

Water Inventory and Analysis Project

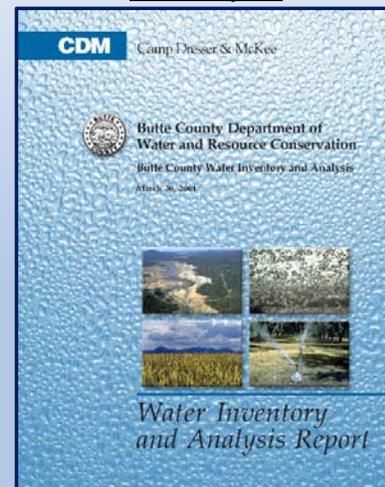
Prepared by
Davids Engineering, Inc. and
Butte County Department of Water
and Resource Conservation
June 14, 2016



Background

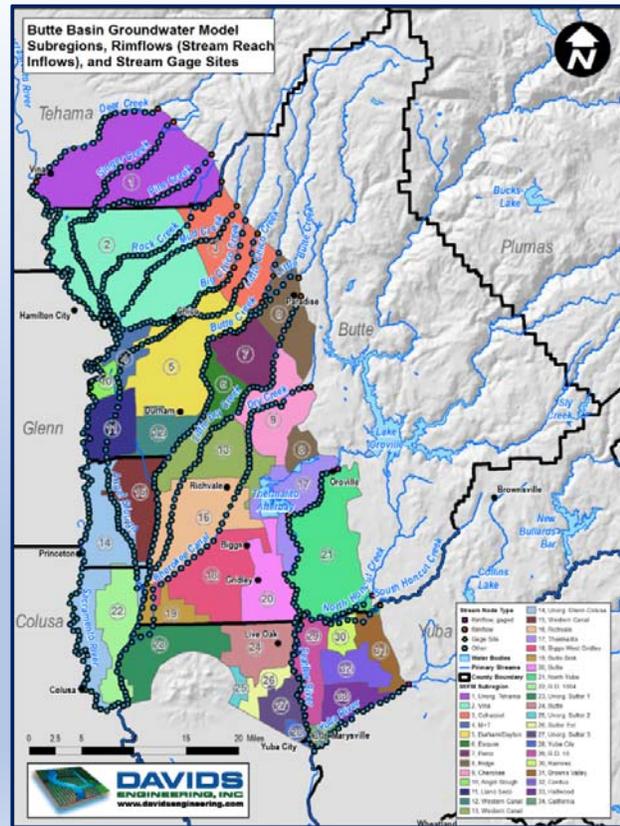
- Update to 2001 Water Inventory and Analysis Report (WI&A)
- Initiated in 2013
- Accounting of Supplies and Demands for 2000 to 2014

2001 Report



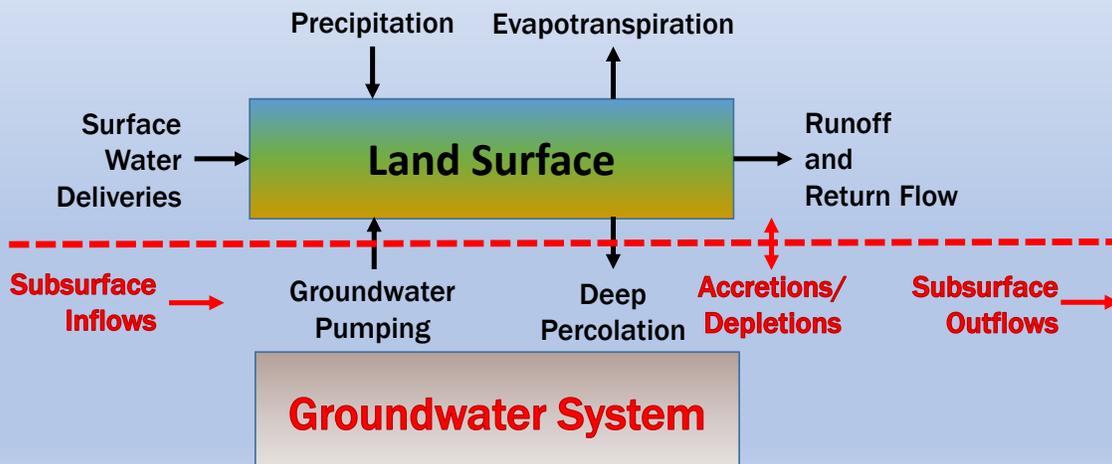
Butte Basin Groundwater Model

- Refinements to inputs to better represent historical hydrologic conditions
- Used to Develop Land Surface Water Budgets



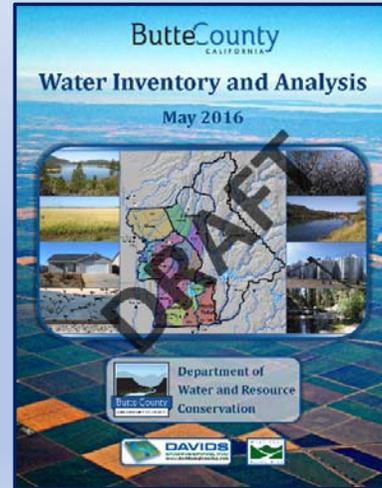
A word about “Water Budgets”

- $\text{Inflows} - \text{Outflows} \pm \text{Change in Storage} = 0$



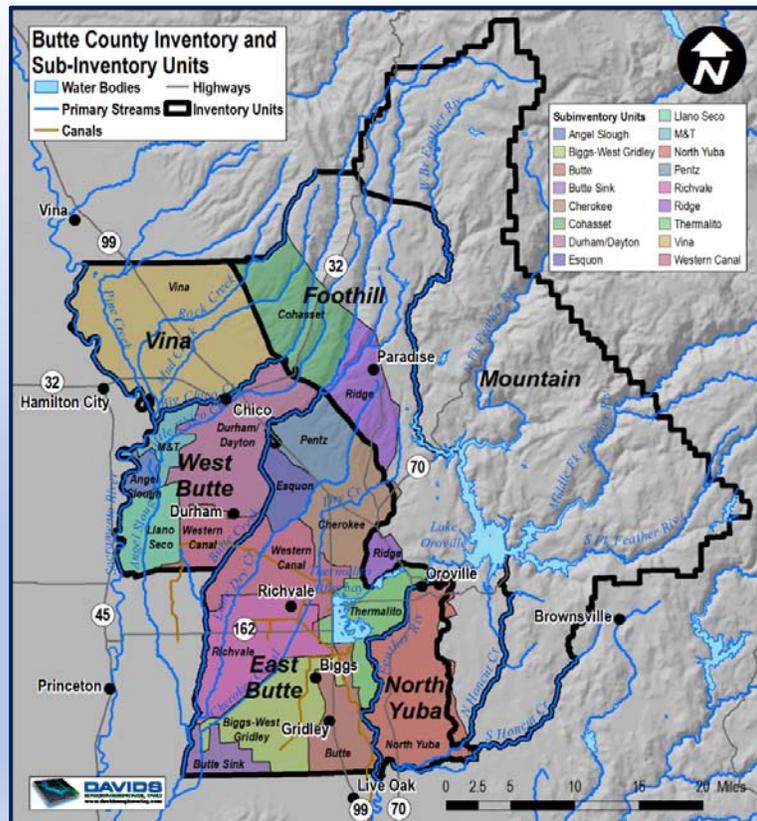
Draft 2016 Water Inventory and Analysis Report

