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Eastern Region

Rebuttal Report on Expert Witness Reports Submitted by Hydro Logic Inc (Ed Squires), and Bill Bonnicksen, and DuWayne Kimball relative to Water Right Transfers 79357, 79380, 79384, and 79466

Prepared for:

Cedar Ridge Dairy
Filer, Idaho

March 6, 2015

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Brockway Engineering, PLLC
March 6, 2015

A. INTRODUCTION

A.1. Objectives

This report addresses the allegations and arguments presented by the various Protestants to the applications for water right transfers by Cedar Ridge Dairy for portions of ground water right 47-7106 to dairy sites and an irrigation well. Water right 47-7106 is located on the Mule Creek Ranch just north of Jackpot, Nevada. Three water rights transfers have been approved by IDWR for moving parts of water right 47-7106 to areas near Buhl, Idaho and Hollister, Idaho. Figure 1 shows the location of the points of diversion for the three approved transfers from water right 47-7106 and the proposed location of the points of diversion for the water right transfer in these proceedings (Transfers 79380, 79357, 79466 and 79384).

A.2. Report Organization

This report presents the response to the comments and concerns expressed by the various experts retained by the Protestants in three separate sections according to the name of the expert witnesses. Each expert witness commented on various topics which are addressed in total under each separate section.

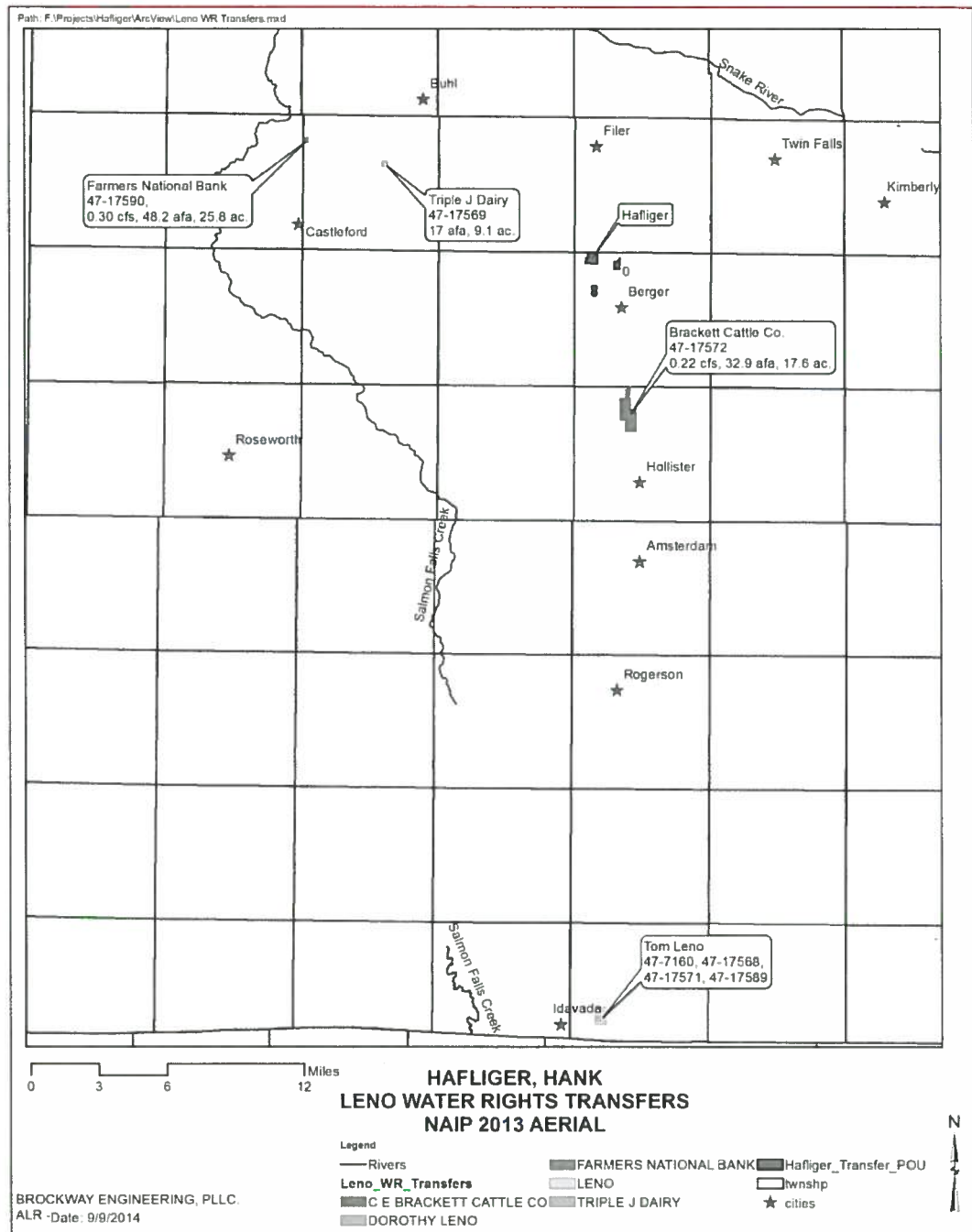


Figure 1: Map Identifying Previous Approved Transfer Locations and Currently Proposed Transfer Locations.

B. Ed Squires

Mr. Ed Squires, Professional Geologist, presented a report relative to Thomas Leno and Four Sisters Dairies Proposed Water Right Transfers which provided a review of available hydrologic reports for the area, local area Well Driller's Reports, a Power Point presentation by Brockway Engineering the "New Irrigation Well" pumping test by Brockway Eng., and the proposed Transfers. Mr. Squires did not submit any opinions on transfer no. 79466 and it is difficult to determine whether his report is specific only to transfer no. 79384 or is addressed to transfer nos. 79357 and 79380 as well.

