Appendix C

San Joaquin River In-channel Capacity Analysis

September 2013

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September 10, 2013

1. INTRODUCTION

Tetra Tech, Inc., dba Mussetter Engineering, Inc. (Tt-MEI) performed a channel capacity evaluation of the San Joaquin River and the Eastside and Mariposa Bypasses between Friant Dam and the confluence with the Merced River to:

1. Determine the in-channel capacity of each reach, defined as the highest flow that can be conveyed through the reach where the water-surface elevation does not exceed the landside (or outside) ground elevation near the base of the levee (referred to as landside levee toe in Draft PEIS/R; DWR, 2011) for any part of the reach.

2. Determine the approximate length of left- and right-bank levee for each reach where the water-surface elevation of an in-channel flow of 2,000 cfs exceeds the landside ground elevation near the base of the levee.

3. Determine the approximate length of left- and right-bank levee for each reach where the water-surface elevation of an in-channel flow of 4,500 cfs exceeds the landside ground elevation near the base of the levee.

Only limited data are currently available regarding characteristics and performance criteria (including Factor of Safety) for levees along the San Joaquin River. To provide information that the U.S. Bureau of Reclamation (Reclamation) can use to limit the release of Interim and Restoration flows, as necessary prior to sufficient data becoming available to determine the Factor of Safety, as well as to prioritize future data collection and analysis activities, landside ground elevations near the base of the levees were determined and compared to computed water-surface elevations over a range of flows. The evaluation was conducted using the HEC-RAS 1-D steady-state hydraulic models developed by Tt-MEI for the San Joaquin River Restoration Program (SJRRP), and is based purely on the comparison of water-surface and landside ground elevations independent of levee characteristics. This memorandum summarizes the methods and results of the analysis, and represents an update to Appendix I of the Draft PEIS/R (DWR, 2011). All results herein shall supersede those presented in the Draft Appendix I (DWR, 2011).

2. METHODOLOGY AND ASSUMPTIONS

The following sections describe the methodology and assumptions that were used in performing the analysis. The analysis specifically focused on identifying the maximum discharge that can be conveyed through each reach where the water-surface elevation does not exceed the landside ground elevation near the base of the levee (i.e., in-channel flow capacity), and included an estimate of the length along the levee where outside ground elevations are exceeded by water-surface elevations at 2,000 and 4,500 cfs. The 2,000- and 4,500-cfs flows represent the potential high and low range of flows that may be needed to achieve the Restoration Goal of the settlement.

2.1. River Reaches

The seepage potential was evaluated for each subreach that is bounded by levees in Reaches 2A, 2B, 3, 4A, 4B2, 5, Middle Eastside Bypass, Lower Eastside Bypass, and the Mariposa Bypass (**Figure 1**). As part of the SJRRP, new setback levees are being evaluated for Reach 4B1 to safely convey restoration flows. Since the current capacity is assumed to be negligible, it is assumed that no restoration flows will be conveyed in this reach until channel capacity improvements are made. Therefore, Reach 4B1 was not included in this analysis. Setback levees will also be constructed in Reach 2B, but because interim-flow releases will be routed through this reach prior to construction, capacity of the outside ground along the levees upstream from the direct impacts of Mendota Pool was evaluated.

2.2. Hydraulic Models and Topographic Data

Hydraulic models for the study reaches, which were initially developed based on 2-foot contour mapping developed in 1998/1999 for the Sacramento and San Joaquin River Basins Comprehensive Study, have been recently updated using improved modeling techniques, 2008 LiDAR mapping, and 2009-2011 bathymetry, where available. The most up-to-date model available was used for each reach as summarized in **Table 1**. Discharge capacities reported in this analysis are based on water-surface profiles developed by running the models over a series of local discharges with downstream boundary conditions based on the same local discharges for each reach.

Table 1. Summary of basis for topography in each modeled reach.

Reach	Topographic Data Source	Reference
2A	2008 overbank LiDAR; 2010 in-channel bathymetry	Tt-MEI, 2012a
2B	2008 overbank LiDAR; 2009-2010 in-channel bathymetry	Tt-MEI, 2012a
3	2008 overbank LiDAR; 2009-2010 in-channel bathymetry	Tt-MEI, 2012a
4A	2008 overbank LiDAR; 2010-2011 in-channel bathymetry	Tt-MEI, 2012b
4B2	2008 overbank LiDAR; 2010-2011 in-channel bathymetry	Tt-MEI, 2012c
5	2008 overbank LiDAR; 2011 in-channel bathymetry	Tt-MEI, 2012d
Middle Eastside Bypass	2008 overbank LiDAR; 2010-2011 in-channel bathymetry	Tt-MEI, 2012b
Lower Eastside Bypass	2008 overbank LiDAR; 2010-2011 in-channel bathymetry	Tt-MEI, 2012e
Mariposa Bypass	2008 overbank LiDAR (includes in-channel data)	Tt-MEI, 2012b

2.3. Outside Ground Elevations

Elevations of land protected by and adjacent to the levees (outside ground) for all reaches were updated as part of this evaluation based on the 2008 LiDAR data incorporated into the updated hydraulic models. Elevations were identified at each model cross section primarily through inspection of the cross-sectional topography and verified through review of the aerial photography and contour mapping (2008 LiDAR). In general, the landside ground elevations adjacent to the overall levee structure were selected, regardless of whether the terrain was flat or sloped to or away from the levee. A series of examples indicating where the outside ground elevations were selected is shown in **Appendix A**.

3. RESULTS

Computed water-surface profiles were compared to the outside ground elevations adjacent to both the left and right levees along the extent of each reach. The in-channel flow capacity of each reach was determined to be the highest flow rate through the reach where the water-surface elevation does not exceed the outside ground elevation for any part of the reach. Approximate lengths of each site where the outside ground elevations are overtopped by the water-surface elevations associated with a local discharge of 2,000 and 4,500 cfs were then estimated from the available mapping, topography at adjacent cross sections, and the actual length along the levee as indicated in aerial photography.

3.1. Reach 2A

Reach 2A is approximately 13 miles long and extends from Gravelly Ford (near the upstream end of the project levees) downstream to the Chowchilla Bypass Bifurcation Structure. Computed water-surface profiles are based on a downstream boundary condition that corresponds with elevations observed during field visits between November 2009 and June 2011. Along the right and left levees in Reach 2A, the highest local discharge for which the water-surface is at or below the outside ground elevation is 1,630 and 2,430 cfs, respectively (**Figures 2 and 3**). At 2,000 cfs, water-surface elevations exceed the outside ground elevations only along the right levee, at a total length of 1,240 feet. At 4,500 cfs, water-surface elevations exceed the outside ground elevations along 7,410 feet of left levee, and 10,100 feet of right levee (**Table 2**). Segments of levee where ground elevations are exceeded by water-surface elevations at a local discharge of 2,000 and 4,500 cfs are delineated in **Figures 4 and 5**.

3.2. Reach 2B

Reach 2B is approximately 11 miles long and extends from the Chowchilla Bypass Bifurcation Structure downstream to Mendota Dam. Outside ground elevations along the lower portion of this reach (downstream from approximately Sta 4765+00) are generally lower than the normal pool elevation at Mendota Dam. As a result, the existing flow capacity was evaluated for the entire reach as well as only for the portion of the reach upstream from the influence of the pool.

When considering the entire reach, including Mendota Pool, the capacity along both sides of the channel is 0 cfs (**Figures 6 and 7**). At a local discharge of 2,000 cfs, water-surface elevations exceed ground elevations over approximately 4 miles along the left levee and 3.6 miles along the right levee (Table 2). At 4,500 cfs, the length where water-surface elevations exceed ground elevations along the left levee increases to about 10 miles, and the length along the right levee increases to about 7.7 miles. If only the portion of the reach upstream from the influence of the pool is considered, the highest local discharge in which the water surface is at or below the outside ground elevation is about 1,120 cfs along the left levee and 1,550 cfs along the right levee (Table 2). In this portion of the reach, water-surface elevations at 2,000 cfs exceed the outside ground elevations along 8,730 feet of levee on the left side of the channel and 8,320 feet along the right. At a local flow of 4,500 cfs, the lengths increase significantly to 7 miles along the left levee and 4.5 miles along the right levee. The portions of levee along the entire reach where ground elevations are exceeded by water-surface elevations at a local discharge of 2,000 and 4,500 cfs are delineated in **Figures 8 and 9**.

Table 2. Summary of in-channel capacity discharge and approximate length of levee in each reach where the outside ground elevation is below the water-surface elevation at 2,000 and 4,500 cfs.

Reach	Levee Side	Discharge Capacity[1] (cfs)	Length of Levee at 2,000 cfs (ft)	Length of Levee at 4,500 cfs (ft)
Reach 2A	Left	2,430	0	7,410
Reach 2A	Right	1,630	1,240	10,100
Reach 2B (Entire Reach)[2]	Left	0	21,200	53,300
Reach 2B (Entire Reach)[2]	Right	0	18,800	40,400
Reach 2B (Excluding Mendota Pool)[3]	Left	1,120	8,730	36,800
Reach 2B (Excluding Mendota Pool)[3]	Right	1,550	8,320	23,900
Reach 3	Left	3,680	0	18,800
Reach 3	Right	2,760	0	18,900
Reach 4A	Left	970	4,570	44,400
Reach 4A	Right	1,340	4,140	49,900
Reach 4B2	Left	1,370	6,060	35,480
Reach 4B2	Right	50[4]	14,750	38,670
Reach 5 (All Levees)	Left	1,940	640	15,580
Reach 5 (All Levees)	Right	2,500	0	3,970
Reach 5 (Excluding Left Levee downstream of Mud Slough)	Left	2,350	0	12,950
Reach 5 (Excluding Left Levee downstream of Mud Slough)	Right	2,500	0	3,970
Middle Eastside Bypass	Left	10	38,760	49,500
Middle Eastside Bypass	Right	370	25,800	47,600
Lower Eastside Bypass	Left	2,970	0	10,650
Lower Eastside Bypass	Right	2,890	0	8,400
Mariposa Bypass	Left	650	15,700	17,570
Mariposa Bypass	Right	350	13,700	17,570

[1]Capacity based on outside ground elevations.
[2]Entire reach including Mendota Pool.
[3]Portion of reach above influence of Mendota Pool (upstream of Sta 4765+00).
[4]Capacity assumes deep depressions are included, otherwise capacity would increase to 930 cfs.

3.3. Reach 3

Reach 3 is about 22 miles long and extends from Mendota Dam downstream to Sack Dam. Outside ground elevations are reasonably high along much of the reach except for the area immediately upstream of Sack Dam (**Figures 10 and 11**). Discharge capacity in this area is limited by a depression on the right side that has a capacity of 2,760 cfs. On the left side of the channel, the capacity of the outside ground elevation is 3,680 cfs (Table 2). The 2,000-cfs discharge profile does not exceed any of the outside ground elevations. At 4,500 cfs, however, water-surface elevations exceed outside ground elevations along approximately 3.6 miles of levee on both the left and right sides of the river (Table 2; **Figure 12**).

3.4. Reach 4A

Reach 4A is about 23 miles long and extends from Sack Dam downstream to the Sand Slough Control Structure (SSCS). The boundary condition is based on interim conditions and assumes that all flow in Reach 4A is directed into the Eastside Bypass, without any additional flow contribution from the Chowchilla Bypass. The computed water-surface profiles in Reach 4A indicate that the maximum local discharge for which the water-surface is at or below the outside ground elevation is 1,340 cfs for the right levee and 970 cfs for the left levee (**Figures 13 and 14**). At a local flow of 2,000 cfs, computed water-surface elevations exceed less than one mile of outside ground on either side of the channel, but at 4,500 cfs, at least 8 miles of ground are exceeded along the left levee and almost 10 miles are exceeded along the right levee (Table 2; **Figures 15 and 16**).

3.5. Reach 4B2

Reach 4B2 extends approximately 12 miles from the Mariposa Bypass downstream to the confluence with the Lower Eastside Bypass and Bear Creek. Computed water-surface elevations in this reach were developed based on a downstream boundary condition that assumes no additional flow from the Eastside Bypass. The ground adjacent to the right levee in Reach 4B2 has a localized but deep depression near Sta 1205+89, which is similar to many other depressions in this reach (see Figure A.3), that limits the in-channel capacity to about 50 cfs (**Figure 17**; Table 2). However, aerial photographs and contour mapping indicate that these depressions are not on or adjacent to agricultural land, are relatively small, and can contain water even at low flows (Tt-MEI, 2011). If these local, right side depressions are excluded from the analysis, the capacity along the right levee increases to about 930 cfs (Figure 17). The outside ground along the left levee is not as low, which results in an in-channel capacity of approximately 1,370 cfs (**Figure 18** and Table 2). Based on a local discharge of 2,000 cfs, water-surface elevations would exceed ground elevations along about 6,060 feet of the left levee and about 14,750 feet along the right levee (Table 2). At, 4,500 cfs, water-surface elevations exceed the outside ground elevations on either side of the channel over approximately 7 miles of the reach. Segments of levee in Reach 4B2 where ground elevations are exceeded by water-surface elevations at a local discharge of 2,000- and 4,500 cfs are delineated in **Figures 19 and 20**.

3.6. Reach 5

Reach 5 extends downstream from Bear Creek to the confluence with the Merced River. Computed water-surface profiles in this reach were developed based on a downstream boundary condition that corresponds to a published discharge rating curve at the San Joaquin

River at Newman gage, and assumes that the contribution of flow from the Merced River is added based on an equivalent occurrence frequency and hydrologic year type specified in the Settlement Agreement (Tt-MEI, 2012f). In addition, the analysis is based on the assumption that no flow is added at Salt and Mud Sloughs. Because most of the areas with limited capacities occur along the mid- to upper portion of this reach, assumptions regarding the downstream boundary condition have very little impact on the results. The one exception is a levee feature that exists along the left side of the channel near the downstream end of the reach. Based on available information, this feature is not a Project Levee, but the analysis was conducted both with and without this levee segment.

When considering the left downstream levee feature in the analysis, the highest local discharge for which the water-surface is at or below the outside ground elevation is 1,940 and 2,500 cfs along the left and right levees, respectively (**Figures 21 and 22**; Table 2). However, since much of the outside ground adjacent to the left levee contains many local depressions (Tt-MEI, 2011), these results likely represent a conservative estimate of the in-channel discharge capacity in this reach. At a local discharge of 2,000 cfs, computed water-surface elevations do not exceed the outside ground elevations along the right levee and only exceed 640 feet along the left levee (Table 2). At 4,500 cfs, the length along the left levee where water-surface elevations exceed the landside ground elevations increases to about 3 miles, and the length along the right levee increases to almost 4,000 feet. If the left levee at the lower end of the reach is not considered, the highest local discharge in which the water surface is at or below the outside ground elevation increases to about 2,350 cfs (capacity along right levee does not change (Table 2). Without including the lower left levee, water-surface elevations at 2,000 cfs do not exceed the outside ground elevations along either levee in Reach 5, and at 4,500 cfs, the length along the left levee decreases from 3 to 2.5 miles. The portions of levee along the entire reach where ground elevations are exceeded by estimated water-surface elevations at a local discharge of 2,000 and 4,500 cfs are delineated in **Figures 23 and 24**.

3.7. Middle Eastside Bypass

The Middle Eastside Bypass extends downstream approximately nine miles from the confluence of the Upper Eastside Bypass near the Sand Slough Control Structure (SSCS) to the Mariposa Bypass. At the upstream end of this reach, the channel bed is very near the elevation of the ground outside of the levees on both the right and left sides (**Figures 25 and 26**). The Merced National Wildlife Refuge Weir is located in about the middle of this reach (Sta 732+25) and has the potential to greatly influence water-surface elevations for several miles upstream. Model runs were based on the assumption that all gates in the weir were fully open to reduce the backwater effect as much as possible. The slightly raised El Nido Road also creates a backwater condition that has the potential to impact the water-surface elevation in the upper portion of the reach. The computed water-surface profiles indicate that the highest local discharge for which the water-surface is at or below the outside ground elevation along the left levee is only about 10 cfs, and along the right levee is only 370 cfs (Table 2). It is important to note that this result is based solely on comparison of elevations, and does not account for the proximity of the in-channel flows to the levees and levee characteristics. At 2,000 cfs, a length of approximately 7.3 miles was identified where the outside ground elevations are at or below the water-surface elevation on the left side of the river, and almost 5 miles were identified along the right side (Table 2 and **Figure 27**). At 4,500 cfs, approximately 9 miles of levee on either side of the river would be exceeded (**Figure 28**).

The lowest in-channel capacity along the Middle Eastside Bypass occurs within the upper portion of the reach, which is influenced by downstream backwater conditions as well as sediment deposition. In this area, channel bed elevations are similar to the elevations of the landside ground near the base of the levee, occurring more frequently along the left levee than the right. However, the low flow channel within this area is typically located more than 500 feet away from the left levee. Therefore, if in addition to landside ground elevations, distance between the channel and levee are also considered, the in-channel discharge capacity is likely greater than 10 cfs in this portion of the Middle Eastside Bypass. In all, there are three sites where the capacity of the Middle Eastside Bypass is less than 300 cfs. All of these sites occur along the left levee (Figure 26). Site 1 occurs at Station 1015+52 and is the most critical area with a capacity of 10 cfs, as previously described. Site 2 is located adjacent to the Merced Wildlife Refuge at Station 738+14 and has a capacity of 120 cfs. Site 3 occurs about 6,500 feet downstream of Site 1 and has a capacity of 230 cfs.

3.8. Lower Eastside Bypass

The Lower Eastside Bypass continues downstream from the Eastside Bypass Control Structure for approximately 12 miles before merging with the mainstem of the San Joaquin River at the head of Reach 5. Computed water-surface elevations in this reach were developed based on a downstream boundary condition that was derived from water-surface elevations at the upper end of Reach 5 and the assumption of no additional flow from Reach 4B2. Bear Creek is a significant tributary that enters the bypass near Sta 211+24, but for this analysis, no flow contribution was assumed at this location. The computed water-surface profiles indicate that the highest local discharge for which the water-surface is at or below the outside ground elevation along the left levee is 2,970 cfs and along the right levee is 2,890 cfs (**Figures 29 and 30**; Table 2). Outside ground elevations along the entire reach are higher than computed water-surface elevations at a local discharge of 2,000 cfs (Table 2). At 4,500 cfs, however, approximately 2 miles of left levee has outside ground elevations that are lower than the computed water-surface elevations, and about 1.6 miles of ground are lower along the right levee (Table 2; **Figure 31**).

3.9. Mariposa Bypass

The Mariposa Bypass is just over 4 miles long and spans between the Middle Eastside Bypass and Reach 4B2. It is a straight reach bound by the Mariposa Bypass Control Structure on the upstream end and the Mariposa Bypass Drop Structure on the downstream end. The downstream boundary condition for this model is based on computed water-surface elevations in Reach 4B2, but the drop structure on the downstream end is the actual hydraulic control for this reach. Along both the left and right levees in the Mariposa Bypass, the highest local discharge for which the water-surface is at or below the outside ground elevation is 650 and 350 cfs, respectively (**Figures 32 and 33**; Table 2). As evident from the low in-channel capacity, the outside ground elevations in this reach are relatively low, but they are also relatively uniform. As a result, the lengths of levee where the outside ground elevations are below computed water-surface elevations do not change significantly between 2,000 and 4,500 cfs. At 2,000 cfs, almost 2.9 miles of outside ground elevations on either side of the channel are lower than the water-surface elevations, and at 4,500 cfs, 3.3 miles of outside ground are lower (Table 2). The portions of levee along the reach where ground elevations are exceeded by estimated water-surface elevations at a local discharge of 2,000 and 4,500 cfs, which is almost the entire reach, are delineated in **Figures 34 and 35**.

4. REFERENCES

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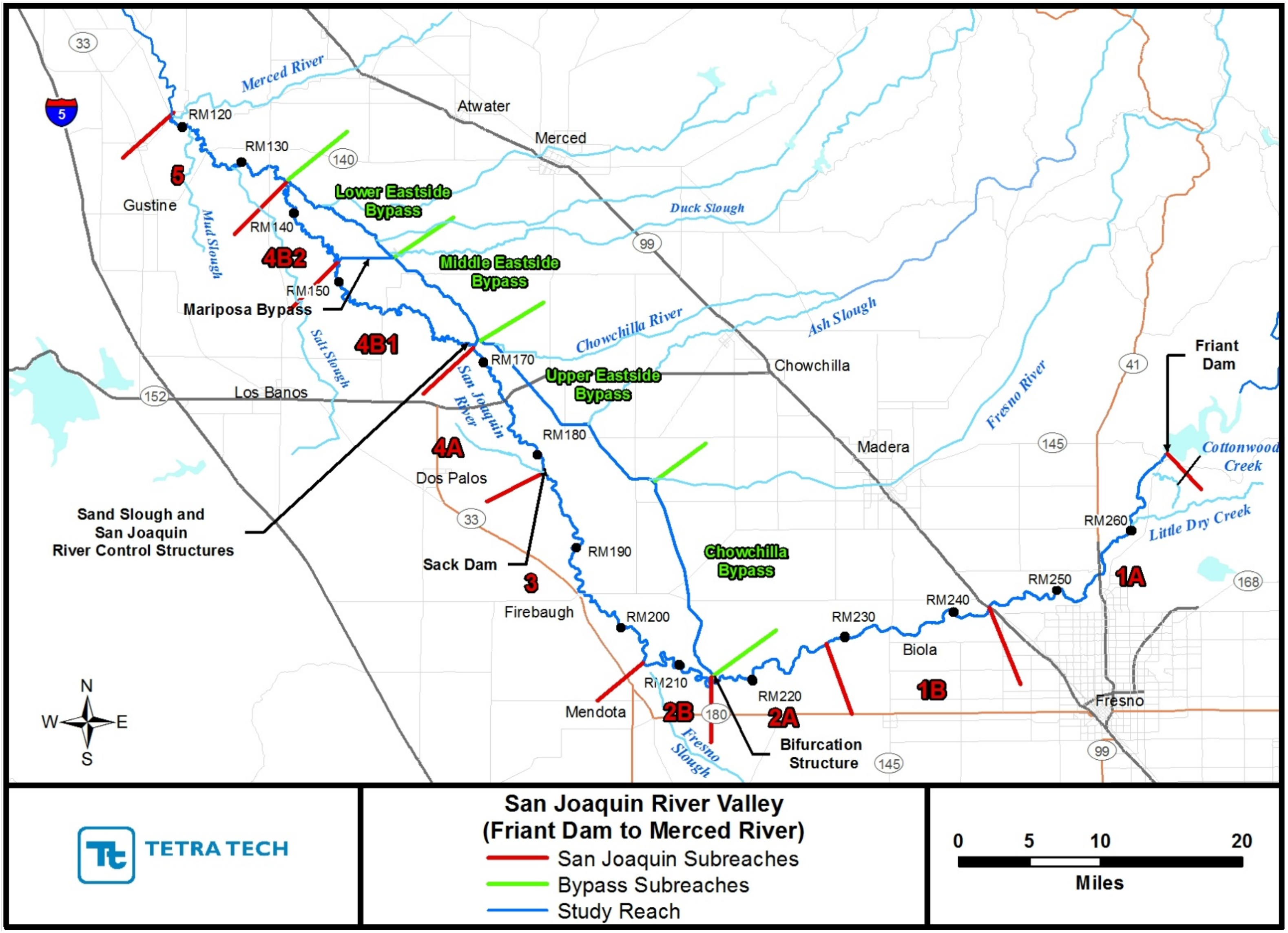

Figure 1. Map of the San Joaquin River Restoration Project Reach showing the subreach boundaries.

