Discussion Support:

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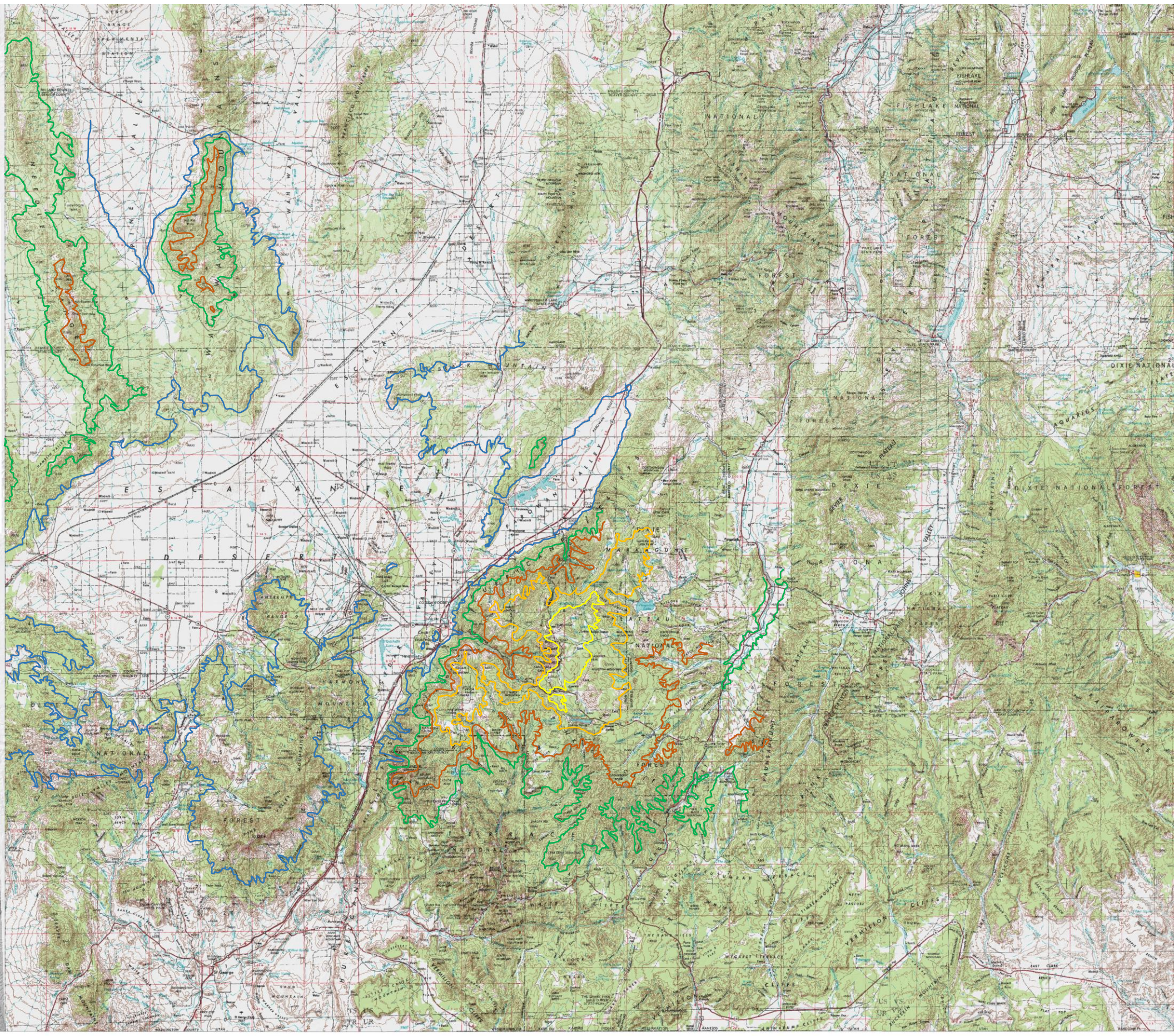
Topography in Area of Interest

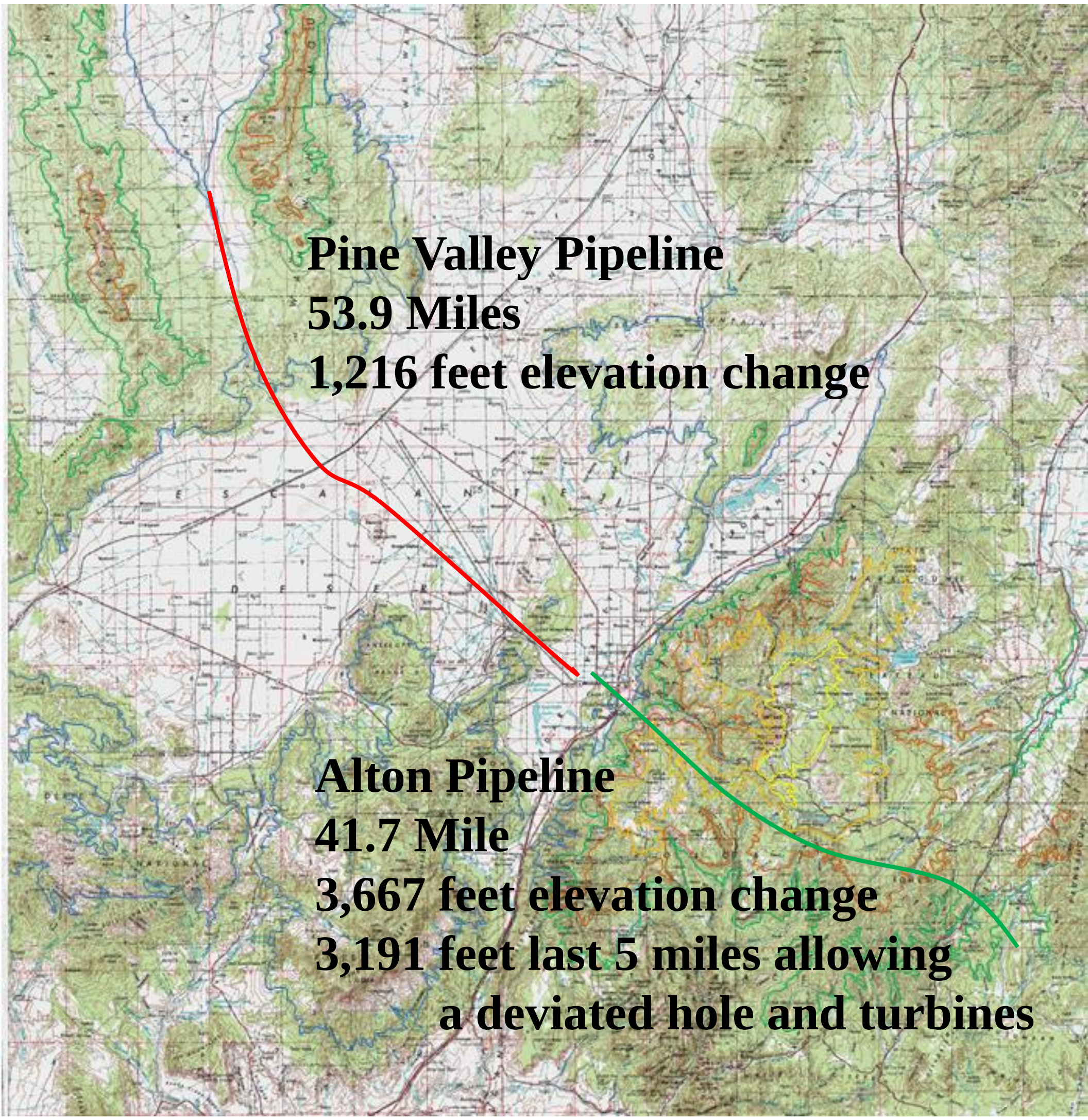


Elevations:

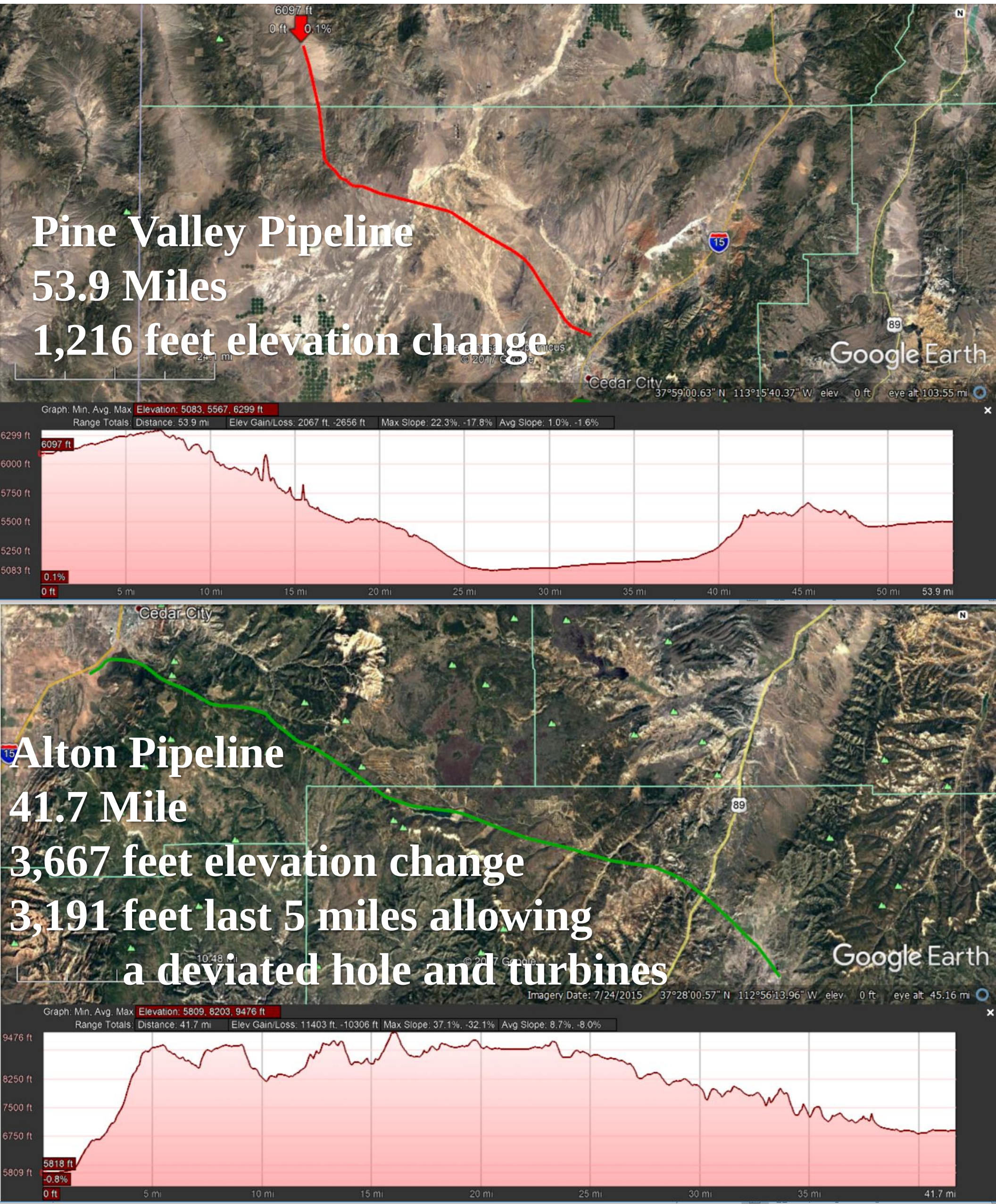
10,000 feet	
9,000 feet	
8,000 feet	
7,000 feet	
6,000 feet	

CICWCD states USGS Priorities:

1. Import water to Cedar Valley
2. Recharge Cedar Valley Aquifer
3. Balance Cedar Valley Aquifer
   drilling more in north



