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3.9 HYDROLOGY AND WATER QUALITY

3.9.1 Affected Environment

3.9.1.1 Surface Water Hydrology

The San Joaquin River originates in the Sierra Nevada Mountains and flows west to the Central Valley. It meets the Sacramento River near the city of Antioch, and together they form the Sacramento-San Joaquin Delta, one of the largest estuaries in the United States. Two distributary rivers, the Old River and the Middle River, flow from the San Joaquin River before it joins the Sacramento River; both of these once were the main channels of the river. Because of the bend in the San Joaquin River channel at the head of the Old River, a substantial portion of the San Joaquin River flow continues down the Old River instead of heading northward along the San Joaquin. Flows along the Old River are eventually divided between the Old River, Middle River, and Grant Line Canal. In response to concerns about impacts to outmigrating salmon resulting from lower flows in these areas, DWR and DFG have installed temporary rock barriers at the head of the Old River in order to keep fish in the main channel of the San Joaquin River.

Surface water in the Delta is dominated by tidal flows from San Francisco and Suisun bays. Additional hydrologic contribution to Delta surface water is runoff from upstream in the Sacramento and San Joaquin River watersheds. Average daily inflow (and outflow) of water from tidal action is approximately 170,000 cubic feet per second (cfs). The average estimated freshwater outflow from the combined watershed is approximately 30,000 cfs (DWR 1993). Approximately 77 percent of the freshwater inflow is derived from the Sacramento River portion of the watershed. The mainstem and tributaries of the San Joaquin River contribute about 15 percent of the total freshwater inflow and streams that flow directly into the Delta (e.g., the Mokelumne River) contribute the remainder of the freshwater.

Surface water flow in the Old River and Connection Slough is dominated by natural tidal variations and is also affected by diversion pumping at the various export pumping facilities. The California Data Exchange Center (CDEC) installs, maintains, and operates an extensive hydrologic data collection network include a suite of hydrologic data collections stations in the Delta. The U.S. Geological Service (USGS) also maintains a set of stream gages in the Delta. Table 3.9-1 displays the peak total flow at selected stations in the Delta for the months of January and February. This table includes both historic and simulated flows to account for the changes in operations for compliance with the recent CVP/SWP Operations BOs (USFWS 2008b, NMFS 2009a). Table 3.9-2 displays the peak total flow at selected stations in the Delta for the months of March and June. This table includes both historic and simulated flows to account for the changes in operations. These results were obtained through the use of the RMA Delta Model (Appendix B).

Figures 3.9-1 through 3.9-8 display the range of simulated net flows comparing simulated historic and current operations at selected stations in the Delta. The month of January was selected a representative of winter conditions in the Delta. These figures include both historic and simulated flows to account for the changes in current operations for compliance with the recent CVP/SWP Operations BOs (USFWS 2008b, NMFS 2009a). Likewise Figures 3.9-9 through 3.9-16 display the range of simulated net flow comparing simulated historic and current operations at selected stations in the Delta. The month of March was selected a representative of

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spring and early summer conditions in the Delta. These figures include both historic and simulated flows to account for the changes in current operations. These results were obtained through the use of the RMA Delta Model (Appendix B).

Delta waters and channels are also subject to large inflow from the Sacramento and San Joaquin River watershed. The Proposed Action would construct facilities in channels that convey a portion of the total runoff from the San Joaquin River watershed. Peak flood flows in early 1997 on the San Joaquin river in the south Delta (Vernalis) have been measured up to 75,000 cfs (USGS, National Water Information System). These peak flows are generally carried downstream in the mainstem of the San Joaquin River, but approximately one-third of the waters are carried in the Old and Middle River segments.

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The lands surrounding the Old River and Connection Slough sites are within 100-year floodplains (Contra Costa County 2005, San Joaquin County 1992). A system of levees protects the lands on the neighboring islands (Holland Tract, Bacon Island, and Mandeville Island), which are below sea level.

3.9.1.2 Surface Water Quality

The SWRCB has adopted water quality control plans and policies to protect the water quality and to control the water resources in the Delta. The Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan) was adopted in 1995 and amended in 2006. Water quality and water rights for the Delta were established via D-1485 (1978) and D-1641 (2000). When combined, the Bay-Delta Plan and applicable Water Right Decisions establish water quality objectives that consider the need for the protection of beneficial uses, including agricultural, domestic, and industrial uses by humans and the needs of the ecosystem. These establish the water quality objectives and set the conditions for water management in the Delta.

Except during period of large regional flood or runoff events, surface water quality in the Old River and Connection Slough also is dominated by natural tidal variations and is affected by diversion pumping at the various export pumping facilities. Figure 4.9-17 illustrates the existing variation in salinity (expressed in µmho/cm). Additional historic flow and salinity information is available in Appendix A.

Table 3.9-1 Historic and Simulated (2004) Peak Total Flow in January and February at Selected Sites in the Delta

		Peak Total Flow (cfs) for Historic and Simulated Operations during January-February 2004							
		Ebb Tide				Flood Tide			
		January		February		January		February	
Station Name	**Code**	**Historical**	**OCAP**	**Historical**	**OCAP**	**Historical**	**OCAP**	**Historical**	**OCAP**
Chipps Island		439,658	442,671	453,332	456,090	-397,568	-386,759	-378,150	-369,202
False River	FAL	55,164	56,240	53,921	54,715	-62,441	-60,552	-63,763	-62,003
Sacramento River @ Freeport	FPT	61,880	61,877	75,076	75,071	17,457	17,507	15,856	15,921
Grant Line Canal	GLC	6,717	6,361	7,594	6,213	-5,466	-5,345	-5,339	-5,012
Old River at Holland Cut	HOL	27,790	29,612	27,104	29,112	-32,970	-31,728	-35,514	-33,618
Jersey Point	JPT	156,167	159,472	155,500	157,996	-166,767	-161,246	-161,544	-157,081
Middle River S of Woodward Cut	MID	4,988	6,741	5,957	7,051	-11,562	-9,438	-11,054	-9,353
Mokelumne River @ SJR	MOK	21,547	21,488	22,755	22,563	-12,942	-13,091	-12,784	-12,799
Mossdale	RSAN087	2,866	2,929	4,432	4,455	61	-148	63	-101
Middle River @ Medford Island	MRC	28,787	31,292	29,270	30,612	-39,660	-37,843	-40,803	-38,881
Old River @ Bacon Island	ROLD024	11,158	13,498	12,514	13,580	-18,658	-16,856	-18,027	-16,487
Old River W of Victoria Island	ROLD034	5,478	7,995	6,913	8,643	-15,345	-11,761	-15,251	-11,690
Old River @ San Joaquin River	OSJ	10,413	11,390	10,493	10,662	-14,518	-13,509	-16,812	-15,867
Prisoner Point	PRI	60,498	63,899	59,557	62,101	-78,862	-75,408	-82,904	-79,676
Rio Vista	RSAC101	143,508	143,270	197,587	197,193	-102,133	-102,473	-100,500	-100,547
Middle River @ Middle River	RMID015	9,826	12,485	11,472	12,816	-19,942	-16,977	-19,277	-16,989
Cashe Slough @ Ryer Island	RYI	98,489	97,616	141,219	140,896	-95,602	-96,081	-91,341	-91,321
San Andreas	SAN	115,368	118,980	113,037	115,539	-129,941	-125,249	-130,095	-124,856

Table 3.9-1 Historic and Simulated (2004) Peak Total Flow in January and February at Selected Sites in the Delta

		Peak Total Flow (cfs) for Historic and Simulated Operations during January-February 2004							
		Ebb Tide				Flood Tide			
		January		February		January		February	
Station Name	**Code**	**Historical**	**OCAP**	**Historical**	**OCAP**	**Historical**	**OCAP**	**Historical**	**OCAP**
Three Mile Slough	SLTRM004	26,556	27,568	26,333	27,220	-37,208	-36,818	-41,352	-40,107
Turner Cut	TRC	1,546	2,256	1,845	2,227	-3,500	-3,319	-3,510	-3,189
Victoria Canal	VIC	2,174	3,359	2,840	3,736	-7,728	-5,556	-8,247	-5,585

Table 3.9-2 Historic and Simulated (2004) Peak Total Flow in March and June at Selected Sites in the Delta

		Peak Total Flow (cfs) for Historic and Simulated Operations during March and June 2004											
		Ebb Tide						Flood Tide					
		March			June			March			June		
Station Name	Code	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB
Chipps Island		424,769	425,783	424,951	440,261	443,911	441,965	-412,075	-409,224	-410,782	-375,050	-369,456	-373,235
False River	FAL	55,765	55,846	55,754	52,197	52,949	52,427	-62,199	-61,621	-61,964	-61,461	-59,915	-60,662
Sacramento River @ Freeport	FPT	19,670	19,652	19,668	72,797	72,797	72,796	5,194	5,195	5,196	23,286	23,305	23,297
Grant Line Canal	GLC	6,029	6,030	5,902	6,730	6,320	6,597	-4,986	-4,275	-4,645	-4,524	-4,082	-4,206
Old River at Holland Cut	HOL	30,439	30,785	30,446	26,477	27,800	26,935	-32,854	-32,293	-32,606	-32,664	-31,637	-32,476
Jersey Point	JPT	157,401	157,777	157,393	150,898	153,504	151,907	-166,792	-165,173	-166,119	-161,052	-156,824	-158,917
Middle River S of	MID	5,671	6,001	5,672	5,816	6,818	6,141	-10,743	-9,954	-9,973	-10,609	-8,538	-9,643

Table 3.9-2 Historic and Simulated (2004) Peak Total Flow in March and June at Selected Sites in the Delta

		Peak Total Flow (cfs) for Historic and Simulated Operations during March and June 2004											
		Ebb Tide						Flood Tide					
		March			June			March			June		
Station Name	Code	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB
Woodward Cut													
Mokelumne River @ SJR	MOK	17,622	17,608	17,622	21,098	21,066	21,053	-13,956	-14,098	-14,014	-11,344	-11,649	-11,448
Mossdale	RSAN087	2,100	2,127	2,106	4,642	4,681	4,653	-107	-289	-174	2,010	1,968	2,007
Middle River @ Medford Island	MRC	31,471	31,681	31,471	28,647	29,865	29,056	-39,214	-38,649	-39,149	-39,345	-37,556	-38,578
Old River @ Bacon Island	ROLD024	13,429	13,616	13,428	12,195	13,254	12,541	-18,238	-17,172	-17,628	-17,623	-15,759	-16,740
Old River W of Victoria Island	ROLD034	6,384	6,981	6,384	6,859	8,342	7,331	-14,744	-12,730	-13,294	-14,925	-10,496	-13,150
Old River @ San Joaquin River	OSJ	12,084	12,178	12,089	10,410	10,738	10,516	-13,896	-13,698	-13,856	-14,887	-13,979	-14,473
Prisoner Point	PRI	63,503	63,752	63,508	59,250	60,957	59,954	-76,768	-75,810	-76,659	-81,763	-78,691	-80,261
Rio Vista	RSAC101	123,309	123,000	123,250	190,696	190,228	190,444	-117,288	-117,176	-117,278	-94,132	-94,199	-94,149
Middle River @ Middle River	RMID015	11,823	12,094	11,825	11,113	12,562	11,593	-19,325	-17,765	-18,260	-18,627	-15,980	-17,398
Cashe Slough @ Ryer Island	RYI	92,075	91,733	91,983	134,628	134,237	134,420	-95,048	-95,054	-95,086	-93,419	-93,606	-93,478
San Andreas	SAN	117,803	118,136	117,805	112,683	115,083	113,631	-128,632	-127,245	-128,071	-129,030	-124,296	-126,708
Three Mile Slough	SLTRM004	28,203	28,298	28,204	24,993	25,701	25,277	-34,839	-34,411	-34,666	-38,841	-37,641	-38,246
Turner Cut	TRC	2,584	2,640	2,586	1,791	2,127	1,910	-3,840	-3,758	-3,805	-3,647	-3,276	-3,558

Table 3.9-2 Historic and Simulated (2004) Peak Total Flow in March and June at Selected Sites in the Delta

		Peak Total Flow (cfs) for Historic and Simulated Operations during March and June 2004											
		Ebb Tide						Flood Tide					
		March			June			March			June		
Station Name	Code	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB	Historical	OCAP-LB	OCAP-UB
Victoria Canal	VIC	2,613	2,908	2,616	2,971	3,620	3,133	-7,770	-6,172	-6,815	-8,046	-5,036	-6,908

Table 3.9-3 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during January-February 2004											
		Ebb Tide						Flood Tide					
		January			February			January			February		
Station Name	Code	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change
Chipps Island		442,671	440,997	0%	456,090	454,538	0%	-386,759	-386,185	0%	-369,202	-368,106	0%
False River	FAL	56,240	55,340	-2%	54,715	53,789	-2%	-60,552	-61,353	-1%	-62,003	-61,442	1%
Sacramento River @ Freeport	FPT	61,877	61,874	0%	75,071	75,071	0%	17,507	17,500	0%	15,921	15,927	0%
Grant Line Canal	GLC	6,361	6,361	0%	6,213	6,250	1%	-5,345	-5,448	-2%	-5,012	-5,175	-3%
Old River at Holland Cut	HOL	29,612	16,976	-43%	29,112	16,768	-42%	-31,728	-21,177	33%	-33,618	-22,018	35%

