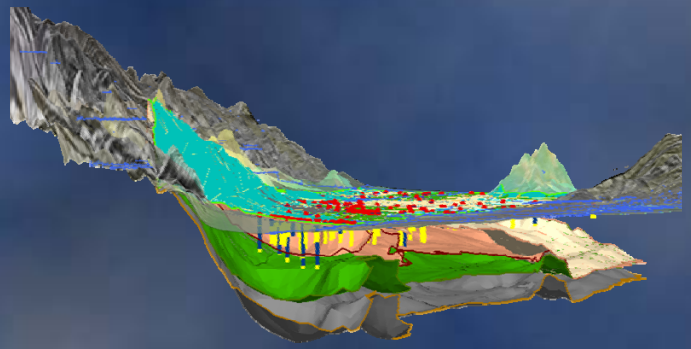
CDM

Butte Basin IWFM Model

Brian J. Heywood, P.E.



California Central Valley Groundwater Modeling Workshop
Berkeley, CA
July 10 - 11, 2008

Co-Authors

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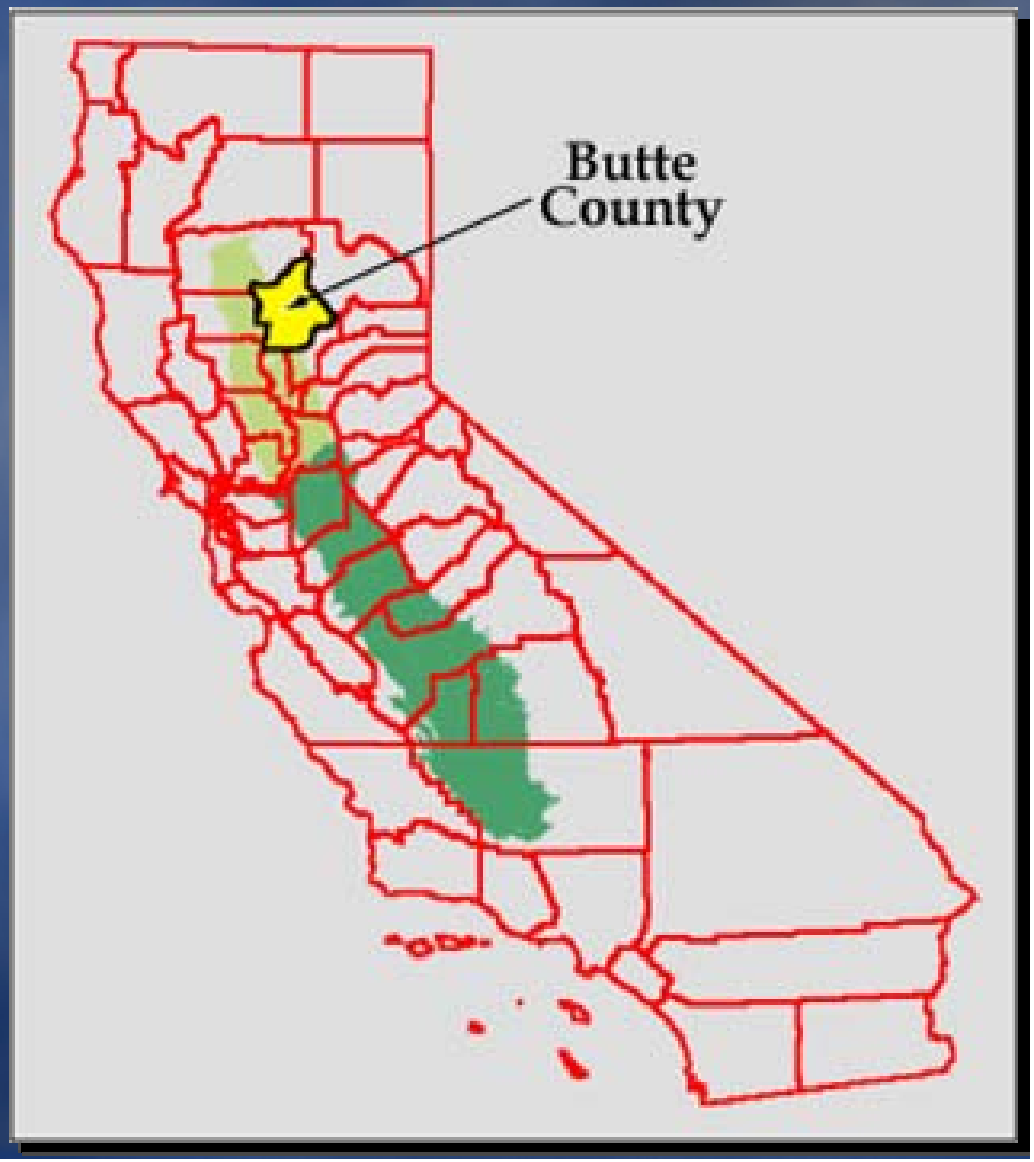
- Karilyn J. Heisen, CDM
- Kristen McKillop, Butte County, CA: Dept. of Water & Resource Conservation

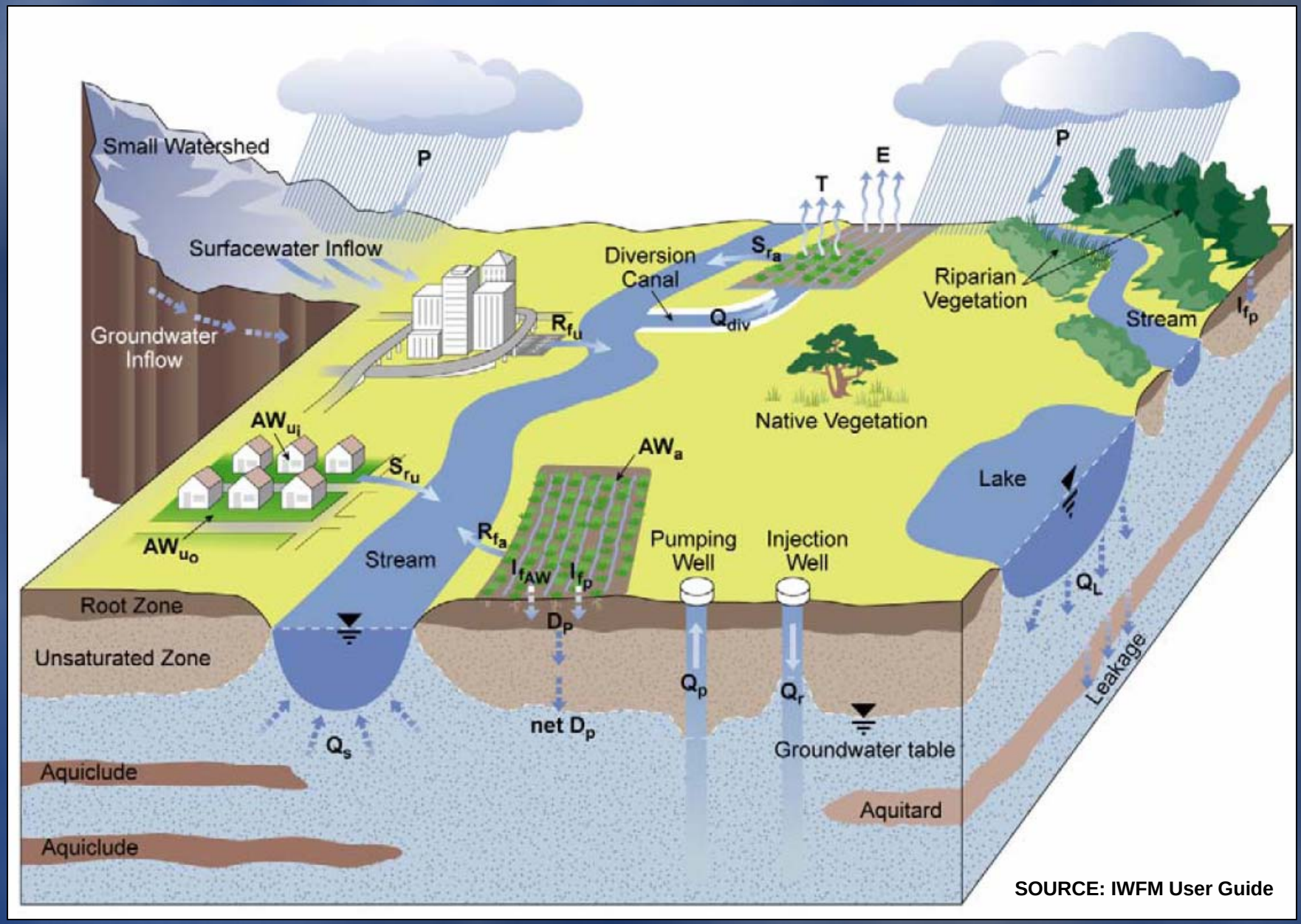
Butte County IWFM Model

- Where?
  - Butte County, CA
  - Agriculture is predominant land use
  - Surface water is primary ag. supply
  - Groundwater and surface water supply municipal / industrial uses



Model Code

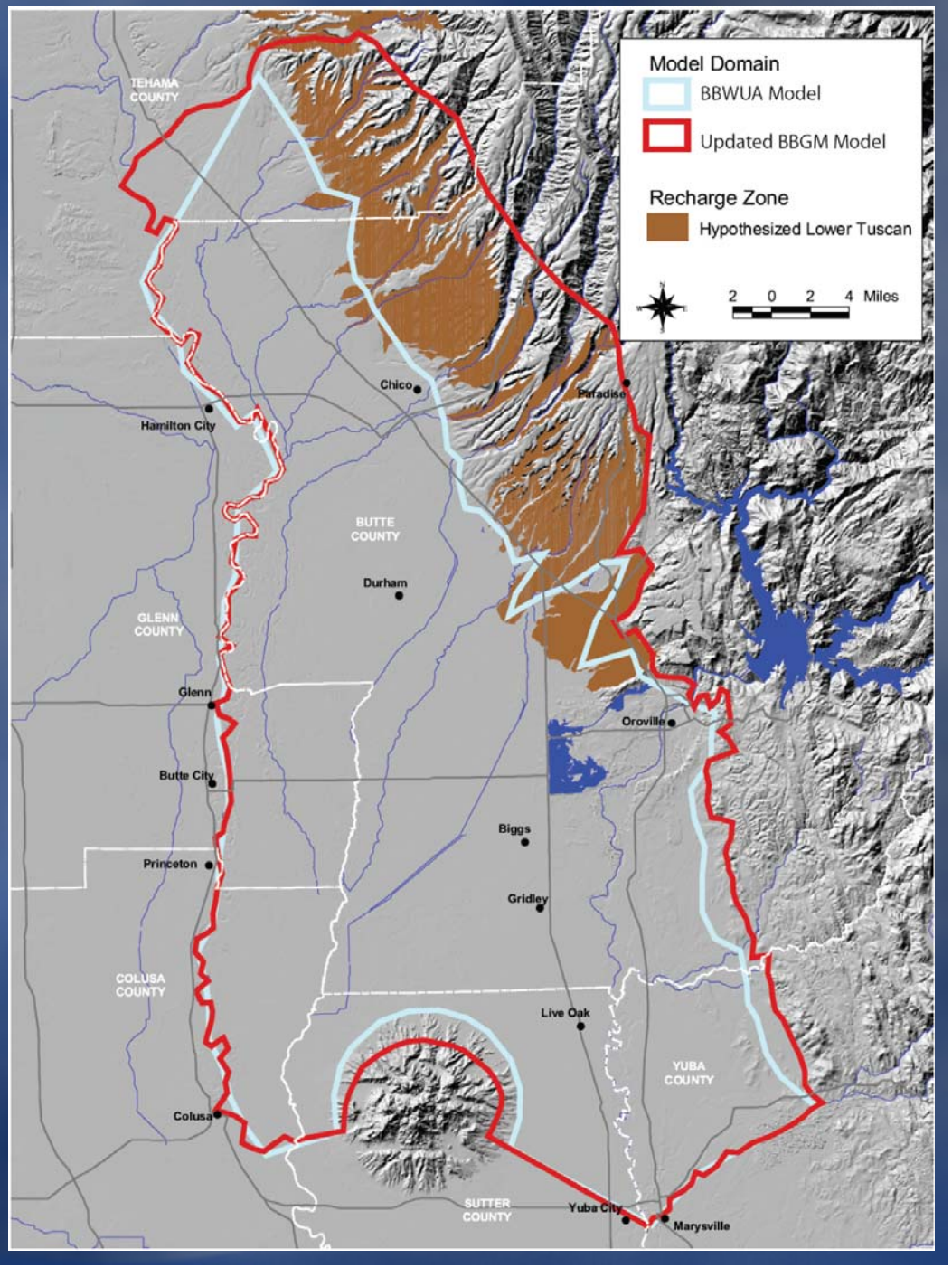
- IWFM – Integrated Water Flow Model
  - California Department of Water Resources
  - Quasi-3D finite element model
  - Simulates
    - Groundwater flow
    - Stream flow
    - Rainfall/runoff process
    - Land use
    - Agricultural crop demand
    - Unsaturated zone flow



