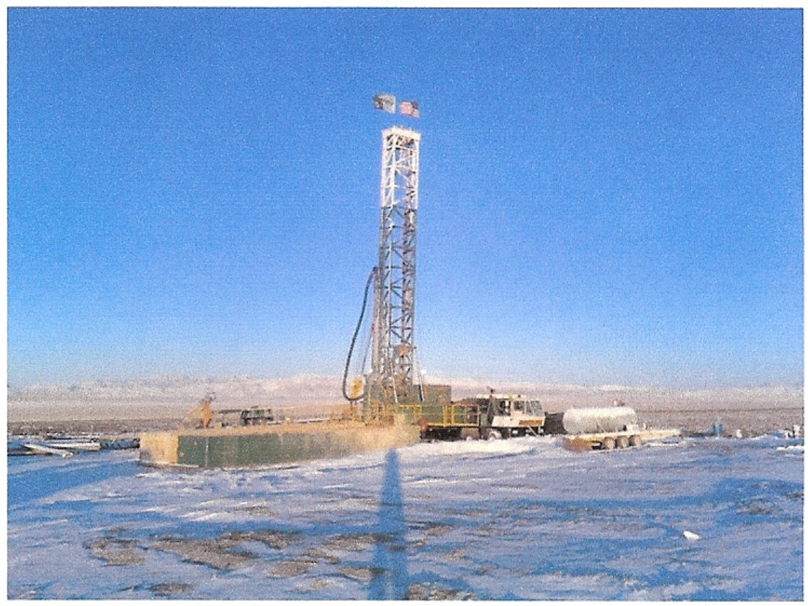
Report

Well PW-1 Completion and Testing

Dry Lake Valley, Lincoln County, Nevada



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September 2010
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Introduction

This report documents the drilling, construction, aquifer testing and water quality sampling of Production Well No. 1 (PW-1) drilled for Lincoln County Water District, Lincoln County, Nevada and Vidler Water Company, Carson City, Nevada (Lincoln/Vidler) in Dry Lake Valley in central Lincoln County, Nevada. The well is located in Section 5, Township 1 South, Range 65 East (Mount Diablo Baseline and Meridian) on Vidler Water Company's Ely Springs Ranch as shown on Figure 1. Well PW-1 was installed to provide water for a pressurized irrigation system to be installed on this property.

Layne Christensen Company (Layne), Fontana, California (Nevada Contractor's License No. 0019101 and Nevada Driller's license No. 2349) was the drilling contractor. Layne filled notice of intent No. 33632 on September 8, 2009 and well PW-1 was drilled and completed between September 22, 2009 and January 15, 2010. On January 18, 2010 Layne finished installing a line-shaft turbine test pump and on January 18th and 19th the well was surged and developed with the pump. Aquifer tests at 1800 gallons per minute (gpm) and 2000 gpm were conducted between January 20th and January 27, 2010. Final well head completions were made on February 22, 2010. Field oversight was provided by Feast Geosciences, LLC, Boise, Idaho, and by Terrain Hydrologic, LLC, Boise, Idaho (subcontractor to Feast Geosciences). Geophysical logging was conducted by Southwest Exploration Services, LLC, Gilbert, Arizona. Water quality analysis was provided by Test America Laboratories, Phoenix, Arizona and isotope analysis was conducted by the Isotope Laboratory, Department of Geology, University of Arizona, Tucson, Arizona.

All depth references in this report, unless otherwise noted, refer to feet below ground surface (bgs).

Well Drilling

On September 22, 2009 a bucket auger rig was used to drill a 42-inch (nominal) diameter hole to 103 feet and Layne installed 100 feet of 32-inch diameter (0.375 inch wall thickness), steel conductor casing. The conductor casing was cemented in the borehole with approximately 28 cubic yards of cement grout. The grout was pumped down a tremie pipe and filled the annulus from bottom to top. The upper part of the borehole had eroded back during drilling and was much larger than the 42-inch nominal bit size and consequently the volume of slurry required to bring the cement to the surface was greater than the theoretical volume of the annulus.

On September 30, 2009 Layne completed setting up a Taylor Model RT 4000 drill rig, Layne Rig No. DR 30. Drilling began on October 1, 2009 with a 17 ½-inch diameter, medium tooth bit using the flooded reverse drilling method. The 17 ½-inch hole penetrated through unconsolidated alluvial materials to a depth of 660 feet where the top of competent bedrock was encountered. The tooth bit was replaced with a 17 ½-inch diameter carbide button bit and the hole was advanced to 768 feet into a hard quartzite. Due to the extremely hard formation, drilling rates were slow and Layne replaced the 17 ½-inch bit with a 14 ¾-inch bit at 768 feet. The 14 ¾-inch borehole was advanced to 1057 feet. Significant drilling mud was lost into fractures between the depths of 1025 and 1050 feet and it was not possible to maintain a full fluid filled borehole. Out of concern that the borehole from 100 to 660 feet may collapse if the drilling fluid level could not be maintained, Vidler Water Company (Vidler) authorized Layne to set an intermediate string of 24 inch diameter steel casing. Layne filled the borehole with gravel to 690 feet and placed a bentonite plug to approximately 700 feet to prevent fluid loss into the gravel. From December 2 through December 6, 2009 Layne reamed the borehole from 100 to 676 feet to a diameter of 30-inches. On December 7 Layne attempted to set the intermediate 24-inch casing however the casing became lodged at 102 feet and was pulled back out. From December 8 through December 19, 2009 Layne re-reamed the borehole and drilled the 30-inch hole an additional 4 feet to 680 feet. On December 21, 2009 the intermediate steel casing (24-inch diameter, 0.375-inch wall) was successfully installed to a depth of 680 feet. Between December 21 and December 23, 2009 approximately 45 cubic yards of cement grout were pumped through a tremie pipe filling the annulus behind the 24-inch casing, from 680 feet to the surface.

Work was suspended for the Christmas holidays and on January 8, 2010 Layne resumed drilling with a 14 ¾-inch button bit. The intermediate casing stabilized the upper part of the hole and consequently Layne was able to use native formation fluid to circulate cuttings and cool the bit for the remainder of the drilling. The borehole reached a final depth of 1881 feet on January 14, 2010 without any additional significant problems.

Layne took deviation surveys on roughly 100 foot intervals as the borehole was advanced. These surveys indicate the borehole was essentially plumb (< ½ degree off) until approximately 1000 feet then began to deviate off of plumb. At 1300 feet the borehole was 2° off plumb and by approximately 1500 feet and extending to the bottom of the hole, Layne's deviation surveys indicated the borehole was >3° off plumb (the maximum scale on Layne's deviation tool).

Table 1 provides a summarized daily log covering the drilling, completion and testing of well PW-1. Appendix A contains the Daily Drilling Reports provided by Layne during the drilling.

Geophysical Logging

The open borehole was geophysically logged on two separate occasions. In anticipation of having to set an intermediate string of casing, the open borehole was logged to a depth 756 feet on October 27, 2009. After the borehole reached total depth of 1881 feet on January 16, 2010, a second suite of logs were recorded on January 17, 2010. The two sets of logs were combined into a single set of logs. Selected geophysical logs are shown on Figure 2 and the combined geophysical logs are provided in Appendix B.

The following geophysical logs were recorded:

- Electric resistivity (Single point, 8-inch normal, 16-inch normal and 64-inch normal)
- Spontaneous Potential (SP)
- Natural Gamma
- Fluid Resistivity
- Temperature

- Sonic Velocity
- Caliper
- Drift and Deviation

Geophysical Log Interpretation

As shown on Figure 2 and discussed in subsequent sections of this report the geophysical logs were used to identify fracture zones, and formation contacts. There were no significant temperature or fluid resistivity inflections noted on the logs. The alluvial portion of the borehole was considerably less resistive than the bedrock portion. As noted on Figure 2, the resistivity values for the alluvial portion of the hole were multiplied by a factor of 10 to better illustrate the resistivity changes within this part of the hole. The geophysical logger recorded the bottom of the borehole at a depth of 1872 feet, a difference of 9 feet from the depth reported by the drillers. This difference is not significant and is attributable to small differences in measurement tallies of the drill pipe, differences in measurement datums and hole fill.

The borehole drift report prepared by Southwest Exploration Services is also included in Appendix B. The drift report indicates the borehole drifted approximately 15 feet westward until approximately 850 feet then began to drift due east. The bottom of the borehole is approximately 31 feet to the east of the well head. The borehole was generally plumb (less than 2 degrees off and within the recommended drift for this size well) until a depth of 1320 feet. Below this depth deviation values rapidly increased and by 1550 feet the borehole drift exceeded the amount recommended by the American Water Works Association. The maximum deviations (4.1 to 4.2 degrees) were recorded at depths of 1520, 1560, 1640 and 1740 feet.

Geologic Interpretation

Geologic samples were collected from the drill cuttings every 10 feet as the borehole was advanced. These chip samples were washed and placed in chip trays. Additional raw (unwashed) samples from selected representative intervals in the alluvium and from each sample interval in the bedrock were retained in cloth sample bags.

The general geologic log for well PW-1 is shown on Figure 2 and Table 2 provides a detailed description of each of the lithologic units penetrated. The chip samples and geophysical logs were used to identify and confirm depth intervals of lithologic units. Some of the lithologic unit breaks indicated by the geophysics were indistinguishable in hand specimens and there were obvious lithologic breaks identified in the chip samples that were not reflected in the geophysics. These differences were typically within larger lithologic units and were not significant to the overall geologic interpretation.

