RECLAMATION

Managing Water in the West

Southern Delta Water Quality

Salinity Workshop

January 16, 2007

U.S. Department of the Interior
Bureau of Reclamation

Presentation Overview

- CALSIM II Water Quality Module
- Seasonality of Vernalis Objectives
- Basin Hydrology & Drought Risk Assessment
- Salinity Relationship between Vernalis and South Delta stations
- Scoping Considerations

Past CALSIM II Approach to Estimate San Joaquin River Water Quality

- Original Kratzer equation (Pre-CALSIM II)
  - Estimating monthly average EC at Maze Road bridge
    - Relate EC with total flow at Maze
    - Exponential EC-flow relationship
  - Regression last calibrated in 1990
- Previous CALSIM II approach
  - Maze EC
    - Explicit EC for Westside returns
    - Modified Kratzer eq. for relating EC with remaining flow at Maze
  - Vernalis EC estimated by salt balance
    - Estimated Maze EC
    - Explicit EC for inflows between Maze and Vernalis

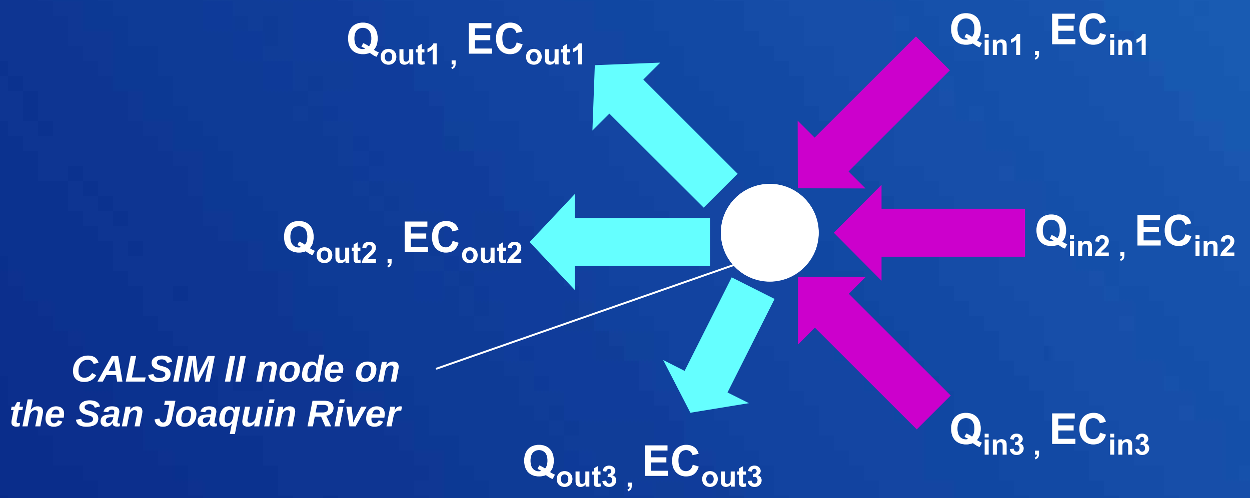
RECLAMATION

New Water Quality Module

- Future and application oriented approach
- Primary Objectives
  - Improve the accuracy of Maze EC estimates
  - Increase the flexibility of water quality simulation
  - Increase the model consistency and integration
- Secondary Objectives [technical specifications]
  - Modular approach
  - Model compatibility with DSM2-SJR
  - Consistent protocol for data communication

RECLAMATION

Mass Balance in Flow and Salt



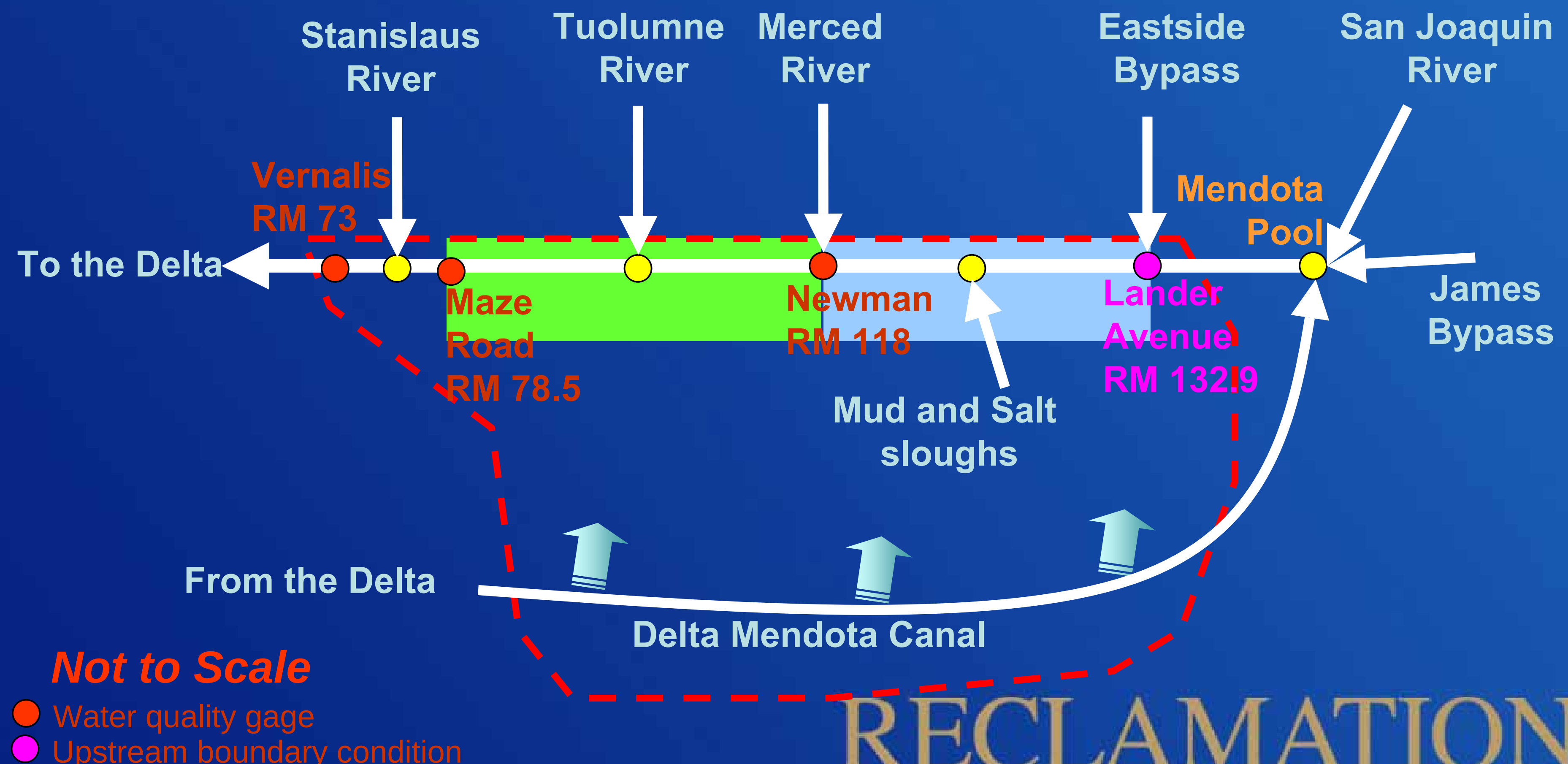
Flow Balance: $\Sigma\, Q_{in} = \Sigma\, Q_{out}$

