

PRELIMINARY ANALYSIS OF TRANSPORT

IN THE

SACRAMENTO-SAN JOAQUIN DELTA

March 8, 1995

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based on
Analyses by Flow Science, Inc.
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Table 1

SUMMARY OF RUNS

(All Flows in cfs, Cross Channel Gates: 1=closed, 2=open)

Sacramento River Flow	San Joaquin River Flow	Total Exports	Net Delta Ag	Cross Channel Gates	Delta Outflow	QWEST	Exports as % of Inflow
7560	2270	7000	3900	2	-1070	-2897	71
14233	4270	7000	3900	2	7603	-1165	38
29000	6270	7000	3900	2	24370	5105	20
10000	3000	7460	3900	2	1640	-1895	57
10000	3000	4460	3900	2	4640	1105	34
10000	3000	460	3900	2	8640	5105	4
7560	2270	7000	3900	1	-1070	-5131	71
14233	4270	7000	3900	1	7603	-2130	38
29000	6270	7000	3900	1	24370	870	20
10000	3000	7460	3900	1	1640	-4495	57
10000	3000	4460	3900	1	4640	-1495	34
10000	3000	460	3900	1	8640	2505	4
4050	1220	7000	3900	2	-5630	-5000	133
7865	2355	7000	3900	1	-680	-5000	68
10000	3000	10565	3900	2	-1465	-5000	81
10000	3000	7965	3900	1	1135	-5000	61
10716	3220	7000	3900	2	3036	-1000	50
16735	5025	7000	3900	1	10860	-1000	32
10000	3000	6565	3900	2	2535	-1000	51
10000	3000	3965	3900	1	5135	-1000	31
17300	5210	7000	3900	2	11610	2965	31
25500	7675	7000	3900	1	22275	2965	21
10000	3000	2600	3900	2	6500	2965	20
10000	3000	0	3900	1	9100	2965	0
10000	2000	7000	0	2	5000	100	58
10000	2000	7000	0	1	5000	-2500	58
5000	1000	4000	0	2	2000	600	67
5000	1000	4000	0	1	2000	-1250	67
15000	5000	7000	0	2	13000	4600	35
15000	5000	7000	0	1	13000	1250	35
15000	5000	9000	0	2	11000	2600	45
15000	5000	9000	0	1	11000	-750	45
15000	5000	12000	0	2	8000	-400	60
15000	5000	12000	0	1	8000	-3750	60
10000	2000	7000	3900	2	1100	-2435	58
10000	2000	7000	3900	1	1100	-5035	58
5000	1000	4000	3900	2	-1900	-1935	67
5000	1000	4000	3900	1	-1900	-3785	67
15000	5000	7000	3900	2	9100	2065	35
15000	5000	7000	3900	1	9100	-1285	35
15000	5000	9000	3900	2	7100	65	45
15000	5000	9000	3900	1	7100	-3285	45
15000	5000	12000	3900	2	4100	-2935	60
15000	5000	12000	3900	1	4100	-6285	60

