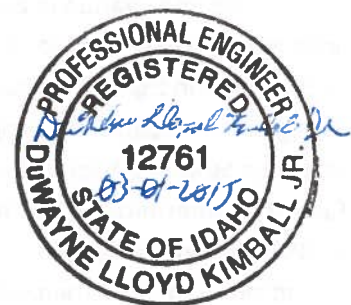


Kimball
Ex-Rp Rebuttal

Rebuttal to Expert Report and Narrative Relative to Water Right Transfer #79384 for Irrigation



By: DuWayne Kimball, P.E.

Date: February 28, 2015

I was asked to provide a rebuttal to the "Expert Report and Narrative Relative to Water Right Transfer #79384 for Irrigation" prepared by Brockway Engineering P.L.L.C. I will address this by referencing the material in the original document and then providing a rebuttal to that information.

The information in this report can also be used for a rebuttal for transfers #79357 and #79380.

Expert Report

A.2 Executive Summary last sentence states, "Approval of Transfer 79384 will not result in any significant impact on groundwater levels or injure any existing water rights, included the Protestants' domestic wells." Of note, I am sure this report has it owns grammar issues but when taking direct quotes from the expert report I did not make changes to possible grammar errors.

Rebuttal

I think the information in the expert report is not defined very well and will discuss further in the rebuttal. The pump test (although not likely performed to any engineering standard) indicated a drop in water levels in the test well of 153 feet. I would not consider 153 feet an insignificant impact to groundwater levels. It does not appear that testing or evidence provided in the expert report is sufficient to conclusively say in any manner whether there will or will not be harm to the Protestants' domestic wells as a conclusive pump test requires running the pump test for a longer duration and monitoring the pump test well, as well as other wells, in the vicinity during the duration of the test.

Expert Report

Page 5, 1st paragraph last sentence states, "This analysis is provided in Appendix D."

Rebuttal

The information in appendix D deals with the development of the static water levels at the proposed new diversion location. It may be accidentally omitted but I am very interested in these calculations on the determination that 94% of the water right is considered "primary". My educational background indicates 94% irrigation efficiency to be unreasonably high. The textbook *Principles of Farm Irrigation System Design* by Larry James and published in 1993 lists irrigation efficiencies on page 86 in Table 2.3. Intermittent mechanical move is listed as 70-80% efficiency and continuous mechanical move at 80%. Without access to the calculations I have no way to know if irrigation efficiency may be defined in a different manner than what may be used in some textbooks or if some unreasonable assumptions have been made.

Expert Report

Page 8, 1st full paragraph states, "a *Preliminary Report on Ground Water in the Salmon Falls Area, Twin Falls County, Idaho* written by K.H. Fowler in 1960."

Rebuttal

The expert report states, "The general direction of ground water movement is a north to northwest direction toward the Snake River." It is important to note that the boundaries of the study shown on page 2, Figure 1 of the Fowler report does not include the Mule Creek drainage so no inference should be made that the groundwater in the Mule Creek drainage or groundwater for the original point of diversion for the proposed transfer also flows in a north to northwest direction.

The expert report states, "Wells in the area have drilled through Snake River Basalt and into sedimentary strata consisting of silt, clay, sand and some gravel. It is this sedimentary strata that provides water to domestic, stock and smaller irrigation wells." I think the statement may be somewhat simple and/or misleading in nature and I want to quote quite extensively from the Fowler report on page 5 which goes into much more detail in the nature of where water may be present:

"Joints, fractures, and openings between successive flows, and lenses of permeable sediments between flows yield moderate to large quantities of water to wells where they are saturated. Between joints and interflow layers the basalt is relatively impermeable. On the whole, the transmissibility of the basalt aquifer in this area is much less than at most other places on the Snake River Plain. The size of the joints and the contact openings between flows become progressively smaller with depth so that where the depth to water is several hundred feet the basalt yields little water to wells. Most of the domestic, irrigation, and stock wells in the area produce water from the basalt or from the intercalated sediments, and at some places where the depth to water is moderate, their yield is adequate."

Expert Report

Page 8, last partial paragraph in the expert report states, "a report entitled *Water Resources-Reconnaissance Series Report 48, Water-Resources Appraisal of the Snake River Basin in Nevada* written by Donald Moore and Thomas Eakin in 1968." The expert report further states, "Moore and Eakin indicate by this report that the several northern Nevada ground water aquifers are directly linked and flow northward into the ground water aquifers of Idaho."

Rebuttal

It should also be mentioned that the Series Report 48 also indicates that groundwater flows from Idaho into Nevada which would be a south flowing direction. Page 24 of the Series Report 48 states,

"Ground water moves from areas of recharge to areas of discharge; that is, in the direction of lower potential hydraulic head. The flood plains, which are the areas of principal ground-water

discharge, have a gradient down the axes of the valleys.... The general movement is from the mountains toward the valley axis and with a downstream component in response to the gradient of the flood plain."

