Staff Technical Workshop Part 5:
South Delta Salinity

December 12, 2016

State Water Board Presenters:
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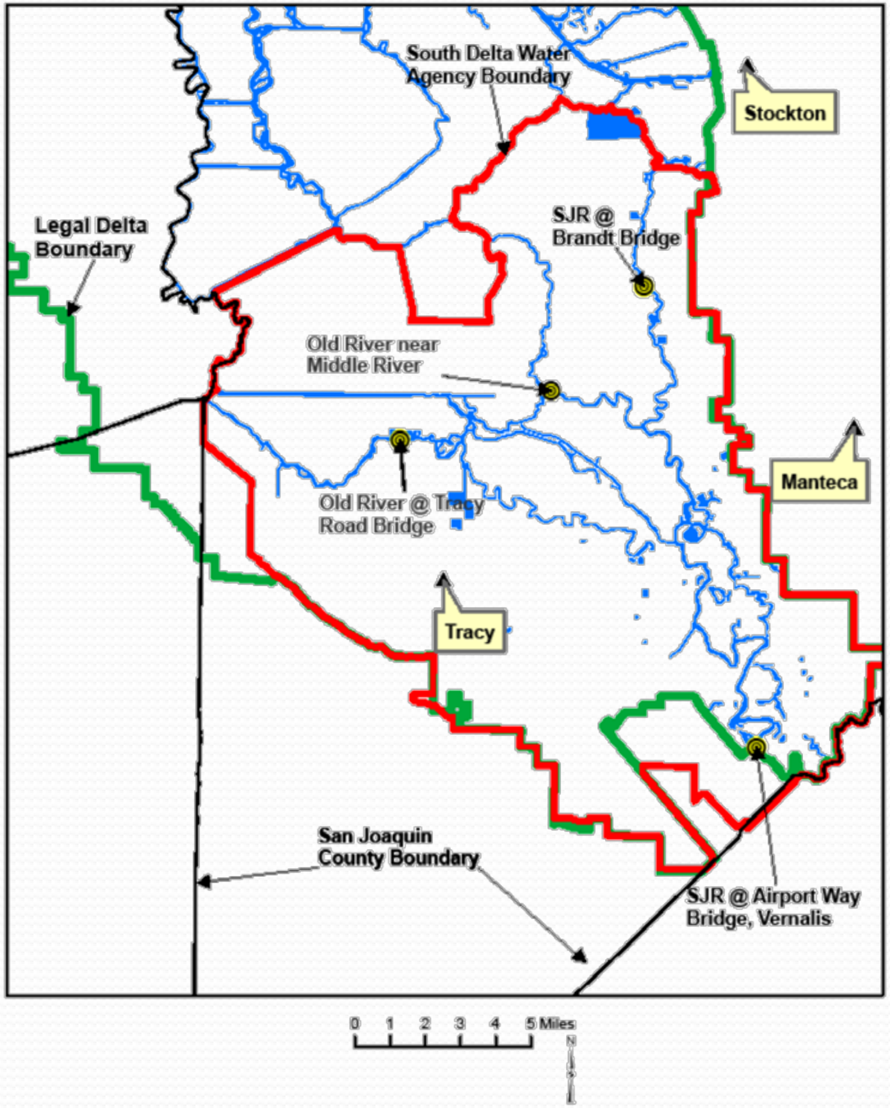
Topics Covered

- History of South Delta Salinity Issues
- Current and Proposed Objectives
- Key points of the Hoffman Report
- Modeling South Delta Salinity in WSE
- Summary of the Antidegradation Analysis

Current Southern Delta Salinity Objectives

- April through August: 0.7 millimhos per centimeter (mmhos/cm) EC
  - based on the salt sensitivity and growing season of beans
- September through March: 1.0 mmhos/cm EC
  - based on the growing season and salt sensitivity of alfalfa during the seedling stage
- 4 Salinity compliance stations within the south Delta:
  - San Joaquin River at Vernalis
  - San Joaquin River at Brandt Bridge
  - Old River at Middle River
  - Old River at Tracy Road Bridge.



Hoffman Report, Figure 1.1.

Proposed Southern Delta Salinity Objective

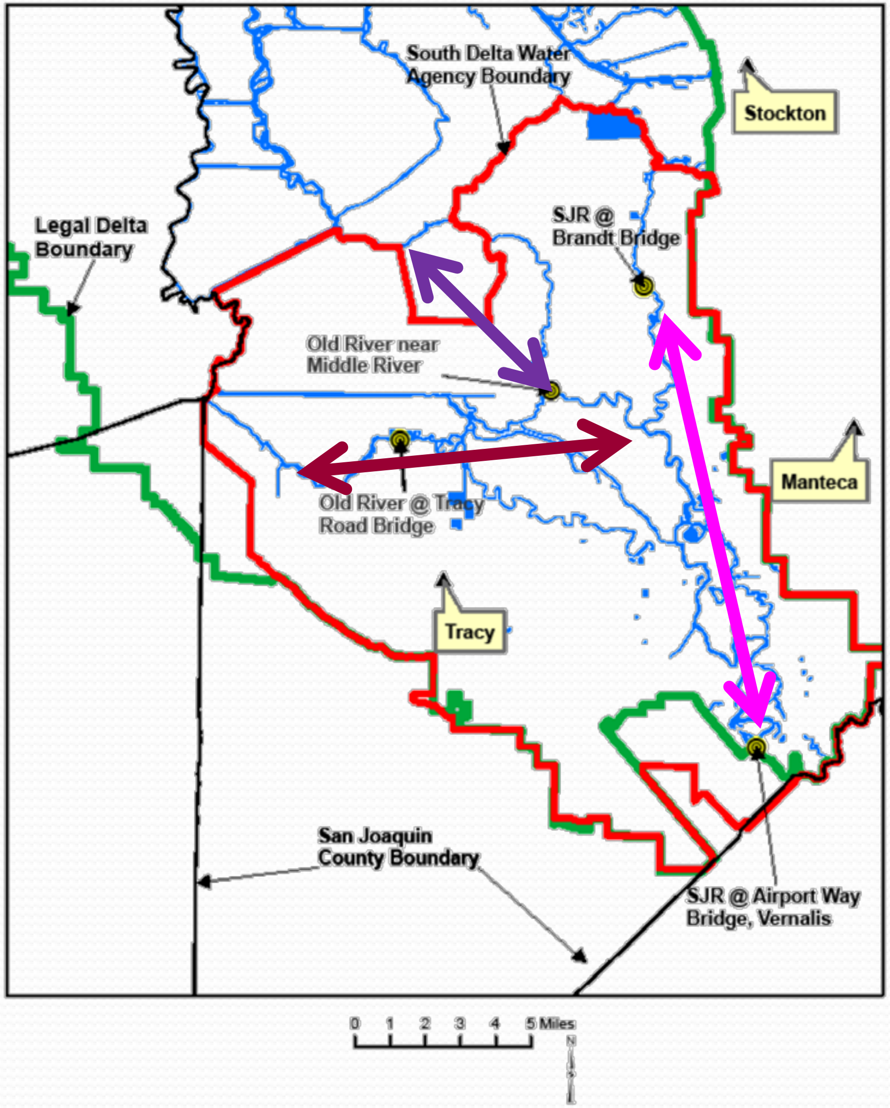
- Year round objective of 1.0 deciSemens per meter (dS/m) EC
- Three compliance locations changed to channel segments

Proposed Southern Delta Salinity Objective Reaches

SJR from Vernalis to Brandt Bridge

Middle River from Old River to Victoria Canal

Old River/Grant Line Canal from Head of Old River to West Canal



Hoffman Report, Figure 1.1.