Table 3.9-3 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during January-February 2004											
		Ebb Tide						Flood Tide					
		January			February			January			February		
Station Name	Code	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change
Jersey Point	JPT	159,472	159,641	0%	157,996	158,154	0%	-161,246	-160,569	0%	-157,081	-155,983	1%
Middle River S of Woodward Cut	MID	6,741	6,638	-2%	7,051	6,984	-1%	-9,438	-9,587	-2%	-9,353	-9,533	-2%
Mokelumne River @ SJR	MOK	21,488	21,857	2%	22,563	22,731	1%	-13,091	-14,582	-11%	-12,799	-14,602	-14%
Mossdale	RSAN087	2,929	2,917	0%	4,455	4,454	0%	-148	-149	0%	-101	-117	-16%
Middle River @ Medford Island	MRC	31,292	37,012	18%	30,612	35,617	16%	-37,843	-47,566	-26%	-38,881	-50,264	-29%
Old River @ Bacon Island	ROLD024	13,498	15,369	14%	13,580	15,430	14%	-16,856	-19,007	-13%	-16,487	-19,714	-20%
Old River W of Victoria Island	ROLD034	7,995	8,042	1%	8,643	8,686	1%	-11,761	-12,146	-3%	-11,690	-11,956	-2%
Old River @ San Joaquin River	OSJ	11,390	18,582	63%	10,662	18,814	76%	-13,509	-19,256	-43%	-15,867	-21,982	-39%
Prisoner Point	PRI	63,899	73,984	16%	62,101	71,384	15%	-75,408	-90,169	-20%	-79,676	-94,854	-19%
Rio Vista	RSAC101	143,270	143,481	0%	197,193	197,180	0%	-102,473	-102,722	0%	-100,547	-101,149	-1%
Middle River @ Middle River	RMID015	12,485	10,495	-16%	12,816	10,929	-15%	-16,977	-15,843	7%	-16,989	-15,772	7%
Cashe Slough @ Ryer	RYI	97,616	97,904	0%	140,89	140,890	0%	-96,081	-96,156	0%	-91,321	-91,427	0%

Table 3.9-3 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during January-February 2004											
		Ebb Tide						Flood Tide					
		January			February			January			February		
Station Name	Code	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change
Island					6								
San Andreas	SAN	118,980	119,100	0%	115,539	115,756	0%	-125,249	-126,456	-1%	-124,856	-125,747	-1%
Three Mile Slough	SLTRM004	27,568	27,528	0%	27,220	27,203	0%	-36,818	-37,023	-1%	-40,107	-39,715	1%
Turner Cut	TRC	2,256	2,908	29%	2,227	2,948	32%	-3,319	-4,460	-34%	-3,189	-4,240	-33%
Victoria Canal	VIC	3,359	3,293	-2%	3,736	3,644	-2%	-5,556	-5,671	-2%	-5,585	-5,620	-1%

Table 3.9-4 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in March 2004

		Juvenile Period - March 2004											
		Ebb Tide						Flood Tide					
Station Name	Code	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound
Chipps Island		443,911	440,718	441,965	439,116	-1%	-1%	-369,456	-372,369	-373,235	-376,864	-1%	-1%
False River	FAL	52,949	50,900	52,427	49,772	-4%	-5%	-59,915	-57,195	-60,662	-57,551	5%	5%
Sacramento River @ Freeport	FPT	72,797	72,795	72,796	72,793	0%	0%	23,305	23,269	23,297	23,270	0%	0%
Grant Line Canal	GLC	6,320	5,975	6,597	6,147	-5%	-7%	-4,082	-2,073	-4,206	-2,133	49%	49%
Old River at Holland Cut	HOL	27,800	15,672	26,935	21,667	-44%	-20%	-31,637	-10,111	-32,476	-16,367	68%	50%
Jersey Point	JPT	153,504	150,217	151,907	147,850	-2%	-3%	-156,824	-152,306	-158,917	-154,319	3%	3%
Middle River S of Woodward Cut	MID	6,818	6,369	6,141	5,674	-7%	-8%	-8,538	-9,359	-9,643	-10,148	-10%	-5%
Mokelumne River @ SJR	MOK	21,066	21,887	21,053	22,101	4%	5%	-11,649	-13,473	-11,448	-13,440	-16%	-17%
Mossdale	RSAN087	4,681	4,639	4,653	4,609	-1%	-1%	1,968	1,989	2,007	2,010	1%	0%
Middle River @ Medford Island	MRC	29,865	34,319	29,056	32,925	15%	13%	-37,556	-51,245	-38,578	-52,555	-36%	-36%
Old River @ Bacon Island	ROLD024	13,254	14,511	12,541	13,706	9%	9%	-15,759	-3,901	-16,740	-1,671	75%	90%
Old River W of Victoria Island	ROLD034	8,342	7,966	7,331	6,951	-5%	-5%	-10,496	-6,566	-13,150	-8,272	37%	37%
Old River @ San Joaquin River	OSJ	10,738	18,858	10,516	18,756	76%	78%	-13,979	-22,503	-14,473	-22,206	-61%	-53%
Prisoner Point	PRI	60,957	71,704	59,954	70,598	18%	18%	-78,691	-96,856	-80,261	-98,755	-23%	-23%

Table 3.9-4 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in March 2004

		Juvenile Period - March 2004											
		Ebb Tide						Flood Tide					
Station Name	Code	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound
Rio Vista	RSAC101	190,228	190,906	190,444	191,299	0%	0%	-94,199	-94,387	-94,149	-94,357	0%	0%
Middle River @ Middle River	RMID015	12,562	10,145	11,593	9,220	-19%	-20%	-15,980	-26,438	-17,398	-28,004	-65%	-61%
Cashe Slough @ Ryer Island	RYI	134,237	134,724	134,420	135,043	0%	0%	-93,606	-93,625	-93,478	-93,493	0%	0%
San Andreas	SAN	115,083	112,353	113,631	110,120	-2%	-3%	-124,296	-122,271	-126,708	-124,409	2%	2%
Three Mile Slough	SLTRM004	25,701	24,660	25,277	23,996	-4%	-5%	-37,641	-36,237	-38,246	-36,766	4%	4%
Turner Cut	TRC	2,127	3,038	1,910	2,722	43%	43%	-3,276	-6,041	-3,558	-6,219	-84%	-75%
Victoria Canal	VIC	3,620	3,344	3,133	2,664	-8%	-15%	-5,036	-6,590	-6,908	-8,176	-31%	-18%

Table 3.9-5 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in June 2004

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during June 2004											
		Ebb Tide						Flood Tide					
Station Name	Code	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound
Chipps Island		425,783	421,024	424,951	420,002	-1%	-1%	-409,224	-412,285	-410,782	-414,874	-1%	-1%
False River	FAL	55,846	54,039	55,754	54,054	-3%	-3%	-61,621	-59,544	-61,964	-59,575	3%	4%
Sacramento River @ Freeport	FPT	19,652	19,652	19,668	19,668	0%	0%	5,195	4,676	5,196	4,668	-10%	-10%
Grant Line Canal	GLC	6,030	5,865	5,902	5,724	-3%	-3%	-4,275	-4,275	-4,645	-4,298	0%	7%
Old River at Holland Cut	HOL	30,785	19,486	30,446	28,537	-37%	-6%	-32,293	-21,351	-32,606	-32,287	34%	1%
Jersey Point	JPT	157,777	153,314	157,393	152,782	-3%	-3%	-165,173	-160,164	-166,119	-161,240	3%	3%
Middle River S of Woodward Cut	MID	6,001	5,766	5,672	5,378	-4%	-5%	-9,954	-10,013	-9,973	-10,451	-1%	-5%
Mokelumne River @ SJR	MOK	17,608	18,913	17,622	18,958	7%	8%	-14,098	-16,158	-14,014	-16,205	-15%	-16%
Mossdale	RSAN087	2,127	2,070	2,106	2,176	-3%	3%	-289	-21	-174	83	93%	148%
Middle River @ Medford Island	MRC	31,681	36,768	31,471	36,486	16%	16%	-38,649	-51,345	-39,149	-51,987	-33%	-33%
Old River @ Bacon Island	ROLD024	13,616	14,874	13,428	14,656	9%	9%	-17,172	-17,158	-17,628	-17,155	0%	3%
Old River W of Victoria Island	ROLD034	6,981	7,009	6,384	6,447	0%	1%	-12,730	-12,730	-13,294	-12,755	0%	4%
Old River @ San	OSJ	12,178	19,792	12,089	19,919	63%	65%	-13,698	-23,900	-13,856	-23,572	-74%	-70%

Table 3.9-5 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in June 2004

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during June 2004											
		Ebb Tide						Flood Tide					
Station Name	Code	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound
Joaquin River													
Prisoner Point	PRI	63,752	76,161	63,508	76,023	19%	20%	-75,810	-93,745	-76,659	-94,445	-24%	-23%
Rio Vista	RSAC101	123,000	124,759	123,250	124,850	1%	1%	-117,176	-118,385	-117,278	-118,495	-1%	-1%
Middle River @ Middle River	RMID015	12,094	10,096	11,825	9,905	-17%	-16%	-17,765	-28,909	-18,260	-30,332	-63%	-66%
Cashe Slough @ Ryer Island	RYI	91,733	92,335	91,983	92,434	1%	0%	-95,054	-95,768	-95,086	-95,780	-1%	-1%
San Andreas	SAN	118,136	115,591	117,805	115,133	-2%	-2%	-127,245	-124,669	-128,071	-125,525	2%	2%
Three Mile Slough	SLTRM004	28,298	27,172	28,204	27,041	-4%	-4%	-34,411	-32,817	-34,666	-32,905	5%	5%
Turner Cut	TRC	2,640	3,400	2,586	3,318	29%	28%	-3,758	-6,276	-3,805	-6,454	-67%	-70%
Victoria Canal	VIC	2,908	2,626	2,616	2,332	-10%	-11%	-6,172	-6,715	-6,815	-8,119	-9%	-19%

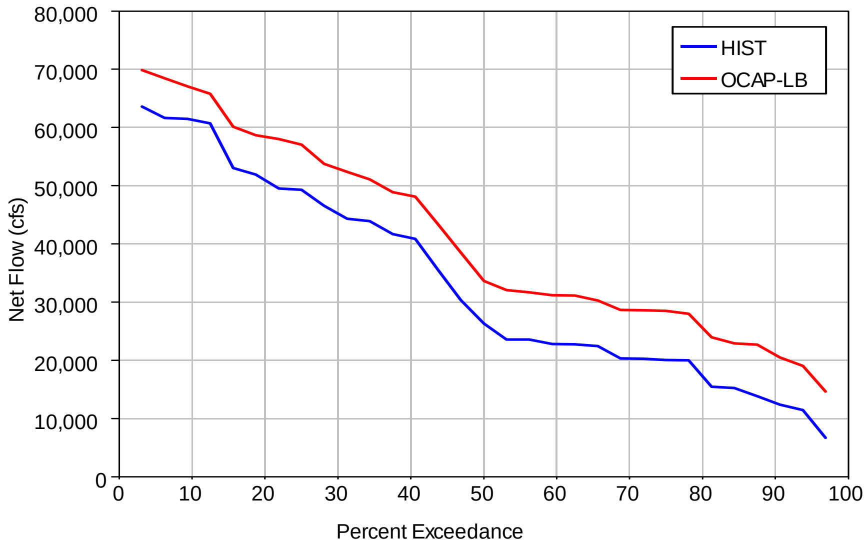

Figure 3.9-1 Net Flow Exceedance for Historical and OCAP Simulations at Chipps Island for January 2004.

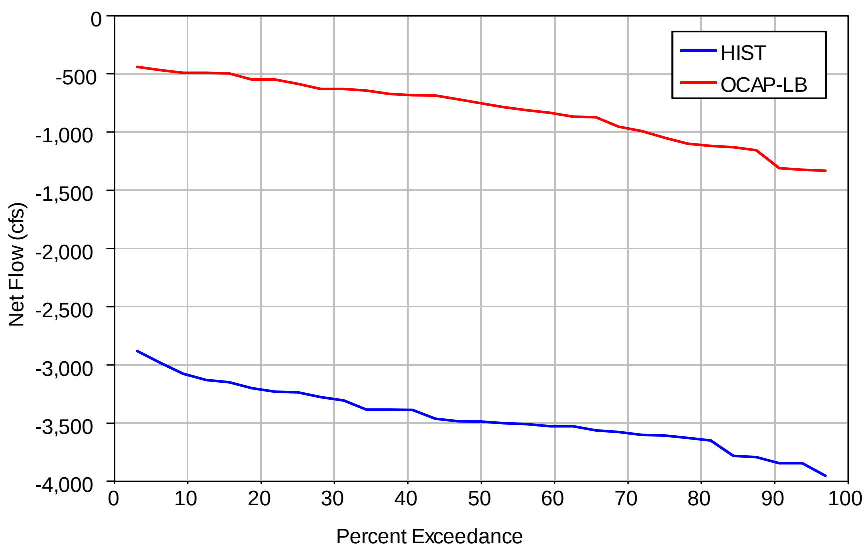

Figure 3.9-2 Net Flow Exceedance for Historical and OCAP Simulations at MID (Middle River South of Woodward Canal) for January 2004.

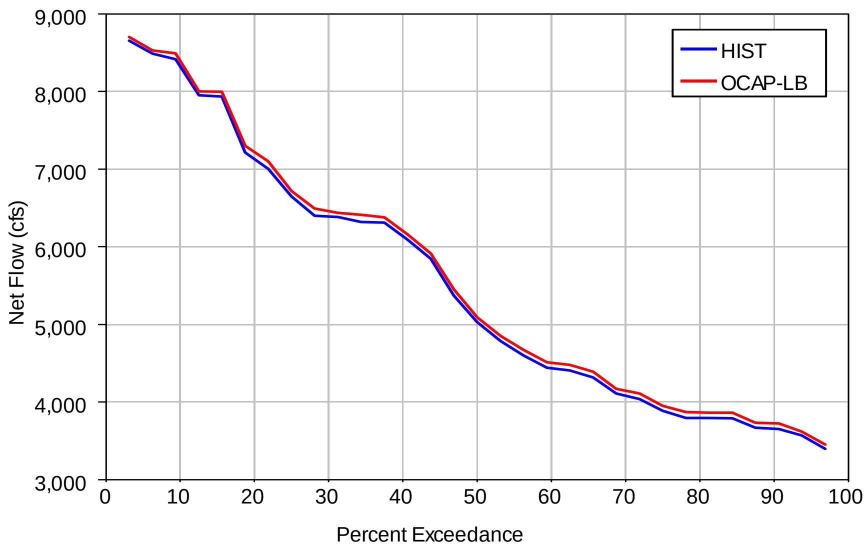

Figure 3.9-3 Net Flow Exceedance for Historical and OCAP Simulations at MOK (Mokelumne River at San Joaquin River) for January 2004.

