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Testing and Evaluation of Pajarito Well No. 2

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INTRODUCTION

Pajarito Well No. 2 (PW-2) was constructed in 1965. The well extends to a total depth of 2300 ft. It is screened from 1004 ft. to 2280 ft. with 14 in. x 0.040 in. louvered screen, (McLin, 2005). The well is equipped with two 2 in. sch. 40 gage lines which enter the casing at a depth of about 995 ft.

The well began pumping coarse sand and fine gravel in 2007. The material is believed to be gravel pack from around the well screen and casing. The well was equipped with a turbine ump with the inlet at 1011 ft., which is about seven feet below the top of the screen It was hypothesized that the screen openings in the 1011 ft. interval may have eroded by water falling back down the column pipe when the pump shuts off.

INVESTIGATION

The pump was pulled, and the casing screen were cleaned with a wire brush. Video logs were conducted before and after the wire brushing procedure. These video logs did not reveal any apparent enlargement of the screen openings (in the 1011 ft. interval or any other level), and no other openings in the screen or casing were noted. It was, however, noted that in the second video log, water appeared to be entering the well through one of the gage line openings in the casing at about 995 ft. A particle of falling rust or other debris can be seen diverting laterally as it passed between the video camera and gage line opening in the casing.

The aquifer is known to exhibit a vertical downward gradient, or decreasing head with depth. This information suggested a second hypothesis, i.e. the gravel pack material could be entering the well through a hole in the gage line. Since the gage line wall thickness is 0.154 in. and the casing thickness is probably 0.312 in. it is likely the gage line would rust through before the casing.

Subsequent investigation of the well in April 2008 included a step test at 310gpm 605gpm, 833gpm and 1041gpm for 30 minutes intervals, spinner logs at the three highest pumping rates, and a video log at 1041gpm.

ANALASES

The video log that was conducted while the test pump was producing 1041gpm confirmed that one of the gage lines was conducting air entrained water into the well. Water is apparently cascading into the gage line, entraining air and entering the well at the bottom of the gage line. This very strongly suggests that the gravel pack material is also entering the well through the breached gage line.

It is not known with certainty whether one or both gage lines are breached. One of the gage lines has a pressure transducer stuck in it. The other gage line was

used to collect water levels during the step test conducted in April 2008. If the gage line used for the step test is breached, one would expect the pumping water level in that gage line to be higher than the pumping water level in the well casing. It was noted during the video log conducted on April 16, 2008, when the well was being pumped at 1041gpm, the water level in the well was within one foot of the water level in the gage line. This suggests, although not conclusively, that the gage line with the stuck pressure transducer is the one that is breached.

The step test conducted on PW-2 provides insight into the condition of the well and a means of estimating a safe pumping rate. The desired pumping rate of the well is 1250gpm. TABLE 1 shows the specific capacities for PW-2 in 1965, 2003 and April 2008. The reduction in specific capacity between 1965 and 2008 is significant, suggesting that encrustation of the screens or formation near the wall is occurring.

Driscoll, 1986 provides a means of estimating the portions of the head loss experienced by water entering a well that are attributable to laminar and turbulent flow. The analysis is presented in TABLE 2 and FIGURE 1. At 1250gpm, 71% of the head loss is attributable to laminar flow.

The pump column is 980ft., and the bowls are 20ft. long resulting in a pump intake depth of 1000ft. The net positive suction head requirement is 22ft. With the static level at 867ft., the lowest allowable pumping level is 978ft. Using a specific capacity of 14.9gpm, (TABLE 1), results in a pumping level of 951ft. at 1250gpm, (27ft. above the minimum pumping level). A specific capacity of 14.9gpm is representative of a 30 minute pumping intervals. The pumping level will be lower for longer pumping intervals.

The spinner logs conducted on April 16, 2008 indicate virtually all the water is entering the well between a depth of 1000ft. and 1750ft. The total depth of the well is 2300ft. The geophysical logs, which were conducted when the well was drilled in 1965, indicate the most productive zones are 825ft-1000ft., 1830ft., 1900ft., and 2230ft. to 2320ft. A possible explanation is that the well screens in the most productive zones have become encrusted due to high entrance velocities in those areas This explanation would also account for the observed reduction in specific capacity between 1965 and 2008. Water quality data suggests any encrustation is probably being caused by precipitation of silica, which would be difficult to remove chemically.

CONCLUSIONS

- One (or both) of the gage lines in the well is almost certainly breached allowing gravel pack material into the well. If left unattended, formation material will probably start entering the well also.

- The specific capacity of the well has declined from 24.5 in 1965 to 14.9 in 2008 indicating the well screens and/or the formation adjacent to the well are becoming encrusted.

- It appears the desired 1250gpm capacity of the well can be maintained in the short term without exceeding the available drawdown. However, additional reductions in well capacity are expected, and the flow may need to be restricted by a valve or by other means in the future.

RECOMMENDATIONS

- Any breaches in the gage lines should be identified and repaired as soon as possible to stop the gravel pack and formation material from entering the well, and to assure accurate water level measurements. The gage line(s) might be repaired using a k-packer and polyethylene tubing or by installing a metal packer and a stainless steel air line.

- The pumping water level should be noted regularly to assure it does not fall below 978ft If the pumping level approaches 978ft., the pumping rate should be restricted as necessary.

