C2VSimCG – CalSim3 Alignment Project – Groundwater Dynamic Link Library (GWDLL)

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Outline

- Motivation for model alignment
- Project goals
- Alignment of applications – GWDLL
- Preliminary results
- Summary

Motivation

Differences in models

- CalSim Hydrology
  - CSHydro
  - Small watershed module
  - Rim watershed module
- IWFM/IDC(GWDLL)
  - C2VSimCG v1.0 from r374
  - New features
  - Bug fixes
  - Compiler upgrades

Project Goals

- Alignment of engines (GWDLL, IDC, small watersheds)
  - Extract GWDLL from IWFM-2015
  - Implement features from legacy CSHydro in IDC
    - Multiple rice and refuge categories
    - ET_o and crop/habitat coefficients as input
  - Combine small watersheds module with IDC
- Alignment of applications
  - Alignment of stream reaches and nodes between C2VSimCG v1.0 and CS3
  - Redefine small watershed boundaries to comply with CS3 watersheds and C2VSimCG boundary
  - Extend CSHydro DUs to cover small watersheds and C2VSimCG grid cells that are outside of CS3 boundary
  - Calibrate new CSHydro (v2.0) against legacy CSHydro to produce as similar flows as possible

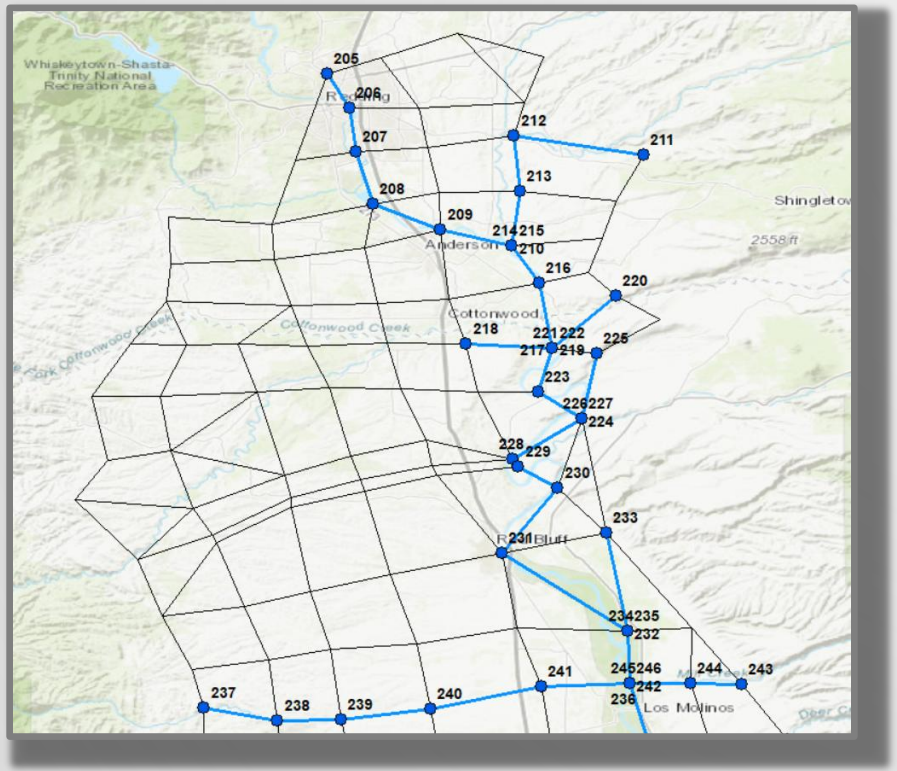
Alignment of Numerical Engines – GWDLL

- A new GWDLL was extracted from the latest IWFM engine
- All functions are the same so WRESL code for DLL function calls do not change
- Code setup promotes immediate emanation of new features and bug fixes between GWDLL, CSHydro v2.0, IDC and IWFM
- Minimize developing CalSim-specific engines and the need to maintain multiple code sets

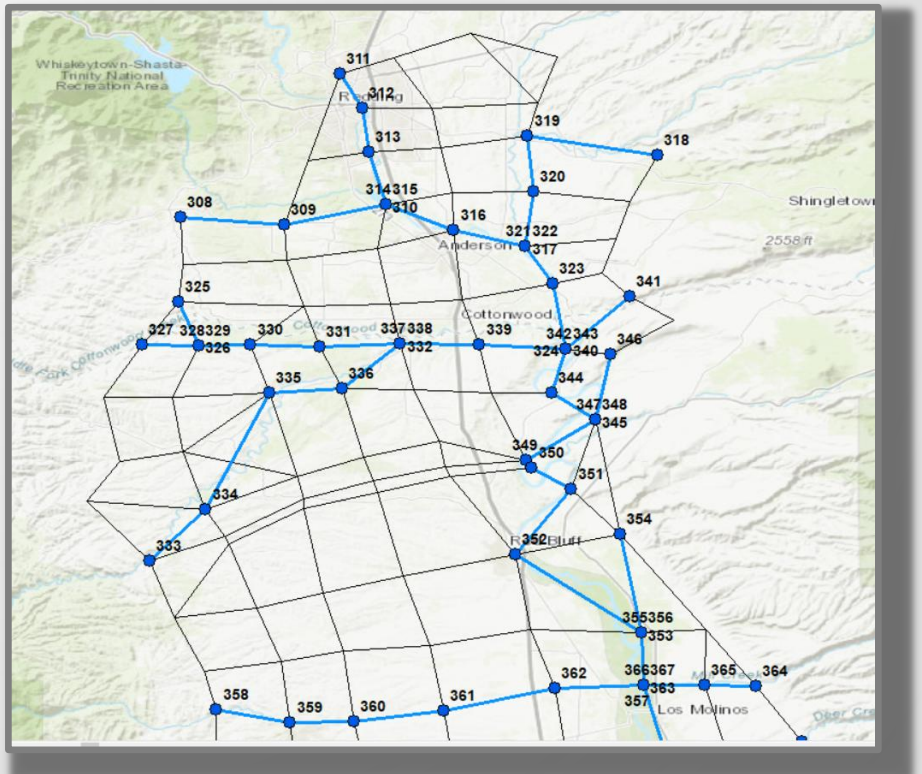
Alignment of Applications – GWDLL

- Populated GWDLL with aquifer parameters from C2VSimCG v1.0
- Updated stream node and reach numbers in WRESL code