Proposed Southern Delta Salinity Objective

- Year round objective of 1.0 deciSemens per meter (dS/m) EC
- Three compliance locations changed to channel segments
  - SJR from Vernalis to Brandt Bridge
  - Middle River from Old River to Victoria Canal
  - Old River/Grant Line Canal from Head of Old River to West Canal
- Continued conditions in USBR and DWR's water rights
  - USBR - 0.7 EC at Vernalis April - Aug; 1.0 EC Sep - March
  - DWR & USBR - 1.0 EC year round in the interior Delta locations
  - DWR & USBR - Continued operations of agricultural barriers or other reasonable measures to address impacts of SWP/CVP operations on water levels and flow conditions

Proposed Southern Delta Salinity Objective

- Other Requirements
  - Comprehensive Operations Plan - Information, actions, performance goals to address SWP/CVP export operations on water levels and flow conditions affecting salinity
  - Monitoring and reporting
  - Study to characterize dynamics of water level, flow, and salinity conditions

- LSJR flow objectives would improve salinity conditions

Salt Tolerance of Crops (Hoffman Report) – Main Conclusions

- Salinity in southern Delta surface waters appears suitable for all agricultural crops
- Salt sensitive crops of significance in the southern Delta include almond, apricot, dry bean, and walnut
- Relatively high leaching fractions are associated with an overall irrigation efficiency of 75% for furrow and border irrigation methods predominant in the southern Delta.
  - Data from drains in the western part of the southern Delta suggest leaching fractions are between 0.21 and 0.27, with minimums ranged from 0.11 to 0.22

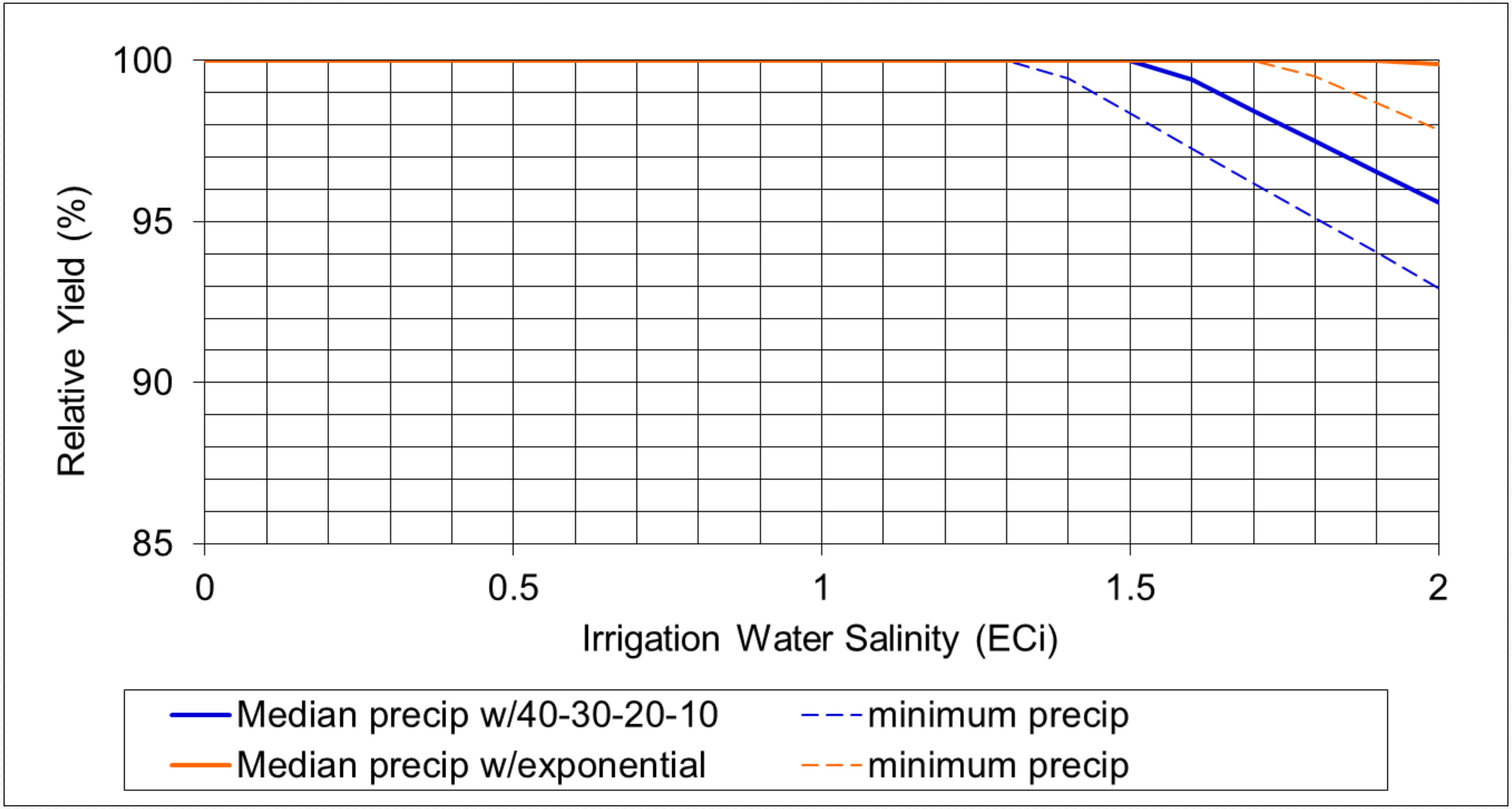
Salt Tolerance of Crops (Hoffman Report) – Main Conclusions

- Salinity could be increased up to 0.9 to 1.1 dS/m and be protective of all crops normally grown in the southern Delta (based on modeling in report and other model studies)
  - Might lead to yield loss of about 5% during low rainfall years

