

WATER RESOURCES SERVICE
DEPARTMENT OF ENVIRONMENT

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GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS
NEAR DUNCAN, BRITISH COLUMBIA

FINAL REPORT

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SYNOPSIS

This report covers a groundwater research project carried out in 1975 on the Cowichan River aquifers located along both sides of the Cowichan River south of Duncan, British Columbia.

There were three main objectives to be met in this project, namely:

- (a) Water Quantity: The need to prove up 1,600 U.S. gallons per minute for the year 1980 demand and potential for 4,000 U.S. gallons per minute capacity by the year 2000.
- (b) Water Quality: To ascertain whether the groundwater supply from the Cowichan aquifers is potable.
- (c) Effect of Groundwater Withdrawals: To evaluate the effect, if any, of groundwater withdrawals by production wells in the aquifers on the flows in the Cowichan River.

To meet these objectives, six monitor wells, one test well, and one observation well were completed under this groundwater research project. Monitoring, sampling and well testing were also carried out.

Hydrographs of water level fluctuations were obtained from the six monitor wells completed in the "upper aquifers". Hydrographs of water level fluctuations in these wells show a close relationship to changes in the stage of the Cowichan River.

An 8-inch test well and a 6-inch observation well were completed with screens and tested, first in the "lower aquifer" and then in the "middle aquifer". Pumping tests carried out on the 8-inch test well indicate a production well can be completed in the "middle aquifer" which should be capable of yielding 800 to 1,000 U.S. gallons per minute. Potential for a second production well is also very good. The groundwater potential for proving up a 4,000 U.S. gallon per minute supply from the Cowichan aquifers would appear on the basis of present information to be very good, particularly, if we consider the whole aquifer area adjacent to the Cowichan River and not restrict this assessment to the Fraser property

where the test well is sited.

A limiting factor in the "middle aquifer" appears to be its limited thickness and the restriction this places on well screen design length. There were also problems associated with the screen development in the test well. In view of the above, careful well design, well development, testing and monitoring procedures will be required on production wells completed in this aquifer.

Bacteriological water quality analyses are not yet completed, but chemical analyses show the groundwater in the "middle and upper aquifers" to be soft; also, no chemical constituents were present in amounts that will cause a health hazard.

The high transmissivity values of 900,000 U.S. gallons per day per foot width obtained from the test well "middle aquifer" pumping tests, together with the similarity in the observation well hydrograph curves compared to the Cowichan River stage hydrographs, suggest there is a good hydraulic continuity between the Cowichan River and the wells completed in the "middle aquifer". It is also expected that groundwater withdrawals will affect river flows to some extent, however the exact relationship will not be known until production wells are utilized over a long term and the records analyzed.

Pumping tests carried out earlier when the test well was first screened in the "lower aquifer" gave T values of only 26,000 U.S. gallons per day per foot width. This T value is about 3 per cent of the "middle aquifer" value and, therefore, we would expect that the "lower aquifer" well yield would only be a fraction of the total yield of a production well screened in both "lower and middle aquifers". Therefore, it is recommended that the "lower aquifer" is not used for future production well completions.

This report includes appendices which give details of well logs, well designs, test data, results, analyses, graphical plots, and hydrographs. Also included in the report are subsurface sections, tables and cost estimates for a production well.

Following the completion of the final well tests, and the writing of this report, the 8-inch test well casing and screen subsided 1.17 feet. Another three-hour pumping test was then run in the test well and a small drop in well performance was recorded from 170 down to 159 U.S. gallons per minute per foot of drawdown for the three-hour pumping period. Remedial measures were taken to prevent further subsidence in the well.

As the report was finalized prior to subsidence, a short addendum has been included (before the tables and figures in this report). Also included in the addendum are results of the three-hour well test and revised sketches showing the test well design measurements with respect to the datum after well subsidence took place.

ACKNOWLEDGEMENTS

The writer acknowledges the major contribution made by the Ground-water Section staff in the several phases of this program, and particularly Mr. F. Chwojka who has been responsible for field supervision of the well drilling program, surveying and the collection of the monitor well data and subsequent compilation of the results into graphs and figures. Also thanks to Mr. A. Kohut for pumping test supervision, Mr. E. Tradewell for pumping test and hydrograph data analysis, and interpretation, to Mr. W. Hodge for analysis of pumping test results and completion of graphs, to Miss Janis Wright for typing and Miss Denise Cormier for assembling the report. The help given by Mr. E. Stannard and Mr. B. Patterson of the Water Investigations Branch is also acknowledged. The cooperation of the District of North Cowichan is appreciated, particularly Mr. Don McCool, Works Superintendent, who arranged for an alternative water supply for Mr. Fraser during the pumping test periods; also acknowledgement is made to the District for pump equipment used on some of the well tests.

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GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS
NEAR DUNCAN, BRITISH COLUMBIA

1. INTRODUCTION

This report covers the design, drilling and construction of seven monitor wells and one test well completed under Water Investigations Branch, Groundwater Section Contract #60.

Previous internal memoranda on file include notes on the geology and groundwater potential of the south end area of the District of North Cowichan. There are also a number of consultant reports etc. on file. A summary of this information is given in Report #1, "Groundwater Potential Available to the Corporation of the District of North Cowichan at the South End of the District".

Mr. S. B. Mould was appointed coordinator of technical investigations needed to determine the feasibility of alternate sources of water supply for the District of North Cowichan.

The investigation was prepared at the request of the Environment and Land Use Committee.

The well drilling contractor was Mr. Ken Slade, Drillwell Enterprises Limited, R.R. #2, Cowichan Station, B. C. Subcontractors for the well testing were Mr. J. Jaundrew of B. C. Aquifer Testing and Equipment Victoria, B. C., and Mr. S. M. Fraser of Aqua-Flow Testing and Equipment Limited Langley, B. C. Drilling commenced on the monitor wells on September 10, 1975 and work at the south end was completed on December 12, 1975. A cable tool drilling rig was used throughout for the well drilling.

The area, in which are located the monitor wells and test well drilled under Contract 60 in the Cowichan River aquifers, is shown on the key plan, Figure No. 1. In Figure No. 2, the locations of the monitor

wells and test well are shown in more detail.

2. MONITOR WELLS - WELL LOGS AND WELL DESIGN

The six monitor wells constructed on the Patterson property are located and designed to help provide answers to two of the three main objects of the research project, namely:

- 1) to ascertain whether the groundwater supply from the Cowichan Aquifers is potable, and
- 2) to evaluate the effect, if any, of the groundwater withdrawals from production wells on the flow in the Cowichan River.

From Figure No. 2 we see that the collection boxes for sewerage effluent for the eastern part of the Patterson trailer park are located about 900 feet from the test well site location. The topographic gradient from the boxes is also towards the test well site, also the gradient of the groundwater table and direction of groundwater movement. See Section No. 6. Since the summer of 1975, effluent disposal into the boxes has been discontinued. However, to evaluate possible downstream groundwater contamination, four monitor wells were installed: Nos. 120-123, see Figure No. 2 and Sections Nos. 4, 5 and 6. Two additional monitor wells were installed near the river, Nos. 124 and 125 (see Figure No. 2), to help evaluate the response of the water table to changes in river stage.

Details of the well logs, grain size analysis, well designs, etc. are given in Appendix No. 1.

The monitor wells were completed with 160 PVC, 4-inch, ID pipe and slotted screen (slot size .020 inches). All monitor wells were completed with a surface 6-inch, ID steel casing and fitted with a locked cap or locked recorder box.

In monitor well Nos. 120, 121 and 124 two impervious zones of hardpan? or till? were encountered at shallow depth (less than 31 feet). Within a sand and gravel sequence to evaluate these subsurface conditions, two monitor wells were installed; one screen was set within a sand and

gravel sequence above the upper impervious zone in well 121, and one screen was completed to below the lower impervious zone in well 120. These two monitor wells are therefore located in a suitable position to monitor groundwater quality above and below the impervious layers immediately down gradient from the disconnected effluent boxes. Likewise, the shallow monitor well No. 123 and the deeper monitor well No. 122 are suitably placed to monitor groundwater quality on the Patterson-Fraser property boundary closer to the test well site area.

3. TEST WELL 130 - WELL LOG AND WELL DESIGN

Details of the well log, grain size analyses and well design are given in Appendix No. 2. Also, see the Addendum for revised measurements with respect to the datum.

After placing the surface casing, the test well was drilled and cased with 8-inch, ID casing to 152 feet (see Drawings 1 and 2, Appendix No. 2). A fine to coarse-grained, blue-black coloured sand with some gravel lenses extended from 90 to 104 feet. This has been designated for this report as the "lower aquifer". Below this depth the materials became finer with some good samples of wood, cones and seeds being recovered in the 114- to 124-foot zone. Above the "lower aquifer" is a 16-foot thickness of blue silty clay with some pebbles. Coarse gravel and sand with minor brown silt forms the "middle aquifer" between 54 and 69 feet. The design details for the test well screen set first in the "lower aquifer" are given in Drawing 4, Appendix No. 2. The 10-foot, 40 slot, 8-inch nominal size stainless steel well screen was set between 94 and 104 feet below ground surface datum. The design transmitting capacity was 269 U.S. gallons per minute.

Following the pumping tests in the "lower aquifer", the screen was withdrawn and after pulling back the casing, a second test well screen was set in the "middle aquifer" between 58 and 69 feet below ground surface datum (see Drawing 3, Appendix No. 2). The 8-inch nominal size stainless steel Johnson's well screen consisted of 2 feet of 50 slot (58-60 feet),

2 feet of 100 slot (60-62 feet), 7 feet of 150 slot (62-69 feet). The design transmitting capacity is 501 U.S. gallons per minute. The screen assembly, including riser pipe, lead packer and bail bottom, is 15 feet 4 inches long. The top of the lead packer is swedged at 54 feet below datum.

Following the initial pumping tests in the "middle aquifer", it became apparent that the well was not responding as expected and drawdown became excessive. A decision was made to further develop the well using a water jetting tool belonging to the Groundwater Section. A high pressure, high capacity pump was obtained by the contractor to deliver about 100 U.S. gallons per minute at 100 lbs. pressure. Water was then forced through the jetting tool and the well screen into the natural sand and gravel formations surrounding the well screen. The material so loosened was carried in suspension to the surface where it was removed by a smaller contractor's suction pump. Further surging was also carried out in the screen.

The pump test that followed was successful and it was apparent that the well had returned and even improved on its former specific capacity.

The annular space between the surface and 8-inch casing was grouted to act as a seal, and a steel cap with lock was fitted to the 8-inch casing at the well head.

4. OBSERVATION WELL 131 - WELL LOG AND WELL DESIGN

Details of the well log and well design are given in Appendix No. 3 for observation well No. 131. This well is located 20 feet from the test well and was drilled and constructed mainly for pumping test requirements. However, this well should be retained for long-term monitoring purposes.

Observation well 131 was drilled and cased with 6-inch ID steel casing to 99 feet (see Drawings 1 and 2, Appendix No. 3). The design details for the observation well screen set first in the "lower aquifer" are given in Drawing 4 Appendix No. 3. The 4-foot, 20 slot, 6-inch nominal

size stainless steel well screen was first set between 95 and 99 feet below ground surface datum. Following pumping tests in the test well for the "lower aquifer", the screen was withdrawn and after pulling back the casing the same screen was reset in the "middle aquifer" between 65 and 69 feet below ground surface datum (see Drawing 3, Appendix No. 3). The top of the lead packer is set at 64 feet below datum. The well lead is completed with a Stevens water level recorder, recorder housing and casing extension.

5. RELATIONSHIP BETWEEN HEIGHT OF WATER IN THE COWICHAN RIVER
AND GROUNDWATER LEVELS IN THE COWICHAN AQUIFERS

A. "Middle Aquifer"

One of the three main objectives or terms of reference for this groundwater research project is an evaluation of the effect, if any, of groundwater withdrawals from the test site area, on flow in the Cowichan River.

In an attempt to obtain data which could be used in a study of this problem we installed five automatic water level recorders on monitor wells and observation wells in the test area. Three other monitor wells are being read manually.

Figure No. 3 shows the relationship between water height in feet on the Water Survey of Canada Cowichan River gauge near Duncan and water height in feet on the Water Resources temporary Cowichan River gauge near the test well site area. The data plotted to produce the curve for the period of gauge readings between October 23rd and December 14th is completed on Table No. 1.

The curve on Figure No. 3 has been used to obtain all the "calculated values" for the Cowichan River water height near the test well site at Duncan. These calculated values are compiled, along with the W.S.C. gauge readings for the period of record October 23rd to December 14th, 1975, in Table No. 2.

Because our observation well No. 131 and our test well No. 130 are completed in the "middle aquifer" the relationships between the river and this aquifer are important. The observation well No. 131 has only been completed in the "middle aquifer" since November 21st and the hydrograph covering the period November 21st to December 12th is shown in Figure No. 9. This hydrograph is based on Stevens chart recorder graphs. From Table No. 2 a hydrograph has also been drawn on Figure No. 9 of the calculated water heights of the Cowichan River near the test well site at Duncan, B. C. The similarity of the two hydrographs in Figure No. 9 is readily apparent, particularly for the period immediately prior to the pumping test. During this specific period the slope of the two hydrographs are very similar. If we compute the decline in the river water height for, say, the five-day period December 8th to December 12th, we find there is a drop of 0.53 feet in water height; this averages out to 0.106 feet decline in head each day over this specific period.

The value 0.106 feet is important as the final constant rate pumping test on the test well screened in the "middle aquifer" was carried out between 10:30 A.M. on December 10th and 10:30 A.M. on December 11th. During this period and the subsequent period of rapid recovery we have through these hydrographs been able to correct out pumping test data to allow for the decline in static water level due to decline in water height in the Cowichan River. The very high transmissivity values obtained from the "middle aquifer" pumping tests (see next section) and the similarity in the hydrograph curves for observation well and river water height suggest that there is good hydraulic continuity between the Cowichan River and the "middle aquifer".

B. "Lower Aquifer"

Figure No. 8 has been constructed in the same manner as Figure No. 9 discussed above. The observation well No. 131 was initially completed in the "lower aquifer" and manual readings were taken between October 23rd and November 3rd; after this period a Stevens automatic water level recorder was fitted. The relationship between river water height

and well water level is not good at times of low river flow; however, the correlation improves after the first week in November and is particularly close in the last few days of the hydrograph record, suggesting that at higher water there is close hydraulic connections between the river and the "lower aquifer". Further data is required at times of low river flow.

C. "Upper Aquifer"

Due to insufficient time being available from the end of the data collection period and the completion date for the final report, no analysis has been made of the hydrographs made from water levels in the monitor wells. Some hydrographs for monitor wells are attached as Appendix No. 8.

6. PUMPING TESTS AND ANALYSES - "LOWER AQUIFER"

In order to establish a pumping rate "Q" for the constant rate test in test well No. 130 in the "lower aquifer", two step drawdown pumping tests were first run in the well. The flow rate (Q) was determined by orifice plate and pipe.

The first step drawdown test was run at approximately 241 U.S. gallons per minute for 180 minutes (see Appendix No. 4). The initial static reading was 4.18 feet below the measuring point or 3.09 feet below ground surface, and the drawdown reached 17.63 (see Drawing No. 1, Appendix No. 4). The specific capacity based on this test, is about 13.6 U.S. gallons per minute per foot of drawdown.

The transmissivity 'T' of the "lower aquifer" was calculated at 37,400 U.S. gallons per day per foot width for the first line slope T_1 . This compares favourably with a T value of 40,500 U.S. gallons per day per foot width in the observation well No. 131 (Drawing 3, Appendix No. 4). The fluctuations in drawdown of less than one foot at the end of the test are interpreted as due to small variations in the pumping rate over that period. These drawdown fluctuations are also present in

the observation well readings for the same time period (see Drawing 3, Appendix No. 4).

In recovery (see Appendix No. 4) the residual drawdown was 0.2 of a foot after 60 minutes in the test well. The transmissivity "T" was calculated at 25,450 U.S. gallons per day per foot width for the test well and 21,200 U.S. gallons per day per foot width for the observation well.

A second step test was then run for 90 minutes. The pumping rate was not stabilized in the initial part of the test and the rate Q varied between 335-369 U.S. gallons per minute. Transmissivity readings varied between 22,300 to 36,080 U.S. gallons per day per foot width (see Drawing 5, Appendix No. 4). In observation well No. 131 (Drawing 7, Appendix No. 4) "T" values were between 19,000 and 21,000 U.S. gallons per day per foot width. Both wells appear to be intersecting a recharge boundary after about 40 minutes of pumping.

In recovery T values for both wells were in the range 20,000-26,000 U.S. gallons per day per foot width (see Drawings 6 and 8, Appendix No. 4).

The main drawdown test in the "lower aquifer" was run on November 4th and 5th, 1975 for 24 hours. The pumping rate "Q" was 401 U.S. gallons per minute. This rate was in excess of the design rate for the well screen (269 U.S. gallons per minute); however, maximum drawdown was 29.02 feet. A recharge boundary appeared to be encountered after about 25 minutes and the drawdown reached a condition of near stabilization after one hour's pumping (Drawing 9, Appendix No. 4). The same conditions appeared to prevail in the observation well (Drawing 11, Appendix No. 4). A 4-inch orifice plate and a 6-inch pipe were installed at the well head and discharged the water into a metal tank. From this a centrifugal pump piped the water through a 4-inch irrigation pipe line to the Cowichan River about 500 feet away. The static water level datum was 3.92 feet below the measuring point or 2.41 feet below the ground surface when the test commenced. The

specific capacity of the test well based on this test is about 13.8 U.S. gallons per minute per foot of drawdown.

Transmissivity readings vary between 22,055 U.S. gallons per day per foot width for the observation well to 29,800 U.S. gallons per day per foot width for the test well, for the first line slope T, (see Drawings 9 and 11, Appendix No. 4).

The test well recovered to its former static 1,300 minutes after pump shut down; however, recovery was virtually complete, (0.1 feet) 100 minutes after pump shut down (see Drawing 10, Appendix No. 4). The observation well recovered to its former static about 1,400 minutes after pump shut down, and recovery was virtually complete (0.1 ft.), 175 minutes after pump shut down (Drawing 12, Appendix No. 4). Transmissivity values are 27,700 U.S. gallons per day per foot width for the test well and 39,208 U.S. gallons per day per foot width for the observation well.

Computations of the aquifer storage coefficient, based on a "T" value of 25,950 U.S. gallons per day per foot width, is $S = 0.012$ or 1.2×10^{-2} (see Drawings 13 and 14, Appendix No. 4).

No corrections have been made to the groundwater level due to decline in water height in the Cowichan River during the pump test period (see Figure No. 8).

7. PUMPING TEST AND ANALYSES "MIDDLE AQUIFER" BEFORE REDEVELOPMENT

An attempt was made to carry out the pumping tests on the test well with a large capacity suction pump. On November 27th two short step drawdown tests were run. The pumping rate Q was approximately 517 U.S. gallons per minute in the first test and 530 U.S. gallons per minute on the second test. Both tests were cut short due to breakdowns in the cooling system of the diesel power unit. The maximum drawdown prior to shut down was 4.40 feet for 50 minutes of pumping and in the second test 4.43 feet for 35 minutes of pumping. Because both tests were run for an insufficient period of time, the detailed results are not included in this report.

A line shaft turbine pump was then installed in the test well and a constant rate pumping test commenced on December 2nd. The pumping test rate "Q" was approximately 600 U.S. gallons per minute. Almost immediately it became readily apparent that the drawdown was considerably more than had been expected for this rate of pumping. After 30 minutes the drawdown was 16.23 feet; after 400 minutes the drawdown was 35 feet (see Drawing 1, Appendix No. 5). At this point a decision was made to shut down the well. Recovery was rapid, within minutes. The drilling contractor then carried out further well development as previously described and a second constant rate test was run on December 10th and 11th, described below.

8. PUMPING TEST AND ANALYSES "MIDDLE AQUIFER" AFTER REDEVELOPMENT

This constant rate was run at approximately 510 U.S. gallons per minute and reached a condition of near stabilization after a few minutes. Static water level in the well at the commencement of the test was 4.29 feet below the measuring point or 2.78 feet below ground surface. The drawdown at the end of the 24-hour test period was 3.32 feet. The specific capacity of the test well based on a pumping rate of 510 U.S. gallons per minute is 148.8 U.S. gallons per minute per foot of drawdown. This is a striking improvement on the specific capacity of 13.8 U.S. gallons per minute obtained just prior to well development (see Drawing 2, Appendix No. 5).

Observation well 131 is located 18.25 feet away. The drawdown in this well was less than one foot for the period of the test (Drawing 3, Appendix No. 5) and in the Fraser well 175 feet away the drawdown was only .25 foot (Drawing 4, Appendix No. 5).

Recovery readings in the test well, observation well No. 131 and Fraser well showed almost instantaneous recovery to within 0.20 feet within the first minute (see Drawings 5, 6 and 7, Appendix No. 5). Readings were discontinued after about 100 minutes in the test well so that the pump column could be removed. The recorder graph on observation well No. 131

continued to plot the groundwater level which once again began to decline minutes after pumping stopped in response to lowering river stage (see Figure No. 9). As discussed in a previous section, the average decline in the groundwater level and the river level is about 0.106 feet per day. A correction factor has therefore been applied to all the drawdown and recovery readings taken during the final test and the corrected drawdown and recovery readings are given in Appendix No. 6. This slightly alters the total drawdown in the test well to 3.21 feet and the specific capacity to 158.9 U.S. gallons per minute per foot drawdown. The transmissivity value for the Fraser observation well is about 900,000 U.S. gallons per day per foot width. This value has been accepted as a conservative value for "T". Several of the values obtained from Drawings 2-7, Appendix No. 5 and Drawings 1 and 2, Appendix No. 6 for "T" are over one million. However, the small increments of drawdown being observed, together with pump fluctuations affecting drawdown, slightly suggest the more conservative figure be accepted for "T".

The distance-drawdown curve (corrections applied) gives a value for S, the coefficient of storage of 0.26, using the more conservative value for T (see Drawing 3, Appendix No. 6).

In recovery it is noted that after applying the corrective factor, only .05 residual drawdown was left after 90 minutes when the pump column was removed, and 0.09 in observation well No. 131, after the same period. From this point in time the water level once again continued to decline in response to drop in the water height of the river.

9. WATER QUALITY

The chemical analyses of the water collected from the monitor wells and the observation well are attached as Appendix No. 7.

The bacteriological analysis of the monitor wells and observation well are being carried out under the direction of Department of Health staff (Mr. G. Duffield and Mr. S. Chan).

In a recent telephone conversation with Mr. Chan a verbal report was obtained on the "lower aquifer" analyses of three samples, namely, 1/5, 0/5, 0/5. The analyses indicate the water in the "lower aquifer" is potable.

Bacteriological sample analyses on the "middle aquifer" are not yet processed. The monitor wells are also being sampled by Department of Health in late December or early January.

A review of the chemical analysis available to date was undertaken by Mr. G. Duffield, Department of Health. He commented that the samples show extremely soft water, typical of most shallow aquifers. No harmful constituents are present in concentrations that are a health hazard.

A further review of the data should be undertaken when all the analyses are available.

10. CONCLUSIONS AND RECOMMENDATIONS

A. GENERAL

There are three main objectives or terms of reference for the groundwater research project on the Cowichan River aquifers:

1. Water Quantity:

The need to prove up 1,600 U.S. gallons per minute for the year 1980, demand and potential for 4,000 U.S. gallons per minute capacity by the year 2000.

2. Water Quality:

To ascertain whether the groundwater supply from the Cowichan aquifers is potable.

3. Effect of Groundwater Withdrawals:

To evaluate the effect, if any, of the groundwater withdrawals from production wells on the flow in the Cowichan River.

The conclusions and recommendations obtained so far from this research project are discussed below. Further work on the data obtained

so far and on future data still to be collected should be carried out before submission of a final report is made.

B. WATER QUANTITY STUDIES

1. First Production Well

Based on the results obtained from this project, a production well can be completed in the "middle aquifer" which should be capable of yielding between 800 to 1,000 U.S. gallons per minute. The limiting factor would appear to be the designed transmitting capacity of the screen that can be set within this relatively narrow depth zone. It is readily apparent that the very high specific capacity of test well No. 130 would indicate potential production wells capable of at least twice the yield given above. However, the problems encountered on the test well, when the specific capacity dropped sharply under testing and the subsequent redevelopment needed to bring the well back to its former specific capacity, indicate the need for extreme caution before attempting to pump production wells over the designed transmitting capacity of the screen.

The test well log also indicates that there are a number of water-bearing sand and gravel zones within the "upper aquifer" sequence. A decision on whether to utilize the "upper aquifer" zones would in part depend on the production well driller's log, on design costs and on the results and recommendations of a bacteriological sampling program being carried out by the Department of Health in the existing monitor wells.

We do not recommend that the "lower aquifer" be included in the screen design for a production well. Our reason for this is primarily based on the pump test results which indicate transmissivity values for the "lower aquifer" of about 26,000 U.S. gallons per day per foot width. This T value is only about 3 percent of the most conservative T values obtained for the "middle aquifer". We would therefore expect that the "lower aquifer" yield would only be a fraction of the total well yield in a production well screened in both "aquifers".

Based on the results obtained in test well No. 130, we have estimated in Table No. 3 the cost of one 16-inch production well completed with a 16-inch screen designed to produce 900 U.S. gallons per minute at about \$20,000. Costs for the additional screen and development time required to produce 1,500 U.S. gallons per minute using part of the upper as well, are about \$22,000 (see Table No. 3). The correct spacing between the existing test well and the past production well can be determined on the basis of the "Middle Aquifer" test results. It is estimated that the first production well should be sited a minimum of 50 feet from the test well site for minimum interference effects. Estimated pumping level in a 1,500 U.S. gallons per minute production well would be about 23 feet below ground level after allowing for interference from test well No. 130 and for decline in river level during periods of low flow.

2. Second Production Well

On the basis of present information and test results, the potential for a second production well on the Fraser property is very good - assuming a yield requirement of between 1,000 and 1,500 U.S. gallons per minute. There may, however, be some need for special development techniques to be used on any production well in the Cowichan aquifers and also the possibilities of later redevelopment due to a decline in well performance cannot be ruled out. We have only limited information about these two problems. It is only by constructing these two production wells and pumping them under simulated production conditions for a period of time that we will be able to obtain answers to these questions.

3. Groundwater Potential

The groundwater potential for proving up a 4,000 U.S. gallons per minute supply from the Cowichan aquifers would appear on the basis of present information to be very good, particularly, if we can consider the whole aquifer area adjacent to the Cowichan River and not restrict this assessment to the Fraser property above.

We now have enough information to proceed with the first and second production wells on the Fraser property.

4. Test Well No. 130

- a) The "middle aquifer" well yield in the present test well should not exceed a pumping rate of approximately 500 U.S. gallons per minute. This maximum rate represents the design transmitting capacity of the screen at entrance velocities of 0.1 feet per second. The limited thickness of the "middle aquifer" is a limiting factor on large capacity well screen design. The test well has an estimated specific capacity, based on a pumping rate of 510 U.S. gallons per minute, and a 3-foot drawdown of about 159 U.S. gallons per minute per foot of drawdown. As we have about 45 feet of available drawdown in the well after allowing for low summer water levels, the theoretical capacity of a larger production well could be in the thousands of gallons per minute. Unfortunately, so far as the "middle aquifer" is concerned, there are some limiting factors to the above assumptions - firstly, the limited thickness of the aquifer - mentioned above, and secondly, the problems encountered in earlier tests when the specific capacity suddenly plunged downward and only by redevelopment was the well returned to its former capacity. For those reasons it is recommended that the well yield for test well No. 130 remain at the screen design figure of approximately 500 U.S. gallons per minute.
- b) The bottom of the pump assembly should be set no lower than 50 feet below the ground surface or 50.9 feet below the top of the casing. Allowing for interference from a production well, and for decline in river level during the summer months, the pumping level would be about 16 feet.

The pump should be allowed to operate for several hours at a

time. It should not be flashing on and off repeatedly over a short time period.

- c) When the well is put into production, a meter reading in gallons per minute should be installed at the well head to measure the amount of water pumped and the hours of pumping.
- d) The well must neither be overpumped or backflushed. A few grains of sand were still coming through with the samples of water collected for inspection. However, further pumping will develop the natural pack around the well screen and this problem should rapidly clear up.
- e) A check valve should be installed on the discharge side of the pump to prevent backflushing also.
- f) The pump should not be supported on the well casings, but on the surrounding concrete foundations pad.
- g) Provision should be made for taking pumping water levels and static water levels in the well. The usual installation is a 3/4-inch standard galvanized pipe strapped to the pump column. This pipe will then permit an electric sounding line to be easily lowered into it without danger of snagging. Alternatively, this pipe can be used as an air line to be used in conjunction with a pressure gauge and tire pump to give a reading of the water level in the well.
- h) No septic tank, drain field or sewer line should be placed within several hundred feet of the well site.
- i) Water quality samples should be taken twice a year for chemical analysis. One sample should be collected and sent for analysis in August; a second should be sent in December or January. Bacteriological samples will be taken and analysed according to recommendations of the local Health Officer.

- j) Twice-weekly records of the water levels and production rates should be kept during the first year of operation. Daily records should be taken for the first month of operation. The records should be analysed after the first month, then first year of operation in order to reassess the well performance under production conditions.
- k) The well house should be constructed with a concrete pad; the well casing should be welded to a steel I beam buried in the concrete pad. Provision should be made so that part of the roof can be removed if a hoist is required to raise or lower the pump into the well.

5. Observation Well No. 131

It is recommended that the Groundwater Section of the Water Investigations Branch or the District of North Cowichan retain this well as an observation well and that monthly recorder charts continue to be taken. The well head should be completed with a small concrete pad around the casing. A 5-year agreement should be made with the landowners for access and permission to service and maintain the well and recorder.

C. WATER QUALITY STUDIES

Bacteriological sampling and analysis of the groundwater is being carried out under the direction of Department of Health staff (Mr. G. Duffield and Mr. S. Chan). Chemical analyses of groundwater in all wells completed under this project have been taken by Water Investigations staff. Not all the results are yet available; those that are, are included in Appendix No. 7. A review of the bacteriological sampling program will have to wait until after the sampling program is completed.

A review of the chemical analyses available to date was undertaken by Mr. G. Duffield. He commented that the results show extremely soft water, typical of more shallow aquifers. No harmful constituents are present in concentrations that are a health hazard.

The monitor well program is discussed in more detail under Section No. 2 of this report and in Appendix No. 1 (attached).

D. EFFECTS OF GROUNDWATER WITHDRAWALS

Because our observation well No. 131 and our test well No. 130 are completed in the "middle aquifer" the relationships between the river and this aquifer are important. Figure No. 9 shows a hydrograph for observation well No. 131 (middle aquifer) compared with a hydrograph based on calculated water heights of the Cowichan River near the test well site at Duncan (see Section No. 5 of this report for details). The similarity of the two hydrographs in Figure No. 9 is relatively apparent and we have been able to correct our pumping test data to allow for the change in groundwater level due to change in the water height of the Cowichan River. The very high transmissivity values obtained from the "middle aquifer" pumping tests, and the similarity in the hydrograph curves for observation well and river water height suggest that there is good hydraulic continuity between the Cowichan River and the "middle aquifer". It is also expected that groundwater withdrawals will affect river flows to some extent, however the exact relationship will not be known until production wells are utilized over a long term and the records analyzed. Further data and analysis are also required for the "lower aquifer" and "upper aquifer".

ADDENDUM TO FINAL REPORT
GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS NEAR DUNCAN

ADDENDUMCASING SUBSIDENCE

Two weeks after the completion of the pumping test and this report the ground level around the test well for a radius of 2 feet sank 12 to 15 inches. The top of the 8-inch casing and the well screen were also measured and it was found the casing had dropped 1.17 feet; the bottom of the well screen had dropped 1.17 feet.

A pumping test was run for three hours in the well to check the specific capacity. Results indicated a small drop in well performance from 170 U.S. gallons per minute per foot drawdown to 159.2 U.S. gallons per minute per foot drawdown. There was no evidence of the well pumping sand and recovery was almost instantaneous (see well readings attached to this Addendum). It is concluded that the initial drop in well capacity after the first tests (see report) may have been due to slumping around the screen due to cavities being formed below silt layers during well development. Subsequent development caused further cavities to be formed which were progressively filled by the overlying material which eventually caused the slump around the ground at the well head. It is more difficult to explain the drop in the screen, but it can only be assumed that the gravel packing placed in the drilled hole below the bottom of the screen had settled and allowed the screen to drop as well as the casing.

Remedial measures were taken in late January, 1976 to weld a casing extension at the well head to both the 10-inch and 8-inch casings. These casings were then welded together and further strengthened with two 10-foot long angle irons welded to the casing at ground surface. The well is not expected to subside any further due to these precautionary measures.

As the report was finalized prior to the subsidence in the well, we have attached to this addendum a revised diagram of the well design measurements with respect to the datum, also a sketch showing the well head completion design (Figure Nos. 1 and 2 in the Addendum).

WATER QUALITY

The samples taken for chemical analyses have now been analysed and are all included in Appendix No. 7. A high concentration of iron was found in three shallow monitor wells: 1.2 mg/l in Well No. 1400121, 3.4 mg/l in well 1400122 and 7.9 mg/l in Well No. 1400123. In all cases the concentration dropped to acceptable levels of less than 0.3 ppm after pumping and resampling (see Appendix No. 7). We interpret the initial concentration as being due to a iron rust residue associated with the drilling and on to metal casing used in the well construction. This residue cleared up with pumping before resampling.

In summary, the water is soft and no chemical constituents were detected in concentrations that are a health hazard.

TO ACCOMPANY ADDENDUM TO FINAL REPORT
THREE-HOUR "CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 130
MIDDLE AQUIFER AFTER CASING SUBSIDENCE

Contract #60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

January 21, 1976

Time	Time (t) Since Start of Pumping in Mins.	Depth to Water In Well From Top of Casing In Feet	Drawdown in Well In Feet (static) = 6.18, 12:50 p.m.	Height of Water In Tube On Orifice Pipe In Inches	U.S. Gals Per Min. Discharge From Well
13:05	0	6.18	0		
13:05½	.5	9.37	3.19		
13:06	1.0			40.5	
13:06½	1.5	8.01	1.83		
13:07	2.0	8.80	2.62	39.5	
13:07½	2.5	8.75	2.57	29.5	
13:08	3.0	8.75	2.57	739.5	
13:08½	3.5	8.75	2.57		
13:09	4.0	8.75	2.57		
13:09½	4.5	8.75	2.57		
13:10	5.0	8.74	2.56	39.5	
13:11	6.0	8.75	2.57		398 U.S. gallons per minute
13:12	7.0	8.70	2.52		
13:13	8.0	8.75	2.57		
13:14	9.0	8.74	2.56		
13:15	10.0	8.74	2.56		
13:17	12.0	8.74	2.56		
13:19	14.0	8.73	2.55		
13:21	16.0	8.74	2.56		
13:23	18.0	8.74	2.56		
13:25	20.0	8.74	2.56		
13:30	25.0	8.72	2.54		
13:35	30.0	8.71	2.53	39.25	
13:40	35.0	8.71	2.53		
13:45	40.0	8.71	2.53		
13:50	45.0	8.68	2.50		
13:55	50.0	8.68	2.50		
14:05	60.0	8.68	2.50		
14:15	70.0	8.66	2.48		
14:25	80.0	8.66	2.48		
14:35	90.0	8.66	2.48		
14:45	100.0	8.65	2.47		
15:35	150.0	8.66	2.48		
16:25	200.0				
17:15	250.0				

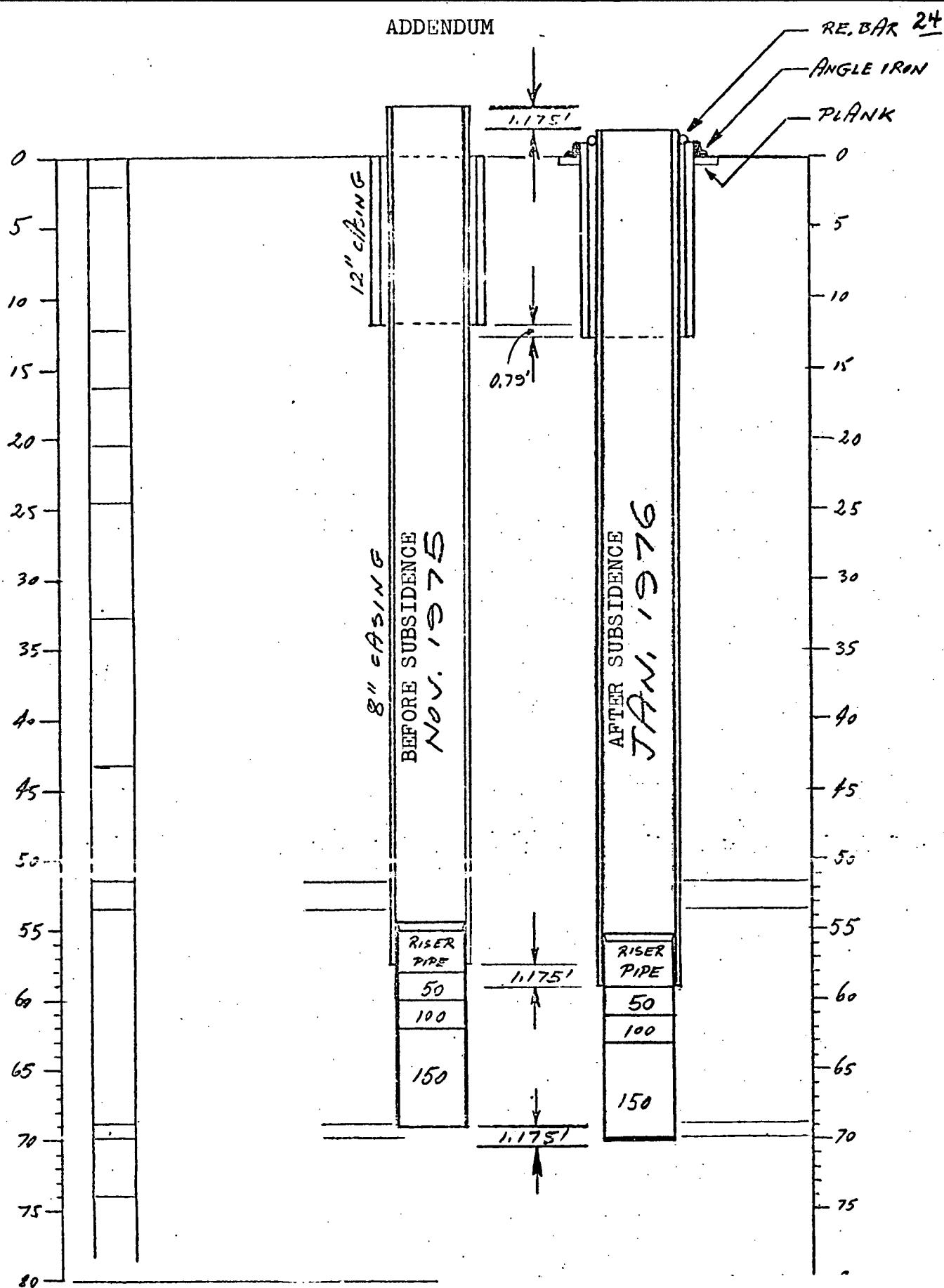
TO ACCOMPANY ADDENDUM TO FINAL REPORT
 READINGS TAKEN ON OBSERVATION WELL 131
 DURING 3-HOUR "CONSTANT RATE" PUMPING TEST OF WELL 130
 MIDDLE AQUIFER; AFTER CASING SUBSIDENCE

Contract #60
 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B.C.

January 21, 1976

Time	Time (t) Since Start of Pumping In Mins.	Depth to Water In Well From Top Of Casing In Feet	Drawdown In Well In Feet (static = 7.52)	
13:05	0	7.52		39½" 398 U.S. gallons per minute
13:05½	0.5	8.12	0.60	
13:06	1	8.12	0.60	40½
13:06½	1.5	8.11	0.59	
13:07	2	8.11	0.59	39½
13:07½	2.5	8.11	0.59	
13:08	3	8.11	0.59	39½
13:08½	3.5	8.11	0.59	
13:09	4	8.11	0.59	
13:09½	4.5	8.11	0.59	
13:10	5	8.11	0.59	39½
13:11	6	8.11	0.59	
13:12	7	8.11	0.59	
13:13	8	8.11	0.59	
13:14	9	8.11	0.59	
13:15	10	8.11	0.59	
13:17	12	8.12	0.60	
13:19	14	8.12	0.60	
13:21	16	8.12	0.60	
13:23	18	8.12	0.60	
13:25	20	8.12	0.60	
13:30	25	8.12	0.60	
13:35	30	8.12	0.60	
13:40	35	8.12	0.60	39¼
13:45	40	8.12	0.60	
13:50	45	8.12	0.60	
13:55	50	8.12	0.60	
14:05	60	8.12	0.60	
14:15	70	8.13	0.60	
14:25	80	8.13	0.60	
14:35	90	8.13	0.60	
14:45	100	8.13	0.60	39¼
15:35	150			
15:25	200			
15:15	250			

ADDENDUM



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

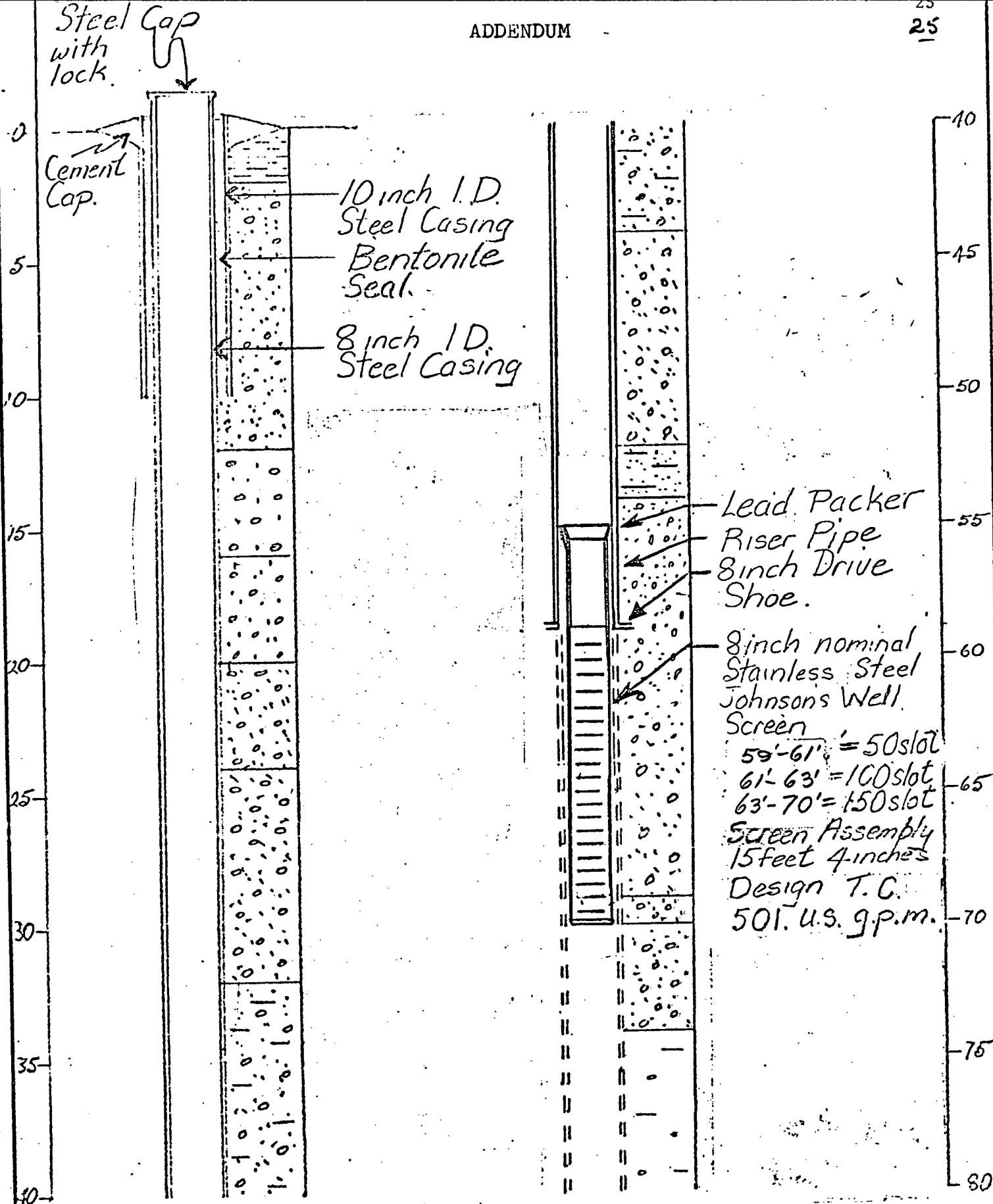
SCALE: VERT. *1 inch = 10 feet*

HOR.

DATE

Dec 1975

TO ACCOMPANY
ADDENDUM TO FINAL REPORT
REVISED SKETCH SHOWING TEST WELL DESIGN
MEASUREMENTS WITH RESPECT TO DATUM
BEFORE AND AFTER WELL SUBSIDENCE



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

SCALE: VERT. *1 inch = 5 feet*
HOR.

DATE
Dec 1975

TO ACCOMPANY
ADDENDUM TO FINAL REPORT
REVISED DETAILS OF TEST WELL
CONSTRUCTION - MIDDLE AQUIFER
MEASUREMENTS WITH RESPECT TO DATUM
AFTER WELL SUBSIDENCE

FINAL REPORT

TABLE NO. 1

"DATA USED TO DRAW CURVE IN FIGURE NO. 3"

Date	Cowichan River Water Height in feet. W.S. of Canada Gauge near Duncan	Cowichan River Water Height W.R.S. temporary Gauge near Test Well Site - Duncan
October 23, 1975	6.34	
24	6.20	1.08
25	6.50	-
26	6.40	-
27	6.70	1.68
28	6.55	1.48
29	7.75	1.9
30	7.57	2.35
31	7.25	2.11
November 1, 1975	7.60	-
2	7.62	-
3	8.40	3.05
4	8.82	3.33
5	8.78	3.27
6	8.85	3.32
7	9.52	3.70
8	9.33	-
9	8.78	-
10	8.38	3.05
11	8.00	-
12	8.00	2.83
13	8.45	3.01
14	9.80	4.00
15	10.28	-
16	9.72	-
17	9.21	3.74
18	8.80	3.47
19	8.42	3.23
20	8.05	3.02
21	7.63	2.80
22	7.40	-
23	7.50	-
24	7.48	2.65
25	7.30	2.48
26	7.30	2.51
27	7.10	2.36
28	6.90	-
29	6.70	-
December 1, 1975	6.55	1.77
2	8.55	(Washed out
3	10.88	during night)

TABLE NO. 1 (con't)

"DATA USED TO DRAW CURVE IN FIGURE NO. 3"

Date	Cowichan River Water Height in feet. W.S. of Canada Gauge near Duncan	Cowichan River Water Height W.R.S. temporary Gauge near Test Well Site - Duncan
4	9.67	3.85
5	9.07	3.37
6	8.41	-
7	8.11	-
8	7.88	2.73
9	7.67	2.61
10	7.59	2.48
11	7.32	2.31
12	7.10	2.17
13	6.84	-
14	6.77	-

TABLE NO. 2
TABLE USED TO PLOT FIGURE NO. 8

Date	Cowichan River Water Height in feet. W.S. of Canada Gauge near Duncan	Calculated Values for W.R.S. temporary Gauge near Test Well Site - Duncan. Values obtained from curve in Figure 3.
October 23, 1975	6.34	1.51
24	6.20	1.20
25	6.50	1.74
26	6.40	1.60
27	6.70	1.85
28	6.55	1.77
29	7.75	2.71
30	7.57	2.60
31	7.25	2.45
November 1, 1975	7.60	2.63
2	7.62	2.62
3	8.40	3.04
4	8.82	3.27
5	8.78	3.25
6	8.85	3.29
7	9.52	3.70
8	9.33	3.58
9	8.78	3.25
10	8.38	3.03
11	8.00	2.88
12	8.00	2.88
13	8.45	3.08
14	9.80	3.92
15	10.28	4.33 extrapolated
16	9.72	3.85
17	9.21	3.50
18	8.80	3.26
19	8.42	3.05
20	8.05	2.85
21	7.63	2.67
22	7.40	2.50
23	7.50	2.71
24	7.48	2.62
25	7.30	2.48
26	7.30	2.48
27	7.10	2.35
28	6.90	2.22
29	6.70	1.97
30	6.60	1.86

TABLE NO. 2 (con't)

TABLE USED TO PLOT FIGURE NO. 8

Date	Cowichan River Water Height in feet. W.S. of Canada Gauge near Duncan	Calculated Values for W.R.S. temporary Gauge near Test Well Site - Duncan. Values obtained from curve in Figure 3.
December 1, 1975	6.55	1.55
2	8.55	3.12
3	10.88	5.00 extrapolated
4	9.67	3.82
5	9.07	3.42
6	8.41	3.04
7	8.11	2.88
8	7.88	2.78
9	7.67	2.67
10	7.59	2.58
11	7.32	2.48
12	7.10	2.35
13	6.84	2.12
14	6.77	2.05

FINAL REPORT

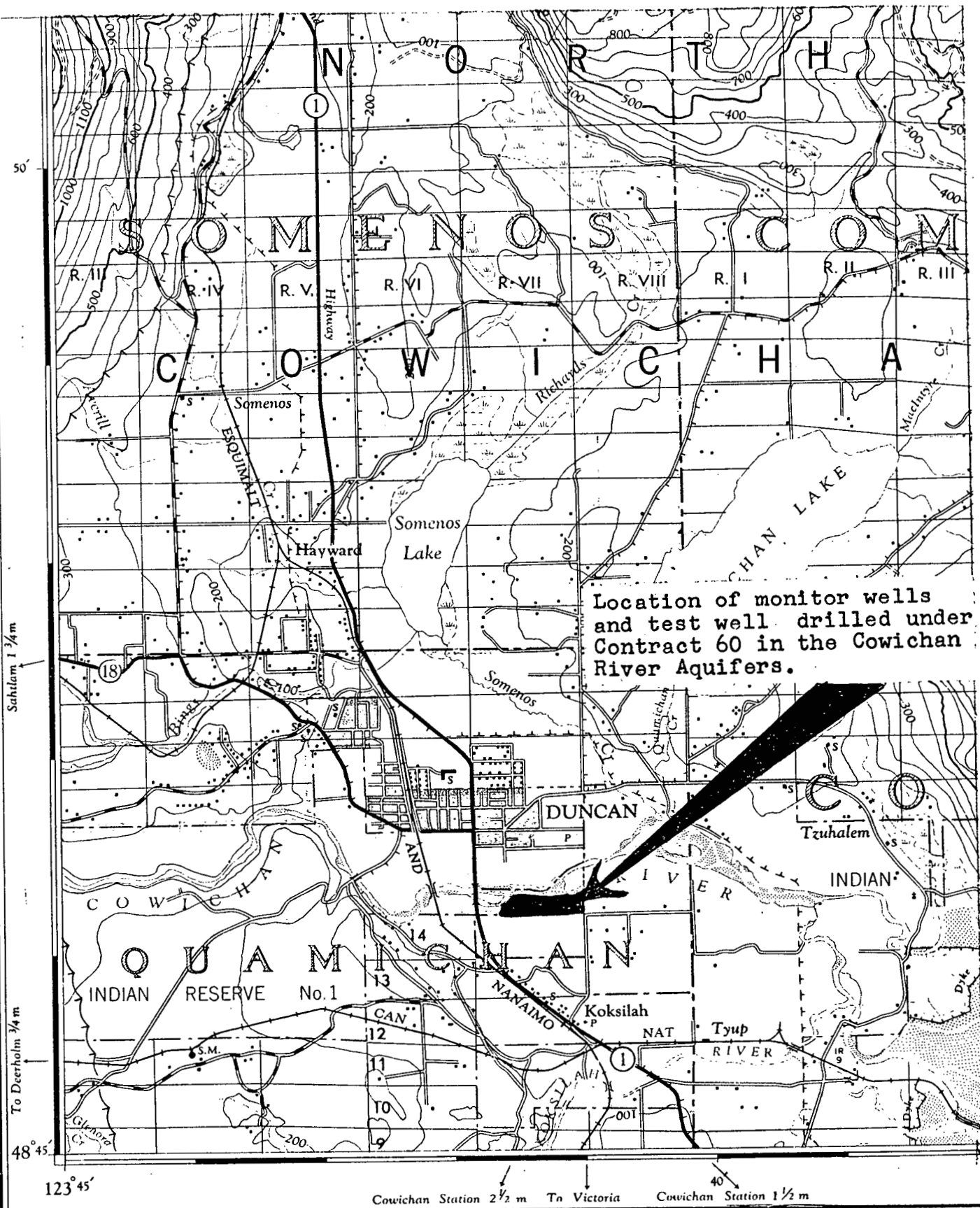
TABLE NO. 3

COST ESTIMATES OF 16-INCH PRODUCTION WELL COMPLETED WITH 16-INCH NOMINAL SCREEN
A. DESIGN COST ESTIMATES FOR 900 US GALLONS PER MINUTE

Item No.	Description	Unit	Estimated Unit Price	Number of Units Required	Estimated Job Costs
1	Mobilization of equipment, excluding pumping equipment, to and from job site.	lump sum	200	1	200
2	Mobilization of pumping equipment to and from job site.	lump sum	800	1	800
3	Cost to drill and case 20-inch casing.	per foot	52	15	780
4	Cost to drill and case 16-inch casing.	per foot	44	70	3,080
5	Cost of supplying 16-inch drive shoe.	each	425	1	425
6	Cost of running overlap casing.	per foot	20	15	300
7	Running bailing tests, install stainless steel screen, develop wells, grout casing, and do other authorized hour work.	per hour	40	70	2,800
8	Charge for standby of rig and crew during delays caused by Water Resources Service (not to exceed 8 hours per day, 40 hours per week).	per hour	25	16	400
9	16-inch Nominal Stainless Steel Johnsons Well Screen	per foot	220	11	2,420
	Packer	each	200	1	200
	Bail Bottom	each	100	1	100
10	Setting pump, laying discharge pipe etc.	per hour	40	16	640
11	Cost of rental of 700 feet of discharge pipe, calibrated flow meter, orifice plates and pipes, as specified for the duration of contract.	lump sum	500	1	500
12	Running pumping test as specified using pump power unit and flow measuring gear as supplied by the contractor for pump testing 16 production well.				
13	First 24 hours	per hour	40	24	960
	After 24 hours	per hour	39	8	312
	(c) Standby for recovery	per hour	35	8	280
14	Job 6. Costs for above				14,197
15	20% extra work and equipment rental not specified above				2,839
16	Job Costs for above including 20% extra				17,036
17	Engineering Supervision (15% of Job Costs - Item 16)				2,555
18	Total December 1975 Job Costs for 900 USgpm, 16-inch well				\$ 19,591

B. DESIGN COST ESTIMATES FOR 1500* USgals/min
*(Based on partial use of "Upper Aquifer" as well as Middle Aquifer)

1	Total December 1975 Job Costs for 900 USgpm 16-inch well --				\$ 19,591
	Plus				
2	16-inch Nominal Stainless Steel Johnsons Well Screen --	per foot	220	8	1,760
3	Additional development costs for longer screen.	per hour	40	16	640
4	Total December 1975 Job Costs for 1500 USgpm, 16-inch production well.				\$ 21,991



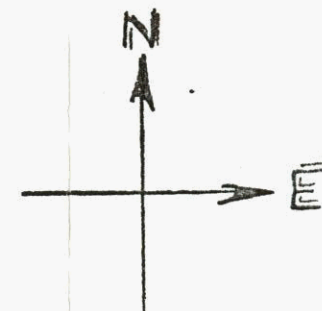
BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C. - Key Plan

SCALE: VERT.
HOR. 1.25 in. = 1 mile

DATE
Dec. 1975

J. C. Fowersaker ENGINEER
FILE No. 0239013 DWG. No. Figure 1



EXISTING WELL
ANDERSON #2

131
130

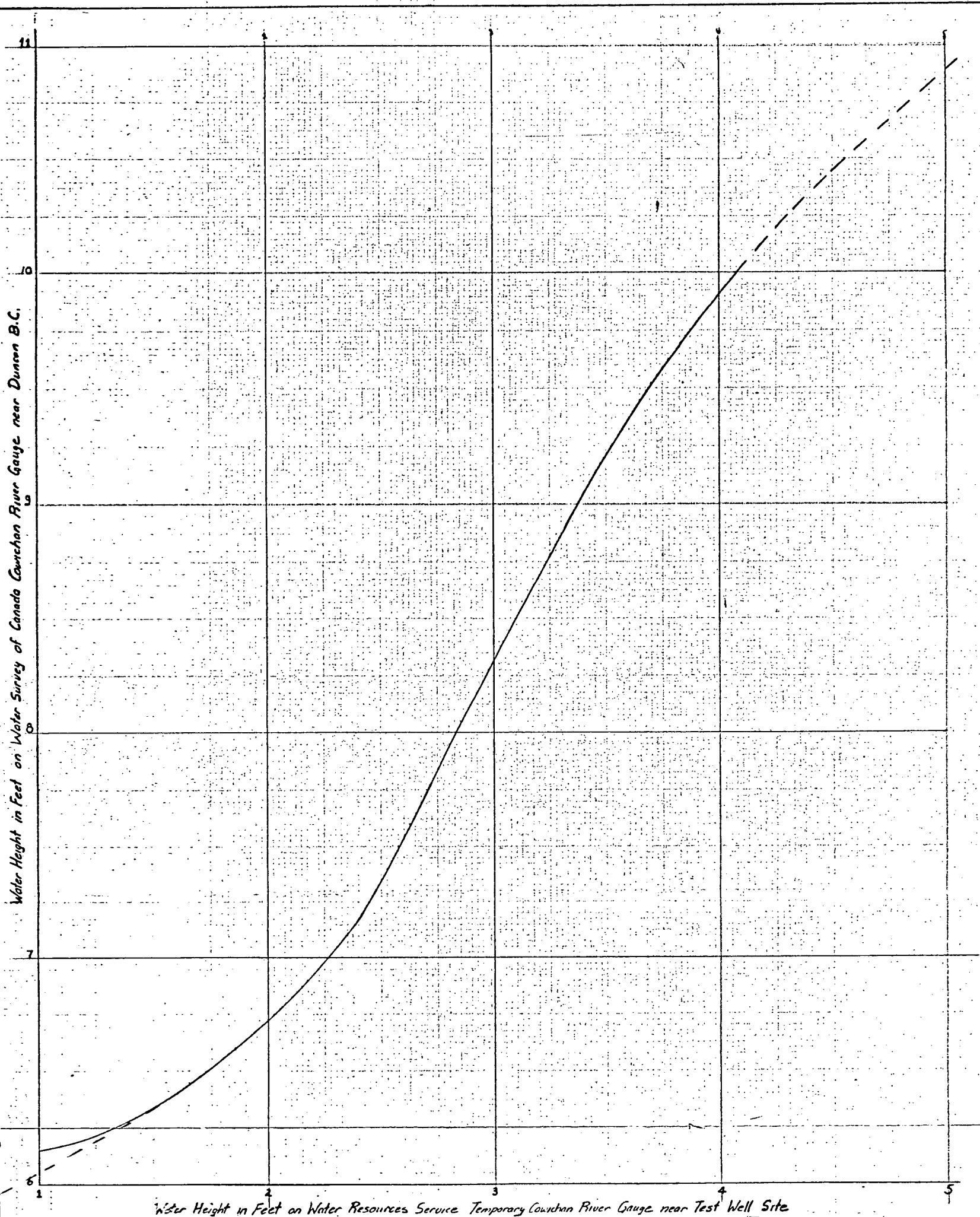
BOYS ROAD

ASTERLY TORTION OF
SECTION 15 RANGE 7
QUAMICHAN DISTRICT

BRITISH COLUMBIA -
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

WELL SITE LOCATIONS
● LOCATION OF MONITOR WELLS
● LOCATION OF TEST WELL
CONTRACT No: 60, DUNCAN

FCHWOTKA
DATE
SCALE: VERT. N.A.
HOR. 1" = 100 FEET
T.C. FOWERAKER ENGINEER
FILE No. 0239013 DWG. No. Figure N° 2



Constructed and Drawn
by
E. Tradewell.