C2VSimCG r374

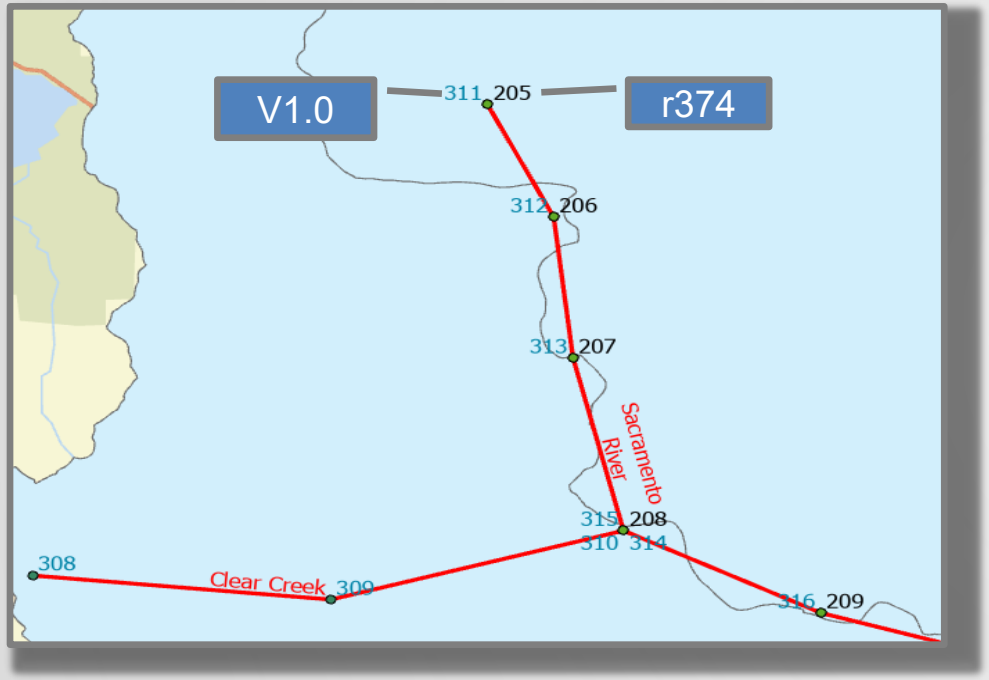


C2VSimCG v1.0



Alignment of Applications – GWDLL

Update stream node and reaches



Parameters updated

- Stream gain-loss (GetSeep) references
- Tiledarin node references
- Groundwater/stream head references
- New stream reaches and nodes
- Inflows for new stream reaches

D:\CalSim\CS3_C2VSimCG_Project\08.11_DCR23_BL\08.11_DCR23_BL\Run\CVGroundwater\SetStrmFlow_First.wresl

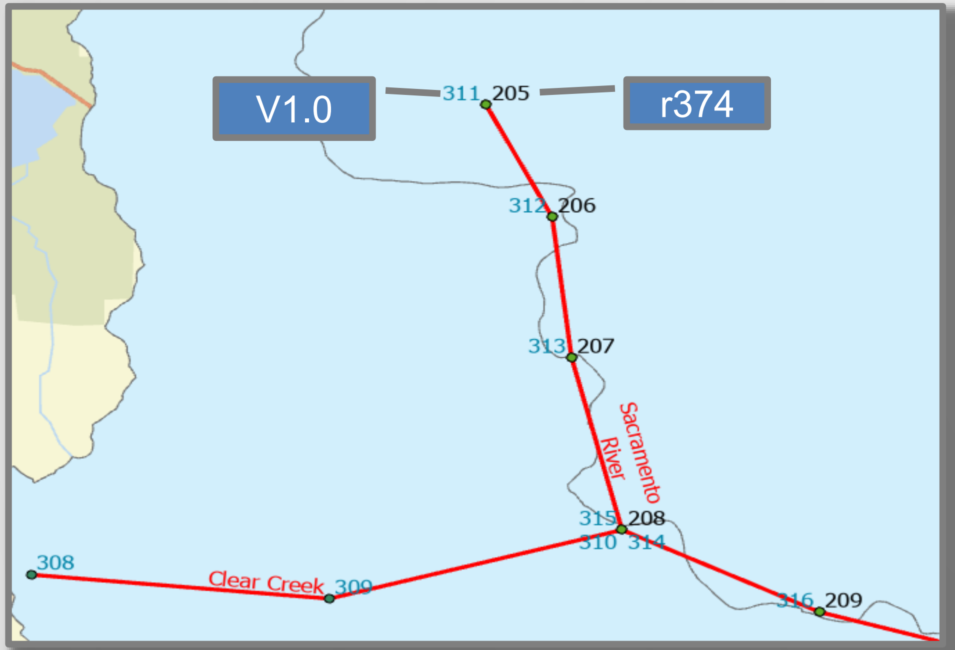
```
313 !!!!!!!!!!!!!!!!!!!     !
314 !!!!!!!!!!!!!!!!!!!     !
315 !!!!!!!!!!!!!!!!!!!     !
316 tial] + C_SAC296[gw_initial])/2 * cfs_cfm,205) }
317
318 tial] + C_SAC294[gw_initial])/2 * cfs_cfm,206) }
319
```

D:\CalSim\CS3_C2VSimCG_Project\newDLL_newStrNd_GetSep_TD_SWGW_newData\Run\CVGroundwater\Set

```
328 !!!!!!!!!!!!!!!!!!!     !
329 !!!!!!!!!!!!!!!!!!!  MW  !
330 !!!!!!!!!!!!!!!!!!!     !
331 tial] + C_SAC296[gw_initial])/2 * cfs_cfm,311) }
332
333 tial] + C_SAC294[gw_initial])/2 * cfs_cfm,312) }
334
```

Alignment of Applications – GWDLL

Update stream node references in variables



WRESL codes updated

- SaveHeads_Stages.wresl
- SetStrmFlow_First.wresl
- SetStrmFlow_Second.wresl
- SetStrmFlow_Third.wresl
- SetStrmFlow_Fourth.wresl
- SetStrmFlow_SJRBASE_GW1.wresl
- SetStrmFlow_SJRBASE_GW2.wresl
- SetStrmFlow_SJRBASE_GW3.wresl
- SetStrmFlow_SJRBASE_GW4.wresl
- SetStrmFlow_using_GW_INITIAL.wresl
- SetStrmFlow_using_SJR_WQ2.wresl
- SetStrmFlow_using_SJRBASE_GW4.wresl

D:\CalSim\CS3_C2VSimCG_Project\08.11_DCR23_BL\08.11_DCR23_BL\Run\System\SystemTables_Sac\arcs-Seepage.wresl

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!! Sacramento River                    !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
define  SG205_SAC296_32 {lower unbounded upper unbounded kind 'STREAM-GAIN'
define  SG206_SAC294_32 {lower unbounded upper unbounded kind 'STREAM-GAIN'
define  SG207_SAC289_32 {lower unbounded upper unbounded kind 'STREAM-GAIN'
define  SG208_SAC287_32 {lower unbounded upper unbounded kind 'STREAM-GAIN'
define  SG209_SAC281_32 {lower unbounded upper unbounded kind 'STREAM-GAIN'
```

D:\CalSim\CS3_C2VSimCG_Project\newDLL_newStrNd_GetSep_TD_SWGW_newData\Run\System\System

