

# CALVIN: Model & Updates

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# Outline

"All models are wrong, but some are useful." G.E.P. Box (1979)

- CALVIN Model
- Updates
  - Demand Areas
  - Time-series Data
  - Network-Flow
- Preliminary Results
- Conclusion

# Need for Updates

Data,  
Changing  
Conditions

Maintain the applicability



Better represent California's  
water system

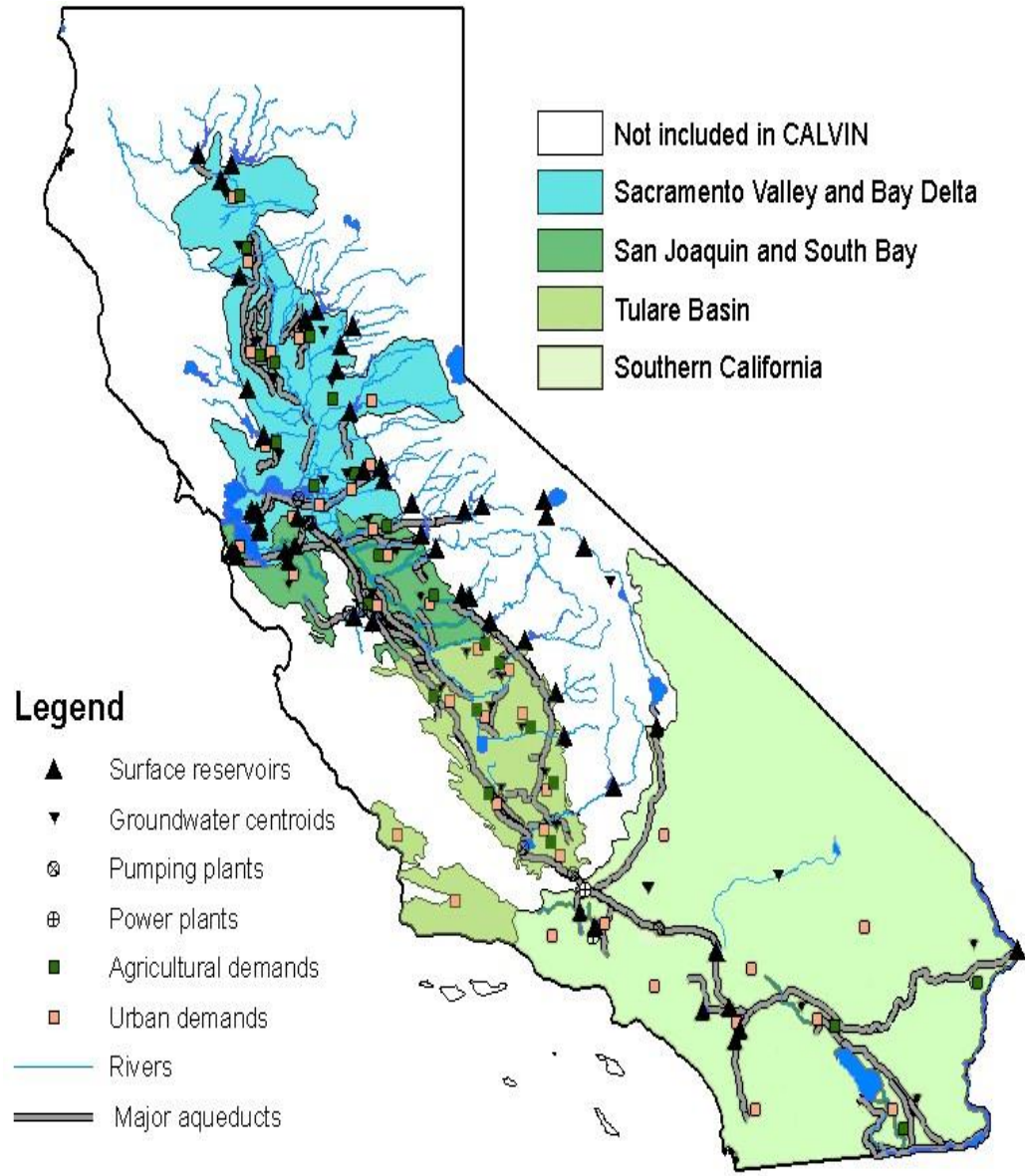
SWAP,  
CALSIM II,  
C2VSim

Integrate to other models

# CALVIN



- Hydro-economic model
- California water infrastructure
- 82 years of monthly data & operations
- Minimize water scarcity & operating costs



