Appendix C

Levee Capacity Evaluation of Geotechnical Gravelly Ford (Reach 2A) Study Area

August 2015

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1. INTRODUCTION

To support the California Department of Water Resources (DWR) with estimates of levee capacity in the San Joaquin River Restoration Program (SJRRP) project reach, Tetra Tech Inc. performed an analysis to establish a maximum flow capacity along the levees in Reach 2A (**Figure 1**). The maximum flow capacity was based on results of a Geotechnical Condition Report (GCR) developed for the levees in this reach (Kleinfelder, 2015). The GCR indicates that a total of 8 reaches were identified in Reach 2A by the geotechnical team and designated by letters from A to H[1] (**Figures 2 and 3**). An analysis cross section was selected for each reach as being representative of the location where seepage or stability issues are most likely to occur. The GCR identifies the selected maximum water-surface elevation on the levee at each cross section that would not exceed geotechnical criteria for seepage and slope stability (Kleinfelder, 2015). This memorandum summarizes the methods and results of the capacity evaluation. This work was completed under the River Engineering Services for the San Joaquin River Restoration Program Contract, Task Order 2.

2. METHODOLOGY

The locations of the GCR cross sections were mapped relative to the cross sections in the one-dimensional (1-D) hydraulic (HEC-RAS) model of each particular reach (Tetra Tech, 2014) using ArcGIS. In addition to the reach letter, the GCR cross sections are identified by a station number that refers to a distance along the levees. Both identifiers are referred to in this analysis. The model cross sections upstream and nearest to each of the GCR cross sections were identified to provide the reference locations in which to compare computed water-surface elevations[2] for the purpose of estimating flow capacities (**Figure 4**). The model cross section upstream of the GCR cross section also provides a more conservative estimate of the maximum flow capacity than the one located downstream of the GCR cross section.

A range of flows up to 6,000 cfs were modeled in Reach 2A. Flows above a Restoration Flow of 4,500 cfs were modeled in Reach 2A because higher flows may occur in this reach due to attenuation and flow losses in order to deliver a maximum Restoration Flow of 4,500 cfs to Reach 2B. The operational configurations of the Chowchilla Bypass Bifurcation Structure and the impacts on the upstream water-surface elevations are complex. As a result, computed

[1] A total of 8 reaches were identified and designated by letters A through H. Reach E, however, was not analyzed due to low levee heights (Kleinfelder, 2015).

[2] Regional subsidence maps prepared by Reclamation of the Restoration Area show that subsidence rates in Reach 2A during the period of December 2011 to December 2013 are on the order of 0.15 to 0.3 feet per year (Reclamation, 2013). The subsidence maps also suggest that the magnitude of subsidence is relatively uniform along the length of Reach 2A. Although a detailed analysis of the impacts of subsidence on predicted water-surface elevations has not taken place, application of a uniform rate of subsidence (i.e. then entire reach is lowered a constant amount) would not have an impact on predicted levee capacities. As a result, the impacts of subsidence are not included in this evaluation.

water-surface profiles for this analysis are based on a downstream boundary condition that corresponds with observed water-surface elevations surveyed immediately upstream of the Bifurcation Structure over a range of flows, which was assumed to represent a typical operational condition (Tetra Tech, 2014).

The GCR elevation at the assigned model cross section was then used to interpolate a flow based on computed water-surface elevations that were run over a range of flows. If the associated flow was greater than 6,000 cfs, then a capacity of ">6,000 cfs" was reported and no further calculations were made.

3. RESULTS

Based on existing conditions computed water-surface elevations, all seven of the analyzed reaches have a capacity of at least 6,000 cfs (**Figure 5**; **Table 1**) and will meet geotechnical criteria for levee seepage and slope stability at maximum Restoration Flows in the reach.

Table 1. Flow capacities at the GCR cross sections in Reach 2A.

GCR Reach[1]	GCR Station (ft)	Representative Model Cross Section	GCR Selected Maximum WSE (ft)	Flow Capacity (cfs)
A	11418+00	526981	176	>6,000
B	11560+00	541706	182.5	>6,000
C	11644+00	549708	185.3	>6,000
D	11708+00	555801	189.7	>6,000
F	11647+00	521166	173.3	>6,000
G	11742+00	532395	178.7	>6,000
H	11830+00	538908	182.6	>6,000

[1]Reaches A through D are located along the right levee, and Reaches F through H are located along the left levee of the San Joaquin River. Reach E is located along the upper end of the right levee, and was not analyzed because of low levee heights (Kleinfelder, 2015).

