Service 2012) for the current status of the species.

Environmental Baseline

Valley Elderberry Longhorn Beetle

The closest beetle occurrence in the CNDDB (2013) is about 0.5 mile from the proposed project. Suitable habitat for the beetle (in the form of elderberry shrubs) exists in numerous places along the 41 miles of proposed levee repair. A total of 267 elderberry shrubs were mapped within the action area. Many others exist at various locations between the levee and the river. Of these SBFCA is proposing to avoid 175 elderberry shrubs and transplant 91 elderberry shrubs. Because the action area is within the range of the species, there are known occurrences from the vicinity of the action area, and suitable habitat is present, the Service concludes that it is reasonably likely for the beetle to occupy the action area.

Giant Garter Snake

The *Draft Recovery Plan for the Giant Garter Snake* subdivides the range of the species into four recovery units (Service 1999b). The action area for the proposed project is located within the Sacramento Valley Recovery Unit. There are 20 records of the snake within 5 miles of the action area. The closest occurrence documented in the CNDDB is 2 miles from the action area. Snakes have the potential to occur within the action area because suitable aquatic and upland habitat is present as it is hydrologically connected to areas that support rice agriculture and areas where the snake has previously been detected. The action area is a long corridor that occasionally has irrigation ditches, which run parallel to the levee for limited stretches. The main threat to the snake in the action area is loss of habitat or connectivity due to channel and levee maintenance.

Effects of the Proposed Action

Valley Elderberry Longhorn Beetle

Ninety-one elderberry shrubs will be removed and transplanted. The 91 affected shrubs have 361 stems between 1 and 3 inches, 92 stems between 3 and 5 inches and 100 stems greater than 5 inches at ground level.

Loss of an elderberry shrub or even a stem can affect the beetle breeding and feeding because adult beetles rely solely on elderberry foliage and flowers for food and must lay their eggs on elderberry stems to successfully reproduce.

Transplantation of elderberry shrubs that are or could be used by beetle larvae is expected to adversely affect the beetle. Beetle larvae will be killed or the beetle's life cycle will be interrupted during or after the transplanting process. For example:

1. Transplanted elderberry shrubs may experience stress or become unhealthy due to changes in soil, hydrology, microclimate, or associated vegetation. This may reduce their quality as habitat for the valley elderberry longhorn beetle, or impair their production of habitat-quality stems in the future.

2. Elderberry shrubs may die as a result of transplantation.

3. Branches containing larvae may be cut, broken, or crushed as a result of the transplantation process.

SBFCA has proposed to transplant one shrub outside of the elderberry shrub's dormant season (November 1 to February 15). To offset the increased risk of the transplantation not being successful SBFCA has proposed to plant 2.5 times the number of elderberry seedlings at the Star Bend Conservation Area.

Temporal loss of habitat will occur. Although conservation measures for effects on the beetle will involve creation or restoration of habitat, it generally takes 5 or more years for elderberry plants to become large enough to support beetles, and it may take 25 years or longer for riparian habitats to reach their full value. Temporal loss of habitat may cause fragmentation of habitat and isolation of subpopulations.

Permanent and temporary habitat loss adversely affects the beetles breeding and foraging requirements. Habitat creation and transplantation of the shrubs will minimize these effects. Success of a restoration site has been linked to presence of transplanted elderberry shrubs that have served to colonize a newly created riparian habitat. Transplants that survive also provide diversity within the conservation area as they are older, larger shrubs within the plantings of young small elderberry seedlings. The Star Bend Conservation Area will be protected with a conservation easement and managed in perpetuity for riparian habitat including valley elderberry longhorn beetle habitat, through development of the *Feather River West Levee Project Mitigation and Monitoring Plan.*

Giant garter snake

Aquatic habitat for the snake near the levee construction varies along the 41 miles of the proposed project. Small areas of aquatic habitat are present in Contract A and C and they are hydrologically connected to areas that support habitat for the snake (rice). Contract D has the largest amount of snake aquatic habitat as the Sutter Butte Canal parallels the levee for longer lengths. Canal filling due to cutoff wall construction will permanently fill 0.004 acre of snake aquatic habitat. Upland habitat around this aquatic habitat will be temporarily disturbed but returned to pre-project condition within one year. Temporary effects will result from temporary fill of aquatic habitat for construction access, reshaping the slope of the Sutter Butte Canal and adjacent levee, and degradation and reconstruction of the levee. These activities will temporarily affect 6.81 acres of aquatic habitat. Levee degradation and reconstruction will temporarily affect 112.47 acres of upland habitat. All temporarily affected areas will be restored to pre-project conditions within the same year the disturbance will occur. This will minimize effects to giant garter snakes because the amount of time the habitat will be unavailable to the snake will be minimized. Permanently affected habitat, such as the canals that will be made smaller will be offset by purchasing 0.012 acre of giant garter snake habitat at Westervelt Ecological Services' Sutter Basin Conservation Bank in Sutter County. None of the borrow sites in the project description have upland or aquatic giant garter snake habitat.

The majority of the construction work will occur during the giant garter snake active season (May 1 to October 1). Increased construction activity in areas where snakes are known to occur could expose snakes to increased risks of injury and mortality from predation, exposure, vehicular traffic, and construction equipment. Because snakes are more mobile during the active season, these effects should be lessened. There are a few activities which SBFCA could not construct during the active season. Because of cooler temperatures in the inactive season (October 1 to May 1), the snake is not as mobile and is most frequently found within burrows. Ground disturbing activities during this timeframe will increase the likelihood of snake mortality when the burrows are disturbed with heavy equipment. SBFCA has proposed to disturb (clear and grub) the out of season work area and place exclusion fencing around the work area during the active season which will create an area that will not support overwintering snakes (lack of burrows). This will minimize the chance of injuring or killing an overwintering snake during out of season construction. This will only occur on one side of the canal, leaving the other side of the canal available as overwintering habitat for the snake.

Temporary effects within the action area will affect both aquatic and upland snake habitat. In some locations degradation of the levee could cause soil to fall into the aquatic habitat or fuel or oil leaks could also adversely affect the habitat and the snake. Placement of sediment fencing and implementing sediment and contaminant BMPs will lessen this effect. Levee degradation will temporarily make upland habitat unavailable to the snake during the active season. Snakes use upland habitat for thermoregulation both as a place to bask and as a place to escape extreme heat (burrows) and cover for shedding and giving birth to young. While snakes are more active during the summer months and more likely to move away from construction, some snakes may choose to remain where they are and therefore will be subject to mortality when construction activities are occurring. In addition to direct mortality, the upland habitat will be temporarily unavailable to the snake during construction. Even once construction is completed it will take a

year or two for the upland habitat to become completely functional for the snake, with burrows or crevices available for them to use. This is likely to result in disturbance, displacement, injury, and/or mortality of snakes. To lessen these effects SBFCA is implementing the conservation measures described above as well as affecting only one side of the canal. This will leave the other side of the canal intact and available to the snake for use, minimizing displacement of snakes. Additionally, because of the staging of construction not all of the upland habitat will be unavailable for use at one time. It will be staged as construction progresses through the various contracts.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed project are not considered in this section, because they require separate consultation pursuant to section 7 of the Act. Any future land use conversions and routine agricultural practices are not subject to Federal authorization or funding and may alter the habitat or result in take of listed valley elderberry longhorn beetle or giant garter snake and are, therefore, cumulative to the proposed project.

Conclusion

After reviewing the current status of the valley elderberry longhorn beetle and giant garter snake, the environmental baselines for these species, the effects of the proposed project, and the cumulative effects on this species, it is the Service's biological opinion that the proposed FRWLP, as described herein, is not likely to jeopardize the continued existence of these species. Although critical habitat has been designated for the beetle, the proposed action will not affect critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary for listed species of this biological opinion and must be implemented by the Corps and SBFCA in order for the exemption in section 7(o)(2)

to apply. The Corps has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Federal agency (1) fails to adhere to the terms and conditions of the incidental take statement, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Valley Elderberry Longhorn Beetle

The Service expects that incidental take of the valley elderberry longhorn beetle will be difficult to detect or quantify. The cryptic nature of this species and their relatively small body size make the finding of an injured or dead specimen unlikely. The species occurs in habitats that make them difficult to detect. Due to the difficulty in quantifying the number of beetles that will be taken as a result of the proposed action, the Service is quantifying take incidental to the project as the number of elderberry stems one inch or greater in diameter at ground level (beetle habitat) that will become unsuitable for beetles due to direct or indirect effects as a result of levee construction. Therefore, the Service estimates that all beetles inhabiting 91 elderberry plants containing stems 1 inch or greater at ground level (361 stems between 1-3 inches, 92 stems between 3 and 5 inches and 100 stems $\geq$5 inches; see Table 1 in the text) will be taken as a result of the proposed action.

Giant Garter Snake

The Service anticipates that incidental take of the snake will be difficult to detect or quantify for the following reasons: the snake is cryptically colored, secretive, and known to be sensitive to human activities. Snakes may avoid detection by retreating to burrows, soil crevices, vegetation, or other cover. Individual snakes are difficult to detect unless they are observed, undisturbed, at a distance. Most close-range observations represent chance encounters that are difficult to predict. It is not possible to make an accurate estimate of the number of snakes that will be harassed, harmed or killed during construction activities (staging areas, work on canal banks, levee degradation and reconstruction, soil borrow areas, and vehicle traffic to and from borrow areas). In instances when take is difficult to detect, the Service may use the quantification of acreage as a surrogate for the individuals that will be taken. Therefore, the Service anticipates take incidental to this project as the 0.004 acre of suitable habitat that will be permanently lost and the 119.28 acres (6.81 acres aquatic and 112.47 acres upland) of suitable snake habitat that will be temporarily lost. Upon implementation of the Reasonable and Prudent Measure, Terms and Conditions, and the Proposed Conservation Measures considered herein, incidental take within this acreage for the proposed project, will be exempt from the prohibitions described under Section 9 of the Act.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the beetle or snake.

Reasonable and Prudent Measures

The Service has determined that the following reasonable and prudent measure is necessary and appropriate to minimize the adverse effects of the Feather River West Levee Project to the beetle and snake and their habitat in the action area.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps and SBFCA must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

The following Terms and Conditions implement the Reasonable and Prudent Measure:

1. All the conservation measures as described in the project description, and as restated here in this biological opinion, must be fully implemented and adhered to.

2. The Corps, SBFCA, and PG&E shall include full implementation and adherence to the conservation measures as outlined in the biological opinion as a condition of any permit or contract issued for the project.

3. In order to monitor whether the amount or extent of take anticipated from implementation of the proposed project is approached or exceeded, the Corps and SBFCA shall adhere to the following reporting requirement. Should this anticipated amount or extent of incidental take be exceeded, the Corps must immediately reinitiate formal consultation as per 50 CFR 402.16.

    a. For those components of the proposed project that will result in habitat degradation or modification whereby incidental take in the form of harm or mortality is anticipated, the Corps and SBFCA will provide weekly updates to the Service with a precise accounting of the total acreage of habitat effected or number of elderberry shrubs and size of stems at ground level transplanted. Updates shall also include any information about changes in the Project Description and not analyzed in this biological opinion.

4. SBFCA shall provide a photo documentation report showing pre- and post-project area conditions for giant garter snake.

Salvage and Disposition of Individuals

The Sacramento Fish and Wildlife Office will be notified within 1 day of the finding of any dead or injured snake or beetle to determine the appropriate measures for salvage and disposition. The Service contact person is the Habitat Conservation Division Chief. In addition, the Recovery Division Chief shall also be notified within 1 day of the procedures implemented for salvage and disposition of the snake or beetle. The applicant must report to the Service immediately any information about take or suspected take of listed species not authorized in this biological

opinion. Notification must include the date, time, and location of the incident or of the finding of a dead or injured listed species. The Habitat Conservation and Recovery Divisions Chiefs can be contacted at (916) 414-6600. The California Department of Fish and Wildlife should also be contacted at (916)358-2900.

CONSERVATION RECOMMENDATIONS

Conservation recommendations are suggestions of the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of new information. These measures may serve to further minimize or avoid the adverse effects of a proposed action on listed, proposed, or candidate species, or on designated critical habitat. They may also serve as suggestions on how action agencies can assist species conservation in furtherance of their responsibilities under section 7(a)(1) of the Act, or recommend studies improving an understanding of a species' biology or ecology. Wherever possible, conservation recommendations should be tied to tasks identified in recovery plans. The Service is providing you with the following conservation recommendations:

1. The Corps and SBFCA should assist in the implementation of the draft, and when published, the final Recovery Plan for the snake.

2. The Corps and SBFCA should provide funding to researchers studying topics identified by the Service in the draft, and when published, the final Recovery Plan for the snake.

3. The Corps should use environmental restoration authorities to acquire and restore beetle and snake habitat.

To be kept informed of actions minimizing or avoiding adverse effects or benefiting listed and proposed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation with the Corps on the Feather River West Levee Project. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the proposed action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this opinion; or (4) a new species or critical habitat is designated that may be affected by the proposed action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

If you have any questions regarding this Feather River West Levee Project biological opinion, please contact Jennifer Hobbs, at (916) 414-6541 or Doug Weinrich, Deputy Assistant Field Supervisor, at (916) 414-6563.

Sincerely,

Roberta Gerson

for Jan C. Knight
Acting Field Supervisor

cc:
Jeff Koschak, Corps, Sacramento, CA
Jenny Marr, CDFW, Chico, CA
Jennifer Haire, ICF, Sacramento, CA

Literature Cited

California Natural Diversity Database (CNDDB). 2013. Natural Heritage Division, California Department of Fish and Game. Sacramento, California.

U.S. Fish and Wildlife Service (Service). 1999a. Conservation Guidelines for the Valley Elderberry Longhorn Beetle. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California.

_____. 1999b. Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*). U.S. Fish and Wildlife Service, Portland, Oregon. x + 192 pp.

_____. 2006. Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California.

_____. 2012. Giant Garter Snake *(Thamnophis gigas)* 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California. 46 pp.

Part F.5

U.S. Fish and Wildlife Service Special-Status Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825

February 10, 2012

Document Number: 120210051632

Jennifer Haire
ICF International
630 K Street, Suite 400
Sacramento, CA 95814

Subject: Species List for Feather River West Levee Project

Dear: Ms. Haire

We are sending this official species list in response to your February 10, 2012 request for information about endangered and threatened species. The list covers the California counties and/or U.S. Geological Survey 7½ minute quad or quads you requested.

Our database was developed primarily to assist Federal agencies that are consulting with us. Therefore, our lists include all of the sensitive species that have been found in a certain area *and also ones that may be affected by projects in the area*. For example, a fish may be on the list for a quad if it lives somewhere downstream from that quad. Birds are included even if they only migrate through an area. In other words, we include all of the species we want people to consider when they do something that affects the environment.

Please read Important Information About Your Species List (below). It explains how we made the list and describes your responsibilities under the Endangered Species Act.

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be May 10, 2012.

Please contact us if your project may affect endangered or threatened species or if you have any questions about the attached list or your responsibilities under the Endangered Species Act. A list of Endangered Species Program contacts can be found here.

Endangered Species Division

These buttons will not appear on your list.

Revise Selection

Print this page

Print species list before going on to letter.

Make Official Letter

U.S. Fish & Wildlife Service

Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Counties and/or U.S.G.S. 7 1/2 Minute Quads you requested

Document Number: 120210051632

Database Last Updated: September 18, 2011

Quad Lists

Listed Species

Invertebrates

- Branchinecta conservatio
  - Conservancy fairy shrimp (E)
- Branchinecta lynchi
  - vernal pool fairy shrimp (T)
- Desmocerus californicus dimorphus
  - valley elderberry longhorn beetle (T)
- Lepidurus packardi
  - vernal pool tadpole shrimp (E)

Fish

- Acipenser medirostris
  - green sturgeon (T) (NMFS)
- Hypomesus transpacificus
  - delta smelt (T)
- Oncorhynchus mykiss
  - Central Valley steelhead (T) (NMFS)

- Critical habitat, Central Valley steelhead (X) (NMFS)

- Oncorhynchus tshawytscha
  - Central Valley spring-run chinook salmon (T) (NMFS)
  - Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
  - winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

- Ambystoma californiense
  - California tiger salamander, central population (T)

- Rana draytonii
  - California red-legged frog (T)

Reptiles

- Thamnophis gigas
  - giant garter snake (T)

Plants

- Orcuttia tenuis
  - slender Orcutt grass (T)

- Tuctoria greenei
  - Greene's tuctoria (=Orcutt grass) (E)

Candidate Species

Birds

- Coccyzus americanus occidentalis
  - Western yellow-billed cuckoo (C)

Quads Containing Listed, Proposed or Candidate Species:

NICOLAUS (529A)

YUBA CITY (544A)

SUTTER (544B)

OLIVEHURST (544D)

PALERMO (560A)

BIGGS (560B)

GRIDLEY (560C)

County Lists

No county species lists requested.

Key:

- (E) Endangered - Listed as being in danger of extinction.
- (T) Threatened - Listed as likely to become endangered within the foreseeable future.
- (P) Proposed - Officially proposed in the Federal Register for listing as endangered or threatened.
- (NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.
- Critical Habitat - Area essential to the conservation of a species.
- (PX) Proposed Critical Habitat - The species is already listed. Critical habitat is being proposed for it.
- (C) Candidate - Candidate to become a proposed species.
- (V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.
- (X) Critical Habitat designated for this species

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, or may be affected by projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Amphibians will be on the list for a quad or county if pesticides applied in that area may be carried to their habitat by air currents.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regardless of whether they appear on a quad list.

Plants

Any plants on your list are ones that have actually been observed in the area covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

Some of the species on your list may not be affected by your project. A trained biologist and/or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list.
See our Protocol and Recovery Permits pages.

For plant surveys, we recommend using the Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

Your Responsibilities Under the Endangered Species Act

All animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

> Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.
- During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.
- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.
- Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compensates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our Map Room page.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information

for land management planning and conservation efforts. More info

Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6520.

Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be May 10, 2012.

Part F.6

California Natural Diversity Database Special-Status Species List—Plants

California Department of Fish and Game
Natural Diversity Database
Special-status plants & sensitive natural communities
Biggs, Gridley, Nicolaus, Olivehurst, Palermo, Sutter, & Yuba City Quads

	Scientific Name/Common Name	Element Code	Federal Status	State Status	GRank	SRank	CDFG or CNPS
1	Astragalus tener var. ferrisiae Ferris' milk-vetch	PDFAB0F8R3			G1T1	S1	1B.1
2	Delphinium recurvatum recurved larkspur	PDRAN0B1J0			G3	S3	1B.2
3	Great Valley Cottonwood Riparian Forest	CTT61410CA			G2	S2.1	
4	Great Valley Mixed Riparian Forest	CTT61420CA			G2	S2.2	
5	Juncus leiospermus var. ahartii Ahart's dwarf rush	PMJUN011L1			G2T1	S1.2	1B.2
6	Monardella douglasii ssp. venosa veiny monardella	PDLAM18082			G5T1	S1.1	1B.1
7	Navarretia leucocephala ssp. bakeri Baker's navarretia	PDPLM0C0E1			G4T2	S2	1B.1
8	Northern Hardpan Vernal Pool	CTT44110CA			G3	S3.1	
9	Orcuttia tenuis slender Orcutt grass	PMPOA4G050	Threatened	Endangered	G2	S2	1B.1
10	Pseudobahia bahiifolia Hartweg's golden sunburst	PDAST7P010	Endangered	Endangered	G2	S2	1B.1
11	Sagittaria sanfordii Sanford's arrowhead	PMALI040Q0			G3	S3	1B.2
12	Tuctoria greenei Greene's tuctoria	PMPOA6N010	Endangered	Rare	G1	S1	1B.1

Part F.7

California Natural Diversity Database Special-Status Species List—Wildlife

California Department of Fish and Game
Natural Diversity Database
Feather River West Levee Project - animals
Quads searched: Nicolaus, Yuba City, Sutter, Olivehurst, Biggs, Gridley, and Palermo

	Common Name/Scientific Name	Element Code	Federal Status	State Status	GRank	SRank	CDFG or CNPS
1	Antioch Dunes anthicid beetle *Anthicus antiochensis*	IICOL49020			G1	S1	
2	California black rail *Laterallus jamaicensis coturniculus*	ABNME03041		Threatened	G4T1	S1	
3	California linderiella *Linderiella occidentalis*	ICBRA06010			G3	S2S3	
4	Sacramento Valley tiger beetle *Cicindela hirticollis abrupta*	IICOL02106			G5TH	SH	
5	Sacramento anthicid beetle *Anthicus sacramento*	IICOL49010			G1	S1	
6	Sacramento splittail *Pogonichthys macrolepidotus*	AFCJB34020			G2	S2	SC
7	Swainson's hawk *Buteo swainsoni*	ABNKC19070		Threatened	G5	S2	
8	bald eagle *Haliaeetus leucocephalus*	ABNKC10010	Delisted	Endangered	G5	S2	
9	bank swallow *Riparia riparia*	ABPAU08010		Threatened	G5	S2S3	
10	burrowing owl *Athene cunicularia*	ABNSB10010			G4	S2	SC
11	chinook salmon - Central Valley spring-run ESU *Oncorhynchus tshawytscha*	AFCHA0205A	Threatened	Threatened	G5	S1	
12	giant garter snake *Thamnophis gigas*	ARADB36150	Threatened	Threatened	G2G3	S2S3	
13	greater sandhill crane *Grus canadensis tabida*	ABNMK01014		Threatened	G5T4	S2	
14	northern harrier *Circus cyaneus*	ABNKC11010			G5	S3	SC
15	silver-haired bat *Lasionycteris noctivagans*	AMACC02010			G5	S3S4	
16	tricolored blackbird *Agelaius tricolor*	ABPBXB0020			G2G3	S2	SC
17	valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	IICOL48011	Threatened		G3T2	S2	
18	vernal pool fairy shrimp *Branchinecta lynchi*	ICBRA03030	Threatened		G3	S2S3	
19	vernal pool tadpole shrimp *Lepidurus packardi*	ICBRA10010	Endangered		G3	S2S3	
20	western mastiff bat *Eumops perotis californicus*	AMACD02011			G5T4	S3?	SC
21	western pond turtle *Emys marmorata*	ARAAD02030			G3G4	S3	SC
22	western spadefoot *Spea hammondii*	AAABF02020			G3	S3	SC
23	western yellow-billed cuckoo *Coccyzus americanus occidentalis*	ABNRB02022	Candidate	Endangered	G5T3Q	S1	

Part F.8

California Native Plant Society Inventory of Rare and Endangered Plants List

Inventory of Rare and Endangered Plants

v7-12feb 2-21-12

Status: Home Page - Mon, Feb. 27, 2012 11:18 c

Basic Tools:

- All CNPS-listed plants
- Checkbox and Preset search
- Getting Started guide

Tech Tools:

- Query Builder
- Query by list of names
- Nine-quad search

Database indexes

- CNPS List
- State Status
- Federal Status
- Family
- County
- Life Form
- Topo Quad
- Common Name

Members and Friends:

- Request assistance
- Submit survey data
- Show your Plant Press

other things:

- Documentation and Resources
- Looking for common plants?
- Home of CNPS

Quick Search Form:

Search

- **more**

8th EDITION interface now available online!.....
Same data, but now includes GIS and many improvements. Not all 7th Edition features have been added yet - you can continue to use them here. To simplify access to the new features, such as GIS, each record in the 7th Edition now has a link to the corresponding details page in the 8th Edition.

INTRODUCTION to the 7th EDITION

CalPhotos archive
What rare plant is this?
(Click on image.)

The CNPS Inventory of Rare and Endangered Plants is now published on-line and updated quarterly. Along with the latest Inventory data from CNPS, you will find a variety of search tools, maps, thumbnail illustrations, and links to additional information.

The statewide CNPS website has extensive • **background information** about the Inventory. Since the publication of the last hardcopy 6th Edition in 2001, the review process and revisions have been ongoing. Stay informed and get involved!

Users of the Inventory may find it helpful to read the • **FAQ**.
example: "Which search method should I use?" (answer)
New users might want to consult the • **Getting Started** guide.

The last hardcopy edition was August 2001, but much of the front matter remains useful and informative:

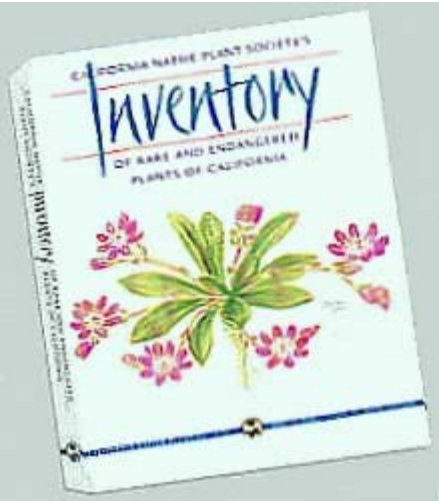
Rarity in Vascular Plants - Peggy L. Fiedler
Rare Bryophytes in California - James R. Shevock
Bibliography for Biology and Conservation of Rare Plants - Peggy L. Fiedler and James P. Smith, Jr.
Conserving Plants with Laws and Programs under the California Department of Fish and Game - Sandra Morey and Diane Ikeda
The California Natural Diversity Database- Roxanne L. Bittman
The Natural Communities Program - Todd Keeler-Wolf

The Federal Endangered Species Act and Rare Plant Protection in California - Jim A. Bartel, Jan C. Knight, and Diane Elam

Sensitive Plant Management on the National Forests and Grasslands in California - Bradley E. Howell

Rare Plant Conservation on Bureau of Land Management Lands - John Willoughby

History of the CNPS Rare Plant Program



CNPS Inventory of Rare and Endangered Plants

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Reformat list as: Standard List - with Plant Press controls -

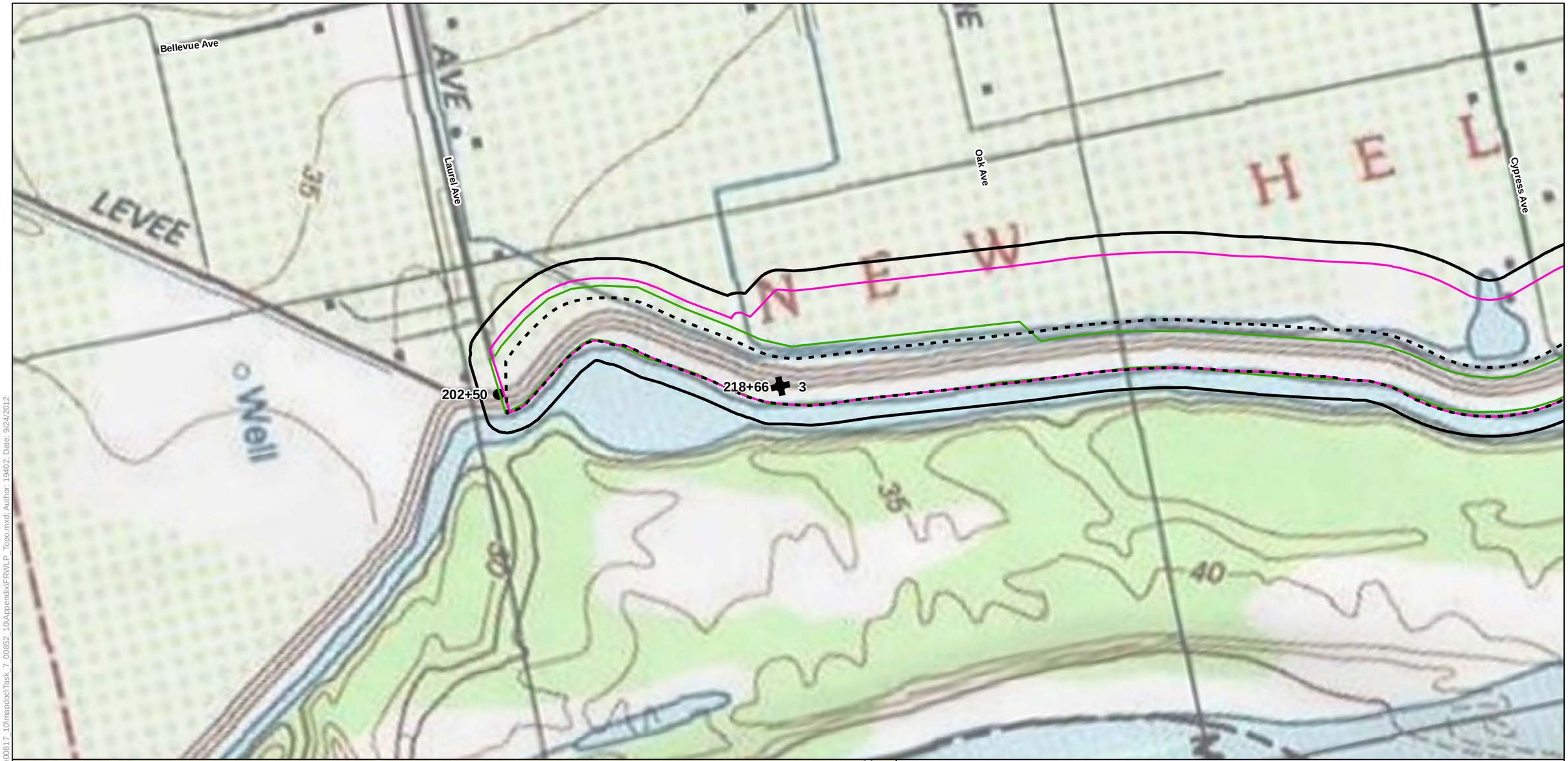
ECOLOGICAL REPORT

scientific	family	life form	blooming	communities	elevation	CNPS
Astragalus tener var. ferrisiae	Fabaceae	annual herb	Apr-May	•Meadows and seeps (Medws)(vernally mesic) •Valley and foothill grassland (VFGrs)(subalkaline flats)	2 - 75 meters	List 1B.1
Delphinium recurvatum	Ranunculaceae	perennial herb	Mar-Jun	•Chenopod scrub (ChScr) •Cismontane woodland (CmWld) •Valley and foothill grassland (VFGrs)/alkaline	3 - 750 meters	List 1B.2
Juncus leiospermus var. ahartii	Juncaceae	annual herb	Mar-May	•Valley and foothill grassland (VFGrs)(mesic)	30 - 229 meters	List 1B.2
Monardella douglasii ssp. venosa	Lamiaceae	annual herb	May-Jul	•Cismontane woodland (CmWld) •Valley and foothill grassland (VFGrs)/heavy clay	60 - 410 meters	List 1B.1
Orcuttia tenuis	Poaceae	annual herb	May-Sep(Oct), Months in parentheses are uncommon.	•Vernal pools (VnPls)	35 - 1760 meters	List 1B.1
Pseudobahia bahiifolia	Asteraceae	annual herb	Mar-Apr	•Cismontane woodland (CmWld) •Valley and foothill grassland (VFGrs)/clay, often acidic	15 - 150 meters	List 1B.1
Sagittaria sanfordii	Alismataceae	perennial rhizomatous herb emergent	May-Oct	•Marshes and swamps (MshSw)(assorted shallow freshwater)	0 - 650 meters	List 1B.2
Tuctoria greenei	Poaceae	annual herb	May-Jul(Sep), Months in parentheses are uncommon.	•Vernal pools (VnPls)	30 - 1070 meters	List 1B.1

Part F.9

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

[28 Sheets]



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 1

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Feet

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Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 2

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Feet

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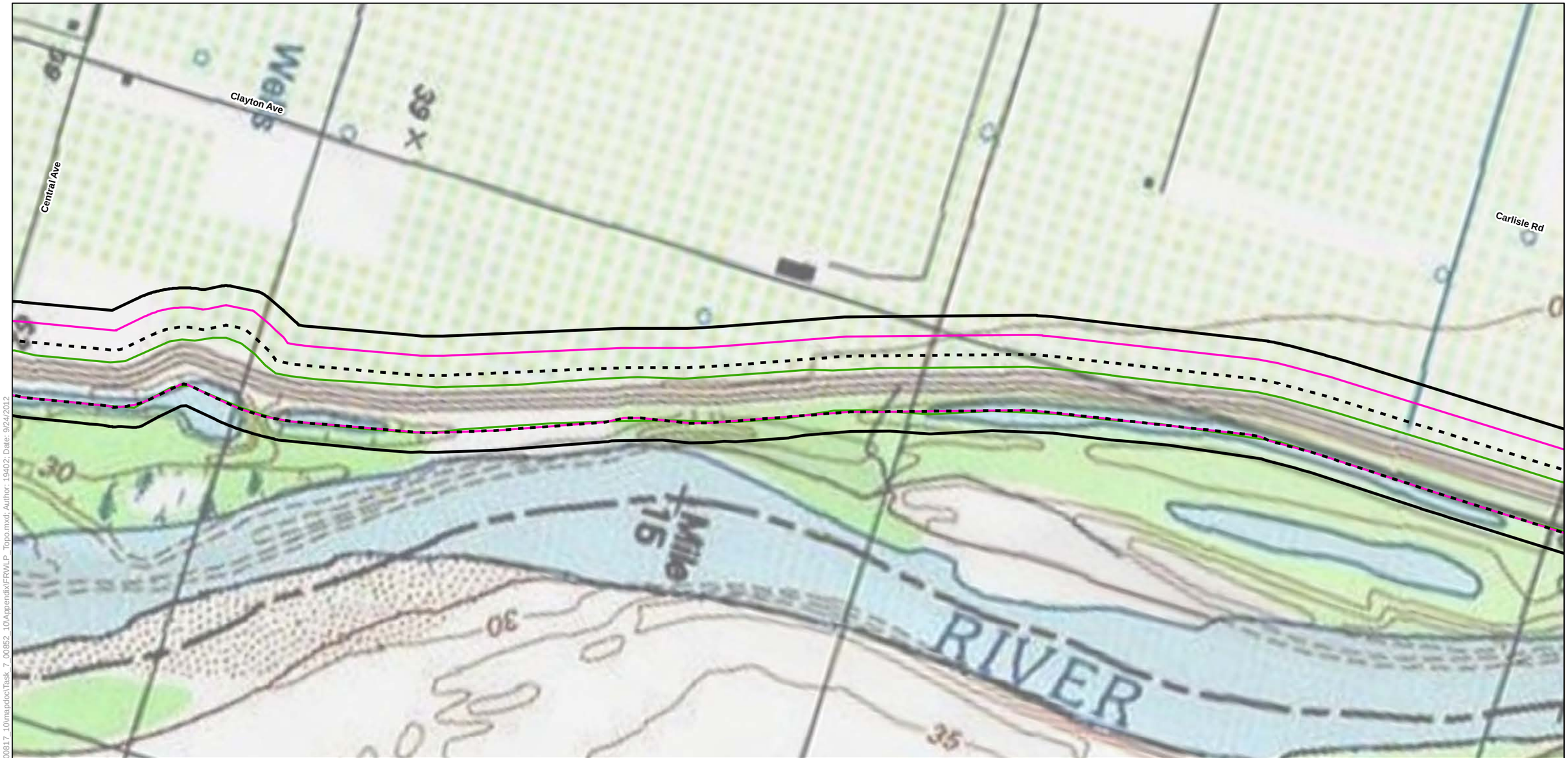

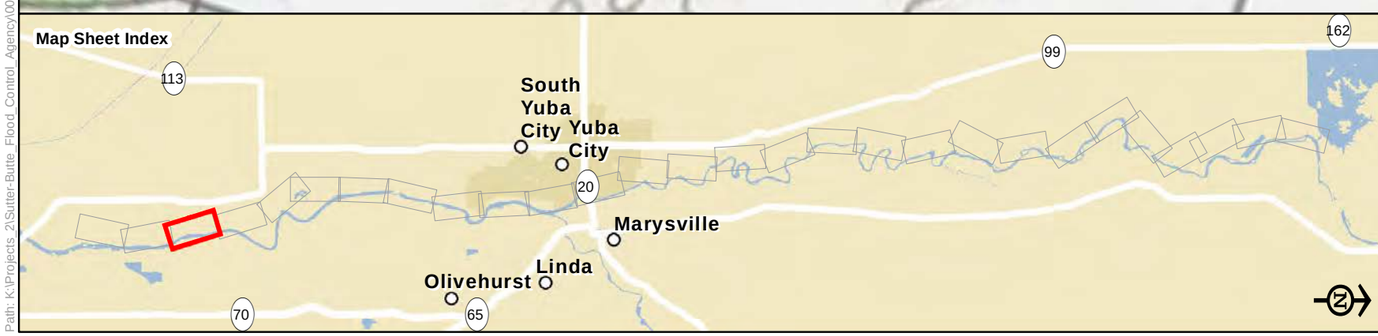

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 3

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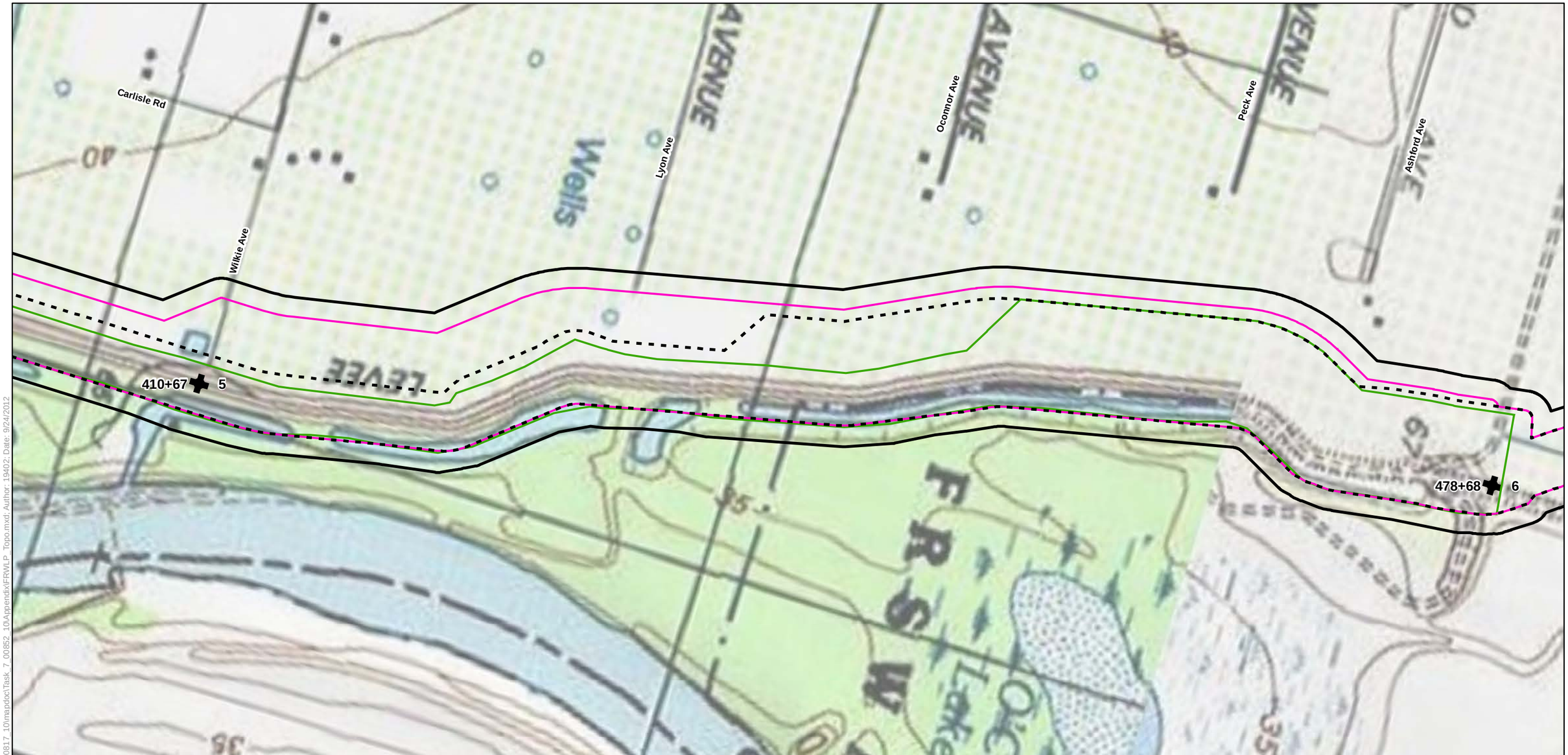

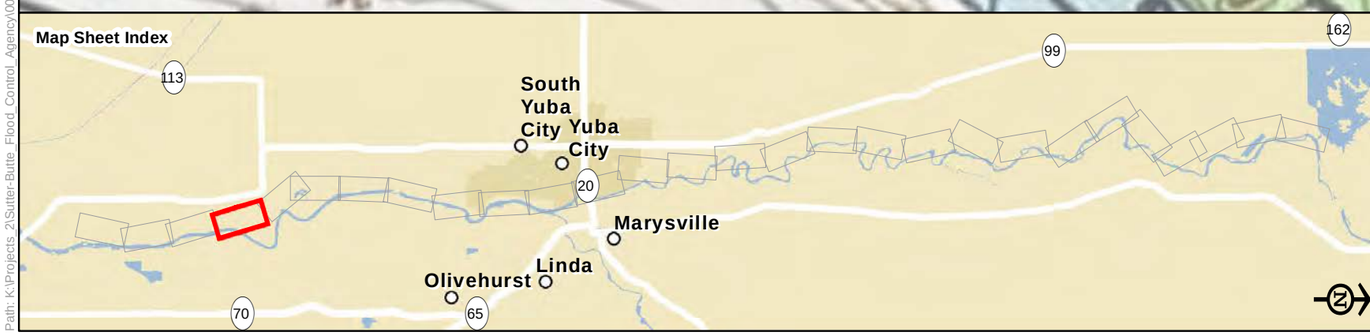

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 4

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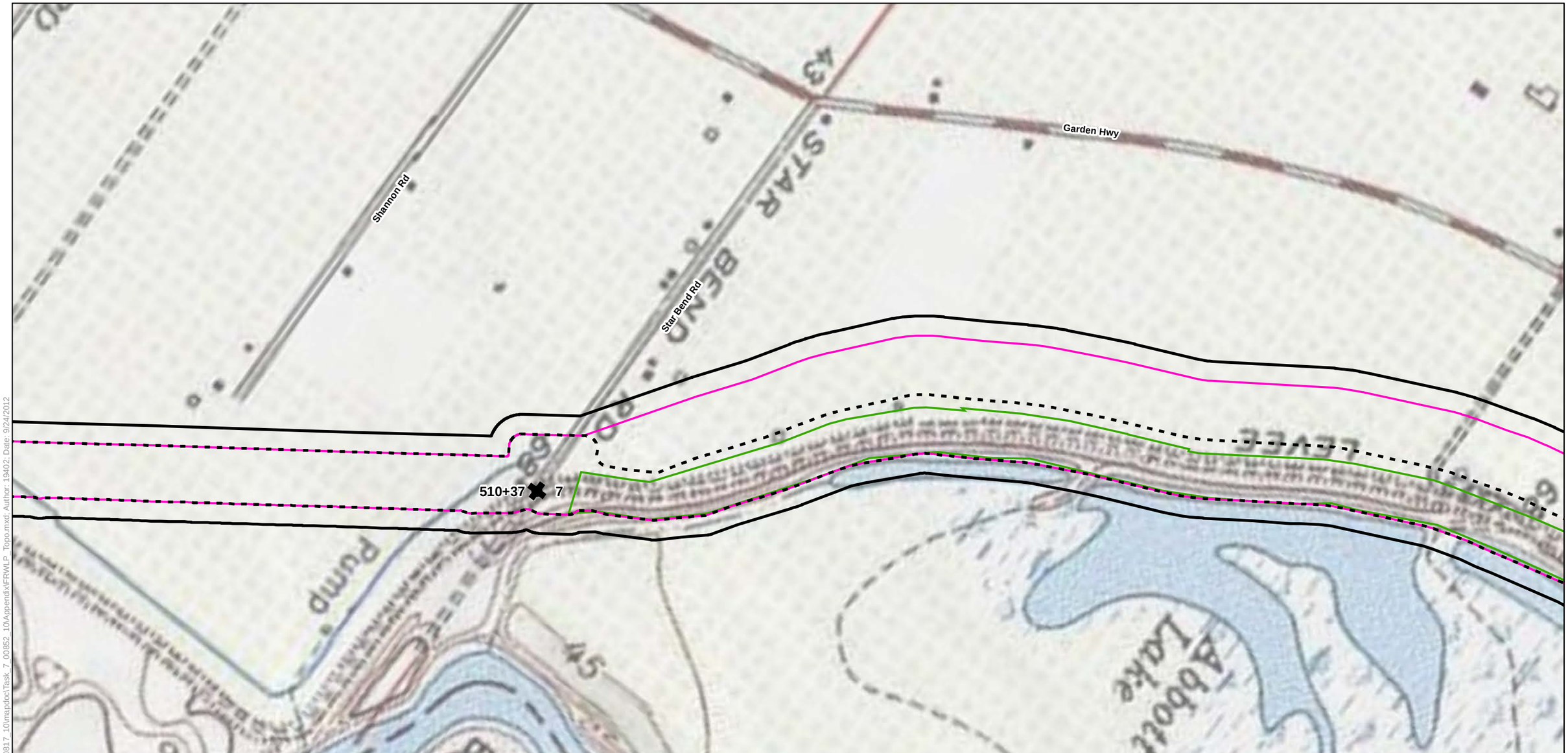
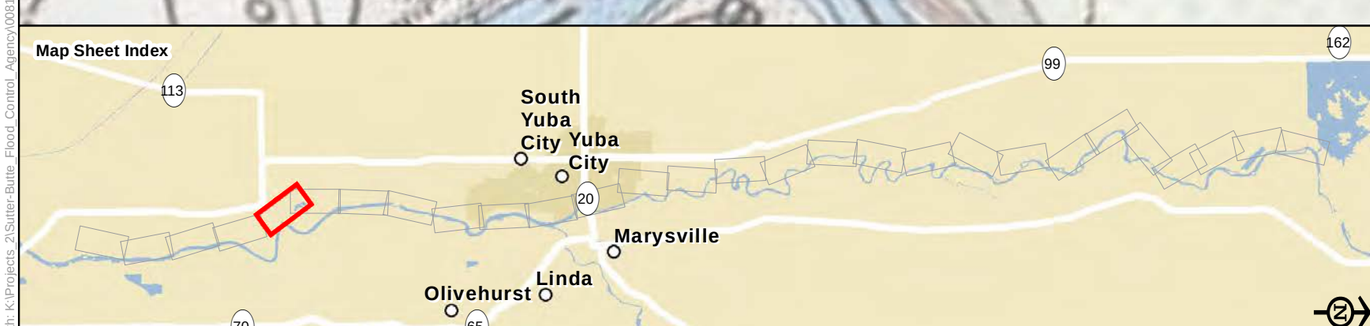
Feet





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 5

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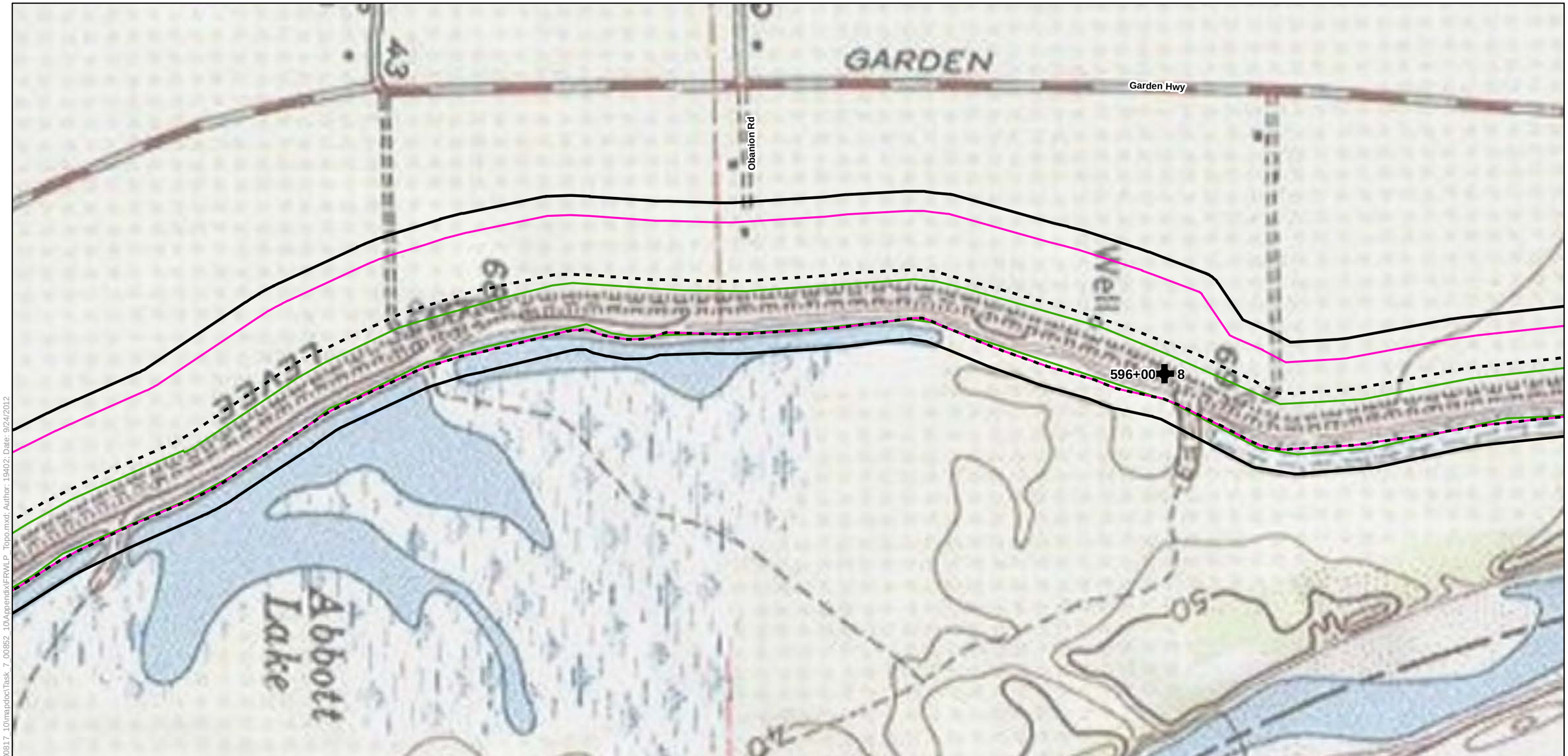

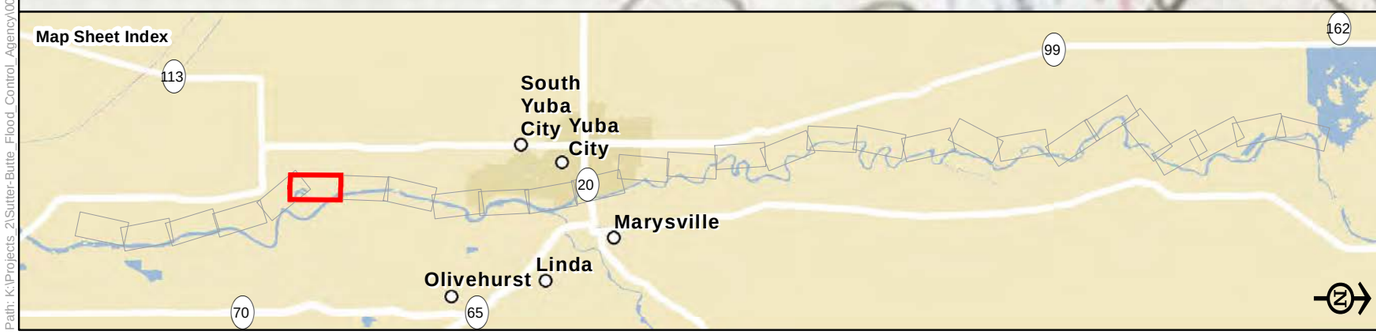

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 6

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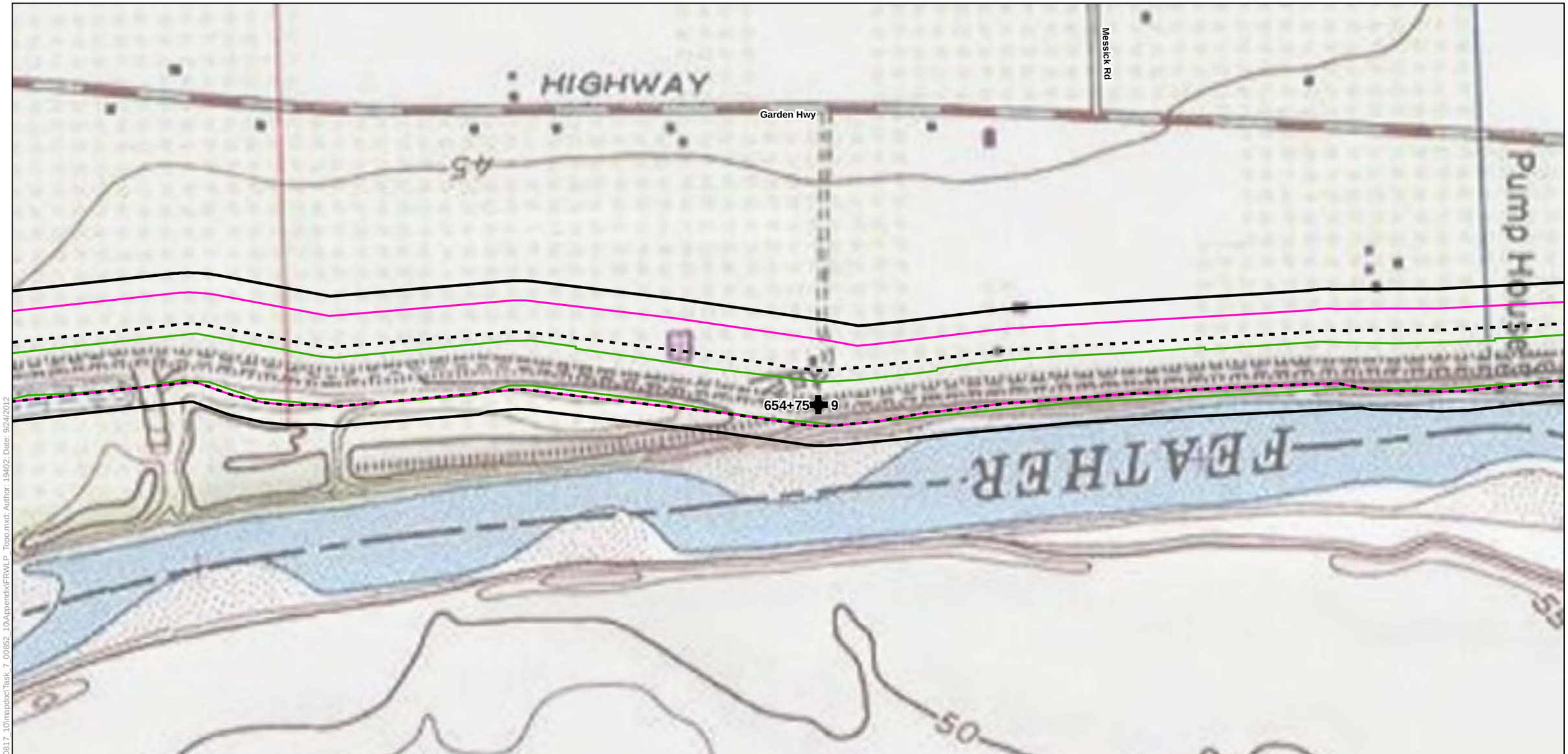

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 7

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Feet

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Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 8

0 250 500
Feet

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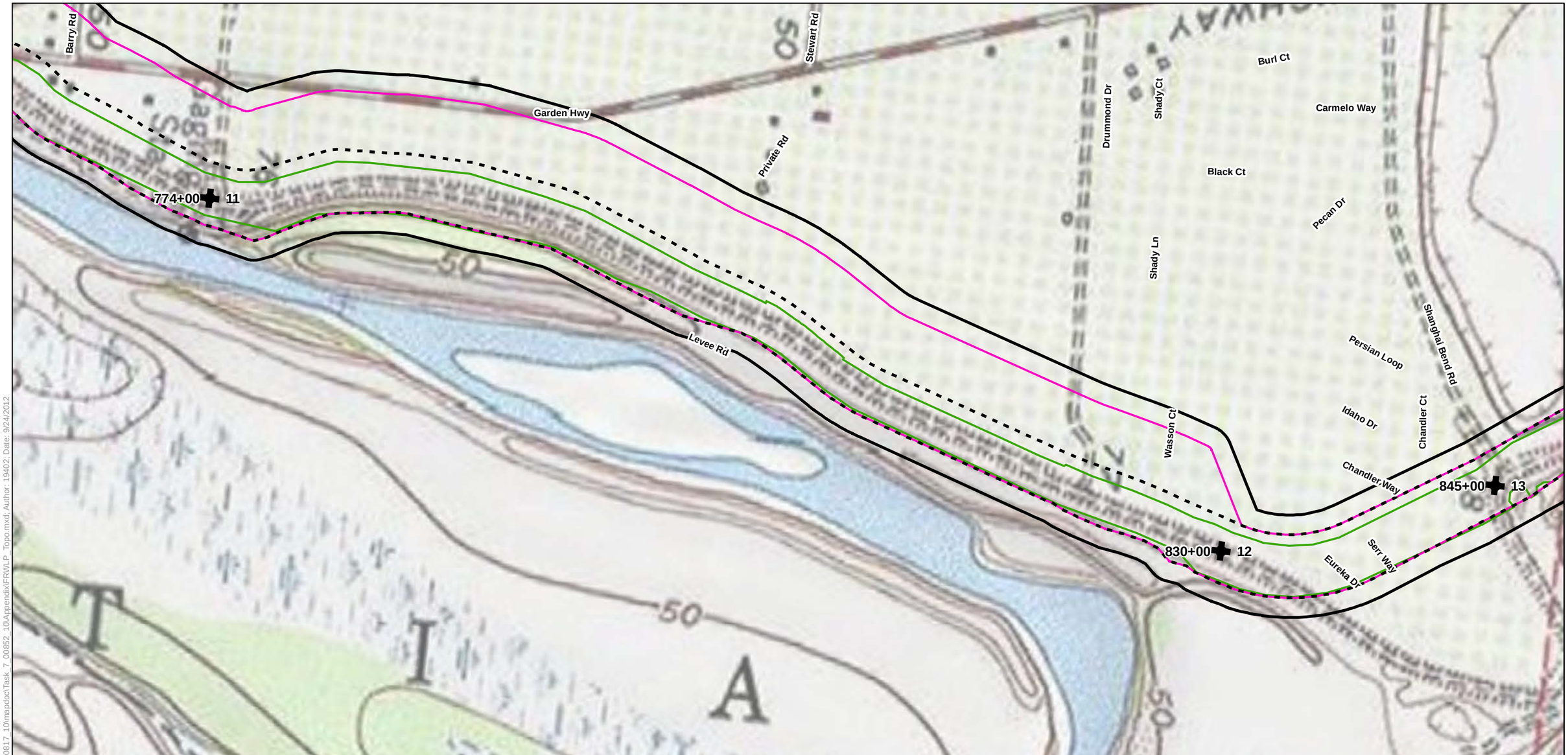

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 9

0 250 500
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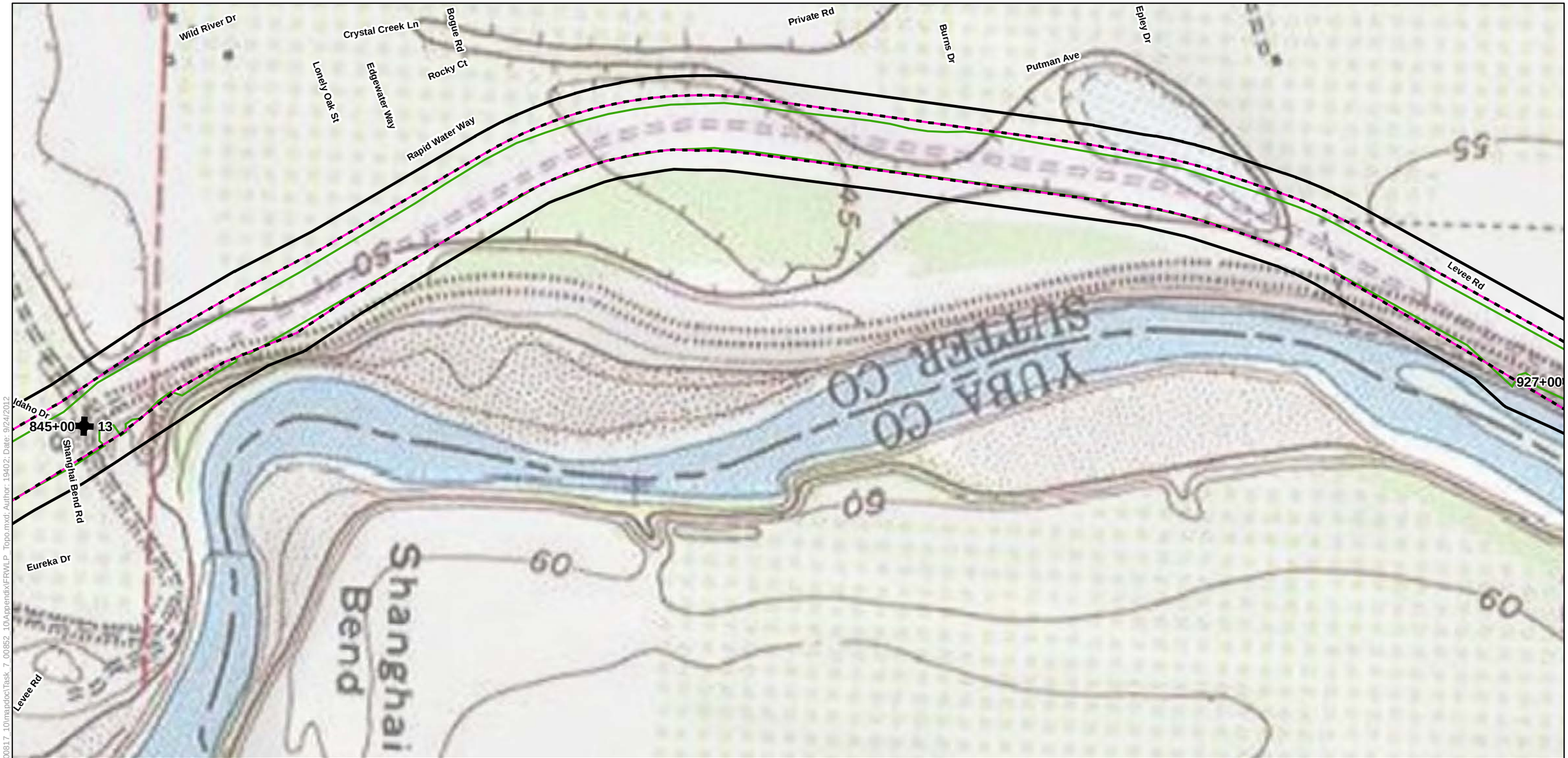

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 10

0 250 500
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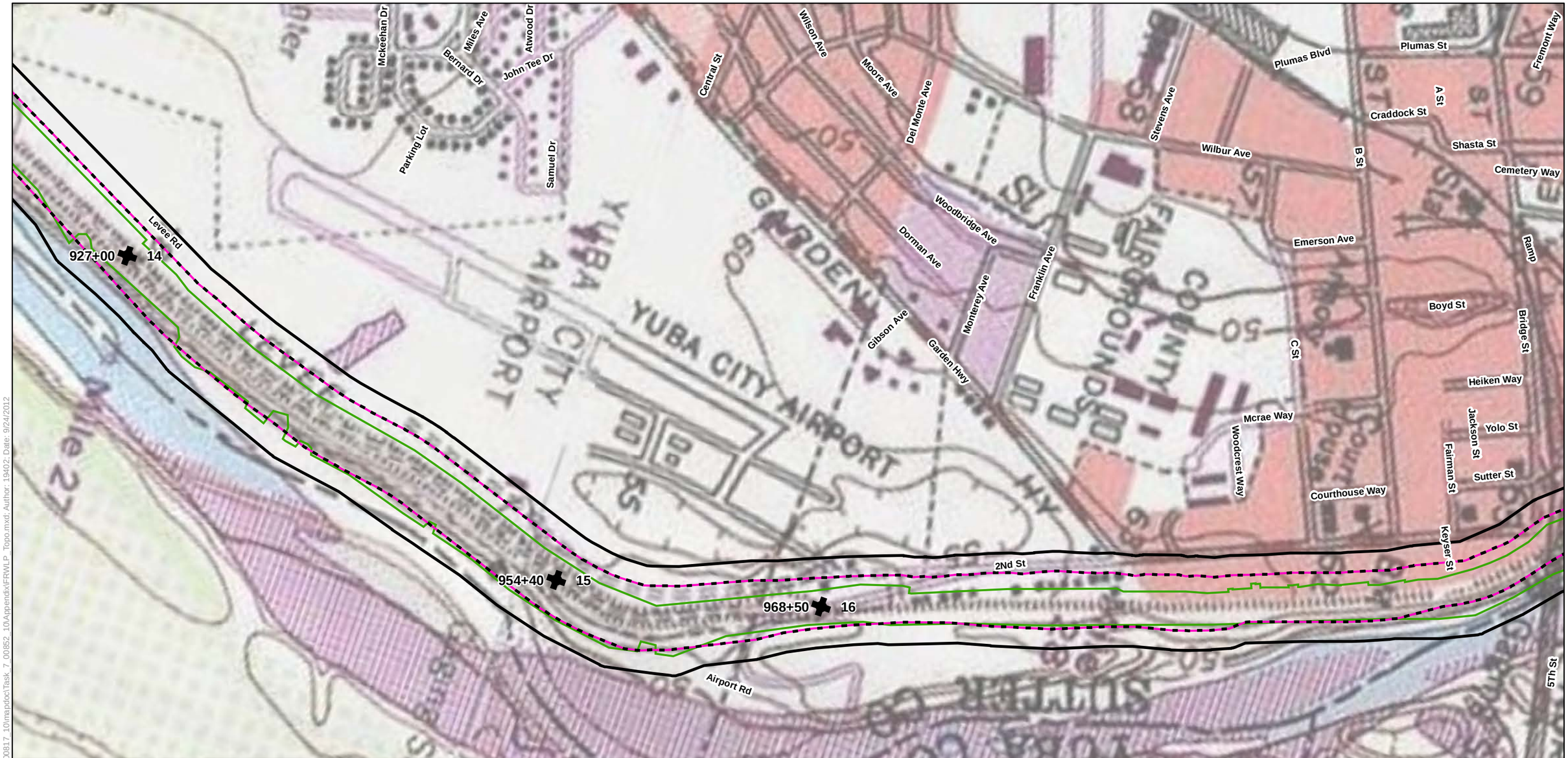

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 11

0 250 500
Feet

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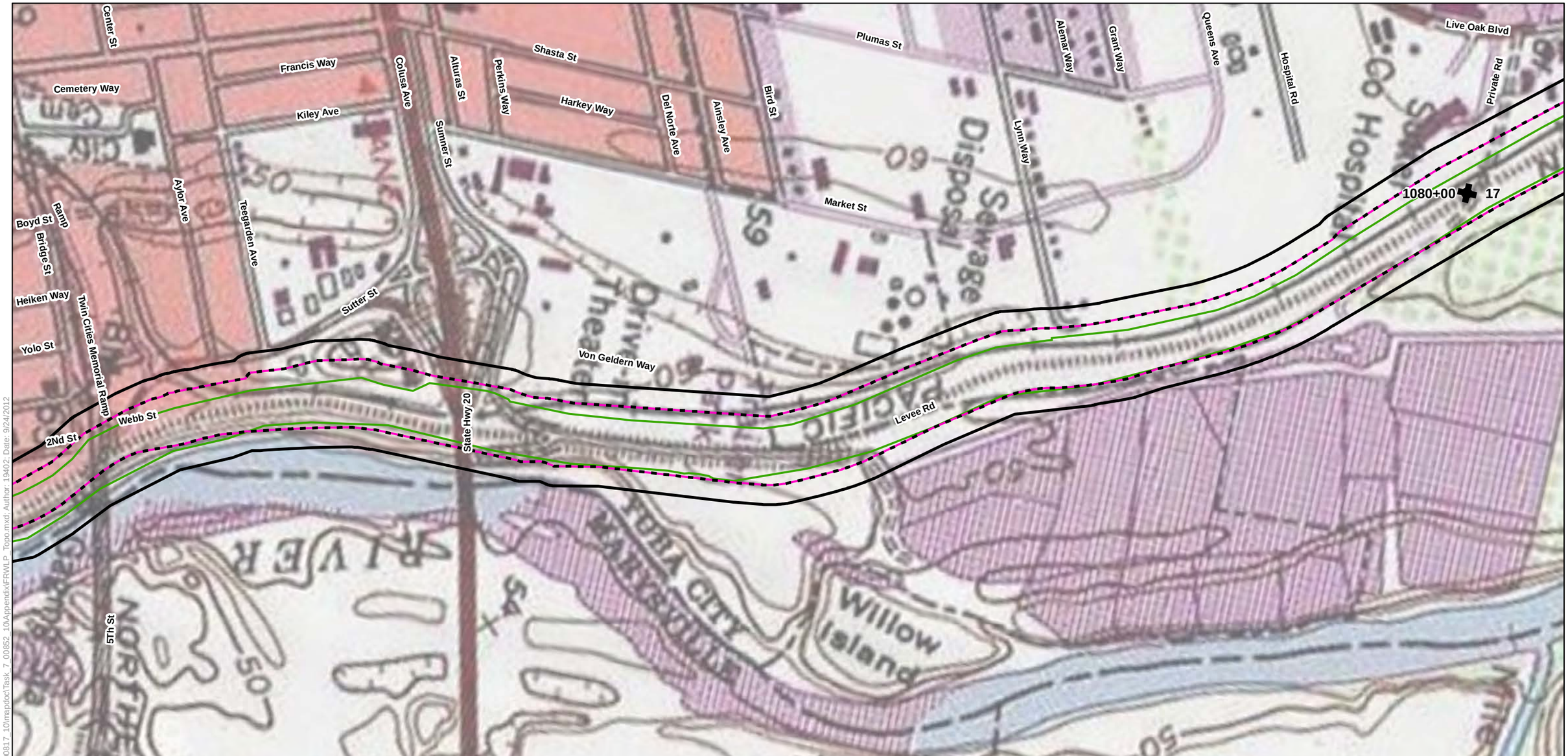

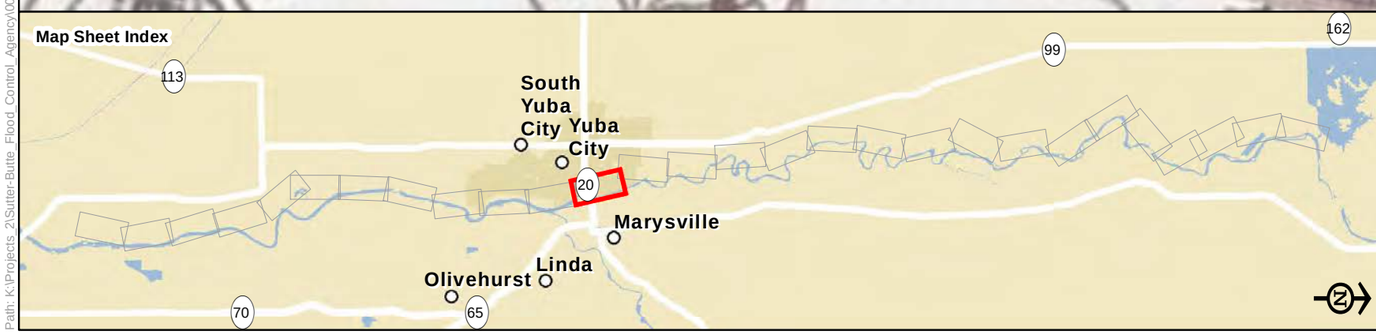

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 12

0 250 500
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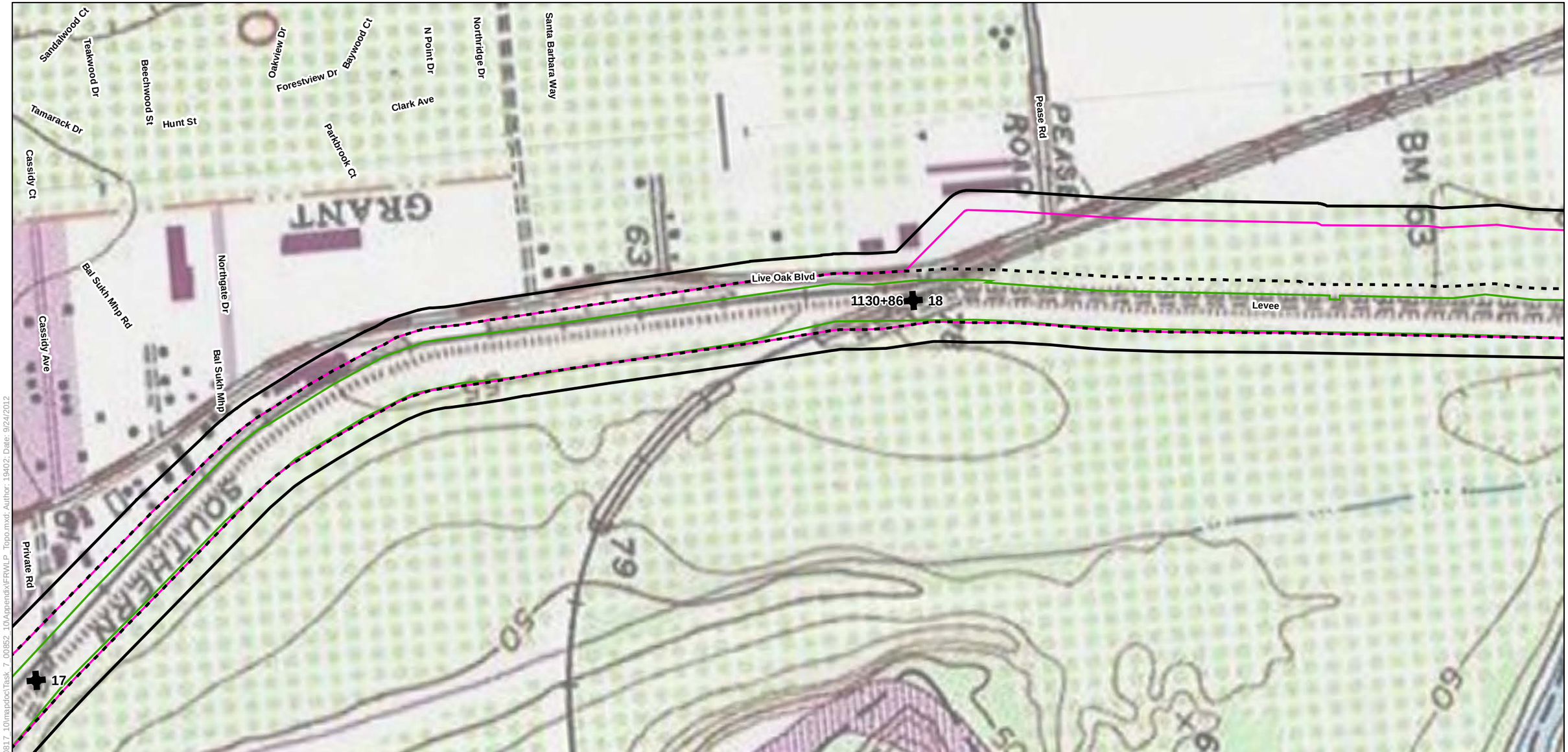

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 13

0 250 500
Feet

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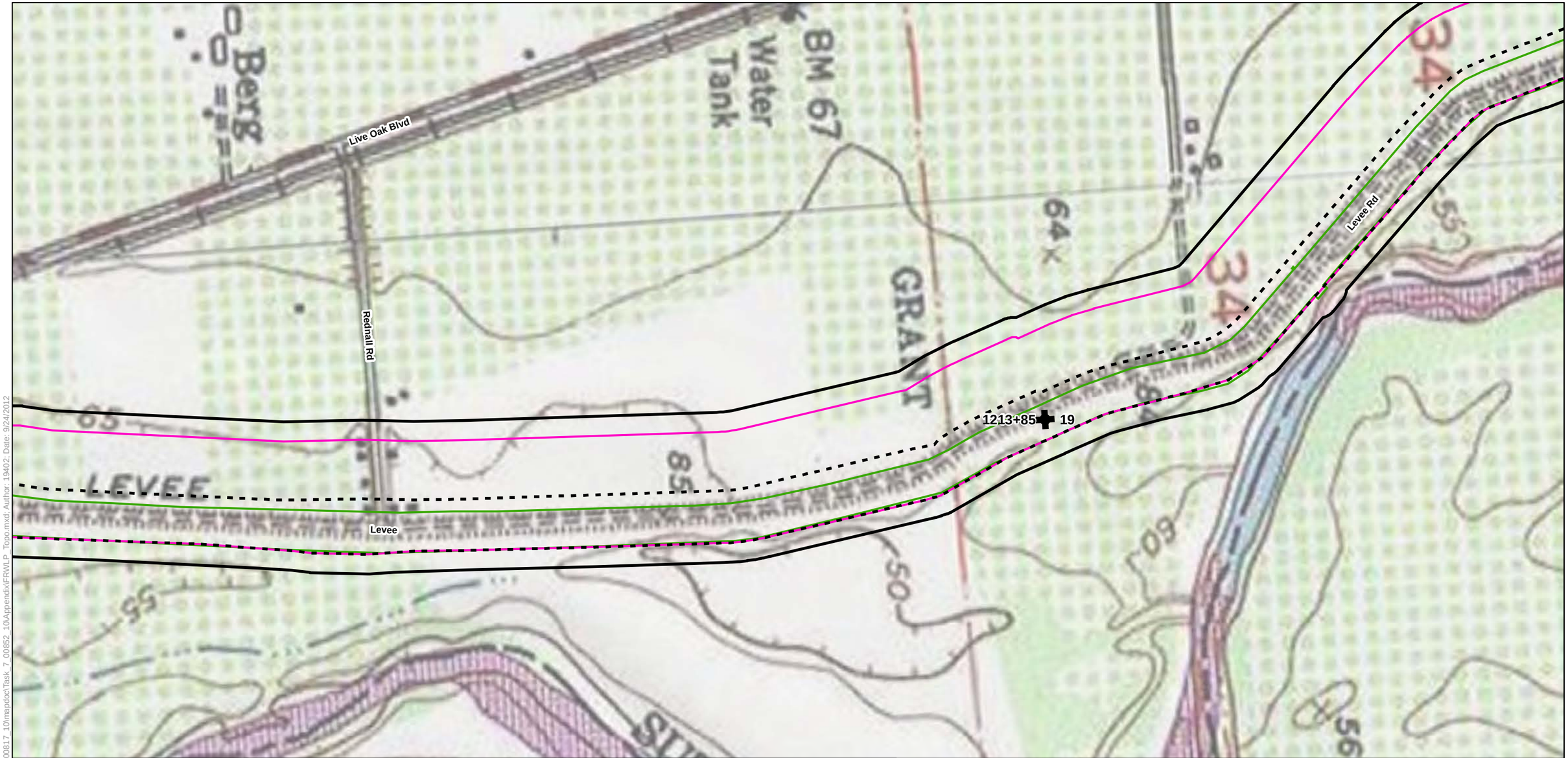

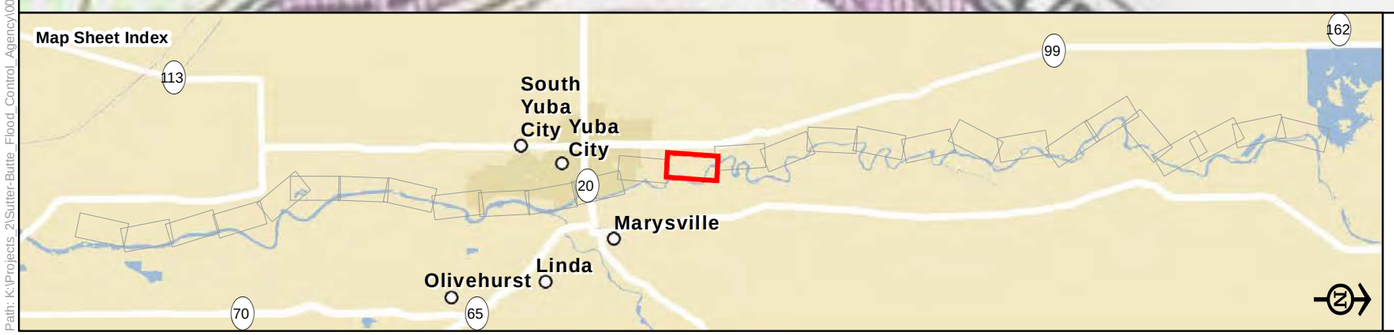

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 14

0 250 500
Feet

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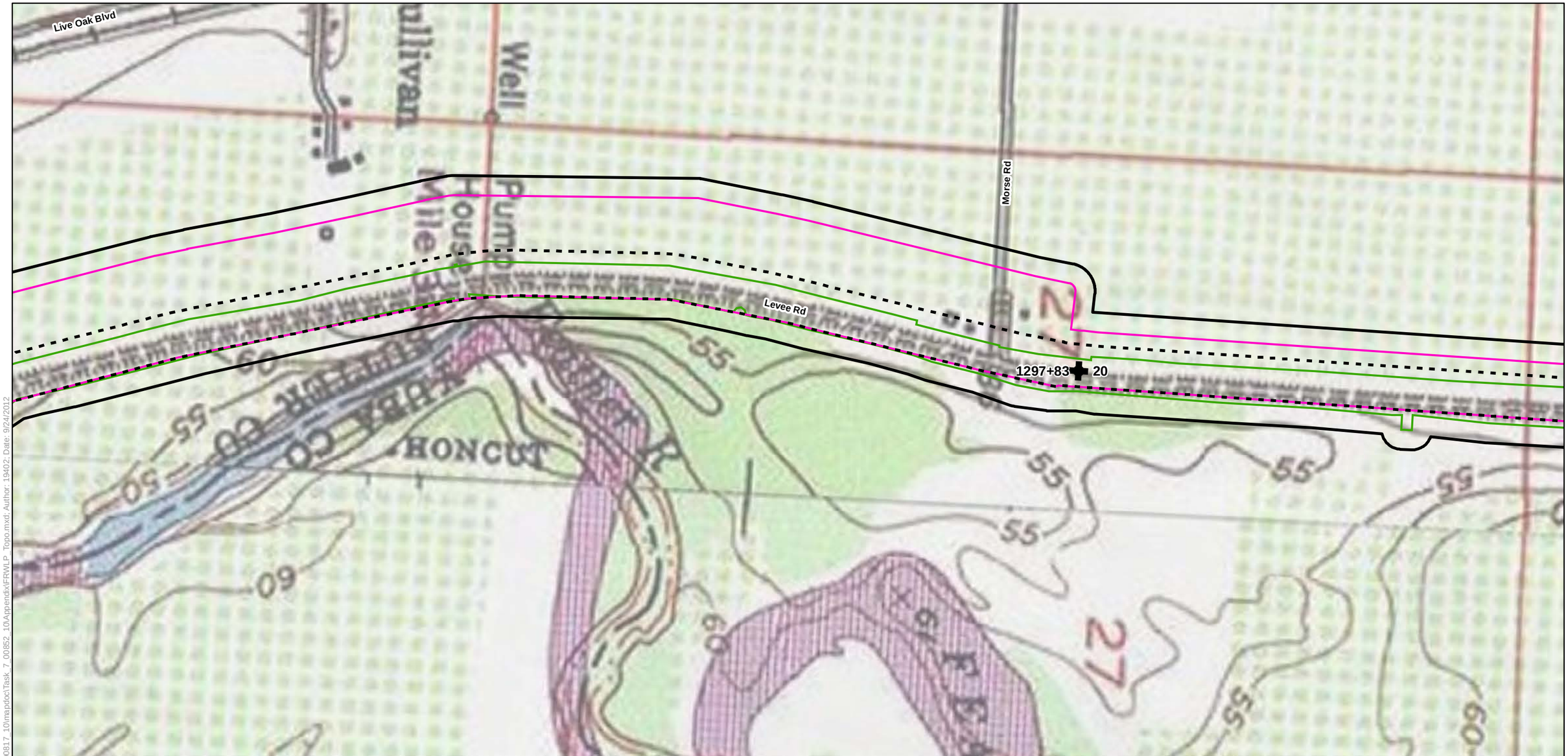

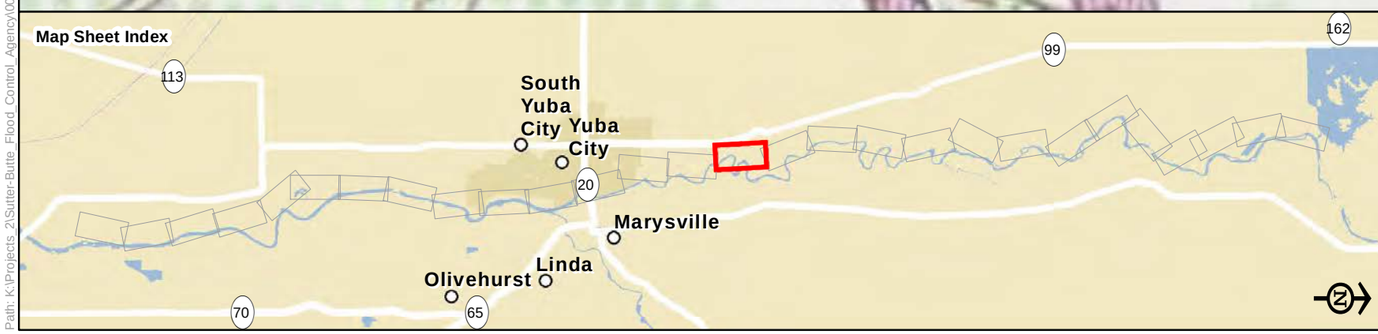

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 15

0 250 500
Feet

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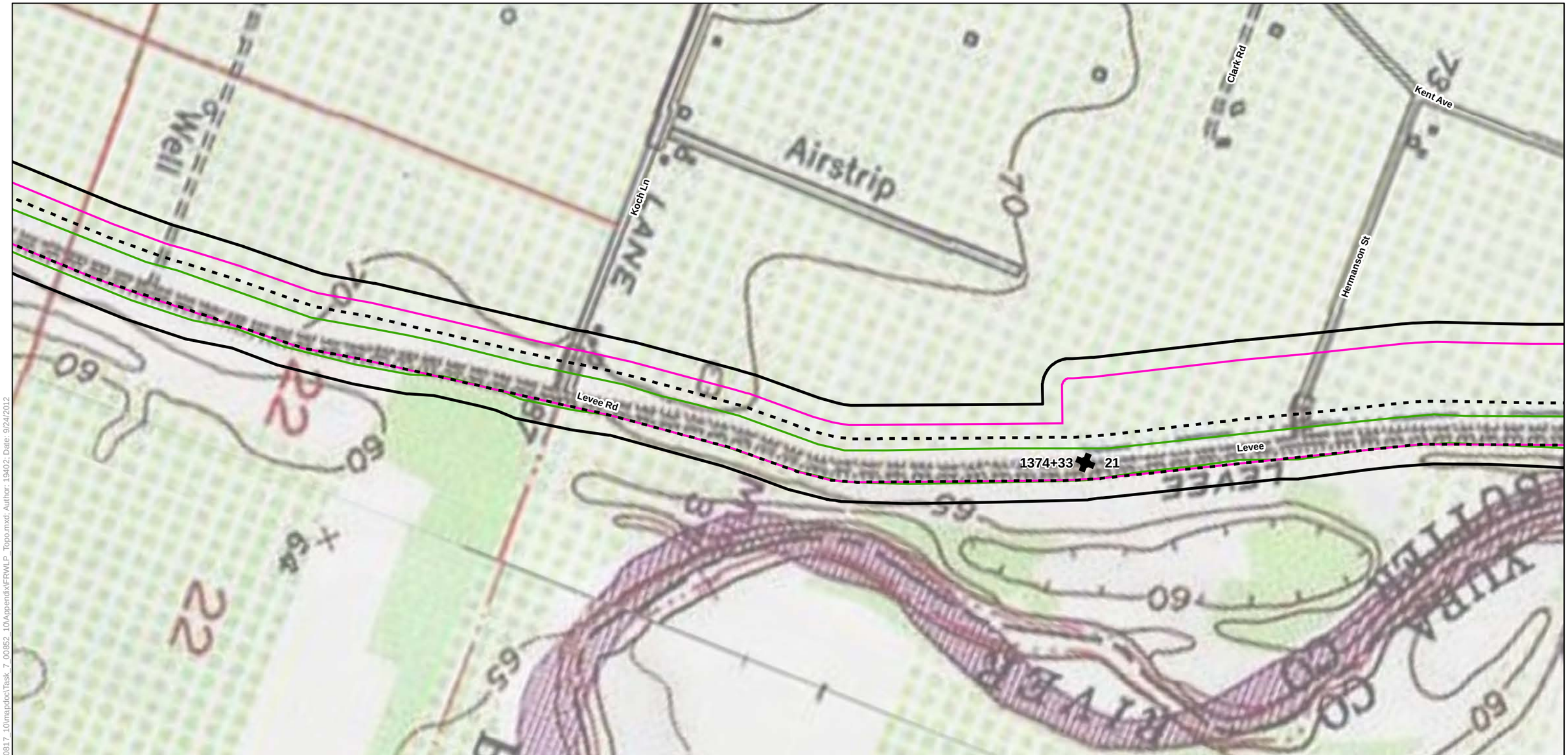