**FIGURE 2
RELEASE POINTS AND DESTINATION POINTS**

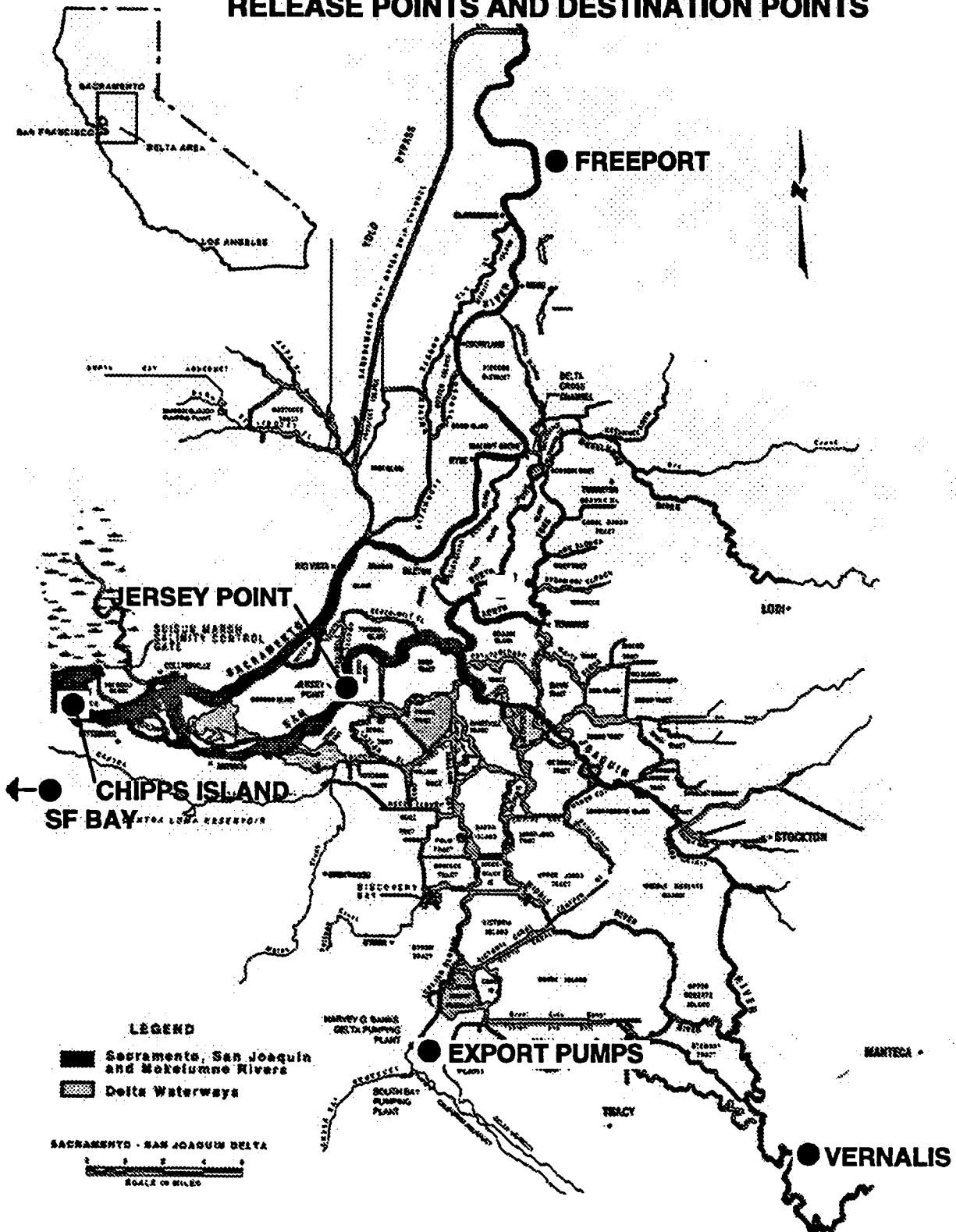
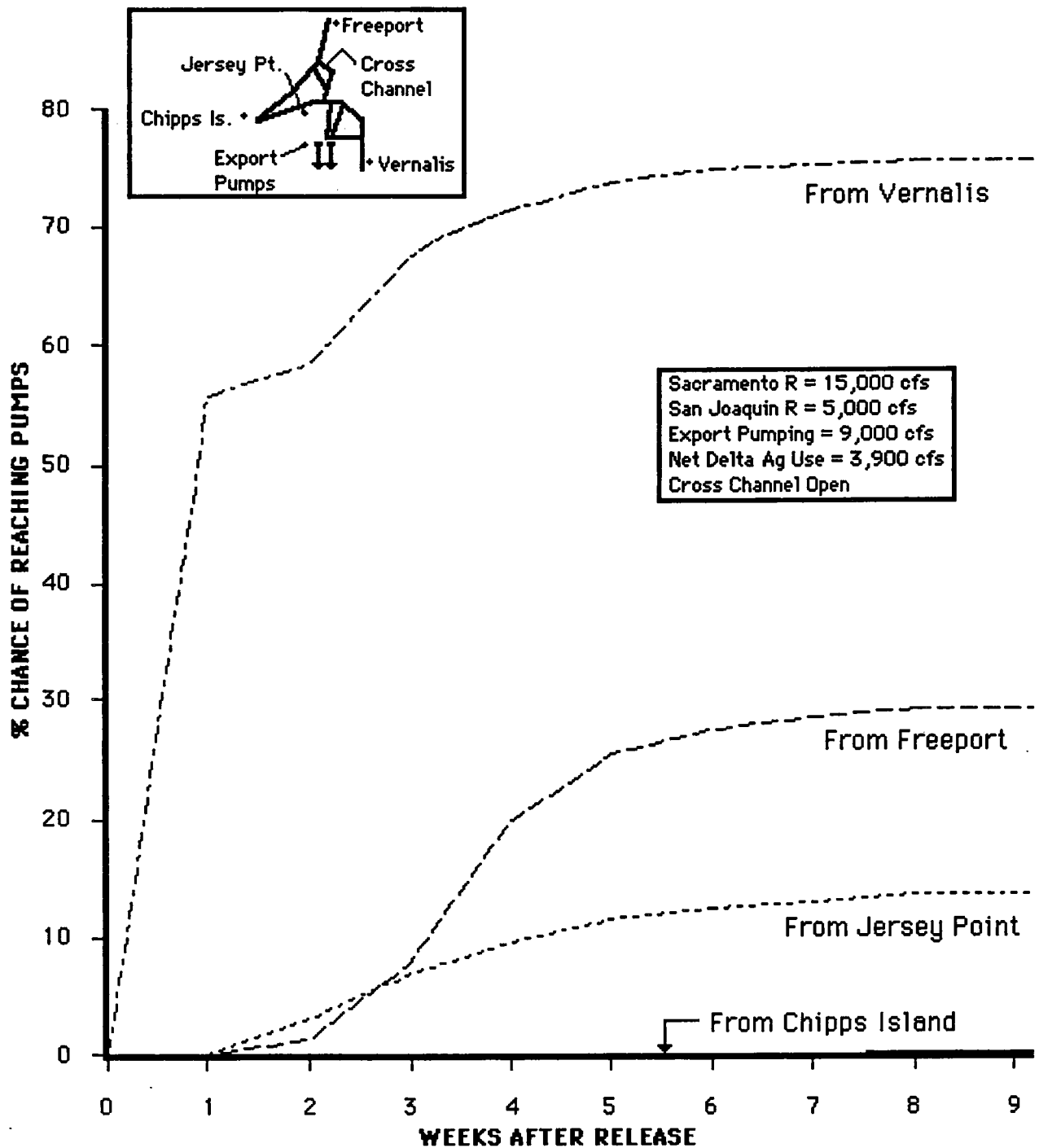