The top of bedrock at well PW-1 is a hard, well cemented, dolomitic breccia 25 feet thick that extends from 660 to 685 feet (Figure 2 and Table 2). The breccia directly overlies a massive, sugary, vitreous, orthoquartzite 125 feet thick (685-810 feet). The quartzite has been tentatively identified as the Eureka Quartzite of Ordovician age on the basis of formation descriptions in Tschanz and Pampeyan (1970).

Using the Eureka Quartzite as a basis, and from additional descriptions in Tschanz and Pampeyan (1970), the overlying breccia appears to be a remnant of the Bristol Thrust Sheet. Underlying the vitreous quartzite is calcareous sandstone about 30 feet thick (810-840 feet) that has been tentatively assigned as the basal member of the Eureka Quartzite. Beneath the Eureka Quartzite and extending to the total depth of the well (1881 feet) is a thick, generally shaley, limestone that is believed to be the Ordivician Pogonip Group (undivided) as described by Tschantz and Pampeyan (1970). On the basis of geophysics and chip samples it was possible to differentiate several discrete limestone units within this section as shown on Figure 2 and Table 2.

The highly fractured interval between 1010 and 1030 feet is probably a major fault zone although geologic units on either side of this interval are similar. A second, discrete fractured interval from 1390 to 1410 feet marks the contact between crystalline limestone (above) and an argillaceous (clayey) limestone below and is probably also a fault zone.

Water Bearing Intervals

The first major water production zone was in fractured limestone from 1010-1030 feet. Below 1050 feet the borehole was advanced using native water and consequently additional zones of fluid loss were not observed. The quantity of water produced during drilling increased with depth from 60 to over 300 gpm. The upper limit of discharge was governed by the air pressure, air volume and airline setting and once the discharge reached approximately 300 gpm additional contributions from the formation could not be seen. Below 1410 feet both the sonic log and observations of fractures noted during drilling indicate decreasing additional water bearing potential, especially below about 1650 feet.

The major water bearing zones in well PW-1 are highly fractured intervals from about 1010 to 1030 feet and from 1140 to 1240 feet within the Pogonip Group. Numerous other fractured intervals were identified on the sonic velocity log (Appendix B) between 1150 and 1410 feet. Most of these fractures probably also contribute yield to the finished well. The significant fracture zones from the sonic log are:

680-690	960-970
730-740	1010 -1030
775-825	1060-1070
850-860	1150-1240

Numerous small fractures 1240-1410 ft.

Several discrete fractures 1500 to 1650 ft.

Numerous times during the course of drilling, water levels were measured both as "static" water levels taken before drilling resumed after joint changes and deviation surveys, and as "pumping" levels during drilling. The typical air-lift discharge during drilling was approximately 300 gpm. These water level measurements indicated a consistent static water level of about 408 feet and a pumping water level of 425 feet below ground level.

Completion

On November 20, 2009 Vidler applied to the Nevada State Engineers office for a well construction waiver to allow the well to be completed as an open hole below an anticipated final 16 inch diameter casing depth of 860 feet. The State Engineers office approved the waiver request (R-630) on December 18, 2009. The waiver request was applied for after the fractured bedrock was encountered at 1025 – 1050 feet but before the decision was made to install the 24-inch intermediate casing. Vidler approved the installation of 24 inch casing into the top of bedrock to stabilize the upper part of the hole which would allow drilling using only native formation fluid. As described previously, this was accomplished on December 23, 2009 with the final installation and cementing of the 24 inch casing from 680 feet to the surface.

When the borehole was drilled to total depth it was determined that the bedrock formations from the bottom of the intermediate casing at 680 feet to the bottom of the hole were competent. On January 25, 2010 Vidler applied to the State Engineers office to modify the waiver to allow the then current construction (24-inch casing cemented to 680 feet and open rock hole to 1881 feet). Following submittal of addition documentation of casing properties, the Nevada State Engineers office approved the waiver modification request on February 8, 2010. The final construction of well PW-1 consists of 32-inch diameter conductor casing from 0 to 100 feet, 24-inch casing from +1.5 feet to 680 feet, 17 ½-inch diameter open hole from 680 to 768 feet and 14 ¾-inch diameter open hole from 768 to 1881 feet (Figure 2).

Appendix C provides copies of the documents and correspondence between Vidler and the Nevada State Engineers Office regarding the Well Completion Waiver. Appendix C also provides the Notice of Intent, and the final Well Driller's Report completed by Layne for well PW-1.

Discharge Permits and Monitoring

The State of Nevada Division of Environmental Protection issued Vidler a Temporary Discharge Permit (No. TNEV2010324, effective dates August 11, 2009 – February 10, 2010) for the discharge of development and pumping test water from well PW-1. The permit contained requirements for control of the pumping test discharge to prevent erosion and subsequent discharge of turbid water to the waters of the State of Nevada, water quality monitoring to determine if deleterious substances were discharged to waters of the State of Nevada and to document the discharge through photographs and field notes.

Discharge from the drilling and air lift pumping was directed into steel tanks to allow solids to settle. The discharge point from the tank was lined with plastic sheeting to minimize erosion and the discharge was directed down a natural drainage west of the drill rig. This water rapidly infiltrated within approximately 800 feet of the discharge point.

The discharge from the pump surge development and pumping tests was directed to a natural drainage north of the rig. The discharge area was protected with straw bales, plastic sheeting and a corrugated steel panel to provide erosion control and energy dissipation. The pumping discharge traveled westward in the drainage approximately 1000 feet then spread out laterally into multiple slow moving, low-energy, lobate flow and wetting fronts. The maximum extent of the discharge gradually advanced westward approximately an additional 2000 feet over the testing period.

The lateral extent of the discharge from the drilling, air-lift pumping, pump surging development and the subsequent pumping tests, was located in the field each day and marked with a lath and flagging. The lath was moved each day as the discharge slowly advanced down slope from east to west during the course of the pumping. All discharge infiltrated and was contained entirely on Vidler's property. At the end of the last pumping test the maximum westerly extent of the wetting front was located and documenting photographs were taken. On March 28, 2010 Vidler submitted a Discharge Report to the Nevada Division of Environmental Protection in satisfaction of the requirements for the discharge permit. Appendix D provides the Temporary Discharge Permit and the Discharge Report submitted by Vidler.

Well Development

After the borehole reached total depth on January 14, 2010, air-lift surging was conducted for approximately 8 hours. Air-lift surging consisted of lifting water to the surface and then turning off the air and letting the column of water fall back down the well bore. After surging, the well was air-lift pumped for 3 hours to clear the well prior to geophysical logging. Field water quality parameters measured on a grab sample of the discharge at the end of air-lift pumping indicated a temperature of 23.0° C and a conductivity of 500 µS. The water was slightly cloudy and the discharge was estimated at 300-400 gpm.

On January 17, 2010 Layne Christensen installed a ten stage, vertical line shaft, turbine pump on 10-inch column to a depth of 670 feet. A portable diesel test drive engine was attached the pump drive. A 1¼- inch pvc pipe was installed with the pump to provide access for a water level probe. Discharge pipe was routed to a natural drainage approximately 60 feet north of the well head. The discharge area was protected from erosion by use of plastic sheeting. Hay bales and a panel of corrugated sheet metal were used for energy dissipation and to provide additional erosion control and sediment capture. The discharge piping included two mechanical vane type totalizing flow meters and a controlling gate valve.

From January 18th to mid-night January 19, 2010 the well was developed by pump-surging. This technique used the pump to lift a column of water to the surface then the pump was shut off letting the column of water back-flush into the well. Pump surging was much more effective than air-lift surging because it involved lifting a 10-inch column of water all the way to the surface. Periodically the well was pumped to discharge to remove the turbid water accumulating in the well. Initial pumping and surging rates were limited to 500 gpm but were progressively increased to over 2000 gpm as the well efficiency increased. During this stage of the development process short operational tests were conducted by holding the discharge constant and measuring pumping water levels to determine the maximum probable pumping rate that could be sustained for the planned 3 day constant rate pumping test. The final stage of the development consisted of a 5.4 hour constant-rate test at 1800 gpm on January 19, 2010.

Aquifer Testing

After the single rate step test water level recovery was monitored for 15 hours prior to starting the planned 3 day test. Water levels recovered quickly after the step test and were within 1 foot of the initial water levels taken during drilling, prior to development and periodically during development. The 3 day constant rate pumping test was started on January 20, 2010 at 15:15. The pumping rate was established at 1800 gpm as quickly as possible by a combination of engine speed and discharge pressure. Water levels were measured down the pvc access pipe using a Powers Well Sounder water level probe. The 3 day aquifer test was completed at 15:15 on January 23, 2010. Water level recovery measurements were taken until 15:05 on January 24, 2010. There were no significant mechanical problems with the pump and drive equipment, discharge measuring devices or with the water level measurements for either the pumping or recovery portions of the test. The well was pumped for three days (4320 minutes) and the maximum drawdown at the end of the pumping test was 205.8 feet (pumping water level of 613.7 feet below top of pvc, 609.4 feet below ground level). At the end of the recovery period water level was 410.2 feet below the top of the pvc. The specific capacity at 1800 gpm is approximately 8.8 gallons per minute per foot of drawdown, gpm/ft.

The 1800 gpm pumping rate was selected as the probable maximum rate that could be safely sustained for the 3 day test on the basis of short pre-test steps and the 5.4 hour constant rate test. After 3 days of pumping at 1800 gpm there was still approximately 60 feet water above the pump. To determine the effective maximum well yield a second, shorter, constant rate test was conducted at 2000 gpm. This test was started at 15:06 on January 24, 2010 and ran until 19:49 on January 25, 2010 (approximately 27 ½ hours). Recovery was measured until 07:20 on January 26, 2010. The drawdown at the end of the test was 231.2 feet (pumping water level of 637.1 feet below ground level). There were no equipment problems experienced during the 2000 gpm constant rate pumping test. The specific capacity at 2000 gpm is approximately 8.7 gpm/ft.