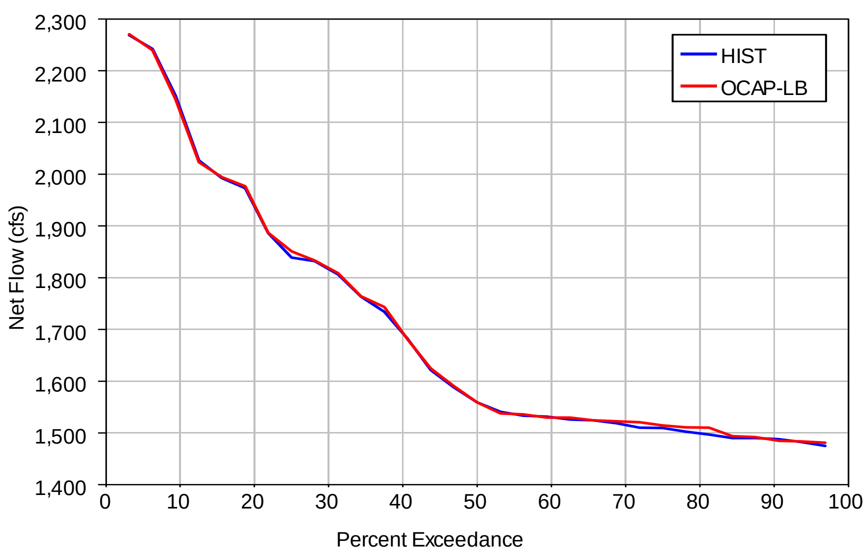

Figure 14 Net Flow Exceedance for Historical and OCAP Simulations at MOS (RSAN087, San Joaquin River at Mossdale) for January 2004

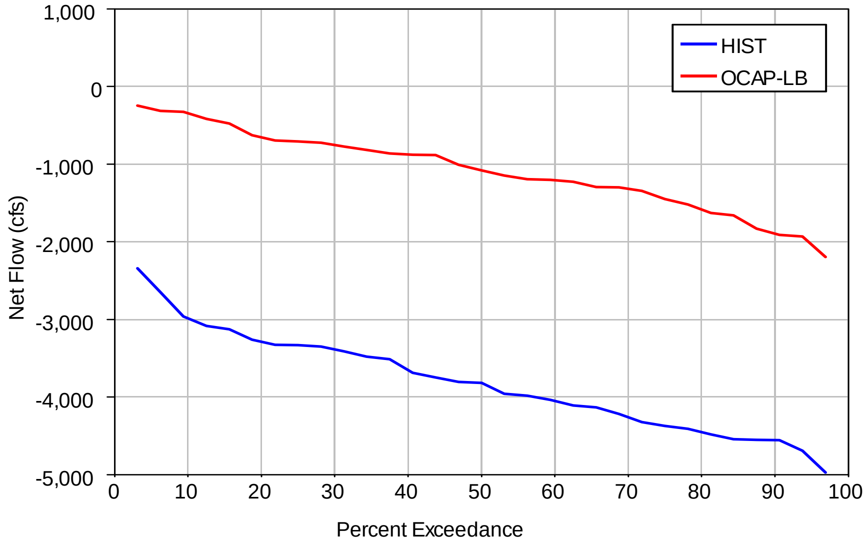

Figure 3.9-5 Net Flow Exceedance for Historical and OCAP Simulations at MRC (Middle River at Medford Island) for January 2004.

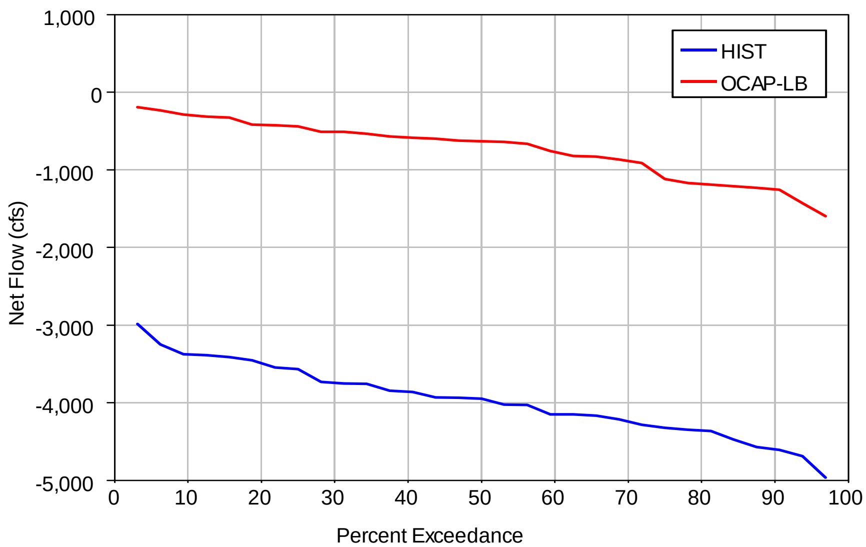

Figure 3.9-6 Net Flow Exceedance for Historical and OCAP Simulations at OLD (ROLD024, Old River at Bacon Island) for January 2004

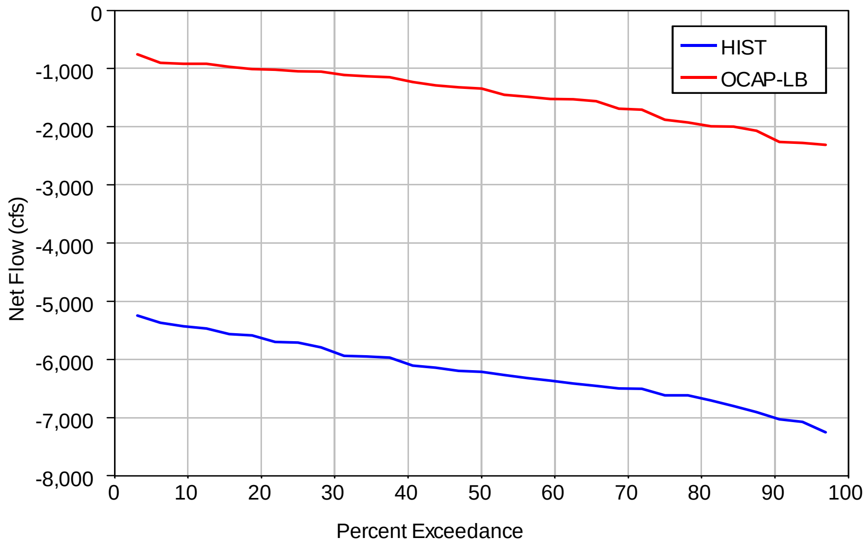

Figure 27 Net Flow Exceedance for Historical and OCAP Simulations at OLF (ROLD034, Old River near Byron) for January 2004

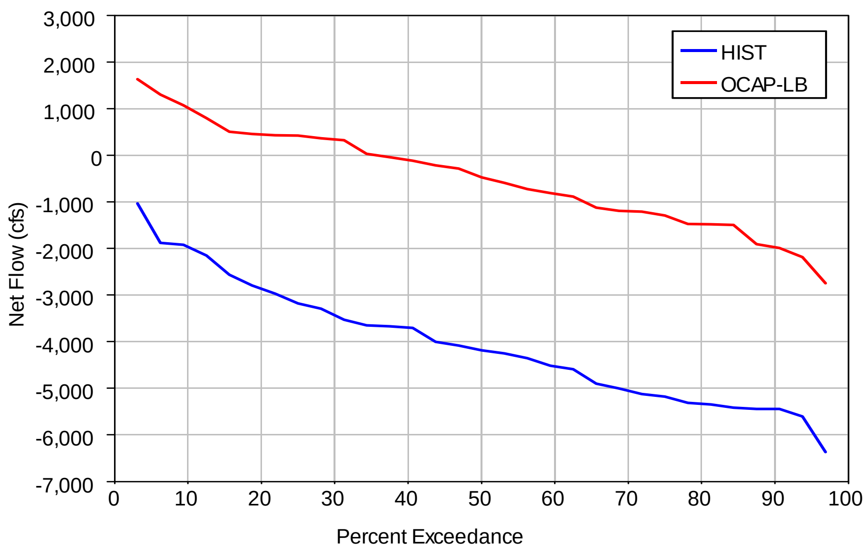

Figure 3.9-8 Net Flow Exceedance for Historical and OCAP Simulations at PRI (Prisoner Point) for January 2004

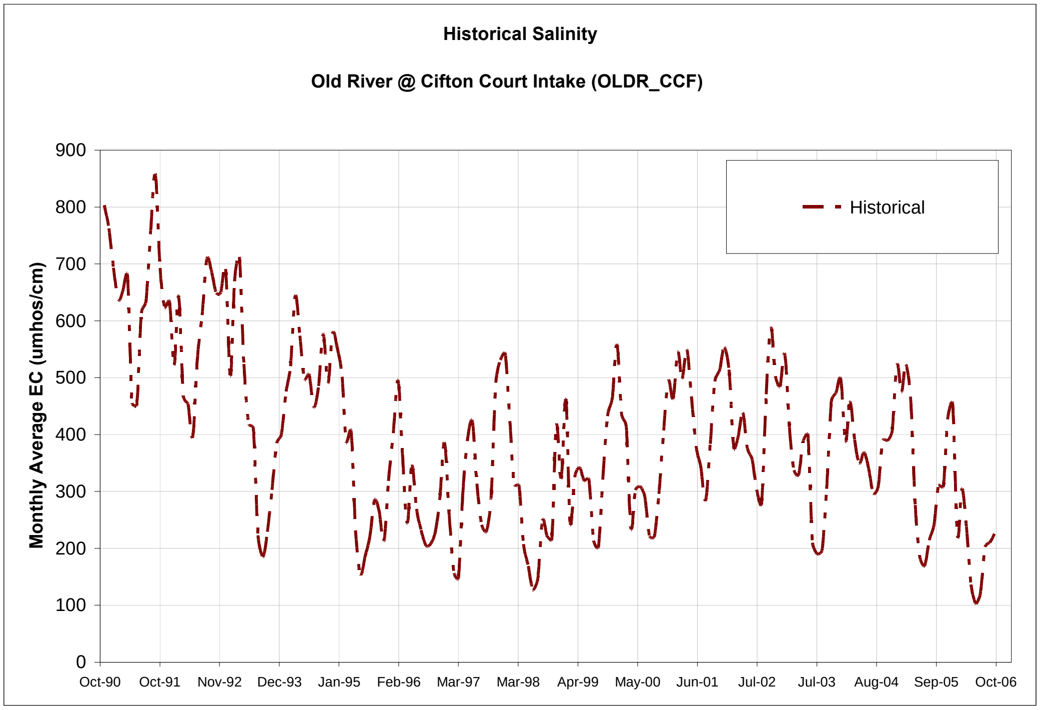

Figure 4.9-17 Historic Salinity (μmho/cm) at the 2-Gates Locations

Comment [LW4]: need to check figure numbers

General water quality in the Delta has been the subject of much analysis debate with regard to its intended use. At some times and in some locations water quality in the Delta has been determined to be in violation of water quality objectives and impaired its beneficial uses. These violations have led to the development of Total Maximum Daily Load (TMDL) programs in an effort to control the input of these pollutants from their sources, including municipal, domestic, industrial, and agricultural wastewater and stormwater (Lee et al. 2004). Delta waters have been impaired by many factors including:

- Bioaccumulation of organochlorine "legacy" pesticides and other toxic materials (DDT, chlordane, dieldrin, PCBs, dioxins/furans, and heavy metals), organophosphorus-based pesticides, and pyrethroid-based pesticides that is a threat to the health of those who use some types of Delta fish as food.

- Elevated concentrations of total organic carbon and nutrients (principally nitrogen and phosphorus compounds), which stimulate algal and other plant growth and require additional treatment prior to the use as a domestic water supply source to control excessive trihalomethanes. The added nutrients also causes tastes and odors issues in the water supply.

- Influent water, principally from the San Joaquin River, also carries salts and other dissolved solids that exceed water quality objectives and is an important issue for agriculture relying on Delta waters.
- Excessive algal and aquatic weed growth can contribute to a reduction in dissolved oxygen. This may result in the degradation of the rest of the aquatic ecosystem including fish kills.
- Invasive and non-native aquatic organisms have also resulted in the change in water quality and are suspected to be a major contributor to other ecosystem changes in the Delta.
- Population growth in the surrounding and adjacent watershed has increased point and non-point pollution, including the addition of ammonia and other common chemical and compounds.

3.9.1.3 Groundwater

The Project sites are located in the Tracy Subbasin of the Great Valley Geomorphic Province (DWR 2006). The Tracy Subbasin is composed of four defined strata: the Tulare Formation, Older Alluvium, Flood Basin Deposits, and Younger Alluvium. The Flood Basin Deposits consist primarily of silts and clays between the Younger Alluvium and older and deeper sediments, and include occasional gravel interbeds in areas adjacent to existing waterways. Because of their fine-grained nature, the flood basin deposits have low permeability and correspondingly low yields to water wells. Occasional zones of fresh water are found in these basin deposits, but they generally contain poor quality groundwater. The Younger Alluvium aquifer unit includes sediments deposited in the channels of active streams as well as overbank deposits and terraces of those streams. This unit is locally highly permeable and is less than 100 feet thick.

