

Technical Memorandum

Channel Capacity Report 2020 Restoration Year



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7 **List of Abbreviations and Acronyms**

8	CCAG	Channel Capacity Advisory Group
9	CCR	Channel Capacity Report
10	CFS	Cubic feet per second
11	CPT	Cone Penetration Test (Cone Penetrometer Test)
12	CVFPB	Central Valley Flood Protection Board
13	DWR	Department of Water Resources
14	GCR	Geotechnical Conditions Report
15	LMAs	Local Maintaining Agencies
16	LSJLD	Lower San Joaquin Levee District
17	LSJRFC Project	Lower San Joaquin River Flood Control Project
18	MNWR	Merced National Wildlife Refuge
19	NRDC	Natural Resources Defense Council
20	NOD	Notice of Determination
21	O&M	Operations and Maintenance
22	PEIS/R	Program Environmental Impact Statement/Environmental
23		Impact Report
24	Reclamation	Bureau of Reclamation
25	Restoration Area	San Joaquin River Restoration Program Restoration Area
26	RM	River mile
27	ROD	Record of Decision
28	SJLE Project	San Joaquin Levee Evaluation Project
29	SJRRP	San Joaquin River Restoration Program
30	WSE	Water Surface Elevation

1 Definitions

2 **San Joaquin River Restoration Program (SJRRP):** The SJRRP (also abbreviated as Program)
3 was established in late 2006 to restore and maintain fish populations in good condition in the
4 mainstem of the San Joaquin River (SJR) below Friant Dam to the confluence of the Merced
5 River, while reducing or avoiding adverse water supply impacts.

6 **Settlement:** In 2006, the SJRRP was established to implement the Stipulation of Settlement in
7 *NRDC, et al., v. Kirk Rodgers, et al.*

8 **Program Environmental Impact Statement/Environmental Impact Report (PEIS/R):** The
9 Bureau of Reclamation (Reclamation), as the federal lead agency under the National
10 Environmental Policy Act (NEPA) and the California Department of Water Resources (DWR),
11 the state lead agency under the California Environmental Quality Act (CEQA), jointly prepared a
12 Program Environmental Impact Statement/Report (PEIS/R) and signed a Record of Decision and
13 Notice of Determination (ROD and NOD), respectively, in 2012 to implement the Settlement.

14 **Channel Capacity Advisory Group (CCAG):** The Channel Capacity Advisory Group provides
15 focused input to Reclamation’s determination of “then-existing channel capacity” within the
16 Restoration Area.

17 **Then-existing channel capacity:** The channel capacity within the Restoration Area that
18 correspond to flows that would not significantly increase flood risk from Restoration Flows in
19 the Restoration Area. This annual report will recommend updating then-existing channel
20 capacity based on recently completed evaluations.

21 **In-channel capacity:** The channel capacity at which the water surface elevation is maintained at
22 or below the elevation of the outside ground (i.e., along the landside levee toe).
23

1 1.0 Executive Summary

2 The San Joaquin River Restoration Program (SJRRP) was established in late 2006 and is a
3 comprehensive, long-term effort to restore flows to the San Joaquin River from Friant Dam to
4 the confluence of the Merced River and restore a self-sustaining Chinook salmon fishery in the
5 river while reducing or avoiding adverse water supply impacts. The first water releases from
6 Friant Dam in support of the SJRRP, called Interim Flows, began October 1, 2009, which later
7 became Restoration Flows beginning on January 1, 2014. The SJRRP has committed to reporting
8 annually the upper limit of Restoration Flows that will not significantly increase flood risk within
9 the Restoration Area. This Channel Capacity Report (CCR) is for the 2020 Restoration Year
10 (2020 CCR) and is the seventh report in a series of annual reports required to fulfill a
11 commitment in the SJRRP’s environmental document.

12 To determine the upper limit of Restoration Flows that can be conveyed in each channel, the
13 SJRRP has completed comprehensive evaluations of over 60 miles of levees which include a
14 drilling program and seepage and stability modeling to evaluate the risk of levee failure. For
15 those levees that have not been evaluated, the SJRRP keeps Restoration Flows within the
16 channel to prevent water on the levee itself which also reduces the risk of a levee failure. This
17 CCR details the recommended upper limit of Restoration Flows, which is referred to as “then-
18 existing” channel capacity that can be conveyed in each reach based on levee capacity. The
19 previous and recommended then-existing channel capacities in the San Joaquin River and flood
20 bypasses are shown in Table ES-1. Recommended capacity changes were made in the Middle
21 Eastside Bypass, Mariposa Bypass and Reach 4B2.

22 It should be stated that in addition to consideration of then-existing channel capacities, the
23 release of Restoration Flows would also be limited by agricultural seepage. These limiting flows
24 are shown as footnotes in Table ES-1. It should also be acknowledged that then-existing channel
25 capacities identified in this report are applicable to Restoration Flows only, and are often much
26 less than the flows the channels will convey during flood events. Flood releases are routed based
27 on a different set of criteria, and even though the flows can exceed current levee seepage and
28 slope stability criteria (which define then-existing capacity limits) they have not historically
29 resulted in significant levee failures.

30 A complete discussion of the data and analysis conducted to determine previous then-existing
31 channel capacities can be found on the SJRRP website:

32 <http://www.restoresjr.net/restoration-flows/levee-stability-channel-capacity/>

33

Table ES-1.

Current and Recommended Then-existing Channel Capacity

Reach	Current Then-existing Channel Capacity (cfs) ¹	Recommended Then-existing Channel Capacity (cfs) ¹
Reach 2A	6,000 ²	6,000 ²
Reach 2B	1,210	1,210
Reach 3	2,860 ³	2,860 ³
Reach 4A	2,840 ⁴	2,840 ⁴
Reach 4B1	Not Analyzed	Not Analyzed
Reach 4B2	930	4,300
Reach 5	2,350	2,350
Middle Eastside Bypass	580	1,070 ⁵
Lower Eastside Bypass	2,890	2,890
Mariposa Bypass	350	1,800

¹ Then-existing channel capacity shown in this table is based on levee stability only and does not consider Restoration Flow limitations related to agricultural seepage.

² Capacity not assessed for flows greater than 6,000 cfs. Restoration Flows are limited to approximately 2,140 cfs due to agricultural seepage.

³ Restoration Flows are limited to approximately 720 cfs due to agricultural seepage.

⁴ Restoration Flows are limited to approximately 250 cfs due to agricultural seepage.

⁵ In 2019 one of the weirs that allowed for flow diversions within the Merced National Wildlife Refuge was removed, so the capacity would be 1,070 cfs based on geotechnical data.

The 2020 CCR also includes a summary of two studies completed in 2019, one that is related to subsidence and the other that is a geotechnical evaluation of the levees in two of the reaches which resulted in recommended changes in then-existing channel capacity. The first study, *Evaluation of the Effects of Future Subsidence on Capacity up to 2,500 cfs in Reach 4A and Middle Eastside Bypass*, evaluates the potential effects of future subsidence on the flow capacity of the Middle Eastside Bypass and Reach 4A over the next several years. This was to help the SJRRP determine which levees in these reaches need to be improved to reduce the risk of a levee failure from future increases in Restoration Flows. The study shows that most of the levees will continue to convey Restoration Flows. However, approximately 2.5 miles of levees may need improvement after the next 15 years or so because of ongoing subsidence. These levees should be periodically assessed by the SJRRP to determine if improvements are needed.

The second study, *Levee Capacity Evaluation of Mariposa Bypass and Reach 4B2*, helps determine then-existing channel capacities of the Mariposa Bypass and Reach 4B2 using geotechnical evaluations of the levees in these reaches. The results of the study show that approximately 7 miles of levees would need improvement to convey up to maximum Restoration Flows. Because of the levee evaluations, this CCR recommends a change of then-existing channel capacities in Reach 4B2 and the Mariposa Bypass from 930 cfs to 4,300 cfs, and 350 cfs to 1,800 cfs, respectively.

The other recommended change to then-existing channel capacity is for the Middle Eastside Bypass. The current then-existing channel capacity for this reach was based on the operation of weirs that were used to divert water in the Merced National Wildlife Refuge. The weirs are no longer operational, as one of the weirs was removed in 2019. This now results in a change in

1 then-existing channel capacity from 580 cfs to 1,070 cfs and is based on a previous geotechnical
2 evaluation of the levees in that reach.