Figure 3
CHANCES OF REACHING EXPORT PUMPS



Results from Version IX of Fischer Delta Model

Table 2
SUMMARY OF MODELING RESULTS

All Flows in cfs								% Chance of Getting to Export Pumps from Freeport			% Chance of Getting to Export Pumps from Jersey Point			% Chance of Getting to Export Pumps from Chipps Island			% Chance of Getting to Carquinez St (SF Bay) from Freeport			% Chance of Getting to Carquinez St (SF Bay) from Jersey Point		
Sacramento River Flow	San Joaquin River Flow	Total Exports	Net Delta Ag	Cross Channel Gates	Delta Outflow	QWEST	Exports as % of Inflow	In 14 Days	In 28 Days	In 56 Days	In 14 Days	In 28 Days	In 56 Days	In 14 Days	In 28 Days	In 56 Days	In 14 Days	In 28 Days	In 56 Days	In 14 Days	In 28 Days	In 56 Days
7560	2270	7000	3900	2	-1070	-2897	71	0	19	40	3	18	42	0	1	8	0	0	1	0	1	6
14233	4270	7000	3900	2	7603	-1165	38	0	12	22	1	6	8	0	0	0	0	3	28	1	14	57
29000	6270	7000	3900	2	24370	5105	20	0	1	1	0	0	0	0	0	0	2	47	80	21	80	97
10000	3000	7460	3900	2	1640	-1895	57	0	19	40	3	18	42	0	1	8	0	0	1	0	1	6
10000	3000	4460	3900	2	4640	1105	34	0	12	22	1	6	8	0	0	0	0	3	28	1	14	57
10000	3000	460	3900	2	8640	5105	4	0	1	1	0	0	0	0	0	0	2	47	80	21	80	97
7560	2270	7000	3900	1	-1070	-5131	71	0	12	36	4	23	53	0	1	12	0	0	2	0	1	5
14233	4270	7000	3900	1	7603	-2130	38	0	8	20	1	9	19	0	0	0	0	8	33	1	10	42
29000	6270	7000	3900	1	24370	870	20	0	0	0	0	0	0	0	0	0	6	55	81	15	73	95
10000	3000	7460	3900	1	1640	-4495	57	0	14	35	4	20	44	0	1	6	0	1	8	0	2	12
10000	3000	4460	3900	1	4640	-1495	34	0	2	14	0	3	12	0	0	0	0	2	18	0	6	31
10000	3000	460	3900	1	8640	2505	4	0	0	0	0	0	0	0	0	0	0	5	40	1	18	68
4050	1220	7000	3900	2	-5630	-5000	133	0	10	31	6	32	65	0	3	31	0	0	0	0	0	1
7865	2355	7000	3900	1	-680	-5000	68	0	12	36	4	23	51	0	1	10	0	0	3	0	1	6
10000	3000	10565	3900	2	-1465	-5000	81	4	37	54	11	37	62	0	2	16	0	0	1	0	1	4
10000	3000	7965	3900	1	1135	-5000	61	1	14	35	2	18	43	0	0	5	0	1	8	0	2	12
10716	3220	7000	3900	2	3036	-1000	50	0	17	33	2	10	20	0	0	1	0	0	7	0	4	24