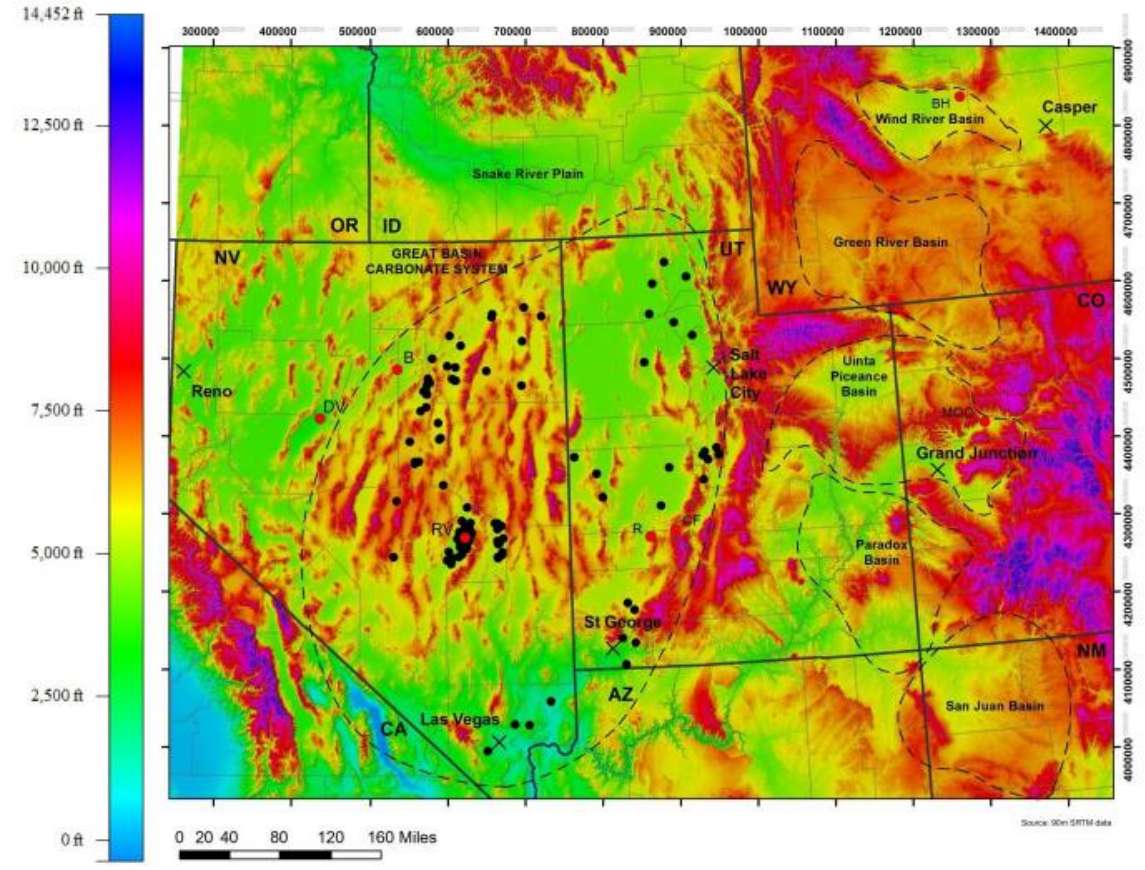
GoogleEarth Cross-Sections along proposed pipelines

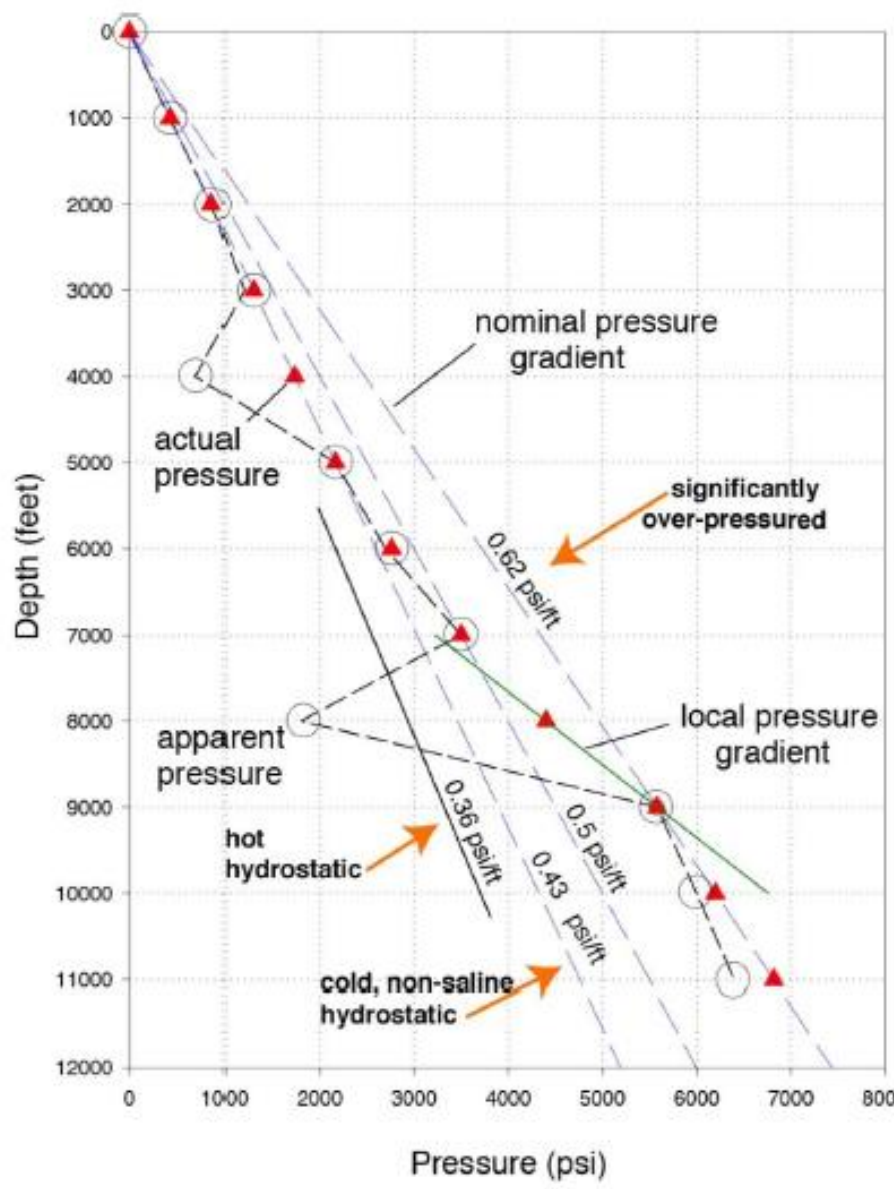


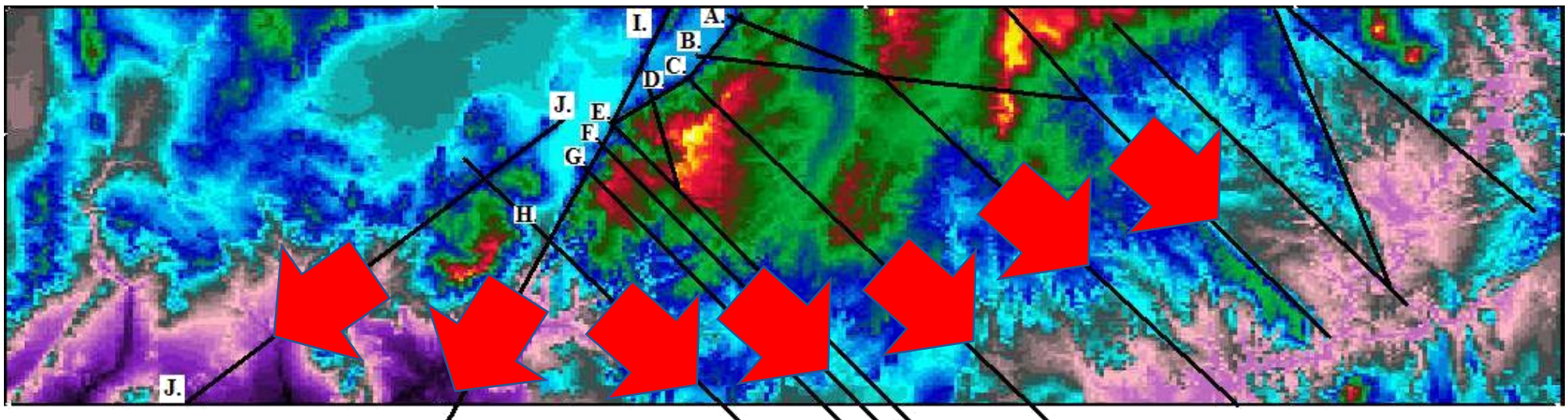
Pine Valley Pipeline
53.9 Miles
1,216 feet elevation change

Alton Pipeline
41.7 Mile
3,667 feet elevation change
3,191 feet last 5 miles allowing a deviated hole and turbines

Low Hydrostatic Pressure Shows: Southern Great Basin Leaks to the south and to the southeast into the Grand Canyon