Page 25 of Series Report 48 states,

"Most recharge to the ground-water systems in the Snake River basin in Nevada is derived from precipitation with that basin, including that part of the area in Idaho which drains to Nevada."

These two statements would indicate that the Mule Creek drainage groundwater flows into Nevada.

Expert Report

Page 10, 1st full paragraph in the expert report states, "The United States Geological Survey published *Water Resources of the Salmon Falls Creek Basin Idaho – Nevada*, by E.G. Crosthwaite in 1969." The report further states, "The natural discharge direction of the ground water flow is northward towards the Twin Falls tract and the Snake River."

Rebuttal

It should be noted on page D22 of the USGS report that groundwater flow contours were not developed for the Mule Creek area.

Expert Report

Page 10, last paragraph states, "The general interpretation of the all referenced published reports indicate ground water recharge occurs in northern Nevada in the Jackpot area and southern Idaho in Twin Falls County and that the aquifer flows northward towards the Snake River." The paragraph later states, "The general flow direction of the ground water aquifer is in a north northwest direction."

Rebuttal

My general interpretation of the information provided in the reports is that the groundwater contours will generally have a tendency to follow the natural ground elevation contours. This means the groundwater in the Mule Creek drainage will travel to the south into Nevada and will eventually loop its way back into Idaho following the ground elevation decline. The groundwater at that point of re-entry into Idaho will then flow in a general north direction as Brockway's expert report has indicated.

Expert Report

Page 12, USGS Monitoring Well Discussion

Rebuttal

The location of the two referenced USGS monitoring wells are such a distance away that they are not indicators for what is happening for the proposed point of diversions. The monitoring wells are both just north of the desert and may not show the effects of higher efficiency irrigation conversions.

I do not agree that the two USGS wells are as stable as indicated in the expert report. There appears to be a trend from approximately 1980 to approximately 1998 where the groundwater table depths became shallower (particularly section 2 well) and then from 1998 to present the groundwater depths have become deeper.

Expert Report

Page 16, 1st paragraph of the expert report mentions water level measurements were taken from some of the dairy wells in 2014.

Rebuttal

I attempted to find out if I could see how the new water level measurements may compare with original measurements. Appendix D mentions a well located in 11S 16E 6 SENE measured on 01/15/2014 to have a static water level of 288 feet. This well appears to be measured again on 02/16/2005 or 2/18/2005 to have a static water level of 262 feet. This is a drop of 26 feet in the static water level from the 2005 to the 2014 readings. It is unknown whether the measurements were taken using correct protocols but the measurements being taken during similar seasonal dates should eliminate most of the seasonal variation. As a side note, I attempted to get the static biannual static water level measurements that were part of the conditions of approval of the Hafliger water right transfer from the late 1990's but IDWR was not able to locate the data.

Expert Report

Page 23, Winflow analysis 1 of the expert report uses the hydraulic conductivity in the 1998 Cosgrove.

Rebuttal

To say that any particular well within a zone or cell matches the assumed hydraulic conductivity for the cell or zone seems inappropriate. Models have many assumptions that are used to simplify the world so that calculations can be made. There are cases where there are uncertainties which the actual conditions are unknown and assumptions need to be made and there are cases where it becomes over burdensome to include all available data so assumptions are made to simplify calculations.

Expert Report

Page 23, Winflow analysis 2 of the expert report.

Rebuttal

I have multiple issues on how Table 2 is developed.

- The first is the aquifer bottom being 700 feet. I attempted to find the 700 foot depth in the Fowler, 1960 report and was not able to locate the information. I view Bonnichsen's expert report of the aquifer thickness being in the 100 to 250 foot thickness as being more accurate.
- The two wells that have the highest transmissivity and hydraulic conductivity appear suspect to include as representative of the conditions for the locations for the proposed transfer point of diversion .
 - Well number 4 well log is attached in the Appendix. The drawdown appears to be 121 feet instead of 21 feet as the expert report used in the table. This significantly increases the calculated transmissivity and hydraulic conductivity.
 - Well number 7 is in very close proximity to the high line canal and is a significantly shallower well than the others listed in the table. This well is likely heavily influenced by recharge from the high line canal and as such produces shallower groundwater depths. The shallower groundwater depths are more likely to reside in less consolidated material and as such have higher transmissivities and hydraulic conductivities.
 - An interesting observation in that there appears to be a fairly strong correlation of the well distance from the high line canal and the calculated transmissivity and hydraulic conductivity with those wells being closer to the canal having higher values.
- Likely a cut and paste error and not significant to the results but I suspect well #10 may have an incorrect location listed for the township, range, and section.
- The table has an inconsistency as it lists 0.15 for storativity and the report lists the storativity as 0.12 on page 19 of the same report.
- Using means instead of medians for the determining calculated transmissivity and hydraulic conductivity significantly skews the results and particularly when one well log appears to be read incorrectly and a second well log is a non-representative situation with substantially higher values. The mean or average likely skews the calculation much higher than they realistically are for the proposed points of diversion.
- The irrigation well was test pumped (although possibly not to some engineering standard) and the expert appears to disregard these results in favor of using a suspect average.
- My calculated transmissivity and hydraulic calculations using the Bradbury and Rothschild method are attached in the appendix. I have deleted the well that appears to be heavily influenced by the high line canal and corrected the drawdown on another well. I calculated the median hydraulic conductivity of 0.7 and since the pump tested well was higher I feel it is more appropriate to use its hydraulic conductivity of 0.9.
- Even though I used the hydraulic conductivity from the test well it should be mentioned that the expert report does not list to what standard the pump test was