```
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!! Sacramento River          !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
define  SG311_SAC296_32 {lower unbounded upper unbounde
define  SG312_SAC294_32 {lower unbounded upper unbounde
define  SG313_SAC289_32 {lower unbounded upper unbounde
define  SG314_SAC287_32 {lower unbounded upper unbounde
define  SG316_SAC281_32 {lower unbounded upper unbounde
```

Alignment of Applications – GWDLL

Update stream node and reach numbers

SystemTables_Delta
- arcs-returns.wresl (naming)
- arcs-seepage.wresl (naming)
- constraints-returns.wresl (*naming-not in use)
- constraints-Runoff.wresl (naming)
- constraints-Seepage_Delta.wresl (naming)
- constraints-Seepage_Delta_GW_INITIAL.wresl (naming)
- constraints-Seepage_Delta_TS.wresl (naming)
- constraints-Seepage_Delta_using_GW_FOURTH.wresl (naming)

SystemTables_LowerAmerican
- arcs-Seepage.wresl (naming)
- constraints-Connectivity.wresl (naming)
- constraints-seepage_initial.wresl (naming)

SystemTables_LowerMokelumne
- arcs-Seepage.wresl
- arcs-TileDrain.wresl(name + nodes)
- arcs-TileDrain_TS.wresl
- constraints-Connectivity.wresl
- constraints-Runoff.wresl
- constraints-Seepage-StandAlone1.wresl
- constraints-Seepage-StandAlone2.wresl
- constraints-Seepage_DeltaES.wresl
- constraints-Seepage_DeltaES_GW_INITIAL.wresl
- constraints-Seepage_DeltaES_init.wresl

SystemTables_LowerMokelumne *(contd)*
- constraints-Seepage_DeltaES_TS.wresl