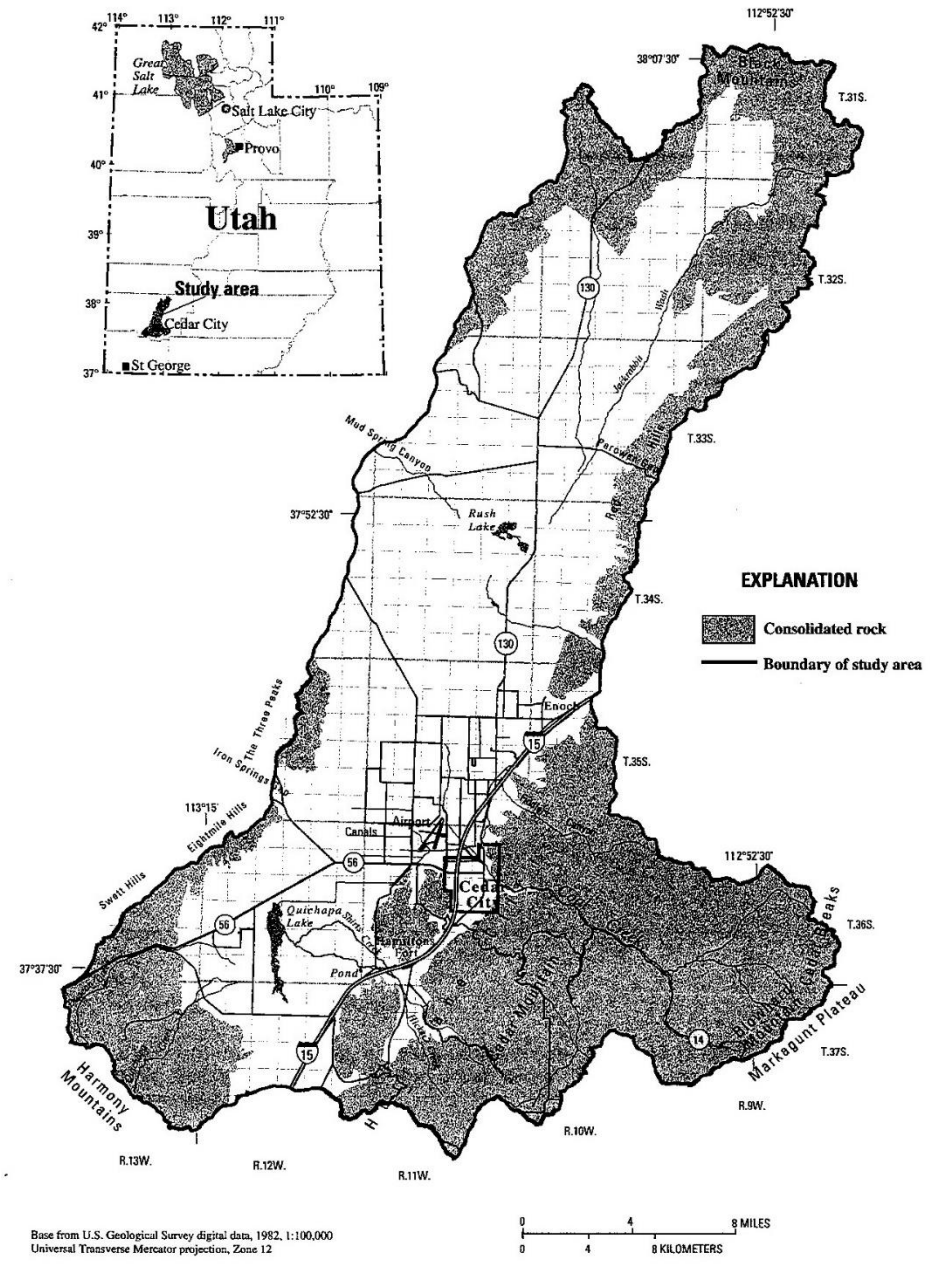




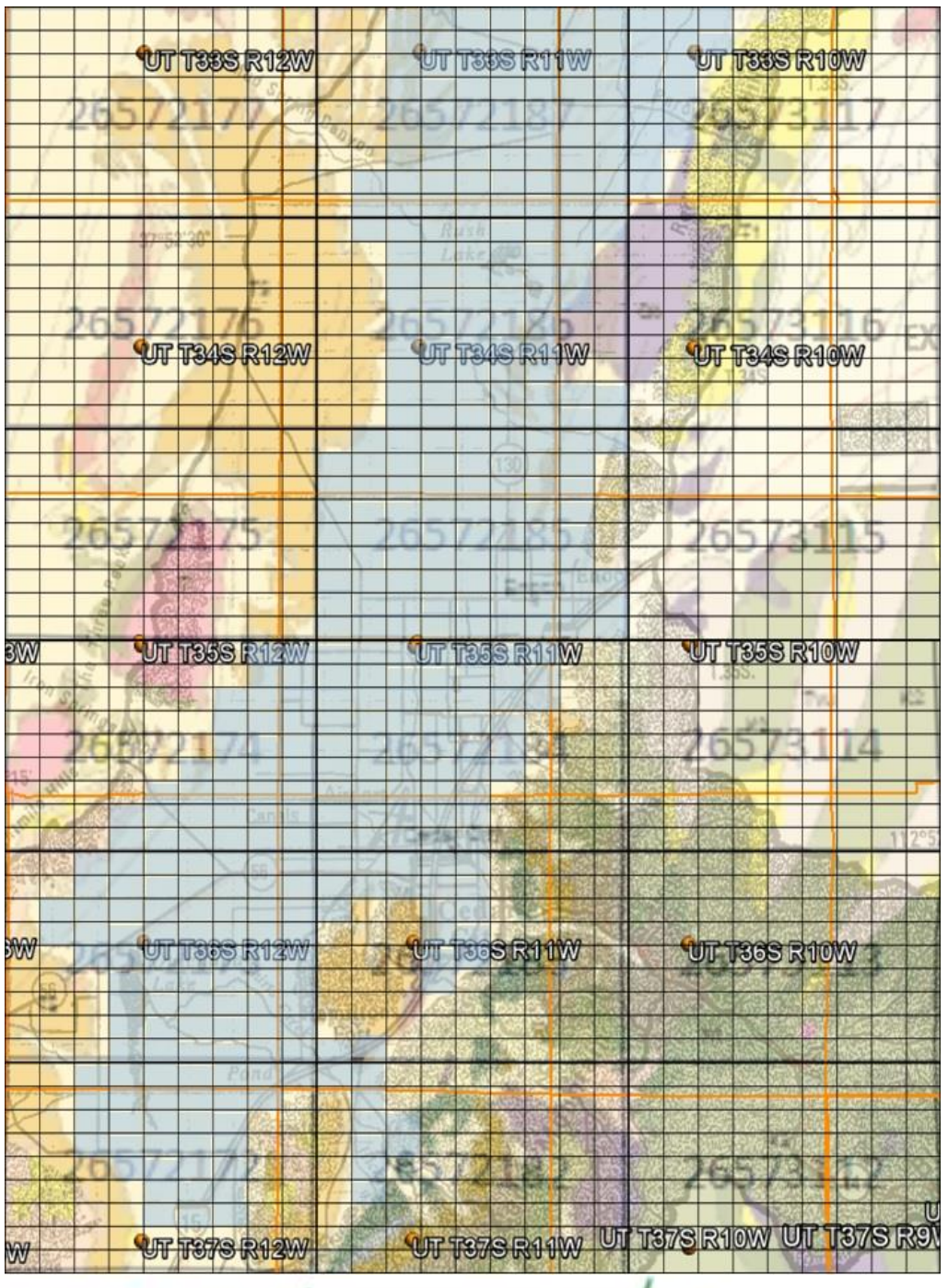
A. Paragonah Canyon
B. Parowan Canyon
C. Summit Canyon
D. Fiddlers Canyon
E. Cedar Canyon
F. Kararaville Canyon
G. Five Fingers
H. New Harmony
I. Hurricane Fault
J. Pinevalley

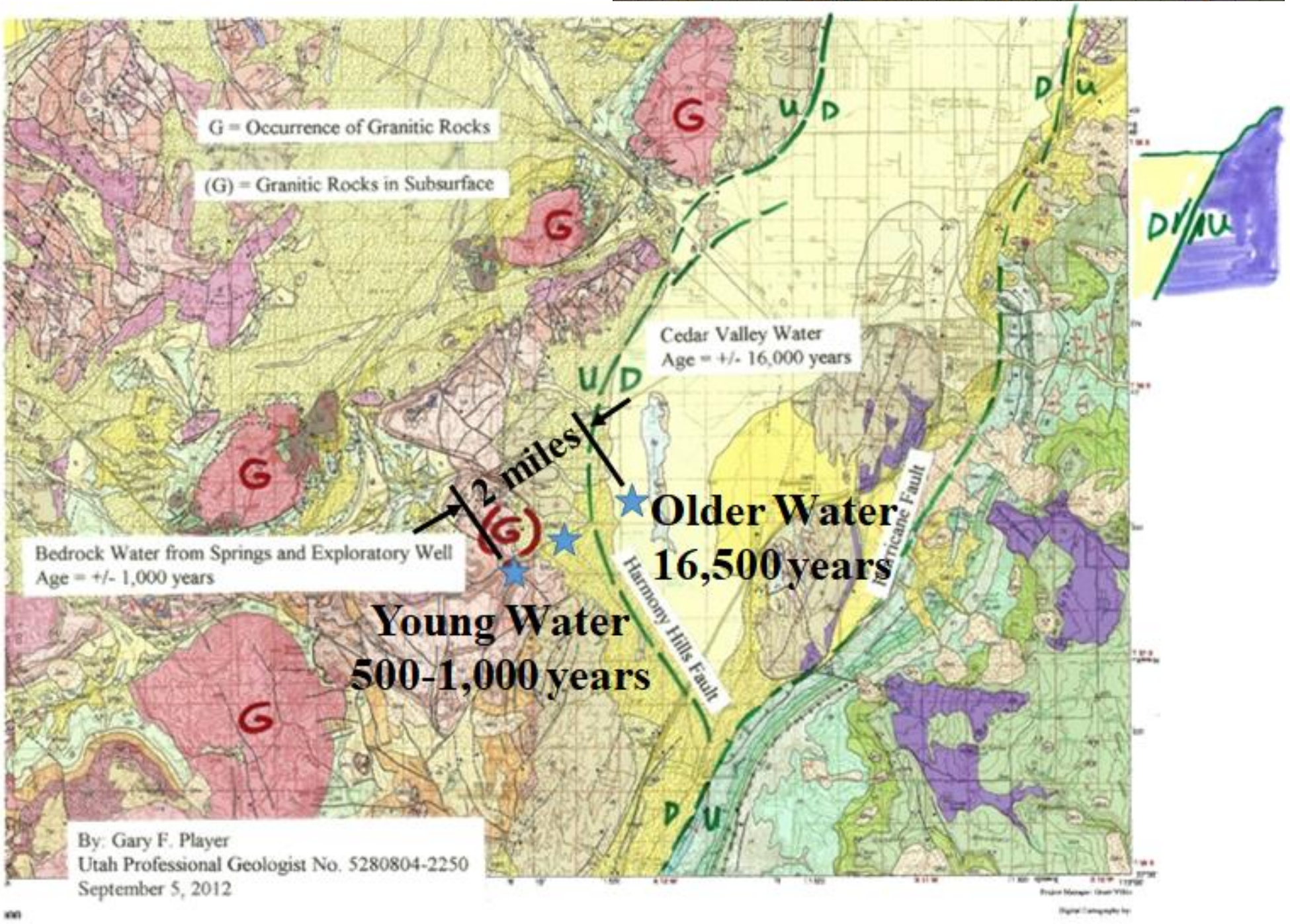
Possible Fault Geopressure Leak Pathways from Cedar Valley to the Colorado River

Difference Between the Cedar Valley Aquifer and the Cedar Valley Drainage Basin



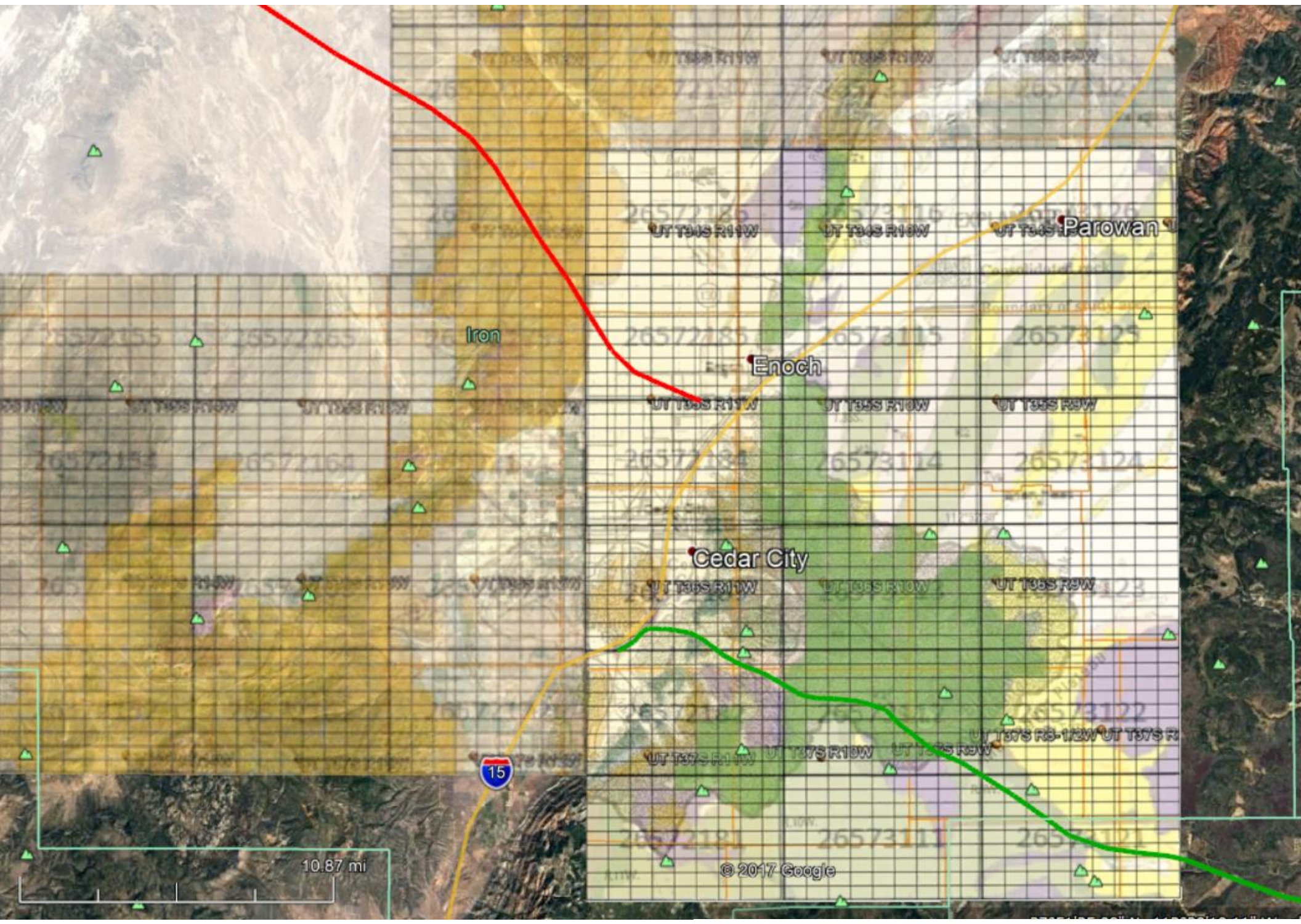
Location of Cedar Valley study area, Iron County, Utah.





Cedar Valley is Surrounded by 2 Untapped Aquifers:

1. Fractured Quartz Monzonite on West
2. Cretaceous on Cedar Mountian



Straight Cliffs Formation over Dakota Formation, north of Highway 14 at Mile 8, east of Cedar City.