3.9.2 Regulatory Setting

3.9.2.1 Federal

Clean Water Act

The EPA is the federal agency responsible for water quality management and administers the federal Water Pollution Control Act Amendments of 1972 and 1987, collectively known as the CWA. The CWA establishes the principal federal statutes for water quality protection. It was established with the intent "to restore and maintain the chemical, physical, and biological integrity of the nation's water, to achieve a level of water quality which provides for recreation in and on the water, and for the propagation of fish and wildlife." Several key sections of the CWA guide the regulation of water pollution in the United States:

- **Section 208, Water Quality Control Plans**. This section requires the preparation of local water quality control plans throughout the nation. Each water quality control plan covers a defined drainage area. The primary goal of each water quality control plan is to attain water quality standards established by the CWA and the state governments within the defined area of coverage. Minimum content requirements, preparation procedures, time constraints, and federal grant funding criteria pertaining to the water quality control plans are established in Section 208. Preparation of the water quality control plans has been delegated to the individual states by the EPA.

- **Section 401, Water Quality Certifications**. This section of CWA requires that, prior to the issuance of a federal license or permit for an activity or activities that may result in a discharge of pollutants into navigable waters (see Section 404 discussion, below), the permit applicant must first obtain a certification from the state in which the discharge would originate. A state certification indicates that the proposed activity or activities would not result in a violation of applicable water quality standards established by federal or state law, or that there are no water quality standards that apply to the proposed activity.
- **Section 402, NPDES.** The NPDES requires permits for pollution discharges into water bodies such that the permitted discharge does not cause a violation of federal and state water quality standards. NPDES permits define quantitative and/or qualitative pollution limitations for the permitted source, and control measures that must be implemented to achieve the pollution limitations. Pollution control measures are often referred to as BMPs.
- **Section 404, Discharge of Dredge and Fill Material.** Section 404 assigns the Corps with permitting authority for proposed discharges of dredged and fill material into waters of the U.S., defined as "…waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; territorial seas and tributaries to such waters."

The Corps typically considers all natural drainages with defined beds and banks to be waters of the U.S. Section 404 establishes procedures by which the permitting agency is to review, condition, approve, and deny permit requests. Per the regulations, permitting agencies are responsible to conduct public noticing and provide the opportunity for public hearings during the review of each permit request. This includes informing USFWS and/or the NMFS of each permit request. Consultation with USFWS and/or NMFS is required for proposed discharges that could affect species protected by the federal ESA. Measures that are required by USFWS and/or NMFS to minimize impacts to federally protected species must be included as conditions of the permit.

Rivers and Harbors Act

The Rivers and Harbors Act (RHA) of 1899 prohibits the unauthorized alteration or obstruction of any navigable waters of the United States. As defined by the RHA, navigable waters include all waters that are:

- Historically, presently, or potentially used for interstate or foreign commerce and
- Subject to the ebb and flow of tides

Regulations implementing Section 10 of the RHA are coordinated with regulations implementing CWA Section 404. The RHA specifically regulates:

- Construction of structures in, under, or over navigable waters
- Deposition or excavation of material in navigable waters

- All work affecting the location, condition, course, or capacity of navigable waters

The RHA is administered by the Corps. If a proposed activity falls under the authority of RHA Section 10 and CWA Section 404, the Corps processes and issues a single permit. For activities regulated only under RHA Section 10, such as installation of a structure not requiring fill, permit conditions may be added to protect water quality during construction. The San Joaquin River is considered a navigable water between the mouth of the river and Sycamore Road (a point about 7 miles downstream of U.S. Highway 99 near Fresno).

National Flood Insurance Program

FEMA administers the National Flood Insurance Program (NFIP). FEMA has completed Flood Insurance Rate Maps that identify Special Flood Hazard Areas in the Project area. To comply with the NFIP, communities must adopt a floodplain management ordinance addressing construction and habitation in flood zones. In California, DWR provides and encourages communities to adopt the California Model Floodplain Management Ordinance.

Executive Order 11988-Floodplain Management

Executive Order 11988 requires federal agencies to recognize the values of floodplains and to consider the public benefits from restoring and preserving floodplains. Under this order the Corps is required to take action and provide leadership to:

- Avoid development in the base floodplain
- Reduce the risk and hazard associated with floods
- Minimize the impact of floods on human health, welfare, and safety and
- Restore and preserve the beneficial and natural values of the base floodplain.

3.9.2.2 State

Comment [BB5]: Shane will have to clarify on the necessity of State regulatory sections.

Porter-Cologne Act

The Porter-Cologne Act (California Water Code Section 13000) is the principal law governing water quality regulation in California. It establishes a comprehensive program to protect water quality and the beneficial uses of water. The Porter-Cologne Act applies to surface waters, wetlands, and groundwater, and to both point and non-point sources of pollution. Pursuant to the Porter-Cologne Act, it is the policy of the State of California that:

- The quality of all the waters of the State shall be protected
- All activities and factors affecting the quality of water shall be regulated to attain the highest water quality within reason and
- The State must be prepared to exercise its full power and jurisdiction to protect the quality of water in the State from degradation

Pursuant to the Porter-Cologne Act, the responsibility for protection of water quality in California rests with the SWRCB. The SWRCB administers federal and state water quality regulations for California's ocean waters and also oversees and funds the state's nine RWQCBs.

The RWQCBs prepare water quality control plans, establish water quality objectives, and carry out federal and state water quality regulations and permitting duties for inland water bodies, enclosed bays, and estuaries within their respective regions. The Porter-Cologne Act gives the SWRCB and RWQCBs broad powers to protect water quality by regulating waste discharge to water and land and by requiring clean up of hazardous wastes.

Section 401 Water Quality Certification

The CVRWQCB has jurisdiction over issues concerning CWA Section 401 Water Quality Certifications for the Project site.

Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Estuary (SWRCB 2006)

Generally, the Water Quality Control Plans from all nine of the RWQCBs and the California Ocean Plan (prepared and implemented by the SWRCB) collectively constitute the State Water Quality Control Plan. However, the SWRCB prepared the Bay-Delta Plan to the requirements of the CWA and the California Porter-Cologne Act. The Bay-Delta Plan supplemented other water quality control plans adopted by the SWRCB and RWQCBs, and State policies for water quality control as they relate to the Bay-Delta Estuary watershed. The other plans and policies established by the RWQCBs to adopt water quality standards and requirements for specific contaminants and other factors which have the potential to impair beneficial uses or cause nuisance. The Bay-Delta Plan has been designed to support the intentions of the CWA and the Porter-Cologne Act by: (1) characterizing watersheds within the Delta; (2) identifying beneficial uses that exist or have the potential to exist in each water body; (3) establishing water quality objectives for each water body to protect beneficial uses or allow their restoration, and; (4) providing an implementation program that achieves water quality objectives. Implementation program measures include monitoring, permitting, and enforcement activities.

Comment [BB6]: confusing

Stormwater Permit

Construction activities that involve 0.5 or more acres of land disturbance must comply with the General Permit for Discharges of Storm Water Associated with Construction Activity (Construction General Permit, 99-08-DWQ), which regulates stormwater originating from construction activities. Construction activity subject to this permit includes clearing, grading and disturbances to the ground such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility.

The Construction General Permit requires the development and implementation of a SWPPP. Section A of the Construction General Permit describes the elements that must be contained in a SWPPP. These elements include a site map(s) that shows the construction site perimeter, existing and proposed buildings, lots, roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the project. The SWPPP must list the BMPs the discharger will use to protect storm water runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for “non-visible” pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment.

The SWRCB is in the process of reissuing the Construction General Permit and released a preliminary draft of the new permit on March 2, 2007 (SWRCB 2007). A revision to the draft was released in March 2008. When adopted, this permit will replace the 1999 Construction General Permit and, as proposed, would require the permittee to implement additional minimum BMPs. The revised draft permit also requires specific analytical procedures to determine whether the BMPs are preventing further impairment due to sediment and preventing non-visible pollutants from violating water quality objectives. The new requirements would require monitoring (i.e., sampling and testing) of the quality of stormwater discharges at most sites. In addition, all sites would be required to meet new development and redevelopment performance standards to minimize or mitigate hydrologic impacts.

Fish and Game Code, Sections 1601 to 1603

Under Sections 1601 to 1603 of the Fish and Game Code, DFG must be notified prior to any project that would divert, obstruct, or change the natural flow, bed, channel, or bank of any river, stream, or lake. The term "stream" can include intermittent and ephemeral streams, rivers, creeks, dry washes, sloughs, blueline streams, and watercourses with subsurface flows. The Project Proponent will apply for a Streambed Alteration Agreement from DFG.

3.9.3 Environmental Consequences

3.9.3.1 No Action Alternative

The No Action alternative would not affect surface or groundwater hydrology or water quality because no gates or other facilities would be constructed across the Old River or Connection Slough channels or on adjacent lands. Hydrologic and water quality conditions would remain as they have in the past. The historic conditions resulting in negative (upstream) net flow in certain channels in the Delta would be modified by the implementation of the controls established by the recent biological opinions (USFWS 2008b, NMFS 2009a).

3.9.3.2 Proposed Action

Implementation of the Proposed Action would result in minor, short-term impacts during construction to turbidity in waters adjacent to the facilities sites and would temporarily alter the flow path and velocity for tidal and watershed discharge flows through Old River and Connection Slough (and adjacent Delta channels) and thereby change one of the principal components of delta smelt habitat in the central and south Delta. These changes in peak flow would vary depending on the timing, amount and other characteristic (principally turbidity) of inflow from the Sacramento-San Joaquin Rivers watershed. Changes to the movement of water and the timing of water movements were evaluated using the RMA Delta Model and the "Delta Model Simulation II" (DSM2) computer model. The RMA Delta Model (described in more detail in Appendix B) and DSM2[1] calculates stages, flows, velocities; many water quality parameters and the movement of individual particles. The RMA Delta Model has been enhanced to simulate the upstream movement of delta smelt.

When the gates are closed, the Proposed Action would alter the regional flow-path of water in some portions of the Delta region. These changes are shown in Table 3.9-3 for the period

[1] Detailed descriptions of DSM2 are available at http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dsm2/dsm2.cfm.

designed to protect adult delta smelt and Table 3.9-4 for the juvenile delta smelt period. The greatest change to flow rates would be found in channels immediately adjacent to the Proposed Action facilities. On a more regional basis, water that would currently flow in the Old River or Connection Slough channels would be re-directed to other nearby north-south channels (e.g., Middle River). When the gates are open, the Proposed Action would have an negligible effect on Delta hydrology and water quality. These changes were compared using historic flow and salinity data for the period 1991-2006. Detailed results are available in Appendix E.

Comment [LW7]: App E is the ops plan—should this be A?

Figures 3.9-18 through Figure 3.9-26 displays the range of simulated net flow comparing current operations and the flow from the implementation of the Proposed Action at selected stations in the Delta. The month of January was selected a representative of conditions in the Delta the Proposed Action would be operated for the protection of adult delta smelt. Likewise Figures 3.9-27 through 3.9-35 displays the range of simulated net flow comparing current operations and the flow from the implementation of the Proposed Action at selected stations in the Delta. The month of March was selected a representative of conditions in the Delta the Proposed Action would be operated for the protection of juvenile and larval delta smelt. These results were obtained through the use of the RMA Delta Model (Appendix A).

Table 3.9-3 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during January-February 2004											
		Ebb Tide						Flood Tide					
		January			February			January			February		
Station Name	Code	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change
Chipps Island		442,671	440,997	0%	456,090	454,538	0%	-386,759	-386,185	0%	-369,202	-368,106	0%
False River	FAL	56,240	55,340	-2%	54,715	53,789	-2%	-60,552	-61,353	-1%	-62,003	-61,442	1%
Sacramento River @ Freeport	FPT	61,877	61,874	0%	75,071	75,071	0%	17,507	17,500	0%	15,921	15,927	0%
Grant Line Canal	GLC	6,361	6,361	0%	6,213	6,250	1%	-5,345	-5,448	-2%	-5,012	-5,175	-3%
Old River at Holland Cut	HOL	29,612	16,976	-43%	29,112	16,768	-42%	-31,728	-21,177	33%	-33,618	-22,018	35%
Jersey Point	JPT	159,472	159,641	0%	157,996	158,154	0%	-161,246	-160,569	0%	-157,081	-155,983	1%
Middle River S of Woodward Cut	MID	6,741	6,638	-2%	7,051	6,984	-1%	-9,438	-9,587	-2%	-9,353	-9,533	-2%
Mokelumne River @ SJR	MOK	21,488	21,857	2%	22,563	22,731	1%	-13,091	-14,582	-11%	-12,799	-14,602	-14%
Mossdale	RSAN087	2,929	2,917	0%	4,455	4,454	0%	-148	-149	0%	-101	-117	-16%
Middle River @ Medford Island	MRC	31,292	37,012	18%	30,612	35,617	16%	-37,843	-47,566	-26%	-38,881	-50,264	-29%
Old River @ Bacon Island	ROLD024	13,498	15,369	14%	13,580	15,430	14%	-16,856	-19,007	-13%	-16,487	-19,714	-20%
Old River W of Victoria	ROLD03	7,995	8,042	1%	8,643	8,686	1%	-11,761	-12,146	-3%	-	-11,956	-2%

