

Appendix G

Identification and Prioritization of Levee Segments for Geotechnical Exploration and Analyses

March 2012





Date March 28, 2012
Subject Identification and Prioritization of Levee Segments for Geotechnical Exploration and Analyses, San Joaquin River Restoration Program

This technical memorandum (TM) presents the identification and prioritization of levee segments within the Restoration Area of the San Joaquin River Restoration Program (SJRRP) for geotechnical exploration to assist the SJRRP manage flood risks in implementing SJRRP actions.

1 Introduction

The Bureau of Reclamation (Reclamation), lead agency for the SJRRP, has initiated restoration releases from Friant Dam (Interim Flows) and is evaluating alternatives for routing of long-term Restoration Flows to support reintroduction of fish into the San Joaquin River as required by the Stipulation of Settlement (Settlement). The Department of Water Resources (DWR) is not a settling party in the Settlement, however, the State of California has signed a Memorandum of Understanding with the Settling Parties under which DWR states that it intends to assist in various aspects of the planning, design, and construction of physical improvements identified in the Settlement, including projects related to flood protection, levee relocation, construction standards and Maintenance. DWR's Division of Flood Management (DFM) has been tasked to assess the impacts of Restoration flows under the SJRRP on flood management and operations in the Restoration Area and to develop strategies to manage those impacts. DFM has developed the SJRRP Levee Evaluation (SJLE) Project to assist the SJRRP in identifying potential flood impacts to levee seepage and stability due to current and future Restoration flows under the SJRRP.

2 Task Objective and Scope

The SJLE Project will include reconnaissance-level geotechnical evaluations, geotechnical explorations, and seepage and stability analyses at multiple water surface elevations. As part of the reconnaissance level evaluation, the objective of this identification and prioritization of levees is to establish the need for geotechnical analyses to assess potential flood impacts posed by Restoration flows and to prioritize those needs to assist future DFM and Reclamation geotechnical explorations and analyses.

The scope of this task is to support the SJLE Project by:

- Identifying all existing Lower San Joaquin River Flood Control Project (Project) and non-Project levee segments along which Restoration flows under the SJRRP may be routed under near-term or long-term Restoration flow scenarios; and
- Prioritizing levee segments for potential future geotechnical exploration and analyses based on existing hydraulic analyses and anticipated routing alternatives identified by the SJRRP.

3 Data Inputs

The primary source for information regarding the location of levees within the Restoration Area and the extent of any past geotechnical exploration data is the DWR's Non-Urban Levee Evaluation (NULE) Project administered by the DFM, Flood Risk Assessment and Mitigation Office.

Hydraulic data to determine the location and length of segments along which levees may be contacted by Restoration flows is being provided by Tetra Tech, dba Mussetter Engineering, Inc. (TT-MEI) under contract to the DWR South Central Regional Office.

Information regarding the potential routing options is based on planning and environmental documents prepared by the SJRRP, including but not limited to, the Working Draft Framework for Implementation (June 2012) and the Program EIS/EIR (July 2012); and on-going correspondence with the SJRRP project teams for the Reach 2B and Reach 4B site-specific projects.

4 Limitations

The levee identification subtask is limited to the delineation of levee features within the Restoration Areas to support the subsequent prioritization subtask and makes no distinction or differentiation based on existing geotechnical integrity data. The NULE Project has performed preliminary analyses of levee segments within the Restoration Area using largely existing information and has performed select geotechnical explorations of some levee segments for which the data will be integral to future efforts to support SJRRP levee management efforts. However, this work was performed to support the Central Valley Flood Protection Plan and therefore, analyses specific to the SJRRP will be necessary to address Restoration Goals with respect to flood management.

The prioritization of levees for future geotechnical exploration and analyses is based on hydraulic analysis only and is not based on levee characteristics or levee performance. The hydraulic modeling data used for the prioritization are not final and future updates to this prioritization will be provided as model information and ground, levee, and channel topography is collected. This includes additional model and ground information to include recently identified subsidence. This prioritization document shall be considered a living document and will be updated as necessary.

