Groundwater Modeling for Santa Margarita Basin GSP

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Santa Margarita Groundwater Agency

January 23, 2020

Objectives

1. Provide update on model improvements compared to recommendations from model review
2. Preview next steps

Update on Model Improvements

Expand Model to Represent Entire Basin

I. COMPARE TO SGMA STANDARDS

Standard	Evaluation	Notes	Recommendation
Publicly available documentation	✓	USGS MODFLOW-NWT	---
Peer reviewed mathematical foundation and model code	✓	USGS MODFLOW-NWT	---
Public domain open-source software	✓	USGS MODFLOW-NWT	---
Covers entire basin (at a minimum)	No	Needs to encompass entire area affected by the GSA's gw activities (pumping, recharge projects, etc).	Expand active model grid to represent entire basin as defined by DWR Bulletin 118.
Boundary conditions consistent between adjacent basin models	No	Santa Cruz Mid-County Basin model	Modify as part of grid expansion for consistency with Mid-County Basin model.
Based on detailed HCM	✓	Based on expert reports and input From basin stakeholders.	---
Sensitivity tests and uncertainty analysis	✓	Limited to climate scenario.	GSP and local applications will require prediction sensitivity analysis.
Model adaptability (e.g., accommodate additional data and/or refined HCM)	✓	MODFLOW platform provides multiple versions and capabilities making it adaptable. Recharge estimator can be problematic.	Recharge estimator requires documentation.

California Department of Water Resources Sustainable Groundwater Management Program, "Best Management Practices for the Sustainable Management of Groundwater Modeling BMP," December 2016.
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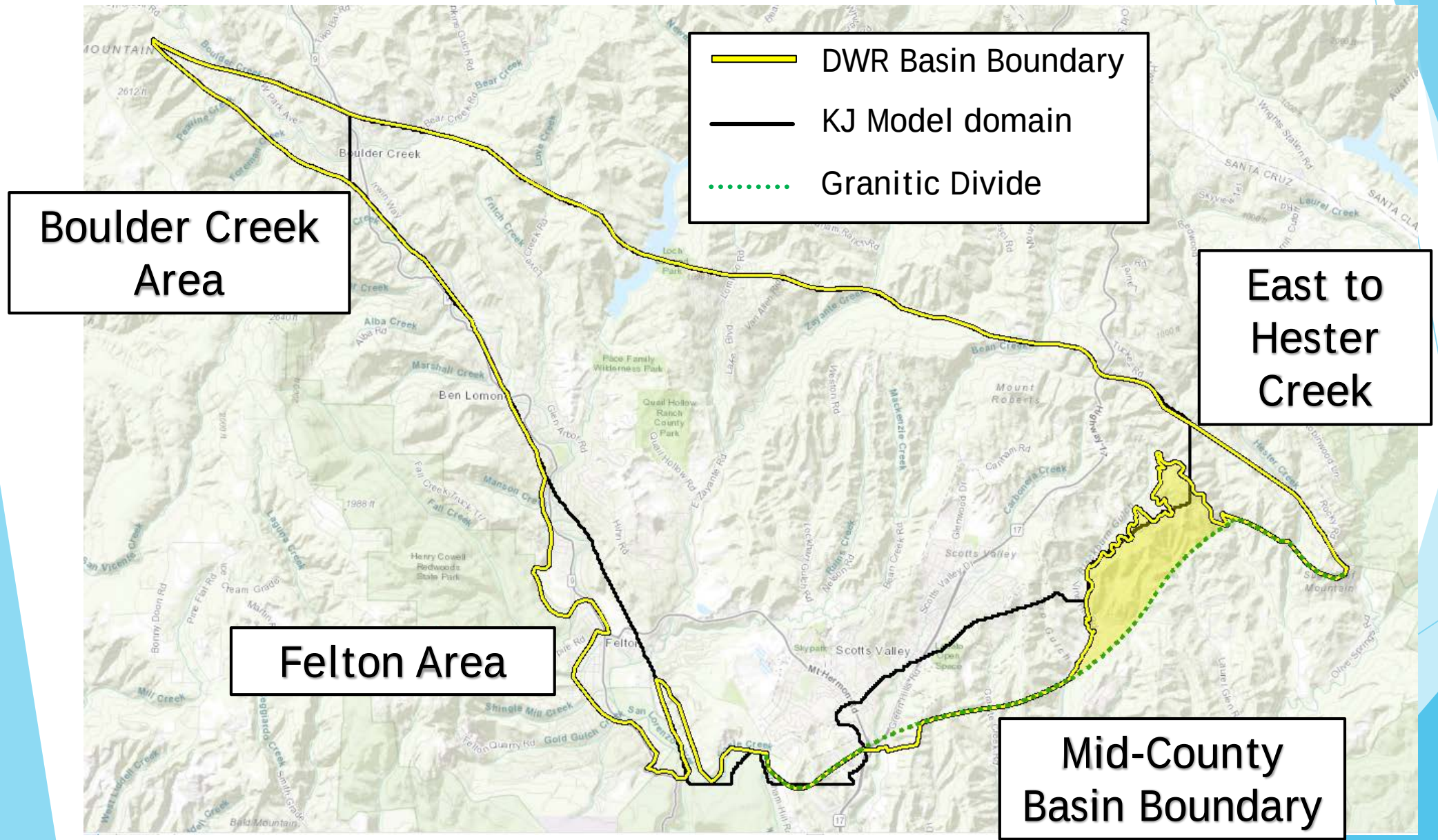
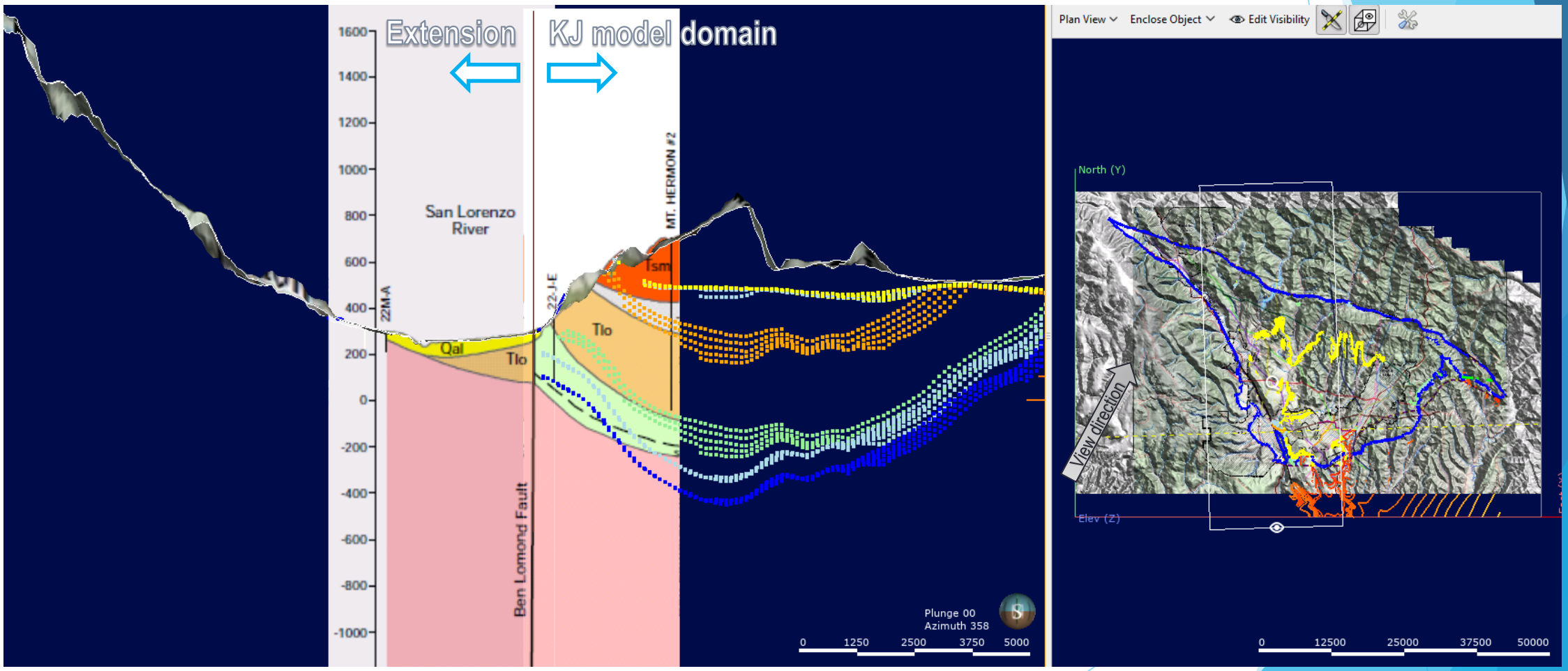
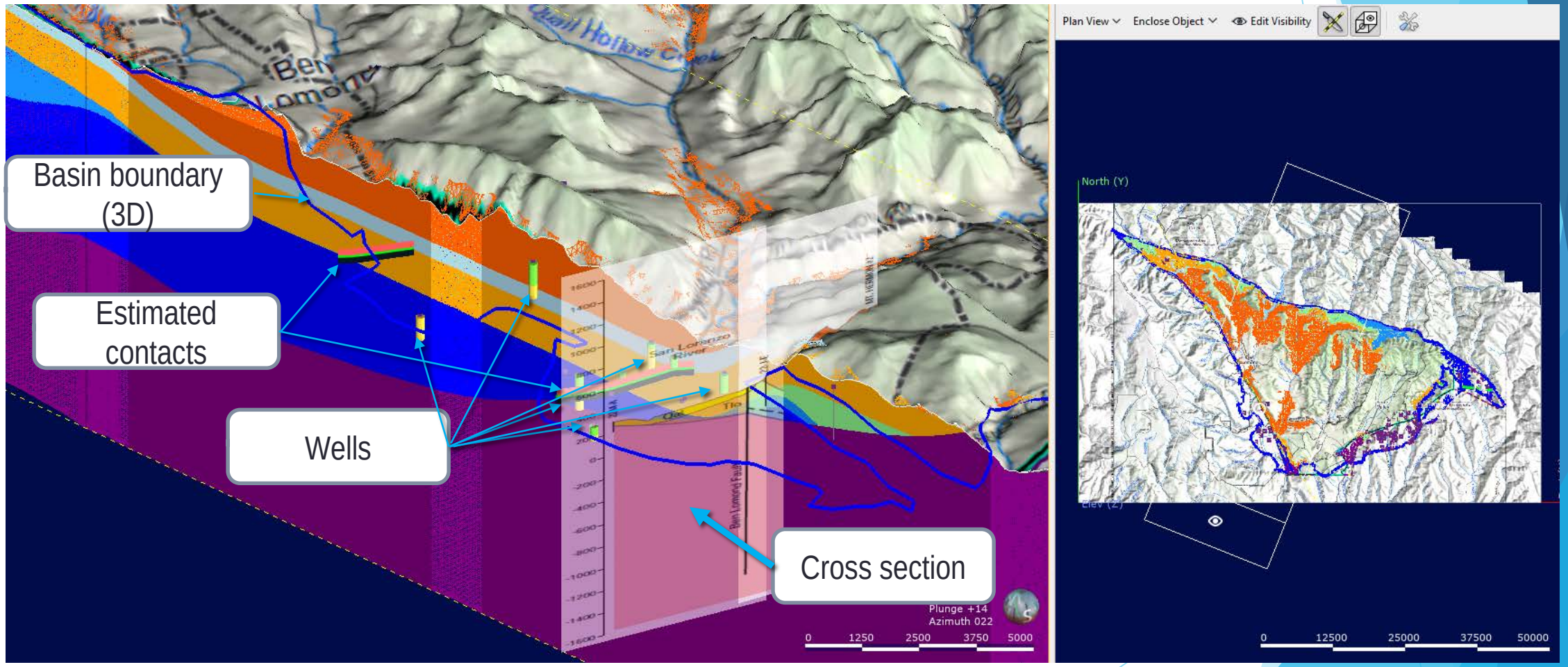
Model Expanded in Four Areas