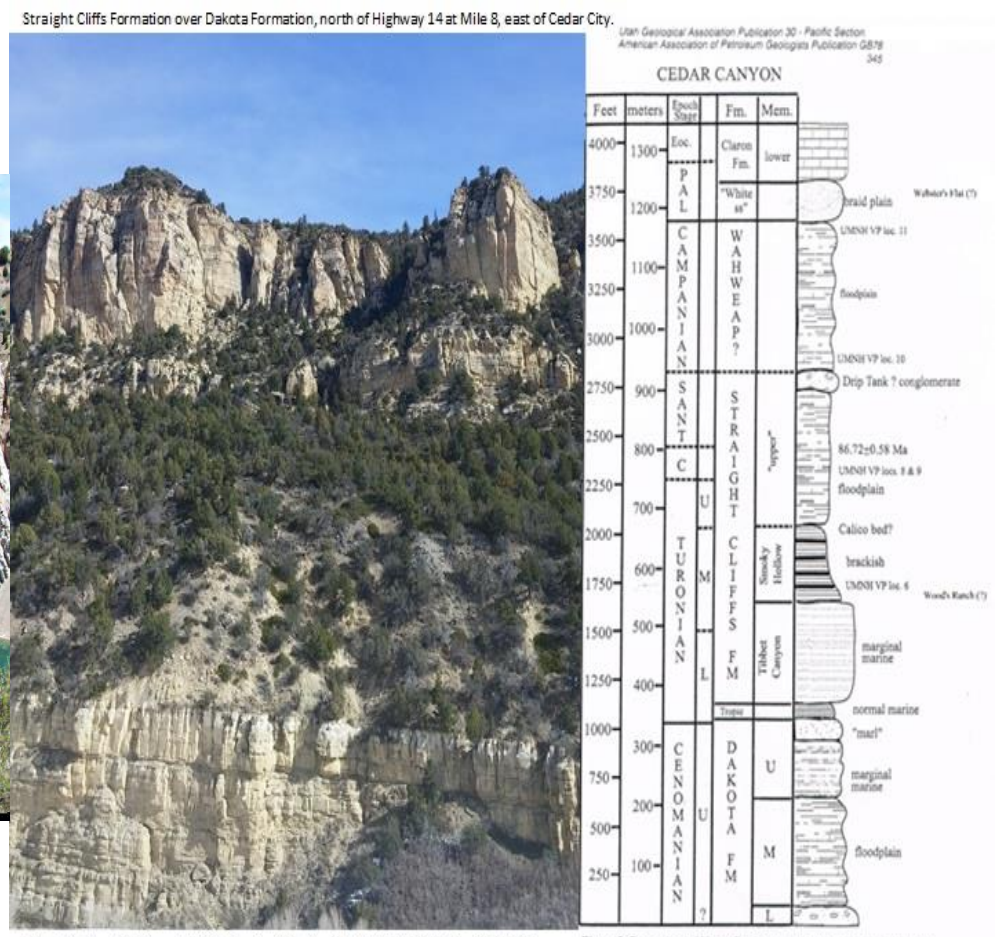
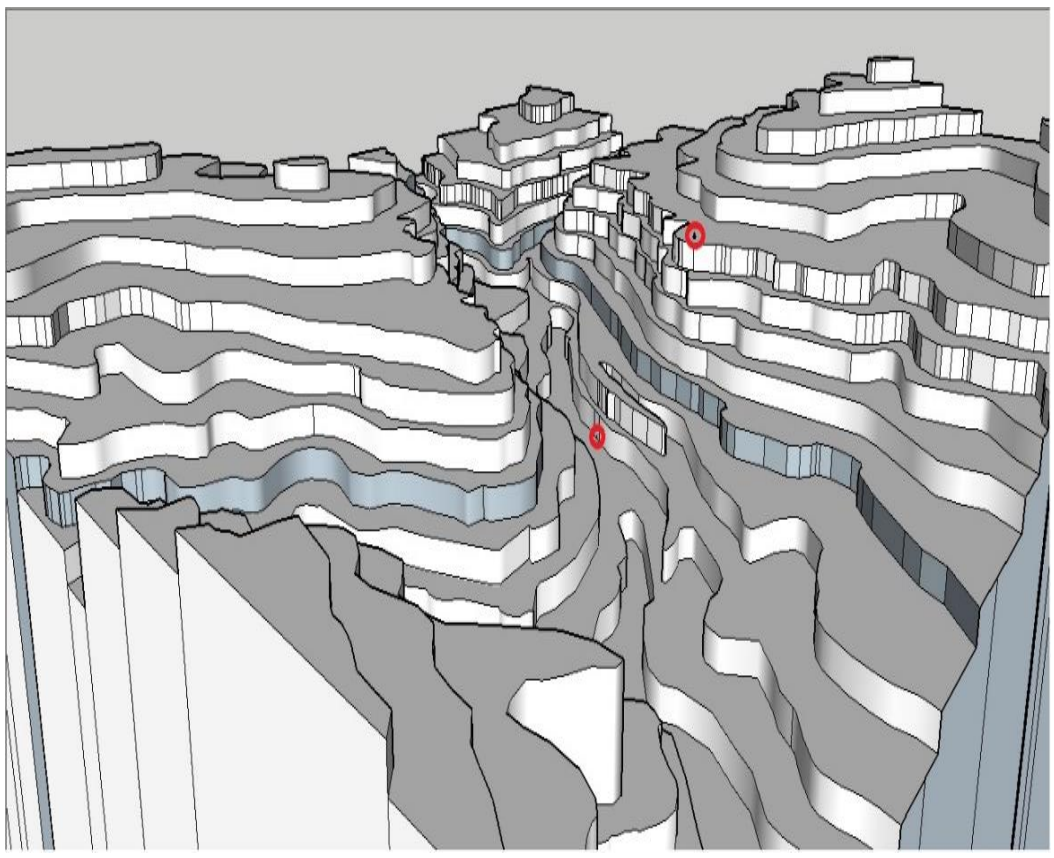
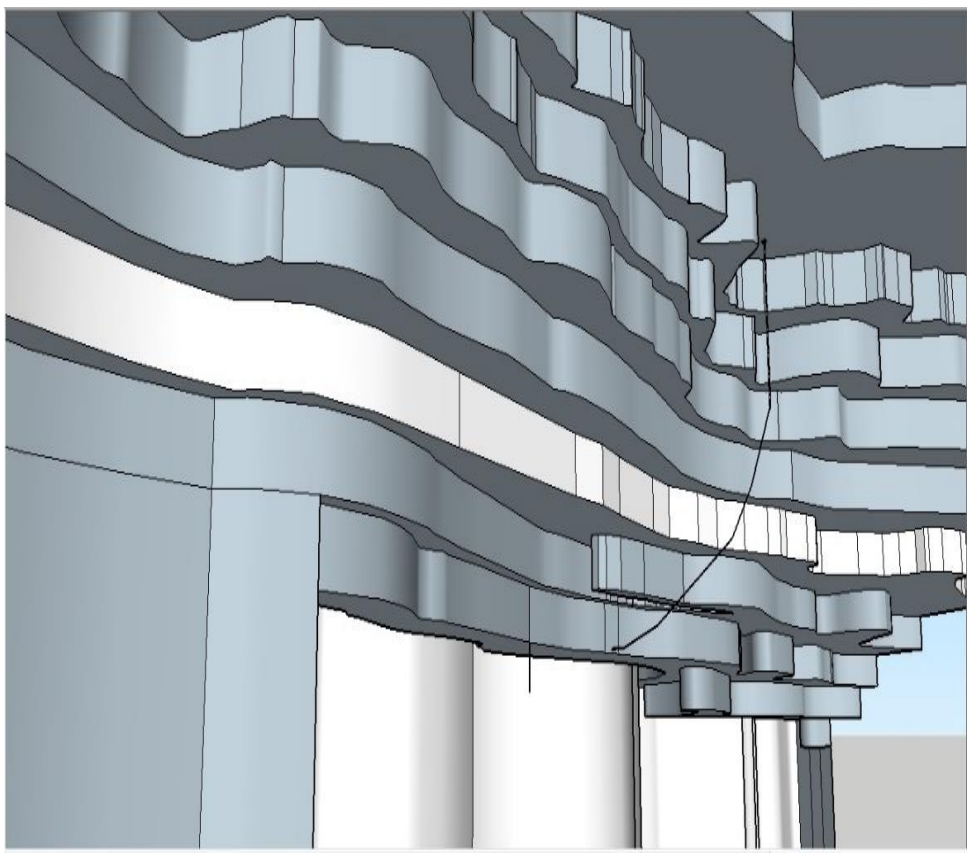


Photo by Gary F. Player, Utah Professional Geologist 5280804-2250, March 14, 2015

Figure 5. Comparison of Upper Cretaceous and lower Tertiary stratigraphy in Cedar and Parowan Canyons. The Parowan section is hung on the contact between the Claron and Grand Castle Formations.

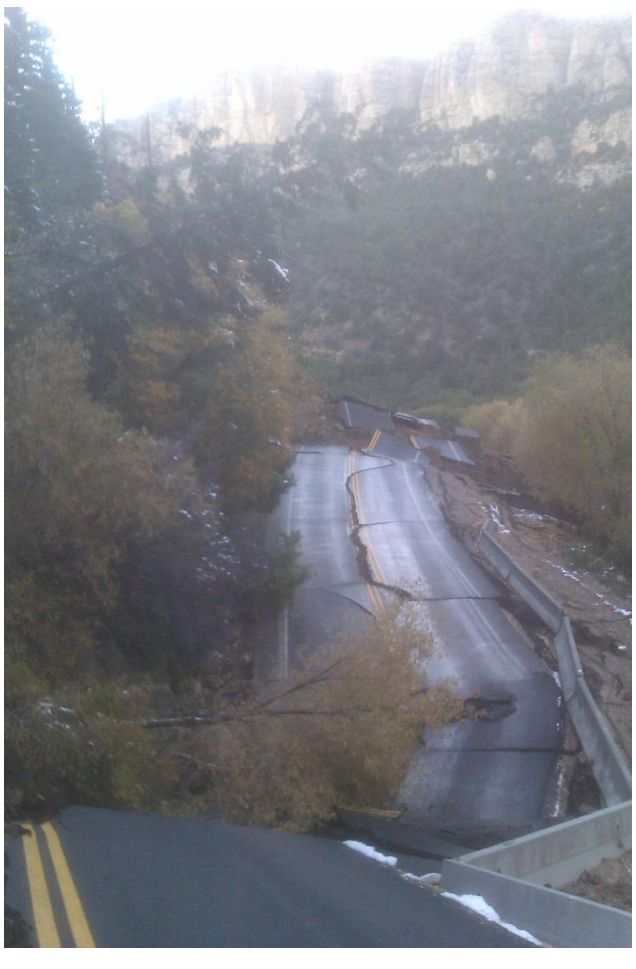
Deviated Hole from Straight Cliffs to Dakota Sandstone which, with turbines in the well, could also be a new source of energy

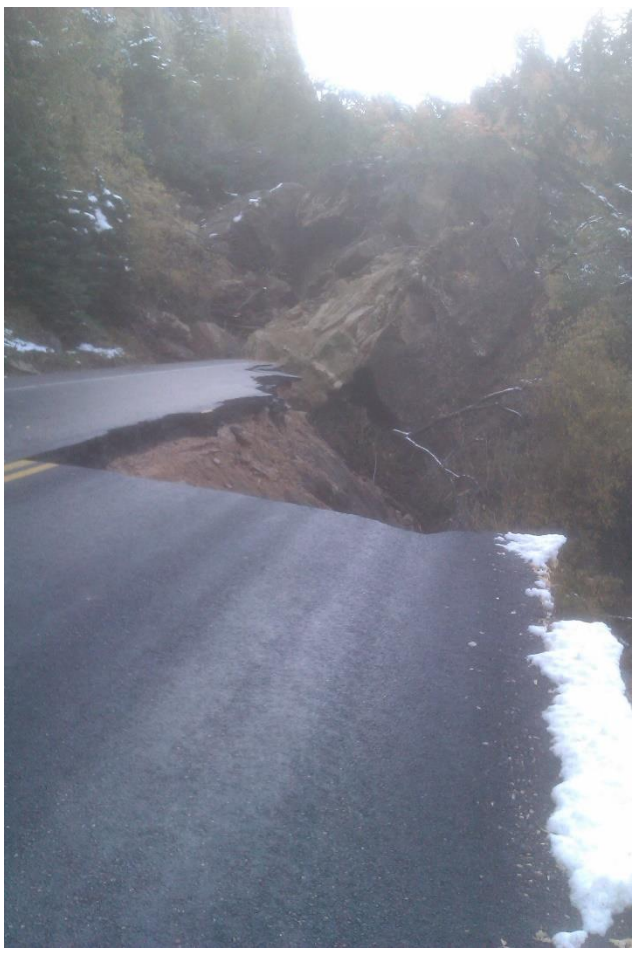




What is the cost to repair the road?

Compared to the cost of drilling a deviated hole and draining the water out of the cliffs to prevent landslides?





