Kenny Lake Ventures, LLC

Date: April 9, 2018
To: Utah Division of Water Rights
Subject: Likely Availability of "New Water" in Bedrock Aquifers Surrounding Cedar Valley
By: Gary F. Player, Utah Professional Geologist 5280804-2250

INTRODUCTION

I am a geologist with 52 years of experience developing natural resources from Alaska to Venezuela. I settled my family in Cedar City in 1989, and have been directly involved in the development of local water resources since about 1995. My wife, Corrie Lynne Player, has written many of my reports, as well as several books about foster parenting and the rearing of teenagers, along with numerous newspaper and magazine articles for local and national publications.

My experience with water resources began in 1973 when I helped to identify several alternative water supplies for development by the city of Anchorage, Alaska. The municipality took our report to heart and began construction of a 30-mile pipeline to import water from glacial Eklutna Lake to supplement water wells and local surface water supplies within the city's boundaries. The City now provides municipal culinary water to more than 300,000 residents from sources we identified.

STATEMENT OF THE PROBLEM

Residents of Cedar City and surrounding portions of Iron County are using more water than is replaced each year by precipitation and infiltration from streams that flow into Cedar Valley from surrounding mountain ranges. Water levels in municipal and agricultural wells have locally declined several hundred feet in the past 20 years, and annual water production from the Cedar Valley aquifer exceeds estimated recharge by approximately 5,000 acre-feet each year. Utah's Division of Water Rights is tracking the "over drafting" and may soon be forced to limit the use of local water rights. In other words, alternative sources of water must be identified and developed as soon as possible.

Several alternatives have been explored, including a pipeline from Lake Powell to Iron County (rejected by voters), and, more recently, development of ground water in western portions of Beaver County for shipment by pipeline to Cedar City. That plan to import water from Beaver County could cost Iron County residents more than $200 million for wells and pipelines.

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HOW TO SOLVE THE WATER SHORTAGE

I have been advocating a much less expensive alternative since about 2006: development of ground water from bedrock aquifers in the mountains that surround Cedar Valley. My experience drilling oil wells and water wells throughout much of the western United States has taught me that great amounts of fluids are present in the openings ("intergranular porosity") between sandstone grains, and in the cracks ("fractures") that are ubiquitous in hard sedimentary (sandstones and limestones) and igneous (basalts and granites) rocks. Wherever the water is produced in wells uphill from Cedar Valley, it can be pumped into streams and/or short (inexpensive) pipelines for easy transport to municipal culinary systems and farms.

Where the fluid is oil (like at Alaska's Prudhoe Bay, Utah's Uinta Basin, and much of California's Great Valley) companies and individuals earn good incomes, but the oil is eventually gone and does not replace itself. In contrast, water produced from bedrock aquifers, whether from intergranular porosity or fracture systems, is replaced each year by infiltration of five to ten percent of the volume of melting snow and rainfall. A likely estimate for recharge into bedrock aquifers surrounding Cedar Valley is at least 20,000 acre-feet per year, four times the annual valley recharge deficit now occurring.

PROOF OF WATER AVAILABILITY IN BEDROCK

My theory of bedrock water availability has now been proven in at least four productive wells:

(1) A Brian Head City well that produces about 1,000 gallons per minute from Cretaceous sandstones;
(2) An Enoch City well that produces about 800 gallons per minute from 424 feet of fractured quartz monzonite (granite) east of the Hurricane Fault system, at the base of the Hurricane Cliffs;
(3) A Cedar City exploratory well that produced about 150 gallons per minute from 200 feet of fractured granite underlying Quichapa Volcanics at Quichapa Creek (the well was not deepened due to lack of funding); and
(4) A private well 2 miles east of Three Peaks that produced 1,400 gallons per minute from 250 feet of fractured ("decomposed") granite with just 102 feet of drawdown during a 5-day test. The water level in the well stabilized at a mere 10 feet below ground level immediately after the test.

All of these wells were drilled into aquifers that are separate from the Cedar Valley alluvial aquifer. Transition to pumping from the bedrock instead of the alluvium will ease over drafting of the valley.

POSSIBLE OCCURRENCE OF "NEW WATER" IN BEDROCK AQUIFERS

Much of the ground water now being produced in Cedar Valley is 16,000 year-old water derived from Lake Bonneville. While the lake did not connect directly at the surface with previously much larger Quichapa Lake, large quantities of ground water flowed southward from Parowan Valley. Most of that ground water was transmitted in aquifers that were recharged by infiltration of Lake Bonneville water into underlying sand and gravel (alluvial) aquifers.

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In contrast, age-dated water from springs sourced in bedrock surrounding Cedar Valley is known to be 500 to 1,000 years old. That young water infiltrates each year from the surface into the bedrock and moves relatively rapidly away from Cedar Valley, following the dips in sedimentary rocks such as the Straight Cliffs Sandstone, or fracture systems in volcanic rocks and quartz monzonites. Water is blocked from entering the valley by low permeability clays that have formed along the nearly vertical traces of the Hurricane Fault system at the western boundary of the Markagunt Plateau, and previously unnamed faults east of the Harmony Hills and The Three Peaks west of Cedar Valley.

LEGAL STATUS OF WATER IN BEDROCK AQUIFERS

Very little water is now being utilized from bedrock aquifers surrounding Cedar Valley. Waters from both the Brian Head municipal well and Enoch City well (adjacent to its water tank east of Interstate 15) are developed with water rights transferred to the wells from Parowan Creek Irrigation District and Cedar Valley. In contrast, future waters to be developed from fractured quartz monzonite and sandstone aquifers are not allocated.

I propose that the UDWR consider the possibility that water from bedrock aquifers be classified as "new water." In support of that request, I have attached copies of (1) a map showing the known occurrence of fractured igneous rocks surrounding Cedar Valley, and (2) a cross section from Iron Springs to the Enoch water tank showing the likely occurrence of fractured quartz monzonite aquifers under Cedar Valley and east of Interstate 15. The availability of rights to new waters will provide the economic stimulation necessary to finance exploratory drilling.

