Butte County Water Inventory and Analysis Proposed Methodologies

Butte County Water Commission

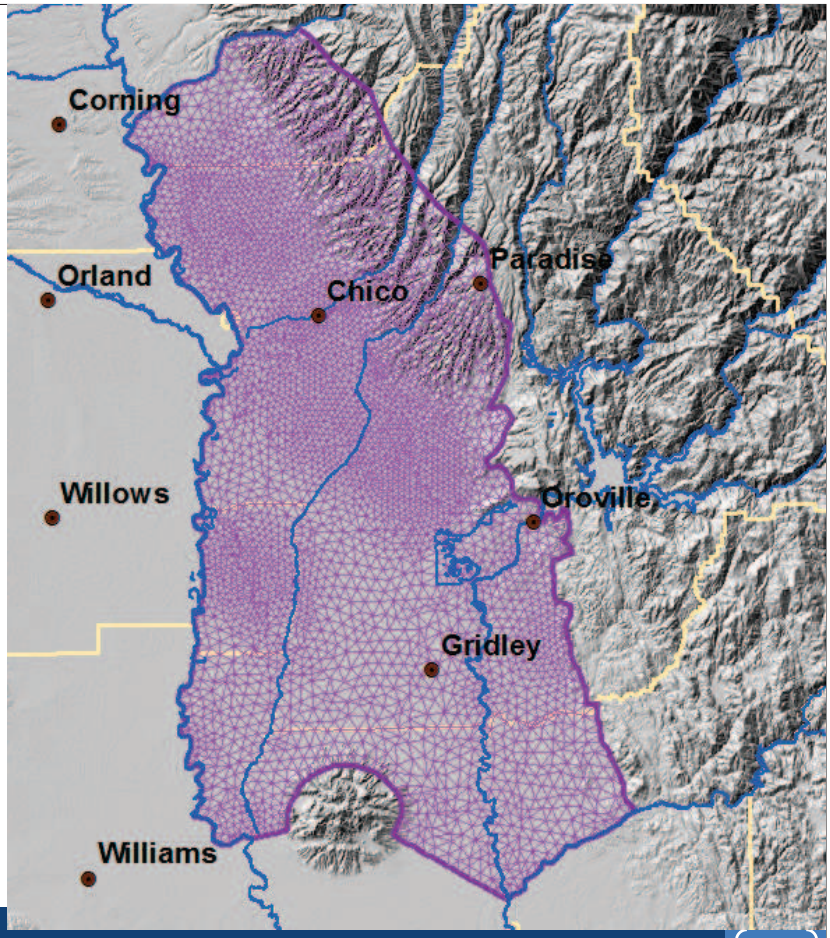
November 6, 2013

Overview

- Water Inventory and Analysis & Butte Basin Groundwater Model Update
- Overview of Model Mechanics
- Advisory Committee Meeting October 24
- Recommended Methodologies

Butte Basin Groundwater Model

- Climate, land use, pumping, diversions, geology (aquifer properties), soil type, etc.
- Node spacing varies from 2,500 to 5,000 feet