# Hydrology

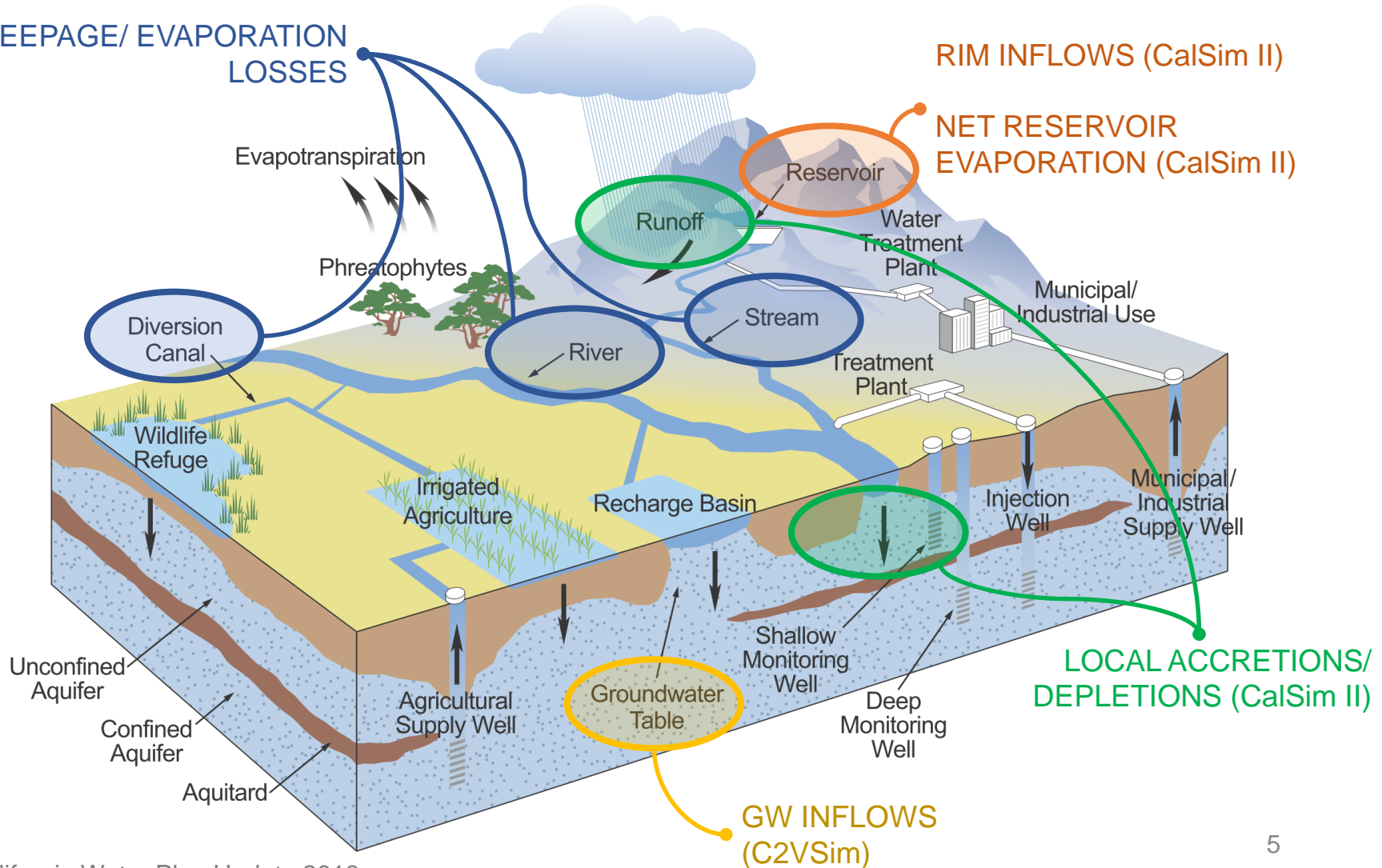
SEEPAGE/ EVAPORATION  
LOSSES

RIM INFLOWS (CalSim II)

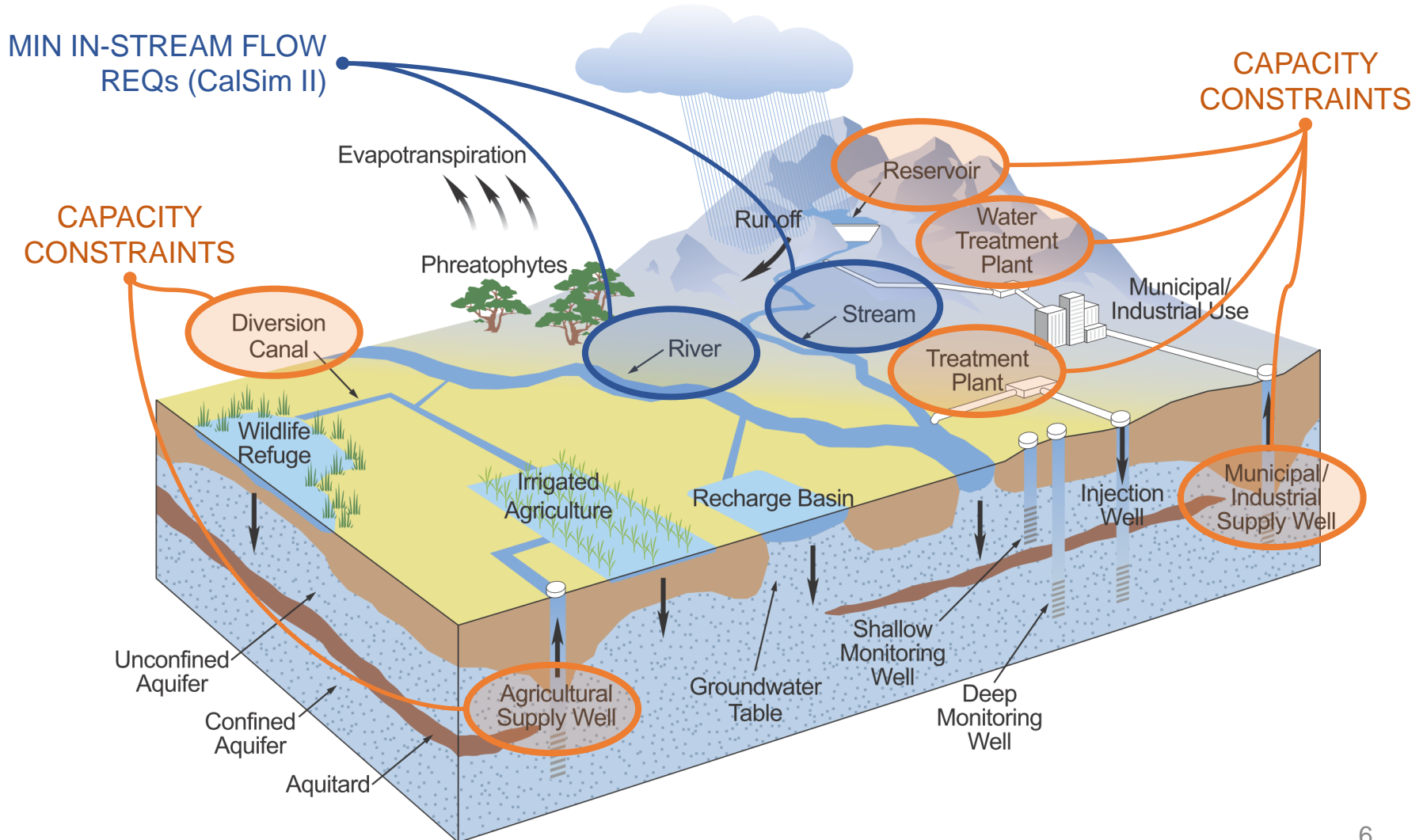
NET RESERVOIR  
EVAPORATION (CalSim II)

LOCAL ACCRETIONS/  
DEPLETIONS (CalSim II)