- constraints-seepage_DeltaES_using_GW_FOURTH.wresl
- constraints-seepage_DeltaES_using_SJRBASE_GW4.wresl
- constraints-TileDrain_DeltaES.wresl
- constraints-TileDrain_DeltaES_using_SJRBASE_GW4.wresl
- Weight-table.wresl

SystemTables_LowerYuba
- constraints-Connectivity.wresl

SystemTables_Sac
- arcs-Channels.wresl
- arcs-Seepage.wresl
- arcs-TileDrain.wresl wresl(name + nodes)
- arcs-TileDrain_TS.wresl
- constraints-Connectivity.wresl
- constraints-Runoff.wresl
- constraints-Seepage_SAC.wresl
- constraints-Seepage_SAC_GW_INITIAL.wresl
- constraints-Seepage_SAC_TS.wresl
- constraints-Seepage_SAC_using_GW_FOURTH.wresl
- Constraints-TileDrain_SAC.wresl
- constraints-TileDrain_SAC_using_GW_FOURTH.wresl
- SeepageTribReachOutput_SAC.wresl

Alignment of Applications – GWDLL

Update stream node and reach numbers

SystemTables_SJREast

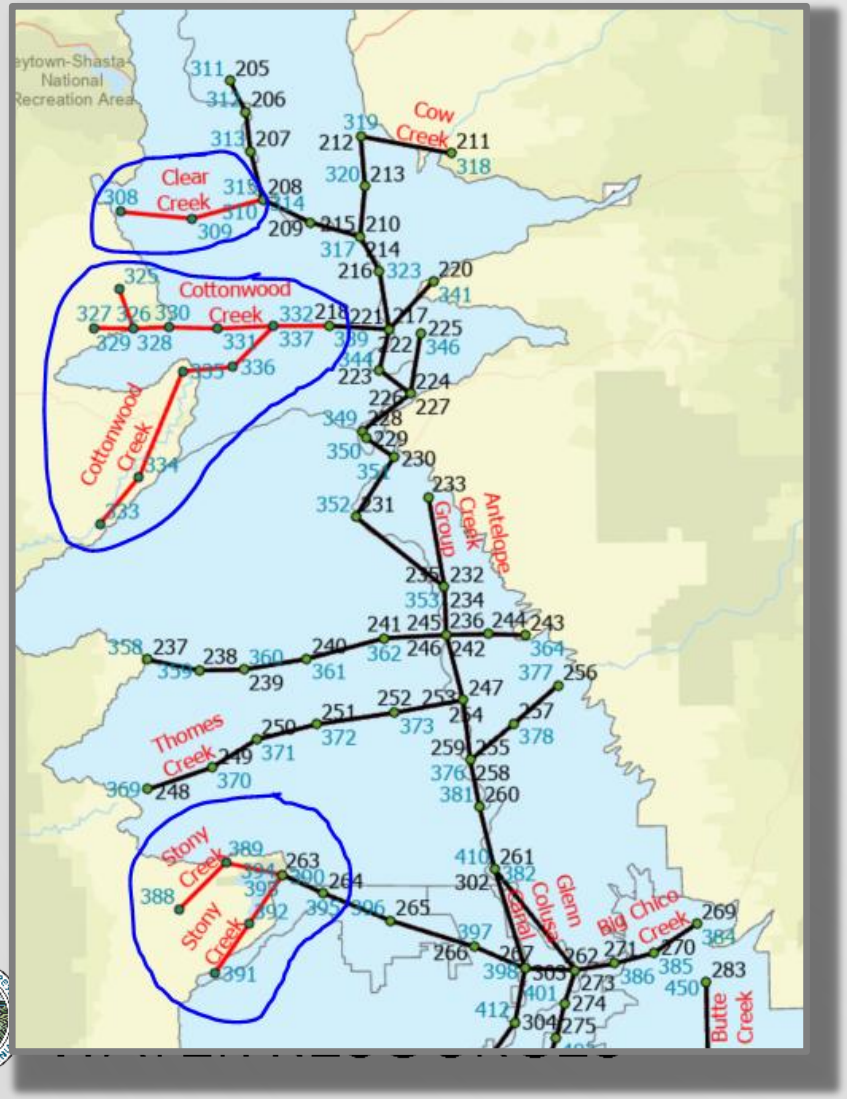
- arcs-Channels.wresl (new streams)
- arcs-Inflows.wresl (new inflows)
- arcs-seepage.wresl (naming)
- arcs-TileDrain.wresl
- arcs-TileDrain_TS.wresl
- constraints-Connectivity.wresl
- constraints-Runoff.wresl (naming)
- constraints-Seepage_SJREast.wresl(name+node)
- constraints-Seepage_SJREast_init.wresl
- constraints-Seepage_SJREast_TS.wresl
- constraints-Seepage_SJREast_using_GW_INITIAL.wresl
- constraints-Seepage_SJREast_using_SJRBASE_GW4.wresl
- constraints-TileDrain_DeltaES.wresl
- constraints-TileDrain_DeltaES_using_SJRBASE_GW4.wresl