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

SCALE: VERT. 1 foot = 4 inches
HOR. 1 foot = 4 inches

DATE
Dec. 1975

TO ACCOMPANY REPORT ON
Groundwater Research Project
Cowichan River Aquifers
Duncan B.C.

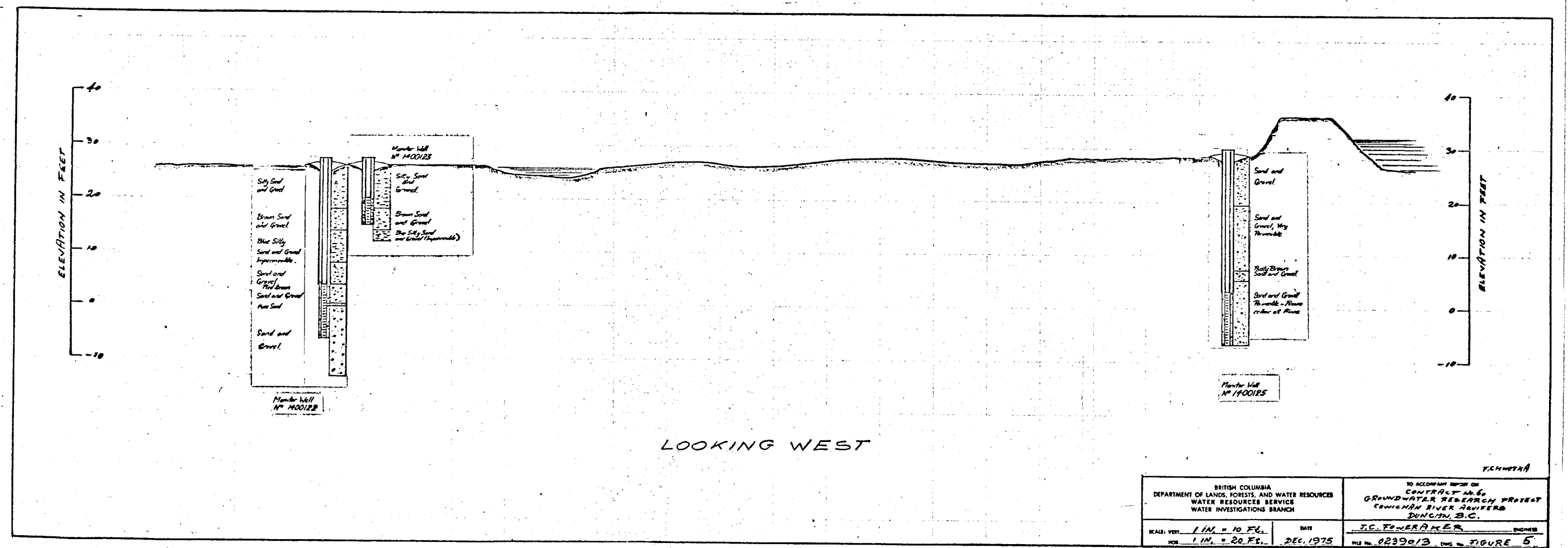
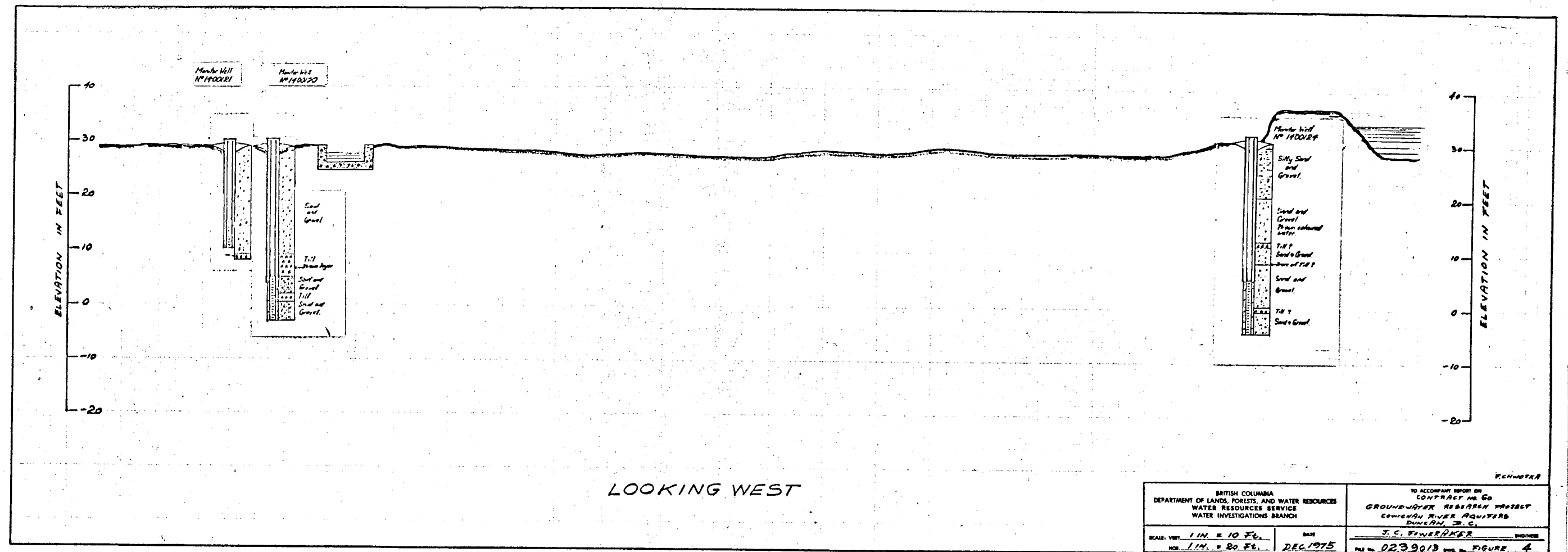
J.C. Foweraker

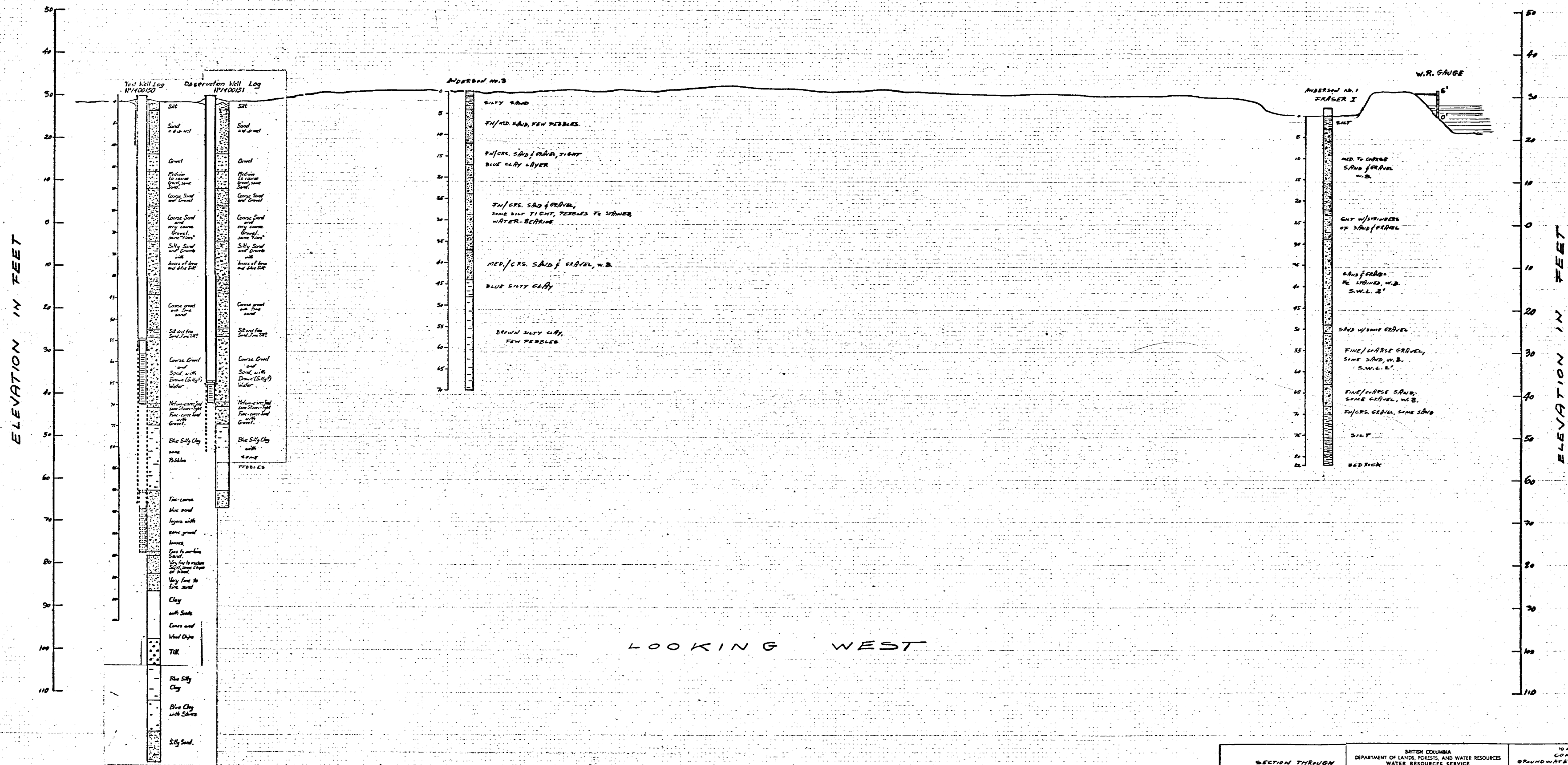
ENGINEER

FILE No. 0239013

DWG. No. Figure 3

Relationship between water height
in feet on Water Survey of Canada
Cowichan River Gauge near Duncan
and water height in feet on Water
Resources Service Temporary Cowichan
River Gauge near Test Well Site.





LOOKING WEST

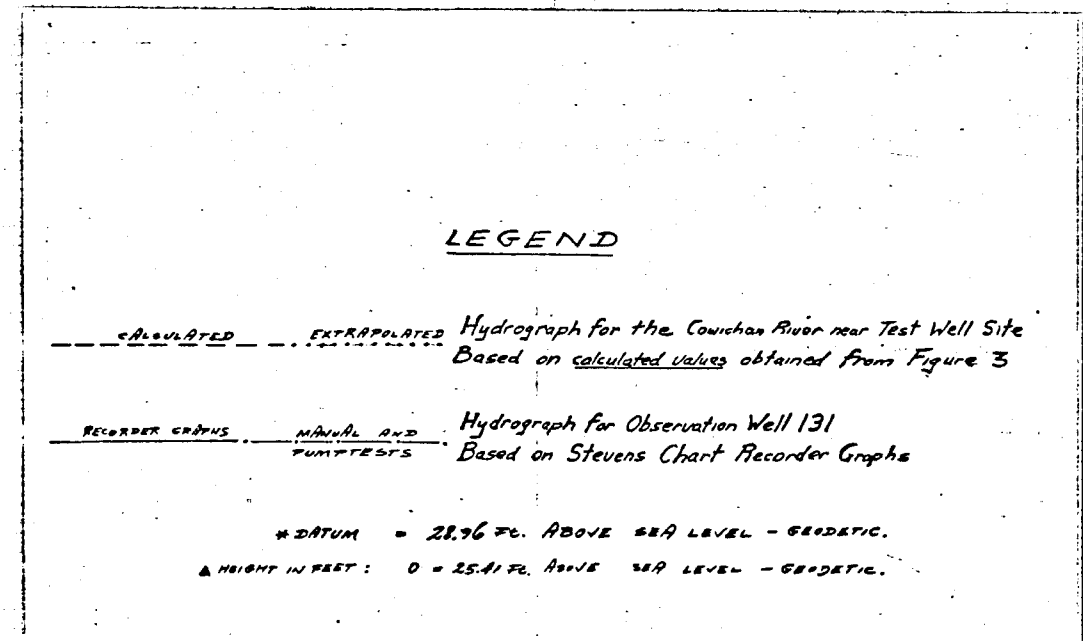
SECTION THROUGH TEST/MONITOR WELLS 130, 131, ANDERSON 3 & 1		BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON CONTRACT NO. 60 GROUNDWATER RESEARCH PROJECT LOWICHAU RIVER RESERVE SQUAMISH, B.C.	
SCALE: VERT. 1 IN. = 10 FEET HOR. 1 IN. = 20 FEET	DATE FEB. 1975	F.C. FENWICKER ENGINEER FILE NO. 0239013 DWG. NO. FIG. 7			

WATER HEIGHT IN FEET

WATER LEVEL BELOW DATUM IN FEET

WATER HEIGHT IN FEET

23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
OCTOBER NOVEMBER



Constructed and Drawn by F. CHWOSKA	Hydrograph for Observation Well 131 and Hydrograph based on calculated water heights of the Cowichan River near the Test Well Site at Duncan B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON Groundwater Research Project Cowichan River Aquifers Duncan B.C.	
		SCALE: VERT. 43' SHOWS	DATE Dec. 1975	FILE NO. 0239013	FIGURE NO. 8

CALCULATED WATER HEIGHT IN FEET ON COWICHAN RIVER A

5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0

OBSERVATION WELL 131
WATER LEVEL BELOW DATUM IN FEET

2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0

20 21 22 23 24 25 26 27 28 29 30
NOVEMBER

1 2 3 4 5 6 7 8 9 10 11 12
DECEMBER

AVERAGE DECLINE
IN WATER HEIGHT
0.106 FT. PER DAY

PUMPTEST

2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0

5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0

LEGEND

--- CALCULATED --- EXTRAPOLATED Hydrograph for the Cowichan River near Test Well Site
Based on calculated values obtained from Figure 3
--- RECORDER GRAPHS --- PUMPTESTS Hydrograph for Observation Well 131
Based on Stevens Chart Recorder Graphs

* DATUM = 28.96 FT. ABOVE SEA LEVEL - GEODETIC.

A HEIGHT IN FEET: 0 = 25.41 FT. ABOVE SEA LEVEL - GEODETIC.

Constructed and
Drawn by
F. CHWOTKA

Hydrograph for Observation Well 131
and
Hydrograph based on calculated water
heights of the Cowichan River near
the Test Well Site at Duncan, B.C.

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FOREST AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
SCALE: VERT. 0.5" = 1.0' H
DATE: DEC 1975
FILE NO. 0239213

TO ACCOMPANY REPORT ON
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.
J. Foweraker
ENGINEER
FIGURE NO. 9

Water Height in Feet on Water Survey of Canada
Cowichan River Gauge near Duncan B.C.

Hydrograph of water heights on Water Survey of Canada Cowichan River Gauge near Duncan B.C.

Precipitation in Inches

28 29 30
SEPTEMBER
1 2 3 4 5 6 7 8 9 10 11 12
OCTOBER
13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
NOVEMBER
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
DECEMBER
1 2 3 4 5 6 7 8 9 10 11 12

Precipitation at Duncan Forestry Station 1975

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON Groundwater Research Project Cowichan River Aquifers Duncan B.C. J. Edwards ENGINEER		Comparison between water heights in the Cowichan River near Duncan and Precipitation.
SCALE: VERT. — as shown — HOR. —	DATE Dec 1975	FILE NO. 3232013 FIG. NO. Figure 10		

APPENDIX NO. 1

MONITOR WELLS

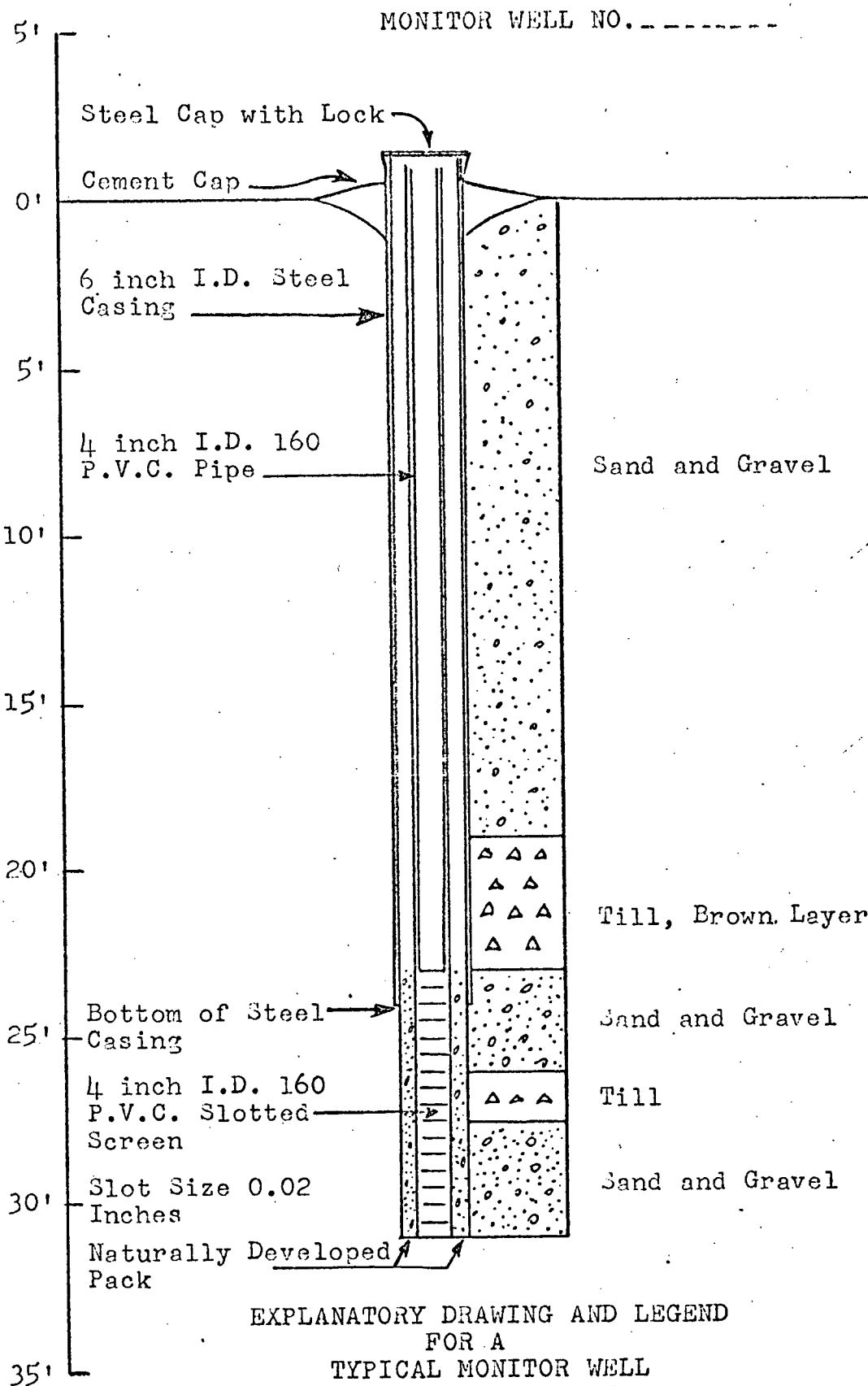
120 to 125

DRILL LOGS

WELL DESIGNS

GRAIN SIZE ANALYSES

DEPTH IN FEET



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 feet

HOR.

DATE

Nov. 1975

J. C. Foweraker ENGINEER

FILE No. 0239013

DWG. No. 1 Appendix 1

APPENDIX NO. 1MONITOR WELL 1400 120:

Feet	Log
0-4	Gravel fill, water at 4'5"
4-19	Brown water bearing and and gravel
19-21.5	Layer glacial till
21.5-22	Change in water - brown to silty
22-23	Till layer
23-26	Coarse water bearing gravel
26-27.5	Layer glacial till
27.5-31	Coarse water bearing gravel

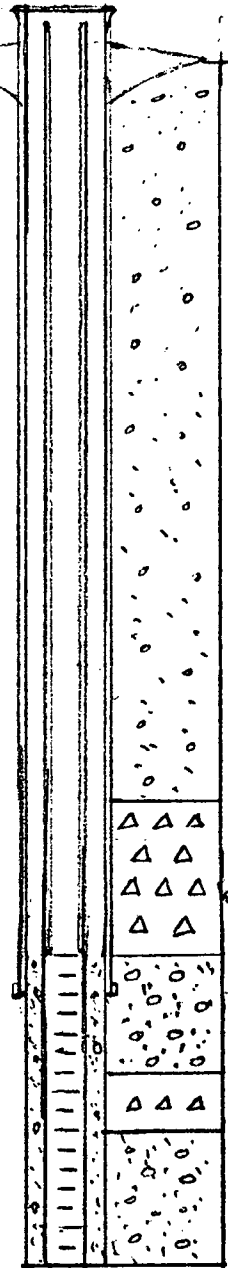
End of hole

Because of the till layer at 22.23 feet depth a rubber packer was installed above the screen on the 4-inch 112, 160 PVC plastic pipe, and pipe and screen well set so that the packer was placed at a depth of 22-23 feet. The screen below was set at 23-31 feet and consisted of 8 feet of 160 PVC 4-inch 1.12 well screen with slot size .020 inches. The bottom of the screen was capped and all couplings were glued. The metal bind casing was withdrawn to 24 feet. The top of well cap is 14 inches above grade.

This well was pumped for a short period of time at 30-35 gallons per minute, a drawdown of about 6 to 8 inches was recorded. Preliminary static was established at 4 feet 5 inches.

5'
0'
5'
10'
15'
20'
25'
30'
35'

Monitor Well
No 1400120



Sand
and
Gravel

Till
Brown layer

Sand and
Gravel

Till

Sand and
Gravel.

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 feet
HOR. _____

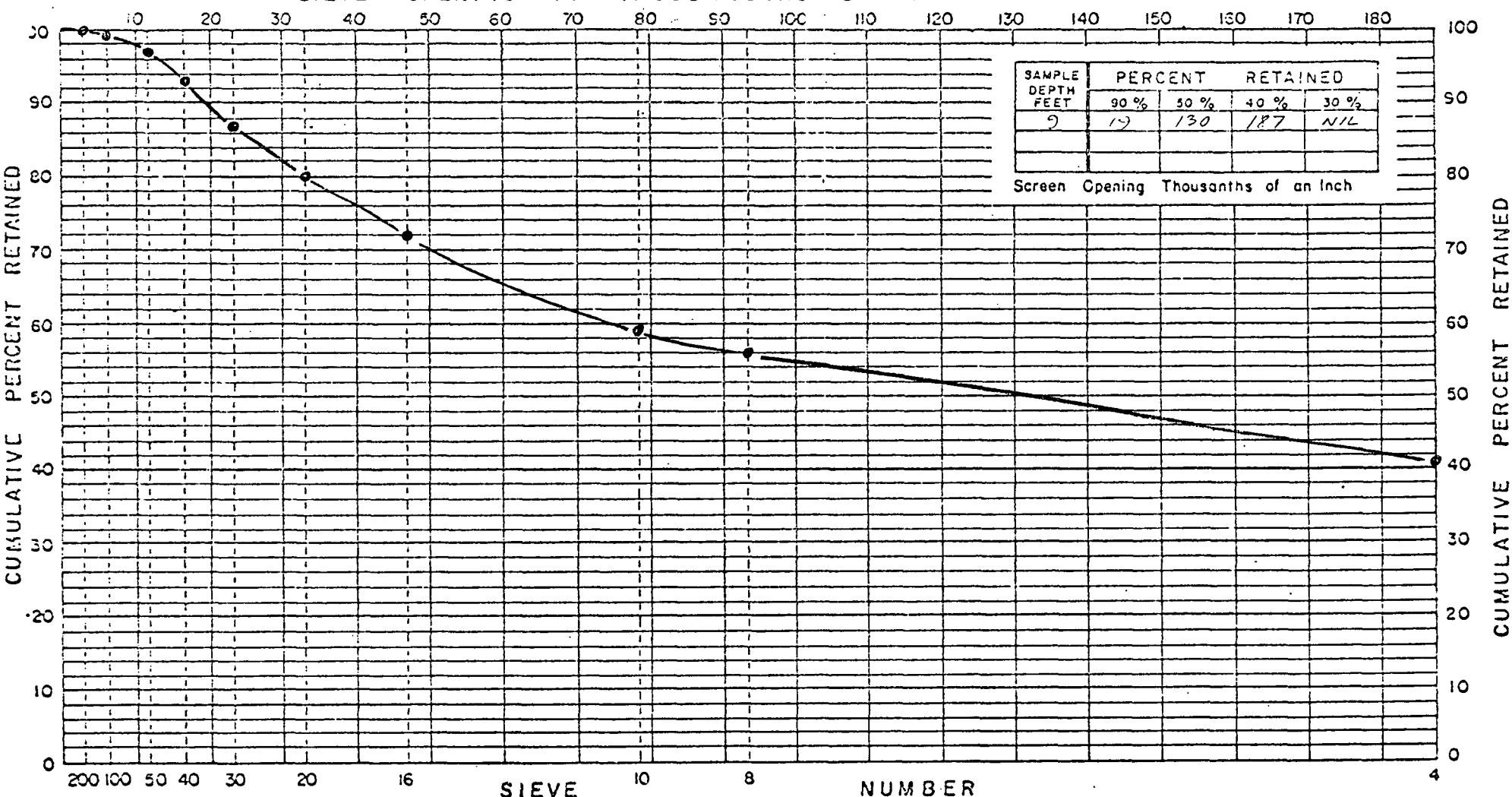
DATE
Nov. 1975

J. C. Foweraker ENGINEER
FILE No. 0239013 DWG. No. _____

DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

[illegible]

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH		FEET	
OPENING	RET. ON	WT. RET.	CUM. % RET.

SAMPLE DEPTH 9		FEET	
OPENING	RET. ON	WT. RET.	CUM. % RET.
	7	710	40.7
	8	978	56.2
	10	1034	59.4
	15	1252	71.8
	20	1392	79.8
	30	1514	87.0
	40	1618	92.7
	50	1686	96.6
	100	1738	99.5
	200	1742	100.0

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
Groundwater Section

SIEVE ANALYSIS

PROJECT: CONTRACT 60

LOCATION: DUNCAN - SILVER PARK

WELL No. 1400120

SAMPLED BY: Fred

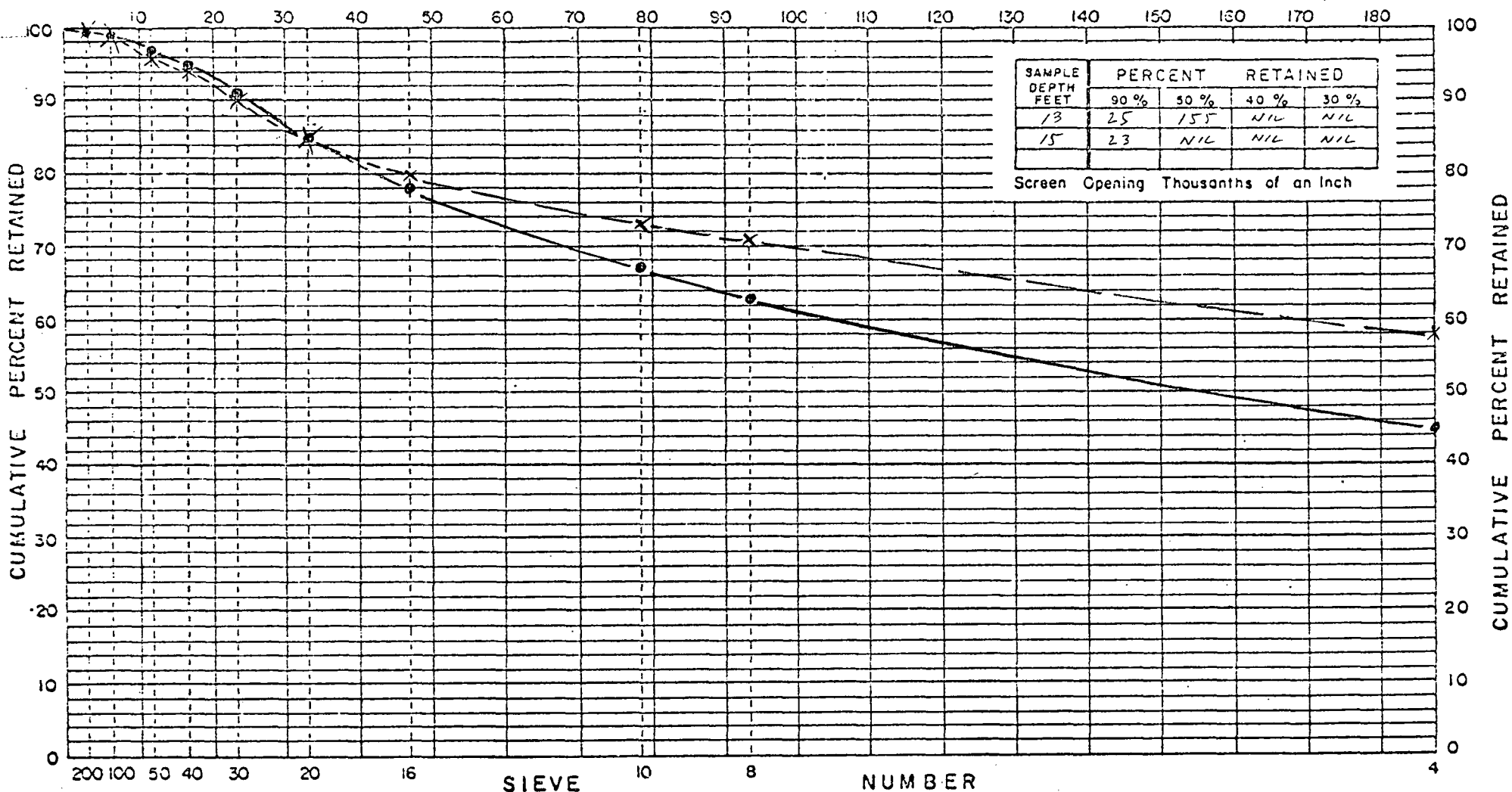
SIEVE ANALYSIS BY: Chiwajka

DATE: Sept. 18, 1975

Percent of sample not sieved 1/2" or over _____ %

Percent of sample not sieved 1/2" or over _____ %
TOTAL WT. 1742 100%

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 13 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	720	45.1
	8	1088	62.8
	10	1152	66.6
	16	1352	78.2
	20	1462	84.7
	30	1570	90.8
	40	1624	95.0
	50	1682	97.4
	100	1710	99.0
	200	1722	99.5

SAMPLE DEPTH 15 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	1200	58.0
	8	1466	70.8
	10	1512	73.0
	16	1660	80.2
	20	1750	84.5
	30	1850	89.5
	40	1938	93.5
	50	1998	96.4
	100	2048	99.0
	200	2064	99.7

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL NO.	1400120
SAMPLED BY:	Fred Chwojko
SIEVE ANALYSIS BY:	Fred Chwojko
DATE:	Sept. 17, 1975

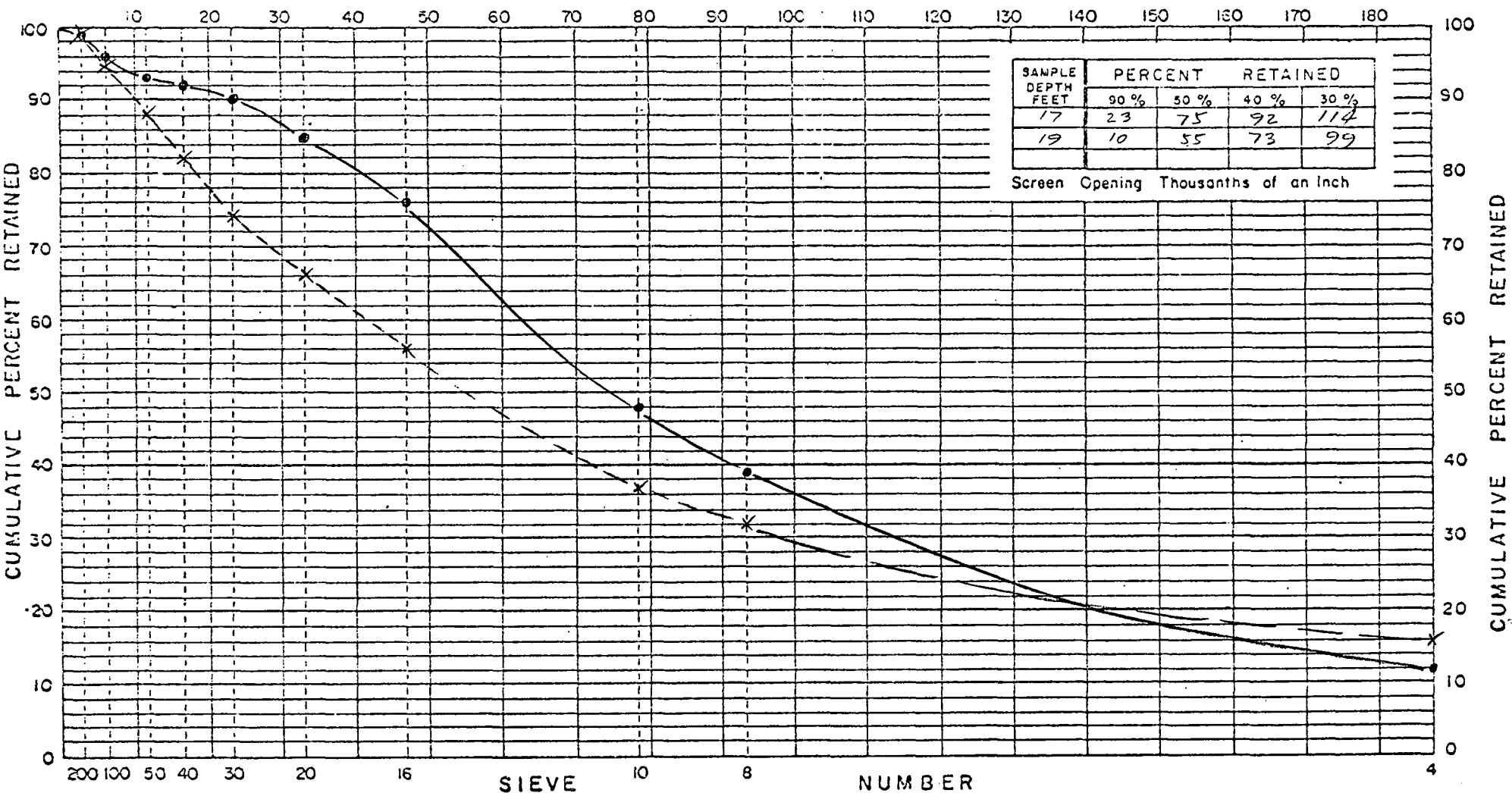
Percent of sample not sieved 1/2" or over
 NIL %

Percent of sample not sieved 1/2" or over
 NIL %

Tot. wt 1732 100%

Tot. wt 2072 100%

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 17 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		212	12.1
8		692	39.1
10		834	47.5
16		1338	76.2
20		1498	85.3
30		1580	90.0
40		1610	91.7
50		1630	93.0
100		1680	95.6
200		1730	98.5

Percent of sample not sieved $\frac{1}{2}$ " or over
%

TOTAL WT. 1756 100%

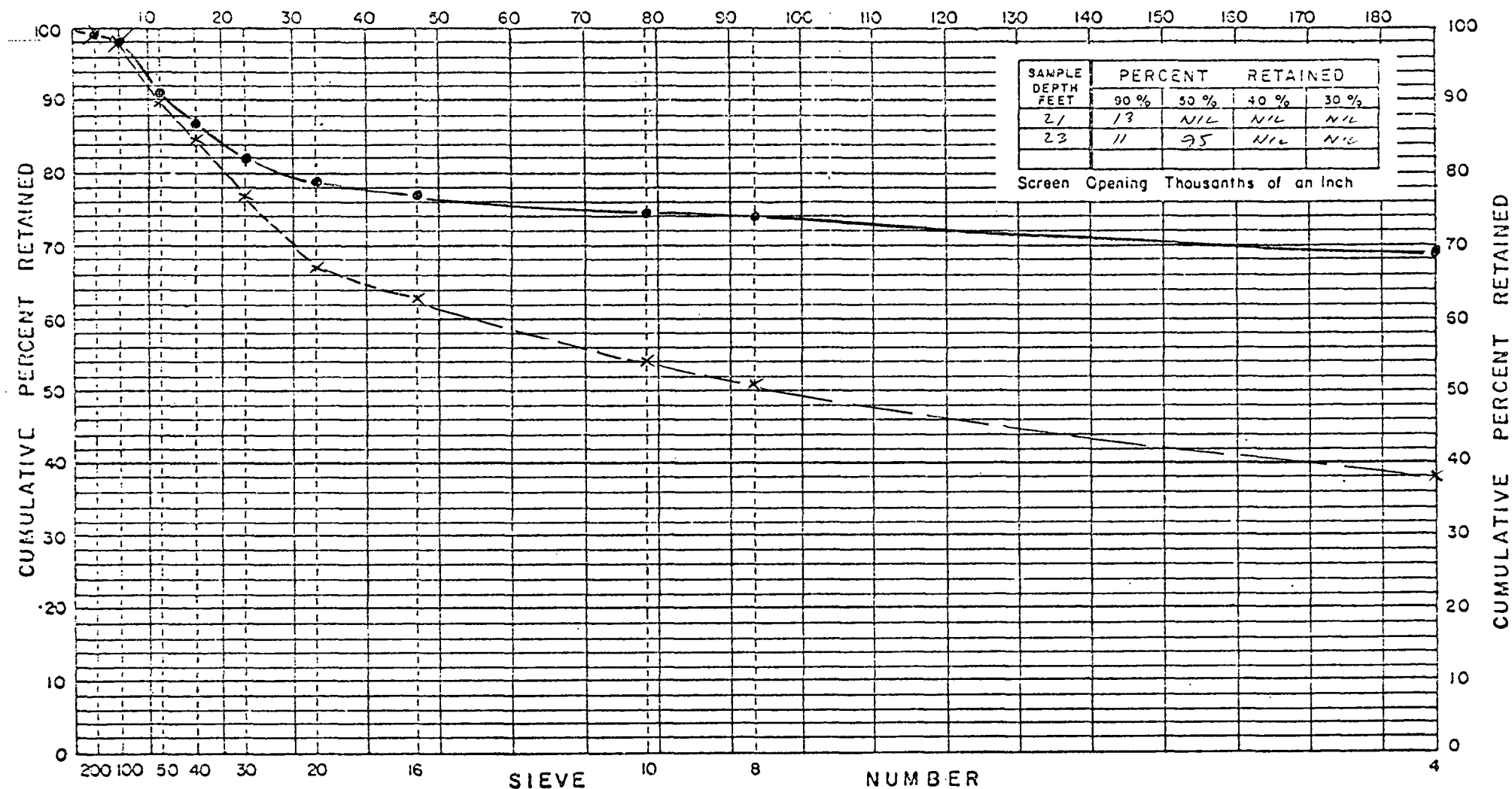
SAMPLE DEPTH 19 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		270	15.8
8		534	31.5
10		632	37.0
16		962	56.3
20		1130	66.0
30		1270	74.2
40		1400	81.8
50		1500	87.6
100		1624	95.0
200		1680	98.3

Percent of sample not sieved $\frac{1}{2}$ " or over
%

TOTAL WT. 1710 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL No.	1700 120
SAMPLED BY:	Frid
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 18, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 21 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	1352	68.9	
8	1452	73.5	
10	1468	74.2	
16	1516	76.5	
20	1554	78.5	
30	1626	82.1	
40	1726	87.2	
50	1804	91.1	
100	1934	97.8	
200	1966	99.2	

Percent of sample not sieved V2" or over

TOTAL WT. 1980 100%

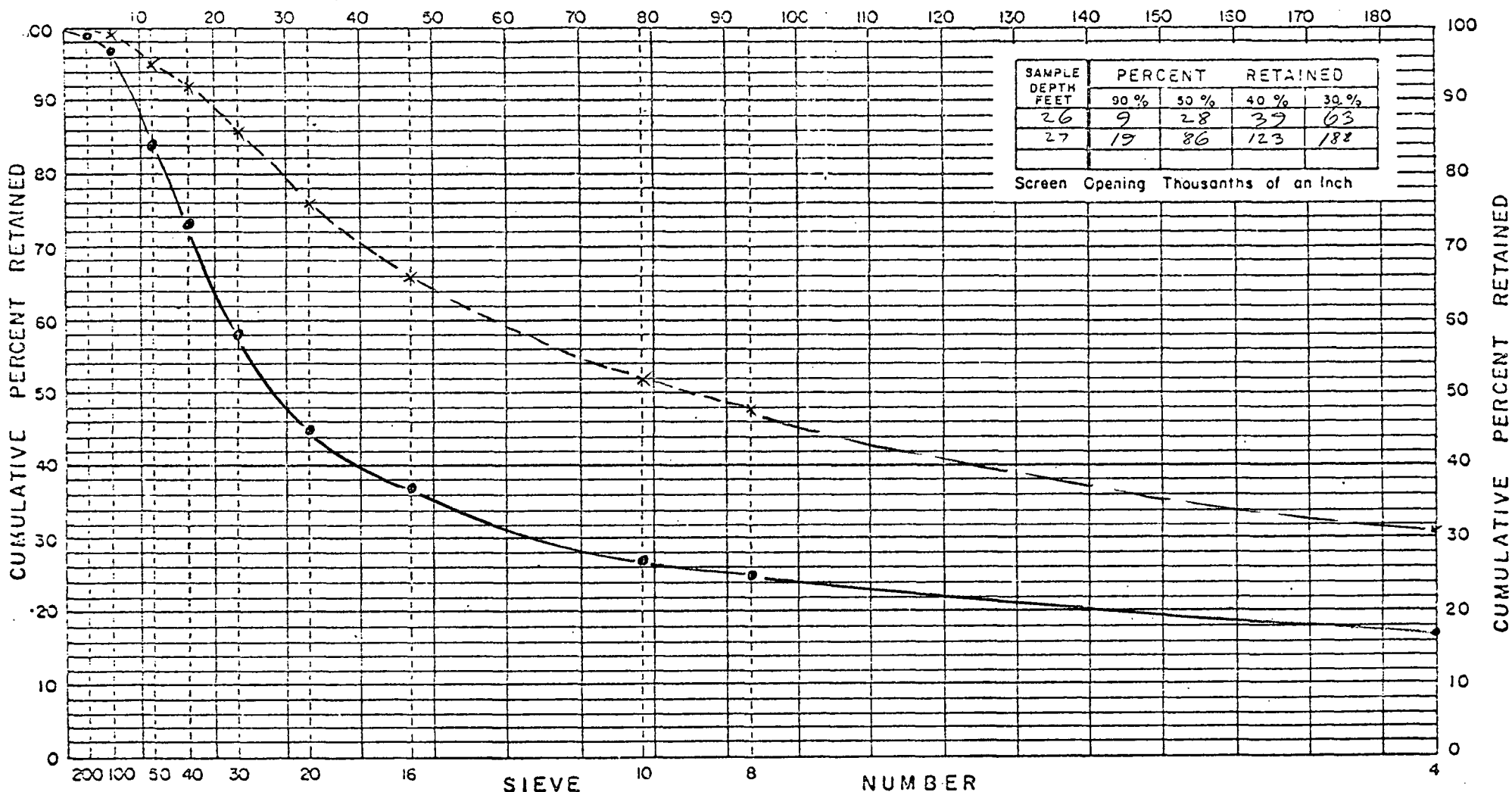
SAMPLE DEPTH 23 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	764	38.0	
8	1024	51.0	
10	1080	53.7	
16	1260	62.6	
20	1390	69.0	
30	1540	76.5	
40	1700	84.5	
50	1814	90.4	
100	1976	98.2	
200	2004	99.7	

Percent of sample not sieved V2" or over

TOTAL WT. 2016 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL No.	1400120
SAMPLED BY:	And Chwojka
SIEVE ANALYSIS BY:	And Chwojka
DATE:	Sept. 18, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 26 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		310	17.1
8		458	25.3
16		496	27.4
30		666	36.8
60		818	45.0
120		1048	57.7
240		1318	72.6
480		1516	83.5
960		1758	96.7
1920		1796	99.0

SAMPLE DEPTH 27 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		624	30.8
8		974	48.0
16		1058	52.2
30		1346	65.2
60		1530	75.5
120		1736	85.6
240		1860	91.8
480		1928	95.0
960		1994	98.5
1920		2010	99.3

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
Groundwater Section

SIEVE ANALYSIS

PROJECT: *CONTRACT 60*

LOCATION: *DUNCAN - SILVER P. PARK*

WELL No. *1400120*

SAMPLED BY: *Fred*

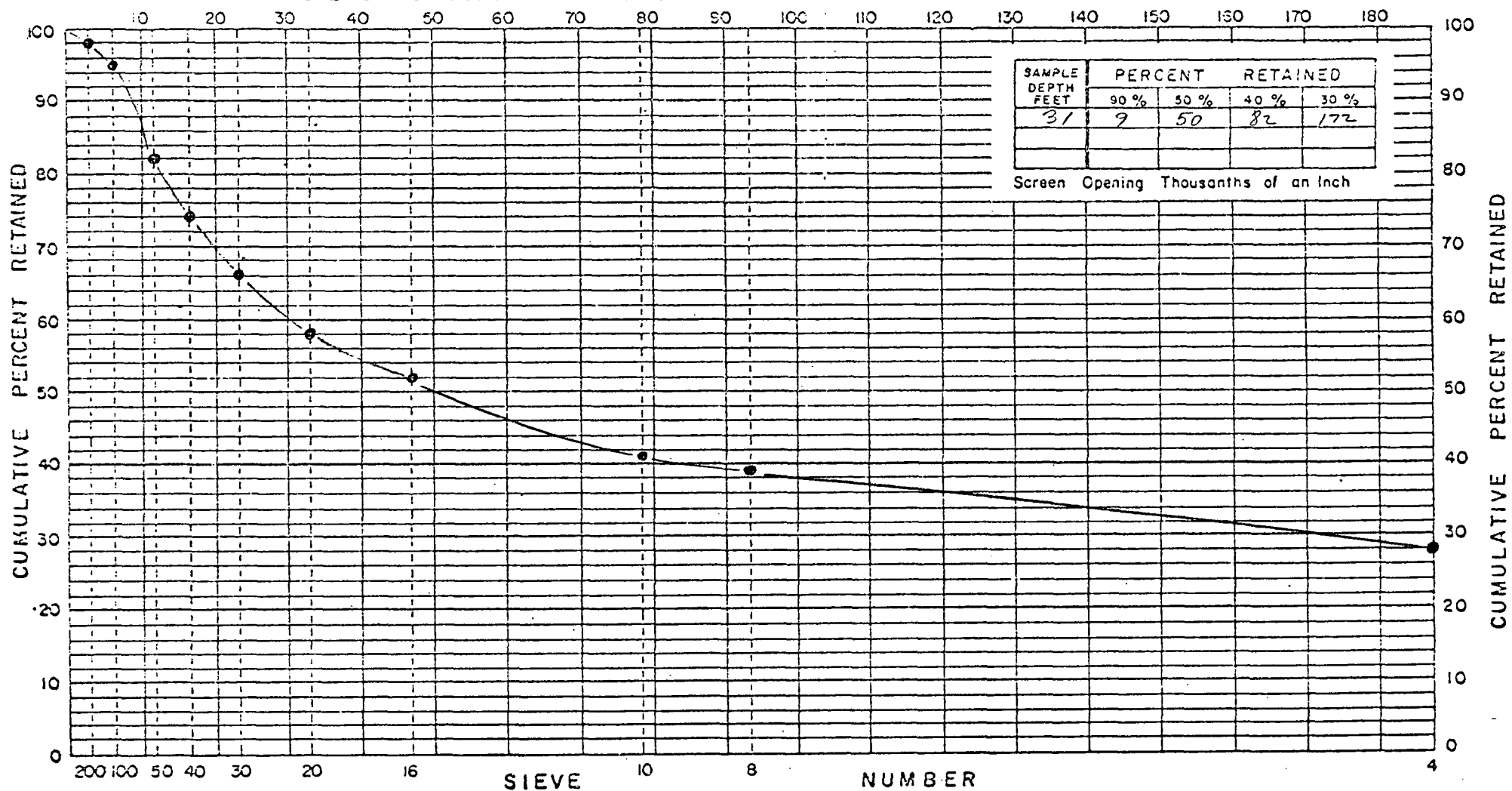
SIEVE ANALYSIS BY: *Chwojka*

DATE: *Sept. 18, 1975*

Percent of sample not sieved V2" or over
%
TOTAL WT. *1814* 100 %

Percent of sample not sieved V2" or over
%
TOTAL WT. *2026* 100 %

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 31 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	528	27.6
	8	750	39.2
	10	798	41.7
	16	994	51.8
	20	1118	58.3
	30	1270	66.2
	40	1426	74.4
	50	1560	81.5
	100	1813	92.8
	200	1870	97.5

SAMPLE DEPTH FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
Groundwater Section

SIEVE ANALYSIS

PROJECT: *CONTRACT 60*

LOCATION: *DUNCAN - SILVER PIRK*

WELL No. *1400120*

SAMPLED BY: *Free*

SIEVE ANALYSIS BY: *Chwojka*

DATE: *Sept. 18, 1975*

Percent of sample not sieved V2" or over
%

Percent of sample not sieved V2" or over
%

Top 10. 10. 10. 10. 10. 10. 10. 10. 10. 10.

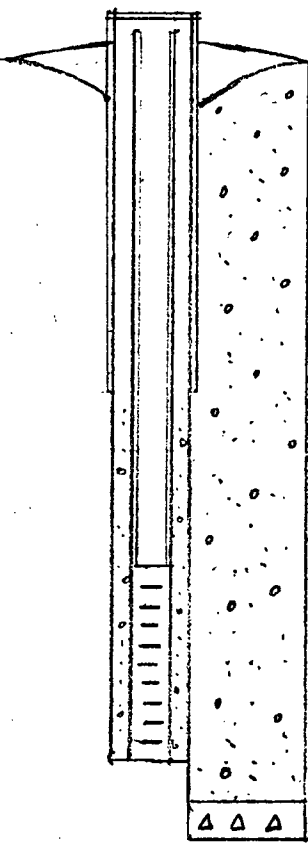
MONITOR WELL 1400 121

Feet	Log (same as 1400 120)
0-4	Gravel fill, water at 4'5"
4-19	Brown water bearing sand and gravel
19-20	Layer glacial till

End of hole

Five feet of PVC screen set between 13 and 18 feet. Steel casing withdrawn to 8½ feet below ground level. The well was subsequently pumped for a short period at 30-35 US gpm. The drawdown reached the screen at 13 feet, however, no drawdown was observed in 1400 120. Preliminary to the water level was established on September 11, at 4 feet 5 inches.

5
0
5
10
15
20
25



Monitor Well
N° 1400121

Sand and
Gravel.

Till

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan
J. C. Foweraker ENGINEER

SCALE: VERT. 1 inch = 5 ft.
HOR. _____

DATE
Nov. 1975

FILE No. 0239013 DWG. No. _____

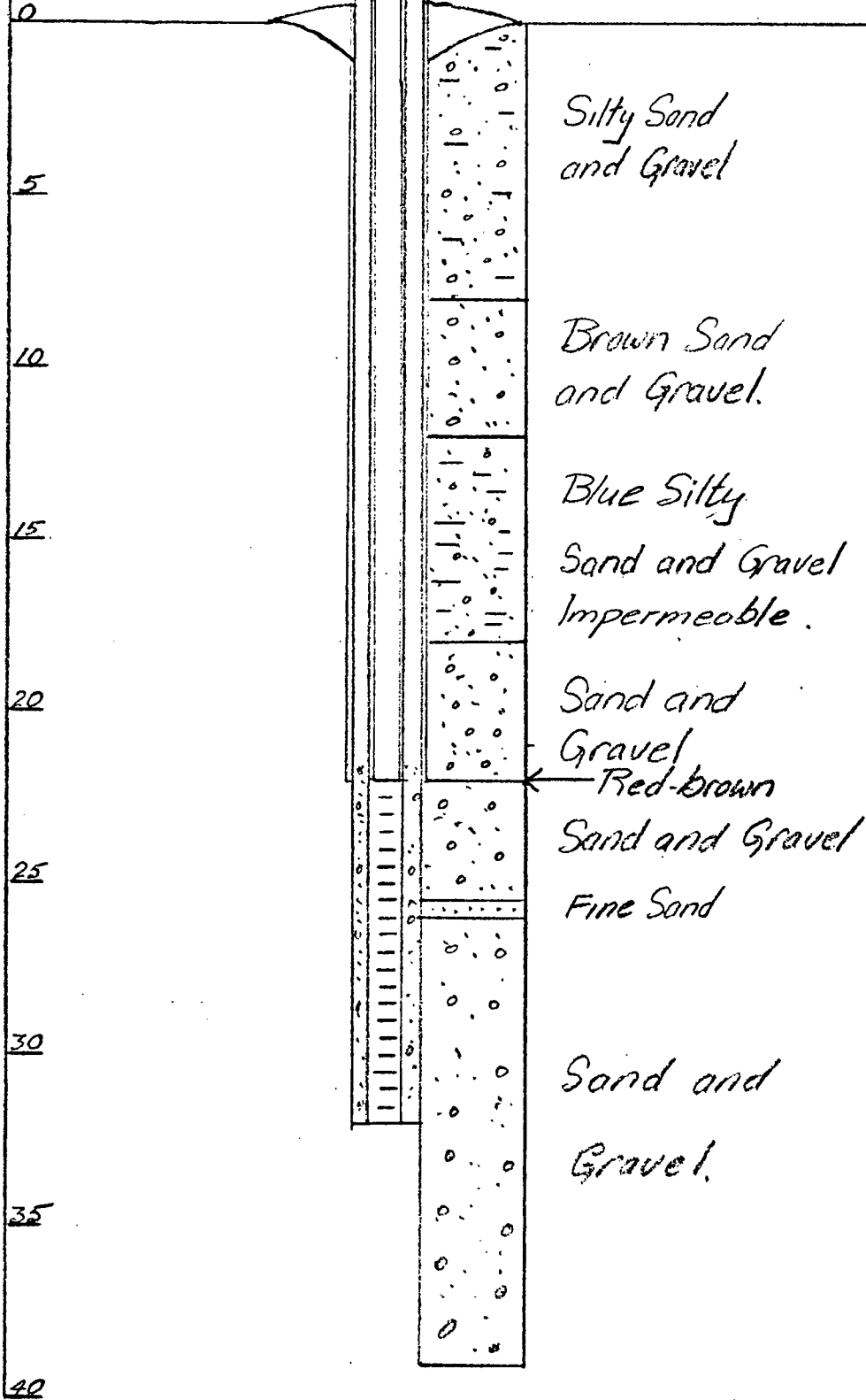
MONITOR WELL 1400 122

Feet	Log
0-8	Silty sand and gravel
8-12	Brown washed sand and gravel
12-18	Silty blue sand and gravel water shutoff
18-19	Water bearing gravel and sand
19-22	Sand and gravel
22	Red-brown colour to sample and to water
22-25.5	Washed sand and gravel
25.5-26	Fine sand
26-39	Washed sand and gravel

End of Hole

Ten feet of PVC 4 inches 1D 20 slot screen set between 22 and 32 feet.

Monitor Well
N° 1400122



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FOREST AND WATER RESOURCES
WATER RESOURCES SERVICE
VICTORIA, BRITISH COLUMBIA

1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 ft
HOR.

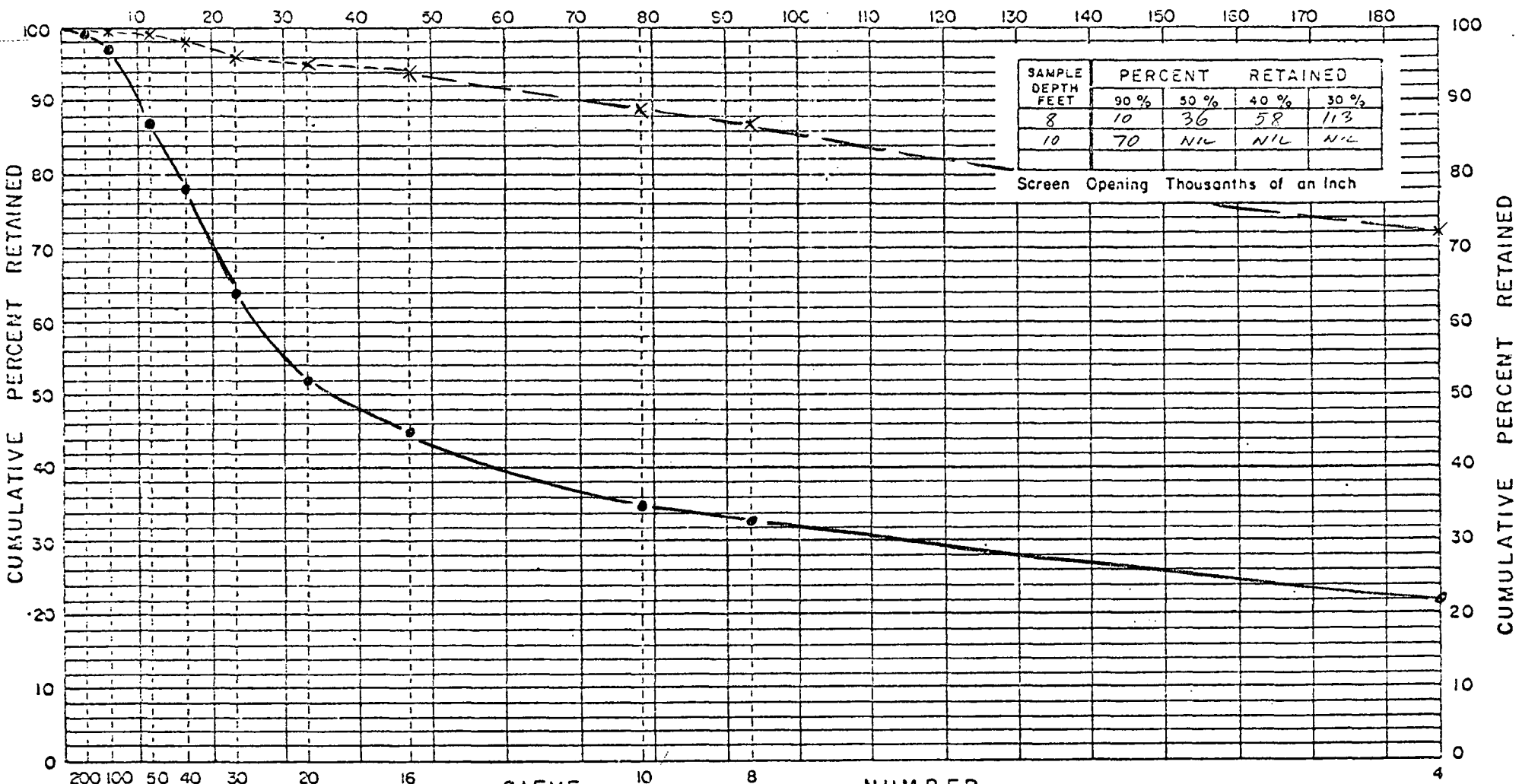
DATE
Nov. 1975

J.C. Macleod
ENGINEER
FILE No. C237013 DWG. No.

DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

[illegible]

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 8 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	392	22.4
	8	574	32.9
	10	616	35.3
	16	776	44.5
	20	902	51.6
	30	1106	63.5
	40	1350	77.5
	50	1512	86.5
	100	1682	96.6
	200	1722	98.2

Percent of sample not sieved 1/2" or over

Total wt. 1744 100 %

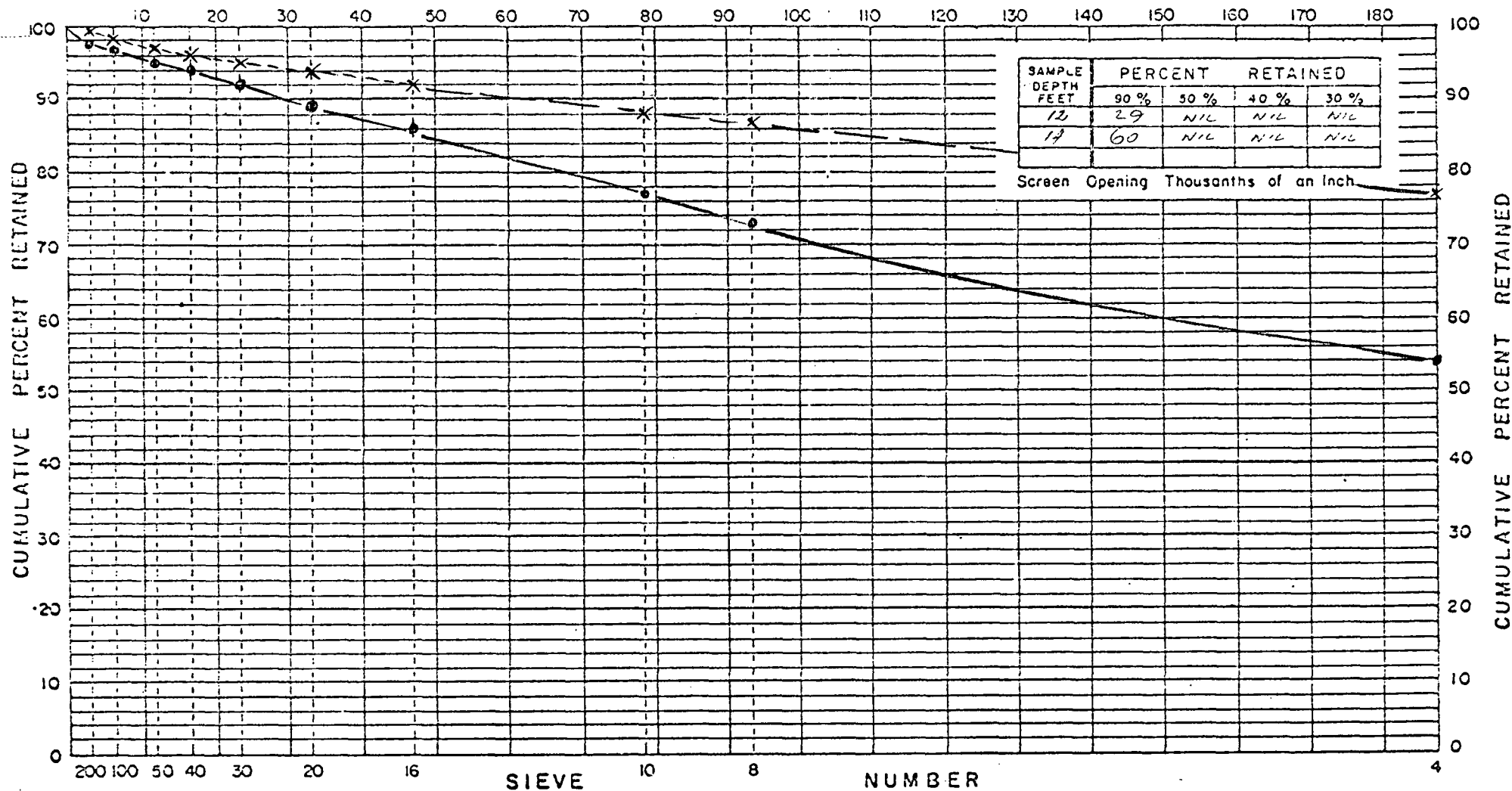
SAMPLE DEPTH 10 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	1512	72.3
	8	1812	86.5
	10	1854	88.7
	16	1952	93.5
	20	1986	95.0
	30	2014	96.2
	40	2040	97.5
	50	2060	98.5
	100	2082	99.6
	200	2090	99.9

Percent of sample not sieved 1/2" or over

Total wt. 2096 100 %

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER P.I.P.K
WELL No.	1400122
SAMPLED BY:	Frd
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 19, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 12 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		1140	53.6
8		1554	73.0
10		1630	76.6
16		1822	85.6
20		1898	89.0
30		1954	92.0
40		1992	93.5
50		2014	95.4
100		2052	96.5
200		2080	97.7

Percent of sample not sieved V2" or over
%

TOTAL WT. 2130 100 %

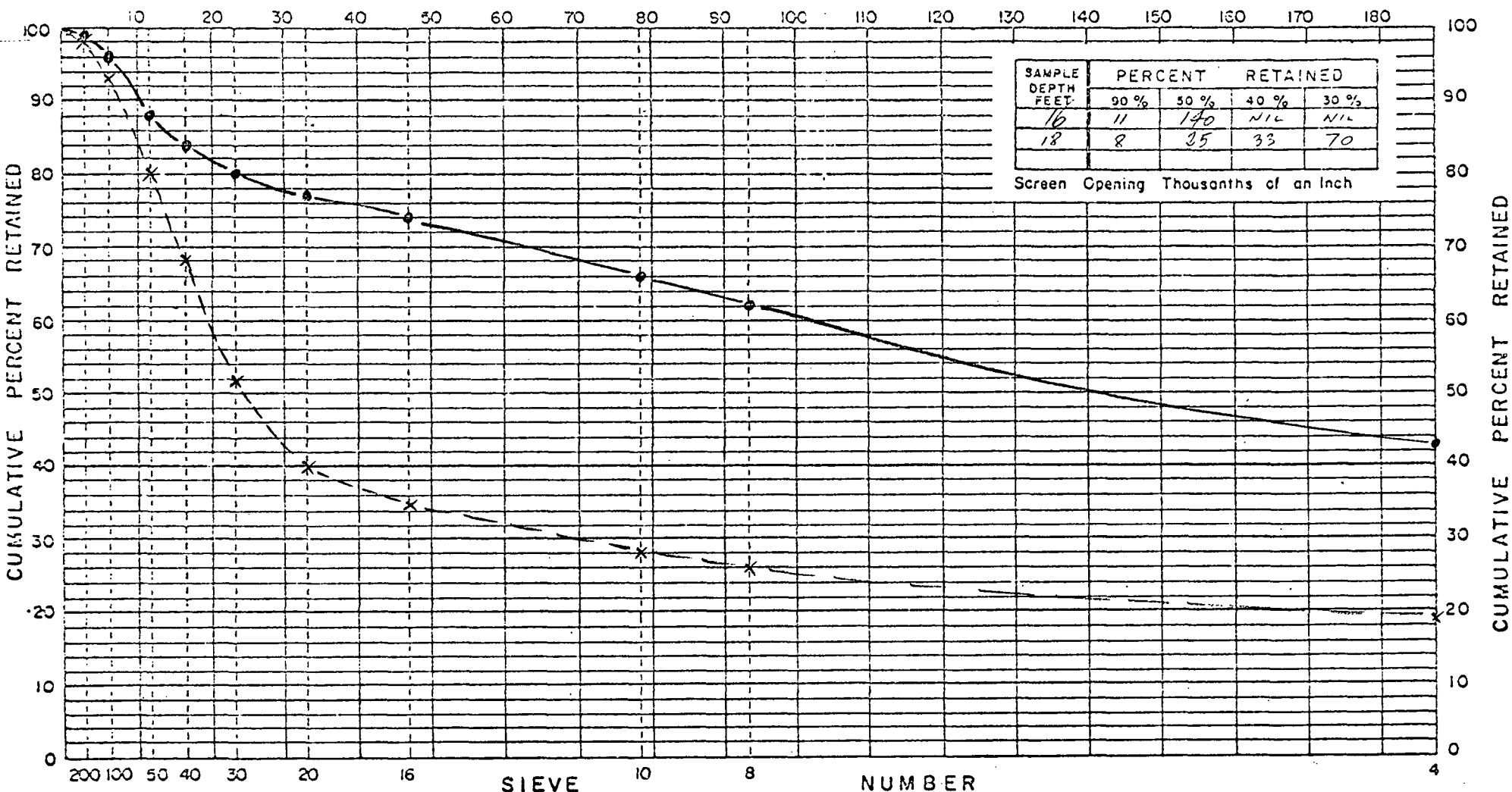
SAMPLE DEPTH 14 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		1124	76.6
8		1270	86.5
10		1296	88.2
16		1356	92.4
20		1374	93.6
30		1390	94.8
40		1404	95.7
50		1416	96.5
100		1438	98.0
200		1452	99.0

Percent of sample not sieved V2" or over
%

TOTAL WT. 1468 100 %

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL No.	1400 122
SAMPLED BY:	FED
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 19, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 16 FEET			
OPENINGS	RET. ON	WT. RET.	CUM. % RET.
	4	646	43.0
	8	934	62.0
	10	990	65.7
	16	1110	73.6
	20	1152	76.5
	30	1204	80.0
	40	1258	83.5
	50	1324	88.0
	100	1438	95.5
	200	1488	98.7

Percent of sample not sieved 1/2" or over _____ %

TOTAL WT. 1558 100 %

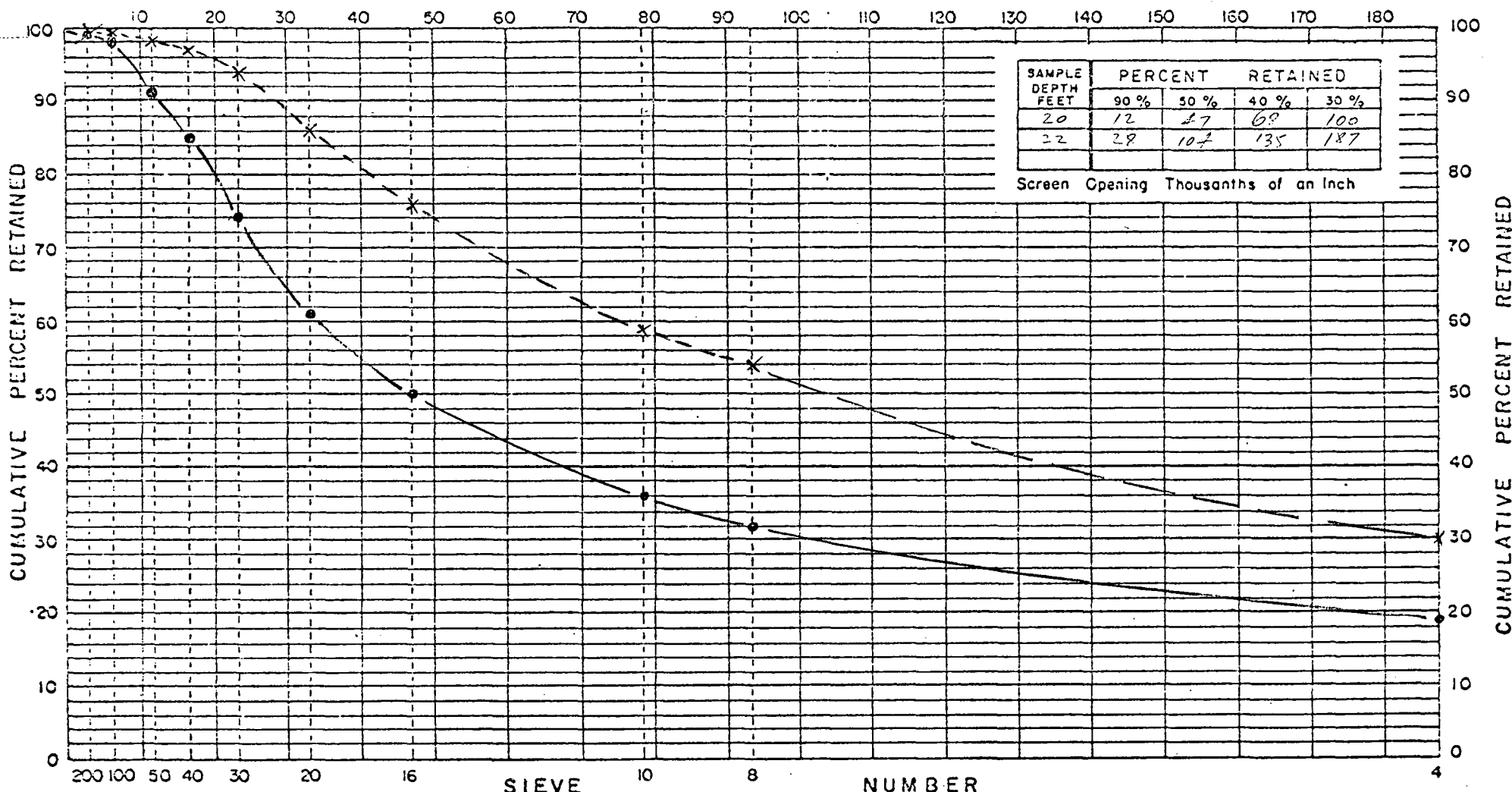
SAMPLE DEPTH 18 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	252	19.0
	8	350	26.4
	10	370	27.9
	16	452	34.6
	20	532	40.1
	30	694	52.3
	40	906	68.4
	50	1064	80.3
	100	1226	92.5
	200	1296	97.6

Percent of sample not sieved 1/2" or over _____ %

TOTAL WT. 1326 100 %

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER P. TRK
WELL NO.	1400122
SAMPLED BY:	Fred
SIEVE ANALYSIS BY:	Chwajka
DATE:	Sept. 19 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 20 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		380	17.3
8		624	31.8
10		698	35.5
16		986	50.3
20		1206	61.4
30		1450	73.8
40		1674	85.3
50		1792	91.1
100		1914	97.5
200		1940	98.7

Percent of sample not sieved V2" or over

TOTAL WT. 1961 100 %

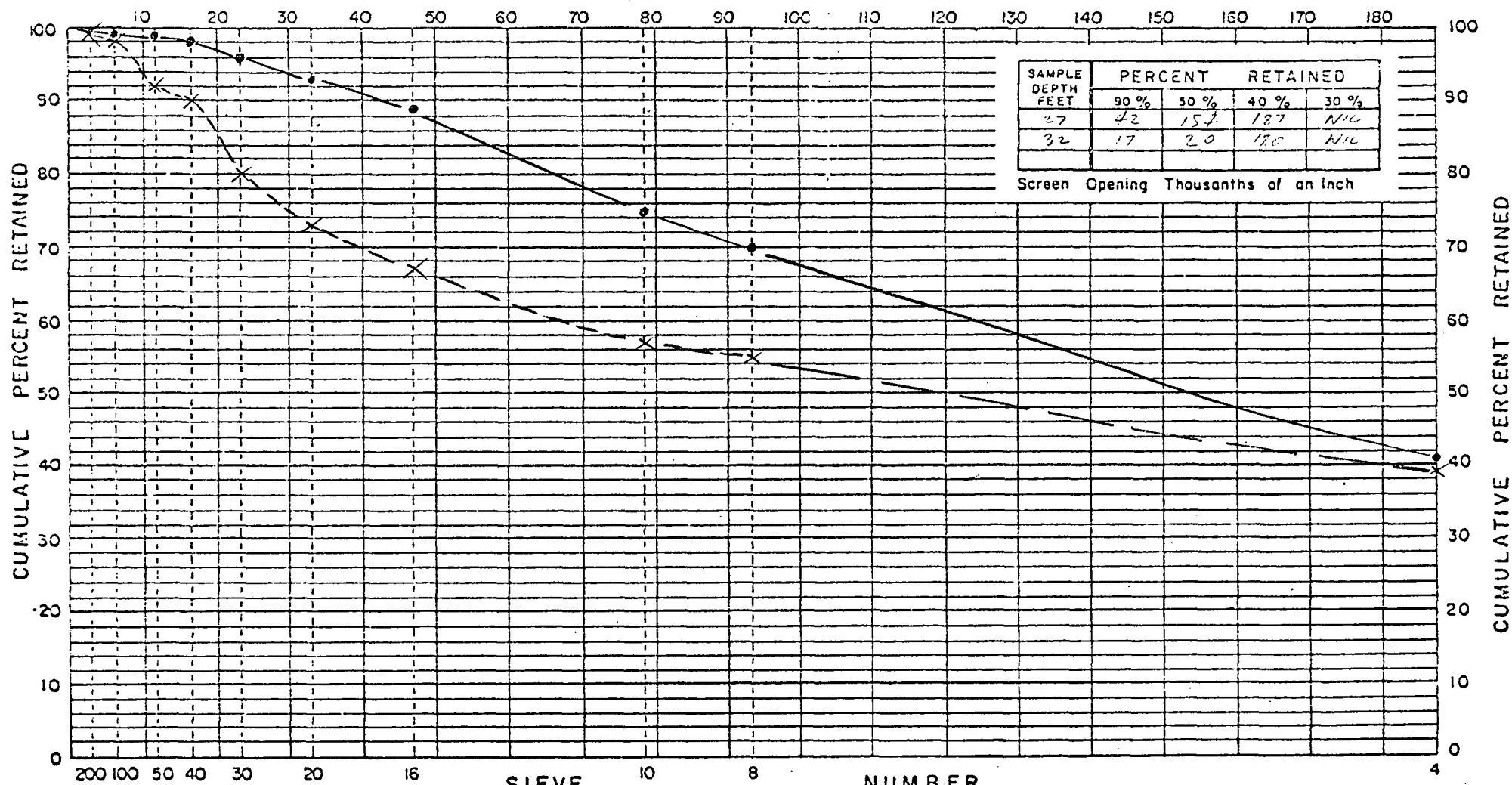
SAMPLE DEPTH 22 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		574	29.9
8		1032	53.9
10		1132	59.2
16		1448	75.5
20		1648	86.0
30		1804	94.1
40		1866	97.3
50		1886	98.4
100		1902	99.4
200		1908	99.5

Percent of sample not sieved V2" or over

TOTAL WT. 1918 100 %

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL No.	1400 122
SAMPLED BY:	Fred
SIEVE ANALYSIS BY:	Chwojko
DATE:	Sept. 19, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 27 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		650	40.6
8		1118	69.7
10		1200	74.8
16		1420	88.6
20		1492	93.0
30		1538	96.0
40		1568	98.0
50		1584	99.0
100		1598	99.6
200		1600	99.9

Percent of sample not sieved 1/2" or over
%

Total wt. 1602 100%

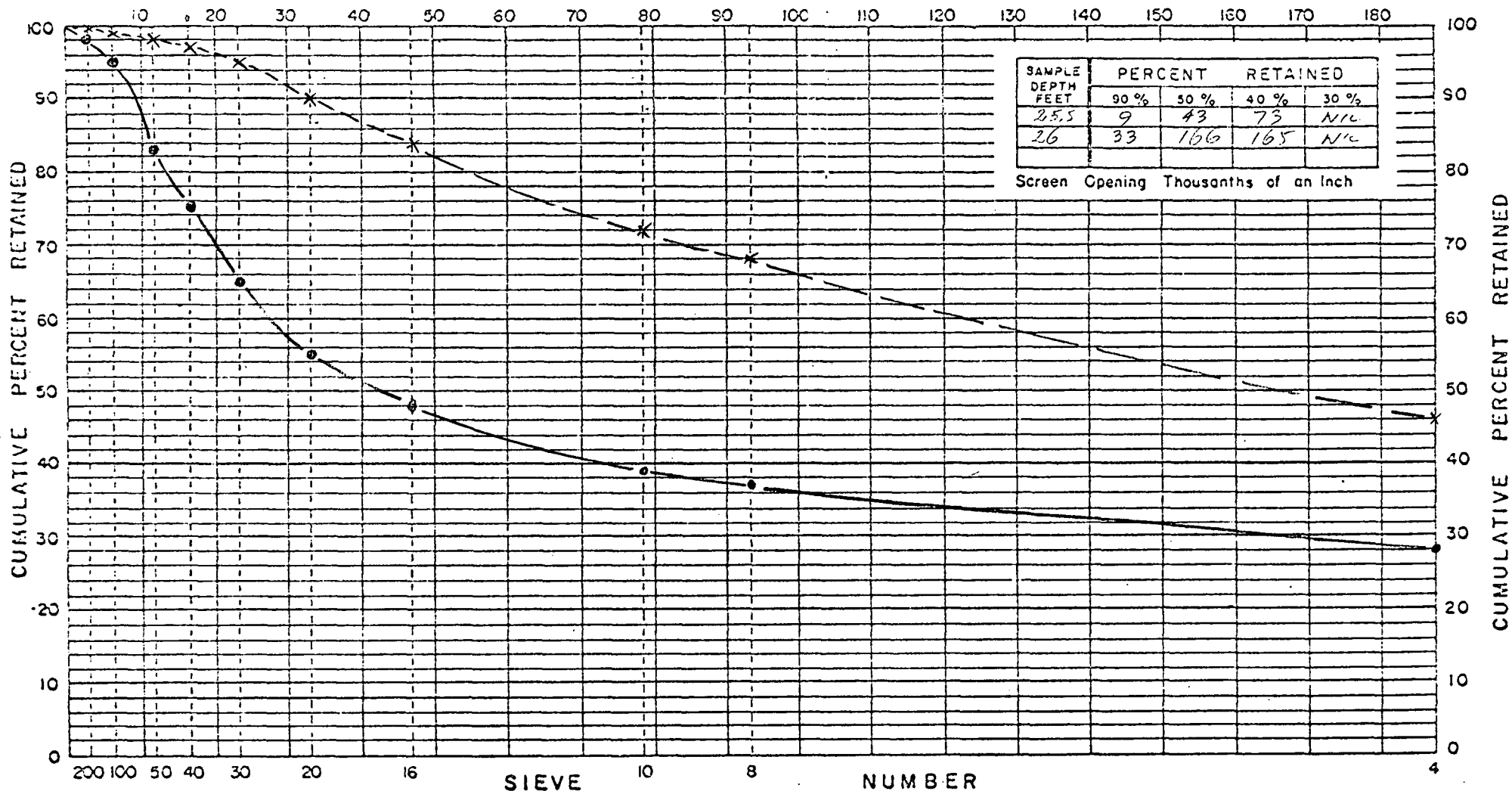
SAMPLE DEPTH 32 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		786	39.2
8		1092	54.5
10		1144	57.2
16		1346	67.2
20		1456	72.5
30		1592	79.5
40		1794	89.5
50		1850	92.3
100		1964	98.0
200		1992	99.4

Percent of sample not sieved 1/2" or over
%

Total wt. 2002 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN-SILVER PARK
WELL No.	1200 122
SAMPLED BY:	fred
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 22, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH FEET	PERCENT RETAINED			
	90 %	50 %	40 %	30 %
25.5	9	43	73	NIL
26	33	166	165	NIL

Screen Opening Thousandths of an Inch

SAMPLE DEPTH 25.5 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	550	28.2	
8	728	37.2	
10	756	38.6	
16	930	47.5	
20	1072	55.0	
30	1272	65.0	
40	1470	75.0	
50	1614	82.5	
100	1854	95.0	
200	1920	98.0	

Percent of sample not sieved 1/2" or over

TOTAL WT. 1956 100%

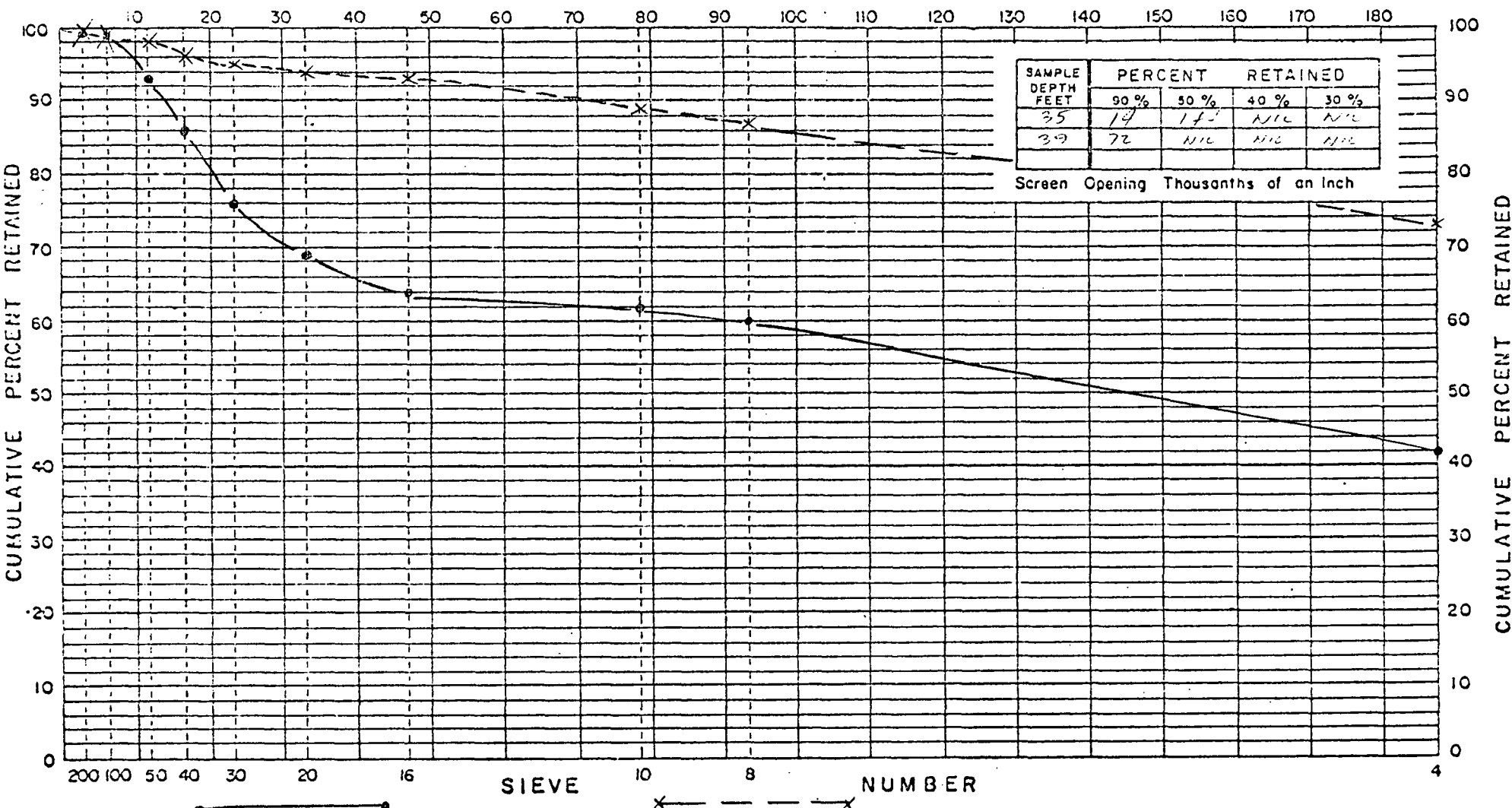
SAMPLE DEPTH 26 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	842	46.0	
8	1250	68.0	
10	1318	71.7	
16	1532	83.5	
20	1648	89.6	
30	1740	94.8	
40	1778	96.7	
50	1800	98.0	
100	1820	99.0	
200	1828	99.5	

Percent of sample not sieved 1/2" or over

TOTAL WT. 1838 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PIRK
WELL No.	1400 122
SAMPLED BY:	Frd
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 19, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 35 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		840	42.2
8		1188	589.5
10		1226	61.5
16		1278	64.1
20		1378	69.2
30		1514	76.0
40		1706	85.6
50		1844	92.5
100		1962	98.5
200		1982	99.5

Percent of sample not sieved 1/2" or over

TOTAL WT. 1992 100%

SAMPLE DEPTH 39 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		1180	72.6
8		1414	87.0
10		1442	89.0
16		1504	92.6
20		1526	94.0
30		1548	95.2
40		1574	96.0
50		1594	98.2
100		1618	99.5
200		1622	99.9

Percent of sample not sieved 1/2" or over

TOTAL WT. 1624 100%

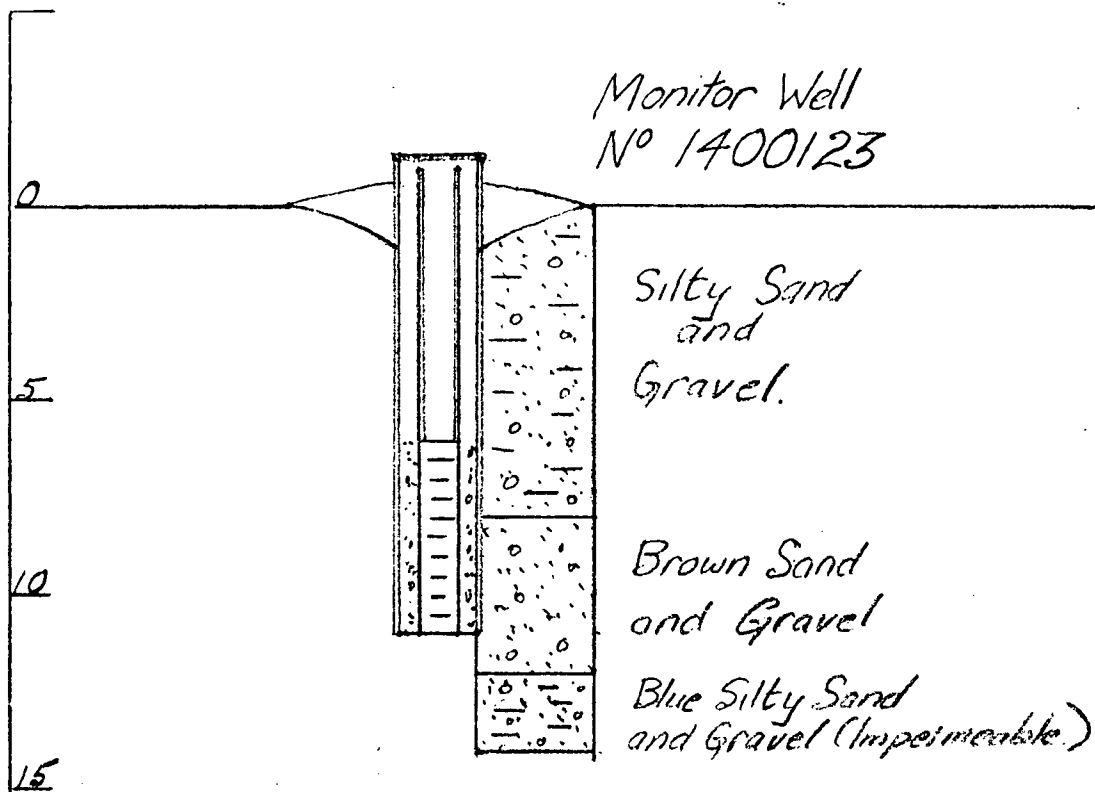
BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL No.	1400122
SAMPLED BY:	Feld
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 23, 1975

MONITOR WELL 1400 123

Feet	Log
0-8	Silty sand and gravel
8-12	Brown washed sand and gravel
12-14.5	Silty blue sand and gravel water shutoff

End of Hole

Log is same as 1400 122. Five feet of PVC 4-inch I.D. 20-slot well screen set between 9 feet and 14 feet. However, the screen heaved and final setting was between 6 feet and 11 feet. The well was subsequently pumped between 35 and 40 US gpm. In one half hour. Drawdown amounted to only 8 inches.



DEPARTMENT OF THE ARMY
ENGINEERING CENTER
WATER RESOURCES SERVICE
FORT BELVOIR, VIRGINIA

1975 Groundwater Potential Study
South End
District of North Cowichan
J.C. Foweraker

ENGINEER

SCALE: VERT. 1 inch = 5 ft.

DATE

Nov 1975

HOR.

FILE No. 0239013 DWG. No.

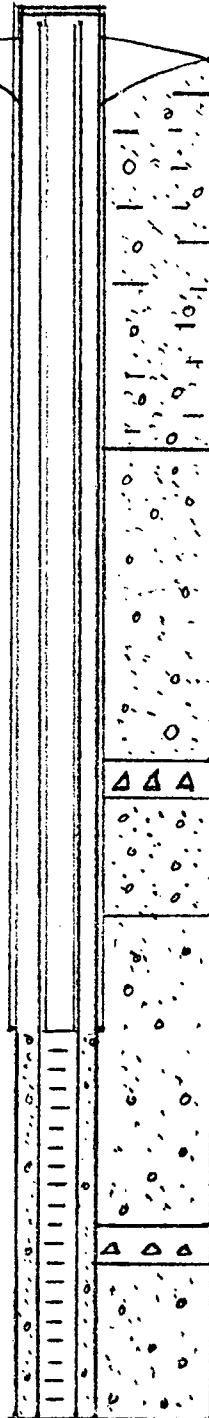
MONITOR WELL 1400 124

Feet	Log
0-3	Fill
3-10	Silty Till
10-18	Sand and Gravel - brownwater
18-19	Light till
19-22	Sand and gravel
22	Traces of till
22-30	Sand and gravel
30-31	Till
31-35	Sand and gravel

A 10-foot section of PVC 4-inch I.D. No. 20 slot screen was set between 25 and 35 feet. A 4-inch PVC pipe connected this to surface inside the 6-inch steel casing which was withdrawn to 25 feet to expose the well screen the well was developed by pumping for 1/2 hour at about 40 gpm.

Monitor Well
No 1400124

0
5
10
15
20
25
30
35



Sitty Sand
and
Gravel.

Sand and
Gravel
Brown coloured
water.

Till ?

Sand & Gravel.

← Trace of Till ?

Sand and
Gravel.

Till ?

Sand & Gravel.

MINISTRY OF
DEPARTMENT OF LANDS, MINERALS AND WATER RESOURCES
GEOLOGICAL SURVEY
NORTH BRITISH COLUMBIA

TO ACCOMPANY REPORT OF
1975 Groundwater Potential Study
South End
District of North Cowichan
J.C. Foweraker ENGINEER

SCALE: VERT. 1 inch = 5 ft
HOR.

DATE
Nov 1975

FILE No. 0239013

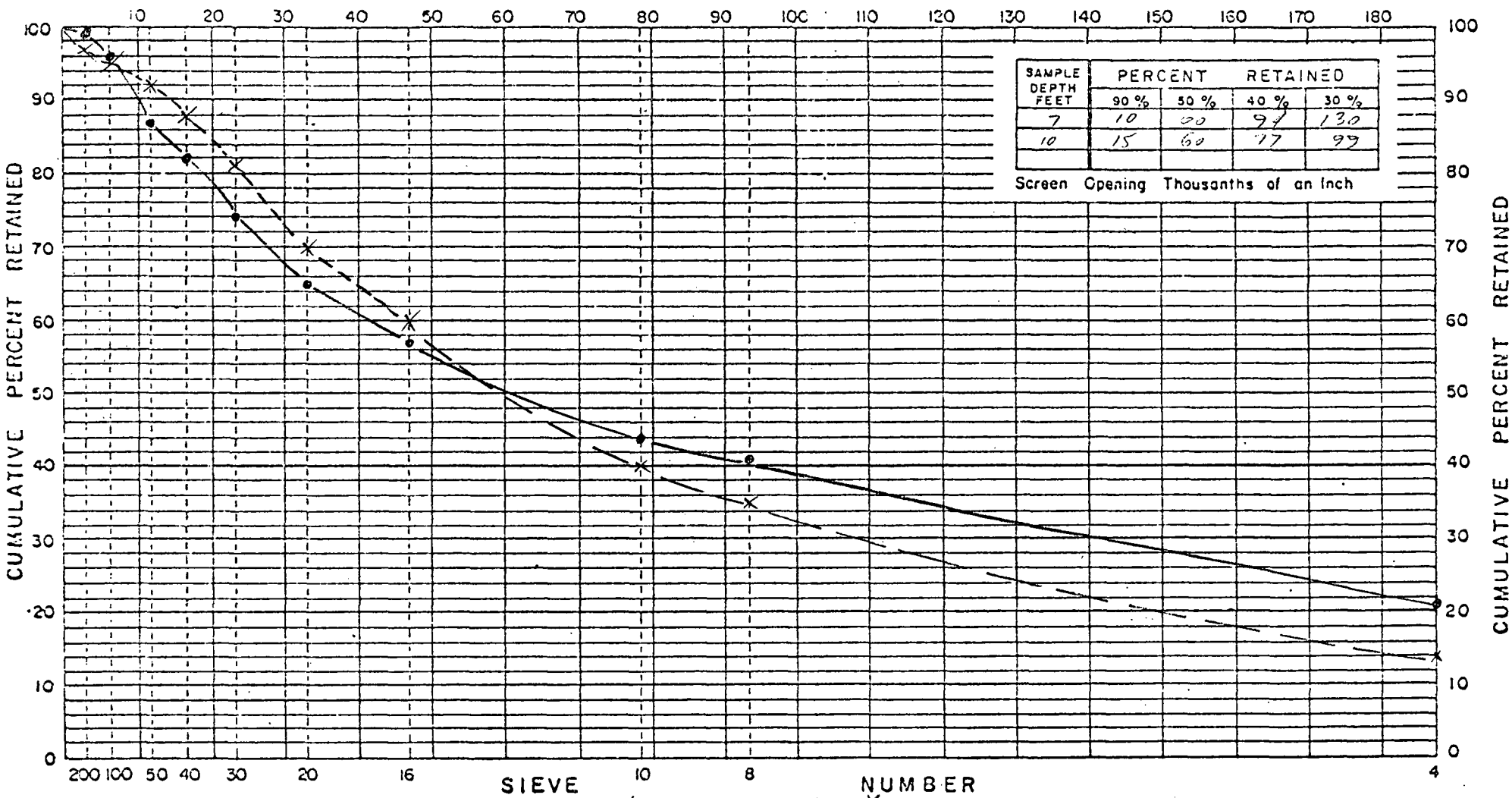
DWG. No.

DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

Depth	Thick- ness in feet	Effective grain size in thous. of an inch	Effective size squared	Possible range of screen slot openings in thous. of an inch			% of sample not sieved ½ in. or over	Depth in feet	Restricted range of screen slot opening in thous. of an inch	Multiple Slot Scr. I		
				Percentage retained						Prelim.	Modif. based on Rule 1	Ru
				50%	40%	30%						
Monitor Well	1400	124										
7		10		60	94	130						
10		15		60	77	99						
14		49		187 ⁺	187 ⁺	187 ⁺						
16		22		84	93	187 ⁺						
18		19		71	187 ⁺	187 ⁺	Total sample weighed, no fraction removed.					
20		47		57	148	187 ⁺						
22		8		40	96	187						
24		85		187 ⁺	187 ⁺	187 ⁺						
26		8		187 ⁺	187 ⁺	187 ⁺						
266		10		28	55	95						
28		9		50	86	187						
32		40		110	135	176						
35		8		38	68	144						

Total sample weighed, no fraction removed.

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 7 FEET			
OPENINGS	RET. ON	WT. RET.	CUM. % RET.
4		364	20.7
8		710	40.5
10		764	43.5
16		1000	57.0
30		1144	65.0
40		1306	74.3
60		1440	82.0
80		1522	85.6
100		1680	95.7
200		1734	99.0

Percent of sample not sieved 1/2" or over

TOTAL WT. 1757 100%

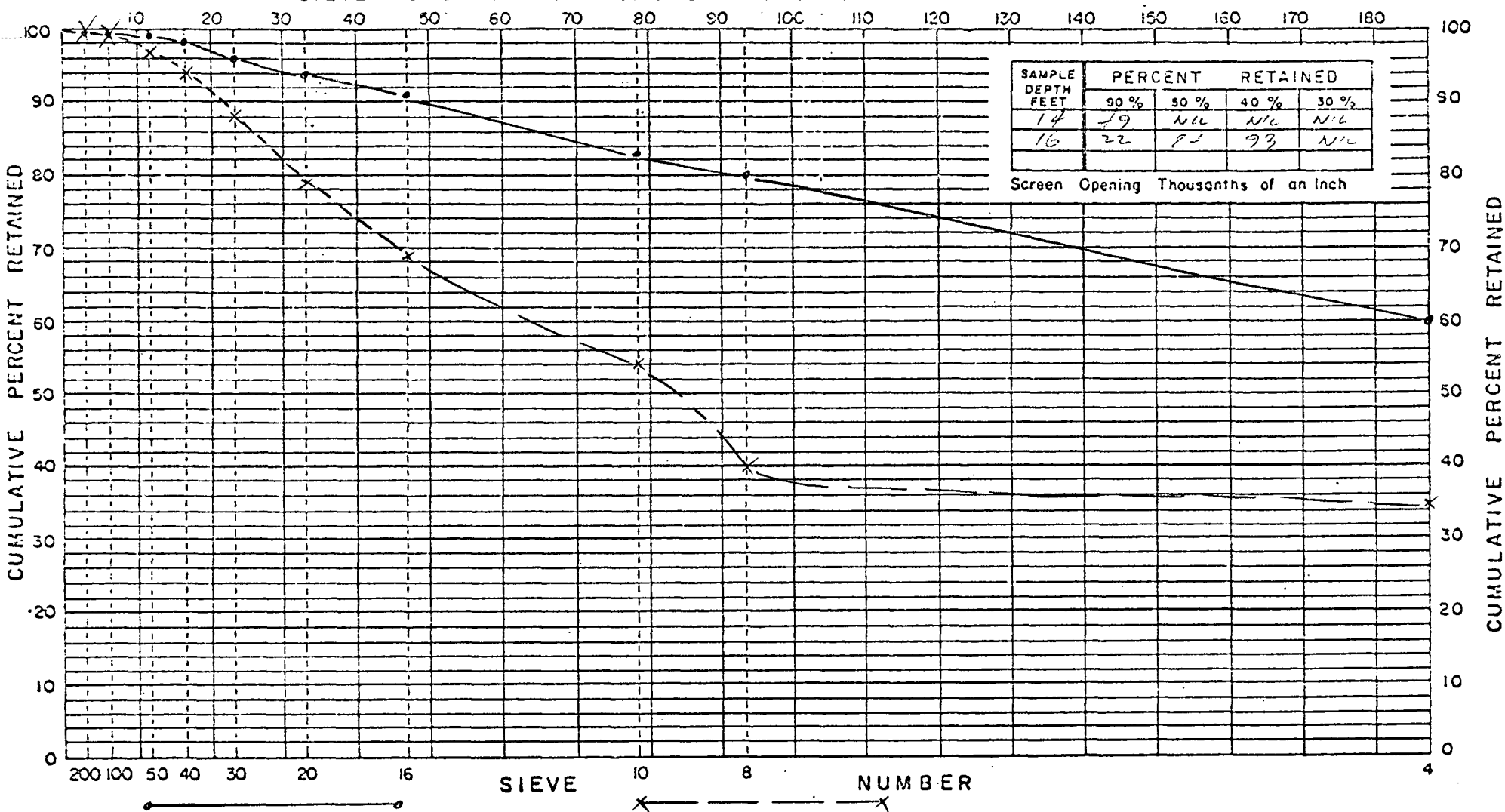
SAMPLE DEPTH 10 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		290	13.5
8		749	34.8
10		866	40.3
16		1280	59.5
30		1512	70.5
40		1736	80.7
60		1888	87.8
80		1970	91.6
100		2054	95.4
200		2092	97.0

Percent of sample not sieved 1/2" or over

TOTAL WT. 2144 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PT. PK
WELL No.	1400 124
SAMPLED BY:	Fied
SIEVE ANALYSIS BY:	Chwojke
DATE:	Sept 23, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 14 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	948	59.5
	8	1266	79.5
	10	1312	82.5
	16	1448	90.8
	20	1501	94.2
	30	1535	96.3
	40	1563	98.0
	50	1576	98.8
	100	1588	99.5
	200	1592	99.8

Percent of sample not sieved 1/2" or over

Total wt. 1591 100%

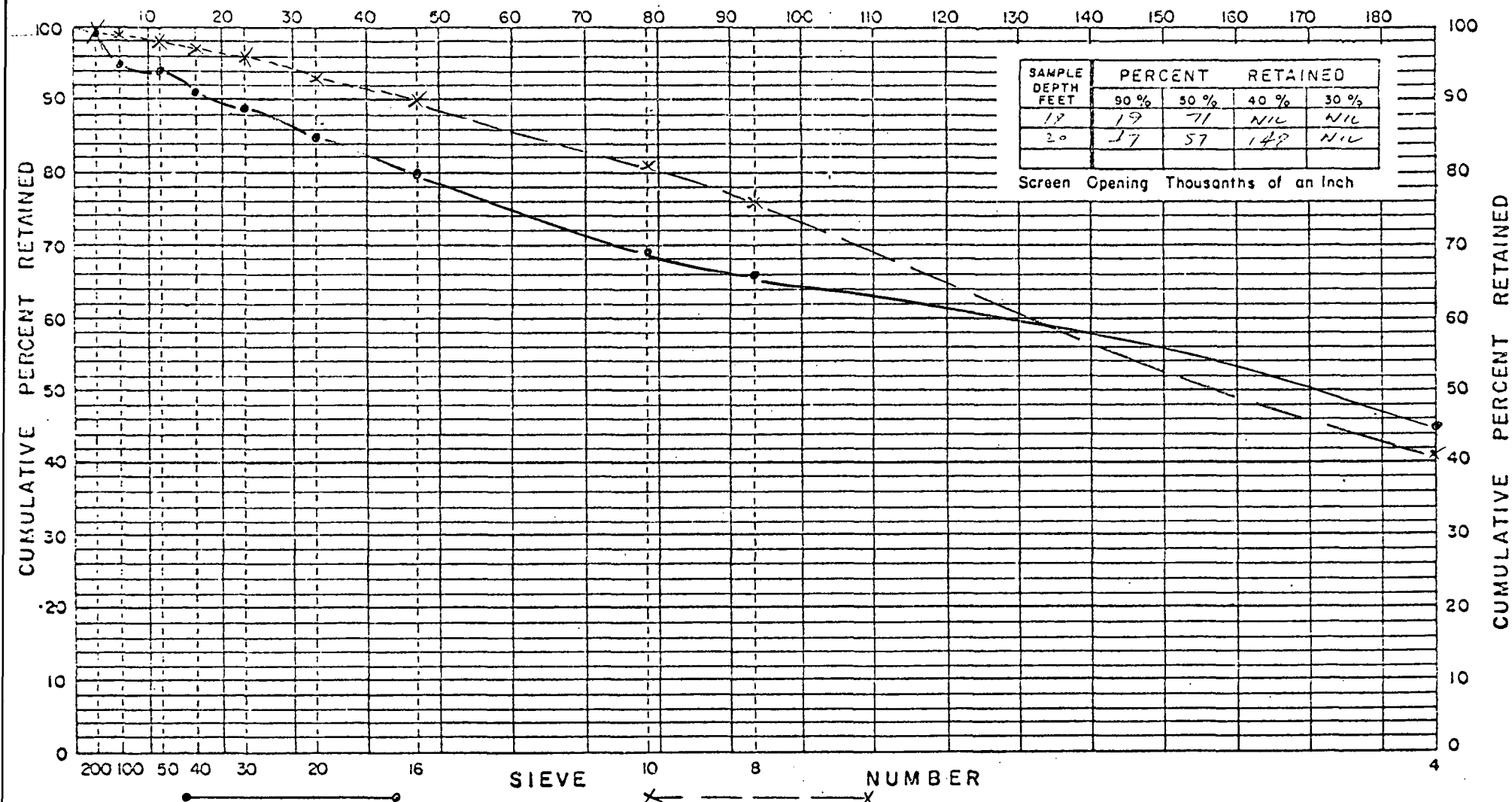
SAMPLE DEPTH 16 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	661	35.4
	8	754	39.9
	10	999	53.5
	16	1290	69.2
	20	1474	79.1
	30	1646	88.3
	40	1758	94.2
	50	1812	97.4
	100	1848	99.0
	200	1856	99.5

Percent of sample not sieved 1/2" or over

Total wt. 1864 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PIKE
WELL No.	1400 124
SAMPLED BY:	FELC
SIEVE ANALYSIS BY:	Chwojko
DATE:	Sept. 23, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 18 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		762	45.3
8		1108	65.7
10		1168	69.4
16		1352	82.3
20		1532	85.1
30		1498	88.8
40		1536	91.2
50		1576	93.6
100		1650	95.3
200		1670	99.2

Percent of sample not sieved $\frac{1}{2}$ " or over
%

TOTAL 1682 100%

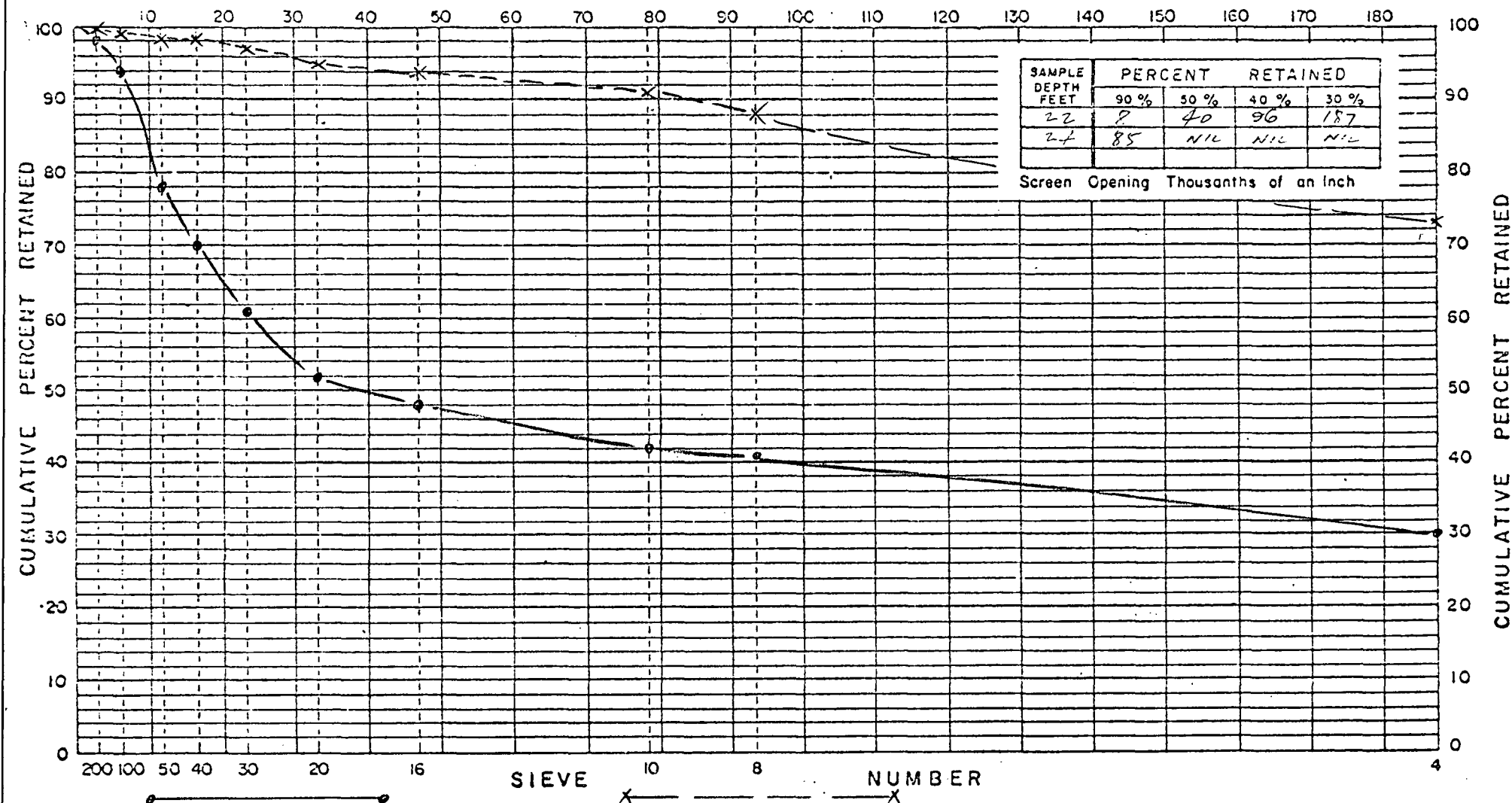
SAMPLE DEPTH 20 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		754	40.9
8		1402	76.0
10		1491	81.0
16		1652	89.6
20		1706	92.5
30		1760	95.5
40		1792	97.0
50		1808	98.0
100		1828	99.1
200		1836	99.6

Percent of sample not sieved $\frac{1}{2}$ " or over
%

TOTAL 1842 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL No.	1400124
SAMPLED BY:	TRC
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 23, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 22 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	462	30.3
	8	618	40.5
	10	623	42.2
	16	728	47.7
	20	798	52.3
	30	928	60.8
	40	1064	69.8
	50	1184	77.7
	100	1426	93.5
	200	1492	98.0

Percent of sample not sieved 1/2" or over _____ %

TOTAL WT. 1528 100 %

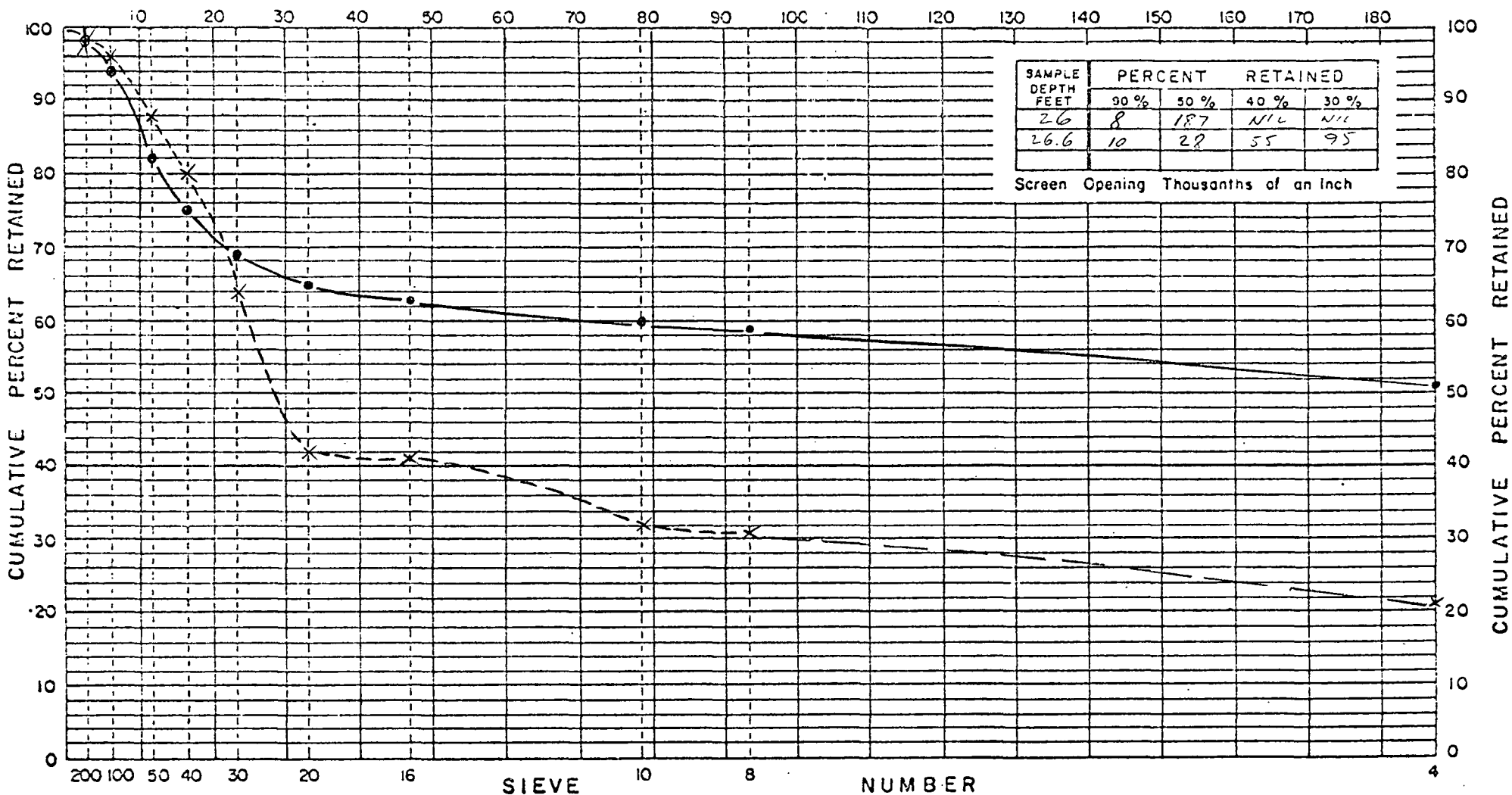
SAMPLE DEPTH 24 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	1366	72.5
	8	1682	88.5
	10	1714	91.0
	16	1778	94.1
	20	1800	95.5
	30	1818	96.5
	40	1838	97.5
	50	1854	98.5
	100	1877	99.5
	200	1886	99.9

Percent of sample not sieved 1/2" or over _____ %

TOTAL WT. 1888 100 %

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL NO.	1400124
SAMPLED BY:	Feld
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 23, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 26 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	676	51.4
	8	774	58.9
	10	786	59.8
	16	826	63.0
	20	856	65.0
	30	908	69.0
	40	994	75.5
	50	1078	82.0
	100	1238	94.0
	200	1298	97.7

Percent of sample not sieved 1/2" or over

TOTAL WT. 1312 100%

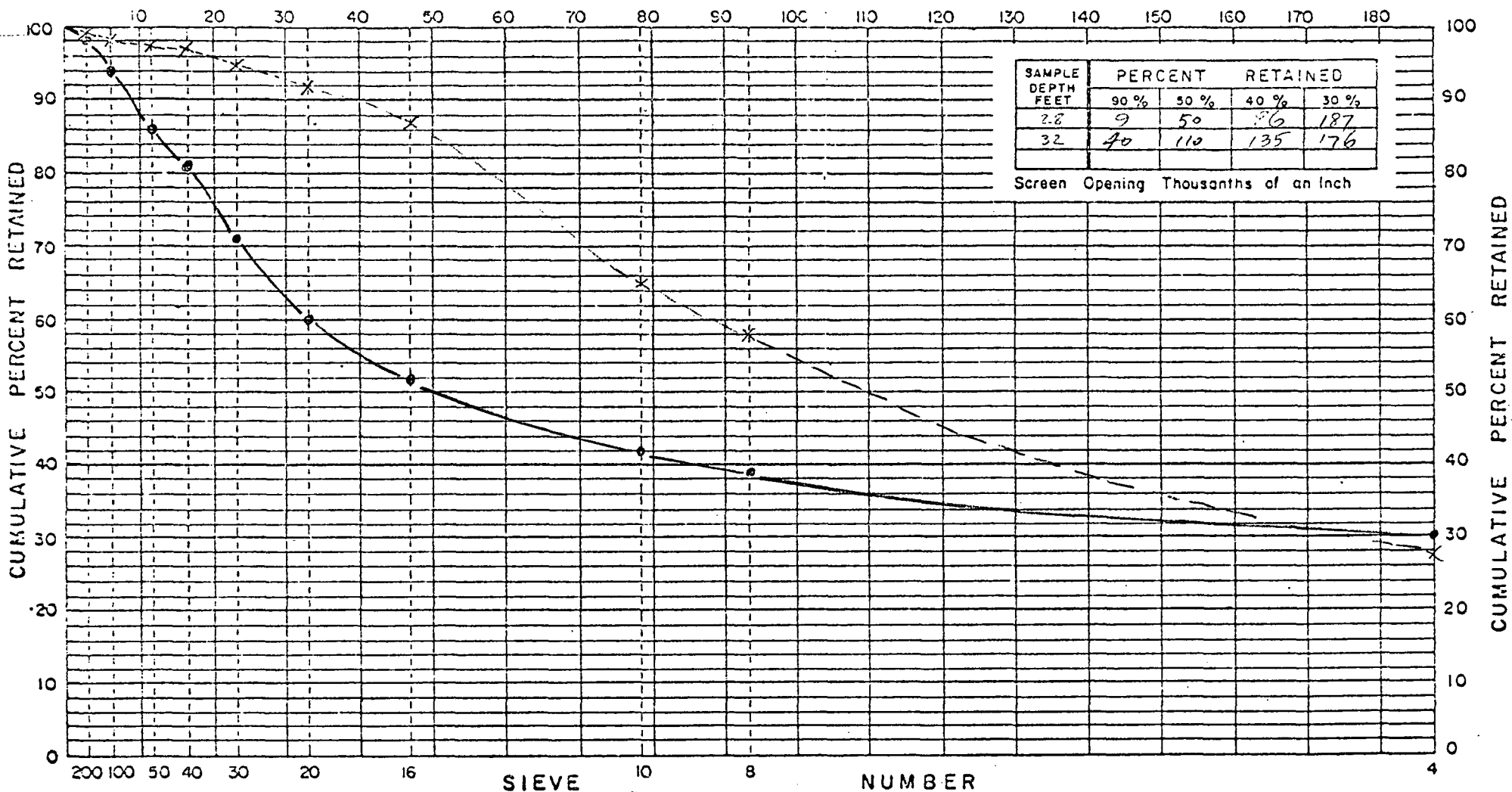
SAMPLE DEPTH 26.6 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	2	332	21.0
	4	486	30.6
	10	512	32.3
	16	648	40.8
	20	768	48.2
	30	1010	63.6
	40	1264	79.7
	50	1396	88.0
	100	1522	96.0
	200	1558	98.3

Percent of sample not sieved 1/2" or over

TOTAL WT. 1586 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PARK
WELL No.	1400124
SAMPLED BY:	TRD
SIEVE ANALYSIS BY:	CL. Wojcik
DATE:	Sept. 23, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 28 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	468		29.6
8	622		39.3
10	662		41.8
16	816		51.5
20	970		60.0
30	1128		71.2
40	1278		80.6
50	1362		86.0
100	1499		94.1
200	1552		98.3

Percent of sample not sieved 1/2" or over
%

TOTAL WT. 1582 100%

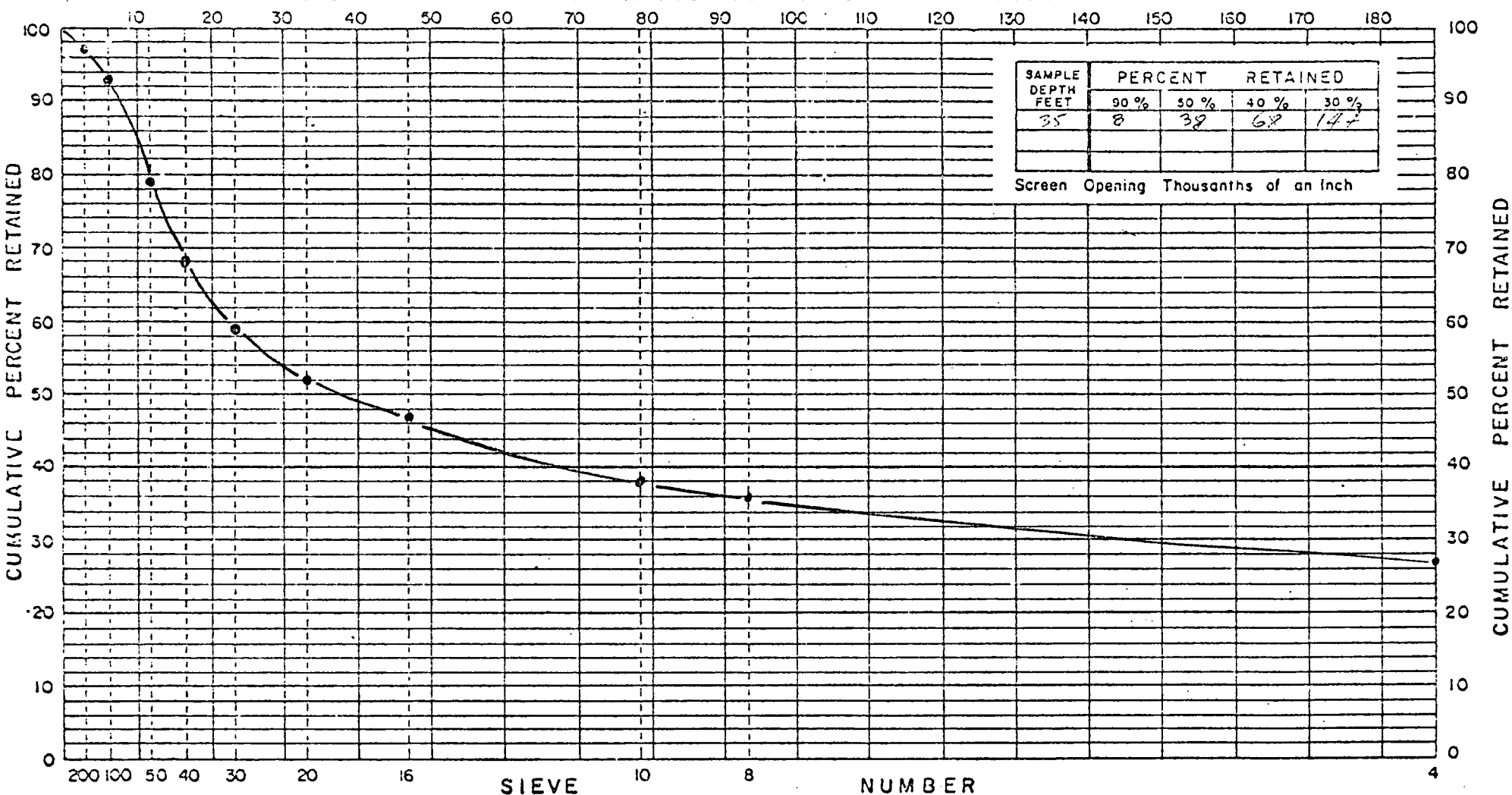
SAMPLE DEPTH 32 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	518		27.6
8	1092		58.3
10	1220		65.0
16	1604		85.6
20	1718		91.6
30	1780		95.0
40	1812		96.7
50	1826		97.5
100	1840		98.5
200	1858		99.0

Percent of sample not sieved 1/2" or over
%

TOTAL WT. 1872 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - SILVER PIRK
WELL No.	1400126
SAMPLED BY:	Feld
SIEVE ANALYSIS BY:	Chwojka
DATE:	Sept. 23, 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 35 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	487	27.4	
8	612	36.3	
10	676	38.2	
16	822	46.5	
20	917	51.8	
30	1044	59.2	
40	1202	68.2	
50	1392	79.0	
100	1623	93.0	
200	1725	97.6	

Percent of sample not sieved 1/2" or over

TOTAL WT. $\frac{NIL}{1767}$ % 100%

SAMPLE DEPTH FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.

