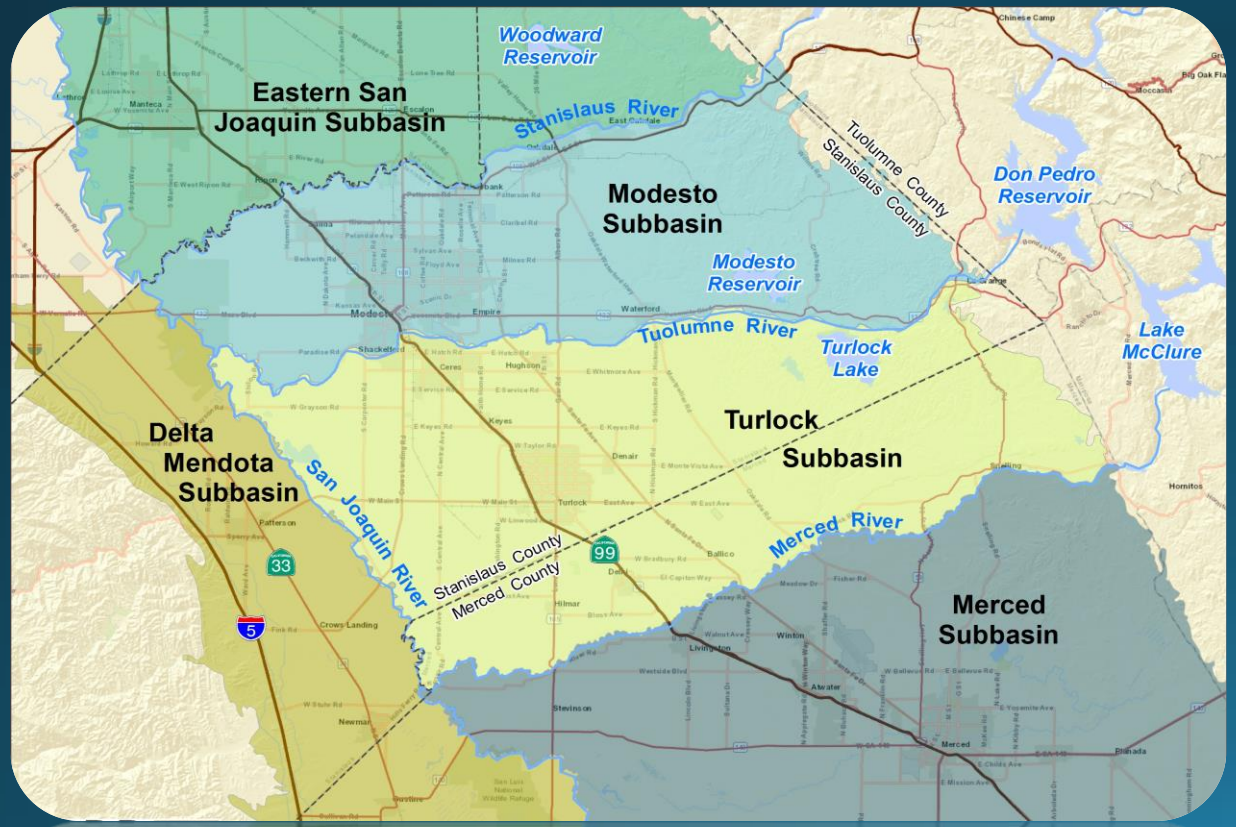
West Turlock Subbasin Groundwater Sustainability Agency (WTSGSA)

East Turlock Subbasin Groundwater Sustainability Agency (ETSGSA)

Turlock Subbasin Groundwater Sustainability Plan (GSP) Technical Workshop No. 2



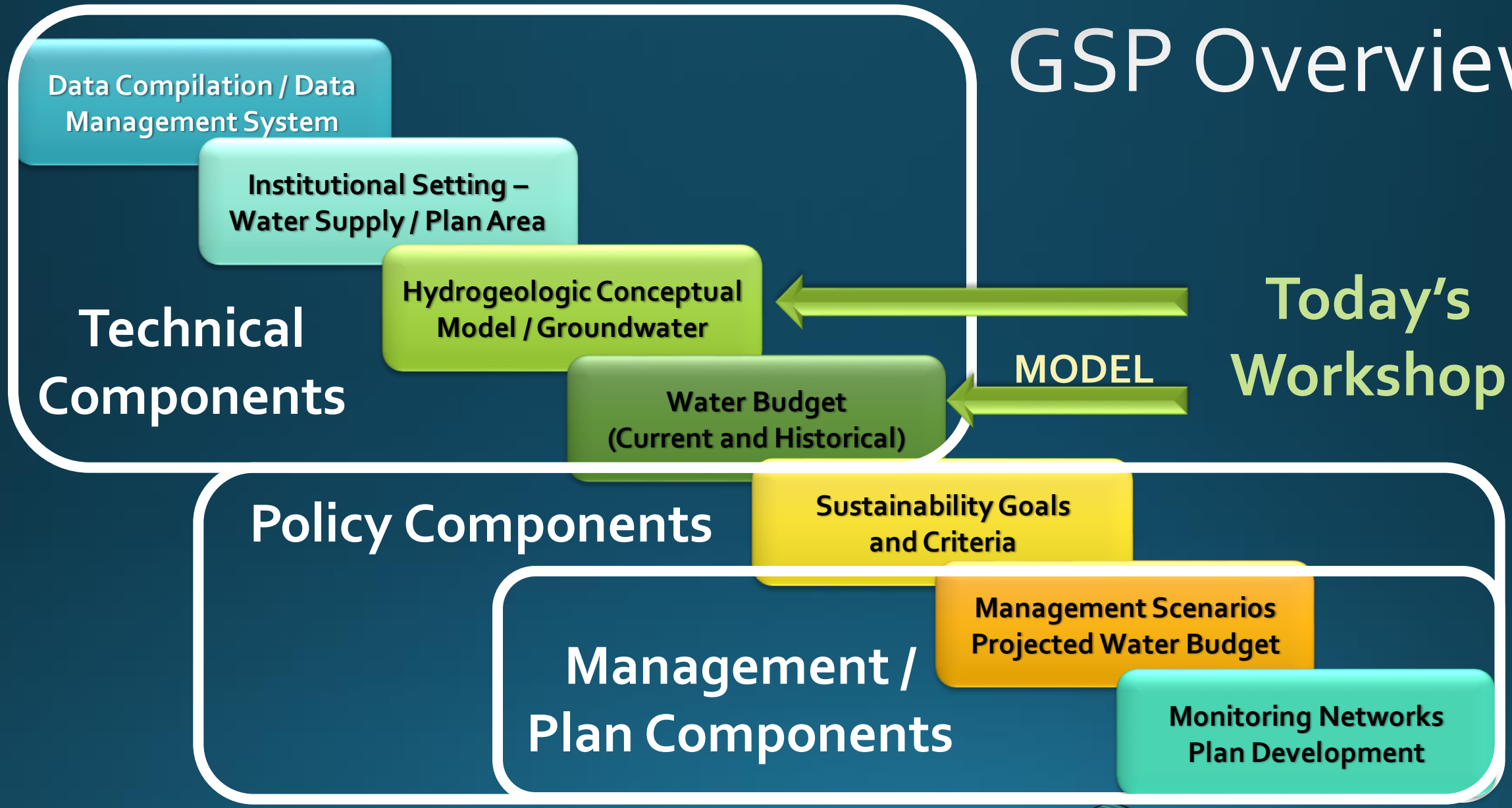
Joint Technical Advisory Committees (TACs) Meeting

December 13, 2018

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

TODD GROUNDWATER

GSP Overview



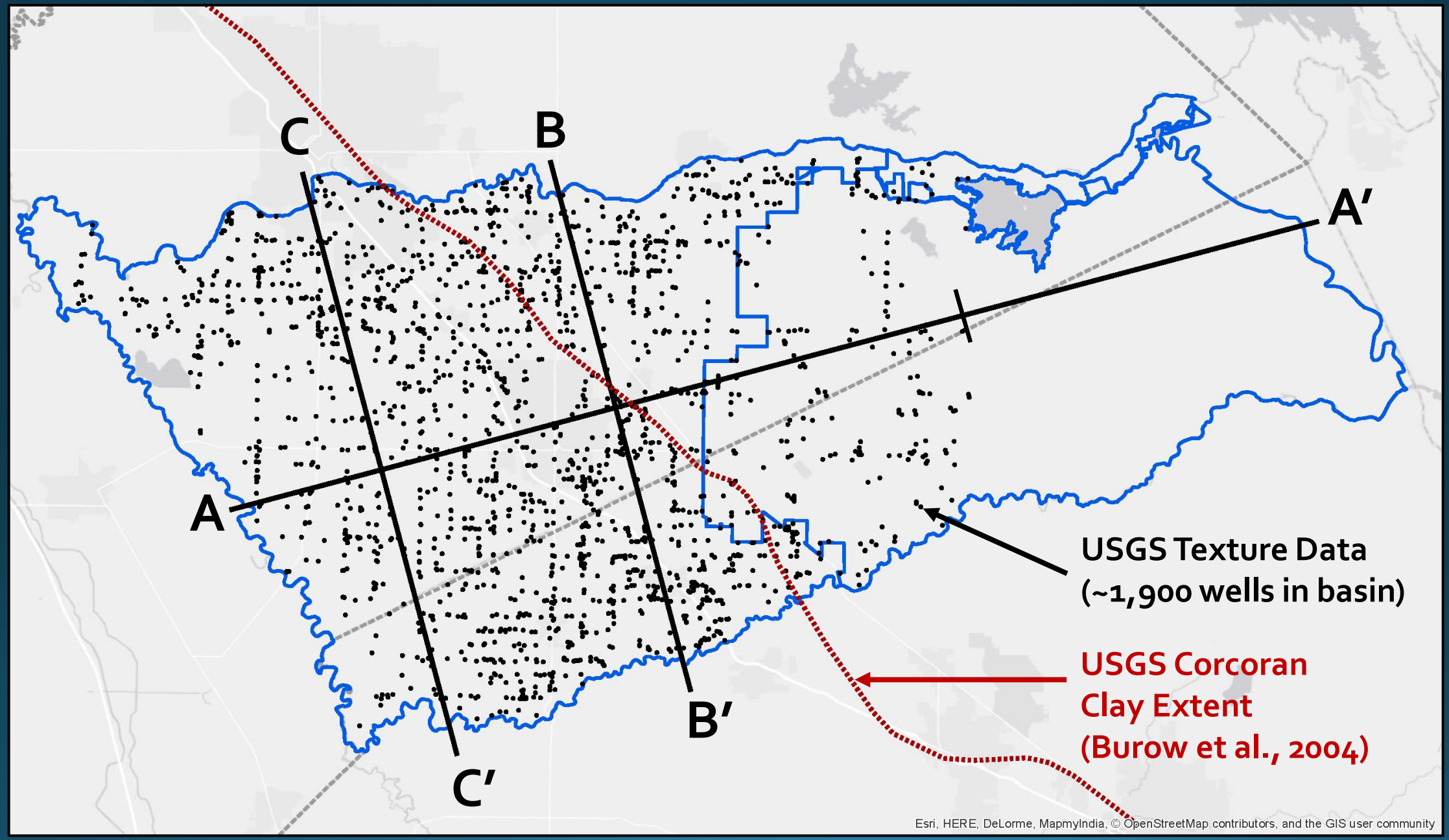
WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

TODD GROUNDWATER

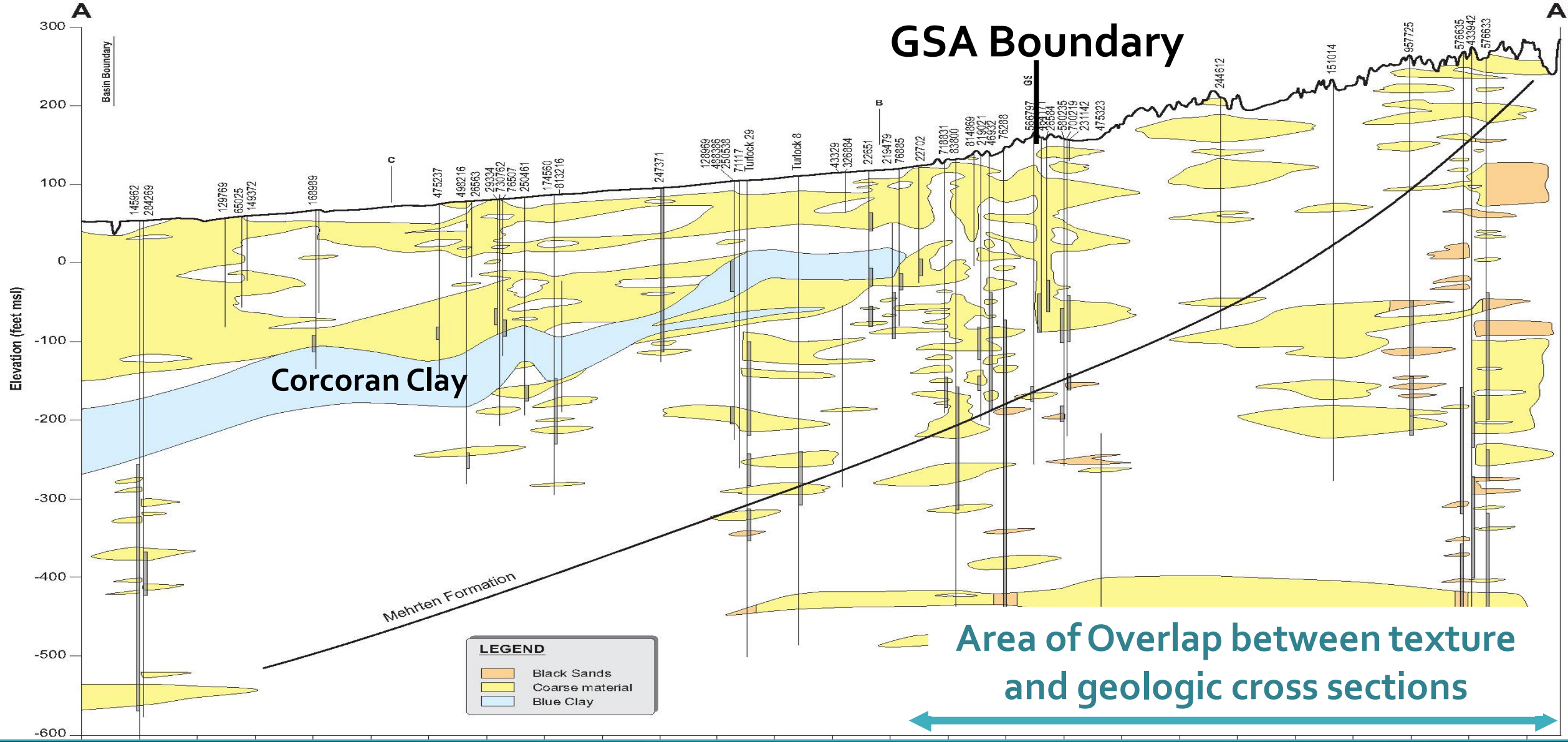
Presentation Outline

- Hydrogeologic Conceptual Model
  - Western texture Cross Sections
  - Eastern geologic Cross Sections
  - Merging the interpretations
  - Coordinating HCM with the Groundwater Model
- Model revisions
  - Goals and objectives – model for sustainability analysis
  - Model enhancement approach
  - Independent Demand Calculator (IDC) updates
  - Groundwater Model updates

Texture Data and Cross Section Transects



WEST EAST



Area of Overlap between texture and geologic cross sections

WOOD RODGERS
BUILDING RELATIONSHIPS ONE PROJECT AT A TIME

TODD GROUNDWATER

Eastern Hydrogeologic Conceptual Model

- Data Sources
  - Previous site work by Wood Rodgers
    - Eastern area, data included detailed lithologic descriptions, geophysical surveys
  - Department of Water Resources Well Completion Reports
    - Wells were located based on descriptions provided on WCR
    - WCR's were classified as "usable" where geologic descriptions contained color modifiers (i.e. "black sands"). Most read sand, clay, sand, clay
    - Lithologic descriptions were classified into geologic units by depth
    - Well locations and geologic unit data were imported into a database
  - Department of Oil, Gas, & Geothermal Resources (DOGGR) Well Logs
    - Geophysical logs were used to delineate top and bottom of major geologic units
    - Some records include descriptions of lithology, but not all
  - Previous Published Reports
    - USGS (i.e., Burow; Marchand), DWR

Eastern Hydrogeologic Conceptual Model

- Approach
  - Hundreds of WCR's were evaluated to classify logs as "good quality" based on descriptive lithologies
  - Wells were located based on information on WCR
  - Classified geologic formations in each well based on lithology
  - Located and reviewed Department of Oil, Gas, & Geothermal Resources well data
  - Utilized existing knowledge of groundwater/aquifer system, published reports, WCR data, and previous work

Eastern Hydrogeologic Conceptual Model

- Geology
  - The marine and non-marine formations underlying the eastern subbasin consist of multiple sedimentary units
  - Sourced from the Sierra Nevada to the east, these units were deposited westward into the valley
  - Formations were deposited on top of each other (oldest to youngest):
    - Valley Springs/Ione Formation
    - Mehrten Formation
    - Turlock Lake Formation
    - Riverbank Formation
    - Modesto Formation