Model Results

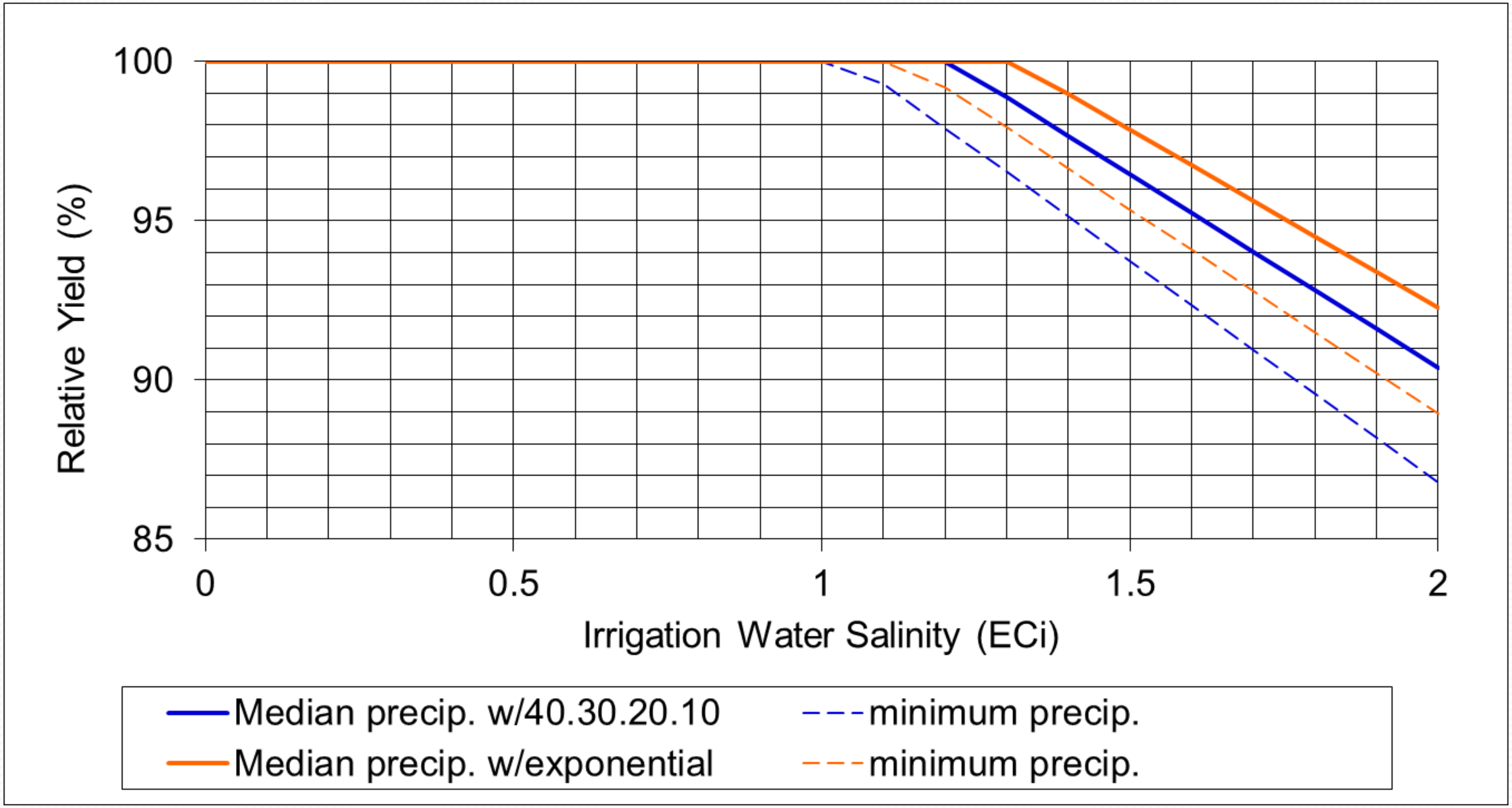
- Two Different steady-state models, based on assumed water uptake:
  - 40-30-20-10
  - exponential
- Two assumptions for precipitation: (with and without)
- Three crops:
  - Bean
  - Alfalfa
  - Almond

Alfalfa Yield with Increasing Irrigation Water Salinity (Leaching Factor = .15)



Based on Figure 5.13b in Appx E (Salt Tolerance of Crops in the Southern Sacramento-San Joaquin Delta)

Alfalfa Yield with Increasing Irrigation Water Salinity (Leaching Factor = .10)



Based on Figure 5.13a in Appx E (Salt Tolerance of Crops in the Southern Sacramento-San Joaquin Delta)

Modeling Salinity in WSE

Calculation for Salinity at Vernalis

- EC at Vernalis was simulated in the WSE model with the following equation:

Adjusted Vernalis EC =

*CALSIM Baseline EC * (CALSIM Baseline Flow/Flow in LSJR Alt)*

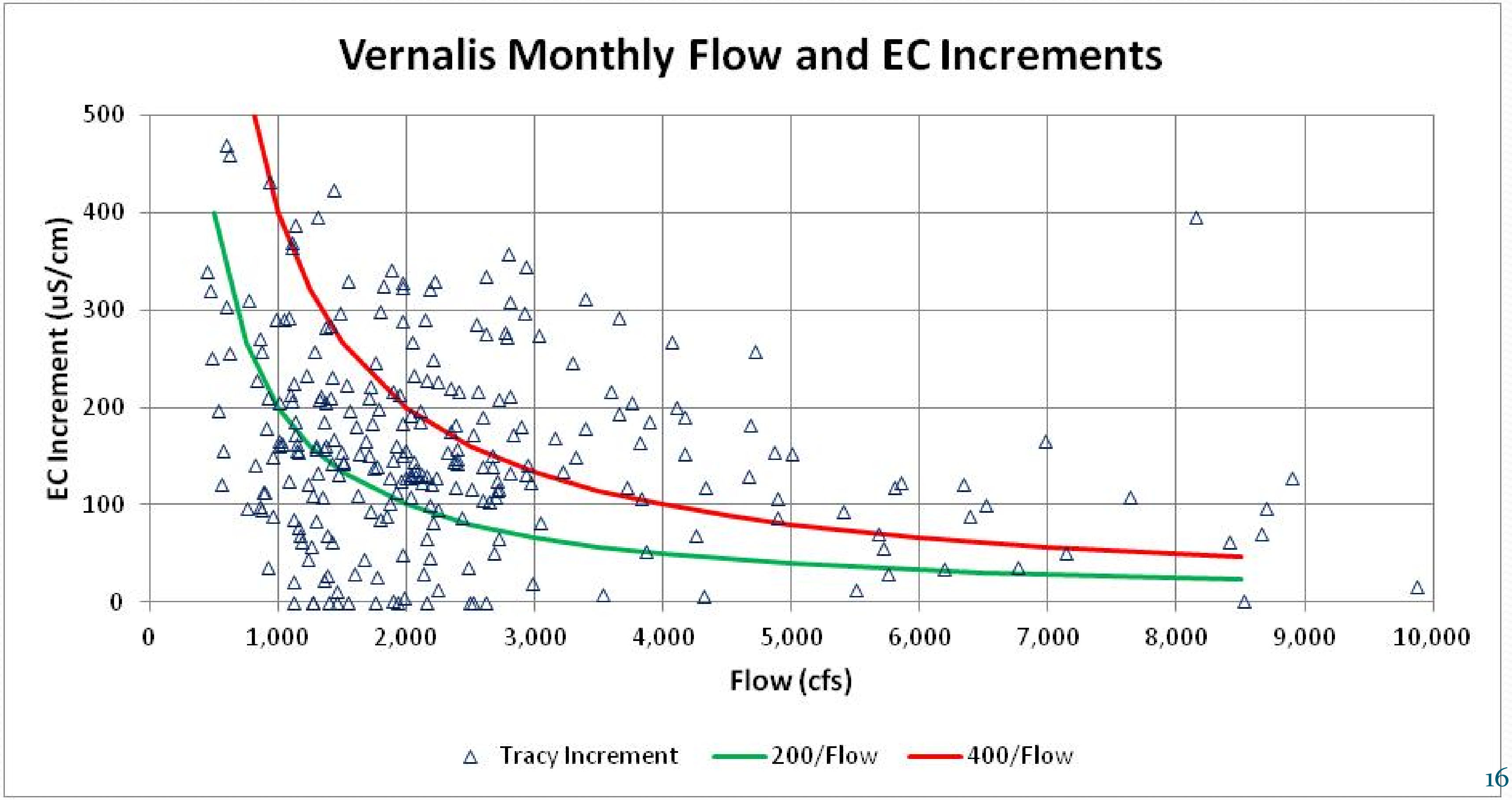
- Assumes that CALSIM reasonably approximates Vernalis Salinity
- Assumes Salinity change is inversely proportional to the change in flow
- For example, a Vernalis flow increase of 10 percent will reduce the Vernalis EC by 10 percent. A flow reduction of 10 percent will increase the EC by 10 percent.

EC Increments for Interior Delta Stations

- EC at interior stations is estimated based on the Vernalis EC plus an increase downstream of Vernalis (referred to as an EC increment)
- The EC increment can be described as the increase in salinity from the Vernalis station to the next station due to additional salt introduced downstream from Vernalis.
- Assumes constant monthly load of salt downstream of Vernalis, so that the EC increases would be inversely related to the Vernalis flow.