Salt Balance: $EC_{out} = \Sigma\, (EC_{in} * Q_{in}) / \Sigma\, Q_{out}$

Performed on a monthly basis

Scope of Water Quality Module

Most Recent gage records at Newman and Maze



RECLAMATION

Two-stage Disaggregation

CALSIM II Flows into SJR → **Flow Disaggregation** → **Salt Disaggregation**

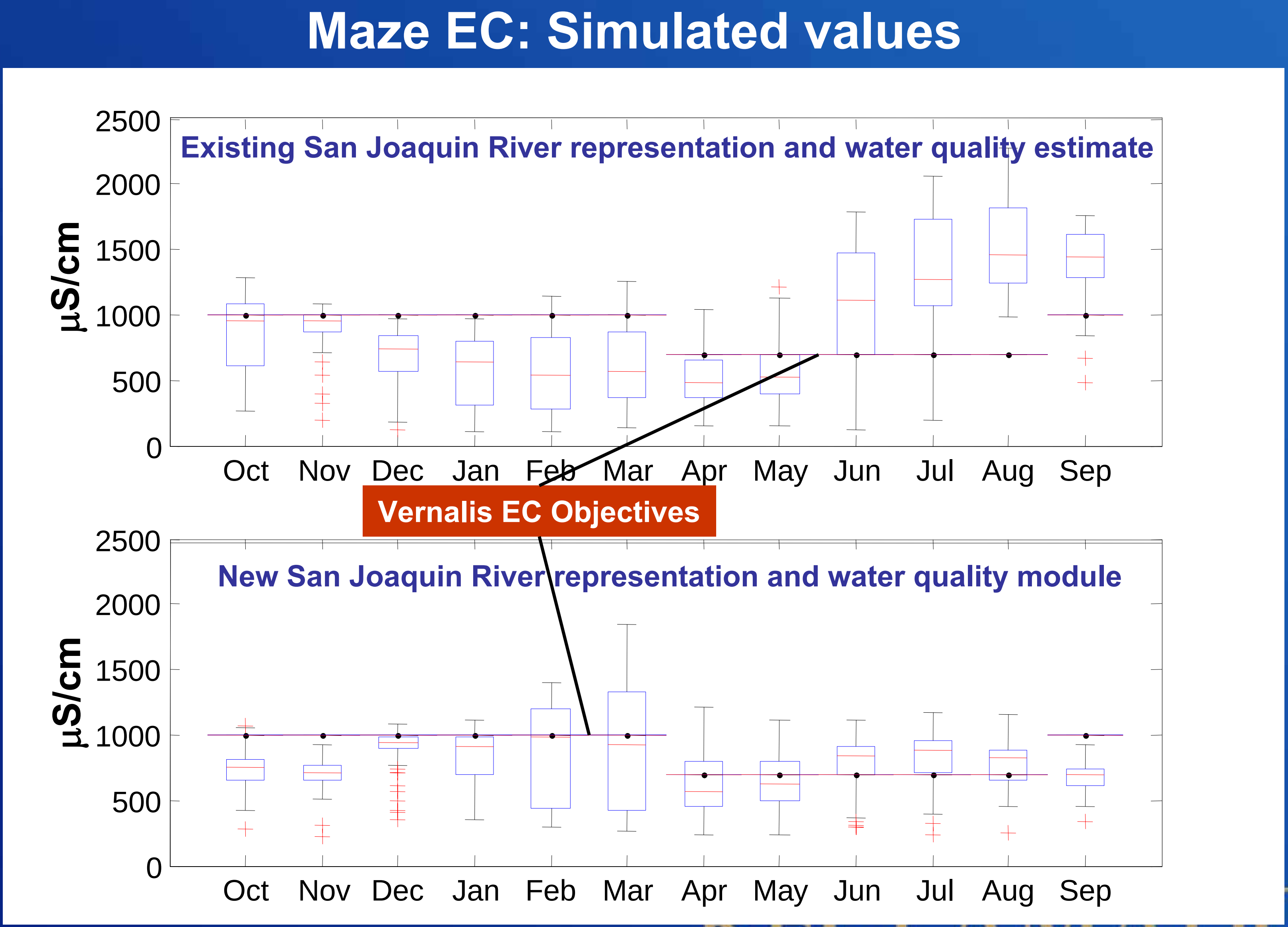
Grouped by
- Geographic region
- Contract type
- Others

Deliveries
- Source
- Location
- Quantity

Returns
- Source
- Location
- Quantity

Quality per
- Source
- Location

Simulated Operations



Water Management Seasonality for objectives at Vernalis

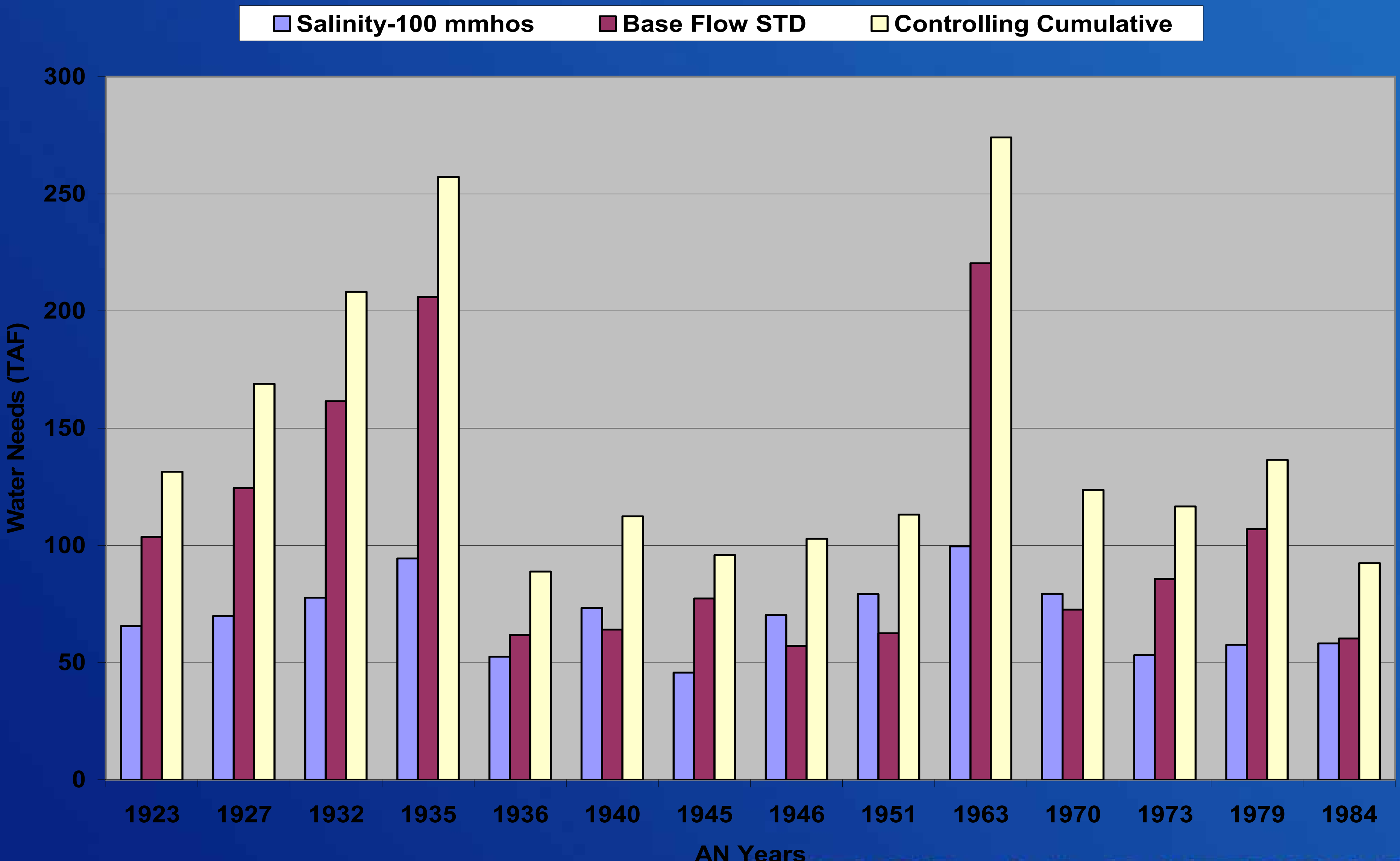
Table 1 Seasonality of Flow Management

Likely Moderate Heavy

Yeartype	Basin Objective	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	Vernalis Salinity	1	0	2	0	1	0	0	1	4	9	0	0
W	Vernalis Base Flow					5	2	1	1	7			
AN	Vernalis Salinity	0	0	1	0	2	4	0	0				0
AN	Vernalis Base Flow					8		1	0				
BN	Vernalis Salinity	0	0	4	4			5	7				0
BN	Vernalis Base Flow					9		1	1				
D	Vernalis Salinity	0	0	1	2								0
D	Vernalis Base Flow					12		2	0				
C	Vernalis Salinity	1	0	8	10								0
C	Vernalis Base Flow					0	1	2	1	4			

RECLAMATION

Variability of flow-based standards



RECLAMATION

General Conclusions from Seasonality Analysis

- Vernalis salinity management is likely from mid winter to peak irrigation months in Dry and Critical conditions.
- Vernalis salinity management diminishes as conditions progress toward wetter conditions.
- Fishery base flow management is likely in individual non-rainy Feb, Mar, and June of AN,BN, and D conditions.
- Fishery base flow management diminishes as conditions trend to a critical year.
- Interaction of the two objectives is influenced by SJ basin reservoir management and can compete for limited resources.