5 Identification of Levee Segments

Study Area. The Study Area for the SJLE Project (Figure 1) is consistent with the Study Area of the SJRRP as defined in the Program EIS/EIR (2012) with two exceptions. The Study Area excludes Reaches 1A and 1B along which no flood control features are present. The Study Area also excludes Reach 4B1 for which the Settlement acknowledged that new flood control features were necessary except for short Project levee segments on either bank at the downstream end of the reach. Reach 2B, for which the Settlement also acknowledged that new flood control features were necessary is included in the Study Area. However, the prioritization of levees in this reach is dependent upon whether the existing levees are part of Settlement-directed improvements. Because Restoration flows may be routed through a portion of the bypass system, the Study Area also includes the Eastside Bypass from Washington Road to the San Joaquin River at Reach 5 and the Mariposa Bypass which connects the Eastside Bypass and the San Joaquin River at Reach 4B.

Identification of Levees Within the Study Area. The data sources used in the NULE program were used to identify levee features within the Study Area. Under NULE, DWR gathered levee data from internal sources, the California Levee Database, and other sources including levee maintaining authorities, reclamation districts, and landowners. Figure 2 provides the location of Project and non-Project levees identified under NULE within the Study Area. Project levees are those that are part of

the State Plan of Flood Control (SPFC) for which CVFPB or DWR have provided assurances of operation and maintenance to federal agencies. NULE also identified appurtenant non-Project levees which provide protection to basins which also receive protection from Project levees or that could impact the performance of a Project levee. Figure 2 also identifies a separate levee feature at the downstream portion of Reach 5 near RM 120 which was not identified as an appurtenant levee under NULE but which is included in the SJLE Project based on data collected by MEI-TT hydraulic analyses. Field reconnaissance has not been performed for this segment, however based on available aerial photography, the feature appears to be a portion of a ring levee protecting agricultural land east of the town of Gustine.

6 Criteria for Prioritization of Levees for Geotechnical Evaluation

Prioritization of levees for geotechnical evaluation were based on two criteria: 1) magnitude of flows at which water surface elevations could impact levee performance; and 2) whether the levee segment would be used by SJRRP to pass near-term or long-term Restoration flows. The following are more detailed discussions of these criteria, how they were applied to the prioritization, and limitations to their use.

6.1 Channel Flow

In developing the levee prioritization, MEI-TT performed a hydraulic analysis for a 2,000 cfs and 4,500 cfs flow to compare the water surface elevations with ground surface elevations adjacent to the landside levee toe. The landside levee toe elevation was selected as the point of analysis because historic levee performance data from DWR and local levee agency sources indicate that flows at or above this level may result in underseepage that could decrease levee stability or landside seepage that could inhibit the ability to flood fight during high water events.

The initial analysis was performed at 2,000 cfs since conveyance of 2,000 cfs throughout the system was identified as a SJRRP core action to allow continuity of flows for fish passage, provide temperature management ability, and allow floodplain inundation (Working Draft Framework for Implementation, 2012). Analysis was also performed at 4,500 cfs in each reach, since the Settlement identifies that channel improvement projects should ensure conveyance of at least 4,500 cfs. The two flows were analyzed in each reach, ignoring any seepage losses or tributary inflows. The hydraulic analysis is currently being reviewed and identification of impacted levee segments is subject to change. After the analysis is finalized, DWR-DFM will reassess the prioritization of levees as warranted.

6.2 Use of Levee Segment for Near-term and Long-term Restoration Flows

The prioritization also took into account whether the levee segment would be used by SJRRP to pass near-term or long-term Restoration flows. Using information provided by the SJRRP, Reaches 2A, 2B, 3, 4A, and the Eastside Bypass below Washington Road are currently, or have the possibility of, conveying Restoration flows without completion of site-specific implementation projects for the SJRRP (near-term). However, Reach 4B1, 4B2, and the Mariposa Bypass will need the completion of implementation projects to convey Restoration flows (long-term). Furthermore, since most of the Reach 4B1 does not have the capacity to convey significant flows, and existing levees are not part of the initial project alternatives, Reach 4B1 was mostly excluded from the analyses (with the exception of the Project levees which are described in Section 8.3). Reach 2B remains in the analysis, but any geotechnical exploration and analyses on the existing levees will wait until a decision is made that existing levees will be used as part of the Reach 2B site-specific project.

