COMPLETION REPORT

CONSTRUCTION AND TESTING OF A STANDBY COMMUNITY WATER SUPPLY WELL ON SUMAS I.R. NO. 6

Prepared for

SUMAS INDIAN BAND
3092 Sumas Mountain Road, R.R. #4
ABBOTSFORD, B.C. V2S 4N4

Prepared by

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JULY 25, 1991

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July 25, 1991

Sumas Indian Band
3092 Sumas Mountain Road, R.R. #4
ABBOTSFORD, B.C. V2S 4N4

Attention: Chief Lester Ned

Subject: **Completion Report**
Construction and Testing of a Standby Community Water Supply Well on Sumas I.R. No. 6

Dear Sirs:

Enclosed herewith is our completion report concerning the standby community water supply well recently constructed and tested by A & H Construction Ltd. on Sumas I.R. No. 6.

We trusted that the report meets with your approval. Please call if you wish to discuss any aspect of the contents of the report.

Yours truly,

PACIFIC HYDROLOGY CONSULTANTS LTD.

E. Livingston, P. Eng.

c.c. Mr. Pat Dooley, DIAND Technical Services
Mr. Peter Mazey, Health and Welfare Canada

COMPLETION REPORT

CONSTRUCTION AND TESTING OF A STANDBY COMMUNITY WATER SUPPLY WELL

ON SUMAS I.R. NO. 6

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1.0 SUMMARY AND CONCLUSIONS

1. A 200 m (8") diameter standby water supply well has been constructed on Sumas I.R. No. 6 to supply the Community of Kilgard.

2. Kilgard Well No. 2 is completed in the same local aquifer as Well No. 1, and as a recently constructed well on the Jensen Property adjacent to Sumas I.R. No. 6 on the east. Bedrock was reached at a depth of 10.1 m (33 ft) in Kilgard Well No. 2; in Well No. 1, where the bottom of the aquifer was at 12.8 m (42 ft), the saturated aquifer thickness is much greater.

3. Contrary to the conclusion reached earlier, the local aquifer that yields water to the Kilgard Wells is a confined or, at least, semi-confined aquifer, and not a water table aquifer. This is shown by the immediate drawdown which occurred in Kilgard Well No. 1 and the Jensen Well when pumping of Kilgard Well No. 2 began.

4. The performance (specific capacity) of Well No. 2 is better than that of Well No. 1. In 1977, when pumping Well No. 1 at a rate about 7.95 L/sec (105 igpm), the drawdown after about seven hours of pumping was 1.62 m (5.3 ft), for a specific capacity of 4.91 L/sec/m (19.8 igpm/ft); during the recent pump testing of Well No. 2 at a rate of 8.67 L/sec (114.5 igpm), the drawdown after about seven hours of pumping was 1.54 m (5.06 ft), for a specific capacity of 5.63 L/sec/m (22.63 igpm/ft).

5. In any case, the constriction to the capacity of either of the Kilgard Wells is the local extent of the aquifer which results in continuous drawdown in the aquifer until the cone of drawdown expands sufficiently to intercept the Sumas River recharge boundary. Testing of Well No. 1 in 1978 showed that the recharge boundary would be intercepted in about 3300 minutes when pumping at a rate of 9.08 L/sec (120 igpm).

6. The screen assembly in Kilgard Well No. 2 includes a 2.1 m (7 ft) long sump of blank pipe below the well screen; therefore, with provision for cooling of the pump motor, the permanent pump could be set below the screen.

7. As shown during the recent pump testing of Kilgard Well No. 2, the water levels in all three wells which are constructed in the local Kilgard Aquifer decline as though they are one well when the Aquifer is pumped at an high rate. Thus the combined pumping from the Kilgard Wells and the nearby Jensen Well should not exceed 9.08 L/sec (120 igpm), at least until such time as monitoring shows that an higher rate is feasible.

8. Either Kilgard Well No. 1 or No. 2 can, therefore, be pumped individually at a rate up to 9.08 L/sec (120 igpm) or simultaneously at a combined rate of 9.08 L/sec.

9. Available water analyses from 1978 (by Can Test Ltd.) and 1990 (by Analytical Service Laboratories Ltd.) for samples of groundwater from Kilgard Well No. 1, along with a recent analysis (Norwest Labs) of groundwater from the Jensen Well, in detail show significant differences for which the reason is not apparent; some of the differences appear to be lab' error. However, the important conclusion is that the groundwater in the local aquifer at Kilgard is generally of excellent quality for domestic consumption.

10. No coliforms were detected in bacteriological samples collected near the start and near the end of the seven hour pumping test of Kilgard Well No. 2 in May 1991. Neither were coliform bacteria detected in a sample collected from the Jensen Well near the end of pump testing in March 1991. Thus, there is no widespread bacterial pollution in the Kilgard Aquifer.

11. All things considered, there is every reason to believe that improvements proposed for the Well Field area should adequately protect the shallow Kilgard Aquifer from the intermittent bacterial pollution which has occurred.

2.0 RECOMMENDATIONS

The following recommendations are made in regard to the use and protection of the Kilgard Wells on Sumas I.R. No. 6:

1. In selecting a pump capacity for Kilgard Well No. 2 for standby, consider the pattern of water use in the system but do not install a pump which will deliver more than 9.08 L/sec (120 igpm).

2. Include in the well head installations, provision for monitoring both water consumption and water levels. For the former, a totalizing water meter and an hour meter are required; for measuring water levels, a small diameter PVC tube strapped to the drop pipe of the pump, and through which an electric water level indicator can be lowered, has been shown to be suitable.

3. Improve well head drainage and aquifer protection by carrying out the following:

   a. Extend the well casing at Kilgard Well No. 1 such that the casing is above any potential flood level.

   b. Extend both the surface and well casing at Kilgard Well No. 2 above any potential flood level and ensure that any windows cut in the casings for the pitless adaptor are properly sealed.

   c. Prevent any surface water from entering the ground immediately upslope of the Wells or from moving down along the well casings, by installing a shallow cut-off drain upslope of the Wells.

   d. In the vicinity of the Wells, seal the water line trench between the Wells with a bentonite sealant.

   e. Convey, by a trough, the small stream from the hillside to a point beyond the Wells where it can no longer directly enter the ground in the vicinity of the Wells.

4. Commence a program of data collection to ensure that any declines in aquifer, well or pump performance are immediately evident.

3.0 INTRODUCTION

The purposes of this report are to:

1. Present the data collected during the construction and testing of a standby water well to supply the community of Kilgard on Sumas I.R. No. 6.

2. Address the issue of protection of the groundwater source from pollution.

Background information concerning the capacity of Kilgard Well No. 1, of the aquifer which yields water to the Well, and about bacterial contamination of the well water source, are contained in the following letter-reports by Pacific Hydrology Consultants Ltd.:

1. To David Nairne & Associates Ltd. dated October 28, 1986, on the subject "Evaluation of the Capacity of the Existing Well Which Supplies the Community of Kilgard on Sumas I.R. No. 6".

2. To David Nairne & Associates Ltd. dated April 12, 1988, on the subject "Step-Drawdown Pumping Test to Check the Performance of the Kilgard Community Well on Sumas I.R. No. 6".

3. To Sumas Band dated February 28, 1991, on the subject "Improvements to the Groundwater Source and Water System on Sumas I.R. No. 6".

The services to be provided by Pacific Hydrology for the project covered by this report were outlined in an "Agreement Between Sumas Indian Band and Pacific Hydrology Consultants Ltd.", dated and signed on 12 March 1991, to be as follows:

2.1 A site visit of February 5, 1991, discussions with Band Officials, among others, prior to, during and following the visit, and subsequent preparation of a letter-report dated February 28, which has already been presented to the Band.

2.2 Preparation of documents for Band approval to obtain prices and to make a contract with a drilling contractor for construction and testing of standby well in close proximity to the existing well.

2.3 Supervision of the construction and testing of a new standby well, including sieve analyses, design of the well screen, etc., and collection of water samples for chemical and bacterial analysis.

2.4 Supervision of pump testing of the new well.

2.5 Preparation of a report on the project and meetings with the Band, as appropriate, to discuss the progress and/or results.

Subsequently it was mutually agreed that Sumas Band would accept responsibility for Item 2.2.

Figure 1 in Appendix A is an area location map and site plan of Sumas I.R. No. 6; the site plan of the northeast part of the Reserve shows the approximate locations and relative positions of the Kilgard Wells and of the nearby Jensen Well.

4.0 DRILLING AND WELL CONSTRUCTION

The drilling and construction of Kilgard Production Well No. 2 was carried out by A & H Construction Ltd. under an agreement made with Sumas Band. The 200 mm (8") diameter well was drilled using an air rotary drill. Drilling began by installing 5.6 m (18.5 ft) of 300 mm (12") diameter surface casing, below which drilling continued with 200 mm (8") diameter casing to bedrock at a depth of 10.1 m (33 ft). Open-hole drilling was continued into the bedrock to a final depth of 18.4 m (60.5 ft).