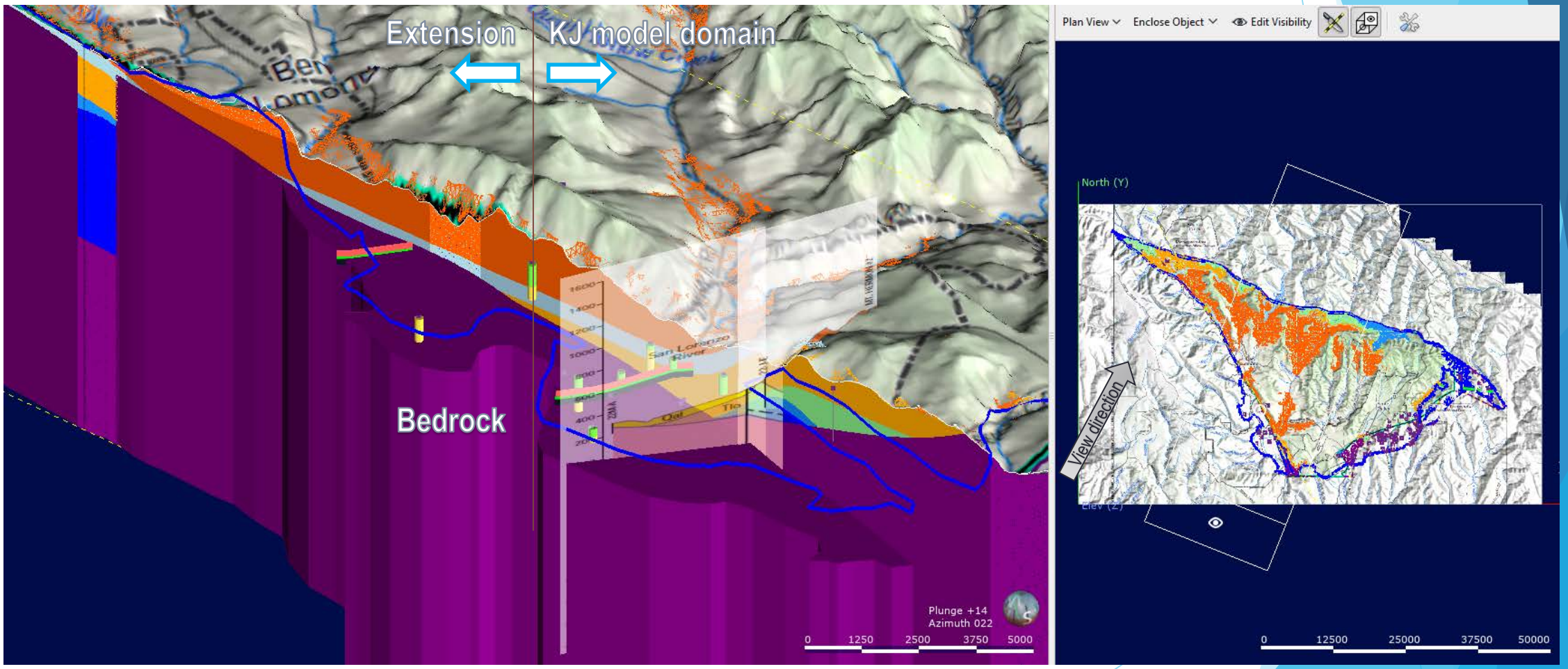
Geologic Model (Leapfrog) used to Extend Model Layers