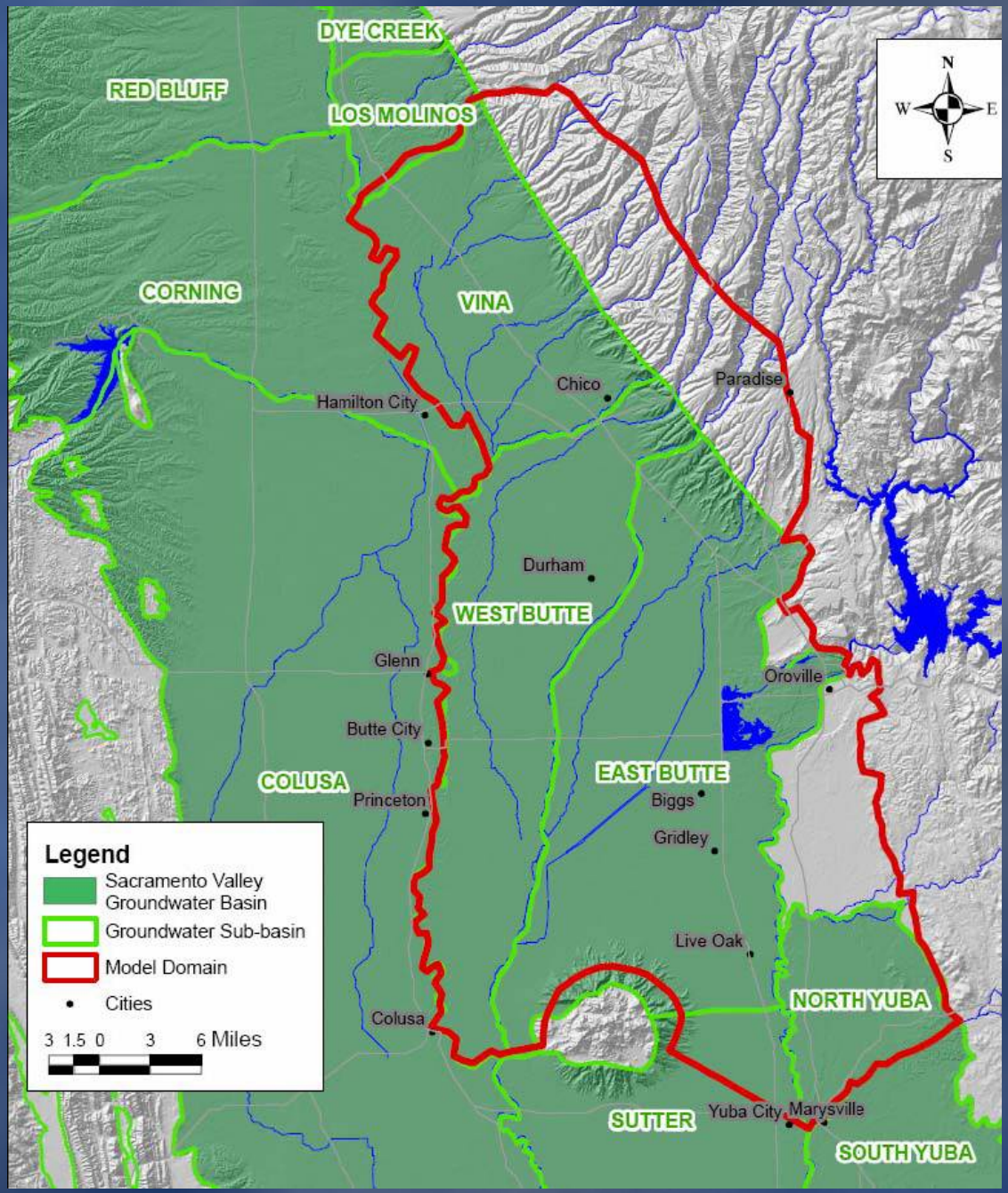
SOURCE: IWFM User Guide

Model Domain

- River Boundaries
  - Sacramento River
  - Yuba River
  - Deer Creek
- Expanded to Include Lower Tuscan Recharge Zone