A 1.5 m (5.0 ft) long Johnson stainless steel 200 mm (8") nominal diameter screen was installed in the interval 8.6 to 10.1 m (28 to 33 ft) by the standard pull-back method and development was carried out by air surging. The screen assembly includes a 2.1 m (7 ft) long sump of 178 mm (7") i.d. pipe below the screen. Development was continued until the amount of sand that could be brought through the screen was reduced to an acceptable level.

The driller's litholog of sediments encountered in Kilgard Well No. 2 is included in Appendix B (Page B - 1); details about construction of the Well are shown on Figure 2 (Page B - 3). For easy reference, included in Appendix B are the litholog and construction details for Kilgard Well No. 1, and also for the nearby Clarence Jensen Well which was used as an observation well during the pumping test of the new Kilgard Well No. 2.

The dimensions of the two Kilgard Wells are contained in Table 1 which follows.

Table 1. Dimensions of Kilgard Production Wells

Well	Completed Depth		Location of Well Screen		Static Water Level	
	m	(ft)	m	(ft)	m	(ft)
No. 1-1977	12.2	(40)	10.5 - 12.2	(34.3 - 40)	2.63	(8.63)
No. 2-1991	12.2	(40)	8.35 - 10.1	(27.4 - 33)	2.44	(8.00)

(Note that all measurements are below ground at the time of well construction.)

5.0 PUMPING TEST

5.1 Test Procedure

Kilgard Well No. 2 was pump tested on May 21 by A & H Construction Ltd. using a submersible test pump. The discharge rate during pumping was measured by timing the filling of a container of known volume. The discharge water was conveyed away from the Well by about 107 metres (350 ft) of 100 mm (4") diameter lay-flat pipe. Water levels were measured with electric water level indicators. The water levels in Kilgard Well No. 1, at a distance of 9.3 m ($30\frac{1}{2}$ ft), and the Clarence Jensen Well, at a distance of 40 m (131.2 ft), were observed during the test.

Pumping of Kilgard Well No. 2 began on May 21 at 9:00 a.m. and was continued for 420 minutes (7 hours) at a constant-rate of 8.67 L/sec ($114\frac{1}{2}$ igpm). Following the termination of pumping, the recovering water level was observed for 1010 minutes. The purpose of the test was not to obtain information for aquifer evaluation since this is available from extensive pump testing of Well No. 1 but, rather, to obtain information on well performance and well interference.

5.2 Test Results

Data collected during the pumping test of Kilgard Well No. 2 are contained in Appendix C. The data have been plotted in the usual way according to standard straight line methods of analyzing pumping test data, with drawdown versus log of time since pumping started and, in the case of the recovery data, residual drawdown versus log of the ratio,

$$\frac{\text{time in minutes since pumping started}}{\text{time in minutes since pumping stopped}}$$

The drawdown data for all three wells are plotted on the same graph, as are the recovery data.

The plot of the drawdown data (Figure 3, Page C - 8) is effective in showing:

1. All three Wells draw down in the same manner, in response to the lowering of the water table in the local aquifer by the pumping of Well No. 2. The total drawdown in each of the Wells after seven hours of pumping was as follows:
   - Kilgard Well No. 2 (Pumping) - 1.543 m (5.06 ft);
   - Kilgard Well No. 1 (Observation) - 1.474 m (4.835 ft);
   - Clarence Jensen Well (Observation - 1.047 m (3.43 ft).
2. As expected, from previous long-duration pumping of Kilgard Well No. 1 in 1977 and 1978, the water level in the aquifer (and Wells) was still drawing down after seven hours of pumping.

The plot of the recovery data (Figure 4, Page C - 9) shows:

1. Similar to the response of the water levels in all three Wells during pumping, the trends of the straight-line recoveries are all the same.
2. The water levels in all three Wells will recover completely, confirming that recharge to the aquifer is satisfactory.

A comparison of the performance of the new Kilgard Well No. 2 with that of Well No. 1, for a similar pumping rate and duration of pumping, is contained in Table 2 which follows.

Table 2. Comparison of Performances of Kilgard Production Wells

Well	Pumping Rate		Duration of Pumping	Drawdown		Specific Capacity	
	L/sec	(igpm)	(minutes)	m	(ft)	L/sec/m	(igpm/ft)
No. 1-1977	7.95	(105)	409	1.61	(5.29)	4.94	(19.85)
No. 2-1991	8.67	(114½)	420	1.55	(5.09)	5.59	(22.50)

The table shows that the performance (specific capacity) of the new Well No. 2 is somewhat better than that of Well No. 1, inspite of the fact that the aquifer is thinner at Well No. 2.

5.3 Analysis of Results

The recent pump testing of Kilgard Well No. 2 is consistent with the results of previous long-duration testing of Kilgard Well No. 1. However, contrary to earlier assumptions that the aquifer is a water table aquifer, the immediate drawdown which occured in both Kilgard Well No. 1 and the Jensen Well due to the pumping of Kilgard Well No. 2 is a more characteristic response of a confined aquifer. Under the prevailing circumstances, this has no particular significance other than it implies that the aquifer is protected by a less permeable layer. Attention is drawn to the driller's record for Well No. 1 which shows "clay, sand and gravel" from 1.2 to 3.7 m (4 to 12 ft); this may represent a less permeable confining layer.

The greater implication of the test results from the pump testing of Kilgard Well No. 2 is that other wells to obtain additional water should obviously not be constructed in the Kilgard Aquifer. This is shown by the continuing drawdown that occurred during long-duration pumping of Well No. 1 in 1978 which resulted in a specific capacity of 2.96 L/sec/m (11.92 igpm/ft) after pumping at a rate of 9.08 L/sec (120 igpm) between 2400 and 4020 minutes of pumping. This is in contrast to the previously mentioned short-duration specific capacity of 4.94 L/sec/m (19.85 igpm/ft) after only seven hours of pumping.

6.0 WELL AND AQUIFER CAPACITY AND AQUIFER MANAGEMENT

In the prevailing situation at Sumas I.R. No. 6, the well capacity is controlled primarily by the response of the local aquifer to pumping, in which continuous drawdown occurs until the cone of drawdown eventually intercepts the recharge boundary of the Sumas River. Extensive pump testing has clearly shown that the aquifer capacity is at least 9.08 L/sec (120 igpm) and, at such a rate, about 45% of the total available drawdown above the screen in Well No. 1 would be used. As shown by the recent pump testing of Well No. 2, mutual well interference controls well capacity such that the two Kilgard Wells must be considered one Well. Thus, in equipping the Wells with pumps, the choice becomes either to equip each Well with a pump of maximum capacity about 9.08 L/sec for individual pumping or to equip each Well with a pump of capacity 4.54 L/sec (60 igpm) for individual and/or simultaneous pumping.

The projected pumping water levels for individual pumping of the Kilgard Wells at the two rates are as shown in Table 3 which follows.

Table 3. Individual Capacities of Kilgard Production Wells

Well	Capacity		Projected Pumping Water Level*		% of Total Available Drawdown	Remarks
	L/sec	(igpm)	m	(ft)		
No. 1-1977	4.54	(60)	4.6-4.9	(15 - 16)	23	
	9.08	(120)	6.1-6.7	(20 - 22)	45	
No. 2-1991	4.54	(60)	4.1-4.7	($13\frac{1}{2}$- $15\frac{1}{2}$)	26	Note that there is less available drawdown in Well No. 2.
	9.08	(120)	5.2-5.8	(17 - 19)	46	

[*Below original ground level and assuming a minimum static level about 3 m (10 ft).]

Under the prevailing circumstances, where the Kilgard Aquifer is an important water source which cannot easily be replaced, proper aquifer management cannot be over-emphasized. In a properly managed aquifer, production wells should be operated in such a way as to obtain the following information:

1. the amount of water pumped from each well in a given period;

2. the water level in the well when the pump is not running;

3. the water level in the well when the pump is running.

The only reliable way to determine 1. is to install metering at the Well(s). Flow estimates based on pump performance curves or on the amount of power consumed are not satisfactory. A totalizing water meter to record consumption and an hour meter to record the duration of pumping in any period are necessary to accurately calculate pumping rate. This is important in monitoring well performance so that declines in performance, which will result in reduced well capacity, are immediately detected, enabling well rehabilitation to be carried out during low demand periods. Good management may also include periodic well rehabilitation.

Experience shows that the most satisfactory method for measuring water levels is an electric water level indicator; to facilitate water level measurements by this method, a small diameter plastic tube is usually taped to the drop pipe of the pump.

When a well is properly equipped for monitoring, it is possible to quickly determine whether the well performance has decreased, whether the pump is performing properly or whether both pump and well performance may have declined. A rational and systematic well and pump maintenance program then becomes possible. Data should be analyzed once each year in order to check for the following:

1. Long-term depletion of the aquifer(s).

2. Cumulative effect of mutual well interference during long-term continuous pumping.

3. Changes, usually declines, in well performance.

In an aquifer management strategy at Kilgard, the two main concerns are:

1. The overall long-term performance of the aquifer, particularly if the water demand in the Kilgard System approaches the indicated 9.08 L/sec (120 igpm) aquifer capacity.