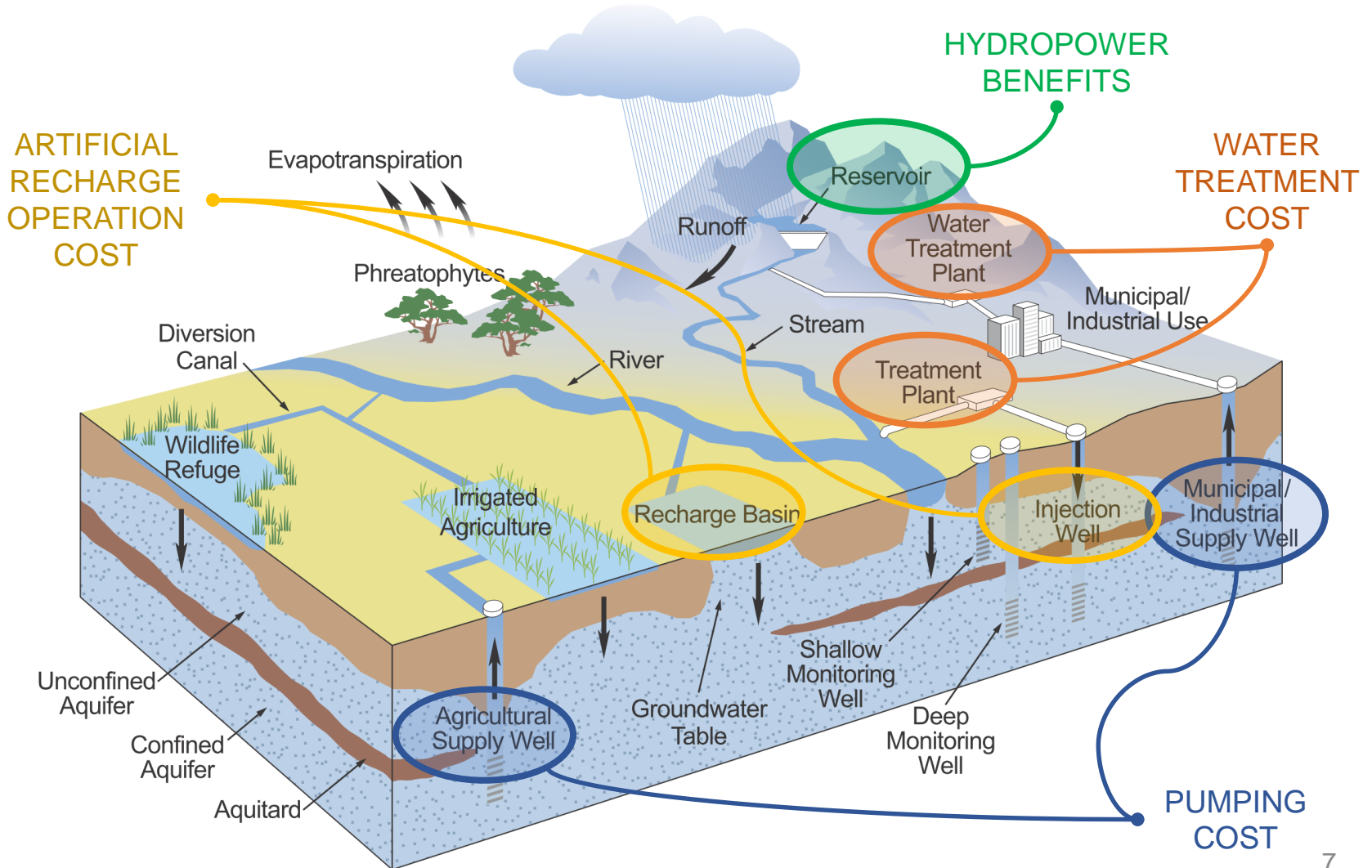
GW INFLOWS  
(C2VSim)



