Verification of Hydrogeologic Conceptual Model(HCM) of C2VSimFG

CNRA\DWR\SGMO\ MODELING AND TOOLS SUPPORT SECTION

Behrooz Etebari, MS. PG

Objectives

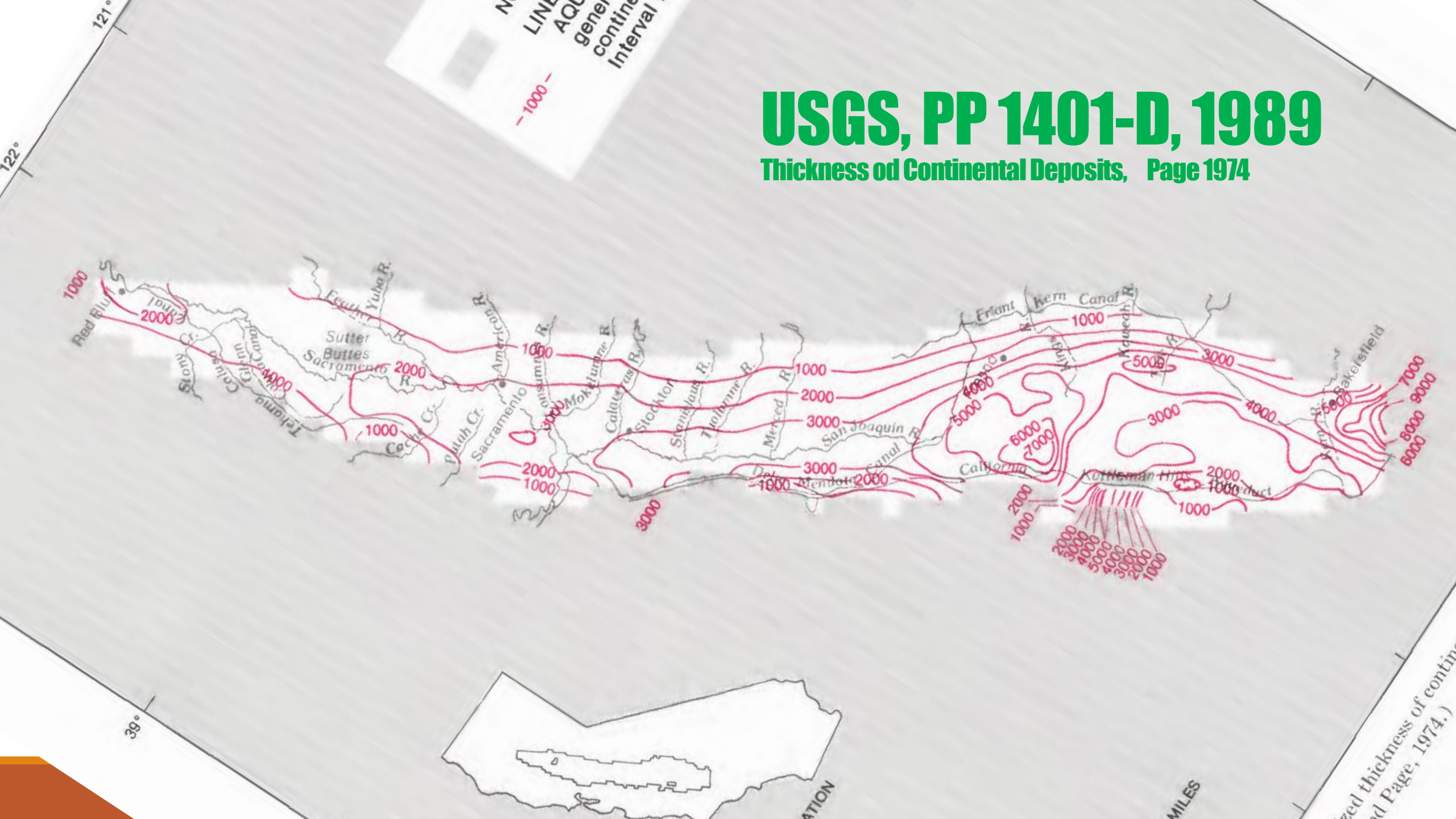
- Improving HCM with a finer resolution
- Improving C2VSimFG model calibration

Prominent geologic feature updates:

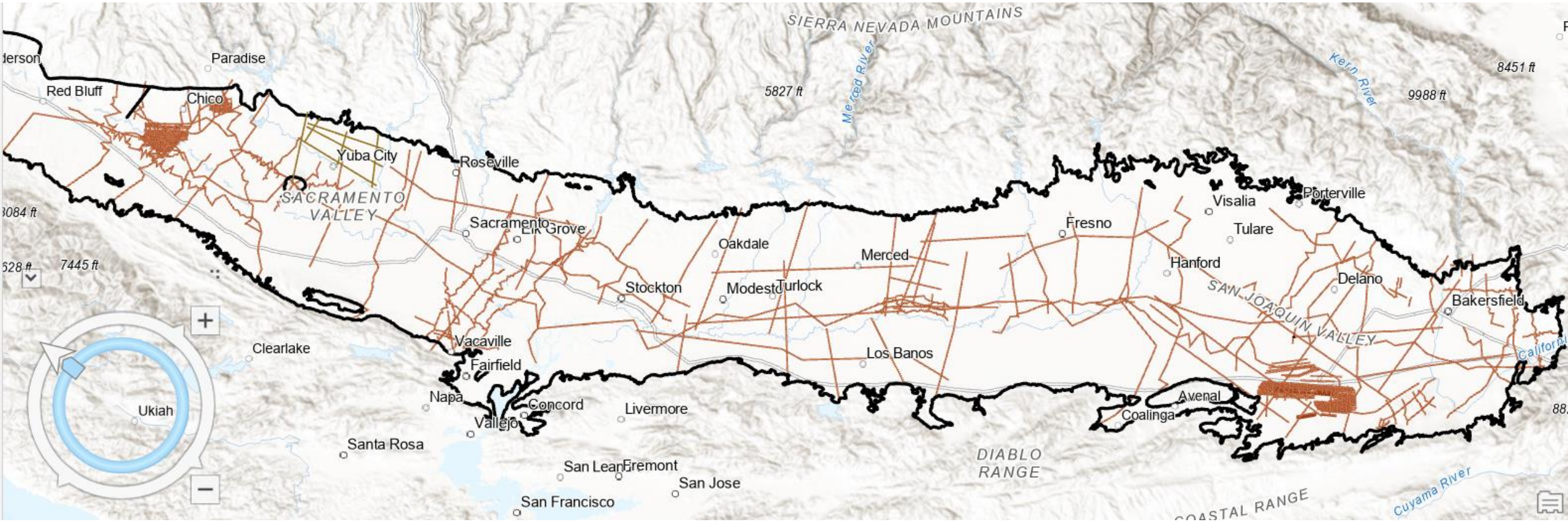
- Elk Hills (no Groundwater zone detected by neutron logs)
- Feather River(AEM shows two needle-like dikes)
- Lost Hills (Shallow zone of injection, also seismic surveys shows)
- Mount Poso area(perforated intervals of oil and gas wells within kern River Series)
- Lovejoy Basalt below base of fresh water
- Tracy GSA proposing to extend Corcoran Clay beneath Bay Delta (evidence: well#263 & 265, API# 0407700423, 0407700439,…)
- Kern County GSA reported multiple aquifer systems near model boundary(sedimentary rocks)

USGS, PP 1401-D, 1989

Thickness od Continental Deposits, Page 1974

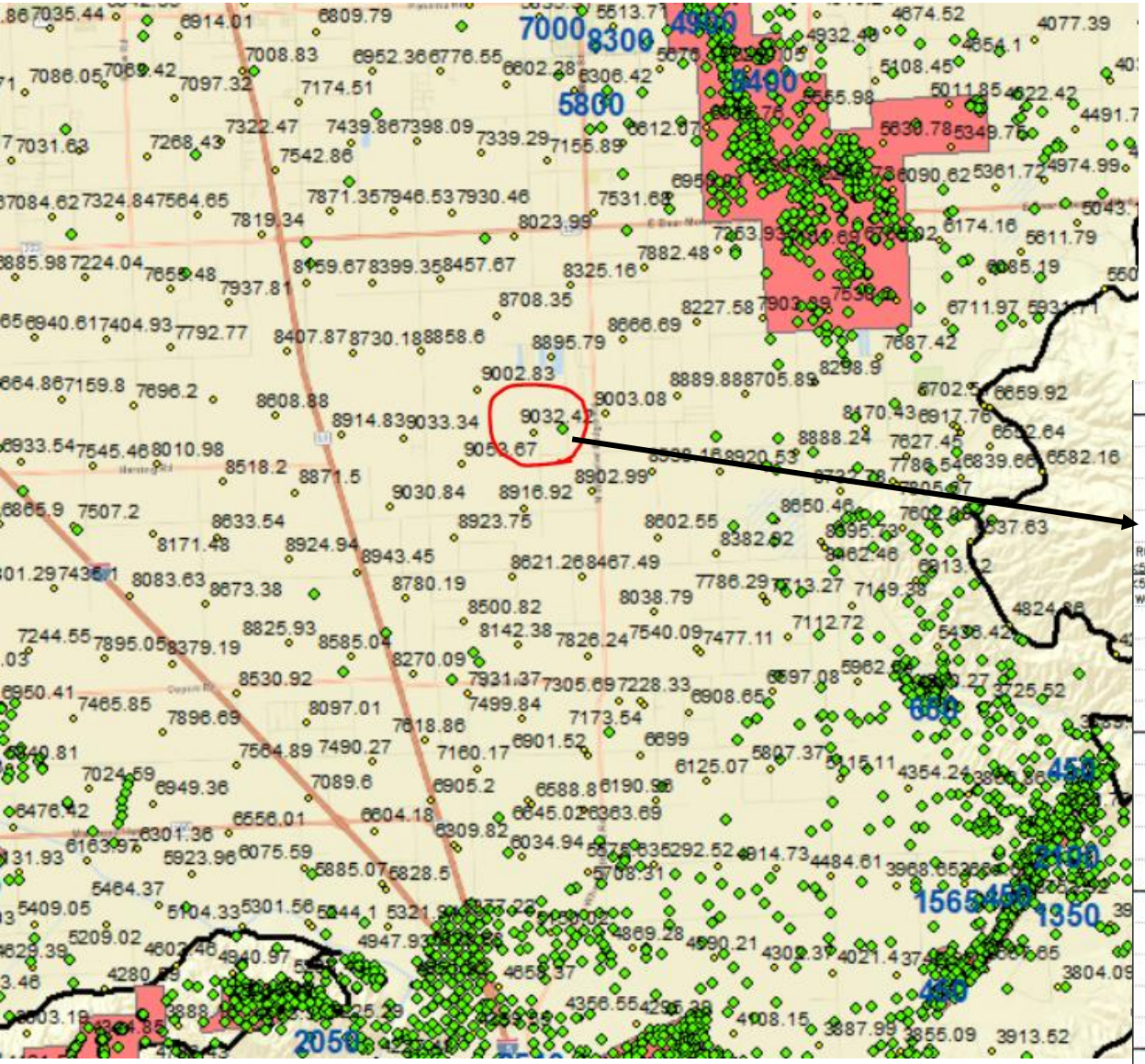


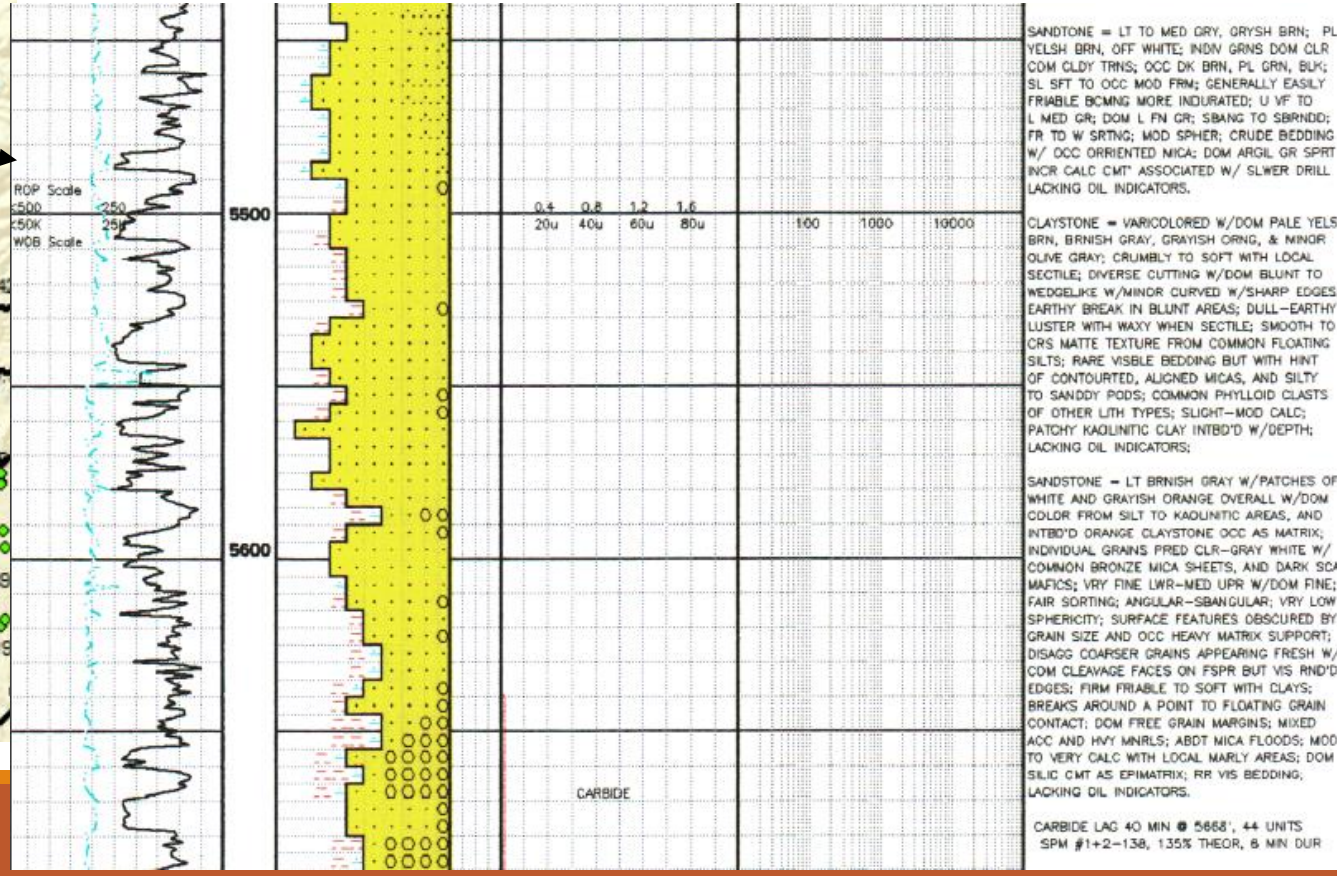
All HCMs/profiles (GSPs, Aquifer Exemptions, Seismic Surveys, old AEMs)