Mr. Squires commented on the pumping test of the new well and presented a plethora of opinions relating to the pumping test protocol and procedure. Specifically, he opined that the well test was deficient in the amount of water level data obtained, the pre-test water level trends were not measured in the aquifer, the post- test water level recovery measurements were made for only 9 minutes, the discharge was not held constant, no digital data-logger instruments were used, water level data was not plotted or analyzed, no hydrogeological analysis was presented, well discharge was to a depression less than 75 feet away from the well, and no information was presented on the well itself.

First of all, Mr. Squires makes an initial erroneous assumption as to the purpose of the test of the well. Mr. Squires, in his capacity as consulting geologist for municipal providers may have assumed that the well test was performed to obtain data to estimate aquifer characteristics for the purpose of predicting impacts to nearby water levels in existing wells or to design pumping equipment for the new discharge, or to evaluate specific responses like delayed yield or document long-term recovery response.

In fact, the short term pumping test objective was simply to determine the approximate yield of the well utilizing the available pumping equipment and available access to adjacent wells and information. This pumping test was not designed to determine aquifer characteristics, although it did provide some approximate data; nor was it designed to determine impacts to adjacent wells. The pump test utilized a 40 hp pump and motor because that was the largest pump available locally that would fit in the well bore and time to determine the yield of the existing well was limited. A larger pump could have been used to obtain yield data for discharges nearer the proposed flow rates but a larger pump was not available.

A data logger was not deemed necessary since the objective of the test was only to determine ultimate yield of the well. If the goal was to explore the time/drawdown relationships as Mr. Squires ultimately did (Figure 1, Hydro Logic report) then use of a data logger would have been justified.

Mr. Squires is critical of the test because only one pre-test water level measurement was cited in the Brockway report at 33 minutes prior to the commencement of pumping. Mr. Squires is again applying his expected criteria for a municipal well pump test or a pump test for a long term aquifer evaluation. It is highly unlikely that any significant rising or declining trends in the regional aquifer would have been evident in the period 33 minutes before the pump was started or that any effects due to pumping of domestic wells would have been discernable in 33 minutes.

Again, the criteria for a pumping test or a "quality –controlled pumping test" as Mr. Squires advocates, could require many of the more definitive water measurement and analytical techniques which Mr. Squires proposes. However, our experience with evaluation of irrigation or dairy wells do not require and do

not warrant the more elaborate and expensive analyses which Mr. Squires advocates.

Mr. Squires refers repeatedly to the Power Point presentation that was prepared and presented to the Protestants at an information meeting on October 9 and 22, 2014. This preliminary presentation was prepared for the interested neighbors and Protestants to explain the need for and the concept of the proposed transfer and not to explain or elaborate on the techniques or analysis of the pump test performance or data. Apparently, the only information which Mr. Squires is utilizing in his critique of the water right transfer and pump test is the Power Point presentation and some answers to interrogatories provided by the Applicants. Neither Mr. Squires nor his clients have provided any background data so it is difficult to determine what exactly was reviewed and relied upon for his report.

Mr. Squires states that 'Other than the conclusions by Brockway Engineering on the Power Point slide, that the water level "90% of the drawdown recovered within 8 minutes", and that "The pumping water level remained constant after pumping for over eight hours"(response to protestant's interrogatory No 16), there is no scientific analysis, plotting, interpretation, or conclusions presented.". It is premature for Mr. Squires to critique the proposed transfer analysis based only on his apparent review of answers to interrogatories and a preliminary Power Point presentation intended for lay persons only last fall.

It is inferred by Mr. Squires that the priority of the water right proposed for transfer, 47-17589 would likely need to be changed in some way to mitigate for impacts to existing wells at the new location (Paragraph 3, ii, page 6, Hydro Logic). Our experience is contrary to this assertion. In fact, the three water right transfers from this same water right approved by IDWR to be moved to areas in the same general vicinity have not resulted in any required changes in priority

(Figure 1). There is no reason to assume that approval of Transfer 79384 will require a change in water right priority.

Mr. Squires' conclusions (Paragraph 4a, page 7, Hydro Logic) on the pumping test of the irrigation well are all premature and based upon his incorrect assumption of the objective of the pump test. His suggestion that the Transfers should not be approved "until such time that a responsible and well-planned aquifer test can be designed and conducted using area domestic wells as monitoring wells (including the wells of the nearby Protestants) for the production wells(s) proposed by the transfer at the proposed pumping rates in the transfer" (Paragraph 4, a, iv, page 7, Hydro Logic) is not warranted. This kind of analysis was not required for previous transfers to the same general area and is required by IDWR for wells using water for irrigation and/or stockwater and commercial water uses.

Further, the assertion that "the numerical model presented by Brockway Engineering is 1) not applicable to the known subsurface conditions and should not be relied upon for such purposes, and 2) should not be used to predict future aquifer conditions, and 3) is meaningless and useless for that purpose" is not persuasive because it represents an opinion based on a review of incomplete information and lack of understanding and requirements of IDWR for water right transfer evaluations.

Mr. Squires further concludes that the Transfers should not be allowed unless: 1) the associated water rights are designated with subordinate (junior) priority dates compared to the neighboring domestic water rights, 2) a long term monitoring program is in place at least six months prior to commencement of proposed new pumping, and 3) a pumping test of several days including water level measurements in surrounding domestic wells, pre-test, drawdown, and recovery periods, 4) including input from the Protestants and approval from IDWR, and 5)

a long-term ground water level monitoring plan to be reviewed by the Protestants and the IDWR.” These recommendations represent a ‘wish list’ which are above and beyond the IDWR normal requirements for approval of this transfer or for other transfers and should not be adopted by IDWR in these proceedings. Mr. Squires also proposed that IDWR be requested to delay action on the proposed Transfers and develop conditions of approval for any approved transfer protecting Protestant’s point of diversion priority dates. Again, even though IDWR has discretion in attaching conditions to transfer approval, these recommendations are not standard conditions and should not be considered by IDWR.