4. REFERENCES

Bureau of Reclamation, 2013. December 2011 to December 2013 Subsidence Result Maps.

Tetra Tech, 2014. San Joaquin River and Bypass System 1-D Steady State HEC-RAS Model Documentation, Draft technical memorandum prepared for the California Dept. of Water Resources, Fresno, California, March.

Kleinfelder, 2015. Geotechnical Condition Report, San Joaquin River Restoration Program Gravelly Ford (Reach 2A) Study Area. Prepared for Department of Water Resources. April.

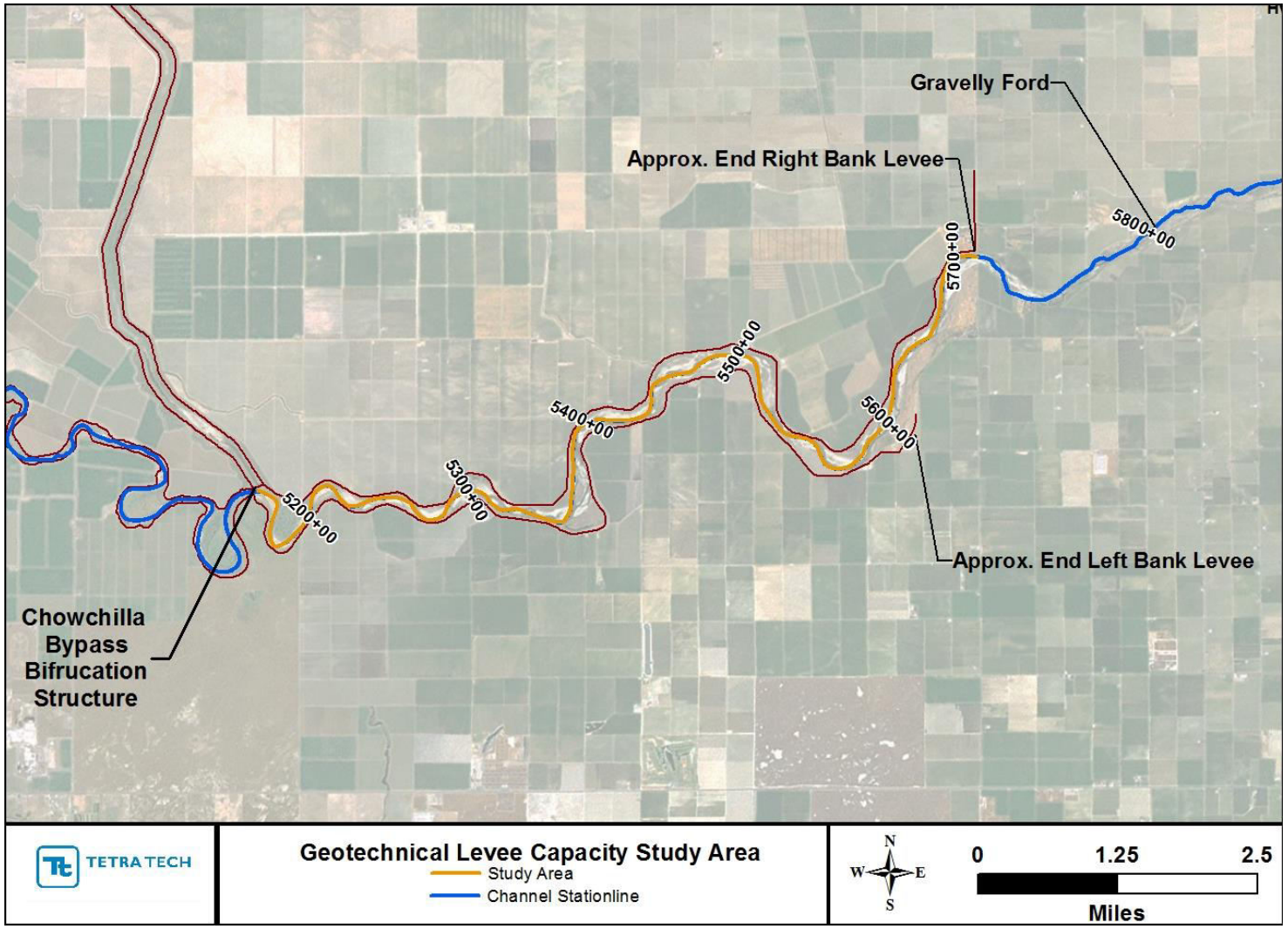

Figure 1. Site map of study area.