Wire-logs and Mud-Logs

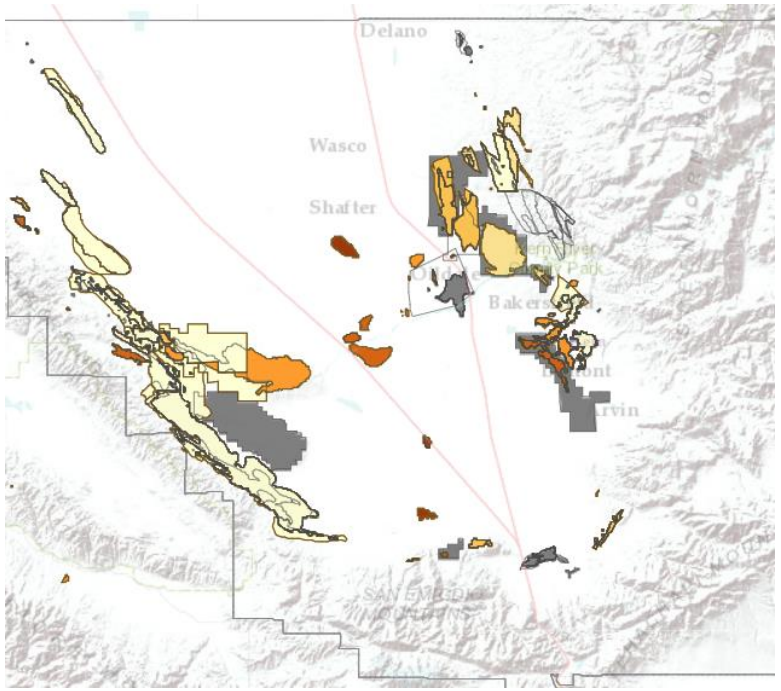
DOC, DOGGR





API: 0403003879

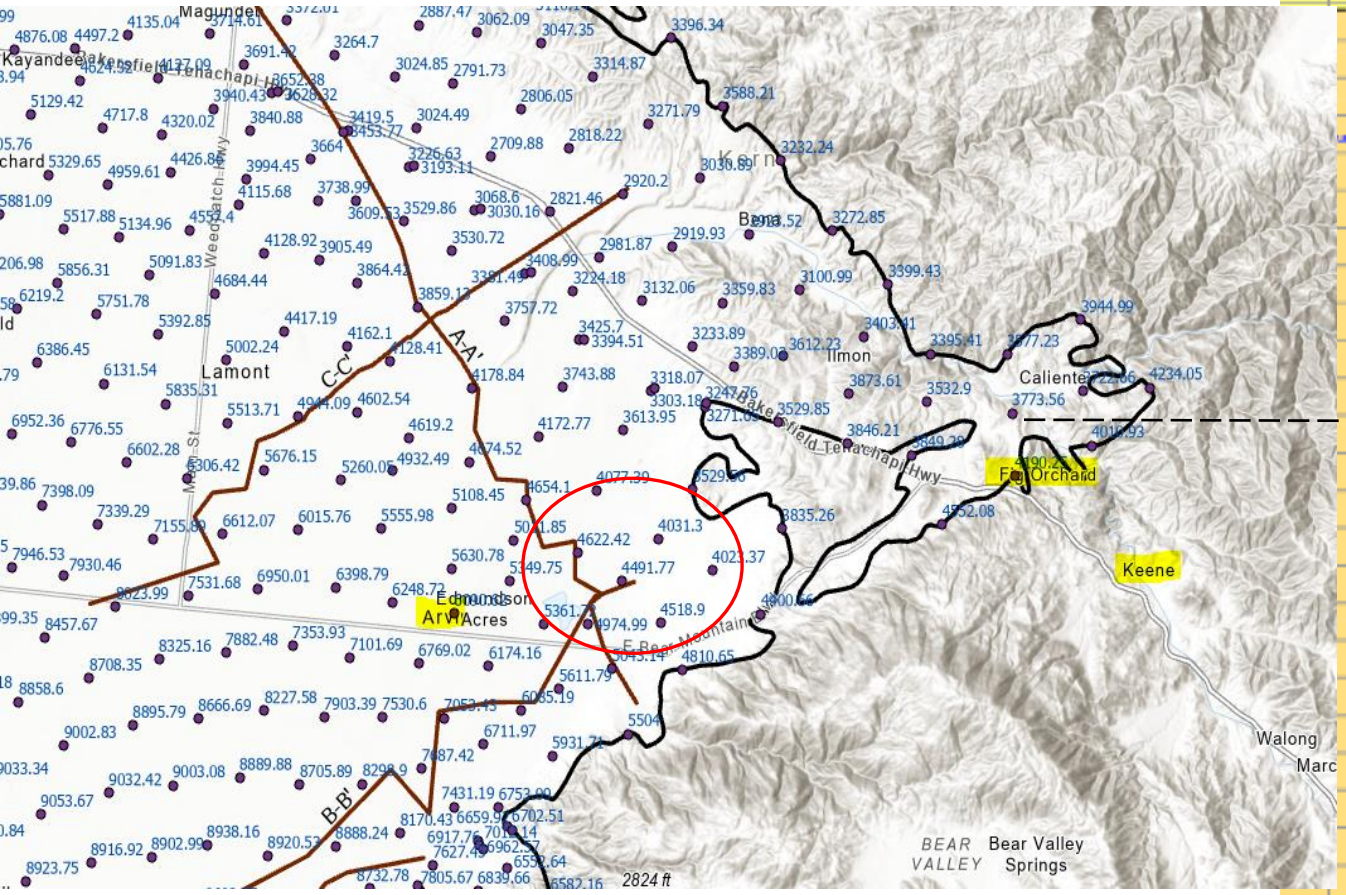
Aquifer Exemption DOC, DOGGR

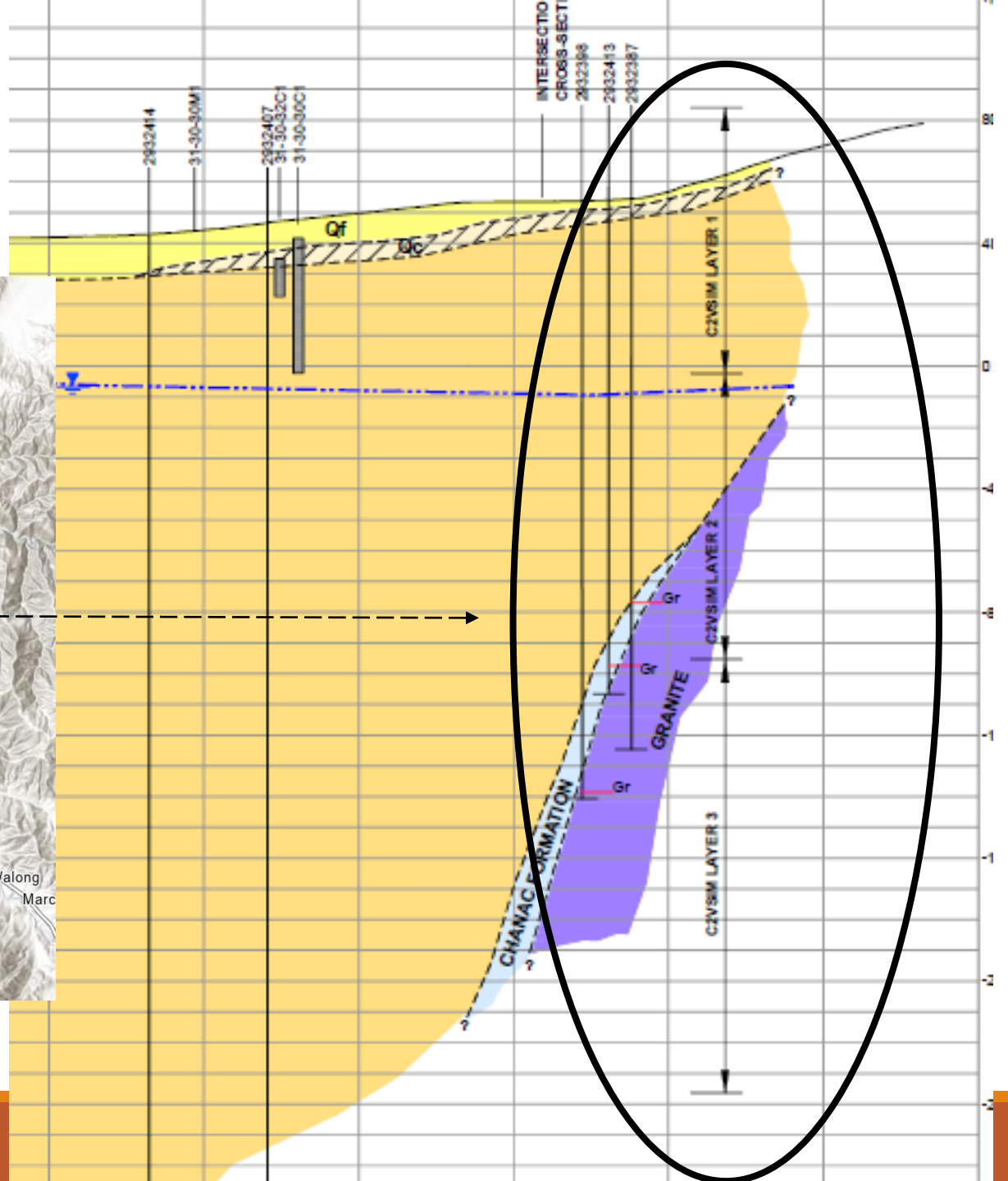


Kern County GPS

(Henry Miller Water District)

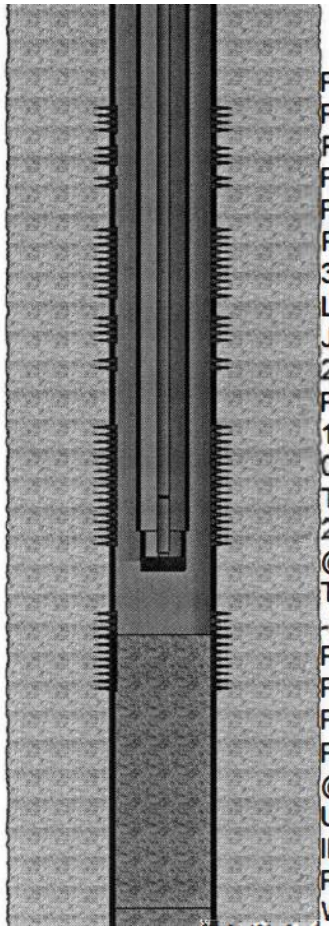
GEI consultant,





X-Section B-B’ , Kern County

Perforated intervals



Perforation Interval Open-Open @(743-795)
Perforation Interval Open-Open @(818-850)
Perforation Interval Open-Open @(863-870)
Perforation Interval Open-Open @(922-1002)
Perforation Interval Open-Open @(1020-1050)
Perforation Interval Open-Open @(1067-1080)
38 - 0.875 (7/8 in.) D x 30 Rod @(34-1174)
Left Hand Back Off Tool - 0.875" @(1174)
J-55 3.500 OD/ 9.30# T&C External Upset 2.992 ID 2.867 Drift @(10-1193)
Perforation Interval Open-Open @(1135-1200)
1 - 0.875 (7/8 in.) D x 30 Rod @(1175-1205)
0.750 (3/4 in.) D x 2 Rod Sub @(1205-1207)
Tubing Pump Barrel (NON-SERIALIZED) - 25-225-THBM-13-0-2-2 (Bore = 2.25) @(1193)-1210)
Tubing Pump Plunger (NON-SERIALIZED) - -225-T-0-15 (Bore = 2.25) @(1207)
Perforation Interval Open-Open @(1237-1250)
Perforations - Closed-Closed @(1250-1280)
Producing Interval @(743-1280)
Plug Back Total Depth-Cement Cap @(1250-1400)
Unknown 7.000 OD/ 23.00# Round Long 6.366 ID 6.241 Drift @(0-1410)
Plug Back Total Depth @(1400-1411)
Wellbore Hole OD-20.0000 @(0-1411)

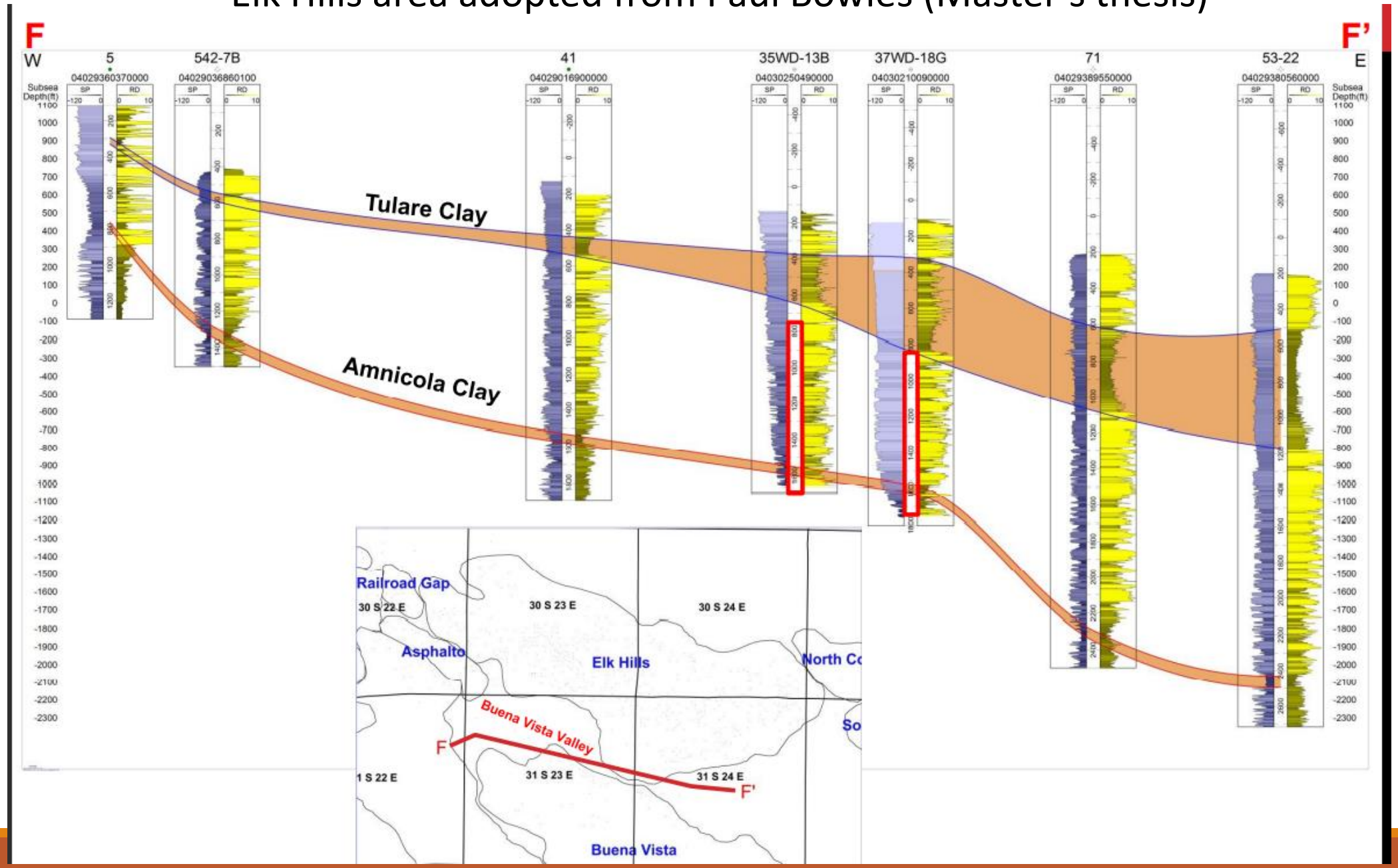
Perforated intervals = Evidence of gas/ oil = oil reservoir