3 The SJRRP continues to implement studies and projects to refine then-existing channel capacity
4 estimates and increase capacities to meet the 4,500 cfs maximum Restoration Flows.
5 Specifically, the Reach O levee improvement project and Reach 2B Improvements project will
6 increase flow capacities in the Middle Eastside Bypass and Reach 2B, respectively. These
7 projects will begin in 2020 and will be detailed in future CCRs.
8

1 2.0 Introduction

2 The San Joaquin River Restoration Program (SJRRP) was established in late 2006 to implement
3 a Stipulation of Settlement (Settlement) in *NRDC, et al., v. Kirk Rodgers, et al.* The U.S.
4 Department of the Interior, Bureau of Reclamation (Reclamation), the Federal lead agency under
5 the National Environmental Policy Act (NEPA), and the California Department of Water
6 Resources (DWR), the State lead agency under the California Environmental Quality Act
7 (CEQA), prepared a joint Program Environmental Impact Statement/Report (PEIS/R) to support
8 implementation of the Settlement. The Settlement calls for releases of Restoration Flows, which
9 were initiated in 2014 and are specific volumes of water to be released from Friant Dam during
10 different water year types, according to Exhibit B of the Settlement. Federal authorization for
11 implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act
12 (Act) (Public Law 111-11). Reclamation signed the Record of Decision (ROD)/Notice of
13 Determination (NOD) on September 28, 2012. Both the PEIS/R and the ROD/NOD committed
14 to establishing a Channel Capacity Advisory Group (CCAG) to determine and update estimates
15 of then-existing channel capacities as needed and to maintain Restoration Flows at or below
16 estimates of then-existing channel capacities. Then-existing channel capacities in the Restoration
17 Area (the San Joaquin River between Friant Dam and the confluence of the Merced River)
18 correspond to flows that would not significantly increase flood risk from Restoration Flows.
19 Sections of the PEIS/R applicable to the CCAG are included in Appendix A of this report.

20 This Channel Capacity Report (CCR) for the 2020 Restoration Year (2020 CCR) is the seventh
21 in the series of annual reports required to fulfill the commitments in the ROD/NOD. The 2014
22 CCR was the first report that was followed by six subsequent reports that based recommended
23 then-existing channel capacities on new information regarding levee stability, subsidence or
24 other SJRRP considerations. The reports also included information on the CCAG roles and
25 responsibilities, technical factors when considering channel capacity, the criteria and evaluation
26 process for determining capacity, as well as the data and analytical tools used to determine
27 channel capacity. Previous Channel Capacity Reports can be found at the SJRRP website at the
28 following link:

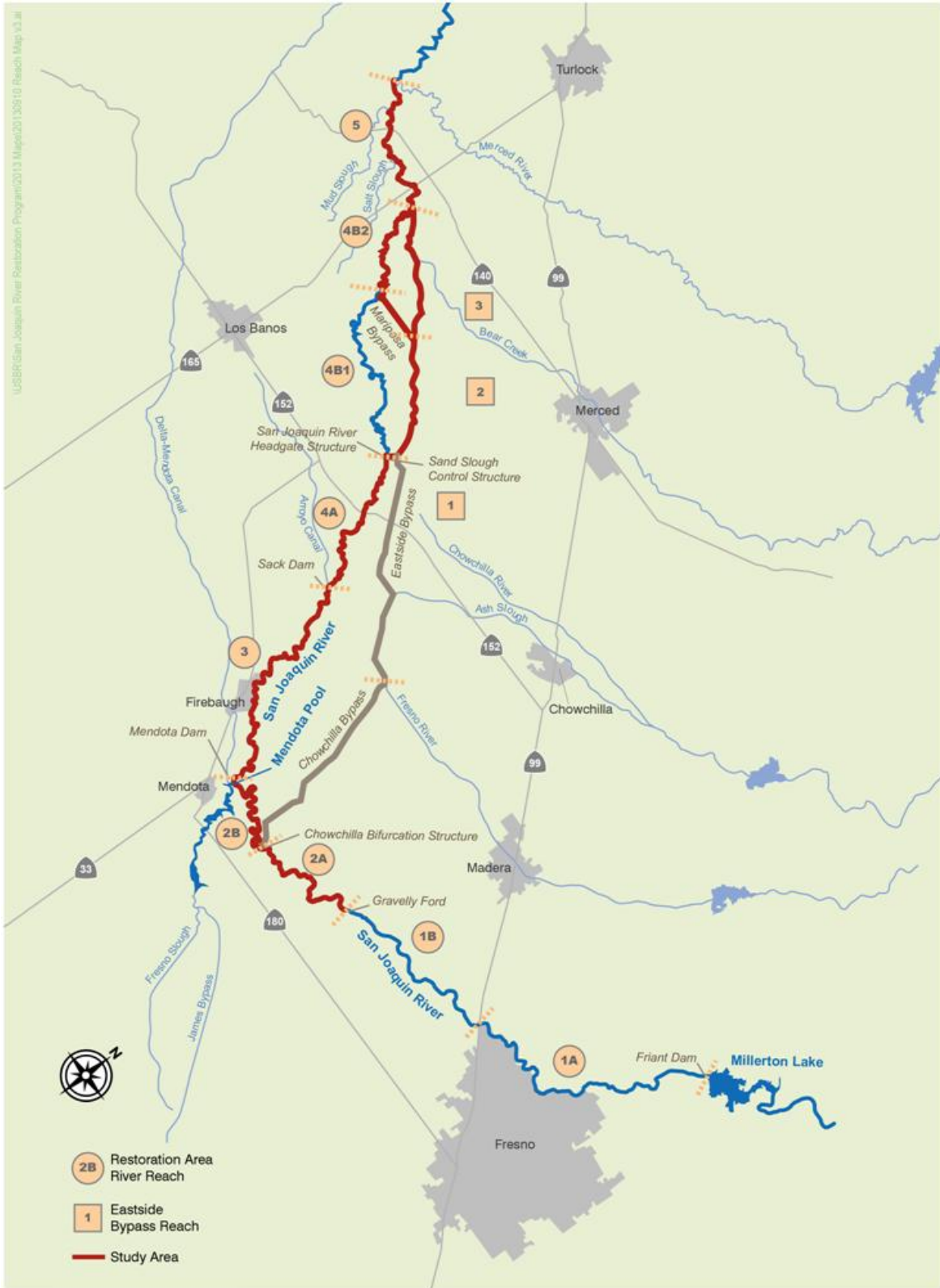
29 <http://www.restoresjr.net/restoration-flows/levee-stability-channel-capacity/>

30 The 2020 CCR updates then-existing channel capacities for the Middle Eastside Bypass,
31 Mariposa Bypass and Reach 4B2 of the San Joaquin River. Then-existing channel capacities for
32 other reaches in the Restoration Area will remain the same as those recommended in the 2018
33 and 2019 CCRs. The 2018 CCR recommended then-existing channel capacity is based on
34 geotechnical data in portions of Reach 2A, Reach 4A, and the Middle Eastside Bypass. This
35 year's CCR includes two new studies related to subsidence and channel capacity based on
36 geotechnical assessments of the levees in the Mariposa Bypass and Reach 4B2. The CCR also
37 includes a summary of studies and monitoring that will be completed the following year. All
38 other background information on channel capacity, including how then-existing channel capacity
39 was developed, can be found in the 2018 CCR.

1 The 2020 CCR was available for a 60-day public review and comment period beginning on
2 November 4, 2019 to January 3, 2020. Written comments via e-mail were received by Mr. Kevin
3 Pilgrim. DWR also provided comments. The comments and responses are included in
4 Appendix D.
5

1 **3.0 Study Area**

2 The study area starts from the Friant Dam and ends at the confluence of the San Joaquin River
3 with the Merced River. The CCR will focus on the portion of the study area where levees exist
4 along channels to control flows. The leveed reaches on the San Joaquin River start at Gravelly
5 Ford (RM 226.9) and continue to the Merced River confluence (RM 118.2). The study area also
6 includes the Eastside Bypass from the Sand Slough Connector Channel to the confluence with
7 the San Joaquin River and the Mariposa Bypass. The study area reaches are shown in Figure 3-1.
8 Currently, Restoration Flows pass through Reaches 1 through 4A, the Sand Slough Connector
9 Channel and the Eastside Bypass before entering Reach 5 of the San Joaquin River. Portions of
10 the Study area are also within the Lower San Joaquin River Flood Control (LSJRFC) Project,
11 which includes 191 miles of levees and protects over 300,000 acres. An additional 67 miles of
12 non-Project levees also provide flood protection along the San Joaquin River.



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Figure 3-1.
San Joaquin River Reaches and Flood Bypass System

4.0 Completed Channel Capacity Studies and Related Work

The following sections summarize the new technical studies that have been completed at the time of publication of this report that relate to channel capacity. This year's report includes two studies, one that describes the projected effect of subsidence on the ability of the system to convey Restoration Flow and one that determines then-existing channel capacities in the Mariposa Bypass and Reach 4B2 based on the findings from the levee evaluations performed in 2019.

The first study, *Evaluation of the Effects of Future Subsidence on Capacity up to 2,500 cfs in Reach 4A and Middle Eastside Bypass*, evaluates the potential effects of subsidence through 2031 on the flow capacity of the Middle Eastside Bypass and Reach 4A. The goal of this study is to identify the levees that will need to be improved to convey 2,500 cfs considering the effects of subsidence and the maximum allowable water surface elevation (WSE). The maximum allowable WSE is based on geotechnical evaluations of the levees in these reaches that identified the point on the levees where underseepage would create significant risk of levee failure based on USACE criteria for levee seepage and slope stability. The second study, *Levee Capacity Evaluation of Mariposa Bypass and Reach 4B2*, determines then-existing channel capacities of the Mariposa Bypass and Reach 4B2 based on maximum allowable WSEs using geotechnical evaluations for these reaches. Both studies are described below.