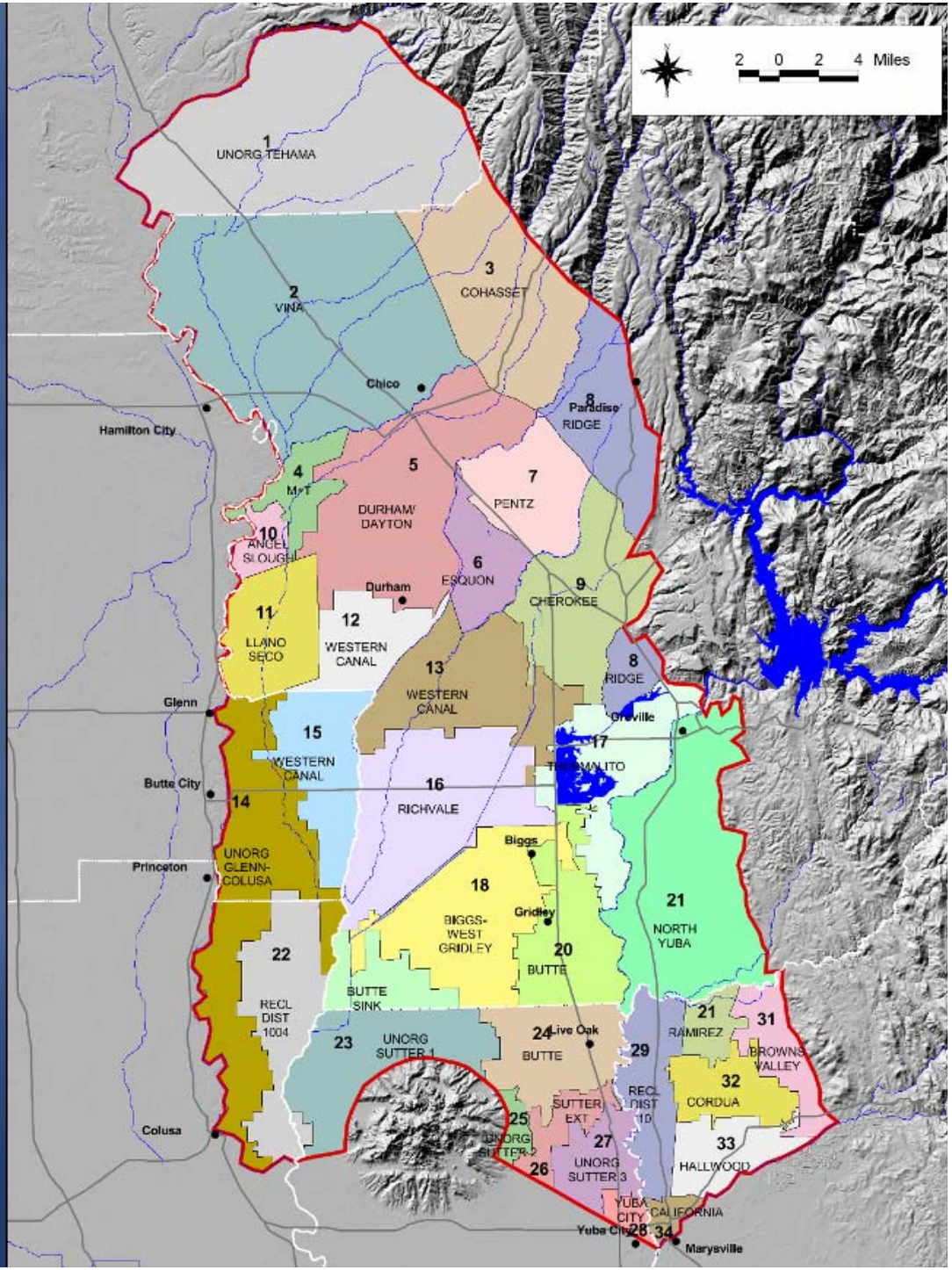


Groundwater Basins

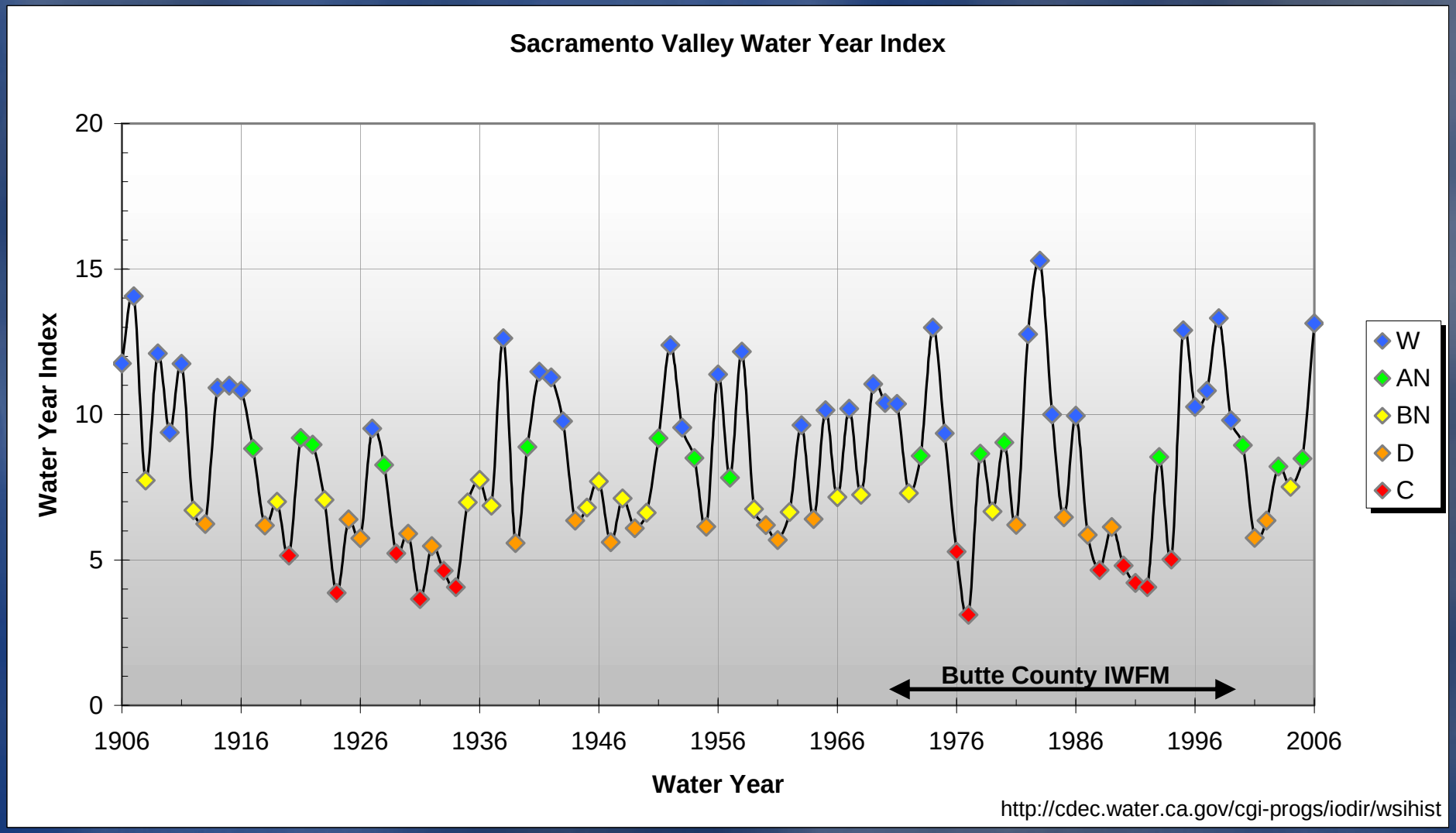


Subregions

- 35 subregions

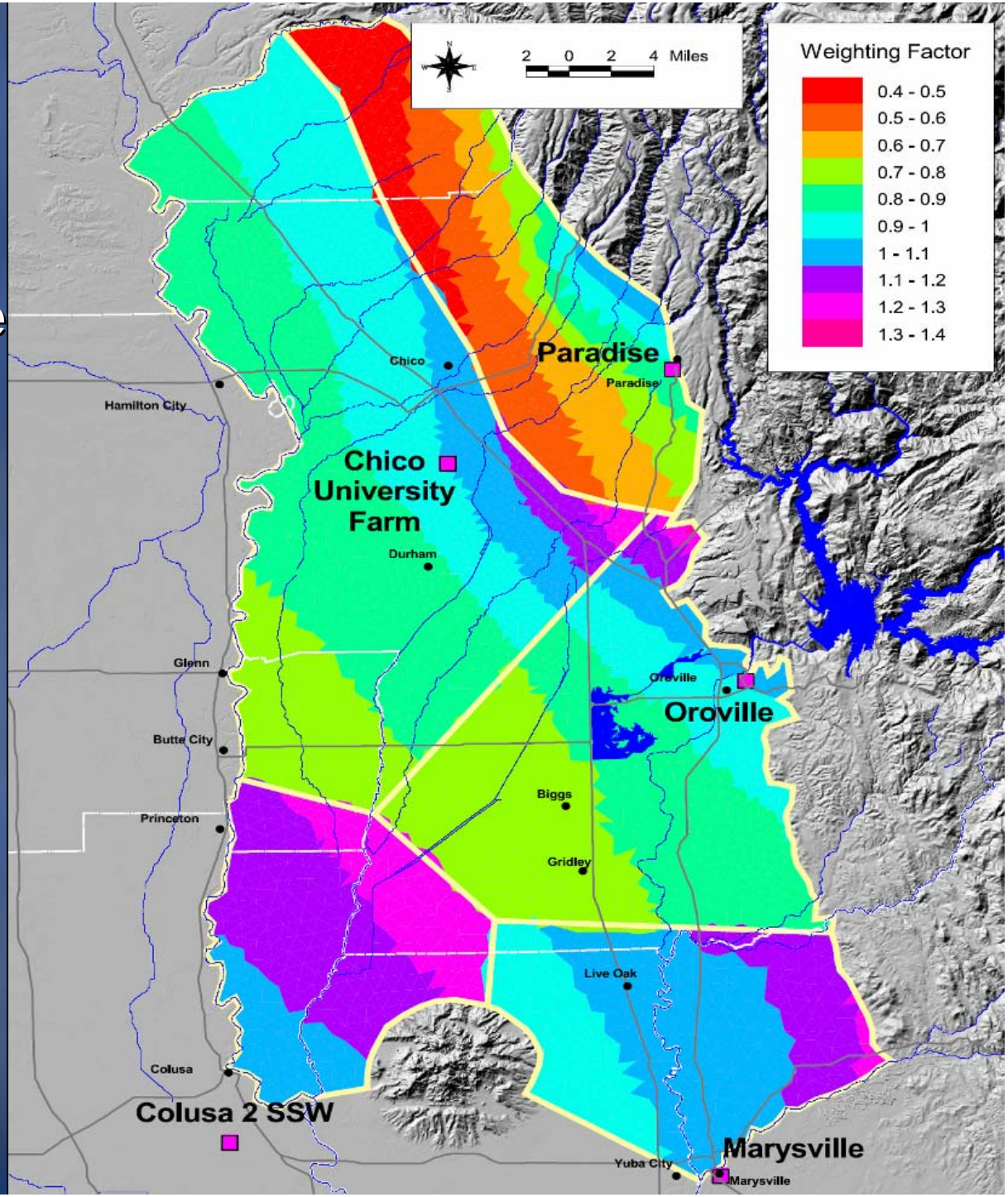


Simulation Time Period



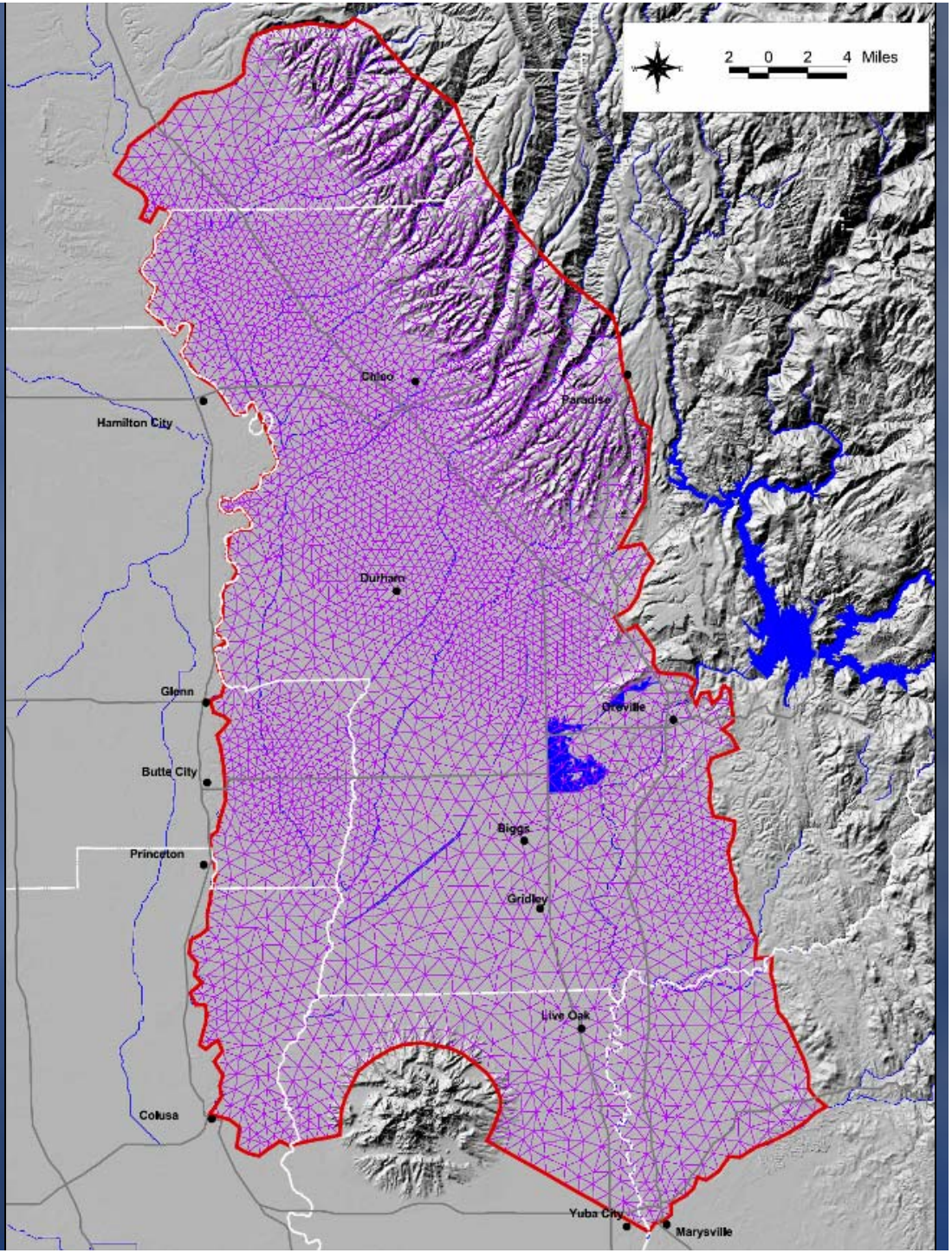
Historic Precipitation

- Model uses five gages
  - Paradise
  - Chico
  - Oroville
  - Colusa
  - Marysville



Model Grid

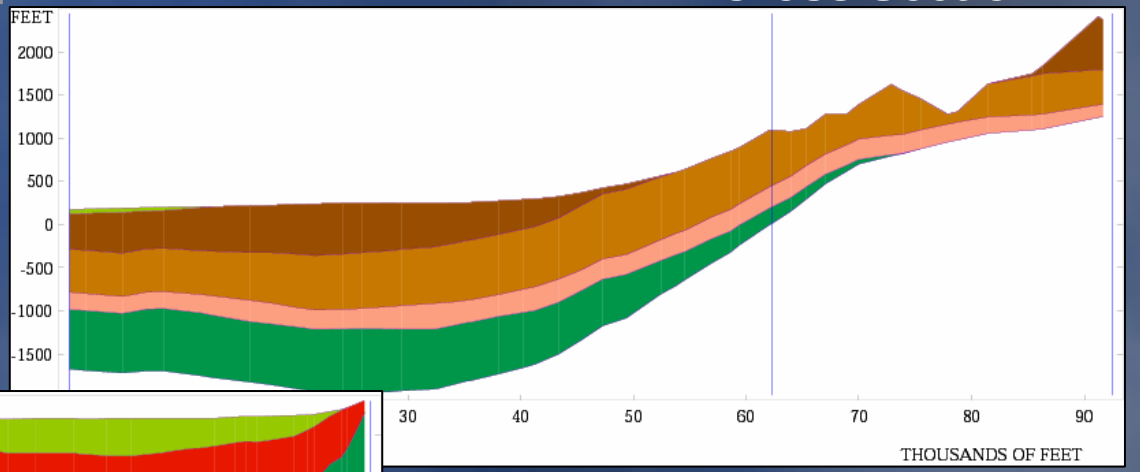
- 7,216 elements
- 3,770 nodes



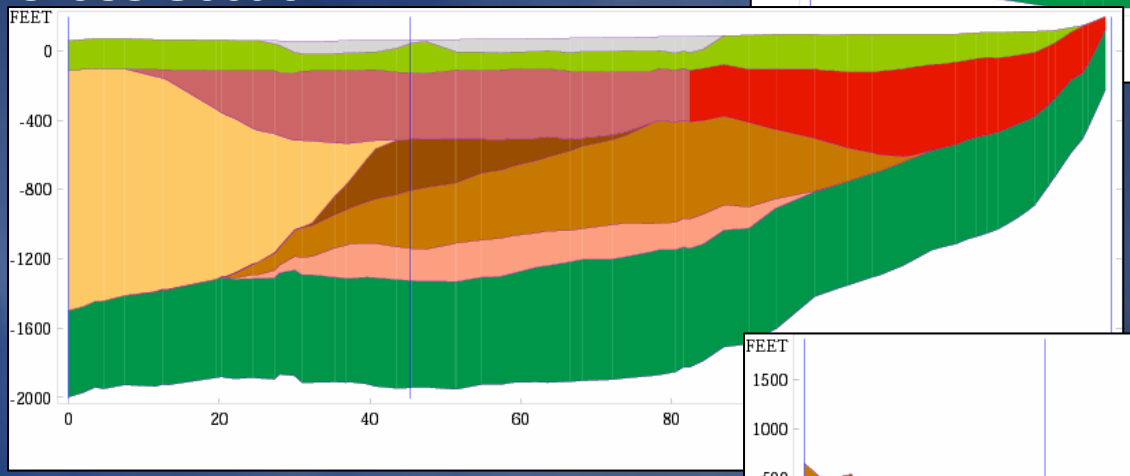
Subsurface Representation

Sections plotted from model.

