

Updates to CalSim3 Existing Conditions Land Use Dataset & Planning Study Impacts Analysis

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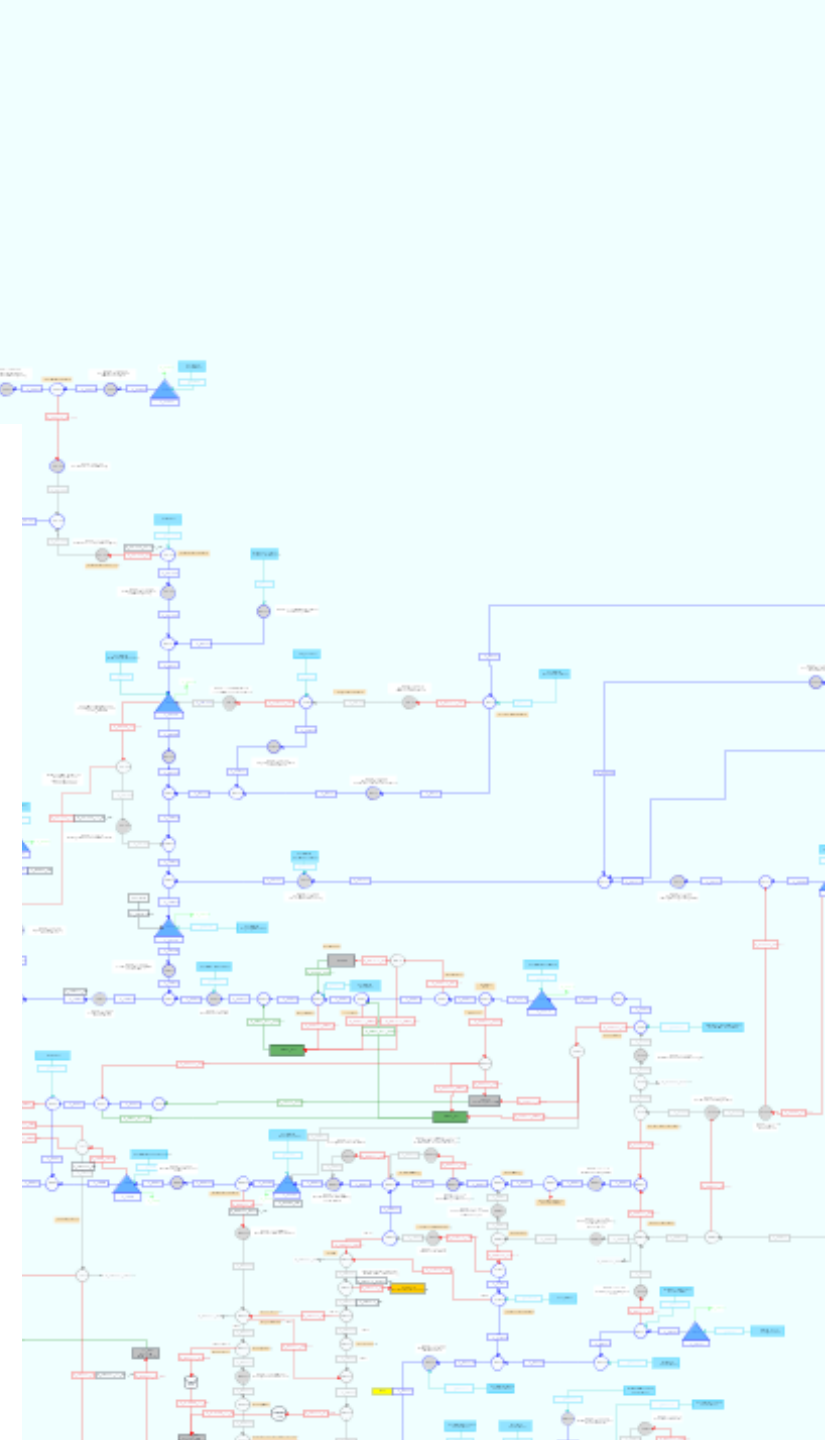
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Agenda

Introduction:

- Background on Land Use Dataset in CalSim 3
- Purpose

Methodology:

- Updated Land Use Data and GIS Analysis
- Changes to CalSimHydro Inputs

Results:

- Land Area Differences
- Planning Study Impacts



Background



Land Use Data Sources

Current CalSim3 Existing Level of Development Land Use:

- Average irrigated crop area for the **10-year period from 2004 – 2013**
- Source: **County land use surveys**, Agricultural Commissioners' reports, and other sources
 - Each county's land use survey was updated approximately every 7 years.
 - Accessible from the **DWR Land Use Data Viewer** ([CADWR Land Use Viewer](#))
- **Implementation of land use data survey:**
 - CalSim 3 treats a unit of land that is double-cropped as two separate units of land.
 - Consequently, a unit of native vegetation within CalSim 3 is reclassified as irrigated land when double cropping is being modeled.
 - Idle crop grouped with 'Native Vegetation'



Land Use Data Sources

Updated Land Use Dataset:

- Land IQ data, which has been developed in partnership with DWR since 2014, provides satellite-based land use data for the State of California.
- **Available Land IQ land use data:**
 - 2014, 2016, 2018, 2019, **2020**, 2021, 2022, 2023 - 2024 (provisionary)
 - 2020 data was selected for implementation to CalSim3
- Land IQ data include separate category for fallowed/idle crop acreage, spring, summer, winter crop attributes.

Purpose



Implement Land IQ 2020 Land Use dataset into CalSimHydro



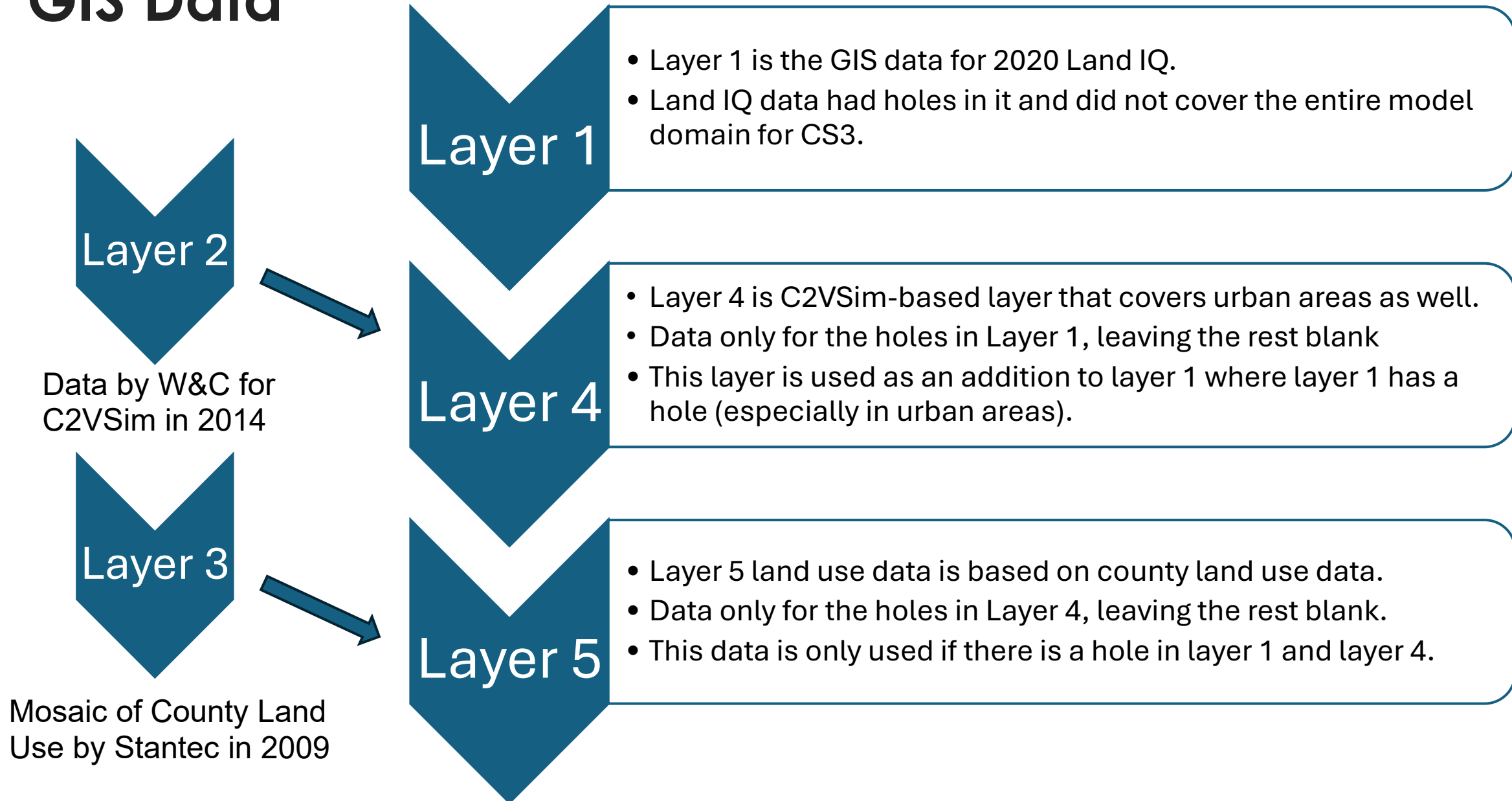
Assess the changes in CalSim3 outputs using the 2023 DCR model