Table 3.9-3 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during January-February 2004											
		Ebb Tide						Flood Tide					
		January			February			January			February		
Station Name	Code	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change	OCAP	Proposed Action	% change
Island	4										11,690		
Old River @ San Joaquin River	OSJ	11,390	18,582	63%	10,662	18,814	76%	-13,509	-19,256	-43%	-15,867	-21,982	-39%
Prisoner Point	PRI	63,899	73,984	16%	62,101	71,384	15%	-75,408	-90,169	-20%	-79,676	-94,854	-19%
Rio Vista	RSAC101	143,270	143,481	0%	197,193	197,180	0%	-102,473	-102,722	0%	-100,547	-101,149	-1%
Middle River @ Middle River	RMID015	12,485	10,495	-16%	12,816	10,929	-15%	-16,977	-15,843	7%	-16,989	-15,772	7%
Cashe Slough @ Ryer Island	RYI	97,616	97,904	0%	140,896	140,890	0%	-96,081	-96,156	0%	-91,321	-91,427	0%
San Andreas	SAN	118,980	119,100	0%	115,539	115,756	0%	-125,249	-126,456	-1%	-124,856	-125,747	-1%
Three Mile Slough	SLTRM004	27,568	27,528	0%	27,220	27,203	0%	-36,818	-37,023	-1%	-40,107	-39,715	1%
Turner Cut	TRC	2,256	2,908	29%	2,227	2,948	32%	-3,319	-4,460	-34%	-3,189	-4,240	-33%
Victoria Canal	VIC	3,359	3,293	-2%	3,736	3,644	-2%	-5,556	-5,671	-2%	-5,585	-5,620	-1%

Table 3.9-4 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in March 2004

		Juvenile Period - March 2004											
		Ebb Tide						Flood Tide					
Station Name	Code	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound
Chipps Island		443,911	440,718	441,965	439,116	-1%	-1%	-369,456	-372,369	-373,235	-376,864	-1%	-1%
False River	FAL	52,949	50,900	52,427	49,772	-4%	-5%	-59,915	-57,195	-60,662	-57,551	5%	5%
Sacramento River @ Freeport	FPT	72,797	72,795	72,796	72,793	0%	0%	23,305	23,269	23,297	23,270	0%	0%
Grant Line Canal	GLC	6,320	5,975	6,597	6,147	-5%	-7%	-4,082	-2,073	-4,206	-2,133	49%	49%
Old River at Holland Cut	HOL	27,800	15,672	26,935	21,667	-44%	-20%	-31,637	-10,111	-32,476	-16,367	68%	50%
Jersey Point	JPT	153,504	150,217	151,907	147,850	-2%	-3%	-156,824	-152,306	-158,917	-154,319	3%	3%
Middle River S of Woodward Cut	MID	6,818	6,369	6,141	5,674	-7%	-8%	-8,538	-9,359	-9,643	-10,148	-10%	-5%
Mokelumne River @ SJR	MOK	21,066	21,887	21,053	22,101	4%	5%	-11,649	-13,473	-11,448	-13,440	-16%	-17%
Mossdale	RSAN087	4,681	4,639	4,653	4,609	-1%	-1%	1,968	1,989	2,007	2,010	1%	0%
Middle River @ Medford Island	MRC	29,865	34,319	29,056	32,925	15%	13%	-37,556	-51,245	-38,578	-52,555	-36%	-36%
Old River @ Bacon Island	ROLD024	13,254	14,511	12,541	13,706	9%	9%	-15,759	-3,901	-16,740	-1,671	75%	90%
Old River W of Victoria Island	ROLD034	8,342	7,966	7,331	6,951	-5%	-5%	-10,496	-6,566	-13,150	-8,272	37%	37%
Old River @ San Joaquin River	OSJ	10,738	18,858	10,516	18,756	76%	78%	-13,979	-22,503	-14,473	-22,206	-61%	-53%
Prisoner Point	PRI	60,957	71,704	59,954	70,598	18%	18%	-78,691	-96,856	-80,261	-98,755	-23%	-23%

Table 3.9-4 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in March 2004

		Juvenile Period - March 2004											
		Ebb Tide						Flood Tide					
Station Name	Code	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound
Rio Vista	RSAC101	190,228	190,906	190,444	191,299	0%	0%	-94,199	-94,387	-94,149	-94,357	0%	0%
Middle River @ Middle River	RMID015	12,562	10,145	11,593	9,220	-19%	-20%	-15,980	-26,438	-17,398	-28,004	-65%	-61%
Cashe Slough @ Ryer Island	RYI	134,237	134,724	134,420	135,043	0%	0%	-93,606	-93,625	-93,478	-93,493	0%	0%
San Andreas	SAN	115,083	112,353	113,631	110,120	-2%	-3%	-124,296	-122,271	-126,708	-124,409	2%	2%
Three Mile Slough	SLTRM004	25,701	24,660	25,277	23,996	-4%	-5%	-37,641	-36,237	-38,246	-36,766	4%	4%
Turner Cut	TRC	2,127	3,038	1,910	2,722	43%	43%	-3,276	-6,041	-3,558	-6,219	-84%	-75%
Victoria Canal	VIC	3,620	3,344	3,133	2,664	-8%	-15%	-5,036	-6,590	-6,908	-8,176	-31%	-18%

Table 3.9-5 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in June 2004

	Peak Total Flow (cfs) for Simulated Operations and Proposed Action during June 2004	
	Ebb Tide	Flood Tide

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Station Name	Code	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound
Chipps Island		425,783	421,024	424,951	420,002	-1%	-1%	- 409,224	-412,285	-410,782	-414,874	-1%	-1%
False River	FAL	55,846	54,039	55,754	54,054	-3%	-3%	-61,621	-59,544	-61,964	-59,575	3%	4%
Sacramento River @ Freeport	FPT	19,652	19,652	19,668	19,668	0%	0%	5,195	4,676	5,196	4,668	-10%	-10%
Grant Line Canal	GLC	6,030	5,865	5,902	5,724	-3%	-3%	-4,275	-4,275	-4,645	-4,298	0%	7%
Old River at Holland Cut	HOL	30,785	19,486	30,446	28,537	-37%	-6%	-32,293	-21,351	-32,606	-32,287	34%	1%
Jersey Point	JPT	157,777	153,314	157,393	152,782	-3%	-3%	- 165,173	-160,164	-166,119	-161,240	3%	3%
Middle River S of Woodward Cut	MID	6,001	5,766	5,672	5,378	-4%	-5%	-9,954	-10,013	-9,973	-10,451	-1%	-5%
Mokelumne River @ SJR	MOK	17,608	18,913	17,622	18,958	7%	8%	-14,098	-16,158	-14,014	-16,205	-15%	-16%
Mossdale	RSAN087	2,127	2,070	2,106	2,176	-3%	3%	-289	-21	-174	83	93%	148%
Middle River @ Medford Island	MRC	31,681	36,768	31,471	36,486	16%	16%	-38,649	-51,345	-39,149	-51,987	-33%	-33%
Old River @ Bacon Island	ROLD024	13,616	14,874	13,428	14,656	9%	9%	-17,172	-17,158	-17,628	-17,155	0%	3%
Old River W of Victoria Island	ROLD034	6,981	7,009	6,384	6,447	0%	1%	-12,730	-12,730	-13,294	-12,755	0%	4%
Old River @ San Joaquin River	OSJ	12,178	19,792	12,089	19,919	63%	65%	-13,698	-23,900	-13,856	-23,572	-74%	-70%
Prisoner Point	PRI	63,752	76,161	63,508	76,023	19%	20%	-75,810	-93,745	-76,659	-94,445	-24%	-23%
Rio Vista	RSAC101	123,000	124,759	123,250	124,850	1%	1%	- 117,176	-118,385	-117,278	-118,495	-1%	-1%
Middle River @ Middle	RMID015	12,094	10,096	11,825	9,905	-17%	-16%	-17,765	-28,909	-18,260	-30,332	-63%	-66%

Table 3.9-5 Comparison of Peak Total (Ebb and Flood Tides) Flow: Simulated Operations with Operational Controls and Proposed Action using hydrologic conditions found in June 2004

		Peak Total Flow (cfs) for Simulated Operations and Proposed Action during June 2004											
		Ebb Tide						Flood Tide					
Station Name	Code	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound	OCAP-LB	2GATE-LB	OCAP-UB	2GATE-UB	% change Lower Bound	% change Lower Bound
River													
Cashe Slough @ Ryer Island	RYI	91,733	92,335	91,983	92,434	1%	0%	-95,054	-95,768	-95,086	-95,780	-1%	-1%
San Andreas	SAN	118,136	115,591	117,805	115,133	-2%	-2%	-127,245	-124,669	-128,071	-125,525	2%	2%
Three Mile Slough	SLTRM 004	28,298	27,172	28,204	27,041	-4%	-4%	-34,411	-32,817	-34,666	-32,905	5%	5%
Turner Cut	TRC	2,640	3,400	2,586	3,318	29%	28%	-3,758	-6,276	-3,805	-6,454	-67%	-70%
Victoria Canal	VIC	2,908	2,626	2,616	2,332	-10%	-11%	-6,172	-6,715	-6,815	-8,119	-9%	-19%

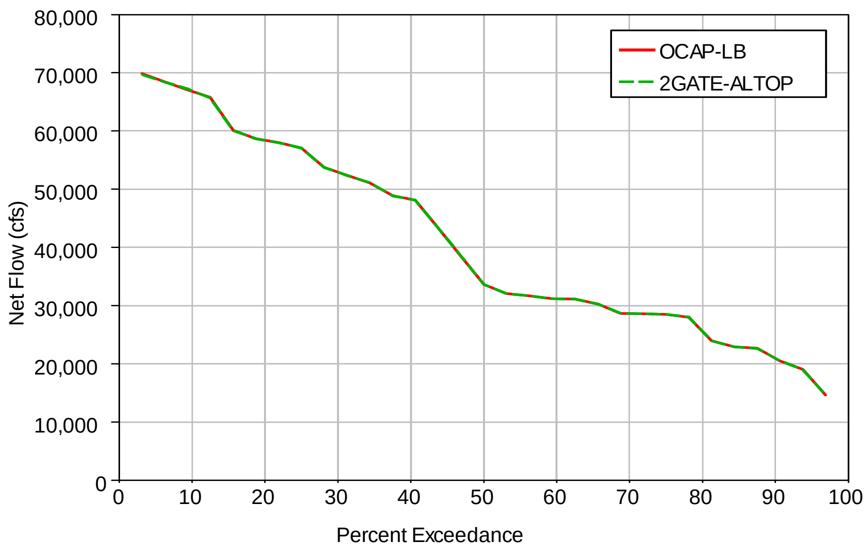


Figure 3.9-9 Net Flow Exceedance for OCAP and 2-Gate Simulations at Chipps Island for January 2004.

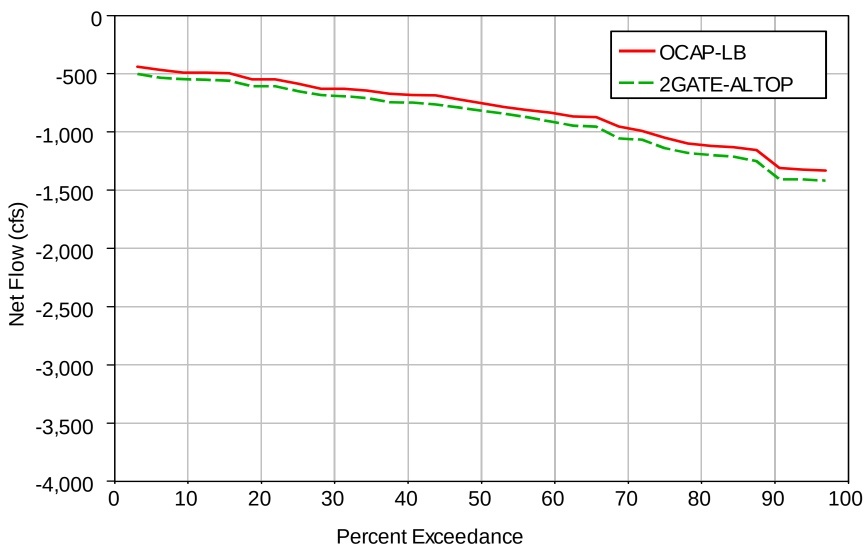


Figure 3.9-10 Net Flow Exceedance for OCAP and 2-Gate Simulations at MID (Middle River South of Woodward Canal) for January 2004 (Adult Period).

