



WaterFix Impacts on Reverse Flows at Freeport Regional Water Project Intake

Testimony Summary

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(EBMUD Exhibit 101)

Presentation Topics

- Tidal Influence at Freeport
- Reverse Flow Impacts from WaterFix



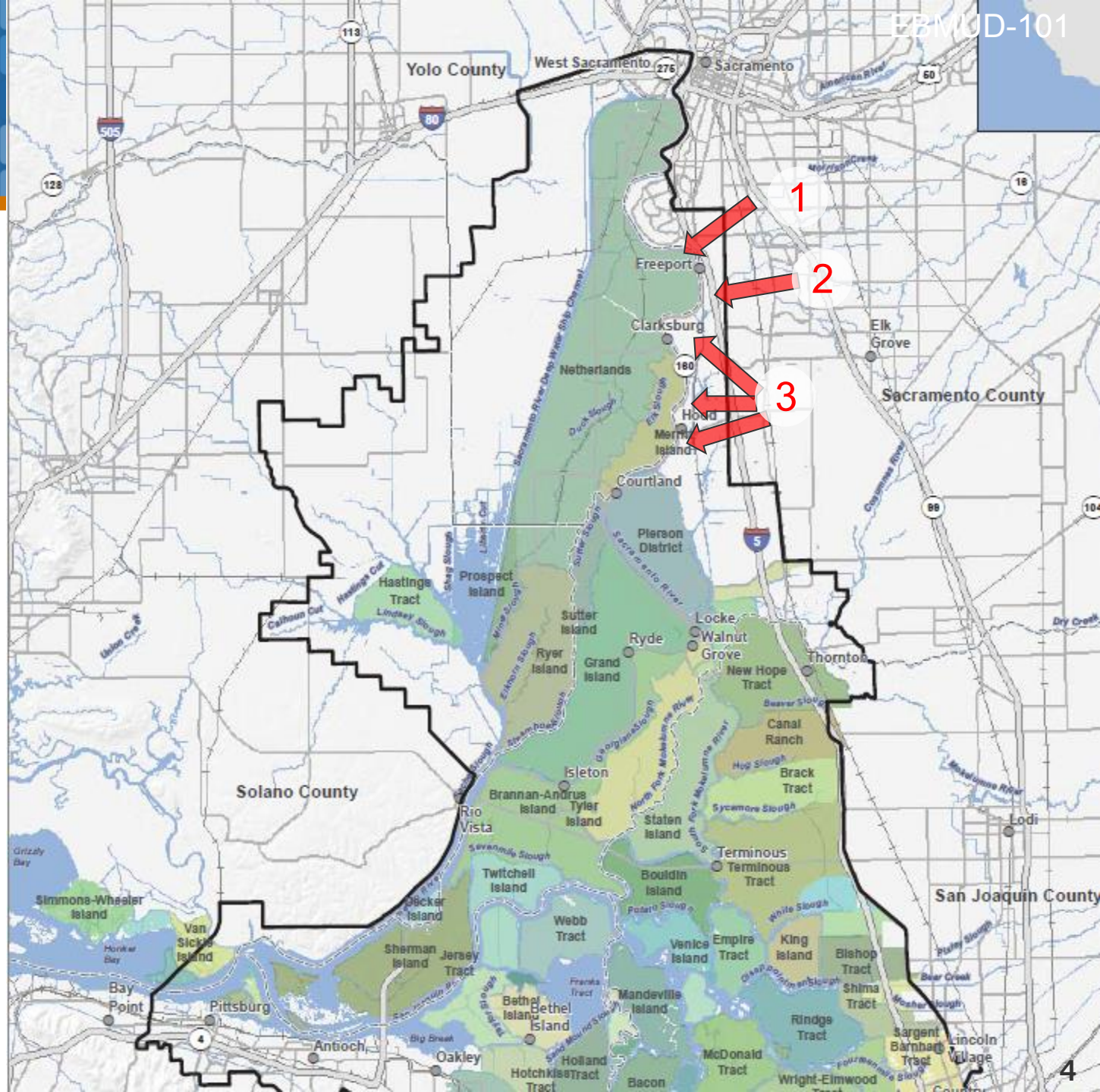
Defining the Problem:

**What is a “significant”
reverse flow event?**

1 –
FRWP Intake

2 –
Regional San
Outfall

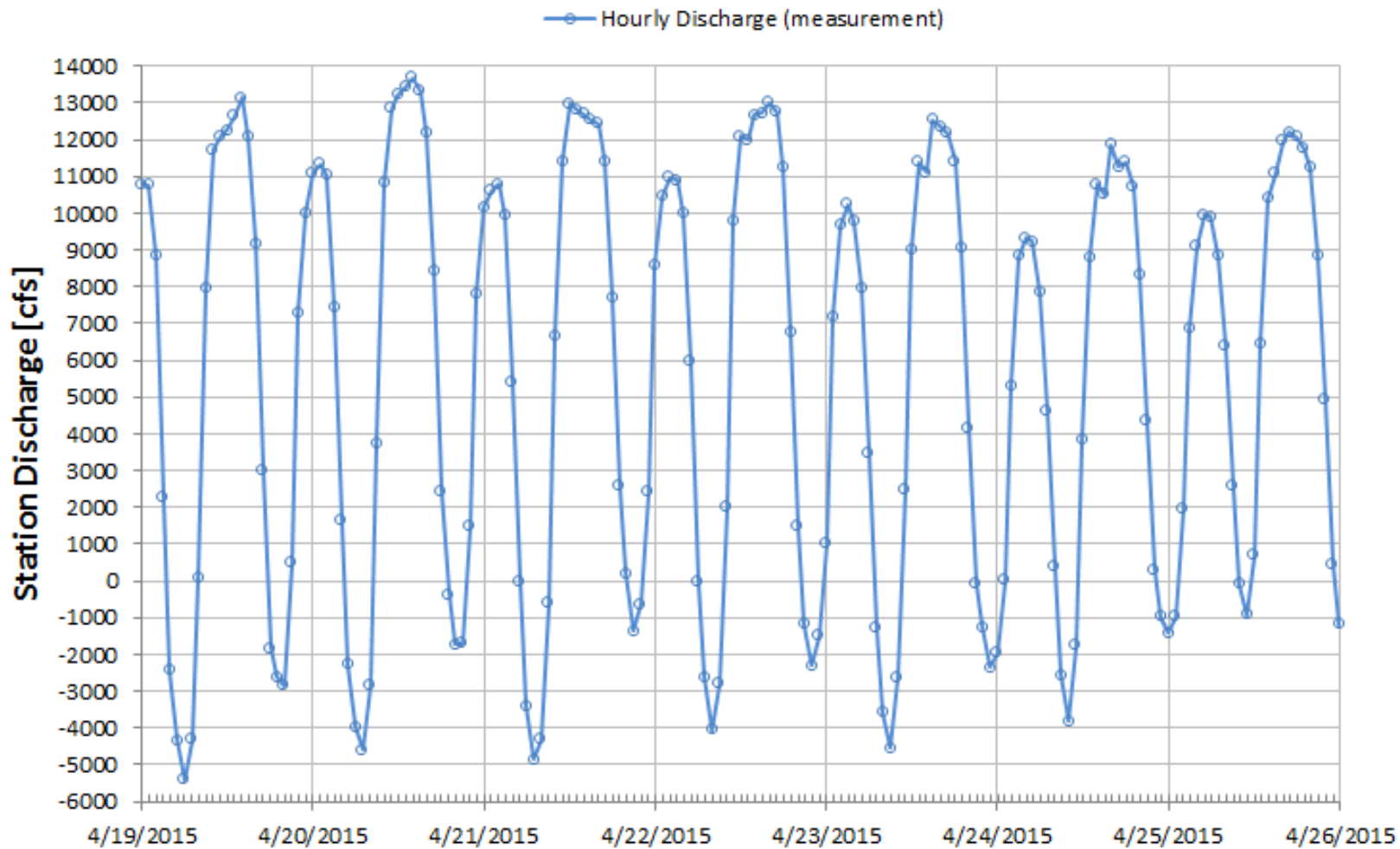
3 –
WaterFix
Intakes



An Example of Tidal Influence

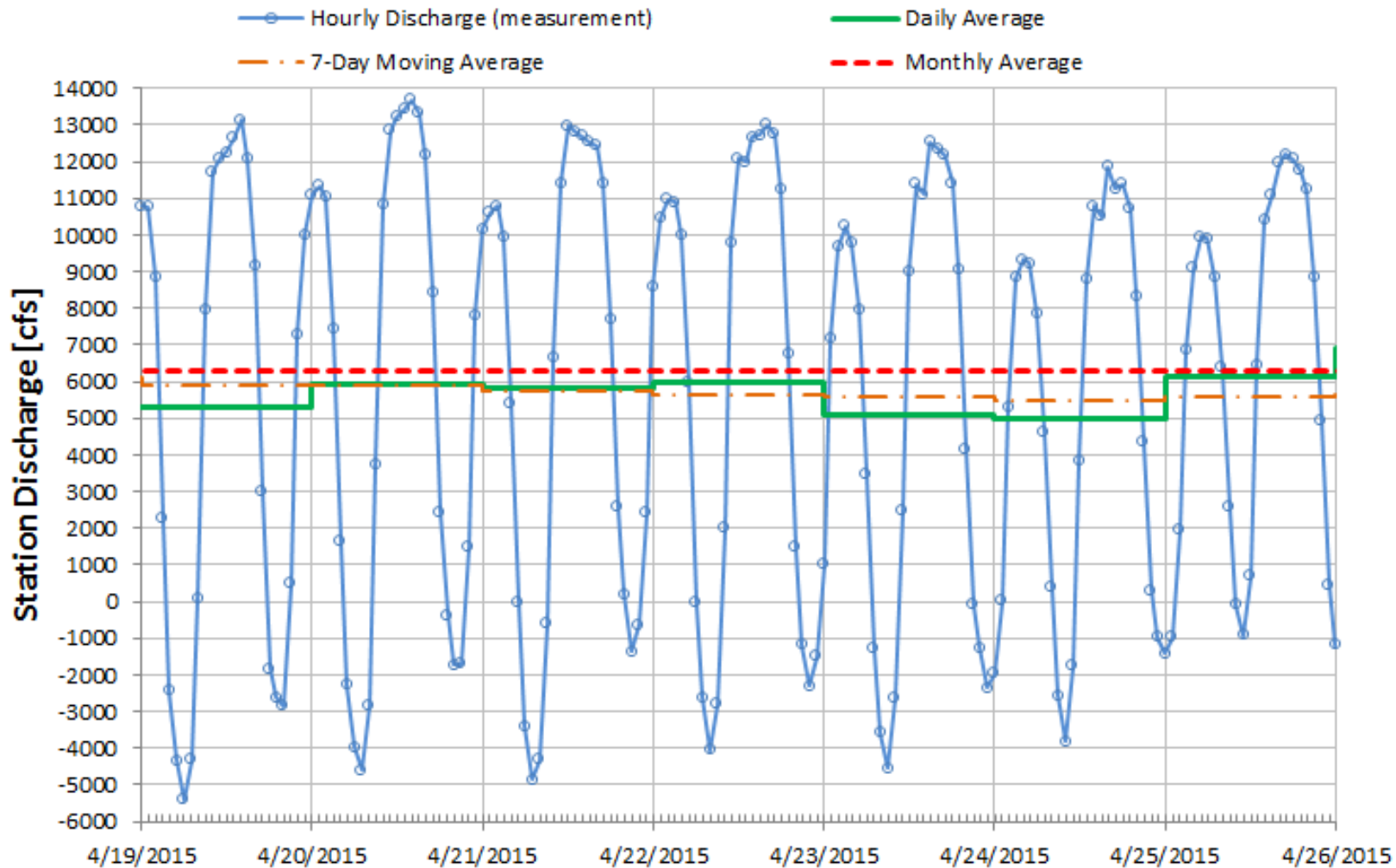


Freeport Gage Station, April 19-25, 2015



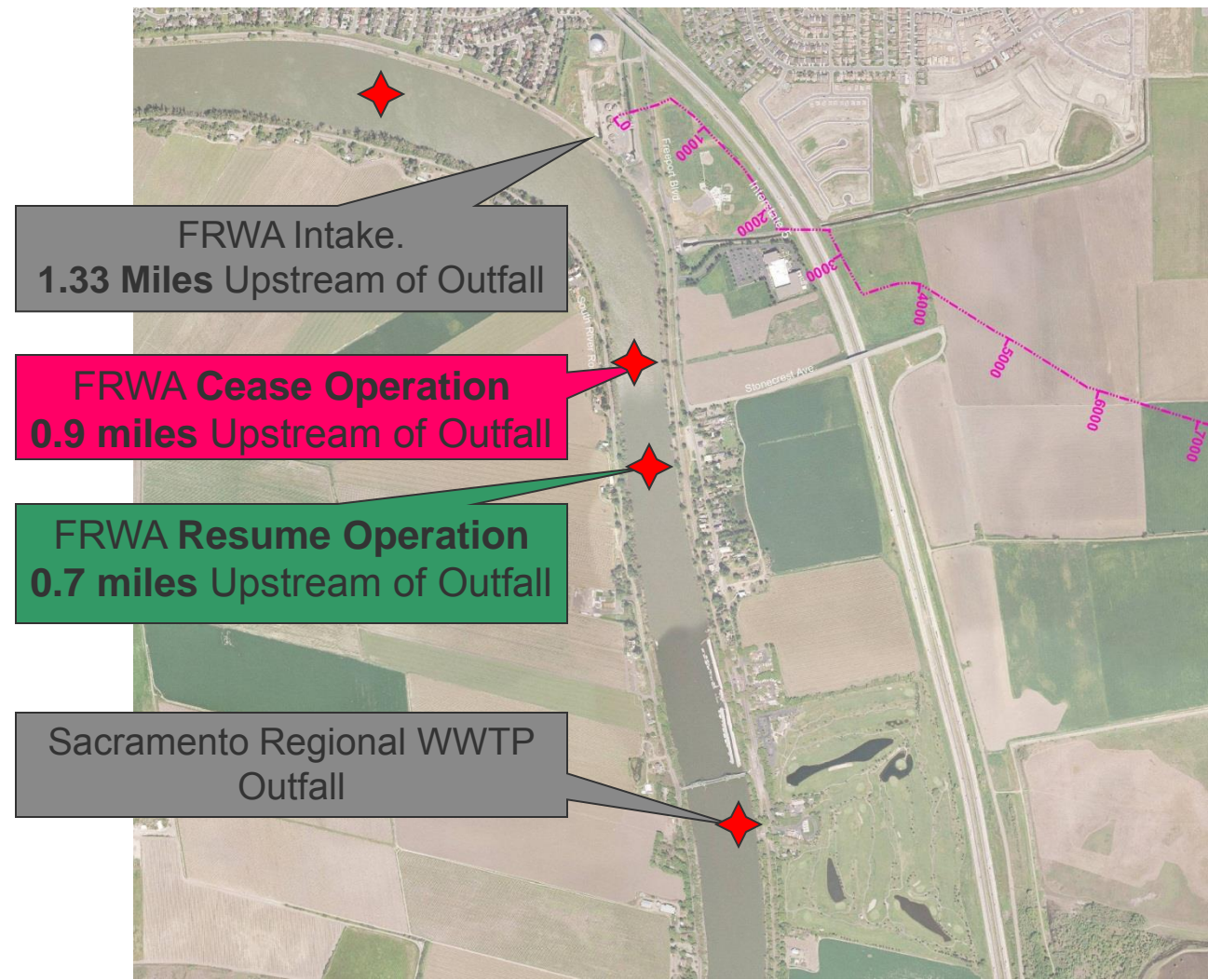
An Example of Tidal Influence

Freeport Gage Station, April 19-25, 2015

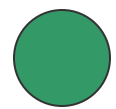




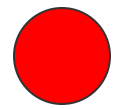
Reverse Flow Operational Criteria



Pumping



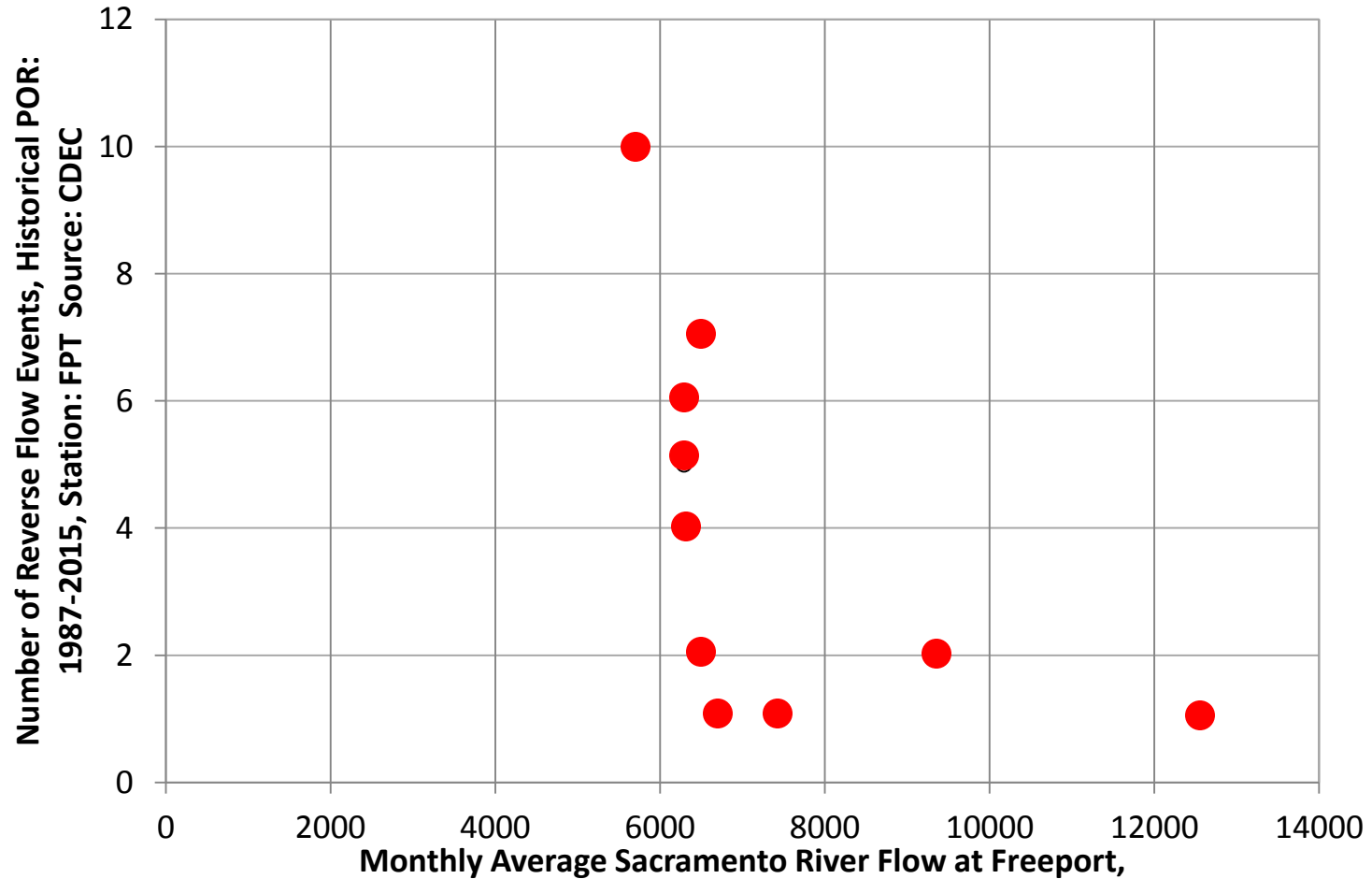
ON



OFF



Historical Reverse Flow Exceedances with Monthly Flow



← Increasing *risk* of reverse flow shutdowns

Technical Analysis Efforts:

Assessing Reverse Flow Impacts to Freeport Regional Water Project

WaterFix's Impact on Freeport

- WaterFix increases SWP/CVP operational flexibility
- New flexibility allows timing and magnitude of north-to-south exports to change
- Shift in export patterns can reduce Sacramento River low flows during droughts
- Lower flows lead to more significant reverse flow events that require Freeport Project shutdowns



