RECLAMATION

Managing Water in the West

CalSim3 and the San Joaquin: Has the Model Changed?

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U.S. Department of the Interior
Bureau of Reclamation

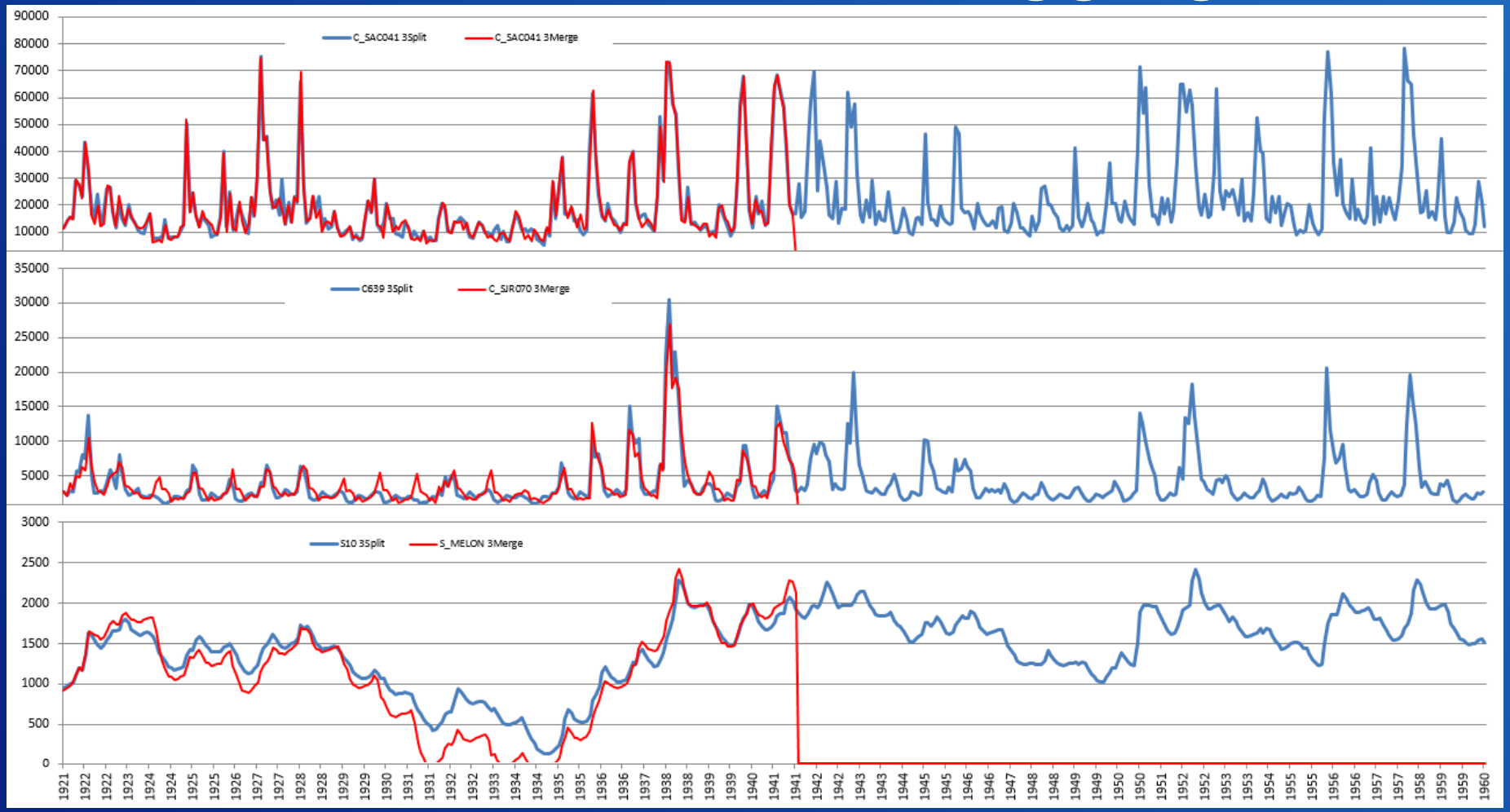
Introduction

- CalSim is the primary water supply reliability planning model for the CVP and SWP
- Compared to CalSim2, CalSim3 provides finer resolution and a consistent template for demands
- Improved groundwater representation through dynamic link with C2VSIM
- Final phase of completing SJR portion of CalSim3 is underway!

Major updates since CWEMF 2015:

- Debugging of WRESL and transition to WRESL+
- Tied the model to target data
  - Compiled Historical database of SJ Valley flows and salinity
  - Summarized Agricultural Water Management Plans
- Included Upper-Watershed logic added for:
  - Cosumnes
  - Mokelumne
  - Stanislaus
  - Tuolumne
  - Upper SJR
- Completed QA/QC of Eastside tributary operations

WRESL Code Debugging



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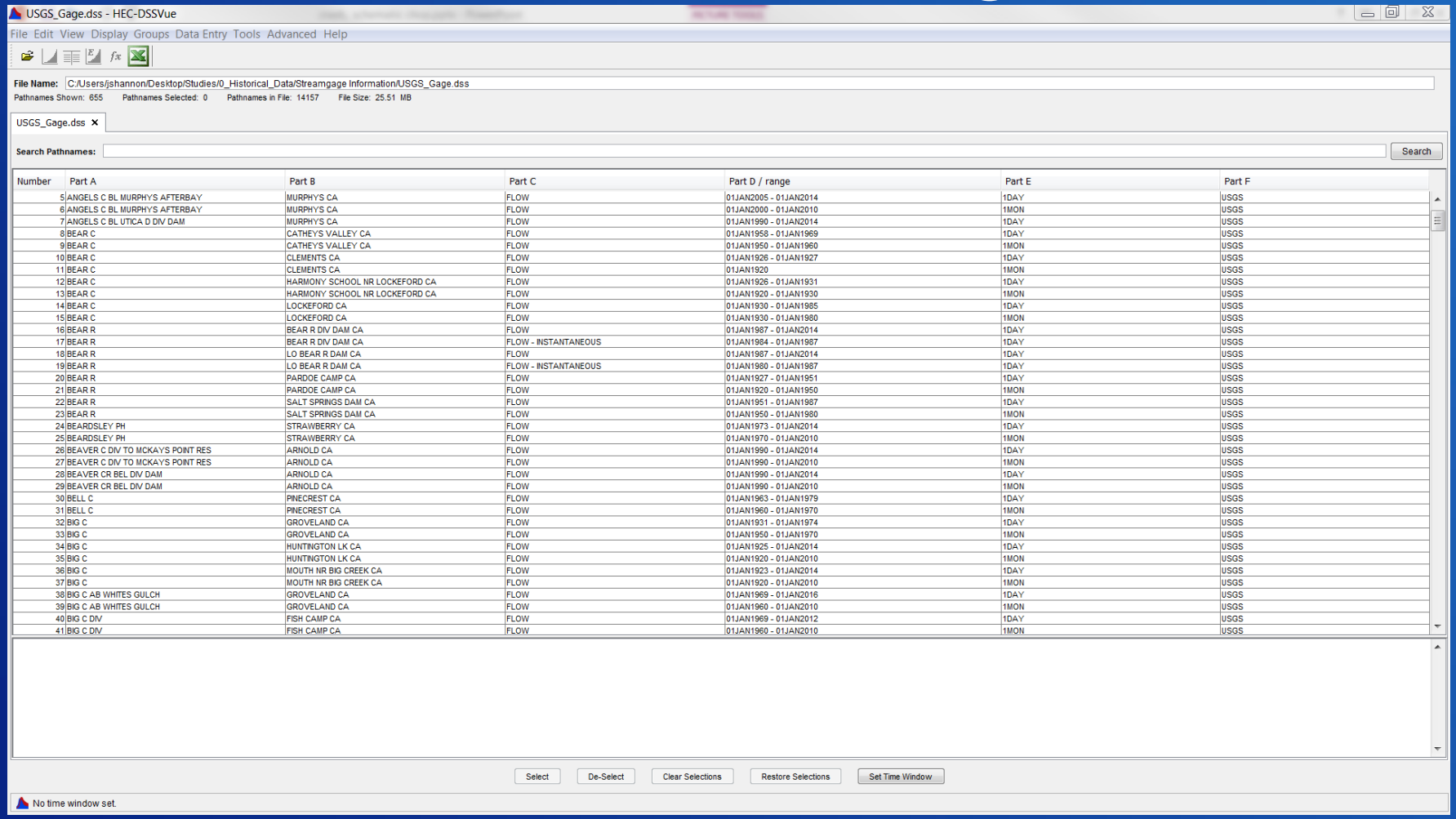
Data Gathering