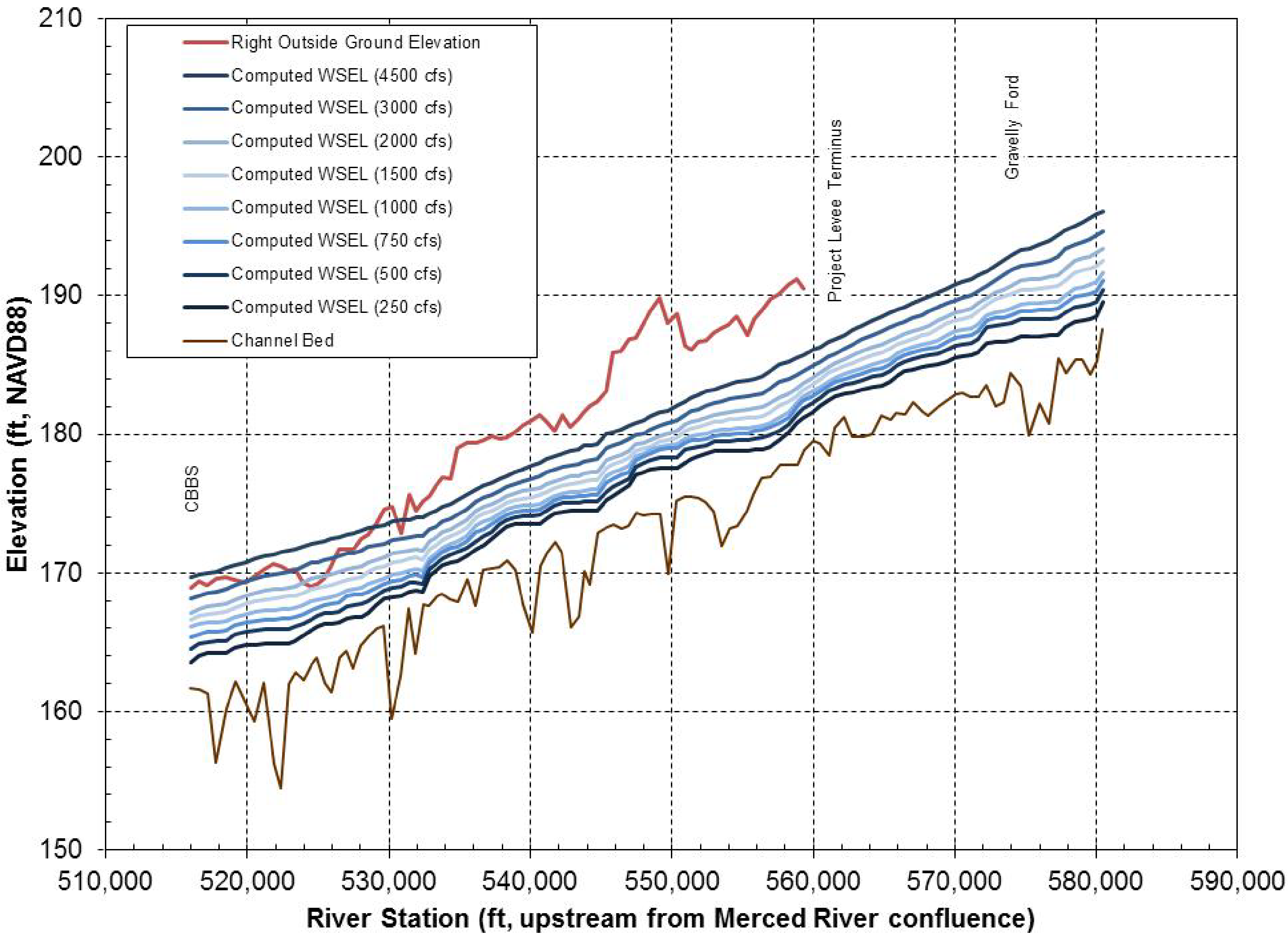

Figure 2. Comparison of outside ground profile with computed water-surface elevations along right levee in Reach 2A.

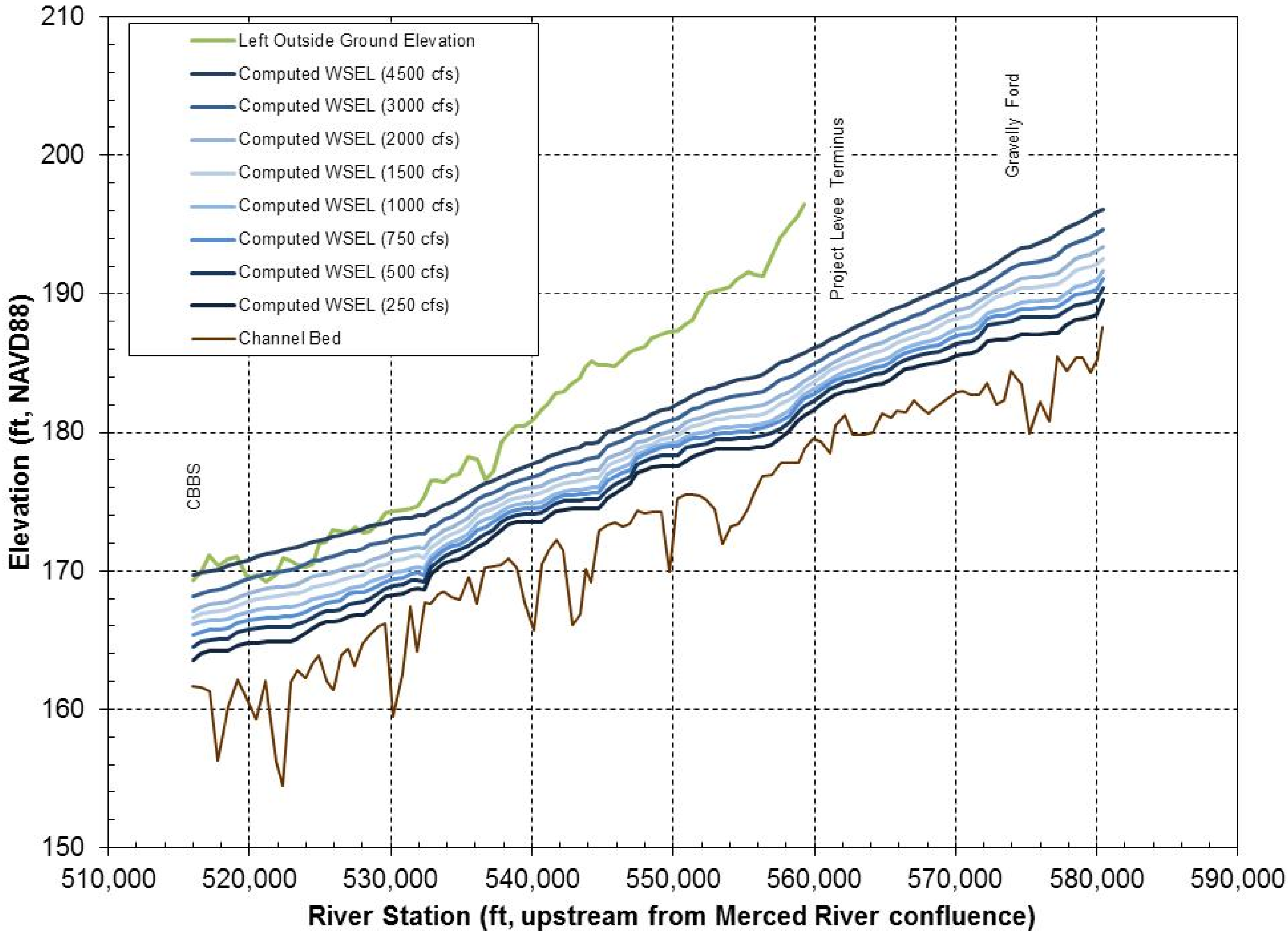

Figure 3. Comparison of outside ground profile with computed water-surface elevations along left levee in Reach 2A.

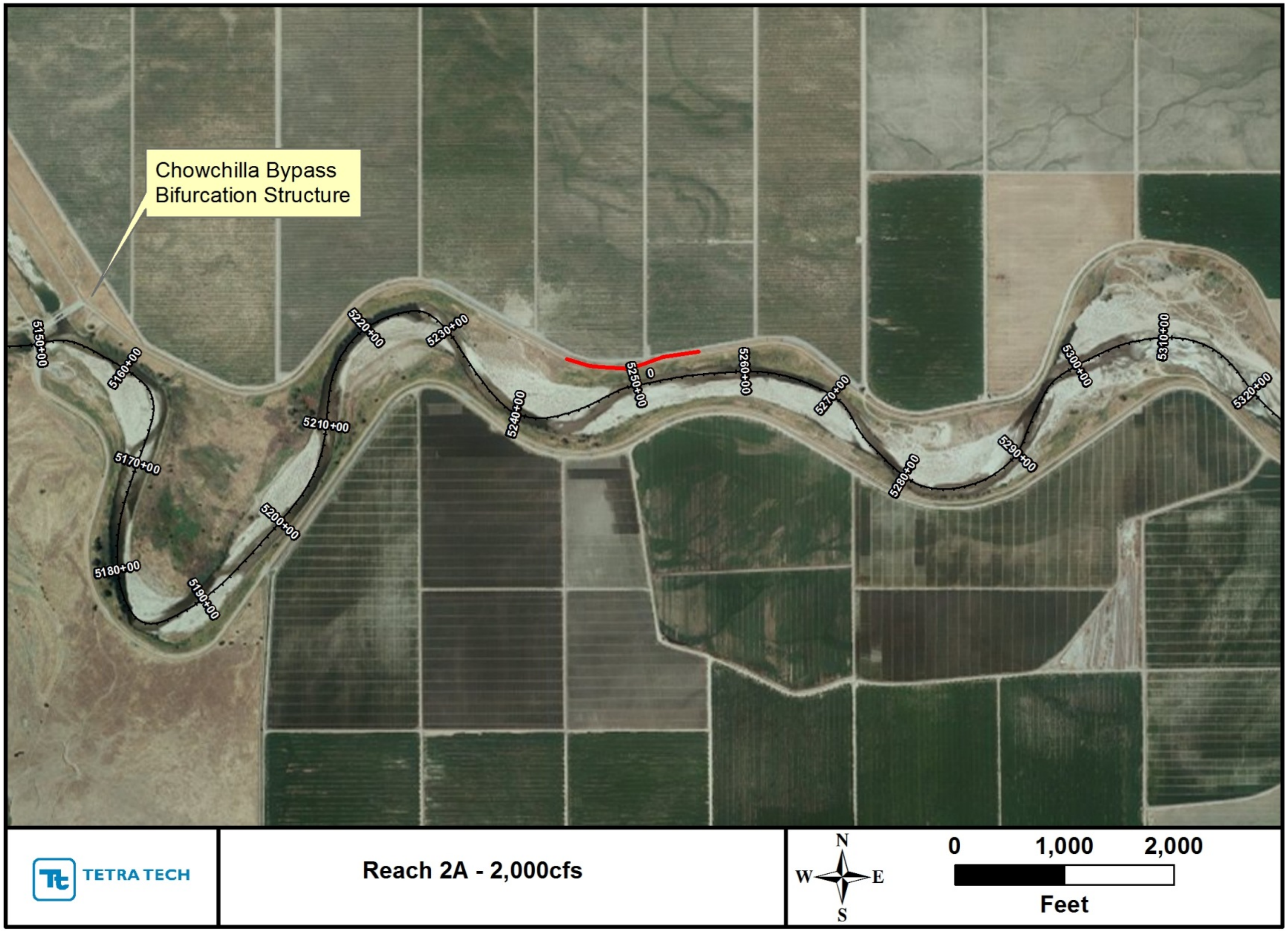

Figure 4. Portions of levee in Reach 2A where the 2,000-cfs water-surface elevation is above the outside ground elevation.

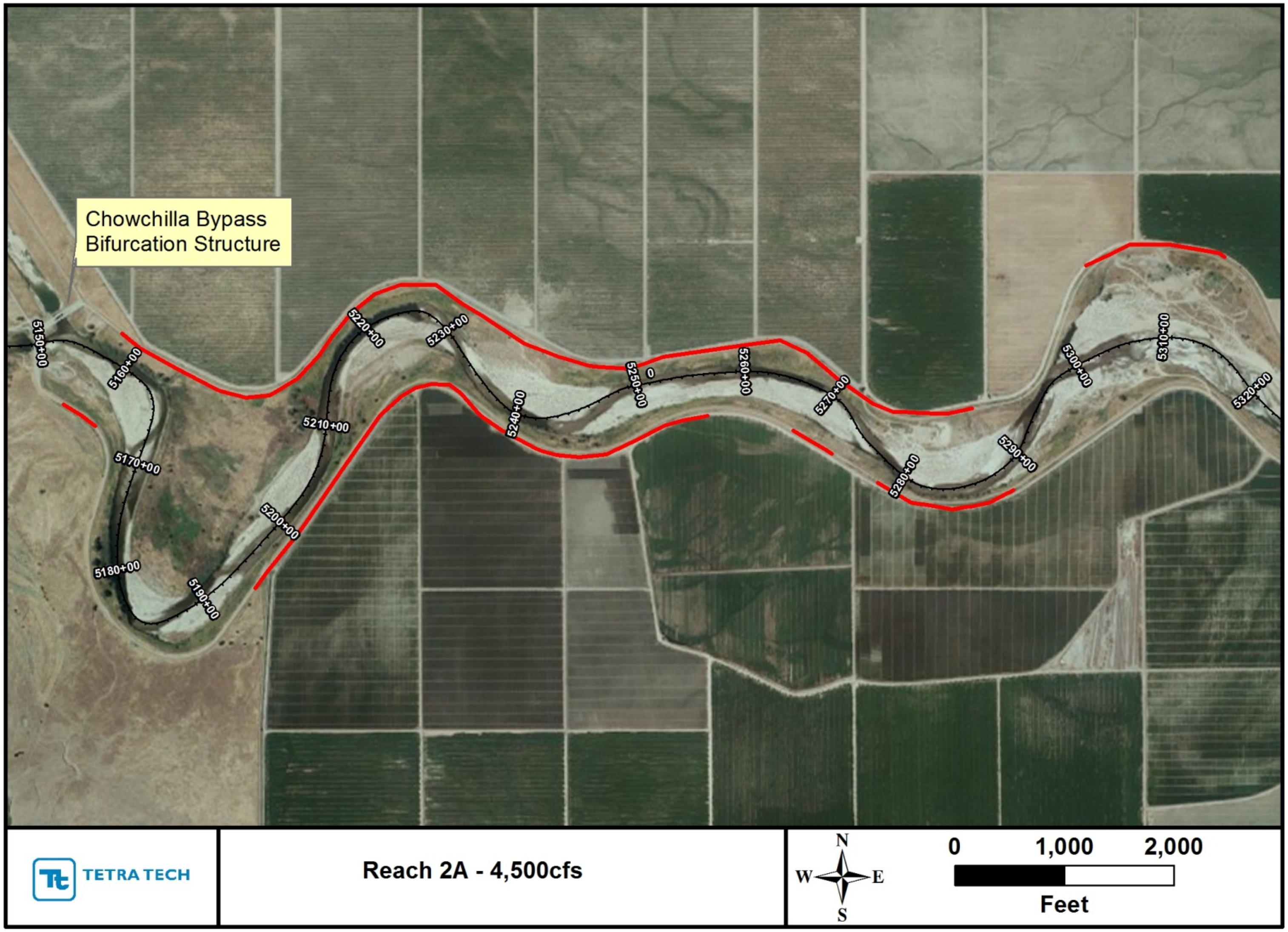

Figure 5. Portions of levee in Reach 2A where the 4,500-cfs water-surface elevation is above the existing outside ground elevation.

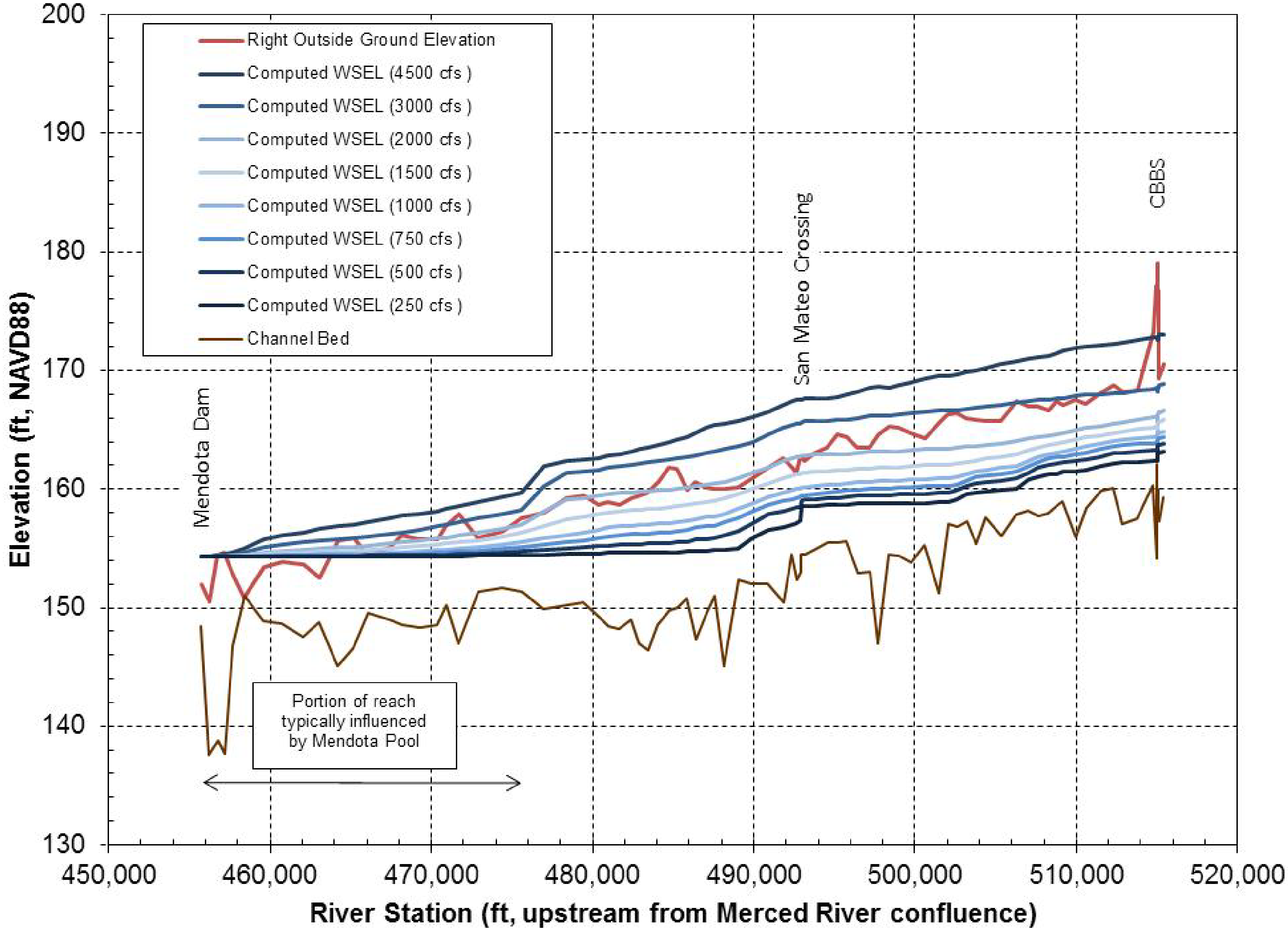

Figure 6. Comparison of outside ground elevation with computed water-surface elevations along right levee in Reach 2B.

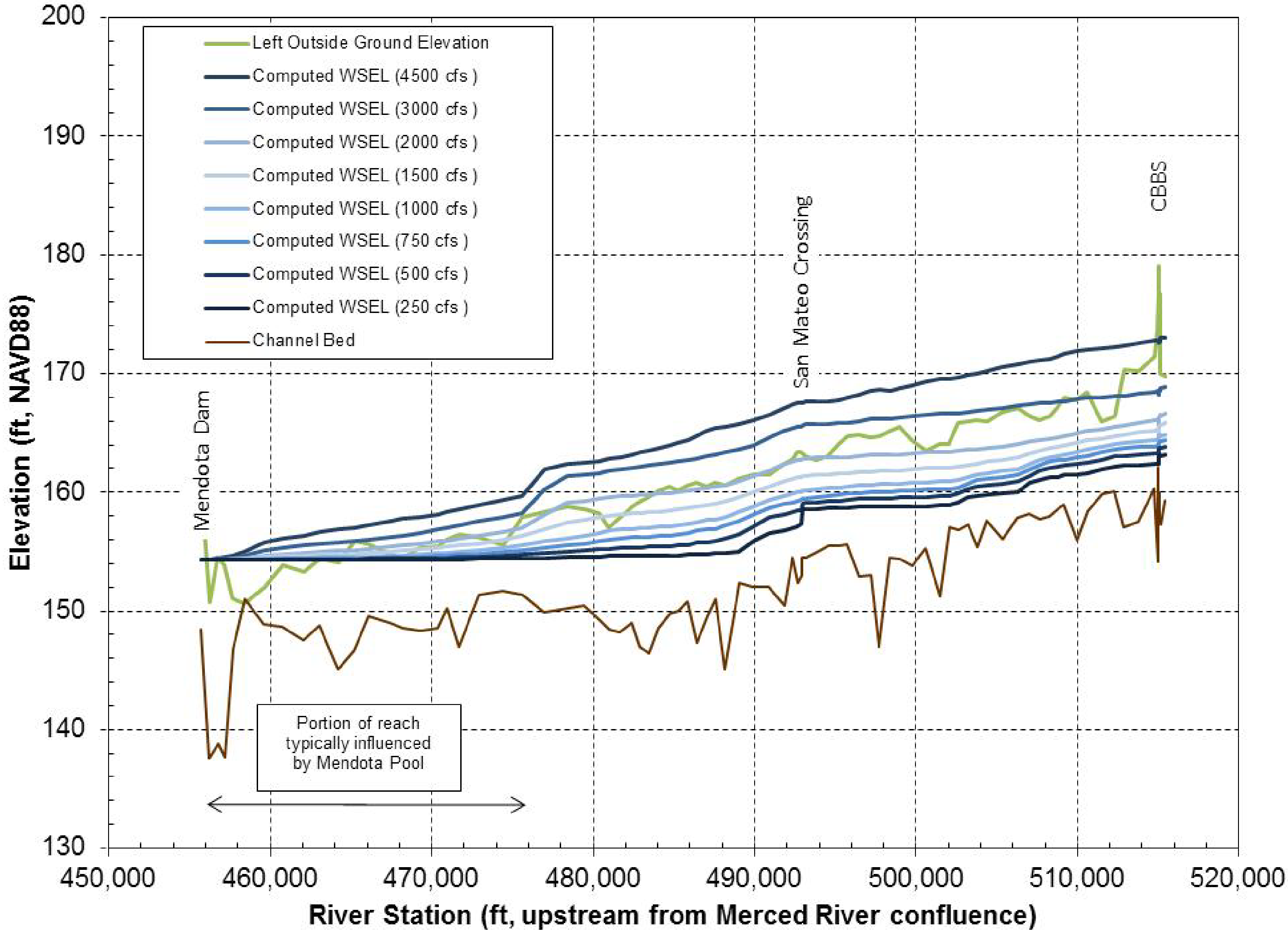

Figure 7. Comparison of outside ground elevation with computed water-surface elevations along left levee in Reach 2B.

