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City of Lathrop and City of Manteca ULDC Evaluation
Minimum Top of Levee and Hydraulic Top of Levee

Prepared for: City of Lathrop & City of Manteca *February 8, 2016*

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Introduction

The minimum top of levee (MTOL) is the required minimum elevation of the physical top of levee for providing reasonable assurance of containing the design water surface elevation (DWSE). The hydraulic top of levee (HTOL) is an elevation at or between the DWSE and the MTOL that is used to provide reasonable assurance that the levee will be stable under extreme loading conditions. This report details the methods used to obtain the MTOL and HTOL, and shows the resulting MTOL and HTOL profiles throughout the levee system.

As with the DWSE, the MTOL and HTOL can each be determined by either the FEMA or USACE method. This study uses the FEMA approach to determine the DWSE, and will therefore use the FEMA approach to in determining the MTOL and HTOL.

Methods

The hydraulic modeling analysis that arrived at the WSELs used in this analysis is detailed in the PBI report, *200-year Freeboard Analysis & Floodplain Mapping within RD17* (May 23, 2014). Wind-wave calculations are also used in this analysis and are detailed in the PBI report, *Wind Setup and Wave Run-up Calculations* which is included in this ULDC submittal.

Minimum Top of Levee (MTOL)

The FEMA approach to determining an MTOL requires demonstration that levee freeboard is sufficient to contain the 200-year flow. The median 200-year water surface elevation (WSEL) and computed wind setup and wave run-up height are required to compute the MTOL with the FEMA approach. The MTOL is the higher of:

A. The median 200-year WSEL + 3 ft
B. The median 200-year WSEL + wind setup and wave run-up height

Hydraulic Top of Levee (HTOL)

Calculation of the HTOL by the FEMA approach requires knowing the median 200-year and 500-year water surface profile. The 200-year and 500-year WSELs were previously discussed in the DWSE TM included in this ULDC submittal. The FEMA approach to determining the HTOL is the lower of:

A. The median 200-year WSEL + 3 feet
B. The median 500-year WSEL

The HTOL without adjustments (in-situ HTOL) was used for initial ULDC analyses and for determination of whether work is required to achieve ULDC compliance. To accommodate uncertainties and future modifications to hydrology, 1 foot will be added to the in-situ HTOL for the design HTOL to be used where geotechnical levee work is required.

Results

Results from the MTOL and HTOL analysis are presented below:

Minimum Top of Levee (MTOL)

The MTOL is controlled by the median 200-year WSEL + wind wave setup and run-up for portions of the RD17 dryland levee, and by the median 200-year WSEL + 3 feet for the rest of the RD17 levee reaches. Table 1 shows the wind setup and wave run-up heights for three analysis points along the dryland levee. The MTOL remains below the surveyed top of levee for all of RD-17.

Table 1: Wind Setup and Wave Run-up heights control the MTOL for portions of the dryland levee.

Station	Wind Setup and Wave Run-up height (ft)	MOTL (ft NAVD-88)
854+10	3.0	32.8
908+60	3.8	34.1
971+60	3.6	34.1

The MTOL profile is presented in Figure 1.

Hydraulic Top of Levee (HTOL)

The median 500-year WSEL controls the HTOL for all levee reaches. The in-situ HTOL profile is presented in Figure 1. A hydraulic summary table is also provided in Attachment A.