Above the most immediate condonement we should identify water sands ➔ aquifer

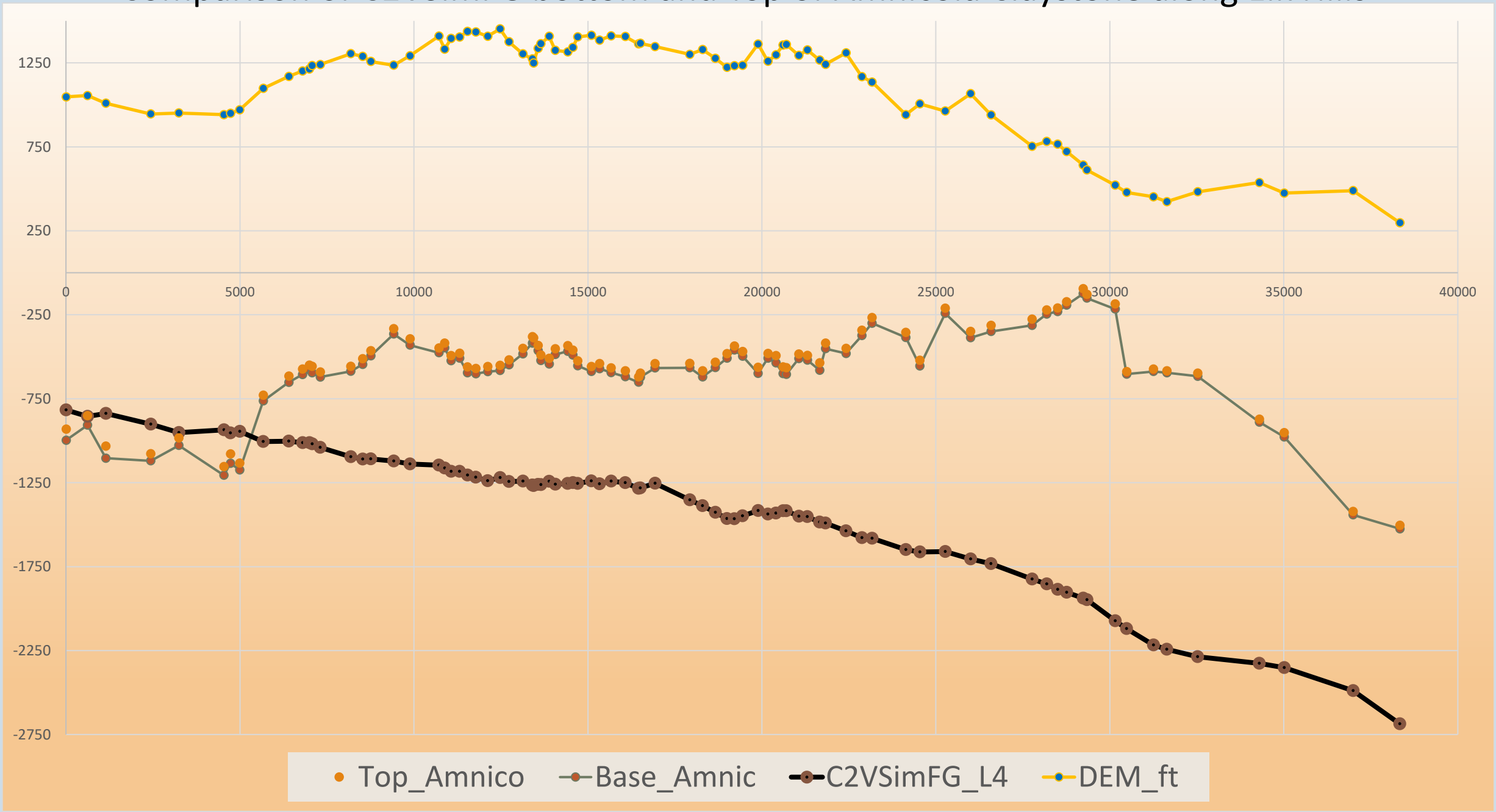
3-8-96 Perforated 7 " Casing with four 1/2" holes per foot over the following intervals:

From:	725	To:	735	C1	Sand.
From:	745	To:	801	G	Sand.
From:	825	To:	850	K	Sand.
From:	863	To:	873	K	Sand.
From:	1005	To:	1022	K1	Sand.
From:	1080	To:	1090	K2	Sand.

Elk Hills area adopted from Paul Bowles (Master's thesis)

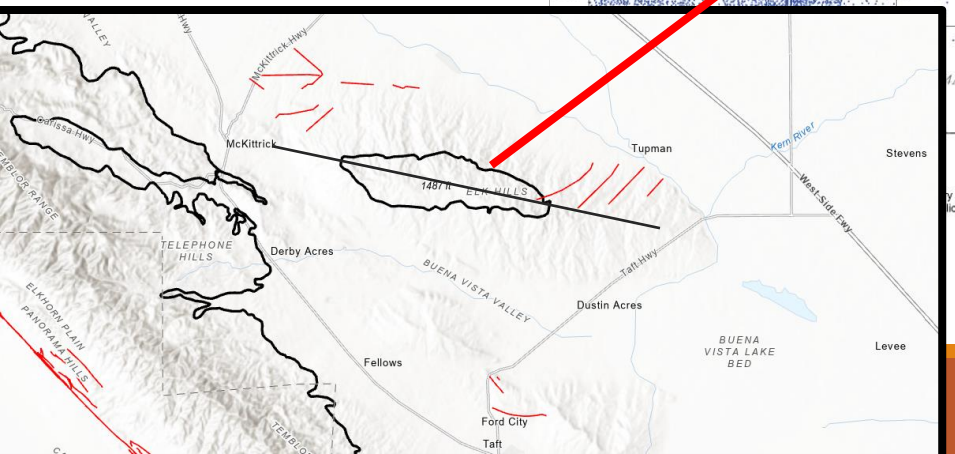


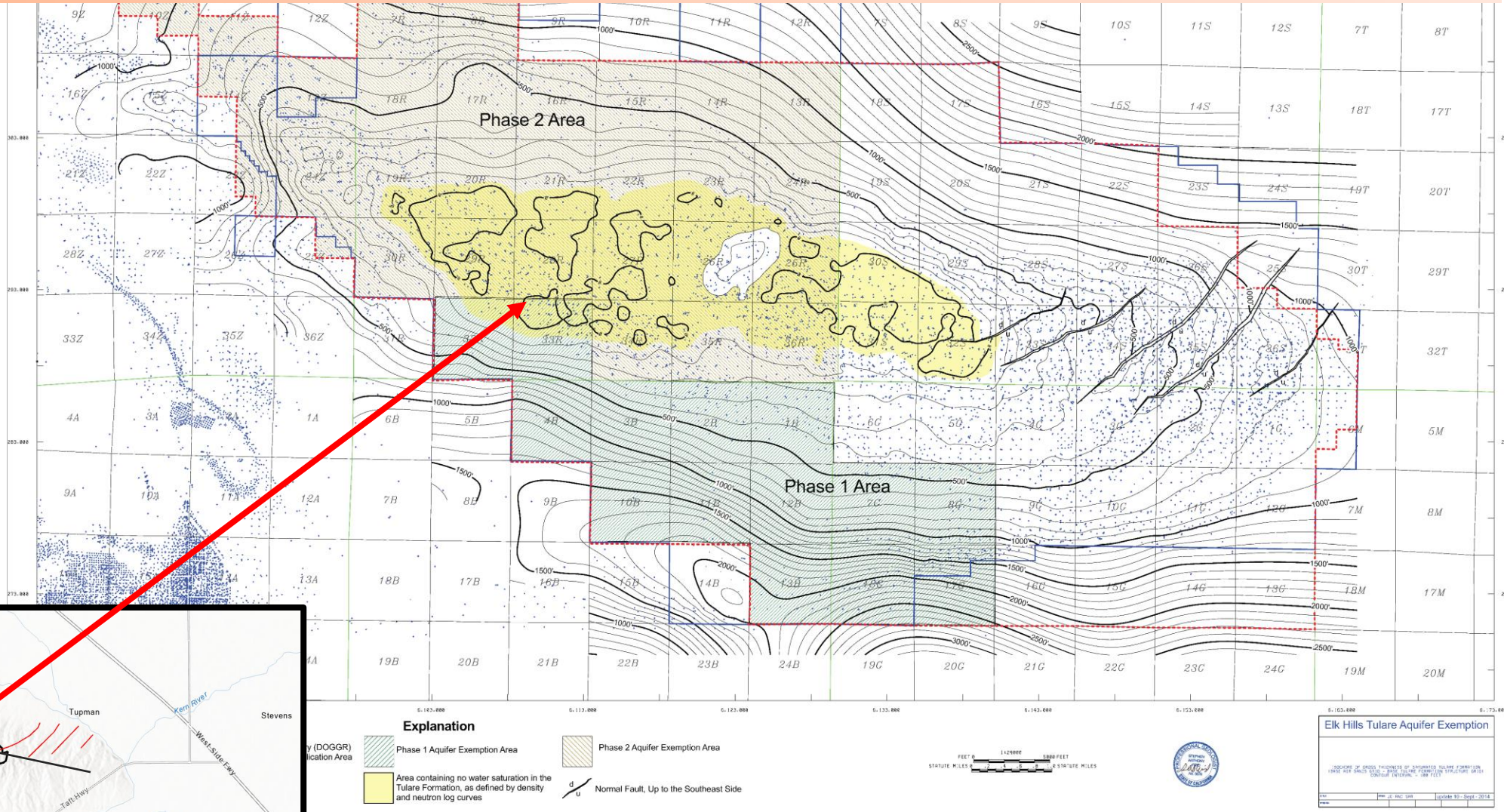
Comparison of C2VSimFG bottom and Top of Amnicola Claystone along Elk Hills



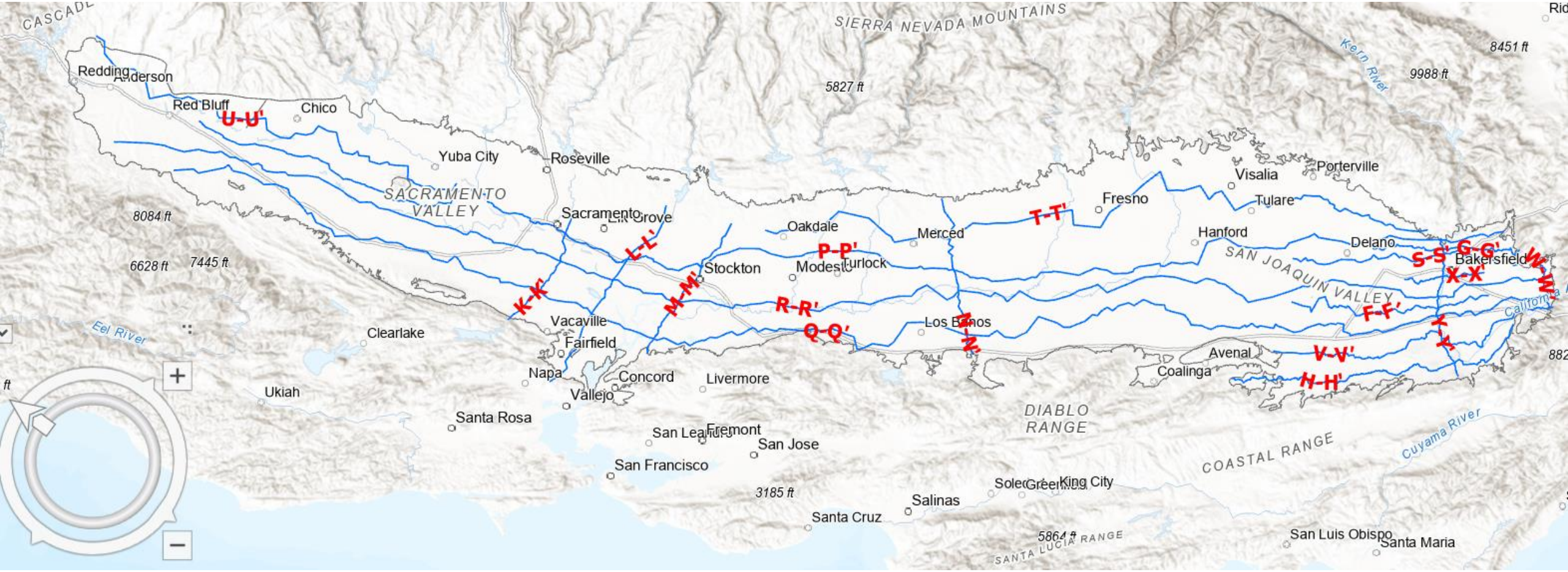
Zone with no groundwater (Elk Hills)

Elk Hills Oil Field Phase 1 Aquifer Exemption

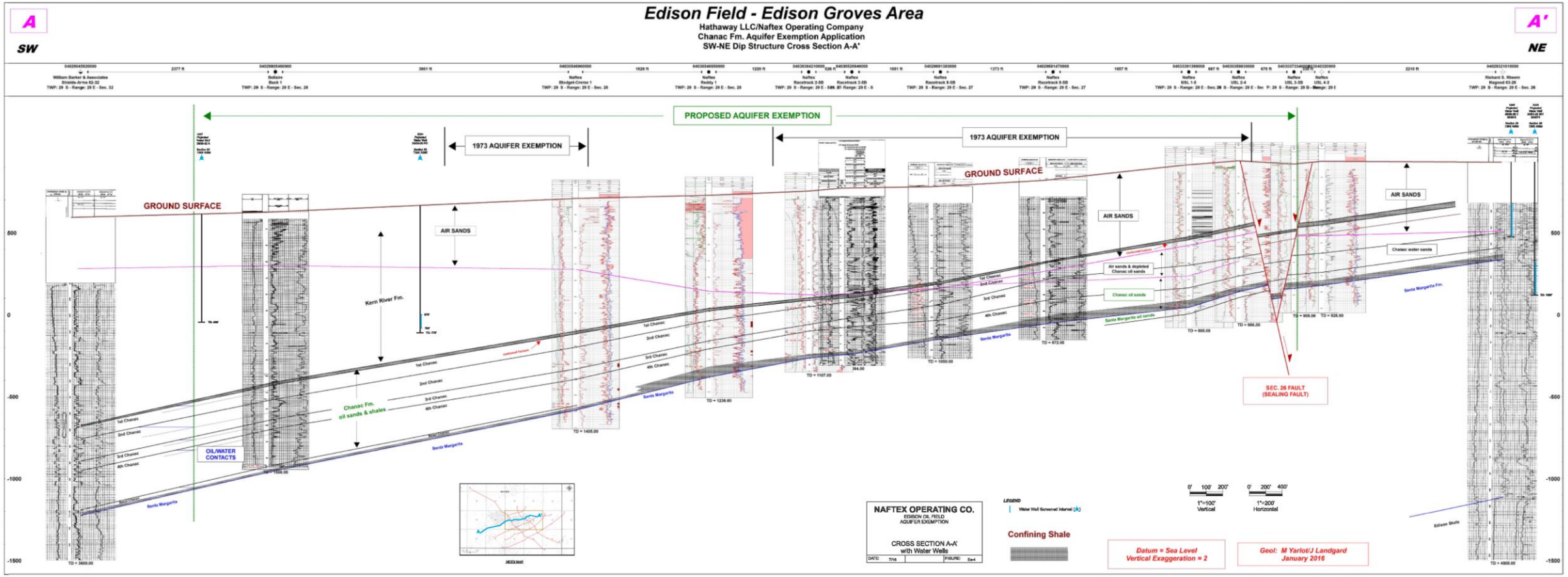




New profiles and selected wire-logs from CalGEM



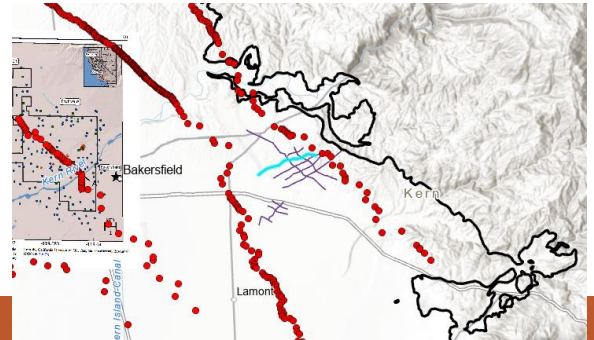
Base of Layer-4 of C2VSimFG is way much deeper than brine water injection (>1000')