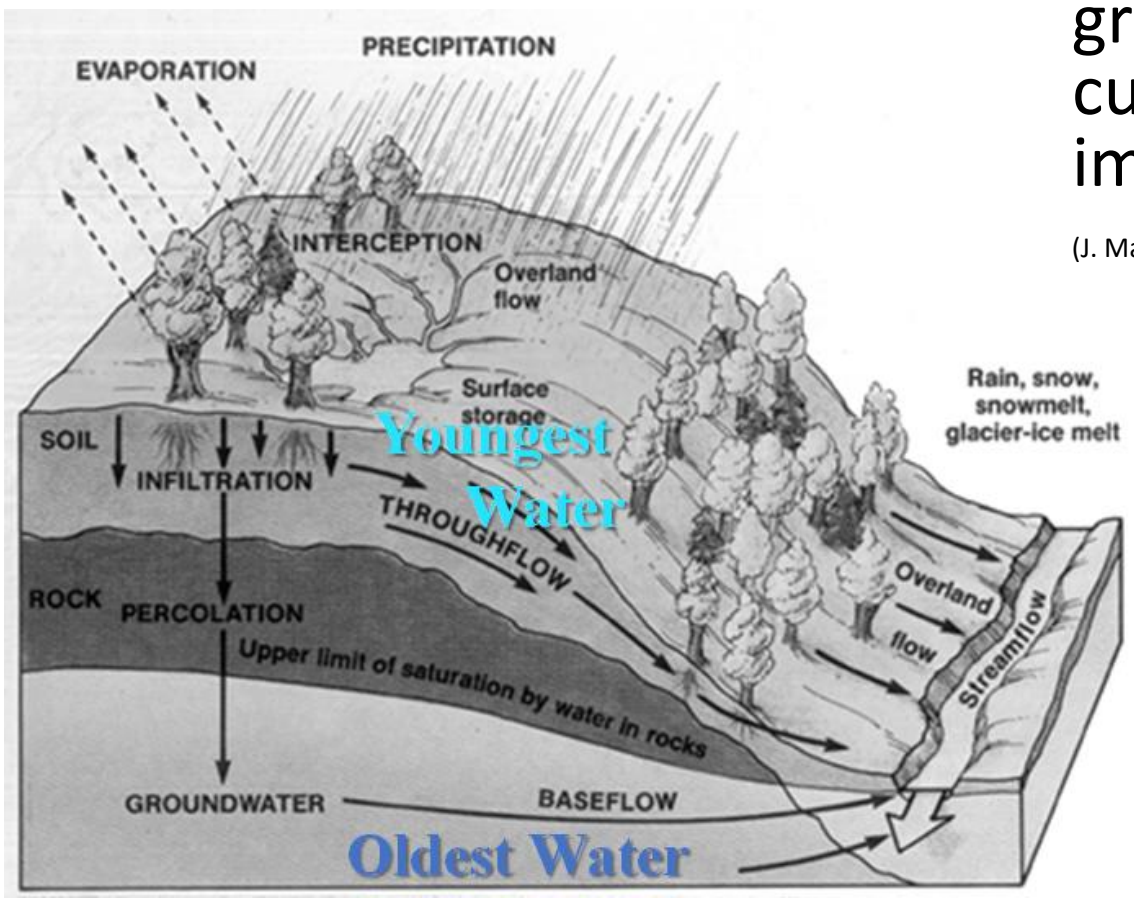
Throughflow, Baseflow, and the Age of Water

- Coal Creek is the principal source of recharge to the Cedar Valley basin-fill aquifer

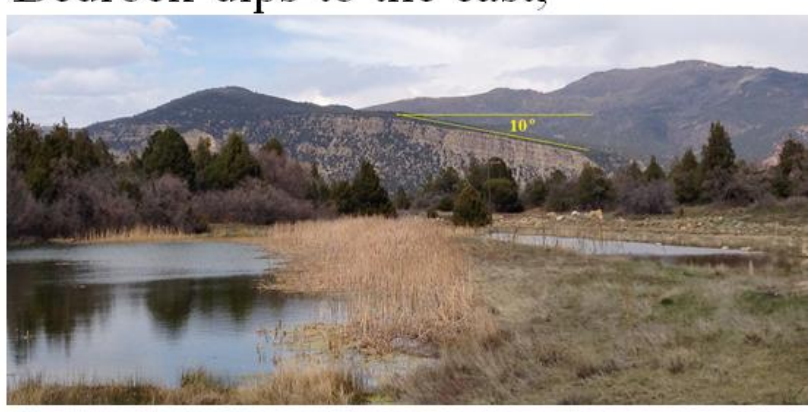
  (Thomas & Taylor, 1946; Bjorklund & others, 1978) .

- Consolidated-rock aquifers are an important secondary component of the Cedar Valley drainage basin's ground water system, but are currently of relatively minor importance for water supply

  (J. Mason, U.S. Geological Survey) .

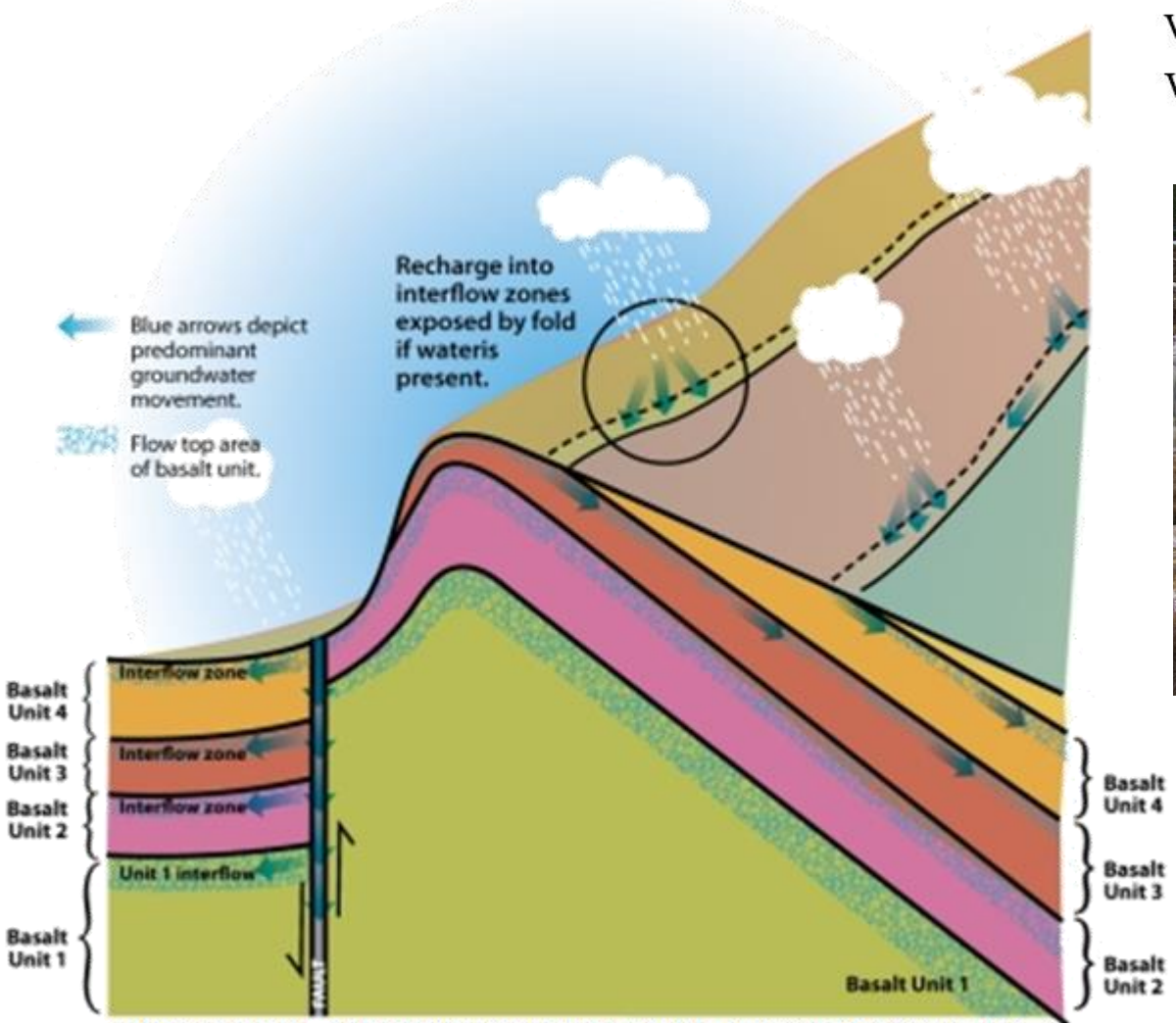


- Bedrock dips to the east;



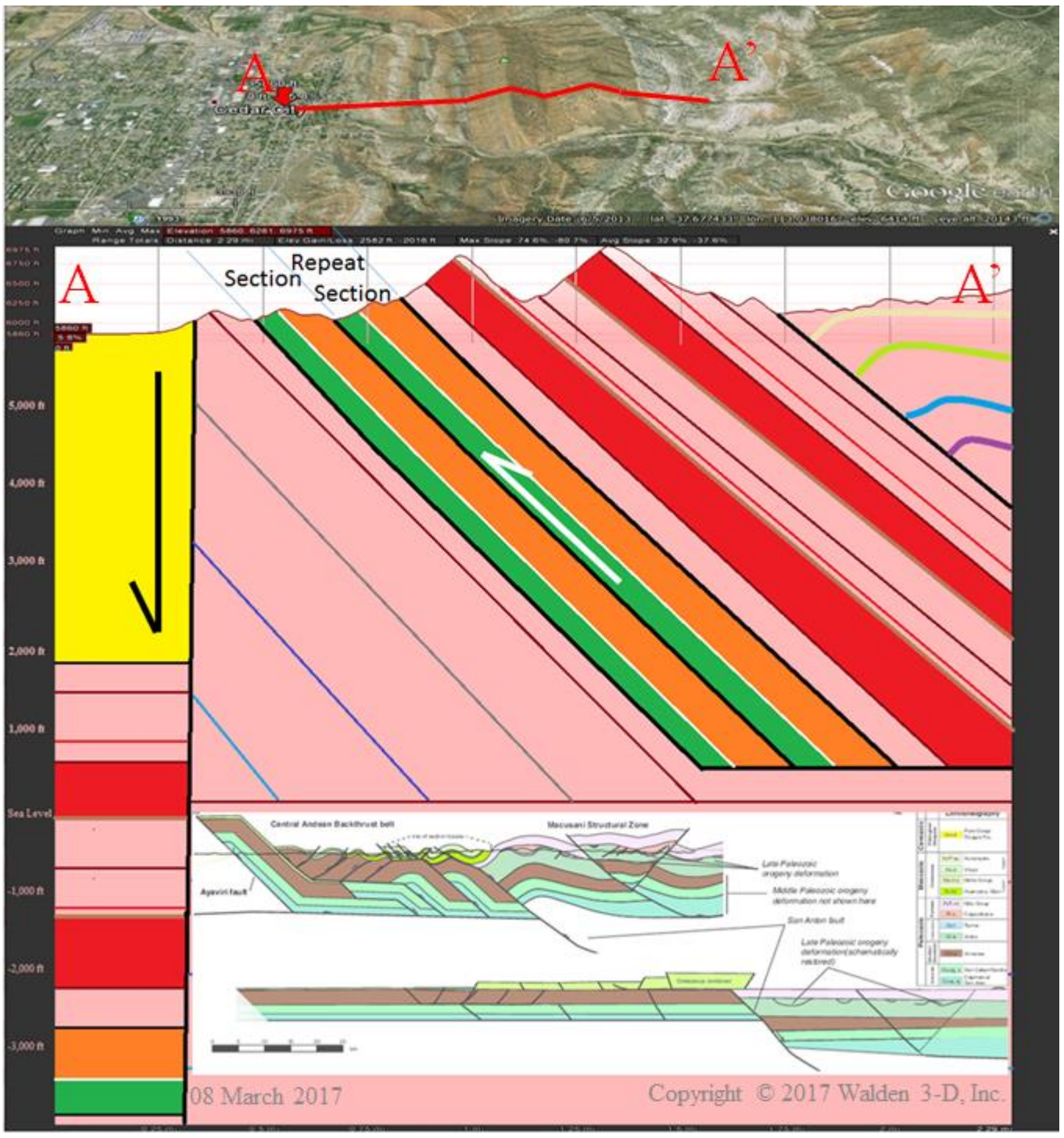
- Faults bounding the valley disrupt baseflow, especially into the Cedar Valley basin fill aquifer, which is isolated by clays and is very shallow.

(note most significant flow is on east facing outcrops, because beds dip east)



http://cbgwma.org/index.php?option=com_content&task=view&id=60&Itemid=115

Refiltration / Seepage Study
Coal Creek into Red Hills



Cedar's Red Hill

excellent example of backthrust

Brad Slaugh at the USGS says a seepage study will only take 1 day plus the time to write up a report.

