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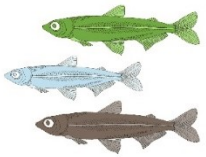
LOOKOUT SLOUGH TIDAL HABITAT RESTORATION AND FLOOD IMPROVEMENT PROJECT

Informational Meeting

Salinity & Bromide

October 8, 2020

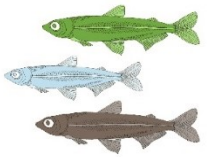


Comments about Salinity and Bromide

Proposed Project could have negative water quality impacts by increasing salinity and bromide concentrations for municipal and agricultural water users.

Specific concerns about analysis include:

- Significance standards for analyzing impacts on water quality
- Modeling approach
- Model configuration and reporting
- Limitations of modeling
- Representative years selected for modeling
- Consideration of water management
- Salinity in upper Cache Slough
- Salinity at municipal drinking intakes
- Salinity in agricultural diversions and soils
- Bromides
- Sea level rise
- Cumulative impacts



Significance Standards

As per CEQA Guidelines, the significance of impacts was based on whether the Proposed Project would "[v]iolate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality."

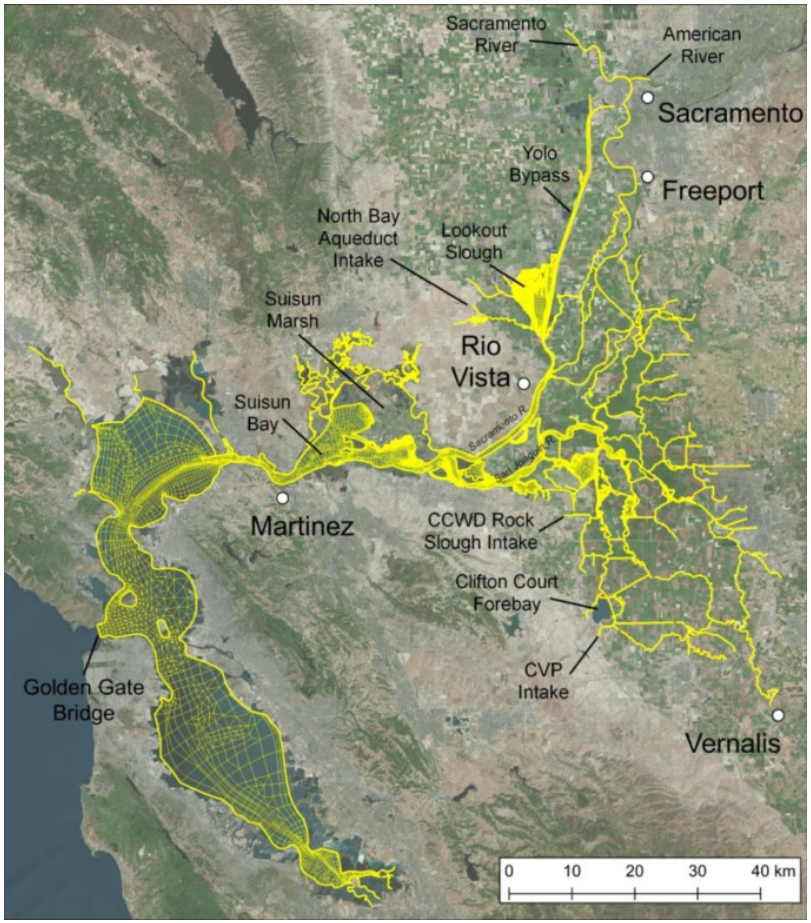
Applicable water quality standards for salinity are the San Francisco Bay/Sacramento-San Joaquin Delta Estuary Plan (Bay-Delta Plan) and California State Water Resources Control Board Decision 1641 (D-1641)

The Draft EIR analyzed whether the Proposed Project would result in non-compliance with the Bay-Delta Plan and D-1641.

The analysis showed that the Proposed Project is not predicted to cause non-compliance or make non-compliance with the D-1641 and Bay-Delta salinity standards more likely.

Modeling Objective and Approach

- Analyze potential for Proposed Project causing changes by using a hydrodynamic model to model existing conditions and proposed conditions, then compare these modeled scenarios to predict potential changes due to the Proposed Project
- Use water's electrical conductance (EC) as a surrogate for salinity, since EC has is widely measured, has well-defined relationship to salinity, and serves as a regulatory standard at some Delta locations
- Develop a two-dimensional (2D) hydrodynamic model of the Delta and San Francisco Bay that transports and mixes EC. Calibrate the model predictions to observed EC in the Delta and Bay
- Compare model predictions of Base conditions and Proposed Project conditions to analyze potential impacts of the Proposed Project on D-1641 and Bay-Delta Plan compliance
- In response to comments, modeling for the Draft EIR (Appendix S) was revised to improve EC predictions and expand the simulated period to three years (2009, 2010, and 2016)



Model Configuration and Reporting

Revised 2D modeling documented in Final EIR's Appendix X:

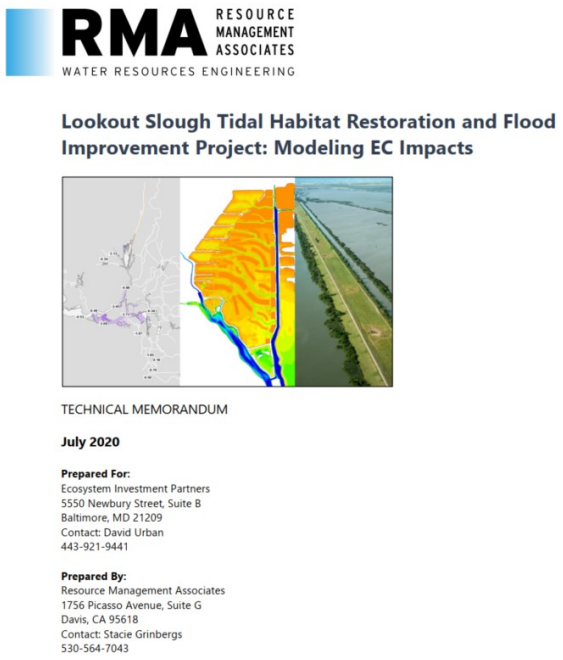
- **Model configuration, including the domain extents, and data used for bathymetry and boundary conditions.**

- **Assumptions made in configuring the model to represent the bathymetry and hydrology of the Delta, Suisun Bay, and San Francisco Bay.**

- **Model calibration to EC observations in the vicinity of the Proposed Project for three different years, (2009, 2010, and 2016) at multiple locations and time intervals.**

- **Evaluation of proposed conditions, both for the Proposed Project and for the Proposed Project with other cumulative regional restoration projects.**

- **Results of the model's EC predictions for the with-Proposed Project conditions are both daily, weekly, and monthly averaged (as appropriate for the relevant standard or to provide additional temporal resolution), converted to chloride and bromide concentrations, and are mapped across the Delta. Results are also provided in granular detail for D-1641 compliance stations and key drinking water intakes.**



RMA RESOURCE MANAGEMENT ASSOCIATES
WATER RESOURCES ENGINEERING

Lookout Slough Tidal Habitat Restoration and Flood Improvement Project: Modeling EC Impacts

TECHNICAL MEMORANDUM

July 2020

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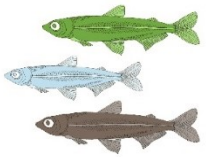
Limitations of Modeling and Approach



- Regional model of the Delta and San Francisco Bay, so some tradeoffs in simulation quality between at specific locations
- Closer to the model's boundaries, predictions are more sensitive to applied boundary conditions, and model can only replicate Delta conditions to the degree that available data can characterize boundary conditions
- At most locations, the coefficient of variation (R^2) between observed and predicted EC is 0.9 or higher, indicating the model's predictions replicate 90% of more of the variance of observed EC.
- At some locations near the Proposed Project, local watershed sources of EC play a larger role, but data to characterize those sources as boundary conditions is very limited.
- As such, the model replicates 67-80% of observed EC variance at some locations.

Station	R^2
Barker Slough (BKS)	0.92
Cache Slough (CCS)	0.67
Rio Vista (RIV)	0.77
Emmanton (EMM)	0.82
Collinsville (CLL)	0.93
Mallard (MAL)	0.94
Antioch (ANC)	0.88
Jersey Point (JER)	0.86
Prisoner Point (PPT)	0.88
Rock Slough (RSC)	0.91
Old River (OBI)	0.92
Clifton Court (CLC)	0.91
Central Valley Project (CVP)	0.90
Grantline Canal (GLC)	0.91
Victoria Canal (VCU)	0.94
Middle River (MDM)	0.92

(for 2009-2010 simulation period)

Years Selected for Modeling

Year	Sacramento Valley	San Joaquin Valley
2006	Wet	Wet
2007	Dry	Critically Dry
2008	Critically dry	Critically Dry
2009	**Dry**	**Below Normal**
2010	**Below Normal**	**Above Normal**
2011	Wet	Wet
2012	Below Normal	Dry
2013	Dry	Critically Dry
2014	Critically Dry	Critically Dry
2015	Critically Dry	Critically Dry
2016	**Below Normal**	**Dry**

Years modeled

Water Supply Index, 2006-2016
SOURCE: DWR California Cooperative Snow Surveys http://cdec.water.ca.gov/reportapp/javareports?name=WSIHIST