Number	Part A	Part B	Part C	Part D / range	Part E	Part F
5	ANGELS C BL MURPHYS AFTERBAY	MURPHYS CA	FLOW	01JAN2005 - 01JAN2014	1DAY	USGS
6	ANGELS C BL MURPHYS AFTERBAY	MURPHYS CA	FLOW	01JAN2000 - 01JAN2010	1MON	USGS
7	ANGELS C BL UTICA D DIV DAM	MURPHYS CA	FLOW	01JAN1990 - 01JAN2014	1DAY	USGS
8	BEAR C	CATHEYS VALLEY CA	FLOW	01JAN1958 - 01JAN1969	1DAY	USGS
9	BEAR C	CATHEYS VALLEY CA	FLOW	01JAN1950 - 01JAN1960	1MON	USGS
10	BEAR C	CLEMENTS CA	FLOW	01JAN1926 - 01JAN1927	1DAY	USGS
11	BEAR C	CLEMENTS CA	FLOW	01JAN1920	1MON	USGS
12	BEAR C	HARMONY SCHOOL NR LOCKEFORD CA	FLOW	01JAN1926 - 01JAN1931	1DAY	USGS
13	BEAR C	HARMONY SCHOOL NR LOCKEFORD CA	FLOW	01JAN1920 - 01JAN1930	1MON	USGS
14	BEAR C	LOCKEFORD CA	FLOW	01JAN1930 - 01JAN1985	1DAY	USGS
15	BEAR C	LOCKEFORD CA	FLOW	01JAN1930 - 01JAN1980	1MON	USGS
16	BEAR R	BEAR R DIV DAM CA	FLOW	01JAN1987 - 01JAN2014	1DAY	USGS
17	BEAR R	BEAR R DIV DAM CA	FLOW - INSTANTANEOUS	01JAN1984 - 01JAN1987	1DAY	USGS
18	BEAR R	LO BEAR R DAM CA	FLOW	01JAN1987 - 01JAN2014	1DAY	USGS
19	BEAR R	LO BEAR R DAM CA	FLOW - INSTANTANEOUS	01JAN1980 - 01JAN1987	1DAY	USGS
20	BEAR R	PARDOE CAMP CA	FLOW	01JAN1927 - 01JAN1951	1DAY	USGS
21	BEAR R	PARDOE CAMP CA	FLOW	01JAN1920 - 01JAN1950	1MON	USGS
22	BEAR R	SALT SPRINGS DAM CA	FLOW	01JAN1951 - 01JAN1987	1DAY	USGS
23	BEAR R	SALT SPRINGS DAM CA	FLOW	01JAN1950 - 01JAN1980	1MON	USGS
24	BEARDSLEY PH	STRAWBERRY CA	FLOW	01JAN1973 - 01JAN2014	1DAY	USGS
25	BEARDSLEY PH	STRAWBERRY CA	FLOW	01JAN1970 - 01JAN2010	1MON	USGS
26	BEAVER C DIV TO MCKAYS POINT RES	ARNOLD CA	FLOW	01JAN1990 - 01JAN2014	1DAY	USGS
27	BEAVER C DIV TO MCKAYS POINT RES	ARNOLD CA	FLOW	01JAN1990 - 01JAN2010	1MON	USGS
28	BEAVER CR BEL DIV DAM	ARNOLD CA	FLOW	01JAN1990 - 01JAN2014	1DAY	USGS
29	BEAVER CR BEL DIV DAM	ARNOLD CA	FLOW	01JAN1990 - 01JAN2010	1MON	USGS
30	BELL C	PINECREST CA	FLOW	01JAN1963 - 01JAN1979	1DAY	USGS
31	BELL C	PINECREST CA	FLOW	01JAN1960 - 01JAN1970	1MON	USGS
32	BIG C	GROVELAND CA	FLOW	01JAN1931 - 01JAN1974	1DAY	USGS
33	BIG C	GROVELAND CA	FLOW	01JAN1950 - 01JAN1970	1MON	USGS
34	BIG C	HUNTINGTON LK CA	FLOW	01JAN1925 - 01JAN2014	1DAY	USGS
35	BIG C	HUNTINGTON LK CA	FLOW	01JAN1920 - 01JAN2010	1MON	USGS
36	BIG C	MOUTH NR BIG CREEK CA	FLOW	01JAN1923 - 01JAN2014	1DAY	USGS
37	BIG C	MOUTH NR BIG CREEK CA	FLOW	01JAN1920 - 01JAN2010	1MON	USGS
38	BIG C AB WHITES GULCH	GROVELAND CA	FLOW	01JAN1969 - 01JAN2016	1DAY	USGS
39	BIG C AB WHITES GULCH	GROVELAND CA	FLOW	01JAN1960 - 01JAN2010	1MON	USGS
40	BIG C DIV	FISH CAMP CA	FLOW	01JAN1969 - 01JAN2012	1DAY	USGS
41	BIG C DIV	FISH CAMP CA	FLOW	01JAN1960 - 01JAN2010	1MON	USGS

