CALSIM II - San Joaquin River Basin Development, Refinements and Results

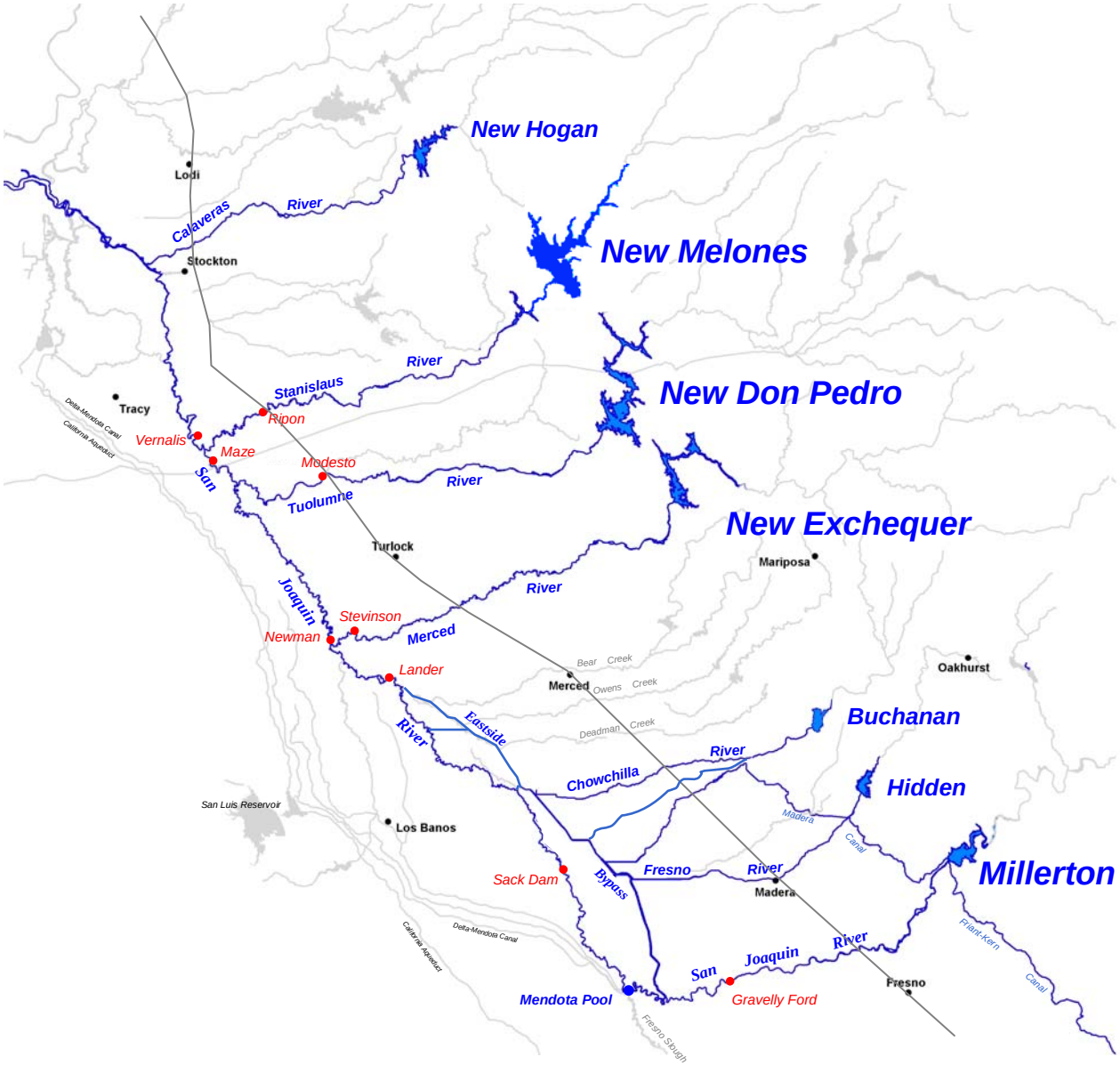
Presentation by Dan Steiner
On behalf of the San Joaquin River Group Authority
April 24, 2006

CALSIM II - San Joaquin River Basin Development Project

Project Objectives

- Create a contemporary depiction of San Joaquin River Basin hydrology and operations
- Develop a structure within CALSIM II that recognizes physical linkages and processes that can be responsive to data driven changes in the future
- Document the development of the model and its data

Geographic Scope



CALSIM II Current Conditions Test Simulation

- **CALSIM II monthly simulation 1922-2003**
- **Represents current basin operations**
  - **Decision 1641**
  - **Decision 1422**
  - **New Melones 1997 Interim Operations Plan**
  - **San Joaquin River Agreement**
  - **Current tributary requirements**
- **System operating rules and demands consistent with recent (1998-2005) era**

CALSIM II San Joaquin River Basin Enhancements

- Revised hydrology
- Land use based demands for Eastside water districts and adjacent areas
- Improved system operating rules
- Revised mapping of Westside and Eastside connectivity
- Refinement / Addition of Friant and Calaveras systems
- New formulation for calculation of water quality at Vernalis

Revised Hydrology

- **Stream Accretions**

  Mass balance approach using long-term gages

  Accounts for water entering and leaving stream reaches

  + Downstream Gage

  - Upstream Gage

  + Diversions

  - Return Flows

  + Runoff Adjustment

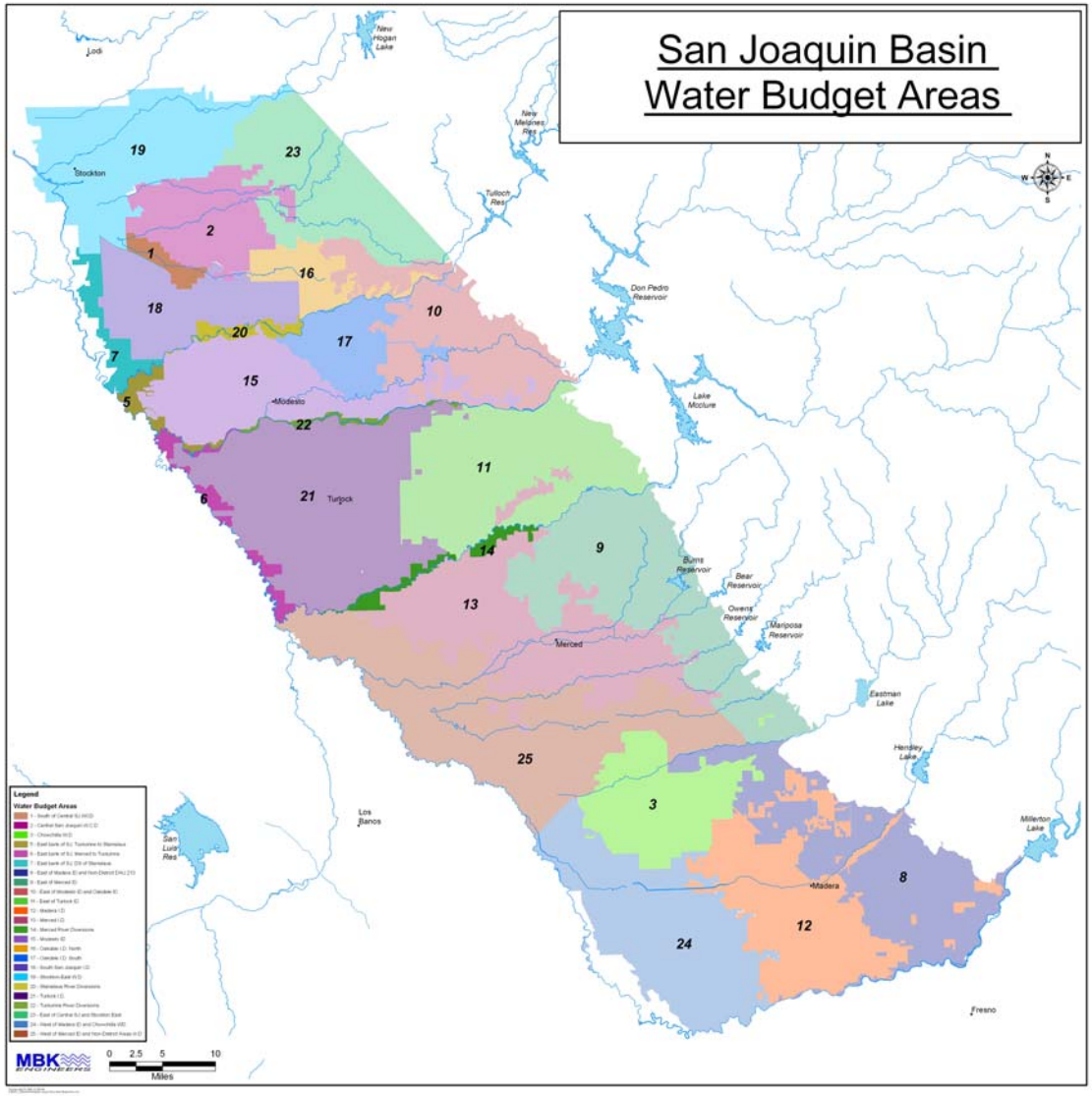
- **Resultant Value Represents**

  Precipitation runoff

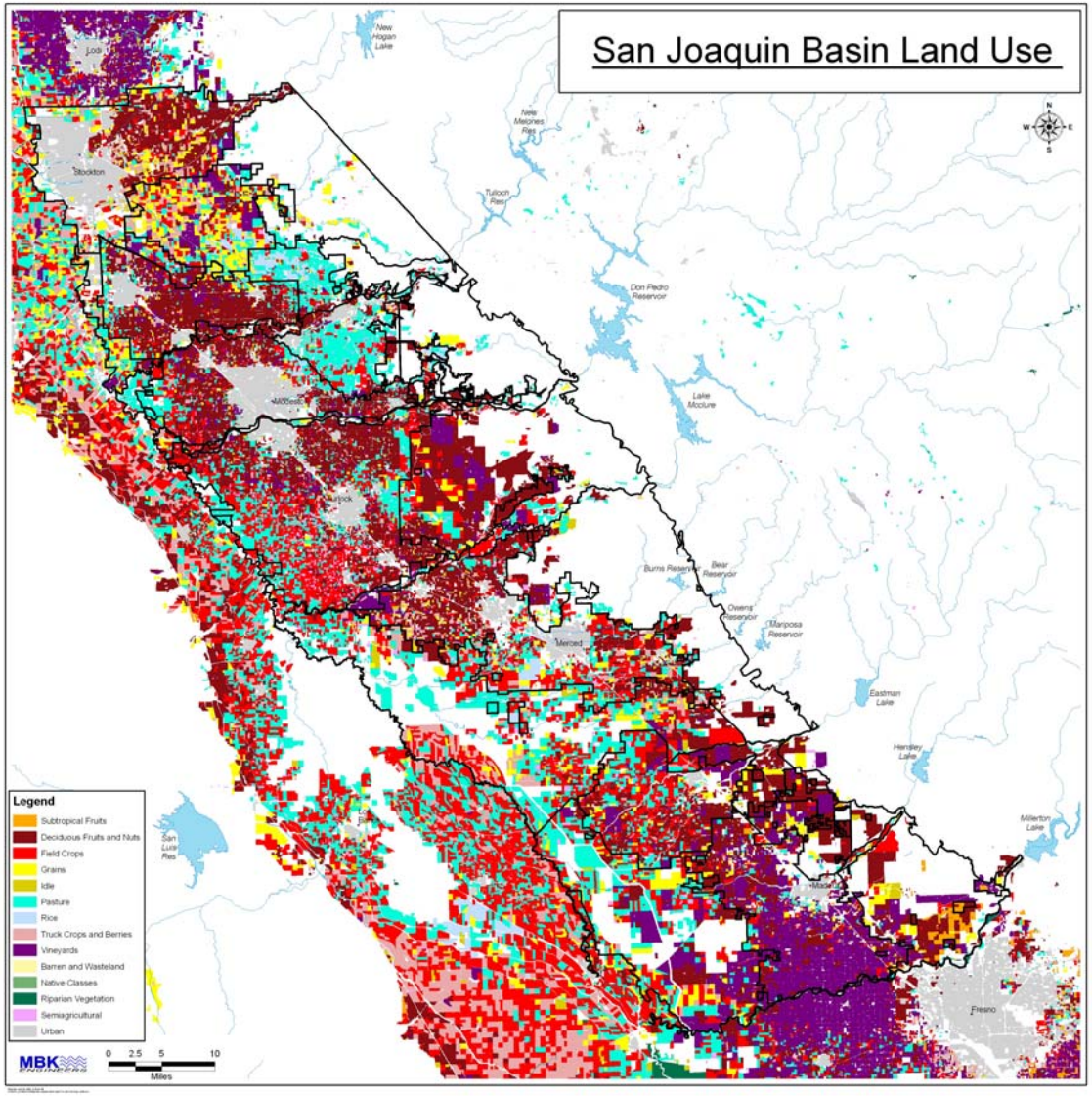
  Historical stream-groundwater interaction

  Gage errors

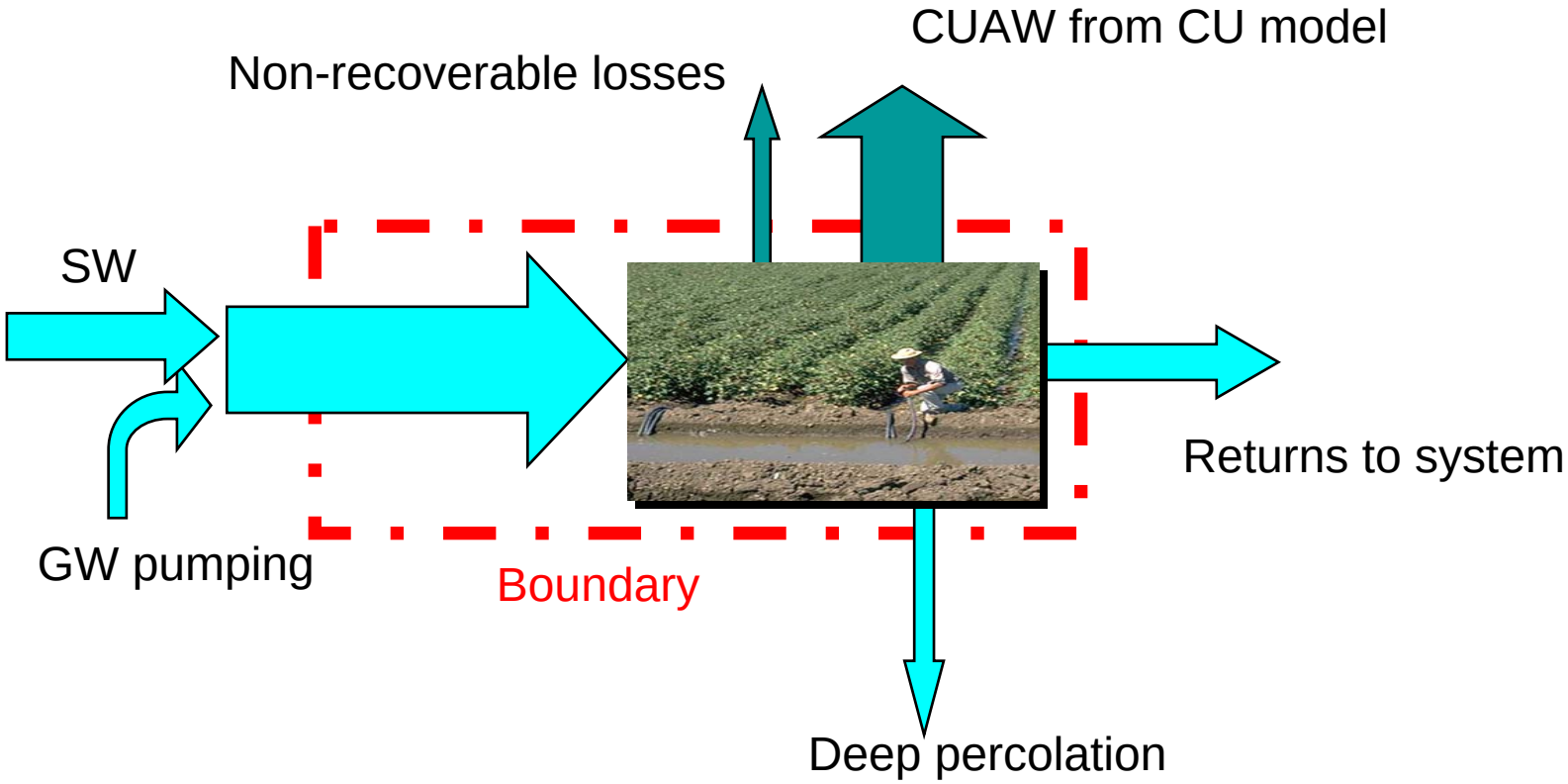
Representation of Land-use Based Demands
Water Use Areas



Representation of Land Use Based Demands
Land Use



Conceptual Area Water Balance Based on Land Use Demands



Water Budgets and Representation of System Operations

- Use historical land use to estimate consumptive use
- Use historical operations data to perform water budgets
- Results of water budgets are used to develop
  - Stream diversion requirements
  - Groundwater use parameters
  - District Operations
- Approach varies depending on available data
- Validation of system operations
  - Ensure model simulation depicts recent operations

Data Exchange and Collaboration

Local Entities

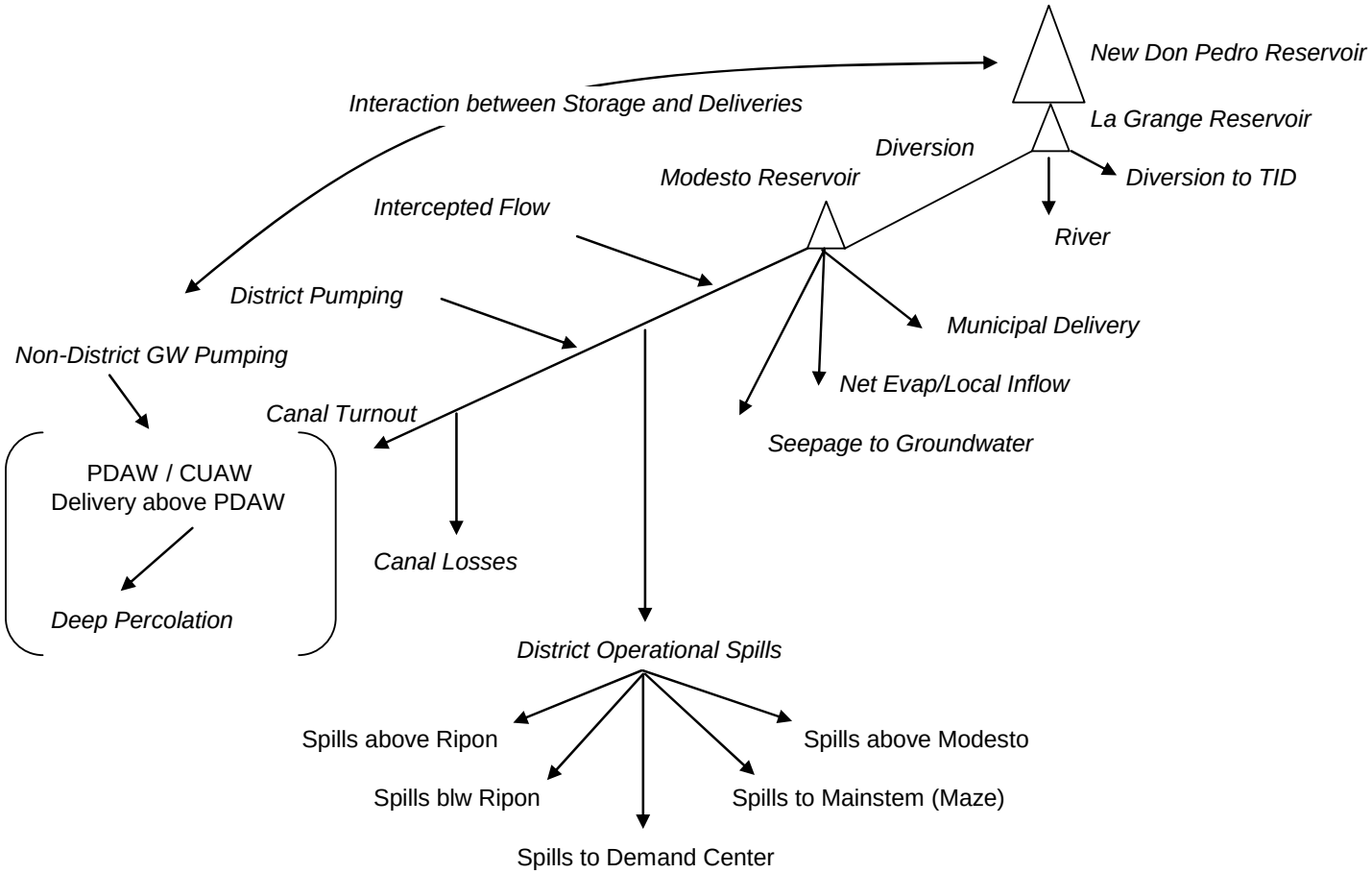
- Madera Irrigation District
- Chowchilla Water District
- Merced Irrigation District
- Turlock Irrigation District
- Modesto Irrigation District
- Oakdale Irrigation District
- South San Joaquin Irrigation District
- Stockton East Water District
- The San Joaquin River Exchange Contractors
- Friant Water Users

