Ukiah Valley Basin Groundwater Sustainability Agency Technical Advisory Committee Meeting

Ukiah Valley Groundwater Sustainability Plan Development Update

October 15, 2019

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GEI Consultants
UC Davis Water Management Lab
SCI Consulting Group

Outline

- HCM & DMS Update and Discussion
- Water Budget Preliminary Discussion
  - Root Zone Water Budget
  - Hydrological Model
  - Groundwater Model
  - Integration
- Review and Commenting Process
- Prop. 68 Grant

Draft Hydrogeologic Conceptual Model

Ukiah Valley Basin Groundwater Sustainability Plan

Overview

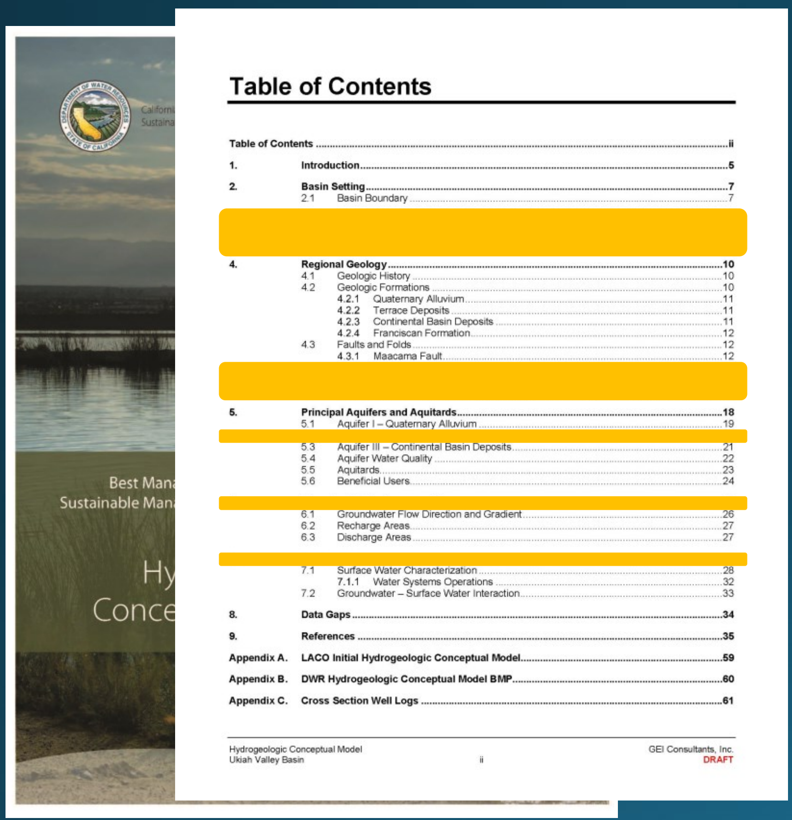
HCM Structure and SGMA Requirements

Significant Sections and Changes

Data Gaps and Additional Analysis

DMS

HCM Structure and SGMA



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Ukiah Valley Basin ii GEI Consultants, Inc.
DRAFT

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HCM Structure and SGMA Requirements

Significant Sections and Changes

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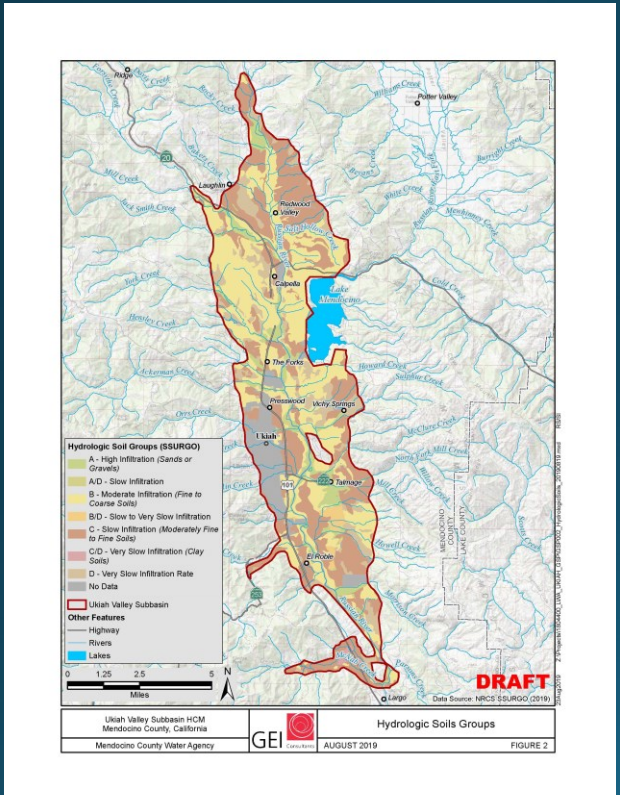
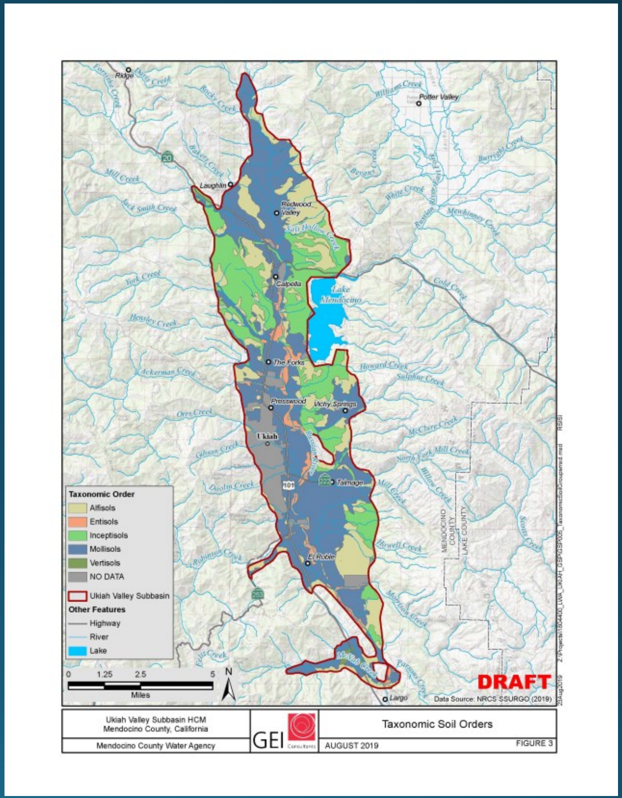
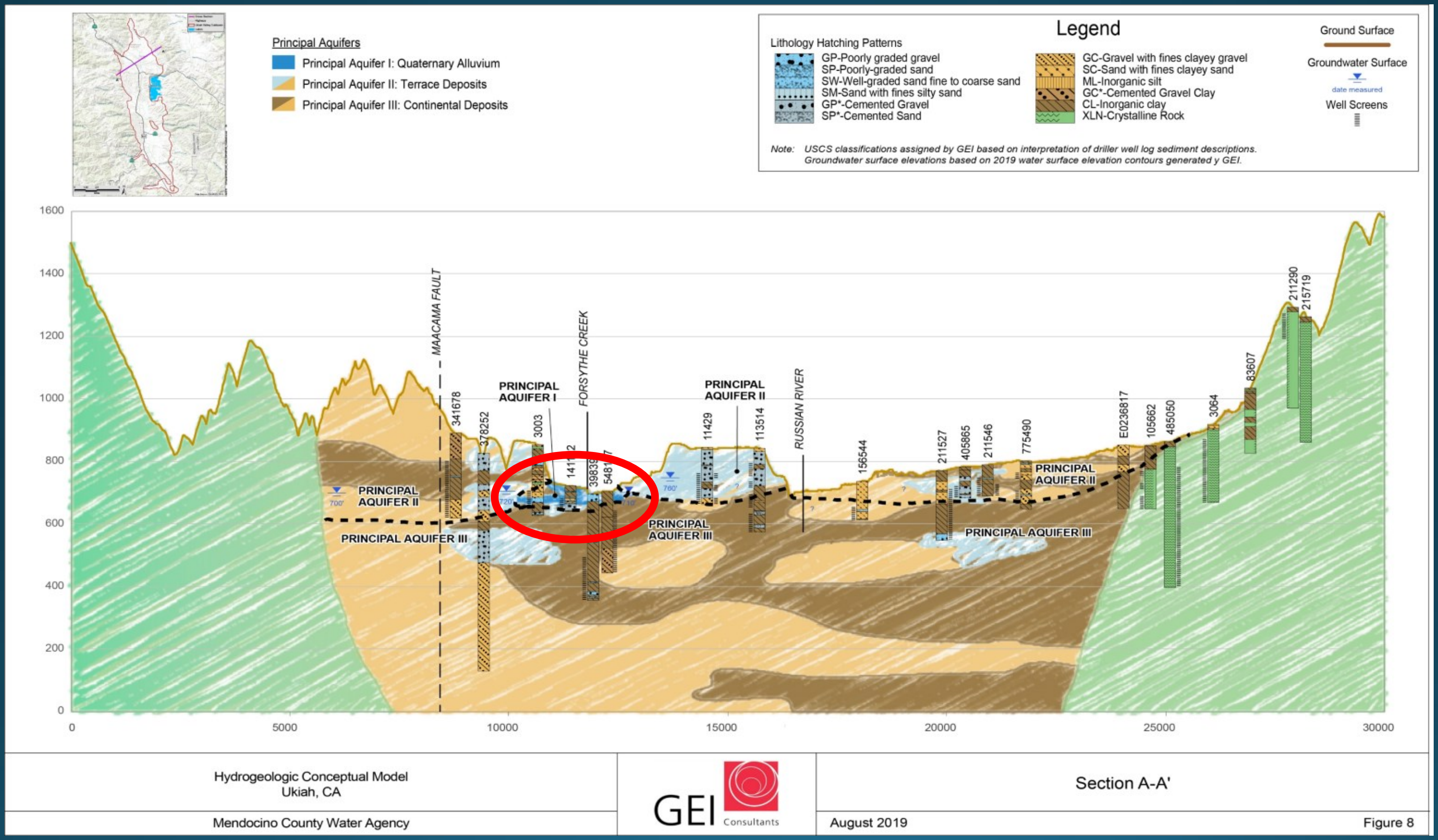
DMS

Soils Analysis





Textural Cross Sections A-A’



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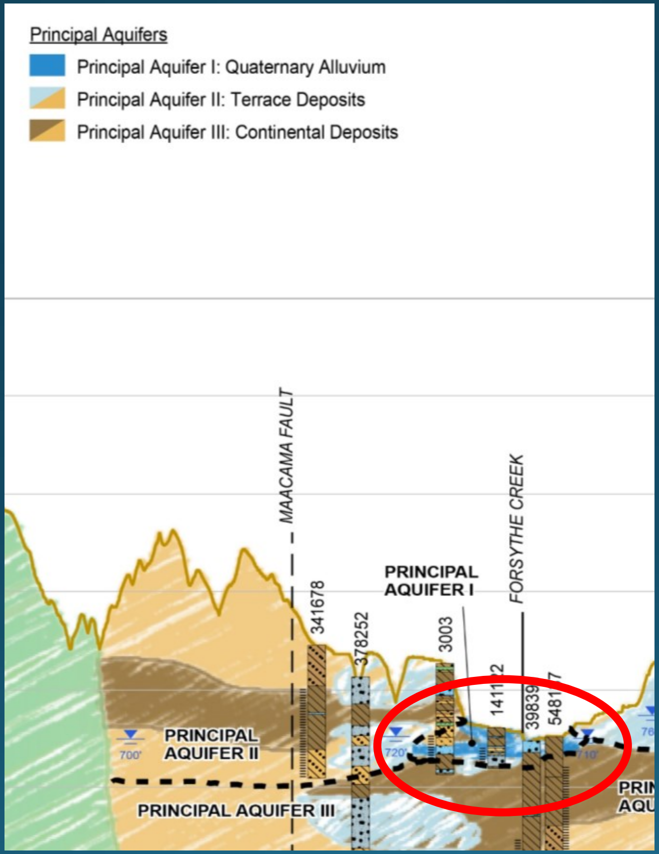
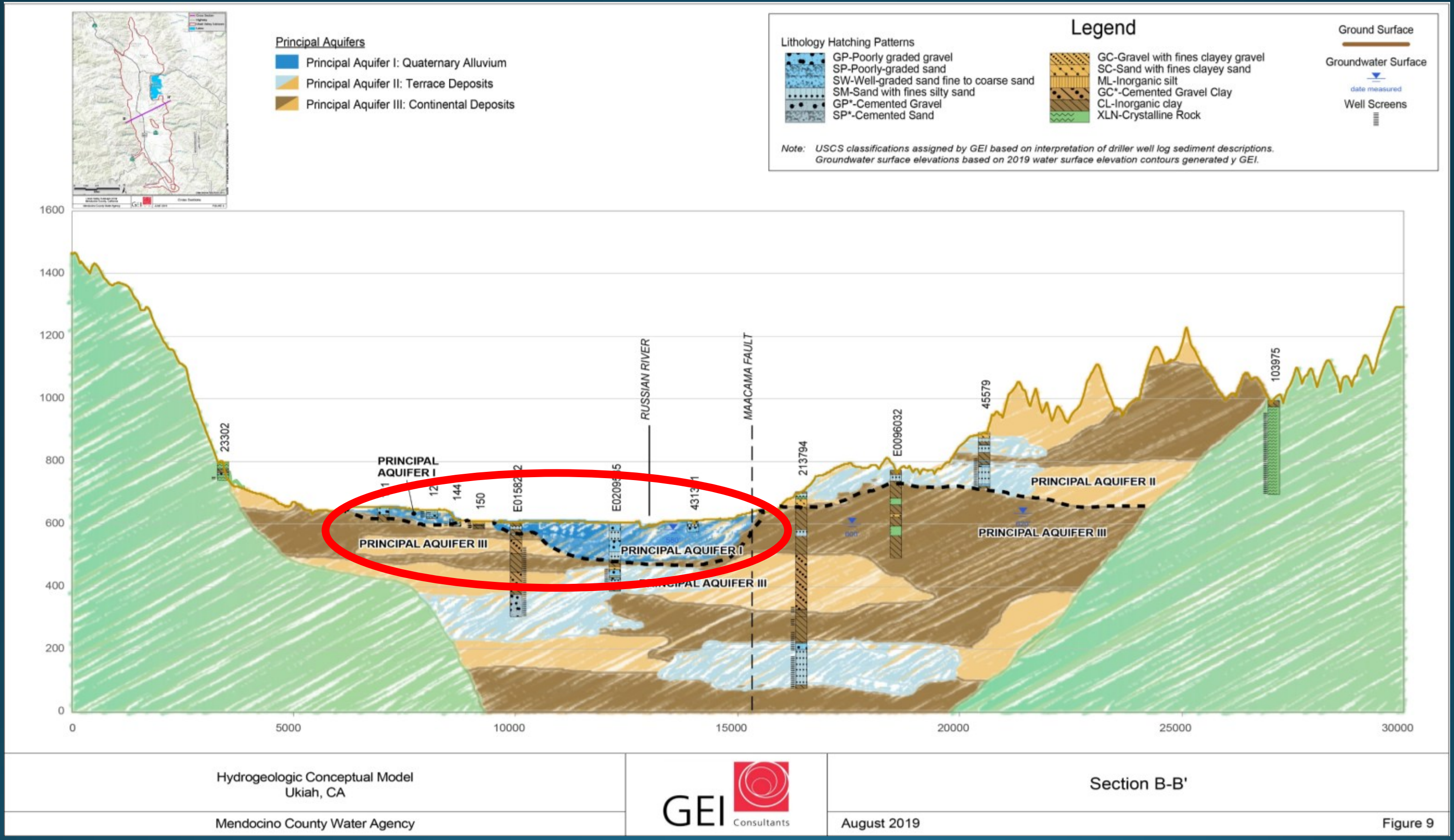
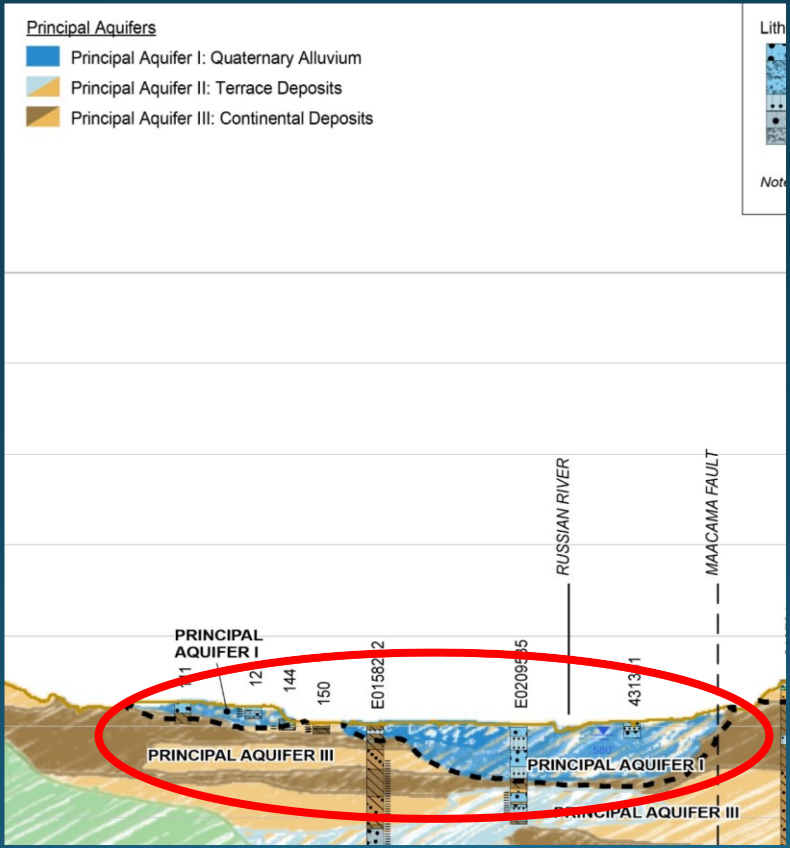