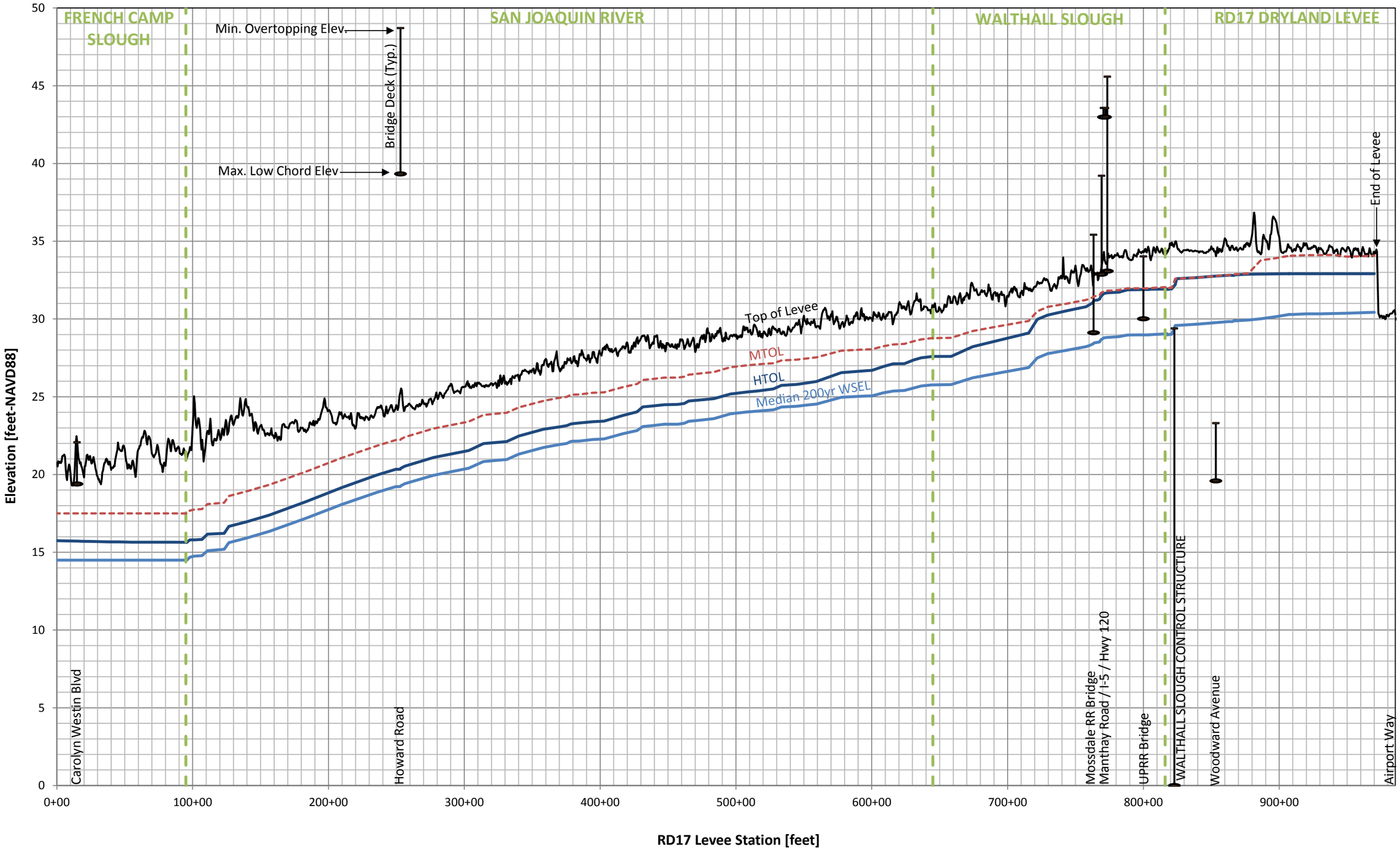

Figure 1: MTOL and HTOL for in-situ evaluation

ATTACHMENT A

HYDRAULIC SUMMARY TABLE

(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
	Stationing			Design Parameters for Minimum ULDC Requirements						Design Parameters with Uncertainty Allowances (for reaches requiring work)								Identification of "Work" vs. "No Work" Reaches				MTOL	HTOL	Misc. Hydraulic Data		
				DWSE	MTOL			HTOL		DWSE			MTOL			HTOL										
Stream	PBI Model Station	PBI Model Station	Approx. KSN RD17 Levee Station	200yr WSEL	DWSE + 3-feet	Wind Setup/ Wave Runup[a]	Minimum Top of Levee (MTOL)	500yr WSEL	Hydraulic Top of Levee (HTOL)	200yr WSEL	ULDC 7.1.3. Adjustments and Other Considerations	Adjusted DWSE	Adjusted DWSE + 3-feet	Wind Setup/ Wave Runup[a]	Adjusted Minimum Top of Levee (MTOL)[b]	Adjusted 500yr WSEL	Adjusted Hydraulic Top of Levee (HTOL)	Surveyed Top of Levee	Freeboard Check	Other Physical Work Required?	Identification of Reaches Requiring Work	Final MTOL	Final HTOL	Seismic Stability	Erosion Analysis	Rapid Drawdown
	[miles]	[miles]	[feet]	[feet-NAVD88]	[feet-NAVD88]	[feet]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[feet]	[feet-NAVD88]	[feet-NAVD88]	[feet]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[OK / feet deficient]	[Yes / No]	[Work / No Work]	[feet-NAVD88]	[feet-NAVD88]	10yr WSEL [feet-NAVD88]	200yr Velocity [ft/sec]	Expected 30 day Drop in Stage [feet]
French Camp Slough	2.1954100	2.1954	-1+18	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	20.8	--	--	--	17.5	16.74	11.6	1.2	3.7
French Camp Slough	2.0058300	2.0058	8+40	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	20.4	OK	No	No Work	17.50	15.73	11.5	1.1	3.7
French Camp Slough	1.9867001	1.9867	9+40	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	20.5	OK	No	No Work	17.50	15.73	11.5	1.2	3.7
French Camp Slough	1.9185200	1.9185	14+25	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	22.5	OK	No	No Work	17.50	15.72	11.5	1.0	3.7
French Camp Slough	1.8995800	1.8996	15+40	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	21.5	OK	No	No Work	17.50	15.72	11.5	1.1	3.7
French Camp Slough	1.8200400	1.8200	17+45	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	20.8	OK	No	No Work	17.50	15.71	11.5	0.9	3.7
French Camp Slough	1.6537499	1.6537	25+10	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	20.9	OK	No	No Work	17.50	15.70	11.4	1.1	3.7
French Camp Slough	1.3361501	1.3362	38+90	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	20.8	OK	No	No Work	17.50	15.67	11.3	1.2	3.7
French Camp Slough	1.1844500	1.1845	46+00	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	21.6	OK	No	No Work	17.50	15.67	11.3	1.0	3.7
French Camp Slough	1.1842600	1.1843	45+99	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	21.6	OK	No	No Work	17.50	15.67	11.3	1.0	3.7
French Camp Slough	0.9946800	0.9947	54+95	14.5	17.5	-	17.5	15.7	15.7	14.5	1.0	15.5	18.5	-	18.5	16.7	16.7	20.5	OK	No	No Work	17.50	15.65	11.3	1.3	**3.7**
French Camp Slough	0.7539600	0.7540	64+50	14.5	17.5	-	17.5	15.6	15.6	14.5	1.0	15.5	18.5	-	18.5	16.6	16.6	22.8	OK	No	No Work	17.50	15.65	11.3	0.9	3.7