Modeling Agencies

- Reclamation
- Department of Water Resources

Representation of Tributary System Operations

Illustrative Example



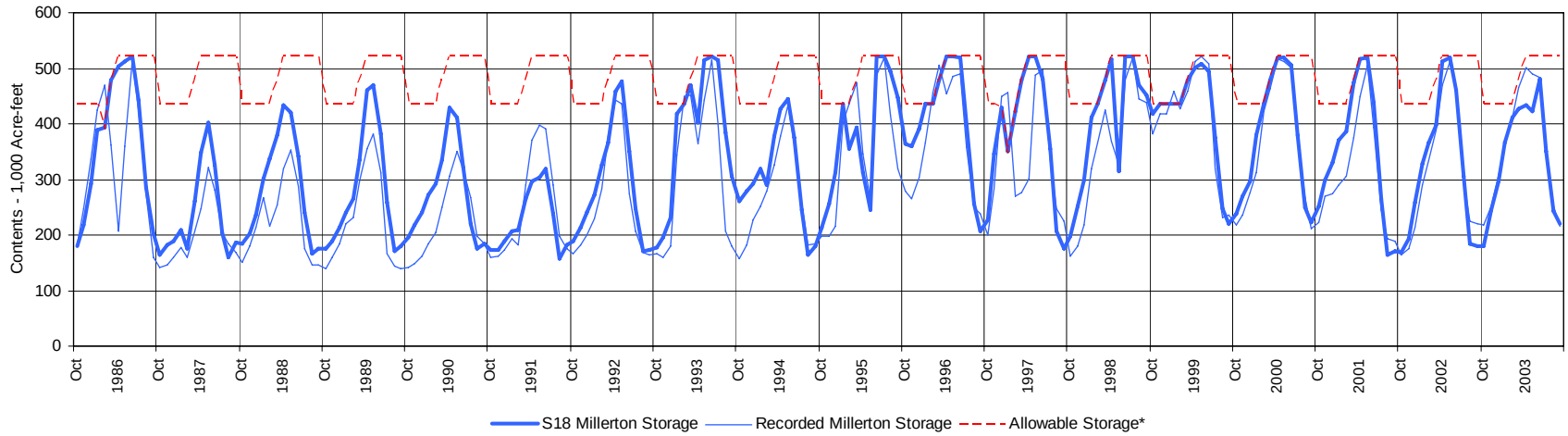
Comparisons to Historical Operations

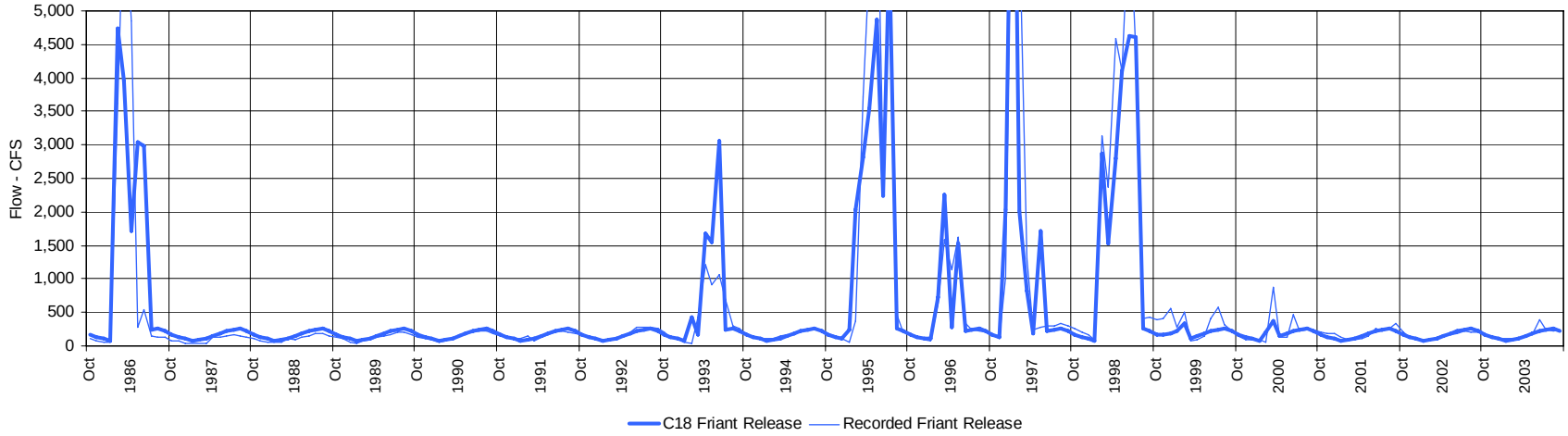
Factors Affecting Comparison to Historical Record

- **Systems are in a state of flux. Local facilities, policies and requirements change with time.**
- **Modeling does not capture issues that arise in actual operation. Local decisions based on real-time circumstances that may change year to year.**
- **Modeled demands assume constant land use.**
- **Modeled demands assume constant monthly ET rates.**
- **Monthly model does not capture daily decisions.**
- **Modeled flood operations can vary from historical.**

Validation of Tributary System Operations

Millerton Operations





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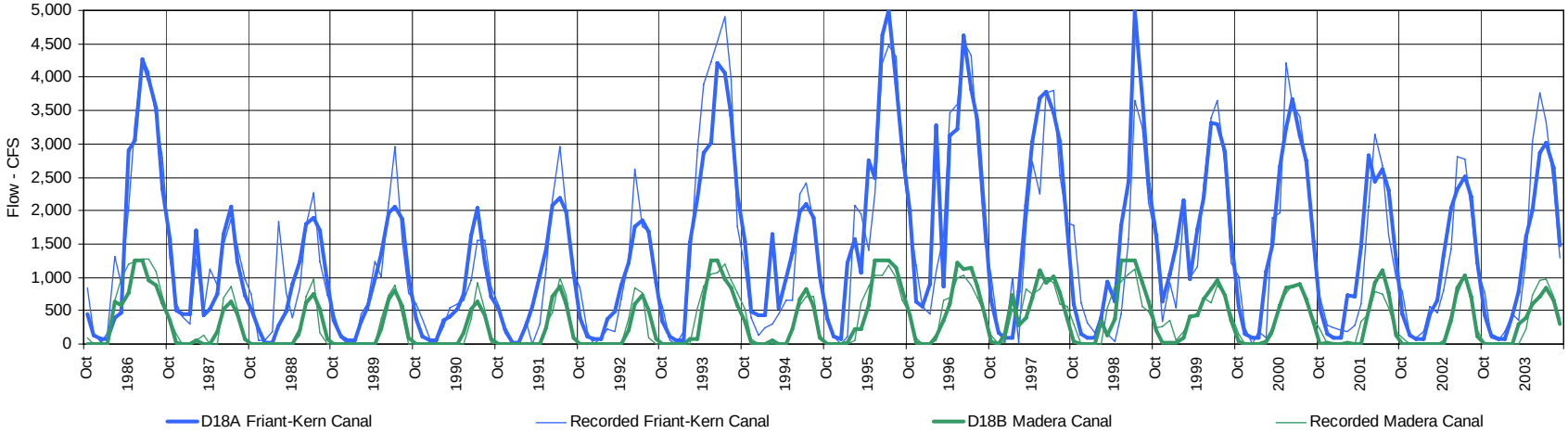
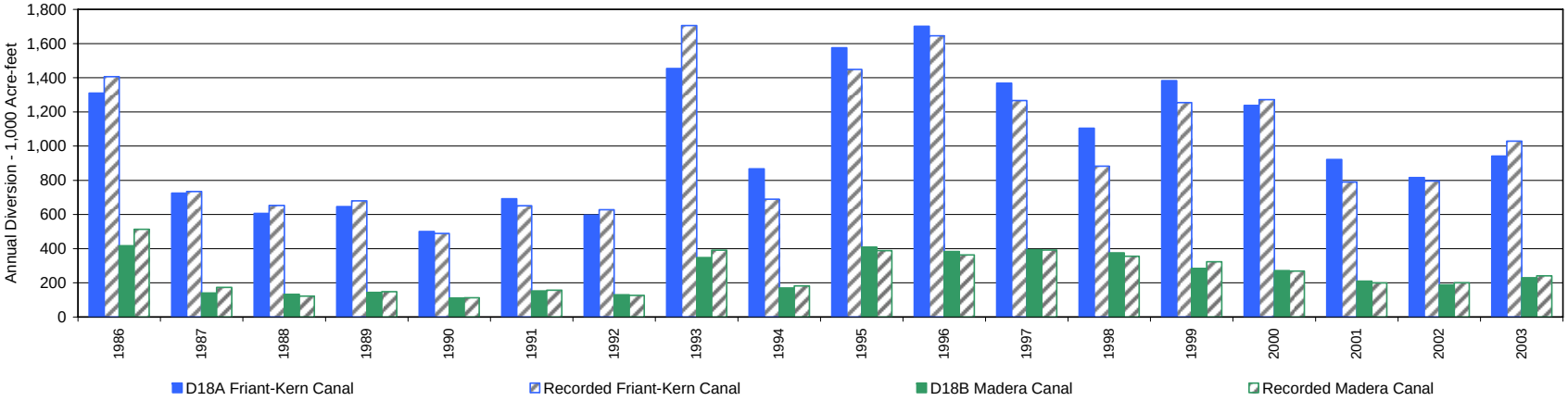
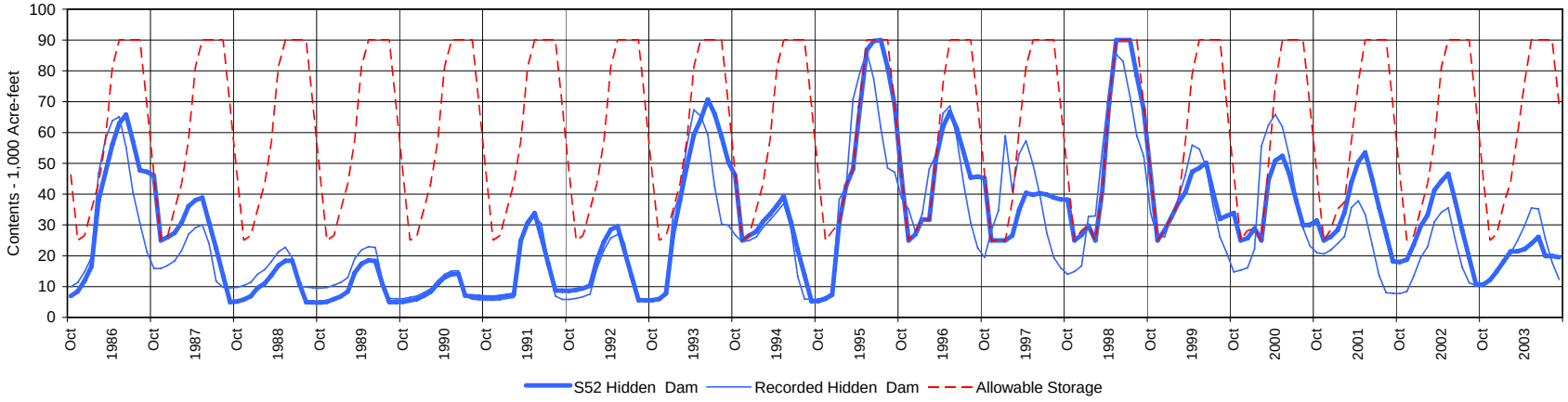
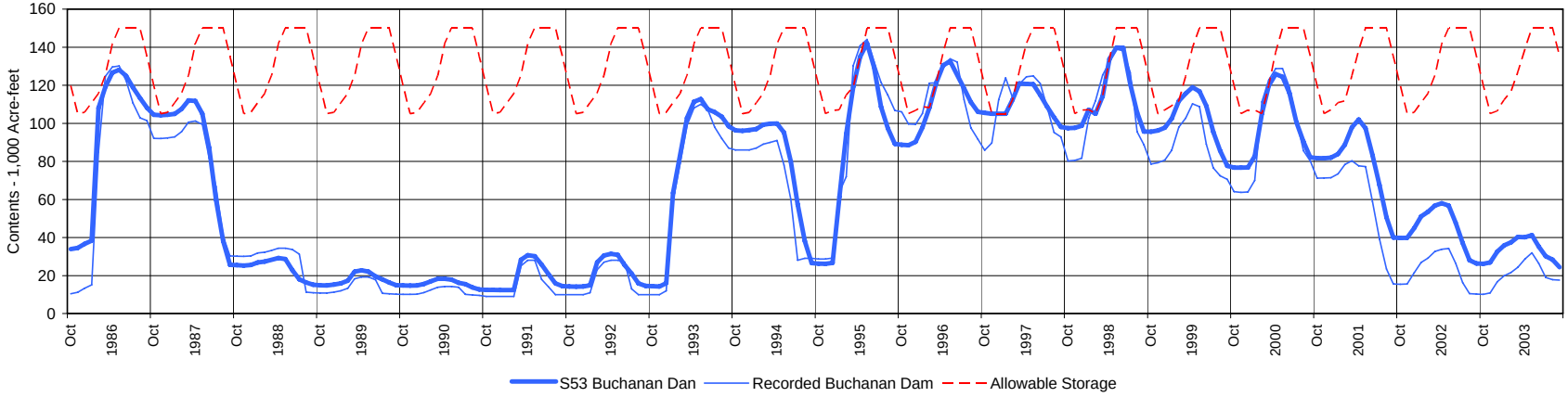




Validation of Tributary System Operations

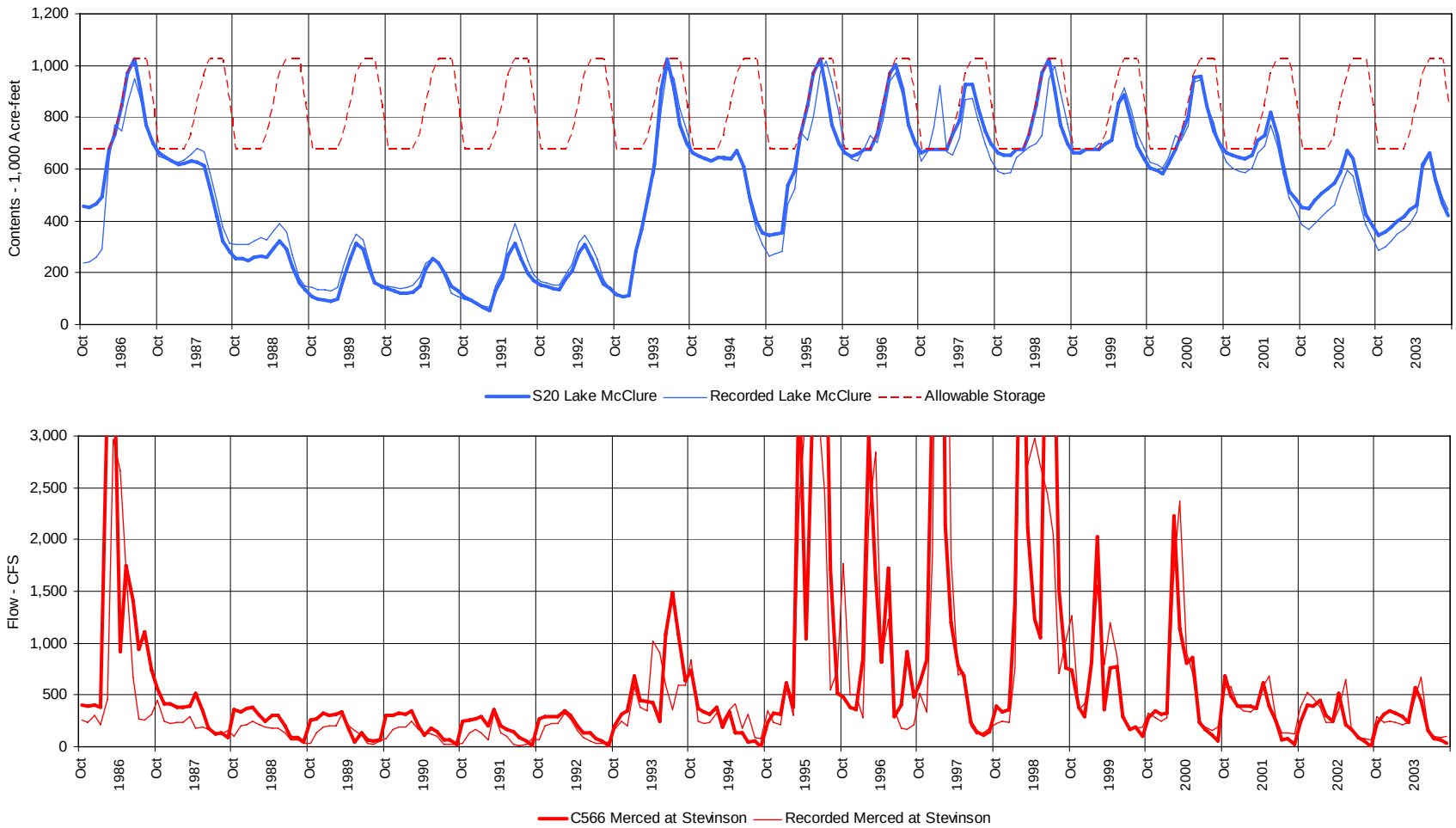
Hidden and Buchanan Operations





Validation of Tributary System Operations

Merced River Operations



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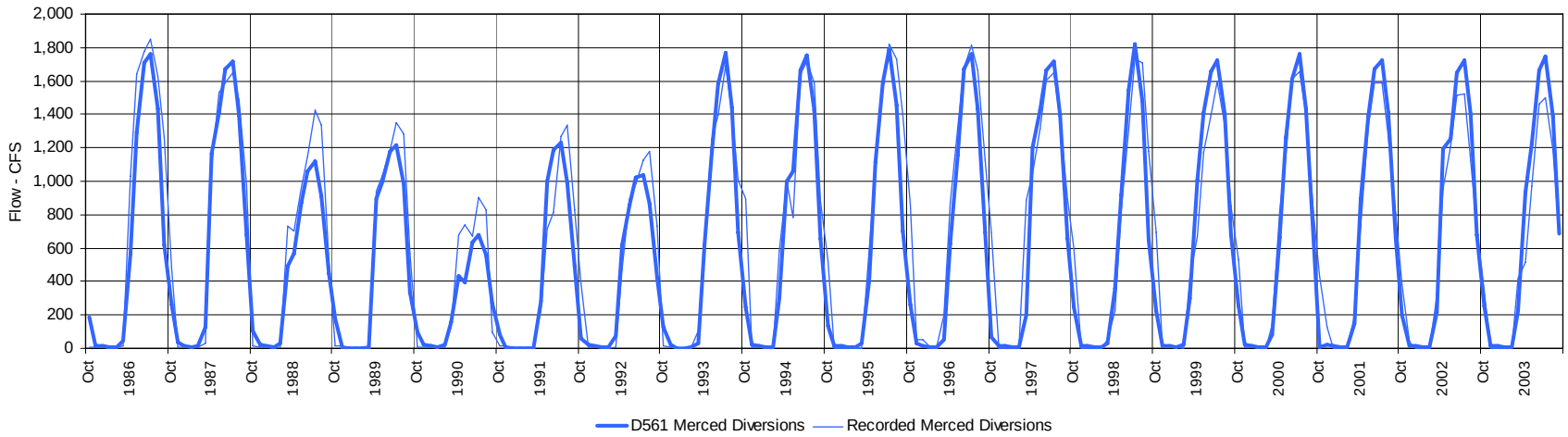
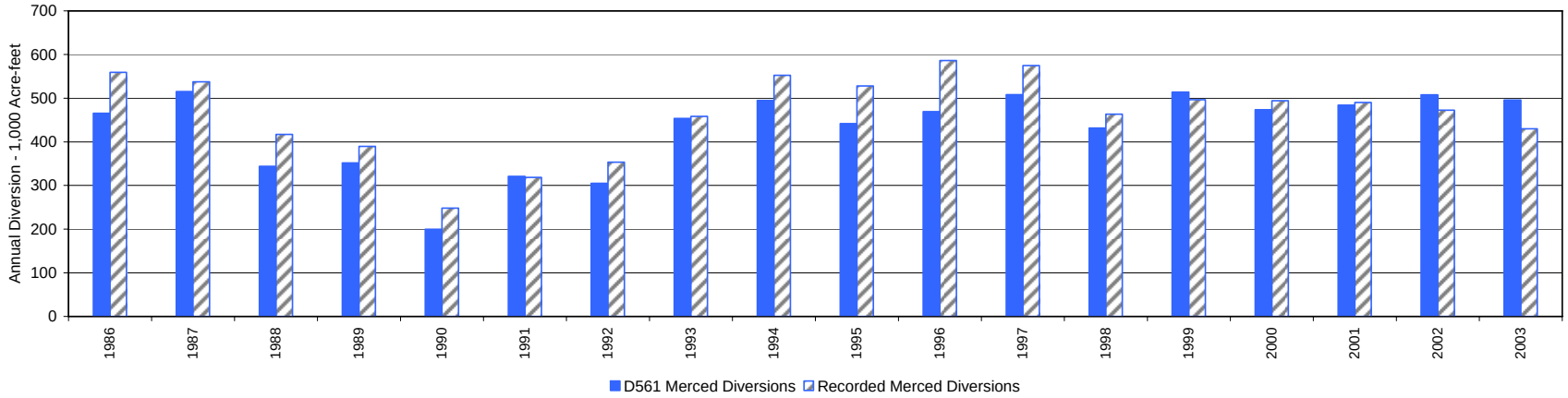
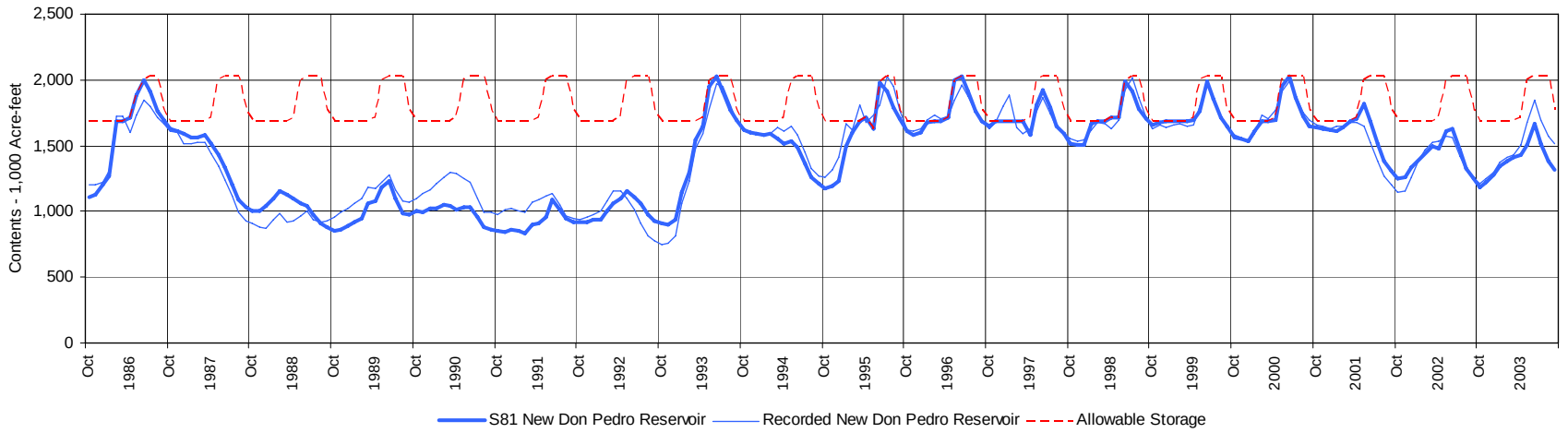
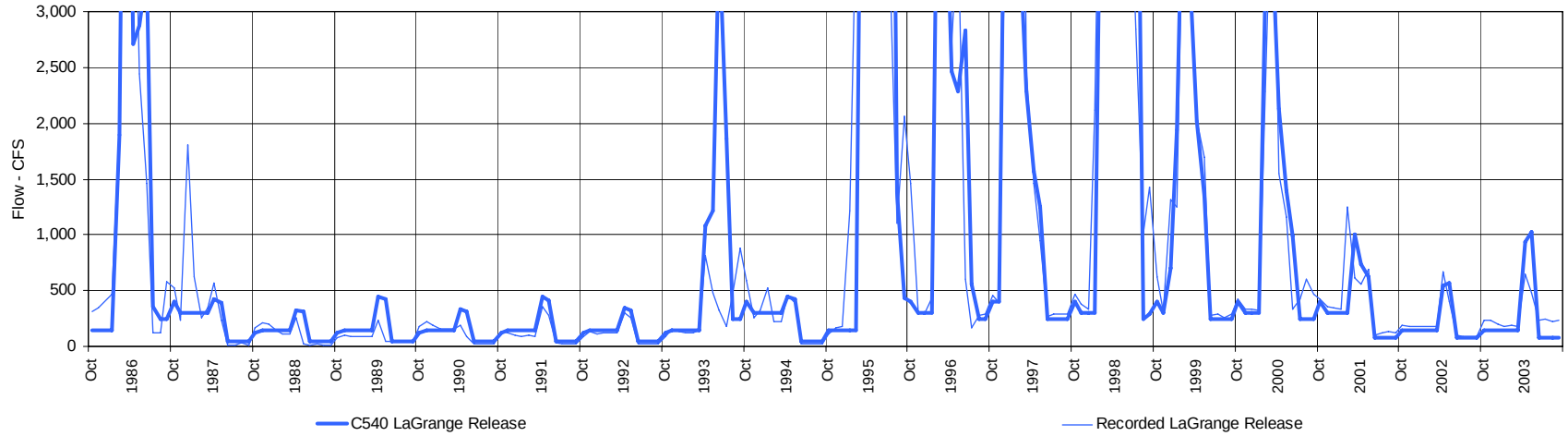