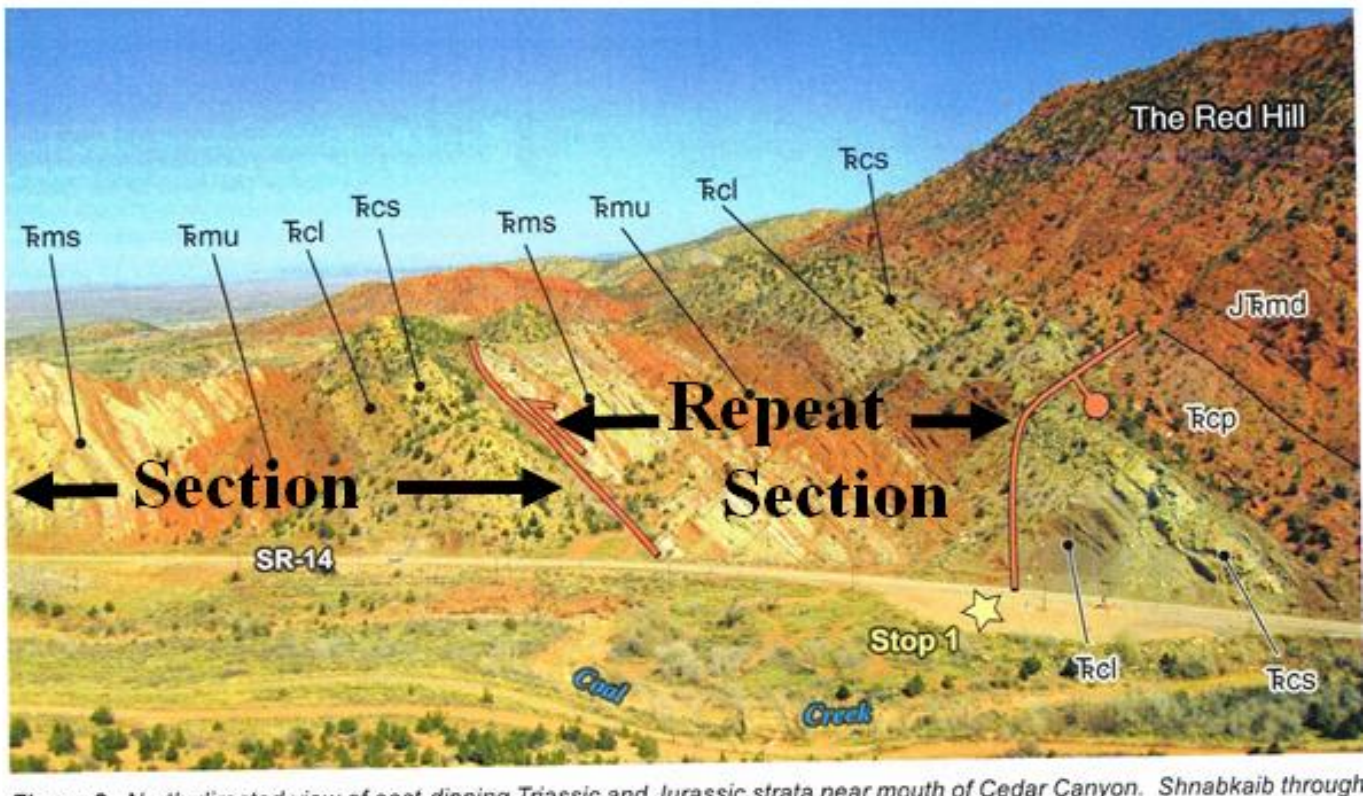


Figure 2. *North-directed view of east-dipping Triassic and Jurassic strata near mouth of Cedar Canyon. Shnabkaib through Shinarump strata are repeated along a thrust fault. Bar and ball on downthrown side of normal fault. Trms =Shnabkaib Member of the Moenkopi Formation, Trmu =upper red member of the Moenkopi Formation, Trcl =lower member of the Chinle Formation, Trcs =Shinarump Conglomerate Member of the Chinle Formation, Trcp =Petrified Forest Member of the Chinle Formation, JTrcs =Dinosaur Canyon Member of the Moenave Formation. Photo courtesy of Tyler Knudsen.*

MacLean, J.S., Biek, R.F., and Huntoon, J.E., editors

Value of water in Cedar Value

$250 m+/hm
12,000 Wah Wah ⇒ $9,259.26/acft
15,000 Pine Valley
27,000 AF

$500,000 test
1,000 AF $ ~~4,600~~ 500 /af
2,000 AF $ 250/af
3,000 AF $ 166/acft
4,000 AF $ 125/ac ft
5,000 AF $ 100/ac ft
6,000 AF $ 83/ac ft
7,000 AF $ 71/ac ft

Opinion

The water need challenges in our valley

test
0.002%
0.2%
cost
P.plan

by Paul **COZZENS**
Cedar City Council, CICWCD Board member
GMP Committee member

Dear Friends and Constituents,

Utah is one of the fastest growing states in the country and Iron county is one of the fastest growing counties in the state. This is good news, however, it can sometimes be a bit of a challenge where water is concerned.

I just completed the first year of my second four-year term on the City Council. I have had the privilege the last five years to serve as a board member on the Central Iron County Water Conservancy District (CICWCD). The opportunity to serve in this capacity has been a great learning experience for me. Due to this assignment and my position on the Cedar City Council, I feel necessary to give you a report on a few things that have been on my mind.

Many of you are already aware of the serious challenges we face regarding our water needs in this valley. The state water engineer and other experts have determined that the annual safe yield about 21,000 acre-feet. However, we (municipalities, agriculture, CICWCD, and private) are depleting about 28,000 acre-feet—creating a deficit of about 7,000 acre-feet per year.

The state water engineer is tasked with the responsibility of monitoring these situations, protecting this precious natural resource, and ensuring that the water supply is sustainable. He traveled to Cedar City twice in 2016 and met with the public to discuss the need for our basin's groundwater management plan. Recently, in response to a request from the state engineer he has recommended that the water users in the valley form a Groundwater Management Plan Committee (GMPC). The 10 members of the committee will be meeting monthly in an effort to solve some of our water challenges and help prevent the loss of personal water rights.

In our first meeting, we discussed many issues including: importing water, water conservation, unused water rights (not factored in), future growth, and recharge projects. If we don't solve this problem, the state engineer will be forced to begin reducing water rights until a balanced equilibrium is reached in the aquifer. This means that if you had water flowing into a 55-gallon barrel full of holes (with each hole representing a water right),as the water drops, you would not lose that right, but the flow to holes at the top of the barrel would cease sooner than those with higher priority rights at the bottom.

A large percentage of the City's water rights would become junior and could become unusable in the future, in today's market the value of that water is tens of millions of dollars. Please be aware that the CICWCD; the municipalities of Enoch, Cedar City, and Kanarraville; Iron County; and agriculture users are taking this seriously.

Cedar City has been successfully recharging about 1,800 acre-feet of water near the airport for the past 10 years and is currently looking at options which involve putting the 2,600 acre feet of effluent from the wastewater-treatment plant to better use through agriculture and gravel pit recharge. These projects are expensive and we have limited funds, but it is critical that we solve these challenges.

Last year, the CICWCD successfully completed a recharge project in Enoch and are working on another project near Quichapa Lake where the water is largely wasted because the layer of clay under the Lake prevents water from recharging into the aquifer and is wasted through evaporation. Efforts have been made in the past to reclaim this water. However, once the water reaches the lake, it becomes so contaminated it can't be pumped to another area and used for recharge. Currently, we are working on a new diversion structure near Quichapa Lake which will divert excess water before it hits the lake. The water will then be channeled northwest, under State Route 56, and pumped to an area of land that has excellent percolation qualities. This is an exciting venture due to the fact that this is the area of extraction for the lion's share of Cedar City's water and is the aquifer most critically in decline. These recharge efforts are critical because they will help tremendously in bringing our aquifer into balance.

OP/ Ed

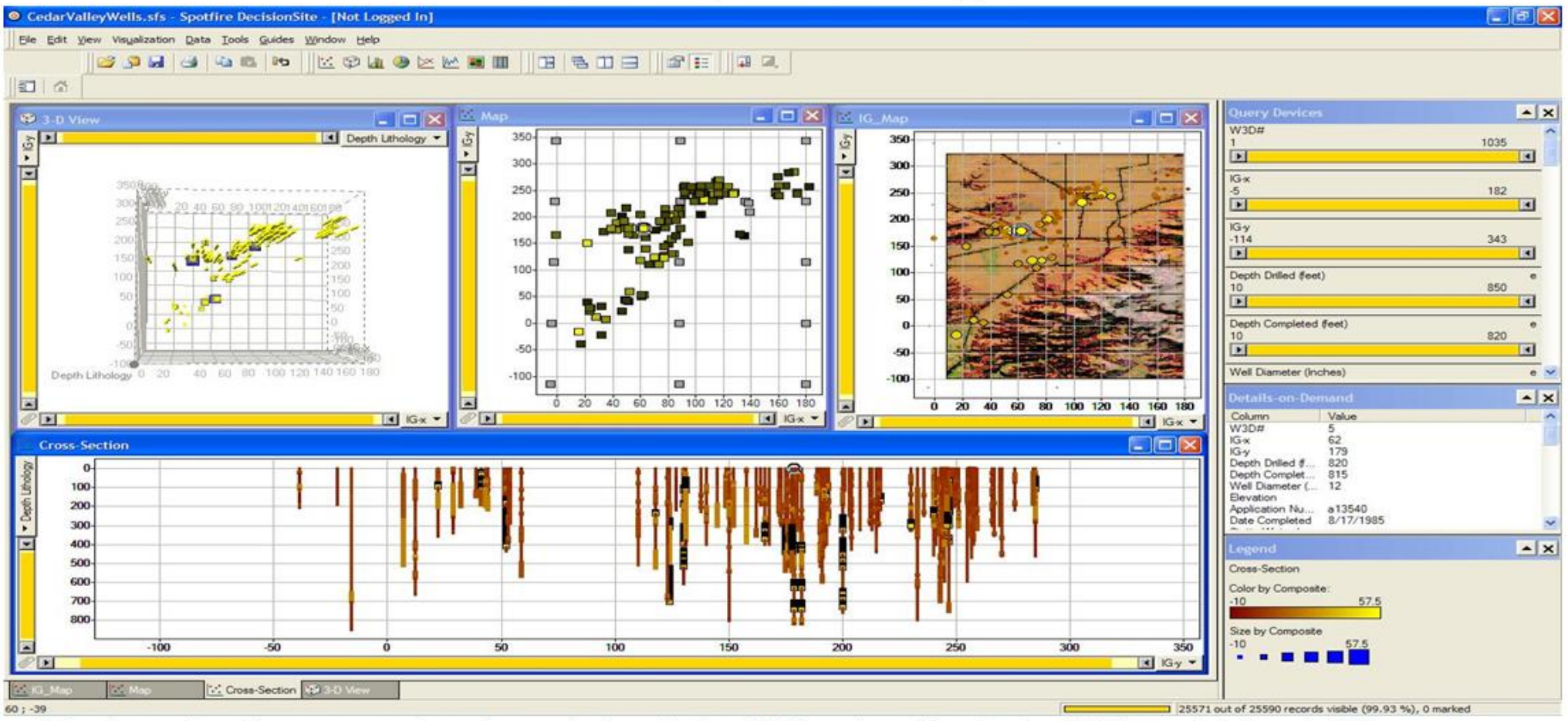
Another project being considered is to import water from the west desert valleys of Wah Wah and Pine (West of Milford). The state engineer has approved portions of our filings and we are working to import up to 12,000 acre-feet from Wah Wah and 15,000 acre-feet from Pine Valley. This long-term project comes with a price tag of about $250 million (a little over half of what the Lake Powell pipeline would have cost), but is critical for the future growth and sustainability of our valley. Conservation projects by the Iron County School District, Cedar City Corporation, CICWCD, and private efforts have been very positive as well. However, much more can and should be done.

In Cedar City, we are currently going through the process to create a parks and recreation master plan and are soliciting input from our citizens to determine priorities. Some of the venues being considered are high ticket items that I am struggling to even discuss as we wrangle with the issue of water in our county. I believe water has to be our first priority. In order to do that, we have to distinguish between needs and wants. We also have to realize that taxpayers' money is not endless and we need to find more ways to create opportunities for private and public partnerships that will allow us to have parks and recreational activities and venues without having to take from resources that are currently needed elsewhere.