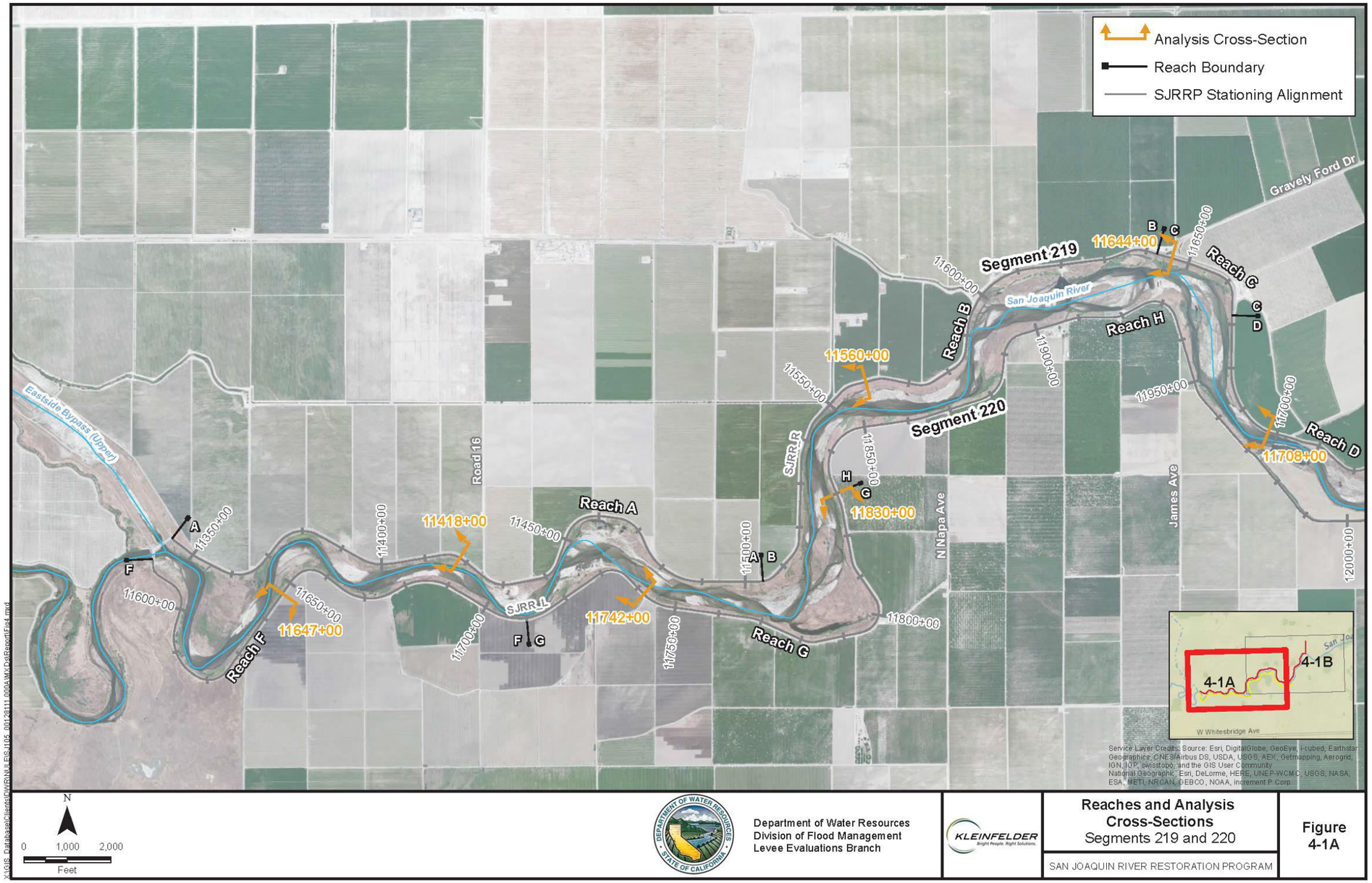

Figure 2. GCR analysis reaches and cross sections in the lower portion of Reach 2A (Figure 4-1a from Kleinfelder, 2015).