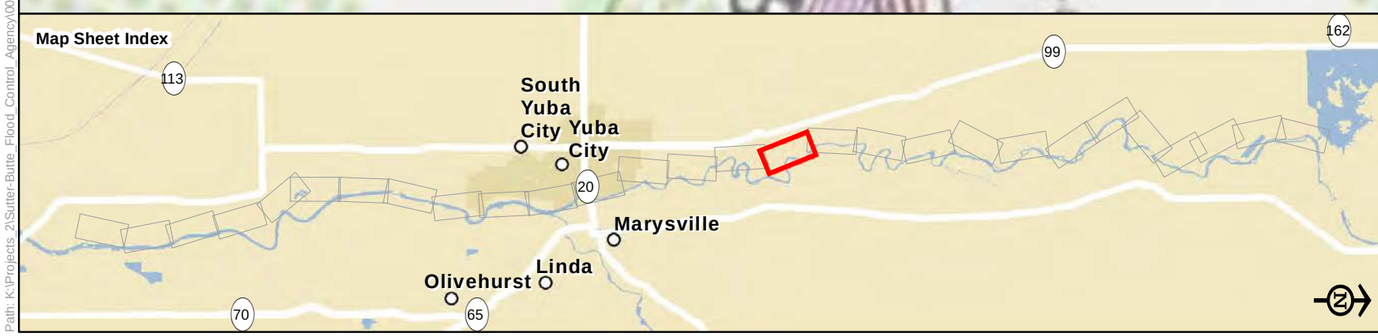

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 16

0 250 500
Feet

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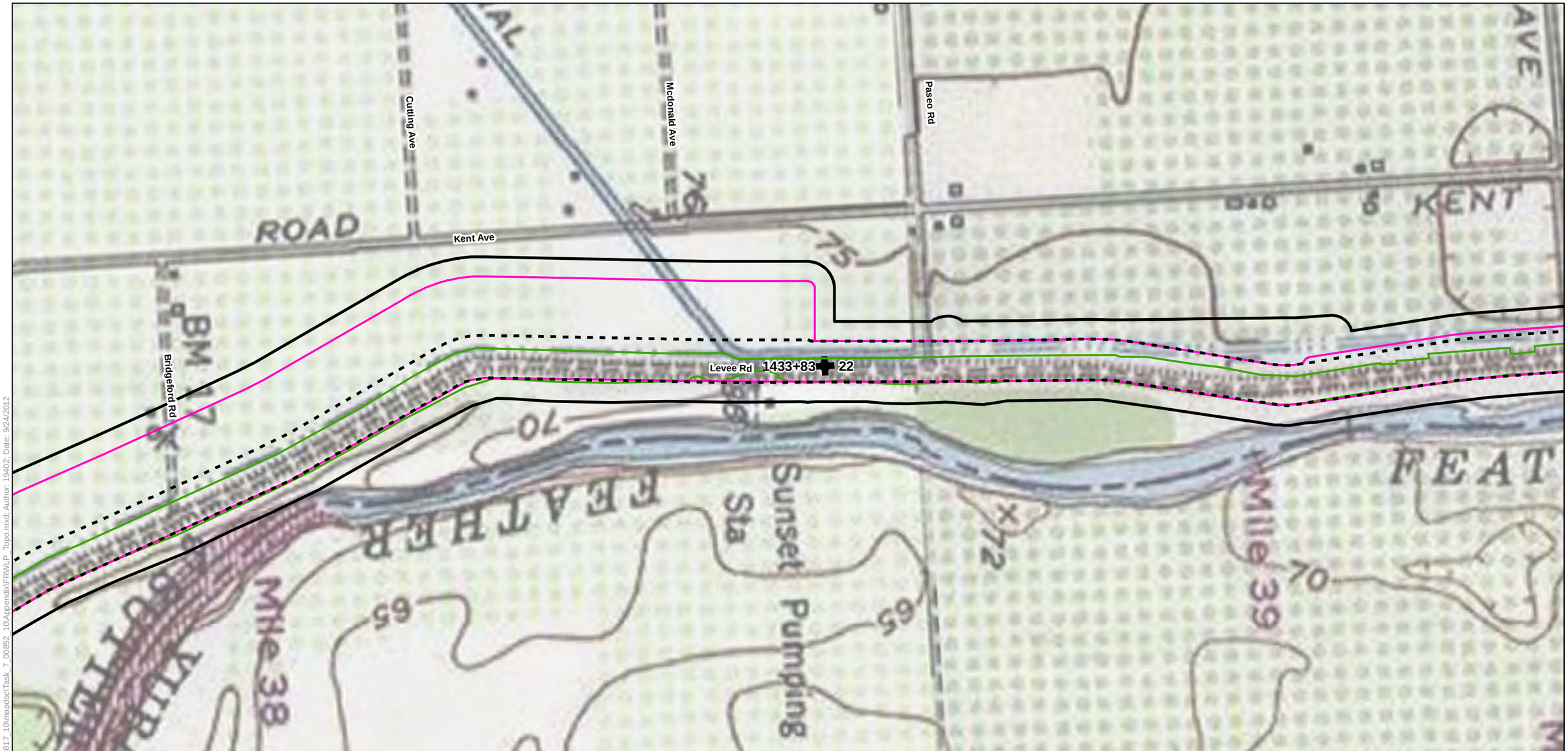

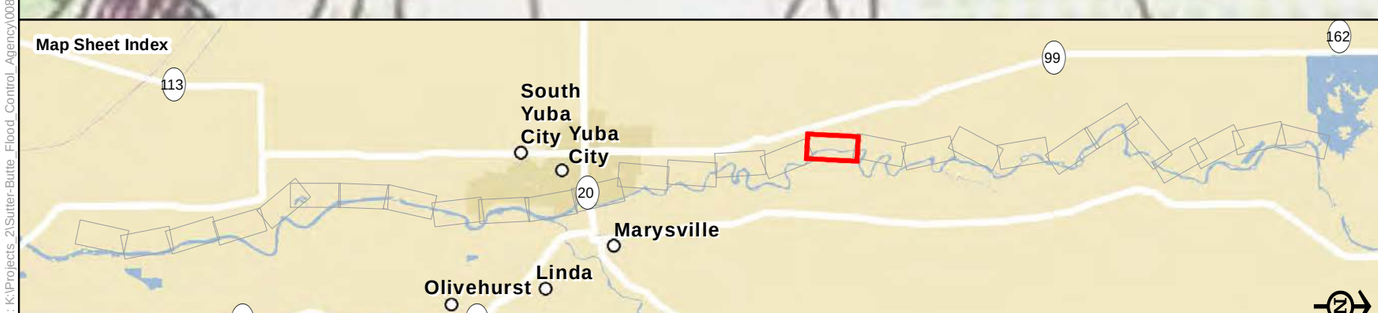

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 17

0 250 500
Feet

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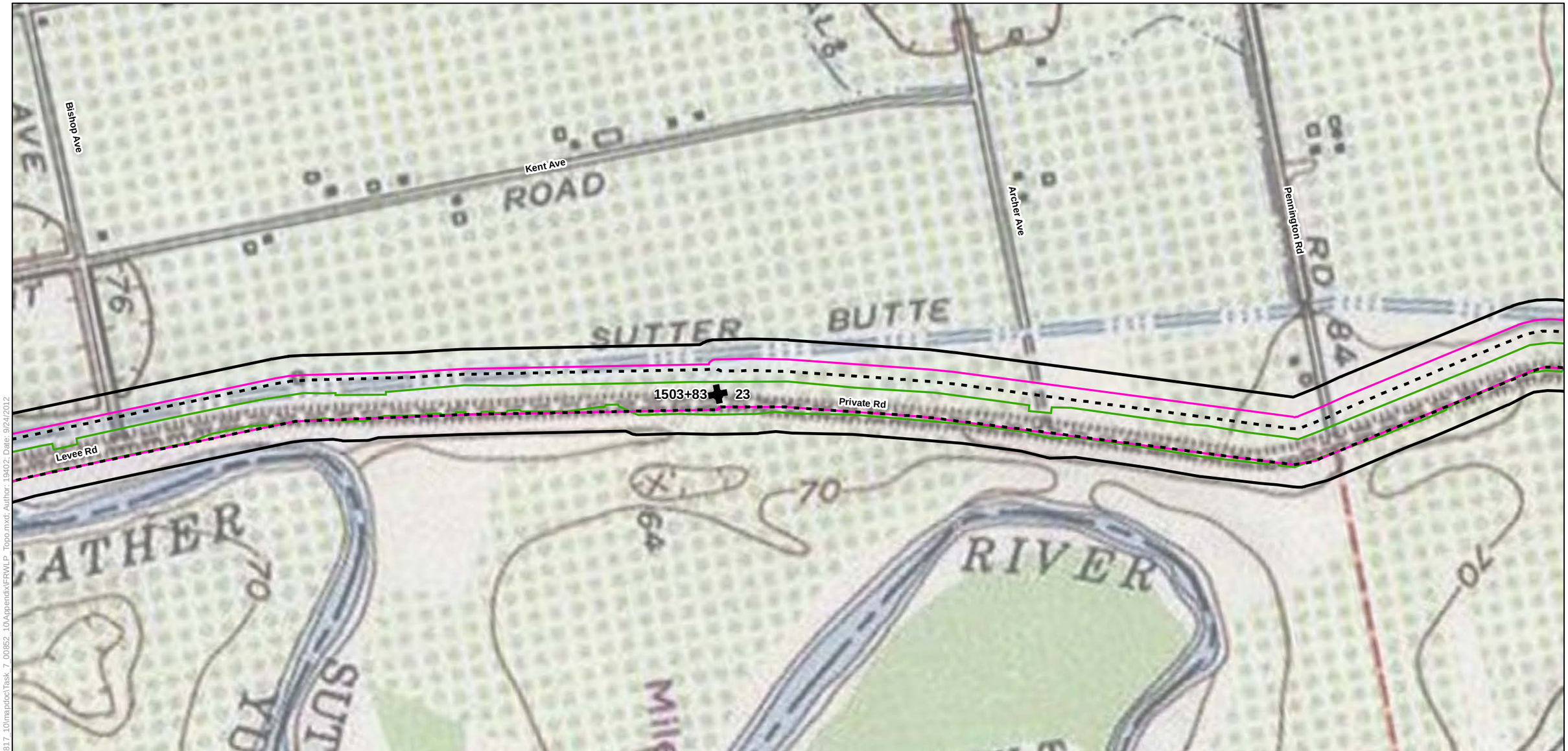

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 18

0 250 500
Feet

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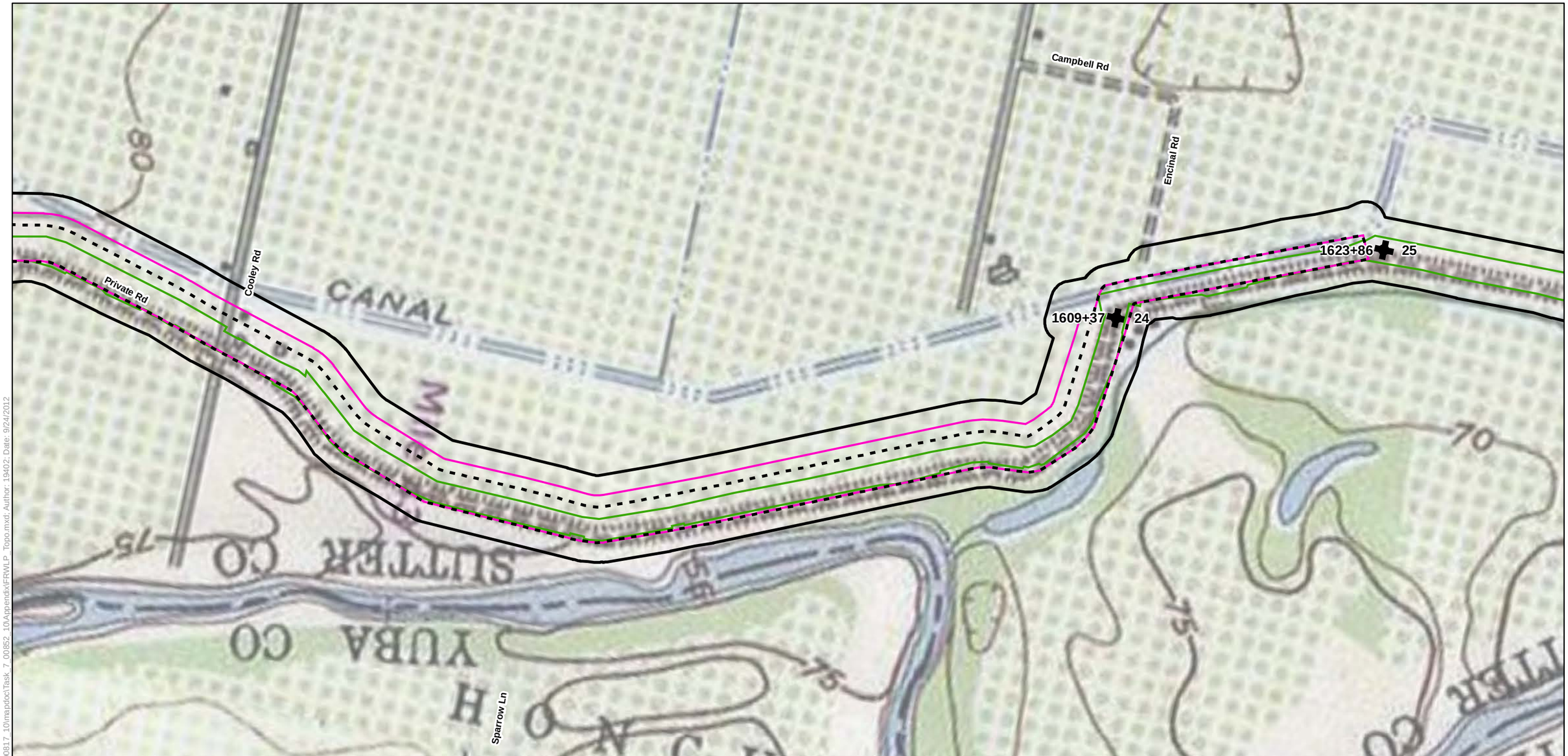

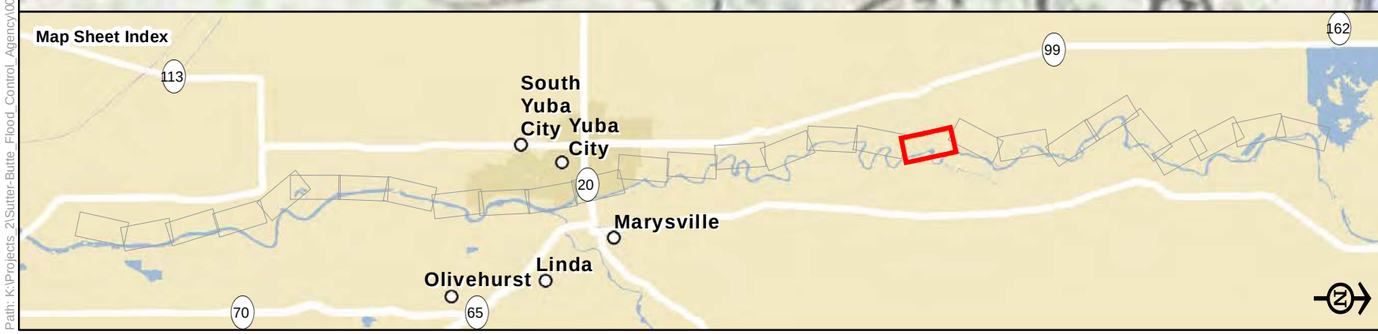

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 19

0 250 500
Feet

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Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 20

0 250 500
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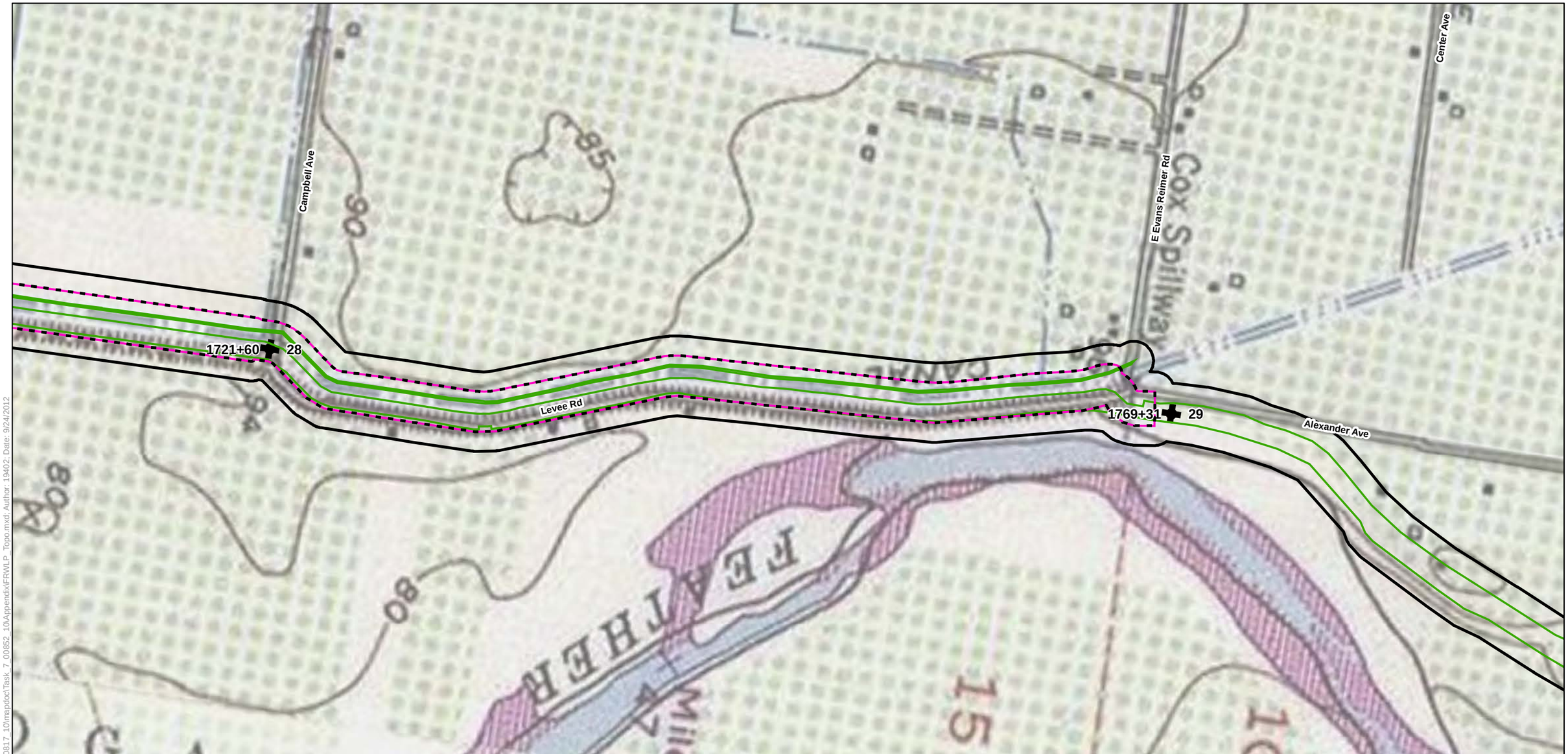

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 21

0 250 500
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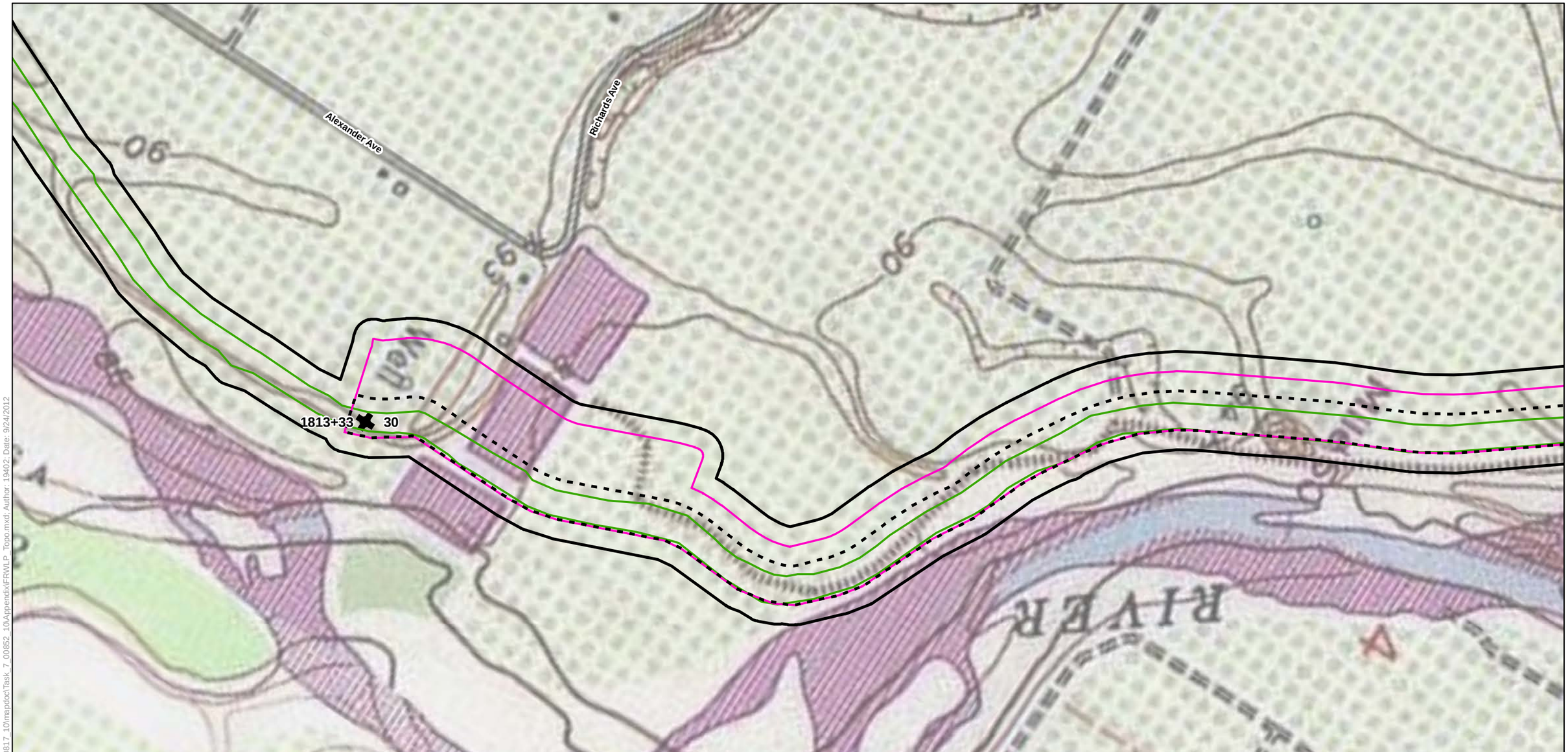

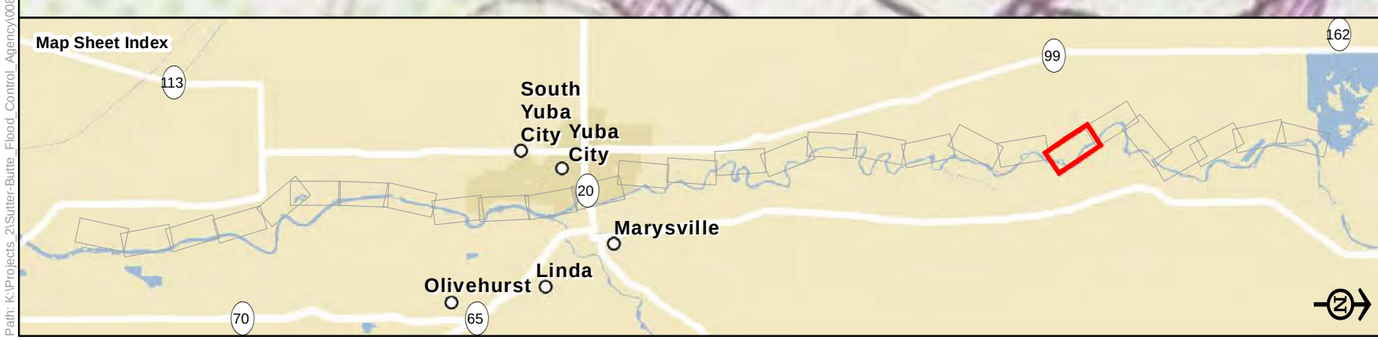

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 22

0 250 500
Feet

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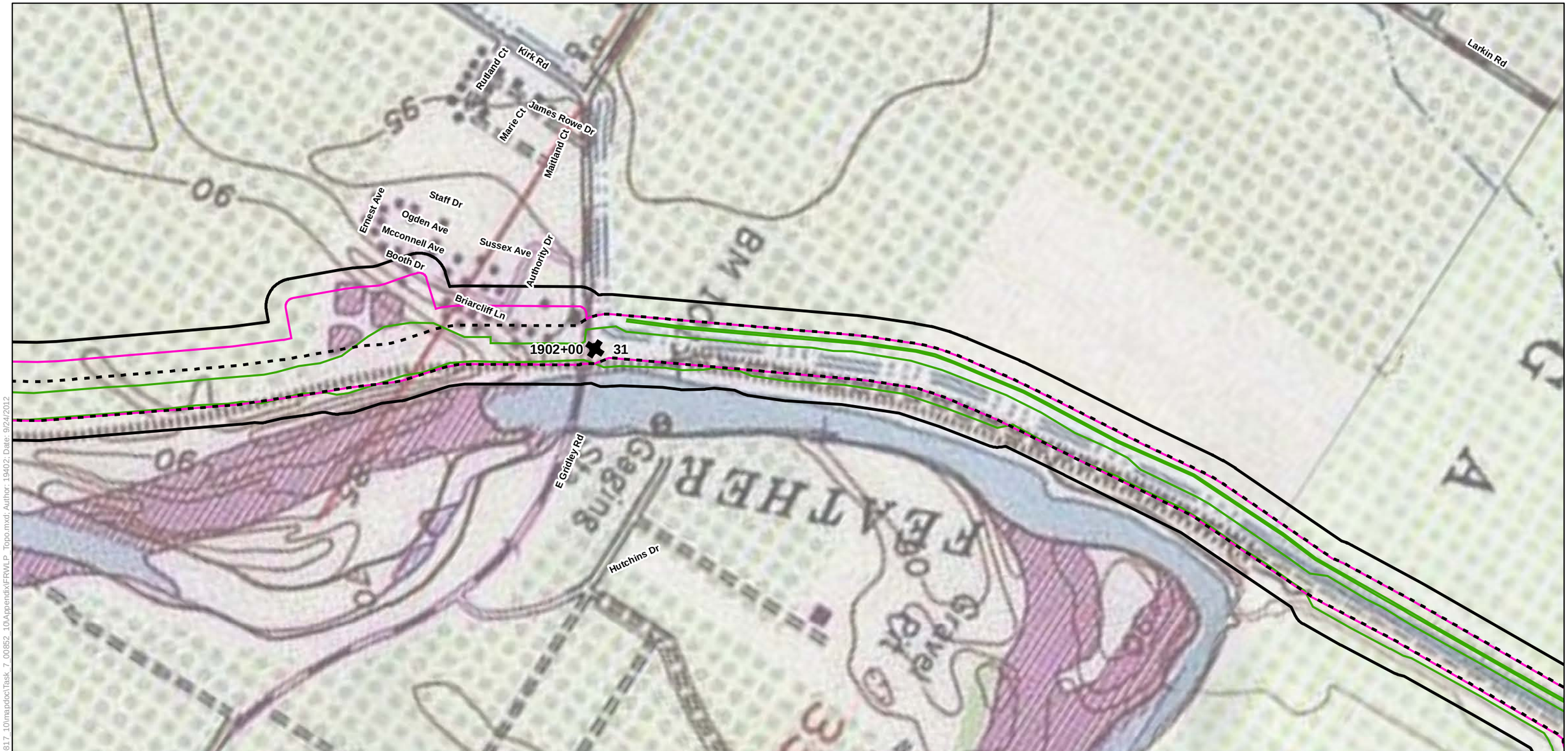

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 23

0 250 500
Feet

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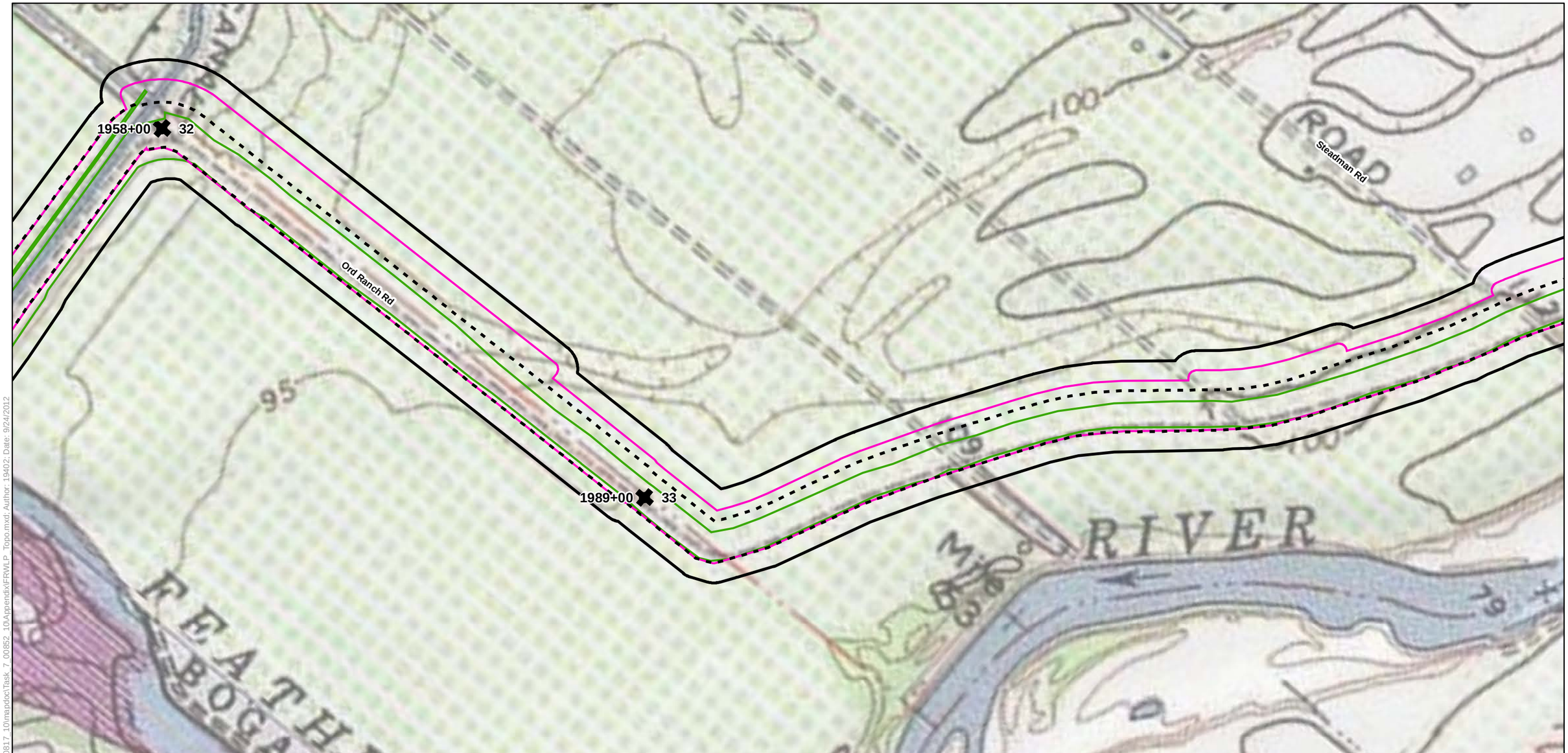

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 24

0 250 500
Feet

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Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 25

0 250 500
Feet

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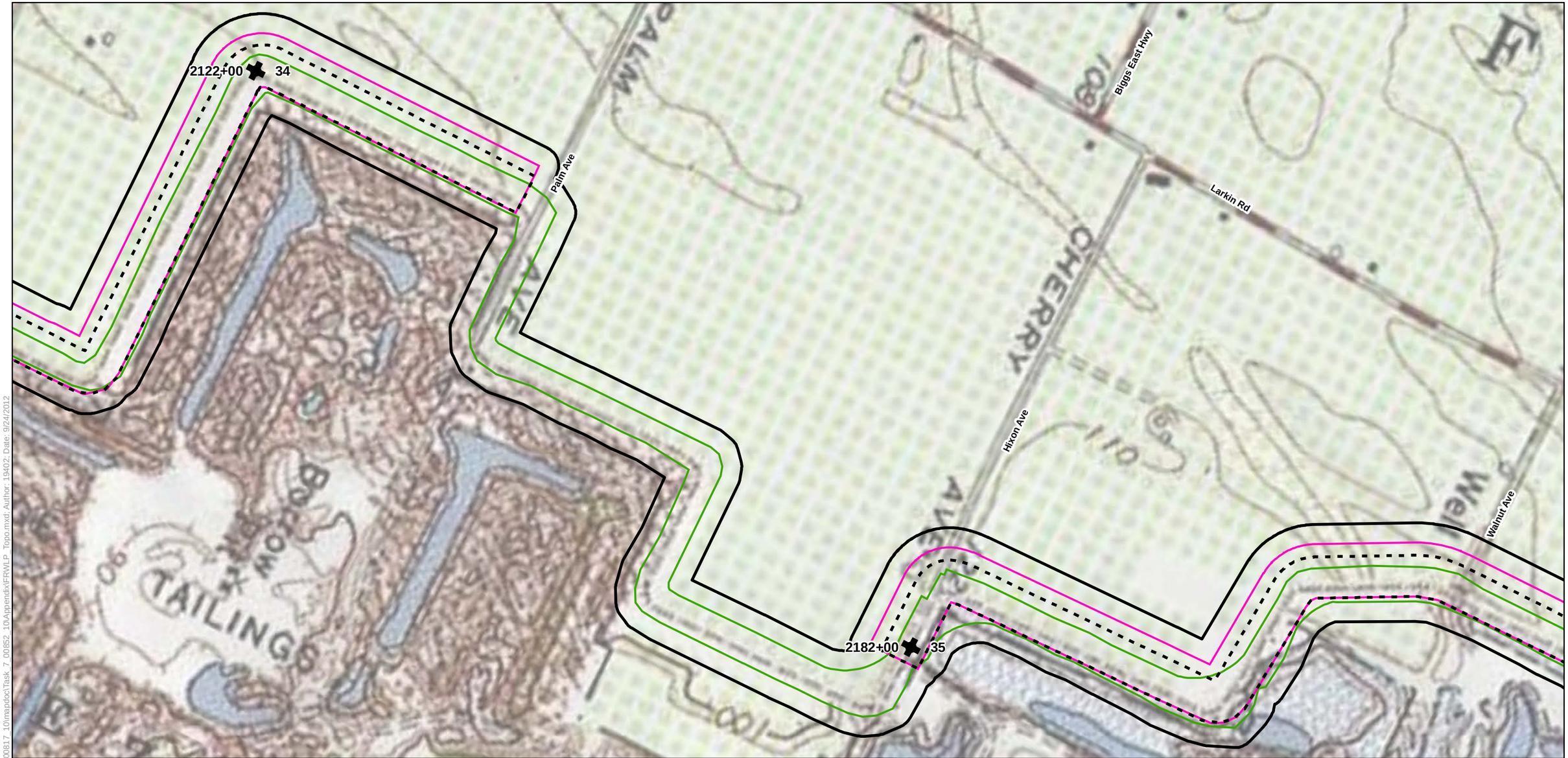

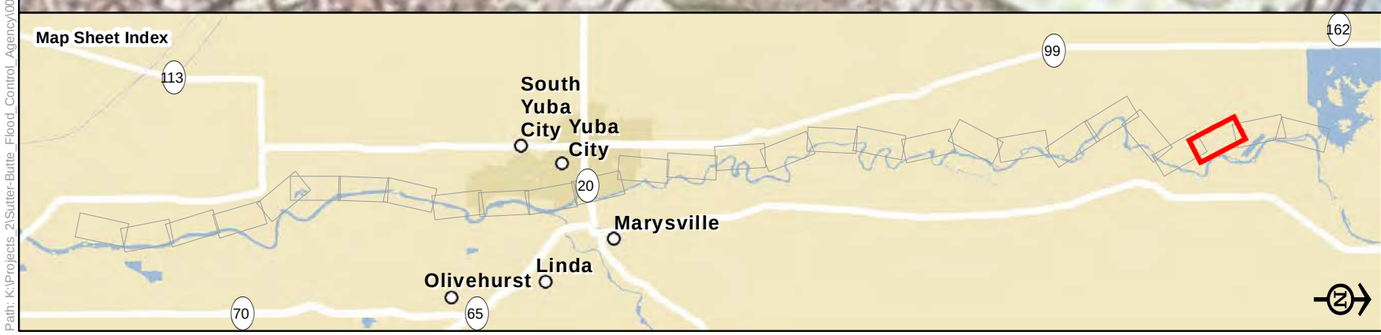

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 26

0 250 500
Feet

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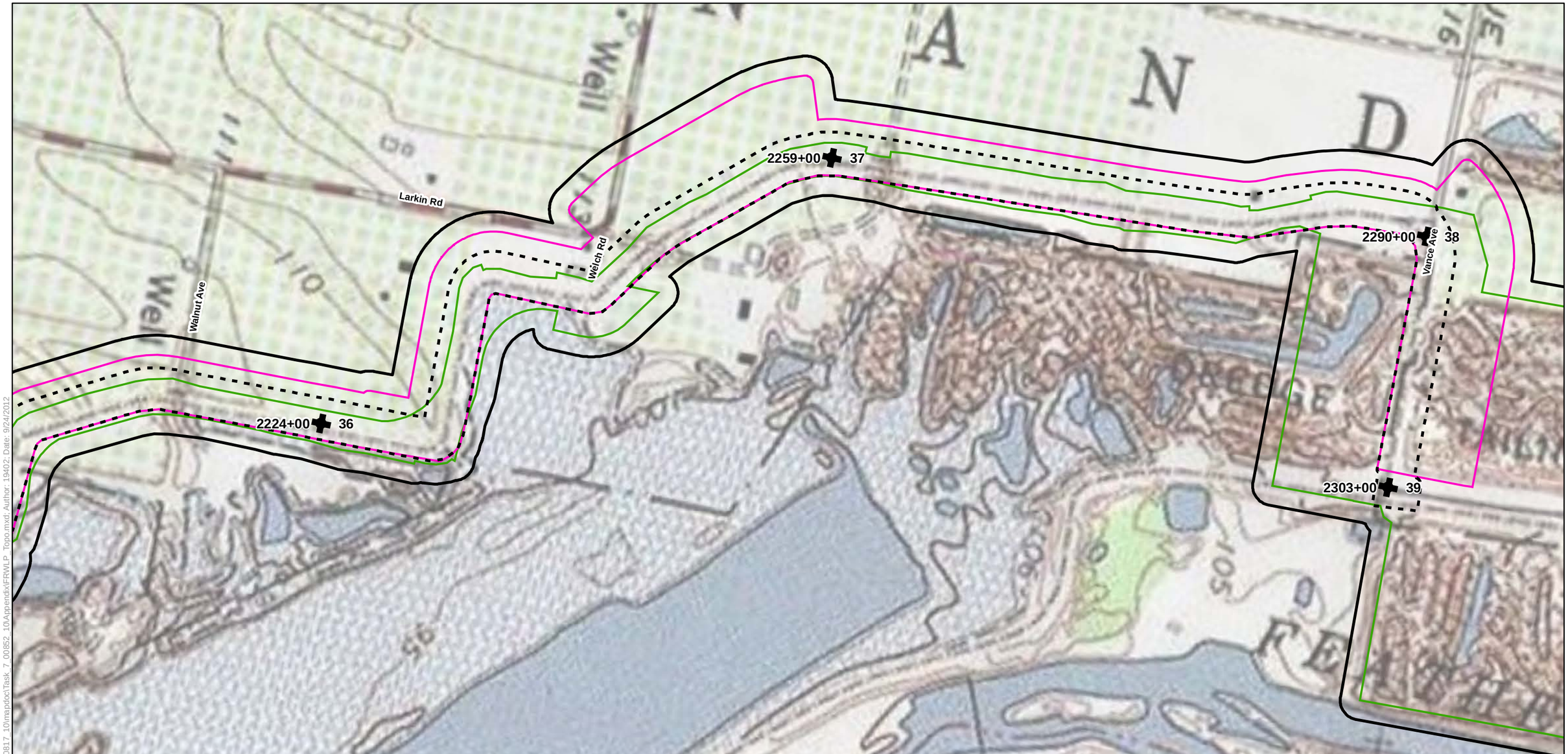

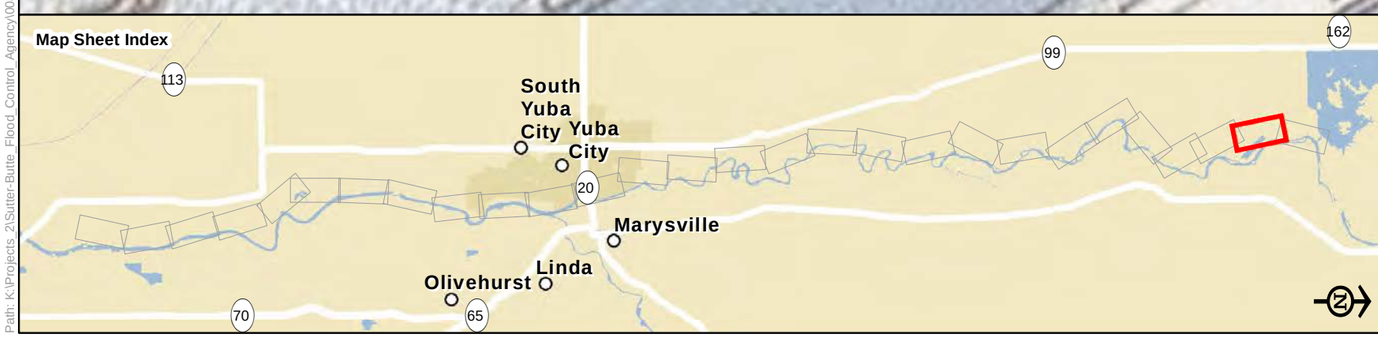

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 27

0 250 500
Feet

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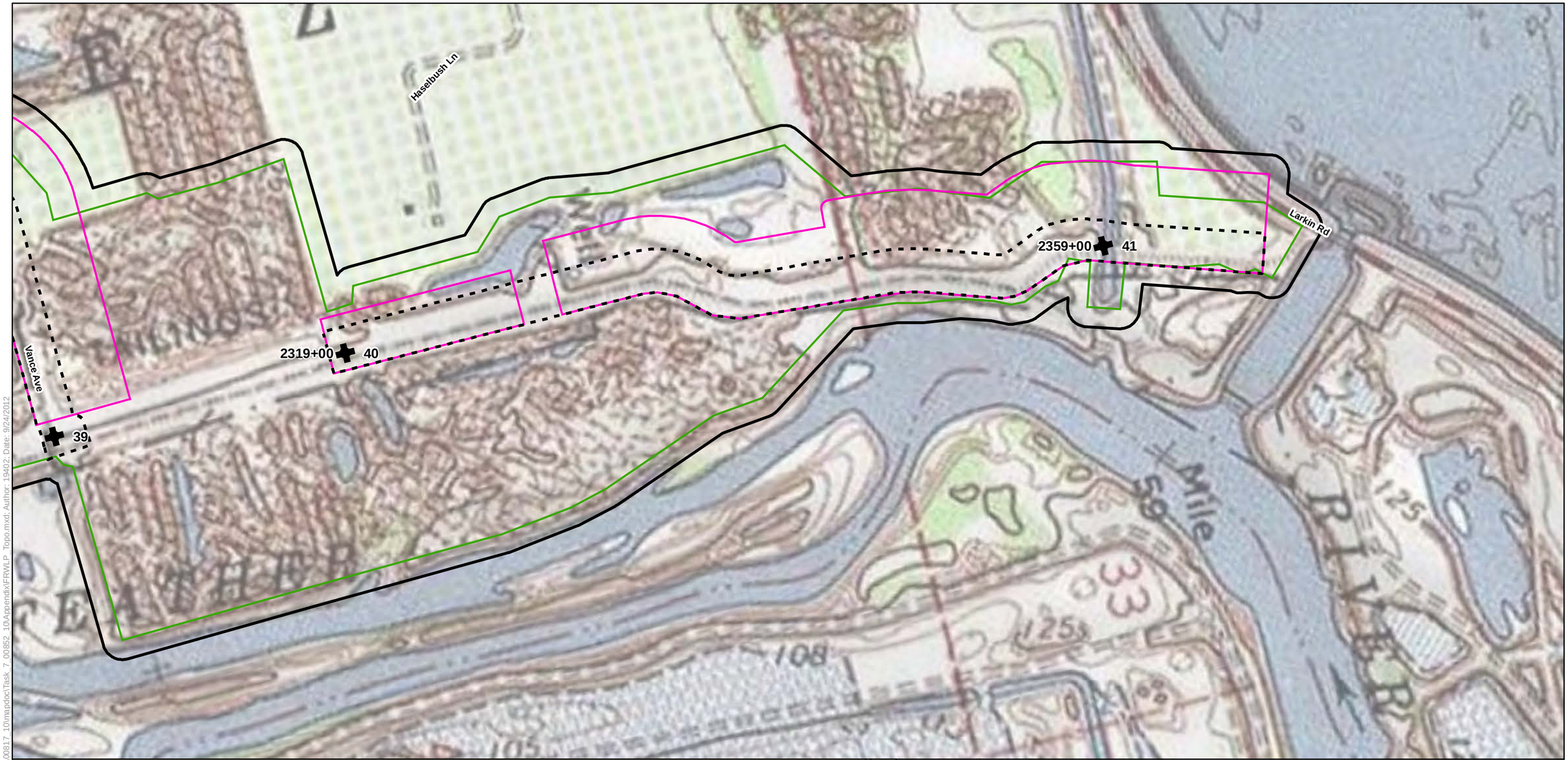

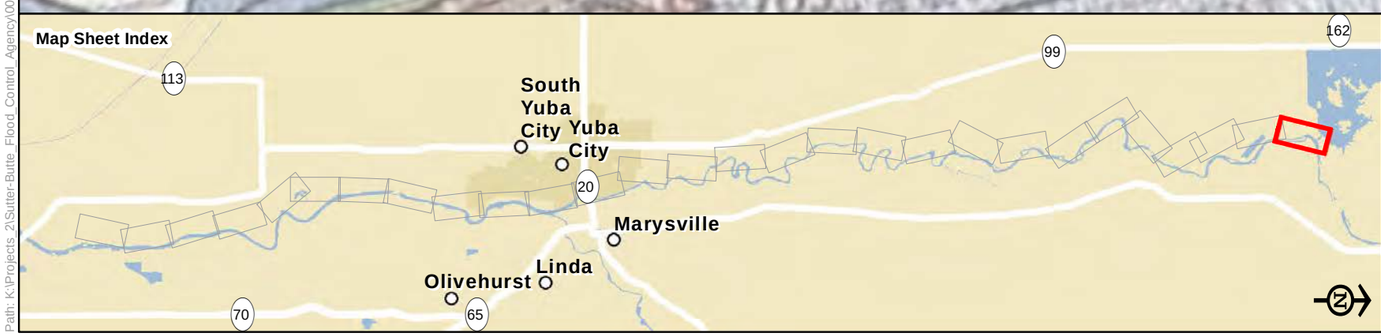

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

USGS 7.5-minute Topographic Maps in the Vicinity of the Biological Study Area

Sheet 28

0 250 500
Feet

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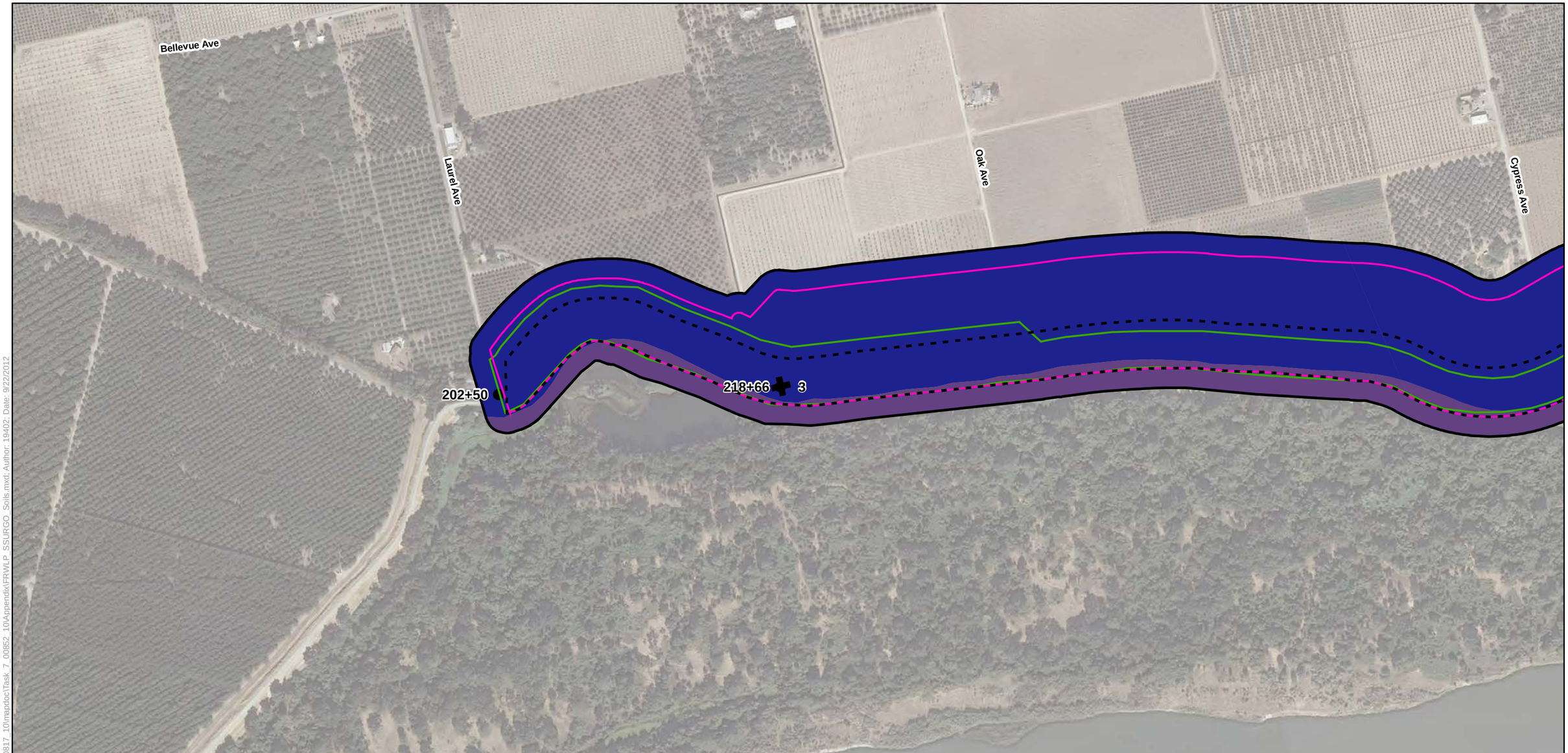
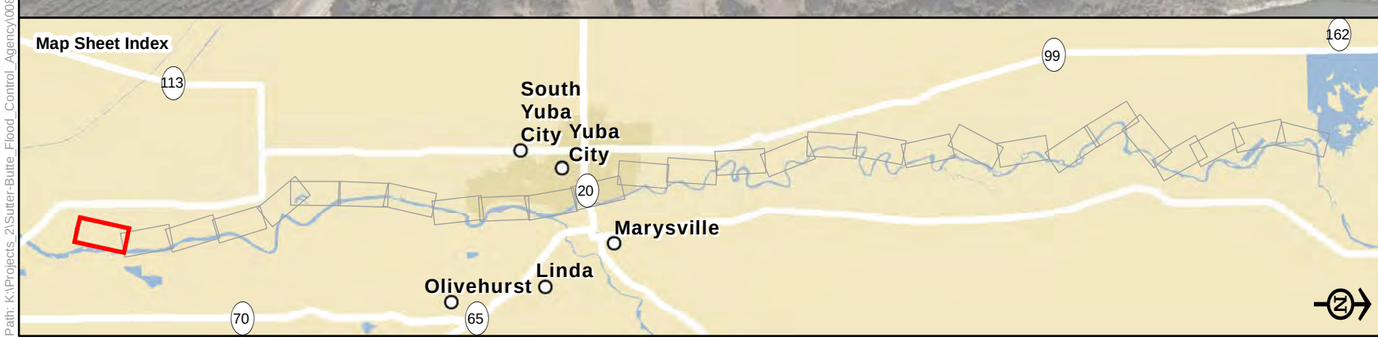
Part F.10

Soil Map Units in the Biological Study Area

[28 Sheets]





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

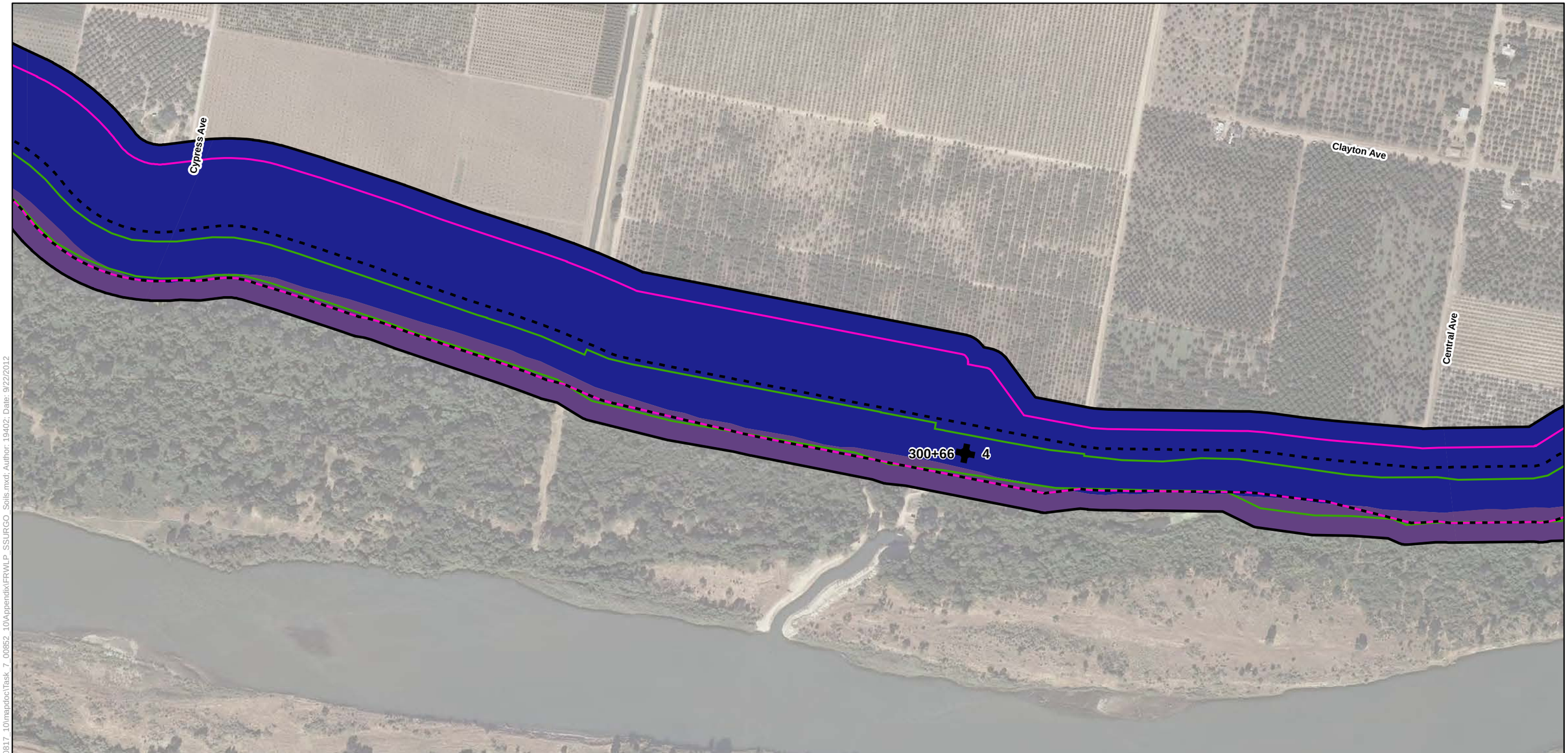
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes

Soil Map Units in the Biological Study Area

Sheet 1

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/22/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

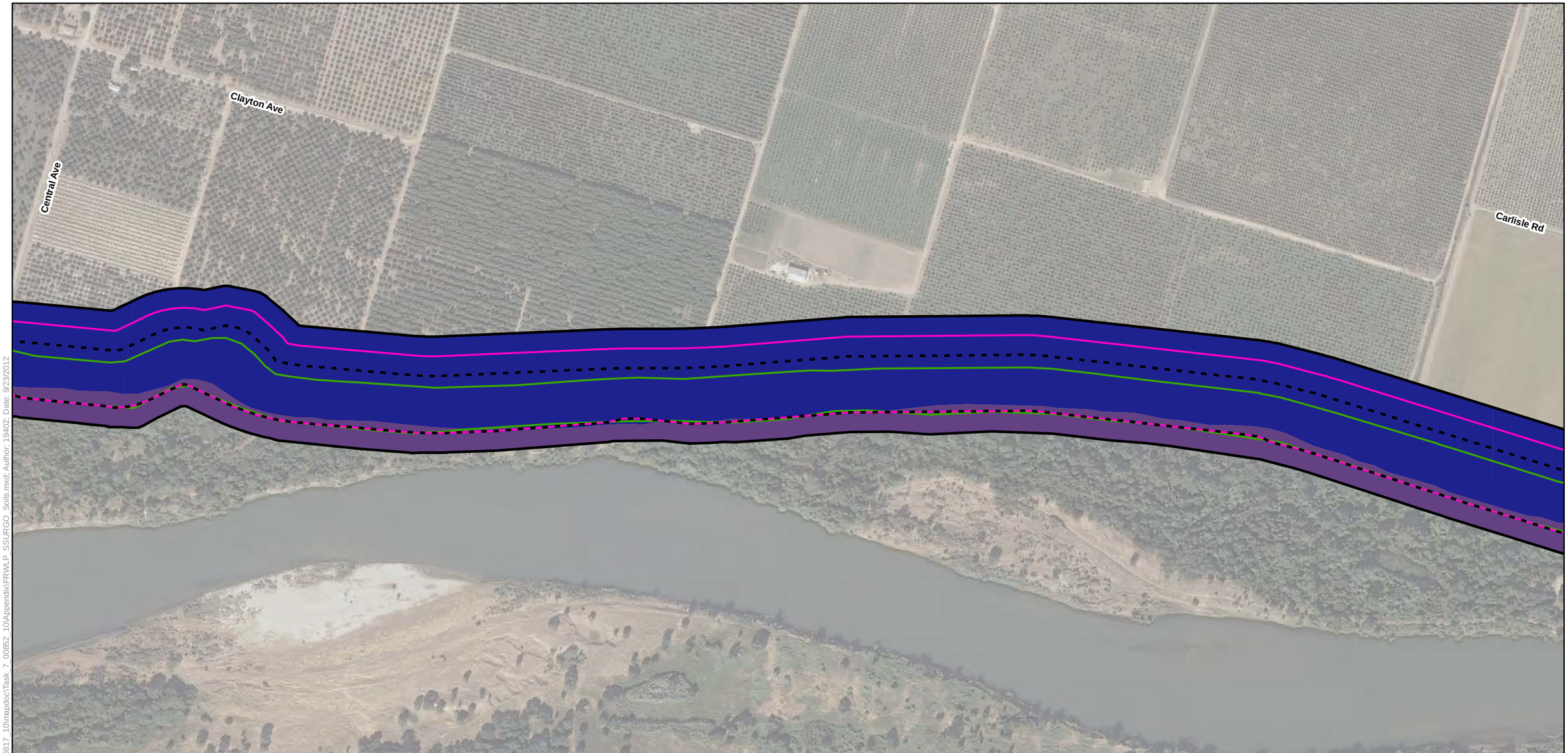
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes

Soil Map Units in the Biological Study Area

Sheet 2

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/22/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

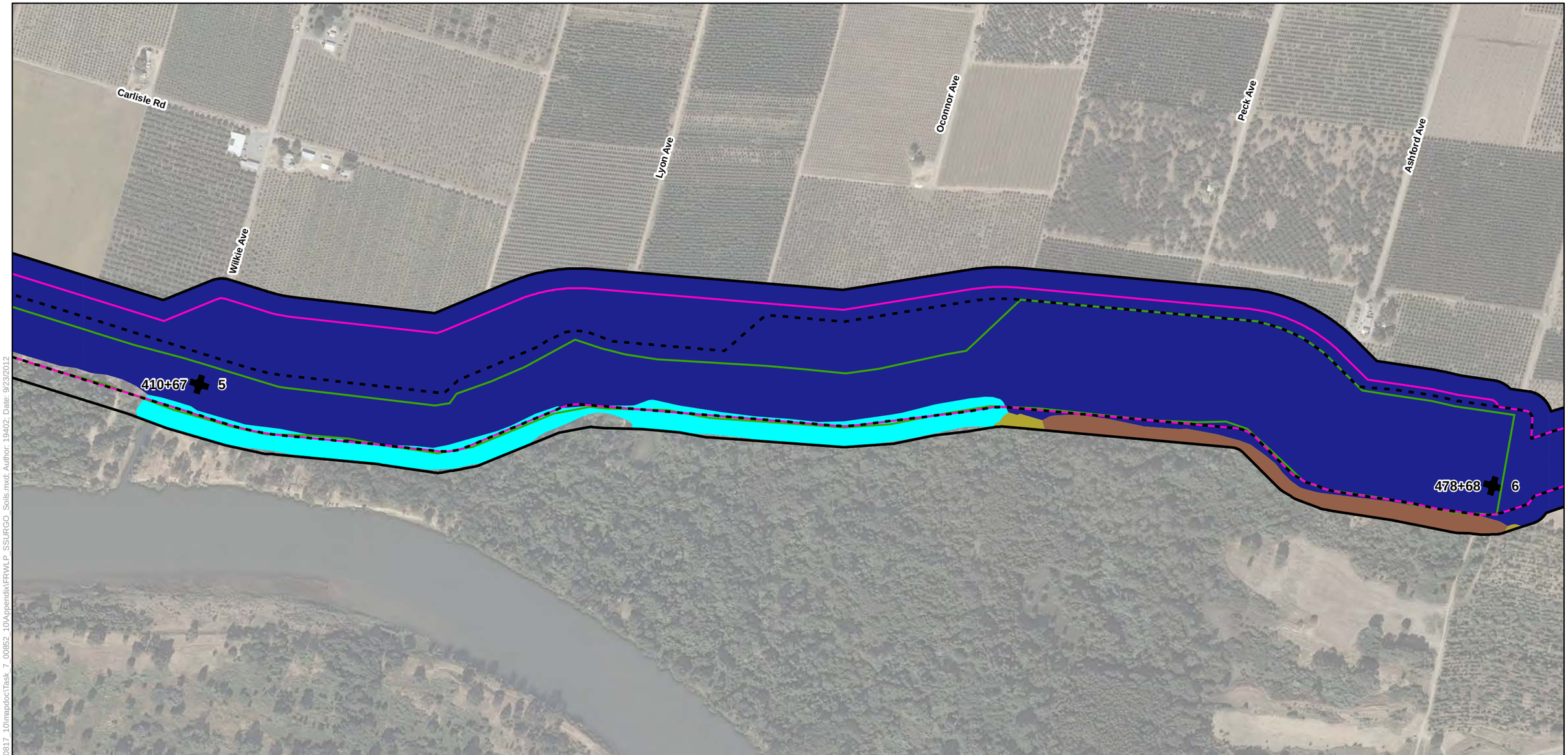
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes

Soil Map Units in the Biological Study Area

Sheet 3

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

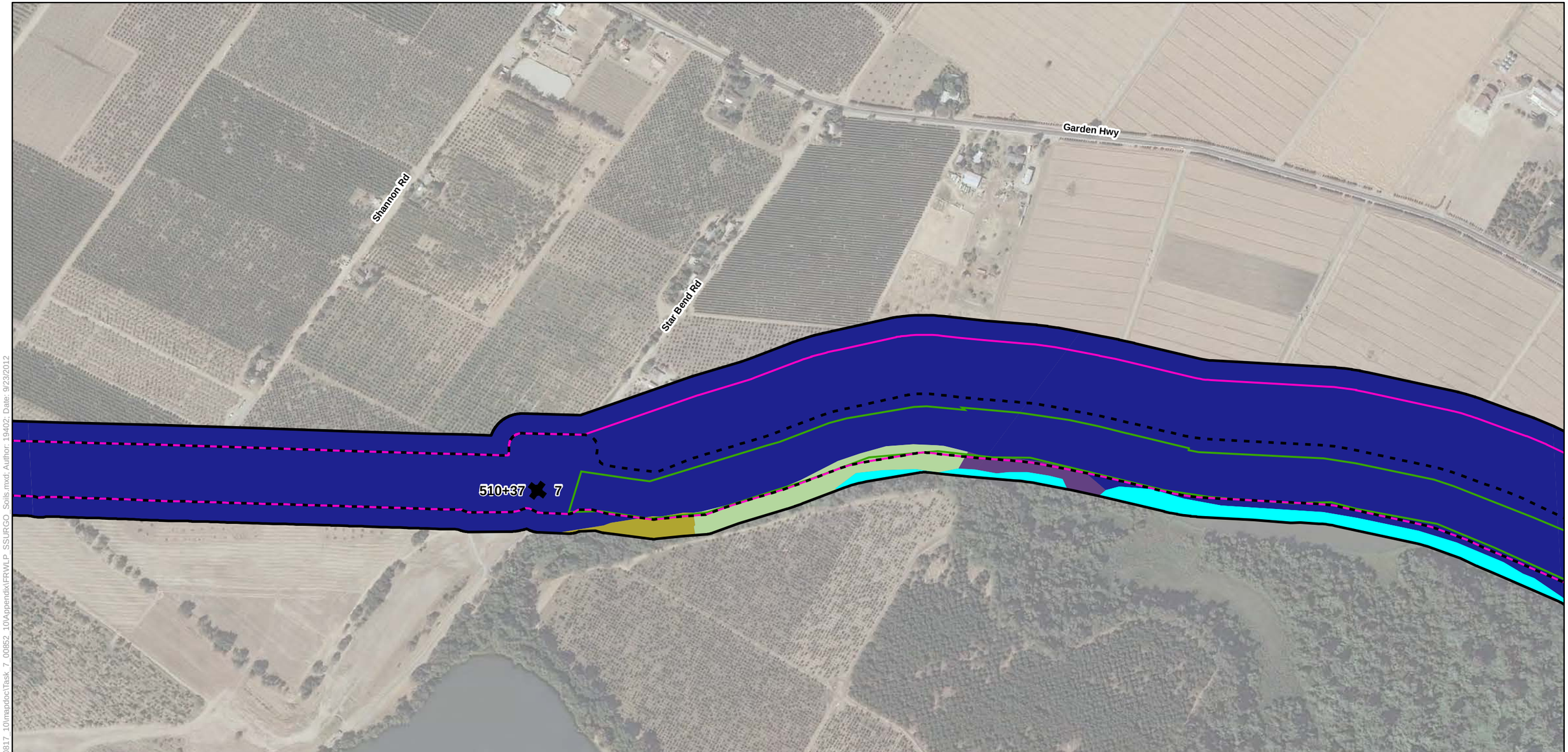
- Columbia Fine Sandy Loam, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Holillipah Loamy Sand, Channeled, 0 To 2 Percent Slopes
- Shanghai Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Water

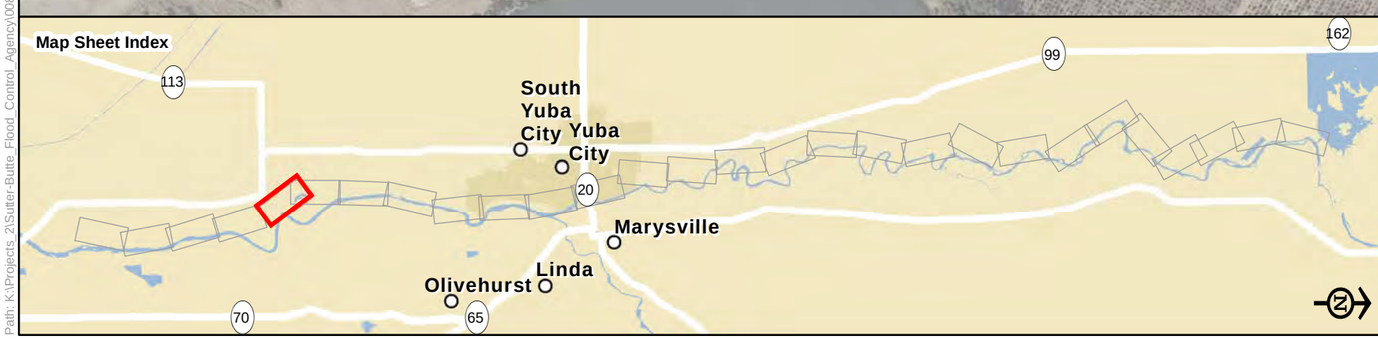
Soil Map Units in the Biological Study Area

Sheet 4

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

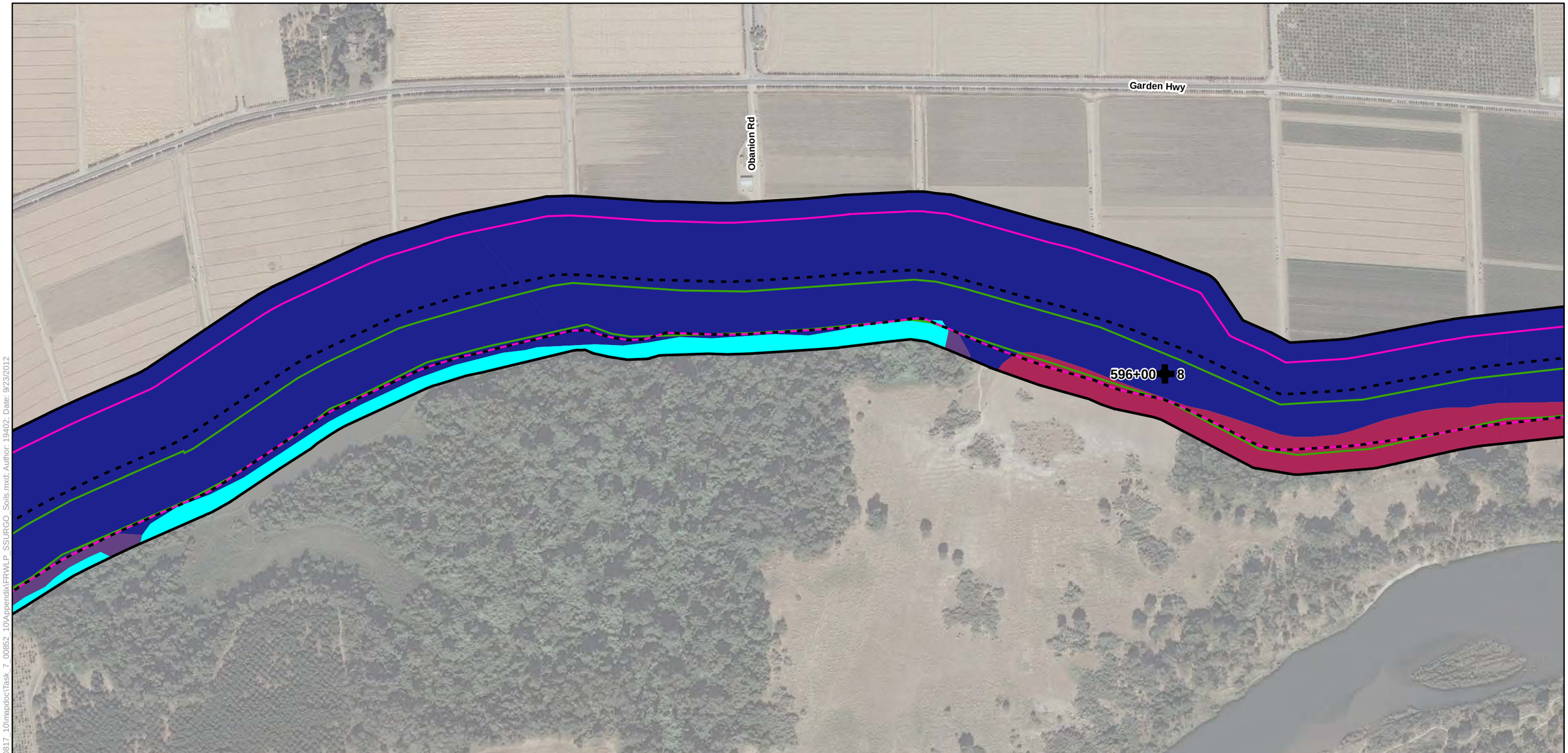
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Holillipah Loamy Sand, Channeled, 0 To 2 Percent Slopes
- Shanghai Silt Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Water

Soil Map Units in the Biological Study Area

Sheet 5

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

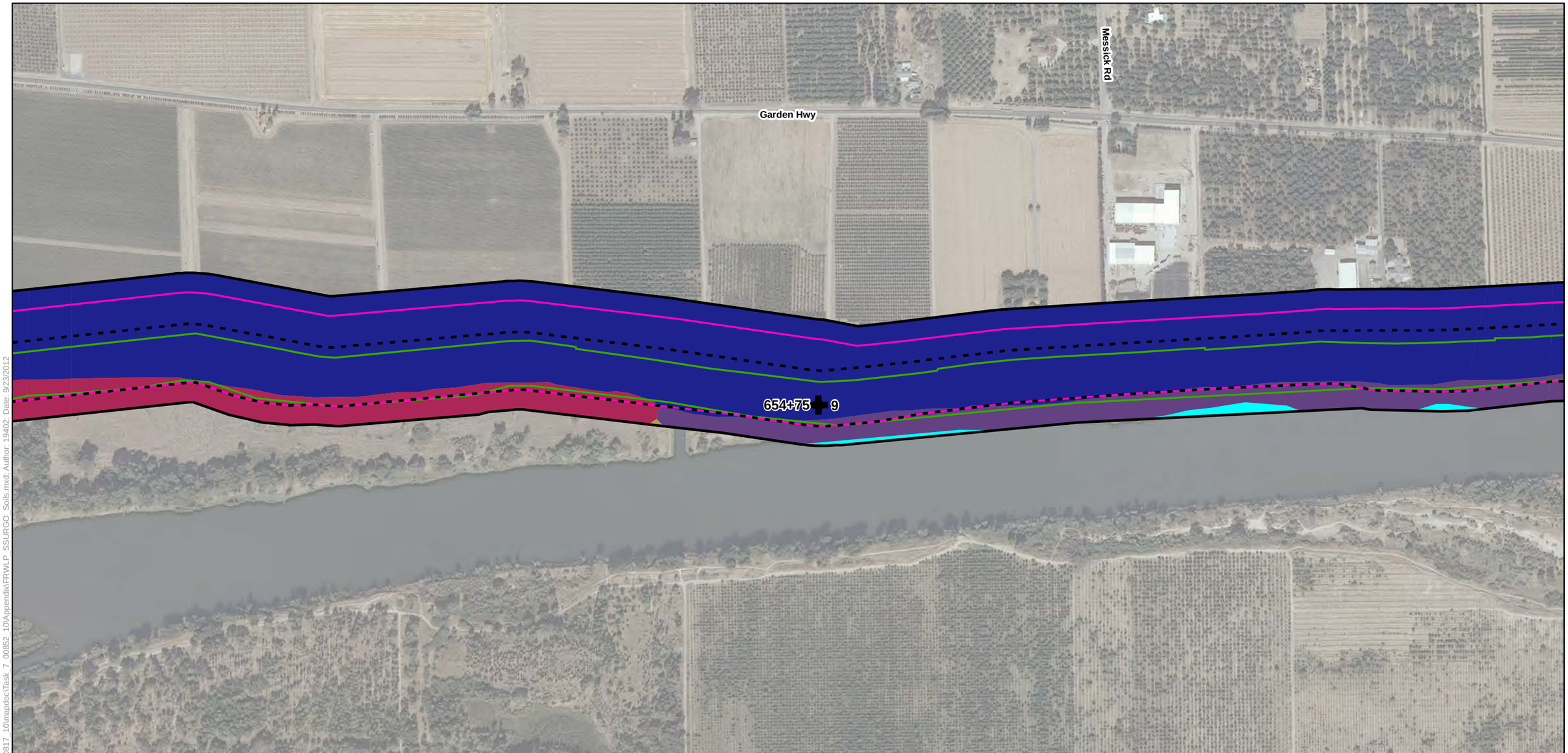
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Holillipah Loamy Sand, Frequently Flooded, 0 To 2 Percent Slopes
- Water

Soil Map Units in the Biological Study Area

Sheet 6

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

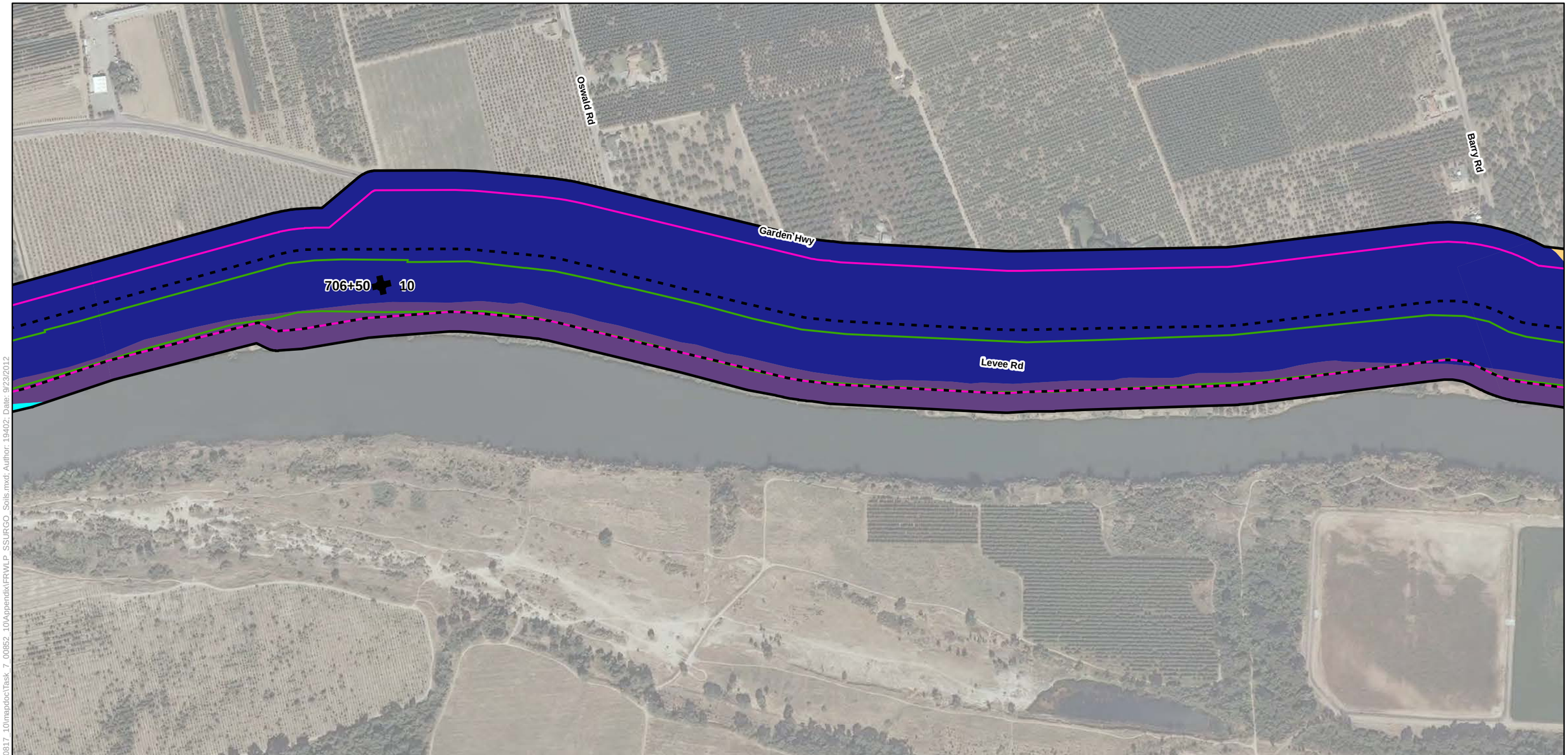
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Holillipah Loamy Sand, Channeled, 0 To 2 Percent Slopes
- Holillipah Loamy Sand, Frequently Flooded, 0 To 2 Percent Slopes
- Water

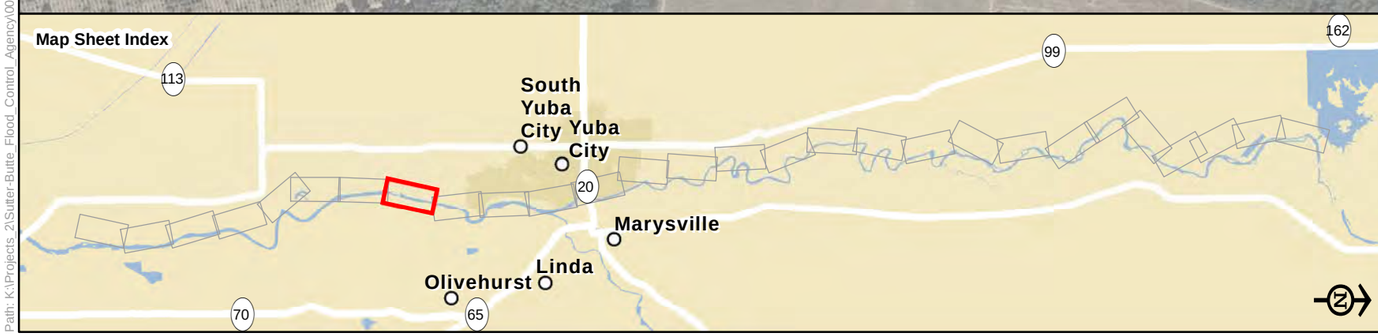
Soil Map Units in the Biological Study Area

Sheet 7

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

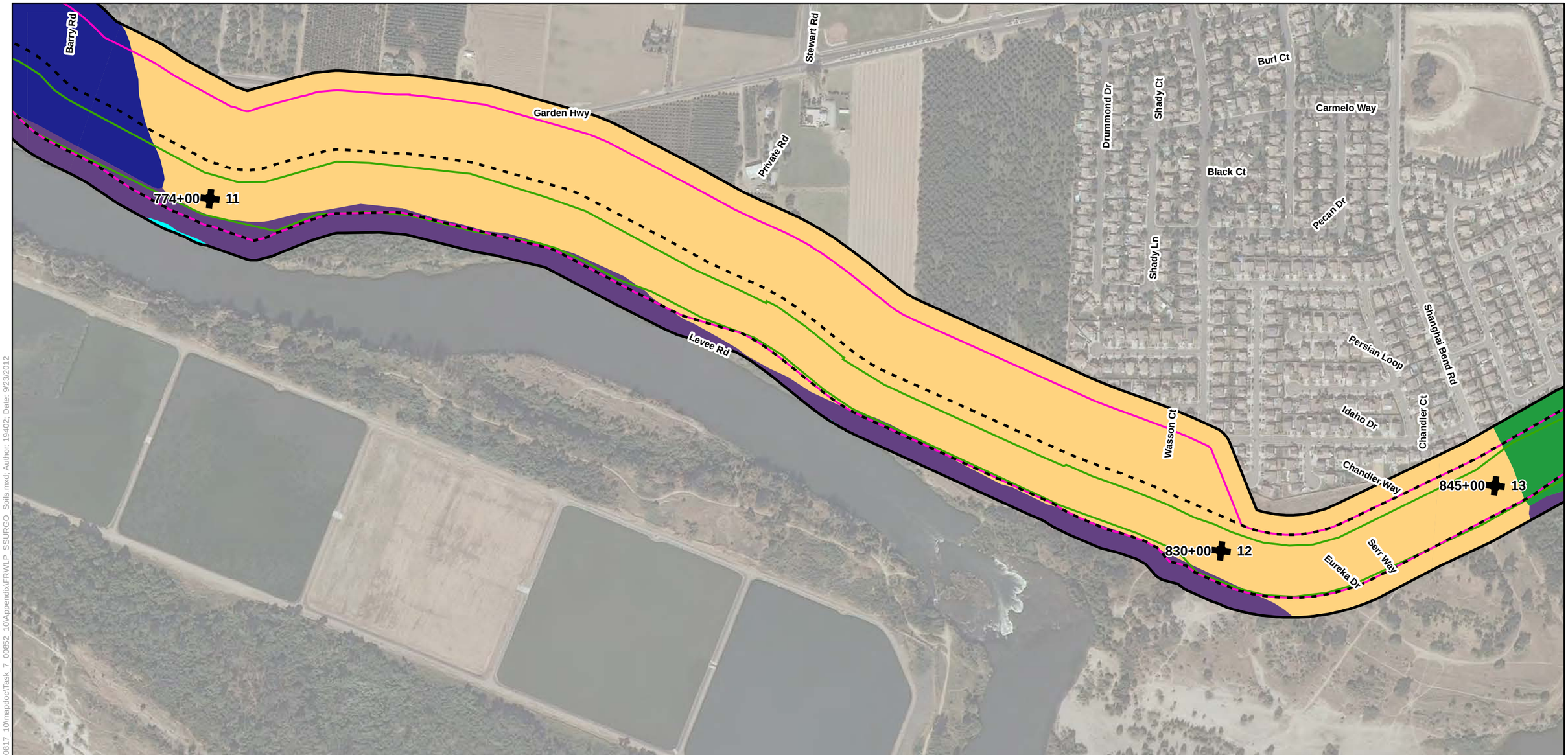
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Conejo-Tisdale Complex, 0 To 2 Percent Slopes
- Water

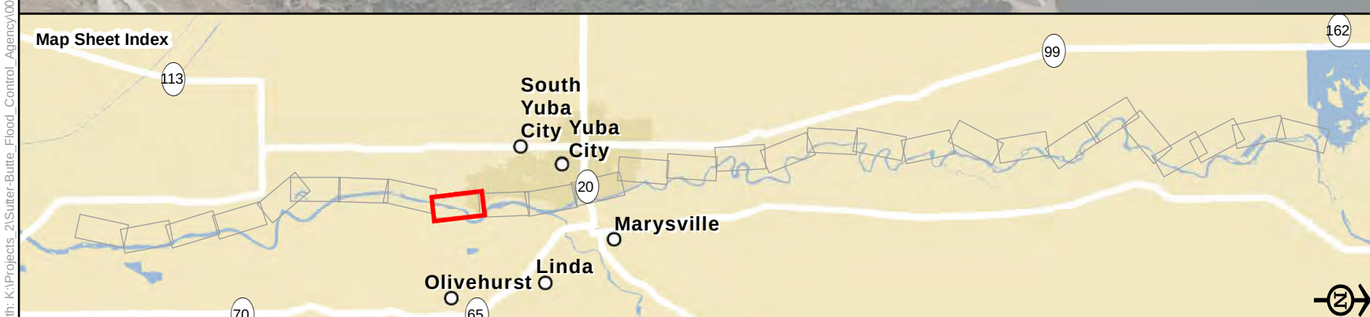
Soil Map Units in the Biological Study Area

Sheet 8

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

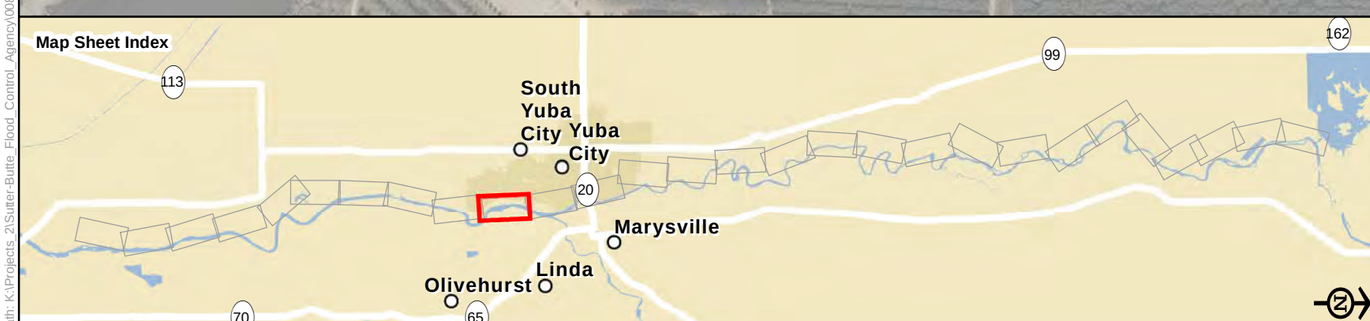
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Conejo-Tisdale Complex, 0 To 2 Percent Slopes
- Shanghai Silt Loam, 0 To 2 Percent Slopes
- Water