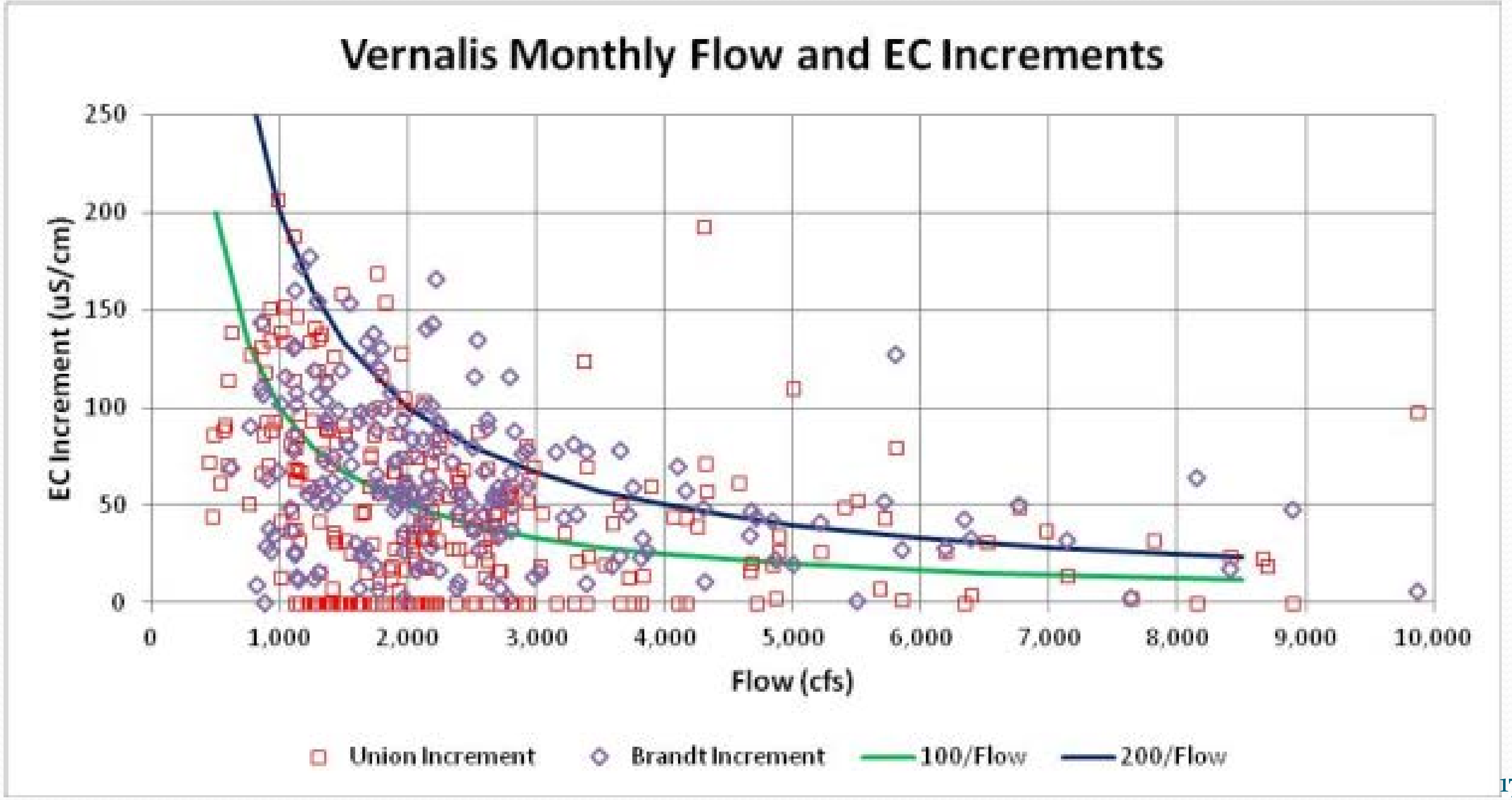
Calculation for Salinity Increment at Tracy Blvd. Bridge

EC increase from Vernalis to Tracy Blvd. bridge (µS/cm) = 300,000/SJR flow at Vernalis (cfs)