Validation of Tributary System Operations

Tuolumne River Operations





Validation of Tributary System Operations

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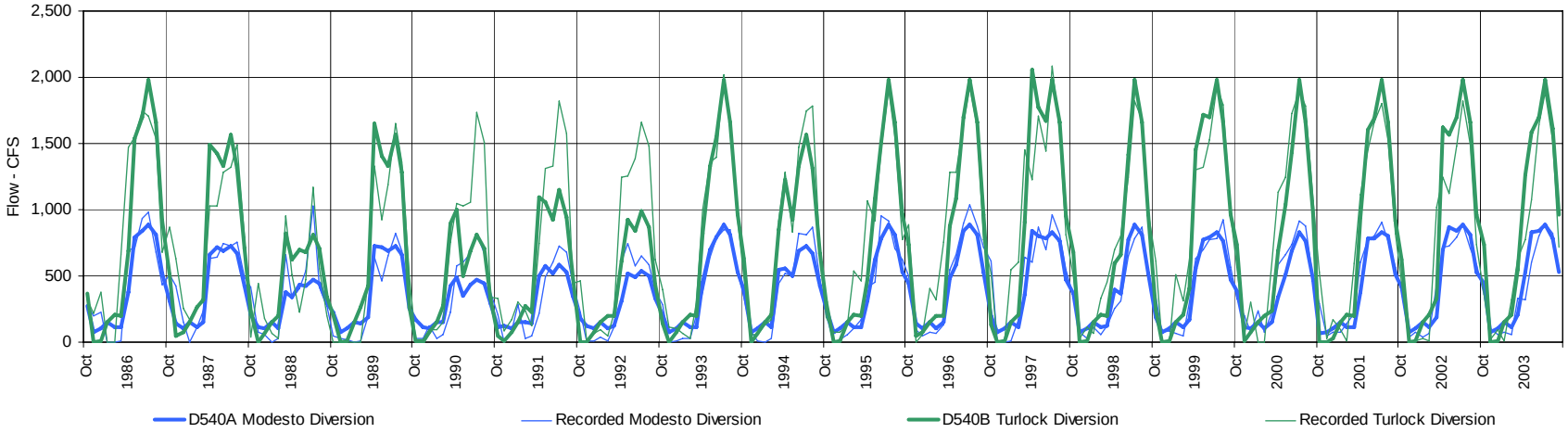
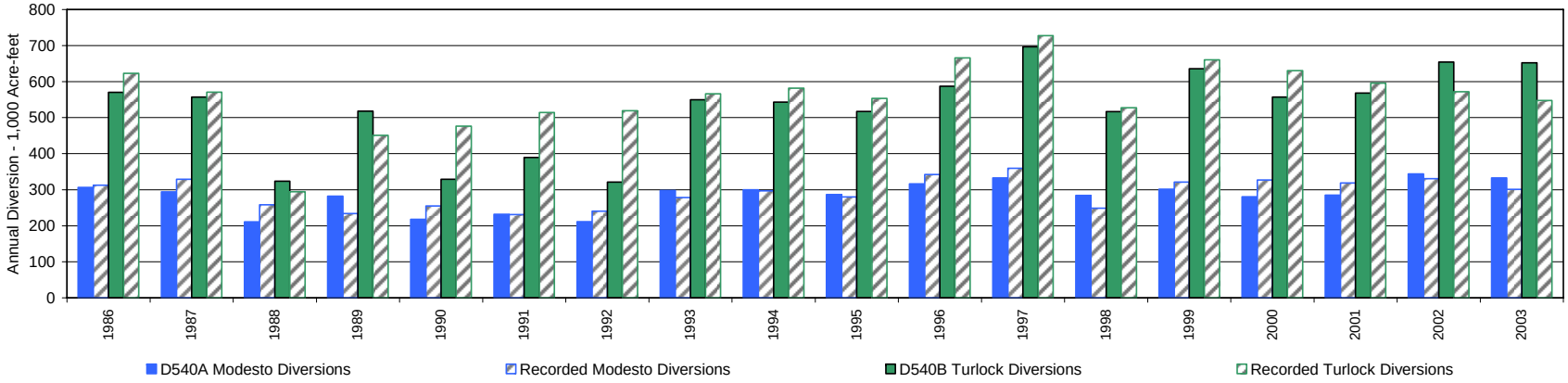
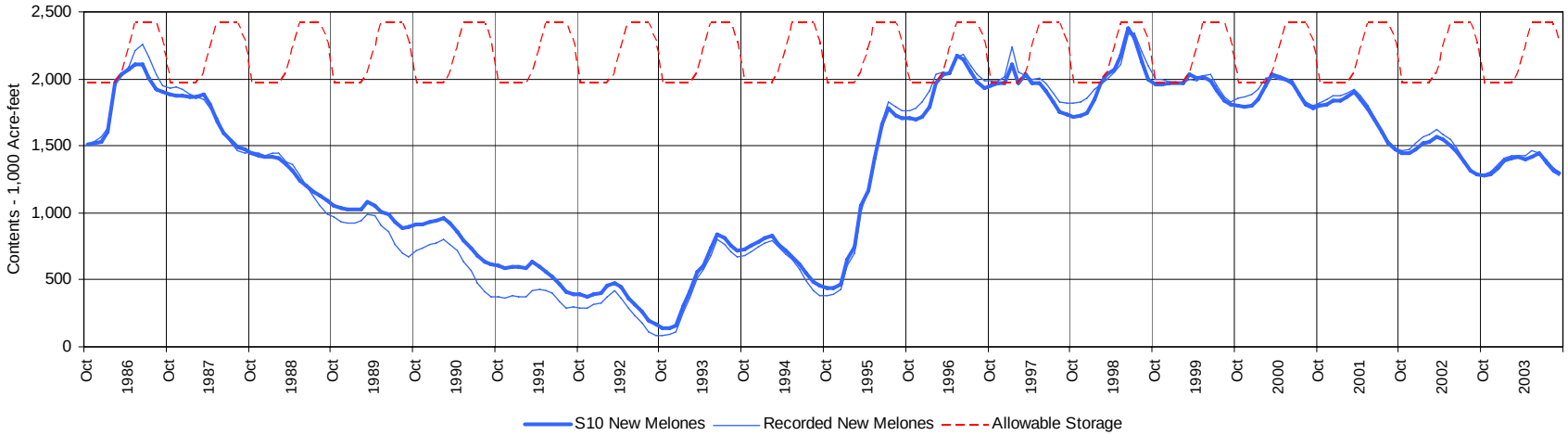
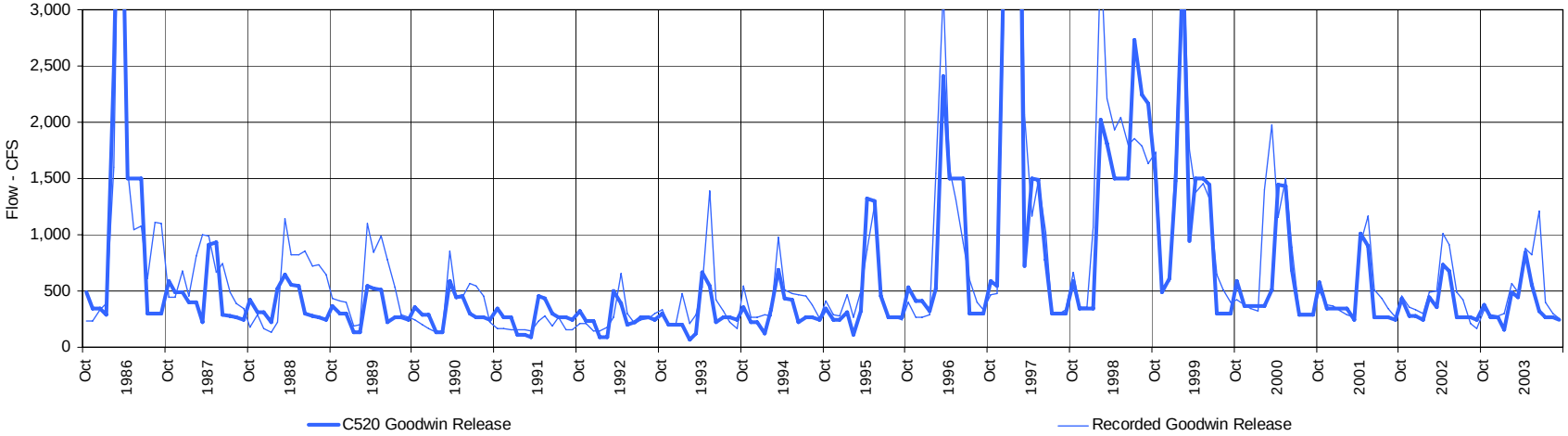




Validation of Tributary System Operations

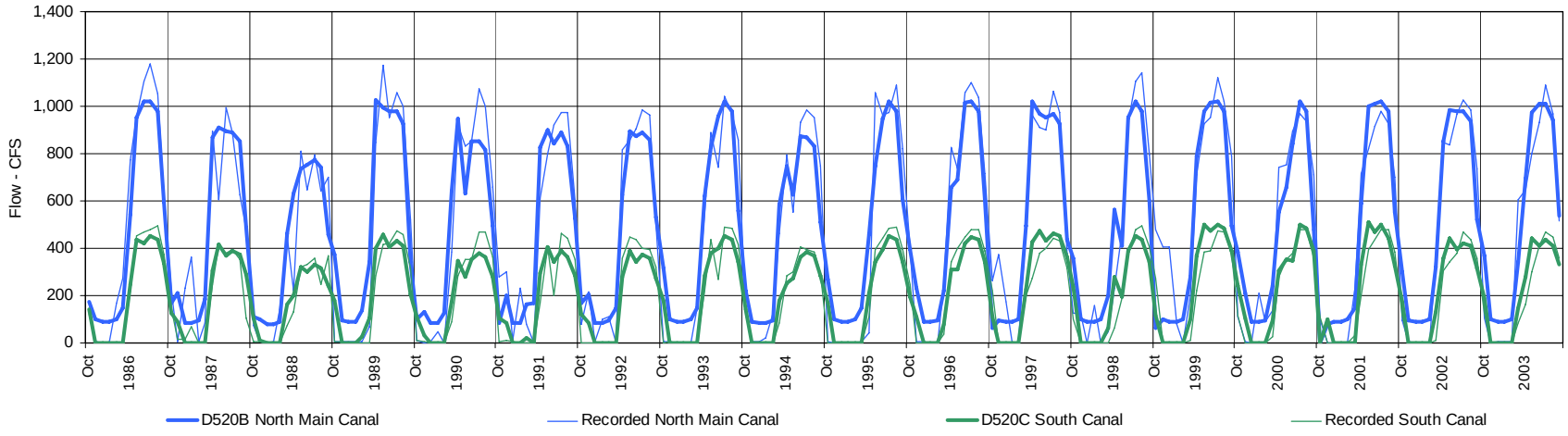
Stanislaus River Operations

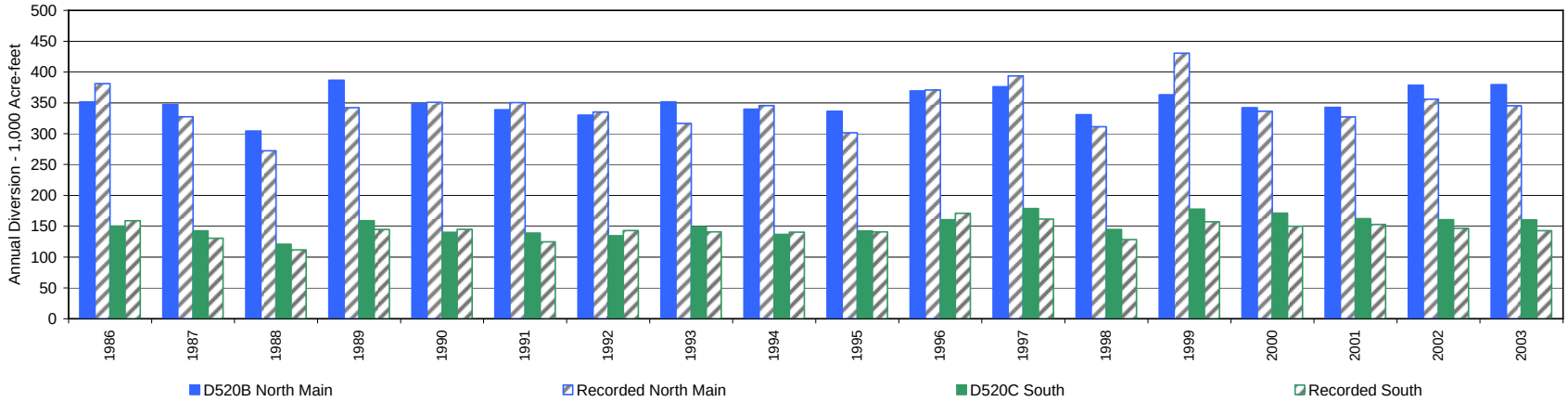




Validation of Tributary System Operations

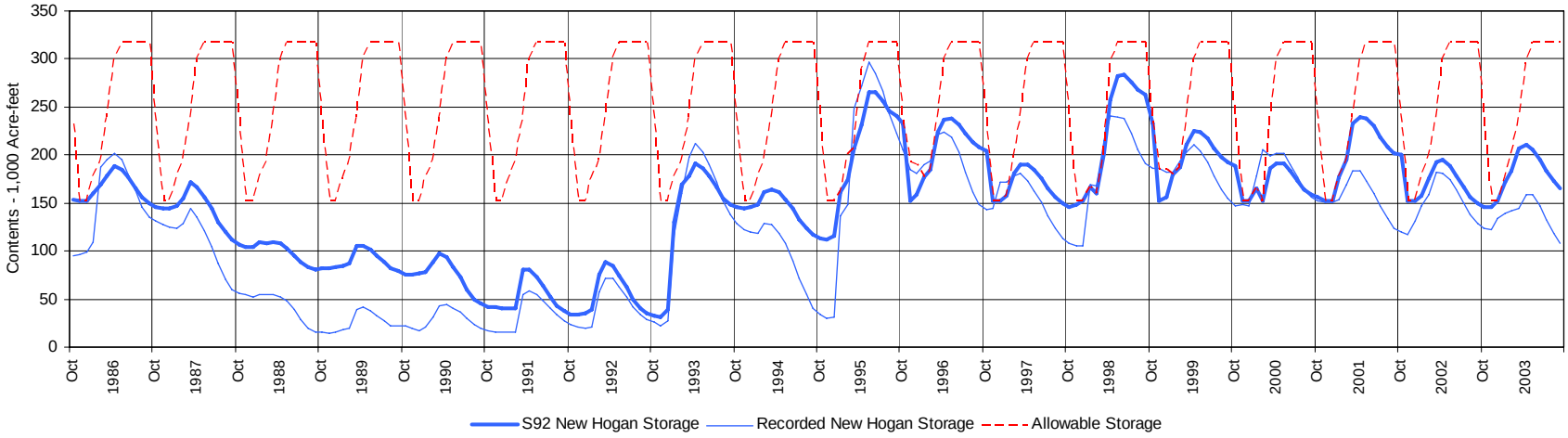
Stanislaus River Operations





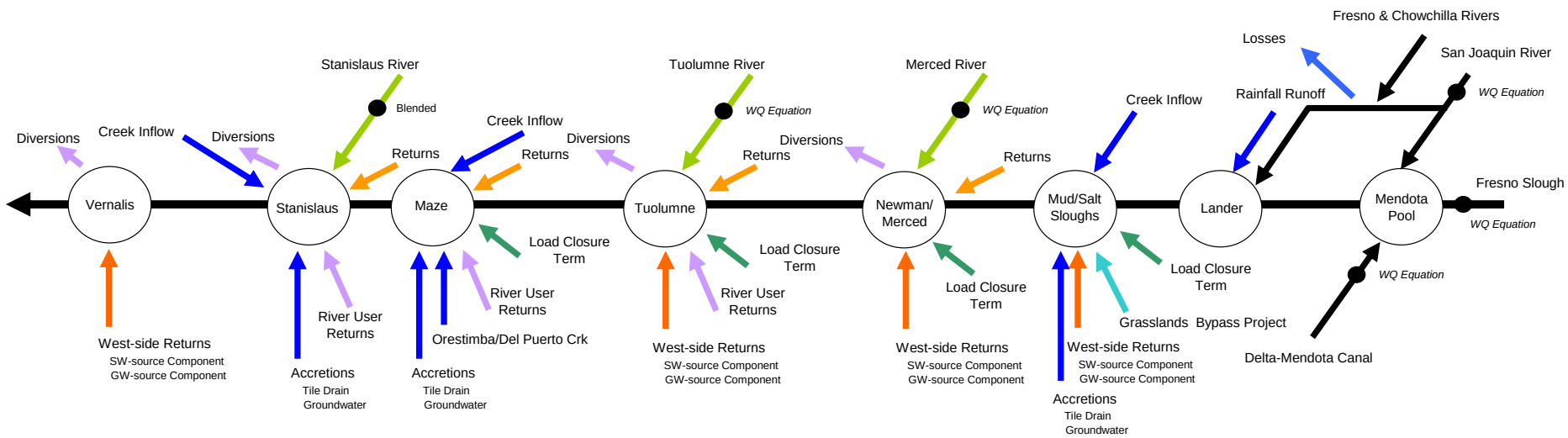
Validation of Tributary System Operations

Calaveras River Operations

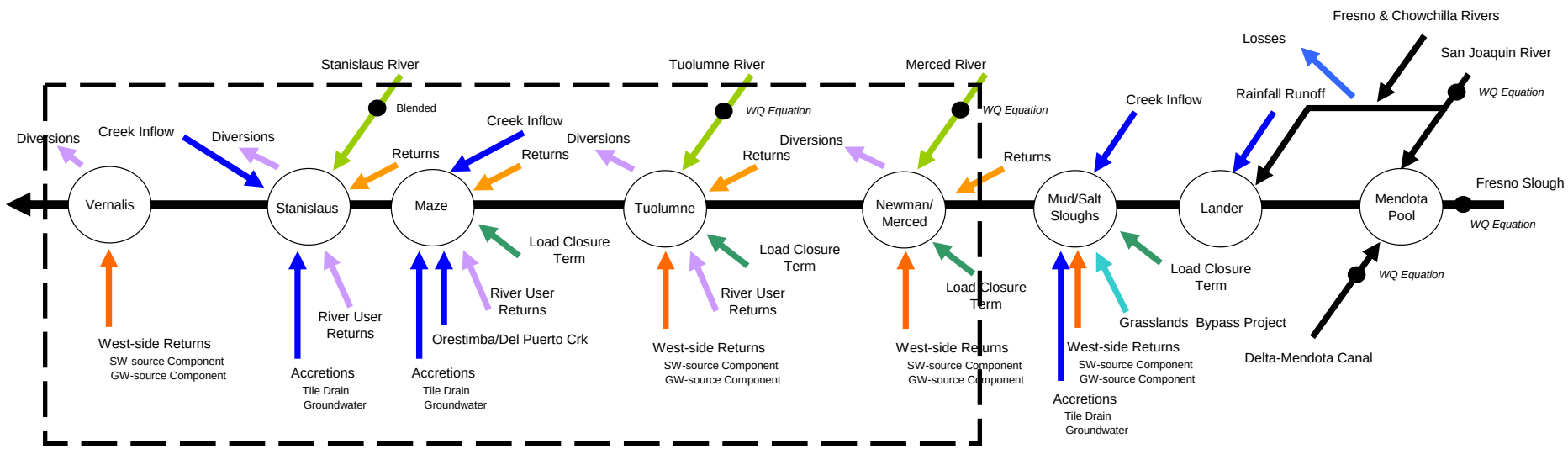


Mainstream San Joaquin River Depiction

San Joaquin River Mainstem Components



Mainstream San Joaquin River Depiction



Newman to Vernalis Accretion Area

Mainstream San Joaquin River Depiction

Initial Challenge
Mainstem Newman to Vernalis Accretions

Mass balance approach using long-term gages

Accounts for water entering and leaving stream reaches

+ Downstream Gage
- Upstream Gage
+ Diversions
- Return Flows
+ Runoff Adjustment