General recommendations offered by Mr. Squires do not address the statutory criteria regarding transfer approval and provide no opinion on whether or not the four transfers meet those criteria.

C. Bill Bonnichsen, Ph.D.

C.1. The Geologic Situation Near Berger, Idaho

No quantitative values or data were provided in the February 11, 2015 report “The Geologic Situation Near Berger, Idaho relating to impact of Transfers 79380, 79357, 79466 and 79384” on the local aquifer. It is difficult to make plans or managerial decisions without quantitative values and impacts. General claims to injury cannot be substantiated without data or numeric impact values.

The general synopsis of the description of the geologic framework in the Berger, Idaho area appears to be accurate.

There was no data supporting the claim that there is no subterranean aquifer connection between Jackpot, Nevada and Berger, Idaho. Only general opinions regarding the geologic structures between Jackpot, Nevada and Berger, Idaho

are provided. No hydraulic or aquifer characteristics data was provided to support Bonnichsen's opinion.

In contrast, Crosthwaite, 1969, indicated that basalt flows overlie Idavada Volcanics which is composed of silicic tuff, ash, clay, silt, sand and gravel. Alluvial and windblown deposits cover the majority of the study area. The upper basin or watershed is located in Nevada and consists of several drainages from mountain ranges. The natural discharge direction of the ground water flow is northward through the Salmon Falls Creek Reservoir and continues northward through the Rogerson, Hollister and Berger areas into the Twin Falls tract and the Snake River. A small amount of aquifer water is discharged into Salmon Falls Creek.

A USGS study of the Salmon Falls Area by Fowler, 1960, states that the geology of the area consists of volcanic and sedimentary strata of various types which range from nearly impermeable to moderately permeable. Wells in the area have drilled through Snake River Basalt and into sedimentary strata. It is this sedimentary strata that provides water to domestic, stock and smaller irrigation wells.

It is evident that there is sufficient ground water in the area of the town Jackpot, Nevada and Rogerson, Idaho. The populous of Jackpot and Rogerson are dependent upon ground water wells to provide for domestic water needs. There are also multiple ground water irrigation water rights in the area of Jackpot, Rogerson and Hollister that obtain water from the local underground aquifer. The ground water aquifer is being supplied water from local water shed basins in Nevada and Idaho.

Based on the published reports and the data that is available, we believe that ground water flows north out of Nevada and into southern Idaho. The ground

water flows northward past Rogerson and Hollister to provide ground water to the Castleford, Buhl and Filer areas. This ground water aquifer provides adequate water for the towns of Rogerson and Hollister as well as many domestic residences. The ground water aquifer is able to provide sufficient water to the existing water rights recognized by the Idaho Department of Water Resources.

D. DuWayne Kimball

D.1. Water Budget

The Cosgrove report provided both an overview of the aquifer characteristics and water use as well as a ground water model of the Twin Falls tract. Mr. Kimball cites this report (Development of a Transient Ground-Water Model for the Twin Falls Area, Idaho, Cosgrove 1997). Cosgrove left out the Salmon Falls inflow of 5,800 acre-feet because the Salmon Falls Creek Canyon was the boundary of the study area. The 5,800 acre feet was not included in the analysis but was only referenced. Therefore, there was no addition error made by Cosgrove as claimed in the Budget Report prepared by Kimball.

We agree with Kimball's statement that, "the 1997 report appears to make a logical assumptions from the data that is available and is a good starting point for a water budget."

Kimball hypothesized regarding two simulation scenarios in the report which no irrigation occurred and with 100% high efficiency sprinkler conversion. These scenarios are general overview scenarios that do not specifically apply to Transfers 79380, 79357, 79466 and 79384.

The scenarios analyzed in the Cosgrove 1997 report were performed on behalf of the Twin Falls City Council who funded the work performed by Cosgrove. The City Council of Twin Falls was trying to analyze possible new municipal well

locations south of the Twin Falls airport. The scenarios analyzed were not meant to represent any expected future water use or non-use. The scenarios were simply hypothetical situations that postulated a 30% sprinkler conversion from surface irrigation over the next 30 years. Cosgrove did not postulate on a no irrigation scenario.

The 1998 Cosgrove transient state model report, shows an output from output cell 41, 11 (near Berger, Idaho) that showed annual amplitude of fluctuation in the aquifer of approximately 5 feet. The USGS monitoring wells corroborate with the simulated model results by recording a 5 foot annual fluctuation in the two USGS monitoring wells.

The 1998 Cosgrove transient state model report indicated that current conditions in the aquifer show no trend in water levels in a 10 year period. Meaning that the aquifer is stable.

There were four transient model scenarios run for analysis by Cosgrove as outlined in the 1998 report. The first scenario was the Current Basin Conditions Scenario, which was run for comparison with the other three scenarios. The basin is considered to be in equilibrium and only seasonal water fluctuations affect the water levels.

The second scenario was the 30% Sprinkler Scenario which represents a 30% tract-wide conversion to sprinkler irrigation. At the time of the study, irrigation in the tract was 90% surface irrigation and 10% sprinkler irrigation. With this scenario, less water is applied for irrigation purposes because sprinkler irrigation is more efficient than furrow irrigation. Therefore, less seepage water will enter the ground water aquifer. The simulated impact of this scenario was an approximate drop in water levels from Buhl to Castleford of 34 feet.

The third scenario was a 30 cfs Recharge Scenario which incorporated three 10 cfs recharge wells along the High Line Canal. The three hypothetical recharge wells were located in close proximity of the intersection of the High Line Canal and Washington Street in Twin Falls, Idaho. The theoretical wells were operated from April 1 to October 1 annually. The proposed recharge had a predicted impact of approximately 6 feet but the impact diminished rapidly with distance away from the three recharge wells.