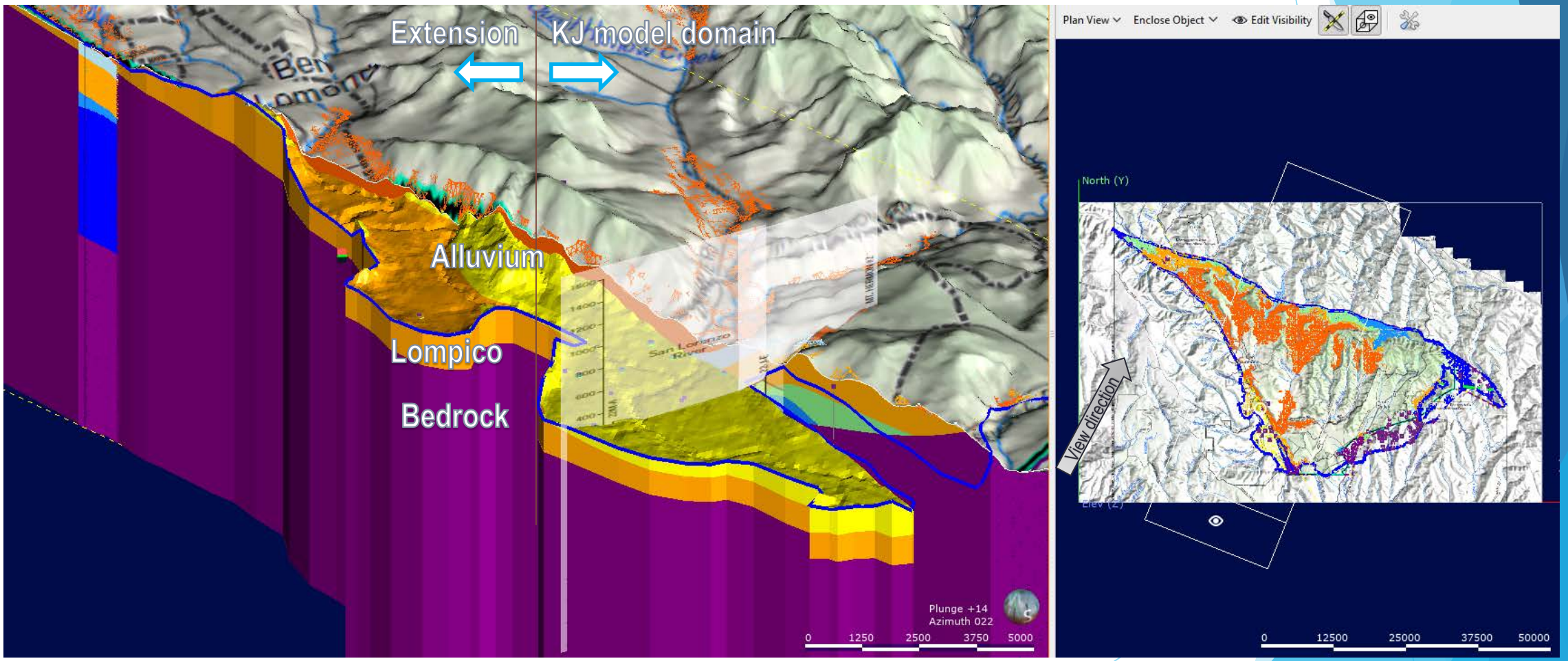
Geologic Model incorporates multiple types of information



Example view of area east of Ben Lomond Fault

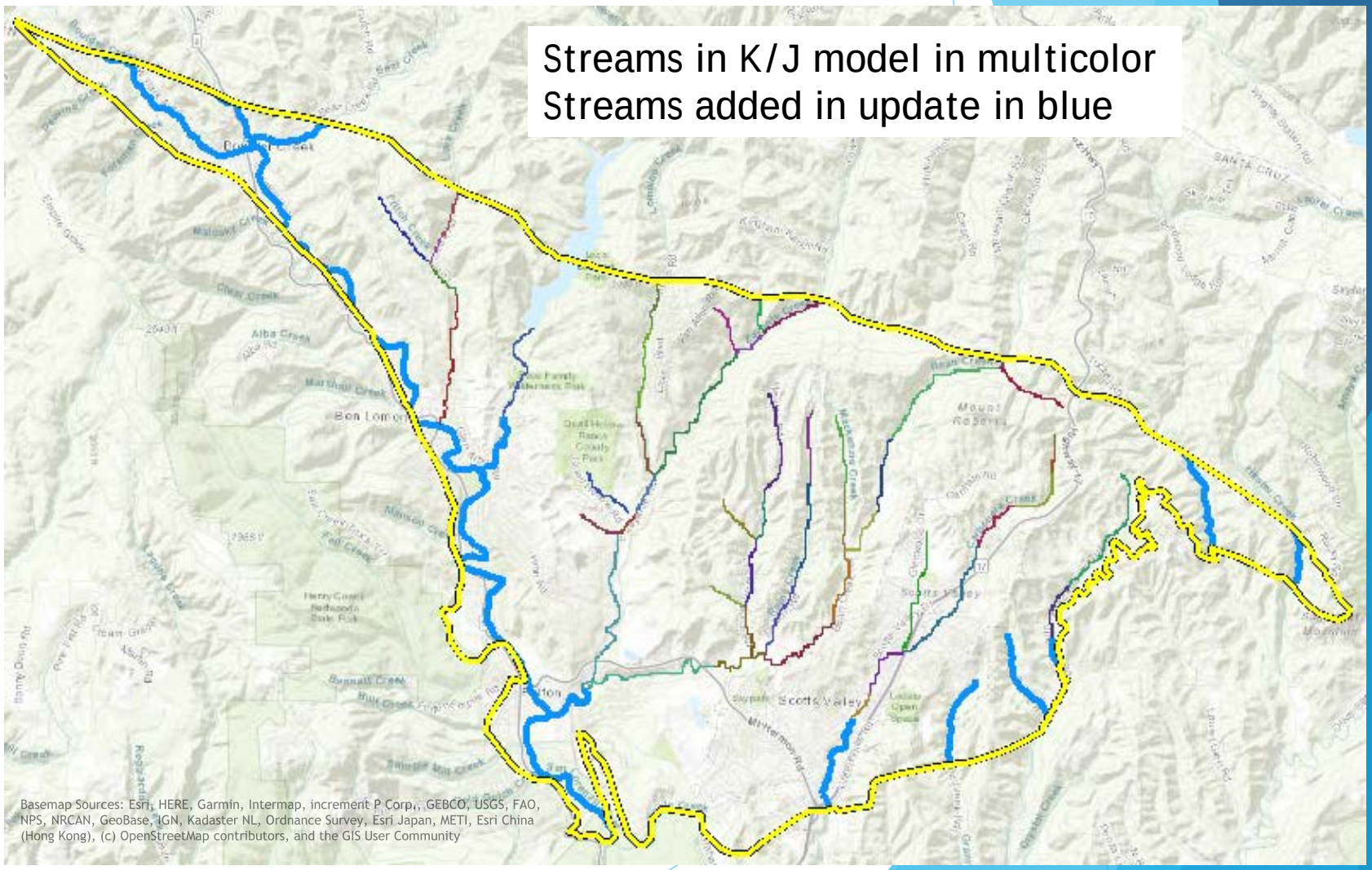


Example view of Felton Area west of Ben Lomond Fault



Model Expansion Requires Adding to the Stream Network

- Added new streams to account for surface water and groundwater interaction in extended areas
- Converted San Lorenzo River to be part of the basin stream network



Modify Boundary Conditions for Consistency with Santa Cruz Mid-County Basin

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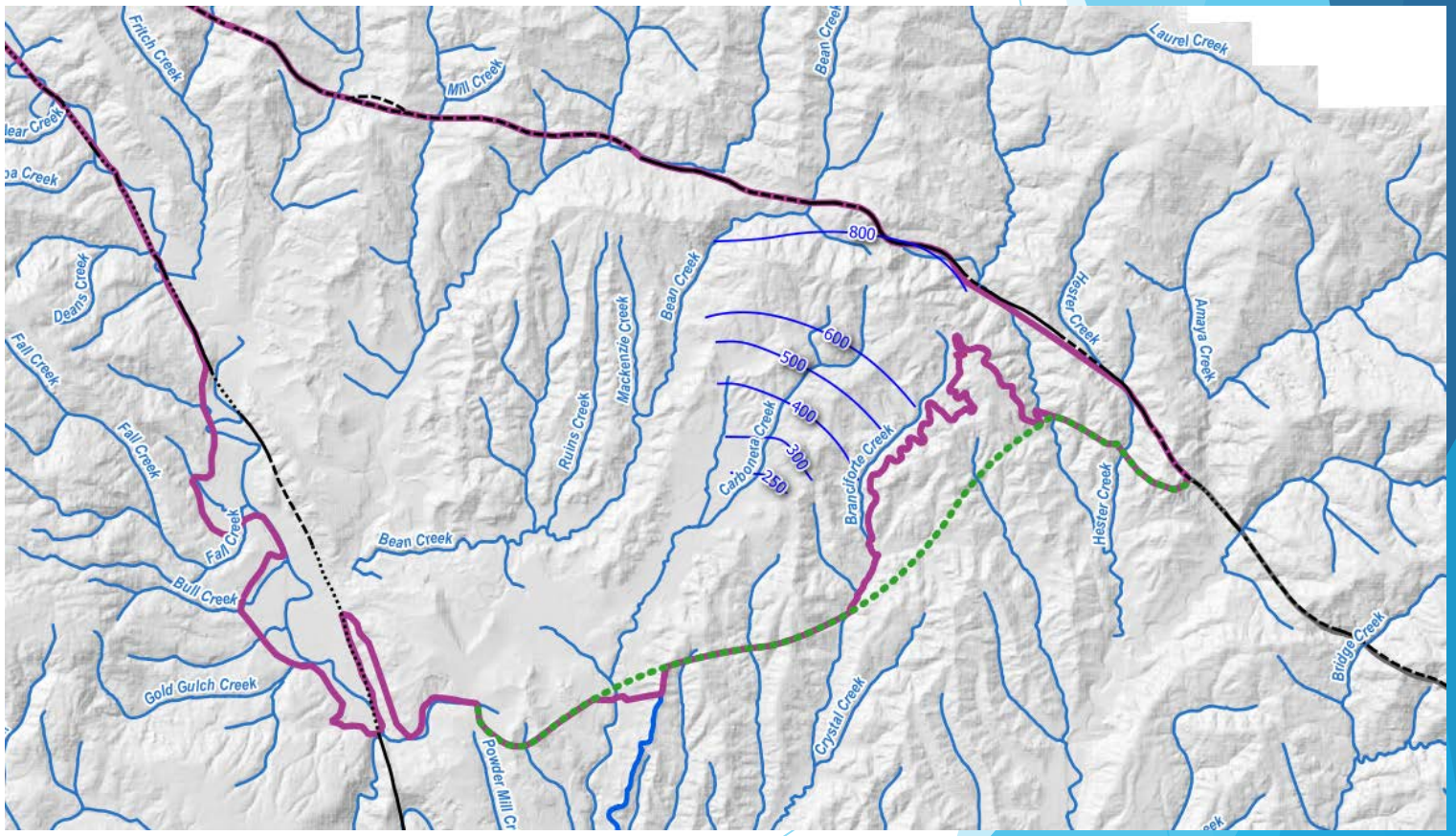
Modify Model to be Consistent with Basin Boundary Modification