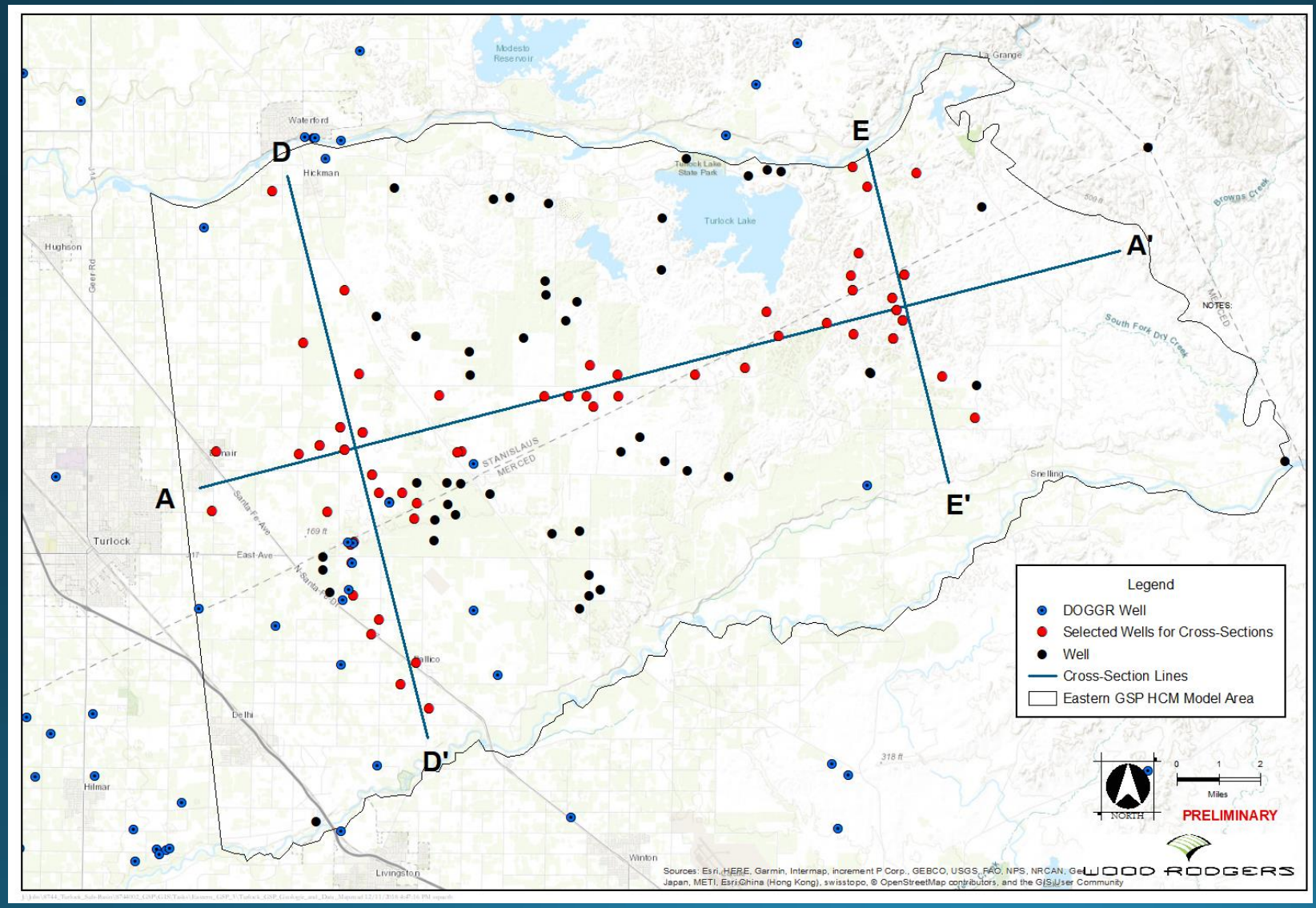
Eastern Hydrogeologic Conceptual Model

- Regional tectonic activity uplifted the Sierra Nevada, resulting in the sedimentary units being tilted as well
- The stress resulted in localized folding and faulting of the sediments in the valley
- Regional faulting and folding has been mapped in the area, trending northwest-southeast

Eastern Hydrogeologic Conceptual Model

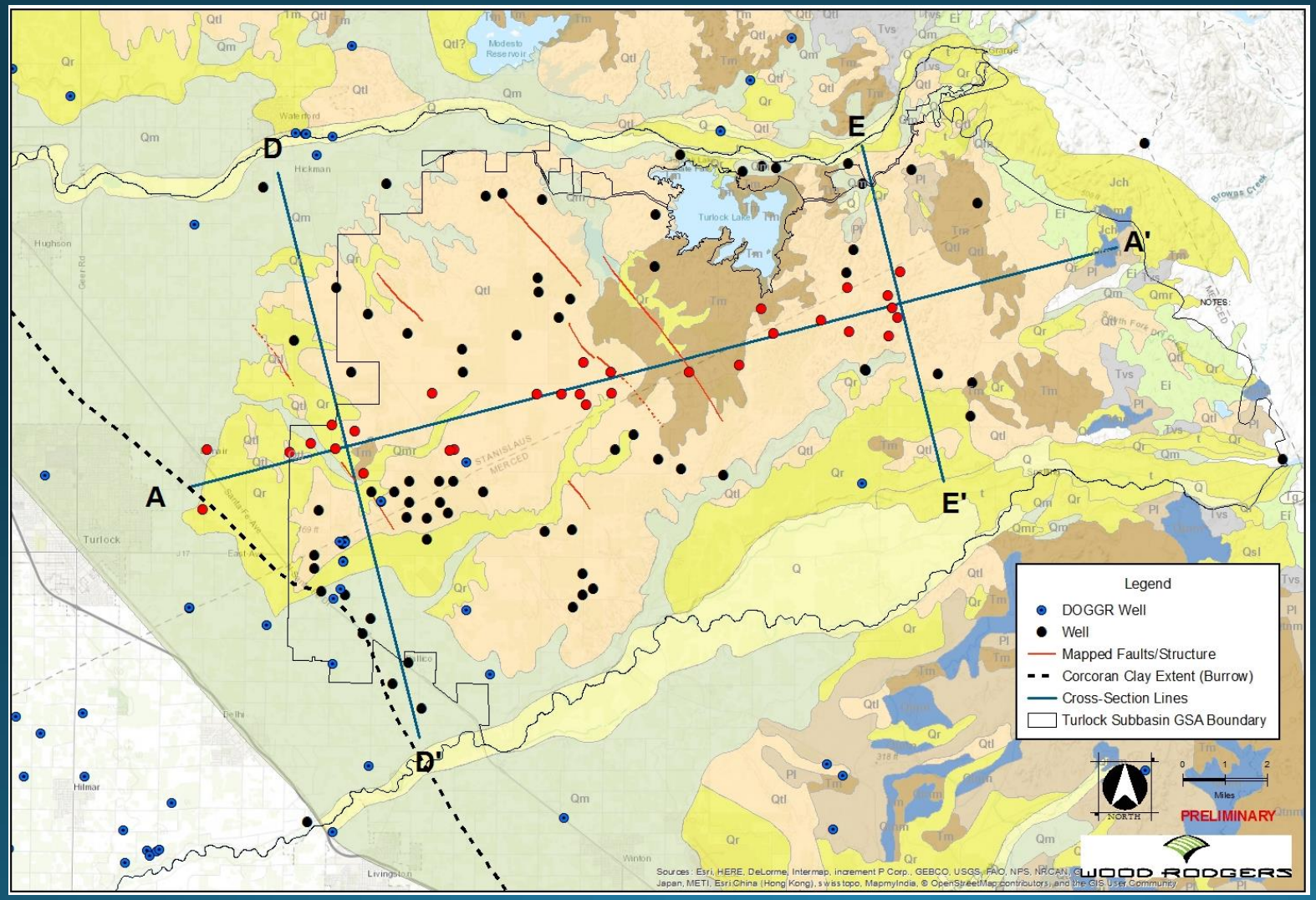
- Development
  - Wells within 5,000 feet of the cross section line were selected
  - Upper formations, including the Riverbank, Modesto, and Turlock Lake Formations were classified as one unit based on similar texture and lithologies in subsurface
  - Mehrten Formation was classified
  - Valley Springs (non-marine) and Ione Formation (marine) were classified as one unit, primarily due to elevated salinity
  - Major formations were correlated between each well
  - Surface geologic map data were integrated with data from the subsurface