French Camp Slough	0.5253700	0.5254	73+60	14.5	17.5	-	17.5	15.6	15.6	14.5	1.0	15.5	18.5	-	18.5	16.6	16.6	21.7	OK	No	No Work	17.50	15.65	11.3	1.4	3.7
French Camp Slough	0.2793500	0.2794	85+55	14.5	17.5	-	17.5	15.6	15.6	14.5	1.0	15.5	18.5	-	18.5	16.6	16.6	22.2	OK	No	No Work	17.50	15.64	11.2	1.5	3.7
French Camp Slough	0.0662900	0.0663	93+95	14.5	17.5	-	17.5	15.6	15.6	14.5	1.0	15.5	18.5	-	18.5	16.6	16.6	21.5	OK	No	No Work	17.50	15.64	11.1	2.2	3.7
French Camp Slough	0.0661000	0.0661	93+94	14.5	17.5	-	17.5	15.6	15.6	14.5	1.0	15.5	18.5	-	18.5	16.6	16.6	21.5	OK	No	No Work	17.50	15.64	11.1	2.2	3.7
San Joaquin River	5.7184401	5.7184	95+70	14.5	17.5	-	17.5	15.6	15.6	14.5	1.0	15.5	18.5	-	18.5	16.6	16.6	21.0	OK	No	No Work	17.50	15.64	11.1	4.9	3.8
San Joaquin River	5.7186298	5.7186	95+71	14.5	17.5	-	17.5	15.6	15.6	14.5	1.0	15.5	18.5	-	18.5	16.6	16.6	21.0	OK	No	No Work	17.50	15.64	11.1	4.9	3.9
San Joaquin River	5.7892699	5.7893	97+90	14.7	17.7	-	17.7	15.8	15.8	14.7	1.0	15.7	18.7	-	18.7	16.8	16.8	21.8	OK	No	No Work	17.68	15.80	11.2	4.0	4.0
San Joaquin River	5.8741202	5.8741	101+25	14.7	17.7	-	17.7	15.8	15.8	14.7	1.0	15.7	18.7	-	18.7	16.8	16.8	24.6	OK	No	No Work	17.75	15.80	11.3	5.9	4.1
San Joaquin River	5.9748802	5.9749	106+85	14.8	17.8	-	17.8	15.8	15.8	14.8	1.0	15.8	18.8	-	18.8	16.8	16.8	22.2	OK	No	No Work	17.78	15.83	11.3	6.5	4.2
San Joaquin River	6.0504398	6.0504	110+85	15.1	18.1	-	18.1	16.2	16.2	15.1	1.0	16.1	19.1	-	19.1	17.2	17.2	22.8	OK	No	No Work	18.10	16.17	11.4	5.5	4.3
San Joaquin River	6.2951398	6.2951	123+20	15.2	18.2	-	18.2	16.2	16.2	15.2	1.0	16.2	19.2	-	19.2	17.2	17.2	22.5	OK	Yes	WORK REQUIRED	18.19	17.22	11.5	7.4	4.4
San Joaquin River	6.3684301	6.3684	126+60	15.6	18.6	-	18.6	16.7	16.7	15.6	1.0	16.6	19.6	-	19.6	17.7	17.7	22.8	OK	Yes	WORK REQUIRED	18.61	17.66	11.6	5.9	4.5
San Joaquin River	6.6451302	6.6451	139+85	15.9	18.9	-	18.9	17.0	17.0	15.9	1.0	16.9	19.9	-	19.9	18.0	18.0	24.4	OK	Yes	WORK REQUIRED	18.92	17.97	11.8	6.6	4.6
San Joaquin River	6.9216399	6.9216	156+50	16.3	19.3	-	19.3	17.4	17.4	16.3	1.0	17.3	20.3	-	20.3	18.4	18.4	22.5	OK	Yes	WORK REQUIRED	19.34	18.39	12.0	6.8	**4.8**
San Joaquin River	7.4335599	7.4336	183+50	17.2	20.2	-	20.2	18.3	18.3	17.2	1.0	18.2	21.2	-	21.2	19.3	19.3	22.7	OK	Yes	WORK REQUIRED	20.19	19.26	12.4	6.9	5.0
San Joaquin River	7.9358201	7.9358	209+55	18.1	21.1	-	21.1	19.2	19.2	18.1	1.0	19.1	22.1	-	22.1	20.2	20.2	24.0	OK	Yes	WORK REQUIRED	21.07	20.15	12.8	6.6	5.1
San Joaquin River	8.4411097	8.4411	235+75	18.9	21.9	-	21.9	20.0	20.0	18.9	1.0	19.9	22.9	-	22.9	21.0	21.0	24.3	OK	Yes	WORK REQUIRED	21.85	20.96	13.2	6.0	5.3
San Joaquin River	8.7200804	8.7201	249+60	19.2	22.2	-	22.2	20.3	20.3	19.2	1.0	20.2	23.2	-	23.2	21.3	21.3	24.3	OK	Yes	WORK REQUIRED	22.22	21.34	13.4	5.8	5.4
San Joaquin River	8.7719803	8.7720	252+80	19.2	22.2	-	22.2	20.3	20.3	19.2	1.0	20.2	23.2	-	23.2	21.3	21.3	25.3	OK	No	No Work	22.22	20.34	13.4	6.3	5.6
San Joaquin River	8.7829599	8.7830	253+40	19.3	22.3	-	22.3	20.4	20.4	19.3	1.0	20.3	23.3	-	23.3	21.4	21.4	25.5	OK	No	No Work	22.28	20.40	13.4	6.3	5.7
San Joaquin River	8.8354197	8.8354	256+20	19.4	22.4	-	22.4	20.5	20.5	19.4	1.0	20.4	23.4	-	23.4	21.5	21.5	24.1	OK	Yes	WORK REQUIRED	22.41	21.53	13.5	5.9	5.9
