



Clearwater Geosciences, LLP
Ground Water Development and Exploration

March 10, 2014

Mr. James Cefalo
Idaho Department of Water Resources
900 North Skyline Drive, Suite A
Idaho Falls, ID 83402-1718

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MAR 11 2014

Department of Water Resources
Eastern Region

RE: REQUEST FOR CLARIFICATION OF MODEL RESULTS – WILLIAMS 15-7373

Dear Mr. Cefalo:

In a previous application for Vic Riches Water Right, Application 15-7347, I modeled aquifer drawdown using a transmissivity from the Davis Pumping test. When the new well was pumped the drawdown was 65 ft versus 4 feet predicted. I can think of two reasons for the difference: 1) the pumping rate for the Riches test was 1925 gpm and I modeled 1500 gpm, and 2) the Theis assumptions in the modeling program assume a perfectly efficient well, i.e. no head loss caused by inefficiencies in well construction. Seldom are wells perfectly efficient, which causes the actual drawdown to be greater than the predicted. I will do my best to evaluate below if the modeled versus the actual drawdowns are reasonable.

The Drillers Log for the Peoa River Valley Ranch well (Vic Riches) is provided in Attachment 1. The well is 323 ft deep and has 16-inch casing to a depth of 217 ft. The lower portion of the well is open hole but the formation was noted as not being water bearing by the driller. The well is perforated from 80 to 87 ft, 95 to 105 ft and 110 to 182 ft with a total of 408 perforations. The perforations are ½ by 4 inches. The total open area in the casing is 816 sq inches or 5.6 sq ft. A flow rate of 1925 gpm yields an entrance velocity of 0.77 ft/second. The generally accepted recommendation to maintain laminar flow and an efficient well is 0.1 ft/second (Driscoll, 1986, p. 996). Thus, based on these calculations and the description in the well log the argument can be made that this is an inefficient well. The actual area open to water bearing formation may be further reduced because a large interval of perforations 45 to 80 ft and 85 to 105 ft are noted on the well log as not having water. This is 55 ft out of the total perforated length of 139 ft or 39.5%. Eliminating 39.5 % of the perforations results in an open area of 3.39 sq ft. At a flow of 1925 gpm the entrance velocity is 1.3 ft/second. Obviously, this entrance velocity is outside the optimal design criteria for an efficient well.

The other consideration was that I calculated drawdown based on 1500 gpm and the well was tested at 1925 gpm. I recalculated the drawdown for Vic Riches using a pumping rate of 1925 gpm. After 60 minutes of pumping the drawdown is predicted to be 4.4 ft.

I wondered if the drawdown listed on the data sheet from Cordingly Pump Company is actually depth to water. In that case the actual drawdown would be 20 ft (65 ft minus the static of 45 ft). However, Cordingly Pump Company told me 65 ft was the drawdown and not the depth to water.

I checked the Davis Pump test analysis and rematched the drawdown curves. In the initial analysis I stated that it is very difficult to get a good storativity value from a single well test and this is true. In the rematch, I used a storativity of 0.1 (the same value used in the first analysis) and still found a transmissivity value 7.8×10^{-4} . The reprocessed data sheet is in Attachment 2. I also investigated what using a lower storativity value would do to the predicted drawdown, by rerunning the simulation using a storativity of 0.00094. The predicted drawdown after 60 minutes of pumping is 6 ft. Not much different from the previous calculation using my original numbers.



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These calculations indicate that the modeling numbers are fairly robust, even when varying the storativity over 2 orders of magnitude. The other possibility is that the aquifer is heterogeneous and that the transmissivity at the new Vic Riches location is less than the value at the Jeff Davis location. However, for the Williams application, I went through an empirical approach developed from the modified nonequilibrium (Jacob) equation presented in Driscoll, 1986, (p. 1021). The method is crude but it suggests that the transmissivity at the Davis, Peoa Ranch and Mills are similar but lower than the aquifer test results indicate. Table 1 presents the results. The results of a pumping test are generally accepted as more accurate than the Driscoll method. The point is that aquifer transmissivity appears to be similar in the different locations.

Table 1 Calculated transmissivity using specific capacities from irrigation wells.