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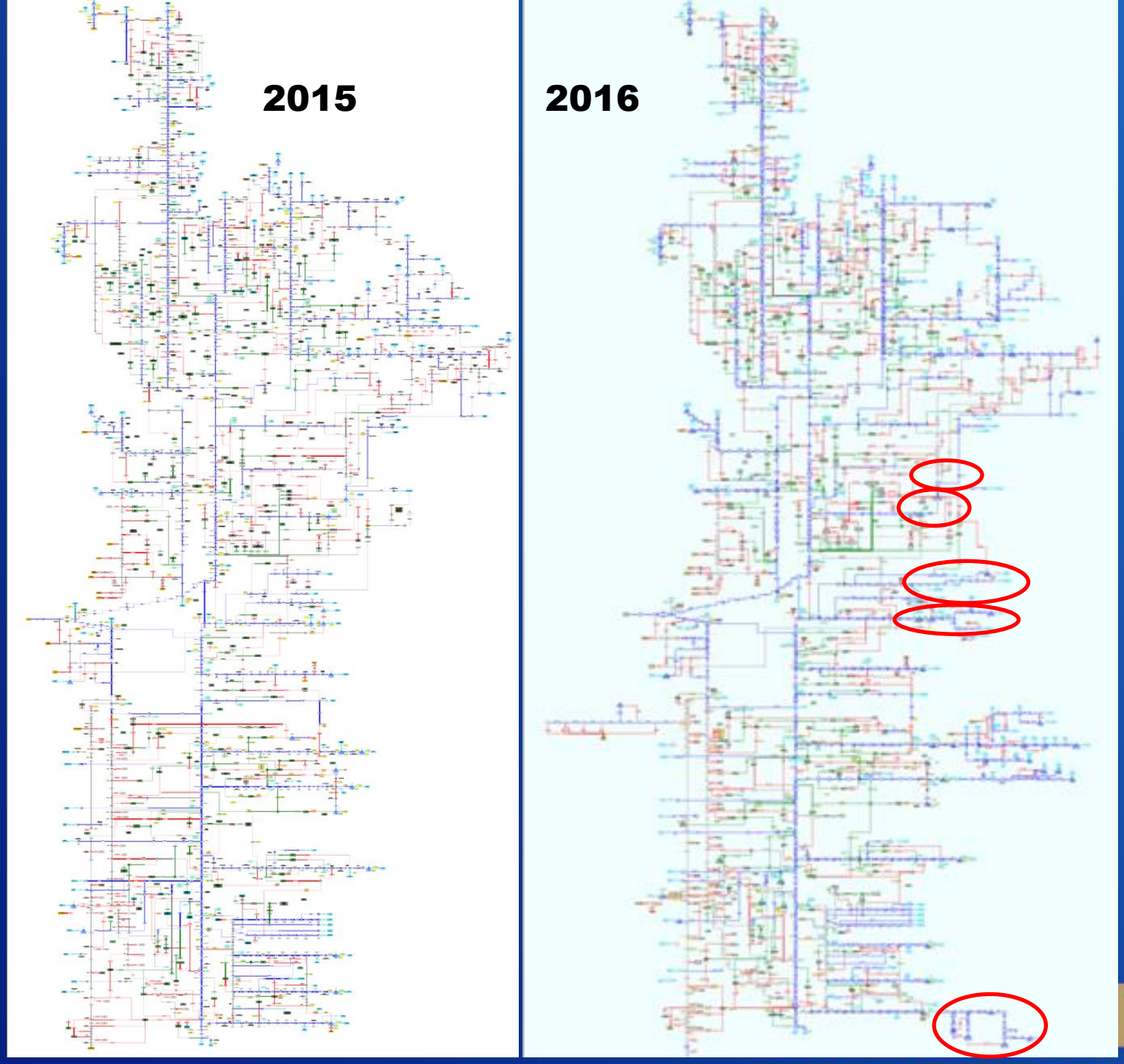