I'm open to any additional ideas you may have. Please don't hesitate to call me or email me at Paul@CozzensCabinets.com if you would like to discuss this important issue.

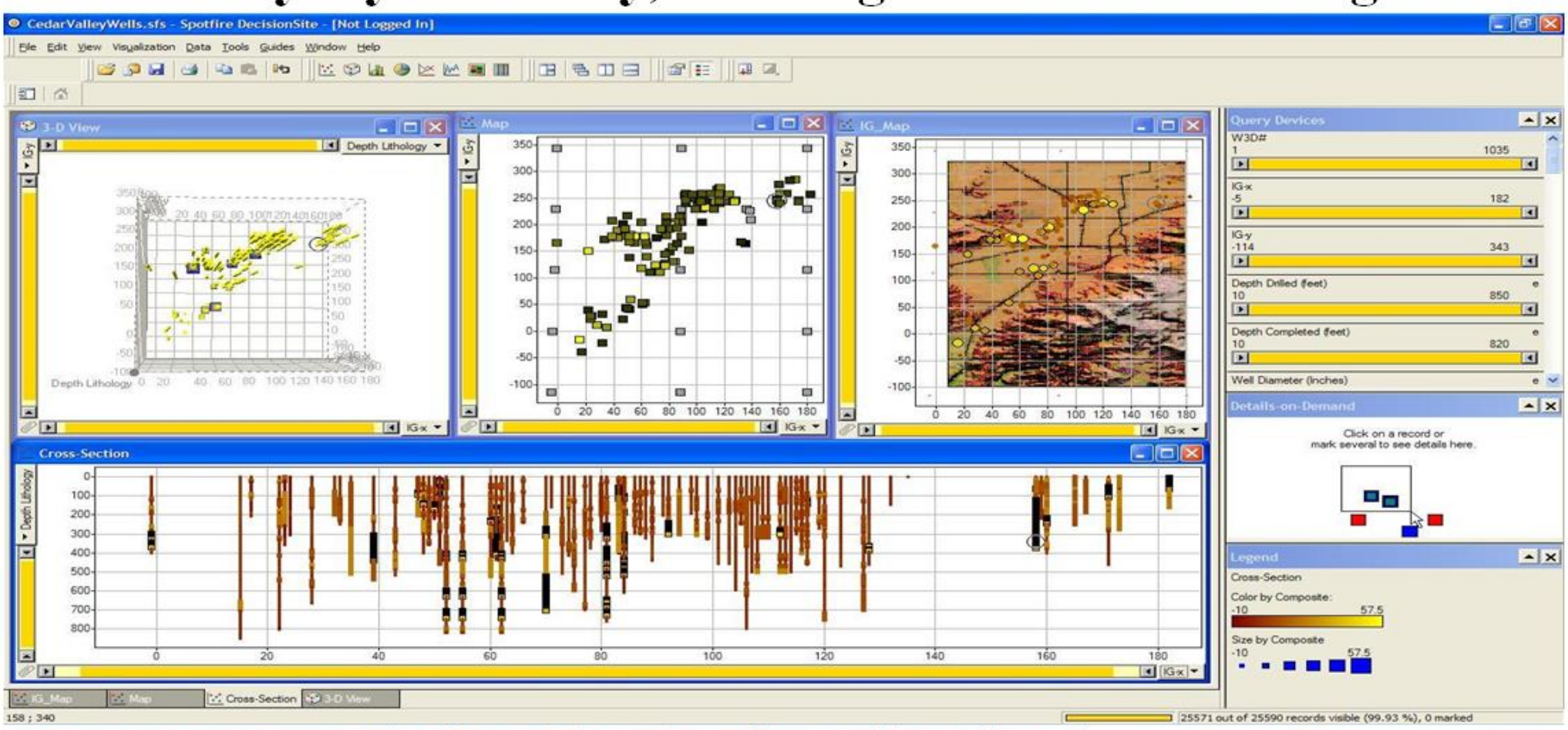
Tapped Cedar Valley Aquifer Shallow

Few wells in Cedar Valley are deeper than 800 feet



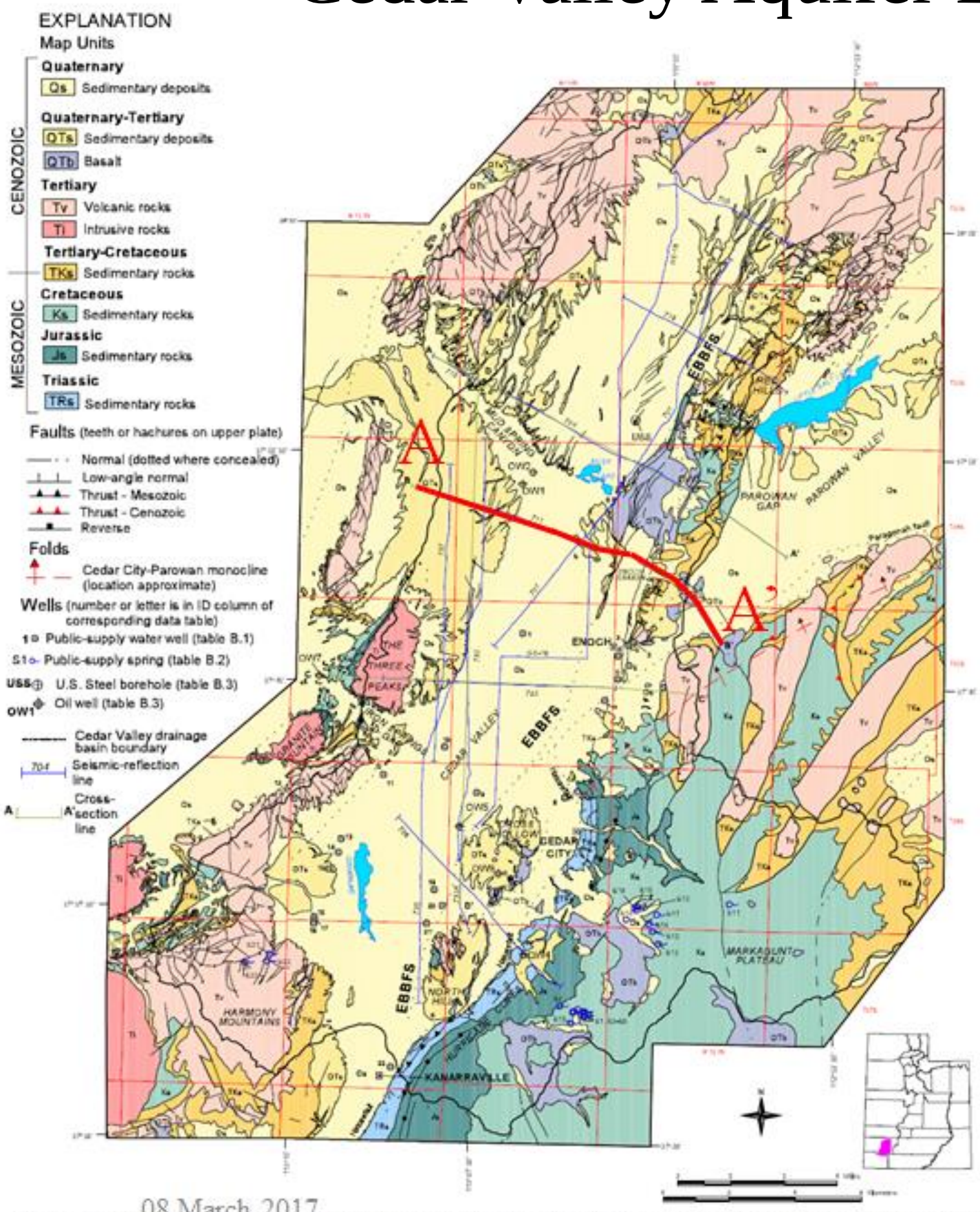
North-to-South cross-section through the Cedar Valley Aquifer, Roice Nelson, 19 Sep 2005.

Details show somewhat isolated shallow aquifers bounded by layers of clay, isolating Lake Bonneville age water



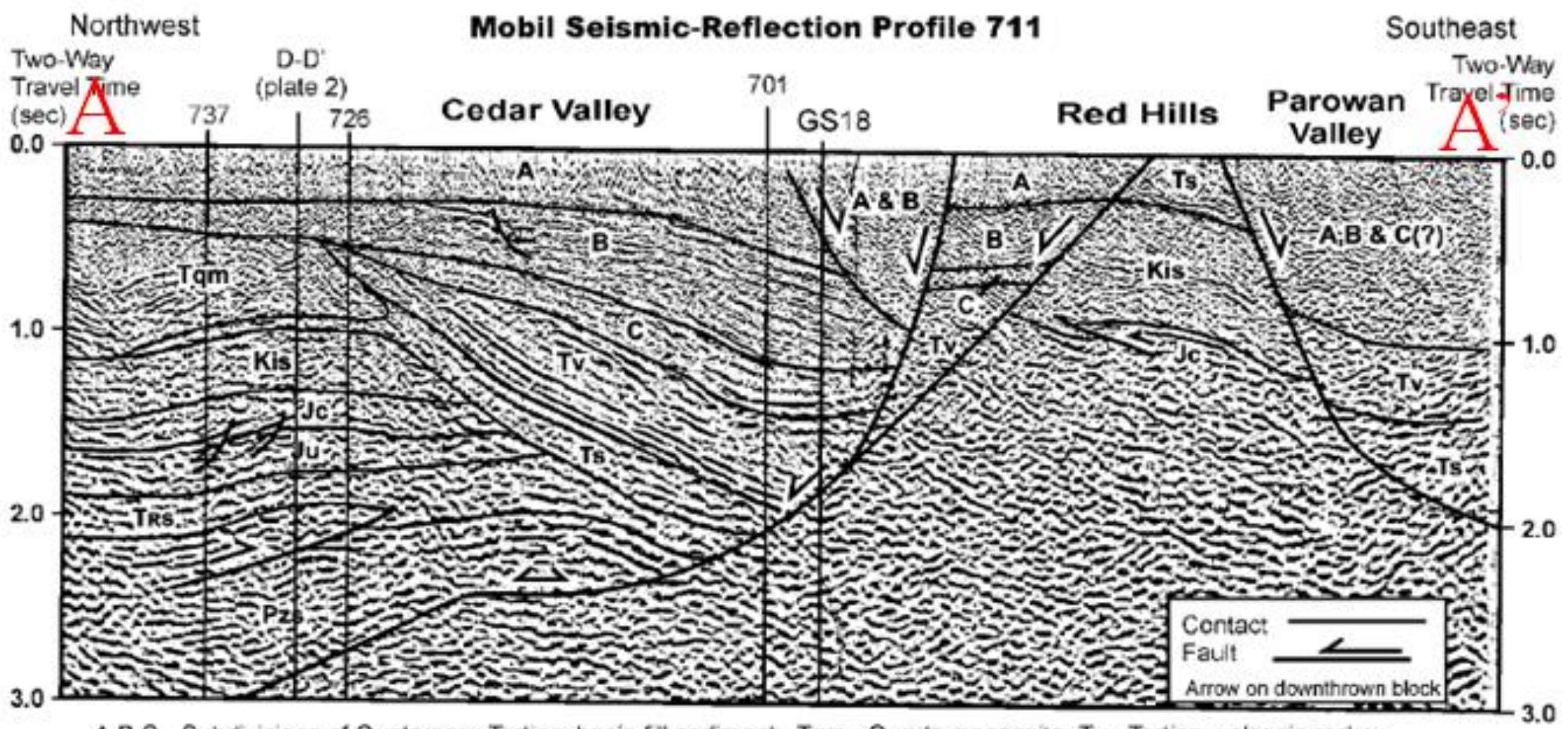
West-to-East cross-section through the Cedar Valley Aquifer, Roice Nelson, 19 Sep 2005.