RECLAMATION

Vernalis Salinity Data Assessment – Long-term Dilution Needs

Vernalis Dilution Needs (TAF)

Source WQ	Longterm Avg.	Yeartype				
		W	AN	BN	D	C
100	111	12	70	128	156	225
300	165	18	108	190	233	331
cost ratio	1.5	1.5	1.6	1.5	1.5	1.5
500	344	38	246	396	487	675
cost ratio	3.1	3.2	3.5	3.1	3.1	3.0

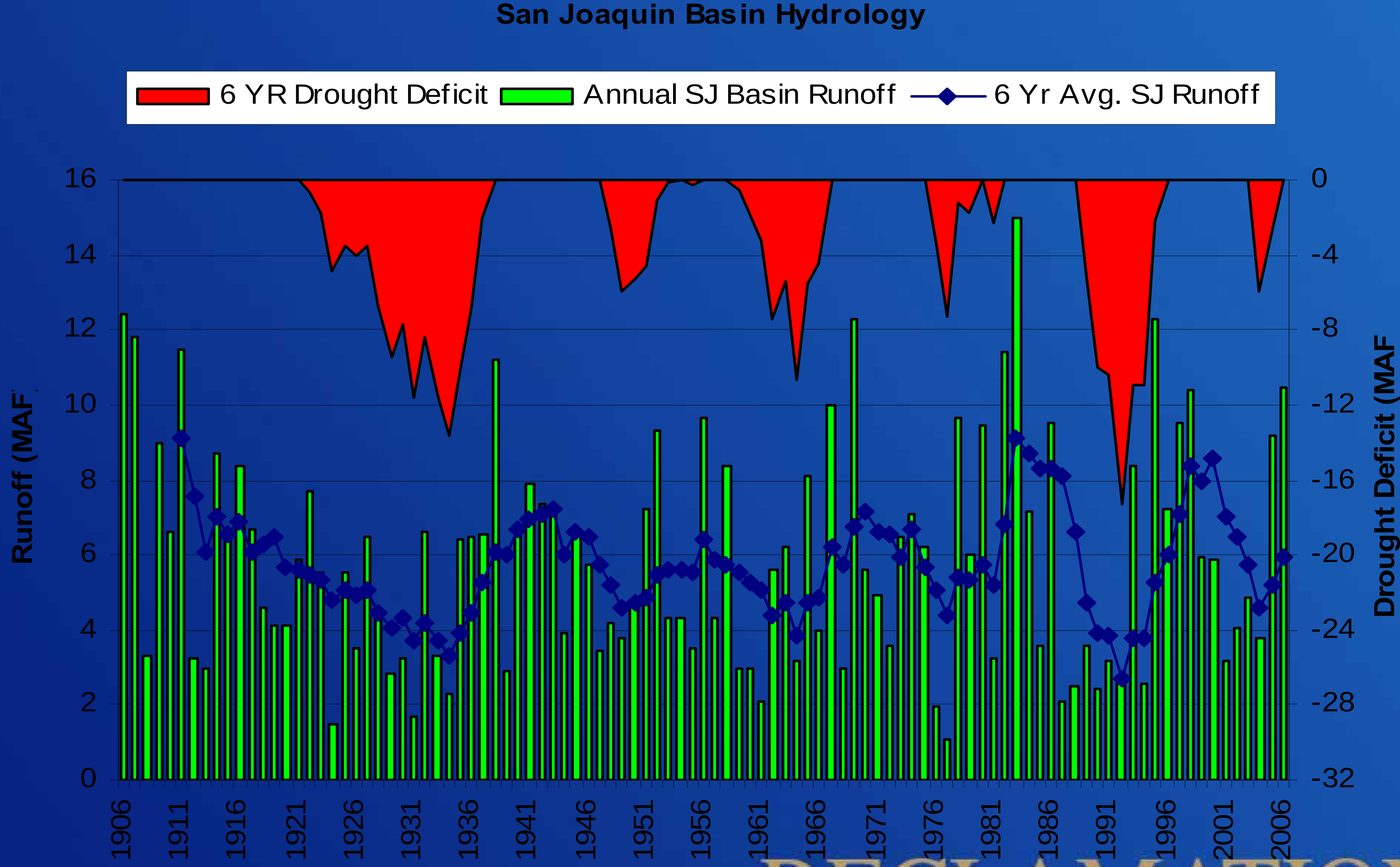
Values based on CALSIM Maze. Rd. Information
and a monthly target of 0.65 EC at Vernalis

RECLAMATION

Dilution Source - Key Points

- 100 mmhos source quality is representative of east-side water sources
- 300 to 500 mmhos source quality is representative of west-side water sources
- The dilution effectiveness and subsequent volumes necessary to perform dilution are highly sensitive to initial quality.

San Joaquin Basin Hydrology

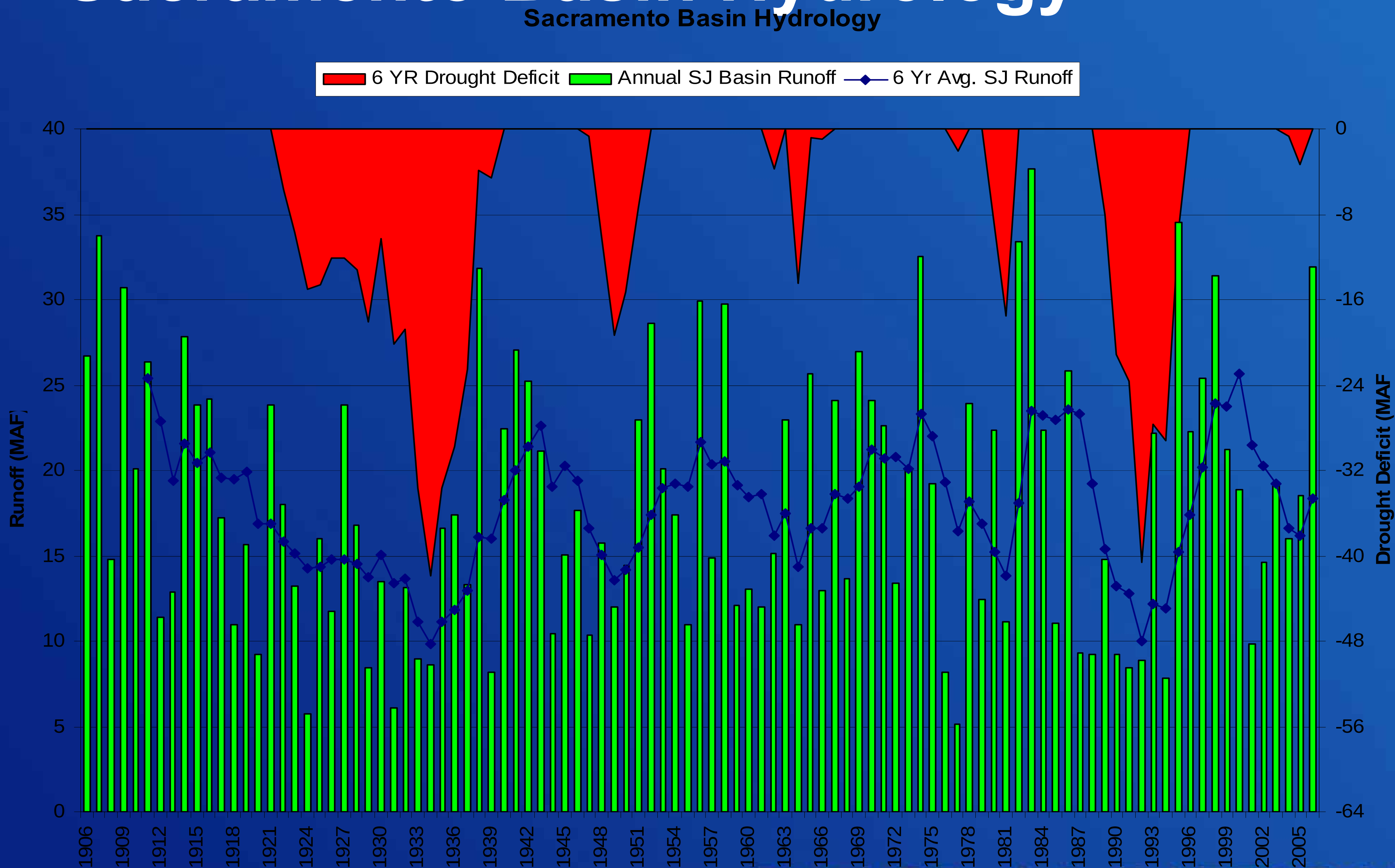


RECLAMATION

San Joaquin Hydrology

- Cyclic nature of dry periods is apparent and occurs roughly every 10 to 15 years.
- Severity of early 1990's drought is the greatest experienced and significantly more severe than 1930's drought.
- Several droughts reach deficit of 6 MAF and then subside, usually due to a single very large annual runoff.