Soil Map Units in the Biological Study Area

Sheet 9

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

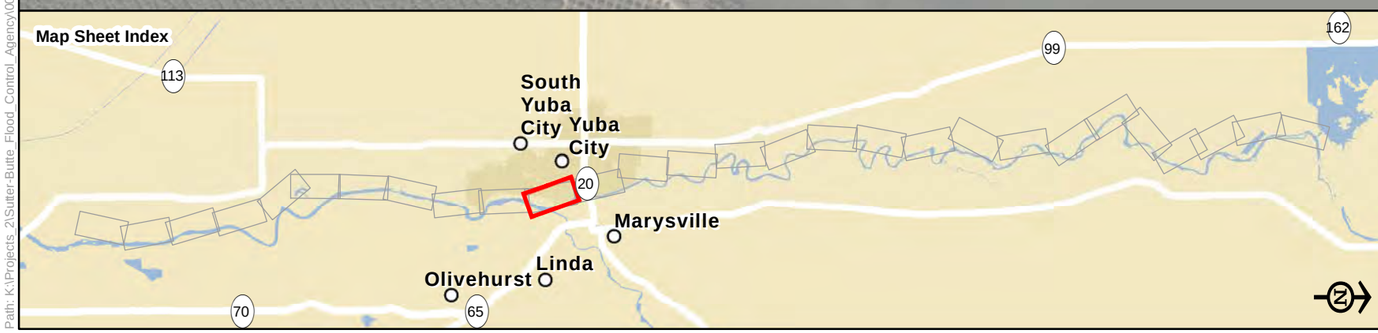
- Columbia Fine Sandy Loam, 0 To 2 Percent Slopes
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo-Tisdale Complex, 0 To 2 Percent Slopes
- Shanghai Silt Loam, 0 To 2 Percent Slopes
- Holillipah Loamy Sand, 0 To 2 Percent Slopes
- Water

Soil Map Units in the Biological Study Area

Sheet 10

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

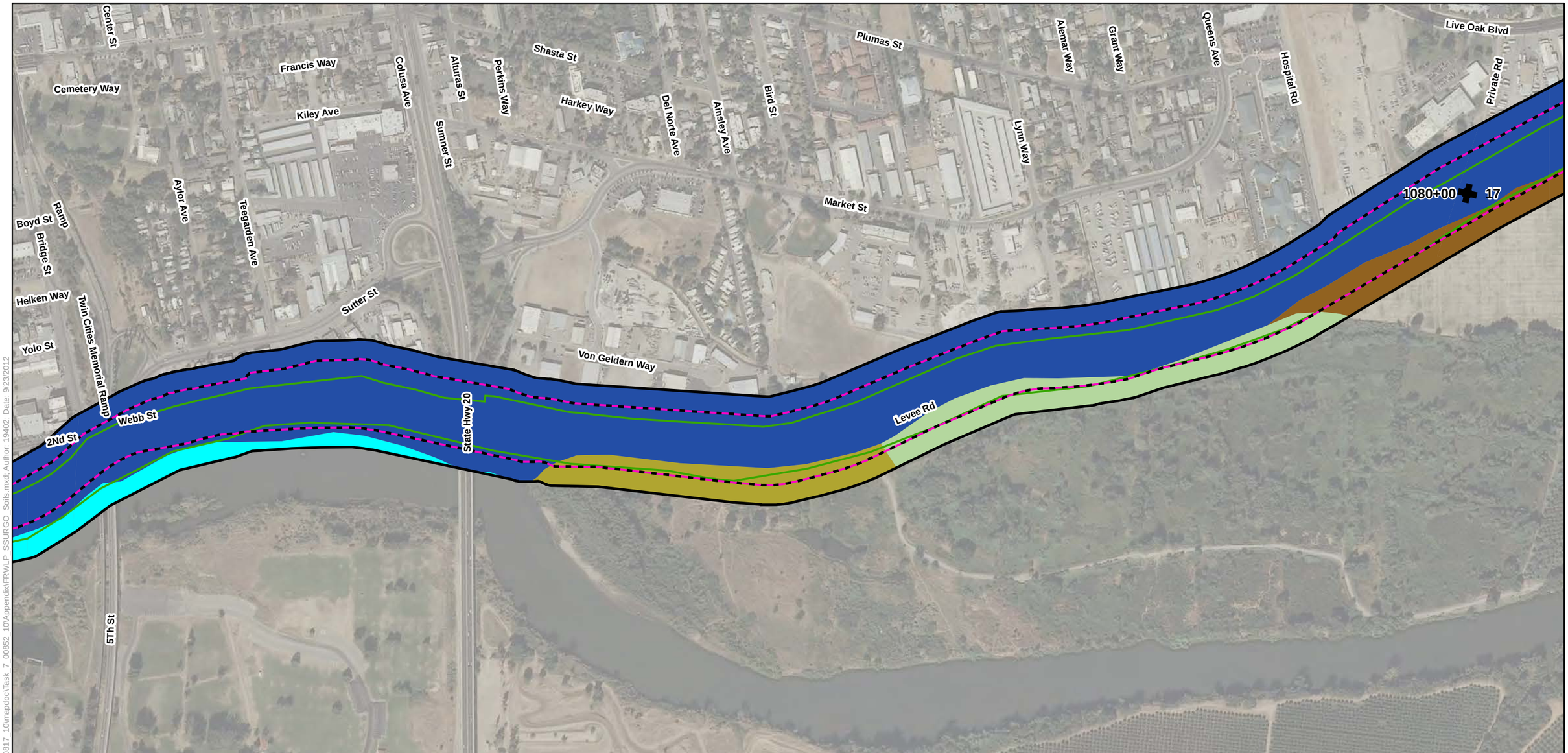
- Columbia Fine Sandy Loam, 0 To 2 Percent Slopes
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo-Urban Land Complex, 0 To 2 Percent Slopes
- Riverwash
- Water

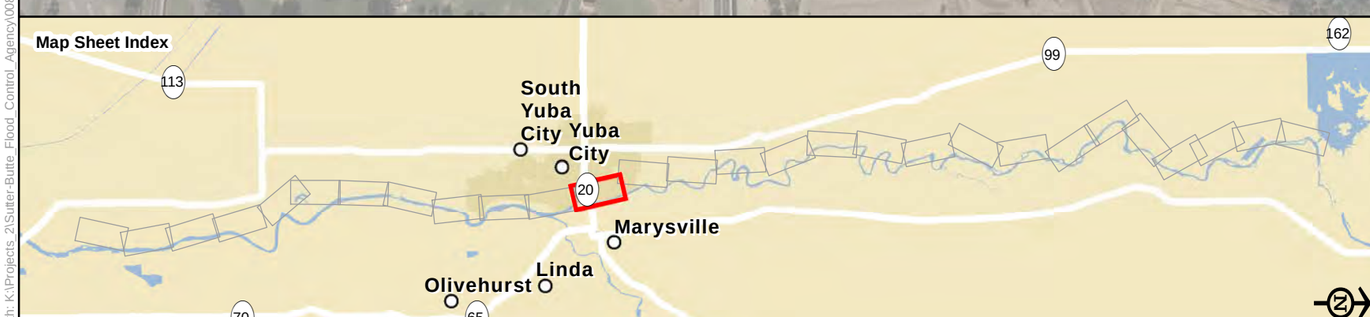
Soil Map Units in the Biological Study Area

Sheet 11

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

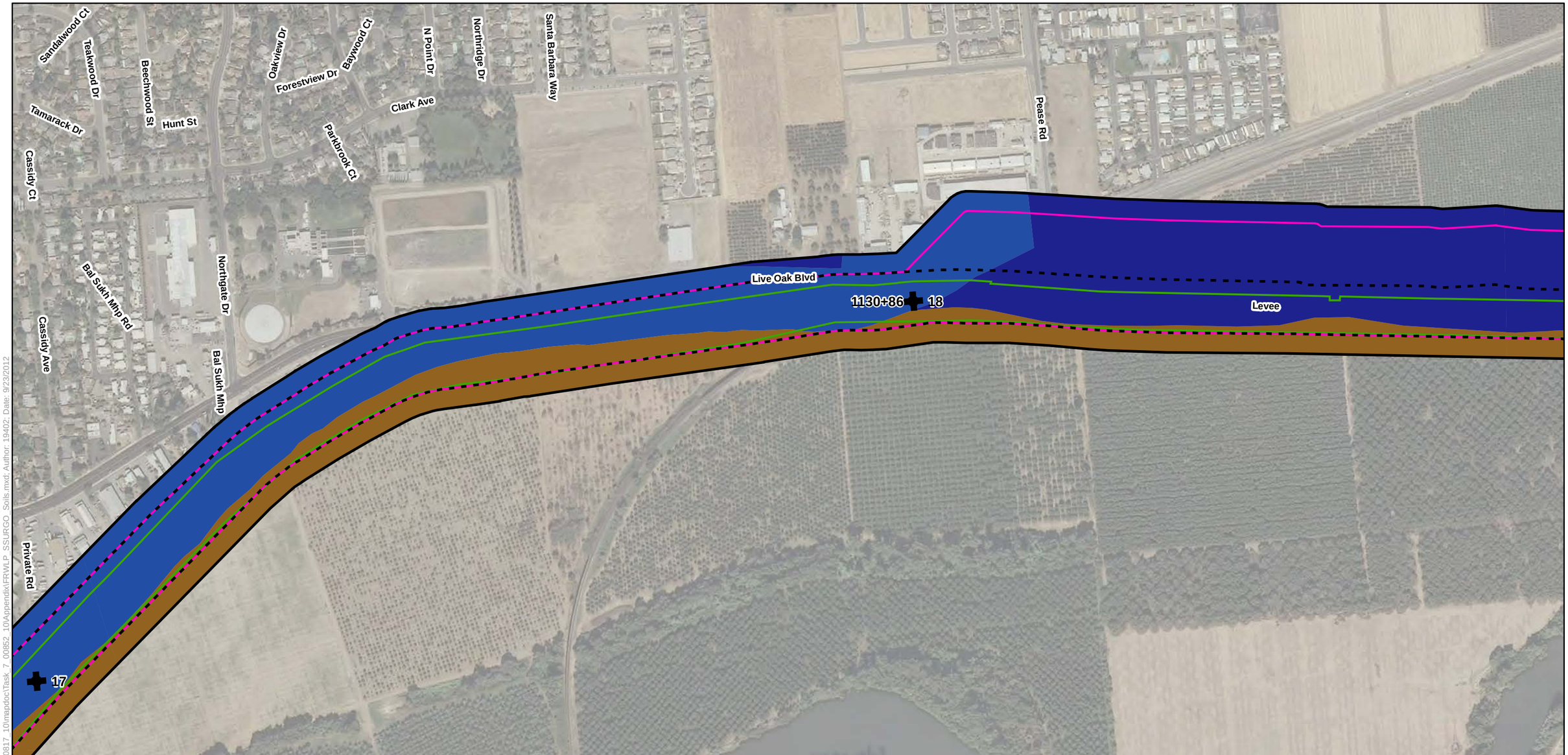
- Conejo-Urban Land Complex, 0 To 2 Percent Slopes
- Holillipah Loamy Sand, Channeled, 0 To 2 Percent Slopes
- Nueva Loam, Occasionally Flooded, 0 To 1 Percent Slopes
- Shanghai Silt Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Water

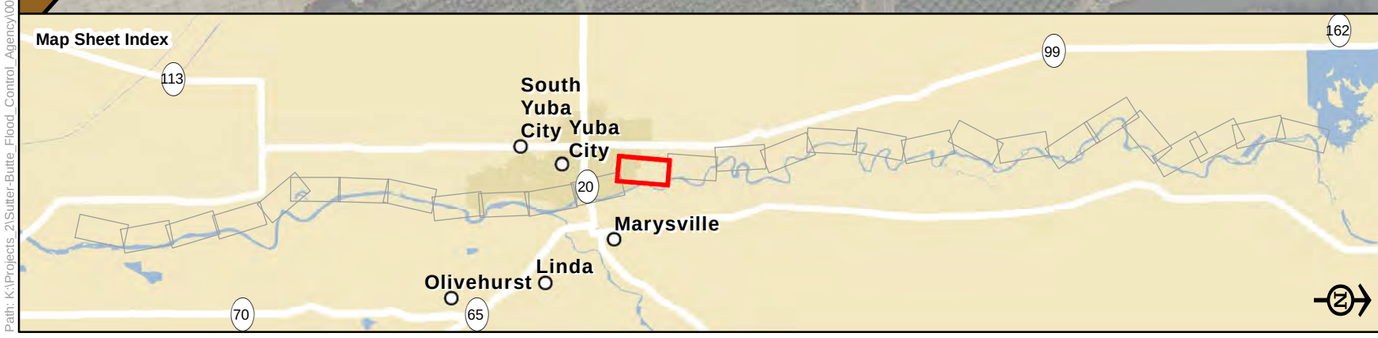
Soil Map Units in the Biological Study Area

Sheet 12

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

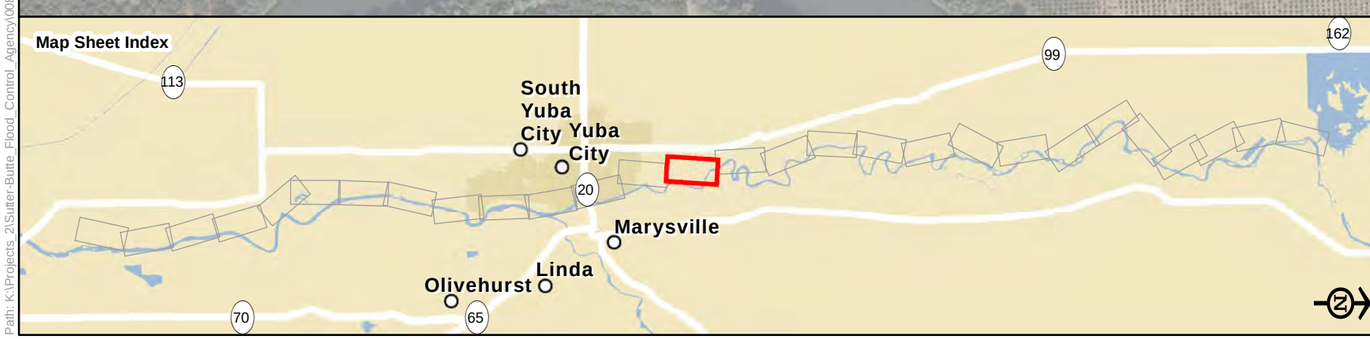
- Conejo Loam, 0 To 2 Percent Slopes
- Conejo-Urban Land Complex, 0 To 2 Percent Slopes
- Nueva Loam, Occasionally Flooded, 0 To 1 Percent Slopes

Soil Map Units in the Biological Study Area

Sheet 13

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\maprjoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

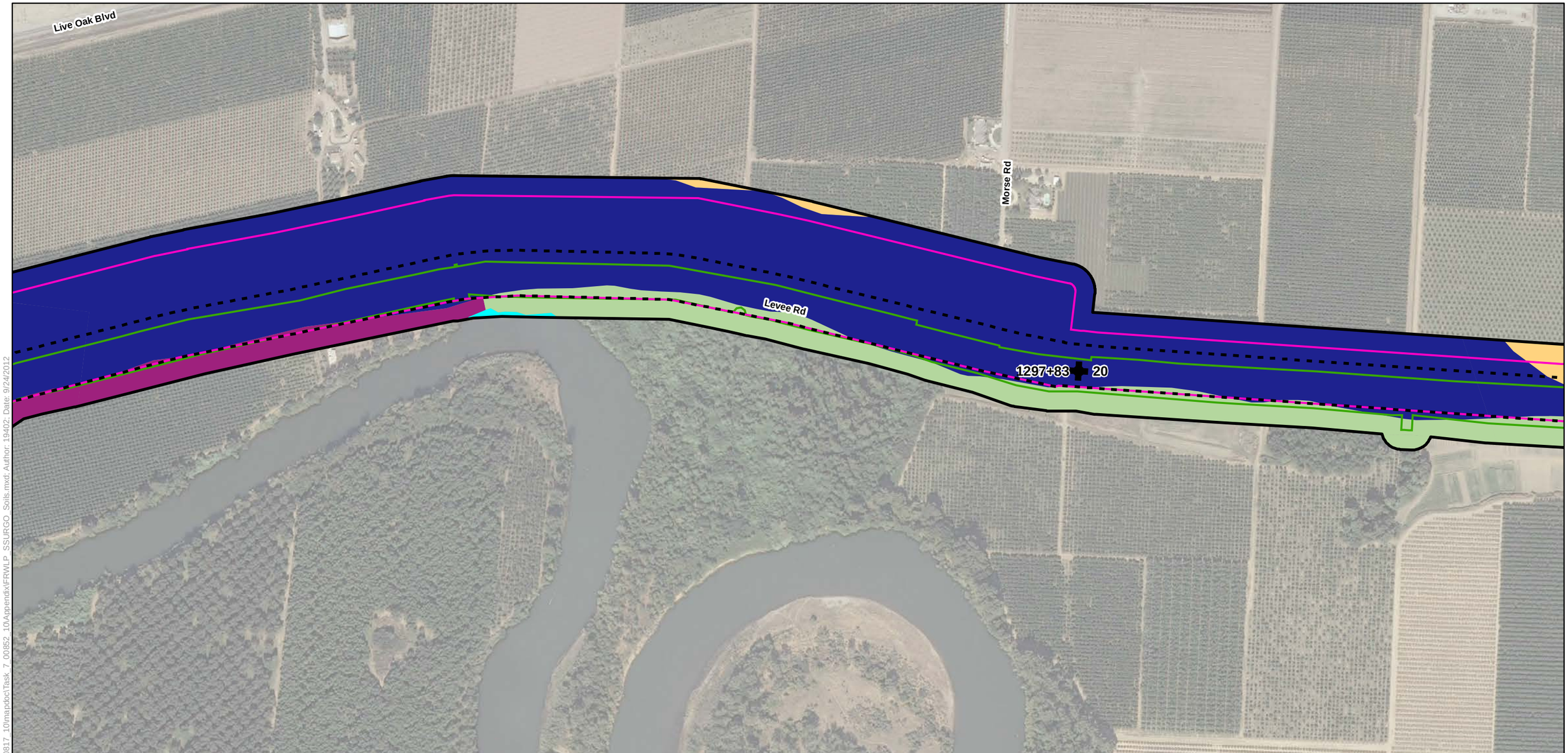
- Columbia Fine Sandy Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Nueva Loam, Occasionally Flooded, 0 To 1 Percent Slopes
- Shanghai Silt Loam, Frequently Flooded, 0 To 2 Percent Slopes

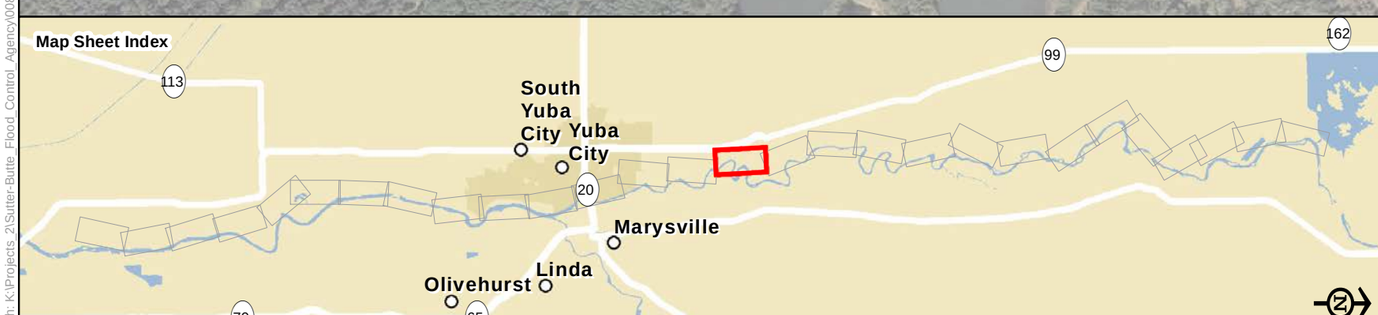
Soil Map Units in the Biological Study Area

Sheet 14

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

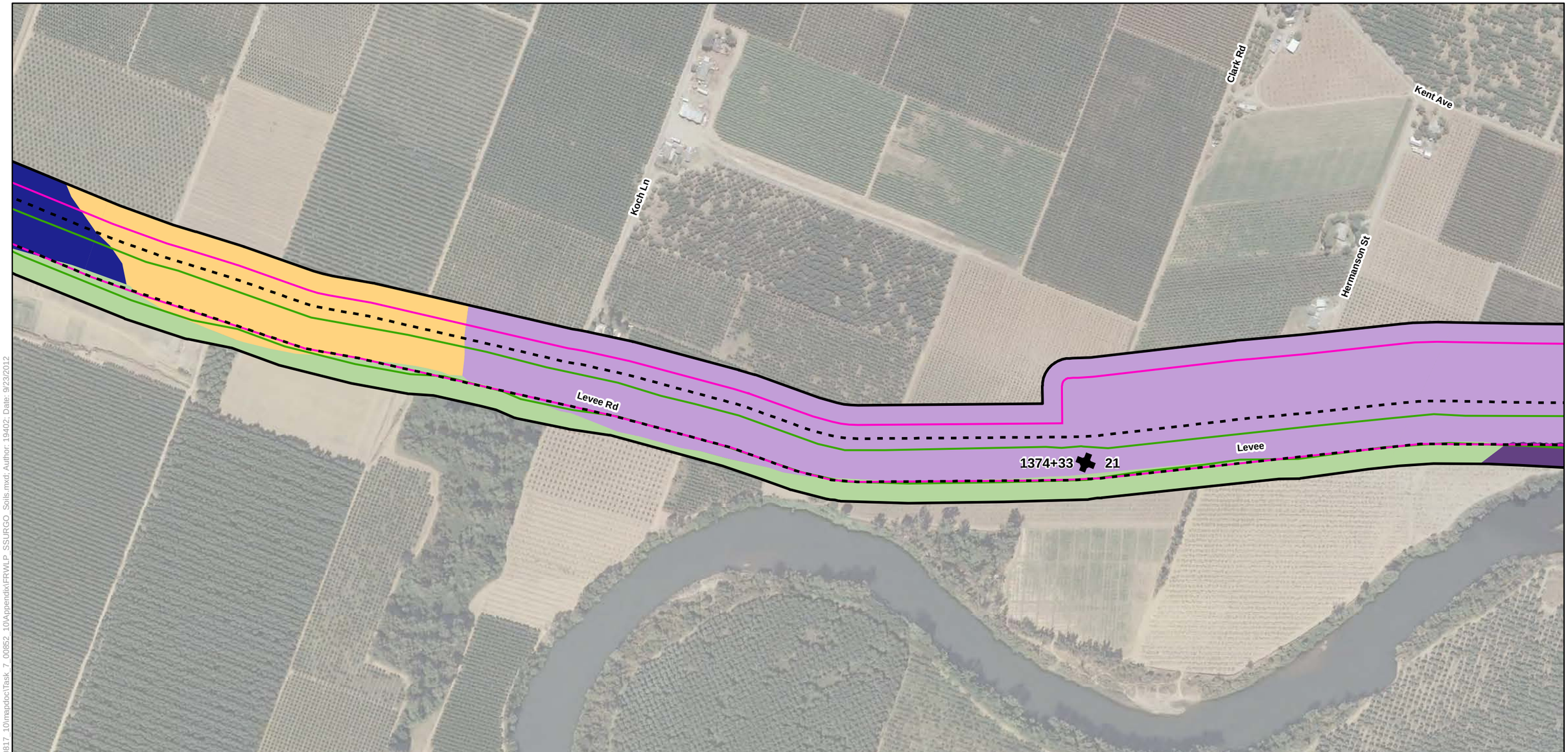
- Columbia Fine Sandy Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Conejo-Tisdale Complex, 0 To 2 Percent Slopes
- Shanghai Silt Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Water

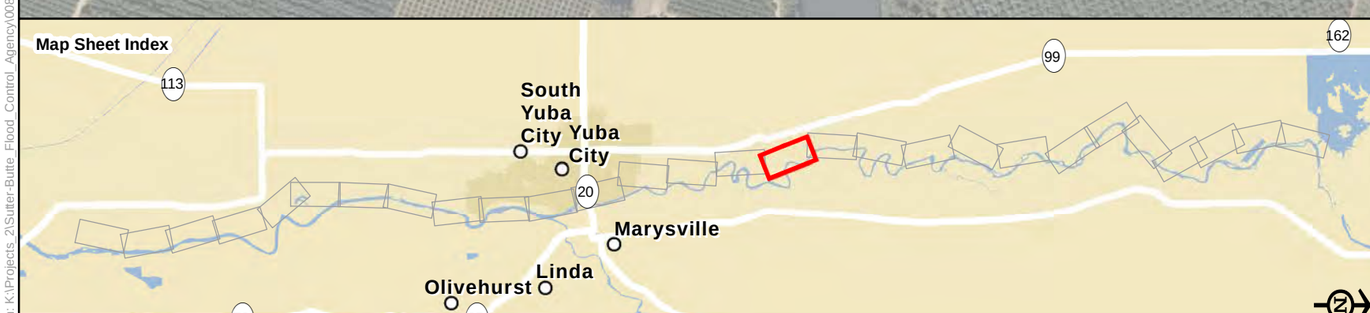
Soil Map Units in the Biological Study Area

Sheet 15

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/24/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

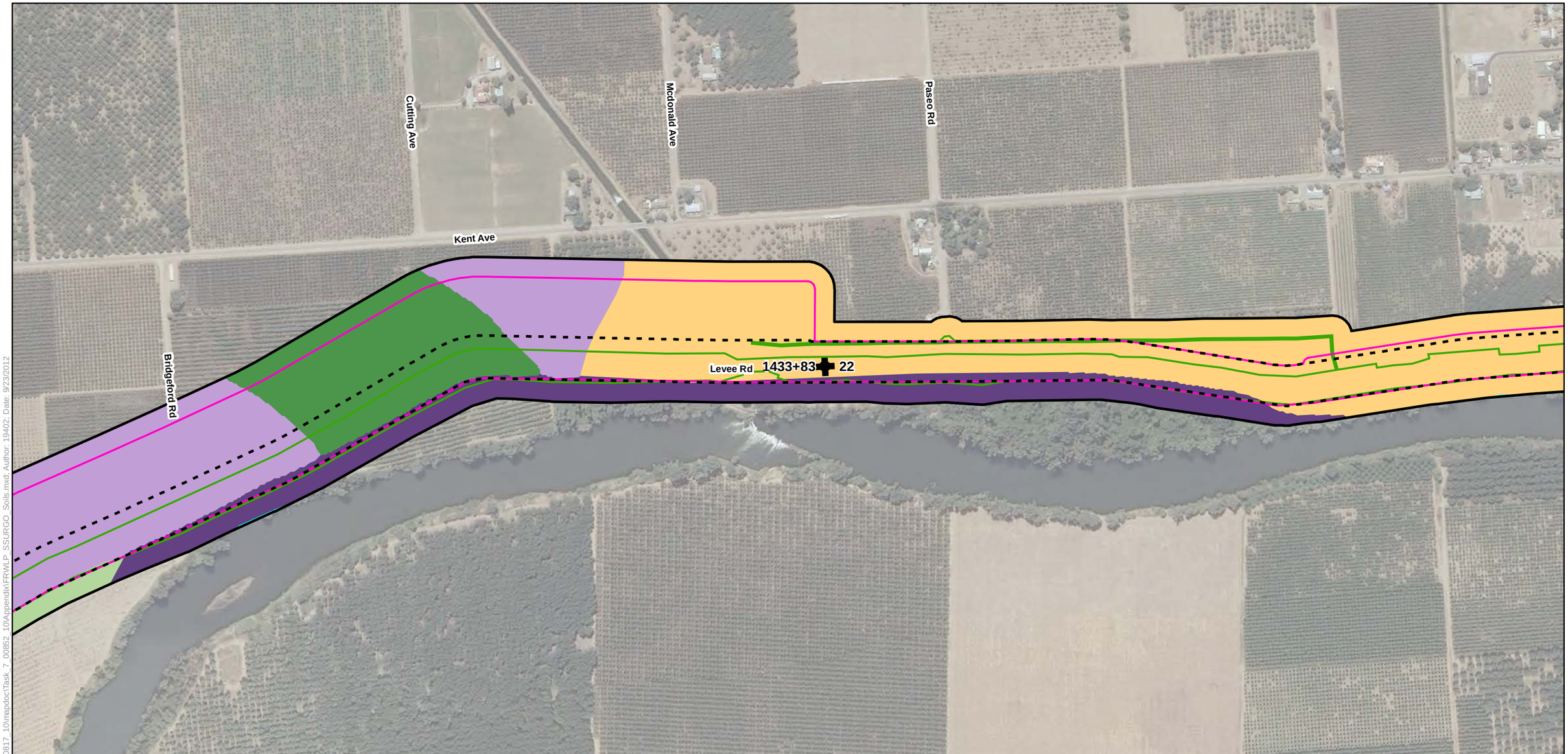
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo Loam, 0 To 2 Percent Slopes
- Conejo-Tisdale Complex, 0 To 2 Percent Slopes
- Marcum-Gridley Clay Loams, 0 To 1 Percent Slopes
- Shanghai Silt Loam, Frequently Flooded, 0 To 2 Percent Slopes

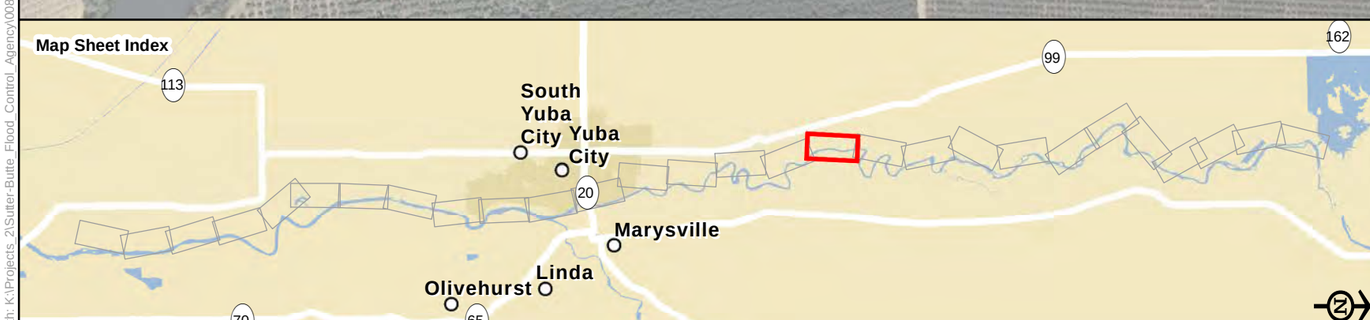
Soil Map Units in the Biological Study Area

Sheet 16

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

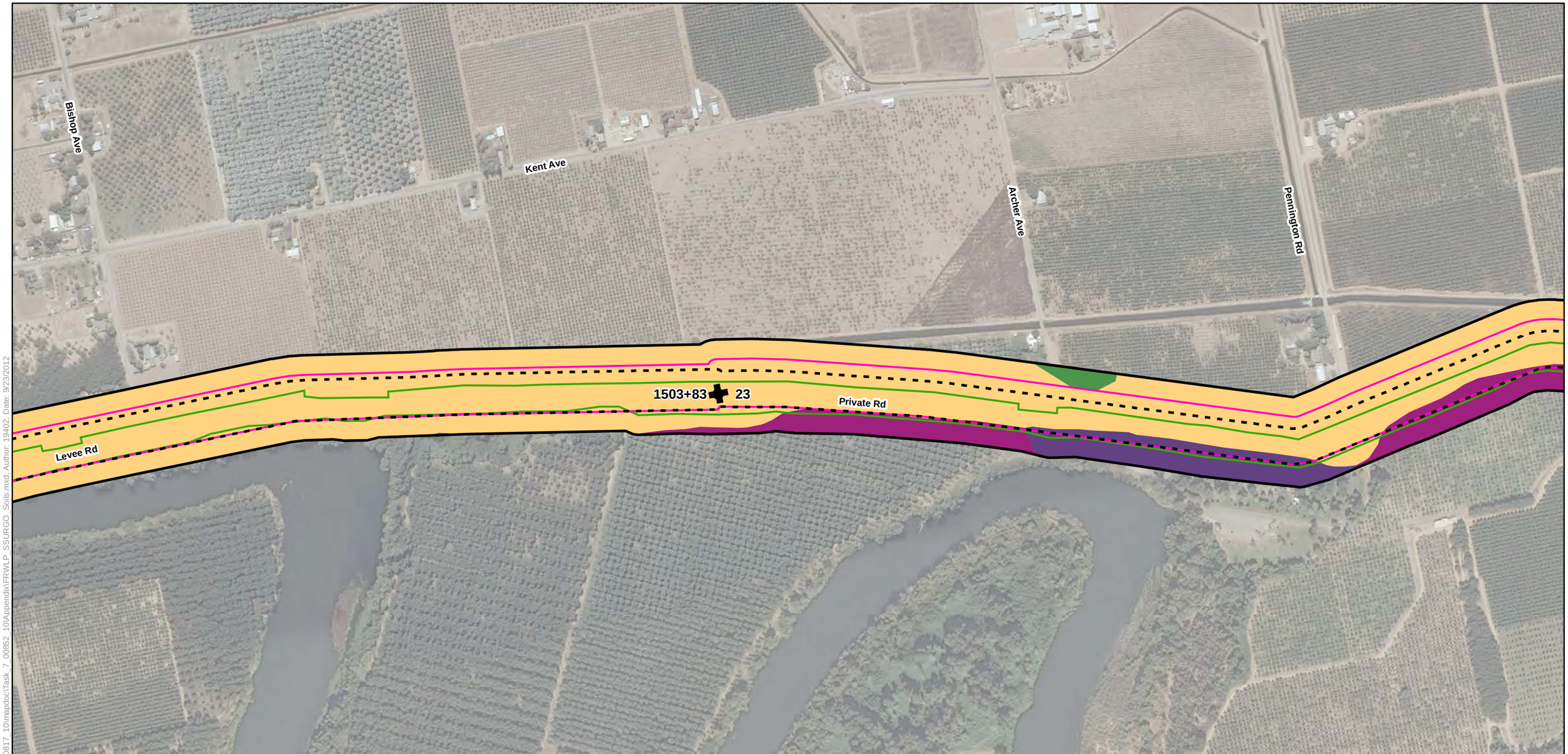
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Conejo-Tisdale Complex, 0 To 2 Percent Slopes
- Liveoak Sandy Clay Loam, 0 To 2 Percent Slopes
- Marcum-Gridley Clay Loams, 0 To 1 Percent Slopes
- Shanghai Silt Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Water

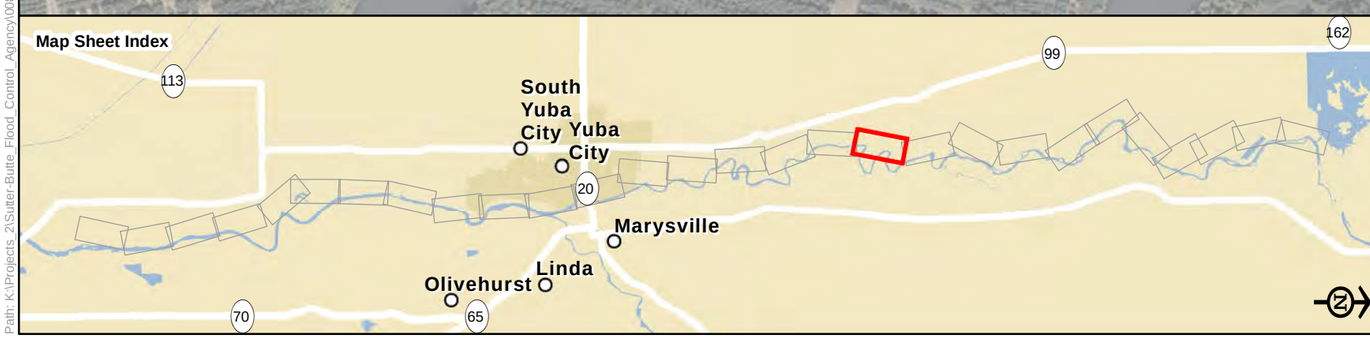
Soil Map Units in the Biological Study Area

Sheet 17

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

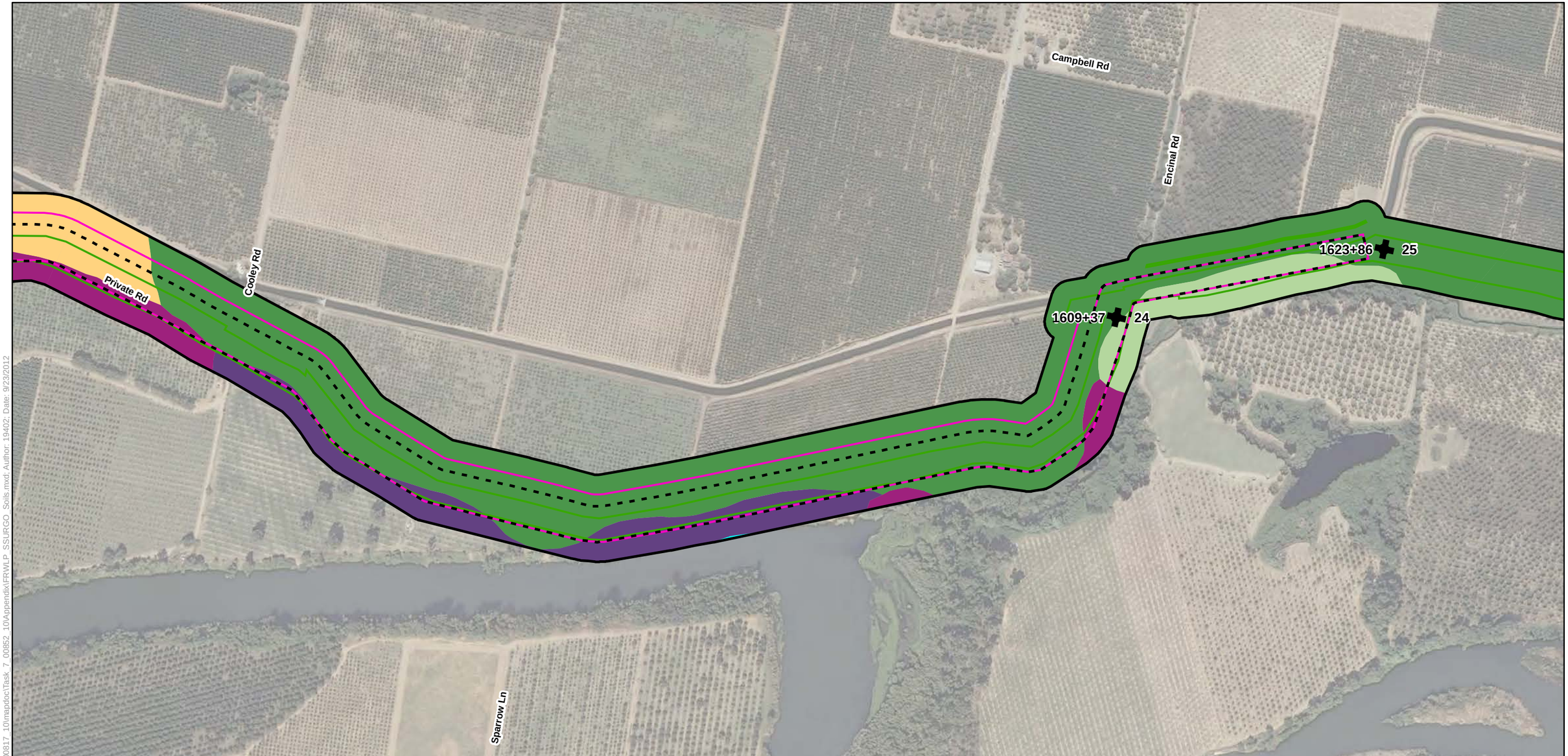
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Columbia Fine Sandy Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Conejo-Tisdale Complex, 0 To 2 Percent Slopes
- Liveoak Sandy Clay Loam, 0 To 2 Percent Slopes
- Water

Soil Map Units in the Biological Study Area

Sheet 18

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

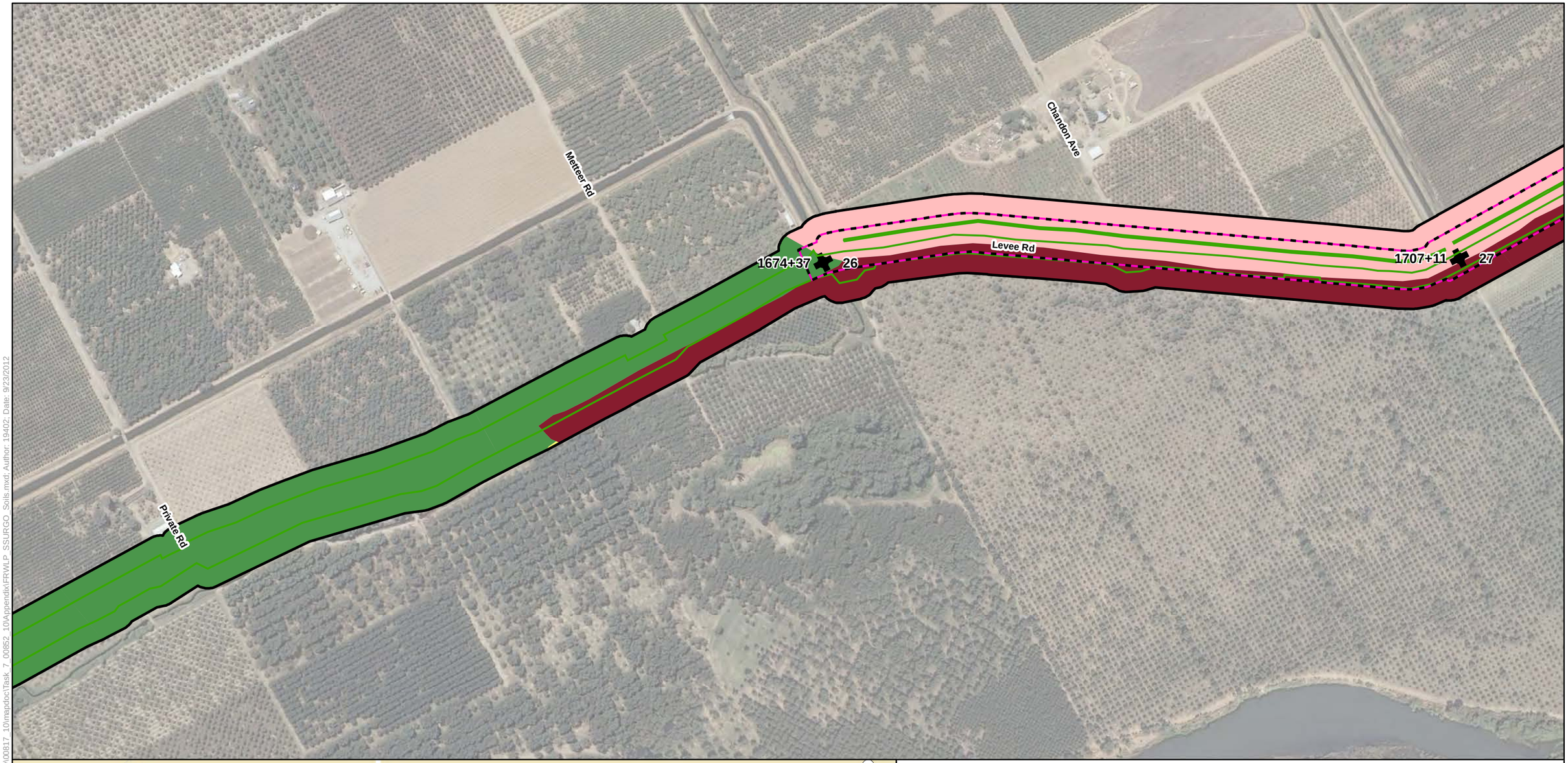
- Columbia Fine Sandy Loam, Channeled, 0 To 2 Percent Slopes
- Columbia Fine Sandy Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Conejo-Tisdale Complex, 0 To 2 Percent Slopes
- Liveoak Sandy Clay Loam, 0 To 2 Percent Slopes
- Shanghai Silt Loam, Frequently Flooded, 0 To 2 Percent Slopes
- Water

Soil Map Units in the Biological Study Area

Sheet 19

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

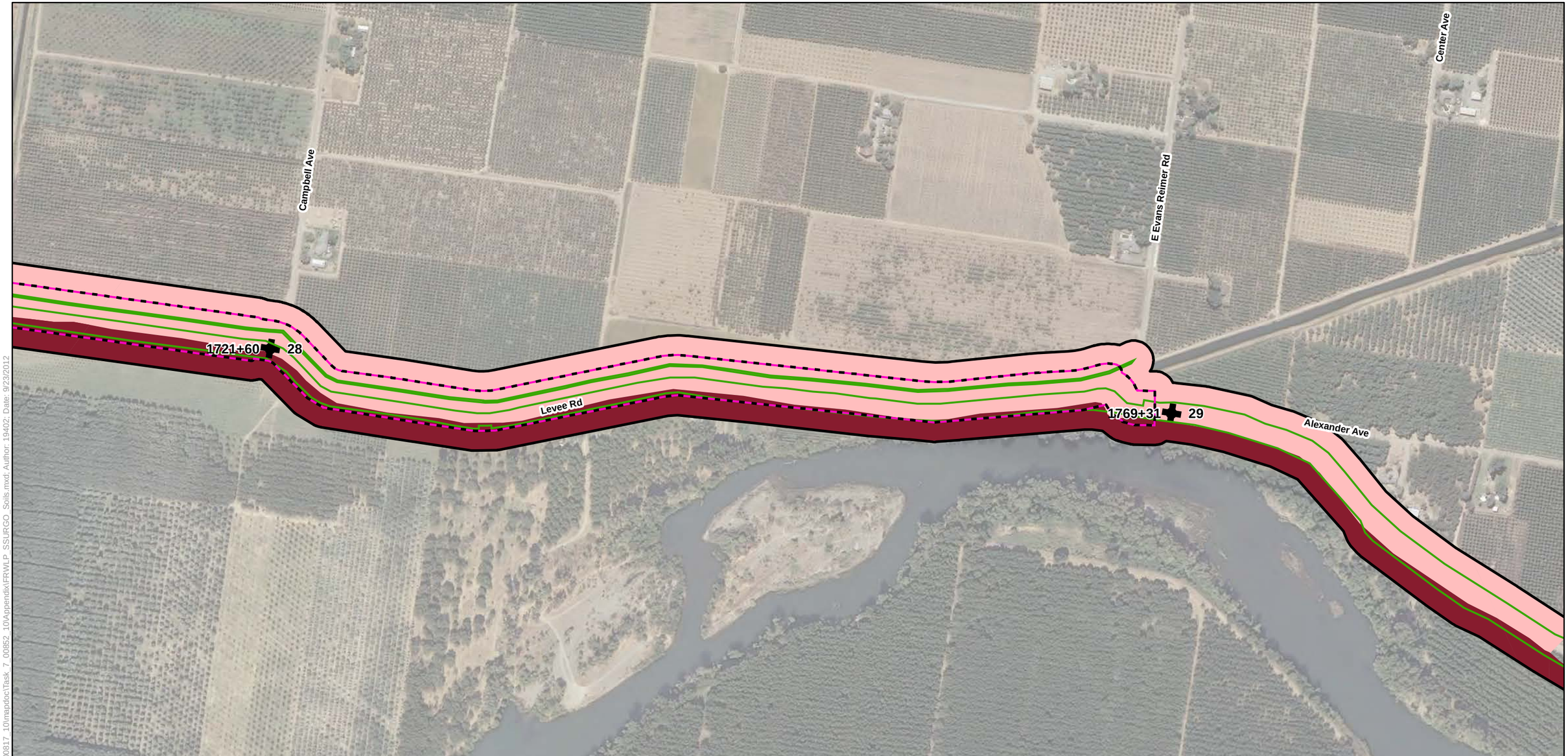
- Boga-Loemstone Complex, 0 To 1 Percent Slopes
- Liveoak Sandy Clay Loam, 0 To 2 Percent Slopes
- Columbia Fine Sandy Loam, 0 To 2 Percent Slopes, Frequently Flooded
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Frequently Flooded

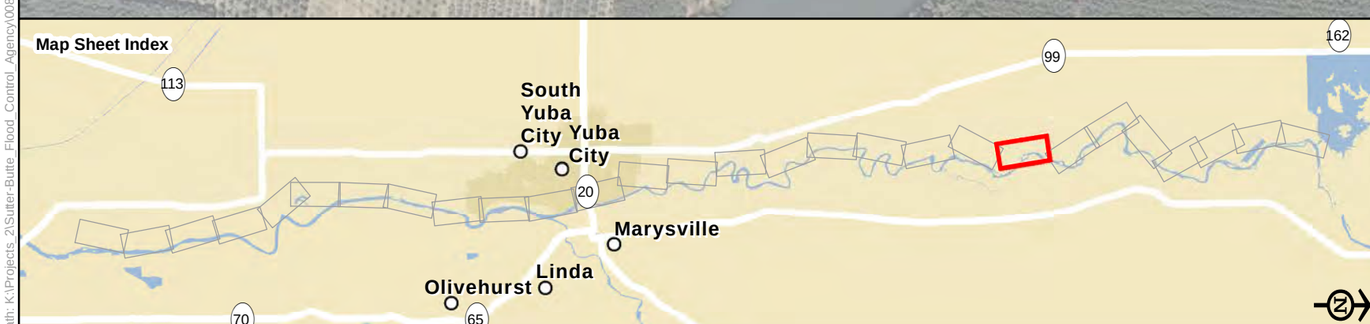
Soil Map Units in the Biological Study Area

Sheet 20

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

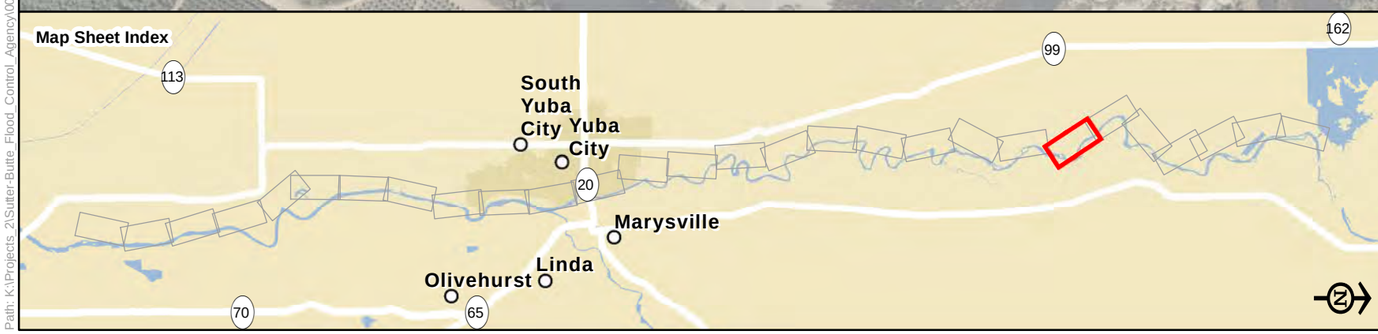
- Boga-Loemstone Complex, 0 To 1 Percent Slopes
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Frequently Flooded
- Water

Soil Map Units in the Biological Study Area

Sheet 21

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

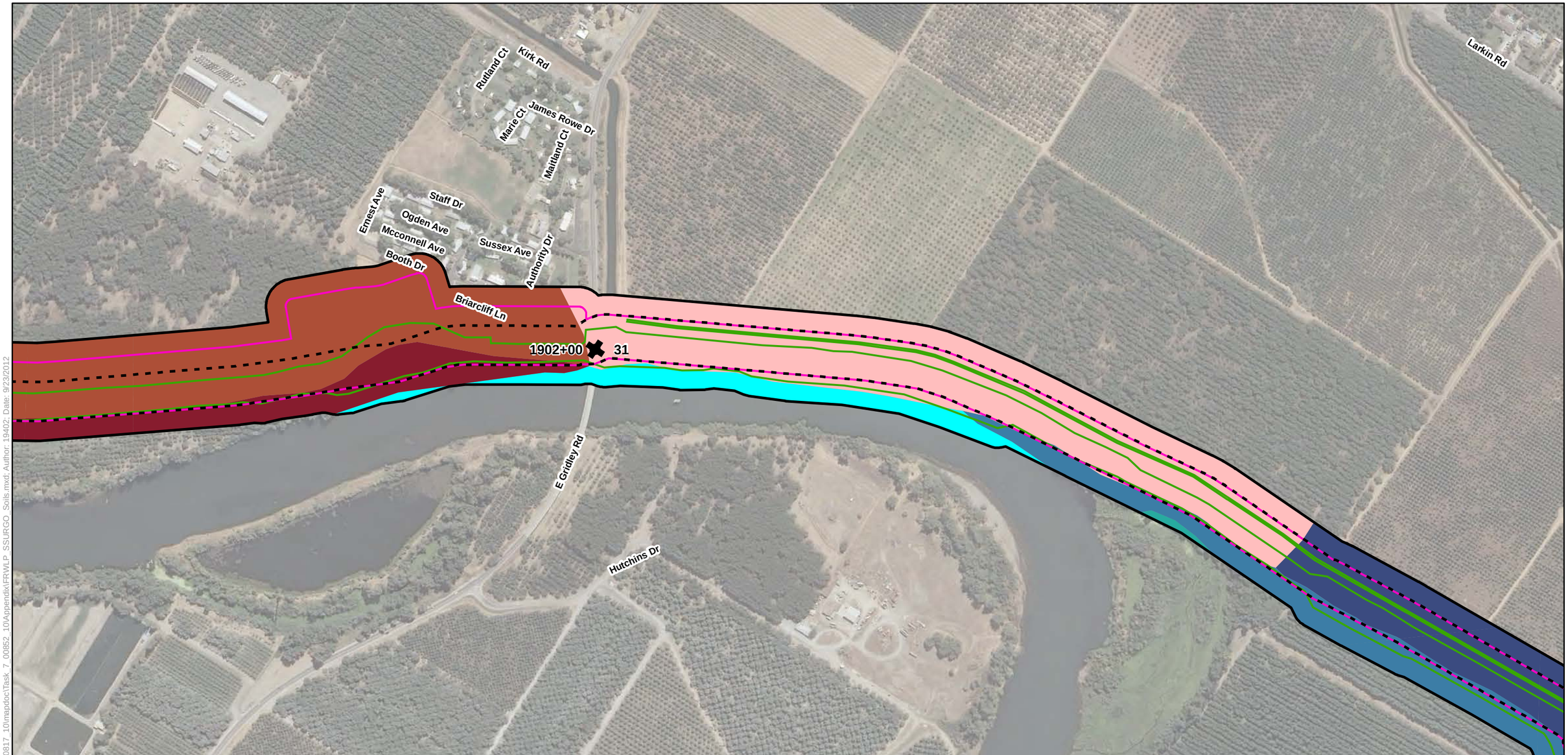
- Boga-Loemstone Complex, 0 To 1 Percent Slopes
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Frequently Flooded
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Rarely Flooded
- Liveoak Sandy Clay Loam, 0 To 2 Percent Slopes
- Liveoak Sandy Loam, 0 To 2 Percent Slopes
- Water

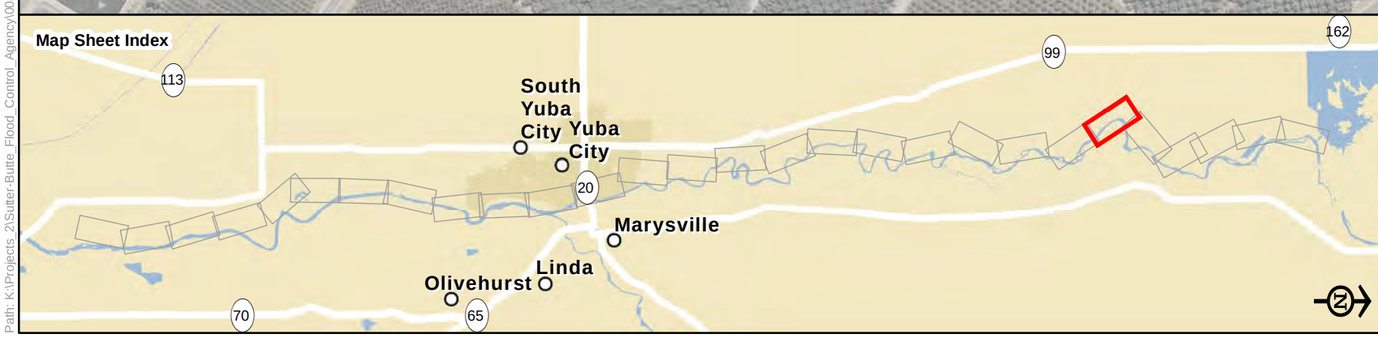
Soil Map Units in the Biological Study Area

Sheet 22

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

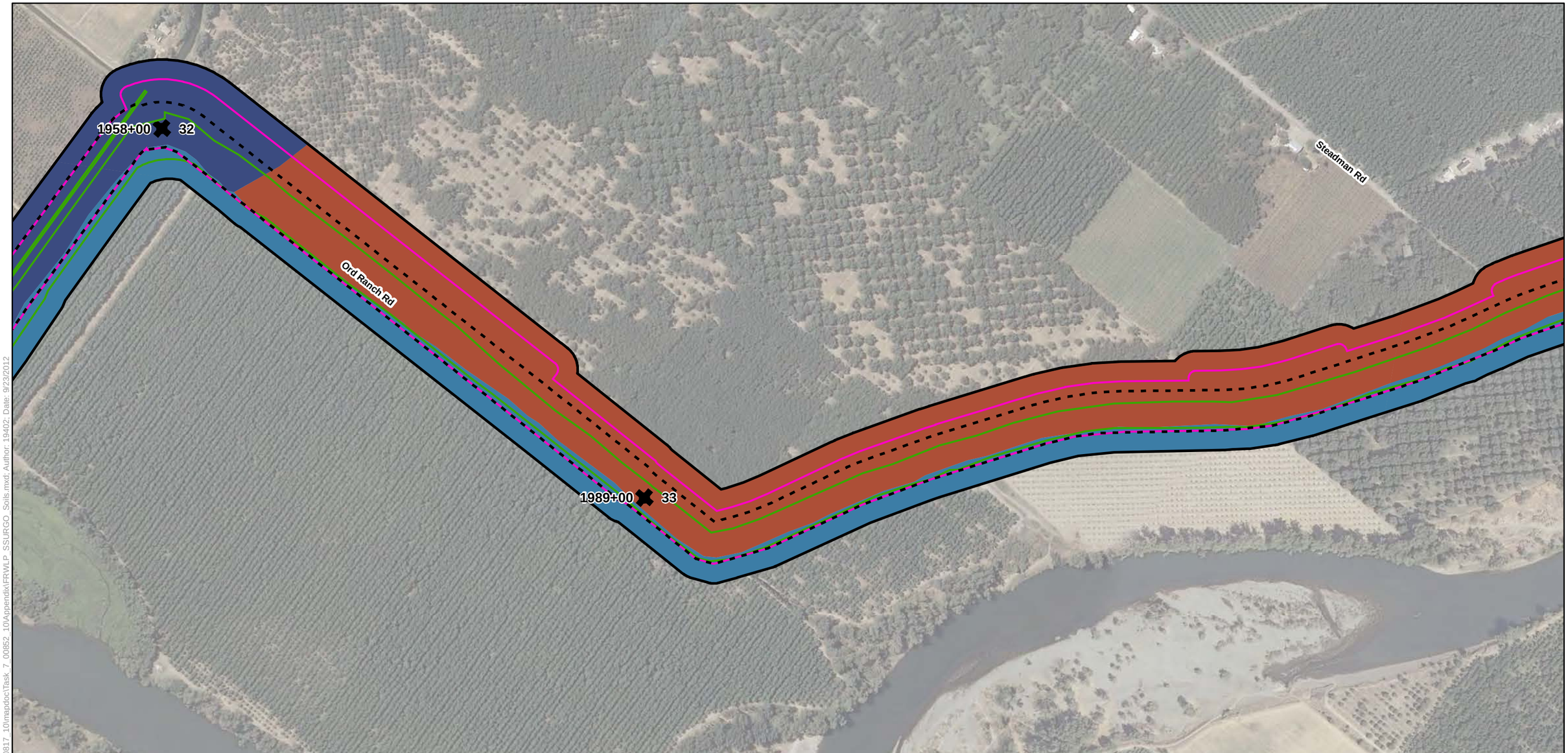
- Boga-Loemstone Complex, 0 To 1 Percent Slopes
- Columbia, 0 To 2 Percent Slopes, Frequently Flooded
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Frequently Flooded
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Occasionally Flooded
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Rarely Flooded
- Gianella Loam, 0 To 1 Percent Slopes, Rarely Flooded
- Water

Soil Map Units in the Biological Study Area

Sheet 23

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

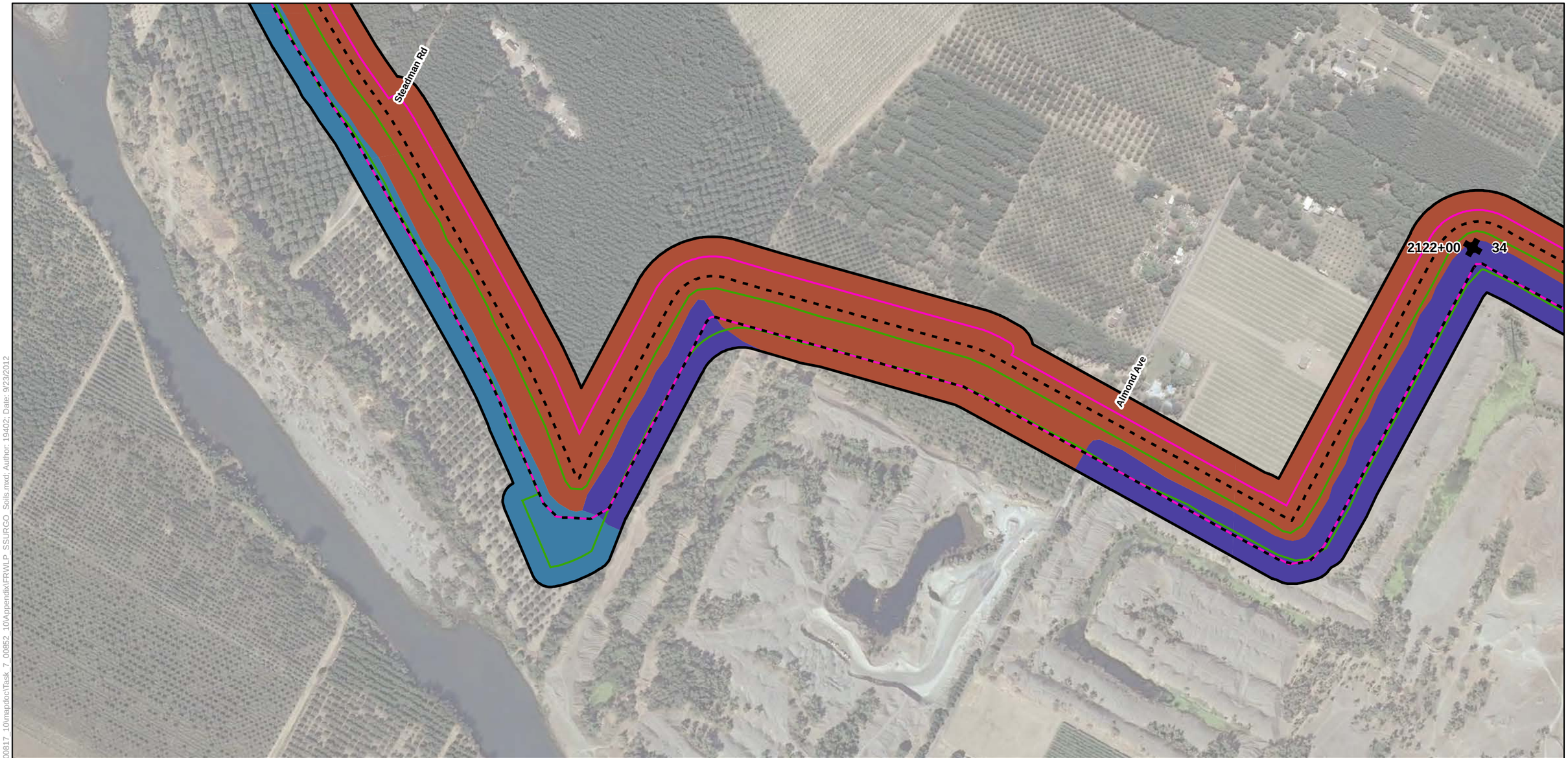
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Occasionally Flooded
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Rarely Flooded
- Gianella Loam, 0 To 1 Percent Slopes, Rarely Flooded

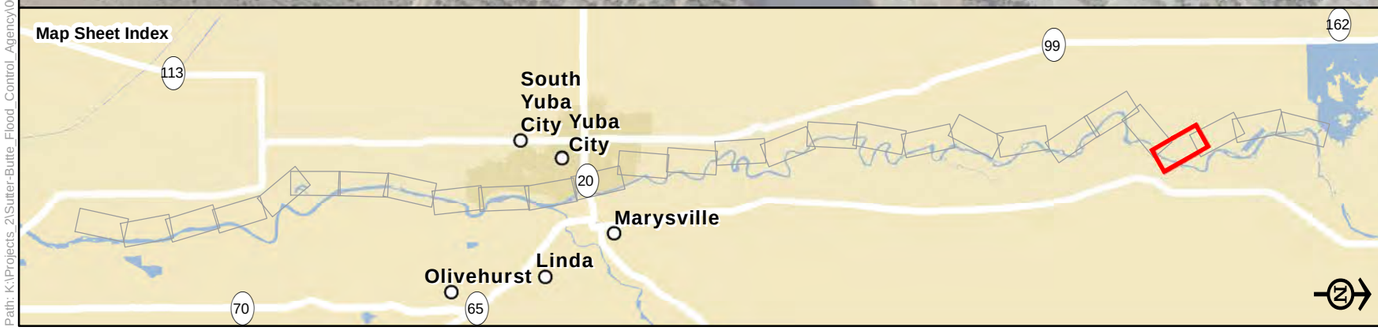
Soil Map Units in the Biological Study Area

Sheet 24

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

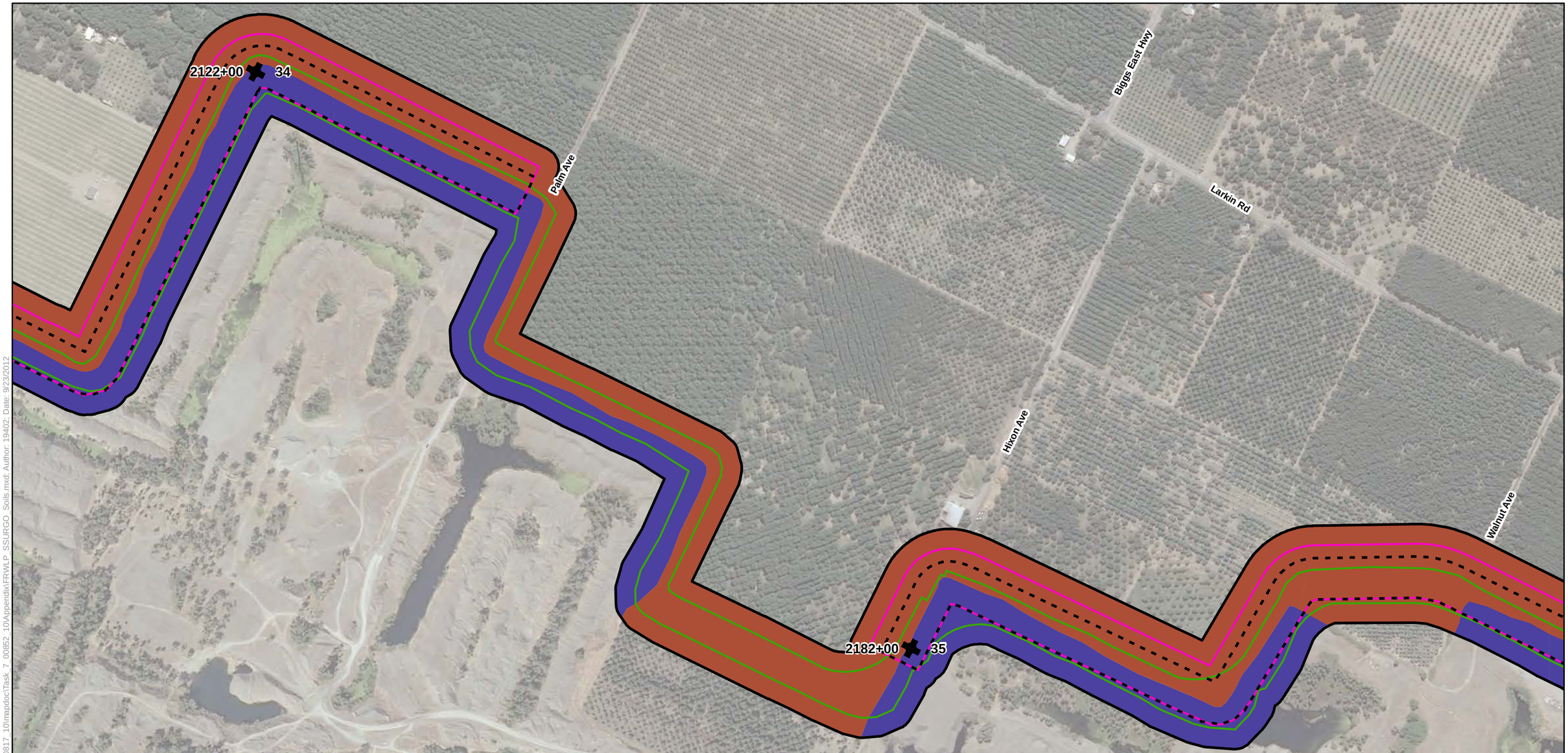
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Occasionally Flooded
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Rarely Flooded
- Xerorthents, Tailings, 0 To 50 Percent Slopes

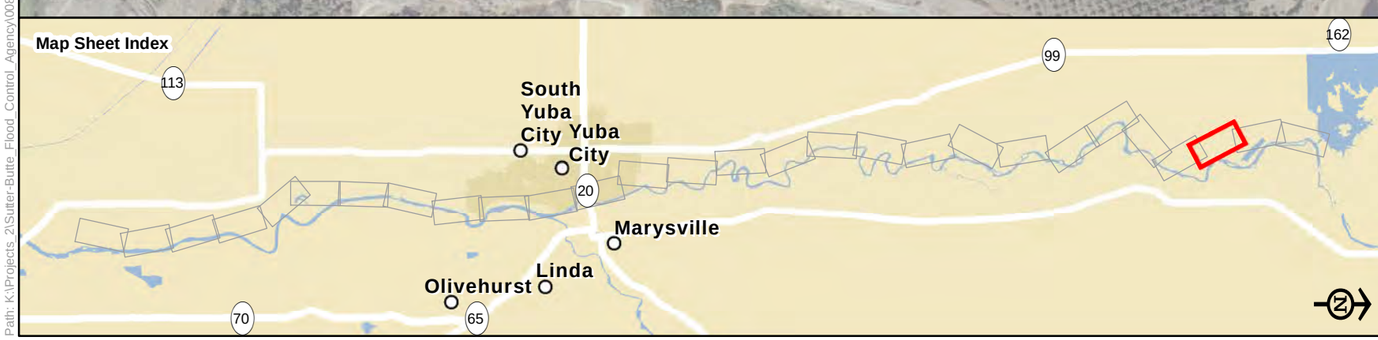
Soil Map Units in the Biological Study Area

Sheet 25

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

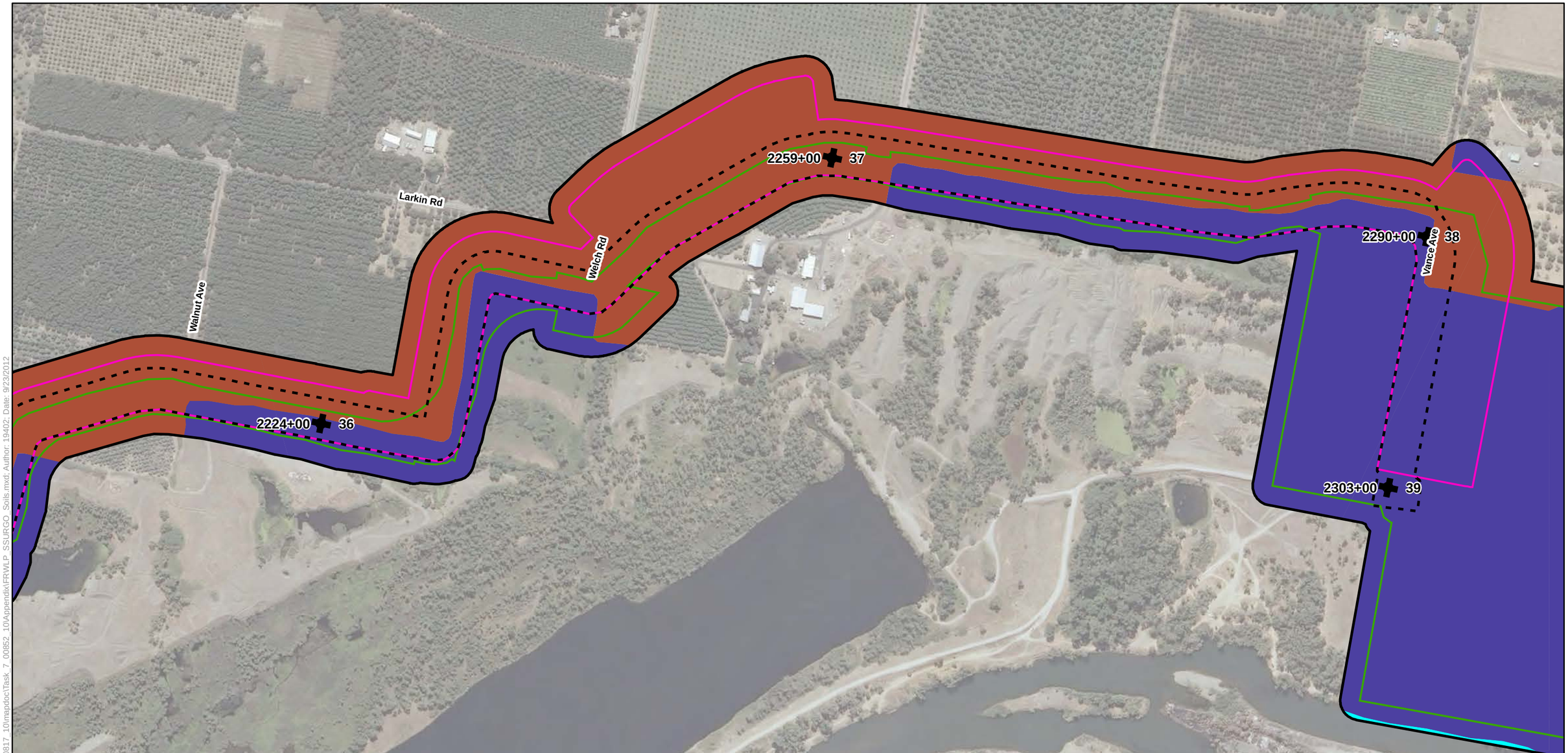
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Rarely Flooded
- Xerorthents, Tailings, 0 To 50 Percent Slopes

Soil Map Units in the Biological Study Area

Sheet 26

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

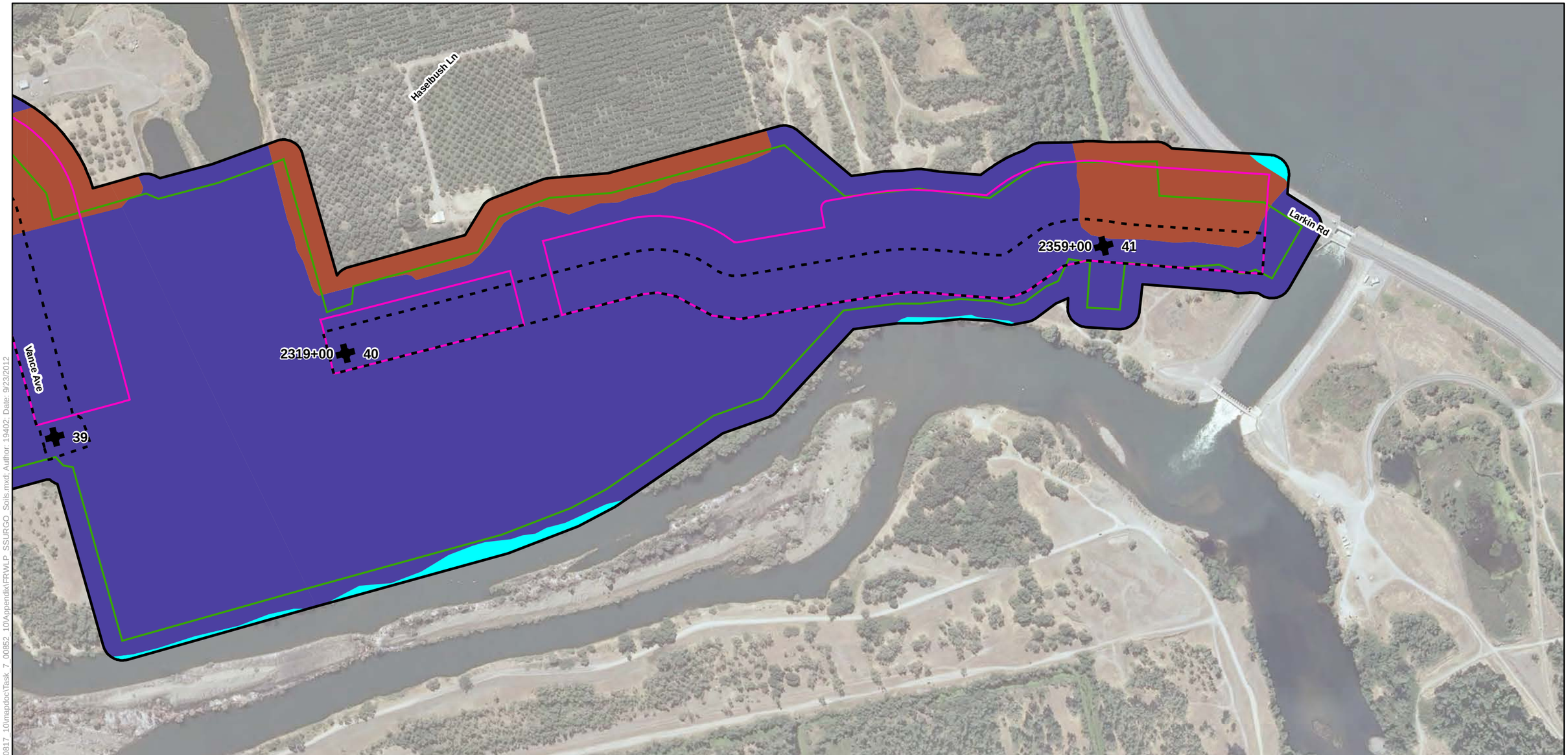
- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Rarely Flooded
- Xerorthents, Tailings, 0 To 50 Percent Slopes
- Water

Soil Map Units in the Biological Study Area

Sheet 27

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_0852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Soil Map Unit

- Gianella Fine Sandy Loam, 0 To 1 Percent Slopes, Rarely Flooded
- Xerorthents, Tailings, 0 To 50 Percent Slopes
- Water

Soil Map Units in the Biological Study Area

Sheet 28

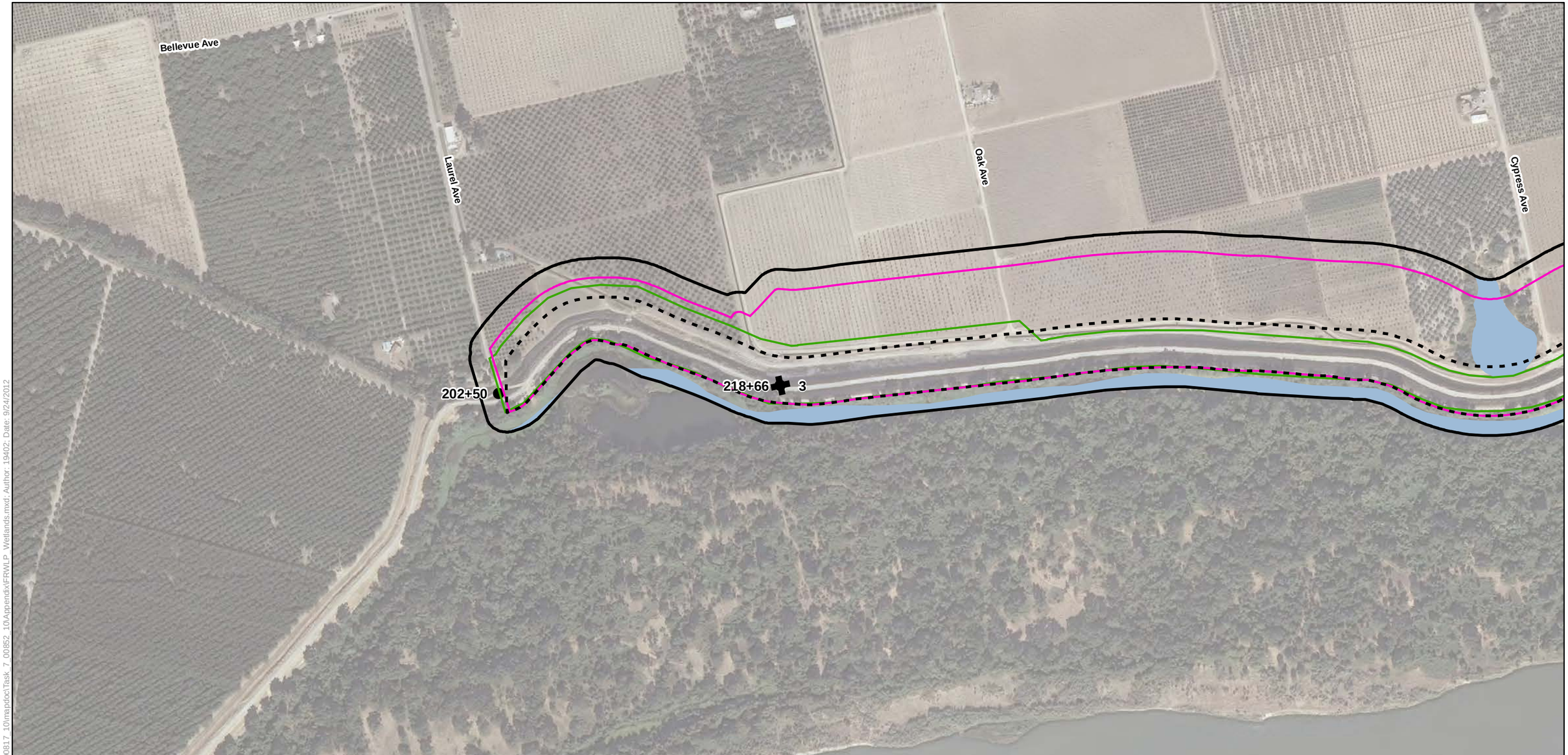
0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_SSURGO_Soils.mxd; Author: 19402; Date: 9/23/2012

Part F.11

National Wetlands Inventory Mapping in the Biological Study Area

[28 Sheets]



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

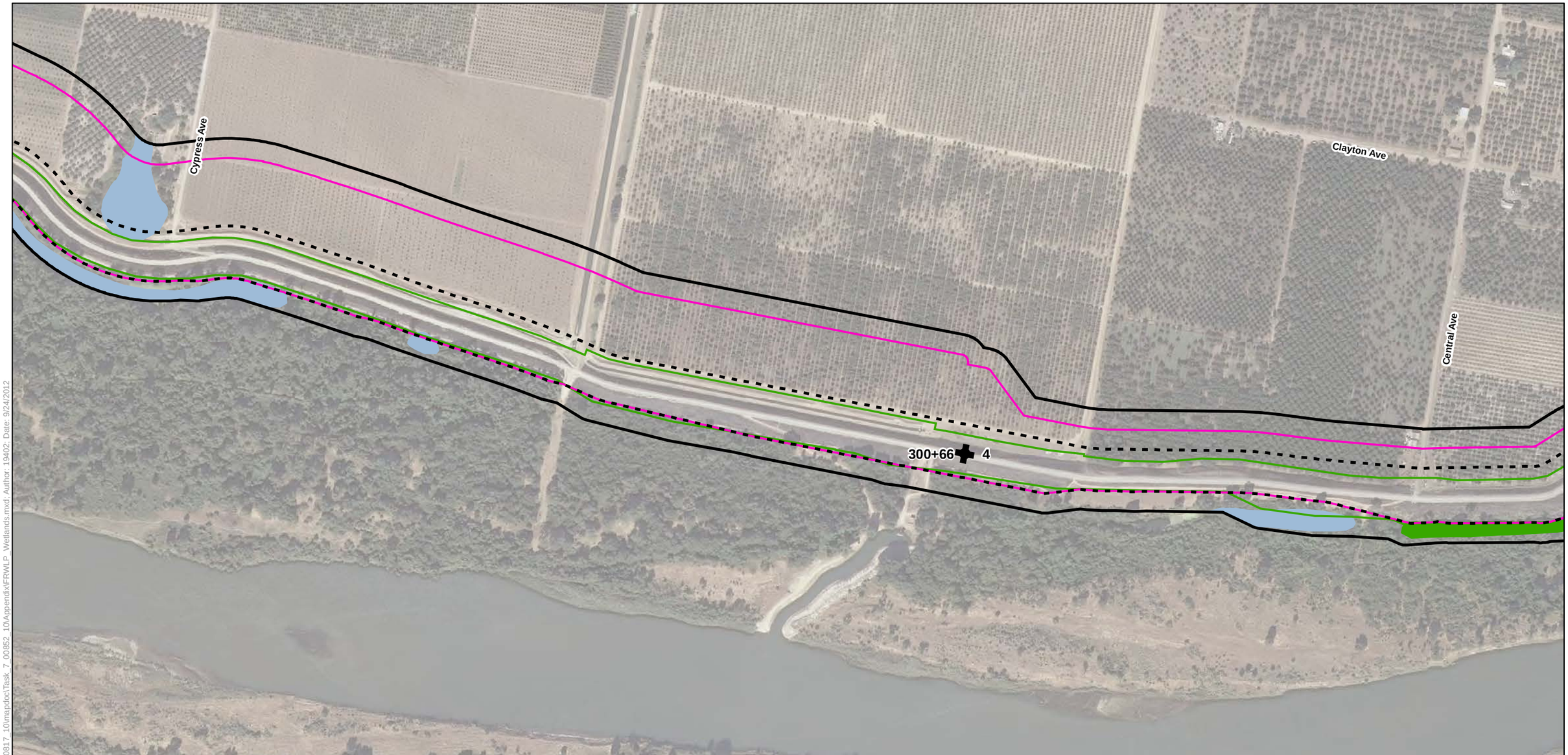
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 1