Percent of sample not sieved 1/2" or over

%

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
Groundwater Section

SIEVE ANALYSIS

PROJECT: CONTRACT 60
LOCATION: DUNCAN - SILVER PITRK
WELL No. 1400121
SAMPLED BY: FLD
SIEVE ANALYSIS BY: Chwofka
DATE: Sept. 23, 1975

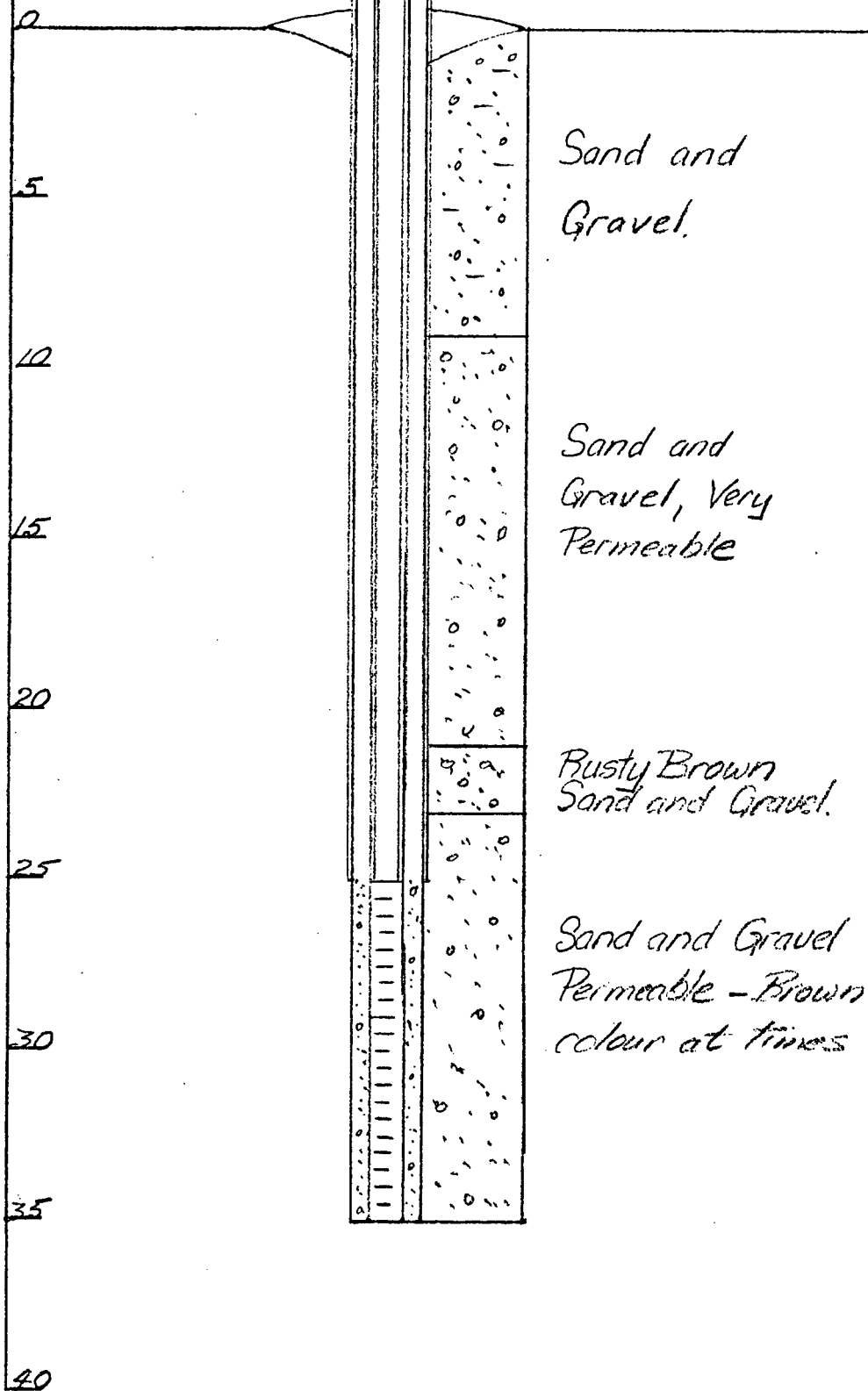
MONITOR WELL 1400 125

Feet	Log
0-9	Sand and gravel
9-21	Loose sand and gravel
21-23	Rusty brown layer of gravel
23-36	Loose sand and gravel, brown at times

End of hole

A 10-foot section of PVC 4-inch ID No. 20 slot screen was set between 25 and 35 feet. The steel casing was pulled back to 25 feet to expose the screen. The well was developed by pumping for about one half hour.

Monitor Well
No 1400125



DEPARTMENT OF LANDS, FORESTS AND WATER RESOURCES

1975 Groundwater Potential Study
South End
District of North Cowichan
J.C. Fournier
ENGINEER

SCALE: VERT. 1 inch = 5 ft

DATE

Nov 1975

HOR.

FILE No. 0239013

DWG. No.

DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

[illegible]

APPENDIX NO. 2

TEST WELL 130

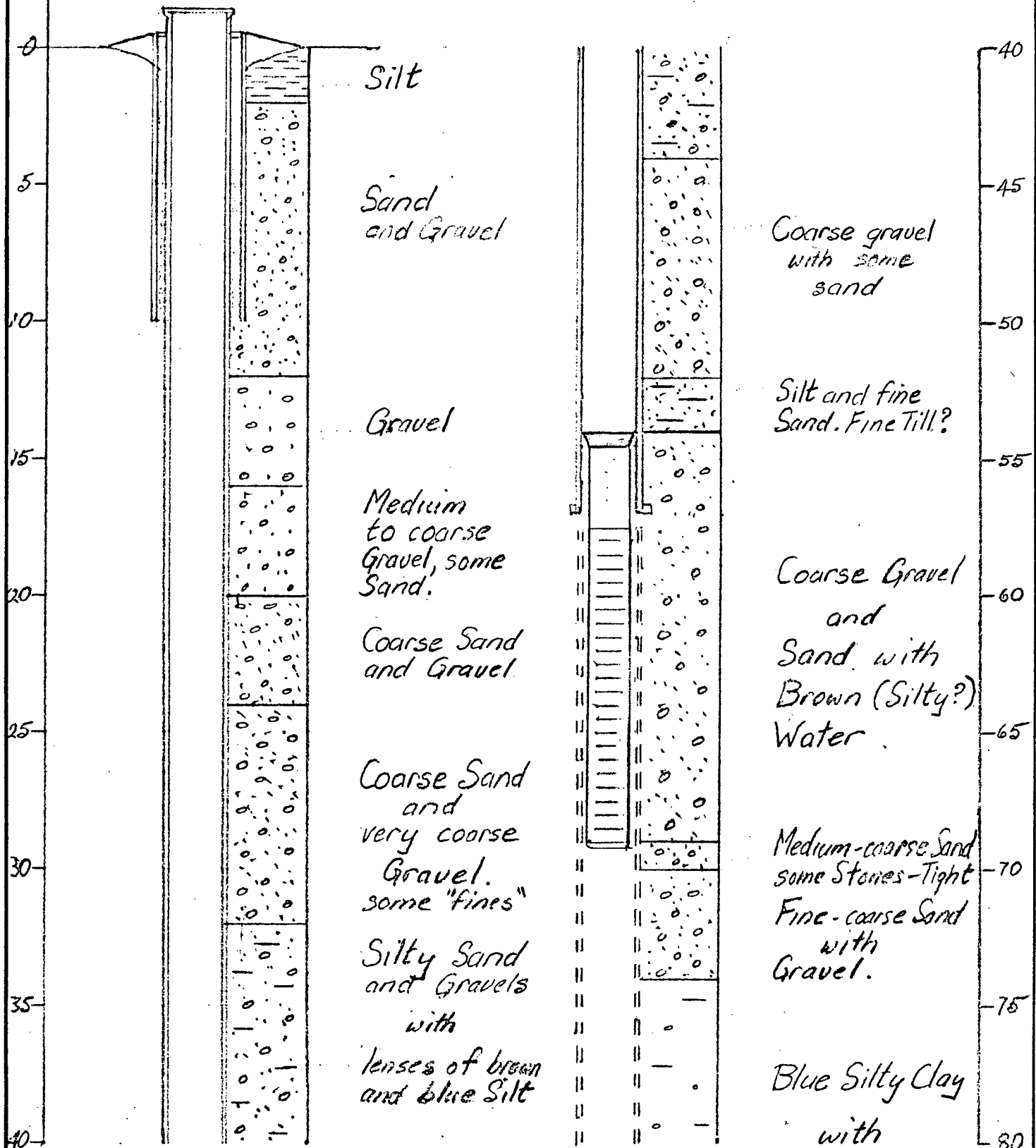
WELL LOG

WELL DESIGN

GRAIN SIZE ANALYSES

Test Well
N°1400130

Sheet 1 of 2



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

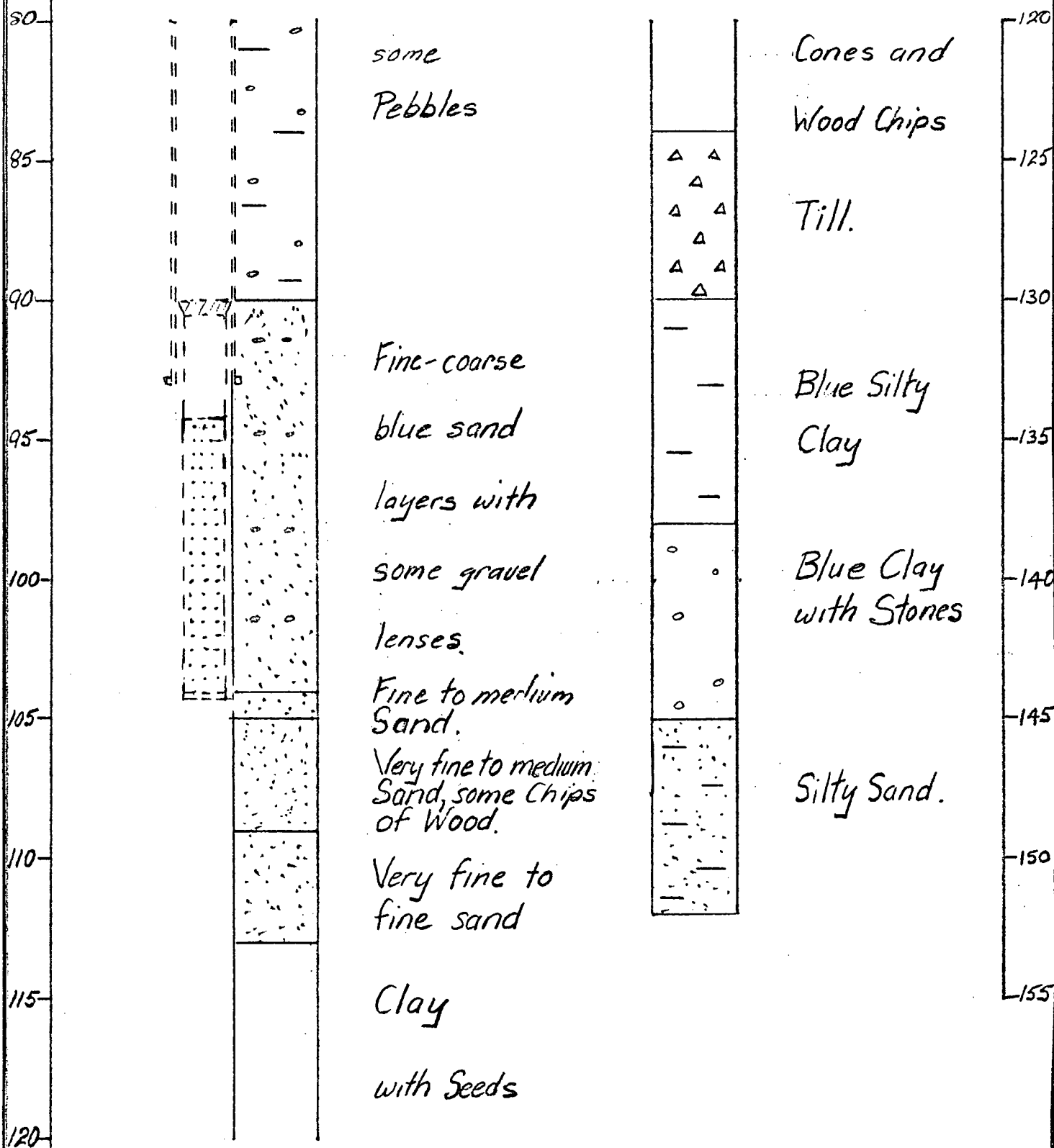
TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 feet
HOR. _____

DATE
Dec 1975

J.C. Foweraker ENGINEER
FILE No. 0230013 DWG. No. 1 Appendix 2

Test Well N°1400130 Sheet 2 of 2



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 feet

DATE

Dec 1975

J.C. Foweraker

ENGINEER

HOR.

FILE No. 0254015

DWG. No. 2 Appendix 2

Steel Cap
with
lock

Test Well Construction Details Nº 1400130 Middle Aquifer

Cement
Cap.

10 inch I.D.
Steel Casing

Bentonite
Seal

8 inch I.D.
Steel Casing

Lead Packer

Riser Pipe

8 inch Drive
Shoe.

8 inch nominal
Stainless Steel
Johnson's Well
Screen

58-60' = 50 slot

60-62' = 100 slot

62-69' = 150 slot

Screen Assembly
15 feet 4 inches

Design T.C.

501. u.s.g.p.m.

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

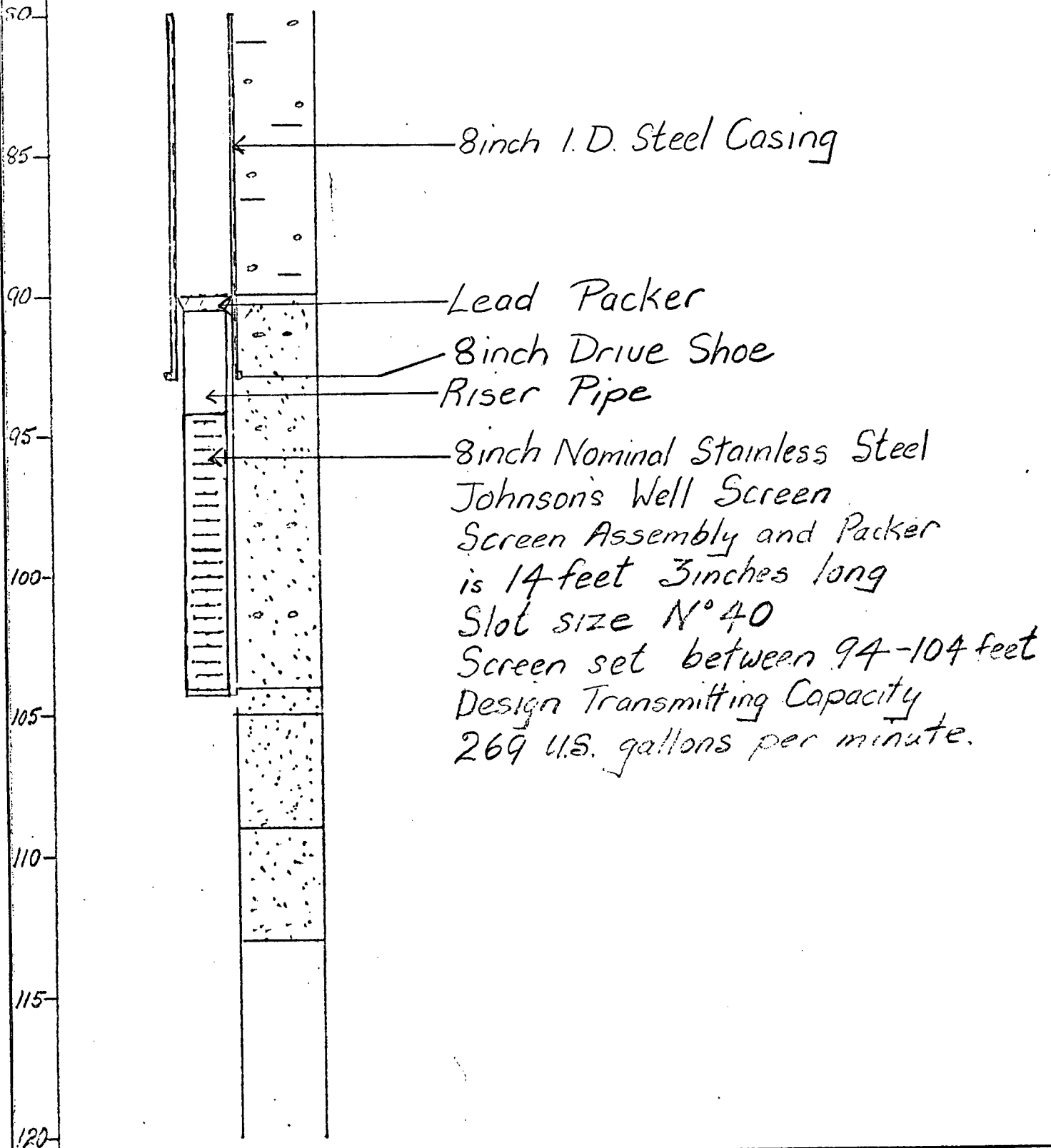
TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 feet
HOR.

DATE
Dec 1975

J.C. Foweraker ENGINEER
FILE No. 0250015 DWG. No. 3 Appendix 2

Test Well Construction Details N°1400130 Lower Aquifer



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 feet

HOR.

DATE

24 1975

J.C. P... ENGINEER

FILE No. 0220217 DWG. No. 4 Appendix 2

APPENDIX NO. 2

TABLE NO. 1

TEST WELL 130 TRANSMITTING CAPACITY OF SCREEN DESIGNED FOR MIDDLE AQUIFER

<u>Table No. 1 Appendix 2</u>	<u>Transmitting</u>	<u>Capacity of Screen</u>	<u>Designed for "Middle Aquifer"</u>		<u>Test Well 130</u>
Depth in feet	Design slot size in thous. of 1 inch	Intake area for slot opening in sq. inches per ft.	T.C. per ft. of screen in US gpm	T.C. in US gpm	
58-60	50	100	31	62	
60-62	100	148	46	92	
62-69	150	160	49.6	<u>347</u>	
		Total T.C. for Screen		501 US gpm	

TEST WELL 130 TRANSMITTING CAPACITY OF SCREEN DESIGNED FOR "LOWER AQUIFER"

94-104	40	87	26.9	<u>269</u>	
		Total T.C. for Screen		269 US gpm	

TABLE. NO. 2

TEST WELL NO. 130 - DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

Depth	Thick- ness in feet	Effective grain size in thous. of an inch	Effective size squared	Possible range of screen slot openings in thous. of an inch			% of sample not sieved $\frac{1}{2}$ in. or over	Depth in feet	Restricted range of screen slot opening in thous. of an inch	Multiple Slot Scr. Des.		
				50%	40%	30%				Prelim.	Modif. based on Rule 1	Mod. bas on Rule 2
12	(12)	10	100	45	62	85	39.6	12	85	85	85	85
14	2	20	400	78	110	137	75.3	14	137	137	85	85
16	2	19	361	104	138	161	75.5	16	161	161	137	137
18	2	21	441	59	75	101	43.1	18	101	101	101	101
20	2	15	225	43	54	70	31.9	20	70	70	70	70
22	2	17	289	55	68	79	7.9	22	79	79	70	70
24	2	27	729	67	79	72	23.7	24	62	62	61	62
26	2	15	225	42	60	83	59.0	26	83	83	62	62
28	2	20	400	63	85	125	52.2	28	125	125	83	83
30	2	22	484	75	97	126	68.0	30	126	126	125	125
32	2	1	1	20	33	54	27.7	32	20	20	20	20
34	2	7	49	22	40	69	15.8	34	22-40	30	20	20
36	2	8	64	40	65	98	34.8	36	65-98	40	30	30
38	2	8	64	20	28	47	63.7	38	23	28	28	28
40	2	5	25	28	69	120	55.1	40	69	69	28	28
42	2	11	121	28	32	39	68.3	42	32-39	32	32	32
44	2	15	225	80	112	150	47.5	44	150	150	32	32
46	2	6	36	67	101	136	43.2	46	136	136	136	64

TABLE NO. 2

TEST WELL NO. 130 - DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

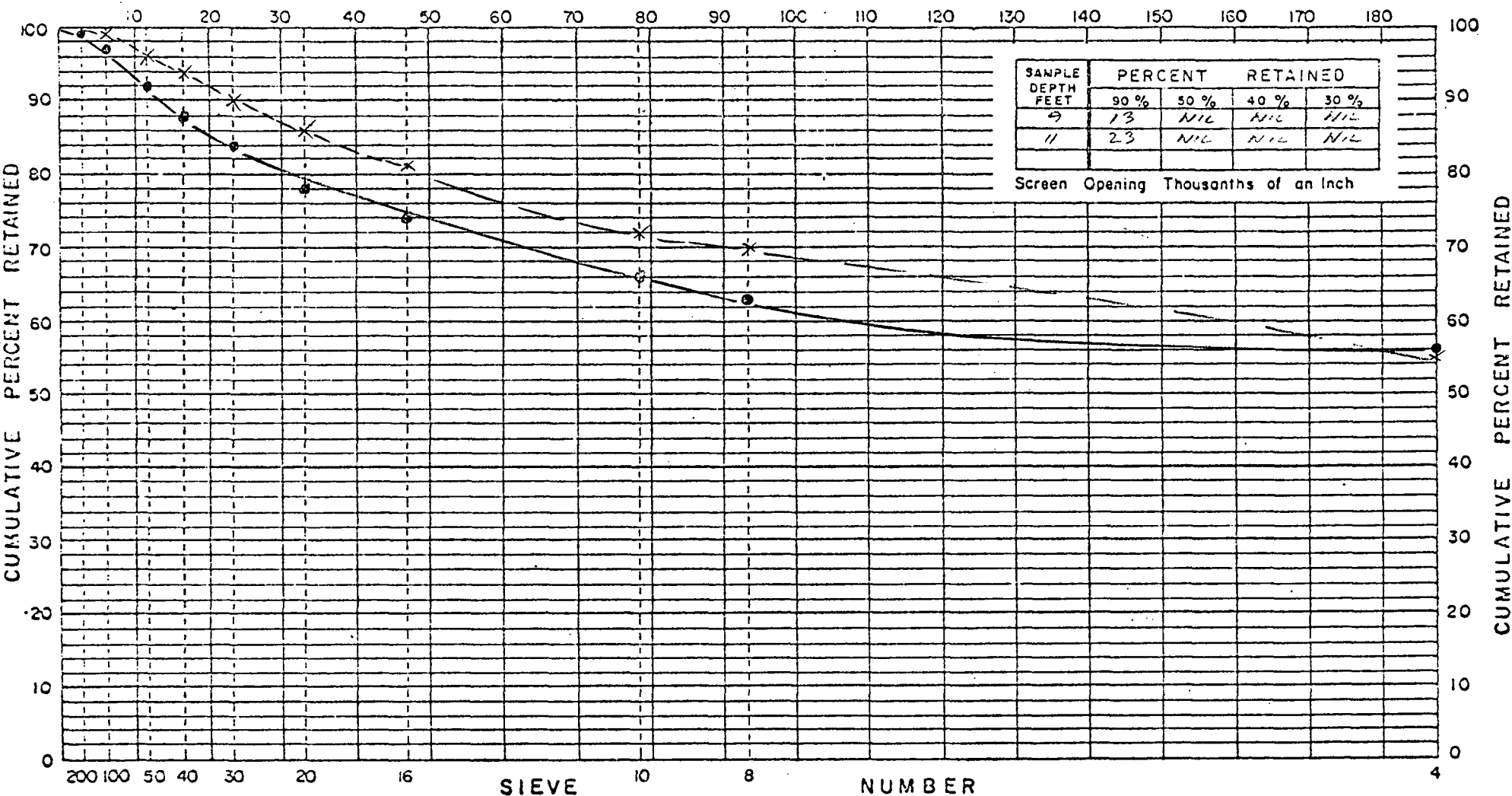
Depth	Thickness in feet	Effective grain size in thous. of an inch 90%	Effective size squared	Possible range of screen slot openings in thous. of an inch			% of sample not sieved $\frac{1}{2}$ in. or over	Depth in feet	Restricted range of screen slot opening in thous. of an inch	Multiple Slot Scr. Des		
				50%	40%	30%				Prelim.	Modif. based on Rule 1	Mod. based on Rule 2
48	2	9	81	26	38	54	69.0	48	38-54	50	50	50
50	2	18	324	104	130	156	62.2	50	156	156	50	50
52	2	1	1	7	16	47	19.0	52	7	7	7	7
54	2	7	49	13	16	19	4.8	54	13	13	7	7
56	2	9	81	43	75	103	49.5	56	75-103	100 ⁺	13	13
58	2	12	144	67	94	126	66.9	58	126	126	100 ⁺	26
60	2	9	81	85	110	153	79.6	60	153	153	126	52
62	2	15	225	125	150	177	70.6	62	177	177	153	104
64	2	39	1521	139	157	177	55.6	64	177	177	177	177
66	2	26	676	119	143	173	86.0	66	173	173	173	173
68	2	26	676	141	160	179	80.6	68	179	179	173	173
70	2	14	196	31	41	69	57.0	70	41-69	60	60	66
74	4	8	64	20	25	36	46.7	74	25	25	25	25
75	1	6	36	36	73	112	48.0	75	73	73	25	25
77	2	1	1	3	4	6	9.2	77	3	3	3	3
92	(15)	12	144	30	37	47	8.4	92	37-47	40	3	3
94	2	8	64	32	42	57	12.1	94	42-57	50	40	6
96	2	7	49	36	47	62	16.6	96	62	62	50	12

TABLE NO. 2

TEST WELL NO. 130 - DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

[illegible]

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 9 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	950	50.6
	8	1120	63.4
	10	1234	65.7
	16	1350	73.5
	20	1470	78.3
	30	1570	83.6
	40	1640	88.4
	60	1720	92.2
	100	1820	97.3
	200	1866	99.4

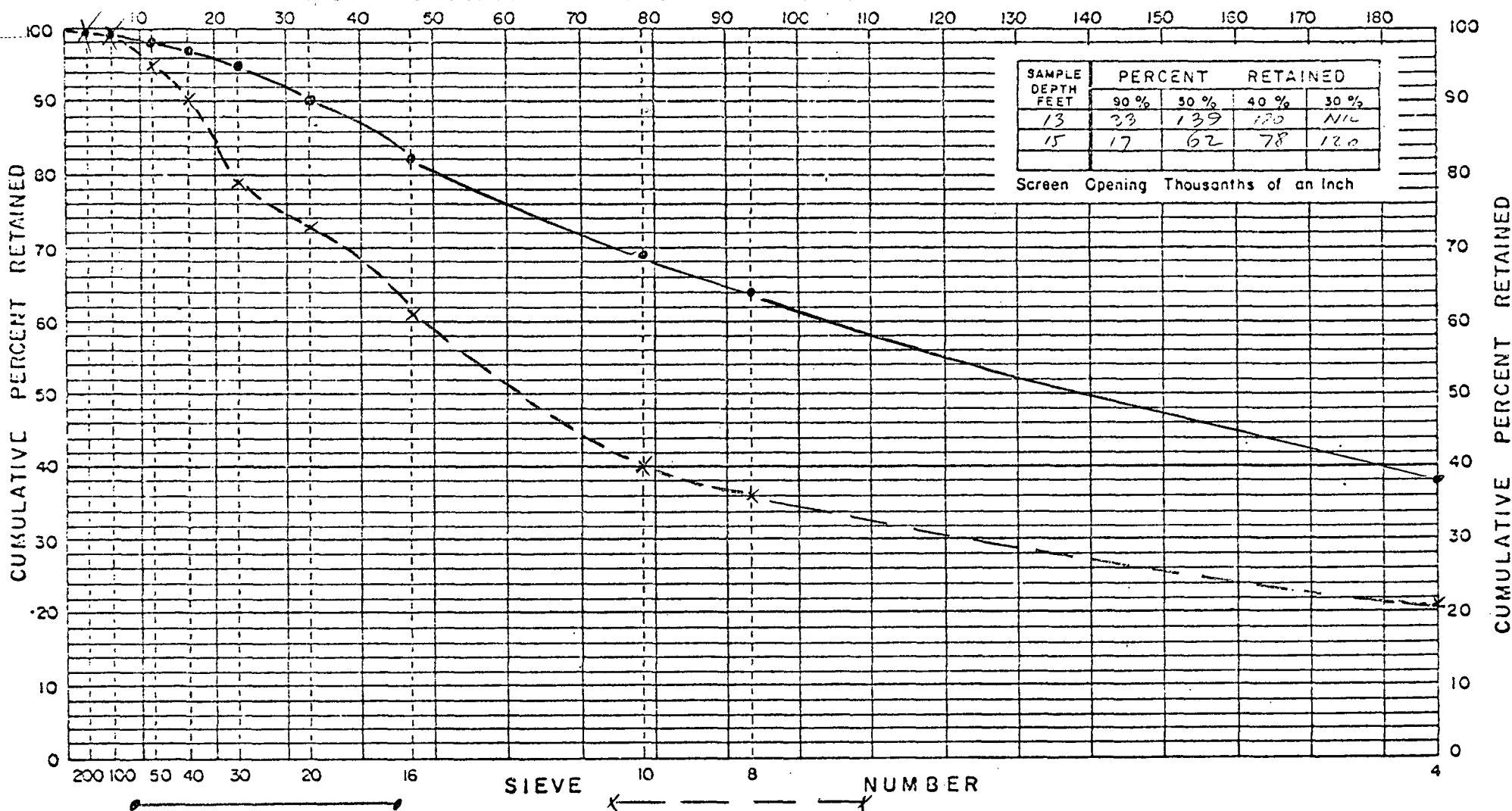
Percent of sample not sieved 1/2" or over
 100%

SAMPLE DEPTH 11 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	970	54.8
	8	1236	69.8
	10	1275	72.0
	16	1440	81.4
	20	1516	85.5
	30	1600	90.4
	40	1684	94.0
	60	1704	96.3
	100	1750	98.8
	200	1760	99.5

Percent of sample not sieved 1/2" or over
 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	1770
LOCATION:	1770
WELL NO.:	1770
SAMPLED BY:	1770
SIEVE ANALYSIS BY:	1770
DATE:	1770

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 13 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	1000		37.8
8	1090		63.5
10	1125		69.0
16	1170		82.3
20	1250		90.4
30	1350		94.5
40	1450		96.7
50	1550		98.0
100	1710		99.0
200	1720		99.7

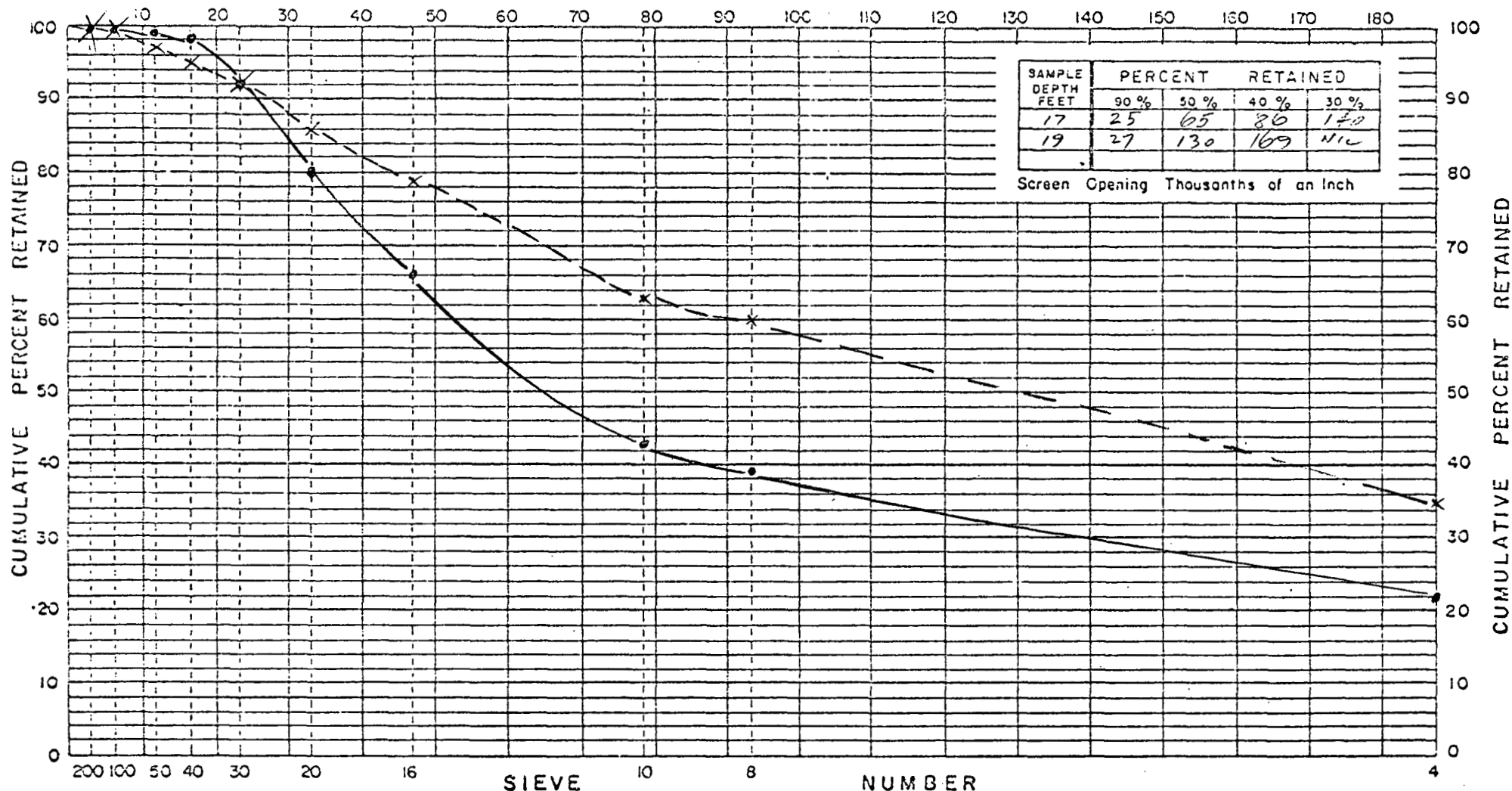
Percent of sample not sieved 1/2" or over

SAMPLE DEPTH 15 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	1000		20.6
8	1000		36.4
10	1060		40.0
16	1180		60.5
20	1210		73.4
30	1350		78.8
40	1480		89.8
50	1570		95.2
100	1650		98.9
200	1640		99.5

Percent of sample not sieved 1/2" or over

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	60
LOCATION:	
WELL NO.	1650
SAMPLED BY:	SMITH, J. A.
SIEVE ANALYSIS BY:	SMITH, J. A.
DATE:	29 Sept. 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 17 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	200		22.4
10	200		38.7
20	270		43.3
40	1257		85.8
60	1200		79.5
80	1360		94.5
100	1060		97.5
120	200		98.6
150	2004		99.6
200	2010		99.7

SAMPLE DEPTH 19 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	600		34.8
10	1040		60.3
20	1104		63.0
40	1360		78.8
60	1480		85.7
80	1590		92.0
100	1646		95.3
120	1670		96.7
150	1700		98.5
200	1710		99.2

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
Groundwater Section

SIEVE ANALYSIS

PROJECT: *Contract 60*

LOCATION: *Point 11, Station 17.00*

WELL No. *1100125*

SAMPLED BY: *CHADLER*

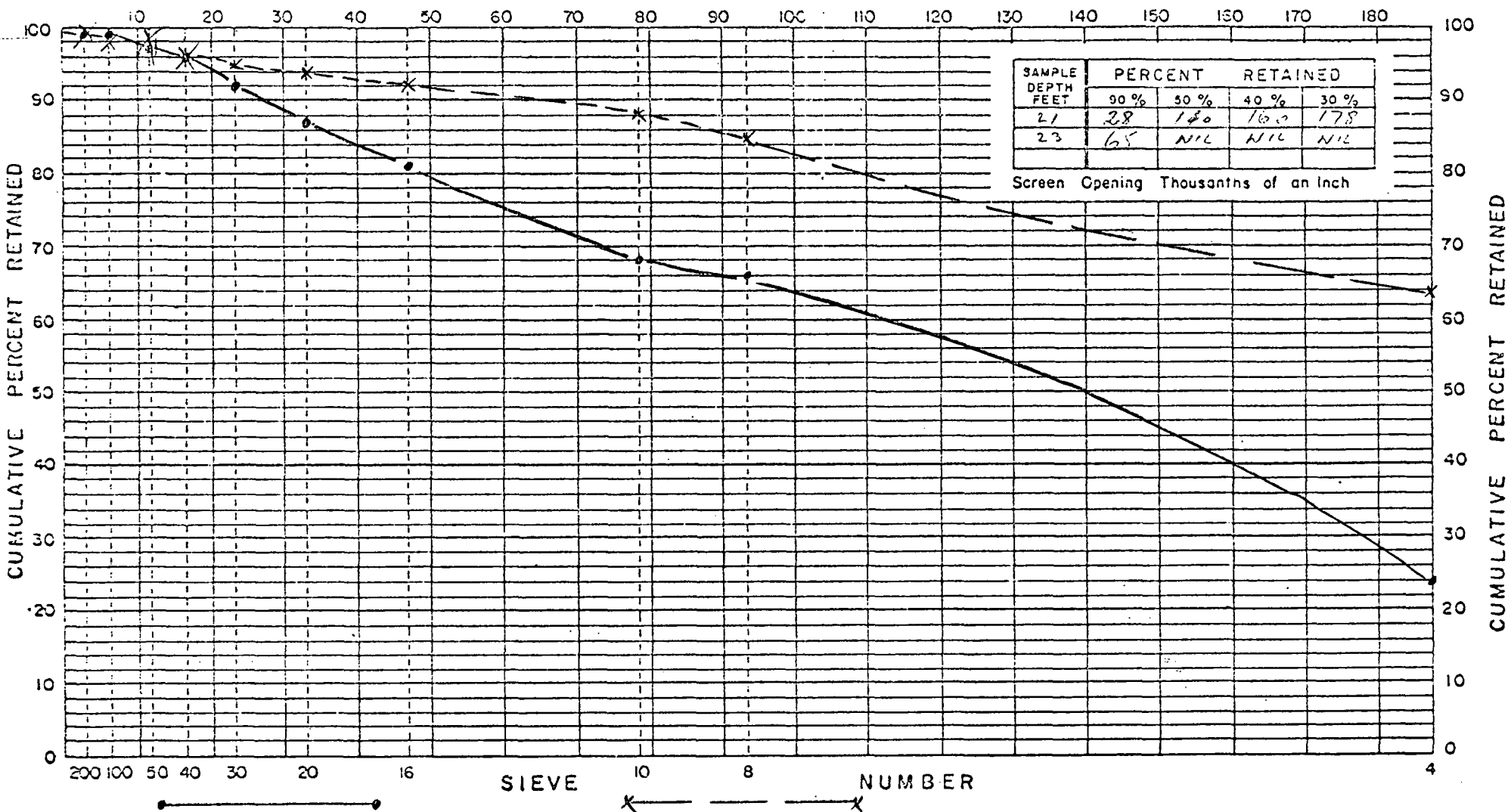
SIEVE ANALYSIS BY: *CHADLER*

DATE: *25. Sept. 1955*

Percent of sample not sieved 1/2" or over
100%

Percent of sample not sieved 1/2" or over
100%

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 21 FEET			
OPENINGS	RET. ON	WT. RET.	CUM. % RET.
	430		23.9
	1184		65.8
	1230		68.4
	1454		80.9
	1560		86.6
	1660		92.2
	1720		95.5
	1749		97.0
	1780		99.0
	1786		99.2

Percent of sample not sieved 1/2" or over

1800. 100%

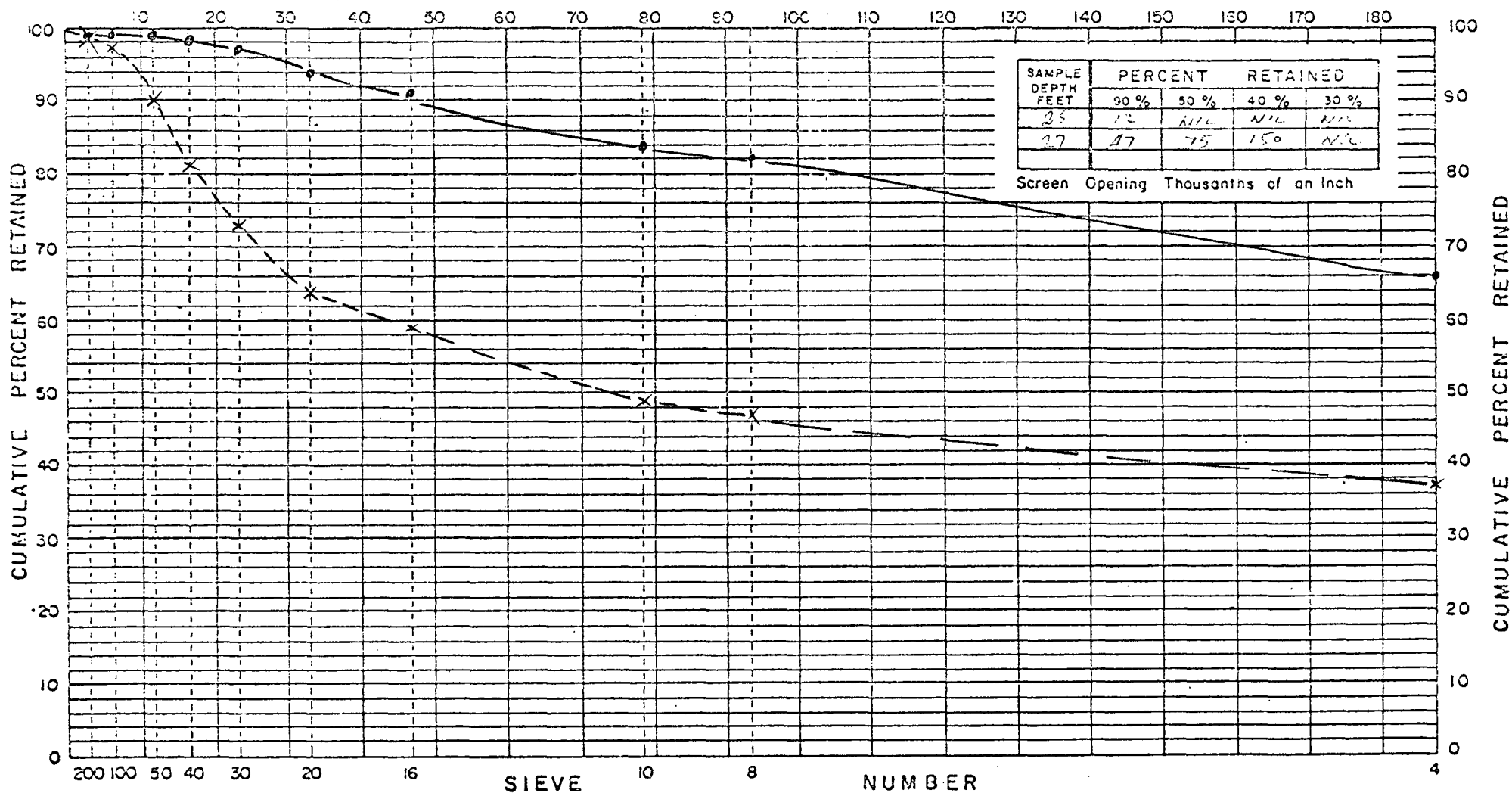
SAMPLE DEPTH 23 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	1400		64.0
	1870		85.4
	1918		87.6
	2014		92.0
	2050		93.6
	2084		95.2
	2110		96.3
	2130		97.3
	2158		98.5
	2170		99.0

Percent of sample not sieved 1/2" or over

2190 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	1400 125
LOCATION:	
WELL No.	1400 125
SAMPLED BY:	
SIEVE ANALYSIS BY:	
DATE:	25- SEPT. 1970

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 25 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		1250	66.4
8		1550	82.3
10		1582	84.3
16		1740	91.3
20		1770	94.0
25		1830	96.5
40		1850	98.3
50		1866	99.0
100		1874	99.5
200		1880	99.8

Percent of sample not sieved 1/2" or over

1880 100%

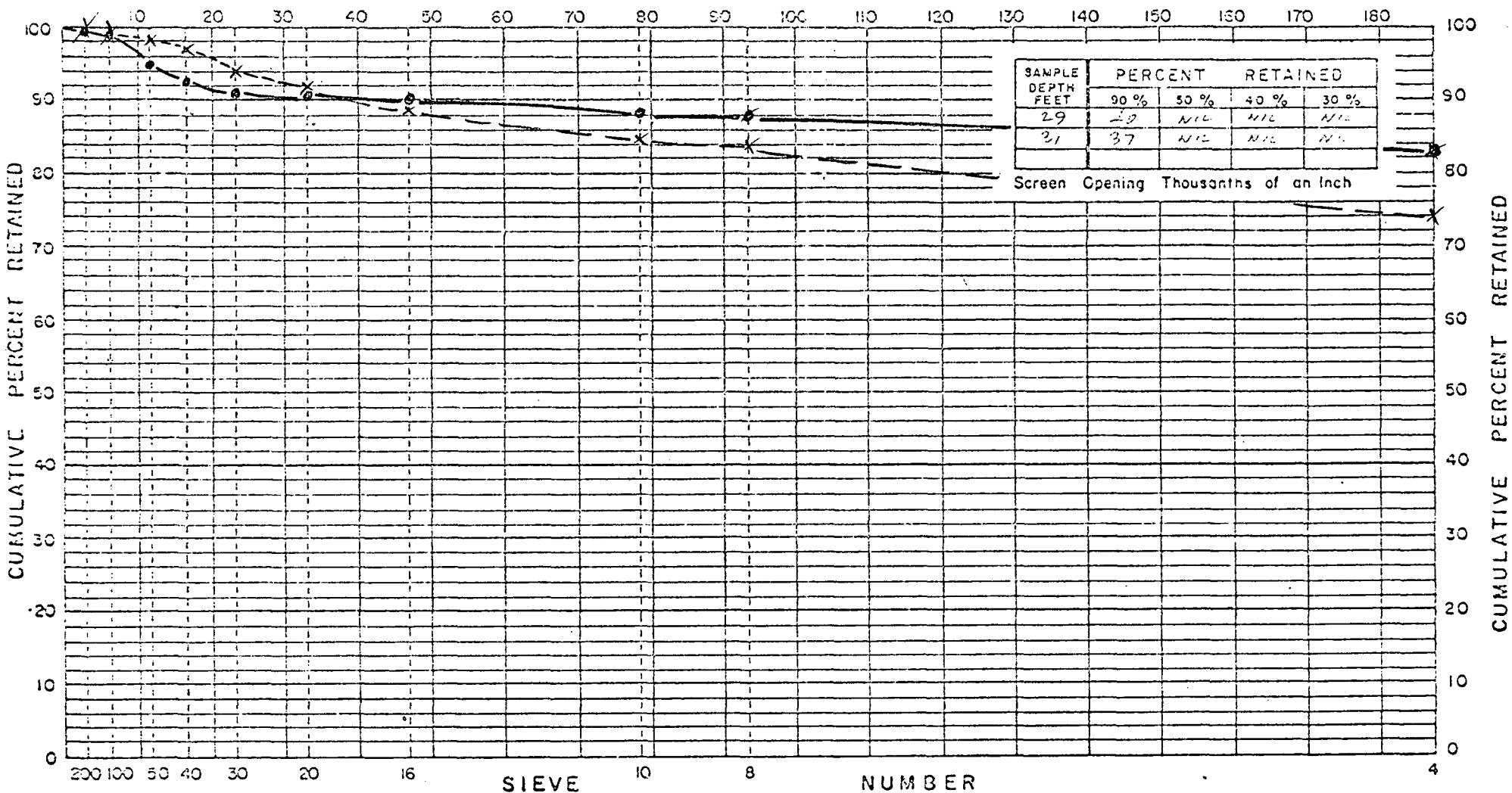
SAMPLE DEPTH 27 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		630	37.8
8		786	47.3
10		810	48.8
16		970	58.5
20		1070	63.5
25		1204	72.5
40		1350	81.2
50		1484	89.5
100		1620	97.5
200		1634	98.5

Percent of sample not sieved 1/2" or over

1660 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	TRINITY - SILVER PARK
WELL No.	1400125
SAMPLED BY:	CHODURA
SIEVE ANALYSIS BY:	STANFIELD
DATE:	15 SEP 75

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 29 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		1518	82.7
7		1610	87.8
10		1630	88.3
15		1646	89.6
20		1654	90.3
30		1668	91.0
40		1694	92.5
50		1746	95.0
100		1814	99.0
200		1822	99.5