Resultant Value Represents

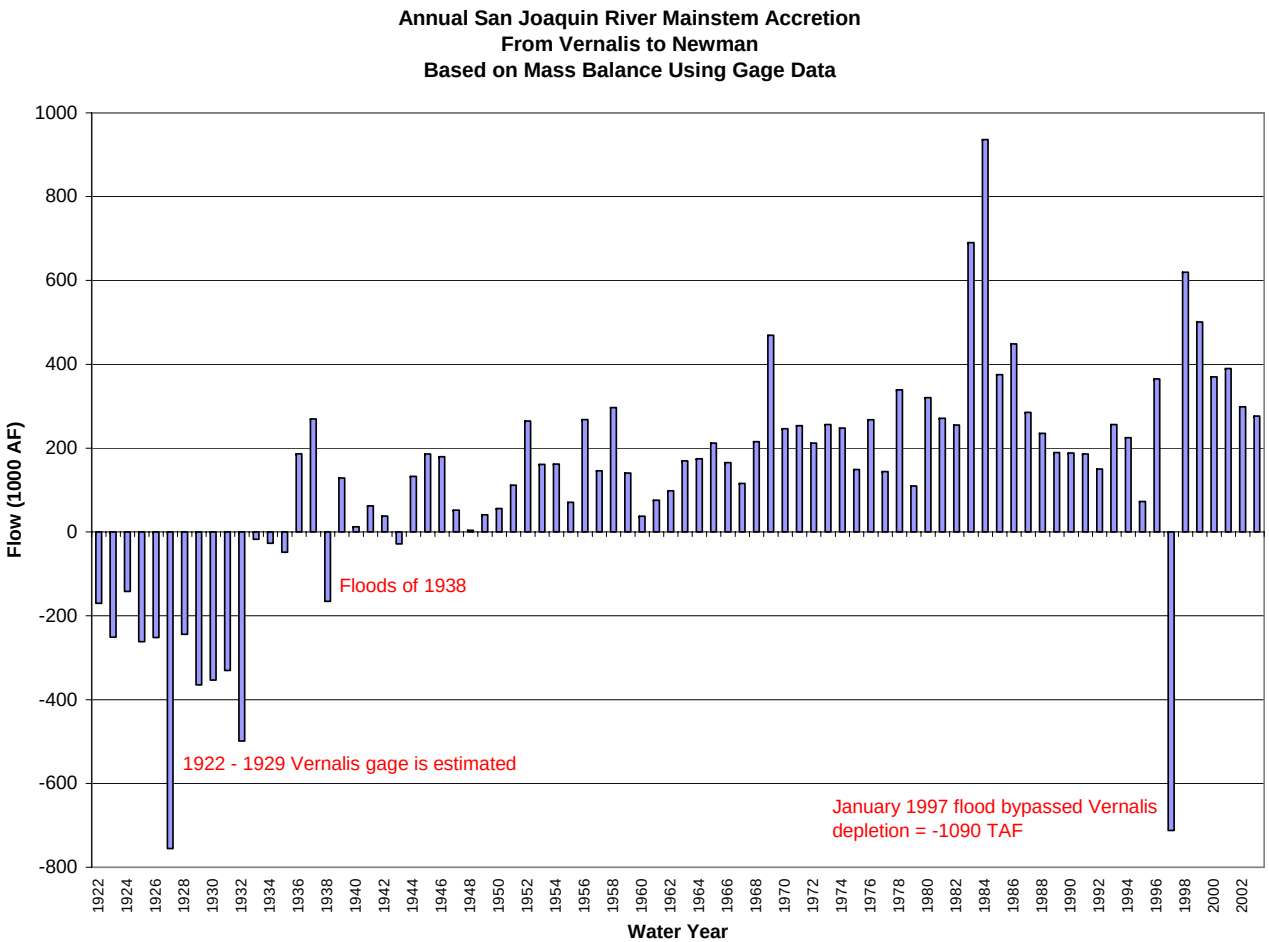
Precipitation runoff

Historical stream-groundwater interaction

Gage errors

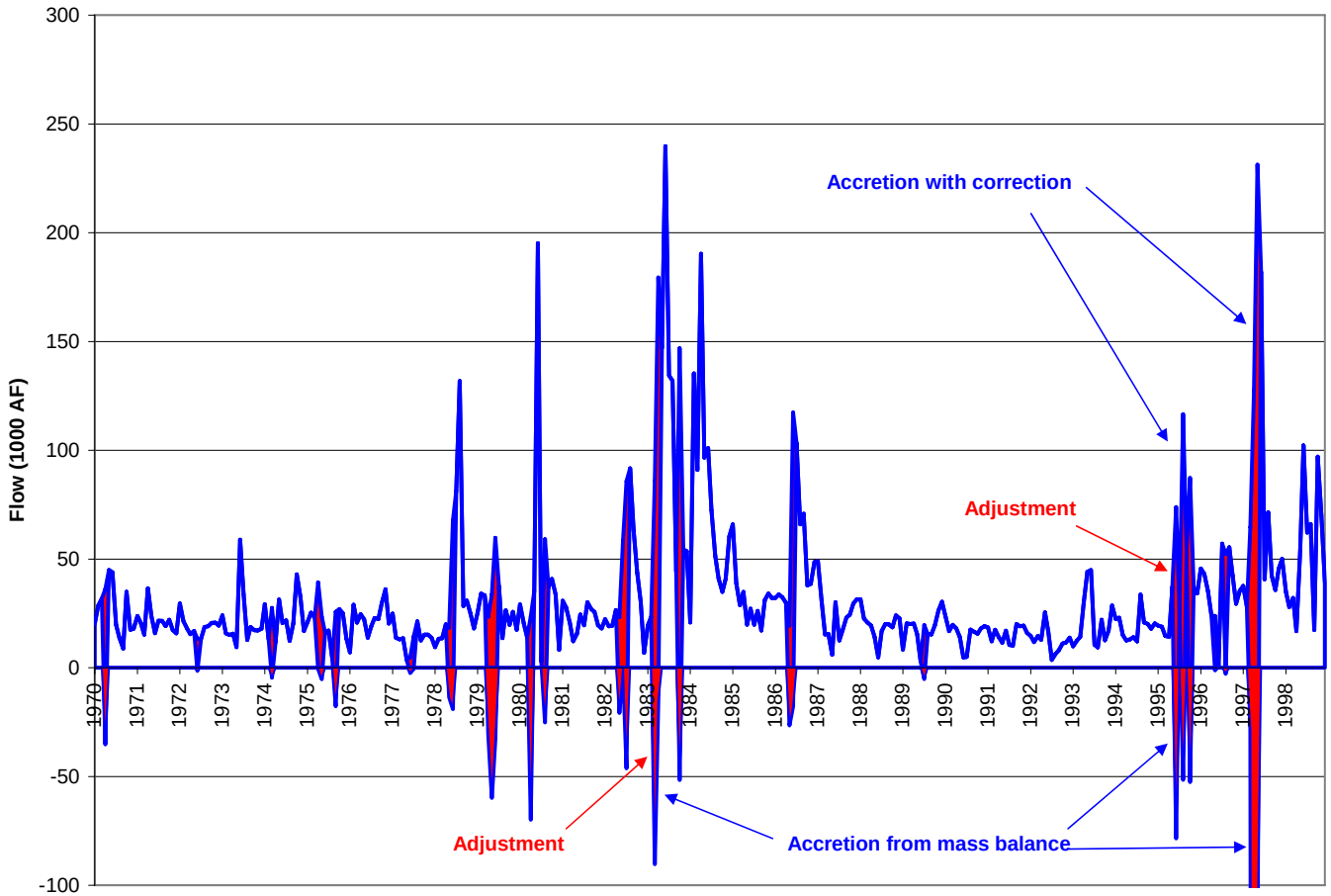
Mainstream San Joaquin River Depiction

Calculated Mass Balance Newman to Vernalis Accretion



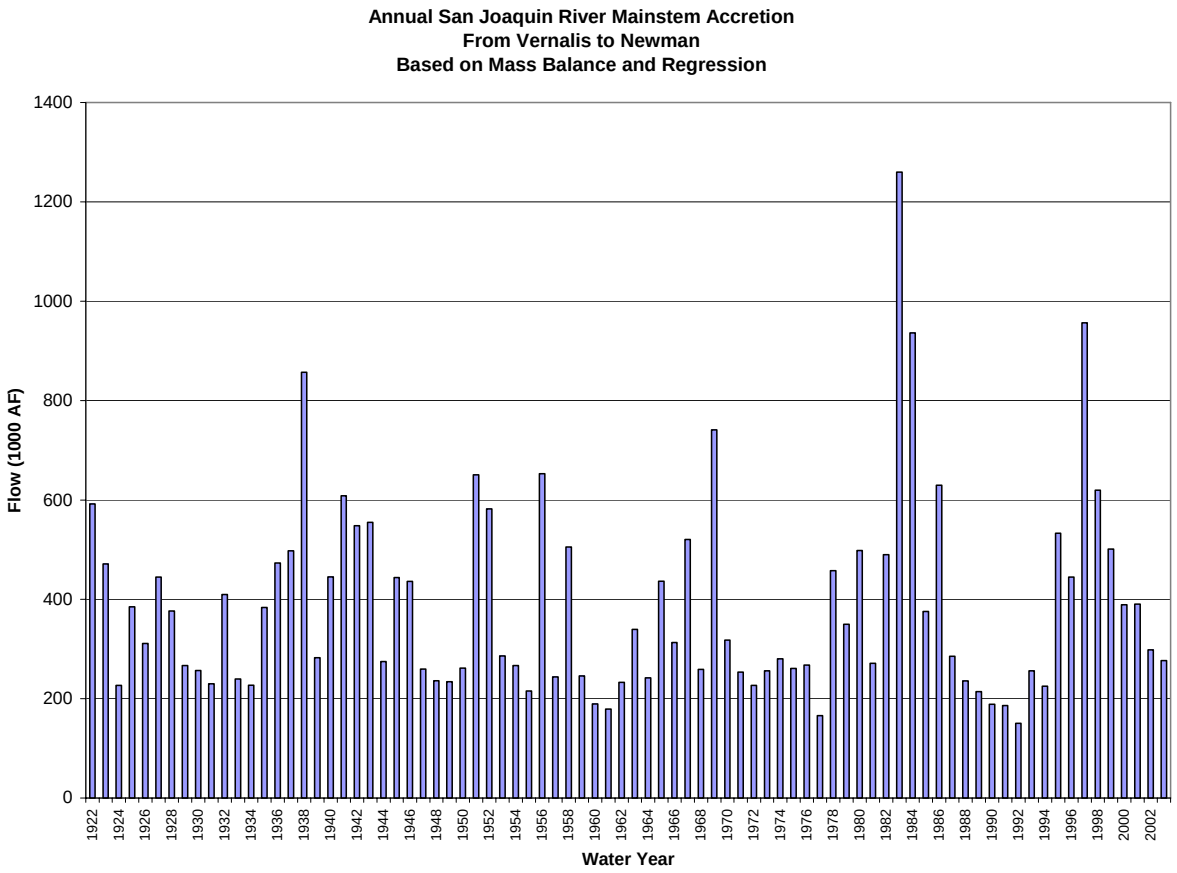
Mainstream San Joaquin River Depiction

Recent Period Mass Balance Accretion Calculation Based on Gage Records

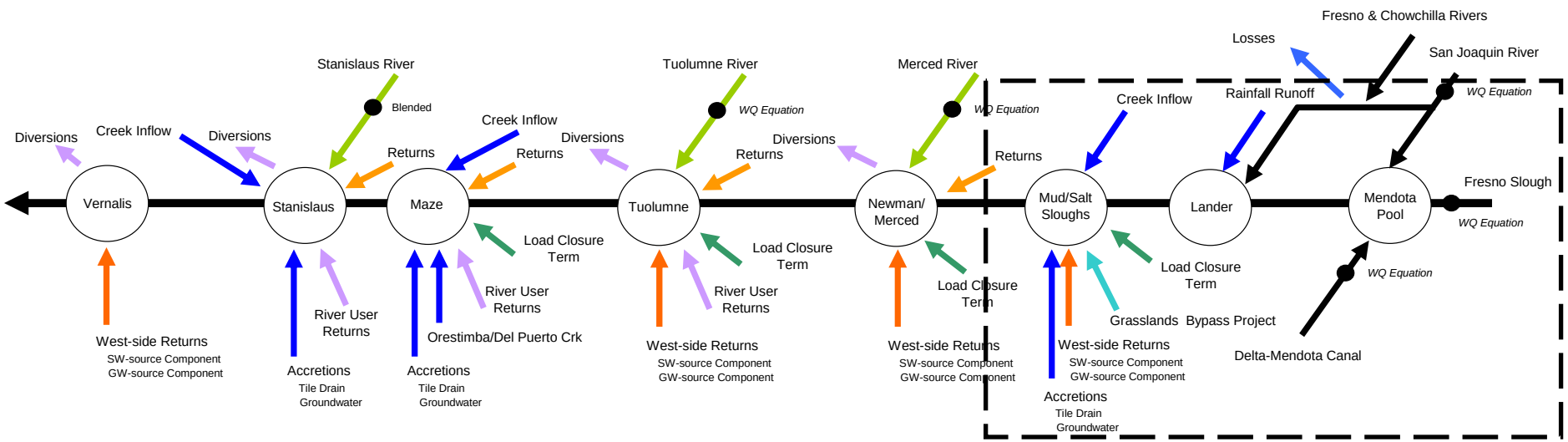


Mainstream San Joaquin River Depiction

Calculated Mass Balance Accretion with Adjustments



Mainstream San Joaquin River Depiction



Above Newman Accretion Area

Mainstream San Joaquin River Depiction

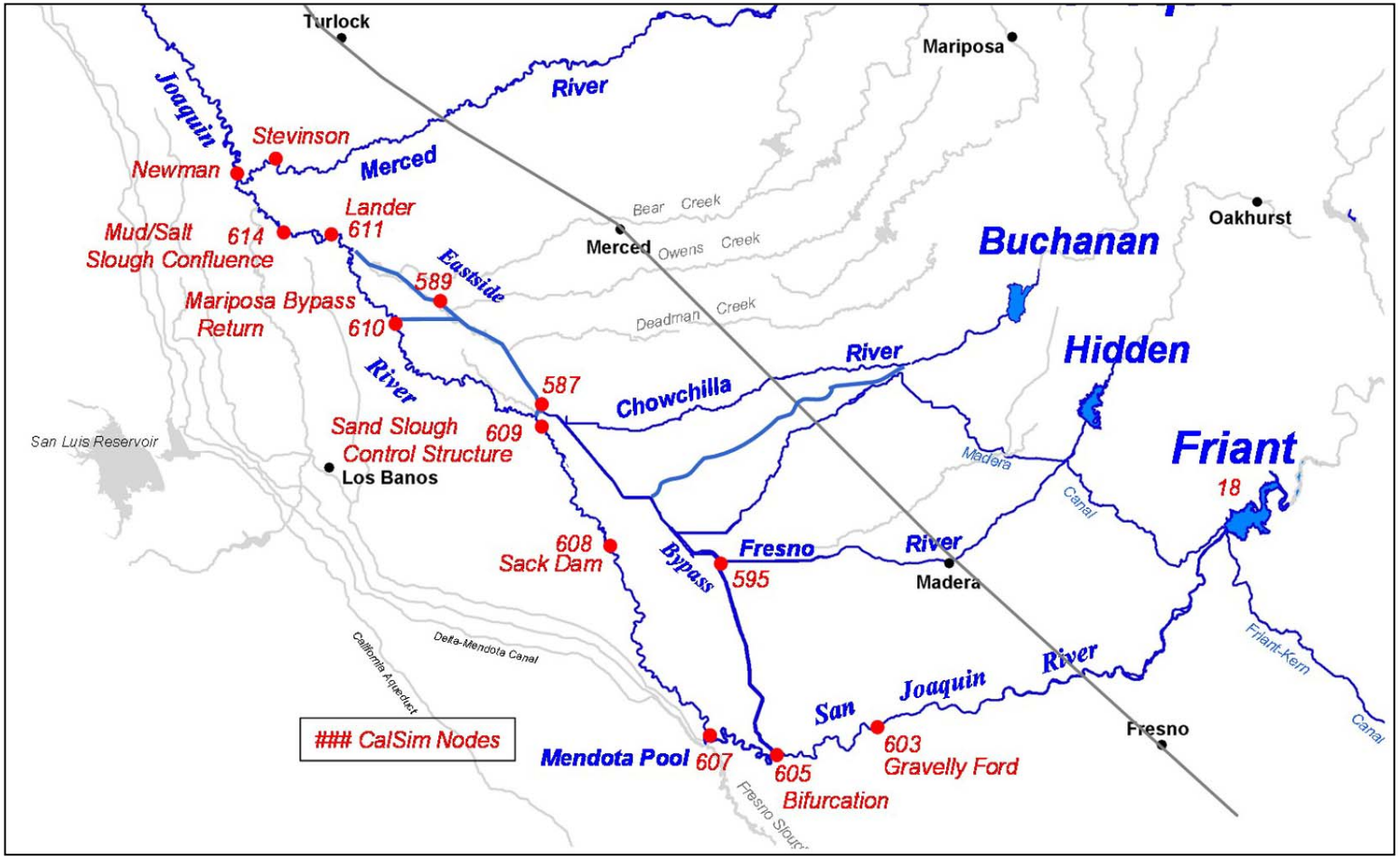
Recent Refinements
Upstream of Newman Operations and Accretions

Refinements and Modifications

- **Replaced large mass balance accretion-depletion term with explicit stream-reach losses and rainfall runoff term**
- **Refined stream-reach structure below Gravelly Ford to Lander Avenue**
- **Replaced boundary water quality equation at Lander Avenue with explicit water quality tracking below Gravelly Ford**

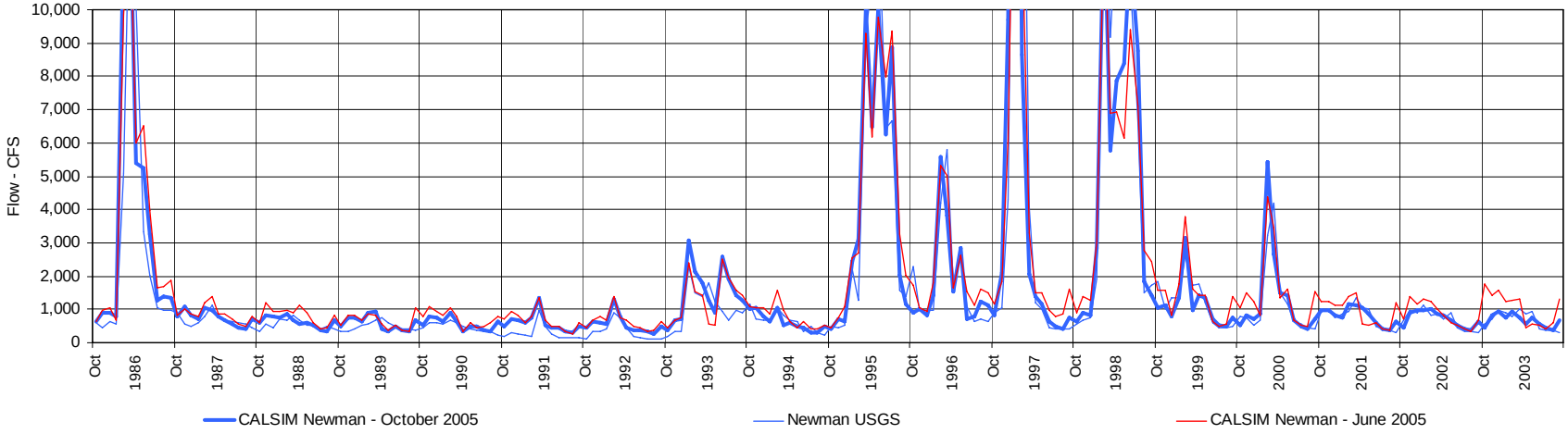
Mainstream San Joaquin River Depiction

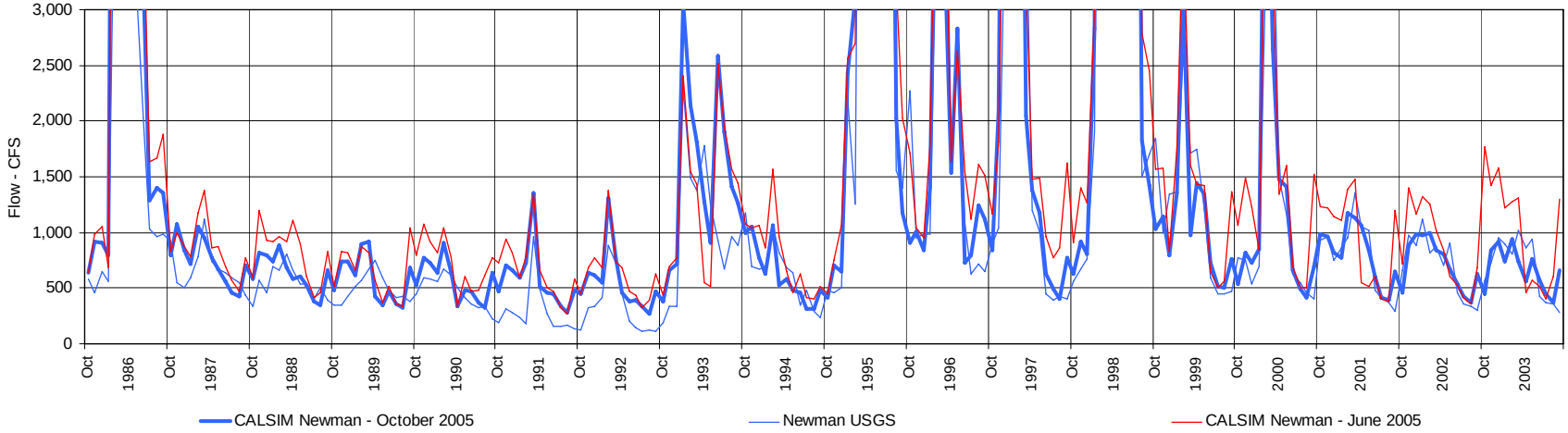
Recent Refinements
Upstream of Newman Operations and Accretions