Byron Clark, P.E.
 Davids Engineering, Inc.
 June 14, 2016



Analytical Approach

- Characterization of recent historical hydrology
- Development of multi-year water budgets



Note on Uncertainty

- Updates to the BBGM and WI&A rely on the best available information
- All data and estimates are subject to uncertainty
- Trends and differences are more reliable than absolute numbers



2016 WI&A Results

- Land Use
- Hydrology and Water Sources
 - Precipitation
 - Streamflow and surface water diversions
 - Groundwater pumping
- Water Budgets

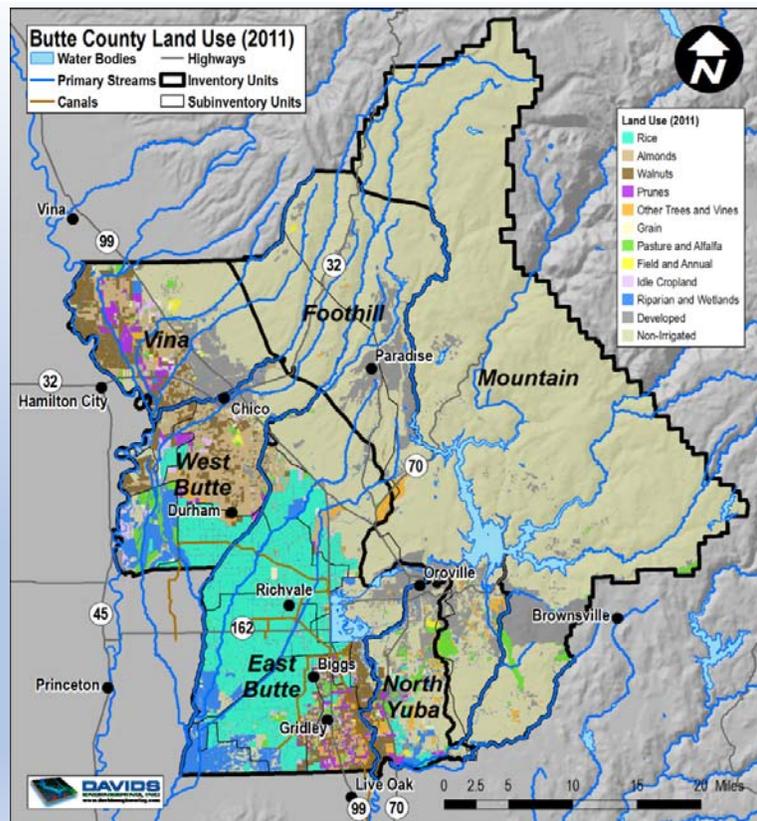