Figure 3 shows the water level before, during and after the 3 day 1800 gpm and 27 hour 2000 gpm tests. As can be seen from this graph, water levels quickly drew down to below 600 feet during both tests then gradually declined for the remainder of the tests and that water level recovery was essentially instantaneous for both pumping rates. The graph also shows that the pumping rates for both tests were held reasonably steady at approximately 1800 gpm and 2000 gpm.

At about 1 ¾ days into the 1800 gpm test the pumping rate fell due to clogging fuel filters in the drive engine. The pumping rate was quickly restored but as it was being adjusted it exceeded 1800 gpm for a short period. As shown on Figure 3 water levels quickly responded to the increased pumping rate but also quickly readjusted to the overall constant rate.

As shown on Figure 3, at 660 minutes into the 2000 gpm test the pumping rate increased by about 70 gpm. Although it appears on the curve that the pumping rate increased suddenly, the step like shape of the curve is an artifact of calculating the flow between individual totalizing flow meter readings. As can also be seen on Figure 3, prior to this pumping rate increase water level was rising. Neither the discharge valve nor engine speed was adjusted during this period consequently the pumping rate increase was probably in response to the rising water levels. Increased pumping rate with a corresponding rise in water level is typically due to an increase in well efficiency from continued development although no significant increase in turbidity was observed.

Appendix E provides the tabulated water levels, pumping rates and field observations recorded during the 3 day 1800 gpm and the 27 hour 2000 gpm constant rate pumping tests and subsequent recovery periods. Appendix E also contains copies of the Daily Pumping Test reports prepared by Layne's on-site representative during the pump surge development and aquifer tests.

Aquifer Properties

Figure 4 is a semi-log plot of the time-drawdown for the 1800 gpm test. As can be seen on Figure 4 the data form a very well defined straight line after about 20 minutes of pumping. The estimated transmissivity (T) for the aquifer based on this test is 67,900 gallons per day per foot (gpd/ft). At about time(t) = 2500 minutes water levels suddenly began to drop but this trend was short lived and water levels quickly returned to the long term test trend. The test was continued for an additional 1800 minutes after this event. There was no corresponding increase in pumping rate recorded to correlate with this unusual water level response and there is no identified explanation.

The semi-log time-recovery plot for the 1800 gpm test is provided as Figure 5. As shown on this figure the late time recovery (left side of the graph) form a straight line and the estimated T from these data is 132,000 gpd/ft. Early time recovery is affected by the back flushing water from the pump column and although shown on the graph the early time T is not considered valid.

Figure 6 is the semi-log plot of time drawdown for the 2000 gpm test. There are two straight line projections shown on this figure. A well established straight line segment is present from about 50 minutes to approximately 380 minutes. There was a long period of gradual water level recovery from 380 until about 1000 minutes then a second straight line portion appears to be forming. This interim recovery was established over a period of about 10 hours which indicates it was not due to a short term variation in pumping rate or measurement error. There was a slight increase in sand content noted during this interval but no obvious indication of continued well development which should have resulted in a temporary increase in turbidity. There are no other known pumping wells in the area that could explain this observation. The tentative conclusion is that the water levels responded to an increase in well efficiency, perhaps due to additional fractures opening up. The test would have had to have been continued for several more days to determine if the drawdown curve was going to re-establish at the same trend as prior to this perturbation or if a new trend line would be developed. The initial flat line segment of the drawdown data provides a T of 105,600 gpd/ft, which is similar to the 1800 gpm test results.

Figure 7 provides the semi-log plot of the recovery data from the 2000 gpm test. The late time portion of the time recovery plot (left side of graph) produces a straight line segment with an indicated T of 176,000 gpd/ft. The early time T on this graph is not considered valid.

Based on these data the T of the aquifer at this location ranges from 67,900 to 176,000 gpd/ft with an average value of all four estimates of 120,375 gpd/ft. It is not possible to estimate a storage coefficient from single well tests but given the fractured nature of the aquifer the coefficient should be relatively low (S= <.0001). In addition, using the estimated T and comparing the actual drawdown to the theoretical drawdown indicates the well is only about 15-20 % efficient. This indicates there are high velocities within the primary water producing fractures in combination with head loss associated with moving water up the relatively rugose (rough) open borehole.

Figure 8 provides a semi-log plot of both tests with long term projections out to one month (potential operational cycle) and eight months (potential growing season). This graph illustrates there was about 40 feet more drawdown in the well pumping at 2000 gpm than at 1800 gpm over the same test period but that water levels at both pumping rates were declining at the same rate. Projecting these trends out in time indicates that the water level will still be above the bottom of the casing (680 feet) after eight months of pumping at either rate.

The primary precaution to be noted for the graph shown on Figure 8 is that it illustrates projections of pumping water levels out over 80 times further in time than the well was tested. The estimated transmissivity is high and water levels quickly recovered to pre-test levels indicating the aquifer is fairly extensive and highly fractured. However, since this is a fractured limestone aquifer system there are potentially numerous other faults and fractures of unknown hydrologic characteristics that may be encountered over longer pumping periods. Some of these features may be barriers to flow which could cause water levels to decline faster than the projections made from short term tests.

Water Quality

On January 21, 2010, approximately 1070 minutes into the 1800 gpm pumping test, a water sample was collected from a sample port attached to the discharge pipe. The sample was shipped under chain of custody for laboratory analysis of common ions, dissolved metals, oxygen/deuterium isotopes and carbon 13/14 age dating. The metals sample was filtered in the field with an in-line 0.45μ filter. Field parameters taken at the time of sampling indicated the water temperature was 24.4 C and had a pH 7.54 and conductivity 466 uS. During the aquifer tests additional field parameters were recorded. These data are provided on the aquifer test data sheets in Appendix E. The water chemistry results are provided in Table 3 and the laboratory reports are included in Appendix F.

The laboratory data indicate this water is a mixed calcium-magnesium-sodium-bicarbonate water chemistry type. The water is cold and of exceptionally good quality with low total dissolved solids (280 mg/L). Arsenic was detected at a concentration of 8.3 μg/L. This concentration is below the drinking water standard for arsenic of 10.0 μg/L. There were no other significant metals detected and no constituents exceeding primary or secondary drinking water standards were reported. The carbon-13 value is essentially that of water associated with carbonate rocks. This value indicates a minimal amount of exposure to soil carbon dioxide. The carbon-14 value yields a raw (uncorrected age) of 18,000 years rounded to nearest 1,000 years. The oxygen-18 and deuterium (-101 permil) indicates the water is regional carbonate aquifer groundwater.

Pump Shaft

On January 17, 2010, during installation of the line-shaft turbine test pump, Layne dropped a section of line shaft into the well. The shaft is 2 ½-inches in diameter and 20 feet long. The shaft is made of a steel alloy designated as AISI 1045 by the manufacturer. A product slip sheet of AISI 1045 steel is provided in Appendix G.

On January 29, 2010, after the test pump was removed following the aquifer tests, Layne ran a borehole video log to try to locate the shaft. The video log showed that below approximately 1600 feet the borehole was too murky to see the walls of the borehole. The murky water below 1600 feet indicates there was little or to no movement of water through the lower part of the borehole. The video log recorded the bottom of the hole at 1872 feet and could not locate the shaft. A copy of the video log and a one-page illustrated summary of the video log are provided in Appendix G.

On February 1, 2010 Vidler directed Layne to attempt to remove the shaft. On February 3, 2010 Vidler obtained the metallurgy of the shaft from Layne and forwarded this information to a geochemist for review to determine if leaving the shaft in the well would impact the water quality in this well. The geochemical review determined that the shaft posed no significant threat to the water chemistry if left in the well. On February 5 Layne made two separate attempts to fish out the shaft but were not successful. The top of the shaft was not located during either fishing attempt. Since the position of the shaft was not known Vidler directed Layne to run back into the hole with a drill bit and push the shaft to the bottom of the hole. Layne drilled and pushed the shaft down to 1871 feet on February 7, 2010.

Summary and Conclusions

Lincoln/Vidler completed Production Well No.1 (PW-1) into the regional carbonate aquifer in Dry Lake Valley, Lincoln County, NV. The well penetrated 660 feet of alluvium and was advanced 1221 feet into bedrock to a total depth of 1881 feet. Vider was granted a waiver from the Nevada State Engineer to allow open-hole completion below the 24 inch steel casing that was set to 680 feet. Static water level in the final well is approximately 405 feet below ground level. A steel pump shaft 20 feet long by 2 ½-inches in diameter is wedged in the bottom of the hole at approximately 1871 feet.

The bedrock formations penetrated are tentatively identified as the Ordovician Eureka Quartzite and underlying shaley limestones of the Ordovician Pogonip Group. Multiple fractures contribute water to the well with the most significant fractures occurring between 1010 and 1250 feet. There are additional contributions from lesser fracture systems to a depth of approximately 1650 feet. There appears to be little additional well yield gained below 1650 feet.

The well was tested at 1800 gpm for 72 hours (3 days) and at 2000 gpm for approximately 27 hours. The maximum pumping water level approached 640 feet below ground level corresponding to a drawdown of 235 feet at 2000 gpm. Water levels recovered quickly to near pre-test levels after each test. The transmissivity for the aquifer is approximately 120,000 gpd/ft based on the time-drawdown and time-recovery data collected during both aquifer tests. The specific capacity of the well at 1800 gpm is 8.8 gpm/ft and 8.7 gpm/ft at 2000 gpm.