For example, Mr. Frank Nichols of Cedar City now owns the abandoned ARCo Three Peaks well, drilled to explore for oil in 1984 and 1985. Neither oil nor gas was encountered in the well, and all of the deeper zones below 7,000' were sealed off with cement plugs. However, a thick "laccolith" of quartz monzonite is present from 2,322' to 6,286' below ground. Accurate sonic and resistivity logs disclose several hundred feet of heavily fractured quartz monzonite, with the best zone for possible water production occurring from about 2,490' to 2,690' measured depth. Frank owns large quantities of water rights in the Escalante drainage, but the ARCo well may be capable of production rates on the order of 5,000 gallons per minutes, exceeding his rights. He hopes to recover his investments by producing water for sale to municipal or County entities.

Please consider this request for apportioning "new water" rights in appropriate areas surrounding Cedar Valley.

Gary F. Player

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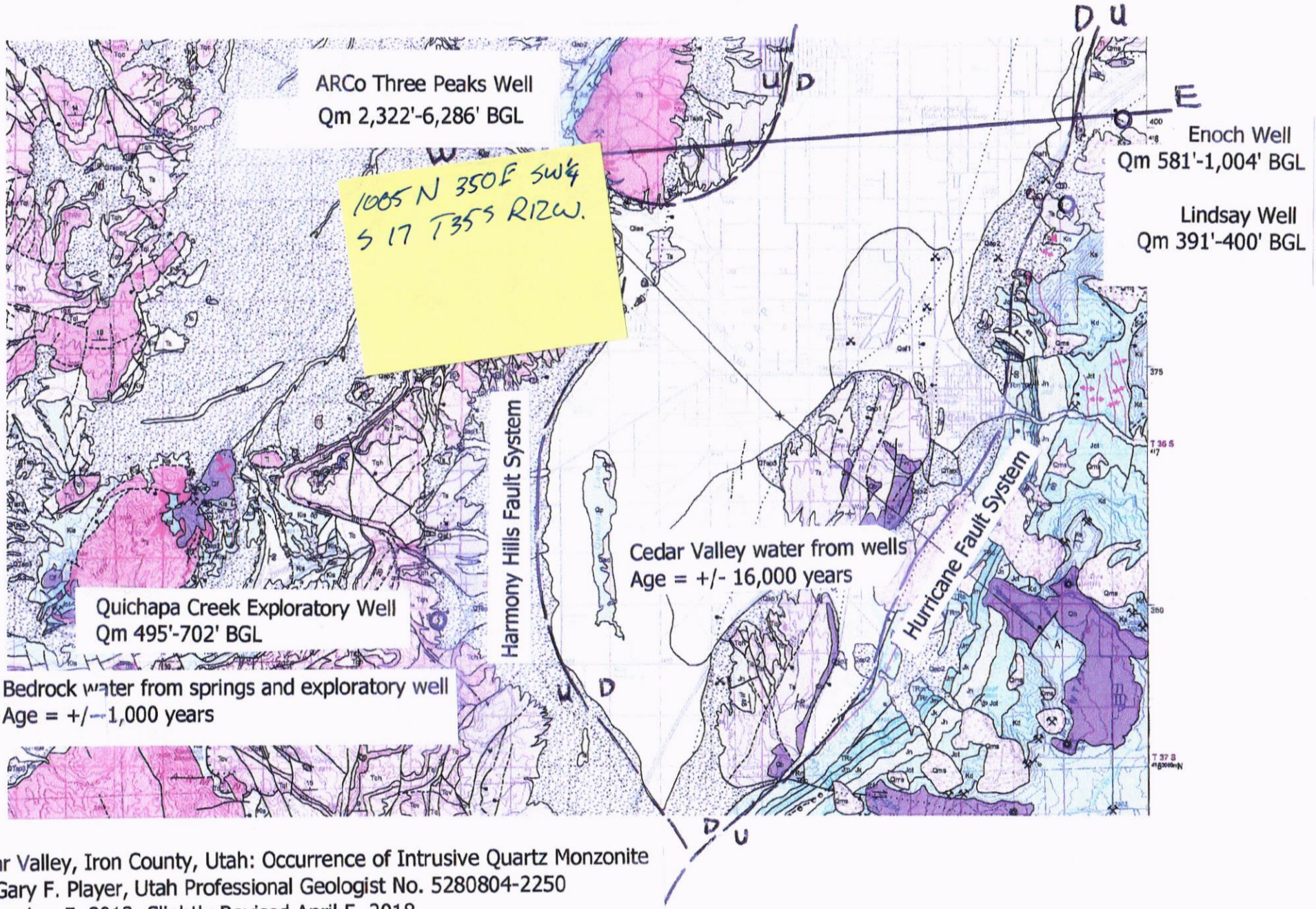
O = Wells encountering quartz monzonite (Qm) in sub-surface
Tig, Tit, Tis, Tii, Tip, Tiq = intrusive Qm and latite at outcrop



Cedar Valley, Iron County, Utah: Occurrence of Intrusive Quartz Monzonite
By: Gary F. Player, Utah Professional Geologist No. 5280804-2250
September 5, 2012; Slightly Revised April 5, 2018

State

Schlumberger

LONG SPACED SONIC/WAVEFORMS/ BOREHOLE COMPENSATED SONIC

COUNTY IRON
FIELD WILDCAT
LOCATION 17 T35S R12W
WELL THREE PEAKS #1
COMPANY ARCO EXPLORATION

COMPANY ARCO EXPLORATION COMPANY

WELL THREE PEAKS #1

FIELD WILDCAT

COUNTY IRON STATE UTAH

Confidential

RECEIVED
APR 15 1985
DIVISION OF OIL GAS & MINING

LOCATION 1005 FSL 350 FWL

43-021-30006

API SERIAL NO.	SEC.	TWP	RANGE
	17	35S	12W

Other Services:

Permanent Datum: G.L. ; Elev.: 5390
Log Measured From K.B. 27 Ft. Above Perm. Datum
Drilling Measured From K.B.

