

Preliminary Climate Change Impacts Assessment for the Sacramento-San Joaquin Delta

Jamie Anderson Ph.D., P.E.
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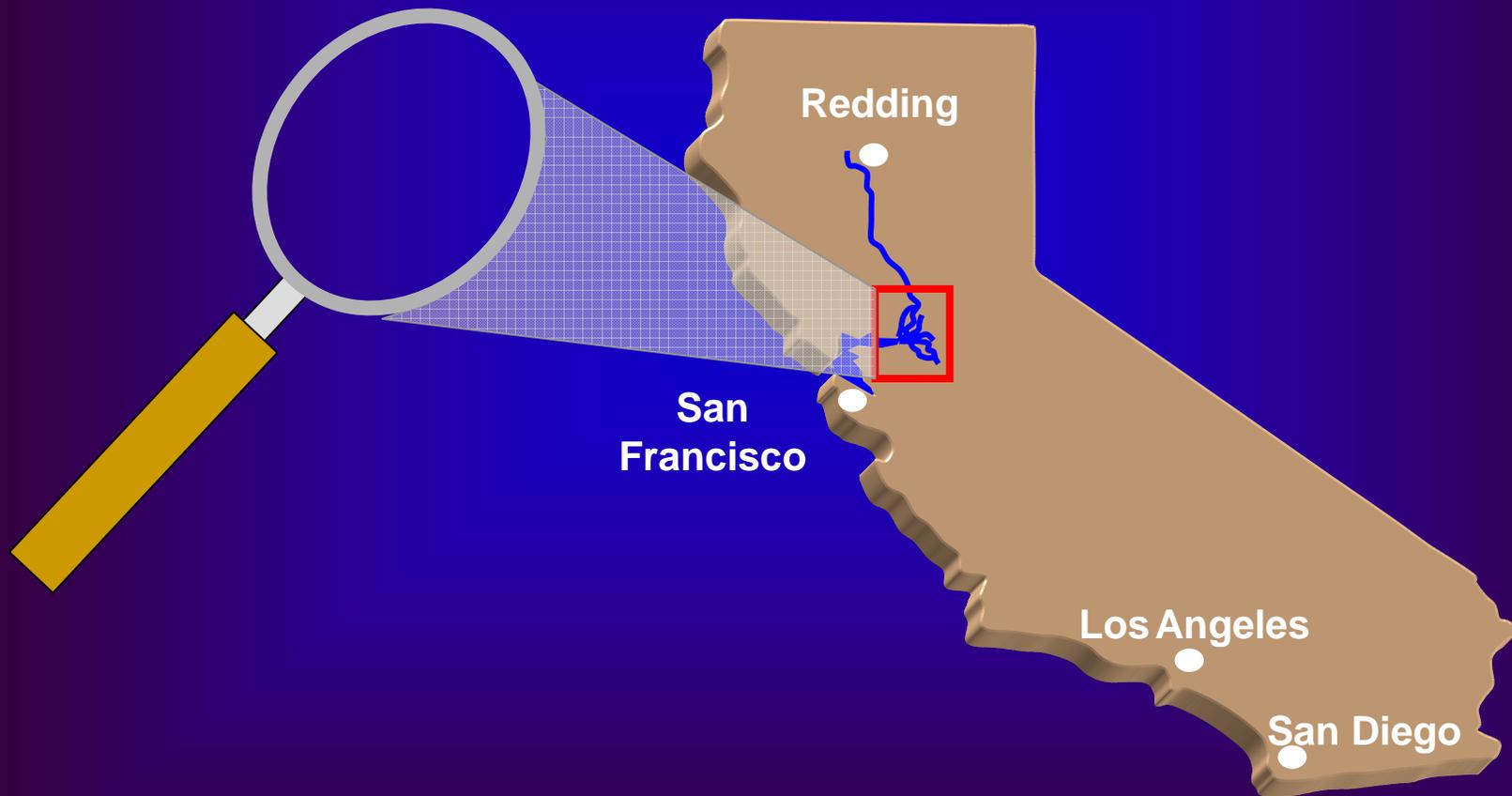
Modeling Support Branch
Bay Delta Office