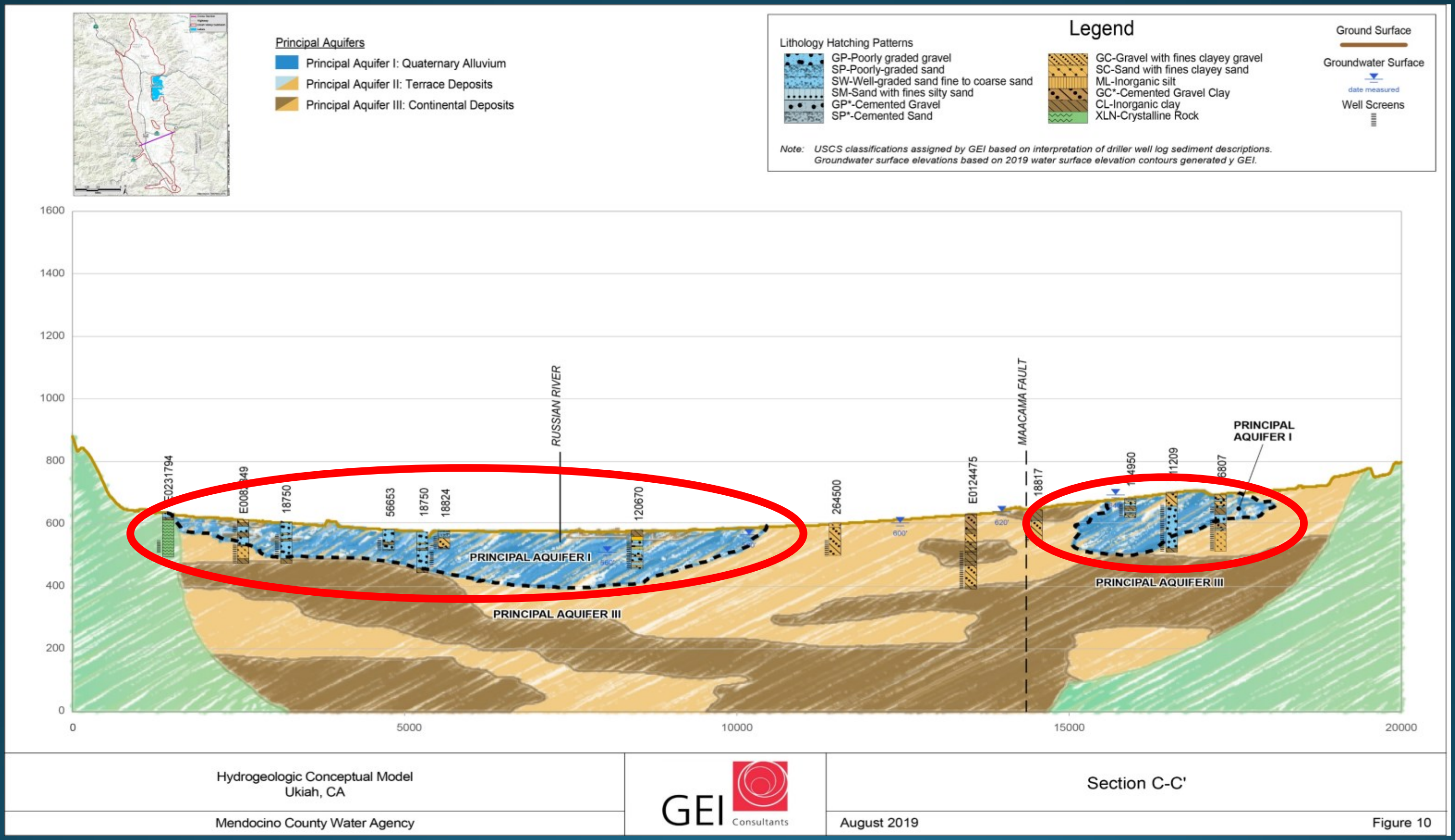
Textural Cross Sections B-B’



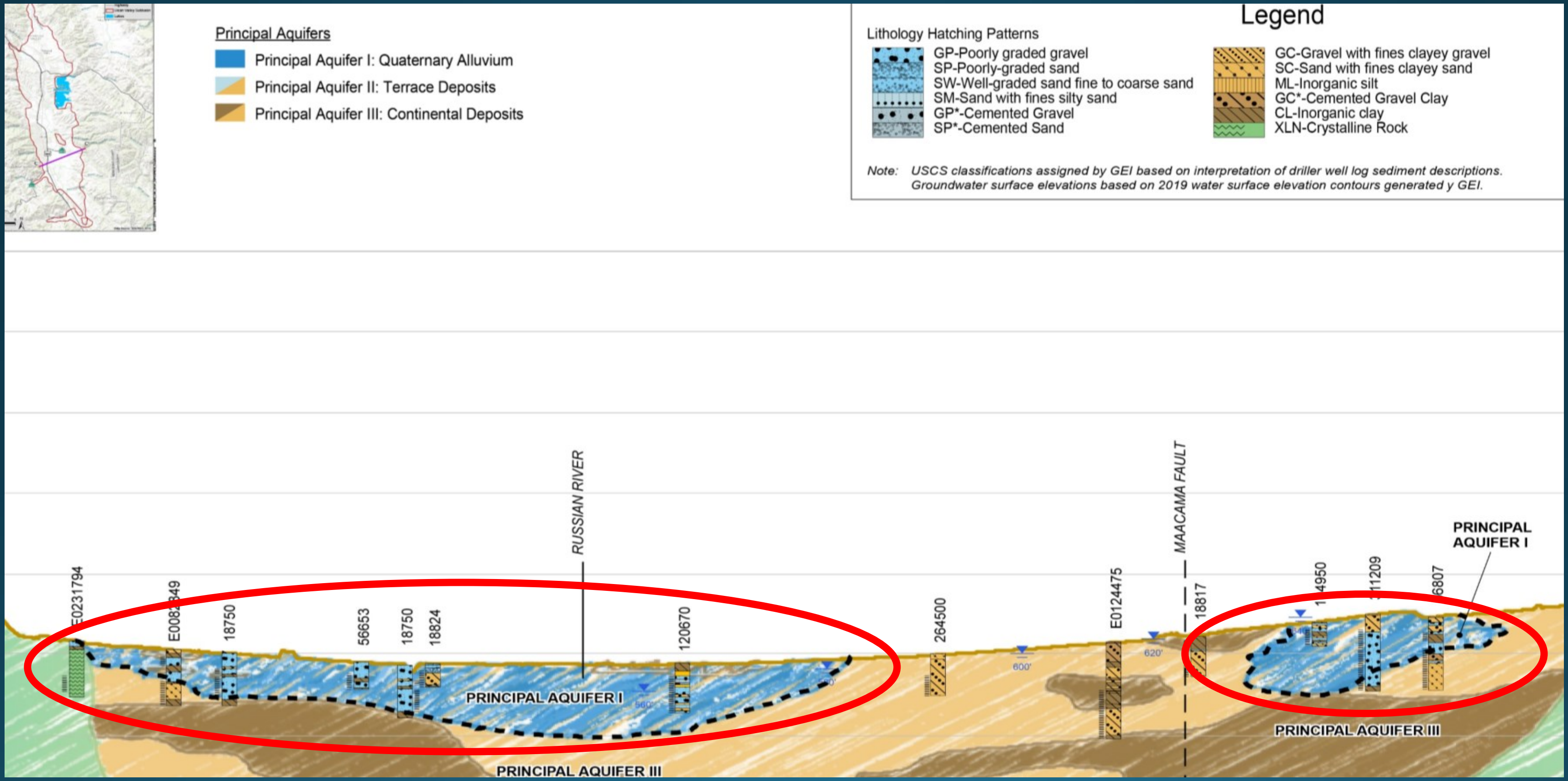
Textural Cross Sections B-B’



Textural Cross Sections C-C'



Textural Cross Sections C-C'



Principal Aquifers

3 Principal Aquifers

- Quaternary Alluvium
- **Terrace Deposits**
- Continental Deposits

		Recent Alluvium		Terrace Deposits		Continental Deposits	
		Hydraulic Properties	Thickness	Hydraulic Properties	Thickness	Hydraulic Properties	Thickness
Literature Review	Cardwell	Specific Capacity: 5-400 gpm/ft Yield: > 100 gpm	50-80 ft.	Specific Capacity: < 1gpm/ft Yield: App. 60 gpm	Up to 200 ft.	Specific Capacity: < 1gpm/ft Yield: 50 gpm	1,500
	DWR 118	Specific Yield: 20%	50-80 ft.	Unconfined/confined conditions	Up to 200 ft.		Up to 2,000 ft.
	Ferrar	Connection to River Yield: up to 1,000 gpm	< 100 ft.	Specific Capacity: 0.02 - 7.1 gpm/ft Yield: 1-100 gpm		Specific Capacity: 0.004 - 1.33 gpm/ft Yield: 0.75-50 gpm	Up to 2,000 ft.
HCM		Specific Capacity: 8-33 gpm/ft Conductivity: 153-218 ft/day	20-200 ft.	Specific Capacity:0.1-5.7 gpm/ft Conductivity: 0.23 - 15.75 ft/day	Up to 200 ft.	Specific Capacity: 0.02-1.95 Conductivity: 0.01-0.51 ft/day	> 2,000 ft.

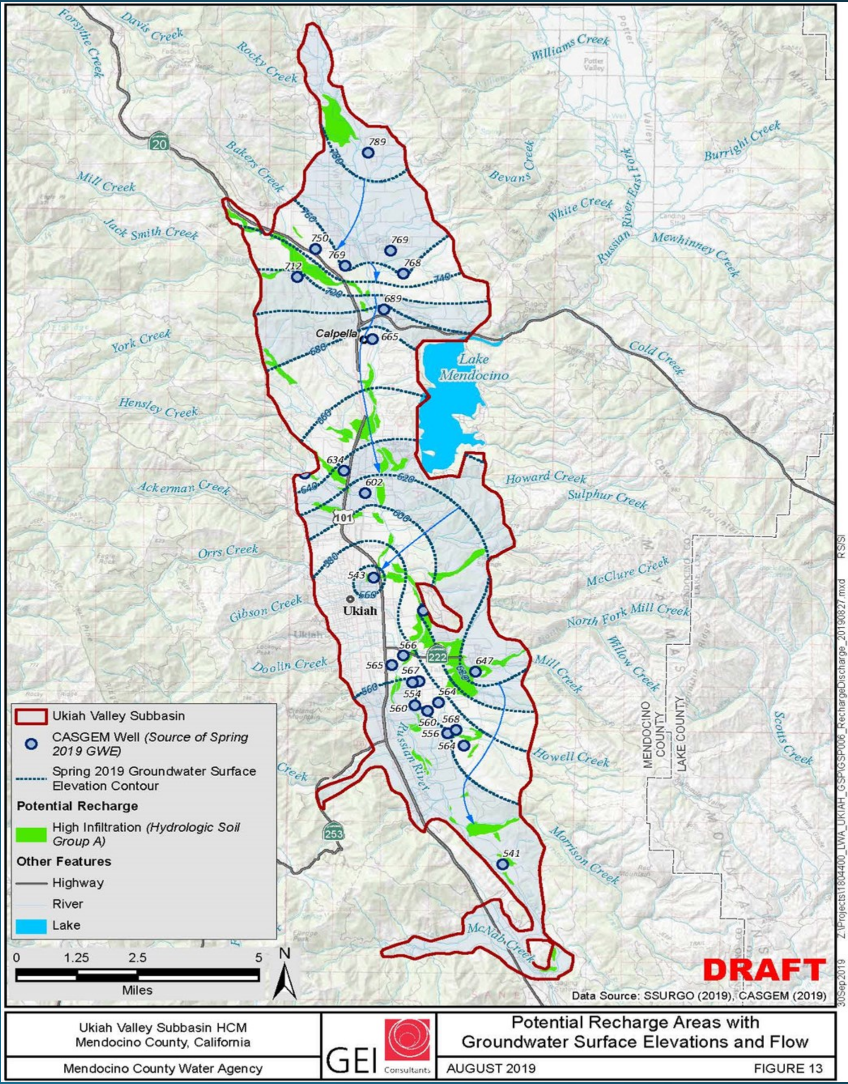
Notes: ft. = feet
gpm = gallons per minute

Broke out the 3 principal aquifers based on geologic units; very distinct hydrogeologic properties and uses