	Flow Rate (gpm)	Drawdown (ft)	Specific Capacity (gpm/ft)	Transmissivity (ft ² /day)
Dave Mills	550	50	11.0	2941
Peoa Ranch	1925	65	29.6	7919
Davis Test	140	18.4	7.6	2034
			Average	4298

It appears to me that the difference between the predicted drawdown and the actual drawdown is caused by well inefficiency. I estimated the well inefficiency by assuming that the modeled drawdown is the theoretical drawdown for a 100-percent efficient well. The efficiency in this case is $4/65 = 6$ percent. Even using the lower storativity value the well efficiency is $6/65 = 10\%$. These numbers are low, but within the range of possibility. The only way to know for sure is to conduct a pumping test of the Peoa Ranch Well.

Respectfully,

Thomas R. Wood, PhD, PG



References

Driscoll, F.G., 1986, Groundwater and Wells, Second Edition, Published by Johnson Filtration Systems Inc.



Attachment 1

WELL LOG



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Form 238-7
6/07

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

1. WELL TAG NO. D 00103026

Drilling Permit No. _____

Water right or injection well # _____

2. OWNER: Peoa River Valley Ranch

Name _____

Address 3970 E Hwy 36

City Malad State ID Zip 83262

3. WELL LOCATION:

Twp. 15 North ☐ or South ☒ Rge. 35 East ☒ or West ☐

Sec. 23 SE 1/4 SE 1/4 1/4

Gov't Lot _____ County Oreida

Lat. 42 ° 16.089 (Deg. and Decimal minutes)

Long. 112 ° 19.816 (Deg. and Decimal minutes)

Address of Well Site 5501 S 400 W

City Malad

Lot _____ Blk. _____ Sub. Name _____

4. USE:

☐ Domestic ☐ Municipal ☐ Monitor ☒ Irrigation ☐ Thermal ☐ Injection

☐ Other _____

5. TYPE OF WORK:

☒ New well ☐ Replacement well ☐ Modify existing well

☐ Abandonment ☐ Other _____

6. DRILL METHOD:

☒ Air Rotary ☐ Mud Rotary ☐ Cable ☐ Other _____

7. SEALING PROCEDURES:

Seal material	From (ft)	To (ft)	Quantity (lbs or ft ³)	Placement method/procedure
Bentonite	0	38	42 bags	overbore

8. CASING/LINER:

Diameter (nominal)	From (ft)	To (ft)	Gauge/Schedule	Material	Casing Liner	Threaded	Welded
14	0	217	38	Steel	☒	☐	☒

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 217

9. PERFORATIONS/SCREENS:

Perforations ☒ Y ☐ N Method machine

Manufactured screen ☐ Y ☐ N Type _____

Method of Installation _____

From (ft)	To (ft)	Slot size	Number/ft	Diameter (nominal)	Material	Gauge or Schedule
80	87	1/2	32	16	Steel	3.75
95	105	1/2	56	16	Steel	3.75
110	182	1/2	320	16	Steel	3.75

Length of Headpipe _____ Length of Tailpipe _____

Packer ☐ Y ☐ N Type _____

10. FILTER PACK:

Filter Material	From (ft)	To (ft)	Quantity (lbs or ft ³)	Placement method

11. FLOWING ARTESIAN:

Flowing Artesian? ☐ Y ☐ N Artesian Pressure (PSIG) _____

Describe control device _____

12. STATIC WATER LEVEL and WELL TESTS:

Depth first water encountered (ft) 80 Static water level (ft) 50

Water temp. (°F) 58 Bottom hole temp. (°F) _____

Describe access port 0.500

Well test:

Drawdown (feet)	Discharge or yield (gpm)	Test duration (minutes)	Pump	Bailer	Air	Flowing artesian
			☐	☐	☒	☐

Water quality test or comments: good

13. LITHOLOGIC LOG and/or repairs or abandonment:

Bore Dia. (in)	From (ft)	To (ft)	Remarks, lithology or description of repairs or abandonment, water temp.	Water	
				Y	N
20	0	15	clay		X
20	15	40	gravel + clay		X
16	40	65	gravel + clay		X
16	65	85	solid sandstone gravel		X
16	85	90	gravel	X	
16	90	95	Brown Rock		X
16	95	100	Sand pea gravel		X
16	100	105	loose Rock Hard		X
16	105	110	gravel		X
16	110	180	clay + gravel		X
16	180	200	gravel	X	
16	200	220	gravel clay		X
16	220	300	Soft Shale & gravel		X
16	300	320	Br. shale + little gravel		X
16	320	330	Br. + Red clay + shale gravel		X
16	330	333	cement/gravel grout very Hard		X

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MAY 15 2013

Department of Water Resources
Eastern Region

Completed Depth (Measurable): 333

Date Started: 3-27-13 Date Completed: 4-12-13

14. DRILLER'S CERTIFICATION:

I/we certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name Midwest Well Drilling Co. No. 543

*Principal Driller Michael Zander Date 4-13-13

*Driller _____ Date _____

*Operator II John Lee Date 4-13-13

Operator I _____ Date _____

* Signature of Principal Driller and rig operator are required.