2. A record of aquifer response to the use of the Kilgard Wells so as to discourage other potential users from constructing wells in the local aquifer.

Included in Appendix E is a data sheet suitable for tabulating the various parameters required for effective well and aquifer management. From these data, various calculations and plots can be prepared to show what is happening and, from such analysis, trends to declines in well, aquifer and/or pump performance will become apparent long before they are serious enough to become major problems.

7.0 GROUNDWATER QUALITY

As shown by several analyses of groundwater from the Kilgard Aquifer, the water is a fairly soft and moderately mineralized calcium + magnesium/ bicarbonate + sulphate type of water which is of general good quality for domestic uses. Included in Table 4 in Appendix D are the results of three chemical analyses of groundwater from the Kilgard Aquifer. Even though the analyses are by three different laboratories several years apart, the results are generally consistent. However, in detail, there are at least two large differences in specific ion content:

1. The initial analysis by Can Test Ltd. for a sample collected from Well No. 1 during pump testing in 1978 shows a sulphate content of 25.3 mg/L, while a sample collected from the Kilgard Water System (H. Silver House) in 1990 shows only 3.2 mg/L and the recent analysis from the Jensen Well shows only 6.8 mg/L.

2. The 1978 analysis of water from Well No. 1 and the 1990 analysis of water from the System (H. Silver House) show respective calcium contents of 18.9 mg/L and 17.2 mg/L, while the recent analysis of water from the Jensen Well shows only 1.3 mg/L of calcium; the latter almost certainly is an error.

Included in Appendix D are the results of bacteriological analyses of samples collected from the new Well No. 2 during pump testing at the end of May 1991 - one sample was collected about one hour after pumping started (ASL analysis) and the other was collected near the end of the seven hours of pumping (Norwest Labs' certificate). Neither of these samples contained any coliform bacteria. The certificate for the analysis of a water sample collected from the Jensen Well during pump testing in March 1991, which is included in Appendix D, shows that water pumped from the Kilgard Aquifer by the Jensen Well was also free of coliform bacteria. Thus, there is no evidence of widespread pollution of the Kilgard Aquifer and the best explanation for the intermittent high levels of coliforms in water from Well No. 1 is that surface water from the stream off the hillside to the north directly enters the ground near the Well.

8.0 WELL AND AQUIFER PROTECTION

The recent bacteriological analyses of samples of groundwater collected during pump testing of Kilgard Well No. 2, which did not show any coliform bacteria, and also the results of the recent pumping test of Well No. 2, which indicated that there is a low permeability confining layer over the Kilgard Aquifer, indicate that there is no widespread pollution of the Aquifer. All things considered, the most likely explanation for the intermittent bacterial pollution, which has been detected in the groundwater from Kilgard Well No. 1, is the small intermittent stream which flows off the hillside north of the Well and, as reported in Pacific Hydrology's letter of February 26 to Sumas Band, was observed to enter the ground at a distance about 20 to 30 metres (65 to 100 ft) from the Well.

While the recent pump testing shows that there is a low permeability layer confining the Kilgard Aquifer, the Wells are located in an area which was disturbed during quarrying operations that took place many years ago. This disturbance may explain why the stream would enter the ground inspite of the confining layer indicated by pump testing - that is, the protective layer at that location may have been removed. To prevent bacterial pollution from this source, Pacific Hydrology's letter of February 28, 1991 recommeneded

> "...as a first step, the small stream be conveyed to a point beyond the Well where it can no longer directly enter the ground. This can be done by installing a trough, preferably a corrugated steel trough on the surface of the ground, to discharge in the field east of the Well."

As further resolution of the problem of intermittent bacterial pollution of the well water source, Pacific Hydrology's letter of February 28 recommended proceeding as follows to eliminate the possibility of flood levels rising above the casing of existing Well No. 1:

1. Removing the present pump house and its concrete floor.
2. Excavating around the well casing to a depth about one metre (3.3 ft) below present grade.
3. Extending the well casing about 1½ to 2 metres (5 to 6½ ft).
4. Installing and grouting in place, with either concrete or a bentonite seal, a surface casing one size large than the existing casing.

5. Placing $1\frac{1}{2}$ to 2 metres of fill around the Well, making a ramp on one side so that a drilling rig or pump hoist can work on the Well.

6. Finally, replacing the concrete floor and putting the pump house back in place.

In our opinion, this is still a reasonable course of action to take to resolve the potential for flooding of the existing well casing. However, A & H Construction Ltd. have proposed to the Band in a letter, with sketches, dated April 24, 1991 that the existing casing in Well No. 1 be raised above flood level within the existing pump house rather than dismantling the pump house and raising the floor. If so, a surface casing could be placed by breaking up the concrete and excavating around the existing 200 mm (8") diameter well casing by hand and then grouting in place a 300 mm (12") diameter surface casing. However, all things considered, it is probably advisable to disturb the ground around the existing Well as little as possbile. A bentonite surface seal around the upper part of the well casing could be placed by drilling through the concrete floor and pumping in grout.

At the new Well No.2 which is constructed with an outer 300 mm (12") diameter casing, A & H Construction have proposed to protect the well head by extending the well casing above potential flood level and installing a berm around the Well, with the 300 mm (12") diameter surface casing grouted in place and cut off at ground level. All things considered, it seems advisable to extend both casings above flood level with a steel plate welded over the annular opening between the two casings. It is obviously essential that, if windows are cut into the casings for the pitless adaptor, they be properly sealed after installation.

As added protection of the well head areas, the following measures are recommended:

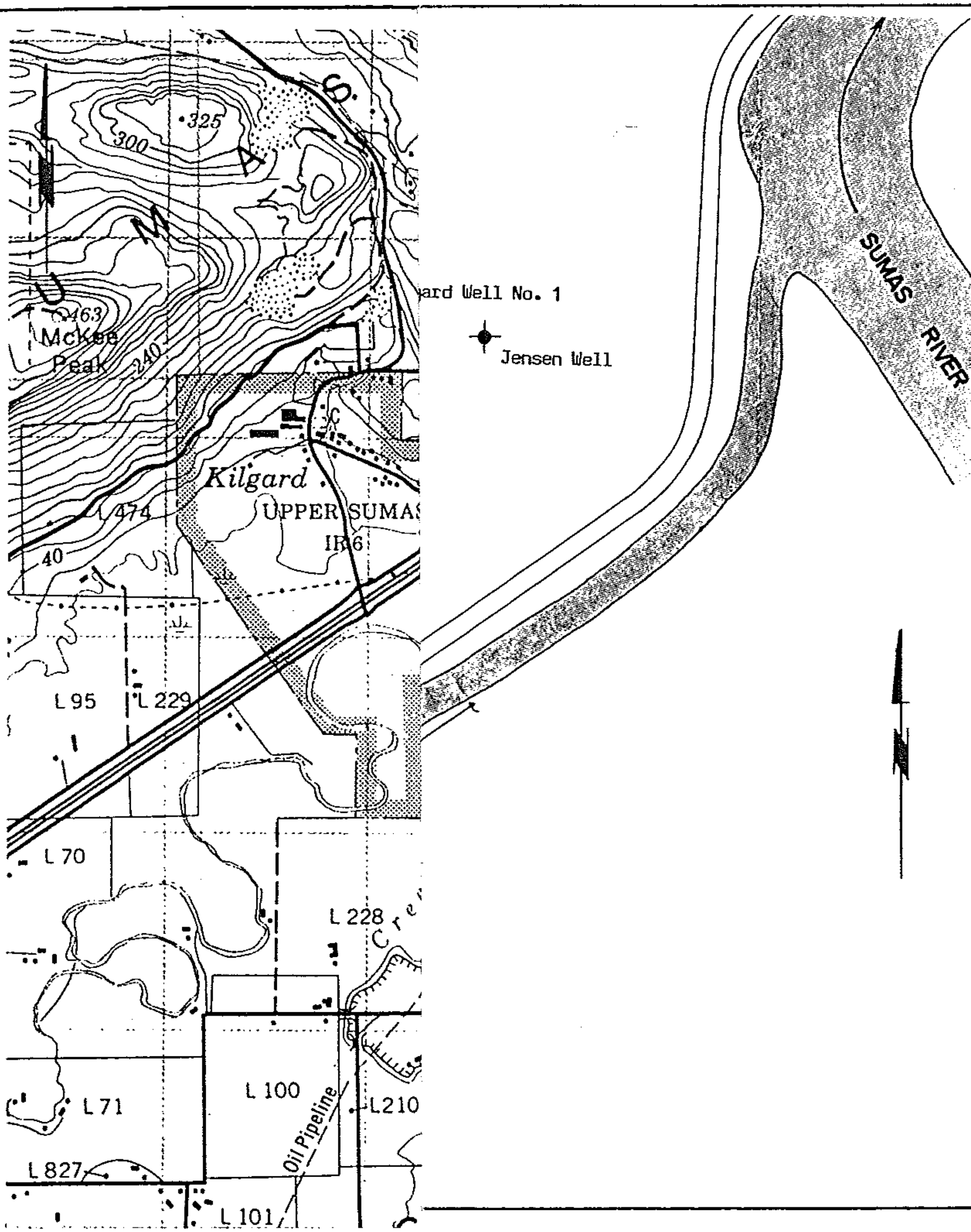
1. Install a cutoff drain upslope of the Wells to prevent surface water and shallow subsurface water from moving toward and down along the well casings.