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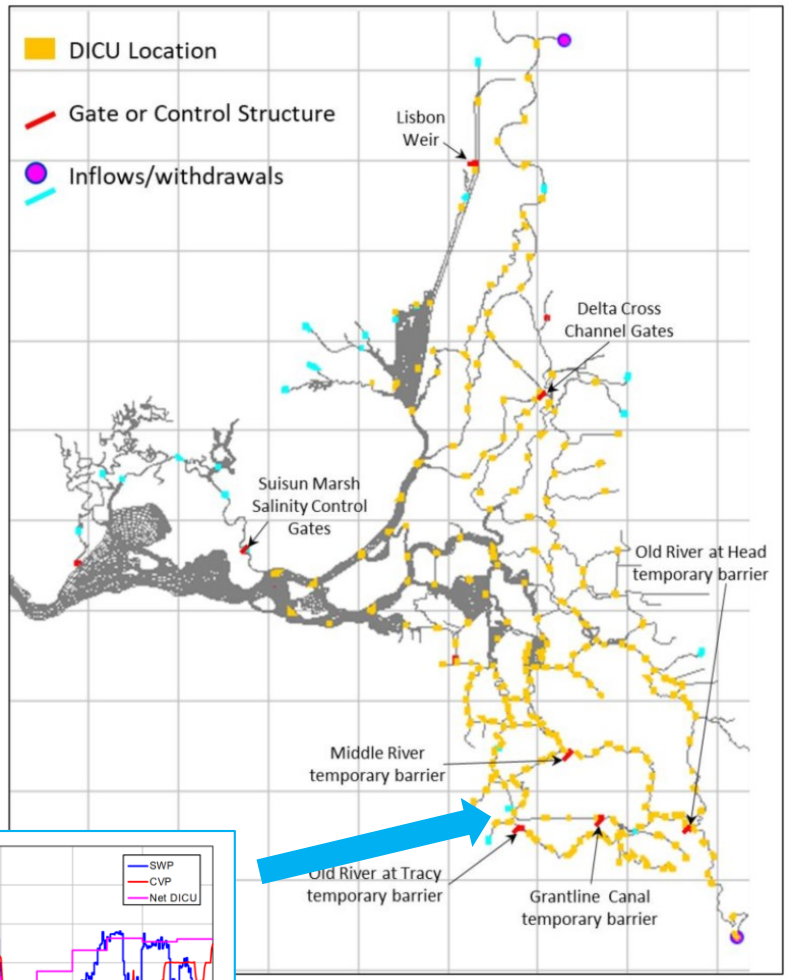
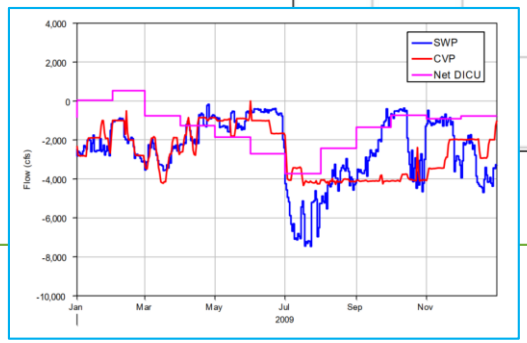
Consideration of Water Management

- Modeling included historic State Water Project (SWP), Central Valley Project (CVP), and local water management measures that occurred during years analyzed (2009, 2010, 2016).
- For these water management conditions, the Proposed Project was predicted to not cause non-compliance or make non-compliance with D-1641 salinity standards more likely
- Since Proposed Project is predicted to not trigger any water management changes to meet D-1641 standards and to not trigger Bay Delta Term 91 curtailment, there would be no need to alter SWP, CVP, and/or local water management measures.





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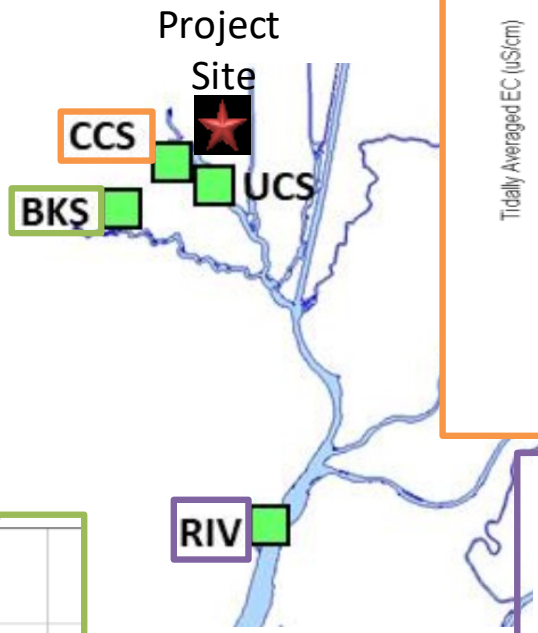
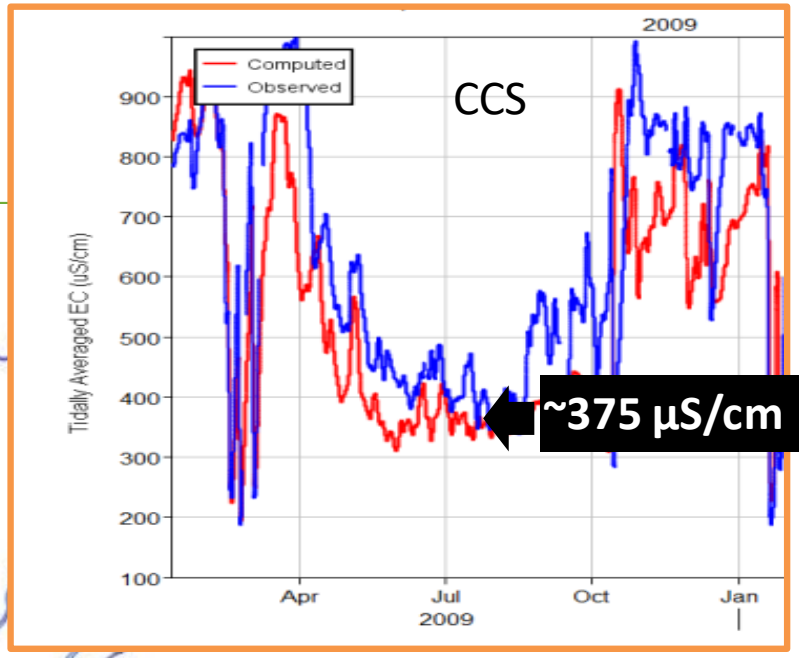
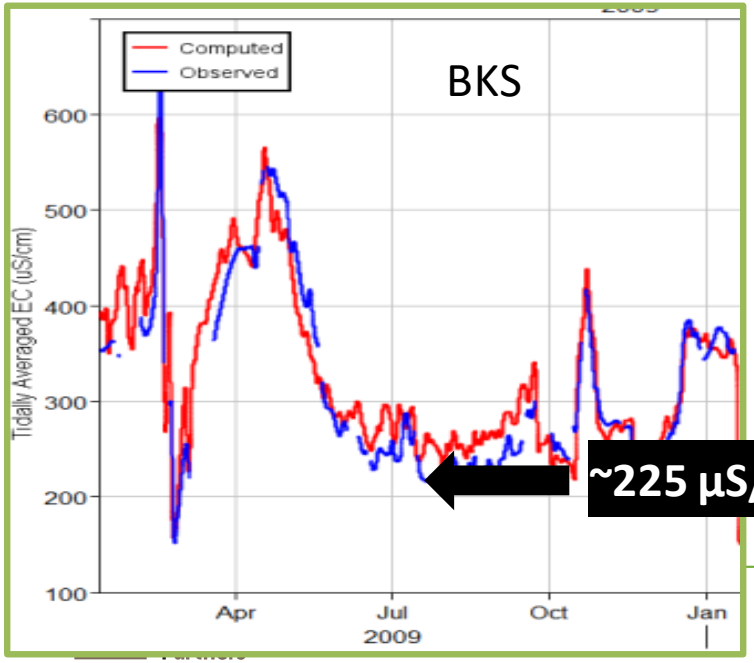
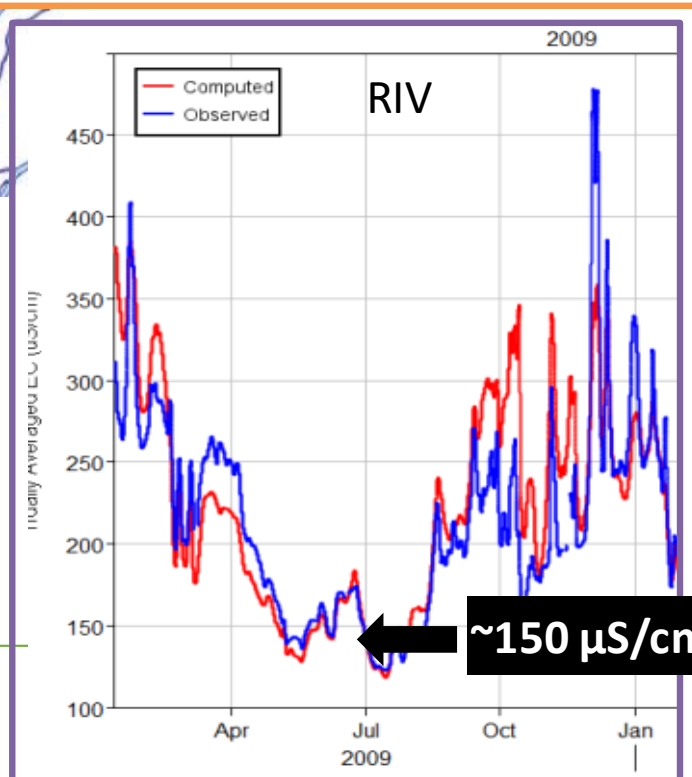
Observed EC in Cache Slough Complex