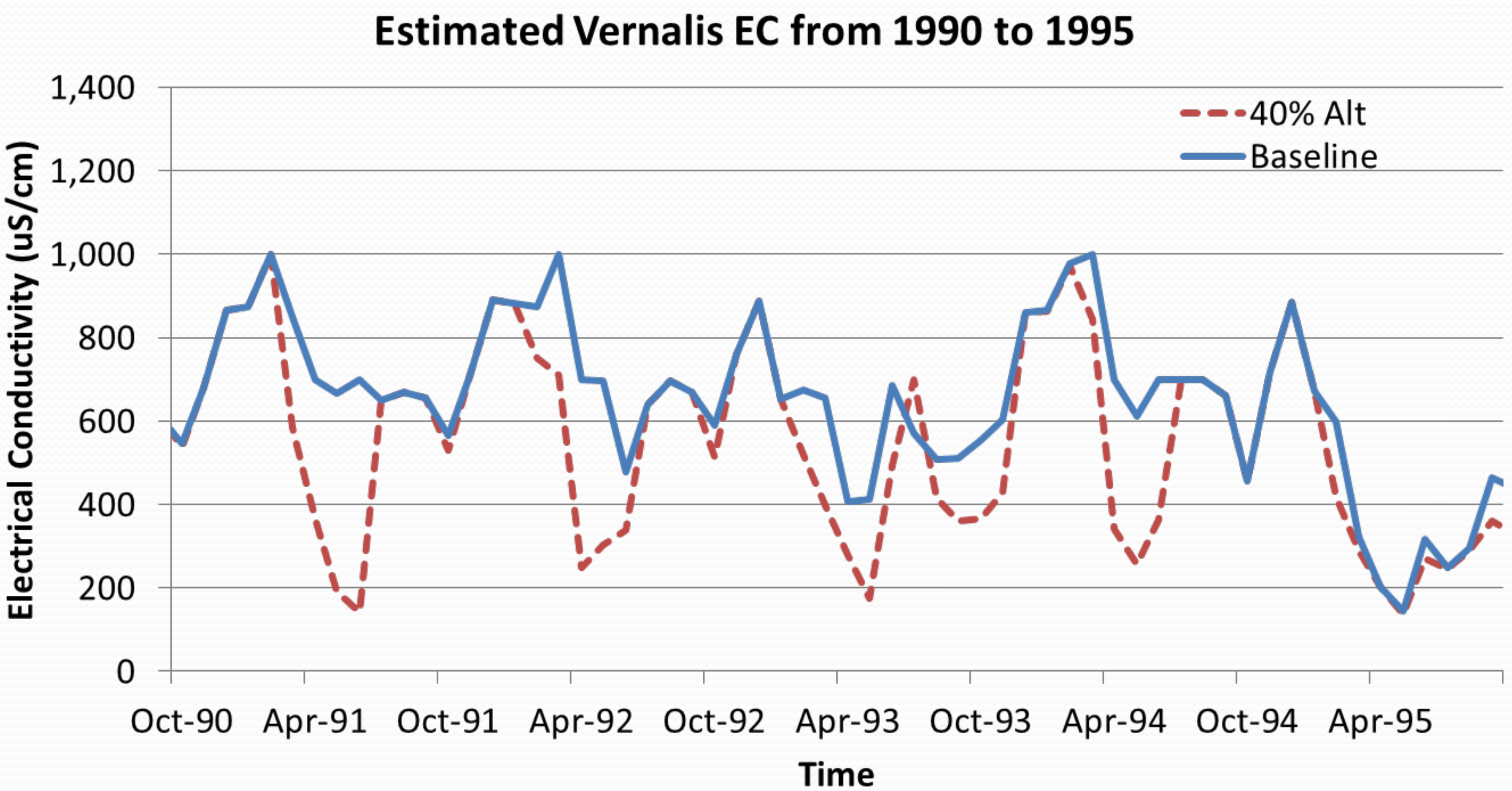


Calculation for Salinity Increment at Brandt Bridge and Union Island

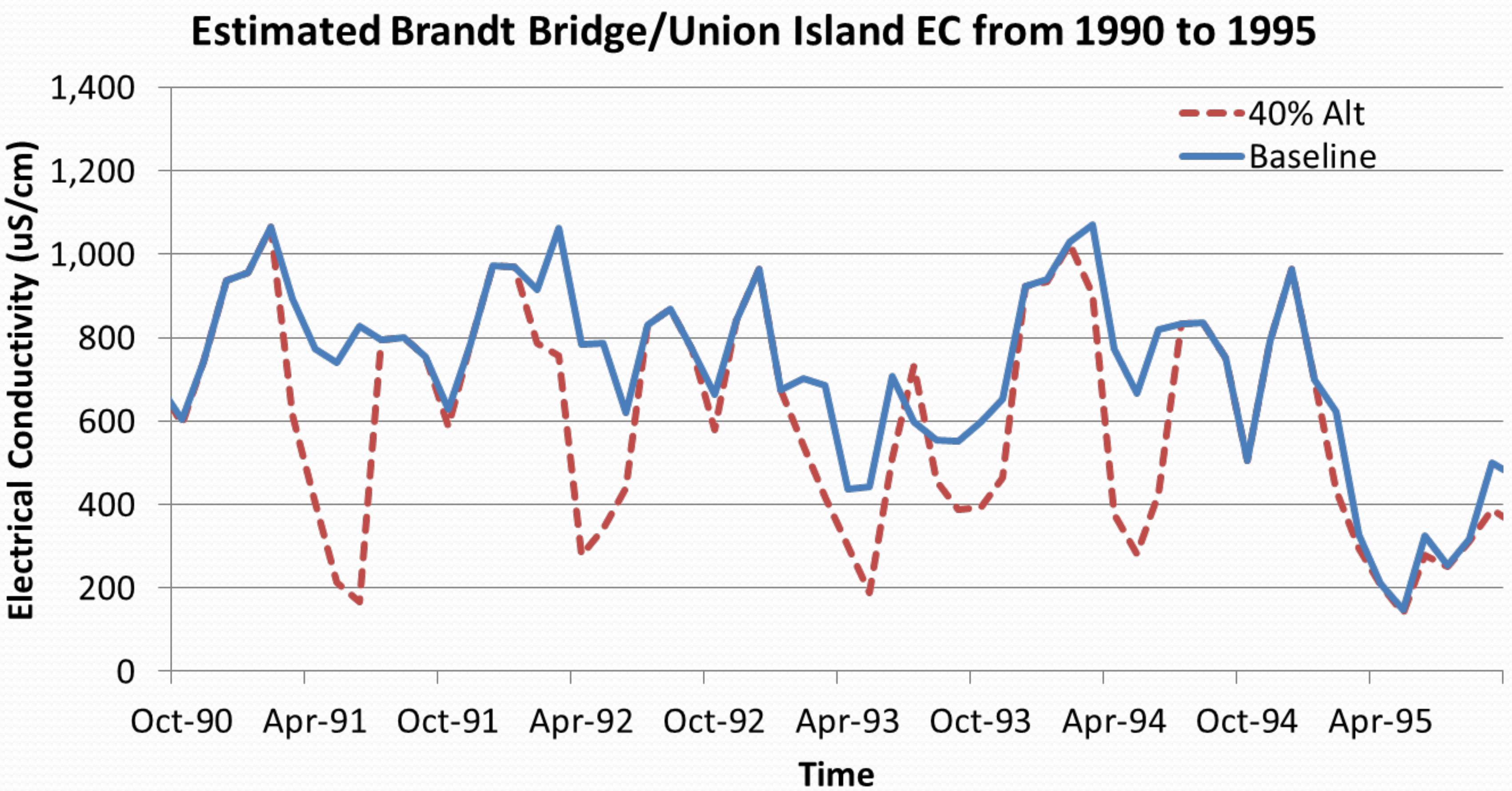
EC increase from Vernalis to Brandt Bridge or Union Island (µS/cm) = 100,000/SJR flow at Vernalis (cfs)