# Constraints



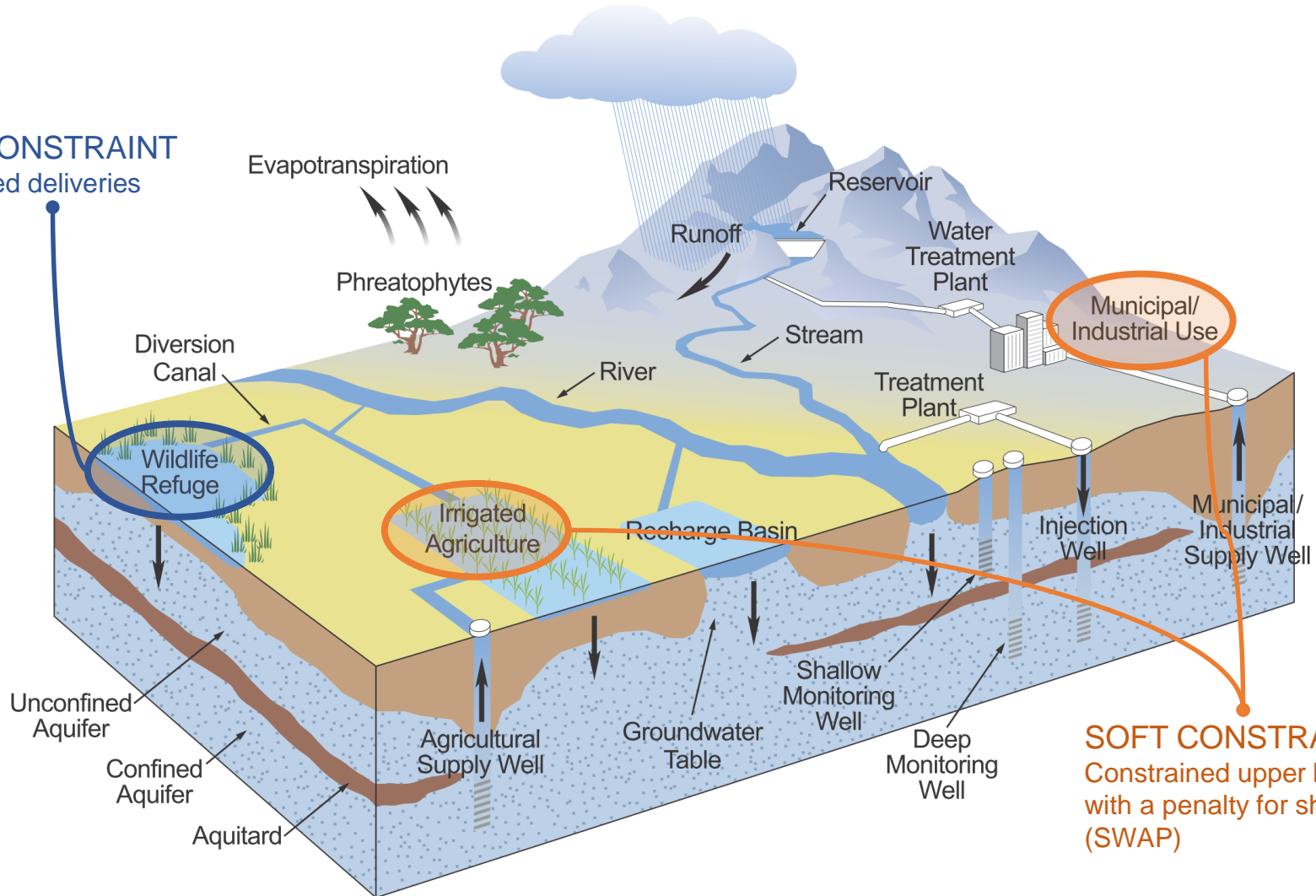
# Operating Costs





# Demands

**HARD CONSTRAINT**  
Constrained deliveries



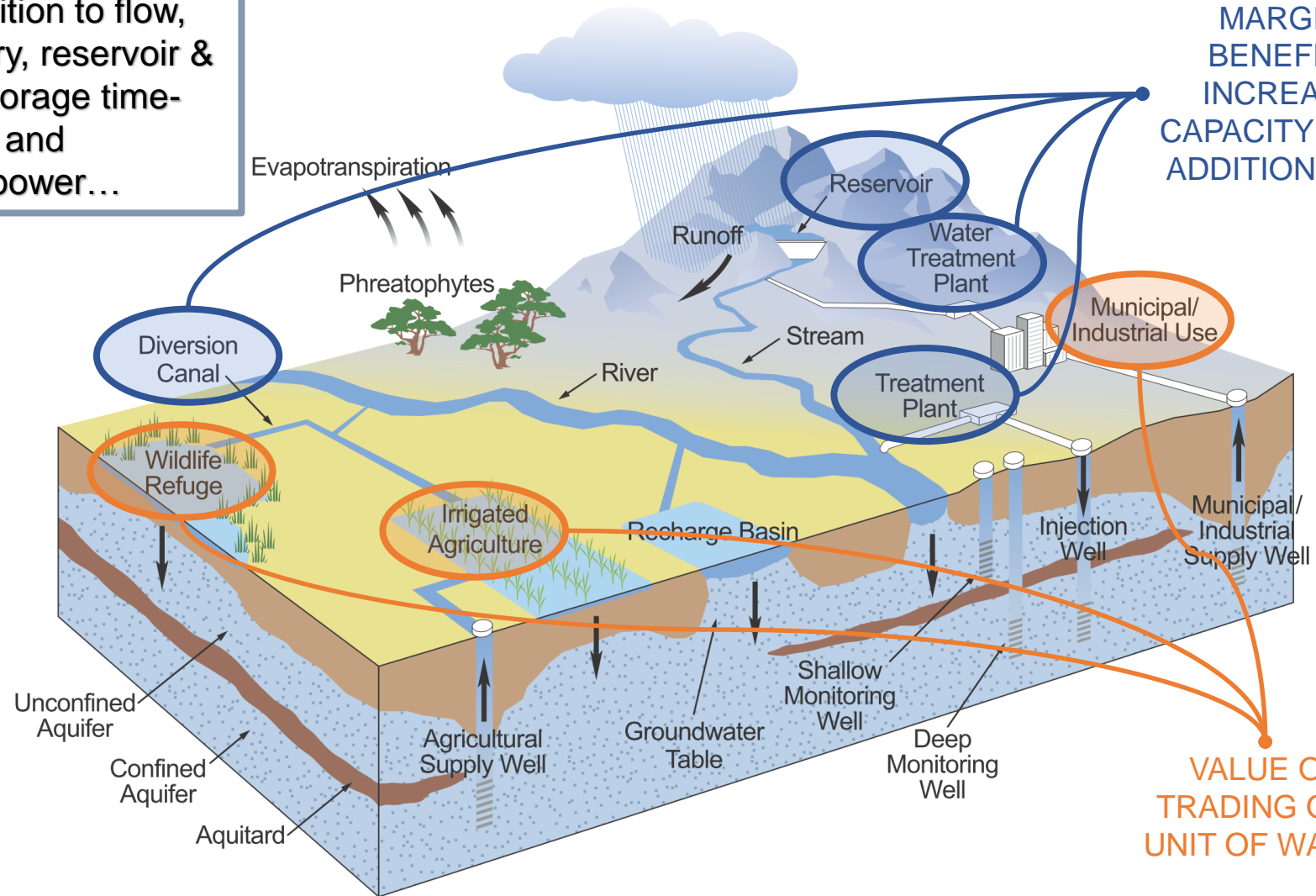
**SOFT CONSTRAINT**  
Constrained upper bound  
with a penalty for shortage  
(SWAP)



# Outputs

In addition to flow, delivery, reservoir & GW storage time-series and hydropower...