Sacramento Basin Hydrology



RECLAMATION

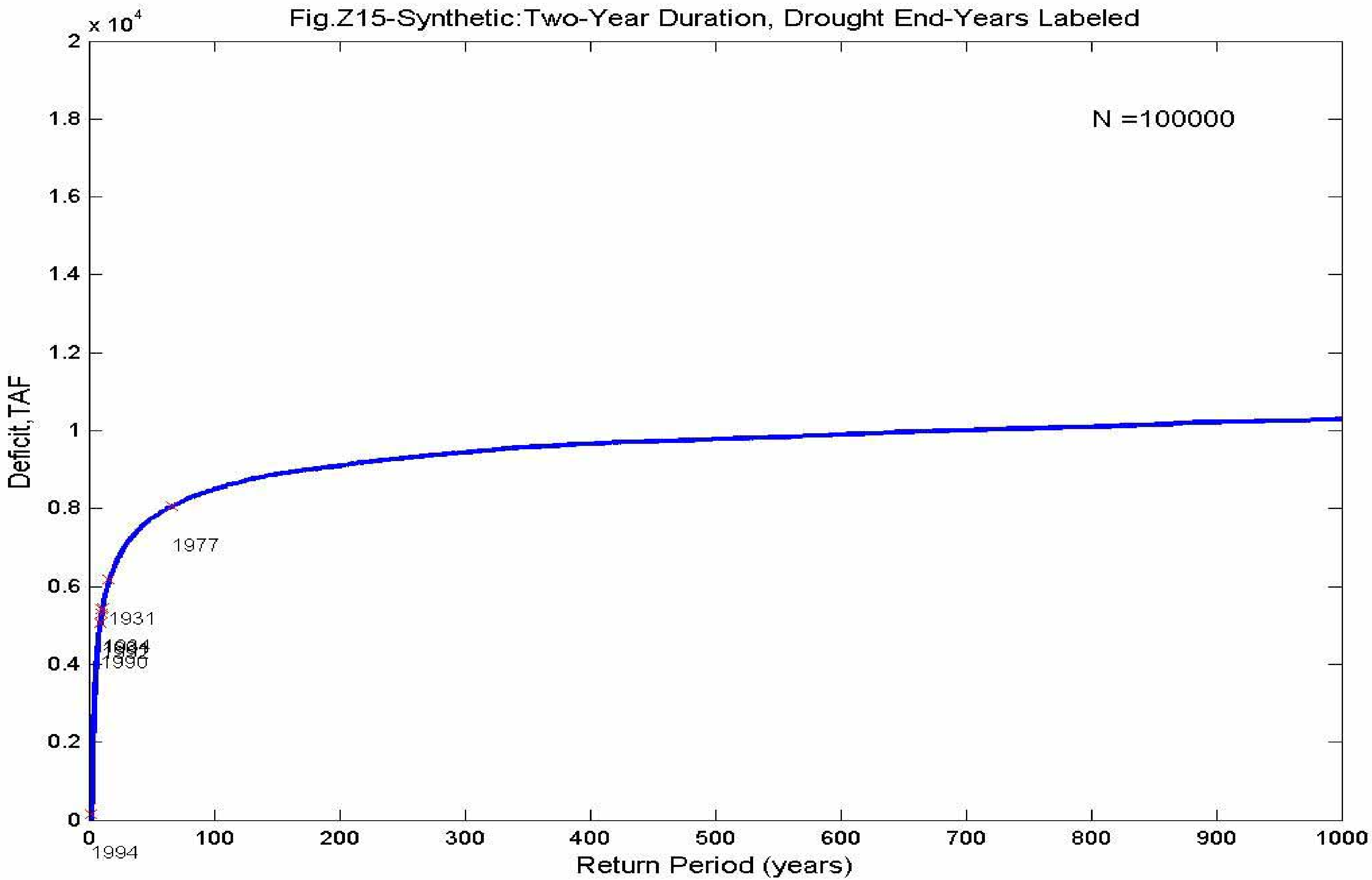
Comparison of Sac and SJ Hydrology

- **Cyclic nature of water deficient periods is apparent and occurs roughly every 10 to 15 years.**

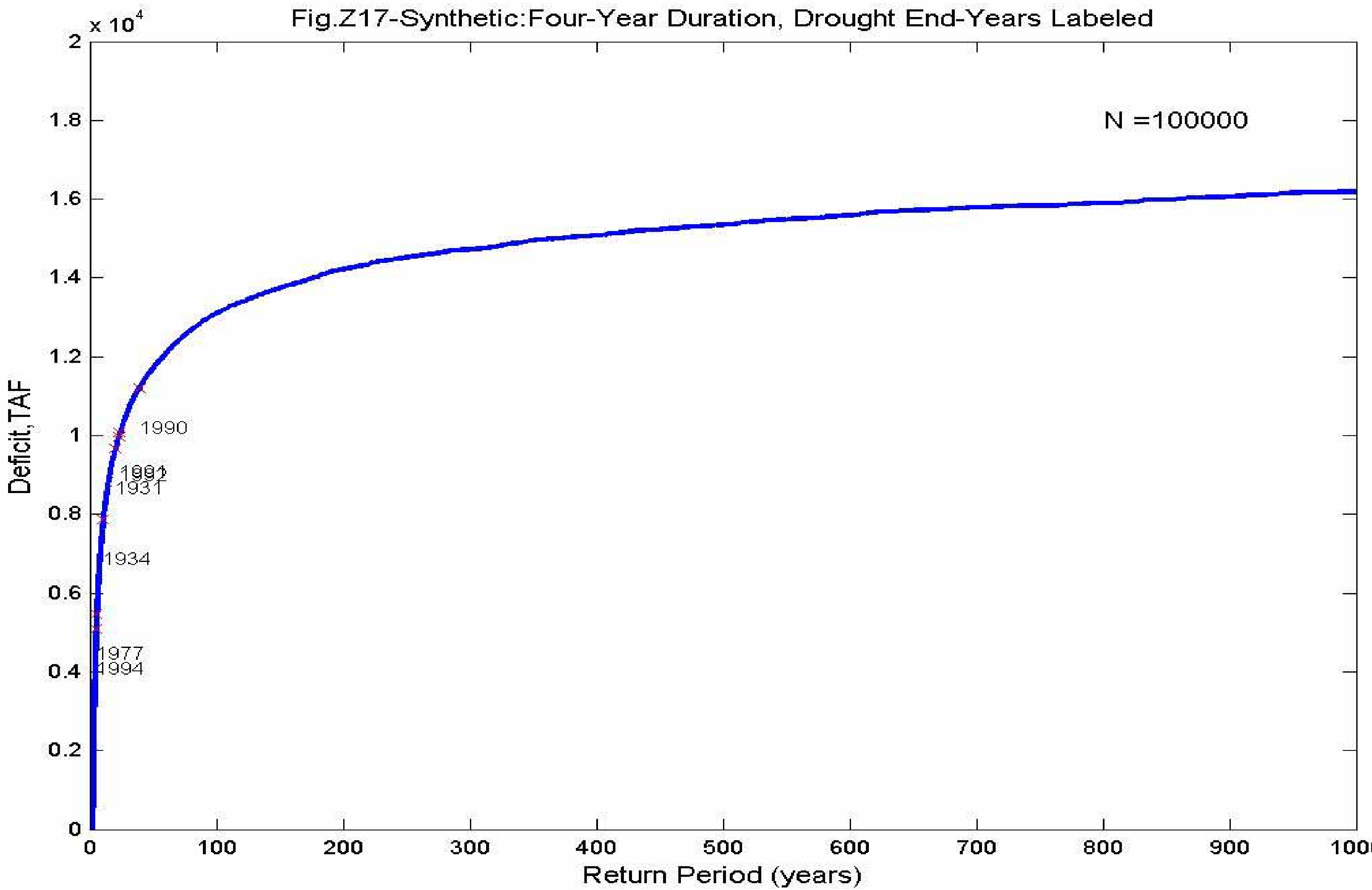
- **Severity of early 1990’s drought roughly the same as the 1930’s drought.**