7 Prioritization Categories

Using the criteria described in Section 6, DWR-DFM classified levee segments in the Study Area to one of three categories representing an increasing priority for the need to complete geotechnical evaluation and analyses.

Priority 1 – Levee segments which may or are being used to transmit near-term Restoration flows and along which flows of 2,000 cfs would result in a water surface at or above the ground surface elevation at the landside levee toe.

Priority 2 - Levee segments which will not be used for Restoration flows until key decisions are made about implementation projects and/or they are completed that will allow Restoration flows to be routed to the reach and along which flows of 2,000 cfs would result in water surface at or above the ground surface elevation at the landside levee toe.

Priority 3 - Levee segments which will not be used for Restoration flows until implementation projects are completed that will allow Restoration flows to be routed to the reach and along which flows of 4,500 cfs would result in water surface at or above the ground surface elevation at the landside levee toe.

8 Identification of Levees by Priority

The following is a brief description of the levee segments identified in each prioritization category. Figure 3 shows the locations of the levee segments as described and Table 1 summarizes the levee mileage by priority.

8.1 Priority 1

The following levee segments are assigned to Priority 1 based on potential impacts at a flow of 2,000 cfs and potential use for near-term Restoration flows:

Eastside Bypass and Reach 4A.

- Eastside Bypass, right bank from the Mariposa Bypass confluence upstream to a point approximately 0.5 miles upstream of Washington Road (approx. 10.5 miles)
- Eastside Bypass, left bank from the Mariposa Bypass confluence upstream to a point approximately 0.5 miles upstream of Washington Road (approx. 10.1 miles)
- Reach 4A, right bank from the confluence with the Eastside Bypass at Sand Slough upstream approximately 2.1 miles
- Reach 4A, left bank from the confluence with the Eastside Bypass at Sand Slough upstream approximately 2 miles

Hydraulic analyses indicated that the Reach 4A segments and nearly all of the Eastside Bypass levee segments would have potential impacts at 2,000 cfs. The Phase 1 Assessment that DWR-DFM performed under its NULE Project included these segments. The resultant Geotechnical Assessment Report classified all of these segments as Hazard Class C (high likelihood of failure or need to flood fight at the assessment water surface elevation) with the exception of the Eastside Bypass right bank which was most classified as Hazard Class B (moderate). The assessment water

surface elevation varied under the NULE Project evaluations based on available data, however, the assessment water surface elevation within the Study area was 3 feet below the levee crest for the San Joaquin River segments and 4 feet below the levee crest for the bypass segments."

Reach 2A.

- Reach 2A – right bank from the Chowchilla Bypass bifurcation structure upstream approximately 10.2 miles
- Reach 2A – left bank from the Chowchilla Bypass bifurcation structure upstream approximately 4.7 miles

Only a portion of the right bank portion of these segments had potential impacts at 2,000 cfs based on the hydraulic analyses. They were assigned to Priority 1 because the Reach conveys both near-term and long-term flows and because DWR-DFM has already performed geotechnical explorations along this right bank of Reach 2A such that geotechnical analyses would require minimal additional geotechnical exploration. The Phase 1 Assessment that DWR-DFM performed under its NULE Project included these segments. The resultant Geotechnical Assessment Report classified all of these levee segments as Hazard Class C (high likelihood of failure or need to flood fight at the assessment water surface elevation).

8.2 Priority 2

The following levee segments are assigned to Priority 2 based on potential impacts at flows of 2,000 cfs and use only for long-term Restoration flows:

Reach 4B2 and Mariposa Bypass.

- Reach 4B2 – right bank along entire reach (7.9 miles)
- Reach 4B2 – left bank along entire reach (7 miles)
- Mariposa Bypass – right bank along entire reach (3.3 miles)
- Mariposa Bypass – left bank along entire reach (3.4 miles)

Hydraulic analyses indicated that all of the Mariposa Bypass segments and significant portions of the Reach 4B2 levee segments would have potential impacts at 2,000 cfs. The Phase 1 Assessment that DWR-DFM performed under its NULE Project included these segments. The resultant Geotechnical Assessment Report classified all of these levee segments as Hazard Class C (high likelihood of failure or need to flood fight at the assessment water surface elevation).

Reach 2B.

