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COMPLETION REPORT

EASZEE DRIVE (1982) WELL

for

108 WATER WORKS

by

W. L. BROWN, P. ENG.

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82-269

May 1982

INTRODUCTION

Problems were reportedly experienced with the Easzee Drive (1972) Well in August, 1979. On August 22, 1979, the pump in this well could reportedly no longer supply water to the water system. The submersible pump was therefore disconnected from the system and pumped to waste. A considerable amount of rock, shale and silt were reportedly pumped from the well. The pump was then put back into use to supply the 108 Ranch for the remainder of the summer.

A new pump was then purchased for the Easzee Drive (1972) Well and Action Drilling of 100 Mile House was employed to remove the original pump and inspect the well. On October 4, 1979, the original pump was pulled from the well. The pump and drop pipe reportedly showed a great deal of corrosion with holes actually eaten through the pump bowls. A bare wire was noted on the pump leads which may have caused electrolysis.

On October 5, 1979, the cleaning operation on the well was started by Action Drilling using an air rotary rig. At a depth of 104 meters (340 feet), it is reported that dirty water, shale and rocks up to 3.81 cm (1½ inches) were blown from the well. The maximum depth that could be penetrated during the cleaning operation was 110 meters (359) feet which was 5 meters (15 feet) from the bottom of the well. A hole gauge was then lowered into the well but it could only reach a depth of 79 meters (258 feet). Based upon this information, Ranch personnel decided to set the new pump with the suction at about 73 meters (240 feet). After setting the new pump into the well, a total of 8 days were spent rawhiding and pumping the well to try and clear the turbidity and rocks. On October 26, 1979, the well was again put on the system at a reduced rate but it continued to produce dirty and rock-filled water until it could not produce any water. In February, 1982, the 108 Ranch Water Works contacted Brown, Erdman & Associates Ltd. and, on February 9, 1981, Mr. R. B. Erdman of this office made an inspection of the well and reviewed its history. This review indicated that severe damage had taken place in the well. The 3.8 cm (1½ inch) diameter rocks that were produced by the pump were much too large to have come through the well screen. Several courses of action were considered. The final two alternatives were to rehabilitate the existing well or drill a new well. The rehabilitation of the well was the most economic in both time and money so that it was tried first.

REMEDIAL WORK

On February 11, 1982, Action Drilling set up over the well and pulled the pump. The pump was in good condition and could be reused. A straight pull on the 20.3 cm (8-inch) diameter casing which had originally been set to a depth of 91.5 m (300 feet) would not move it. The next day, an attempt was made to recover the casing by alternately driving down and pulling up. This operation succeeded in freeing the casing and, on February 13, 1982, 79.3 meters (260 feet) of casing was removed from the hole. The lower end of the recovered casing had been eaten tissue paper thin where the casing had broken. Several holes were noted in the casing, one of which was 30.5 by 15.2 cm (1 foot by 6 inches) in size.

It was then decided to attempt to drill up the remaining steel pipe and screens in the well. On February 15, a 20 cm diameter (7 7/8") bit was run into the well but the bit became plugged before any hole could be drilled. At the same time, mechanical problems with the drilling rig compressor made further work impossible with this machine. A cable tool machine was then brought onto the site in an attempt to clean the hole. Several days were spent trying to get past bridges in the hole at a depth of 30.5 meters (100 feet). When these attempts failed it was decided to drill a new well.

NEW WELL

Telephone contact was made with three drilling contractors who had equipment large enough to complete an air rotary hole to a depth of 116 meters (380 feet). Jay Dee Drilling of Langley had the lowest estimated cost and had equipment available. Jay Dee Drilling arrived on the site on February 24, 1982 and the drilling operation started.

Experience with the construction of Easzee Drive (1972) Well indicated that fractured limestone and red shales between depths of 17.7 and 41.8 meters (58 and 137 feet) was where caving problems should be encountered. The pipe schedule used to overcome this possible problem called for 30 cm (12-inch) surface casing to be set through the overburden and then a 30 cm (11 7/8-inch) hole to be drilled to a depth that was below the fractured limestone. 25.4 cm (10-inch) diameter casing would then be placed in the well and drilling would continue with a 25 cm (9 3/4-inch) bit to the total depth. After the completion of drilling, 15 cm (6-inch) diameter stainless steel screens and 20 cm (8-inch) internal-external flush plastic pipe would be set in the hole.