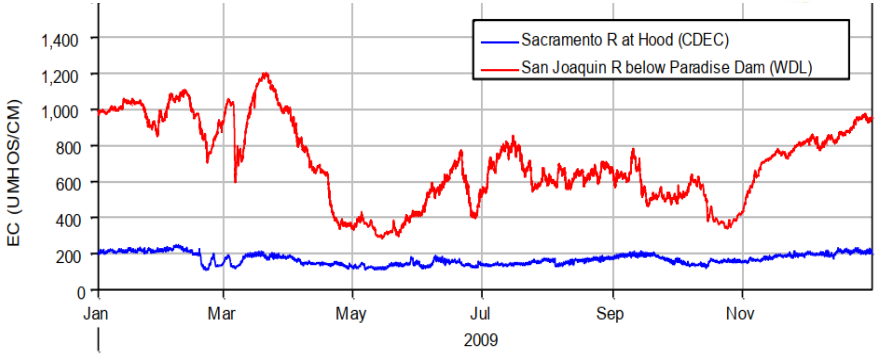


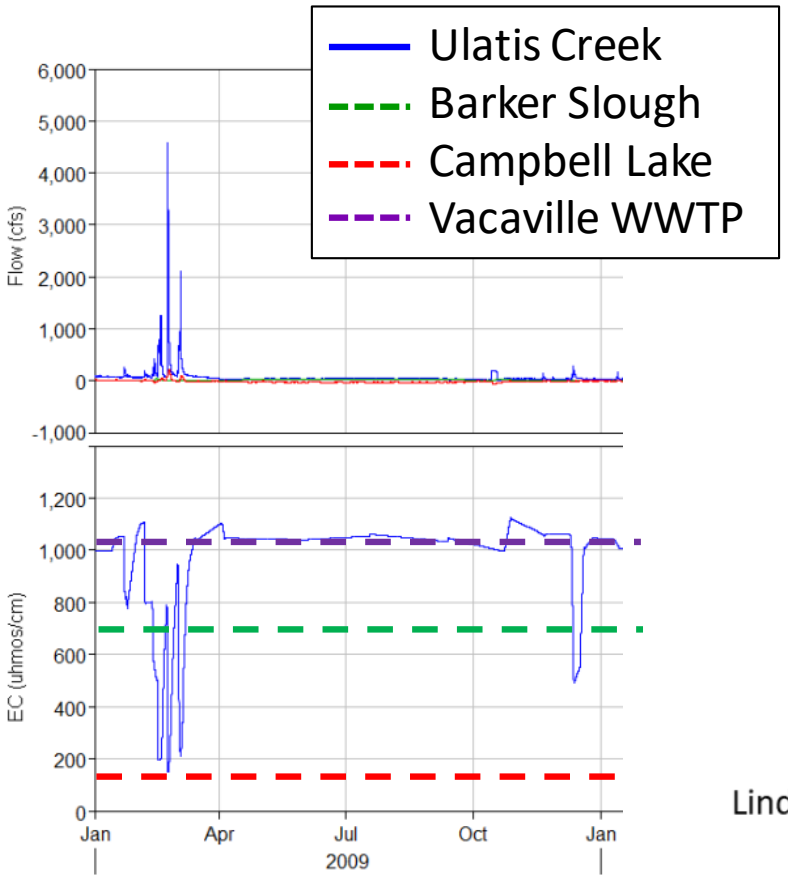


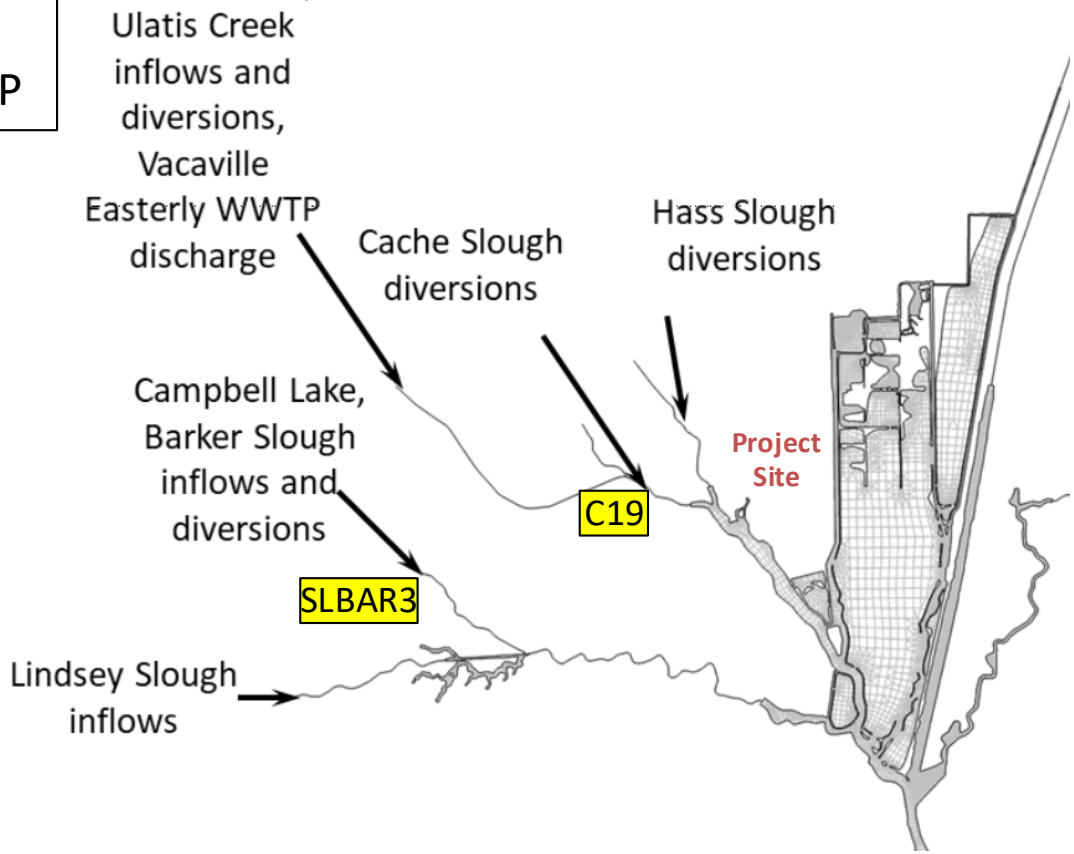




Replicating High EC in Upper Cache Slough: Model Boundary Conditions







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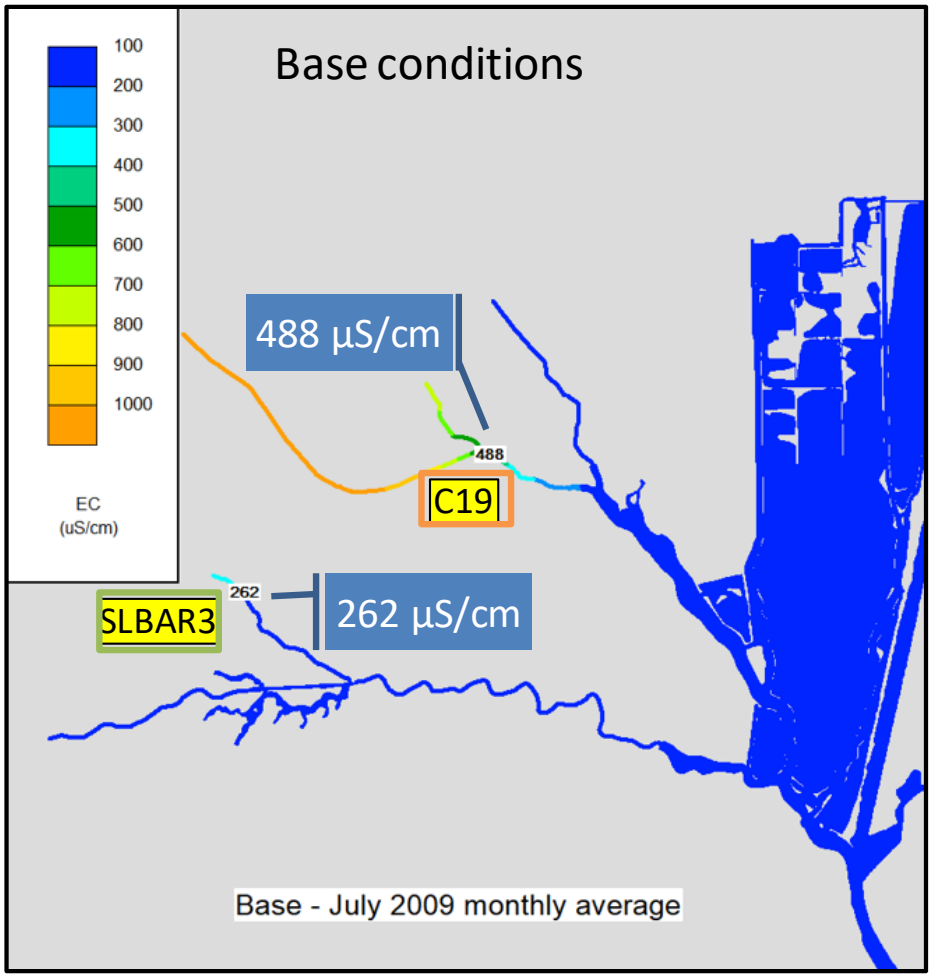
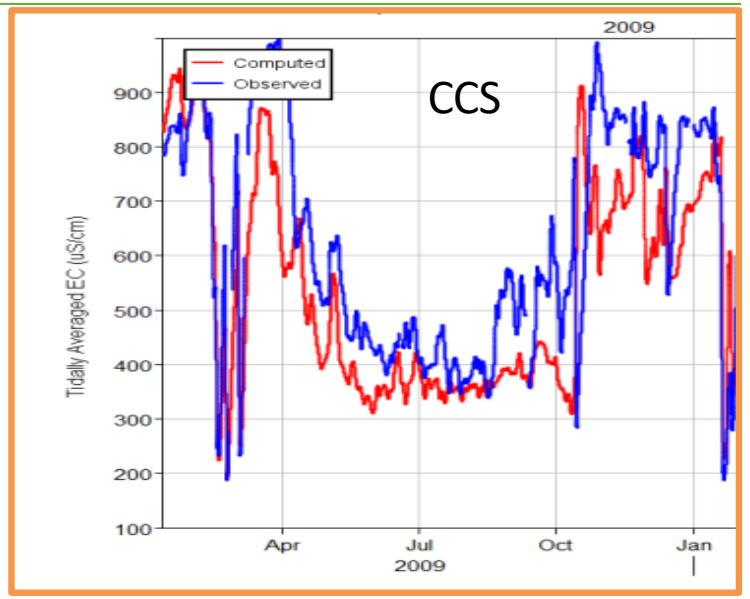
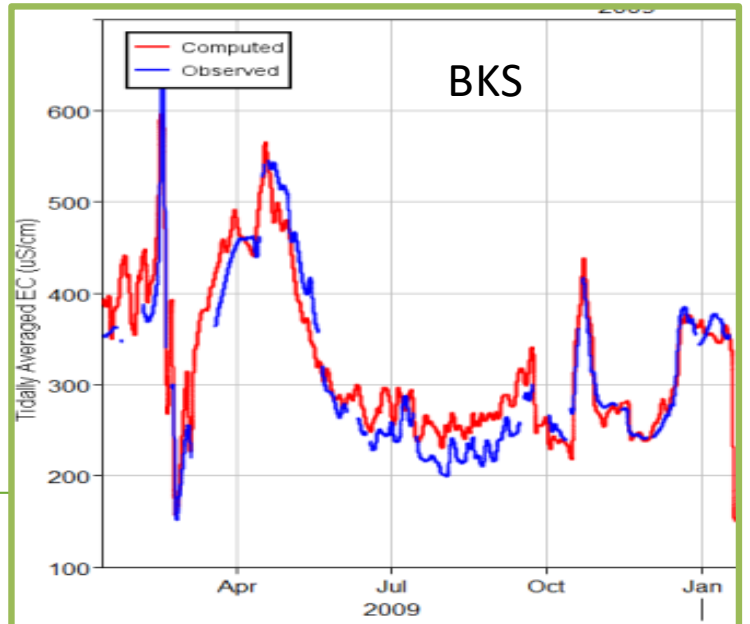
Modeled EC in Cache Slough Complex – July 2009