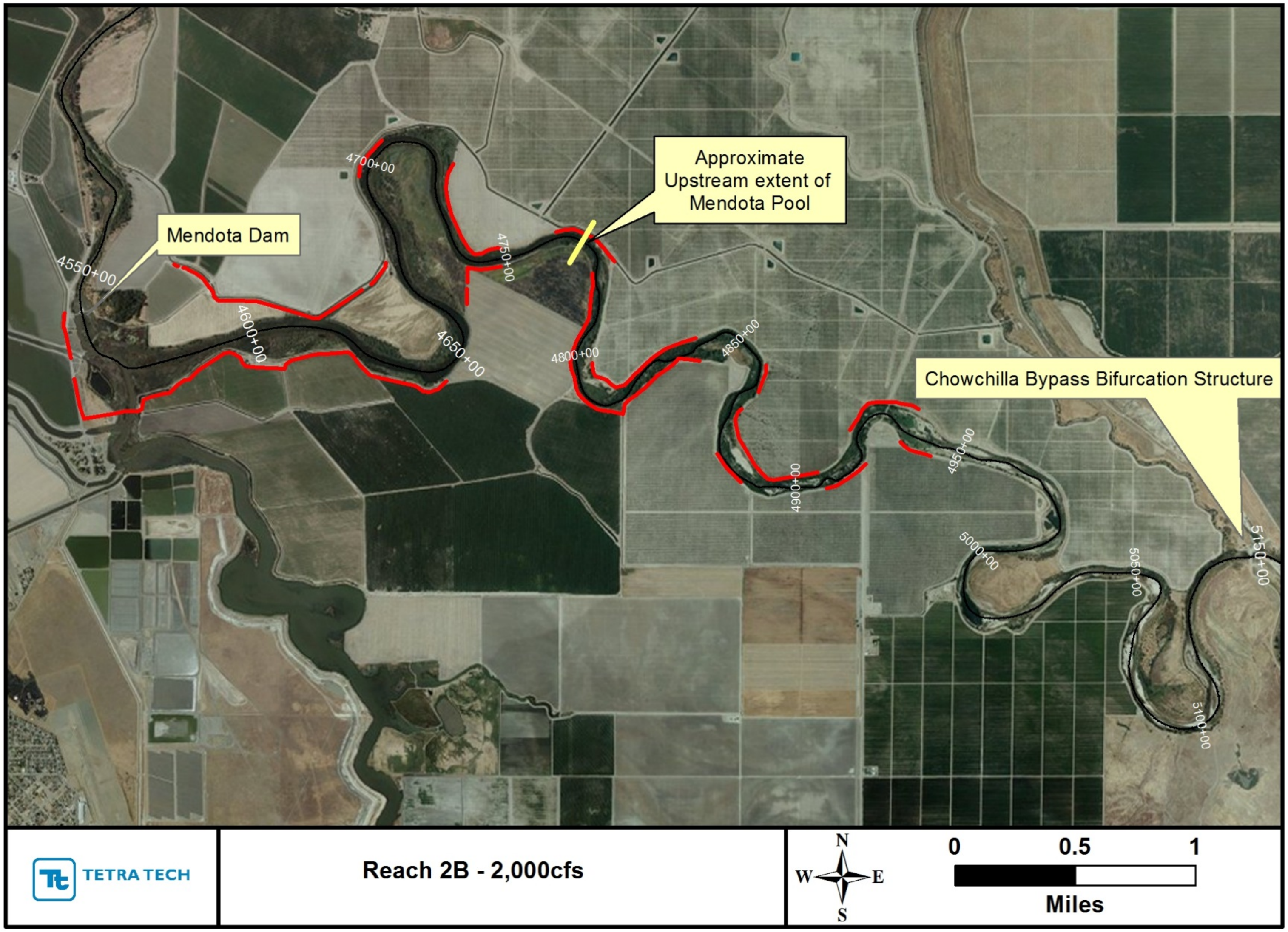

Figure 8. Portions of levee in Reach 2B where the 2,000-cfs water-surface elevation is above the outside ground elevation.

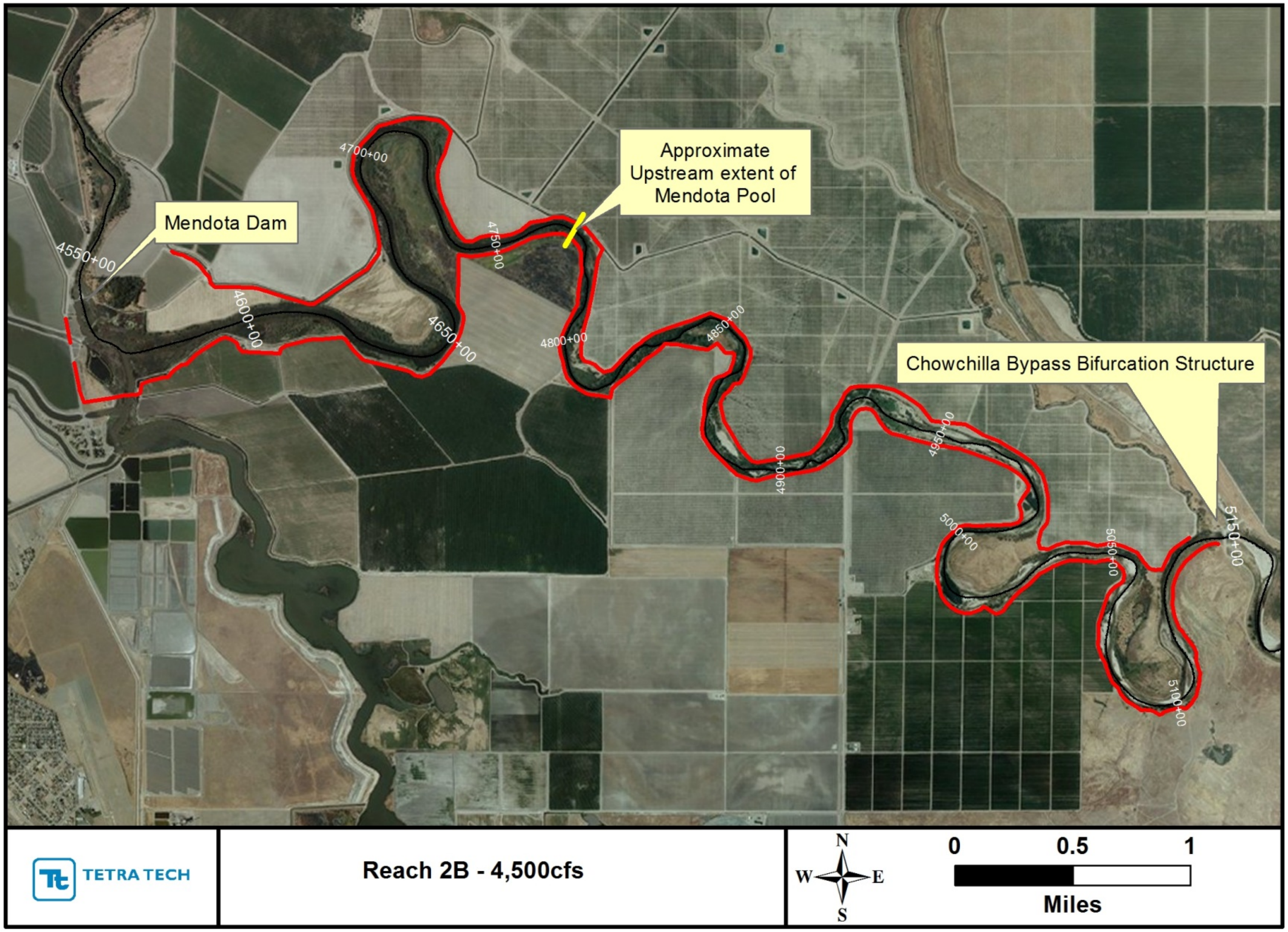

Figure 9. Portions of levee in Reach 2B where the 4,500-cfs water-surface elevation is above the outside ground elevation.

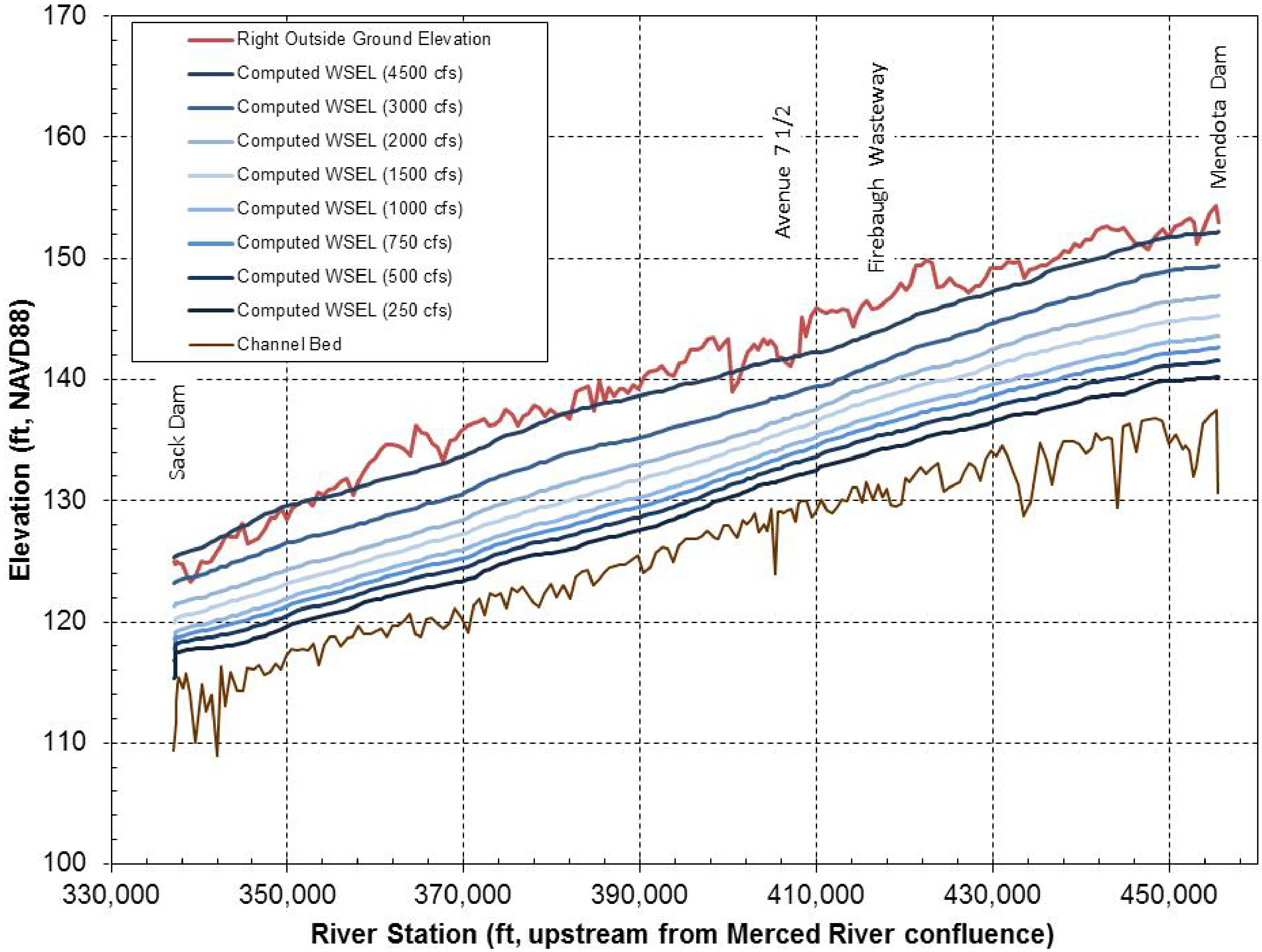

Figure 10. Comparison of outside ground elevation with computed water-surface elevations along right levee in Reach 3.

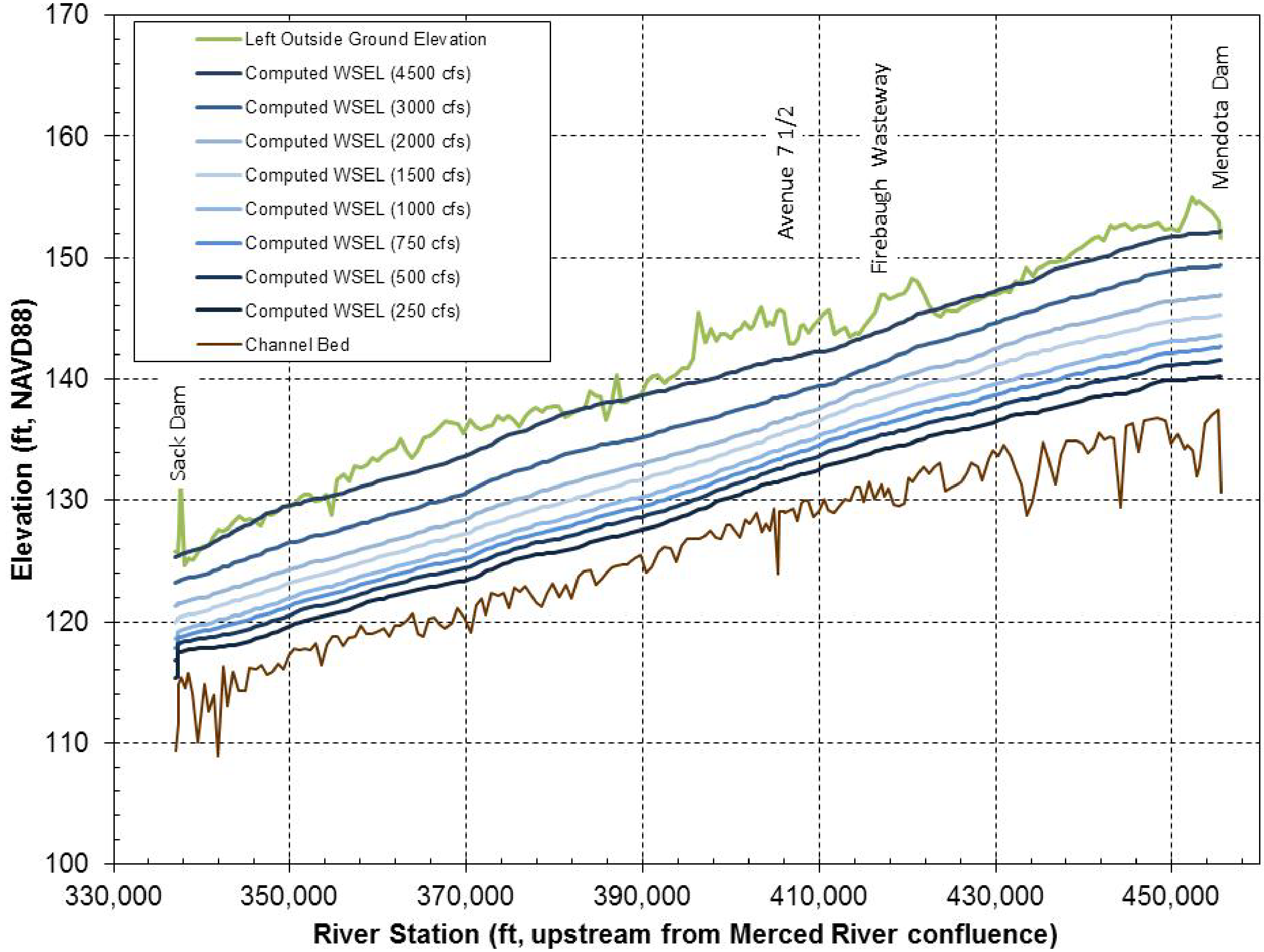

Figure 11. Comparison of outside ground elevation with computed water-surface elevations along left levee in Reach 3.

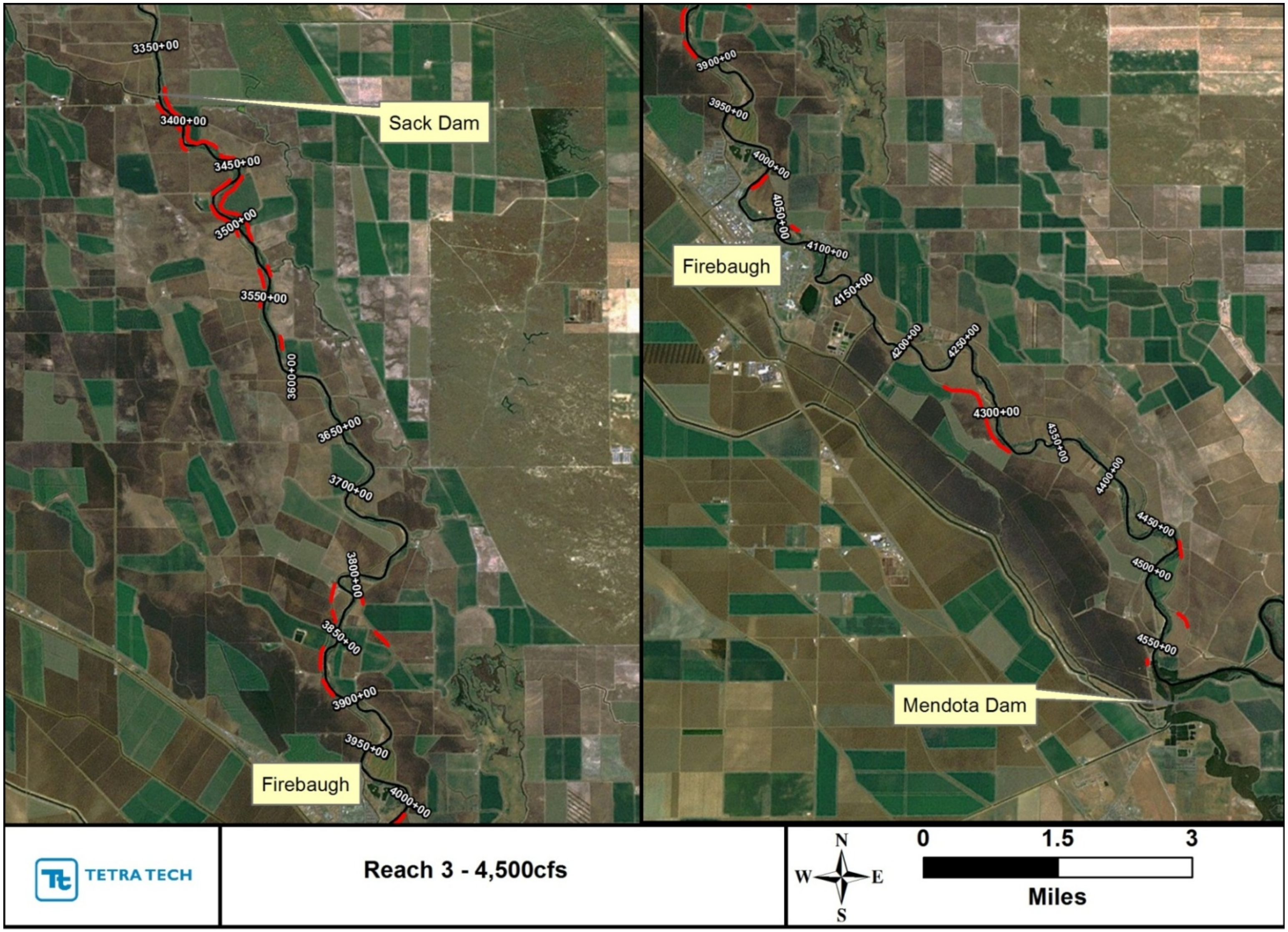

Figure 12. Portions of levee in Reach 3 where the 4,500-cfs water-surface elevation is above the existing outside ground elevation.

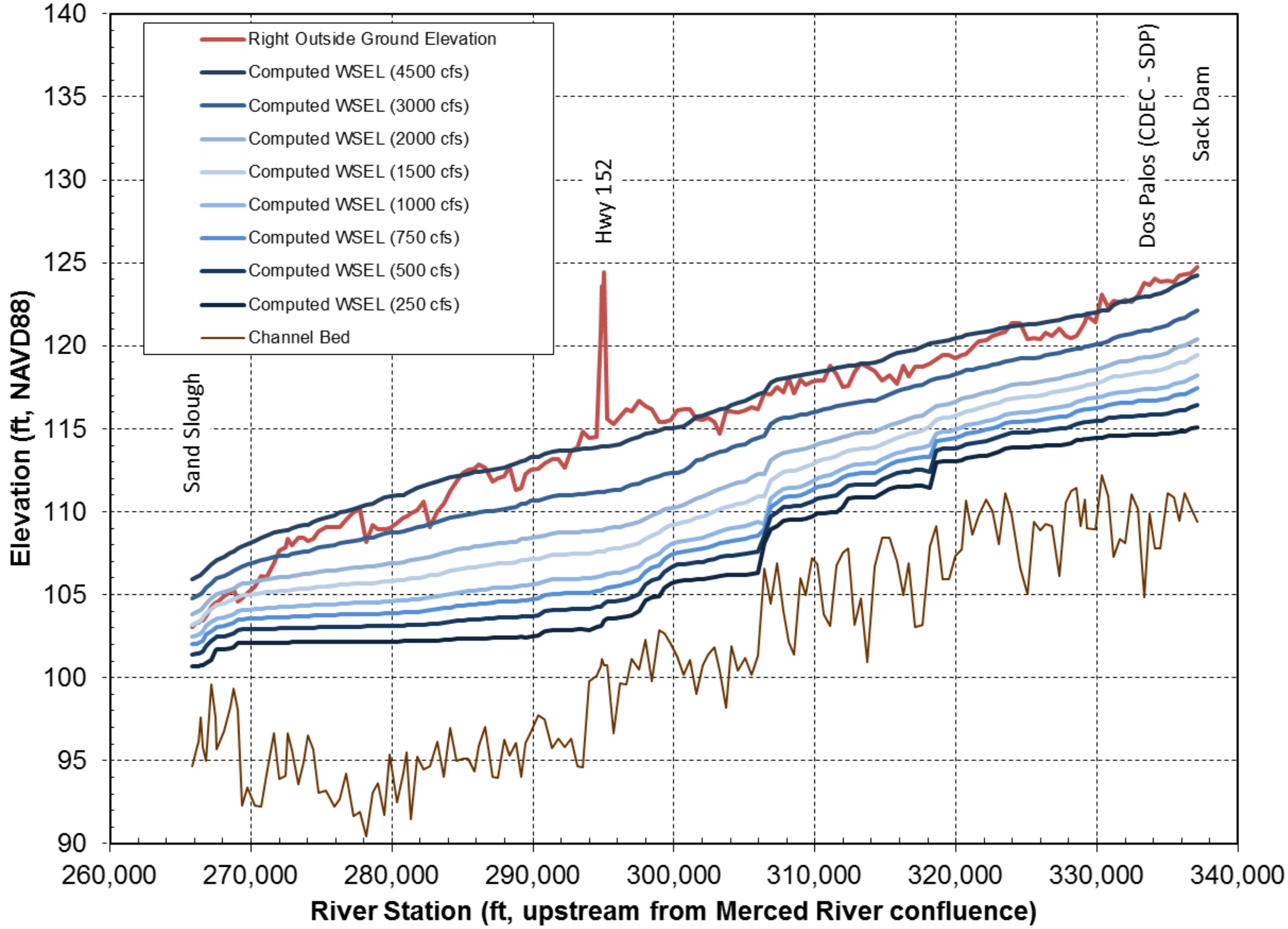

Figure 13. Comparison of outside ground elevation with computed water-surface elevations along right levee in Reach 4A.