- write-SeepageDLL_SJREast_using_SJRBASE_GW4.wresl

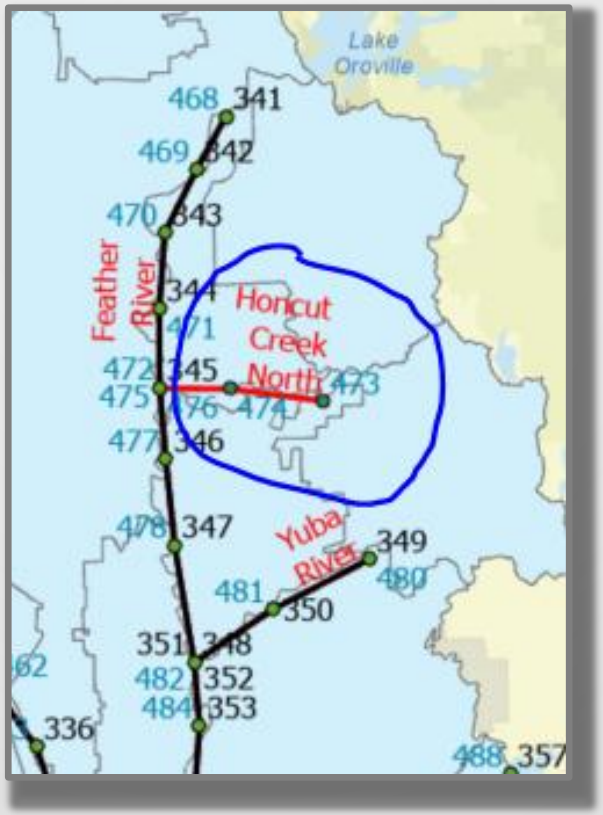
SystemTables_SJRWest

- arcs-Channels.wresl (new streams)
- arcs-Inflows.wresl (new inflows)
- arcs-seepage.wresl (naming)
- arcs-TileDrain.wresl
- arcs-TileDrain_TS.wresl
- constraints-Connectivity.wresl
- constraints-Runoff.wresl (naming)
- constraints-Seepage_SJRWest.wresl(name+node)
- constraints-Seepage_SJRWest_init.wresl
- constraints-Seepage_SJRWest_TS.wresl
- constraints-Seepage_SJRWest_using_SJRBASE_GW4.wresl
- constraints-TileDrain_DeltaES.wresl
- constraints-TileDrain_DeltaES_using_SJRBASE_GW4.wresl

Alignment of Applications – GWDLL

Introduce/Modify Stream Reaches and Nodes – SAC Valley

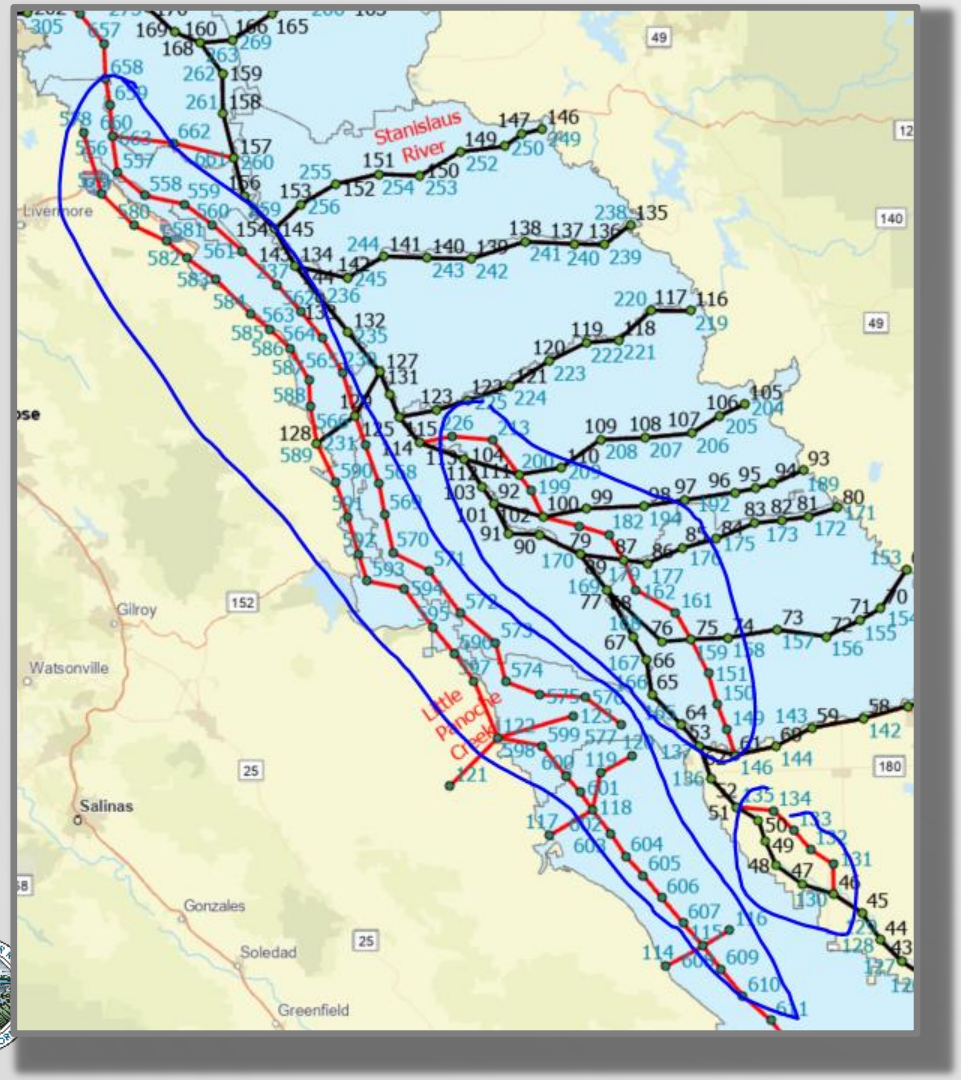




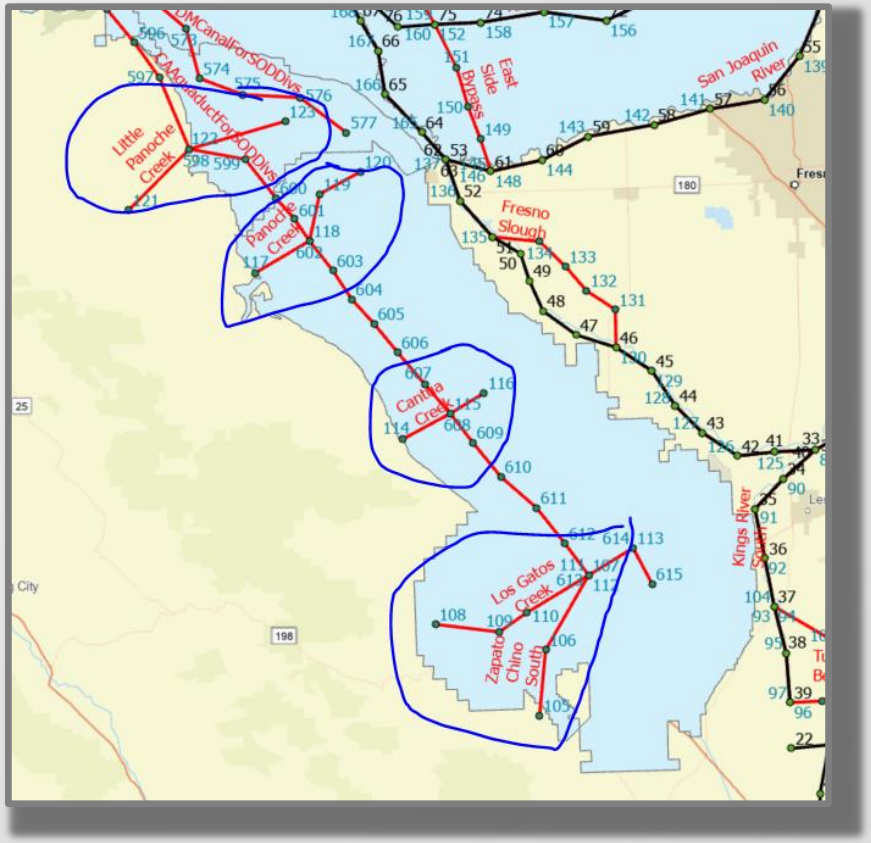
Clear Creek
Cottonwood Creek
Stony Creek
Honcut Creek North

Alignment of Applications – GWDLL

Introduce/Modify Stream Reaches and Nodes – SJR Valley



California Aqueduct (CAA)
Delta Mendota Channel (DMC)
Fresno Slough
East Side bypass



Little Panoche Creek
Panoche Creek
Cantua Creek
Los Gatos Creek
Zapato Chino Creek

Preliminary Results

Longterm summary

- New GWDLL
- Aquifer parameters from C2VSimCG v1.0
- Aligned CS3 WRESL code with new reaches and nodes
- Hydrology from CSHydro V2.0

	1922-2021			
	09.02_DCR23_Hist_NEW_12302024	09.02_DCR23_Hist	Diff	% Diff
River Flows				
Trinity R blw Lewiston	737	737	0	0
Trinity Export	501	501	0	0
Clear Cr blw Whiskeytown	146	146	0	0