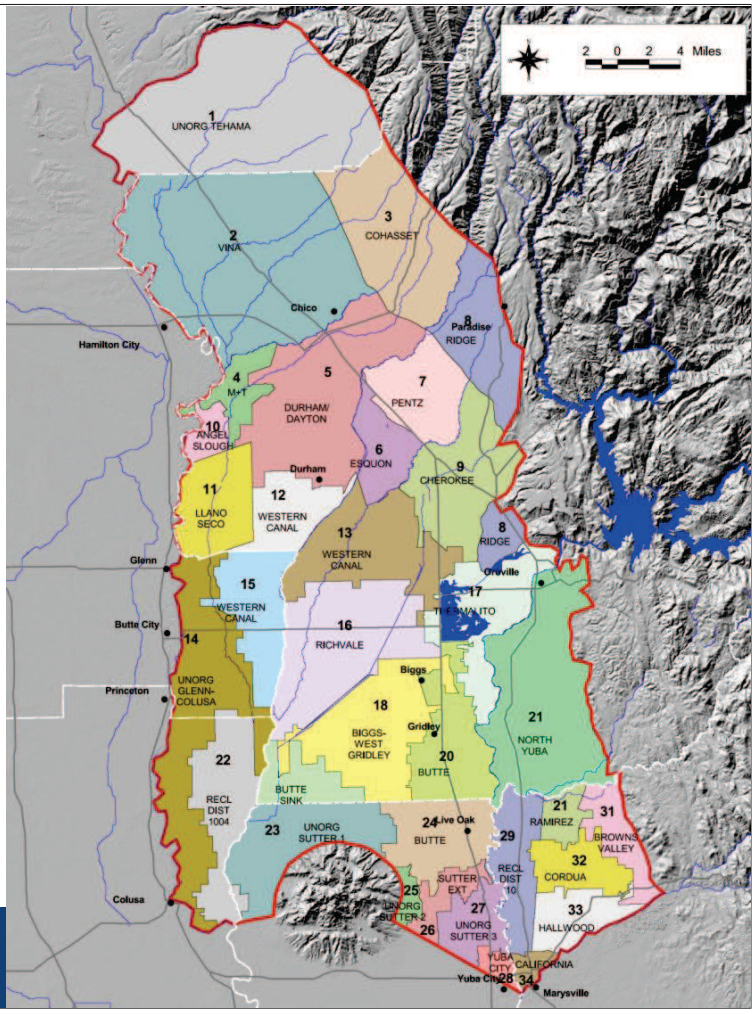


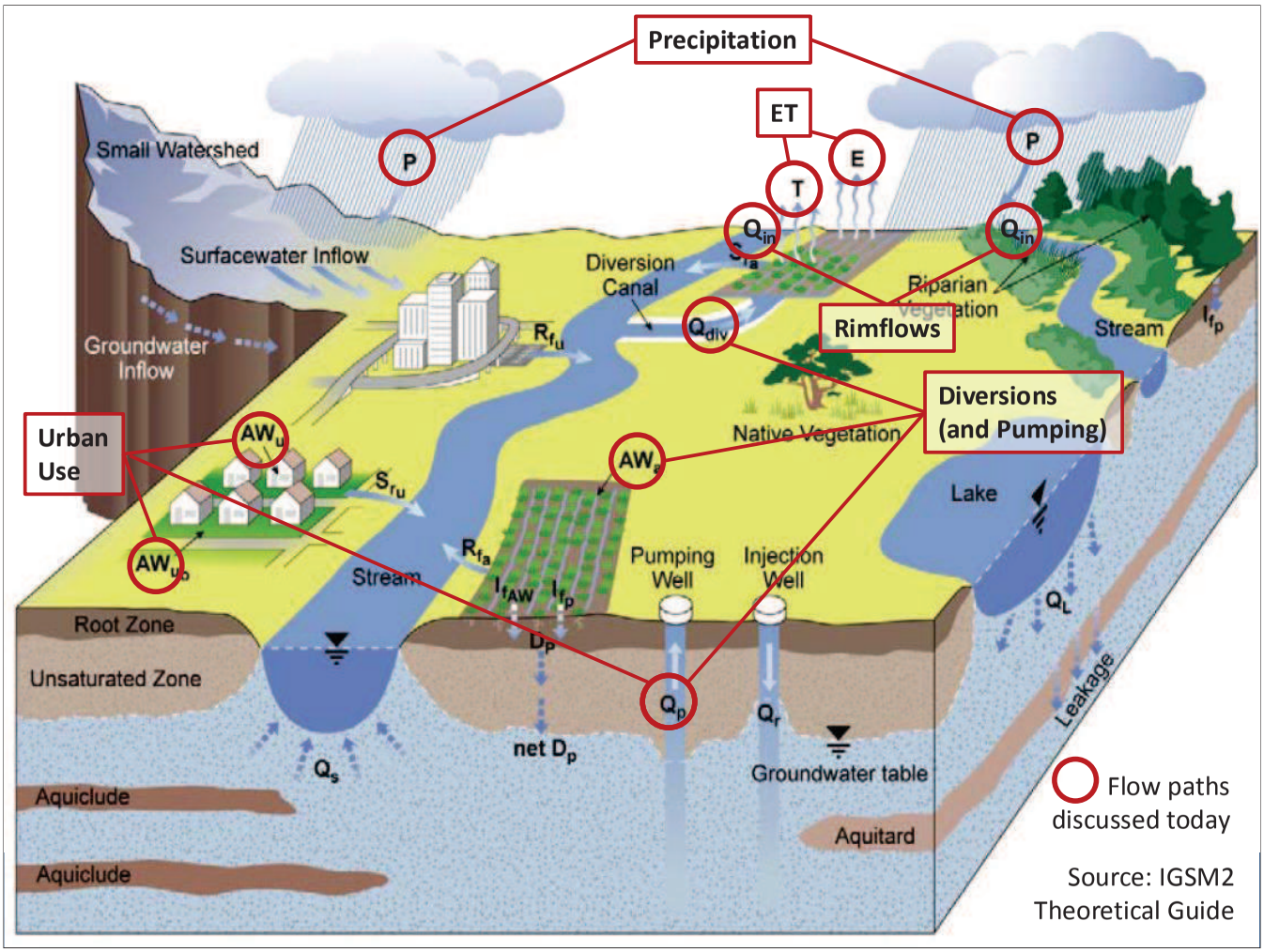
Butte Basin GW Model

- Daily time step
  - some input is monthly/annually
- Currently 1970-1999
- Extending input to 2012 (today's focus)
- Model code: IWFM v.4, supported by DWR
  - Uses demand calculator (IDC v.4) to estimate crop water demand and therefore groundwater pumping

Sub-regions

- Use the model to develop/update water budgets over time for each sub-region
- 34 sub-regions
- Consistent with inventory sub-units