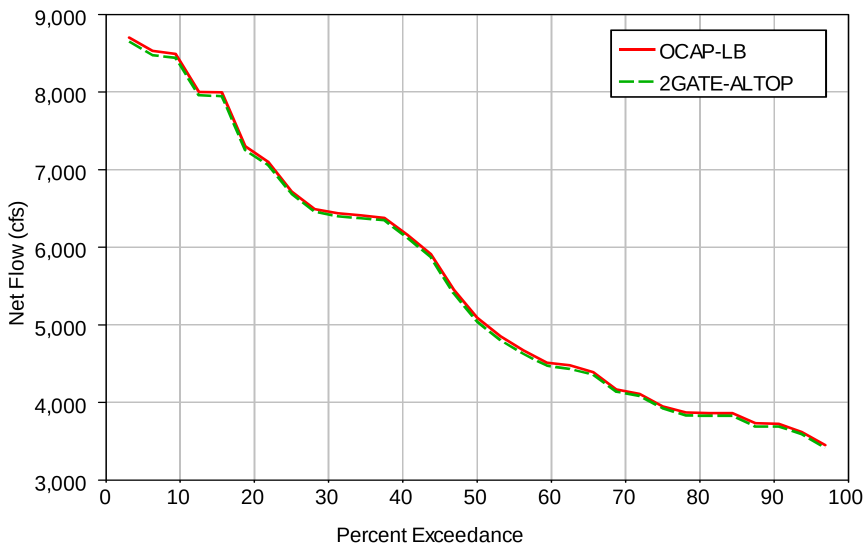


Figure 3.9-11 Net Flow Exceedance for OCAP and 2-Gate Simulations at MOK (Mokelumne River at San Joaquin River) for January 2004

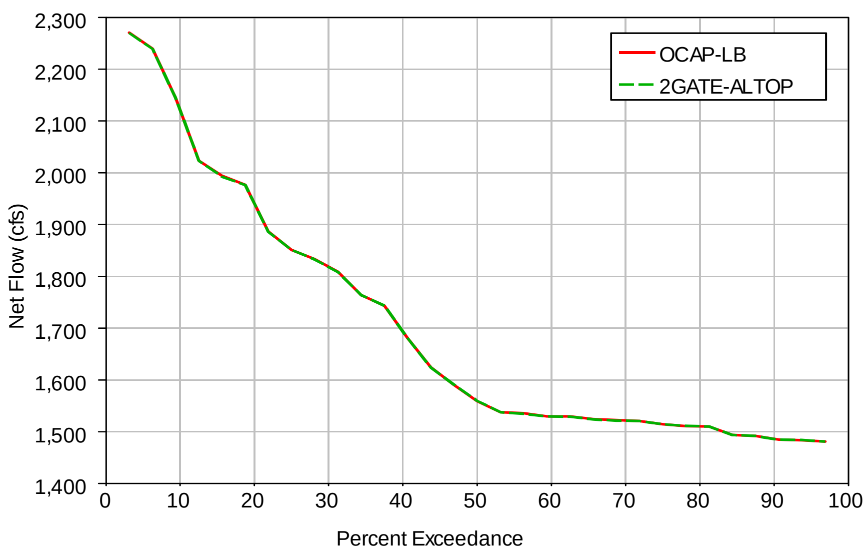


Figure 3.9-12 Net Flow Exceedance for OCAP and 2-Gate Simulations at MOS (RSAN087, San Joaquin River at Mossdale) for January 2004

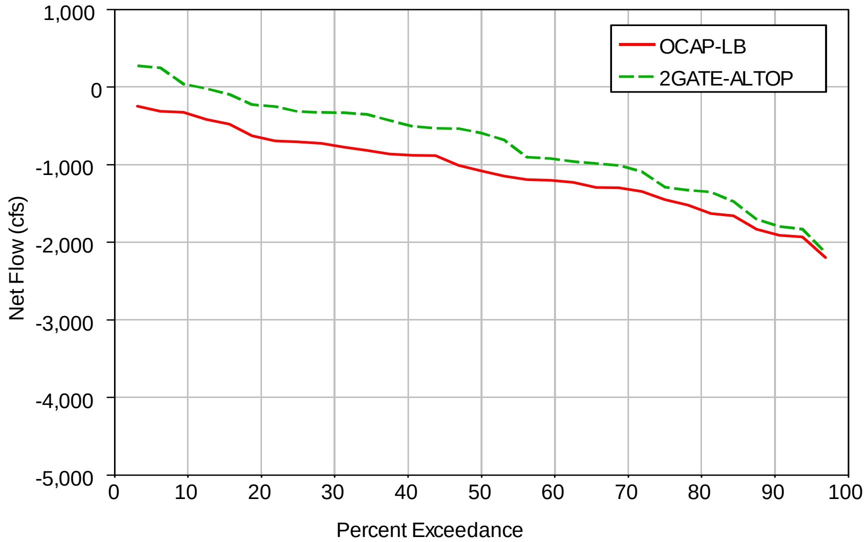


Figure 3.9-13 Net Flow Exceedance for OCAP and 2-Gate Simulations at MRC (Middle River at Medford Island) for January 2004

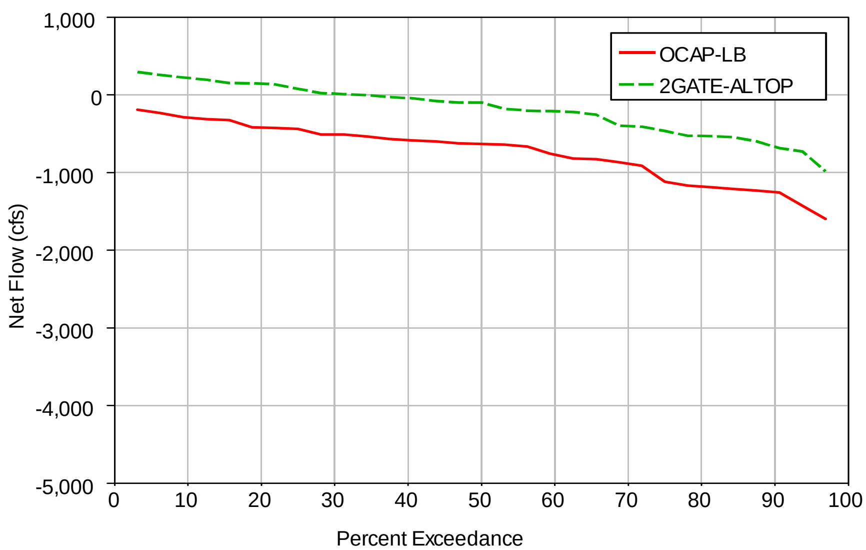


Figure 3.9-14 Net Flow Exceedance for OCAP and 2-Gate Simulations at OLD (ROLD024, Old River at Bacon Island) for January 2004

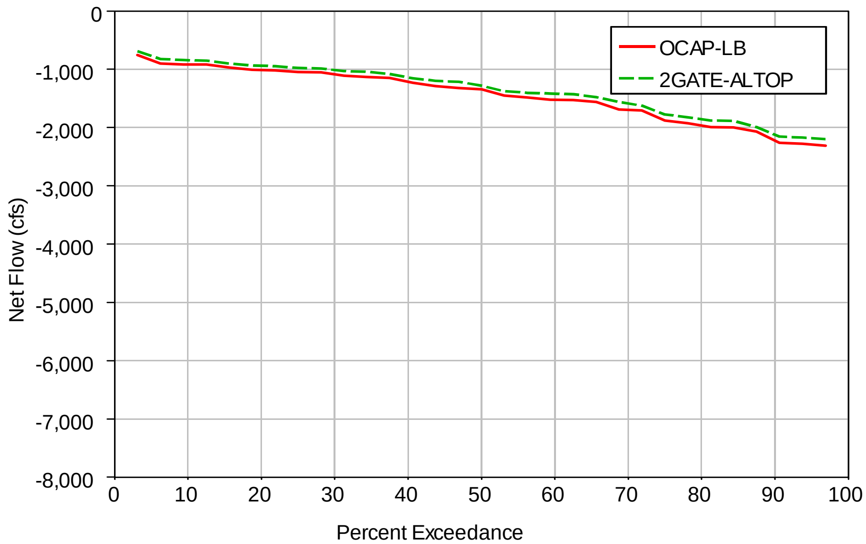
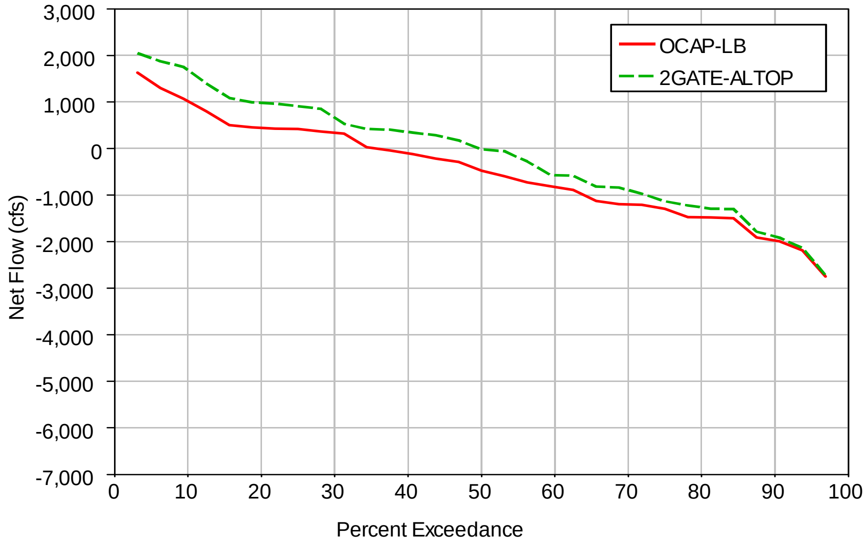


Figure 3.9-15 Net Flow Exceedance for OCAP and 2-Gate Simulations at OLF (ROLD034, Old River near Byron) for January 2004



1

2 **Figure 3.9-16 Net Flow Exceedance for OCAP and 2-Gate Simulations at PRI (Prisoner Point) for**
3 **January 2004**

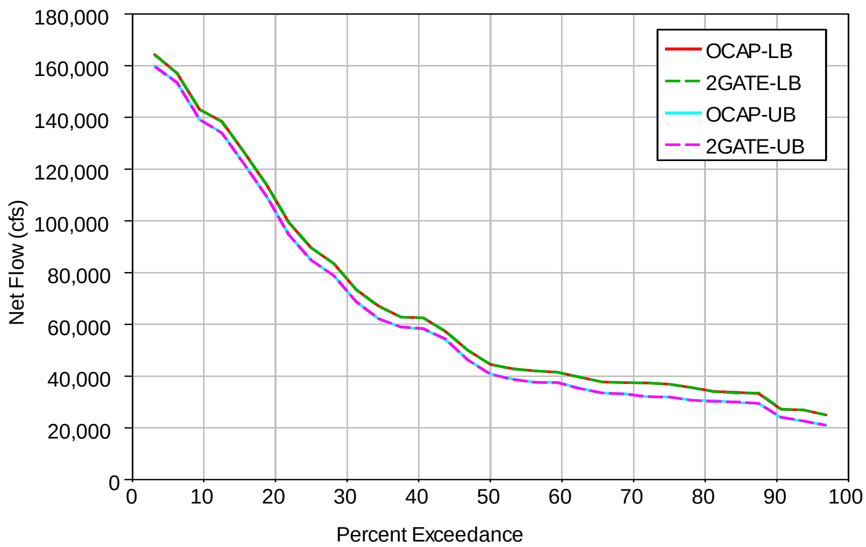


Figure 4-18 Net Flow Exceedance for OCAP and 2-Gate Simulations at Chipps Island for March 2004

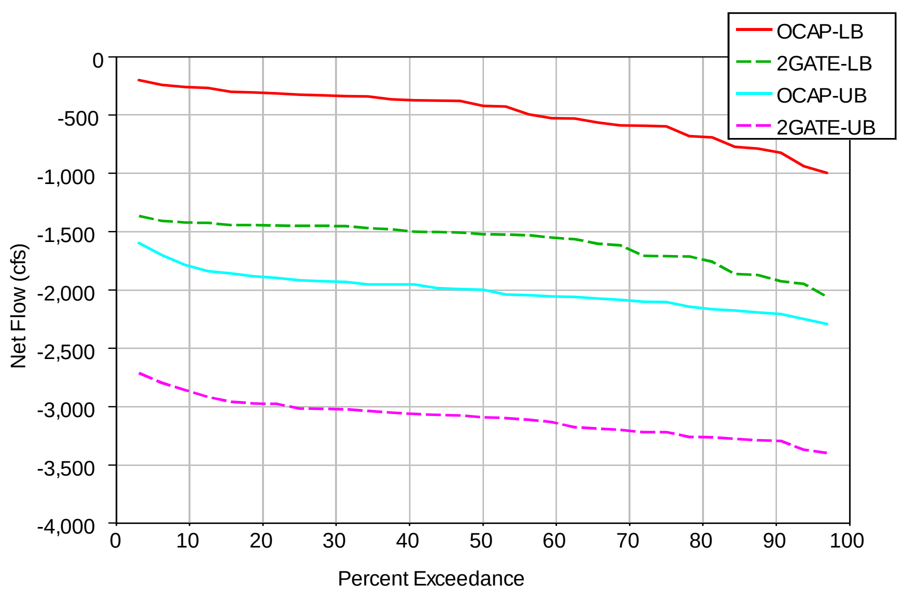


Figure 519 Net Fow Exceedance for OCAP and 2-Gate Simulations at MID (Middle River S of Woodward Canal) for March 2004

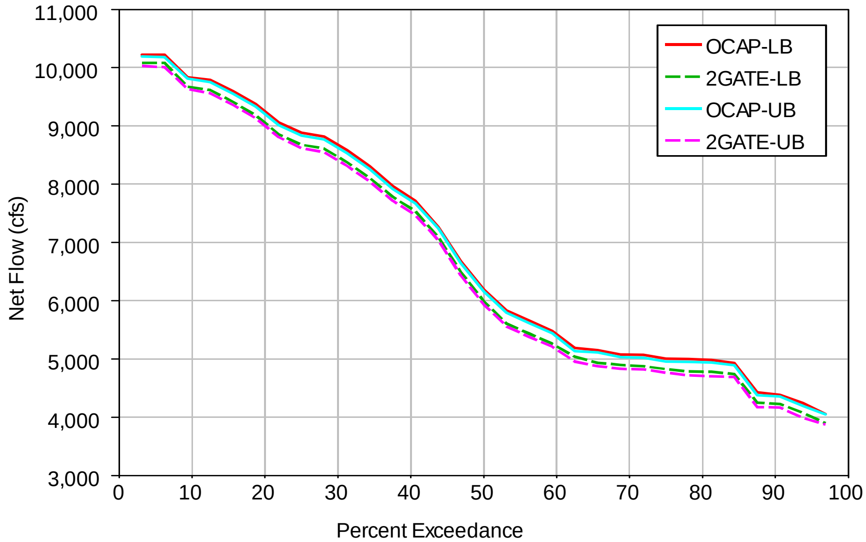


Figure 3.9-20 Net Flow Exceedance for OCAP and 2-Gate Simulations at MOK (Mokelumne River at San Joaquin River) for March 2004