Land Use

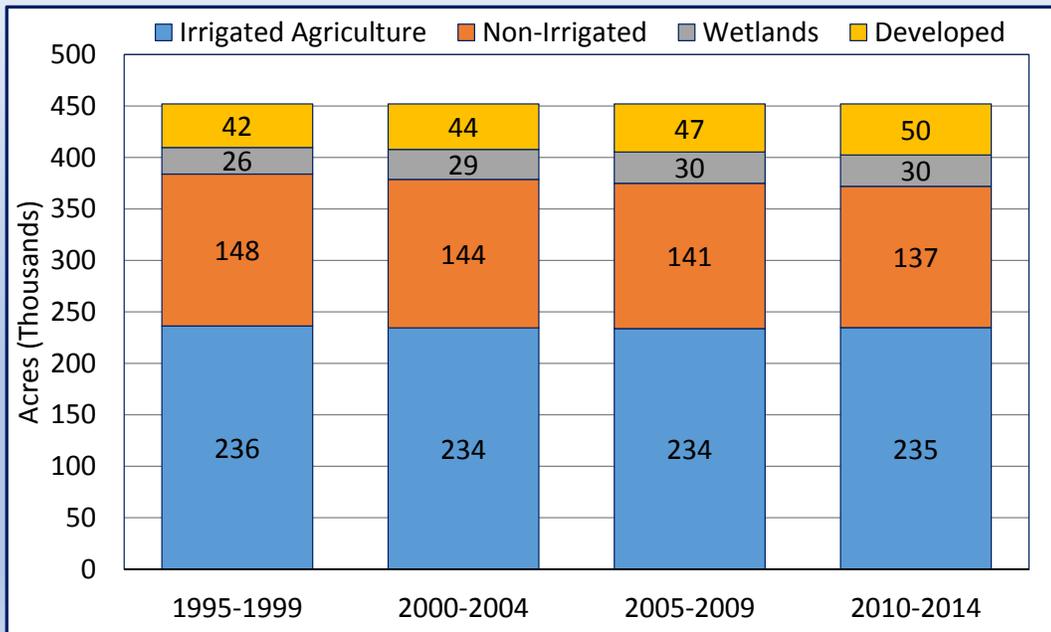


County-Wide Land Use

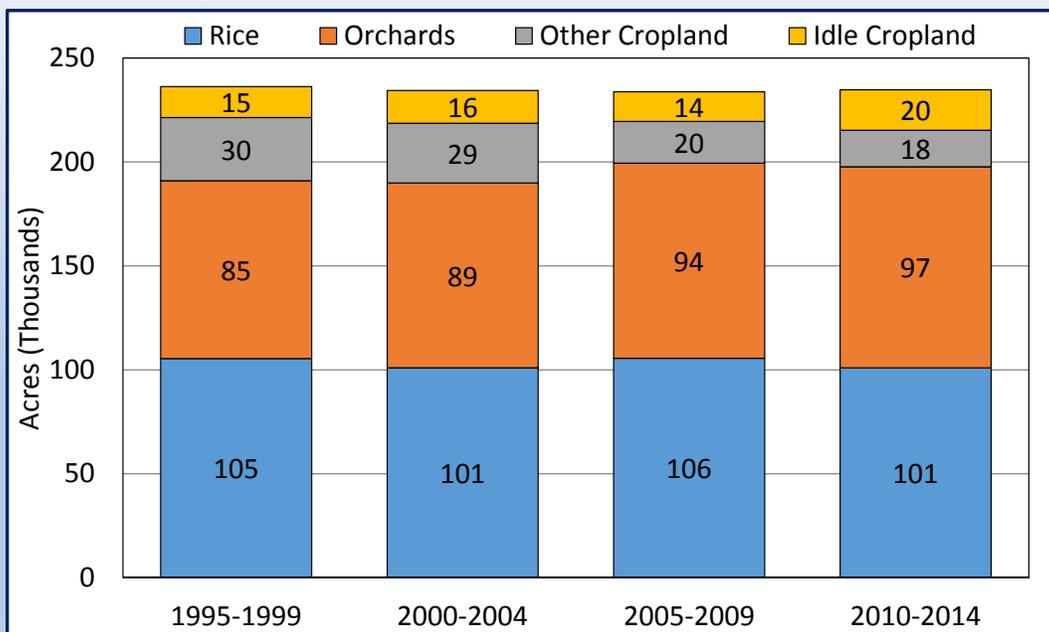
- DWR surveys from 1994, 1999, 2004, 2011
- Identifies land use, water source, and other attributes
- High spatial detail
- Annual changes estimated from ag. commissioner crop reports through 2014



Valley Floor General Land Use



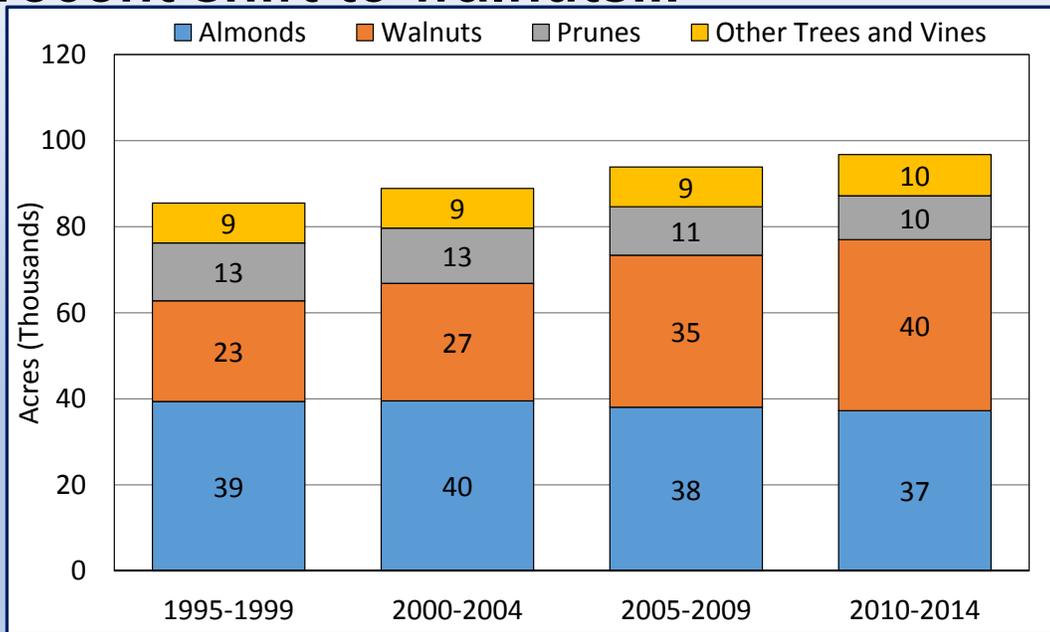
Total irrigated agricultural acreage relatively stable since 2000



Valley Floor Irrigated Land Use



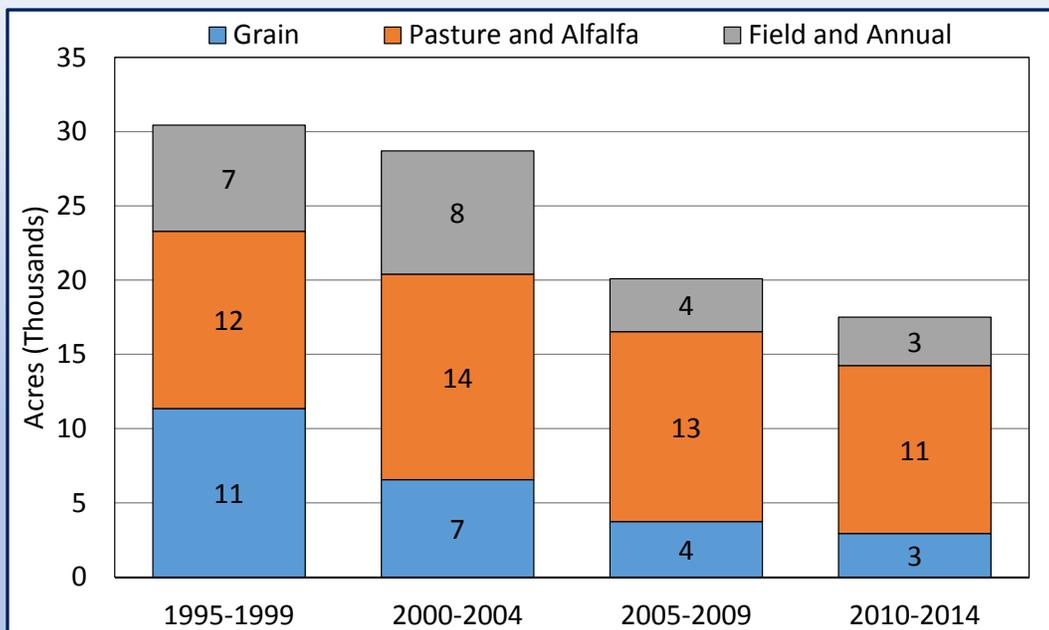
Increasing orchard acreage and recent shift to walnuts...