Acknowledgements

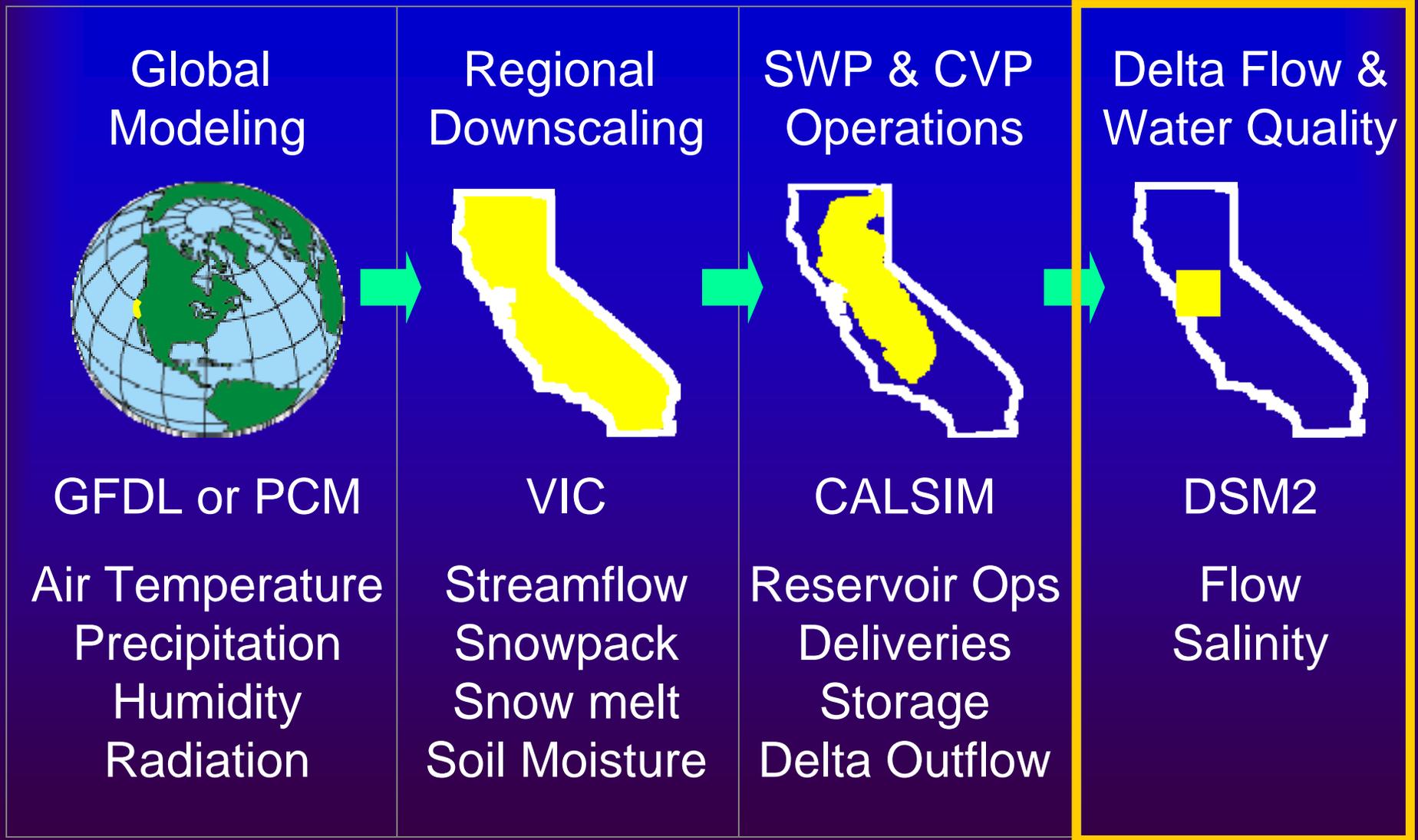
- Project Guidance
 - Francis Chung
- Peer Reviewers
 - Paul Hutton, MWD
 - Leah Orloff, CCWD
 - K.T. Shum, EBMUD
- Technical Analysis
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 - Michael Mierzwa
 - Tara Smith
 - Paul Hutton
 - Mike Durant



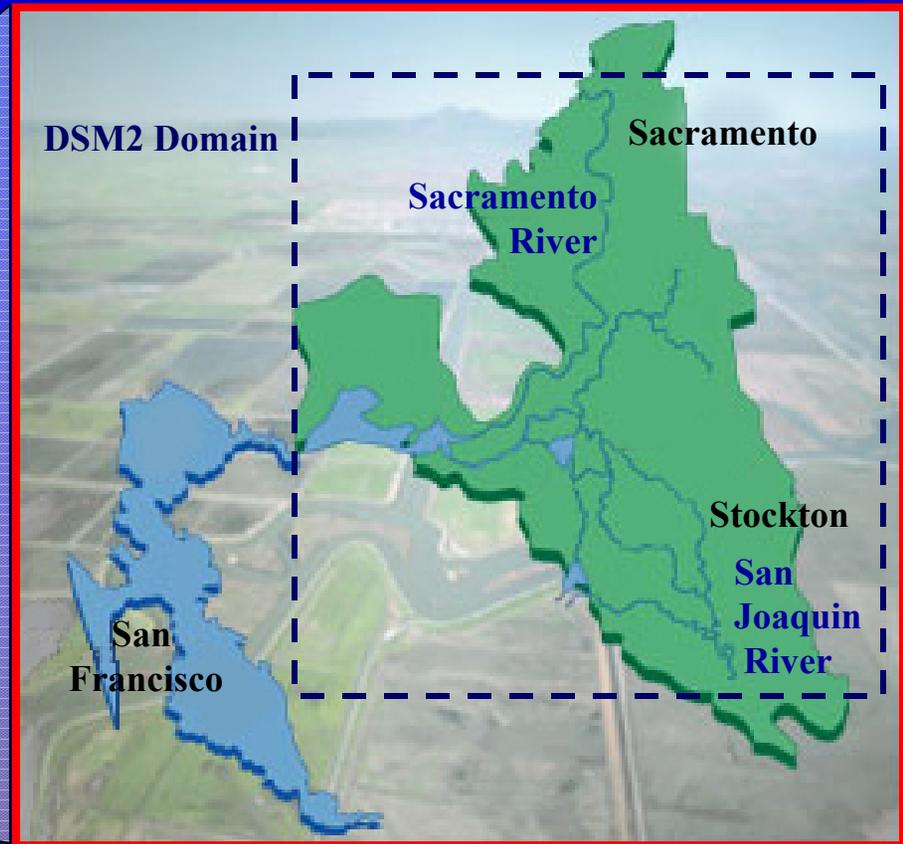
Focus on **Delta water quality** considering capabilities of current system operating rules to mitigate for climate change