MARGINAL BENEFIT OF INCREASING CAPACITY BY ONE ADDITIONAL UNIT



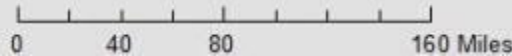
VALUE OF TRADING ONE UNIT OF WATER

# Agricultural Demand Areas

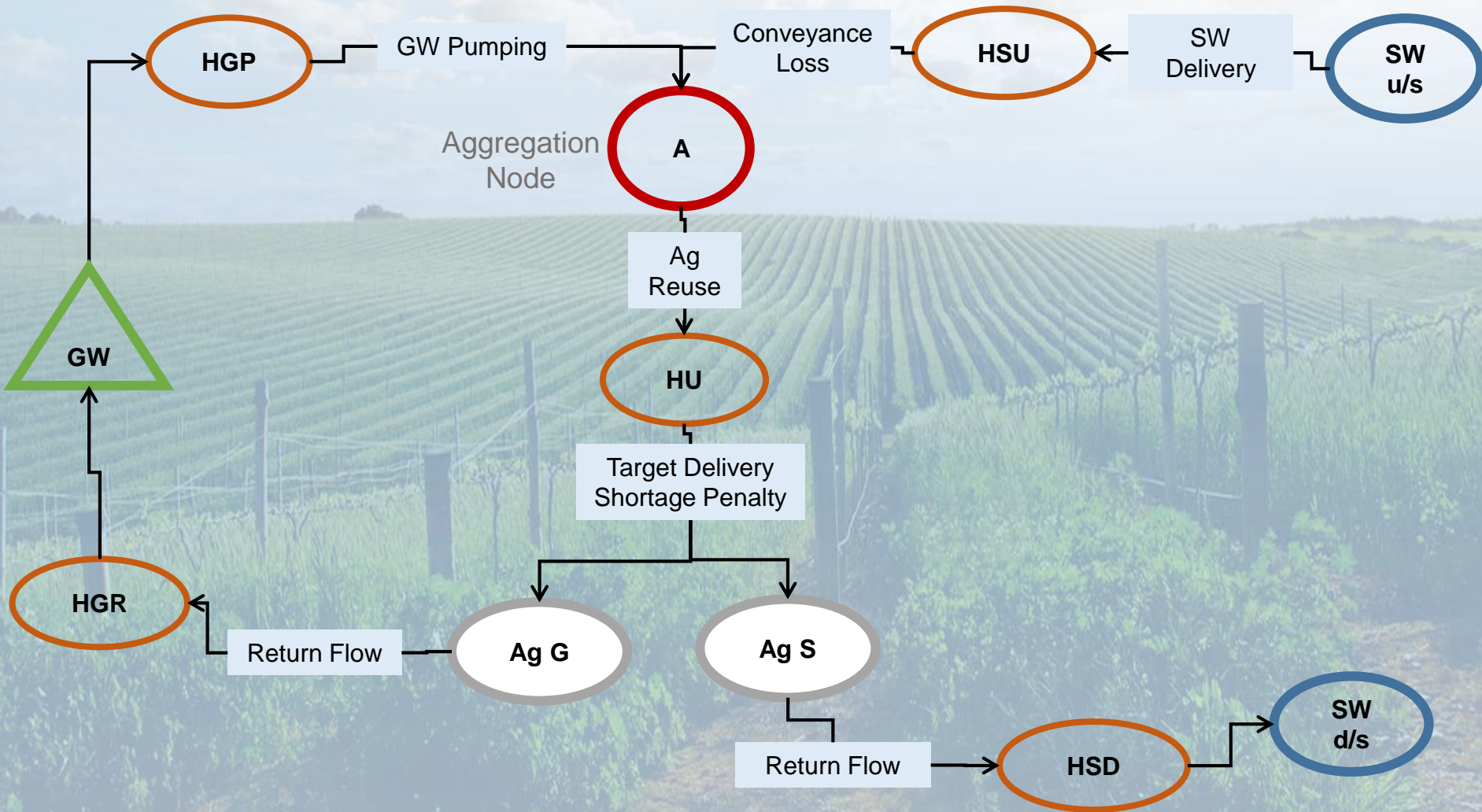
Updated Target Demand & Scarcity Penalties