Elev.: K.B. 5416.9
D.F. 5415.0
G.L. 5390.0

Date	6/30/84	9/20/84	1/17/85	
Run No.	ONE	TWO	THREE	
Depth—Driller	2424	11640	12358	
Depth—Logger (Schl.)	2428	11612	12339	
Btm. Log Interval	2412	11598	12339	
Top Log Interval	85	2428	11638	
Casing—Driller	17½ @ 85	13-3/8 @ 2422	9-5/8 @ 11641	@
Casing—Logger	85	2428	11638	
Bit Size	17½	12¼	8½	
Type Fluid in Hole	FGM	LIME MUD	LIME MUD	
Dens. / Visc.	8.9 / 52.0	9.0 / 54.0	8.7 / 38.0	/
pH / Fluid Loss	9.3 / 28.0 ml	12.1 / 7.2 ml	12.6 / 22.8 ml	/ ml
Source of Sample	FLOWLINE	FLOWLINE	FLOWLINE	
Rm @ Meas. Temp.	2.280@80 °F	1.040@76 °F	.827 @ 56 °F	@ °F
Rmf @ Meas. Temp.	1.960@80 °F	.962@76 °F	.629 @ 56 °F	@ °F
Rmc @ Meas. Temp.	2.610@80 °F	.681@76 °F	1.240 @ 56 °F	@ °F
Source: Rmf / Rmc	MEAS / MEAS	MEAS / MEAS	MEAS / CALC	/
Rm @ BHT	1.387@136 °F	.350 @239 °F	.201 @252 °F	@ °F
TIME: Circulation Stopped	06:00	03:00	16:00	
TIME: Logger on Bottom	11:30	20:00	05:30	
Max. Rec. Temp.	136 °F	239 °F	252 °F	°F
Equip. / Location	8206 / FARM	8206 / FARM	8174 / FARM	/
Recorded By	LINK	BADOWSKI	HOWARD	
Witnessed By	GOWARD	JACKSON	BULKEMA	