Relevant Prior Analysis

Table 3: Reverse Flow Events with Advective Transport Exceeding 0.9 Miles for DWR Modeling Studies, 1974-1991 Hydrology.

Model Study	Brief Description	Number of Events
EX_ROA0_SLR0_CC0	Existing Case, Includes Fall X2	25
EX_No_FallX2_ROA0_SLR0_CC0	Existing Case, No Fall X2	30
NAA_ELT_ROA0_SLR15_CC5	No Action Case, Early	70
NAA_LL_T_ROA0_SLR45_CC5	No Action Case, Late	178
NAA_ROA0_SLR0_CC0	No Action Case, General	22
ALT4_ELT_ROA25_SLR15_CC5	Action Case, Early	14
ALT4_LL_T_ROA65_SLR45_CC5	Action Case, Late	21

Table 4: Reverse Flow Events with Advective Transport Exceeding 0.9 Miles for MBK Modeling Studies, 1921-2003 Hydrology and 1974-1991 Hydrology.

Model Study	Brief Description	Number of Events 1921-2003 Hydrology	Number of Events 1974-1991 Hydrology
MBK_FutBase_CC0_SLR0	Base Case	203	55
MBK_BDCP_ALT4_CC0_SLR0_ROA0	Action Case	237	64
MBK_FutBase_CC0_SLR0_ROA25	Base Case with Restoration	49	11
MBK_BDCP_ALT4_CC0_SLR0_ROA25	Action Case with Restoration	55	12

Relevant Prior Analysis