Eastern Hydrogeologic Conceptual Model

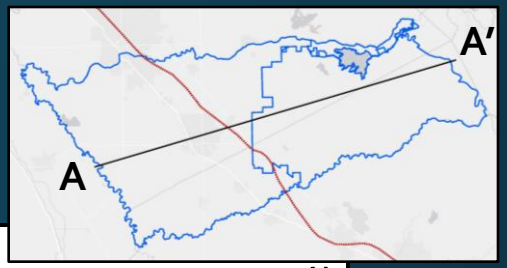


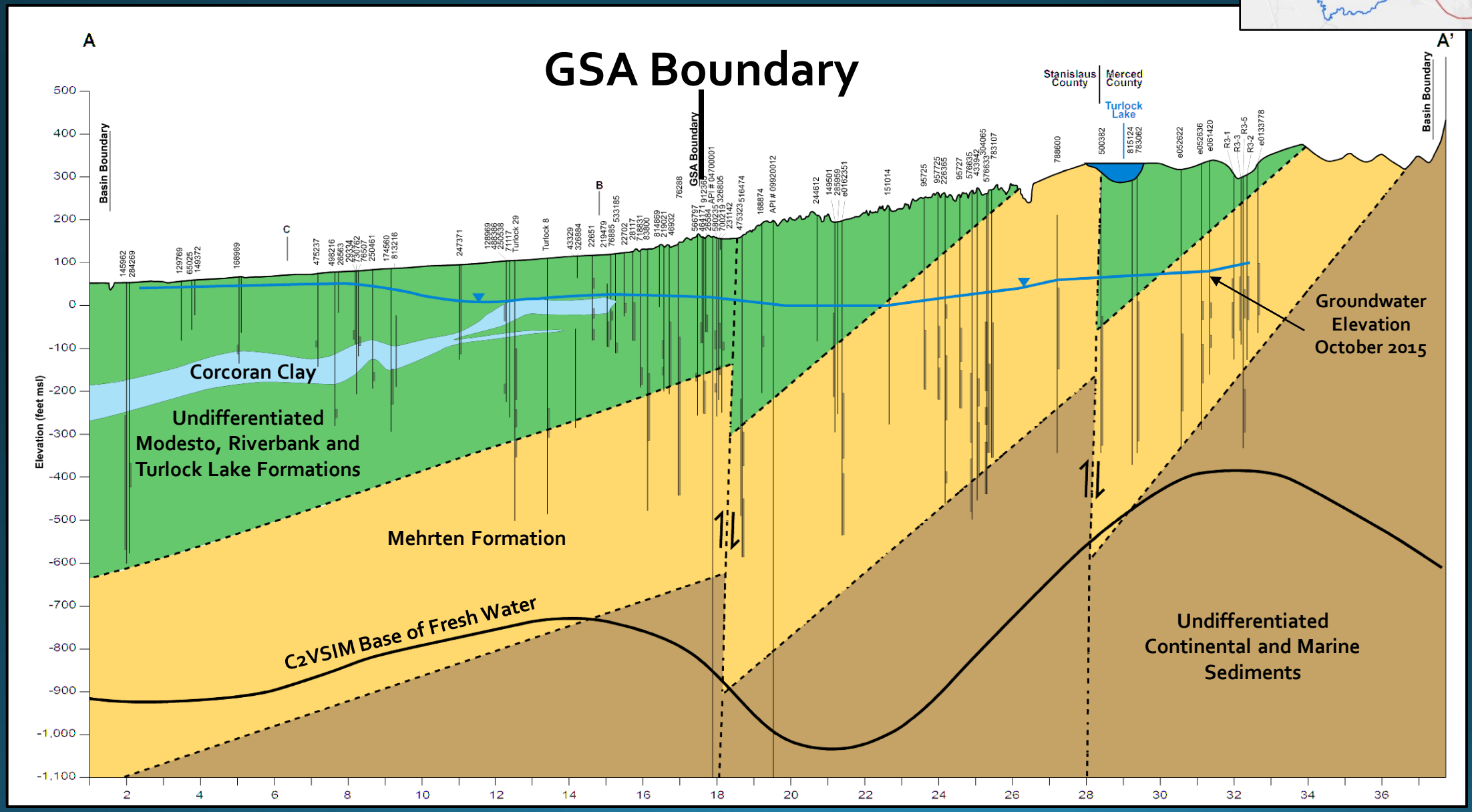
TODD GROUNDWATER

Eastern Surface Geology and Structure

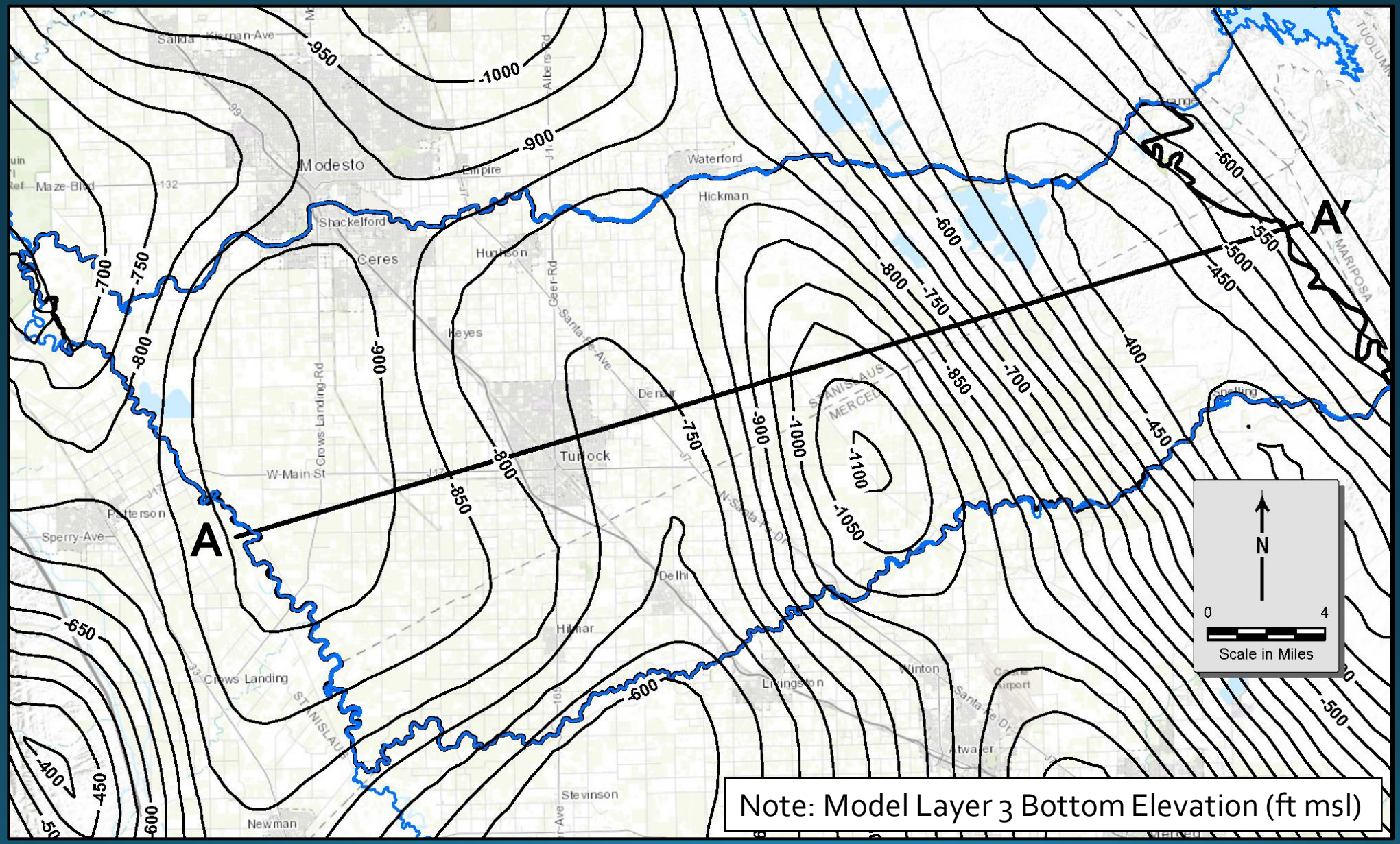


Regional Cross Section

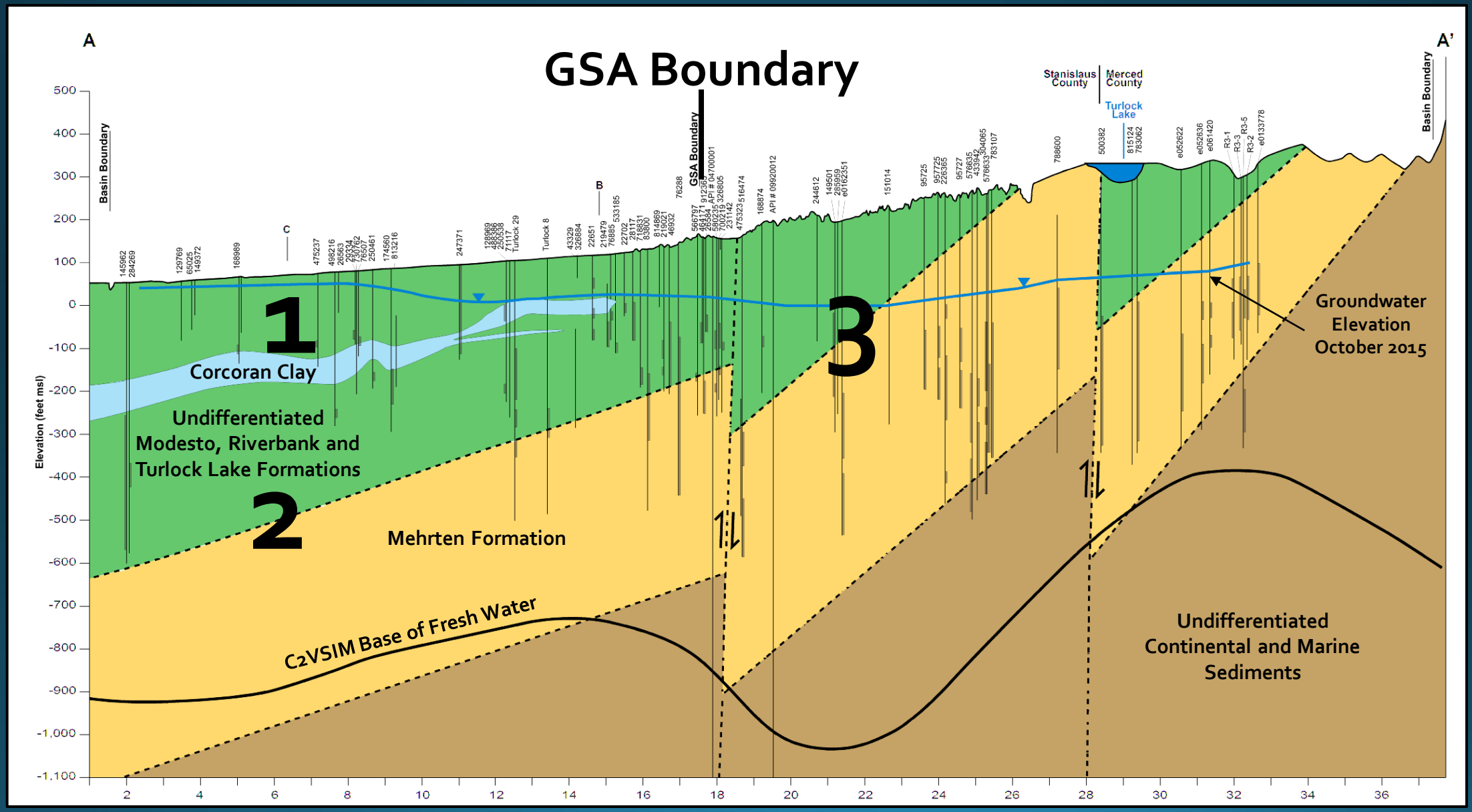




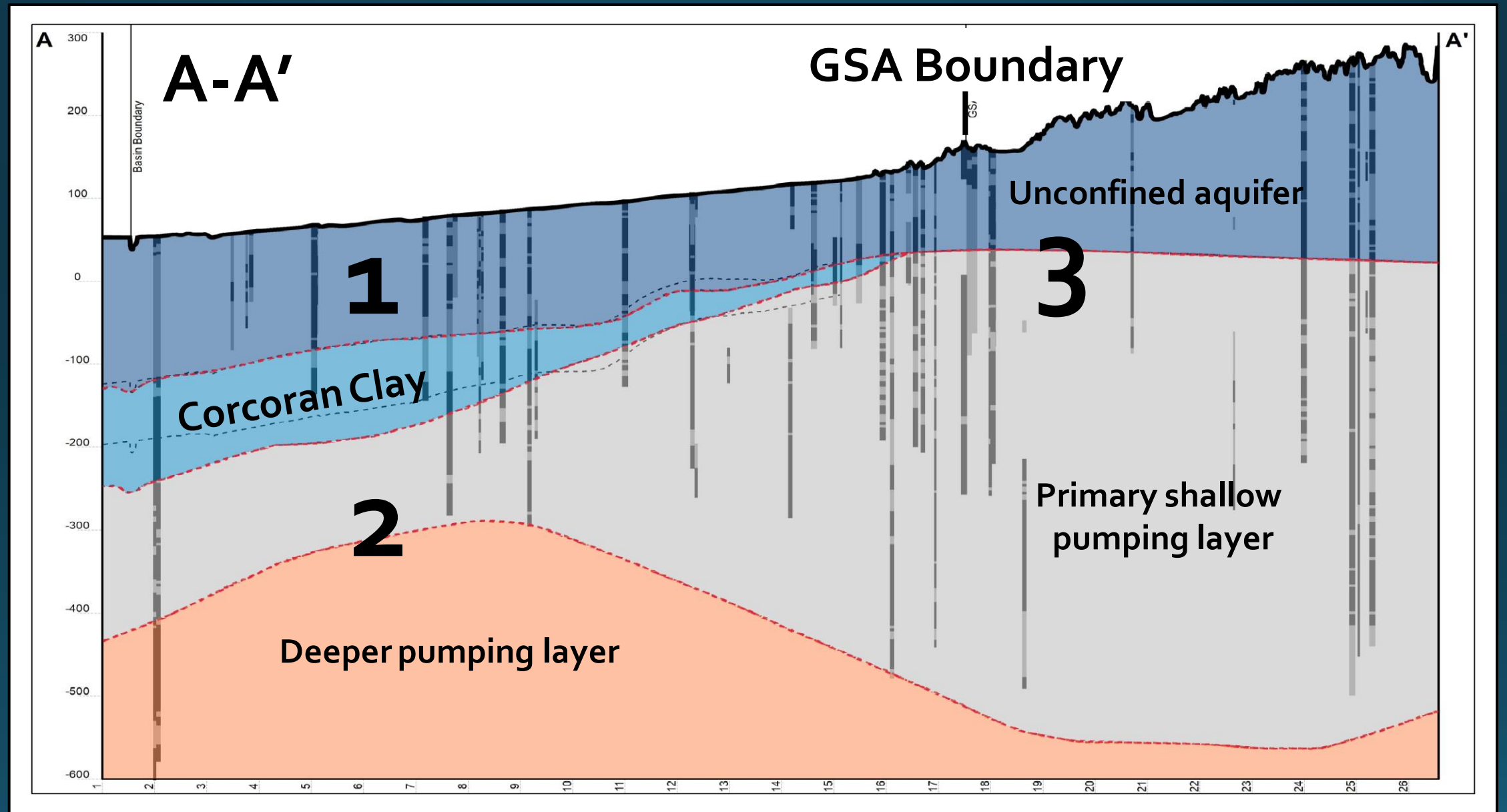
C2VSIM Base of Fresh Water



Principal Aquifer Recommendations

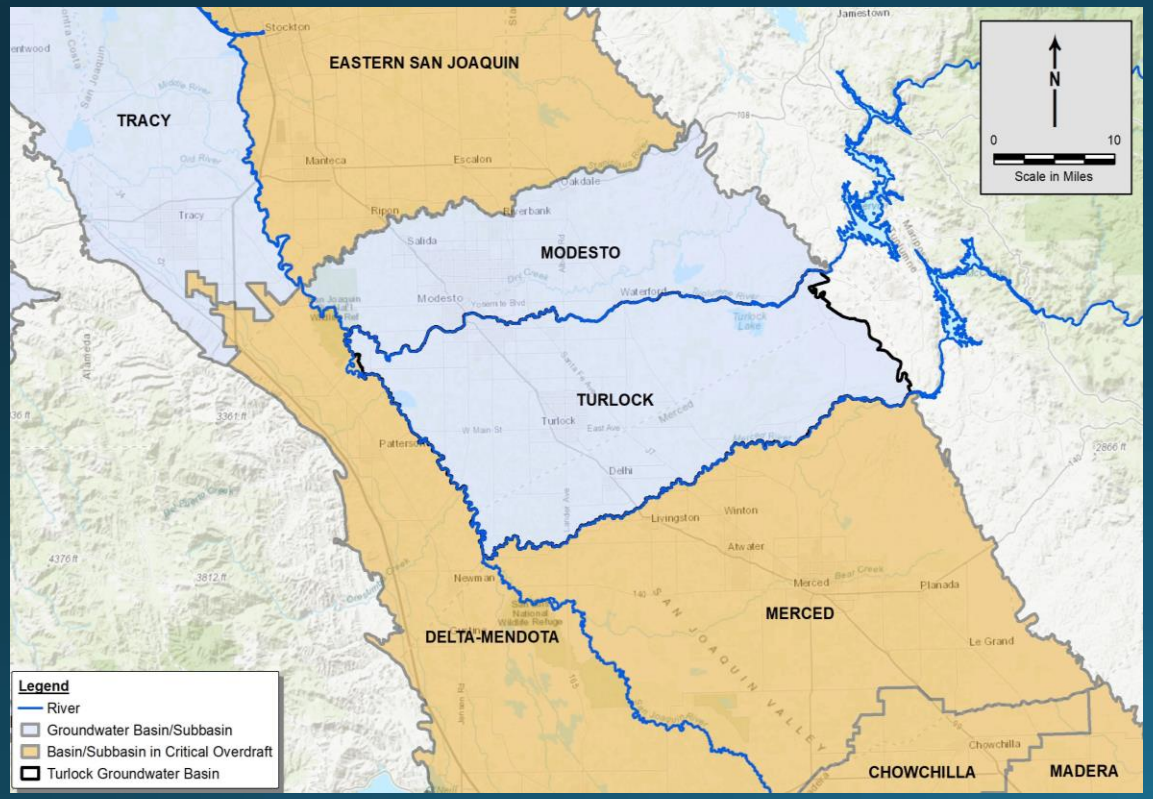


Principal Aquifers and Model Layers



West Turlock Subbasin Groundwater Sustainability Agency

East Turlock Subbasin Groundwater Sustainability Agency



C2VSimFG-Turlock Update for Turlock Subbasin GW Sustainability Plan (GSP)