performed. Most testing practices in engineering have standards or protocols for certain tests. I would recommend a multiple well test following American Society of Testing and Materials (ASTMS) standards. Two standards that likely pertain to this situation include:

- ASTM D4043 *Guide for Selection of Aquifer Test Method in Determining Hydraulic properties by Well Technique*
- ASTM D4045 *Test Method (Field Procedures) for Withdrawal and Injection Well Testing For Determining Hydraulic Properties of Aquifer Systems*

Expert Report

Page 26 of the expert report states:

“The hydraulic conductivity value of 15.3 ft/day is considered very conservative compared to published values for similar strata. Hydraulic conductivity values are best calculated from pump tests that have a high discharge over an extended period of time. The high discharge rate is important to stress or maximize the ability of the aquifer to provide water. If a pump test is not capable of stressing the aquifers ability to provide water, then the estimated hydraulic conductivity value will be smaller than the actual hydraulic conductivity value.”

Rebuttal

I do not agree that 15.3 ft/day is considered a very conservative approach and in my opinion 15.3 ft/day is not conservative. I would conservative would be 0.5 to 0.7 ft/day for hydraulic conductivity. The statement also indicates that if pump tests do not stress the aquifer then they may be misleading. Are they alluding that their pump test is not adequate? If the pump test is not adequate, then what was the purpose of the pump test? If the pump test is adequate, why not use the results?

I wanted to run the experts results and my results in the Theis equation to see if the expert aquifer conditions or my aquifer conditions more closely match the actual pump test results. I set the radius at 0.5 feet which is essentially the well itself. Brockway's aquifer conditions indicate a drawdown of 4.7 feet at 16 hours into the pump test. My aquifer conditions indicate a drawdown of 88.9 feet at 16 hours into the pump test. The measured drawdown in the pump test was 153 feet.

Expert Report

Modflow analysis for protestant wells.

Rebuttal

Putting incorrect data into a model will produce incorrect results out of the model. I would suggest that Brockway run a third analysis using a hydraulic conductivity value that is determined after a more standardized pump test. If a decision is made that a more formal pump test is not required then

perform a third analysis using the hydraulic conductivity of 0.9 ft/day generated using his initial pump test.

General Recommendations

A determination needs to be made if one can transfer water that flows out of the State and potentially back into the State at a later time. If the determination is made that this is not acceptable then the water right transfer should be rejected as it is my opinion that this is the condition that is occurring for this transfer.

If a determination is made that transferring water that leaves the State and enters back into the State is an acceptable practice, then the applicant should perform an extended period multiple well pump test using an ASTM or other acceptable standard. The protestants should have the opportunity to inspect the proceedings of the well test. Also in my opinion, if the transfer is approved the applicant should install some well water level data loggers in a couple of protestant wells in close proximity to the point of diversion to be able to monitor water levels over time and forewarn if problems may be arising in the future. The monitoring may prevent a potential situation where a pre-1978 domestic well runs dry in the middle of an irrigation season at which point substantial investment has been made in the crop and a water call could potentially be made by the pre-1978 well.



DuWayne Kimball, P.E.

APPENDIX

USE TYPEWRITER OR
BALL POINT PEN

State of Idaho
Department of Water Resources

WELL DRILLER'S REPORT

State law requires that this report be filed with the Director, Department of Water Resources within 30 days after the completion or abandonment of the well.