Split Existing Areas

New Ag Area: Bard WD

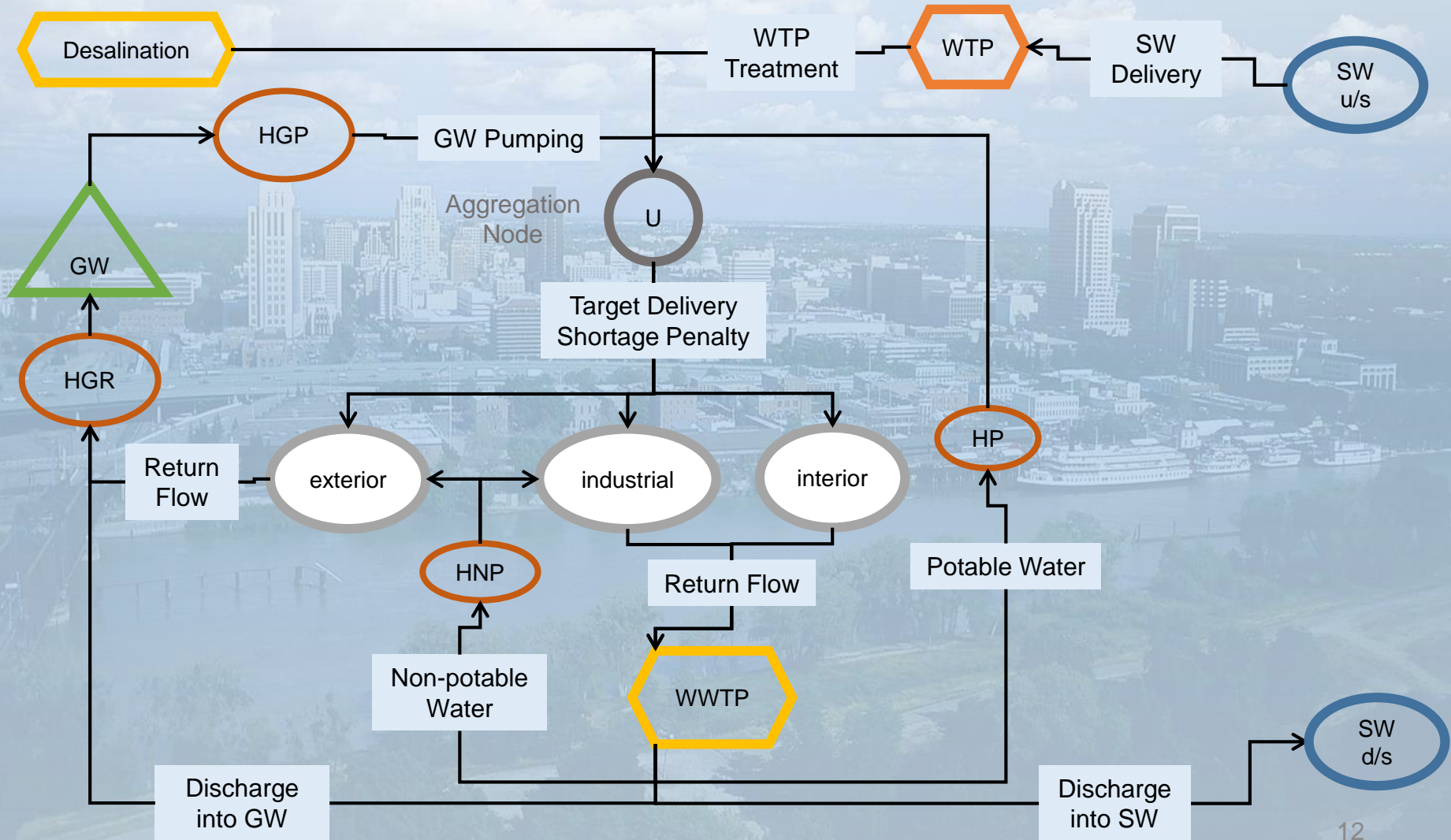


# Ag Representation



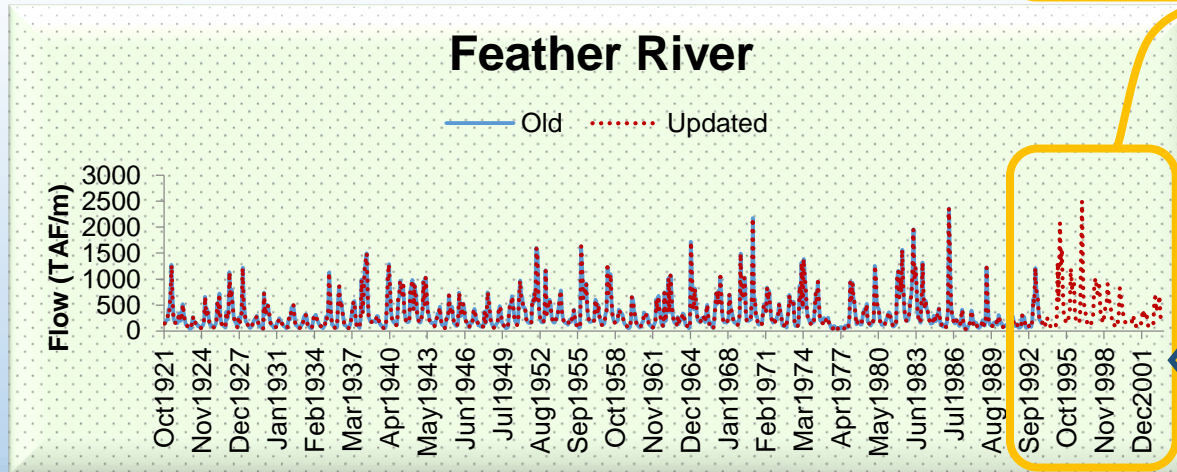


# Urban Representation

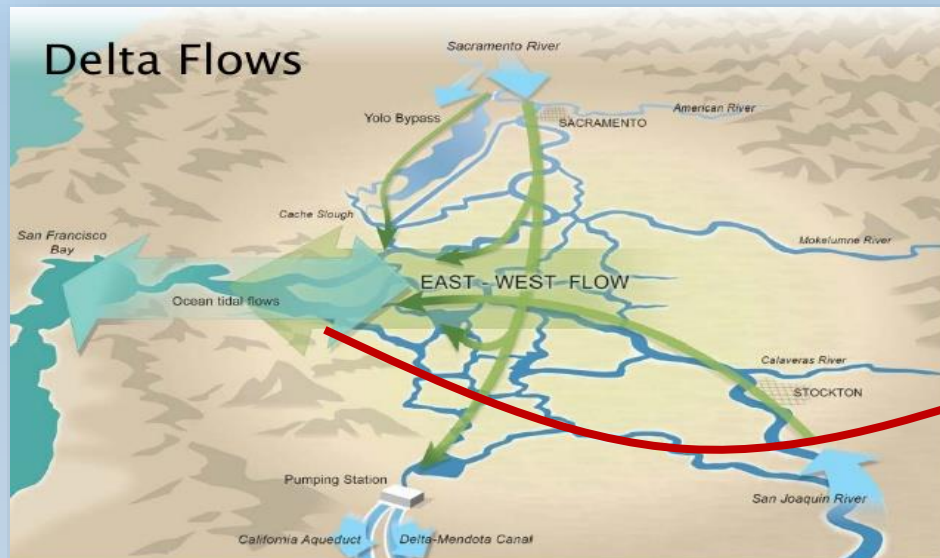


# Time-Series Data

Extension:  
Oct 1993 to Sep 2003



- Full / Partial Replacement
- Regression
- Year Type



Delta Outflows