Joint Technical Advisory Committees (TACs) Meeting

December 13, 2018

WOODARD &CURRAN

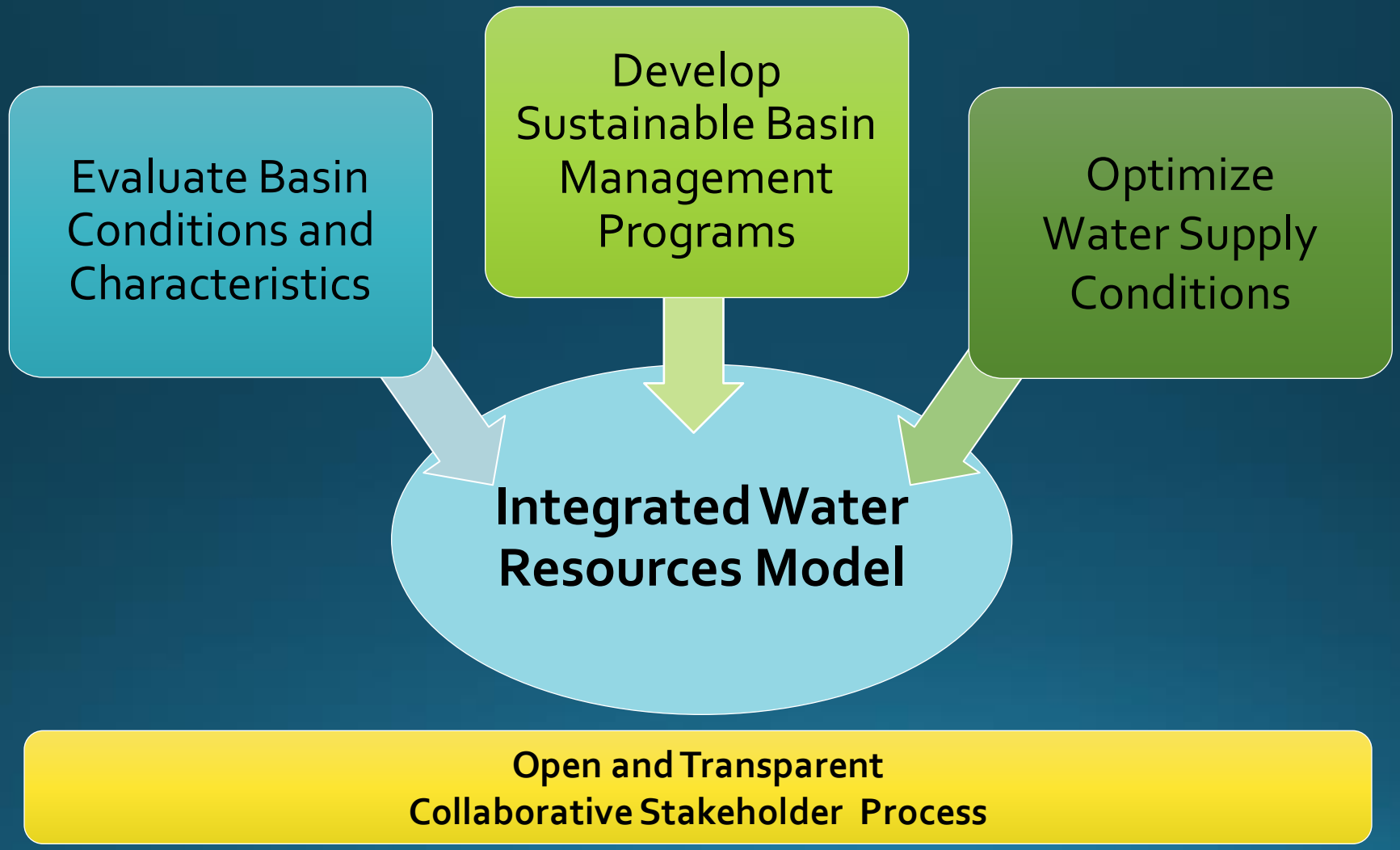
DAVIDS ENGINEERING, INC

TODD GROUNDWATER

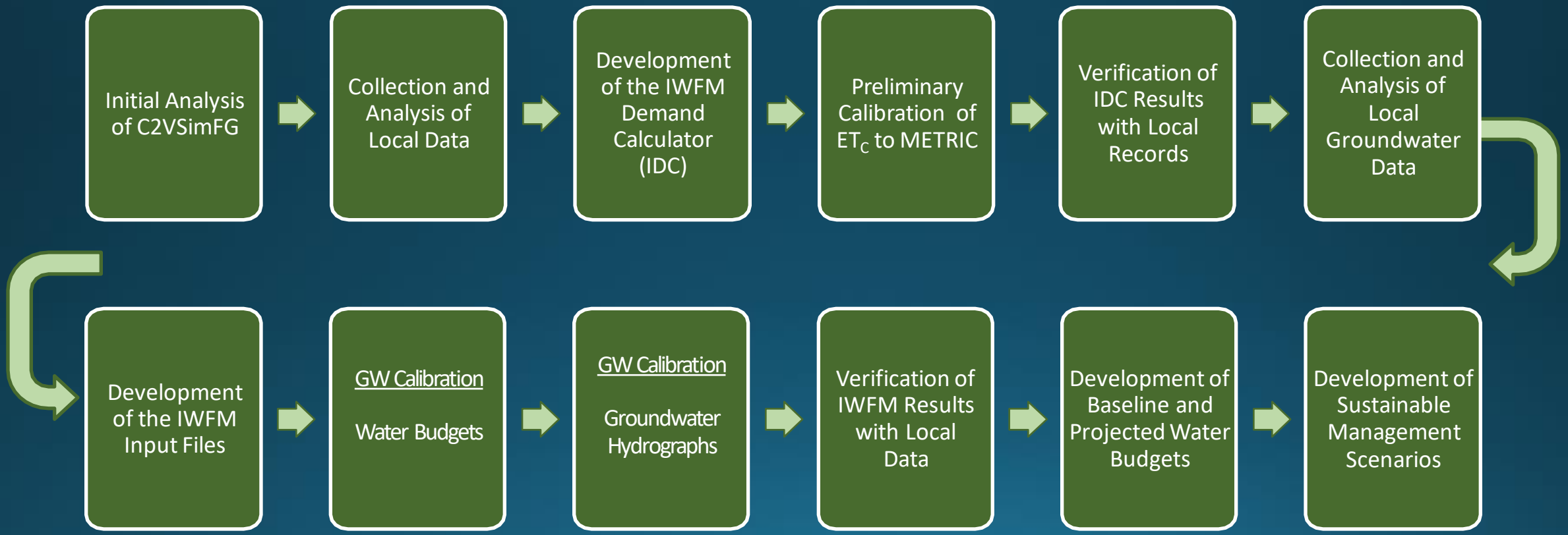
Agenda

1. Goals and Objectives
2. Model Enhancement Approach
3. IDC Updates
4. GW Model Updates Plan

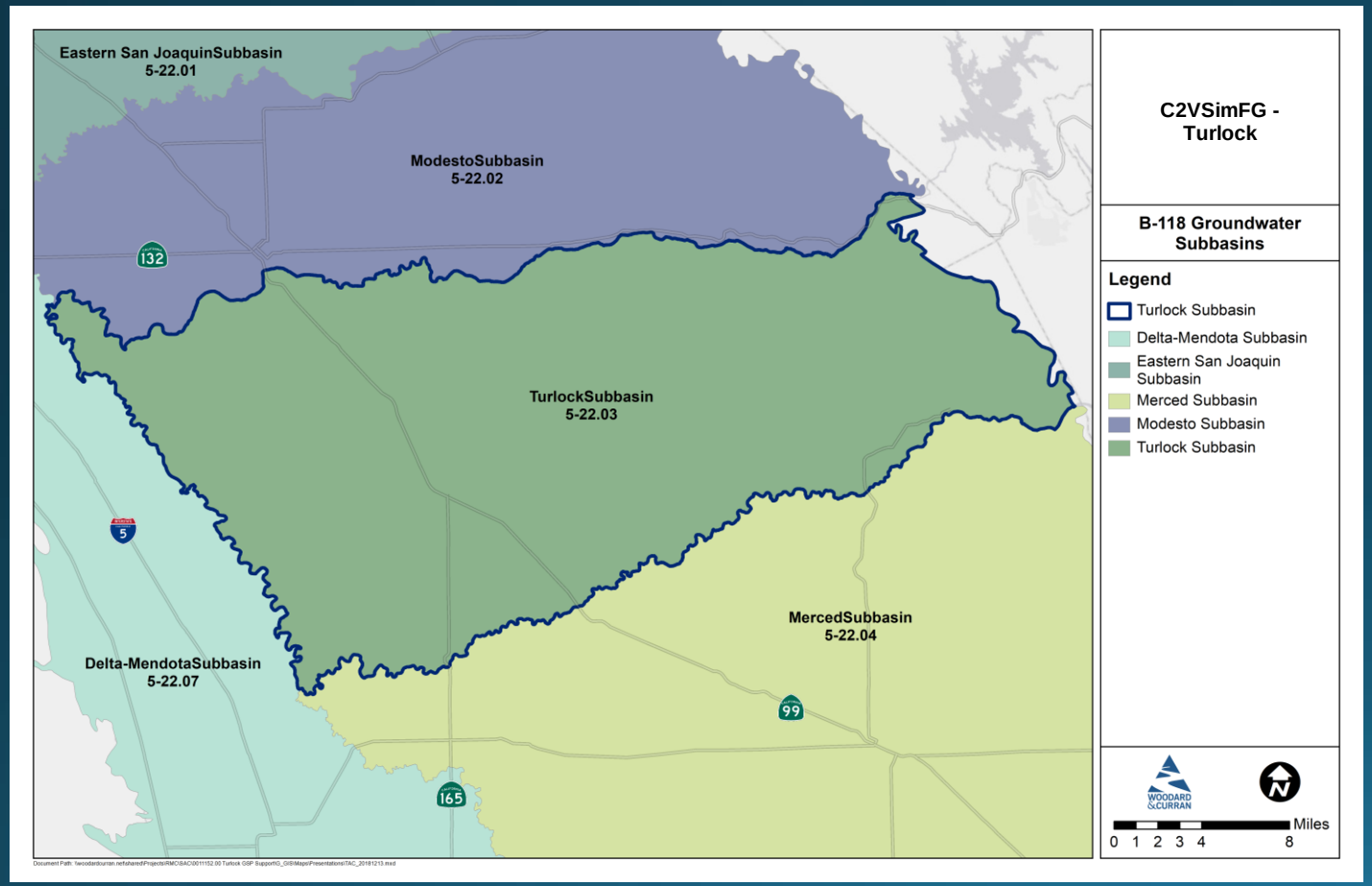
Goals for C2VSimFG-Turlock



Model Development Process



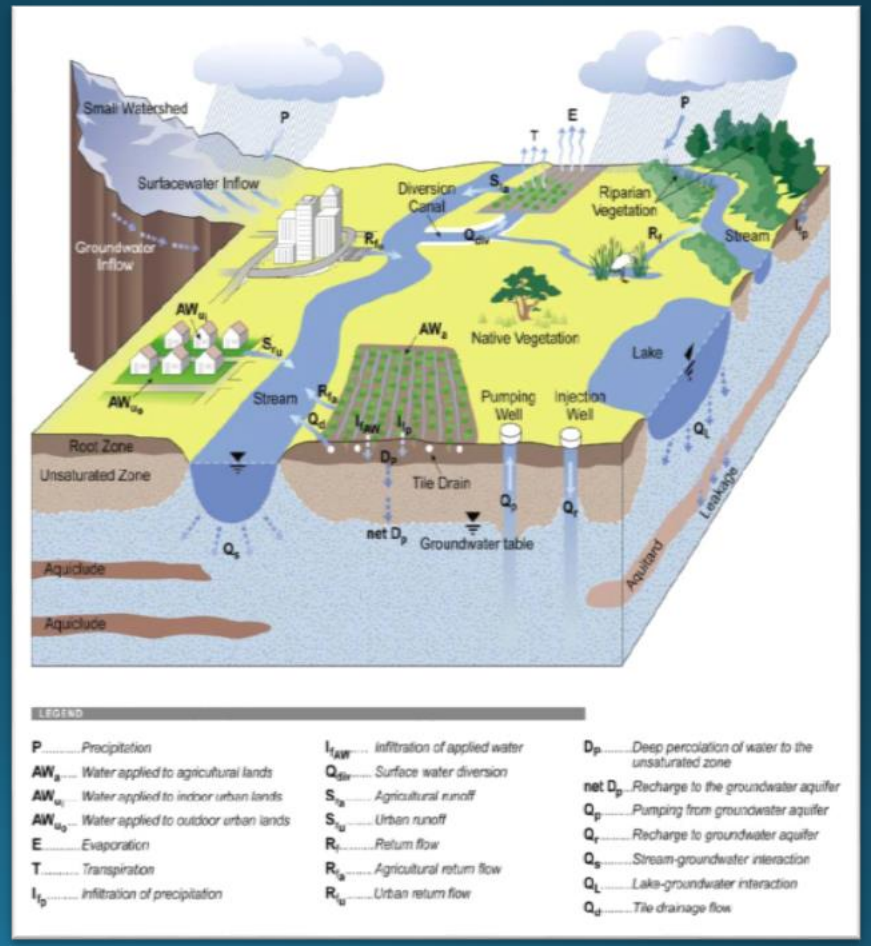
Model Study Area



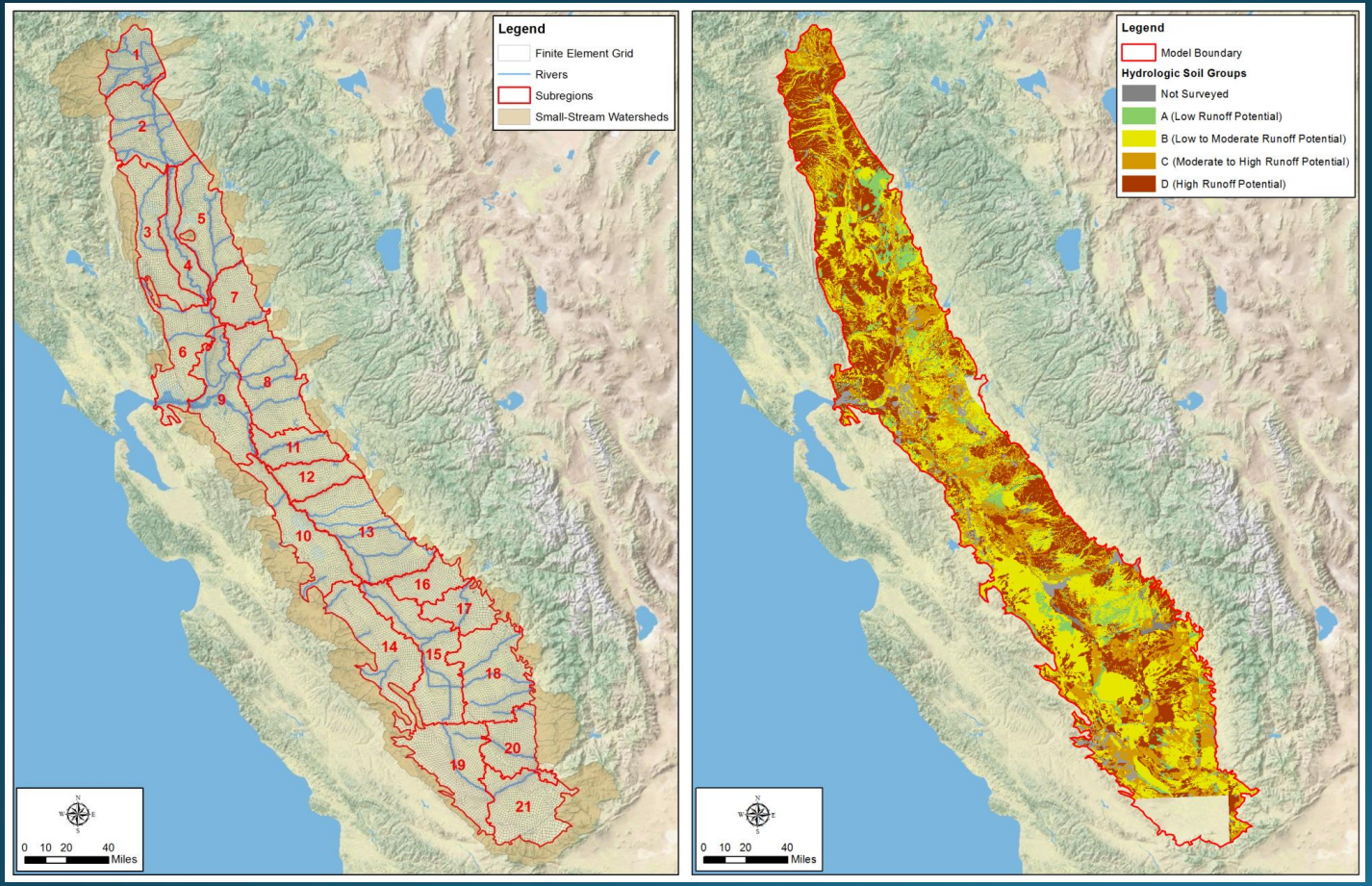
- Basin Characteristics
  - Historical Conditions
  - Natural Conditions
  - Stream-Aquifer Interaction
  - Land Subsidence
  - Water Quality
- SGMA Support
  - Groundwater Sustainability
  - Groundwater Banking
  - Project Benefits Assessment

Numerical Model Platform

- **I**ntegrated **W**ater **F**low **M**odel (IWFM)
- Developed and Supported by DWR
- Used in numerous basins throughout the state
- Recommended for SGMA and GSP Development



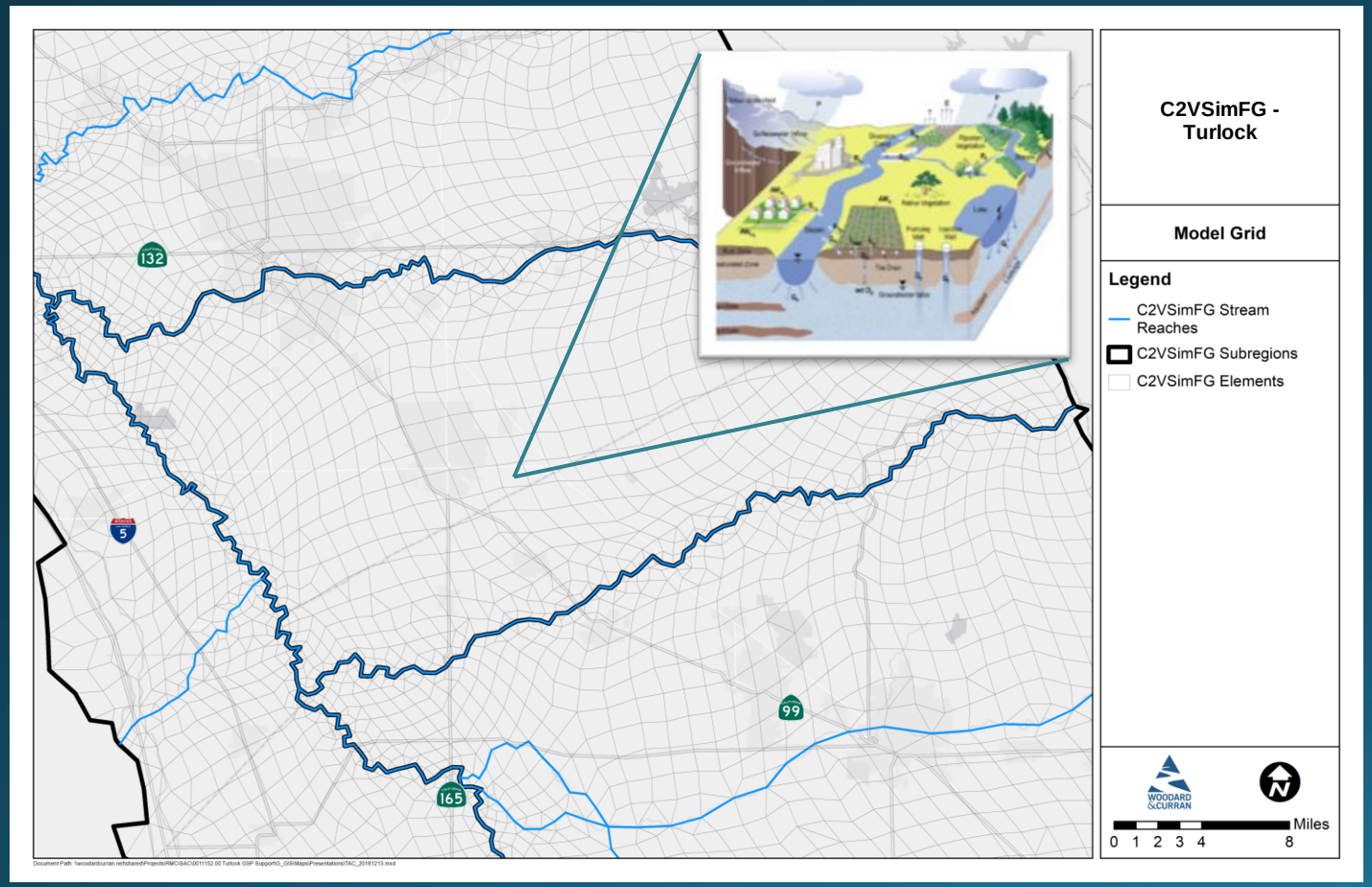
IWFM in the Central Valley



CV2VSimFG Grid Statistics

- 17,696 Nodes
  - Stream Lines
  - Agency Boundaries
  - ¼ Mile Discretization
- 19,563 Elements
  - Average Size = 24 Acres
  - 607,000 Total Acres
- 71 Stream Reaches

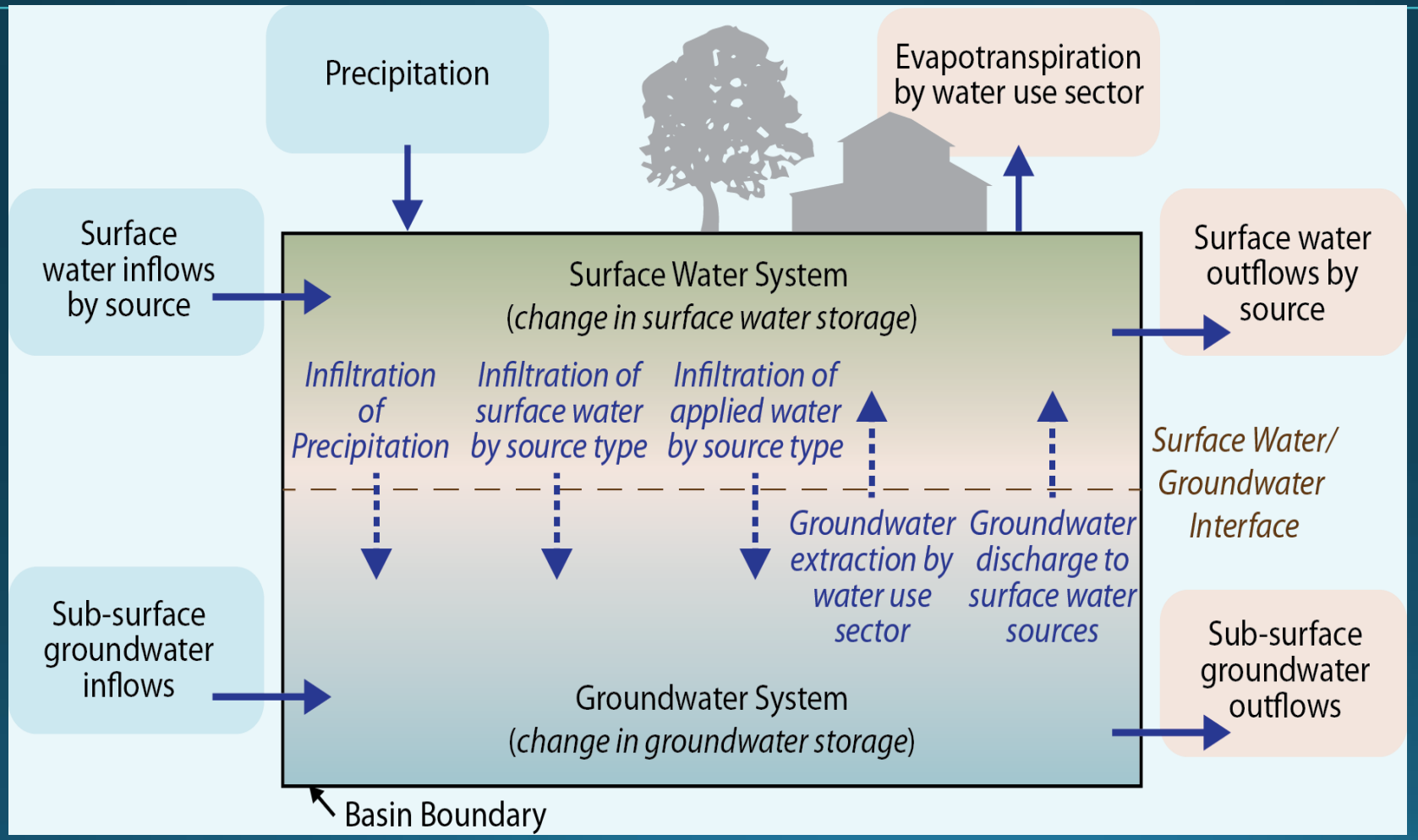
C2VSimFG in the Turlock Subbasin



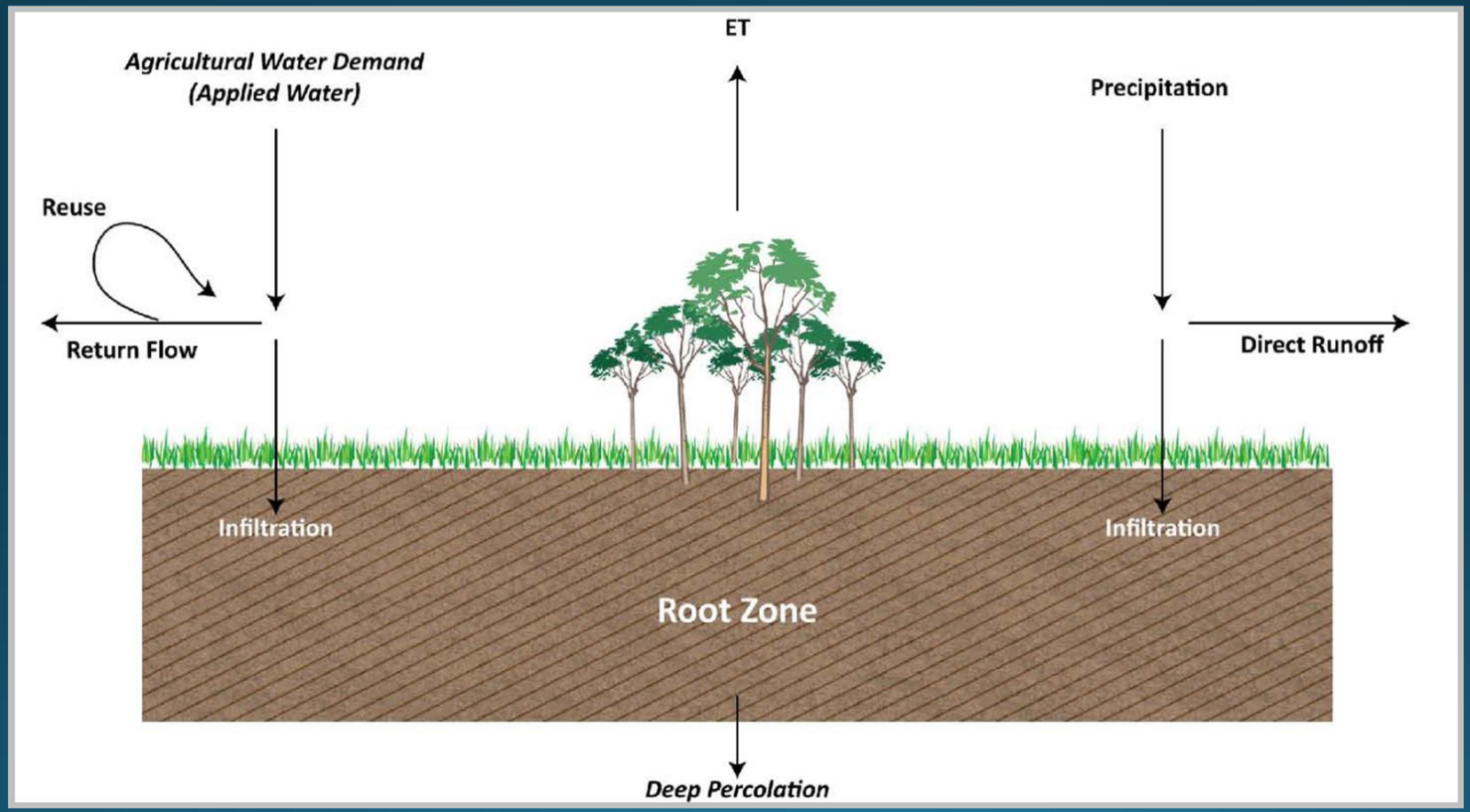
Grid Statistics

- 865 Nodes
  - Stream Lines
  - Agency Boundaries
  - ¼ Mile Discretization
- 960 Elements
  - Average Size = 362 Acres
  - 348,000 Total Acres
- 6 Stream Reaches