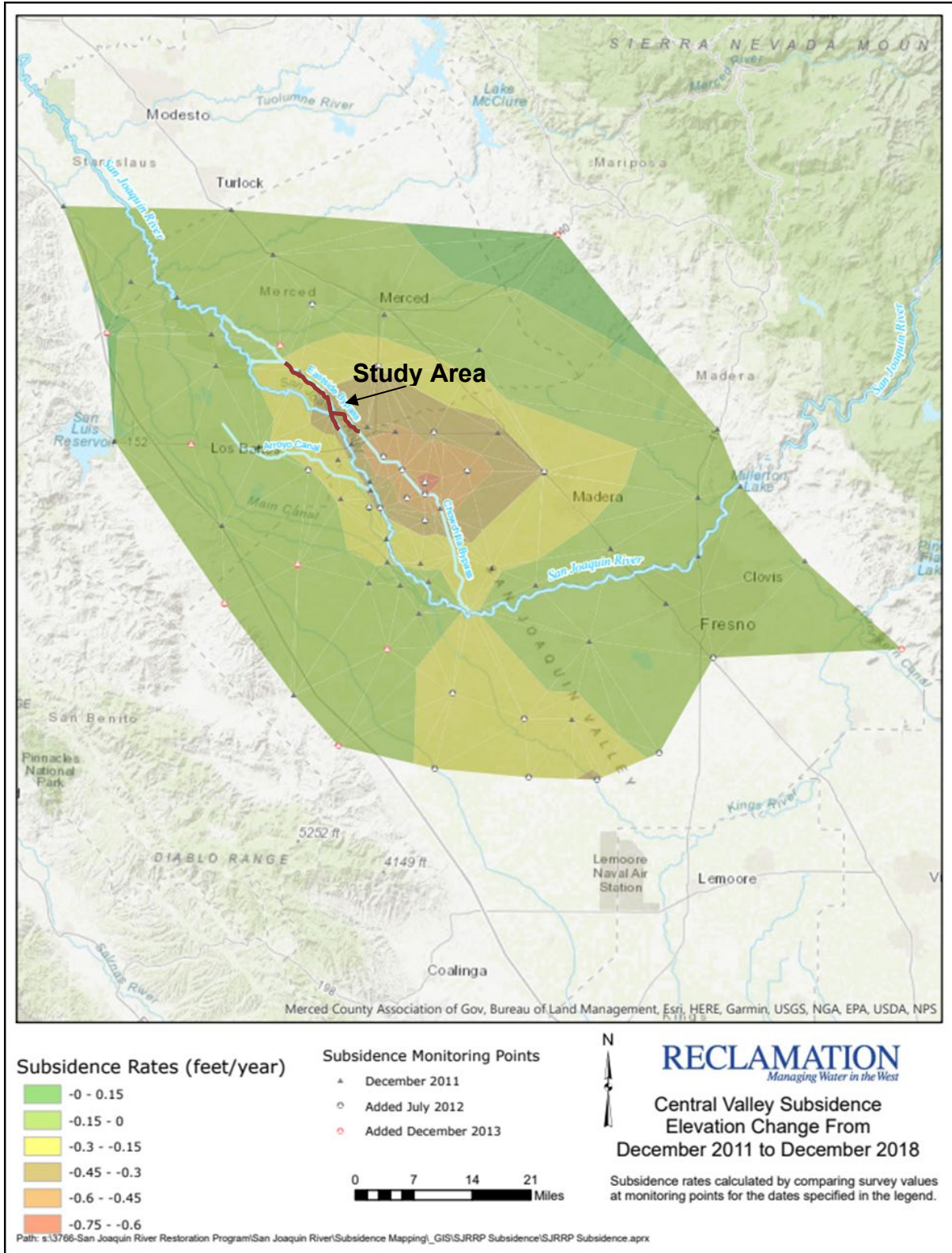
4.1 Subsidence Study for Flows up to 2,500 cfs

Subsidence is affecting channel capacities throughout the Restoration Area; the reaches that subsidence has the highest potential to change then-existing channel capacity are the Middle Eastside Bypass and 2.5 miles of the downstream end of Reach 4A. DWR performed a hydraulic study that estimates the effects of subsidence on channel capacities in 2016 and then estimates the effects of future subsidence to 2031 on channel capacities in these reaches. This study identifies the levees within the Middle Eastside Bypass and Reach 4A that may need to be improved to convey 2,500 cfs considering subsidence and the maximum allowable WSE. The maximum allowable WSEs were documented in a Geotechnical Condition Report (GCR) prepared by DWR in 2015. The study, *Evaluation of the Effects of Future Subsidence on Capacity up to 2,500 cfs in Reach 4A and Middle Eastside Bypass*, dated September 2019, is included in Appendix B and is summarized below.

4.1.1 Study Topography and Tools

The study was conducted using validated 1-D steady state Hydrologic Engineering Center's River Analysis System (HEC-RAS) baseline models of the river and flood bypass with 2008 topography and where available 2010-2011 bathymetry. The model geometry was updated based on top of levee surveys completed by DWR in 2016. In updating the model geometry, the 2008 cross-sections elevations were adjusted by the total subsidence that was measured between the

1 2008 LiDAR and the 2016 surveys. The model geometry was further modified to reflect future
2 subsidence conditions in 2031. For the 2031 condition, the elevations in the model were adjusted
3 by the total amount of subsidence that was projected to occur between 2016 and 2031. The total
4 amount of subsidence was calculated using average annual rates from 2011 to 2018 determined
5 by Reclamation in its bi-annual surveys. Figure 4-1 shows the average annual subsidence rates
6 range from about 0.15 ft/year to 0.75 ft/year in the Restoration Area and about 0.15 ft/year to
7 0.5 ft/year in the Middle Eastside Bypass and Reach 4A. The total amount of subsidence that was
8 estimated to occur between 2016 to 2031 is shown in Table 4-1.



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**Figure 4-1.
Regional Subsidence Map**

1 **4.1.2 Analysis and Results**

2 The hydraulic models were used to compute the WSEs at 2,500 cfs in 2016 and 2031(subsided
3 condition). The computed water-surface profiles at 2,500 cfs in the Middle Eastside Bypass and
4 Reach 4A were compared to the maximum allowable WSEs for each reach identified in the 2015
5 GCR (Figures 4-2 and 4-3). Table 4-1 summarizes the maximum allowable WSEs, the WSEs at
6 2,500 cfs, and the WSE difference for 2016 and 2031 for each reach identified in the GCR. The
7 water surface profiles and the maximum allowable WSE are shown in Figures 4 through 6 of
8 Appendix B. Figures 4-2 and 4-3 identify those reaches that exceed the maximum allowable
9 WSE and therefore exceed the USACE criteria for seepage and stability at flows greater than
10 2,500 cfs.

11 **Table 4-1.**

12 **Results for 2016 and 2031 Allowable Maximum WSE and WSE at 2,500 cfs**

GCR Reach	Subsidence 2016-2031 Total (ft)	2016 Maximum Allowable	2016 2,500 cfs WSE (ft)	2016 WSE Elevation Difference (ft)	2031 Maximum Allowable WSE (ft)	2031 2,500 cfs WSE (ft)	2031 WSE Elevation Difference (ft)
A	-2.8	98.1	93.3	4.8	95.4	90.9	4.5
B	-3.1	104.1	93.7	10.4	101.0	91.3	9.7
C	-3.3	97.2	96.2	1.0	93.9	93.1	0.8
D	-3.5	99.3	98.5	0.8	95.8	95.1	0.7
E	-4.8	102.3	99.6	2.7	97.5	95.9	1.6
F	-5.4	101.2	99.9	1.3	95.9	96.0	-0.1
G	-5.7	109.7	100.9	8.8	104.1	96.3	7.8
H	-5.6	106.6	100.4	6.2	100.9	96.1	4.8
I	-5.6	106.1	100.4	5.7	100.4	96.1	4.3
J	-2.9	94.9	93.4	1.5	92.0	91.0	1.0
K	-3.2	99.5	95.3	4.2	96.3	92.4	3.9
L	-3.4	98.3	98.3	0.0	94.9	95.0	-0.1
L	-4.0	100.0	99.1	0.9	96.0	95.6	0.4
M	-4.1	104.1	99.2	4.9	100.0	95.7	4.3
N	-4.6	101.3	99.6	1.7	96.7	95.9	0.8
O	-5.0	98.1	99.8	-1.7	93.0	95.9	-2.9

13 Reach O, located along the right levee, was the only reach that exceeds the maximum allowable
14 WSE at 2,500 cfs in 2016. The capacity of this reach is limited to 1,070 cfs (Tetra Tech, 2015)
15 and is scheduled to be improved in 2020. By 2031, the hydraulic models predicted that the WSE
16 in three of the reaches will encroach upon or exceed the maximum allowable WSEs if
17 subsidence continues at the annual average rate calculated between 2011 to 2018. The WSE in
18 Reaches O, F and L are each predicted to encroach on the maximum allowable WSE by 2031
19 (see Figure 4-2). The WSE at 2,500 cfs in Reach F and L reaches would be approximately
20 0.1 feet above the maximum allowable WSE.