- **Other droughts do not approach similar levels of severity.**

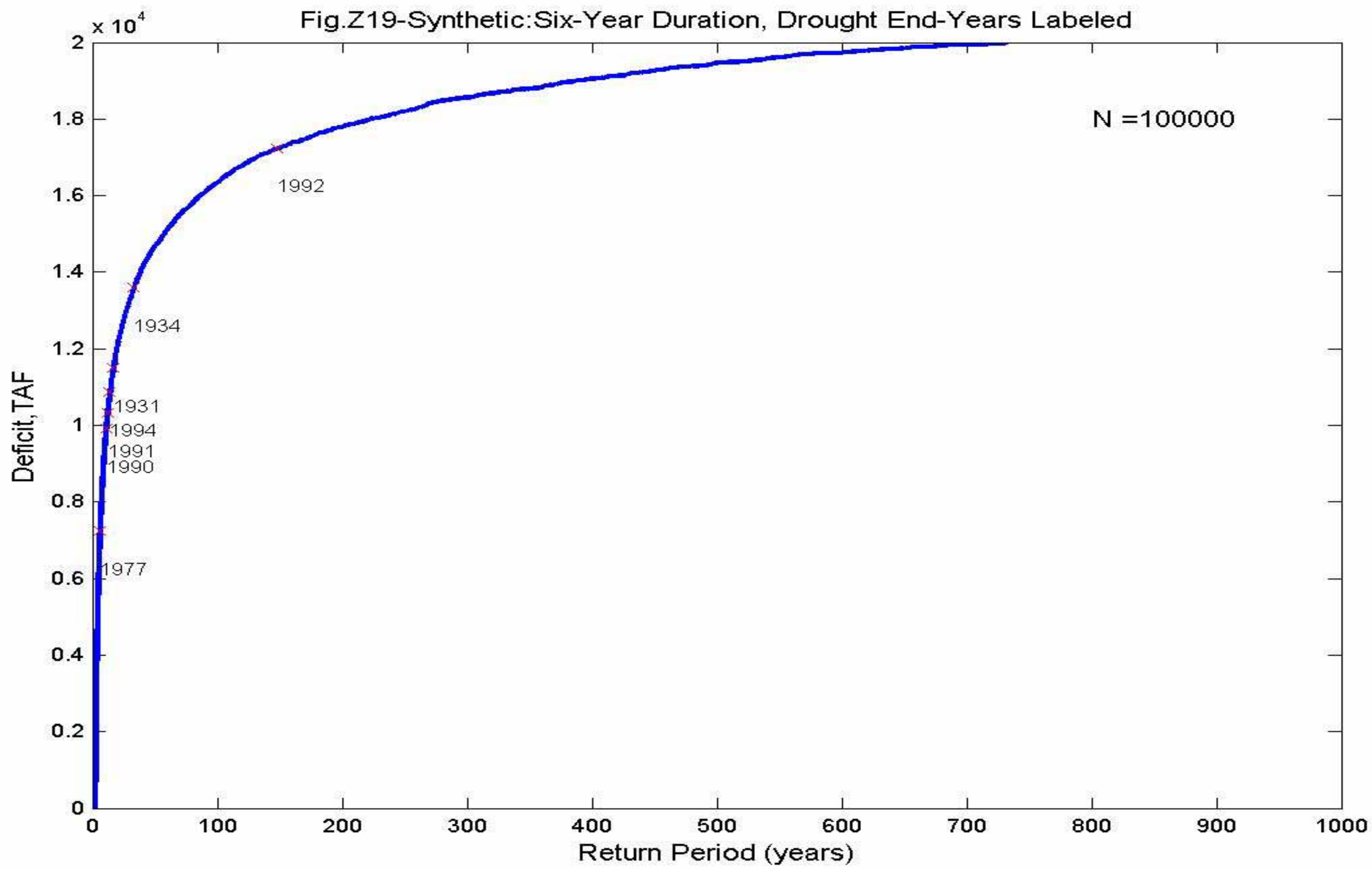
Preliminary San Joaquin Basin Drought Return Period Estimates



Preliminary San Joaquin Basin Drought Return Period Estimates



Preliminary San Joaquin Basin Drought Return Period Estimates



Key Points - Preliminary San Joaquin Basin Drought Analysis

- The 1990’s drought is statistically very different from 1930’s drought and is about three times less likely to occur.

- To manage all San Joaquin basin objectives against such a severe re-occurrence, would result in an extremely restrictive approach to other beneficial uses in the basin.

- An overall management approach may need to include a “priority strategy” as drought deficit accumulates in order to best manage for the complexity of beneficial uses in the basin.