Valley Floor Orchard Land Use



Orchards Replacing Other Crop Acreage



Valley Floor Other Crop Land Use



Land Use Summary

- Land use relatively stable since 2000
- Valley Floor developed lands increased approximately 7,000 acres between 2000 and 2014
- Orchards have shifted from almonds and prunes to walnuts
- Overall increase in orchards is offset by decreases in other, non-rice crops



Land Use Summary

- Limited potential for expansion of irrigated agricultural acreage
 - Some potential expansion in the East Butte and North Yuba inventory units
 - Quantifying potential as part of demand scenario development
 - Evaluate potential impacts as part of future analysis
- DWR preparing land use survey for 2015
 - Review results when available
 - Identify any recent expansion not identified by available crop reports

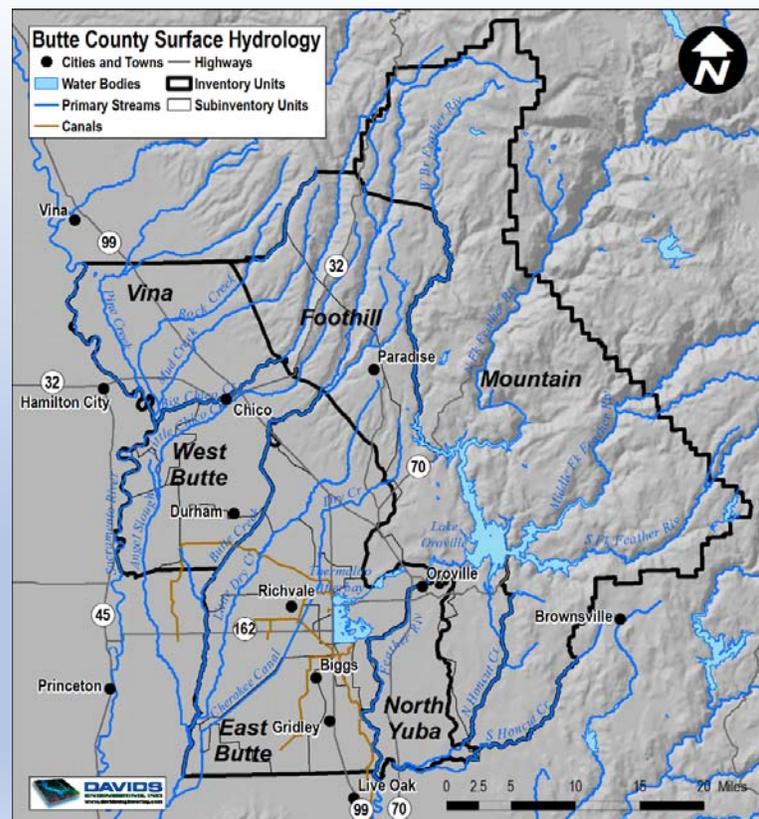


Hydrology and Water Sources



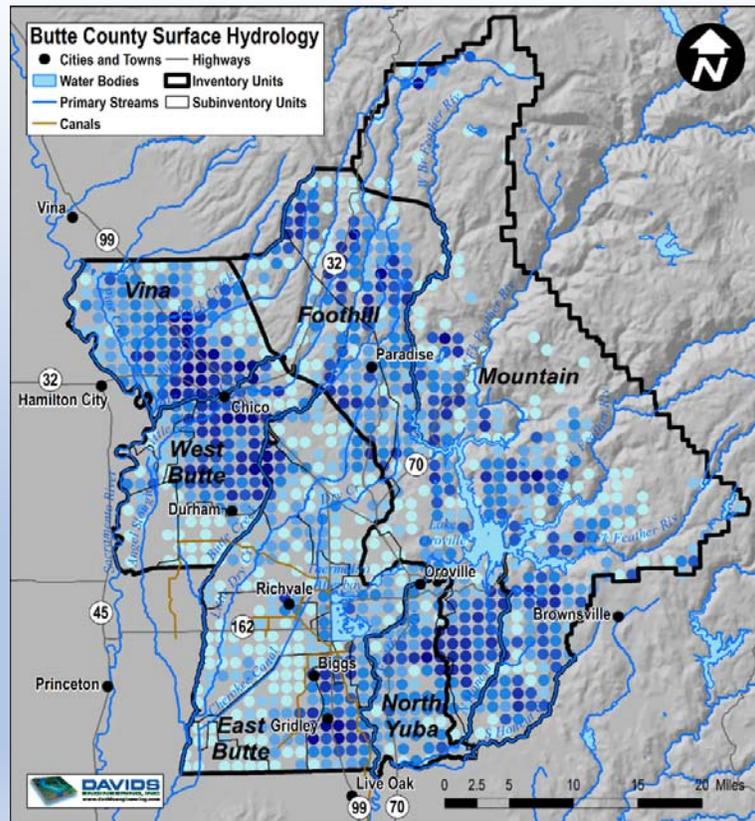
Water Sources or “Inflows”