Sacramento R @ Keswick	6138	6136	2	0
Sacramento R @ Wilkins Slough	6155	6134	20	0
Feather R blw Thermalito	2926	2968	-42	-1
Feather R at Sac R confluence	5093	5154	-60	-1
Yuba R @ Marysville	1477	1488	-11	-1
Sacramento R @ Verona	12888	12740	148	1
American R blw Nimbus	2490	2483	6	0
American R at Sac R confluence	2407	2415	-8	0
GW Pumping Sac Total	3247	3192	55	2
Delta Inflow	**21892**	**21533**	**359**	**2**
Sacramento R @ Hood	15566	15382	184	1
Yolo Bypass	2684	2556	127	5
Mokelumne R	837	875	-38	-4
Calaveras R	113	112	1	1
San Joaquin R d/s Vernalis	2692	2608	85	3
Net DICU DCD	**793**	**793**	**0**	**0**
Napa and Solano via NBA SWP	**65**	**65**	**0**	**0**
CCWD	**139**	**139**	**0**	**0**
CCWD CVP	128	128	0	0
CCWD DS	9	9	0	1
CCWD Delta Transfers	2	2	0	2

21892	**21533**	**359**	**2**
15566	15382	184	1
2684	2556	127	5
837	875	-38	-4
113	112	1	1
2692	2608	85	3

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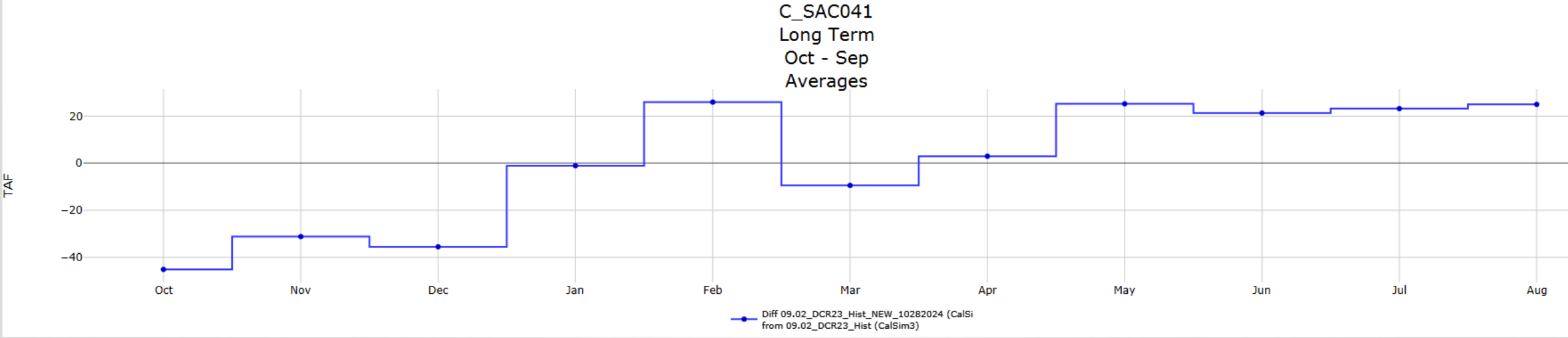
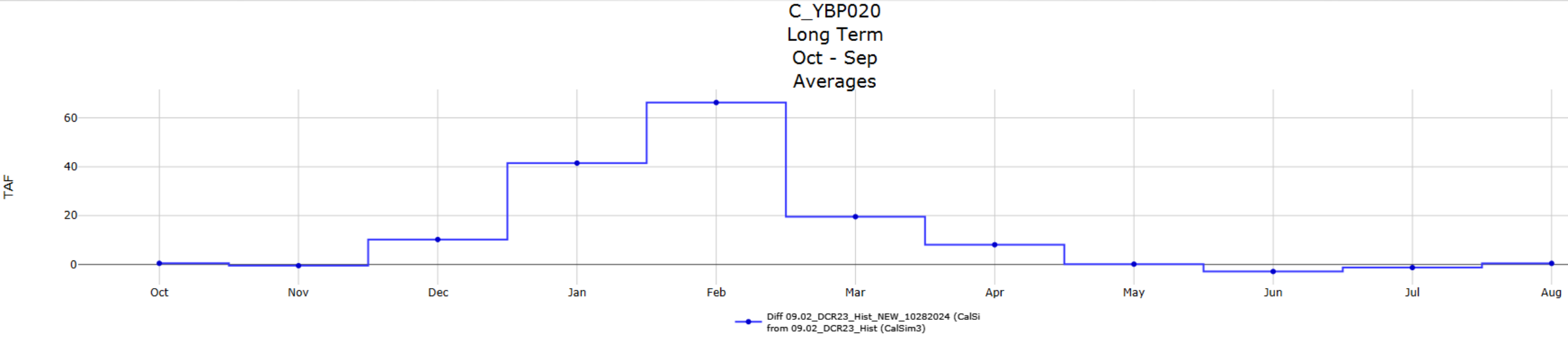
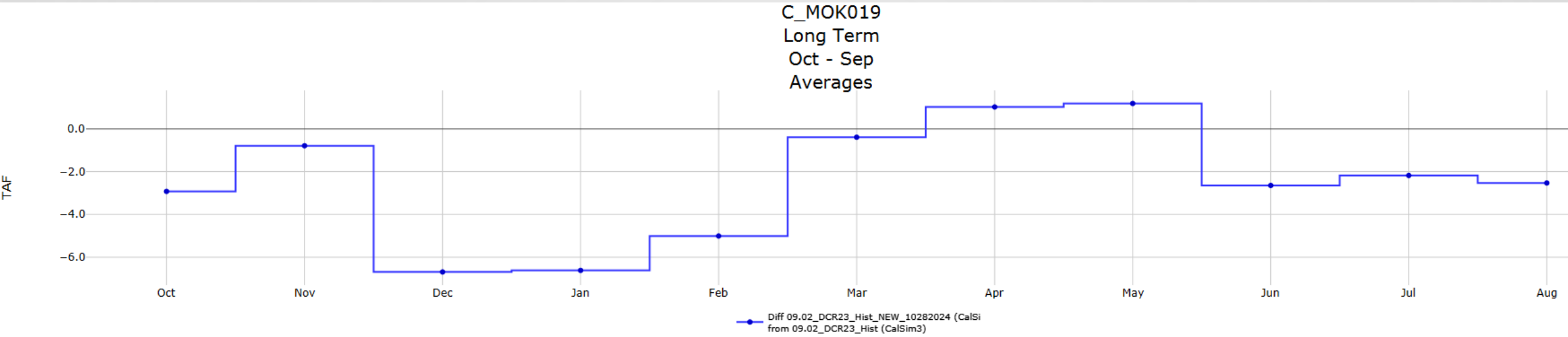
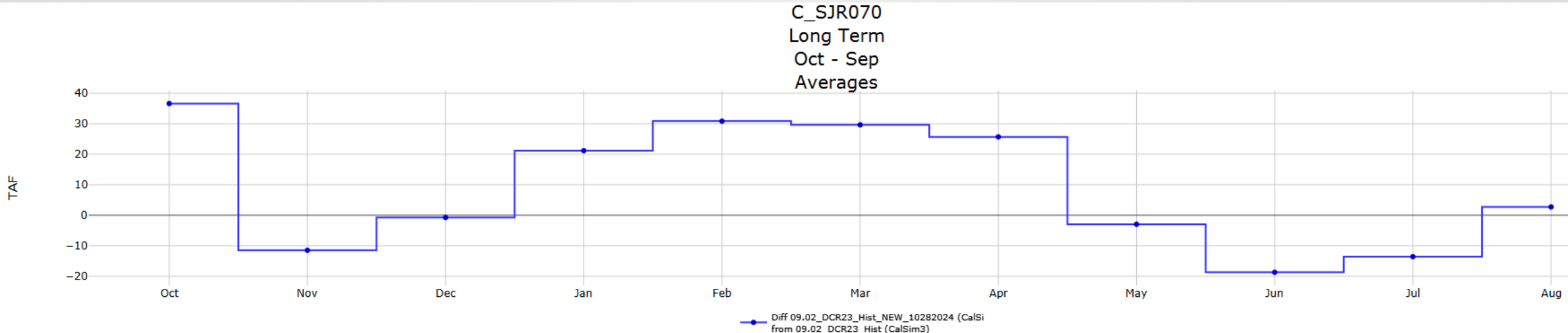
Preliminary Results





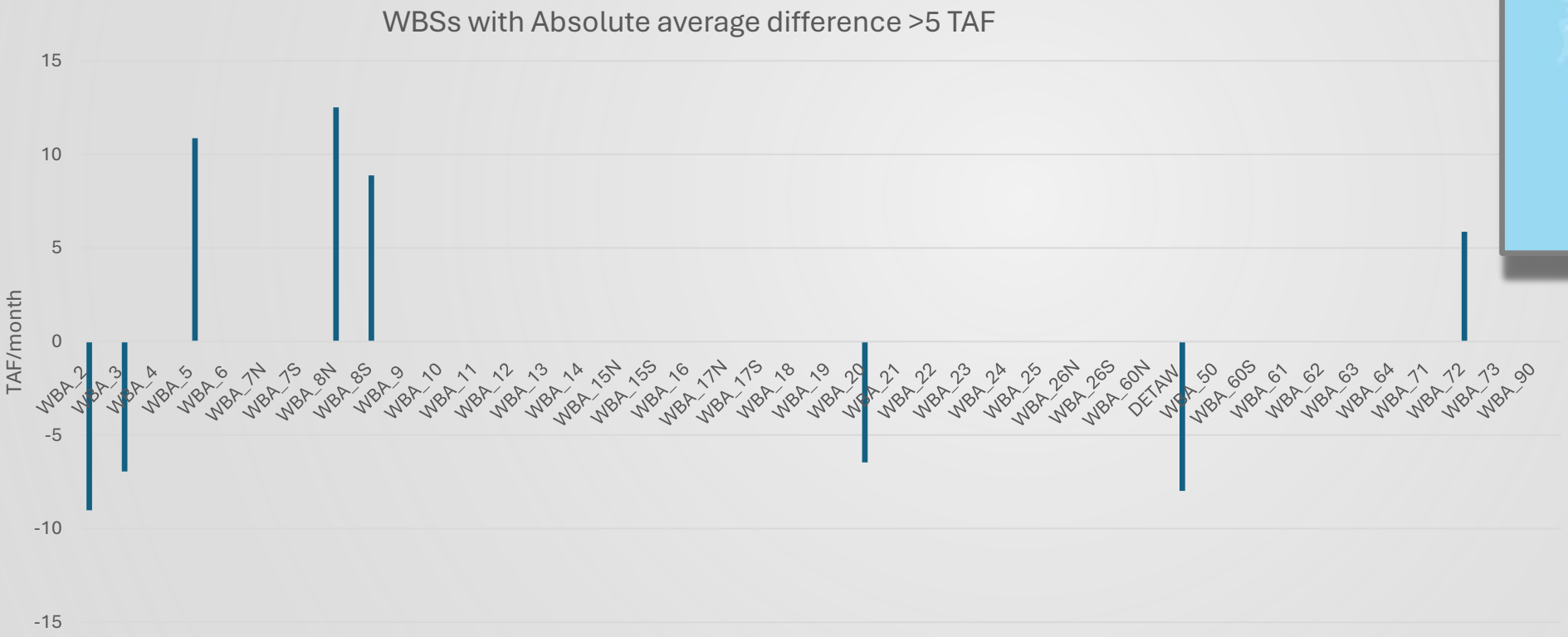
Preliminary Results





Preliminary Results

Stream-GW exchange WBAs (8) with monthly differences >5TAF



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Preliminary Results – WBA2 nodes

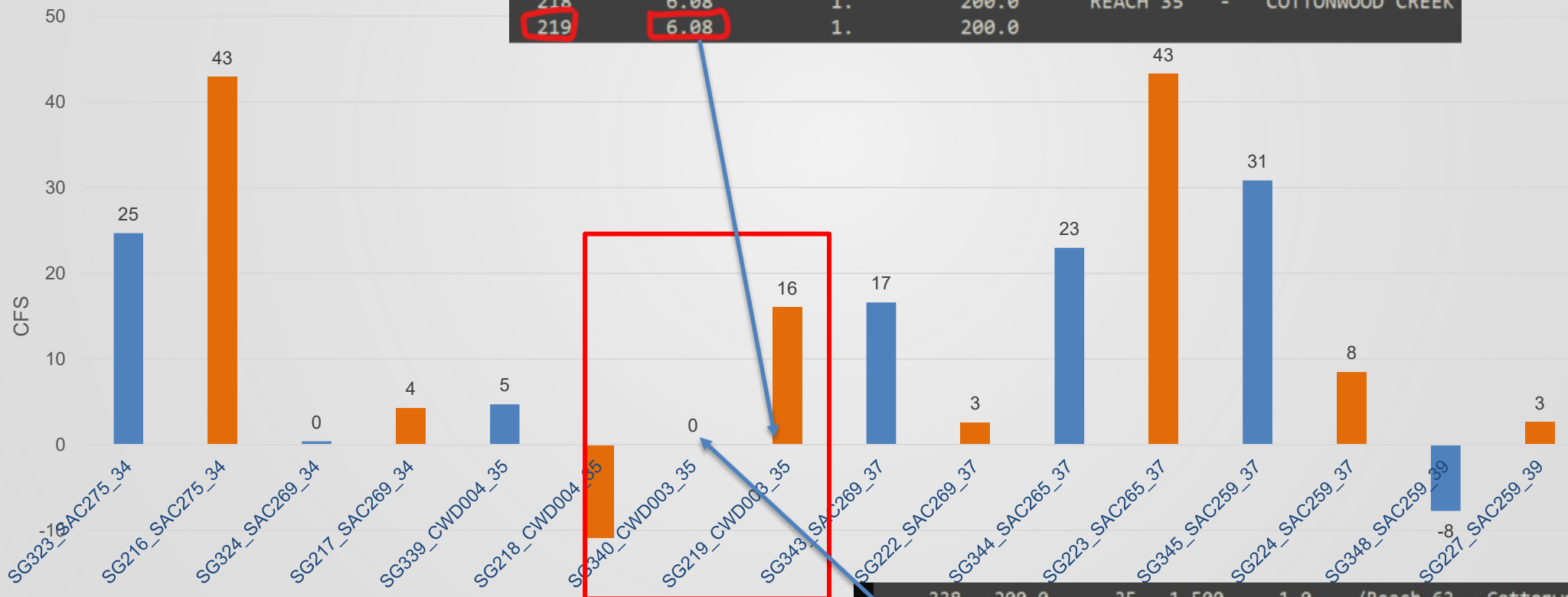
Node level Stream-GW interactions – WBA2