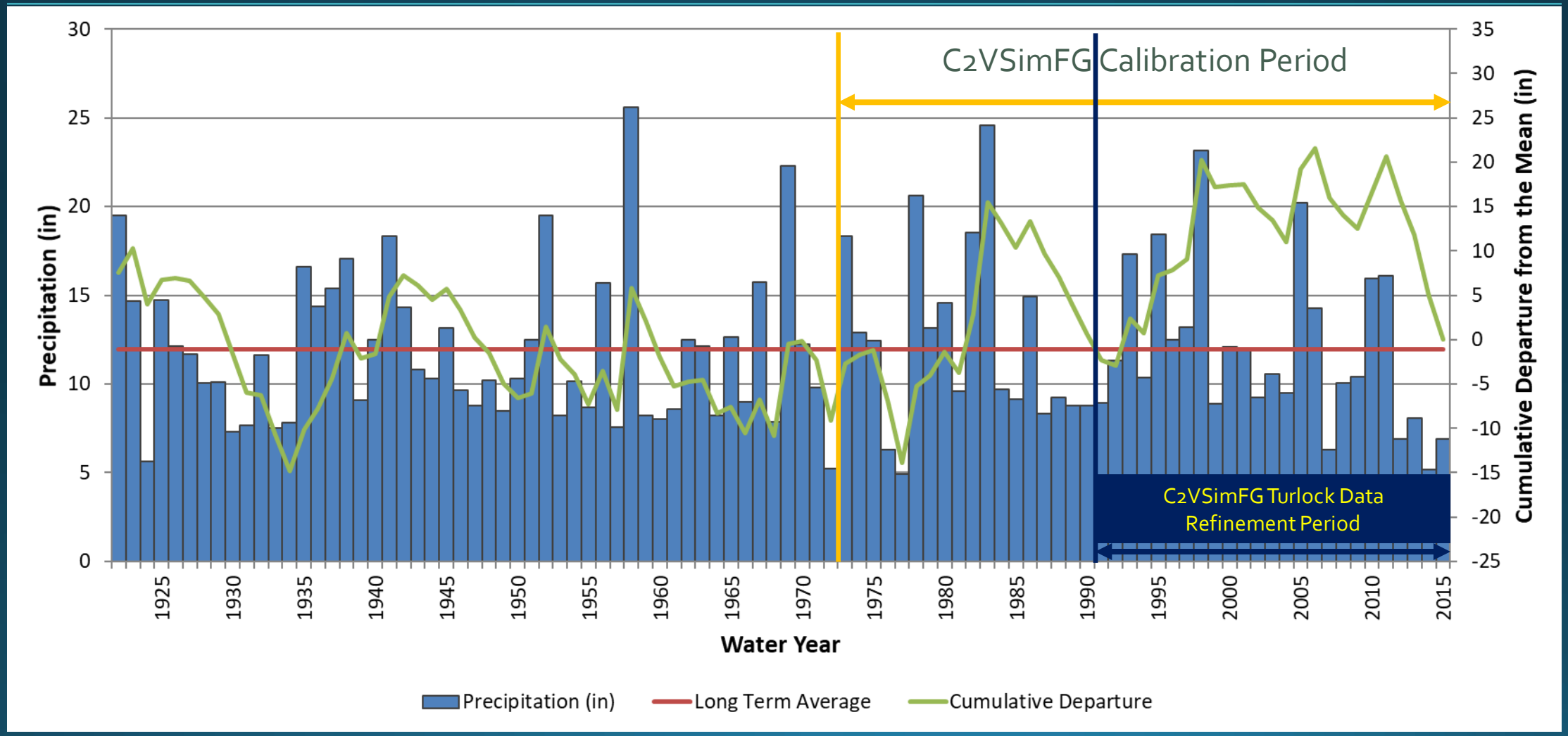
What is IWFM Demand Calculator (IDC)?



The IWFM Demand Calculator (IDC)



C2VSimFG Hydrology



Model Refinements

Irrigation Management

- Evapotranspiration
- Irrigation Period
- Rooting Depths
- Reuse and Return Flow
- Target Soil Moisture
- Curve-Numbers

Surface Water Deliveries

- Turlock Lake Releases
- Out-of-District Deliveries
- Operational Spills
- Storm Releases and Spills

C2VSimFG Data Sources

State and Federal Datasets

- Precipitation PRISM
- Actual ET: CalSIMETAW
- Aquifer Parameters: USGS Texture Model
- Stream Network: USGS and DWR Gaging Stations, Calsim 3
- SW Deliveries: Calsim 3
- GW Wells: CASGEM and OSWCR
- GW Pumping: C2VsimCG, CWP, IDC Estimates

C2VSimFG-Turlock
Data Sources

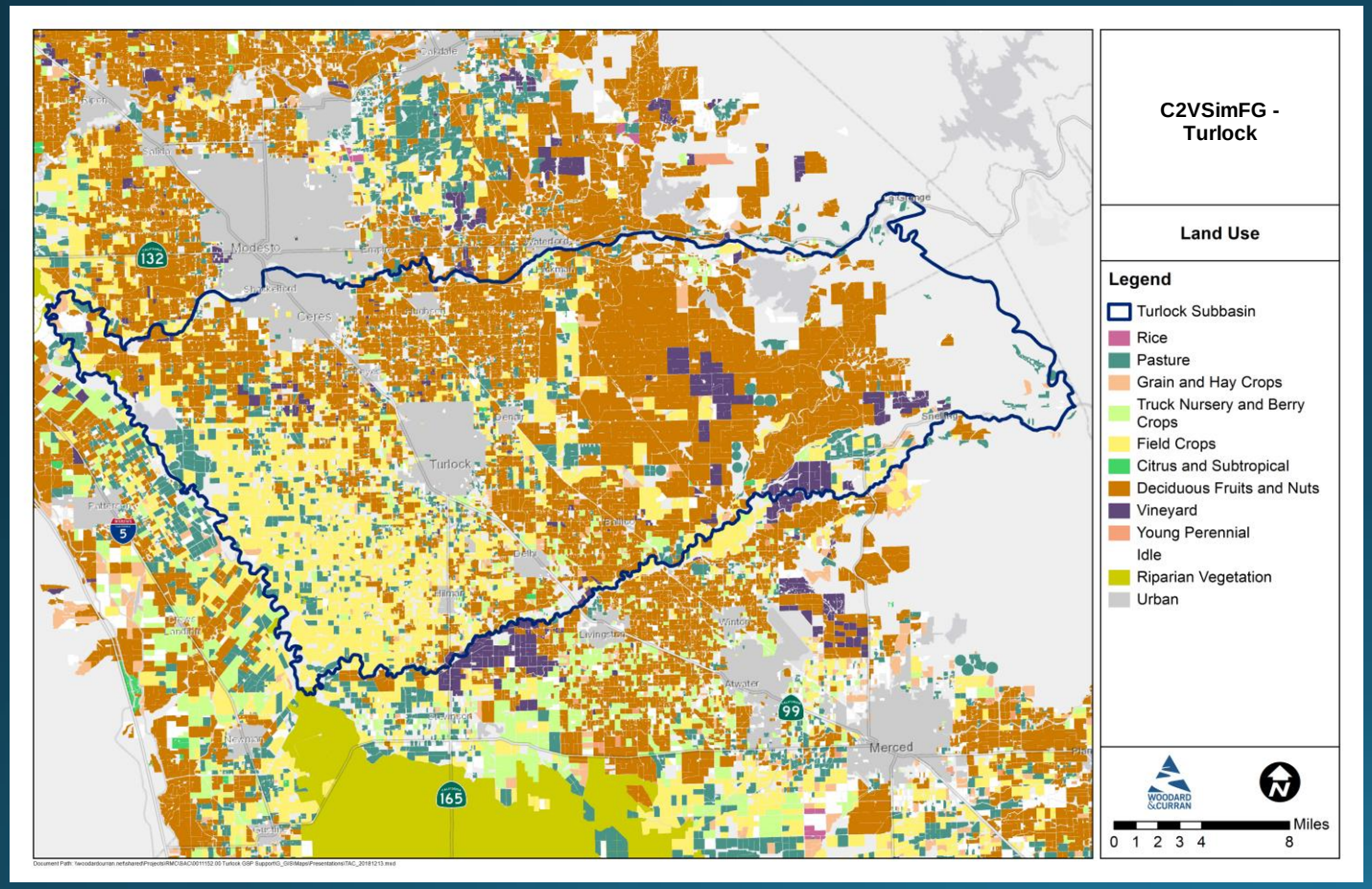
Local Datasets

- Precipitation: PRISM (Verified with CIMIS Station 71, 168, and 206)
- Actual ET: ITRC's METRIC datasets
- Aquifer Parameters: Potential Aquifer Tests
- Stream Network: See Next Slide
- SW Deliveries: See Next Slide
- GW Wells: Potential Well completion reports, etc.
- GW Pumping: Inc. Rented, Drainage, and Municipal Wells

C2VSimFG-Turlock
Updated Stream Network

- Operational Flows:
  - Added new time series with measured canal spills from TID
    - Highline Line Spill
    - Lower Stevinson Spill
    - Laterals 6 and 7 Spill
    - Lateral 5 ½ Lower Spill
    - Laterals 4 ½ , 4, 5 ½ , 5 (Hodges) Spill
    - Laterals 2 ½ and 3 Spill
    - Lateral 2 Spill
    - Hickman Spill
    - Ceres Main (Faith Home) Spill
- Diversions
  - Added new time series with surplus deliveries from TID to parcels outside TID
  - Adjusted surface water deliveries to account for Turlock Reservoir operations

C2VSimFG-Turlock
Land Use and Cropping Patterns

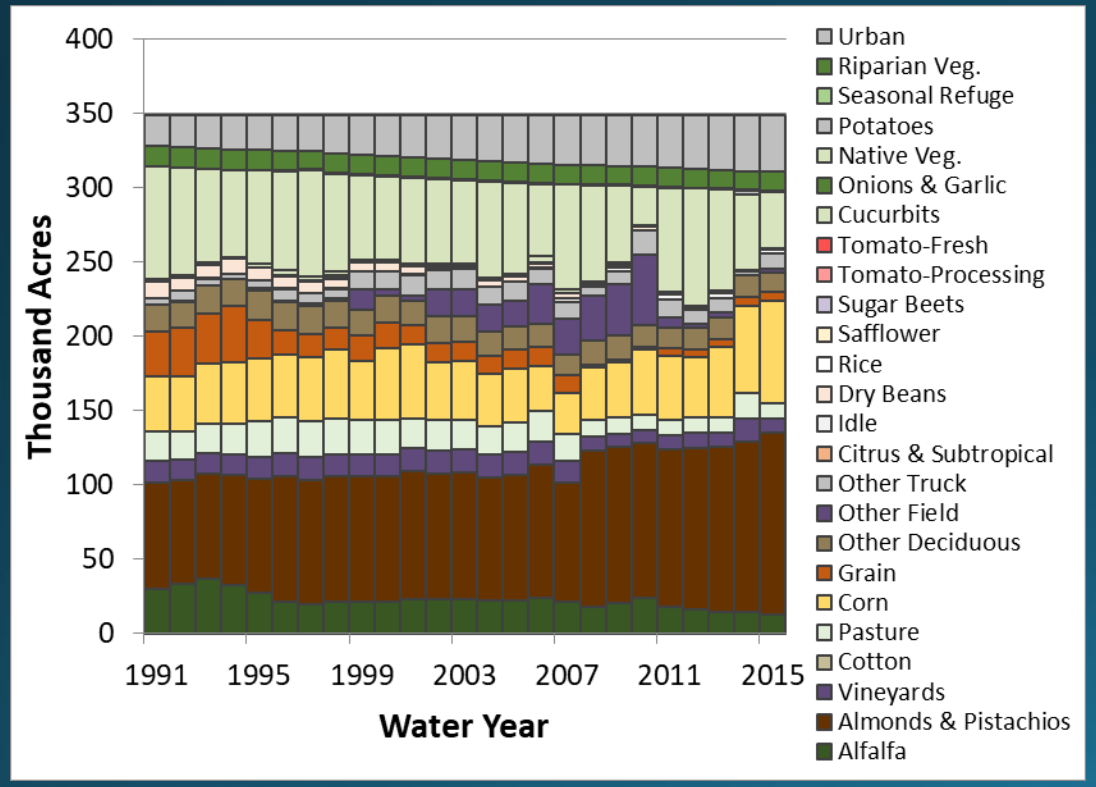


Available Data

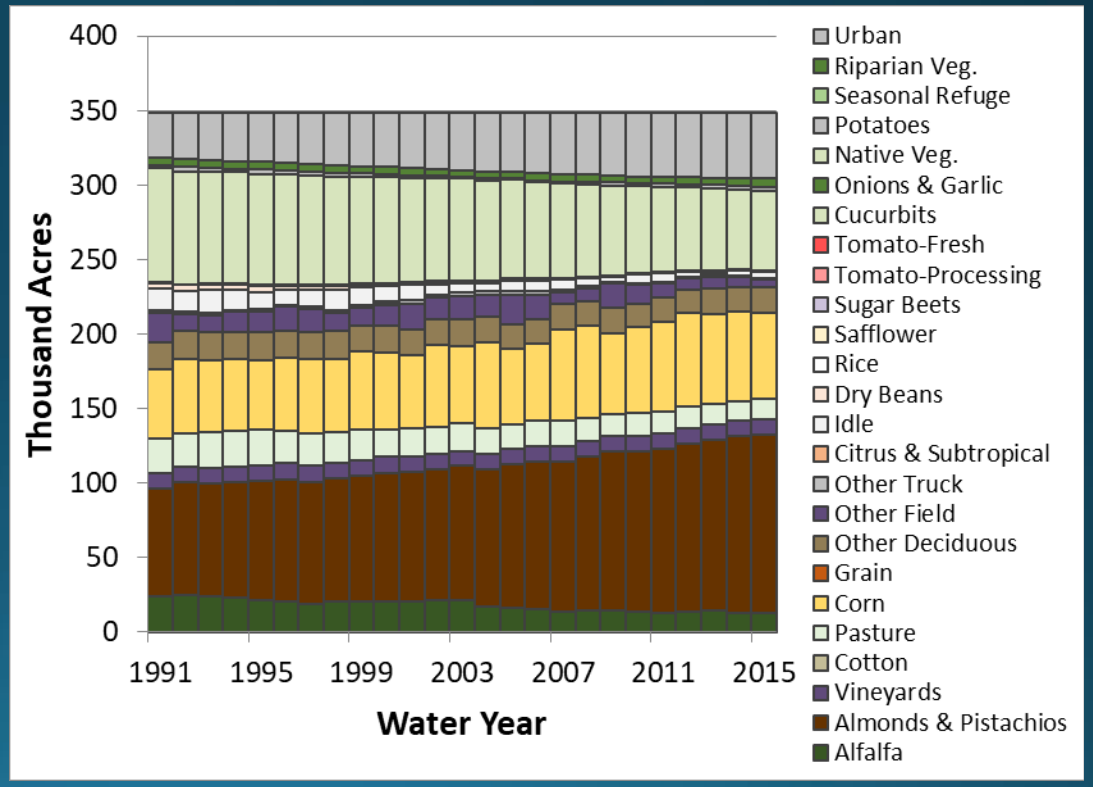
- Base Data from DWR Land Use Surveys
- Modifications based on:
  - Turlock ID Cropping Records
  - Merced and Stanislaus County Spatial Data