The fourth scenario was a 30 cfs Recharge Superimposed on 30% Sprinkler Scenario. This scenario indicated that water levels basin wide would continue to drop and there would be a local benefit to recharge from the three hypothetical recharge wells. The small positive affect of the 30 cfs recharge is overshadowed by the over all decline in surface irrigation.

The 1997 Cosgrove report (page 65) states: "The steady state model does not allow changes to scenario conditions during the running of the model. The model is run until the basin reaches equilibrium, so the conditions are essentially applied for an infinite length of time. Model results represent an 'extreme case' since the stresses have been applied for infinite length of time and the resulting changes represent an upper limit to expected responses."

The 1997 and 1998 Cosgrove reports contain no analysis of a scenario in which 100% conversion occurs from surface irrigation to sprinkler. It is not accurate to assume that the model results can be linearly altered to represent a 100% conversion of surface irrigation to sprinkler irrigation.

The statements and conclusions provided by Cosgrove, modified and then restated by Kimball do not reflect actual or estimated impacts that Transfers 79380, 79357, 79466 and 79384 will have on any of the Protestants domestic wells or the local aquifer in general.

A review of the data provided by the USGS monitoring wells, that are in vicinity of the dairies, indicate that the groundwater aquifer in the area of Transfers 79380, 79357, 79466 and 79384 is stable. There is no statistical trending of increased or decreased water levels occurring in the aquifer at this time.

D.2. Groundwater Flow Direction for Originating Point of Diversion in Township 16S, Range 16E, Section 20.

The two wells in the Mule Creek drainage identified by Kimball are located on property previously owned by the Applicant Thomas Leno (Figure 2). The south well identified by Kimball is actually located approximately one mile north of the location identified in Kimball's report. This well is the irrigation well utilized for irrigation from parent water right 47-7106. The north well identified by Kimball is actually a domestic well for a house located on the Leno property. The house is currently abandoned. Well logs for the two wells is provided in Appendix A.

The irrigation well is located approximately $\frac{3}{4}$ of a mile north west of the domestic well. The GPS elevations and coordinates for the irrigation and the domestic well