Methodology

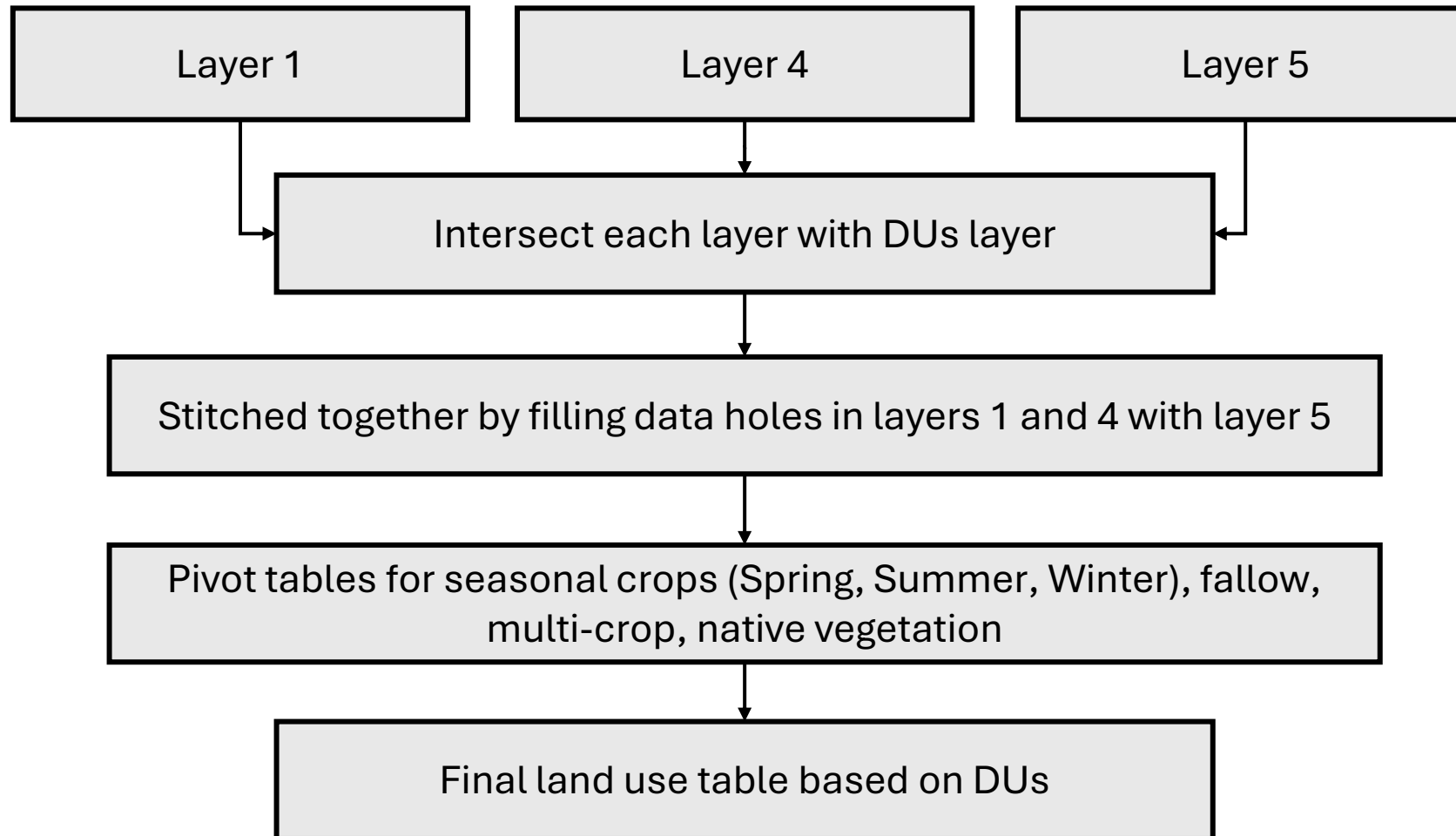


GIS Data





GIS Analysis





Updated Land Use Data

- Land use categories in CalSim3:
 - 1) 20 Agricultural crop categories
 - 2) Urban
 - 3) Managed Wetlands
 - 4) Native Vegetation

DCR 23 CalSim3 Land Use Types and Associated Land Use Codes

DCR 2023 with 2020 Land Use	
Land Use Code	Land Use Type in DCR 2023
AL	Alfalfa
AP	Almonds-Pistachios
DB	Beans
CR	Corn
CO	Cotton
CU	Cucurbits
GR	Grain
NV	Native Vegetation
OG	Onions and Garlic
OR	Other Deciduous
FI	Other Field
TR	Other Truck
PA	Pasture
PO	Potatoes
RI	Rice
SF	Safflower
WL	Seasonal and Permanent Wetlands
SO	Sub-Tropical
SB	Sugar Beets
TH	Tomatoes Hand-Picked
TM	Tomatoes Machine-Picked
UR	Urban
VI	Vineyards
ID	Idle Crops
MC	Multi-Crop



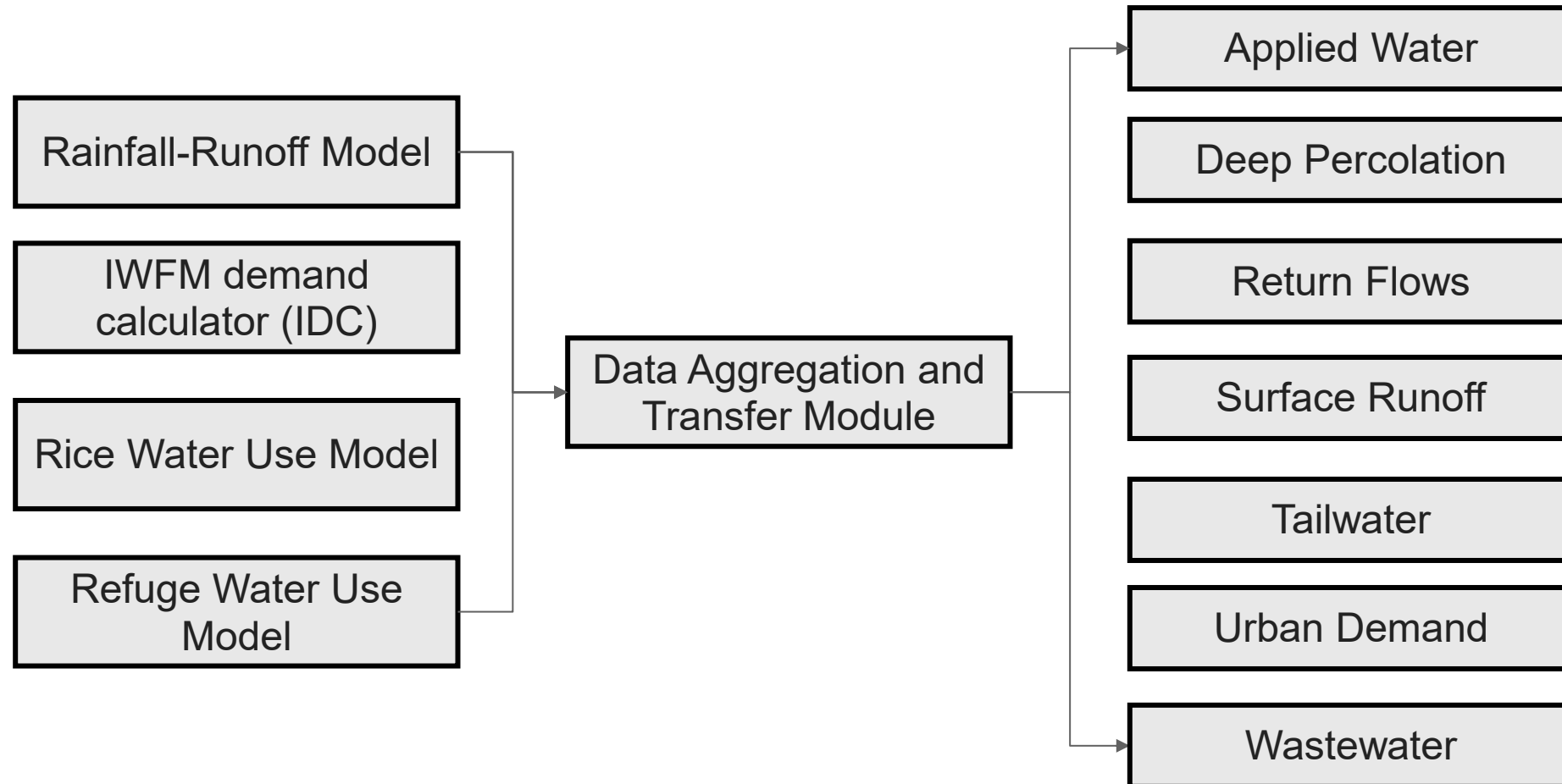
Including Idle Crops (ID) and Multi-Crop (MC) Categories

- What are ID/MC?
 - Idle crops refers to crops left unharvested or uncultivated within a field.
 - Multi-crops refers to the practice of growing two or more crops in the same piece of land during one year.