The 29 cm (11 3/4-inch) hole was carried to a depth of 48 meters (157 feet) where sound rock was encountered. The 25.4 cm (10-inch) diameter casing was placed into the hole and driven to 45 meters (147 feet). Drilling then proceeded to 115 meters (378 feet) as scheduled. While making dummy trips to ensure that the hole was clear of obstacles which could cause the 20.3 cm (8-inch) plastic pipe and screens to hang up, the drill pipe and collar became stuck in the hole. Several days were expended using various methods to free the drill steel but all were to no avail. It was then decided to abandon this attempt and construct a new well.

COMPLETED WELL (Easzee Drive (1982) Well)

After a new drill collar and bit were brought on site, the second well was started. The casing schedule was revised to carry the 25.4 cm (10-inch) casing as deep as possible to prevent the recurrence of the problems experienced in the first well. After setting surface casing, drilling proceeded with a 29.8 cm (11 3/4-inch) diameter bit to 78 meters (257 feet). At this depth, some caving rock was encountered. The tools were removed from the hole and 25.4 cm (10-inch) diameter casing was set at a depth of 53 meters (175 feet). At this point, the bottom of the pipe started to crimp. Blowing from below the casing showed that the sluffing problem had not been corrected so a different approach had to be considered and the casing was removed from the hole.

The solution used included (after setting surface casing) running a 31 cm (12 1/4-inch) diameter bit with the 25.4 cm (10-inch) casing directly behind it. After the hole had been completed at total depth, the bit was to be backed off and left in the bottom of the hole.

At a depth of 91 meters (298 feet), the 25.4 cm (10-inch) casing could no longer be advanced so drilling proceeded to a total depth of 114 meters (375 feet) with water-bearing fractures in the limestone at depths of 98 meters (322 feet) and 105 to 109 meters (343 to 358 feet). The bit was then pulled back to the bottom of the 25.4 cm (10-inch) casing and broken off. Unfortunately, the bit did not drop to the bottom of the hole but became hung up above the water-bearing fractures. This obstruction in the hole required the construction of a side wall hook which righted the bit and allowed it to drop to the bottom of the well. The hole was then backfilled to 110 meters (361 feet) with drain rock and the 6.4 meter (21-foot) long stainless steel screen and 105 m of plastic pipe assembly were set. The well screens are supporting the weight of the plastic pipe which extends to surface. After the screen had been set, the drill rods were run into the well and, after one hour of development by air surging the well was clean. A completed well log is shown at the conclusion of this report.

The submersible pump which had been used in the original well was set into the new well with the suction at 97 meters (318 feet) below the 30.58 cm (12-inch) diameter well flange.

TEST PUMPING

The test pumping commenced on March 22, 1982 at 13:50 and was terminated 1200 minutes later. During the test, a constant pumping rate of 30.3 L/Sec (400 U.S. gpm) was maintained. The water level in the well declined from a static level of 28.6 meters (94 feet) to a pumping level of 58.2 meters (191 feet) at the end of the test. The aquifer coefficients calculated from this pump test data are similar to those obtained during the 10-day pumping test on the original well run in July, 1972. The original transmissivity was calculated to be 7×10^{-4} m^2/sec (5000 U.S. gpd/ft) at the start of the test declining to 2×10^{-4} m^2/sec (1670 U.S. gpd/ft) at the end of the test. As can be seen on the enclosed plots of the drawdown and recovery, a transmissivity of 7×10^{-4} m^2/sec (4800 U.S. gpd/ft) was calculated from water level readings taken during the first part of the test. As the test proceeded, the transmissivity declined to 4×10^{-4} m^2/sec (2800 U.S. gpd/ft). If testing had been carried on longer, additional negative boundaries would have been encountered and the transmissivity would have declined to the original (1972) figure of 2×10^{-4} m^2/sec (1700 U.S. gpd/ft).

CHEMICAL ANALYSIS

The attached chemical analyses were performed on water which was collected close to the end of both the 1982 and 1972 pump tests. As can be seen, the waters from the 1972 and 1982 wells are almost identical. This would be expected since the wells are only approximately 6 meters (20 feet) apart. To determine if either corrosion or electrolysis was the problem in the 1972 Well, a calculation of the Ryznar Stability Index was made. The following parameters were used:

pH at 7.35
Total Dissolved Solids at 1070 mg/L
Alkalinity at 444 mg/L
Calcium at 119 mg/L

Values for S and C in the formula below are read from charts. Total Dissolved Solids is used to obtain a value of S and alkalinity and calcium ion concentration is used to determine C. The formula is:

$$I = S - C - pH$$

therefore,

$$I = 23.2 - 9.35 - 7.35 = 6.5$$

A stability index of 6.5 would indicate mild to no scale and negligible corrosion. Therefore, the problem in the Easzee Drive (1972) Well was most probably caused by electrolysis rather than corrosion.