Mainstream San Joaquin River Depiction

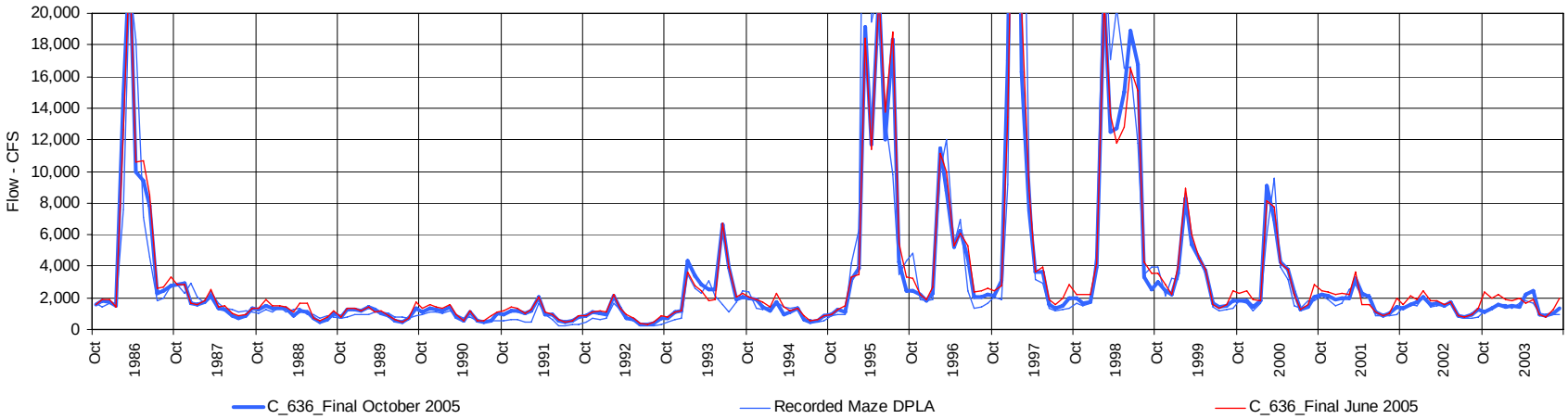
Flow at Newman before and after Refinements

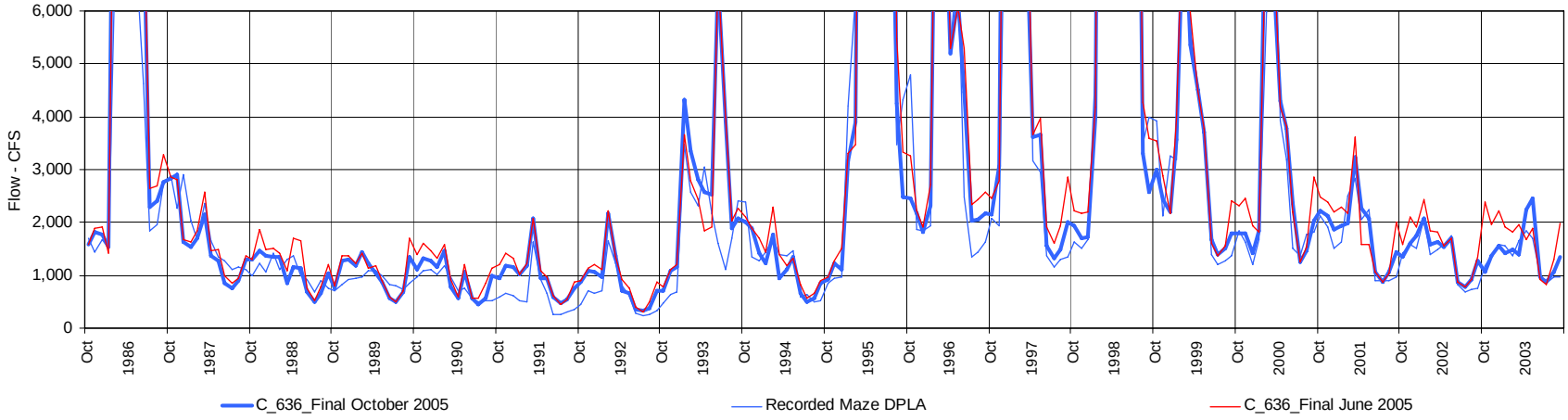




Mainstream San Joaquin River Depiction

Flow at Maze before and after Refinements

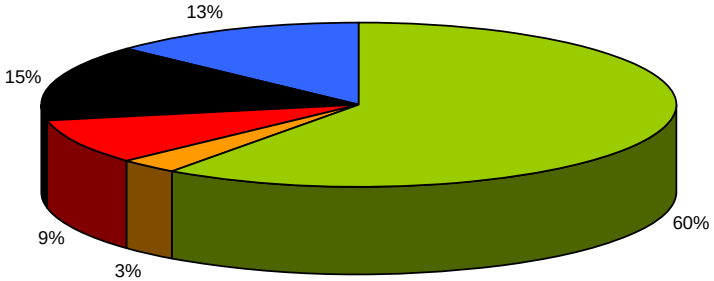




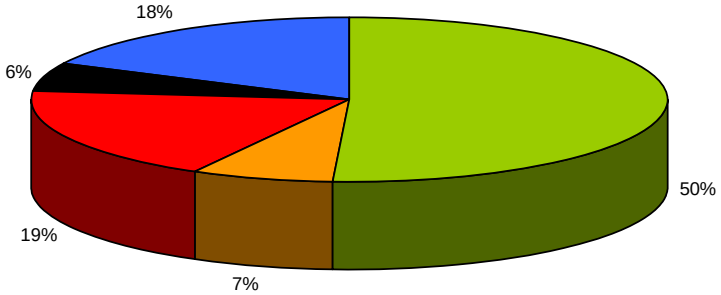
Mainstream San Joaquin River Depiction

General Disaggregation of Flow Reaching Vernalis

San Joaquin River Flow Components
Average of All Years
Vernalis Flow Approximately 3,000,000 Acre-feet



San Joaquin River Flow Components
Average of All Dry and Critical Years
Vernalis Flow Approximately 1,400,000 Acre-feet



	Average of All Years		Average of Dry Years	
	1,000 Acre-feet	Percent of Total	1,000 Acre-feet	Percent of Total
Major ES Tributary Inflow	**1,826**	**60**	**693**	**51**
Merced near Stevinson	*445*		*210*	
Tuolumne near Modesto	*834*		*343*	
Stanislaus near Ripon	*547*		*350*	
ES Surface Returns	**97**	**3**	**97**	**7**
West Side Surface Returns	**266**	**9**	**253**	**19**
Exchange Contractors & WM Areas	*222*		*216*	
Remaining West-side	*44*		*37*	
SE Tributary Inflow	**459**	**15**	**76**	**6**
SE Tributaries	*266*		*18*	
Rainfall Runoff	*193*		*58*	
Unmeasured Inflow	**398**	**13**	**242**	**18**
Local Creek Inflow	*365*		*209*	
Groundwater & Minor Drainage	*33*		*33*	
Totals	**3,046**	**100**	**1,361**	**100**

Mainstream San Joaquin River Depiction

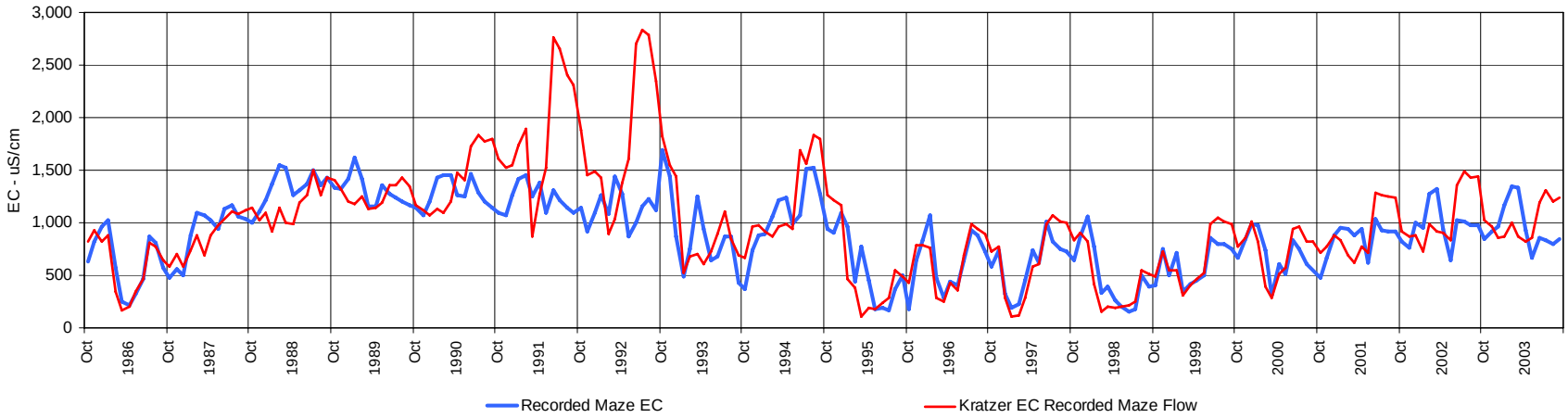
Previous Modeling Estimates of SJR Water Quality

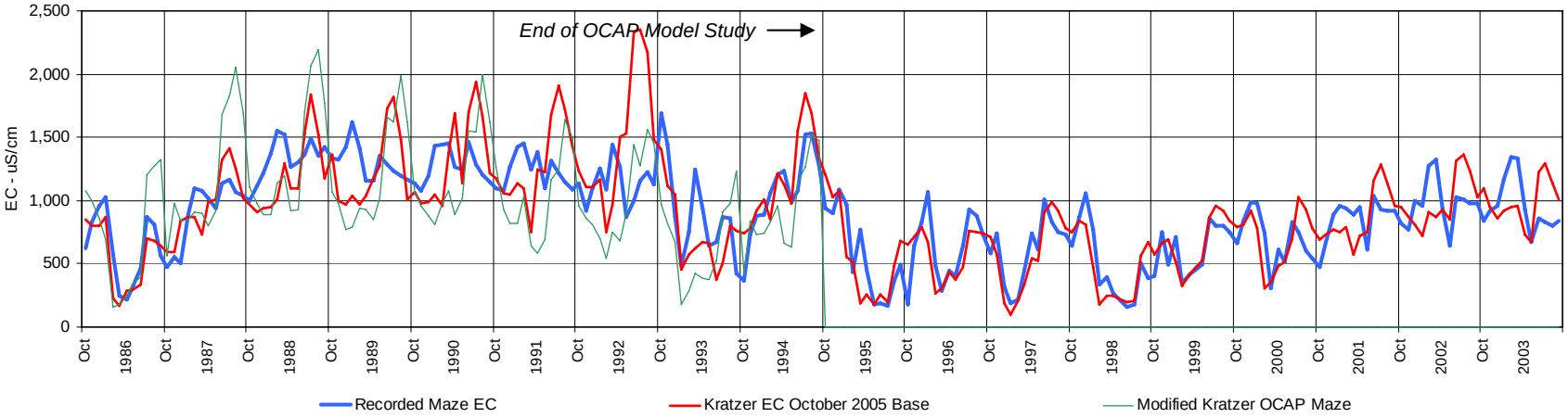
- **Original Kratzer equation estimates monthly average EC in the San Joaquin River at Maze Road bridge.**
  - **Single equation describes EC as a function of total flow at Maze**

- **SANJASM, DWRSIM and previous CALSIM II model used modified disaggregated method for estimating monthly average EC.**
  - **Explicit EC assigned to Westside return flows, blended with**
  - **Modified Kratzer equation describing the remaining flow at Maze**

Mainstream San Joaquin River Depiction

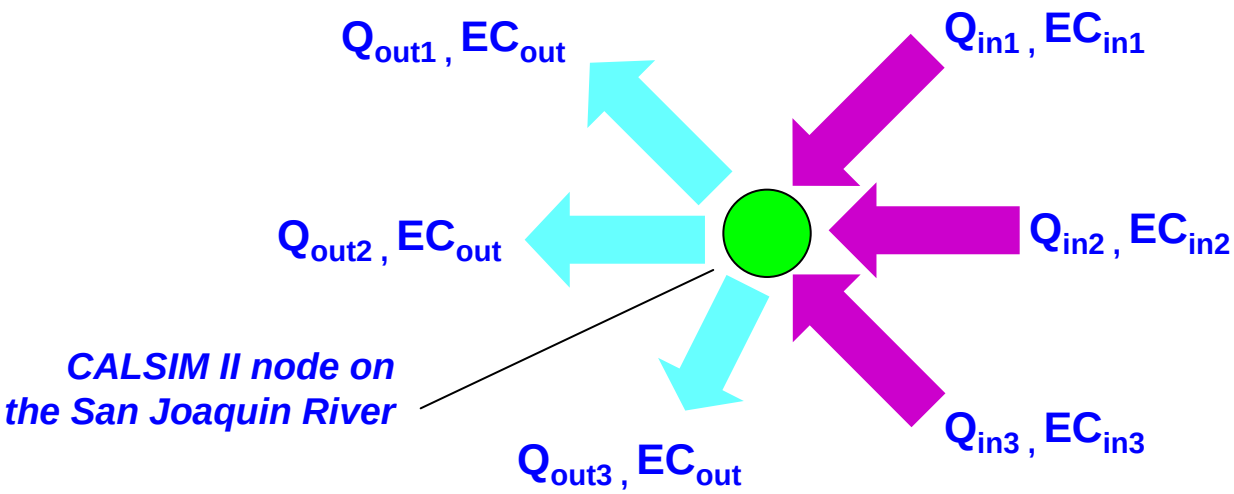
Previous Modeling Estimates of SJR Water Quality



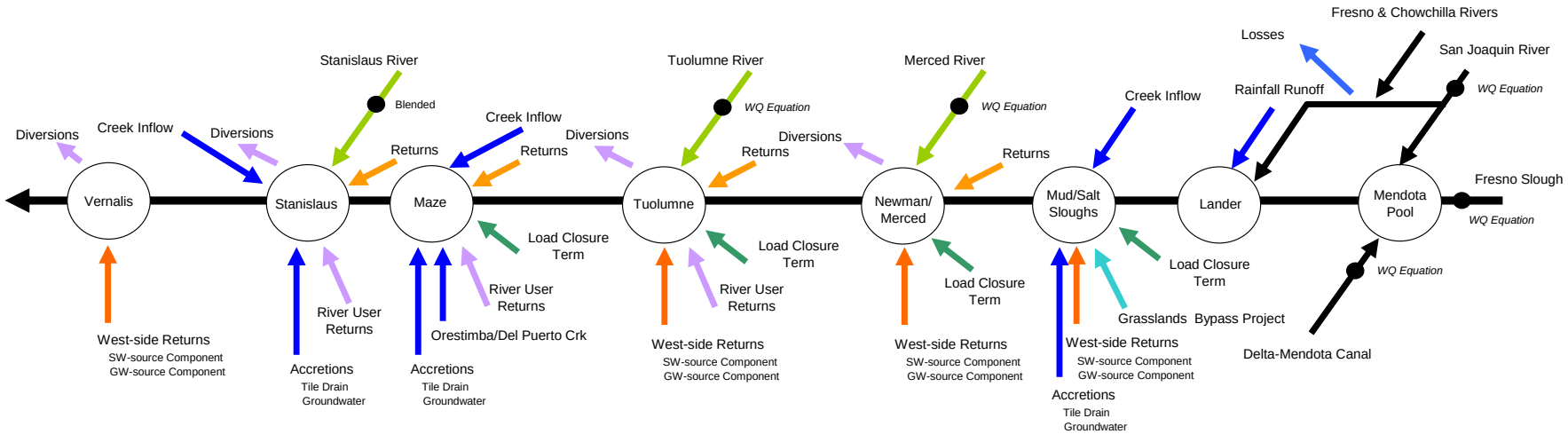


Mainstream San Joaquin River Depiction

New Approach
Flow and Quality Disaggregation
Mass Balance



Mainstream San Joaquin River Depiction



Disaggregation Water Quality Assumptions

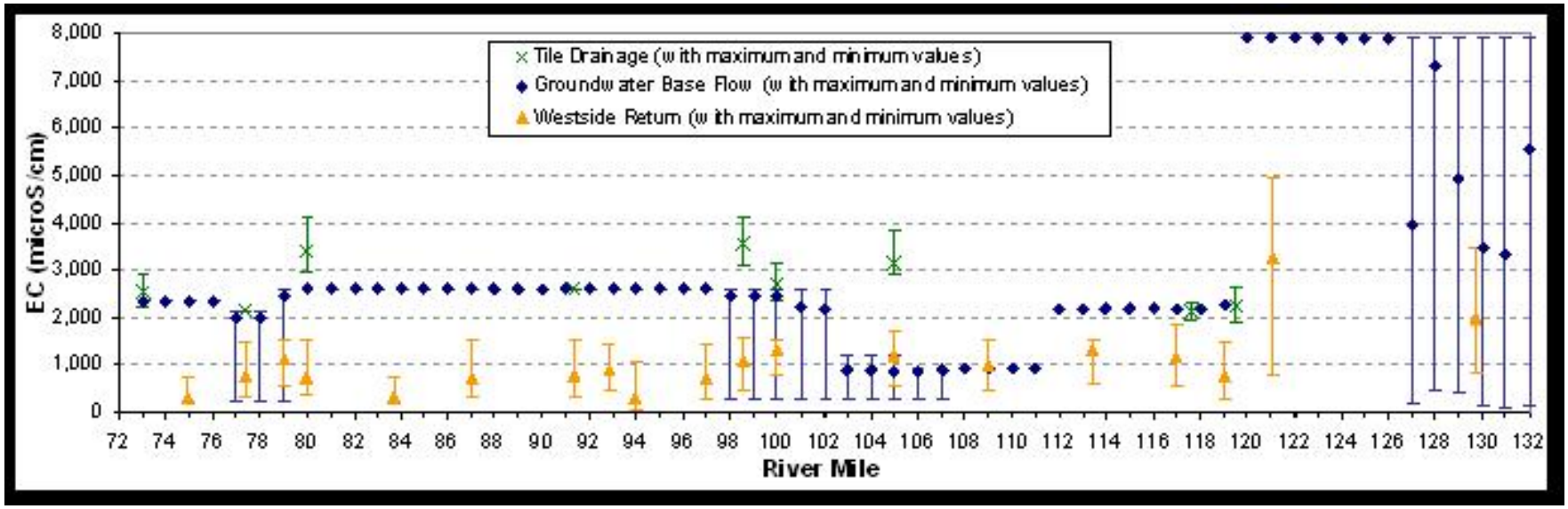
Tributaries	
San Joaquin River at Bifurcation	Assumed value, 100 µS/cm
Fresno Slough at Mendota Pool	Assumed value, 100 µS/cm
Merced River near Stevinson	Flow v EC equation (1999-2004 gage record)
Tuolumne River near Modesto	Flow v EC equation (1999-2004 gage record)
Stanislaus River near Ripon	Mass balance (Goodwin value 85 µS/cm)
Tributary Accretions	Single monthly array (CALSIM II, 2002)
Eastside Returns	
Districts and Adjacent Lands	Single monthly array (CALSIM II, 2002)
West-side Returns	
Grassland Bypass Project	Single monthly array (Grassland Bypass Project data, 1997-2003)
Exchange Contractors	Single monthly array (Data, 2000-2003)
Wildlife Management Areas	WETMANSIM-031604-ver01.00 (Flow weighted average)
Adjacent Lands	Year type variable monthly array (SJRIO, 2003 version)
DMC Districts	Year type variable monthly array (SJRIO, 2003 version)

Mainstem Accretions	
Local Runoff	Not assigned (Included in load closure term)
Groundwater	Year type variable monthly array (SJRIO, 2003 version)
Tile Drainage	Year type variable monthly array (SJRIO, 2003 version)
Orestimba/Del Puerto Cr	Not assigned (Included in load closure term)
Rainfall Runoff upstream of Merced	Assumed value, 100 µS/cm
DMC into Mendota Pool	Year type variable monthly array
Mud/Salt Slough Base Flow	Single monthly array (Grassland Bypass Project data)

Mainstream San Joaquin River Depiction

Disaggregation Water Quality

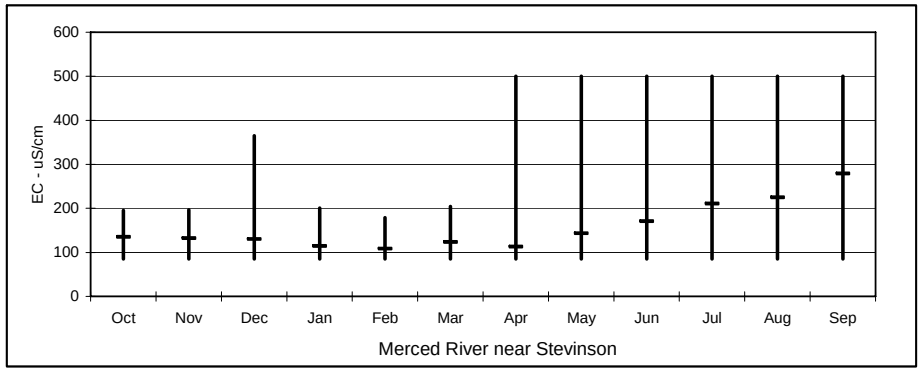
Assumptions for Mainstem Groundwater Base Flow, Tile Drainage and West-side Returns