CalSimHydro

CalSimHydro is a hydrology preprocessor tool that produces input data for CalSim 3 models.





Changes to CalSimHydro Inputs – Growing Season

Changes to CalSimHydro Inputs in Parameter.dat file

```
C This data file contains the parameters used in the Rainfall-Runoff Model.
C
C*****
C                                     Growing Season for Each Crop
C                                     (CROP FACTORS)
C-----
C      Growing Season
C      Start      End
C      Month      Month      (Months in Calendar Year)
C-----
C      1         12 /AL 1 Alfalfa
C      3         10 /AP 2 Almonds and Pistachio
C      5         10 /CO 3 Cotton
C      5         9  /CR 4 Corn
C      4         9  /CU 5 Cucurbits
C      7         9  /DB 6 Beans
C      4         9  /FI 7 Other Field
C      1         5  /GR 8 Grain
C      1         12 /NV 9 Native Vegetation
C      3         10 /OG 10 Onions and Garlic
C      3         10 /OR 11 Other Deciduous
C      1         12 /PA 12 Pasture
C      4         8  /PO 13 Potatoes
C      0         0  /RI 14 Rice
C      3         9  /SB 15 Sugar Beets
C      4         7  /SF 16 Safflower
C      1         12 /SO 17 Sub-Tropical
C      4         8  /TH 18 Fresh Tomatoes
C      4         8  /TM 19 Process Tomatoes
C      4         9  /TR 20 Other Truck
C      0         0  /UR 21 Urban
C      4         11 /VI 22 Vineyards
C*****
```



```
C This data file contains the parameters used in the Rainfall-Runoff Model.
C
C*****
C                                     Growing Season for Each Crop
C                                     (CROP FACTORS)
C-----
C      Growing Season
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C      1         12 /AL 1 Alfalfa
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C      5         10 /CO 3 Cotton
C      5         9  /CR 4 Corn
C      4         9  /CU 5 Cucurbits
C      7         9  /DB 6 Beans
C      4         9  /FI 7 Other Field
C      1         5  /GR 8 Grain
C      1         12 /NV 9 Native Vegetation
C      3         10 /OG 10 Onions and Garlic
C      3         10 /OR 11 Other Deciduous
C      1         12 /PA 12 Pasture
C      4         8  /PO 13 Potatoes
C      0         0  /RI 14 Rice
C      3         9  /SB 15 Sugar Beets
C      4         7  /SF 16 Safflower
C      1         12 /SO 17 Sub-Tropical
C      4         8  /TH 18 Fresh Tomatoes
C      4         8  /TM 19 Process Tomatoes
C      4         9  /TR 20 Other Truck
C      0         0  /UR 21 Urban
C      4         11 /VI 22 Vineyards
C      1         12 /ID 23 Idle Crops
C      1         12 /MC 24 Multi-Crops
C*****
```

New Crop
Categories {

```
1 12 /ID 23 Idle Crops
1 12 /MC 24 Multi-Crops
```



Changes to CalSimHydro Data Files

- **Rainfall-Runoff Model:**
 - LUBySoilTypePCN.dat
 - main.dat
 - Parameter.dat
- **IWFM Demand Calculator (IDC):**
 - ELandUse.dat
 - ET.dat
 - InfiltrationExist.dat
 - Initial.dat
 - IrigEfficiency.dat
 - Main.dat
 - MinMoisture.dat
 - OutputPathnames.dat
 - Parameter.dat
- **Input DSS:**
 - CS3_ET.dss
 - CS3_LandUseDU.dss
 - CS3_MSMR_IRREFF.dss



Changes to CalSimHydro Inputs – Curve Numbers (CN)



Changes made to accommodate new crop categories within CalSimHydro



Idle Crops:

Growing season year-round

Growing Season CN: Table 9-1 NRCS handbook for "Fallow: Crop residue cover"



Multi-Crop:

Growing season year-round

Growing Season CN used corn CN (SCS TR-55)



DCR 2023 Planning Study Run



DCR 2023 CS3 model, Danube 9.3.1 Historical Model, was used in the analysis.



DCR 2023 uses existing conditions with the historical hydrology dataset.



DCR 2023 was used as the base model.

DCR 2023 with the updated CalSimHydro data was used as the alternative.