- Precipitation
- Streamflow and Surface Water Diversions
- Groundwater Pumping



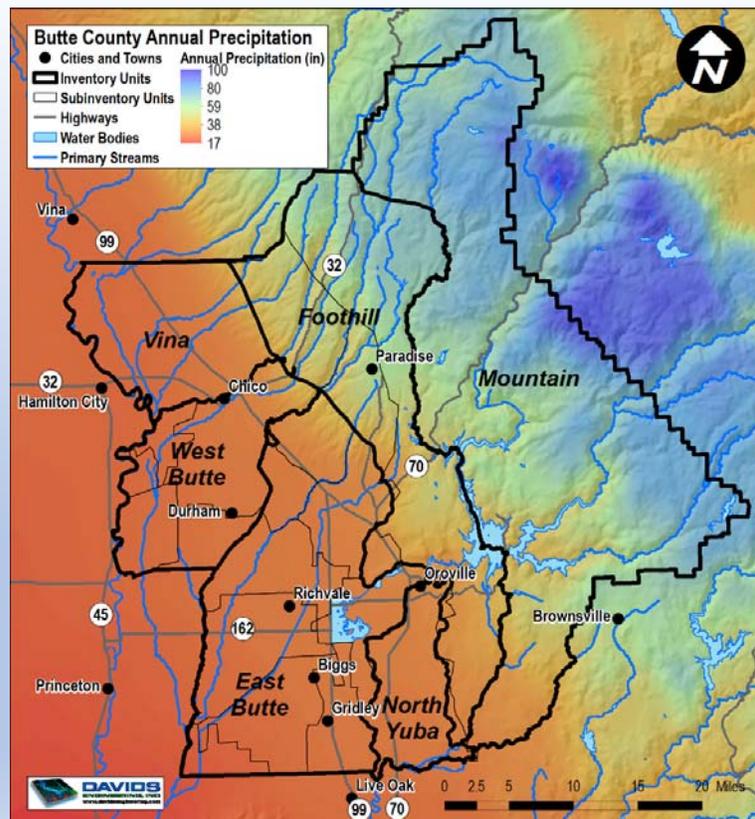
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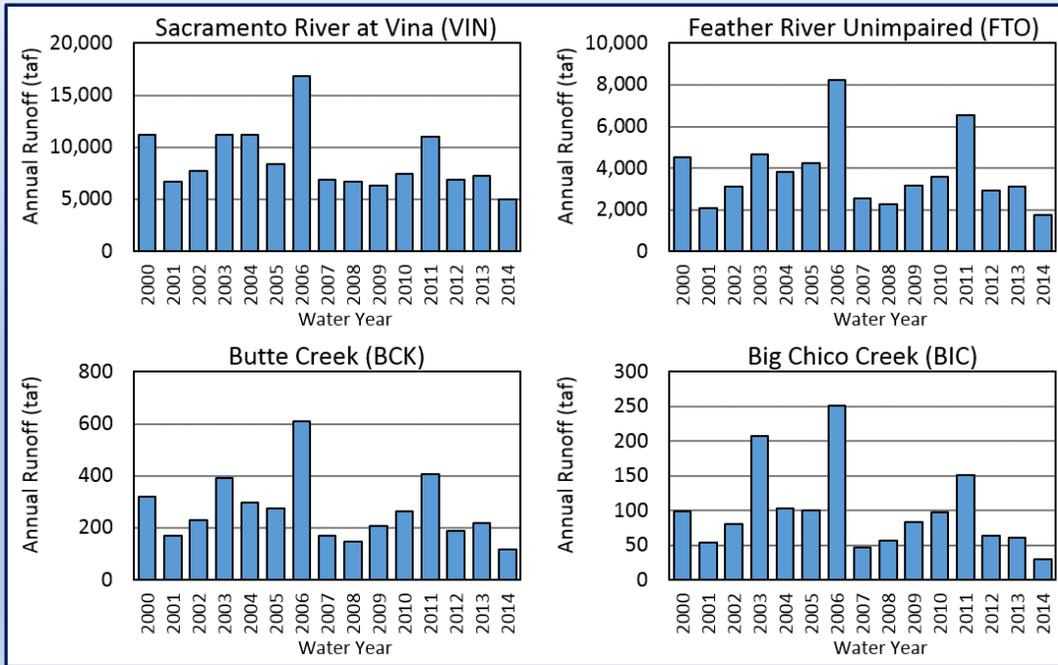


Large Variations in Average Annual Precipitation

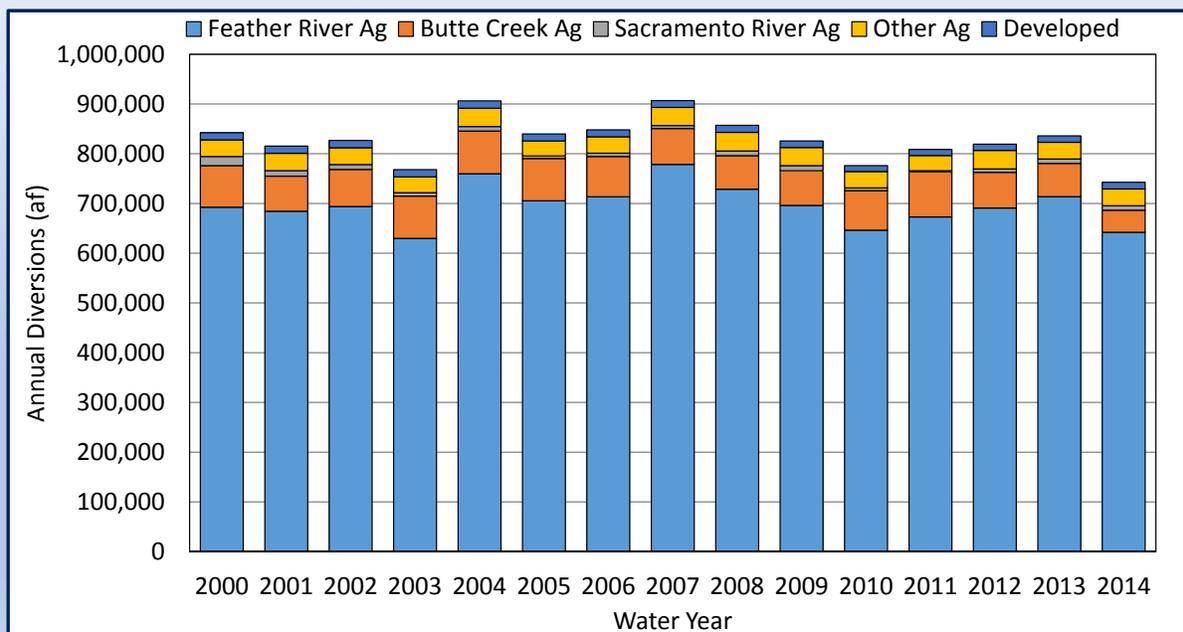
- Approx. 17 to 100 inches per year depending on location
- Influences irrigation requirements, surface water supply, groundwater recharge
- Timing matters