Excess

Required

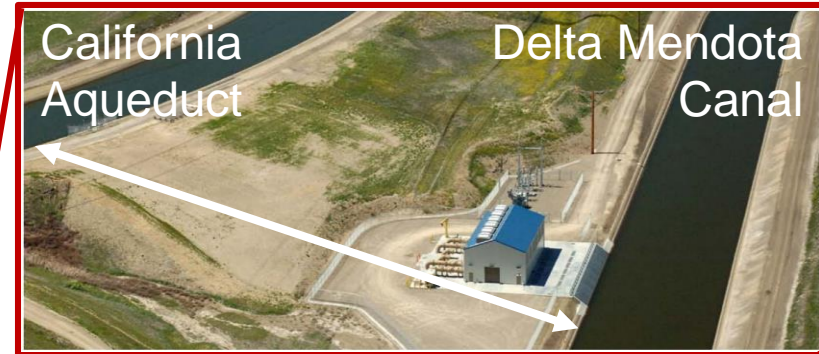
4994 TAF/y

**Delta outflow** is the net amount of water flowing out of the Delta toward the San Francisco Bay

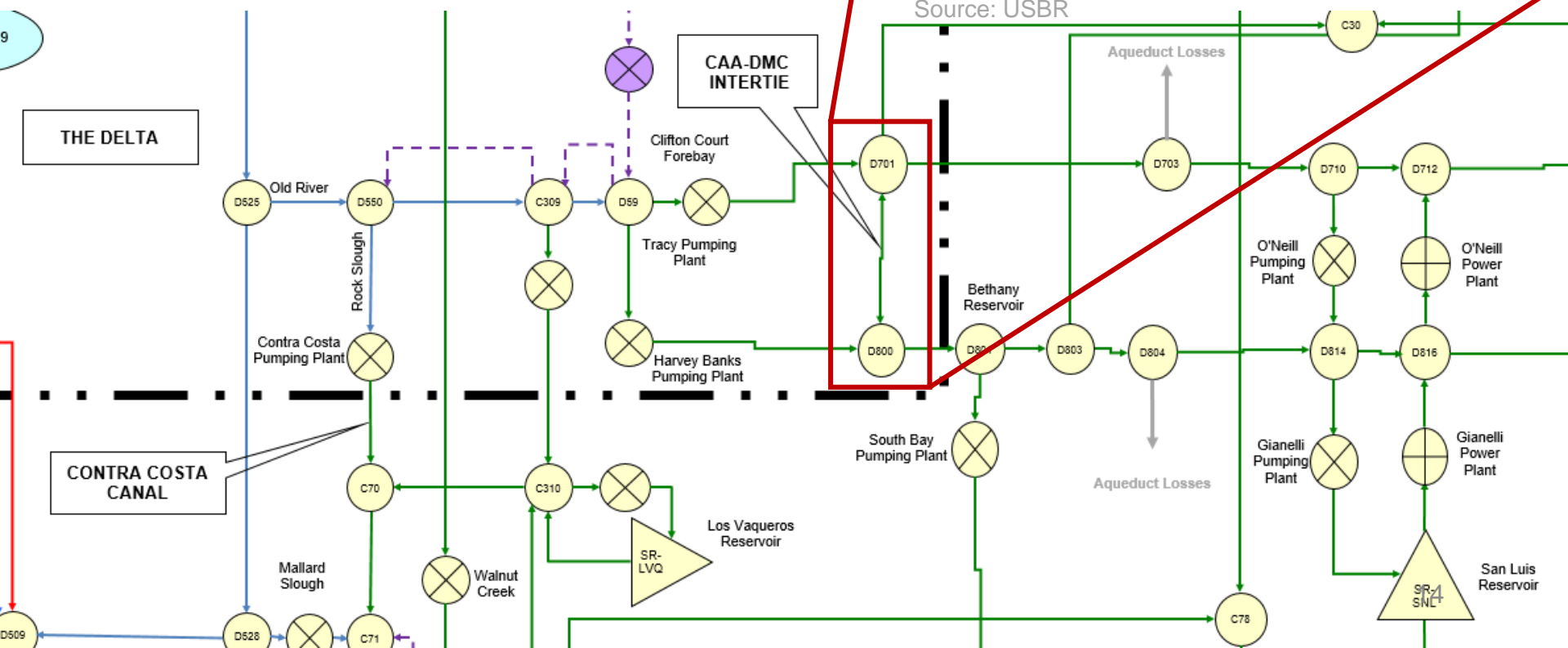
9

# CAA/DMC Intertie

- Completed in 2012
- CAA to DMC 900 cfs (gravity)
- DMC to CAA 467 cfs (pump)
- Adds flexibility to operations