Source: IGSM2 Theoretical Guide

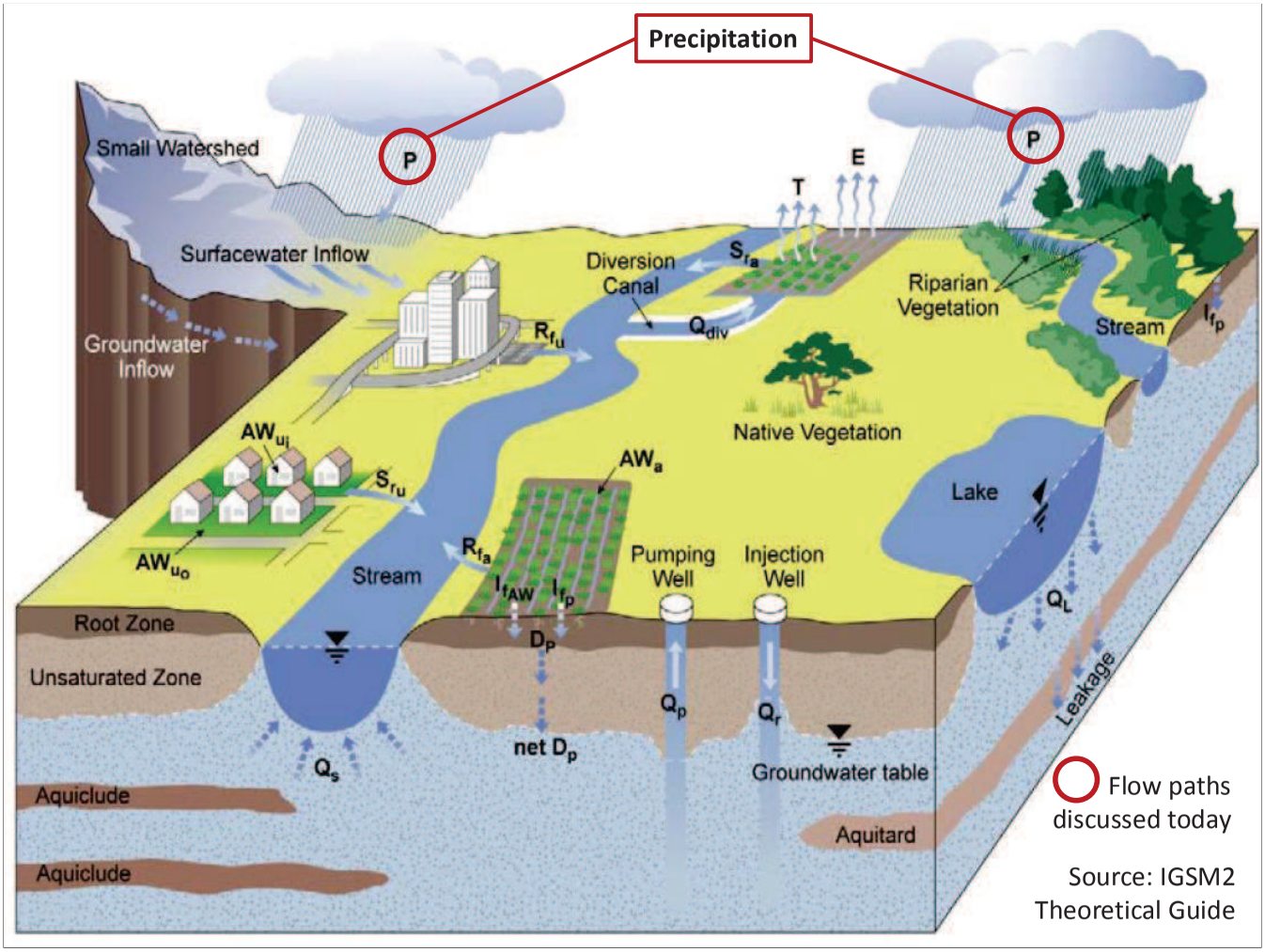
Datasets to Update/Develop

- Precipitation and Reference Evapotranspiration (ET)
- Crop Coefficients
- Land Use and Future Cropping
- Irrigation Efficiency
- Rimflows and Diversions
- Urban Pumping
- Climate Change Hydrology (Precipitation and Stream Flows)

Used to build estimates of crop ET, applied water demands, and associated diversions

Approach to Developing Methodologies

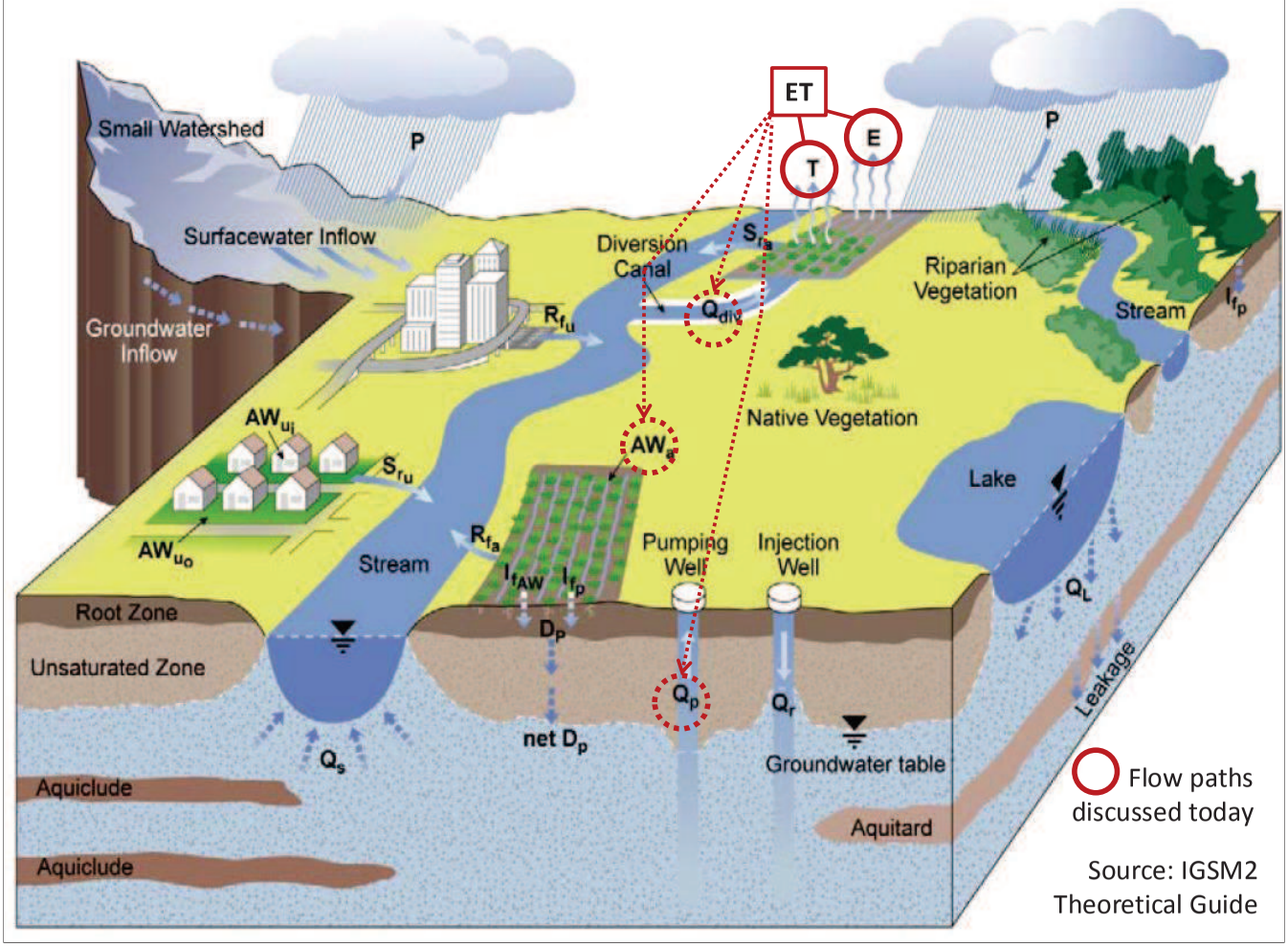
- Review and build on previous work
- Discussions with local water managers
- Prior methodology where reasonable
- New methodology where advantageous
- Update some historical (pre-1999) datasets
- Review with Project Advisory Committee and update based on guidance