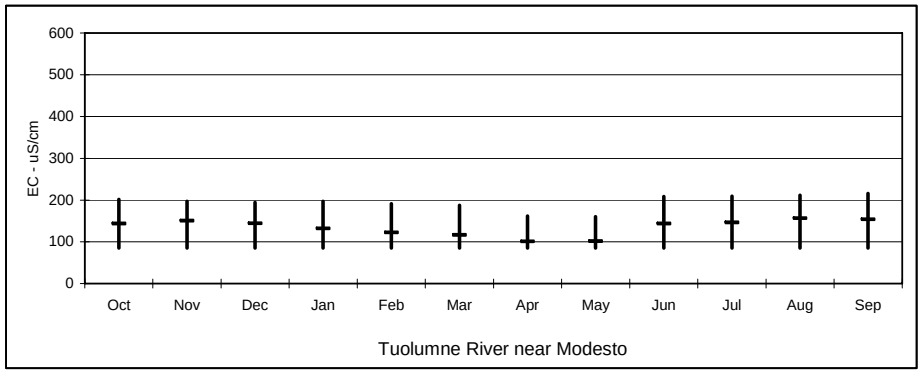


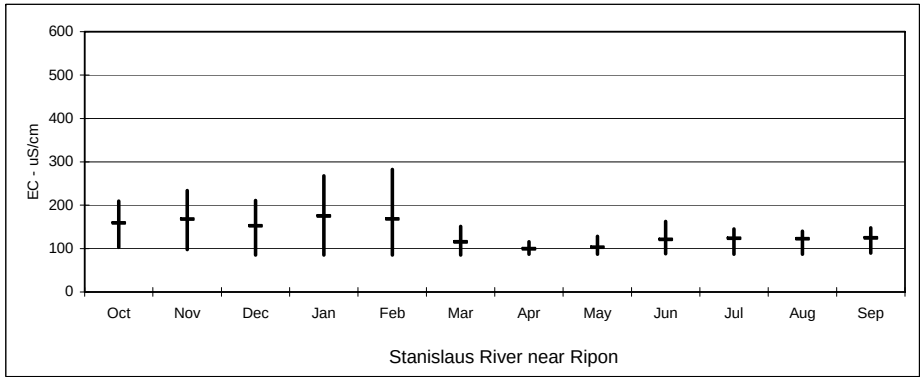
Mainstream San Joaquin River Depiction

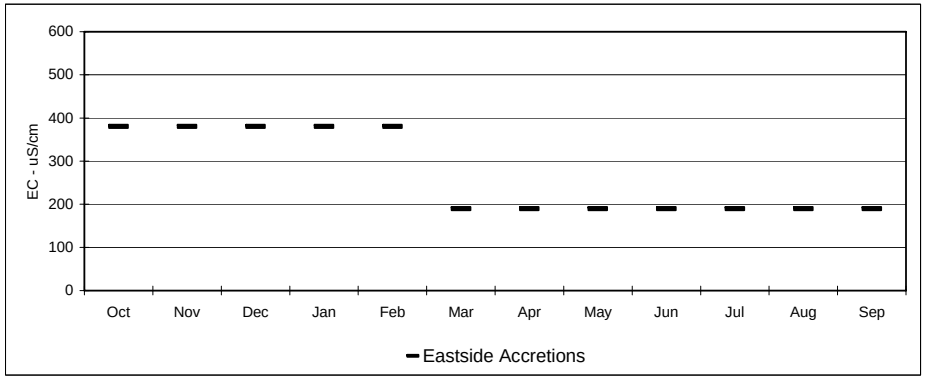
Disaggregation Water Quality

Results of Eastside Tributaries
Range of Values for 1922-2003 Simulation Period





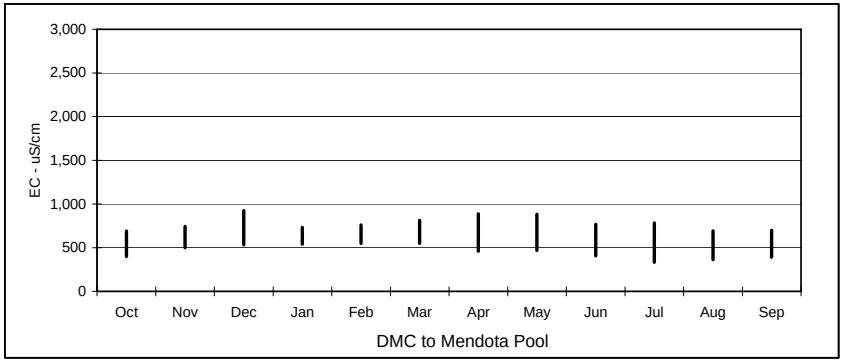


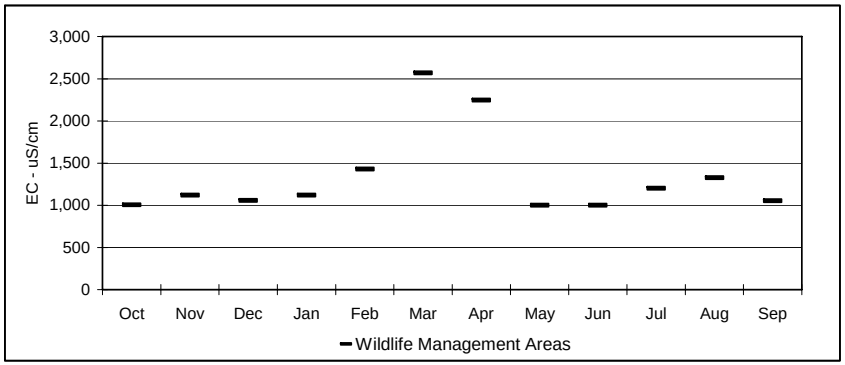


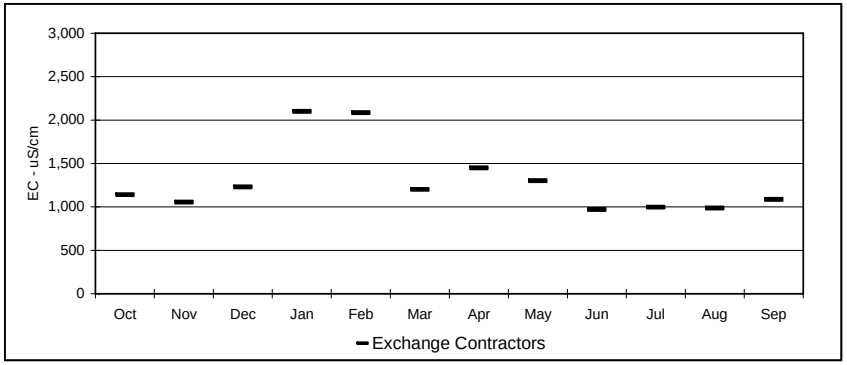
Mainstream San Joaquin River Depiction

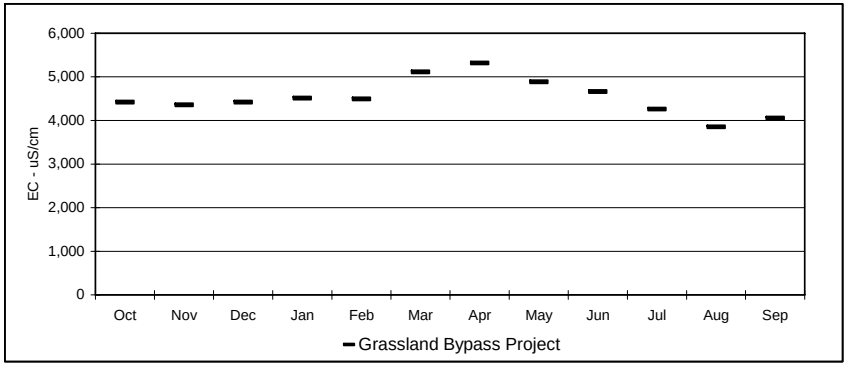
Disaggregation Water Quality

Additional West-side Assumptions
Range of Values for 1922-2003 Simulation Period









Mainstream San Joaquin River Depiction

Water Quality Calibration

Initial water quality result less than acceptable

- **Attempt to assign water quality to calculated accretions**
- **Results compared at Newman (Hills Ferry), Maze and Vernalis**
- **Mixed results with no systematic resolution**

Developed “Load Closure” methodology

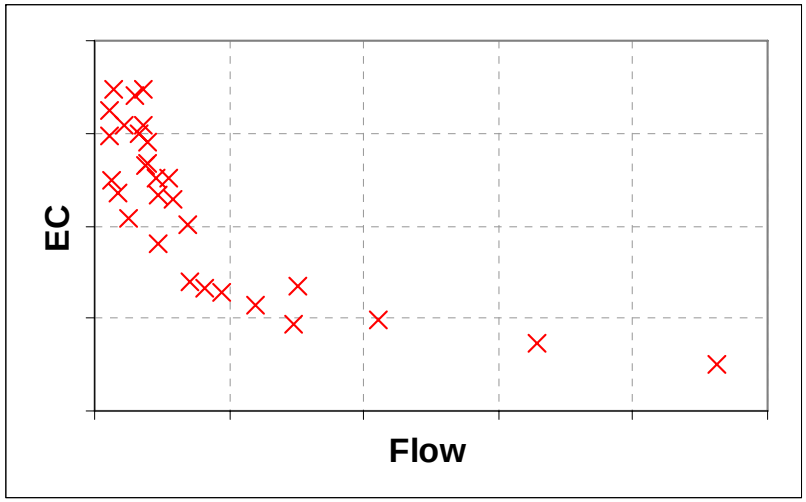
- **Adds loading to mass balance**
- **Calibrated to recent Newman (Hills Ferry) and Maze records**

Mainstream San Joaquin River Depiction

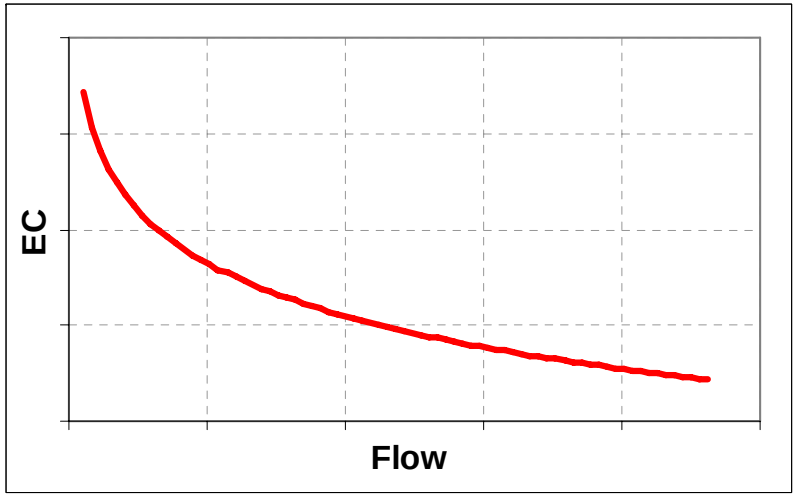
Water Quality Calibration

- **Step 1: Develop equations for the relationship between historical flow and EC**
  - **Newman (Hills Ferry), 3 equations: Aug-Nov, Dec-Mar, and Apr-Jul**
  - **Maze, 6 equations: Aug-Sep, Oct-Nov, Dec-Jan, Feb-Mar, Apr-May, and Jun-Jul**

Flow-EC Relationship Based on Historical Gage Records



Best Fit Regression Equation

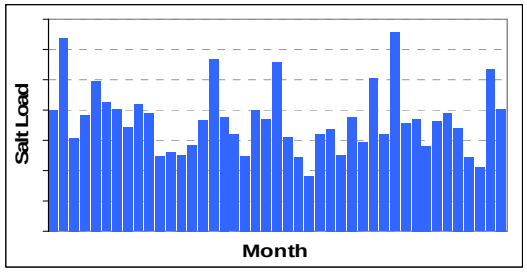


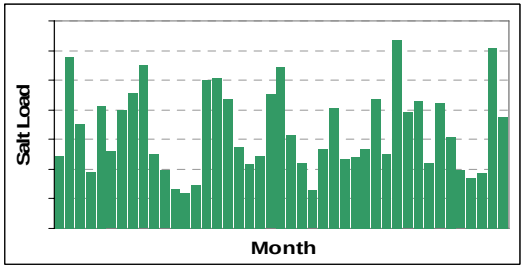
Mainstream San Joaquin River Depiction

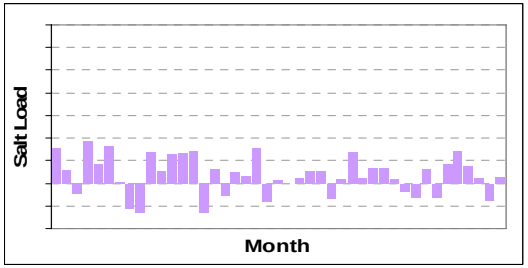
Water Quality Calibration

- **Step 2: Calculate expected load based on modeled flow and EC equation, remove load of explicit modeled flows and determine residual load (missing load)**

Expected Load - **Explicit Modeled Load** = **Residual Load**





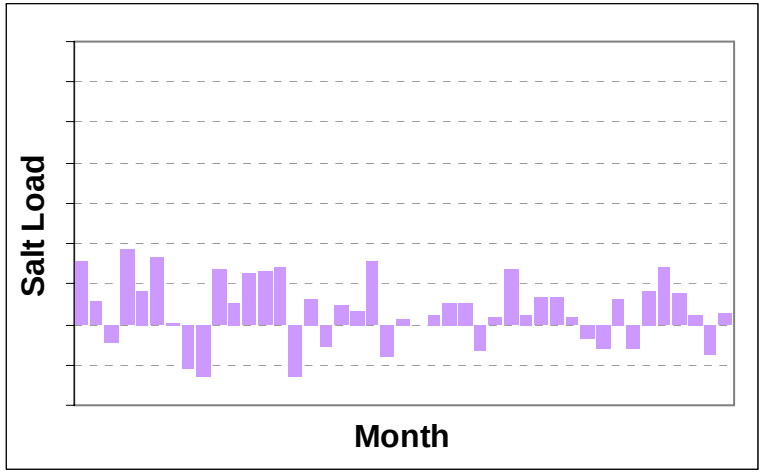


Mainstream San Joaquin River Depiction

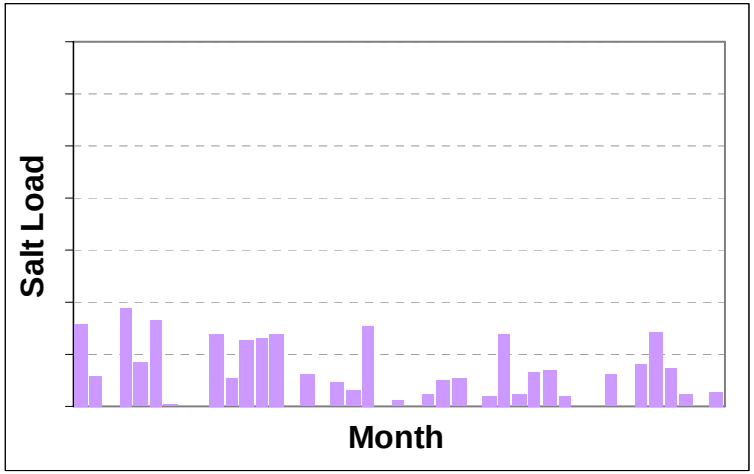
Water Quality Calibration

- **Step 3: Input "positive" residual loads (adding load to mass balance thereby increasing salinity) as a time-series in CALSIM II upstream of Newman (Hills Ferry) and Maze**

Calculated Residual Load



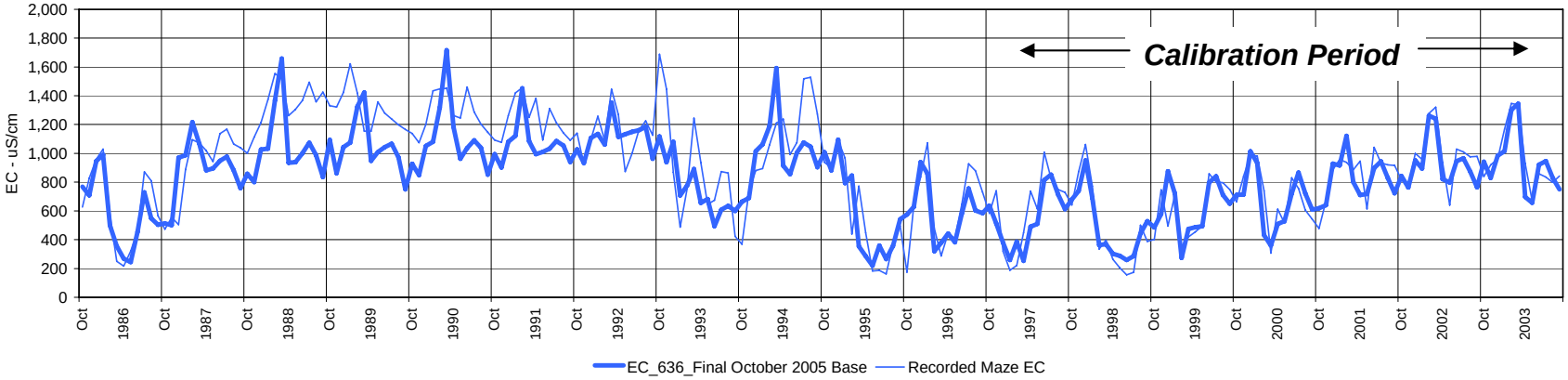
Positive Residual Loads Only



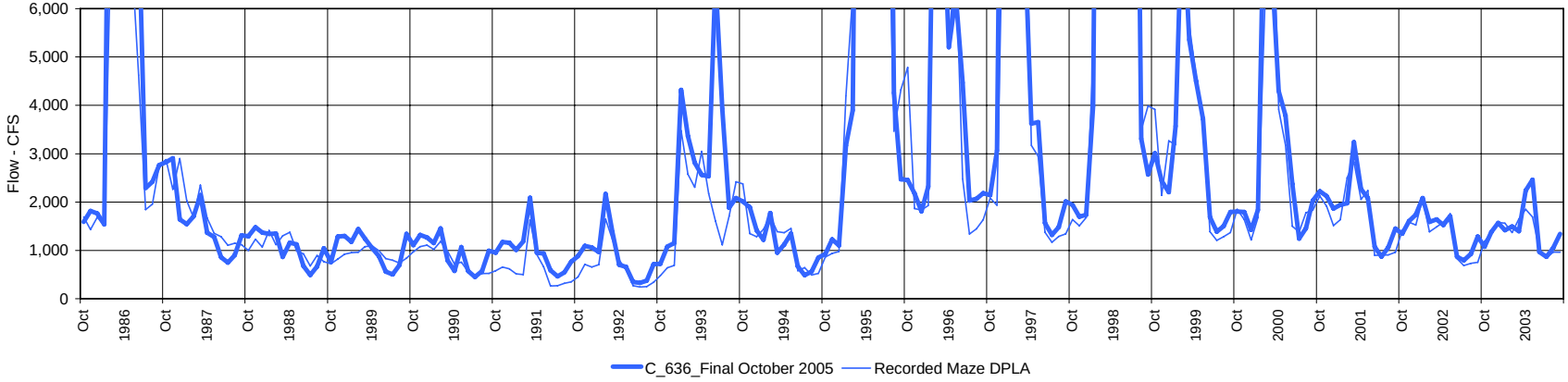
Note: Results indicate that "negative" residuals (over-estimation of salinity with explicit parameters) do not occur during months when New Melones water quality releases are required.