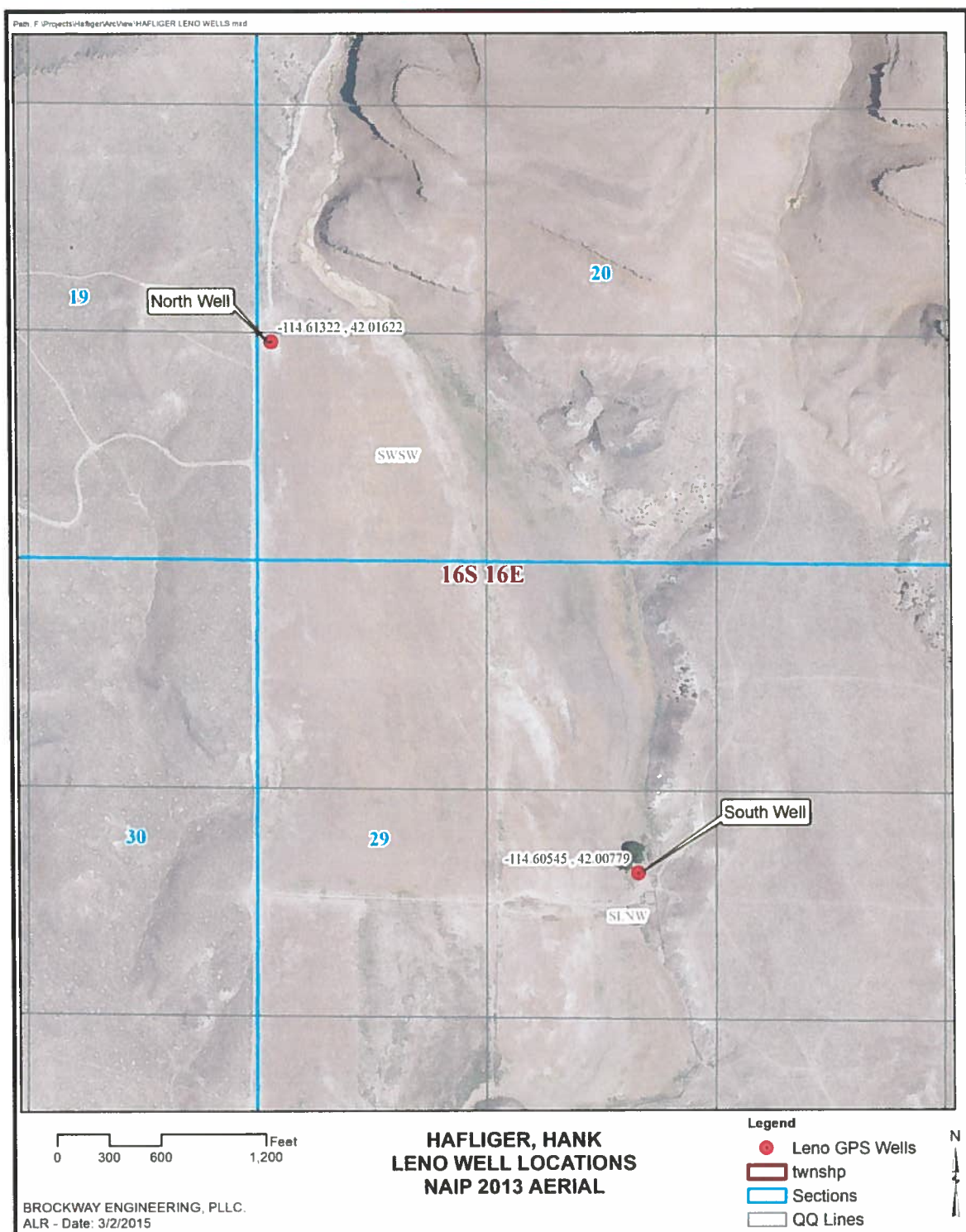


Figure 2: Well Locations on the Leno Ranch

have been obtained. The ground surface elevation at the irrigation well is 5,701 feet and the ground surface elevation for the domestic well is 5,583 feet. The static water level in the irrigation well is 77 feet below the ground surface based on the well drillers log. The static water level in the domestic well is 18 feet below the ground surface based on the well driller's log. A diagram of the relationship of the ground surface elevation and the static water level in each well (based on the well drillers reports) is provided in Appendix A. Photographs of the irrigation well and domestic well are included in Appendix A.

There is no evidence provided by the well driller's log that indicates that either of these two wells are artesian wells. The well driller's logs do not indicate at what depth water was first encountered during drilling. The well driller's logs do indicate at what depth the water bearing zones were encountered. The well driller's also recorded the recorded static water level of the well.

A site visit February 28, 2015 confirmed the wells locations and that the wells are not flowing artesian wells.

An artesian or pressure aquifer occurs where groundwater is confined under pressure greater than atmospheric by overlying relatively impermeable strata. When a well penetrates such an aquifer, the water level will rise above the bottom of the confining bed, Ground Water Hydrology 2nd Edition, Todd 1980.

It is agreed that in general, the groundwater will flow in the same direction as the land surface gradient.

References

- Crosthwaite, E.G., 1969
Water Resource of the Salmon Falls Creek Basin Idaho-Nevada.
Contributions to the hydrology of the United States. Geological Survey
Water-Supply Paper 1879-D. U.S. Department of the Interior
- Fowler, K.H, 1960
Preliminary Report on Ground Water in the Salmon Falls Area, Twin Falls
County, Idaho. Geological Survey Circular 436
- Todd, D.K, 1980
Groundwater Hydrology, Second Edition

Appendix

Appendix A: Ground Water Well Logs

USE TYPEWRITER OR
BALL POINT PEN

State of Idaho
Department of Water Administration

WELL DRILLER'S REPORT

State law requires that this report be filed with the State Registration Engineer
within 30 days after completion or abandonment of the well.