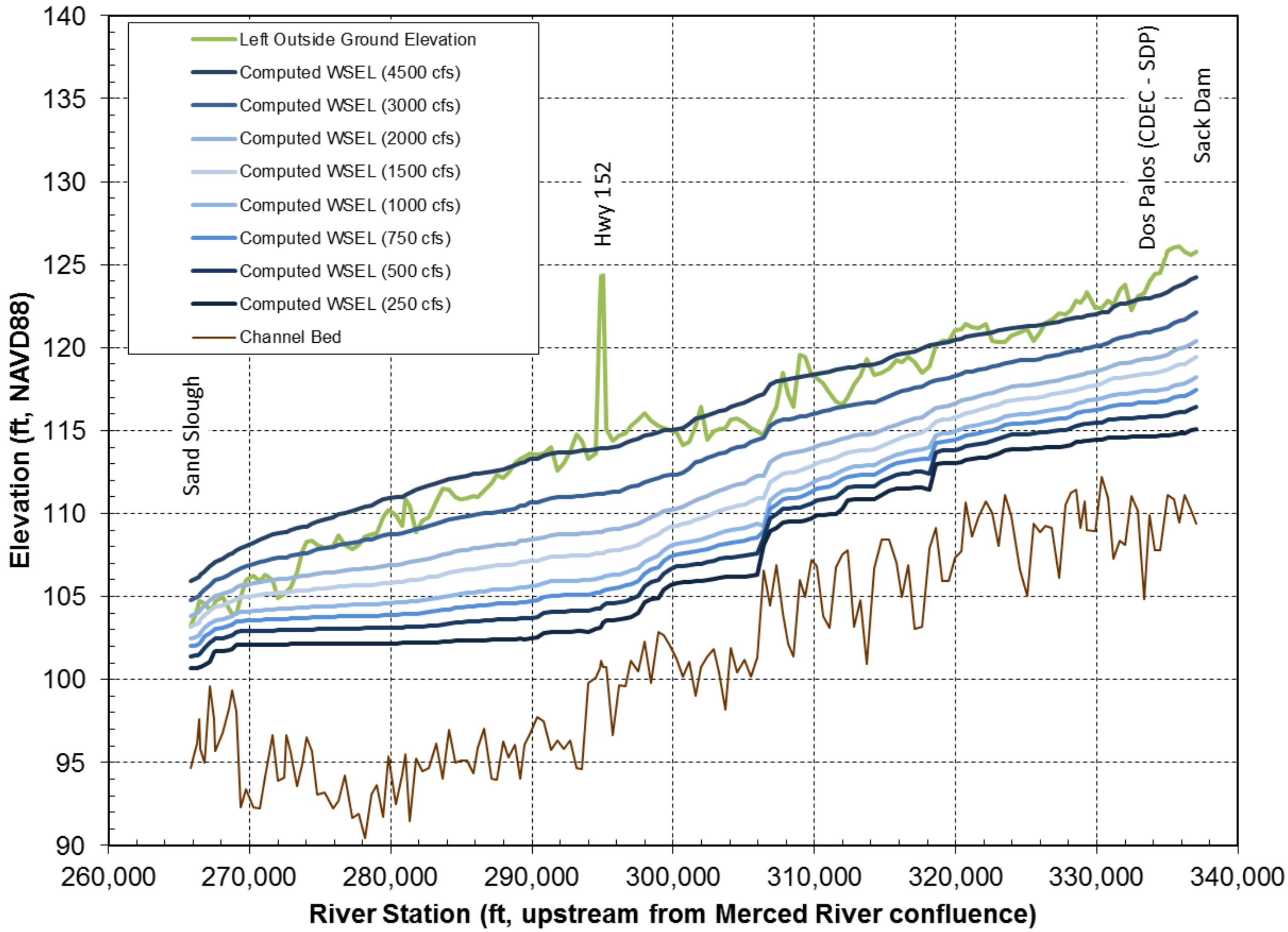

Figure 14. Comparison of outside ground elevation with computed water-surface elevations along left levee in Reach 4A.

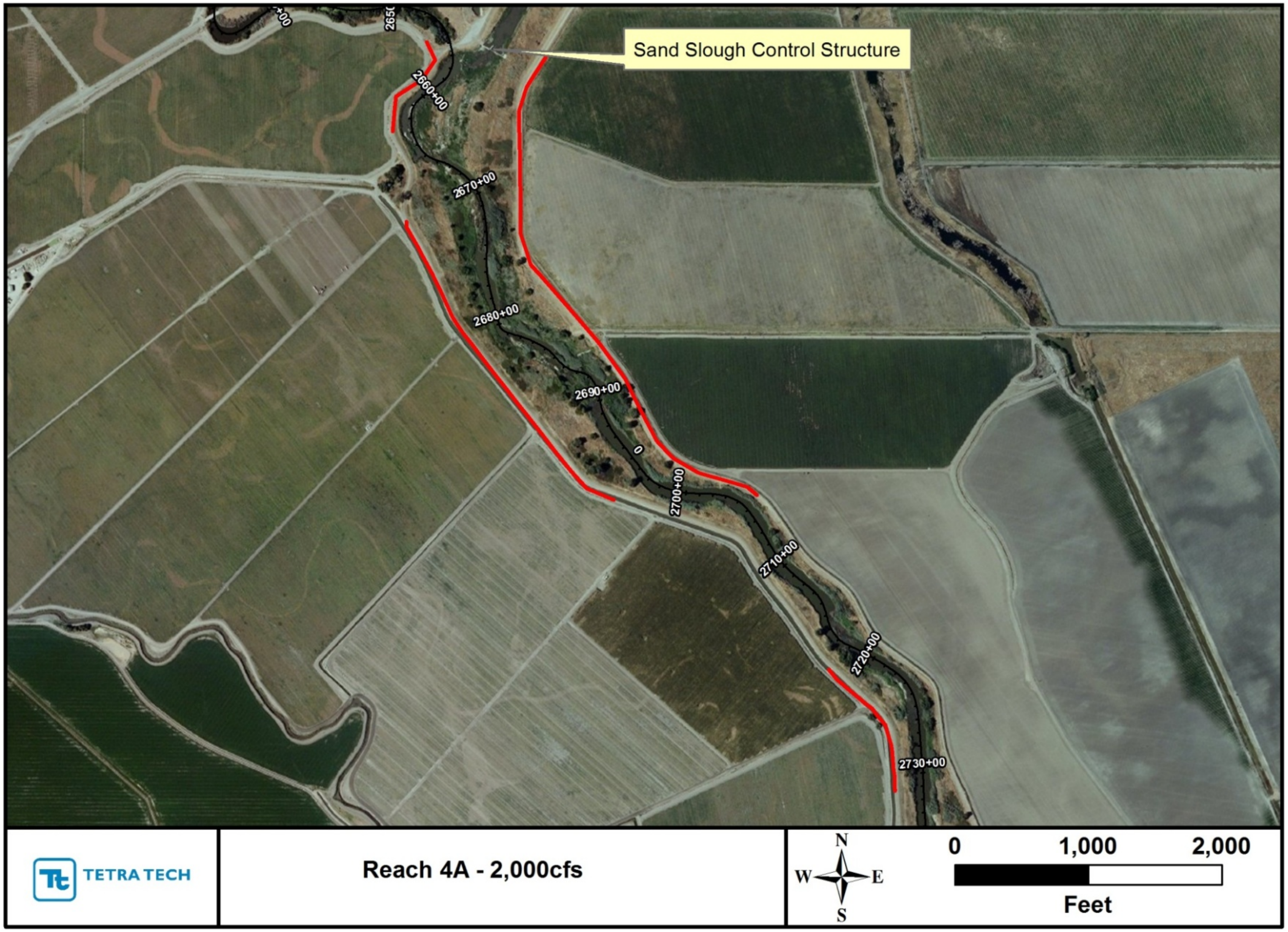

Figure 15. Portions of levee in Reach 4A where the 2,000-cfs water-surface elevation is above the existing outside ground elevation.

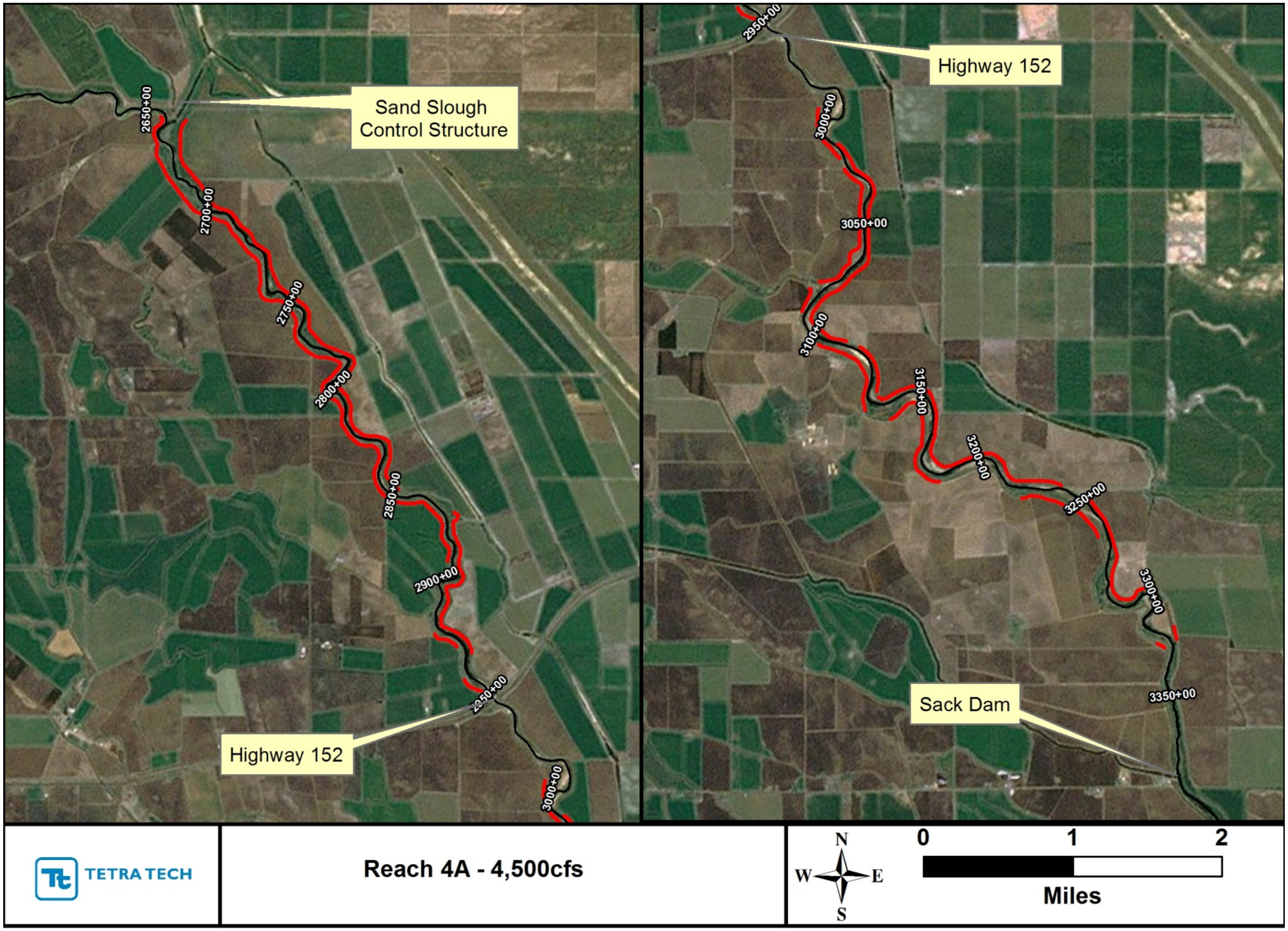

Figure 16. Portions of levee in Reach 4A where the 4,500-cfs water-surface elevation is above the existing outside ground elevation.

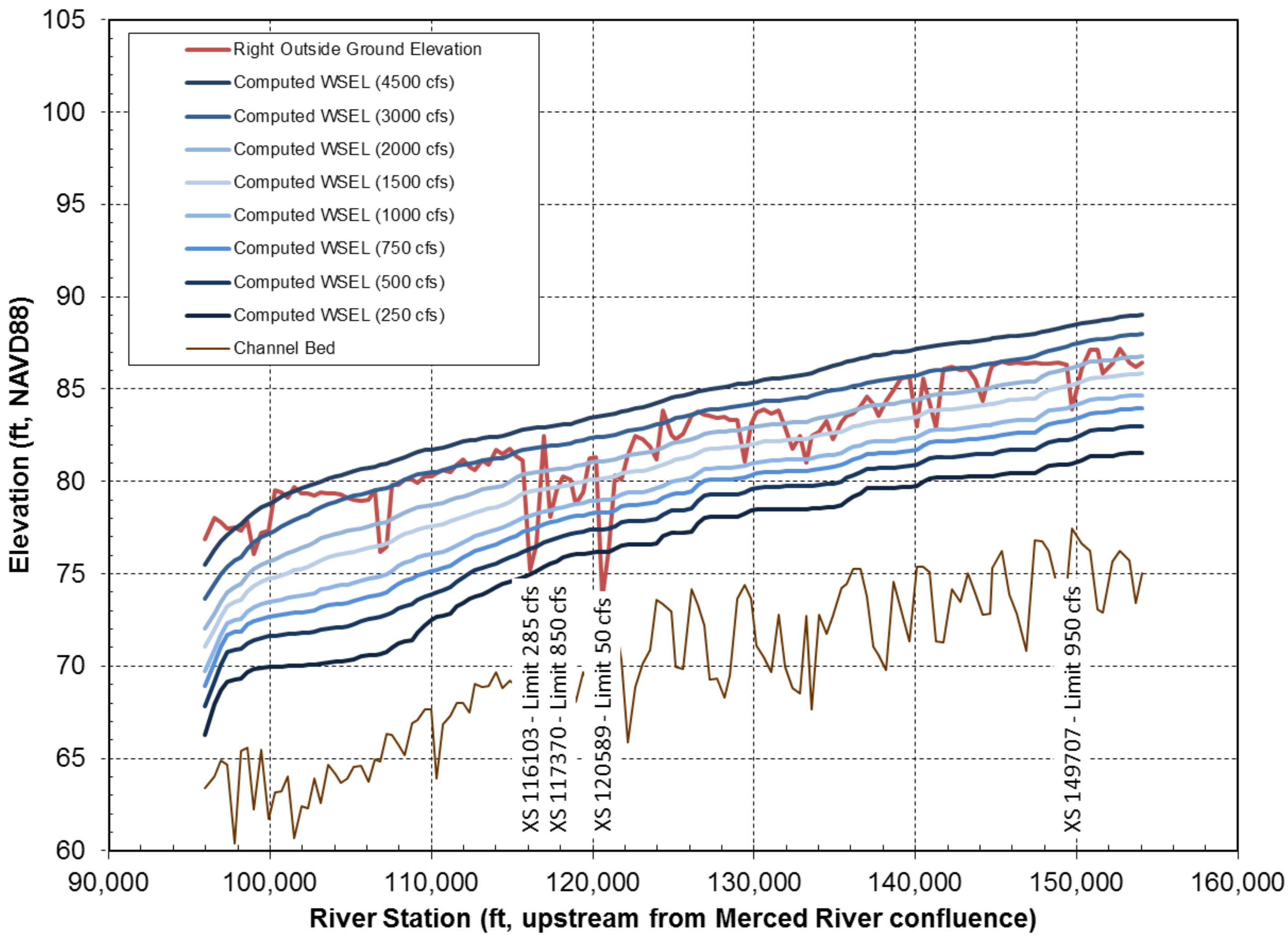

Figure 17. Comparison of outside ground elevation with computed water-surface elevations along right levee in Reach 4B2.

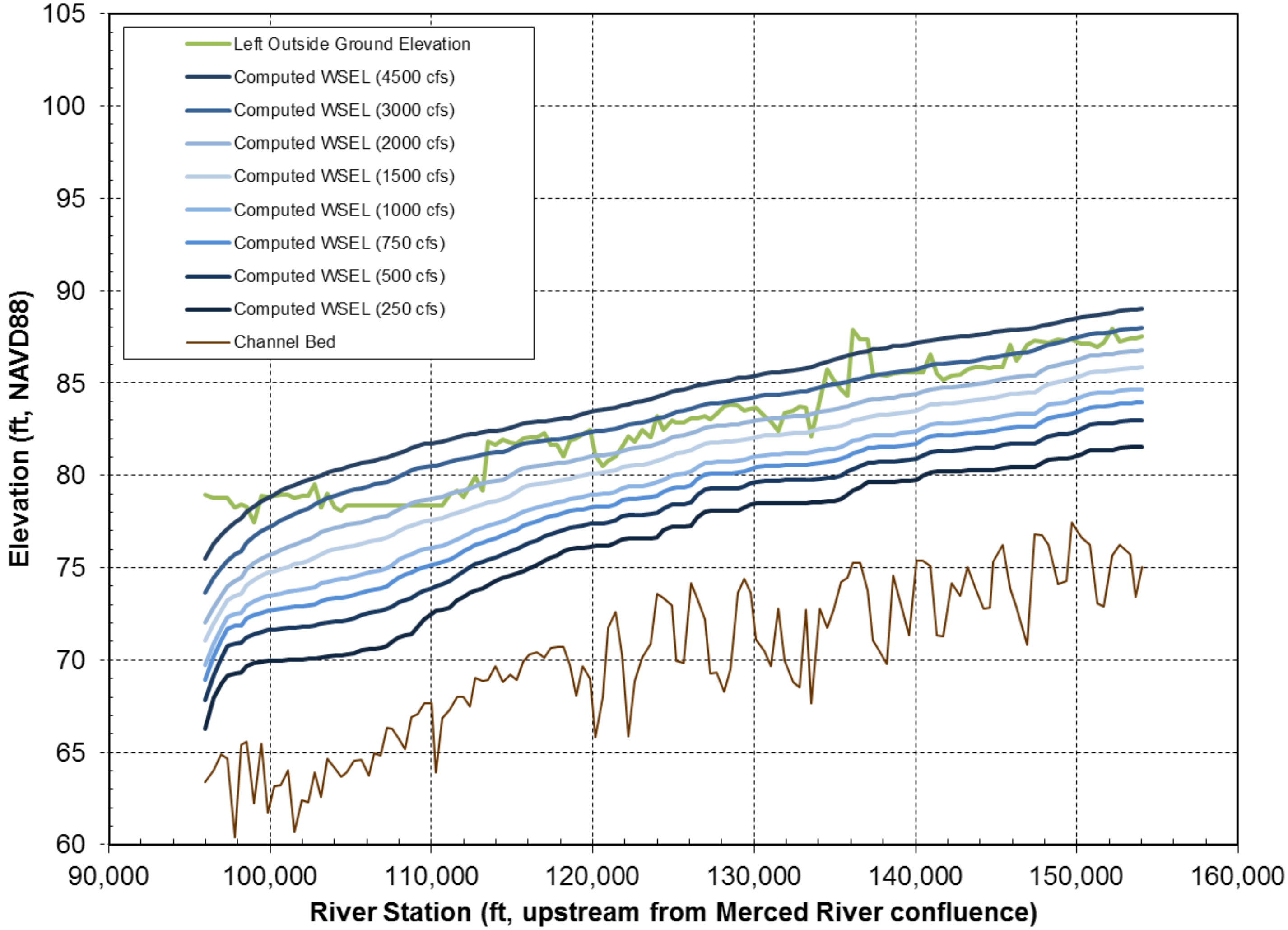

Figure 18. Comparison of outside ground elevation with computed water-surface elevations along left levee in Reach 4B2.