What the BDCP modeling told us:

North Delta Diversion
+ New Tidal Marsh

Fewer Shutdown
Events at Freeport

North Delta Diversion
— New Tidal Marsh

More Shutdown
Events at Freeport

Freeport Reverse Flow Impact Analysis: Two Methods

INDIRECT → Use CalSim-II

Assess risk of WaterFix-caused increase in reverse flows by analyzing changes in Sacramento River flows downstream of Freeport intake

DIRECT → Use DSM2

Assess changes in reverse flow events by analyzing fine-timescale (15-min) velocity output at Freeport intake



Analysis of Petitioners' CalSim-II WaterFix Modeling

Number of “Low-Flow” Months where WaterFix Scenario Reduces Monthly Average Flow at Freeport (vs. NAA):

Period of Interest	H3	H4	Bnd1	Bnd2
1929-1934 Drought (Oct. 1928 - Oct. 1934, $N = 73$)	9	7	6	5
1976-1977 Drought (Oct. 1975 - Nov. 1977, $N = 26$)	4	4	3	4
1987-1992 Drought (Oct. 1986 - Nov. 1992, $N = 74$)	12	5	5	8
Drought Subtotal ($N = 173$)	25	16	14	17
WY 1922-2003 ($N = 984$)	34	22	22	20

WaterFix operations will further reduce flows during droughts, when flows are already low.