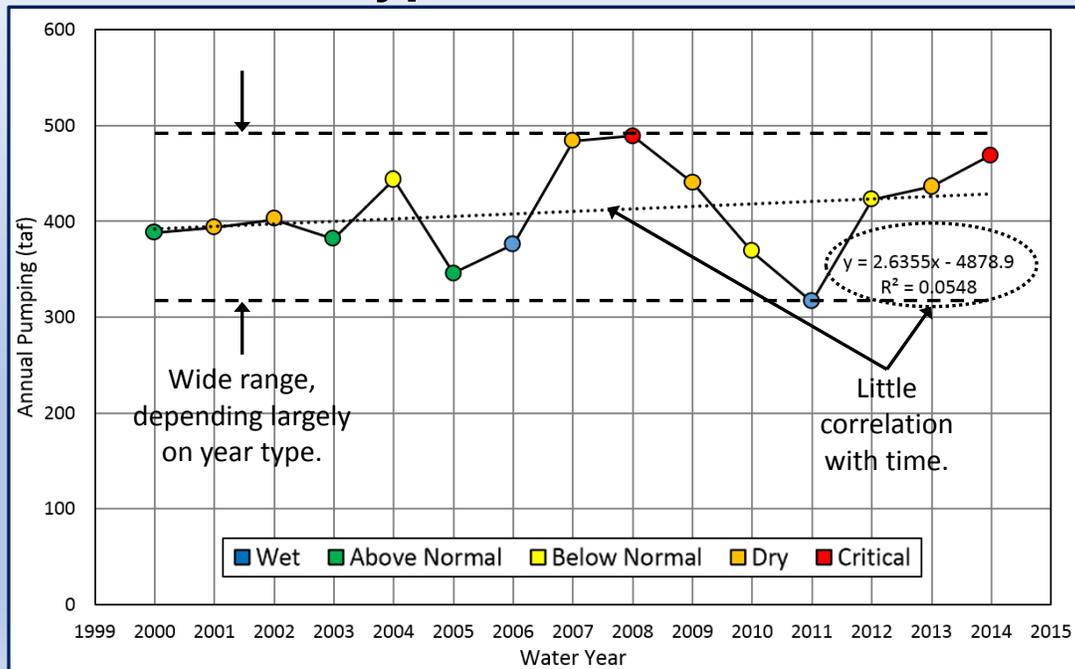
Also Large Variations in Streamflow



Surface Water Diversions Relatively Stable



Groundwater Pumping Variable by Water Year Type



Hydrology and Water Sources Summary

- Annual precipitation and resulting streamflows highly variable
- Surface water supplies relatively steady despite year-to-year differences in precipitation due to senior water rights and water supply agreements (settlement contracts)
- Variability in precipitation is a driver of year-to-year differences in groundwater pumping

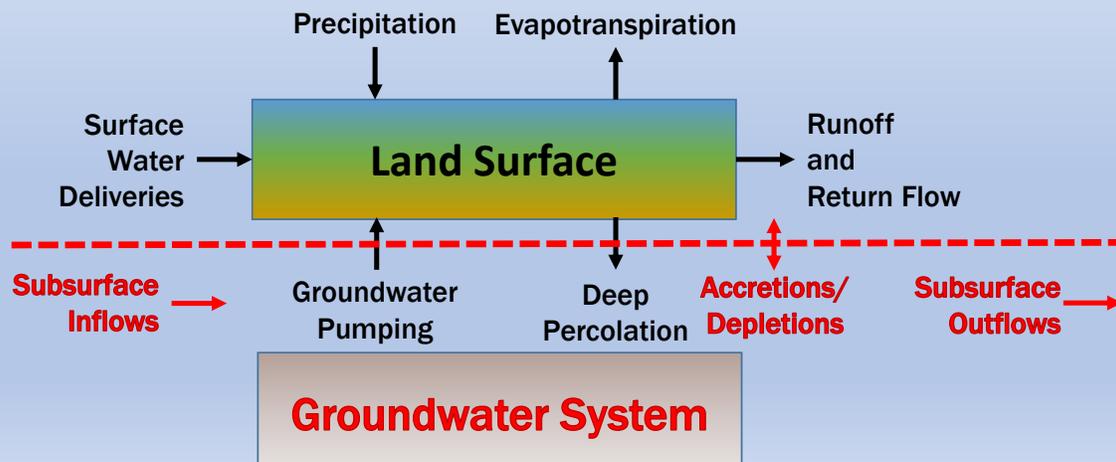


Land Surface Water Budgets



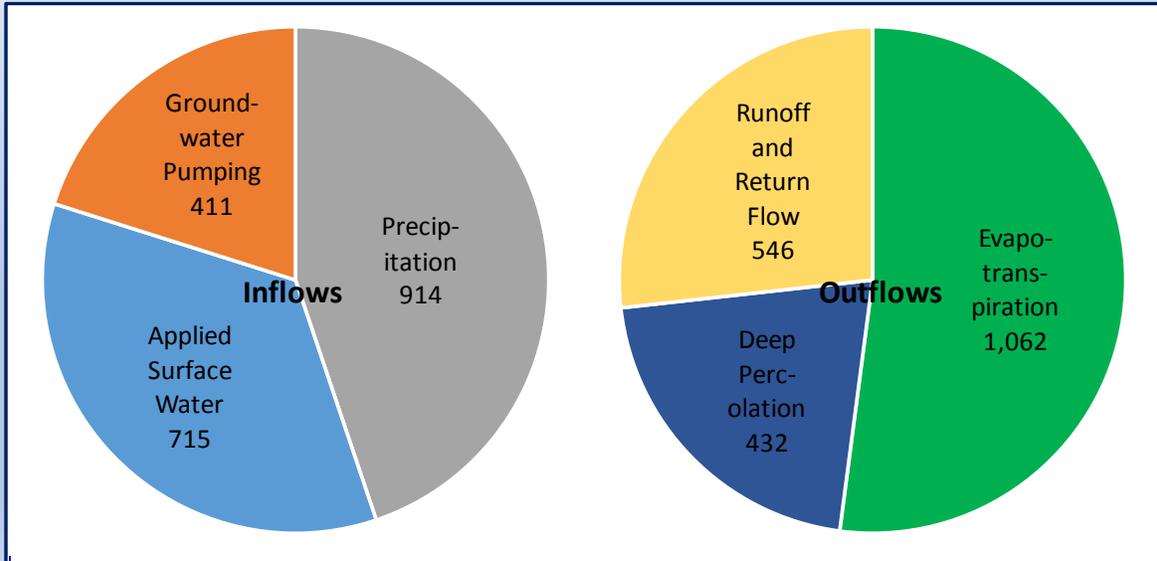
Land Surface Water Budgets

- Valley floor inventory units (and subinventory units)
- Overall and by general land use
 - Irrigated agriculture and wetlands
 - Developed lands
 - Non-irrigated lands
- $\text{Inflows} - \text{Outflows} \pm \text{Change in Storage} = 0$



Valley Floor Overall Water Budget

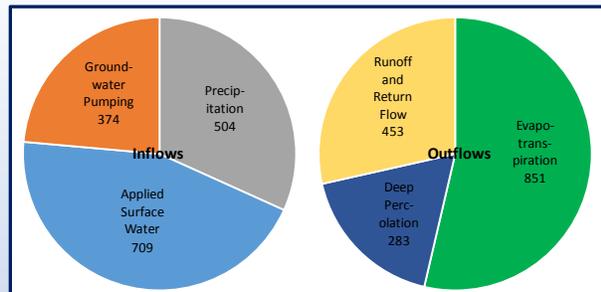
Average Annual Inflows and Outflows (thousands of acre-feet)



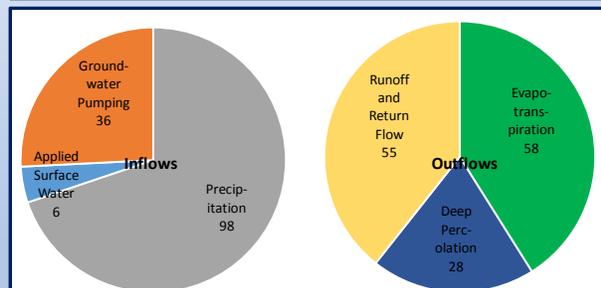
Valley Floor Average Annual Water Budgets