1. WELL OWNER Name <u>M Danos</u> Address <u>Filet Idaho</u> Owner's Permit No. _____	7. WATER LEVEL Static water level <u>193</u> feet below land surface Flowing? ☐ Yes ☒ No G.P.M. flow _____ Temperature _____ ° F. Quality _____ Artesian closed-in pressure _____ p.s.i. Controlled by ☐ Valve ☐ Cap ☐ Plug																																																																																								
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Abandoned (describe method of abandoning) _____	8. WELL TEST DATA ☒ Pump ☐ Bailer ☐ Other Discharge G.P.M. <u>900</u> Draw Down <u>21'</u> Hours Pumped <u>7</u>																																																																																								
3. PROPOSED USE ☐ Domestic ☒ Irrigation ☐ Test ☐ Other (specify type) _____ ☐ Municipal ☐ Industrial ☐ Stock ☐ Waste Disposal or Injection	9. LITHOLOGIC LOG 105263 <table border="1" style="width:100%"><thead><tr><th rowspan="2">Hole Diam.</th><th colspan="2">Depth</th><th rowspan="2">Material</th><th colspan="2">Water</th></tr><tr><th>From</th><th>To</th><th>Yes</th><th>No</th></tr></thead><tbody><tr><td>10"</td><td>0</td><td>2</td><td>Top Soil</td><td></td><td></td></tr><tr><td>"</td><td>2</td><td>37.2</td><td>Cl. Lava</td><td></td><td></td></tr><tr><td></td><td>32</td><td>65</td><td>Rd " Hard</td><td></td><td></td></tr><tr><td></td><td>65</td><td>140</td><td>Cl. " "</td><td></td><td></td></tr><tr><td>16"</td><td>140</td><td>165</td><td>Rd " "</td><td></td><td></td></tr><tr><td></td><td>165</td><td>190</td><td>Cl. " "</td><td></td><td></td></tr><tr><td></td><td>190</td><td>215</td><td>Rd " "</td><td></td><td></td></tr><tr><td></td><td>215</td><td>225</td><td>Cl. " Hard</td><td></td><td></td></tr><tr><td></td><td>225</td><td>240</td><td>Cl. " "</td><td></td><td></td></tr><tr><td></td><td>240</td><td>305</td><td>Cl. Shale</td><td></td><td></td></tr><tr><td></td><td>305</td><td>357</td><td>Cl. Lava Layer + 50' clay</td><td></td><td></td></tr><tr><td></td><td>357</td><td>414</td><td>Cl. Lava</td><td></td><td></td></tr><tr><td></td><td>414</td><td>495</td><td>Rd " "</td><td></td><td></td></tr></tbody></table>	Hole Diam.	Depth		Material	Water		From	To	Yes	No	10"	0	2	Top Soil			"	2	37.2	Cl. Lava				32	65	Rd " Hard				65	140	Cl. " "			16"	140	165	Rd " "				165	190	Cl. " "				190	215	Rd " "				215	225	Cl. " Hard				225	240	Cl. " "				240	305	Cl. Shale				305	357	Cl. Lava Layer + 50' clay				357	414	Cl. Lava				414	495	Rd " "		
Hole Diam.	Depth		Material	Water																																																																																					
	From	To		Yes	No																																																																																				
10"	0	2	Top Soil																																																																																						
"	2	37.2	Cl. Lava																																																																																						
	32	65	Rd " Hard																																																																																						
	65	140	Cl. " "																																																																																						
16"	140	165	Rd " "																																																																																						
	165	190	Cl. " "																																																																																						
	190	215	Rd " "																																																																																						
	215	225	Cl. " Hard																																																																																						
	225	240	Cl. " "																																																																																						
	240	305	Cl. Shale																																																																																						
	305	357	Cl. Lava Layer + 50' clay																																																																																						
	357	414	Cl. Lava																																																																																						
	414	495	Rd " "																																																																																						
4. METHOD DRILLED ☒ Cable ☐ Rotary ☐ Dug ☐ Other	10. Work started <u>1/10/78</u> finished <u>4/27/78</u>																																																																																								
5. WELL CONSTRUCTION Diameter of hole <u>16</u> inches Total depth <u>500</u> feet Casing schedule: ☒ Steel ☐ Concrete Thickness <u>1/4</u> inches Diameter <u>16</u> inches From <u>2</u> feet To <u>140</u> feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet _____ inches _____ inches _____ feet _____ feet Was casing drive shoe used? ☐ Yes ☒ No Was a packer or seal used? ☒ Yes ☐ No Perforated? ☐ Yes ☒ No How perforated? ☐ Factory ☐ Knife ☐ Torch Size of perforation _____ inches by _____ inches Number _____ From _____ To _____ _____ perforations _____ feet _____ feet _____ perforations _____ feet _____ feet _____ perforations _____ feet _____ feet Well screen installed? ☐ Yes ☒ No Manufacturer's name _____ Type _____ Model No. _____ Diameter _____ Slot size _____ Set from _____ feet to _____ feet Diameter _____ Slot size _____ Set from _____ feet to _____ feet Gravel packed? ☐ Yes ☒ No Size of gravel _____ Placed from _____ feet to _____ feet Surface seal depth <u>20'</u> Material used in seal ☒ Cement grout ☐ Pudding clay ☐ Well cuttings Sealing procedure used ☒ Sherry pit ☐ Temporary surface casing ☐ Overbore to seal depth	11. DRILLERS CERTIFICATION Firm Name <u>Chuck Jones</u> Firm No. <u>84</u> Address <u>Reidley</u> Date <u>6/5/78</u> Signed by (Firm Official) <u>Chuck Jones</u> and <u>Bernard Longhorn</u> (Operator)																																																																																								
6. LOCATION OF WELL Sketch map location must agree with written location. 47  Subdivision Name _____ Lot No. _____ Block No. _____ County <u>Twila Falls</u> <u>NW 1/4 NE 1/4 Sec. 5 T. 11 N/S. R. 16 E/W</u>	12. RECEIVED JUL 11 1978 Department of Water Resources																																																																																								