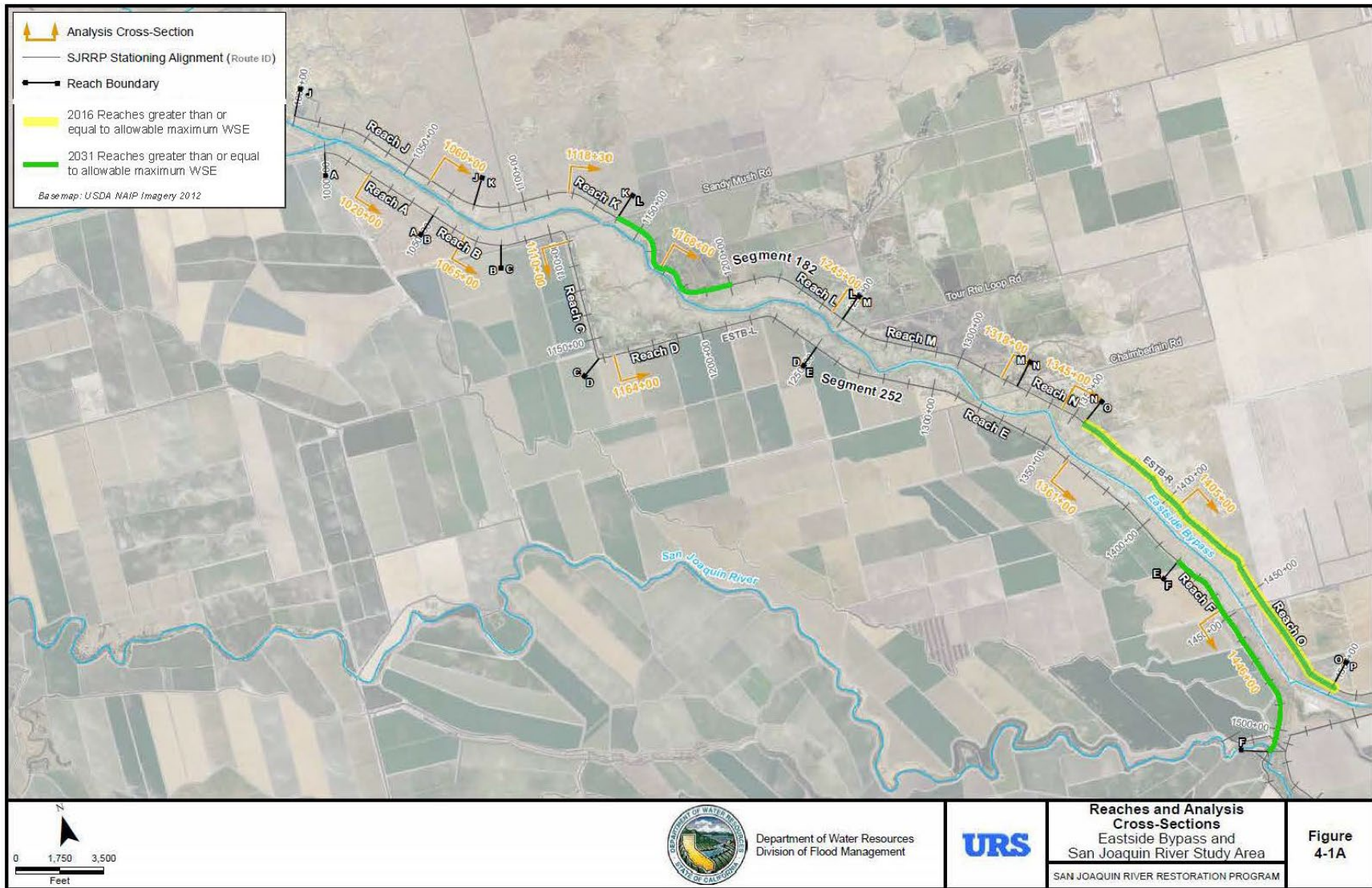
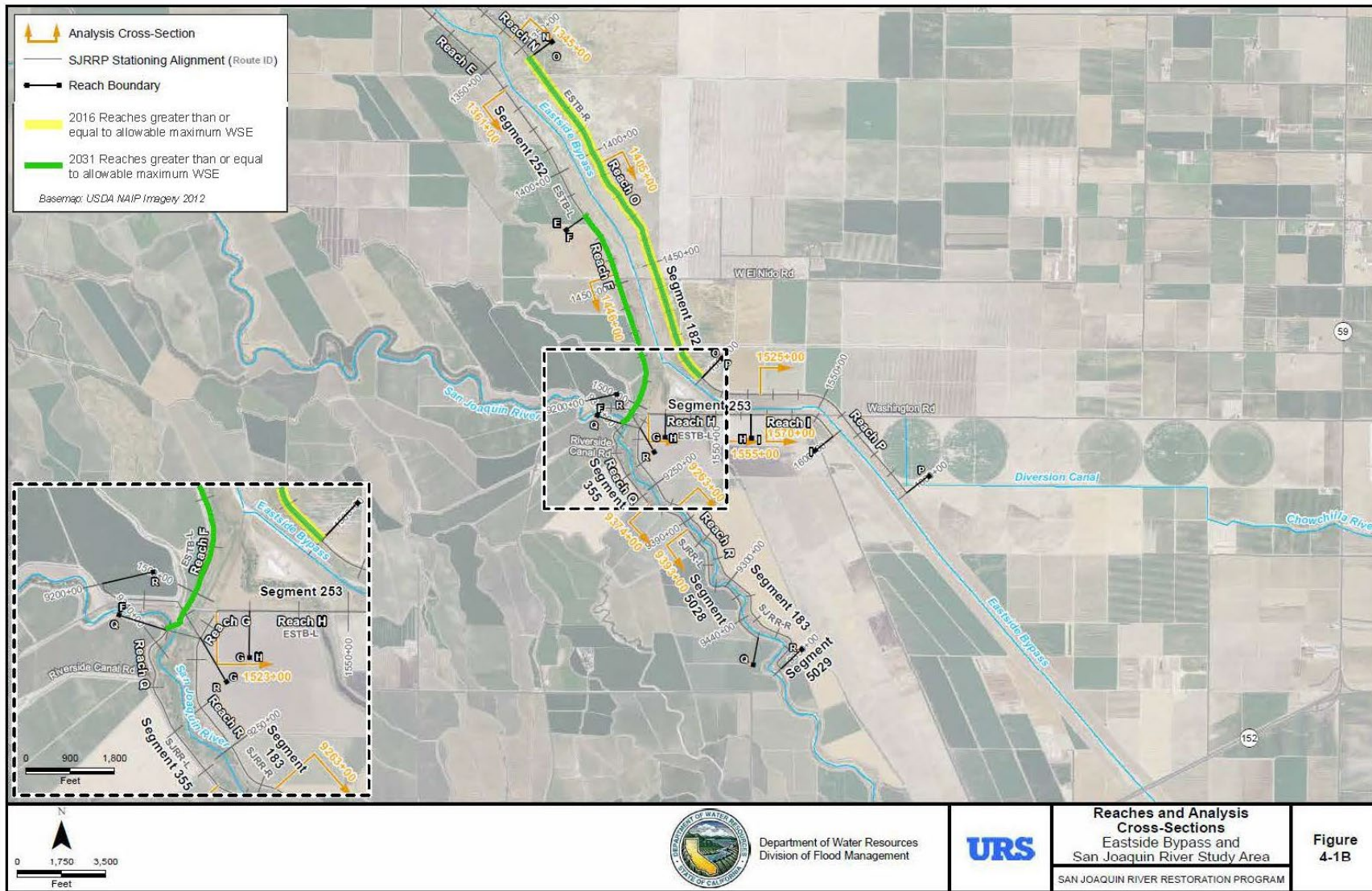


Figure 4-2.
Middle Eastside Bypass Reaches with Then-existing Channel Capacities Less than 2,500 cfs

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Figure 4-3.
Upper Eastside Bypass and Reach 4A with Then-existing Channel Capacities Less than 2,500 cfs

1 4.1.3 Conclusion

2 The results of this hydraulic analysis show that the WSE at 2,500 cfs is still below the maximum
3 allowable WSE in 2016 even when subsidence is considered. Although Reach O is currently
4 exceeding the maximum allowable WSE, DWR plans on improving Reach O in 2020 which will
5 increase the capacity of the reach to least 2,500 cfs. However, because subsidence is reducing the
6 capacity in this reach, the SJRRP needs to determine if additional reaches need improvement
7 over the next several years. The results show that subsidence could reduce the capacity of
8 approximately 2.5 miles of levees in Reaches F and L to less than 2,500 cfs by 2031. Although
9 the SJRRP will meet its goal of providing channel capacity up to 2,500 cfs by 2024, the reaches
10 that are close to the maximum allowable WSE at 2,500 cfs will be evaluated periodically to
11 determine if improvements will be needed over the next five to ten years.