RECLAMATION

General Salinity Relationship between Vernalis and Brandt Bridge

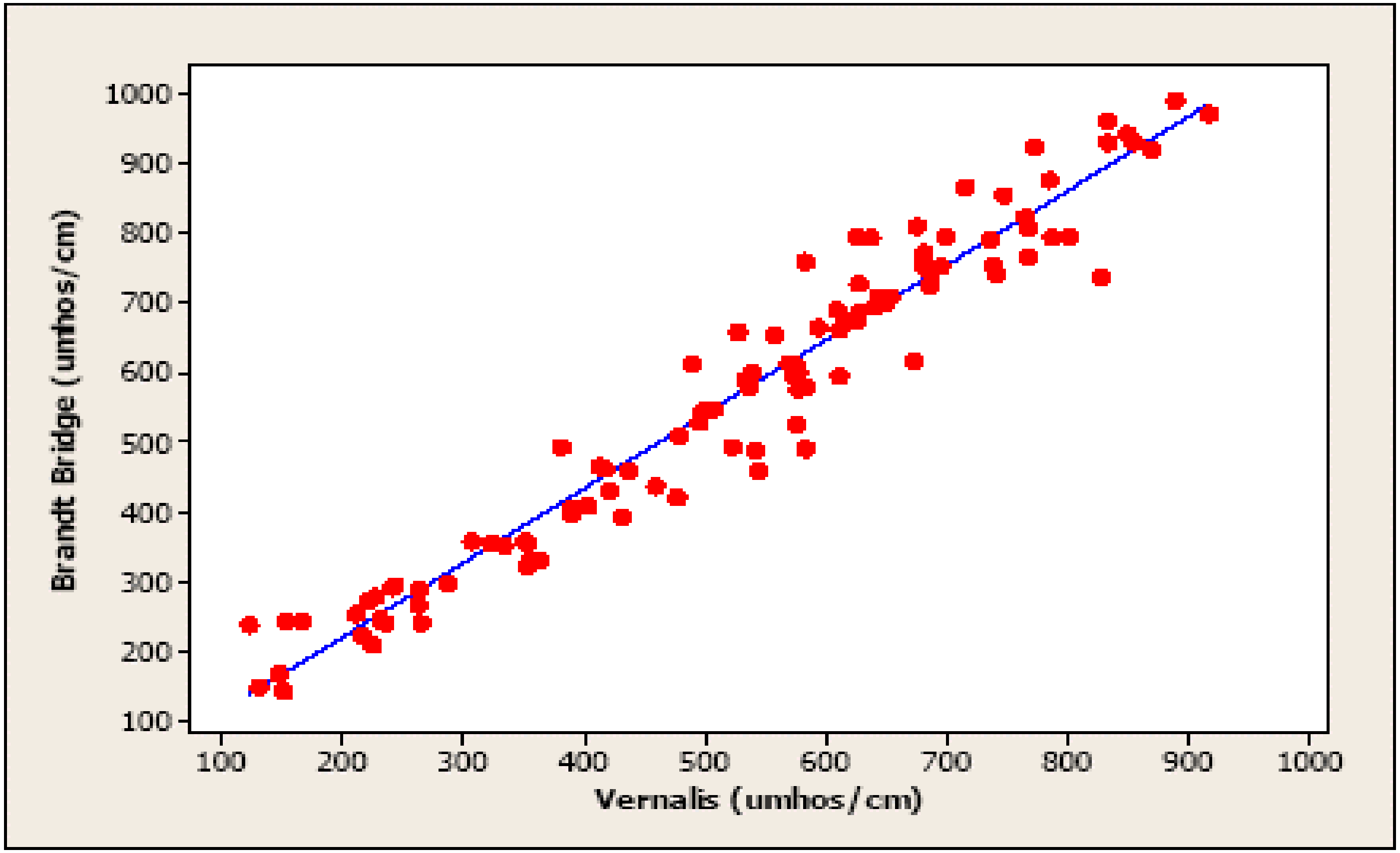


Figure 8: Monthly EC at Brandt Bridge vs. Vernalis

Confidence Buffer Relationship from Vernalis to Brandt Bridge

- 0.15 EC buffer at Vernalis provides 95% confidence at Brandt Bridge

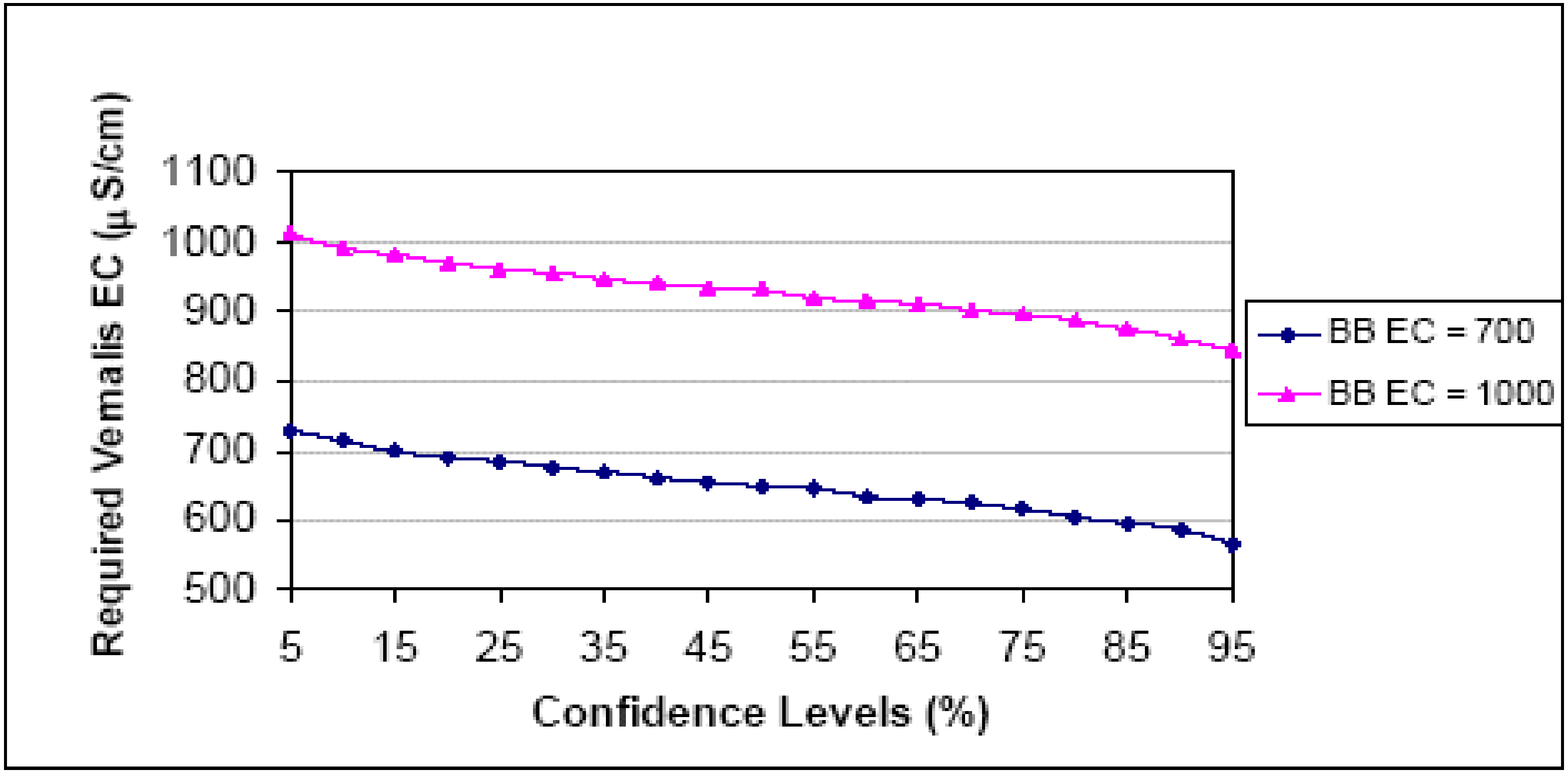


Figure 9: Required Vernalis EC to Ensure Target Brandt Bridge EC at Different Confidences Levels

Seasonality of San Joaquin Basin Objectives

Table 2

Seasonality of Flow Management

Likely Moderate Heavy

Yeartype	Basin Objective	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	Vernalis Salinity	1	0	2	0	1	0	0	1	4	9	0	0
W	Vernalis Base Flow					5	2	1	1	7			
W	Brandt B. Salinity	2	1	7	2	2	0	2	3	9		5	0
AN	Vernalis Salinity	0	0	1	0	2	4	0	0				0
AN	Vernalis Base Flow					8		1	0				
AN	Brandt B. Salinity	1	0	9	6	4	10	4	5				0
BN	Vernalis Salinity	0	0	4	4			5	7				0
BN	Vernalis Base Flow					9		1	1				
BN	Brandt B. Salinity	1	0		13								0
D	Vernalis Salinity	0	0	1	2								0
D	Vernalis Base Flow					12		2	0				
D	Brandt B. Salinity	0	0	14	13								0
C	Vernalis Salinity	1	0	8	10								0
C	Vernalis Base Flow					0	1	2	1	4			
C	Brandt B. Salinity	4	1										1

Salinity Data Assessment – Long-term Dilution Needs

Vernalis vs. Brandt Bridge Dilution Needs (TAF)

Dilution Target	Longterm Avg.	Yeartype				
		W	AN	BN	D	C
Vernalis	111	12	70	128	156	225
BB	226	53	177	277	336	376
ratio cost	2.0	4.4	2.5	2.2	2.1	1.7

Values based on CALSIM Maze. Rd. Information

100 mmhos dilution source water quality

RECLAMATION

Long-term Cumulative Water Needs Assessment

Cumulative Water Needs (TAF)

Water Target	Longterm Avg.	Yeartype				
		W	AN	BN	D	C
Vernalis Salinity	111	12	70	128	156	225
Vernalis Salinity + Base Flow	130	24	144	134	162	225
ratio cost	1.2	2.1	2.1	1.0	1.0	1.0
Brandt B. Salinity + Base Flow	236	59	213	277	337	376
ratio cost	2.1	5.0	3.1	2.2	2.2	1.7

Values based on CALSIM Maze. Rd. Information
100 mmhos dilution source water quality

RECLAMATION

Seasonality of San Joaquin Basin Objectives

- By treating Brandt Bridge salinity as a flow-based objective, the potential need for flow management response increases substantially.
- The flow-management response would occur earlier and last longer into the year and be of a larger magnitude.
- The long-term effects of salinity management at Brandt Bridge on reservoir storages and water supply beneficial uses have never been analyzed.

SWRCB FEIR for Implementation 1995 Bay/Delta Plan

- Southern Delta Salinity Implementation Alternative Assumptions (Page IX-10)
  - Alt 1 – D-1485 in Delta, D-1422 at Vernalis and Temporary Barriers.
  - Alt 2 1995 Bay Delta Flow Objectives and Temporary Barriers.
  - Alt 3 1995 Bay Delta Flow Objectives and Permanent Barriers
    - Alt 2 and Alt 3 assume Bay Delta Flow Objectives are met at Vernalis.
    - FEIR analysis concluded exceedence of South Delta objectives is likely.

Summary

- We today have a clearer understanding of the dynamic nature of the San Joaquin Basin, and we have better tools to represent the many changes underway.
- Given the hydrology and highly allocated water resources of the basin, the implementation and management of actions have effects reaching over multiple years, beneficial uses, and other objectives.
- In order to fully understand these complex interactions, we should take advantage of the best available tools to help scope the issues and quickly move forward.