USE ADDITIONAL SHEETS IF NECESSARY

FORWARD THE WHITE COPY TO THE DEPARTMENT

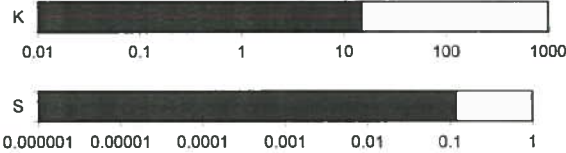
Field Data				Depth to Water				Test Duration	Mean Pumping Rate	Screened Interval		Estimated Parameters			Calculated Results				Calc. Transmissivity per day (T)	Calc. Conductivity (K)					
Well No.	Name	Location	Well Diam.	Initial	Final	feet	feet			feet	feet	Depth to Top	Depth to Bottom	Storage Coef (S)	Well loss Coef (C)	Aquifer Thickness (b)	Measured Drawdown (s _m)	Saturated Screen Length (L)			Well loss (s _w)	Partial Penetration Parameter (s _p)	Specific Capacity		
(#)	(Description)		inches	feet	feet	feet	feet	hours	gpm				sec ² /ft ⁵	feet	feet	feet	feet	feet	sq ft/sec	gpm/ft	ft/day				
1	13 Domestic	T, R, S, QQ	6	210.0	300.0	300.0	345.0	1	20.0			0.12	0	250.0	90.00	45.0	0.0E+00	22.51	0.22	180	0.7				
2	27 Domestic	11S15E1SESW	6	269.0	290.0	290.0	355.0	1	30.0			0.12	0	250.0	21.00	65.0	0.0E+00	14.75	1.43	848	3.4				
3	32 Domestic	11S15E1NNWNE	6	410.0	500.0	500.0	555.0	2	20.0			0.12	0	250.0	90.00	55.0	0.0E+00	17.99	0.22	151	0.6				
4	80 Irrigation	11S16E17NNW	16	193.0	314.0	314.0	485.0	21	900.0			0.12	0	250.0	121.00	171.0	0.0E+00	1.92	7.44	1696	6.8				
5	84 Domestic	11S16E5NNWNE	6	340.0	400.0	400.0	500.0	3	15.0			0.12	0	250.0	60.00	100.0	0.0E+00	8.06	0.25	93	0.4				
6	86 Domestic	11S16E6NNWNE	6	288.0	360.0	360.0	500.0	0.5	19.0			0.12	0	250.0	72.00	140.0	0.0E+00	4.18	0.26	58	0.2				
8	102 Irrigation	11S16E9NESE	12	318	450	450	720.0	4	100.0			0.12	0	250.0	132.00	270.0	0.0E+00	-0.28	0.76	73	0.3				
9	114 Irrigation	10S15E36SESW	6	250	340	340	343.0	0.5	20.0			0.12	0	250.0	90.00	3.0	0.0E+00	333.16	0.22	2301	9.2				
10	Pump Test Well		8	247	400	400	550.0	16	140.0			0.12	0	250.0	153.00	150.0	0.0E+00	3.32	0.92	236	0.9				
																			Mean			626			2.5
																			Median			180			0.7

I recommend use of 0.9 ft/day from pump test for hydraulic conductivity.

Drawdown Prediction for Confined Aquifers, Theis(1935)