Percent of sample not sieved 1/2" or over _____ %

1822 100%

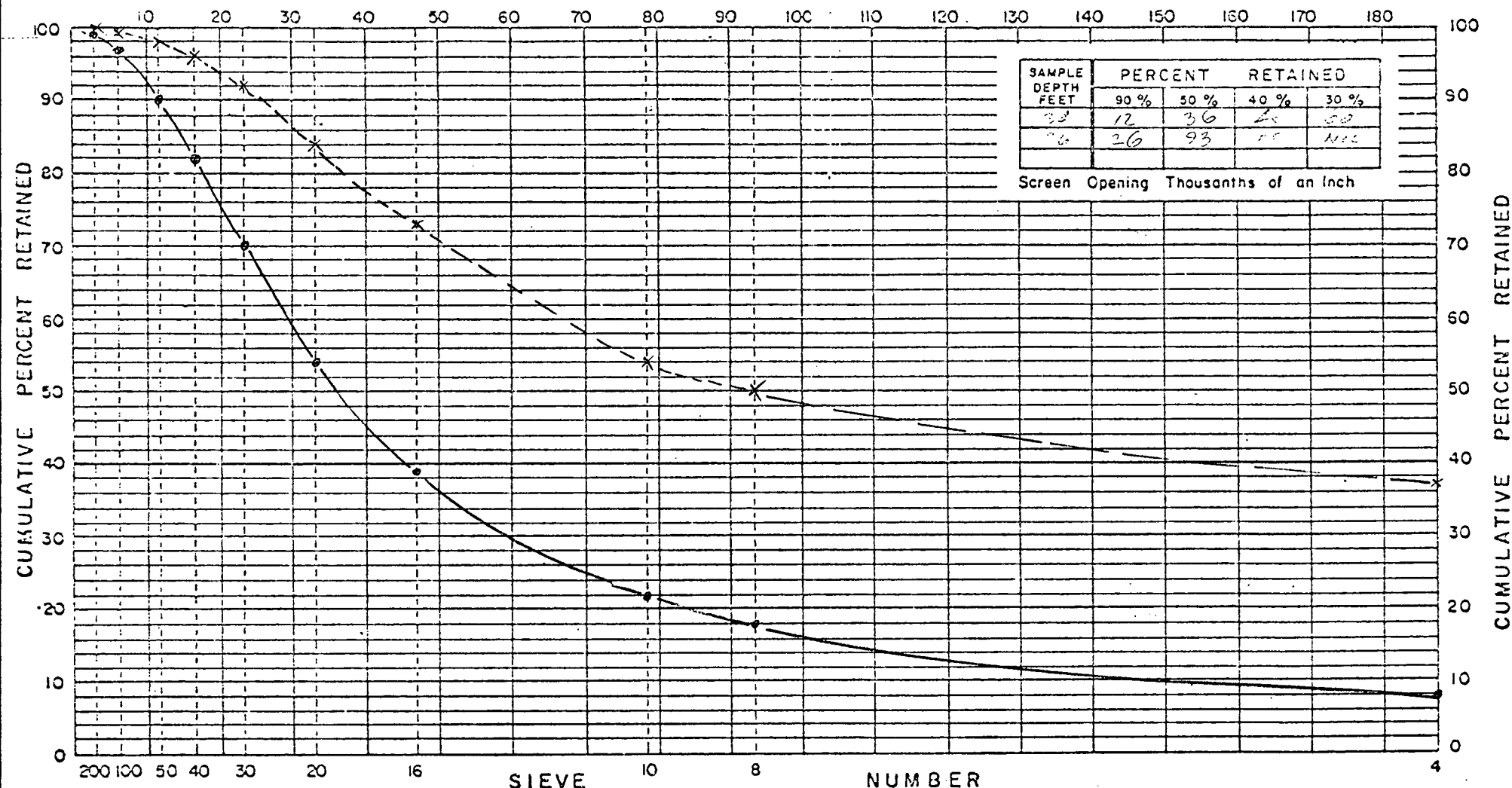
SAMPLE DEPTH 31 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4		1426	74.0
7		1610	83.5
10		1640	85.0
16		1724	89.3
20		1770	91.7
30		1820	94.3
40		1870	97.0
50		1890	98.0
100		1920	99.5
200		1924	99.8

Percent of sample not sieved 1/2" or over _____ %

1924 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTACT 60
LOCATION:	DUNCAN SILVER PORE
WELL NO.	1400/25
SAMPLED BY:	CHW/OJKA
SIEVE ANALYSIS BY:	STANLEY
DATE:	25 SEPT 1976

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 33 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	100		9.3
8	296		18.4
20	357		21.7
40	630		39.2
60	1126		54.0
80	1126		70.0
100	1324		82.3
120	1440		89.5
140	1560		96.8
160	1586		98.5

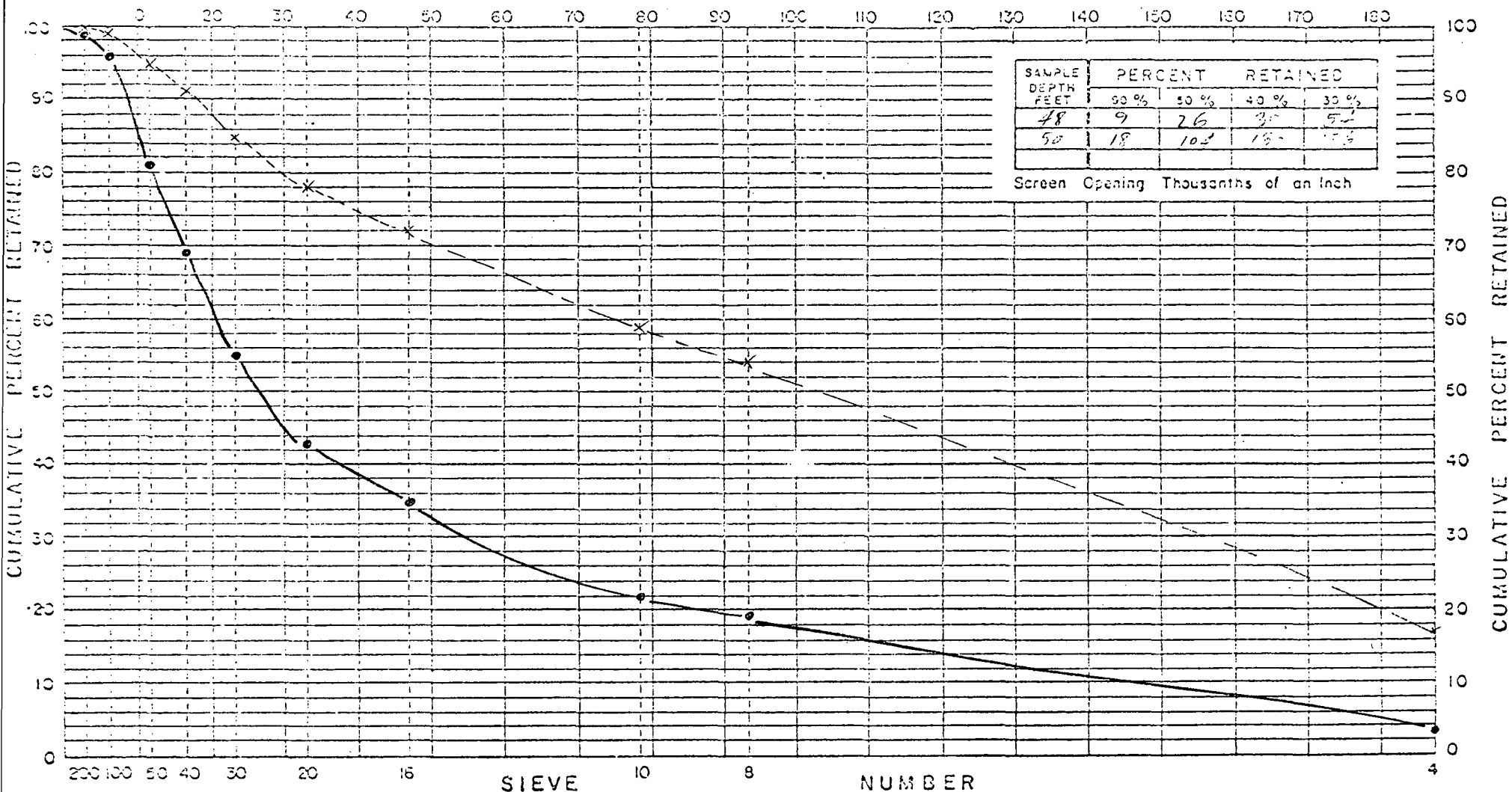
Percent of sample not sieved 1/2" or over
16.10

SAMPLE DEPTH 76 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	644		37.4
8	960		50.0
20	932		54.2
40	1250		72.6
60	1436		83.5
80	1580		92.0
100	1650		96.0
120	1680		97.6
140	1706		99.3
160	1716		99.8

Percent of sample not sieved 1/2" or over
100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CHARTER 62
LOCATION:	THUNDER - SILVER TAIL
WELL No.	1000-115
SAMPLED BY:	W. L. L. L.
SIEVE ANALYSIS BY:	W. L. L. L.
DATE:	25-10-1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 48 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	20	3.8
	8	100	19.2
	10	116	22.2
	16	182	34.9
	20	224	43.0
	30	286	55.0
	40	360	69.0
	50	424	81.0
	100	500	95.8
	200	514	98.5
	PAN	522	

Percent of sample not sieved 1/2" or over

1119

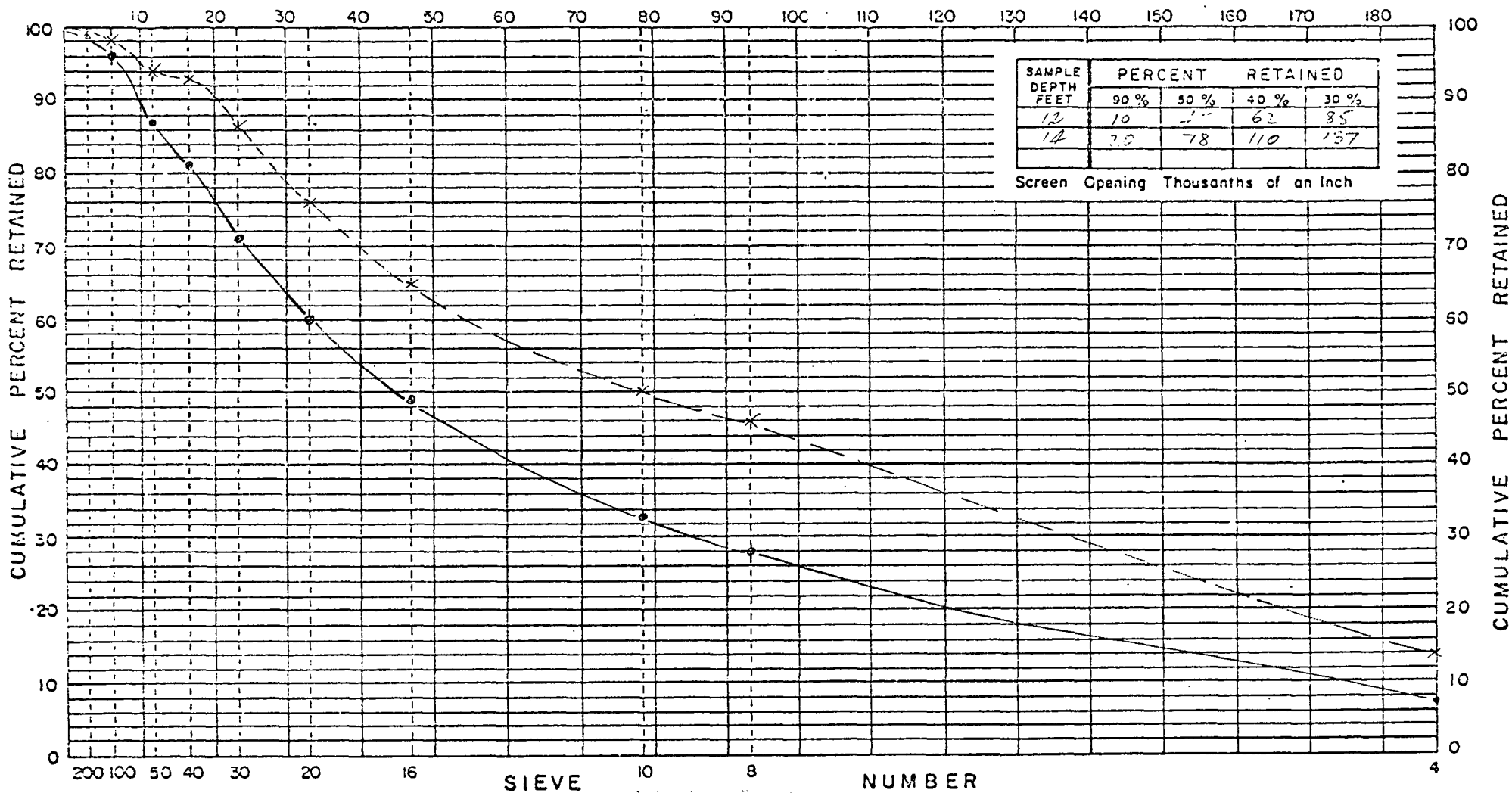
SAMPLE DEPTH 50 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	136	17.5
	8	418	52.0
	10	458	59.0
	16	560	72.1
	20	606	78.0
	30	658	85.0
	40	704	90.8
	50	738	95.0
	100	766	98.8
	200	772	99.5
	PAN	776	

Percent of sample not sieved 1/2" or over

1276

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - FRYLIER'S
WELL NO.:	1-22-190
SAMPLED BY:	CHWOK, J.
SIEVE ANALYSIS BY:	STANNARD
DATE:	29. SEPT. 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



812 - 12 - 8 1/2 FEET

SAMPLE DEPTH FEET	OPENING	RET. ON	WT. RET.	CUM. % RET.
12	20	206	94	7.6
14	40	1160	342	38.0
16	60	1726	412	49.2
18	80	450	612	69.2
20	100	1550	722	79.6
22	120	1000	812	87.6
24	140	1614	1002	92.4
26	160	1900	1228	98.0
28	180	2000	1192	98.4
30	200	2000	1222	98.4

Percent of sample not sieved $\frac{1}{2}$ " or over
812 39.6%

INC $\frac{1}{4}$ " = 2005

1692

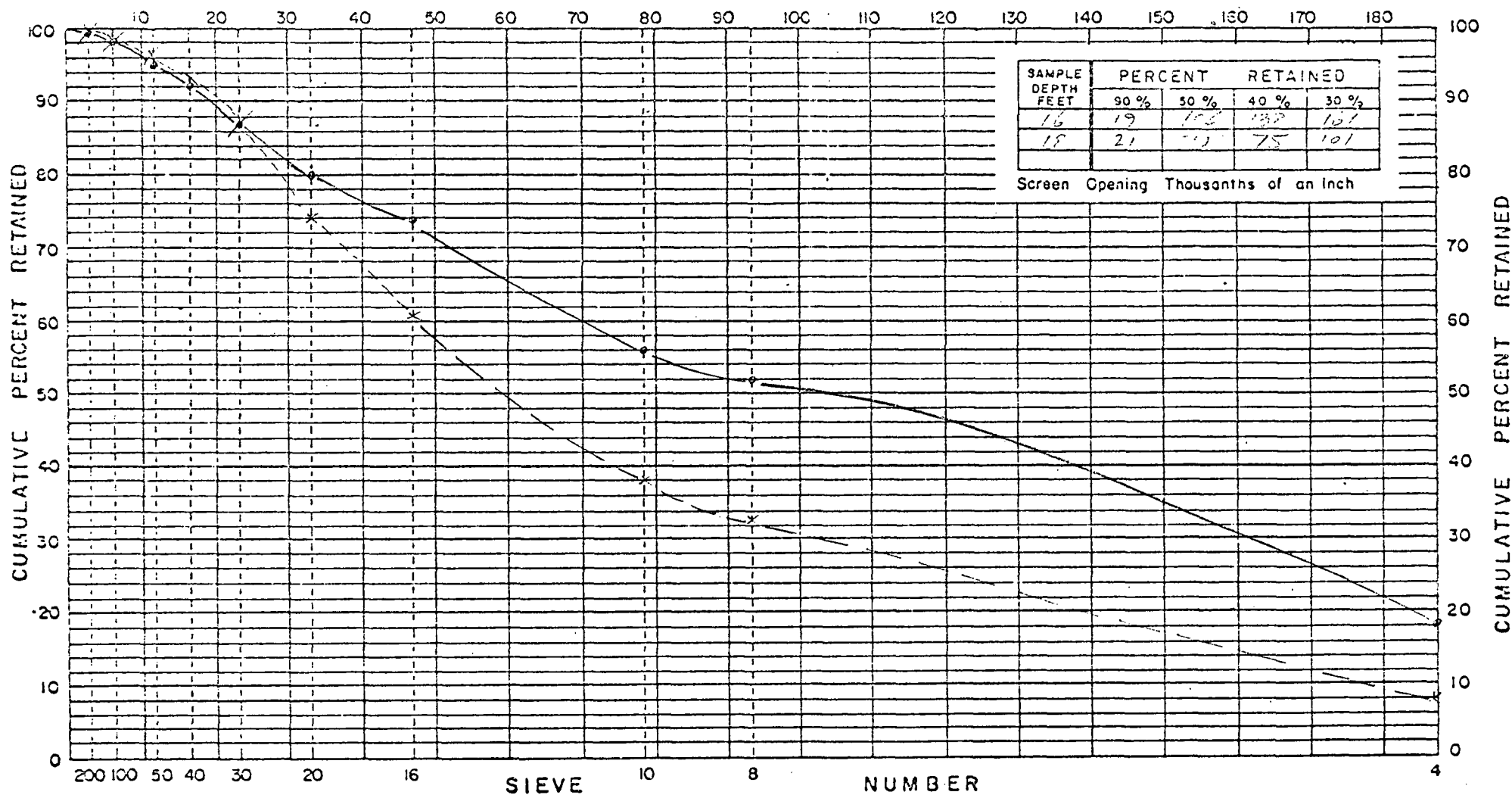
SAMPLE DEPTH FEET	OPENING	RET. ON	WT. RET.	CUM. % RET.
12	20	1770	72	14.0
14	40	1748	256	46.0
16	60	1770	278	50.0
18	80	2054	362	65.0
20	100	2116	424	76.0
22	120	2101	482	86.5
24	140	2210	518	93.0
26	160	2216	524	94.0
28	180	2332	544	97.5
30	200	2410	548	98.5

Percent of sample not sieved $\frac{1}{2}$ " or over
1692 75.3%

TOTAL = INC $\frac{1}{4}$ " = 2250

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	Contract 60
LOCATION:	
WELL No.	00130
SAMPLED BY:	
SIEVE ANALYSIS BY:	
DATE:	

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 16 FEET				
OPENING	RET. ON	WT. RET.	CUM. % RET.	
4	1235	2	18.3	
6	1650	238	52.0	
8	1510	258	56.2	
10	1750	338	73.7	
16	1776	364	79.5	
30	1812	400	87.2	
40	1834	422	92.0	
50	1846	434	94.8	
100	1862	450	98.1	
200	1868	456	99.5	

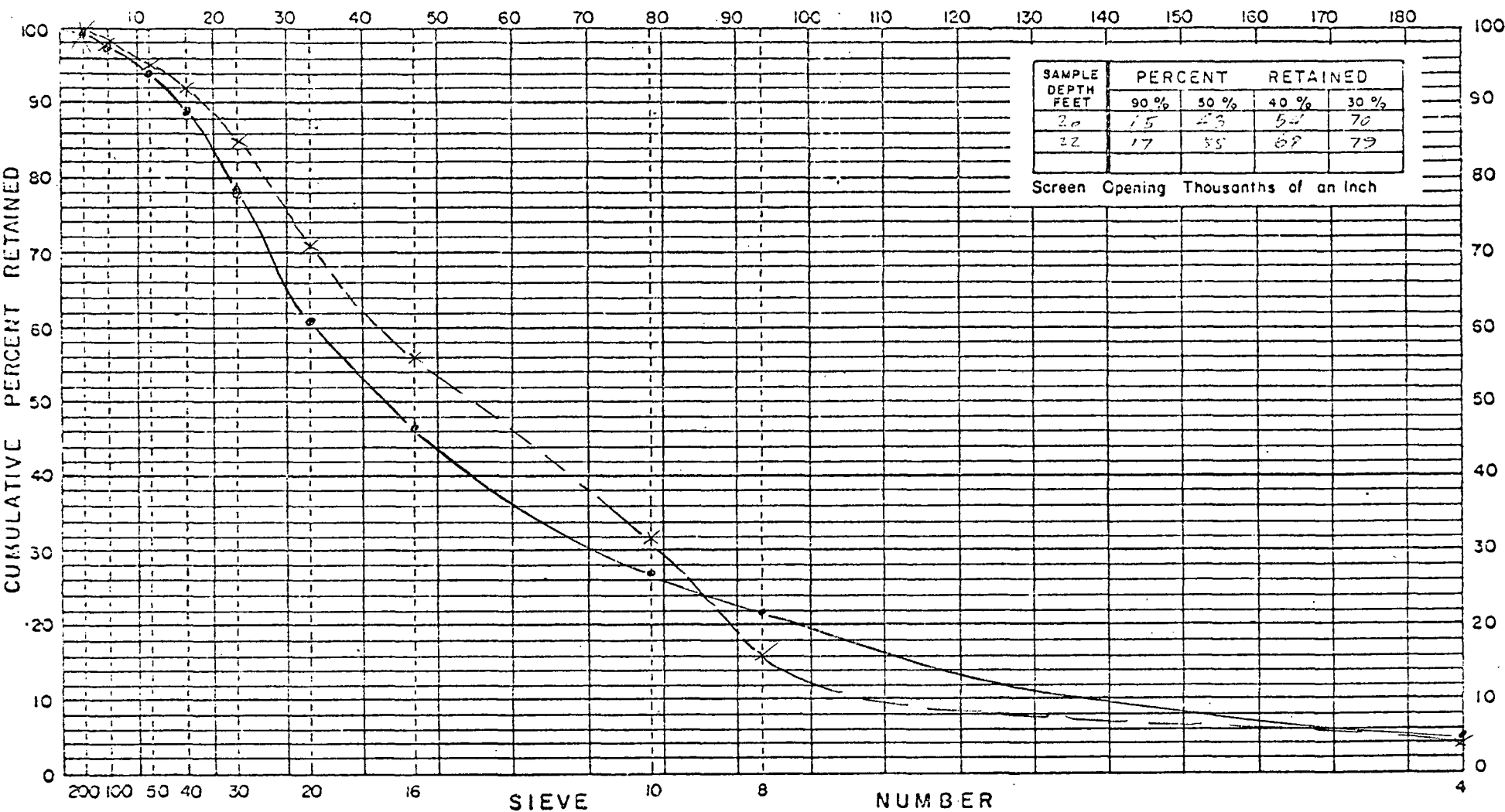
Percent of sample not sieved $\frac{1}{2}$ " or over
 $\frac{1868}{1812} = 75.5\%$
 $\frac{1868}{1812} = 187\%$

SAMPLE DEPTH 18 FEET				
OPENING	RET. ON	WT. RET.	CUM. % RET.	
4	610	60	8.1	
8	802	242	32.7	
10	840	280	37.8	
16	1010	450	62.8	
30	1106	546	73.7	
40	1204	644	87.0	
50	1250	690	93.7	
100	1270	710	96.0	
200	1284	724	97.9	
200	1290	730	98.6	

Percent of sample not sieved $\frac{1}{2}$ " or over
 $\frac{730}{560} = 13.1\%$
 $\frac{730}{560} = 1300\%$

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	TUNNEL - 23410214
WELL NO.	1000130
SAMPLED BY:	CHANDLER
SIEVE ANALYSIS BY:	SEAN WARD
DATE:	17. JAN 1975

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 20 FEET				
OPENING	RET. ON	WT. RET.	CUM. % RET.	
4	1530	64	5.1	
8	860	272	22.0	
15	920	334	26.8	
20	1166	580	46.5	
30	1260	764	61.3	
40	1556	970	77.8	
60	1700	1110	89.4	
80	1756	1170	93.9	
100	1802	1216	97.5	
200	1820	1232	99.0	

Percent of sample not sieved $\frac{1}{2}$ " or over
 586 31.9 %

1232 100 %
 1232 - 586 = 646

SAMPLE DEPTH 22 FEET				
OPENING	RET. ON	WT. RET.	CUM. % RET.	
4	160	50	3.9	
8	446	336	26.2	
15	520	410	32.0	
20	832	722	56.4	
30	1020	910	71.1	
40	1190	1080	84.5	
60	1282	1172	91.7	
80	1326	1216	95.0	
100	1362	1252	98.0	
200	1274	1262	98.8	

Percent of sample not sieved $\frac{1}{2}$ " or over
 110 7.9 %

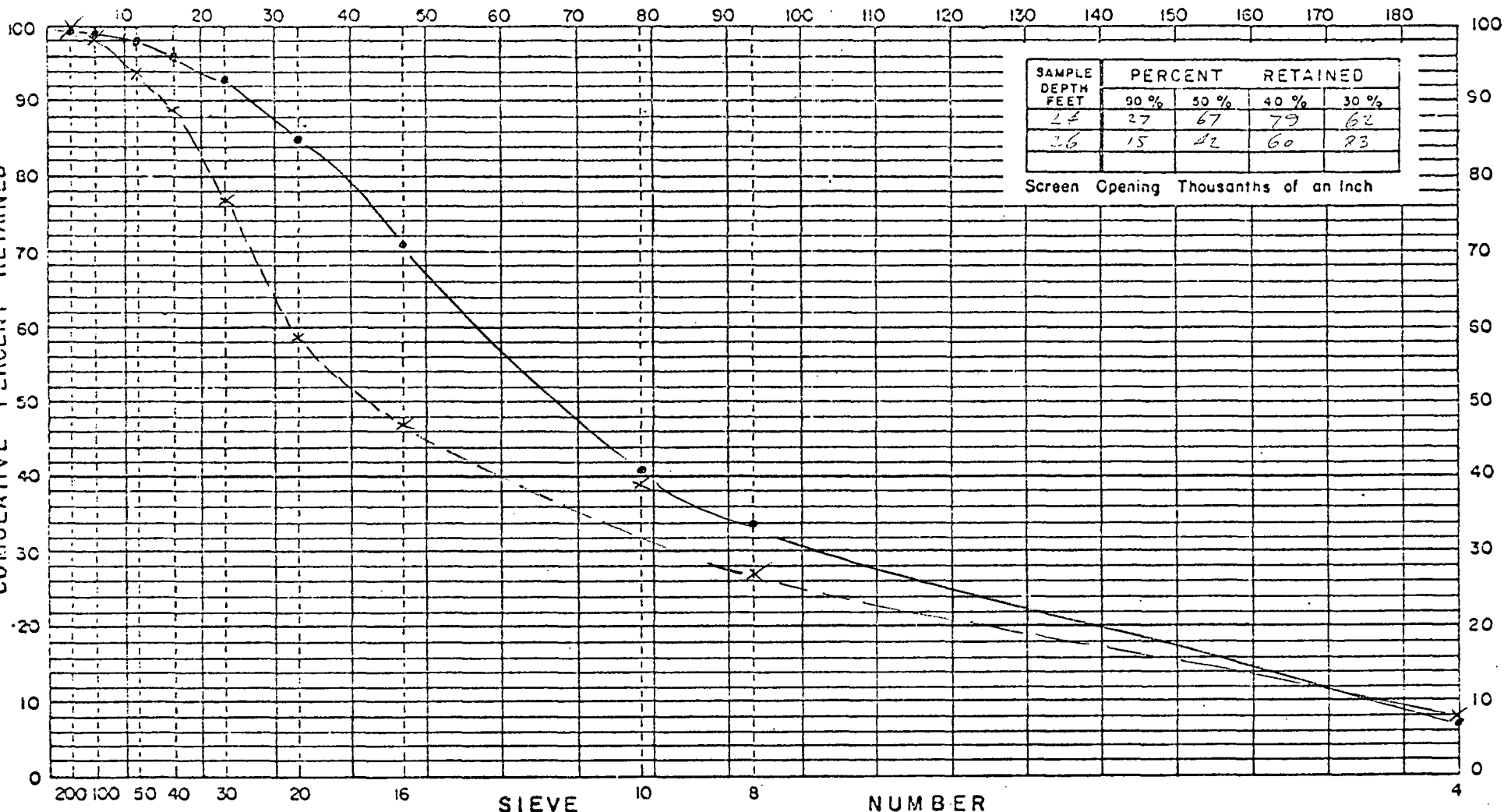
1262 100 %
 1262 - 110 = 1152

BRITISH COLUMBIA
 DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
 WATER RESOURCES SERVICE
 WATER INVESTIGATIONS BRANCH
 Groundwater Section

SIEVE ANALYSIS

PROJECT: *Current 60*
 LOCATION: *TR-751512*
 WELL No.: *1402130*
 SAMPLED BY: *J. J. J. J.*
 SIEVE ANALYSIS BY: *J. J. J. J.*
 DATE: *12-3-60*

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 24 FEET				
OPENING	RET. ON	WT. RET.	CUM. %	RET.
	4	1132	74	7.0
	8	690	262	34.3
	10	756	228	40.6
	16	1076	748	71.0
	20	1226	898	85.0
	30	1310	982	93.0
	40	1342	1016	96.3
	50	1360	1032	97.7
	100	1372	1044	99.0
	200	1372	1054	99.6

Percent of sample not sieved $\frac{1}{2}$ " or over
 328 23.7 %

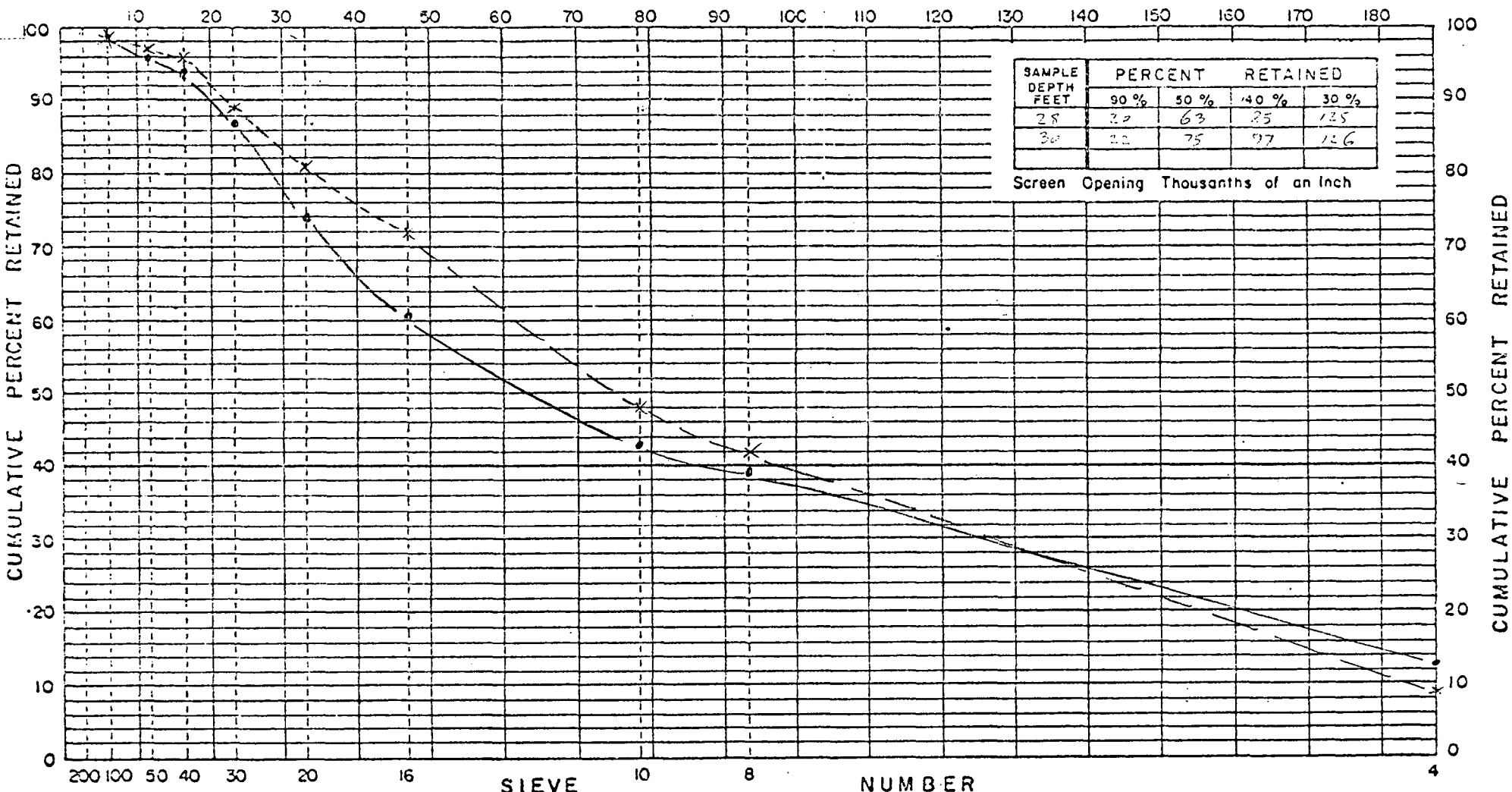
SAMPLE DEPTH 26 FEET				
OPENING	RET. ON	WT. RET.	CUM. %	RET.
	4	1330	68	7.8
	8	1500	238	27.2
	10	1520	258	29.4
	16	1670	408	46.6
	20	1782	520	59.2
	30	1940	678	77.4
	40	2040	778	88.6
	50	2090	828	94.3
	100	2124	862	98.1
	200	2130	868	99.0

Percent of sample not sieved $\frac{1}{2}$ " or over
 1262 59.0 %

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT - 60
LOCATION:	TRAIL - FRASER'S
WELL No.	12-130
SAMPLED BY:	CHANDLER
SIEVE ANALYSIS BY:	SPRINGFIELD
DATE:	27 - Sept - 1945

TOTAL = 112 1/2" = 2140

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 28 FEET				
OPENINGS	RET. ON	WT. RET.	CUM. %	RET.
2	1004	92	12.7	
4	1100	222	38.7	
10	1130	318	42.7	
15	1260	448	60.3	
20	1530	548	73.7	
25	1460	648	87.1	
30	1510	698	94.9	
40	1535	716	96.2	
50	1544	732	98.5	
60	1552	740	99.5	

Percent of sample not sieved $\frac{1}{2}$ " or over
 812 52.2 %

TOTAL = INC $\frac{1}{2}$ " = 1555

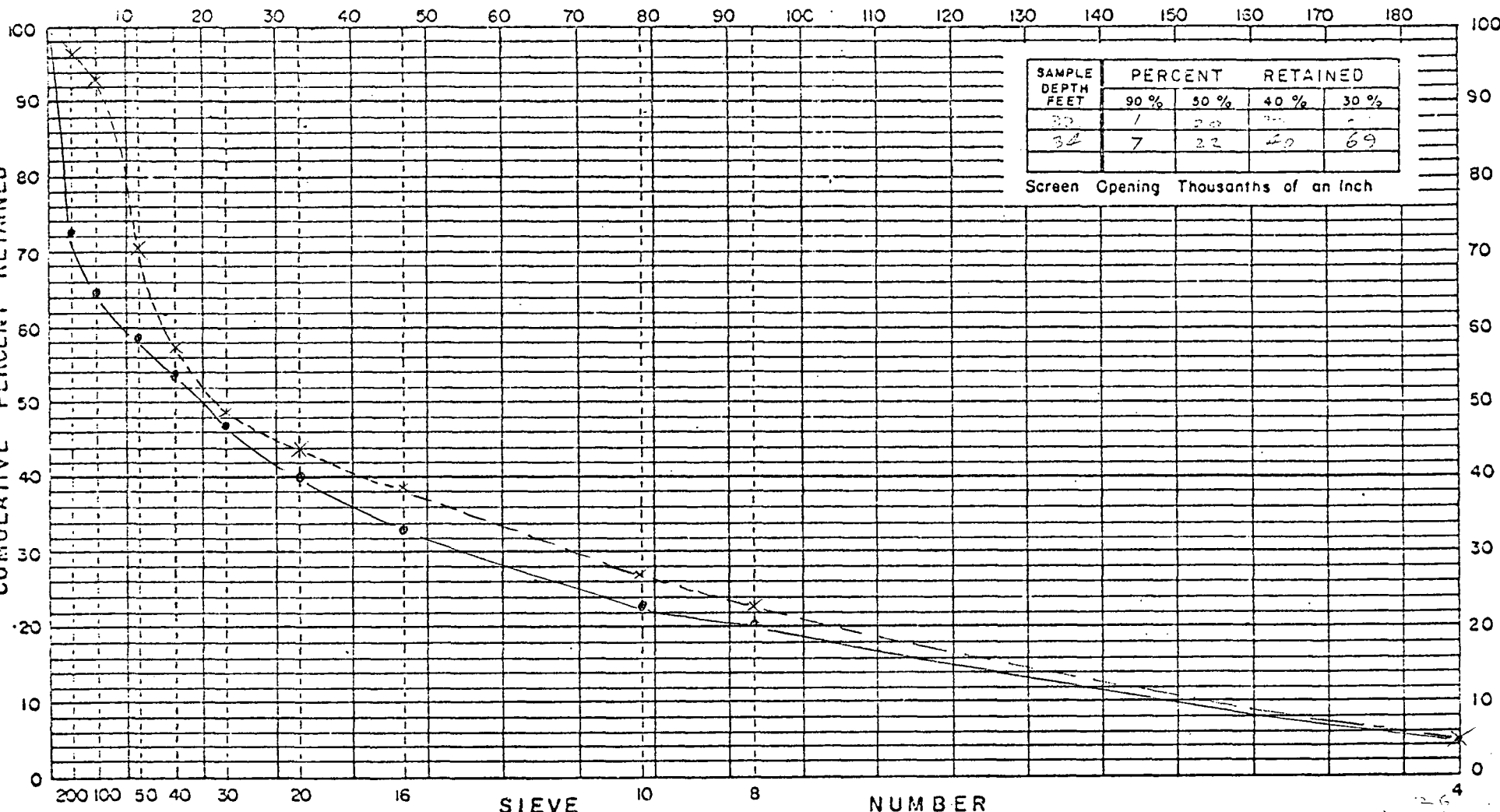
SAMPLE DEPTH 30 FEET				
OPENING	RET. ON	WT. RET.	CUM. %	RET.
2	1300	52	8.8	
4	1496	242	42.2	
10	1530	282	47.9	
15	1670	322	71.6	
20	1722	474	80.6	
25	1770	522	88.5	
30	1810	562	95.5	
40	1820	572	97.0	
50	1830	582	98.7	
60	1834	586	99.5	

Percent of sample not sieved $\frac{1}{2}$ " or over
 1248 68.0 %

TOTAL = INC $\frac{1}{2}$ " = 1836

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CENTRE 60
LOCATION:	22ND AVE - FRASER'S
WELL No.	1700130
SAMPLED BY:	DEWITT
SIEVE ANALYSIS BY:	DEWITT
DATE:	27- SEPT. 75

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 32 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	50		4.7
8	218		20.4
10	250		23.4
16	360		33.6
20	430		40.2
30	502		46.9
40	576		53.8
50	630		59.9
100	812		64.6
200	714		72.3

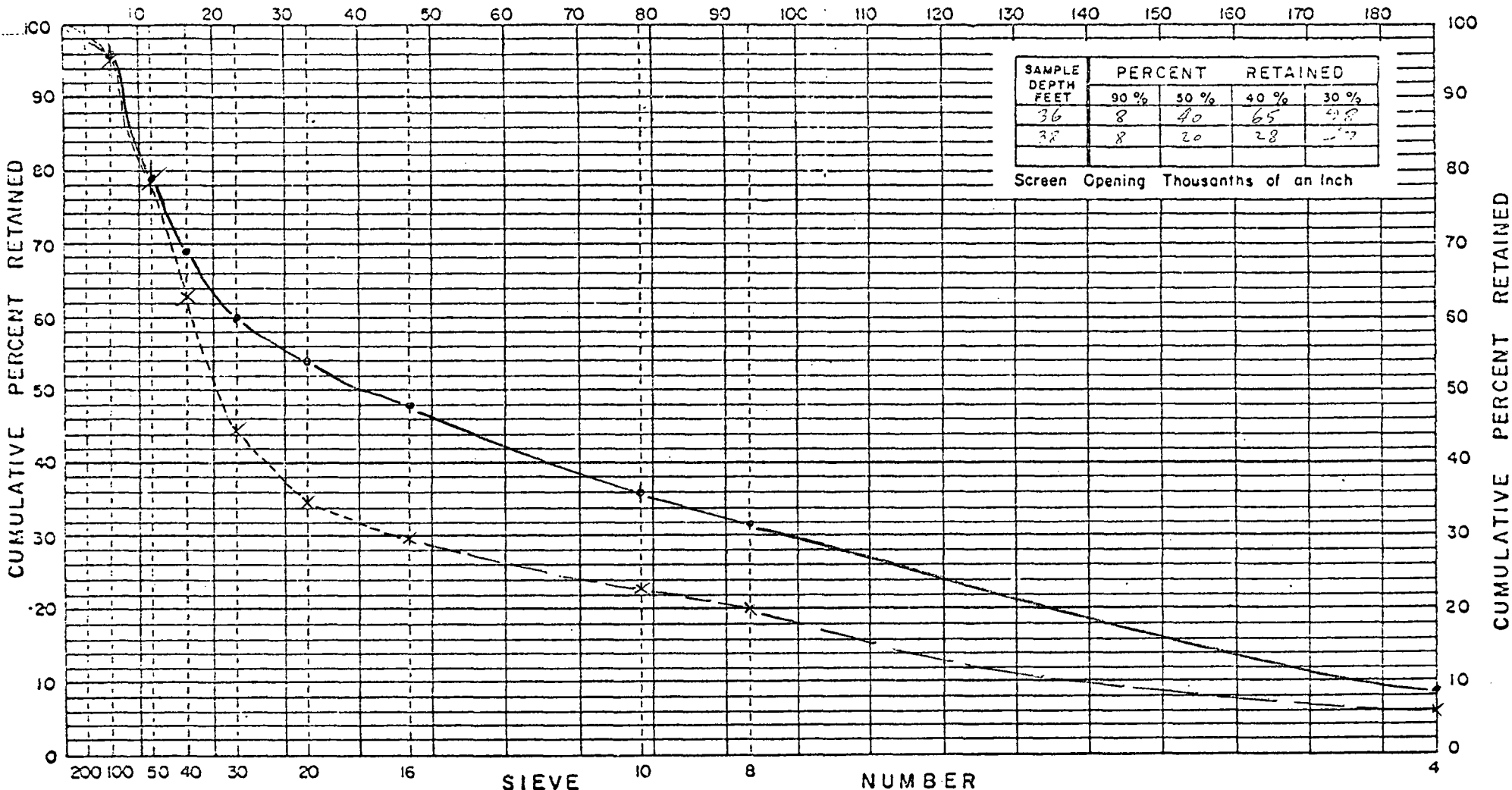
Percent of sample not sieved $\frac{1}{2}$ " or over

SAMPLE DEPTH 34 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	50		4.7
8	218		20.4
10	293		27.5
16	312		32.6
20	312		32.6
30	522		49.0
40	56		57.7
50	781		70.5
100	997		93.2
200	1032		96.7

Percent of sample not sieved $\frac{1}{2}$ " or over

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - FRASER'S
WELL No.	140130
SAMPLED BY:	STANFORD
SIEVE ANALYSIS BY:	STANFORD
DATE:	29. JULY 75

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH 36 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	2	100	8.7
	8	338	31.9
	10	352	36.0
	16	512	48.3
	20	508	53.6
	30	142	59.6
	40	732	69.1
	60	826	79.0
	100	1012	96.2
	200	1000	97.8

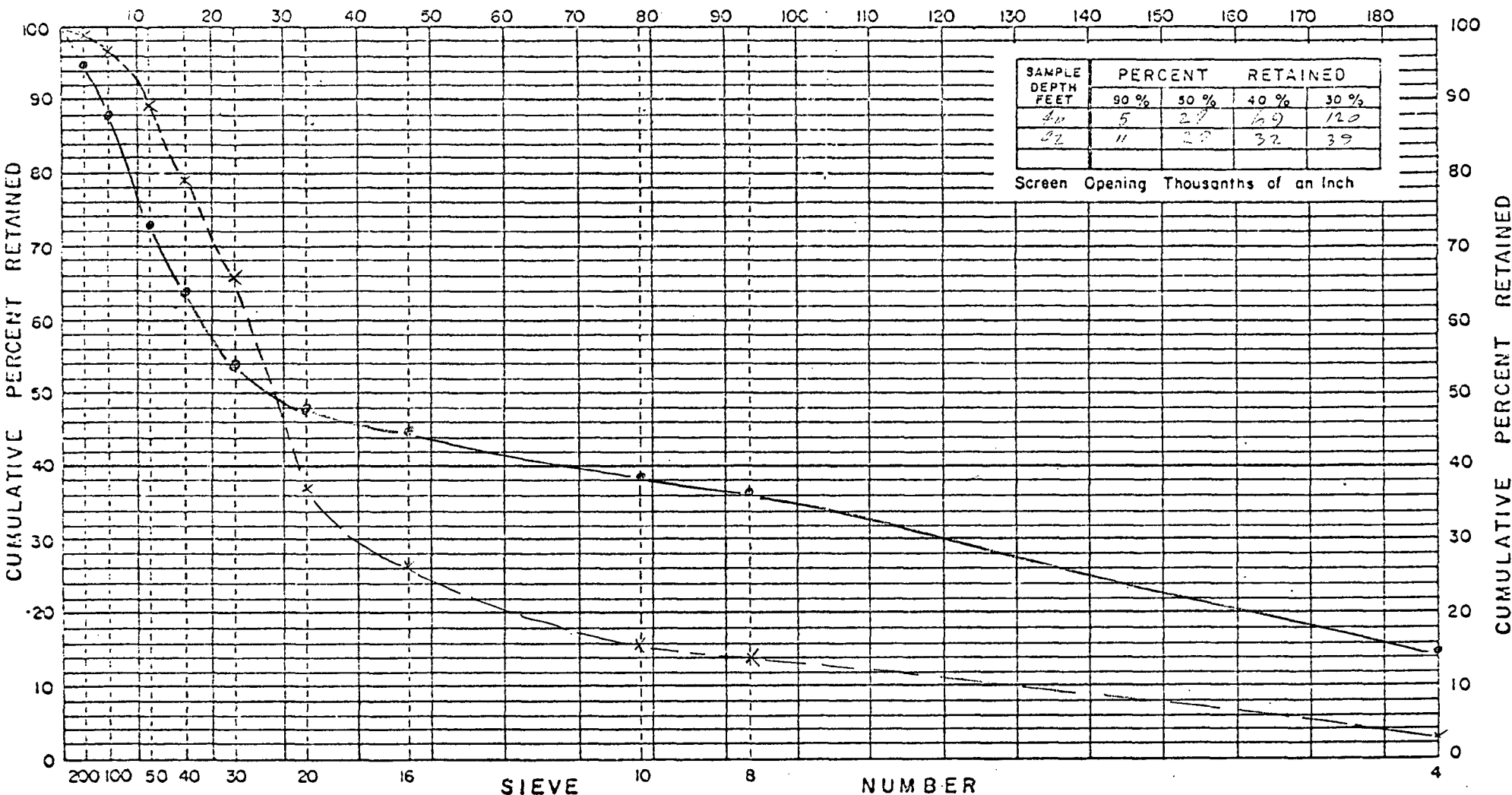
Percent of sample not sieved $\frac{1}{2}$ " or over
 5.6 34.8% 100

SAMPLE DEPTH 38 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	2	68	6.0
	8	126	19.7
	10	144	22.6
	16	142	29.8
	20	224	35.0
	30	284	44.5
	40	402	63.0
	60	500	78.5
	100	610	95.5
	200	630	98.6

Percent of sample not sieved $\frac{1}{2}$ " or over
 1.24 63.7% 100
 176

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 600
LOCATION:	JUNCTION - 7000' E
WELL NO.	1-100120
SAMPLED BY:	SPANNARD
SIEVE ANALYSIS BY:	SPANNARD
DATE:	

SIEVE OPENING IN THOUSANDTHS OF AN INCH



SAMPLE DEPTH / FEET	OPENING	RET. ON	WT. RET.	CUM. % RET.
4	122	14.9		
8	290	35.5		
10	314	38.2		
16	366	44.8		
20	390	47.7		
30	440	53.9		
40	518	63.5		
50	576	73.0		
100	722	78.2		
200	774	94.6		

Percent of sample not sieved $\frac{1}{2}$ " or over

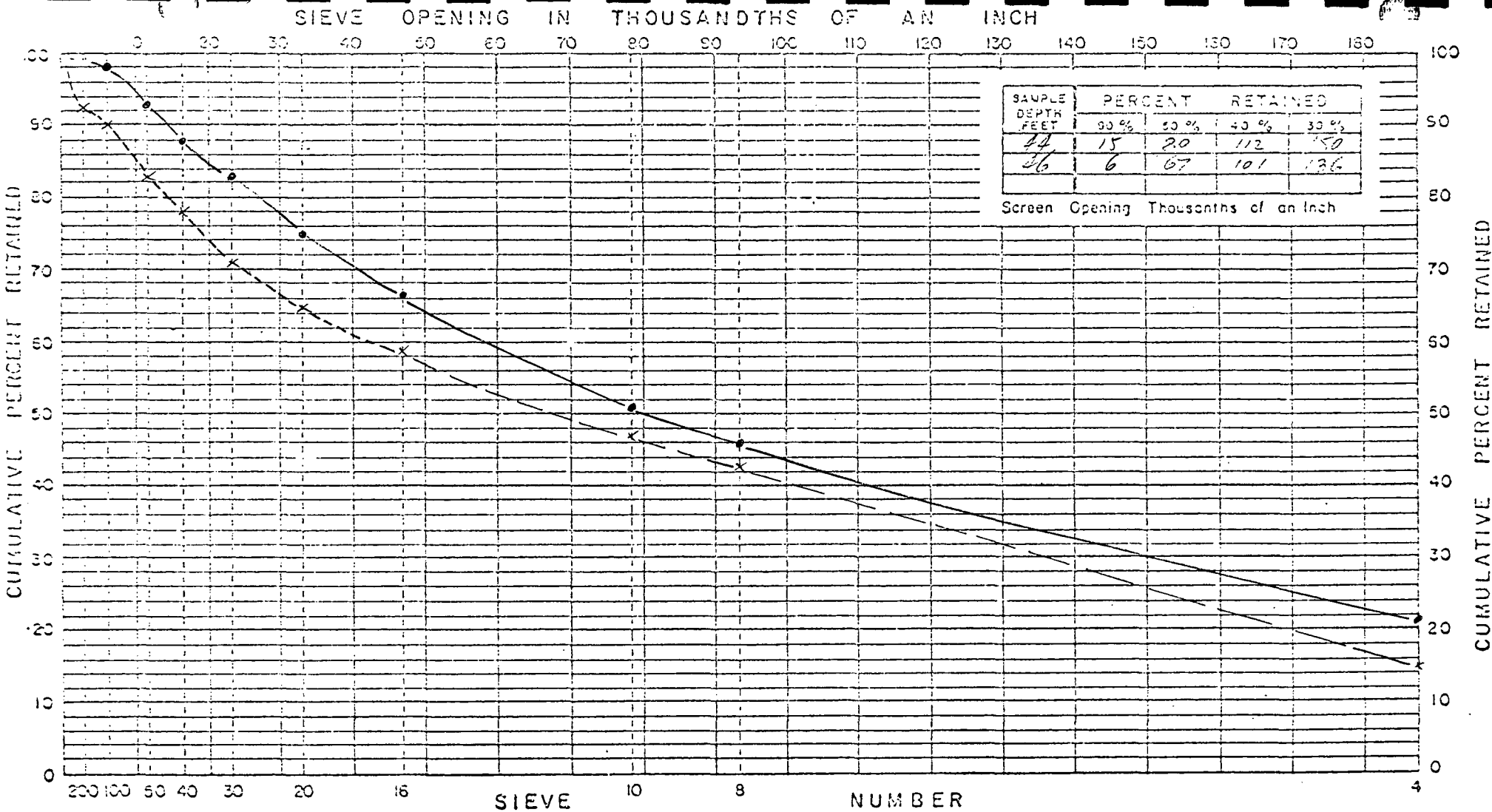
1000 55.1 % 14

SAMPLE DEPTH / FEET	OPENING	RET. ON	WT. RET.	CUM. % RET.
4	18	3.2		
8	78	10.0		
10	90	16.2		
16	148	26.5		
20	208	37.2		
30	368	66.0		
40	440	75.0		
50	500	89.5		
100	540	96.5		
200	550	98.5		

Percent of sample not sieved $\frac{1}{2}$ " or over

1200 3.3 % 14

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CA - 5157 600
LOCATION:	DUNCAN - FRASER'S
WELL NO.	100-130
SAMPLED BY:	J. A. 1000
SIEVE ANALYSIS BY:	SYNNARD
DATE:	29. Sept 75



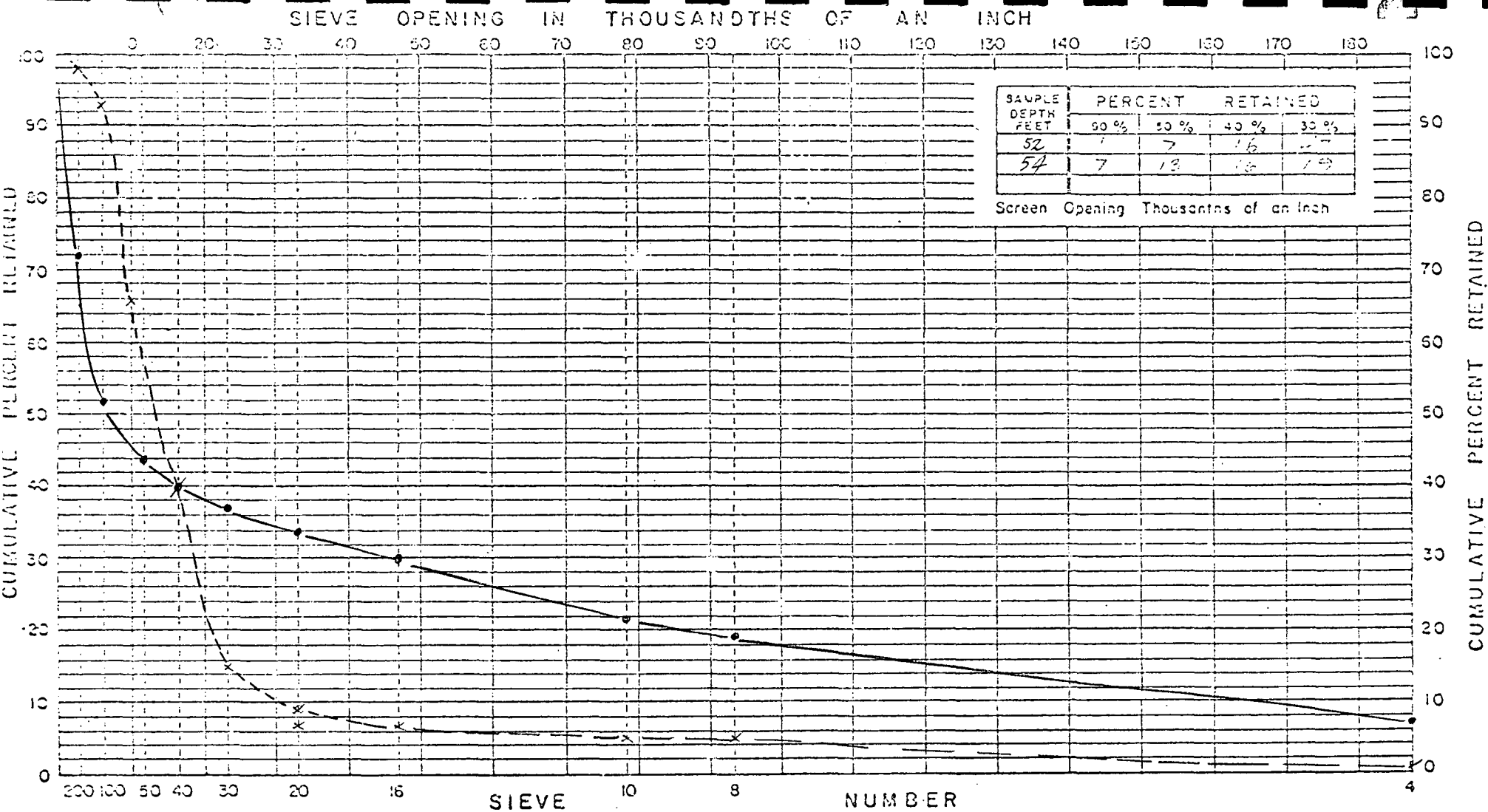
SAMPLE DEPTH 44 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	136	21.8
	8	392	46.0
	10	436	51.0
	16	566	66.5
	20	638	75.0
	30	708	83.0
	40	758	88.0
	50	772	93.0
	100	832	97.6
	200	842	98.8

PAN 852
Percent of sample not sieved $\frac{1}{2}$ " or over
756 75.5%

SAMPLE DEPTH 46 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	164	15.2
	8	460	42.7
	10	504	46.7
	16	640	59.3
	20	700	64.9
	30	770	71.4
	40	844	78.0
	50	900	83.7
	100	972	90.0
	200	998	92.3

PAN 1008
Percent of sample not sieved $\frac{1}{2}$ " or over
756 75.2%

BRITISH COLUMBIA	
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES	
WATER RESOURCES SERVICE	
WATER INVESTIGATIONS BRANCH	
Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - FRASER'S
WELL NO.	1200130
SAMPLED BY:	CHANDLER
SIEVE ANALYSIS BY:	STANWARD
DATE:	29. SEPT. 76



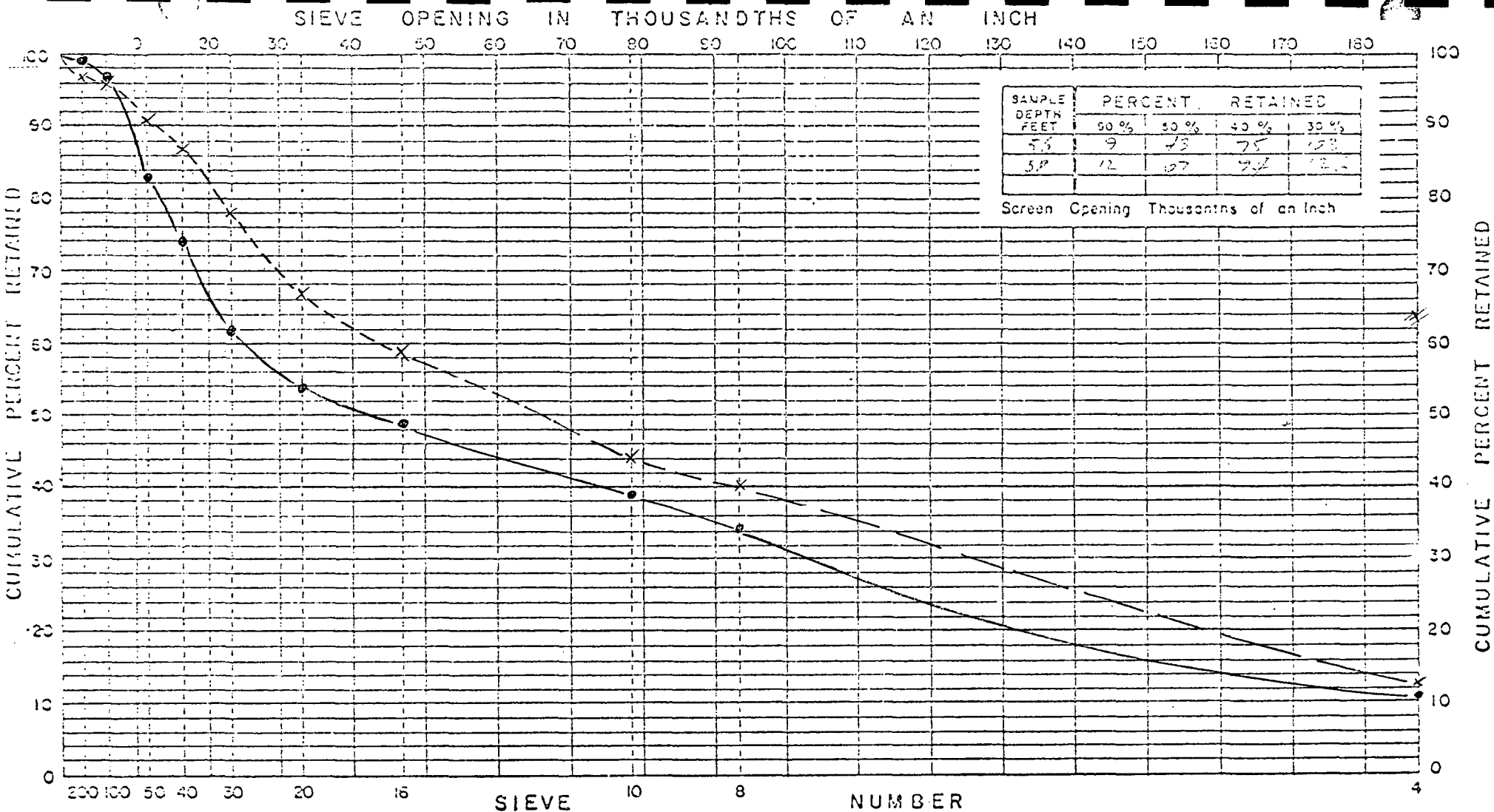
SAMPLE DEPTH 52 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	104		7.5
8	270		19.5
10	306		21.8
16	418		30.2
20	448		33.8
30	506		36.6
40	556		39.8
50	602		43.5
100	716		51.8
200	1000		72.2