Source: IGSM2 Theoretical Guide

Precipitation

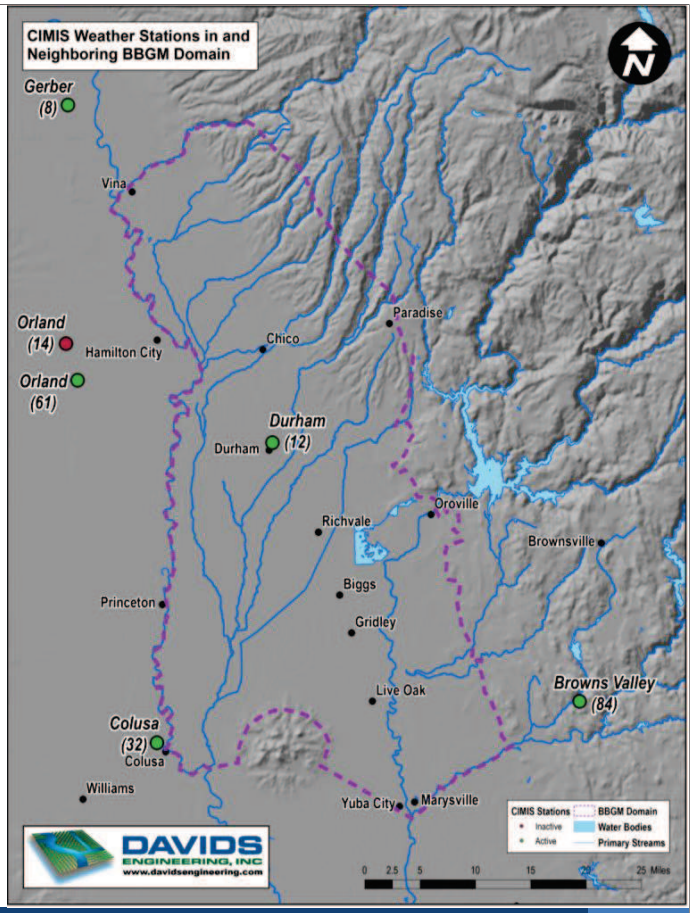
- Source of supply to meet demands and provide recharge
- Recommended Approach
  - Follow prior approach to distribute values spatially
  - Update for current model (software) version
  - Apply QC procedures to new and old data
  - Fill data gaps (both new and old)
  - For Oroville data gap, strongly consider Paradise station due to similarity in elevation, or a combination of Paradise and Marysville



Source: IGSM2 Theoretical Guide

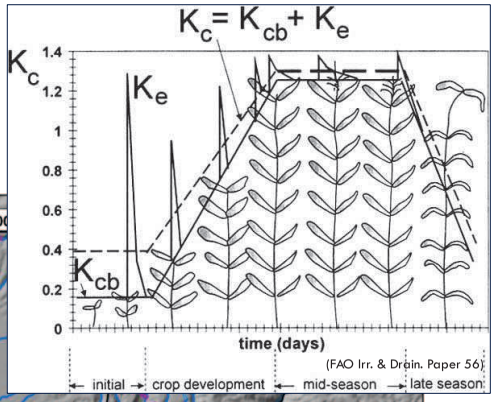
Reference Evapotranspiration

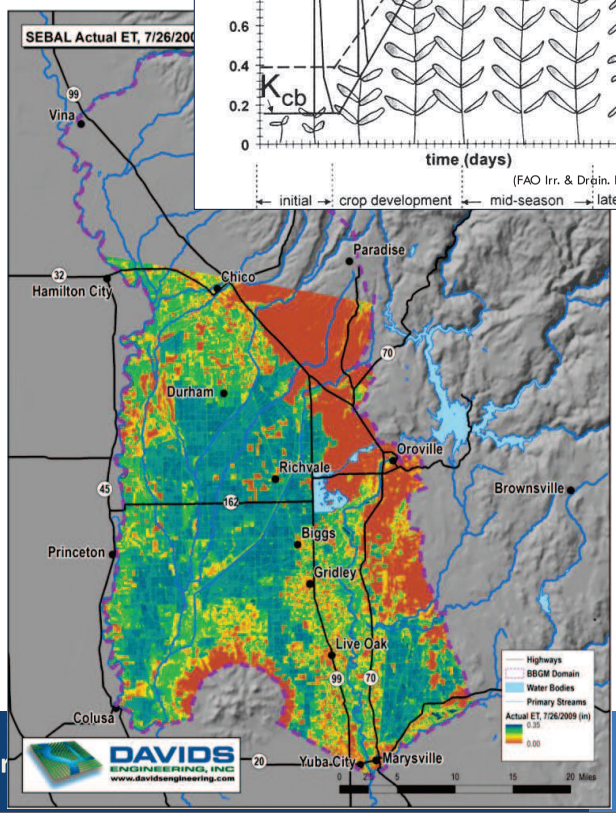
- Calculate ET over time for each land use type
- Recommended Approach
  - Durham CIMIS reference ET (ETo) with area-specific crop coefficients
  - Develop time varying ET estimates back to 1970
  - Estimate ETo prior to 1982 based on temperature and local calibration
  - Consider private weather stations (e.g., WeatherNet) for historical temperature data