16735	5025	7000	3900	1	10860	-1000	32	0	5	15	1	6	12	0	0	0	1	16	48	1	18	60
10000	3000	6565	3900	2	2535	-1000	51	0	8	18	0	1	5	0	0	0	0	1	11	0	8	41
10000	3000	3965	3900	1	5135	-1000	31	0	1	10	0	2	8	0	0	0	0	2	20	0	7	36
17300	5210	7000	3900	2	11610	2965	31	0	8	15	0	3	4	0	0	0	0	11	49	2	29	79
25500	7675	7000	3900	1	22275	2965	21	0	1	3	0	1	2	0	0	0	10	54	80	9	61	92
10000	3000	2600	3900	2	6500	2965	20	0	0	3	0	0	1	0	0	0	0	1	21	1	12	57
10000	3000	0	3900	1	9100	2965	0	0	0	0	0	0	0	0	0	0	0	6	43	1	20	72
10000	2000	7000	0	2	5000	100	58	0	23	45	2	10	18	0	0	0	0	1	15	0	7	38
10000	2000	7000	0	1	5000	-2500	58	0	15	40	3	15	32	0	0	1	0	3	22	0	6	29
5000	1000	4000	0	2	2000	600	67	0	3	33	0	4	14	0	0	1	0	0	4	0	3	19
5000	1000	4000	0	1	2000	-1250	67	0	0	15	0	6	28	0	0	3	0	1	15	0	3	15
15000	5000	7000	0	2	13000	4600	35	0	7	15	0	2	3	0	0	0	0	14	65	3	37	88
15000	6000	7000	0	1	13000	1250	35	0	3	12	0	4	6	0	0	0	1	22	66	2	28	79
15000	5000	9000	0	2	11000	2600	45	1	18	26	2	6	7	0	0	0	0	9	51	2	26	78
15000	5000	9000	0	1	11000	-750	45	0	12	24	2	10	17	0	0	0	0	16	54	1	19	62
15000	5000	12000	0	2	8000	-400	60	6	35	45	7	16	22	0	0	0	0	5	30	1	12	52
15000	5000	12000	0	1	8000	-3750	60	3	27	42	9	28	44	0	0	2	0	10	36	1	9	35
10000	2000	7000	3900	2	1100	-2435	58	0	22	40	3	16	34	0	0	4	0	0	3	0	2	13
10000	2000	7000	3900	1	1100	-5035	58	0	15	36	4	23	48	0	1	8	0	1	7	0	2	10
5000	1000	4000	3900	2	-1900	-1935	67	0	3	24	0	8	29	0	0	5	0	0	0	0	1	4
5000	1000	4000	3900	1	-1900	-3785	67	0	3	19	0	9	35	0	0	7	0	0	1	0	1	4
15000	5000	7000	3900	2	9100	2065	35	0	9	18	1	4	5	0	0	0	0	5	36	1	19	68
15000	5000	7000	3900	1	9100	-1285	35	0	6	16	1	6	13	0	0	0	0	11	41	1	14	52
15000	5000	9000	3900	2	7100	65	45	1	20	29	3	10	14	0	0	0	0	3	24	1	11	50
15000	5000	9000	3900	1	7100	-3285	45	1	14	27	4	16	30	0	0	1	0	7	30	1	8	34
15000	5000	12000	3900	2	4100	-2935	60	7	35	46	10	25	37	0	0	2	0	2	12	0	5	24
15000	5000	12000	3900	1	4100	-6285	60	4	28	43	12	39	58	0	2	9	0	4	17	0	4	16