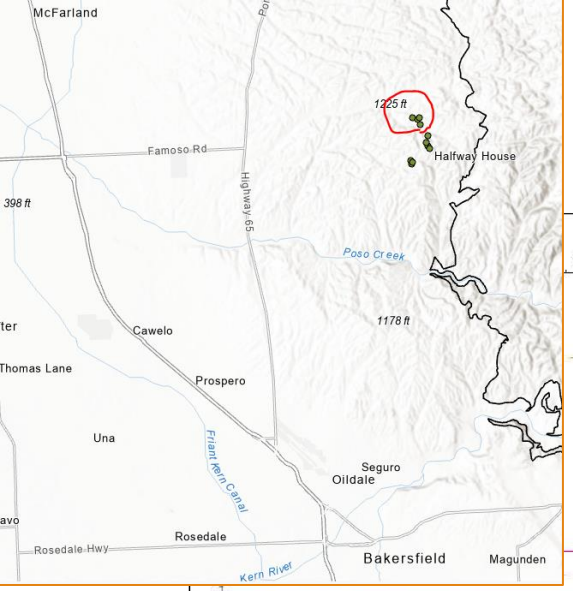
Base of C2VSimFG Model

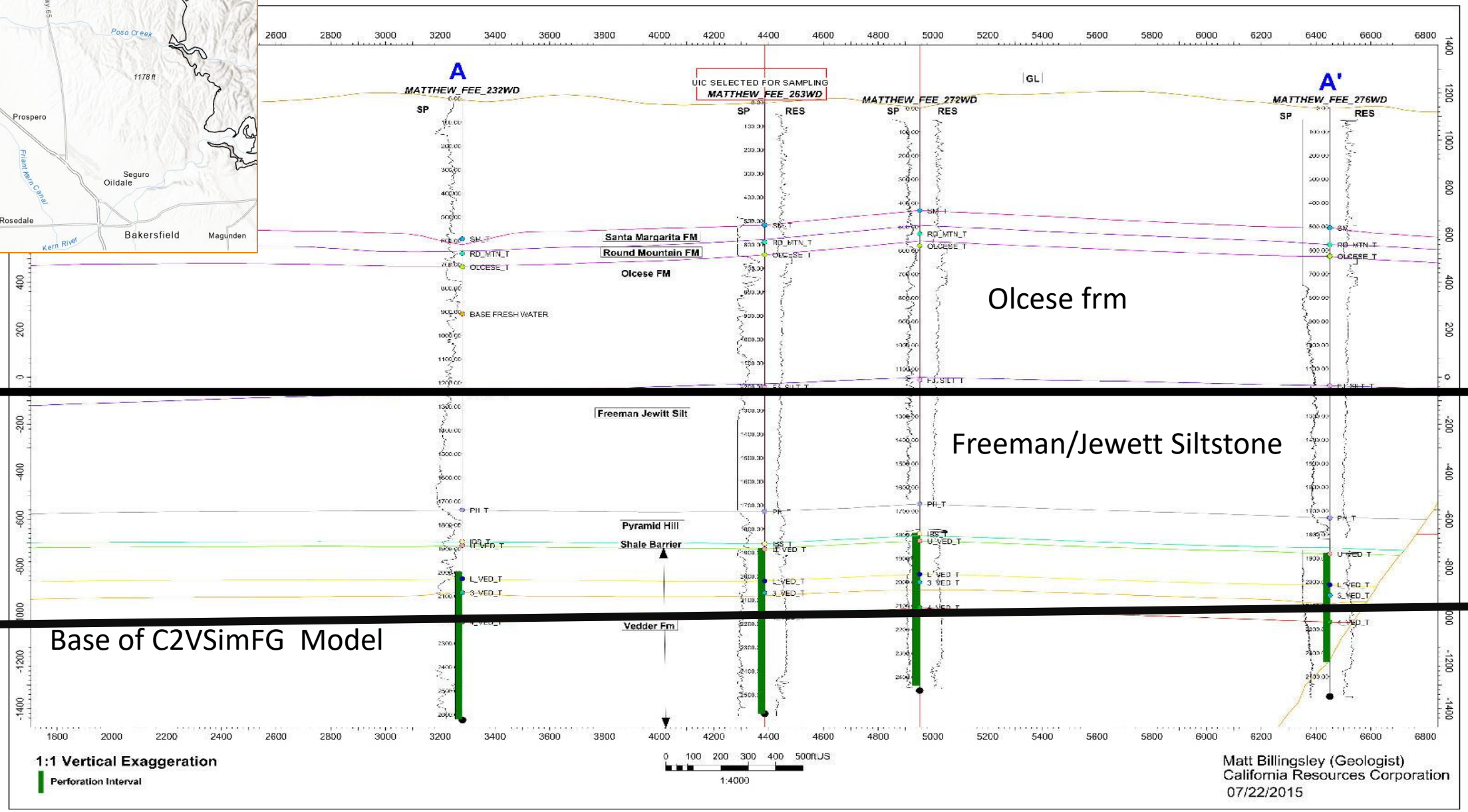
-2000
-2500
-3000

Profile A-A ' from **Edison phase -1** (Aquifer exemption)



Mount Poso Underground Injection Control





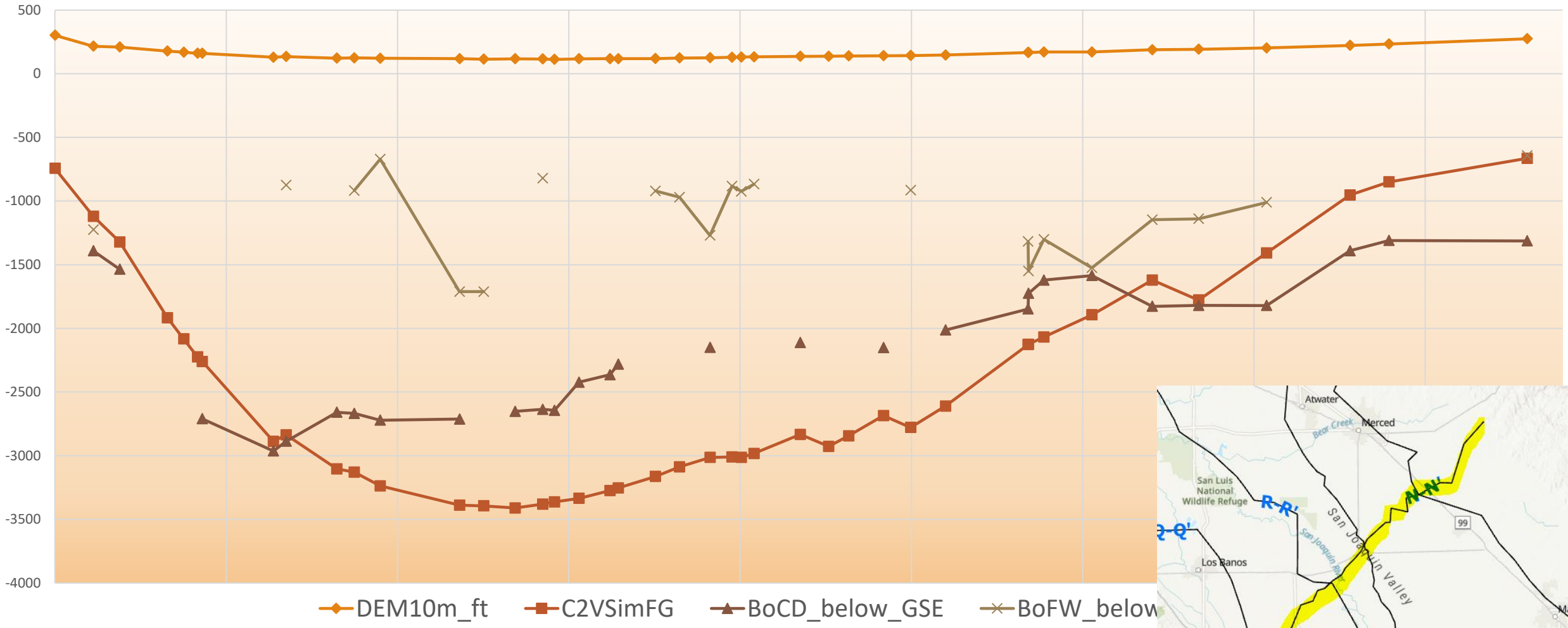
C2VSimFG vs x-section P-P'

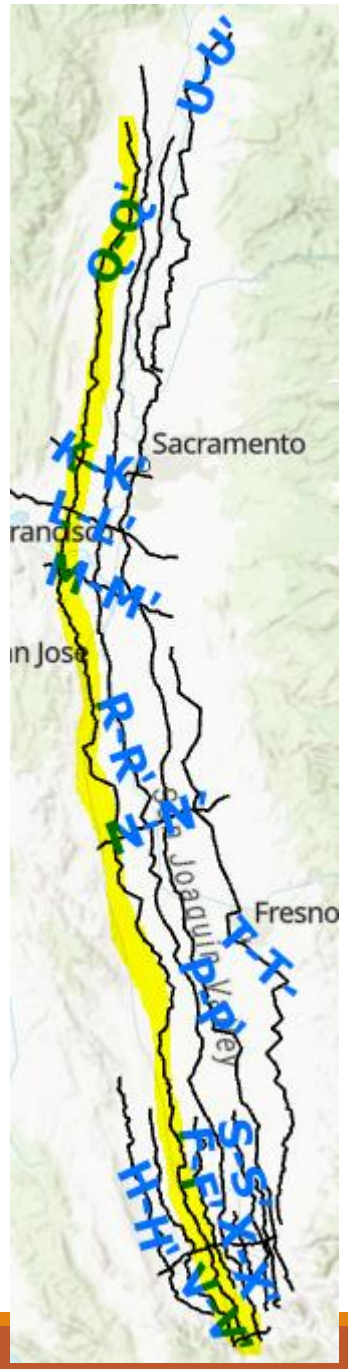
2000
1000
0
-1000
-2000
-3000
-4000
-5000
-6000

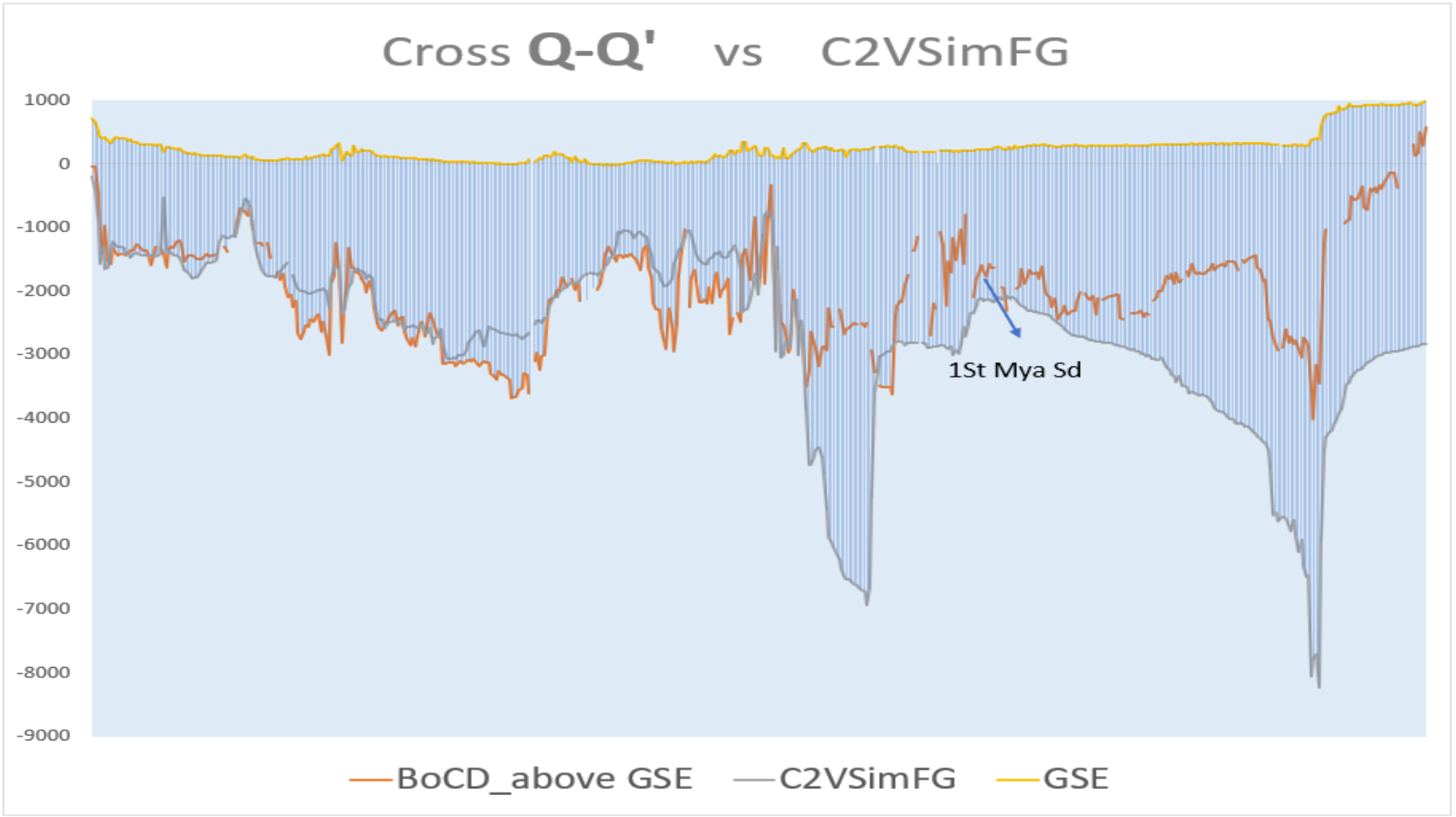
DEM10m_ft
base_L4_C2VSimFG
base of Up_Cont dep