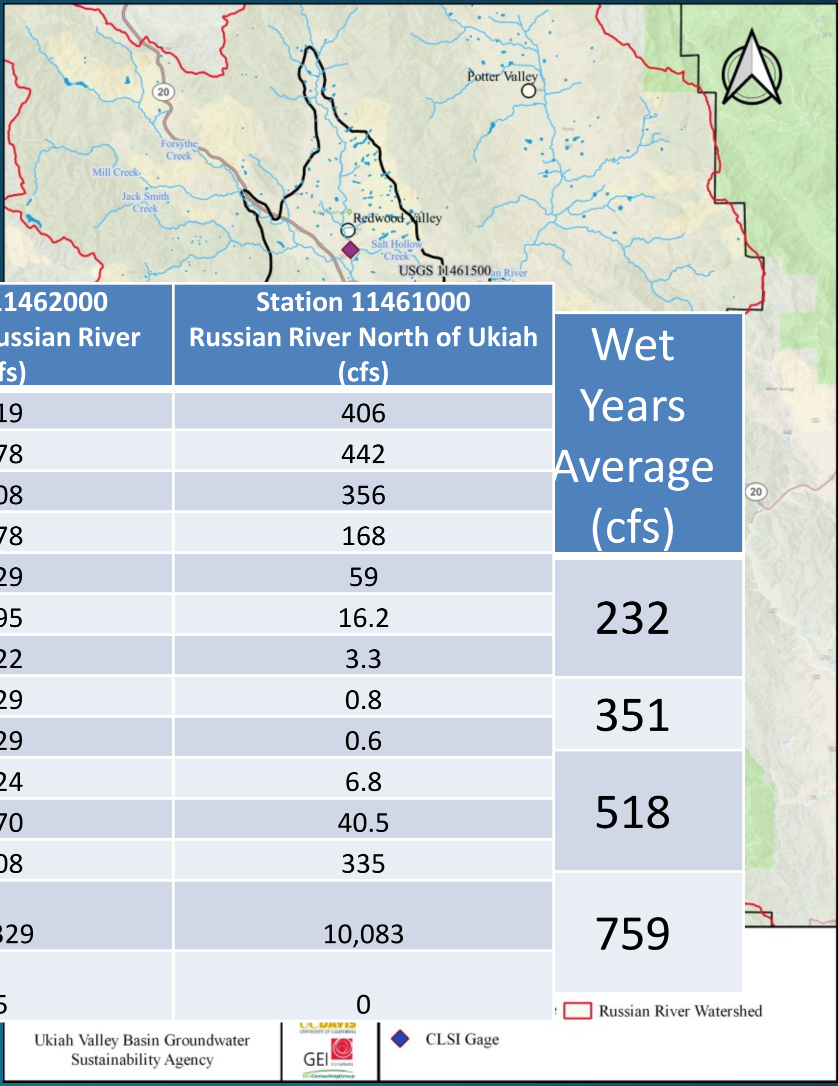
Groundwater Recharge and Discharge

- Recharge where coarse soils found in addition to streambeds
- Groundwater flow and discharge determined from contours

Did the required work for SGMA that wasn't done in the previous HCM



Surface Water Characterization

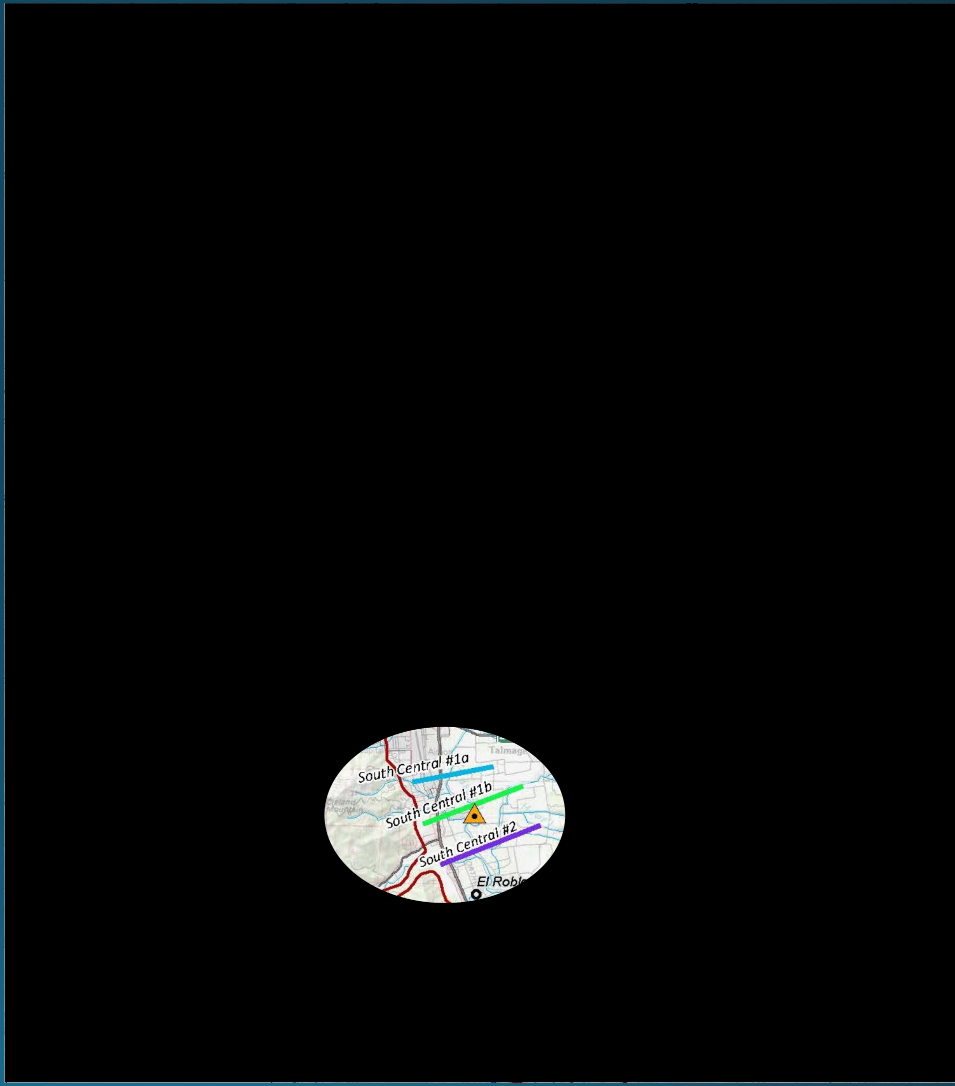


Month	Station 11462500 Russian River North of Hopland (cfs)	Station 11462000 East Fork Russian River (cfs)	Station 11461000 Russian River North of Ukiah (cfs)
January	1563	519	406
February	1517	478	442
March	1118	308	356
April	592	278	168
May	297	229	59
June	176	195	16.2
July	174	222	3.3
August	181	229	0.8
September	179	229	0.6
October	197	224	6.8
November	220	170	40.5
December	920	208	335
Max historical flow	27,403	5,329	10,083
Min historical flow	21	5	0

Station	Wet Years Average (cfs)
114610	232
114620	351
114620	518
114625	759

Surface Water/Groundwater

Monitoring wells paired with stream gauges will characterize GW/SW interaction



HCM Structure and SGMA Requirements

Significant Sections and Changes

Data Gaps and Additional Analysis

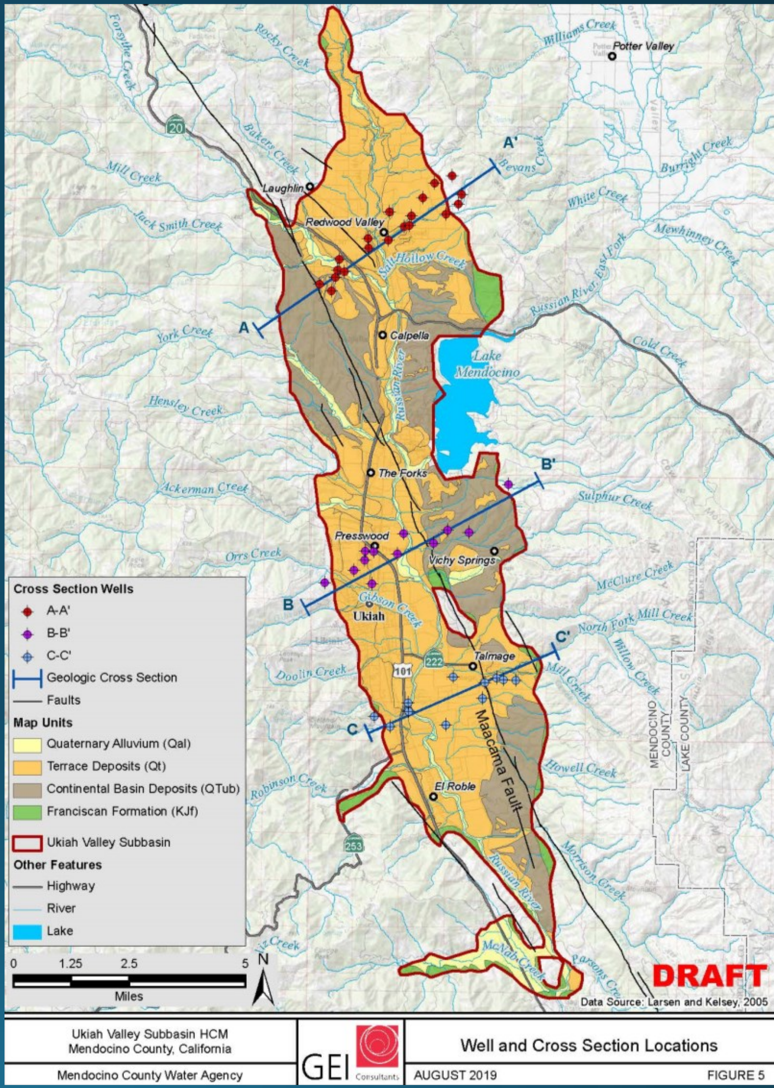
DMS

Data Gaps

- Additional North-South cross section
- Water Quality Data (Principal Aquifer I and Russian River)
- Pump test data
- Imported and exported water supplies

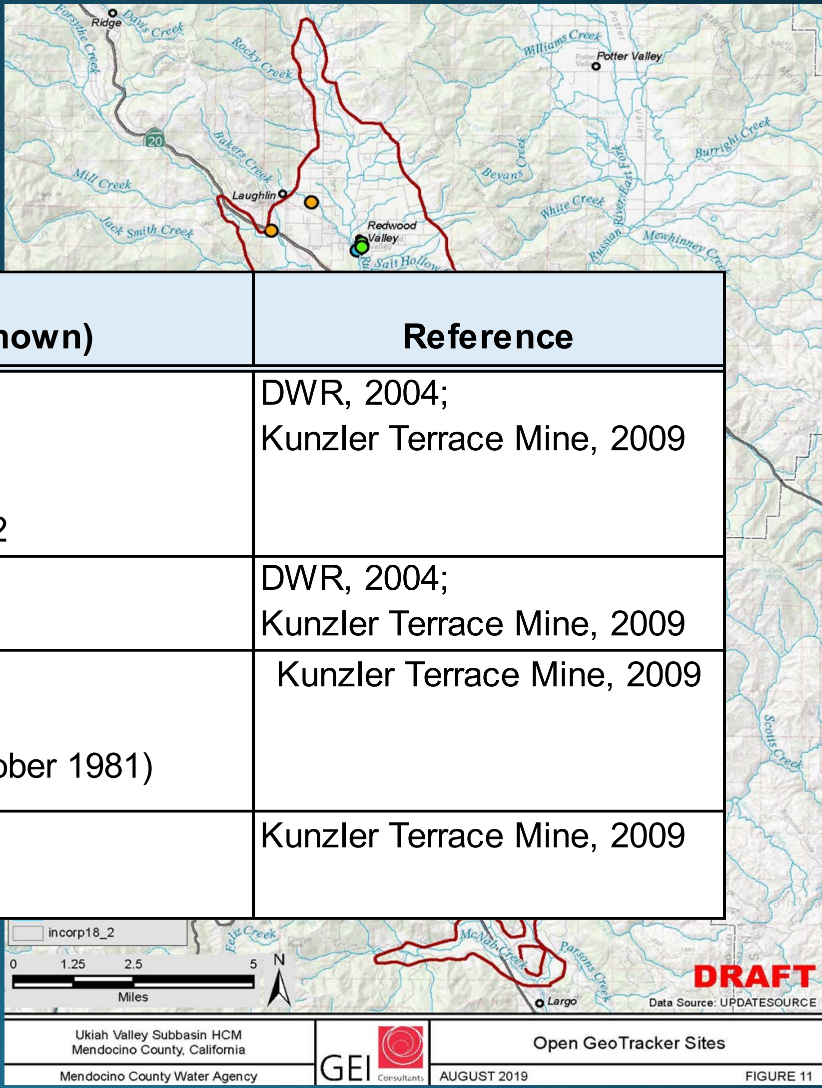
North-South Cross Section

North-south cross section will help to define extent of principal aquifers in the basin



Water Quality

Constituent Parameter	Reported range (units as shown)	Reference
Total Dissolved Solids	· Range: 87-301 mg/L · Average: 166 mg/L · 190.0 mg/l (KP-MW 1, 1 July 2005) · 190.0 mg/L (Well P 6 2, October 2002	DWR, 2004; Kunzler Terrace Mine, 2009
Total Hardness	· Moderately Hard to Hard Bicarbonate	DWR, 2004; Kunzler Terrace Mine, 2009
Chloride	· 7.3 mg/L (KP-MW 1, 1 July 2005) · 6.1 mg/L (Well P6, 2 October 2002) · 6.5 mg/L (015N012W08F001M3, October 1981)	Kunzler Terrace Mine, 2009
Electrical Conductivity	· 250.0 (July, 2005) · 293.0 (015N012W08F001M3)	Kunzler Terrace Mine, 2009