Table 3
REGRESSION EQUATIONS FOR BASIC CONTROL FACTORS

FROM	TO	TIME DAYS	EQUATION All flow values in cfs Cross Channel Gate (XCG) = 1 for closed, 2 for open	R ²
FREEPORT	EXPORT PUMPS	14	% = 0	≈ 1.00
		28	$\% = -9.7 - 0.6 \frac{SAC}{1000} - 0.3 \frac{SJR}{1000} + 3.3 \frac{EXPORTS}{1000} + 0.4 \frac{DELTA G}{1000} + 3.9 \frac{XCG}{1}$	0.79
		56	$\% = 10.2 - 0.5 \frac{SAC}{1000} - 5.1 \frac{SJR}{1000} + 5.2 \frac{EXPORTS}{1000} + 0.2 \frac{DELTA G}{1000} + 2.0 \frac{XCG}{1}$	0.90
		MAX	$\% = 30.4 - 0.0 \frac{SAC}{1000} - 10.1 \frac{SJR}{1000} + 5.8 \frac{EXPORTS}{1000} - 0.9 \frac{DELTA G}{1000} - 0.5 \frac{XCG}{1}$	0.87
JERSEY PT.	EXPORT PUMPS	14	$\% = 2.3 - 0.2 \frac{SAC}{1000} + 0.0 \frac{SJR}{1000} + 1.0 \frac{EXPORTS}{1000} + 0.3 \frac{DELTA G}{1000} - 0.3 \frac{XCG}{1}$	0.69
		28	$\% = 2.3 - 0.5 \frac{SAC}{1000} + 2.7 \frac{SJR}{1000} + 3.7 \frac{EXPORTS}{1000} + 1.7 \frac{DELTA G}{1000} - 3.7 \frac{XCG}{1}$	0.80
		56	$\% = 21.2 - 0.3 \frac{SAC}{1000} - 9.1 \frac{SJR}{1000} + 6.3 \frac{EXPORTS}{1000} + 3.4 \frac{DELTA G}{1000} - 9.9 \frac{XCG}{1}$	0.85
		MAX	$\% = 40.1 + 0.0 \frac{SAC}{1000} - 14.7 \frac{SJR}{1000} + 7.3 \frac{EXPORTS}{1000} + 3.7 \frac{DELTA G}{1000} - 12.8 \frac{XCG}{1}$	0.84
CHIPPS ISLAND	EXPORT PUMPS	14	% = 0	≈ 1.00
		28	% = 0	≈ 1.00
		56	$\% = 1.3 + 0.0 \frac{SAC}{1000} - 2.3 \frac{SJR}{1000} + 1.2 \frac{EXPORTS}{1000} + 1.2 \frac{DELTA G}{1000} - 0.4 \frac{XCG}{1}$	0.48
		MAX	$\% = 10.2 + 0.1 \frac{SAC}{1000} - 7.2 \frac{SJR}{1000} + 2.5 \frac{EXPORTS}{1000} + 2.8 \frac{DELTA G}{1000} - 1.4 \frac{XCG}{1}$	0.57
FREEPORT	SF BAY	14	% = 0	≈ 1.00
		28	$\% = -4.5 + 1.8 \frac{SAC}{1000} - 2.1 \frac{EXPORTS-SJR}{1000} - 0.8 \frac{DELTA G}{1000} - 0.6 \frac{XCG}{1}$	0.72
		56	$\% = 19.7 + 3.1 \frac{SAC}{1000} - 5.0 \frac{EXPORTS-SJR}{1000} - 4.7 \frac{DELTA G}{1000} - 0.1 \frac{XCG}{1}$	0.89
		MAX		
JERSEY PT.	SF BAY	14	$\% = -4.2 + 0.5 \frac{SAC}{1000} - 0.8 \frac{EXPORTS-SJR}{1000} + 0.0 \frac{DELTA G}{1000} + 1.7 \frac{XCG}{1}$	0.52
		28	$\% = -7.5 + 2.4 \frac{SAC}{1000} - 4.1 \frac{EXPORTS-SJR}{1000} - 1.6 \frac{DELTA G}{1000} + 6.8 \frac{XCG}{1}$	0.78
		56	$\% = 23.7 + 3.3 \frac{SAC}{1000} - 7.6 \frac{EXPORTS-SJR}{1000} - 5.7 \frac{DELTA G}{1000} + 11.5 \frac{XCG}{1}$	0.91
		MAX		

Table 4
SUMMARY OF EQUATIONS RELATING TRANSPORT
TO QWEST, EXPORTS AS % INFLOW, AND DELTA OUTFLOW

FROM	TO	TIME DAYS	EQUATION (% Chance of Getting From-To in Time Shown)	CORRELATION COEFFICIENT
Freeport	Export Pumps	14	$\% \approx 0$	-1.00
		28	$\% = 9.9 - 1.6 \frac{QWEST}{1000}$	0.24
Freeport	Export Pumps	28	$\% = 1.5 + 0.2 \frac{EXPORTS}{INFLOW} \%$	0.24
		28	$\% = 12.1 + 0.0 DELTAOUTFLOW$	0.00
		56	$\% = 20.9 - 3.5 \frac{QWEST}{1000}$	0.49
Freeport	Export Pumps	56	$\% = 1.5 + 0.5 \frac{EXPORTS}{INFLOW} \%$	0.55
		56	$\% = 35.6 - 0.7 DELTAOUTFLOW$	0.11
		14	$\% = 1.8 - 0.6 \frac{QWEST}{1000}$	0.39
Jersey Pt	Export Pumps	14	$\% = -1.0 + 0.1 \frac{EXPORTS}{INFLOW} \%$	0.29
		14	$\% = 2.6 + 0.0 DELTAOUTFLOW$	0.00
		28	$\% = 8.6 - 2.9 \frac{QWEST}{1000}$	0.68
Jersey Pt	Export Pumps	28	$\% = -4.5 + 0.3 \frac{EXPORTS}{INFLOW} \%$	0.55
		28	$\% = 17.3 - 0.4 DELTAOUTFLOW$	0.06
		56	$\% = 20.9 - 3.5 \frac{QWEST}{1000}$	0.49
Jersey Pt	Export Pumps	56	$\% = -9.8 + 0.7 \frac{EXPORTS}{INFLOW} \%$	0.68
		56	$\% = 42.6 - 1.3 DELTAOUTFLOW$	0.20