xsection **M-M'** vs base L4 of C2VSimFG

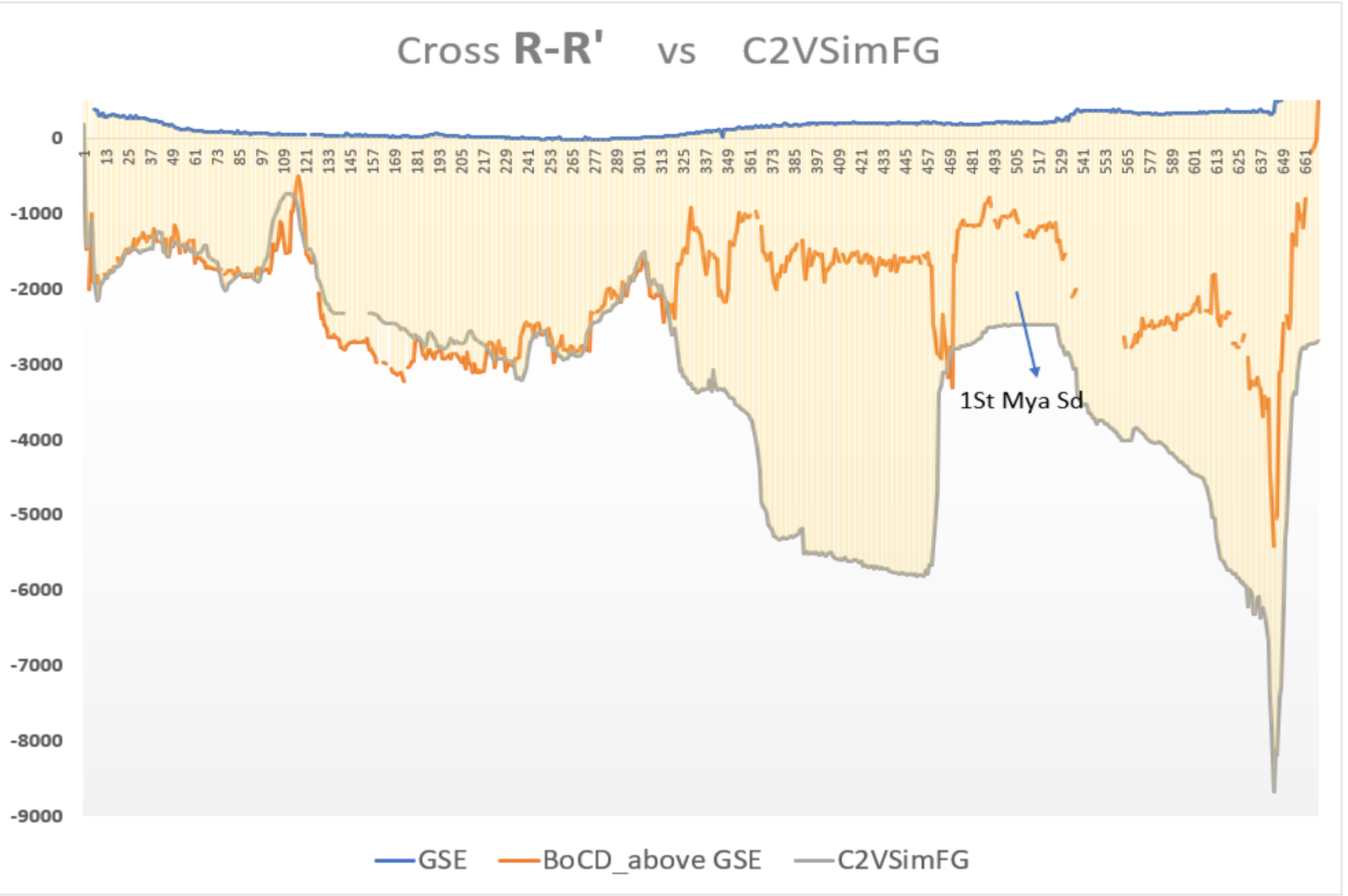
XSECTION N-N' VS C2VSIMFG




Q-Q'
Sacramento
San Joaquin Valley
Fresno


Cross Q-Q' vs C2VSimFG
1000
0
-1000
-2000
-3000
-4000
-5000
-6000
-7000
-8000
-9000
1St Mya Sd
BoCD_above GSE
C2VSimFG
GSE


Mendocino National Forest
Coastal Range
Sacramento
Fremont
Stockton
San Joaquin Valley
Fresno
Visalia
Sequoia National Fore
a Barbara
O-O'
U-U'
P-P'
K-K'
L-L'
M-M'
N-N'
T-T'
R-R'
F-F'
H-H'
A-A'
G-G'
S-S'


Cross R-R' vs C2VSimFG
0
-1000
-2000
-3000
-4000
-5000
-6000
-7000
-8000
-9000
1St Mya Sd
GSE
BoCD_above GSE
C2VSimFG