RECEIVED

1. WELL OWNER Name <u>Tam Leno</u> Address <u>2225 Castberry Lane</u> <u>Los Vegas, Nevada</u> Owner's Permit No. _____		7. WATER LEVEL Static water level <u>77</u> feet below land surface Flowing? ☐ Yes ☒ No G.P.M. flow _____ Temperature <u>68</u> ° 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 ☐ Sailer ☐ Other _____ <table border="1"> <tr> <th>Discharge G.P.M.</th> <th>Draw Down</th> <th>Hours Pumped</th> </tr> <tr> <td><u>60</u></td> <td><u>5'</u></td> <td><u>2</u></td> </tr> </table>		Discharge G.P.M.	Draw Down	Hours Pumped	<u>60</u>	<u>5'</u>	<u>2</u>																																																																																																																																																																																																																																														
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LITHOLOGIC LOG <u>046197</u> <table border="1"> <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>8</td><td>0</td><td>14</td><td>Rock, hard pan + tan clay</td><td></td><td>X</td></tr> <tr><td></td><td>14</td><td>58</td><td>Tan clay + rock chips</td><td></td><td>X</td></tr> <tr><td></td><td>58</td><td>77</td><td>Brown sandy clay</td><td></td><td>X</td></tr> <tr><td></td><td>77</td><td>148</td><td>Grey sand stone</td><td>X</td><td></td></tr> <tr><td></td><td>148</td><td>156</td><td>Brown sand stone</td><td></td><td>X</td></tr> <tr><td></td><td>156</td><td>233</td><td>Brown sandy clay + shale</td><td></td><td>X</td></tr> <tr><td></td><td>233</td><td>247</td><td>Grey sandy clay + shale</td><td></td><td>X</td></tr> <tr><td></td><td>247</td><td>268</td><td>Brown clay</td><td></td><td>X</td></tr> <tr><td></td><td>268</td><td>278</td><td>Grey sand stone</td><td></td><td>X</td></tr> <tr><td></td><td>278</td><td>290</td><td>Brown sandy clay</td><td></td><td>X</td></tr> <tr><td></td><td>290</td><td>302</td><td>Grey sand stone</td><td></td><td>X</td></tr> <tr><td></td><td>302</td><td>326</td><td>Brown clay</td><td></td><td>X</td></tr> <tr><td></td><td>326</td><td>351</td><td>Grey sand stone</td><td></td><td>X</td></tr> <tr><td></td><td>351</td><td>354</td><td>Brown sand stone + clay</td><td></td><td>X</td></tr> <tr><td></td><td>354</td><td>423</td><td>light grey clay</td><td></td><td>X</td></tr> <tr><td></td><td>423</td><td>443</td><td>Grey sand stone</td><td></td><td>X</td></tr> <tr><td></td><td>443</td><td>477</td><td>Brown sandy clay + layers of sand</td><td></td><td>X</td></tr> <tr><td></td><td>477</td><td>482</td><td>Consolidated rock chert</td><td></td><td>X</td></tr> <tr><td></td><td>482</td><td>554</td><td>light grey shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>554</td><td>567</td><td>Brown limestone</td><td></td><td>X</td></tr> <tr><td></td><td>567</td><td>575</td><td>yellow shale</td><td></td><td>X</td></tr> <tr><td></td><td>575</td><td>583</td><td>light grey shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>583</td><td>589</td><td>Rock</td><td></td><td>X</td></tr> <tr><td></td><td>589</td><td>604</td><td>Tan shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>604</td><td>608</td><td>Rock</td><td></td><td>X</td></tr> <tr><td></td><td>608</td><td>621</td><td>light grey shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>621</td><td>718</td><td>Dark grey shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>718</td><td>758</td><td>light grey shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>758</td><td>760</td><td>Black rock</td><td></td><td>X</td></tr> <tr><td></td><td>760</td><td>781</td><td>light grey shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>781</td><td>809</td><td>light grey shale</td><td></td><td>X</td></tr> <tr><td></td><td>809</td><td>863</td><td>Dark grey shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>863</td><td>870</td><td>Dark grey sandy clay</td><td></td><td>X</td></tr> <tr><td></td><td>870</td><td>943</td><td>Dark grey clay + shale</td><td></td><td>X</td></tr> <tr><td></td><td>943</td><td>985</td><td>light grey shale (sticky)</td><td></td><td>X</td></tr> <tr><td></td><td>985</td><td>994</td><td>Grey shale + black rock chips</td><td></td><td>X</td></tr> <tr><td></td><td></td><td></td><td>green tuff (candy)</td><td></td><td>X</td></tr> <tr><td></td><td>994</td><td>1021</td><td>Black wharite</td><td></td><td>X</td></tr> <tr><td></td><td>1021</td><td>1080</td><td>Black wharite + green tuff + layers of fine grey clay</td><td></td><td>X</td></tr> </tbody> </table>		Hole Diam.	Depth		Material	Water		From	To	Yes	No	8	0	14	Rock, hard pan + tan clay		X		14	58	Tan clay + rock chips		X		58	77	Brown sandy clay		X		77	148	Grey sand stone	X			148	156	Brown sand stone		X		156	233	Brown sandy clay + shale		X		233	247	Grey sandy clay + shale		X		247	268	Brown clay		X		268	278	Grey sand stone		X		278	290	Brown sandy clay		X		290	302	Grey sand stone		X		302	326	Brown clay		X		326	351	Grey sand stone		X		351	354	Brown sand stone + clay		X		354	423	light grey clay		X		423	443	Grey sand stone		X		443	477	Brown sandy clay + layers of sand		X		477	482	Consolidated rock chert		X		482	554	light grey shale (sticky)		X		554	567	Brown limestone		X		567	575	yellow shale		X		575	583	light grey shale (sticky)		X		583	589	Rock		X		589	604	Tan shale (sticky)		X		604	608	Rock		X		608	621	light grey shale (sticky)		X		621	718	Dark grey shale (sticky)		X		718	758	light grey shale (sticky)		X		758	760	Black rock		X		760	781	light grey shale (sticky)		X		781	809	light grey shale		X		809	863	Dark grey shale (sticky)		X		863	870	Dark grey sandy clay		X		870	943	Dark grey clay + shale		X		943	985	light grey shale (sticky)		X		985	994	Grey shale + black rock chips		X				green tuff (candy)		X		994	1021	Black wharite		X		1021	1080	Black wharite + green tuff + layers of fine grey clay		X
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	156	233	Brown sandy clay + shale		X																																																																																																																																																																																																																																																		
	233	247	Grey sandy clay + shale		X																																																																																																																																																																																																																																																		
	247	268	Brown clay		X																																																																																																																																																																																																																																																		
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	326	351	Grey sand stone		X																																																																																																																																																																																																																																																		
	351	354	Brown sand stone + clay		X																																																																																																																																																																																																																																																		
	354	423	light grey clay		X																																																																																																																																																																																																																																																		
	423	443	Grey sand stone		X																																																																																																																																																																																																																																																		
	443	477	Brown sandy clay + layers of sand		X																																																																																																																																																																																																																																																		
	477	482	Consolidated rock chert		X																																																																																																																																																																																																																																																		
	482	554	light grey shale (sticky)		X																																																																																																																																																																																																																																																		
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	567	575	yellow shale		X																																																																																																																																																																																																																																																		
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	758	760	Black rock		X																																																																																																																																																																																																																																																		
	760	781	light grey shale (sticky)		X																																																																																																																																																																																																																																																		
	781	809	light grey shale		X																																																																																																																																																																																																																																																		
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	943	985	light grey shale (sticky)		X																																																																																																																																																																																																																																																		
	985	994	Grey shale + black rock chips		X																																																																																																																																																																																																																																																		
			green tuff (candy)		X																																																																																																																																																																																																																																																		
	994	1021	Black wharite		X																																																																																																																																																																																																																																																		
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6. LOCATION OF WELL Sketch map location must agree with written location.  County <u>Twin Falls</u> <u>NW 1/4 Sec. 32, T. 16 N., R. 16 E.</u>		10. DRILLER'S CERTIFICATION This well was drilled under my supervision and this report is true to the best of my knowledge. <u>Boley & Henry</u> <u>86</u> Driller's or Firm's Name Number <u>Murtavus, Idaho</u> Address <u>Blaine Boley</u> Signed By Date																																																																																																																																																																																																																																																					