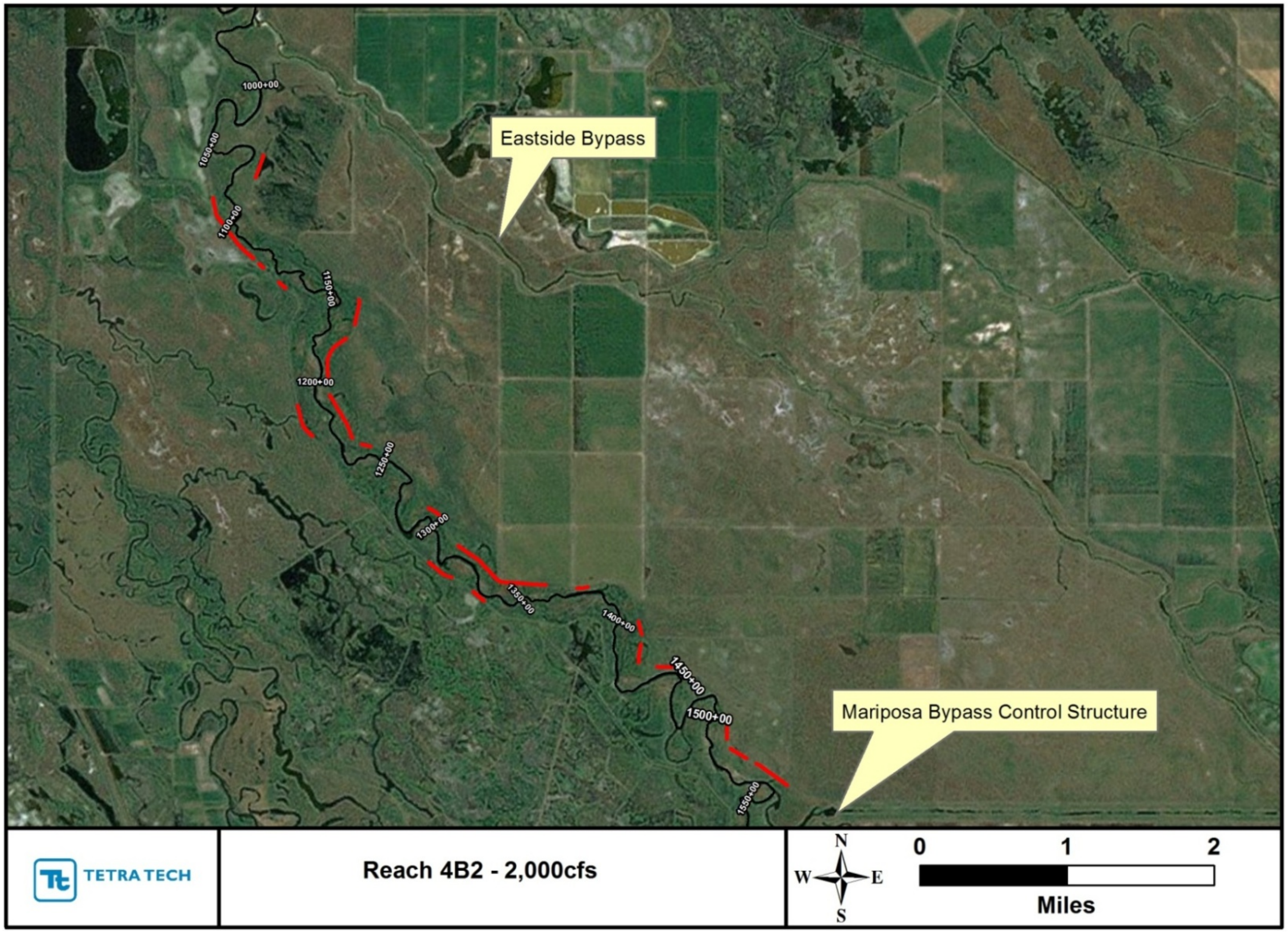

Figure 19. Portions of levee in Reach 4B2 where the 2,000-cfs water-surface elevation is above the existing outside ground elevation.

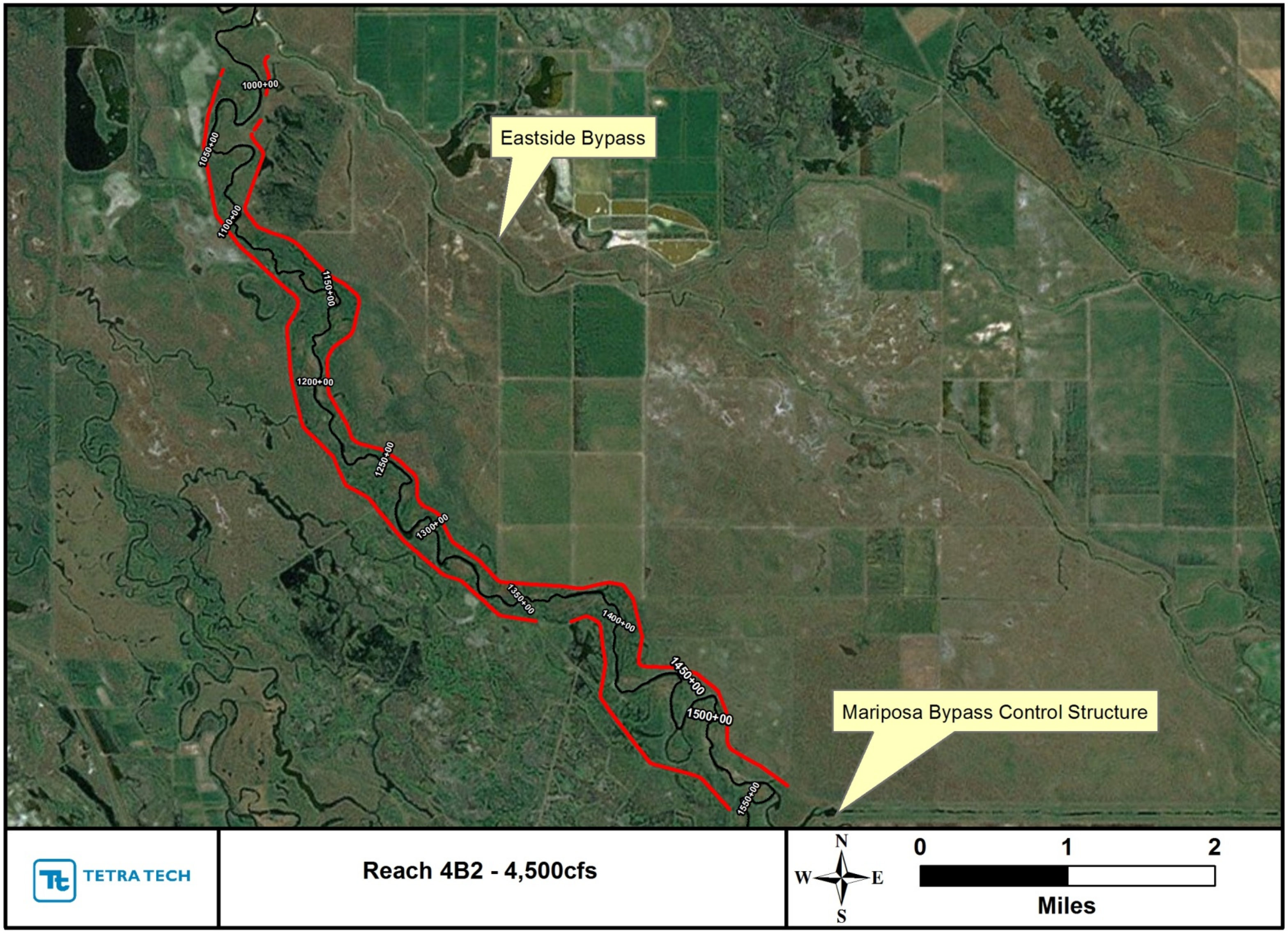

Figure 20. Portions of levee in Reach 4B2 where the 4,500-cfs water-surface elevation is above the existing outside ground elevation.

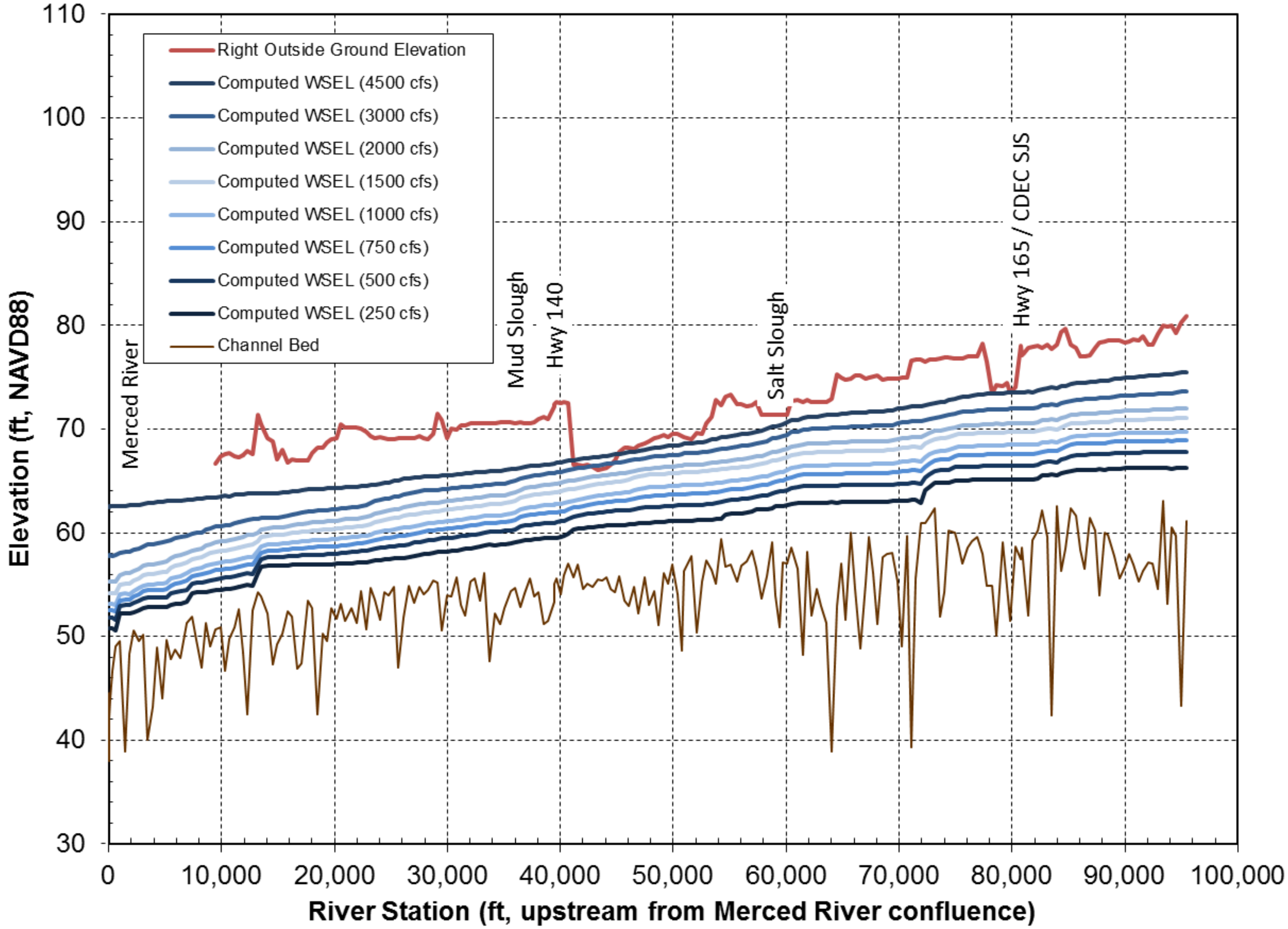

Figure 21. Comparison of outside ground elevation with computed water-surface elevations along right levee in Reach 5.

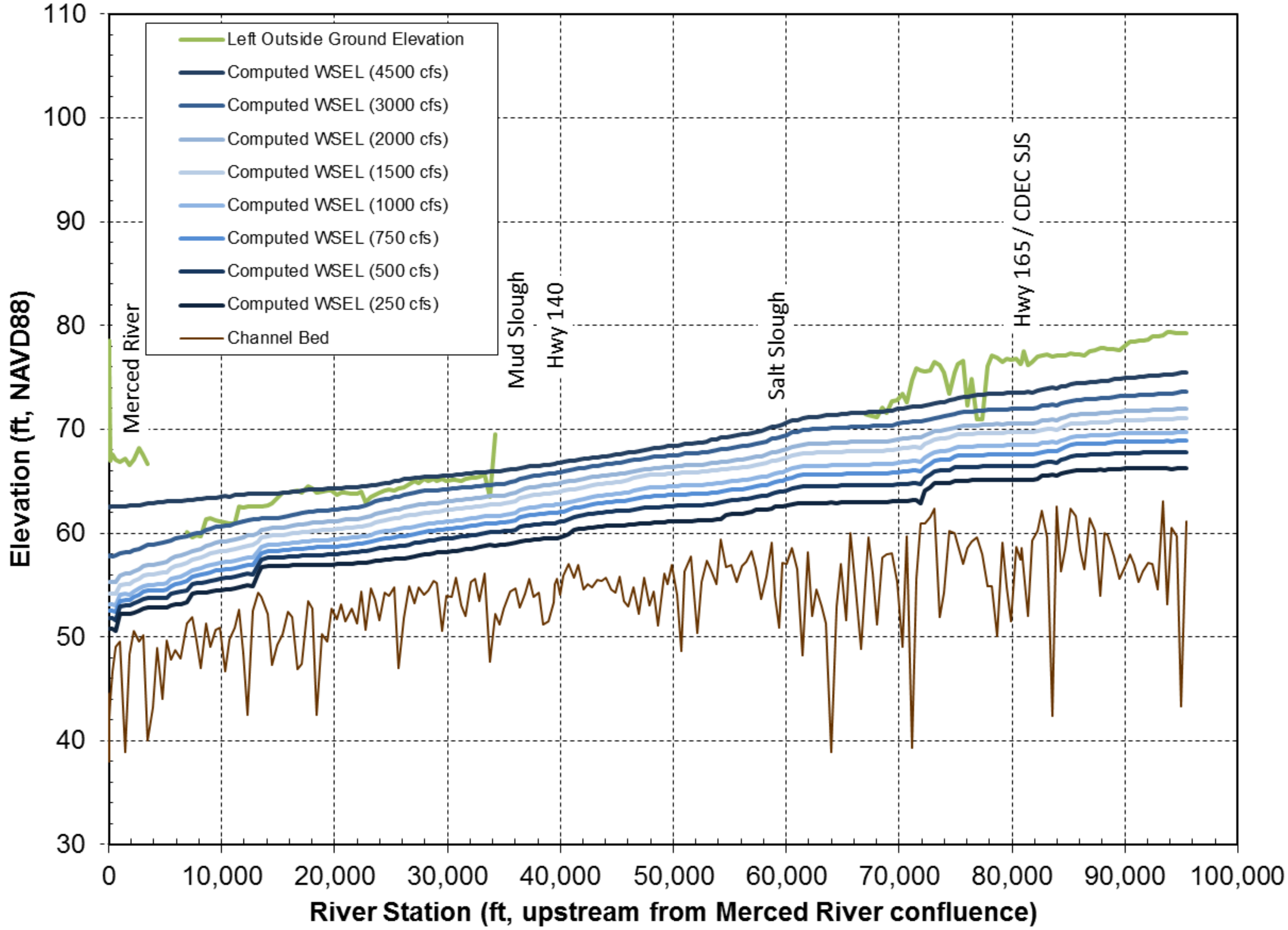

Figure 22. Comparison of outside ground elevation with computed water-surface elevations along left levee in Reach 5.

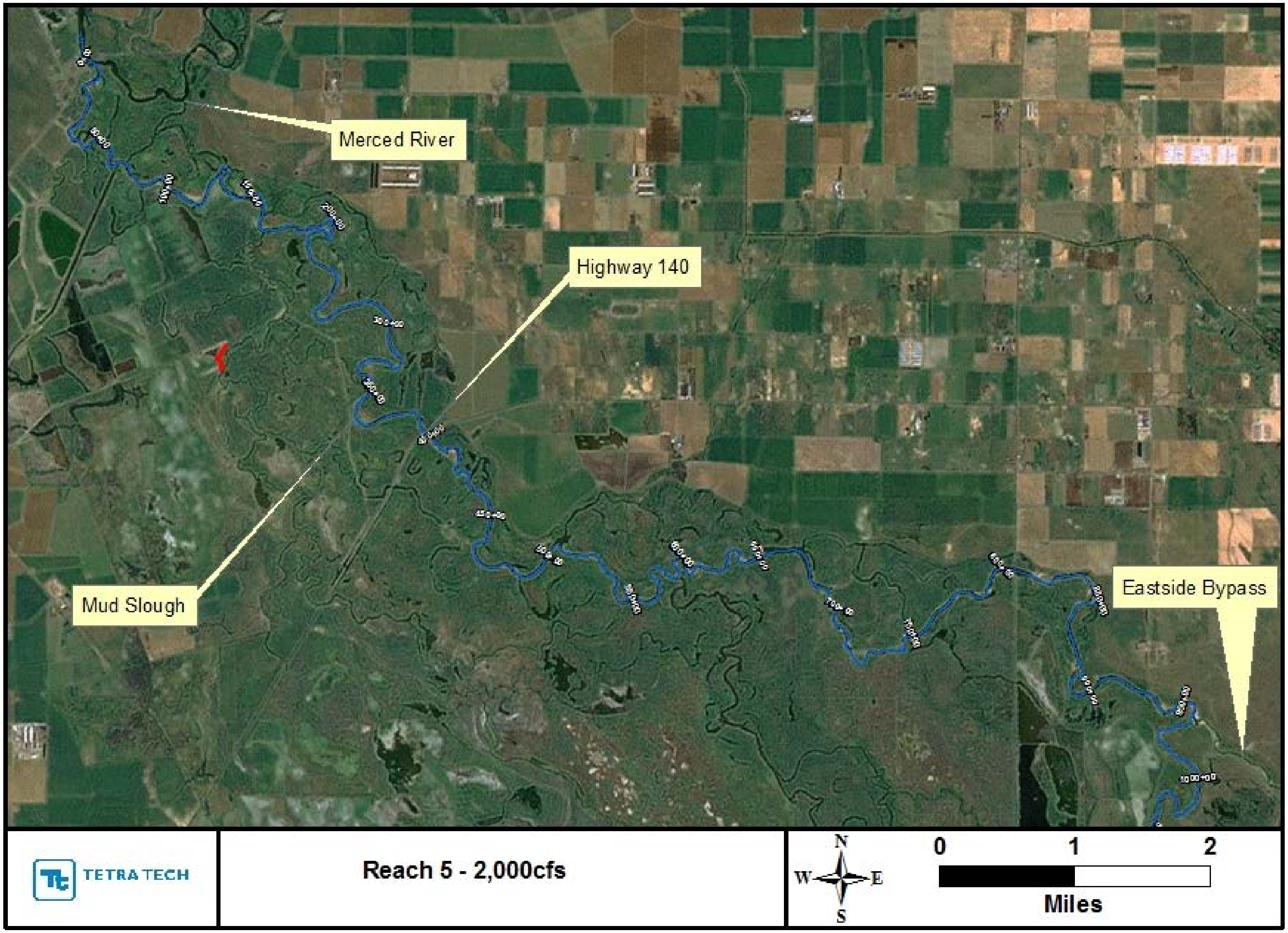

Figure 23. Portions of levee in Reach 5 where the 2,000-cfs water-surface elevation is above the existing outside ground elevation.

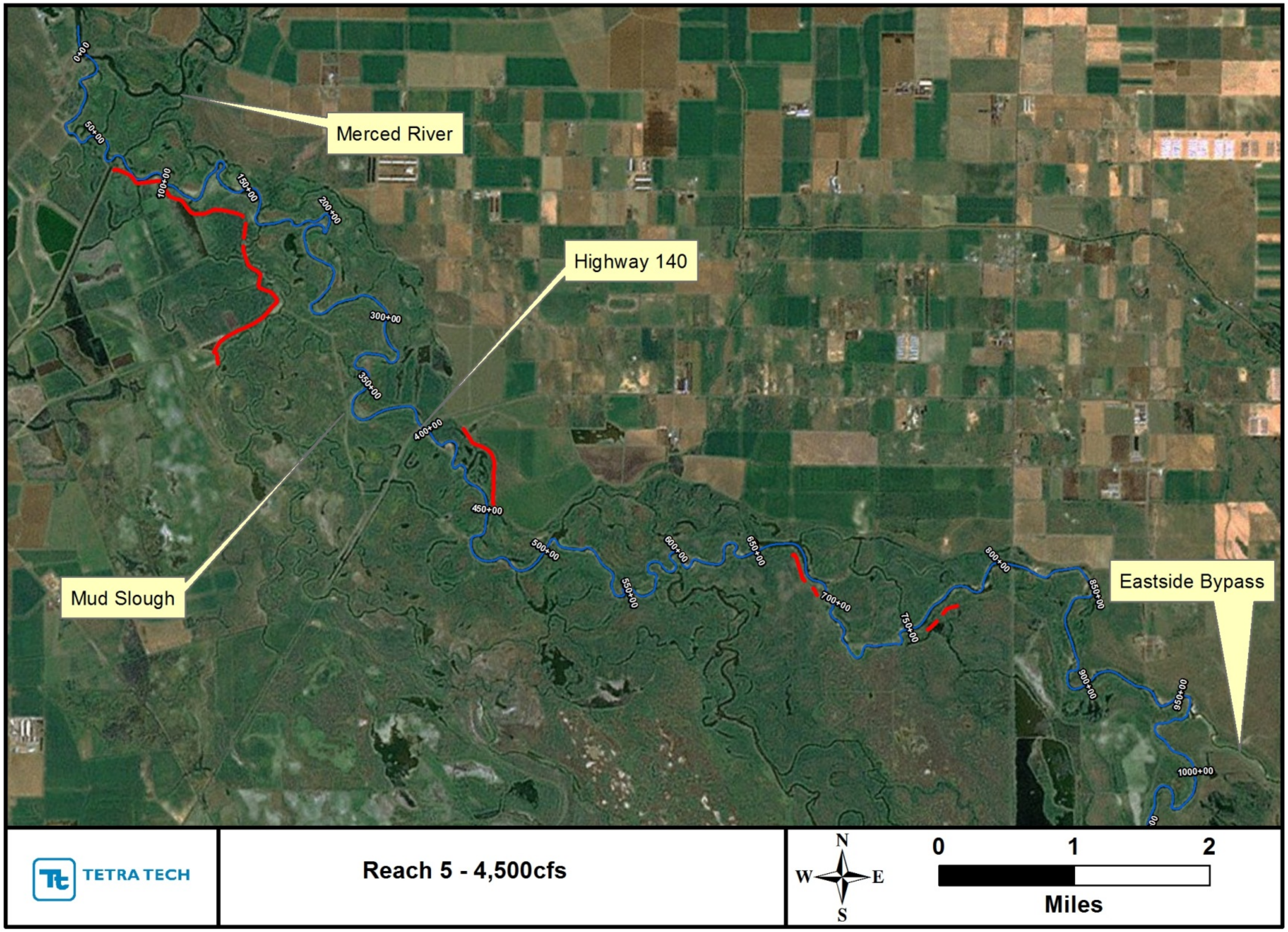

Figure 24. Portions of levee in Reach 5 where the 4,500-cfs water-surface elevation is above the existing outside ground elevation.