WELL CAPACITY

In August of 1972, the well was rated at a capacity of 18.9 L/sec (250 U.S. gpm) with the pump suction set at 83.8 meters (275 feet). At that time, it was concluded that, after 100 days of drought, there would be 13.1 meters (43 feet) of safety in the well. At a pumping rate of 22.7 L/sec (300 U.S. gpm), it was calculated that the safety would be 3.35 meters (11 feet). In the new 1982 well, the pump is set at a depth of 97 m (318 feet) so that, at a pumping rate of 22.7 L/sec (300 U.S. gpm), there will be 16.5 meters (54 feet) of water above the pump suction after 100 days of drought.

The records which have been kept by the 108 Ranch Water Works indicate that, with the way the existing pump was set up, it was meeting their water requirements with a pumping level of 71.3 meters (234 feet) before the well failure. The flow from the pump is being restricted by an orifice in the discharge line. This orifice should be left in place but may be modified if, after this summer, water level measurements indicate additional drawdown is available and additional water is required.

Present calculations indicate that the well should be capable of producing 22.7 L/sec (300 U.S. gpm).

RECOMMENDATION

It is very obvious that there is sufficient water in the ground to supply water to the 108 Waterworks Co. Ltd. system but no safety exists to protect users against pump or well failure. Had our recommendations of 1972 been followed, the panic of February, 1982 could have been avoided. The Walker Valley Well should be rehabilitated and further test drilling should be completed.

WTN 49975

EASZEE DRIVE (1982) WELL

Depth (feet)	Depth (meters)	Description
0 - 14	0 - 4.27	Overburden
14 - 58	4.27 - 17.68	Siltstone & limestone
58 - 90	17.68 - 27.44	Shale (red, soft)
		Static Water Level 28.7 m (94 ft)
90 - 92	27.44 - 28.05	Siltstone
92 - 137	28.05 - 41.77	Limestone, faulted, gouge-filled
137 - 162	41.77 - 49.39	Shale, red
162 - 215	49.39 - 65.55	Shale, grey
215 - 226	65.55 - 68.90	Shale, red
226 - 234	68.90 - 71.34	Shale, grey
234 - 242	71.34 - 73.78	Shale, red
242 - 247	73.78 - 75.30	Siltstone, grey
247 - 263	75.30 - 80.18	Shale, red
263 - 275	80.18 - 83.84	Siltstone
275 - 280	83.84 - 85.37	Shale, red
280 - 298	85.37 - 90.85	Siltstone
298 - 375	90.85 - 114.33	Limestone

Fractures: 98.17 m (322 ft) 104.57 m to 109.15 m (343 to 358 ft) **(water-bearing)**

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Report On Water Samples for Chemical Analysis

File No. 3506 A

Report No.

Reported to Robinson, Roberts & Brown
1632 McGuire
North Vancouver, B.C.

Date August 4, 1972

We have tested the sample of water submitted by you on July 26, 1972 and report as follows:

Sample Identification

The sample was submitted in a plastic bottle labelled -

"Block Bros. 108 Mile Ranch, Eazee Drive No. 1, Sample 2 - July 24, 1972"

Method of Testing

The sample was tested in accordance with the procedures set down in "Standard Methods for the Examination of Water and Waste Water" - 13th Edition, published by the American Public Health Association, 1971.

Chemical Analysis of Water Sample

Test		1	
pH (electrometric)		7.95	
Color (Pt-Co scale)		L 0.5	ppm
Turbidity (SiO_2 scale)		3.3	ppm
Suspended Matter		3.7	ppm
Fixed		3.3	ppm
Volatile		0.4	ppm
Hardness (Calculated)		632.8	ppm
Dissolved Anions			
Alkalinity			
Bicarbonates	HCO_3	460.	ppm
Carbonates	CO_3	nil	ppm
Hydroxyl Ion	OH	nil	ppm
Chlorides	Cl	4.0	ppm
Sulfates	SO_4	401.5	ppm
Phosphates	PO_4	L 0.1	ppm
Nitrates	N	L 0.1	ppm
Dissolved Cations			
Silica	SiO_2	13.2	ppm
Iron	Fe	0.05	ppm
Aluminum	Al	L 0.05	ppm
Calcium	Ca	122.1	ppm
Magnesium	Mg	79.9	ppm
Sodium	Na	66.0	ppm
Potassium	K	9.1	ppm
Manganese	Mn	L 0.05	ppm
Copper	Cu	0.010	ppm
Lead	Pb	L 0.01	ppm
Zinc	Zn	0.067	ppm
Total Iron	Fe	0.62	ppm
Total Silica	SiO_2	14.6	ppm
Total Dissolved Solids		1158.	ppm
Fixed		928.	ppm
Volatile		230.	ppm