2. Adjacent to the Wells, backfill the trench for the water line connection between the Wells, and also the connection to the water main, with fine-grained sediments containing a bentonite sealant.

APPENDIX A

WELL LOCATION MAP AND SITE PLAN

FIGURE 1



Notes:

1. The base map is 1:50,000 scale ... gure 1, Job Number 1593-P; Job Name - "Upper Sumas ... ng Title - "Site Plan"; of scale 1:2,000; dated ... scale of 1:30,000; contour int...
2. ▶ ◎ outlines location of ... ter well, as identified.

APPENDIX B

LITHOLOGS AND WELL CONSTRUCTION DETAILS

WTN 107839

KILGARD COMMUNITY WELL NO. 2

Location: In the northeast corner of Sumas I.R. No. 6, at a distance 9.3 m (30½ ft) west of Well No. 1.

Date of construction: May 16, 1991.

Contractor: A & H Construction Ltd.

Driller's litholog:

0 - 2.1 m (0 - 7 ft)	shale gravel containing a 1.2 m (4 ft) boulder
2.1 - 10.1 m (7 - 33 ft)	shale gravel
10.1 - 18.4 m (33 - 60.5 ft)	bedrock.

Diameter: 200 mm (8") with 5.6 m (18½ ft) of 300 mm (12") diameter surface casing without a shoe.

Static water level: On May 21, 1991, prior to pump testing, 2.74 m (9.00 ft) below the well casing stickup of 0.3 m (1 ft).

Completion:

Kilgard Well No. 2 is completed with the following assembly of 200 mm (8") nominal diameter Johnson stainless steel well screen and 178 mm (7") i.d. blank pipe:

at top at 8.35 m (27.4 ft)	type K packer
1.5 m (5 ft) of	2.03 mm (0.080") slot screen with bottom at 10.1 m (33 ft)
2.1 m (7 ft) of	178 mm (7") i.d. pipe
at bottom at 12.2 m (40 ft)	bail bottom.

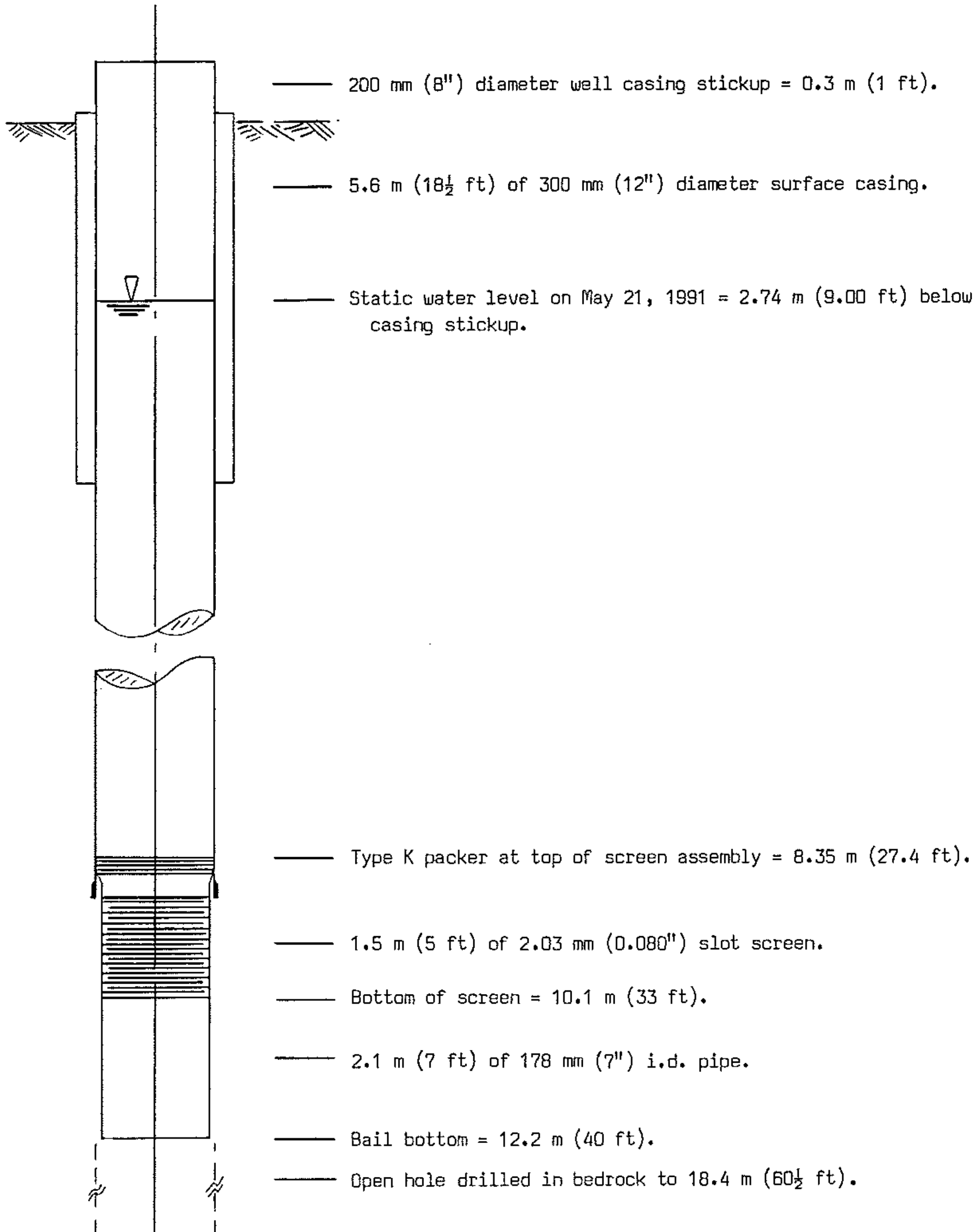
Measurements are below ground at the time of well construction.

KILGARD COMMUNITY WELL NO. 2 (cont'd)

Performance: Kilgard Well No. 2 was pump tested on May 21, 1991 for 420 minutes (7 hours) at a constant rate of 8.67 L/sec (114.5 igpm), with drawdown of 1.54 m (5.06 ft) for a specific capacity of 5.63 L/sec/m (22.63 igpm/ft).

Capacity: Like Kilgard Well No. 1, the capacity of Well No. 2 is controlled by the capacity of the local aquifer, estimated to be about 7.57 L/sec (100 igpm), and not by the Well itself. A pump of capacity up to 9.08 L/sec (120 igpm) can be installed in the well for individual short-duration pumping.

FIGURE 2	KILGARD WELL NO. 2 CONSTRUCTION DETAILS



Notes:

1. The sketch is not to scale.
2. All measurements are below ground at the time of well construction unless otherwise noted.
3. The well screen is 200 mm (8") nominal diameter Johnson stainless steel.

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KILGARD COMMUNITY WELL NO. 1

Location: In the northeast corner of Sumas I.R. No. 6.

Date of construction: September 1971.

Contractor: A & H Construction Ltd.

Driller's litholog:

0 - 1.2 m	(0 - 4 ft)	fill
1.2 - 3.7 m	(4 - 12 ft)	clay, sand and gravel
3.7 - 13.1 m	(12 - 42 ft)	gravel.

Diameter: 200 mm (8").

Static water level: 3.0 m (9.88 ft) below top of well casing on October 11, 1977; 2.60 m (8.52 ft) below top of well casing on March 31, 1988.

Completion: Kilgard Well No. 1 is completed with 1.5 m (5 ft) of Johnson stainless steel 200 mm (8") nominal diameter well screen with 1.52 mm (0.060") slots; at the top of the assembly, at 10.5 m (34.4 ft), is a lead packer and, at the bottom at 12.2 m (40 ft), a bail bottom.

KILGARD COMMUNITY WELL NO. 1 (cont'd)

Well performance:

Date	Static Water Level		Duration of Pumping	Pumping Rate		Drawdown		Specific Capacity	
	m	(ft)	(minutes)	L/sec	(igpm)	m	(ft)	L/sec/m	(igpm/ft)
10/11/77	3.01	(9.88)	0-1459	7.95	(105)	2.17	(7.12)	3.66	(14.75)
			1459-1519	6.21	(82)	1.89	(6.20)	3.28	(13.22)
06/12/78	1.97	(6.46)	0-2400	6.06	(80)	1.84	(6.04)	3.29	(13.25)
			2400-2430	9.08	(120)	2.17	(7.12)	4.18	(16.85)
			2430-4020	9.08	(120)	3.07	(10.07)	2.96	(11.92)
			4020-7020	6.81	(90)	2.42	(7.93)	2.81	(11.35)
03/31/88	2.69	(8.82)	0- 30	4.54	(60)	0.69	(2.25)	6.58	(26.67)
			30- 60	5.83	(77)	0.86	(2.82)	6.78	(27.30)
			60- 90	6.36	(84)	1.07	(3.50)	5.94	(24.00)
			90- 120	8.18	(108)	1.64	(5.39)	4.99	(20.04)
			120- 150	9.31	(123)	2.12	(6.95)	4.39	(17.70)

Well capacity: Long-duration pump testing in October 1977 and June 1978 showed an aquifer capacity about 7.57 (100 igpm), with a well capacity as great as 9.07 L/sec (120 igpm) for short-duration pumping.