Analysis of Petitioners' DSM2 WaterFix Modeling

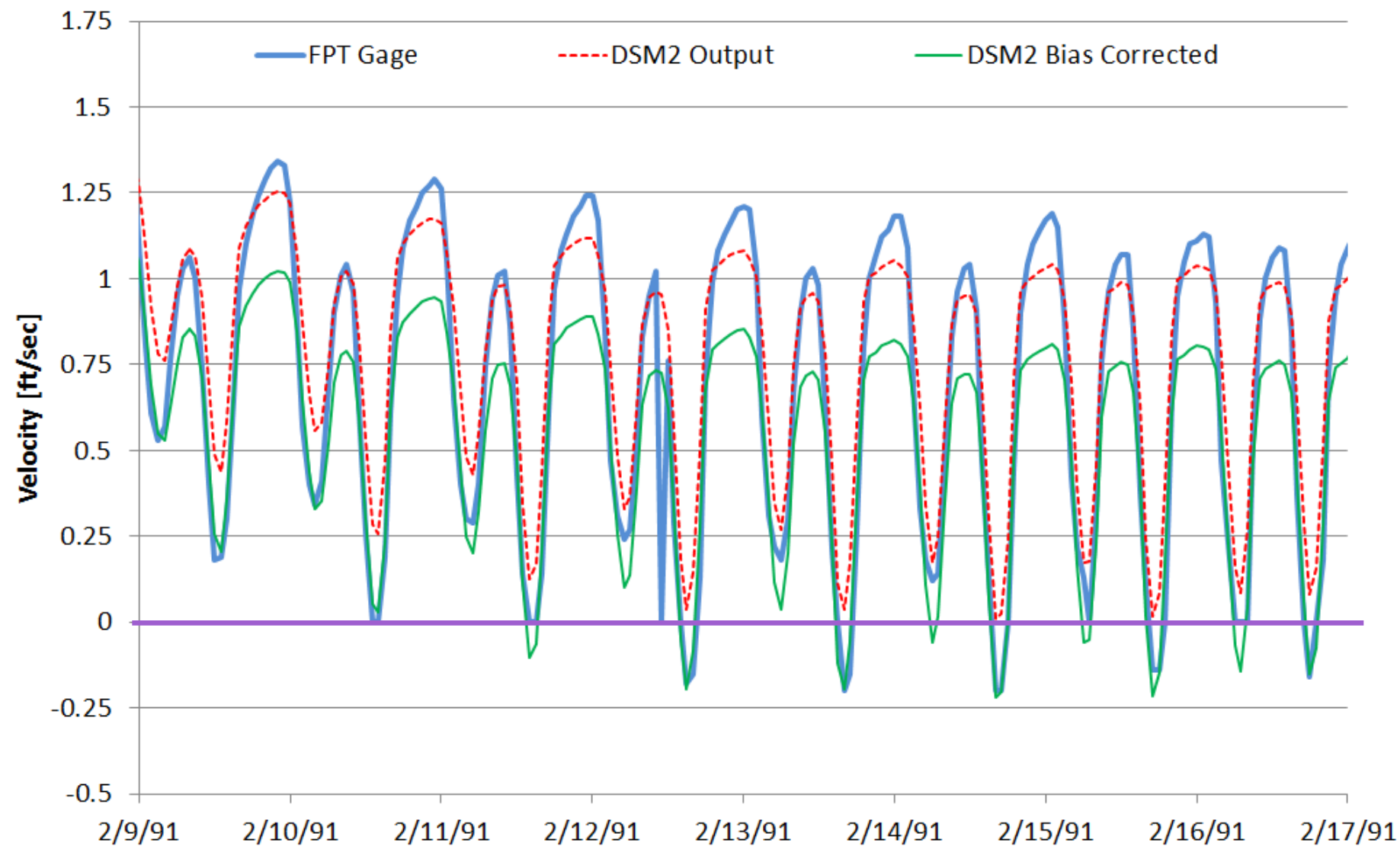
Number of Modeled “Shutdown Events” at Freeport:

Period of Interest	NAA	H3	H4	Bnd1	Bnd2
1976-1977 Drought (Oct. 1975 - Oct. 1977)	31	30	33	27	28
1987-1992* Drought (Oct. 1987 - Sep. 1990)	71	51	45	50	56
WY 1975-1991 Total (Oct. 1974 - Sep. 1991)	113	89	86	82	96

*WY 1992, the last year of the 1987-1992 drought is not included in DSM2 simulations

Long-term “high level” rollup suggests WaterFix operation could moderately reduce significant reverse flow events under most scenarios.

DSM2 Historical Simulation shows Velocity Output Bias



Analysis of Bias-Corrected DSM2 WaterFix Modeling

Number of Modeled “Shutdown Events” at Freeport:

Period of Interest	NAA	H3	H4	Bnd1	Bnd2
1976-1977 Drought (Oct. 1975 - Oct. 1977)	165	183	183	160	176
1987-1992* Drought (Oct. 1987 - Sep. 1990)	377	374	332	326	328
WY 1975-1991 Total (Oct. 1974 - Sep. 1991)	596	572	541	500	504