Water quality data indicate the water from PW-1 is cold (24°C), has a pH of about 7.6 and low total dissolved solids (280 mg/L). There were no constituents above safe drinking water standards. Oxygen/deuterium isotopes indicate the water is from the regional carbonate aquifer. Age dating indicates the water is approximately 18,000 years old.

Long term projections indicate the well can support pumping at up to 2000 gpm for an 8 month growing season. However, long term projections based on short term pumping tests in a fractured rock aquifer carry a high degree of uncertainty. Unknown barriers and fracture systems may be encountered with longer pumping periods that could cause pumping water levels to decline faster or slower than was experienced during the testing phase.

References

Tschanz and Pampeyan, 1970 , Geology and Mineral Deposits of Lincoln County, Nevada: Nevada Bureau of Mines and Geology Bulletin 73.

Tables and Figures

Summarized Daily Log for Well PW-1

Dry Lake Valley, NV Vidler Water Co.

Dates	Summary of Activities
09/22/09	Drill 42-inch hole to 103 ft. with bucket auger.
09/23/09	Set 94.5 ft tremie then 100 ft. 32-inch, 0.375-inch wall conductor casing. Pump cement grout and pull tremie. Grout at 35 ft.
09/24/09	Finsh grouting annulus to surface.
09/25/09	Mobilize drill rig and set up equipment.
09/26/09	Mobilize drill rig and set up equipment.
09/27/09	Mobilize drill rig and set up equipment.
09/28/09	Mobilize drill rig and set up equipment.
09/29/09	Mobilize drill rig and set up equipment.
09/30/09	Mobilize drill rig and set up equipment.
10/01/09	Start drilling with 17 1/2 inch toothed bit. Clean out conductor casing and drill alluvium to 144 ft.
10/02/09	Drilling alluvium with 17 1/2 inch toothed bit. Drill to 314 ft.
10/03/09	Drilling alluvium with 17 1/2 inch toothed bit. Drill to 449 ft.
10/04/09	Drilling alluvium with 17 1/2 inch toothed bit. Hard gravels, change to new toothed bit at 558 ft. Drill to 659 ft.
10/05/09	Drilling alluvium, top bedrock at 660 ft. Change to 17 1/2 inch button bit at 673 ft. Slow drilling. Hole at 683 ft.
10/06/09	Drilling bedrock, slow, hard. Hole at 705 ft.
10/07/09	Drilling bedrock, slow, hard. Hole at 717 ft.
10/08/09	Drilling bedrock, slow, hard. Bit buttons in cuttings, replace bit with used 17 1/2 inch button bit. Hole at 728 ft.
10/09/09	Drilling bedrock, slow, hard. Hole at 743 ft.
10/10/09	Drilling bedrock, slow, hard. Hole at 749 ft.
10/11/09	Drilling bedrock, slow, hard. Trip hole, put on used 17 1/2 inch button bit at 750 ft. Drill to 752 ft.
10/12/09	Drilling bedrock, slow, hard. Hole at 756 ft. No penetration, trip partially out and wait for decision.
10/13/09	Change to 14 3/4" rock bit, add collars. Drill bedrock, hard. Slow. Hole at 761 ft.
10/14/09	Drilling bedrock with 14 3/4 inch button bit, drill to 772 ft. Pull bit and check, broken buttons. Water watch to wait on decision.
10/15/09 -11/16/09	Water watch, wait on new 14 3/4 inch bit to be machined.
11/17/09	Ream out-of-gauge hole with old 17 1/2 inch bit to 773 ft.
11/18/09	Drill to 775 with 17 1/2 inch bit. Trip hole, change to new hardened 14 3/4 inch bit. Drill to 810 ft.
11/19/09	Drill to 1057 ft. with 14 3/4 inch bit. Losing mud beginning at 1025. Lost circulation with hole at 1057. Mixed mud, out of water, unable to continue. Trip bit.
11/20/09	Bit okay but has few broken buttons, fluid level in hole 408 ft. bgl. Shut down to wait on decision. Water watch.
11/21/09 - 12/1/09	Water watch. Decision to set 24 inch intermediate casing to approx. depth of 700 ft. Re-tool for 30" reamer and re-mobe crews to site.
12/02/09	Fill hole with gravel and place bentonite plug 710-700 ft. Ream hole from 96 to 131 ft. to 30 inch.
12/03/09	Ream hole to 30 inch to 472 ft.
12/04/09	Ream hole to 30 inch to 612 ft.
12/05/09	Ream hole to 30 inch to 665 ft.
12/06/09	Ream hole to 30 inch. Trip tools and change bit. Ream to 676 ft. Unable to penetrate. Decision to set 24 inch casing to this depth.
12/07/09	Run in tremie to 660 feet and start in with 24 inch casing. Casing wedged at 102 feet. Pull casing, 2 centralizers missing. Start trip back in to ream. Re-ream hole to 30 inchs to 175 ft.

Table 1
Daily Drilling Log
Well PW-1, Lincoln Co., NV
Vidler Water Co.

Summarized Daily Log for Well PW-1

Dry Lake Valley, NV Vidler Water Co.

Dates	Summary of Activities
12/8/09 - 12/19/09	Re-ream hole to 30 inches to 676 ft. Drill new 30 inch hole to 680 ft.
12/20/09	Condition hole. Run caliper survey. Run 24-inch casing to 680 feet.
12/21/09	Set gravel and bentonite plugs inside 24 inch casing. Pump 16 cyds cement into annulus. Tag cement at 445 ft.
12/22/09	Pumped 14 cyds cement. Tag cement at 258 ft.
12/23/09	Pump 8 cyds cement. Tag cement at 132 ft. Pump cement to ground surface. Shut down for holidays.
12/24/09 - 1/7/10	Holiday shutdown.
01/08/10	Run in hole with 14 3/4 inch bit and begin cleanout. Chase hole with 14 3/4 inch bit to 671 ft.
01/09/10	Clean out hole to 1046 ft. with 14 3/4 inch bit.
01/10/10	Clean out hole to 1057 ft. Drill new 14 3/4 inch hole to 1235 ft.
01/11/10	Drill new 14 3/4 inch hole to 1451 ft.
01/12/10	Drill new 14 3/4 inch hole to 1625 ft.
01/13/10	Drill new 14 3/4 inch hole to 1704 ft.
01/14/10	Drill new 14 3/4 inch hole to 1860 ft.
01/15/10	Drill new 14 3/4 inch hole to 1881 ft. Air-lift surge. Air lift pump, trip hole, rig down.
01/16/10	Geophysical logging. Continue to rig down. Move rig off hole for pump rig to set up.
01/17/10	Start setting turbine pump for development and pumping test.
01/18/10	Finish pump and drive engine set up. Conduct pump-surge development 13:45-24:00.
01/19/10	Pump-surge development 07:00 - 17:30. Single rate step test at 1800 gpm 18:35 - 24:00.
01/20/10	Track well recovery. Start 3 day aquifer test at 15:15.
01/21/10	Continue 3 day aquifer test @ 1800 gpm. Collect water sample for ions, metals and isotopes.
01/22/10	Continue 3 day aquifer test @ 1800 gpm.
01/23/10	End 3 day aquifer test at 15:15. Begin recovery test.
01/24/10	Track well recovery. Start 1 day aquifer test at 2000 gpm @ 15:06.
01/25/10	Continue pumping at 2000 gpm. End test at 19:49. Track water level recovery.
01/26/10	Track water level recovery. Rig down pumping equipment.
01/27/10	Final water level @ 07:20. Begin pulling pump.
01/28/10	Rigging down and removing pumping equipment from well site.
01/29/10	Layne video logs well to find pump shaft dropped in well on Jan. 17 (not reported or recorded by pump crew at the time).
1/30/10 - 2/3/10	Layne planning and tooling up for fishing to remove pump shaft.
02/04/10	Re-set rig over well and run in with fishing tools
02/05/10	Fish for shaft, trip fishing tool up check for fish, no fish, run fishing tool back to bottom. Start tripping out with fishing tool.
02/06/10	Trip out fishing tool, no fish. Clean up site and equipment.
02/07/10	Trip in with 14 3/4 inch bit. Tag shaft at 1867, mash and twist shaft into bottom of hole, approximate top 1871 ft.
02/08/10	Trip all tools and rig down.
2/9/10 - 2/21/10	Layne removes ancillary equipment and cleans and regrades site.
02/22/10	Layne completes extention of well head to 18" agl.
02/26/10	State of Nevada accepts final well head and releases Layne from site.

Table 1 (Continued)
Daily Drilling Log
Well PW-1, Lincoln Co., NV
Vidler Water Co.

Geologic Log for Well PW-1

Dry Lake Valley, NV Vidler Water Co.