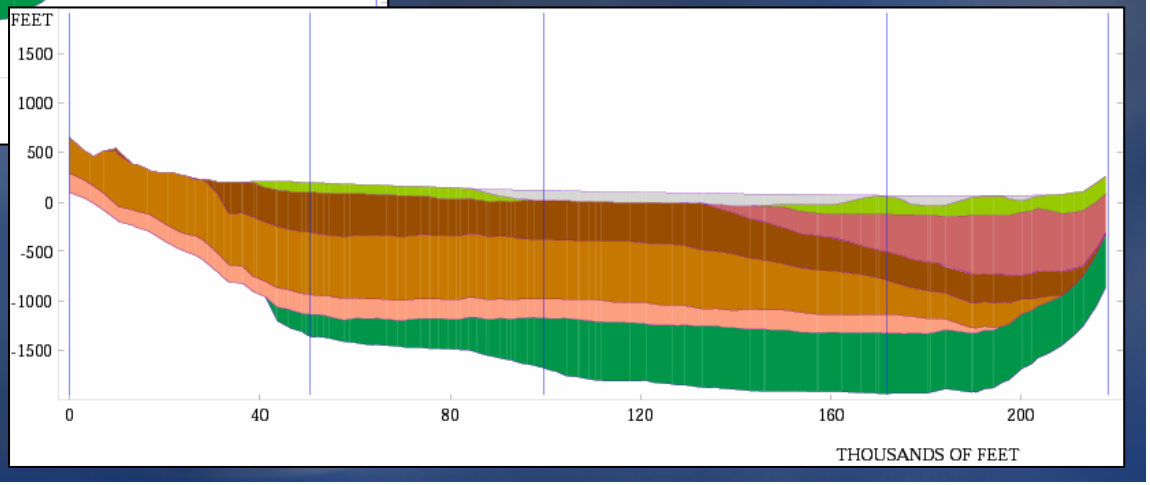
Cross Section A

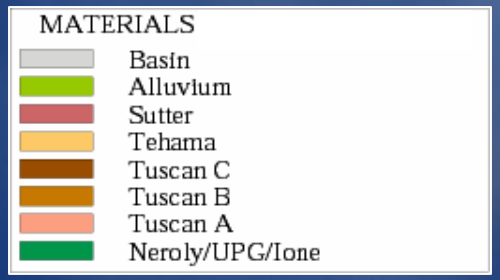


Cross Section D



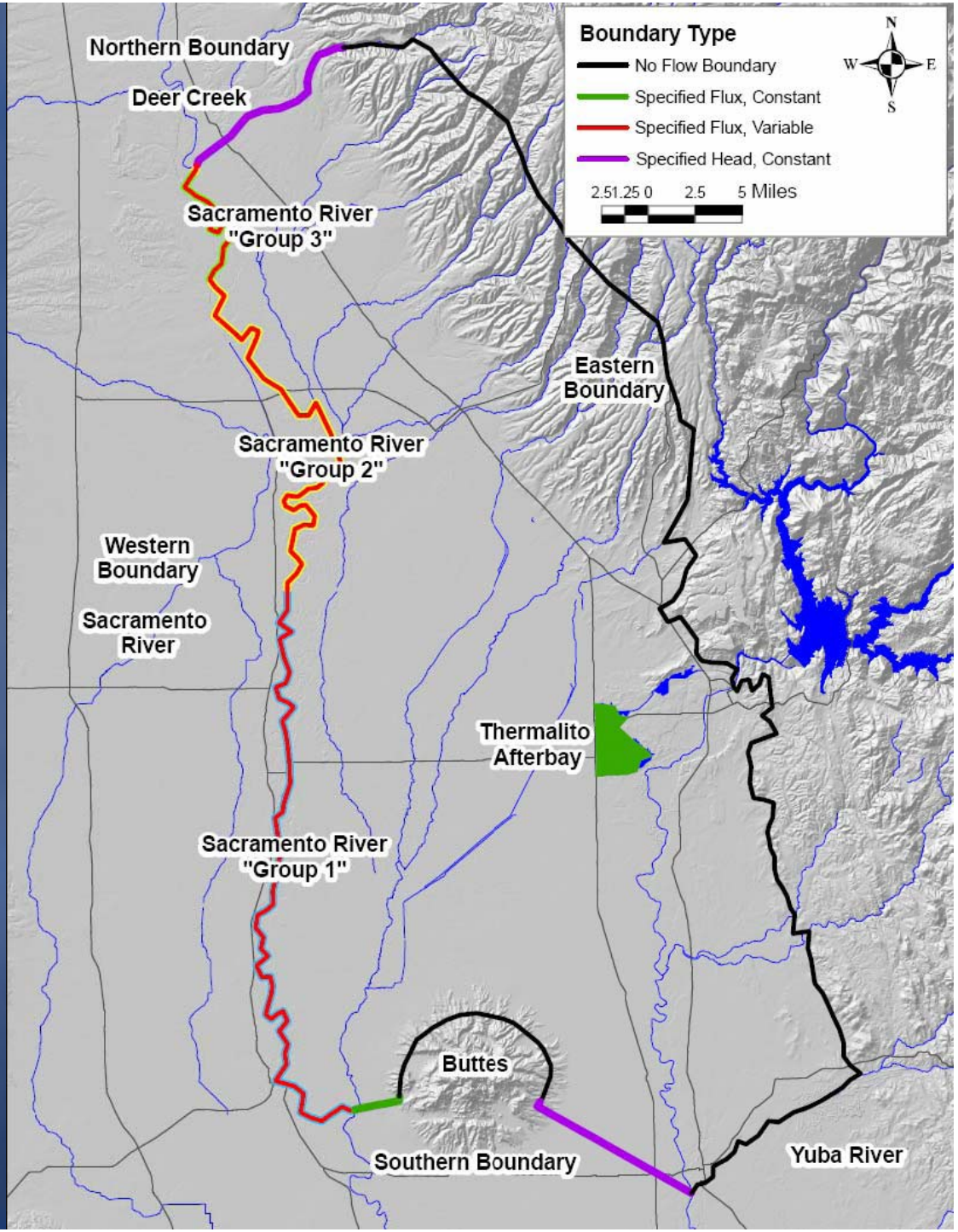
Cross Section E





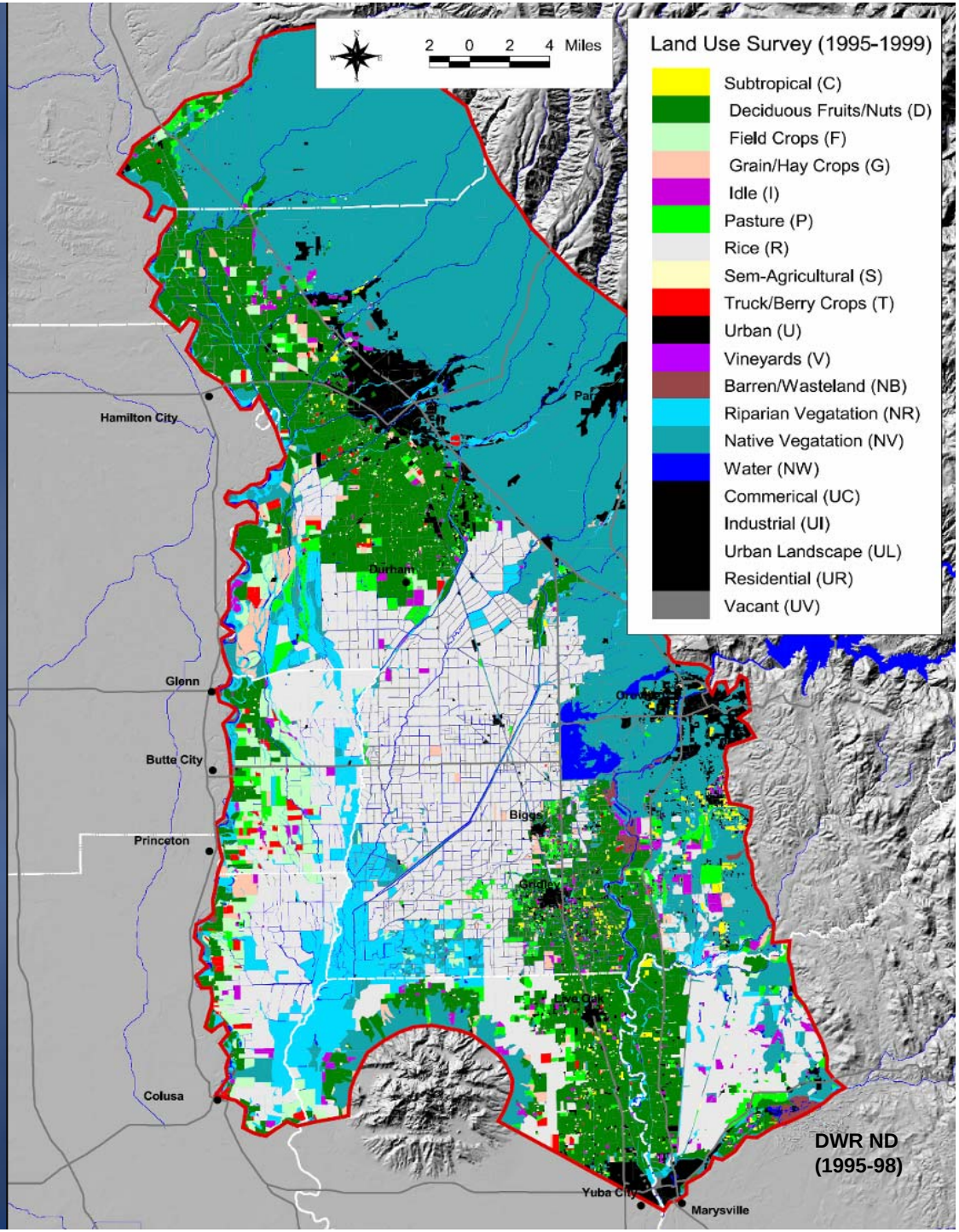
Boundary Conditions

- No Flow
- Specified Flux
  - Constant
  - Variable
- Specified Head
  - Constant



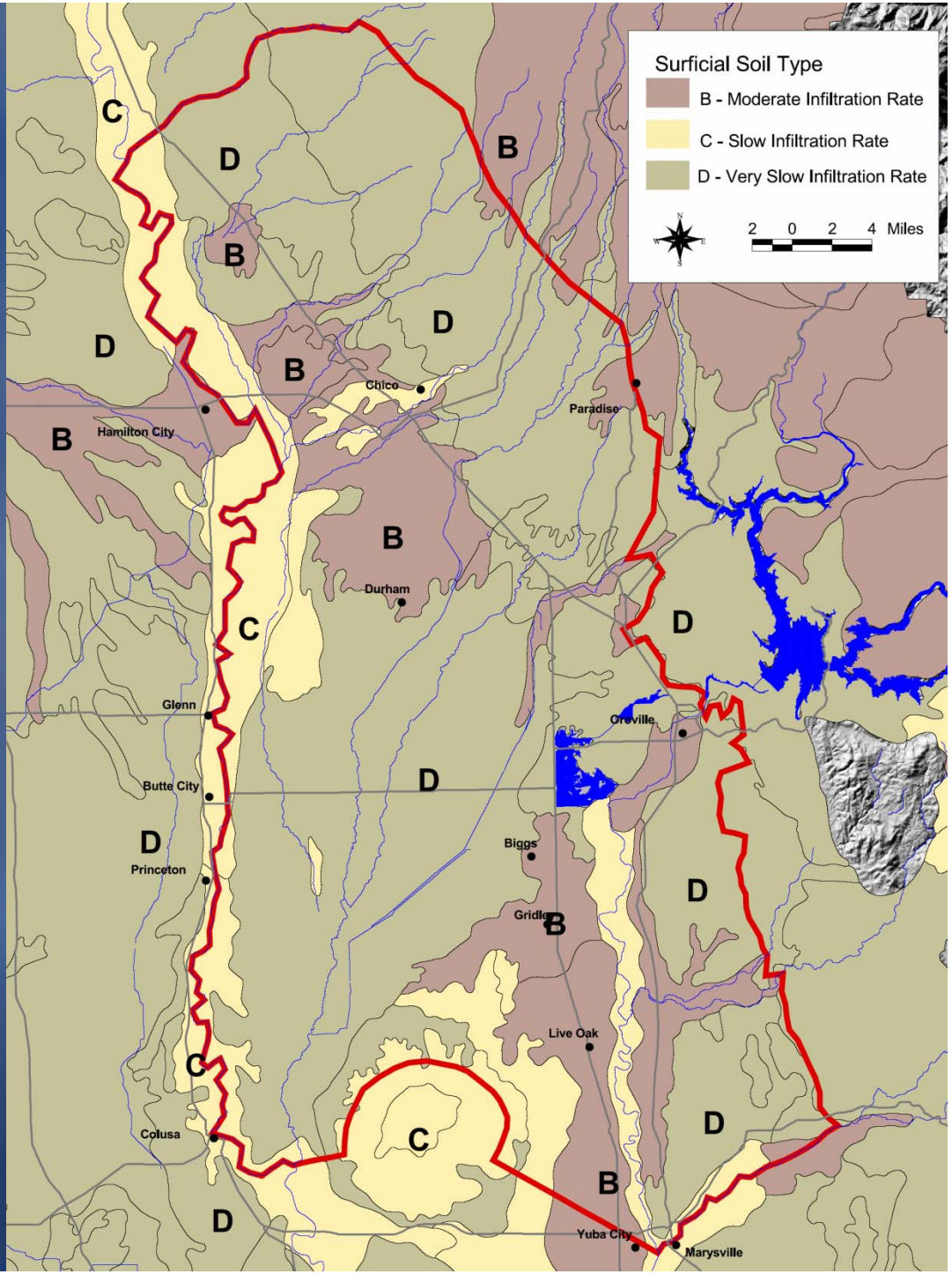
Land Use

- Agricultural
- Urban
- Native
- Riparian



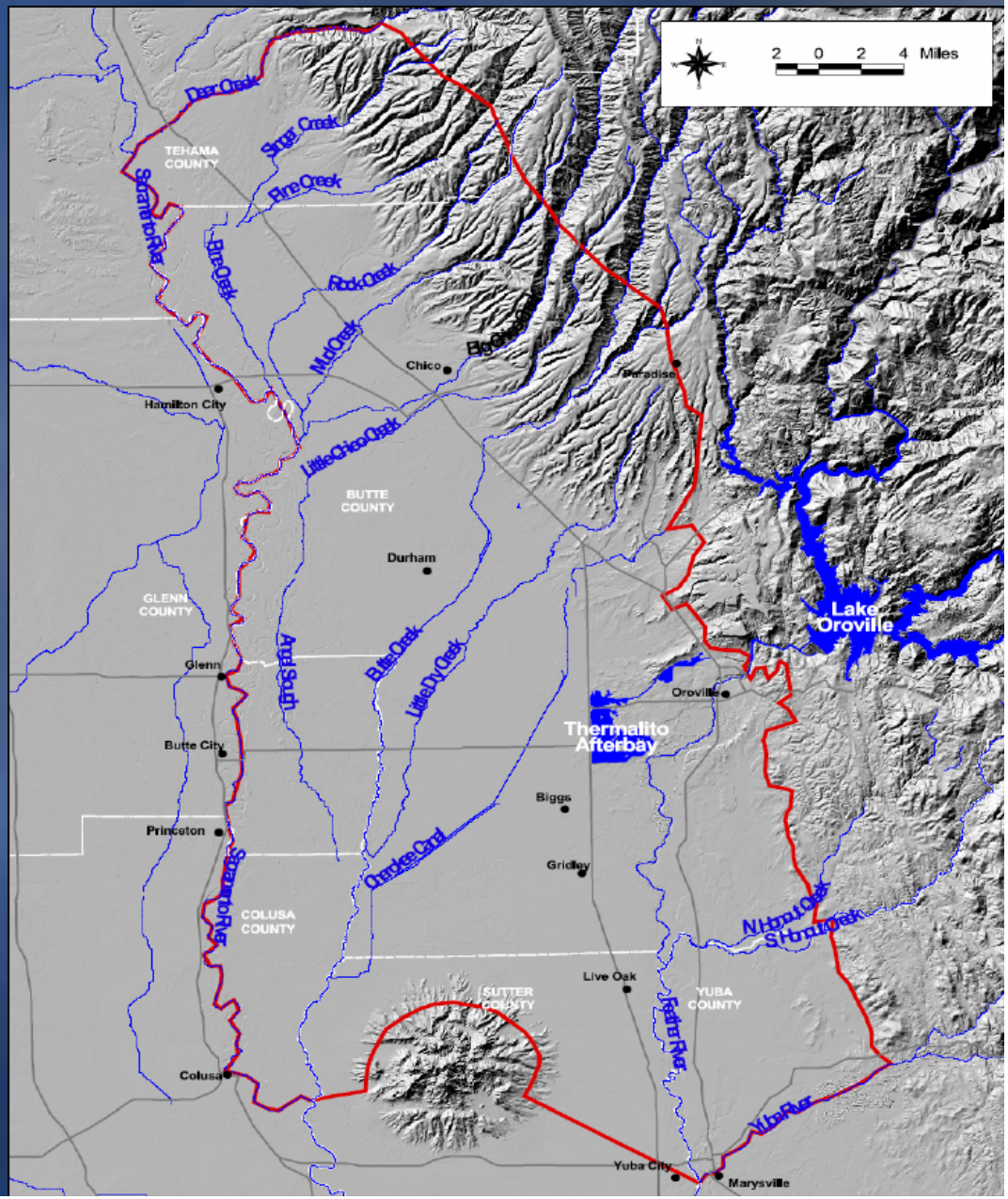
Soil Data

- State Soil Geographic (STATSGO) Data
  - USDA
  - NRCS
  - National Soil Survey Center
  - Miscellaneous Publication Number 1492
- Each element assigned soil value