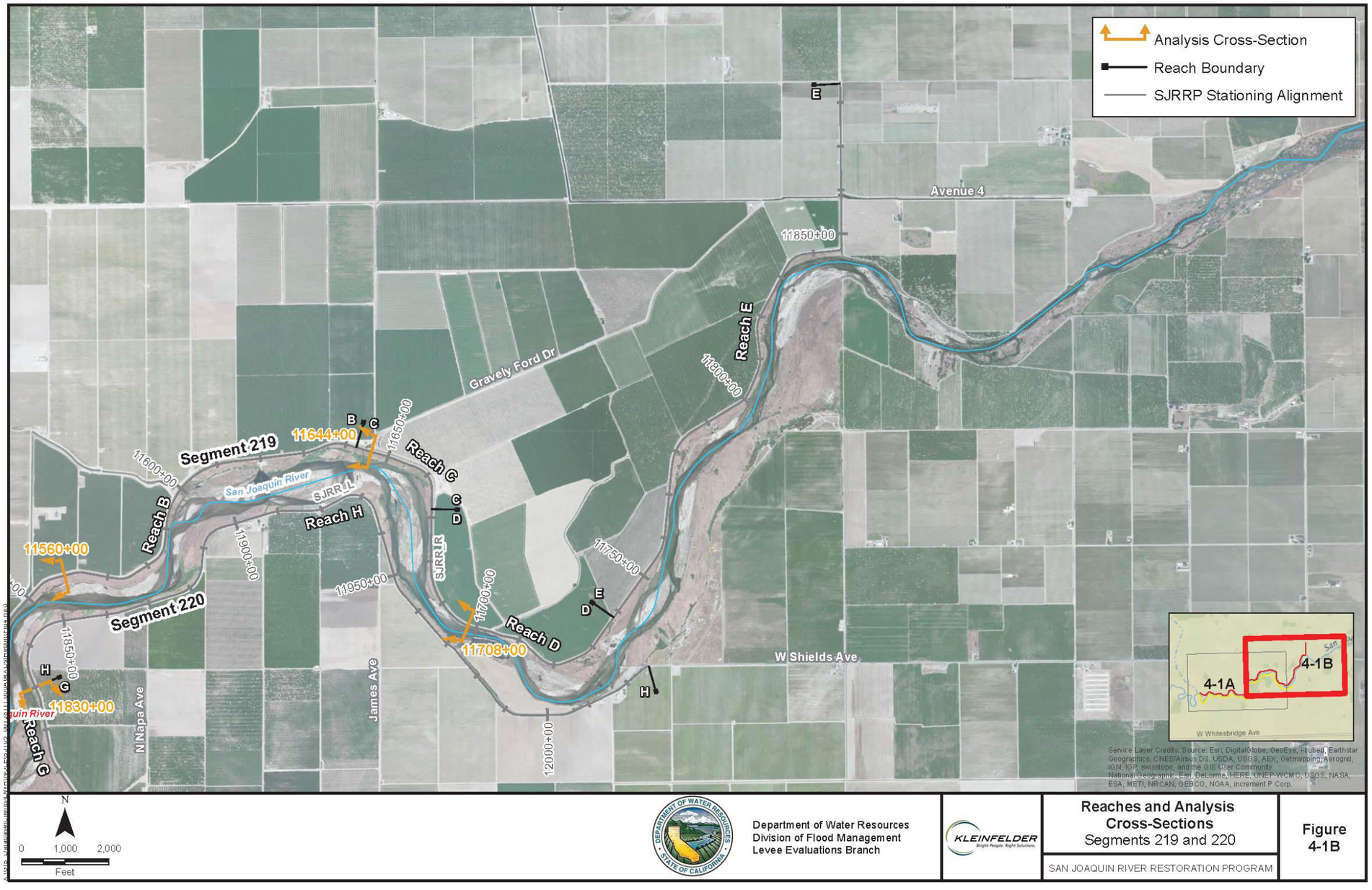

Figure 3. GCR analysis reaches and cross sections in the upper portion of Reach 2A (Figure 4-1b from Kleinfelder, 2015).