- Reach 2B – right bank along entire reach (7.6 miles)
- Reach 2B – left bank along entire reach (8.3 miles)

Hydraulic analyses indicated that significant portions of the Reach 2B levee segments would have potential impacts at 2,000 cfs. These segments were assigned to Priority 2 because although they would have potential impacts at 2,000 cfs, the existing levees would likely not be used to convey Restoration flows as part of the Settlement-directed project. Additional geotechnical explorations by DWR-DFM could be considered if the existing levees were included as part of the implemented project as Reach 2B has the potential for Near-term uses. The Phase 1 Assessment that DWR-DFM performed under its NULE Project included these segments. The resultant Geotechnical Assessment Report classified all of these levee segments as Hazard Class C (high likelihood of failure or need to flood fight at the assessment water surface elevation) or lacking data.

8.3 Priority 3

The following levee segments are assigned to Priority 3 based on potential impacts at flows of 4,500 cfs and are used only for long-term Restoration flows:

- Reach 3, both banks, isolated segments identified on Figure 3 (14.4 miles)
- Reach 4A, for both banks the remainder of reach not included in Priority 1 except for approximately 2 mile segment upstream of Highway 152 (18.7 miles)
- Reach 4B1, both banks, Project levees segments at downstream end of reach (5.8 miles)
- Reach 5, isolated segments on both banks as identified on Figure 3 (2 miles)
- Eastside Bypass, for both banks from the Mariposa Bypass confluence downstream approximately 2.5 miles (5 miles total)

Hydraulic analyses indicated that all of these levee segments would have potential impacts at 4,500 cfs. The Phase 1 Assessment that DWR-DFM performed under its NULE Project included these segments. The Geotechnical Assessment Report classified all of these levee segments as Hazard Class B or C (moderate to high likelihood of failure or need to flood fight at the assessment water surface elevation) or lacking data.

As shown in Figure 3, the Priority 3 category also includes levee segments in Reach 4B1 on both banks upstream of the Mariposa Bypass confluence (5.8 miles total). As indicated earlier, under the Settlement future channel improvements will be required in Reach 4B1 that will likely require new levee alignments. However the identified Priority 3 levee segments are Project levees currently maintained as part of the State Plan of Flood Control and could be incorporated into the future channel improvements. Hydraulic analyses were not available for these segments. The NULE Geotechnical Assessment Report classified all of these levee segments as Hazard Class C (high likelihood of failure or need to flood fight at the assessment water surface elevation).

8.4 Non Priority Levee Segments and Excluded Reaches

Remaining reaches not identified under one of the three priority classifications have been identified as either Non-Priority or Excluded levee segments. Non-priority levees are defined as segments where hydraulic analyses indicate that the water surface elevation at the landside toe at a Restoration flows of 4,500 cfs would be below the ground surface and not expected to have a significant flood impact due to seepage and stability. Excluded segments are those where levee features are not present and thus hydraulic analyses were not performed, or bypass segments that are have been excluded for use for Restoration flows.

Table 1

SJRRP Levee Mileage, Prioritized for Geotechnical Evaluation

San Joaquin River	Mileage (both banks)					Total
	Priority 1	Priority 2	Priority 3	Non Priority ⁽¹⁾	Excluded ⁽²⁾	
Reach 5	0.0	0.0	2.0	21.8	0.0	23.8
Reach 4B2	0.0	14.9	0.0	0.0	0.0	14.9
Reach 4B1	0.0	0.0	5.8	0.0	18.8	24.6
Reach 4A	4.1	0.0	18.7	3.7	0.0	26.5
Reach 3	0.0	0.0	14.4	24.9	0.0	39.3
Reach 2B	0.0	15.9	0.0	0.0	0.0	15.9
Reach 2A	14.9	0.0	0.0	3.7	0.0	18.6
Total (San Joaquin River)	19	30.8	40.9	54.1	18.8	163.6
Bypass System						
Mariposa Bypass	0.0	6.7	0.0	0.0	0.0	6.7
Eastside Bypass	20.6	0.0	5.0	15.6	21.0	62.2
Chowchilla Canal	0.0	0.0	0.0	0.0	32.0	32.0
Total (Bypasses)	20.6	6.7	5.0	15.6	53.0	94.2
Total Length (mi)	39.6	37.5	45.9	69.7	71.8	257.8