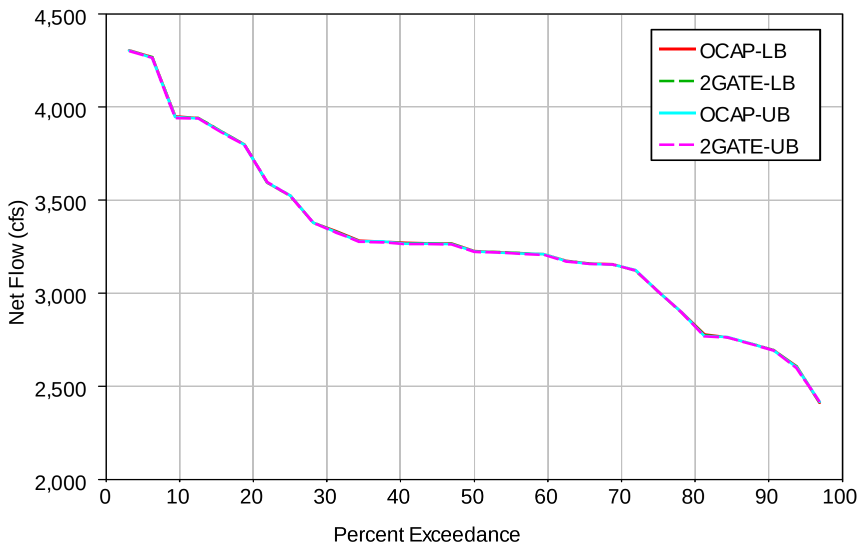


Figure 3.9-21 Net Flow Exceedance for OCAP and 2-Gate Simulations at MOS (RSAN087, San Joaquin River at Mossdale) for March 2004

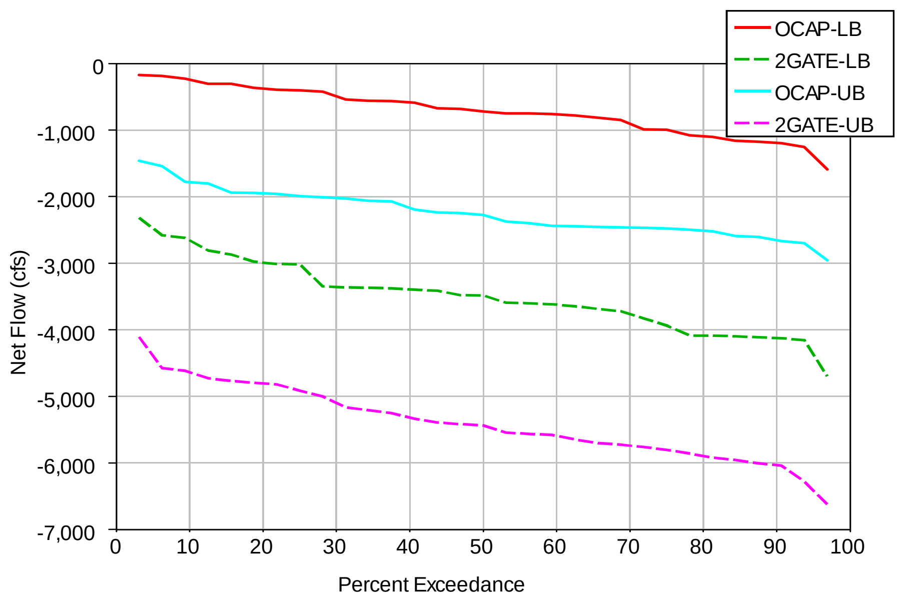


Figure 3.9-22 Net Flow Exceedance for OCAP and 2-Gate Simulations at MRC (Middle River at Medford Island) for March 2004

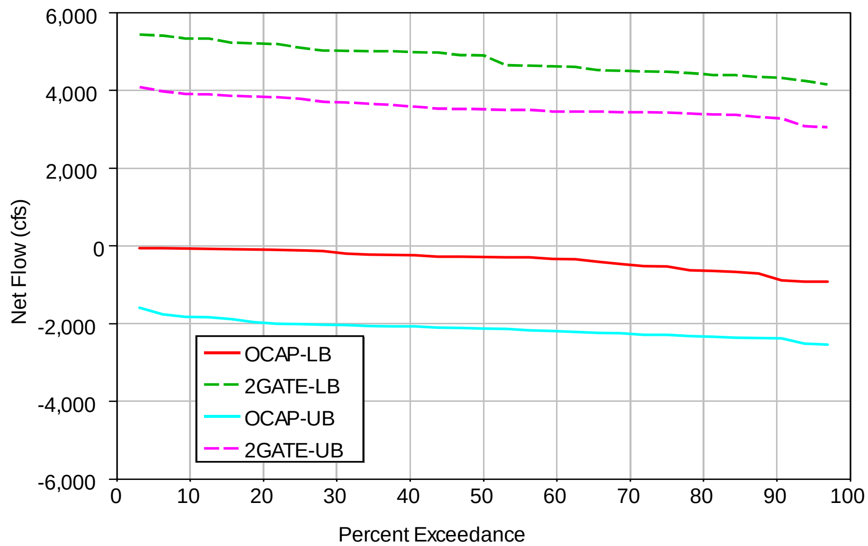


Figure 3.9-23 Net Flow Exceedance for OCAP and 2-Gate Simulations at OLD (ROLD024, Old River at Bacon Island) for March 2004

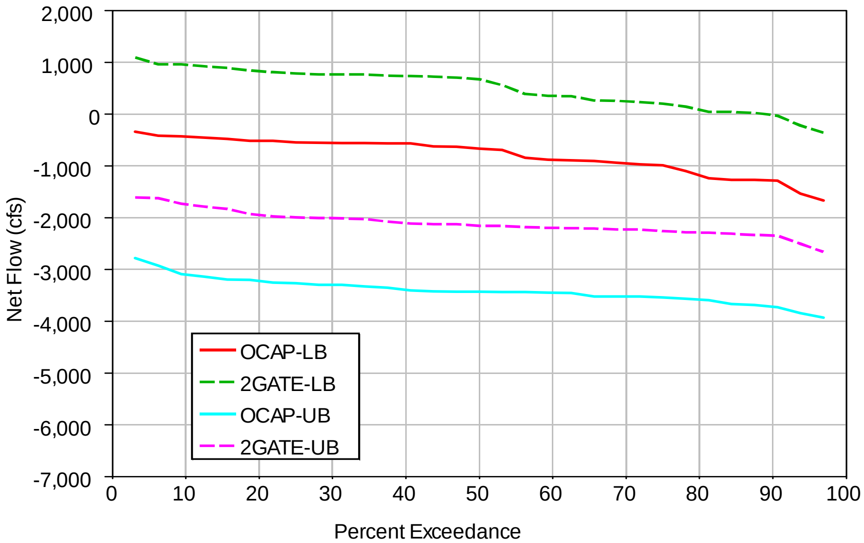


Figure 3.9-24 Net Flow Exceedance for OCAP and 2-Gate Simulations at OLF (ROLD034, Old River near Byron) for March 2004

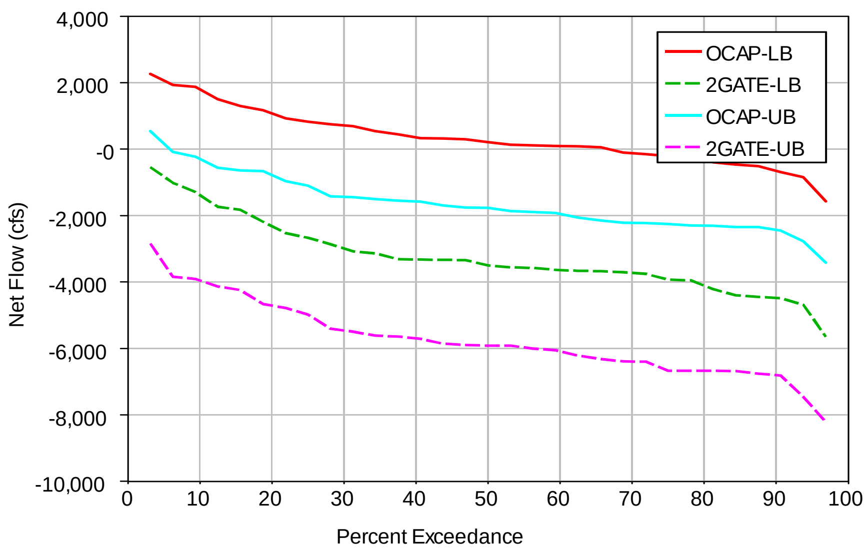


Figure 3.9-25 Net Flow Exceedance for OCAP and 2-Gate Simulations at PRI (Prisoner Point) for March 2004

Depending upon the duration of the closure, weather and initial water quality conditions could result in changes in water quality similar to those found in other dead-end sloughs of the Delta. When the gates are closed, small portions of channels adjacent to the Old River and Connection Sloughs barriers would likely receive reduced mixing, which may result in slightly degraded water quality in the form of somewhat reduced oxygen, minor changes in salinity, and may have a tendency to allow for the development of patches of aquatic plants and temporarily trap floating debris. This effect would be temporary and would not be as pronounced as conditions in permanent dead-end sloughs because operations of the Proposed Action are anticipated to include a relatively short closure periods (up to approximately two hours per day), the gates would not be completely sealed, and some small flow volumes would move past the gates. These conditions would dissipate soon after the gates were opened. These changes would be most pronounced when ambient air temperature is high, winds speeds are low, and tidal action is small. Therefore, changes to water quality would be small.

Due to its proximity to the Proposed Action facilities, changes in salinity could occur at the compliance location at Rock Slough specified under D-1641. Simulations of the Proposed Action operations conducted using DSM2 indicate that operation of the Proposed Action would not to lead to violations of the Rock Slough standard, although there were instances (winter) when salinity was increased by a small amount compared to existing conditions at Rock Slough (Figure 4.9-26). Installation of barriers and closure of the gates would generally improve water quality at Rock Slough by reducing salinity intrusion. During winter months, gate closure would reduce local flushing, which could lead to degradation of water quality at Rock Slough. This would only be a significant concern if CCWD operations required significant flow from Rock Slough. In general, CCWD minimizes the use of Rock Slough during the winter and spring, and the gates would be operated to flush any build up of agricultural drainage water in the channel if necessary.

The Proposed Action is projected to result in small increases in average monthly salinity at other regional locations. The greatest anticipated increase in average monthly salinity at a location not adjacent to the Proposed Action site would be approximately 8 percent at the San Joaquin River near Jersey Point. However, this would not result in a violation of a water quality standard.

The greatest anticipated change in salinity changes indicated by the model results is a reduction (improvement in water quality) of approximately 20 percent at “Middle River upstream of Mildred” and “Woodward Cut” based on the average monthly salinity (in April) This magnitude of a salinity reduction at these locations, south of the proposed facilities, would be a beneficial impact on existing water quality and water uses.

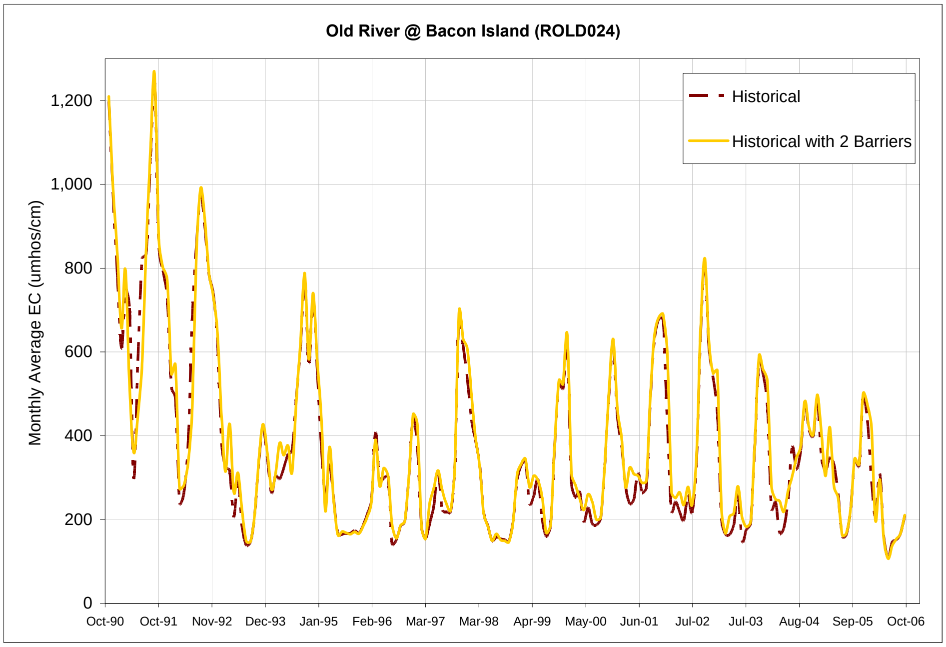


Figure 4.9-26 Projected Salinity near the CCWD Rock Slough Water Diversion Location

The Proposed Action would only contact the uppermost portion of groundwater-bearing formations as a result of dredging to approximately 35 feet below sea level and would have no effect on local or regional groundwater hydrology or groundwater water quality. The Proposed Action would not increase the use of groundwater, nor would it interfere with natural groundwater recharge because no impermeable surfaces would be created on land.

Construction

Comment [LW8]: need to reorganize entire discussion by construction and ops—hydrology, water quality,etc.

Construction would occur primarily within the Old River and Connection Slough channels and generally would not require grading or other topographic modifications. Channel bottom material would be dredged and disposed of on the northeast corner of Bacon Island. The dredged material would be confined within a bermed area and would not result in erosion or siltation. Dredging for the foundation for the barge-mounted gates would result in a short-term increase in sediment load in a channel. This increase in turbidity would dissipate quickly as suspended particles settled to the bottom after dredging was complete. Moreover, as described in Section 2, turbidity would be monitored during in-water construction, and work would cease as needed to prevent exceedance of the standards approved by the regulatory agencies.