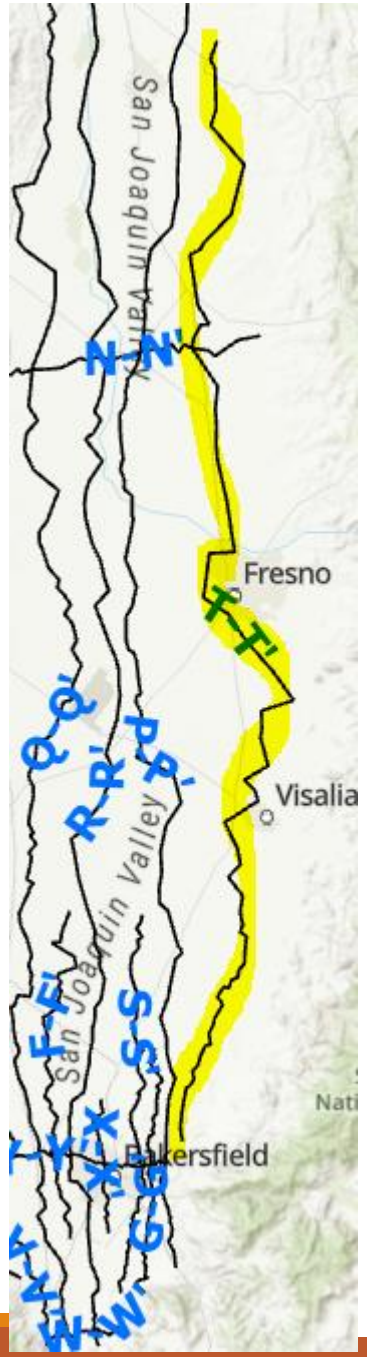
Cross **S-S'** vs C2VSimFG

1000
0
-1000
-2000
-3000
-4000
-5000
-6000
-7000

Kern River Series Perforated intervals are showing oil-bearing sandstones

Santa Margarita frm Perforated intervals are showing oil-bearing sandstones

GSE — BoCD_above GSE — C2VSimFG

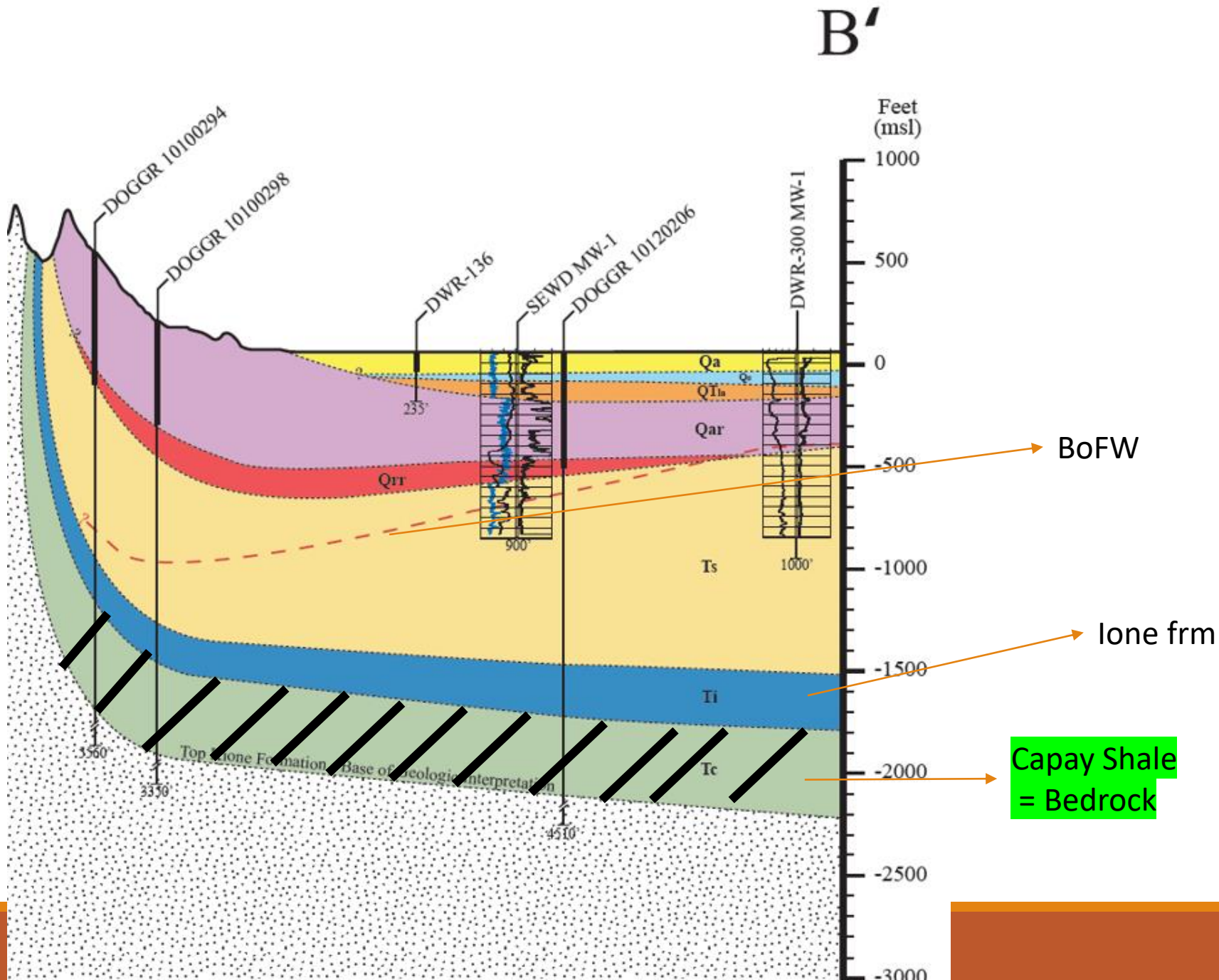


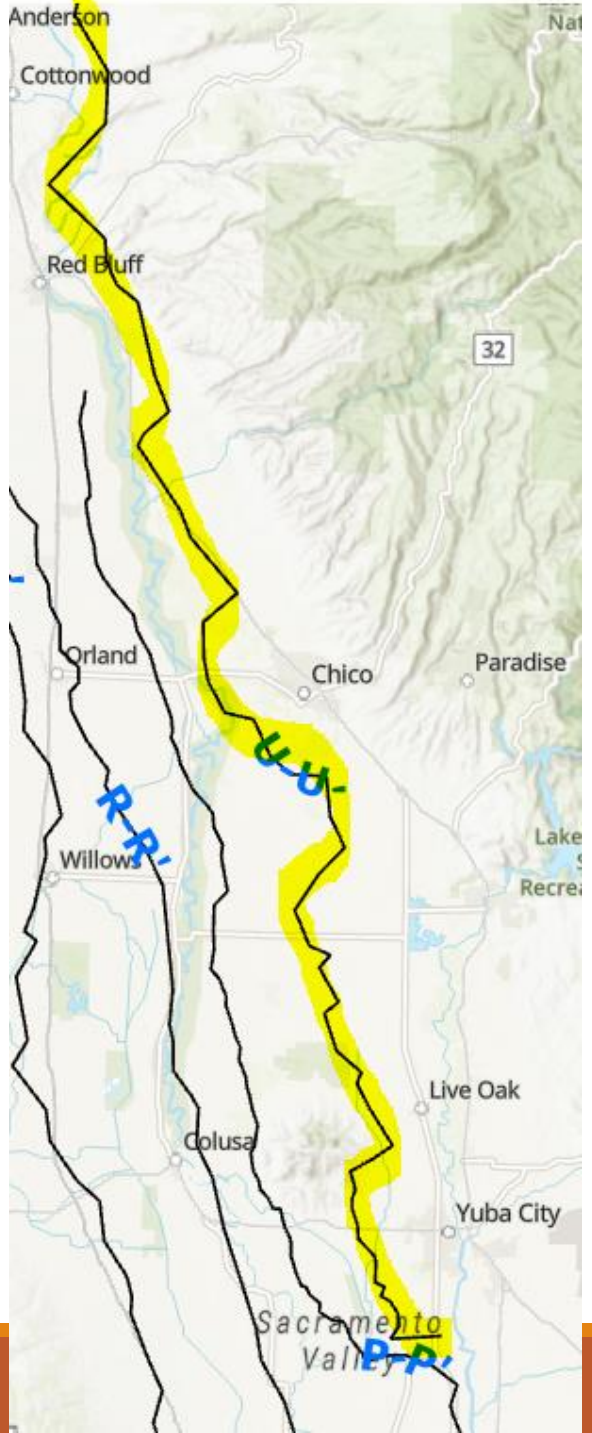
Cross T-T' vs C2VSimFG

1500
1000
500
0
-500
-1000
-1500
-2000
-2500
-3000
-3500

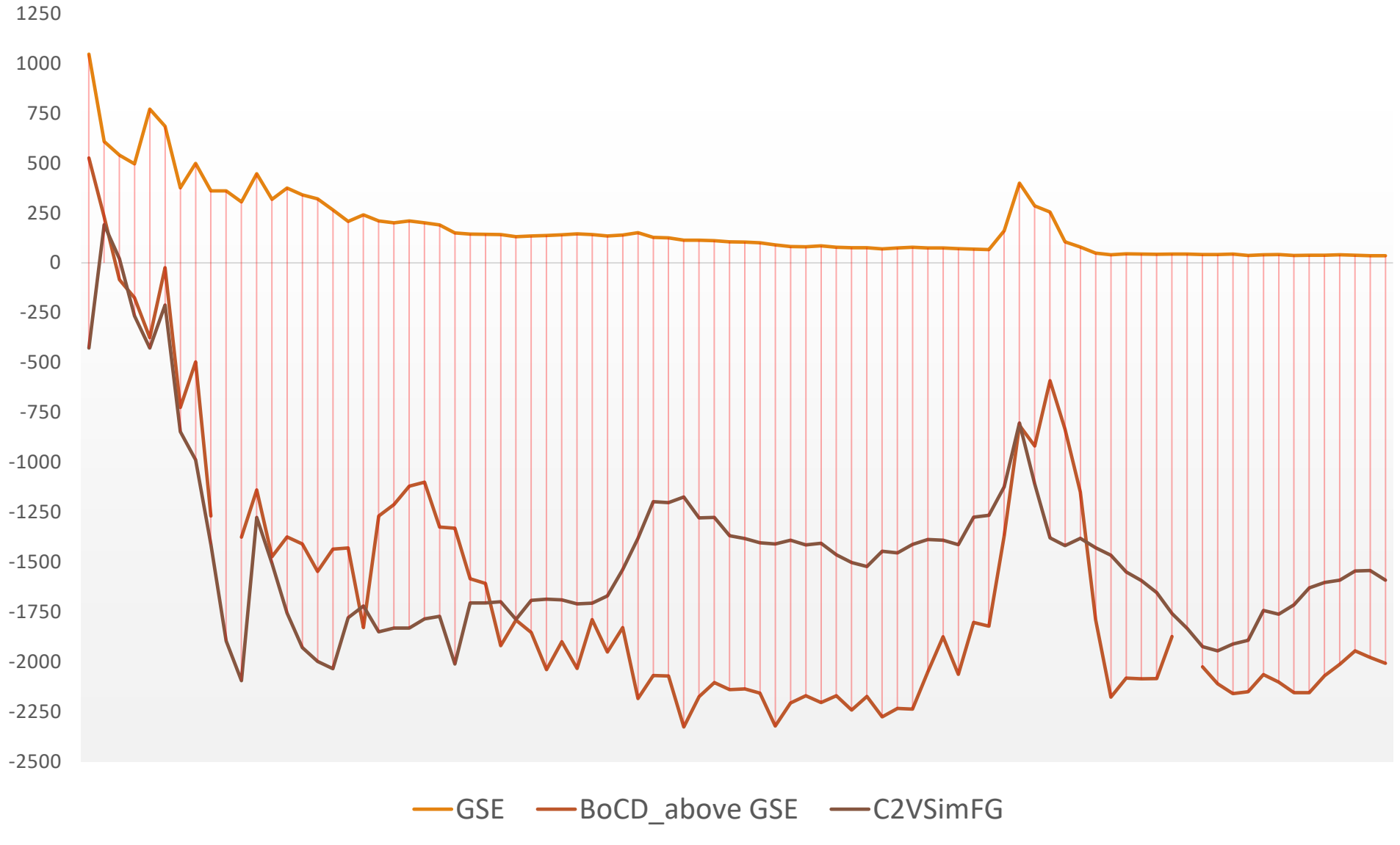
Kern River Frm

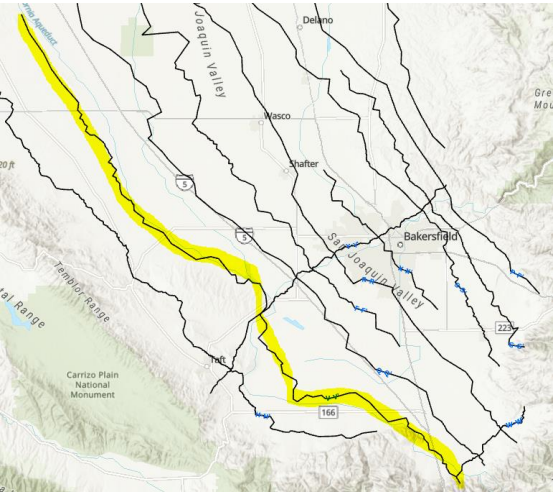
GSE
BoCD_above GSE
C2VSimFG


B′
Feet
(msl)
1000
500
0
-500
-1000
-1500
-2000
-2500
-3000
DOGGR 10100294
DOGGR 10100298
DWR-136
SEWD MW-1
DOGGR 10120206
DWR-300 MW-1
235'
900'
1000'
3560'
3330'
4510'
Qa
QTla
Qar
QTT
Ts
Ti
Tc
BoFW
Ione frm
Capay Shale
= Bedrock

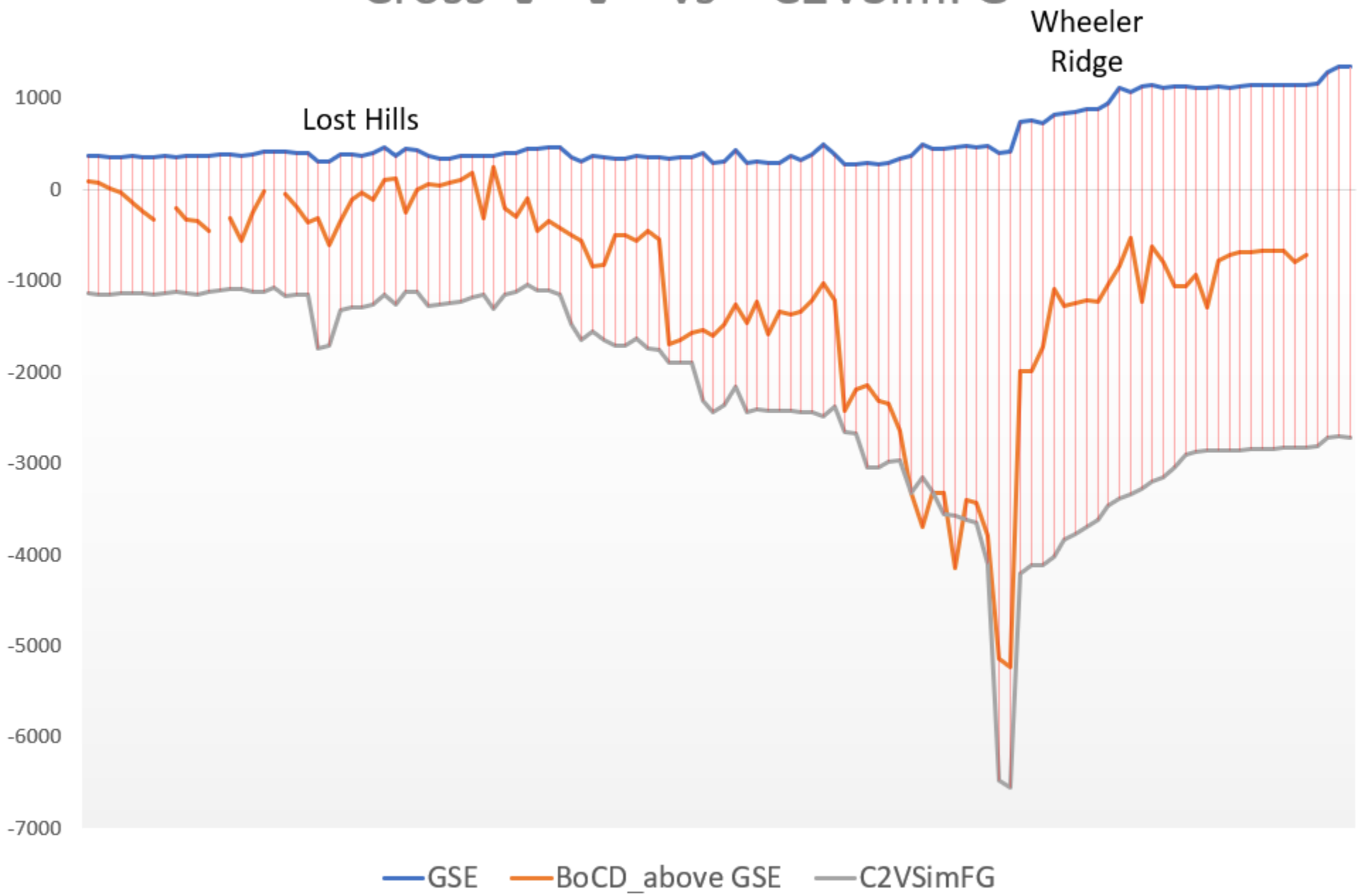


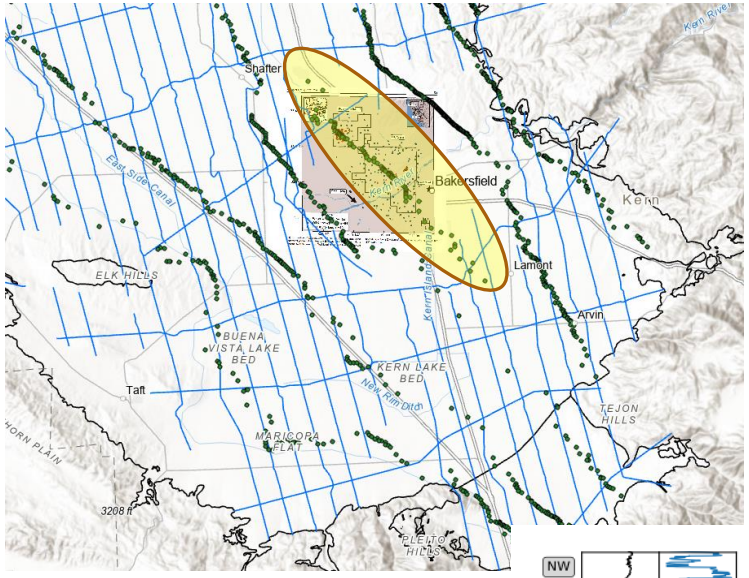
Cross **U-U'** vs C2VSimFG





Cross V-V' vs C2VSimFG





USGS report: (**Groundwater salinity mapping using geophysical log analysis) by** Michael J. Stephens

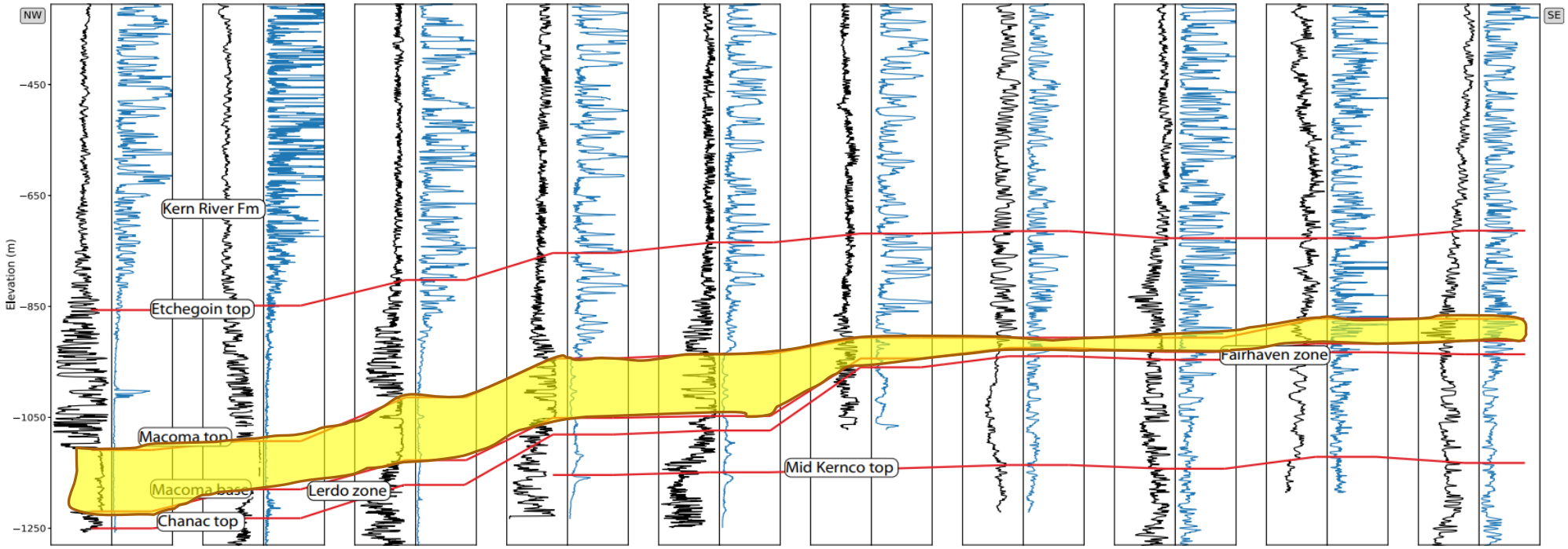
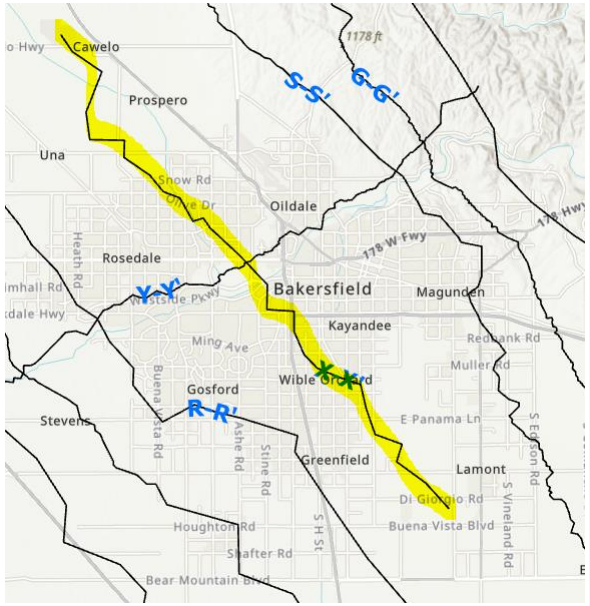
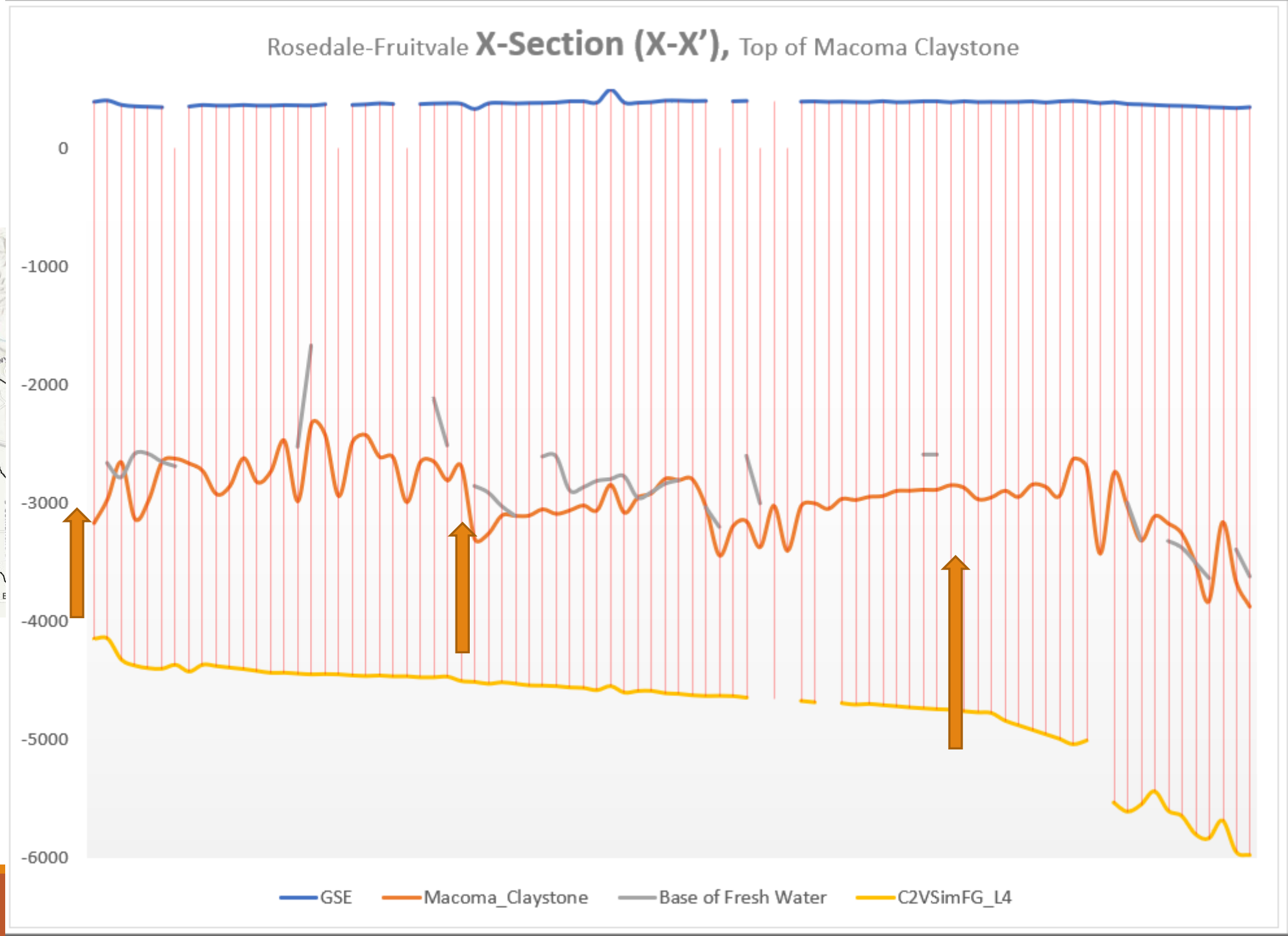
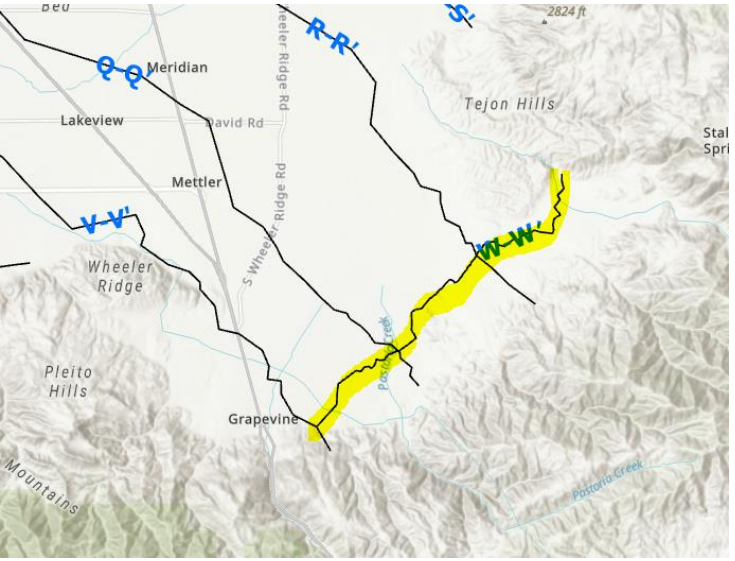