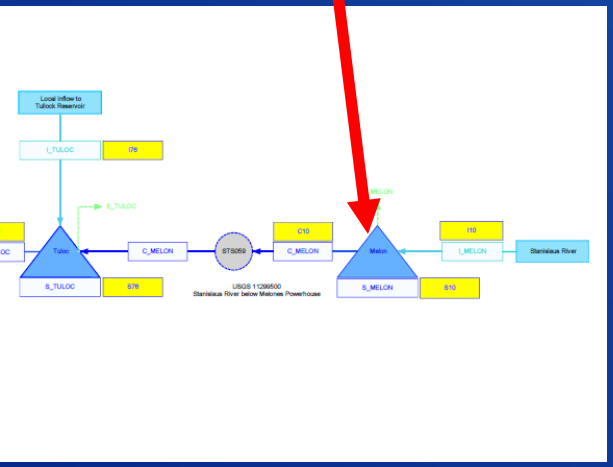
Cosumnes
Mokelumne

Stanislaus
Tuolumne

San Joaquin

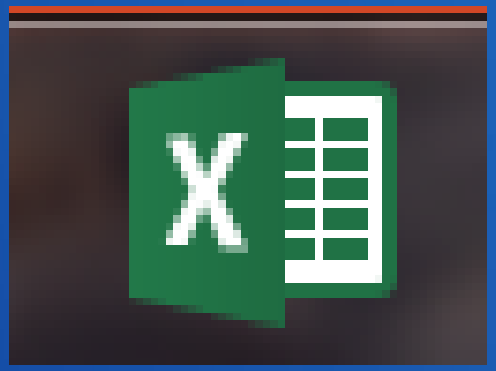
Upper Watershed Models

New Melones



Inflow Time Series

Dedicated Watershed Models



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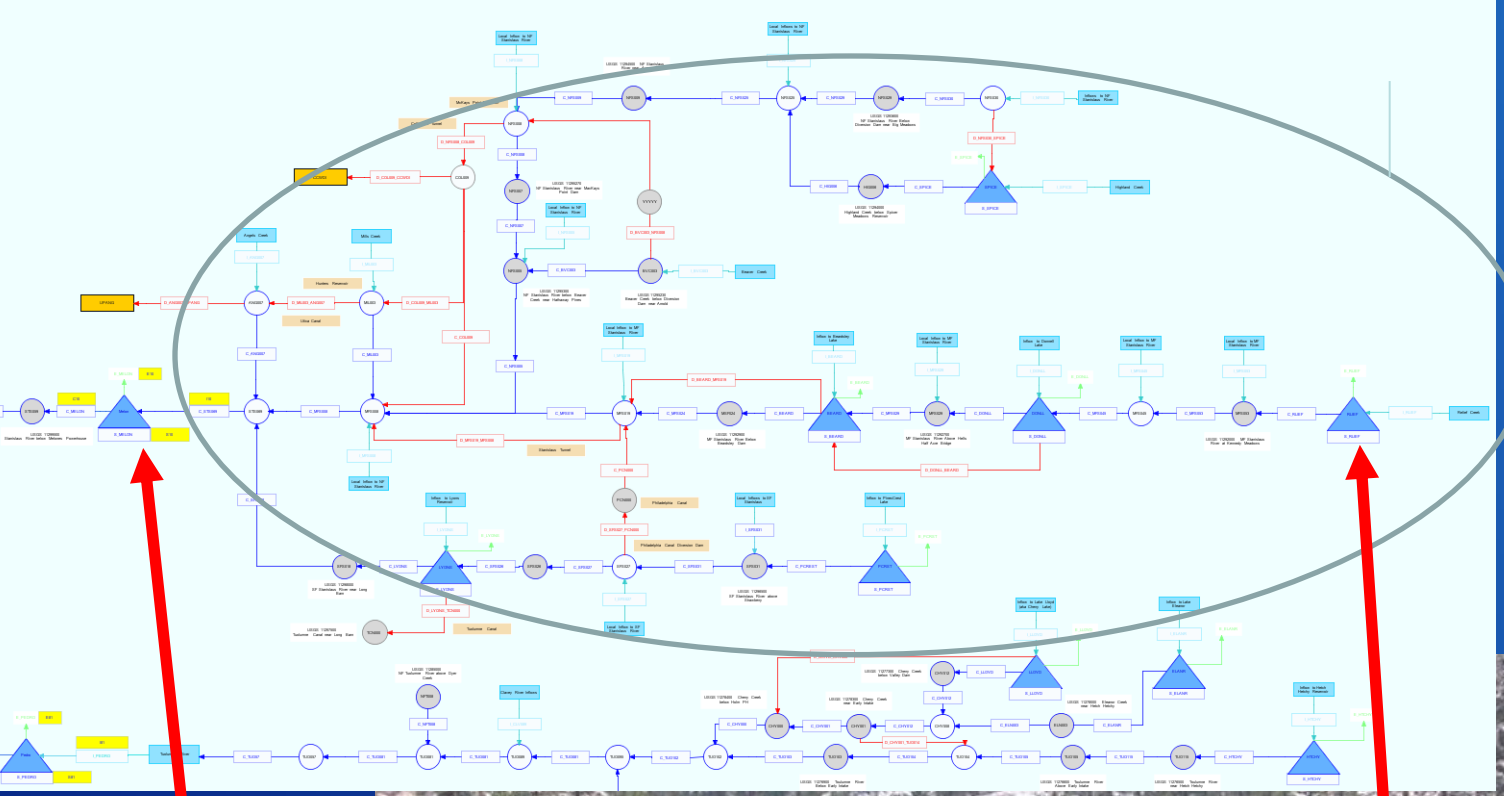
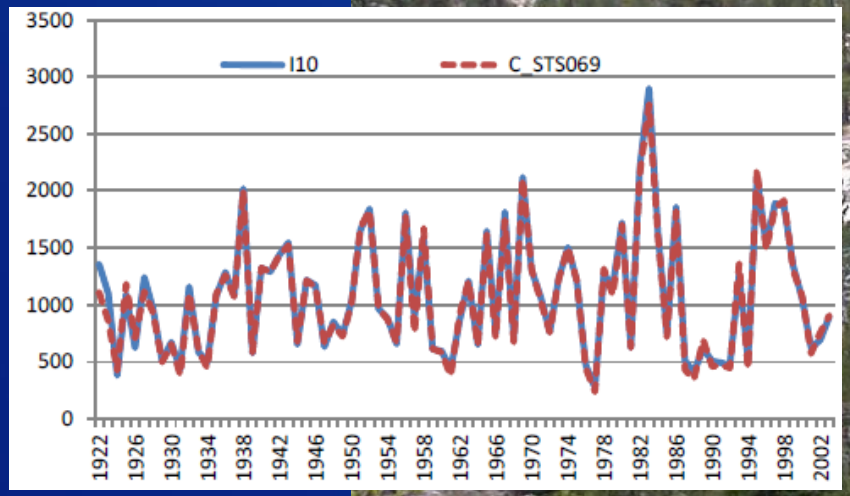
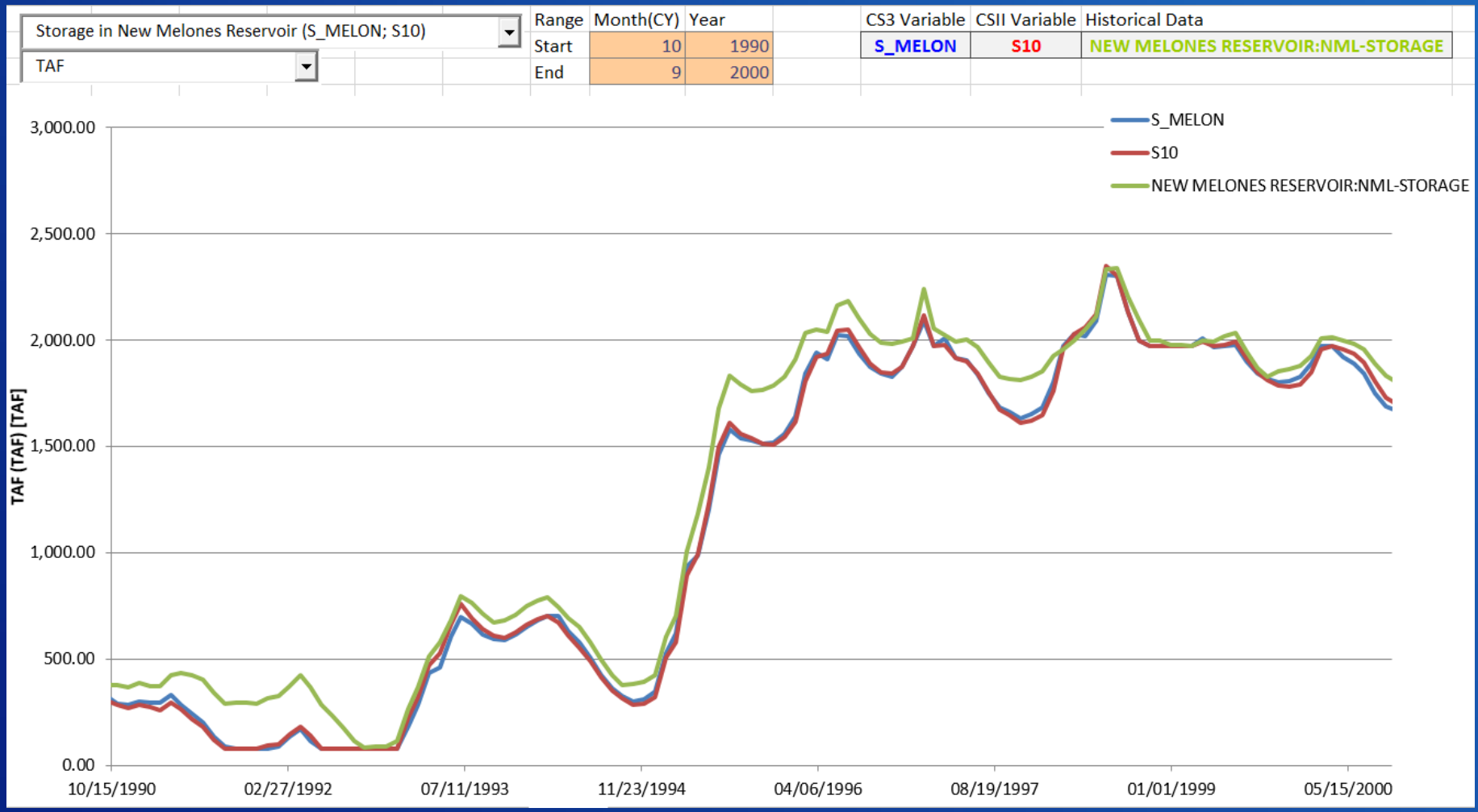