Table 4 (continued)
SUMMARY OF EQUATIONS RELATING TRANSPORT
TO QWEST, EXPORTS AS % INFLOW, AND DELTA OUTFLOW

FROM	TO	TIME DAYS	EQUATION (% Chance of Getting From-To in Time Shown)	CORRELATION COEFFICIENT
Chipps Is	Export Pumps	14	$\% \approx 0$	
Chipps Is	Export Pumps	28	$\% \approx 0$	
Chipps Is	Export Pumps	56	$\% = 2.2 - 1.2 \frac{QWEST}{1000}$	0.41
Chipps Is	Export Pumps	56	$\% = -6.0 + 0.2 \frac{EXPORTS}{INFLOW} \%$	0.62
Chipps Is	Export Pumps	56	$\% = 9.2 - 0.4 DELTAOUTFLOW$	0.19
		14	$\% = 0.7 + 0.2 QWEST$	0.11
Freeport	SF Bay	14	$\% = 1.7 - 0.0 \frac{EXPORTS}{INFLOW} \%$	0.11
		14	$\% = -1.3 + 0.1 DELTAOUTFLOW$	0.11
		28	$\% = 11.9 + 2.6 \frac{QWEST}{1000}$	0.26
Freeport	SF Bay	28	$\% = 26.0 - 0.3 \frac{EXPORTS}{INFLOW} \%$	0.29
		28	$\% = -14.2 + 1.5 DELTAOUTFLOW$	0.47
		56	$\% = 34.4 + 6.0 \frac{QWEST}{1000}$	0.50
Freeport	SF Bay	56	$\% = 65.8 - 0.8 \frac{EXPORTS}{INFLOW} \%$	0.51
		56	$\% = -13.9 + 2.7 DELTAOUTFLOW$	0.54

Table 4 (continued)
SUMMARY OF EQUATIONS RELATING TRANSPORT
TO QWEST, EXPORTS AS % INFLOW, AND DELTA OUTFLOW

FROM	TO	TIME DAYS	EQUATION (% Chance of Getting From-To in Time Shown)	CORRELATION COEFFICIENT
Jersey Pt	SF Bay	14	$\% = 2.8 + 0.9 \frac{QWEST}{1000}$	0.30
		14	$\% = 6.7 - 0.1 \frac{EXPORTS}{INFLOW} \%$	0.23
		14	$\% = -4.4 + 0.4 DELTAOUTFLOW$	0.32
Jersey Pt	SF Bay	28	$\% = 19.8 + 5.0 \frac{QWEST}{1000}$	0.52
		28	$\% = 41.2 - 0.5 \frac{EXPORTS}{INFLOW} \%$	0.39
		28	$\% = -18.4 + 2.1 DELTAOUTFLOW$	0.52
Jersey Pt	SF Bay	56	$\% = 49.2 + 8.8 \frac{QWEST}{1000}$	0.76
		56	$\% = 89.2 - 1.0 \frac{EXPORTS}{INFLOW} \%$	0.61
		56	$\% = -9.0 + 3.2 DELTAOUTFLOW$	0.52