- Groundwater level data and results from Santa Cruz Mid-County Basin model are consistent with no-flow boundary along the granitic divide
- Model extended east of basin boundary to granitic divide



Develop Projected Hydrology including Compatibility with Climate Change

II. SGMA OBJECTIVES

Objective	Evaluation	Notes	Recommendation
Water Budget			
Historical (1985-2016) and current (2015) conditions	✓	1985-2016	---
Forecasting changes and undesirable results (50-year planning and implementation horizon)			
Predicted response	No	2016-2066	Develop projected hydrology including climate change effects on rainfall and temperature.
Chronic lowering of groundwater levels	✓	2016-2066	Develop projected hydrology
Reduction of groundwater storage	✓	2016-2066	Develop projected hydrology
Land subsidence	No	Not applicable	---
Seawater intrusion	No	Not applicable	---
Degraded groundwater quality	No	Superfund site and non-point source nitrogen issues.	Implement MT3D or MODPATH as/if needed (not required by DWR).
Depletions of surface water interconnected to groundwater	✓	Baseflows needed to address fishery and supply issues.	Develop projected hydrology
Other Criteria			
Land Use changes	No	Paving and cannabis farms can change rainfall and runoff.	Develop methodology/instructions to adjust land use in recharge estimator.

California Department of Water Resources Sustainable Groundwater Management Program, "Best Management Practices for the Sustainable Management of Groundwater Modeling BMP," December 2016.
California Department of Water Resources and Climate Change Technical Advisory Group, "Perspectives and Guidance for Climate Change Analysis," August 2015.

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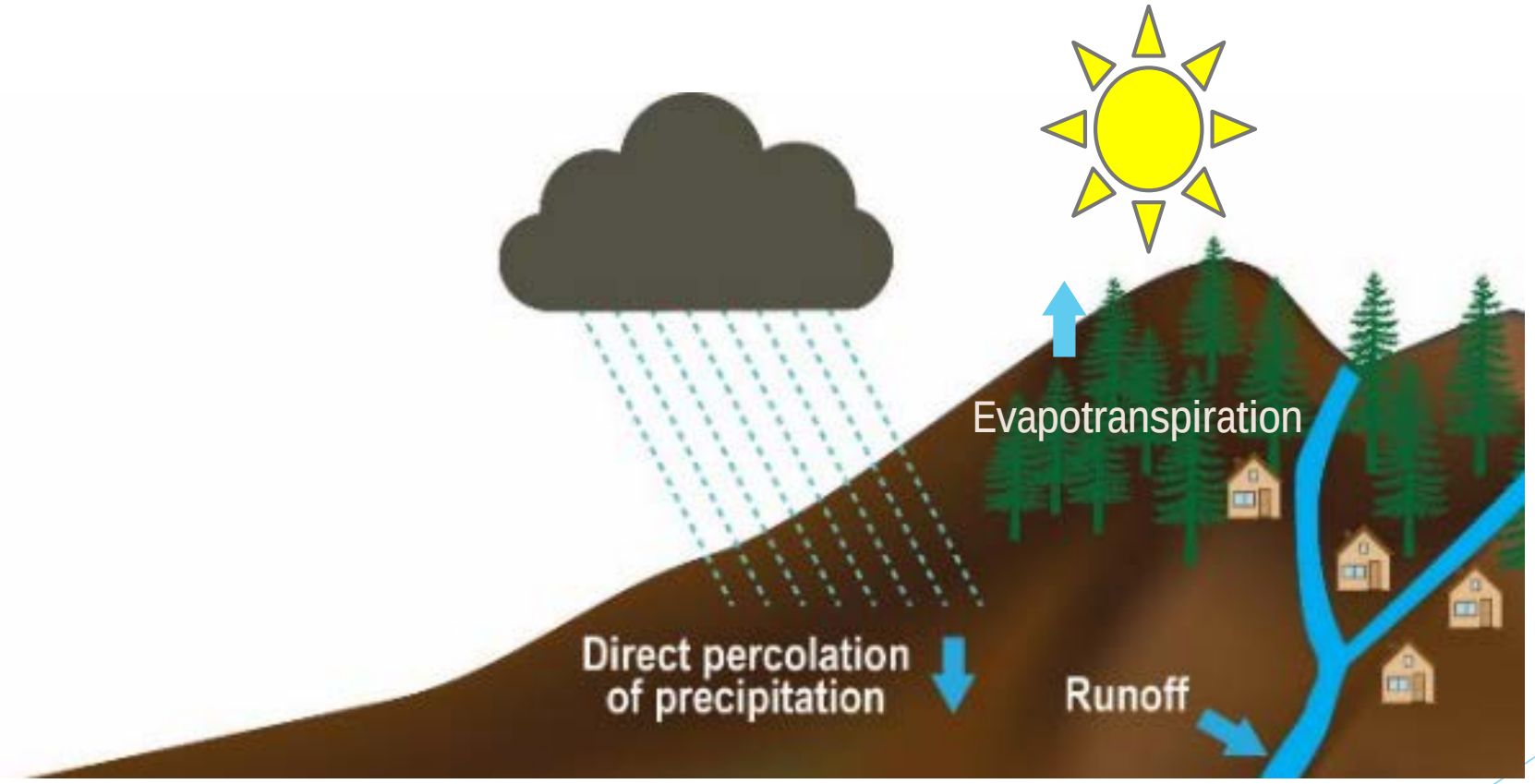
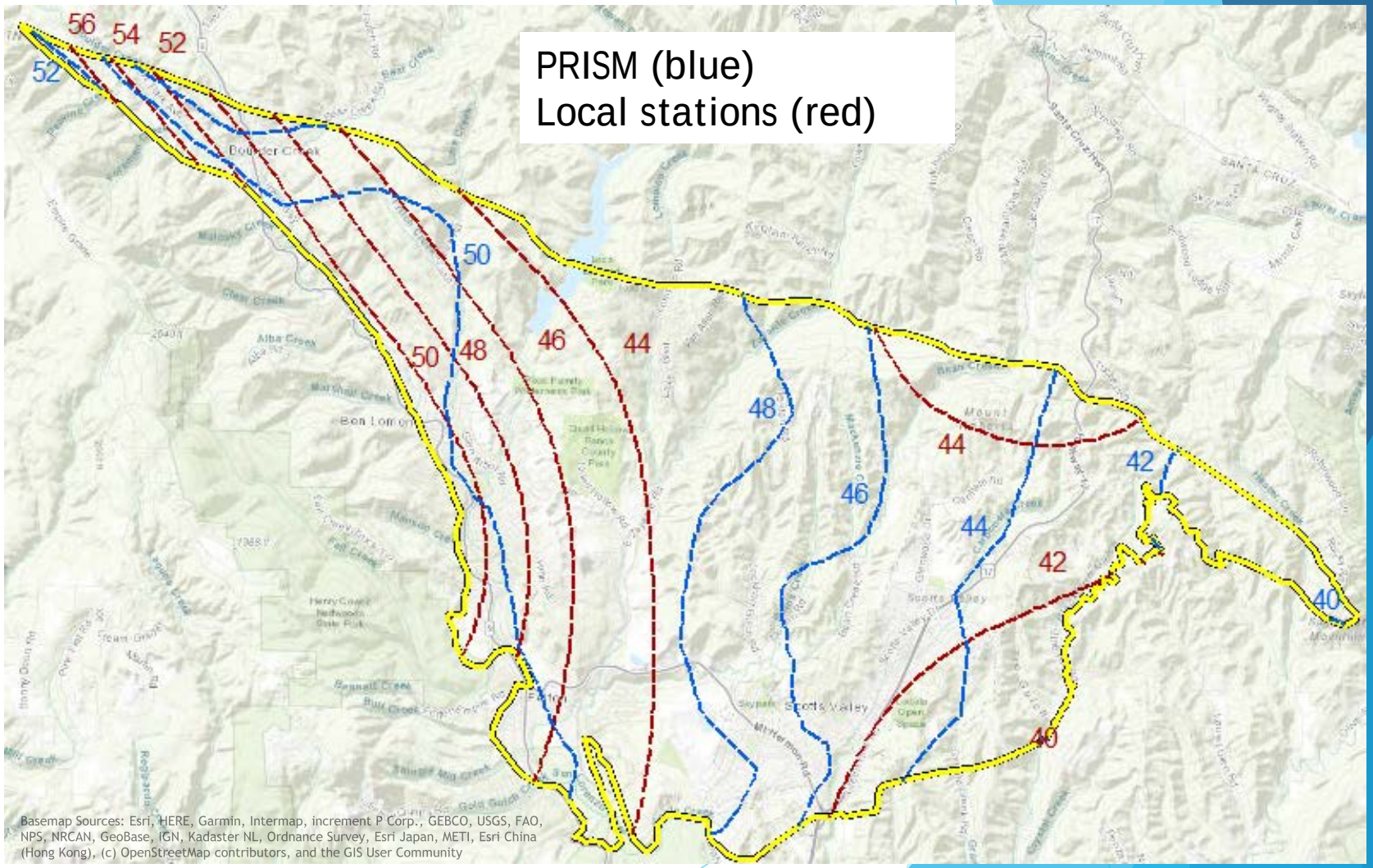
Rainfall and temperature should affect recharge