Crop Coefficients

- Multiplied by reference ET to calculate ET over time for each land use type
- Recommended Approach for Update
  - Develop local crop coefficients from available satellite ET data
  - Calculate crop coefficients from Durham CIMIS station
  - Estimate winter crop coefficients based on UC Davis/DWR irrigation scheduling tool



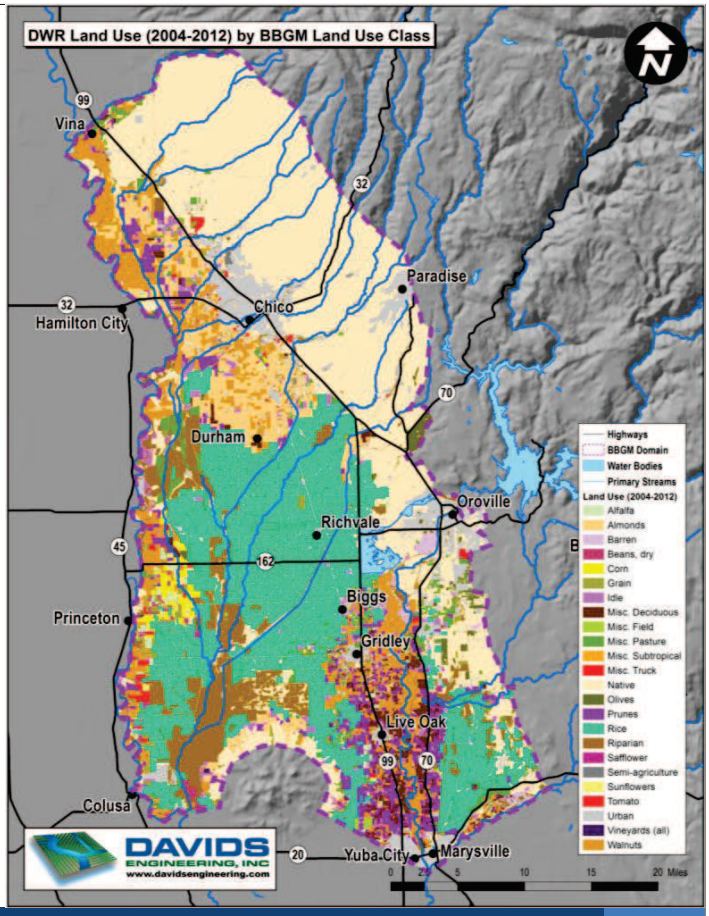


Historical Land Use

- Used to estimate consumptive use (ET) and applied water demands
- Recommended Approach
  - Aggregate at element scale (higher resolution)
  - Interpolate over time based on DWR crop surveys and ag. commissioner crop reports
  - Account explicitly for rice fallowing for transfer
  - Coordinate with Ag. Commissioner to evaluate dynamic shift to orchards in recent years