Percent of sample not sieved $\frac{1}{2}$ " or over
 PAN 1384
 21.1 19.1 % 1.1

SAMPLE DEPTH 54 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	10		0.89
8	54		4.8
10	60		5.3
16	82		7.3
20	100		8.9
30	174		15.5
40	443		32.8
50	740		65.8
100	1042		92.6
200	1102		98.0

Percent of sample not sieved $\frac{1}{2}$ " or over
 PAN 1126
 48 4.8 % 1.2

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CENTRIFUG 60
LOCATION:	BONCHIN - R. J. SER'S
WELL NO.	1400130
SAMPLED BY:	CHANDLER
SIEVE ANALYSIS BY:	STANDARD
DATE:	29- SEPT. 75



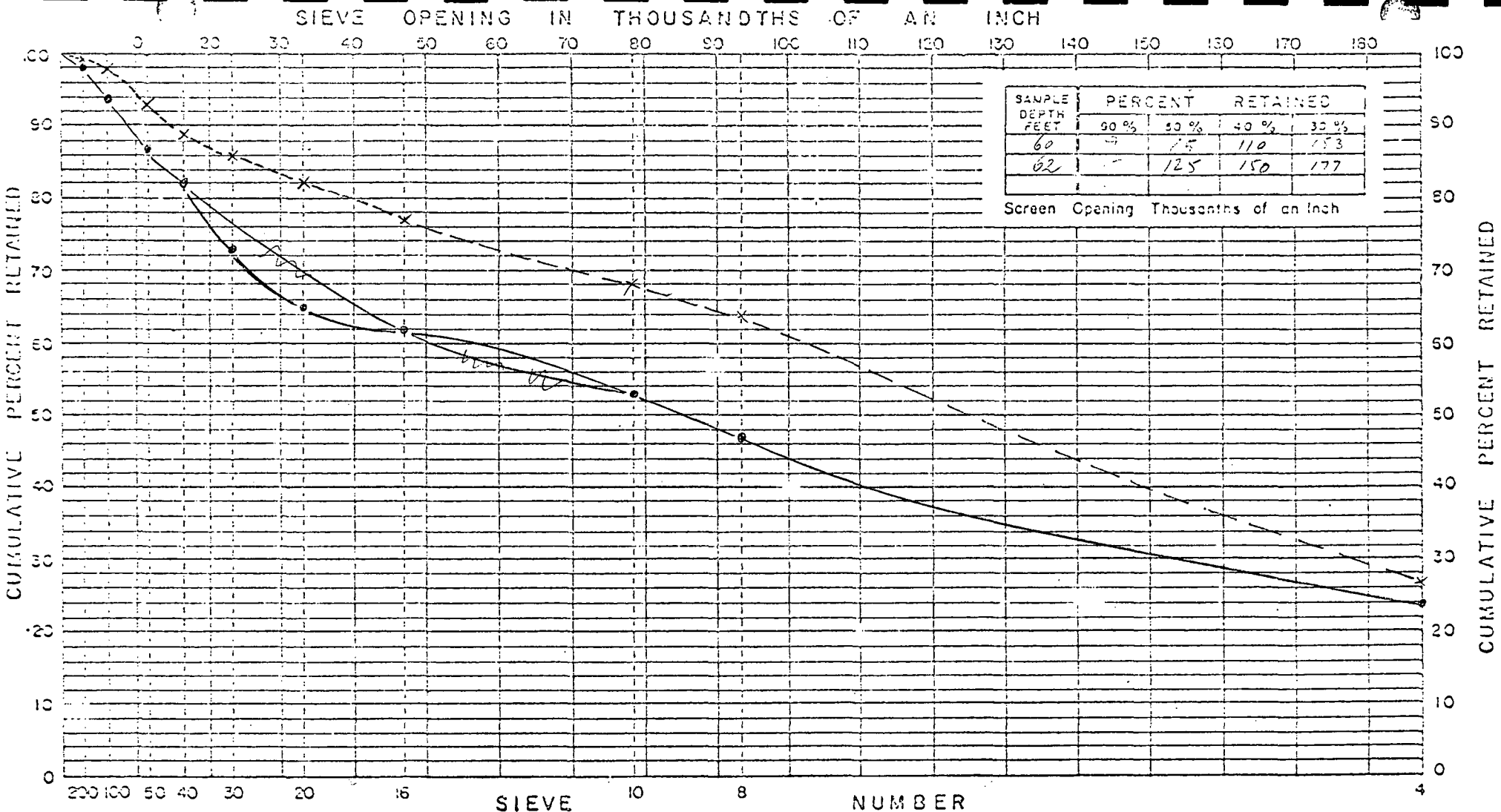
SAMPLE DEPTH 56 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	108		11.1
9	330		32.4
10	363		38.8
16	466		47.0
20	570		53.7
30	592		57.2
40	706		71.2
50	790		77.2
100	920		96.8
200	940		97.2

Percent of sample not sieved 1/2" or over
2.8%

SAMPLE DEPTH 58 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	62		12.5
9	200		40.1
10	220		44.4
16	290		58.5
20	334		67.3
30	384		72.5
40	430		86.7
50	450		90.8
100	474		95.6
200	486		96.9

Percent of sample not sieved 1/2" or over
3.1%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 120
LOCATION:	DUNCAN - FRASER'S
WELL NO.	120130
SAMPLED BY:	
SIEVE ANALYSIS BY:	BRANDON
DATE:	20 SEP. 75



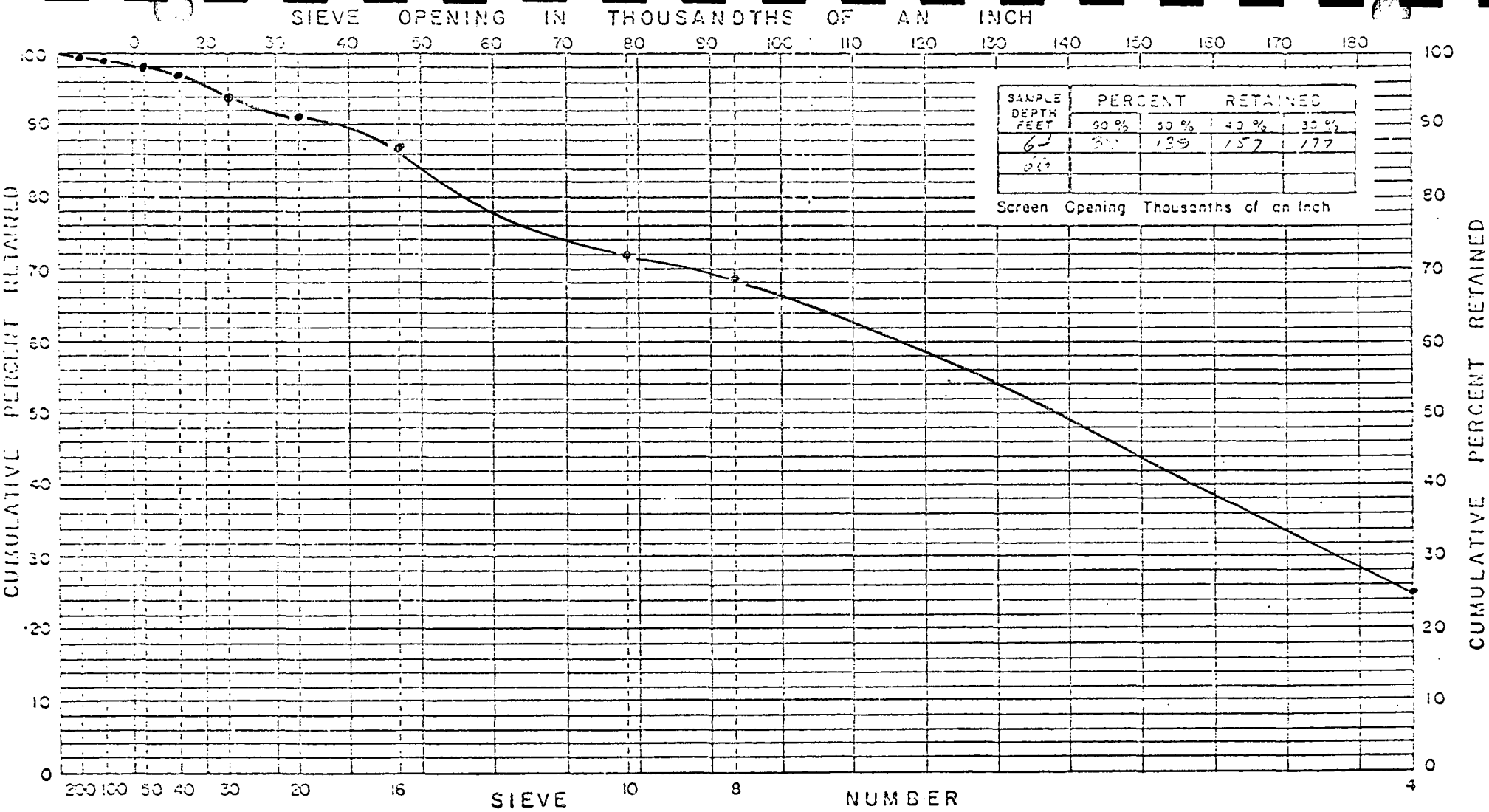
SAMPLE DEPTH #60 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
20	4	72	20.4
40	8	170	47.2
60	10	182	50.3
80	16	218	60.2
100	20	236	65.0
120	30	264	73.0
140	40	276	82.0
160	50	316	87.3
180	100	340	94.0
200	200	354	98.0
240	1200	362	99.7

Percent of sample not sieved $\frac{1}{2}$ " or over

SAMPLE DEPTH #62 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
20	4	152	27.0
40	8	260	64.0
60	10	282	67.8
80	16	444	78.8
100	20	464	82.3
120	30	484	85.7
140	40	522	89.0
160	50	522	92.5
180	100	530	97.5
200	200	556	98.6
240	1200	564	99.7

Percent of sample not sieved $\frac{1}{2}$ " or over

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRIBUTOR
LOCATION:	DUNCAN - FRASER
WELL NO.	1-122130
SAMPLED BY:	SHAW, J. H.
SIEVE ANALYSIS BY:	SHAW, J. H.
DATE:	30 SEPT 75



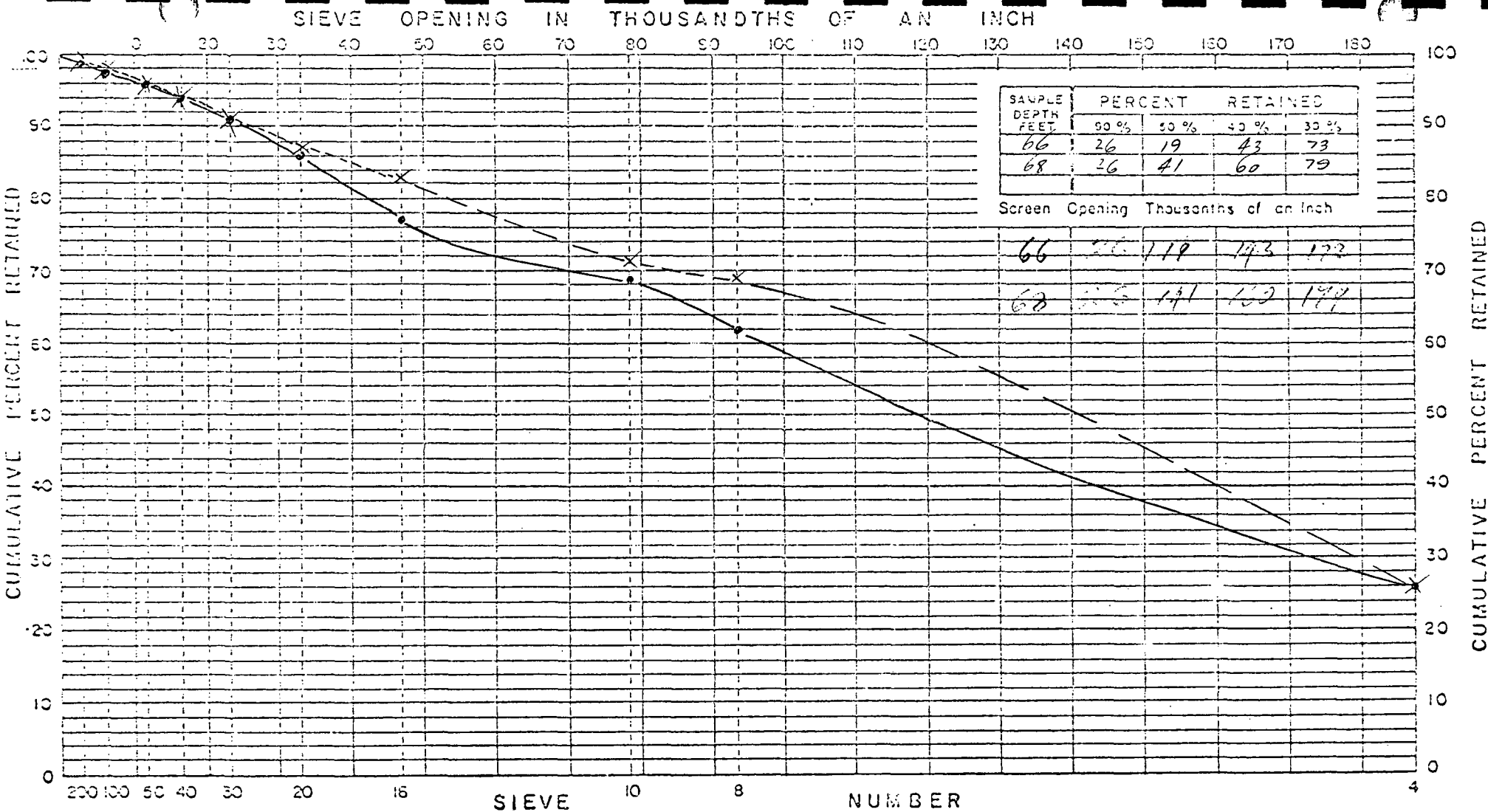
SAMPLE DEPTH 64 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	172		22.8
8	474		68.5
10	500		72.0
16	604		87.0
20	634		91.5
30	654		94.3
40	668		96.5
50	678		97.9
100	688		99.4
200	690		99.5

Percent of sample not sieved $\frac{1}{2}$ " or over
 870 55.6%

SAMPLE DEPTH 66 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4			
8			ON
10			
16			Next
20			
30			Next
40			
50			
100			
200			

Percent of sample not sieved $\frac{1}{2}$ " or over
 100%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	WENTHLEY 100
LOCATION:	DUNCRAIG - FRASERIE
WELL NO.	1400130
SAMPLED BY:	CHWILDT
SIEVE ANALYSIS BY:	STANNARD
DATE:	30. Sept. 1975



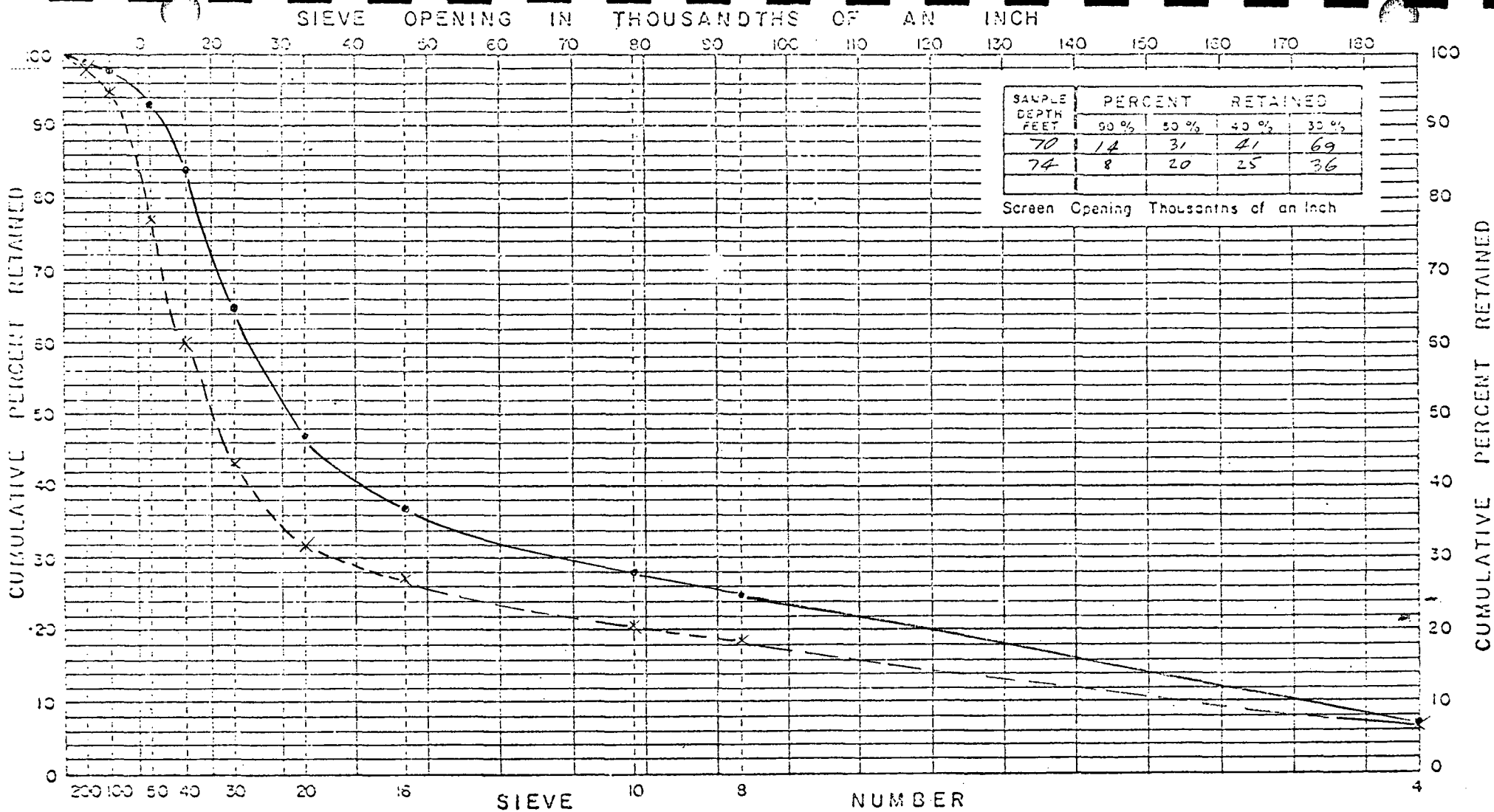
SAMPLE DEPTH 66 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	68	26.2	
8	162	62.4	
10	173	68.5	
16	204	77.3	
20	224	86.1	
30	236	90.9	
40	244	94.0	
50	250	96.2	
100	254	97.7	
200	256	98.5	

Percent of sample not sieved 1/2" or over
 PAN 260
 1.00 26.2% 10%

SAMPLE DEPTH 68 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	96	26.4	
8	250	68.7	
10	260	71.5	
20	302	82.9	
30	316	87.0	
40	330	90.7	
50	342	94.0	
100	356	98.0	
200	360	99.0	

Percent of sample not sieved 1/2" or over
 PAN 364
 1512 23.6% 1874

BRITISH COLUMBIA	
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES	
WATER RESOURCES SERVICE	
WATER INVESTIGATIONS BRANCH	
Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 60
LOCATION:	DUNCAN - FRASER'S
WELL NO.	1100130
SAMPLED BY:	CHAMBERS
SIEVE ANALYSIS BY:	STANNED
DATE:	1 OCT 1975



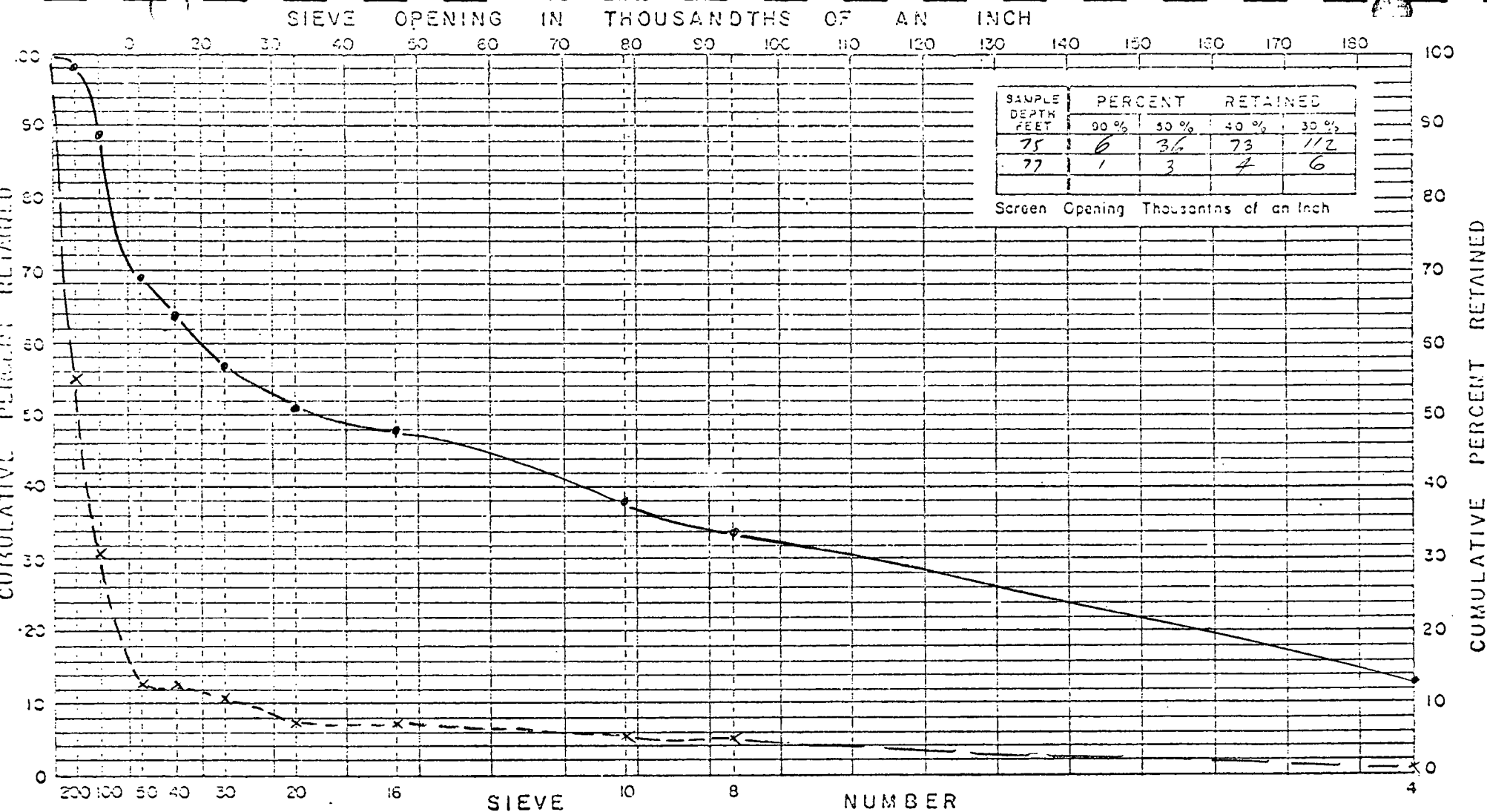
SAMPLE DEPTH 70 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	1/2	50	7.2
	6	170	24.6
	10	192	27.6
	16	270	39.0
	20	326	47.2
	30	426	60.5
	40	580	83.5
	60	640	91.5
	100	676	97.7
	200	684	98.9

Percent of sample not sieved 1/2" or over
 1.1% 57.2% 1.36

SAMPLE DEPTH 74 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	1/2	64	7.2
	6	166	18.6
	10	184	20.6
	16	214	27.1
	20	286	32.0
	30	388	43.5
	40	538	60.4
	60	688	77.1
	100	850	95.2
	200	876	98.2

Percent of sample not sieved 1/2" or over
 1.1% 57.2% 1.36
 778 16.7%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT: 61
LOCATION:	DUNCAN - FRISER'S
WELL NO.	1400130
SAMPLED BY:	CHIVOLICH
SIEVE ANALYSIS BY:	STANNARD
DATE:	1. OCT 1975



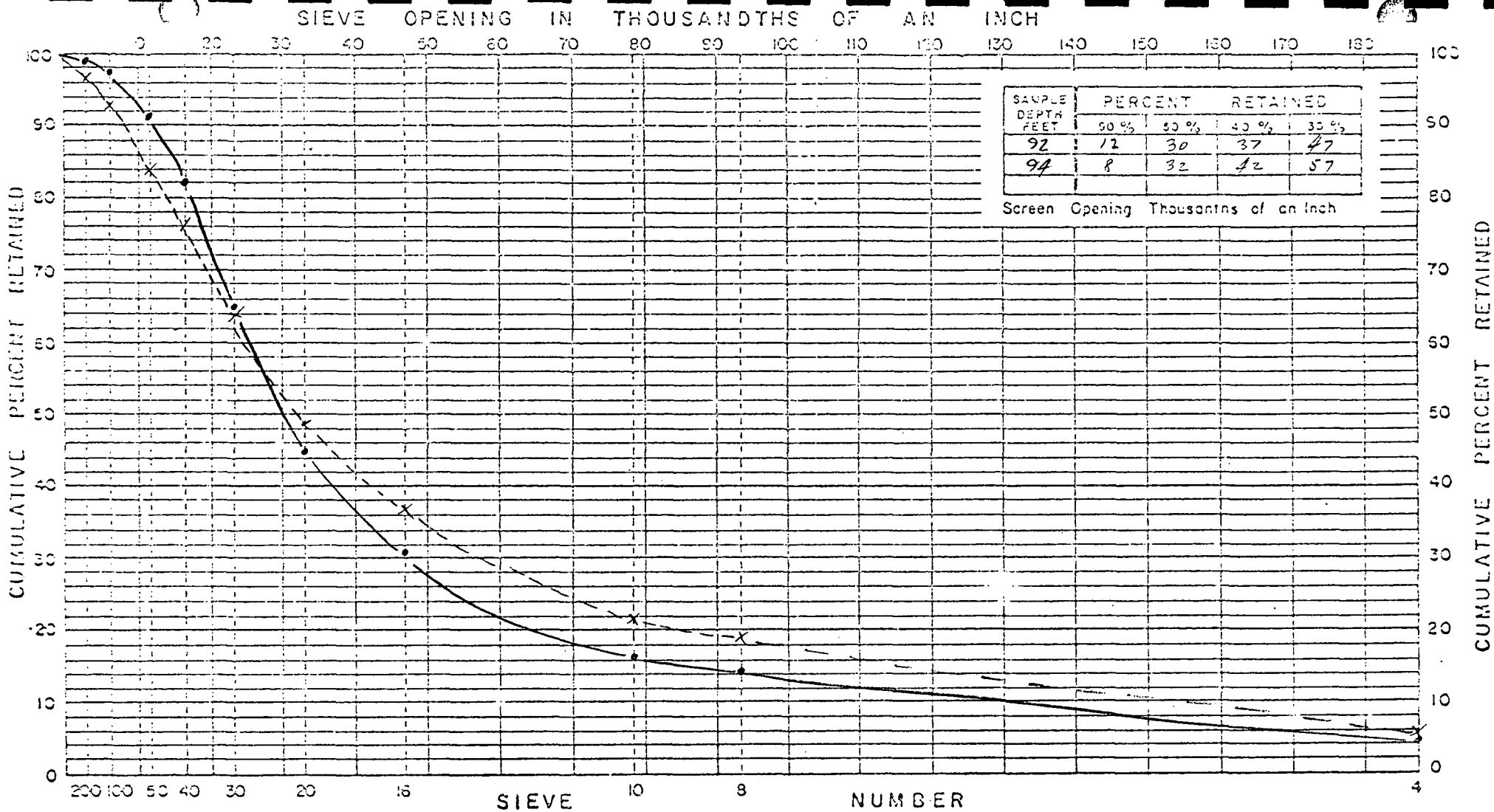
SAMPLE DEPTH 75 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
12	134		13.3
20	244		34.0
30	370		37.6
40	484		48.0
60	514		51.0
80	574		57.0
100	630		63.5
150	698		72.2
200	816		88.7
240	986		97.6

Percent of sample not sieved V2" or over

SAMPLE DEPTH 77 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
12	10		1.1
20	46		5.1
30	50		5.5
40	64		7.1
60	70		7.7
80	92		10.1
100	112		12.3
150	116		12.8
200	280		30.7
240	498		55.0

Percent of sample not sieved V2" or over

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT 20
LOCATION:	DUNCAN
WELL NO.	1400130
SAMPLED BY:	CHANDLER
SIEVE ANALYSIS BY:	CHANDLER
DATE:	1 APR 1975



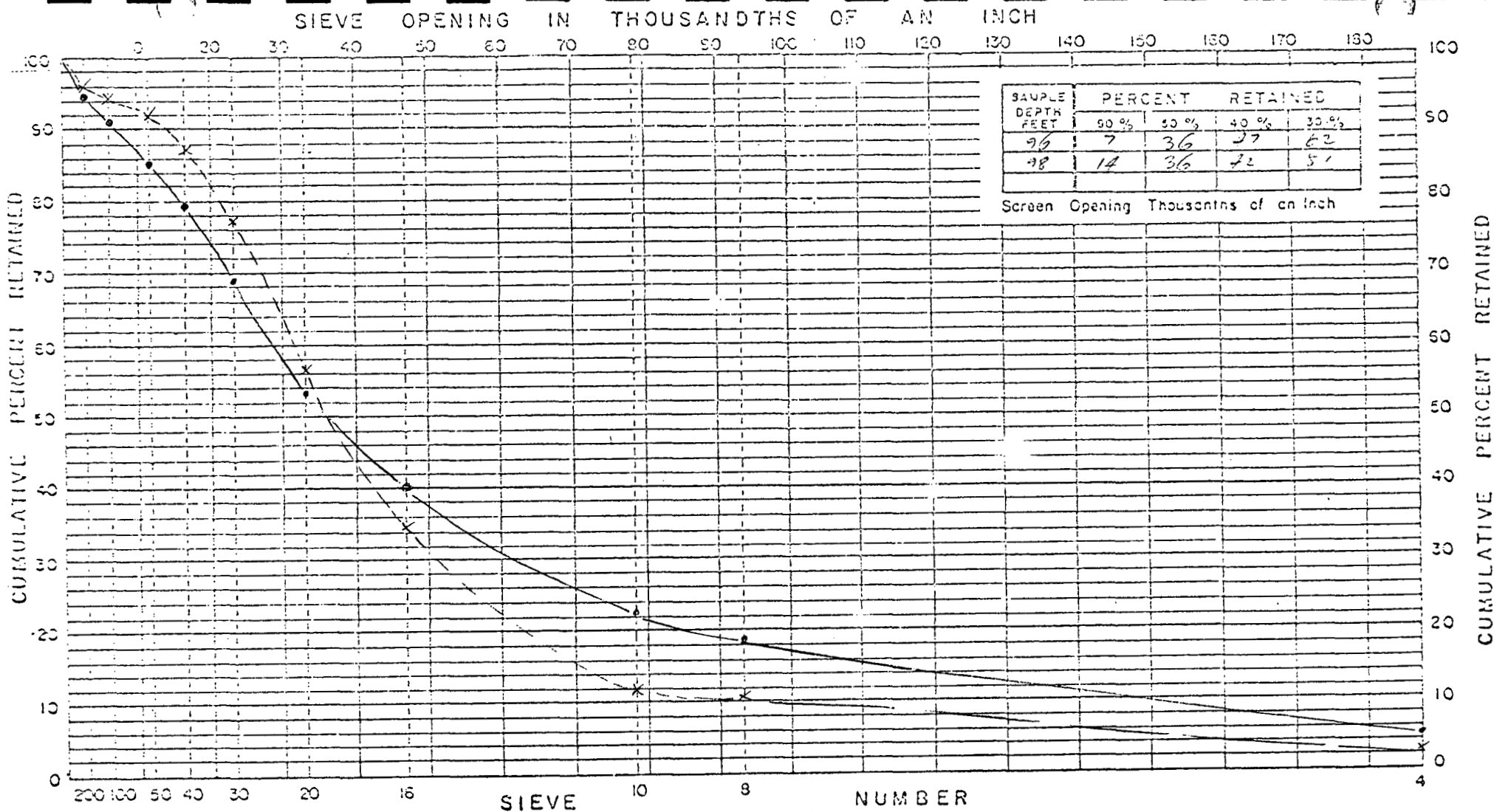
SAMPLE DEPTH 12 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	54	4.5
	8	192	14.3
	10	218	16.3
	16	416	31.4
	20	500	35.0
	30	874	65.5
	40	1048	82.1
	50	1250	91.5
	100	1300	97.5
	200	1320	99.0

Percent of sample not sieved 1/2" or over
 100 2.4% 1.5%

SAMPLE DEPTH 94 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
	4	100	5.6
	8	340	19.0
	10	396	22.2
	16	662	37.0
	20	874	48.8
	30	1138	63.6
	40	1360	76.0
	50	1500	84.2
	100	1670	93.2
	200	1730	96.5

Percent of sample not sieved 1/2" or over
 246 12.1% 203%

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTINENTAL
LOCATION:	DUNCAN - F.R. 100130
WELL NO.	1100130
SAMPLED BY:	CHWAKA
SIEVE ANALYSIS BY:	STANNARD
DATE:	21 - OCT - 1976



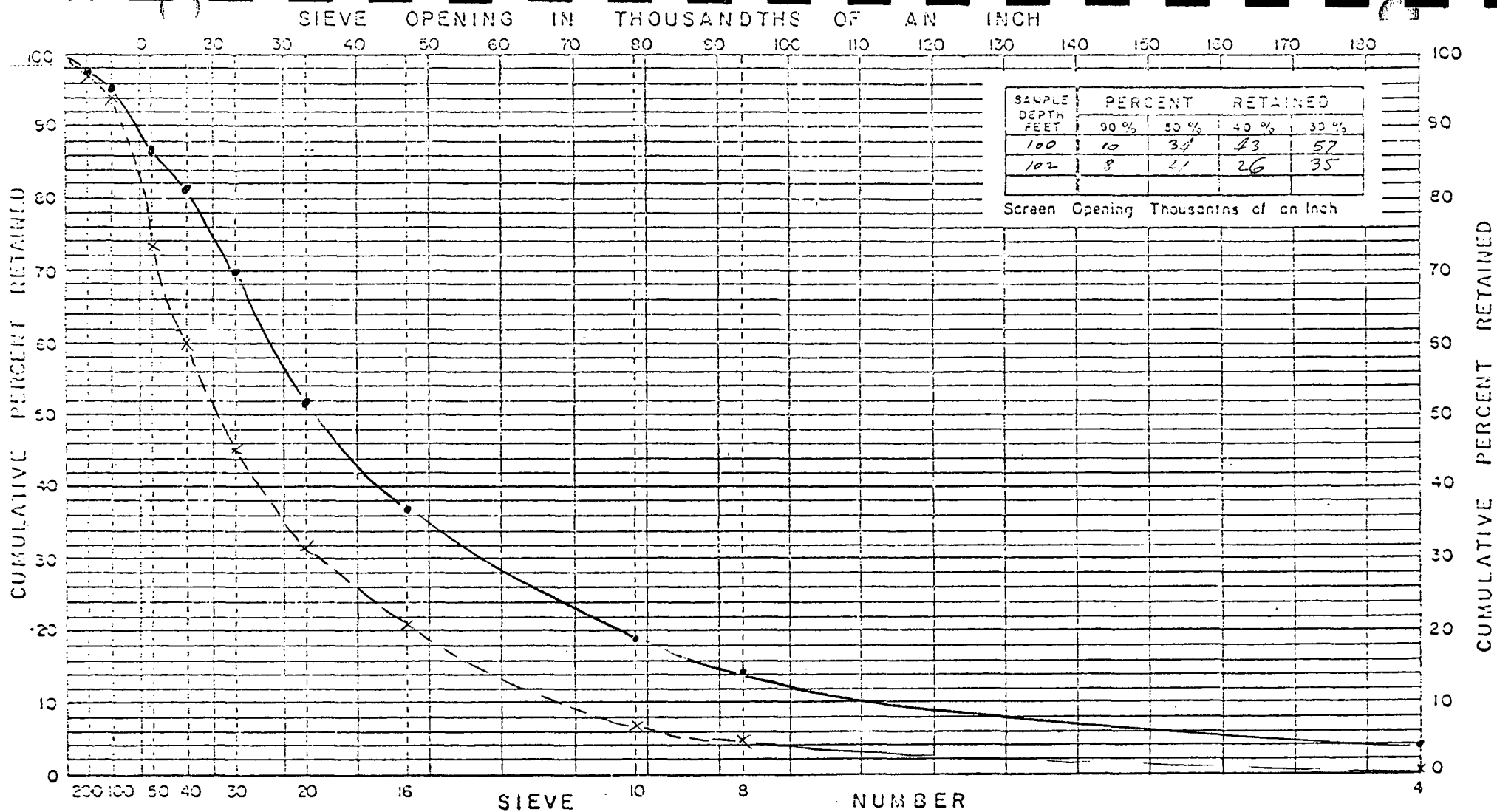
SAMPLE DEPTH 76 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
		76	5.7
		272	19.4
		322	22.8
		570	40.3
		754	53.1
		976	62.1
		1124	79.5
		1210	85.6
		1282	91.0
		1344	95.0

Percent of sample not sieved V2" or over

SAMPLE DEPTH 98 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
		114	2.8
		64	10.4
		120	12.2
		554	34.9
		896	56.5
		1232	77.6
		1390	87.6
		1454	91.7
		1500	94.5
		1526	96.0

Percent of sample not sieved V2" or over

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTINUED 6
LOCATION:	WATER 1 - 100000
WELL NO.:	100000
SAMPLED BY:	100000
SIEVE ANALYSIS BY:	100000
DATE:	100000



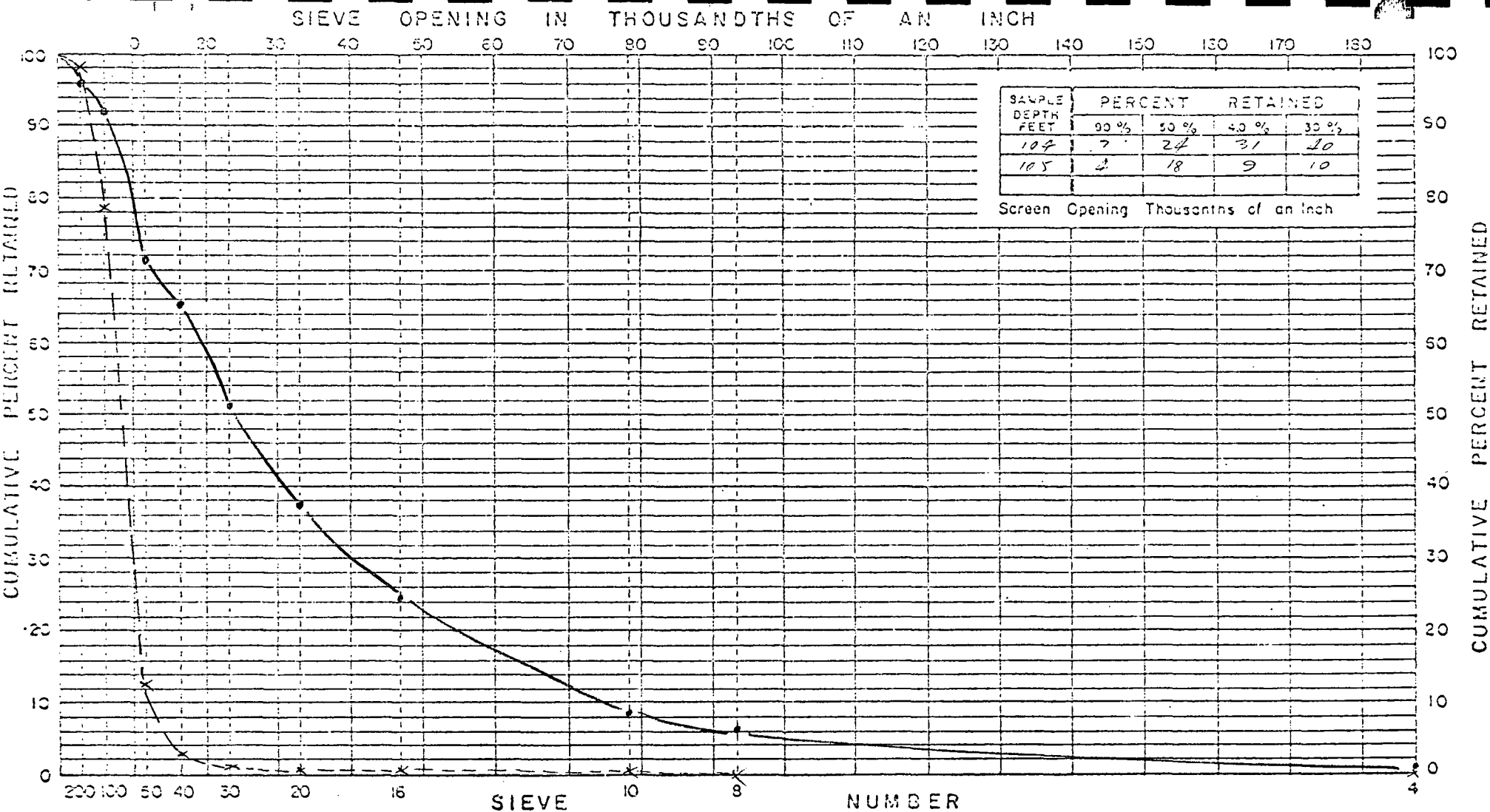
SAMPLE DEPTH FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
200	1	17	4.0
100	4	160	17.6
50	10	334	19.7
30	20	666	37.3
20	30	932	52.2
15	40	1244	69.2
10	60	1452	81.5
7.5	80	1556	87.0
5	100	1704	93.5
2.5	200	1746	97.2
1.5		1784	

Percent of sample not sieved 1/2" or over

SAMPLE DEPTH FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
200	1	10	0.55
100	4	88	4.9
50	10	124	6.9
30	20	376	20.8
20	30	572	31.6
15	40	824	45.6
10	60	1086	60.0
7.5	80	1326	73.5
5	100	1694	94.0
2.5	200	1750	97.0
1.5		1806	

Percent of sample not sieved 1/2" or over

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	Groundwater - 100
LOCATION:	Donkey Creek - 100
WELL NO.:	100-100
SAMPLED BY:	Chandler
SIEVE ANALYSIS BY:	Franklin
DATE:	10-10-1977



SAMPLE DEPTH 1011 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
11	12		0.9
8	92		6.2
10	112		8.5
16	246		24.7
20	500		37.9
30	680		51.5
40	862		65.3
60	1012		71.7
80	1214		92.2
100	1266		96.2

Percent of sample not sieved 1/2" or over 1.1%

SAMPLE DEPTH 105 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
11	0		0
8	0		0
10	2		0.2
16	6		0.48
20	8		0.61
30	14		1.1
40	34		2.7
60	154		12.4
80	1100		88.3
100	1220		98.2

Percent of sample not sieved 1/2" or over 1.1%

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH
Groundwater Section

SIEVE ANALYSIS

PROJECT: *Groundwater - 60*

LOCATION: *Duncan - 105*

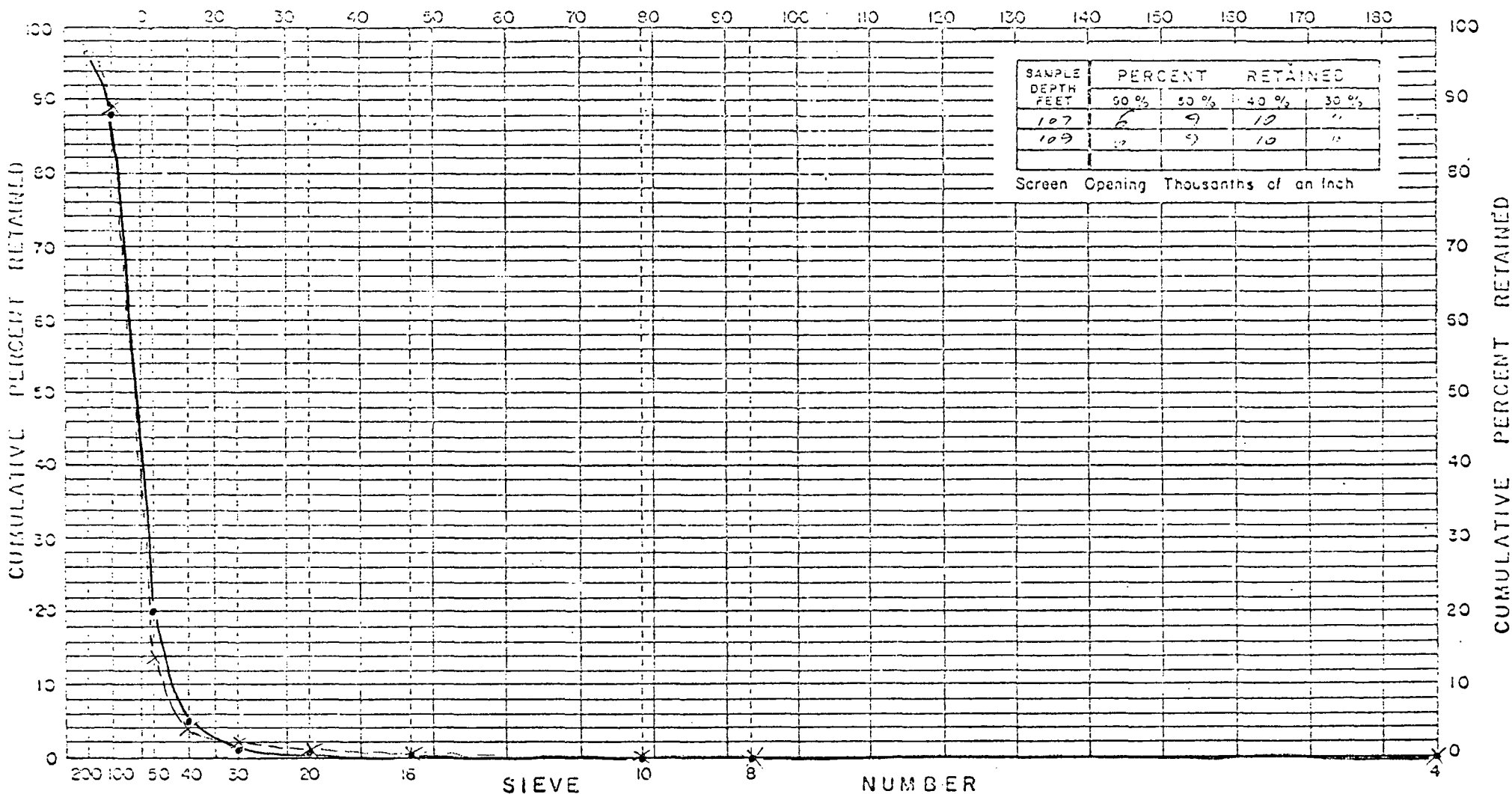
WELL NO. *1400120*

SAMPLED BY: *CHUCKER*

SIEVE ANALYSIS BY: *STANFORD*

DATE: *2 - OCT - 1975*

SIEVE OPENING IN THOUSANDTHS OF AN INCH



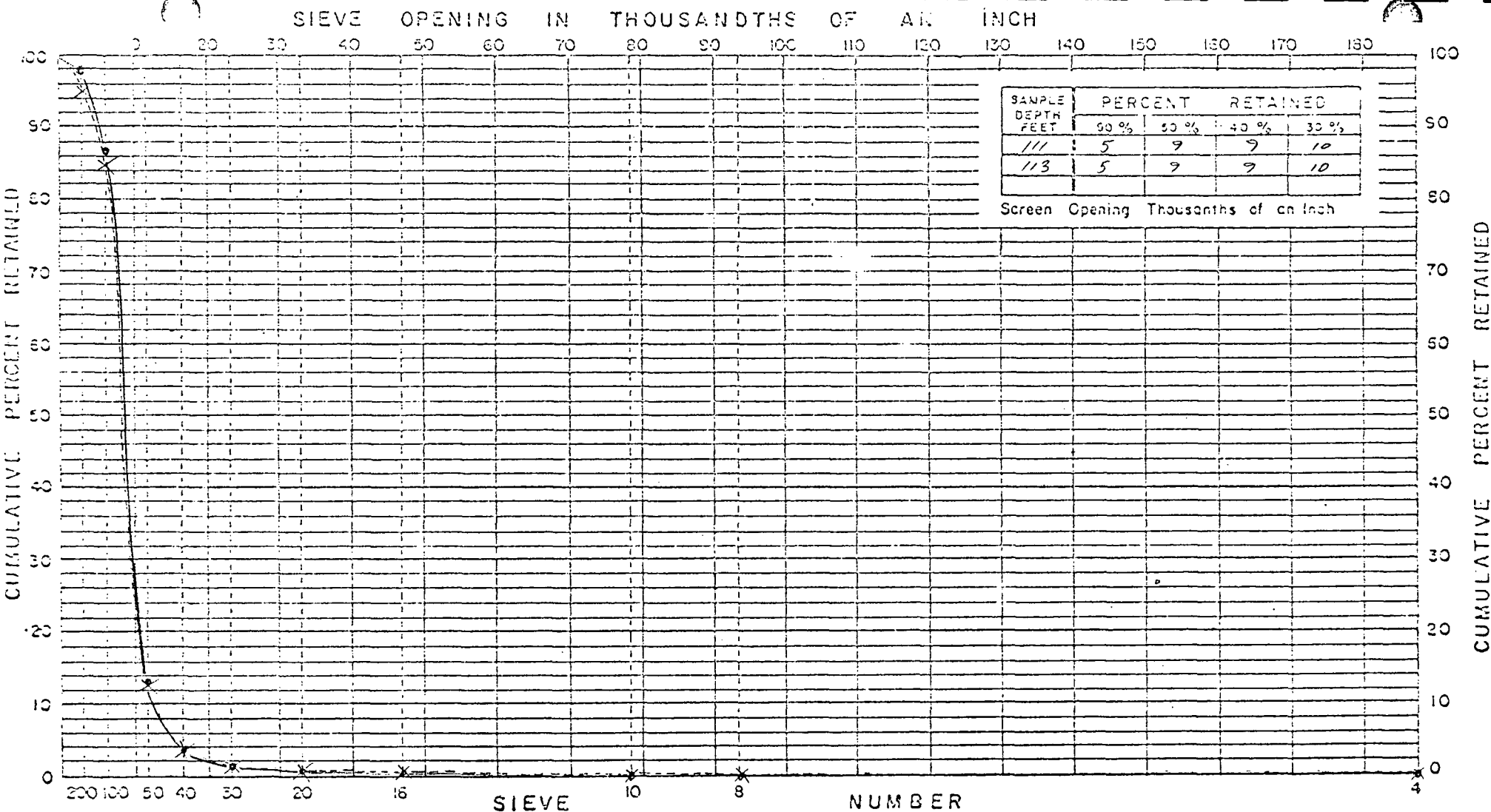
SAMPLE DEPTH 107 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	0	0	0
8	0	0	0
10	0	0	0
15	4	0.32	0.32
20	8	0.64	0.64
30	14	1.12	1.12
40	62	4.96	4.96
50	248	19.8	19.8
100	1102	88.5	88.5
200	1202	96.5	96.5

Percent of sample not sieved 1/2" or over
N/A %

SAMPLE DEPTH 109 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	0	0	0
8	0	0	0
10	2	0.13	0.13
15	10	0.66	0.66
20	16	1.06	1.06
30	28	1.81	1.81
40	66	4.20	4.20
50	214	14.2	14.2
100	1330	88.5	88.5
200	1478	98.3	98.3

Percent of sample not sieved 1/2" or over
N/A %

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	CONTRACT - 60
LOCATION:	DEVELOPMENT - 100
WELL NO.:	100
SAMPLED BY:	100
SIEVE ANALYSIS BY:	100
DATE:	100



SAMPLE DEPTH 111 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	0		1
8	0		1
10	0		1
16	4		2.27
20	12		0.825
30	26		1.79
40	55		3.85
50	200		13.75
100	15.04		87.0
200	1424		98.0

Percent of sample not sieved 1/2" or over
 PPN-1452
 111.6 %

SAMPLE DEPTH 113 FEET			
OPENING	RET. ON	WT. RET.	CUM. % RET.
4	0		0
8	0		0
10	0		0
16	6		0.4
20	10		0.7
30	20		1.3
40	54		3.5
50	140		12.5
100	1293		89.7
200	1452		95.4

Percent of sample not sieved 1/2" or over
 PPN-1528
 0 NIL %

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH Groundwater Section	
SIEVE ANALYSIS	
PROJECT:	Contract 60
LOCATION:	DONOHUE - FRASER'S
WELL NO.	1400430
SAMPLED BY:	CHANDLER
SIEVE ANALYSIS BY:	STANWELL
DATE:	2-OCT-1975

APPENDIX NO. 3

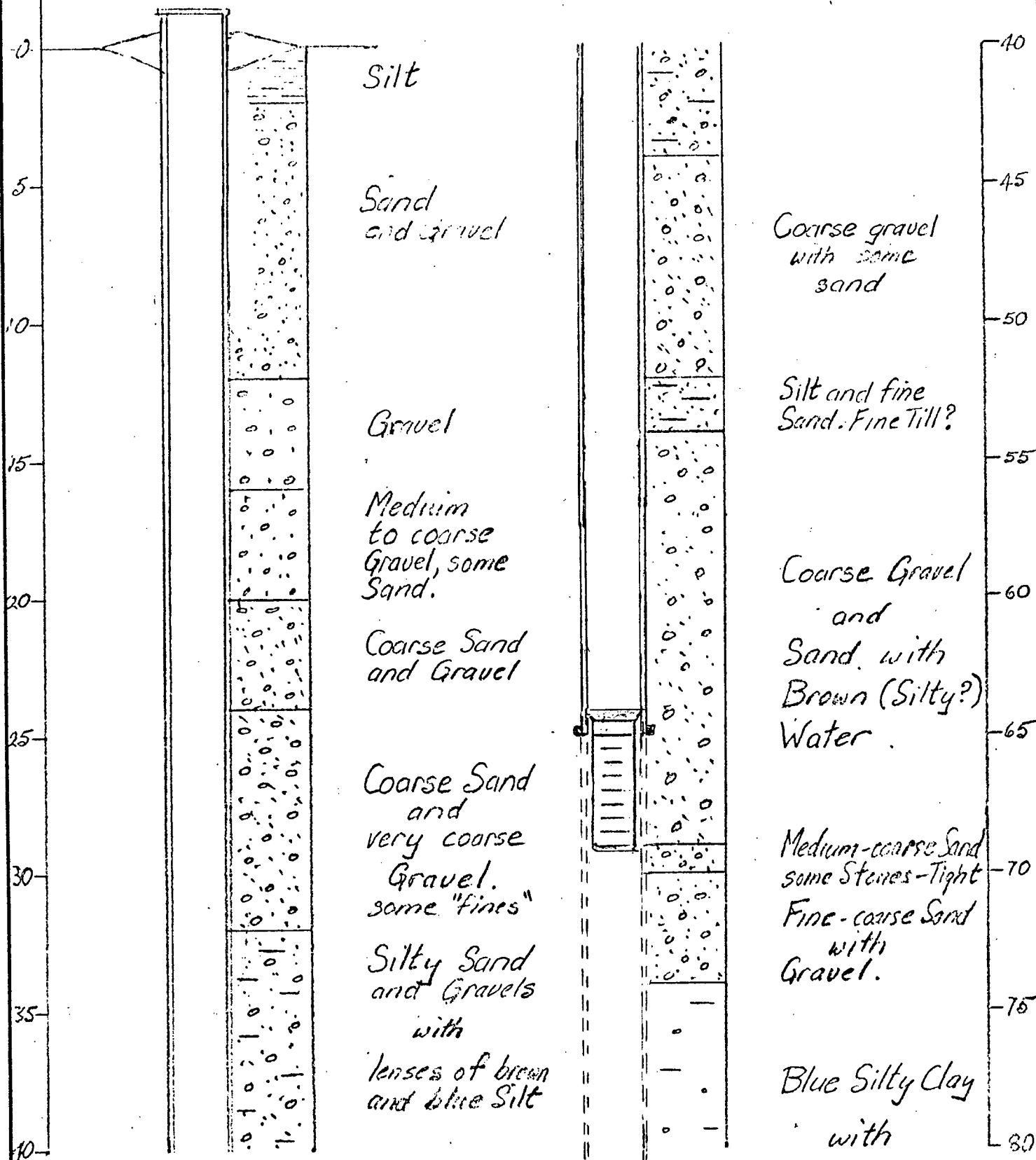
OBSERVATION WELL 131

WELL LOG

WELL DESIGN

Observation Well Log

Nº 1400131 Sheet 1 of 2



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

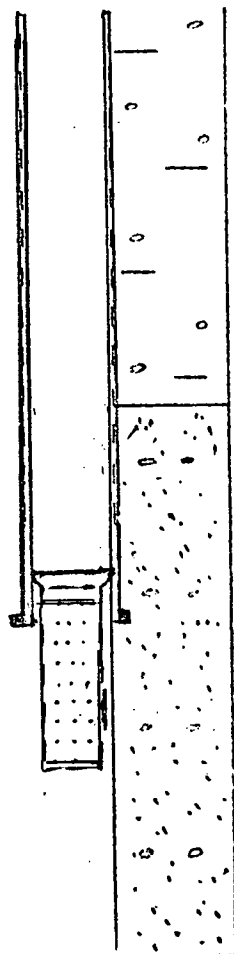
SCALE: VERT. 1 inch = 5 feet
HOR. _____

DATE
Dec 1975

J.C. Foweraker ENGINEER
FILE No. 0230015 DWG. No. 1/Appendix 3

Observation Well Log No 1400131 - Sheet 2 of 2

50
 85
 90
 95
 100
 105



some
 Pebbles

Fine-coarse
 blue sand
 layers with
 some gravel
 lenses.