L = less than

Remarks

Examination of the above results indicated that the water as represented by the submitted sample was a very hard highly mineralized water. The dissolved minerals present were primarily the bicarbonates and sulfates of calcium, magnesium and sodium.

The water met the American Public Health Association standards for domestic water on all individual tests conducted. However, the sum of all these constituents (Total dissolved solids) was above the accepted standard (1000. ppm). The sulfate content (401.5 ppm) was above the recommended limit (250. ppm) but within the accepted limit (500. ppm).

Prior to its use for drinking purposes we would suggest that the water be tested for its bacteriological purity.

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D. K. Dixon

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Report On: Analysis of water samples

File No.: 5751E

Report No.:

Reported To: Brown, Erdman & Associates Ltd.
1409 Bewicke Avenue
North Vancouver, B.C.

P.O. #:

Date: March 31, 1982

Attention: Dick Erdman

We have tested the sample of water submitted by you on March 24, 1982 and report as follows:

PROJECT: 82-269, 108 RANCH

SUMMARY:

The water represented by the sample "EASZEE DRIVE" submitted can be characterized as a very hard water, also very high with respect to dissolved mineralization.

For the parameters tested, the sample met the limits set by "Guidelines for Canadian Drinking Water Quality, 1978", published by the authority of Health and Welfare, Canada with the exception of total dissolved solids (limit = 500 mg/L) and fluoride (limit = 1.5 mg/L). Total dissolved solids is evaluated in terms of its constituents, in this case mainly hardness (Calcium, and Magnesium), alkalinity, & sulfate. Hardness is of concern due to incrustation or scaling problems that may result in water systems, and due to taste problems. Alkalinity may also be of concern for aesthetic reasons.

The fluoride was noted to be borderline.

SAMPLE IDENTIFICATION:

The sample was received in plastic bottles, labelled as follows:

PROJECT: 108 RANCH
PROJECT NO: 82-269
DATE SAMPLED: MARCH 23

CTL#	IDENTIFICATION
1	Easzee Drive

..../2

Form No. 7 L

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RESULTS OF TESTING:

SAMPLE #		1
CLIENT SAMPLE I.D.		108 RANCH-EASZEE
PHYSICAL TESTS		
pH		7.35
Conductivity (micromhos/cm)		1240.
Colour [Pt-Co scale] (CU)		< 5.
Turbidity (JTU)		4.0
Hardness (mg/L)	$CaCO_3$	572.
SOLIDS (mg/L)		
Total Suspended		2.5
Total Dissolved		1070.
DISSOLVED ANIONS (mg/L)		
Alkalinity: Bicarbonate	HCO_3	444.
Alkalinity: Carbonate	CO_3	Nil
Alkalinity: Hydroxide	OH	Nil
Chlorides	Cl	4.92
Sulfates	SO_4	340.
Nitrates and Nitrites	N	< 0.010
Fluorides	F	1.60
DISSOLVED METALS (mg/L)		
Cadmium	Cd	< 0.020
Calcium	Ca	119.
Copper	Cu	< 0.015
Iron	Fe	0.12
Lead	Pb	< 0.080
Magnesium	Mg	64.9
Manganese	Mn	0.021
Potassium	K	8.17
Silicon	SiO_2	14.0
Sodium	Na	69.3
Zinc	Zn	0.062
TOTAL METALS (mg/L)		
Iron	Fe	0.51
Manganese	Mn	0.025

mg/L = milligrams per liter
< = Less than = Not Detected

METHOD OF TESTING:

The analysis was carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 15th Edition, 1980 and 14th Edition, 1975; published by the American Public Health Association.

The metals were determined by using Inductively Coupled Plasma Spectrographic analysis.

RESULTS OF TESTING:

See page 3

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Elaine McLellan
(per) Judi M. Mitchell, B.Sc.,
Chemist

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