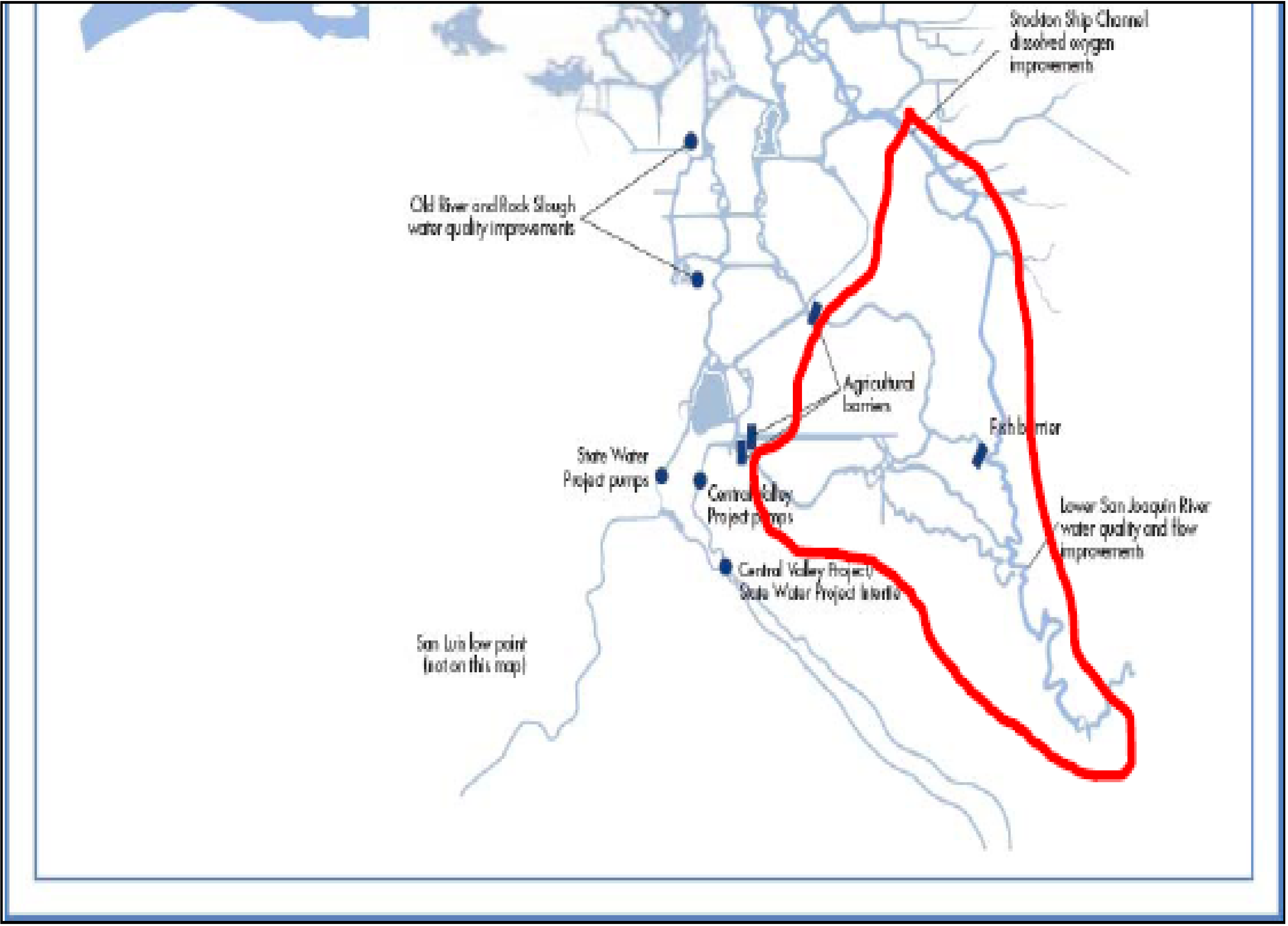


Figure 2. Zone of San Joaquin River Dominance Under Temporary Barriers

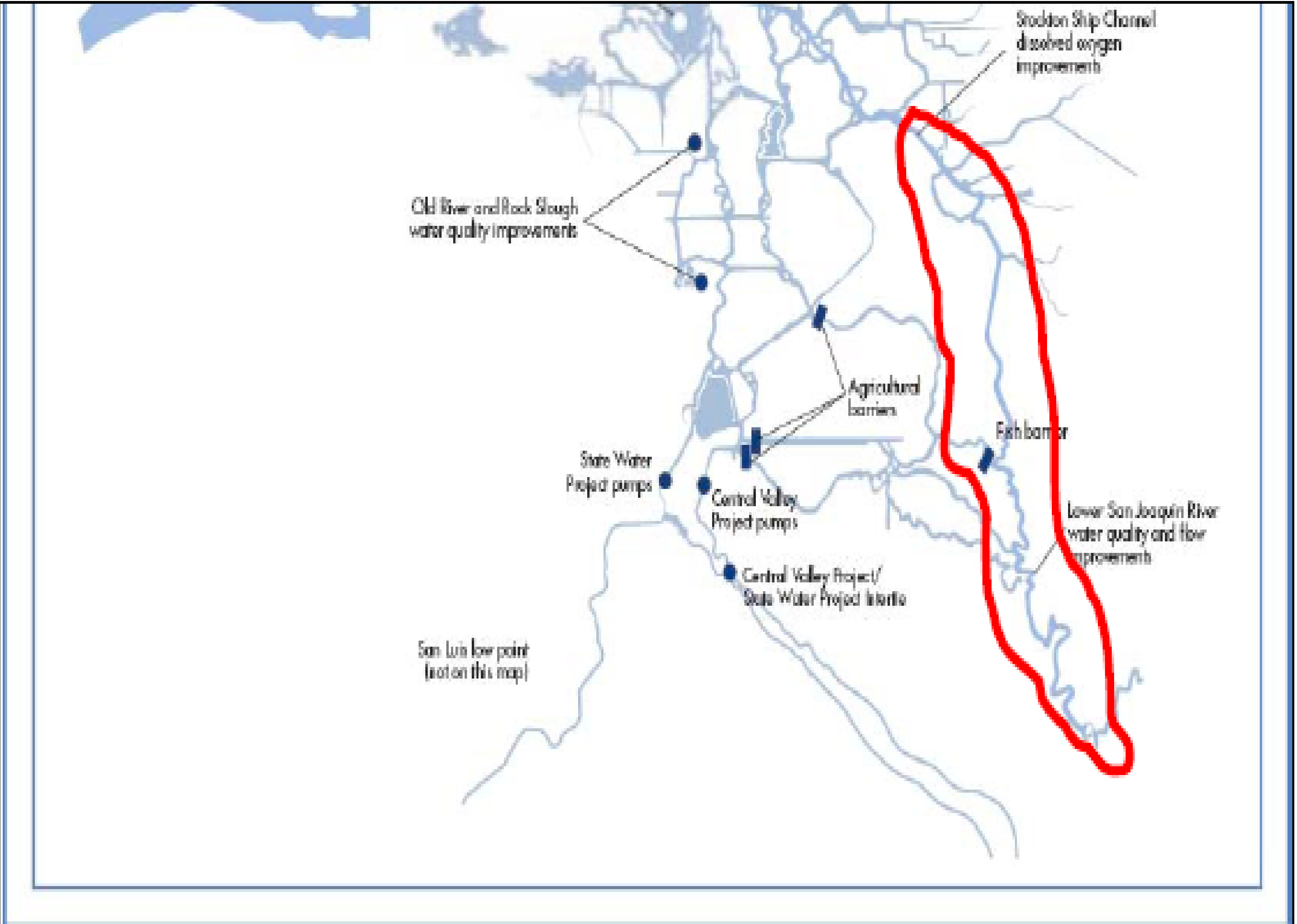


Figure 3. Zone of San Joaquin River Dominance Under Permanent Gates

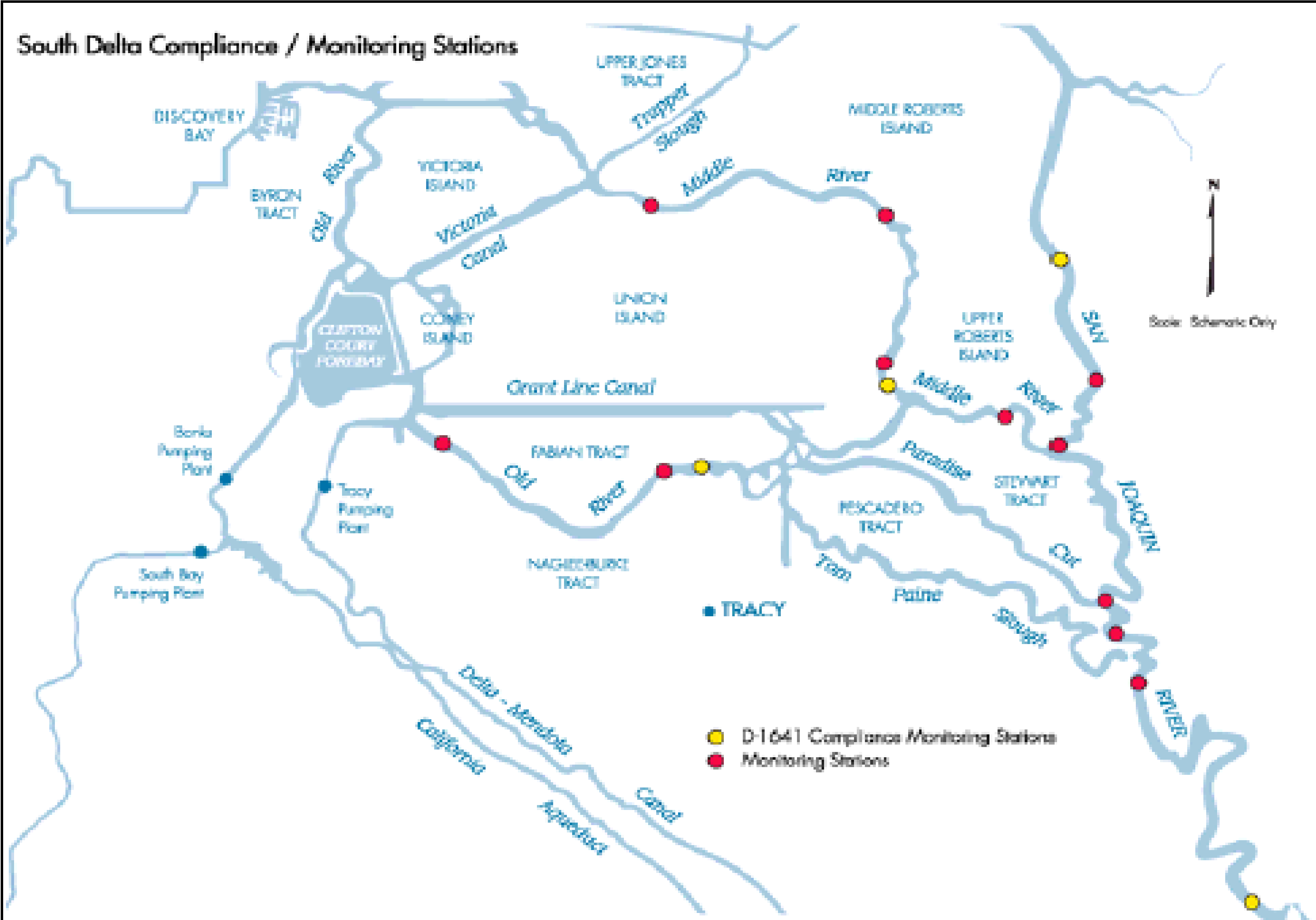