Analysis Process



Bay-Delta System

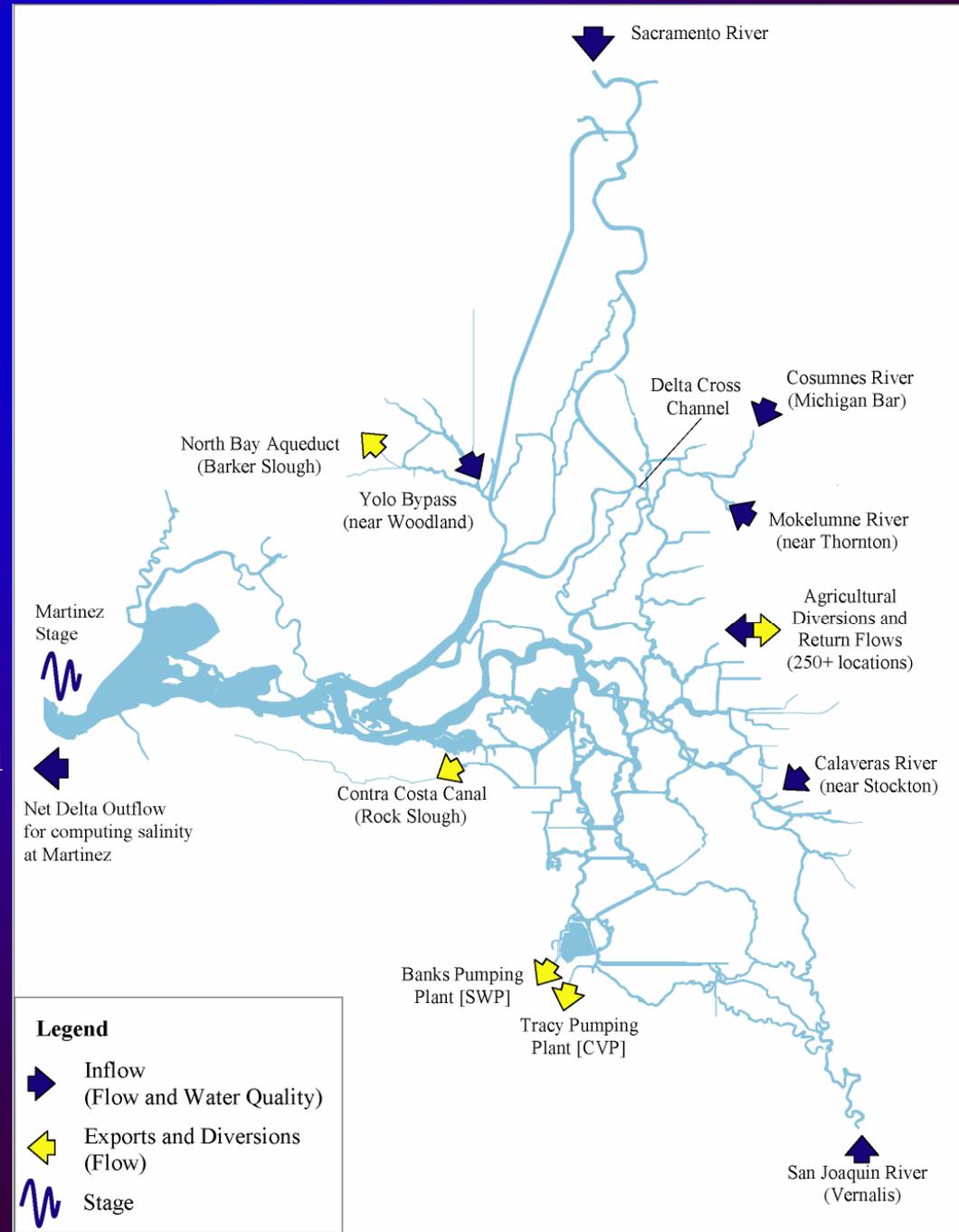


Preliminary Delta Simulations

- 16-year DSM2 planning studies wy1976-1991
 - Flows and water levels
 - Salinity
- Base case and 4 climate change scenarios
 - Present sea level
 - 1ft sea level rise
- CalSim-II modified system operations for climate change for maintaining Delta WQ