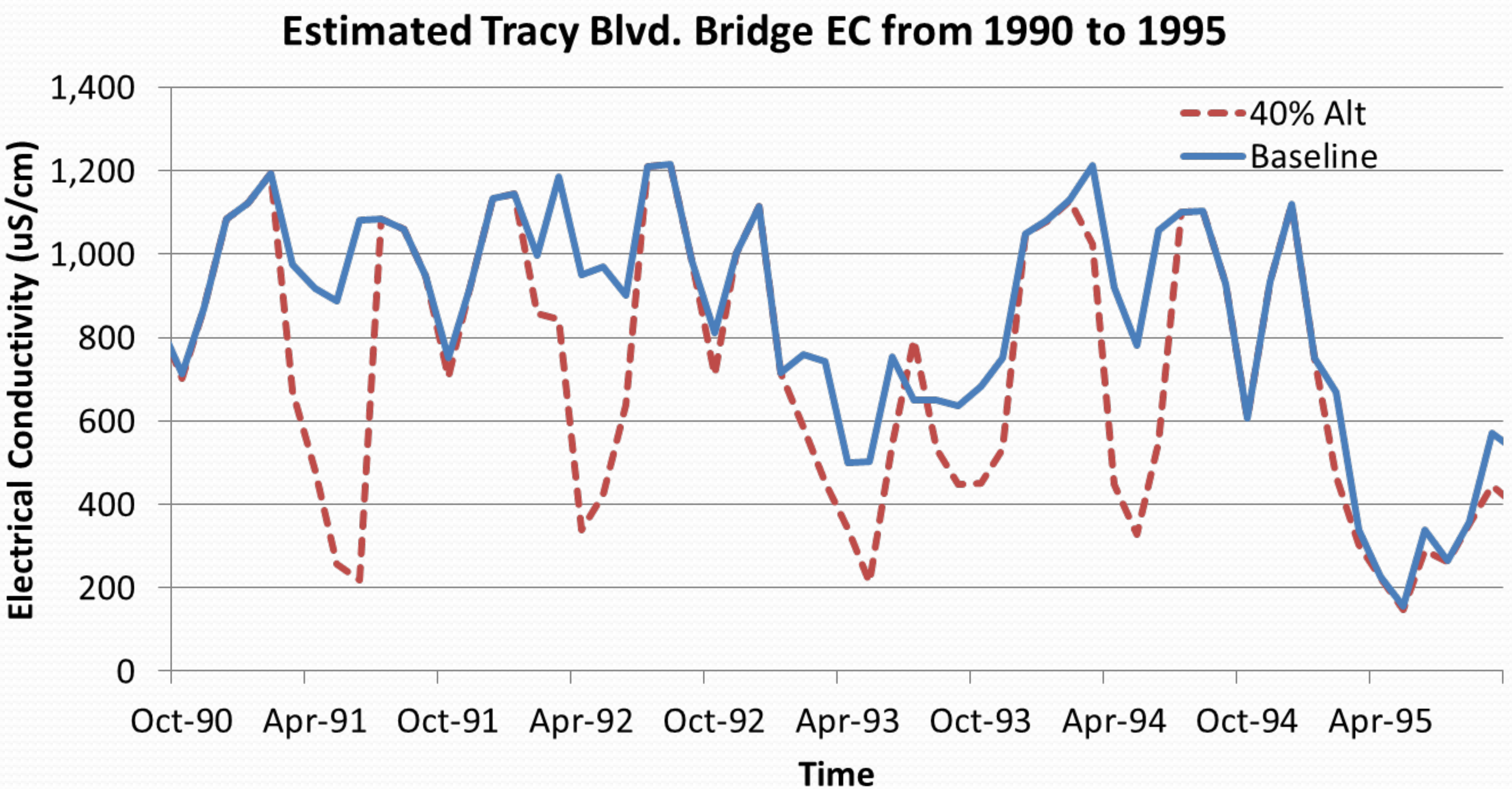
Estimated Change in Vernalis Salinity



Estimated Change in Salinity at Brandt Bridge and Union Island



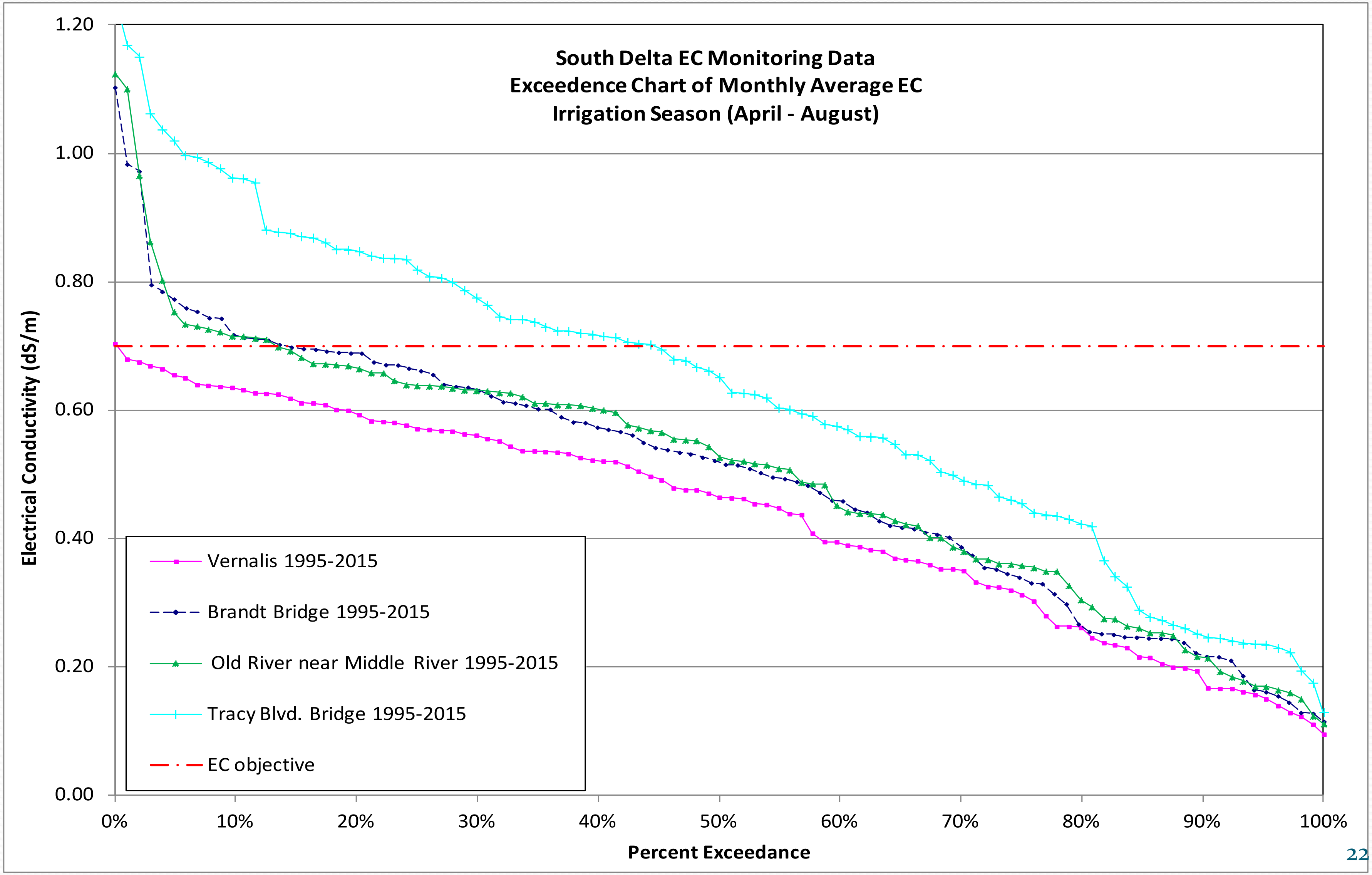
Estimated Change in Salinity at Tracy Blvd. Bridge