12 4.2 Priority 2 Geotechnical Assessment

13 Levee evaluations along the San Joaquin River and flood bypasses are being conducted by DWR
14 to assist the SJRRP in assessing flood risks due to levee seepage and stability associated with the
15 release of Restoration Flows for the SJRRP. The evaluations were performed under DWR's San
16 Joaquin Levee Evaluation (SJLE) Project (Section 7.2.4) and included the exploration and
17 evaluation of existing levees within the Restoration Area that will be used to convey future
18 Restoration Flows.

19 In identifying the priorities of the SJLE Project, DWR classified levee segments in the
20 Restoration Area in one of three categories representing an increasing priority for the need to
21 complete the geotechnical evaluation and analyses. Details of the specific tasks, including the
22 methodology for prioritization of the levees are summarized in Section 10.1.2 of the 2014 CCR.
23 Priority 1 levees, which were completed in 2014 are in Reach 2A, the Middle Eastside Bypass,
24 and the lowest portion of Reach 4A. The Priority 2 levee evaluations were completed in 2019
25 and include about 30 miles of levees in Reach 4B2 and the Mariposa Bypass. The evaluations
26 included reconnaissance-level geotechnical explorations, soils testing, and seepage and stability
27 analyses at multiple water surface elevations along multiple levee segments. The results for the
28 Priority 2 levees are included in a 2019 GCR.

29 The following section summarizes the flow analysis completed to identify the maximum flow
30 that can be conveyed on the levees in each reach without exceeding USACE criteria for levee
31 underseepage and slope stability. The study, *Levee Capacity Evaluation of Mariposa Bypass and*
32 *Reach 4B2*, dated January 2020, is included in Appendix C. Figure 4-4 shows the study area and
33 reaches.

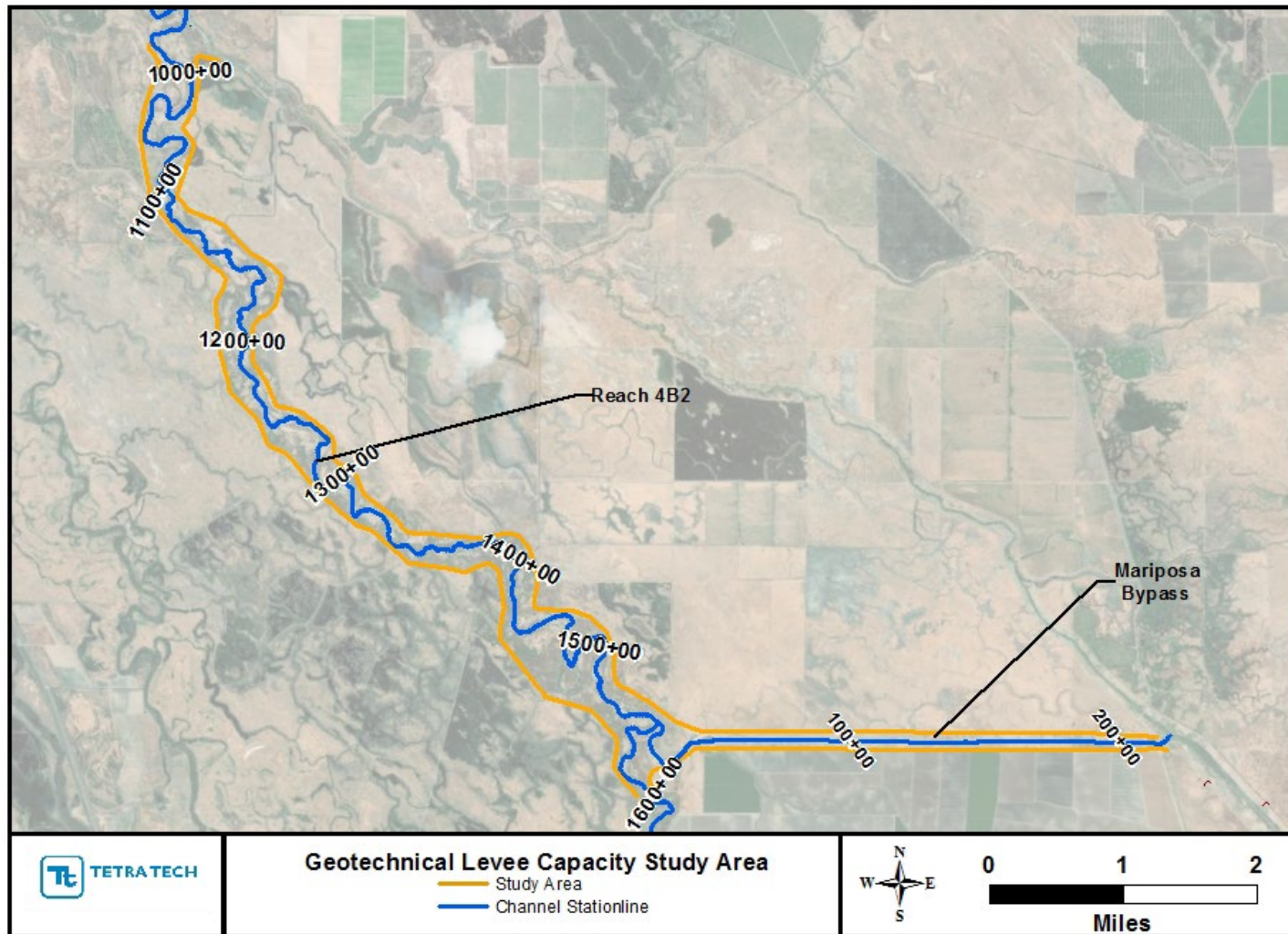


Figure 4-4.
Site Map of Study Area

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1 4.2.1 Study Topography and Tools

2 The result of the Priority 2 evaluations were the maximum allowable WSEs in 21 sub-reaches
3 (Figures 2 through 5 of Appendix C) within Reach 4B2 and the Mariposa Bypass. A hydraulic
4 analysis was completed to establish flow capacity in these levee sub-reaches using the maximum
5 allowable WSEs from the Priority 2 levee evaluations. In performing the analyses, 1-D hydraulic
6 models developed for the SJRRP were employed. The geometry in the existing-conditions
7 hydraulic models are based on 2008 LiDAR overbank elevations and 2011/2012 in-channel
8 bathymetry. These models were not adjusted for subsidence due to the lack of subsidence in
9 these areas that would result in a change to the capacities.

10 4.2.2 Analysis and Results

11 A range of flows up to the full Restoration Flow of 4,500 cfs were modeled in Reach 4B2 and
12 the Mariposa Bypass. The maximum allowable WSEs at the assigned model cross sections were
13 used to interpolate a discharge based on flow profiles for the range of flows. If the associated
14 discharge was greater than 4,500 cfs then a capacity of “>4,500 cfs” was reported and no further
15 analyses was made. Because a canal is landside and adjacent to a majority of the left levee, the
16 maximum allowable WSEs were developed for two canal scenarios: maximum WSEs based on
17 no water in the canal and maximum WSEs assuming a flow depth of two feet in the canal. Table
18 4-2 summarizes the maximum allowable WSEs, and discharge capacity for each sub-reach.

19 Table 4-2 shows that in Reach 4B2, when considering the maximum allowable WSE assuming a
20 dry canal, 17 of 22 analyzed sub-reaches had a capacity that exceeded the maximum Restoration
21 Flows of 4,500 cfs. For this scenario where the canal is dry, the limiting capacity would be
22 1,950 cfs. Assuming a depth of 2 ft in the canal resulted in only one sub-reach that had a capacity
23 of less than 4,500 cfs, which increased the limiting capacity to 4,300 cfs in Reach 4B2. Table 4-3
24 shows that in the Mariposa Bypass when considering the maximum allowable WSE and a dry
25 canal, six of the of the eleven sub-reaches had a capacity of less than 4,500 cfs. For this scenario,
26 the limiting capacity is 335 cfs. Although the number of sub-reaches that exceed 4,500 cfs did
27 not change when assuming 2 ft of water in the adjacent canal, the overall limiting capacity
28 increased to 1,800 cfs.

29 4.2.3 Conclusions

30 The SJRRP does not plan to convey Restoration Flows in Reach 4B2 or the Mariposa until future
31 channel work is performed throughout the Restoration Area (Section 6.3). However, the results
32 of this study will be used to update then-existing channel capacity for these reaches.
33 Then-existing channel capacities in the 2020 CCR will now be based on geotechnical data and
34 not on in-channel capacity. The results do show that at least flows up to 2,500 cfs can be
35 conveyed in Reach 4B2. To convey full Restoration Flows of up to 4,500 cfs, about 1 mile of
36 levees in Reach 4B2 and about 6 miles of levees in the Mariposa Bypass would need to be

1 improved. In reaches adjacent to canals, the maximum WSE is based on 2-foot depth of water in
 2 the adjacent canals. This assumption is based on observations that the canals are usually wet
 3 during flood events. This assumption would need to be evaluated and monitored, as well as
 4 discussed with the canal owners prior to applying these results. Future subsidence may also
 5 result in changes in capacity in these reaches and should be considered when determining future
 6 levee improvements.