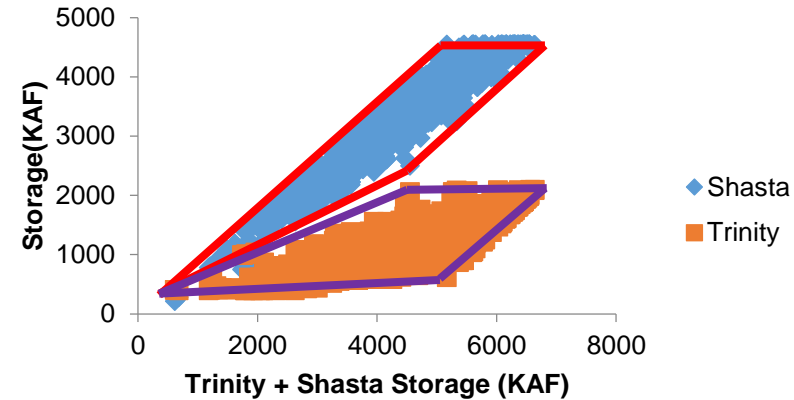
Source: USBR



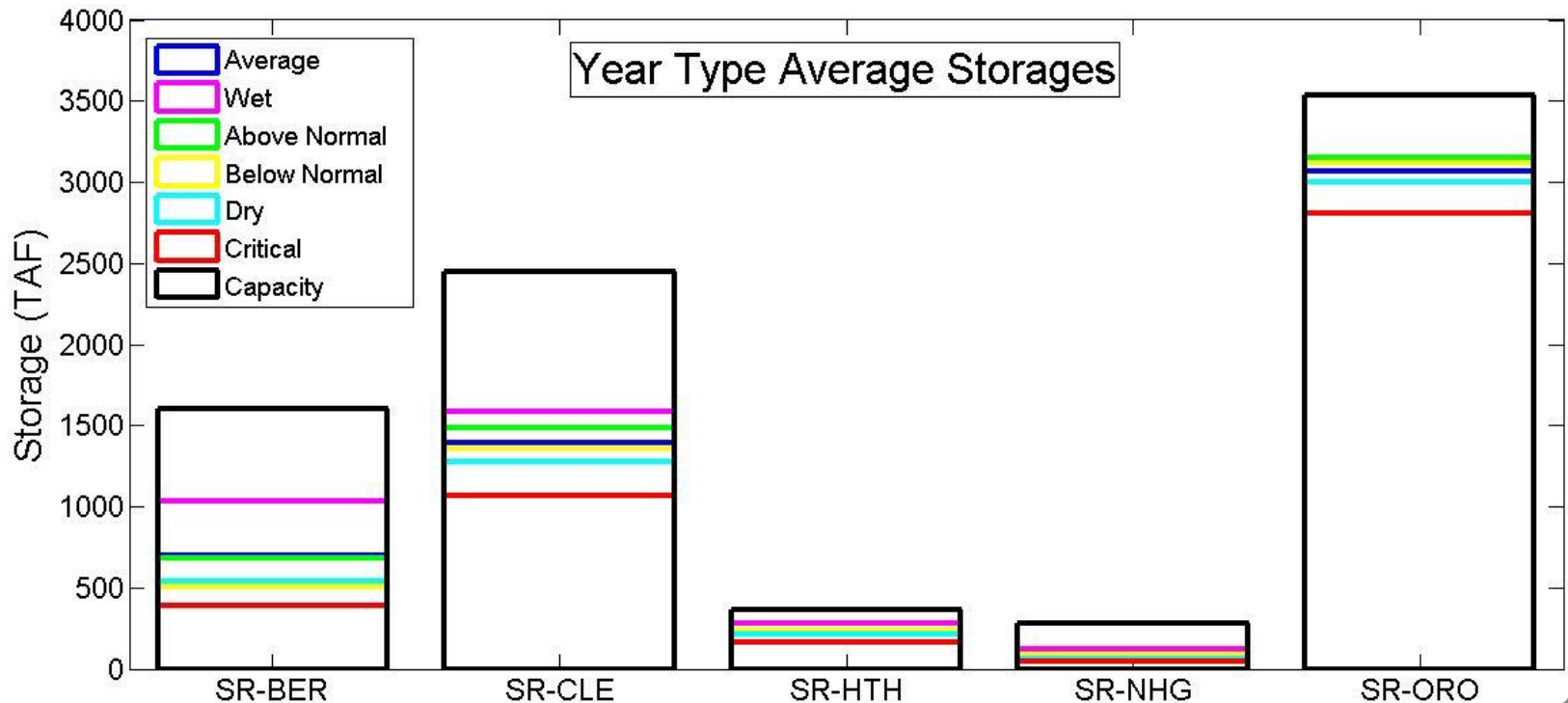
# Preliminary Results

- Expected storage values
- Inferred optimal reservoir operating rules

Storage Allocation between Shasta and Trinity

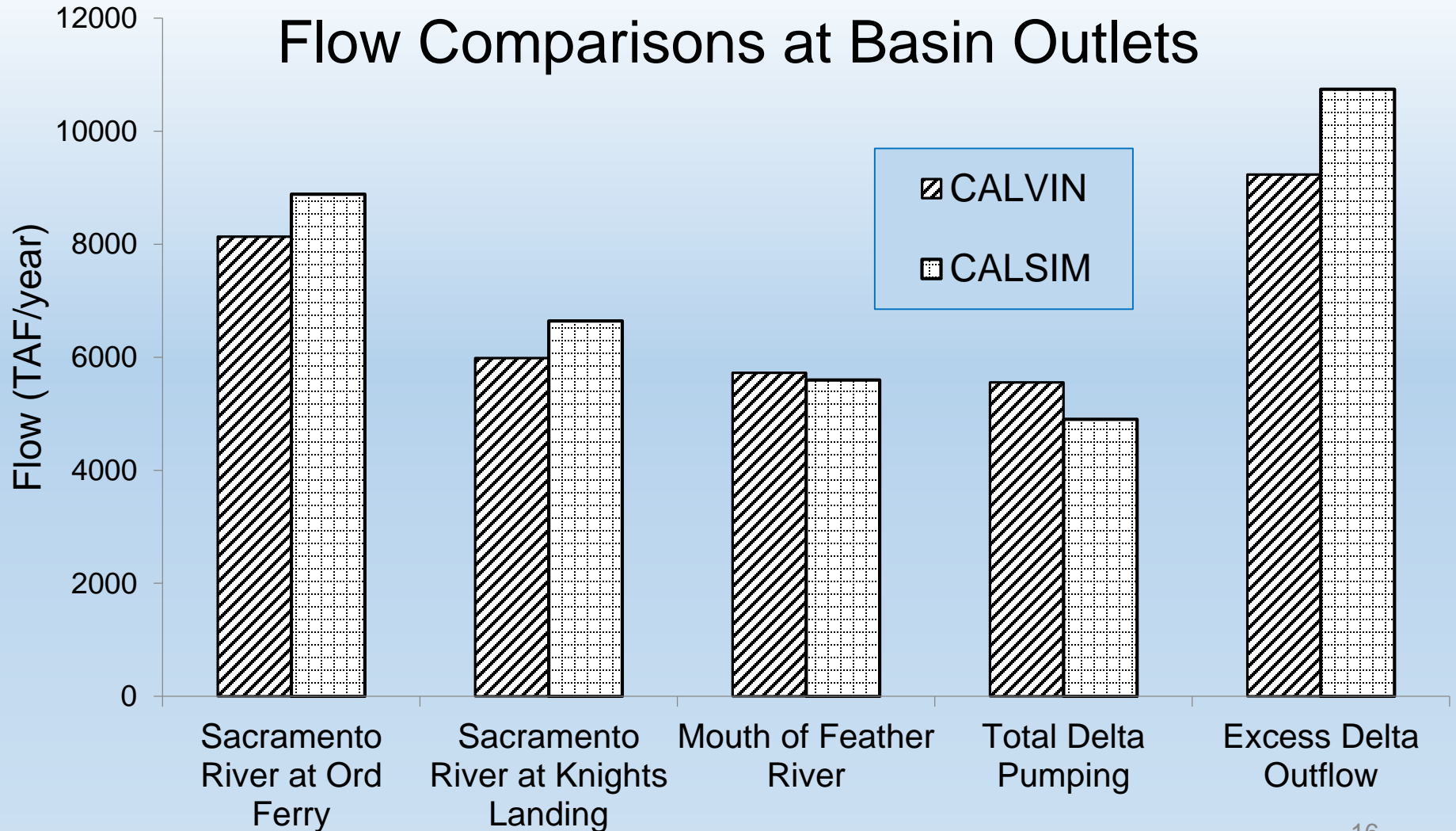


(Source: Nelson , 2013, MS Thesis)





# CALVIN vs CALSIM II



# Conclusions

- Updated...
  - Ag/Urban representation
  - Ag target demand
  - Time-series data
  - Network-Flow representation
- Improved...
  - California water representation in CALVIN

# CALVIN Short Course

April 2015

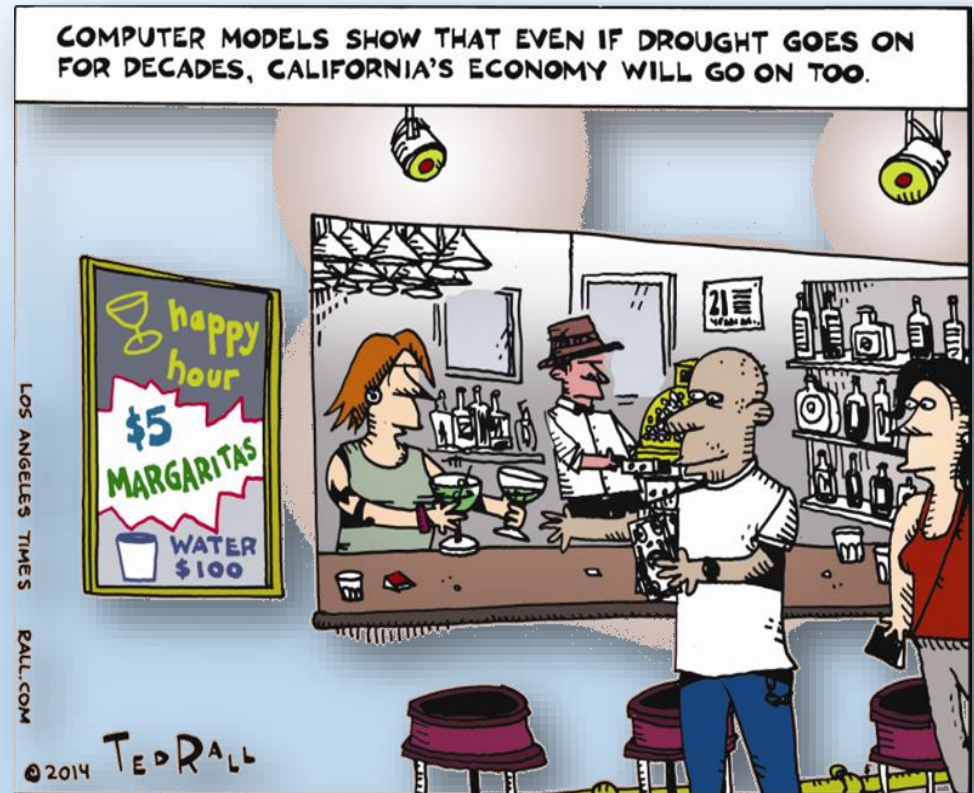
- Theory behind CALVIN
- Navigate through database
- Applications; dam removal, capacity expansion
- Post-processing

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For more information:

<https://watershed.ucdavis.edu/s hed/lund/CALVIN/>



Source: LA Times