From	To	Description
0	200	Alluvium. Poorly Sorted (GM) gravels and sand with fines. Gravel to boulder fraction consists of sub-rounded to sub-angular gray limestones and calcium cemented sandstones, and pink tuffs. Sand fraction (#4 to silt) is sub-rounded to sub-angular. Calcareous matrix. Fines fraction is calcareous silt and some light brown clays. Minor fluid loss 115-200 ft.
200	400	Alluvium. Poorly Sorted (GM) gravels and sand with fines and clay. Gravel and sand same as above. Light brown clay. Minor fluid loss at 200-217 and 320-370 ft.
400	660	Alluvium. Poorly Sorted (GM) gravels and sand with fines. Gravel and sand same as 0-200 feet. Calcareous matrix. Fines fraction is calcareous silt and some light brown clays. Occasional clayey zones from 550 to 580, 600 to 610 , and 630 to 660 ft. Minor fluid loss at 460-500, 542 , and 600 ft.
660	685	Cemented Breccia. Dolomite clasts, angular, dark gray in a calcium-cemented sandstone matrix. Occasional light gray clay. Iron staining present from 660 to 670 feet. Small fracture zone at 677 feet, fluid take zone at bottom of breccia/top of quartzite.
685	810	Quartzite. Orthoquartzite, vitreous, sugary texture. White (N9) with pale yellowish orange (10YR 8/6) and grayish pink (5 R 8/2) staining. Minor, discrete fractures and fluid take zones at 685, 724, 747, 749, and 754 ft. ft, 747 ft, 754 ft, and 762 ft.
810	840	Sandstone. Fine to very fine grained. Rounded. Calcium-cemented. Pale red (10 R 6/2), pale reddish brown (10 R 5/4), grayish red (10 R 4/2). Occasional clay seam.
840	895	Limestone. Argillaceous, medium light gray (N6) and has shaley partings. Calcite veining present. Abundant fracture faces coated with iron stain of grayish orange (10 YR 7/4) color. Occasional calcite crystal lithics up to 1/2". Some brown clay from 860 to 880 ft.
895	1010	Limestone. MIcro-crystalline, medium light gray (N6) with shaley partings and calcite mottling and veining. Abundant fracture faces coated with grayish-orange (10 YR 7/4) iron stain. Thin brown clay layers from 960 to 980 ft. Fracturing at 925 ft, 940 ft, and 950 to 955 ft. Fluid take zone at 925 feet.
1010	1030	Limestone. Microcrystalline, medium light gray (N5) as above, occasional shaley partings and calcite veining. Highly fractured, fluid take. Lost circulation zone.
1030	1060	Limestone. Microcrystalline, medium light gray (N5) fractured with iron staining and calcite veining, as above.
1060	1160	Limestone. Argillaceous, dark gray (N4), shaley partings and calcite veining. Abundant fracture faces coated with grayish orange (10 YR 7/4) iron stain.
1160	1240	Limestone. Argillaceous, Medium light gray (N5), shaley partings, clay and calcite veining present. Softer.
1240	1280	Limestone. Argillaceous, dark gray (N4), shaley partings and abundant calcite veining. Fracture faces coated with grayish orange iron stain.
1240	1390	Limestone. Fine crystalline, medium gray (N6). Calcite veining. Fracture faces coated with grayish orange iron stain.
1390	1410	Broken limestone and light gray clay (fault gouge?), probable fault zone.
1410	1780	Limestone. Argillaceous, light (N6) and dark (N4) gray with shaley partings. Calcite veining present. Many fracture faces coated with of grayish orange (10 YR 7/4) iron stain color between 1430 and 1530 ft.
1780	1881	Limestone. Fine cyrstalline, medium gray (N5) with occasional shaley partings and abundant calcite veining Occasional fracture coated with grayish orange (10 YR 7/4) iron stain.

Table 2
Geologic Log
Well PW-1, Lincoln Co., NV
Vidler Water Co.

Water Chemistry and Isotopes
Well PW-1

Dry Lake Valley, NV Vidler Water Co.

Sample Date: January 21, 2010

Constiuent	Reporting Limit	Concentraion	Units
Calcium	2.0	**37**	mg/L
Magnesium	2.0	**19**	mg/L
Potassium	2.0	**3.9**	mg/L
Silica	0.21	**26**	mg/L
Sodium	2.0	**37**	mg/L
Aluminum (dissolved)	0.2	ND	mg/L
Arsenic (dissolved)	0.1	ND	mg/L
Iron (dissolved)	0.05	ND	mg/L
Manganese (dissolved)	0.01	ND	mg/L
Nickel (dissolved)	0.01	ND	mg/L
Alkalinity as CaCO3	6.0	**190**	mg/L
Bicarbonate Alkalinity as CaCO3	6.0	**190**	mg/L
Carbonate Alkalinity as CaCO3	6.0	ND	mg/L
Chloride	2.0	**15**	mg/L
Fluoride	0.04	**0.73**	mg/L
Hydroxide Alkalinity as CaCO3	6.0	ND	mg/L
Sulfate	2.0	**32**	mg/L
Total Dissolved Solids	20	**280**	mg/L
Alkalinity, Phenolphthalein	6.0	ND	mg/L

Field Parameters at Time of Sample

Temperature (°C)	24.4
Conductivity (µS)	466
pH	7.54

Isotopes

	$\delta^{18}O$ ‰	δD ‰
	-13.4	-101
Analytical Precision (1-sigma)	0.08	0.9

	$\delta^{13}C$ ‰	C14 (pMC)*
	-7.4	13.2 +/- 0.2
Analytical Precision (1-sigma)	0.15	

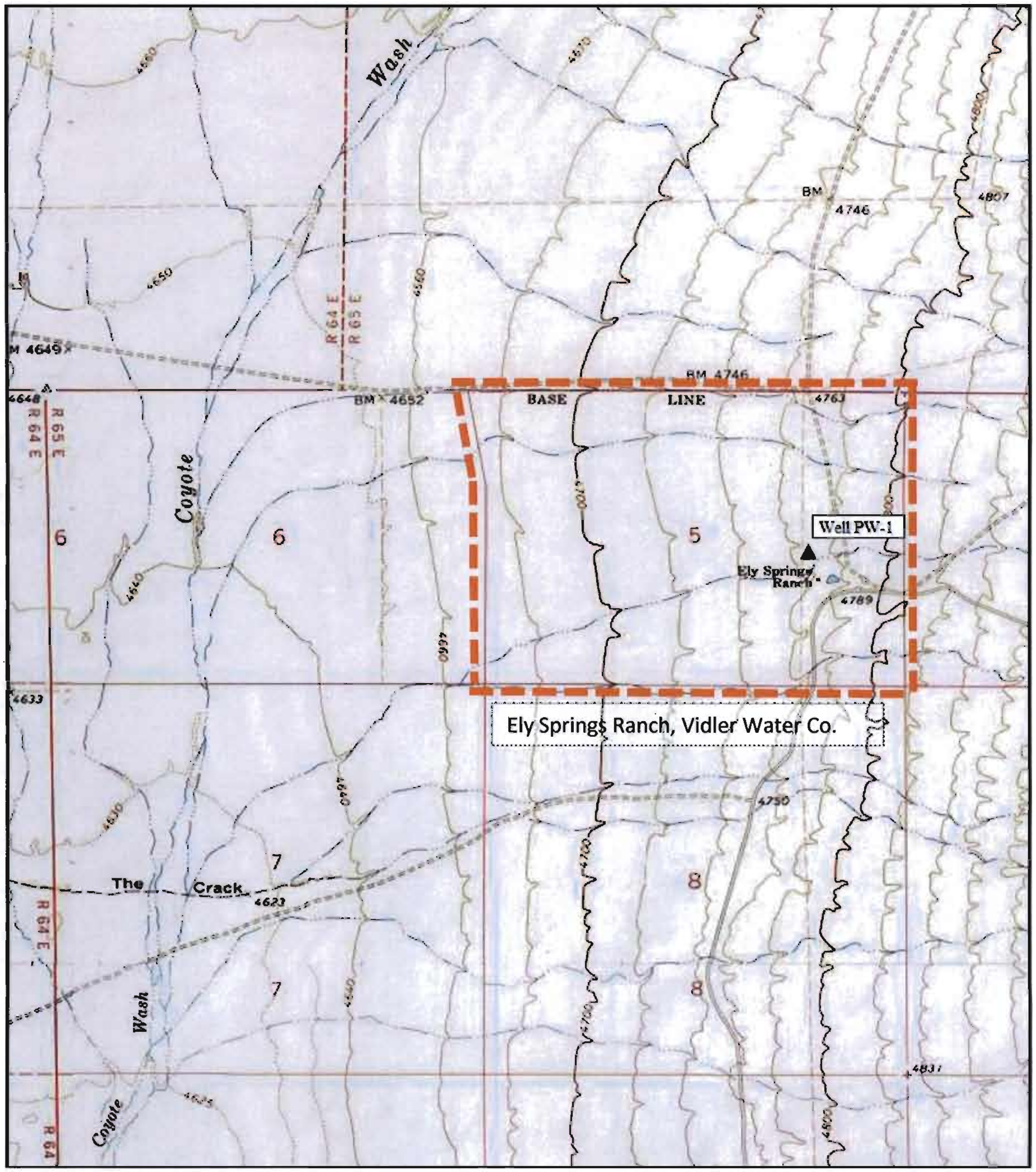
Notes:

Dissolved metals filtered in field with 0.45µ in-line filter.