Expert Report Parameters
Brockway aquifer conditions

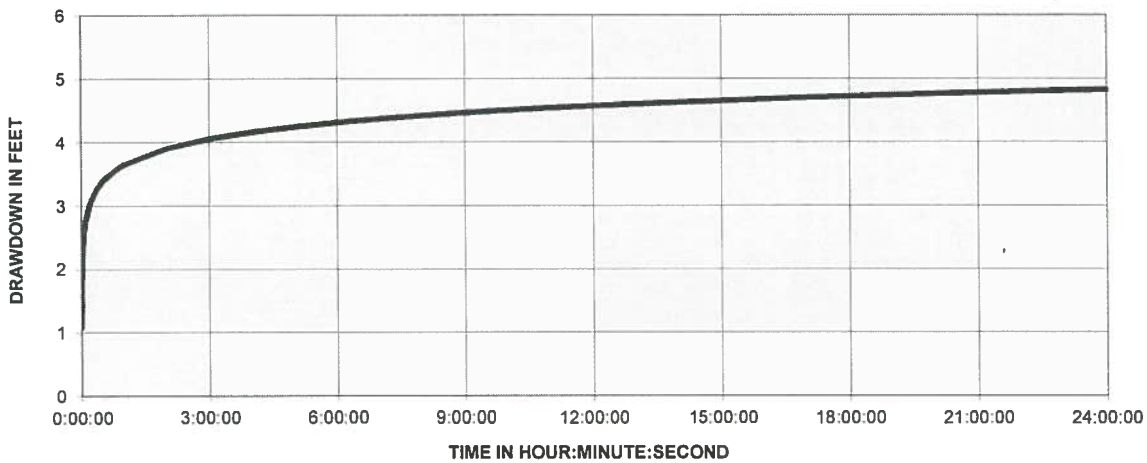
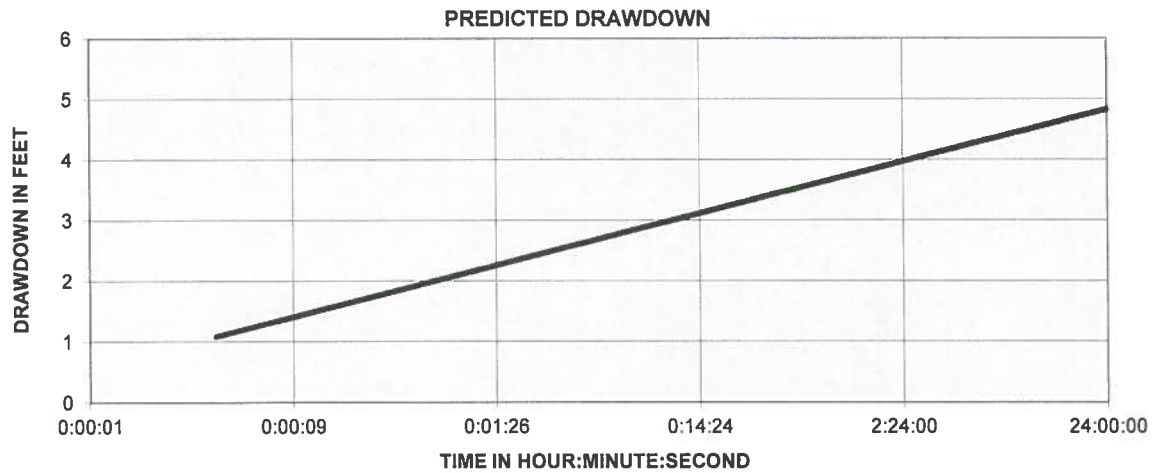
Hydraulic conductivity, K, ft/day	15.3
Aquifer Thickness, b, ft	376.5
Storage Coefficient, S	0.12
Pumping Rate, GPM	140
Distance from well, ft	0.5



Equation used in prediction

$$s = \frac{Q(W(u))}{4\pi T} \quad u = \frac{r^2 S}{4Tt}$$

s is drawdown, W(u) is the well



Transmissivity, ft²/day 5760.45
pumping rate ft³/day 26951.87166

24

Calculations for time drawdown graphs

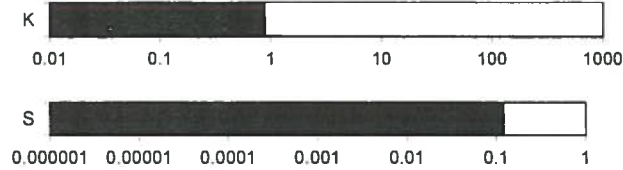
time, hour	drawdown	u	W(u)
0:00:04	1.087115285	0.031247559	2.919799
0:00:07	1.339418567	0.015623779	3.597441
0:00:11	1.488459226	0.010415853	3.997738
0:00:14	1.594584054	0.00781189	4.28277
0:00:18	1.677065978	0.006249512	4.504302
0:00:22	1.744579524	0.005207926	4.685631
0:00:25	1.801677321	0.004463937	4.838986
0:00:29	1.851197445	0.003905945	4.971988
0:00:32	1.894889165	0.003471951	5.089336
0:00:36	1.93397274	0.003124756	5.194308
0:01:12	2.191468404	0.001562378	5.885896
0:01:48	2.342242165	0.001041585	6.290847
0:02:24	2.449254121	0.000781189	6.578262
0:03:00	2.532279015	0.000624951	6.801253
0:03:36	2.600122974	0.000520793	6.983469
0:04:12	2.657489	0.000446394	7.137544
0:04:48	2.707184651	0.000390594	7.271018
0:05:24	2.751022882	0.000347195	7.38876
0:06:00	2.790237516	0.000312476	7.494083
0:12:00	3.048254997	0.000156238	8.187073
0:18:00	3.199200385	0.000104159	8.592485
0:24:00	3.306301942	7.81189E-05	8.880141
0:30:00	3.389378371	6.24951E-05	9.103269
0:36:00	3.45725725	5.20793E-05	9.28558
0:42:00	3.514648788	4.46394E-05	9.439724
0:48:00	3.564363617	3.90594E-05	9.573249
0:54:00	3.608215772	3.47195E-05	9.691028
1:00:00	3.647442862	3.12476E-05	9.796385
2:00:00	3.905513257	1.56238E-05	10.48952
3:00:00	4.056476219	1.04159E-05	10.89498
4:00:00	4.163586604	7.81189E-06	11.18266
5:00:00	4.246668036	6.24951E-06	11.4058
6:00:00	4.314550561	5.20793E-06	11.58812
7:00:00	4.371944519	4.46394E-06	11.74227
8:00:00	4.421661428	3.90594E-06	11.8758
9:00:00	4.465514881	3.47195E-06	11.99358
10:00:00	4.504743152	3.12476E-06	12.09894
11:00:00	4.54022944	2.84069E-06	12.19425
12:00:00	4.572625889	2.60396E-06	12.28126
13:00:00	4.602427755	2.40366E-06	12.36131
14:00:00	4.630019972	2.23197E-06	12.43541
15:00:00	4.655707712	2.08317E-06	12.50441
16:00:00	4.679736988	1.95297E-06	12.56894
17:00:00	4.702309031	1.83809E-06	12.62957
18:00:00	4.723590525	1.73598E-06	12.68673
19:00:00	4.743721092	1.64461E-06	12.74079