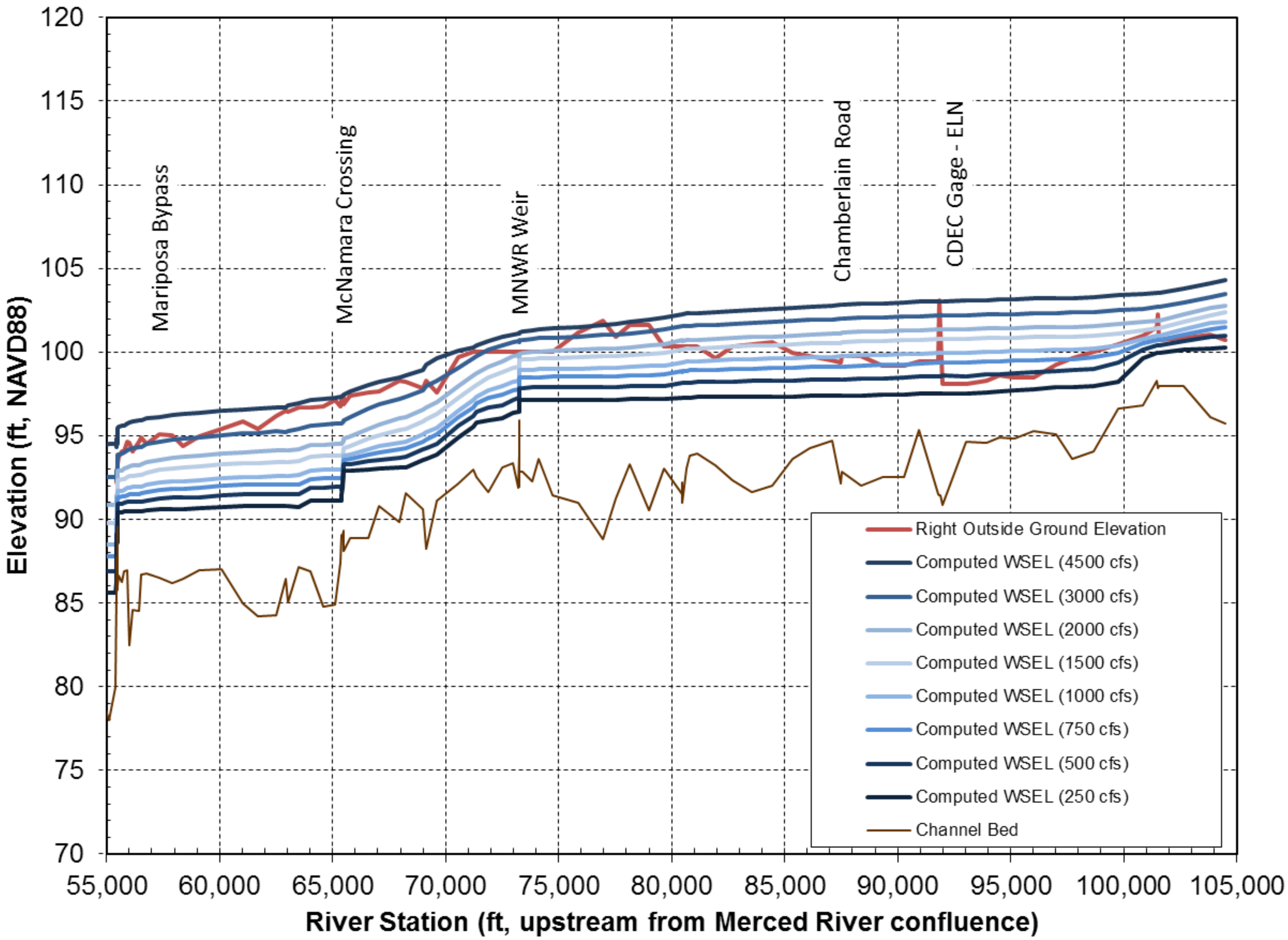

Figure 25. Comparison of outside ground elevation with computed water-surface elevations along right levee in Middle Eastside Bypass.

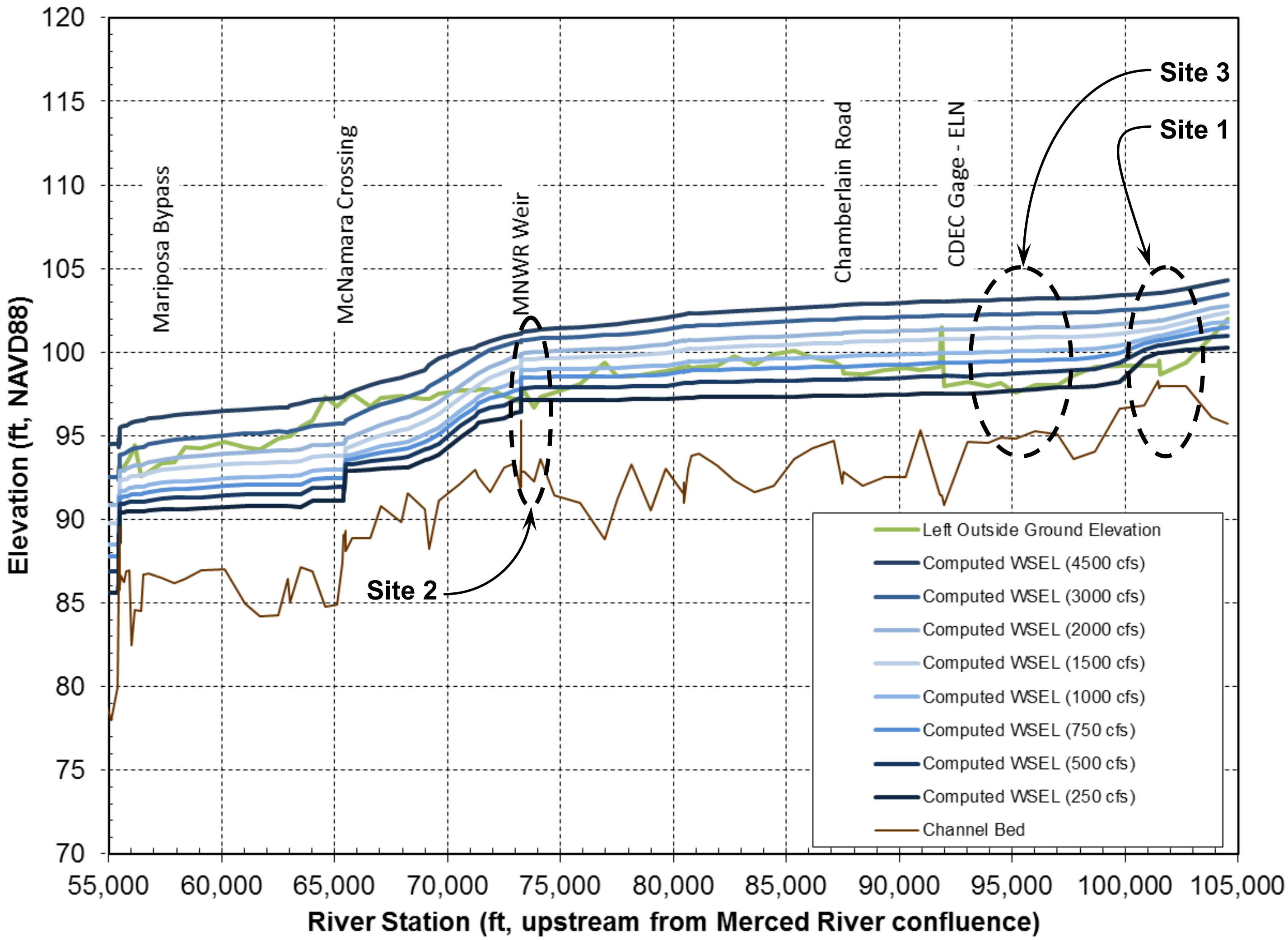

Figure 26. Comparison of outside ground elevation with computed water-surface elevations along left levee in Middle Eastside Bypass as well as identification of the three critical sites along the left levee.

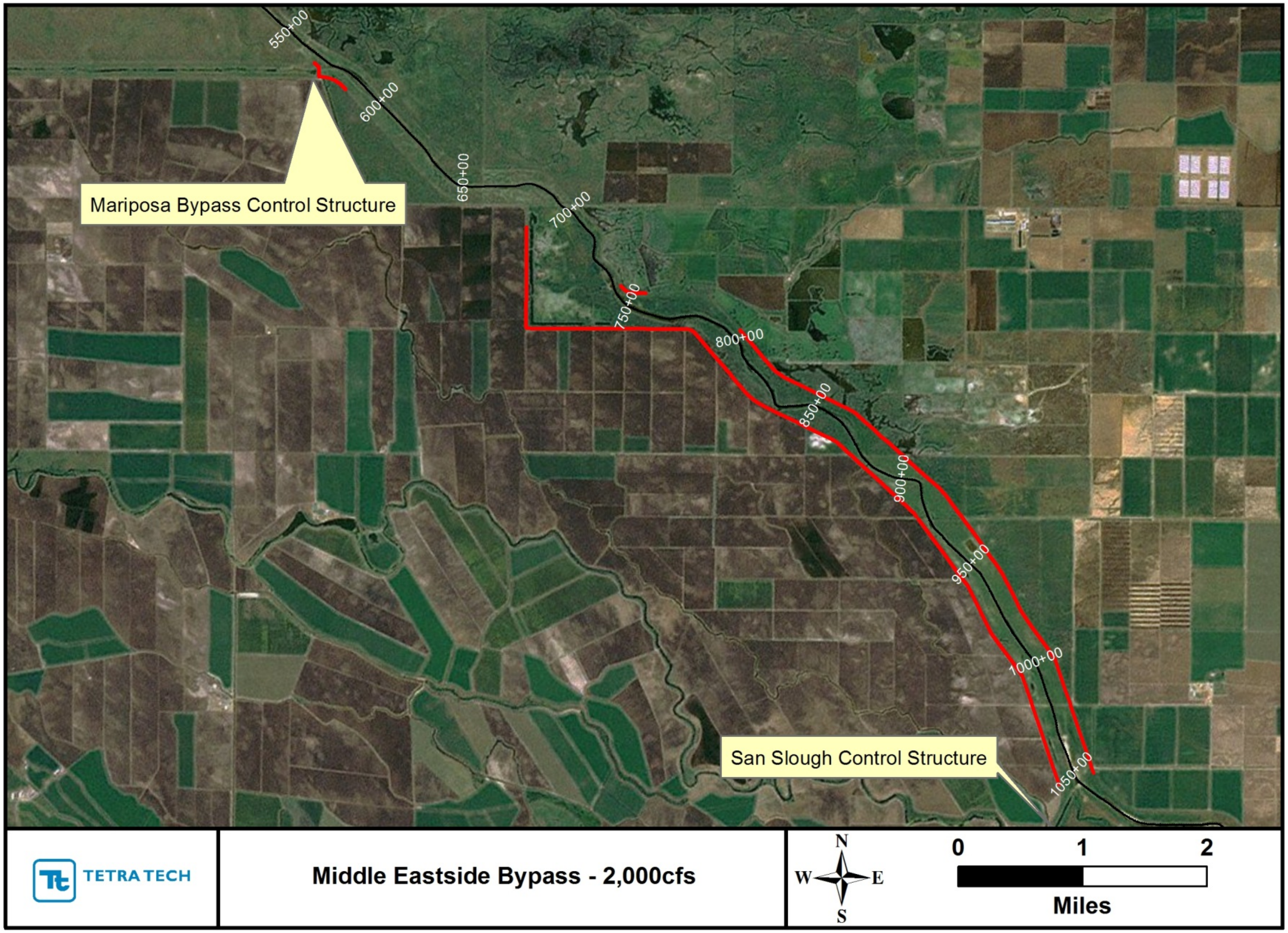

Figure 27. Portions of levee in the Middle Eastside Bypass where the 2,000-cfs water-surface elevation is above the existing outside ground elevation.

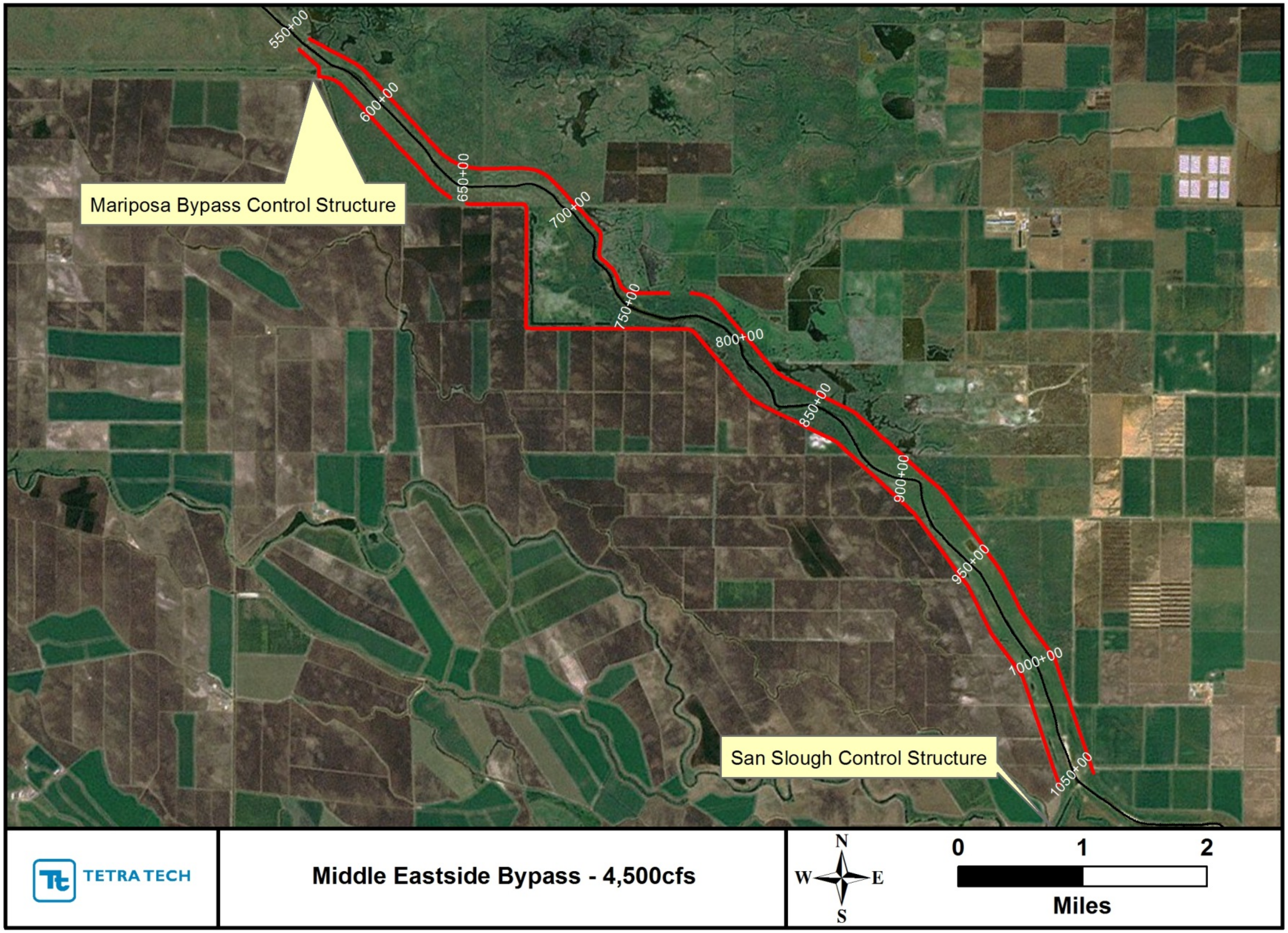

Figure 28. Portions of levee in the Middle Eastside Bypass where the 4,500-cfs water-surface elevation is above the existing outside ground elevation.

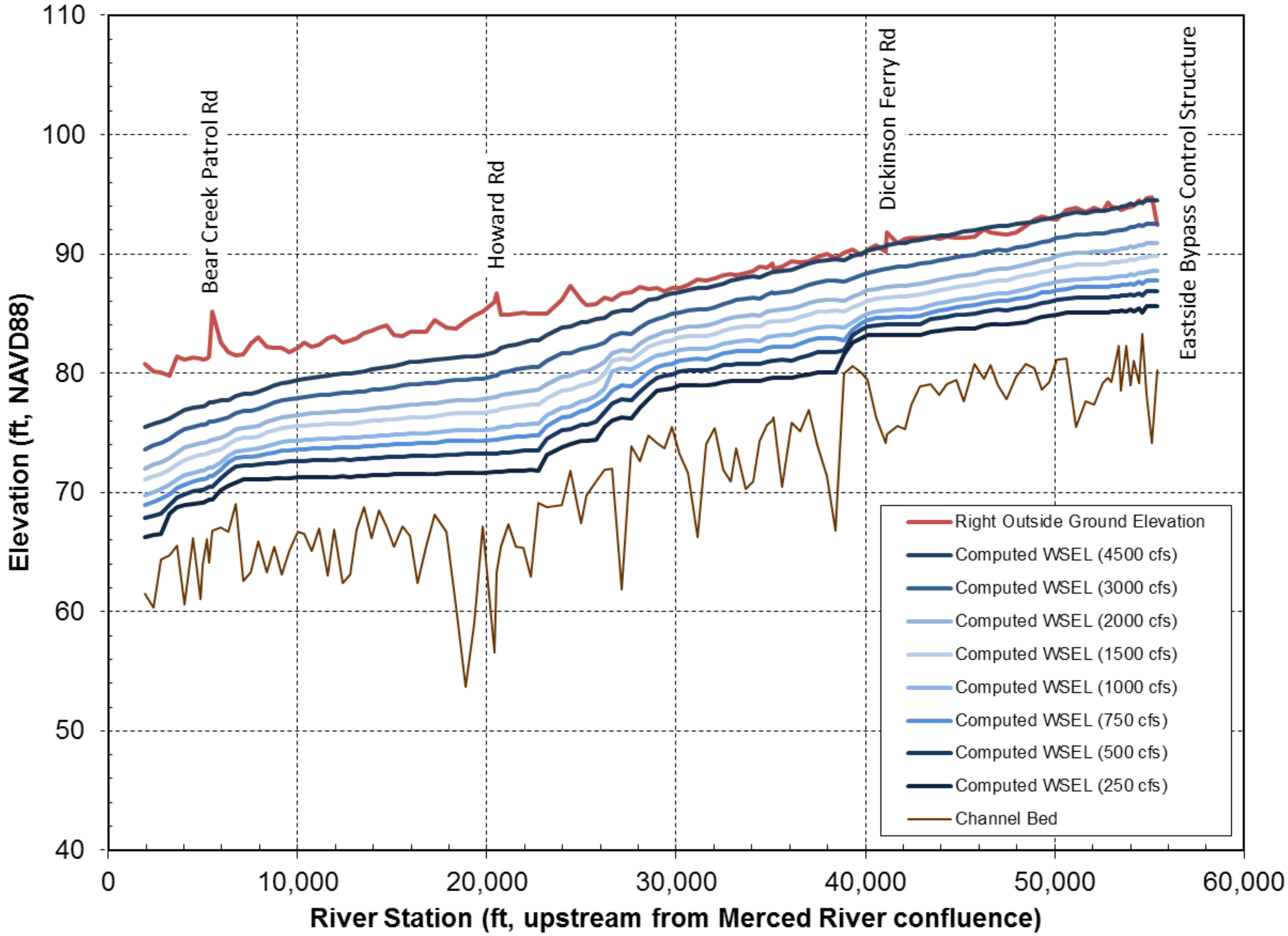

Figure 29. Comparison of outside ground elevations with computed water-surface elevations along right levee in Lower Eastside Bypass.

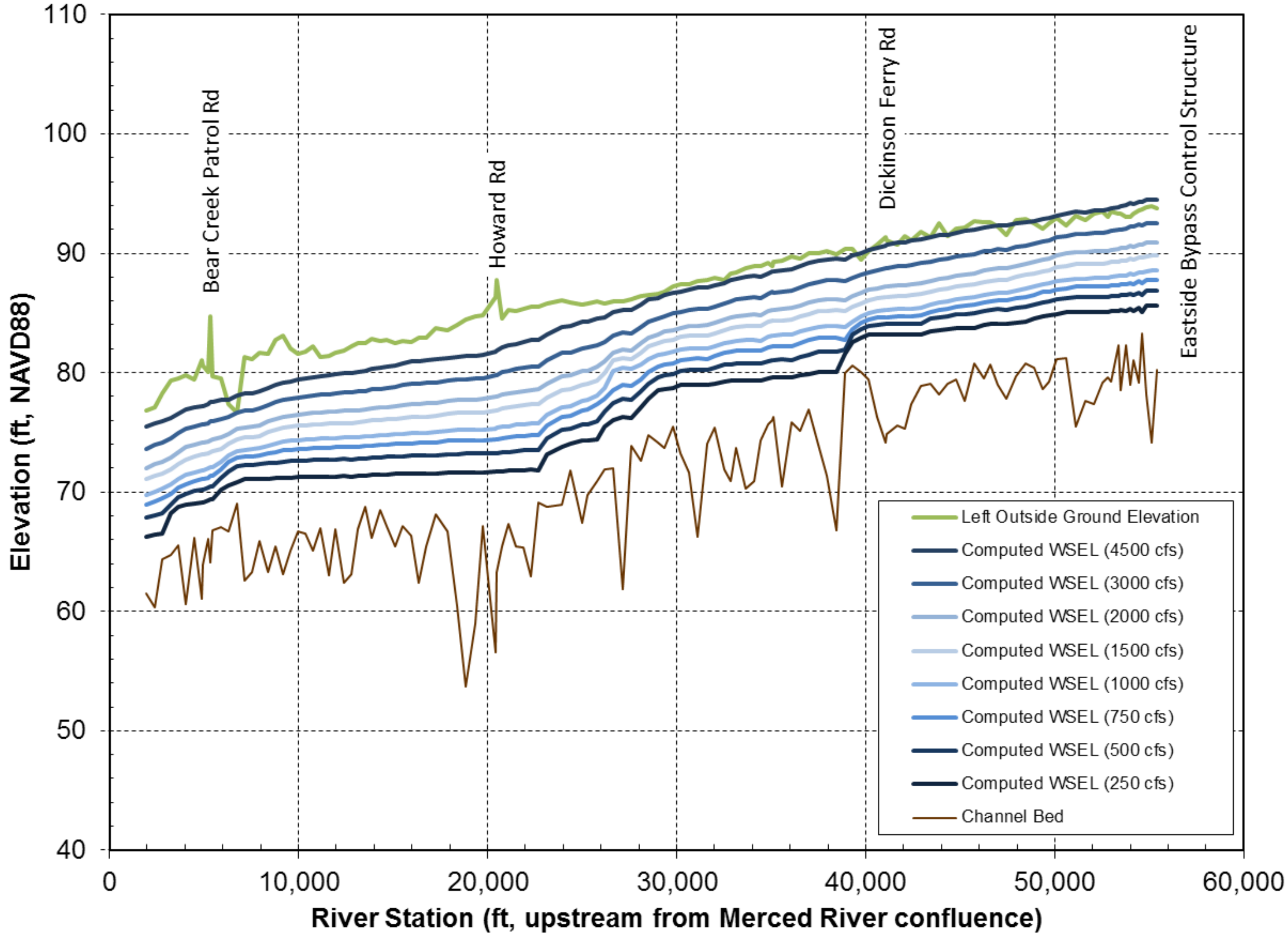

Figure 30. Comparison of outside ground elevations with computed water-surface elevations along left levee in Lower Eastside Bypass.