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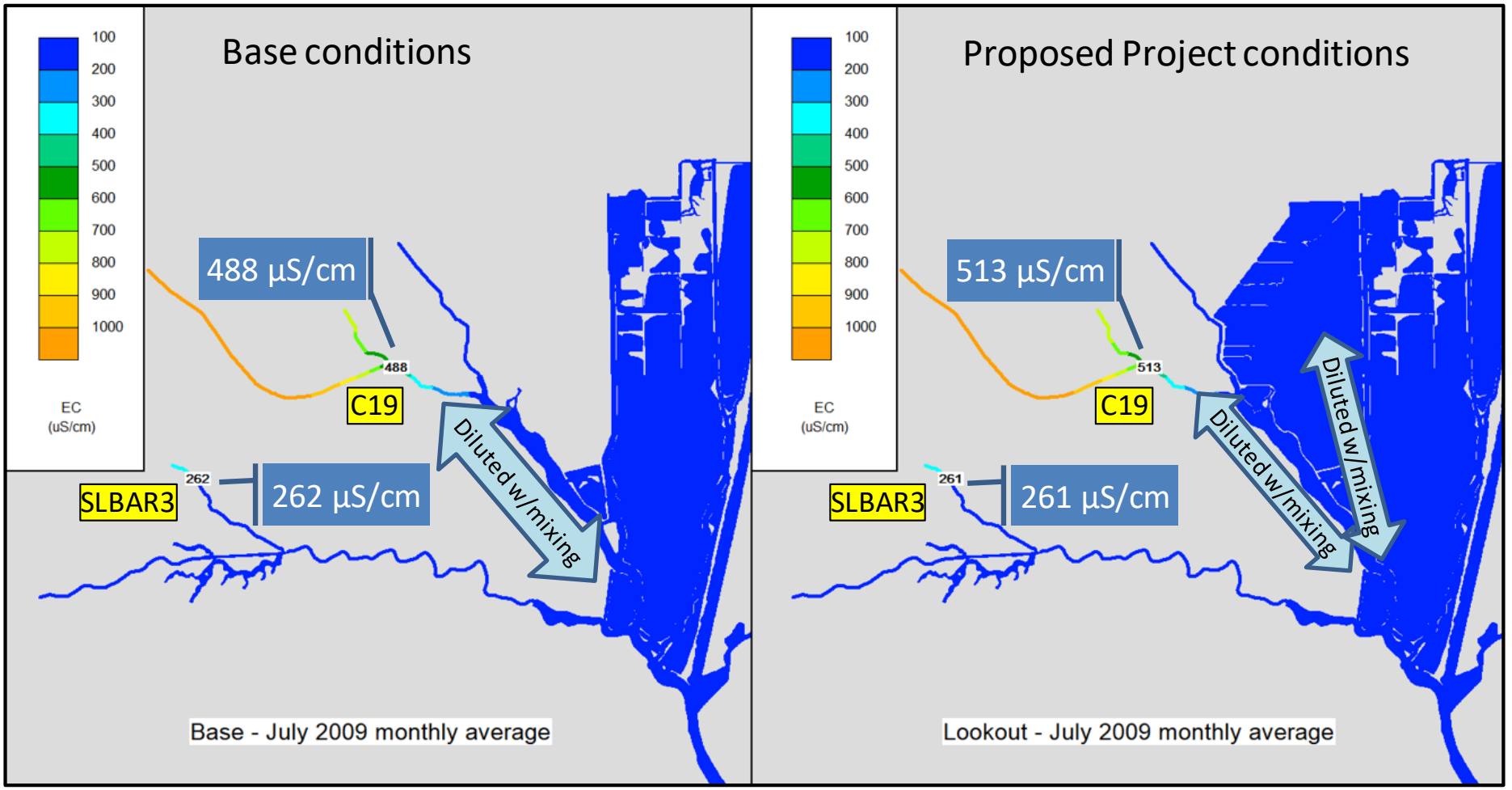

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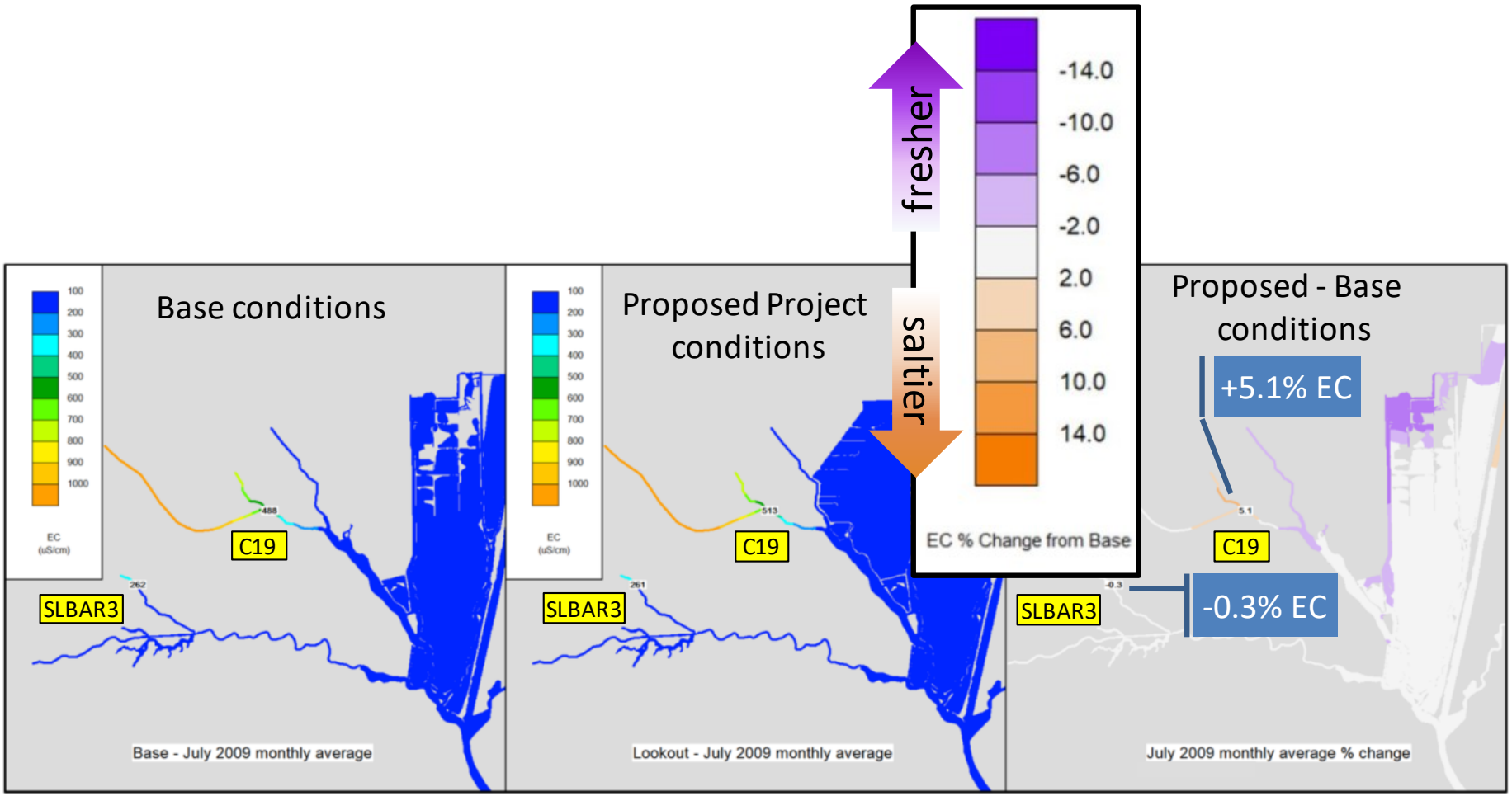
Percentage Change in EC – July 2009



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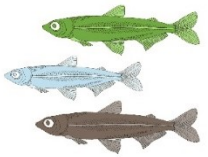


Cumulative Impacts

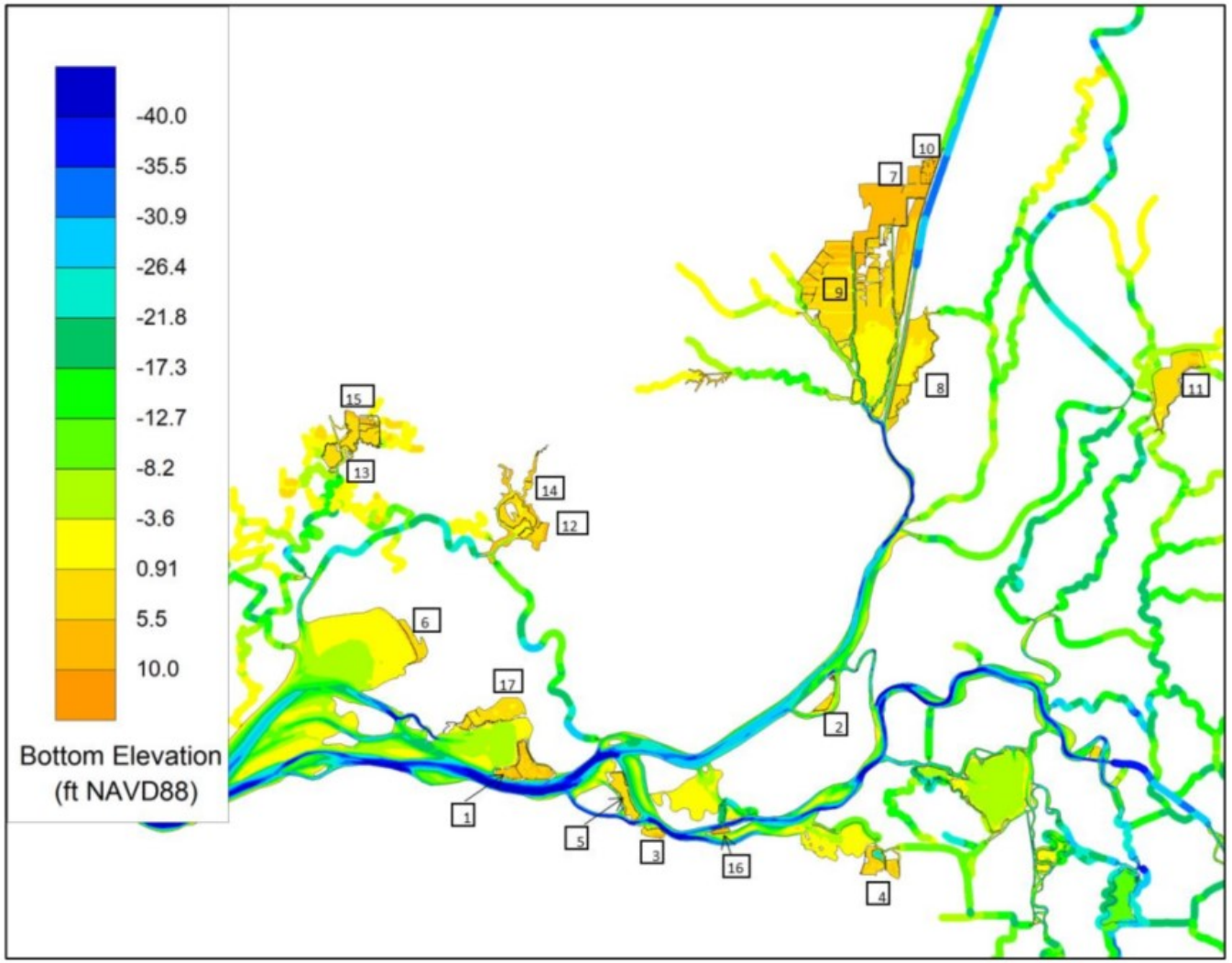
Two scenarios that included Regional Restoration projects were simulated with the hydrodynamic and EC modeling to analyze the cumulative effects:

- all the Regional Restoration projects *without* the Proposed Project
- all the Regional Restoration projects *with* the Proposed Project

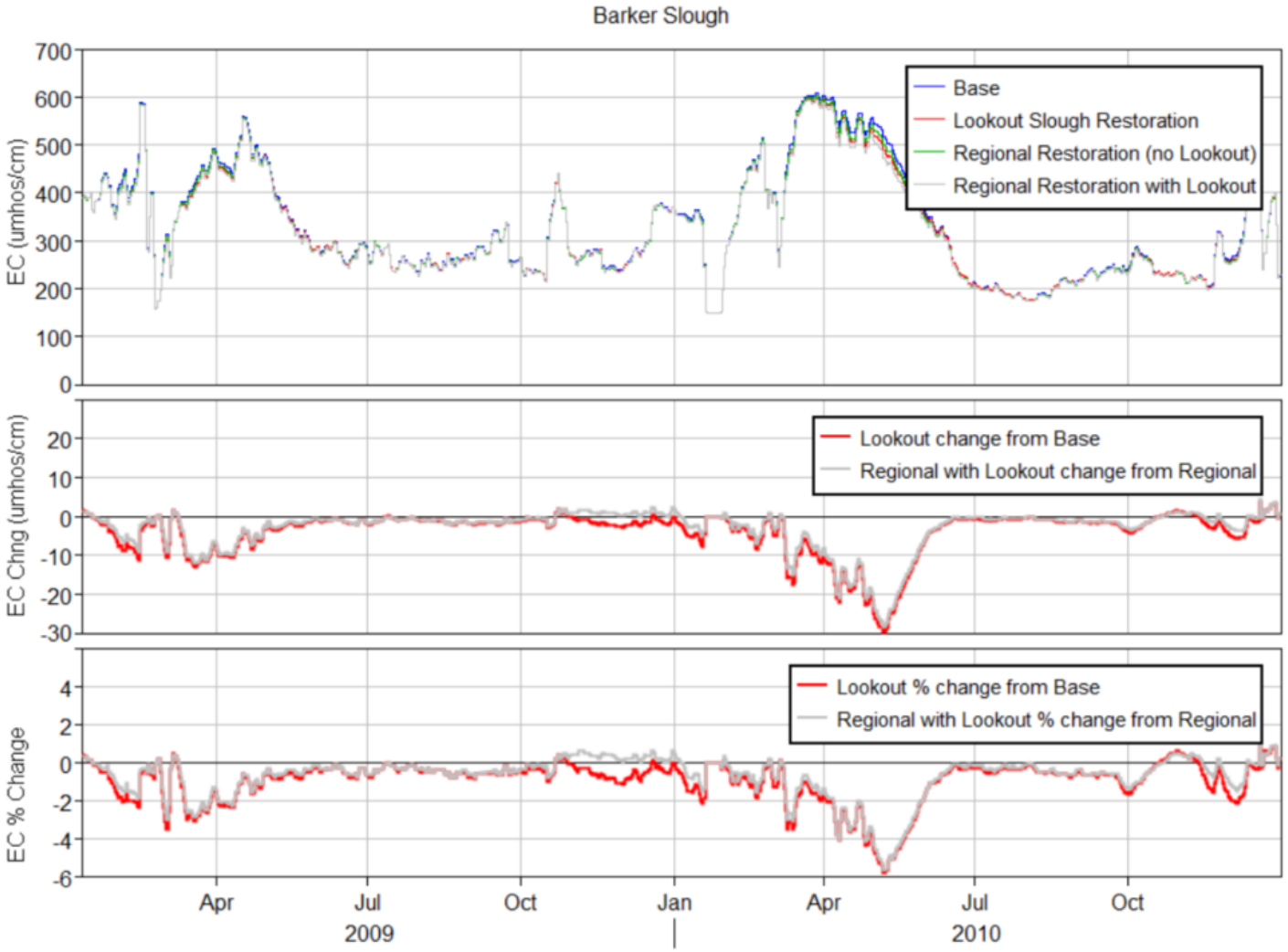
The effects of the Proposed Project on the cumulative impact was analyzed as the difference between these two scenarios

Regional Restoration Projects Considered for Cumulative Impacts

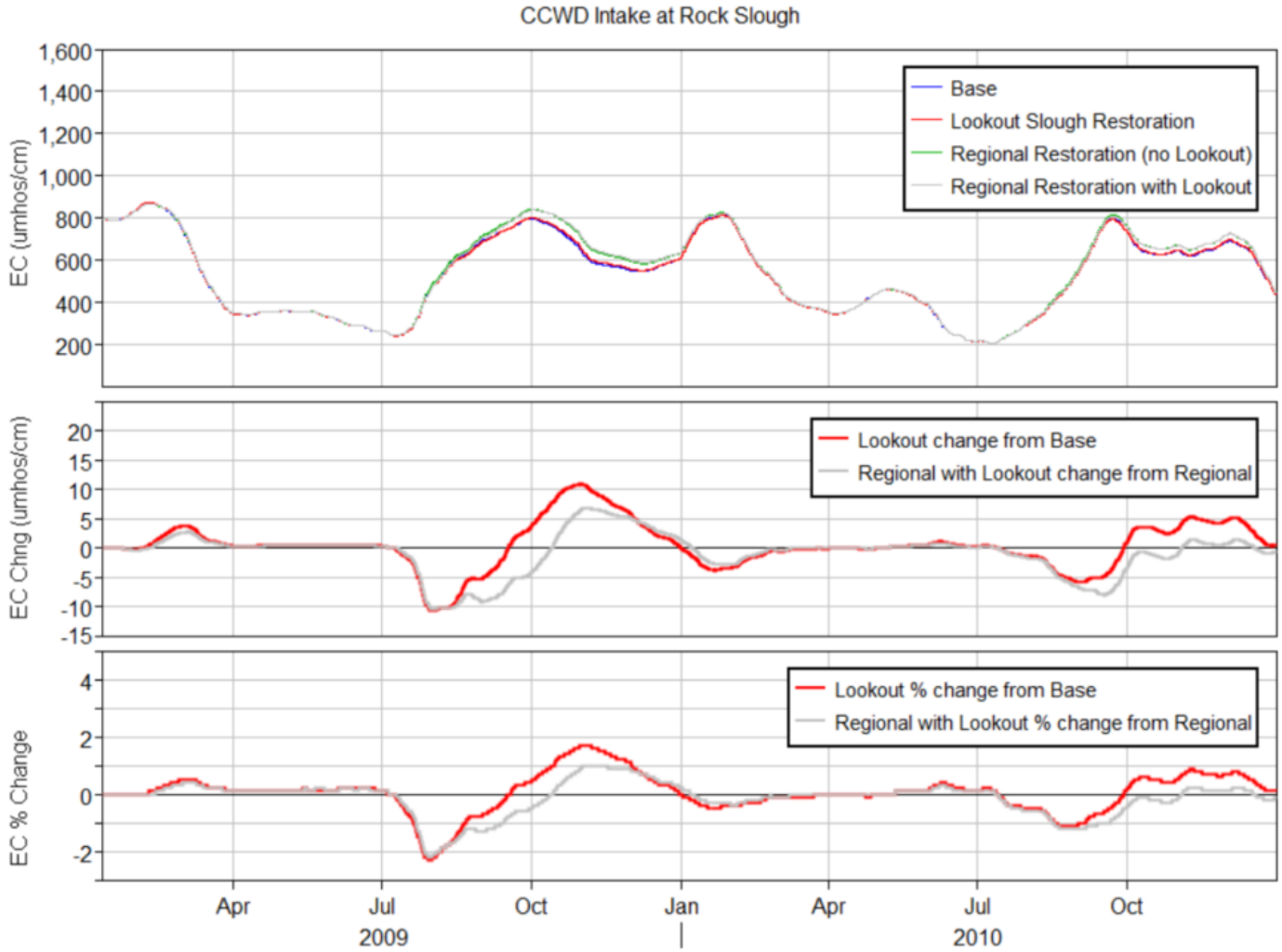
1. Chipps Island
2. Decker Island
3. DOW Wetlands
4. Dutch Slough
5. Winter Island
6. Tule Red
7. Lower Yolo
8. Prospect Island
9. Lookout Slough
10. Flyway Farms
11. McCormack Williamson
12. Arnold Slough
13. Wings Landing
14. Bradmoor
15. Hill Slough
16. West Island
17. Mallard Farms