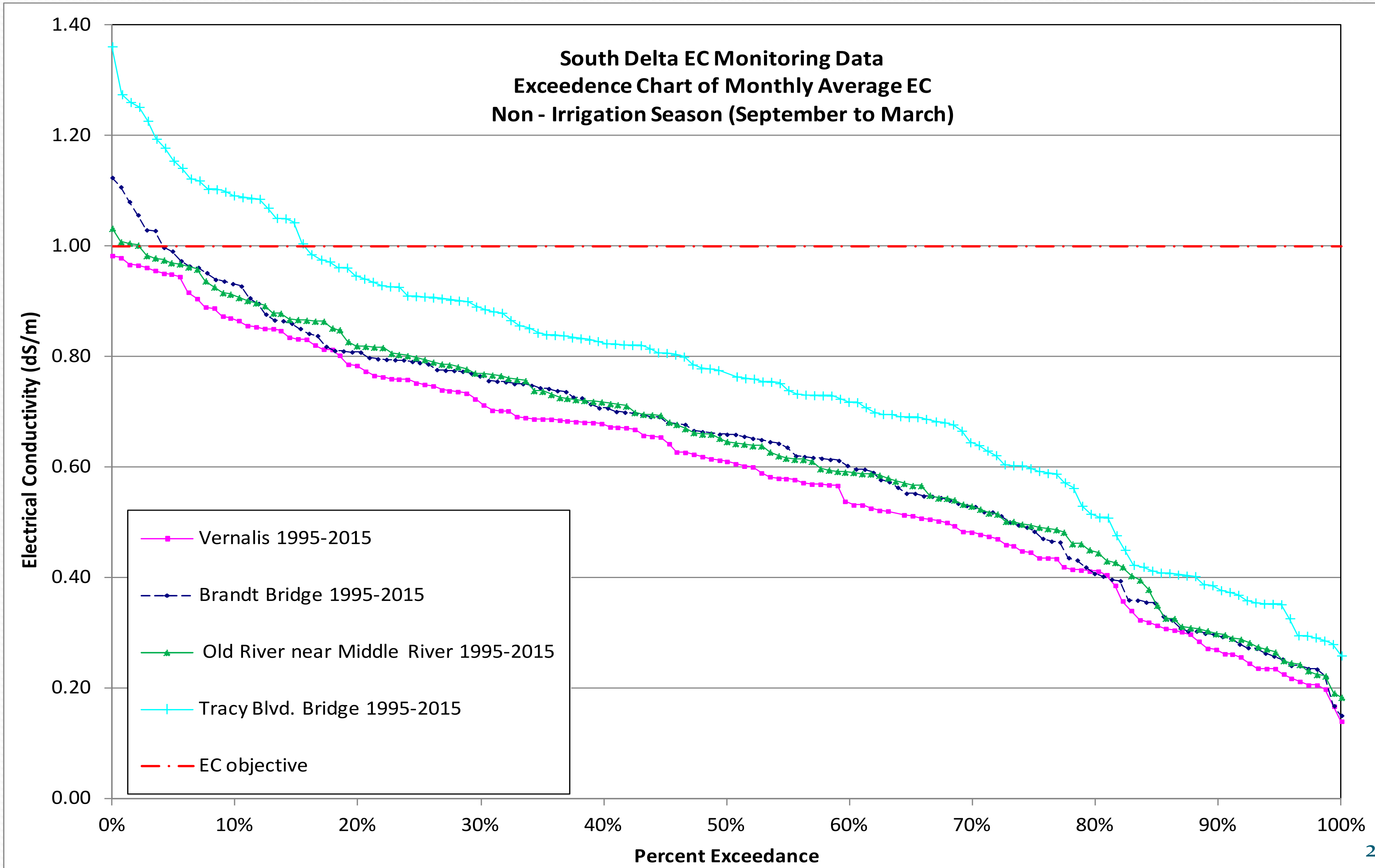
Antidegradation Summary

- Proposed change to LSJR flow objectives and southern Delta salinity objectives would not result in reduced water quality
- Antidegradation analysis done because raising salinity objectives may appear to allow water quality degradation
- Principal change that could affect water quality is LSJR flows
  - Increased February through June flows
  - No change, or slight decreases, in July through January flows
- Results:
  - No change in water quality stemming from new salinity objectives (maintains current condition)
  - Improved mean annual salinity stemming from higher LSJR flows

Exceedance Chart of Monthly Average EC Values at South Delta Monitoring Locations for Irrigation Months from 1995–2015 (Figure 23-1)



Exceedance Chart of Monthly Average EC Values at South Delta Monitoring Locations for Non-Irrigation Months from 1995–2015 (Figure 23-2)



Annual Average Change in Salinity

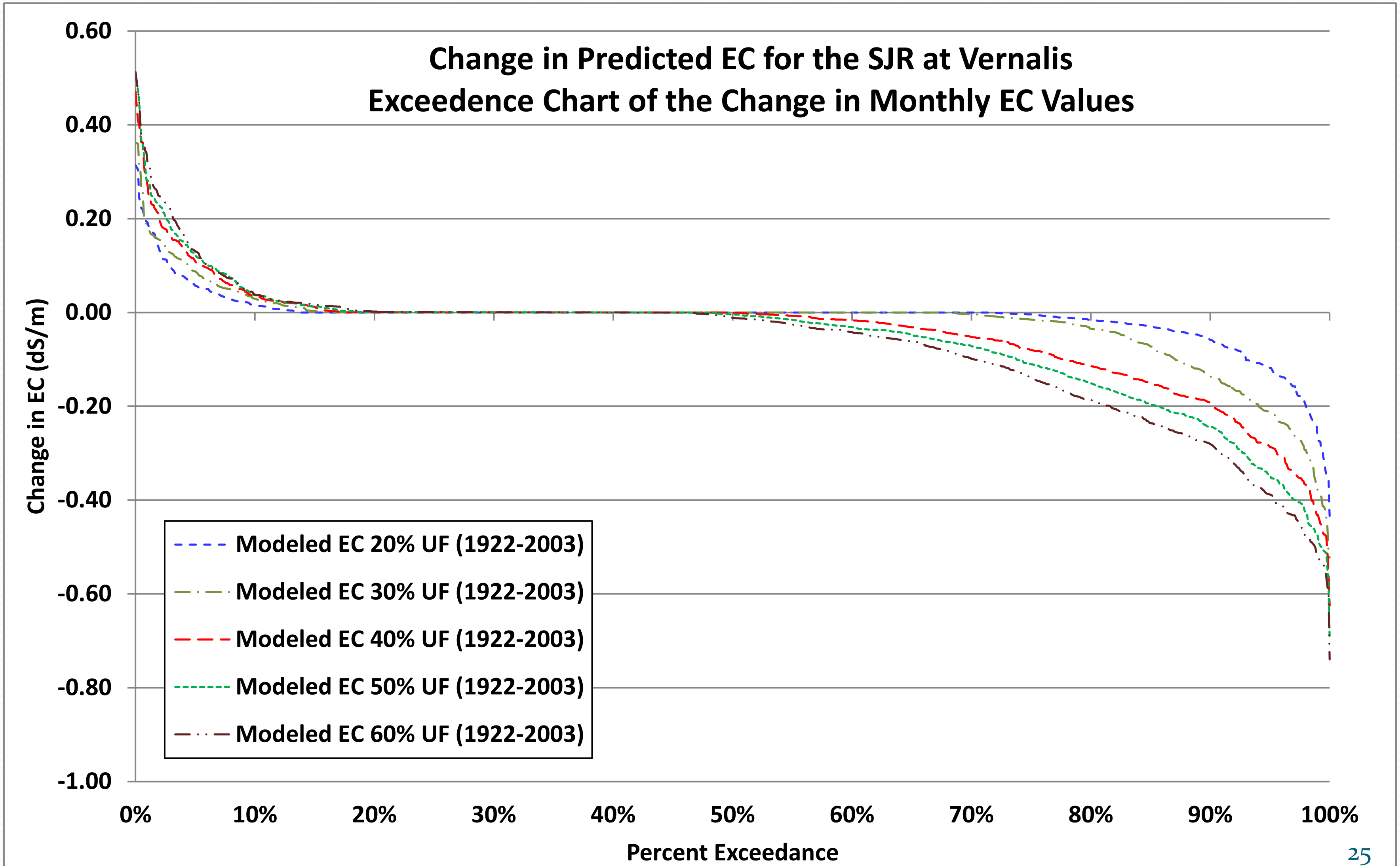
Table 23-2. Annual Average EC at Southern Delta Compliance Locations under Modeled Baseline Conditions and the Change in Value based on Percent of Unimpaired Flow

	Annual Average EC (dS/m)					
		Change from Baseline EC				
	Baseline	20% UF	30% UF	40% UF	50% UF	60% UF
SJR at Vernalis	0.57	-0.01	-0.02	-0.04	-0.06	-0.07
SJR at Brandt Bridge	0.61	-0.01	-0.02	-0.05	-0.06	-0.08
Old River near Middle River	0.61	-0.01	-0.02	-0.05	-0.06	-0.08
Old River at Tracy Boulevard Bridge	0.70	-0.01	-0.03	-0.06	-0.07	-0.09