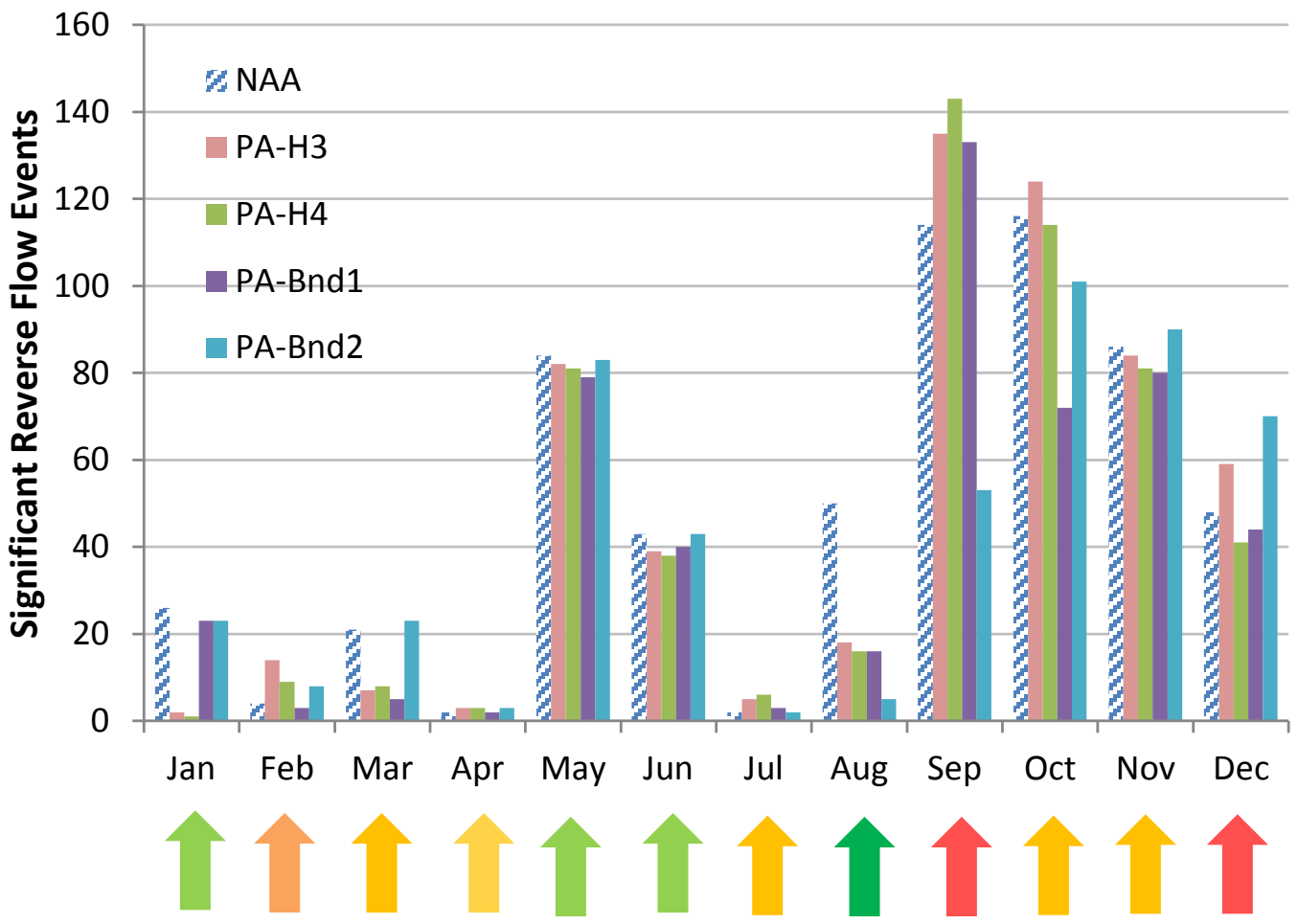
*WY 1992 (final year of 1987-1992 drought) not included in Petitioners’ DSM2 simulations.

*Without bias correction, DSM2 **significantly underestimates** the frequency of significant reverse flow events in all scenarios (including the NAA).*



A closer look at “shutdown events” – month by month

Bias-Corrected DSM2 Modeled Significant Reverse Flow Events by Month (1976-1991):



Under WaterFix, shutdown events are more frequent in some months.

arrow indicator color key

good bad



Putting the Modeling Together

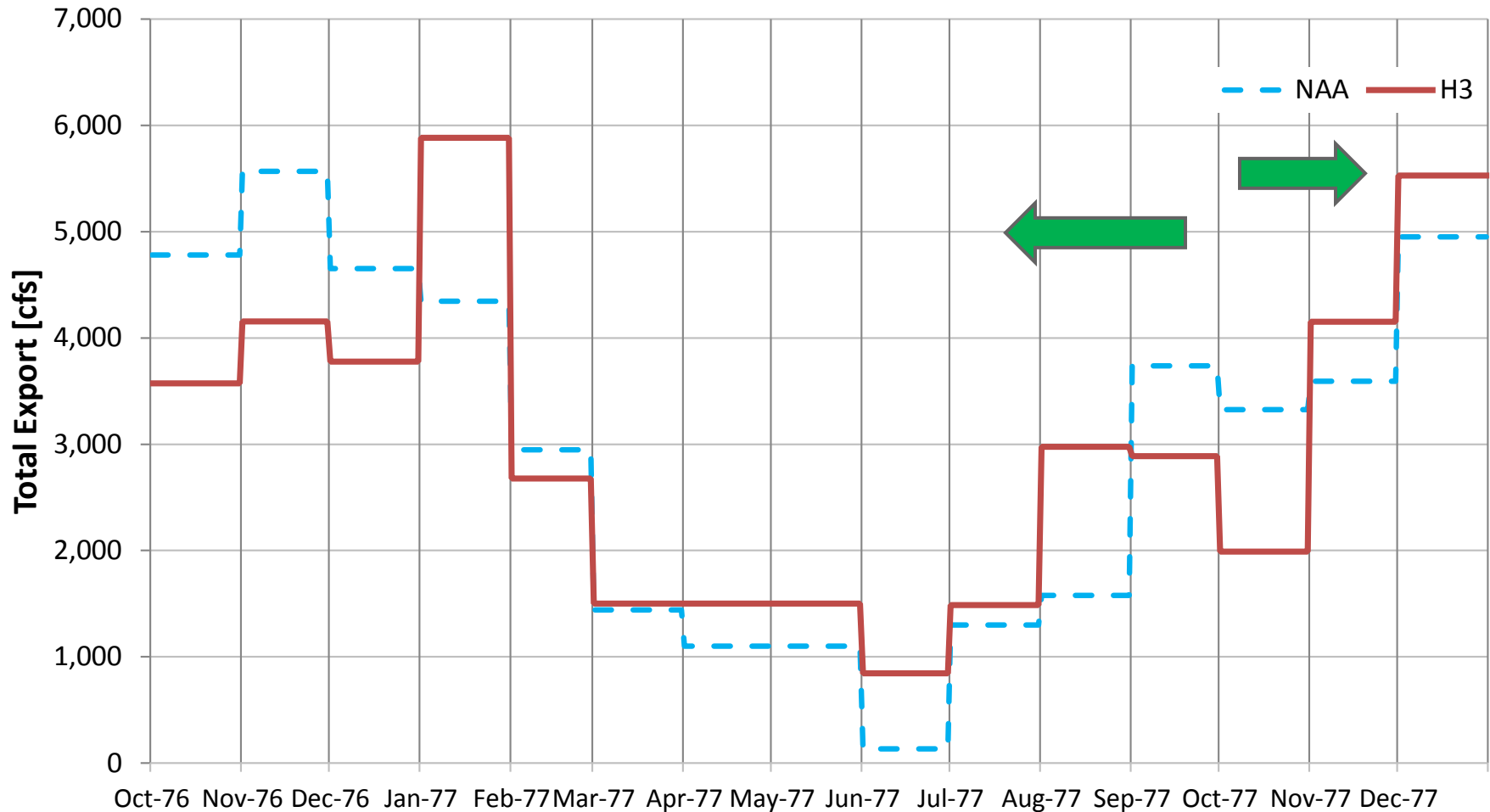
year	month	Number of Significant Reverse Flow Events					Corresponding Monthly Average Flow [cfs]				
		NAA	H3	H4	Bnd1	Bnd2	NAA	H3	H4	Bnd1	Bnd2
1976	11	0	9	9	9	9	9,288	7,880	7,880	7,910	7,863
		<i>(change)</i>	9	9	9	9		-1,408	-1,408	-1,378	-1,425
1976	12	6	16	16	16	17	8,437	7,564	7,564	7,589	7,469
		<i>(change)</i>	10	10	10	11		-873	-873	-848	-968
1977	9	17	37	37	38	26	6,916	6,058	6,056	6,032	6,687
		<i>(change)</i>	20	20	21	9		-858	-860	-884	-229
1977	10	35	43	43	20	36	6,085	5,826	5,827	6,870	6,187
		<i>(change)</i>	8	8	-15	1		-259	-258	785	102
1987	9	8	21	20	17	0	7,898	7,222	7,260	7,522	10,088
		<i>(change)</i>	13	12	9	-8		-676	-638	-376	2,190
1988	7	0	3	3	1	0	11,890	9,233	9,185	9,423	11,397
		<i>(change)</i>	3	3	1	0		-2,657	-2,705	-2,467	-493
1990	9	16	23	20	28	11	7,353	7,092	7,364	6,842	7,889
		<i>(change)</i>	7	4	12	-5		-261	11	-511	536
1990	12	17	18	18	3	27	7,178	7,132	7,190	9,703	6,471
		<i>(change)</i>	1	1	-14	10		-46	12	2,525	-707
1991	2	1	12	7	1	7	11,551	8,819	9,054	10,684	9,607
		<i>(change)</i>	11	6	0	6		-2,732	-2,497	-867	-1,944
1991	6	4	10	10	12	10	9,694	8,292	8,303	8,107	8,217
		<i>(change)</i>	6	6	8	6		-1,402	-1,391	-1,587	-1,477
1991	8	0	14	14	14	0	8,925	7,833	7,856	7,803	9,584
		<i>(change)</i>	14	14	14	0		-1,092	-1,069	-1,122	659