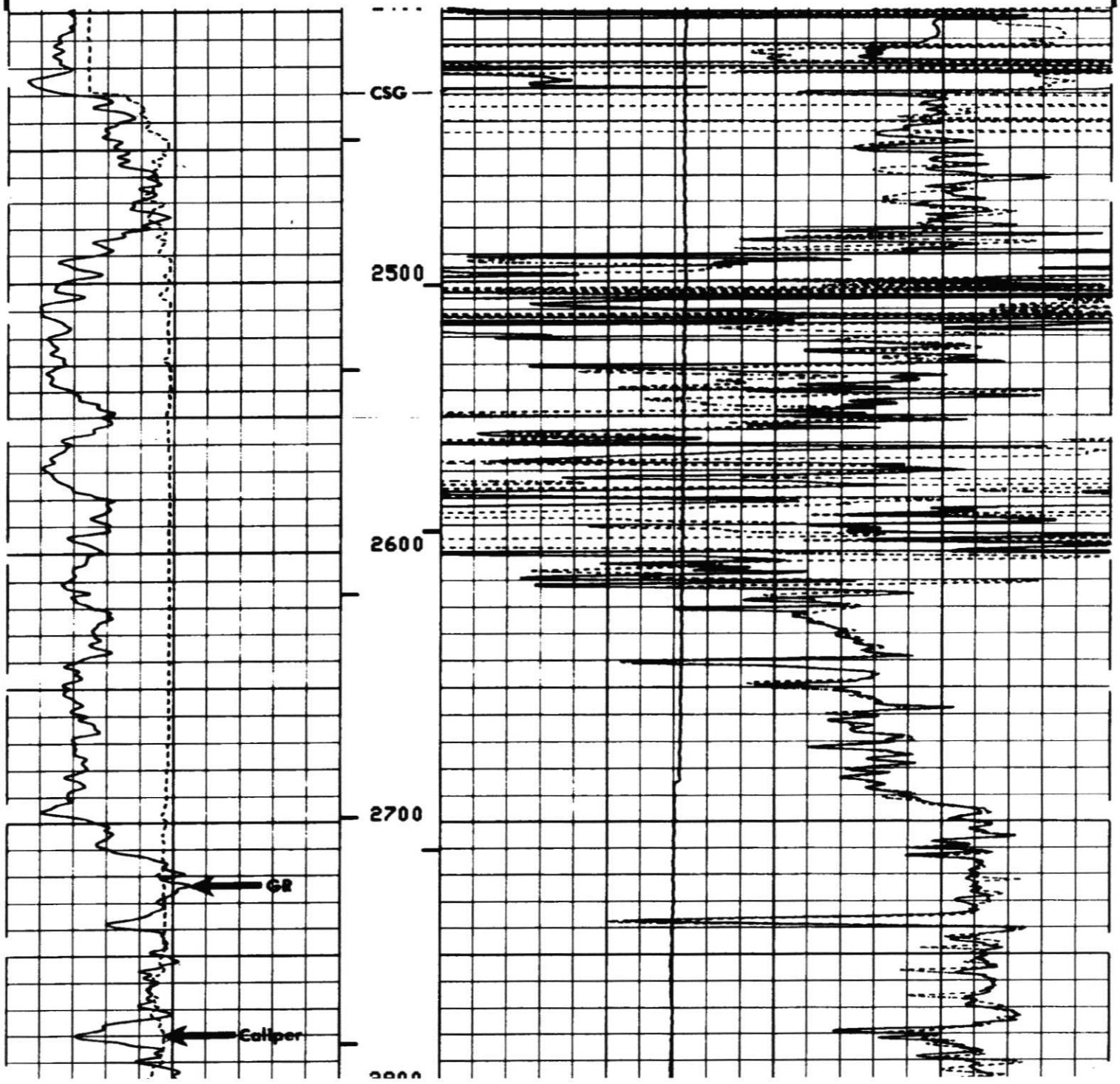
SWS—1166-K

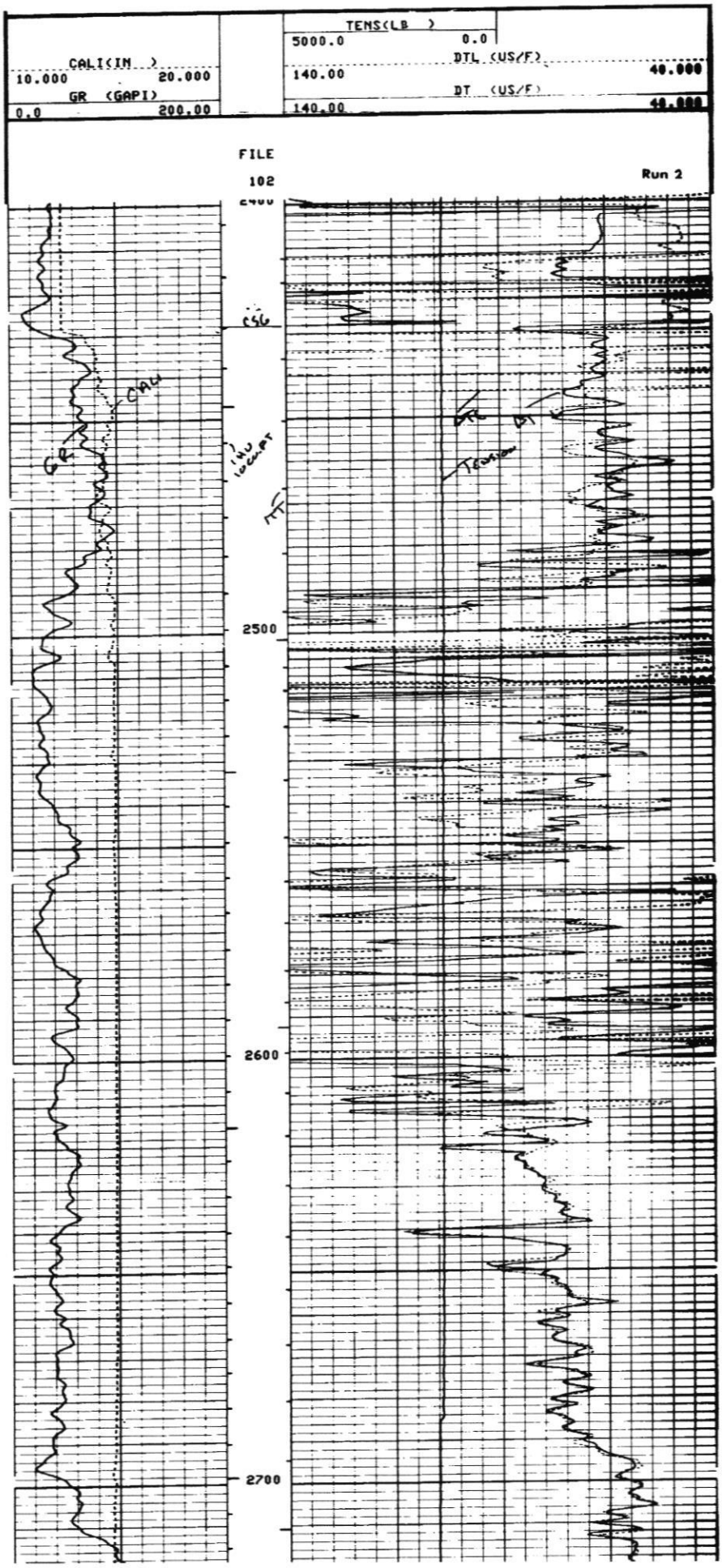
CALI(IN)		TENS(LB)
10.000		5000.0
20.000		0.0
GR (GAPI)		DTL (US/F)
0.0		140.00
200.00		40.000
		DT (US/F)
		140.00
		40.000

FILE

102

Run 2




CALI(IN)
10.000
20.000
GR (GAPI)
0.0
200.00
TENS(LB)
5000.0
0.0
DTL (US/F)
140.00
40.000
DT (US/F)
140.00
40.000
FILE
102
Run 2
CSG
CALI
GR
INU LOG.PT
TENSION
DT
2500
2600
2700

Plug #5 mixed and spotted 10 sx cement inside cut off 13 3/8" x 9 5/8" casing annulus.

Plug #4: Pumped 20 sx cement from 25' to ground level inside 9 5/8" casing.

20" Surface casing to 112' K.B. Hole size 24"

13 ½" casing from surface to 2,422' K.B. Hole size 17 ½".