San Joaquin River	9.2501898	9.2502	277+30	20.0	23.0	-	23.0	21.1	21.1	20.0	1.0	21.0	24.0	-	24.0	22.1	22.1	24.7	OK	Yes	WORK REQUIRED	22.95	22.09	13.8	5.5	6.1
San Joaquin River	9.7528296	9.7528	303+25	20.4	23.4	-	23.4	21.5	21.5	20.4	1.0	21.4	24.4	-	24.4	22.5	22.5	25.8	OK	No	No Work	23.40	21.54	14.1	6.2	6.2
San Joaquin River	9.9698696	9.9699	314+10	20.8	23.8	-	23.8	22.0	22.0	20.8	1.0	21.8	24.8	-	24.8	23.0	23.0	25.7	OK	No	No Work	23.83	21.99	14.3	5.1	6.4
San Joaquin River	10.2598200	10.2598	331+20	21.0	24.0	-	24.0	22.1	22.1	21.0	1.0	22.0	25.0	-	25.0	23.1	23.1	25.9	OK	No	No Work	23.97	22.12	14.5	6.2	6.5
San Joaquin River	10.4649296	10.4649	340+20	21.3	24.3	-	24.3	22.5	22.5	21.3	1.0	22.3	25.3	-	25.3	23.5	23.5	26.2	OK	No	No Work	24.32	22.48	14.7	5.7	6.7
San Joaquin River	10.7819700	10.7820	358+50	21.7	24.7	-	24.7	22.9	22.9	21.7	1.0	22.7	25.7	-	25.7	23.9	23.9	27.0	OK	No	No Work	24.74	22.91	14.9	5.0	6.8
San Joaquin River	10.9706097	10.9706	369+50	21.9	24.9	-	24.9	23.1	23.1	21.9	1.0	22.9	25.9	-	25.9	24.1	24.1	26.9	OK	Yes	WORK REQUIRED	24.92	24.05	15.1	4.0	7.0
San Joaquin River	11.0416298	11.0416	375+60	22.0	25.0	-	25.0	23.1	23.1	22.0	1.0	23.0	26.0	-	26.0	24.1	24.1	27.2	OK	Yes	WORK REQUIRED	25.00	24.15	15.1	5.1	7.2
San Joaquin River	11.1675701	11.1676	377+90	22.1	25.1	-	25.1	23.2	23.2	22.1	1.0	23.1	26.1	-	26.1	24.2	24.2	27.5	OK	Yes	WORK REQUIRED	25.11	24.23	15.2	3.4	7.3
San Joaquin River	11.2895403	11.2895	379+35	22.1	25.1	-	25.1	23.3	23.3	22.1	1.0	23.1	26.1	-	26.1	24.3	24.3	27.2	OK	Yes	WORK REQUIRED	25.14	24.27	15.2	5.1	7.5
San Joaquin River	11.3956003	11.3956	384+60	22.1	25.1	-	25.1	23.3	23.3	22.1	1.0	23.1	26.1	-	26.1	24.3	24.3	27.5	OK	Yes	WORK REQUIRED	25.15	24.31	15.2	5.4	7.6
San Joaquin River	11.4662399	11.4662	394+30	22.3	25.3	-	25.3	23.4	23.4	22.3	1.0	23.3	26.3	-	26.3	24.4	24.4	27.9	OK	Yes	WORK REQUIRED	25.25	24.40	15.3	4.9	7.8
San Joaquin River	11.5550604	11.5551	402+90	22.3	25.3	-	25.3	23.4	23.4	22.3	1.0	23.3	26.3	-	26.3	24.4	24.4	28.1	OK	Yes	WORK REQUIRED	25.29	24.44	15.3	5.4	**8.1**
San Joaquin River	11.8768396	11.8768	416+90	22.6	25.6	-	25.6	23.8	23.8	22.6	1.0	23.6	26.6	-	26.6	24.8	24.8	28.2	OK	Yes	WORK REQUIRED	25.62	24.80	15.6	5.5	8.1
San Joaquin River	12.0569496	12.0569	427+20	22.8	25.8	-	25.8	24.0	24.0	22.8	1.0	23.8	26.8	-	26.8	25.0	25.0	28.7	OK	Yes	WORK REQUIRED	25.83	25.03	15.7	5.3	8.2
San Joaquin River	12.1794796	12.1795	431+40	23.1	26.1	-	26.1	24.3	24.3	23.1	1.0	24.1	27.1	-	27.1	25.3	25.3	28.9	OK	Yes	WORK REQUIRED	26.08	25.35	15.8	3.6	8.2
San Joaquin River	12.2931204	12.2931	437+65	23.1	26.1	-	26.1	24.4	24.4	23.1	1.0	24.1	27.1	-	27.1	25.4	25.4	28.3	OK	Yes	WORK REQUIRED	26.13	25.40	15.9	4.0	8.3
San Joaquin River	12.3717098	12.3717	447+40	23.2	26.2	-	26.2	24.5	24.5	23.2	1.0	24.2	27.2	-	27.2	25.5	25.5	28.3	OK	Yes	WORK REQUIRED	26.23	25.49	16.0	3.7	8.3
San Joaquin River	12.5374298	12.5374	457+15	23.2	26.2	-	26.2	24.5	24.5	23.2	1.0	24.2	27.2	-	27.2	25.5	25.5	28.4	OK	Yes	WORK REQUIRED	26.23	25.51	16.1	5.0	8.4
San Joaquin River	12.6300402	12.6300	462+00	23.3	26.3	-	26.3	24.6	24.6	23.3	1.0	24.3	27.3	-	27.3	25.6	25.6	28.1	OK	Yes	WORK REQUIRED	26.29	25.57	16.1	5.0	8.4