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

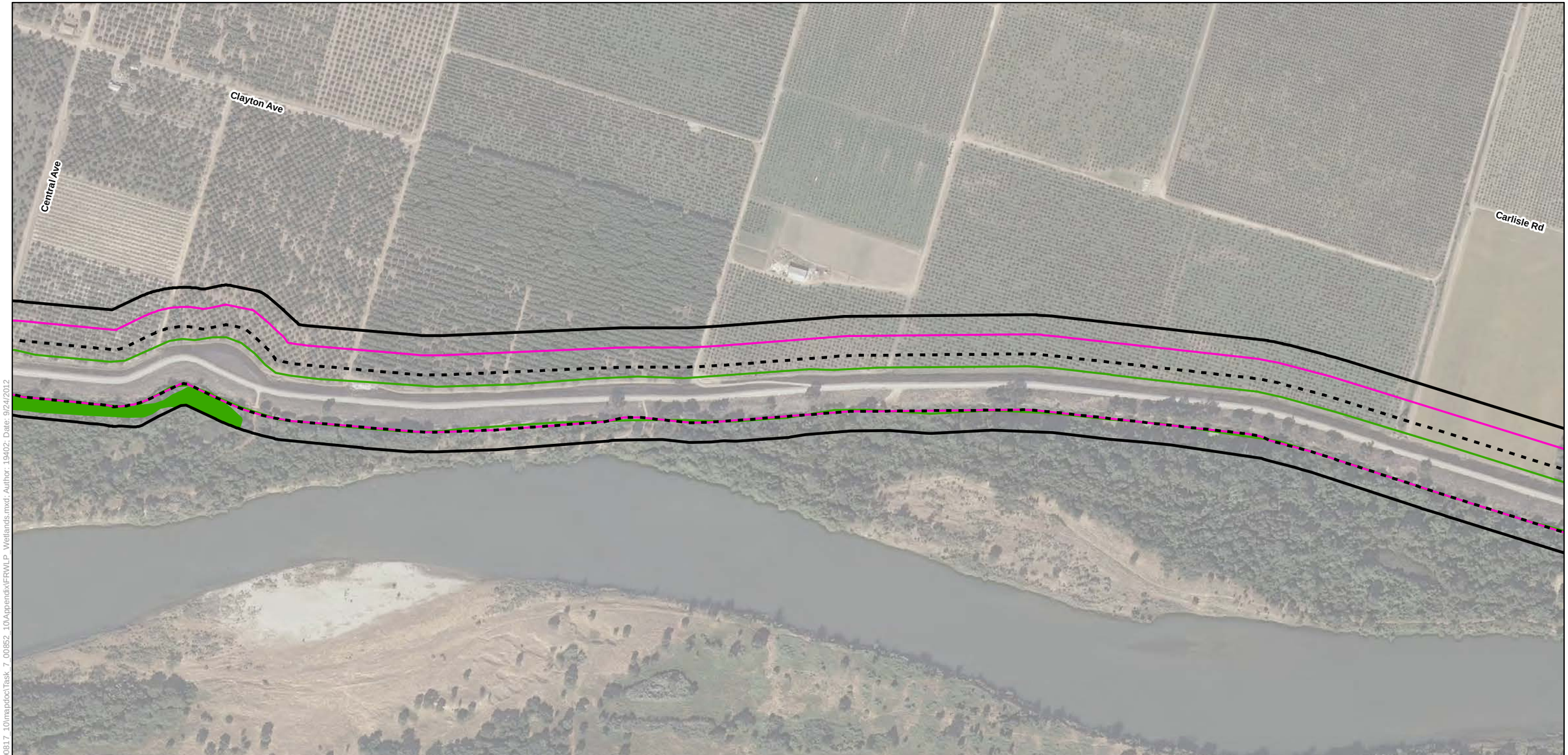
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

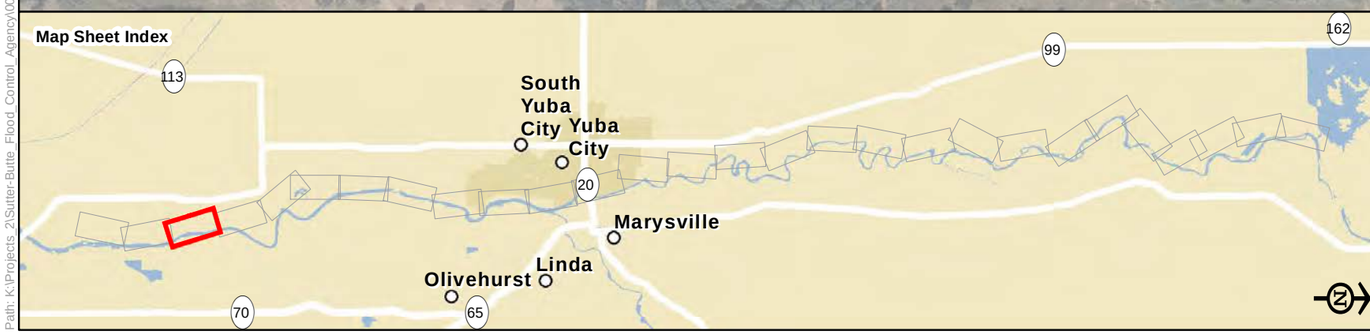
National Wetlands Inventory Mapping in the Biological Study Area

Sheet 2

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 3

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012

Carlisle Rd

Wilkie Ave

Lyon Ave

Oconnor Ave

Peck Ave

Ashford Ave

410+67 5

478+68 6

Map Sheet Index

113

South Yuba City

Yuba City

20

Marysville

Linda

Olivehurst

70

65

99

162

Legend

Biological Study Area

Alternative 1

Alternative 2

Alternative 3

Reach

Station 202+50

Wetland Type

Freshwater Emergent Wetland

Freshwater Forested/Shrub Wetland

Freshwater Pond

Lake

Riverine

Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 4

0 250 500

Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012

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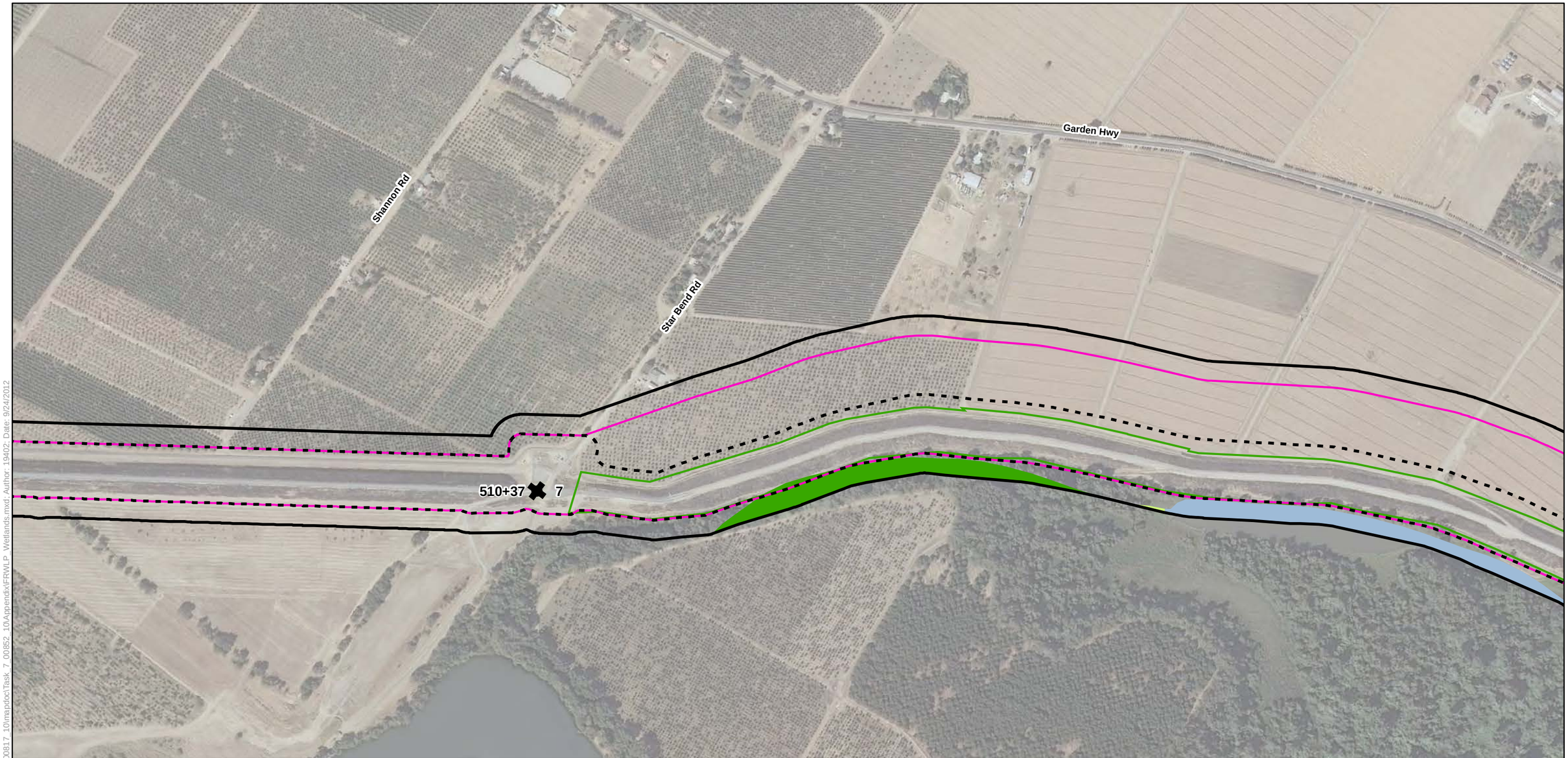
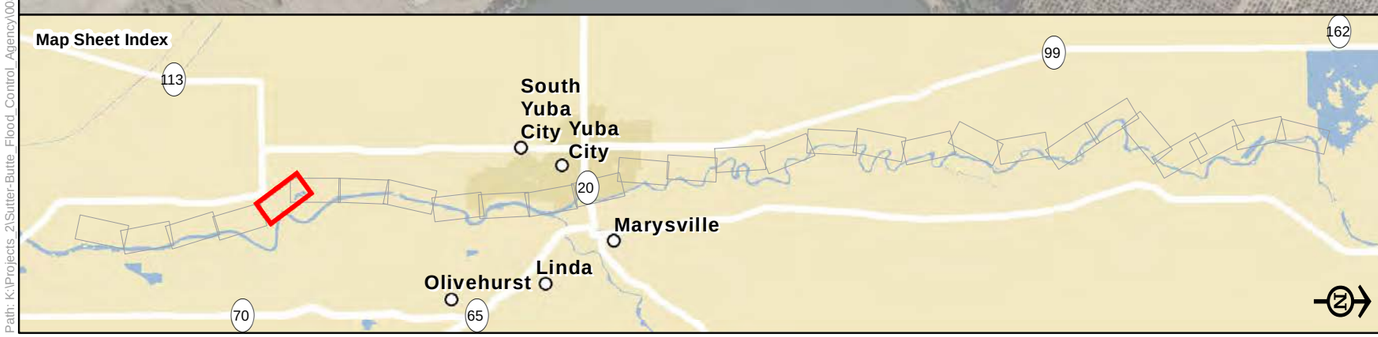




Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

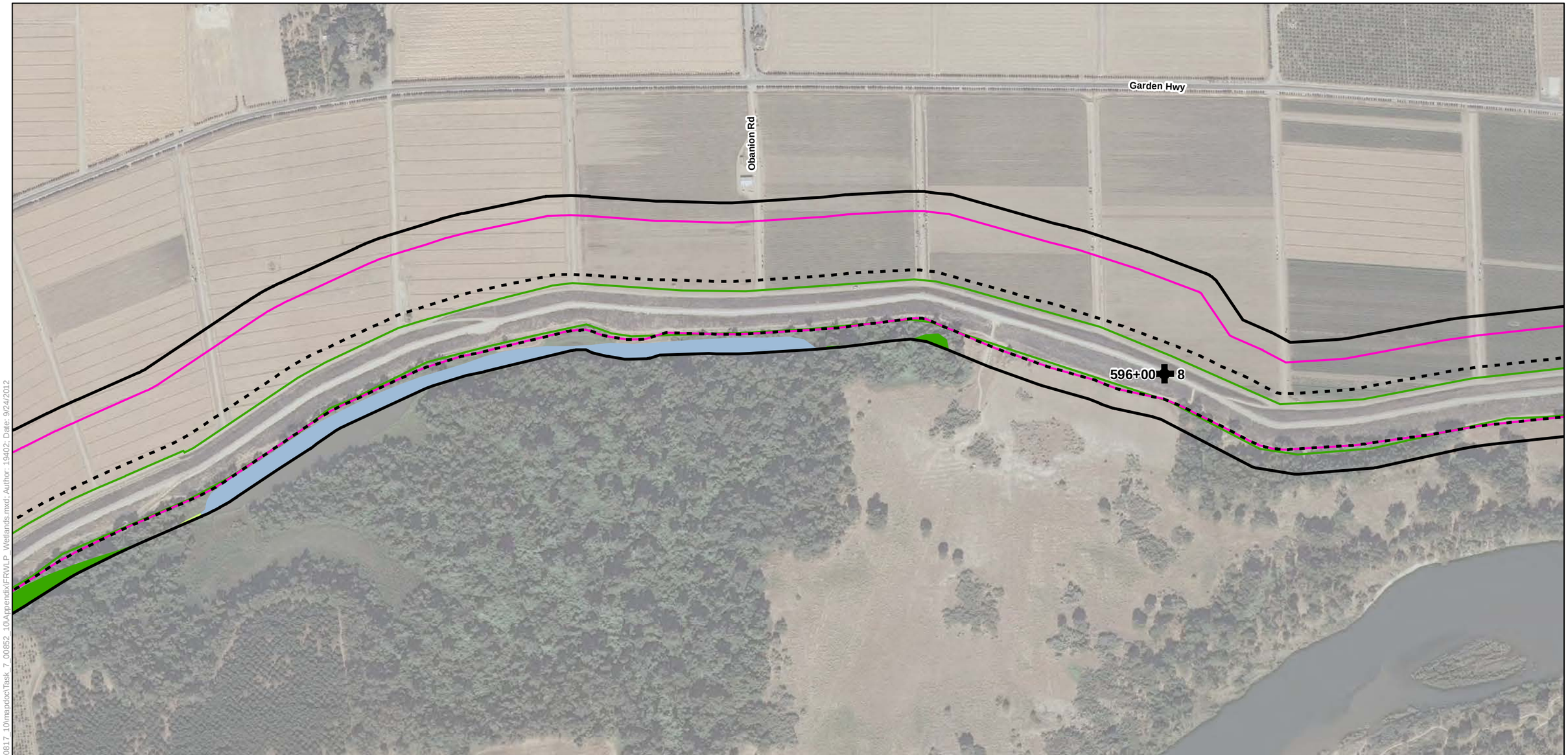
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 5

0 250 500
Feet



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

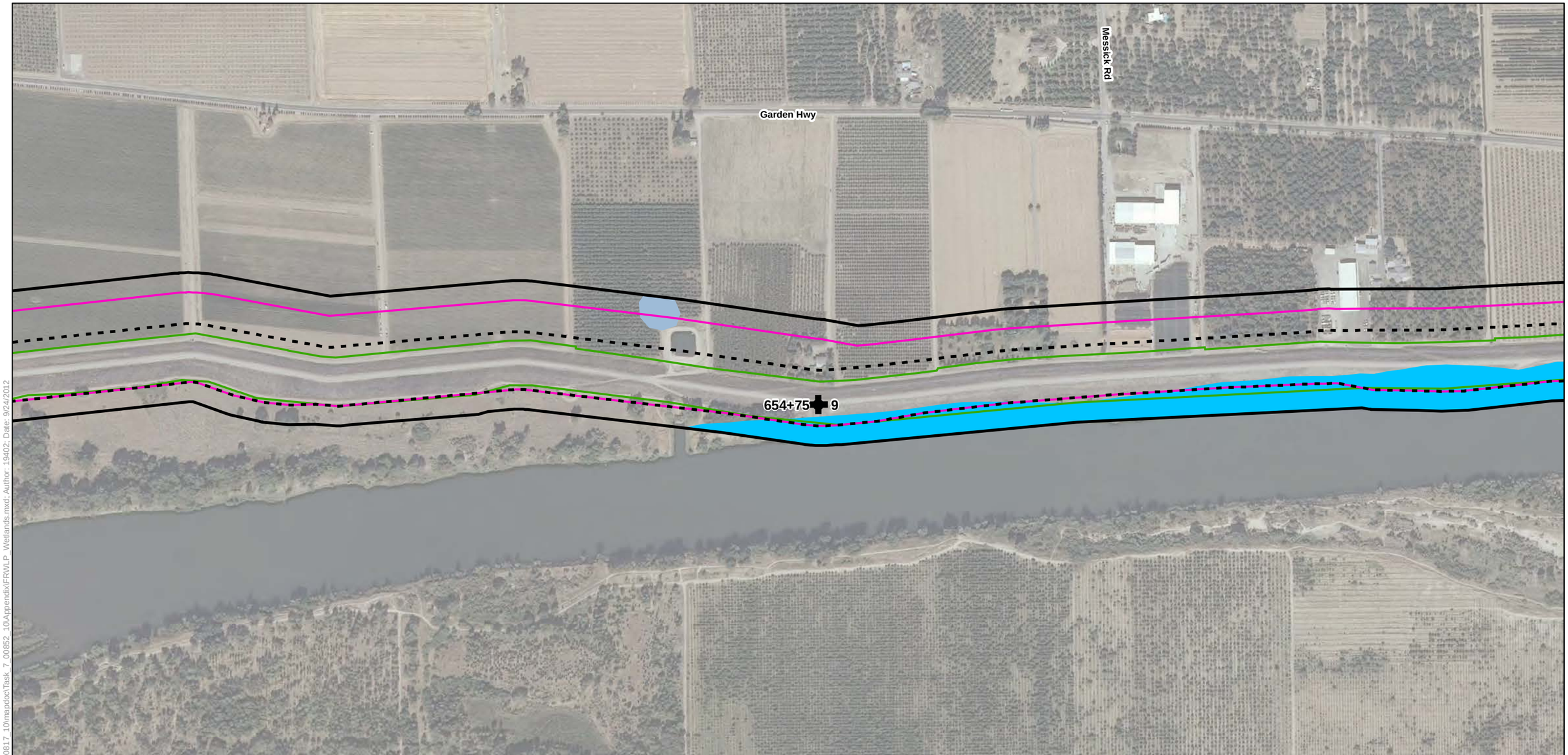
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 6

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

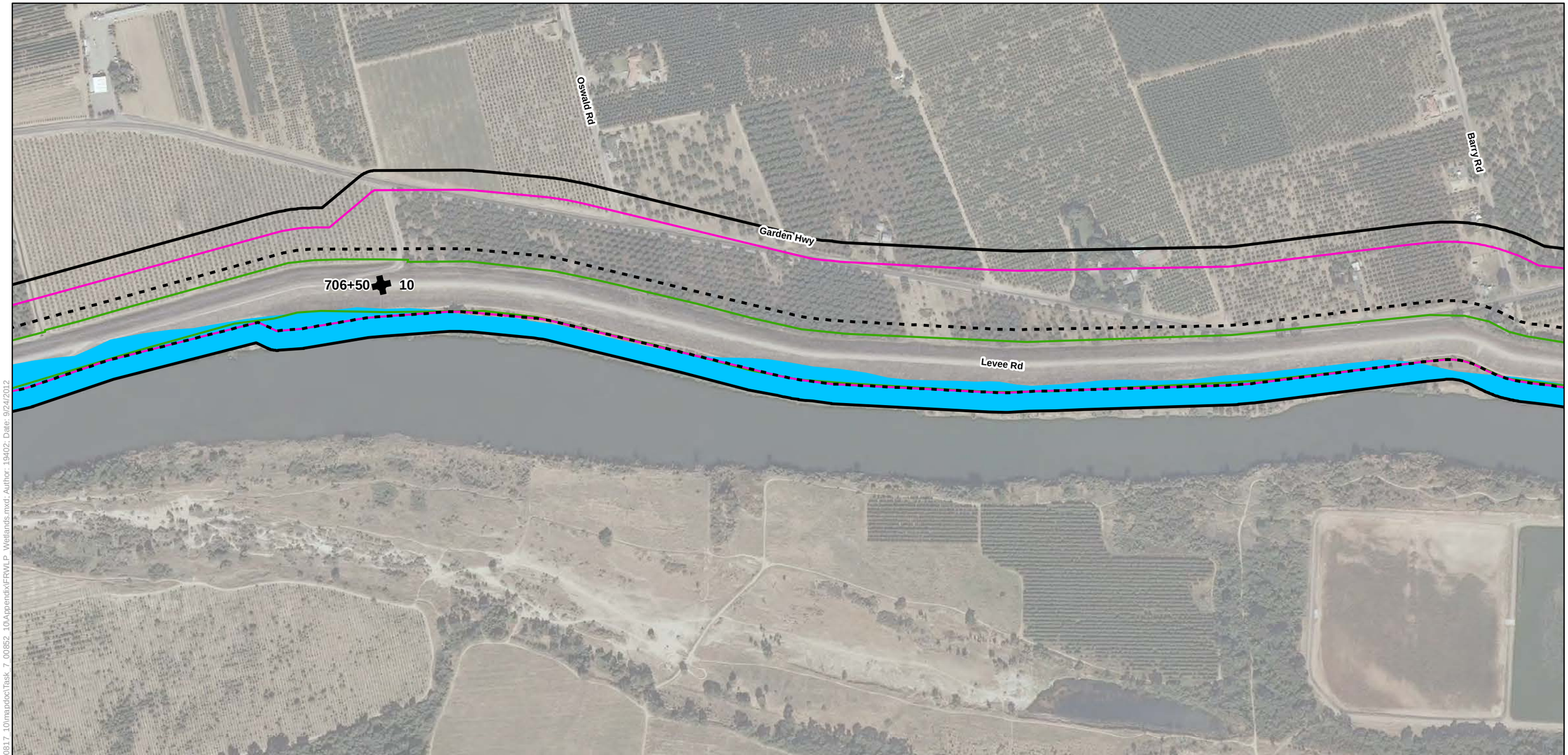
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 7

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

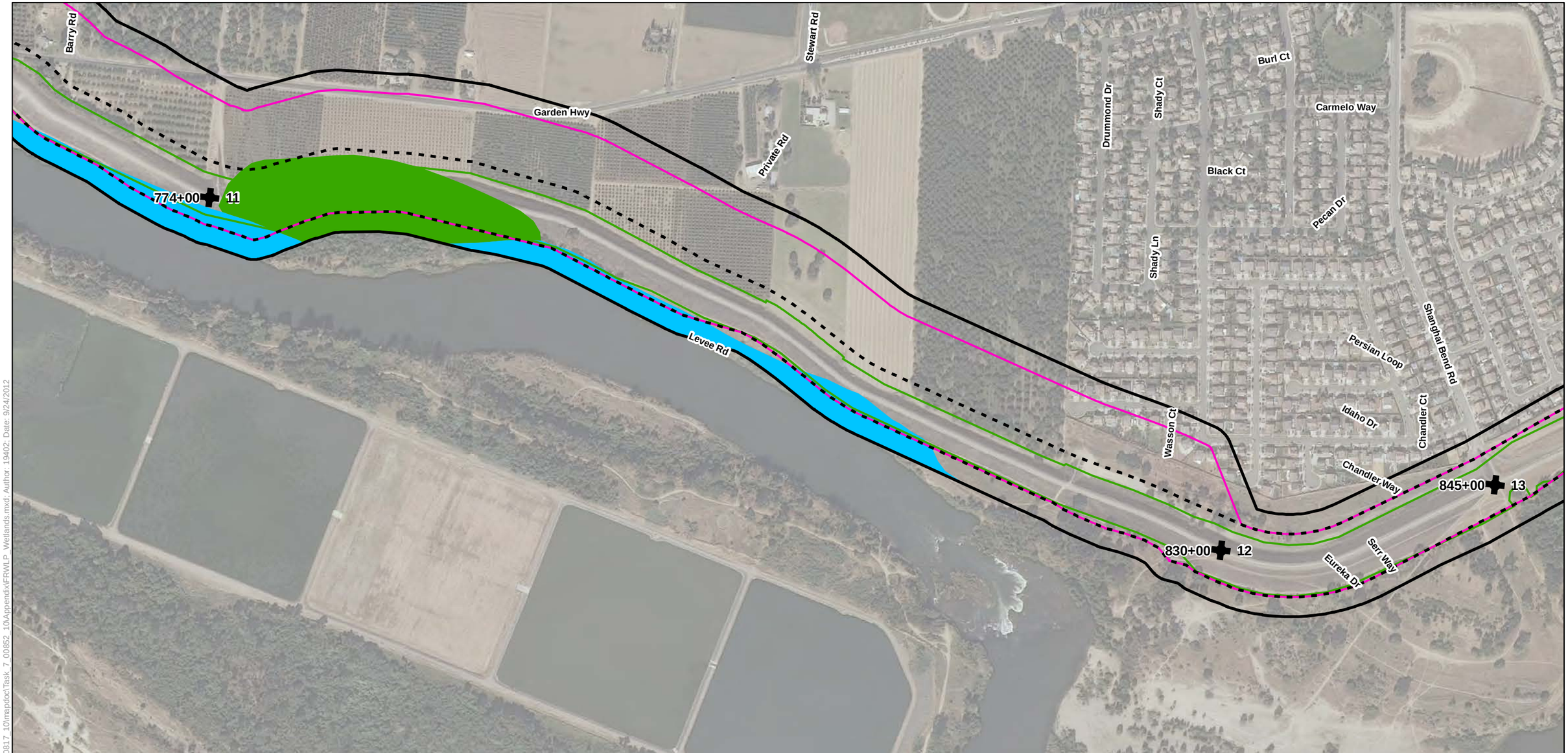
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 8

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\0817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 9

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012

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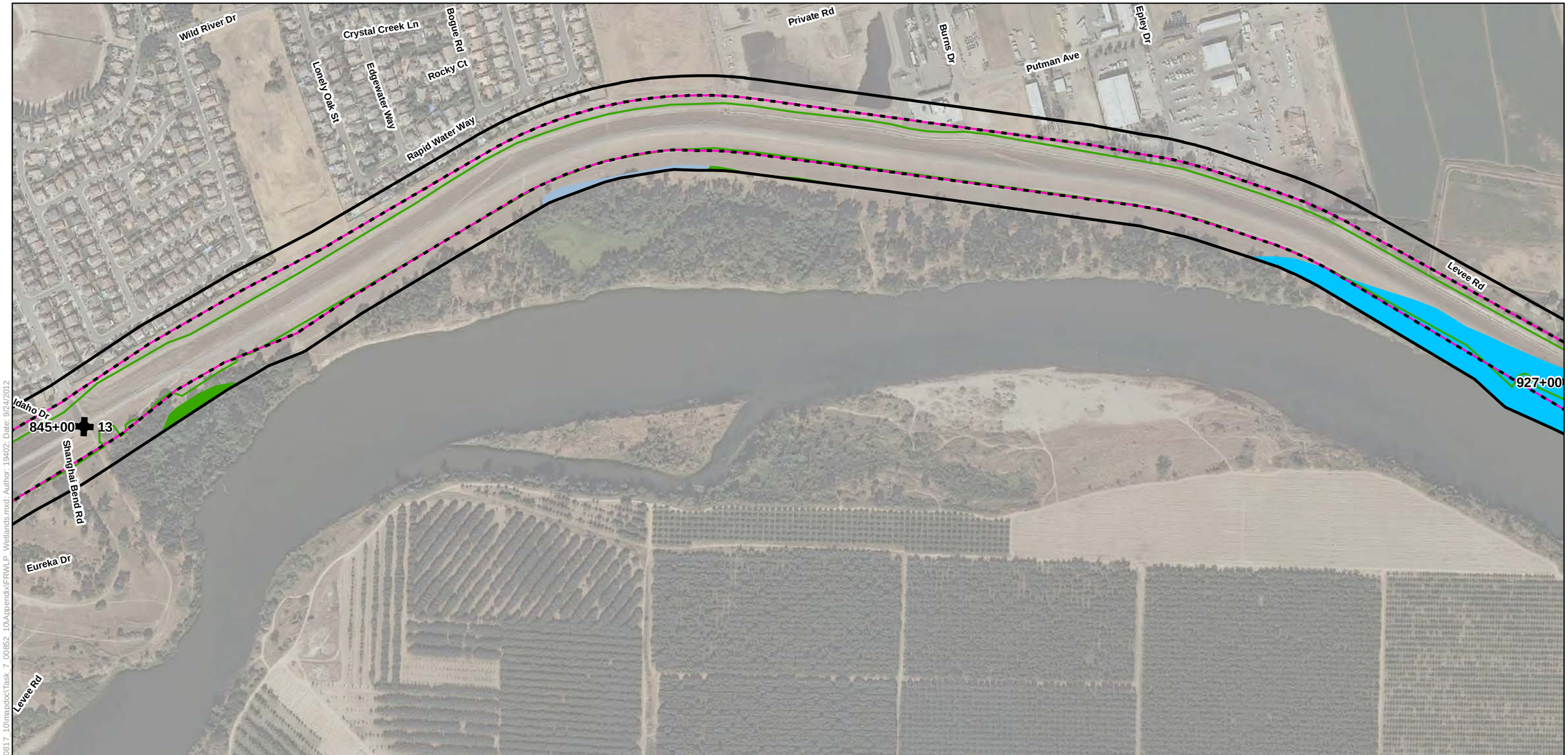


Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

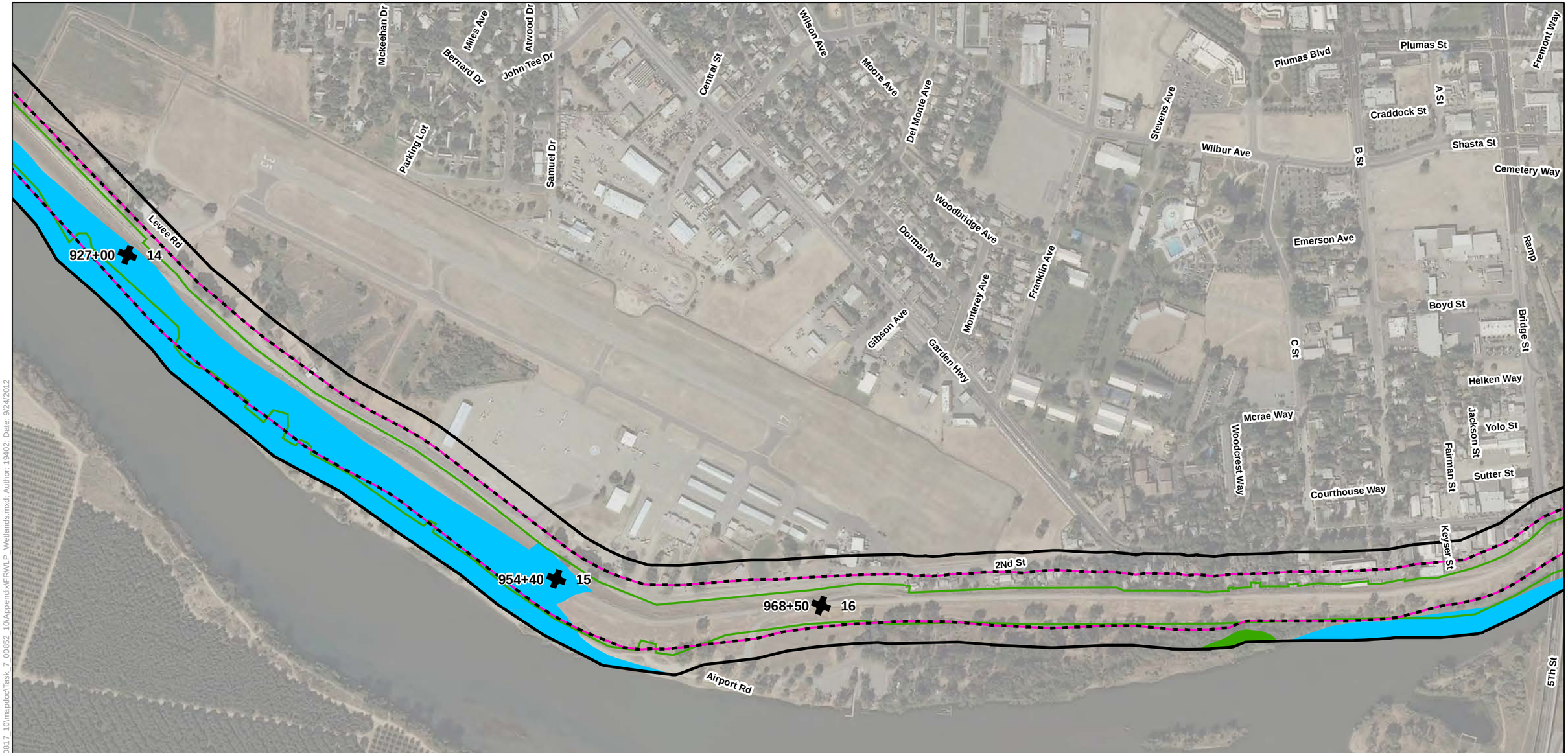
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

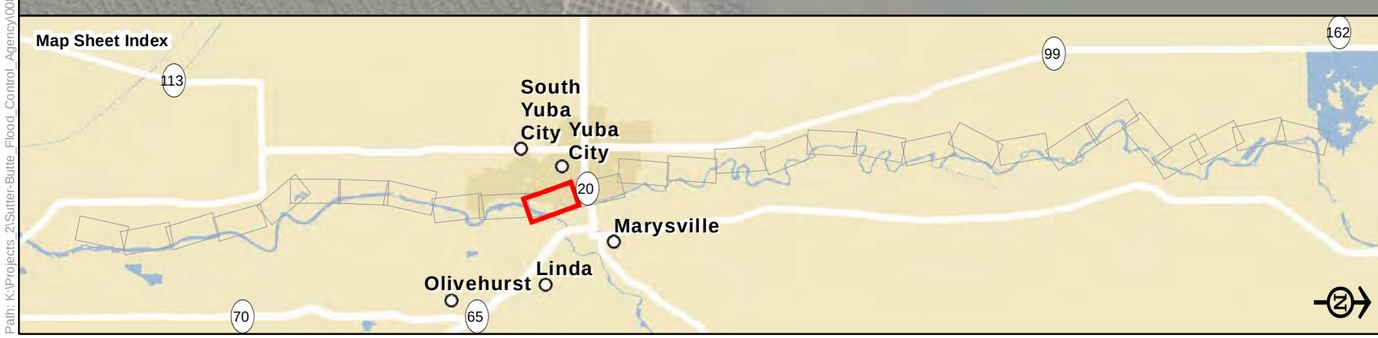
National Wetlands Inventory Mapping in the Biological Study Area

Sheet 10

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

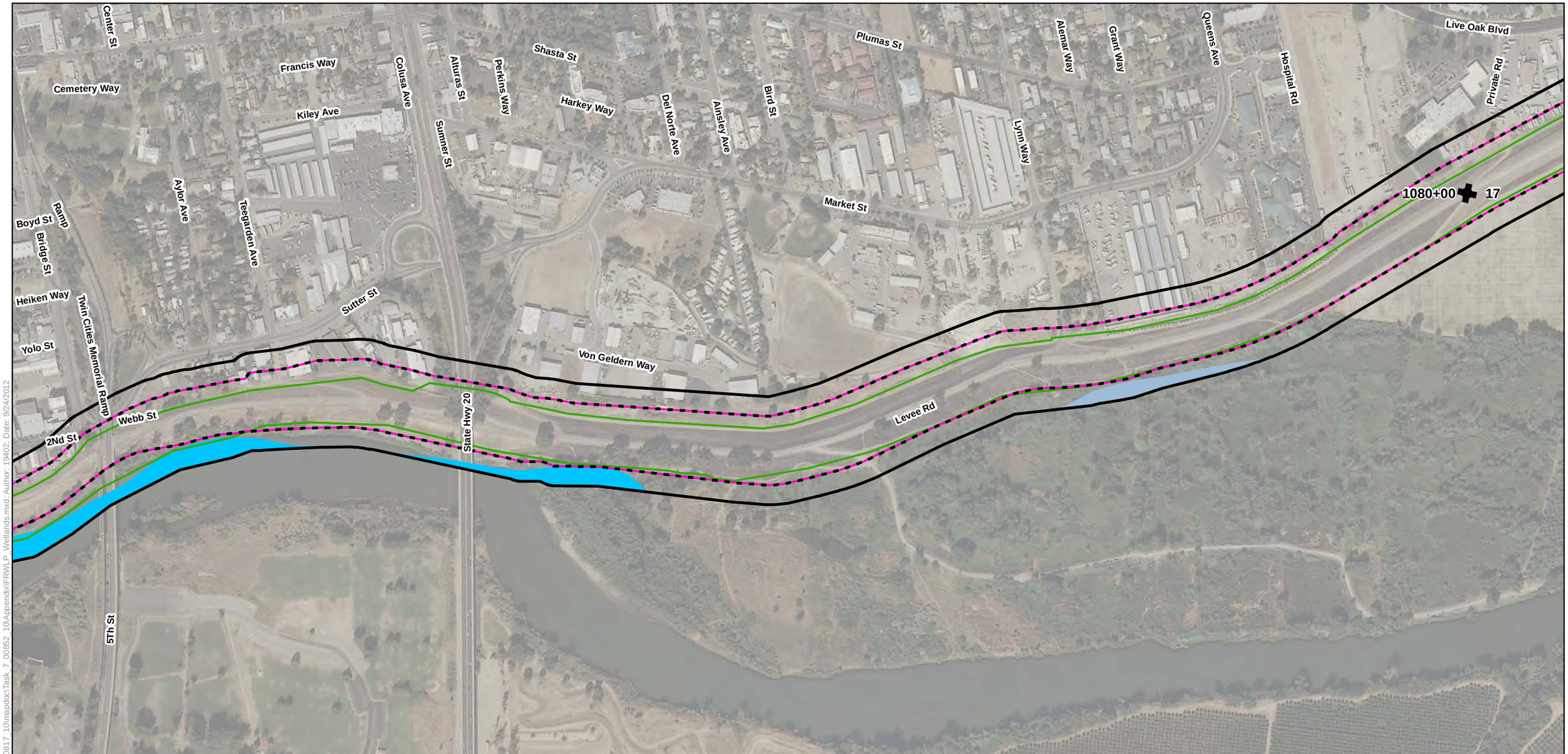
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 11

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

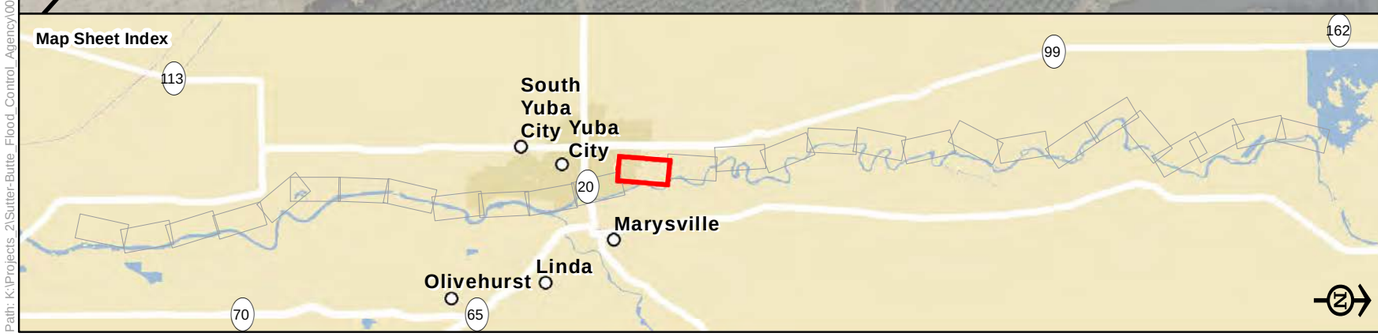
National Wetlands Inventory Mapping in the Biological Study Area

Sheet 12

0 250 500
Feet

Sandalwood Ct
Teakwood Dr
Beechwood St
Oakview Dr
Forestview Dr
Baywood Ct
N Point Dr
Northridge Dr
Santa Barbara Way
Pease Rd
Tamarack Dr
Hunt St
Clark Ave
Parkbrook Ct
Cassidy Ct
Bal Sukh Mhp Rd
Northgate Dr
Cassidy Ave
Bal Sukh Mhp
Live Oak Blvd
1130+86
18
Levee
Private Rd
17

Map Sheet Index



Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

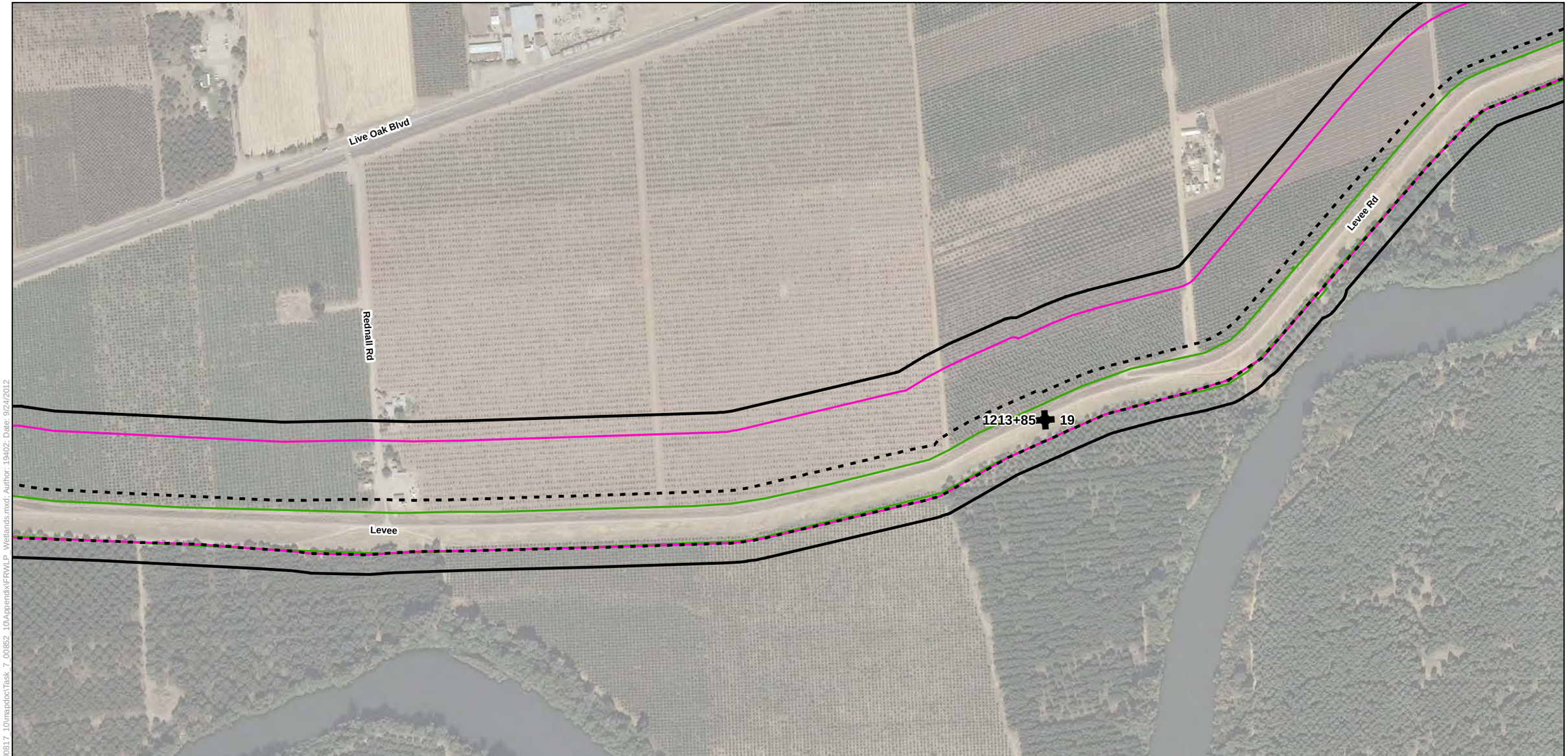
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

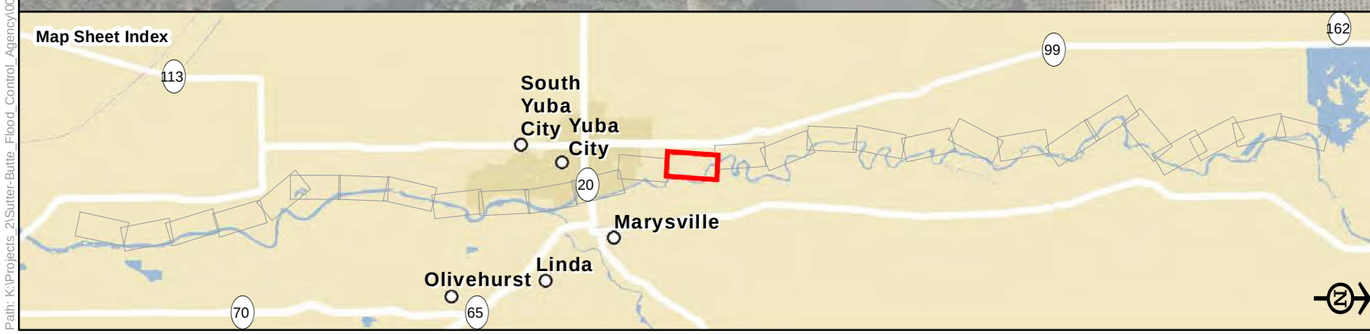
National Wetlands Inventory Mapping in the Biological Study Area

Sheet 13

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

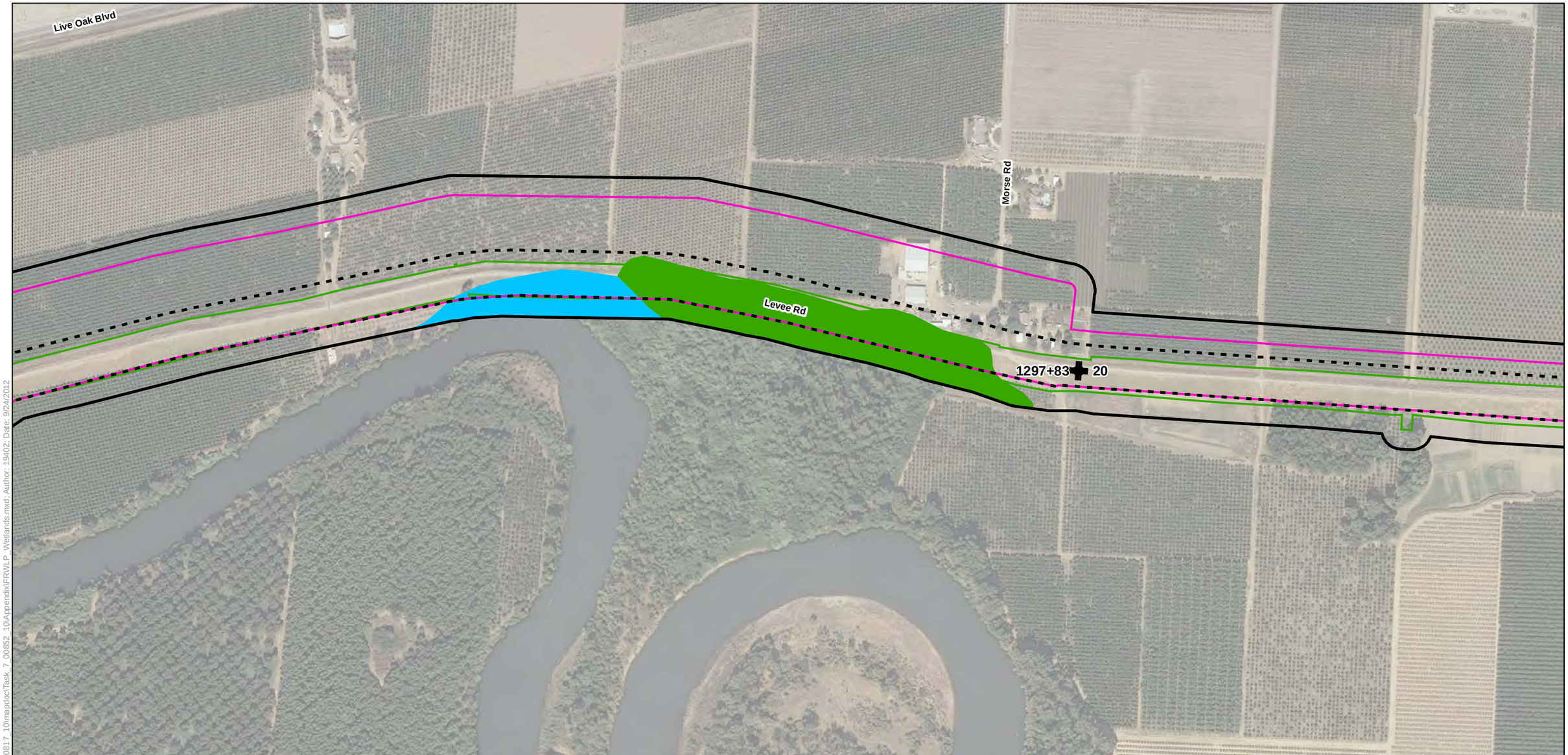
Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

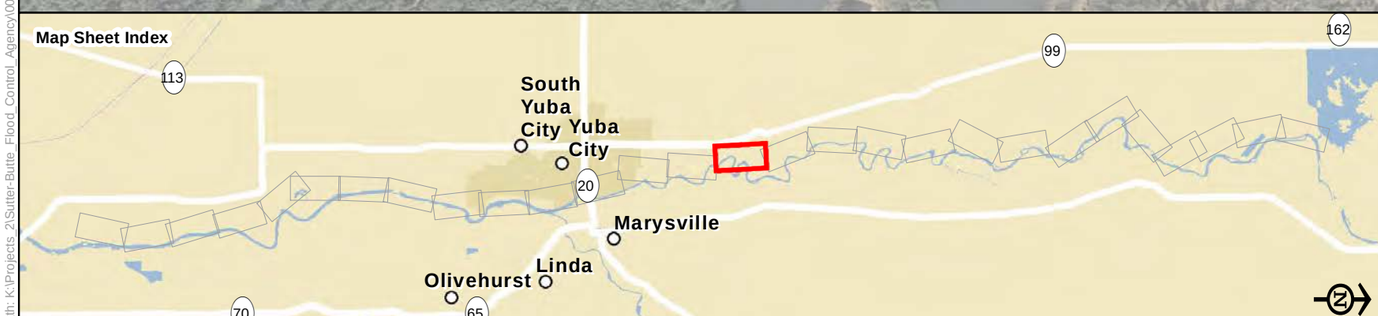
National Wetlands Inventory Mapping in the Biological Study Area

Sheet 14

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012





Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 15

0 250 500
Feet

Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012

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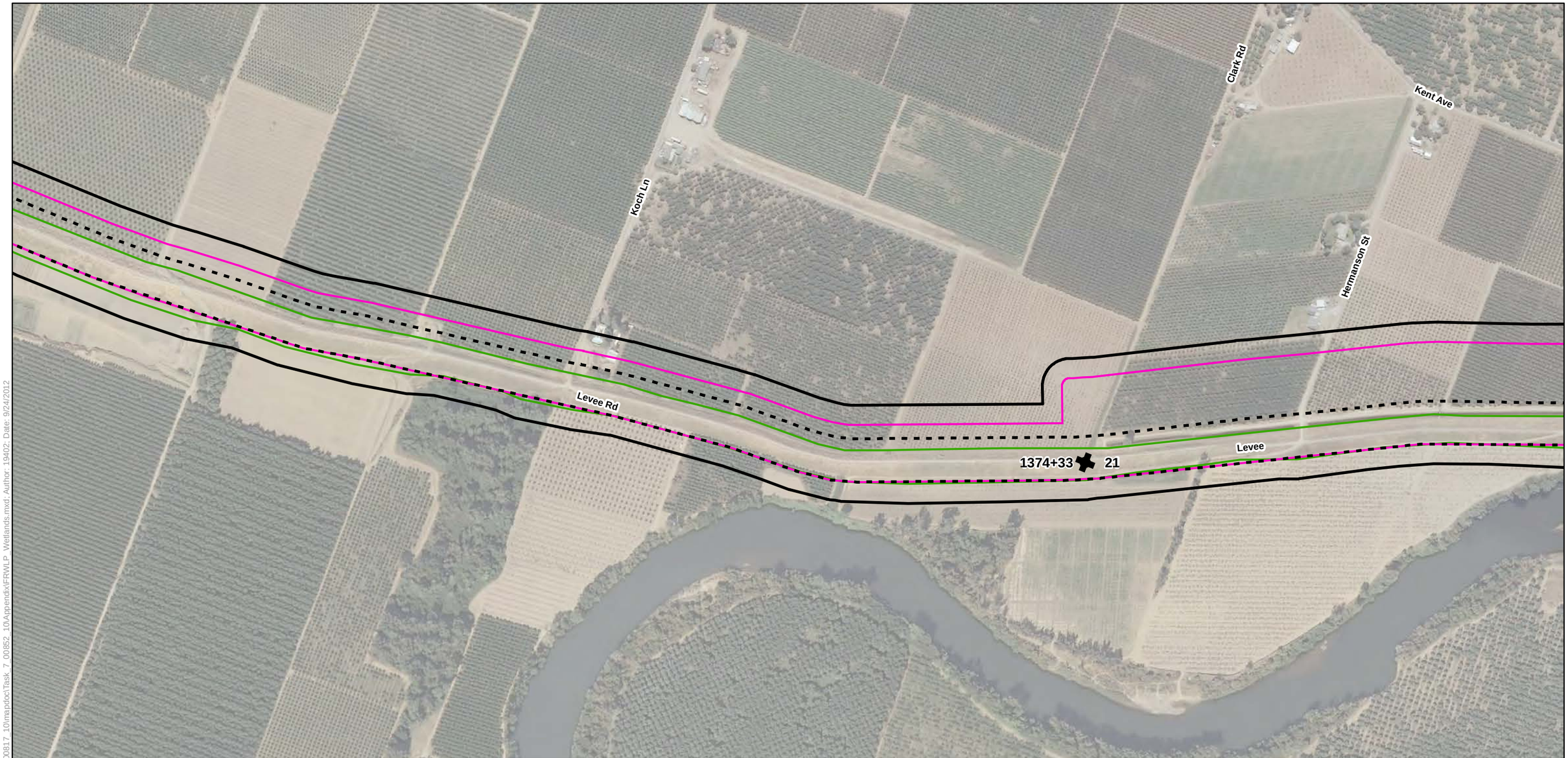

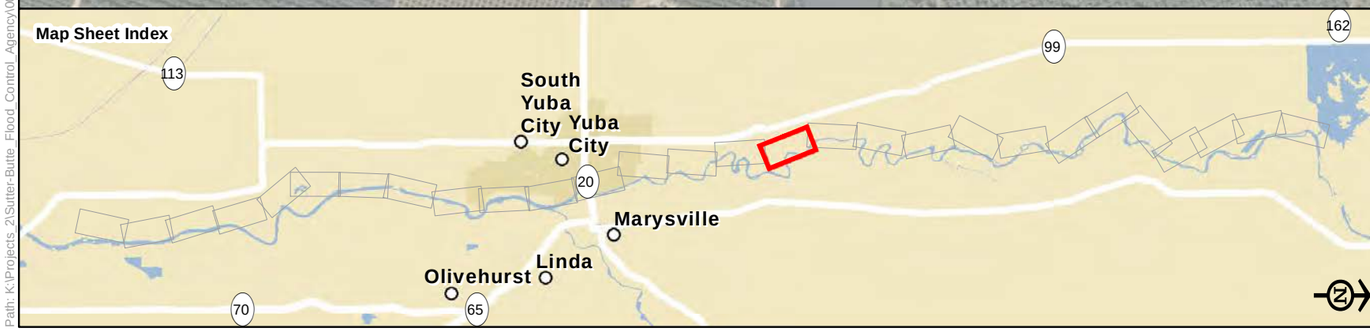

Legend

- Biological Study Area
- Alternative 1
- Alternative 2
- Alternative 3
- Reach
- Station 202+50

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 16

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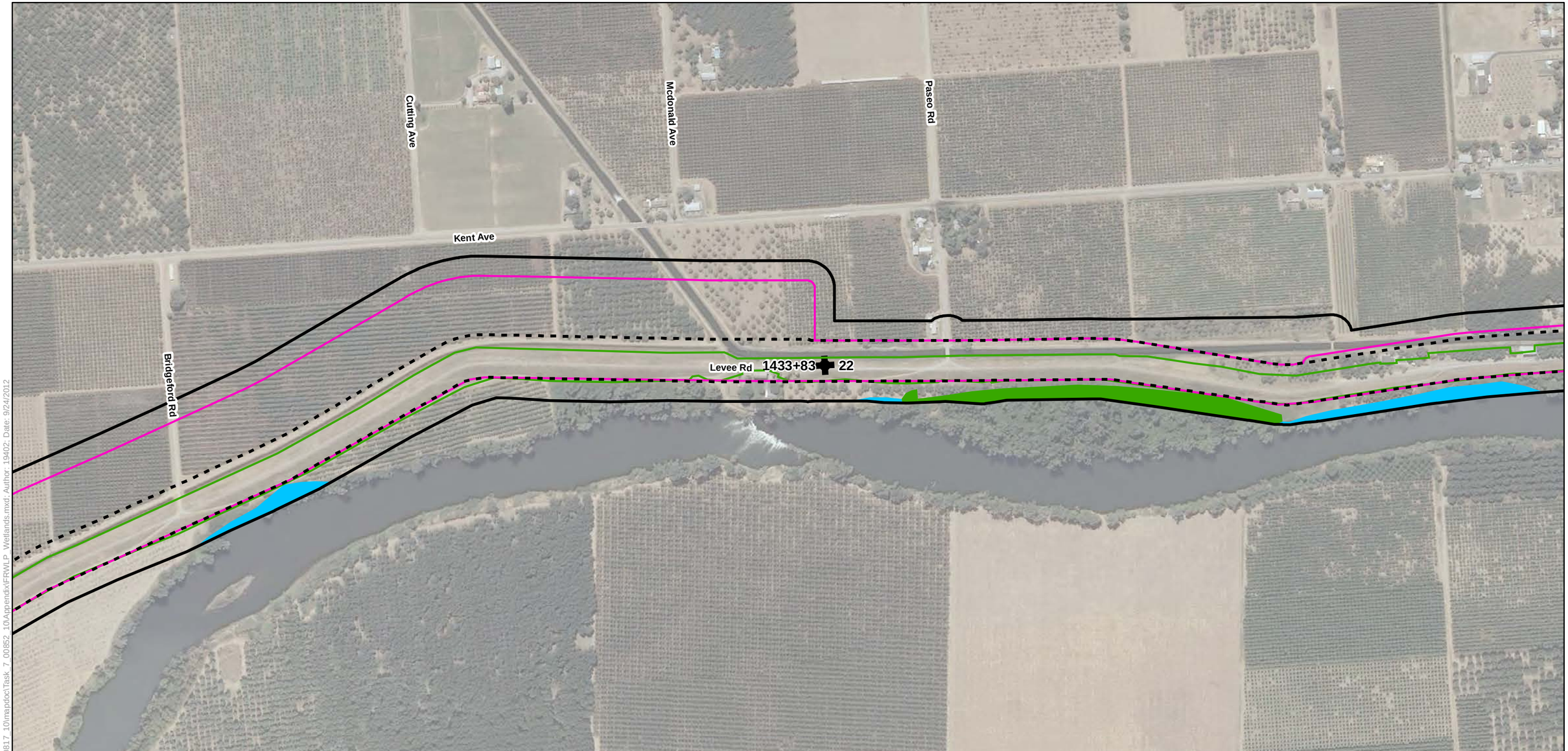
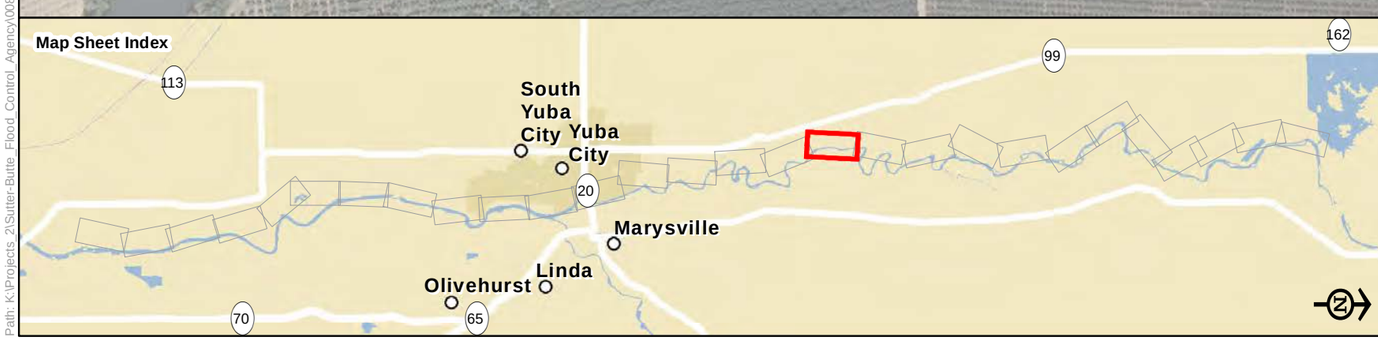
Feet





Legend

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National Wetlands Inventory Mapping in the Biological Study Area

Sheet 17

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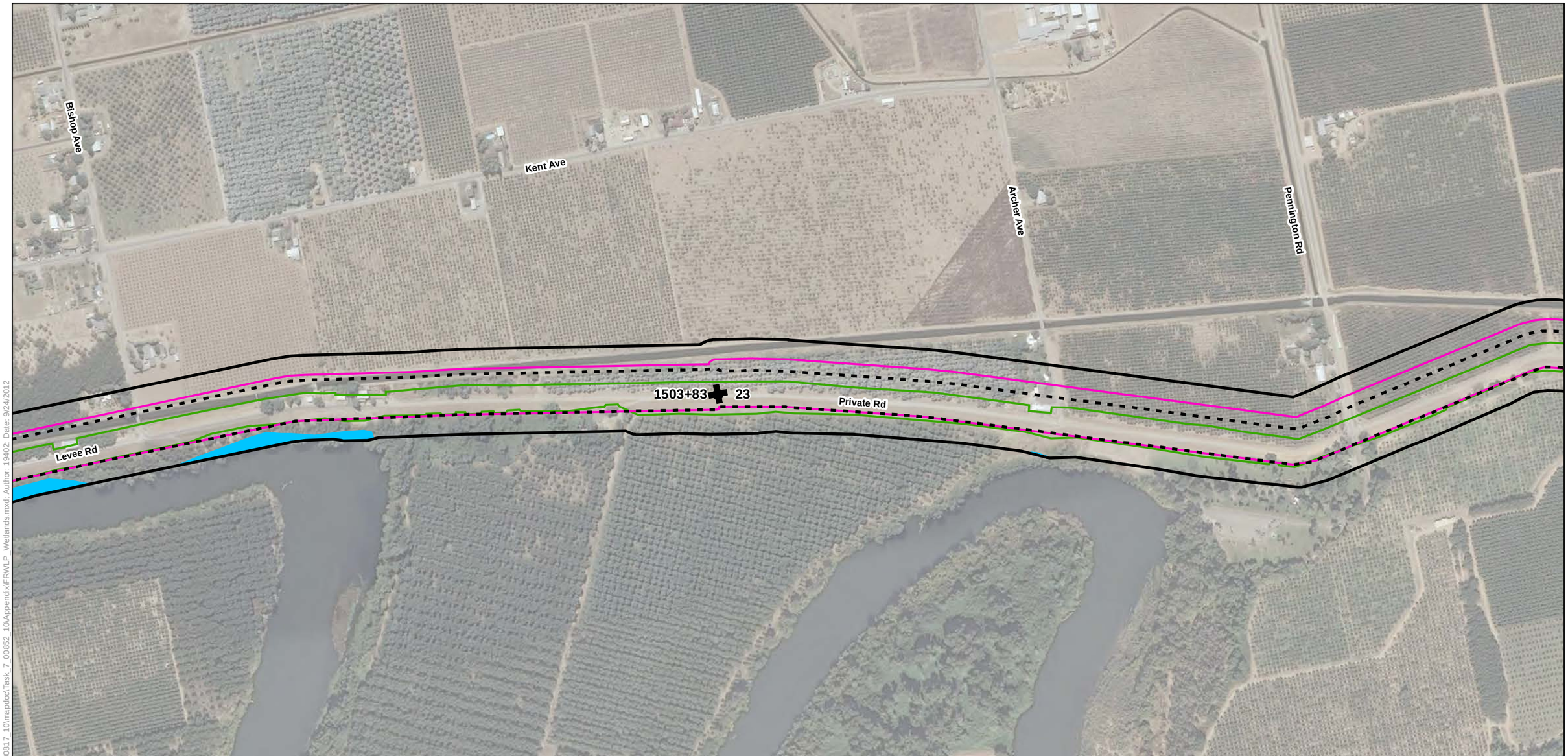
Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00817_10\mapdoc\Task_7_00852_10\Appendix\FRWLP_Wetlands.mxd; Author: 19402; Date: 9/24/2012



Legend

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National Wetlands Inventory Mapping in the Biological Study Area

Sheet 18

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Campbell Rd

Encinal Rd

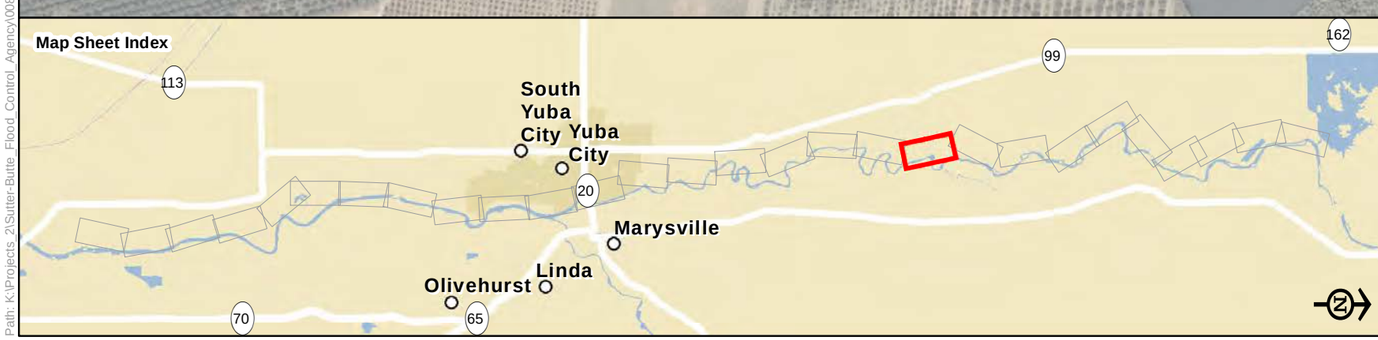
Cooley Rd

Private Rd

1623+86 25

1609+37 24

Sparrow Ln



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National Wetlands Inventory Mapping in the Biological Study Area

Sheet 20

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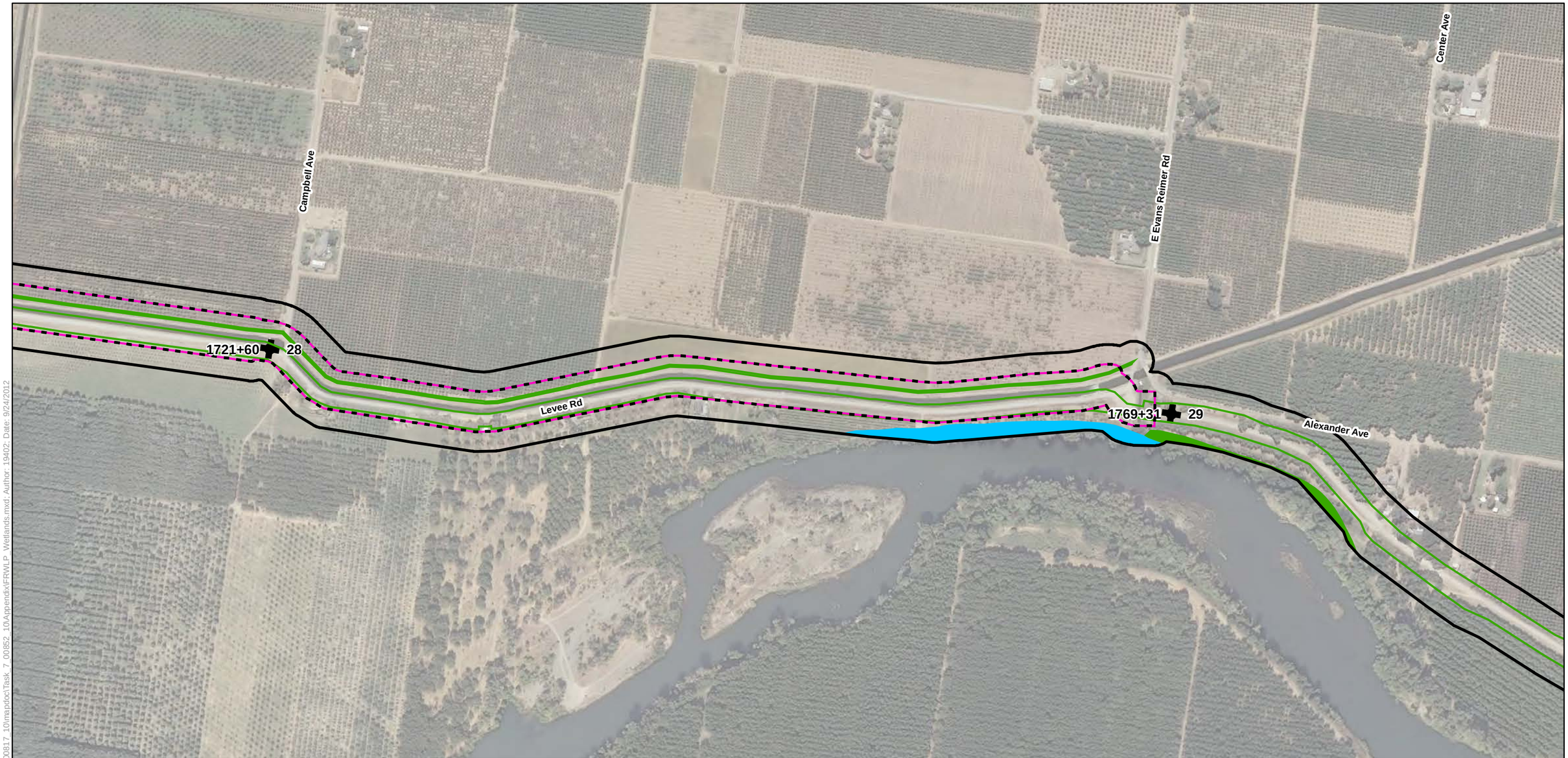

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National Wetlands Inventory Mapping in the Biological Study Area

Sheet 21

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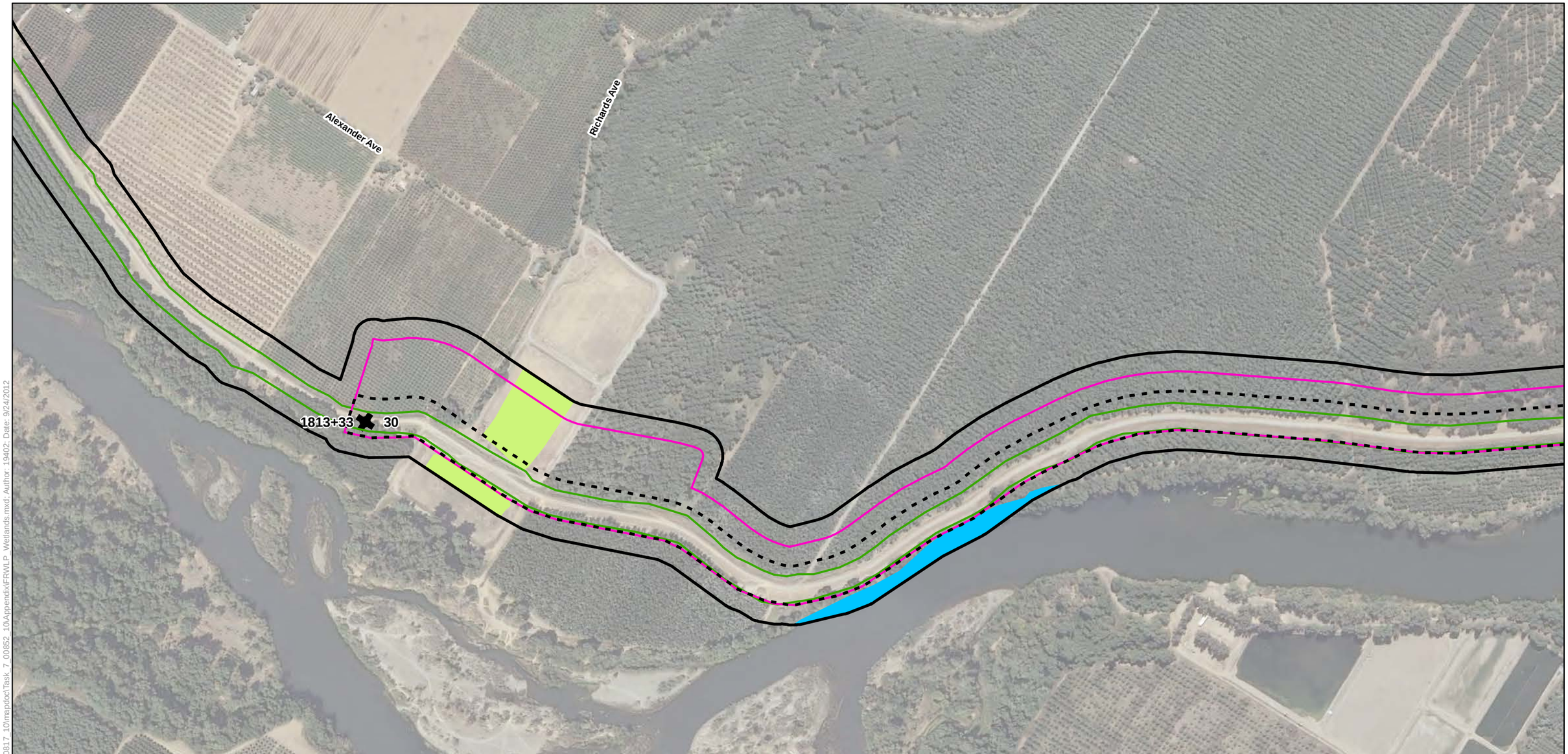

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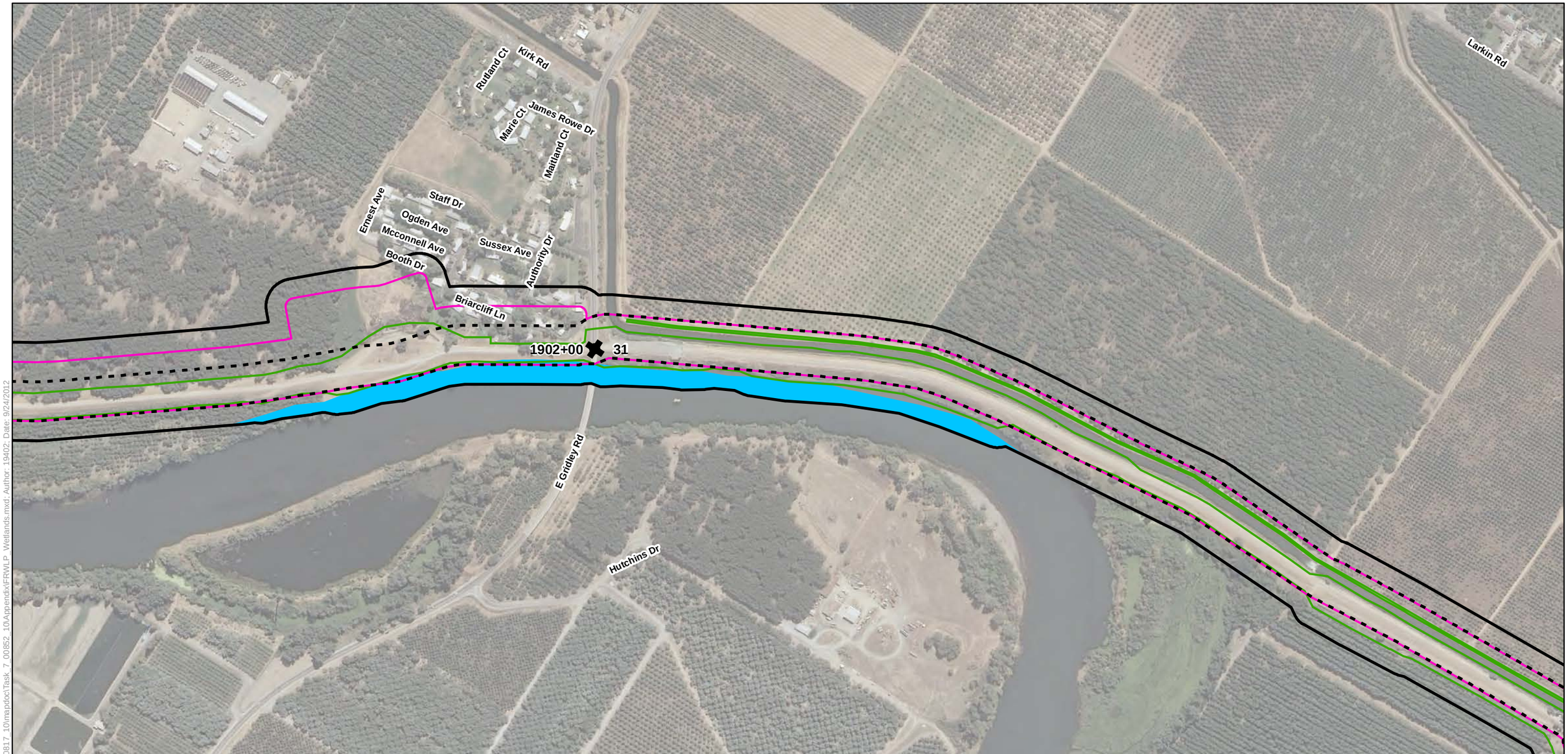

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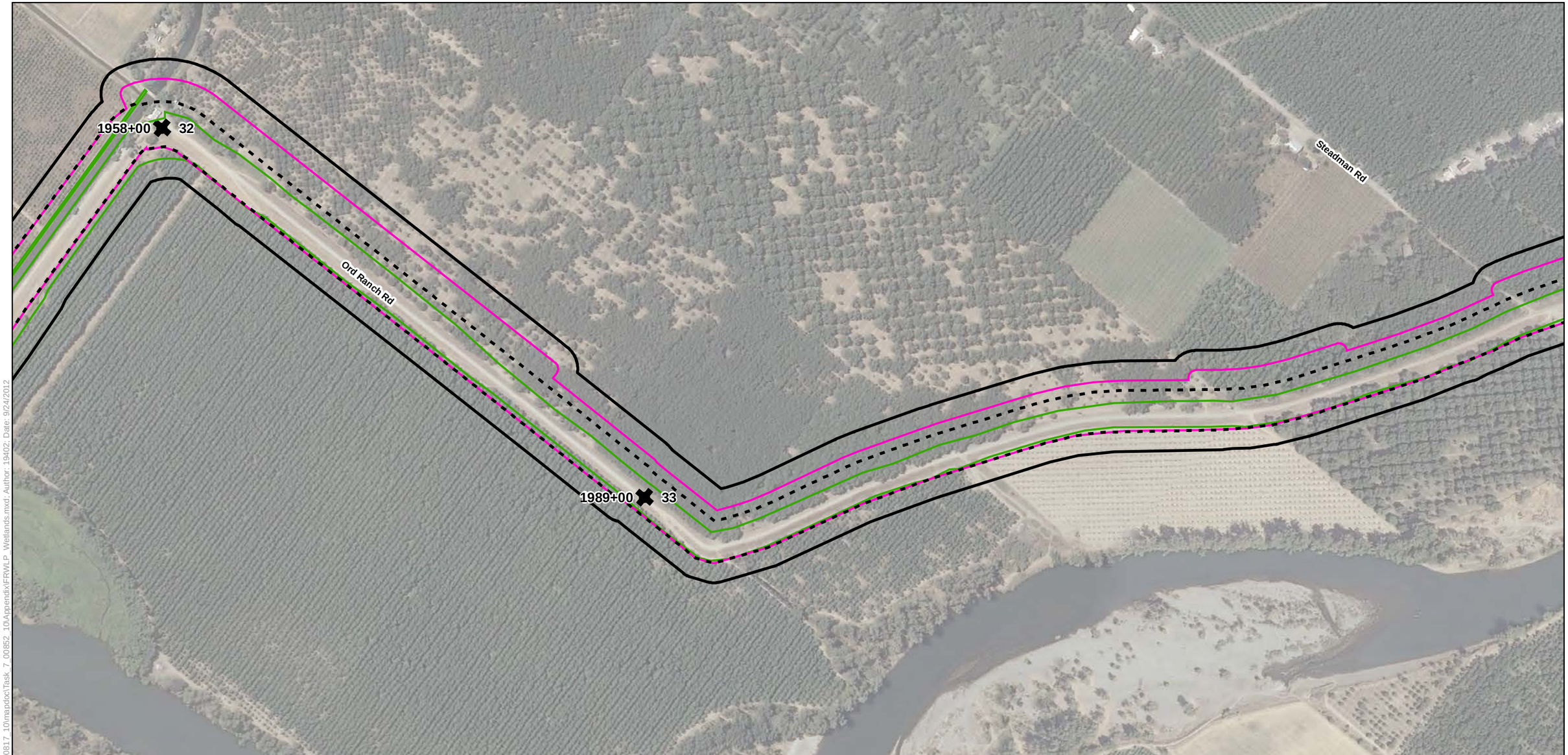

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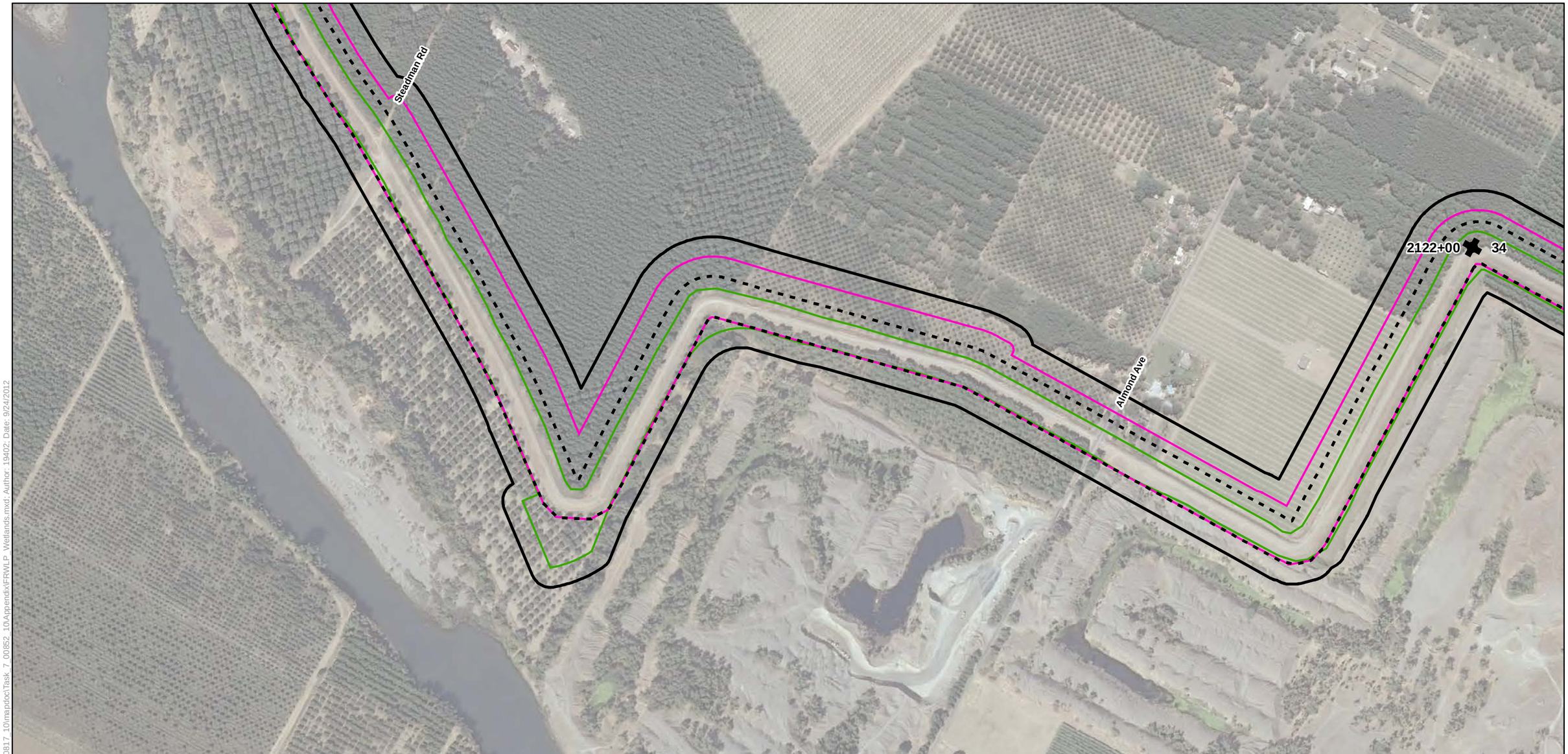

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National Wetlands Inventory Mapping in the Biological Study Area

Sheet 25

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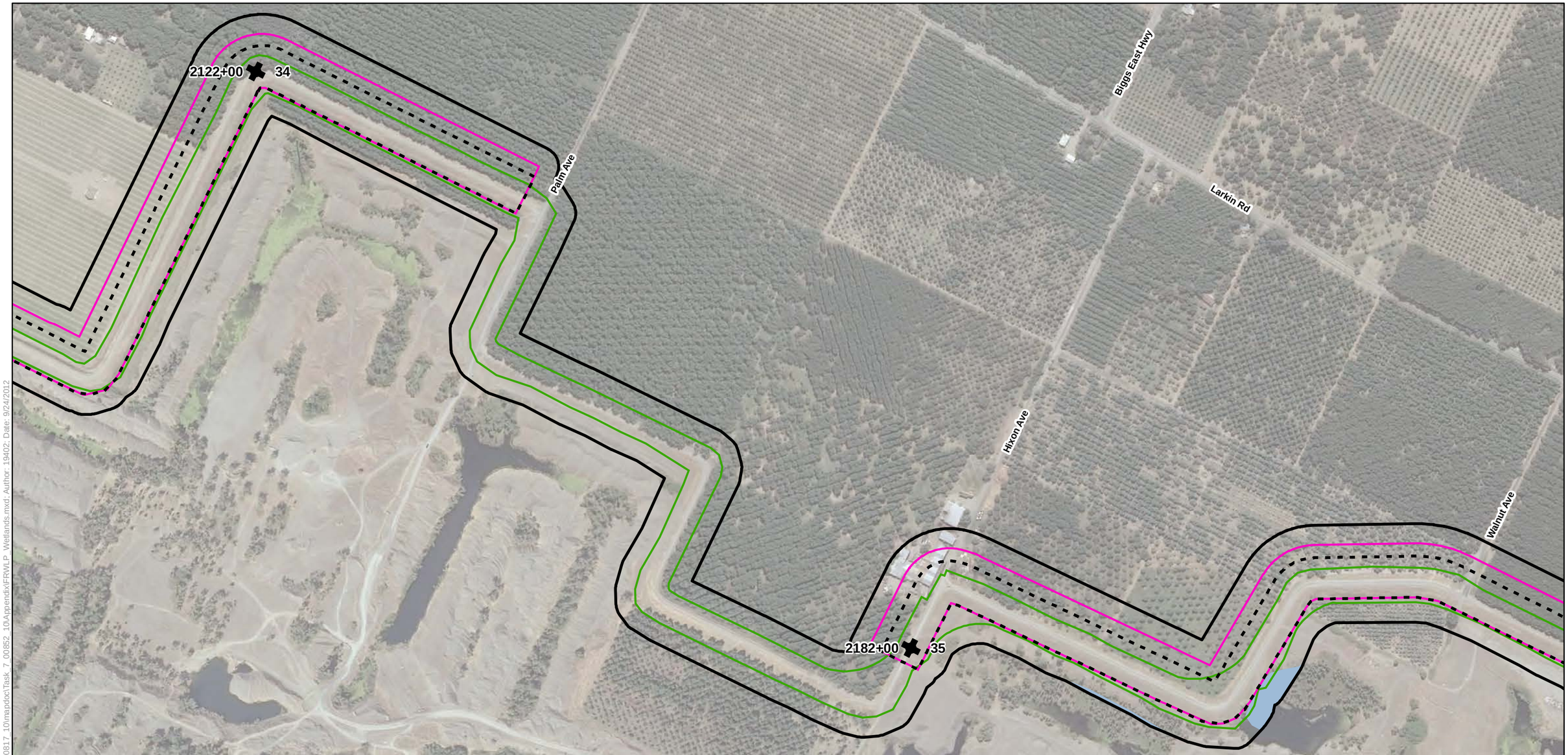

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National Wetlands Inventory Mapping in the Biological Study Area

Sheet 26

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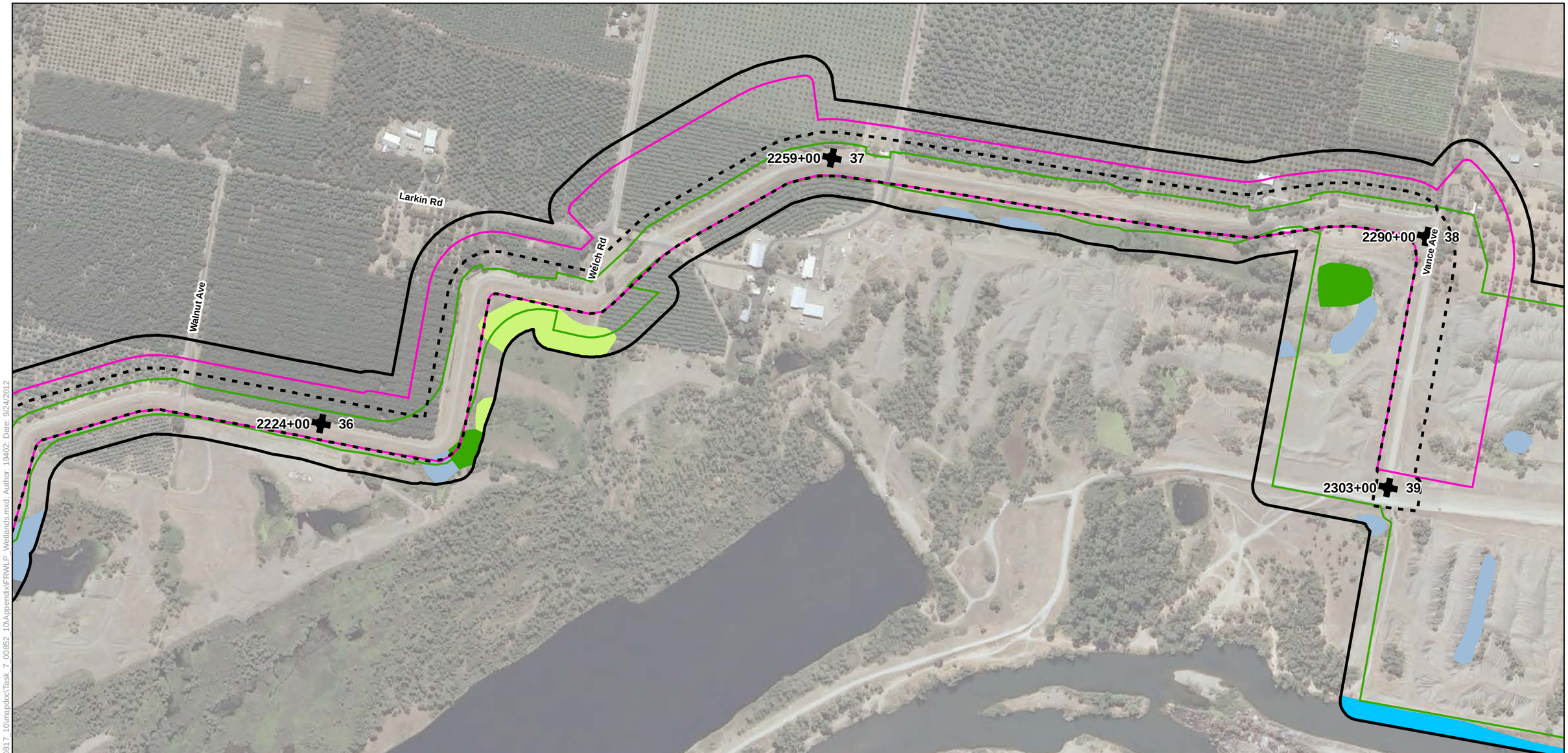

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National Wetlands Inventory Mapping in the Biological Study Area

Sheet 27

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Haselbush Ln

Vance Ave

Larkin Rd

39

2319+00 40

2359+00 41

Map Sheet Index

113 99 162 20 70 65

South Yuba City

Yuba City

Marysville

Linda

Olivehurst

Legend

Biological Study Area

Alternative 1

Alternative 2

Alternative 3

Reach

Station 202+50

Wetland Type

Freshwater Emergent Wetland

Freshwater Forested/Shrub Wetland

Freshwater Pond

Lake

Riverine

Source: Wetlands - U.S. Fish and Wildlife Service, Nationional Wetlands Inventory (2012).