Fig. 2 Cross section of geophysical well logs along A–A′ from Fig. 1. The black curves are spontaneous potential (SP) and the blue curves are deep-reading resistivity. Select geologic formations are correlated across the section. The Macoma Claystone, within the basal Etchegoin Formation, is a regionally extensive clay unit which acts as a hydraulic barrier


Cawelo
Prospero
Una
Snow Rd
Oildale
178 W Fwy
Rosedale
Bakersfield
Magunden
Kayandee
Ming Ave
Redbank Rd
Muller Rd
Wible Rd
Gosford
Stevens
E Panama Ln
Greenfield
Lamont
Di Giorgio Rd
Buena Vista Blvd
Houghton Rd
Shafter Rd
Bear Mountain Blvd
S-S'
G-G'
Y-Y'
X-X'
R-R'


Rosedale-Fruitvale X-Section (X-X'), Top of Macoma Claystone
0
-1000
-2000
-3000
-4000
-5000
-6000
GSE
Macoma_Claystone
Base of Fresh Water
C2VSimFG_L4


Meridian
Lakeview
Mettler
Wheeler Ridge
Pleito Hills
Grapevine
Tejon Hills
Q-Q'
R-R'
V-V'
W-W'

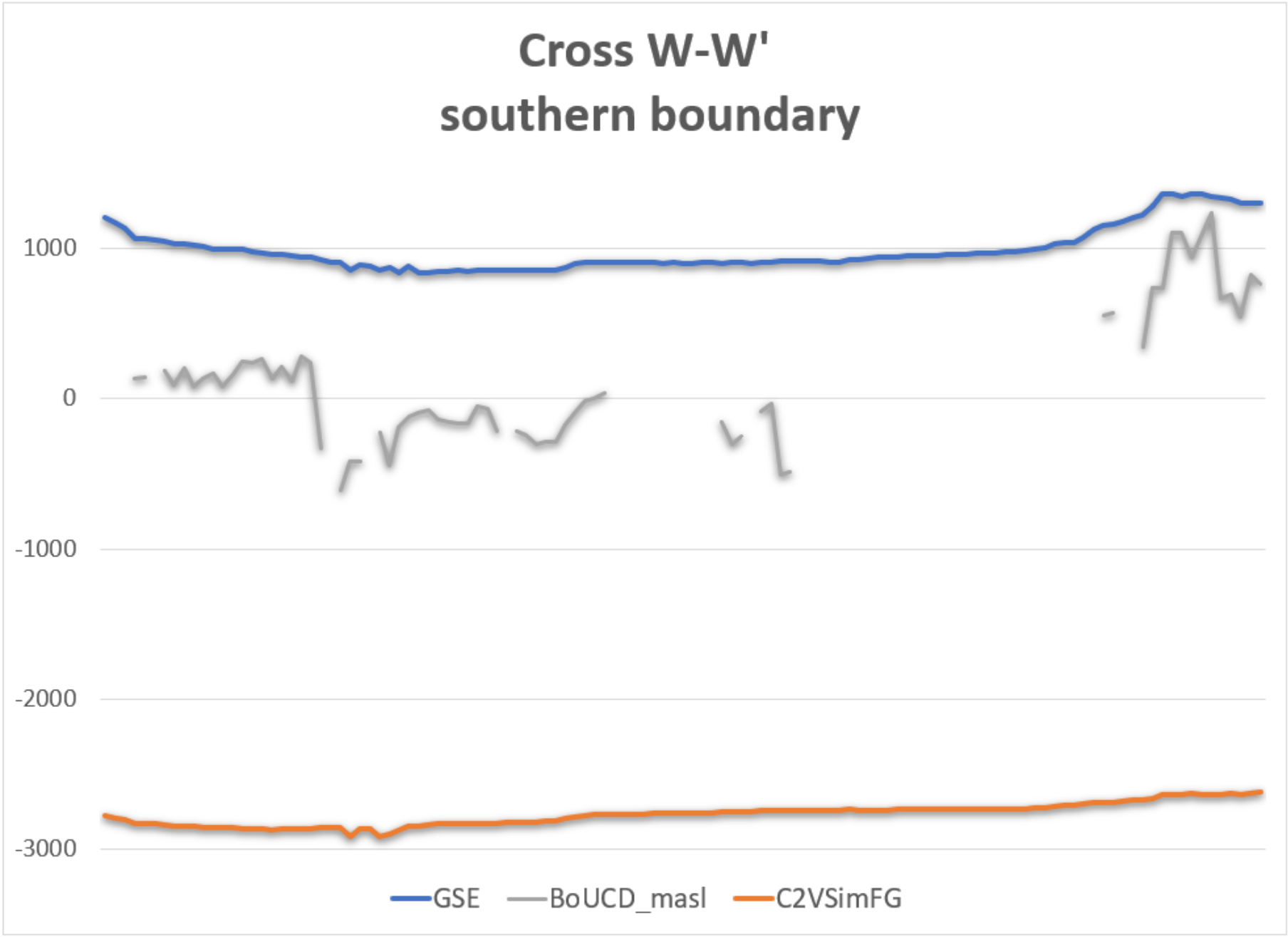
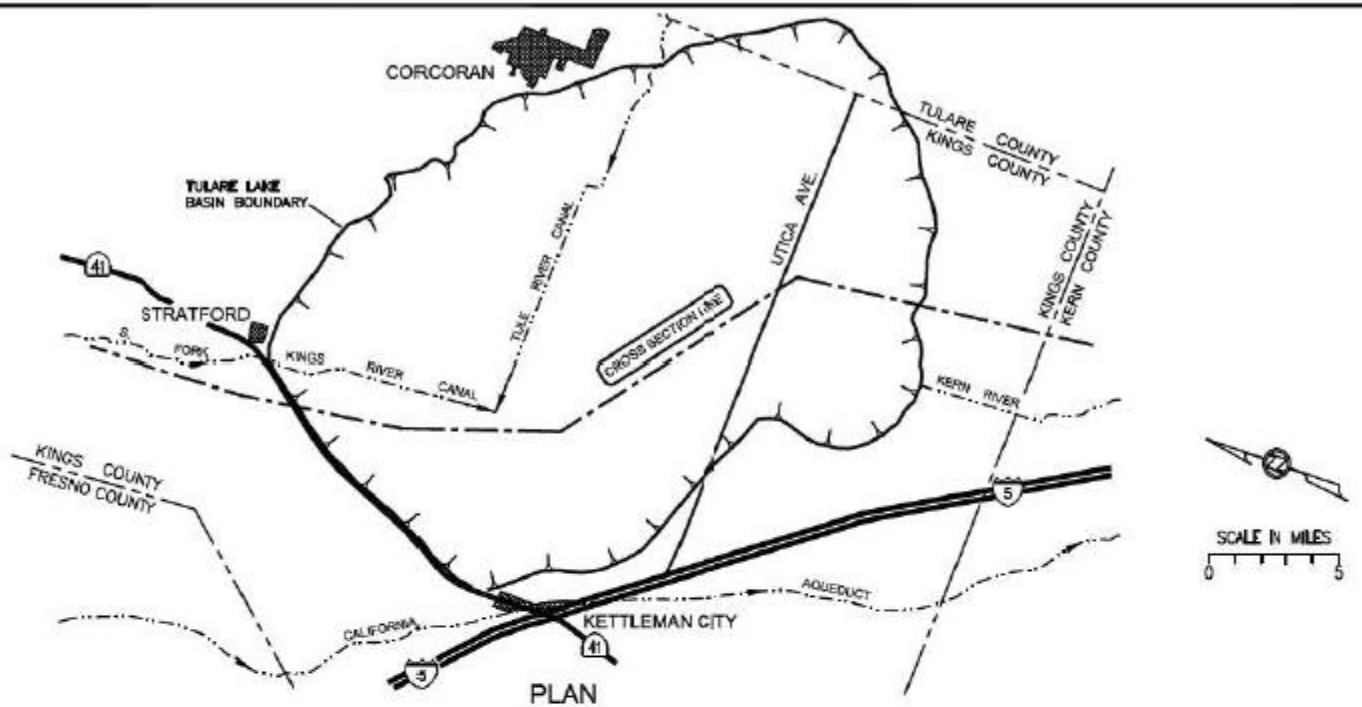
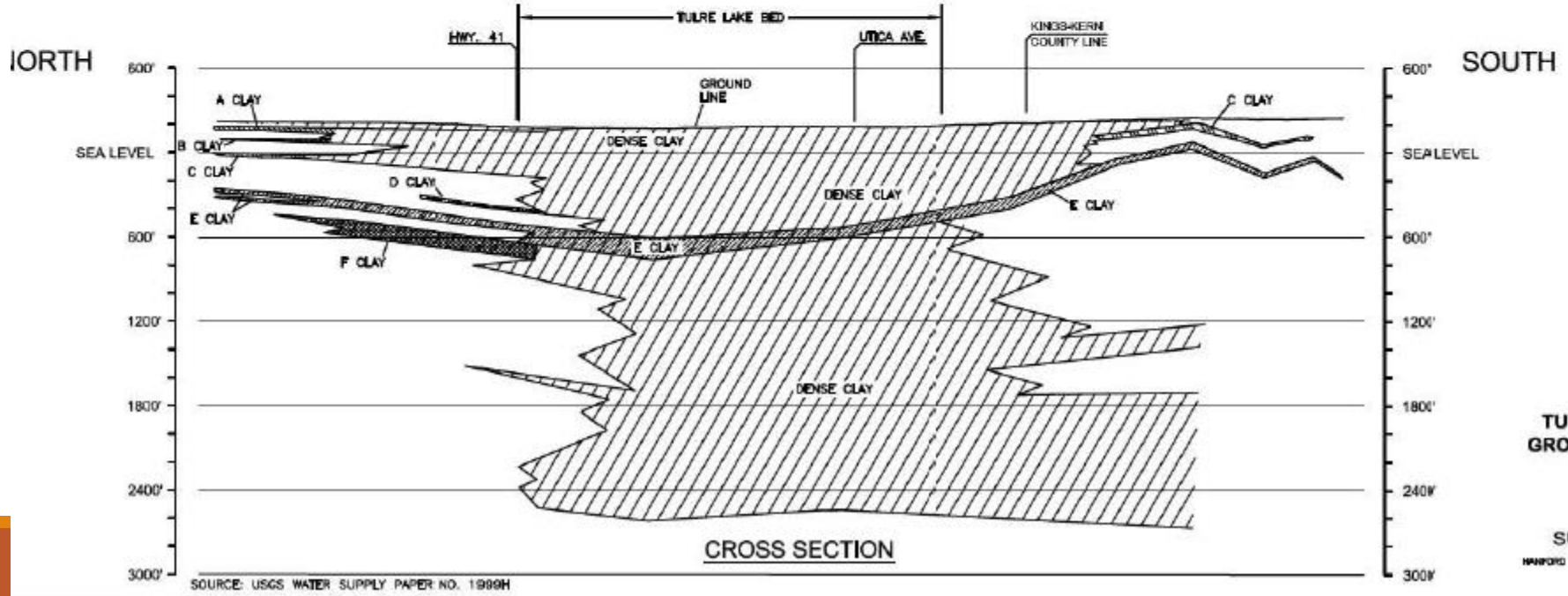