Ions and metals: Test America Laboratories, Phoenix, AZ

Isotopes: Isotope Laboratory, Department of Geosciences, University of AZ, Tucson, AZ

*pMC = Percent Modern Carbon



Base: USGS Ely Springs 7.5" topographic map

0.0 0.5 1.0 miles

0.0 0.5 1.0 1.5 km

TN MN

12½

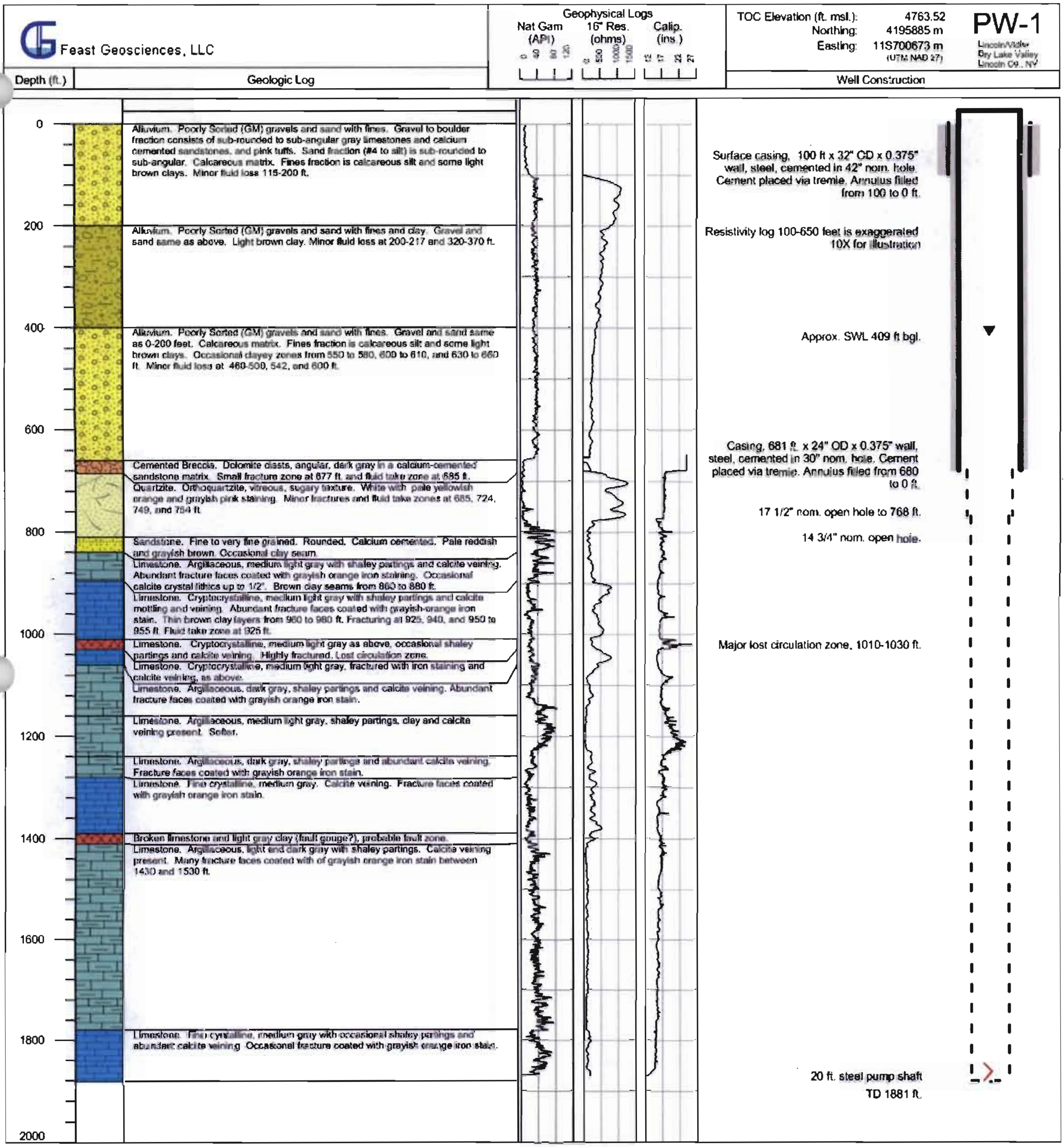
03/05/10

Figure 1

Location of Well PW-1

Dry Lake Valley, Lincoln Co., NV

Lincoln Co./Vidler Water Co.



Well PW-1 Construction

Drilled: Aug. 22, 2009 - Jan. 15, 2010
Developed: Jan. 18 - Jan. 19, 2010
Contractor: Layne Christensen Drilling, Fontana, CA
Drilling Method: Flooded Reverse
Geophysical Logging: SW Exploration Services, Gilbert, AZ
Geologists: C. Parker and C. Feast, Feast Geosciences, Boise, ID

Well PW-1 Testing

Date: Jan. 20-23, 2010
72 hr constant rate pumping test
Q = 1800 gpm, DD = 206 ft
Field Parameters:
Temp. 24.4.0 C, EC = 491 uS
pH = 7.65, ORP = -60 mV

Figure 2
Geologic Log, Selected Geophysical Logs and Well Construction Details of Well PW-1
Lincoln County Water District and Vidler Water Company
Dry Lake Valley, Lincoln Co., NV

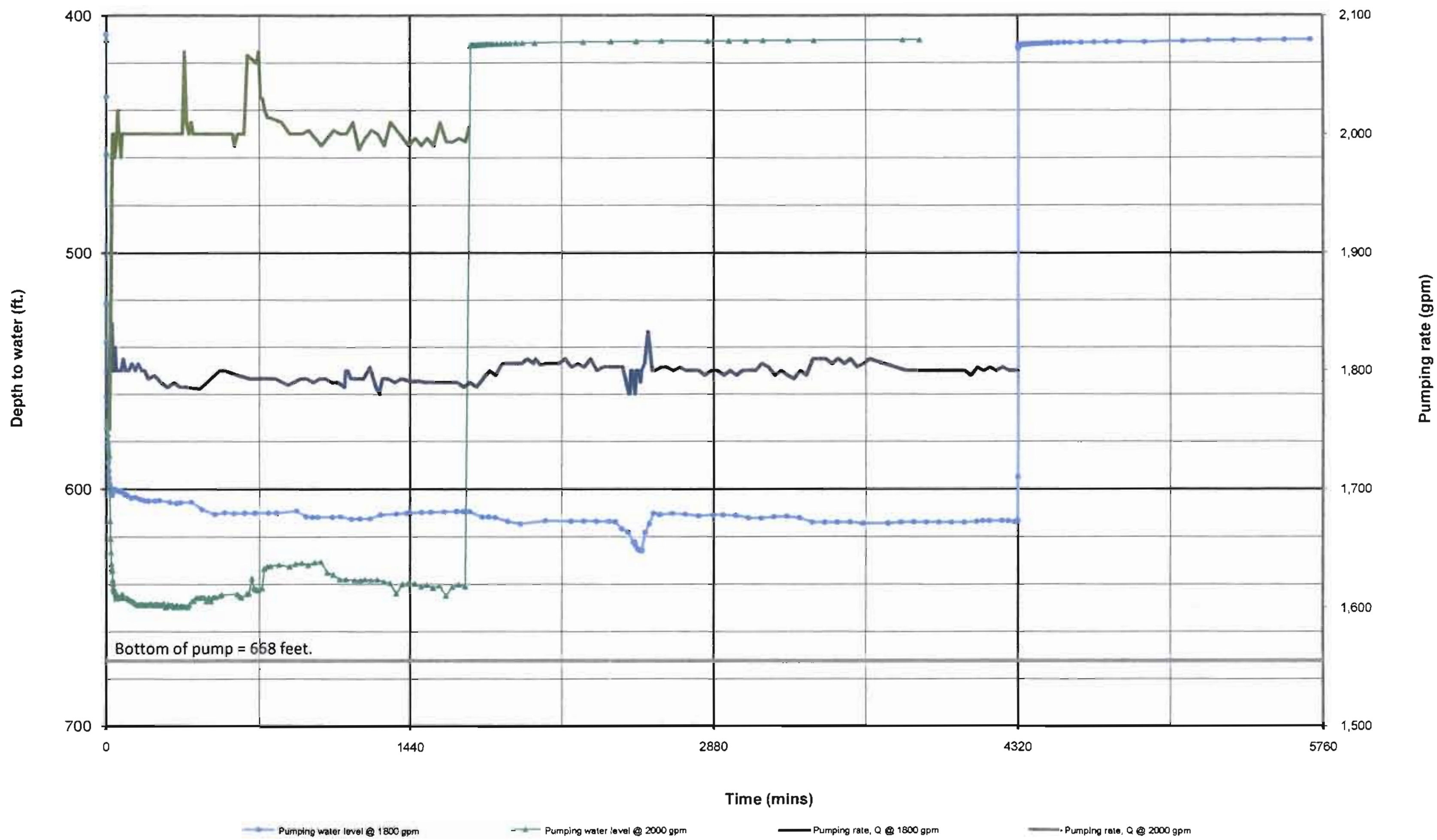


Figure 3
Water Levels and Pumping Rates at Well PW-1
During 1800 and 2000 gpm Tests, January 2010
Vidler Water Co., Dry Lake Valley, NV