National Wetlands Inventory Mapping in the Biological Study Area

Sheet 28

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Appendix G

SBFCA, FRWLP Approach for Addressing Existing Levee Encroachments

WOOD RODGERS

MEMORANDUM – DRAFT

TO: Mr. Chris Krivanec, P.E., G.E., HDR, Inc.

FROM: Jonathan Kors, P.E., PMP

DATE: January 13, 2012

SUBJECT: SBFCA, Feather River West Levee Project, Approach for Addressing Existing Levee Encroachments

INTRODUCTION

In 2010, the Sutter Butte Flood Control Agency (SBFCA) embarked on the Feather River West Levee (FRWL) Project. The project seeks to rehabilitate 44 miles of existing levee along the west bank of the Feather River through Sutter and Butte Counties. A geotechnical assessment of the levees has been completed and the potential mitigation measures to address the deficiencies in each reach have been analyzed by the design team. The alternatives are outlined in detail in the Project Pre-design Formulation Report (PFR) (Reference 1). The design of the project is currently approaching the 65 percent level. For construction, the project is broken up into four contract packages, as described in Reference 2 below. The construction packages, listed in priority order, are as follows: Project C, Project D, Project B, and Project A. The limits of each project are shown on Figure 1. Project C and Project D will be constructed in 2013 and 2014, while Project A and Project B will be constructed in 2014 and 2015.

The levee in each project possesses numerous encroachments which will need to be addressed by the work because they either: a) present a threat to the stability of the levee system, b) do not currently comply with levee encroachment criteria; or c) will be disrupted or otherwise impacted by the levee rehabilitation work. Some of the encroachments have been reviewed and permitted by the Central Valley Flood Protection Board (CVFPB), while others pre-date the establishment of the State Reclamation Board (now the CVFPB), and have been "grandfathered" into the system. The permit status of others remains to be determined. Typical encroachments include pressure pipelines (water supply pipelines from waterside pump stations and drainage pipelines from landside drainage pump stations), gravity drainage pipes, gas lines, telephone utilities, overhead utilities, structural encroachments, and other types and variations as discussed below.

The purpose of this Memorandum is to provide a complete listing of the encroachments (as complete as possible based upon available information), outline the approach to handling project encroachments in general, and outline the approach to handling specific encroachments located within Project areas C and D.

REFERENCES

1. HDR, Wood Rodgers, URS, and MHM, "Pre-design Formulation Report, Feather River West Levee – Segments 1 through 7, Sutter Butte Levee Rehabilitation Program, Sutter and Butte Counties, California," February 2011.

2. Peterson Brustad, Inc., "Preliminary Construction Ordering Analysis," July 11, 2011.

3. Wood Rodgers and HDR, 30-Percent Design Drawings, February 2011.

MASTER ENCROACHMENTS LIST

MHM Engineers, the HDR design team member assigned primary design responsibility for utilities disrupted by the project, has developed a Master Encroachments List for identifying all utilities and encroachments on the project. To build the list, MHM performed a field review of the levee, listing all encroachments that were identifiable in the field. The physical location of encroachments identified were captured using GPS equipment. In addition, CVFPB encroachment logs were reviewed by MHM and compared with the encroachments identified in the field. Other sources of information included the U.S. Army Corps of Engineer's (USACE) Periodic Inspection Report and as-built documentation of various projects located along the alignment. The Master Encroachments List represents the most comprehensive source of information on encroachments impacted by the project. The list continues to be maintained by MHM and is updated as additional information becomes available. The current version of the list is included as Appendix A.

ENCROACHMENT NOMENCLATURE AND CATEGORIZATION

Given the number of encroachments the project must address and the variable nature of how each will be addressed, it was determined that a means to describe and categorize the encroachments was necessary to efficiently coordinate the work with regulatory agencies, utility owners, and the public. For this purpose, Wood Rodgers developed the outline presented on Figure 2. The outline divides all levee encroachments into two categories, those that only encroach on the levee right-of-way, and those that encroach on the levee prism itself. From this distinction, the categories are divided into three subcategories: Structural Encroachments, Wet Utility Encroachments, and Dry Utility Encroachments. These subcategories divide the encroachments in a manner that describes how the project will address them in general. In general, for levee Right-of-Way encroachments, all three categories will not be addressed by the project, but by SBFCA or the local maintaining agency over time. For Levee Prism encroachments, Structure and Wet Utility encroachments will be addressed by the levee improvement contractor. Levee prism dry utility encroachments will be addressed in advance of the levee improvement contractor's work to clear the way for the levee improvements.

PROJECT-SPECIFIC ENCROACHMENTS HANDLING

Wood Rodgers has reviewed the Master Encroachment List and the construction drawings (Reference 3), and has developed project specific listings for encroachments. The intent of these lists is to inform the reader how each individual encroachment will be handled by the project. The lists incorporate the nomenclature outlined in Figure 2. It is noted that the lists present some encroachments that are treated in a manner different than the general rules described above. In many cases, these encroachments fall into the exceptions described in the notes section of Figure 2. In addition, there are encroachments that either fully comply with all levee safety and encroachment criteria already, or are located in areas of the levee where work is not being performed (no work reaches). These encroachments also generally require treatment in a manner other than general case.

To determine how each specific encroachment is being treated, the Project-specific lists for Project C and Project D are included as Figure 2 and Figure 4, respectively. These lists are color coded to show how each encroachment will be addressed (or not addressed) by the project. Those addressed by the levee rehabilitation contractor during construction are coded blue. Those addressed by a separate contractor (or utility company) prior to the levee rehabilitation contractor are coded red, and those that will be addressed by SBFCA or the local levee maintaining agency (Levee District 1, Levee District 9, or MA 3, 12, or 16) over time, are coded green.

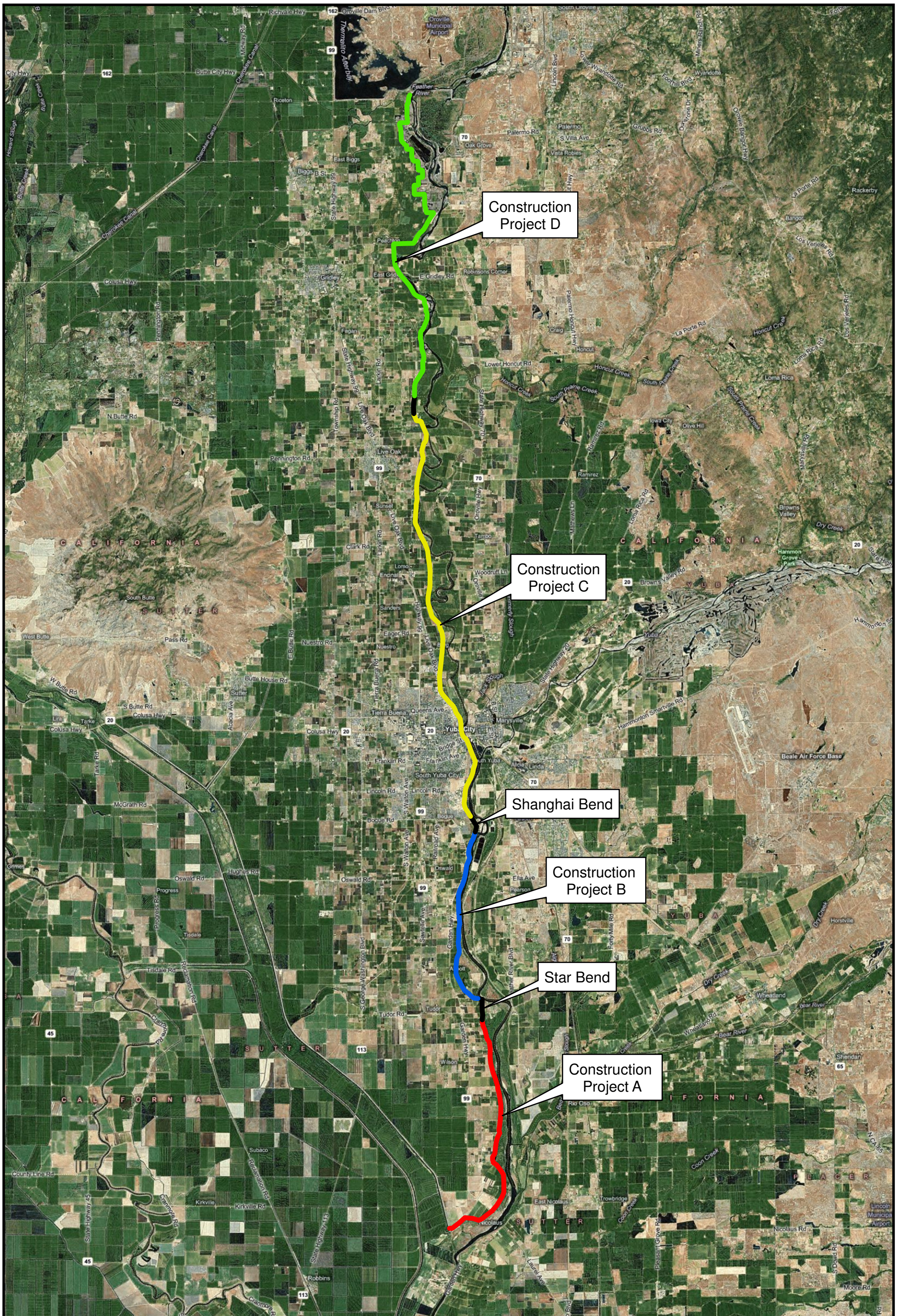
CONCLUSIONS AND RECOMMENDATIONS

It is proposed that these project-specific lists (and this Memorandum) be shared with the Department of Water Resources, CVFPB, and USACE, as well as affected members of the public, to communicate SBFCA's intentions for handling each encroachment encountered on the project. When this coordination has occurred, the design team should begin coordinating with the affected utility owners to advance the design of utility relocations on the project.

The final version of this Memorandum will address the handling of project encroachments for all Projects (A, B, C, and D).

Attachments

FIGURES



PETERSON . BRUSTAD . INC
ENGINEERING . CONSULTING
1180 Iron Point Rd., Suite 260
Folsom, CA 95630
Phone: (916) 608-2212
Fax: (916) 608-2232

N

0 1 2 3 Miles

1" = 3 mi.

JUNE 24, 2011

SUTTER COUNTY

CONSTRUCTION PROJECTS

FIGURE

1

FIGURE 2

SUTTER BUTTE FLOOD CONTROL AGENCY
FEATHER RIVER WEST LEVEE PROJECT
PROPOSED NOMENCLATURE AND PROJECT APPROACH TO LEVEE ENCROACHMENTS

Levee Encroachment

All Utilities and Structures Within the Levee Footprint or Project Right-of-Way (ROW) Limits

Levee Prism Encroachment[1]

Encroachment Located Within the Levee Prism

ROW Encroachment[1]

Encroachment Located Within Project ROW Limits[2] Only

Levee Prism Structure Encroachment[3]

Retaining Wall
Railroad Tracks
Home
Shed
Roadway/Bridge

Levee Prism Wet Utility Encroachment[3]

Pump Discharge Line
Gravity Drainage Pipeline
Sewer Outfall
Natural Gas Pipeline
Ag Turnout

Levee Prism Dry Utility Encroachment[3]

Telephone Cable
Overhead Power
Fiber Optic Cable

ROW Structure Encroachment

Home
Shed
Roadway
Railroad Tracks

ROW Wet Utility Encroachment

Ag or Drainage Canal[4]
Water Supply Pipeline
Sewer Pipeline
Natural Gas Pipeline
Ag well
Ag Turnout

ROW Dry Utility Encroachment

Telephone Cable
Overhead Utility[4]
Fiber Optic Cable

Notes:

1. All utilities running parallel to the levee, unless located within the levee prism, are considered ROW Encroachments. All utilities running perpendicular to the levee are considered Levee Prism Encroachments, with the exception of overhead utilities, which are **ONLY** a levee prism encroachment if a supporting pole is located within the levee prism.

2. ROW Encroachments are those encroachments that fall within the limits of the Project ROW, 20 feet from landside levee toe, and 15 feet from waterside levee toe.

3. In general, levee prism structure and wet utility encroachments will be relocated or otherwise modified as part of the levee improvement contract. Levee prism dry utility encroachments will be addressed where expeditious or necessary to do so in advance of the levee improvement contract.

4. ROW wet or dry utility encroachments will be relocated prior to the levee improvement contract if they are deemed an impediment to construction access.

FIGURE 3
SUTTER BUTTE FLOOD CONTROL AGENCY
FEATHER RIVER WEST LEVEE PROJECT
ENCROACHMENTS COORDINATION LIST - PROJECT C (STATION 845+00 TO 1623+86)

Color Coding Key-

Green: Addressed by SBFCA or Local Maintaining Agency over time	Blue: Addressed by the levee rehabilitation contractor
Black: Complies with criteria or is not impacted by levee rehabilitation work.	Red: Addressed in advance of levee rehabilitation

STATION	TYPE	DESCRIPTION	OWNER	UTILITY DISRUPTED BY LEVEE WORK?	REMOVAL, RELOCATION, OR RETROFIT REQUIRED?	PERMITTED?
856+08	LP_WUE	24" seepage interceptor pump discharge line	City of Yuba City	Y	N	Y
856+23	LP_WUE	24" storm drain pump discharge line	City of Yuba City	Y	N	Y
881+41	LP_WUE	6" and 14" relief well pump station	LD1 of Sutter County	Y	N	N
893+84	LP_WUE	12" storm drain pipe	City of Yuba City	Y	N	Y
893+84	LP_WUE	16" pump station discharge pipe (Burns Drive Pump Station)	City of Yuba City	Y	N	Y
894+22	LP_DUE	24 kV underground cable	PG&E	Y	N	Y
894+22	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	Y
899+45	LP_WUE	12" pipe crossing	TBD	Y	N	Y
912+94	LP_DUE	2 (16") gas lines	PG&E	Y	N	N
959+00 to 972+00	ROW_DUE	Overhead powerline, utility poles in close proximity to levee toe	TBD	N	Y	?
971+70	LP_DUE	Utility pole in levee slope	TBD	Y	Y	?
972+50 To 993+50	ROW_SE	Homes and outbuildings along 2nd Street	Various	N	Y	Y
989+40	LP_SE	Outbuilding at 2nd Street	TBD	N	Y	Y
990+55	LP_SE	Outbuilding at 2nd Street	TBD	N	Y	Y
990+75	LP_SE	Outbuilding at 2nd Street	TBD	N	Y	Y
992+45	LP_SE	Outbuilding at 2nd Street	TBD	N	Y	Y
992+75	LP_SE	Outbuilding at 2nd Street	TBD	N	Y	Y
995+75	LP_SE	County Courthouse storage building	Sutter County	N	Y	
998+50 to 1000+40	ROW_SE	Buildings at levee toe	TBD	N	Y	?
1003+72	LP_DUE	Utility pole in levee slope	PG&E	N	Y	N
1005+25	ROW_SE	Building at levee toe	TBD	N	Y	?
1006+07	LP_DUE	Utility pole in levee slope	PG&E	Y	Y	Y
1006+93	LP_DUE	Utility and anchor pole	PG&E	Y	Y	Y
1007+46	LP_DUE	Light pole for bike path on evee crown	City of Yuba City	N	N	N
1008+00 To 1025+00	ROW_DUE	Overhead power running parallel to LS levee toe	PG&E	N	Y	Y
1008+00 To 1014+00	LP_SE	Short retaining wall at LS levee slope, holds levee back from power poles	TBD	N	Y	?
1008+75	LS_DUE	Utility pole in waterside levee slope	PG&E	Y	Y	Y
1012+00	ROW_SE	Building at levee toe	TBD	N	Y	?
1014+00 to 1018+00	ROW_SE	Buildings at levee toe	TBD	N	Y	?
1019+00	LP_WUE	4" Pipe abandoned in place above existing cutoff wall	TBD	N	N	N
1019+82	LP_DUE	Light pole for bike path on levee crown	TBD	N	N	N
1020+30	LP_DUE	Emergency telephone call box at levee waterside toe	Pac Bell	N	N	N
1022+15	LP_DUE	Light pole for bike path on levee crown	TBD	N	N	N
1025+00	LP_DUE	Utility pole in levee slope and parallel OH crossing (impacts gap closure)	PG&E	Y	Y	?
1026+78	LP_DUE	10" communications conduit beneath levee and river	TBD	Y	N	Y
1028+09	LP_DUE	Utility pole at levee crown	TBD	N	N	N

Color Coding Key-

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STATION	TYPE	DESCRIPTION	OWNER	UTILITY DISRUPTED BY LEVEE WORK?	REMOVAL, RELOCATION, OR RETROFIT REQUIRED?	PERMITTED?
1036+87	LP-DUE	Telephone conduit	Pac Bell	N	N	Y
1037+90	LP-DUE	Telephone conduit	Pac Bell	N	N	Y
1038+50	LP-DUE	8" gas line abandoned in place	TBD	N	Y	N
1043+20	LP_WUE	Gilziser Slough drainage pump station - 4 pipes total	City of Yuba City	N	N	Y
1043+40	LP_WUE	Abandoned Gilziser Slough Sewer Pipe	City of Yuba City	N	N	Y
1054+75	LP_DUE	Emergency telephone call box at levee landside slope	Pac Bell	N	N	N
1055+00	LP_DUE	Light pole for bike path in levee slope	TBD	N	N	N
1073+41	LP_DUE	16-inch gas line	PG&E	N	N	N
1094+40	LP_DUE	3" steel pipe crossing - abandoned	TBD	Y	Y	?
1096+75	LP_WUE	Yuba City raw water intake facility (3 Pipes)	City of Yuba City	Y	N	Y
1097+00	ROW_DUE	Utility pole in close proximity to levee toe	PG&E	N	Y	Y
1107+82	LP_DUE	Utility and Anchor Pole	PG&E	Y	Y	N
1111+50	LP_WUE	Yuba City north area drainage pipe	City of Yuba City	Y	N	Y
1126+00 to 1131+30	ROW_DUE	Overhead powerline, utility poles in close proximity to levee toe	TBD	N	Y	?
1131+00	LP_SE	Union Pacific railroad tracks	UPRR	Y	Y	Y
1131+50	LP_DUE	Fuel line	UPRR	Y	Y	Y
1132+61	LP_DUE	Underground fiber optic cable marker	TBD	Y	Y	?
1135+40	LP_WUE	16" gas line	PG&E	Y	N	Y
1139+25	LP_DUE	Utility pole and anchor pole	PG&E	Y	Y	?
1152+40	ROW_DUE	Twin 110kV utility tower at levee toe	PG&E	N	Y	Y
1170+05	LP_DUE	Utility pole and anchor pole	PG&E	Y	Y	?
1174+00	ROW_WUE	Ag well in close proximity to levee toe	Private	N	Y	?
1174+35	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	N
1176+90	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	N
1179+05	ROW_DUE	Utility pole and guy wire at levee toe	PG&E	N	Y	?
1179+05 to 1201+25	ROW_DUE	Overhead power running parallel to LS levee toe	PG&E	N	Y	?
1180+75	LP_WUE	12" pipe crossing - abandoned	TBD	N	Y	?
1181+00	LP_WUE	3" irrigation pipe crossing - abandoned	TBD	N	Y	?
1182+15	LP_WUE	8" drainage pipe crossing - abandoned	TBD	N	Y	?
1182+75	LP_WUE	20" irrigation pipeline (may not be in place at this time)	Private	Y	N	Y
1200+60	ROW_WUE	Pump station at levee toe	Private	N	Y	N
1200+68	LP_WUE	10" irrigation pipeline - abandoned	Private	Y	N	N
1222+15	ROW_DUE	Utility pole and guy wire at levee toe	PG&E	N	Y	N
1223+80	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	N
1225+90	LP_DUE	Utility pole at levee crown	PG&E	Y	Y	N
1229+43	ROW_WUE	Pump station within 10' of toe	Private	N	Y	Y
1229+43	LP_WUE	16" pump station discharge pipe	Private	Y	Y	Y
1265+55	LP_WUE	18" pump station discharge pipe - abandoned	Private	N	Y	Y
1266+80	ROW_DUE	Utility pole and guy wire at levee toe	PG&E	N	Y	N
1284+91 to 1293+66	ROW_WUE	Concrete lined ditch	Private	N	Y	N
1289+50 to 1291+50	ROW_SE	Farm structures and out buildings in close proximity to levee toe	Private	N	Y	N
1293+66	ROW_DUE	Utility pole and guy wire at levee toe	PG&E	N	Y	

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STATION	TYPE	DESCRIPTION	OWNER	UTILITY DISRUPTED BY LEVEE WORK?	REMOVAL, RELOCATION, OR RETROFIT REQUIRED?	PERMITTED?
1298+60 to 1315+02	ROW_WUE	Seepage interceptor trench	LD9	N	N	N
1314+80	LP_WUE	20" pump station discharge pipeline	Private	Y	N	Y
1327+00	ROW_DUE	Utility pole and guy wire at levee toe	PG&E	N	Y	N
1347+06	LP_DUE	Telecommunication line	TBD	Y	Y	N
1375+75 To 1430+50	ROW_WUE	Sutter Extension Sunset Lateral Ditch	Sutter Extension	N	N	Y
1429+80	ROW_WUE	Overhead powerlines, utility poles at waterside levee toe	PG&E	Y	Y	N
1430+50	ROW_SE	Pump station and electrical equipment at landside toe	Sutter Extension	N	N	Y
1430+50	LP_WUE	36", and (2) 60" pump station discharge pipes (Sunset Pump Station)	Sutter Extension	Y	Y	Y
1430+50 To 1490+00	ROW_WUE	Sutter Extension Main Canal	Sutter Extension	N	N	N
1460+65	LP_WUE	6" PVC irrigation pipeline	Private	Y	Y	N
1463+00	ROW_SE	Reisdence in close proximity to levee toe	Private	N	Y	N
1470+00	LP_SE	Ramp to residence on landside at levee crown	Private	Y	Y	N
1470+00	ROW_SE	Residence on pile foundation at landside levee toe	Private	N	Y	N
1473+50	LP_SE	Fence at waterside levee toe	Private	Y	Y	N
1479+98	LP_SE	Private gate across levee	Private	Y	Y	N
1482+00 To 1486+00	ROW_SE	Private residences in close proximity to levee landside toe	Private	N	Y	N
1518+50 To 1520+50	ROW_SE	Large shop structure at landside levee toe	Private	N	Y	N
1520+25	ROW_DUE	Utility pole in levee slope	TBD	N	Y	N
1528+35	LP_WUE	6" steel pipe crossing	Private	Y	Y	Y
1532+86	LP_WUE	6" steel pipe crossing	Private	Y	Y	Y
1536+00	ROW_DUE	Utility pole and guy wire at levee toe	PG&E	N	Y	N
1536+15	LP_WUE	36" pipe crossing	RD 777	Y	Y	Y
1549+70	LP_WUE	12" pipe crossing	TBD	Y	Y	Y
1556+00 To 1558+00	ROW_SE	Residences at landside levee toe	Private	N	Y	N
1556+35	ROW_DUE	Utility pole in close proximity to levee toe	PG&E	N	Y	Y
1556+50	LP_WUE	8" pipe crossing through levee	Private	Y	Y	Y
1585+60	LP_WUE	12" pipe crossing through levee	Private	Y	Y	Y
1610+91	LP_WUE	18" CM pipe crossing	RD 777	Y	Y	Y
1611+50	ROW_SE	Residence at levee waterside toe and driveway at levee crown	Private	Y	Y	N
1610+50 To 1623+86	ROW_WUE	Sutter Butte Main Canal at landside toe	Sutter Extension	Y	N	Y

FIGURE 4
SUTTER BUTTE FLOOD CONTROL AGENCY
FEATHER RIVER WEST LEVEE PROJECT
ENCROACHMENTS COORDINATION LIST - PROJECT D (STATION 1623+86 TO 2368+00)

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STATION	TYPE	DESCRIPTION	OWNER	UTILITY DISRUPTED BY LEVEE WORK?	REMOVAL, RELOCATION, OR RETROFIT REQUIRED?	PERMITTED?
1635+50	ROW_SE	Farm structure in close proximity to levee toe	Private	N	Y	N
1637+60 to 1638+50	ROW_SE	Farm structure and fence in close proximity to levee toe	Private	N	Y	N
1638+99	LP_WUE	(2) 24" steel pipe crossing	RD 777	N	Y	Y
1651+80	LP_DUE	Utility pole in levee slope	PG&E	N	Y	N
1654+20	LP_DUE	Utility pole at levee toe	PG&E	N	Y	N
1663+80 to 1664+90	ROW_SE	House and outbuilding at landside toe	Private	N	Y	N
1665+30 to 1674+50	ROW_DUE	Utility poles and overhead powerlines at landside toe	PG&E	N	Y	N
1674+50 to 1766+00	ROW_WUE	Sutter Butte Main Canal at landside toe	Sutter Extension	N	N	Y
1675+27	LP_WUE	60"x72" RCP culvert	Butte County Drainage District No.1	N	Y	Y
1675+96	ROW_DUE	Utility pole in levee slope	TBD	N	Y	N
1675+96 to 1705+00	ROW_DUE	Utility poles and overhead powerlines at landside toe	TBD	N	Y	?
1697+95	ROW_DUE	Utility pole at levee toe	AT&T	N	Y	Y
1698+50	ROW_SE	Farm structure in close proximity to levee toe	Private	N	Y	N
1699+62	ROW_WUE	Propane tanks at levee toe	Private	N	Y	N
1706+82 to 1724+82	ROW_SE	Fence at waterside levee toe	Private	N	Y	Y
1722+60 to 1734+10	ROW_DUE	Overhead powerlines, utility poles in waterside slope	TBD	N	Y	N
1728+29	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	Y
1730+00	ROW_SE	Residence in close proximity to levee toe	Private	N	Y	N
1734+00	ROW_DUE	Utility pole at levee toe	TBD	N	Y	?
1738+10	ROW_SE	Residence at waterside levee toe and driveway at levee crown	Private	N	Y	N
1741+32	LP_WUE	16" drainage pipe crossing	Butte County Drainage District No.1	N	Y	N
1756+27	LP_WUE	12" CM pipe crossing - abandoned	TBD	N	Y	N
1765+15	LP_WUE	12" steel pipe crossing	TBD	N	Y	N
1765+33	LP_WUE	12" plastic sleeved concrete irrigation pipe	Private	N	Y	Y
1767+60	LP_WUE	(2) 60" drainage pipes	Butte Water District, Sutter Extension Water District	N	Y	Y
1777+00	LP_WUE	24" CM drainage pipe	TBD	N	Y	Y
1781+50	ROW_SE	Farm structure in close proximity to levee toe	TBD	N	Y	N
1782+50	ROW_DUE	Utility pole at levee toe	TBD	N	Y	?
1784+70	LP_WUE	24" CM drainage pipe crossing	TBD	N	Y	Y
1785+25	LP_WUE	24" CM drainage pipe crossing	TBD	N	Y	Y

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STATION	TYPE	DESCRIPTION	OWNER	UTILITY DISRUPTED BY LEVEE WORK?	REMOVAL, RELOCATION, OR RETROFIT REQUIRED?	PERMITTED?
1786+00 to 1787+40	ROW_SE	Residence and outbuilding in close proximity to levee toe	TBD	N	Y	?
1792+96	LP_WUE	24" CM drainage pipe crossing - abandoned	TBD	N	Y	Y
1799+43	LP_WUE	8" irrigation pipe crossing	Private	N	Y	Y
1809+65	LP_WUE	24" CM drainage pipe crossing	TBD	N	Y	Y
1813+70	LP_WUE	24" CM pipe crossing	TBD	Y	Y	Y
1816+63 to 1823+20	ROW_SE	Chain link fence at waterside and landside levee toe	City of Gridley	N	Y	Y
1816+63 to 1823+00	ROW_WUE	Sewer ponds in close proximity to waterside and landside levee toe	City of Gridley	N	Y	N
1818+72	LP_WUE	24" CM pipe crossing	City of Gridley	Y	Y	Y
1823+05	LP_WUE	12" cement coated and lined steel pipe through 24" CM pipe crossing	City of Gridley	Y	Y	Y
1834+41	LP_WUE	12" pipe through 24" CM pipe crossing	TBD	Y	Y	Y
1850+02	LP_WUE	18" cast iron sewer pipe crossing	City of Gridley	Y	Y	Y
1868+17	LP_WUE	18" drainage pipe crossing	Butte County Drainage District	Y	Y	N
1888+52	LP_WUE	8" steel pipe crossing	City of Gridley	Y	Y	Y
1889+97	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	Y
1892+00	ROW_DUE	Utility pole in close proxitmity to levee toe	PG&E	N	Y	?
1893+70	LP_WUE	3/4" galvanized iron water pipe crossing	TBD	Y	Y	Y
1895+10	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	?
1896+90 to 1900+20	ROW_SE	Residences in close proximity to landside levee toe	TBD	N	Y	?
1900+82 to 1906+60	ROW_DUE	Overhead powerlines, utility poles in landside slope	PG&E	Y	Y	N
1903+00 to 1957+00	ROW_WUE	Sutter Butte Main Canal at landside toe	Sutter Extension	N	N	Y
1903+96	LP_DUE	Guy wire over levee, guy pole at waterside of levee crown	PG&E	Y	Y	N
1906+50	LP_SE	Structure on levee crown	TBD	Y	Y	?
1906+58	LP_DUE	Utility pole at waterside of levee crown	PG&E	Y	Y	Y
1934+52	LP_WUE	36" CM pipe crossing	TBD	Y	Y	N
1947+33	LP_DUE	Utility pole at levee toe, 3" steel conduit crossing	TBD	Y	Y	N
1955+79	LP_SE	Residence on levee crown	Private	Y	Y	Y
1956+00 to 1958+50	LP_SE	Farm structures on levee slopes and at levee toes	TBD	Y	Y	N
1957+10	ROW_DUE	Utility pole on levee slope	TBD	Y	Y	N
1957+90	LP_WUE	24" CM irrigation pipe crossing - abandoned	TBD	Y	Y	Y
1961+11	LP_WUE	(2) 60" CM drainage pipe crossing	TBD	Y	Y	Y
2014+00	LP_WUE	7" steel pipe through 12" steel pipe crossing	Private	Y	Y	Y
2017+80	LP_WUE	22" reinforced concrete encased steel irrigation pipe crossing	TBD	Y	Y	Y
2020+81	ROW_SE	Large steel tank at levee toe	TBD	N	Y	N
2026+00	LP_WUE	12" reinforced concrete encased steel irrigation pipe crossing	TBD	Y	Y	Y
2032+50	LP_WUE	12" reinforced concrete encased steel irrigation pipe crossing	TBD	Y	Y	Y
2038+15	ROW_SE	Farm structure at levee toe	TBD	N	Y	?
2092+20	ROW_DUE	Utility pole in close proxitmity to levee toe	TBD	N	Y	?
2092+69	LP_DUE	Underground telephone cable crossing	TBD	Y	Y	N
2092+70	LP_WUE	5" irrigation pipe crossing - aluminum pipe	Private	Y	Y	Y
2038+00	ROW_DUE	Utility pole in levee slope	PG&E	N	Y	Y
2138+80	LP_WUE	2" galvanized steel irrigation pipe crossing	Private	N	Y	Y

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2142+00	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	Y
2178+20 to 2185+50	ROW_DUE	Overhead telephone line, utility pole at levee toe	PT&T	N	Y	Y
2178+37	LP_WUE	16" steel irrigation pipe crossing	TBD	N	Y	Y
2185+20	ROW_SE	Farm structures at levee toe	Private	N	Y	?
2201+92	LP_WUE	10" reinforced concrete encased steel pipe crossing - abandoned	TBD	Y	Y	Y
2208+56	ROW_WUE	Ag well in close proximity to levee toe	Private	N	Y	N
2208+56 to 2215+00	ROW_DUE	Overhead powerline, utility pole in close proximity to levee toe	PG&E	N	Y	?
2239+50 to 2241+00	ROW_SE	Residence and outbuilding in close proximity to levee toe	Private	N	Y	N
2239+56	LP-WUE	24" CM drainage pipe crossing	TBD	Y	Y	Y
2243+75	ROW_SE	Outbuilding in close proximity to levee toe	Private	N	Y	N
2244+80	LP_WUE	24" CM drainage pipe crossing	TBD	Y	Y	Y
2248+70	LP_DUE	Underground telephone cable crossing	TBD	Y	Y	N
2250+11	ROW_SE	Concrete structure in levee slope	TBD	N	Y	N
2250+76	` LP_WUE	24" CM irrigation pipe crossing	TBD	Y	Y	Y
2256+61	LP_WUE	24" reinforced concrete encased CM irrigation pipe crossing	TBD	Y	Y	Y
2257+15	LP_WUE	24" CM pipe crossing	TBD	Y	Y	Y
2260+90 to 2261+90	ROW_SE	Residence at levee toe	Private	N	Y	?
2260+95	LP_WUE	24" CM pipe crossing	TBD	Y	Y	Y
2261+11	ROW_DUE	Propane tank at levee toe	Private	N	Y	N
2261+56	ROW_DUE	Propane tank at levee toe	Private	N	Y	N
2261+60	ROW_SE	Retaining wall at levee toe	Private	N	Y	N
2262+65	LP_WUE	24" CM drainage pipe crossing	TBD	Y	Y	Y
2264+70 to 2268+45	ROW_DUE	Overhead powerline, utility poles at levee toe	PG&E	N	Y	N
2268+27	LP_WUE	24" reinforced concrete encased CM irrigation pipe crossing	TBD	Y	Y	Y
2274+56	LP_WUE	24" CM pipe crossing	TBD	Y	Y	N
2274+86	LP_WUE	24" reinforced concrete encased CM drainage pipe crossing	TBD	Y	Y	Y
2281+00 to 2282+50	ROW_SE	Residence and driveway in close proximity to levee toe	Private	N	Y	?
2282+25	ROW_SE	Farm structure at levee toe	Private	N	Y	?
2282+80	ROW_DUE	Utility pole at levee toe	PG&E	N	Y	N
2283+42	LP_WUE	24" reinforced concrete encased CM irrigation pipe crossing	TBD	Y	Y	Y
2283+62	LP_WUE	24" CM pipe crossing	TBD	Y	Y	Y
2352+96	LP_WUE	24" CM pipe crossing	TBD	Y	Y	Y
2353+04	LP_WUE	24" CM pipe crossing	TBD	Y	Y	Y
2359+05 to 2359+58	LP_SE	Sutter Butte Head Works structure	Biggs West Gridley Water District	Y	Y	Y
2367+90	LP_DUE	Utility pole in levee crown	TBD	Y	Y	?
2368+00 to 2369+70	LP_SE	Chain link fence on levee crown	TBD	Y	Y	?

APPENDIX

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
				2371+00					Hamilton Bend Levee Transition																		
		D	41	2368+00					End Reach 41																		
1		D	41	2365+00			Not Verified		To construct After bay River Outlet and dredge tailing training dike.	Cutoff Wall		Struc									3930 and 5041	yes, cond 5	1965	Department of Water Resources		no	no
2		D	41	2359+58	2,291,802.63	6,663,263.33	39°27'16.849"N	121°38'24.675"W	Old Sutter Butte Head Works Levee North	Cutoff Wall	Appears the structure will need to be removed and levee constructed through the area. MHM will include demo plan and levee civil will prepare plans for new levee.	IR(G)				138.88							part of orig O&M 1955	Biggs West Gridley Water District	1713 West Gridley Road, Gridley, CA	yes	yes
3		D	41	2359+57	2,291,800.70	6,663,265.27	39°27'16.830"N	121°38'24.650"W	Old Sutter Butte Head Works North	Cutoff Wall		IR(G)				135.34	130.32	131.97	137.27	132.14			part of orig O&M 1955	Biggs West Gridley Water District	1713 West Gridley Road, Gridley, CA	yes	yes
4		D	41	2359+07	2,291,752.42	6,663,249.77	39°27'16.353"N	121°38'24.550"W	Old Sutter Butte Head Works South	Cutoff Wall		IR(G)				135.30							part of orig O&M 1955	Biggs West Gridley Water District	1713 West Gridley Road, Gridley, CA	yes	yes
5		D	41	2359+05	2,291,752.84	6,663,244.36	39°27'16.358"N	121°38'24.919"W	Old Sutter Butte Head Works Levee South	Cutoff Wall		IR(G)				138.69							part of orig O&M 1955	Biggs West Gridley Water District	1713 West Gridley Road, Gridley, CA	yes	yes
		D	40/41	2359+00					Reach 40/41 Transition																		
6		D	40	2352+90	2,291,166.67	6,663,263.09	39°27'10.563"N	121°38'24.710"W	12 kv overhead electrical power line crossing	Cutoff Wall		EL	OH			139.23								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
7		D	40	2352+80	Not Verified		Not Verified		24 Inch CM pipe through levee. Concrete saddle and apron with Calco Slide gate.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)		122.7 (USED)			130.08	131.75	137.03	131.86	pre-1955		part of orig O&M 1955			no	no
8		D	40	2345+79	2,290,475.75	6,663,109.16			10 inch Iron Pipe through levee that appears to be abandoned	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	IR(P)	12.7	126.37	127.20	139.90	129.30	130.94	136.34	131.14						yes	yes
		D	39/40	2319+00					Reach 39/40 Transition																		
9		D	39	2312+05	Not Verified		Not Verified		24 Inch CM pipe through levee. Concrete saddle and apron with Calco automatic drainage gate.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)		124.0 (USED)			124.25	125.63	132.37	127.85	pre-1955		part of orig O&M 1955			no	no
		D	38/39	2303+00					Reach 38/39 Transition																		
10	0.0-0.3	D	38	2301+00	Not Verified		Not Verified		To excavate dredger tailings from the right bank of the Feather River. The tailings are to be excavated from an area approximately 100 feet landward of the landward levee toe. **The application was deemed incomplete on 8-4-98**	Cutoff Wall		Struc									16006	no issued	1992	Mathews Ready-mix, Inc	P.O. Box 386, Gridley, CA 95948		
		D	37/38	2290+00					Reach 37/38 Transition																		
		D	37	2285+00					Maintenance Area 07 / Hamilton Bend Levee Transition																		
1	11.68	D	37	2283+65	2,285,659.90	6,661,586.51			24 Inch CM pipe through levee. Concrete saddle and apron with Calco automatic drainage gate.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)	15.0	115.70	117.70	132.70	121.35	122.59	128.94	126.23	pre-1955		part of orig O&M 1955			no	no
2	11.68	D	37	2283+44	2,285,640.25	6,661,593.28	39°26'15.978"N	121°38'46.270"W	24 Inch reinforced concrete encased CM irrigation pipe through levee. Slide Gate in 36 inch CM pipe riser on the waterside slope. 8 inch Irrigation pipe ran through existing pipe, pipe ends not exposed	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	IR(P)	17.3	113.40	115.40	132.70	121.34	122.58	128.93	126.22	pre-1955		part of orig O&M 1955			yes	yes
3	11.66	D	37	2282+57	2,285,558.49	6,661,622.35	39°26'15.196"N	121°38'45.906"W	12 kv overhead electrical power line crossing	Cutoff Wall		EL	OH			132.97								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
4	11.52	D	37	2274+95	2,284,812.04	6,661,741.46	39°26'07.730"N	121°38'44.408"W	24 Inch CM pipe through levee. Automatic drainage gate on waterside outlet, headwall on land side inlet. Both ends of the pipe have been cleared to operate.	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	17.8	112.30	114.30	132.11	120.83	122.04	128.24	125.98	pre-1955		part of orig O&M 1955			yes	yes
5	11.52	D	37	2274+86	2,284,802.77	6,661,742.00			24 Inch CM reinforced concrete encased drainage pipe through levee. Slide Gate in 36 inch CM pipe riser on the waterside slope. Neither pipe end located or exposed.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)	21.8	108.30	110.30	132.10	120.83	122.04	128.24	125.97	pre-1956		part of orig O&M 1956			no	no
6	11.39	D	37	2268+27	2,284,144.45	6,661,772.03	39°26'01.214"N	121°38'44.047"W	24 Inch reinforced concrete encased CM irrigation pipe through levee. Slide Gate in 36 inch CM pipe riser on the waterside slope with waterside outlet broken off and plugged.	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. Pumping could be option. Should be part of 30 percent but not included.	IR(G)	18.4	111.30	113.30	131.70	120.44	121.62	127.71	125.78	pre-1955		part of orig O&M 1955			yes	yes
7	11.33	D	37	2265+50	2,283,868.22	6,661,784.45	39°25'58.464"N	121°38'43.916"W	12 kv overhead electrical power line crossing	Cutoff Wall		EL	OH			131.39								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
8	11.28	D	37	2262+69	2,283,587.31	6,661,797.10	39°25'55.665"N	121°38'43.763"W	24 Inch CM drain pipe through levee with landside headwall. Automatic Drainage Gate on the waterside end with splash pan and saddle headwall.	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	18.0	110.85	112.85	130.80	120.21	121.39	127.42	125.62	pre-1955		part of orig O&M 1955			yes	yes
9	11.27	D	37	2262+14	2,283,532.17	6,661,800.26	39°25'55.162"N	121°38'43.739"W	Road Across Levee North	Cutoff Wall		Road				131.10								County of Butte	7 County Center Drive, Oroville, CA 95965	yes	yes
10	11.27	D	37	2261+90	2,283,505.66	6,661,801.21	39°25'54.900"N	121°38'43.729"W	Road Across Levee South	Cutoff Wall		Road				131.20								County of Butte	7 County Center Drive, Oroville, CA 95965	yes	yes
11	11.26	D	37	2261+56	2,283,474.37	6,661,801.73	39°25'54.590"N	121°38'43.723"W	Propane tank at landside toe	Cutoff Wall						130.73										yes	yes
12	11.25	D	37	2261+11	2,283,429.45	6,661,804.82	39°25'54.146"N	121°38'43.686"W	Propane tank at landside toe	Cutoff Wall						130.31										yes	yes
13	11.24	D	37	2260+55	2,283,374.22	6,661,809.27			24 Inch CM pipe through levee. Concrete saddle and apron with Calco automatic drainage gate.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)	18.1	110.20	112.20	130.30	120.17	121.35	127.37	125.57	pre-1955		part of orig O&M 1955			no	no
	11.22	D	36/37	2259+00					Reach 36/37 Transition																		
14	11.18	D	36	2256+94	2,283,026.77	6,661,894.43			24 Inch CM pipe through levee. Concrete saddle and apron with Calco automatic drainage gate.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)	17.1	111.00	113.00	130.10	120.10	121.29	127.29	125.47	pre-1955		part of orig O&M 1955			no	no
15	11.17	D	36	2256+71	2,283,007.16	6,661,905.92	39°25'49.881"N	121°38'42.345"W	24 Inch reinforced concrete encased CM irrigation pipe through levee. Slide Gate in 36 inch CM pipe riser on the waterside slope. Neither pipe end located or exposed.	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. Pumping could be option but not enough information available of the pump system. Should be part of 30 percent but not included.	IR(G)	19.1	109.00	111.00	130.10	120.09	121.29	127.29	125.46	pre-1955		part of orig O&M 1955			yes	yes
16	11.17	D	37	2270+00			Not Verified		To construct a 50 x 100 foot walnut processing building in the right overflow area of the Feather River.	Cutoff Wall		Struc									12787	yes, cond. 13	1979	Rio Bonito Ranch	Route 1, Box 111, Biggs, CA 95917	no	no
17	11.05	D	36	2250+76	2,282,559.01	6,662,297.09	39°25'45.524"N	121°38'37.456"W	24 Inch CM irrigation pipe through levee. Slide gate in 36 inch CM pipe riser on the waterside slope and slide gate in 48 inch RCP standpipe on landside toe.	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. Pumping could be option but not enough information available of the pump system. Should be part of 30 percent but not included.	IR(G)	16.4	111.50	113.50	129.90	119.97	121.18	127.15	125.29	pre-1955		part of orig O&M 1955			yes	yes
18	11.04	D	36	~~2250+10~~	~~2,282,509.99~~	~~6,662,339.63~~	~~39°25'45.038"N~~	~~121°38'36.916"W~~	~~Concrete structure in waterside slope of levee Removed~~	Cutoff Wall		?				130.18										yes	yes

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
19	11.02	D	36	2248+30	2,282,389.90	6,662,473.42	39°25'44.066"N	121°38'35.638"W	Underground telephone cable through levee at south side of paved road over levee	Cutoff Wall	Not sure if the conduit meets title 23 or 200 WSEL requirements.	TL				130.10	119.92	121.14	127.10	125.23						yes	yes
20	10.96	D	36	2245+52	2,282,232.77	6,662,702.59			24 Inch CM drain pipe through levee. Automatic Drainage Gate on the waterside end buried and not located.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)	15.1	112.99	114.99	130.10	119.87	121.09	127.04	125.15	pre-1955		part of orig O&M 1955			no	no
21	10.84	D	36	2239+66	2,281,676.83	6,662,766.65	39°25'36.688"N	121°38'31.483"W	24 Inch CM drain pipe through levee. Concrete headwall at both toes and automatic Drainage Gate in 36 inch concrete standpipe on berm. House near land toe, land end not located it could possibly be in house back yard.	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	15.8	111.90	113.90	129.70	119.75	120.99	126.91	124.98	pre-1955		part of orig O&M 1955			yes	yes
	10.29	D	35/36	2224+00					Reach 35/36 Transition																		
22	10.15	D	35	2216+71	2,280,223.64	6,663,692.84	39°25'22.387"N	121°38'19.785"W	12 Kv power line crossing of levee. One pole 215 feet water ward of levee toe with overhead clearance of 27 feet.	Cutoff Wall		EL	OH			127.30					6221	yes, cond 5	1968	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
23	10.24	D	35	2208+56	2,279,495.37	6,664,025.97	39°25'15.175"N	121°38'15.577"W	Pump on the landside setup to pump only to land side of levee, no standpipe, no permanent pipe over levee	Cutoff Wall		IR(G)				125.50	118.36	119.67	125.53	122.99						yes	yes
24	10.12	D	35	2201+87	2,279,440.81	6,664,690.55	39°25'14.617"N	121°38'07.169"W	Abandoned 10 inch reinforced concrete encased steel irrigation pipe through levee. Slide gate in 24 inch concrete standpipe at the waterside toe. Pipe ends not located or exposed.	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	IR(G)	13.1	111.97	112.80	125.90	117.36	118.68	124.42	122.10	pre-1955		part of orig O&M 1955			yes	yes
25	9.82	D	35	2182+45	2,277,864.11	6,665,182.53	39°24'59.006"N	121°38'00.922"W	Power pole at land side toe	Cutoff Wall		EL	OH			124.34										yes	yes
		D	34/35	2182+00					Reach 34/35 Transition																		
26	9.67 - 9.81	D	34	2178+48	2,277,831.66	6,665,565.26	39°24'58.671"N	121°37'56.047"W	To replace an existing buried telephone cable with aerial cable crossing of the right bank of the Feather River at the end of Cherry Road. The aerial telephone will be placed on an existing PG&E poles. Due to two right angle bends in the levee, the overhead cable will cross the levee crown at two locations within the extension	2138+00 to 2182+00, No Rehabilitation Required		EL	OH			125.00					9076 and 12663	yes, cond 13	1979 and 1979	Pacific Telephone and Telegraph Company	1426 Howe Avenue, Suite 50, Sacramento, CA 95825	no	no
27	9.66	D	34	2178+39	2,277,825.68	6,665,571.75	39°24'58.571"N	121°37'56.003"W	16 inch steel irrigation pipe through levee. Slide gate in 36 inch concrete standpipe at the waterside toe. Concrete distribution box at the landside toe.	2138+00 to 2182+00, No Rehabilitation Required	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. Pumping could be option but not enough information available on pump.	IR(G)	13.2	110.07	111.40	124.60	114.66	115.80	120.42	119.64	pre-1955		part of orig O&M 1955			yes	yes
28	8.75	D	34	2138+22	2,275,157.46	6,664,140.19	39°24'32.295"N	121°38'14.342"W	Power line crossing of levee and guy wire	2122+00 to 2138+00, Cutoff Wall		EL	OH			123.64					5865	yes, cond 5	1969	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
29	8.73	D	34	2127+33	Not Verified		Not Verified		To authorize an existing 2 inch irrigation pipeline through the right bank of the Feather Rivers. Removable pipe over levee found at 2120+50	2122+00 to 2138+00, Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	IR(P)	2.0	122.1 (USED)			109.61	110.62	114.58	113.41	14200	yes, cond 13	1985	Clinton W. Moffitt	2770 Larkin Road, Biggs, CA 95917	no	no
	8.41	D	33/34	2122+00					Reach 33/34 Transition																		
30	8.10	D	33				Not Verified		To plant a Kiwi vineyard parallel to the direction of river flow with a minimum row spacing of 4.9 meters and 2.4 meters spacing within each row.	Cutoff Wall		Trees									13504	yes, cond 13	1982	Benjamin L. Couberly	7240 Suretre Lane, Loomis, CA 95650	no	no
31	7.85	D	33	2092+90	2,272,415.47	6,665,972.41	39°24'04.914"N	121°37'51.140"W	Underground telephone cable through levee on north side of paved road over the top of the levee.	Cutoff Wall		TL				120.52	109.60	110.60	114.56	113.40						yes	yes
32	7.85	D	34	2092+37					Power line crossing of levee on south side of road	2122+00 to 2138+00, Cutoff Wall		EL	OH			123.64								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
33	7.81	~~D~~	~~33~~	~~2092+70~~	~~Not Verified~~		~~Not Verified~~		~~5" aluminum irrigation pipe through levee. **Pipeline has been removed**~~	~~Cutoff Wall~~	~~Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.~~	~~IR(P)~~									5520	permit denied	1966	John Kucek	1118 Almond Avenue, Biggs, CA 95917	n/a	n/a
34	7.69	D	33	2084+03	2,271,531.48	6,666,011.72			5" x 0.25" wall steel irrigation line through levee	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	IR(P)	2.2	116.28	116.70	118.90	108.96	109.98	113.96	112.72	17895 and 17895-A	yes, cond 20	2005	John Kucek	1118 Almond Avenue, Biggs, CA 95917	no	no
35	6.75	D	33	2037+15	2,268,425.64	6,666,455.64	39°23'25.666"N	121°37'45.190"W	115 kv pole crossing of levee.	Cutoff Wall		EL	OH			114.41					12901		1980	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
36	6.88	D	33	2032+90	Not Verified		Not Verified		12 inch reinforced concrete encased steel irrigation pipe through levee. Slide gate in 24 inch concrete standpipe at waterside toe.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	IR(G)	14.0				105.35	106.23	109.77	109.67	pre-1955		part of orig O&M 1955			no	no
37	6.74	D	33	2026+40	Not Verified		Not Verified		12 inch reinforced concrete encased steel irrigation pipe through levee. Slide gate in 24 inch concrete standpipe at waterside toe.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	IR(G)	13.5				104.72	105.59	109.10	109.36	pre-1955		part of orig O&M 1955			no	no
38	6.63	D	33	2020+81	2,267,049.65	6,665,590.75	39°23'12.100"N	121°37'56.278"W	Large steel tank on land side at toe of levee	Cutoff Wall						114.01										yes	yes
39	6.59	D	33	2018+00			Not Verified		To retain a spur levee between the right bank project levee and the bank of the low water channel, a distance of approximately 600 feet. The spur levee is normal to the project levee and to the direction of the overbank flow. The levee varies from 3 to 6 feet above ground surface.	Cutoff Wall		Struc									9626	no	1974	Jack Mariani Farms, Inc.	25000 El Camino Real, Santa Clara, CA 95051	no	no
40	6.58	D	33	2017+78	2,266,812.83	6,665,317.53	39°23'09.770"N	121°37'59.770"W	22 inch reinforced concrete encased steel irrigation pipe through levee. Slide gate in 36 inch concrete standpipe at waterside toe.	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. Pumping could be option but not enough information available of the pump system. Should be part of 30 percent but not included.	IR(G)	13.9	97.87	99.70	113.60	104.08	104.92	108.35	109.09	pre-1955		part of orig O&M 1955			yes	yes
41	6.34	D	33	2005+20	Not Verified		Not Verified		7 inch steel pipe sleeved through the existing 12 inch steel pipe through levee. The annular space between the two pipes is plugged with concrete on both ends. Slide gate in concrete risers on both ends.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	IR(G)	AG	101.1 (USED)			103.36	104.17	107.50	108.61	Pre-1955 and 4591	yes, cond 5	Pre-1955 for original pipe and 1965 for sleeve	Jack Mariani Farms, Inc.	Route 1, Box 54, Larkin Road, Biggs, CA 95917	no	no
42	6.14	D	33	2007+00			Not Verified		To construct 1255 feet of spur levee from west project levee to the Feather River west bank.	Cutoff Wall		Struc									4963	yes, cond 5	1974	Boeger River Ranch	Route 1, Box 265, Gridley, CA	no	no
43	5.10-6.15	D	33	1995+00			Not Verified		To authorize an existing walnut orchard on the right bank overflow area of the Feather River/	Cutoff Wall											15613	no	1991	William H. Cilker	16075 Matilija Drive, Los Gatos, CA 95030		
	5.93	D	32/33	1989+00					Reach 32/33 Transition																		
44	5..60-6.15	D	32	1970+00			Not Verified		To interplant trees in an existing pear orchard on the right bank overflow area of the Feather River	Cutoff Wall		Struc									6004 and 6053	yes, cond 5	1968	W.H. Cilker	16075 Matilija Drive, Los Gatos, CA 95030	no	no
45	5.50	D	32	1961+03	2,264,727.12	6,660,794.20	39°22'49.332"N	121°38'57.487"W	Two 60 inch CM drainpipes through levee. Automatic drainage gates on waterside end and concrete headwalls on both ends.	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	20.0	85.70	90.70	110.70	101.68	102.54	105.86	106.12	pre-1955		part of orig O&M 1955			yes	yes
	5.38	D	31/32	1958+00					Reach 31/32 Transition																		
46	5.44	D	31	1957+75	2,264,471.77	6,660,429.36	39°22'46.822"N	121°39'02.146"W	To construct a earthen Berm, equipment storage shed, labor apartment and multiple-purpose building on the landward berm of the levee. The 32 foot by 34 foot building will be located adjacent to an existing shop building. The proposed building will be located on an existing earth fill located on landward slope of the levee and will be 10 feet from the toe of the levee.	Cutoff Wall		Struc				110.67					5392 and 5709, 5709A	yes, cond 5	1966 and 1967	William H. Cilker	16075 Matilija Drive, Los Gatos, CA 95030	yes	yes

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
47	5.40	D	31	1956+20	2,264,512.56	6,660,422.66			24 inch CM irrigation pipe through levee. Slide gate in concrete riser pipe on landside berm. Pipe runs under mobile home.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	IR(G)	11.0	97.00	99.00	110.00	101.64	102.50	105.81	105.96	pre-1955		part of orig O&M 1955			no	no
48	5.40	D	31	1956+10					Modular Home Located on the Levee Top	Cutoff Wall																	
49	5.10	D	31	1947+33	2,263,626.47	6,660,477.81	39°22'38.465"N	121°39'01.570"W	Service pole 10' from water side toe with 3" steel conduit through top of levee	Cutoff Wall		EL				110.18										yes	yes
50	4.98	D	31	1934+54	2,262,349.20	6,660,521.29	39°22'25.839"N	121°39'01.079"W	24 inch steel pipe through levee. Slide gate in concrete box on the water side slope. (Corps list pipe as 36 inch CMP)	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	17.5	89.90	91.90	109.40	101.42	102.28	105.57	105.14						yes	yes
51	4.44	D	31	1906+58			Not Verified		To authorize construction of stream gauging station on the right bank levee of the Feather River	Cutoff Wall		Struc				109.76					5730	yes, cond 5	1967	Department of Water Resources	P.O. 9137, Sacramento, CA 95816	no	no
52	4.44	D	31	1906+58	2,259,711.16	6,661,315.13	39°21'59.734"N	121°38'51.100"W	12 kv Pole line over levee. One pole 10 foot landward and one pole on levee for DWR and service electrical to water side building	Cutoff Wall		EL	OH			109.76					5857	yes, cond 5	1967	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
53	4.32	D	31	1903+96	2,259,482.14	6,661,442.38	39°21'57.465"N	121°38'49.491"W	To extend 3 phase No. 4 ACSR 12 kv pole line across right bank levee of the Feather River. Line to provide power to new pump for Roy Mathews	Cutoff Wall		EL	OH			107.72					5351	yes, cond 5	1966	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
54	4.30	D	31	1902+19	2,259,338.81	6,661,543.33	39°21'56.045"N	121°38'48.213"W	Oroville-Gridley Highway Bridge Upstream	Cutoff Wall		Bridge				111.65					4123		1964	County of Butte	7 County Center Drive, Oroville, CA 95965	yes	yes
55	4.3-5.3	D	31				Not Verified		Open channel on land side of levee at toe	Cutoff Wall		IR(G)														yes	yes
	4.30	D	30/31	1902+00					Reach 30/31 Transition																		
56	4.30	D	30	1901+79	2,259,317.57	6,661,574.18	39°21'55.834"N	121°38'47.821"W	Oroville-Gridley Highway Bridge Downstream	Cutoff Wall		Bridge				110.16					4123	yes, cond 5	1964	County of Butte	7 County Center Drive, Oroville, CA 95965	yes	yes
57	4.25	D	30	1900+82	2,259,239.50	6,661,630.24	39°21'55.060"N	121°38'47.111"W	Power pole at land side toe	Cutoff Wall		EL	OH			106.55								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
58	4.17	D	30	1893+60	Not Verified		Not Verified		3/4 inch galvanized iron waterline through levee	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find to verify.	WL	3.1 rd	103.0 (USED)			98.34	99.40	103.31	102.01	pre-1955		part of orig O&M 1955			no	no
59	4.16	D	30	~~1893+20~~	~~Not Verified~~		~~Not Verified~~		~~6 inch concrete encased cast iron sewer pipe through levee~~	Cutoff Wall	plans indicate they have been removed	WW	13.9 rd	92.5 (USED)							pre-1955		part of orig O&M 1955				
60	4.15	D	30	~~1892+60~~	~~Not Verified~~		~~Not Verified~~		~~6 inch concrete encased cast iron sewer pipe through levee~~	Cutoff Wall	plans indicate they have been removed	WW	13.8 rd	92.5 (USED)							pre-1955		part of orig O&M 1955				
61	4.14	D	30	~~1892+20~~	~~Not Verified~~		~~Not Verified~~		~~Two 4 inch concrete encased cast iron sewer lines through the levee. The Discharge end connected to the CM pump house at the landside toe of the how levee.~~	Cutoff Wall	plans indicate they have been removed	WW(P)	1.5 rd	93.0 (USED)							pre-1955		part of orig O&M 1955				
62	4.11	D	30	1892+89	2,258,542.19	6,662,052.68	39°21'49.413"N	121°38'42.751"W	Pole line over the levee.	Cutoff Wall		EL	OH			106.57								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
63	4.10	D	30	1891+25	2,258,506.36	6,662,137.72	39°21'48.132"N	121°38'42.351"W	Pole line over the levee.	Cutoff Wall		EL	OH			106.06										yes	yes
64	4.10	D	30	1888+70	2,258,285.10	6,662,367.26	39°21'46.416"N	121°38'39.013"W	Pole Line over the levee. 1 pole 10 feet from toe.	Cutoff Wall		EL	OH			106.32					5351		1966	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
65	3.38-4.25	D	30	1888+50	2,258,298.89	6,662,410.71	39°21'45.734"N	121°38'37.237"W	To expand an existing waste water treatment facility on the left bank of the Feather River and to install a 6 inch force main along the right bank levee of the Feather River/	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find to verify.	WW(P)	2.5 rd	103.0 (USED)		106.44	98.12	99.11	103.00	101.70	12103A	yes, cond 13	1979	City of Gridley	685 Kentucky Street, Gridley, CA 95948	yes	yes
66	3.95	D	30	1887+29	2,258,210.65	6,662,463.86	39°21'44.858"N	121°38'36.548"W	12 kv power line crossing of levee	Cutoff Wall		EL	OH			106.57										yes	yes
67	3.80	D	30	1868+17	Not Verified		Not Verified		Butte County Drainage District No. 1. An 18-Inch pipe through Levee.	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Should be part of 30 percent but not included.	SD(G)					96.11	97.09	101.11	100.10				Butte County Drainage District	7 County Center Drive, Oroville, CA 95965	yes	yes
68	3.35	D	30	1849+80	2,255,332.08	6,664,793.22	39°21'16.403"N	121°38'07.290"W	18 inch cast iron sewer pipe through levee. Concrete thrust block for cutoff walls on both shoulders. Siphon breaker in concrete pipe riser on the waterside shoulder.	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Should be part of 30 percent but not included.	WW(P)	2.8 rd			103.50	94.96	95.93	100.03	99.20	5722	yes, cond 5	1967	City of Gridley	685 Kentucky Street, Gridley, CA 95948	yes	yes
69	3.04	D	30	1834+42	2,254,466.85	6,665,951.72	39°21'07.717"N	121°37'52.331"W	24 inch CM drainage pipe through levee. Automatic drainage gate on waterside toe. 12 inch pipe sleeved through 24 inch pipe.	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	IR (G)	12.5	88.00	90.00	102.50	93.69	94.66	98.93	97.61	pre-1955		part of orig O&M 1955			yes	yes
70	2.82	D	30	1823+01	2,253,380.39	6,666,199.22	39°20'56.968"N	121°37'49.236"W	24 Inch CM pipe through levee. 36 inch RCP riser on the waterside slope. Same pipe as below	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	21.8	77.60	79.60	101.40	93.46	94.43	98.68	96.94	pre-1955		part of orig O&M 1955			yes	yes
71	2.82	D	30	1823+01	2,253,380.39	6,666,199.22	39°20'56.968"N	121°37'49.236"W	12 Inch cement coated and lined steel sewer pipe sleeved through the existing 24 inch CM pipe. Annular space pressure grouted.	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. Pumping up and over levee does not appear to be feasible.	WW(G)	21.8	77.60	79.60	101.40	93.46	94.43	98.68	96.94	5722	yes, cond 5	1967	City of Gridley	685 Kentucky Street, Gridley, CA 95948	yes	yes
72	2.74	D	30	1818+72	2,252,948.28	6,666,209.81	39°20'52.697"N	121°37'49.258"W	24 Inch CM pipe through levee. Slide gate in 36 inch CM riser on the waterside slope.	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	WW(G)	25.2	74.10	76.10	101.30	93.36	94.33	98.59	96.69	pre-1955		part of orig O&M 1955	City of Gridley	685 Kentucky Street, Gridley, CA 95948	yes	yes
73	2.7-2.82	D	30				Not Verified		Sewer Ponds located within 30' of both toes of the levee	Cutoff Wall																yes	yes
74	2.70	D	30	1816+63	2,252,738.86	6,666,205.04	39°20'50.627"N	121°37'49.195"W	City of Gridley. To install approximately 660 feet of chain link fence on the waterside toe and to authorize approximately 600 feet of 6 foot high chain link fence on the landside toe of the right bank levee of the Feather River	Cutoff Wall		Fence				101.58					16912	yes, cond 17	1999	City of Gridley	685 Kentucky Street, Gridley, CA 95948	yes	yes
75	2.63-2.75	D	30	1815+00			Not Verified		City of Gridley. To operate a sand borrow pit and gravel borrow pit within the Feather River Designated Floodway, located on the right bank overflow of the Feather River.	Cutoff Wall		Struc									12614	yes, cond 13	1987	City of Gridley	685 Kentucky Street, Gridley, CA 95948	yes	yes
76	2.60	D	30	1813+70	Not Verified		Not Verified		24 Inch CM pipe through levee. Concrete saddle and apron with Calco Slide gate.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)		93.5 (USED)			93.25	94.22	98.48	96.39			part of orig O&M 1955				
		D	29/30	1813+33					Reach 29/30 Transition																		

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
77	2.55	D	29	1809+65	2,252,095.81	6,666,415.94	39°20'44.262"N	121°37'46.526"W	24 Inch CM pipe through levee. Automatic drainage gate on waterside propped open and concrete headwall on land side.	No Rehabilitation Required	The pipeline is appears to be very close to meeting the elevation requirement over 200 year WSEL. type of pipe might not meet Title 23. We will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	4.5	94.90	96.90	101.40	93.15	94.12	98.39	96.15	pre-1955		part of orig O&M 1955			yes	yes
78	2.50-2.70	D	29	1809+00			Not Verified		Existing Prune and Walnut Orchard on right bank overflow area of the Feather River	No Rehabilitation Required		Trees									7782	yes, cond 13	1971	W.L. Boyd	Route 1, Box 578, Gridley, CA 95948	no	no
79	2.35	D	29	1799+44	2,251,083.54	6,666,333.91	39°20'34.260"N	121°37'47.640"W	8"x .25" thick wall with exterior taped wrapped to a minimum thickness of 30 mil. The irrigation pipeline irrigation pipeline through levee	No Rehabilitation Required	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	IR(P)	2.1	97.83	98.50	100.60	92.87	93.83	98.12	95.58	17213	yes, cond 35	2000	Robert C. Waller	585 Cowee Avenue, Gridley, CA 95948	yes	yes
80	2.20	D	29	1792+96	2,250,482.00	6,666,094.79	39°20'28.324"N	121°37'50.715"W	Abandoned 24 inch CM drainage pipe through levee. Automatic drainage gate on waterside and concrete distribution box at waterside toe. Land side end of the pipe is not located	No Rehabilitation Required	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Meets 30 percent design criteria not included.	SD(G)	10.2	87.40	89.40	99.60	92.50	93.47	97.81	95.17	pre-1955		part of orig O&M 1955			yes	yes
81	2.11-2.50	D	29	1790+00			Not Verified		To authorize leveling and planting walnut and peach orchard on right overflow area of Feather River	No Rehabilitation Required		Trees									6622	no	1973	Robert C. Waller	585 Cowee Avenue, Gridley, CA 95948	no	no
82	2.10	D	29	1785+55	Not Verified		Not Verified		24 Inch CM drain pipe through levee. Concrete Headwall at land side. Automatic Drainage Gate on waterside with splash pad.	No Rehabilitation Required	The pipeline is appears to be very close to meeting the elevation requirement over 200 year WSEL. type of pipe might not meet Title 23. We will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)				100.00	92.05	93.04	97.50	94.89	pre-1955		part of orig O&M 1955			yes	yes
83	2.10	D	29	1785+24	2,249,771.67	6,665,793.11			24 Inch CM drain pipe through levee. Concrete Headwall at land side. Automatic Drainage Gate on waterside with splash pad.	No Rehabilitation Required	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Could not find, need to pothole to verify.	SD(G)	5.7	92.30	94.30	100.00	92.04	93.03	97.49	94.88	pre-1955		part of orig O&M 1955			no	no
84	1.94	D	29	1777+00	2,249,094.57	6,665,330.01	39°20'14.641"N	121°38'00.521"W	24 Inch CM drain pipe through levee. Concrete Headwall at land side. Automatic Drainage Gate on Waterside.	No Rehabilitation Required	The pipeline is appears to meet the elevation requirement over 200 year WSEL. type of pipe might not meet Title 23. We will need a positive shut-off structure installed and automatic drainage gate on waterside of levee. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	4.5	93.40	95.40	99.90	91.71	92.71	97.27	94.72	pre-1955		part of orig O&M 1955			yes	yes
85	1.77-2.12	D	28	1770+00			Not Verified		To authorize existing walnut trees, located on the right bank of the Feather River.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		Trees									12388	yes, cond 13	1978	Robert Waller	Route 1, Box 920, Gridley, CA 95948	no	no
	1.79	D	28/29	1769+31					Reach 28/29 Transition																		
86	1.76	D	28	1767+67	2,248,176.53	6,665,251.10	39°20'05.570"N	121°38'01.573"W	Cox Spillway. North 60 Inch drain pipes through Levee. Slide Gates in 78 inch CM pipe wells on the waterside slope. Concrete bulkhead on both ends. Reinforced concrete spillway at the waterside end.	Address Sutter Butte Main Canal. Rehabilitation Work TBD	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	8.4	86.70	91.70	100.10	91.31	92.33	97.02	94.54	pre-1955		part of orig O&M 1955	Butte Water District, Sutter Extension Water District	735 Virginia Street, Gridley, CA 95948	yes	yes
87	1.76	D	28	1767+57	2,248,167.22	6,665,252.49	39°20'05.478"N	121°38'01.556"W	Cox Spillway. South 60 Inch drain pipes through Levee. Slide Gates in 78 inch CM pipe wells on the waterside slope. Concrete bulkhead on both ends. Reinforced concrete spillway at the waterside end.	Address Sutter Butte Main Canal. Rehabilitation Work TBD	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. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent but not included.	SD(G)	8.4	86.70	91.70	100.10	91.31	92.33	97.02	94.53	pre-1955		part of orig O&M 1955	Butte Water District, Sutter Extension Water District	735 Virginia Street, Gridley, CA 95948	yes	yes
88	1.72-1.75	D	28	1767+30	2,248,140.77	6,665,254.84	39°20'05.217"N	121°38'01.527"W	To construct an 12kv aerial power line crossing of the right bank levee of the Feather River. The power line will extend from an existing pole located landward of the project levee to a new 50 foot pole located at least 20 feet water ward of the water ward toe of the levee/ The shall be 34 feet of clearance between the levee crown and the power line. The length of the span shall be 201 feet. The power line will extend from the 50 foot poles to a 30 foot pole to be located 135 downstream. This power line shall serve a pump covered by permit 11987 b Cox Brothers.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		EL	OH			100.33					12020	yes, cond 13	1977	Pacific Gas and Electric Company	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
89	1.71	D	28	1766+00			Not Verified		To construct, operate, and maintain a 12kv aerial power line extension across the right bank levee, channel, and left bank overflow of the Feather River. A 55 foot pole will be installed 31 feet water ward of the water ward shoulder of levee. The overhead conductors will extend from an existing pole, located 138 feet landward of the landward toe of levee, the proposed 55 pole. The span between the two poles will be 212 feet. A minimum clearance of 35 feet will be provided between the overhead conductors and the top of the levee. The proposed extension will extend across the river and floodway for an additional 3,165.5 feet and will consist of	Address Sutter Butte Main Canal. Rehabilitation Work TBD		EL	OH			100.33					12241	yes, cond 13	1977	Pacific Gas and Electric Company	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
90	1.71	D	28	1765+33	2,247,975.94	6,665,181.76	39°20'03.574"N	121°38'02.510"W	12-inch CM pipe through the Levee. Slide Gate on the landside end and concrete distribution box on waterside.	Address Sutter Butte Main Canal. Rehabilitation Work TBD	The pipeline does not appear to meet the elevation requirement over 200 year WSEL. Type of pipe appears to meet Title 23. We will need a positive shut-off structure installed and automatic drainage gate on waterside of levee.	IR(G)	4.5	94.50	95.50	100.00	91.03	92.09	96.90	94.55			1979	Cox Bros	Route 1, Box 926, Gridley, CA 95948	yes	yes
91	1.70	D	28	1765+15	2,247,960.44	6,665,189.22	39°20'03.424"N	121°38'02.404"W	To install an irrigation pump on the right bank of the Feather River with a 12 inch steel pipe across the berm, levee, and the Sutter Butte Canal to existing orchards on the right bank downstream from Evans-Reimer Road. Concrete headwall at the waterside toe	Address Sutter Butte Main Canal. Rehabilitation Work TBD	The pipeline is appears to meet the elevation requirement over 200 year WSEL. Type of pipe might not meet Title 23. We will need a positive shut-off structure installed and automatic drainage gate on waterside of levee.	IR(P)	0.7	98.50	99.50	100.20	91.02	92.08	96.90	94.55	11987	yes, cond 13				yes	yes
92	1.55	D	28	1756+27	2,247,101.40	6,665,410.42	39°19'54.940"N	121°37'59.617"W	Abandoned 12-inch CM pipe through the Levee. Slide Gate on the landside end and concrete distribution box on waterside.	Address Sutter Butte Main Canal. Rehabilitation Work TBD	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	SD(G)	7.1	90.67	91.67	98.80	90.74	91.82	96.71	94.29						yes	yes
93	1.5-1.60	D	28	1753+50			Not Verified		To plant approximately 1.13 hectares of kiwi plants and install an irrigation system supplied by an existing water well.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		Trees									13410	yes, cond 13	1982	Edwin Roach	955 East Evans Reimer Road, Gridley, CA 95948	no	no
94	1.45-1.50	D	28	1753+50			Not Verified		To install a n electrical pole line service extension to a new agricultural pump on the right bank overflow area of the Feather River.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		EL	OH								13436	yes, cond 13	1982	Pacific Gas & Electric	5555 Florin-Perkins Road, Sacramento, CA 95826	no	no
95	1.30	D	28	1745+00			Not Verified		To retain a newly constructed barn on the right bank overflow area of the Feather River, approximately 150 feet water ward of the right bank levee of the Feather River.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		EL	OH								10823	no	1975	W.W. Alexander	Route 1, Box 718, Gridley, CA 95948	no	no
96	1.27	D	28	1741+32	2,245,620.98	6,665,550.58	39°19'40.299"N	121°37'57.893"W	Butte County Drainage District No. 1. A 16-Inch pipe through Levee. Emergency Repair Work on Pipe 3/5/02. Pipe not physically located	Address Sutter Butte Main Canal. Rehabilitation Work TBD	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. Pumping up and over levee does not appear to be feasible.	SD(G)	9.0	87.00	89.00	97.77	90.28	91.38	96.38	93.85				Butter County Drainage District No. 1	7 County Center Drive, Oroville, CA 95965	yes	yes
97	1.00	D	28	1728+33	2,244,365.98	6,665,826.21	39°19'27.883"N	121°37'54.450"W	To install a 12kv pole line westerly across the right bank levee of the Feather River and the Sutter Butte Canal, then northerly approximately 180 meters for service to well pump.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		EL	OH								13359	yes, cond. 13	1982	Pacific Gas & Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
98	0.94	D	28	1724+61	2,244,008.46	6,665,796.35	39°19'24.351"N	121°37'54.848"W	12 kv overhead electrical power line and telephone line crossing	Address Sutter Butte Main Canal. Rehabilitation Work TBD		EL	OH			97.77										yes	yes
99	0.62-1.00	D	28						1800 feet of 4.5 foot tall barbed wire fence located at waterside toe of levee.	Address Sutter Butte Main Canal. Rehabilitation Work TBD											17271			Peckema Bros			
	0.90	D	27/28	1721+60					Reach 27/28 Transition																		
100	0.90	D	27	1721+20	2,243,713.99	6,665,636.50	39°19'21.446"N	121°37'56.897"W	End 18" wide, 12-25 feet deep cutoff wall on crown with monitoring system 2000 lineal feet.	Address Sutter Butte Main Canal. Rehabilitation Work TBD						96.10								The Research Foundation of CSU Chico		yes	yes

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
101	0.78	D	27	1707+34	2,242,329.23	6,665,666.71	39°19'07.758"N	121°37'56.584"W	Begin 18" wide, 12-25 feet deep cutoff wall on crown with monitoring system 2000 lineal feet.	Address Sutter Butte Main Canal. Rehabilitation Work TBD						96.80								The Research Foundation of CSU Chico		yes	yes
	0.77	D	26/27	1707+11					Reach 26/27 Transition																		
102	0.46	D	26	1699+62	2,241,637.34	6,665,378.46	39°19'00.931"N	121°38'00.288"W	Propane storage tanks at waterside toe of levee	Address Sutter Butte Main Canal. Rehabilitation Work TBD		G				97.13										yes	yes
103	0.44	D	26	1697+96	2,241,496.45	6,665,289.21	39°18'59.542"N	121°38'01.430"W	To retain a telephone line aerial crossing of the right bank levee of the Feather River. The aerial telephone line extends from a pole located landward of the Sutter Butte Main Canal to a pole located near water ward toe of the levee.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		TL	OH			97.58					10422	no	1975	Pacific Telephone and Telegraph Co.	1426 Howe Avenue, Suite 50, Sacramento, CA 95825	yes	yes
104	0.40	D	26	1695+85			Not Verified		To construct a caretaker/ranch office and remove an existing structure on the right bank designated floodway of the Feather River.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		Struc									15891	no	1992	J.F. Desmond	P.O. Box 211, Gridley, California 95948		
105	0.30	D	26	1691+00			Not Verified		To authorize farm buildings (a walnut processing plant and shop) on the water ward toe of the right bank levee on the Feather River, 200 feet north of Chandon Avenue. The buildings are a 30 x 80 foot walnut dehydrator and a 40 x 40 shed.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		Struc									11963	yes, cond. 13	1977	J.F. Desmond	P.O. Box 211, Gridley, California 95948		
106	0.00-0.53	D	26	1690+00			Not Verified		To level and plant 160 acres of land between right bank levee and Feather River, off end of Chandon Avenue and opposite mouth of Honcut Creek.	Address Sutter Butte Main Canal. Rehabilitation Work TBD		Trees									6566	yes, cond 5	1969	Butte Farms, Inc.	P.O. Box 338, Gridley, CA 95948		
107	0.01	D	26	1675+98	2,239,584.22	6,664,224.05	39°18'40.683"N	121°38'15.081"W	12 kv power line crossing of levee	Address Sutter Butte Main Canal. Rehabilitation Work TBD		EL	OH			96.20					3692	yes, cond 5	1961	Pacific Gas and Electric Company	530 E Street, Marysville, CA 95901	yes	yes
	0.00	D	26	1675+50					Maintenance Area 16/ Maintenance Area 7 Transition																		
1	4.09	D	26	1675+27	2,239,518.21	6,664,204.12	39°18'40.036"N	121°38'15.340"W	Butte County Drainage District No. 1. 60" x 72" RCP culvert through levee. Slide gate in concrete well on waterside slope.	Address Sutter Butte Main Canal. Rehabilitation Work TBD	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. Pumping up and over levee does not appear to be feasible.	SD(G)	17.0	73.90	78.90	95.90	87.76	89.02	94.62	91.42	pre-1955		part of orig O&M 1955	Butter County Drainage District No. 1	7 County Center Drive, Oroville, CA 95965	yes	yes
		D	25/26	1674+37					Reach 25/26 Transition																		
2	3.9-3.94		25	1670+00			Not Verified		To plant kiwi plants in place of fruit and nut trees on the right bank overflow of the Feather River south of Chandon Avenue near Live Oak.	No Rehabilitation Required		Trees									12200	yes, cond 13	1981	Lois Scoonmaker	1424 Mirada, Yuba City, CA 95991	no	no
3	3.90		25	1667+00			Not Verified		To clear the overflow area of brush and construct a foot bridge over an old channel that meanders across the overflow area. To install a septic tank and leach lines, electric service, drill a well and park a mobile home in the overflow area.	No Rehabilitation Required		Struc									7438	yes, cond 13	1971	Grover James	925 N. Rancho Road, El Sobrante, CA 94803	no	no
4	3.85		25	1665+32	2,238,525.15	6,664,192.56	39°18'30.216"N	121°38'15.536"W	To construct a 12 kv aerial power line extension across the levee and into the floodway of the Feather River. An existing pole on the landside of the levee will be replaced with a new 55 foot pole to be located 13 feet from the landward toe of the levee. The overhead conductors will extend across the levee to a 55 foot pole located in the floodway 140 feet from the waterside toe of the levee. The span between the 2 poles will be 233 feet. A minimum clearance of 31 feet will be provided.	No Rehabilitation Required		EL	OH			95.67					7101	yes, cond 5	1970	Pacific Gas and Electric Company	530 E Street, Marysville, CA 95901	yes	yes
5	3.65		25	1653+15	2,237,309.20	6,664,181.79	39°18'18.198"N	121°38'15.734"W	12 Kv overhead power line crossing and along levee	No Rehabilitation Required		EL	OH			95.17								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
6	3.41-3.73		25	1650+00			Not Verified		To retain a walnut orchard on the right bank overflow area of the Feather River. The orchard is located a narrow strip of ground between the project levee and Drainage District No. 1's drain ditch.	No Rehabilitation Required		Trees									11855	yes, cond 13	1976	Madsen Ranch	P.O. Box 134, Live Oaks, CA 95953	no	no
7	3.39		25	1639+00	2,235,906.77	6,664,006.17	39°18'04.327"N	121°38'17.999"W	RD 777 Lateral 11. There are 2-24 inch steel pipes through levee. Automatic drainage gates on waterside end of pipe.	No Rehabilitation Required	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. Pumping up and over levee does not appear to be feasible.	SD(G)	16.2	78.40	80.40	94.60	87.19	88.46	94.09	90.91	pre-1955		part of orig O&M 1955	Reclamation District No. 777	P.O. Box 876, Gridley, CA 95948	yes	no
8	3.38		25						Construction of Waterside Approach Ramp 500 feet north of Campbell Road and Meader Road	No Rehabilitation Required											3019	yes, cond 4	1959	Peder Pederson	Route 1, Box 33, Live Oak, CA	yes	no
9	3.38		25	1638+72	2,235,879.28	6,664,006.22	39°18'04.071"N	121°38'18.040"W	12 Kv overhead power line crossing and along levee	No Rehabilitation Required						94.50										yes	yes
10	3.14-3.39		25	1635+00			Not Verified		To plant a prune orchard on the right bank overflow area of the Feather River at the end of Riviera Road	No Rehabilitation Required											8616	yes, cond 13	1973	James Eva	11751 Meteer Road, Live Oak, CA 95953	no	no
		C	24/25	1623+86					Reach 24/25 Transition																		
11	2.87	C	24	1610+92	2,233,196.84	6,664,513.54	39°17'37.519"N	121°38'11.755"W	RD 777 Lateral 12. An 18 inch CM pipe through levee. Automatic drainage gate on waterside end of pipe.	Cutoff Wall and excavate and place 4.5 feet of compacted clay in bottom of Sutter Butte 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. Pumping up and over levee does not appear to be feasible.	SD(G)	17.3	76.50	78.00	93.80	87.00	88.28	93.90	90.69	pre-1955		part of orig O&M 1955	Reclamation District No. 777	P.O. Box 876, Gridley, CA 95948	yes	yes
	2.83	C	23/24	1609+37					Reach 23/24 Transition																		
12	2.38	C	23	1585+05	Not Verified		Not Verified		Abandoned 12 inch CM pipe through levee. Automatic drainage gate on waterside end of pipe	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find pipe.	?		86.4 (USED)			86.21	87.54	93.24	89.74	pre-1955		part of orig O&M 1955			no	no
13	1.83	C	23	1557+00			Not Verified		To add approximately 575 feet of 12 kv line to an existing power line on Cooley Road and within the overflow area of the Feather River	Cutoff Wall		EL	OH			92.80					12792	yes, cond. 13	1971	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	no	no
14	1.83	C	23	1556+58	2,228,785.42	6,665,751.32	39°16'53.885"N	121°37'56.205"W	To extend a 12 kv pole line from the intersection of Cooley Road and the right bank levee of the Feather across the levee and continue for 1500 feet easterly along Cooley Road. The pole line will serve a 25 HP river pump.	Cutoff Wall		EL	OH			92.80					7336	yes, cond. 13	1971	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
15	1.83	C	23	1556+22	2,228,750.17	6,665,741.92			8 inch CM pipe through levee. Automatic drainage gate on waterside end of pipe.(No gate found, ARV on land side by structure. Line may be to the north pump plant from permit 7380)	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find to verify.	IR(P)	8.0	81.0 (USED)		92.80	85.09	86.54	92.64	89.01	pre-1955		part of orig O&M 1955			no	no
16	1.80	C	23	1555+00			Not Verified		To install pumping plants at two locations on the right bank of the Feather River	Cutoff Wall		IR(P)									7380	yes, cond 13	1971	William Filter, Jr.	Route 2, Box 9, Chico, CA 95926	no	no
17	1.71	C	23	1549+63	2,228,117.97	6,665,558.67			12 inch CM pipe through levee. Automatic drainage gate on waterside end of pipe. Pipe partially plugged	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find pipe.	SD(G)	12.5	79.05	80.05	92.50	85.05	86.51	92.61	88.91	pre-1955		part of orig O&M 1955			no	no
18	1.30-1.83	C	23	1548+00			Not Verified		To level and plant walnuts and either peaches or prunes on the right bank overflow area of the Feather River upstream from Live Oak Park.	Cutoff Wall		Trees									6997	yes, cond 5	1970	William Filter, Jr.	Route 2, Box 9, Chico, CA 95926	no	no
19	1.50	C	23	1539+00			Not Verified		To install 25 HP pumping plants at two locations on the right bank of the Feather River	Cutoff Wall		IR(P)									7380	yes, cond 13	1971	William Filter, Jr.	Route 2, Box 9, Chico, CA 95926	no	no
20	1.45	C	23	1536+12	2,226,796.70	6,665,666.06	39°16'34.268"N	121°37'57.407"W	RD 777 Lateral 7. There is a 36 inch CM pipe through levee. Automatic drainage gate on waterside end of pipe.	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. Pumping up and over levee does not appear to be feasible.	SD(G)	13.7	75.65	78.65	92.32	84.94	86.40	92.52	88.68	pre-1955		part of orig O&M 1955	Reclamation District No. 777	P.O. Box 876, Gridley, CA 95948	yes	yes
21	1.45	C	23	1535+95	2,226,780.47	6,665,668.20	39°16'34.070"N	121°37'57.365"W	To extend a 12 kv pole line 410 feet northerly to supply a 25 HP pump located in the river. The pump is pump referenced in permit 7380.	Cutoff Wall		EL	OH			92.39					7335	yes, cond 13	1971	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
22	1.44	C	23	1535+64	2,226,750.14	6,665,678.35	39°16'33.770"N	121°37'57.237"W	To widen access road to Live Oak Recreation Area at the east end of Pennington Road on the right bank levee and berm of the Feather River	Cutoff Wall		Struc									7294	yes, cond 5	1971	County of Sutter	1160 Civic Center Blvd, Yuba City, CA 95993	yes	yes
23	1.40	C	23	1535+00			Not Verified		To Install 2500 lf of 2 inch diameter Sch 40 PVC water pipe and 600 lf of 1 inch Sch 40 PVC pipe within the west bank overflow. (Permit number has been changed to 7440-D)	Cutoff Wall		W(P)									18256	yes, cond 24	2007	County of Sutter	1130 Civic Center Blvd, Yuba City, CA 95993		