WTN 107840

CLARENCE JENSEN WELL

Location: On the property adjacent on the east to Sumas I.R. No. 6, at a distance 40 m (131.2 ft) east of Kilgard Well No. 2.

Date of construction: March 1991.

Contractor: A & H Construction Ltd.

Driller's litholog:

0 - 2.4 m	(0 - 8 ft)	top soil
2.4 - 11.3 m	(8 - 37 ft)	sand and gravel.

Diameter: 150 mm (6").

Static water level: 2.03 m (6.67 ft) below the well casing stickup of about 0.4 m (15"), on March 25, 1991; 1.974 m (6.47 ft) on May 25.

Completion: The Clarence Jensen Well is completed with 1.2 m (4 ft) of 1.27 mm (0.050") slot Johnson stainless steel screen, with a type K packer and bail bottom, set between 9.8 and 11.3 m (32.3 and 37 ft).

Performance: The Clarence Jensen Well was pump tested on March 25 and 26, 1991 for 24 hours at a constant rate of 1.1 L/sec (15 igpm), which resulted in maximum drawdown of 0.44 m (1.46 ft) for a specific capacity of 2.5 L/sec/m (10.3 igpm/ft).

APPENDIX C

PUMPING TEST DATA AND PLOTS

PUMP TEST – DRAWDOWN DATA

21	MAY	1991
DAY	MONTH	YEAR

CONTRACTOR A & H Construction Ltd.

PROJECT SUMAS INDIAN BAND – SUMAS I.R. NO. 6

Location Northeast corner of Sumas I.R. No. 6

Well No. 2

Pumping Rate (Q) Constant at 114½ igpm (8.67 L/sec)

Datum Point Top of well casing

Elevation of Datum Point one ft (0.3 m) above ground

Static Water Level 9.00 ft (2.74 m)

Screen Location 27½ to 33 ft (8.38 to 10.06 m)

TIME HR.	TIME MIN.	ELAPSED TIME t (MIN.)	DISTANCE TO WATER	DRAWDOWN (ft)		SECONDS TO FILL 55 USGAL	PUMPING RATE (igpm)	REMARKS
09	00		9.00					Start pump.
09	00½	½	9.46	0.46				
09	01	1	9.48	0.48				
09	01½	1½	9.48	0.48				
09	02	2	9.50	0.50				
09	02½	2½	9.52	0.52				
09	03	3	9.54	0.54				
09	03½	3½	9.56	0.56				
09	04	4	9.59	0.59				
09	04½	4½	9.60	0.60				
09	05	5	9.625	0.625		24	114½	
09	06	6	9.67	0.67				
09	07	7	9.71	0.71				
09	08	8	9.75	0.75				
09	09	9	9.77	0.77				
09	10	10	9.79	0.79				
09	12	12	9.81	0.81				
09	14	14	9.83	0.83				
09	16	16	9.875	0.875				
09	18	18	9.96	0.96				
09	20	20	10.08	1.08				
09	25	25	10.23	1.23				
09	30	30	10.375	1.375				
09	35	35	10.51	1.51				
09	40	40	10.625	1.625				
09	50	50	10.875	1.875				
10	15	75	11.29	2.29				
10	40	100	11.44	2.44		24	114½	

PUMP TEST – DRAWDOWN DATA

21	MAY	1991
DAY	MONTH	YEAR

PROJECT SUMAS INDIAN BAND - SUMAS I.R. NO. 6

Well No. 2 Static Water Level 9.00 ft (2.74 m)

TIME		ELAPSED TIME	DISTANCE TO WATER	DRAWDOWN (ft)		SECONDS TO FILL 55 USGAL	PUMPING RATE (igpm)	REMARKS
HR.	MIN.	t (MIN.)						
11	30	150	12.19	3.19				
12	20	200	12.625	3.625				
13	10	250	13.04	4.04				
14	00	300	13.33	4.33				
14	50	350	13.59	4.59				
15	40	400	13.94	4.94				
16	00	420	14.06	5.06				Stop pump.

PUMP TEST – RECOVERY DATA

21/22	MAY	1991
DAY	MONTH	YEAR

PROJECT SUMAS INDIAN BAND – SUMAS I.R. NO. 6

Well No. 2

Datum Point Top of well casing   Elevation of Datum Point one ft (0.3 m) above ground

Static Water Level 9.00 ft (2.74 m)   Total Drawdown 14.06 ft (4.29 m)

TIME		ELAPSED TIME SINCE PUMPING STARTED	ELAPSED TIME SINCE PUMPING STOPPED	RATIO (t/t')	DISTANCE TO WATER	RESIDUAL DRAWDOWN (ft)		REMARKS
HR.	MIN.	t (min.)	t' (min.)					
16	00	420			14.06	5.09		Stop pump.
16	00½	420½	½	841	13.71	4.71		
16	01	421	1	421	13.71	4.71		
16	01½	421½	1½	281	13.67	4.67		
16	02	422	2	211	13.65	4.65		
16	02½	422½	2½	169	13.625	4.625		
16	03	423	3	141	13.58	4.58		
16	03½	423½	3½	121	13.54	4.54		
16	04	424	4	106	13.52	4.52		
16	04½	424½	4½	94.3	13.48	4.48		
16	05	425	5	85	13.46	4.46		
16	06	426	6	71	13.39	4.39		
16	07	427	7	61	13.32	4.32		
16	08	428	8	53.5	13.23	4.23		
16	09	429	9	47.7	13.17	4.17		
16	10	430	10	43.0	13.11	4.11		
16	12	432	12	36.0	13.06	4.06		
16	14	434	14	31.0	12.98	3.98		
16	16	436	16	27.25	12.91	3.91		
16	18	438	18	24.3	12.81	3.81		
16	20	440	20	22.0	12.71	3.71		
16	25	445	25	17.8	12.52	3.52		
16	30	450	30	15.0	12.45	3.45		
16	35	455	35	13.0	12.29	3.29		
16	40	460	40	11.5	12.19	3.19		
16	50	470	50	9.4	11.99	2.99		
17	15	495	75	6.6	11.625	2.625		
17	40	520	100	5.2	11.18	2.18		
18	40	580	160	3.6	10.67	1.67		
22/08	50	1430	1010	1.4	9.08	0.08		

PUMP TEST – DRAWDOWN DATA

21	MAY	1991
DAY	MONTH	YEAR

CONTRACTOR A & H Construction Ltd.

PROJECT SUMAS INDIAN BAND – SUMAS I.R. NO. 6

Location Kilgard No. 1 - 9.3 m (30½ ft) east of No. 2
Jensen -40.0 m (131 ft) east of Kilgard No. 2

Well Observation (Kilgard No. 1 & Jensen)   Pumping Rate (Q) -

Datum Point Tops of well casings   Elevation of Datum Point KG1 - 0.4 m (15") above concrete floor
Jensen - 0.4 m (15") above ground

Static Water Level KG1 - 8.875 ft (2.706 m)
Jensen - 1.974 m (6.47 ft)   Screen Location KG1 - 34.4 - 40 ft (10.5 - 12.2 m)
Jensen - 32.3 to 37 ft (9.8 - 11.3 m)

TIME		ELAPSED TIME	KILGARD NO. 1		JENSEN			REMARKS
HR.	MIN.	t (MIN.)	DISTANCE TO WATER	DRAWDOWN (ft)	DISTANCE TO WATER	DRAWDOWN (m)		
09	00		8.875		1.974			Static levels; start
								Pump in Kilgard
								Well No. 2.
09	00½	½	9.08	0.205	1.997	0.023		
09	01	1	9.10	0.225	2.000	0.026		
09	01½	1½	9.125	0.250	2.012	0.038		
09	02	2	9.15	0.275	2.018	0.044		
09	02½	2½	9.15	0.275	2.023	0.049		
09	03	3	9.15	0.275	2.024	0.050		
09	03½	3½	9.17	0.295	2.027	0.053		
09	04	4	9.21	0.335	2.031	0.057		
09	04½	4½	9.23	0.355	2.036	0.062		
09	05	5	9.23	0.355	2.038	0.064		
09	06	6	9.27	0.395	2.045	0.071		
09	07	7	9.29	0.415	2.052	0.078		
09	08	8	9.35	0.475	2.061	0.087		
09	09	9	9.40	0.525	2.067	0.093		
09	10	10	9.44	0.565	2.073	0.099		
09	12	12	9.58	0.705	2.085	0.111		
09	14	14	9.625	0.750				
09	15	15			2.102	0.128		
09	16	16	9.67	0.795				
09	18	18	9.75	0.875				
09	20	20	9.81	0.935				
09	22	22			2.145	0.171		
09	25	25	9.92	1.045	2.158	0.184		
09	30	30	10.02	1.145				
09	35	35	10.17	1.295				