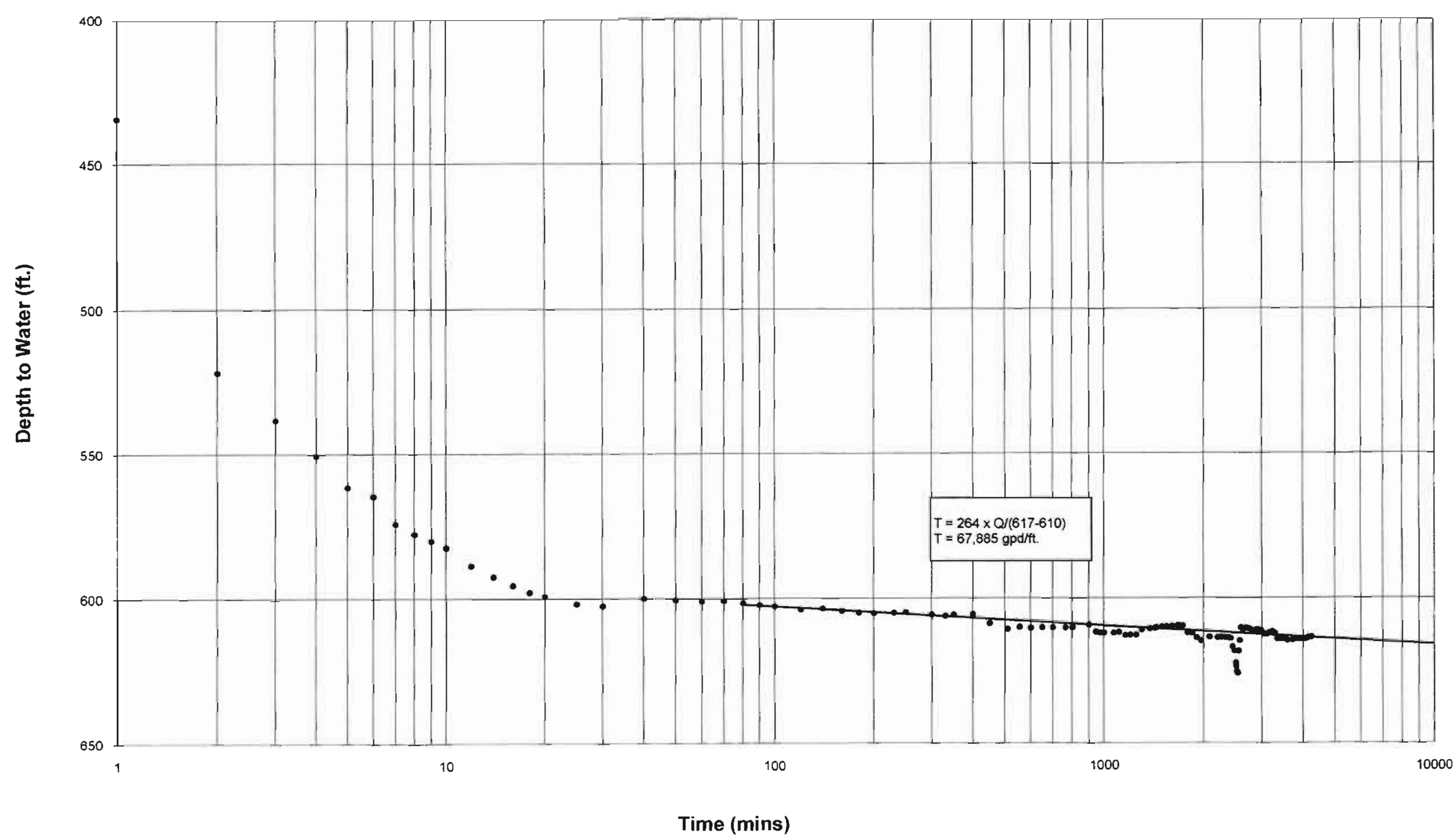


Figure 4

Time-Drawdown Plot for Well PW-1

During 3 Day Test @ 1800 gpm, January 2010

Vidler Water Co., Dry Lake Valley, NV

Feast Geosciences, LLC

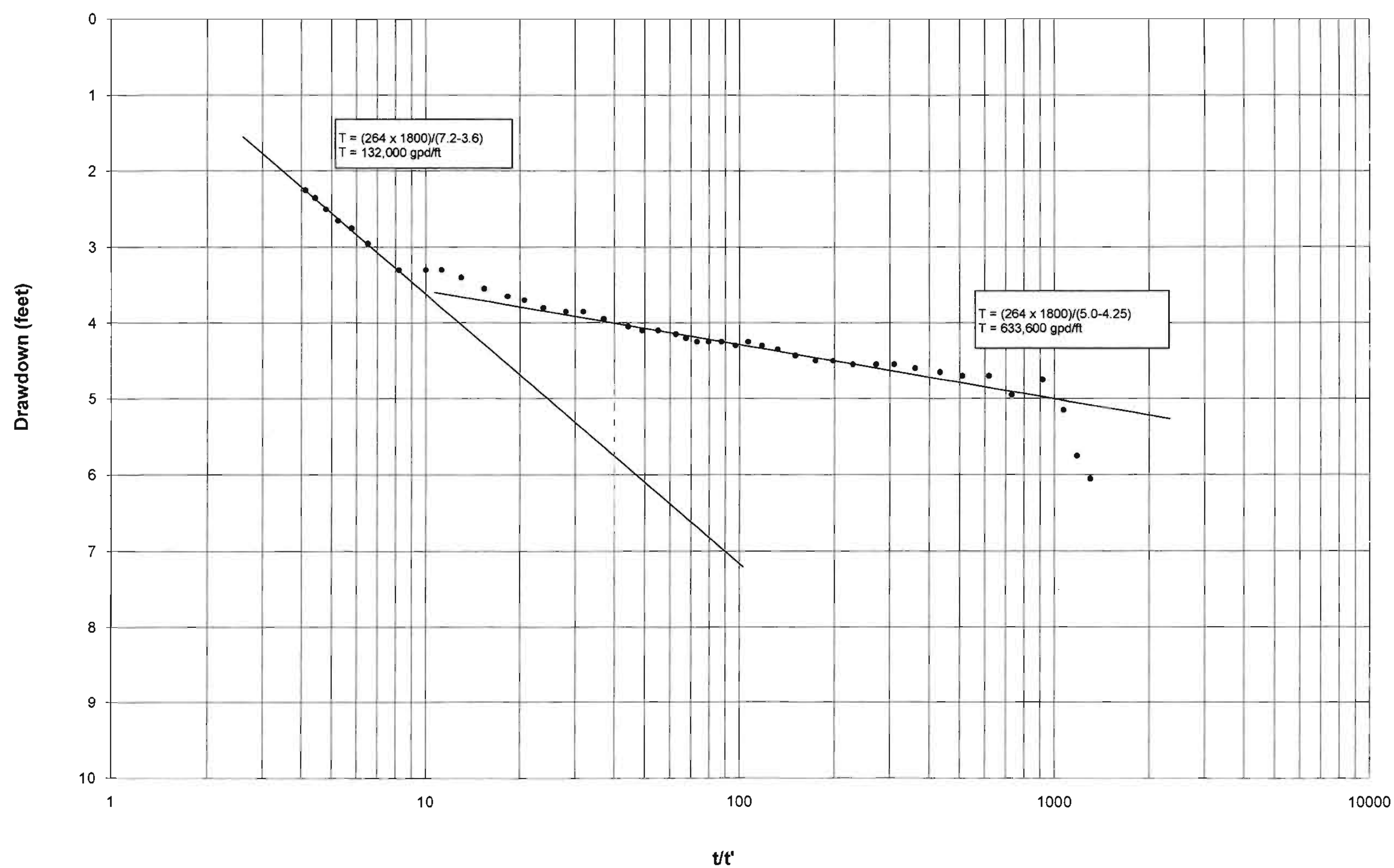


Figure 5
Time-Recovery Plot for Well PW-1
Following 3 Day Test @ 1800 gpm, January 2010
Vidler Water Co., Dry Lake Valley, NV