New Melones



Relief Reservoir

New Melones Reservoir



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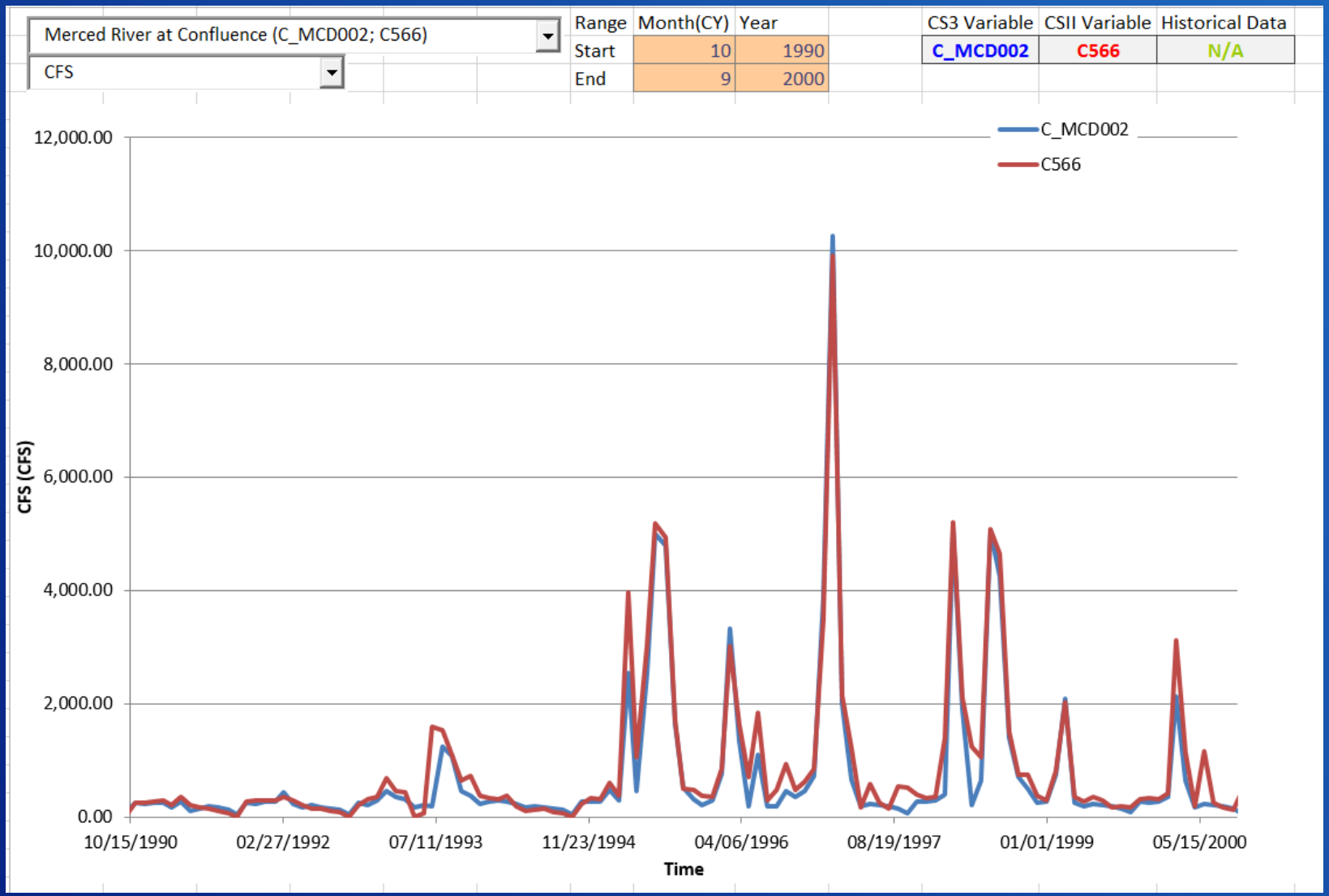
Merced River Confluence with SJR



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Current Development Tasks

- CalSimHydro Calibration of Applied Water Demands
- Quality Control Analysis of SJR-West CalSim3 Logic
- Groundwater model integration assessment

CalSimHydro Calibration

- **Match Applied Water output to recent CVO Data**
- **Calibration by adjusting distribution parameters:**
  - **Minimum soil moisture**
  - **Irrigation season length**

Table 11-7. Crop Minimum Soil Moisture

Crop[1]	Minimum Soil Moisture (fraction of available soil moisture)[2]											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
San Joaquin River Hydrologic Region												
Alfalfa	0.44	0.22	0.22	0.22	0.22	0.67	0.89	1.00	0.89	0.78	0.67	0.56
Almonds/Pistachios	0.44	0.22	0.22	0.22	0.22	0.56	0.89	1.00	0.89	0.78	0.67	0.56
Corn	0.17	0.17	0.17	0.17	0.17	0.67	0.67	0.67	0.83	0.75	0.50	0.33
Cotton	0.11	0.11	0.11	0.11	0.11	0.89	0.72	0.56	1.00	0.89	0.89	0.11
Cucurbits	0.22	0.22	0.22	0.22	0.22	0.22	0.67	0.89	1.00	0.89	0.89	0.44
Dry Beans	0.17	0.17	0.17	0.17	0.17	0.67	0.67	0.67	0.83	0.75	0.50	0.33
Grain	0.17	0.17	0.33	0.50	0.50	0.50	0.50	0.17	0.17	0.17	0.17	0.17
Onions/Garlic	0.22	0.22	0.22	0.22	0.22	0.22	0.67	0.89	1.00	0.89	0.89	0.44
Other Deciduous	0.44	0.22	0.22	0.22	0.22	0.56	0.89	1.00	0.89	0.78	0.67	0.56
Other Field	0.17	0.17	0.17	0.17	0.17	0.67	0.67	0.67	0.83	0.75	0.5	0.33
Other Truck	0.22	0.22	0.22	0.22	0.22	0.22	0.67	0.89	1.00	0.89	0.89	0.44
Pasture	0.50	0.33	0.33	0.33	0.33	0.67	1.00	1.00	0.83	0.67	0.67	0.67
Potatoes	0.22	0.22	0.22	0.22	0.22	0.22	0.67	0.89	1.00	0.89	0.89	0.44
Safflower	0.17	0.17	0.17	0.17	0.17	0.67	0.67	0.67	0.83	0.75	0.5	0.33
Subtropical	0.33	0.17	0.17	0.17	0.17	0.5	0.67	1.00	1.00	1.00	0.83	0.67
Sugar Beets	0.40	0.27	0.27	0.27	0.27	0.53	0.53	1.00	1.00	0.8	0.67	0.53
Tomatoes (Hand)[3]	0.13	0.13	0.13	0.13	0.13	0.13	0.40	1.00	1.00	0.87	0.73	0.40
Tomatoes (Machine)[3]	0.13	0.13	0.13	0.13	0.13	0.13	0.40	1.00	1.00	0.87	0.73	0.40
Vineyard	0.40	0.27	0.27	0.27	0.27	0.27	0.67	1.00	0.93	0.8	0.67	0.53

Notes:

[1] Rice parameters described under Rice Water Use Model.

[2] In CalSimHydro, the available soil moisture in the root zone is assumed to be equal to field capacity.

[2] Hand-picked tomatoes are also known as fresh tomatoes. Machine-picked tomatoes are also known as processed tomatoes.

Table 11-6. Irrigation Season and Growing Season

Crop Type	Months of Irrigation indicated by 1, Growing Season Indicated by Shading											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
San Joaquin River Hydrologic Region and Tulare Lake Hydrologic Region												
Alfalfa	1	1	1	1	1	1	1	1	1	1	1	1
Almonds/Pistachios	1					1	1	1	1	1	1	1
Corn							1	1	1	1	1	1
Cotton			1	1	1	1	1	1	1	1	1	
Cucurbits									1	1	1	1
Dry Beans									1	1	1	1
Grain			1	1	1	1	1	1				
Onions/Garlic			1	1	1	1	1	1	1			
Other Deciduous	1					1	1	1	1	1	1	1
Other Field							1	1	1	1	1	
Other Truck	1	1	1	1	1	1	1	1				1
Pasture	1	1				1	1	1	1	1	1	1
Potatoes							1	1	1	1	1	
Rice[1]							1	1	1	1	1	1
Safflower					1	1	1	1	1	1		
Subtropical	1	1	1	1	1	1	1	1	1	1	1	1
Sugar Beets	1	1				1	1	1	1	1	1	1
Tomatoes (Hand)[2]					1	1	1	1	1	1	1	
Tomatoes (Machine)[2]					1	1	1	1	1	1	1	
Vineyard	1						1	1	1	1	1	1

Notes:

[1] Flood-up for 20 percent of rice fields is assumed to occur at the end of April

[2] Hand-picked tomatoes are also known as fresh tomatoes. Machine-picked tomatoes are also known as processed tomatoes.