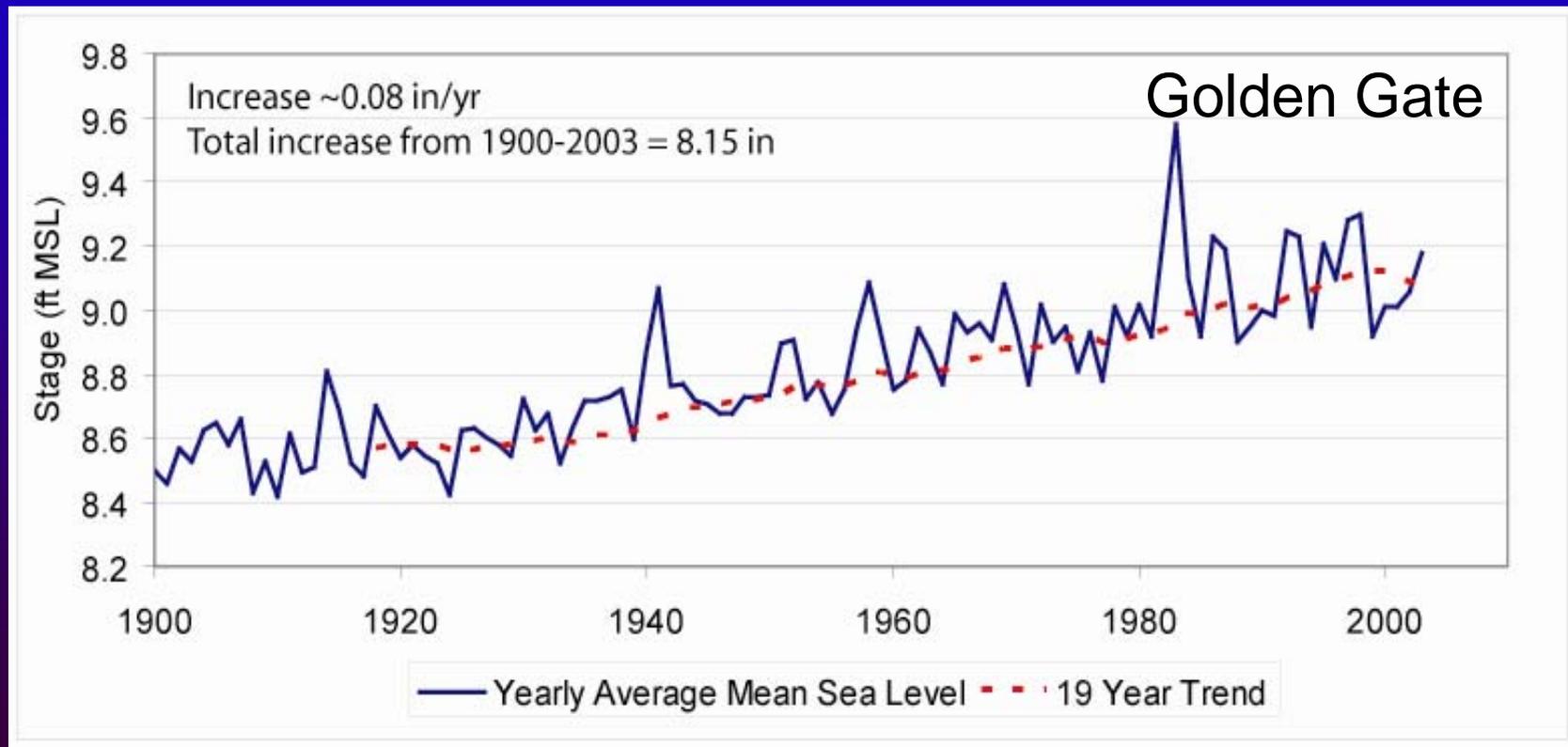
DSM2 Simulations

- Inflows and exports from CalSim reflect runoff for 2050 climate change
- No additional changes in operations for SLR
- Martinez EC computed from NDO for each scenario
- Vernalis EC from CalSim
- 2020 DICU
- No South Delta barriers



Sea Level Rise (SLR)

- Projected global increase by end of 21st century 0.3ft to 2.9 ft
- Initial studies assume 1ft SLR



Preliminary Sea Level Rise Studies

- Uniform 1 ft increase in Martinez stage
- Two Martinez EC assumptions
 - No change in Martinez EC
 - Increase in Martinez EC from regression relationship from 2-D modeling study
- No additional changes to operations to reduce salt intrusion