```
C-------------------------------------------------------------------------
C    IR       CSTRM       DSTRM         WETPR      River Name (Optional)
C-------------------------------------------------------------------------
```

WBA2 - Average Stream- Ground Water interaction (+) Gain from Stream (-) Loss from Stream

Blue - New GW DLL; New Aquifer Parameters; New CS Hydro; Orange Base

```
 218        6.08          1.          200.0       REACH 35   -   COTTONWOOD CREEK
 219        6.08          1.          200.0
```




```
 338    200.0      35    1.500      1.0    /Reach 63 - Cottonwood Creek
 339    200.0      36    2.316      1.0
 340    200.0      37    0.000      1.0
 341    400.0      38    1.727      1.0    /Reach 65 - Sacramento River
```

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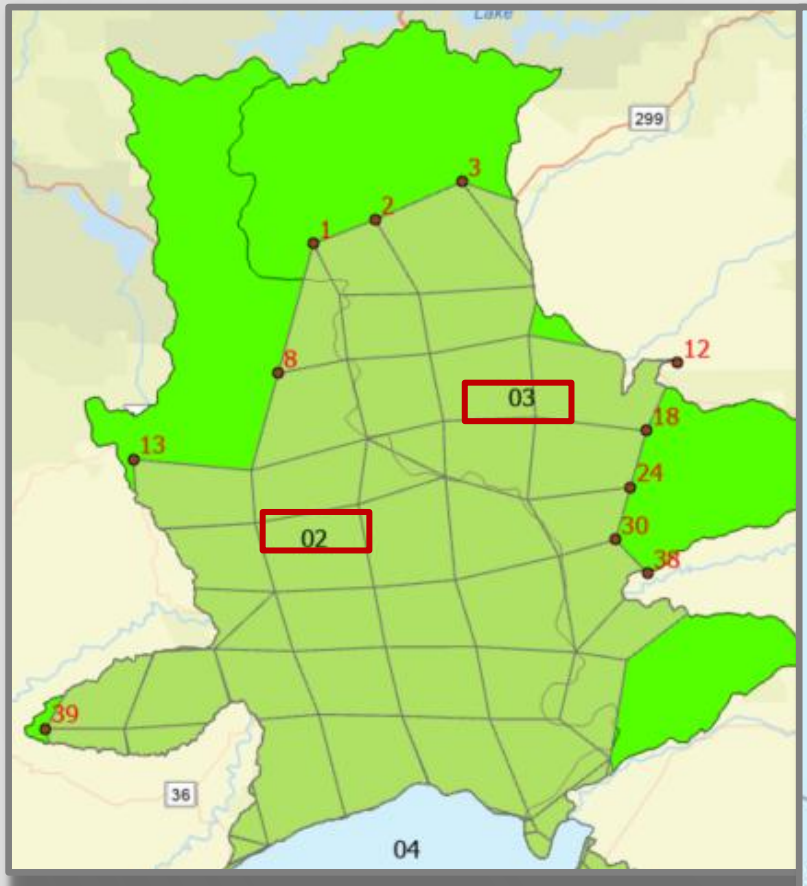
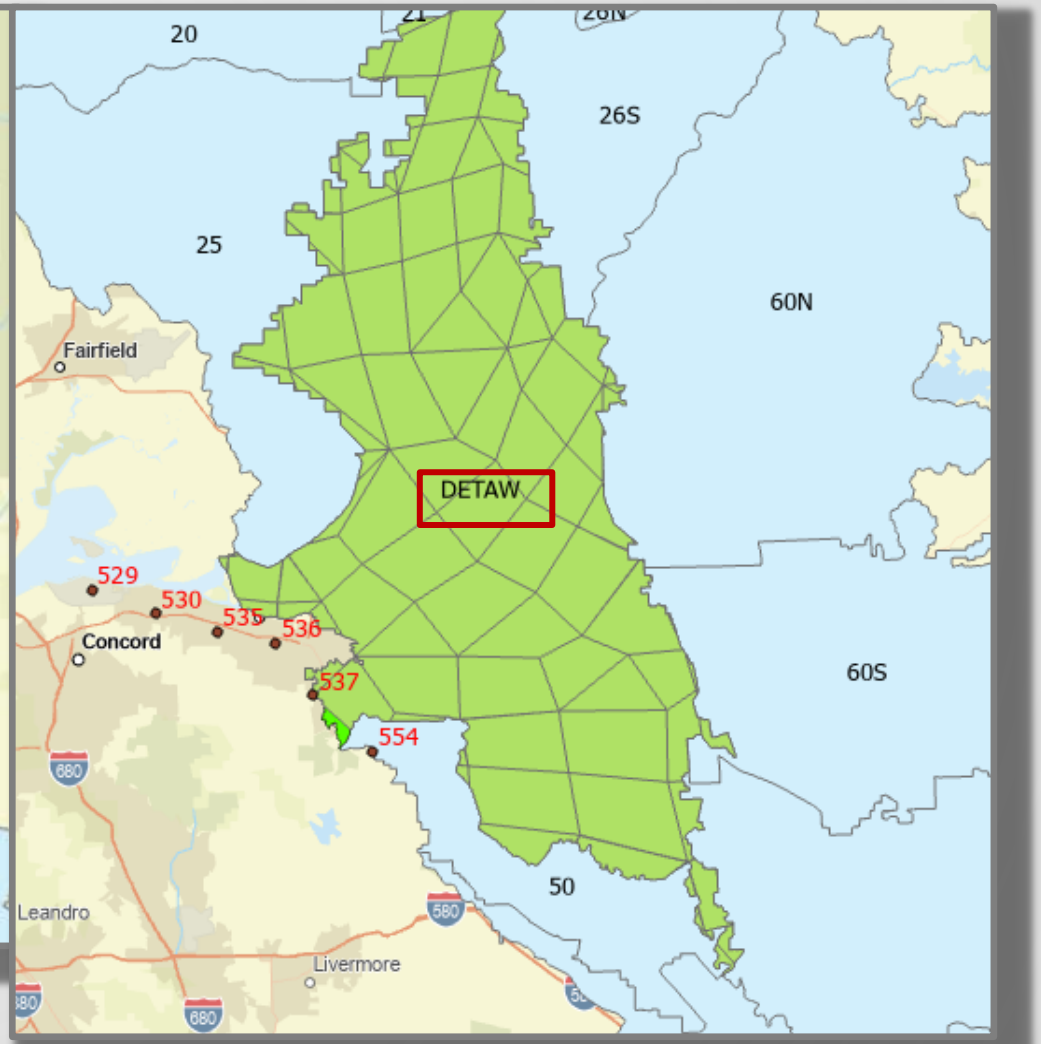
Preliminary Results QAQC

Impact of Boundary flows – setting to zero





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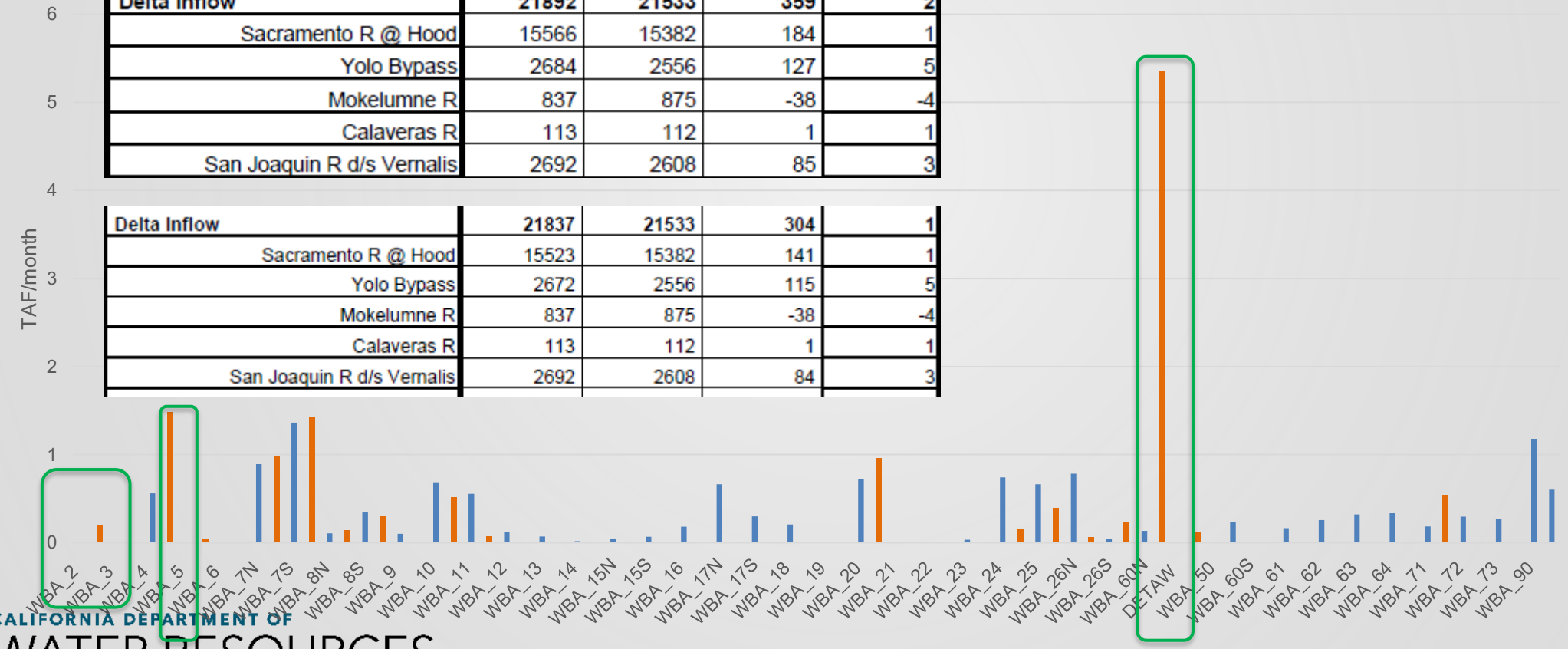