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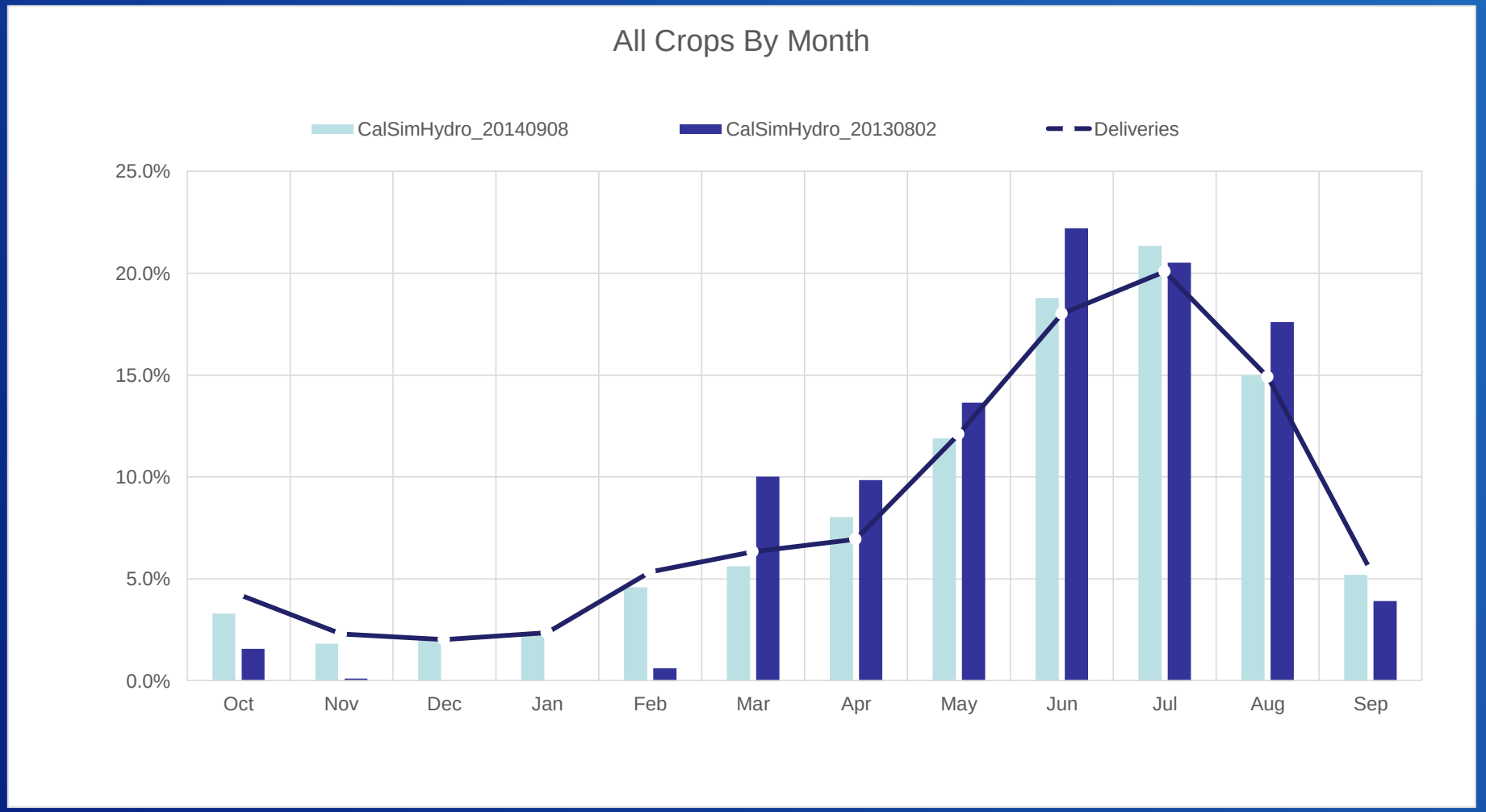
CalSimHydro Calibration



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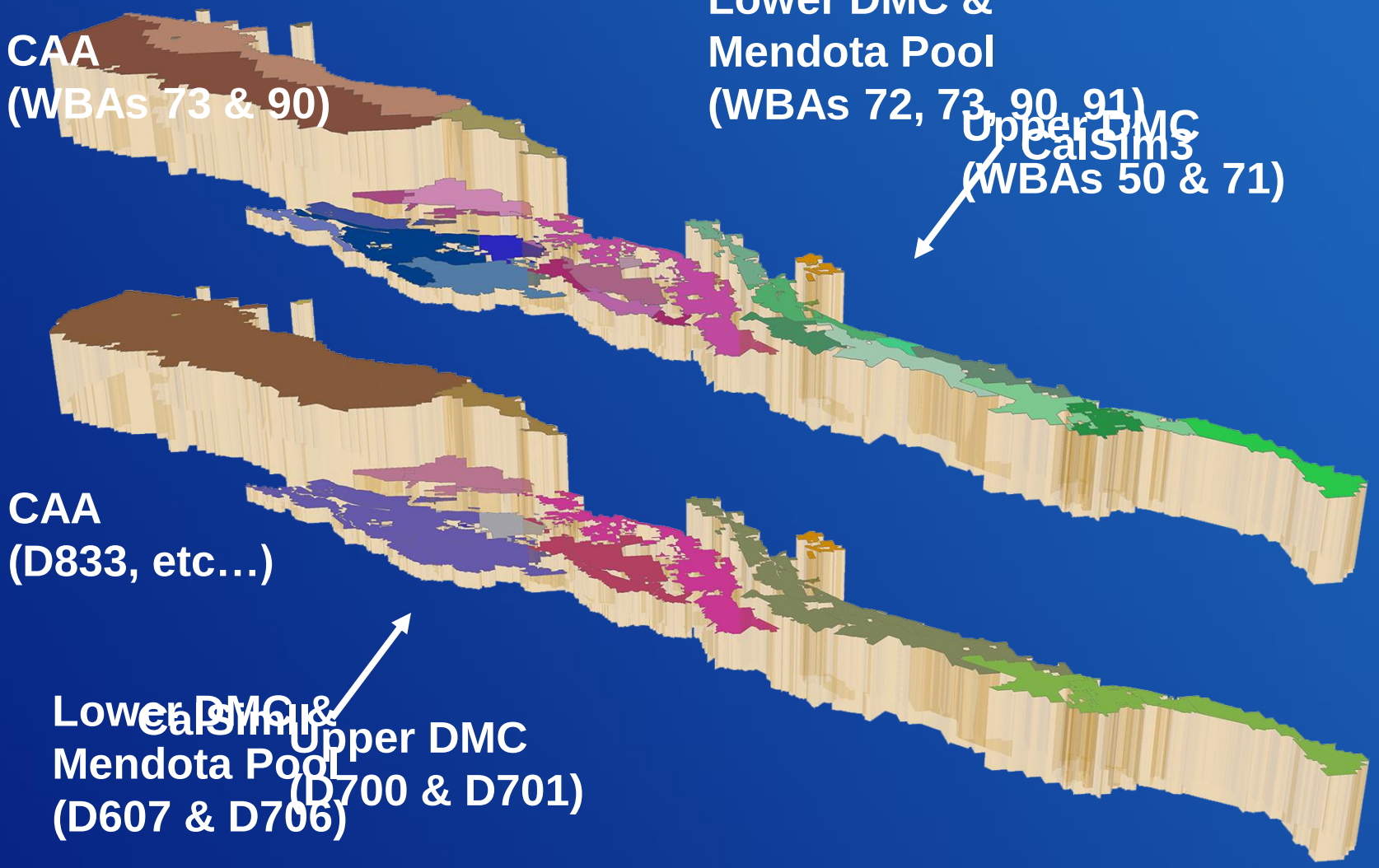
CalSim3 Westside SJR