Results



Land Area Differences in Thousand Acres

New
Categories

Almonds-Pistachios

Native Vegetation Urban

RESULTS

WBA	AL	AP	CO	CR	CU	DB	FI	GR	OG	OR	PA	PO	RI	SB	SF	SO	TH	TM	TR	VI	NV	UR	WL	ID	MC	
02	-0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.5	-0.8	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.1	-0.1	-3.6	2.9	0.0	0.8	0.0
03	-0.1	0.1	0.0	0.0	0.1	0.0	0.0	1.7	0.0	-0.7	-1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.0	3.9	0.0	0.8	0.1	
04	-1.3	16.2	0.0	-1.1	-0.6	-0.2	-0.4	2.0	0.0	6.2	-5.0	0.0	-1.0	0.0	0.2	1.4	0.0	0.0	0.0	-0.2	0.1	-39.5	13.1	0.0	9.4	0.9
05	-0.7	-1.7	0.0	0.4	-0.2	-0.5	0.0	-0.3	0.0	0.9	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1	0.1	-10.1	9.5	-0.3	2.8	0.0
06	0.0	2.0	0.0	-0.2	0.0	0.0	0.0	0.6	0.0	0.8	-0.6	0.0	0.0	0.0	0.0	-1.3	0.0	0.0	0.1	0.0	-7.0	4.7	0.0	0.3	0.6	
07N	-7.7	36.7	0.6	-4.1	1.1	-0.3	-2.6	2.0	0.0	9.3	-2.1	0.0	-7.3	0.0	-0.4	1.9	0.0	0.4	-0.1	-1.9	-55.8	11.1	0.0	13.8	4.9	
07S	-4.1	19.8	-1.8	-2.3	-3.2	-0.6	2.5	-1.7	-1.1	2.6	1.0	0.0	-0.8	0.0	-0.1	1.2	0.0	-6.0	-0.1	0.9	-24.9	10.8	0.0	7.8	0.2	
08N	-2.6	0.2	-0.1	-1.5	-0.3	-0.4	-3.0	-1.5	0.0	4.1	-0.3	0.0	-6.5	0.0	-0.2	0.2	0.0	-0.2	0.0	0.0	-0.5	9.7	-3.2	4.8	1.1	
08S	-2.5	15.2	-0.9	-0.3	-1.8	-0.3	1.9	-3.2	-0.2	6.9	1.2	0.0	-16.7	0.0	-2.5	0.0	0.0	0.0	0.0	-0.1	-19.8	14.9	-7.6	14.1	1.8	
09	-0.6	1.3	0.3	-1.3	-0.7	-1.4	-1.9	-0.7	0.0	7.8	2.0	0.0	-4.8	0.0	0.3	0.2	0.0	0.8	0.1	0.0	-2.7	3.8	-6.9	3.3	1.2	
10	-0.2	-0.8	0.0	-1.3	0.0	0.0	-0.1	0.9	0.0	1.9	-0.9	0.0	-1.7	0.0	-0.1	-0.2	0.0	-0.7	-0.2	0.0	-8.0	9.9	-0.7	2.0	0.2	
11	-1.1	4.3	-0.3	-0.5	-0.2	-0.3	-0.5	-0.2	0.0	4.8	-1.8	0.0	-2.6	0.0	-0.2	-0.1	0.0	0.1	0.1	0.0	-16.9	15.9	-3.3	2.8	0.2	
12	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.2	-0.5	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-3.5	1.8	-0.8	0.8	0.0	
13	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	-0.6	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	-6.0	4.2	0.0	0.7	0.0	
14	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-1.4	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.8	0.0	0.0	0.2	0.0	
15N	0.0	1.4	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.5	-0.9	0.0	-0.3	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-4.5	3.3	0.0	0.6	0.2	
15S	0.1	3.7	0.0	-0.6	0.0	-0.2	0.1	0.4	0.0	-0.6	-1.9	0.0	0.2	0.0	-0.1	1.0	0.0	0.0	0.0	0.0	-16.7	11.0	0.0	2.7	0.9	
16	-0.1	4.0	0.0	-0.3	-0.7	-0.2	0.3	0.6	0.0	-3.7	-0.1	0.0	-0.9	0.0	0.3	0.0	0.0	-0.1	0.4	0.1	-7.7	5.9	0.0	2.2	0.1	
17N	0.0	0.9	0.0	0.0	0.0	-0.2	-0.1	-0.2	0.0	-1.0	-0.2	0.0	-0.9	0.0	0.0	0.5	0.0	0.0	0.0	0.0	-0.4	0.9	0.0	0.8	0.0	
17S	-0.1	0.7	-0.2	0.2	-0.3	-1.6	-0.5	0.4	0.0	0.4	0.1	0.0	2.2	0.0	0.5	0.2	0.0	0.9	0.0	0.0	-5.5	1.5	0.0	0.8	0.1	
18	0.1	0.3	-0.1	0.2	-0.7	-1.8	0.0	-0.2	0.0	1.0	-0.1	0.0	-3.8	0.0	-0.9	0.0	0.0	1.4	-0.2	0.0	-0.5	2.9	0.0	1.3	1.1	
19	-0.6	0.3	0.0	-1.2	-2.9	-3.1	2.4	-4.8	0.1	1.4	0.0	0.0	4.0	0.0	-1.0	0.0	0.0	1.2	0.1	0.0	-5.3	5.5	0.0	3.8	0.2	
20	-10.8	24.3	0.0	-1.6	-0.2	0.1	0.6	-6.0	-0.4	5.0	0.4	0.0	1.3	0.0	0.1	2.1	0.0	-5.4	0.8	2.2	-36.7	14.6	0.0	6.9	2.6	
21	-2.4	2.2	0.0	-1.8	-0.8	0.2	0.6	3.7	0.0	-1.4	0.9	0.0	-2.9	0.0	-0.3	0.0	0.0	-1.1	0.1	0.0	-5.9	3.0	-0.9	6.1	0.5	
22	-1.7	0.5	0.0	-1.9	0.0	-0.1	0.1	6.0	0.0	1.8	-0.2	0.0	0.5	0.0	-0.4	0.0	0.0	-0.1	0.0	0.0	-15.3	5.5	0.0	4.5	0.7	
23	-0.3	5.8	0.0	-0.4	0.0	0.0	-0.5	1.9	0.0	2.3	-0.9	0.0	-3.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	-17.0	5.8	0.0	6.1	0.2	
24	0.4	1.9	0.0	-0.3	0.0	0.0	-0.1	1.9	0.0	1.0	-0.1	0.0	-1.9	0.0	0.0	0.1	0.0	0.0	0.0	0.1	-52.5	45.9	0.0	3.3	0.2	
25	-13.6	18.9	0.0	-1.7	0.0	-1.0	-8.9	2.9	-0.1	4.2	-1.7	0.0	0.7	0.0	-0.2	0.2	0.0	-0.5	0.0	0.1	-47.6	24.5	0.0	19.6	4.3	
26N	0.0	0.3	0.0	0.0	-0.1	0.0	0.0	-0.1	0.0	0.0	-0.7	0.0	-0.6	0.0	-0.1	-0.1	0.0	0.0	0.0	-0.1	-30.6	29.5	0.0	2.7	0.0	
26S	-1.4	0.3	0.0	-2.3	0.0	0.0	-0.1	1.0	0.0	0.5	-1.2	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	-0.8	0.9	-23.8	21.6	0.0	3.9	1.9	
50	-2.3	5.9	0.0	-1.7	-0.5	1.2	0.0	-0.7	0.0	2.9	-2.2	-0.8	-0.1	-0.7	0.1	0.2	-0.2	0.9	0.1	-1.6	-1.9	-0.2	-0.3	2.0	0.5	
60N	0.5	6.7	0.0	-16.9	-0.7	-0.5	-3.3	6.6	0.0	3.8	-1.0	0.0	0.1	0.0	-0.2	1.1	0.0	-1.6	-0.3	2.1	-59.3	42.5	0.0	11.7	8.8	
60S	-3.5	15.3	0.1	-10.6	1.3	-1.8	-2.2	-7.3	0.3	19.3	-1.3	0.2	-1.8	0.0	0.1	0.5	0.0	-13.3	-1.0	-5.0	-21.4	17.3	0.0	5.5	9.4	
61	-4.0	43.1	0.0	-33.8	0.4	-0.5	-17.8	-5.1	-0.1	0.8	-9.3	0.0	-3.6	0.0	-0.1	-0.6	0.0	-1.1	-3.1	-4.4	-32.1	40.5	0.0	8.7	22.4	
62	-9.0	27.8	0.0	-59.1	-0.5	-1.4	-35.3	-12.0	0.0	-2.9	-3.3	3.6	0.0	0.0	0.0	0.1	0.0	-0.5	-6.2	-3.1	-3.3	46.1	0.0	7.5	51.5	
63	-11.3	49.1	-7.5	-41.1	-0.6	0.0	-16.6	1.7	0.1	-0.4	-11.0	8.0	-1.0	-0.8	0.0	0.0	0.0	-4.7	-15.5	1.7	-34.5	27.4	0.0	11.4	45.6	
64	-21.7	121.2	-6.4	-26.4	-0.2	-0.2	-20.0	-4.7	0.1	-0.3	-1.7	0.0	0.0	-0.3	-0.3	2.8	0.0	-1.3	-1.3	-18.0	-93.5	26.5	0.0	22.8	23.1	
71	-7.5	25.9	-0.2	-5.0	-2.5	-9.1	-7.1	-2.9	0.0	-5.7	-0.8	0.0	0.0	0.0	-0.5	1.2	0.0	-12.7	-3.4	1.1	1.6	13.2	0.0	10.5	3.9	
72	-24.1	32.2	1.3	-25.9	-0.4	-6.8	-25.6	7.6	1.3	0.3	-4.5	0.0	-0.3	-1.6	0.0	0.0	0.0	0.6	-1.7	-0.9	-9.4	20.6	0.0	7.9	28.9	
73	-7.0	32.1	-17.8	-1.1	-6.2	-0.2	-22.0	4.9	-3.0	0.2	5.2	0.0	-1.5	-0.8	-1.5	0.3	0.0	-9.3	-7.2	0.2	-1.2	9.3	0.0	24.9	1.6	
90	-9.4	103.1	-74.6	-6.1	-6.9	-3.7	-8.7	-22.5	-1.6	-1.2	-0.6	0.2	0.0	-2.4	-5.5	2.2	0.0	-26.1	-14.2	3.7	-132.9	32.3	0.0	170.7	4.3	
91	-3.7	3.3	-3.6	1.1	-0.1	0.0	-0.2	0.6	-1.7	-0.5	-0.1	0.0	0.0	-0.3	0.0	0.0	-2.8	2.2	-0.2	-0.3	-4.4	0.5	0.0	4.5	0.3	
Total	-154.5	626.4	-111.0	-250.6	-28.4	-34.8	-168.8	-25.5	-6.4	73.2	-48.2	11.1	-55.5	-6.9	-13.1	15.8	-2.9	-76.2	-54.1	-21.7	-864.6	573.7	-23.5	417.7	224.3	



Average Annual Flow Comparisons in TAF/yr (1922-2021)