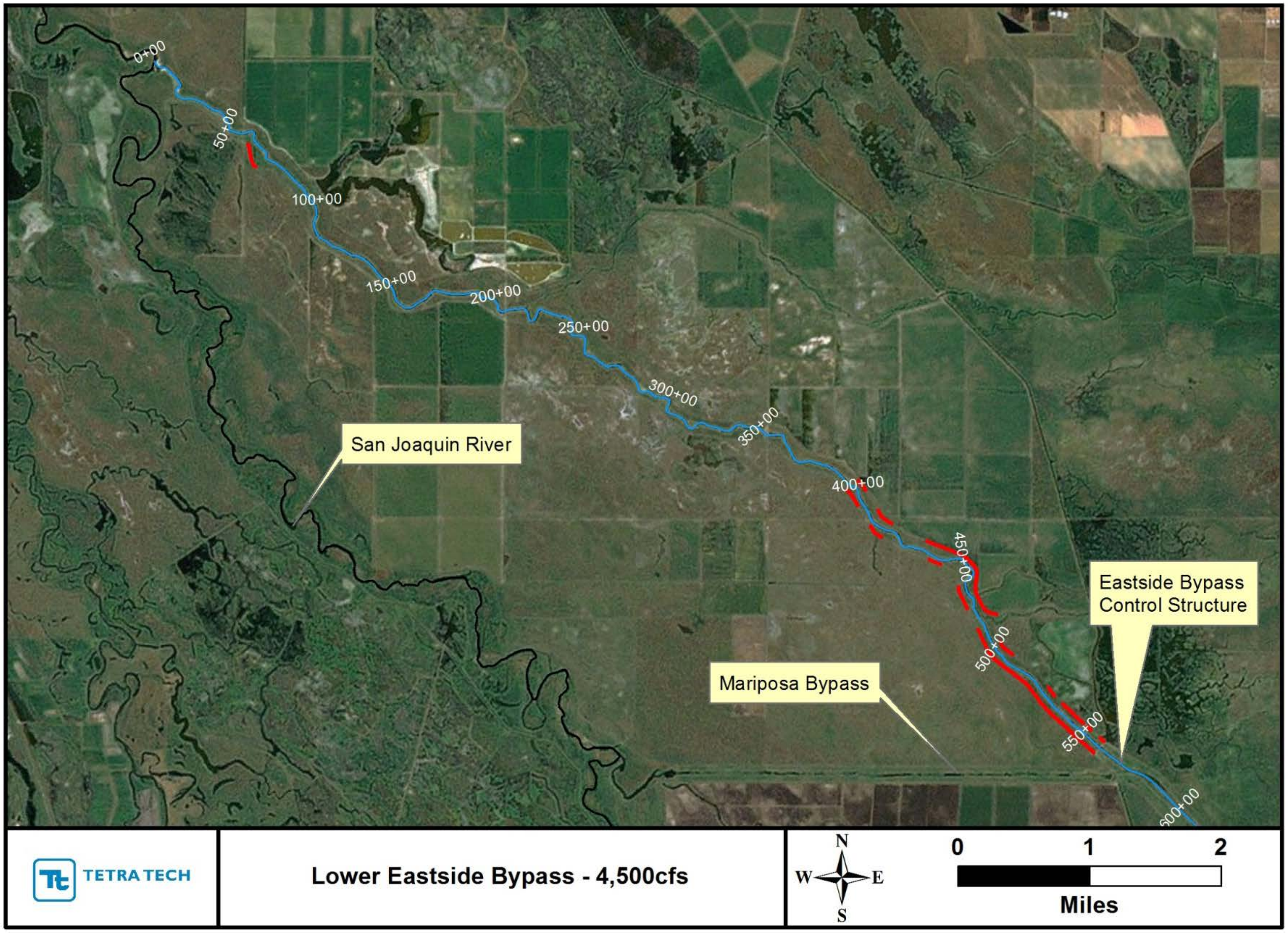

Figure 31. Portions of levee in the Lower Eastside Bypass where the 4,500-cfs water-surface elevation is above the existing outside ground elevation.

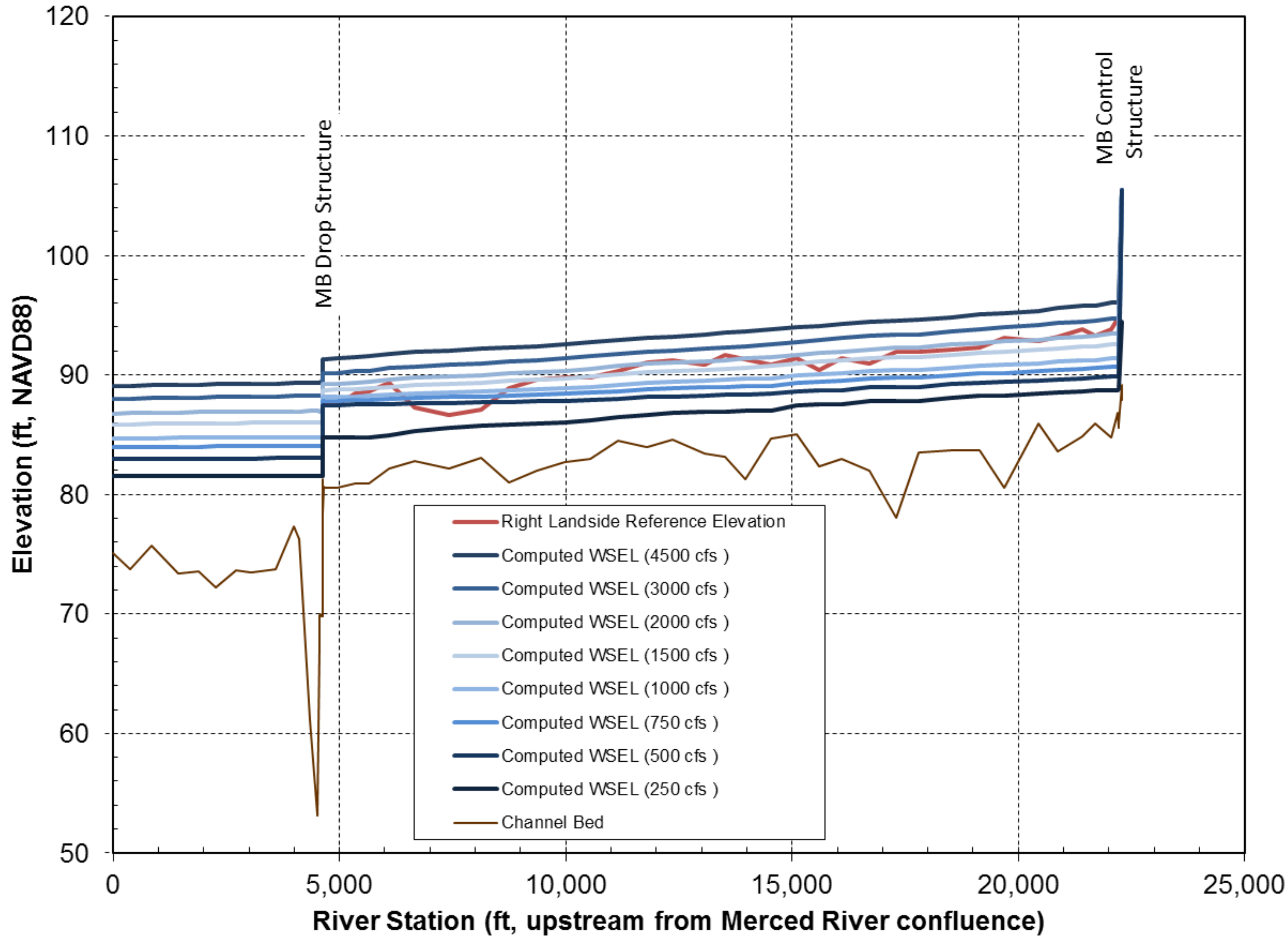

Figure 32. Comparison of outside ground elevation with computed water-surface elevations along right levee in Mariposa Bypass.

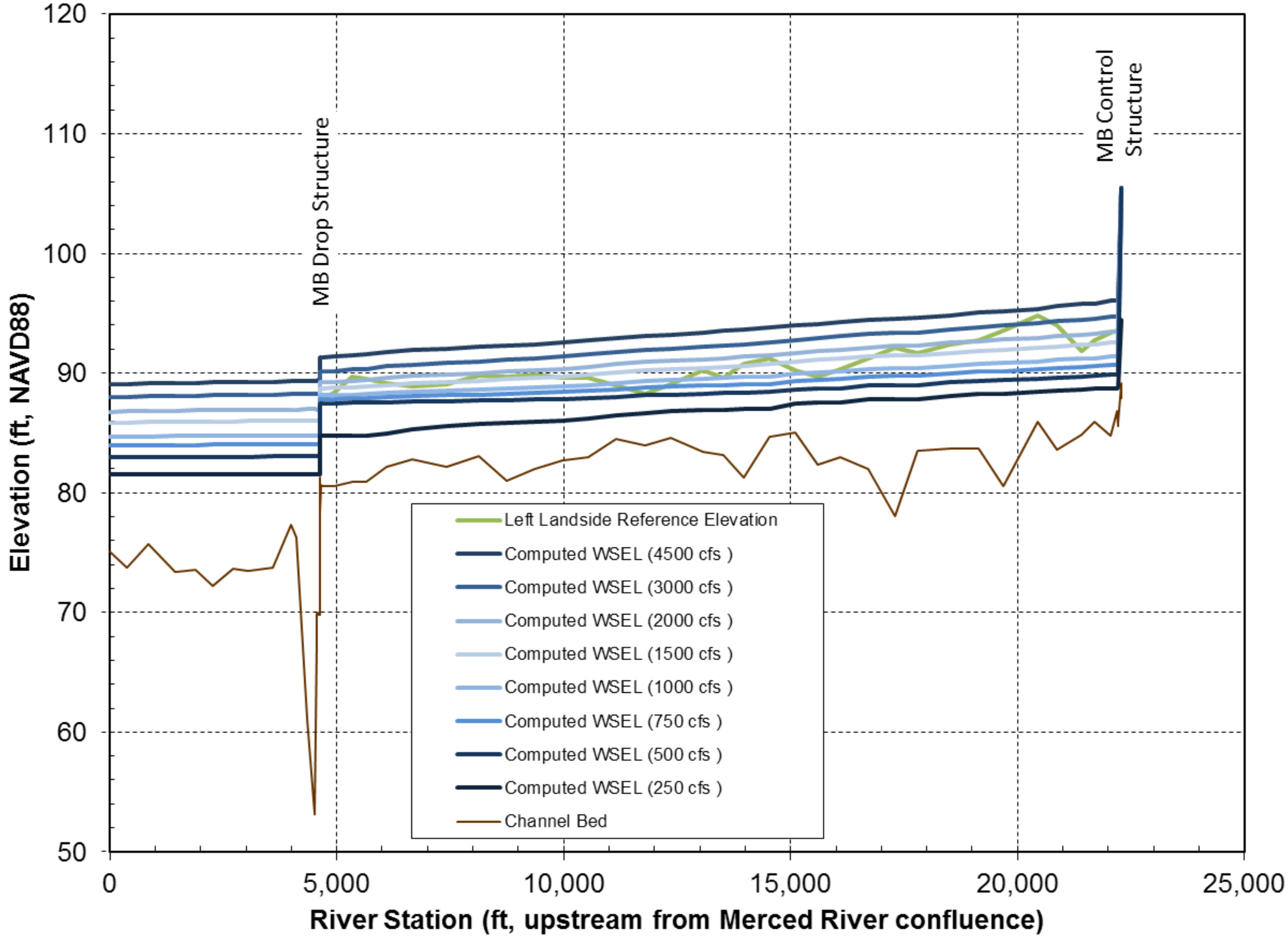

Figure 33. Comparison of outside ground elevation with computed water-surface elevations along left levee in Mariposa Bypass.

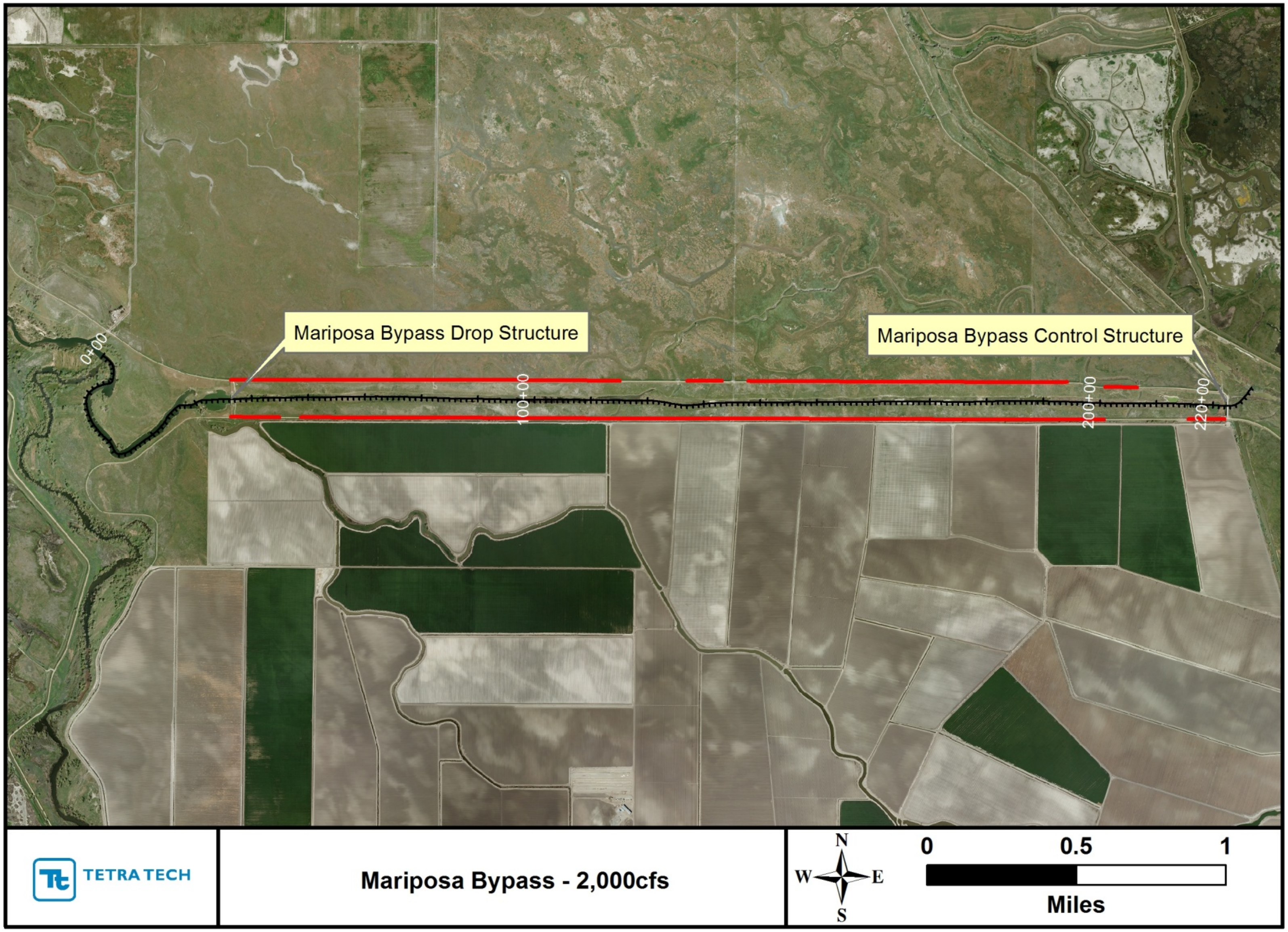

Figure 34. Portions of levee in the Mariposa Bypass where the 2,000-cfs water-surface elevation is above the existing outside ground elevation.

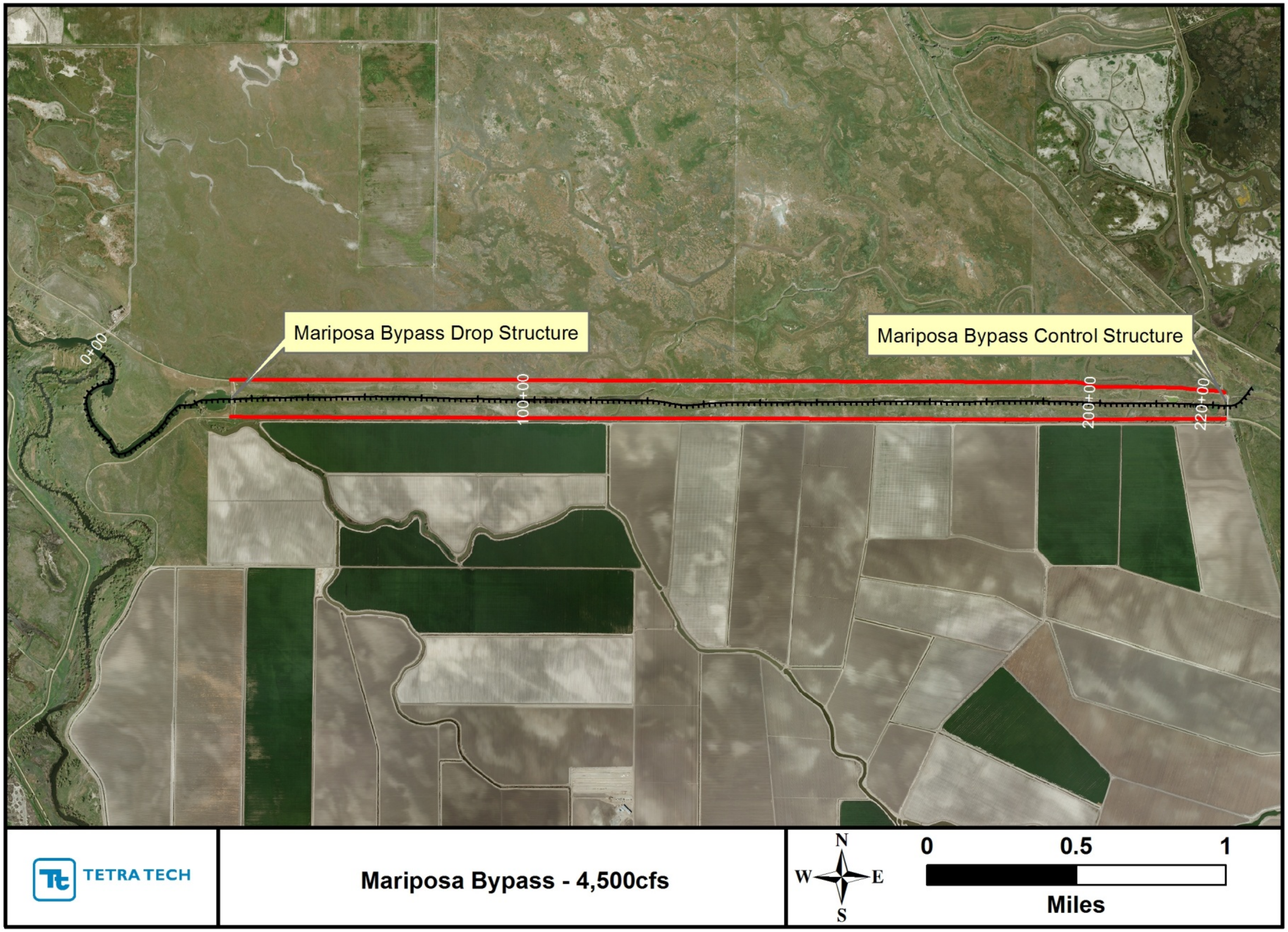

Figure 35. Portions of levee in the Mariposa Bypass where the 4,500-cfs water-surface elevation is above the existing outside ground elevation.

APPENDIX A

Examples of Selected Outside Ground Elevation Locations

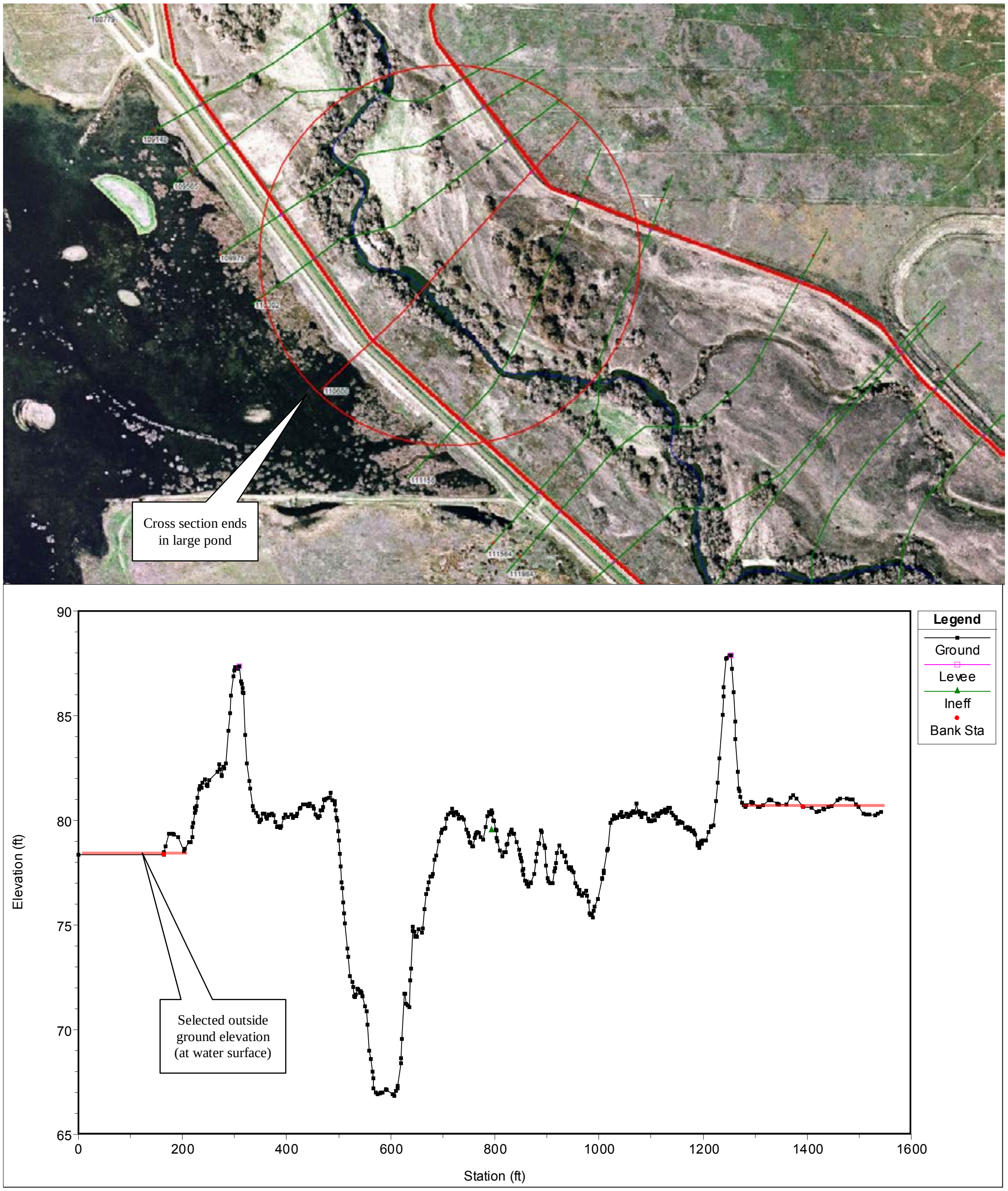

Figure A.1: Reach 4B2 – Plan and profile view of XS 110688. The left side of the cross section terminates in a pond immediately adjacent to the levee.