San Joaquin River	12.6957598	12.6958	465+30	23.4	26.4	-	26.4	24.7	24.7	23.4	1.0	24.4	27.4	-	27.4	25.7	25.7	28.3	OK	Yes	WORK REQUIRED	26.42	25.72	16.1	4.4	8.5
San Joaquin River	12.8048496	12.8048	470+40	23.5	26.5	-	26.5	24.8	24.8	23.5	1.0	24.5	27.5	-	27.5	25.8	25.8	28.0	OK	Yes	WORK REQUIRED	26.47	25.77	16.2	4.8	8.5
San Joaquin River	13.0565500	13.0566	483+70	23.6	26.6	-	26.6	24.9	24.9	23.6	1.0	24.6	27.6	-	27.6	25.9	25.9	28.9	OK	Yes	WORK REQUIRED	26.59	25.88	16.3	5.4	8.6
San Joaquin River	13.2756701	13.2757	495+90	23.9	26.9	-	26.9	25.2	25.2	23.9	1.0	24.9	27.9	-	27.9	26.2	26.2	28.9	OK	Yes	WORK REQUIRED	26.90	26.18	16.5	4.3	8.6
San Joaquin River	13.4781303	13.4781	507+90	24.0	27.0	-	27.0	25.3	25.3	24.0	1.0	25.0	28.0	-	28.0	26.3	26.3	29.3	OK	Yes	WORK REQUIRED	27.02	26.31	16.6	4.5	8.7
San Joaquin River	13.5434704	13.5435	516+30	24.1	27.1	-	27.1	25.4	25.4	24.1	1.0	25.1	28.1	-	28.1	26.4	26.4	28.9	OK	No	No Work	27.08	25.37	16.7	3.7	8.8
San Joaquin River	13.7023697	13.7024	527+60	24.2	27.2	-	27.2	25.5	25.5	24.2	1.0	25.2	28.2	-	28.2	26.5	26.5	29.5	OK	No	No Work	27.16	25.51	16.7	5.2	8.8
San Joaquin River	13.8336096	13.8336	533+50	24.3	27.3	-	27.3	25.7	25.7	24.3	1.0	25.3	28.3	-	28.3	26.7	26.7	29.0	OK	No	No Work	27.34	25.73	16.9	4.3	8.9
San Joaquin River	14.0294399	14.0294	544+70	24.4	27.4	-	27.4	25.8	25.8	24.4	1.0	25.4	28.4	-	28.4	26.8	26.8	29.8	OK	No	No Work	27.39	25.80	16.9	4.9	8.9
San Joaquin River	14.2194004	14.2194	553+30	24.5	27.5	-	27.5	25.9	25.9	24.5	1.0	25.5	28.5	-	28.5	26.9	26.9	29.8	OK	No	No Work	27.48	25.90	17.0	5.3	9.0
San Joaquin River	14.3716698	14.3717	559+30	24.5	27.5	-	27.5	26.0	26.0	24.5	1.0	25.5	28.5	-	28.5	27.0	27.0	29.5	OK	No	No Work	27.53	25.98	17.1	5.9	9.0
San Joaquin River	14.6741304	14.6741	577+50	25.0	28.0	-	28.0	26.6	26.6	25.0	1.0	26.0	29.0	-	29.0	27.6	27.6	29.7	OK	No	No Work	27.97	26.55	17.4	1.8	9.1
San Joaquin River	14.9779100	14.9779	595+00	25.0	28.0	-	28.0	26.7	26.7	25.0	1.0	26.0	29.0	-	29.0	27.7	27.7	29.9	OK	No	No Work	28.05	26.66	17.5	4.6	9.1
San Joaquin River	15.1485500	15.1486	600+15	25.1	28.1	-	28.1	26.7	26.7	25.1	1.0	26.1	29.1	-	29.1	27.7	27.7	30.0	OK	No	No Work	28.05	26.70	17.5	5.2	9.2
San Joaquin River	15.2739201	15.2739	608+60	25.3	28.3	-	28.3	26.9	26.9	25.3	1.0	26.3	29.3	-	29.3	27.9	27.9	30.4	OK	No	No Work	28.26	26.94	17.7	3.1	9.2
San Joaquin River	15.3720303	15.3720	615+70	25.4	28.4	-	28.4	27.1	27.1	25.4	1.0	26.4	29.4	-	29.4	28.1	28.1	29.7	OK	No	No Work	28.36	27.11	17.7	4.4	9.3
San Joaquin River	15.5080099	15.5080	624+00	25.4	28.4	-	28.4	27.1	27.1	25.4	1.0	26.4	29.4	-	29.4	28.1	28.1	30.8	OK	No	No Work	28.40	27.13	17.8	4.2	9.3
San Joaquin River	15.6250496	15.6250	630+90	25.6	28.6	-	28.6	27.4	27.4	25.6	1.0	26.6	29.6	-	29.6	28.4	28.4	31.0	OK	No	No Work	28.57	27.36	17.9	3.1	9.4
San Joaquin River	15.7214499	15.7214	636+50	25.7	28.7	-	28.7	27.5	27.5	25.7	1.0	26.7	29.7	-	29.7	28.5	28.5	30.5	OK	No	No Work	28.69	27.51	18.0	2.9	9.4
San Joaquin River	15.9045897	15.9046	644+09	25.8	28.8	-	28.8	27.6	27.6	25.8	1.0	26.8	29.8	-	29.8	28.6	28.6	30.4	OK	No	No Work	28.77	27.58	18.1	2.5	9.5
San Joaquin River	15.9047804	15.9048	644+10	25.8	28.8	-	28.8	27.6	27.6	25.8	1.0	26.8	29.8	-	29.8	28.6	28.6	30.4	OK	No	No Work	28.77	27.59	18.1	2.5	9.5