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Table 4-2.
Flow Capacities of Sub-reaches in Reach 4B2

Sub-Reach Location	Model Cross Section	Maximum Allowable WSE Assuming Dry Canal (feet)	Discharge Capacity (cfs)	Maximum Allowable WSE Assuming 2 ft depth in Canal (feet)	Final Discharge Capacity (cfs)
A	994+43	83.2	> 4,500	N/A ¹	> 4,500
B1	1099+75	82.4	> 4,500	N/A	> 4,500
B2	1139+89	80.5	2,450	82.5	> 4,500
C1	1222+01	84.7	> 4,500	N/A	> 4,500
C2	1269+30	86.2	> 4,500	N/A	> 4,500
D	1357+61	83.7	1,950	86.5	> 4,500
E1	1404+59	89.8	> 4,500	N/A	> 4,500
E2	1422+67	89.0	> 4,500	N/A	> 4,500
F1	1462+79	87.8	4,440	88.4	> 4,500
F2	1497+07	87.7	3,370	88.3	4,300
I	1010+90	82.1	> 4,500	N/A	> 4,500
J	1135+26	83.5	> 4,500	N/A	> 4,500
K	1156+70	84.0	> 4,500	N/A	> 4,500
L1	1173+70	84.9	> 4,500	N/A	> 4,500
L2	1198+24	84.2	> 4,500	N/A	> 4,500
L3	1235+54	84.5	> 4,500	N/A	> 4,500
L4	1260+91	85.4	> 4,500	N/A	> 4,500
L5	1345+20	88.0	> 4,500	N/A	> 4,500
M	1381+94	85.0	2,570	87.0	> 4,500
N	1396+07	88.0	> 4,500	N/A	> 4,500
O	1453+75	89.4	> 4,500	N/A	> 4,500
P	1512+68	91.1	> 4,500	N/A	> 4,500

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¹ N/A (not applicable) means there is not a canal adjacent to that sub-reach, so a capacity assuming 2-ft of water in the canal was not completed.

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**Table 4-3.
Flow Capacities at the GCR Cross Section in the Mariposa Bypass**

Sub-Reach Location	Model Cross Section	Maximum Allowable WSE Assuming Dry Canal (feet)	Discharge Capacity (cfs)	Maximum Allowable WSE Assuming 2 ft depth in Canal (feet)	Final Discharge Capacity (cfs)
G	14+43	88.0	2,940	89.0	4,310
H1	99+61	86.5	335	90.0	1,830
H2	185+13	90.5	980	93.8	3,210
Q	3+80	87.0	2,170	N/A ¹	2,170
R	66+64	91.8	> 4,500	N/A	> 4,500
S	87+43	93.0	> 4,500	N/A	> 4,500
T1	156+06	91.5	1,800	N/A	1,800
T2	191+46	97.8	> 4,500	N/A	> 4,500
T3	204+36	92.8	1,920	93.0	2,050
T4	216+99	98.9	> 4,500	N/A	> 4,500
U	35+85	90.2	> 4,500	N/A	> 4,500

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¹ N/A (not applicable) means there is not a canal adjacent to that sub-reach, so a capacity assuming 2-ft of water in the canal was not completed.

5.0 Recommended Then-existing Channel Capacities

The purpose of this section is to present the recommended then-existing channel capacities based on results from the channel capacity studies summarized in this and previous reports. Then-existing channel capacities are defined as flows that would not significantly increase flood risk from Restoration Flows in the Restoration Area. To reduce this risk, the PEIS/R included levee design criteria for levee slope stability and underseepage Factors of Safety based on USACE criteria for levees. The application of the criteria requires the collection and evaluation of data at locations throughout the Restoration Area. Until adequate data are available to apply the USACE criteria, the release of Restoration Flows would be limited to those that would remain in-channel (the water surface elevation in the river remains below the levees). How then-existing channel capacity is determined for each reach is described below.

In-channel capacities were the best estimate of then-existing channel capacities for Reach 2B, Reach 3, portions of Reach 4A, Reach 5, and Lower Eastside Bypass. The studies used to determine the capacities in these reaches are summarized in the 2017 and 2018 CCRs. These include: the *San Joaquin River In-channel Capacity Analysis* (Tetra Tech, 2015b) (included in the 2017 CCR) with update included in Appendix B of the 2018 CCR. For Reach 2A, the lower 2.5 miles of Reach 4A, and the Middle Eastside Bypass adequate data was available to perform a geotechnical analysis and these results were used to determine then-existing channel capacity. The study details used to determine the then-existing channel capacity for Reach 2A, and the lower 2.5 miles of Reach 4A are included in the 2017 CCR with an update included in Appendix C of the 2018 CCR.

The 2020 CCR recommends changes to then-existing channel for three reaches: Reach 4B2, the Mariposa Bypass, and the Middle Eastside Bypass. The previous studies used to determine then-existing channel capacity in the Middle Eastside Bypass considered geotechnical analysis and the operations, as well as, removal of the weirs within the Merced National Wildlife Refuge. One of the weirs was removed in 2019 as described in Section 6.3 and results in a recommended change to then-existing channel capacity from 580 cfs to 1,070 cfs. The change in recommended then-existing channel capacity is based on the previous geotechnical assessment and data described in Appendix C of the 2018 CCR.

The *Levee Capacity Evaluation of Mariposa Bypass and Reach 4B2* summarized in Section 4.0 — Completed Channel Capacity Studies and Related Work, did update the results of the in-channel capacity analysis used to develop the then-existing channel capacity in Reach 4B2 and the Mariposa Bypass. In Reach 4B2, then-existing channel capacity increased from 930 cfs to 4,300 cfs and is now based on geotechnical data. In the Mariposa Bypass, the capacity increased from 350 cfs to 1,800 cfs and is also now based on geotechnical data. Table 5-1 summarizes the current and recommended then-existing channel capacities for each reach of the San Joaquin River and the flood bypasses, as well as the method used to determine then-existing channel capacity.

Then-existing channel capacities recommended below do not consider limitations to Restoration Flows as it relates to agricultural seepage. For the 2020 Restoration Year, releases of Restoration

1 Flows in Reach 2A, Reach 3, and Reach 4A are limited by agricultural seepage, and not levee
 2 stability. Table 5-1 also notes current limitations of Restoration Flows based on agricultural
 3 seepage. Details of how these seepage limits are determined and limit Restoration Flows are in
 4 the *Seepage Management Plan* described in Section 6.2.2 of this report.

5 **Table 5-1.**
 6 **Current and Recommended Then-existing Channel Capacity**

Reach	Current Then-existing Channel Capacity (cfs) ¹	Recommended Then-existing Channel Capacity (cfs) ¹	Method used to determine Then-existing Channel capacity
Reach 2A	6,000 ²	6,000 ²	Geotechnical Assessment
Reach 2B	1,210	1,210	In-channel
Reach 3	2,860 ³	2,860 ³	In-channel
Reach 4A	2,840 ⁴	2,840 ⁴	Geotechnical Assessment and In-channel
Reach 4B1	Not Analyzed	Not Analyzed	--
Reach 4B2	930	4,300	Geotechnical Assessment
Reach 5	2,350	2,350	In-channel
Middle Eastside Bypass	580	1,070 ⁵	Geotechnical Assessment
Lower Eastside Bypass	2,890	2,890	In-channel
Mariposa Bypass	350	1,800	Geotechnical Assessment

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¹ Then-existing channel capacity shown in this table is based on levee stability only and does not consider limitations to Restoration Flows related to agricultural seepage.
² Capacity not assessed for flows greater than 6,000 cfs. Restoration Flows are limited to approximately 2,140 cfs due to agricultural seepage.
³ Restoration Flows are limited to approximately 720 cfs due to agricultural seepage.
⁴ Restoration Flows are limited to approximately 250 cfs due to agricultural seepage.
⁵ In 2019 one of the weirs that allowed for flow diversions within the Merced National Wildlife Refuge (MNWF) was removed, increasing the capacity to 1,070 cfs.

6.0 Program Actions with the Potential to Improve Then-existing Channel Capacity

Throughout Settlement implementation, the maximum downstream extent and rate of Restoration Flows to be released would be limited to then-existing channel capacity. As channel or structure modifications are completed, corresponding maximum Restoration Flow releases would be increased in accordance with then-existing channel capacity and the release schedule. Consistent with the commitments made in the PEIS/R ROD, Restoration Flows would be reduced, as needed, to address material seepage and levee stability impacts, as identified in the *Physical Monitoring and Management Plan* in Appendix D of the PEIS/R. If the San Joaquin River within the Restoration Area contains flow other than Restoration Flows, concurrent Restoration Flows may be reduced such that the total flow does not exceed then-existing channel capacity. If flood control releases from Friant Dam or other flood control facilities in the San Joaquin River system exceed the concurrent scheduled Restoration Flows, no additional releases above those required for flood control would be made for SJRRP purposes.

Until sufficient data are available to determine the levee seepage and stability Factors of Safety, Reclamation would limit Restoration Flow releases to those flows which would remain in-channel. When sufficient data are available to determine the Factors of Safety, Reclamation would limit the release of Restoration Flows to those flows which would maintain standard USACE levee performance criteria at all times.