Water Quality Analysis

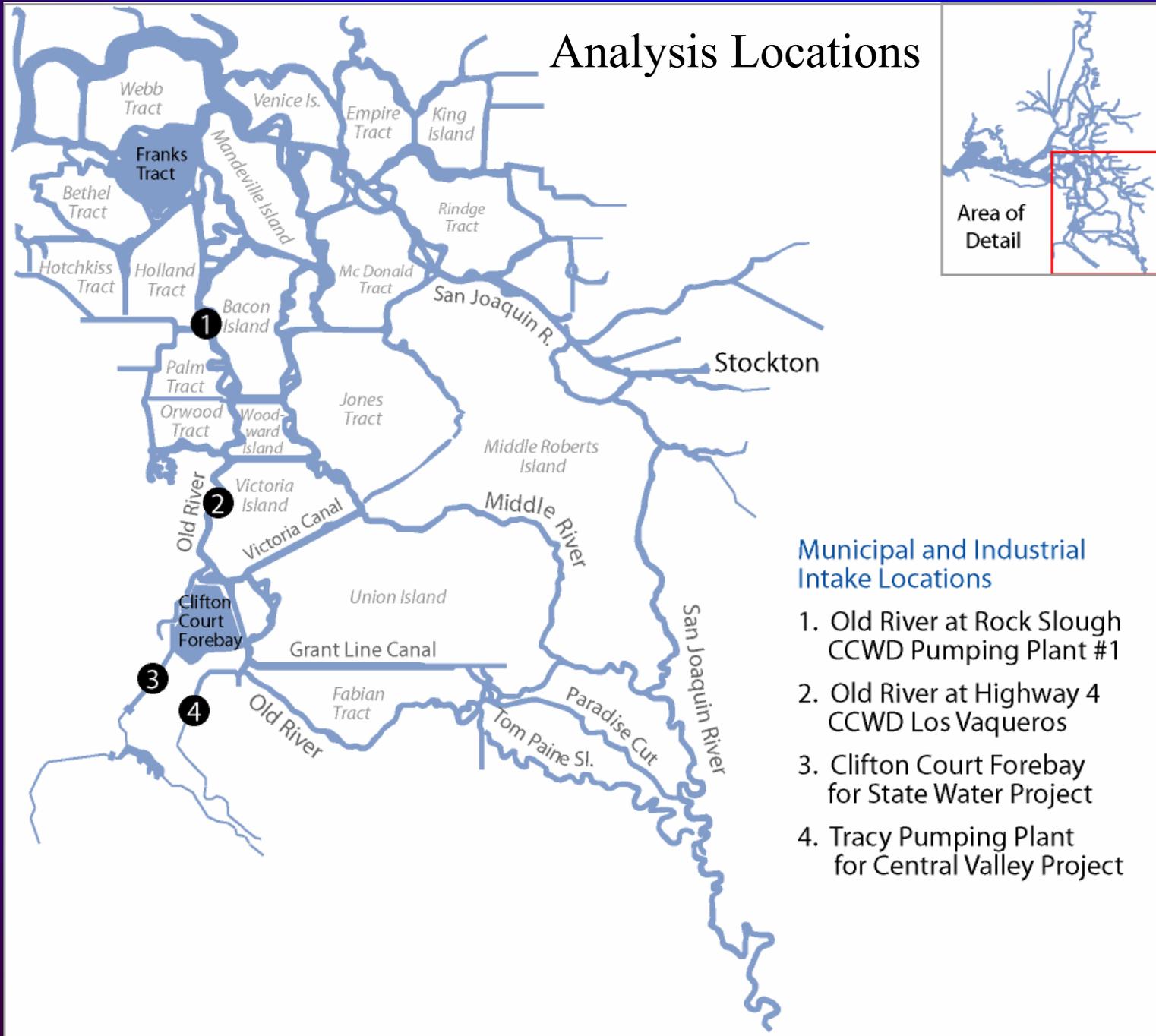
- Selected D1641 Water Quality Standards

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Municipal and Industrial Compliance Locations	Daily average Cl < 250 mg/l											
Contra Costa Pumping Plant #1	Cl < 150 mg/l for a required # of days based on year type											