20:00:00	4.762818857	1.56238E-06	12.79209
21:00:00	4.780984645	1.48798E-06	12.84088
22:00:00	4.7983052	1.42034E-06	12.8874
23:00:00	4.814855693	1.35859E-06	12.93185
24:00:00	4.8307017	1.30198E-06	12.97441

Drawdown Prediction for Confined Aquifers, Theis(1935)

Expert Report Parameters
Kimball aquifer conditions

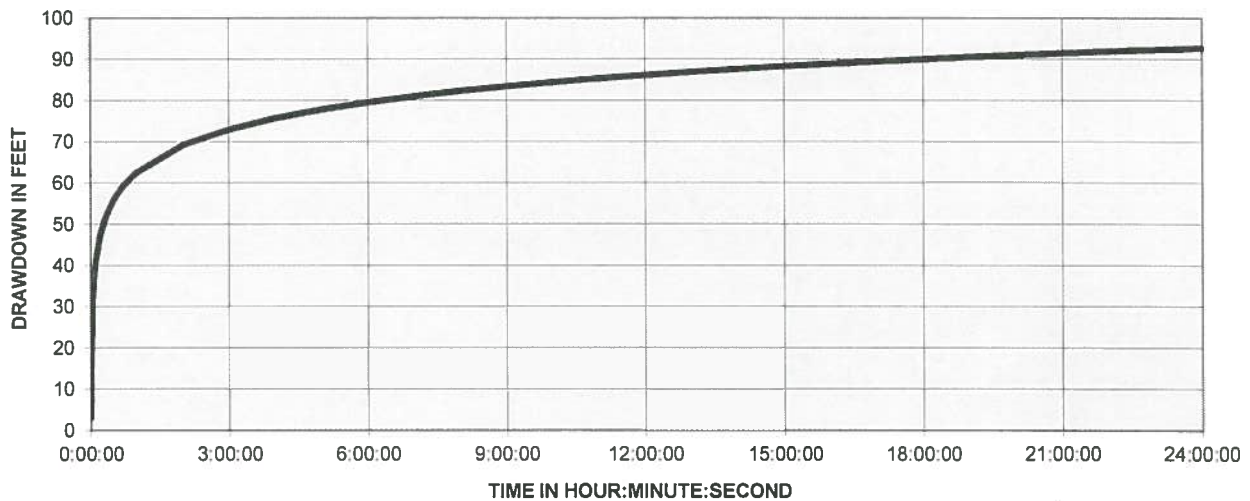
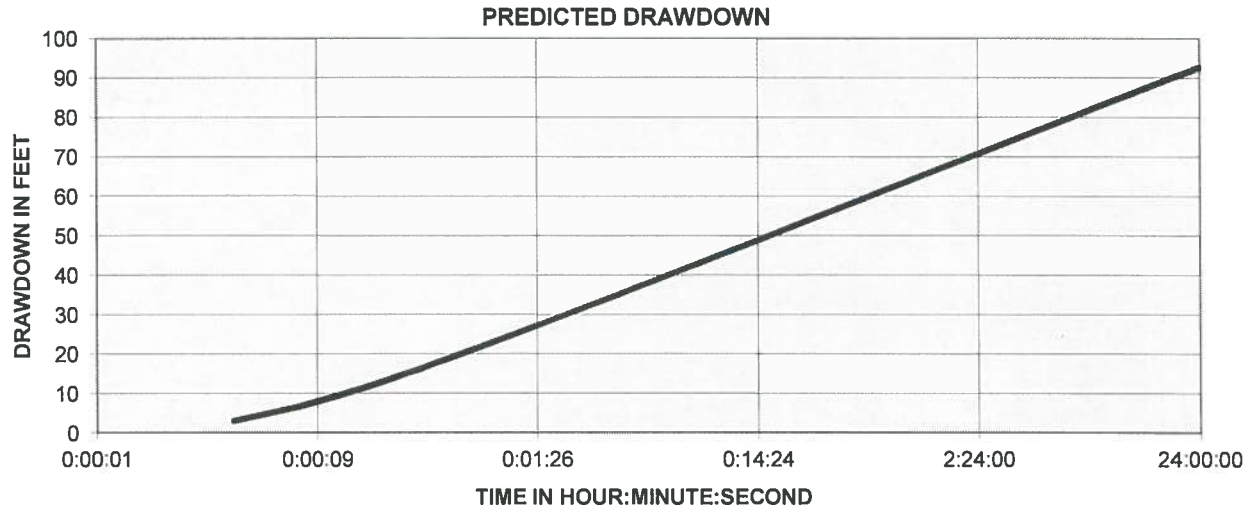
Hydraulic conductivity, K, ft/day	0.9
Aquifer Thickness, b, ft	250
Storage Coefficient, S	0.12
Pumping Rate, GPM	140
Distance from well, ft	0.5