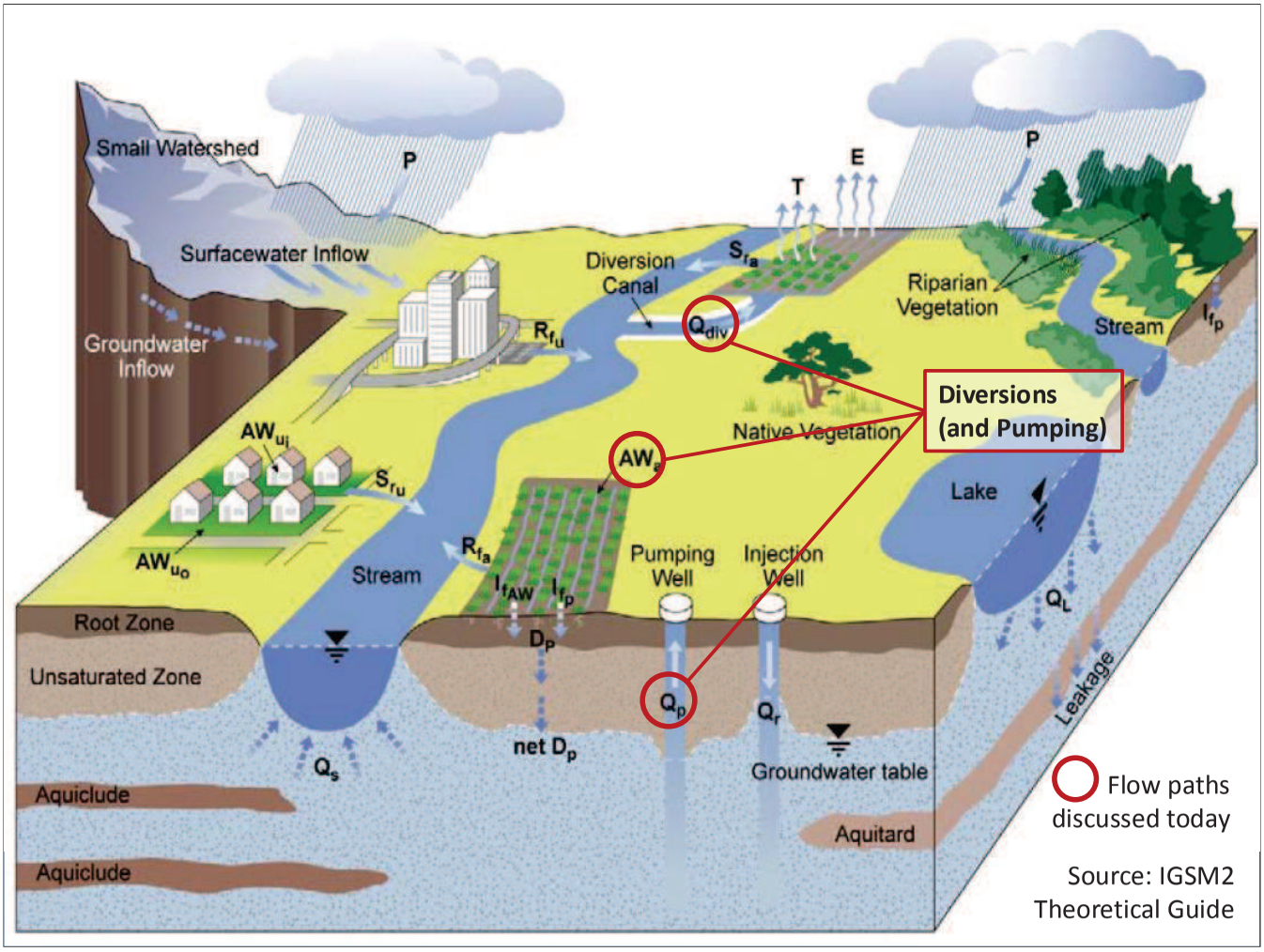
County	DWR Survey Years	Approx. Acres within BBGM Domain	Percent of BBGM Domain
Butte	1994, 1999, 2004, 2011*	517,503	64%
Tehama	1994, 1999, 2005*, 2012*	76,879	9%
Glenn	1993, 1998, 2003, 2009*	45,037	6%
Colusa	1993, 1998, 2003, 2009*	42,046	5%
Sutter	1998, 2004	69,009	9%
Yuba	1995, 2005*	58,831	7%

* Survey not yet finalized.



Future Land Use

- Recommended Approach
  - Develop suite of scenarios exploring upper-bound effects on the basin
    - Crop changes associated with changing water source (groundwater vs. surface water)
    - Potential for newly irrigated land (topography, soils, water availability)
  - Project general changes for 2040 or 2050 based on Sac. Valley results of Statewide Agricultural Production Model (SWAP 2009)