Mainstream San Joaquin River Depiction

Water Quality Results - Maze



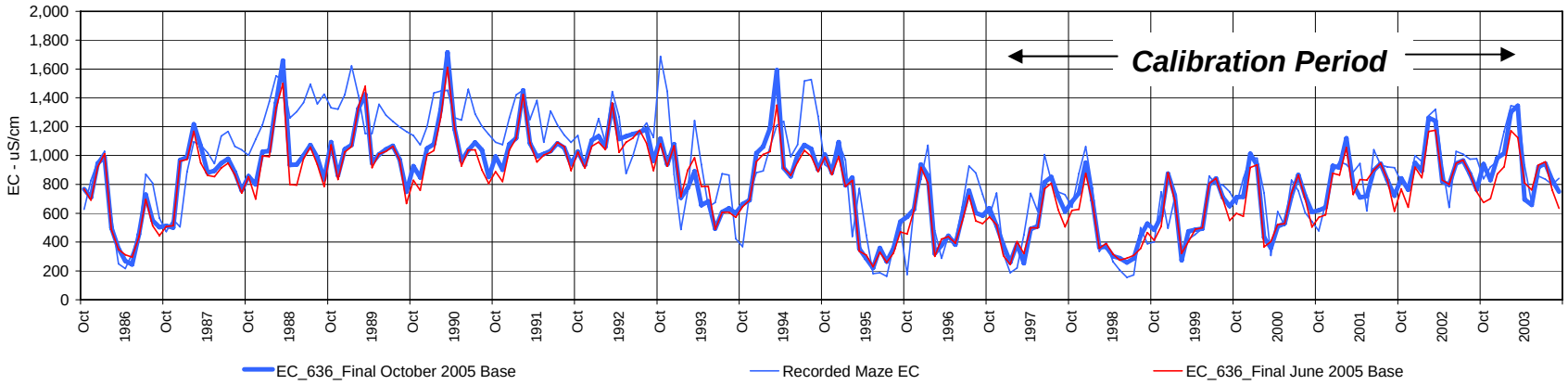
Flow Results - Maze



Mainstream San Joaquin River Depiction

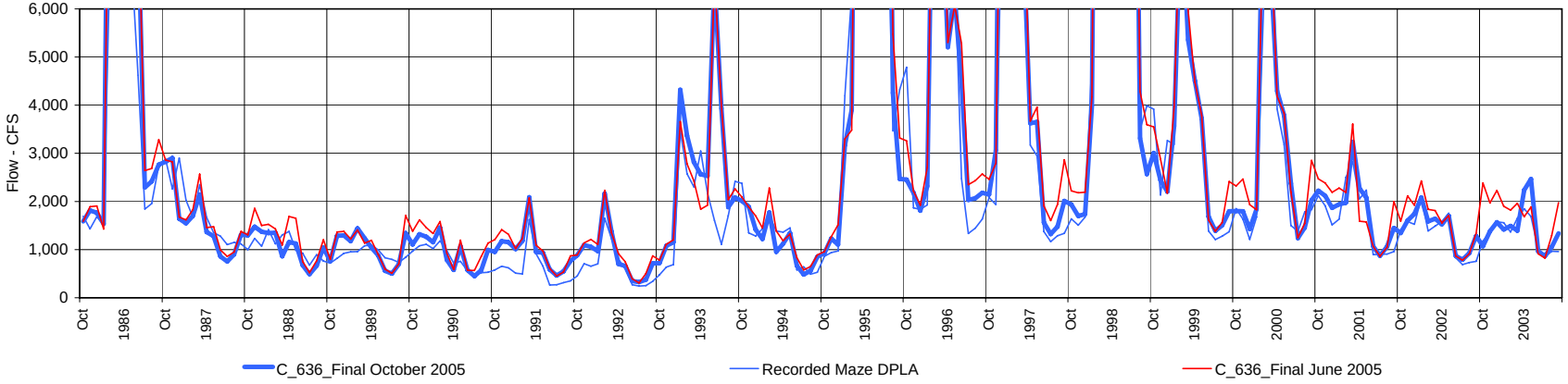
Water Quality Results – Maze

Comparison to June Model



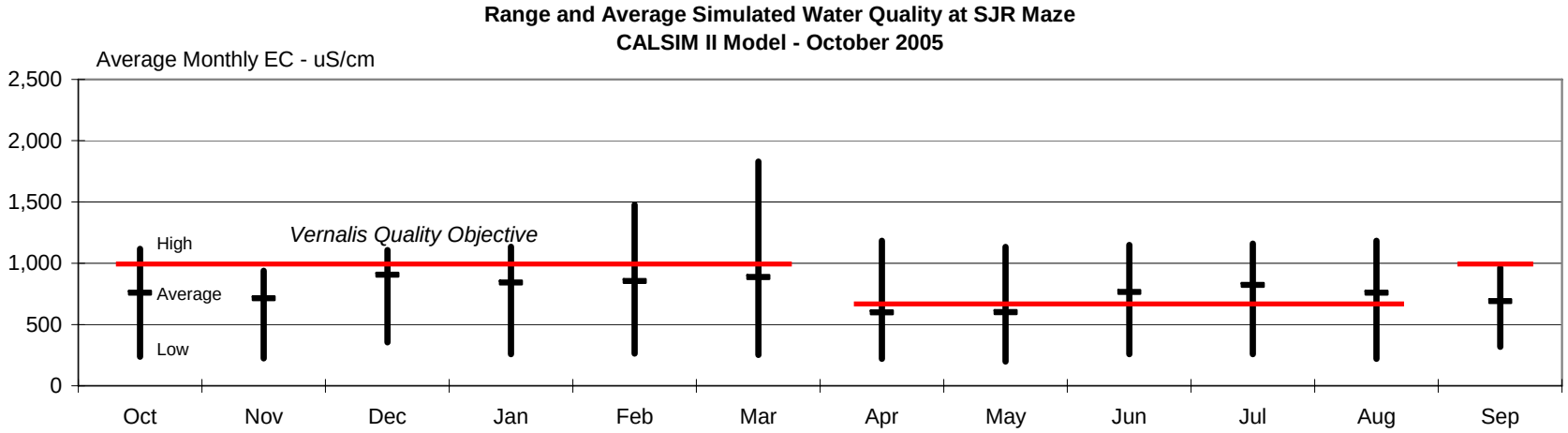
Flow Results – Maze

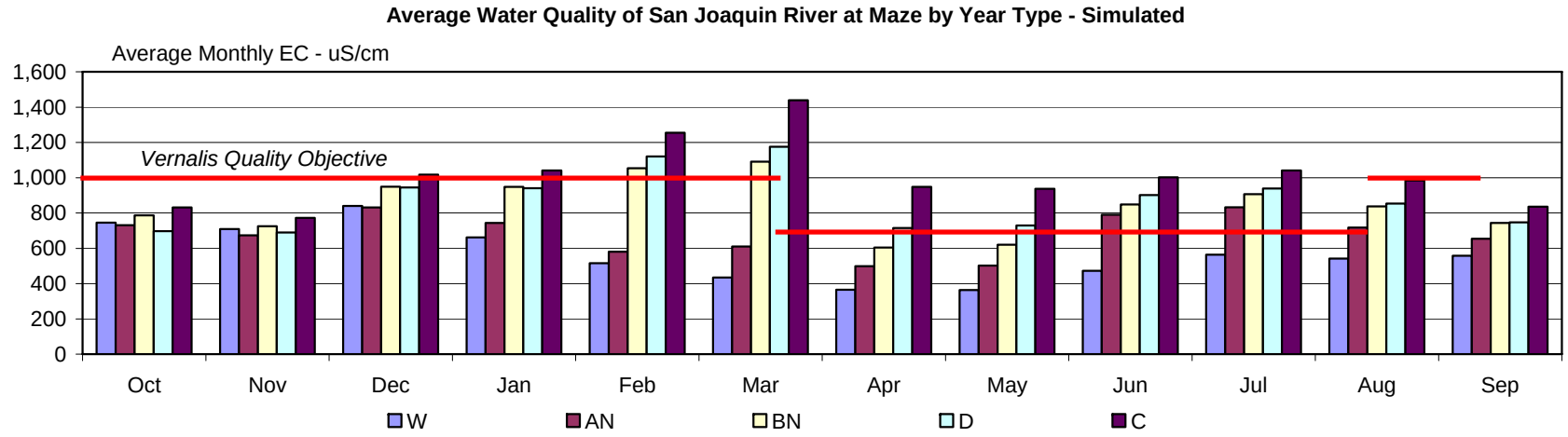
Comparison to June Model



Mainstream San Joaquin River Depiction

Water Quality Results – Maze

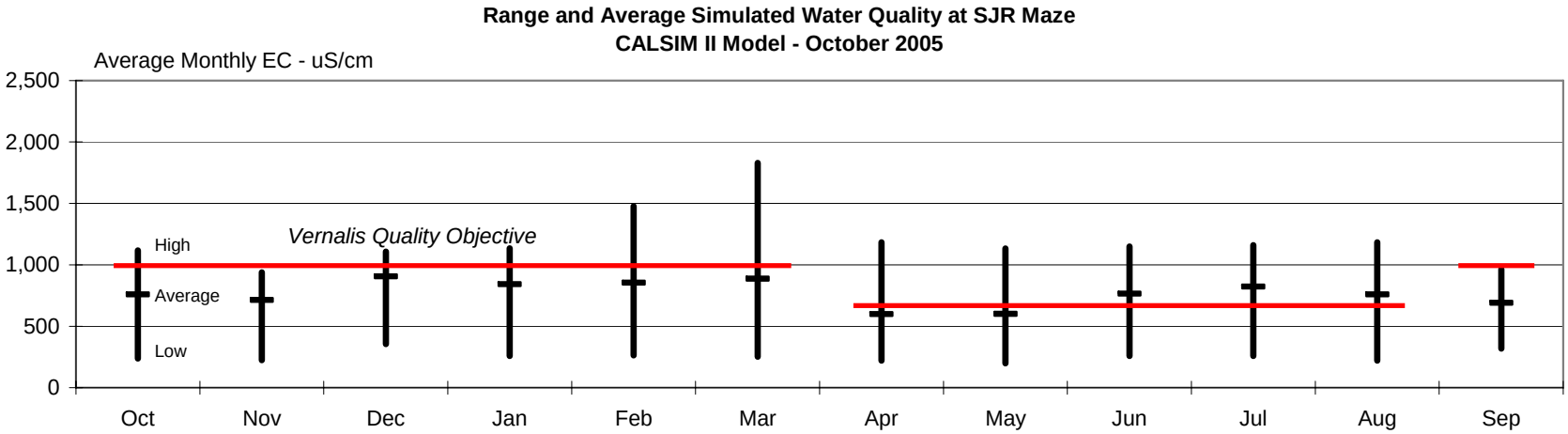


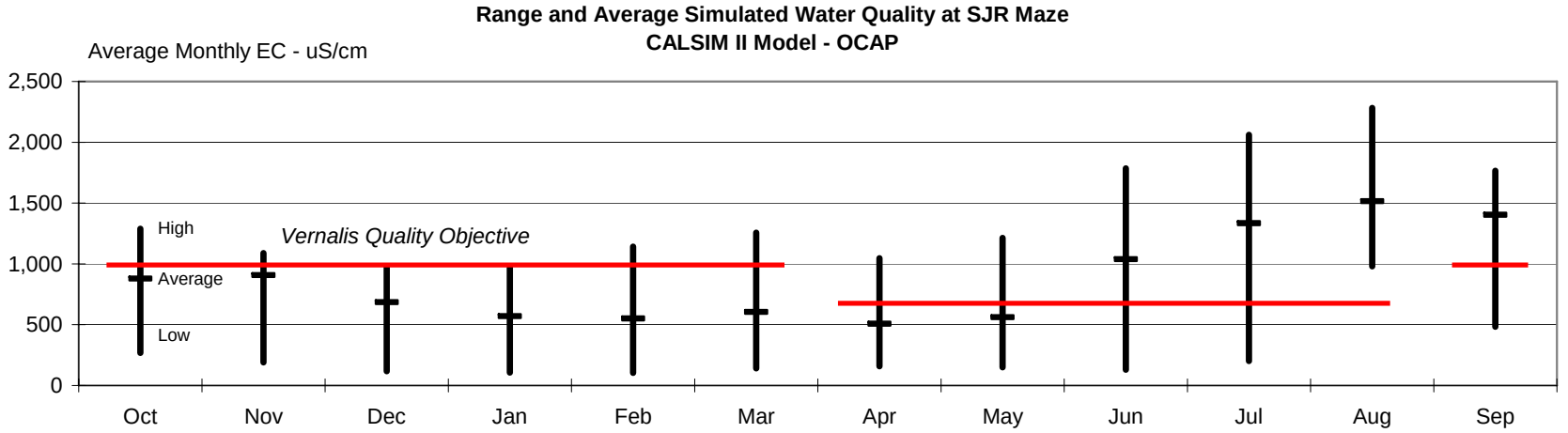


Mainstream San Joaquin River Depiction

Water Quality Results – Maze

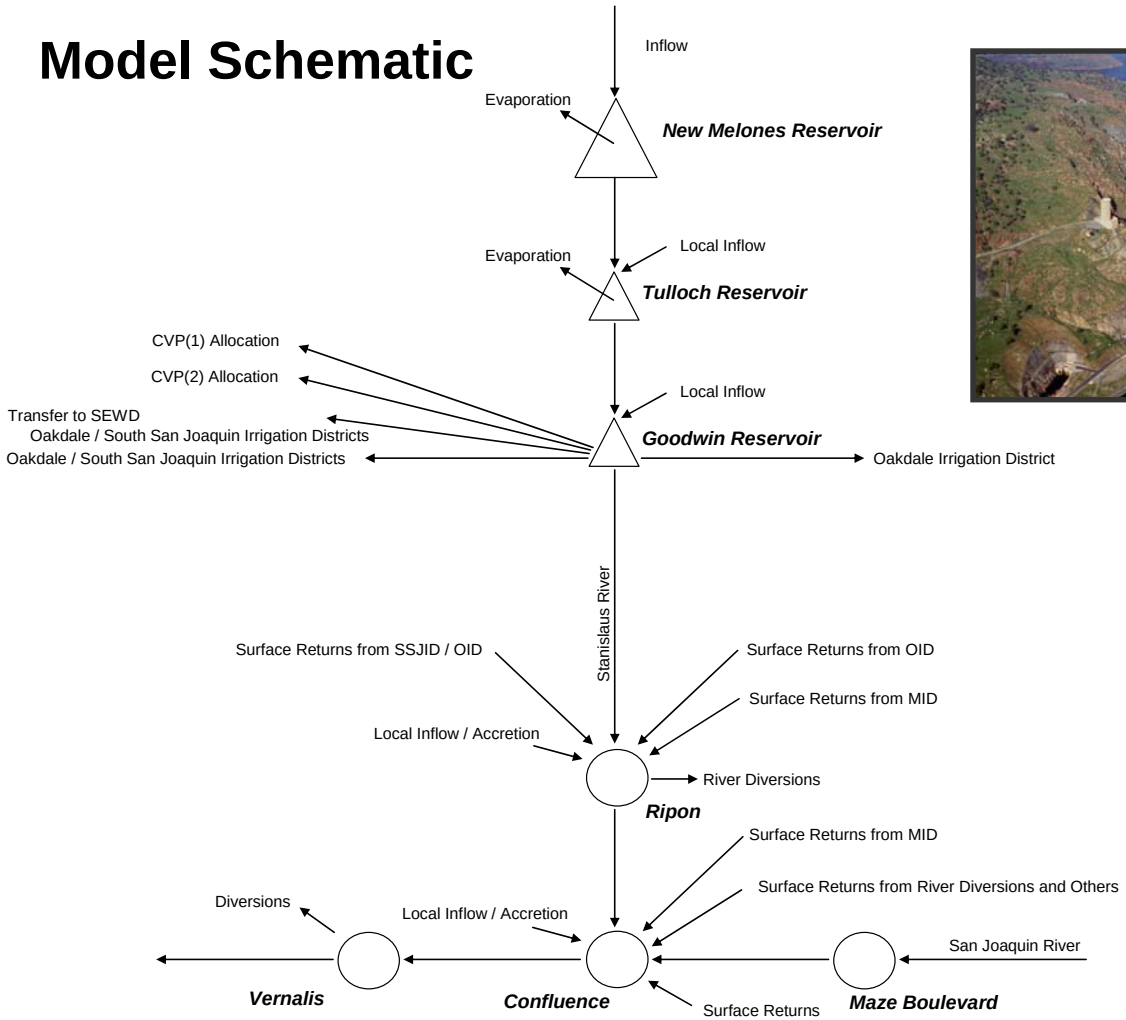
Comparison to Earlier Modeling





Vernalis and New Melones Results

Model Schematic



Simulation of San Joaquin River at Vernalis

New Melones Interim Plan of Operations

New Melones Storage Plus Inflow		Fishery		Vernalis Water Quality		Bay-Delta		CVP Contractors*	
From	To	From	To	From	To	From	To	From	To
0	1,400	0	98	0	70	0	0	0	0
1,400	2,000	98	125	70	80	0	0	0	0
2,000	2,500	125	345	80	175	0	0	0	59
2,500	3,000	345	467	175	250	75	75	90	90
3,000	6,000	467	467	250	250	75	75	90	90

* CVP Contractors: Stockton East Water District and Central San Joaquin Water Conservation District

1. Releases for the fishery according to an assumed pattern associated with the allocated volume.
2. Releases up to the amount needed above the fishery release to meet the Vernalis water quality requirement, these accumulated releases cannot exceed the annual Vernalis water quality allocation.
3. Releases for DO at Ripon (surrogated as a flow requirement at Goodwin), with no volume limitation except the flow requirement itself.
4. Releases for the Vernalis D-1641 Bay-Delta flow requirement. The IPO assumed that the Vernalis flow requirement release occurred as the second step; however, for modeling simplicity the release is modeled last. Results are rarely affected by the shift in order.

Simulation of San Joaquin River at Vernalis

Vernalis Objectives

The current water quality objective at Vernalis is a running 30-day average of 700 uS/cm for April 1 through August 31, and 1000 uS/cm for September 1 through March 31.

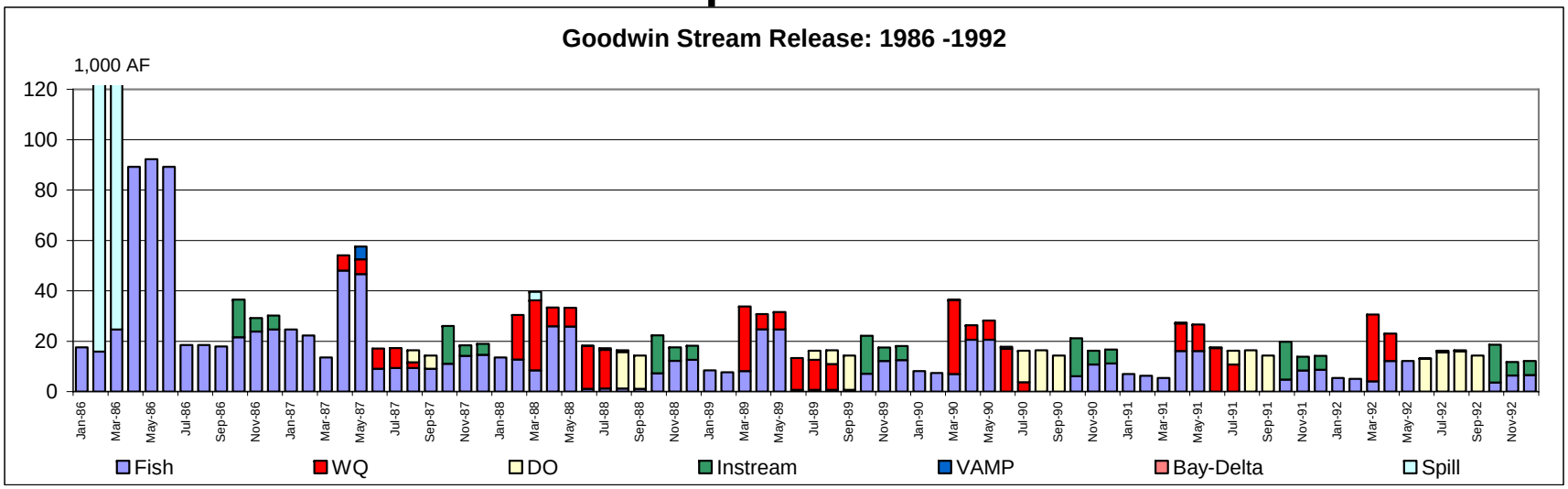
For the February through June non-pulse period (cfs):

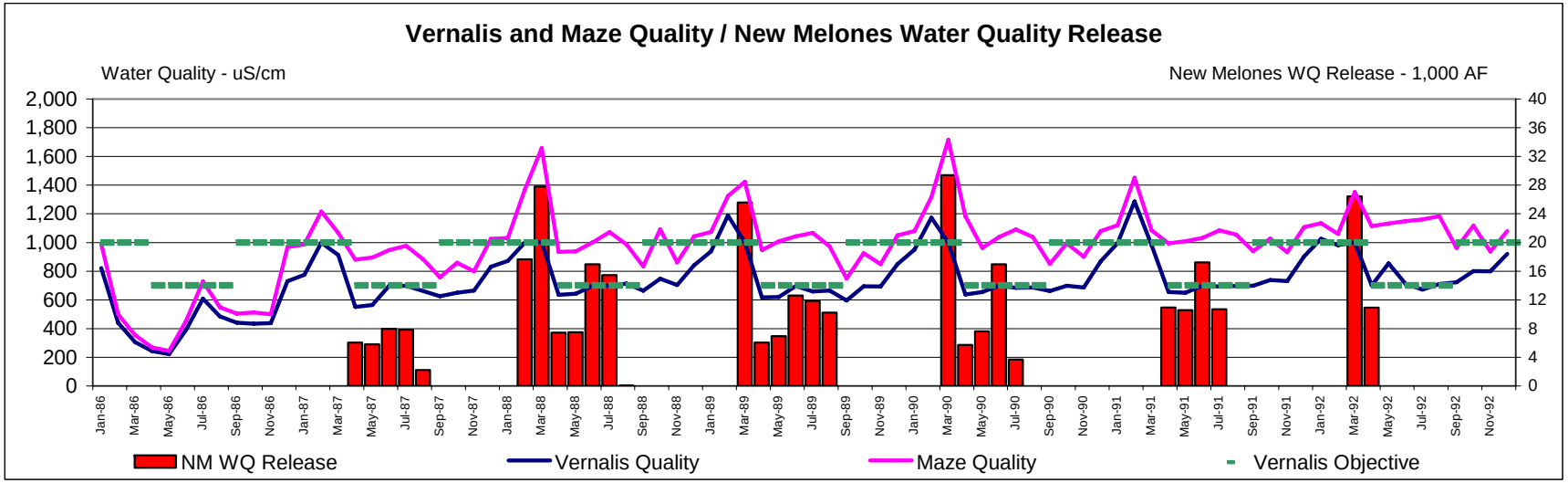
San Joaquin Basin Index	X2 Required At or West of Chipps	X2 Required East of Chipps
Wet	3420	2130
Above Normal	3420	2130
Below Normal	2280	1420
Dry	2280	1420
Critical	1140	710

October objectives

Simulation of San Joaquin River at Vernalis

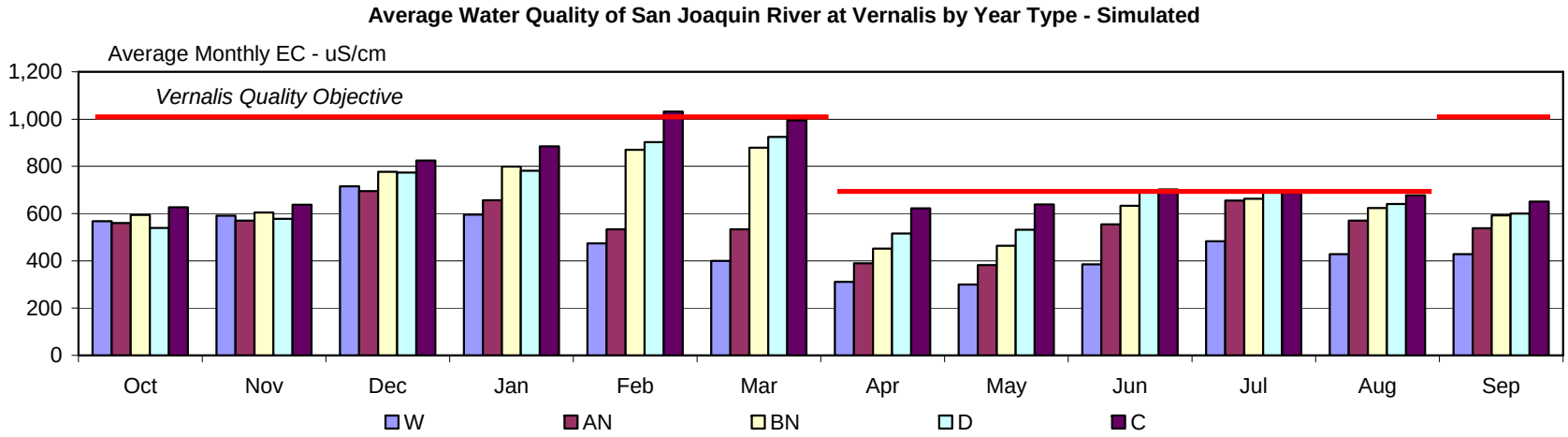
New Melones Operations and Vernalis





Simulation of San Joaquin River at Vernalis

Vernalis Water Quality Compliance



Water Quality Exceedences

Average Monthly Water Quality at Vernalis - Simulated (uS/cm)												
WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1961	C	C	C	C	1038	C	C	C	C	C	C	C
1977	C	C	C	C	C	C	C	C	C	C	718	C
1988	C	C	C	C	C	C	C	C	C	C	715	C
1989	C	C	C	C	1189	C	C	C	C	C	C	C
1990	C	C	C	C	1173	C	C	C	C	C	C	C
1991	C	C	C	C	1287	C	C	C	C	C	C	C
1992	C	C	C	1026	C	C	C	1013	712	C	710	C
1994	C	C	C	C	C	C	C	C	751	705	711	C
Notes: "C" means water quality was within compliance for month. Exceedence during April or May is during non-pulse flow period.												