Example results – Barker Slough Pumping Plant



Example results – Contra Costa Water District Intake at Rock Slough

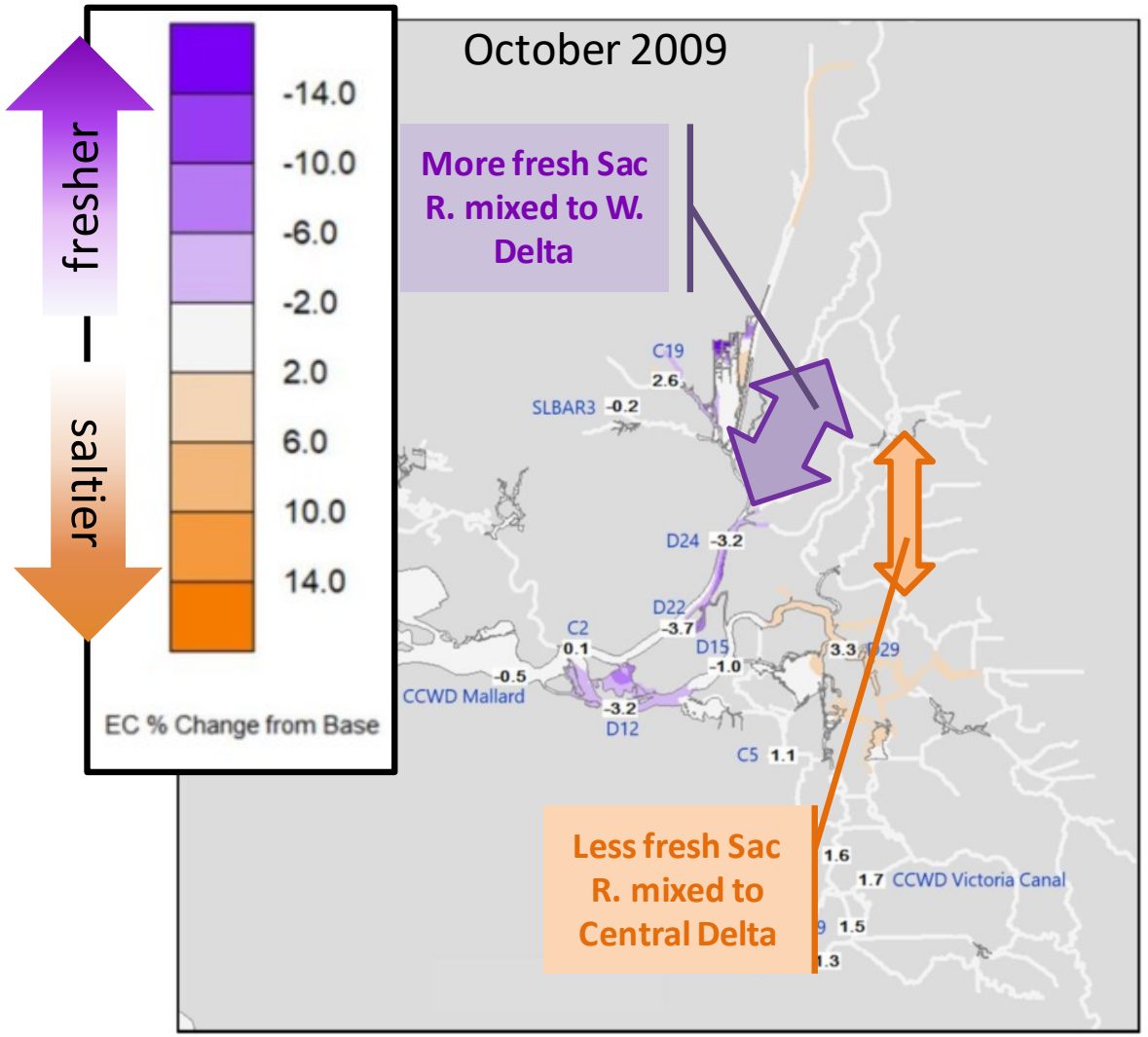


Example Results – Monthly Averaged Changes in EC

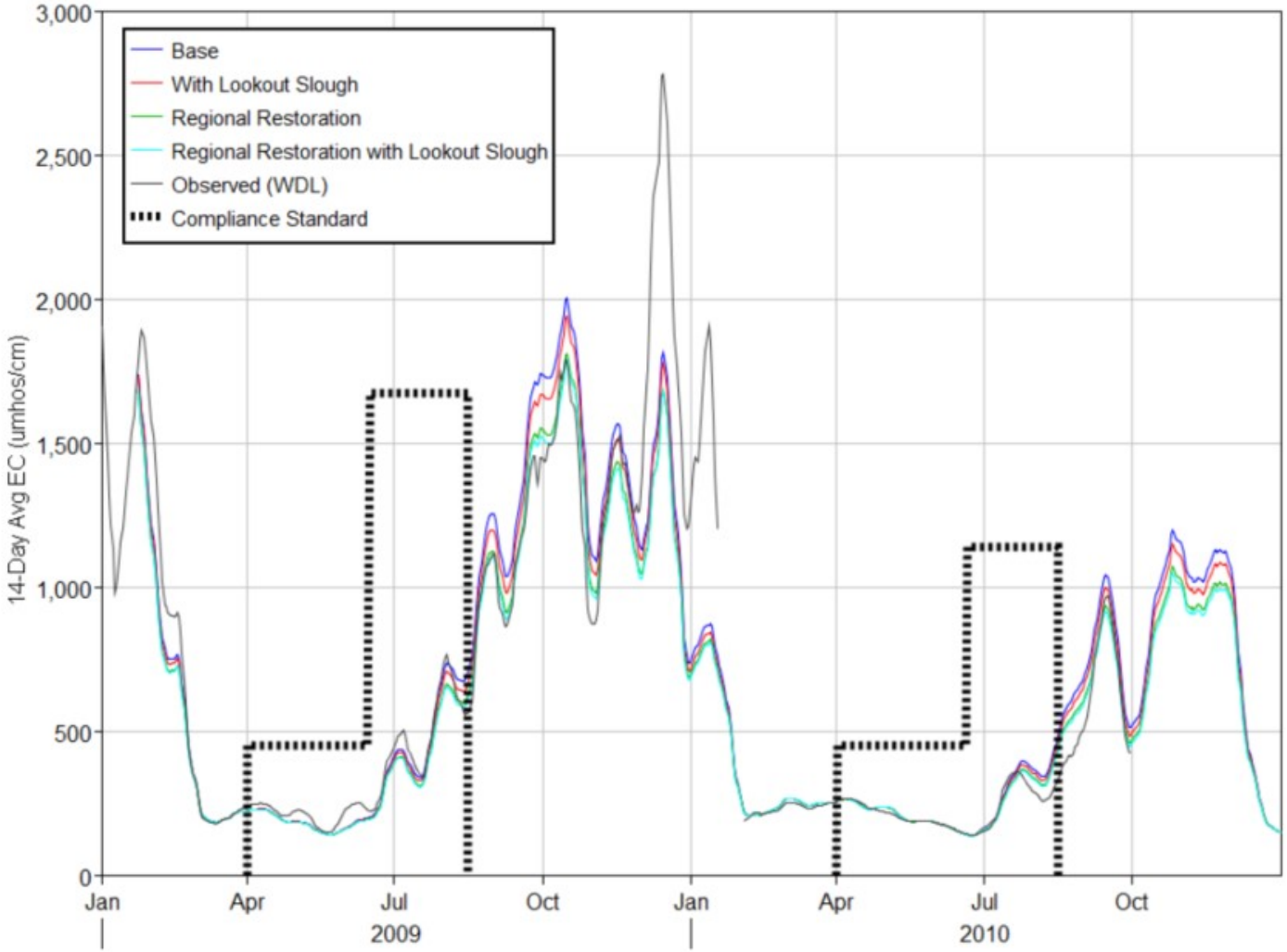
	SLBAR3 – Barker Slough NBA Intake						C5 – Contra Costa Intake at Rock Slough					
		With Lookout Slough		Regional Restoration	Regional Restoration with Lookout Slough			With Lookout Slough		Regional Restoration	Regional Restoration with Lookout Slough	
	Base EC µS/cm	EC change µS/cm	% EC change	EC µS/cm	EC change µS/cm	% EC change	Base EC µS/cm	EC change µS/cm	% EC change	EC µS/cm	EC change µS/cm	% EC change
Jan-2009	390.5	-0.8	-0.2%	390.5	-0.3	-0.1%	798.7	-0.1	0.0%	798.0	-0.1	0.0%
Feb-2009	372.4	-5.1	-1.3%	372.4	-3.8	-1.0%	837.0	1.7	0.2%	836.5	1.0	0.1%
Mar-2009	387.8	-8.0	-2.0%	387.8	-7.2	-1.9%	505.6	1.7	0.3%	510.4	1.3	0.3%
Apr-2009	479.1	-7.4	-1.5%	479.1	-6.7	-1.4%	346.0	0.3	0.1%	348.7	0.3	0.1%
May-2009	345.8	-2.3	-0.6%	345.8	-1.7	-0.5%	347.2	0.5	0.1%	349.1	0.5	0.1%
Jun-2009	275.5	-1.3	-0.5%	275.5	-1.1	-0.4%	287.0	0.5	0.2%	288.2	0.4	0.1%
Jul-2009	260.5	-0.9	-0.3%	260.5	-0.8	-0.3%	303.1	-3.2	-1.1%	304.9	-2.9	-0.9%
Aug-2009	254.6	-1.4	-0.5%	254.6	-1.3	-0.5%	596.8	-8.1	-1.4%	608.6	-9.4	-1.5%
Sep-2009	285.4	-1.6	-0.6%	285.4	-1.4	-0.5%	745.5	-0.6	-0.1%	779.1	-6.7	-0.9%
Oct-2009	291.7	-0.7	-0.2%	291.7	-0.3	-0.1%	736.5	8.1	1.1%	793.9	1.5	0.2%
Nov-2009	256.2	-1.7	-0.6%	256.2	0.9	0.4%	577.5	8.2	1.4%	629.6	6.0	1.0%
Dec-2009	312.5	-1.6	-0.5%	312.5	0.7	0.2%	567.4	2.5	0.4%	600.6	3.1	0.5%