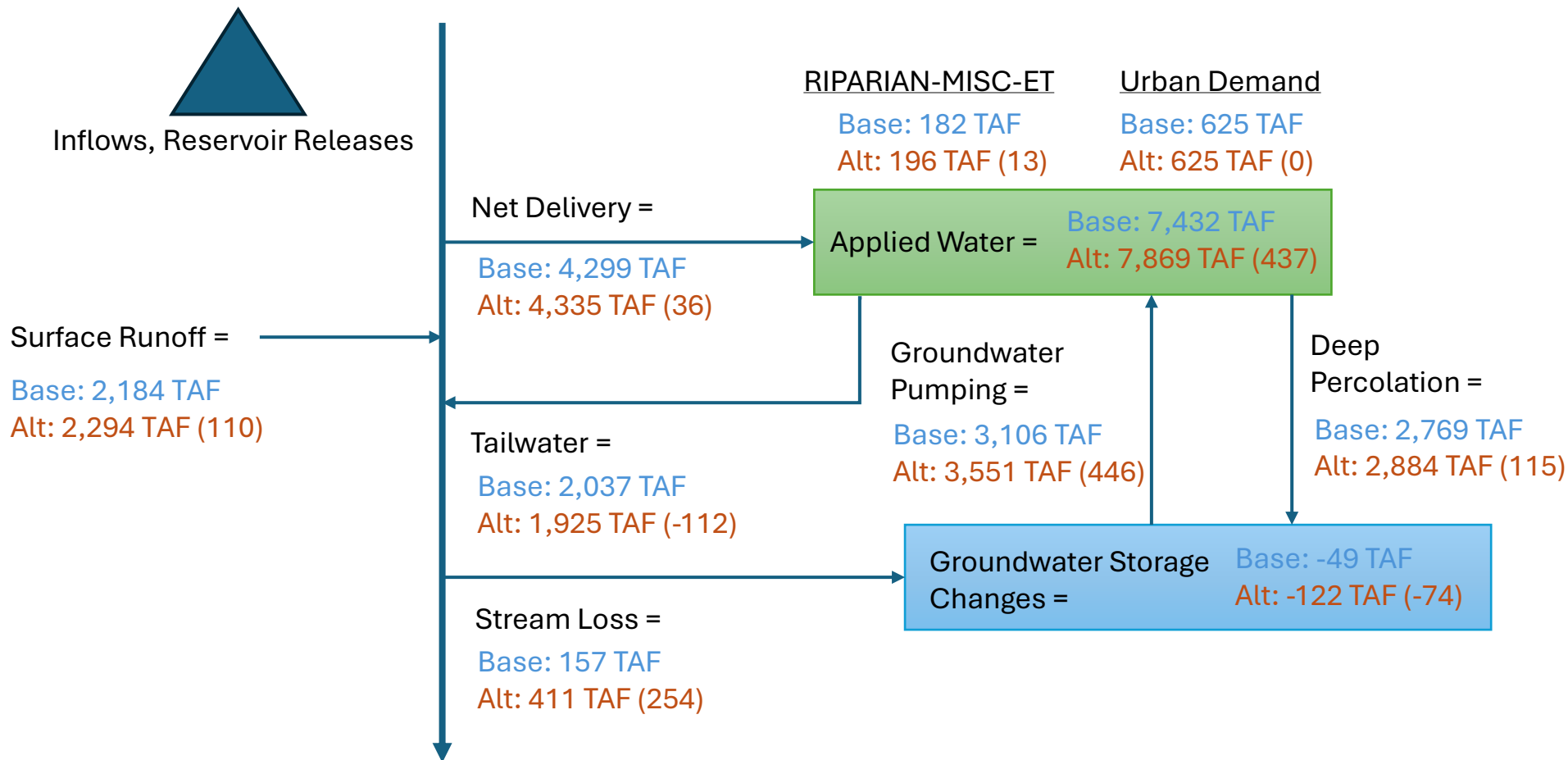
	DCR 2023	DCR 2023 with 2020 Land Use	Changes
River Flows			
Trinity River below Lewiston	741	736	-6 (-1%)
Trinity Export	497	503	6 (1%)
Clear Creek below Whiskeytown	146	146	0 (0%)
Sacramento River at Keswick	6,130	6,144	14 (0%)
Sacramento River at Wilkins Slough	6,250	6,224	-26 (0%)
Feather River below Thermalito	2,965	2,960	-5 (0%)
Feather River at Sacramento River confluence	5,187	5,144	-43 (-1%)
Yuba River at Marysville	1,488	1,472	-16 (-1%)
Sacramento River at Verona	12,936	12,773	-163 (-1%)
American River below Nimbus	2,471	2,474	3 (0%)
American River at Sacramento River Confluence	2,396	2,391	-5 (-1%)
Delta Inflows	21,883	21,523	-360 (-2%)
Sacramento River at Hood	15,561	15,432	-129 (-1%)
Yolo Bypass	2,664	2,541	-124 (-5%)
Mokelumne River	873	872	-2 (0%)
Calaveras River	112	111	-1 (-1%)
San Joaquin River Downstream of Vernalis	2,672	2,568	-105 (-4%)
Total Delta Outflow	16,075	15,802	-273 (-2%)
Delta Exports	5,034	4,950	-84 (-2%)
Banks	2,526	2,443	-83 (-3%)
Banks SWP	2,442	2,361	-81 (-3%)
Banks CVP	66	64	-2 (-3%)
Banks WTS	18	19	1 (6%)
Jones	2,509	2,507	-2 (0%)
Jones CVP	2,509	2,507	-2 (0%)
Jones WTS	0	0	0 (0%)
SWP Delivery: TA + CO	2,338	2,264	-74 (-3%)
SWP Shortage: Total	49	55	7 (14%)
CVP Delivery: Total	4,679	4,632	-46 (-1%)
CVP Shortage: Total	7	21	14 (188%)
OMR014	-3,656	-3,624	32 (1%)



Planning Model Water Budget Summary – Sacramento Valley

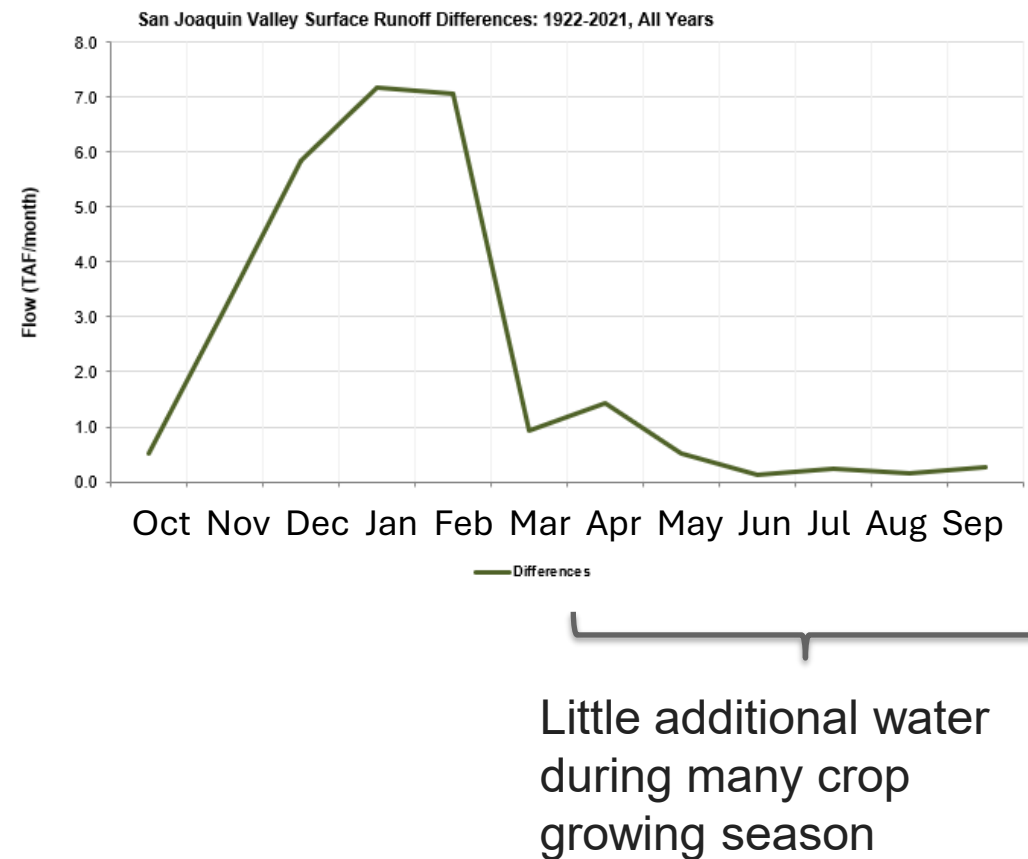
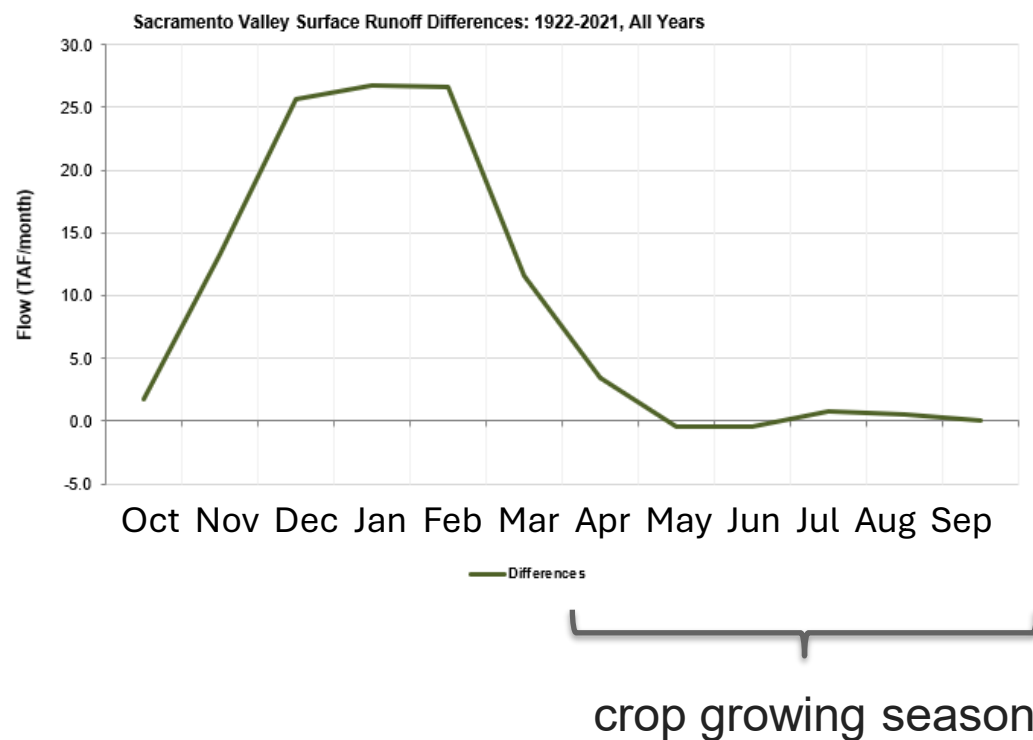
Base: DCR 2023 Danube Existing Conditions Historical Hydrology