Simulation of San Joaquin River at Vernalis

Vernalis Flow Compliance

Water	Vernalis Flow Objective - cfs					Above/Below Flow Objective - cfs					NM
Year	Feb	Mar	Apr	May	Jun	Feb	Mar	Apr	May	Jun	Index - TAF
1922	3420	3420	3334	3420	3420	2331	1450	3199	2533	10071	2271
1923	3420	3254	2689	3378	2818	1630	0	3740	836	0	2506
1924	784	1043	710	710	710	1362	760	695	590	315	1784
1925	2034	2280	2165	2280	1907	829	267	998	1522	201	2192
1926	1666	2280	1993	2280	1420	593	-248	752	-78	31	1954
1927	3420	3420	3420	3420	3205	631	-155	107	80	-955	2393
1928	2250	2280	2280	2280	1535	512	3103	1226	546	220	2390
1929	802	1001	810	710	724	1450	992	956	829	607	1898
1930	1140	1140	1126	932	710	1044	880	410	668	503	1765
1931	848	738	782	710	710	1250	914	497	685	341	1394
1932	3376	3420	3377	2921	3162	1406	-575	-1147	30	-1075	1828
1933	1635	1448	2079	1448	1449	530	629	-360	365	18	1575
1934	1140	1140	1040	710	710	1073	726	225	638	360	1273
1935	3420	3420	3248	3420	3334	-1018	-625	1162	52	-889	1611
1936	3376	3420	3377	3420	2861	7905	3674	3470	949	-633	2193
1937	2360	3420	3420	3420	3377	12840	7171	5743	5176	-601	2409
1938	3420	3420	3420	3420	3420	20643	26568	13867	18645	16990	3504
1939	1696	1503	2079	1420	1420	1399	1804	25	548	24	2331
1940	3376	3420	3420	3420	2947	763	3745	4177	1639	0	2698
1941	3420	3420	3420	3420	3420	12375	8387	6596	6248	4679	2874
1942	3420	3420	3291	3420	3334	6155	2814	4906	5910	5074	3100
1943	3420	3420	3420	3420	2732	6249	16453	5254	2058	2490	3090
1944	1687	2280	2108	1448	1707	1416	904	497	844	358	2379
1945	3420	3420	3248	3045	2947	7016	4923	2039	1387	0	2655
1946	3420	3420	3291	3378	2861	2482	1966	746	1262	117	2738
1947	1604	2280	2251	1503	1420	1336	-306	-561	103	52	2221
1948	2250	1475	1850	2280	2194	-312	346	264	-211	-3	2133
1949	1574	1642	2280	2225	1735	568	796	-423	-257	84	1965
1950	2280	2280	2251	2280	1936	3	-139	-225	-519	398	2157
1951	3420	3420	3377	3045	2388	6293	2624	398	-97	0	2695
1952	3376	3420	3420	3420	3420	938	9405	7887	14137	13069	3410
1953	2280	2280	2165	2225	1735	2051	0	643	1159	520	2695
1954	2280	2280	2280	2280	1649	0	-89	395	571	199	2408
1955	2280	1697	1621	1448	1649	-163	276	273	490	-194	[illegible]
1956	3376	3420	3420	3378	3377	8400	3356	1735	2064	5166	[illegible]
1957	1696	2280	2280	1614	1993	745	0	[illegible]			
1958	3420	3420	3420	3420	3420	292	6845	[illegible]			
1959	2280	2280	2137	1531	1420	1359	617	[illegible]			
1960	918	1140	1140	863	724	1476	681	[illegible]			
1961	864	1140	1054	724	710	1047	567	[illegible]			
1962	1696	2280	2223	2280	1592	3442	1307	[illegible]			
1963	3420	3420	3248	3420	3377	-412	-978	[illegible]			
1964	2250	1781	1535	1448	1449	-125	61	[illegible]	[illegible]	[illegible]	[illegible]
1965	3420	3420	3162	3420	2947	2846	1796	4088	296	0	[illegible]
1966	2280	2280	2251	2225	1449	2352	433	-421	-376	-96	[illegible]
1967	3420	3420	3420	3420	3420	-861	1563	12061	11119	13156	3188
1968	2250	2280	2251	1475	1420	932	173	194	873	88	2413
1969	3420	3420	3420	3420	3420	25053	17743	16343	22651	22300	3474
1970	3420	3420	3420	2130	2216	5115	3834	-41	838	0	2720
1971	2280	2280	2280	2252	2108	154	539	805	836	0	2609
1972	2250	2280	2280	1725	1477	0	-559	-489	33	-78	2247
1973	3420	3420	3420	3295	3334	1455	1011	788	167	0	2569
1974	3420	3420	3420	3420	3334	1191	4664	2935	951	2883	3024
1975	3420	3420	3420	3129	3420	4338	4384	2296	-54	3815	2927
1976	799	793	839	710	710	1628	1095	826	863	523	2199
1977	771	724	710	710	710	985	551	300	697	25	1588
1978	3420	3420	3420	3420	3334	3374	5442	8294	6622	6037	2257
1979	3420	3420	3420	2837	3291	4803	5542	1712	5474	-91	2541
1980	3376	3420	3420	3295	2861	19234	12561	3741	3660	7373	3005
1981	2280	2280	2251	1559	1420	234	495	288	874	77	2381
1982	3420	3420	3420	3420	3420	13891	12426	24170	14546	7636	3419
1983	3420	3420	3420	3420	3420	31148	45118	17926	22304	24564	3965
1984	3376	3420	3420	2588	2775	6598	3678	1175	1360	118	2765
1985	1727	2197	1879	2003	1420	1278	429	257	265	103	2352
1986	3420	3420	3420	3337	2732	13985	25129	8543	7835	6841	3149
1987	848	1140	1126	710	710	1255	1415	312	715	503	2190
1988	1125	890	796	710	710	764	587	707	703	300	1713
1989	864	863	1140	1126	710	761	938	197	25	178	1597
1990	1140	807	1025	710	710	525	599	-112	742	168	1268
1991	741	724	1126	710	710	615	1602	114	545	189	989
1992	784	1140	1068	738	710	1616	753	-27	-107	-132	747
1993	3420	3420	3420	3420	3377	135	-425	-1605	-1623	3647	1359
1994	833	1112	896	710	710	1317	449	162	857	196	1097
1995	3420	3420	3420	3420	3420	724	16297	9475	19282	9292	2509
1996	3376	3420	3420	3420	3420	8562	8102	3327	4565	2718	3024
1997	3420	3420	3377	2879	2302	19349	5716	-149	1101	216	2749
1998	3420	3420	3420	3420	3420	20423	11198	10935	13154	17095	3374
1999	3420	3420	3420	3337	3205	8304	3240	1683	437	0	2860
2000	3376	3420	3420	3378	2775	6180	4334	1166	602	478	2684
2001	1789	2280	2223	1420	1420	616	1323	-245	350	4	2240
2002	2280	2280	2194	1420	1420	-243	-217	-993	300	-201	2023
2003	2280	2280	2194	1420	1420	-300	-358	-685	378	-91	2034

Simulated Periods of Compliance by Year-Type and Month

Wet

Non-compliance in at least 1 month 5/24 years.
Annual Range: 2-124 TAF

	Feb	Mar	Apr	May	Jun
Non-compliance months	1/24	1/24	2/24	2/24	1/24
Range of Non-compliance - TAF	48	27	4-48	2-50	36

Above Normal

Non-compliance in at least 1 month 8/16 years.
Annual Range: 1-155 TAF

	Feb	Mar	Apr	May	Jun
Non-compliance months	2/16	4/16	2/16	2/16	6/16
Range of Non-compliance - TAF	23-56	10-60	1-34	3-25	5-64

Below Normal

Non-compliance in at least 1 month 7/13 years.
Annual Range: 5-65 TAF

	Feb	Mar	Apr	May	Jun
Non-compliance months	2/13	3/13	5/13	5/13	3/13
Range of Non-compliance - TAF	17	5-22	7-20	7-17	1-5

Dry

Non-compliance in at least 1 month 9/13 years.
Annual Range: 7-68 TAF

	Feb	Mar	Apr	May	Jun
Non-compliance months	2/13	4/13	6/13	1/13	5/13
Range of Non-compliance - TAF	7-13	13-34	3-30	2	1-12

Critcal

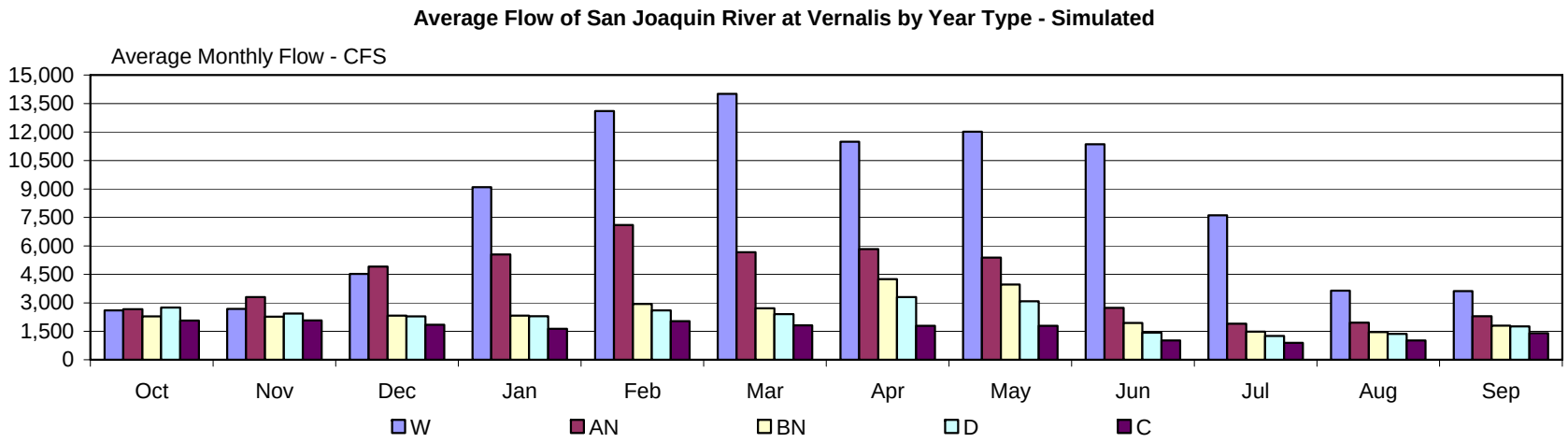
Non-compliance in at least 1 month 2/16 years.
Annual Range: 3-12 TAF

	Feb	Mar	Apr	May	Jun
Non-compliance months	0/16	0/16	2/16	1/16	2/16
Range of Non-compliance - TAF	0	0	1-3	3	3-12

Values shown for April/May represent non-compliance during non-pulse flow period.

Simulation of San Joaquin River at Vernalis

Vernalis Flow Conditions

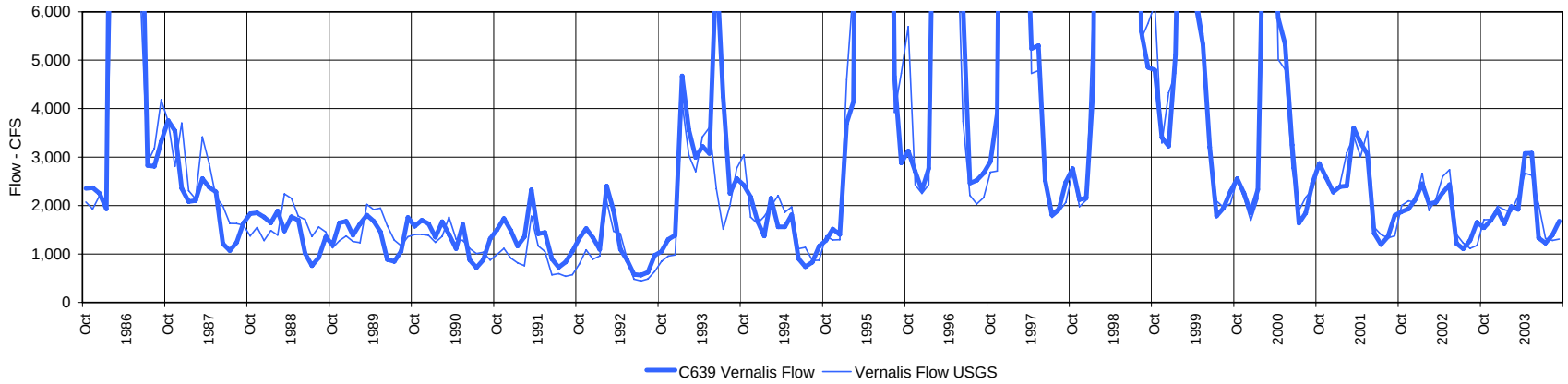


Vernalis Flow by Year Type - CFS

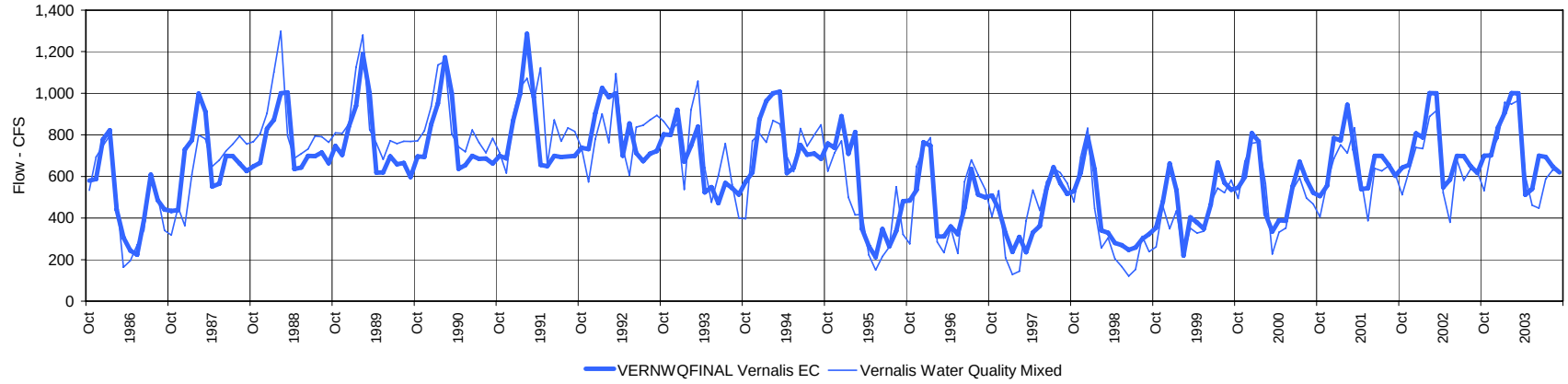
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
W	2,608	2,685	4,528	9,098	13,102	14,010	11,496	12,020	11,355	7,616	3,646	3,626
AN	2,671	3,302	4,910	5,542	7,103	5,675	5,828	5,375	2,736	1,902	1,959	2,297
BN	2,279	2,275	2,319	2,326	2,948	2,716	4,249	3,965	1,940	1,486	1,454	1,805
D	2,747	2,440	2,281	2,297	2,595	2,411	3,303	3,083	1,435	1,253	1,361	1,768
C	2,071	2,083	1,841	1,637	2,036	1,815	1,792	1,790	1,016	889	1,016	1,408
All	2,485	2,584	3,372	4,796	6,497	6,375	6,049	6,033	4,591	3,208	2,094	2,351

Simulation of San Joaquin River at Vernalis

Vernalis Flow Comparison



Vernalis Water Quality Comparison



Sensitivity Analysis

New Melones Operation Affected by Maze Conditions

For the calibration period, October 1996 through September 2003, due to an apparent underestimation of EC at Maze the CALSIM II External Review identified an annual “potential” additional need for New Melones releases of approximately 50 thousand acre-feet; although, it was recognized that some of this potential need may occur when other New Melones releases are already meeting this need.

It was recommended that the model developers evaluate how much of this potential need translates into an “actual” need.

<u>Findings of Additional Analysis</u>

- Refinements of hydrology and recalibration of closure term improved comparison between modeled Maze and historical Maze
- Operation analysis performed with “recorded” Maze conditions for the October 1996 through September 2003 period resulted in an average “actual” annual need of about 13 thousand acre-feet, and only about 2 thousand acre-feet if the model could operate to the 30-day running average water quality objective.

Conclusions Regarding Revised CALSIM II

General Improvements and Developed Capabilities

Eastside Demands

- Modeled demands now reflect land use and district operations. Replaces representation of “fixed diversion requirement” that was relatively insensitive to climate variability.
- Revised CALSIM-II with land-use-based water demands can be used for simulation of projected land use.

Eastside Hydrology and Operations

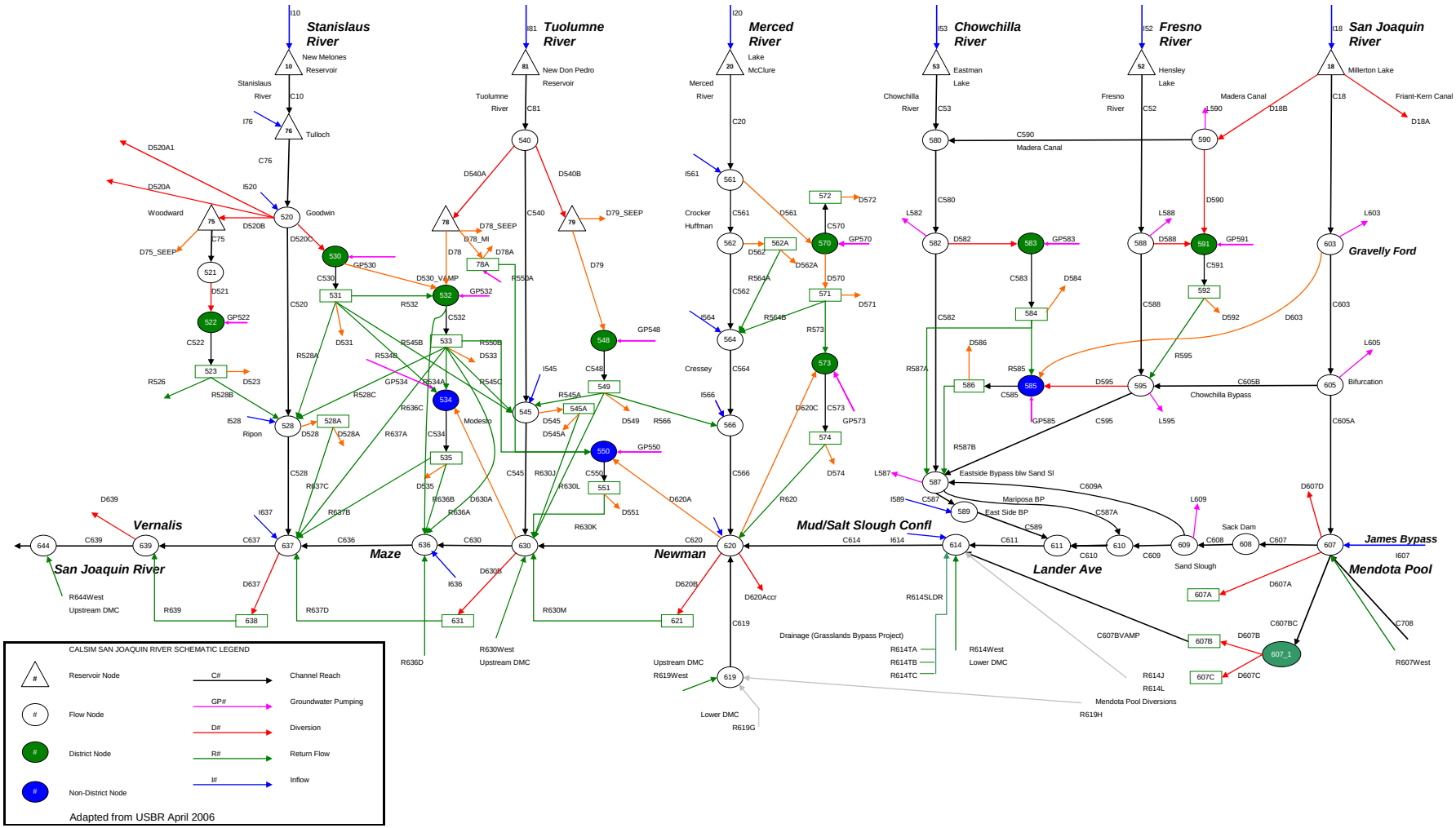
- Operations reflects local district input.
- Hydrology reflects recent historical data and is consistent with water budgeting approach – “Water Management Areas”

Salinity Module

- Disaggregated salinity loads
- Reflects recent historical salinity conditions.
- Enables source-management analyses (limited).

Conclusions Regarding Revised CALSIM II

Concluding Remarks

- The revised CALSIM II is a significantly improved tool compared to earlier tools
- The model is intended for scenario study
- It was originally developed for CVP/SWP needs; however, its usefulness has broadened
- The model will always be a work-in-progress with refinements being implemented

CALSIM II San Joaquin River Basin Model