- A plan for replacement of well PW-2 should be developed and implemented as necessary.

TABLE 1

Pajarito Well No. 2 Specific Capacities

Date	Pumping Rate (gpm)	Pumping Duration (min)	Specific Capacity (gpm/ft.)	Notes
July 7, 1965	1250	unknown	24.5	Herkenhoff, (interpolated)
Feb. 3, 2003	1250	30	20.8	Melin, 2005
April 16, 2008	1250	30	14.9	This Investigation (extrapolated)

TABLE 2

Pajarito Well No. 2 Laminar vs. Turbulent Flow

Flow (Q) (gpm)	Drawdown (ft.)	Specific Capacity Q/AS (gpm/ft.)	AS/Q
310	17	18.2	0.0548
605	37	16.3	0.0612
833	55	15.1	0.0660
1041	68	15.1	0.0663

Flow (gpm)	% Laminar Head loss	% Turbulent Head loss
500	86	14
1000	76	24
1250	71	29

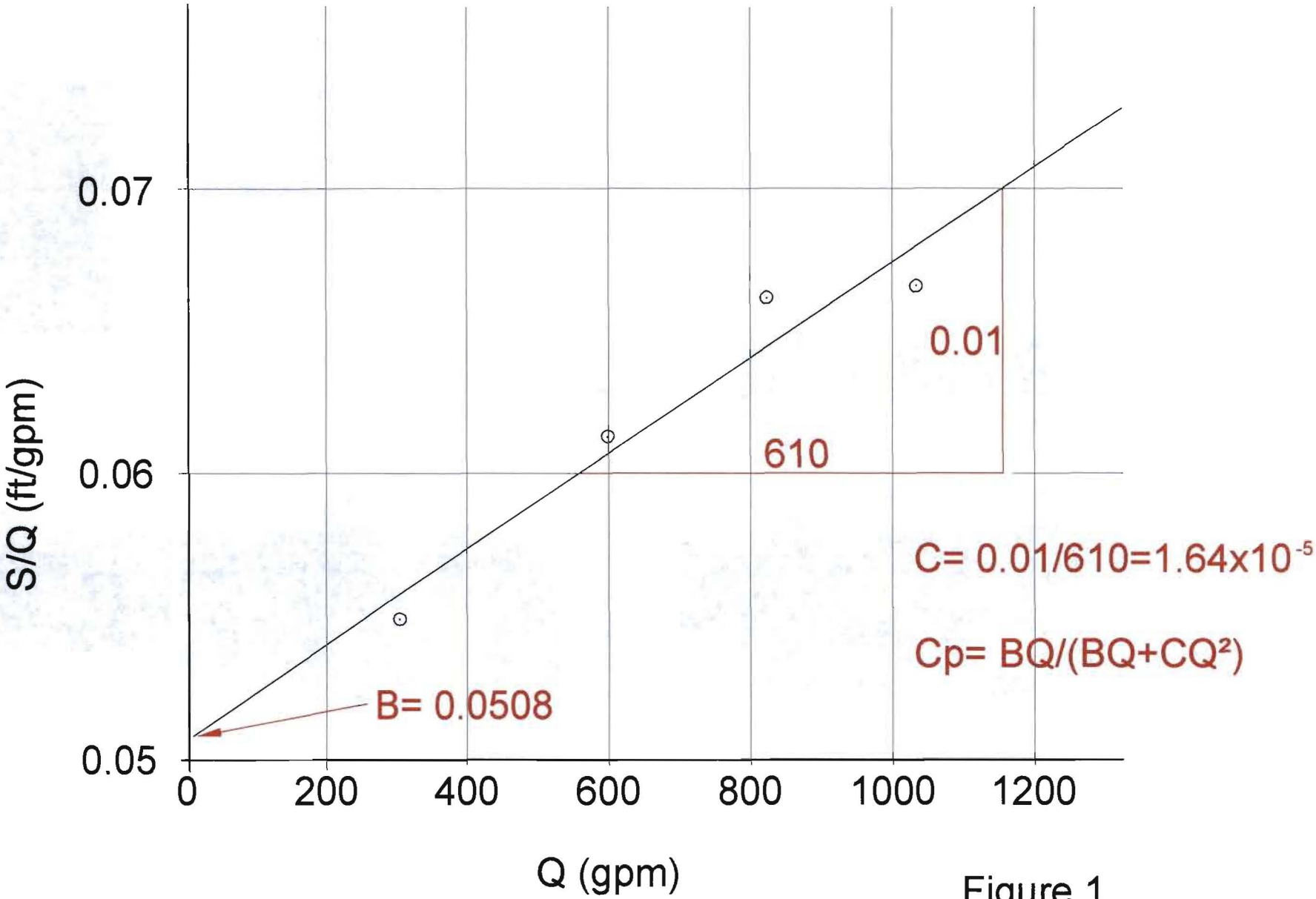

Figure 1
Laminar vs. Turbulent Flow
Well PW-2
Los Alamos Co. New Mexico

Bibliography

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Herkenhoff, Gordon and Associates, 1965, Step Test Results of Pajarito Well No. 2.

McLin, S.G. 2005, Analyses of the PW-2 Aquifer Test using Multiple Observation Wells.