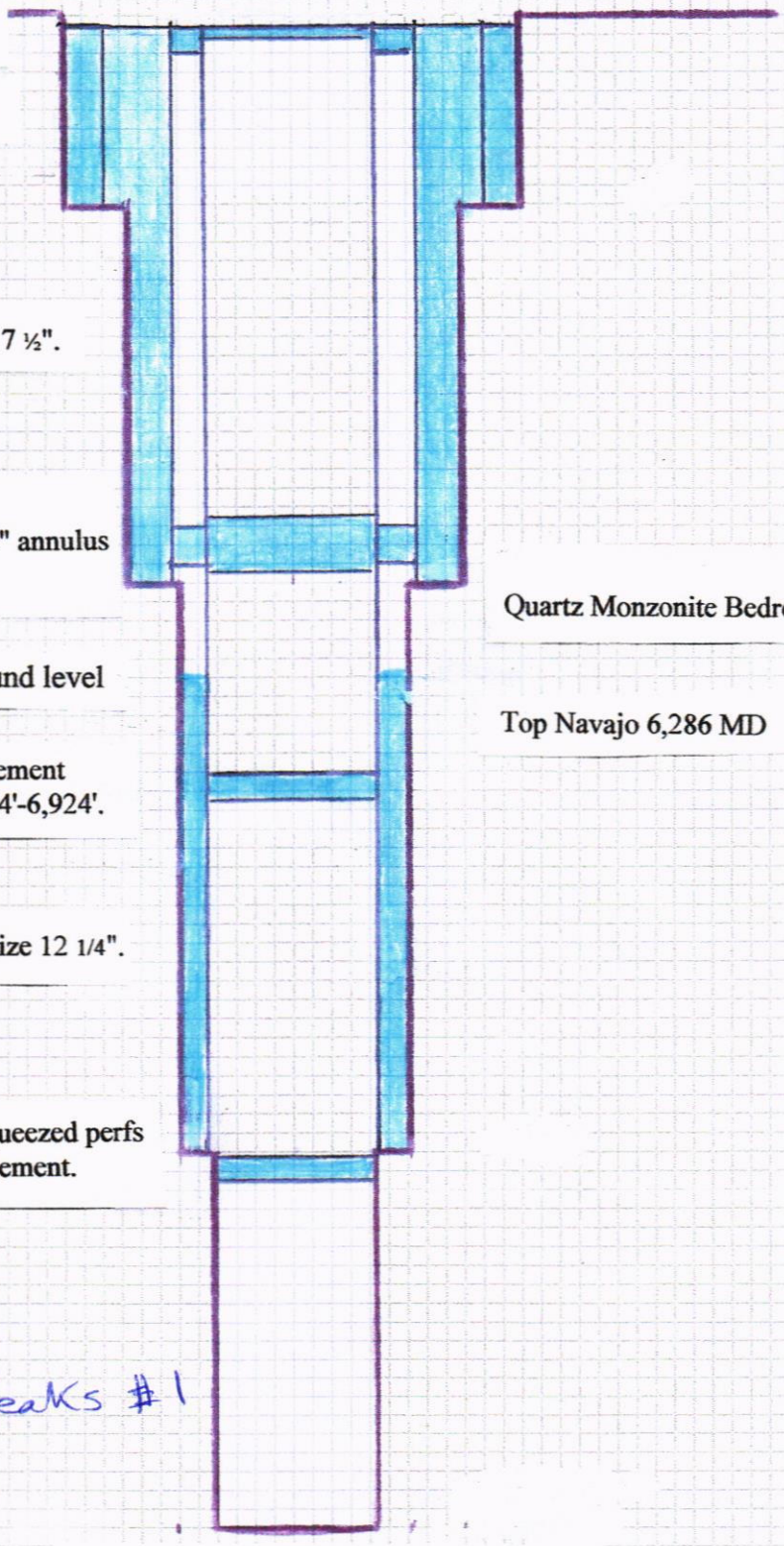
Plug #3: Perf'd 4 holes in 9 5/8" casing @2,350'. Pumped 80 sx cement from 2,250'-2,350' in 13 3/8" x 9 5/8" annulus and from 2,225' to 2,375' inside 9 5/8" casing.

Top of Cement = +/- 4,420 feet below ground level

Plug #2: Pumped 50 sx cement in 9 5/8" casing from 7,054'-6,924'.

9 5/8" casing from surface to 11,640' K.B. Hole size 12 1/4".

Plug #1: Set retainer at 11,590'. Squeezed perfs from 11,642'-11,688' with 100 sx cement.



Quartz Monzonite Bedrock

Top Navajo 6,286 MD

ARCo Three Peaks #1

Total Depth 15,590' in 8 ½" open hole.

Kenny Lake Ventures, LLC

Gary F. Player Cell: (435) 590 8705
dirtdoctor43@gmail.com

Mr. Brent Hunter, Chairman
Central Iron County Water Conservancy District
88 E. Fiddler's Canyon Drive
Cedar City, Utah 84721

Subject: Reentry of the ARCo Three Peaks No. 1 Wildcat Well

Dear Brent:

ARCo drilled the Three Peaks well at the east end of Iron Springs Gap in the SW quarter of the SW quarter of Section 17, T. 35 S., R. 12 W. in 1984 and 1985. The well reached a total depth of 15,590 feet without detecting any showings of oil and gas. However, the well did penetrate a potential ground water aquifer–the "fractured quartz monzonite," from 2,322 feet below ground level (BGL) to 6,286 feet BGL.

My review of the "sonic" log run in open hole (before casing was set) disclosed a very porous interval at the depths proposed for perforating. The porous zone is most likely to be a highly fractured portion of the quartz monzonite aquifer.

The well was plugged and abandoned by ARCo on March 15, 1985. Several cement plugs were placed in the 9 and 5/8" casing below 11, 590 feet BGL, from 7,050 feet to 6,920 feet BGL, and from 2,350 feet to 2,225 feet BGL. One last plug was set from the surface to 25 feet BGL.

Most important, the 9 and 5/8" casing is open for potential future aquifer testing below 2,350 feet BGL. In order to test the quartz monzonite (Qm) aquifer, a workover rig similar to one available from Grimshaw Drilling in Enoch, would set up over the hole and drill out the surface plug and the next shallow plug present from approximately 2,225 feet to 2,350 feet BGL.

Once the plugs have been drilled out, the well should be pressure tested by filling it with water and applying about 200 psi pressure at the surface. Once the casing is proven to be intact, the next step will be to enter the casing with a perforating gun and fire 24 to 48 shots through the casing in the interval from 2,480 feet to 2,610 feet BGL.

Wells drilled into the same Qm zone at Quichapa Creek and at the base of the Pine Valley Mountains southwest of New Harmony are very productive of high quality water. The closest well (Quichapa) penetrated only the first two hundred feet of the Qm, but was producing at a rate of about 150 gallons per minute by air lift while the well was being drilled. Wells at New Harmony have been pump tested at rates on the order of 2,500 gallons per minute with little drawdown.