(1) - water surface elevation at landside levee toe below ground surface at 4,500 cfs

(2) - no levee features present or levees excluded from Restoration flows

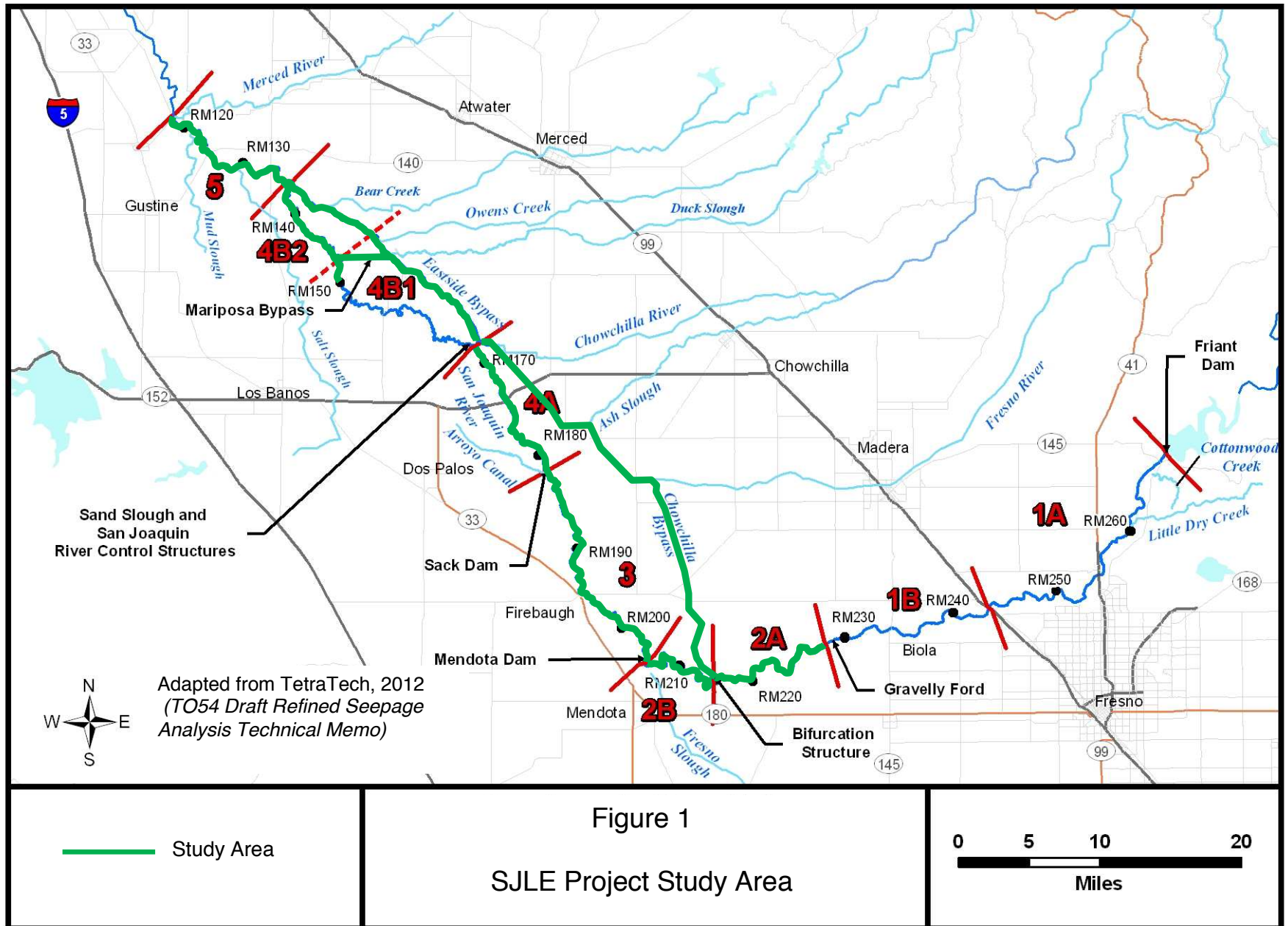
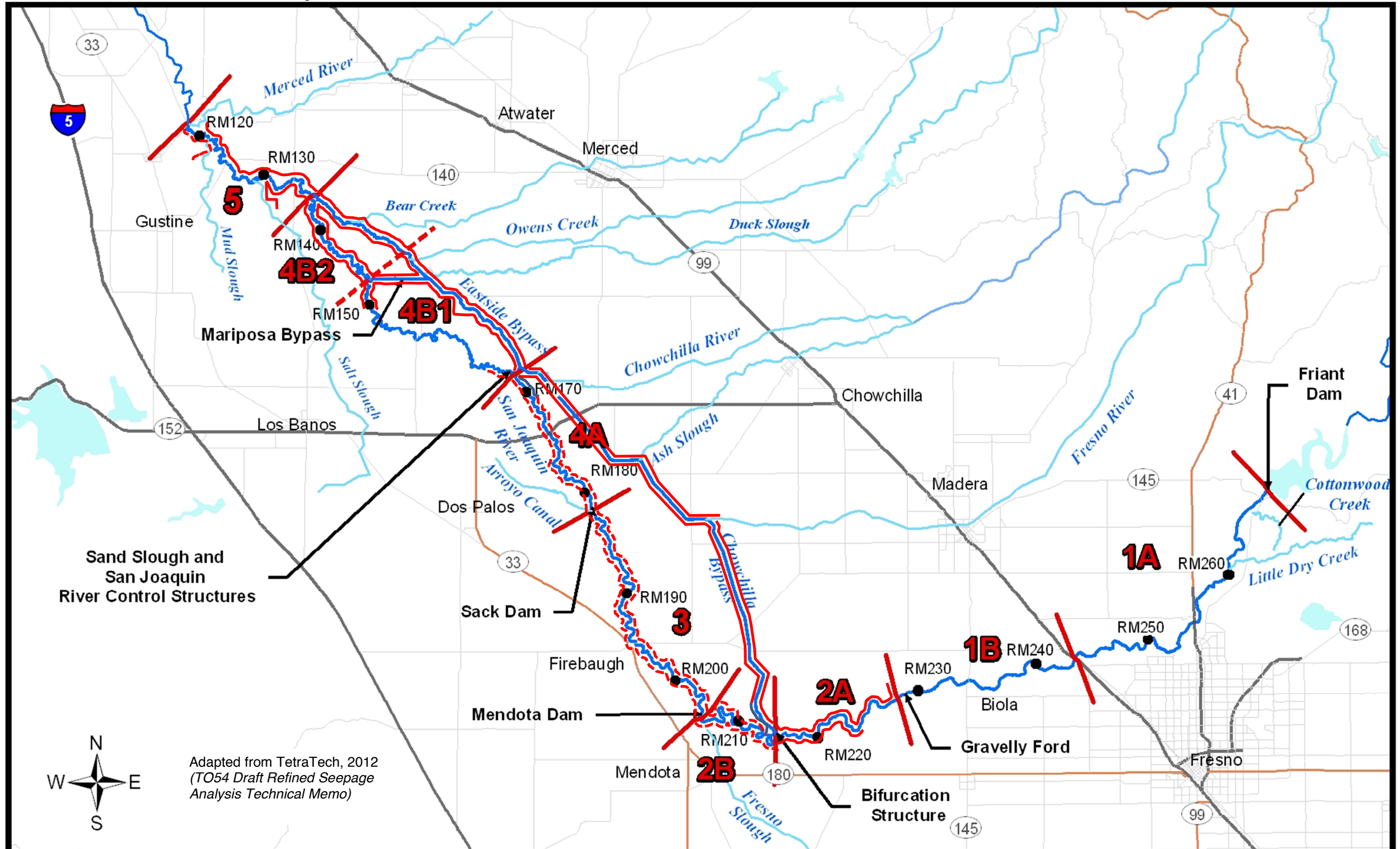