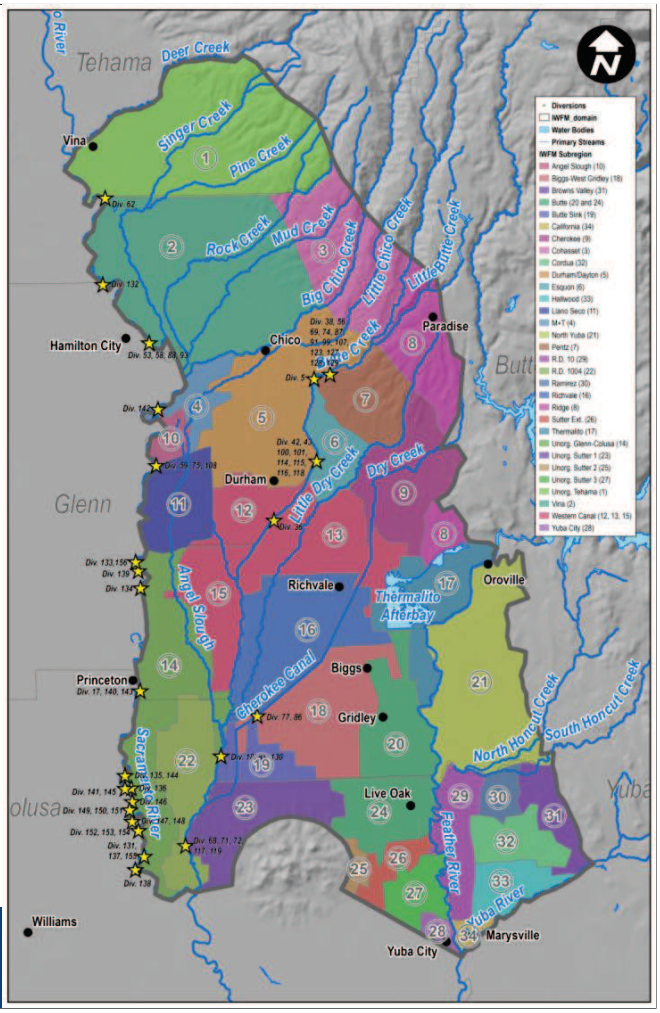


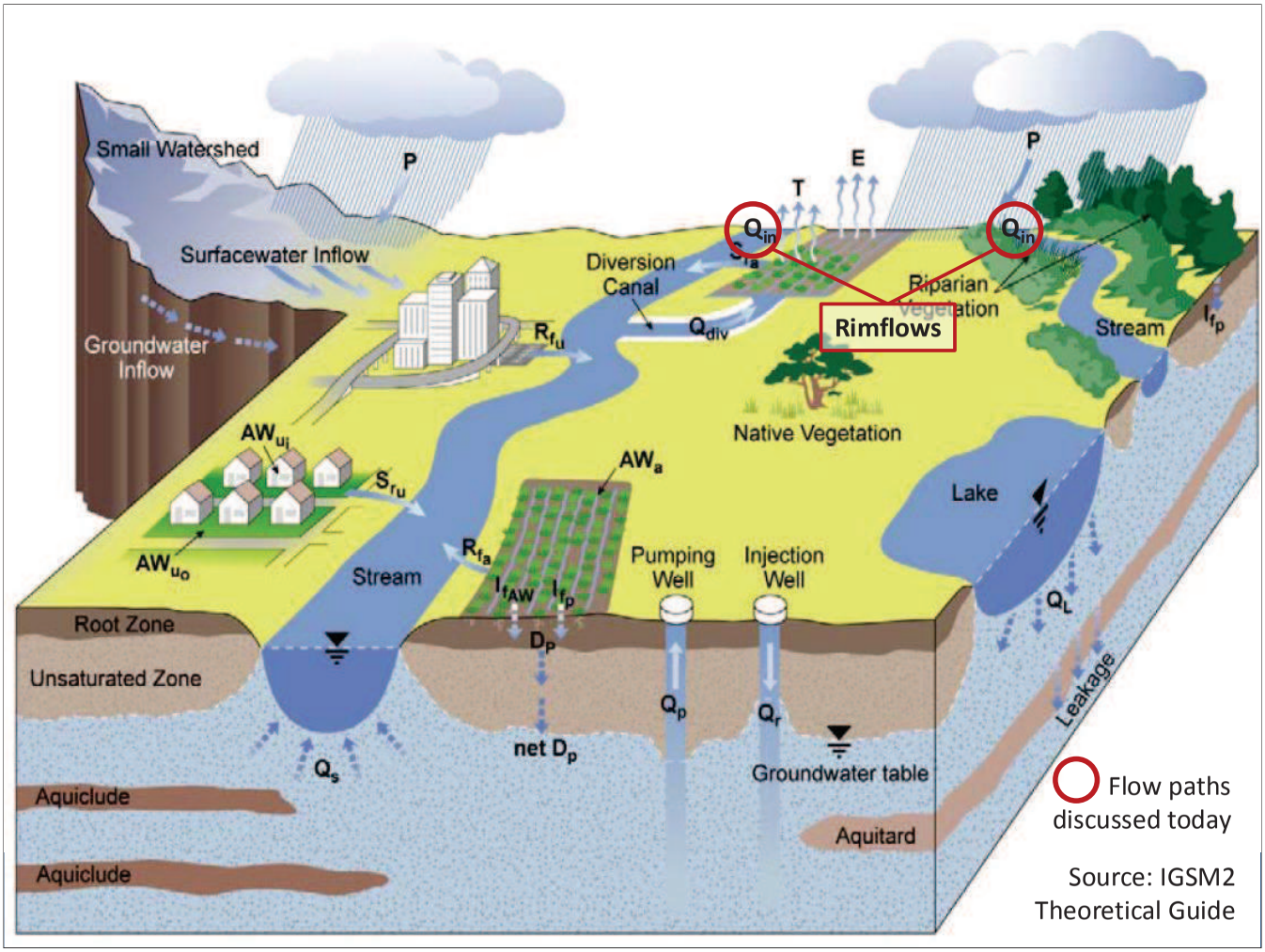
Irrigation Efficiency

- Applied to estimate demands (diversions and pumping), primarily where historical data are not available
- Recommended Approach
  - Update prior estimates based on available data
  - Consider configuring model to reflect changes in irrigation practices over time (e.g., conversion of orchards from flood to pressurized irrigation)
  - Review with Allan Fulton, UCCE Irrigation and Water Resources Advisor

Diversions

- Recommended Approach
  - Actual diversion records (detailed supplier water balances from Feather River AWMP)
  - Estimated demands
  - Consider updates for period prior to 1999