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
24	1.36-1.39	C	23	1534+00			Not Verified		To construct a water supply system, a sanitary disposal system and restrooms for the Live Oak Recreational Area	Cutoff Wall		Struc									6855	yes, cond 5	1969	County of Sutter	1130 Civic Center Blvd, Yuba City, CA 95993		
25	1.36	C	23	1532+40	Not Verified		Not Verified		Potential Pipe Crossing. 6" Steel through levee	Cutoff Wall	Not sure about the elevation criteria being met. 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.	?		82.2 (USED)		91.91	84.80	86.27	92.41	88.56	pre-1955		part of orig O&M 1955			yes	yes
26	1.36	C	23	1532+45	2,225,437.02	6,665,722.95	39°16'20.789"N	121°37'56.738"W	Pump Station adjacent to Levee	Cutoff Wall		IR(P)									7380	yes, cond 13	1971	William Filter, Jr.	Route 2, Box 9, Chico, CA 95926	yes	yes
27	1.33-1.43	C	23	1530+00			Not Verified		Live Oak Park to authorize trailer site, a porch, a metal storage building, fence across the waterside berm and waterside slope of the levee, on the right bank of the overflow area of the Feather River.	Cutoff Wall		Struc									7440	yes, cond 13	1973	County of Sutter	1160 Civic Center Blvd, Yuba City, CA 95993	no	no
28	1.17	C	23	1524+35	Not Verified		Not Verified		Potential Pipe Crossing. 6" Steel through levee	Cutoff Wall	Not sure about the elevation criteria being met. 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.	?		80.1 (USED)		91.67	84.27	85.80	92.05	87.89	pre-1955		part of orig O&M 1955			yes	yes
	0.75	C	22/23	1503+83					Reach 22/23 Transition																		
29	0.50-1.10	C	22	1530+00			Not Verified		To authorize existing pear orchard and plant 10 additional acres on the right bank overflow of the Feather River downstream of Archer Road	Cutoff Wall		Trees									12672	yes, cond 13	1980	Elvyn Denny	2034 Fir Street, Live Oak, CA 95953	no	no
30	0.70-1.14	C	22	1520+25			Not Verified		To extend approximately 1,950 feet of 12kv electric service line in the right bank overflow area of the Feather River downstream from Archer Avenue crossing	Cutoff Wall		EL	OH								12824	yes, cond 13	1979	Pacific Gas and Electric Company	P.O. Box 7444, Sacramento, CA 95826	no	no
31	0.64	C	22	1493+88	2,222,717.57	6,664,731.41			Location of gate with no access	Cutoff Wall		Fence				91.44					17139	yes, cond 16				yes	yes
32	0.47	C	22	1492+00			Not Verified		To construct an aerial telephone crossing of the right bank levee of the Feather River	Cutoff Wall		structure									6256	yes, cond 5	1969	Pacific Telephone and Telegraph Company	3675 "T" Street, Sacramento, CA	no	no
33	0.42-.47	C	22	1482+00			Not Verified		To authorize a 4 x 17 foot wooden walkway on the landside shoulder; two tool sheds, four walnut trees, a barbed wire and wooden fence within 10 feet landward of the landside toe, and an electrical gate across the crown of the right bank levee of the Feather River.	Cutoff Wall		structure									17139	yes, cond 15	1999	Wayne Sue	P.O. Box 213, Live Oak, California 95953	yes	yes
34	0.38	C	22	1479+98	2,221,343.18	6,664,540.45	39°15'40.364"N	121°38'09.549"W	Location of electric gate with no access	Cutoff Wall		Fence				91.44					17139	yes, cond 16				yes	yes
35	0.19	C	22	1470+15	2,220,360.26	6,664,561.50	39°15'30.656"N	121°38'11.766"W	To authorize a 4 x 17 foot wooden walkway on the landside shoulder and a 6 x 300 foot wooden lattice fence within 10 feet landward of the landside toe and parallel to the right bank of levee of Feather River	Cutoff Wall		structure									17168	yes, cond 15	1999	Mariko Gushi	1320 Bishop Road, Live Oak, CA 95953	yes	yes
36	0.15	C	22	1468+70			Not Verified		To authorize four trees (oleander, pines, cherry, and birch) on the landside slope and a 5 foot high, 170 foot long wire fence within 7 feet of landward of the landside toe of the right bank levee of the Feather River	Cutoff Wall		structure									17129	yes, cond 14	1999	Kevin and Mary Ann McCool	1210 Bishop Road, Live Oak, CA 95953	no	no
37	0.10	C	22	1466+02	2,219,947.02	6,664,564.97	39°15'26.570"N	121°38'11.743"W	Transformer located 40'± from land side toe	Cutoff Wall		EL				95.06										yes	yes
38	0.10	C	22	1465+50			Not Verified		To construct access ramp across the right bank levee of the Feather River	Cutoff Wall		Struc									4741	yes, cond 5	1964	Edward J. Heinrich	2434 Archer Avenue, Live Oak, CA 95953	no	no
39	0.10	~~C~~	~~22~~	~~1465+50~~			~~Not Verified~~		~~The existing 36 inch CMP installed in 1913 failed on March 1964. The permit was for repair of levee and removal of the pipe prior to November 1964.~~	~~Cutoff Wall~~		~~IR(G)~~		~~57.7 (USED, Waterside) 70.0, USED, landward)~~							4556 and 4719	yes, cond 5	1964 and 1965	Butte Water District, Sutter Extension Water District	735 Virginia Street, Gridley, CA 95948	no	no
40	0.00-0.25	C	22	1461+00			Not Verified		To maintain existing your walnut orchards on the right bank of the Feather River, downstream from Bishop Avenue.	Cutoff Wall		Trees									11762	yes, cond 13	1976	Edward J. Heinrich	2434 Archer Avenue, Live Oak, CA 95953	no	no
		C	22	1460+00					Levee District No. 9 Levees /Maintenance Area 16 Transition																		
	5.73	C	21/22	1433+83					Reach 21/22 Transition																		
41	5.67	C	21	1430+55	2,216,425.27	6,664,383.06	39°14'51.685N	121°38'14.253"W	Sunset Pump Station owned an operated by Sutter Extension Main Pump Station. This is the 60 Inch steel pipe a through the levee. Pump end has gate valves on structure. Automatic drainage gates on the landside end.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and proper check valves at pump. Pumping up and over levee does not appear to be feasible.	IR(P)	15.6	80.61	85.61	91.16	81.70	83.63	90.27	85.74	pre-1955 and 3610	yes, cond 5 (for pumps)	part of orig O&M 1955 and 1961	Sutter Extension Water District	4525 Franklin Road, Yuba City, CA 95993-9316	yes	yes
42	5.67	C	21	1430+47	2,216,417.64	6,664,382.64	39°14'51.614N	121°38'14.261"W	Sunset Pump Station owned an operated by Sutter Extension Main Pump Station. This is the 60 Inch steel pipe a through the levee. Pump end has gate valves on structure. Automatic drainage gates on the landside end.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and proper check valves at pump. Pumping up and over levee does not appear to be feasible.	IR(P)	15.6	80.42	85.42	91.13	81.70	83.63	90.27	85.74	pre-1955 and 3610	yes, cond 5 (for pumps)	part of orig O&M 1955 and 1961	Sutter Extension Water District	4525 Franklin Road, Yuba City, CA 95993-9316	yes	yes
43	5.67	C	21	1430+40	2,216,410.86	6,664,382.27	39°14'51.758N	121°38'14.247"W	Sunset Pump Station owned an operated by Sutter Extension Main Pump Station. This is the 36 inch steel pipe through the levee. Pump end has gate valves on structure. Automatic drainage gates on the landside end.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and proper check valves at pump. Pumping up and over levee does not appear to be feasible.	IR(P)	15.6	82.92	85.92	91.18	81.70	83.63	90.27	85.74	pre-1955 and 3611	yes, cond 5 (for pumps)	part of orig O&M 1955 and 1961	Sutter Extension Water District	4525 Franklin Road, Yuba City, CA 95993-9316	yes	yes
44	5.67	C	21	1430+40			Not Verified		To construct and operate a vertical-perforated plate fish screen with a power operated brush on the right bank of Feather River. Located at Sunset Pump Plant.	Cutoff Wall		IR									13381	yes, cond 13	1982	Department of Fish and Game	1701 Nimbus Road, Ranch Cordova, CA 95670	no	no
45	5.67	C	21		Not Verified		Not Verified		36" CM pipe crossing through levee	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find pipe. Should be part of 30 percent but not included	IR									pre-1955		part of orig O&M 1955			no	no
46	5.67	C	21	1429+98	2,216,368.25	6,664,376.98	39°14'51.204"N	121°38'14.314"W	12 KV OH Power	Cutoff Wall		EL	OH			91.19								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
47	5.67	C	21	1429+68	2,216,338.71	6,664,376.58	39°14'50.912"N	121°38'14.321"W	12 KV OH Power	Cutoff Wall		EL	OH			91.18								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
48	5.65	C	21	1429+50			Not Verified		Existing rubble coffer dam constructed with Rec Board Permit 3610. Repair coffer dam.	Cutoff Wall		IR									3610 and 7762	no	1961 and 1971	Sutter Extension Water District	4525 Franklin Road, Yuba City, CA 95993-9316	yes	no
49		C	21	1428+50					Sutter Butte Main Canal Begin (Station 1428+50 to 1433+83) - Main Irrigation Canal approx 420 cfs	Cutoff Wall		IR															
49	5.20	C	21				Not Verified		12 kv pole line crossing of levee 30 feet from waterside toe for 792 feet	Cutoff Wall		EL	OH								8533		1973	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	no	no
50	5.08	C	21	1399+27	2,213,450.77	6,664,966.80	39°14'22.343"N	121°38'06.965"W	To install a 12 kv pole line across and along the right bank levee of the Feather River.	Cutoff Wall		EL	OH			90.49					7439	yes, cond 13	1971	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
51	4.91	C	21				Not Verified		End Seepage Interceptor Trench located on landside toe of levee	Cutoff Wall		SEEP									15201	no	1991	Levee District No. 9	1190 Civic Center Blvd., Yuba City, CA 95991	no	no
52	4.91-5.08	C	21				Not Verified		Plant 9 acres of Kiwi plants on waterside of levee between Bridgeford and Hermanson Avenues	Cutoff Wall		Trees									12589	yes, cond 13	1978	Tom-A-Hay Farms, Inc.	P.O. Box 461, Live Oak, CA 95953		
53	4.83-4.91	C	21				Not Verified		Plant 14 acres of Kiwi plants on waterside of levee upstream of Hermanson Avenue	Cutoff Wall		Trees									12623	yes, cond 13	1979	John Tomlinson and Anthony Hess	P.O. Box 461, Live Oak, CA 95953		
54	4.73-4.81	C	21				Not Verified		To construct a well and septic tanks for 2 mobile homes and to extend electrical service to well on right bank overflow area of Feather River	Cutoff Wall		Struc									7994	yes, cond 13	1972	Johnny McReyonlds	2650 The Alameda, Santa Clara, CA 95050	no	no
55	4.76-4.83	C	21				Not Verified		To plant 8 acres of kiwi plants, a submersible pump, and underground sprinkler system on the right bank overflow area of the Feather River	Cutoff Wall		Trees									12816	yes, cond 13	1979	Tom-A-Hay Farms, Inc.	8935 Sinnard Avenue, Live Oak, CA 95953	no	no

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
56	~~4.81~~	~~C~~	~~21~~				~~Not Verified~~		~~To pump storm water from landward drainage ditch over the right bank levee of the Feather River from one separate location for approximately size at the end of Hermansen Road. **Pipe has been removed**~~	~~Cutoff Wall~~		~~SD(P)~~									13611	yes, cond 13	1983	Sundown Farms, Inc.	1350 Hermansen Avenue, Live Oak, CA 95953	n/a	n/a
57	4.80	C	21	1391+96	2,212,767.43	6,665,226.86	39°14'15.579"N	121°38'03.695"W	To extend a 12 kv pole line out into the right bank levee and overflow area of the Feather River	Cutoff Wall		EL	OH			89.77					8533	yes, cond 13		Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
58	4.50	C	21	1375+35	2,211,296.56	6,665,998.34	39°14'01.009"N	121°37'53.965"W	Sutter Extension Sunset Lateral Begin (Station 1375+35 to 1428+50) Open irrigation ditch 15 feet from landside toe	Cutoff Wall		IR				89.42								Sutter Extension Water District	4525 Franklin Road, Yuba City, CA 95993-9316	yes	yes
59	4.48	C	21	1374+94	2,211,260.36	6,666,016.66	39°14'00.651"N	121°37'53.734"W	Begin Seepage Interceptor Trench located on landside toe of levee	Cutoff Wall		SEEP									15201	no	1991	Levee District No. 9	1190 Civic Center Blvd., Yuba City, CA 95991	no	no
60	4.10-4.38	C	21	1375+00			Not Verified		To level and plant 13 acres Peach Orchard on the right bank overflow area of the Feather River	Cutoff Wall		Trees									9846	yes, cond 13	1975	Bruce Jenlins	7035 Kent Avenue, Live Oaks, CA 95953	no	no
	4.47	C	20/21	1374+33					Reach 20/21 Transition																		
61	4.10-4.38	C	20	1350+00			Not Verified		To plant peach trees and to establish two wells and install pumping plants in right bank overflow of the Feather River	Cutoff Wall		EL	OH								6380	yes, cond 5	1969	James Eager	7245 Larkin Road, Yuba City, CA 95953	no	no
62	4.10-4.38	C	20	1350+00			Not Verified		To extend 12 kv pole line parallel to the water ward toe of levee for a distance of approximately 1,500 feet north from Koch Lane, on the right bank overflow area of the Feather River/	Cutoff Wall		EL	OH								10749	yes, cond 13	1975	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	no	no
63	4.10	C	20	1347+37	2,208,612.74	6,666,676.45	39°13'34.454"N	121°37'45.485"W	To install a 60 foot pole 86 feet from the landward toe of the levee, a 60 foot pole 10 feet from the water ward toe of the levee and 6 additional poles on the right bank overflow of the Feather River. The 12kv electrical service will be extend across the levee to serve a pump installed under Permit 6380. The span across the levee will be 234 feet. The clearance between the overhead wires and the top of the levee will be 21 feet	Cutoff Wall		EL	OH			89.77					6515	yes, cond 13	1969	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
64	4.10	C	20	1347+00	2,208,582.82	6,666,680.19	39°13'34.158"N	121°37'45.487"W	Underground communication cable through levee	Cutoff Wall		TL	4.0			89.58	79.98	82.33	88.93	84.39						yes	yes
65	4.00	C	20	1345+00			Not Verified		To plant prune orchard on the right bank overflow area of the Feather River, downstream from Koch Road	Cutoff Wall		Trees									9278	yes, cond 13	1974	Justin Micheli	6005 Highway 99, Live Oak, CA 95993	yes	yes
66	4.00	C	20	1345+00			Not Verified		To retain walnut orchard on the right bank overflow area of the Feather River, downstream from Koch Road	Cutoff Wall		Trees									9277	no	1974	Justin Micheli	6005 Highway 99, Live Oak, CA 95993	yes	yes
67	~~3.72~~	~~C~~	~~20~~	~~1328+10~~	~~Not Verified~~		~~Not Verified~~		~~To pump storm water from landward drainage ditch over the right bank levee of the Feather River from three separate location for approximately size at the end of Hermansen Road. **Pipe has been removed**~~	Cutoff Wall		~~SD(P)~~									13603	yes, cond 13	1983	Justin Micheli	6005 Highway 99, Live Oak, CA 95993	no	no
68	3.71	C	20	1328+00			Not Verified		To construct a 12 kv aerial power line on the right bank overflow area of the Feather River	Cutoff Wall		EL	OH								11593, 11593A	yes, cond 13	1976	Pacific Gas and Electric Company	One Tower, Spear Tower, San Francisco, CA 94105	yes	no
69	3.71	C	20	1327+00	2,206,597.56	6,666,928.33	39°13'14.525"N	121°37'42.389"W	12KV overhead power line crossing	Cutoff Wall		EL	OH			89.71								Pacific Gas and Electric Company	One Tower, Spear Tower, San Francisco, CA 94105	yes	no
70	3.53	C	20	1317+15	Not Verified		Not Verified		Temporary storm discharge pipe through levee	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find pipe	SD(P)									13603		1983	Justin Micheli	6005 Highway 99, Live Oak, CA 95993	no	no
71	3.49	C	20	1315+03	2,205,398.45	6,666,943.63	39°13'02.672"N	121°37'42.272"W	End Seepage Interceptor Trench located on landside toe of levee	Cutoff Wall		SEEP									15201		1991	Levee District No. 9	1471 Coats Drive, Yuba City, CA 95991	yes	no
72	3.48	C	20	1314+80	2,205,375.80	6,666,944.25	39°13'2.438"N	121°37'42.272"W	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.	Cutoff Wall	Not sure whether pipeline meets the elevation criteria. The pipeline appears to meet title 23 requirements . Pumping could be option but not enough information available of the pump system. Should be part of 30 percent but not included	SD(P)	2.0	84.73	86.40	88.20	79.00	81.65	88.28	83.94	13657	yes, cond 13	1983	Micheli	6005 Highway 99, Live Oak, CA 95993	yes	yes
73	3.45-3.75	C	19	1312+08			Not Verified		To plant an orchard and grade the land on the right bank overflow area of the Feather River. The project is located north of Yuba City approximately 5.5miles.	Cutoff Wall		Trees									3688	no	1961	Micheli	6005 Highway 99, Live Oak, CA 95993		
73	~~3.30~~	~~C~~	~~20~~	~~1305+30~~	~~Not Verified~~		~~Not Verified~~		~~To pump storm water from landward drainage ditch over the right bank levee of the Feather River from one separate location for approximately size at the end of Hermansen Road. **Pipe has been removed**~~	~~Cutoff Wall~~		~~SD(P)~~									13610	yes, cond 13	1983	Wilmax Farms, Inc	1857 Encinal Road, Live Oak, CA 95953	n/a	n/a
	3.18	C	19/20	1297+83					Reach 19/20 Transition																		
74	3.0-3.3	C	19	1295+00			Not Verified		To plant an orchard and grade the land on the right bank overflow area of the Feather River. The project is located north of Yuba City approximately 1.3 miles upstream (north) of the intersection of Eager Road and Live Oak Boulevard	Cutoff Wall		Trees									16298	no	1995	Timothy and Lori Filter	1010 Morse Road, Live Oak, CA 95953		
75	3.10	C	19	1293+66	2,203,266.22	6,666,867.99	39°12'41.599"N	121°37'43.329"W	End Concrete Lined Ditch on landside toe of levee	Cutoff Wall		SEEP				89.14								USACE?	1325 J Street, Sacramento, CA	yes	yes
76	3.08	C	19	1293+66	2,203,266.22	6,666,867.99	39°12'41.599"N	121°37'43.329"W	12 KV Overhead Power line crossing of levee. One pole 6 foot from levee toe.	Cutoff Wall		EL	OH			89.14					4584	yes, cond 5	1964	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
77	3.00	C	19						Begin Seepage Interceptor Trench located on landside toe of levee	Cutoff Wall		SEEP									15201	no	1991	Levee District No. 9	1471 Coats Drive, Yuba City, CA 95991	no	no
78	2.90	C	19	1284+91	2,202,406.27	6,666,705.08	39°12'33.105"N	121°37'45.443"W	Begin Concrete Lined Ditch on landside toe of levee	Cutoff Wall		SEEP				88.65								USACE?	1325 J Street, Sacramento, CA	yes	yes
79	2.56	C	19	1266+71	2,200,600.09	6,666,626.50	39°11'40.511"N	121°37'23.859"W	12KV overhead power line crossing	Cutoff Wall		EL	OH			88.28								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
80	2.54	C	19	1265+59	2,200,487.69	6,666,648.86	39°12'14.101"N	121°37'46.217"W	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)	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. Pumping up and over levee does not appear to be feasible. Pump does not appear to be used any longer and could remove as part of project. Should be part of 30 percent but not included	IR(P)	18.3	70.05	71.55	88.30	78.41	81.22	87.80	82.99	pre-1955		0			yes	yes
81	1.86	C	19	1229+41	2,197,325.05	6,668,184.53	39°11'42.843"N	121°37'26.919"W	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.	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information. Type of pipe might not meet Title 23. We will need a positive shut-off structure installed and automatic drainage gate on waterside of levee.	IR(P)	3.0 or deeper through levee?			87.52	77.96	80.90	87.42	82.61	pre-1955		part of orig O&M 1955			yes	yes
82	1.80	C	19	1226+06	2,197,092.42	6,668,425.95	39°11'40.511"N	121°37'23.859"W	12 KV power pole located in landside slope	Cutoff Wall		EL	OH			87.29										yes	yes
		C	18/19	1213+85					Reach 18/19 Transition																		
83	1.32	~~C~~	~~18~~	~~1200+69~~	~~2,194,694.58~~	~~6,669,169.33~~	~~39°11'16.779"N~~	~~121°37'14.543"W~~	~~Abandoned 10 inch steel pipe through levee. Waterside end open. Steel Plate welded on landward end. Pump and Standpipe at the landside end.~~	~~Cutoff Wall~~	~~Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.~~	~~IR(P)~~	~~2.8~~		84.55	87.80						removed	2011	Wilbur Rev & 1994 Trust Etal	P.O. Box 3730, Yuba City, CA 95992	yes	yes
84	1.20	C	18						12 KV power line in overflow and levee crossing north of Rednall Road	Cutoff Wall		EL	OH								11960, 11960A	yes, cond 13	1979	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105		

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
85	0.98	C	18	1182+75	Not Verified		Not Verified		20 Inch steel pipeline through levee **(not installed)** - Plans prepared by MHM Job No. 78-158	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information. Type of pipe might not meet Title 23. Could not find pipeline in the field. Should be part of 30 percent but not included.	IR(A)	3.0								12634	yes, cond 13	1979	Favero Farms	600 Rednall Road, Yuba City, CA 95991	no	no
86	0.97	C	18	1181+50	Not Verified		Not Verified		Abandoned 8 inch steel pipe through levee. Pipe plugged on the waterside toe.	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find in field.	IR(A)	4.0	76.6 (USED)			77.08	80.24	86.59	81.90	pre-1955		part of orig O&M 1955			no	no
87	0.96	C	18	1180+98	2,192,727.96	6,669,163.92	39°10'57.338"N	121°37'14.737"W	3 inch steel pipe through levee crown	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information. Type of pipe might not meet Title 23. Could not find pipeline in the field.	IR(?)	1.0	86.05	86.30	87.30	77.07	80.24	86.58	81.89						yes	yes
88	0.95	C	18	1180+50	Not Verified		Not Verified		One 12 inch steel pipe through levee. Pipe exposed on landside slope	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information. Type of pipe might not meet Title 23. Could not find pipeline in the field.	IR(A)	1.0				77.06	80.23	86.57	81.89						no	no
89	~~0.98~~	~~C~~	~~18~~	~~1182+75~~	~~Not Verified~~		~~Not Verified~~		~~To install an irrigation pump and a buried pipeline landward over the right bank levee of the Feather River, upstream Rednall Road. **Not install per Reclamation Board**~~	~~Cutoff Wall~~		~~IR(P)~~									12634	yes, cond 13	1981	Favero Farms	600 Rednall Road, Yuba City, CA 95991	n/a	n/a
90	0.80	C	18	1174+05	2,192,034.01	6,669,096.85	39°10'50.484"N	121°37'15.605"W	Water Well and Pump 20 feet from Landside toe	Cutoff Wall						87.29										yes	yes
91	0.75	C	18	1170+04	2,191,638.99	6,669,057.61	39°10'46.581"N	121°37'16.124"W	12KV overhead power line crossing	Cutoff Wall		EL	OH			87.18								Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
92	0.40	C	18	1152+55	2,189,899.09	6,668,879.71	39°10'29.390"N	121°37'18.475"W	Twin 110 KV Tower line across Feather River	Cutoff Wall		EL	OH			86.95					3365	yes, cond 4	1960	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
93	0.18	C	18	1138+22	2,188,574.27	6,668,732.99	39°10'16.301"N	121°37'20.408"W	12 KV and 40/60 KV power pole located in landside slope	Cutoff Wall		EL	OH			86.71								Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
94	0.08	C	18	1135+31	2,188,188.41	6,668,676.43	39°10'12.536"N	121°37'21.138"W	16 inch gas line through the levee. Marker post on the waterside shoulder	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information. Type of pipe might not meet Title 23. We will need a positive shut-off structure installed and automatic drainage gate on waterside of levee.	GL	3.5			86.50	76.15	79.58	85.73	81.27				Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	yes	yes
95	16.52-16.65 and 0.00-0.10	C	17	1133+00			Not Verified		To construct 1,180 feet of 12 kv line in the right bank overflow area of the Feather River	Cutoff Wall		EL	OH								12750	yes, cond. 13	1979	Pacific Gas and Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	no	no
		C	18	1132+61					Levee District No. 1 Levees /Levee District No. 9 Transition																		
1	16.65	C	18	1132+09	2,187,967.19	6,668,647.98	39°10'09.827"N	121°37'21.468"W	8-5/8" steel pipeline within railroad right-of-way parallel to tracks	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information. Type of pipe might not meet Title 23. We will need a positive shut-off structure installed and automatic drainage gate on waterside of levee.	GL				84.80	76.09	79.54	85.67	81.07	3823	yes, cond 5	1961	Southern Pacific Pipe Line Co.	610 South Main Street, Los Angeles, CA	yes	yes
2	16.65	C	18	1131+82	2,187,840.25	6,668,647.20	39°10'09.827"N	121°37'21.468"W	Fiber optic warning sign	Cutoff Wall	The fiber optic most likely does not meet the elevation requirement over 200 year WSEL becuase the cable appears to run adjacent to rail which is barely above the 200 year. Type of wire might not meet Title 23.	TL				84.80	76.09	79.54	85.67	81.07						yes	yes
		C	17/18	1130+86					Reach 17/18 Transition																		
3	16.65	C	17	1130+47	2,187,705.38	6,668,643.93	39°10'07.716"N	121°37'21.585"W	Union Pacific Railroad Crossing. There is no stop log structure.	Cutoff Wall	The railroad crossing does not include any structure. There is not a stop log structure and is simply a low area within the levee.	RR	6.0			81.32								Union Pacific RR	1400 Douglas Stop #1640, Omaha, NE 68179	yes	yes
4	16.60	C	17	1128+00			Not Verified		To construct a ramp on the waterside slope of the right bank levee on the Feather River adjacent to the SPRR.	Cutoff Wall		Struc									10525	yes, cond. 13	1975	Keith Boone	P.O. Box 95, Live Oak, CA 95953	no	no
5	16.60	C	17	1127+48	2,187,405.84	6,668,629.29	39°10'04.756"N	121°37'21.787"W	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.	Cutoff Wall	Not sure whether pipeline meets the elevation criteria or title 23 requirements but newer permit . Pumping could be option but not enough information available of the pump system.	SD(P)				87.90	76.02	79.48	85.59	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	yes	yes
6	16.56	C	17	1125+00			Not Verified		To retain an existing irrigation well in the right bank overflow area of the Feather River.	Cutoff Wall		Well									12759	yes, cond. 13	1979	DiFiore Ranches	5028 Carlson Road, Yuba City, CA 95991	no	no
7	16.29	C	17	1111+46	2,185,808.02	6,668,723.59	39°09'48.957"N	121°37'20.672"W	North Yuba City 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	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	SD(P)	1.1	83.17	84.50	85.60	75.75	79.21	85.29	80.77	14420	no	1986	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
8	16.20	C	17	1107+82	2,185,444.63	6,668,754.75	39°09'45.365"N	121°37'20.297"W	12 KV crossing & power pole located in landside slope	Cutoff Wall		EL	OH			86.09								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
9	16.01	C	17				39°09'35.29"N	121°37'15.71"W	To install an intertie to an existing waste water line and abandon approximately 40 feet of 24 inch diameter pipe on the right bank of the Feather River.	Cutoff Wall		RW(P)	4.0								15331	no	1989	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
10	16.01	C	17	1096+81	2,184,404.96	6,669,131.69	39°09'35.073"N	121°37'15.566"W	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)	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	RW(P)	5.0	81.05 rd	83.6 est	87.70	75.61	79.08	85.16	80.62	5758 & 6016 & 13957 & 13593 & 15330	yes, cond 13	1967 & 1968 & 1984 & 1983 & 1989	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
11	16.01	C	17	1096+71	2,184,406.70	6,669,130.73	39°09'35.090"N	121°37'15.578"W	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)	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	RW(P)	4.7	81.80 rd	83.8 est	87.80	75.61	79.08	85.16	80.62	5758 & 6016 & 13957 & 13593 & 15330	yes, cond 13	1967 & 1968 & 1984 & 1983 & 1989	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
12	16.01	C	17	1096+62	2,184,416.62	6,669,124.90	39°09'35.189"N	121°37'15.652"W	Yuba City Water Treatment Plant 42"cement mortar lined and coated welded steel pipe waterline crossing of levee (copy of record drawings)	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	RW(P)	2.5	82.50 rd	86.1 est	88.40	75.61	79.08	85.16	80.61	17977	yes, cond 28	2005	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
13	16.00	C	17	1096+74	2,184,416.62	6,669,124.90	39°09'35.189"N	121°37'15.652"W	To install a 12 kv aerial pole line extension across the right bank levee of the Feather River. The pole line shall serve the Yuba City Water treatment Plant intake pump station	Cutoff Wall		EL	OH			88.30					6067	yes, cond 5	1968	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
		C	16/17	1080+00					Reach 16/17 Transition																		
14	15.68	C	16	1079+91	2,183,133.99	6,670,212.82			8 inch Gas Line	Flatten Waterside Slope	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe may or may not meet Title 23. Appears no work required but need to pothole to verify.	GL	3.5				75.51	78.99	85.03	80.36				Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
15	15.56	C	16	1073+41	2,182,671.85	6,670,670.15	39°09'17.878"N	121°36'56.126"W	16 inch Gas Line (PG&E Map shows the gas main as 12 inch)	Flatten Waterside Slope	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe may or may not meet Title 23. Appears no work required but need to pothole to verify.	GL	3.5			85.65	75.51	78.99	85.03	80.21				Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
16	15.15	C	16	1054+75	2,181,074.23	6,671,588.96	39°09'02.048"N	121°36'44.548"W	Telephone Call box on landside hinge point	Flatten Waterside Slope		TL				86.66										yes	yes
17	14.98	C	16	1043+52	not verified		not verified		Abandon 36 inch pipe	Flatten Waterside Slope	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	SS(A)									pre-1955		part of orig O&M 1955			no	no

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
18	14.98	C	16	1043+52	2,180,149.57	6,672,223.24			Abandoned 27 inch Centrifugal Spun Concrete Pipe. City of Yuba City Drawing 214-D per 1949 plans	Flatten Waterside Slope	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	SS(A)	38.6	45.45	47.70	86.30	75.17	78.56	84.45	79.61	pre-1955	no	1949	City of Yuba City	1120 Civic Center Blvd., Yuba City, CA 95991	no	no
19	14.98	C	16	1043+45	2,180,137.11	6,672,230.51	39°08'52.758"N	121°36'36.455"W	To install a 36 Inch discharge pipe through right bank of Feather River.	Flatten Waterside Slope	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify. Working on obtaining as-built drawings.	SD(P)	5.0	80.0 rd	83.0 rd	86.40	75.17	78.56	84.45	79.61	13930	yes, cond 13	1984	Gilsizer Drainage County Drainage District	701 Bogue Road, Yuba City, CA 95991	yes	yes
20	14.98	C	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	Flatten Waterside Slope	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify. Working on obtaining as-built drawings.	SD(P)	2.0	81.3 rd	83.0 rd	86.30	75.17	78.56	84.45	79.61	12074	yes, cond 13	1977	Gilsizer Drainage County Drainage District	701 Bogue Road, Yuba City, CA 95991	yes	yes
21	14.98	C	16	1043+22	2,180,121.72	6,672,237.88	39°08'52.605"N	121°36'36.362"W	To construct a 24 inch steel pipe storm drainage discharge pipe crossing the west levee of the Feather River	Flatten Waterside Slope	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify. Working on obtaining as-built drawings.	SD(P)	4.0	81.3 rd	83.3 rd	86.20	75.17	78.56	84.45	79.61	7019	yes, cond 5	1970	Gilsizer Drainage County Drainage District	701 Bogue Road, Yuba City, CA 95991	yes	yes
22	14.98	C	16	1043+03	2,180,106.36	6,672,244.70	39°08'52.453"N	121°36'36.276"W	Gilsizer Slough Storm Drain Facilities. A 16 inch welded steel discharge pipe crossing of levee. (copy of record drawings)	Flatten Waterside Slope	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe appears to meet Title 23. The cover over pipe is questionable. Appears no work required but need to pothole to verify.	SD(P)	1.3	83.30 rd	84.7 est	85.90	75.17	78.56	84.44	79.61	3112	yes, cond 4	1959	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
23	14.88	~~C~~	~~16~~	~~1037+50~~	~~Not Verified~~		~~Not Verified~~		~~Abandoned 8 inch gas line through levee. Removed per Permit 1445A~~	~~Flatten Waterside Slope~~	~~Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.~~	~~GL~~					75.08	78.46	84.30	79.41	pre-1955 (installed) and 1445A (removed)	yes, cond 13	part of orig O&M 1955 and 1974 (abandon)	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	no	no
24	14.43-15.26	C	16						4,400 lineal feet of Blanket Drain on landside slope of levee starting approx 0.20 miles downstream of 10th Street Bridge extending north	Flatten Waterside Slope											15034		1988	Levee District No. 1	243 Second Street, Yuba City, CA 95991	no	no
25	14.67	C	16	1028+11	2,178,636.47	6,672,461.02	39°08'37.915"N	121°36'33.611"W	Power pole in waterside slope	Flatten Waterside Slope		EL				82.67										yes	yes
26	14.73	C	16	1029+10	2,179,608.80	6,672,356.03	39°08'47.530"N	121°36'34.890"W	To bury existing two submarine telephone cables into two parallel trenches 100 feet apart in the channel of the Feather River. Both cables were installed per Permit 1334 in September 15, 1948.	Flatten Waterside Slope		TL	5.0			84.71					1334 and 11851	yes, cond. 13	1948 and 1977	Pacific Telephone and Telegraph Company	1426 Howe Avenue, Suite 50, Sacramento, CA 95825	yes	yes
27	14.71	C	16	1028+10	2,179,506.59	6,672,370.16	39°08'46.519"N	121°36'34.717"W	To bury existing two submarine telephone cables into two parallel trenches 100 feet apart in the channel of the Feather River. Both cables were installed per Permit 1334 in September 15, 1948.	Flatten Waterside Slope		TL	2.0			84.77					1334 and 11851	yes, cond. 13	1948 and 1977	Pacific Telephone and Telegraph Company	1426 Howe Avenue, Suite 50, Sacramento, CA 95825	yes	yes
28	14.68	C	16	1026+71	21,784,783.54	6,672,514.29	39°08'36.643"N	121°36'33.928"W	10" Drain line in levee water side slope for bridge area drainage	Flatten Waterside Slope	Not sure if the conduit meets the elevation requirement over 200 year WSEL. The type of conduit may or may not meet Title 23 but it is newer encroachment permit. Need to pothole to verify.	TL				89.72					16995					yes	yes
29	14.64	C	16	1026+58	2,178,488.35	6,672,429.49	39°08'36.452"N	121°36'34.019"W	40 foot long retaining wall landside of levee just upstream of the Feather River Bridge	Flatten Waterside Slope		Road									15133	no	1988	Levee District No. 1	243 Second Street, Yuba City, CA 95991	yes	yes
30	14.63	C	16	1026+22	2,178,451.96	6,672,425.20	39°08'36.093"N	121°36'34.075"W	Feather River Bridge (SR 20) upstream side	Flatten Waterside Slope		Bridge				94.25					pre-1955			Caltrans		yes	yes
31	14.62	C	16	1025+32	2,178,375.92	6,672,443.76	39°08'35.340"N	121°36'33.844"W	Feather River Bridge (SR 20) downstream side	Flatten Waterside Slope		Bridge				93.90					pre-1955			Caltrans		yes	yes
32	14.62	C	16						Seismic Retro of Feather River Bridge	Flatten Waterside Slope		Bridge									16324		1995	Caltrans			
33	14.62	C	16	1024+95	2,178,319.03	6,672,456.34	39°08'34.777"N	121°36'33.687"W	12 kv power line across levee	Flatten Waterside Slope		EL	OH			88.17										yes	yes
34	14.61	C	16	1024+70			Not Verified		Backfill Community Swimming Pool located near the base of the Feather River Bridge (10th Street Bridge)	Flatten Waterside Slope											7599	yes, cond 13	1971	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	no	no
35	14.60	C	16	1024+48	2,178,296.55	6,672,470.53	39°08'34.556"N	121°36'33.508"W	40 foot long retaining wall landside of levee just downstream of the Feather River Bridge	Flatten Waterside Slope		Road									15133	no	1988	Levee District No. 1	243 Second Street, Yuba City, CA 95991	yes	yes
36	14.56	C	16	1021+95	2,178,044.07	6,672,487.29	39°08'32.058"N	121°36'33.310"W	12 kv power line across levee	Flatten Waterside Slope		EL	OH			84.48								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
37	14.55	C	16				Not Verified		Telephone line on river slope of levee 260 feet downstream of Feather River Bridge (10th Street Bridge)	Flatten Waterside Slope		TL									2703		1957	AT&T			
38	14.55	C	16	1020+85	Not Verified		Not Verified		Abandon 4 inch pipe	Flatten Waterside Slope	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.		1.3	77.72			74.85	78.16	83.90	78.75						yes	yes
39	14.52	C	16	1020+30	2,177,879.35	6,672,496.38	39°08'30.430"N	121°36'33.203"W	Telephone Call box on waterside hinge point	Flatten Waterside Slope		TL				84.09										yes	yes
40	14.51	C	16	1019+82	2,177,832.15	6,672,504.71	39°08'29.963"N	121°36'33.100"W	Power pole in waterside slope	Flatten Waterside Slope		EL	OH			84.09										yes	yes
41	14.43 to 15.26	C	16	1013+00			Not Verified		To place approximately 4,000 feet of blanket drain and filter trench on the right bank of levee of the Feather River upstream and downstream of the SR 20 Bridge	Flatten Waterside Slope		Struc									15034	no	1988	Levee District No. 1	243 Second Street, Yuba City, CA 95991	yes	yes
42	14.36	C	16	1010+75	2,176,773.87	6,672,930.97	39°08'19.484"N	121°36'27.747"W	Install Guy within in landside slope of levee, 12 kV overhead electric	Flatten Waterside Slope		EL				85.00					2640	yes, cond 4	1957	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
43	14.30	C	16	1008+38	2,176,779.63	6,672,929.15			12 kv power line across levee	Flatten Waterside Slope		EL	OH			84.62								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
44	14.60-14.79	C	16	1007+50			Not Verified		To construct approximately 1,300 feet of 12 foot wide bicycle trail on the crown of the right bank levee of the Feather River. The Project is located in Yuba City between the 5th Street Bridge and the easterly extension of Teagarden Avenue	Flatten Waterside Slope		Struc									16344	no	1995	County of Yuba	915 8th Street, Suite 125, Marysville, CA 95901	no	no
45	14.30	C	16						Bike Path below Twin Cities Memorial Bridge	Flatten Waterside Slope		Road									16235		1992	City of Yuba City and City of Marysville	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
46	14.30	C	16	1007+51	2,176,709.34	6,672,981.09	39°08'18.844"N	121°36'27.115"W	Twin Cities Memorial Bridge upstream side	Flatten Waterside Slope		Bridge				87.92					2481	yes, cond 4	1957	County of Sutter and Yuba	1120 Civic Center Blvd., Yuba City, CA 95991	yes	yes
47	14.30	C	16	1007+46	2,176,706.50	6,672,984.37	39°08'18.816"N	121°36'27.073"W	Light pole in water side levee slope	Flatten Waterside Slope		EL	OH											City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
48	14.30	C	16	1007+06	2,176,671.72	6,673,005.93	39°08'18.471"N	121°36'26.801"W	Twin Cities Memorial Bridge downstream side	Flatten Waterside Slope		Bridge				87.99					2481	yes, cond 4	1957	County of Sutter and Yuba	1120 Civic Center Blvd., Yuba City, CA 95991	yes	yes
49	14.30	C	16	1006+93	2,176,642.84	6,672,995.25	39°08'18.186"N	121°36'26.939"W	Power line and Anchor in Levee (actual location)	Flatten Waterside Slope		EL				87.92					2367		1957	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
50	14.28	C	16	1006+60	2,176,647.27	6,673,046.63	39°08'18.228"N	121°36'26.286"W	Sacramento Northern Railroad	Flatten Waterside Slope		RR				86.76					pre-1955		part of orig O&M 1955	Union Pacific Railroad	1400 Douglas Stop #1640, Omaha, NE 68179	yes	yes
51	14.28	C	16	1006+07	2,176,610.55	6,673,084.90	39°08'17.863"N	121°36'25.803"W	Power Pole and anchor in slope of levee. 100 feet south of the SNRR bridge w/ service power overhead	Flatten Waterside Slope		EL	OH			84.44					2475		1957	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
52	14.25	C	16	1005+80			Not Verified		Authorize concrete steps ad 4 inch diameter PVC pipe on the landward slope and a pump house within 10 feet of the landward toe.	Flatten Waterside Slope											16450	yes. Cond 15	1996	City of Yuba c/o Parks and Recreation	1201 Civic Center Blvd., Yuba City, CA 95991	no	no
53	14.28	C	16	1003+72	2,176,461.52	6,673,266.98	39°08'16.382"N	121°36'23.500"W	Power Pole and anchor in slope of levee. 300 feet south of the SNRR bridge	Flatten Waterside Slope		EL	OH			83.28								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
54	14.22	C	16	1000+55			Not Verified		City of Yuba City. To replace the existing retaining wall with an 8 foot high, 76 foot long concrete retaining wall on the landside of the right (east) bank levee of Feather River.	Flatten Waterside Slope											16844	yes. Cond 27	1998	City of Yuba c/o Parks and Recreation	1201 Civic Center Blvd., Yuba City, CA 95993	no	no
55	14.23	C	16				Not Verified		Authorize a 3-wire barded wire fence and two mature trees at the landward toe. The project is located at 563 Second Street	Flatten Waterside Slope											16449	yes. Cond 18	1996	Levee District No. 1	430 Second Street, Yuba City, CA 95991	no	no
56	14.17	C	16				Not Verified		Authorize a 3-wire barded wire fence with a gate within 5 feet of the levee toe and two mature trees at the landward toe. The project is located on Keyser Street	Flatten Waterside Slope											16448	yes. Cond 17	1996	Levee District No. 1	430 Second Street, Yuba City, CA 95991	no	no
57	14.13	C	16				Not Verified		Authorize a 120 foot long building at the landward toe	Flatten Waterside Slope											16447	no	1996	Rodney and Eleanor Fletcher	511 Second Street, Yuba City, CA 95991	no	no
58	14.04	C	16				Not Verified		To excavate 25 feet into landward side of the right bank of the Feather River and construct a concrete retaining wall to provide parking lot space. The project is located at 463 2nd Street behind the Sutter County Administration Building/	Flatten Waterside Slope		Struc									13951 and 13951 (revised)	yes. Cond 13 (original) and no (revised)	1984 & 1996 (revised)	County of Sutter	1160 Civic Center Boulevard, Yuba City, CA 95993	no	no
59	14.01	C	16	993+50			Not Verified		Authorize a building near the landward toe of the levee.	Flatten Waterside Slope											16446	yes. Cond 16	1996	Dolores Scott	160 C Street, Yuba City, CA 95991	no	no
60	13.84-14.01	C	16	993+56			Not Verified		To install approximately 1,010 feet of 8 foot high chain link fence on the waterside side of the right bank levee of the Feather River.	Flatten Waterside Slope											16499	no	1997	Levee District No. 1	430 Second Street, Yuba City, CA 95991	no	no
61	13.98	C	16				Not Verified		Authorize a shed, concrete wall, and chain-link fence with gate at landward toe. The permit also covers two steel posts on the shoulder and seventeen mature trees on the landward slope	Flatten Waterside Slope											16445	yes. Cond 18	1996	Joe and Patricia Benatar	423 Second Street, Yuba City, CA 95991	no	no
62	13.96	C	16				Not Verified		Authorize a shed at the landward toe	Flatten Waterside Slope											16444	yes. Cond 16	1996	Lois Murphy Brown	413 Second Street, Yuba City, CA 95991	no	no
63	13.95	C	16				Not Verified		Authorize a two-story garage and shop building at the landward toe and six mature trees on the landward slope	Flatten Waterside Slope											16443	no	1996	Marjorie Von Geldern	407 Second Street, Yuba City, CA 95991	no	no
64	13.94	C	16				Not Verified		Authorize a building at the landward toe and 21 mature trees and sprinkler system on the landward slope.	Flatten Waterside Slope											16442	no	1996	Max and Sandra McClendon	379 Second Street, Yuba City, CA 95991	no	no
65	13.93	C	17	988+05	2,175,065.02	6,673,942.87			3 inch steel pipe, does not appear to cross levee anymore	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.						74.40	77.54	82.89	78.21				unknown		no	no
66	13.93	C	16				Not Verified		Authorize a garage and a shed at the landward toe	Flatten Waterside Slope											16441	yes. Cond 16	1996	Howard and Raona Hall	373 Second Street, Yuba City, CA 95991	no	no
67	13.91	C	16				Not Verified		Authorize a small building, a chain-link fence, four mature trees at the landward toe, and five clumps of oleanders on the landward slope.	Flatten Waterside Slope											16440	yes. Cond 20	1996	Est. James Barr	365 Second Street, Yuba City, CA 95991	no	no
68	13.90	C	16				Not Verified		Authorize a small building and a chain link fence on an existing retaining wall at the landward toe, concrete stairs, a steel pipe frame, and two large mature trees on the landward slope. A hose bib on the landward shoulder of the right bank of levee	Flatten Waterside Slope											16439	no	1996	Mark Poole	355 Second Street, Yuba City, CA 95991	no	no
69	13.88	C	16				Not Verified		Authorize a see-through fence on a 5 foot retaining wall, steps, and nine mature trees on the landward slope.	Flatten Waterside Slope											16438	yes. Cond 20	1996	Charles and Jean Sanders	349 Second Street, Yuba City, CA 95991	no	no
70	13.87	C	16				Not Verified		Authorize concrete steps with railing and pomegranate bush on landward slope. The permit also covers a concrete retaining wall at the landward toe.	Flatten Waterside Slope											16437	yes. Cond 16	1996	Theodore and Mary Wilkins	341 Second Street, Yuba City, CA 95991	no	no
71	13.86	C	16				Not Verified		Authorize Chain Link fence with gate, three oleander trees, and steps within the landward slope.	Flatten Waterside Slope											16436	yes. Cond 18	1996	Glenn and Jean Koball	335 Second Street, Yuba City, CA 95991	no	no
72	13.84	C	16				Not Verified		Authorize Chain Link fence with gate, three oleander trees, and steps within the landward slope.	Flatten Waterside Slope											16435	yes. Cond 21	1996	Steve and Nancy Albrecht	329 Second Street, Yuba City, CA 95991	no	no
73	13.81	C	16				Not Verified		Authorize building, barbed wire fence, and ten trees at landward toe	Flatten Waterside Slope											16434	yes. Cond 21	1996	Dennis Coakley	306 West 24th Avenue, San Mateo, CA 94403	no	no
74	13.77	C	16				Not Verified		Authorize a 60 foot long see-through board fence and 75 foot long clothesline and landward toe. A shed 5 feet from landward toe and a mature oak tree on the landward slope	Flatten Waterside Slope											16433	yes. Cond 17	1996	Ronald Souza	1550 Elizabeth Lane, Yuba City, CA 95993	no	no
75	13.76	C	16				Not Verified		Authorize a chain-link fence with gate within 10 feet of landward toe	Flatten Waterside Slope											16432	yes. Cond 19	1996	Stevenson Family Trust	459-1/2 Palora Avenue, Yuba City, CA 95991	no	no
76	13.75	C	16				Not Verified		Authorize a see-through fence and storage shed within 10 feet of the landward toe. The project is located at 265 Second Street, Yuba City, CA	Flatten Waterside Slope											16431	yes. Cond 17	1996	Margaret Kellett	265 Second Street, Yuba City, CA 95991	no	no
77	13.74	C	16				Not Verified		Authorize a see-through fence and storage shed within 5 feet of the landward toe. The project is located at 261 Second Street, Yuba City, CA	Flatten Waterside Slope											16430	yes. Cond 19	1996	Ernest Sandoval	22301 Dersch Road, Anderson, CA 96007	no	no
78	13.73	C	16				Not Verified		Authorize a Chain Link fence with gate within 5 feet of landward toe, a cedar tree at the landward toe, and stone steps on the landward slope. This project is located at 255 Second Street.	Flatten Waterside Slope											16429	yes. Cond 17	1996	Teresa Filby	2072 Sanborn, Yuba City, CA 95993	no	no
79	13.68	C	16				Not Verified		Authorize a shed and three trees at the landward toe of the right bank levee of the Feather River. The project is located at 225 Second Street, Yuba City, CA 95991	Flatten Waterside Slope											16428	no	1996	Minnie and Marvin Cole	2061 Royo Rancho Road, Yuba City, CA 95993	no	no
80	13.67	C	16				Not Verified		Authorize a 6 foot high chain link fence and gate at the right bank levee of the Feather River	Flatten Waterside Slope											16427	yes. Cond 17	1996	Dossie and Wanda Smith	219 Second Street, Yuba City, CA 95991	no	no
81	13.65	C	16				Not Verified		Authorize a residence within 5 feet of the landward toe	Flatten Waterside Slope											16426	yes. Cond 16	1996	Ronald Brockman	209 Second Street, Yuba City, CA 95991	no	no
82	13.64	C	16				Not Verified		Authorize a residence at landward toe and oak on the landward slope	Flatten Waterside Slope											16425	no	1996	Carl and Sandra Stout	201 Second Street, Yuba City, CA 95991	no	no
83	13.55	C	16	975+00			Not Verified		To construct a restroom facility with septic tank and leach lines at the Yuba City Boat Ramp on the right bank of the Feather River.	Flatten Waterside Slope											10967	yes, cond 13	1976	County of Sutter	1160 Civic Center Blvd., Suite D, Yuba City, CA 95993		
84	13.53	C	16	972+00			Not Verified		To construct improvement for the boat launching ramp and related facilities on the right bank of the Feather River.	Flatten Waterside Slope											2623	yes, cond 4	1957	Department of Fish and Game		no	no
85	13.53	C	16	972+00			Not Verified		To construct improvement for the Yuba City Boat Ramp consisting of a paved parking area, restroom facilities, floating boat dock and extension of concrete boat ramp on the right bank of the Feather River	Flatten Waterside Slope											5741, 11989	no	1991	County of Sutter	1160 Civic Center Blvd., Suite D, Yuba City, CA 95993		
86	13.53	C	16	972+00			Not Verified		To reconstruct an existing access road to the Yuba-Sutter Boat Ramp on the right bank of the Feather River	Flatten Waterside Slope											9294	yes, cond 13	1974	County of Sutter	1160 Civic Center Blvd., Suite D, Yuba City, CA 95993		
87	13.53	C	16	972+00			Not Verified		To maintain and operate existing boat dock for public use for boating, fishing, and a campground with related facilities including a mobile home on the right bank of the Feather River.	Flatten Waterside Slope											10830, 15741	yes, cond 13	1978	William Baldner	80 2nd Street, Yuba City, CA 95991		
		C	15/16	968+50					Reach 15/16 Transition																		
88		C	15	968+00			Not Verified		To construct 120 lineal feet of sheet piles retaining wall, and nine 10 x 10 foot boat docks supported by seven 12 inc diameter steel piles to an existing 30 foot wide ramp (Yuba City Boat Ramp)	Cutoff Wall	Located within floodway. Does not affect levee project.										17230	yes. Cond 26	2000	County of Sutter	1160 Civic Center Boulevard, Yuba City, CA 95993		
		C	14/15	954+40					Reach 14/15 Transition																		
89		C	14				Not Verified		12 kv cable	No Rehabilitation Required																	

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
		C	13/14	927+00					Reach 13/14 Transition																		
90	12.50-13.07	C	15	925+00			Not Verified		To construct access ramps	Cutoff Wall	Located within floodway. Does not affect levee project.										7460A		1974	County of Sutter	1160 Civic Center Boulevard, Yuba City, CA 95993		
90	12.51	C	13	913+19	2,168,046.21	6,673,496.81	39°06'53.190"N	121°36'21.046"W	Two 16 inch gas lines. (PG&E map shows the gas lines as 12 inch)	Cutoff Wall and relief wells at 200 foot and 65 feet deep	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required.	GL	3.0			82.00	72.16	75.17	80.17	77.14				Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
91	12.15	C	13	894+23	2,166,221.70	6,673,147.49	39°06'35.171"N	121°36'25.578"W	To install a 12kv buried power cable through the right bank levee and across the right bank overflow of the Feather River, a total distance of 896 feet. Poles will be installed near the top of the banks of the low water channel and aerial cable will be placed between the two poles which will be connected to the underground cable.	Cutoff Wall and relief wells at 200 foot and 65 feet deep		EL	UG								12407	yes, cond. 13	1978	Pacific Gas and Electric Company	One Tower, Spear Tower, San Francisco, CA 94105	no	no
92	12.14	C	13	893+84	2,166,181.41	6,673,142.43	39°06'34.772"N	121°36'25.614"W	Garden Highway Industrial Park. To install a 12 inch steel storm drain pipeline through the right bank levee of the Feather River	Cutoff Wall and relief wells at 200 foot and 65 feet deep	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	SD(P)	3.3	77.70	78.70	82.00	71.72	74.77	79.80	76.93	12827	yes, cond. 13	1979	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
93	12.12	C	13	893+78	2,166,175.45	6,673,142.43	39°06'34.772"N	121°36'25.614"W	Burns Drive Storm Water Pump Station. 16 inch steel storm drain discharge pipe through levee.	Cutoff Wall and relief wells at 200 foot and 65 feet deep	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	SD(P)	2.7	77.97	79.30	82.00	71.72	74.77	79.80	76.93	15863	?	1992	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
94	11.90	C	13	881+41	2,164,942.19	6,673,036.13	39°06'22.535"N	121°36'27.067"W	Levee District No. 1 Relief Well Pump Station 6" and 14" pipes located just southeast of the Waste Water Treatment Plant	Cutoff Wall and relief wells at 200 foot and 65 feet deep	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe appears to meet Title 23. The cover over pipe is questionable. Appears no work required but need to pothole to verify.	RW(P)	5.1	75.23	76.40	81.50	71.49	74.54	79.57	76.79				Levee District No. 1	243 Second Street, Yuba City, CA 95991	yes	yes
95	11.43	C	13	856+23	2,162,702.52	6,674,085.34	39°06'05.587"N	121°36'18.675"W	South Yuba City Storm Drainage Pump Station 24 inch 7 GA Steel Pipe asphalt coated and wrapped with asphalt saturated felt discharge pipe	Cutoff Wall and relief wells at 200 foot and 65 feet deep	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	SD(P)	5.2	76.80	78.80	82.00	70.94	74.02	79.04	76.38	15565	no	1992	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
96	11.43	C	13	856+08	2,162,689.81	6,674,093.30	39°06'05.587"N	121°36'18.675"W	South Yuba City Seepage Interceptor Pump Station 24 inch 7 GA Steel Pipe asphalt coated and wrapped with asphalt saturated felt discharge pipe	Cutoff Wall and relief wells at 200 foot and 65 feet deep	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	SD(P)	5.2	76.80	78.80	82.00	70.94	74.01	79.03	76.37	15565	no	1992	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
97	11.24 - 11.95	C	13						Seepage Interceptor Trench and additional relief wells. The improvements were adjacent to the River Oaks subdivision between the wastewater treatment plant and Shanghai Road. All work on landside of levee.	Cutoff Wall and relief wells at 200 foot and 65 feet deep											15850		1991	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	no	no
98	10.80 - 16.00	C	16				Not Verified		Bike Path below Twin Cities Memorial Bridge	Flatten Waterside Slope		Road									16820	yes. Cond 28	1998	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991		
		C	12/13	845+00					Reach 12/13 Transition																		
99	10.60 - 11.15		12						Shanghai Bend Road Setback levee project	No Rehabilitation Required														USACE	1325 J Street, Sacramento, CA	no	no
		B	11/12	830+00					Reach 11/12 Transition																		
100	10.57	B	11	828+55	2,160,267.77	6,675,134.01	39°05'36.240"N	121°36'00.697"W	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	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe might appears to meet Title 23. Appears no work required. We have as-built drawings.	WW(P)	2.3	75.70 rd	77.8 est	79.80	69.02	72.20	77.24	75.15	7151D	yes, cond 13?	1974	City of Yuba City	1201 Civic Center Blvd., Yuba City, CA 95991	yes	yes
101	10.47	B	11				Not Verified		To place an 18 inch storm drain pipeline through the levee on the right bank of the Feather River **(project was not completed - no pipeline installed)**	Cutoff Wall		SD(P)									13219	yes, cond 13	1981	Hauss and Steel Inc.	3909 Garden Highway, Yuba City, CA 95991	n/a	n/a
	9.55	B	10/11	774+00					Reach 10/11 Transition																		
102	9.50	B	10				Not Verified		Construct gauging station 150 feet downstream of Shanghai Bend	Cutoff Wall											4033	yes, cond 5	1962	Department of Water Resources	1120 N Street, Sacramento, CA	no	no
103	9.11	B	10	750+40	2,152,869.21	6,673,338.66	39°04'23.178"N	121°36'23.886"W	115 kv steel tower transmission line crossing of levee	Cutoff Wall		EL	OH								7647		1971	Pacific Gas and Electric Company	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
104	9.10	B	10	750+10	2,152,823.05	6,673,332.24	39°04'22.722"N	121°36'23.970"W	12 kv power line crossing of levee	Cutoff Wall		EL									3665	yes, cond 5	1961	Pacific Gas and Electric Company	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
	8.27	B	9/10	706+50					Reach 9/10 Transition																		
105	8.00	B	9	692+00			Not Verified		To construct 140 lineal feet of sheet piles retaining wall, and nine 10 x 20 foot boat docks supported by seven 12 inch diameter steel piles to an existing 30 foot wide ramp (Boyd Pump Boat Ramp)	Cutoff Wall	Located within floodway. Does not affect levee project.										1723, 11586, 11587	yes. Cond 26	2000	County of Sutter	1160 Civic Center Boulevard, Yuba City, CA 95993		
106	7.94	B	9	692+00			Not Verified		To improve the existing Boyd Pump Boat Launching Facility by widening the existing ramp to 30 feet with 4 foot walkways on each side, paving existing access road, and expanding parking area by 25 spaces, and placing riprap on the right bank of the Feather River.	Cutoff Wall		Struc									14380	yes, cond 13	1985	County of Sutter	1160 Civic Center Boulevard, Yuba City, CA 95993	yes	yes
107	7.94	B	9	692+00			Not Verified		To construct boat launching ramp, well, pump, pressure system, and sanitary facilities on the right bank overflow of the Feather River	Cutoff Wall		Struc									2675	yes, cond 5	1958	Department of Fish and Game		no	no
108	7.94	B	9	689+09	2,146,949.33	6,672,031.04	39°03'24.759"N	121°36'40.813"W	Oswald Mutual Water Company (Boyds Pump) 18 inch epoxy coated mortar lined steel pipe through existing 24 inch concrete pipe crossing of levee	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and gate valve at pump. Pumping up and over levee does not appear to be feasible.	IR(P)	27.6	46.00	48.20	75.80	65.22	68.52	73.36	70.91	pre-1955 & 18181	yes, cond 29	part of orig O&M 1955 & 2007	Oswald Mutual Water Company	Yuba City, CA 95991	yes	yes
109	7.94	B	9	689+00	2,146,953.52	6,672,029.11	39°03'24.759"N	121°36'40.813"W	To replace an existing pole line with a new pole line across the right bank levee of the Feather River. A new pole will be placed 10 feet landward of the landward toe of the levee and another pole will be placed 24 feet water ward of the water ward toe of the levee.	Cutoff Wall		EL	OH			75.94					11663	yes, cond 13	1976	Pacific Gas and Electric Company	5555 Florin Perkins Road, Sacramento, CA 95826	yes	yes
110	7.94	B	9	689+00	2,146,953.52	6,672,029.11	39°03'24.759"N	121°36'40.813"W	To place a service line on a PG&E pole crossing the right bank levee of the Feather River	Cutoff Wall		TL	OH			75.94					11610	yes, cond 13	1976	Pacific Gas and Electric Company	1426 Howe Avenue, Suite 50, Sacramento, CA 95826	yes	yes
111	7.47	B	9	664+07	2,144,450.88	6,672,127.42	39°03'00.186"N	121°36'39.792"W	Sierra Gold Nursery. An 8 inch steel pipe through levee. This pipe was pressure checked and in 1984 as part of permit 13980 to connect to existing pipe.	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	SD(P)	3.6	70.23	70.90	74.50	64.57	67.89	72.68	69.90	pre-1955 & 13980	yes, cond 13	part of orig O&M 1955 & 1984	Sierra Gold Nursery	5320 Garden Highway, Yuba City, CA 95991	yes	yes
112	7.40 - 7.64	B	9	664+20			Not Verified		To reconstruct and pave a 12 foot wide, approximately 1370 feet long road on the landside toe of the right bank levee of the Feather River	Cutoff Wall			4.0								17128	yes. Cond 23	1999	Sierra Gold Nursery	5320 Garden Highway, Yuba City, CA 95991		
	7.29	B	8/9	654+75					Reach 8/9 Transition																		
113	7.18	B	8	649+11	2,142,954.74	6,672,128.18	39°02'45.228"N	121°36'39.774"W	12 kv power line across levee 1900 feet downstream of Mesick Road	Cutoff Wall		EL	OH								4017 & 4378		1962 & 1963	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
114	7.16	B	8	647+74	2,142,830.08	6,672,119.48	39°02'43.998"N	121°36'39.919"W	Feather Water District North Pump Station 1-26" irrigation discharge pipes	Cutoff Wall	The pipeline appears to meet the elevation requirement over 200 year WSEL. May not meet 1957 profile requirement. The type of pipe may or may not meet Title 23. Appears no work required.	IR(P)	1.6	69.90	71.90	73.50	64.28	67.60	72.36	69.33	4127	yes, cond 5	1962	Feather Water District	280 Willkie Avenue, Yuba City, CA 95991	yes	yes
115	7.16	B	8	647+70	2,142,826.16	6,672,118.89	39°02'43.961"N	121°36'39.926"W	Feather Water District North Pump Station 1-26" irrigation discharge pipes	Cutoff Wall	The pipeline appears to meet the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Appears no work required.	IR(P)	1.3	70.15	72.15	73.50	64.28	67.60	72.36	69.33	4127	yes, cond 5	1962	Feather Water District	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
116	7.16	B	8	647+66	2,142,822.01	6,672,118.27	39°02'43.917"N	121°36'39.942"W	Feather Water District North Pump Station 1-26" irrigation discharge pipes	Cutoff Wall	The pipeline appears to meet the elevation requirement over 200 year WSEL. May not meet 1957 profile requirement. The type of pipe may or may not meet Title 23. Appears no work required.	IR(P)	1.4	70.10	72.10	73.50	64.28	67.60	72.36	69.33	4127	yes, cond 5	1962	Feather Water District	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
117	7.16	B	8	647+61	2,142,817.52	6,672,117.60	39°02'43.870"N	121°36'39.951"W	Feather Water District North Pump Station 1-26" irrigation discharge pipes	Cutoff Wall	The pipeline appears to meet the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Appears no work required.	IR(P)	1.3	70.15	72.15	73.50	64.28	67.60	72.36	69.33	4127	yes, cond 5	1962	Feather Water District	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
118	6.69	B	8	622+79	2,140,350.59	6,671,955.66	39°02'19.494"N	121°36'42.102"W	12 kv power line across levee	Cutoff Wall		EL	OH								4003		1962	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
	6.41	B	7/8	596+00					Reach 7/8 Transition																		
119	6.35	B	7	592+67	2,137,447.24	6,671,791.94	39°01'50.802"N	121°36'44.334"W	12 kv power line across levee	565+00 to 596+00 Cutoff Wall		EL	OH								4530	yes, cond 5	1963	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
120	6.00	B	7	587+00	2,136,925.70	6,671,619.94	39°01'45.654"N	121°36'46.542"W	Spur Levee upstream of Abbott Lake	565+00 to 598+87 Cutoff Wall											3787 and 4254	yes, cond 5	1961 and 1963	C.E. Sullivan	5320 Garden Highway, Yuba City, CA 95991	yes	yes
121	5.5 - 6.2	B	7	560+00			Not Verified		To fill in approximately one mile of an existing irrigation ditch at the waterside toe of the right bank of the Feather River.	510+37 to 546+00 Cutoff Wall		Struc									14717	no	1987	Department of Fish and Game	1701 Nimbus Road, Ranch Cordova, CA 95670		
122	5.50	B	7	560+00			Not Verified		To construct a water well with a 14 inch casing in the right bank overflow of the Feather River at Abbott Lake	510+37 to 546+00 Cutoff Wall		Struc									12837	yes, cond. 13	1980	A.S. Cozzolino	9 Cozzolino Drive, Millbrae, CA 94030	no	no
123	5.50	B	7	560+00			Not Verified		To extend approximately 2,500 of 12kv electric service line in the right bank overflow area of the Feather River near Abbott Lake to serve 25 HP Ag Pump for A.S. Cozzolino.	510+37 to 546+00 Cutoff Wall		EL	OH								12832	yes, cond. 13	1980	Pacific Gas & Electric Company	5555 Florin-Perkins Road, Sacramento, CA 95826	no	no
124	5.22	B	7	545+41	2,132,940.57	6,672,317.26	39°01'06.071"N	121°36'37.818"W	Crushed CMP Riser in Land Side Slope. Possible location of 8 inch steel pipe.	510+37 to 546+00 Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	IR(A)	3.1	67.33	68.00	71.10	63.16	66.46	71.05	67.11	pre-1955		part of orig O&M 1955			yes	yes
125	5.05	~~B~~	~~7~~	~~536+73~~	~~2,132,153.19~~	~~6,672,681.57~~	~~39°00'58.434"N~~	~~121°36'33.348"W~~	~~Existing 10 inch steel pipe. Removed in 1964 by Levee District No. 1 as part of permit 4775~~	~~510+37 to 546+00 Cutoff Wall~~	~~Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.~~	~~IR(?)~~									pre-1955 and 4775	yes, cond 5	part of orig O&M 1955	Levee District No. 1	243 Second Street, Yuba City, CA 95991	yes	yes
126	5.05	B	7	536+64	2,132,149.73	6,672,692.81			5 inch steel drainage pipe	510+37 to 546+00 Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	SD(P)	2.0			70.50	63.04	66.34	70.91	66.94	2161	yes, cond 5	1955	C.E. Sullivan	5320 Garden Highway, Yuba City, CA 95991	no	no
127	4.91	B	7	529+47	2,131,549.40	6,673,081.12			Abandon 6 inch pipe	510+37 to 546+00 Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	IR(A)	4.0			70.60	62.95	66.25	70.81	66.72	pre-1955		part of orig O&M 1955			no	no
128	4.50-5.25	B	7						Seepage Interceptor Trench for Star Bend Relief Well Pumps	510+37 to 546+00 Cutoff Wall														USACE	1325 J Street, Sacramento, CA	yes	yes
129	4.50	B	7	512+08	2,130,379.55	6,674,329.99	39°00'40.852"N	121°36'12.526"W	Corp of Engineers Star Bend Road Relief Well Pump Station north 15" Steel Discharge Pipe Crossings	510+37 to 546+00 Cutoff Wall	The pipeline meets the elevation requirement over 200 year WSEL based on the as-built information and type of pipe meets Title 23 requirements. Does not require any work. It does not meet 1957 criteria	SD(P)	3.8	66.15	67.40	71.20	62.77	66.06	70.59	66.37	no permit issued	no		USACE	1325 J Street, Sacramento, CA	yes	yes
130	4.50	B	7	512+04	2,130,375.66	6,674,332.71	39°00'40.814"N	121°36'12.492"W	Corp of Engineers Star Bend Road Relief Well Pump Station south 15" Steel Discharge Pipe Crossings	510+37 to 546+00 Cutoff Wall	The pipeline meets the elevation requirement over 200 year WSEL based on the as-built information and type of pipe meets Title 23 requirements. Does not require any work. It does not meet 1957 criteria	SD(P)	3.7	66.25	67.50	71.20	62.77	66.06	70.59	66.37	no permit issued	no		USACE	1325 J Street, Sacramento, CA	yes	yes
131	4.50	B	7	510+97	2,130,288.81	6,674,393.77	39°00'39.904"N	121°36'11.680"W	12 kv power line crossing of levee	510+37 to 546+00 Cutoff Wall		EL	OH			72.22					5072	yes, cond 5	1965	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
	4.49	B	6/7	510+37					Reach 6/7 Transition																		
132	4.0-4.19		6	510+50			Not Verified		To retain a 12 kv overhead service line and four power poles in the right bank overflow area of the Feather River.	No Rehabilitation Required		EL	OH								15786	no	1992	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
133	4.48		6	510+36	2,130,239.19	6,674,428.41	39°00'39.435"N	121°36'11.304"W	Volcano Vista Farms 18 inch steel irrigation discharge pipe crossing of levee	No Rehabilitation Required	The pipeline meets the elevation requirement over 200 year WSEL based on the as-built information and type of pipe meets Title 23 requirements. Does not require any work.	IR(P)	4.0	68.08 rd	69.6 est	73.64	62.75	66.05	70.57	66.35	18438	yes. Cond 19	2009	Volcano Vista Farms	P.O. Box 9, Meridian, CA 95957	yes	yes
134	4.08		6	510+30					To install 20 hp irrigation pump and to retain an existing walnut orchard (35 acres) all on the right bank of the Feather. Now owned by Volcano Vista Farms and located on Tudor Mutual Pump Station (relocated pipeline part of permit 18438)	No Rehabilitation Required		IR(P)									10551	yes, cond 13	1975	John R. Johnson/M.L. Gilbertson	8104 Garden Highway, Yuba City, CA 95991	no	no
135	4.48		6	510+25	2,130,230.41	6,674,434.54	39°00'39.345"N	121°36'11.232"W	Tudor Mutual Water Company North 30 inch steel irrigation discharge pipes crossing of levee	No Rehabilitation Required	The pipeline meets the elevation requirement over 200 year WSEL based on the as-built information and type of pipe meets Title 23 requirements. Does not require any work.	IR(P)	4.2	66.92 rd	69.5 est	73.68	62.75	66.05	70.57	66.35	18437	yes. Cond 19	2009	Tudor Mutual Water Company	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
136	4.48		6	510+20	2,130,222.24	6,674,437.45	39°00'39.306"N	121°36'11.196"W	Tudor Mutual Water Company South 30 inch steel irrigation discharge pipes crossing of levee	No Rehabilitation Required	The pipeline meets the elevation requirement over 200 year WSEL based on the as-built information and type of pipe meets Title 23 requirements. Does not require any work.	IR(P)	4.1	66.92 rd	69.5 est	73.57	62.75	66.05	70.57	66.35	18437	yes. Cond 19	2009	Tudor Mutual Water Company	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
	~~4.27~~		~~6~~				levee removed		~~12 inch steel pipe through levee (this pipeline removed as part of 2009 setback levee)~~	~~No Rehabilitation Required~~											~~pre-1955~~		~~part of orig O&M 1955~~			~~no~~	~~no~~
	~~4.25~~		~~6~~				levee removed		~~12 kv power line crossing of levee (this portion of levee removed in 2009 as part of Setback Levee)~~	~~No Rehabilitation Required~~											2502	yes, cond 4	1957	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	no	no
	~~4.18~~		~~6~~				levee removed		~~12 kv power line crossing including 9 power poles and 3 anchors. (appears to cover permit 2502 and 5072)~~	~~No Rehabilitation Required~~											10552	yes, cond 13	1975	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	no	no
	~~4.15~~		~~6~~				levee removed		~~Abandon 14 inch pipe (this pipeline removed as part of 2009 setback levee project). Listed as 10" Steel in original 1955 O&M manual.~~	~~No Rehabilitation Required~~		~~IR(P)~~	~~4.1~~								~~pre-1955~~		~~part of orig O&M 1955~~			~~no~~	~~no~~
137	3.8-4.0		6	508+00					To clear, level, and plant a peach orchard on approximately 170 acres on the right bank of the Feather River.	No Rehabilitation Required		Trees									13033	yes. Cond 31	1980	Mark Teesdale	Route 2, Box 2518, Oroville, CA 95965	no	no
138	3.75 - 4.50		6						3,400 lineal feet of setback levee and removal of 4,500 lineal feet of existing levee	No Rehabilitation Required											18191	yes. Cond 31	2009	Levee District No. 1	243 Second Street, Yuba City, CA 95991	no	no
	3.76	A	5/6	478+68					Reach 5/6 Transition																		
139	3.70		5	475+00			Not Verified		To plant walnut orchard in the right overflow area of the Feather River downstream from Star Bend	456+00 to 478+68 Cutoff Wall and 200 foot Seepage Berm		Trees									6641	yes, cond 5	1969	Leo Gildersleeve	8104 Garden Highway, Yuba City, CA 95991	no	no
	3.44	A	5	461+00					Urban (200 year) North - Nonurban (100 year) South Transition																		
140	3.42	A	5	460+11	2,125,845.57	6,676,268.36	38°59'55.716"N	121°35'48.216"W	Abandon 8" steel drainpipe	456+00 to 478+68 Cutoff Wall and 200 foot Seepage Berm	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	IR(A)	4.1			68.10	60.79	64.06	68.37	63.77	pre-1955		part of orig O&M 1955			yes	yes

LEVEE ENCROACHMENT LIST

APPENDIX A

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
141	3.09	A	5	442+80	2,124,212.69	6676803.8			Abandon 8" steel drainpipe	456+00 to 478+68 Cutoff Wall and 200 foot Seepage Berm	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	IR(A)	4.1				60.24	63.47	67.69	63.12	pre-1955		part of orig O&M 1955			yes	yes
142	2.95	A	5	433+50	2,123,304.56	6,677,004.67	38°59'30.780"N	121°35'39.072"W	Power line across levee to service pole with meter on waterside slope of levee	410+67 to 478+68 Cutoff Wall		EL														yes	yes
143	~~2.60~~	~~A~~	~~5~~	~~417+66~~	~~Not Verified~~		~~pipe removed~~		~~Abandon Existing 24 inch pipe through levee. The permit was revised to removal of 24 inch via 4666A so there should not be any pipe.~~	~~410+67 to 478+68 Cutoff Wall~~		~~SD(G)~~									pre-1955 (install) and 4666 (remove)	yes, cond 5	part of orig O&M 1955 and 1964	Levee District No. 1	243 Second Street, Yuba City, CA 95991	no	no
	2.49	A	4/5	410+67					Reach 4/5 Transition																		
144	2.47	A	4	410+53	2,121,173.09	66,776,661.21	38°59'09.036"N	121°35'31.038"W	Power line crossing to Feather Water District Pumps	Cutoff Wall		EL	OH								4464	yes, cond 5	1963	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
145	2.47	A	4	409+84	2,121,105.29	6,677,660.77	38°59'09.036"N	121°35'31.038"W	To install a 2 inch electrical conduit through the levee. The conduit will be buried in the levee slopes and through the crown with one foot of cover. The conduit will provide electrical service to an existing pumping plant in the floodway of the Feather River.	Cutoff Wall	Not sure if the conduit meets the elevation requirement over 200 year WSEL. The type of conduit may or may not meet Title 23. Need to pothole to verify.	EL	2.0			66.20	59.08	62.19	66.19	62.09	7322	yes, cond 5	1971	Feather Water District	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
146	2.47	A	4	409+66	2,121,086.77	6,677,660.88	38°59'08.25"N	121°35'30.876"W	Feather Water District South Pump Station 1-18" irrigation discharge pipes. The improvements include a reservoir at the landside toe of levee and a inlet channel from river to waterside toe.	Cutoff Wall	Pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	IR(P)	0.8	64.10	65.60	66.40	59.08	62.18	66.18	62.08	5313	yes, cond 5	1966	Feather Water District	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
147	2.47	A	4	409+62	2,121,082.47	6,677,660.77	38°59'08.789"N	121°35'30.876"W	Feather Water District South Pump Station 1-18" irrigation discharge pipes. The improvements include a reservoir at the landside toe of levee and a inlet channel from river to waterside toe.	Cutoff Wall	Pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	IR(P)	0.9	64.05	65.55	66.40	59.08	62.18	66.18	62.08	4228	yes, cond 5	1963	Feather Water District	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
148	2.47	A	4	409+58	2,121,078.48	6,677,660.82	38°59'08.748"N	121°35'30.872"W	Feather Water District South Pump Station 1-18" irrigation discharge pipes. The improvements include a reservoir at the landside toe of levee and a inlet channel from river to waterside toe.	Cutoff Wall	Pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	IR(P)	0.8	64.10	65.60	66.40	59.08	62.18	66.18	62.08	4228	yes, cond 5	1963	Feather Water District	280 Wilkie Avenue, Yuba City, CA 95991	yes	yes
149	2.41	A	4	409+55	2,121,075.08	6,677,660.80	38°59'08.668"N	121°35'30.885"W	Taylor Brothers Farm Irrigation Pump Station. A inclined pump located on the waterside slope of levee with 14 Inch Pipeline through levee	Cutoff Wall	Pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	IR(P)	1.4	63.83	65.00	66.40	59.07	62.17	66.17	62.08	4568A	yes, cond 5	1965	George E. Taylor	182 Wilkie Avenue, Yuba City, CA 95991	yes	yes
150	2.47	A	4	409+50	2,121,069.88	6,677,660.77	38°59'08.721"N	121°35'30.870"W	Feather Water District South Pump Station 1-18" irrigation discharge pipes. The improvements include a reservoir at the landside toe of levee and a inlet channel from river to waterside toe.	Cutoff Wall	Pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	IR(P)	1.7	63.25	64.75	66.40	59.08	62.18	66.18	62.08	4228	yes, cond 5	1963	Feather Water District	182 Wilkie Avenue, Yuba City, CA 95991	yes	yes
151	2.40	A	4	407+72	2,120,892.86	6,677,656.42	38°59'08.668"N	121°35'30.885"W	Abandoned pipe and structure at landside toe, pipe is 8 inch, but the headwall appears that it is ran through a larger older pipe possibly and old drainage pie	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed.	IR(A)	21.8	43.87	44.70	66.50	59.00	62.09	66.08	62.01						yes	yes
152	2.21	A	4	396+32	2,119,752.28	6,677,651.86	38°58'55.692"N	121°35'31.050"W	8 inch pipe crossing. Headwall at land toe, art on land side of crown, and cut pipe near water side toe	Cutoff Wall	Not sure if the pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	IR(A)	4.1	61.74	62.40	66.50	58.59	61.63	65.52	61.54	pre-1955		part of orig O&M 1955			yes	yes
153	1.84	A	4	386+63	2,118,786.69	6,677,704.40	38°58'46.170"N	121°35'30.504"W	Abandon 8 inch pipe crossing, stand pipe on land toe has been destroyed.	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find pipe	IR(A)	4.6			66.10	58.29	61.29	65.12	61.07	pre-1955		part of orig O&M 1955			no	no
154	1.51	A	4	365+00	2,116,703.78	6,678,265.36	38°58'25.482"N	121°35'23.46"W	Abandon 8 inch pipe crossing, stand pipe on land toe has been removed.	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find pipe	IR(A)	4.8			65.10	57.71	60.66	64.40	59.97	pre-1955		part of orig O&M 1955			yes	yes
155	1.00	A	4	342+27	2,114,521.83	6,678,856.40	38°57'22.128"N	121°35'08.814"W	Irrigation Production Well (located xx foot west of levee toe)	Cutoff Wall		IR(W)														no	yes
	0.39	A	3/4	300+66					Reach 3/4 Transition																		
156	0.34	A	3	298+89	2,110,314.83	6,679,535.86	38°57'22.204"N	121°35'07.763"W	Removal of a portion and filling with concrete a portion of an abandoned 36 inch steel pipe through the right bank levee of the Feather River	Cutoff Wall		IR(G)									pre-1955 (install) and 4667	yes, cond 5	part of orig O&M 1955 and 1964	Levee District No. 1	243 Second Street, Yuba City, CA 95991	yes	yes
157	0.36	A	3	298+67	2,110,292.12	6,679,458.78	38°57'22.218"N	121°35'08.814"W	Garden Highway Mutual Water - Irrigation Production Well (located 30 foot west of levee toe)	Cutoff Wall		IR(W)											2009	Garden Highway Mutual Water Company	12755 Garden Highway, Yuba City, CA 95991	yes	yes
158	0.35	A	3	298+38	2,110,262.81	6,679,553.51	38°57'21.757"N	121°35'07.763"W	Garden Highway Mutual Water 54 inch Irrigation Pump Station Discharge Pipeline through Levee. The improvements include a inlet channel from the river to the 200 feet from waterside toe of levee and irrigation canal at the toe of the landside of levee.	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and gate valve at pump. Pumping up and over levee does not appear to be feasible.	IR(G)	25.1	38.00		63.90	55.88	58.57	61.86	57.78	pre-1955		part of orig O&M 1955	Garden Highway Mutual Water Company	12755 Garden Highway, Yuba City, CA 95991	yes	yes
	0.00	A	3	280+90					State Maintenance Area 3 / Levee District No. 1 Levees Transition																		
1	4.05	A	3	219+00	Not Verified		Not Verified		12 inch pipe. Appears to be removed by pipe laying on ground adjacent to location	Cutoff Wall	Not sure if the abandonment meets title 23 requirements or elevation requirements. Could not find pipe.	IR(A)		59.2 (USED)			55.23	57.92	61.19	56.15	pre-1955		part of orig O&M 1955			no	no
	4.01	A	2/3	218+66					Reach 2/3 Transition																		
2	3.84	A	2	209+89	2,101,737.07	6,678,031.40	38°55'57.543"N	121°35'27.300"W	Electrical service crossing for pump	181+00 to 218+66 Cutoff Wall and 100 foot Seepage Berm		EL	OH			62.29										yes	yes
3	3.83	A	2	209+23	2,101,673.35	6,678,014.21	38°55'56.918"N	121°35'27.543"W	Private Irrigation Pump Station. 14 inch welded steel pipe crossing	181+00 to 218+66 Cutoff Wall and 100 foot Seepage Berm	Pipeline meets the elevation requirement over 200 year WSEL. The type of pipe may or may not meet Title 23. Need to pothole to verify.	IR(P)	3.0	59.37 est	60.20	62.90	55.17	57.86	61.13	56.00	1730	yes, cond 3	1952	Robert Crandall	Bogue Road, Route 1, Yuba City, CA 95991	yes	yes
4	3.70 - 4.25	A	2	217+00					National Audubon Society. To plant approximately 4,000 native trees on 40 acres within the right bank overflow area of the Feather River	181+00 to 218+66 Cutoff Wall and 100 foot Seepage Berm		Trees									17012	yes, cond 17	2000	National Audubon Society	555 Audubon Place, Sacramento, CA 95825		
5	2.9-5.19	A	2	217+00					National Audubon Society. To plant approximately 300 to 500 native trees (primarily cottonwoods) on the right bank overflow area of the Feather River.	181+00 to 218+66 Cutoff Wall and 100 foot Seepage Berm		Trees									16817	yes, cond 21	1998	National Audubon Society	555 Audubon Place, Sacramento, CA 95825		
6	3.18	A	2	174+91	Not Verified		Not Verified		12 inch pipe	129+66 to 181+00 Stability Berm and 100 foot Seepage Berm	Not sure if the abandonment meets title 23 requirements or elevation requirements. Could not find pipe.		4.5				54.73	57.40	60.61	55.57						no	no
	0.00	A	1/2	129+66					Reach 1/2 Transition																		
7	2.19-3.00	A	1	125+00					To level 60 hectares of leered land westward of the right bank of the Feather River upstream of the SR 99 Bridge	Cutoff Wall		Struc									8638, 13343, 12590	yes, cond. 13	1982	Nevis Land Co. now owned by DFG	1416 9th Street, Sacramento, CA 95814	yes	yes
8	2.19	A	1	124+32	2,094,124.90	6,679,433.55	38°54'42.235"N	121°35'09.990"W	Hamatani Ranch - Sacramento Avenue Irrigation Pump Station and pipeline crossing	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and gate valve at pump. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent design.	IR(P)		32.01		60.39	53.53	56.08	59.07	53.55	3284	yes, cond 4	1960	T.H. Richards now owned by Odysseus Farms PTN	P.O. Box H, Yuba City, CA 95992	yes	yes
9	2.19	A	1	124+32	2,094,124.90	6,679,433.55	38°54'42.235"N	121°35'09.990"W	24 inch culvert pipe. Part of Sacramento Avenue Irrigation Pump Station	Cutoff Wall	The pipeline does not meet title 23 requirements and will need a positive shut-off structure installed and gate valve at pump. Pumping up and over levee does not appear to be feasible. Should be part of 30 percent design.	IR(P)	26.0	32.01		60.39	53.53	56.08	59.07	53.55	pre-1955		part of orig O&M 1955	T.H. Richards now owned by Odysseus Farms PTN	P.O. Box H, Yuba City, CA 95992	yes	yes
10	2.10	A	1	124+21	2,094,115.32	6,679,426.80	38°54'42.141"N	121°35'10.076"W	12 kv overhead electrical crossing	Cutoff Wall		EL	OH			60.31								Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
11	1.85	A	1	107+21	2,092,674.99	6,678,527.08	38°54'27.944"N	121°35'21.542"W	Remaining abutment for old Nicolaus Bridge	Cutoff Wall		Bridge				60.80								County of Sutter	1160 Civic Center Blvd, Yuba City, CA	yes	yes

LEVEE ENCROACHMENT LIST

					Location (NAD 83)		Location (WGS 84)							Elevations (NGVD 1988)			Water Surface Elevation (NGVD 1988)				CVFPB Permit Information			Owner Information			
	Levee Mile	SBFCA Phase	SBFCA Reach	SBFCA STA	Northing	Easting	Latitude	Longitude	Encroachment	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	Permit No.	Require Permittee to Relocate	Year	Name	Address	verified	Picture Taken
12		A	1	105+00			Not Verified		To construct three 1 acre ponds on the right bank overflow area of the feather River	Cutoff Wall		Struc									16738	no	1997	Department of Fish and Game	1701 Nimbus Road, Suite A, Rancho Cordova, CA 95670		
13		A	1	99+00					Hamatani Ranch Irrigation Canal - Station 99+00 to 107+00	Cutoff Wall		IR(G)												T.H. Richards now owned by Odysseus Farms PTN	P.O. Box H, Yuba City, CA 95992	no	no
14	1.60	A	1	98+00	2,092,080.61	6,677,794.38	38°54'22.101"N	121°35'30.845"W	State Route 99 Crossing of Levee -To install two removable barriers on the roadway shoulders at the SR 99 crossing of the right bank of levee crown of the Feather River.	Cutoff Wall		Bridge				62.03					14286	no	1986	Caltrans	703 B Street, Marysville, CA 95901	yes	yes
15	1.60	A	1	97+61	2,092,071.07	6,677,788.96	38°54'22.007"N	121°35'30.914"W	U.S. Communication cable	Cutoff Wall	Not sure if the conduit meets the elevation requirement over 200 year WSEL. The type of conduit may or may not meet Title 23. Need to pothole to verify.	TL	3.0			61.04					3511					yes	yes
16	1.2-2.7	A	1	74+00			Not Verified		To install two sections of 12KV three phase power lines, approximately 2.3 kilometers in combined length, to provide service for irrigation pumps. The project is located in the overflow area at the right bank levee of the Feather River running north and south of the Garden Highway crossing and over the Nelson Slough levee.	Cutoff Wall		EL	OH							13409	yes, cond 13	1982	Pacific Gas & Electric	5555 Florin-Perkins Road, Sacramento, CA 95826	no	no
17	1.20	A	1	73+39	2,090,564.35	6,675,895.46	38°54'07.197"N	121°35'54.953"W	12 kv overhead electrical crossing	Cutoff Wall		EL	OH			56.04					2483	yes, cond 4	1957	Pacific Gas & Electric	One Tower, Spear Tower, San Francisco, CA 94105	yes	yes
18	1.20	A	1	72+27	2,090,511.86	6,675,799.08	38°54'06.682"N	121°35'56.176"W	Transmission Line Crossing - East Line	Cutoff Wall		EL	OH			55.83							2008	WPA	114 Parkshore Drive, Folsom, CA 95630-4710	yes	yes
19	1.20	A	1	71+89	2,090,504.83	6,675,762.31	38°54'06.614"N	121°35'56.641"W	Transmission Line Crossing - West Line	Cutoff Wall		EL	OH			55.64							2009	WPA	114 Parkshore Drive, Folsom, CA 95630-4710	yes	yes
20	0.80	A	1	52+25	2,091,015.74	6,673,876.41	38°54'11.746"N	121°36'20.470"W	Hamatani Ranch Storm Drainage Pump Station. The pump discharge is a 20 inch pipe and pump is Bryon Jackson 17H0H with 50 HP electrical motor.	Cutoff Wall	The pipeline is appears to meet the elevation requirement over 200 year WSEL based on the record information and type of pipe may or may not meet Title 23. Should be part of 30 percent design.	SD(P)	3.0	49.35 rd	51.02 rd	56.34	50.43	52.76	55.28	48.84	13624	yes, cond. 13	1983	Danna & Danna Inc. now owned by Odysseus Farms PTN	P.O. Box H, Yuba City, CA 95992	yes	yes
21	0.80	A	1	52+25	2,091,015.74	6,673,876.41	38°54'11.746"N	121°36'20.470"W	2-18 inch steel pipes with concrete "U" headwall at waterside toe.	Cutoff Wall	Not sure if the abandonment meets title 23 requirements. Pipe may need to be properly abandoned or completely removed. Could not find pipe.	SD(G)	32.0	24.0 (USED)							pre-1955		part of orig O&M 1955	Danna & Danna Inc. now owned by Odysseus Farms PTN	P.O. Box H, Yuba City, CA 95992	yes	yes
22	0.00	A	1	10+82	2,088,598.75	6,670,597.31	38°53'47.993"N	121°37'02.081"W	To install canal gates on two existing 48 inch CMP culverts under a spur levee on the right bank overflow area of the Feather River	Cutoff Wall		IR(G)	32.0			54.48					13506	yes, cond. 13	1982	Nevis Land Co. now owned by DFG	1416 9th Street, Sacramento, CA 95814	yes	yes
23	0.00	A	1	10+60					Hamatani Ranch Storm Drainage Ditch - Station 10+60 to 68+25	Cutoff Wall		IR(G)	32.0			54.48					13506		1982	Nevis Land Co. now owned by DFG	1416 9th Street, Sacramento, CA 95814	yes	yes
	0.00	A	1	10+00					Begin Reach 1																		

Part of TO 6 Contract

Part of TO 5 Contract

Part of TO 4 Contract

Encroachment but not part of MHM work - Redline HDR or WR Plans

SD(G)	Storm Water - Gravity
SD(P)	Storm Water - Pressure
WW(G)	Waste Water - Gravity
WW(P)	Waste Water - Pressure
IR(G)	Irrigation Line - Gravity
IR(P)	Irrigation Line - Pressure
RW (P)	Raw Water - Pressure
W(P)	Water Line - Pressure
RD	Roadway Crossing
GL	Gas Line
TL	Telephone
EL	Electric Line
SEEP	Seepage

PRELIMINARY

SUTTER BUTTE FLOOD CONTROL AGENCY
FEATHER RIVER WEST LEVEE PROJECT
PG&E ENCROACHMENTS COORDINATION LIST

PROJECT B (STATION 510+37 TO 845+00)
LEVEE CONSTRUCTION TO BEGIN IN 2014

PROJECT NUMBER	STATION	DESCRIPTION	WORK REQUIRED
B-1	592+50	Overhead power line crossing the levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
B-2	622+79	Service pole for irrigation well located at levee toe.	Service pole shall be removed.
B-3	638+20	Service pole for irrigation well located near levee toe.	Service pole shall be removed.
B-4	649+11	Utility pole located at landside levee toe. Overhead power line crossing the levee.	Utility pole shall be relocated 30' from landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
B-5	655+50	Service pole for irrigation well located near levee toe.	Service pole shall be removed.
B-6	655+65 to 664+00	Utility poles running parallel to levee near landside toe.	Utility poles shall be relocated 30' from levee toe.
B-7	669+20	Service pole for irrigation well located at levee toe.	Service pole shall be removed.
B-8	688+90 to 689+40	Utility poles located at the landside levee toe. Overhead power line crossing the levee.	Utility poles shall be relocated 30' from landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required. Utility poles on waterside of levee are not required to be relocated by the CVFPB.
B-9	749+75 to 762+00	Utility poles running parallel to levee at landside toe.	Utility poles shall be relocated a minimum of 30' from levee toe. The Garden Highway is located at the levee toe. The utility poles shall be relocated to the west side of the Garden Highway.
B-10	750+10	Overhead power line crossing the levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
B-11	750+50	Transmission lines crossing the levee.	For information only. Transmission lines will not be disturbed during construction.