- CalSim3 requires AW-driven delivery decisions
  - Groundwater pumping component
  - Return flow degradation implications for SJR water quality
- Westside schematic resolution much improved
  - Deliveries – Main Canal, Arroyo Canal, wasteways, etc.
  - San Luis Reservoir and Joint Use Branch
- QA/QC focus on implications of above for export and storage operational decisions
  - Initial SJR cycle solutions
  - Full cycle solutions including SWP

CalSim3 Westside Demand Units



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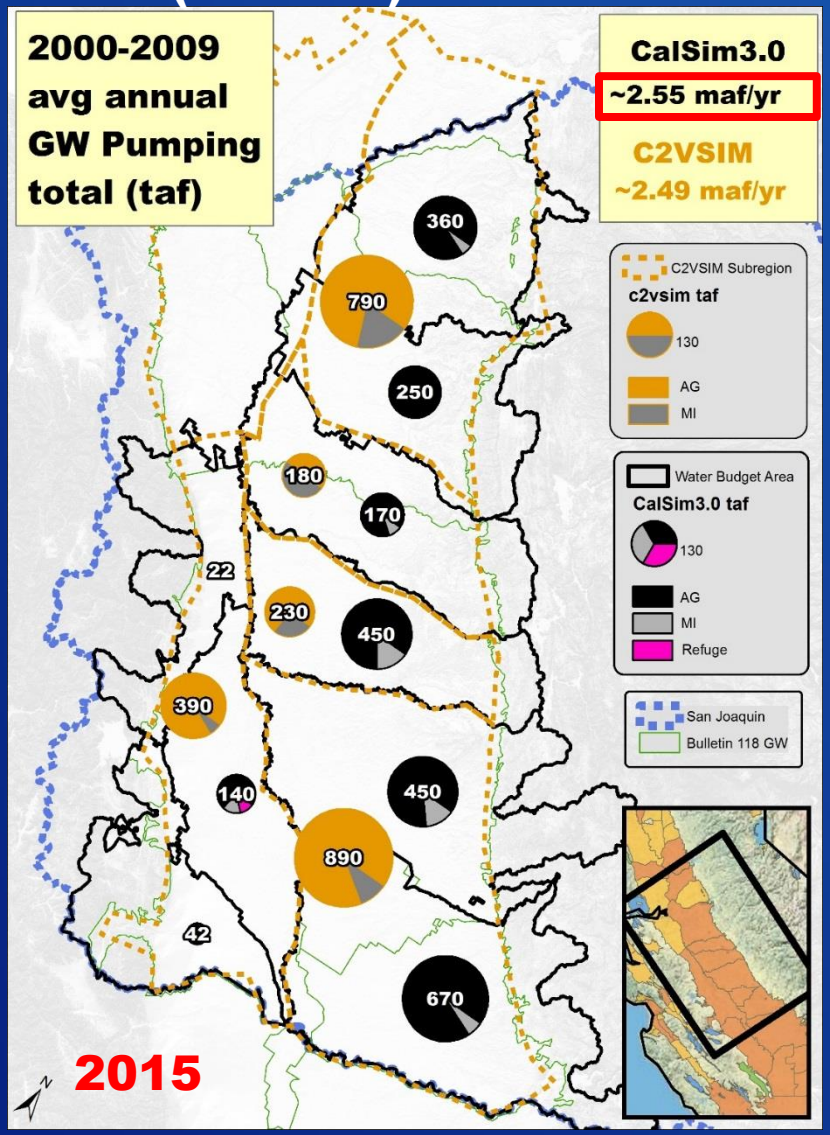
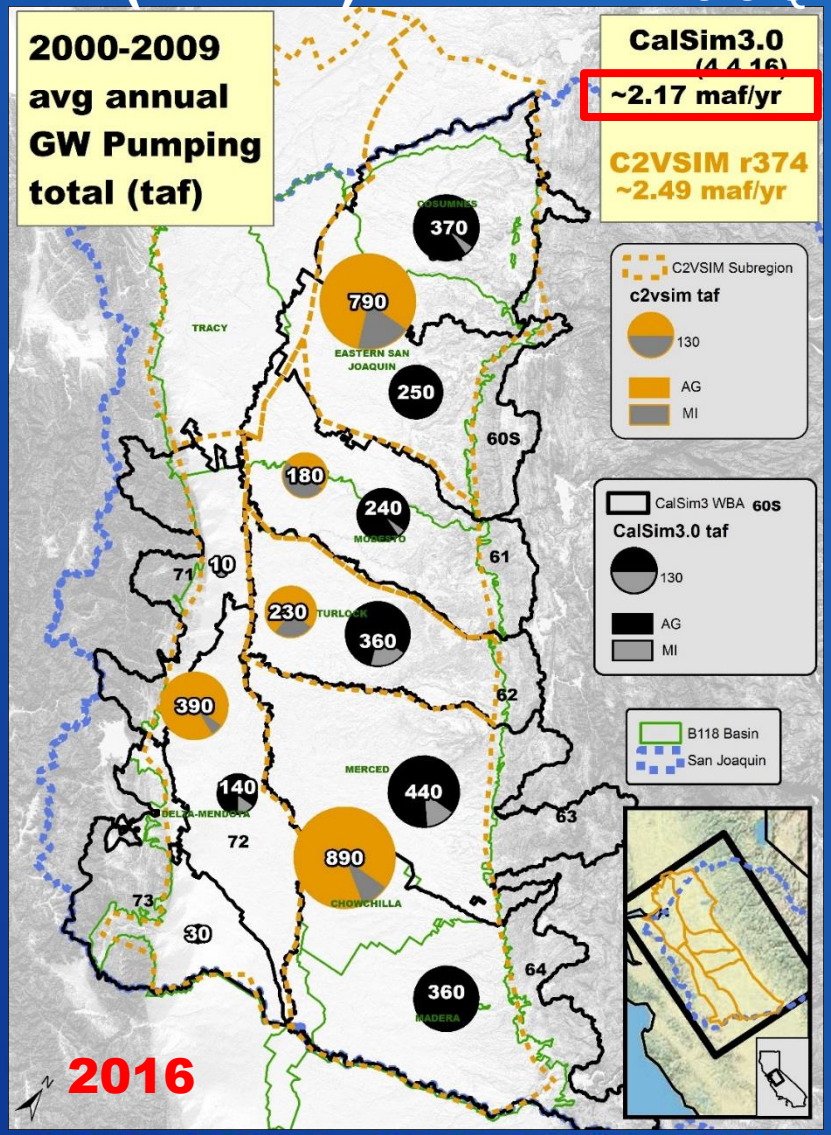
Groundwater Integration

2015 (CWEMF) stand alone SJR



2016 (CWEMF) Sac/SJR → More QAQC



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Groundwater Integration

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Linking groundwater simulation and reservoir system analysis models: The case for California's Central Valley

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[a] California Department of Water Resources, Bay-Delta Office, Modeling Support Branch, 1416 9th Street, Sacramento, CA 95814, USA

Table 1
Absolute differences in stream-aquifer interaction between model iterations.