Alt: DCR 2023 with 2020 Land Use





Surface Runoff Differences (Alt minus Base)

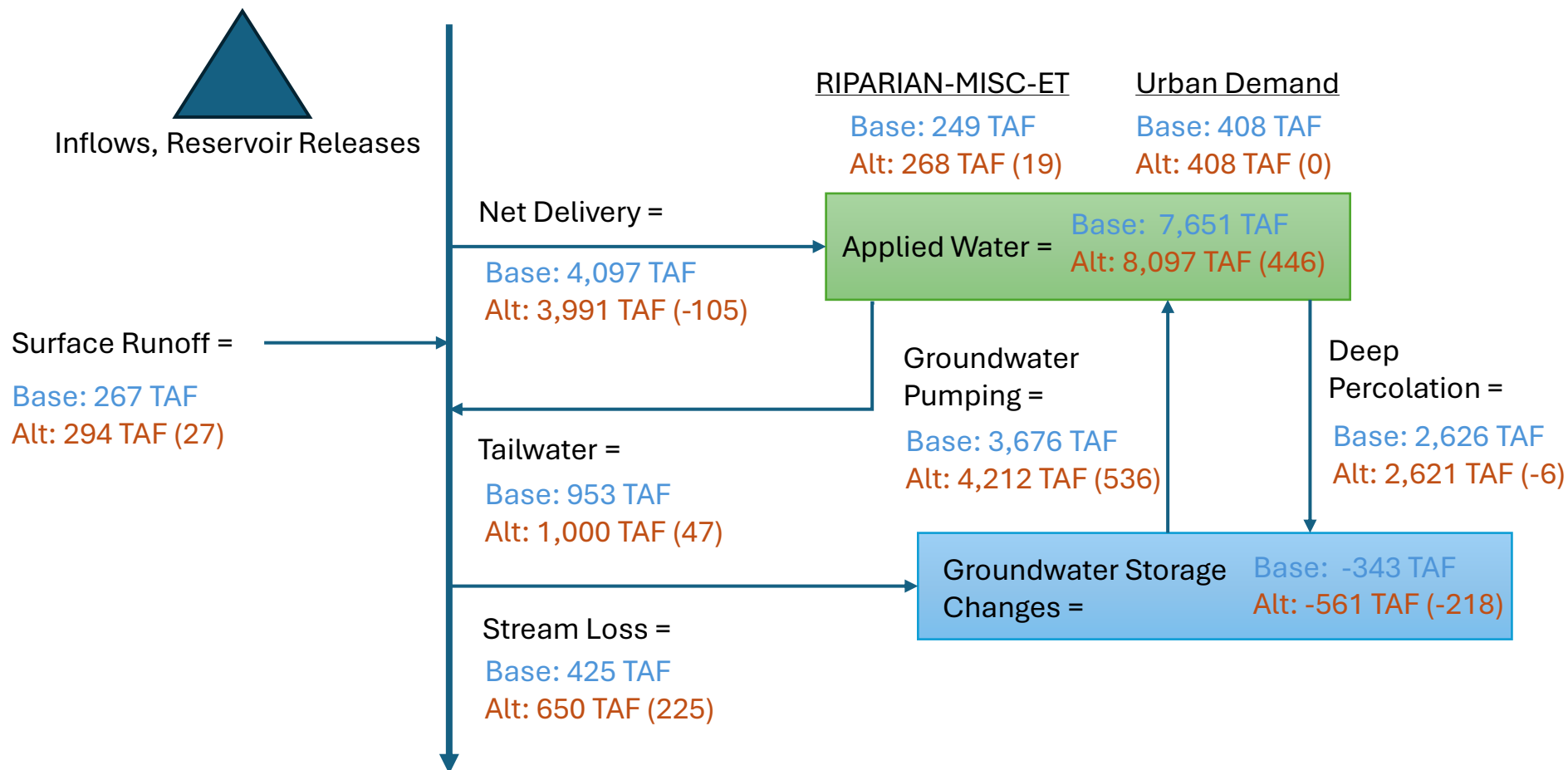




Planning Model Water Budget Summary – San Joaquin Valley

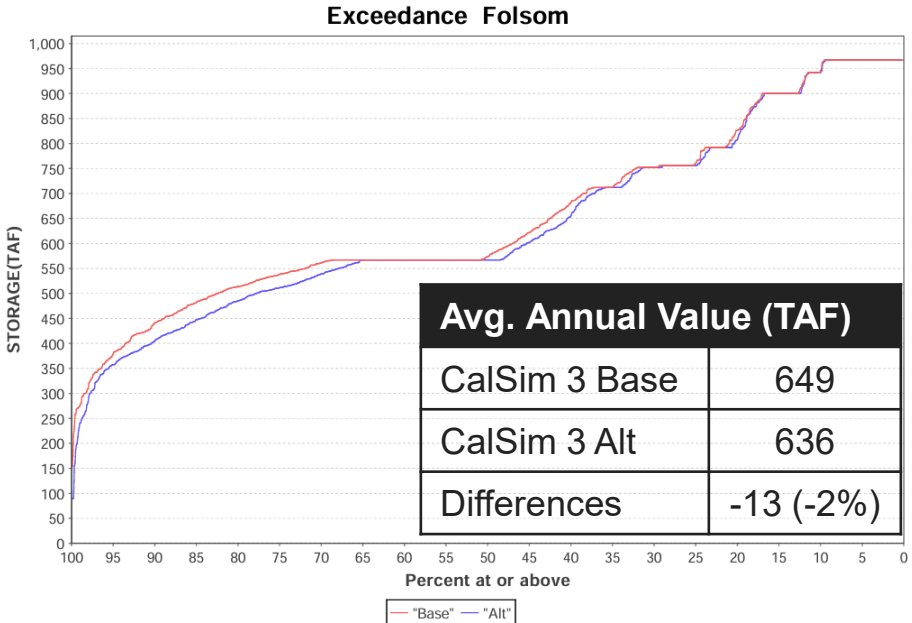
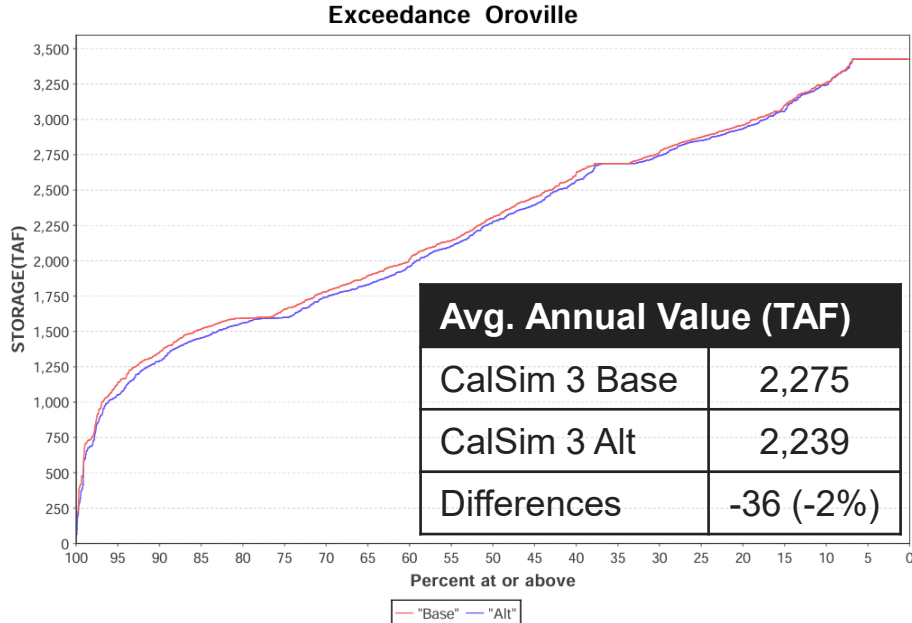
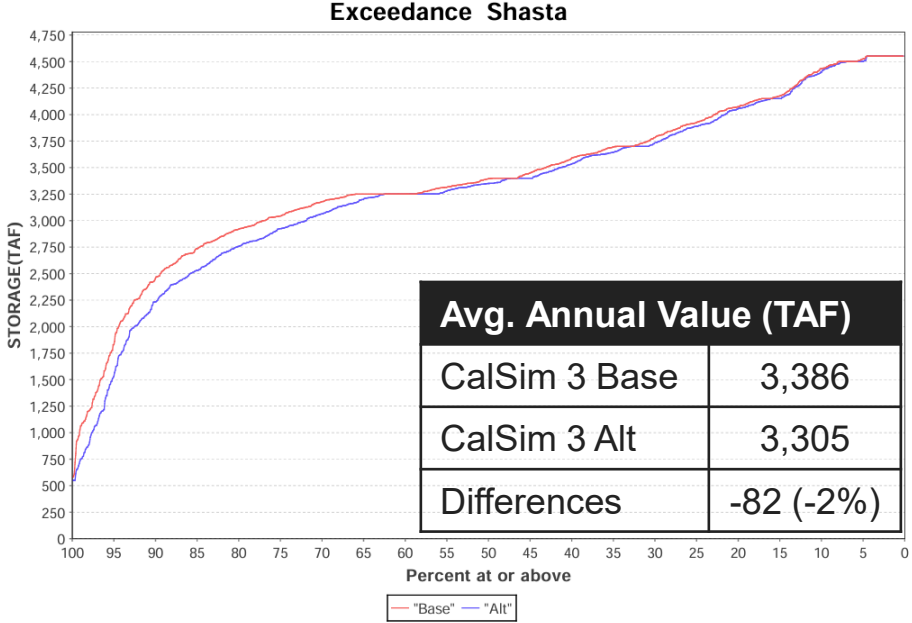
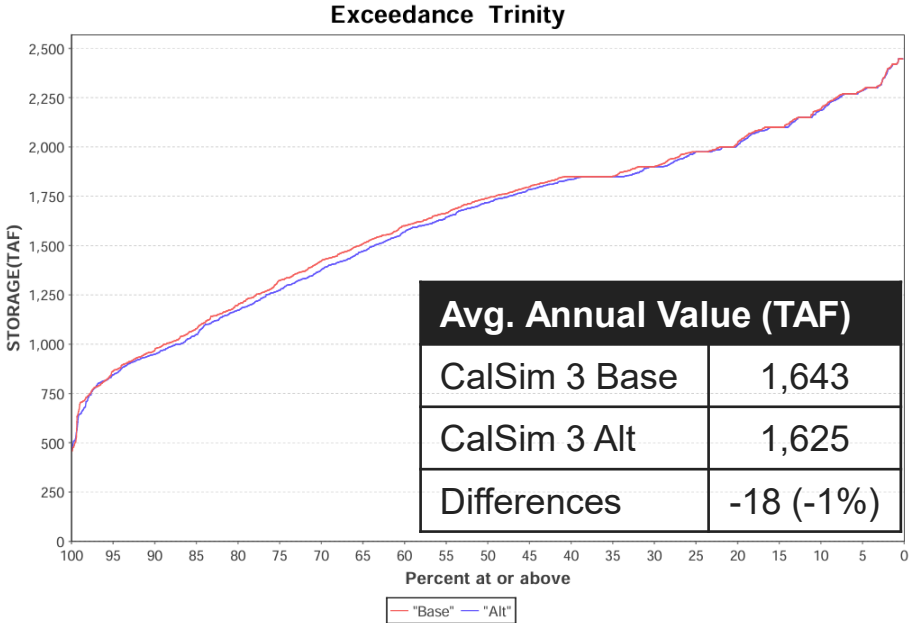