NOTE: The existing utilities shown are based on topographic surveys and review of existing encroachment permits provided for the FRWL Project. Additional utilities may exist that have not been identified by these sources. PG&E shall review the appropriate electrical and gas maps to determine if additional utilities are located within the project area.

4/1/2013

PRELIMINARY

SUTTER BUTTE FLOOD CONTROL AGENCY
FEATHER RIVER WEST LEVEE PROJECT
PG&E ENCROACHMENTS COORDINATION LIST

PROJECT C1 (STATION 1080+00 TO 1623+86)
LEVEE CONSTRUCTION TO BEGIN IN 2014

PROJECT NUMBER	STATION	DESCRIPTION	WORK REQUIRED
C1-1	1080+00	8-inch gas main crossing levee at skewed angle.	Gas main shall be removed or relocated to allow for construction of the levee improvements. The gas mains shall be reconstructed in accordance with the DWR Title 23 requirements. Reconstructed gas main shall cross perpendicularly to the levee.
C1-2	1097+00	Not Used.	
C1-3	1107+82	Utility pole located in waterside slope near levee crown. Overhead power line crossing levee.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-4	1126+00 to 1131+30	Utility poles running parallel to levee near landside toe.	Utility poles shall be relocated a minimum of 30' from the levee toe. Live Oak Blvd is in close proximity to the levee. It may be necessary to relocate the utility poles to the west side of Live Oak Blvd.
C1-5	1135+40	16-inch gas main crossing the levee.	Gas main shall be removed or relocated to allow for construction of the levee improvements. The gas main shall be reconstructed in accordance with the DWR Title 23 requirements.
C1-6	1139+25	Utility pole with guy wire in landside levee slope near levee crown. Overhead power line crossing levee.	Utility pole shall be relocated 30' from landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-7	1152+40	Twin 110kV transmission tower at levee toe. Transmission lines crossing the levee.	For Information only. Transmission tower to remain in place. Transmission lines will not be disturbed during levee construction.
C1-8	1170+05	Utility pole located in landside slope near levee crown. Angle point in the overhead power line. Overhead power line crosses the levee and continues north parallel to the landside toe.	Utility pole shall be relocated 30' from landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-9	1174+35	Utility pole located near landside levee toe.	Utility pole shall be relocated 30' from landside levee toe.
C1-10	1179+05 to 1201+25	Utility poles running parallel to levee at landside toe.	Utility poles shall be relocated 30' from landside levee toe.

C1-11	1195+15	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-12	1222+15	Utility pole located at landside levee toe. Angle point in overhead power line. Overhead power line turns and continues north crossing at a skewed angle to the levee.	Utility pole shall be relocated 30' from landside levee toe.
C1-13	1223+80 to 1227+60	Utility poles running parallel to levee at waterside toe.	Utility poles shall be relocated 1' outside of the waterside construction limit line.
C1-14	1225+90	Utility pole in landside slope at levee crown. Overhead power line crossing levee at skewed angle.	Utility pole shall be relocated 30' from landside levee toe.
C1-15	1266+80	Utility pole in landside slope near levee toe. Overhead power line crossing levee.	Utility pole shall be relocated 30' from landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-16	1293+66	Utility pole located at waterside levee toe. Overhead power line crossing levee.	Utility pole shall be located 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-17	1307+80 to 1339+00	Utility poles running parallel to levee at waterside toe.	Utility poles shall be relocated 1' outside of the waterside construction limit line.
C1-18	1327+00	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-19	1347+40	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-20	1391+96	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-21	1399+28	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-22	1430+00	Substation, transformers, and utility poles located at the waterside slope. Overhead power lines crossing levee.	Substation, transformers, and utility poles shall be protected in place by the levee contractor. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-23	1460+00 to 1471+00	Underground utility line place within crown of levee per PG&E utility maps.	Underground utility shall be relocated a minimum of 30' from the landside levee toe. The top of the Sutter Butte Main Canal is located approximately 50' from the landside levee toe. Two residential structures are located near the landside levee toe, providing approximately 25' between the structure and top of the Sutter Butte Main Canal.
C1-24	1520+25	Utility pole located in landside slope near toe of levee. Overhead power line crossing levee.	Utility pole shall be relocated 30' from landside levee toe. Existing structure is located at the landside levee toe approximately 20' to 30' from the existing overhead power line alignment. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-25	1536+00	Utility pole located at landside levee toe. Overhead power line crossing levee.	Utility pole shall be relocated 30' from landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.

C1-26	1556+58	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C1-27	1611+40	Two utility poles located at waterside levee toe. Overhead power line crossing levee.	Utility poles shall be located 1' outside of the waterside construction limit line. Residential structures are located near poles. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.

PROJECT C2 (STATION 845+00 TO 913+00)
LEVEE CONSTRUCTION TO BEGIN IN 2013

PROJECT NUMBER	STATION	DESCRIPTION	WORK REQUIRED
C2-1	881+50	Utility pole at landside toe of levee next to LD1 relief well pump station.	No work required. Utility pole to remain in place.
C2-2	894+22	12 kV underground cable crossing through levee.	The 12kV underground cable shall be removed to allow for construction of the levee improvements. The 12kV cable shall be replaced after levee construction in accordance with the DWR Title 23 requirements.
C2-3	894+22	Utility pole near landside levee toe.	Utility pole shall be relocated 1' outside of the landside construction limit line.
C2-4	904+50 to 912+94	Gas main running parallel to the levee within 20' of the landside toe.	Gas main to remain in place. Gas main to be analyzed to determine if construction loads will damage pipe.
C2-5	912+94	Gas transmission station located approximately 40' from landside levee toe.	No work required. Gas transmission station to remain in place. Contractor to protect station in place.

PROJECT C2 (STATION 913+00 TO 1080+00)
LEVEE CONSTRUCTION TO BEGIN IN 2014

PROJECT NUMBER	STATION	DESCRIPTION	WORK REQUIRED
C2-6	913+20	Two 12-inch gas lines crossing levee.	Gas mains shall be removed or relocated to allow for construction of the levee improvements. The gas mains shall be reconstructed in accordance with the DWR Title 23 requirements.
C2-7	930+00 to 952+00	Gas main running parallel to the levee at the landside toe.	Gas main to remain in place. Gas main to be analyzed to determine if construction loads will damage pipe.
C2-8	952+10	Not used.	

C2-9	959+00 to 972+00	Utility poles running parallel to levee near landside toe.	Utility poles shall be relocated a minimum of 30' from the levee toe. Second Street is adjacent to the levee toe. The utility poles shall be relocated to the west side of Second Street.
C2-10	971+70	Utility pole in waterside levee slope. Overhead power line crossing levee.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Overhead power line crossing can remain in place.
C2-11	1003+72	Utility pole in landside levee slope near crown of levee. A streetlight is attached to the utility pole.	No work required. Utility pole to remain in place.
C2-12	1006+07	Utility pole in waterside levee slope near crown of levee. A streetlight is attached to the utility pole.	No work required. Utility pole to remain in place.
C2-13	1006+93	Utility pole and anchor within landside levee slope near crown of levee. Overhead power line crossing the levee.	No work required. Utility pole to remain in place. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C2-14	1008+00 To 1025+00	Utility poles and overhead power line running parallel to LS levee toe.	Utility poles shall be relocated a minimum of 1' outside of the construction limit line. A residential structure is in close proximity to the levee at Station 1012+00.
C2-15	1008+75	Utility pole located in waterside levee slope. Overhead power lines crossing levee.	Utility pole shall be located a minimum of 1' outside of the waterside construction limit line. Special consideration of this location is required due to the close proximity of the levee to the river channel.
C2-16	1019+80 to 1022+10	Utility poles in waterside slope near levee crown. Streetlights are attached to the utility poles.	No work required. Utility poles to remain in place.
C2-17	1025+00	Utility pole with guy wires in waterside levee slope and near landside levee toe. Overhead power line crossing levee.	Utility pole near landside toe shall be relocated 30' from the . Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
C2-18	1028+09	Utility pole in waterside slope near levee crown. Streetlight is attached to the utility pole.	No work required. Utility pole to remain in place.
C2-19	1042+50 to 1080+00	Gas main running parallel to the levee at the landside toe.	Gas main to remain in place. Gas main to be analyzed to determine if construction loads will damage pipe.
C2-20	1073+41	12-inch gas main crossing the levee.	The gas main shall be reconstructed to meet current DWR Title 23 requirements.

NOTE: The existing utilities shown are based on topographic surveys and review of existing encroachment permits provided for the FRWL Project. Additional utilities may exist that have not been identified by these sources. PG&E shall review the appropriate electrical and gas maps to determine if additional utilities are located within the project area.

PRELIMINARY

SUTTER BUTTE FLOOD CONTROL AGENCY
FEATHER RIVER WEST LEVEE PROJECT
ENCROACHMENTS COORDINATION LIST - PROJECT D (STATION 1623+86 TO 2368+00)

PROJECT D1 (STATION 2290+00 TO 2368+00)
LEVEE CONSTRUCTION TO BEGIN IN 2014

PROJECT NUMBER	STATION	DESCRIPTION	WORK REQUIRED
D1-1	2335+70 to 2351+70	Utility poles running parallel to levee within landside slope.	Utility poles shall be relocated 30' from the toe of proposed seepage berm.
D1-2	2353+90	Utility pole located at the waterside levee toe.	Utility pole shall be relocated 1' outside of the waterside construction limit line.
D1-3	2360+15 to 2367+90	Utility poles running parallel to levee at the waterside levee toe or within the levee prism.	Utility poles shall be relocated 1' outside of the waterside construction limit line.

PROJECT D2 (STATION 1813+33 TO 2290+00)
LEVEE CONSTRUCTION TO BEGIN IN 2014

PROJECT NUMBER	STATION	DESCRIPTION	ma
D2-1	1887+10	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-2	1888+60 to 1895+10	Utility poles running parallel to the levee at the landside toe.	Utility poles shall be relocated 30' from the landside levee toe. Overhead power lines continue parallel to the levee from Station 1895+10 to 1906+60. Poles shall remain in place between Station 1898+20 to 1906+60. A structure is located at Station 1897+00, between the pole to be relocated at Station 1895+10 and the pole to remain at Station 1898+20.
D2-3	1903+96	Guy wire crossing over levee.	Guy wire shall be removed during levee construction.
D2-4	1906+60	Overhead power lines crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-5	1947+33	Utility pole at waterside levee toe. Underground electrical crossing through levee.	Utility pole shall be relocated 1' outside of the waterside construction limit line. The underground electrical shall be removed and disposed. Unknown if this service is still required.

D2-6	1957+00	Utility pole located at the waterside levee toe. Overhead power line crossing the levee.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Overhead power line shall be lowered during levee
D2-7	1957+10	Utility pole located in the levee crown.	Utility pole shall be relocated 30' from the landside levee toe. Facilities served by utility pole are being removed.
D2-8	2006+10 to 2006+50	Utility poles located at landside levee toe.	Utility poles shall be relocated 30' from the landside levee toe. Utility poles serve an irrigation well that will be relocated.
D2-9	2037+15	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-10	2092+20	Overhead power line crossing levee.	Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-11	2138+00	Utility pole located at the landside levee toe. Overhead power line crosses levee to utility pole located at Station 2142+00.	Utility pole shall be relocated 30' from the landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-12	2142+00	Utility pole located at waterside levee toe.	Utility pole shall be relocated 1' outside of the waterside construction limit line.
D2-13	2178+20 to 2185+50	Utility pole at Station 2178+20 located at the waterside levee toe. Overhead power line crosses levee to utility poles located at the landside levee toe. Power lines continue parallel to the levee.	Utility poles on the waterside of the levee shall be relocated 1' outside of the waterside construction limit line. Utility poles on the landside of the levee shall be relocated 30' from the landside levee toe. Existing structures located at the landside levee toe starting at Station 2184+50 conflict with utility pole relocations on the landside of the levee.
	2209+00 to 2214+45	Utility poles located at landside levee toe.	Utility pole shall be relocated 30' from the landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-14	2216+70	Utility pole located in the waterside slope at the levee crown. Overhead power line crossing the levee.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-15	2249+00	Utility pole located at the landside levee toe. Overhead power line crossing the levee.	Utility pole shall be relocated 30' from the landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-16	2264+70 to 2268+45	Utility poles running parallel to the levee at the landside toe. Overhead power line crosses levee at Station 2265+50 to utility pole located on waterside of the levee.	Utility poles on landside of the levee shall be relocated 30' from the landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-17	2282+80	Utility pole located near the waterside levee toe adjacent to a structure. Overhead power line crossing the levee.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D2-18	2286+00 to 2289+60	Utility poles running parallel to the levee at the landside toe.	Utility poles shall be relocated 30' from the landside levee toe.

PROJECT D3 (STATION 1623+86 TO 1813+33)
LEVEE CONSTRUCTION TO BEGIN IN 2014

PROJECT NUMBER	STATION	DESCRIPTION	WORK REQUIRED
D3-1	1635+50 to 1638+70	Utility poles running parallel to the levee at the waterside levee toe. Overhead power line crossing the levee at Station 1638+70.	Utility poles shall be relocated 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D3-2	1651+80	Utility pole located in the waterside levee slope. Overhead power line crosses the levee at Station 1653+15.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D3-3	1654+20	Utility pole located at the landside levee toe.	Utility pole shall be relocated 30' from the landside levee toe.
D3-4	1665+30 to 1674+50	Utility poles running parallel to the levee at the landside levee toe. Overhead power line crossing the levee at Station 1665+30.	Utility poles shall be relocated 30' from the landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D3-5	1675+96	Utility pole located in the waterside levee slope. Overhead power line crosses the levee.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D3-6	1697+95	Utility pole located at the waterside levee toe. Overhead power line crossing the levee.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
NEW	1722+50	Utility crosses at 1724+55 and 1728+50	Move utilities from waterside to landside to eliminate 1724+55 crossing.
D3-7	1724+90 to 1731+50	Utility poles running parallel to the levee located in the waterside slope or at the waterside levee toe. Overhead power line crossing the levee at Station 1728+30.	Utility poles shall be relocated 1' outside of the waterside construction limit line. Structures located near the waterside levee toe may conflict with the relocation of the utility poles. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
NEW	1748+35	Utility pole located at the landside levee toe.	Utility pole shall be relocated 1' outside of the waterside construction limit line. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D3-8	1767+45	Utility pole located in landside slope near levee crown. Overhead power lines crossing the levee.	Utility pole shall be relocated 30' from the landside levee toe. Temporary removal, de-energizing, raising, or relocation of the power line to support levee construction required.
D3-9	1782+50	Utility pole located at landside levee toe.	Utility pole shall be relocated 30' from the landside levee toe.

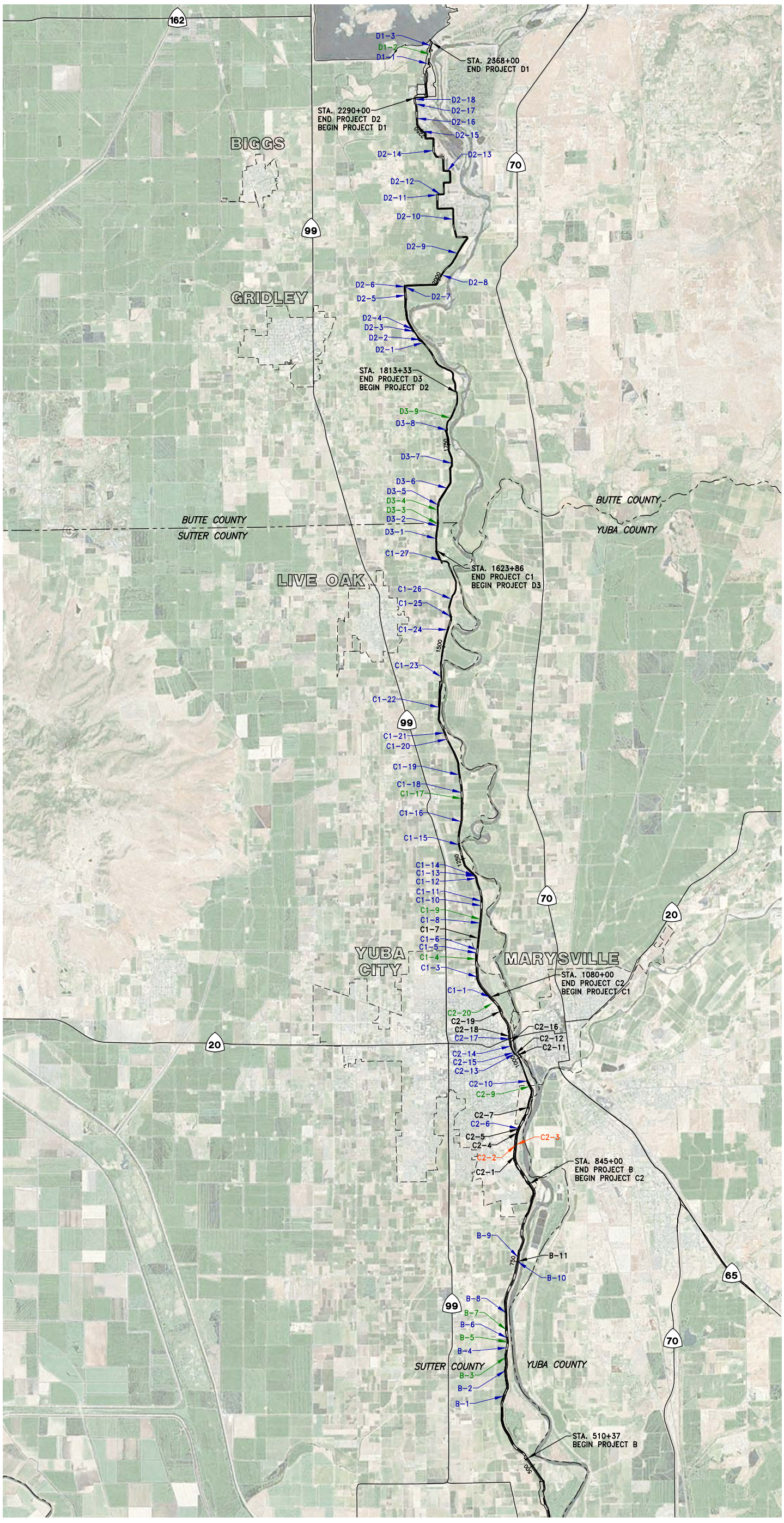
NOTE: The existing utilities shown are based on topographic surveys and review of existing encroachment permits provided for the FRWL Project. Additional utilities may exist that have not been identified by these sources. PG&E shall review the appropriate electrical and gas maps to determine if additional utilities are located within the project area.

PG&E PROJECT COORDINATION

FEATHER RIVER WEST LEVEE

SUTTER BUTTE FLOOD CONTROL AGENCY

APRIL, 2013



6000' 3000' 0 6000'

SCALE: 1" = 6000'

LEGEND

X#-#	PG&E UTILITY TO BE RELOCATED PRIOR TO 2013 CONSTRUCTION
X#-#	PG&E UTILITY TO BE RELCOATED PRIOR TO 2014 CONSTRUCTION
X#-#	PG&E UTILTY TO BE RELOCATED BUT NOT IN CONFLICT WITH LEVEE CONSTRUCTION
X#-#	ITEM LISTED FOR INFORMATION ONLY

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Appendix H

Public Health and Hazards: EDR Data Map Environmental Atlas

ENVIRONMENTAL SITE ASSESSMENT
SUTTER BASIN FEASABILITY STUDY
SUTTER AND BUTTE COUNTIES, CALIFORNIA

1.0 SUMMARY

This report presents the results of an Environmental Site Assessment (ESA) performed during June/July of 2009 by the Environmental Design Section (EDS) of the U. S. Army Corps of Engineers (USACE), Sacramento District. This ESA identified numerous sources of possible contamination due to Hazardous, Toxic, or Radioactive Waste (HTRW) during records research and site investigation.

Data research showed 85 sources of potential contamination within 1/4 mile of the project boundaries. The breakdown of these sources is as follows:

- 51 registered underground storage tanks (UST's) and 3 aboveground storage tanks (AST's).
- 5 sources are listed as small and large generators of EPA regulated hazardous waste.
- 5 sites that had leaking UST's, 2 which have/had affected public drinking water
- 6 known or potential hazardous substance sites under investigation or cleanup
- 2 Waste discharge systems
- 2 Landfills
- 12 suspected drug labs
- 1 pesticide-producing facility

For the majority of the sources, no records were found to indicate that these potential sources have actually caused major contamination, although there are still on-going investigations. For the purpose of this investigation, there are several areas of concern in the event of flooding. Most involve registered UST's, hazardous waste generators, minor tank leaks, UST removal and remediation, and accidental releases.

This Environmental Site Assessment (ESA) did not confirm any known contamination due to Hazardous, Toxic, or Radioactive Waste (HTRW) within the construction zone during records research and field survey.

No field investigation or records review found any evidence to indicate that any other potential sources of contamination would interfere with any planned construction of the levees.

2.0 INTRODUCTION

2.1 Scope of Report

The purpose of this ESA is to identify recognized environmental conditions, including the presence or likely presence of any hazardous substances or petroleum products under conditions that indicate an existing release, a past release, or the material threat of a release into structures, the ground, groundwater or surface waters of the property. This report addresses HTRW within the study area which may affect construction for levee repairs on the Sutter Bypass within the Sutter Basin project. This report was prepared in accordance with ASTM E-1527-94, ER 1165-2-132; Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects; and EC 1105-2-206, Project Modifications for Improvement of the Environment. A data search and an on-site investigation were conducted in order to compile information for this ESA. This assessment did not include sampling or analysis of soil or groundwater.

3.0 PROJECT DESCRIPTION

The focus of this feasibility study is to recommend a plan for flood damage reduction, ecosystem restoration, and recreation in accordance with the Water Resource Council's Principles and Guidelines, and Corps civil works planning policies. The purposes of this PMP revision are to redirect the study to focus on the Sutter Bypass - Feather River sub-basin, to apply the Corps' current levee standards, and to incorporate ecosystem restoration and recreation into the study. Results of the State's geotechnical analysis will be used to define without-project conditions,

including levees that might be at risk of failure.

The study scope will refocus on providing flood damage reduction to the urban areas of Yuba City, Live Oak, Gridley and Biggs in the Sutter Bypass - Feather River sub-basin and developing a flood warning system for the outlying areas of the sub-basin. Other study objectives will include ecosystem restoration and recreation.

Several miles of levees along the Feather River upstream of Yuba City protect close to 30,000 residential homes, 1500 commercial structures, 620 farm houses and buildings, and 120 semipublic structures from devastating floods. Much of these levees are inadequate for the desired protection of the cities at risk. A flood damage reduction project will enhance the public health, safety and welfare by eliminating damages to single family residences, interruptions to interstate commerce and reducing the impacts to agriculture thereby promoting a safe environment for the residents of Sutter County and the economy throughout California and the surrounding areas.

For this report the project has been divided into seven (7) separate sites for ease of investigating and reporting. For the purpose of this ESA a corridor data search and site investigations were conducted. The corridor will consist of the site description plus 1/4 mile on each side of the site, in accordance to ASTM-E 1527-94. Each Site project description is as follows:

Cherokee Canal - This site starts at the inter section of the Cherokee canal and the Clousa highway. The canal runs northeast to the Richvale Highway, where it turns east until it reaches State Highway 99. The levee runs parallel to the Thermalito Afterbay approximately 3 miles south on Highway 99 until it turns east on Hamilton Road. Approximately 1.7 miles east Hamilton Road dead ends into Larkin Road, where the levee turns northeast and follows Thermalito Afterbay to where it intersecs the feather River. This section is approximately 19.7 miles long.

Feather River North (Yuba) - This site roughly follows the Feather River from the Thermolita Afterbay to approximately Metteer road or the Butte/Sutter County line. This section of the project covers about 13.5 miles of the levee.

Feather River North (Sutter) – This section starts at the Butte/Sutter county line of the Feather River and goes south along the river to approximately Pease Road. This section is approximately 9.8 miles long.

Yuba City Levee – This section of the levee project starts at Pease Road on the Feather River and goes south through the Yuba City to the confines of the Feather River and the Yuba River. From there it continues south, mostly following the Garden highway to Star Bend Road. This section is approximately 12.5 miles long.

Feather River South – Starting at Star Bend Road this levee section goes south on the Levee Road, which parallels Highway 99. The Levee Road will cross Highway 99 and continue to the Sutter Bypass, where this section ends. This section is approximately 9.3 miles long.

Sutter Bypass – This section of the project starts at the intersection of the Feather River Levee road and the Sutter Bypass Levee Road and goes north along the Sutter bypass for approximately 17.5 miles. This section ends at the intersection of the Sutter Bypass Levee Road and the Wadsworth Canal Levee Road.

Wadsworth Canal – This 4.5 mile section of the project starts at the intersection of the Sutter Bypass and Wadsworth Canal and goes northeast to end at Butte House road.

4.0 SITE DESCRIPTION

4.1 Location

Sutter Basin is located in the north-central part of California. Sutter County's boundaries include the Sacramento River to the west and the Feather River to the east. Its southern boundary is just downstream of the confluence of the Sacramento River with the Sutter Bypass. The Sutter Bypass passes through Sutter County from the northwest and acts as flood relief for the Sacramento River. The Sutter Bypass conveys flood waters from Butte Basin and additional flood waters from the Sacramento River through the Tisdale Bypass, which connects to the Sacramento River downstream from the town of Grimes. The study area will include the Sutter Bypass – Feather River sub-basin of the Sutter Basin, which extends into the south-central

portion of Butte County along the west side of the Feather River. See Appendix A for site map and legend.

4.2 Site and Vicinity Characteristics

The top of the levees are accessible by vehicle but are limited to public access by locked gates. The predominant use adjacent to the land side of levee is agricultural, while the river side is predominately recreational. Within the study area are several dwellings with their out structures. Most of these dwellings are associated with farming operations. The study area also includes several businesses and show up on several data bases, but appear to have no or little impact on the construction site.

4.3 Descriptions of Improvements on the Site

No improvements have been made to the actual levee in recent years, other than general maintenance and flood damage.

5.0 RECORDS REVIEW

The following sources were used in researching the occurrence of HTRW within the study area. The following information was acquired during a records search and phone interviews.

California Environmental Protection Agency

California EPA has set up a web site, www.swrch.ca.gov/~cw/phome/lusts, for the most updated information. This same list was also duplicated in the data base search.

State Water Resources Control Board

The Division of Clean Water Programs, Tanks Unit, sent a list of leaking underground storage tanks (LUSTs) in the study area. This list was duplicated in the database search.

California Department of Toxic Substances Control

A copy of the CalSites database for the study area was faxed, locating areas where hazardous substances have been released or where the potential for release exists. The database mainly covers spills. This same list was duplicated in the data base search. There was no evidence of any spills that would affect this project.

Data Base Review

Environmental Data Resources (EDR) conducted a records research of the study area consisting of 69 federal, state and publicly available data bases. (See Attachment A for a list of the sources plus a definition and a summary of the information stored in each database).

6.0 SITE RECONNAISSANCE AND OBSERVATIONS

In June and July of 2009, Bruce Van Etten from the Environmental Design Section (EDS) of the United States Army Corps of Engineers-Sacramento District (USACE) visited the study area several times. The objective of the site visit is to identify recognizable environmental concerns in connection with the property. Common environmental concerns that were looked for include the following: asbestos; construction and demolition debris; drums; landfill or solid waste disposal sites; pits, ponds or lagoons; wastewater; fill dirt, depressions, mounds, or any artificial structures; PCB containing transformers; and the presence or likely presence of any hazardous substance or petroleum products on the property under conditions that indicate an existing release, a past release, or a material threat of a release on the property or into the ground, groundwater, or surface water of the property.

6.1 Cherokee Canal

Four (4) Underground Storage tanks (UST's) were mentioned in the data search and located during the site visit. All four of the UST's are outside of the construction zone for this project.

6.2 Feather River North (Yuba)

This section of the levee project contained:

Four (4) UST's

One (1) landfill

Two reports on the HAZNET database.

- Four (4) Underground Storage tanks (UST's) were mentioned in the data search and located during the site visit. All four of the UST's are outside of the construction zone for this project.

- The landfill that is noted in the data base search is actually a burn dump and is located at the end of Walnut Ave., Biggs, California. The burn dump is owned by the California Department of Fish and Game and has been closed for several years. The burn dump presents no obstacle to this project.

- The HAZNET data base extracts copies of hazardous waste manifest received each year by the DTSC. The two sites that showed up on this data base show that hazardous waste was deposed of properly.

6.3 Feather River North (Sutter)

This section of the levee project contained:

Seven (7) UST's

One (1) waste discharge system

Three reports on the HAZNET database

One RCRA-SQG or small quantity generator.

- Seven (7) Underground Storage tanks (UST's) were mentioned in the data search and located during the site visit. All seven of the UST's are outside of the construction zone and present no threat to this project.

- The HAZNET data base extracts copies of hazardous waste manifest received each year by the DTSC. The two sites that showed up on this data base show that hazardous waste was deposed of properly.

-Yuba City Prune Dehydrator showed up on the data base search a facility that treats and/or disposes of liquid or semisolid waste. This is an active facility that is considered a minor threat to water quality and has no reclamation requirements associated with it at this time.

- Andermac, Inc. showed up on the data search as a small quantity generator of hazardous waste. A small quantity generator is a facility that generates more than 100 and less than 1,000 kg of hazardous waste during any calendar month and accumulates less than 6,000 kg of hazardous waste at any time. There are no violations against this facility for generation or disposal of their waste.

6.4 Yuba City Levee

This section of the levee project is the most populated and contained:

Thirty three (33) UST's

Five (5) UST's on the Leaking Underground Storage Tank (LUST) list

One (1) landfill

Three (3) Aboveground Storage Tanks (AST's),

Four (4) RCRA-SQG or small quantity generators

One (1) pesticide producer

Three (3) sites on the Spills, Leaks, Investigation, and Cleanup (SLIC) database

Fifty eight (58) reports on the HAZNET database

Eleven (11) sites on the Clandestine Drug Labs (CDL) database

- Thirty three (33) Underground Storage Tanks (UST's) were mentioned in the data search and located during the site visit. All 33 of the UST's are outside of the construction zone and present no threat to this project.

- There are five UST's on the LUST list that are still open and undergoing cleanup. Two of the sites are in remediation and the other three are undergoing site assessments.

- There is one solid waste facility landfill within the project site but is closed and presents no problems to this project.

- Three (3) Aboveground Storage Tanks (AST's) were mentioned in the data search and located during the site visit. All 3 of the AST's are outside of the construction zone and present no threat to this project.

- There are four facilities that showed up on the data search as a small quantity generator of hazardous waste. A small quantity generator is a facility that generates more than 100 and less than 1,000 kg of hazardous waste during any calendar month and accumulates less than 6,000 kg of hazardous waste at any time. There are no violations against these facilities for generation or disposal of their waste.

- The data search shows the Sutter County Department of Agriculture as a registered pesticide producing establishment of insecticide, fungicide, and Rodenticide. There are no violations against this facility for generation or disposal of their waste and product

- The SLIC (Spills, Leaks, Investigation and Cleanup) program is designed to protect and restore water quality from spills, leaks and similar discharges. All three of the sites on this list are considered an open site undergoing site assessments, but are considered low priority. The sites are outside of the construction zone and presents no threat to this project.

- The HAZNET data base extracts copies of hazardous waste manifest received each year by the DTSC. The 58 sites that showed up on this data base show that hazardous waste was deposed of properly.

- Eleven (11) sites showed up on the Clandestine Drug Labs (CDL) database during a records search. Listing of a location in this database does not indicate that any illegal drug lab materials were or were not present there, and does not constitute a determination that the location either requires or does not require additional cleanup work.

6.5 Feather River South

This section of the levee project contained:

One (1) site on the Clandestine Drug Labs (CDL) database

- One (1) site showed up on the Clandestine Drug Labs (CDL) database during a records search. Listing of a location in this database does not indicate that any illegal drug lab materials were or were not present there, and does not constitute a determination that the location either requires or

does not require additional cleanup work.

6.6 Sutter Bypass

This section of the levee project contained:

One (1) site that showed up on the ENVIROSTOR database.

- The ENVIROSTOR database comes from DTSC and identifies sites that have know contamination or sites for which there may be reason to investigate further. Growers Ag Services, Inc. is considered an open case by the California Regional Water Quality Control Board. A preliminary assessment has been done and no further action is recommended by the EPA. The Central Valley RWQCB (Region 5S) has it listed as a cleanup program site due to presence of discolored soil and pesticide odor noted on site.

6.7 Wadsworth Canal

This section of the levee project contained:

Three (3) UST's

One (1) site on the Spills, Leaks, Investigation, and Cleanup (SLIC) database

- Three (3) Underground Storage Tanks (UST's) were mentioned in the data search and located during the site visit. All 3 of the UST's are outside of the construction zone and present no threat to this project.

- The SLIC (Spills, Leaks, Investigation and Cleanup) program is designed to protect and restore water quality from spills, leaks and similar discharges. The Helena Chemical Company showed up on this list as an open site undergoing a site assessment for potential contamination of fertilizers. The site is outside of the construction zone and presents no threat to this project.

7.0 FINDINGS AND CONCLUSIONS

Based on information gathered during the site visit, data base search, and interviews conducted, there is no apparent HTRW contamination within the study limits.

The results of the interviews and research of available records of known or suspected contaminated sites indicate the potential for HTRW impact from inundation may be significant. The following additional factors should also be considered.

Possible pesticide residuals in the soil due to normal pesticide application.

Possible soil contamination associated with unknown or unregistered UST's and AST's within the study areas.

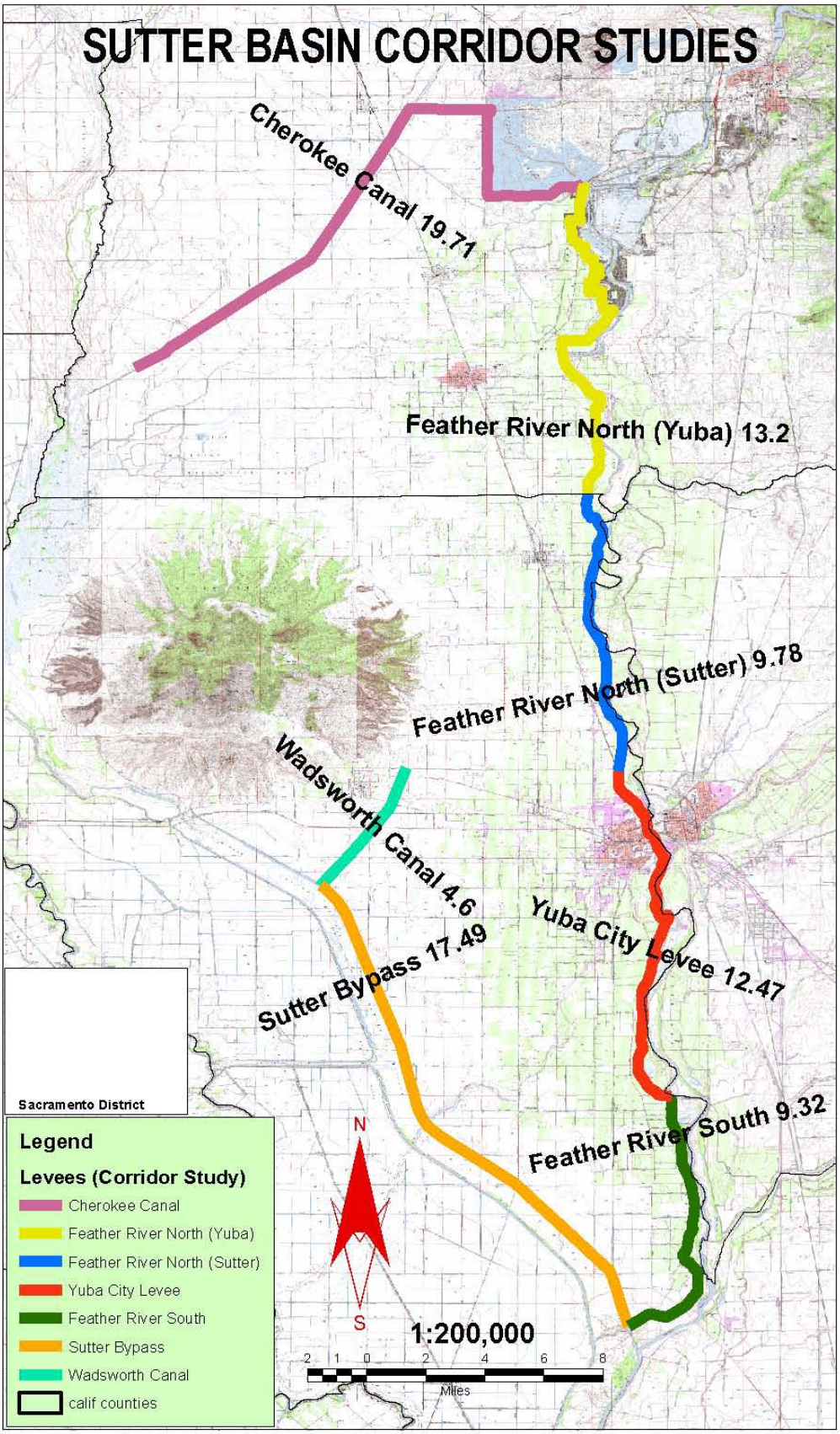
Based on information gathered during the site visit and data base search there is no apparent HTRW contamination, that is not already documented within the study area, that may affect the proposed project.

APPENDICES

Appendix 1 Site Map
Appendix 2 Photos
Appendix 3 Regulatory Research Documentation
EDR

Appendix 1

SITE MAPS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Feather River North (Sutter) 9.78
Wadsworth Canal 4.6
Sutter Bypass 17.49
Yuba City Levee 12.47
Feather River South 9.32
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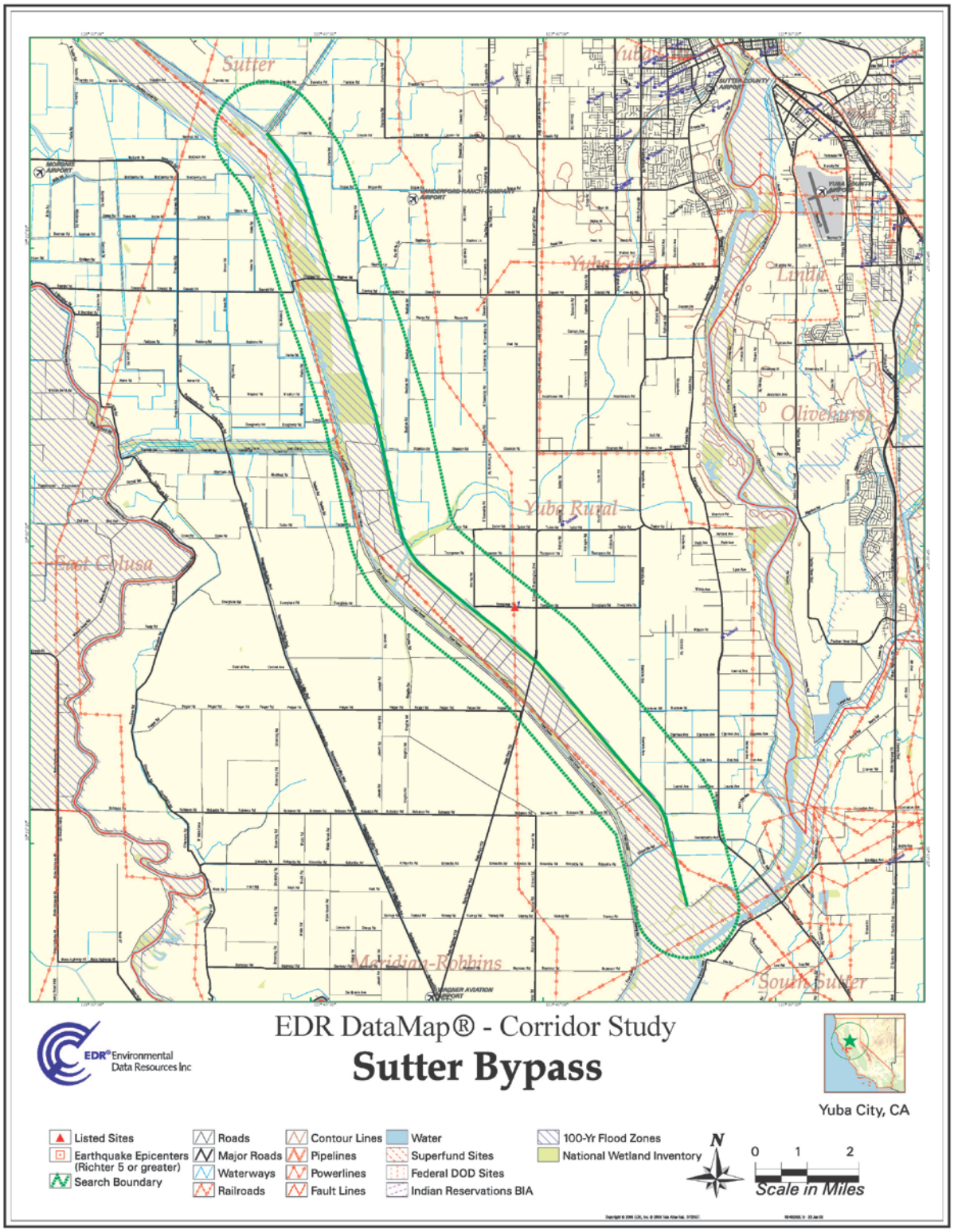
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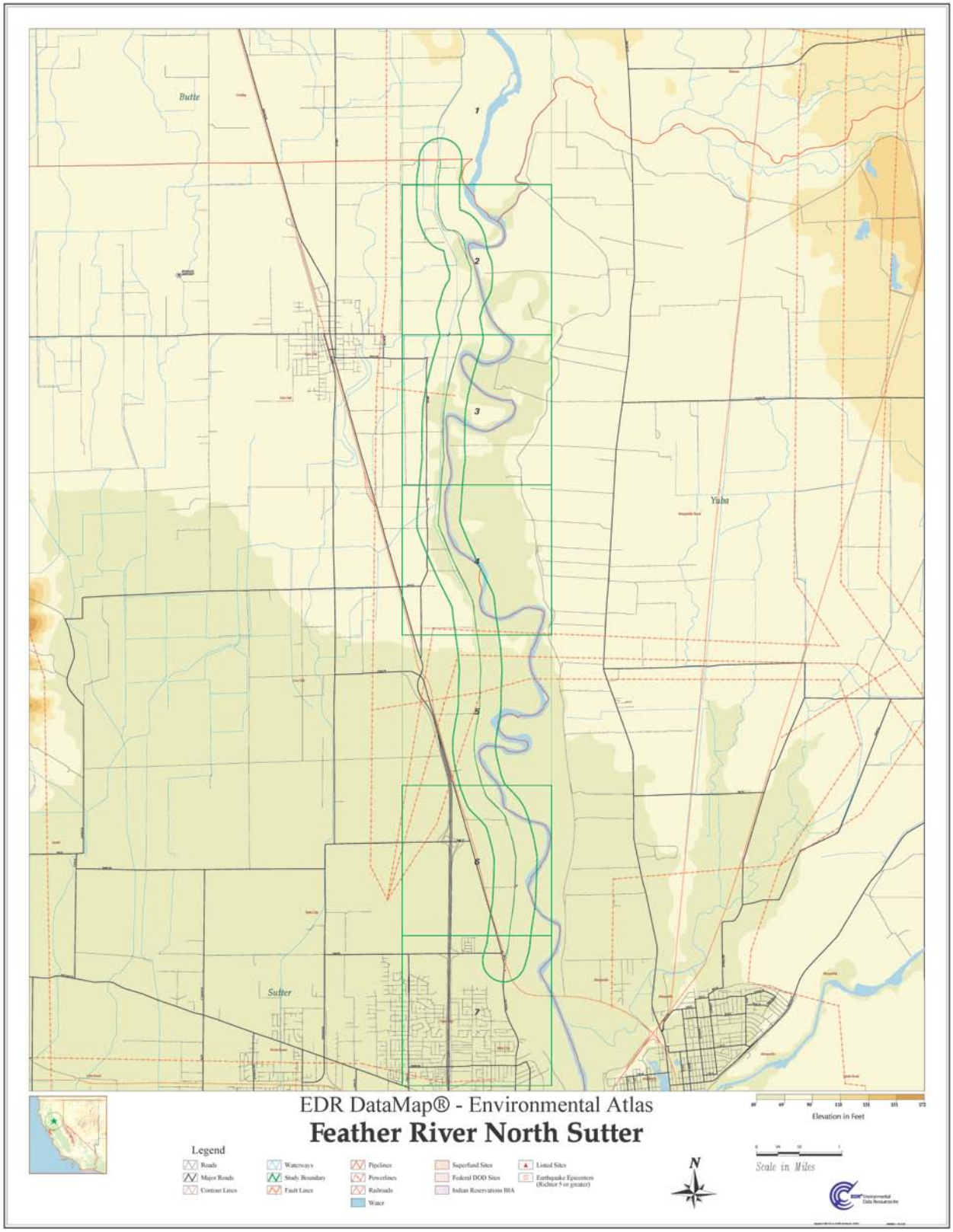
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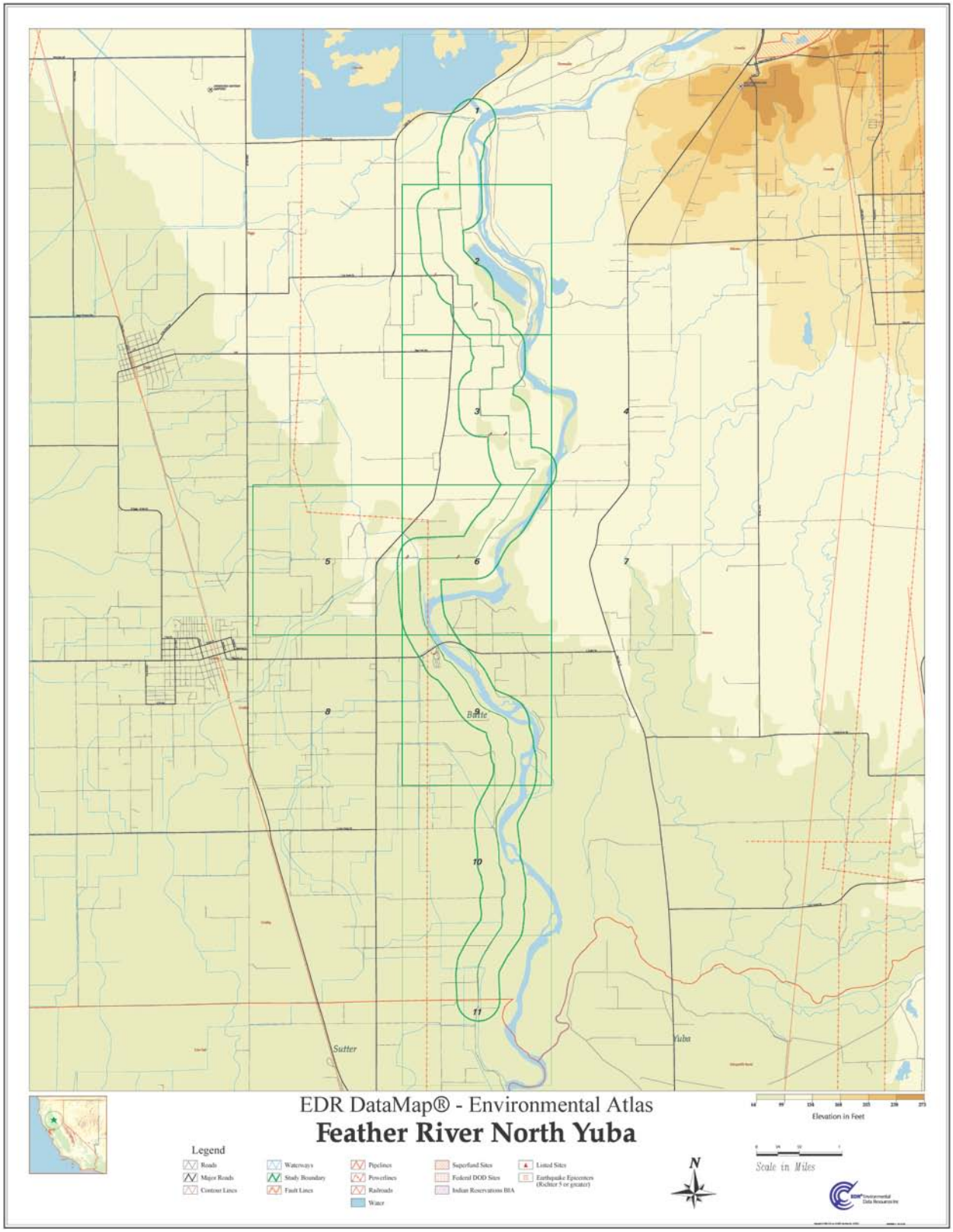
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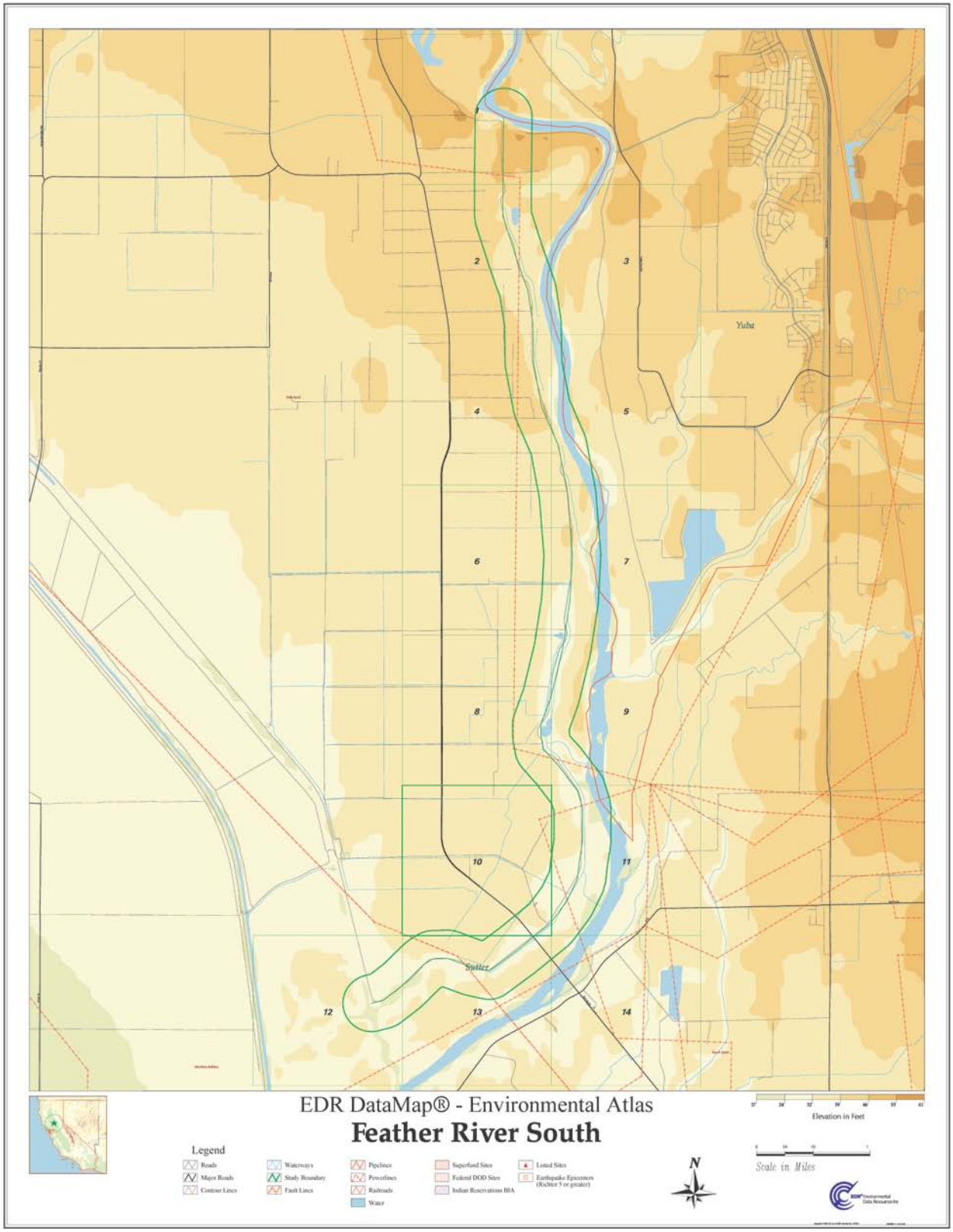
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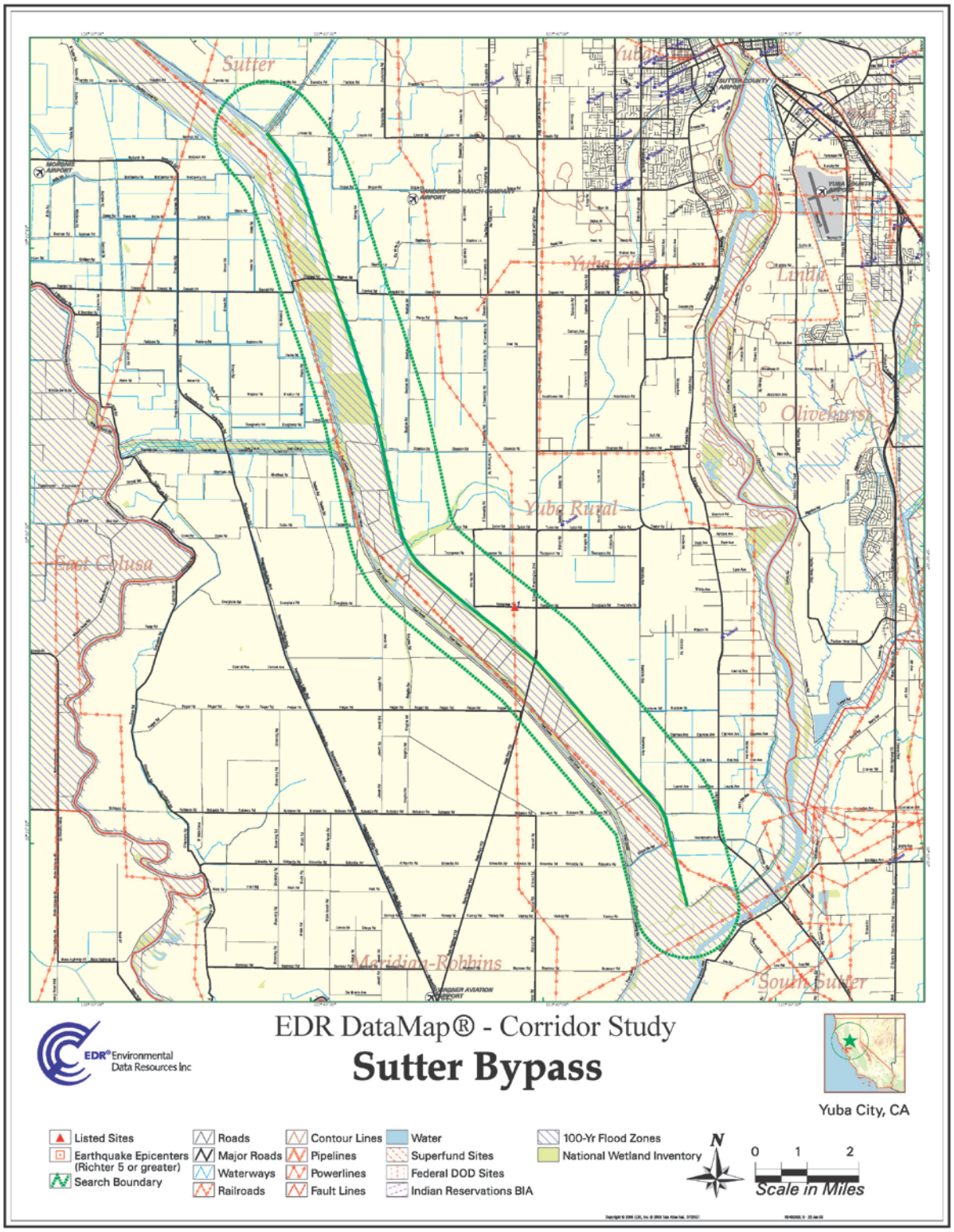
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Railroads
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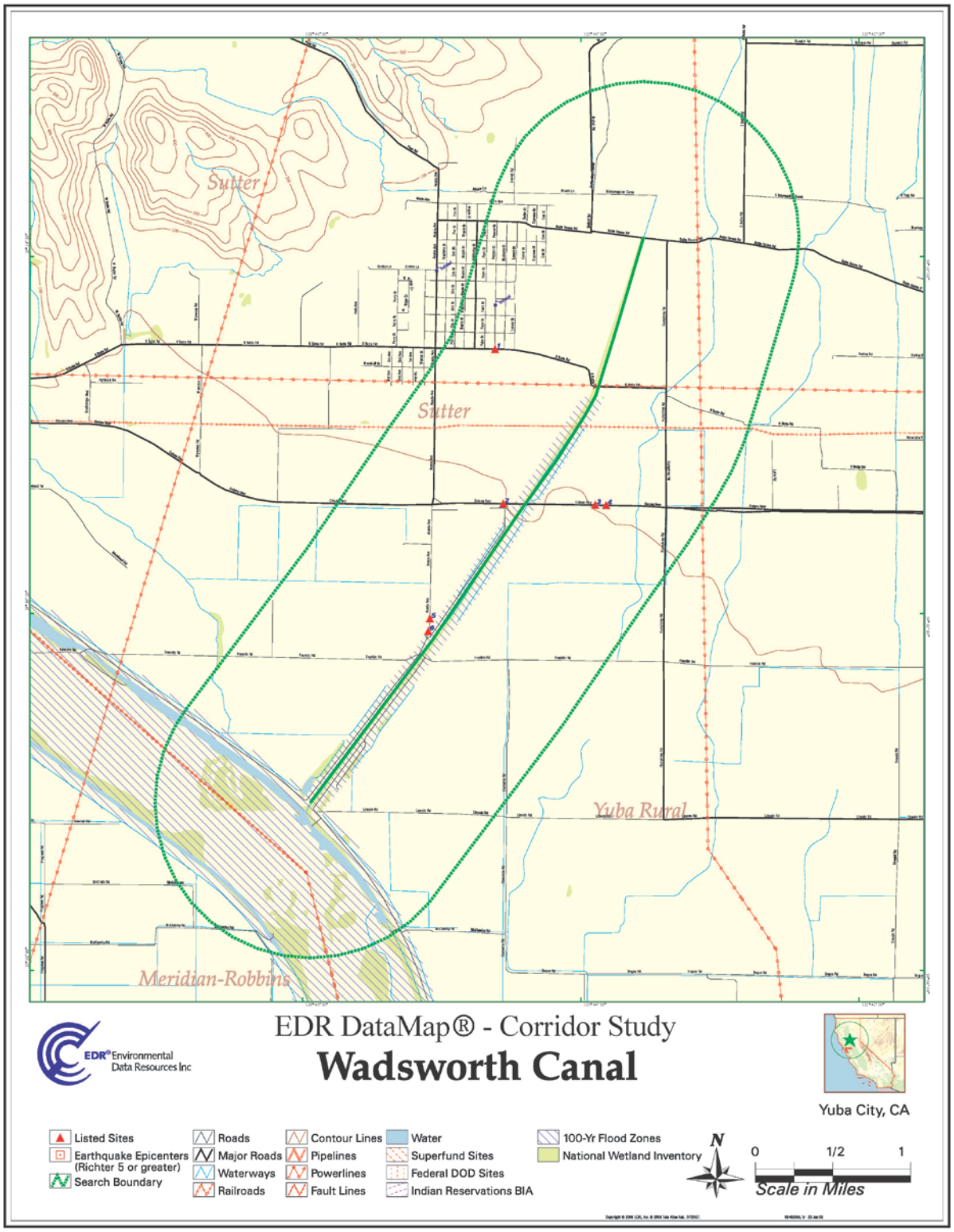
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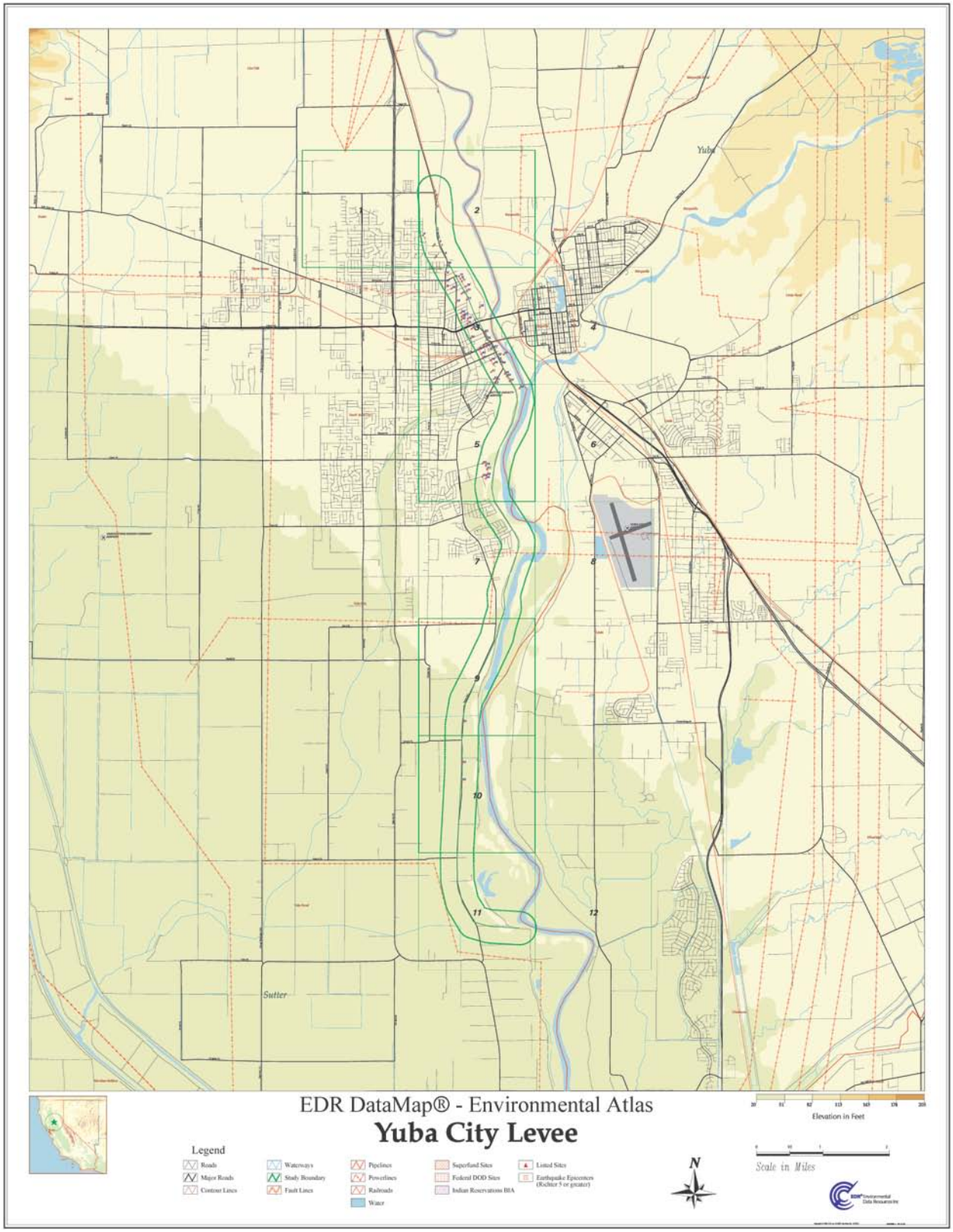
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Federal DOD Sites
Indian Reservations BIA
Listed Sites
Earthquake Epicenters (Richter 5 or greater)
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Scale in Miles

Appendix 2

PHOTOS

Start of the Cherokee Canal, looking NE from the Colusa Highway

Cherokee Canal overcrossing on the Richvale Hwy looking north

Sutter Bypass at Sacramento Ave. on the west side of the canal. Tanks are presumed to hold pesticides but no staining or leaks were visible.

Feather River North (Yuba) at East Gridley Road

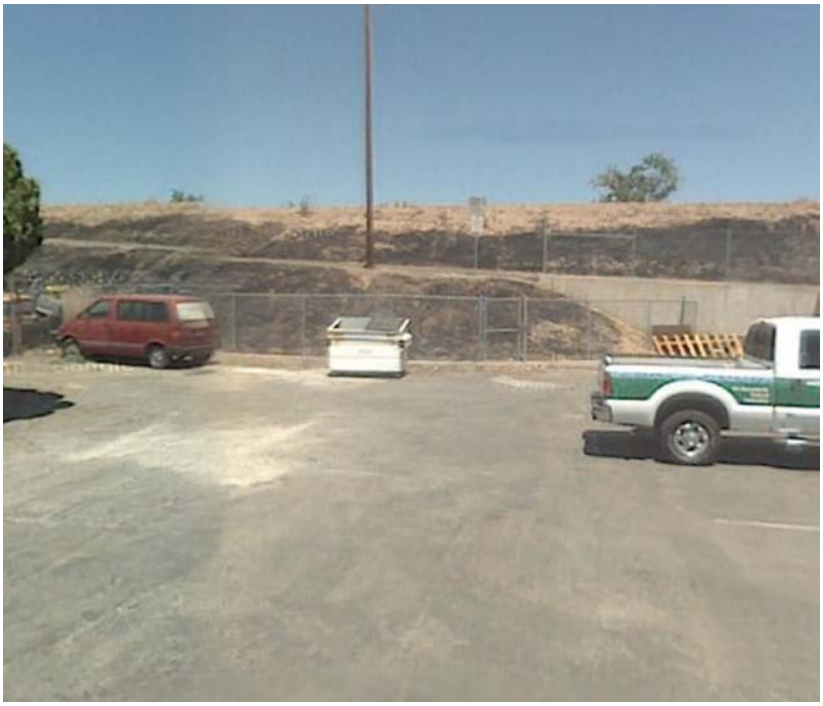
Yuba City Levee, 2nd Street Boat Ramp

Yuba City Levee, 2nd Street

Yuba City Levee, 5th Street

Yuba City Levee, B Street

Yuba City Levee Highway 20



Yuba City Levee, Keyser Street

Yuba City Levee, Sutter Street

Yuba City Levee, Teega Ave.

Feather River South, Laura Ave.

Sutter Bypass

Sutter Bypass

Sutter Bypass

Sutter Bypass

Wadsworth Canal, Butte Road

Wadsworth Canal, Highway 20

Appendix 3

REGULATORY RESEARCH DOCUMENTATION

Appendix I

Cultural Context, Native American Correspondence, and Identified Resource Descriptions

Appendix I

Cultural Context, Native American Correspondence, and Identified Resource Descriptions

This appendix provides information in support of Section 3.17, *Cultural Resources.* This appendix contains a description of the prehistoric, ethnographic, and historic contexts for the FRLWP, a list of previous cultural resource studies performed in and near the footprint of the action alternatives, a list of properties on the National Register of Historic Places (NRHP) that occur near the action alternatives, as well as records of correspondence with the Native American community. Table I-1 presents a list of acronyms and abbreviations found in this appendix.

Table I-1. List of Acronyms and Abbreviations

APE	area of potential effects
APN	assessor's parcel number
B.P.	before present
CEQA	California Environmental Quality Act
CRHR	California Register of Historic Resources
LD 1	Levee District 1
FERC	Federal Energy Regulatory Commission
kV	kilovolt
MGD	million gallons per day
NAHC	Native American Heritage Commission
NRHP	National Register of Historic Places
SRFCP	Sacramento River Flood Control Project
USACE	U.S. Army Corps of Engineers

I.1 Cultural Context

I.1.1 Prehistoric Context

I.1.1.1 Feather River Vicinity, Foothills

The foothill region in the project vicinity corresponds roughly to the ethnographically known Maidu territory, and includes four recognized prehistoric archeological phases: the Mesilla, Bidwell, Sweetwater, and Oroville (Moratto 1984; Selverston et al. 2005).

Dating to approximately 3000–2000 before present (B.P.), the Mesilla Complex is characterized by atlatl projectile points (spear tips), bowl mortars, various shell beads, charm stones, and bone implements. Sites defining this phase apparently reflect seasonal forays into the foothills for hunting and gathering and appear to indicate a Martis influence (Moratto 1984). The Martis culture consists of large atlatl projectile points found at higher altitudes in the Sierra Nevada mountain range.

The Bidwell Complex dates to approximately 2000–1200 B.P., and is defined by milling stones, wooden mortars (inferred from ethnographic sources; none have been found), large slate and basalt points, steatite vessels, and flexed burials. The settlement/subsistence pattern appears to have included permanent villages with surrounding task-specific locations (e.g., hunting, fishing, food processing).

The Sweetwater Complex dates to 1200–500 B.P. Relevant material culture includes shell, bead, and ornament forms; steatite cups; small projectile points (Eastgate, Rose Spring, and Gunther Barbed types); and extended or semi-extended burials.

The Oroville Complex dates to approximately 500–150 B.P. Typical manifestations include bedrock mortars, incised bird bone tubes, gorge hooks, gaming bones, clamshell disk beads, circular dance houses, and tightly flexed burials. This phase ended with the malaria epidemic of 1833, which greatly reduced the Maidu population (Riddell 1978).

I.1.1.2 Valley Prehistory

The prehistoric sequence of the Central Valley has been revised several times, and therefore a variety of terms are used across the relevant literature. Early literature described the prehistoric cultures in terms of different, regional manifestations with unique material culture, called patterns. Frequently used regional divisions refer to Windmiller, Berkeley, and Augustine patterns. The current explanatory framework focuses less on regionally specific aspects and integrates the overall prehistory into a sequence (Bennyhoff and Fredrickson 1994). Bennyhoff and Fredrickson describe the Central Valley prehistory in terms of Early, Middle, and Late Horizons. This revision considers Central Valley prehistory in terms of culture change as a process rather than the more descriptive methods of early literature.

Early Horizon, Pleistocene/Holocene Transition: 12,000–8000 B.P.

Archaeological evidence for human use of the Central Valley during the late Pleistocene and early Holocene is scarce. At the end of the Pleistocene, circa 12,000–8000 B.P., parts of the Sierra Nevada adjacent to the Central Valley were covered with large glaciers, and the valley provided a major transportation route for animals and people. This transportation corridor, perhaps rivaled only by maritime coastal travel, undoubtedly was used heavily by early Californians.

Although rare, the archaeological remains of these activities have been identified in the Central Valley (Ann S. Peak & Associates 1981; Johnson 1967; Treganza and Heizer 1953). Johnson (1967) presents evidence for some use of the Mokelumne River area, under what is now Camanche Reservoir, during the late Pleistocene. A number of lithic cores and a flake were found at three different locations. All lithic specimens were associated with Pleistocene-age gravels. Early research describes this material as part of the Farmington Complex, characterized by core tools and large, reworked percussion flakes (Treganza and Heizer 1953:28). Farther north, at Rancho Murieta, lithic artifacts spanning the reduction sequence, as well as unworked raw material, were recovered from gravel deposits attributed to the late Pleistocene (Ann S. Peak & Associates 1981). However, recent geoarchaeological investigations at CA-STA-69 (in the vicinity of Farmington Complex–type site CA-STA-44) identified Farmington artifacts at the site within Holocene-age alluvial terrace deposits, not Pleistocene-age deposits. These indicate reinvestigation of the age of the Farmington Complex may associate this archaeological culture with the Holocene (Rosenthal et al. 2007).

Most researchers conclude the Pleistocene and early Holocene human economy focused on large game. Although no direct evidence of this exists in the Central Valley, the similarity of the artifact assemblages to those of other locations in western North America, where the association can be demonstrated, supports this argument. Many large Pleistocene mammals suffered extinction during the Pleistocene/Holocene transition. These extinctions were caused by warming temperatures, rising sea levels, and changing precipitation patterns (Meyer and Rosenthal 2008). The Central Valley gradually became both warmer and dryer. Pine forests were replaced with vegetation similar to that found today. The rising sea level filled what is now the San Francisco Bay and created the Sacramento–San Joaquin River Delta marshes. To survive without large game, people had to change their food procurement strategies to make use of a more diverse range of smaller plants and animals (Moratto 1984).

Early Horizon: 8000–4000 B.P.

As humans altered their subsistence strategy to increase the range of pursued food items, their mobility also increased. Small groups of people probably moved through the valley, foothills, and Sierra Nevada to take advantage of seasonally available resources and resources limited to particular unique environments. The ability to move from resource to resource was a critical element of this subsistence strategy (Rosenthal et al. 2007).

Reliance on a number of diverse smaller plants and animals had several consequences. First, people had to move from one area to another to take advantage of the seasonal availability of particular resources. Second, large areas of land were needed to ensure that enough resources were available during all times of the year. Third, more specialized tools were necessary to procure and process the wider range of plants and animals that were being used. This broad-based strategy continued relatively unchanged until approximately 6000 B.P.

As the population slowly increased, it became increasingly difficult for people to obtain seasonally available resources across large areas of land (Meyer and Rosenthal 2008). Dental pathologies in the burial record reveal dietary stress (Moratto 1978). Growing populations decreased the land available to given cultural units, and thus the suite of resources available to those populations. This pressure resulted in a further expansion of the suite of resources pursued, relative to previous conditions.

Fredrickson (1973) identified archaeological indicators of this expansion in the Windmiller site (CA-SAC-107). Artifacts and faunal remains at Windmiller sites indicate that a diverse range of resources were exploited, including seeds, a variety of small game, and fish. The material culture includes trident fish spears; at least two types of fishhooks; quartz crystals and numerous charm stone styles; and a baked clay assemblage that included net sinkers, pecan-shaped fish line sinkers, and cooking balls. Ground-stone items included mortars and pestles. The bone tool industry appears minimal but includes awls, needles, and flakers. People with a Windmiller adaptation buried their dead in formal cemeteries, both within and separate from their villages, in a ritual context that included the use of red ochre, often rich grave offerings, and ventral extension with a predominantly western orientation (although other burial positions, such as dorsal extension and flexed, and cremations are also known) (Moratto 1984). While the Windmiller pattern is identified with the Sacramento–San Joaquin River Delta, work at Camanche Reservoir has identified sites with Windmiller assemblages (Johnson 1967), indicating that other valley settings also were used by people exhibiting these adaptations.

Middle Horizon: 4000–1500 B.P.

In the Middle Horizon, resource specialization resulting from the expanded subsistence strategy is readily visible in the archaeological record. Dietary expansion was associated with new exploitation of niche environments such as marshlands in the Delta. Acorn procurement from oak trees (*Quercus,* sp.) also increased. The acorn had been used before this time, but it became a much more significant portion of the overall diet breadth, with specialized procurement and processing technologies (Rosenthal et al. 2007). People in this period were more sedentary than they had been in the past, and village sites are found throughout the valley along rivers and near other areas with permanent sources of water (Moratto 1984).

Previous research described the Berkeley Pattern identified at CA-Ala-307 as a typical Middle Horizon site (Fredrickson 1973). Sites displaying Windmiller Pattern assemblages, however, also are found in the Middle Horizon. The Windmiller Pattern sites in this period seem to occur with more frequency in or near the Delta, while Berkeley Pattern sites tend to be more prevalent farther north. The Berkeley Pattern differs primarily in its greater emphasis on the exploitation of the acorn as a staple. This distinction is reflected in the more numerous and varied mortars and pestles. This complex is also noted for its especially well-developed bone tool industry and such technological innovations as ribbon flaking of chipped stone artifacts. During this era, flexed burials replaced extended burials, and the use of grave goods generally declined (Moratto 1984).

A restricted land base, coupled with a more specialized resource base, meant that people had to develop economic relationships with groups of people living in other areas who had different specialized resources. Although resources and commodities were being exchanged throughout the region prior to this period, it is during this period that more extensive and more frequently used economic networks developed. Transported resources likely included foods (trans-Sierra acorn movement is known from later periods) and commodities more visible in the archaeological record such as shell and lithic materials (Moratto 1984).

Late Horizon: 1500–150 B.P.

The Late Horizon archaeological record documents further increases in specialization, sedentary settlement, and exchange networks relative to the Middle Horizon. Population continued to increase, and group territories continued to become smaller and more defined. The Delta region of the Central Valley reached population density figures higher than almost any other area of North America (Chartkoff and Chartkoff 1984). Patterns in the activities, social relationships, belief systems, and material culture continued to develop during this period and took forms similar to those described by the first Europeans that entered the area.

The predominant generalized subsistence pattern during this period is called the Augustine Pattern (Fredrickson 1973). Archaeological sites representing the Augustine Pattern show a high degree of technological specialization. Artifacts in this period include artifacts of composite materials, developed reductive technologies such as stone and shell work, and highly specialized adaptive technologies, including basketwork and ceramic production. Other notable elements of the material culture assemblage include flanged tubular smoking pipes; harpoons; ceramic figurines and vessels (Cosumnes Brownware); clamshell disk beads; and small projectile point types such as the Gunther Barbed series. These small projectile points may indicate the use of the bow and arrow. Complex social and economic institutions also are represented by different access to wealth, the

implementation of a shell money system, and the maintenance of extensive exchange networks (Meyer and Rosenthal 2008).

I.1.2 Ethnographic Context

I.1.2.1 Konkow Maidu

The Konkow Maidu occupied foothills east of Chico and Oroville, as well as a portion of the Sacramento Valley (Riddell 1978). Konkow is one of three languages composing the Maiduan language family of the Penutian linguistic stock. Several dialects of Konkow were spoken from the lower extent of the Feather River Canyon to the surrounding hills and in the adjacent parts of the Sacramento Valley (Shipley 1978).

The Konkow lived in village communities of three to five villages, in round semi-subterranean houses covered with earth. It is estimated that a typical village consisted of about 35 people during ethnographic times. Villages were made up of smaller groups. Family units usually were made up of two to five people. A major village with a large assembly and subterranean ceremonial lodge served as the central ceremonial and political focus for affiliated villages in the vicinity. This central village was not necessarily the most populous village but likely served as the residence of the chief, who lived in the ceremonial lodge. The chief's primary roles were advisor and spokesman. The individual villages were self-sufficient, not under the control of a headman (California Department of Water Resources 2004; Riddell 1978).

In winter, the Konkow settled in widely dispersed patterns along river canyons, usually on ridges high above rivers and generally on small flats on the crest of the ridge, or half way down the canyon side. A village-community owned and defended a known territory, which served as a communal hunting and fishing ground. Some villages were located strategically atop isolated knolls in consideration of attack and defense. The Konkow followed an annual gathering cycle that made it necessary for them to leave their winter settlements on the river ridges. In the summer, they traveled into the mountains to hunt. In the spring, they ventured into the valley areas to collect grass seeds (Riddell 1978).

The Konkow harvested greens, tubers, roots, seeds, nuts, and berries. Although wild rye was common in their diet and pine nuts were highly valued, the most important of the harvested foods were acorns, from black oak (*Quercus kelloggi)* in particular. Konkow burned grass and brush cover to optimize the mix of plants eaten by deer. Fisherman pursued salmon on the Feather River. The Konkow also pursued lamprey eels. Terrestrial game eaten by the Konkow included deer, elk, rabbits, squirrels, and birds such as quail, pigeons, and ducks (California Department of Water Resources 2004; Riddell 1978).

Because the Konkow had no complex political organization, the shaman was an important figure in their society. The shaman occupied a role that combined political, spiritual, and medical functions. The shaman role was passed down as a hereditary office from father to son (Riddell 1978).

The Konkow held an annual mourning ceremony, the Keruk, for the recently deceased, which reenacted the death of the creator, Kukumat. For this ceremony a male and female effigy were created, clothed, and burned. The Konkow also offered money, food, and blankets to the god, through incineration. The Maidu participated in the Kuksu cult, also practiced by the Patwin, Pomo, northern Costanoans, and the Coast and Sierra Miwok. Kuksu, "the south god," renewed the world

each year. The ritual was celebrated in round dance houses by dancers with elaborate costumes, including large feather headdresses (Riddell 1978).

Konkow life was little affected by European contact until the gold rush in 1849. At this time miners descended upon the Feather River and surrounding foothills to remove abundant gold. The miners brought diseases that were deadly to the native peoples, decimating the population. These miners also destroyed the landscape with their mining techniques and violently drove the surviving Konkow from their lands. When the mining craze was over, the miners settled in the area and turned large tracts of land into agricultural fields. Because the miners wanted their land, the Konkow were twice driven off their traditional lands. In 1853, the Konkow, along with other Native American groups, were gathered by force and sent to the Nome Lackee reservation in Tehama County. This was not a successful reservation, and most of the families returned to their original lands. In 1863, the Konkow again were rounded up by militias and driven to the Round Valley Reservation in northern Mendocino County. Many of these families remain in Round Valley today. Around the turn of the twentieth century, the Federal government created rancherias for the Konkow, establishing a limited land base for the tribe and formalizing their tribal status with the Federal government. Today the Konkow are very active in cultural preservation in and around the Palermo/Feather River area. (California Department of Water Resources 2004.)

I.1.2.2 Valley Nisenan

The Feather River West Levee Project encompasses lands associated with the Southern Maidu, or Nisenan. The language of the Nisenan, which includes several dialects, is classified in the Maiduan family of the Penutian linguistic stock (Kroeber 1976; Shipley 1978). The western boundary of Nisenan territory was the western bank of the Sacramento River. The eastern boundary was “the line in the Sierra Nevada mountains where the snow lay on the ground all winter” (Littlejohn 1928).

Nisenan permanent villages usually were located on low rises along major watercourses. Village size ranged from 3 houses to 50. Houses were domed structures covered with earth and tule or grass and measured 3.0–4.6 meters in diameter. Brush shelters were used in the summer and at temporary camps during food-gathering rounds. Larger villages often had semi-subterranean dance houses that were covered in earth and tule or brush, with a central smoke hole at the top and an east-facing entrance. Another common village structure was a granary used for storing acorns (Wilson and Towne 1978). A Nisenan village, Holloh, was located just outside of the eastern boundary of the project area along the Bear River.

The Nisenan occupied permanent settlements from which specific task groups set out to harvest the seasonal bounty of flora and fauna provided by the rich valley environment. The Valley Nisenan economy involved riparian resources, in contrast to the Hill Nisenan, whose resource base consisted primarily of acorn and game procurement. The Nisenan cultivated native tobacco (*Nicotiana* sp.), and also managed wild species through burning. The Nisenan harvested blue oak (*Quercus douglasii*) and black oak (*Q. kelloggii*). Acorns could be stored in anticipation of winter shortfalls in resource abundance. Deer, rabbit, and salmon were the chief sources of animal protein in the aboriginal diet, but many other insect and animal species were taken when available.

Religion played an important role in Nisenan life. The Nisenan believe that all natural objects were endowed with supernatural powers. Two kinds of shamans existed: curing shamans and religious shamans. Curing shamans had limited contact with the spirit world and diagnosed and healed

illnesses. Religious shamans gained control over the spirits through dreams and esoteric experiences (Wilson and Towne 1978). The usual mode of burial was cremation (Faye 1923).

The gold rush of 1849 had a devastating effect on the Valley Nisenan. The flood of miners that came to the area in search of gold brought diseases with them that decimated the Nisenan population. Those who survived were subjected to violence and prejudice at the hands of the miners, and the Nisenan eventually were pushed out of their ancestral territory. Although this contact with settlers had a profound negative effect on the Nisenan population, the Nisenan people survive and maintain strong communities.

I.1.3 Historical Context

I.1.3.1 Early Exploration

Spanish exploration of the region began with Gabriel Moraga's forays into the region in 1808. Moraga named one of the area rivers *Rio de las Uvas*, which came to be known as the Yuba River. Hudson's Bay Company trappers later traveled through the region in the 1830s, followed by the expedition led by John C. Fremont in 1846. Sutter County received its name from John A. Sutter, who established Sutter's Fort in Sacramento during the early 1840s and whose Hock Farm and New Helvetia lands included areas of Sutter County (Hoover et al. 1990; Rawls and Bean 2003; Williams et al. 2002).

I.1.3.2 Gold Rush

This region exploded with mining activity during the gold rush, which attracted both American and international settlers. Euro Americans settled the present-day Yuba City/Marysville area intensively during the California gold rush. Beginning in 1849, prospectors and entrepreneurs overran the streams of the Sierra Nevada, including the Feather and Yuba Rivers, in search of riches. Placer miners initially established claims and settlements on watercourses, and then gradually worked back from the flats adjacent to streams to ridges and hillsides.

The flood of 1850 encouraged miners to work areas located above the high-water mark of the Feather and Yuba Rivers. By 1857, hydraulic mining began to replace the placer methods. Hydraulic mining occurred primarily in uplands, while small-scale placer mining operations continued along rivers and streams. Hydraulic mining removed large upland deposits, which were washed into waterways, contributing to disastrous flooding and making waterways un-navigable. The industry went into decline after 1884, when a Federal court outlawed mining debris in rivers in the decision *Woodruff v. North Bloomfield Gravel Mining Company*. Gold excavation in the region was revived with dredge mining operations around Oroville and Honcut after 1900 (Rawls and Bean 2003; Williams et al. 2002).

I.1.3.3 Agriculture and Irrigation

Settlers raised wheat and vegetables in the Yuba City /Marysville area as early as the 1840s. Small-scale hop farming was introduced to the area in 1859. Domesticated cattle and sheep arrived from the Midwest in the early 1850s and multiplied substantially. Agriculture made gains in the region during the 1860s, but in Butte County mining activity increased at the expense of agriculture during the next decade (Rawls and Bean 2003; Williams et al. 2002).