C2VSimFG-Turlock
Updated Annual Cropping Patterns

C2VSimFG-BETA

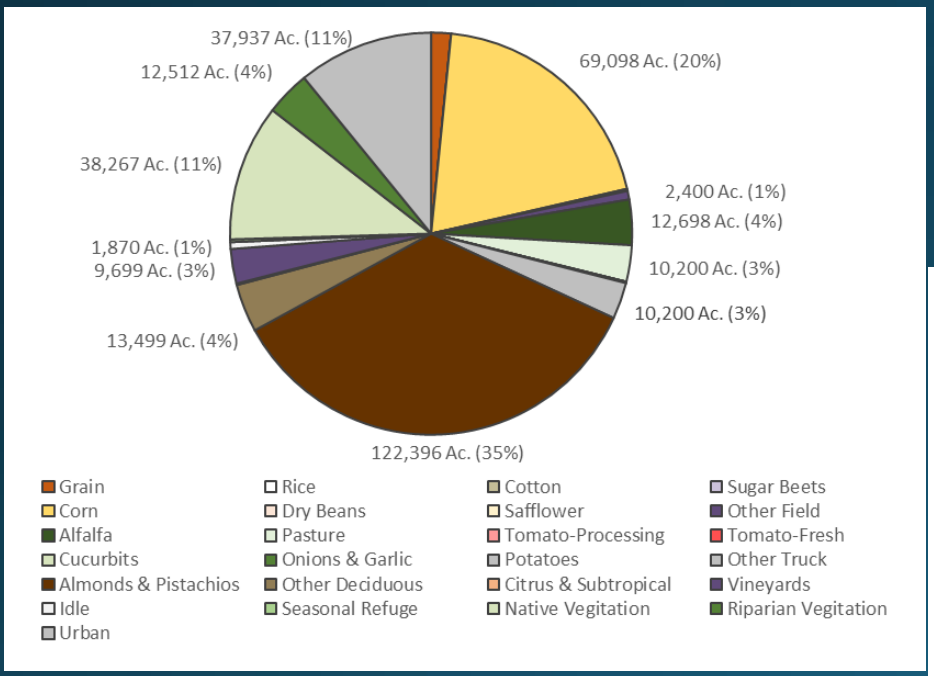


Updated Land Use

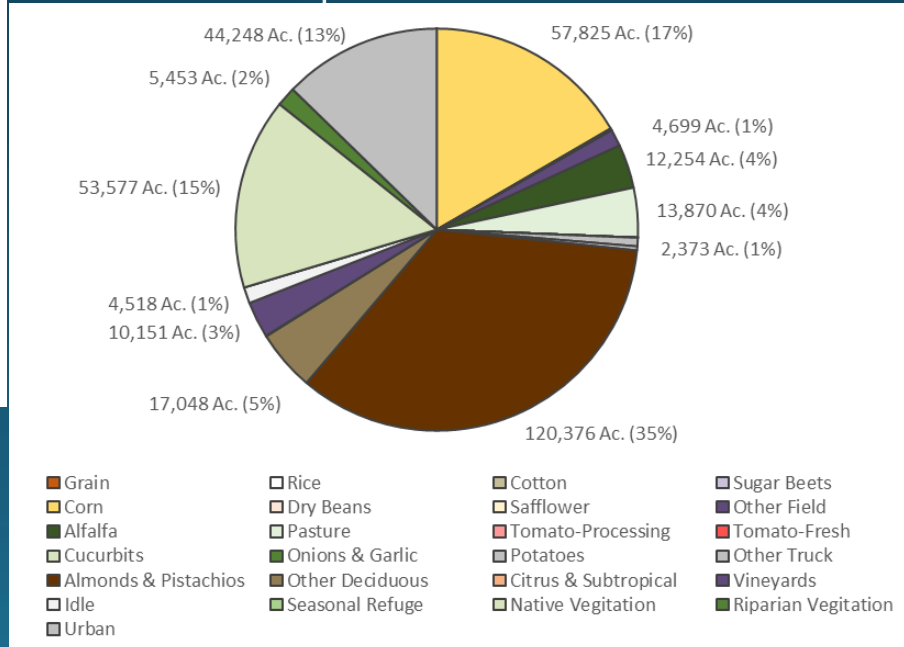


C2VSimFG-Turlock
2015 Updated LU Patterns

C2VSimFG-BETA Land Use

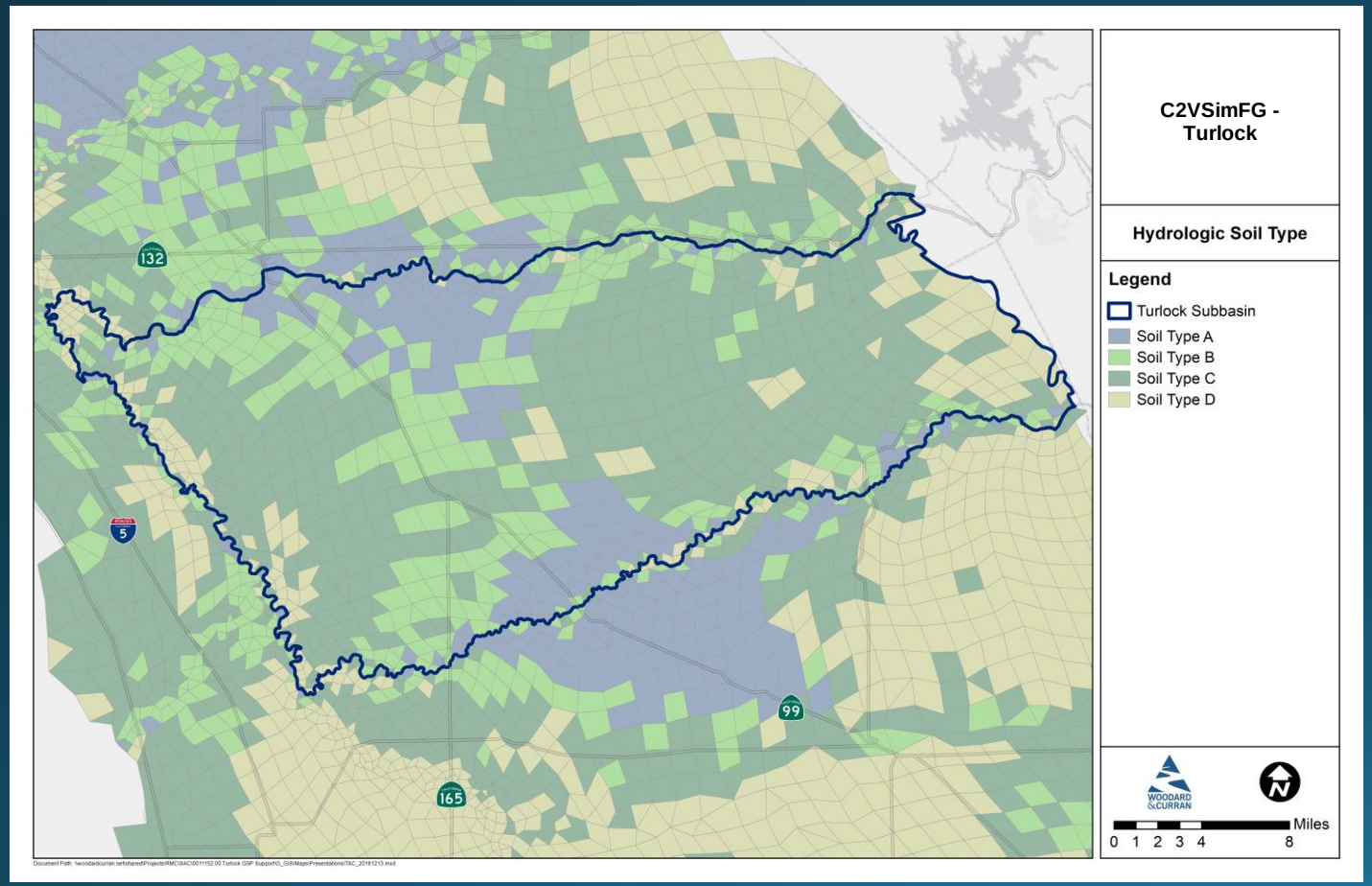


Updated Land Use



2015 C2VSim Land Use Data	C2VSim BETA	Updated LU
Grain	5,549	-
Rice	-	-
Cotton	-	-
Sugar Beets	-	-
Corn	69,098	57,825
Dry Beans	600	628
Safflower	-	-
Other Field	2,400	4,699
Alfalfa	12,698	12,254
Pasture	10,200	13,870
Tomato-Processing	-	-
Tomato-Fresh	-	-
Cucurbits	400	42
Onions & Garlic	-	21
Potatoes	-	2,373
Other Truck	10,200	1,118
Almonds & Pistachios	122,396	120,376
Other Deciduous	13,499	17,048
Citrus & Subtropical	399	140
Vineyards	9,699	10,151
Idle	1,870	4,518
Total Ag. Acreage	259,007	245,063
Seasonal Refuge	781	-
Native Vegitation	38,267	53,577
Riparian Vegitation	12,512	5,453
Urban	37,937	44,248
TOTAL	348,504	348,342

C2VSimFG-Turlock
Soil Types & Required Parameters

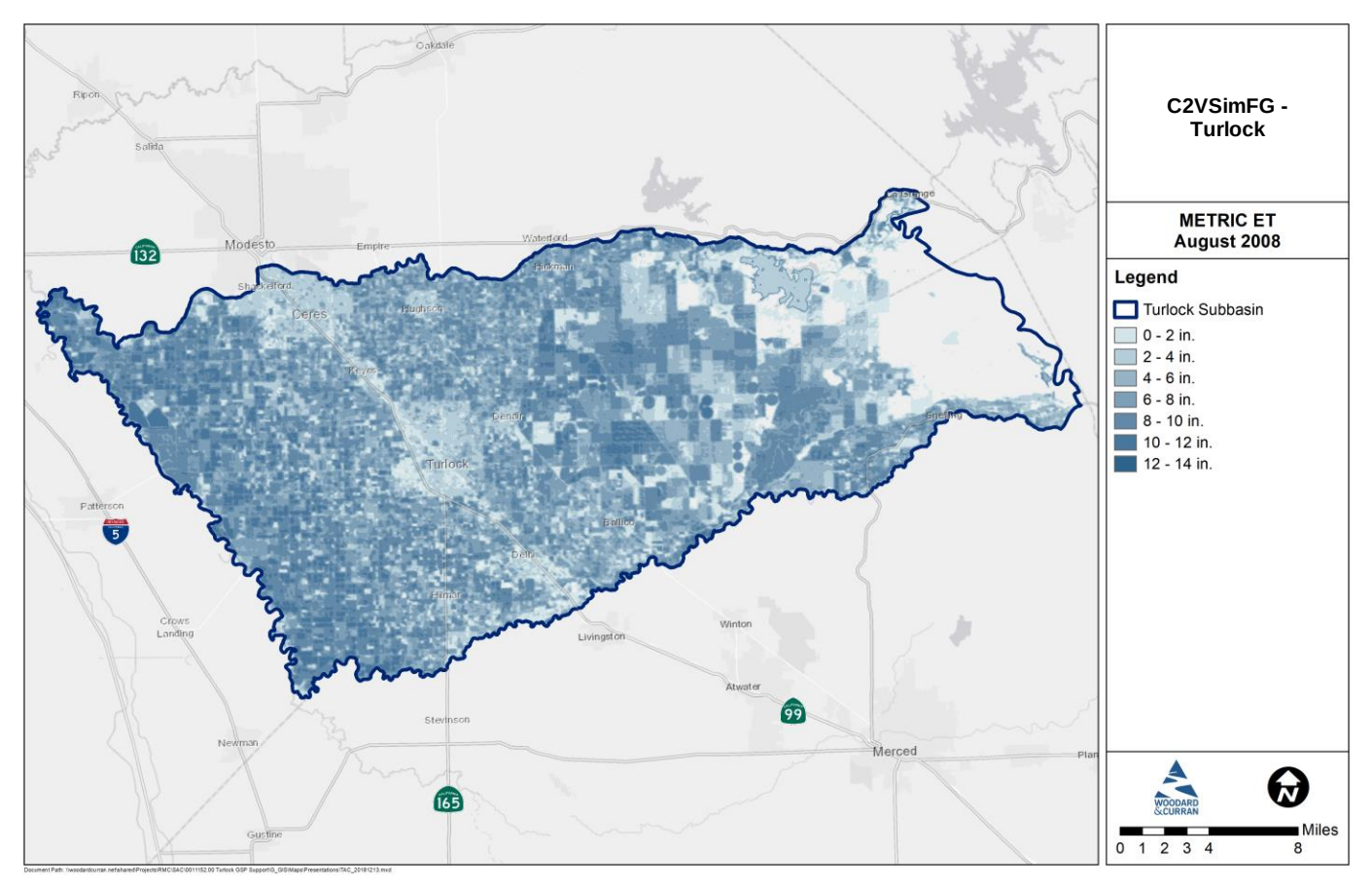


IWFM Parameters

- Source
  - USDA Soil Survey
- Input Parameters
  - Field Capacity
  - Wilting Point
  - Soil Conductivity
  - PSDI: Pore Size Distribution Index

C2VSimFG-Turlock

Remote Sensing Data for Ag. Water Demand Estimation



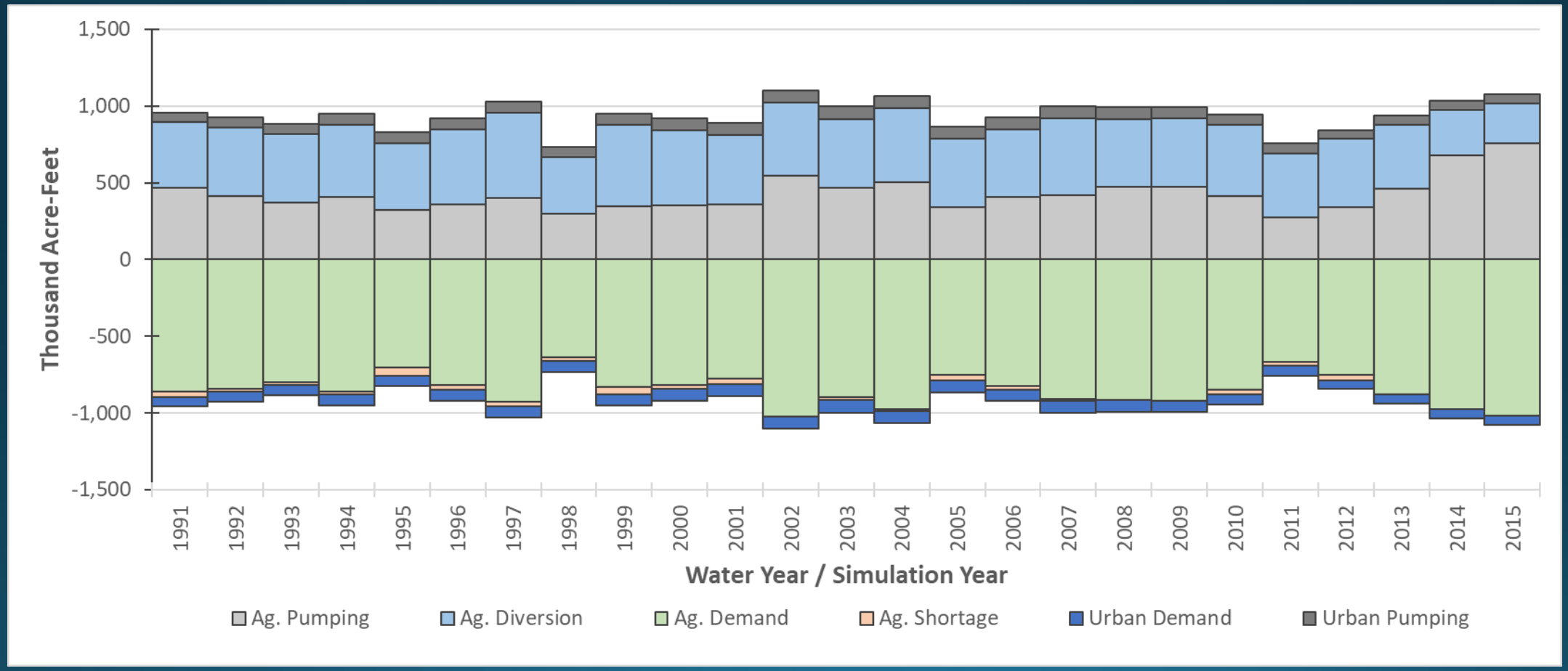
METRIC Process

- Base Data
  - 30 Meter Grid
  - Seasonal Accuracy of +/- 5%
- 9 years of monthly remote sensing data used for model update

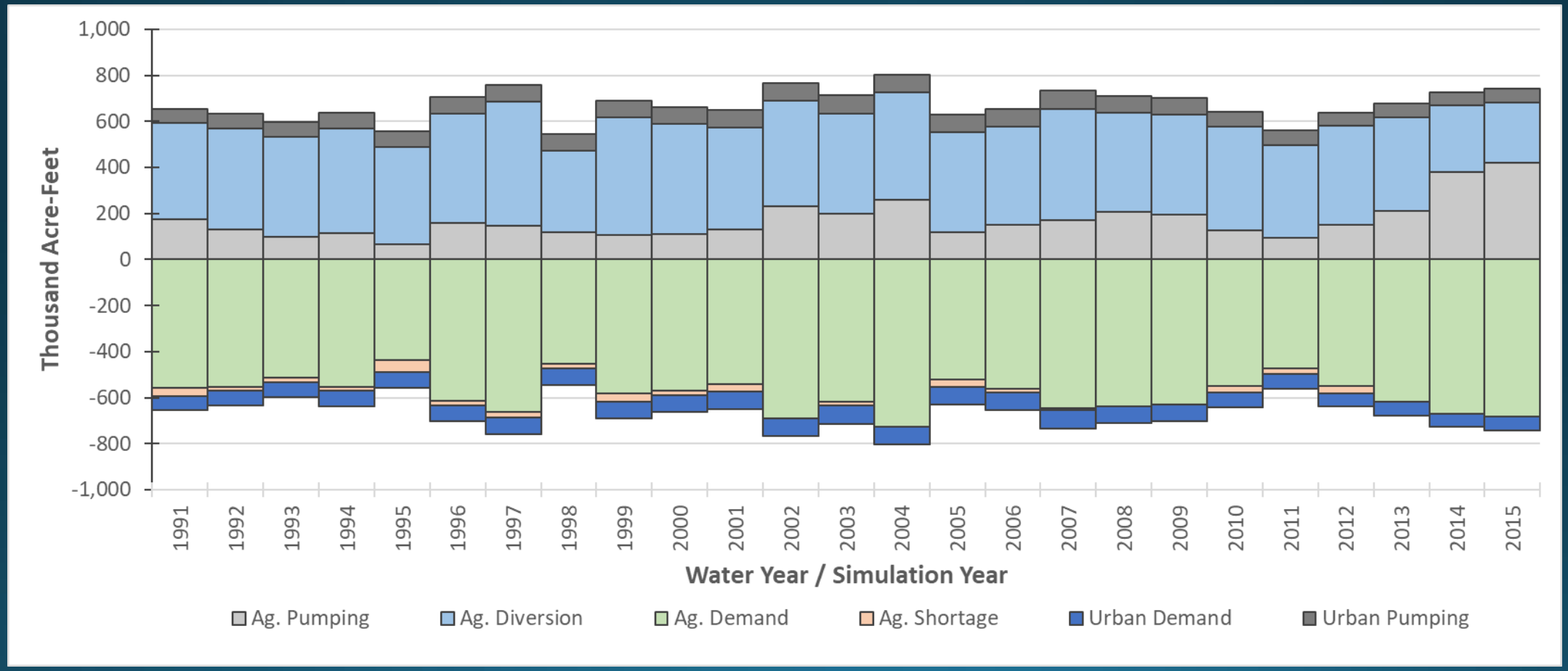
Water Budgets

Land & Water Use

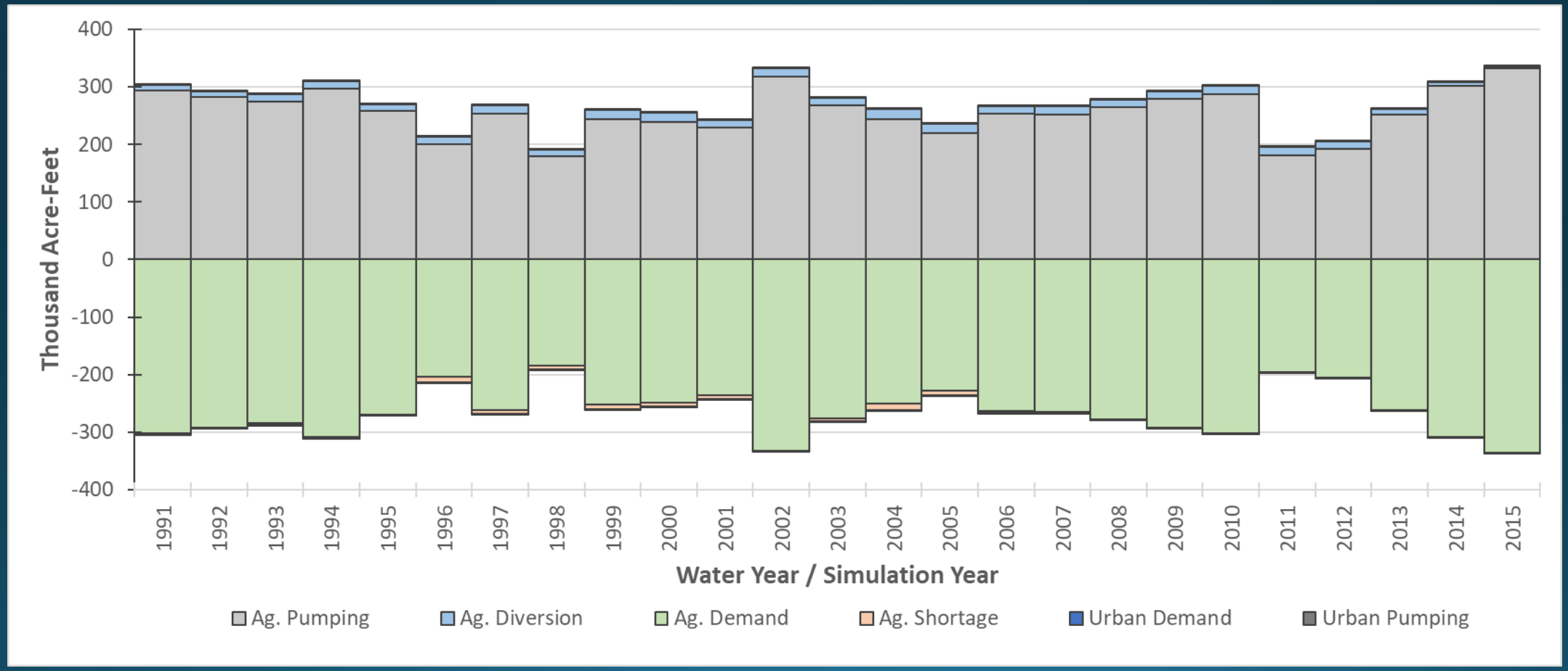
Land and Water Use Budget
Turlock Subbasin