If the initial flow of water from the perforated intervals appears to be indicative of high porosity and permeability in the zone tested, then it would be appropriate to fire additional shots, and then set a 5" diameter, gravel packed slotted liner inside of the 9 5/8" casing in order to control possible entry of loose silt and sand during long term production. Exact details of the completion should be settled upon by consulting with your engineering staff and the drilling company chosen to test and then complete the well.

I believe that Grimshaw Drilling could quickly provide the District with a reasonable estimate of the price to reenter and hopefully complete the well. I have retained all available well records, and could provide them as needed.

Sincerely,

Gary F. Player

Gary F. Player
Consulting Geologist
Utah Professional Geologist No. 5280804-2250

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STANDARD FORM 2015-1 (06/2015)

SUBMISSION OF WATER DEVELOPMENT PROJECTS: RE-ENTRY OF THE ARCo THREE PEAKS EXPLORATORY OIL WELL

Through the development of scientific studies defining the aquifer within the Cedar Basin it has been documented that additional water resources will be necessary to sustain the growth and further development of the area. Without water the future economic development will be impacted by the availability and cost of existing water supplies to accommodate only the growth capable within our current water budget. This form is being circulated to document additional water supply sources that could be utilized to further alleviate the water deficit in the aquifer, as well as provide water for the future residents of the valley. This form will be evaluated for completeness of content. Please ensure that the proposed project is fully defined and information to substantiate the claim is submitted for a complete evaluation.

Name and Address of Applicant
Gary F. Player
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Cedar City, Utah 84720
gfplayer@kennylakeventures.us

Name, Title, and Address of authorized Agent
H. Roice Nelson, Jr.
2155 W 700 S, No. 31
Cedar City, Utah 84720
rnelson@walden3d.com

A. Provide names, addresses, phone numbers and email addresses of those who filled out this form.
See above.

B. Project Description With Vital Details.
1. Scope of Work and Project Description
2. Type of System or Facility
3. Quantity of Water Anticipated
4. Scientific Analysis of Water Resource
5. Uses (irrigation, culinary, industrial, etc.)
6. Years Resource is Available
7. Constructability
8. Additional information to describe resource and availability (additional sheets provided)

B.1. This project is an opportunity to develop ground water from the fractured quartz monzonite bedrock aquifer within the western portion of the Cedar Valley basin as defined by the Utah Division of Water Rights (UDWR). The availability of water would be proven initially with the recompletion of one abandoned exploratory oil well along Iron Springs Road. That ARCo well was drilled on private lands. The well would be re-entered and tested with perforations through existing casing at depths ranging from 2,490 to 2,610 feet below ground level, with projected sustainable productivity of more than 2,000 gallons per minute. Produced water could be pumped into a reservoir constructed in Iron Springs Creek, and allowed to percolate into the Cedar Valley alluvial basin. Water could eventually be conducted approximately 6 miles to the southeast via pipeline to industrial and residential consumers along Utah Highway 56.

B.2. This well would be one of an eventual larger set of wells utilized to reduce over drafting of the Cedar Valley Basin alluvial aquifer system. Water could be utilized for both industrial and culinary purposes. The well location is near to existing power lines and roads so that only minimal new development would be necessary to test the concept.

B.3. A well capable of 2,000 gallons per minute would produce 4.456 cubic feet per second, or 8.836 acre-feet per day. Therefore, one well pumped for 365 days each year would provide more than 3,200 acre-feet.

Recharge estimates for the bedrock aquifers under Harmony Mountains and Three Peaks prepared by Player in 2010 range from 12,800 to 16,000 acre-feet per year, showing that continuous production of 12,000 acre-feet per year would not draw down the bedrock aquifer.

THE AREA UNDERLAIN BY THE FRACTURED QUARTZ MONZONITE AQUIFER WEST OF CEDAR VALLEY IS APPROXIMATELY 200 SQUARE MILES. THE FOLLOWING ESTIMATE OF RECHARGE IS BASED ON 15 INCHES OF PRECIPITATION PER YEAR AND 10% INFILTRATION:

Precipitation = 1.25 feet per year
Infiltration at 10% = .125 feet per year
Area = 200*640 = 128,000 acres
Annual infiltration = .125*128, 000 = 16,000 acre-feet per year

Alternatively, recharge would not be less than 12,800 acre-feet with one foot (12 inches) of precipitation and 0.1 foot of infiltration per year.

B.4. The likelihood of a sustainable bedrock aquifer resource in the Harmony Hills west of Cedar Valley was shown by Player in geohydrologic reports prepared for the Cedar City Water Utility. Scientific studies included estimation of bedrock thickness, and review of published and unpublished chemical analyses of spring waters issuing from the bedrock aquifers. Summaries of those studies are attached to a cover letter for the Player-Nelson submissions.

One water sample was obtained from the Quichapa Creek No. 1 well, drilled in 2012. Water from the quartz monzonite aquifer (encountered below 500 feet) was mixed with water from a thin sandstone layer in the Quichapa Volcanics at about 225 feet below ground level. Total dissolved solids (TDS) in the mixed sample were 205 mG/L (milligrams per liter of water).

Water from the Quichapa Creek Left-hand Canyon spring was sampled on the same day. That water had a lower TDS of 165 mG/L. It is interesting to note that water from the test well was found to be significantly younger (approximately 510 years before present) than water issuing from the surface spring in Quichapa Left-hand Canyon (approximately 1,660 years before present). The age difference suggests that recharge water occurring in the fractured quartz monzonite aquifer is younger than water that is the source of the springs in the shallower but less permeable Quichapa Volcanic rocks.

B.5. Water pumped into a reservoir along Iron Springs Creek would be usable by for irrigation in the western portion of Cedar Valley, allowing farmers and ranchers to switch from expensive pumped wells to virtually free canal water.

B.6. The bedrock aquifer resource is sustainable due to annual infiltration from precipitation. In the unlikely event of long term drought, the production of 3,200 acre-feet per year could be sustained for almost 3,600 years without recharge into the fractured quartz monzonite bedrock aquifer system within the Cedar Valley Basin. That aquifer is estimated to contain more than 11,500,000 acre-feet of water in place.