BRITISH COLUMBIA
 DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
 WATER RESOURCES SERVICE
 WATER INVESTIGATIONS BRANCH

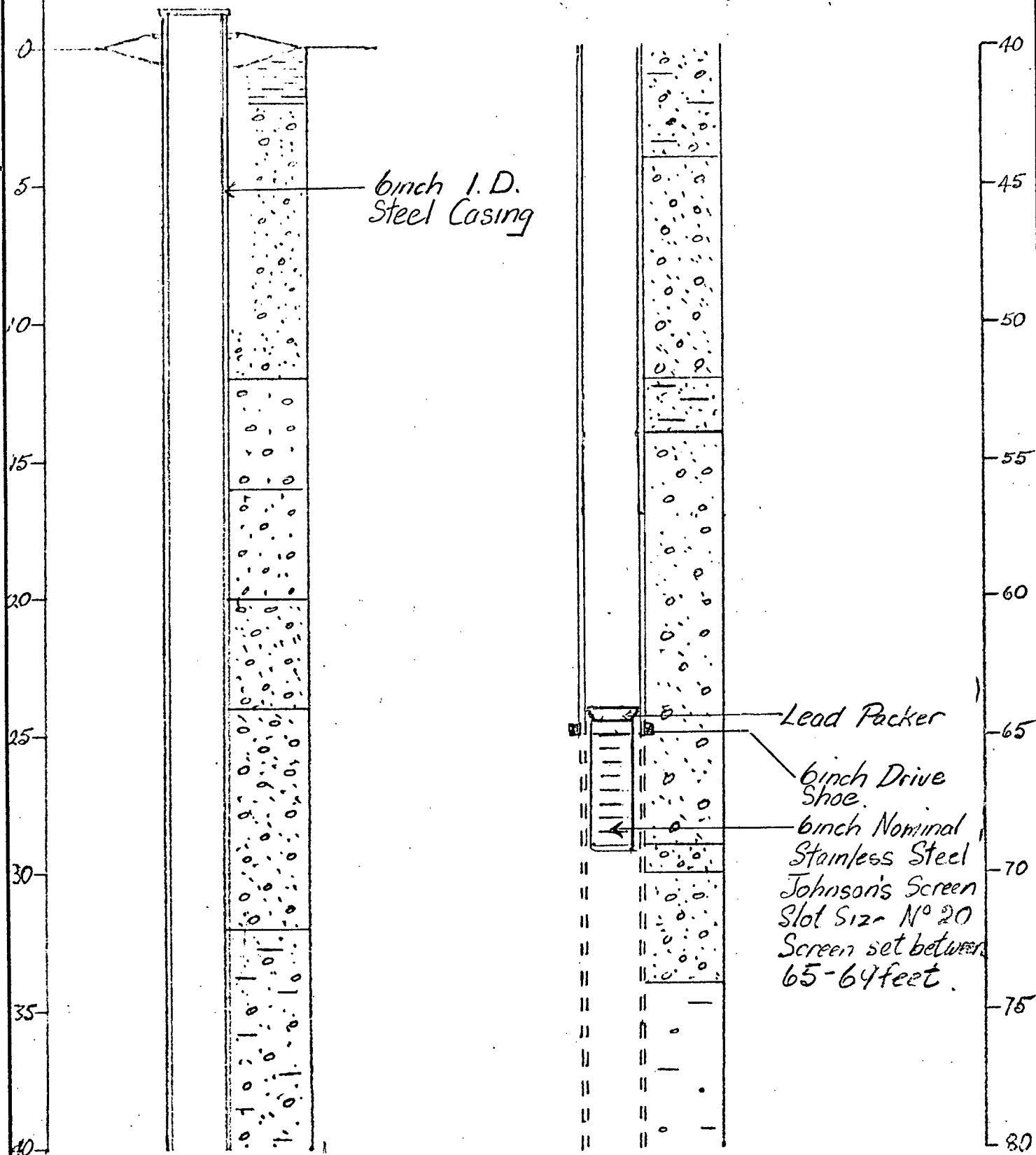
TO ACCOMPANY REPORT ON
 1975 Groundwater Potential Study
 South End
 District of North Cowichan

SCALE: VERT. 1 inch = 5 feet
 HOR. _____

DATE
Dec 1975

J.C. Fowler ENGINEER
 FILE No. 0229215 DWG. No. 2 Appendix 3

Observation Well Construction Details Nº140013! Middle Aquifer



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

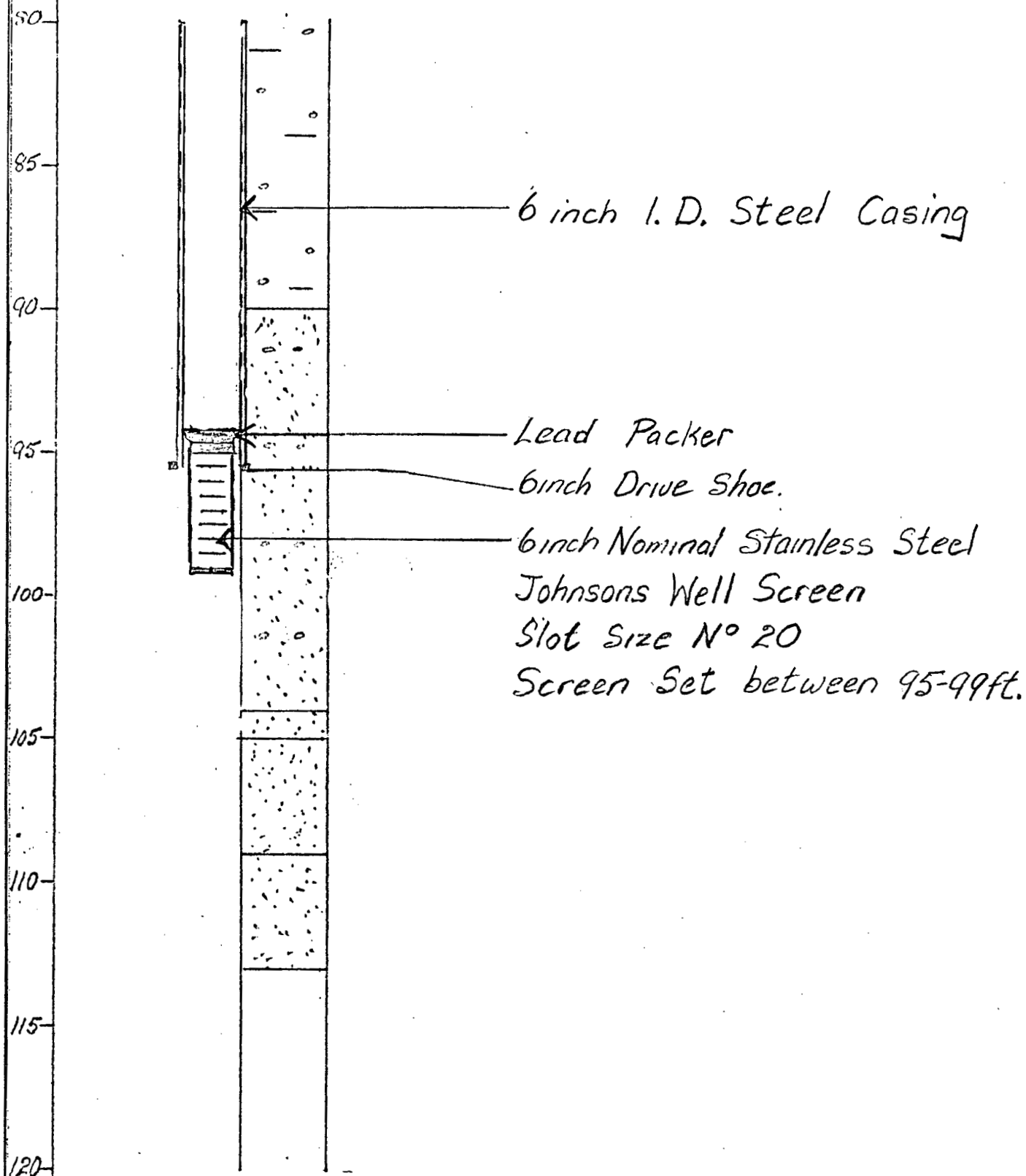
TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 feet
HOR. _____

DATE
Dec 1975

J.C. Foweraker ENGINEER
FILE No. 0270013 DWG. No. 3 Appendix 3

Observation Well Construction Details N°1400131 Lower Aquifer



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
1975 Groundwater Potential Study
South End
District of North Cowichan

SCALE: VERT. 1 inch = 5 feet
HOR. 1 inch = 5 feet

DATE

Dec 1975

J.C. [Signature]

ENGINEER

FILE No. 1400131 DWG. No. 4 Appendix 3

APPENDIX NO. 4

"LOWER AQUIFER"

PUMPING TESTS

WELL READINGS

AND

GRAPHICAL PLOTS

APPENDIX IV

READINGS TAKEN ON WELL NO. 130 DURING
"STEP DRAWDOWN" PUMPING TEST #1 (Lower Aquifer)

Contract #60
 Groundwater Research Project
 Cowichan River Aquifers - Duncan, B.C.

Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static = 4.18')	REMARKS
October 30, 1975				
10:00:00	0	4.18	0	Flow Meter = 961510
:30	.5	24.38	20.20	
1:00	1	25.09	20.91	400 USGPM ?
:30	1.5	24.89	20.71	
2:00	2	23.95	19.77	water grey
:30	2.5			
3:00	3	21.55	17.37	
:30	3.5	20.17	15.99	
4:00	4	19.56	15.38	water clear
:30	4.5	19.45	15.27	260 USGPM ?
5:00	5	19.52	15.34	
6:00	6	19.68	15.50	Oriface = 14 1/8"
7:00	7	19.80	15.62	
8:00	8	19.91	15.73	250 USGPM ?
9:00	9	20.01	15.83	
10:00	10	20.15	15.97	
12:00	12	20.16	15.98	241 USGPM
14:00	14	20.17	15.99	241 USGPM
16:00	16	20.31	16.13	241 USGPM
18:00	18	20.46	16.28	241 USGPM
20:00	20	20.48	16.30	241 USGPM Oriface 13 3/8"
25:00	25	20.59	16.41	241 USGPM Approx. 5 USGPM loss for pipe leakage
30:00	30	20.69	16.51	241 USGPM 11°C water temp.
35:00	35	20.76	16.58	241 USGPM
40:00	40	20.83	16.65	
45:00	45	20.85	16.67	241 USGPM
50:00	50	20.89	16.71	241 USGPM
11:00:00	60	20.89	16.71	
10:00	70	20.95	16.77	
20:00	80	21.03	16.85	241 USGPM
30:00	90	21.06	16.88	
40:00	100	21.07	16.89	241 USGPM
11:52:00	112	21.03	16.85	
00:00	120	21.01	16.83	
10:00	130	21.01	16.83	240 USGPM
20:00	140	21.03	16.85	
30:00	150	21.05	16.87	239 USGPM

APPENDIX IV

READINGS TAKEN ON WELL NO. 130 DURING
"STEP DRAWDOWN" PUMPING TEST #1 (Lower Aquifer)

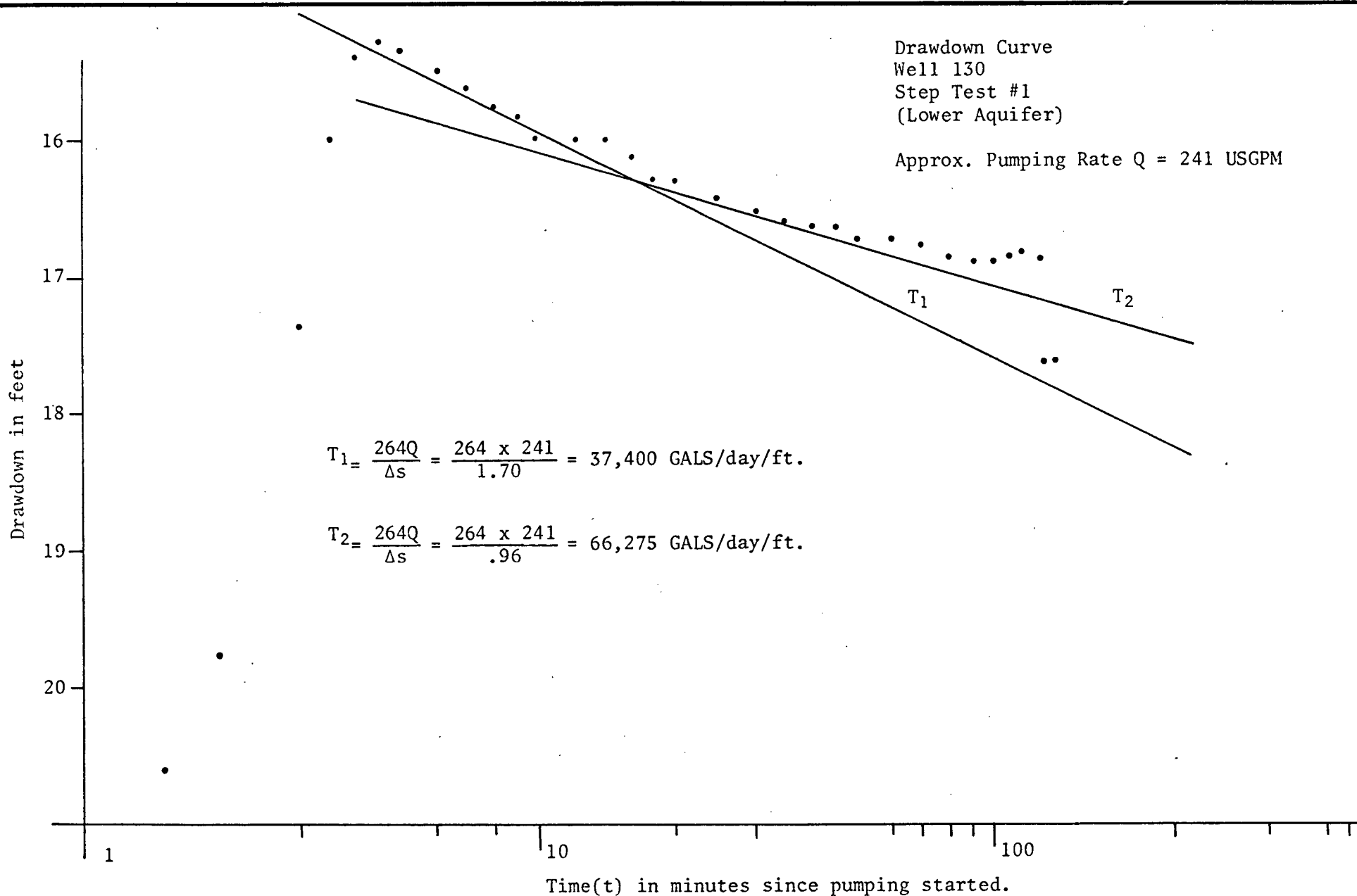
Contract #60

Groundwater Research Project

Cowichan River Aquifers - Duncan, B.C.

Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static = 4.18')	REMARKS																														
40:00	160	21.81	17.63	250 USGPM 249 USGPM Pump shut down *Note: Water level readings taken from a point 0.48' above casing. Total gals. pumped - 44,780 <u>Water Quality Analysis</u> <table><thead><tr><th></th><th>°C</th><th>Cond.</th><th>H₂S</th><th>Fe</th><th>Ph</th></tr></thead><tbody><tr><td>10:30</td><td>11</td><td>80</td><td>Nil</td><td>0.3</td><td>9.3/8.5/7.5+</td></tr><tr><td>11:30</td><td>11</td><td>80</td><td>Nil</td><td>0.22</td><td>7.9/9.2/8.5</td></tr><tr><td>12:30</td><td>11</td><td>80</td><td>Nil</td><td>0.22</td><td>8.0</td></tr><tr><td>15:30</td><td>11</td><td>80</td><td>Nil</td><td>0.27</td><td>8.0</td></tr></tbody></table>		°C	Cond.	H ₂ S	Fe	Ph	10:30	11	80	Nil	0.3	9.3/8.5/7.5+	11:30	11	80	Nil	0.22	7.9/9.2/8.5	12:30	11	80	Nil	0.22	8.0	15:30	11	80	Nil	0.27	8.0
	°C	Cond.	H ₂ S		Fe	Ph																												
10:30	11	80	Nil		0.3	9.3/8.5/7.5+																												
11:30	11	80	Nil		0.22	7.9/9.2/8.5																												
12:30	11	80	Nil	0.22	8.0																													
15:30	11	80	Nil	0.27	8.0																													
45:00	165	21.80	17.62																															
50:00	170																																	
5:00:00	180																																	



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown
HOR. As shown
DATE Dec. 1975
ENGINEER
FILE No. DWG. No. 1 Appendix 4

APPENDIX IV

RECOVERY READINGS IN WELL NO. 130 AFTER "STEP DRAWDOWN" PUMPING TEST

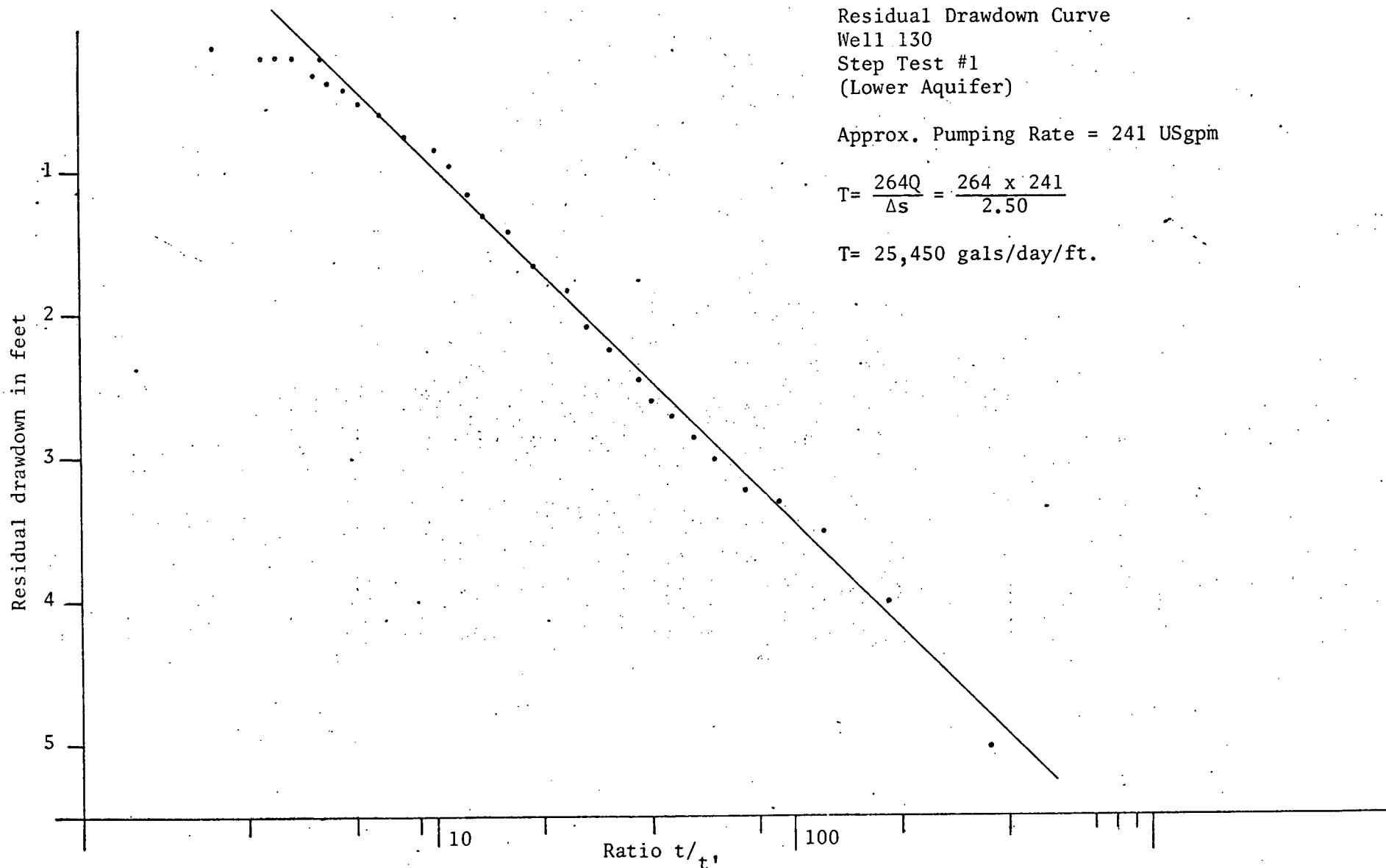
#1 (Lower Aquifer)

Contract #60

Groundwater Research Project

Cowichan River Aquifers - Duncan, B.C. Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped (in mins.)	Value of t/t'	Depth to water in well from top of casing in feet*	Residual drawdown in well in feet (static = 4.18')	Remarks
October 30, 1975						
00:00	180	0		21.84	17.66	<u>*Note</u> All water level readings taken from a point 0.48' above casing datum. Total pumping time = 180 min Total precipitation - nil
:30	180.5	.5	361	9.20	5.02	
1:00	181	1	181	8.20	4.02	
:30	181.5	1.5	121	7.69	3.51	
2:00	182	2	91	7.51	3.33	
:30	182.5	2.5	73	7.42	3.24	
3:00	183	3	61	7.19	3.01	
:30	183.5	3.5	52.42	7.05	2.87	
4:00	184	4	46	6.90	2.72	
:30	184.5	4.5	41	6.78	2.60	
5:00	185	5	37	6.63	2.45	
6:00	186	6	31	6.43	2.25	
7:00	187	7	26.71	6.26	2.08	
8:00	188	8	23.50	6.01	1.83	
9:00	189	9	21.00	5.97	1.79	
10:00	190	10	19	5.85	1.67	
12:00	192	12	16	5.59	1.41	
14:00	194	14	13.85	5.48	1.30	
16:00	196	16	12.25	5.32	1.14	
18:00	198	18	11	5.13	0.95	
20:00	200	20	10	5.02	0.84	
25:00	205	25	8.20	4.94	0.76	
30:00	210	30	7	4.78	0.60	
35:00	215	35	6.14	4.70	0.52	
40:00	220	40	5.50	4.62	0.44	
45:00	225	45	5	4.56	0.38	
50:00	230	50	4.60	4.50	0.32	
1 00:00	240	60	4	4.38	0.20	
10:00	250	70	3.57	4.38	0.20	
20:00	260	80	3.25	4.38	0.20	
30:00	270	90	3			



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Contract #60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT As shown

HOR As shown

J.C. Foweraker

FILE NO.

DWG. No. 2 Appendix 4

DATE

Dec. 1975

ENGINEER

APPENDIX IV

"STEP DOWN" PUMPING TEST #1 (Lower Aquifer) DATA FROM OBSERVATION WELL NO. 131

Contract #60
 Groundwater Research Project
 Cowichan River Aquifer - Duncan, B.C.

Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	Remarks
9:40 AM		7.20				Static water level
0:00	0					Pumping started
0:01	1	9.77	2.57			
0:01 ½	1½	13.21	6.01			
0:02	2	13.96	6.76			
0:02 ½	2½	14.08	6.88			
0:03	3	13.86	6.66			
0:03 ½	3½	13.75	6.55			
0:04	4	-				
0:04 ½	4½	13.60	6.40			
0:05	5	13.67	6.47			
0:06	6	13.77	6.57			
0:06 ½	6½	-				
0:07	7	13.92	6.72			
0:07 ½	7½	14.03	6.83			
0:08	8	-				
0:08 ½	8½	14.28	7.08			
0:09	9	-				
0:09 ½	9½	14.38	7.18			
0:10	10	-				
0:11 ½	11½	14.48	7.28			
0:13 ½	13½	14.59	7.39			
0:16	16	14.72	7.52			
0:18	18	14.83	7.63			
0:22	22	14.97	7.77			
0:25	25	15.04	7.84			
0:30	30	15.15	7.95			
0:35	35	15.20	8.00			
0:40	40	15.27	8.07			
0:45	45	15.30	8.10			
0:50	50	15.32	8.12			
1:00	60	15.38	8.18			
1:13	73	15.39	8.19			
1:15	80	15.42	8.22			
		7.20				
1:30	90	15.47	8.27			
1:40	100	15.47	8.27			

APPENDIX IV

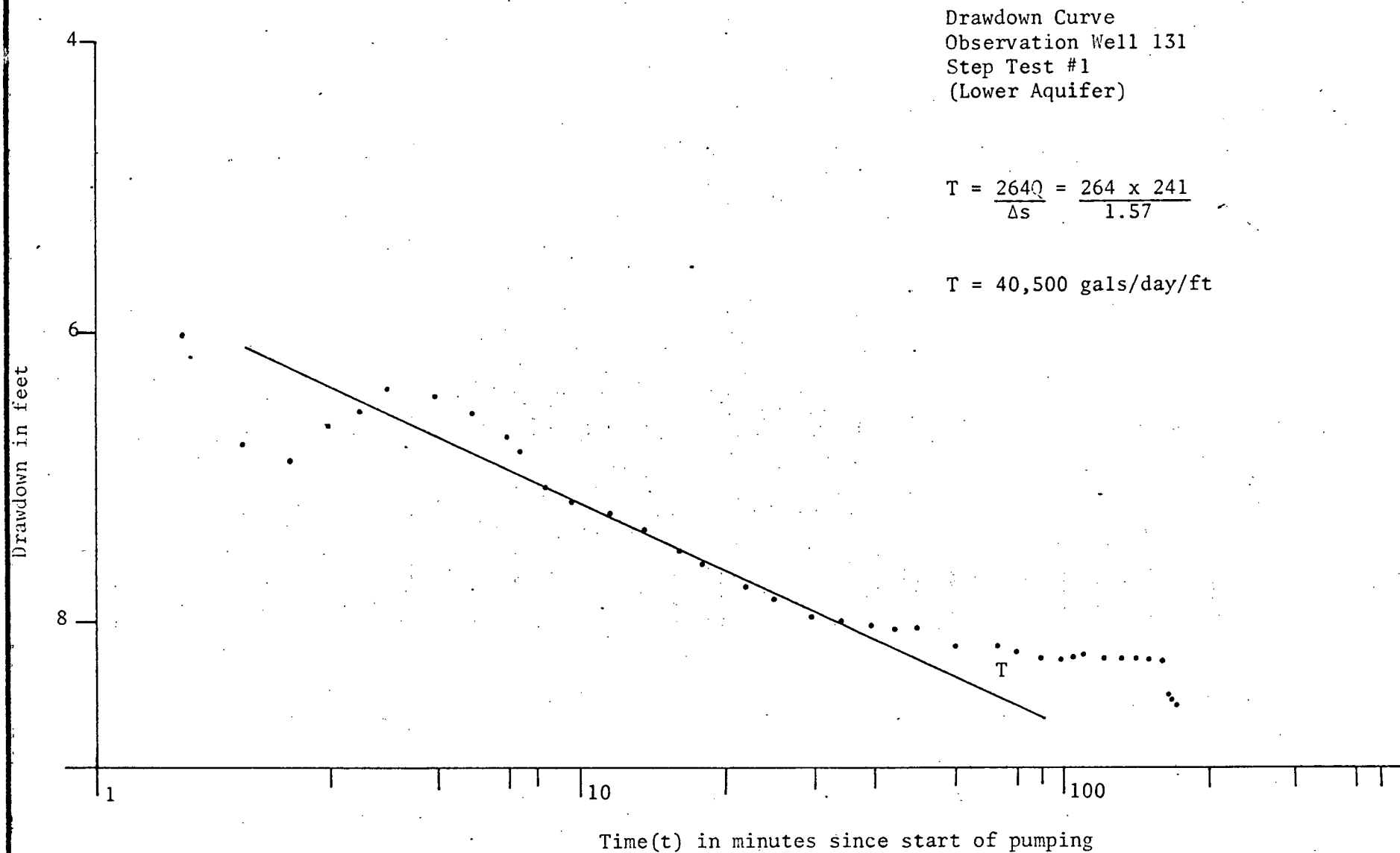
"STEP DOWN" PUMPING TEST #1 (Lower Aquifer) DATA FROM OBSERVATION WELL NO. 131

Contract #60
Groundwater Research Project
Cowichan River Aquifer - Duncan, B.C.

Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	Remarks
11:45	105	15.45	8.25			
11:50	110	15.43	8.23			
12:02 PM	122	15.46	8.26			
12:11	131	15.45	8.25			
12:20	140	15.44	8.24			
12:30	150	15.49	8.29			
12:37	157	15.48	8.28			
12:40	160	-				
12:44	164	15.72	8.52			
12:45	165	15.73	8.53			
12:47	167	15.75	8.55			
12:50	170	15.77	8.57			
12:52	172	15.77	8.57			
12:57	177	15.77	8.57			

*Note:
All water level readings
are taken from a point
4.37 feet above casing
datum.



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown	DATE
HOR. As shown	Dec. 1975
J.C. Foweraker	ENGINEER
FILE No.	DWG. No. 3 Appendix 4

APPENDIX IV

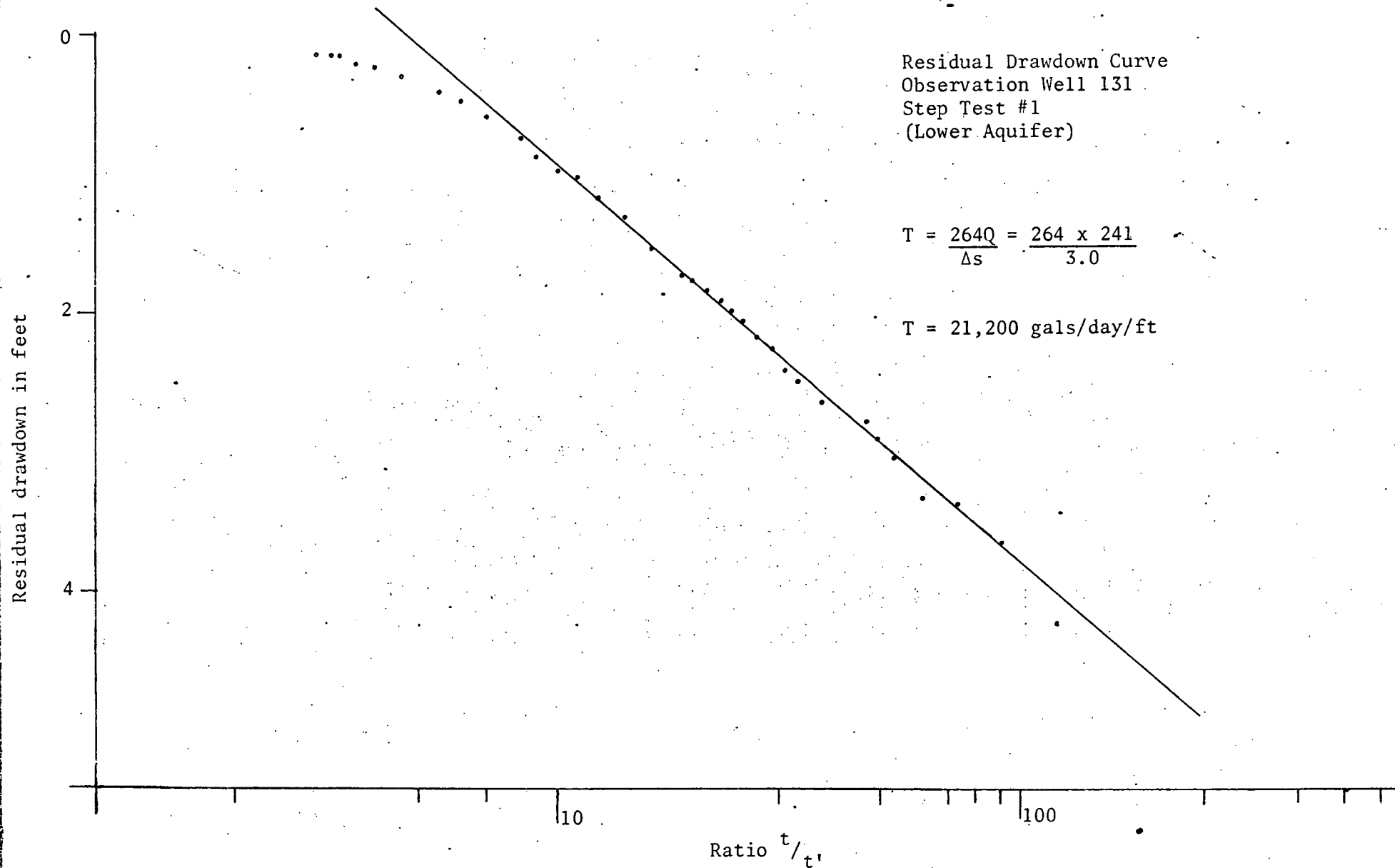
RECOVERY READINGS IN OBSERVATION WELL NO. 131 AFTER "STEP DRAWDOWN" PUMPING TEST

#1 (Lower Aquifer)
Contract #60
Groundwater Research Project
Cowichan River Aquifer - Duncan, B.C.

Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped (in mins.)	Value of t/t'	Depth to water in well from top of casing in feet*	Residual drawdown in well in feet (static =)	Remarks
				7.20		Static Water Level
13:00 PM	180	0	0			
13:00 ½	180.5	0.5	361.00	14.93	7.73	
13:01	181	1.0	181.00	12.86	5.66	
13:01 ½	181.5	1.5	121.00	11.42	4.22	
13:02	182	2.0	91.00	10.87	3.67	
13:02 ½	182.5	2.5	73.00	10.57	3.37	
13:03	183	3.0	61.00	10.42	3.32	
13:03 ½	183.5	3.5	52.42	10.26	3.06	
13:04	184	4.0	46.00	9.99	2.79	
13:04 ½	184.5	4.5	41.00	-		
13:05	185	5.0	37.00	9.83	2.63	
13:05 ½	185.5	5.5	33.72	9.67	2.47	
13:06	186	6.0	31.00	9.59	2.39	
13:06 ½	186.5	6.5	28.69	9.46	2.26	
13:07	187	7.0	26.71	9.36	2.16	
13:07 ½	187.5	7.5	25.00	9.28	2.08	
13:08	188	8.0	23.50	9.17	1.97	
13:08 ½	188.5	8.5	22.18	9.10	1.90	
13:09	189	9.0	21.00	9.03	1.83	
13:09 ½	189.5	9.5	19.95	8.96	1.76	
13:10	190	10.0	19.00	8.92	1.72	
13:12	192	12.0	16.00	8.71	1.51	
13:14	194	14.0	13.86	8.50	1.30	
13:16	196	16.0	12.25	8.35	1.15	
13:18	198	18.0	11.00	8.23	1.03	
13:20	200	20.0	10.00	8.15	0.95	
13:25	205	25.0	8.20	7.94	0.74	
13:30	210	30.0	7.00	7.79	0.59	
13:35	215	35.0	6.14	7.68	0.48	
13:40	220	40.0	5.50	7.60	0.40	
13:50	230	50.0	4.60	7.50	0.30	
14:00	240	60.0	4.00	7.43	0.23	
14:10	250	70.0	3.57	7.41	0.21	
14:20	260	80.0	3.25	7.35	0.15	
14:30	270	90.0	3.00	7.34	0.14	

*Note: All water level readings taken from a point 4.37 feet above casing datum



BRITISH COLUMBIA
 DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
 WATER RESOURCES SERVICE
 WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
 Contract #60
 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B.C.

SCALE VERT. As shown
 HOR. As shown

DATE
 Dec. 1975

FILE No. _____ DWG. No. 4 Appendix 4

ENGINEER

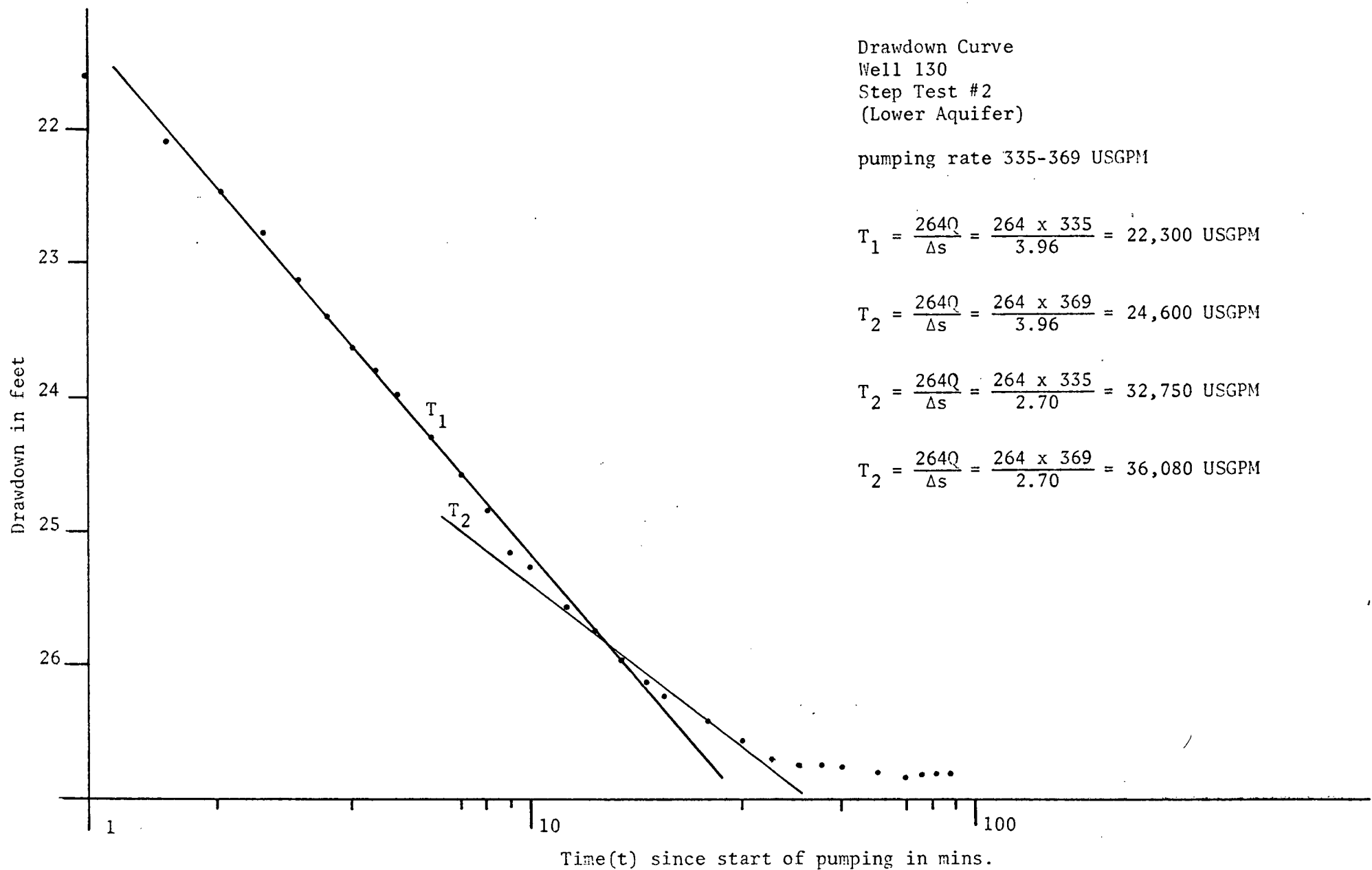
APPENDIX IV

READINGS TAKEN ON WELL NO. 130 DURING
"STEP DRAWDOWN" PUMPING TEST #2 (Lower Aquifer)

Contract #60
 Groundwater Research Project
 Cowichan River Aquifers, Duncan, B.C.

Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	REMARKS
October 30, 1975				
14:30:00		4.28	0	Original Static Level
:30	.5	25.73	21.45	
1:00	1	25.88	21.60	
:30	1.5	26.34	22.06	
2:00	2	26.72	22.44	335 USGPM
:30	2.5	27.05	22.77	
3:00	3	27.39	23.11	366 USGPM
:30	3.5	27.66	23.38	
4:00	4	27.89	23.61	369 USGPM
:30	4.5	28.07	23.79	366 USGPM
5:00	5	28.26	23.98	366 USGPM
6:00	6	28.58	24.30	
7:00	7	28.87	24.59	366 USGPM
8:00	8	29.13	24.85	
9:00	9	29.43	25.15	
40:00	10	29.54	25.26	
42:00	12	29.84	25.56	
44:00	14	30.03	25.75	
46:00	16	30.24	25.96	
48:00	18	30.39	26.11	363 USGPM
50:00	20	30.51	26.23	
55:00	25	30.72	26.44	363 USGPM
5:00:00	30	30.87	26.59	
05:00	35	31.00	26.72	
10:00	40	31.03	26.75	
15:00	45	31.06	26.78	Water Temp. 11°C 362 USGPM
20:00	50	31.07	26.79	
30:00	60	31.09	26.81	
40:00	70	31.11	26.83	
45:00	75	31.09	26.81	
50:00	80	31.10	26.82	
55:00	85	31.10	26.82	
6:00:00	90			Pump shut down



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WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Contract #60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown
HOR. As shown

DATE
Dec. 1975

J.C. Foweraker ENGINEER

FILE No. DWG. No. 5 Appendix 4

APPENDIX IV

RECOVERY READINGS TAKEN ON WELL NO. 130 AFTER "STEP DRAWDOWN" PUMPING TEST

(Lower Aquifer)

Contract #60

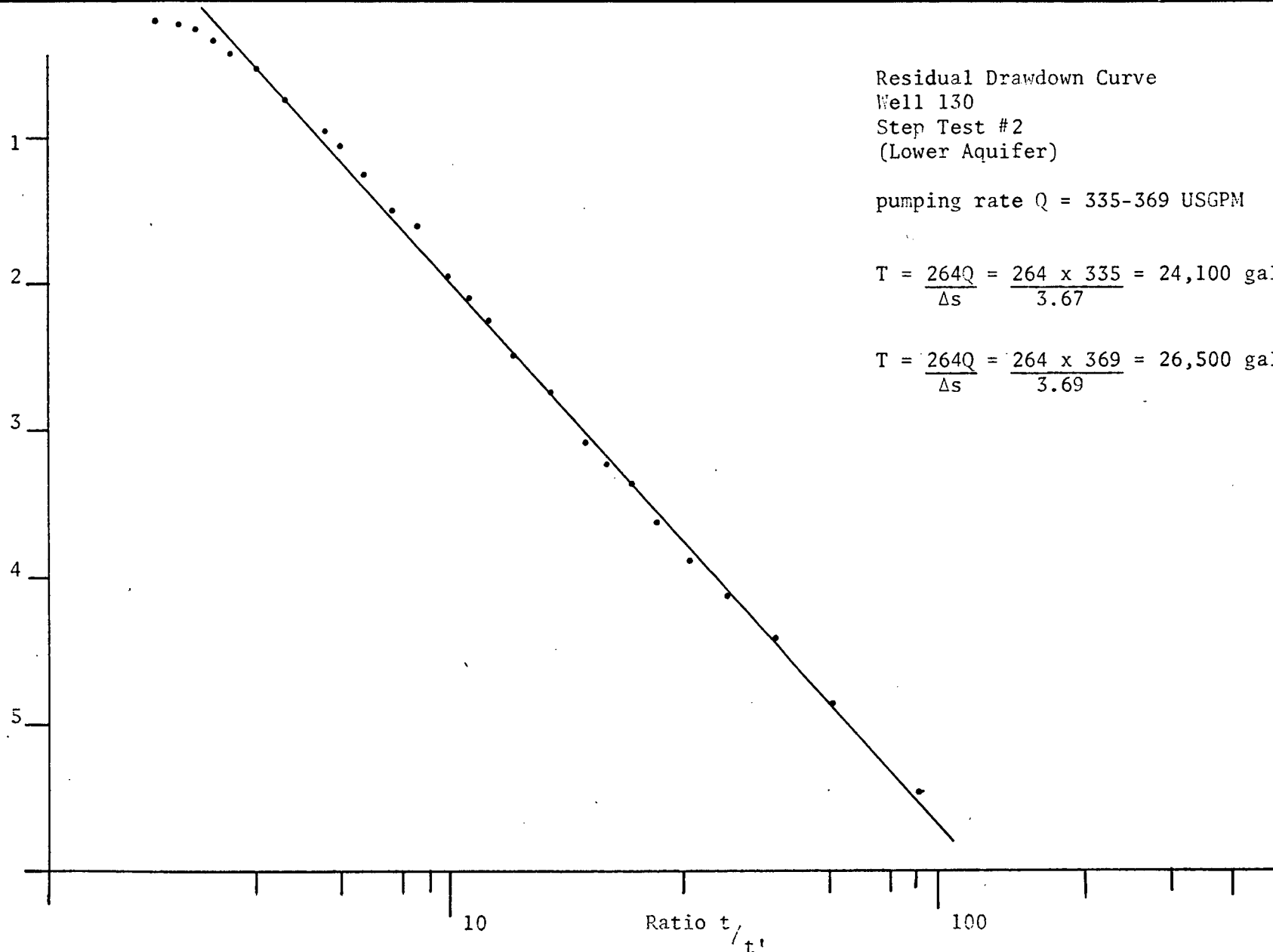
Groundwater Research Project

Cowichan River Aquifers - Duncan, B.C.

Date October 30, 1975

	Time (t) since start of pumping (in mins.)	Time (t') since pumping stopped (in mins.)	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well in feet (static = 4.28)	Remarks
October 30, 1975						*Note - Water level readings are taken from a point .45' above casing datum line.
0:00:00	90	0	0	31.10	26.82	
:30	90.5	.5	181	10.91	6.63	
1:00	91	1	91	9.75	5.47	
:30	91.5	1.5	61	9.15	4.87	
2:00	92	2	46	8.71	4.43	
:30	92.5	2.5	37	8.40	4.12	
3:00	93	3	31	8.17	3.89	
:30	93.5	3.5	26.71	7.90	3.62	
4:00	94	4	23.50	7.64	3.36	
:30	94.5	4.5	21	7.51	3.23	
5:00	95	5	19	7.38	3.10	
6:00	96	6	16	7.03	2.75	
7:00	97	7	13.85	6.78	2.50	
8:00	98	8	12.25	6.55	2.27	
9:00	99	9	11	6.39	2.11	
10:00	100	10	10	6.24	1.96	
12:00	102	12	8.50	5.90	1.62	
14:00	104	14	7.42	5.80	1.52	
16:00	106	16	6.62	5.55	1.27	
18:00	108	18	6	5.36	1.08	
20:00	110	20	5.50	5.24	0.96	
25:00	115	25	4.60	5.03	0.75	
30:00	120	30	4	4.83	0.55	
35:00	125	35	3.57	4.72	0.44	
40:00	130	40	3.25	4.64	0.36	
45:00	135	45	3	4.57	0.29	
50:00	140	50	2.80	4.53	0.25	
17:00:00	150	60	2.50	4.51	0.23	
18:00:00	210			4.33	.0.05	
19:00:00	270			4.31	0.03	
October 31, 1975						
0:00:00				4.32		

Residual Drawdown in feet



Residual Drawdown Curve
Well 130
Step Test #2
(Lower Aquifer)

pumping rate $Q = 335-369$ USGPM

$$T = \frac{264Q}{\Delta s} = \frac{264 \times 335}{3.67} = 24,100 \text{ gals/day/ft.}$$

$$T = \frac{264Q}{\Delta s} = \frac{264 \times 369}{3.69} = 26,500 \text{ gals/day/ft.}$$

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TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown	DATE
HOR. As shown	Dec. 1975
J.C. Foweraker ENGINEER	
FILE No.	DWG. No. 6 Appendix 4

APPENDIX IV

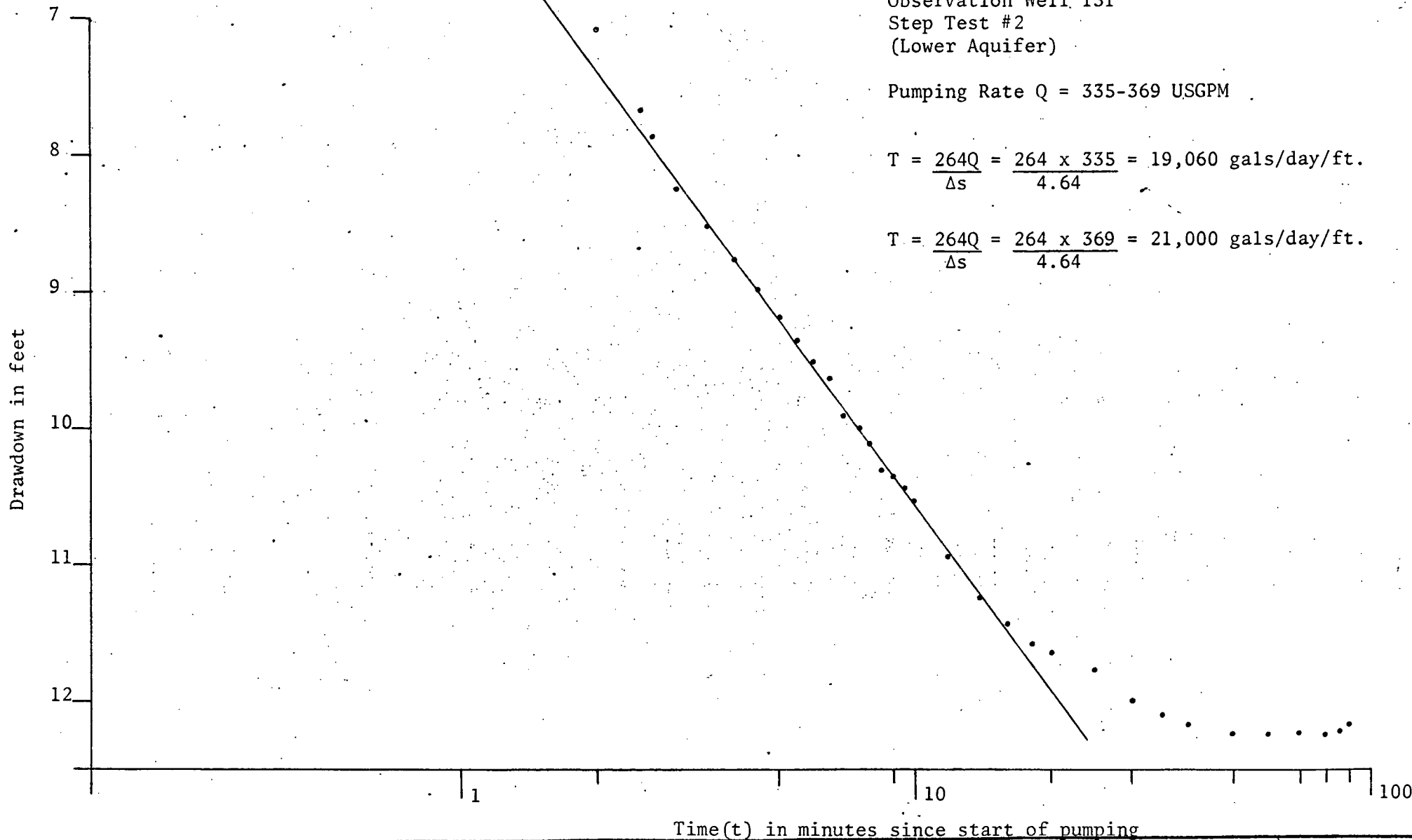
"STEP DOWN" PUMPING TEST #2 (lower aquifer) DATA FROM OBSERVATION WELL NO. 131

Contract #60
Groundwater Research Project
Cowichan River Aquifers - Duncan, B.C.

Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	Remarks
October 30, 1975						
14:30	0	7.34	0			New static level Pumping rate = 335-369 USgpm
14:30 1/2	1/2	10.12	2.78			
14:31	1	12.70	5.36			
14:31 1/2	1 1/2	14.00	6.66			
14:32	2	14.41	7.07			
14:32 1/2	2 1/2	15.00	7.66			
14:33	3	15.59	8.25			
14:33 1/2	3 1/2	15.86	8.52			
14:34	4	16.10	8.76			
14:34 1/2	4 1/2	16.30				
14:35	5	16.52	9.18			
14:35 1/2	5 1/2	16.70	9.36			
14:36	6	16.87	9.53			
14:36 1/2	6 1/2	16.98	9.64			
14:37	7	17.24	9.90			
14:37 1/2	7 1/2	17.33	9.99			
14:38	8	17.45	10.11			
14:38 1/2	8 1/2	17.65	10.31			
14:39	9	17.69	10.35			
14:39 1/2	9 1/2	17.77	10.43			
14:40	10	17.88	10.54			
14:42	12	18.27	10.93			
14:44	14	18.58	11.24			
14:46	16	18.72	11.38			
14:48	18	18.92	11.58			
14:50	20	19.00	11.66			
14:55	25	19.12	11.78			
15:00	30	19.36	12.02			
15:05	35	19.46	12.12			
15:10	40	19.51	12.17			
15:20	50	19.58	12.24			
15:30	60	19.58	12.24			
15:40	70	19.59	12.25			
15:5	75	19.58	12.24			
15:50	80	19.58	12.24			
15:55	85	19.57	12.23			
16:00	90	19.52	12.18	Pump Shut Off		

*Note: All water level readings are taken from a point 4.37 feet above casing datum.



BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	TO ACCOMPANY REPORT ON Contract 60 Groundwater Research Project Cowichan River Aquifers Duncan, B.C.	SCALE: VERT. As shown HOR. As shown	DATE Dec. 1975
		J.C. Foweraker ENGINEER	
		FILE No. _____ DWG. No. 7 Appendix 4	

APPENDIX IV

RECOVERY READINGS IN OBSERVATION WELL NO. 131 AFTER "STEP DRAWDOWN" PUMPING TEST

#2 (lower aquifer)
Contract #60
Groundwater Research Project
Cowichan River Aquifers - Duncan, B.C.

Date October 30, 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped (in mins.)	Value of t/t'	Depth to water in well from top of casing in feet*	Residual drawdown in well in feet (static) = 7.34')	Remarks
OCTOBER 30, 1975						
16:00	90	0	0	19.52	12.18	*Note: All water level readings taken from a point 4.37 feet above datum point.
16:00½	90.5	½	181	16.46	9.12	
16:01	91	1	91	14.04	6.70	
16:01½	91.5	1½	61	13.03	5.69	
16:02	92	2	46	12.33	4.99	
16:02½	92.5	2½	37	11.90	4.56	
16:03	93	3	31	11.57	4.23	
16:03½	93.5	3½	26.7	11.29	3.95	
16:04	94	4	23.5	11.10	3.76	
16:04½	94.5	4½	21.0	10.85	3.51	
16:05	95	5	19.0	10.70	3.36	
16:05½	95.5	5½	17.36	10.60	3.26	
16:06	96	6	16	10.35	3.01	
16:06½	96.5	6½	14.85	-	-	
16:07	97	7	13.86	10.07	2.73	
16:07½	97.5	7½	13.00	9.94	2.60	
16:08	98	8	12.25	9.82	2.48	
16:08½	98.5	8½	11.59	9.73	2.39	
16:09	99	9	11.00	9.63	2.29	
16:09½	99.5	9½	10.47	9.54	2.20	
16:10	100	10	10.00	9.53	2.19	
16:12	102	12	8.5	9.14	1.80	
16:14	104	14	7.43	8.91	1.57	
16:16	106	16	6.62	8.68	1.34	
16:18	108	18	6.00	8.52	1.18	
16:20	110	20	5.50	8.39	1.05	
16:25	115	25	4.60	8.12	.81	
16:30	120	30	4.00	7.97	.63	
16:35	125	35	3.57	7.85	.51	
16:40	130	40	3.25	7.79	.45	
16:45	135	45	3.00	7.71	.37	
16:50	140	50	2.80	7.67	.33	
17:00	150	60	2.50	7.59	.25	
17:10	160	70	2.28			
17:20	170	80	2.12			
18:00	210	120	1.75	7.44	.10	
19:00	270	180	1.50	7.41	.07	
Oct. 31, 1975 @ 1200 hrs. - .				7.47		

Residual Drawdown in feet

Residual Drawdown Curve
Observation Well 131
Step Test #2
(Lower Aquifer)

$$T = \frac{264Q}{\Delta s} = \frac{264 \times 335}{4.37} = 20,200 \text{ gals/day/ft}$$

$$T = \frac{264Q}{\Delta s} = \frac{264 \times 369}{4.37} = 22,300 \text{ gals/day/ft.}$$

Ratio t/t'

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TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River
Duncan, B.C.

SCALE: VERT. As shown
HOR. As shown

J.C. Foweraker

FILE No.