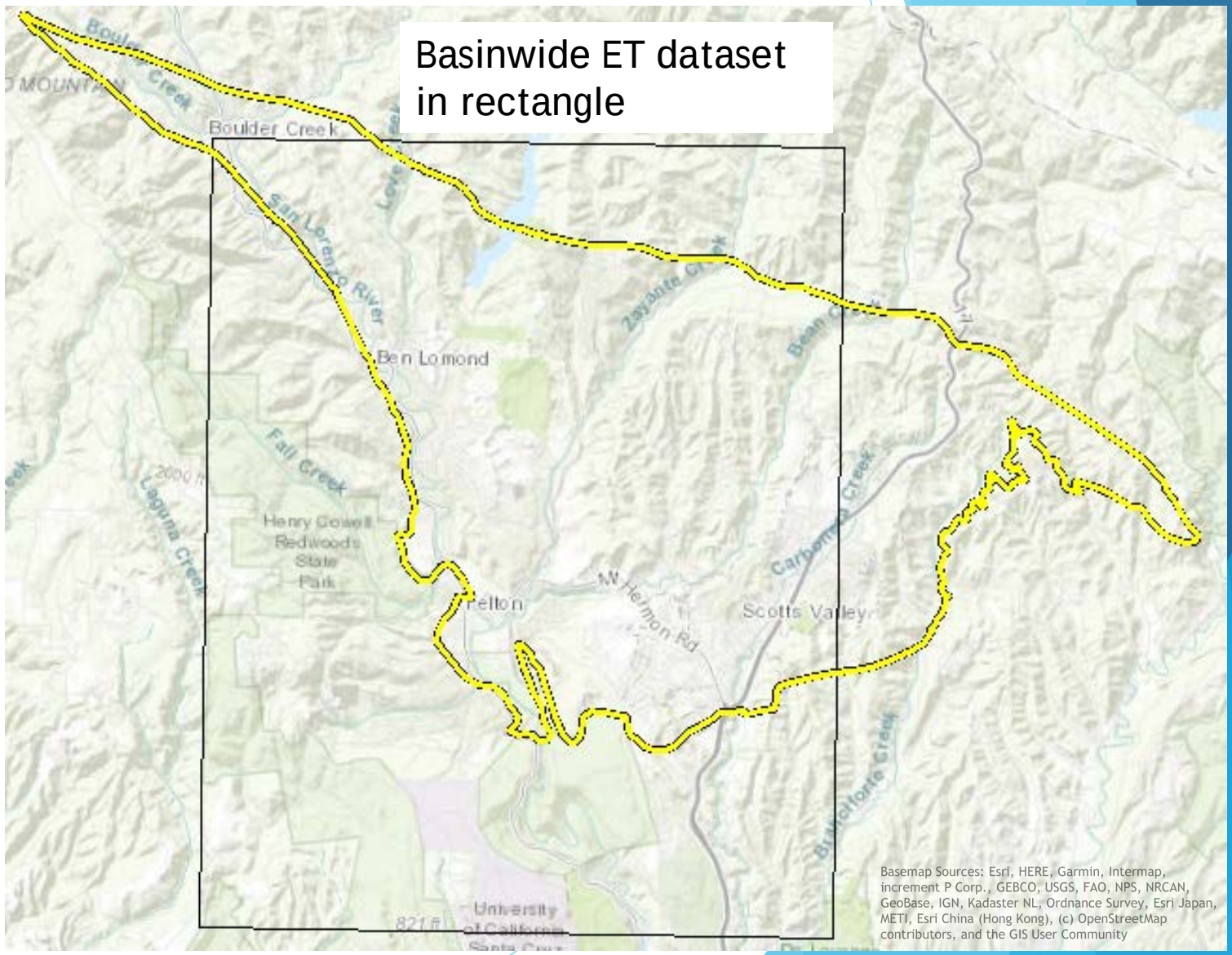
Revise Rainfall Distribution so Future Climate Change can be Applied

- Switched from local station data to PRISM to match grid-based climate change datasets
- PRISM is based on many stations and distributes slightly higher amounts of rainfall in the basin



Revise Evapotranspiration (ET) so Future Temperature Projections can be Simulated

- Calculate recharge and runoff using ET consistent with climate change data sets
- Used PRISM temperature to extend ET through 2018