(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
	Stationing			Design Parameters for Minimum ULDC Requirements						Design Parameters with Uncertainty Allowances (for reaches requiring work)								Identification of "Work" vs. "No Work" Reaches				MTOL	HTOL	Misc. Hydraulic Data		
				DWSE	MTOL			HTOL		DWSE			MTOL			HTOL								Seismic Stability	Erosion Analysis	Rapid Drawdown
Stream	PBI Model Station	PBI Model Station	Approx. KSN RD17 Levee Station	200yr WSEL	DWSE + 3-feet	Wind Setup/ Wave Runup[a]	Minimum Top of Levee (MTOL)	500yr WSEL	Hydraulic Top of Levee (HTOL)	200yr WSEL	ULDC 7.1.3. Adjustments and Other Considerations	Adjusted DWSE	Adjusted DWSE + 3-feet	Wind Setup/ Wave Runup[a]	Adjusted Minimum Top of Levee (MTOL)[b]	Adjusted 500yr WSEL	Adjusted Hydraulic Top of Levee (HTOL)	Surveyed Top of Levee	Freeboard Check	Other Physical Work Required?	Identification of Reaches Requiring Work	Final MTOL	Final HTOL	10yr WSEL	200yr Velocity	Expected 30 day Drop in Stage
	[miles]	[miles]	[feet]	[feet-NAVD88]	[feet-NAVD88]	[feet]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[feet]	[feet-NAVD88]	[feet-NAVD88]	[feet]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[OK / feet deficient]	[Yes / No]	[Work / No Work]	[feet-NAVD88]	[feet-NAVD88]	[feet-NAVD88]	[ft/sec]	[feet]
San Joaquin River	15.9652004	15.9652	645+19	25.8	28.8	-	28.8	27.6	27.6	25.8	1.0	26.8	29.8	-	29.8	28.6	28.6	30.9	OK	No	No Work	28.77	27.59	18.1	4.8	9.6
San Joaquin River	15.9653902	15.9654	645+20	25.8	28.8	-	28.8	27.6	27.6	25.8	1.0	26.8	29.8	-	29.8	28.6	28.6	30.9	OK	No	No Work	28.77	27.60	18.1	4.8	9.6
San Joaquin River	16.2473907	16.2474	658+40	25.8	28.8	-	28.8	27.6	27.6	25.8	1.0	26.8	29.8	-	29.8	28.6	28.6	31.0	OK	No	No Work	28.78	27.60	18.2	6.2	9.7
San Joaquin River	16.5585594	16.5586	674+40	26.2	29.2	-	29.2	28.2	28.2	26.2	1.0	27.2	30.2	-	30.2	29.2	29.2	32.1	OK	No	No Work	29.22	28.22	18.4	5.8	9.7
San Joaquin River	16.8615799	16.8616	693+50	26.5	29.5	-	29.5	28.6	28.6	26.5	1.0	27.5	30.5	-	30.5	29.6	29.6	31.1	OK	No	No Work	29.53	28.63	18.7	5.8	9.8
San Joaquin River	17.2646008	17.2646	715+50	26.9	29.9	-	29.9	29.1	29.1	26.9	1.0	27.9	30.9	-	30.9	30.1	30.1	31.8	OK	No	No Work	29.88	29.09	18.9	6.4	9.8
San Joaquin River	17.6719799	17.6720	721+80	27.5	30.5	-	30.5	30.0	30.0	27.5	1.0	28.5	31.5	-	31.5	31.0	31.0	32.4	OK	No	No Work	30.49	29.97	19.3	3.7	9.9
San Joaquin River	18.0780296	18.0780	729+60	27.8	30.8	-	30.8	30.3	30.3	27.8	1.0	28.8	31.8	-	31.8	31.3	31.3	32.5	OK	No	No Work	30.78	30.25	19.6	5.2	9.9
San Joaquin River	18.2799206	18.2799	743+70	28.0	31.0	-	31.0	30.5	30.5	28.0	1.0	29.0	32.0	-	32.0	31.5	31.5	32.7	OK	No	No Work	30.99	30.53	19.8	5.7	**10.0**
San Joaquin River	18.5439301	18.5439	757+85	28.2	31.2	-	31.2	30.8	30.8	28.2	1.0	29.2	32.2	-	32.2	31.8	31.8	33.1	OK	No	No Work	31.22	30.79	20.0	5.2	10.0
San Joaquin River	18.6047306	18.6047	761+00	28.3	31.3	-	31.3	31.0	31.0	28.3	1.0	29.3	32.3	-	32.3	32.0	32.0	33.2	OK	No	No Work	31.32	30.96	20.1	6.1	10.0
San Joaquin River	18.6566200	18.6566	762+70	28.4	31.4	-	31.4	31.0	31.0	28.4	1.0	29.4	32.4	-	32.4	32.0	32.0	32.6	OK	No	No Work	31.39	31.04	20.1	5.2	10.0
San Joaquin River	18.6740398	18.6740	763+65	28.5	31.5	-	31.5	31.2	31.2	28.5	1.0	29.5	32.5	-	32.5	32.2	32.2	33.0	OK	No	No Work	31.46	31.20	20.2	5.4	10.0
San Joaquin River	18.7287807	18.7288	766+25	28.5	31.5	-	31.5	31.2	31.2	28.5	1.0	29.5	32.5	-	32.5	32.2	32.2	32.5	OK	No	No Work	31.50	31.22	20.2	5.4	10.0