HCM Structure and SGMA Requirements

Significant Sections and Changes

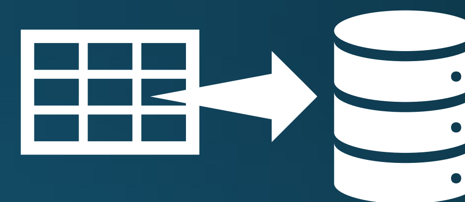
Data Gaps and Additional Analysis

DMS

Our Task: Build a DMS Capable of…

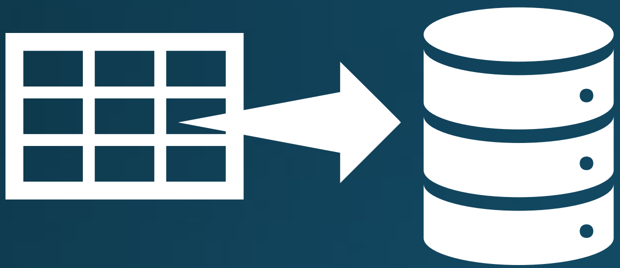
Storing Data

Reporting Data



Importing Data

Our Task: Build a DMS Capable of…



Importing Data

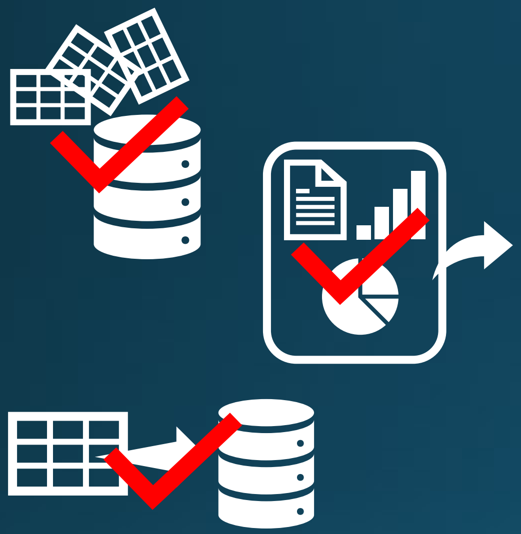
QA/QC data

Import data as GSP is developed

Develop templates to import data

Develop interface to import data from templates

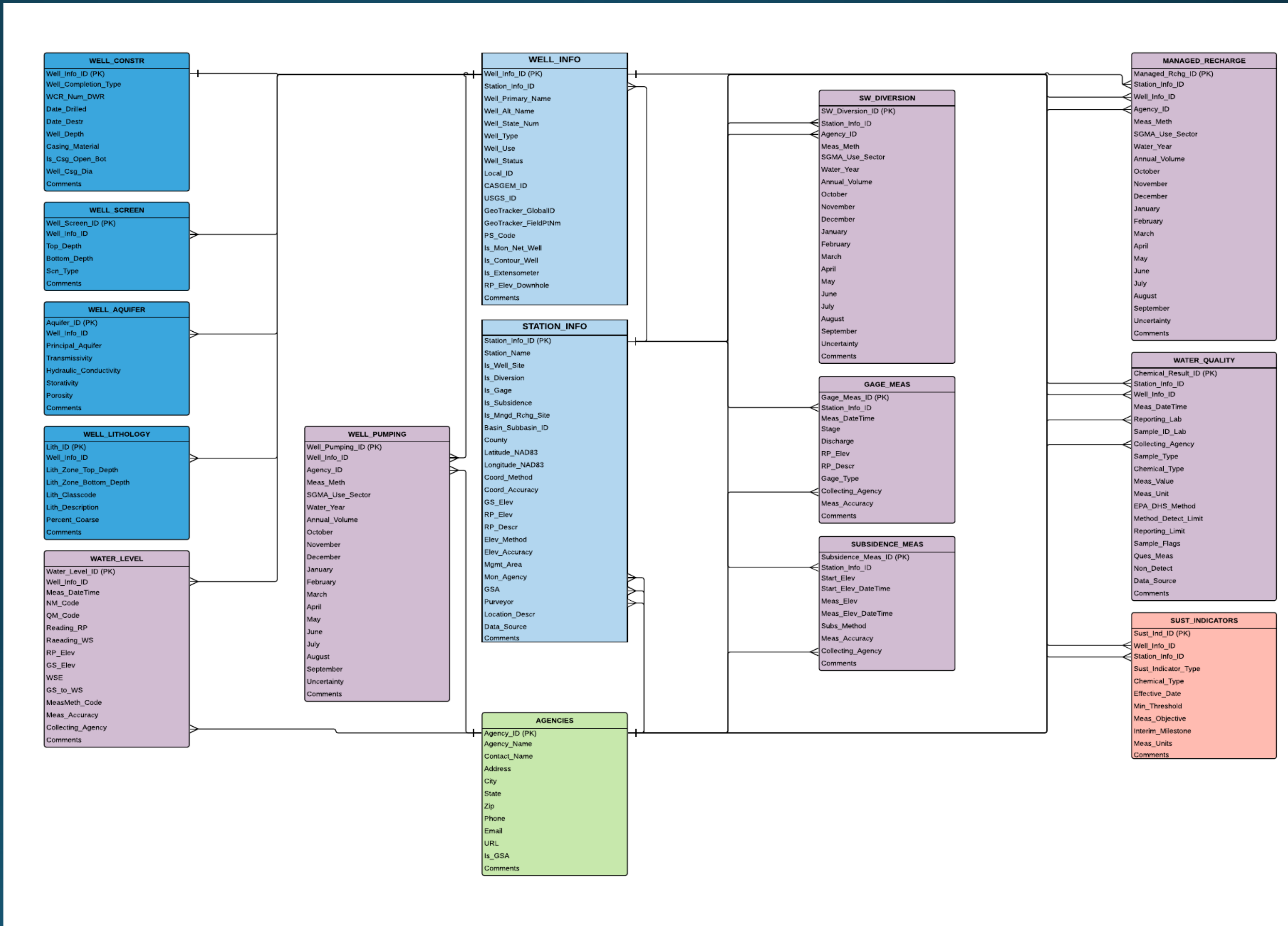
Tasks Completed



Additionally

- Database contains data used to develop HCM
- Ready to import data during continued development of GSP
- Can be deployed when basin is ready

Simpler and More Efficient



Meeting the Requirements

SGMA Requirements:

Article 5, Section 354.40: Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.

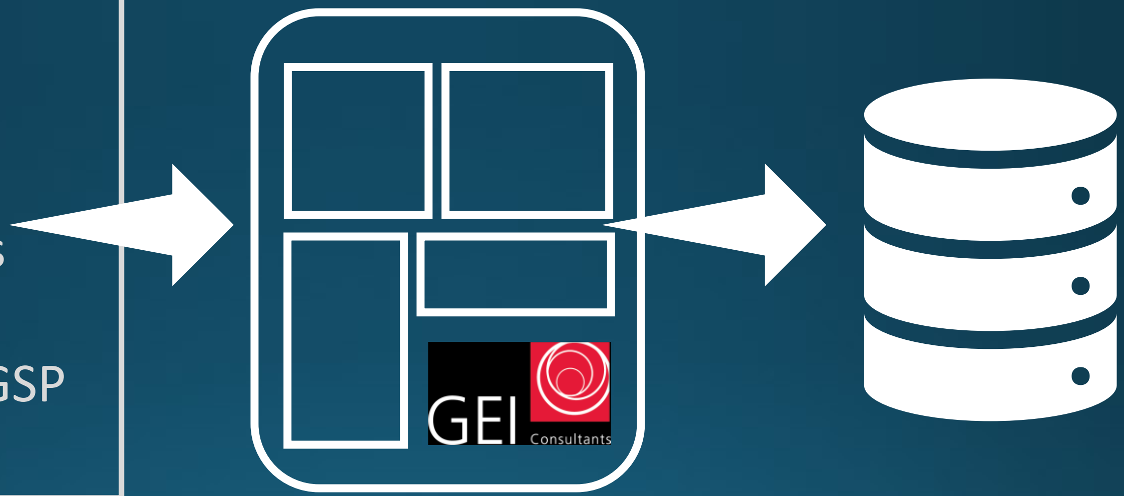
Well information used to develop the basin setting shall be maintained in the Agency's data management system.

Meeting the Requirements

Well Data	Monitoring Data	
Construction Info	**Subsidence**	Water Quality
Screen Info	Diversions	Managed Recharge
Aquifer Info	**Gage Measurements**	Groundwater Level
Lithology Info	Well Pumping	**Sustainability Indicators**

Templates To Make Importing Simpler

- Public data sources
  - CASGEM
  - GAMA GeoTracker
- Data import templates
  - Local agencies
  - Data obtained via GSP development



Data Import Started, but

Data Type	Data Points	Period of Record
Station	149	
Well	145	
Well Construction	97	
Well Screen	169	
Well Lithology	367	
Well Aquifer	0	
Well Pumping	0	
Groundwater Level	676	1966 - 2019
Water Quality	24,291	1984 - 2019
Sustainability Indicators	0	
Managed Recharge	0	
Subsidence	0	
Diversions	0	
Gage Measurement	0	

More Input Required

Data Type	Data Points	Period of Record
Station	149	
Well	145	
Well Construction	97	
Well Screen	169	
Well Lithology	367	
Well Aquifer	**0**	
Well Pumping	**0**	
Groundwater Level	676	1966 - 2019
Water Quality	24,291	1984 - 2019
Sustainability Indicators	**0**	
Managed Recharge	**0**	
Subsidence	**0**	
Diversions	**0**	
Gage Measurement	**0**	

Needed To Work With the DMS:

Staff that has:

- DATABASE SKILLS (ability to write queries)
- VBA programming language (optional)

But if you don’t have someone
we can provide support for YOU!

Questions?

Outline

- **HCM & DMS Update and Discussion**
- Water Budget Preliminary Discussion
  - Root Zone Water Budget
  - Hydrological Model
  - Groundwater Model
  - Integration
- Review and Commenting Process
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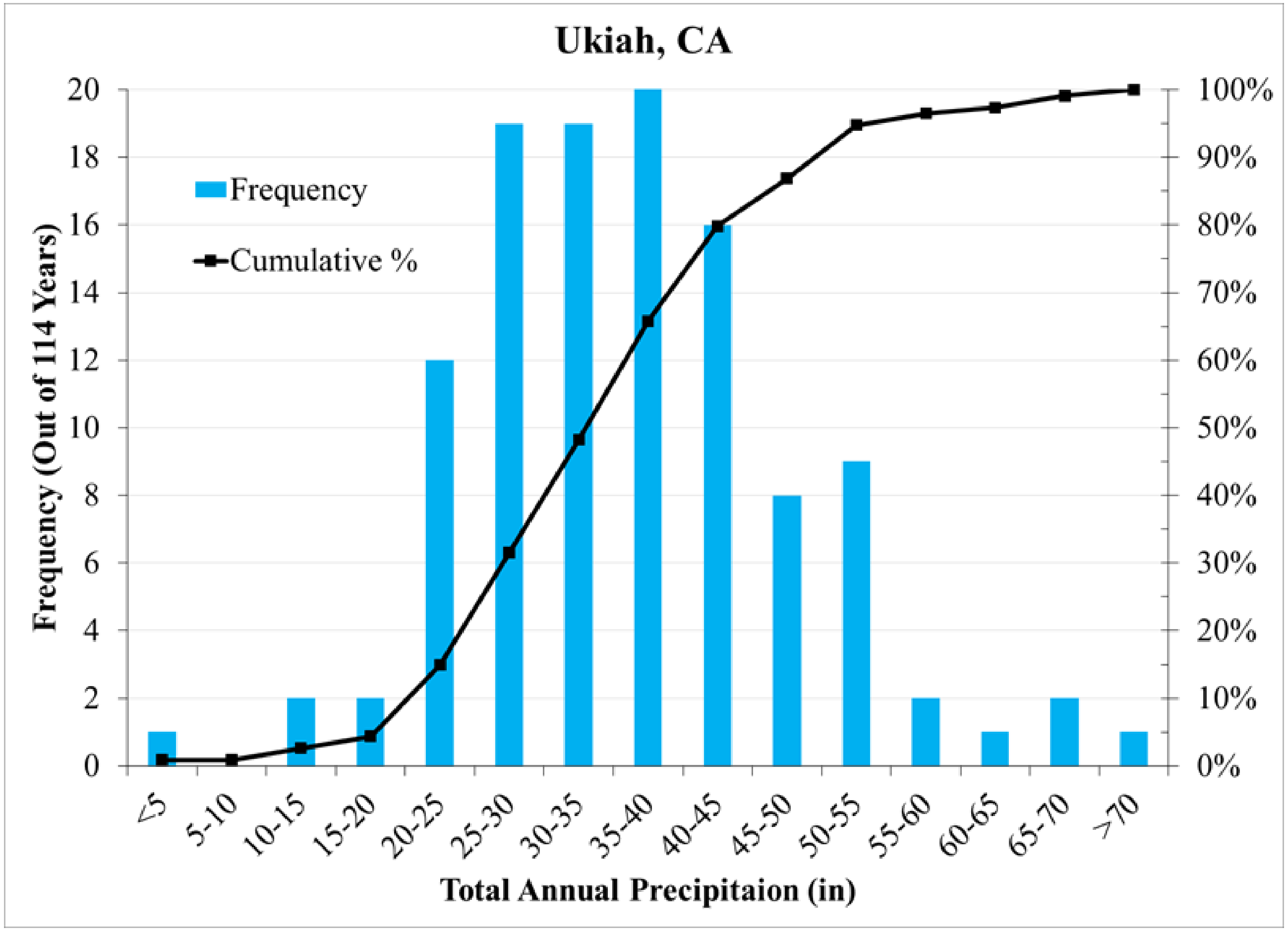
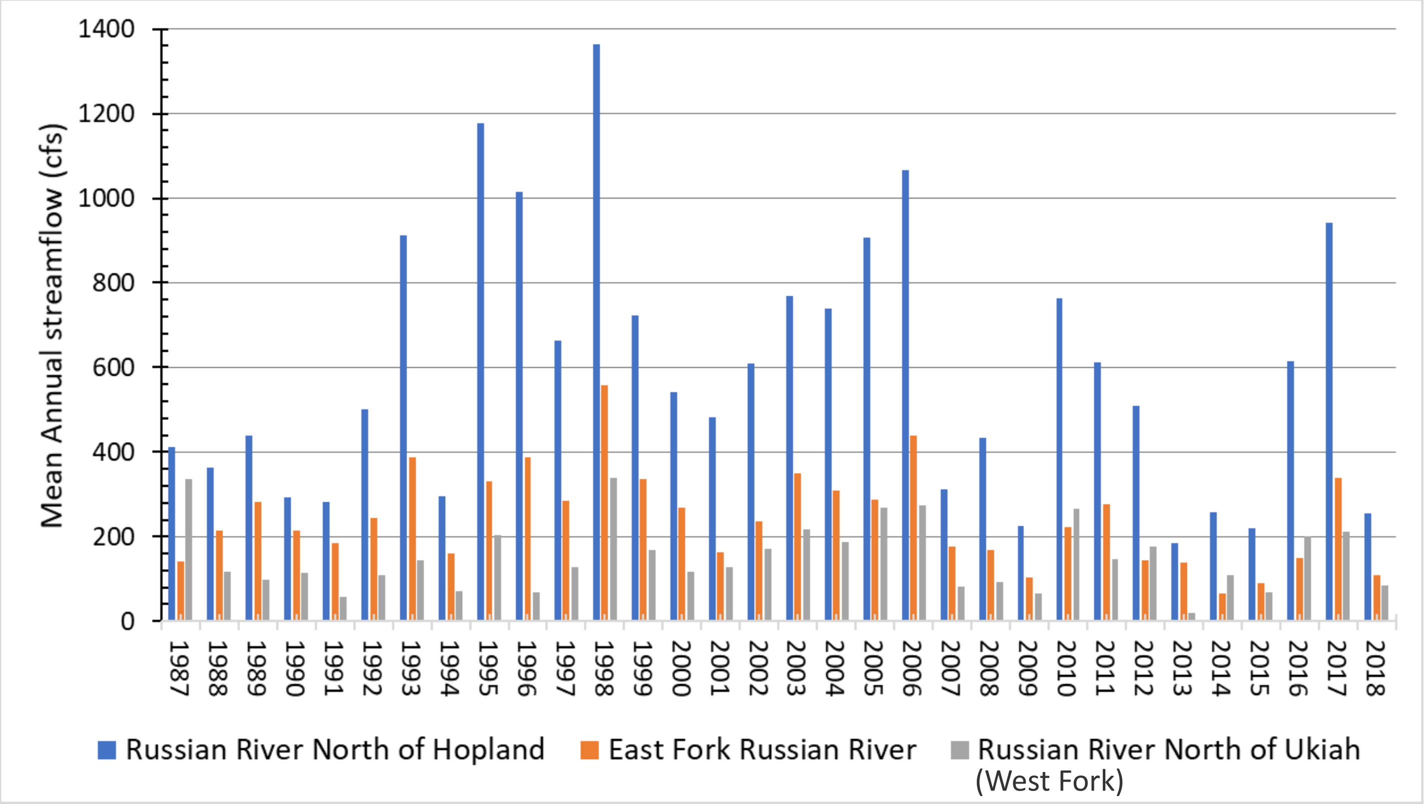
PRMS: Precipitation