Figure 1-1. Well log for Peoa River Valley Well



Attachment 2

DATA PLOTS



PEORIA RIVER VALLEY PUMP TEST

PUMP IS SET AT 200'

STATIC IS 45'

BOTTOM OF WELL IS 300'

DRAW DOWN IS 65' WHEN PUMPING

PUMP IS PRODUCING 1925GPM

PUMP TESTED FOR ONE HOUR

Data Sheet from Cordingly Pump Co.

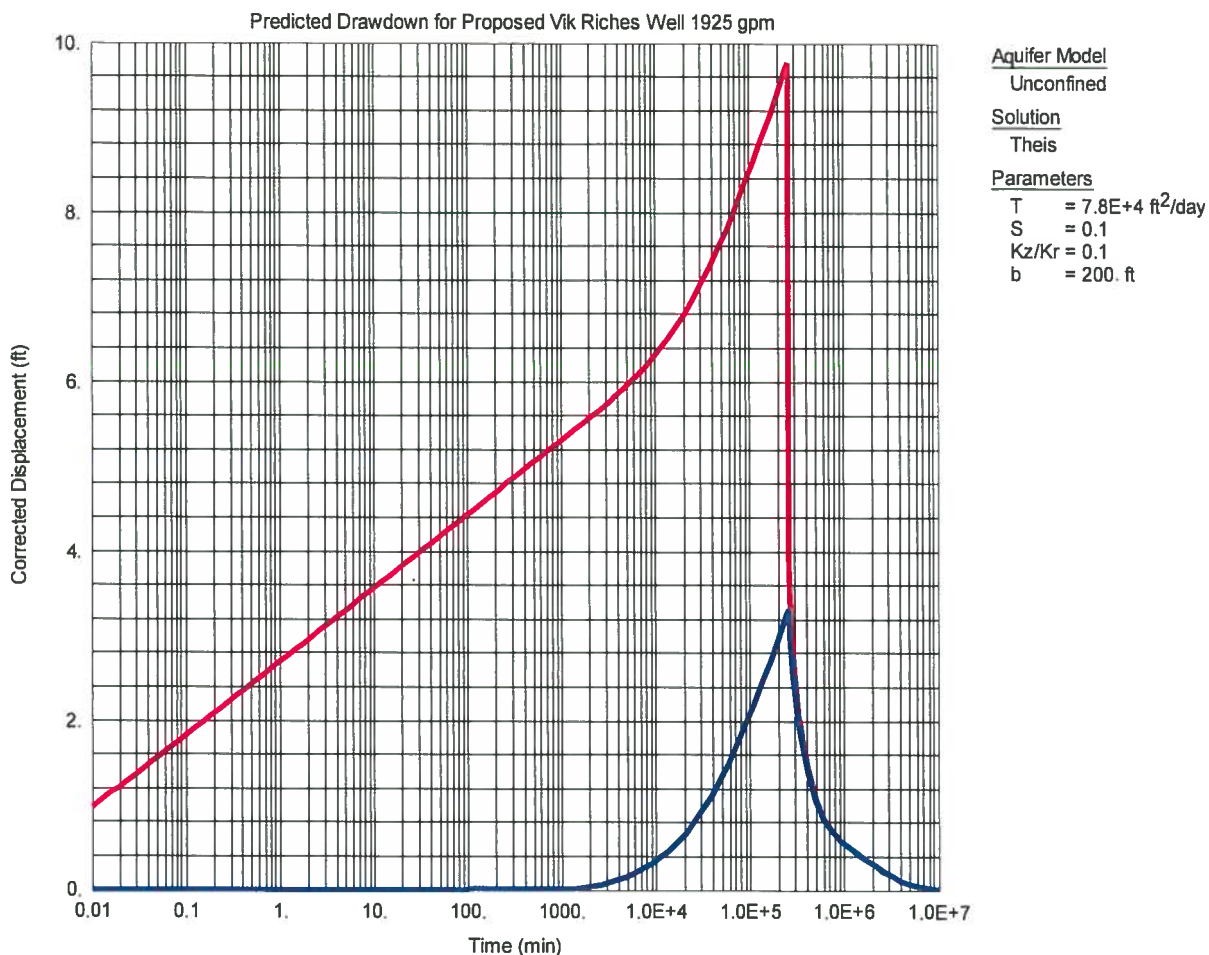


Figure 2-1 Predictive plot of drawdown at 1925 gpm for the full period of use 180 days using the original T and S values. The red line is for the water level in the proposed Riches Well pumping and the blue line is the water level predicted in a well ½ mile north of the proposed Riches Well.