Figure 4. South Delta Compliance and Monitoring Sites

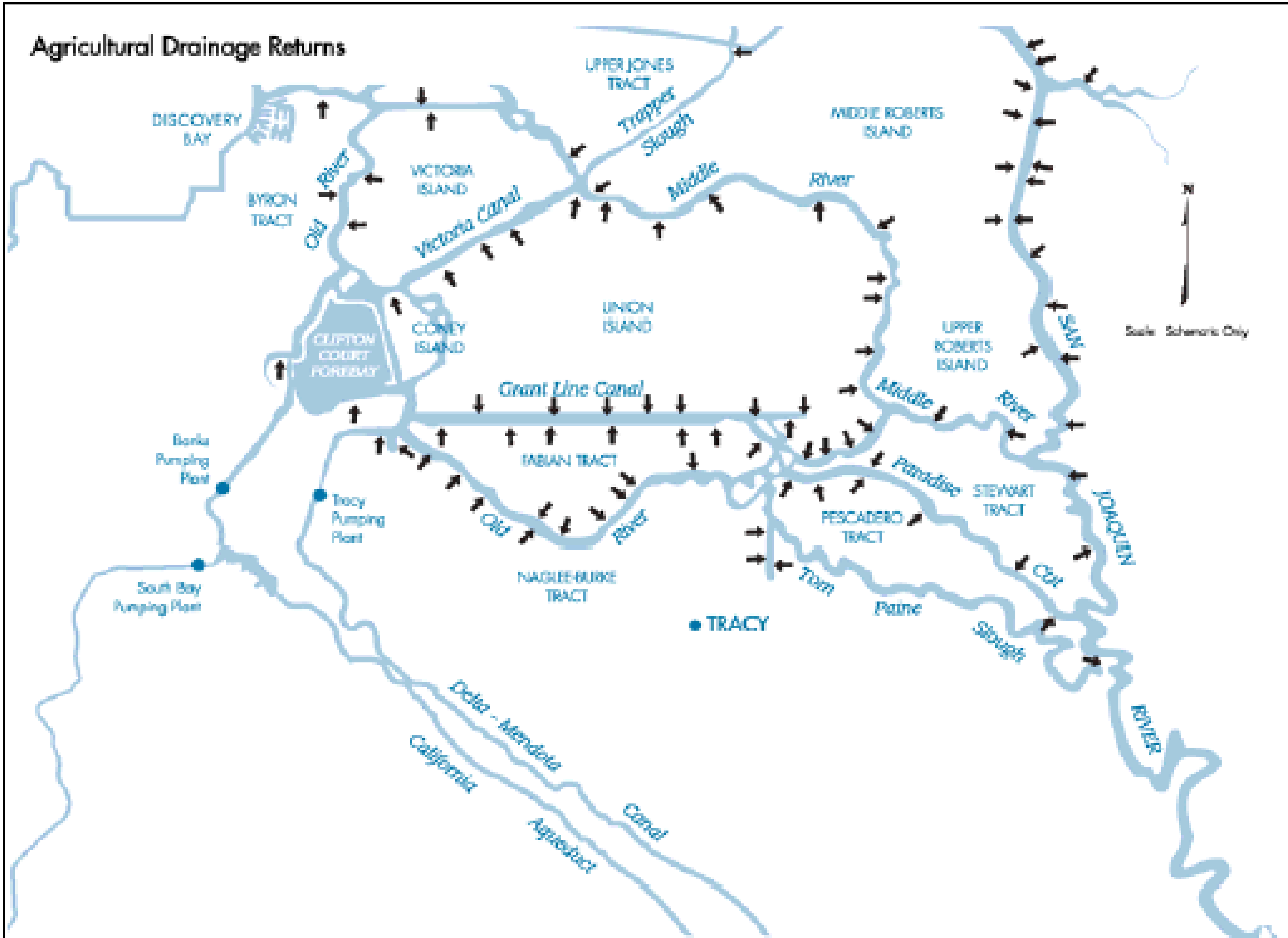


Figure 5. Agricultural Discharges in the South Delta

Figure 7. Municipal and Industrial NPDES Dischargers in the South Delta

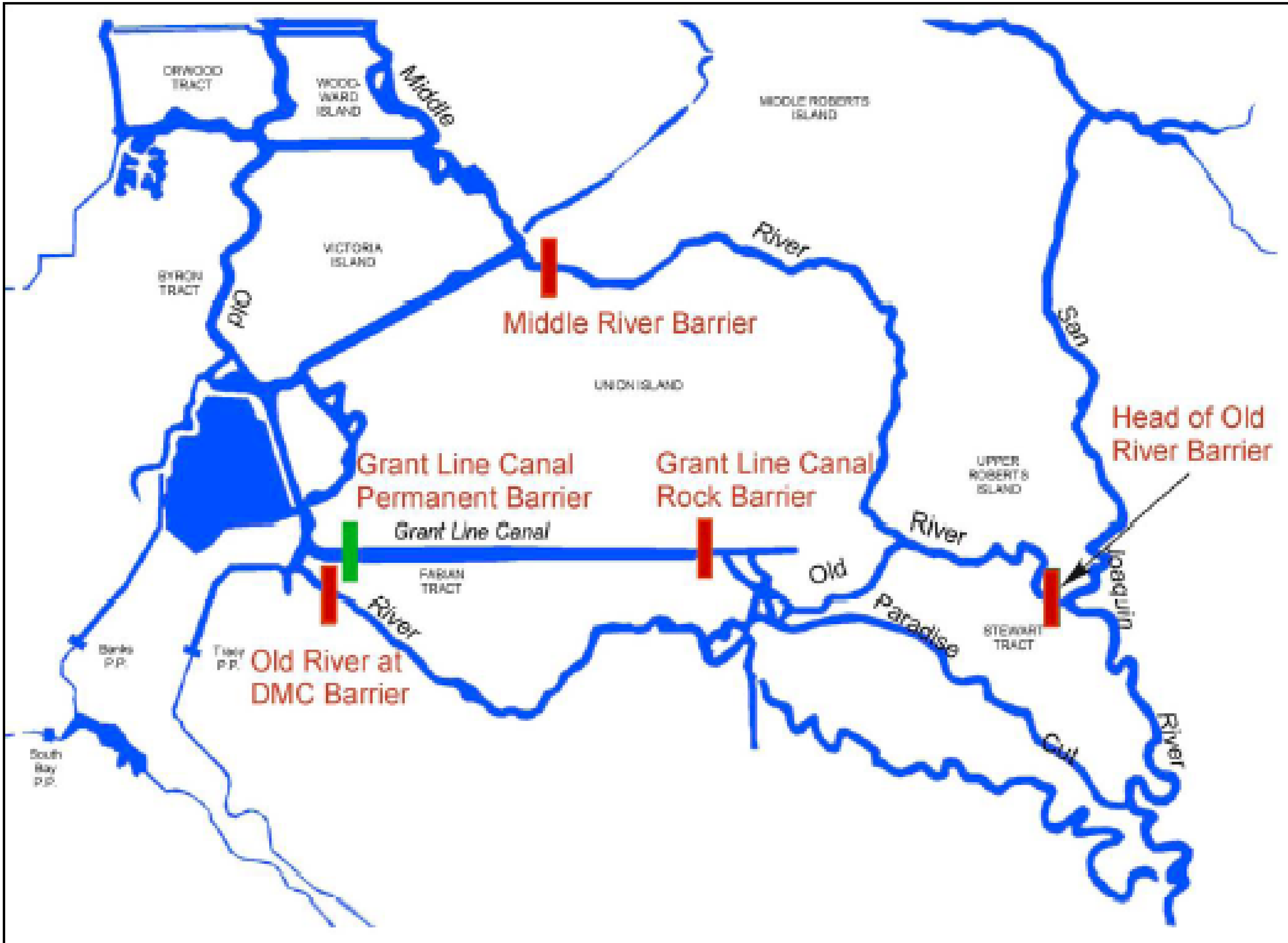


Figure 9. Temporary Barriers Location