Table 5
COMPARISON OF CORRELATION COEFFICIENTS, R2

FROM	TO	TIME DAYS	EQUATION USING			
			ALL BASIC CONTROL FACTORS	QWEST	%EXPORTS/ INFLOW	DELTA OUTFLOW
FREEPORT	EXPORT	14	N/A	N/A	N/A	N/A
		28	0.79	0.24	0.24	0.00
		56	0.90	0.49	0.55	0.11
		MAX	0.87			
JERSEY POINT	EXPORT	14	0.69	0.39	0.29	0.00
		28	0.80	0.68	0.55	0.06
		56	0.85	0.49	0.68	0.20
		MAX	0.84			
CHIPPS ISLAND	EXPORT	14	N/A	N/A	N/A	N/A
		28	N/A	N/A	N/A	N/A
		56	0.48	0.41	0.62	0.19
		MAX	0.57			
FREEPORT	SF BAY	14	N/A	N/A	N/A	N/A
		28	0.74	0.26	0.29	0.47
		56	0.90	0.50	0.51	0.54
		MAX				
JERSEY POINT	SF BAY	14	0.63	0.30	0.23	0.32
		28	0.80	0.52	0.39	0.52
		56	0.90	0.76	0.61	0.52
		MAX				

Boldface indicates the maximum correlation coefficient for each combination of release point, destination, and time.

**CONCLUSIONS
(FOR CONDITIONS ANALYZED, NOT VERY HIGH FLOWS)**

**ESSENTIALLY NO CHANCE OF REACHING EXPORT PUMPS
FROM FREEPORT IN 14 DAYS**

**ESSENTIALLY NO CHANCE OF REACHING EXPORT PUMPS
FROM CHIPPS ISLAND IN 28 DAYS, VERY LITTLE CHANCE IN
56 DAYS**

**ESSENTIALLY NO CHANCE OF REACHING SF BAY
(CARQUINEZ STRAIT) FROM FREEPORT IN 14 DAYS**

**FROM FREEPORT TO EXPORT PUMPS IN 28 DAYS, NEVER
MORE THAN ABOUT 35% (EXPORTS > 10,000 CFS)**

**FOR EXPORTS ~7,000 CFS, TYPICAL VALUES FOR OTHER
PARAMETERS, FREEPORT TO EXPORT PUMPS CHANCES <
10%**

**CLOSING OR OPENING CROSS CHANNEL GATES AFFECTS
28-DAY CHANCES OF REACHING EXPORT PUMPS FROM
FREEPORT BY ONLY ABOUT 4%, EVEN LESS IMPORTANT
FOR LONGER PERIODS**

**QWEST, EXPORTS/INFLOW, AND DELTA OUTFLOW ARE ALL
RELATIVELY POOR PREDICTORS OF TRANSPORT**

BACKGROUND

MOST DELTA REQUIREMENTS ON WATER PROJECTS BASED ON TRANSPORT

EXPORT CURTAILMENTS TO PREVENT TRANSPORT TO PUMPS

X2/OUTFLOW IN PART TO TRANSPORT SPECIES WEST

CROSS CHANNEL GATE CLOSURES TO PREVENT TRANSPORT INTO CENTRAL DELTA

PULSE FLOWS TO TRANSPORT FISH DOWNSTREAM

TWO KEY ASSUMPTIONS IMPLICIT IN THESE REQUIREMENTS

FISH (AND FISH EGGS AND LARVAE) MOVE WITH THE WATER

THE WATER MOVES AS DESCRIBED BY NET FLOW (RESIDUAL FLOW IGNORING TIDAL TRANSPORT)

WE KNOW VERY LITTLE ABOUT THE FACTORS AFFECTING FISH MOVEMENT IN AND THROUGH THE DELTA, INCLUDING RELATIONSHIP TO WATER MOVEMENT.

WE KNOW THAT NET FLOW IS AN UNREALISTICALLY OVERSIMPLIFIED REPRESENTATION OF WATER MOVEMENT.