The following sections identify potential immediate, near-term and long-term actions by the SJRRP that could affect then-existing channel capacity due to changes in the physical conditions within the Restoration Area. The listed potential actions and projects is not a comprehensive list, but a list of actions that may be implemented. If any actions increase then-existing channel capacity, a new Channel Capacity Report will be prepared prior to Reclamation increasing Restoration Flows.

6.1 Immediate Actions

Immediate actions are described at a project-level in the PEIS/R including specific details in the *Physical Monitoring and Management Plan*. Potential immediate actions to a reduction in channel capacity continue to include removal of vegetation and debris and/or restrictions on Restoration Flows that would exceed channel capacity. Since the start of Restoration Flows, the SJRRP has implemented flow limitations and immediate flow reductions to address issues related to capacity, mainly for agricultural seepage and will continue to do so on an as-needed basis during the release of Restoration Flows from Friant Dam. The PEIS/R states that during flood releases from Friant Dam no Restoration Flows will be released, except in the case when flood releases do not meet minimum scheduled Restoration Flows. This CCR addresses Friant releases to meet full Restoration Flows in the system and the channel capacities in the CCR are to ensure flood risk is minimized by Friant Dam releases staying below levees in areas where no levee information is available or below the USACE criteria for levee seepage and stability.

1 Recent conditions have highlighted a situation where Restoration Flows can mix with flood
2 flows when Friant Dam is not in flood operations, but tributaries of the San Joaquin River are in
3 flood operations. These tributaries — Little Dry Creek and Cottonwood Creek in Reach 1A;
4 Kings River in Reach 3; Fresno River, Ash Slough and Berenda Slough in the Upper Eastside
5 Bypass; and Owens Creek, Duck Slough, and Bear Creek in the Lower Eastside Bypass — could
6 in themselves exceed the levee stability criteria or when mixed with Restoration Flows exceed
7 the criteria. The latter could increase flood risk in the system from the additional Restoration
8 Flows from Friant Dam. The reaches that could be affected in this situation include Reach 2A,
9 Reach 2B, Reach 3, Reach 5, Middle Eastside Bypass, and the Lower Eastside Bypass.

10 During any such occurrence, DWR and Reclamation will coordinate on the best way to minimize
11 flood risk. This is a rare case and is not expected to have much significance on levee stability
12 within the Restoration Area. This is especially true in those reaches where agricultural seepage
13 limitations currently exist.

14 **6.2 Near-Term Actions**

15 In addition to immediate actions, the SJRRP is evaluating sediment, vegetation and operational
16 and maintenance projects that are being considered for implementation in the next couple of
17 years (near-term) to address the potential to maintain or increase then-existing channel
18 capacities. The near-term actions are described in more detail in the 2018 CCR and are
19 summarized in the *Physical Monitoring and Management Plan* (in Appendix D of the PEIS/R).
20 Updates on some of these actions are described below.

21 **6.2.1 Maintenance**

22 The maintenance of the channels within the Restoration Area can impact then-existing channel
23 capacity. Specifically, vegetation and how it is managed can reduce channel capacity by
24 increasing channel roughness. Because of the channel being wetted year-round since 2016, the
25 LSJLD is unable to perform some of its channel maintenance activities using its existing
26 resources and procedures. DWR has met with the LSJLD to better understand its maintenance
27 operations to identify what changes are needed to continue maintenance in those reaches that
28 convey Restoration Flows. DWR is currently drafting a report that identifies maintenance
29 methods and potential costs in a wet system. DWR plans to meet with the LSJLD and CVFPB in
30 the latter half of 2019 to discuss the contents of the report and to determine a path forward for
31 implementation.

32 **6.2.2 Seepage Management Plan**

33 Reclamation has developed a *Seepage Management Plan* and *Seepage Project Handbook* to
34 guide efforts related to groundwater seepage. It should be noted that the actions and findings of
35 the *Seepage Management Plan*, although related to channel capacity, is being reported as it

1 relates to agricultural seepage only. Anticipated Restoration Flow limitations for each reach due
 2 to agricultural seepage for the 2020 Restoration Year is shown in Table 6-1.

3 The *Seepage Management Plan* and *Seepage Project Handbook* can be found at the SJRRP
 4 website under the following link:

5 <http://www.restoresjr.net/restoration-flows/seepage-projects/>
 6

7 **Table 6-1.**
 8 **Restoration Flow Limitations as it Relates to Agricultural Seepage**

Reach ¹	Seepage Management Plan Approximate Restoration Flow Limitations ² (cfs)
Reach 2A	2,140
Reach 2B	1,300
Reach 3	720 ³
Reach 4A	250 ³

9 ¹ Only critical reaches have been evaluated for potential seepage impacts.

10 ² Subject to real time groundwater monitoring.

11 ³ Restoration Flow limitation due to agricultural seepage has been updated based on real-time monitoring.

12 **6.3 Long-Term Actions**

13 Long-term actions by the SJRRP will be needed to achieve then-existing channel capacity in the
 14 San Joaquin River and flood bypasses that can convey maximum Restoration Flow releases.
 15 Potential long-term actions could include, but would not be limited to, the following: providing a
 16 larger floodplain between levees through the acquisition of land and construction of setback
 17 levees; re-grading of land between levees; construction of sediment traps; sediment removal;
 18 levee improvements; construction of grade control structures; and channel grading.

19 Long-term actions would require a determination of need, identification for funding, and site-
 20 specific environmental compliance documentation. These actions would be considered by the
 21 SJRRP to allow the continued increase of then-existing channel capacity to meet full Restoration
 22 Flows.

23 The SJRRP is continuing to work on several long-term projects related to changing site-specific
 24 channel capacity as provided for in the Settlement paragraphs 11(a) and 11(b). A status update
 25 on advancement of the long-term progress includes:

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- 2 • Construct Mendota Pool Bypass and Reach 2B Improvements. The Compact Bypass
3 would route flows and fish around the Mendota Pool and would improve channel
4 capacity to at least 4,500 cfs from Reach 2B to Reach 3. Additionally, the Mendota Pool
5 Control Structure would allow for deliveries into Mendota Pool, as appropriate. Pool
6 operations would continue at the same water surface elevation as it does now, and the
7 project includes a fish screen to avoid fish straying into Mendota Pool. Construction of
8 this project is planned to begin in 2020. In the meantime, Reclamation continues to
9 maintain the existing flood conveyance infrastructure. During 2019, Reclamation
10 stabilized existing levees near the Mendota Pool by addressing seven seepage locations
11 and a levee breach that was estimated to be 30 feet wide. A summary of the work
12 completed can be referenced at the following website:

13 http://www.restoresjr.net/?wpfb_dl=2354

14 As construction proceeds and the river slope equilibrates through the new bypass
15 channel, this reach will be an active site of erosion and deposition and may influence
16 downstream sediment transport. Though sediment transport modeling indicates that much
17 of the mobile sediment will move out the Restoration Area, monitoring stations are being
18 established to track the effects of Mendota Pool Bypass on key infrastructure and channel
19 capacity (Section 7.2.6).

- 20 • Construct levee and fish passage improvements in the Middle Eastside Bypass (the
21 Eastside Bypass between the Sand Slough Control Structure and Mariposa Bypass). The
22 improvements that will impact channel capacity include reinforcing two miles of right
23 levee along the Eastside Bypass to improve levee stability and reduce seepage. This
24 improvement will increase Restoration Flows to at least 2,500 cfs in the reach. Another
25 improvement includes removing two weirs located in the Eastside Bypass and operated
26 by U.S. Fish and Wildlife Service within the MNWR to allow for fish passage. Removal
27 of the weirs began in 2019 and will be completed in 2020, and construction of the levee
28 improvements are anticipated to begin in 2020.

29 **6.4 Framework for Implementation**

30 The long-term actions identified above, with the exception of the Reach 4B Project, are included
31 in the SJRRP's 2018 *Funding Constrained Framework for Implementation* (Constrained
32 Framework). This is an update of the 2015 *Revised Framework for Implementation* (Revised
33 Framework), given a more limited future funding stream than previously anticipated. The first
34 stage (termed Stage 1) has the primary goal of beginning the reestablishment of spring-run and
35 fall-run Chinook salmon in the San Joaquin River between the Merced River and Friant Dam
36 through the establishment of volitional fish passage, sufficient flows to manage temperatures,
37 and provide for the basic habitat needs of the species. Both the current Constrained Framework
38 and previous Revised Framework establish the following:

- 1 • Five-year visions to provide clear, realistic, and accomplishable steps towards meeting
2 the Restoration Goal and Water Management Goal;
- 3 • Achievable schedules based upon realistic Federal and State of California appropriation
4 levels, improving our ability to plan and be transparent on actions; and
- 5 • More clearly defined roles and responsibilities for each Implementing Agency, increasing
6 each agency’s ability to budget, plan, and approve construction actions.