Predicted Percentage Change in EC

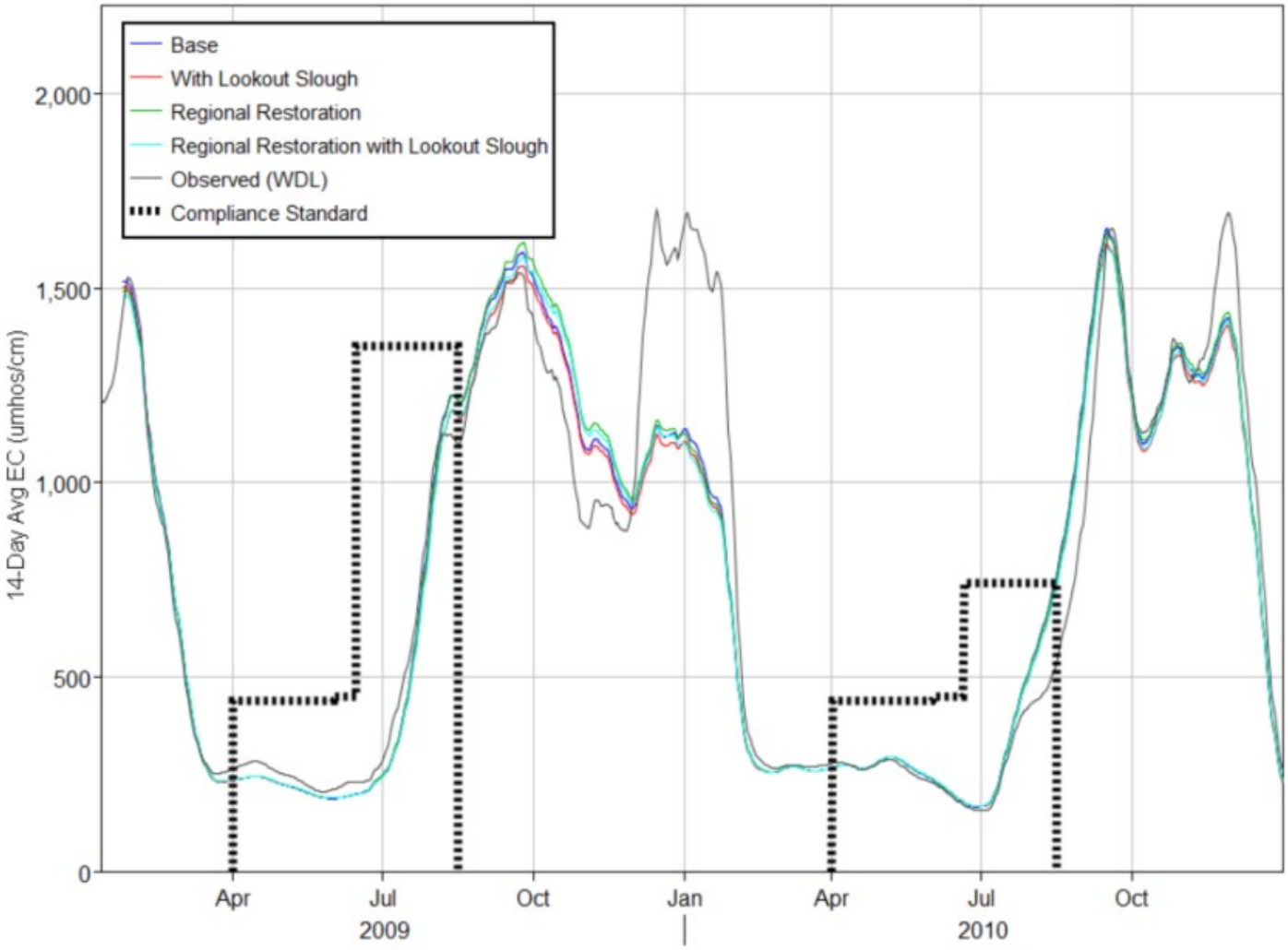
- Modeling results of % change in EC between Base and Proposed Project shown as Delta-wide maps for all three years in July and October
- Delta-wide mapping shows potential EC changes for agricultural users within the Delta



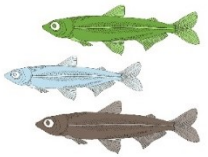
D-1641 compliance at Emmaton



D-1641 compliance at Jersey Point



D-1641 Chloride Standards



When volumetric Martinez source fraction is greater than or equal to 0.4%:

Cl = 0.285(EC) – 50

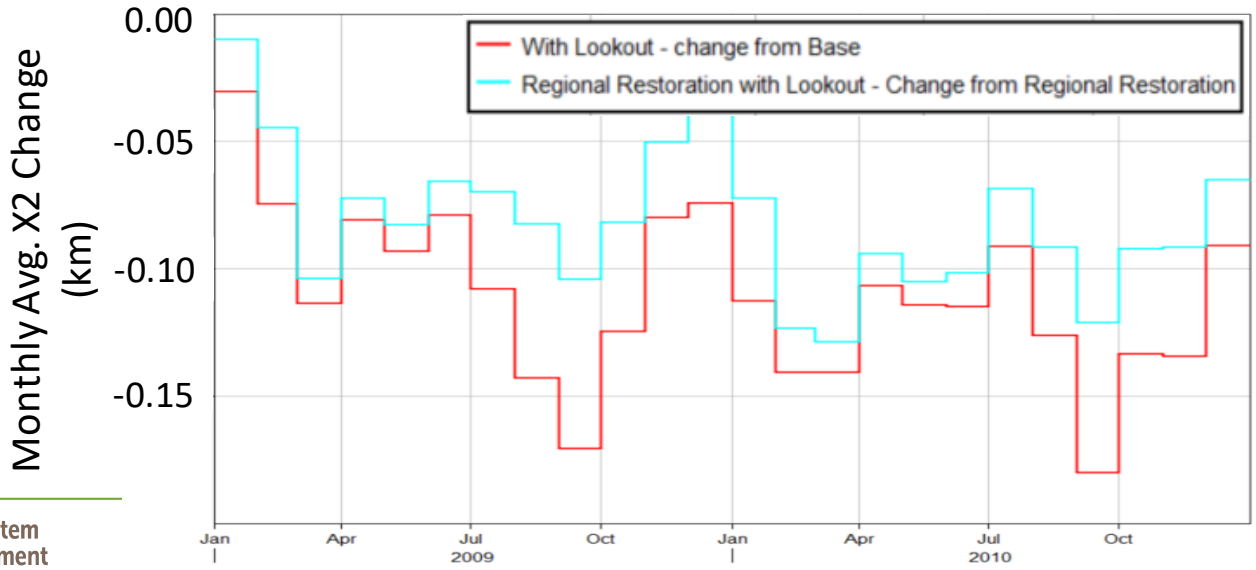
When volumetric Martinez source fraction is less than 0.4%:

Cl = 0.15(EC) - 12

Intake Location	Base	With Lookout	Regional Restoration	Regional Rest with Lookout
	# days < 150 mg/L (165 days req'd at Rock Slough or Antioch)			
CC Rock Slough*	293	293	279	280
Antioch	119	119	119	119
	Max mean daily chloride mg/L (req'd < 250 mg/L)			
CC at Rock Slough	198	198	197	197
CC at Old River	176	176	174	174
CC at Victoria Canal	153	153	153	153
West Canal at Clifton Court	196	196	195	195
DMC Canal	224	224	223	223
Barker Slough	76	76	76	75
C19	139	141	141	141

* # of days are consecutive, meeting the requirement that criteria must be met in intervals of not less than two weeks

Predicted Change in X2



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Bromides Estimated from Modeled EC

Bromide was estimated from modeled EC in conjunction with volumetric Martinez fraction based on the following equations (USBR, 2015).

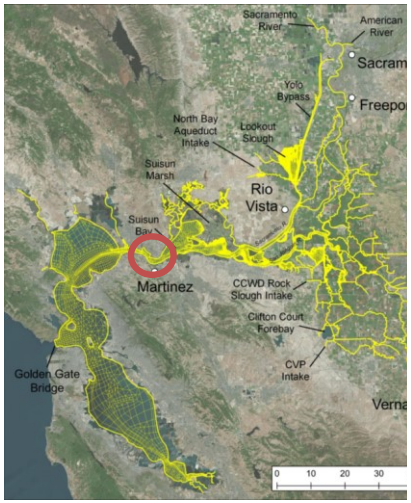
When volumetric Martinez source fraction is greater than or equal to 0.4%:

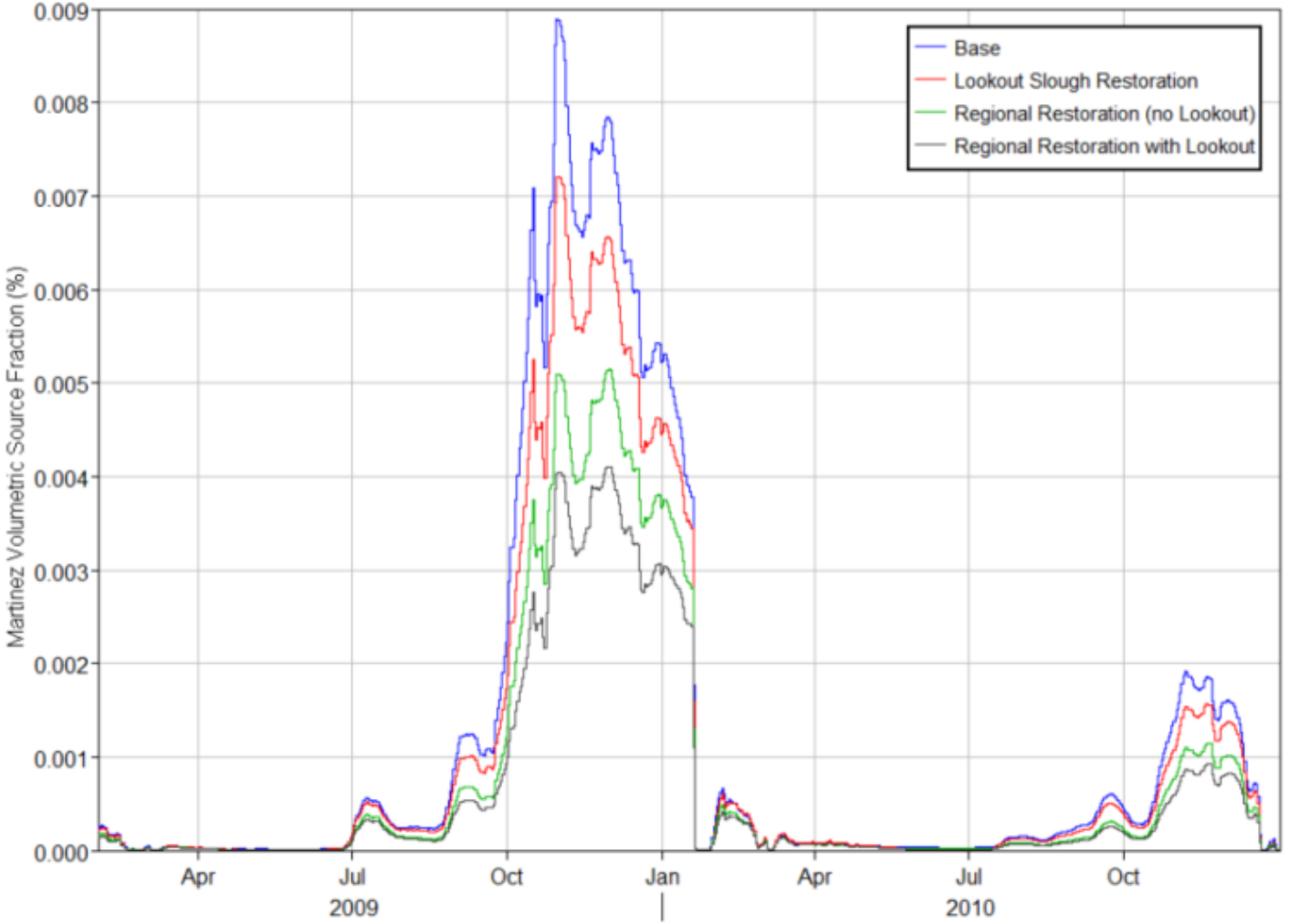
$$Br = 0.000827(EC) - 0.112 \quad (1)$$

When volumetric Martinez source fraction is less than 0.4%:

$$Br = 0.000552(EC) - 0.073 \quad (2)$$

Martinez Source Fraction at Barker Slough Pumping Plant





Bromides - Typical Results

	C5 – Contra Costa Intake at Rock Slough						SLBAR3 – Barker Slough NBA Intake					
		With Lookout Slough		Regional Restoration	Regional Restoration with Lookout Slough			With Lookout Slough		Regional Restoration	Regional Restoration with Lookout Slough	
	Base Br mg/L	Brchange mg/L	% Br change	Br mg/L	Brchange mg/L	% Br change	Base Br mg/L	Brchange mg/L	% Br change	Br mg/L	Brchange mg/L	% Br change
Jan-2009	0.50	0.000	0.0%	0.50	0.000	0.0%	0.14	0.000	-0.3%	0.14	0.000	-0.1%
Feb-2009	0.39	0.001	0.2%	0.39	0.001	0.1%	0.13	-0.003	-2.1%	0.13	-0.002	-1.6%
Mar-2009	0.21	0.001	0.5%	0.21	0.001	0.3%	0.14	-0.004	-3.1%	0.14	-0.004	-2.8%
Apr-2009	0.12	0.000	0.2%	0.12	0.000	0.1%	0.19	-0.004	-2.1%	0.19	-0.004	-1.9%
May-2009	0.12	0.000	0.2%	0.12	0.000	0.2%	0.12	-0.001	-1.0%	0.12	-0.001	-0.8%
Jun-2009	0.09	0.000	0.3%	0.09	0.000	0.3%	0.08	-0.001	-0.9%	0.08	-0.001	-0.8%
Jul-2009	0.13	-0.003	-2.1%	0.13	-0.002	-1.9%	0.07	0.000	-0.7%	0.07	0.000	-0.7%
Aug-2009	0.38	-0.007	-1.7%	0.39	-0.008	-2.0%	0.07	-0.001	-1.1%	0.07	-0.001	-1.1%
Sep-2009	0.50	-0.001	-0.1%	0.53	-0.006	-1.0%	0.09	-0.001	-1.0%	0.08	-0.001	-0.9%
Oct-2009	0.50	0.007	1.4%	0.54	0.001	0.2%	0.09	0.000	-0.4%	0.09	0.000	-0.2%
Nov-2009	0.37	0.007	1.9%	0.41	0.005	1.2%	0.07	-0.001	-1.3%	0.07	0.001	0.8%
Dec-2009	0.36	0.002	0.6%	0.38	0.003	0.7%	0.10	-0.001	-0.9%	0.10	0.000	0.4%

[9] Results are provided with sufficient detail to provide reader with information about small changes. While this level of precision is available from the model, the model's accuracy is likely only one-two significant digits.

[10] Equations converting EC to bromide may be less accurate at the SLBAR3 and C19 locations than for other areas in the Delta, given that these equations were not developed for conditions where local inflows are the primary salinity source, as is the case at these locations.

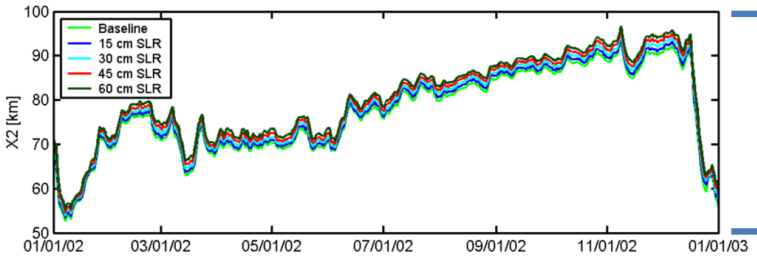
Sea Level Rise Projections – State Guidance

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)				
		MEDIAN	LIKELY RANGE			1-IN-20 CHANCE
		50% probability sea-level rise meets or exceeds...	*66% probability sea-level rise is between...*			*5% probability sea-level rise meets or exceeds...*
					Low Risk Aversion	
High emissions	2030	0.4	0.3	-	0.5	0.6
	2040	0.6	0.5	-	0.8	1.0
	2050	0.9	0.6	-	1.1	1.4

Source: California Ocean Protection Council (2018)

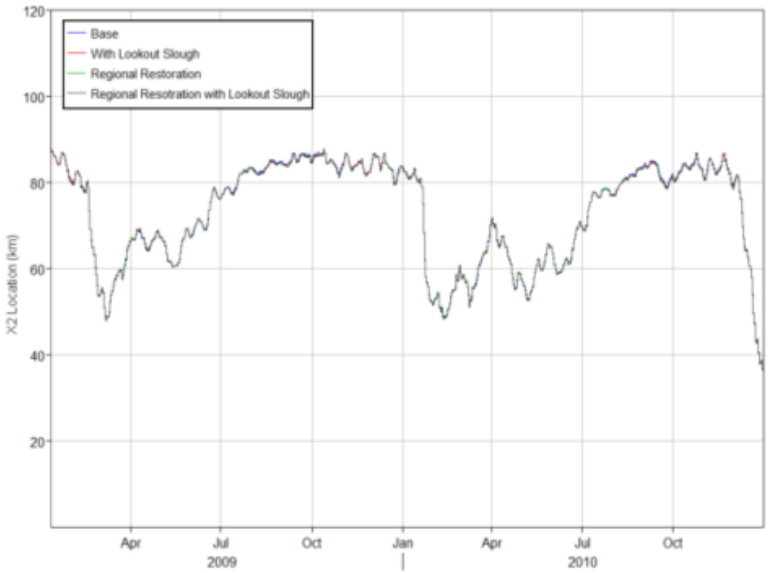
X2 with Sea Level Rise & Lookout Slough

SLR assessment for Bay Delta Conservation Plan



Source: MacWilliams & Gross (2010)

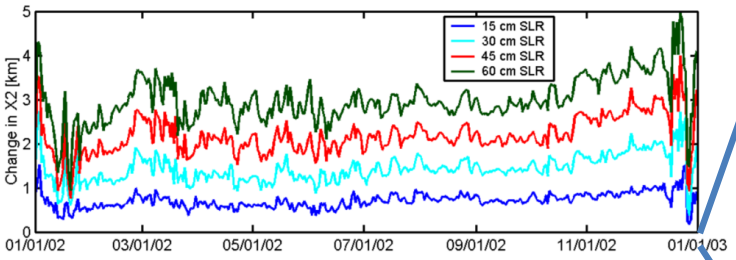
SLR assessment for Lookout Slough



Source: RMA (2020)

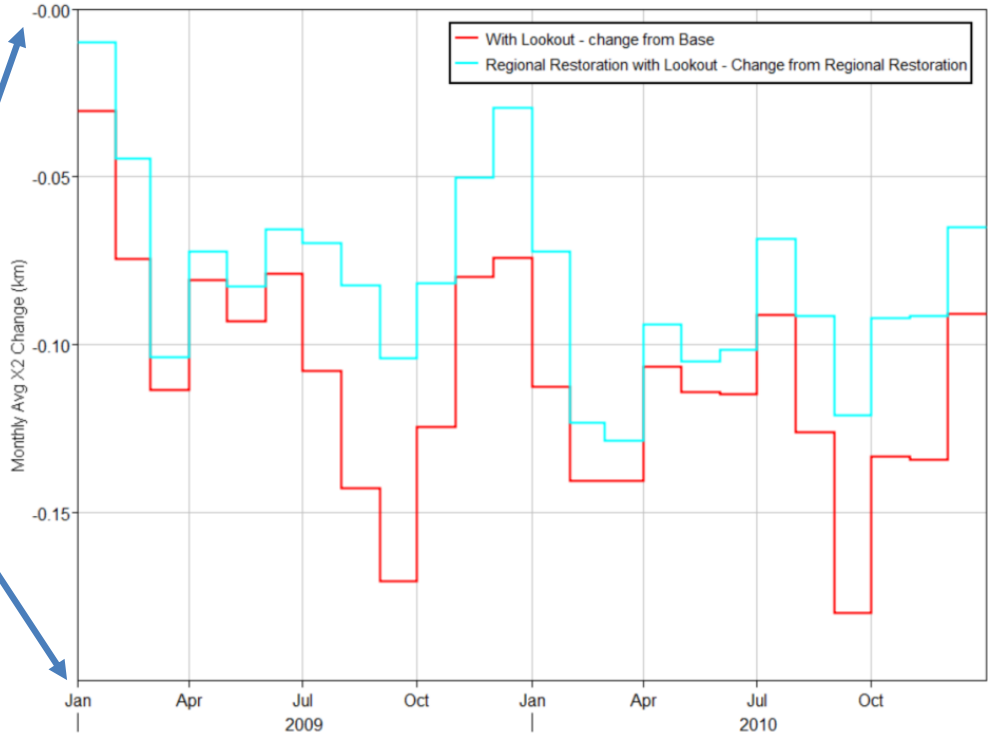
Change in X2 with Sea Level Rise & Lookout Slough

SLR assessment for Bay Delta Conservation Plan

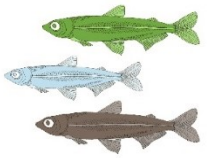


Source: MacWilliams & Gross (2010)

SLR assessment for Lookout Slough



Source: RMA (2020)



Summary of Analyses for the Lookout Slough Project

- D-1641 and Bay-Delta Plan used as basis for salinity significance standards
- Model configuration and results included in Final EIR's Appendix X
- Revised modeling with to improve EC predictions in upper Cache Slough and to model three years (2009, 2010, 2016)
- During summer and fall when Delta outflows are lowest, results showed less than 5% increase in EC for the majority of the modeled compliance locations
- The Proposed Project is not predicted to cause non-compliance or make non-compliance with the D-1641 salinity standard more likely for agriculture, municipal, or fish and wildlife beneficial use
- Changes in X2 due to the Proposed Project are substantially smaller than those predicted to occur due to sea level rise