San Joaquin River	18.7647591	18.7648	767+90	28.5	31.5	-	31.5	31.3	31.3	28.5	1.0	29.5	32.5	-	32.5	32.3	32.3	33.0	OK	No	No Work	31.53	31.28	20.2	5.3	10.0
San Joaquin River	18.7855892	18.7856	768+60	28.7	31.7	-	31.7	31.4	31.4	28.7	1.0	29.7	32.7	-	32.7	32.4	32.4	33.0	OK	No	No Work	31.65	31.44	20.3	4.7	10.0
San Joaquin River	18.8024502	18.8025	769+50	28.7	31.7	-	31.7	31.5	31.5	28.7	1.0	29.7	32.7	-	32.7	32.5	32.5	33.5	OK	No	No Work	31.70	31.52	20.3	4.7	10.0
San Joaquin River	18.8132496	18.8132	769+50	28.7	31.7	-	31.7	31.5	31.5	28.7	1.0	29.7	32.7	-	32.7	32.5	32.5	33.5	OK	No	No Work	31.70	31.52	20.3	4.7	10.0
San Joaquin River	18.8270702	18.8271	771+00	28.8	31.8	-	31.8	31.6	31.6	28.8	1.0	29.8	32.8	-	32.8	32.6	32.6	34.3	OK	No	No Work	31.79	31.64	20.4	4.5	10.0
San Joaquin River	18.8359699	18.8360	771+60	28.8	31.8	-	31.8	31.7	31.7	28.8	1.0	29.8	32.8	-	32.8	32.7	32.7	33.8	OK	No	No Work	31.80	31.65	20.4	4.5	10.0
San Joaquin River	18.8763103	18.8763	773+80	28.8	31.8	-	31.8	31.7	31.7	28.8	1.0	29.8	32.8	-	32.8	32.7	32.7	34.2	OK	No	No Work	31.82	31.69	20.4	4.5	10.0
San Joaquin River	18.9143791	18.9144	775+80	28.8	31.8	-	31.8	31.7	31.7	28.8	1.0	29.8	32.8	-	32.8	32.7	32.7	34.0	OK	No	No Work	31.83	31.70	20.4	4.5	10.0
San Joaquin River	19.0306606	19.0307	782+15	28.9	31.9	-	31.9	31.7	31.7	28.9	1.0	29.9	32.9	-	32.9	32.7	32.7	34.0	OK	No	No Work	31.87	31.73	20.4	4.1	10.0
San Joaquin River	19.1393795	19.1394	788+30	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	33.9	OK	No	No Work	31.97	31.88	20.5	5.4	10.0
San Joaquin River	19.2730808	19.2731	795+65	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	34.2	OK	No	No Work	31.98	31.88	20.5	5.4	10.0
San Joaquin River	19.3431606	19.3432	799+90	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	34.3	OK	No	No Work	31.98	31.89	20.5	5.3	10.0
San Joaquin River	19.3573608	19.3574	800+10	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	34.3	OK	No	No Work	31.98	31.89	20.5	5.4	10.0
San Joaquin River	19.4355793	19.4356	804+19	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	34.5	OK	No	No Work	31.98	31.89	20.5	6.3	10.0
San Joaquin River	19.4357700	19.4358	804+20	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	34.5	OK	No	No Work	31.98	31.92	20.5	6.3	10.0
Walthall Slough_1	0.2162800	0.2163	817+69	29.1	32.1	-	32.1	31.9	31.9	29.1	1.0	30.1	33.1	-	33.1	32.9	32.9	34.4	OK	No	No Work	32.05	31.92	20.6	2.6	10.0
Walthall Slough_1	0.2164700	0.2165	817+70	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	34.4	OK	No	No Work	31.98	31.89	20.5	1.2	10.0
Walthall Slough_1	0.2609800	0.2610	819+55	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	34.9	OK	No	No Work	32.00	31.93	20.5	0.6	10.0
Walthall Slough_1	0.3181800	0.3182	820+90	29.0	32.0	-	32.0	31.9	31.9	29.0	1.0	30.0	33.0	-	33.0	32.9	32.9	34.9	OK	No	No Work	32.02	31.94	20.5	0.2	10.0
Walthall Slough_2	0.3738600	0.3739	823+50	29.6	32.6	3.0	32.6	32.2	32.2	29.6	1.0	30.6	33.6	2.96	33.6	33.2	33.2	35.0	OK	No	No Work	32.59	32.21	25.0	2.8	10.9
Walthall Slough_2	0.3994200	0.3994	824+55	29.6	32.6	3.0	32.6	32.8	32.6	29.6	1.0	30.6	33.6	2.96	33.6	33.8	33.6	34.8	OK	No	No Work	32.59	32.59	25.0	2.8	10.9
Walthall Slough_2	0.4918500	0.4918	824+55	29.6	32.6	3.0	32.6	32.8	32.6	29.6	1.0	30.6	33.6	2.96	33.6	33.8	33.6	34.8	OK	No	No Work	32.59	32.59	25.0	2.8	10.9
Walthall Slough_2	0.6357800	0.6358	837+35	29.7	32.7	3.0	32.7	32.8	32.7	29.7	1.0	30.7	33.7	2.96	33.7	33.8	33.7	34.4	OK	No	No Work	32.65	32.65	25.0	1.1	10.9