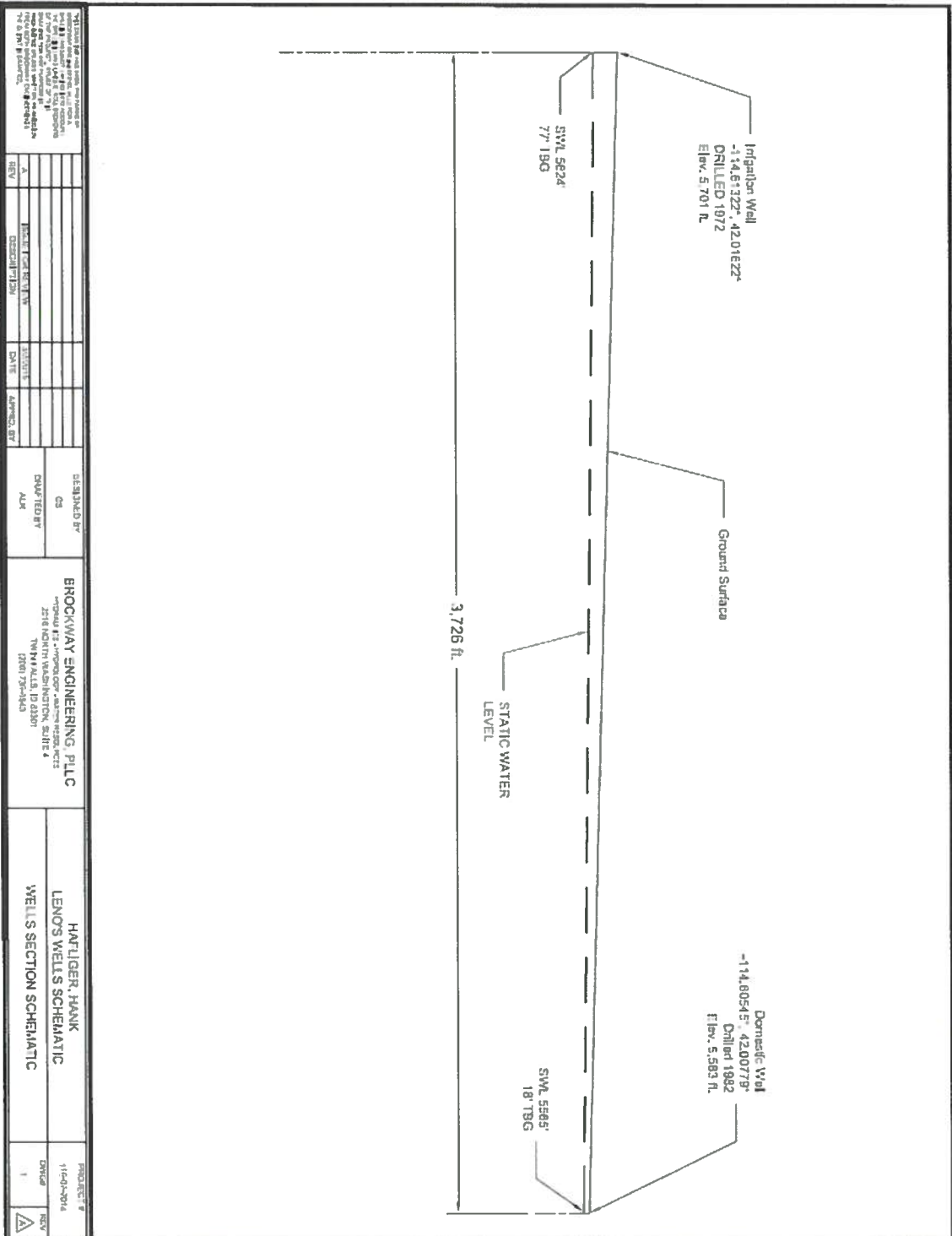
USE ADDITIONAL SHEETS IF NECESSARY

FORWARD THE WHITE, BLUE, AND PINK COPIES TO THE DEPARTMENT

Form 238-7
1/78STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORTState law requires that this report be filed with the Director, Department of Water Resources
within 30 days after the completion or abandonment of the wellUSE TYPEWRITER OR
BALLPOINT PEN**RECEIVED**

JUN 18 1982

1. WELL OWNER Name <u>TOH LENO</u> Address <u>BOX 162 WELLS, NEV 89835</u> Owner's Permit No. _____		7. WATER LEVEL Static water level <u>18</u> feet below land surface Flowing? ☐ Yes ☒ No G.P.M. flow _____ Artesian closed-in pressure _____ p.s.i. Controlled by: ☐ Valve ☐ Cap ☐ Plug Temperature _____ °F. Quality _____																																	
2. NATURE OF WORK ☒ New well ☐ Deepened ☐ Replacement ☐ Abandoned (describe method of abandoning) _____		8. WELL TEST DATA ☐ Pump ☒ Bailor ☐ Air ☐ Other _____																																	
3. PROPOSED USE ☒ Domestic ☐ Irrigation ☐ Test ☐ Municipal ☐ Industrial ☐ Stock ☐ Waste disposal or injection ☐ Other _____ (specify type)		9. LITHOLOGIC LOG <u>079466</u> <table border="1"> <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>2 1/2"</td> <td>0</td> <td>73</td> <td>BRN SANDY CLAY</td> <td></td> <td>X</td> </tr> <tr> <td>6"</td> <td>73</td> <td>102</td> <td>GRAVEL & BRN SAND</td> <td></td> <td>X</td> </tr> <tr> <td>6"</td> <td>102</td> <td>175</td> <td>BRN SANDSTONE w/ INTERMITTENT LAYERS OF BRN SANDY CLAY</td> <td></td> <td>X</td> </tr> </tbody> </table>		Hole Diam.	Depth		Material	Water		From	To	Yes	No	2 1/2"	0	73	BRN SANDY CLAY		X	6"	73	102	GRAVEL & BRN SAND		X	6"	102	175	BRN SANDSTONE w/ INTERMITTENT LAYERS OF BRN SANDY CLAY		X				
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4. METHOD DRILLED ☐ Rotary ☐ Air ☐ Hydraulic ☐ Reverse rotary ☒ Cable ☐ Dug ☐ Other _____		10. Work started <u>14 JUNE 82</u> finished <u>24 JUNE 82</u>																																	
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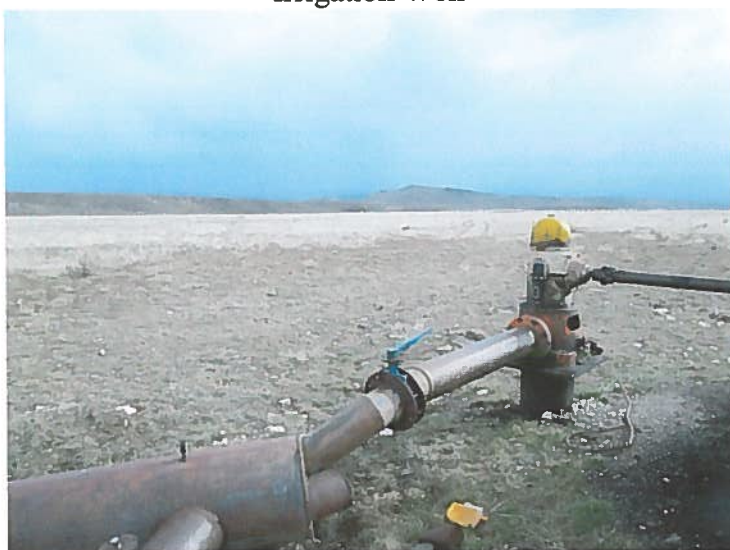