Base: DCR 2023 Danube Existing Conditions Historical Hydrology

Alt: DCR 2023 with 2020 Land Use



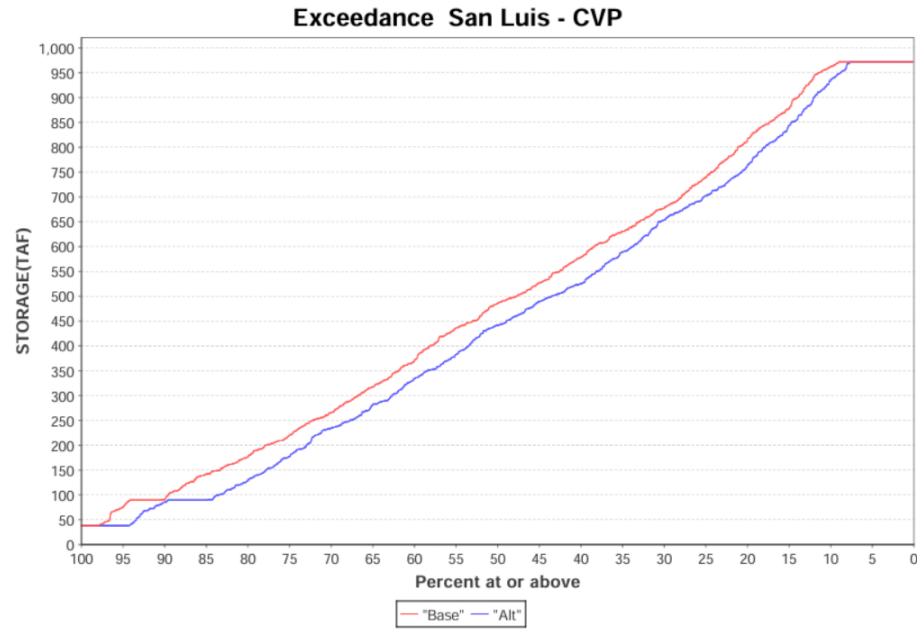


Sacramento Valley – Changes in Storage



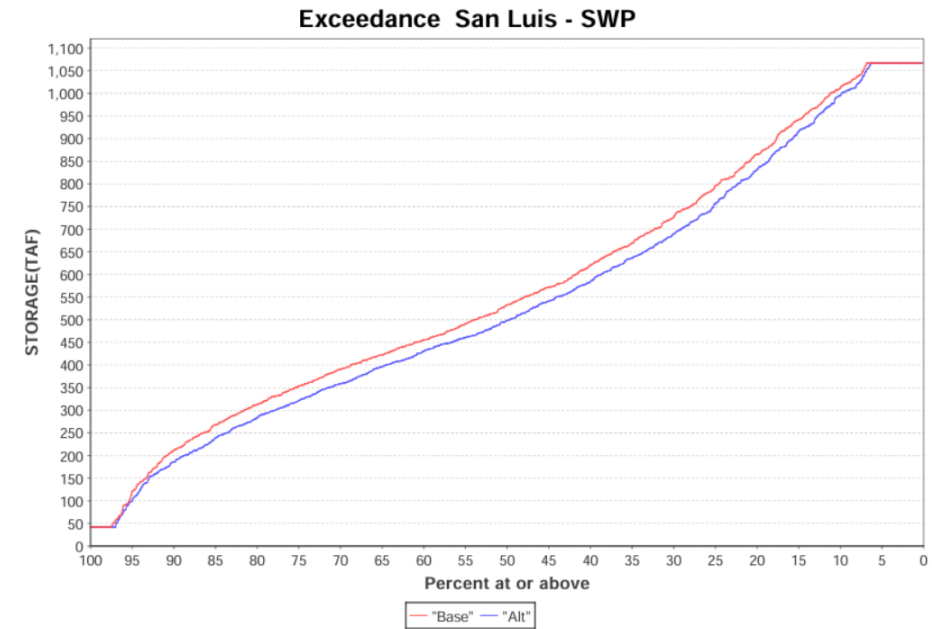


San Joaquin Valley – Changes in Storage



Avg. Annual Value (TAF)

CalSim 3 Base	493
CalSim 3 Alt	458
Differences	-36 (-7%)