PRMS: Streamflow



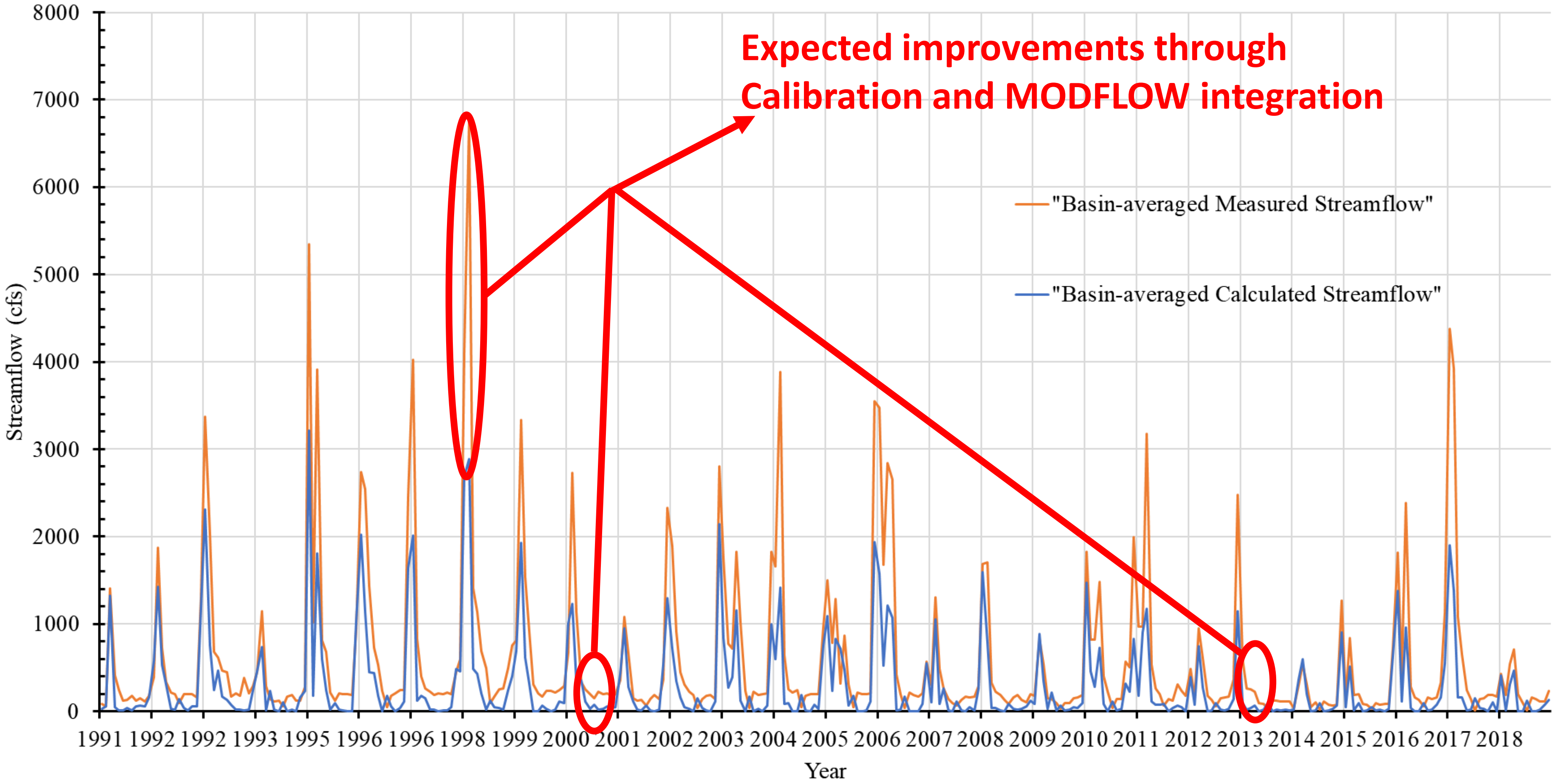
PRMS: State of the Model

- Hydrological Simulation is complete.
  - Releases from PVP and subsequently Mendocino Lake is simulated through USGS/CDEC stream gauge.
  - Surface water and groundwater diversions are being estimated and are not yet included.

- To be done by January 2020:
  - Final diversion estimations to be completed and implemented in the model.
  - Calibration and validation of the model.
  - Complete historical and current surface water budget.
  - Preliminary integration into the GSFLOW Framework.

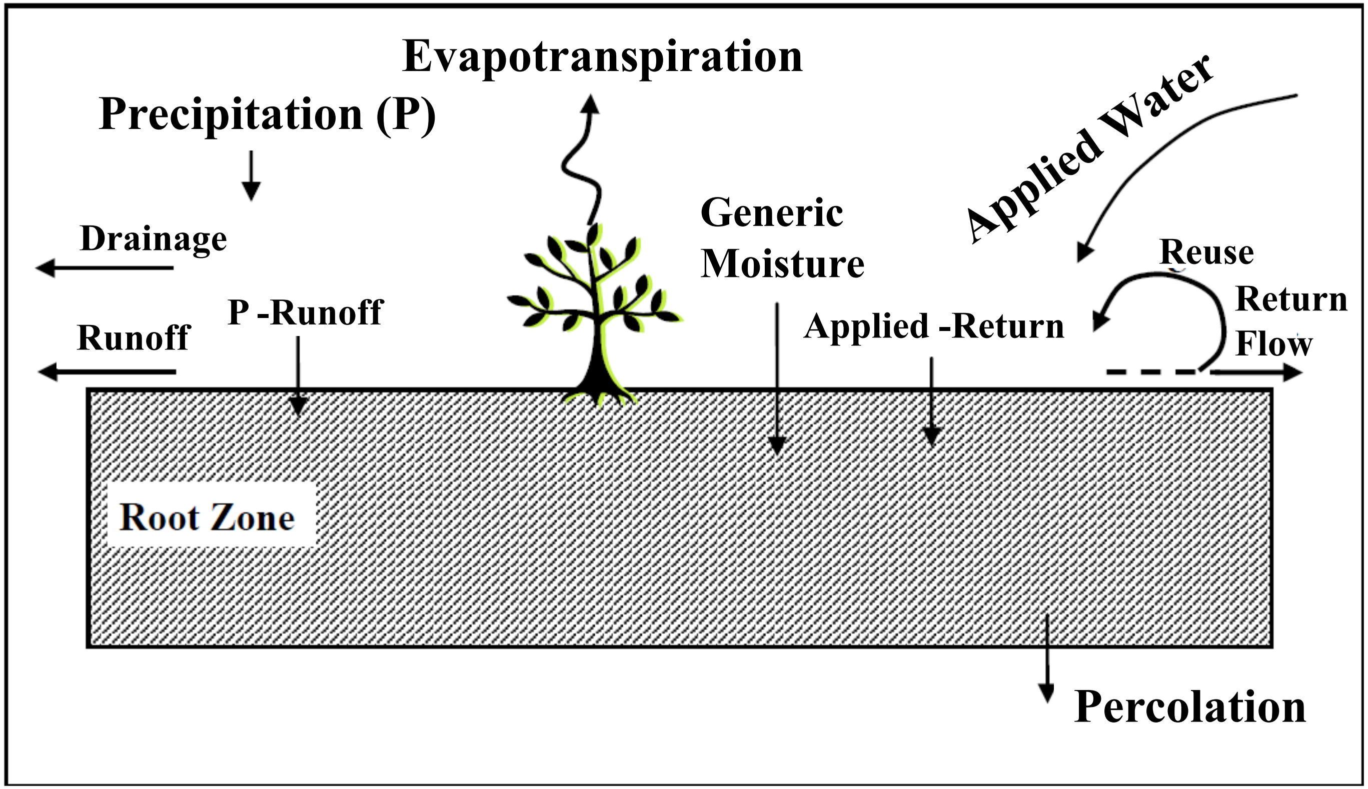
PRMS: Pre-Calibration Results

- Simulated at Hopland Gauge (Basin's Drainage)



Integrated Water Flow Model Demand Calculator (IDC)

- IDC calculates agricultural and urban water demands at a river basin.
- Agricultural water demand is calculated based on climate data, crop types, crop acreages, soil properties and irrigation methods.
- Urban demand is calculated based on population and per-capita water usage.



IDC: Discretization

- Spatial: 228 Combinations of unique Land Use, Hydrologic Soil Type, and Precipitation.

- Temporal:
  - From Jan 1, 1991
  - To Dec 31, 2018
  - Daily timesteps
  - 10,227 timesteps

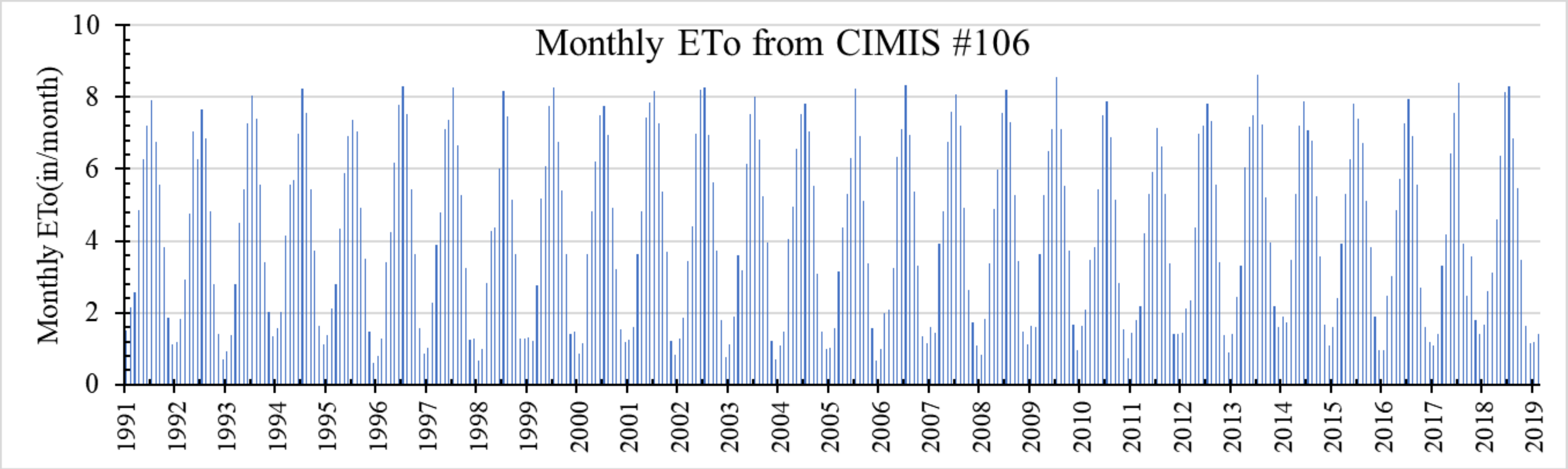
Grazing
Fruits
Grapes
Pasture
Citrus/Subtropical
Apples
Greens and Vegetables
Idle
Walnuts
Grains
Grass
Field Crops
Pears
Pistachios
Alfalfa/Clover
Peaches & Nectarines
Not irrigated
Native Vegetation
Urban
Water
Riparian Vegetation

Precipitation
NOAA POTTER VALLEY POWERHOUSE
Average of: NOAA UKIAH MUNICIPAL AIRPORT; UKIAH

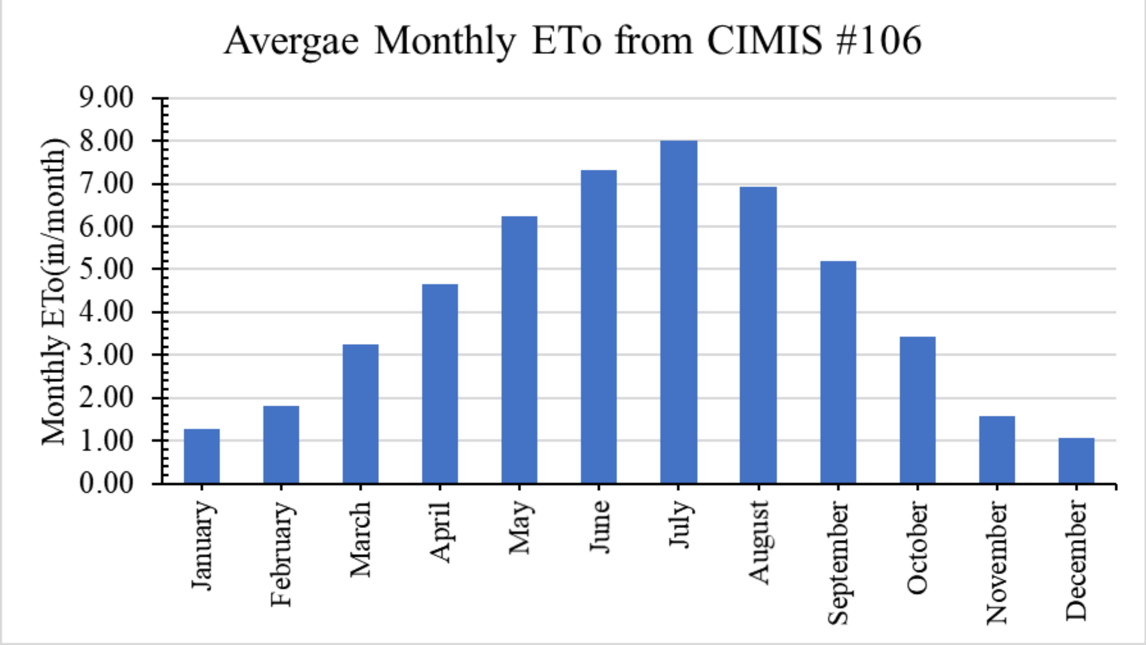
Soil Type
A
B
C
D
Unknown

ETo
CIMIS Station# 106 (Sanel Valley)*

IDC: ETo



Monthly ETo from CIMIS #106
Monthly ETo(in/month)
10
8
6
4
2
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019



Avergae Monthly ETo from CIMIS #106
Monthly ETo(in/month)
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
January
February
March
April
May
June
July
August
September
October
November
December