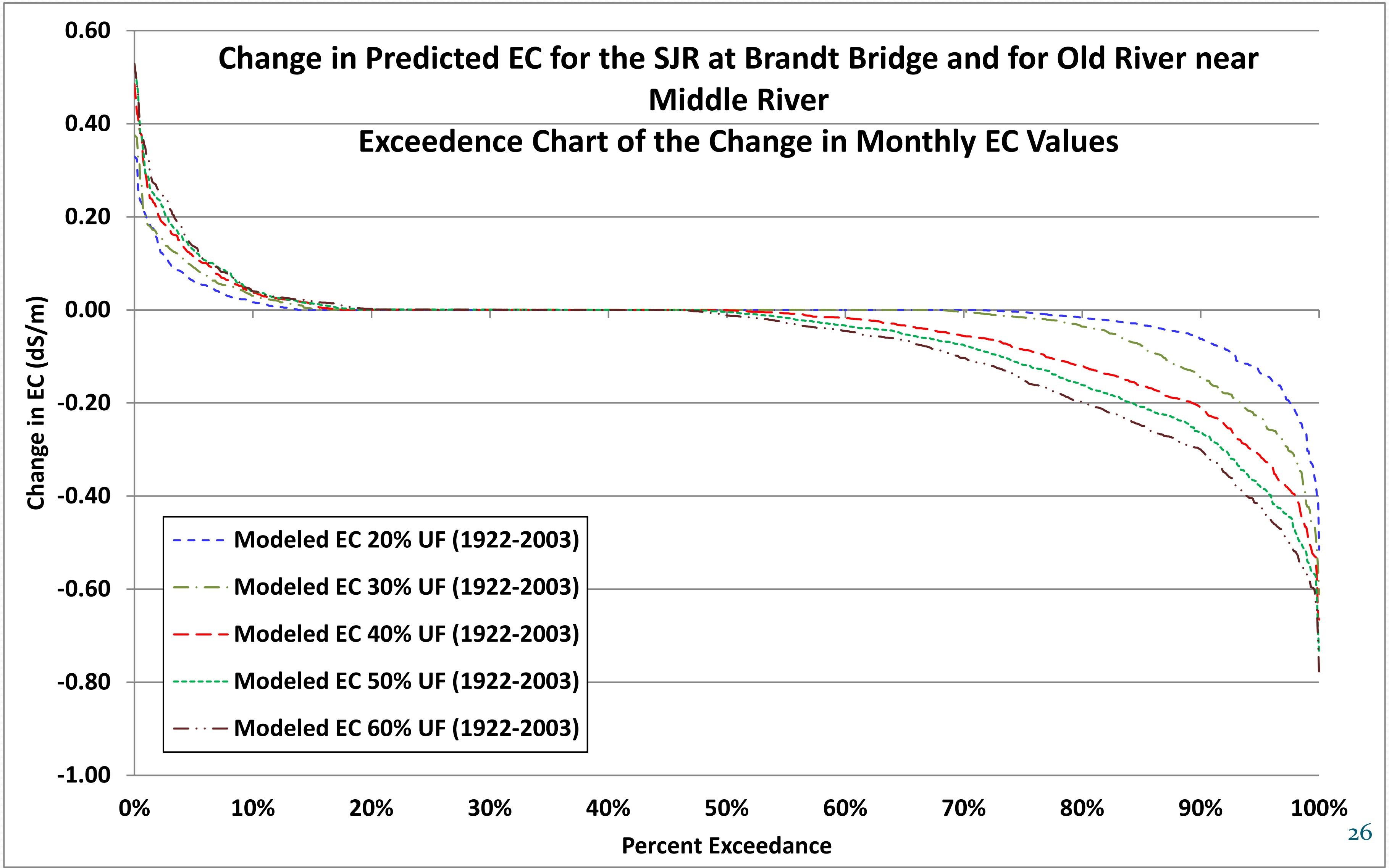
EC (dS/m) = electrical conductivity (salinity) as measured in deciSiemens per meter

UF = unimpaired flow

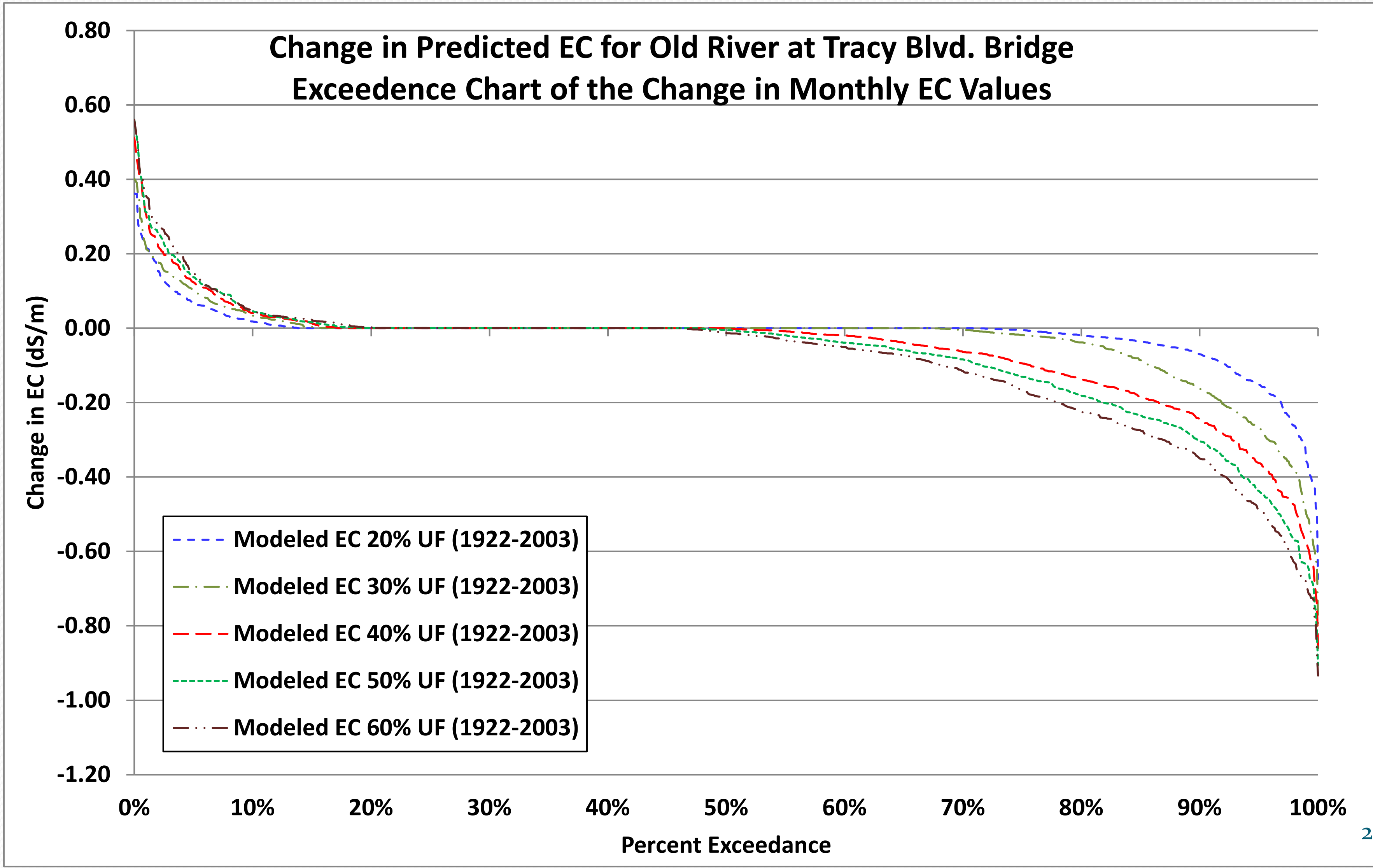
Exceedance Chart of the Change in Monthly EC Values for the SJR at Vernalis Based on Percent of Unimpaired Flow, Relative to Modeled Baseline (Figure 23-5)



Exceedance Chart of the Change in Monthly EC Values, for the SJR at Brandt Bridge and for Old River near Middle River Based on Percent of Unimpaired Flow, Relative to Modeled Baseline (Figure 23-6)



Exceedance Chart of the Change in Monthly EC Values for Old River at Tracy Boulevard Bridge Based on Percent of Unimpaired Flow, Relative to Modeled Baseline (Figure 23-7)



Conclusions

- Proposed salinity objectives and program of implementation would not result in changed salinity conditions in the southern Delta
- Proposed flow objectives would generally improve salinity conditions in the southern Delta
- Salinity in southern Delta surface waters appears suitable for all agricultural crops

Further Information

- More information on these topics can be found in the following chapters and appendices of the SED:
  - Chapter 5, *Surface Hydrology and Water Quality*
  - Chapter 23, *Antidegradation Analysis*
  - Appendix F.1, *Hydrologic and Water Quality Modeling*
  - Appendix F.2, *Evaluation of Historical Flow and Salinity Measurements of the Lower San Joaquin River and Southern Delta*
  - Appendix E, *Salt Tolerance of Crops in the Southern Sacramento-San Joaquin Delta*
- These chapters, as well as the Water Supply Effects Model, can be found at:

http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/2016_sed/index.shtml.