During the 1880s the agricultural economy increased markedly, as a result of two factors. First, the conversion of hydraulic-mining water conduits to irrigation systems, a process dominated by private companies in this region of California, introduced the possibility of transforming otherwise poor land into highly productive agricultural land. Second, the railroad and, by the late 1880s, the refrigerated rail car, encouraged local farmers' participation in a wider range of markets (Rawls and Bean 2003; Williams et al. 2002).

Fruit production became a major element of the regional economy during the last two decades of the nineteenth century. Citrus colonies were organized in Butte County between 1886 and 1895, the most prominent of which were Thermalito, Palermo, and Rio Bonito (Frederich 1974).

The shift from grain to fruit production in the late nineteenth century inspired efforts to build the region's first significant agricultural irrigation systems; dedicated agricultural irrigated networks had not operated until that time. In 1891, convinced that Butte County farmers required a supplemental source of water to reliably irrigate their diversifying farms, Biggs resident Thomas Fleming proposed a system of canals and lateral ditches to serve the area around Gridley. Under Fleming's plan, this forerunner to the current Sutter-Butte Canal would have included a weir and diversion canal that began on the west bank of the Feather River near Hamilton, and several lateral ditches to deliver water from the main trunk of the canal to Gridley-area farmers. Fleming consulted with local landowners and commissioned a survey of the land on which he planned to construct his canal system, but failed to secure the capital required to begin construction on the project (McGie 1980:52).

In 1904, the Butte Canal Company was organized and work began on the construction of the canal, laterals, and headgate on the Feather River (McGie 1980:12). The Butte County Canal opened in 1905 and included a Sutter County extension that operated separately. The availability of irrigated land led to the advertisement of relatively small, subdivided lots, on which the California Irrigated Land Company advised prospective buyers to grow fruit, vines, and alfalfa; the last of these had to be imported from Utah until the advent of reliable Sacramento Valley irrigation (McGie 1980:12, 13).

Following a 1909 lawsuit, Butte County Canal Company took possession of the water rights of Sutter County Canal Company, which had previously purchased water from the Butte County operation and conveyed it through a southern extension of the Butte County Canal. The company was formally rechristened Sutter-Butte Canal Company in 1911.

The financial decline that affected the Sutter-Butte Canal Company in the 1930s and 1940s continued into the 1950s. Frustrated with rising usage fees, landowners in the Gridley, Biggs, and Live Oak areas voted to buy out Sutter-Butte Canal Company water rights in those areas. In 1950 a group of Sutter County growers initiated plans for the Sutter Extension Water District. By December of that year, a majority of land owners in the proposed district elected to purchase what was then 19% of Sutter-Butte Canal Company's water rights and the company's Sunset Pumping Plant. With this purchase—and two that predated it—Sutter-Butte Canal Company's service area was reduced to only sections of Gridley and Live Oak. In July 1953, overcoming the objections of Gridley Colony Ditch #1 and Biggs Ditch Company, the Butte Water District successfully orchestrated the acquisition of this remaining Sutter-Butte territory, bringing the run of the Sutter-Butte Canal Company to an end. Over the preceding 30 years, its holdings had been divided by the two aforementioned districts, plus the Biggs-West Gridley Water District and Richvale Irrigation District (McGie 1980:61, 66–68).

I.1.3.4 Settlement of Local Towns

A large portion of the project area was originally included in John A. Sutter's New Helvetia land grant established in 1841. In order to support his settlement in Sacramento, Sutter started a livestock ranch called the Hock Farm near the site of what would become Yuba City. Yuba City was founded in 1849 on land purchased from John Sutter by Samuel Brannan, Pierson Reading, and Henry Cheever. They established a distribution center for supplying the gold rush 49ers. Sam Brannan, as senior partner, had the town site laid out and hired agents to sell lots. During the gold rush, Marysville, on the east bank of the Feather River, overshadowed Yuba City because it was easier for miners arriving by riverboat from San Francisco and Sacramento to reach the gold fields to the east. It was not until after the gold rush was over, and people turned to the fertile land west of the river, that Yuba City began to prosper. Yuba City was established as the county seat by a vote in 1856 and incorporated January 23, 1908 (Rawls and Bean 2003; Williams et al. 2002).

A residential district along 2nd Street began to form in Yuba City as early as 1869. This development was facilitated by the relocation of commercial and industrial activity near the southern end of 2nd Street further to the north. The 1890 Sanborn map reveals that several blocks along the east side of 2nd Street between C Street to the north and Garden Highway to the south were occupied by the Farmers Union Grain Warehouse. By 1899, the warehouse had moved north to a parcel closer to the growing industrialized area of the town, which encompassed parts of 2nd Street, Keyser Street, and B Street. This change left the area between C Street and the Garden Highway open for residential development. Between 1899 and 1909, the area began to fill in with large-scale residences. By 1927, the area was completely developed with a mix of large-scale residences and more modest homes. The period between 1869 and 1927 is significant because it represents Yuba City's initial phase of residential development, characterized predominantly by single-family homes, many of which were built on a large scale for some of the community's most prominent families. The residences were arranged within a rectilinear urban grid of relatively narrow, but deep, lots along 2nd Street. The homes within this neighborhood gave concrete expression to Yuba City's pattern of stable, residential growth during the late nineteenth century and early decades of the twentieth century.

The California and Oregon Railroad established Biggs in 1870, naming the town after the first rancher to ship grain from the region, Major Marion Biggs. By the early twentieth century, the town of Biggs had an established agricultural industry, predominantly producing hemp, alfalfa, berries, vegetables, and grapes. The town incorporated in 1903. From its beginning, Biggs has been associated with municipally owned public utilities—water works and an electricity distribution system purchased to provide Biggs residents with low cost utilities (Sacramento Bee 1953a; Sacramento Bee Annual Edition for 1902; Gudde and Bright 1998).

The Southern Pacific Railroad Company established the town of Gridley in 1870, naming the town after George W. Gridley, the owner of approximately 8,000 acres, 320 of which encompassed the new town. Gridley was a native of Cazenovia, New York, who migrated to California in 1850 in search of gold. In 1853, Gridley settled in Butte County, where he raised sheep and worked as an auctioneer. The city of Gridley grew steadily during the late nineteenth century, and by 1887 the town had a population of roughly 1,500 residents. From its origins, Gridley had a developed agricultural industry, including an established dairy production and a variety of crop output such as grain and fruit (Gudde and Bright 1998:153; Robb 1915; Sacramento Union 1887).

The town of Live Oak was established in 1874. Named by H. L. Gregory, the town grew steadily but slowly, and by 1881 it included a population of 180 residents. Live Oak historically has been an

agricultural community, producing crops such as walnuts, peaches, prunes, and grain. Ranching and canning also have been an important part of the agricultural industry in Live Oak. In 1947, the town featured the last of 65 canneries opened by the United States Department of Agriculture during World War II in high schools throughout California. The town incorporated in 1947 with a population of approximately 1,500 (Gudde and Bright 1998; Sacramento Bee 1947, 1953b, 1966; Sacramento Union 1881).

I.1.3.5 Flood Control and Reclamation

Impacts from hydraulic mining were felt by most communities and farmers in the Sacramento Valley. In the early years of statehood, the Sacramento Valley experienced extensive flooding. In response, private landowners constructed small levees—between 3 and 4 feet high—near their farms. This was a pattern repeated by most landowners along rivers in the Sacramento area. These levees, however, proved ineffective and failed during the catastrophic floods from this early period (Crawford and Herrick 2006:138; McGowan 1961:287; O'Neill 2006:74). As the floods worsened, landowners attempted to build higher levees, but these too proved ineffective (McGowan 1961:288).

California was included in the Federal Swamp Land Act of 1850, which allowed the state to reclaim its wetlands through the construction of levees. The program, however, was riddled with corruption and problems that compounded levee construction (O'Neill 2006:48–50, 52, 73; U.S. Geological Survey 2006). In the early 1860s, as hydraulic mining increased and flooding continued to be a significant problem for farmers in the Sacramento Valley, a concentrated effort at levee construction began. The state legislature tried to coordinate a levee system and control levee construction by creating the Swamp Land Commission. Modeled after districts in Mississippi, the legislation gave California drainage districts, which were permitted to grant the power to construct levees. It would become the responsibility of state engineers to design the levees for each district. By the end of the first year, there were 28 districts. For a multitude of reasons, including more flooding, landowners who refused to pay levee fees, and others who were unable to pay, the system produced only minor tangible results. The legislature enhanced levee district powers in 1864, which spurred more levee construction (O'Neill 2006:81). However, by 1866, after complaints for local control over the districts, the state was no longer planning a centralized levee system. The following year, the region suffered another catastrophic flood when the American River rose so high that it flowed across the Sacramento River and breached the levees on the west side of the river, north of present-day West Sacramento in Yolo County (McGowan 1961:289).

The Green Act boosted levee construction in 1868. The act eliminated the limit on the number of swampland acres allowed under the Federal swampland program and transferred to landowners the task of creating levee districts. Between 1868 and 1871, almost all remaining swampland passed into the hands of private owners (O'Neill 2006:82). During this period, private owners constructed extensive levee systems that were much larger and, combined with the reclamation of swamplands, made flooding more serious (O'Neill 2006:82; McGowan 1961:287).

Levee construction and flood control were compounded in the 1880s and 1890s as the fight between miners and farmers continued. There was also disagreement between the U.S. Army Corps of Engineers (USACE) and the state about USACE's role and authority in the matter. This hindered Federal involvement. Local reclamation districts continued to build levees in a piecemeal fashion, including levees on the west bank of the Sacramento River. These raised the floodplain, protected the local lands, and blocked natural outlets. This created flood problems for residents farther down the river during the first part of the twentieth century.

In 1903 and 1904, the Sacramento River once again flooded. In 1904, a statewide lobbying organization was created for the purpose of generating more work from the state government for river improvement in cooperation with landowners and other government agencies. The governor created a Board of River Engineers composed of engineers with extensive experience with river management on the Mississippi River. The board recommendation was to relieve stress on the levees by constructing weirs that would temporarily allow excess water to bypass the river channel until a proper channel depth could be achieved. The proposal was rejected by the California Board of Trade, which was pushing for the construction of more levees. This was ultimately the approach adopted by the legislature (O'Neill 2006:94, 104, 106–107).

California continued to lobby the Federal government for help. Another devastating flood in 1907 increased pressure for more Federal funding, but plans for a comprehensive flood control plan stalled after it was learned that the driving force behind the plan was private landowners. It would take until 1911 for California Debris Commission member Thomas H. Jackson to design a comprehensive flood control plan that was more than just constructing levees. This approach was acceptable to the Federal government, and a special session of the state legislature approved California's support and participation in the new flood plan (O'Neill 2006:111, 114–115). Lobbying efforts continued to press the Federal government and finally were successful when the 1917 Flood Control Act was passed. Among other things, the act required USACE to work with state governments and local levee districts and gave $5.6 million to construct flood control facilities in the Sacramento Valley (O'Neill 2006:125). The act authorized the Sacramento River Flood Control Project (SRFCP), which provided for the construction of more levees and the Yolo and Sutter Bypasses. The SRFCP was the first complete Federal flood control project (Bailey 2007:24; California Central Valleys Flood Control Association 1960; O'Neill 2006:125).

Changes to the act were made in 1928, 1937, and 1941. The projects in the Sacramento Valley were further affected by the Flood Control Acts of 1944, 1950, 1958, and 1960. The SRFCP resulted in 980 miles of levee construction (California Central Valleys Flood Control Association 1960). In 1955, another devastating flood occurred in the Sacramento region. A subsequent investigation exposed structural and functional deficiencies in the levees that could not have been foreseen or tested until a flood occurred. The levees in the Sacramento Valley needed maintenance, which continued to be costly. One reason for the deterioration was thought to be erosion caused by increased pleasure boating on the rivers, which caused waves to erode adjacent levees (California Central Valleys Flood Control Association 1960).

Feather River Levees and Local Reclamation

Levee District 1 (LD 1) was formed in April 1868, following a flood in 1867, to construct a portion of the present levees along the Feather River. The Green Act of 1868 fixed the present district boundaries. The flood of 1867 took out the existing levee across Gilsizer Slough. The levee broke again at Gilsizer Slough in 1871. From 1871 on, as hydraulic mining debris raised the bed of the Feather River channel, it was necessary to raise the existing levees and construct and maintain a back levee to protect the district from the waters in Sutter Basin between the Sacramento and Feather Rivers, which overflowed during high-water stages.

Realizing that the levee crown of the Feather River was too close to a possible flood stage, based on past floods and the possibility of the levee being overtopped, LD 1 decided to slab the sides and raise the crowns of all the levees 5 feet above the estimated flood plain. This project consisted of raising the Feather River levee from the south boundary of LD 1 to the wagon bridge between Yuba City and

Marysville. Work started in 1905 and was carried on in different locations along the Feather River until the flood of March 1907. Two breaks occurred on the levee, one on the Starr Bend north of Yuba City and one on the Holmes tract, about 5 miles south of Yuba City (Levee District 1 2009).

Nearly all of LD 1, including Yuba City, was flooded and much of the uncompleted dredger levee was washed away. The dredge work continued on the levee between Star Bend and Yuba City, and work was completed on a sand levee between Shanghai Bend and Yuba City when a flood occurred in 1909. The flood reached an elevation about 1 foot higher than the top of the levee in the pocket where the old bow levee joined the sand levee at Shanghai Bend. A break occurred in the sand levee at its junction with the old bow levee, which eroded to an 800-foot gap, and another break occurred in the sand levee halfway between Shanghai Bend and Yuba City, which eroded to a 2,600-foot gap. These breaks allowed water to overflow the lands between the sand levee and the old original levee along the Garden Highway. The sand levee constructed by the dredger on an alignment slightly east of the original earth levee was washed out, the water overflowed the old levee, and another break occurred just south of Shanghai Bend. During the year following the 1909 flood, the dredger filled the breaks in the sand levee. The moving of sand deposited by the dredger away from the river created a slope of 6–7 feet (Levee District 1 2009).

In 1938, USACE rebuilt the sand levee from Shanghai Bend to Yuba City. The levee was maintained by LD 1 from that time until 1955. In December 1955, California experienced heavy rains. As a result, a large boil exploded between Shanghai Bend and Yuba City. Nearly all of Yuba City was inundated, and 37 people were killed. The levee was rebuilt by USACE, affirming the critical role flood control plays in the regional economy.

I.2 Previous Studies

Table I-2 lists studies that have been completed within the vicinity of the action alternatives.

Table I-2. Previous Studies

Study #	Year	Author(s)	Title
01047	1990	Bouey, P.	Sacramento River Flood Control System Evaluation, Marysville-Yuba City Area
01133	1980	Holman, M., and M. Clark	Archaeological Reconnaissance of the Feather River Project Area: Proposed Feather River Sand and Gravel Quarry
01405	1995	McGowan, D.	Cultural Resources Inventory Report of the Therm II Power Project
01485	1996	Storm, D.	Archaeological Investigations along the Feather River near Nicolaus, Audubon Sanctuary
02666	1998	Dietz, F.	Cultural Resources Assessment within Levee Districts 1 and 9, Maintenance Area 3
03134	1997	Shapiro, W. et al.	Archaeological Assessment within Levee District 1 and 9, Maintenance Area 3
06868	2005	Selverston, M. et al.	Archaeological and Historical Resources Inventory Report, Oroville Facilities Relicensing FERC Project No. 2100
07154	1992	Offerman, J.	Negative ASR: Extension of State Route 65 as a Connection between Routes 70 and 99 in Yuba and Sutter Counties
07165	2005	Quidachay, K., and S. Baxter	Cultural Resources Inventory Report for the Yuba Water Treatment Plant 24 to 30 MGD Water Supply Replacement Project

Study #	Year	Author(s)	Title
08002	2006	Sikes, N.	Cultural Resources Inventory for the City of Live Oak General Plan Update, Sutter County
08783	2006	Neuenschwander, N.	Determination of Eligibility and Effect for the Proposed Feather River Setback Levee at Star Bend Project, Sutter County
08954	2007	Grant, J.	Cultural Resources Report for Geotechnical Borings along the Feather River, Sutter Bypass, and Wadsworth Canal
09539	2008	Leach-Palm, L. et al.	Cultural Resources Inventory of Caltrans District 3 Rural Conventional Highways
09954	2008	Berg, J.	Cultural Resources Inventory for the Pease-Marysville 60kV Transmission Line Project
10202	2008	Jensen, S.	Archaeological Inventory for the Proposed Live Oak Riverfront Boat Park Boat Ramp Project
10203	2008	Jensen, S.	Archaeological Inventory for the Proposed Gridley Boat Ramp Project

FERC = Federal Energy Regulatory Commission
MGD = million gallons per day
kV = kilovolt

I.3 Native American Consultation~~Correspondence~~

As part of the identification efforts for cultural resources, ICF staff requested a list of Native American contacts from the Native American Heritage Commission (NAHC) and a search of the Sacred Lands File maintained by the NAHC. The NAHC responded by letter on March 22, 2012, by providing a list of contacts and indicating that there are no resources identified for the project area in the Sacred Lands File. ICF contacted all parties identified in the NAHC list by letter on September 28, 2012.

USACE has consulted with tribes that are culturally affiliated with the areas where work will occur, as described in Chapter 3.17. The United Auburn Indian Community has provided information regarding cultural resources that may be affected by the alternatives.

I.4 Identified Resources Affected by the Action Alternatives

This section of this appendix provides an overview of the identified (currently known) resources that may be affected by the action alternatives. Additional resources may be identified through inventory efforts, including sampling for sites that are buried or otherwise obscured. [m.avina1]This section has been prepared to provide factual basis describing why these resources are likely to be ~~historical resources under the California Environmental Quality Act (CEQA) and~~ historic properties under the NRHP. ~~This section also provides description of the probable effects of the project and the reasons why preservation in place of all potentially eligible resources may not be feasible.~~

I.4.1 Archaeological Resources

I.4.1.1 CA-BUT-52

This resource consists of a prehistoric "mound" site approximately 91 meters in diameter with midden. Midden consists of organic material deposit during human habitation that is frequently useful in archaeological research for analysis of subsistence and settlement patterns. Mound sites consist of sites that were originally elevated above grade and formed low mounds relative to the surrounding landscape. Burials are also typically found in mound sites. Because any remaining portions of the site may be useful in providing data for archaeological research and because burials frequently contain grave goods that may be used to identify specific time periods of habitation, this site may have both integrity and data potential (NRHP Criterion D~~/California Register of Historical Resources (CRHR) Criterion 4~~). For these reasons it may qualify as an ~~historical resource and~~ historic~~al~~ property.

I.4.1.2 CA-BUT-53

This resource consists of a prehistoric midden and mound site approximately 61 meters in diameter. The site contains human burials, projectile points (*arrowheads*), ground stone artifacts, and shell ornaments. Because any remaining portions of the site may be useful in providing data for archaeological research (NRHP Criterion D~~/CRHR Criterion 4~~) and because burials frequently contain grave goods that may be used to identify specific time periods of habitation, this site may have both integrity and data potential. For these reasons it may qualify as an ~~historical resource and~~ historic property~~historical property~~.

~~CA-BUT-465~~

~~The resource consists of a feature of axe-cut trees, tailings, a road, and other features within an expansive landscape composed of intact and historic-era mined tailings, levees, ponds, original landscape remnants, and other features made between 1898 and 1952 (the larger resource is recorded as CA-BUT-1345). This resource is associated with the significant historical theme of gold mining. This resource is also potentially useful in studying historic-era activity associated with this theme (NRHP Criterion D/CRHR Criterion 4). Because the resource is expansive it likely has at least some portions with the ability to convey this significance. For these reasons it may qualify as an historical resource and historical property.~~

I.4.1.3 I.4.1.4 CA BUT-496

This resource consists of a prehistoric site with burials, measuring approximately 27 meters by 46 meters. Identified materials include *Olivella* beads, *Haliotis* pendants, project points, ear spools, and net weights. Because any remaining portions of the site may be useful in providing data for archaeological research (NRHP Criterion D) and because cultural material noted on the site may be used to identify specific time periods of habitation, this site may have both integrity and data potential. For these reasons it may qualify as an historic property.

I.4.1.4 CA-BUT-1123

This resource consists of a prehistoric deposit spanning 90 meters with human remains and "invertebrate fragments." Flaked stone tools and ground stone artifacts were noted. If the site

retains portions with integrity and useful information it may be valuable for research domains (NRHP Criterion D)~~/CRHR Criterion 4)~~. For these reasons it may qualify as an historical resource and historic property~~historical property~~.

I.4.1.5 CA-BUT-1345/CA-BUT-465

The resource consists of a feature of axe-cut trees, tailings, a road, and other features within an expansive landscape composed of intact and historic-era mined tailings, levees, ponds, original landscape remnants, and other features made between 1898 and 1952. The resource consists of an expansive landscape composed of intact and historic-era mined tailings, ~~similar to CA-BUT-465~~that is continuous between the resources recorded as CA-BUT-1345 and 435. This resource is associated with the significant historical theme of gold mining. This resource is also potentially useful in studying historic-era activity associated with this theme (NRHP Criterion D~~/CRHR Criterion 4~~). Because the resource is expansive it likely has at least some portions with the ability to convey this significance. For these reasons it may qualify as an ~~historical resource and~~ historic property~~historical property~~.

I.4.1.6 CA-SUT-5

This resource consists of a midden and mound site measuring approximately 30 meters in diameter. The deposit contains midden, glass and clamshell beads, a bone awl, and a pestle (a ground stone implement). Because any remaining portions of the site may be useful in providing data for archaeological research and because burials frequently contain grave goods that may be used to identify specific time periods of habitation, this site may have both integrity and data potential (NRHP Criterion D~~/CRHR Criterion 4~~). For these reasons it may qualify as an ~~historical resource and~~ historic property~~historical property~~.

I.4.1.7 CA-SUT-10

This resource consists of a midden and mound site measuring approximately 60 meters in diameter. The deposit contains midden, burials, shell beads, and shell pendants. Because any remaining portions of the site may be useful in providing data for archaeological research and because burials frequently contain grave goods that may be used to identify specific time periods of habitation, this site may have both integrity and data potential (NRHP Criterion D~~/CRHR Criterion 4~~). For these reasons it may qualify as an ~~historical resource and~~ historic property~~historical property~~.

I.4.1.8 CA-SUT-20

This prehistoric resource consists of a midden deposit of uncertain dimensions, with shell beads and ornaments and burials. Because these materials are useful in prehistoric research (NRHP Criterion D~~/CRHR Criterion 4~~) and because the portions of the site may remain with integrity to provide this utility, this site may qualify as an ~~historical resource and~~ historic property~~historical property~~.

I.4.1.9 CA-SUT-77

This resource contains midden soil, with shell, bone, flaked stone debris, in a deposit spanning 10 meters in diameter. Other noted artifacts include shell beads, a projectile point, and a bone ornament. The identified deposit is consistent with expectations for a habitation site with a burial component such remains and documented cultural constituents may be useful in prehistoric

research (NRHP Criterion D~~/CRHR Criterion 4~~). Because portions of the site may remain with integrity to provide this utility, this site may qualify as an ~~historical resource and~~ historic property~~historical property~~.

I.4.1.10 Previously Unrecorded Prehistoric Village Site

This resource consists of a prehistoric village site identified by the United Auburn Indian Community. Because it is likely to have habitation debris and burials, both of which are usually found in village sites; it likely has the ability to contribute information useful in research. Because it is expansive, it likely contains some remaining portions with integrity. For these reasons it likely qualifies as an historic property. It may have significance under other NRHP eligibility criteria as well.

I.4.2 Built Environment Resources

I.4.2.1 Residential Historic District in Yuba City (Potentially NRHP- and CRHR-eligible)

There are 11 residential buildings located in the project area along 2nd Street in Yuba City that are associated with a potential NRHP- eligible ~~and CRHR-eligible~~ historic district. The boundary for the potential residential historic district would include the east and west sides of 2nd Street between Garden Highway and C Street, and possibly extend a few blocks west of this area. The area appears eligible for listing in the NRHP under Criteria A and C ~~(CRHR Criteria 1 and 3),~~ at the local level of significance in the areas of residential community development and architecture. The period of significance is approximately circa 1870 to approximately 1940 for the district and its contributing resources. The district comprises Yuba City's earliest collection of residential buildings and highlights architectural styles such as Italianate, Craftsman, and Queen Anne Victorian. Table I-3 below describes 11 residential buildings located in the area of potential effects (APE) that are individually eligible and those that would be contributing resources to the potential historic district.

Table I-3. Contributing Elements of the Yuba City Residential Historic District

APN	Address	Resource Name if Applicable	Architectural Style	Eligibility Criteria*
52-552-007	329 2nd Street	William O'Banion House	Italianate	Eligible under NRHP Criteria A and C individually and as a potential historic district contributor
52-552-006	335 2nd Street	NA	Craftsman	Eligible under NRHP Criteria A and C as a potential historic district contributor
52-552-005	341 2nd Street	NA	Craftsman	Eligible under NRHP Criteria A and C as a potential historic district contributor
52-552-004	349 2nd Street	NA	Craftsman	Eligible under NRHP Criteria A and C as a potential historic district contributor
52-552-003	355 2nd Street	NA	Prairie	Eligible under NRHP Criteria A and C as a potential historic district contributor
52-552-002	365 2nd Street	NA	Prairie	Eligible under NRHP Criteria A and C individually and as a potential historic district contributor
52-552-001	373 2nd Street	NA	Craftsman	Eligible under NRHP Criteria A and C as a potential historic district contributor
52-535-007	379 2nd Street	McGruder House	Queen Anne Victorian	Eligible under NRHP Criteria A and C individually and as a potential historic district contributor
52-535-006	407 2nd Street	NA	Queen Anne Victorian	Eligible under NRHP Criteria A and C as a potential historic district contributor
52-535-005	413 2nd Street	G.W. Carpenter House	Queen Anne Victorian	Eligible under NRHP Criteria A and C individually and as a potential historic district contributor
52-535-004	423 2nd Street	Thomas D. Boyd House	Neoclassical	Eligible under NRHP Criteria A and C individually and as a potential historic district contributor

NA = not applicable.

NRHP = National Register of Historic Places.

*Resources are also CRHR-eligible under parallel CRHR criteria.

I.4.2.2 Sutter County Office Building/Courthouse—APN 52-534-001

The Sutter County Office Building located at 463 2nd Street was built in 1953 and designed by master architect Harry J. Devine. The building and associated detached garage appears to meet the eligibility criteria for listing in the NRHP ~~and CRHR under~~ Criterion C ~~and Criterion 3, respectively,~~ as an excellent example of an International-style government building in Sutter County.

I.4.2.3 Masonic Temple—APN 52-516-004

The Masonic Temple located at 501 2nd Street in downtown Yuba City appears eligible for listing in NRHP ~~and CRHR~~ under Criterion C ~~and Criterion 3, respectively,~~ at the local level of significance as an excellent example of an early reinforced concrete building constructed in the Mission Revival style.

I.4.2.4 Gridley Workers Camp Historic District—APN 024-220-030

The Gridley Workers Camp Historic District is located at 850 East Gridley Road in the city of Gridley. The contributing resources associated with the historic district are 25 wood frame units constructed in 1938 by the Farm Security Administration. The district is eligible for listing in the NRHP ~~and CRHR~~ under Criterion A ~~and Criterion 1, respectively,~~ for its association with the Farm Security Administration's efforts during the Great Depression to address the health and housing crisis. The district is also eligible for the NRHP ~~and CRHR~~ under Criterion C ~~and CRHR Criteria 3, respectively,~~ as an excellent example of Farm Security Administration's vernacular architecture and landscape design.

I.4.2.5 Feather River Levee

The Feather River Levee is eligible for the NRHP ~~and CRHR~~ under Criterion A ~~and Criterion 1 , respectively,~~ for its association with advances in flood control in California.

I.4.2.6 P-1340 Sutter Butte Canal

The Sutter Butte Canal (P-1340) appears eligible for listing in the NRHP ~~and CRHR~~ under Criterion A ~~and Criteria 1, respectively,~~ at the local level of significance for its associated with the development of agricultural irrigation in Sutter and Butte Counties.

I.4.2.7 Southern Pacific Shasta Route Historic District (alignment segment and bridge)

Contributing elements of the Southern Pacific Shasta Route Historic District (SPSRHD) are located in the APE. The historic district has been determined eligible for the NRHP under Criteria A, B, and C ~~(CRHR Criteria 1, 2, and 3)~~ with a period of significance of 1863 to 1945. Under Criterion A the district is historically associated with engineering, transportation history, economic history in California and Oregon, as well as the development of the West. The SPSRHD is also NRHP eligible under Criterion B for its association with railroad mogul E.H. Harriman. The bridges located along the route that were built according to the railroad's "Common Standard" design are also NRHP eligible under Criterion C as they represent the particular type, period and methods on construction for railroad bridges built during the period of significance. The rail alignment in the APE is approximately 2,680 feet long and includes a wooden trestle bridge that dates to 1939.

I.4.3 Potential Effects and Treatment

Table I-4 identifies archaeological resources affected by the action alternatives and potential treatment options. Table I-5 lists the built environment resources affected by the action alternatives and potential treatment options.

Table I-4. Archaeological Resources Affected by the Action Alternatives and Potential Treatment

County	Primary Number	Trinomial	Alt 1	Alt 2	Alt 3	Potential Treatment/Basis for Treatment*
Butte	P-04-52	CA-BUT-52	SE	SE	SE	Data Recovery/Construction Constrained by Existing Footprint
Butte	P-04-53	CA-BUT-53	SE	SE	NE	Data Recovery/Construction Constrained by Existing Footprint
Butte	P-04-465 (also P-04-1345)	CA-BUT-465	SE	SE	SE	Data Recovery/Construction Constrained by Existing Footprint
Butte	–	CA-BUT-496	SE	SE	SE	Data Recovery/Construction Constrained by Existing Footprint
Butte	P-04-1123	CA-BUT-1123	SE	SE	SE	Data Recovery/Construction Constrained by Existing Footprint
Sutter	P-51-05*	CA-SUT-5*	SE	SE	NE	Data Recovery/Construction Constrained by Existing Footprint
Sutter	P-51-10	CA-SUT-10	SE	SE	SE	Data Recovery/Construction Constrained by Existing Footprint
Sutter	P-51-20**	CA-SUT-20	NE	NE	NE	Data Recovery/Construction Constrained by Existing Footprint
Sutter	P-51-77	CA-SUT-77	SE	SE	SE	Data Recovery/Construction Constrained by Existing Footprint
Sutter	–	[previously unrecorded village site]***	SE	SE	SE	Data Recovery/Construction Constrained by Existing Footprint

Alt = alternative; SE = significant effect, NE = no effect, effect identified if mapped location occurs within project boundary and coincides with ground disturbing activity.

* CA-SUT-5 has two mapped locations, the first occurs in the disturbance footprint of Alternative 1 and 2 but not 3, the second falls outside all three alternatives.

** Occurs in Reach 15: no work proposed in this reach.

*** Previously unrecorded village site identified by the United Auburn Indian Community.

Table I-5. Built Environment Resources Affected by the Action Alternatives/Potential Treatment

APN	Address	Alternative 1 Effect	Alternative 1 Probable Treatment Plan Options	Alternative 2 Effect	Alternative 2 Probable Treatment Plan Options	Alternative 3 Effect	Alternative 3 Probable Treatment Plan Options
Yuba City Properties							
52-552-007	329 2nd Street	SE	HABS, R, O	SE	HABS, R, O	NS	N/A
52-552-006	335 2nd Street	SE	HABS, R, O	SE	HABS, R, O	NS	N/A
52-552-005	341 2nd Street	SE	HABS, R, O	SE	HABS, R, O	NS	N/A
52-552-004	349 2nd Street	SE	HABS, R, O	SE	HABS, R, O	SE	HABS, DR
52-552-003	355 2nd Street	SE	HABS, R, O	SE	HABS, R, O	SE	HABS, DR
52-552-002	365 2nd Street	SE	HABS, R, O	SE	HABS, R, O	SE	HABS, DR
52-552-001	373 2nd Street	SE	HABS, R, O	SE	HABS, R, O	NS	N/A
52-535-007	379 2nd Street	SE	HABS, R, O	SE	HABS, R, O	NS	N/A
52-535-006	407 2nd Street	SE	HABS, R, O	SE	HABS, R, O	NS	N/A
52-535-005	413 2nd Street	SE	HABS, R, O	SE	HABS, R, O	NS	N/A
52-535-004	423 2nd Street	SE	HABS, R, O	SE	HABS, R, O	SE	HABS, DR, O
52-534-001	463 2nd Street	SE	HABS. O	SE	HABS. O	SE	HABS. O
52-516-004	501 2nd Street	SE	HABS. O	SE	HABS. O	NE	N/A
24-220-030	850 E. Gridley Rd.	NS	N/A	NS	N/A	NE	N/A
Other Properties							
Feather River Levee	Entire APE	SE	O	SE	O	SE	O
P-1340. Sutter Butte Canal	Ends near Levee Rd & Clark Rd	SE	O	SE	O	SE	O
Southern Pacific Shasta Route Historic District	Near Live Oak Blvd and Pease Road (north of Yuba City)	SE	HAER	SE	HAER	SE	HAER

SE =significant effect; NS = not significant; NE = no effect; HABS = documentation per Historic American Buildings Survey; HAER = documentation per Historic American Engineering Record; R = relocation of CRHR-eligible building(s); DR = documentation of 2nd St Historic District with an NRHP nomination form; O = Other resource specific mitigation measure defined in the Built Environment Treatment Plan including but not limited to interpretive displays, online resources, or historic contexts.

N/A = Not applicable—no treatment necessary.

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Appendix J

Programmatic Agreement among the U.S. Army Corps of Engineers, Sutter Butte Flood Control Agency, and the California State Historic Preservation Officer Regarding the Feather River West Levee Project Sutter and Butte Counties, California

PROGRAMMATIC AGREEMENT
AMONG THE
U.S. ARMY CORPS OF ENGINEERS, SUTTER BUTTE FLOOD CONTROL AGENCY, AND
THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER
REGARDING THE
FEATHER RIVER WEST LEVEE PROJECT
SUTTER AND BUTTE COUNTIES, CALIFORNIA

WHEREAS, the Sutter Butte Flood Control Agency (SBFCA) proposes to design and construct the Feather River West Levee Project (Project), to reduce flood risk in the Sutter Basin, which includes portions of Sutter and Butte Counties in the Sacramento Valley of California, and;

WHEREAS, this project requires permits from the U.S. Army Corps of Engineers (Corps) to modify federal levees under Section 14 of the River and Harbors Act (33 US Code Section 408) and a permit to discharge fill to waters of the United States under Section 404 of the Clean Water Act (33 US Code Section 1344), and;

WHEREAS, the project is an undertaking as defined under Section 106 of the National Historic Preservation Act (NHPA, 16 US Code Section 470f) and the implementing regulations (33 CFR Section 800.16[y]) because the project requires federal permitting, and;

WHEREAS, the Corps is the lead federal agency for Section 106 compliance per 36 CFR Section 800.2(a)(2) for the project, and;

WHEREAS, the Corps may not be able to resolve adverse effects by preparing a Memorandum of Agreement under 36 CFR Section 800.2(a)(2) in advance of 408 authorization and 404 permitting; and;

WHEREAS, the Section 106 regulations allow a federal agency to phase identification and evaluation of historic properties if provided for in a programmatic agreement (36 CFR Section 800.4(b)(2)), and;

WHEREAS, the Corps has consulted with and will continue to consult with both federally recognized and other Native American tribes, and the public, and;

WHEREAS, the Corps has provided notice to the Advisory Council on Historic Preservation (ACHP) and by letter dated July 18, 2012, the ACHP has declined to participate in this programmatic agreement (Agreement), and;

WHEREAS, the Corps has consulted with the State Historic Preservation Officer (SHPO) and will continue to consult with the SHPO and provide the SHPO the opportunity to review documents covered by this Agreement, and;

WHEREAS, SBFCA has invited the Central Valley Flood Protection Board (CVFPB) to review and participate as a concurring party to this Agreement because the CVFPB must approve alterations to the project levees per California Water Code Section 8710,

NOW THEREFORE, the Corps, SHPO, SBFCA and the Central Valley Flood Protection Board (CVFPB) agree that the following stipulations will be implemented for all portions of the project, in accordance with this Agreement and the Inventory and Historic Property Treatment Plan (Plan) that will be appended to this Agreement after execution.

STIPULATIONS

Stipulation I. Applicability and Scope, Relationship to Other Agreements

(A) Applicability, Scope, and Method of Implementation

1. This Agreement applies to the project because the project is an undertaking within the meaning of Section 106 of the NHPA, as defined in 36 CFR Section 800.16(y).

2. Although other state and local agencies may issue permits and otherwise provide assistance for portions of the project covered by this Agreement, the Corps remains the lead federal agency responsible for ensuring compliance with all Section 106 responsibilities under the provisions of this Agreement.

3. This Agreement does not negate or supersede any agreements in effect between the Corps and Indian tribes at the time the Agreement is executed, nor does it negate or supersede any agreement documents executed between the Corps and SHPO pursuant to 36 CFR Part 800, with amendments, effective August 5, 2004.

4. SBFCA assumes responsibility for the contracting and supervision of technical cultural resources management work performed to satisfy the stipulations of this Agreement and Section 106 of the NHPA. SBFCA understands that all substantive management decisions and completion of Section 106 milestones are subject to the review, approval, and ultimate discretion of the Corps.

(B) Conflicts with Other Agreement Documents

1. It is possible that a conflict may arise between this Agreement and other agreement documents that govern associated undertakings. The Corps shall endeavor to avoid conflicts with other agreement documents, but in the event of a direct conflict, the Corps shall determine which standards govern and how to proceed. For the Project, SBFCA will only be responsible for implementing the terms of this Agreement.

Stipulation II. Definitions and Standards

1. The definitions set forth at 36 CFR Section 800.16 are applicable throughout this Agreement.

2. "Plan" as used in this document, refers to the Inventory and Historic Property Treatment Plan. This document will describe methodology covering inventory methods, recording of resources, evaluation and treatment of identified resources, curation of recovered materials, and other technical specifications necessary to implement this Agreement. This Plan may be amended separately from the Agreement but cannot revise the substantive requirements of this Agreement.

3. Professional Qualifications: All inventory and evaluation activities prescribed by this Agreement shall be carried out under the authority of the Corps by or under the direct supervision of a person or persons meeting, at a minimum, the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738–44739) in the appropriate disciplines. Nothing in this stipulation, however, may be interpreted to preclude the Corps, SBFCA, or any agent or contractor thereof from using the services of persons who do not meet the Secretary of Interior's Professional Qualifications Standards if they are supervised by an individual who does meet these standards.

Stipulation III. Notices and Communications

(A) Methods of Transmittal

1. The signatory parties agree that reports and deliverables such as inventory reports, findings of effect, and treatment plans may be submitted electronically to signatory parties for review. All decisions from SHPO, such as concurrence in evaluations, findings of effect, and adequacy of treatment, shall be delivered in hard copy and retained by SBFCA and the Corps.

Stipulation IV. Identification of Historic Properties

(A) Phasing of Identification, Evaluation, Determination of Adverse Effects, and Resolution of Adverse Effects on Historic Properties

1. The Corps will perform, or ensure that SBFCA performs, the following steps for discrete phases or activities identified by SBFCA and the Corps, according to the construction schedule or timeline of the larger project.

2. For each phase or activity, the Corps and SBFCA shall define an area of potential effects (APE), complete an inventory of the APE, evaluate identified resources for the National Register of Historic Places (NRHP), make a finding of effect, and develop treatment methods to resolve adverse effects. The Corps will typically submit separate reports for the inventory (including evaluation and findings of effect) and treatment. For example, where identified properties require property-specific treatment that requires consideration and collaboration among consulting parties, the Corps would typically submit the inventory, evaluation, and finding of effect for the APE in one report and submit treatment in a separate later deliverable. All reports prepared under this stipulation shall be subject to the review and approval requirements defined below as part of this stipulation (IV[F]).

(B) Definition of the Area of Potential Effects for Each Phase or Activity

1. The Corps has conducted initial consultation with the SHPO regarding the APE. For each activity or phase dependent on federal authorization or permits from the Corps, the Corps and SBFCA shall define a phase-specific APE, in consultation with the SHPO. The APE shall consist of the construction footprint and any ancillary areas, including but not limited to staging areas, haul roads, utility relocations, and mitigation sites for each phase or activity identified by SBFCA, as well as the surrounding vicinity where the phase-specific footprint may result in direct or indirect effects on historic properties, based upon the nature of the activity and the potentially affected resources, subject to the review and approval of the Corps prior to initiation of cultural resource inventories. The APE will determine the location where the

Corps shall conduct inventory efforts, evaluate identified resources, make a finding of effect, and develop treatment as defined below (Stipulation IV[C] through IV[E]).

(C) Inventory of the Area of Potential Effects

1. The Corps and SBFCA, in consultation with the SHPO and any interested Native American tribes, shall complete an inventory of cultural resources within each phase or activity-specific APE. The inventory shall use efforts appropriate to the kind and frequency of cultural resources that may be encountered, consistent with the methodology of the plan. The inventory will cover the entire APE and shall be designed to identify historic properties prior to construction, to the extent feasible.

2. Based upon the inventory of each phase or activity-specific APE, the Corps may require construction monitoring. The Corps' decision shall be based upon relevant factors such as the density and distribution of identified resources, geomorphology, recommendations from Native Americans (including both federally recognized tribes and other individuals and organizations), historic maps, and other data. Monitoring efforts shall conform to the requirements of the plan with any necessary modifications made based upon the results of the inventory effort.

(D) Evaluation and Finding of Effect

1. For all identified cultural resources, the Corps and SFBCA shall prepare an evaluation for the NRHP, consistent with the methods and standards in the Plan. The Corps shall apply the criteria for evaluation for the NRHP provided in 36 CFR Section 60.4. The Corps and SBFCA shall also include a finding of effect in the inventory and evaluation report, or in a separate deliverable, by applying the criteria of adverse effect in 36 CFR Section 800.5(a)(1).

(E) Resolution of Adverse Effects

1. For all identified historic properties that would be adversely affected by the project, the Corps and SBFCA shall develop treatments to resolve adverse effects. Treatment may consist of avoidance, documentation, data recovery excavations, preservation in place, or other methods identified by the Corps. The Corps may use treatment methods provided in the Plan or may develop, in consultation with the SHPO, interested Native American tribes, or other stakeholders as appropriate, property-specific treatment. If treatment methods described in the Plan are adequate, the Corps may simply refer to those methods in the inventory report, finding of effect document, or stand-alone treatment plan and incorporate them by reference without repeating the full text of the relevant treatment methods.

(F) Review of Reports

1. Reports describing the results of inventory, evaluation, findings of effect and proposed treatment shall be submitted to the SHPO for review. The Corps shall also distribute reports to signatories, concurring parties, and other interested parties upon request. SHPO and other reviewing parties shall have 30 calendar days to review reports, starting on the day the report is transmitted electronically or the date it was received if sent by mail or other physical means. If SHPO does not respond within 30 calendar days, the Corps may proceed with the proposed actions. If SHPO responds with comments, the Corps shall incorporate the comments and provide a revised copy to SHPO and other consulting parties for further review. The SHPO shall have 15 calendar days from the date the revised report is received to review

revised reports prepared under this stipulation. If the SHPO does not respond within this time frame, the Corps may implement the proposed actions in the report and construction dependent upon those findings, if any.

2. Every report and associated management milestone performed under this stipulation shall be deemed complete and adequate when the SHPO provides written concurrence by e-mail or letter.

(G) Ongoing Consultation with Native American Individuals and Organizations

1. The Corps has consulted with the Native American community during development of this Agreement document. During management milestones, such as completion of inventory reports, resource evaluations, findings of effect, and development and implementation of treatment, the Corps shall consult with the Native American individuals and organizations that may attach cultural significance to resources affected by relevant undertakings. The Corps will consider the results of these consultations and attempt to incorporate and follow suggestions regarding management of cultural resources.

(H) Annual Reports

1. At the end of every calendar year during which management activities are performed under this Agreement, SBFCA and the Corps shall prepare and deliver to the SHPO a memorandum summarizing management activities and findings for that calendar year.

Stipulation V. Monitoring and Inadvertent Discoveries and Unanticipated Effects

(A) Workforce Training and Construction Monitoring

1. The Corps or qualified archaeologists retained by SBFCA will provide training to construction personnel regarding proper procedures and conduct in the event that archaeological materials are encountered during construction. This training will cover both the identification of resources that may be encountered during construction and procedures to be followed in the event of a discovery.

2. SBFCA shall conduct monitoring of construction where the Corps, in consultation with the SHPO, determines it is necessary to ensure that identified resources are protected or where there is a high sensitivity for previously unidentified resources. These determinations will be described in each phase or activity-specific inventory report and the plan.

(B) Discovery Procedures for Resources Encountered During Construction

1. If cultural resources are discovered during construction, all construction shall immediately stop within 100 ft (30 m) of the discovery, the location of the discovery will be marked for avoidance, and efforts will be made to prevent inadvertent destruction of the find. The contractor must notify the Corps and SBFCA (if no Corps or SBFCA representatives are on location). The Corps shall determine whether the discovery is a potential NRHP-eligible resource per the criteria in 36 CFR Section 60.4. If the Corps determines that the discovery is not a potentially NRHP-eligible resource, the discovery will be documented and construction may proceed at the direction of the Corps.

2. If the Corps determines that human remains have not been encountered, that the discovery is not an isolated find, and that the discovery may be eligible for the NRHP, the Corps will notify the SHPO and other relevant parties within 48 hours of the discovery. Notification should include a description of the discovery, the circumstances leading to its identification, and recommendations for further action. Where feasible, the notification will also include a tentative NRHP-eligibility discussion per 36 CFR Section 60.4 and a finding of effect per 36 CFR Section 800.5(a)(1). If the resource cannot be evaluated based upon available evidence (for example, where test excavation is required), the Corps shall include a plan of action for further technical work necessary to determine the eligibility of the resource and make a finding of effect per 36 CFR Section 800.5(a)(1). Treatment shall be implemented where necessary to resolve adverse effects on inadvertently discovered historic properties. If treatment is necessary to resolve adverse effects, SBFCA and the Corps shall consult with Native American individuals and organizations that attach cultural significance to the relevant historic properties and with the SHPO prior to implementing treatment. The SHPO shall have 15 calendar days to review findings of effect and treatment plans submitted under this stipulation, when treatment is selected from the attached historic property treatment plan. When new treatment methods are developed, review shall follow Stipulation IV(F) above.

3. If human remains are present, treatment shall conform to the requirements of state law under California Health and Safety Code Section 7050.5 and Public Resources Code Section 5097.98, unless the discovery occurs on federal land. Discoveries on federal land shall conform to the requirements of the Native American Graves Protection and Repatriation Act (NAGPRA, 25 US Code Section 3001 et seq.), after complying with the requirements of California Health and Safety Code Section 7050.5, which requires notice to the County Coroner so the coroner may determine if an investigation into the cause of death is required. These legal requirements, as well as appropriate monitoring, will be described in the plan, as indicated in Attachment 2.

Stipulation VI. Administrative Provisions

(A) Documentation Standards

1. Written documentation of inventory, evaluations, findings of effect and treatment prescribed per this Agreement shall conform to the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (48 FR 44716–44740), as well as to applicable standards and guidelines established by the State of California Office of Historic Preservation[1] and the plan for each phase, agreed upon by the Corps and the SHPO, in consultation with all pertinent stakeholders.

(B) Curation Standards

1. The Corps shall ensure that the materials and records resulting from the activities prescribed in this Agreement are curated in accordance with 36 CFR Part 79, except where state law and regulations, including, but not limited to, California Public Resources Code Sections 5097.98 and 5097.991 for Native American human remains and associated grave goods discovered on non-federal land, require different treatment. Non-burial associated archaeological materials removed from private land shall be subject to the control of the landowner. Additionally, the disposition of any abandoned shipwrecks and

[1]California State Parks, Office of Historic Preservation, *Publications and Forms.* Available: http://ohp.parks.ca.gov/?page_id=1069, Accessed March 5, 2013.

archaeological sites and historic resources on state lands under the jurisdiction of the California State Lands Commission (CSLC) shall be determined by CSLC as provided by California Public Resources Code Section 6313. The Corps will ensure that, to the extent permitted by applicable laws and regulations, the views of the appropriate Native American descendant group(s) are taken into consideration when decisions are made about the disposition of Native American archaeological materials and records.

(C) Confidentiality

1. The signatory parties to this Agreement acknowledge that historic properties covered by this Agreement are subject to the provisions of Section 304 of the NHPA and California Government Code 6254.10 (Public Records Act) relating to the disclosure of archaeological site information and, having so acknowledged, will ensure that all actions and documentation prescribed by this Agreement maintain the confidentiality required by law.

Stipulation VII. Resolving Objections

(A) Resolving Objections

1. Should any party to this Agreement object in writing at any time to the manner in which the terms of this Agreement are implemented, to any action carried out or proposed with respect to implementation of the Agreement (other than the undertaking itself), or to any documentation prepared in accordance with and subject to the terms of this Agreement, the Corps shall immediately notify the other Agreement parties of the objection, request their comments on the objection within 15 days following receipt of the Corps' notification, and proceed to consult with the objecting party for no more than 30 days to resolve the objection. The Corps will honor the request of the other parties to participate in the consultation and will take any comments provided by those parties into account.

2. If the objection is resolved during the 30-day consultation period, the Corps may proceed with the disputed action in accordance with the terms of such resolution.

3. If at the end of the 30-day consultation period, the Corps determines that the objection cannot be resolved through such consultation, then the Corps shall forward all documentation relevant to the objection to the ACHP, including the Corps' proposed response to the objection, with the expectation that the ACHP will, within 45 days after receipt of such documentation:

a. Advise the Corps that the ACHP concurs in the Corps' proposed response to the objection, whereupon the Corps will respond to the objection accordingly. The objection shall thereby be resolved; or

b. Provide the Corps with recommendations, which the Corps will take into account in reaching a final decision regarding its response to the objection. The objection shall thereby be resolved; or

c. Notify the Corps that the objection will be referred for comment pursuant to 36 CFR Section 800.7(c) and proceed to refer the objection and comment. The Corps shall take the resulting comments into account in accordance with 36 CFR Section 800.7(c)(4). The objection shall thereby be resolved.

4. Should the ACHP not exercise one of the above options within 45 days after receipt of all pertinent documentation, the Corps may proceed to implement its proposed response. The objection shall thereby be resolved.

5. The Corps shall take into account any of the ACHP's recommendations or comments provided in accordance with this stipulation with reference only to the subject of the objection. The Corps' responsibility to carry out all actions under this Agreement that are not the subject of the objection shall remain unchanged.

6. At any time during implementation of the measures stipulated in this Agreement, should a member of the public raise an objection in writing pertaining to such implementation to any signatory party to this Agreement, that signatory party shall immediately notify the Corps. The Corps shall immediately notify the other signatory parties in writing of the objection. Any signatory party may choose to comment in writing on the objection to the Corps. The Corps shall establish a reasonable time frame for this comment period. The Corps shall consider the objection, and in reaching its decision, the Corps will take all comments from the other signatory parties into account. Within 15 days following closure of the comment period, the Corps will render a decision regarding the objection and respond to the objecting party. The Corps will promptly notify the other signatory parties of its decision in writing, including a copy of the response to the objecting party. The Corps' decision regarding resolution of the objection will be final. Following issuance of its final decision, the Corps may authorize the action subject to dispute hereunder to proceed in accordance with the terms of that decision.

7. The Corps shall provide all parties to this Agreement, and the ACHP, if the ACHP has commented, and any parties that have objected pursuant to Section C.6 of this stipulation, with a copy of its final written decision regarding any objection addressed pursuant to this stipulation.

8. The Corps may authorize any action subject to objection under this stipulation to proceed after the objection has been resolved in accordance with the terms of this stipulation.

Stipulation VIII. Amendments

(A) Methods for Amending this Agreement

1. Any signatory party to this Agreement may propose that this Agreement be amended, whereupon the signatory parties will consult for no more than 30 calendar days to consider such amendment. The Corps may extend this consultation period. The amendment process shall comply with 36 CFR Section 800.6(c)(1) and Section 800.6(c)(7). This Agreement may be amended only upon the written agreement of the signatories.

(B) Failure to Reach Agreement

1. If the signatory parties cannot reach agreement on proposed amendments, the dispute shall be resolved as provided for in Stipulation VII above.

Stipulation IX. Termination

(A) Power to Terminate

1. Only signatory parties to this Agreement may terminate this Agreement. If this Agreement is not amended as provided for in Stipulation VIII or if any signatory proposes termination of this Agreement, the party proposing termination shall notify the other signatory parties in writing, explain the reasons for proposing termination, and consult with the other parties for no more than 30 calendar days to seek alternatives to termination.

2. Should such consultation result in an agreement on an alternative to termination, the signatories shall proceed in accordance with that agreement and if necessary, shall amend this document in accordance with Stipulation VIII.

3. Should such consultation fail to result in an agreed-upon resolution by the signatory parties, the signatory party proposing termination may terminate this Agreement by promptly notifying the other signatories in writing.

4. If this Agreement is terminated hereunder, and if the Corps determines that the undertaking will nonetheless proceed, then the Corps shall comply with the requirements of 36 CFR Section 800.3–800.6, or request the comments of the ACHP, pursuant to 36 CFR Part 800.

Stipulation X. Duration of the Agreement

1. Unless it is terminated pursuant to Stipulation IX of this Agreement or superseded by another agreement executed for the covered undertakings, this Agreement shall remain in effect until the Corps, in consultation with the other signatory parties to this Agreement, determines that construction, monitoring, and maintenance of all aspects of the undertakings have been completed and all terms of this Agreement have been fulfilled in a satisfactory manner, or until 10 years have passed from the date of execution of this Agreement, whichever comes first. Upon a determination by the Corps that construction, monitoring, and maintenance of all aspects of the covered undertakings have been completed and that all terms of this Agreement have been fulfilled in a satisfactory manner, or upon reaching the 10 year limit, the Corps shall notify the other signatory and concurring parties of this determination in writing, whereupon this Agreement shall be null and void.

Stipulation XI. Effective Date

1. This Agreement shall take effect on the date that it has been executed by all signatory parties.

EXECUTION and implementation of this Agreement is evidence that the Corps has afforded ACHP a reasonable opportunity to comment on this Agreement and the associated undertakings; that the Corps has taken into account the effects of the undertakings on historic properties; and that the Corps has complied with Section 106 of the NHPA and 36 CFR Part 800 for all relevant aspects of the undertaking.

ATTACHMENTS AND FIGURES

Figures 1 and 2, Project Location and Project Area

Attachment 1. Feather River West Levee Project: Description of the Project and U.S. Army Corps of Engineers Undertakings

Attachment 2. Feather River West Levee Project: Outline and Guidance for the Historic Property Treatment Plan

SIGNATORY PARTIES:

U.S. Army Corps of Engineers

By _____ Date _____
William J. Leady, P.E.
Colonel, U.S. Army
District Commander

California State Office of Historic Preservation

By _____ Date _____
Carol Roland-Nawi, PhD
State Historic Preservation Officer

Sutter Butte Flood Control Agency

By _____ Date _____
Michael Inamine
Interim Executive Director
Sutter Butte Flood Control Agency

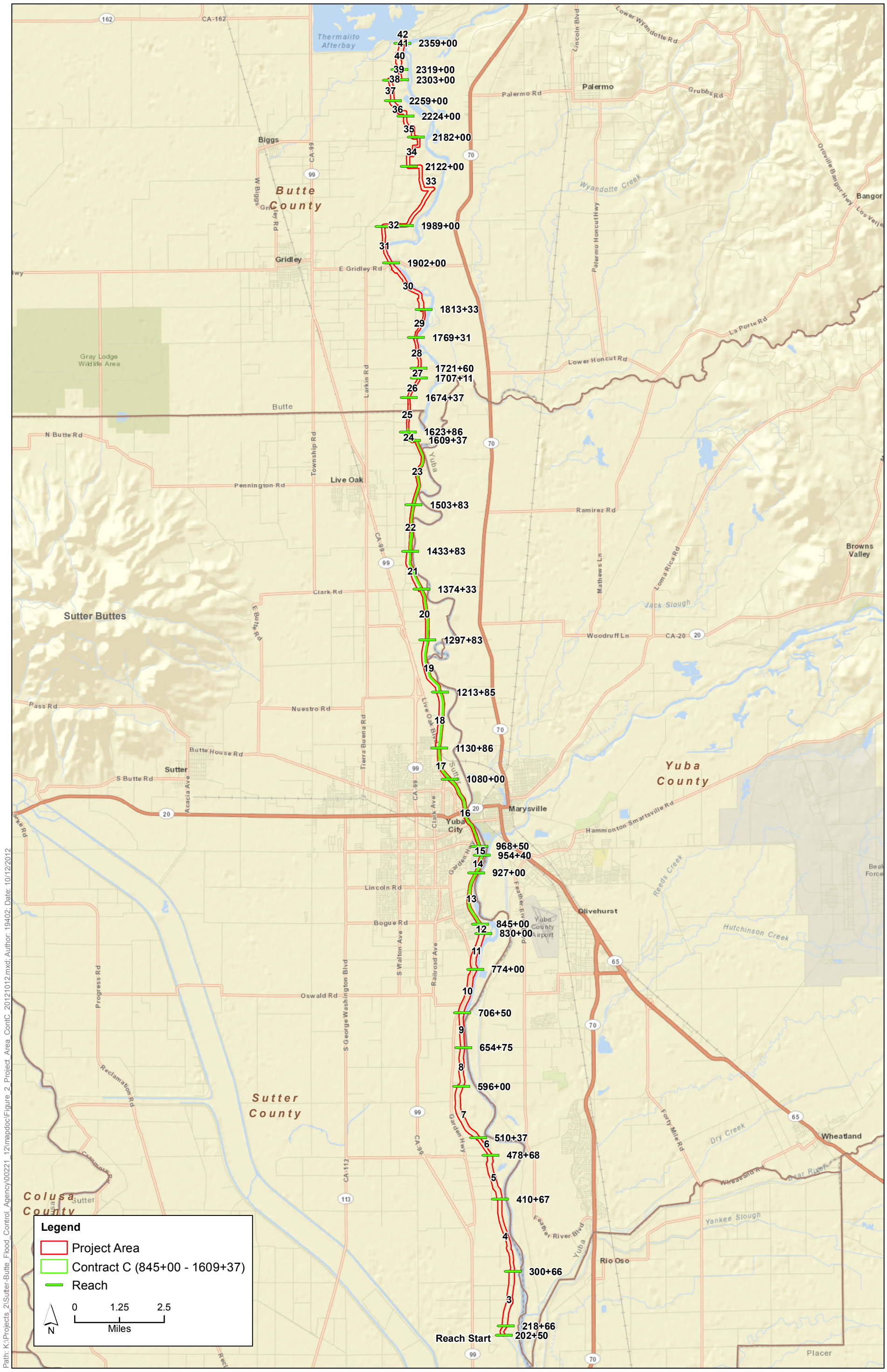
CONCURRING PARTIES:

Central Valley Flood Protection Board

By _____ Date _____
Jay Punia
Executive Officer

Graphics ... 00221.12 (9-2512)

Figure 1
Project Location



Path: K:\Projects_2\Sutter-Butte_Flood_Control_Agency\00221_12\mapdoc\Figure_2_Project_Area_ContC_20121012.mxd; Author: 19402; Date: 10/12/2012

Figure 2
Project Area

Appendix J, Attachment 1

Feather River West Levee Project: Description of the Project and U.S. Army Corps of Engineers Undertakings

Introduction

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. This project would result in the construction of improvements to the Feather River West Levee on levee reaches 2–41.

Within the planning area, SBFCA's goal 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. 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 in the Sutter Basin by addressing known levee deficiencies along the Feather River West Levee from Thermalito Afterbay downstream to a point approximately 4 miles upstream of the Feather River's confluence with the Sutter Bypass.

SBFCA would manage the construction of these improvements through four discrete construction contract mechanisms, spanning construction seasons from 2013 to 2015. The project vicinity and levee reaches where construction is proposed are depicted in Figures 1 and 2. These contracts and the associated levee reaches proposed for repair are summarized in Table 1.

Table 1. Feather River West Levee Project Construction Contracts, Reaches, and Years for Construction

Construction Contract	Project Reaches	Years for Construction
A	2–5	2014–2015
B	6–12	2014–2015
C	13–25	2013–2014
D	26–41	2014–2015

To complete the project, SBFCA must receive authorization from the U.S. Army Corps of Engineers (Corps) to modify the levee under Section 14 of the Rivers and Harbors Act (33 U.S. Code Section 408) (Section 408). SBFCA must also receive authorization from the Corps to discharge fill to waters of the United States under Section 404 of the Clean Water Act (33 U.S. Code Section 1344). Because the project associated with these permits and authorizations may affect historic properties, the Corps must comply with Section 106 of the National Historic Preservation Act (16 U.S. Code Section 470f) (Section 106).

Description of U.S. Army Corps of Engineers Undertakings and Management Approach

The Corps anticipates reviewing and authorizing the entire project under Section 408 in early 2013. This authorization would precede the completion of 100% design drawings for all phases as well as the construction of the four contracts. Completion of the final design drawings depends on the design of ancillary project features such as borrow sites and landside utilities; these features are unrelated to the portion of the project relevant to Section 408. Because the final design would proceed in phases, the delineation of the final area of potential effects on historic properties would also proceed in phases; consequently, the Corps is using the programmatic agreement (PA) as a means of defining Corps commitments for management of historic properties and phasing that management process. The PA would document Section 106 compliance sufficiently for authorization under Section 408 and would guide the Corps in managing historic properties in a phased process that tracks with SBFCA's contracting mechanisms, construction schedule, and design constraints. The Corps will also review applications for permits to discharge fill under Section 404 of the Clean Water Act; the PA provides a means of documenting Section 106 compliance for these permits.

Project Description

The project would be completed in the Sutter Basin. Located in north-central California in Sutter and Butte Counties, the Sutter Basin is part of the Sacramento River Flood Control Project (SRFCP). This elongated, irregularly shaped basin covers about 326 square miles; it is approximately 43 miles long north to south and up to 14 miles wide east to west and is roughly bounded by the Feather River (to the east), Cherokee Canal, the Sutter Buttes, and Sutter Bypass (to the west). Floodwaters potentially threatening the basin originate in 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. Communities in the basin include Yuba City, Biggs, Gridley, Live Oak, and Sutter.

The project is focused on the corridor along the Feather River West Levee from Thermalito Afterbay to a point approximately 4 miles north of the Sutter Bypass. 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, setback levees, erosion protection, and slurry cutoff walls, are likely to be made. 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. (Note that this number is coincidental and one reach does not consistently correspond to a length of 1 mile; additionally, Reach 1 is not a part of the project.) The project area would also include borrow/spoil sites or project mitigation sites outside this corridor.

The affected area generally includes the 40+ miles of the Feather River West Levee from the Thermalito Afterbay to a point approximately 4 miles north of the Sutter Bypass. Along this linear area, open-water habitats include the river, ponds, and canals. Small ditches that provide open-water habitat for wildlife are also present in the affected area. Smaller agricultural canals associated with rice and other flooded crops are also present in the project area. Prehistoric cultural resources are documented in the project footprint and vicinity on both the landside and waterside of the Feather River West Levee. Historic-era archaeological and built environment resources are largely confined to the landside uplands but have the potential to occur on both the landside and waterside.

Appendix J, Attachment 2

Feather River West Levee Project: Outline and Guidance for the Historic Property Treatment Plan

1. Introduction and Description of the Project and Undertakings
   - 1.1 Description of the Project
     - 1.1.1 (brief description of the project that relies upon Corps undertakings)
   - 1.2 Section 106 Undertakings
     - 1.2.1 (brief description of the Section 106 undertakings such as Rivers and Harbors act and Clean Water Act authorization and permits)
   - 1.3 Purpose and Organization of this Historic Properties Treatment Plan

2. Regulatory Context
   - 2.1 Section 106 of the National Historic Preservation Act
     - 2.1.1 Phasing of Management Steps under Section 106 and the Programmatic Agreement
   - 2.2 State and Federal Law Governing Human Remains
     - 2.2.1 California Law
     - 2.2.2 Native American Graves Protection and Repatriation Act

3. Public and Native American Consultation
   - 3.1 Initial Consultation Efforts
     - 3.1.1 (summary of consultation efforts to date)
   - 3.2 Future Consultation
     - 3.2.1 (summary of future consultation as required under the PA)

4. Natural and Cultural Setting
   - 4.1 Natural Environment
   - 4.2 Prehistoric Context
   - 4.3 Ethnographic Context
   - 4.4 Historic Context

5. Technical Methods for Implementing the Programmatic Agreement
   - 5.1 Inventory
     - 5.1.1 Defining the Area of Potential Effects
       - 5.1.1.1 (describe how the APE will be defined for each phase)
     - 5.1.2 Inventory and Recording Methods
     - 5.1.3 Evaluation
       - 5.1.3.1 Evaluation for the National Register of Historic Places
         - 5.1.3.1.1 Archaeological Resources
         - 5.1.3.1.2 Built Environment Resources
         - 5.1.3.1.3 Traditional Cultural Properties
         - 5.1.3.1.4 Rural Historic Landscapes

5.2 Finding of Effect
5.2.1 Application of the Criteria of Adverse Effect Under Section 106

6. Treatment Methods for Resolving Adverse Effects
6.1 Archaeological Resources
6.1.1 (typical treatment methods such as data recovery or preservation in place)
6.2 Built Environment Resources
6.2.1 (typical treatments such as HABS/HAER)
6.3 Traditional Cultural Properties
6.3.1 (typical treatments such as documentation, avoidance, etc.)
6.4 Rural Historic Landscapes
6.4.1 (HALS)

7. Curation of Recovered Materials
7.1 Curation Methods and Standards

8. Construction Monitoring and Inadvertent Discoveries
8.1 Workforce Training
8.2 Monitoring
8.3 Procedures for Inadvertent Discoveries
8.3.1 Stopping Work
8.3.2 Notification to the Corps and Levee Maintaining Agency
8.3.3 Evaluation of the Discovery
8.3.4 Finding of Effect/Treatment (As Necessary)

9. References Cited

Appendix K

Advisory Council on Historic Preservation Correspondence and Native American Consultation

Part K.1

Advisory Council on Historic Preservation Correspondence

Part K.2

Native American Consultation

Part K.1

Advisory Council on Historic Preservation Correspondence

Preserving America's Heritage

July 18, 2012

Ms. Alicia E. Kirchner
Chief, Planning Division
Environmental Resources Branch
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922

Ref: Proposed Feather River West Levee Project
Sutter and Butte Counties, California

Dear Ms. Kirchner:

On July 2, 2012, the Advisory Council on Historic Preservation (ACHP) received your notification and supporting documentation regarding the development of a Programmatic Agreement (PA) for the referenced undertaking. Based upon the information you provided, we have concluded that Appendix A, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases*, of our regulations, "Protection of Historic Properties" (36 CFR Part 800), does not apply to this undertaking. Accordingly, we do not believe that our participation in the consultation to develop this agreement is needed. However, if we receive a request for participation from the State Historic Preservation Officer (SHPO), a Tribal Historic Preservation Officer, an affected Indian tribe, a consulting party or other party, we may reconsider this decision. Additionally, should circumstances change and you determine that our participation is needed to conclude the consultation process, please notify us.

Pursuant to 36 CFR §800.6(b)(1)(iv), you will need to file the final PA, developed in consultation with the California SHPO and any other consulting parties, and related documentation with the ACHP at the conclusion of the consultation process. The filing of the PA and supporting documentation with the ACHP is required in order to complete the requirements of Section 106 of the National Historic Preservation Act.

Thank you for providing us with your notification of adverse effect. If you have any questions, please contact Tom McCulloch at 202-606-8554, or via email at tmcculloch@achp.gov.

Sincerely,

Raymond V. Wallace

Raymond V. Wallace
Historic Preservation Technician
Office of Federal Agency Programs

ADVISORY COUNCIL ON HISTORIC PRESERVATION
1100 Pennsylvania Avenue NW, Suite 803 • Washington, DC 20004
Phone: 202-606-8503 • Fax: 202-606-8647 • achp@achp.gov • www.achp.gov

Part K.2

Native American Consultation

February 23, 2012

Katy Sanchez
California Native American Heritage Commission
915 Capitol Mall, Room 364
Sacramento, California 95814

via e-mail (nahc@pacbell.net)

Subject: Sacred Lands File Search and Contacts Request, Feather River West Levee Project

Dear Ms. Sanchez:

The Sutter Buttes Flood Control Agency (SBFCA) is performing environmental review on proposed improvements to the Feather River West Levee as part of the Feather River West Levee Project (FRWLP). These improvements are necessary to address deficiencies such as through seepage, under seepage, slope stability, erosion and encroachments.

SBFCA would like to enlist the help of members of the Native American community in identifying cultural resources that may be affected by the FRWLP. Because this project will require ground-disturbing construction, identification of cultural resources early in the environmental review process is critical.

Please perform a search of the Sacred Lands File for this project. Maps of the tentative project alignments are attached; the project crosses land within the following locations.

MERIDIAN	TOWNSHIP	RANGE	SECTION	COUNTY	LANDGRANT
MDB&M*			NOT SECTIONED	SUTTER/BUTTE	FERNANDEZ
MDB&M			NOT SECTIONED	SUTTER	BOGA
MDB&M	16N	03E	22	SUTTER	
MDB&M	16N	03E	27	SUTTER	
MDB&M	16N	03E	34	SUTTER	
			0	SUTTER	NEW HELVETIA

*Mount Diablo Base and Meridian

SBFCA would like to identify cultural resources in advance so they may be avoided where feasible. Please provide us with Sacred Lands File information and the most current Native American contact lists for Sutter and Butte Counties via e-mail. Your assistance with this project is appreciated. If you have any questions, please contact me at ICF at mavina@icfi.com, or at 916/231-9732.

Sincerely,

Mike Aviña
Associate

Project Maps (attached)

cc: File

STATE OF CALIFORNIA
Edmund G. Brown, Jr., Governor

NATIVE AMERICAN HERITAGE COMMISSION
915 CAPITOL MALL, ROOM 364
SACRAMENTO, CA 95814
(916) 653-6251
Fax (916) 657-5390

March 22, 2012

Mike Aviña
ICF International
630 K Street
Sacramento, CA 95814

Sent by Fax: 916-737-3030
Number of Pages: 3

Re: Feather River West Levee Project, Sutter and Butte County.

Dear Mr. Aviña:

A record search of the sacred land file has failed to indicate the presence of Native American cultural resources in the immediate project area. The absence of specific site information in the sacred lands file does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Enclosed is a list of Native Americans individuals/organizations who may have knowledge of cultural resources in the project area. The Commission makes no recommendation or preference of a single individual, or group over another. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated, if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe or group. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from any of these individuals or groups, please notify me. With your assistance we are able to assure that our lists contain current information. If you have any questions or need additional information, please contact me at (916) 653-4038.

Sincerely,

Debbie Pilas-Treadway
Environmental Specialist III

Native American Contacts
Sutter and Butte Counties
March 21, 2012

April Wallace Moore
19630 Placer Hills Road
Colfax , CA 95713
530-637-4279

Nisenan - So Maidu
Konkow
Washoe

Enterprise Rancheria of Maidu Indians
Glenda Nelson, Chairperson
2133 Monta Vista Ave
Oroville , CA 95966
info@enterpriserancheria.com
(530) 532-9214
(530) 532-1768 FAX

Maidu

Berry Creek Rancheria of Maidu Indians
Cultural Resources Rep
#5 Tyme Way
Oroville , CA 95966
gmix@berrycreekrancheria.com
(530) 534-3859
(530) 534-1151 FAX

Tyme Maidu

Greenville Rancheria of Maidu Indians
Kyle Self, Chairperson
PO Box 279
Greenville , CA 95947
kself@greenvillerancheria.com
(530) 284-7990
(530) 284-6612 - Fax

Maidu

Berry Creek Rancheria of Maidu Indians
Jim Edwards, Chairperson
#5 Tyme Way
Oroville , CA 95966
gmix@berrycreekrancheria.com
(530) 534-3859
(530) 534-1151 FAX

Tyme Maidu

KonKow Valley Band of Maidu
Patsy Seek, Chairperson
1706 Sweem Street
Oroville , CA 95965
(530) 533-1504

KonKow / Concow
Maidu

Butte Tribal Council
Ren Reynolds
1693 Mt. Ida Road
Oroville , CA 95966

(530) 589-1571

Maidu

Maidu Cultural and Development Group
Lorena Gorbet
PO Box 426
Greenville , CA 95947
(530) 284-1601

Maidu

Enterprise Rancheria of Maidu Indians
Art Angle, Vice Chairperson
2133 Monta Vista Avenue
Oroville , CA 95966
eranch@cncnet.com
(530) 532-9214
(530) 532-1768 FAX

Maidu

Maidu Nation
Clara LeCompte
P.O Box 204
Susanville , CA 96130

Maidu

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code

This list is only applicable for contacting local Native Americans with regard to cultural resources for the proposed Feather River West Levee project, Sutter and Butte Counties

Native American Contacts
Sutter and Butte Counties
March 21, 2012

Mechoopda Indian Tribe of Chico Rancheria
Dennis E. Ramirez, Chairperson
125 Mission Ranch Blvd
Chico , CA 95926
dramirez@mechoopda-nsn.gov
(530) 899-8922 ext 215
(530) 899-8517 - Fax

Mechoopda Maidu
Concow

T si-Akim Maidu
Eileen Moon,Vice Chairperson
1239 East Main St.
Grass Valley , CA 95945
(530) 477-0711

Maidu

Mechoopda Indian Tribe of Chico Rancheria
Mike DeSpain, Director - OEPP
125 Mission Ranch Blvd
Chico , CA 95926
mdespain@mechoopda-nsn.gov
(530) 899-8922 ext 219
(530) 899-8517 - Fax

Mechoopda Maidu
Concow

United Auburn Indian Community of the Auburn Rancheria
David Keyser, Chairperson
10720 Indian Hill Road
Auburn , CA 95603
530-883-2390
530-883-2380 - Fax

Maidu
Miwok

Mooretown Rancheria of Maidu Indians
Gary Archuleta, Chairperson
#1 Alverda Drive
Oroville , CA 95966
frontdesk@mooretown.org
(530) 533-3625
(530) 533-3680 Fax

Maidu
KonKow / Concow

United Auburn Indian Community of the Auburn Rancheria
Marcos Guerrero, Tribal Preservation Committee
10720 Indian Hill Road
Auburn , CA 95603
mguerrero@auburnrancheria.com
530-883-2364
530-883-2320 - Fax

Maidu
Miwok

Mooretown Rancheria of Maidu Indians
James Sanders, Tribal Administrator
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(530) 533-3625
(530) 533-3680 FAX

Maidu
KonKow/Concow

United Auburn Indian Community of the Auburn Rancheria
Gregory S. Baker, Tribal Administrator
10720 Indian Hill Road
Auburn , CA 95603
gbaker@auburnrancheria.com
530-883-2390
530-883-2380 - Fax

Maidu
Miwok

Strawberry Valley Rancheria
Cathy Bishop, Chairperson
PO Box 667
Marysville , CA 95901
catfrmsac2@yahoo.com
916-501-2482

Maidu
Miwok

This list is current only as of the date of this document.

Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and Section 5097.98 of the Public Resources Code

This list is only applicable for contacting local Native Americans with regard to cultural resources for the proposed Feather River West Levee project, Sutter and Butte Counties

September 28, 2012

April Wallace Moore
19630 Placer Hills Road|
Colfax, CA 95713

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

Dear Ms. Moore:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

- Prehistoric archaeological sites and features,
- Sacred lands or locations that are important in Native American culture.
- Places that the Native American community or other local cultural groups currently use for ongoing cultural practices and activities.
- Historic-era resources such as structures, residences, and other built-environment features.

SBFCA recognizes that the locations of many of these resources may be sensitive and confidential. We are requesting information from you about these resources so they may be identified in advance of any activity that may affect them, in order to protect and avoid them to the extent feasible. The location of any resources we identify through our consultation with you will be kept confidential, consistent with State law requirements. SBFCA also requests any comments or feedback you may have about the proposed project and the potential for effects on important cultural resources generally.

Please provide your response within 30 days of receiving this letter. Thank you for your time in responding to this request. I can be reached at (916) 761-2768 or at Mike.Avina@icfi.com.

Please note that the U.S. Army Corps is also reviewing the potential of the project to result in effects on cultural resources listed on or eligible for listing in the National Register of Historic Places (NRHP). The Corps is preparing a programmatic agreement to implement management steps required under the National Historic Preservation Act. You may contact Mr. S. Joe Griffin, Archaeologist, at (916) 557-7897 or by email at s.joe.griffin@usace.army.mil if you have any questions or concerns specifically relating to the potential for effects on resources eligible for or listed on the NRHP, or if you would like to consult with the Corps regarding the management of these resources.

Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Glenda Nelson, Chairperson
Enterprise Rancheria of Maidu Indians
2133 Monta Vista Ave
Oroville, CA 95966

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

Dear Ms. Nelson:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Jim Edwards, Chairperson
Berry Creek Rancheria of Maidu Indians
#5 Tyme Way
Oroville, CA 95966

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

Dear Mr. Edwards:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Please provide your response within 30 days of receiving this letter. Thank you for your time in responding to this request. I can be reached at (916) 761-2768 or at Mike.Avina@icfi.com.

Please note that the U.S. Army Corps is also reviewing the potential of the project to result in effects on cultural resources listed on or eligible for listing in the National Register of Historic Places (NRHP). The Corps is preparing a programmatic agreement to implement management steps required under the National Historic Preservation Act. You may contact Mr. S. Joe Griffin, Archaeologist, at (916) 557-7897 or by email at s.joe.griffin@usace.army.mil if you have any questions or concerns specifically relating to the potential for effects on resources eligible for or listed on the NRHP, or if you would like to consult with the Corps regarding the management of these resources.

Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Kyle Self, Chairperson
Greenville Rancheria of Maidu Indians
PO Box 279
Greenville, CA 95947

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

Dear Mr. Self:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Patsy Seek, Chairperson
KonKow Valley Band of Maidu
1706 Sweem Street
Oroville, CA 95965

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

Dear Ms. Seek:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Ren Reynolds
Butte Tribal Council
1693 Mt. Ida Road
Oroville, CA 95966

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

Dear Mr. Reynolds:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Lorena Gorbet
Maidu Cultural and Development Group
PO Box 426
Greenville , CA 95947

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

Dear Ms. Gorbet:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Art Angle, Vice Chairperson
Enterprise Rancheria of Maidu Indians
2133 Monta Vista Avenue
Oroville, CA 95966

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

Dear Mr. Angle:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Clara LeCompte
Maidu Nation
P.O Box 204
Susanville, CA 96130

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

Dear Ms. LeCompte:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Dennis E. Ramirez, Chairperson
Mechoopda Indian Tribe of Chico Rancheria
125 Mission Ranch Blvd
Chico, CA 95926

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

Dear Mr. Ramirez:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Eileen Moon, Vice Chairperson
Tsi-Akim Maidu
1239 East Main St.
Grass Valley, CA 95945

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

Dear Ms. Moon:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Mike DeSpain, Director – OEPP
Mechoopda Indian Tribe of Chico Rancheria
125 Mission Ranch Blvd
Chico, CA 95926

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

Dear Mr. DeSpain:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

David Keyser, Chairperson
United Auburn Indian Community of the Auburn Rancheria
10720 Indian Hill Road
Auburn, CA 95603

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

Dear Mr. Keyser:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Gary Archuleta, Chairperson
Mooretown Rancheria of Maidu Indians
#1 Alverda Drive
Oroville, CA 95966

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

Dear Mr. Archuleta:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

James Sanders, Tribal Administrator
Mooretown Rancheria of Maidu Indians
#1 Alverda Drive
Oroville, CA 95966

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

Dear Mr. Sanders:

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Please provide your response within 30 days of receiving this letter. Thank you for your time in responding to this request. I can be reached at (916) 761-2768 or at Mike.Avina@icfi.com.

Please note that the U.S. Army Corps is also reviewing the potential of the project to result in effects on cultural resources listed on or eligible for listing in the National Register of Historic Places (NRHP). The Corps is preparing a programmatic agreement to implement management steps required under the National Historic Preservation Act. You may contact Mr. S. Joe Griffin, Archaeologist, at (916) 557-7897 or by email at s.joe.griffin@usace.army.mil if you have any questions or concerns specifically relating to the potential for effects on resources eligible for or listed on the NRHP, or if you would like to consult with the Corps regarding the management of these resources.

Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Gregory S. Baker, Tribal Administrator
United Auburn Indian Community of the Auburn Rancheria
10720 Indian Hill Road
Auburn, CA 95603

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

Dear Mr. Baker:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Cathy Bishop, Chairperson
Strawberry Valley Rancheria
PO Box 667
Marysville, CA 95901

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

Dear Ms. Bishop:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Marcos Guerrero, Tribal Preservation Committee
United Auburn Indian Community of the Auburn Rancheria
10720 Indian Hill Road
Auburn, CA 95603

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

Dear Mr. Guerrero:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Charlie Wright, Chairperson
Cortina Indian Rancheria of Wintun Indians
P.O. Box 1630
Williams, CA 95987

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

Dear Mr. Wright:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Daniel Gomez, Chairman
Cachil DeHe Band of Wintun Indians (Colusa Rancheria)
3730 Highway 45
Colusa, CA 95932

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

Dear Mr. Gomez:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

Enclosures
Figures 1 and 2

September 28, 2012

Andrew Freeman, Chairman
Paskenta Band of Nomlaki Indians of California
P.O. Box 398
Orland, CA 95963

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

Dear Mr. Freeman:

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. This project will involve levee rehabilitation measures to address levee seepage, slope instability, and erosion issues, as well as encroachments on the levee. The project area for the FRWLP occurs 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. The project area is depicted in the enclosed figures. Because these improvements require ground disturbance, they may affect cultural resources. Cultural resources may include but are not necessarily limited to the following:

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Sincerely,

Mike Aviña
ICF International

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Kyle Self, Chairperson
Greenville Rancheria of Maidu Indians
PO Box 279
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Jim Edwards, Chairperson
Berry Creek Rancheria of Maidu Indians
#5 Tyme Way
Oroville, CA 95966

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Lorena Gorbet
Maidu Cultural and Development Group
PO Box 426
Greenville , CA 95947

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Patsy Seek, Chairperson
KonKow Valley Band of Maidu
1706 Sweem Street
Oroville, CA 95965

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Ren Reynolds
Butte Tribal Council
1693 Mt. Ida Road
Oroville, CA 95966

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Glenda Nelson, Chairperson
Enterprise Rancheria of Maidu Indians
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Oroville, CA 95966

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David Keyser, Chairperson
United Auburn Indian Community of the Auburn Rancheria
10720 Indian Hill Road
Auburn, CA 95603

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Mike DeSpain, Director - OEPP
Mechoopda Indian Tribe of Chico Rancheria
125 Mission Ranch Blvd
Chico, CA 95926

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Eileen Moon, Vice Chairperson
Tsi-Akim Maidu
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Dennis E. Ramirez, Chairperson
Mechoopda Indian Tribe of Chico Rancheria
125 Mission Ranch Blvd
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Clara LeCompte
Maidu Nation
P.O Box 204
Susanville, CA 96130

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Art Angle, Vice Chairperson
Enterprise Rancheria of Maidu Indians
2133 Monta Vista Avenue
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Charlie Wright, Chairperson
Cortina Indian Rancheria of Wintun Indians
P.O. Box 1630
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Daniel Gomez, Chairman
Cachil DeHe Band of Wintun Indians
(Colusa Rancheria)
3730 Highway 45
Colusa, CA 95932

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Cathy Bishop, Chairperson
Strawberry Valley Rancheria
PO Box 667
Marysville, CA 95901

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James Sanders, Tribal Administrator
Mooretown Rancheria of Maidu Indians
#1 Alverda Drive
Oroville, CA 95966

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Gregory S. Baker, Tribal Administrator
United Auburn Indian Community of the Auburn Rancheria
10720 Indian Hill Road
Auburn, CA 95603

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Gary Archuleta, Chairperson
Mooretown Rancheria of Maidu Indians
#1 Alverda Drive
Oroville, CA 95966

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Paskenta Band of Nomlaki Indians of California
P.O. Box 398
Orland, CA 95963

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PS Form 3800, Aug

Marcos Guerrero, Tribal Preservation Committee
United Auburn Indian Community of the Auburn Rancheria
10720 Indian Hill Road
Auburn, CA 95603

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MIWOK MAIDU United Auburn Indian Community of the Auburn Rancheria

David Keyser, Chairperson | Gene Whitehouse, Secretary | Brenda Adams, Treasurer | Calvin Moman, Council Member

October 16, 2012

Mike Avina
ICF Jones & Stokes
630 K Street, Suite 400
Sacramento, CA

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

Dear Mr. Avina,

Thank you for requesting information regarding the above referenced project. The United Auburn Indian Community (UAIC) of the Auburn Rancheria is comprised of Miwok and Southern Maidu (Nisenan) people whose tribal lands are within Placer County and ancestral territory spans into El Dorado, Nevada, Sacramento, Sutter, and Yuba counties. The UAIC is concerned about development within its aboriginal territory that has potential to impact the lifeways, cultural sites, and landscapes that may be of sacred or ceremonial significance. We appreciate the opportunity to comment on this and other projects in your jurisdiction.

In order to ascertain whether or not the project could affect cultural resources that may be of importance to the UAIC, we would like to receive copies of any archaeological reports that have been, or will be, completed for the project. We also request copies of future environmental documents for the proposed project so that we have the opportunity to comment on potential impacts and proposed mitigation measures related to cultural resources. The UAIC would also like the opportunity to have our tribal monitors accompany you during the field survey. The information gathered will provide us with a better understanding of the project and cultural resources on site and is invaluable for consultation purposes.

The UAIC's Preservation Committee would like to set up a meeting and consult about the proposed project. Thank you again for taking these matters into consideration, and for involving the UAIC early in the planning process. We look forward to reviewing the aforementioned documents as requested. Please contact Marcos Guerrero, Tribal Historic Preservation Officer, at (530) 883-2364 or email at mguerrero@auburnrancheria.com if you have any questions.

Sincerely,

David Keyser,
Chairman

CC: Marcos Guerrero, THPO

Enterprise Rancheria

Estom Yumeka Maidu Tribe

2133 Monte Vista Ave
Oroville, CA. 95966

Ph: (530) 532-9214
Fax: (530) 532-1768
Email: info@enterpriserancheria.org

October 12, 2012

ICF International
Mike Avina
630 K Street, Suite 400
Sacramento, CA 95814

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

Dear Mr. Avina,

Thank you for your correspondence dated September 28, 2012. Our Environmental and Cultural Departments have completed a preliminary evaluation of your project and have determined that your project falls within the aboriginal territory of the Enterprise Rancheria Estom Yumeka Maidu Tribe. Furthermore, we have determined that your project may contain culturally and/or environmental resources. Please be advised that our departments issued this decision only as a preliminary review and we request a meeting to discuss our concerns in detail.

During projects that contain areas of concern for the Tribe, such as yours, we require that our Cultural Site Monitors oversee any activities during the project that has the potential to disturb or affect identified culturally or environmentally sensitive areas. If any resources are uncovered during ground disturbing activities we require that all work cease within the area of the discovery until an examination of the site and/or materials are conducted by a professional archaeologist and Tribal Monitor. If any human remains are uncovered the Health and Safety Code 7050-55097.9 shall be enforced and adhered to.

The Enterprise Rancheria Estom Yumeka Tribe will work with all authorities on the disposition of all cultural resources. All cultural resources discovered on this project are the property of the Tribe and shall be released to the Tribe immediately.

Upon initial review of your project we foresee being directly involved in the project. We respectfully request that no work begin on your project until a formal meeting and agreement between the Tribe and all parties involved is completed. We look forward to developing a cooperative working relationship with you. Please contact our environmental technician, Ren Reynolds, at 530-532-9214 at your earliest convenience to schedule a meeting.

Sincerely,

C. Smith

Cindy Smith
Environmental Director

Mooretown Rancheria
#1 Alverda Drive
Oroville, CA 95966
(530) 533-3625 Office
(530) 533-3680 Fax

October 3, 2012

ICF International
Attn: Mike Avina
630 K Street, Suite 400
Sacramento, CA 95814

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

Dear Mr. Avina:

Thank you for your notification of the proposed Feather River West Levee Project. Mooretown Rancheria does not have any identified sacred sites which appear to be located within the project locations per se; however, the real possibility exists that any discovered archaeological findings are significant to Mooretown Rancheria and may in fact be directly attributed to our tribal ancestors. Therefore, we respectfully request immediate notification of any archaeological, historic or prehistoric findings. Further, we request the opportunity to review the findings in order to make a determination as to whether or not the findings may have ties to our tribe, and request that our input be considered during the initial stages of review. It has been our unfortunate experience that other projects within the proposed project area have been attributed to other tribes when we were not notified or given any opportunity to review the findings or provide input at any stage.

Sincerely,

Gary W. Archuleta
Tribal Chairman

GWA/llw