Land and Water Use Budget
Turlock West



Land and Water Use Budget
Turlock East

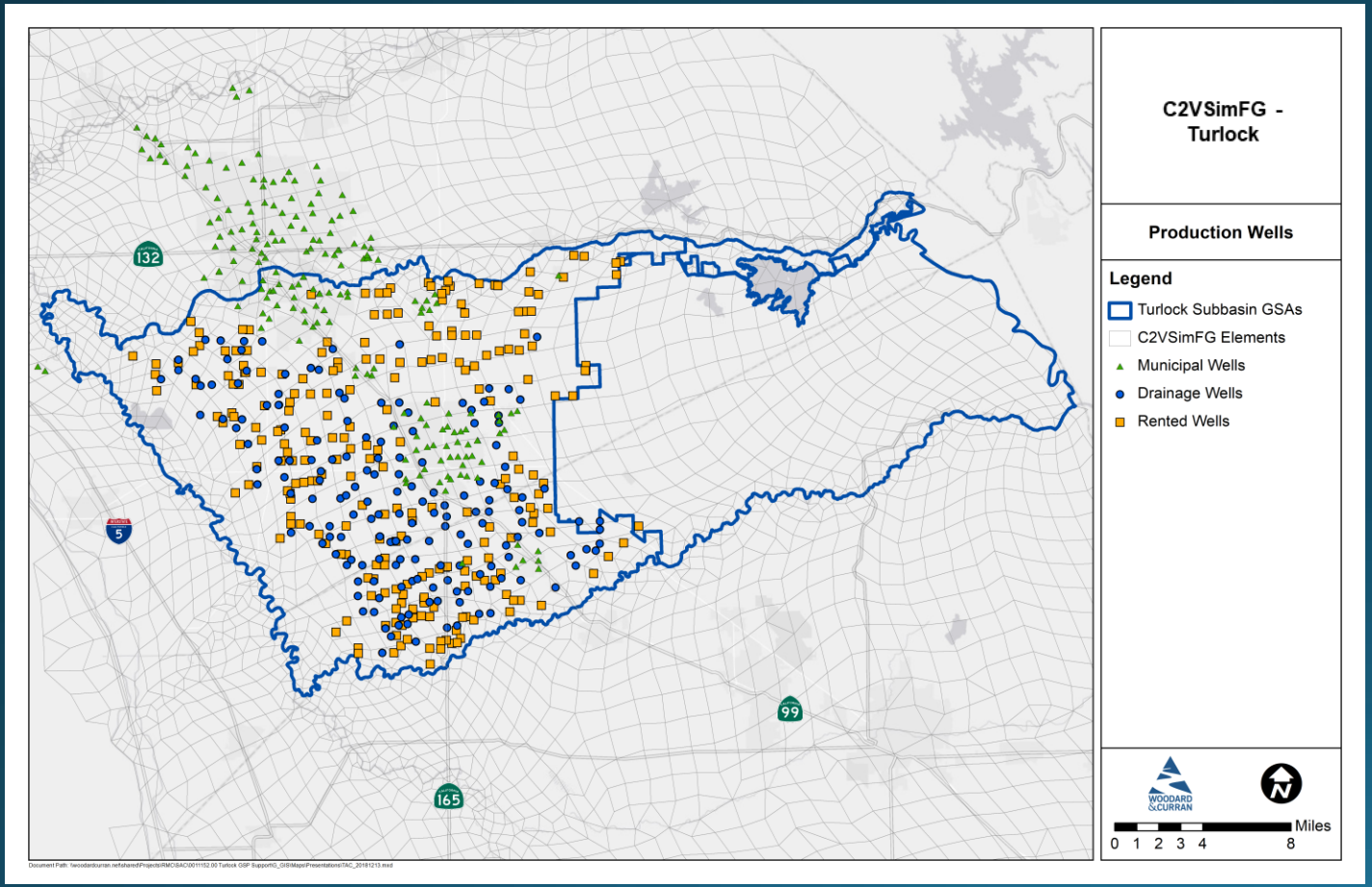


Groundwater System

Groundwater System Refinements

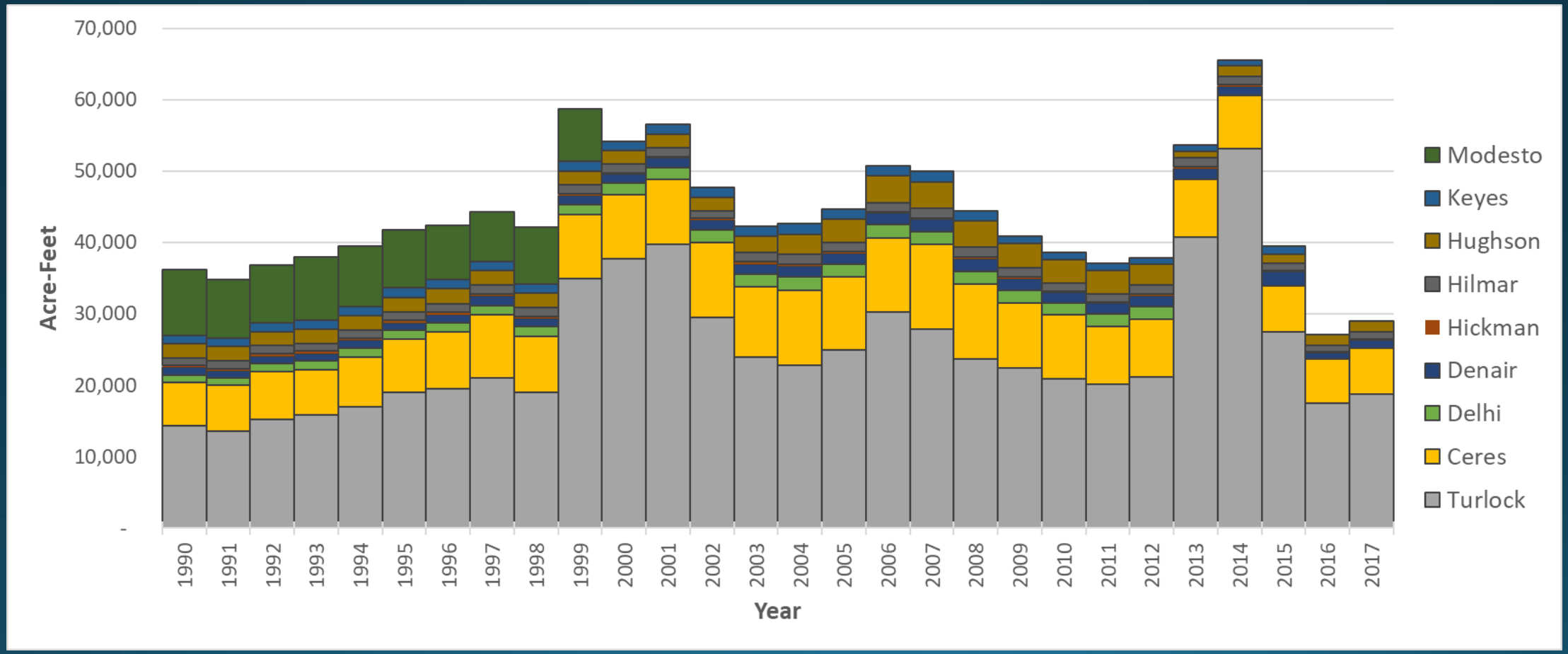
- GW Pumping by well for Municipalities
- Ag Pumping
  - Rented Wells Pumping
  - Drainage Wells
  - Private Pumping Estimates
- Additional Observed GW Level Data for Calibration
- Coordination with the HCM Work during model calibration

Local Groundwater Production Wells



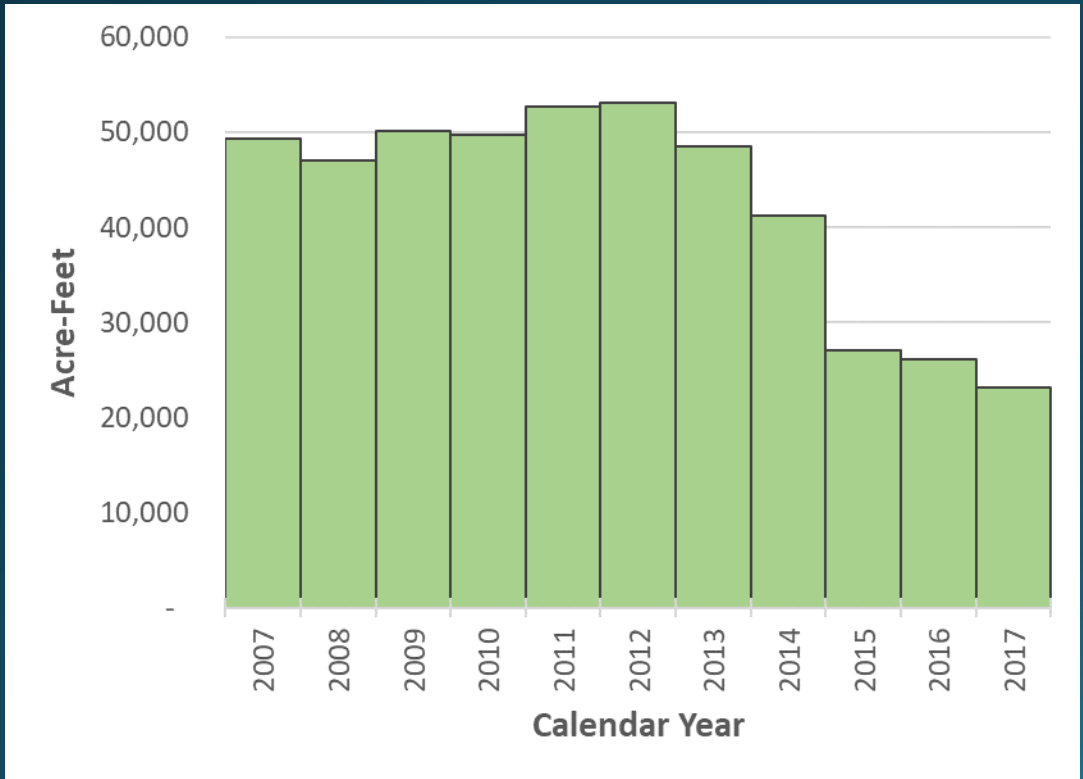
- 170 Drainage Wells
- 241 Rented Wells
- 194 Municipal Wells

Municipal Groundwater Production

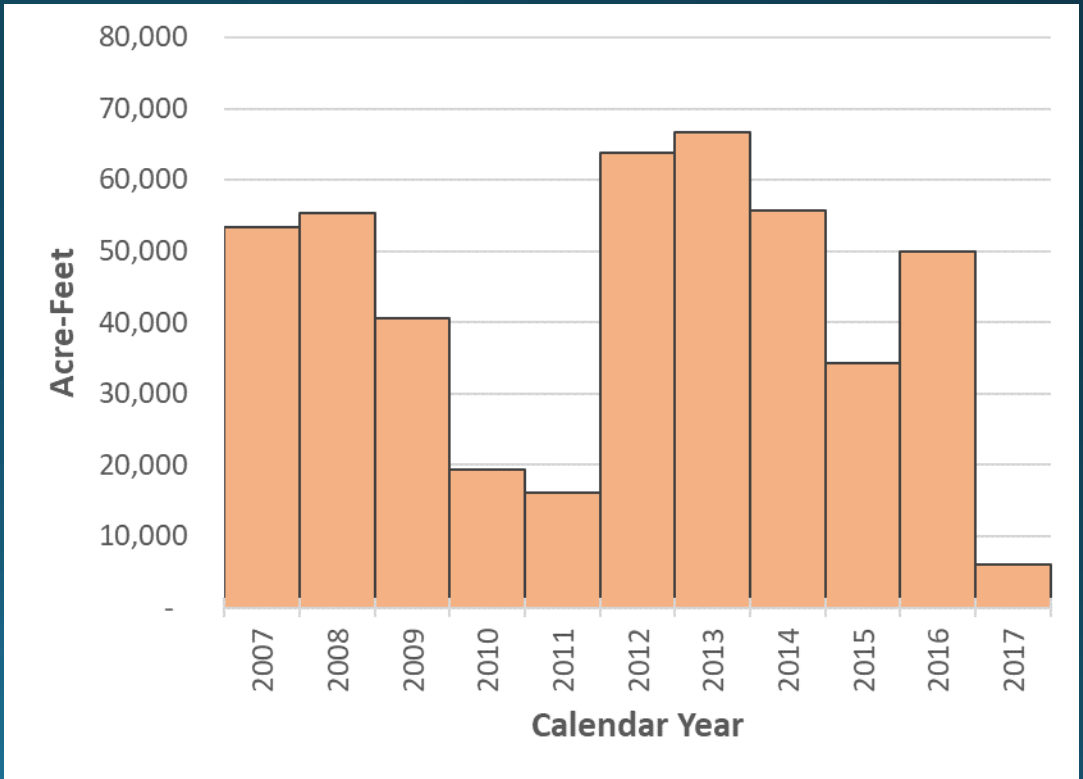


TID Groundwater Production

Drainage Well Pumping



Rented Well Pumping



Proposed Approach
for
Model Application to GSP Development

GW Sustainability Application

Historical Water Budget

Uses historical information for hydrology, precipitation, water year type, water supply and demand, and land use going back a minimum of 10 years.

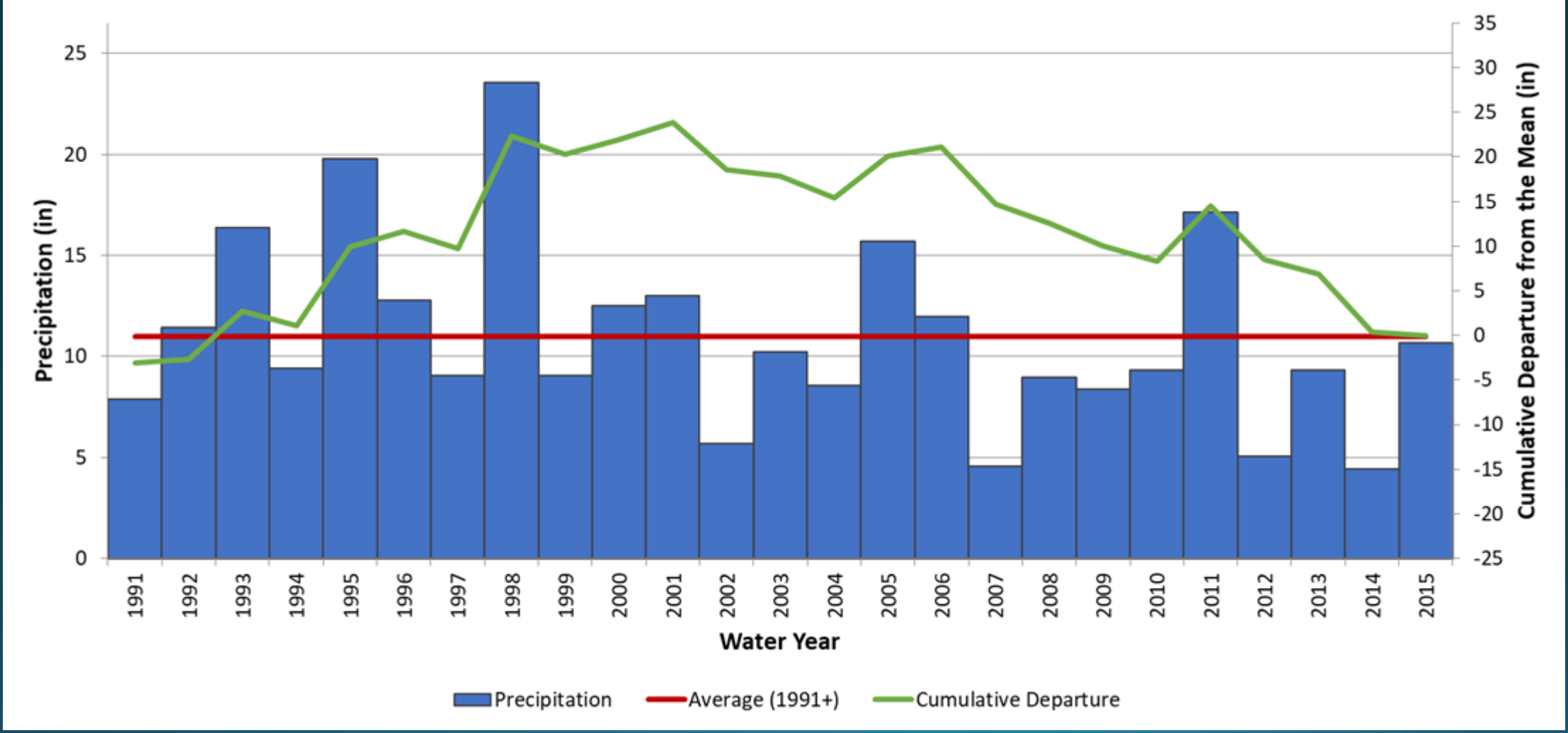
Current Water Budget

Holds constant the most recent or "current" data on population, land use, year type, water supply and demand, and hydrologic conditions.