Preliminary Results - QAQC

Impact of Boundary flows – setting to zero

Average Stream- Ground Water interaction (+) Gain from Stream (-) Loss from Stream
Blue - New GW DLL; New Aquifer Parameters; New CS Hydro
Orange - Base

Delta Inflow	21892	21533	359	2
Sacramento R @ Hood	15566	15382	184	1
Yolo Bypass	2684	2556	127	5
Mokelumne R	837	875	-38	-4
Calaveras R	113	112	1	1
San Joaquin R d/s Vernalis	2692	2608	85	3

Delta Inflow	21837	21533	304	1
Sacramento R @ Hood	15523	15382	141	1
Yolo Bypass	2672	2556	115	5
Mokelumne R	837	875	-38	-4
Calaveras R	113	112	1	1
San Joaquin R d/s Vernalis	2692	2608	84	3



CALIFORNIA DEPARTMENT OF WATER RESOURCES

Summary

- A new GWDLL was extracted from the latest IWFM engine – C2VSimCGV1.0
- WRESL codes are updated to align with new GWDLL
- Calibrated new CSHydro (V2.0) against legacy CSHydro
- Compared preliminary results of updated model vs legacy CSHydro and r374
- QAQC steps are on progress for further parameter improvements or bug fixes

Questions???

Thank you!