PUMP TEST – DRAWDOWN DATA

21	MAY	1991
DAY	MONTH	YEAR

PROJECT SUMAS INDIAN BAND - SUMAS I.R. NO. 6

Well Observation   Static Water Level KG1 - 8.875 ft (2.706 m)
Jensen - 1.974 m (6.47 ft)

TIME		ELAPSED TIME	KILGARD NO. 1		JENSEN			
HR.	MIN.	t (MIN.)	DISTANCE TO WATER	DRAWDOWN (ft)	DISTANCE TO WATER	DRAWDOWN (m)		REMARKS
09	36	36			2.217	0.243		
09	40	40	10.27	1.395				
09	50	50	10.48	1.605	2.284	0.310		
10	02½	62½			2.380	0.406		
10	15	75	10.96	2.085	2.392	0.418		
10	40	100	11.31	2.435	2.461	0.487		
11	30	150	11.85	2.975	2.568	0.594		
12	20	200	12.25	3.375	2.675	0.701		
13	10	250	12.625	3.750	2.775	0.801		
14	00	300	13.00	4.125	2.880	0.906		
14	50	350	13.31	4.435	2.925	0.951		
15	40	400	13.58	4.705	3.000	1.026		
16	00	420	13.71	4.835	3.021	1.047		Stop pump in Kilgard
								Well No. 2.

PUMP TEST – RECOVERY DATA

21	MAY	1991
DAY	MONTH	YEAR

PROJECT SUMAS INDIAN BAND - SUMAS I.R. NO. 6

Well Observation (Kilgard No. 1 & Jensen)

Datum Point Tops of well casings

Elevation of Datum Point KG1 - 0.4 m (15") above concrete floor
Jensen - 0.4 m (15") above ground

Static Water Level KG1 - 8.875 ft (2.706 m)
Jensen - 1.974 m (6.47 ft)

Total Drawdown KG1 - 4.835 ft (1.474 m)
Jensen - 1.047 m (3.43 ft)

TIME		ELAPSED TIME SINCE PUMPING STARTED	ELAPSED TIME SINCE PUMPING STOPPED	RATIO (t/t')	KILGARD NO. 1 DISTANCE TO WATER	KILGARD NO. 1 RESIDUAL DRAWDOWN (ft)	JENSEN DISTANCE TO WATER	JENSEN RESIDUAL DRAWDOWN (m)	REMARKS
HR.	MIN.	t (min.)	t' (min.)						
16	00	420			13.71	4.835	3.021	1.047	Stop pump in
									Kilgard Well
									No. 2.
16	00½	420½	½	841	13.54	4.665			
16	01	421	1	421	13.52	4.645			
16	01½	421½	1½	281	13.46	4.585			
16	02	422	2	211	13.42	4.545			
16	02½	422½	2½	169	13.40	4.525			
16	03	423	3	141	13.35	4.475			
16	03½	423½	3½	121	13.33	4.455			
16	04	424	4	106	13.31	4.435			
16	04½	424½	4½	94.3	13.27	4.395			
16	05	425	5	85	13.25	4.375			
16	06	426	6	71	13.17	4.295			
16	07	427	7	61	13.11	4.235			
16	08	428	8	53.5	13.10	4.225			
16	09	429	9	47.7	13.02	4.145			
16	10	430	10	43.0	12.98	4.105			
16	12	432	12	36.0	12.84	3.965			
16	13	433	13	33.3			2.905	0.931	
16	14	434	14	31.0	12.77	3.895			
16	16	436	16	27.25	12.69	3.815			
16	18	438	18	24.3	12.625	3.750			
16	20	440	20	22.0	12.54	3.665	2.850	0.876	
16	25	445	25	17.8	12.375	3.500			
16	30	450	30	15.0	12.23	3.355			
16	35	455	35	13.0	12.02	3.145			
16	40	460	40	11.5	11.96	3.085	2.730	0.756	
16	50	470	50	9.4	11.79	2.915			
17	15	495	75	6.6	11.40	2.525			

PUMP TEST — RECOVERY DATA

21/22	MAY	1991
DAY	MONTH	YEAR

PROJECT SUMAS INDIAN BAND - SUMAS I.R. NO. 6

Well Observation (Kilgard No. 1 & Jensen)

Datum Point Tops of well casings

Elevation of Datum Point KG1 - 0.4 m (15") above concrete floor
Jensen - 0.4 m (15") above ground

Static Water Level KG1 - 8.875 ft (2.706 m)
Jensen - 1.974 m (6.47 ft)

Total Drawdown KG1 - 4.835 ft (1.474 m)
Jensen - 1.047 m (3.43 ft)

TIME		ELAPSED TIME SINCE PUMPING STARTED	ELAPSED TIME SINCE PUMPING STOPPED	RATIO (t/t')	KILGARD NO. 1 DISTANCE TO WATER	KILGARD NO. 1 RESIDUAL DRAWDOWN (ft)	JENSEN DISTANCE TO WATER	JENSEN RESIDUAL DRAWDOWN (m)	REMARKS
HR.	MIN.	t (min.)	t' (min.)						
17	20	500	80	6.25			2.569	0.595	
17	30	510	90	5.7			2.542	0.568	
17	40	520	100	5.2	11.06	2.185			
18	40	580	160	3.6	10.50	1.625			
18	55	595	175	3.4			2.415	0.441	
22/08	40	1420	1000	1.4	8.92	0.045			
08	50	1430	1010	1.4			1.980	0.006	

Figure 3. Semi-logarithmic Plot of Drawdown in Kilgard Wells and Jensen Well During Pump Testing of Kilgard Well No. 2