IDC: Frost/Heat Control

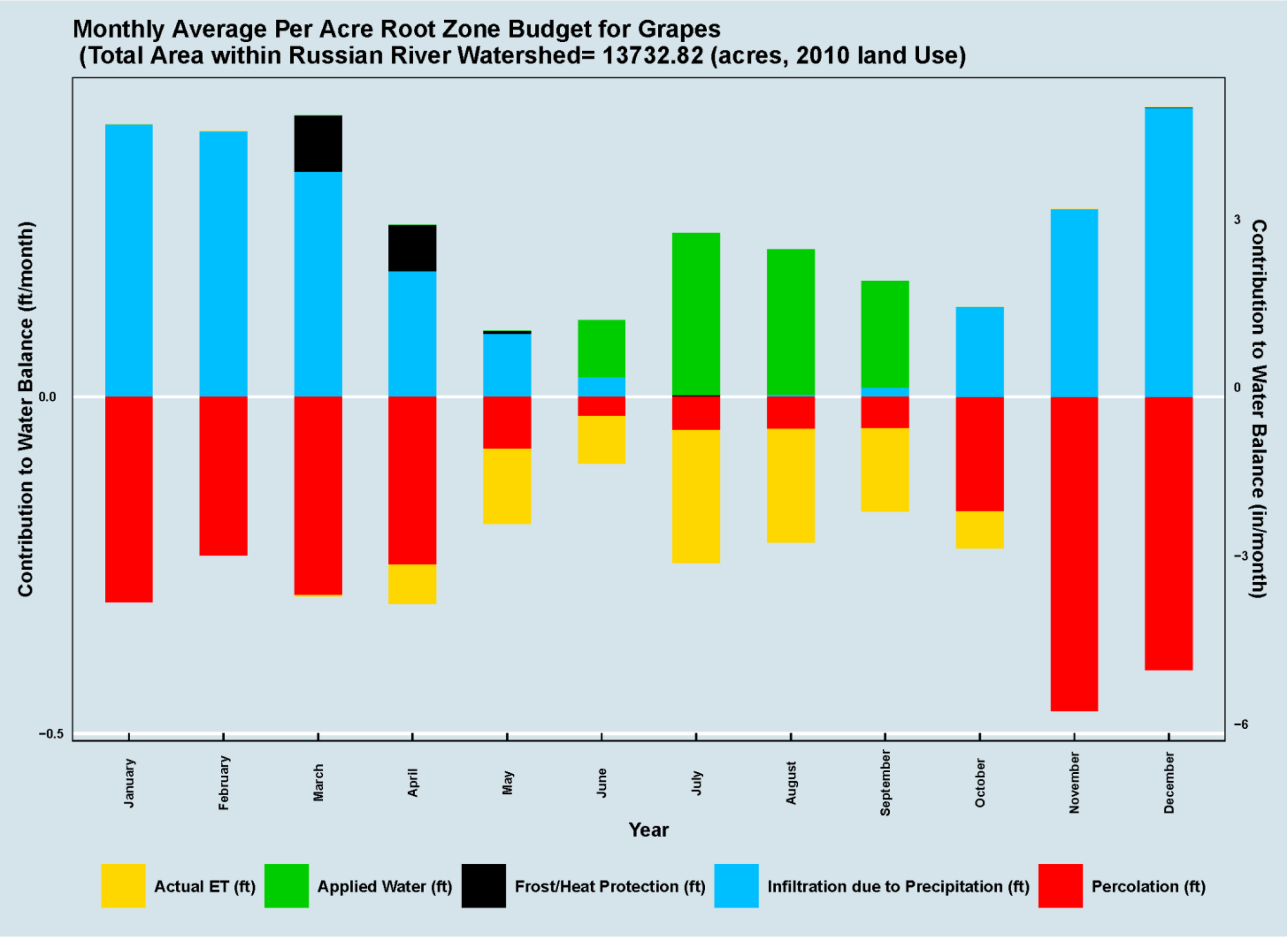
- Problems of hourly data
  - Averaged NOAA Ukiah and CDEC LYO
  - 27% missing data points for 1991-2018
- Frost Control
  - We need to be able to determine individual events and their length for their impact on soil moisture, river, and for future scenarios.
  - Local understating is 5 events per year using 50 gal/min/acre for 3-8 hours. But not every year has a frost event.
  - We prefer not put average values into either PRMS or IDC.
- Heat Control
  - Local understanding is one event per year using the same 50 gal/min/acre for 2-4 hours.
  - Not everybody uses the approach.
  - We prefer to find a way to put exact or constant average in the model for soil moisture and impact on streams.

IDC: Frost/Heat Control

Year	Number of Frost Protection Days	Average Duration of Each Event (hr)
1994	2	9.0
1995	1	9.0
1999	3	8.7
2000	4	8.5
2001	9	8.7
2002	14	9.2
2003	17	8.4
2006	5	8.6
2008	4	7.8
2009	3	8.3
2010	4	7.3
2011	1	7.0
2012	6	8.0

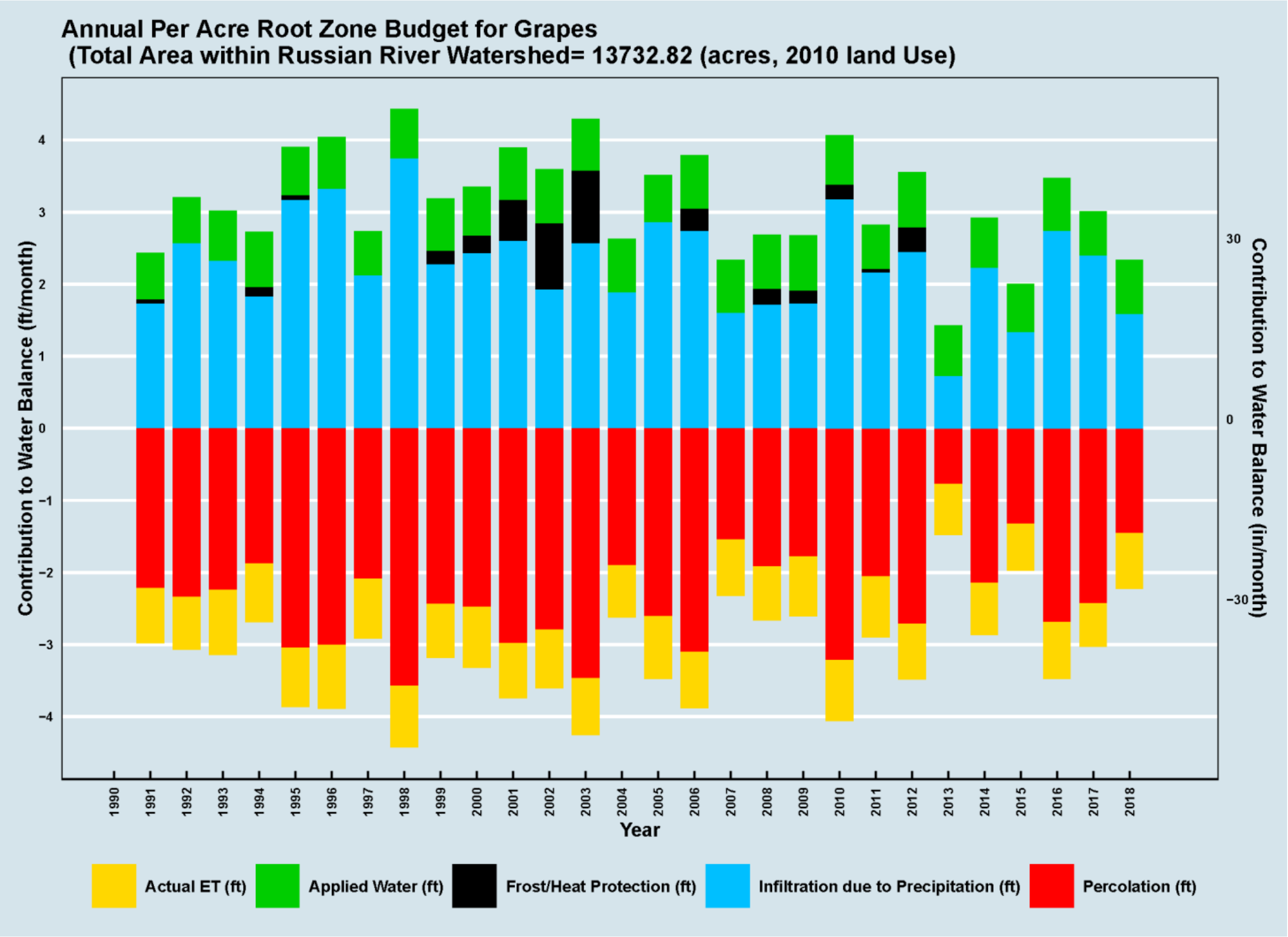
- Are we using the right gauges?
- Are we using the right threshold:
  - 34 F between 9PM-2AM with a decreasing trend
- Is there a resource to directly obtain this information?
- Do these numbers make sense?

IDC: Grapes



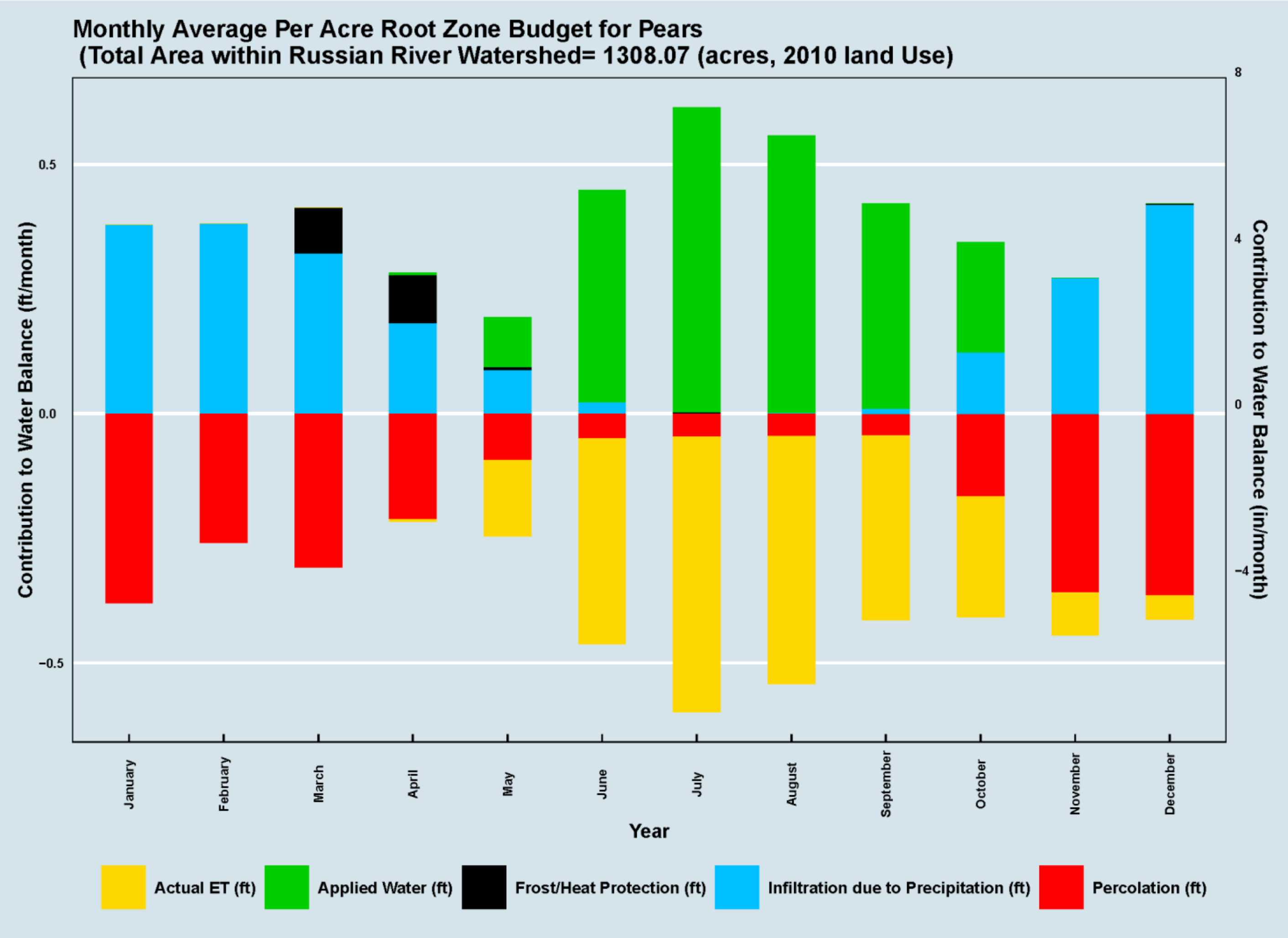
Monthly Average Per Acre Root Zone Budget for Grapes
(Total Area within Russian River Watershed= 13732.82 (acres, 2010 land Use)
Contribution to Water Balance (ft/month)
0.0
−0.5
Contribution to Water Balance (in/month)
3
0
−3
−6
January
February
March
April
May
June
July
August
September
October
November
December
Year
Actual ET (ft)
Applied Water (ft)
Frost/Heat Protection (ft)
Infiltration due to Precipitation (ft)
Percolation (ft)

IDC: Grapes



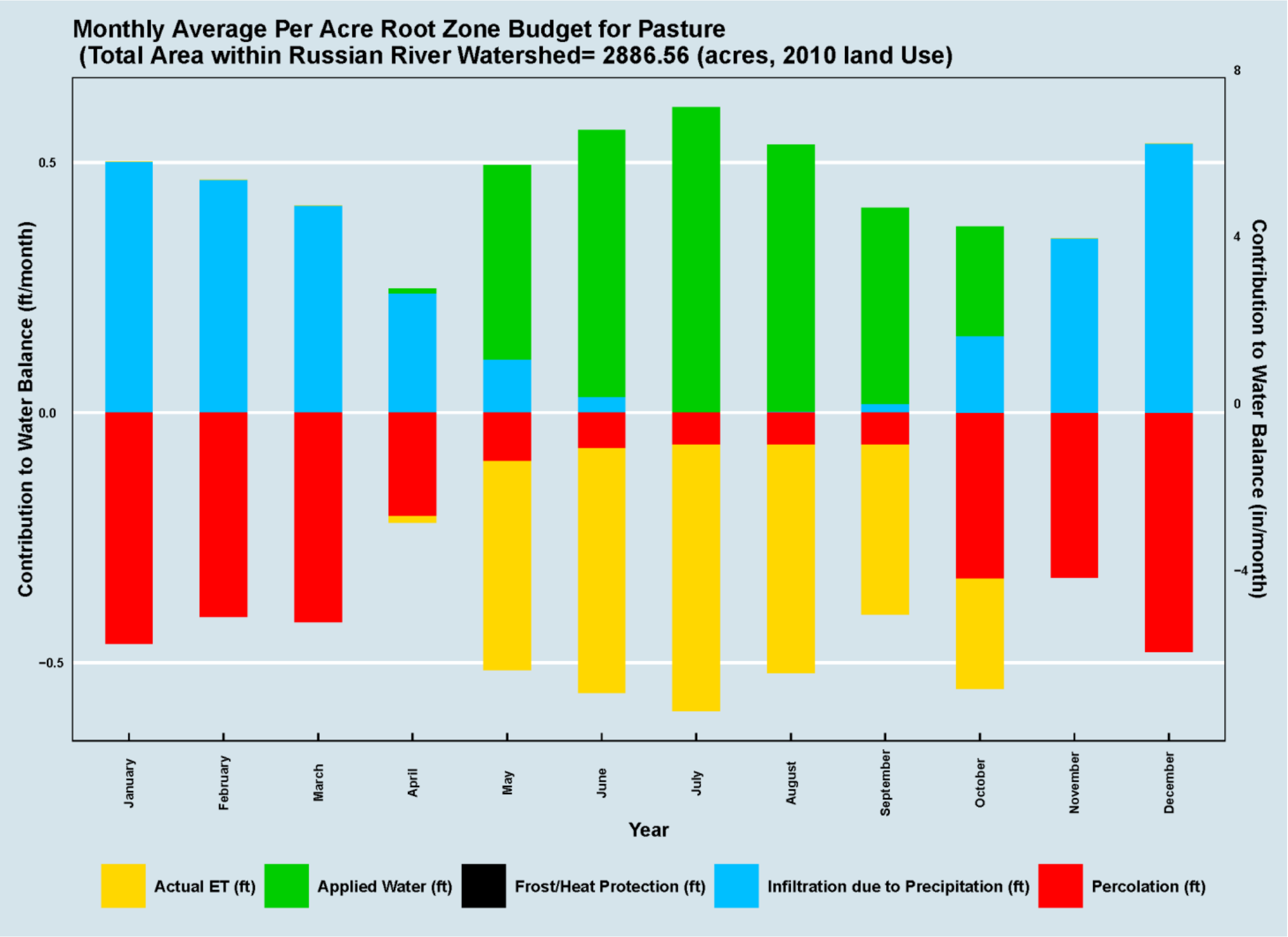
Annual Per Acre Root Zone Budget for Grapes
(Total Area within Russian River Watershed= 13732.82 (acres, 2010 land Use)
Contribution to Water Balance (ft/month)
Contribution to Water Balance (in/month)
4
3
2
1
0
−1
−2
−3
−4
30
0
−30
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Year
Actual ET (ft)
Applied Water (ft)
Frost/Heat Protection (ft)
Infiltration due to Precipitation (ft)
Percolation (ft)