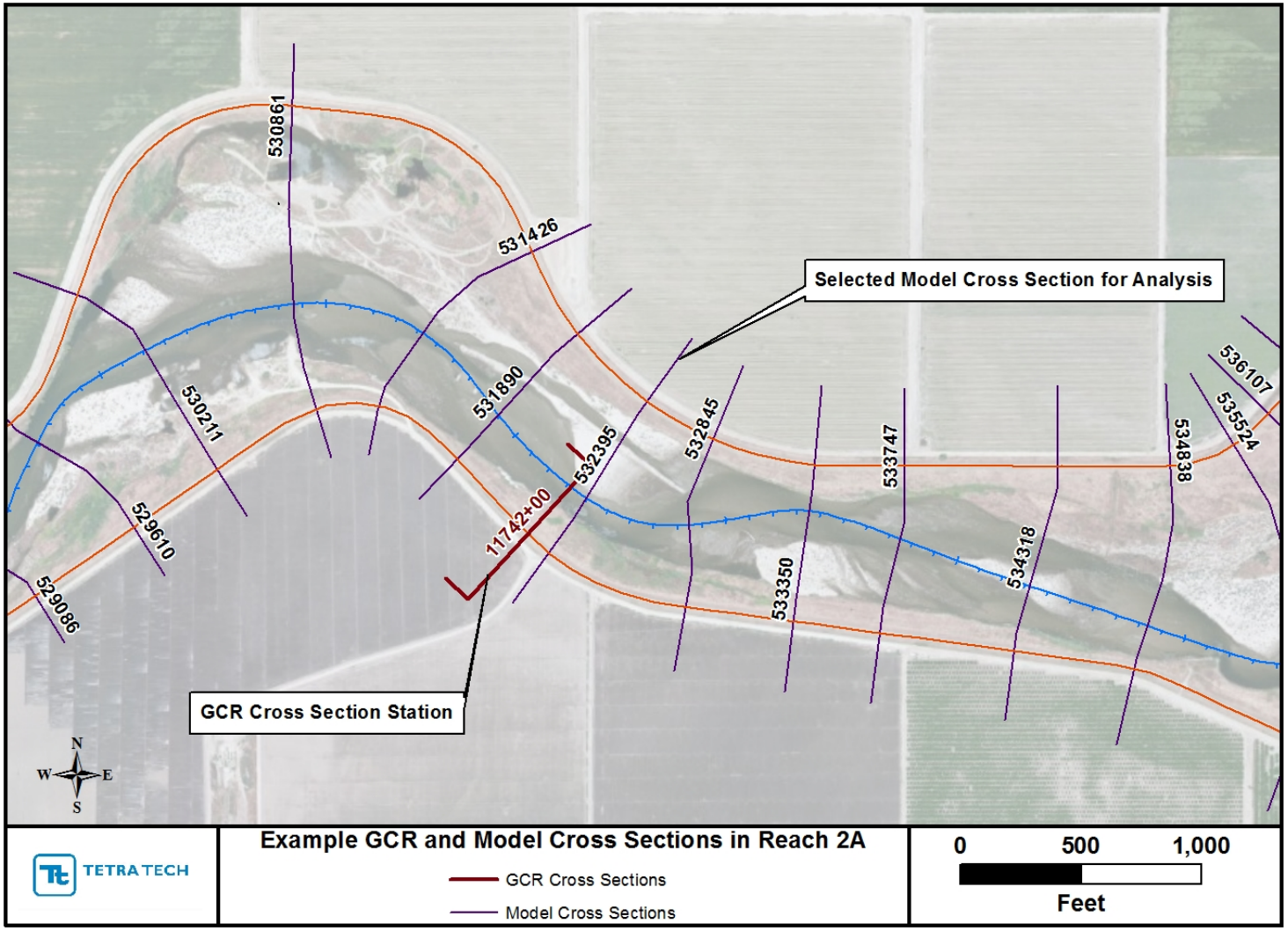

Figure 4. Planview of example GCR cross section and HEC-RAS model cross section selected for capacity calculations.