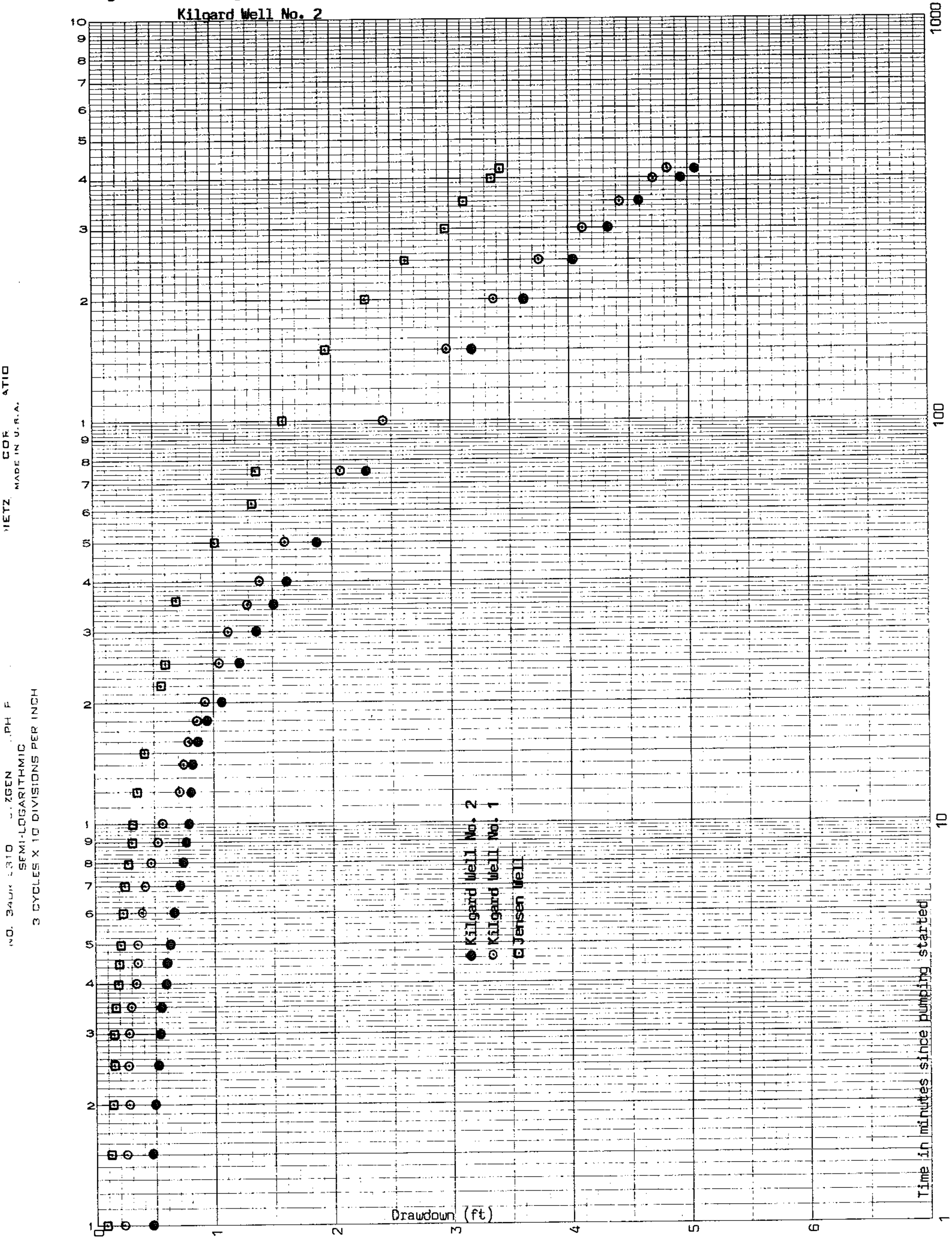
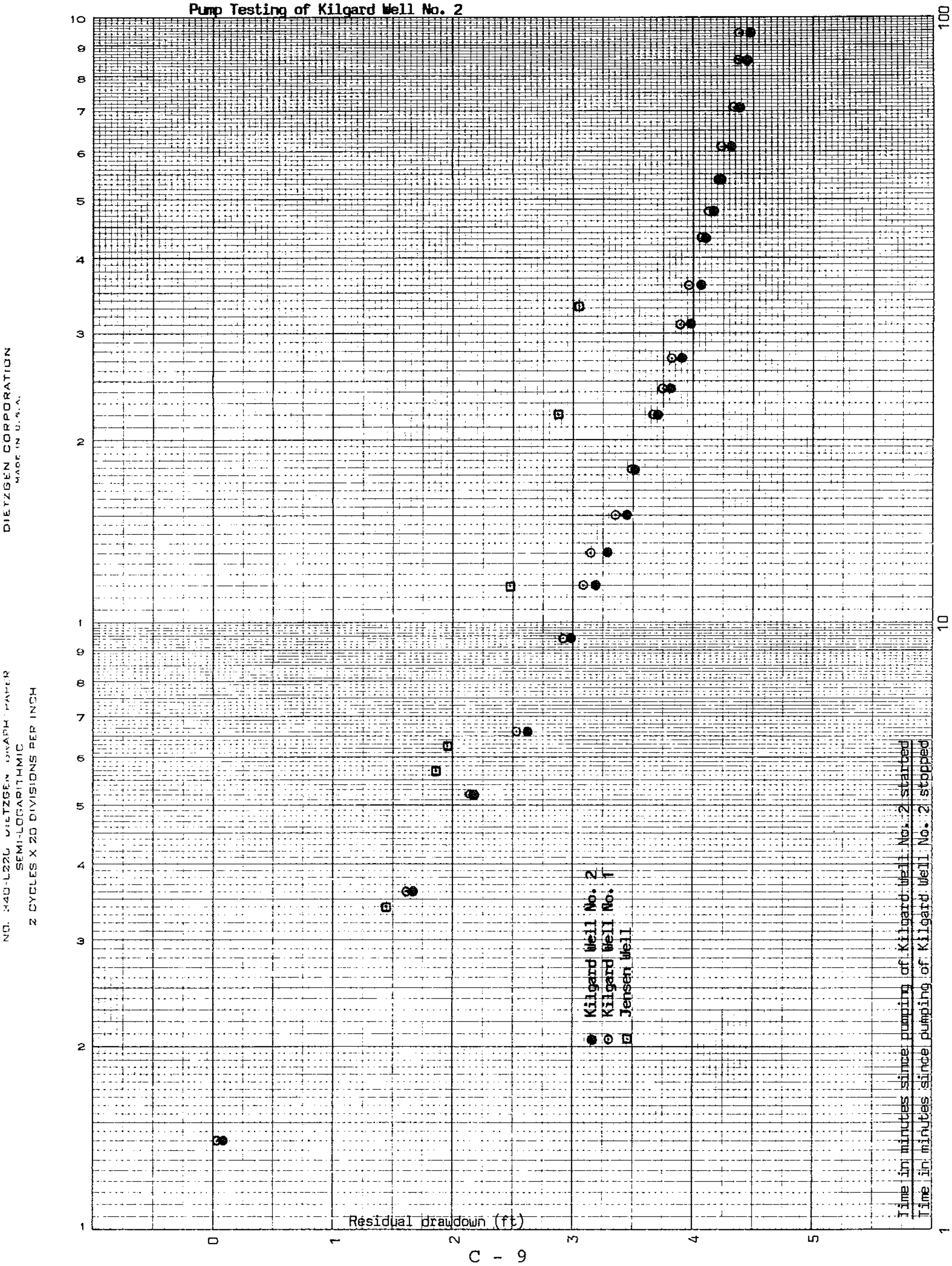


Figure 4. Semi-logarithmic Plot of Recovery of Water Levels in Kilgard Wells and Jensen Well Following Pump Testing of Kilgard Well No. 2



APPENDIX D

GROUNDWATER QUALITY

Table 4. Quality of Groundwater in Kilgard Aquifer

Parameter		Kilgard Well No. 1 at Source (1)	Kilgard Well No. 1 at H. Silver House (2)	Clarence Jensen Well (3)	Drinking Water Guidelines (4)
PHYSICAL TESTS					
pH		6.80	7.61	7.13	6.5 - 8.5
Conductivity (umhos/cm)		156.	115.	150.	-
Colour (CU)		<5.	<5.	-	15.
Turbidity (JTU)		0.08	0.3	-	5.
Dissolved Solids (mg/L)		105.		143.	500.
Total Hardness (mg/L)	$CaCO_3$	63.7		15.	-
DISSOLVED ANIONS (mg/L)					
Alkalinity	HCO_3	49.0	68.3	34.	-
Chloride	Cl	<0.50	<0.5	3.7	250.
Sulphate	SO_4	25.3	3.2	6.8	500.
Nitrate and Nitrite	N	0.871	0.009	2.0	10.
Fluoride	F	0.130	0.05	0.74	1.5
Silicate	SiO_2	2.30	14.4		
TOTAL METALS (mg/L)					
Iron	Fe	<0.030	<0.03		-
Manganese	Mn	<0.003	0.010		-
Cyanide	Cn	<0.01			0.20
Dissolved Metals (mg/L)					
Calcium	Ca	18.9	17.2	1.3	-
Magnesium	Mg	4.01	2.74	2.9	
Potassium	K	0.44	0.36	1.6	
Sodium	Na	4.05	2.57	5.9	
Arsenic	As		0.0040		0.05
Barium	Ba		<0.010		1.0
Boron	B			0.07	5.0
Cadmium	Cd		<0.0002		0.005
Chromium	Cr		<0.015		0.05
Copper	Cu		<0.010	0.00	1.0
Iron	Fe	<0.030	<0.03	0.00	-
Lead	Pb	<0.001	<0.001		0.05
Manganese	Mn	<0.003	0.010	0.00	
Zinc	Zn		0.006	0.01	5.0

Sources of information:

1. Can Test Ltd. File No. 6091C; June 1978.
2. Analytical Service Laboratories Ltd. File 1411B; May 1990.
3. Norwest Labs Analysis 91-1576; March 28, 1991.
4. Maximum acceptable concentration defined by Health and Welfare Canada (1989) and B.C. Ministry of Health (1982).

ASL

CHEMICAL ANALYSIS REPORT

Date: Jun. 02, 1991

ASL File No. 6298B

Report On: Water Analysis

Report To: Pacific Hydrology Consultants
#204 - 1929 W. Broadway
Vancouver, BC
V6J 1Z3

Attention: Ms. Anne Badry

Date Received: May. 21, 1991

METHODOLOGY

Conventional Parameters

These analyses were carried out in accordance with procedures described in "Standard Methods for the Examination of Water and Wastewater" 17th Ed. published by the American Public Health Association, 1989. Further details are available on request.

ASL ANALYTICAL SERVICE LABORATORIES LTD.

Eda Parreno B.Sc.
Project Chemist

Barbara Szczachor B.Sc.
Supervisor, Water Quality Lab

ASL

RESULTS OF ANALYSIS - Water

Parameter	Sumas Band May21/91
Bacteriological Tests	
Coliform Bacteria - Fecal	0
Coliform Bacteria - Total	0

Results are expressed as colonies/100ml.

TELEPHONE (604) 530-4344
FACSIMILE (604) 534-9996

NORWEST LABS

"Keeping B.C. Growing"

WATER ANALYSIS REPORT

W.O. NUMBER : 2624
LAB. NUMBER : 912528

SAMPLE RECEIVED : 05-21-1991
ANALYSIS COMPLETED : 05-24-1991
SAMPLE RETAINED FOR 30 DAYS

SAMPLE SUBMITTED BY :

A & H CONSTRUCTION
BOX 38
ABBOTSFORD, B.C. V2S 4N7

SAMPLE IDENTIFICATION : WATER #2 - SUMAS INDIAN BAND 8TH DRILLED WELL

ANALYTICAL RESULTS		GUIDELINES FOR DRINKING WATER
Total coliforms	0/100ml	Above 2/100 ml unacceptable
Fecal coliforms	0/100ml	Greater than 0/100ml unacceptable

Results quoted as zero indicate concentrations below the following detection limits:

Less than 0.01 mg/l Fe, Cu, Zn, Mn, B
Less than 0.05 mg/l Na, Ca, Mg, K, PO4-P, NH4-N, NO3-N
Less than 0.10 mg/l Cl, Fl, SO4-S; Less than 1 mg/l TDS, TSS, carbonate & bicarbonate

cam test ltd.