Reach ID	Description	Absolute difference between model iterations (m^3/sec)			
		1–0	2–1	3–2	4–3
AMR	American River	0.087	0.007	0.001	0.000
ANT	Antelope Creek	0.004	0.000	0.000	0.000
BCC	Big Chico Creek	0.014	0.000	0.000	0.000
BRR	Bear River	0.012	0.000	0.000	0.000
BTC	Butte Creek	4.371	0.862	0.221	0.064
BTL	Battle Creek	0.020	0.000	0.000	0.000
CBD	Colusa Basin Drain	8.903	1.548	0.249	0.035
CCH	Cache Creek	4.806	1.082	0.418	0.238
COW	Cow Creek	0.183	0.002	0.000	0.000
CWD	Cottonwood Creek	0.019	0.000	0.000	0.000
DRC	Deer Creek (North)	0.013	0.000	0.000	0.000
ELD	Elder Creek	0.046	0.002	0.000	0.000
FTR	Feather River	13.314	3.720	0.173	0.021
MLC	Mill Creek	0.009	0.000	0.000	0.000
PTH	Putah Creek	1.213	0.597	0.287	0.147
PYN	Paynes Creek	0.004	0.000	0.000	0.000
SAC	Sacramento River	32.358	5.633	0.692	0.087
SBP	Sutter Bypass	11.276	1.434	0.203	0.045
STN	Stony Creek	0.934	0.163	0.050	0.015
THM	Thomes Creek	0.092	0.001	0.000	0.000
YBP	Yolo Bypass	3.037	0.410	0.036	0.004
YUB	Yuba River	0.009	0.001	0.000	0.000
Total		67.747	12.004	1.326	0.402

← Sacramento Valley

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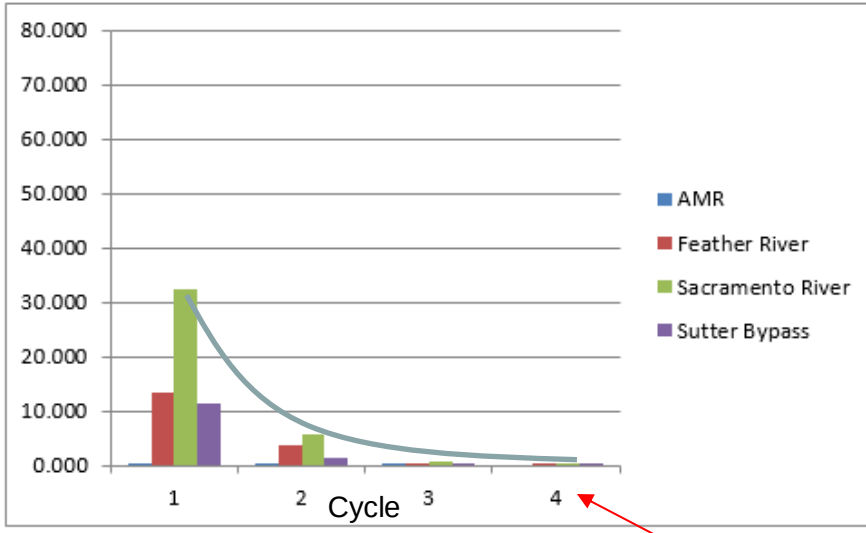
Groundwater Integration

$m^3\ sec^{-1}$

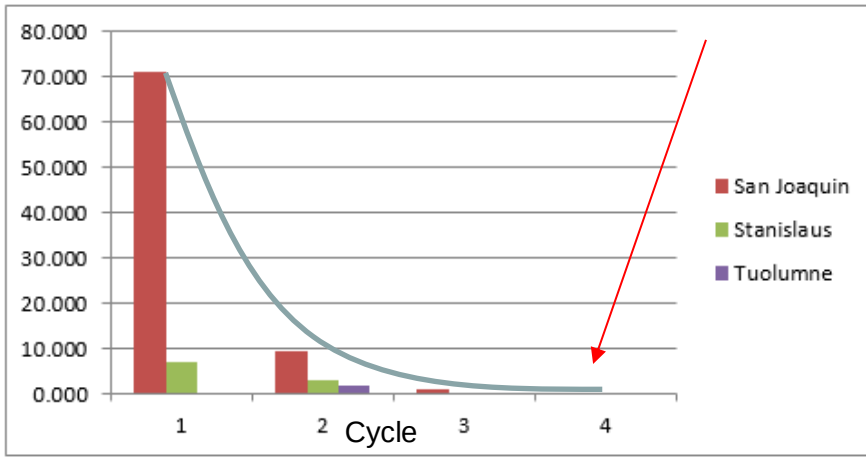
	1-0	2-1	3-2	4-3
American River	0.087	0.007	0.001	0.000
Antelope Creek	0.004	0.000	0.000	0.000
Big Chico Creek	0.014	0.000	0.000	0.000
Bear River	0.012	0.000	0.000	0.000
Butte Creek	4.371	0.862	0.221	0.064
Battle Creek	0.020	0.000	0.000	0.000
Colusa Basin	8.903	1.548	0.249	0.035
Cache Creek	4.806	1.082	0.418	0.238
Cow Creek	0.183	0.002	0.000	0.000
Cottonwood Creek	0.019	0.000	0.000	0.000
Deer Creek	0.013	0.000	0.000	0.000
Elder Creek	0.046	0.002	0.000	0.000
Feather River	13.314	3.720	0.173	0.021
Mill Creek	0.009	0.000	0.000	0.000
Putah Creek	1.213	0.597	0.287	0.147
Paynes Creek	0.004	0.000	0.000	0.000
Sacramento River	32.358	5.633	0.692	0.087
Sutter Bypass	11.276	1.434	0.203	0.045
Stony Creek	0.934	0.163	0.050	0.015
Thomes Creek	0.092	0.001	0.000	0.000
Yolo Bypass	3.037	0.410	0.036	0.004
Yuba River	0.009	0.001	0.000	0.000
sum	67.747	12.004	1.326	0.402

	1-0	2-1	3-2	4-3
Bear Creek	0.000	4.789	0.000	0.000
Chowchilla	0.050	0.801	0.013	0.003
Deadman's Creek	0.000	0.121	0.000	0.000
East Side Bypass	0.002	0.121	0.000	0.000
French Slough	0.076	0.074	0.000	0.000
Fresno River	0.011	0.259	0.001	0.000
Little Panoche Ck	0.000	0.163	0.000	0.000
Merced	0.000	0.112	0.000	0.000
Orestimba Creek	0.042	0.039	0.000	0.000
Salado Creek	0.000	0.143	0.000	0.000
San Joaquin	71.096	9.556	1.068	0.387
Stanislaus	7.081	3.096	0.070	0.004
Tuolumne	0.169	1.908	0.394	0.251
sum	78.526	21.181	1.548	0.645

Sacramento Valley



San Joaquin Valley



<1 $m^3\ sec^{-1}$ by 4th cycle

Future Tasks

- Evaluate CalSim3 Water Quality Module
- Cycle Reformulation
- Corroboration Studies with CalSimII
- Code and File Clean-Up