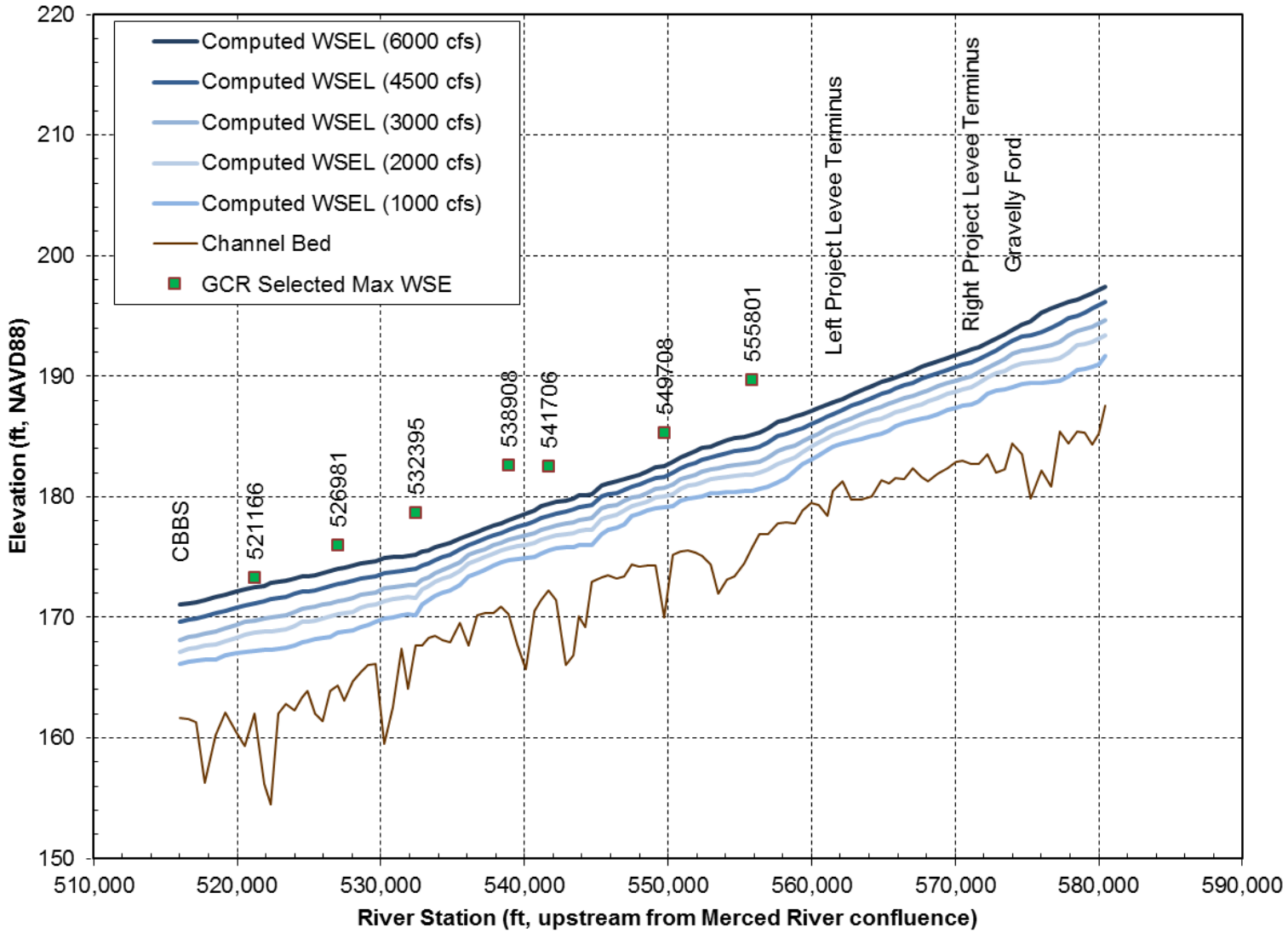

Figure 5. Computed water-surface profiles along Reach 2A. Also shown are the reference points and station identifier for each of the GCR cross sections in this reach.