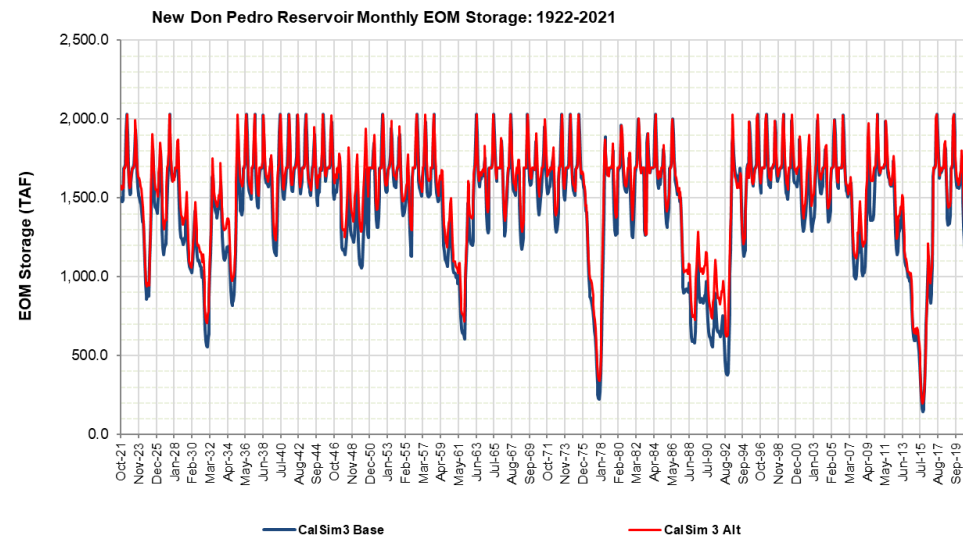
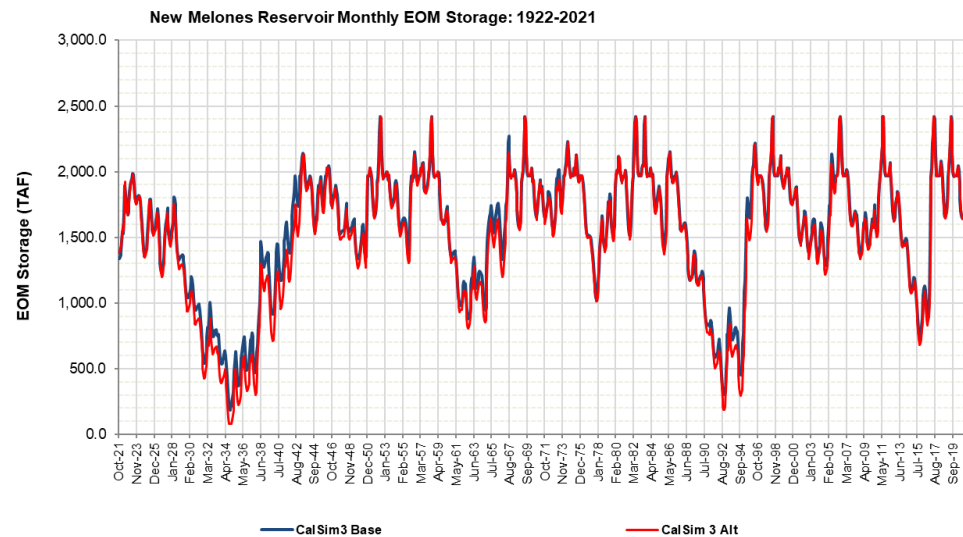


Avg. Annual Value (TAF)

CalSim 3 Base	567
CalSim 3 Alt	541
Differences	-26 (-5%)



San Joaquin Valley – Changes in Deliveries from Stanislaus and Tuolumne Rivers



Name of Major District/ Reservoir	DU	Avg Annual value in Base (TAF)	Avg Annual value in Alt (TAF)	Changes (TAF)
Stockton East WD	60S_PA1	36.37	36.31	-0.06
Central San Joaquin WD	60S_PA2	62.18	60.81	-1.38
Oakdale ID North	61_PA1	96.59	105.00	8.41
Oakdale ID South	61_PA2	125.67	146.17	20.50
South San Joaquin ID	61_PA3	198.34	184.39	-13.96
New Melones Storage	-	1,551	1,503	-48
Modesto ID	61_NA2	193.15	151.66	-41.49
Turlock ID	62_NA3	474.55	424.42	-50.14
New Don Pedro Storage	-	1,450	1,520	70



On-going Work and Next Steps

On-going Work

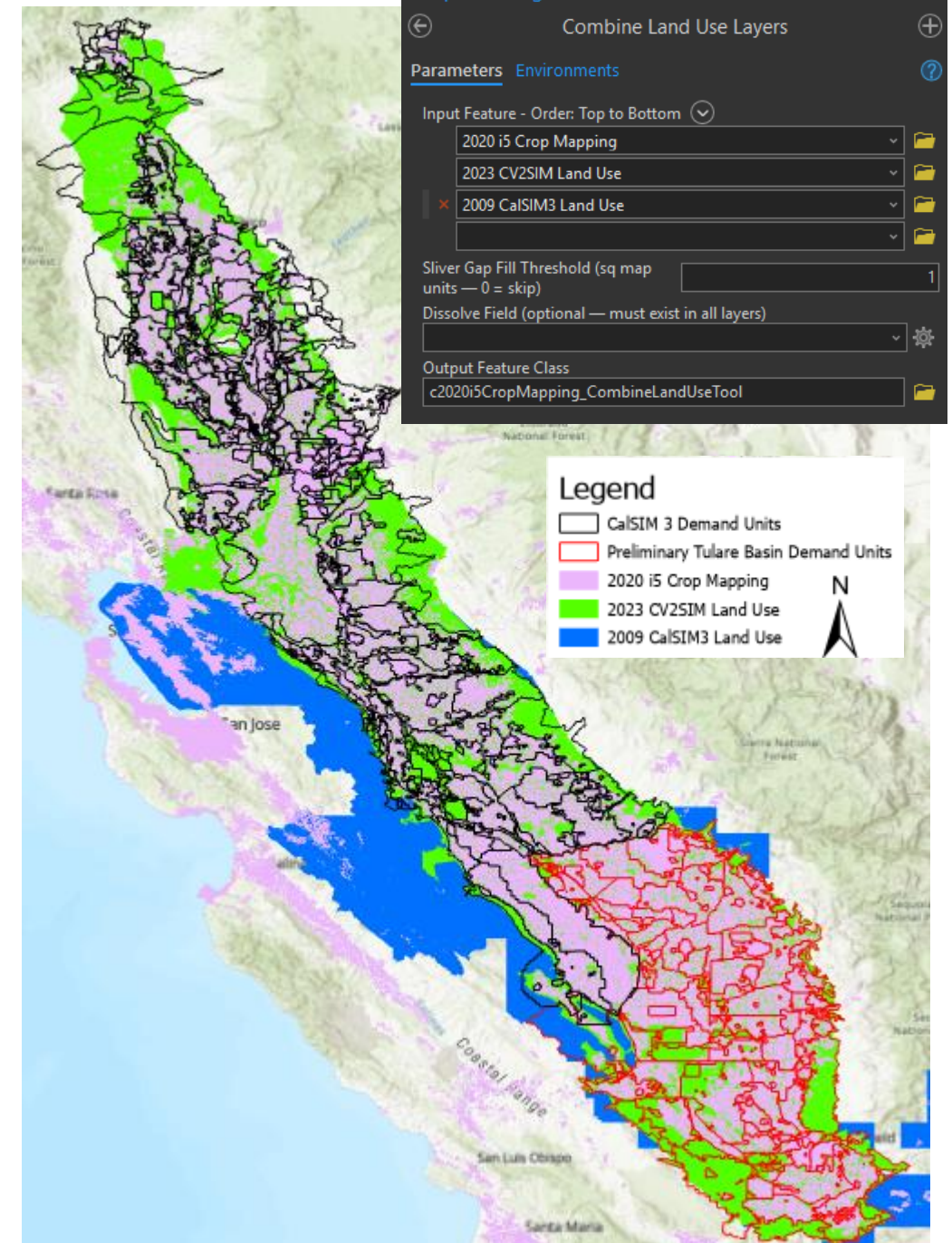
CalSim 3: Land Use Characterization Toolbox

Python-Based Custom ArcGIS Toolbox

- Dynamic user interface for streamlined workflow input.
- Scalable design for expanding datasets and processes.
- Reproducible outputs that improve consistency and accuracy.
- Automated execution that reduces manual effort.

Toolbox Functions

- Combine land use layers.
 - Merge land use datasets.
 - Resolve gaps and overlaps.
 - Optional feature dissolving.
- Convert land use demand units to DSS.
 - Perform spatial analysis with demand units and merged land use layers.
 - Produce CalSim3-compatible DSS input files.



Conclusion



Future consideration and implementation of updated remotely sensed land use datasets in CalSim3 is expected.



These updates can enable future hydrology revisions such as variable land use representation.



This approach provides a reproducible pathway for future CalSim 3 updates as remote-sensing datasets advance.



Thank You

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