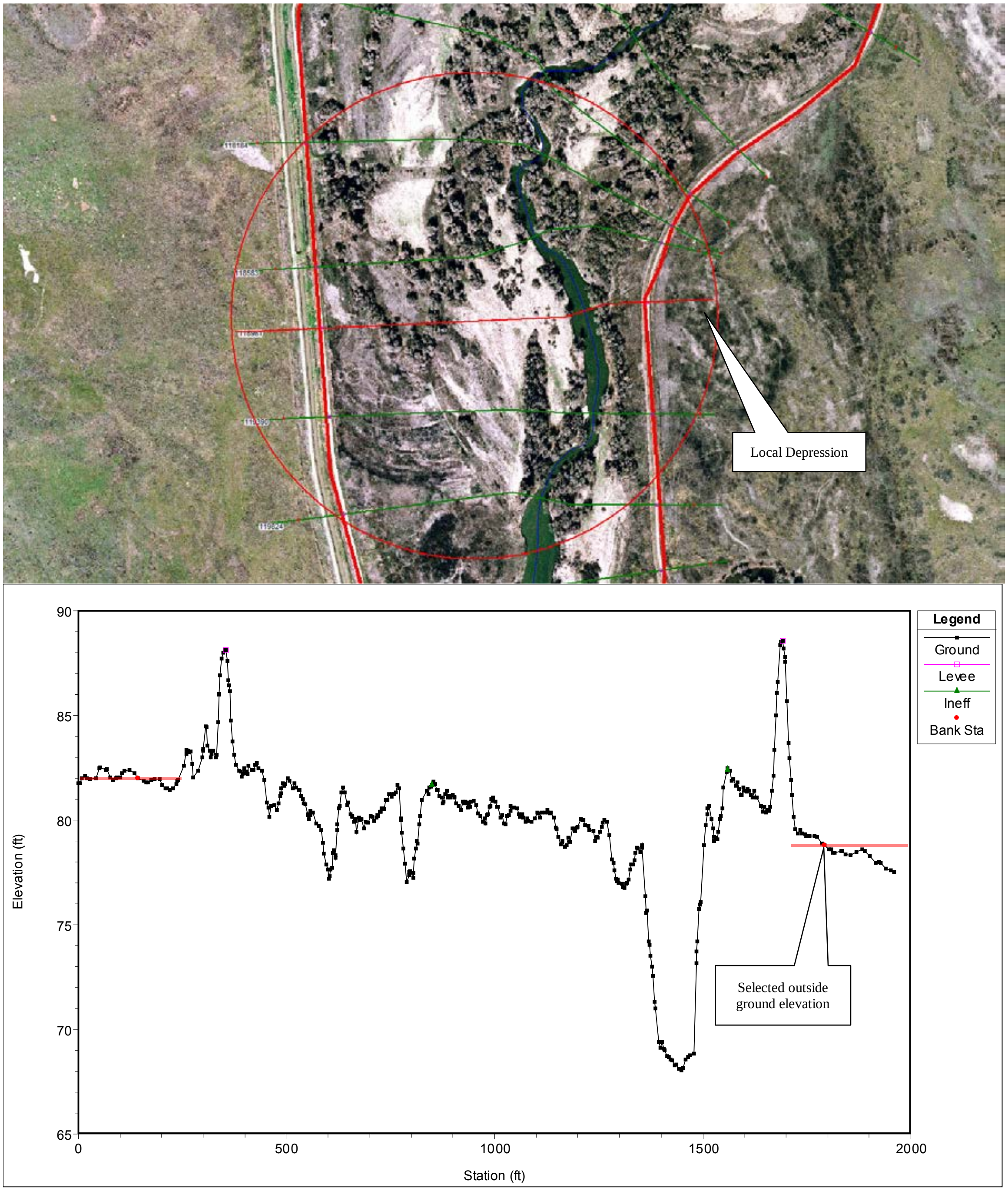

Figure A.2: Reach 4B2 – Plan and profile view of XS 118961. The right overbank slopes away from the levee into an oxbow.

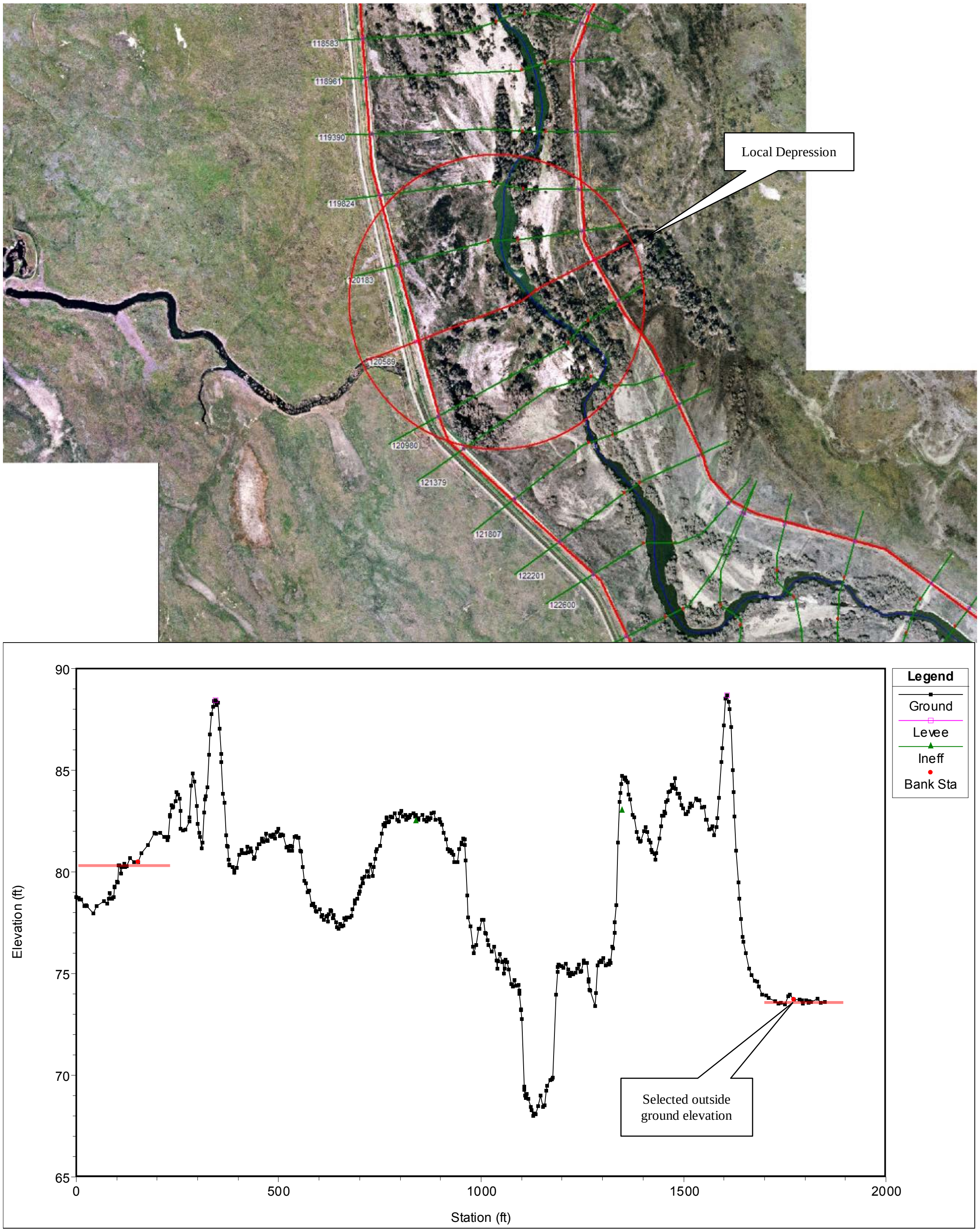

Figure A.3: Reach 4B2 – Plan and profile view of XS 120589. The right overbank ends in a local depression.

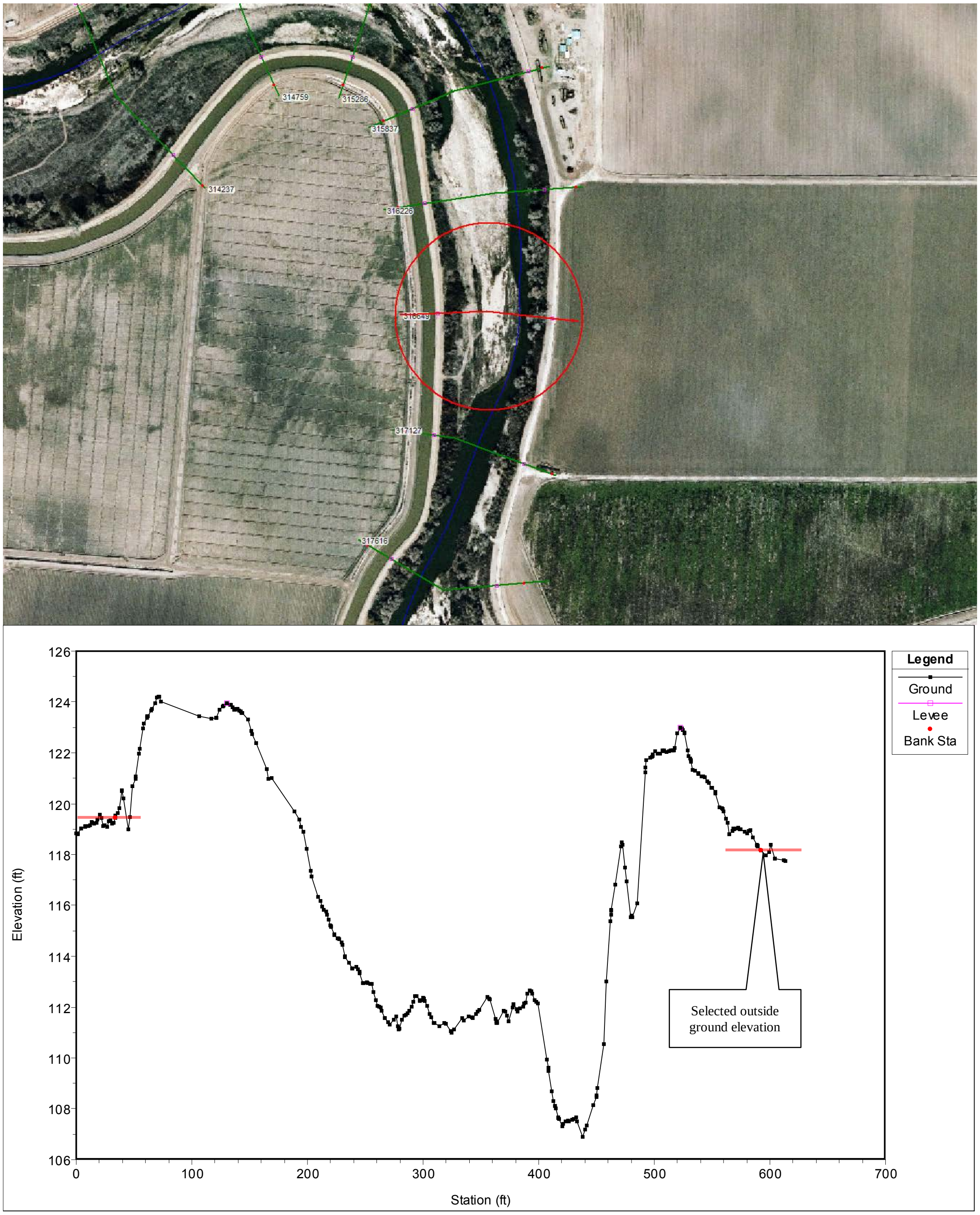

Figure A.4: Reach 4A – Plan and profile view of XS 316649. The right overbank slopes away from the levee.

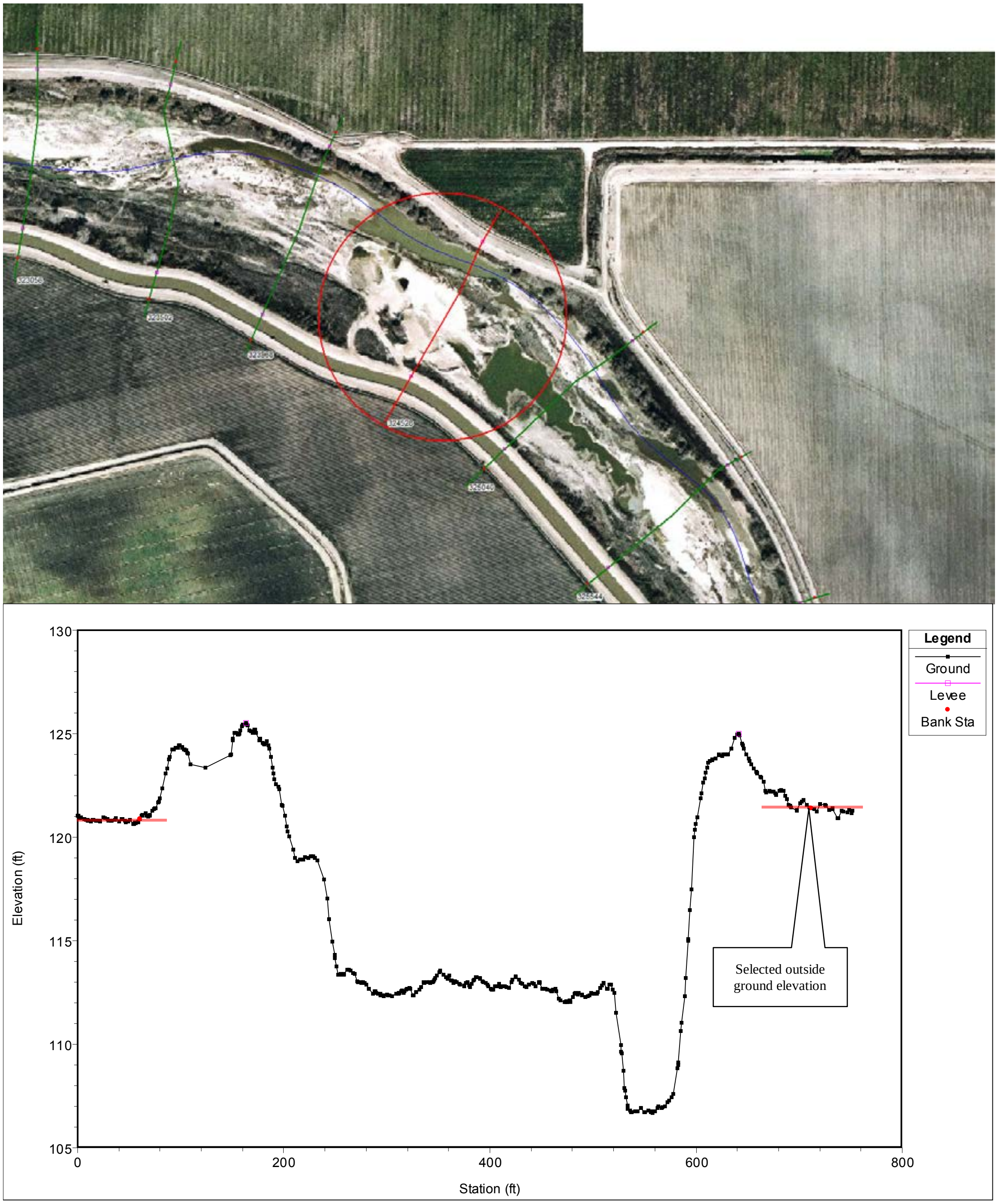

Figure A.5: Reach 4A – Plan and profile view of XS 324528. The right overbank slopes gradually away from the levee.

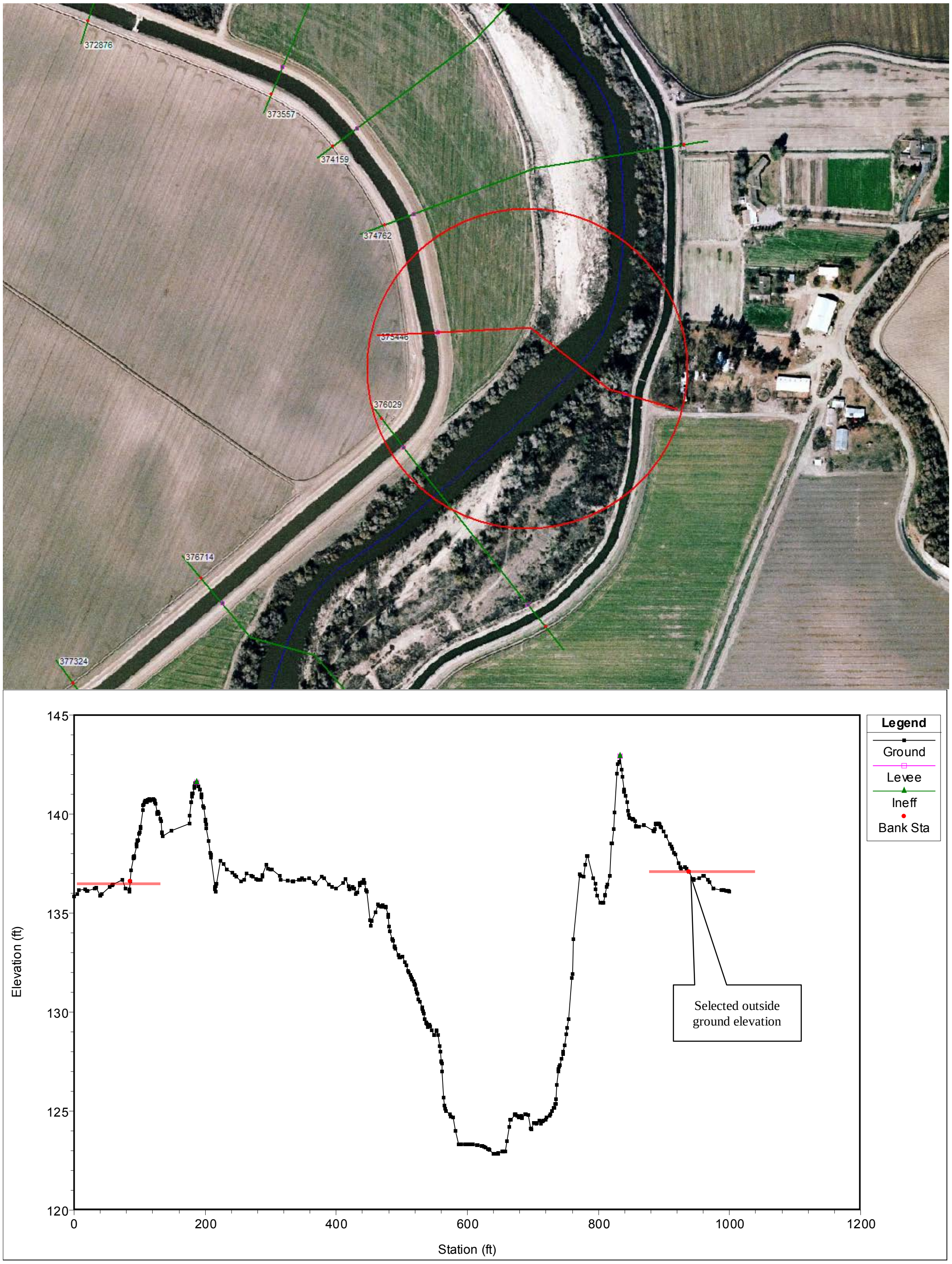

Figure A.6: Reach 3 – Plan and profile view of XS 375446. The right overbank slopes away from the levee.

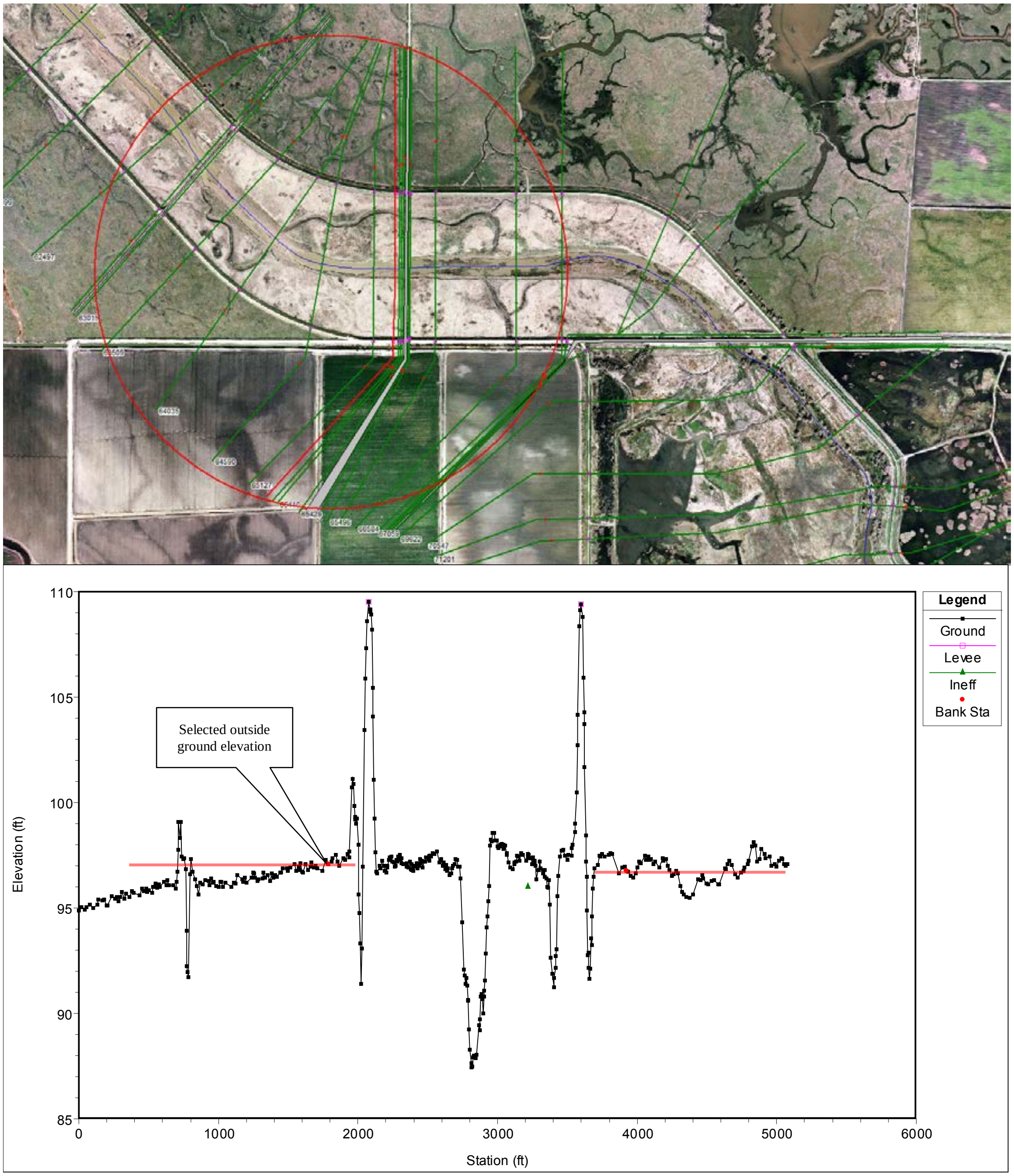

Figure A.7: Middle ESB – Plan and profile view of XS 65344. The left overbank slopes away from levee.