B.7. This well could be drilled by local drilling contractors. Power lines are in place along Highway 14 for easy access to the drill site.

B.8. Summaries of bedrock aquifer studies completed in 2010 are attached to the cover letter for the Player-Nelson submissions. More detailed reports can be provided when requested.

C. A map showing the proposed location for the first well at Woods Ranch is attached.

C.1. The well site is on private property.

C.2. There are no potential conflicts. Re-entry of the well will require a permit from the Utah Division of Oil, Gas, and Mining.

C.3. The area is flat and will not require grading.

D.1. Federal issues are minimal on private property. Iron Springs Creek dried up as the Cedar Basin aquifer was over drawn, and no fishery is present. The proposed area is outside of managed Sage Grouse habitat.

D.2. State issues are few. Cedar Basin water rights will be transferred by the Utah Division of Water Rights into the old ARCo well prior to beginning full scale production. The sources of those water rights would be farmers, ranchers, Cedar City Municipal Water Utility, and Southern Utah University. It is at least possible that the well would discover "new water" that could be appropriated to the District.

D.3. Local issues are unlikely to be problematic

E. **Cost Estimate:** Each exploratory well will cost on the order of $200,000 to complete and equip with pumps and short pipelines to streams. Full development of 15 wells (described in a separate Submission) would cost approximately $3,000,000 to develop 12,000 acre-feet per year. The CAPEX for full development of the aquifer would be on the order of $250 per acre-foot.

F. **Additional Alternatives:** Separate Submissions of Water Development Projects from Player and Nelson include the following: (1) Construction of a Cretaceous aquifer test well at the Sheepherders Cabin Road, about one mile west of Woods Ranch; and (2) Deepening of the Cedar City Quichapa Creek Number 1 well into the fractured quartz monzonite aquifer.

G. **Environmental Effects:** Full scale production of water from the fractured quartz monzonite aquifer west of Cedar Valley could lead to the elimination of over drafting from the Cedar Valley aquifer system.

H. **Cultural Resources:** Iron Springs Gap has provided access to several industrial and mining operations, and has been "disturbed" for 100 years. No cultural or archeological resources are present at the site. For your information, Player served as an environmental inspector during construction of the Kern River Pipeline, and supervised SUU archeologist Barbara Frank as she prepared clearances across a 100-mile segment of the line from Milford to eastern Nevada.

J. **Additional Information:** Player reviewed the Harmony Hills bedrock aquifer system for Cedar City in 2010. All of his work will be available for review with the permission of City Engineer's office. For example, additional data includes meteorological studies, summaries of geology, water analyses, aquifer rock properties, old well records, etc. Summaries of the aquifer study are attached to the cover letter provided with the Player-Nelson Submissions.

Respectfully Submitted,

Gary F. Player

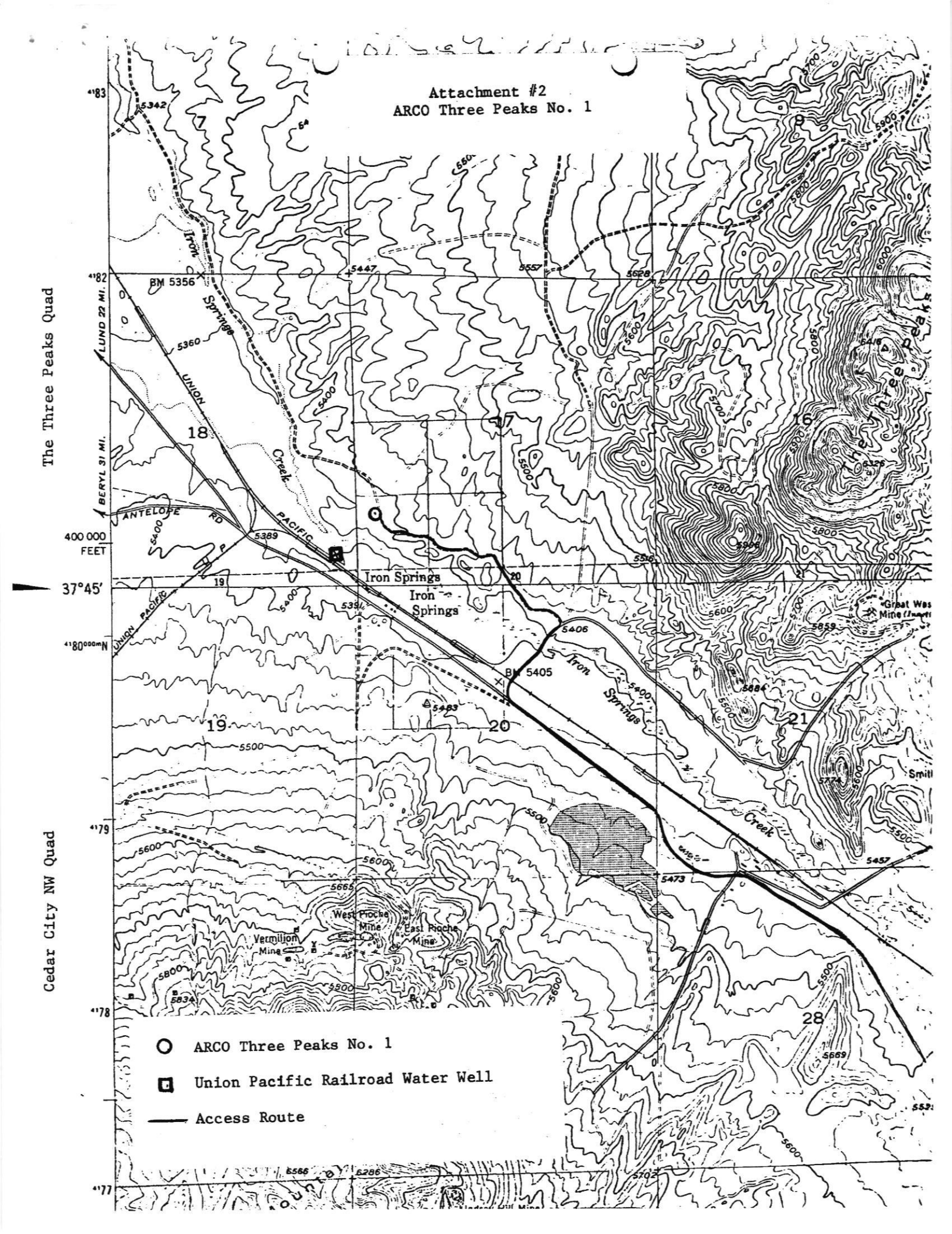
Gary Farnsworth Player
Utah Professional Geologist No. 5280804-2250
Idaho Professional Geologist No. 1050
Certified Petroleum Geologist No. 3097