For ease of reference, increases in significant reverse flow events and corresponding monthly flows are colored with red font. Decreases in significant reverse flow events and corresponding monthly flows are colored with green font. For cases where there is no change in the number of significant reverse flow events, grey font is used. Also, italicized font is used for each "change" row of the table where the NAA is subtracted from the project alternative.

Putting the Modeling Together



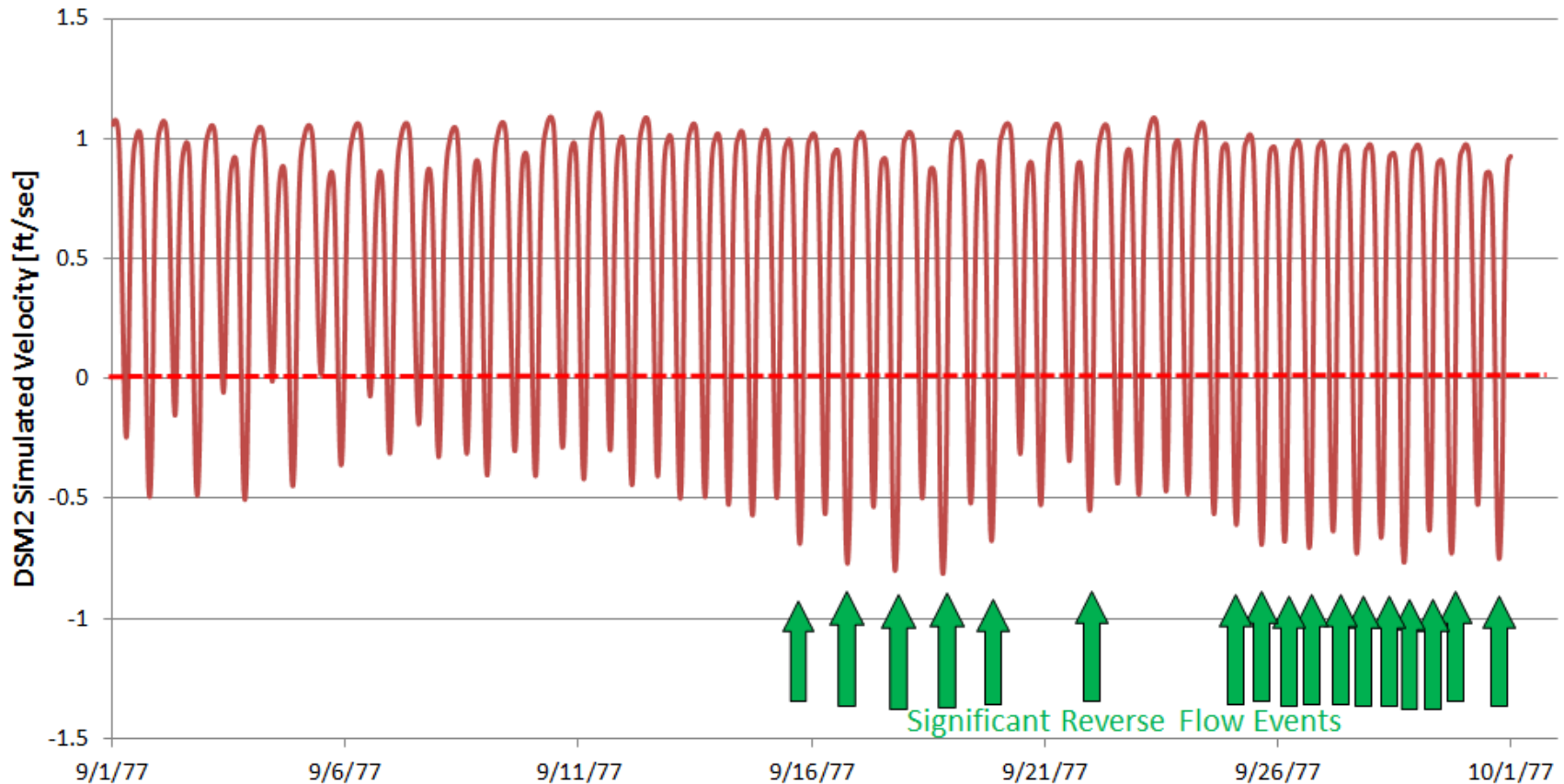
September 1977 Example: Shift in Timing of Exports.