Improve Recharge Estimator

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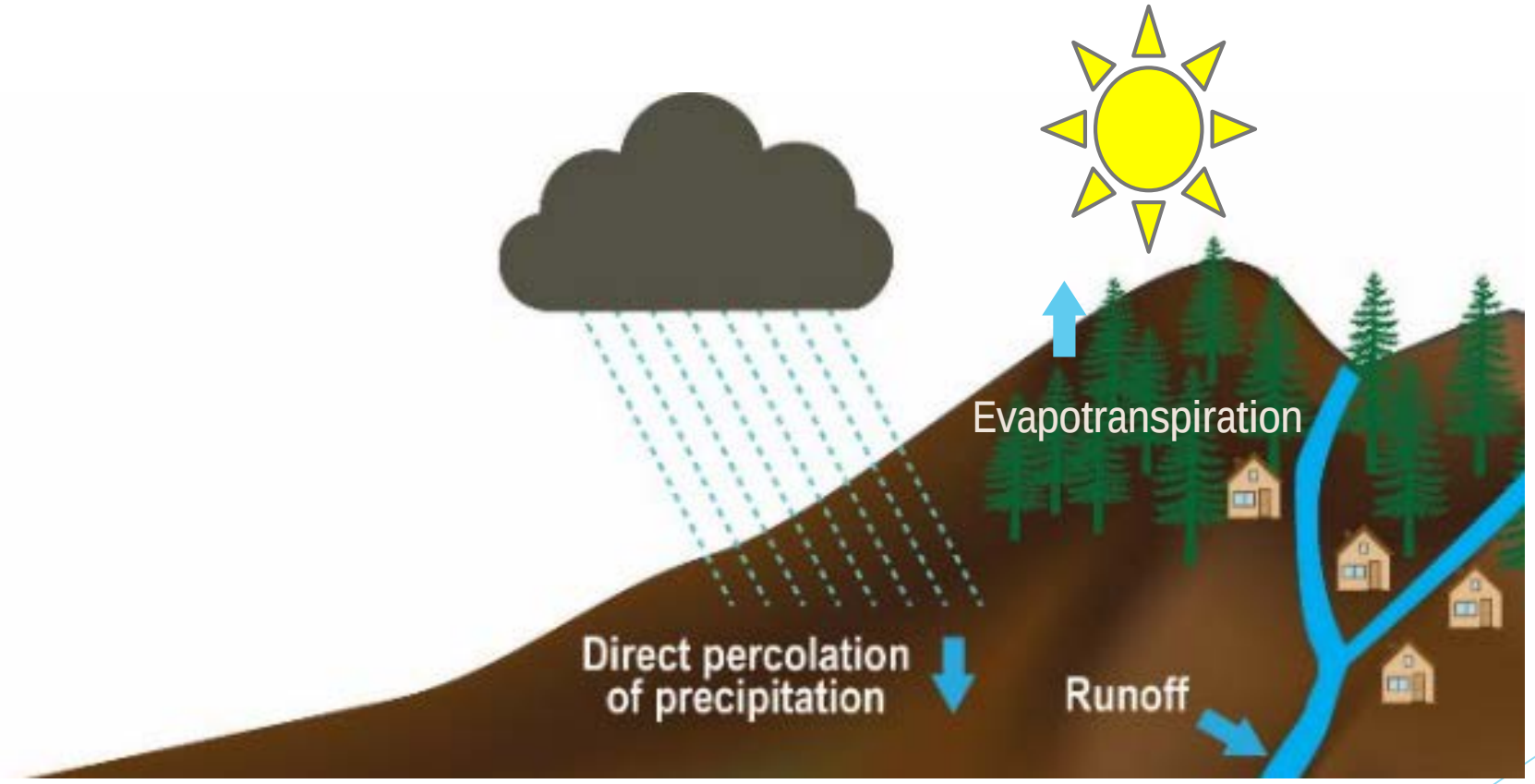
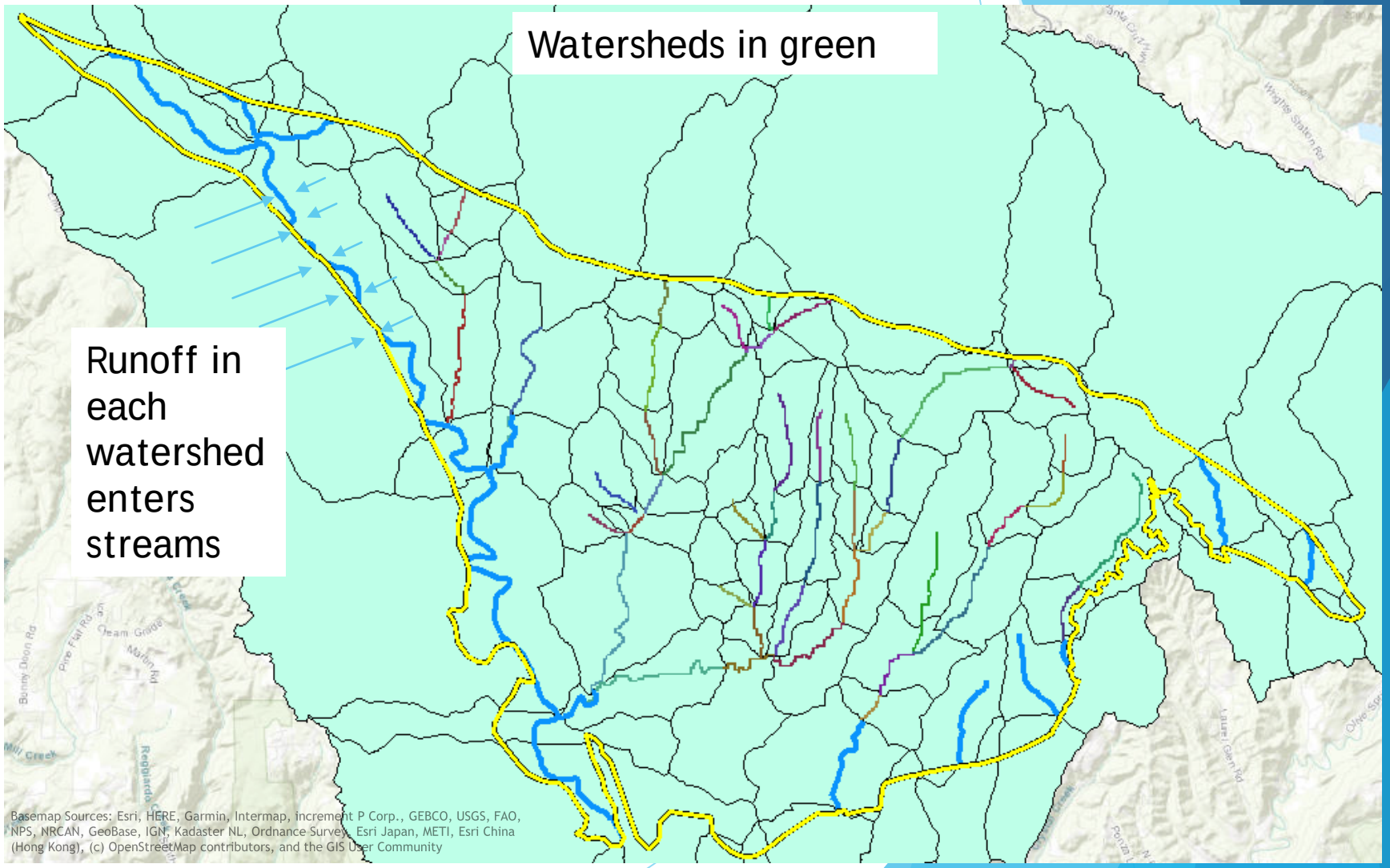
Revise Recharge Calculation so Climate Change can be Simulated



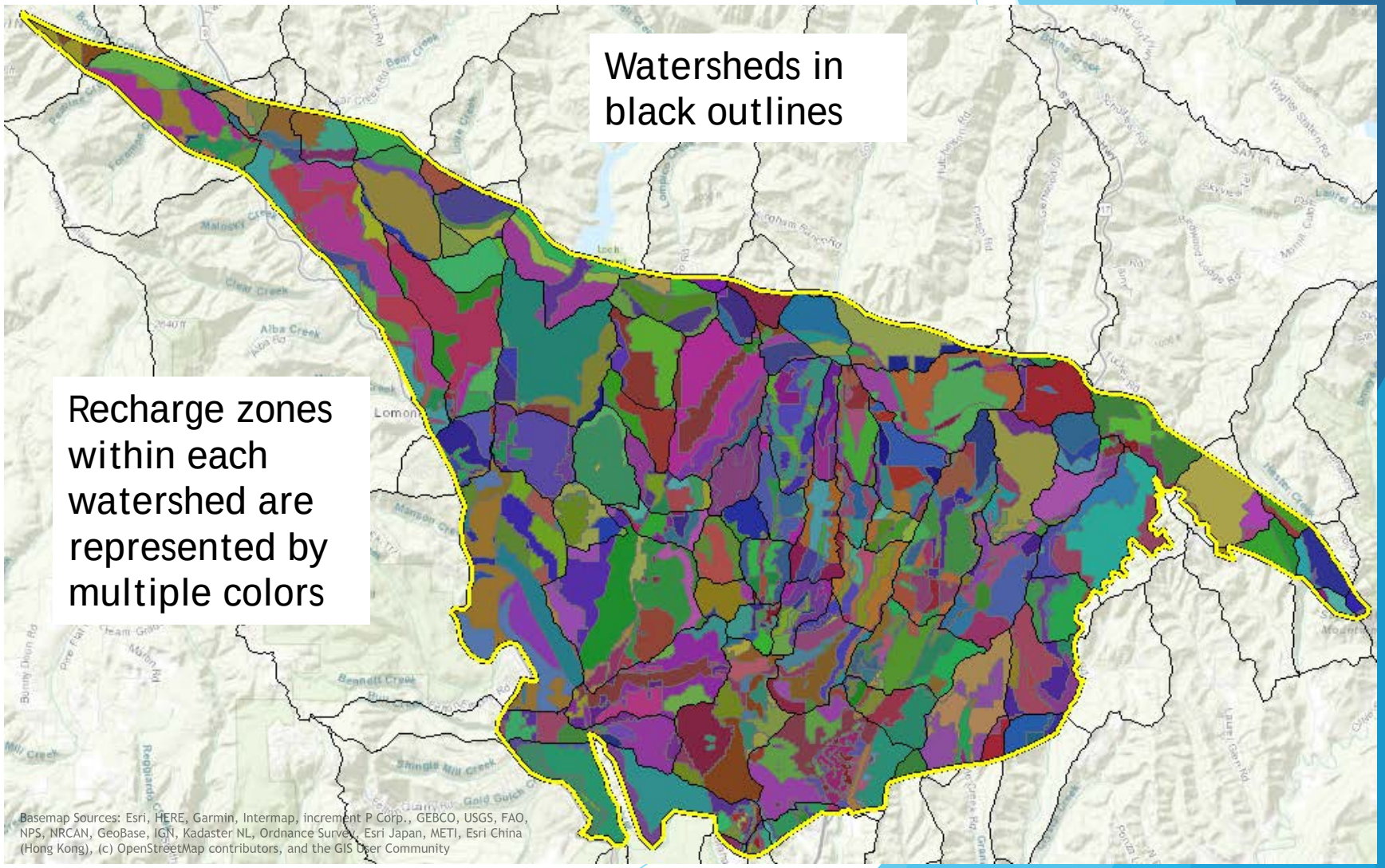
Revise Calculation of Runoff in Recharge Estimator