Walthall Slough_2	0.6850200	0.6850	840+75	29.7	32.7	3.0	32.7	32.8	32.7	29.7	1.0	30.7	33.7	2.96	33.7	33.8	33.7	34.3	OK	No	No Work	32.67	32.67	25.0	0.8	10.9
Walthall Slough_2	0.8996000	0.8996	851+75	29.8	32.8	2.96	32.8	32.8	32.8	29.8	1.0	30.8	33.8	2.96	33.8	33.8	33.8	34.3	OK	No	No Work	32.75	32.75	25.0	4.2	10.9
Walthall Slough_2	1.1232700	1.1233	862+50	29.8	32.8	2.96	32.8	32.8	32.8	29.8	1.0	30.8	33.8	2.96	33.8	33.8	33.8	34.7	OK	No	No Work	32.83	32.81	25.0	0.6	10.9
Walthall Slough_2	1.1314200	1.1314	863+20	29.8	32.8	2.96	32.8	32.8	32.8	29.8	1.0	30.8	33.8	2.96	33.8	33.8	33.8	34.6	OK	No	No Work	32.83	32.82	25.0	0.6	10.9
Walthall Slough_2	1.2117200	1.2117	865+10	29.8	32.8	2.96	32.8	32.8	32.8	29.8	1.0	30.8	33.8	2.96	33.8	33.8	33.8	34.7	OK	No	No Work	32.83	32.81	25.0	0.6	10.9
Walthall Slough_2	1.2924000	1.2924	865+70	29.8	32.8	2.96	32.8	32.8	32.8	29.8	1.0	30.8	33.8	2.96	33.8	33.8	33.8	34.7	OK	No	No Work	32.83	32.80	25.0	0.6	10.9
Walthall Slough_2	1.4031900	1.4032	866+60	29.9	32.9	2.96	32.9	32.8	32.8	29.9	1.0	30.9	33.9	2.96	33.9	33.8	33.8	34.5	OK	No	No Work	32.88	32.80	25.0	0.4	10.9
Walthall Slough_2	1.5425800	1.5426	867+70	29.9	32.9	2.96	32.9	32.8	32.8	29.9	1.0	30.9	33.9	2.96	33.9	33.8	33.8	34.5	OK	Yes	WORK REQUIRED	32.88	33.84	25.0	0.4	10.9
Walthall Slough_2	1.7867100	1.7867	877+25	29.9	32.9	2.96	32.9	32.9	32.9	29.9	1.0	30.9	33.9	2.96	33.9	33.9	33.9	34.9	OK	Yes	WORK REQUIRED	32.93	33.88	25.0	0.5	10.9
Walthall Slough_2	1.9836700	1.9837	886+35	30.0	33.0	3.77	33.8	32.9	32.9	30.0	1.0	31.0	34.0	3.77	34.8	33.9	33.9	34.2	OK	Yes	WORK REQUIRED	33.78	33.89	25.0	0.6	10.9
Walthall Slough_2	2.2408600	2.2409	897+10	30.1	33.1	3.77	33.9	32.9	32.9	30.1	1.0	31.1	34.1	3.77	34.9	33.9	33.9	36.4	OK	Yes	WORK REQUIRED	33.91	33.90	25.0	0.5	10.9
Walthall Slough_2	2.6622601	2.6623	907+40	30.3	33.3	3.77	34.1	32.9	32.9	30.3	1.0	31.3	34.3	3.77	35.1	33.9	33.9	34.6	OK	Yes	WORK REQUIRED	34.06	33.91	25.0	1.6	10.9
Walthall Slough_2	2.6624401	2.6624	907+01	30.3	33.3	3.77	34.1	32.9	32.9	30.3	1.0	31.3	34.3	3.77	35.1	33.9	33.9	34.7	OK	Yes	WORK REQUIRED	34.06	33.91	25.0	1.6	**10.9**
RD17 Tieback Levee	--	#VALUE!	910+00	30.3	33.3	3.77	34.1	32.9	32.9	30.3	1.0	31.3	34.3	3.77	35.1	33.9	33.9	34.3	OK	Yes	WORK REQUIRED	34.06	33.91	--	1.6	10.9
RD17 Tieback Levee	--	#VALUE!	920+00	30.3	33.3	3.77	34.1	32.9	32.9	30.3	1.0	31.3	34.3	3.77	35.1	33.9	33.9	34.9	OK	Yes	WORK REQUIRED	34.10	33.91	--	0.5	10.9
RD17 Tieback Levee	--	#VALUE!	930+00	30.3	33.3	3.77	34.1	32.9	32.9	30.3	1.0	31.3	34.3	3.77	35.1	33.9	33.9	34.5	OK	Yes	WORK REQUIRED	34.10	33.91	--	0.4	10.9
RD17 Tieback Levee	--	#VALUE!	940+00	30.4	33.4	3.77	34.1	32.9	32.9	30.4	1.0	31.4	34.4	3.77	35.1	33.9	33.9	34.2	OK	Yes	WORK REQUIRED	34.12	33.91	--	0.3	10.9
RD17 Tieback Levee	--	#VALUE!	950+00	30.4	33.4	3.64	34.0	32.9	32.9	30.4	1.0	31.4	34.4	3.64	35.0	33.9	33.9	34.6	OK	Yes	WORK REQUIRED	34.01	33.91	--	0.4	10.9
RD17 Tieback Levee	--	#VALUE!	960+00	30.4	33.4	3.64	34.0	32.9	32.9	30.4	1.0	31.4	34.4	3.64	35.0	33.9	33.9	34.0	OK	Yes	WORK REQUIRED	34.04	33.91	--	0.2	10.9
RD17 Tieback Levee	--	#VALUE!	970+00	30.4	33.4	3.64	34.1	32.9	32.9	30.4	1.0	31.4	34.4	3.64	35.1	33.9	33.9	34.3	OK	Yes	WORK REQUIRED	34.07	33.91	--	0.2	10.9

Footnotes:

(a) Wind-wave only controls MTOL for a potion of the RD17 dryland levee.

(b) Includes adjustments and allowances for uncertainties in climate change, etc. Should only be used in certain circumstances where levee raising work is already required.