IDC: Pears



Monthly Average Per Acre Root Zone Budget for Pears
(Total Area within Russian River Watershed= 1308.07 (acres, 2010 land Use)
Contribution to Water Balance (ft/month)
0.5
0.0
−0.5
8
4
0
−4
Contribution to Water Balance (in/month)
January
February
March
April
May
June
July
August
September
October
November
December
Year
Actual ET (ft)
Applied Water (ft)
Frost/Heat Protection (ft)
Infiltration due to Precipitation (ft)
Percolation (ft)

IDC: Pasture



Monthly Average Per Acre Root Zone Budget for Pasture
(Total Area within Russian River Watershed= 2886.56 (acres, 2010 land Use)
Contribution to Water Balance (ft/month)
0.5
0.0
−0.5
Contribution to Water Balance (in/month)
8
4
0
−4
January
February
March
April
May
June
July
August
September
October
November
December
Year
Actual ET (ft)
Applied Water (ft)
Frost/Heat Protection (ft)
Infiltration due to Precipitation (ft)
Percolation (ft)

IDC: Preliminary Results

- In comparison with Lewis et al. (2008), we are over-estimating slightly. This may be due to inaccurate irrigation efficiency, different temporal periods of the two assessments, or different sets of crop coefficients.

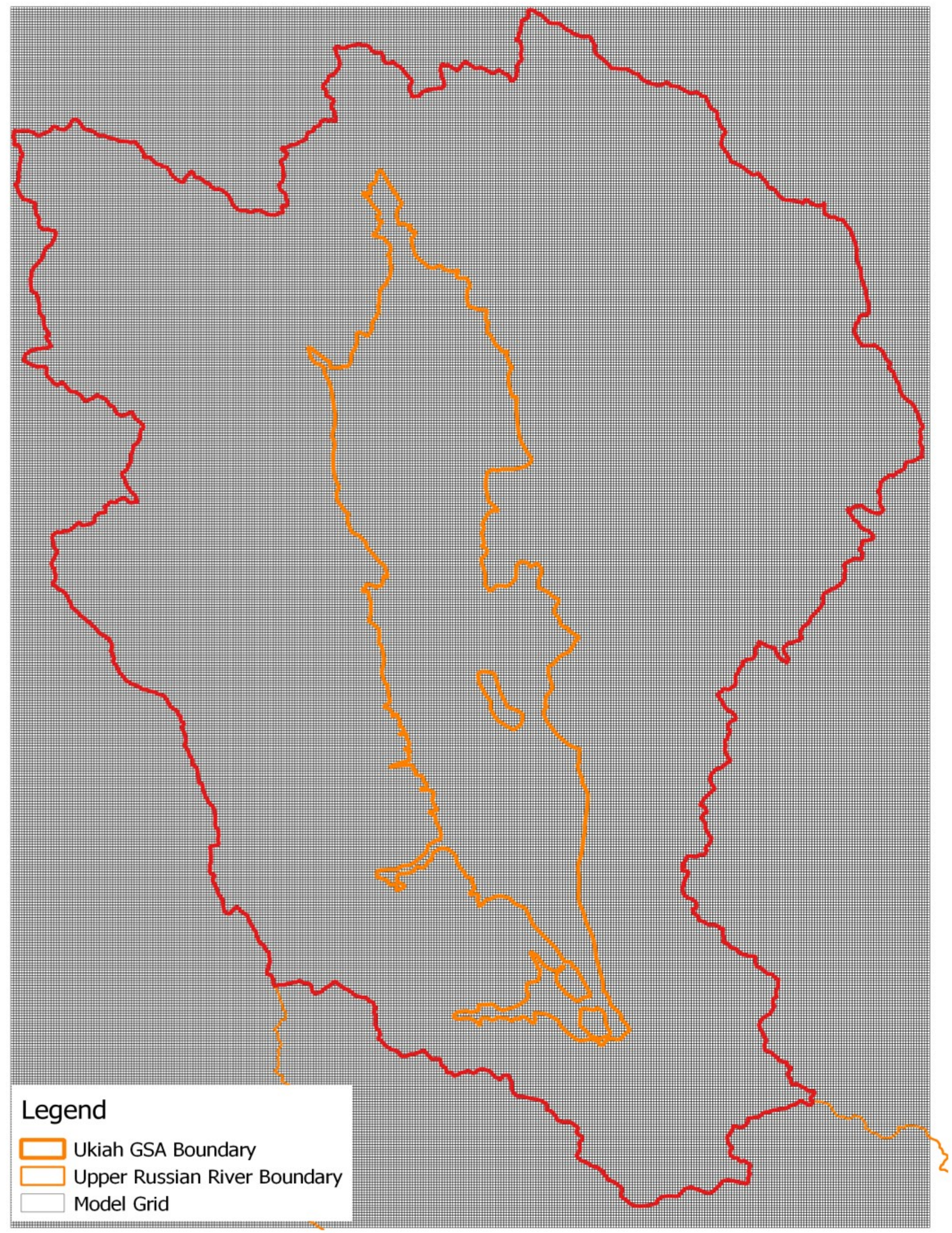
	Area (acres)		Consumptive use (AFY)	
	IDC	Lewis et al.	IDC (Irrigation Efficiency=0.88; Pasture=0.75)	Lewis et al.
Grapes	13733	15540	10895	9479
Pears	1308	1845	3464	4263
Pasture	2887	3144	10333	6287

IDC: What is next?

- Frost and heat protection adjustments. Optimizing the determination of these events may improve our results.
- Temporal adjustments to the land use.
- Temporal adjustments to the irrigation method efficiency.
- Linking the estimated applied water to surface water diversions or well pumpage and add to PRMS.
- Compare IDC results with the new GSFLOW Ag Package and evaluate the difference.

MODFLOW: Model Grid

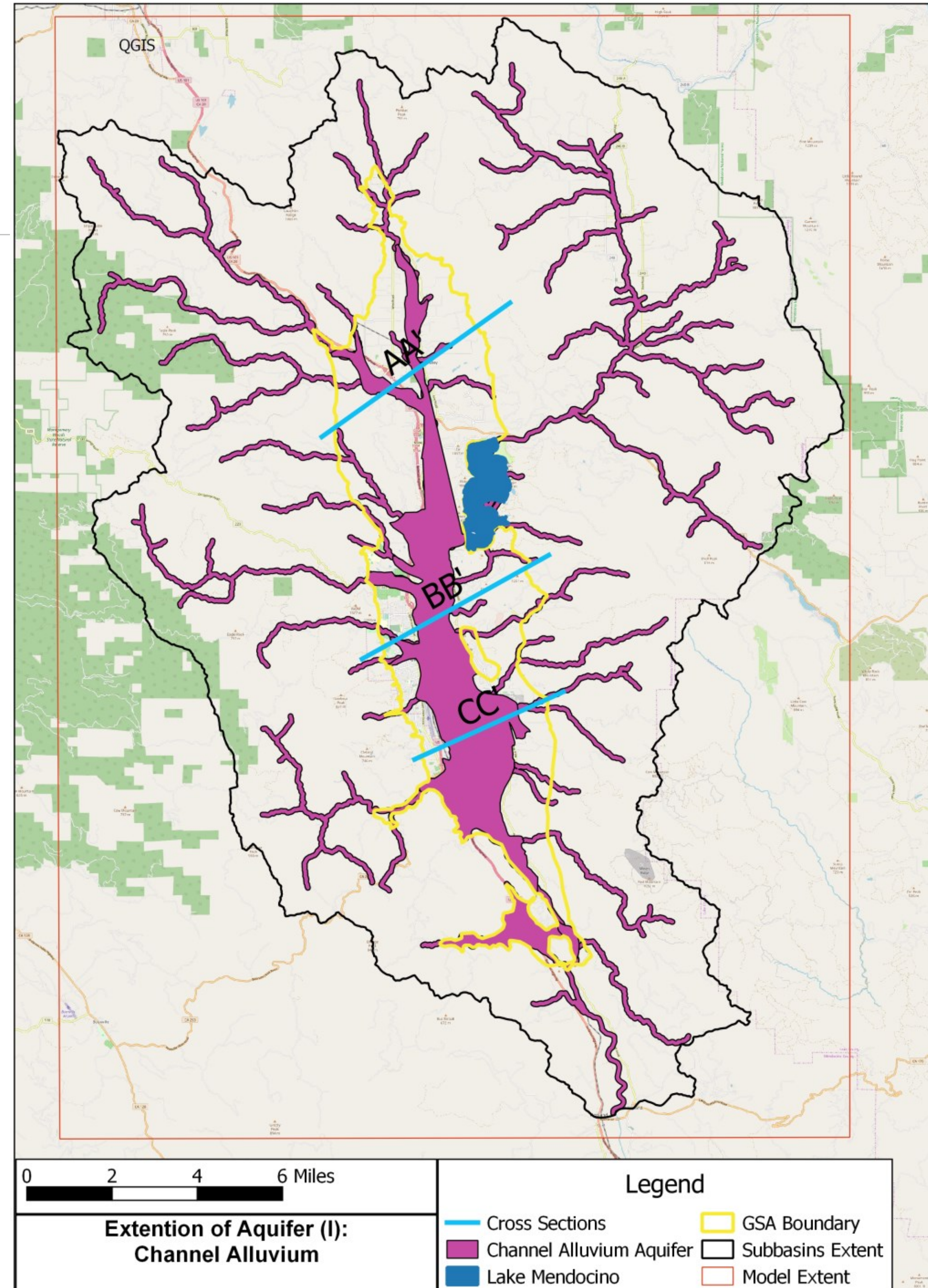
- Spatial: 100m x 100m Grid
  - Rows: 483
  - Columns: 343
  - Cells:165,669
  - Active Area: 238,980 acres
  - Basin Area: 37,531 acres
- Temporal:
  - From Jan 1, 1991
  - To Dec 31, 2018
  - Monthly timesteps
  - 366 timesteps



Model Layers :

- Aquifer(1) :

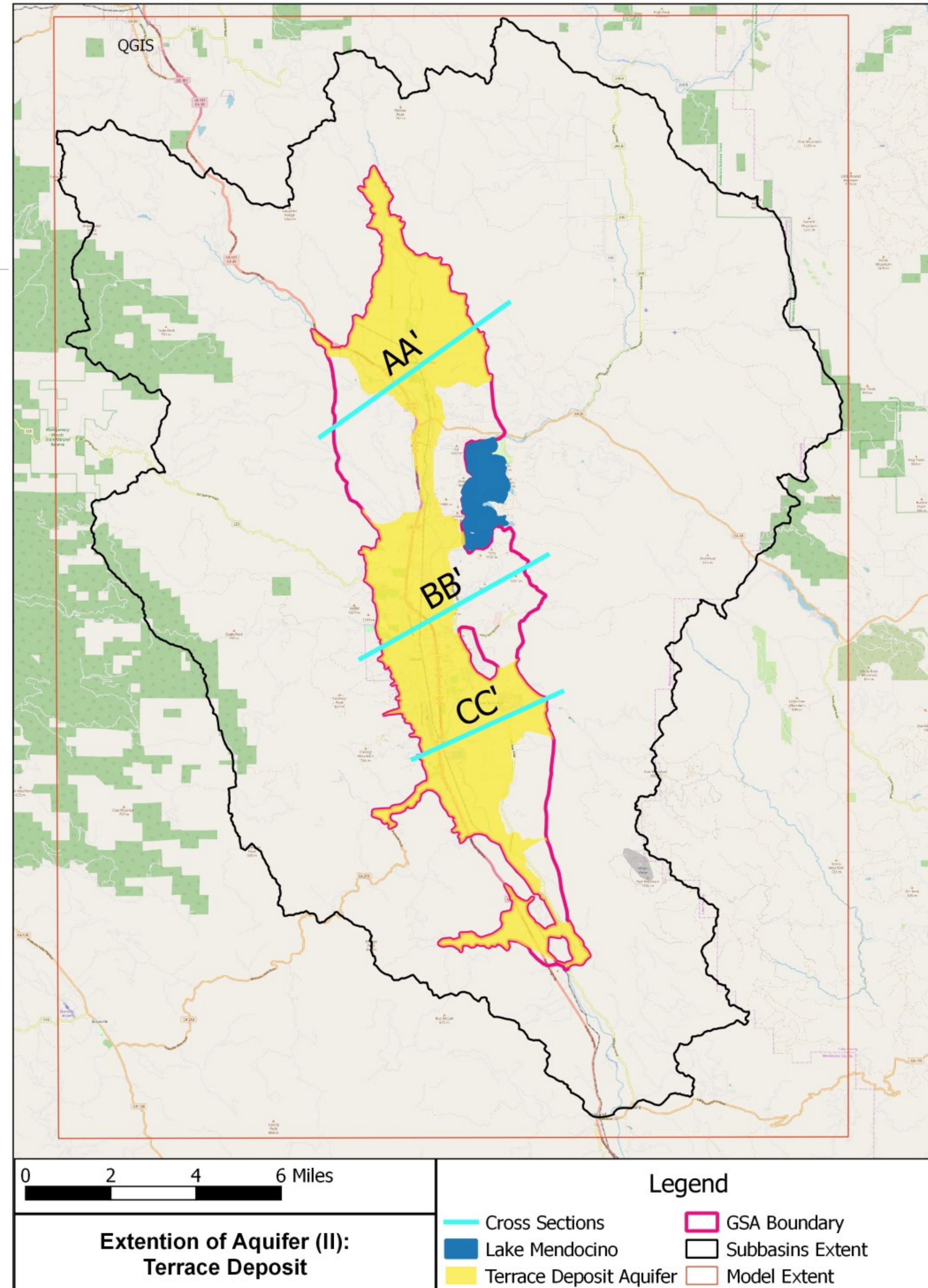
Channel Alluvium



Model Layers :