**Total Inflow/
Outflow
2,038 taf**

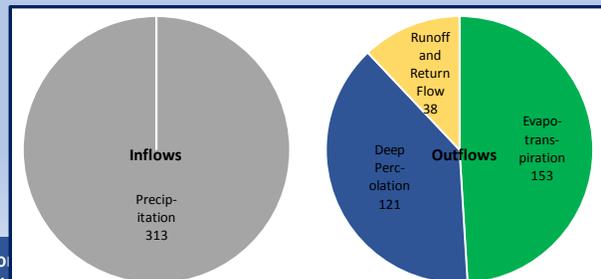
**Irrigated
Ag./Wetlands
(1,587 taf)**



**Developed
Lands
(140 taf)**



**Non-Irrigated
Lands
(312 taf)**



Valley Floor Overall Water Budget

Average Annual Inflows and Outflows by Year Type (thousands of acre-feet)

Water Year	Inflows (taf)			Outflows (taf)			Change in Storage (taf)
	Precipitation	Surface Water	Ground-water	Evapotranspiration	Deep Percolation	Runoff and Return Flow	
Averages by Hydrologic Year Type							
Wet	1,295	715	346	1,043	591	726	2
Above Normal	1,069	705	372	1,049	493	613	14
Below Normal	908	721	412	1,033	433	572	-6
Dry	789	726	431	1,091	372	480	4
Critical	624	691	479	1,070	328	388	-22

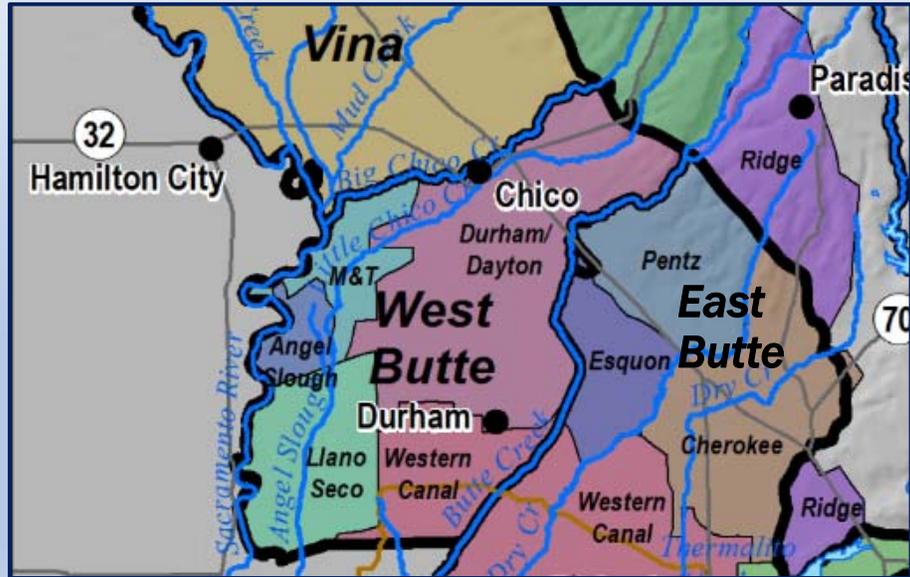


Water Budget Summary

- Irrigated agriculture and wetlands represent the primary use of water and rely mainly on surface water for irrigation
- Magnitude of inflows/outflows varies widely by inventory unit (and subinventory unit) and land use category

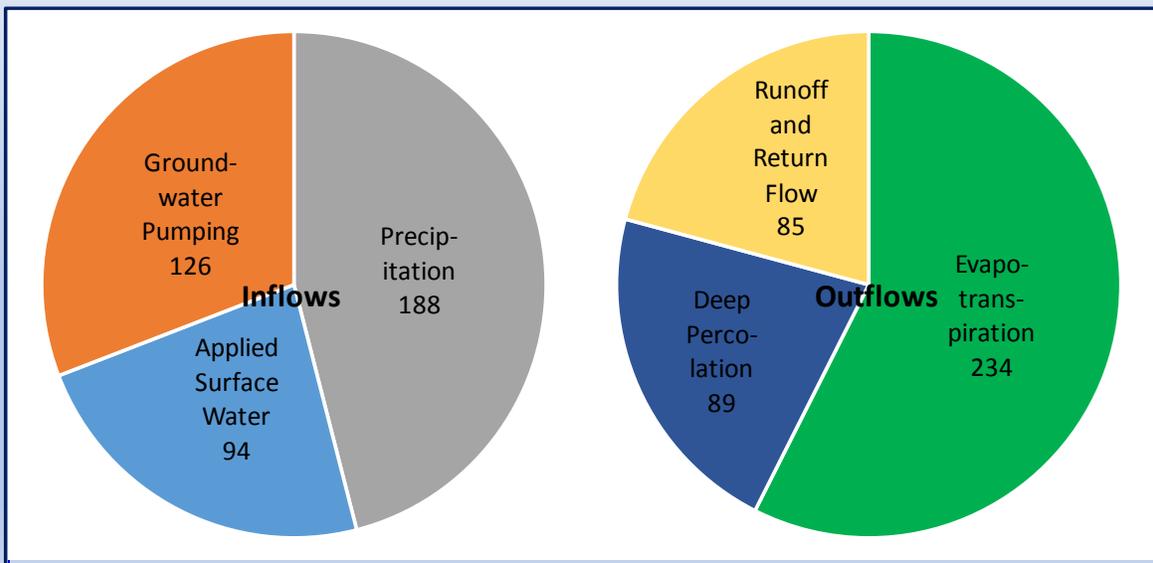


West Butte Inventory Unit



West Butte Overall Water Budget

Average Annual Inflows and Outflows (thousands of acre-feet)