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DESIGNED BY	CS	CHARTERED BY	ALM
DATE		DATE	
APPROVED BY		DATE	
BROCKWAY ENGINEERING, PLLC 2718 NORTH WASHINGTON, SUITE 4 TWIN FALLS, ID 83401 (208) 735-1943			
HATJIGER, HANK LENOX WELLS SCHEMATIC WELLS SECTION SCHEMATIC			
PROJECT #	11C-01-2014	DATE	1
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Domestic Well



Irrigation Well



Appendix B: David K. Todd

Groundwater Hydrology

SECOND EDITION

David Keith Todd

Clay. Clay and coarser materials mixed with clay are generally porous, but their pores are so small that they may be regarded as relatively impermeable. Clayey soils can provide small domestic water supplies from shallow, large-diameter wells.

Types of Aquifers

Most aquifers are of large areal extent and may be visualized as underground storage reservoirs. Water enters a reservoir from natural or artificial recharge; it flows out under the action of gravity or is extracted by wells. Ordinarily, the annual volume of water removed or replaced represents only a small fraction of the total storage capacity. Aquifers may be classed as unconfined or confined, depending on the presence or absence of a water table while a leaky aquifer represents a combination of the two types.

Unconfined Aquifer. An unconfined aquifer is one in which a water table varies in undulating form and in slope, depending on areas of recharge and discharge, pumpage from wells, and permeability. Rises and falls in the water table correspond to changes in the volume of water in storage within an aquifer. Figure 2.5 is an idealized section through an unconfined aquifer; the upper aquifer in Fig. 2.11 is also unconfined. Contour maps and profiles of the water table can be prepared from elevations of water in wells that

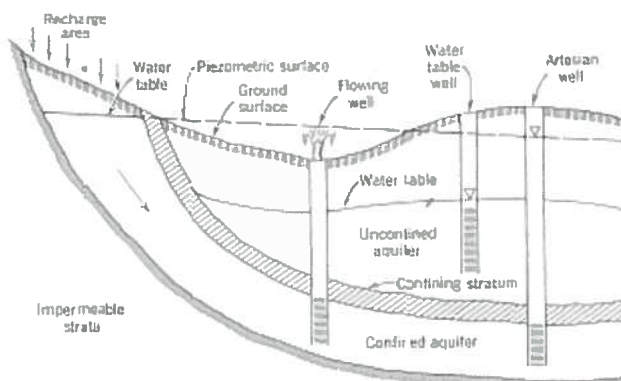


Fig. 2.11 Schematic cross section illustrating unconfined and confined aquifers.

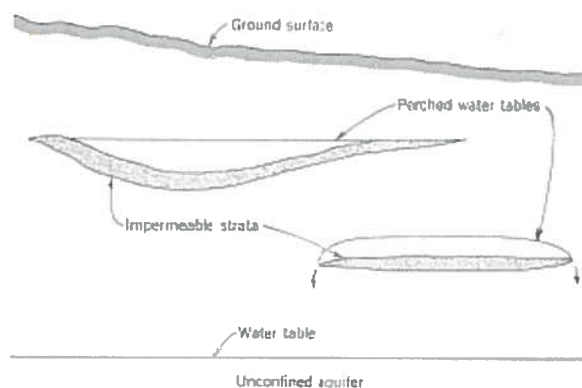


Fig. 2.12 Sketch of perched water tables.

tap the aquifer to determine the quantities of water available and their distribution and movement.

A special case of an unconfined aquifer involves perched water bodies, as illustrated by Fig. 2.12. This occurs wherever a groundwater body is separated from the main groundwater by a relatively impermeable stratum of small areal extent and by the zone of aeration above the main body of groundwater. Clay lenses in sedimentary deposits often have shallow perched water bodies overlying them. Wells tapping these sources yield only temporary or small quantities of water.

Confined Aquifers. Confined aquifers, also known as *artesian*^{*}, or pressure aquifers, occur where groundwater is confined under pressure greater than atmospheric by overlying relatively impermeable strata. In a well penetrating such an aquifer, the water level will rise above the bottom of the confining bed, as shown by the artesian and flowing wells of Fig. 2.11. Water enters a confined aquifer in an area where the confining bed rises to the surface; where the confining bed ends underground, the aquifer becomes uncon-

^{*}The word *artesian* has an interesting origin. It is derived from the French *artésien*, meaning "of or pertaining to Artois," the northernmost province of France. Here the first deep wells to tap confined aquifers were drilled and investigated, from about 1750. Originally the term referred to a well with freely flowing water, but at present it is applied to any well penetrating a confined aquifer or simply the aquifer itself.