Figure 1
SJLE Project Study Area

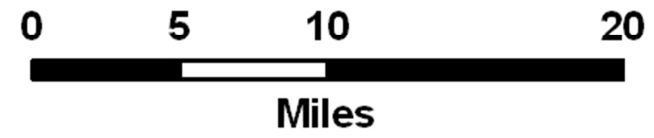


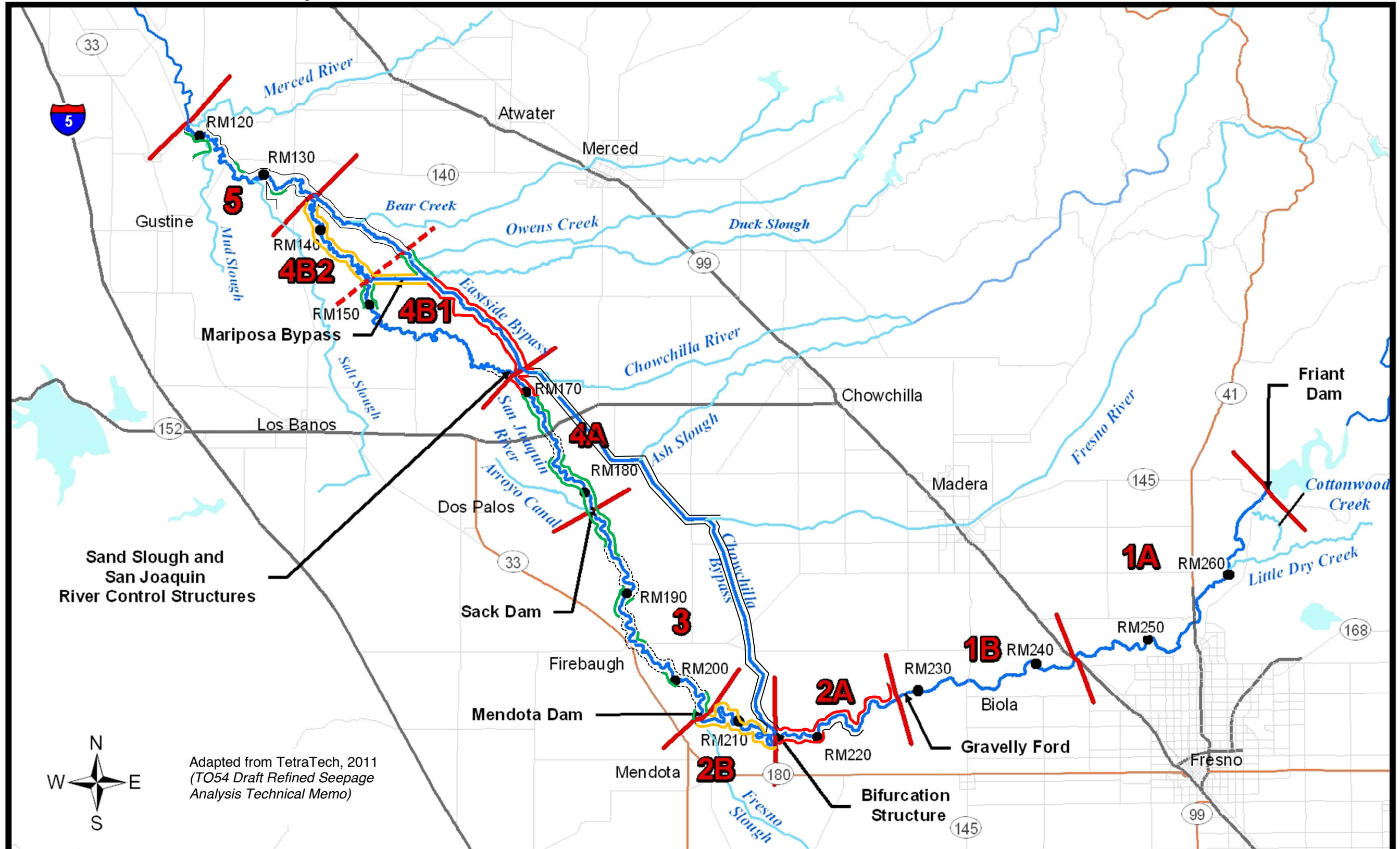
Adapted from TetraTech, 2012
(TO54 Draft Refined Seepage
Analysis Technical Memo)



- Project Levee
- - - Non-project Levee

Figure 2
Identified Levees in the SJLE Project Study Area





Adapted from TetraTech, 2011
(TO54 Draft Refined Seepage
Analysis Technical Memo)



- Priority 1
- Priority 2
- Priority 3

Figure 3
Levee Prioritization – SJLE Project Study Area