- Chloride Mass Loadings at M&I Intakes

Mass loading = Concentrations * Export rate

Analysis Locations

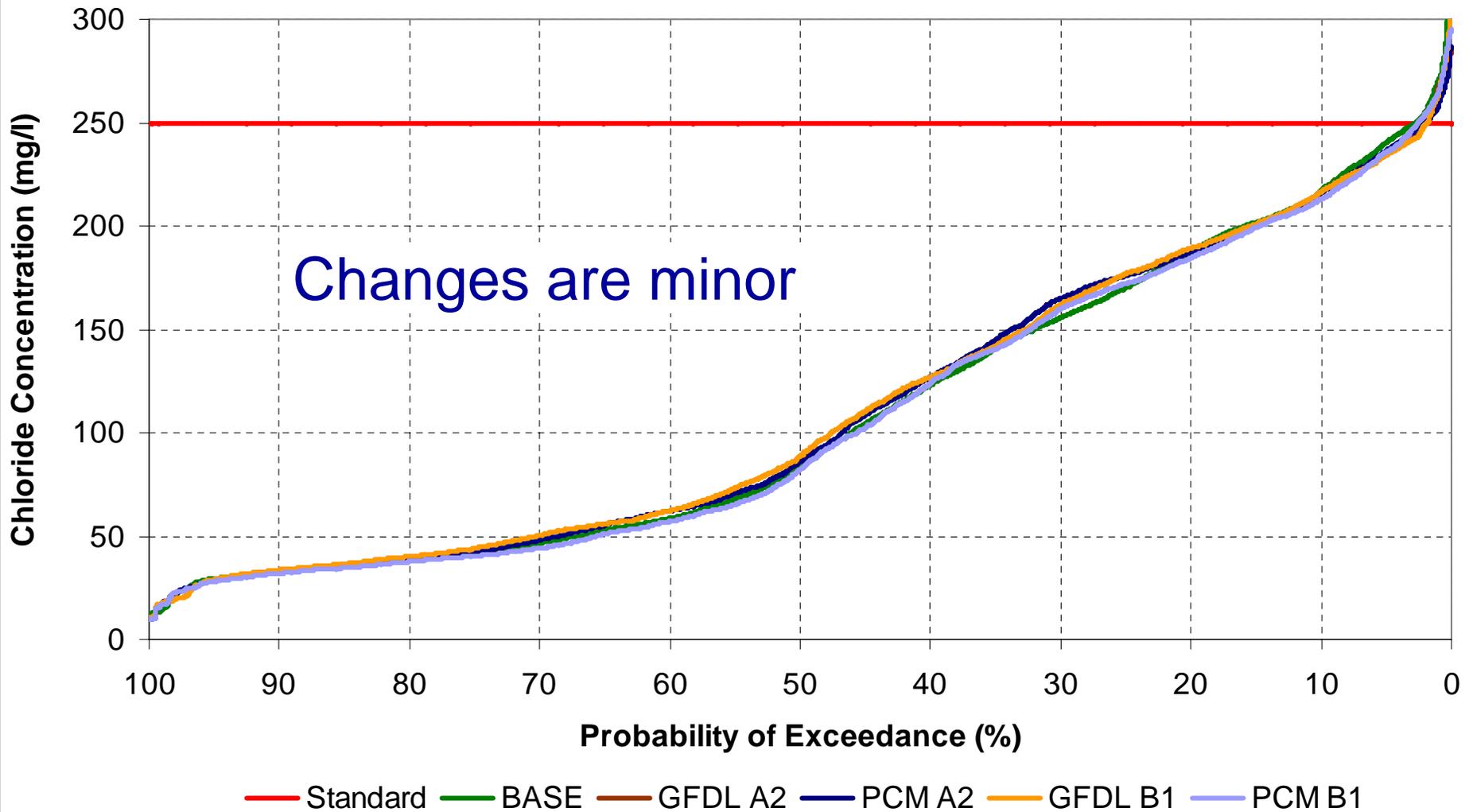


Municipal and Industrial Intake Locations

1. Old River at Rock Slough
CCWD Pumping Plant #1
2. Old River at Highway 4
CCWD Los Vaqueros
3. Clifton Court Forebay
for State Water Project
4. Tracy Pumping Plant
for Central Valley Project

Preliminary Results
Climate Change Only
Present Sea Level

Old River at Rock Sl Chloride Exceedance Curves



250 mg/l Chloride Standard Compliance

Scenario/ Location	BASE	GFDL A2	PCM A2	GFDL B1	PCM B1
Contra Costa-Old R at Rock Sl.	97.2%	98.0%	98.0%	98.2%	97.4%
Contra Costa-Los Vaqueros	99.9%	100%	100%	100%	100%
SWP-Clifton Court	100%	100%	100%	100%	100%
CVP-Tracy	100%	100%	100%	100%	100%

Operational flexibility is able to mitigate for changes in runoff and still meet Delta water quality standards most of the time

150 mg/l Chloride Standard Violations Old River at Rock Slough

	Year	Year Type	Standard: Min Days Cl \leq 150 mg/l	Number of Days Cl \leq 150 mg/l	
				GFDL B1	PCM B1
# Days with Cl \leq 150 mg/l	1989	Dry	165	153	139