- Aquifer(2) :

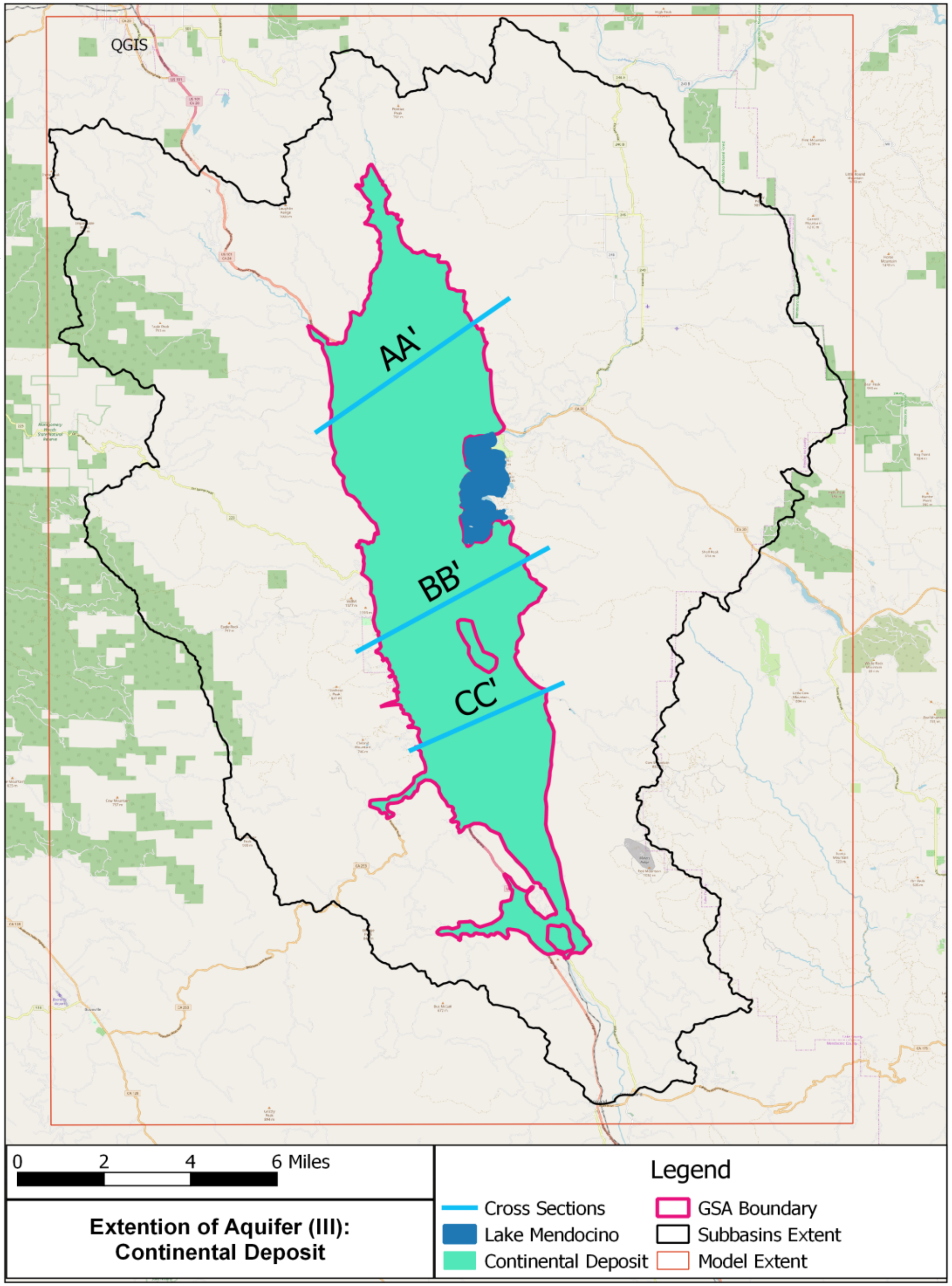
Terrace Deposit



Model Layers :

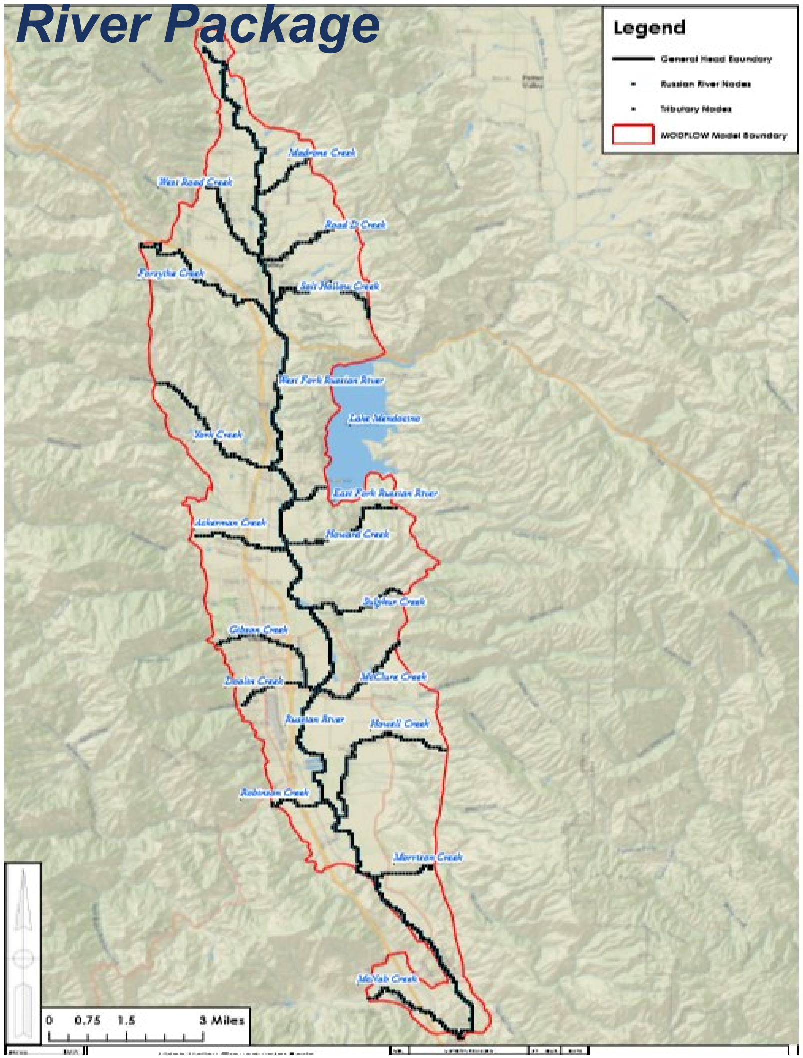
- Aquifer(3):

Continental Deposit

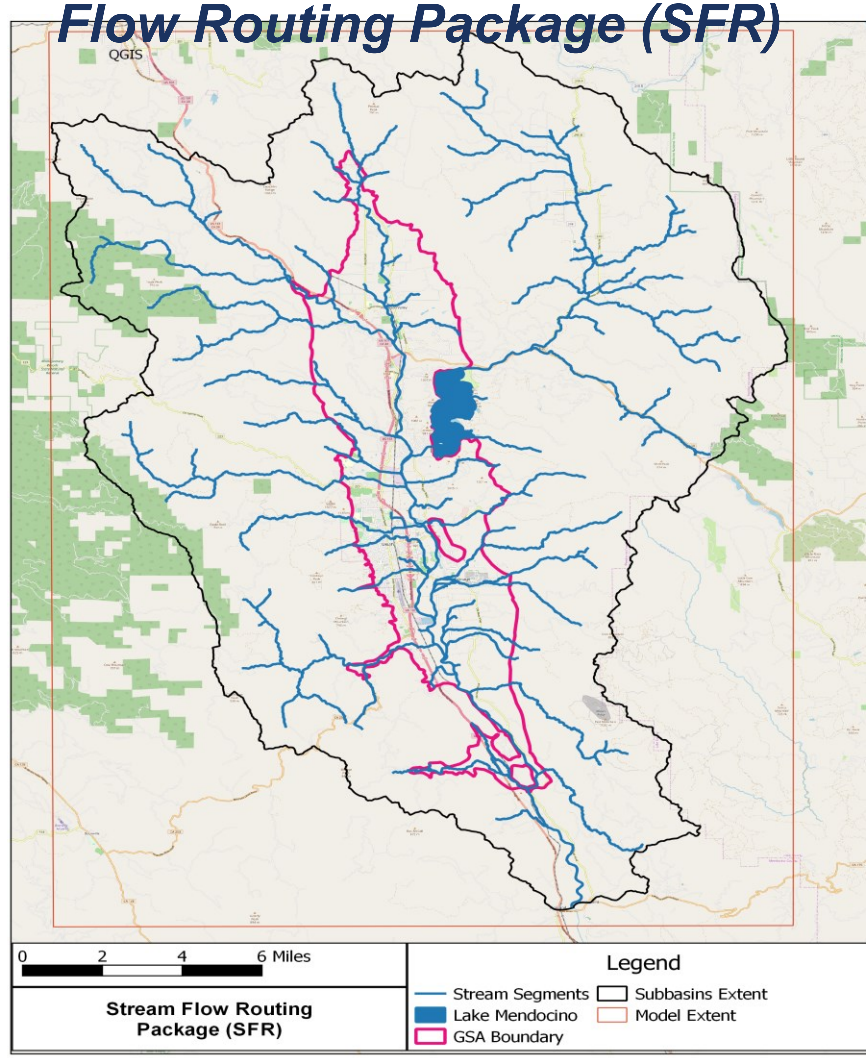


Boundary Conditions: Streams

Previous Modeling Effort: River Package



Current Modeling Effort : Stream Flow Routing Package (SFR)



Boundary Conditions: Pumping

- **Well Package:** defines negative flux at a specific coordinate within the model.

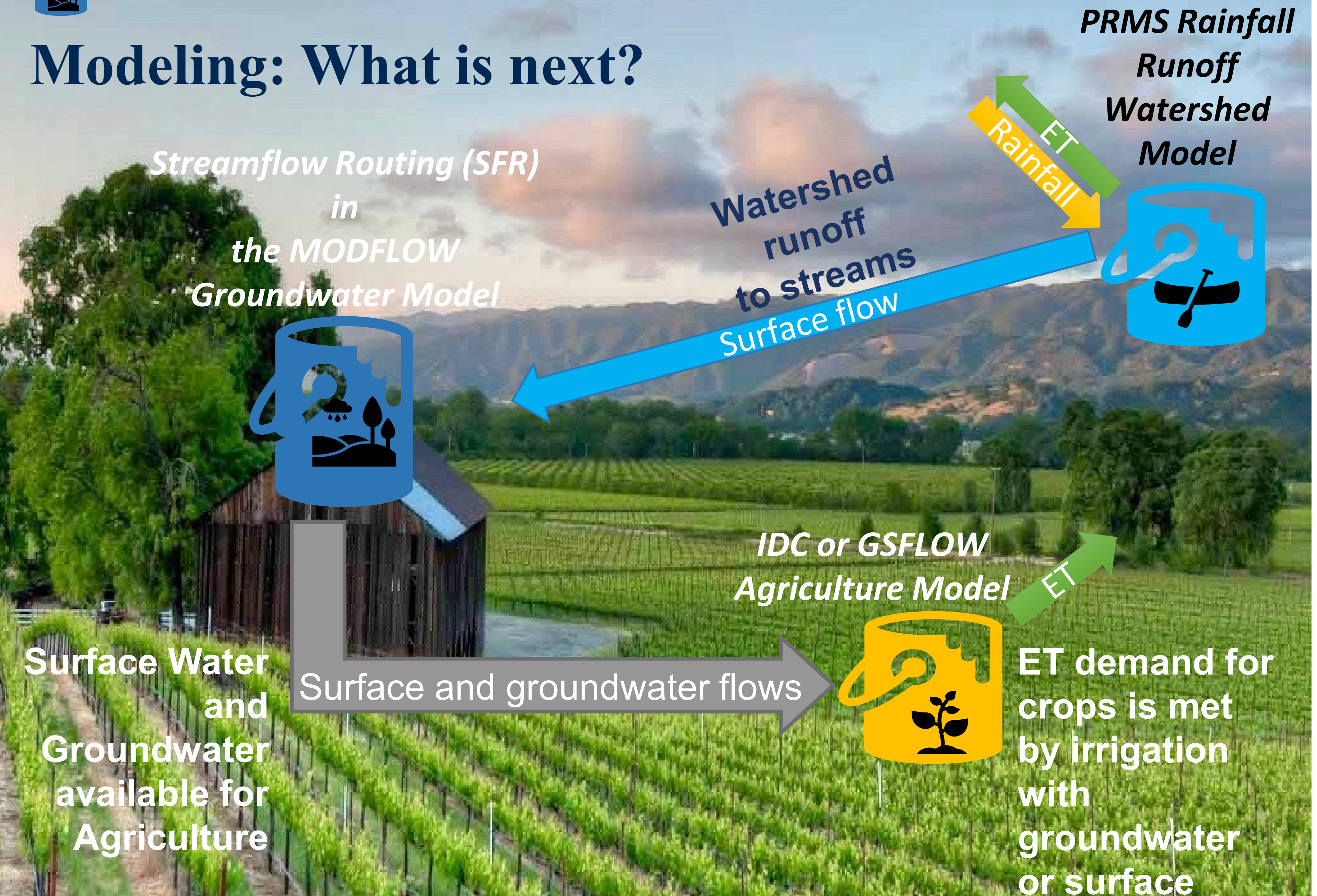
1. Pumping data are available for the Wells Below

Name	*Type*	*Pumping (AF/month) till December 2015*
Calpella W1	MI	2.13
Ukiah WTP	MI	0
Ukiah W2	MI	0
Ukiah W3	MI	10.59
Ukiah W4	MI	0
Ukiah W7	MI	24.59
Ukiah W8	MI	8.05
Willow/Nogard W5	MI	12.35
Willow/Nogard W6	MI	12.35
Willow/Burke W7	MI	12.35
Willow/Burke W8	MI	12.35

2. Pumping data are missing for the Wells Below

Name	*Type*	*Pumping (AF/month)*
Millview W17	MI	-
Millview W12	MI	-
Millview W16	MI	-
Masonite W6	MI	-

Modeling: What is next?



Outline

- HCM & DMS Update and Discussion
- Water Budget Preliminary Discussion
  - Root Zone Water Budget
  - Hydrological Model
  - Groundwater Model
  - Integration
- **Review and Commenting Process**
- Prop. 68 Grant

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Questions?

Thank you!