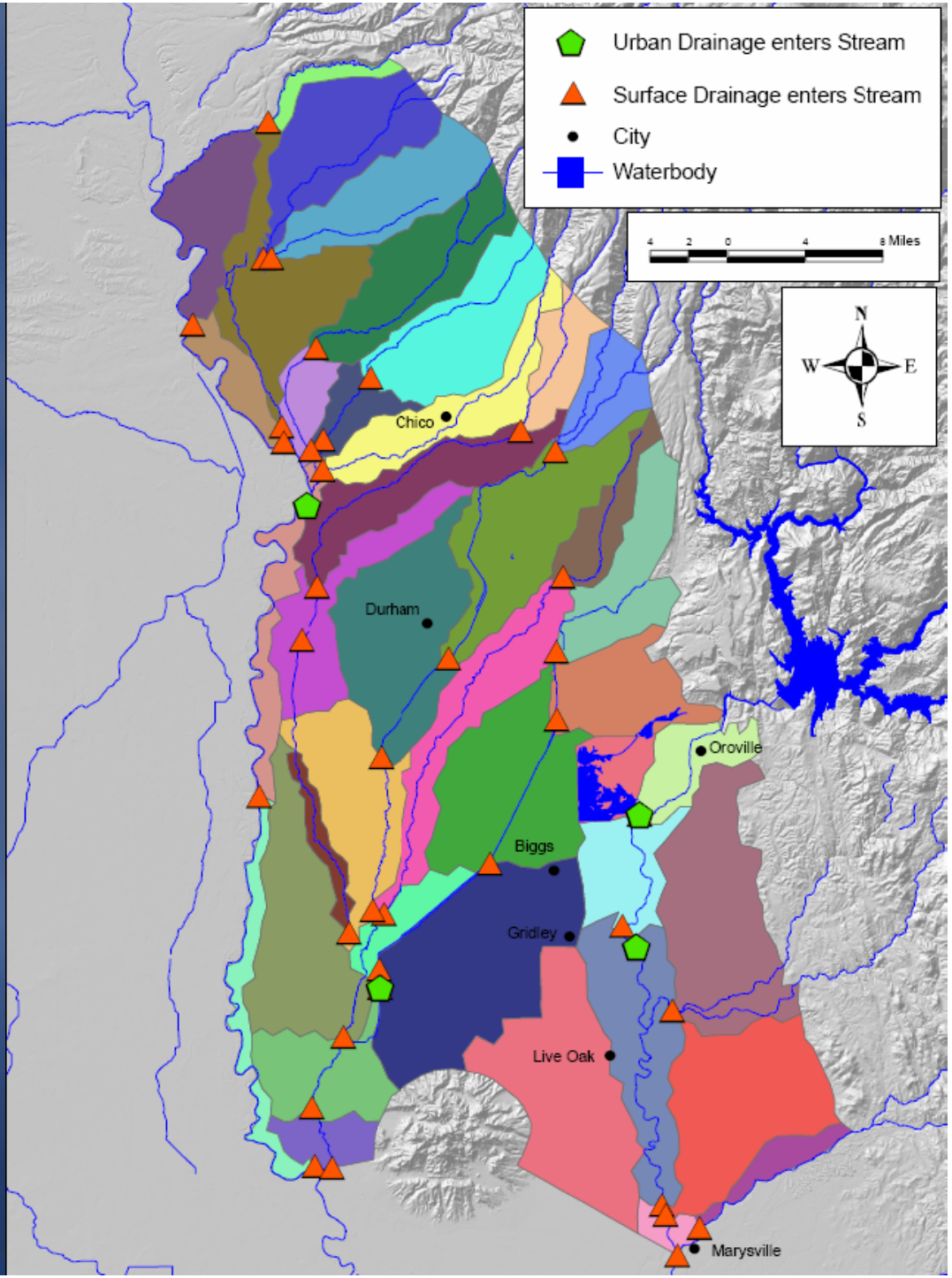


Surface Water

- 25 Reaches
- 744 river nodes

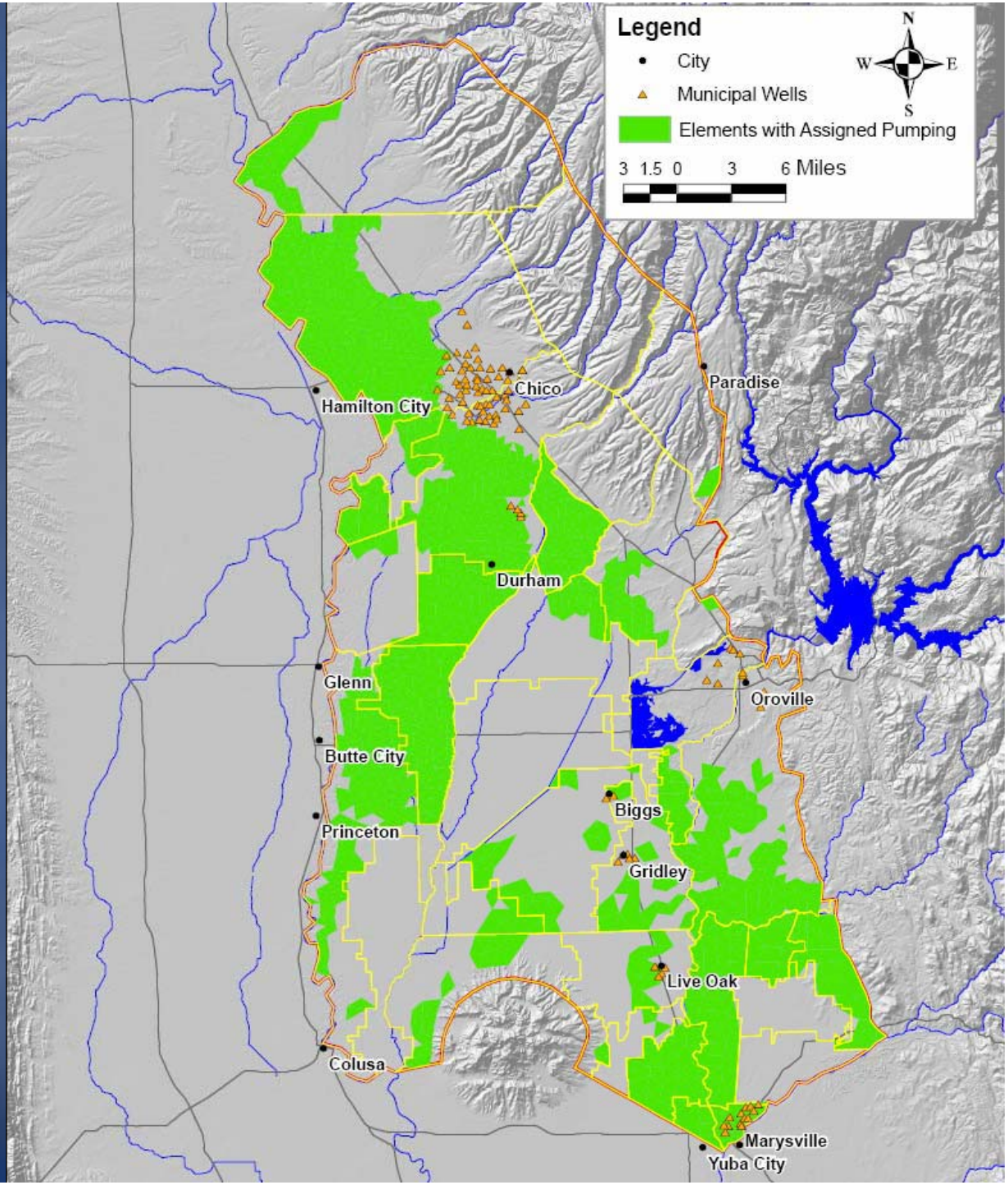


Surface Runoff

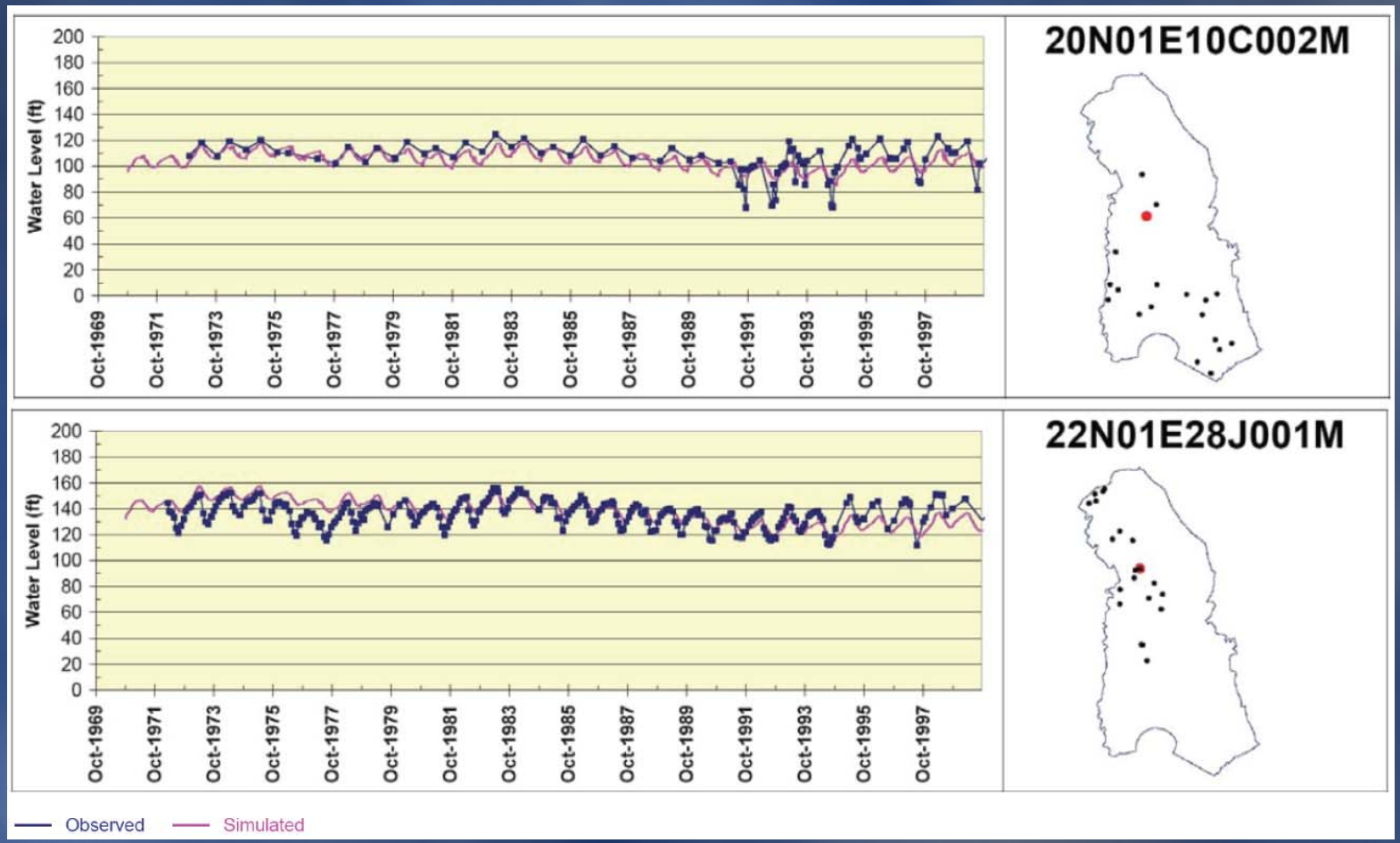


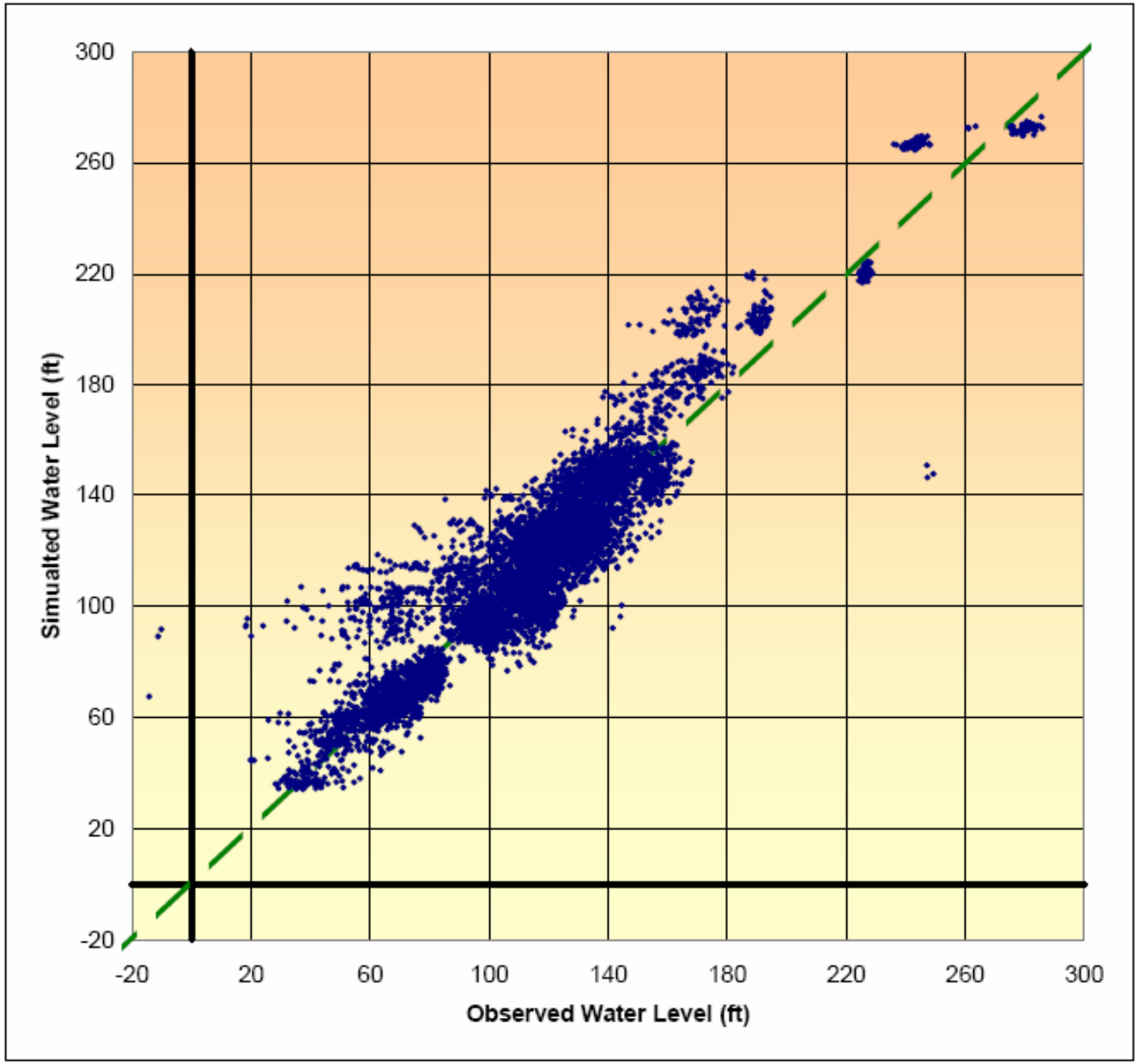
Groundwater Pumping