Cross W-W'
southern boundary
1000
0
-1000
-2000
-3000
GSE
BoUCD_masl
C2VSimFG

FIGURE 1



PLAN



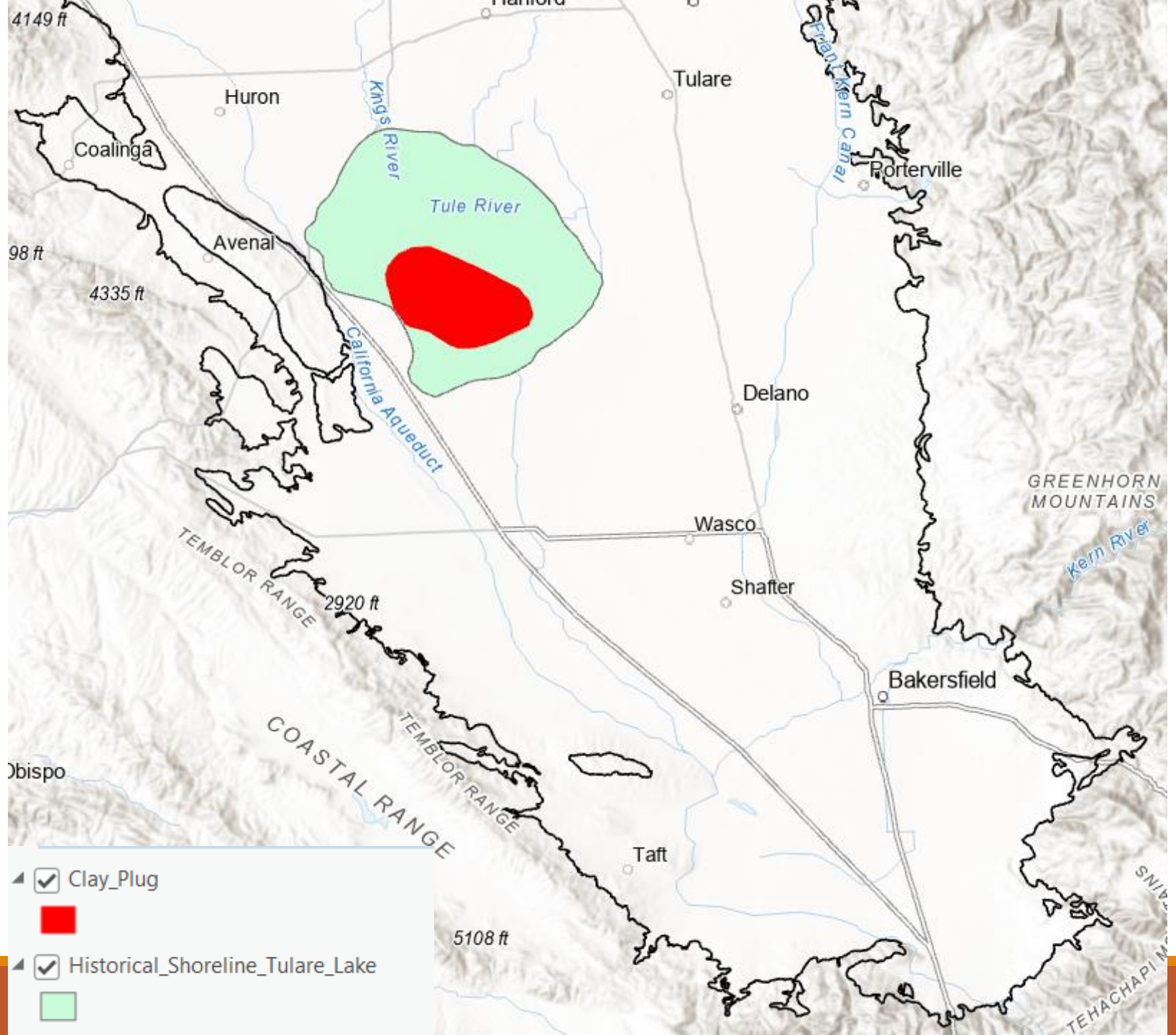
CROSS SECTION

SOURCE: USGS WATER SUPPLY PAPER NO. 1999H

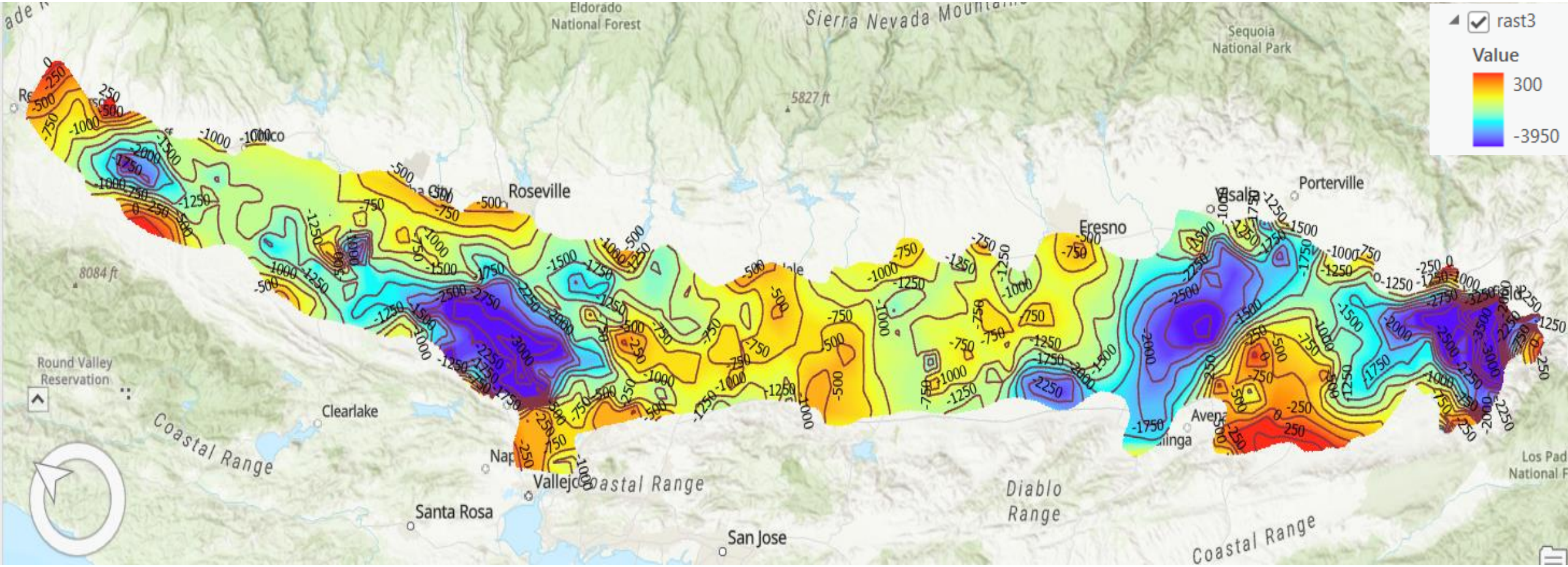
TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

TULARE LAKE BED
GEOLOGIC CROSS SECTION

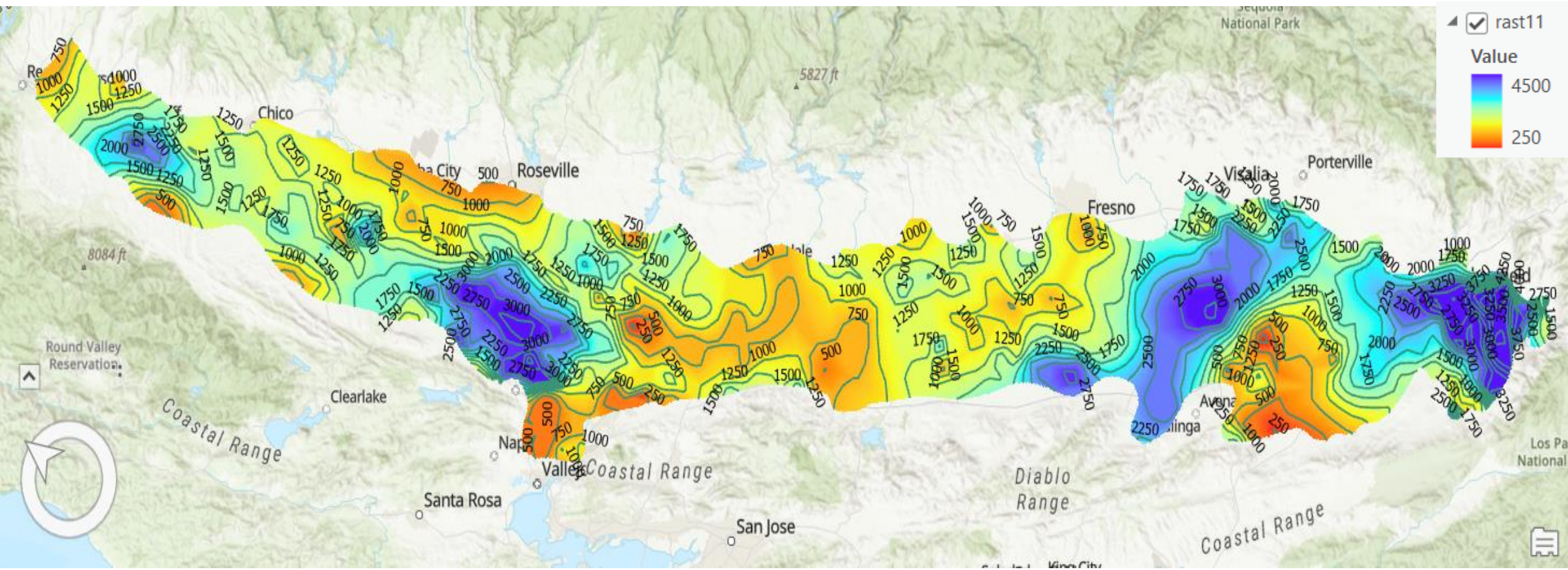
SUMMERS ENGINEERING INC.
HANFORD Consulting Engineers CALIFORNIA


4149 ft
Huron
Coalinga
Kings River
Tulare
Friant-Kern Canal
Porterville
Tule River
Avenal
98 ft
4335 ft
California Aqueduct
Delano
GREENHORN MOUNTAINS
Wasco
Kern River
TEMBLOR RANGE
2920 ft
Shafter
Bakersfield
COASTAL RANGE
TEMBLOR RANGE
Obispo
Taft
5108 ft
Clay_Plug
Historical_Shoreline_Tulare_Lake

Preliminary Base of Fresh Water (masl) heatmap
DWR/SGMO mapped April 2023



Preliminary Base of Fresh Water (bKB) heatmap
DWR/SGMO mapped April 2023

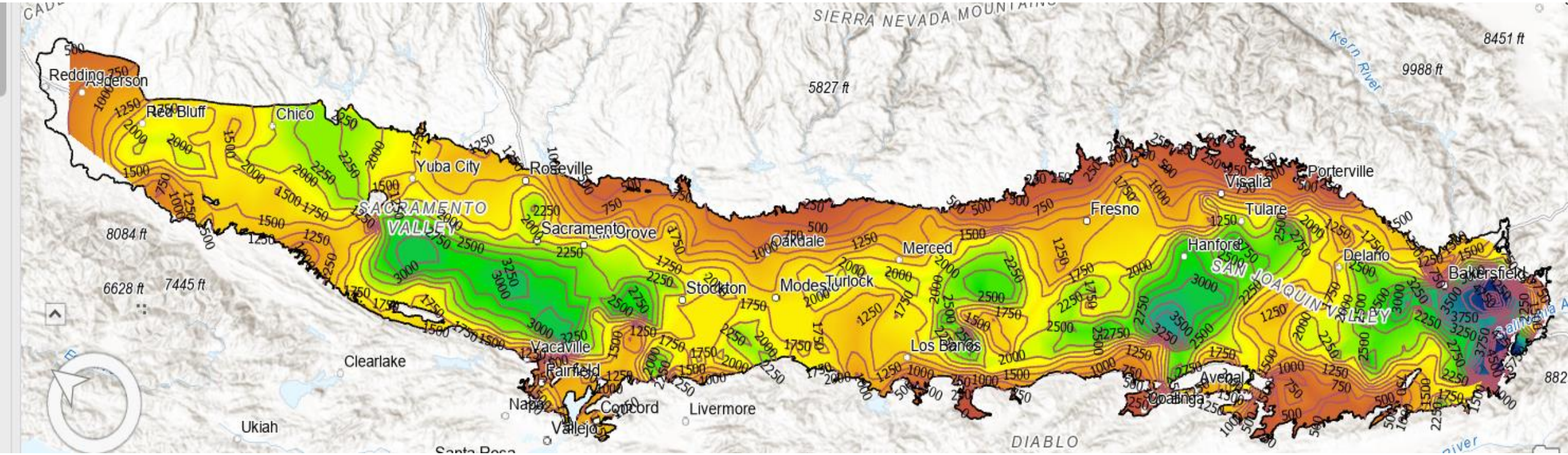


number of oil/gas wells reviewed (CalGEM-Well Finder)

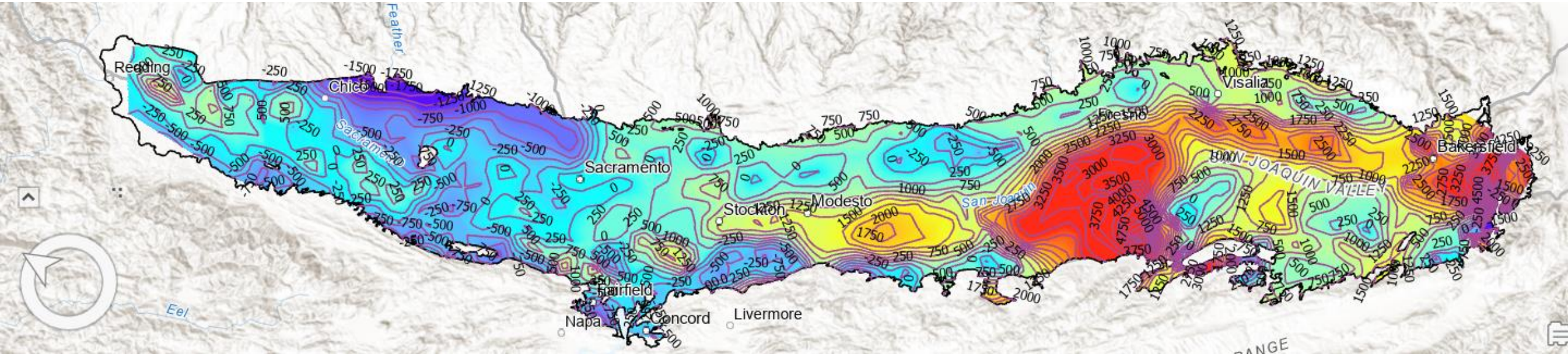
For mapping Base of Fresh Water (BoFW) based upon in-bore geophysical surveys

id	profile	BoUCD	BoFW	id	profile	BoUCD	BoFW
1	F-F’			10	R-R'	697	444
2	G-G’			11	S-S’	371	55
3	H-H’	358 In progress	163	12	T-T’	227	35
4	K-K'	45	42	13	U-U’	85	73
5	L-L'	110	68	14	V-V’	229	65
6	M-M'	53	28	15	W-W’	120	48
7	N-N'	42	23	16	X-X’	99	48
8	P-P'	637	384	17	Y-Y’		
9	Q-Q’	557	374	18	Parsed logs	540	372

Preliminary map of “CV aquifer thickness”
DWR/SGMO mapped April 2023



The difference between C2VSimFG and new bedrock contour-lines



+ C2VSimFG is thicker (contour-lines in yellow & red)
- C2VSimFG is thinner (contour-lines in blue & green)

What are the next steps:

- Doing QA/QC
- Improving the mapped bedrock by adding 3 more x-sections
- Adjust AEM datasets via TDS data from GAMA & contour-lines for BoFW
- Collecting pumping(Aquifer) tests data from OWSCR/ GSPs
- Cross-correlation between adjusted AEM / texture data and pumping test results(T, K).

behrooz.etebari@water.ca.gov