- Updated calculations for documentation and clarity
- Remaining water from rainfall – ET is proportioned to runoff and recharge



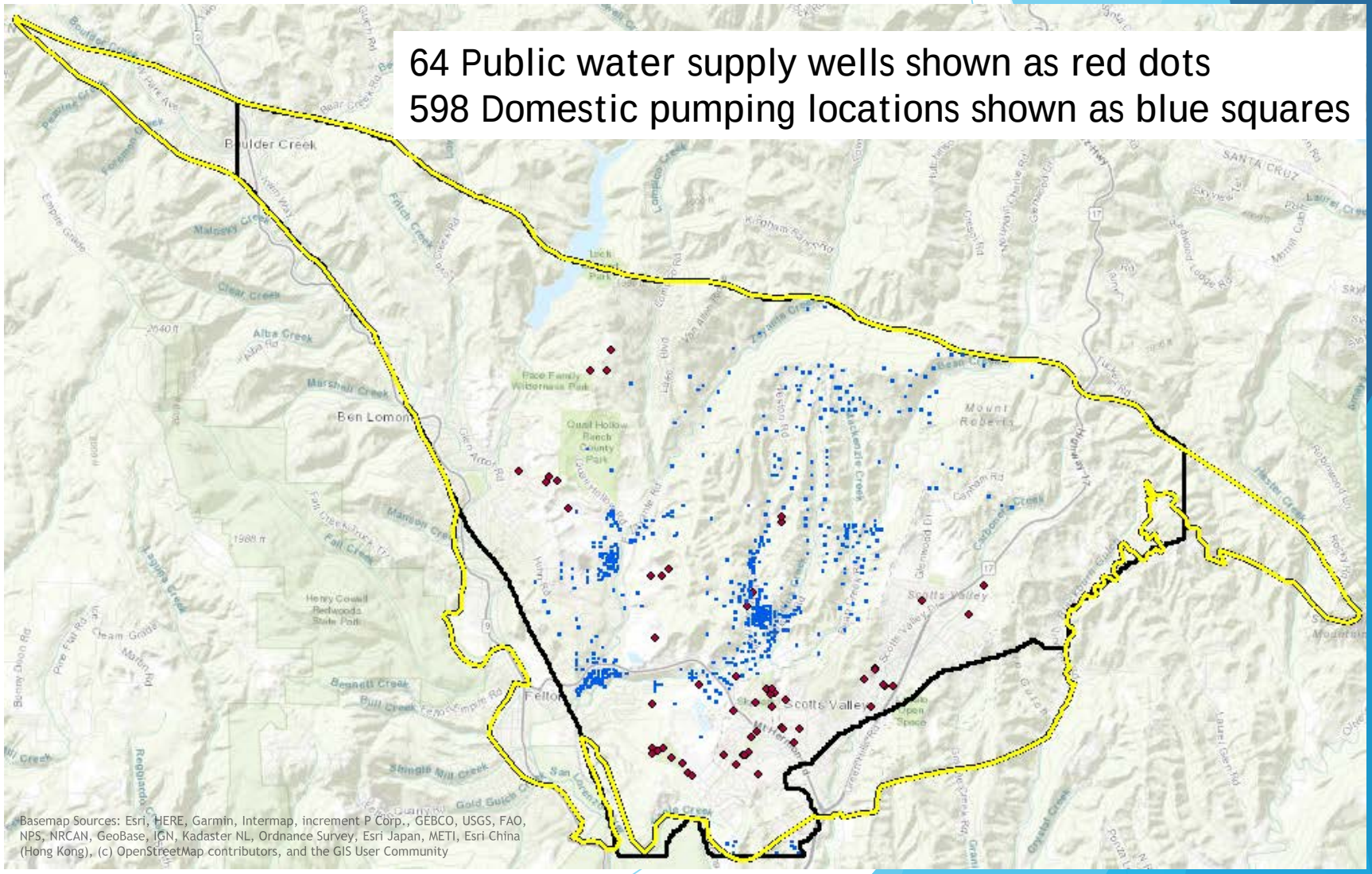
Recharge is dependent on land use and geology

- Remaining water after runoff is distributed as recharge
- Recharge zones in each watershed defined based on land use and geology



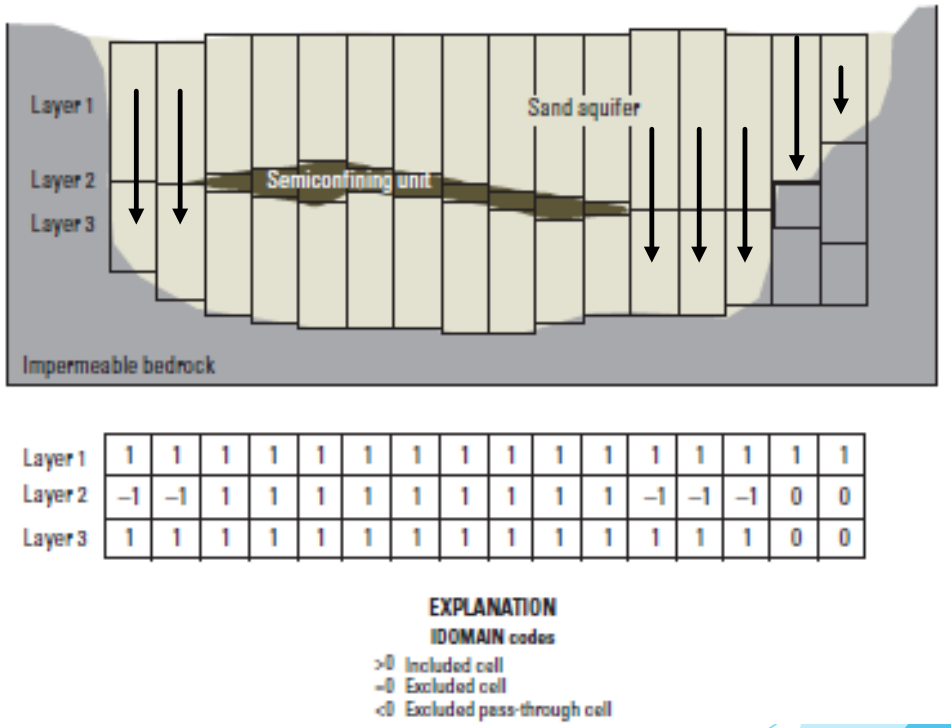
Improve estimates for groundwater pumping

- Incorporated additional data for public water supply wells
- More comprehensive mapping of domestic pumping