- Agricultural
- Urban



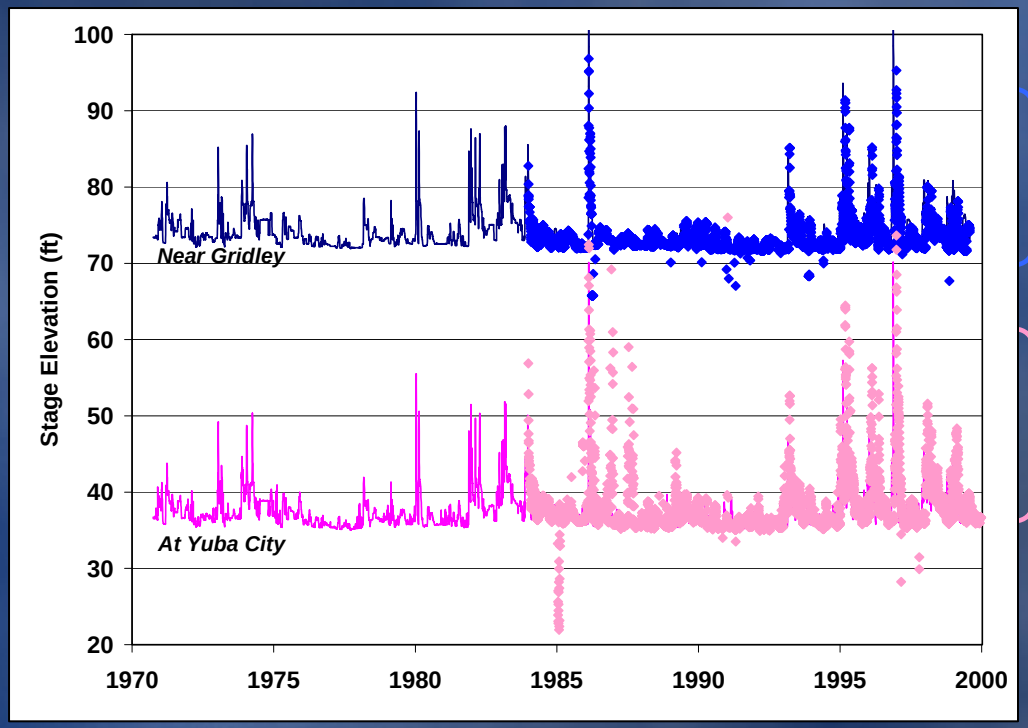
Model Calibration - Groundwater

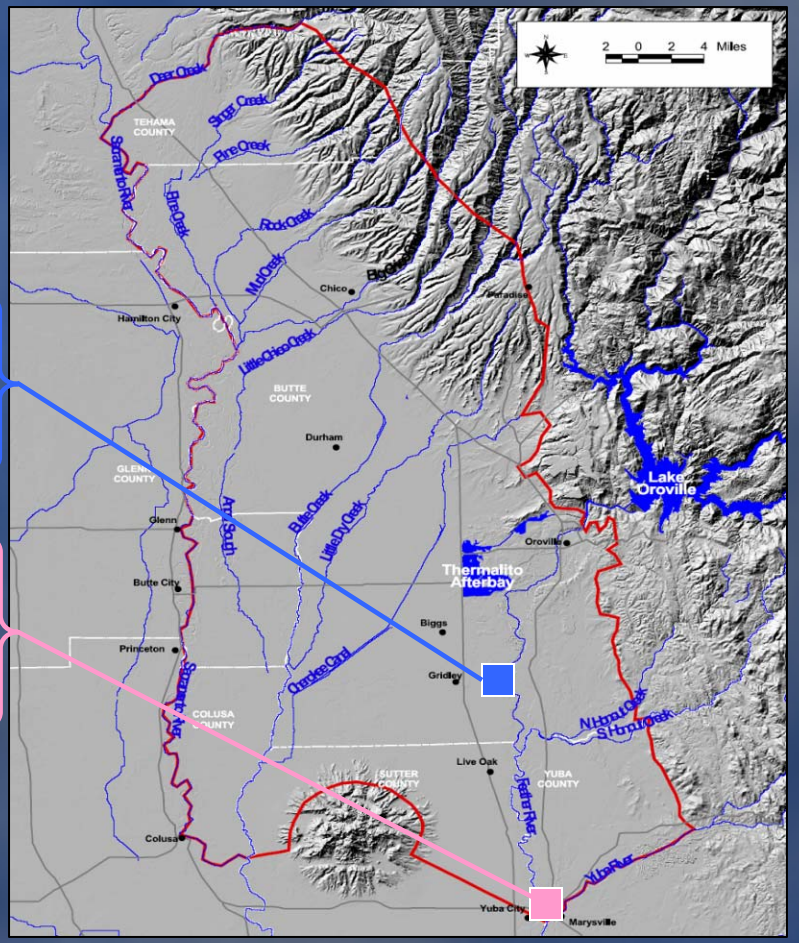



300
260
220
180
140
100
60
20
-20
Simualted Water Level (ft)
-20
20
60
100
140
180
220
260
300
Observed Water Level (ft)