Operations

During operations, the Proposed Action would temporarily and periodically alter the height of the water (stage) at various locations immediately adjacent to the facilities of the Proposed Action. A substantial change in stage could result in the exposure of soils to erosion. As shown in Figure 4.9-27, very little difference is predicted to occur as a result of operations of the Proposed Action. The small change in stage would not result in substantial erosion or siltation.

Although the facilities of the Proposed Action would occasionally alter the existing hydrology of two specific stream channels in the Delta, the facilities have been designed to avoid the substantial modification of hydrology under high flow (flood) conditions from the Sacramento and San Joaquin River watersheds. As a fundamental operational criterion, the gates would be kept open during the high-flow conditions to permit the passage of the flood flows. This would restore much of the pre-Project channel capacity of the Old River and Connection Slough.

DSM2 was used to model the peak flood event from February 1997 event, which was roughly a 100-year event. The stage hydrographs of the existing and "gates open" conditions for this flood event at the Project barrier on Old River are compared in Figure 4.9-27. As the figure illustrates, the barrier would not increase the flood stage profile at the peak stages immediately upstream or downstream of the barrier.

The stage hydrographs of the existing and gates open conditions for the February 1998 flood event at gage location ROLD014 downstream of the barrier are compared in Figure 4.9-29. The stage hydrographs of the existing and gates open conditions for the February 1998 flood event at Gage location ROLD024 upstream of the barrier are compared in Figure 4.9-30. Figures 4.9-29 and 4.9-30 confirm that the barrier would not increase the flood stage profile at the peak stages within a mile upstream or downstream of the barrier.

The exceedance probability expressed as a percent for river stage at the sites immediately upstream and downstream of the barrier is presented in Figure 4.9-31 for the Old River barrier. Lines are shown for the baseline condition, as well as gates open on the upstream side of the structure and gates open on the downstream side of the structure. The exceedance probability plots support the finding of no impact on flood stage greater than 8.4 feet North American Vertical Datum of 1988 (NAVD88) due to the Project barrier. These results include an inherent conservatism in the analysis due to lack of overtopping of the barrier that would normally occur for flood stages greater than 6.6 feet NAVD88. The 100-year flood stage within Old River is 9.71 feet NAVD88.

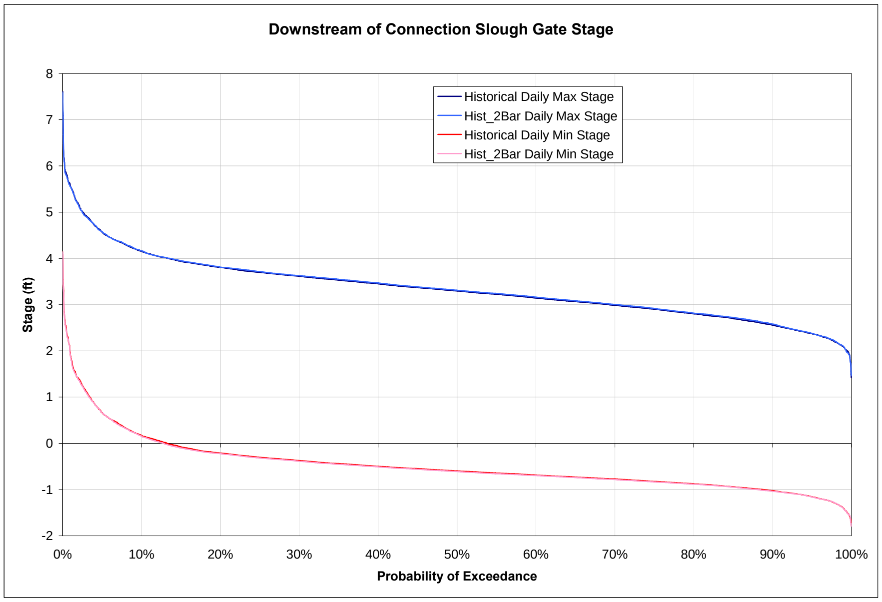


Figure 4.9-27 Change in Low and High Tide Water Surface Elevation near 2-Gates Facilities

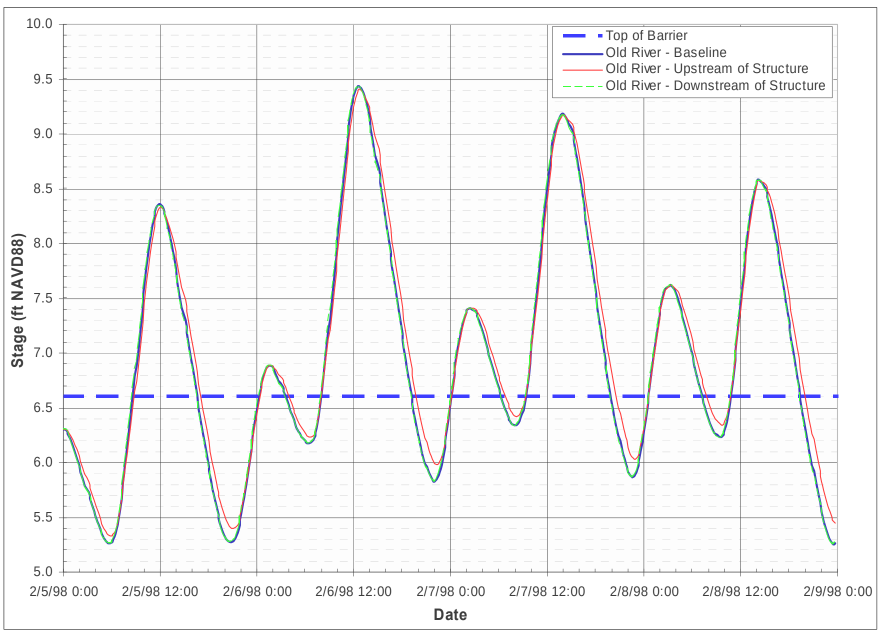


Figure 4.9-28 Stage Profiles for February 1998 Flood Event at Old River—2-Gates Barrier

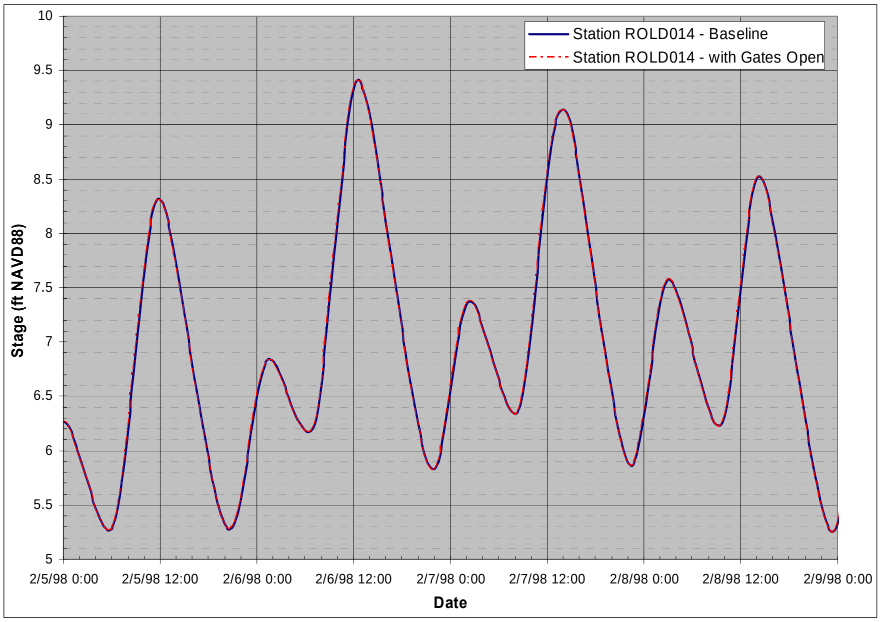


Figure 4.9-29 Stage Profiles for February 1998 Flood Event at Old River Gage Station ROLD014

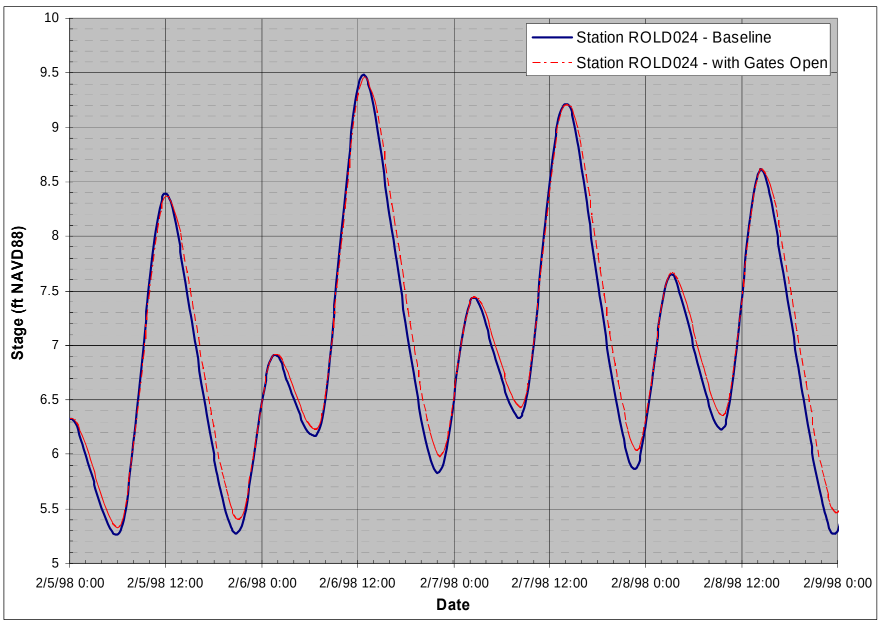


Figure 4.9-30 Stage Profiles for February 1998 Flood Event at Old River Gage Station ROLD024

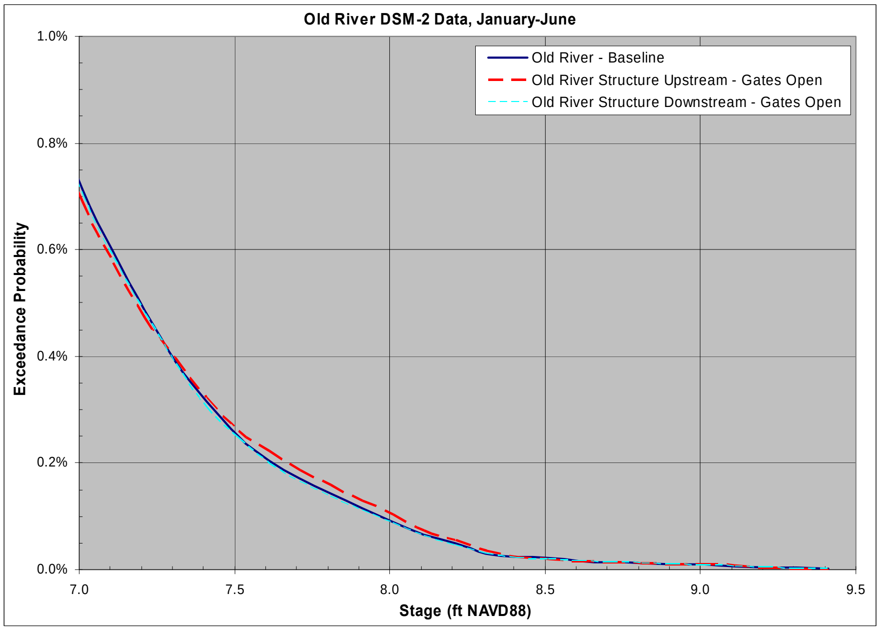


Figure 4.9-31 Exceedance Probabilities for High Stages at Old River—2-Gates Barrier

Additionally, Proposed Action facilities, especially the sheet pile materials connecting the barriers to the existing levee system, are designed to preclude adversely affecting the existing levee system. This design consideration further minimizes the potential to adversely affect off-site flooding. Refer to Appendices L and M for additional detail regarding flooding.

No stormwater drainage systems are in place at the Proposed Action sites; runoff enters the waterways. The only potential source of runoff water would be associated with dredged material disposal. The channel bottoms would be dredged with a clamshell, and the dredged material would be placed in a bermed disposal site on Bacon Island. Material would be largely dewatered by the time it was placed in the storage area, and the berm would confine any potential runoff. The dredged material is not expected to contain contaminants such as heavy metals, because it is in a rural area, well-removed from industrial uses. The runoff from the dredge material disposal site would be controlled using standard BMPs for such sites.

No other water quality impacts have been identified. However, the Proposed Action would include local and regional water quality monitoring to support all testing and adaptive management of the facilities. Water quality monitoring would be conducted at a series of compliance points and at municipal and agricultural water diversion intakes to identify if changes in water quality occur that are associated with Project operations. If these data identify water quality effects associated with the Proposed Action, adjustments to operation criteria would be implemented to minimize salinity or other water quality effects at sensitive locations.

Operational adjustments would primarily involve changes to timing and duration of gate opening.

The Proposed Action would not increase the flood stage profile upstream or downstream of the Proposed Action facilities (Appendices L and M) and therefore would not alter the relationship of housing within the 100-year floodplain.

Geotechnical studies are currently underway to evaluate two options: (1) peat removal along the landward side of the levee near the barrier sites and (2) installation of a seepage barrier mat as well as buttress levees. The peat along the landward side of the levees near the barrier sites would be left in place, except in areas of foundation preparation and post-demonstration removal of the Proposed Action facilities. The potential for seepage to occur where peat is removed would be prevented by installation of a layer of impermeable material topped with a 5-foot layer of crushed rock to act as a seepage barrier.

References:

USGS, NWIS. http://nwis.waterdata.usgs.gov/ca/nwis/peak/?site_no=11303500&

Comment [BB9]: is the reference a typo? What about page 9-47?