1650 PANDORA STREET, VANCOUVER, B.C. V5L 1L6 • TELEPHONE 254-7278 • TELEX 04 54210

Report On: Water Samples for Chemical Analysis

File No. 6091C

Report No.

Date: June 29, 1978

Reported to: Government of Canada
Health & Welfare, Canada
Medical Services, 4th Floor
814 Richards Street, Vancouver, B.C.

Attention: Mr. D. Schwinghamer

We have tested the sample of water submitted by you on June 16, 1978 and report as follows:

SAMPLE IDENTIFICATION:

The sample was submitted in a plastic bottle labelled as follows:

Sumas Band
New Drilled Well
June 16, 1978
C.E. Van Alstyne

METHOD OF TESTING:

The sample was tested in accordance with the procedures set down in "Standard Methods for the Examination of Water and Wastewater" 14th Edition, published by the American Public Health Association.

RESULTS OF TESTING:

(on following page)

RESULTS OF TESTING:

COMPLETE TEST "B"		RESULT	ACCEPTABLE LIMIT***
Physical Tests			
pH		6.80	6.3 - 8.5
Conductivity (micromhos/cm)		156.	-
Turbidity (J.T.U.)		0.08	5.
Colour (Pt-Co Scale) (C.U.)		L 5.	15.
Total Suspended Solids* (mg/L)		0.2	-
Total Dissolved Solids (mg/L)		105.	1000.
Dissolved Anions (mg/L)			
Alkalinity			
Bicarbonates	HCO_3	49.0	-
Carbonates	CO_3	Nil	-
Chlorides	Cl	L 0.50	250.
Sulfates	SO_4	25.3	500.
Nitrates	N	0.87	10.**
Nitrites	N	0.001	**
Fluoride	F	0.130	1.5
Silicates	SiO_2	2.30	-
Dissolved Cations (mg/L)			
Hardness	$CaCO_3$	63.7	-
Calcium	Ca	18.9	200.
Magnesium	Mg	4.01	150.
Potassium	K	0.44	-
Sodium	Na	4.05	-
Iron	Fe	L 0.030	0.30
Manganese	Mn	L 0.003	0.05
Lead	Pb	L 0.001	0.05
Others (mg/L)			
Total Iron	Fe	L 0.030	-
Total Manganese	Mn	L 0.003	-
Total Cyandie	CN	L 0.01	0.20

L = Less than; mg/L = Milligrams per liter (or parts per million for drinking water)
* = Sample filtered on a 0.45 micron membrane
** = Total Nitrate and Nitrite Nitrogen
***. = As set by the Canadian Drinking Water Standards and Objectives, 1968.

CAN TEST LTD.

File No. 60011C
Page 3
June 29, 1978

REMARKS

The water represented by the sample submitted can be characterized as a moderately soft water, low in dissolved mineralization. For the parameters tested, the sample met the limits as set by the "Canadian Drinking Water Standards and Objectives, 1968".

CAN TEST LTD.

(Ms) Judi M. Mitchell, B.Sc.,
Chemist

/fh

ASL

RESULTS OF ANALYSIS

		Sumas Indian Band Hazel Silver House Apr 25/90	Drinking *1 Water Guidelines
Physical Tests			
pH		7.61	6.5-8.5
Conductivity		115.	-
Colour		<5.	15.
Turbidity	NTU	0.3	5.
Anions			
Alkalinity	$CaCO_3$	56.0	-
Sulfate	SO_4	3.2	500.
Chloride	Cl	<0.5	250.
Fluoride	F	0.05	1.5
Silicate	SiO_2	14.4	-
NO3/NO2	N	0.009	10.0
Total Metals			
Iron	T Fe	<0.03	0.30
Manganese	T Mn	0.010	0.05
Dissolved Metals			
Arsenic	D As	0.0040	0.05
Barium	D Ba	<0.010	1.0
Cadmium	D Cd	<0.0002	0.005
Chromium	D Cr	<0.015	0.05
Copper	D Cu	<0.010	1.0
Iron	D Fe	<0.03	-
Lead	D Pb	<0.001	0.05
Manganese	D Mn	0.010	-
Zinc	D Zn	0.006	5.0
Calcium	D Ca	17.2	-
Magnesium	D Mg	2.74	-
Potassium	D K	0.36	-
Sodium	D Na	2.57	- *2

< = Less than T = Total D = Dissolved
NO_3/NO_2 = Nitrate/nitrite nitrogen
Results expressed as milligrams per litre except for pH, Conductivity (µmhos/cm), Colour (CU), and Turbidity (NTU).

*1 "Maximum acceptable concentration" as published by Health & Welfare Canada, 1985

*2 Maximum level not established - of concern to consumers with sodium restricted diet. Levels exceeding 20 mg/L may be of concern in this circumstance.

TELEPHONE (604) 530-4344
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NORWEST LABS

"Keeping B.C. Growing"

WATER ANALYSIS REPORT

W.O. NUMBER : 2139
LAB. NUMBER : 911576

SAMPLE RECEIVED : 03-26-1991
ANALYSIS COMPLETED : 03-28-1991
SAMPLE RETAINED FOR 30 DAYS

SAMPLE SUBMITTED BY :

A & H CONSTRUCTION
BOX 38
ABBOTSFORD, B.C. V2S 4N7
Attention of: MICHAEL
SAMPLE IDENTIFICATION : CLARENCE JENSEN WELL #3 - 3105 ELDRIDGE, ABBOTSFORD

ANALYTICAL RESULTS		GUIDELINES FOR DRINKING WATER
pH	7.13	pH values between 6.5 & 8.5 considered acceptable
Electrical Conductivity	0.15 ms/cm	Values above 1.0 ms/cm indicate increasing salt content
Total Dissolved Solids	143 mg/l	Objective level 500 mg/l; higher values indicate high salts
Total Suspended Solids	7 mg/l	Values above 250 mg/l indicate increasing levels of sediment
Ammonium-N	0.0 mg/l	Acceptable values below 0.5 mg/l; objective level below 0.01 mg/l
Potassium	1.6 mg/l	No acceptable level set; values normally in the 0.5 to 10 mg/l range
Calcium	1.3 mg/l	Below 200 mg/l acceptable; objective level below 75 mg/l
Magnesium	2.9 mg/l	Below 150 mg/l acceptable; objective level below 50 mg/l
Sodium	5.9 mg/l	Below 300 mg/l acceptable; over 20 mg/l high for low sodium diets
Iron	0.00 mg/l	Above 0.3 mg/l may cause staining & deposits; objective limit 0.05 mg/l
Copper	0.00 mg/l	Below 1.0 mg/l acceptable; objective limit below 0.01 mg/l
Zinc	0.01 mg/l	Below 5.0 mg/l acceptable; objective limit below 1.0 mg/l
Manganese	0.00 mg/l	Below 0.05 mg/l acceptable; objective limit below 0.01 mg/l
Phosphate-P	0.0 mg/l	No acceptable limit set; below 0.2 mg/l desirable
Sulphate-S	6.8 mg/l	Below 500 mg/l acceptable; objective limit below 250 mg/l
Nitrate-N	2.0 mg/l	Below 10 mg/l acceptable: high values may indicate contamination
Chloride	3.7 mg/l	Below 250 mg/l acceptable
Fluoride	0.74 mg/l	Values up to 1.2 mg/l desirable; under 1.5 mg/l acceptable
Boron	0.07 mg/l	Below 5.0 mg/l acceptable
Carbonate	0 mg/l	Presence indicates alkaline water
Bicarbonate	34 mg/l	Presence indicates mildly alkaline water
Hardness (CaCO3 equiv)	15 mg/l	Soft waters are less than 75 mg/l; hard waters above 150 mg/l
Total coliforms	0/100ml	Above 2/100 ml unacceptable
Fecal coliforms	0/100ml	Greater than 0/100ml unacceptable

Results quoted as zero indicate concentrations below the following detection limits:

Less than 0.01 mg/l Fe, Cu, Zn, Mn, B
Less than 0.05 mg/l Na, Ca, Mg, K, PO4-P, NH4-N, NO3-N
Less than 0.10 mg/l Cl, Fl, SO4-S; Less than 1 mg/l TDS, TSS, carbonate & bicarbonate

NORWEST SOIL RESEARCH INC 203 - 20771 LANGLEY BY-PASS, LANGLEY, B.C. V3A 5E8

APPENDIX E

DATA SHEET FOR WATER WELL MONITORING

PERFORMANCE AND WATER LEVEL DATA FOR KILGARD WELL NO. ____

Date	Time	Production Meter Reading (m^3)	Water Pumped (m^3)	Time Meter (hrs)	Pumping Time (hrs)	Pumping Rate (L/min)	Distance to Water (m)	Drawdown (m)	Motor Current (amps)	Remarks