Model Calibration – Surface Water

Feather River

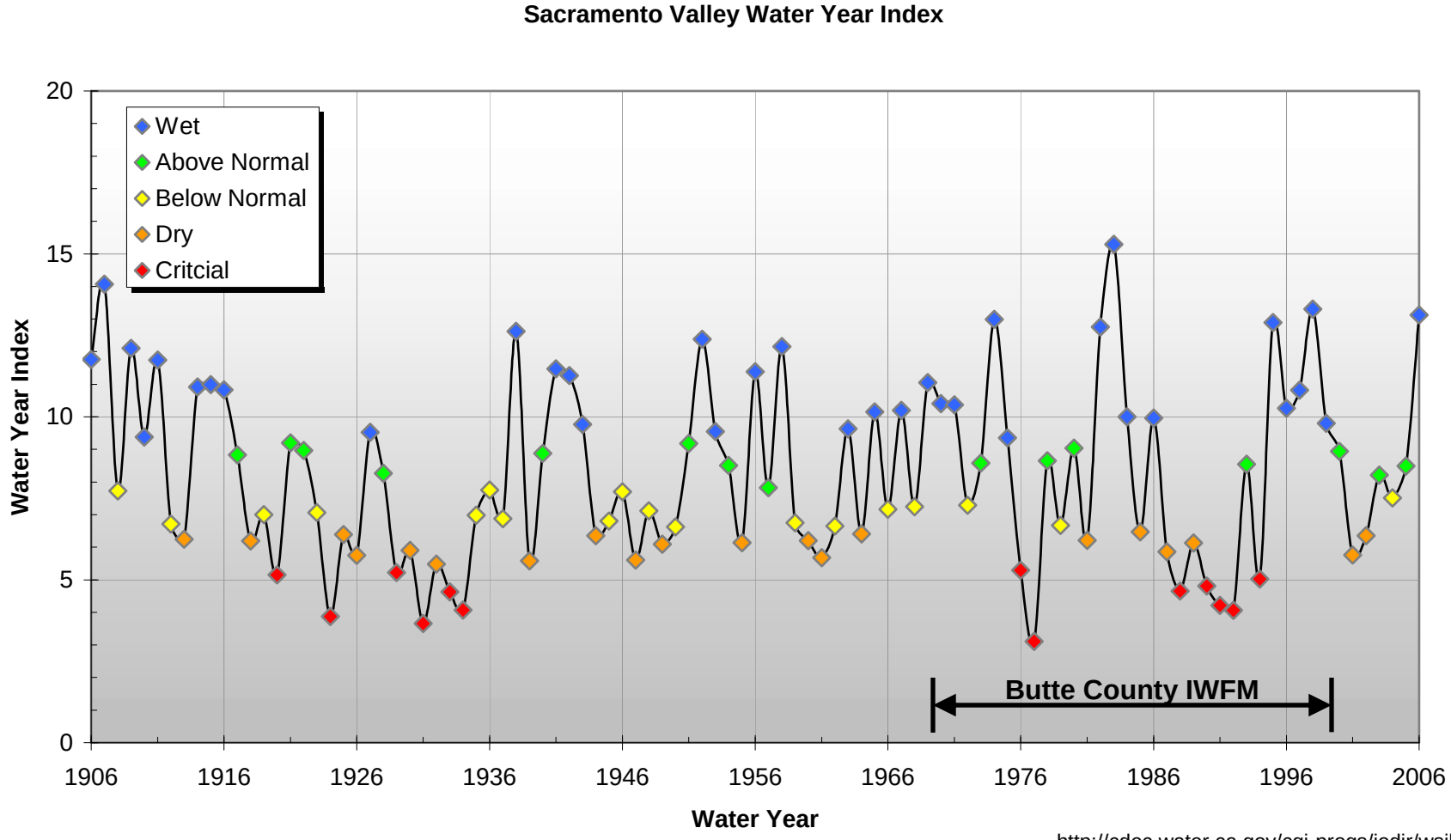




Base Case Development

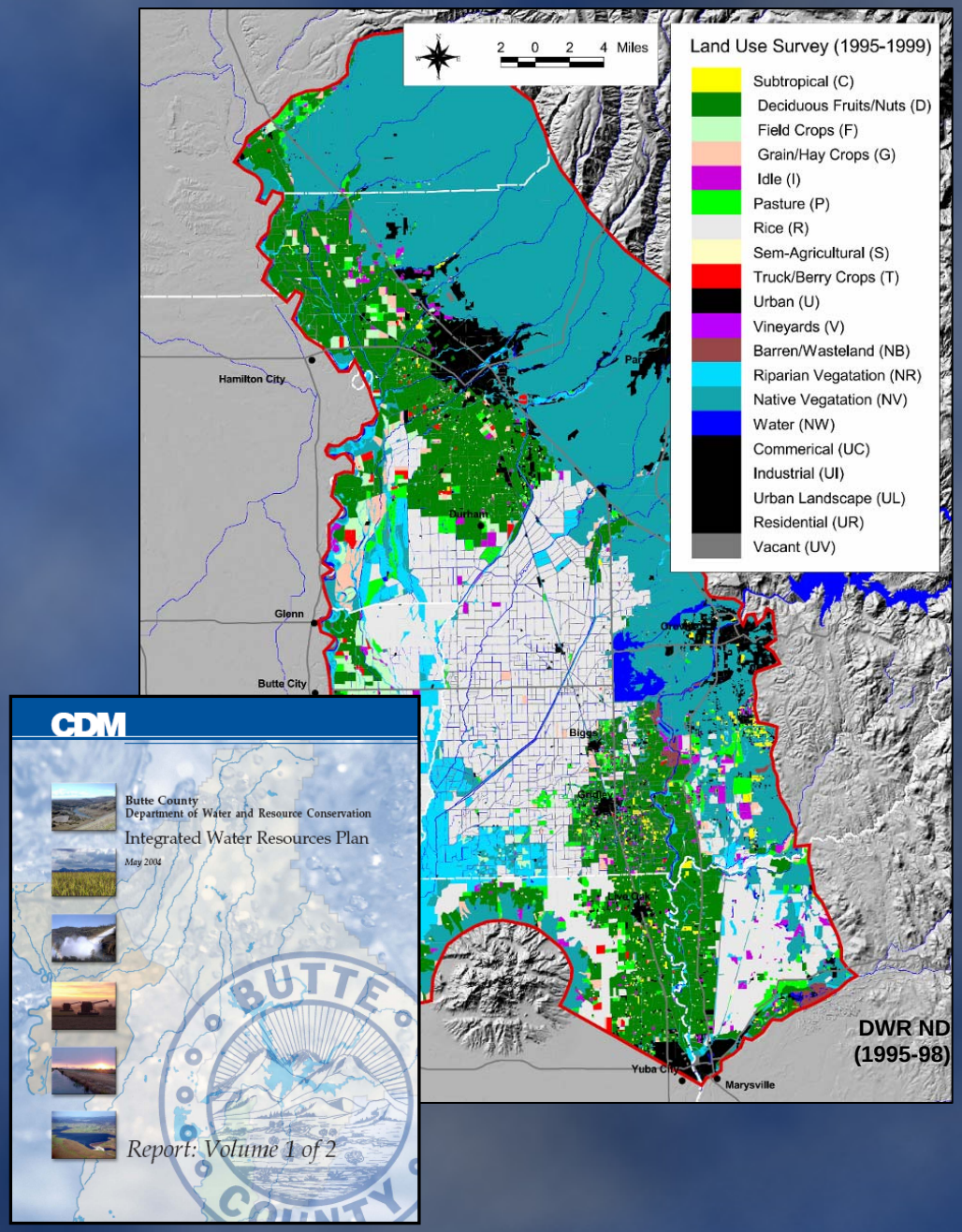
- Simulation period (1970 – 1999)
- Input data requirements
  - Precipitation
  - Stream flow
  - Land use
  - Agricultural diversions

Base Case – Simulation Period



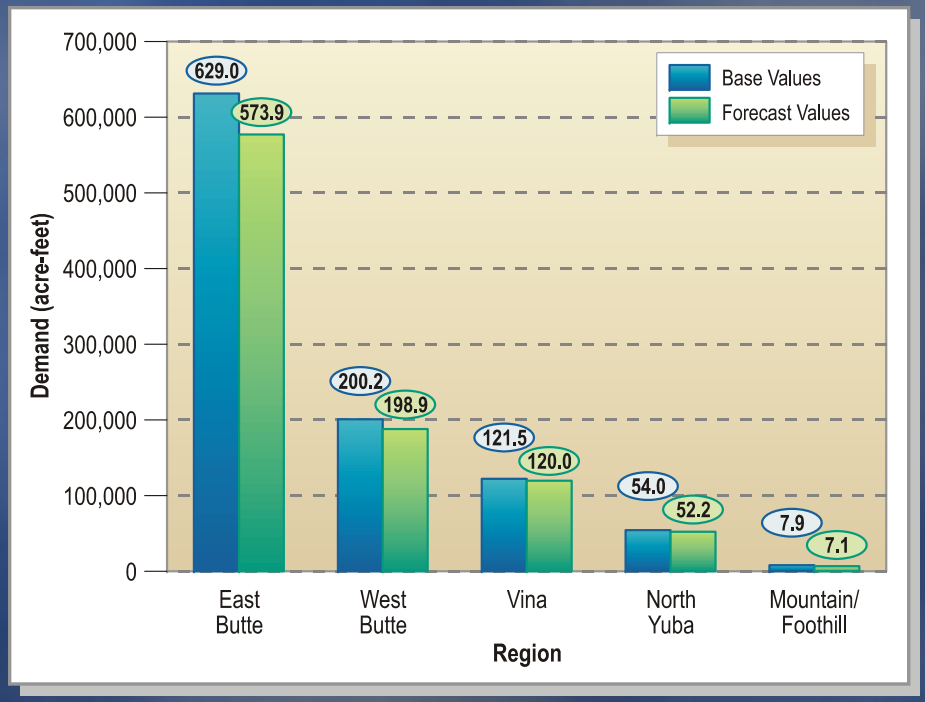
Land Use Data

- Hold land use constant year 2030
  - Urban
  - Agricultural
- Land use was projected in Butte County 2004 IWRP



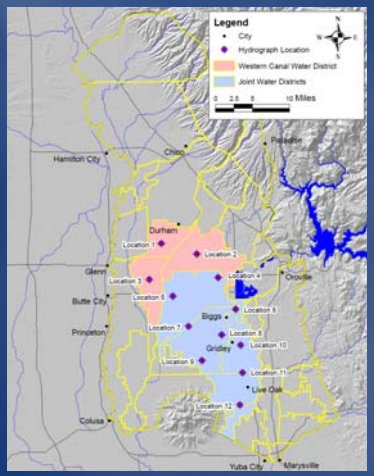
IWRP 2030 Ag Demand Forecast

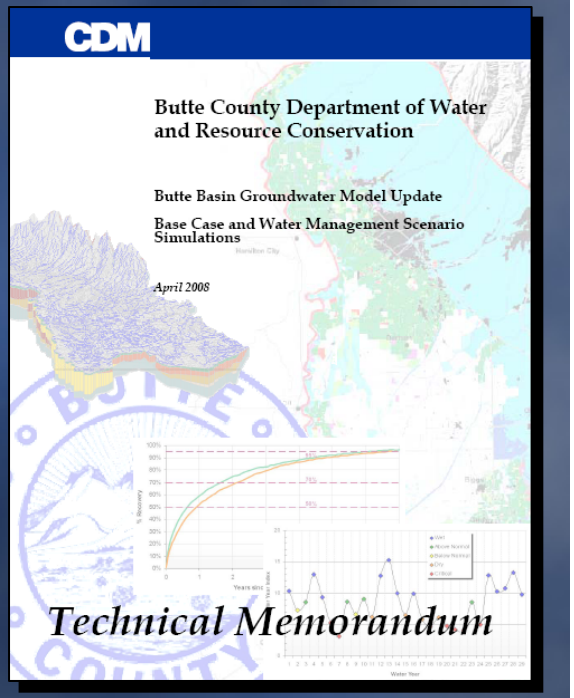
- Decrease irrigated land: 3% in Vina and West Butte
- Decrease irrigated land: 1% in East Butte
- Decrease surface water delivery: 10%
- Set target irrigation efficiencies for each crop



Water Management Scenario

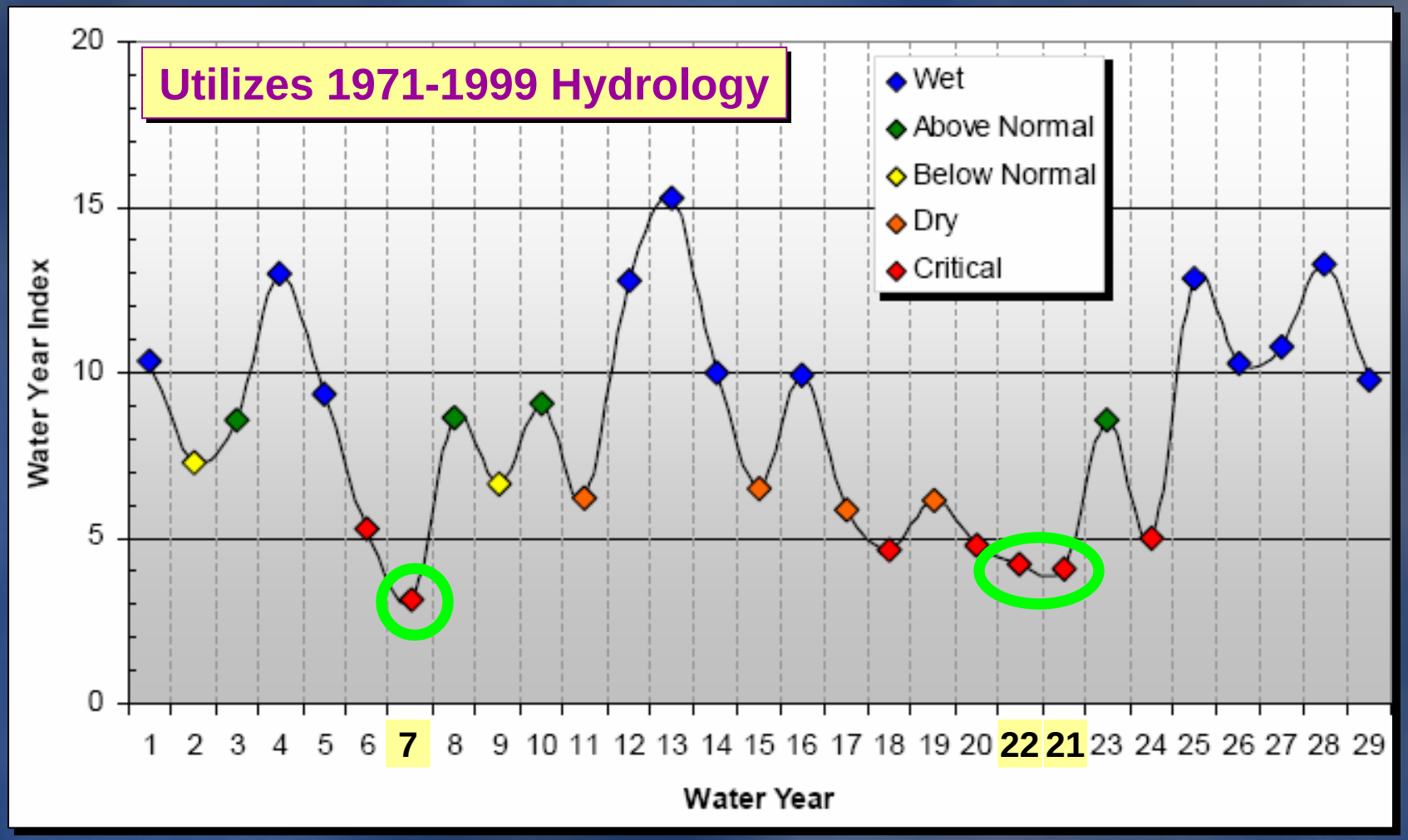
- Cutback of SWP Deliveries
  - Western Canal Water District
  - Joint Water Districts
  - Maximum 50% in any individual year
  - Maximum cumulative 100% within 7 years





DWR has exercised this option historically twice (both with a maximum 50% cutback).