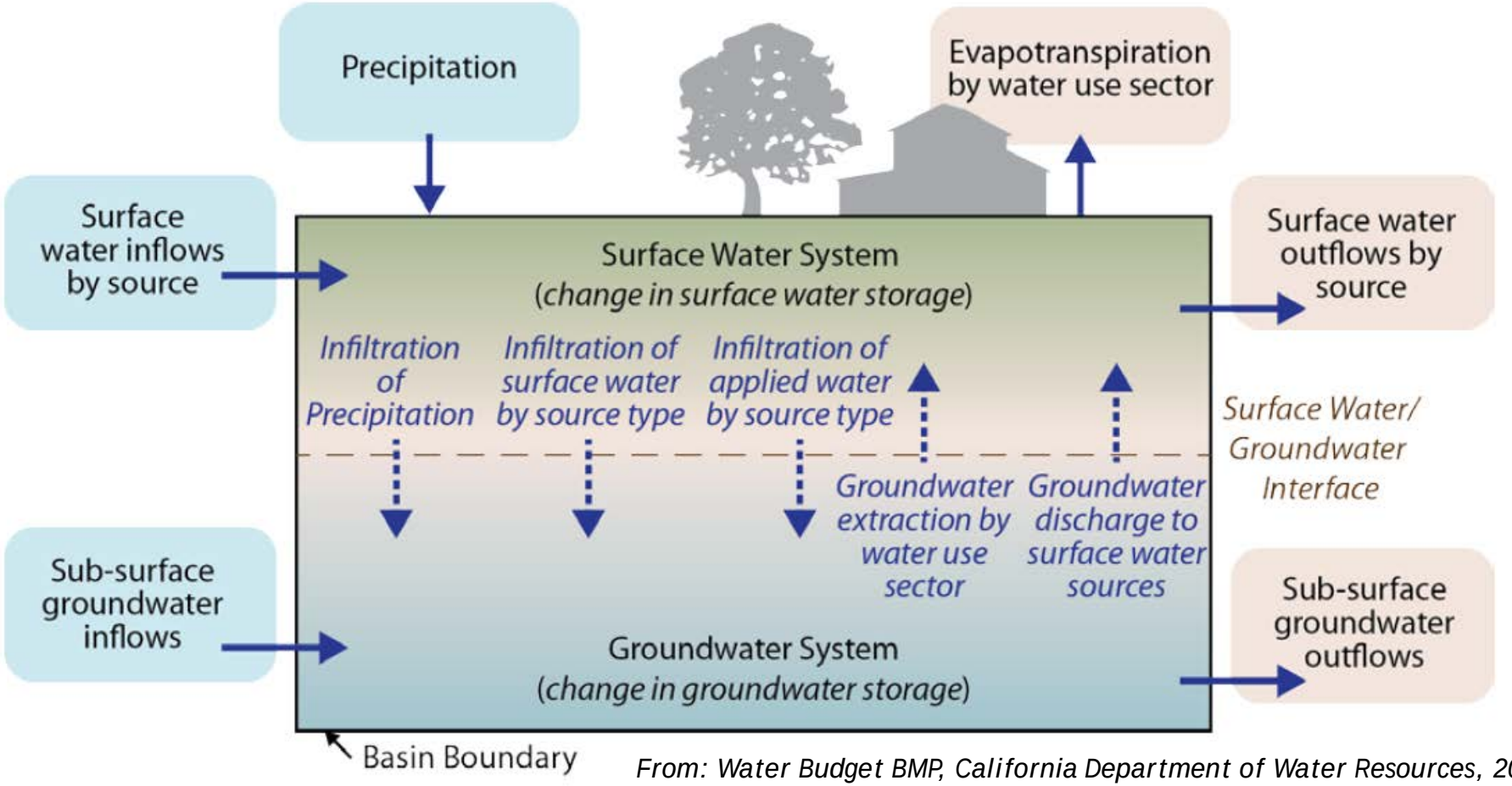
Update to MODFLOW 6 for Numerical Efficiency

- MODFLOW 6 is most recent core version released by USGS
- New capability to exclude layers from calculation where they do not exist



Modified from source: Langevin, C.D., Hughes, J.D., Banta, E.R., Niswonger, R.G., Panday, Sorab, and Provost, A.M., 2017, Documentation for the MODFLOW 6 Groundwater Flow Model: U.S. Geological Survey Techniques and Methods, book 6, chap. A55, 197 p., https://doi.org/10.3133/tm6A55.

MODFLOW 6 facilitates calculation of specific water budget components



From: Water Budget BMP, California Department of Water Resources, 2016

Next Steps

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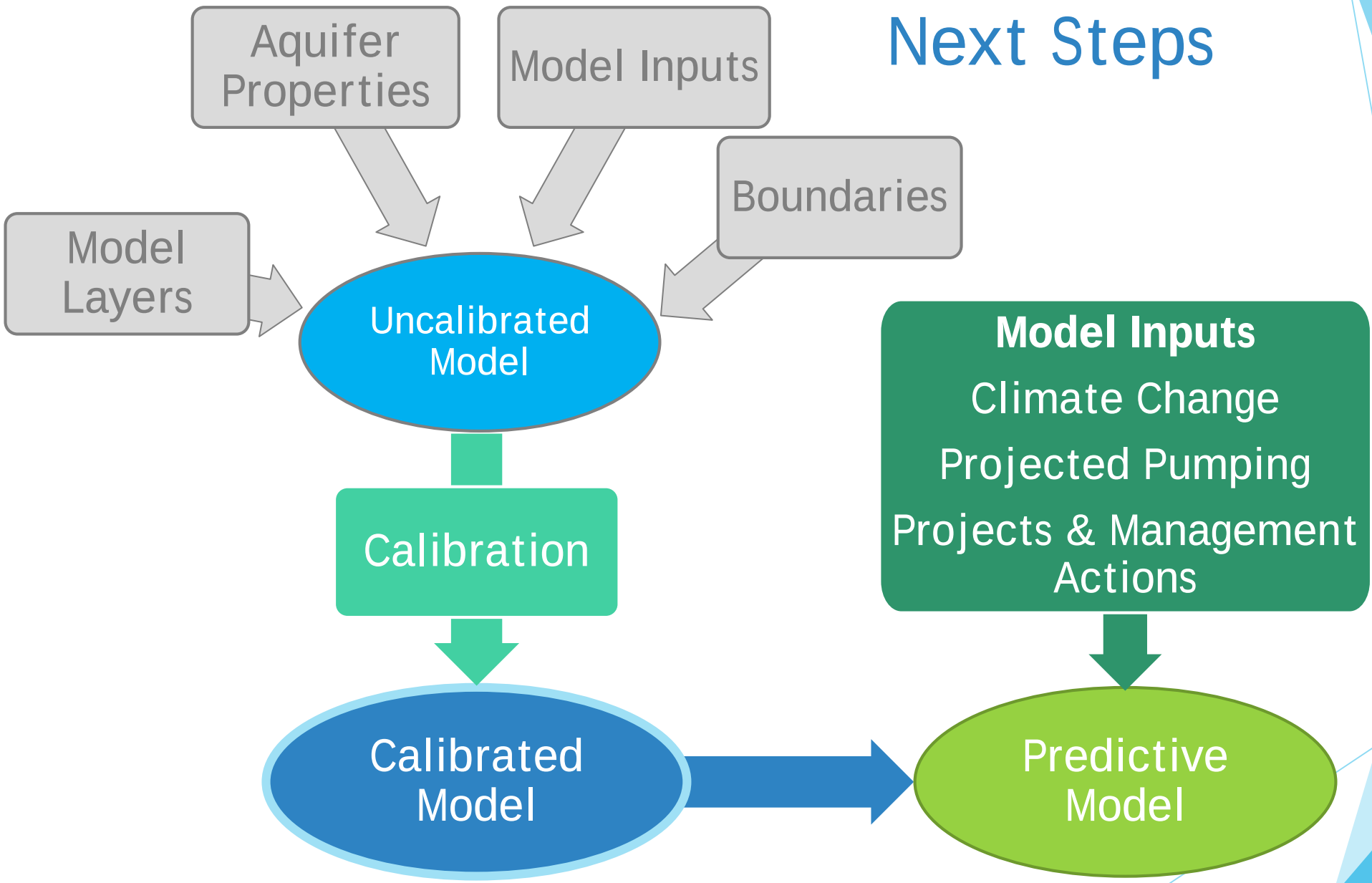
Aquifer Properties
Model Inputs
Boundaries
Model Layers
Uncalibrated Model
Calibration
Calibrated Model
Model Inputs
Climate Change
Projected Pumping
Projects & Management Actions
Predictive Model

Questions