Equation used in predic

$$s = \frac{Q(W(u))}{4\pi T} \quad u = \frac{r^2 S}{4Tt}$$

s is drawdown, W(u) is th



Transmissivity, ft²/day 225
pumping rate ft³/day 26951.87166

24

Calculations for time drawdown graphs

time, hour	drawdown	u	W(u)
0:00:04	3.009098283	0.8	0.315675
0:00:07	6.731119424	0.4	0.70614
0:00:11	9.499508511	0.266666667	0.996563
0:00:14	11.67580563	0.2	1.224871
0:00:18	13.44732225	0.16	1.410715
0:00:22	14.94367131	0.133333333	1.567692
0:00:25	16.24375987	0.114285714	1.70408
0:00:29	17.38753545	0.1	1.82407
0:00:32	18.39969543	0.088888889	1.930252
0:00:36	19.33015792	0.08	2.027864
0:01:12	25.56346844	0.04	2.681781
0:01:48	29.30195059	0.026666667	3.073973
0:02:24	31.9806162	0.02	3.354983
0:03:00	34.06817677	0.016	3.573982
0:03:36	35.78159855	0.013333333	3.753731
0:04:12	37.23198768	0.011428571	3.905887
0:04:48	38.49199333	0.01	4.03807
0:05:24	39.60339709	0.008888889	4.154664
0:06:00	40.59936207	0.008	4.259147
0:12:00	47.16837719	0.004	4.948281
0:18:00	51.02066159	0.002666667	5.352412
0:24:00	53.75644764	0.002	5.639414
0:30:00	55.87950322	0.0016	5.862137
0:36:00	57.61506067	0.001333333	6.044209
0:42:00	59.08248804	0.001142857	6.198152
0:48:00	60.35409195	0.001	6.331552
0:54:00	61.47575177	0.000888889	6.449222
1:00:00	62.4791428	0.0008	6.554484
2:00:00	69.08260388	0.0004	7.247232
3:00:00	72.94634972	0.000266667	7.652565
4:00:00	75.68796302	0.0002	7.940179
5:00:00	77.8146479	0.00016	8.163282
6:00:00	79.55233528	0.000133333	8.345577
7:00:00	81.02155402	0.000114286	8.499708
8:00:00	82.29427456	0.0001	8.633225
9:00:00	83.41691227	8.88889E-05	8.750998
10:00:00	84.42114592	0.00008	8.856348
11:00:00	85.3295994	7.27273E-05	8.951651
12:00:00	86.15896164	6.66667E-05	9.038657
13:00:00	86.92190094	6.15385E-05	9.118695
14:00:00	87.6282724	5.71429E-05	9.192798
15:00:00	88.28589356	5.33333E-05	9.261787
16:00:00	88.90106381	0.00005	9.326322
17:00:00	89.47892743	4.70588E-05	9.386944
18:00:00	90.02375174	4.44444E-05	9.4441
19:00:00	90.53911133	4.21053E-05	9.498164

20:00:00 91.02803031 0.00004 9.549455
21:00:00 91.49309351 3.80952E-05 9.598244
22:00:00 91.93652032 3.63636E-05 9.644762
23:00:00 92.36023262 3.47826E-05 9.689212
24:00:00 92.76590905 3.33333E-05 9.73177