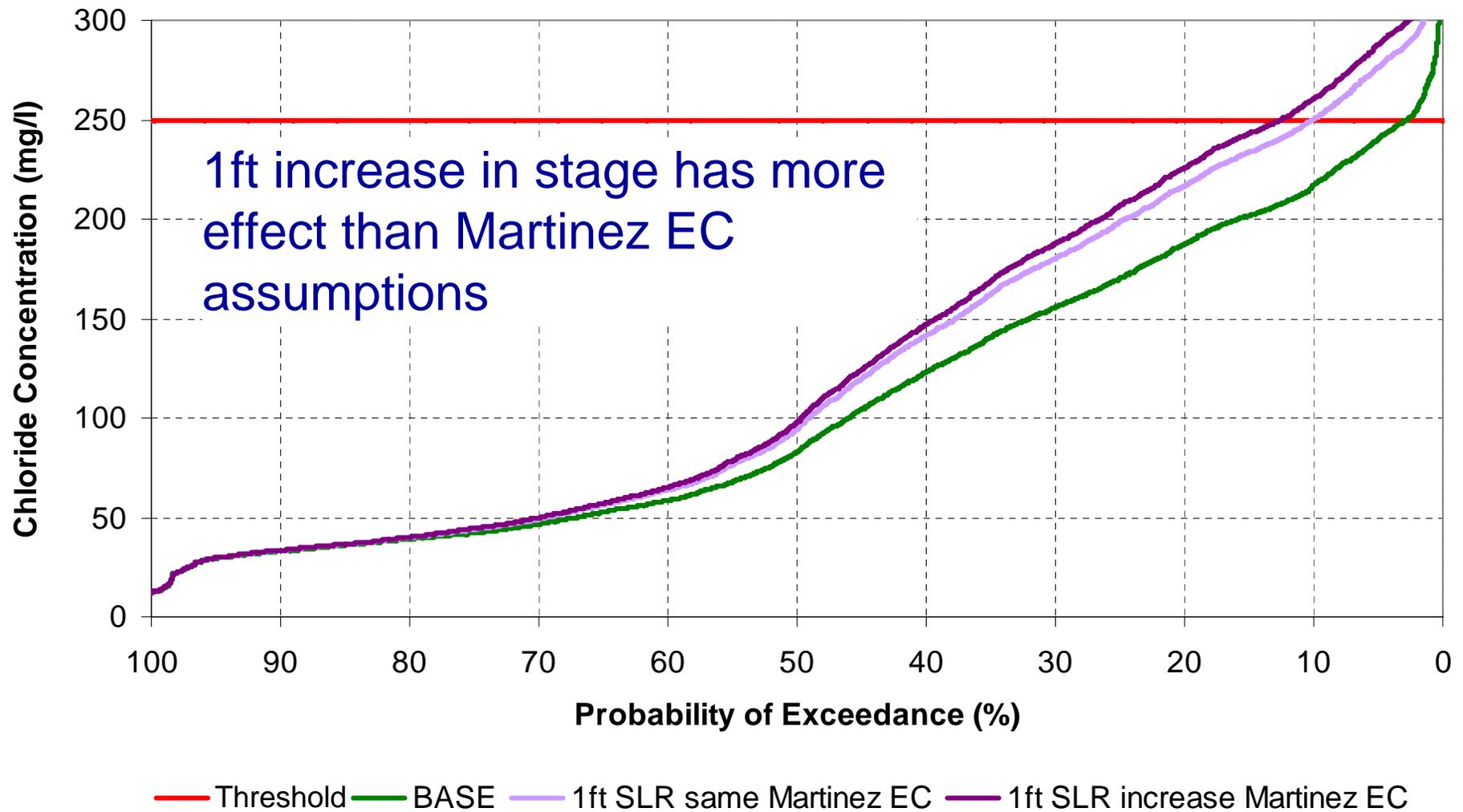
Average Chloride Mass Loadings metric tons/day

	CCC	SWP	CVP
Base	54	711	686
GFDL A2	54	646	648
PCM A2	54	667	663
GFDL B1	55	670	686
PCM B1	54	685	688

Reduced exports lead to reduced chloride mass loadings

Preliminary Results
1ft Sea Level Rise Only
with no changes in operations

Old River at Rock Sl Chloride Exceedance Curves



Operations were not changed for SLR

% time below 250 mg/l Chloride Threshold

Scenario/ Location	BASE	1ft Sea Level Rise same Martinez EC	1ft Sea Level Rise increase Martinez EC
CCWD-Old River at Rock Sl.	97.2%	89.9%	87.5%
CCWD-Old River at Hwy 4*	99.9%	99.7%	99.4%
SWP-Clifton Court	100%	100%	100%
CVP-Tracy	100%	100%	100%

Salt intrusion from a 1ft sea level rise and no changes in operations exceeds threshold at Old R at Rock Sl ~10% of the time

150 mg/l Chloride Threshold Exceedance Old River at Rock Slough with no changes in operations for SLR

Year	Yr. Type	Min Days Cl \leq 150 mg/l	Base	1ft SLR same Martinez EC	1ft SLR increase Martinez EC
1976	Critical	155	177	126	118
1977	Critical	155	161	102	94
1989	Dry	165	184	166	162