Key to line colors

Blue Imaginary well ½ mile north of the proposed POD
Red Proposed POD for Vik Riches

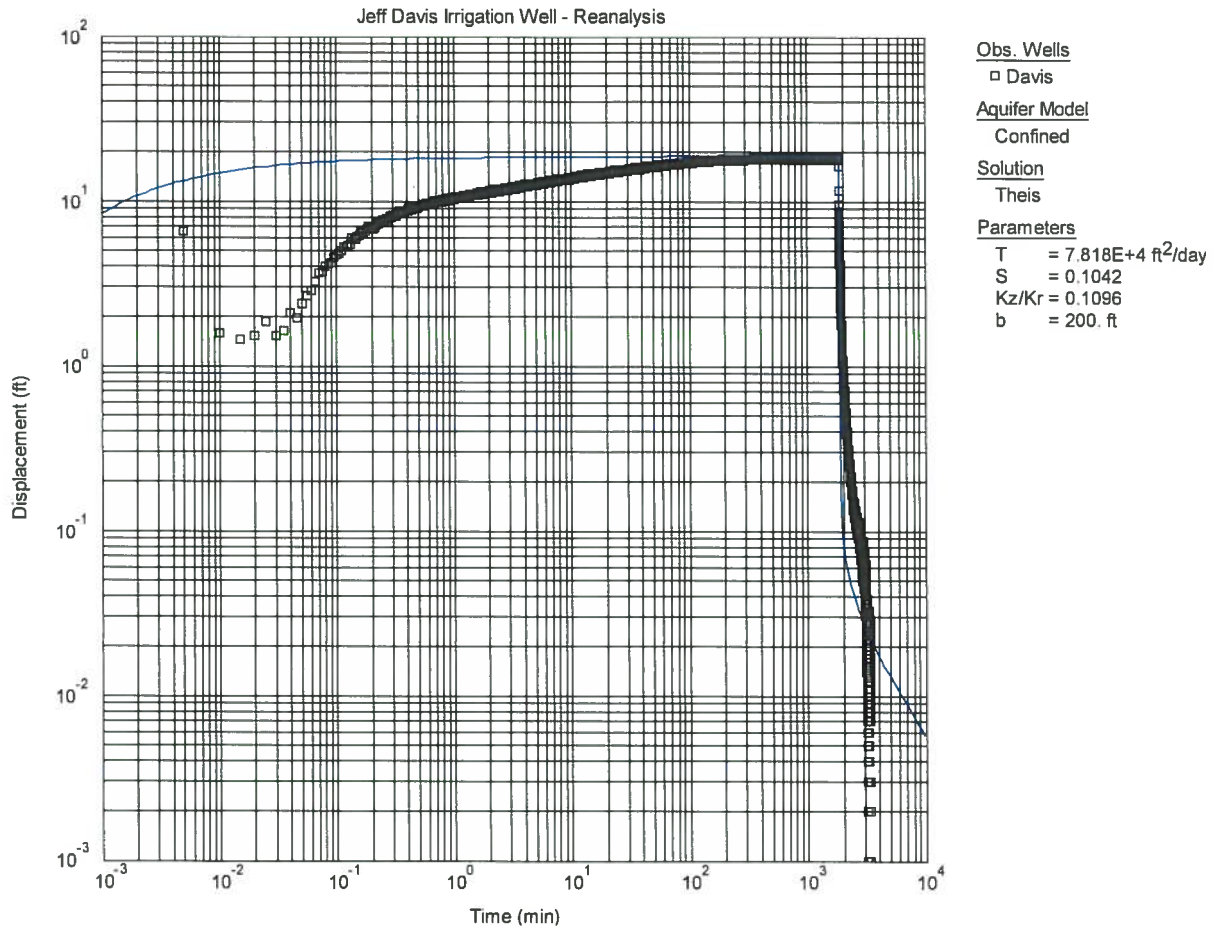


Figure 2-2 Reanalysis of Jeff Davis well test using a lower storativity value.