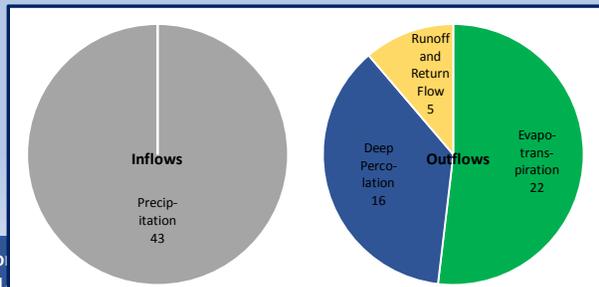
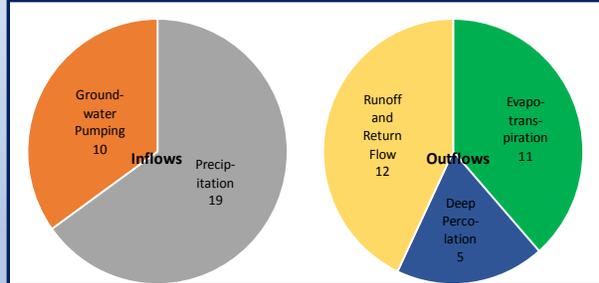
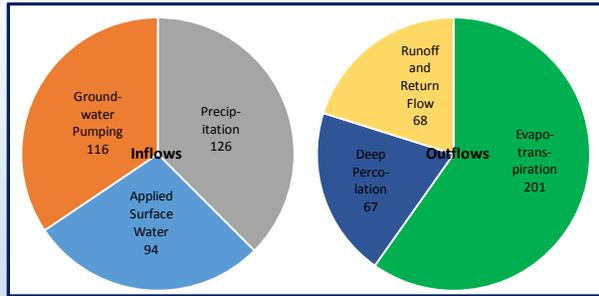
West Butte Average Annual Water Budgets

**Total Inflow/
Outflow
408 taf**

**Irrigated
Ag./Wetlands
(336 taf)**

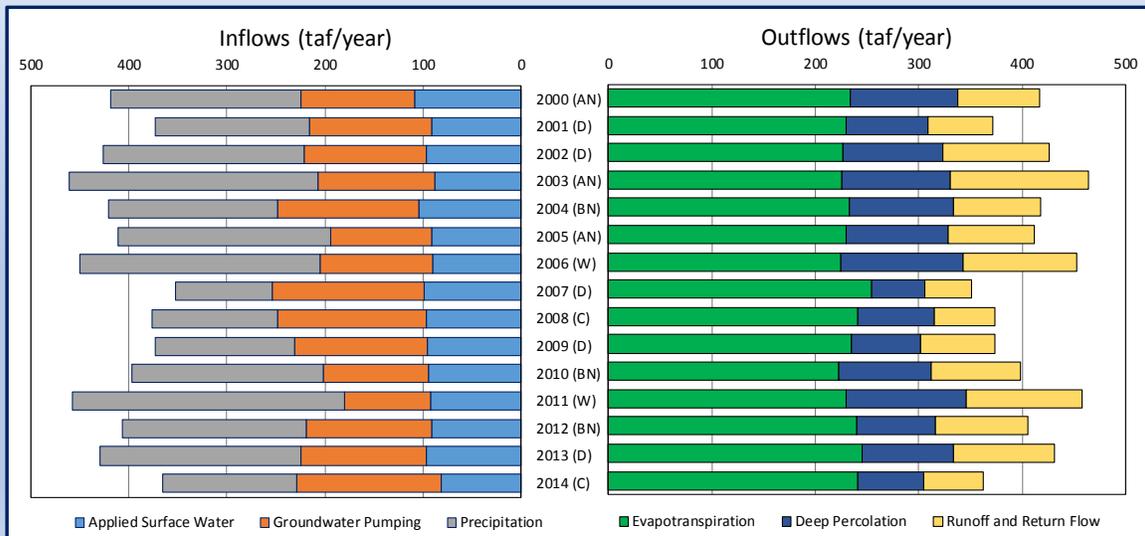
**Developed
Lands
(29 taf)**

**Non-Irrigated
Lands
(43 taf)**



West Butte Overall Water Budget

2000 - 2014 Annual Inflows and Outflows (thousands of acre-feet)



West Butte Overall Water Budget

Average Annual Inflows and Outflows by Year Type (thousands of acre-feet)

Water Year	Inflows (taf)			Outflows (taf)			Change in Storage (taf)
	Precipitation	Surface Water	Ground-water	Evapotranspiration	Deep Percolation	Runoff and Return Flow	
Averages by Hydrologic Year Type							
Wet	261	91	102	227	117	111	-1
Above Normal	222	96	113	230	103	99	2
Below Normal	185	97	126	232	89	87	-1
Dry	161	96	134	238	76	76	1
Critical	132	89	150	241	69	58	-5



Water Budget Summary

- Irrigated agriculture and wetlands represent the primary use of water and rely mainly on groundwater for irrigation
- Annual pumping influenced by precipitation to meet irrigation demands
- Periods of drought result in increased pumping and decreased deep percolation



Relation to Groundwater Conditions

- Land Surface Water Budgets help better understand observed groundwater conditions, but...
- They don't provide the entire picture
 - Stream accretions/depletions
 - Subsurface groundwater flows



Dry Year Observations

- Decreases in deep percolation are greater than increases in pumping
 - Reduced recharge from precipitation
 - Reduced applied surface water
- Decreased recharge (deep percolation) and increased pumping likely contribute to observed groundwater level declines
- Groundwater level declines in recent years are likely primarily due to drought, rather than other factors (e.g. land use changes)



Recommendations

- **Methodology**
 - Continue work with local stakeholders to document diversions, including riparian diversions and water supplies for managed wetlands.
 - Verify and refine groundwater pumping estimates by obtaining pumping data from cooperative landowners.
 - Further investigate the fate of deep percolation from agricultural lands.
 - Refine water budgets for developed lands.



Recommendations (continued)

- Further evaluate BBGM water budgets from historical and current drought periods to better understand factors contributing to recent historic low water levels in some areas.
- Identify and evaluate additional options to adapt to future demands and climate change



Recommendations (continued)

- Continue outreach to educate and inform the public regarding water resources in the County and to gather additional insights.
- Continue process of updating and calibrating the BBGM.
- Continue to assess the use of WI&A information to support development of GSPs under SGMA.



2016 WI&A Structure

Executive Summary

1. Introduction
2. Inventory and Analysis Methodology
3. Land Use and Cropping Patterns
4. Climate and Hydrology
 - Climate
 - Surface Water Hydrology
 - Groundwater Hydrology
5. Historical Water Demands and Supplies
6. Future Water Demands and Supplies
7. Conclusions and Recommendations
8. References



2016 WI&A Structure (continued)

APPENDICES:

- A. Water Suppliers and Managers
- B. Butte County Stream Gages and Monitoring Wells
- C. Subinventory Unit Land Use and Water Budgets
- D. Assessment of Butte County Drought Impacts, 2012-2015



Acknowledgements

- Butte County Board of Supervisors
- Department of Water and Resource Conservation staff
- Butte County Water Commission and Project Advisory Committee
- Local Water Suppliers and Managers
- U.C. Cooperative Extension
- California Department of Water Resources



Questions/Discussion