Cedar Valley Aquifer Deep



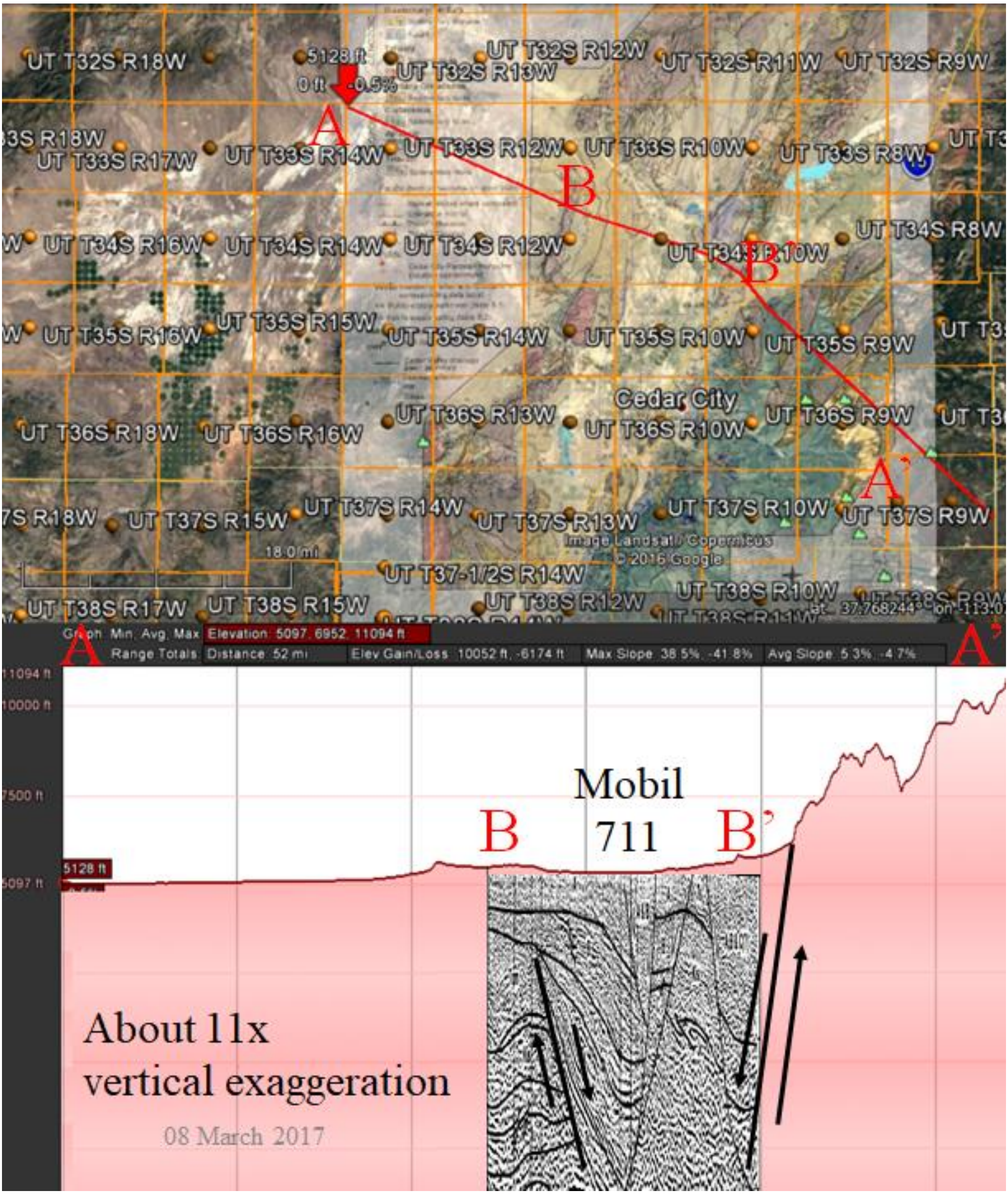
08 March 2017

Figure 6. Simplified geologic map of Cedar Valley drainage basin and adjacent areas. EBBFS is eastern basin-bounding fault system. See figure 5 for stratigraphic column, and appendix A for correlation of map units with those on plates 1 and 2.

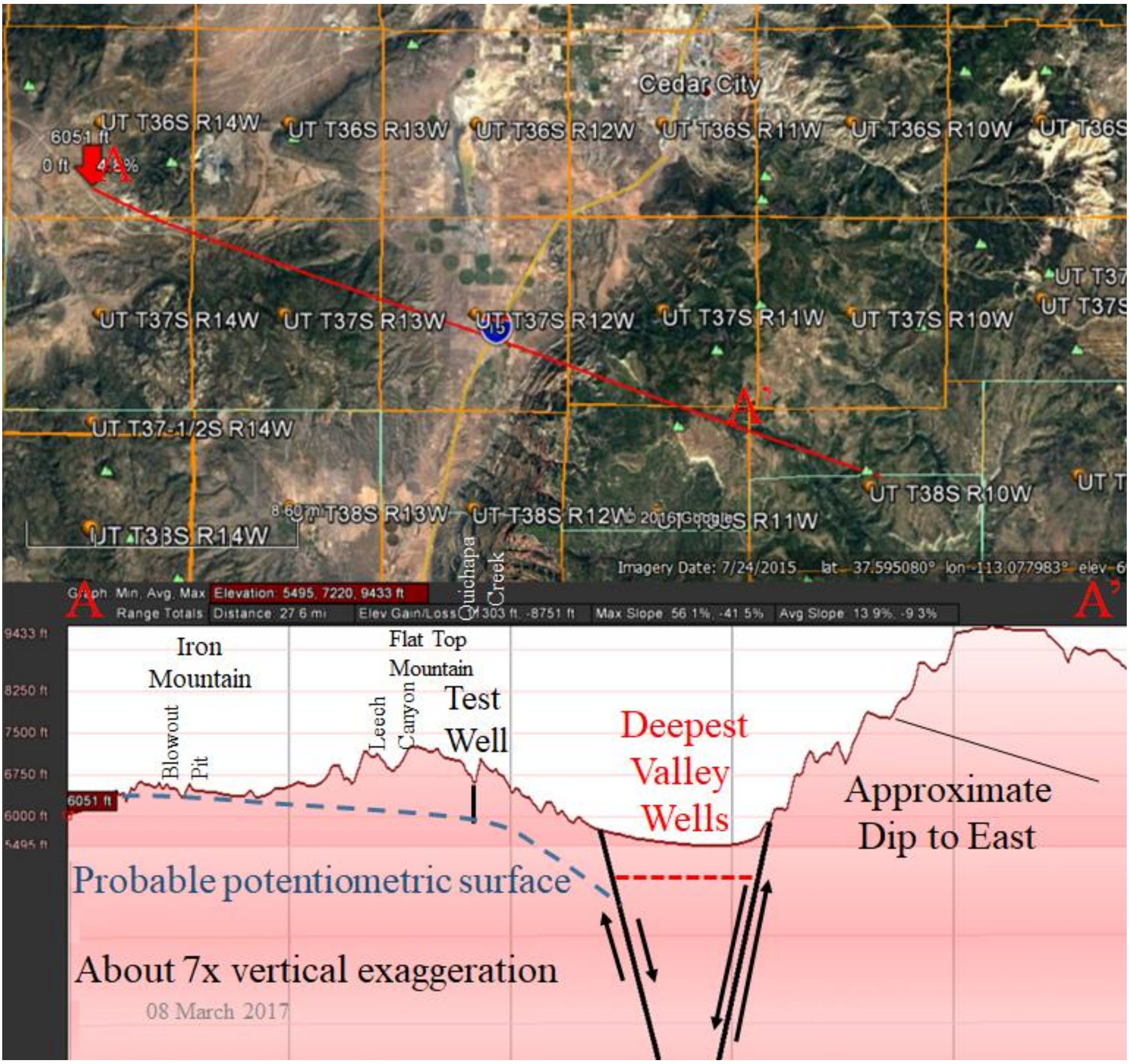


A,B,C - Subdivisions of Quaternary-Tertiary basin-fill sediment; Tqm - Quartz monzonite; Tv - Tertiary volcanic rocks; Ts - Tertiary sedimentary rocks; Kis - Iron Springs Formation; Jc - Carmel Formation; Ju - Navajo Sandstone, Kayenta, and Moenave Formations, undifferentiated; Trs - Triassic sedimentary rocks; Pzs - Paleozoic sedimentary rocks.

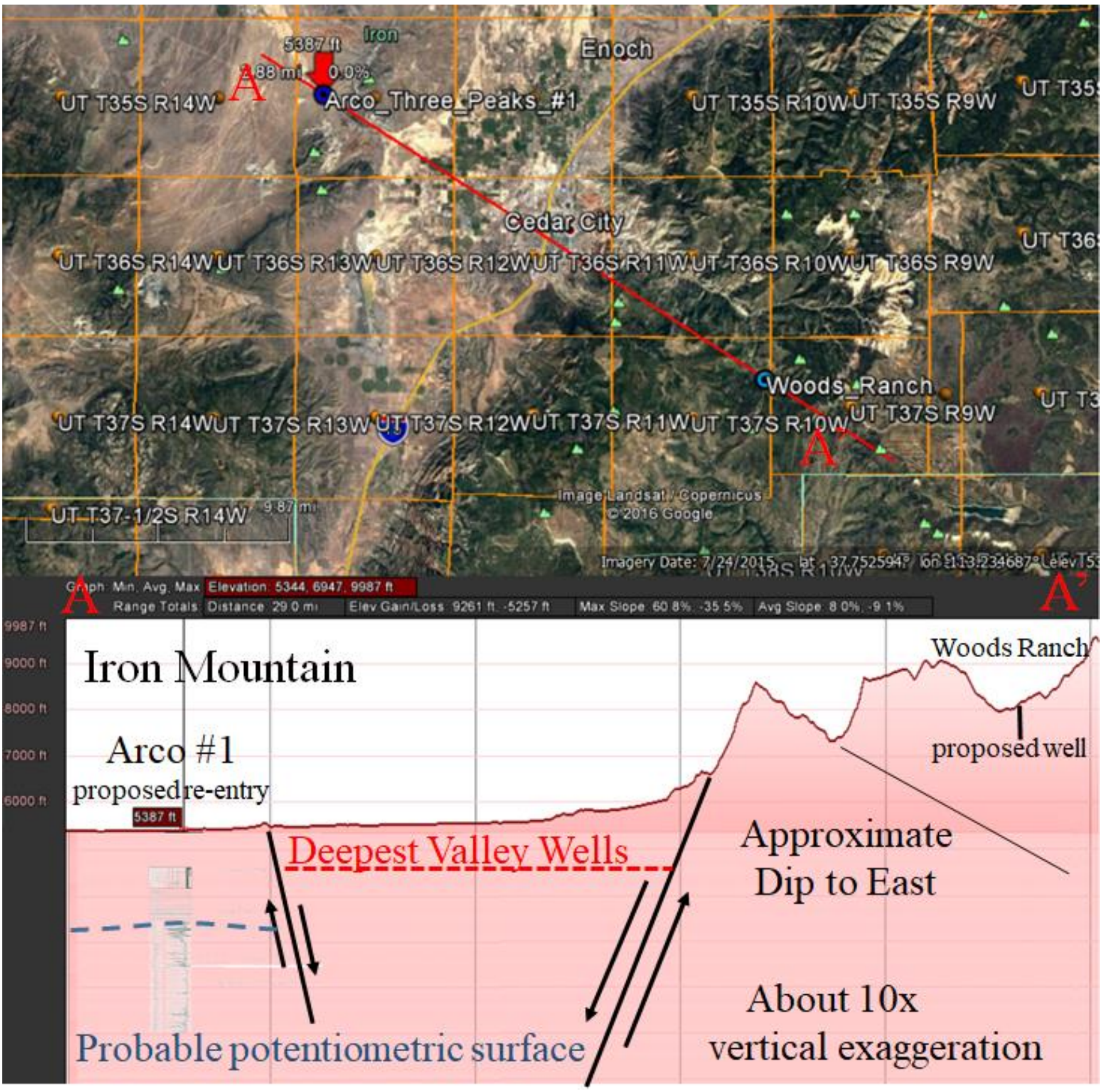
Mobil Line 711 cross-section

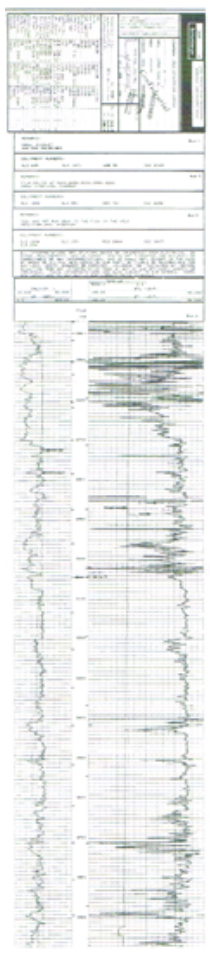


Blowout Pit Cross-Section



Arco #1 – Woods Ranch cross-section





- An opportunity to test the Fractured Quartz Monzonite Aquifer is to reopen this well.

Top Qm = 2,322’
Fractured: 2,500’-2,615’

Fractured: 2,960’-3,050’

- The proposed test in the Cretaceous rocks is at Woods Ranch or Sheepherder’s Cabin.