7 This Constrained Framework provides a more realistic schedule and associated future funding
8 needs for the SJRRP Implementing Agencies to focus on “core” actions identified in the 2012
9 Framework and Implementation of the Settlement and the Settlement Act. The Constrained
10 Framework includes objectives to have 2,500 cubic feet per second of channel capacity
11 throughout the San Joaquin River to Reach 4A, the Eastside Bypass and Reach 5 by the end of
12 2024. Channel capacity improvements include levee improvements identified by the remaining
13 reaches constrained by then-existing channel capacity, and groundwater seepage projects needed
14 to release flows without causing crop yield impacts. Approximately \$20 million of levee
15 improvement projects and \$72 million of seepage projects are included in the Constrained
16 Framework.

17 The Constrained Framework can be found at the SJRRP website under the following link:

18 http://www.restoresjr.net/?wpfb_dl=2163

7.0 Program Studies and Monitoring with the Potential to Inform Then-existing Channel Capacity

There are several factors that can impact and limit channel capacity. Potential factors could include overall levee construction or integrity (e.g., insufficient slope stability factor of safety or underseepage factor of safety); flow duration and timing that could saturate the levee and cause instability; erosion of the stream banks that could cause potential levee failure; sedimentation or scouring; ground subsidence; and increased roughness from vegetation. Other future conditions, such as climate change and operation and maintenance while not directly impacting channel capacity, could have long-term impacts on overall performance of the conveyance system. These factors, as well as others were considered in developing SJRRP studies and monitoring to determine then-existing channel capacity. The following sections summarize studies and data collection activities by the SJRRP to provide a better understanding of then-existing channel capacity or changes in in-channel capacity.

7.1 Technical Studies

The following describes the activities that are ongoing or may be conducted during the next Restoration Year.

7.1.1 San Joaquin Levee Evaluation Project

The SJLE Project led by DWR assists the SJRRP in assessing flood risks associated with the SJRRP with respect to levee seepage and stability. As part of the work, DWR identified three priorities for levee evaluations representing an increasing priority for the need to complete geotechnical evaluations and analyses. DWR has completed its evaluation of Priority 1 levees and as a result will be reinforcing approximately 2 miles of levee along the Eastside Bypass to improve levee stability and reduce seepage (same levee improvement project described in Section 6.3 above). In 2019, DWR also completed a geotechnical assessment of the Priority 2 levees, which are being considered in this CCR. At the end of 2019, DWR will have identified for the SJRRP potential future remediation needs and associated costs for improvement of the Priority 2 levees. Additional geotechnical exploration of the Priority 3 levees has been put on hold until funding becomes available.

7.1.2 Modeling Tools and Updates

The SJRRP has developed hydraulic and sediment transport modeling tools to evaluate the flow, seepage, and structural actions as part of meeting the Restoration Goal of the Settlement. Due to continued subsidence, in 2015 a new flight of aerial photography and LiDAR was flown in all reaches of the San Joaquin River from Friant Dam to the Merced River confluence as well as the Chowchilla, Eastside, and Mariposa Bypasses. Bathymetric surveys were also completed in 2015 and 2016. The data has been processed and new terrain surfaces have been prepared for critical

1 reaches. Some of the modeling tools have been updated to reflect the most recent data depending
2 on the location, priority and effort. Currently, the model used by the SJRRP for the various
3 studies have provided the level of accuracy needed for the specific effort. However, DWR and
4 Reclamation plan to conduct additional site-specific surveys to verify the 2015 LiDAR to
5 determine if all or some of the modeling tools need additional updates.

6 **7.1.3 Subsidence Studies**

7 Previous channel capacity reports include a description of the methods and results of the
8 subsidence monitoring and levee surveys completed by Reclamation and DWR-SCRO for the
9 SJRRP. In 2019, DWR completed topographic surveys of the top of levees in Reach 4A, the
10 Middle Eastside Bypass and the Mariposa Bypass. The results of this subsidence monitoring will
11 be assessed in 2020 to determine if an update to the model topography in key reaches will be
12 necessary. The DWR and bi-annual surveys by Reclamation will continue to determine if
13 subsidence is impacting then-existing channel capacity.

14 **7.2 Monitoring Activities**

15 The SJRRP is continuing various monitoring activities for different studies and purposes. These
16 activities are described in the *Physical Monitoring and Management Plan*, which is in
17 Appendix D of the PEIS/R, the *Restoration Flow Guidelines*, and the *Seepage Management*
18 *Plan*. Typical activities, including flow, sediment mobilization and erosion monitoring, and
19 water surface profile surveys are also described in previous channel capacity reports and are
20 conducted when needed. Updates on the ongoing monitoring activities are described below.

21 **7.2.1 Flow Monitoring**

22 The objective of continuing to monitor flow is to ensure compliance with Restoration
23 Administrator flow recommendations and/or the hydrograph releases in Exhibit B of the
24 Settlement and any other applicable flow releases without exceeding then-existing channel
25 capacity. Reclamation, DWR and the USGS currently maintain several flow and staff gages
26 along the San Joaquin River and tributaries between Friant Dam and the Merced confluence.
27 These gages are used to determine the flow in each reach of the river. In 2019, DWR installed a
28 gage to measure tributary inflows from Owens Creek and plans to install a gage in Reach 4A at
29 Highway 152 later this year. All the gages are available online at the California Data Exchange
30 Center (CDEC).

31 **7.2.2 Water Surface Profile Surveys**

32 Along with flow monitoring, water surface profile (WSP) surveys help inform the SJRRP of the
33 potential changes in stage and channel capacity as a result of a change in specific or reach-wide
34 conditions due to subsidence, vegetation, channel work and sediment transport. To help with

1 model calibration, in June 2019, additional WSP surveys were completed in Reach 3, Reach 4A,
2 the Middle Eastside Bypass and the Mariposa Bypass during Flood Flow releases of about
3 2,500 cfs from Friant Dam. Additional WSP surveys may again be completed in 2019/2020 for
4 some reaches, depending on flow releases from Friant Dam and model calibration needs.

5 **7.2.3 Aerial Photography and Topographic Surveys**

6 The purpose of the aerial photography and topographic surveys is to obtain information about the
7 river stage, hydraulic roughness, river width, and bed elevation to assist with scientific studies
8 that would inform the SJRRP about how physical changes in the system are impacting then-
9 existing channel capacities. In addition to the topographic surveys to monitor for subsidence,
10 additional aerial photography and topographic surveys are being considered over the next three
11 years to aid in the design of the Mendota Pool Compact Bypass and Reach 2B setback levees.
12 Subsidence and future channel changes may also prompt the need for additional surveys in other
13 areas within the next five years.

14 **7.2.4 Vegetation Surveys**

15 The purpose of the previous and future vegetation surveys is to obtain information on the
16 establishment and recruitment of vegetation. This information can be used by the SJRRP to
17 determine if actions need to be taken to address capacity issues as a result of increased roughness
18 from vegetation within the channel and helps inform availability of fish habitat. Annual surveys
19 have occurred since 2011 and future surveys will be conducted annually after flood events as
20 part of baseline SJRRP monitoring. River stage and shallow groundwater levels were monitored
21 in July 2019 in potential recruitment areas during the flood flow ramp-down. The extent and
22 scope of vegetation monitoring is discussed in Section 10.2.5 of the 2014 CCR.

23 **7.2.5 Levee Monitoring Program**

24 The SJRRP has committed to minimizing flood risk from Restoration Flows as outlined in the
25 PEIS/R. This effort includes collecting levee performance data within the Restoration Area with
26 a focus on levees most critical to limiting the release of restoration flows. Because levee
27 evaluations are limited to a seepage and stability analysis, and do not include assessment of other
28 levee failure mechanisms, a field monitoring program was established to evaluate the levees
29 during high-water events and during Restoration Flows, which allow early identification of
30 potential problems.

31 Prolonged flood releases from Friant Dam into the summer months during the Water Year 2019
32 resulted in five rounds of visual levee inspection between February and July. The visual
33 inspections were completed in the Middle Eastside Bypass and Reach 4B2. These inspections did
34 not reveal any major performance issues. Future levee monitoring is expected to continue on an
35 as-needed basis depending on flood and Restoration Flow releases as well as changes in channel
36 capacity identified in future channel capacity reports.

1 **7.2.6 Sediment Monitoring**

2 The purpose of sedimentation mobilization and erosion monitoring is to obtain information on
3 sediment mobilization, bar formation, bank erosion, and bed erosion. This information will be
4 useful for developing studies to determine the impacts of sedimentation and erosion on channel
5 capacity as well as a key step in consideration of any sediment management actions. As
6 described in Section 2.2.4 and Response to Comment O-EC-64 on page ii-197 of the Mendota
7 Pool Bypass and Reach 2B EIS/R, as well as, in the PEIS/R, if unacceptable levels of erosion or
8 deposition occur in priority locations that limit channel capacity or impact infrastructure,
9 monitoring could trigger a suite of erosion and deposition management measures. Details
10 regarding the ongoing sediment monitoring efforts are summarized in 10.2.7 of the 2018 CCR.
11

1 8.0 References

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3 on Capacity up to 2,500 cfs in Reach 4A and Middle Eastside Bypass
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