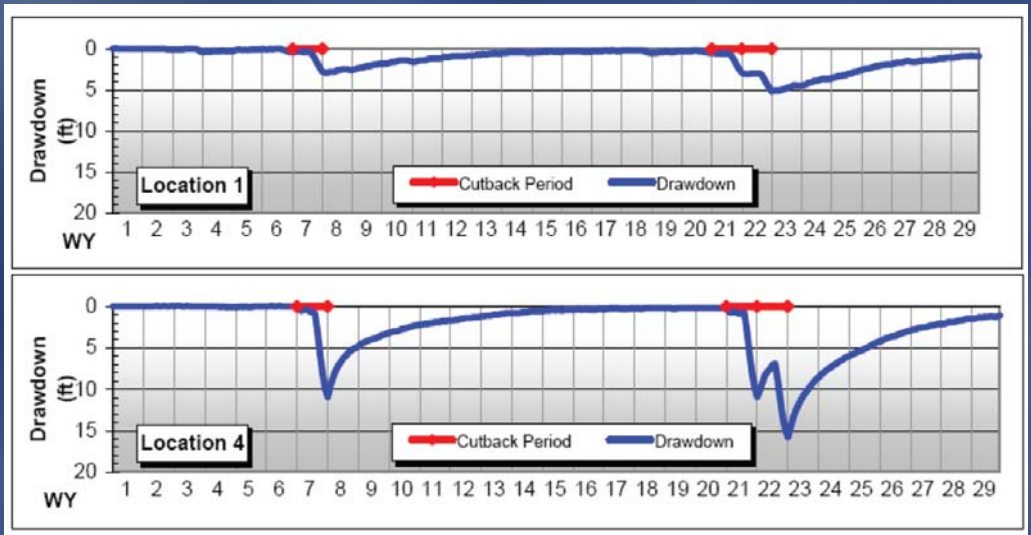
Water Management Scenario



Water and Land Use in Scenario

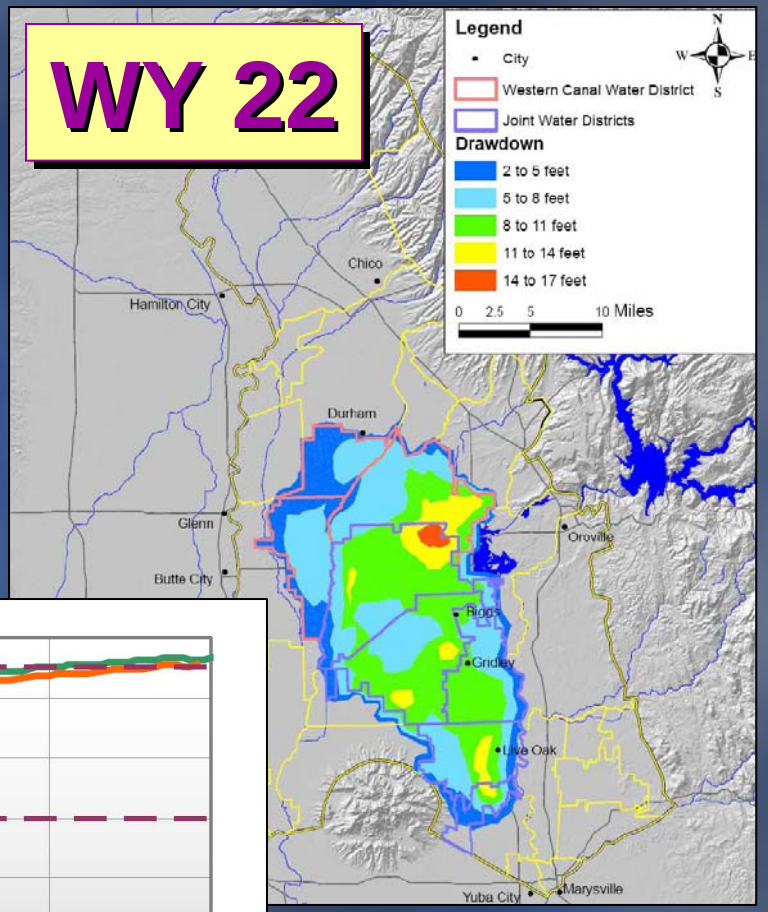
Allocation of Cutback Quantity	WCWD	JWD
Additional Groundwater Pumping (60% of Cutback)	39 TAF	115 TAF
Fallowed Land in lieu of Water Supply (40% of Cutback)	26 TAF	76 TAF

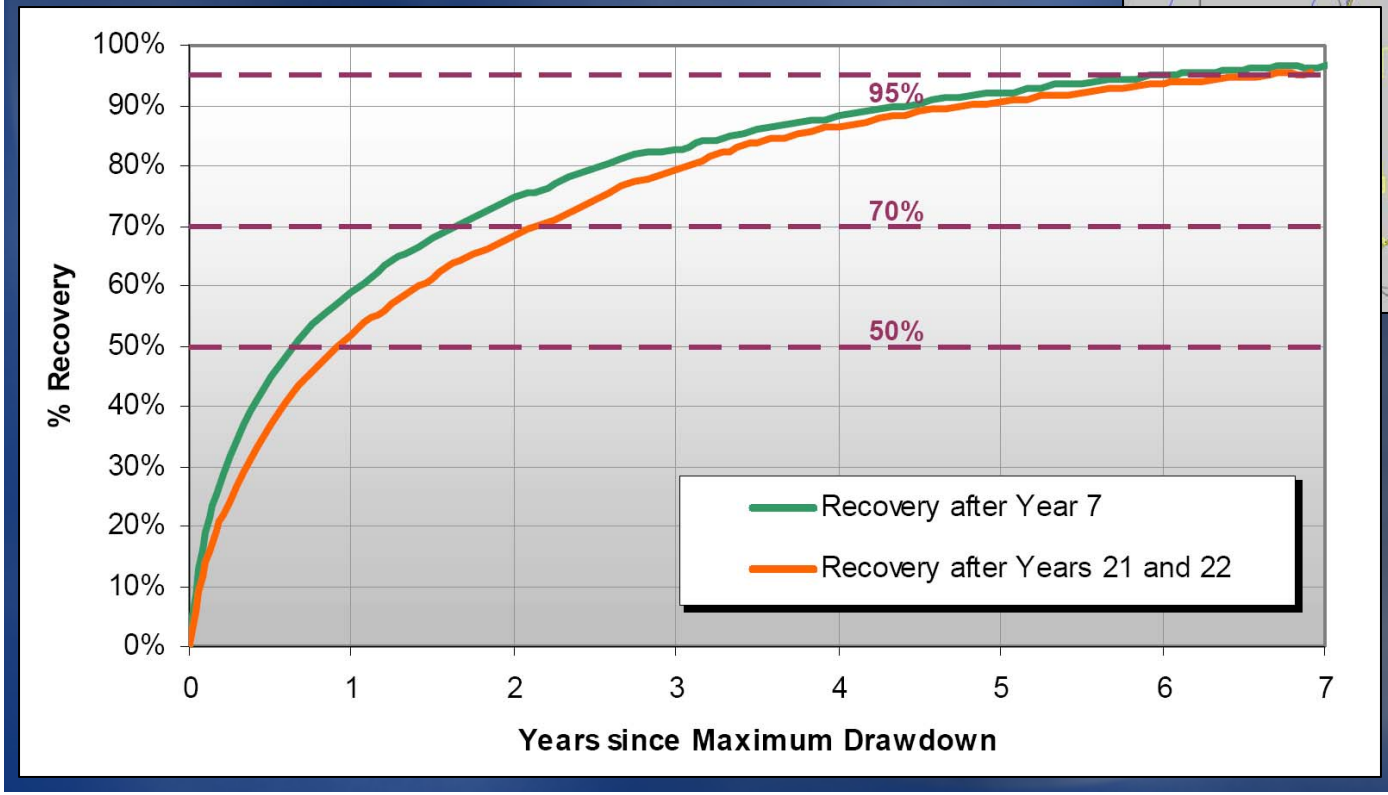
Water Level Drawdown



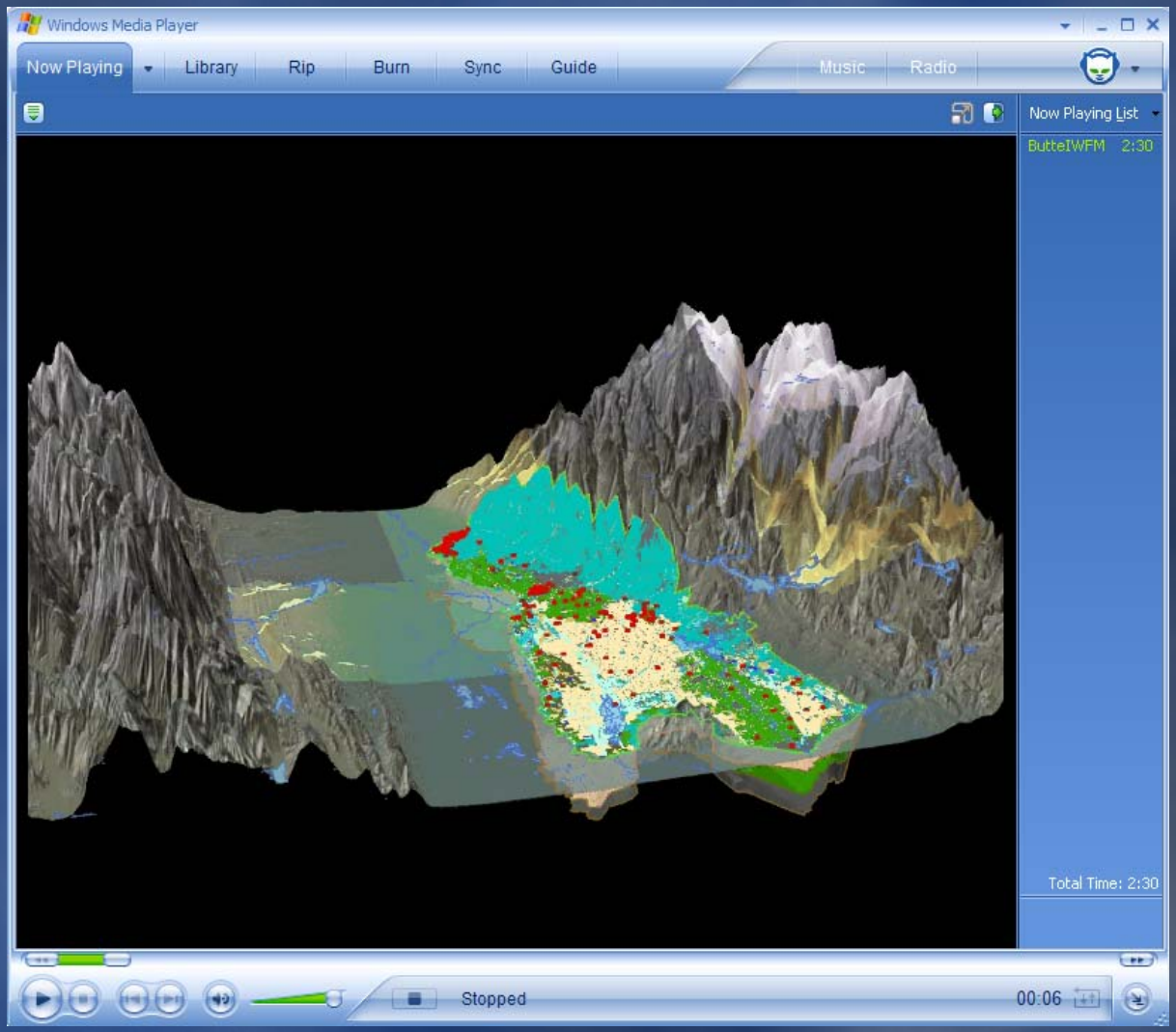
Cutback Year	Average Drawdown (feet)	Maximum Drawdown (feet)
WY 7	4.1	11.2
WY 21	4.2	11.2
WY 22	7.0	15.5

Simulated Drawdown and Recovery





Animation



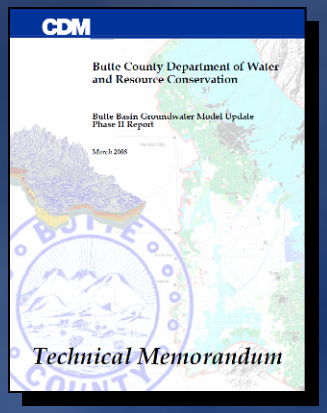
Animations include:

- Terrain
- Rivers
- Land use
- Stratigraphy
- Wells

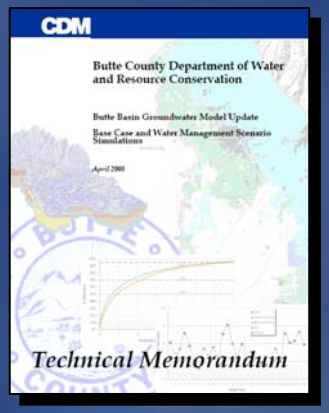
Summary

- Model calibration complete
- Base case developed
  - 2030 level of development
- Water management scenario
  - SWP cutback to WCWD and JWD

Documentation



Butte Basin Groundwater Model Update: Phase II Report
CDM
Spring 2008



Butte Basin Groundwater Model Update: Base Case and Water Management Scenario Simulations
CDM
Spring 2008

Acknowledgements

- Butte County Department of Water & Resource Conservation
- USBR Northern Area Office
- BBWUA; HCI Consultants
- CA DWR Northern District
- CA DWR Bay-Delta Office: Modeling Support Branch

Questions?

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