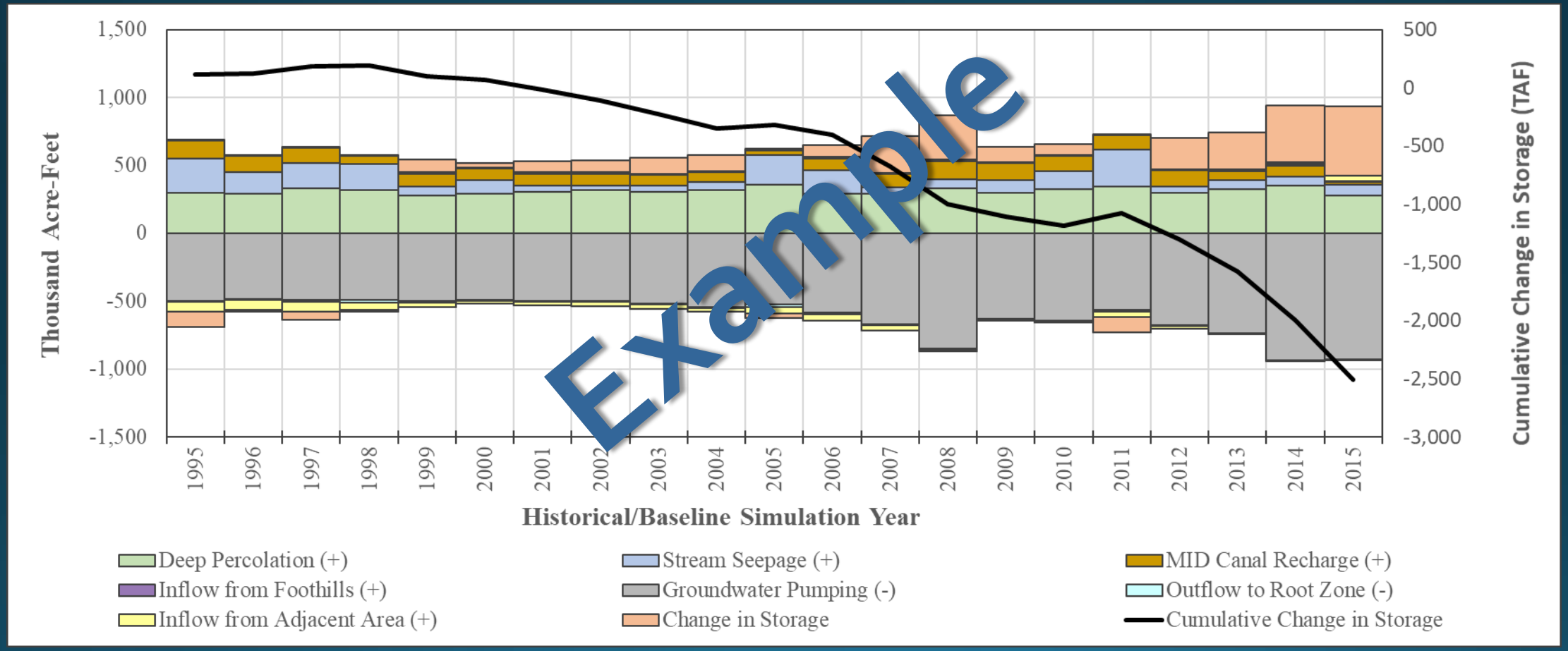
Projected Water Budget

Uses the future planning horizon to estimate population growth, land use changes, climate change, etc.

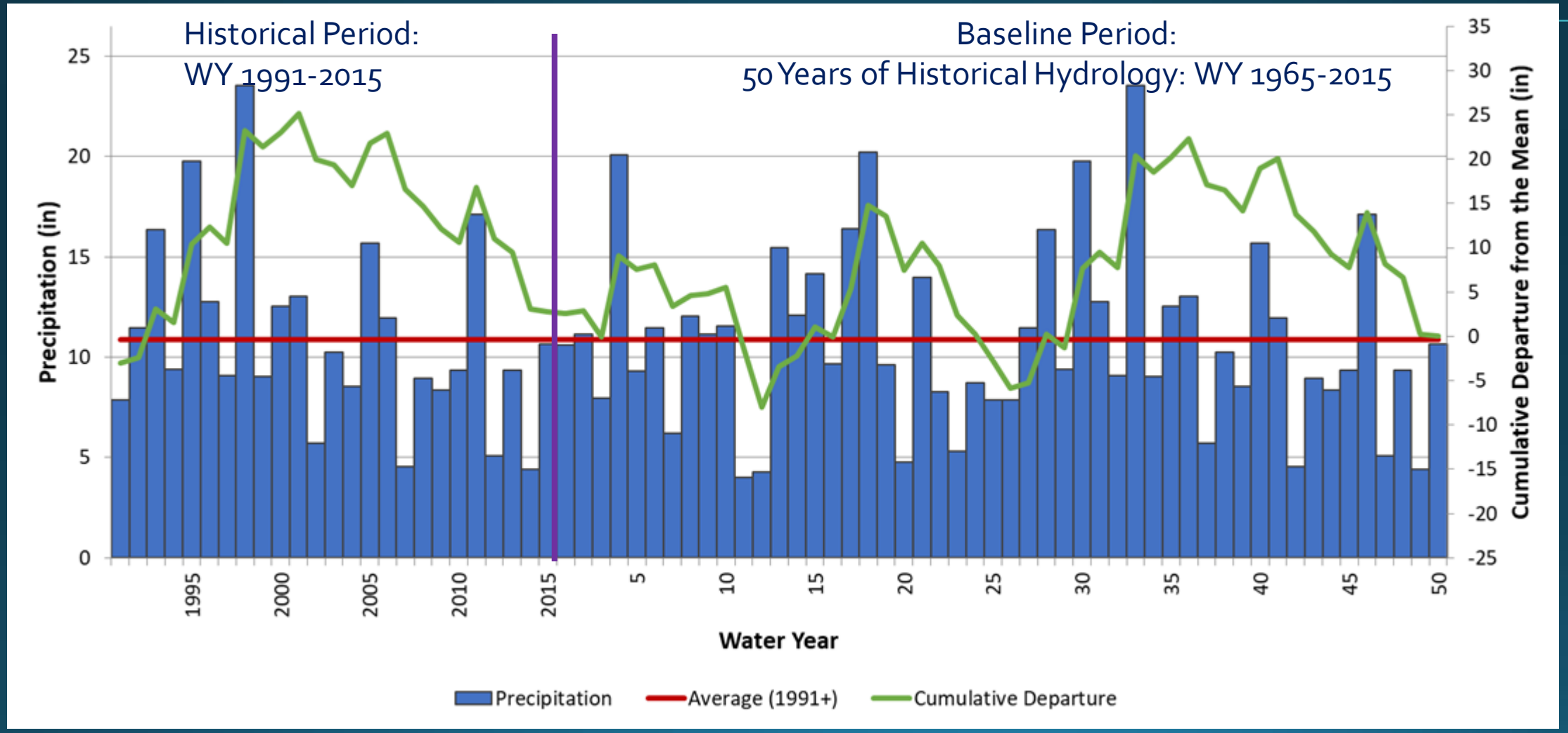
Historical Water Budget Period



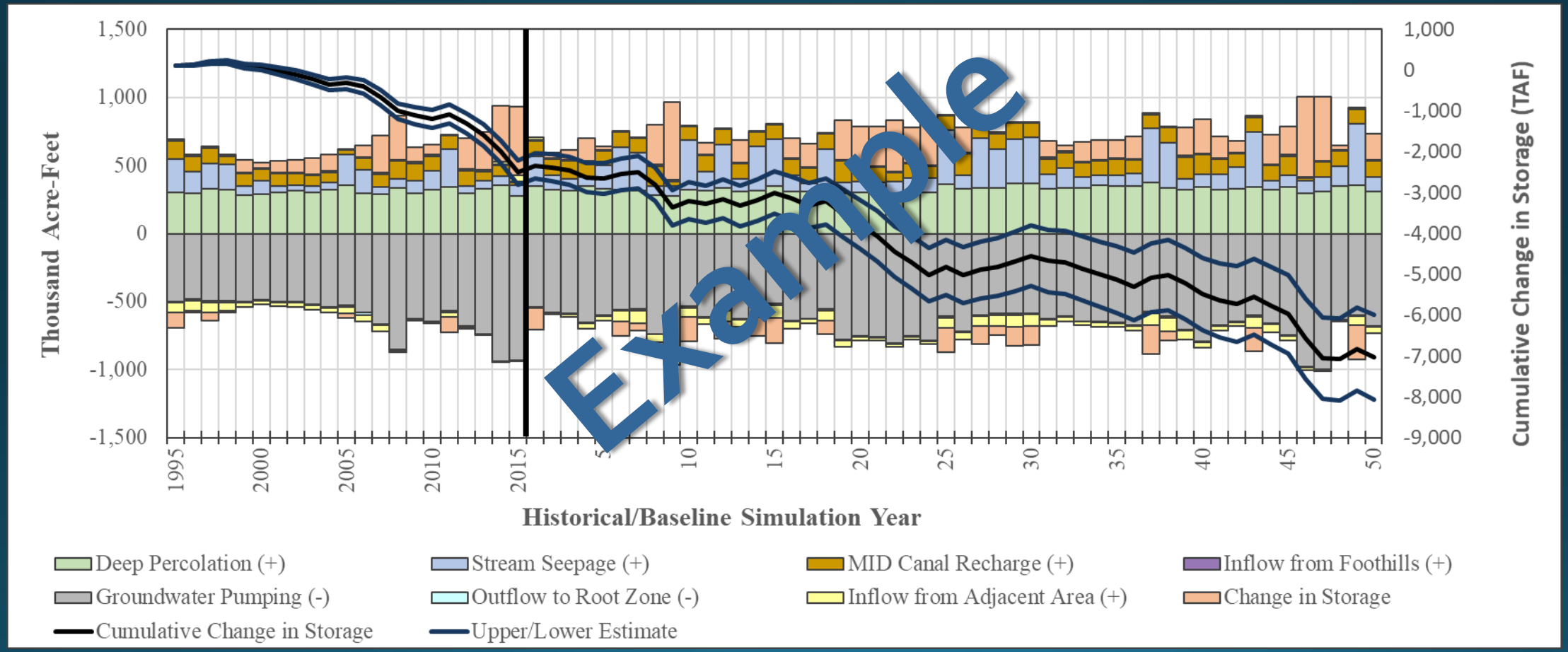
Example Water Budget
Historical Simulation



Baseline Water Budget Period



Example Water Budget
Projected Conditions Baseline

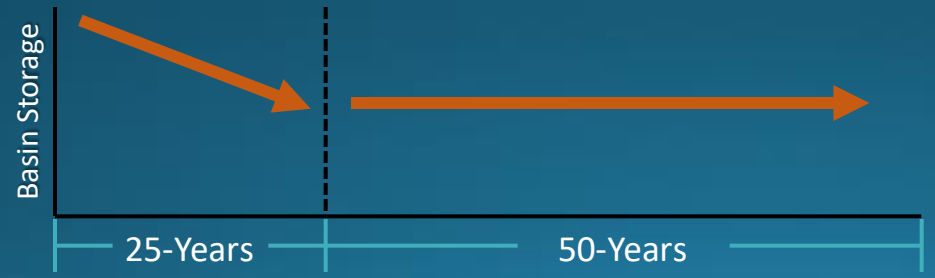


Quantifying Sustainable Yield

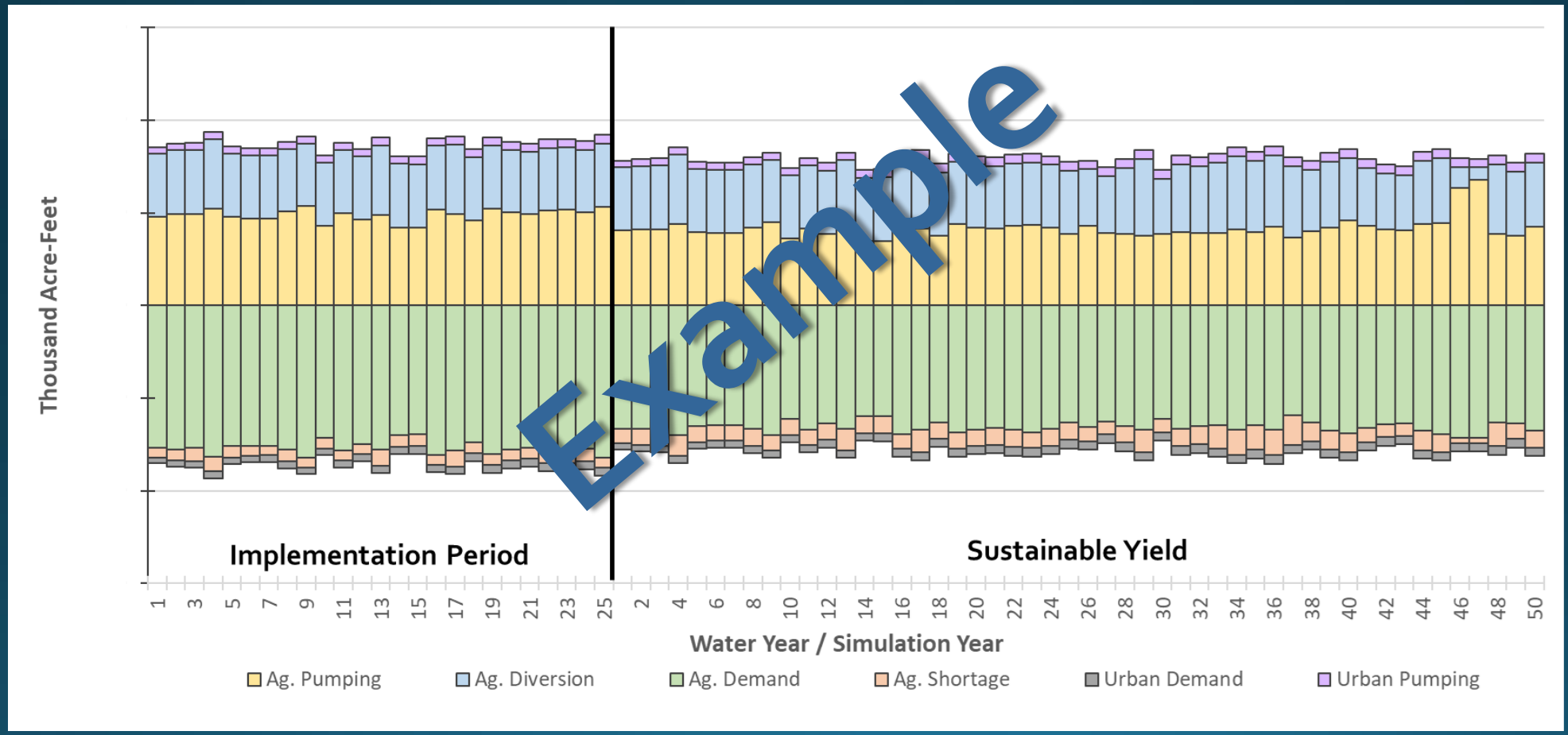
- What is sustainable yield?
  - "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result."
- How do we develop this?
  - Can be developed through a groundwater model scenario, modifying conditions to balance out the change in stored groundwater over time
- How do we work toward a balance?
  - Implement projects and management actions to achieve Long-Term GW sustainability
    - Demand Side
    - Supply Side
    - Combination

Sustainable Yield – Modeling Analysis

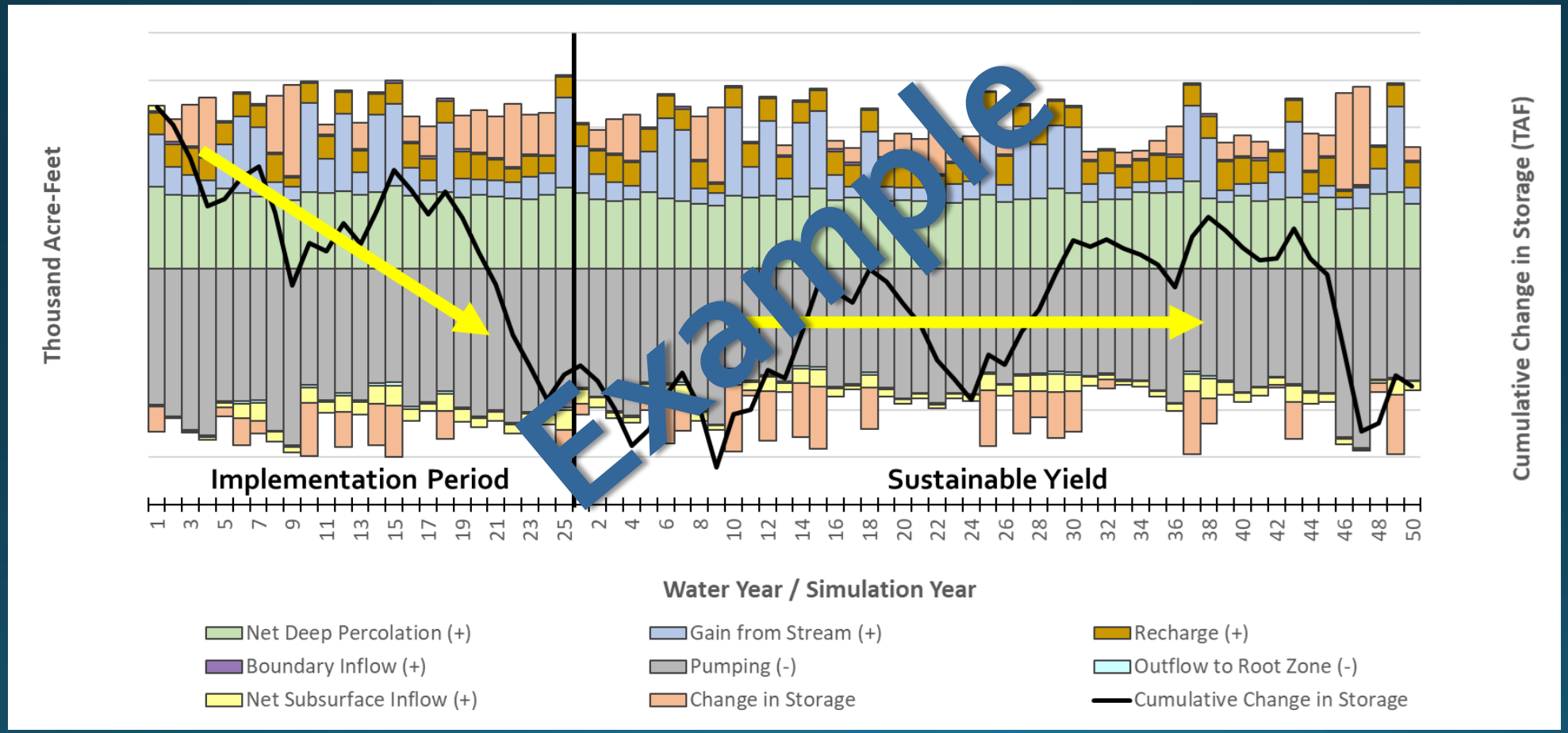
- Modeling Approach
  - Lower groundwater production through reduced agricultural and urban demand across the model domain
- Assumptions
  - 25-Year Implementation Period: operations will remain consistent, and groundwater levels will continue to decline until 2040
  - Inter-Subbasin Flows: adjoining subbasins will operate similarly to Merced, whereas subsurface flows will remain similar to long-term average historical conditions



Example Water Budget
Sustainable Yield Simulation



Example Water Budget
Sustainable Yield Simulation



Next Steps

- QC IDC Data and Model Results
- Incorporate Groundwater Related Data Sets
  - TID Wells
  - Municipal Wells
  - HCM Coordination
  - Updated GW Calibration Locations
- Refine & Update Model Calibration
  - GW Budgets
  - GW Levels
  - Streamflows
  - Interbasin Flows
- Develop Baseline Conditions (Current & Projected)
- Assess Sustainable Yield
- Assess Projects and Management Actions