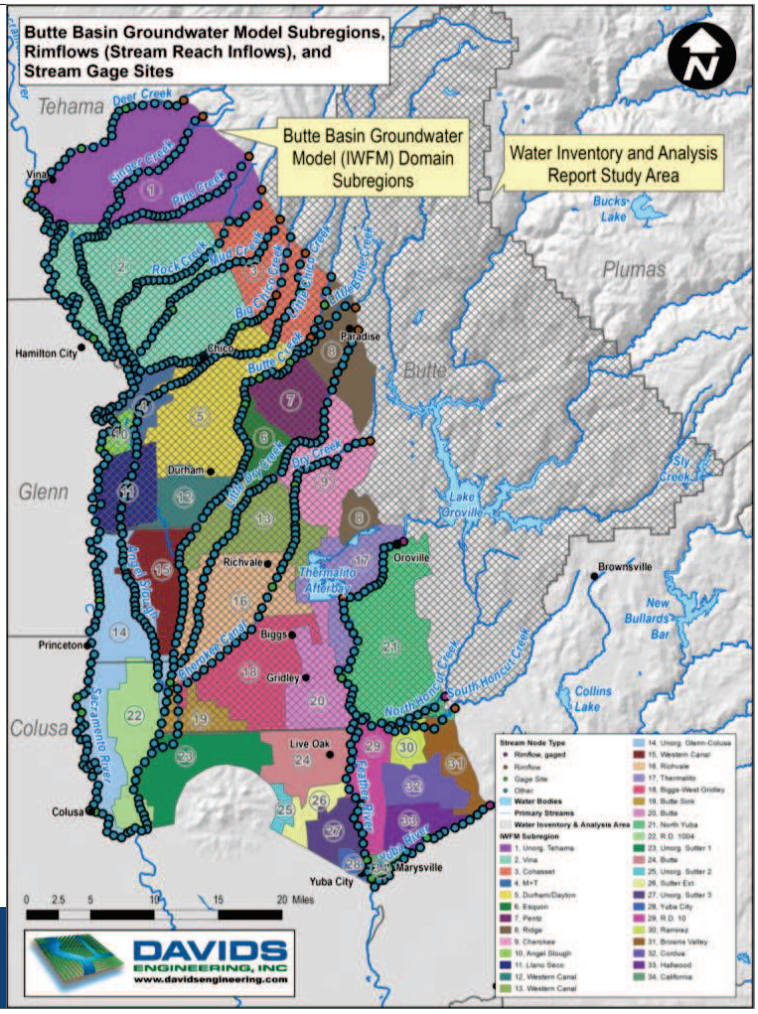


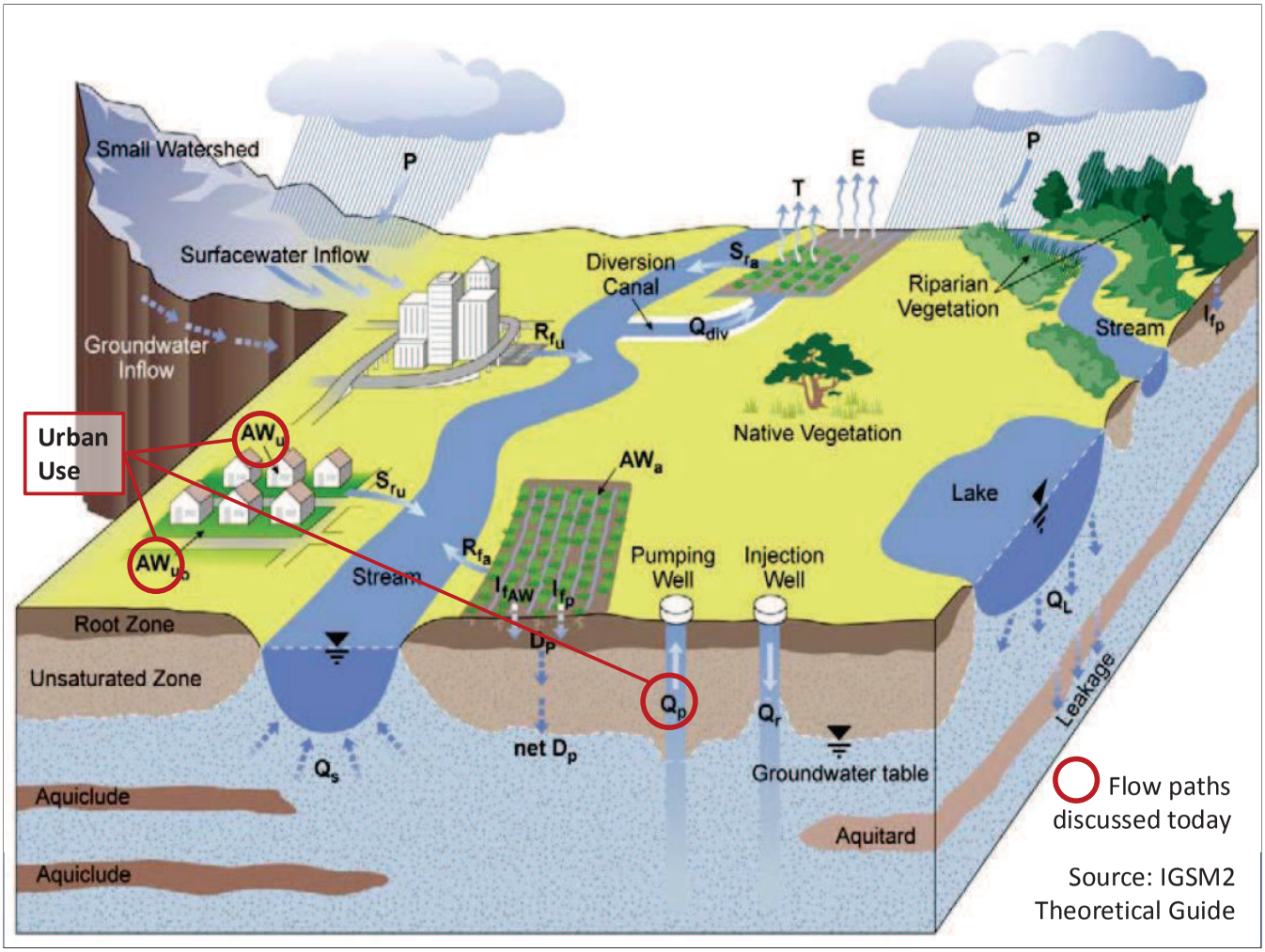


Source: IGSM2 Theoretical Guide

Rimflows

- Recommended Approach
  - Update based on stream gage data, where available
  - Otherwise, calculate using relationship to other stations, consistent with prior work





Source: IGSM2 Theoretical Guide

Urban Pumping

- Recommended Approach
  - Update existing pumping records, including new wells
  - Develop estimates of rural residential pumping based on census data and per-capita water use
  - Project future pumping (2040 or 2050) based on population projections from Urban Water Management Plans or other sources

Climate Change Hydrology

Overview

- Not considered in prior analyses
- Develop hydrology reflecting climate change
- Allows for GW model runs to explore impacts
- Many data sources and analysis options available, depending on objectives and other considerations

Anderson, 2013

Recommendations

- Focus on mid-century time frame (e.g., 2050)
- Utilize one of the twelve "scenarios" developed by the Governor's Climate Action Team (CAT) consistent with the County's Climate Action Plan
  - Each scenario represents a combination of a Global Climate Model and future greenhouse gas emissions
  - For each scenario, potential future precipitation and streamflow information are available
- Use the perturbation ratio (relative change) approach, applied to historical conditions

Questions and Discussion