Putting the Modeling Together



September 1977 Example: WaterFix operation results in an increase from 17 “shutdown events”...

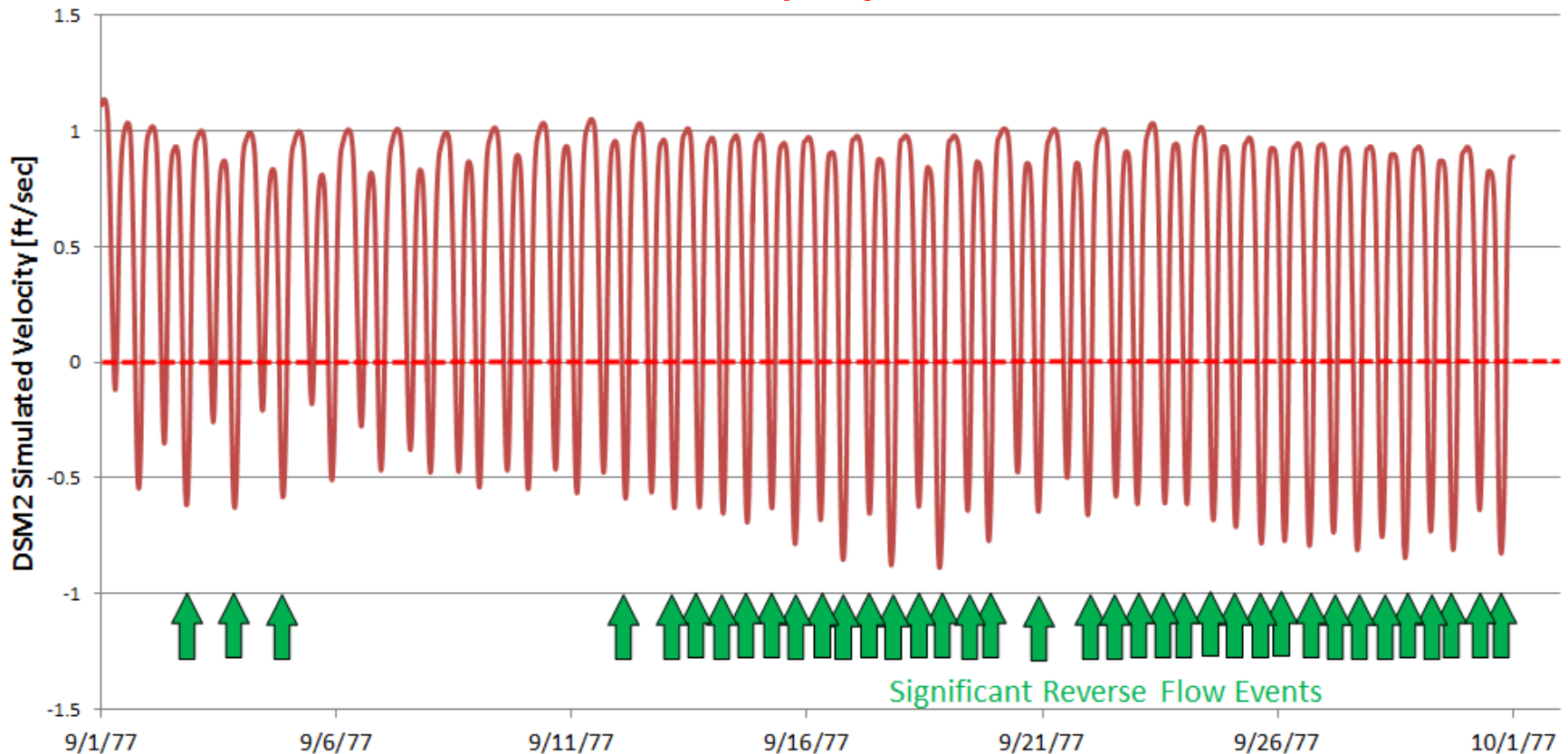


No Action Alternative, Bias-corrected DSM2 Simulation

Putting the Modeling Together



September 1977 Example: ...to 37 “shutdown events” under the H3 project alternative.



H3 Project Scenario, Bias-Corrected DSM2 Simulation

Conclusions

- WaterFix increases operational flexibility
- Flexible operations allow the timing of north-to-south movement of water to shift within the year
- Shifted export timing periodically results in incrementally lower flows in the Sacramento River during droughts, compared to the No Action Alternative

Conclusions (cont'd)

- Periodically lower Sacramento River flows increase the likelihood of reverse flow events severe enough to require the Freeport Project intake to shut down
- WaterFix improves significant reverse flows in winter and spring – but serious reverse flow events are more numerous in the late summer to early winter months
- Proposed north Delta bypass criteria are insufficiently protective