Average Chloride Mass Loadings 1ft SLR, metric tons/day

	CCC	SWP	CVP
Base	54	711	686
1ft SLR	61	786	734
GFDL A2	62	718	695
PCM A2	62	740	710
GFDL B1	63	744	735
PCM B1	61	758	736

Increased salinity intrusion increases chloride mass loadings

Preliminary Results for Climate Change and 1ft Sea Level Rise

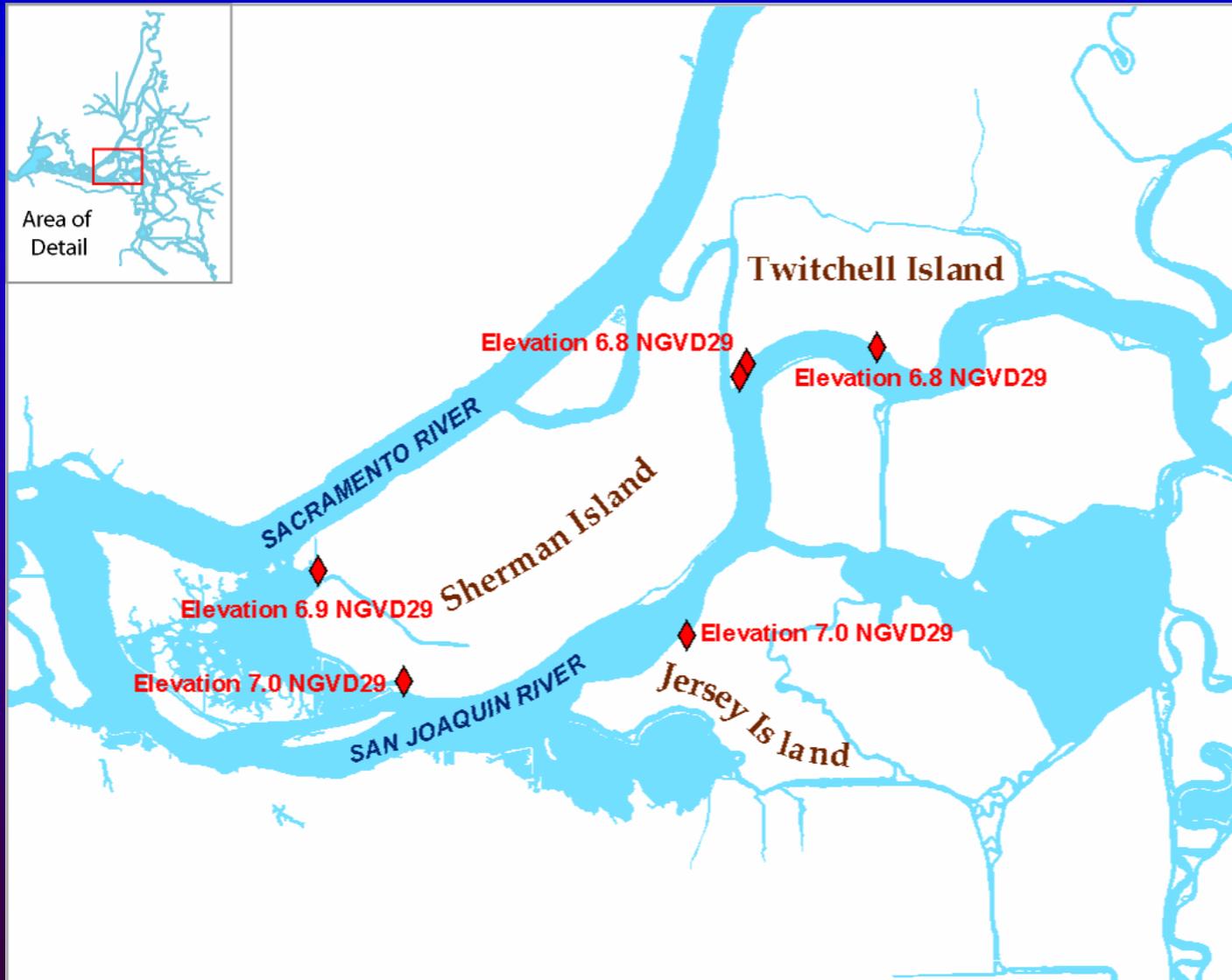
Results are similar to those for sea level rise only

Sea Level Rise Impacts on Levee Overtopping Potential



Photo by Rob Duvall Jan 1, 2006

Minimum Levee Crest Elevations



Levee Overtopping Potential

Location	Min Crest Elev., ft	# of Potential Overtopping Events in 16 yrs			
		Base	4 Climate Change Scenarios	1 ft SLR	4 Climate Change Scenarios 1ft SLR
NW Sherman Is	6.9	0	0	2	2
SW Sherman Is	7.0	0	0	2	2
SW Twitchell Is	6.8	0	0	2	2
SE Twitchell Is	6.8	0	0	2	2
W Jersey Is	7.0	0	0	2	2

Climate change scenarios reflect historical variability

Summary of Preliminary Climate Change Impacts on the Delta

- Existing system flexibility adapted to shifts in runoff with water quality standard compliance similar to the base case
- For a 1 ft sea level rise without adjusting operations, the 250 mg/l chloride threshold at Rock Sl was exceeded ~10% of the time
- A 1 ft sea level rise lead to two potential levee overtopping events in 16-years

Future Directions

- Investigate mitigation measures including further system operational flexibility, especially for SLR
- Characterize salinity intrusion for SLR
 - Develop relationship for models, e.g. ANN, G-model
 - DSM2 boundary condition at Martinez
 - Delta WQ standards in CalSim
- Extend impacts assessments to risk assessments
What is the likelihood that climate change and/or sea level rise scenarios will happen?



[http://baydeltaoffice.water.ca.gov/
climatechange.cfm](http://baydeltaoffice.water.ca.gov/climatechange.cfm)

www.climatechange.ca.gov

Photo by Ralph Finch Jan 4, 2006