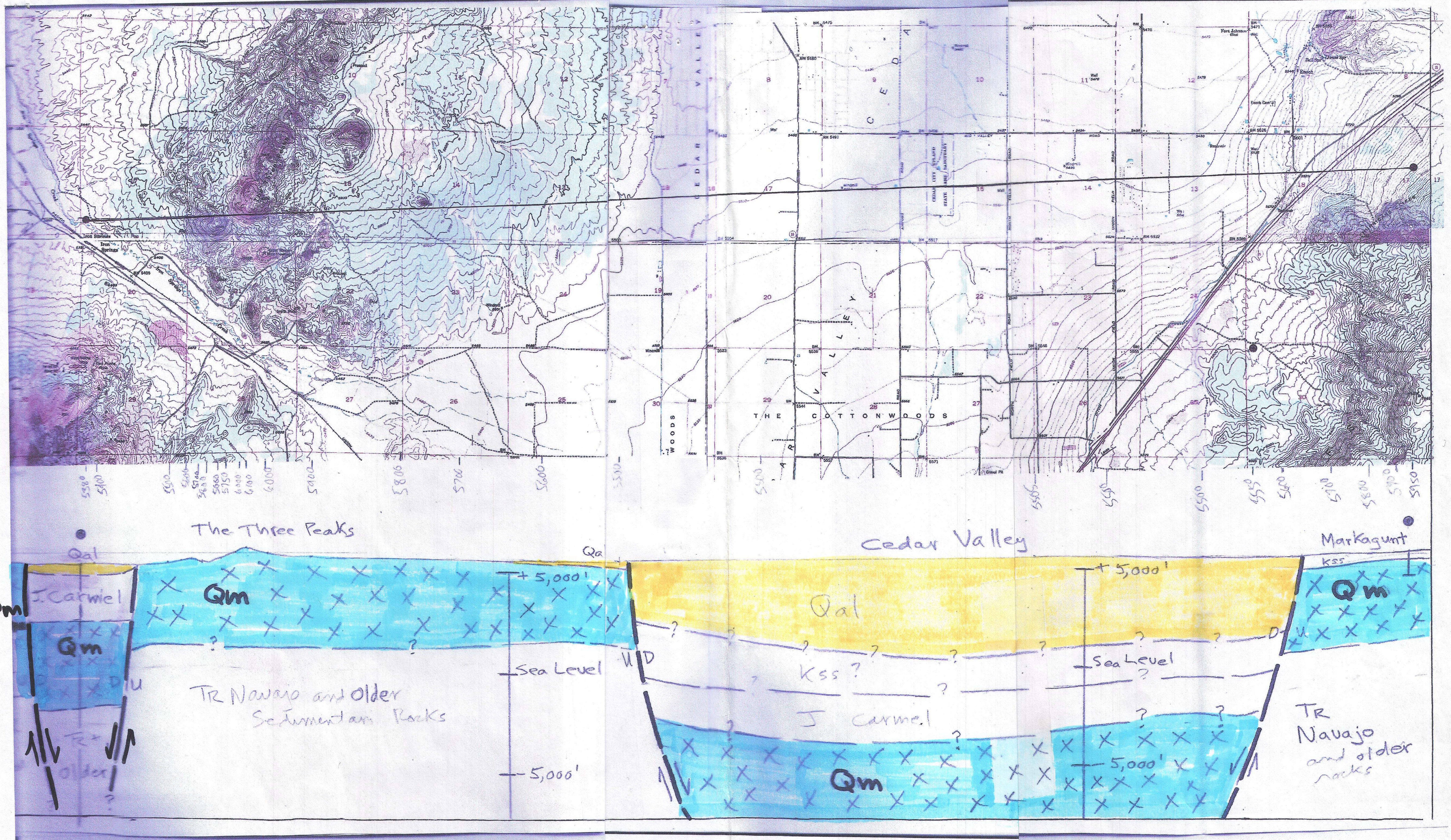
H. Roice Nelson, Jr.
Texas Professional Geoscientist No. 5120
Louisiana Professional Geoscientist No. 879

Attachments:

1. Location Map

C:\Users\Gary\Google Drive\Gary's Folder\AQUA\CICWCD\STANDARD SUBMISSIONS\STANDARD FORM 20151 ARCO THREE PEAKS WELL.wpd


Attachment #2
ARCO Three Peaks No. 1
The Three Peaks Quad
Cedar City NW Quad
ARCO Three Peaks No. 1
Union Pacific Railroad Water Well
Access Route
Iron Springs
Iron Springs
Iron Springs Creek
Union Pacific
Antelope Rd
West Pioche Mine
East Pioche Mine
Vermilion Mine
BM 5356
BM 5405
Lund 22 mi.
Beryl 31 mi.
400 000 FEET
37°45'


CEDAR VALLEY
THE COTTONWOODS
WOODS
The Three Peaks
Cedar Valley
Markagunt
Qal
Qa
Kss
Qm
J. Carmel
D
U
TR Navajo and Older Sedimentary Rocks
+5,000'
Sea Level
-5,000'
Kss ?
J Carmel
TR Navajo and older rocks