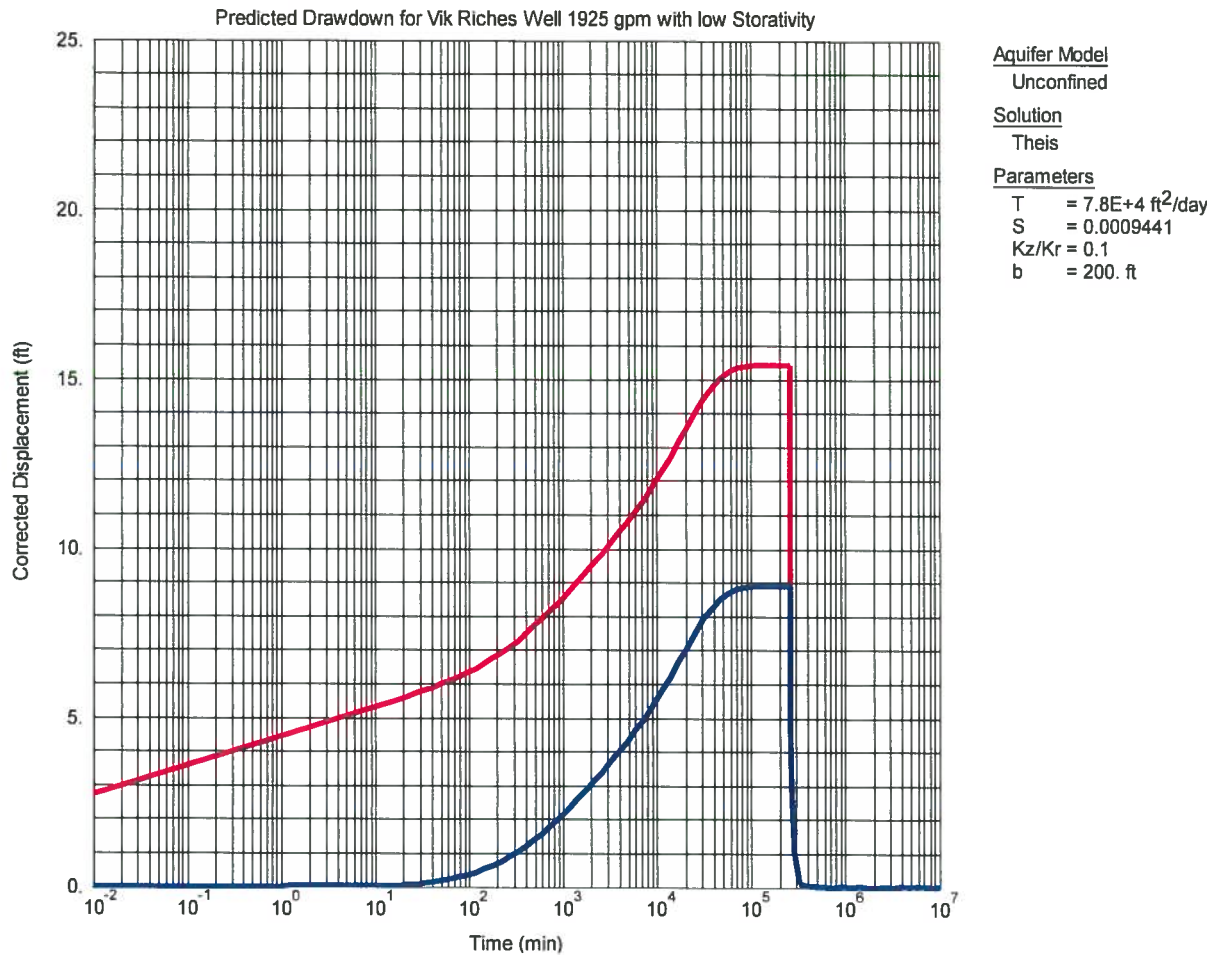


Figure 2-3 Predictive plot of drawdown at 1925 gpm for the full period of use 180 days using the original T and a lower S value. The red line is for the water level in the proposed Riches Well pumping and the blue line is the water level predicted in a well ½ mile north of the proposed Riches Well.

Key to line colors

Blue Imaginary well ½ mile north of the proposed POD
Red Proposed POD for Vik Riches