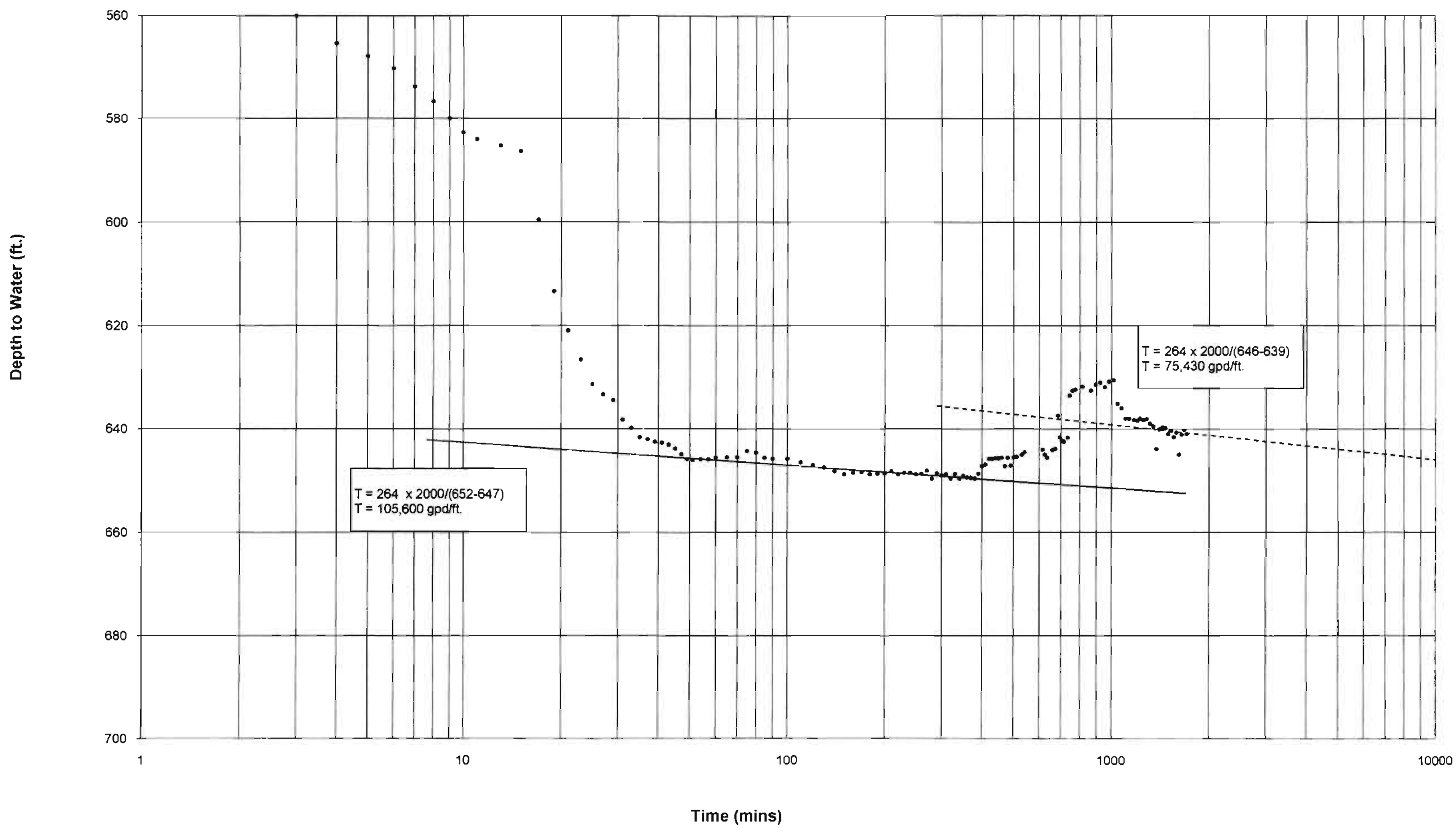


Figure 6

Time-Drawdown Plot for Well PW-1

During 27 Hour Test @ 2000 gpm, January 2010

Vidler Water Co., Dry Lake Valley, NV

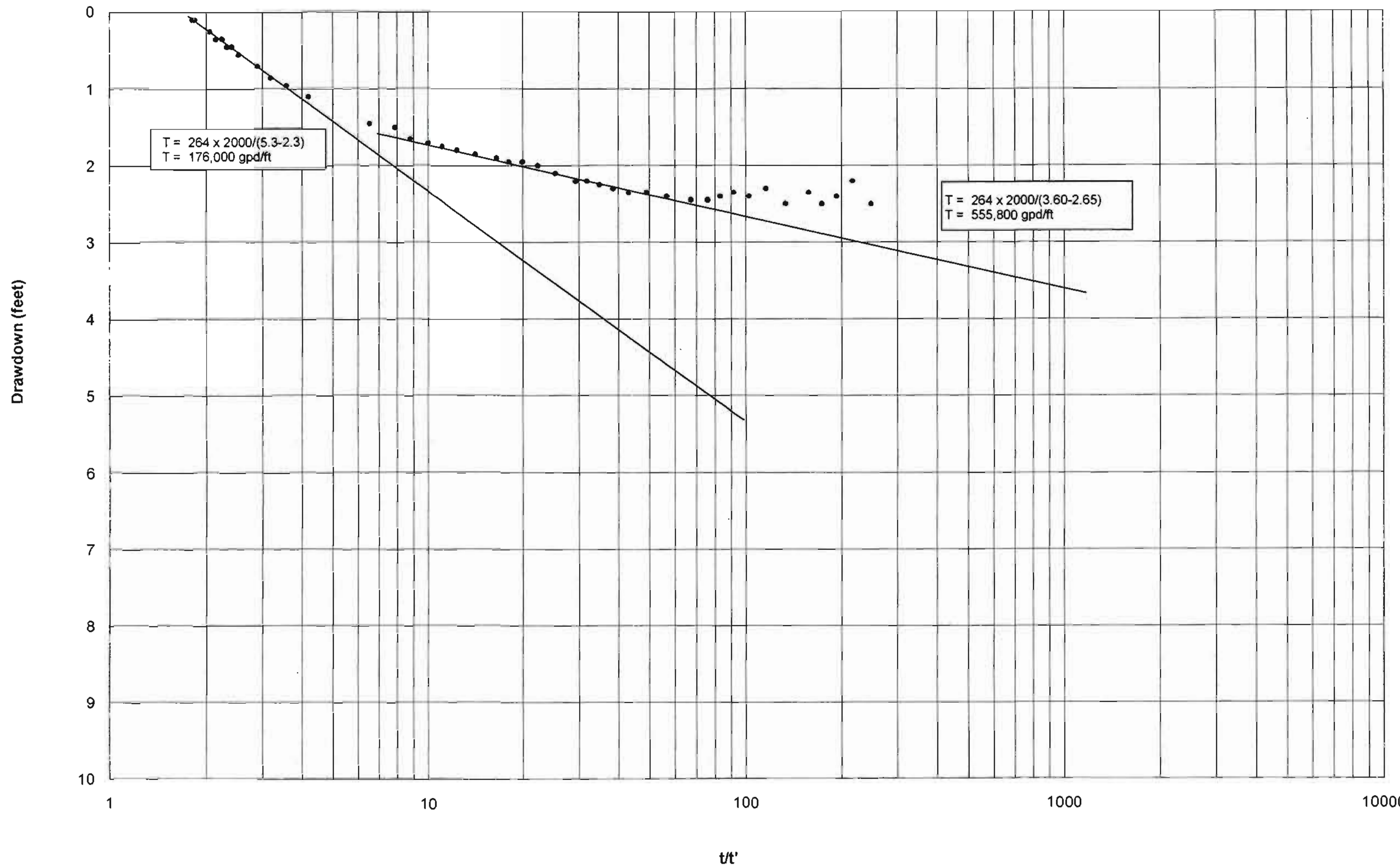


Figure 7

Time-Recovery Plot for Well PW-1

Following 27 hour Test @ 2000 gpm, January 2010

Vidler Water Co., Dry Lake Valley, NV

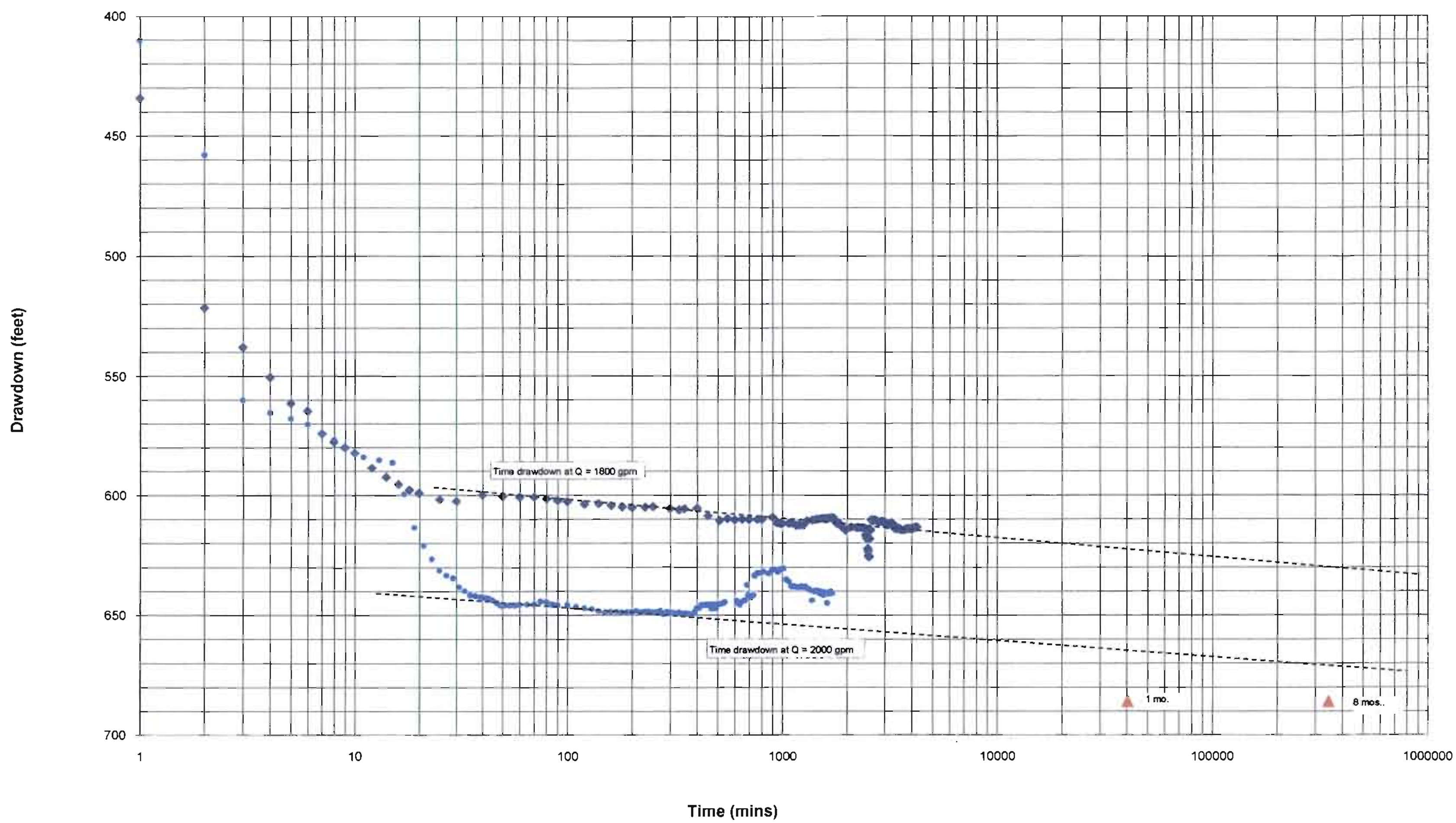


Figure 8

Time-Drawdown Plot for Well PW-1

for 1800 and 2000 gpm Projected Out 8 Months

Vidler Water Co., Dry Lake Valley, NV