DWG. No. 8 Appendix 4

DATE

Dec. 1975

ENGINEER

APPENDIX 4

Groundwater Research Project
Cowichan River Aquifers - Duncan, B.C.
Constant Rate 24 hrs. Test
(Lower Aquifer)

PUMP TEST DATA

LOCATION	Contract 60 Well 130	PUMP SETTING	intake-88'
DRILLER	Drillwell Ent.	PUMPING RATE (S)	400 U.S.gpm
DEPTH OF WELL	104'	TOTAL TIME PUMPED	1440 mins.
DIA. OF WELL	8"	ORIGINAL STATIC LEVEL	3.92 #
ENGINEER	J. Foweraker	TOTAL GALS. PUMPED	m/a
PUMP USED	20 H P.	TOTAL DRAWDOWN	29.01'

TOTAL PRECIPITATION nil

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static = 4.18')	REMARKS
------	--	--	---	---------

November 4, 1975

2:30:00	0	3.92	0	Not as static water level
:30	.5	26.24	22.32	40" (Orifice)
1:00	1	27.55	23.62	at 9:54 AM was 3.88 feet.
:30	1.5	28.08	24.16	
2:00	2	28.54	24.62	
:30	2.5	28.93	25.01	
3:00	3	29.19	25.27	
:30	3.5	29.46	25.54	
4:00	4	29.59	25.67	
:30	4.5	29.82	25.90	
5:00	5	29.90	25.98	
6:00	6	30.20	26.28	40" (Orifice)
7:00	7	30.58	26.66	
8:00	8	30.74	26.82	
9:00	9	30.93	27.01	
40:00	10	31.11	27.19	
42	12	31.46	27.54	
44	14	31.62	27.70	
46	16	31.82	27.90	
48	18	32.01	28.09	40" (Orifice)
50	20	32.11	28.19	
55	25	32.31	28.39	39 7/8" (Orifice)
13:00:00	30	32.50	28.58	40" (Orifice)
10	40	32.58	28.66	
15	45	32.70	28.78	
20	50	32.73	28.81	
30	60	32.81	28.89	
40	70	32.81	28.89	40" (Orifice)
50	80	32.88	28.96	
14:00:00	90	32.88	28.96	

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static = 4.18')	REMARKS
------	--	--	---	---------

10	100	32.88	28.96	
22	112	32.91	28.99	
25	115	32.91	28.99	
50	140	32.93	29.01	40" (Orifice)
5:20:00	170	32.94	29.02	
40	190	32.93	29.01	
6:15:00	225	32.94	29.02	

November 4, 1975

6:40:00	250	32.94	29.02	
17:05	275	32.93	29.01	
17:30	300	32.94	29.02	
17:55	325	32.93	29.01	Lab samples taken
18:20	350	32.93	29.01	Cond. 80 @ 12°C, pH 7.75
19:10	400	32.94	29.02	Fe 0.24, H ₂ S = 0
20:00	450	32.93	29.01	40" (Orifice)
20:50	500	32.93	29.01	
21:40	550	32.89	28.97	
22:30	600	32.84	28.92	Cond. 80 @ 12°C, pH 7.75
23:20	650	32.82	28.90	Fe 0.26, H ₂ S = 0
24:10	700	32.89	28.97	

November 5, 1975

01:00	750	32.85	28.93	40" (Orifice)
01:50	800	32.85	28.93	
02:40	850	32.86	28.94	
03:30	900	32.87	28.95	
04:20	950	32.86	28.94	
05:10	1000	32.86	28.94	
06:00	1050	32.86	28.94	40" (Orifice)
06:50	1100	32.87	28.95	
07:40	1150	32.87	28.95	
08:30	1200	32.90	28.98	
09:20	1250	32.89	28.97	
10:10	1300	32.89	28.97	
11:00	1350	32.90	28.98	40" (Orifice)

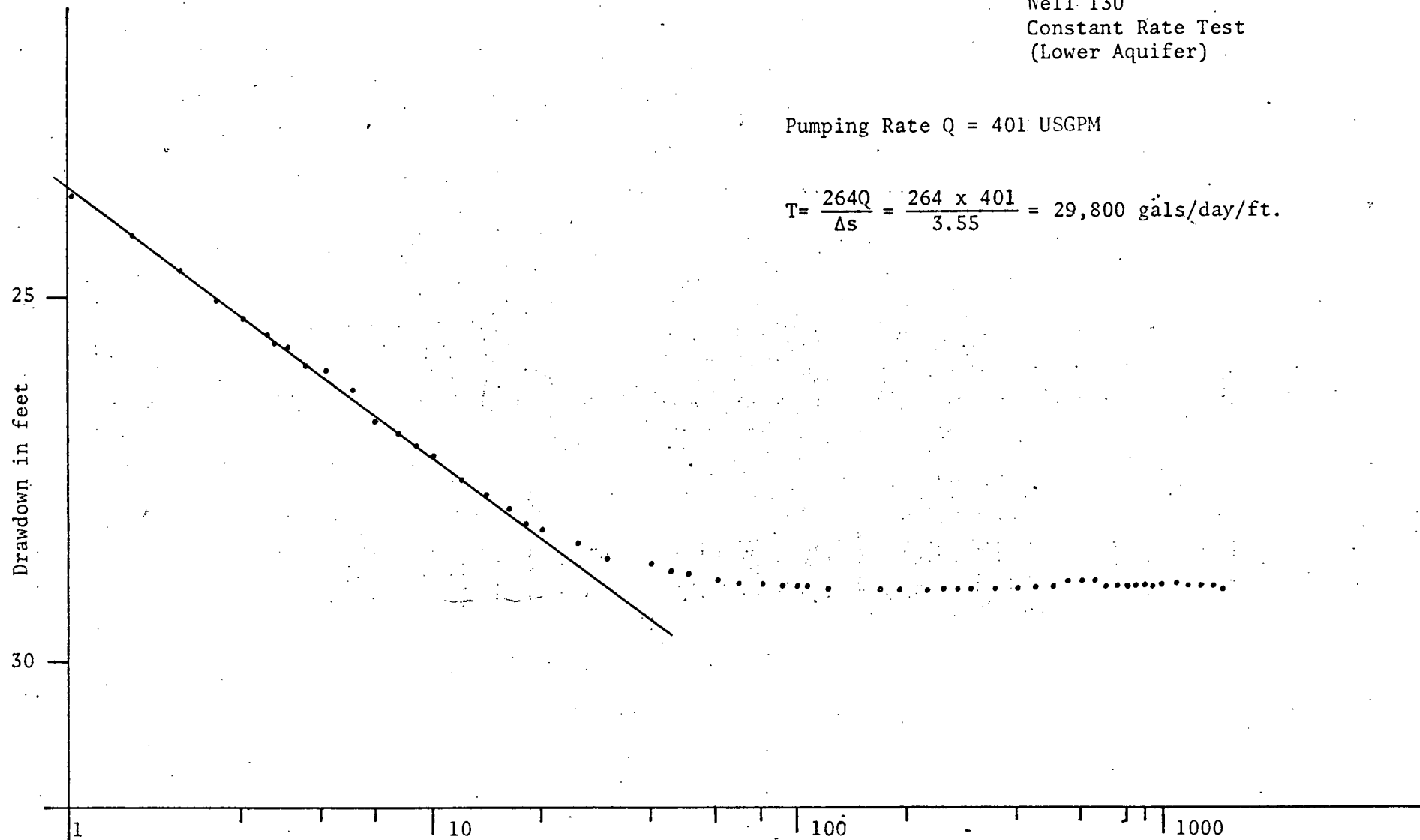
Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static	REMARKS
11:50	1400	32.90	28.98	Lab. samples taken at 12:00 Noon
12:30	1440	32.93	29.01	12:30 PM stop pump

Note all water level readings are taken from a point 0.65 feet above the casing datum.

Drawdown Curve
Well 130
Constant Rate Test
(Lower Aquifer)

Pumping Rate Q = 401 USGPM

$$T = \frac{264Q}{\Delta s} = \frac{264 \times 401}{3.55} = 29,800 \text{ gals/day/ft.}$$



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WATER RESOURCES SERVICE
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TO ACCOMPANY REPORT ON
Contract 60
GROUNDWATER RESEARCH PROJECT
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown
HOR. As shown

DATE
Dec. 1975

ENGINEER

FILE No. _____ DWG. No. 9 Appendix 4

APPENDIX IV

RECOVERY READINGS AFTER CONSTANT RATE PUMPING TEST ON WELL NO. 130

(Lower Aquifer)

Contract 60

Groundwater Research Project

Cowichan River Aquifers - Duncan, B.C. Date November 5, 6, 7, 10th

Time	Time (t) since start of pumping started in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet*	Residual drawdown in well in feet (static = 3.92')	Remarks
November 5, 1975						total pumping time = 1440 min.
12:30:00	1440	0	-	32.93	29.01	
12:30	1440.5	.5	2881.00	10.10	6.18	
13:00	1441	1.0	1441.00	8.91	4.99	
13:30	1441.5	1.5				
14:00	1442	2.0	721.00	8.45	4.53	
14:30	1442.5	2.5	577.00	8.05	4.13	
15:00	1443	3.0	481.00	7.80	3.88	
15:30	1443.5	3.5	412.42	7.57	3.65	
16:00	1444	4.0	361.00	7.33	3.41	
16:30	1444.5	4.5	321.00	7.11	3.19	
17:00	1445	5.0	289.00	6.96	3.04	
17:30	1446	6.0	241.00	6.67	2.75	
18:00	1447	7.0	206.71	6.38	2.46	
18:30	1448	8.0	181.00	6.15	2.23	
19:00	1449	9.0	161.00	5.95	2.03	
19:30	1450	10.0	145.00	5.79	1.87	
20:00	1452	12.0	121.00	5.53	1.61	
20:30	1454	14.0	103.85	5.27	1.35	
21:00	1456	16.0	91.00	5.12	1.20	
21:30	1458	18.0	81.00	4.94	1.02	
22:00	1460	20.0	73.00	4.86	.94	
22:30	1465	25.0	58.60	4.63	.61	
23:00:00	1470	30.0	49.00	4.48	.56	
00:00	1475	35.0	42.14	4.36	.44	
01:00	1480	40.0	37.00	4.20	.28	
02:00	1485	45.0	33.00	4.19	.27	
03:00	1490	50.0	29.80	4.18	.26	
04:00	1500	60.0	25.00	4.10	.18	
05:00	1510	70.0	21.57	4.09	.17	
06:00	1520	80.0	19.00	3.97	.05	
07:00:00	1530	90.0	17.00	4.03	.11	
08:00	1540	100.0	15.40	4.02	.10	
09:40	1560	120	13.00	4.01	.09	
10:14:35	1575	135	11.66	3.99	.07	
10:15:00	1600	160	10.00	3.96	.04	
10:15:25	1625	185	8.78	3.96	.04	

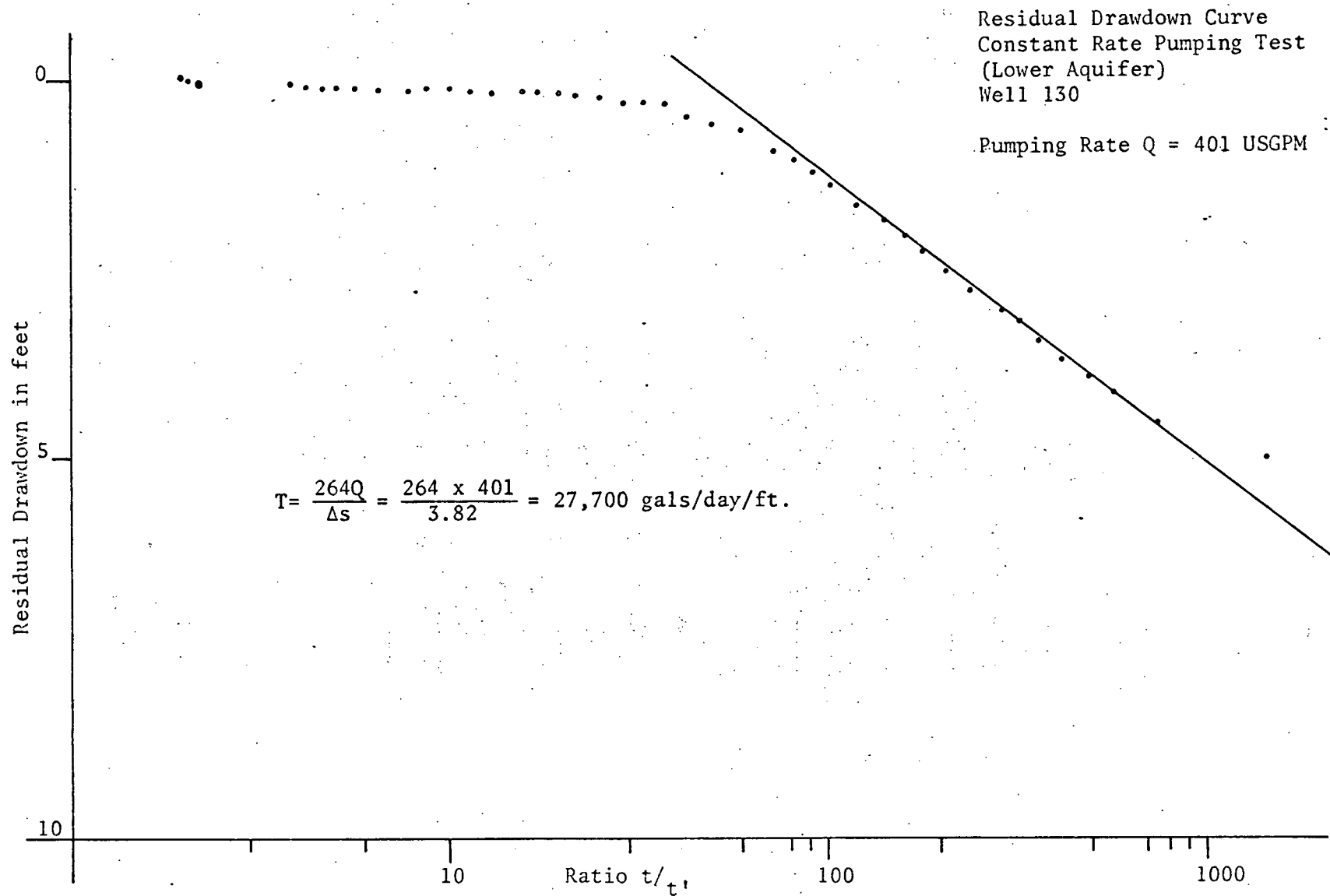
APPENDIX IV

RECOVERY READINGS AFTER CONSTANT RATE PUMPING TEST ON WELL NO. 130

(Lower Aquifer)
Contract 60
Groundwater Research Project
Cowichan River Aquifers - Duncan, B.C.

Date November 5, 6, 7, 10th

Time	Time (t) since start of pumping started in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet*	Residual drawdown in well in feet (static = 3.92')	Remarks
15:50	1650	210	7.85	3.96	.04	
16:40	1700	260	6.53	3.96	.04	
17:30	1750	310	5.64	3.96	.04	
18:20	1800	360	5.00	3.96	.04	
19:10	1850	410	4.51	3.96	.04	
20:00	1900	460	4.13	3.96	.04	
20:50	1950	510	3.82	3.96	.04	
November 6, 1975						
08:30	2640	1200	2.20	3.94	.02	
10:10	2740	1300	2.11	3.91	+ .01	
11:50	2840	1400	2.02	3.87	+ .05	
12:30	2880	1440	2.00	3.86	+ .06	
14:00	2970	1530	1.94	3.85	+ .07	
November 7, 1975						
16:00				2.88	+1.04	
November 10, 1975						
16:00				3.22	+ .70	
						<u>Note:-</u> All water level readings are taken from a point 0.65 ft. above the casing datum.



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WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown
HOR. As shown

J.C. Foweraker

DATE

Dec. 1975

ENGINEER

FILE No. DWG. No. 10 Appendix 4

APPENDIX IV

READINGS TAKEN ON OBSERVATION WELL NO. 131 DURING
"CONSTANT RATE" PUMPING TEST (Lower Aquifer)

Contract #60
Groundwater Research Project
Cowichan River Aquifer - Duncan, B.C.

Date November 4 & 5, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet*	Drawdown in well in feet (static =)	REMARKS
				@ 9:45 AM S.W.L. = 6.82
12:30 PM	0	6.81	0	Pumping started
12:30 ½	½	10.83	4.02	
12:31	1			
12:31 ½	1½	13.88	7.07	
12:32	2	14.69	7.88	
12:33 ½	2½			
12:33	3	15.47	8.66	
12:33 ½	3½	15.82	9.01	
12:34	4	16.15	9.34	
12:34 ½	4½			
12:35	5	16.40	9.59	*Note:
12:35 ½	5½			All water level readings taken from a
12:36	6	16.76	9.95	point 4.37 feet above datum point
12:36 ½	6½	16.90	10.09	
12:37	7			
12:37 ½	7½	17.42	10.61	
12:38	8	17.54	10.73	
12:38 ½	8½			
12:39	9	17.54	10.73	
12:39 ½	9½	17.65	10.84	
12:40	10	17.76	10.95	
12:41	11	17.90	11.09	
12:42	12	18.34	11.53	
12:44	14	18.30	11.49	
12:46	16	18.49	11.68	
12:48	18	18.67	11.86	
12:50	20	18.82	12.01	
12:55	25	19.00	12.19	
13:00	30	19.15	12.34	
13:06	36	19.32	12.51	
13:11	41	19.43	12.62	
13:15	45	19.48	12.67	
13:20	50	19.53	12.72	
13:30	60	19.59	12.78	
13:40	70	19.62	12.81	
13:50	80	19.64	12.83	
14:00	90	19.65	12.84	

APPENDIX IV

READINGS TAKEN ON OBSERVATION WELL NO. 131 DURING
"CONSTANT RATE" PUMPING TEST (Lower Aquifer)

Contract #60
Groundwater Research Project
Cowichan River Aquifer - Duncan, B.C.

Date November 4 & 5, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	REMARKS
14:10	100	19.66	12.85	3 Lab Samples Taken Field Test = Cond. 80 @ 12°C, PH. 7.75 Fe. 0.24 H ₂ S=0
14:20	110	19.66	12.85	
14:30	120	19.65	12.84	
14:35	125	19.67	12.86	
15:00	150	19.67	12.86	
15:30	180	19.66	12.85	
15:50	200	19.69	12.88	
16:15	225	19.69	12.88	
16:40	250	19.68	12.87	
17:05	275	19.68	12.87	
17:30	300	19.69	12.88	
17:55	325	19.68	12.87	
18:20	350	19.68	12.87	
18:45	375	-	-	
19:10	400	19.67	12.86	
20:00	450	19.68	12.87	
20:50	500	19.64	12.83	
21:40	550	19.58	12.77	Field Test = Cond. 80 @ 12°C, PH. 7.75 Fe. 0.26 H ₂ S=nil
22:30	600	19.59	12.78	
23:25	650	19.51	12.70	
November 5, 1975				
00:10	700	19.58	12.77	12 hrs. into test - (New Observer)
00:30	720	19.57	12.76	
01:00	750	19.57	12.76	
01:50	800	19.57	12.76	
02:40	850	19.58	12.77	
03:30	900	19.57	12.76	
04:20	950	19.56	12.75	
05:10	1000			
06:00	1050			
06:50	1100	19.55	12.74	
07:40	1150	19.55	12.74	Samples taken @ 12:00 hrs.
08:30	1200	19.55	12.74	
09:20	1250	19.52	12.71	
10:10	1300	19.53	12.72	
11:00	1350	19.52	12.71	
11:50	1400	19.53	12.72	
12:22	1432	19.53	12.72	
Stopped pumping @ 12:30 hrs.				

APPENDIX IV

RECOVERY READINGS IN OBSERVATION WELL NO. 131 AFTER "CONSTANT RATE" PUMPING TEST

(Lower Aquifer)
Contract #60
Groundwater Research Project
Cowichan River Aquifers - Duncan, B.C.

Date November 5 & 6, 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet*	Residual drawdown in well in feet (static = 6.81')	Remarks
12:30 PM	1440	0	0			Original Static = 6.81' Pumping Stopped
12:30 ½	1440.5	½	2880.00	16.50	9.69	
12:31	1441	1	1441.00			
12:31 ½	1441.5	1½	960.00			
12:32	1442	2	721.00	11.25	4.44	
12:32 ½	1442.5	2½	577.00			
12:33	1443	3	481.00	11.10	4.29	
12:33 ½	1443.5	3½	411.42	10.72	3.91	
12:34	1444	4	361.00	10.50	3.69	
12:34 ½	1444.5	4½	321.00	10.27	3.46	
12:35	1445	5	289.00	10.09	3.28	
12:35 ½	1445.5	5½	261.91	9.88	3.07	
12:36	1446	6	241.00			
12:36 ½	1446.5	6½	222.54	9.59	2.78	
12:37	1447	7	206.71			
12:37 ½	1447.5	7½	193.00	9.36	2.55	
12:38	1448	8	181.00	9.20	2.39	
12:38 ½	1448.5	8½	170.41			
12:39	1449	9	161.00	9.00	2.19	
12:40	1450	10	145.00	8.86	2.05	
12:41	1451	11	131.91	8.70	1.89	
12:42	1452	12	121.00	8.54	1.73	
12:43	1453	13	111.77	8.44	1.63	
12:44	1454	14	103.85	8.31	1.50	
12:45	1455	15	97.00	8.23	1.42	
12:46	1456	16	91.00	8.13	1.32	
12:48	1458	18	81.00	7.98	1.17	
12:50	1460	20	73.00	7.83	1.02	
12:55	1465	25	58.60	7.62	0.81	
13:00	1470	30	49.00	7.44	0.63	
13:05	1475	35	42.14	7.33	0.52	
13:10	1480	40	37.00	7.23	0.42	
13:15	1485	45	33.00	7.19	0.38	
13:20	1490	50	29.80	7.13	0.32	
13:25	1496	56	26.71	7.10	0.29	
13:31	1501	61	24.61	7.06	0.25	
13:40	1510	70	21.57	7.03	0.22	

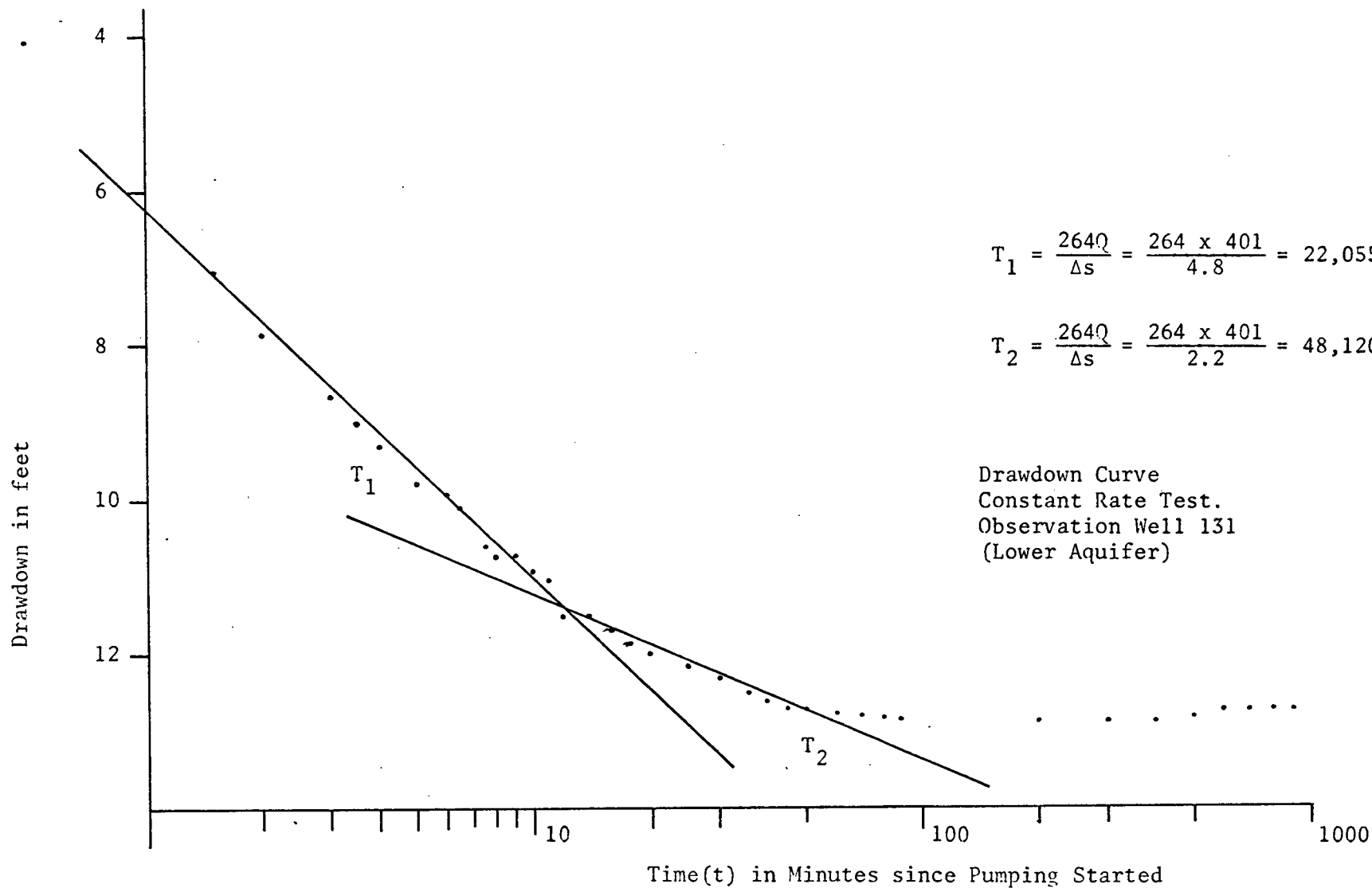
APPENDIX IV

RECOVERY READINGS IN OBSERVATION WELL NO. 131 AFTER "CONSTANT RATE" PUMPING TEST

(Lower Aquifer)
Contract #60
Groundwater Research Project
Cowichan River Aquifers - Duncan, B.C.

Date November 5 & 6, 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well in feet (static = 6.81')	Remarks
13:50	1520	80	19.00	7.00	0.19	
14:00	1530	90	17.00	6.98	0.17	
14:11	1541	101	15.25	6.96	0.15	
14:22	1552	112	13.86	6.95	0.14	
14:35	1565	125	12.52	6.94	0.13	
14:48	1578	138	11.43	6.92	0.11	
15:00	1590	150	10.60	6.92	0.11	
15:25	1615	175	9.23	6.91	0.10	
15:50	1640	200	8.20	6.91	0.10	
16:40	1690	250	6.76	6.90	0.09	
17:00	1710	270	6.33	6.90	0.09	
17:30	1740	300	5.80	6.90	0.09	
18:20	1790	350	5.11	6.90	0.09	
19:10	1840	400	4.60	6.89	0.08	
20:00	1890	450	4.20	6.89	0.08	
21:50	1940	500	3.88	6.88	0.07	
22:30	2040	600	3.40	6.88	0.07	
November 6, 1975						
00:10	2140	700	3.06	6.88	0.07	
00:30	2160	720	3.00	6.88	0.07	
01:50	2240	800	2.80	6.88	0.07	
03:30	2340	900	2.60	6.88	0.07	
05:10	2440	1000	2.44	6.88	0.07	
06:50	2540	1100	2.31	6.88	0.07	
08:30	2640	1200	2.20	6.87	0.06	
10:10	2740	1300	2.11	6.84	0.03	
11:50	2840	1400	2.03	6.81	0.00	
12:30 PM	2880	1440	2.00	6.79		
						*Note: All water level readings are taken from a point 4.37 feet above casing datum. Original static level 24 hrs.



$$T_1 = \frac{264Q}{\Delta s} = \frac{264 \times 401}{4.8} = 22,055 \text{ gals/day/ft.}$$

$$T_2 = \frac{264Q}{\Delta s} = \frac{264 \times 401}{2.2} = 48,120 \text{ gals/day/ft.}$$

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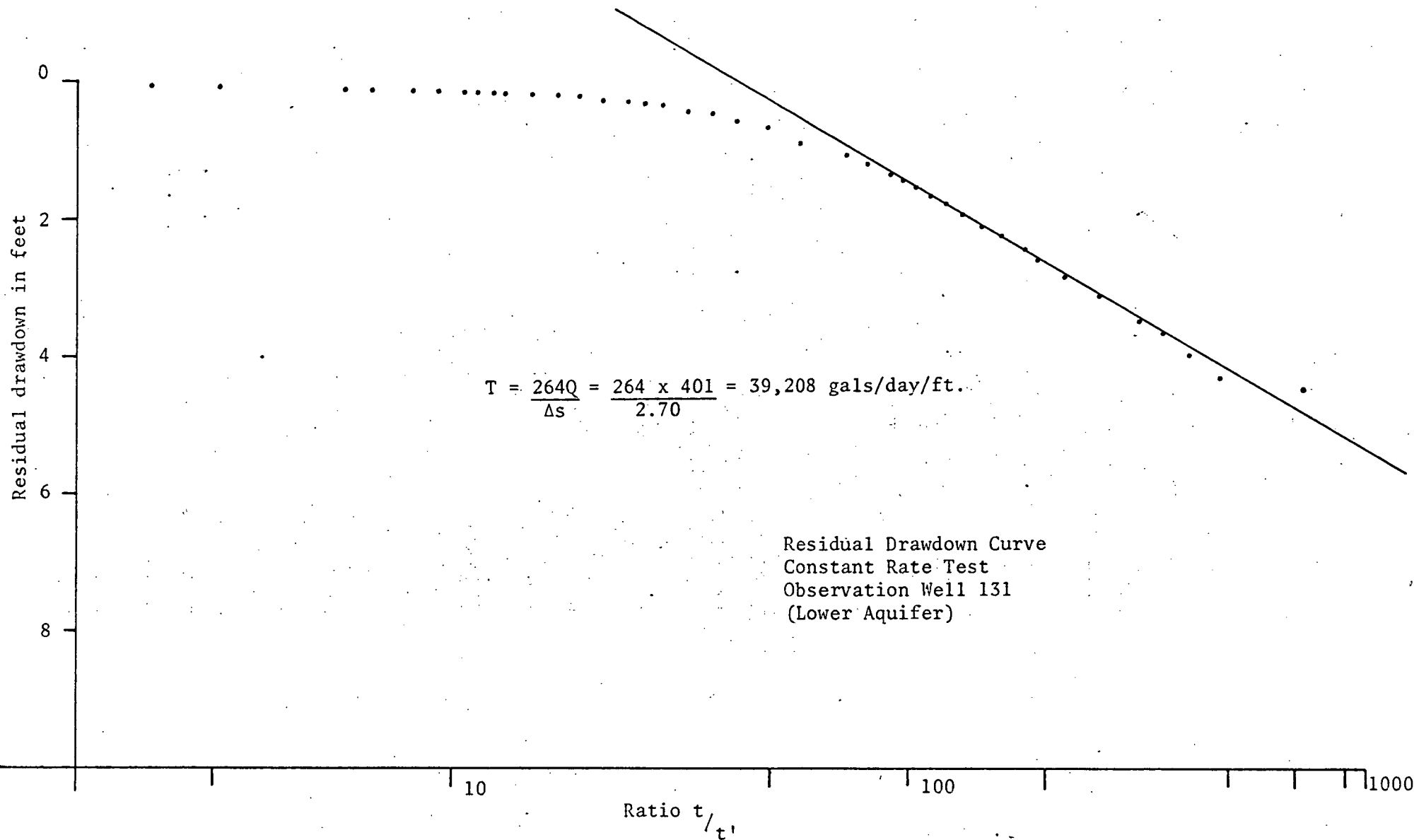
TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown
HOR. As shown

J.C. Foweraker ENGINEER

FILE No. DWG. No. 11 Appendix 4

DATE
Dec. 1975



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Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

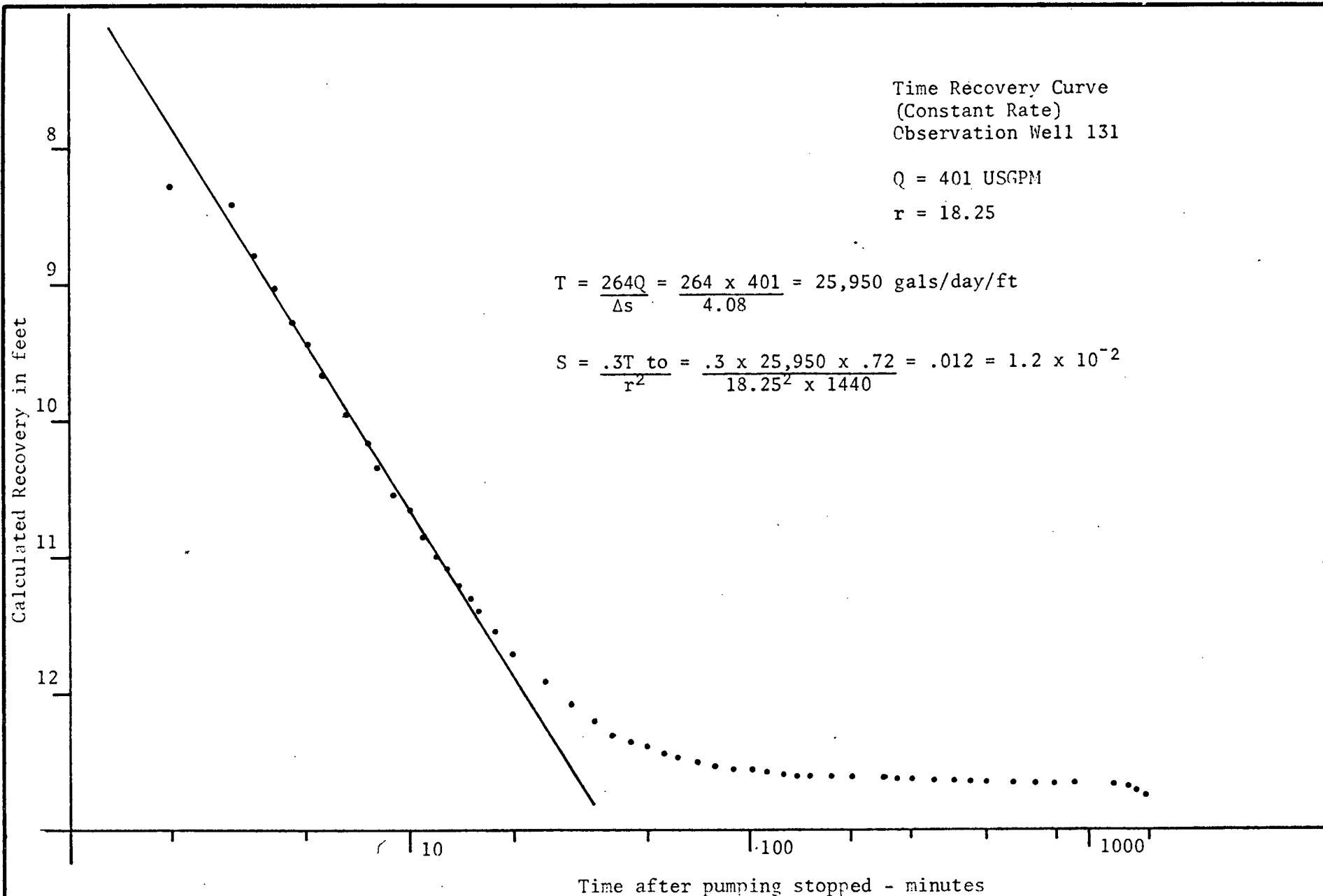
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DATE
Dec. 1975

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Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

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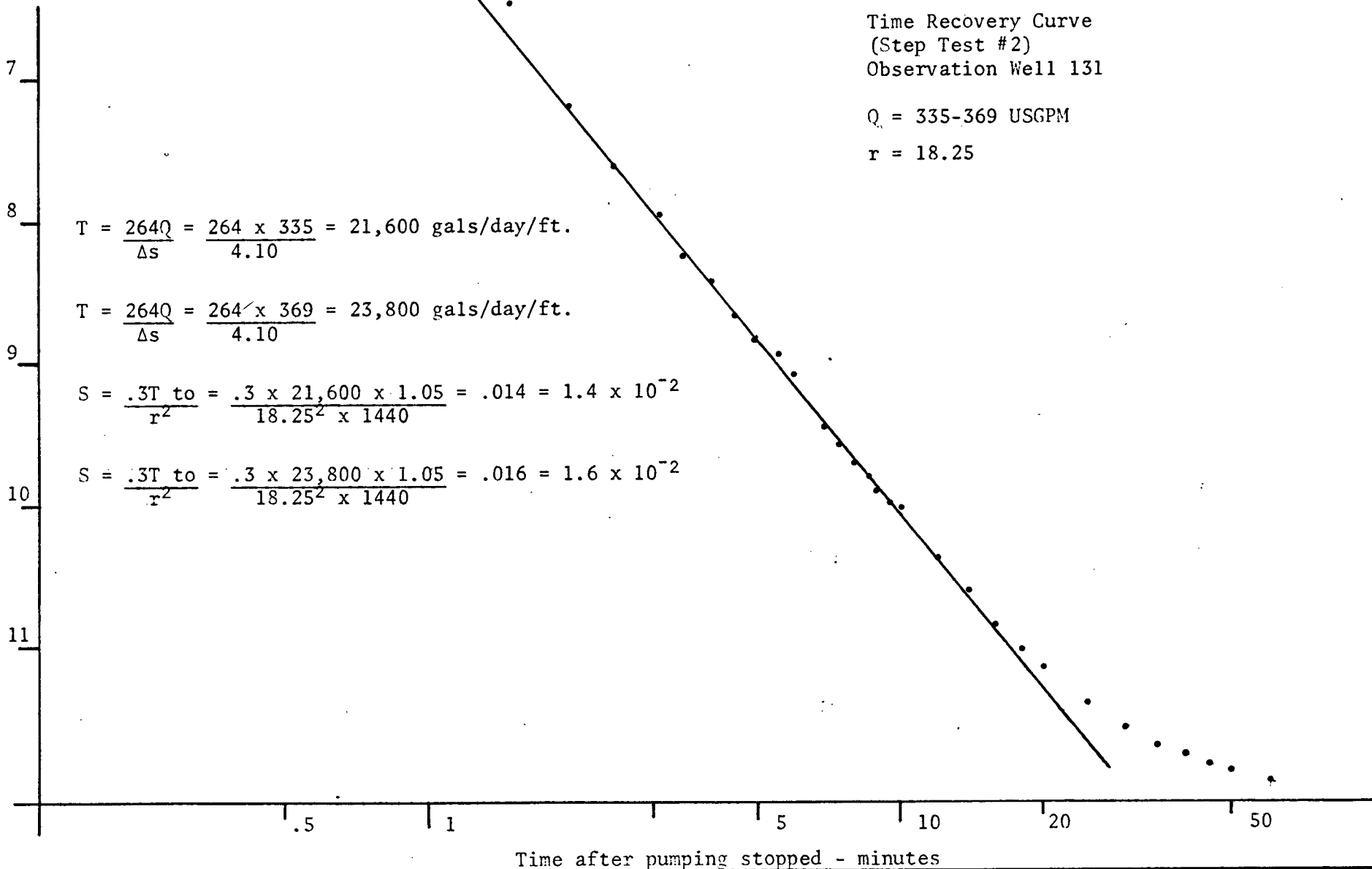
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FILE No. DWG. No. 13 Appendix 4

Calculated Recovery in feet



Time after pumping stopped - minutes

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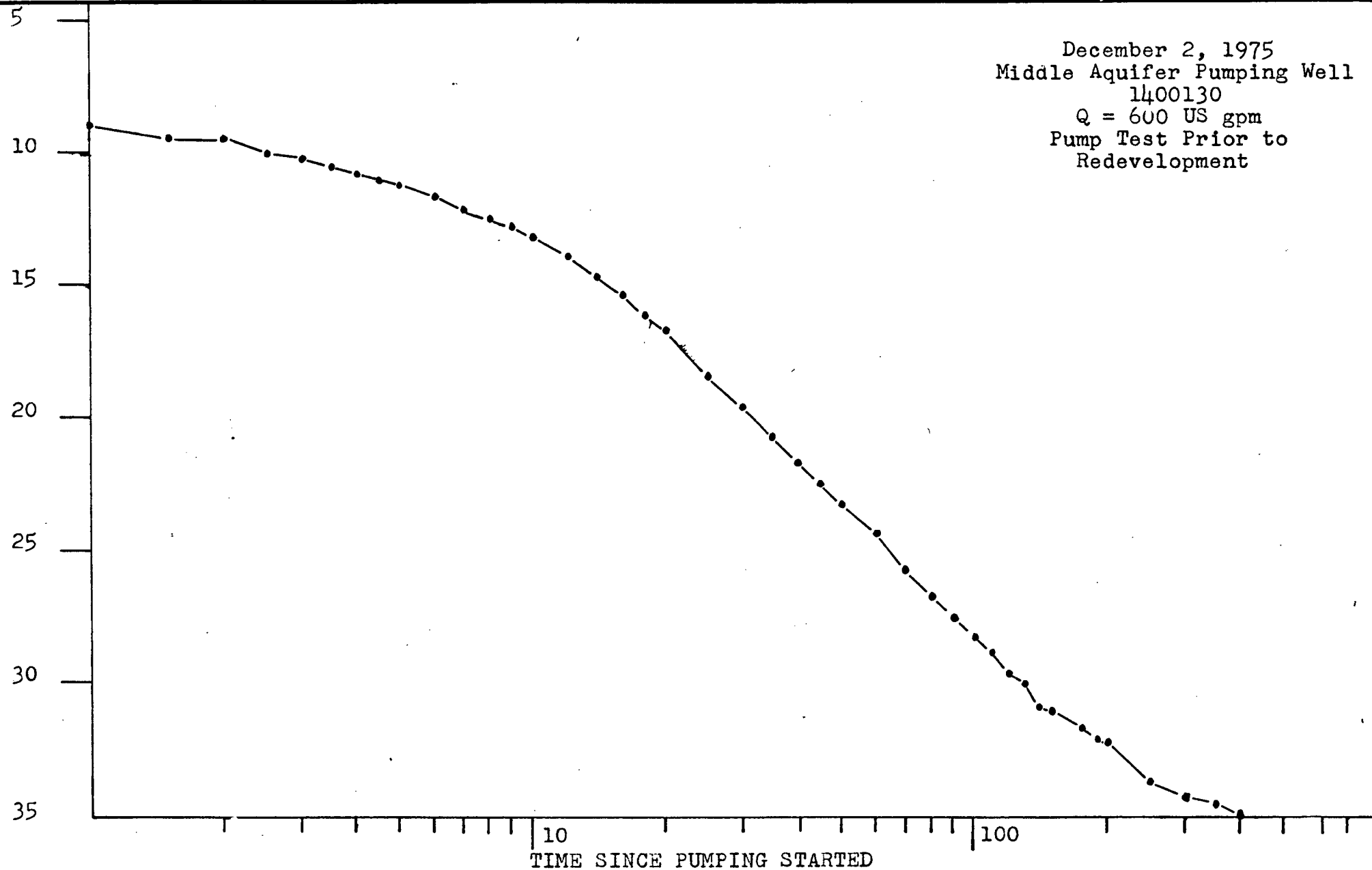
TO ACCOMPANY REPORT ON
Contract #60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown	DATE Dec. 1975
HOR. As shown	
J.C. Foweraker	ENGINEER
FILE No.	DWG. No. 14 Appendix 4

APPENDIX NO. 5
"MIDDLE AQUIFER"
PUMPING TESTS

WELL READINGS
AND
GRAPHICAL PLOTS

WATER LEVEL IN WELL



December 2, 1975
 Middle Aquifer Pumping Well
 1400130
 Q = 600 US gpm
 Pump Test Prior to
 Redevelopment

TIME SINCE PUMPING STARTED

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 CONTRACT # 60
 GROUNDWATER RESEARCH PROJECT
 COWICHAN RIVER AQUIFERS
 DUNCAN, B.C.

SCALE: VERT. As Shown
 HOR. As Shown

J. C. Foweraker

FILE No. 0239013

DWG. No. 1 Appendix 5

DATE

Dec. 1975

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APPENDIX V

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 130 (after redeveloping)

Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B. C.

Date December 10-11, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 4.29)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	Rdgs. by A. Kohut from 0.5 to <u>35</u> minutes 5" oriface, 6" pipe 35 mins. to → Aqua <u>flow</u>
9:30						
9:30 ½	0.5	7.14	2.85			NOTE: .45 + .16 = 0.61' rdgs. taken on base of pump flange, 0.61' above top of casing.
9:31	1.0	7.04	2.75			
9:31 ½	1.5	6.95	2.66			
9:32	2.0	7.00	2.71			
9:32 ½	2.5	7.03	2.74	15"		
9:33	3.0	7.10	2.81			
9:33 ½	3.5	7.23	2.94	16"		
9:34	4.0	7.16	2.87			
9:34 ½	4.5	7.29	3.00	17-17.5"	510	
9:35	5.0	7.23	2.94			
9:36	6.0	7.24	2.95			
9:37	7.0	7.24	2.95			
9:38	8	7.22	2.93			
9:39	9	7.27	2.98			
9:40	10	7.22	2.93			
9:42	12	7.28	2.99			
9:44	14	7.27	2.98			
9:46	16	7.25	2.96			
	18	7.25	2.96			
	20	7.24	2.95			
	25	7.30	3.01			
10:00	30	7.25	2.96			Change readers Aqua Flow
	35	7.26	2.97			
	40	7.19	2.90	1.45'-1.53"		
	45	7.19	2.90			
	50	7.19	2.90			
	60	7.21	2.92			
	70	7.27	2.98			
	80	7.28	2.99			
	90	7.29	3.00	1.42'-1.50'		
	100	7.29	3.00			
12:00	150	7.29	3.00			rdgs. by APK
12:50	200	7.36	3.07	17"-18"	510-524	
1:3:40	250	7.36	3.07			new observer W. Hodge
:00	330	7.40	3.11			
15:40	370	7.45	3.16	17"-18"		
16:10 hrs	400	7.45	3.16			

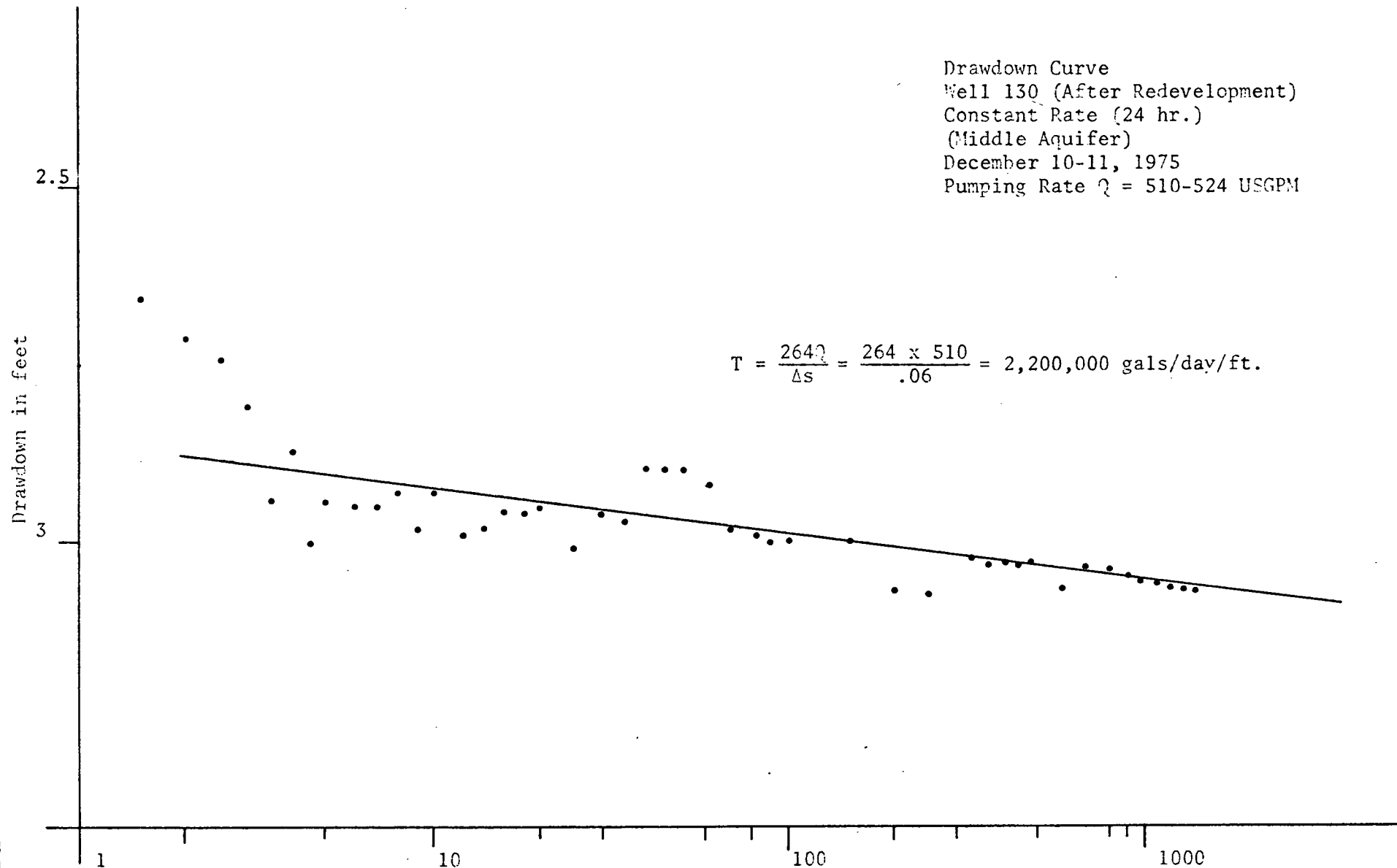
APPENDIX V

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 130 (after redeveloping)

Contract 60.
Groundwater Research Project
Cowichan River Aquifers
Duncan, B. C.

Date December 10-11, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 4.29)	Height of water in tube on orifice pipe in inches 5" orifice 6" pipe	U.S. gals. per min. discharge from well	Rdgs. by A. Kohut from 0.5 to <u>35</u> minutes 5" orifice, 6" pipe 35 mins. to → Aqua <u>flow</u>
17:00	450	7.45	3.16			
17:50	500	7.43	3.14	17½-18"		Oriface
19:30	600	7.61	3.32	17½-18"		Hach test @ <u>1945</u> hrs.
21:10	700	7.48	3.19			ph = 7.1
22:50	800	7.49	3.20	17½-18"		Cond. = 70
00:30	900	7.52	3.23			Temp. = 43.8F
02:10	1000	7.58	3.29	17¼"-18-1/8	Hach test	iron = neg. (.1)
03:50	1100	7.58	3.29		@ 02:10	*no sand present
05:30	1200	7.62	3.33	17½-18½	hrs.	
07:10	1300	7.62	3.33			
08:50	1400	7.65	3.36			
09:30	1440	7.61	3.32			24 hr.



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 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B. C.

SCALE: VERT. As shown
 HOR. As shown

DATE
 Dec. 1975

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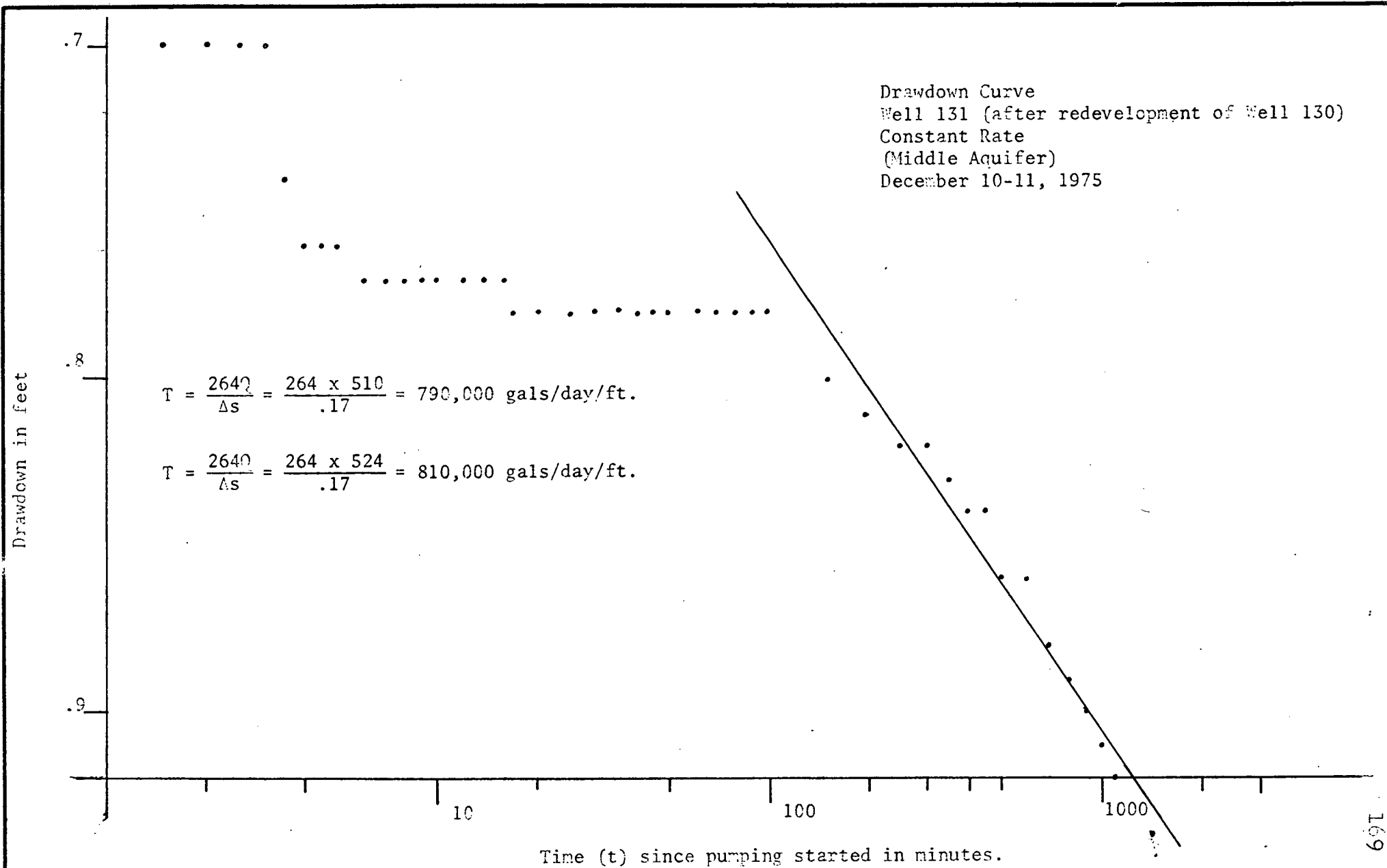
APPENDIX V

READINGS TAKEN ON OBSERVATION WELL NO. 131 DURING
 "CONSTANT RATE" PUMPING TEST OF MIDDLE AQUIFER - 130 AFTER REDEVELOPMENT OF SCREEN

Contract #60
 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B. C.

Date Dec. 10-11, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 6.68)	REMARKS
1750	500	7.54	.86	
1930	600	7.545	.86	
2110	700	7.56	.88	
2250	800	7.57	.89	
0030	900	7.58	.90	New observer B. Patterson
0210	1000	7.59	.91	
0350	1100	7.60	.92	
0530	1200	7.61	.93	
0710	1300	7.62	.94	
0850	1400	7.63	.95	
0930	1440			Pumping stopped



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Contract 60
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Cowichan River Aquifers
Duncan, B. C.

SCALE: VERT. As shown
HOR. As shown

DATE

Dec. 1975

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FILE No. 0239013 DWG. No. 3 Appendix 5

APPENDIX V

READINGS TAKEN ON OBSERVATION WELL NO. FRASER DURING
"CONSTANT RATE" PUMPING TEST OF MIDDLE AQUIFER - AFTER REDEVELOPMENT OF WELL 130

Contract 60
 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B. C.

Date December 10-11, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 5.25)	Measured from top of 2"x4" board over well - deduct 1-5/8" to obtain geodetic el.
0930	0			Static 5.25 at 09:30 hrs.
0930 1/2	1/2	5.30	.05	
0931	1	5.31	.06	
0931 1/2	1 1/2	5.32	.07	
0932	2	5.33	.08	
0932 1/2	2 1/2	5.33	.08	
0933	3	5.33	.08	
0933 1/2	3 1/2	5.33	.08	
0934	4	5.33	.08	
0934 1/2	4 1/2	5.33	.08	
0935	5	5.33	.08	
0936	6	5.33	.08	
0937	7	5.33	.08	
0938	8	5.33	.08	
0939	9	5.33	.08	
0940	10	5.34	.09	
0942	12	5.34	.09	
0944	14	5.34	.09	
0946	16	5.34	.09	
0948	18	5.34	.09	
0950	20	5.34	.09	
0955	25	5.34	.09	
0960	30	5.34	.09	
1005	35	5.35	.10	
1010	40	5.35	.10	
1015	45	5.35	.10	
1020	50	5.35	.10	
1030	60	5.35	.10	
1040	70	5.36	.11	
1050	80	5.36	.11	
1100	90	5.36	.11	
1110	100	5.36	.11	
1200	150	5.37	.12	
1250	200	5.38	.13	
1340	250	5.39	.14	
1430	300	5.41	.16	
1500	350	5.41	.16	
1610	400	5.42	.17	
1700	450	5.41	.16	

new Observer - W. Hodge

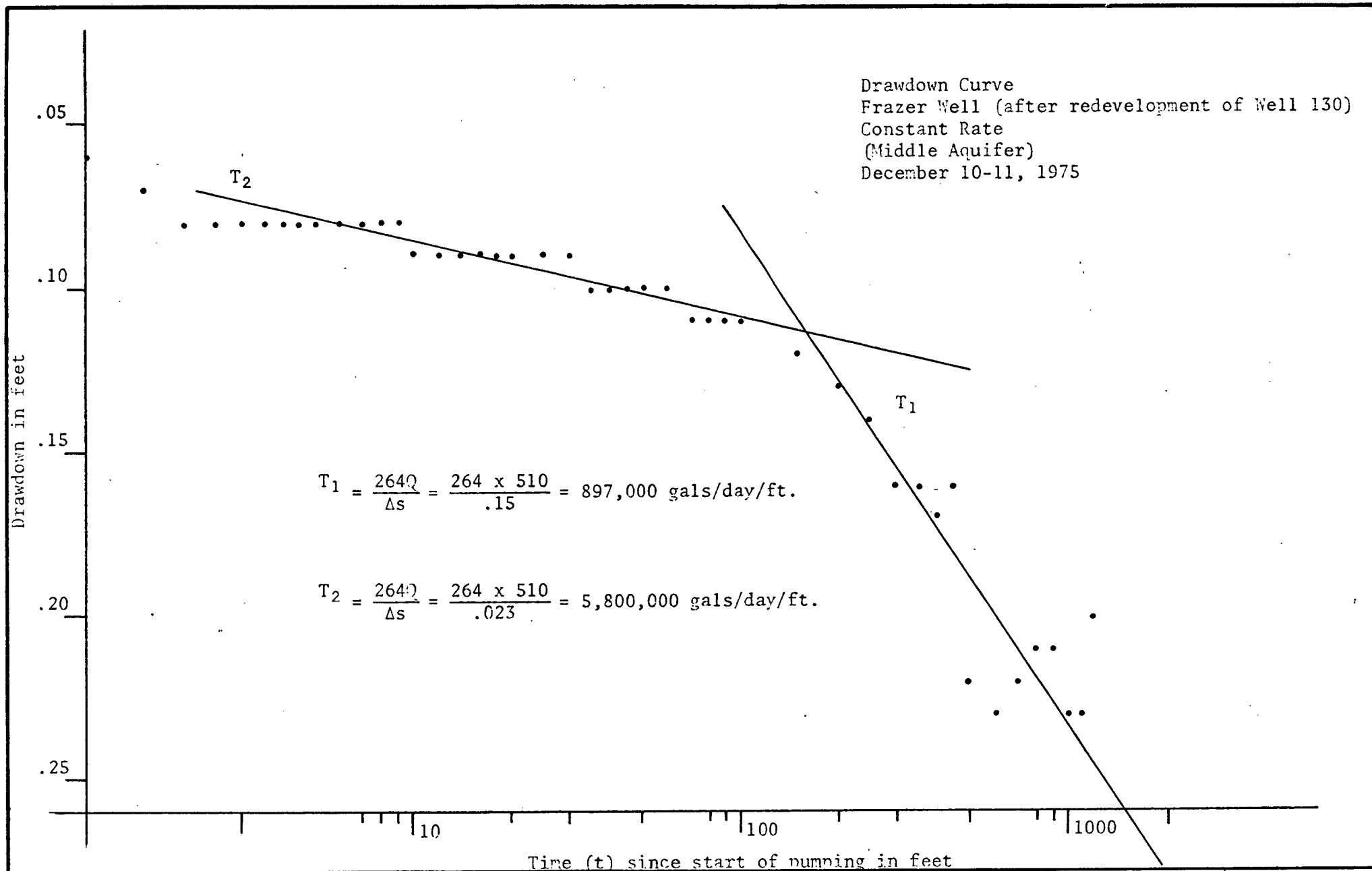
APPENDIX V

READINGS TAKEN ON OBSERVATION WELL NO. FRASER DURING
"CONSTANT RATE" PUMPING TEST OF MIDDLE AQUIFER - AFTER REDEVELOPMENT OF WELL 130

Contract 60
 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B. C.

Date December 10-11, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 5.25)	
1750	500	5.47	.22	
1930	600	5.48	.23	
2110	700	5.47	.22	
2250	800	5.46	.21	
2430	900	5.46	.21	new observer B. Patterson
0210	1000	5.48	.23	
0350	1100	5.48	.23	
0530	1200	5.45	.20	
0710	1300	5.56	.31	
0850	1400	5.58	.33	
0930	1440	5.50	.25	stopped pumping



BRITISH COLUMBIA
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TO ACCOMPANY REPORT ON
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Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown

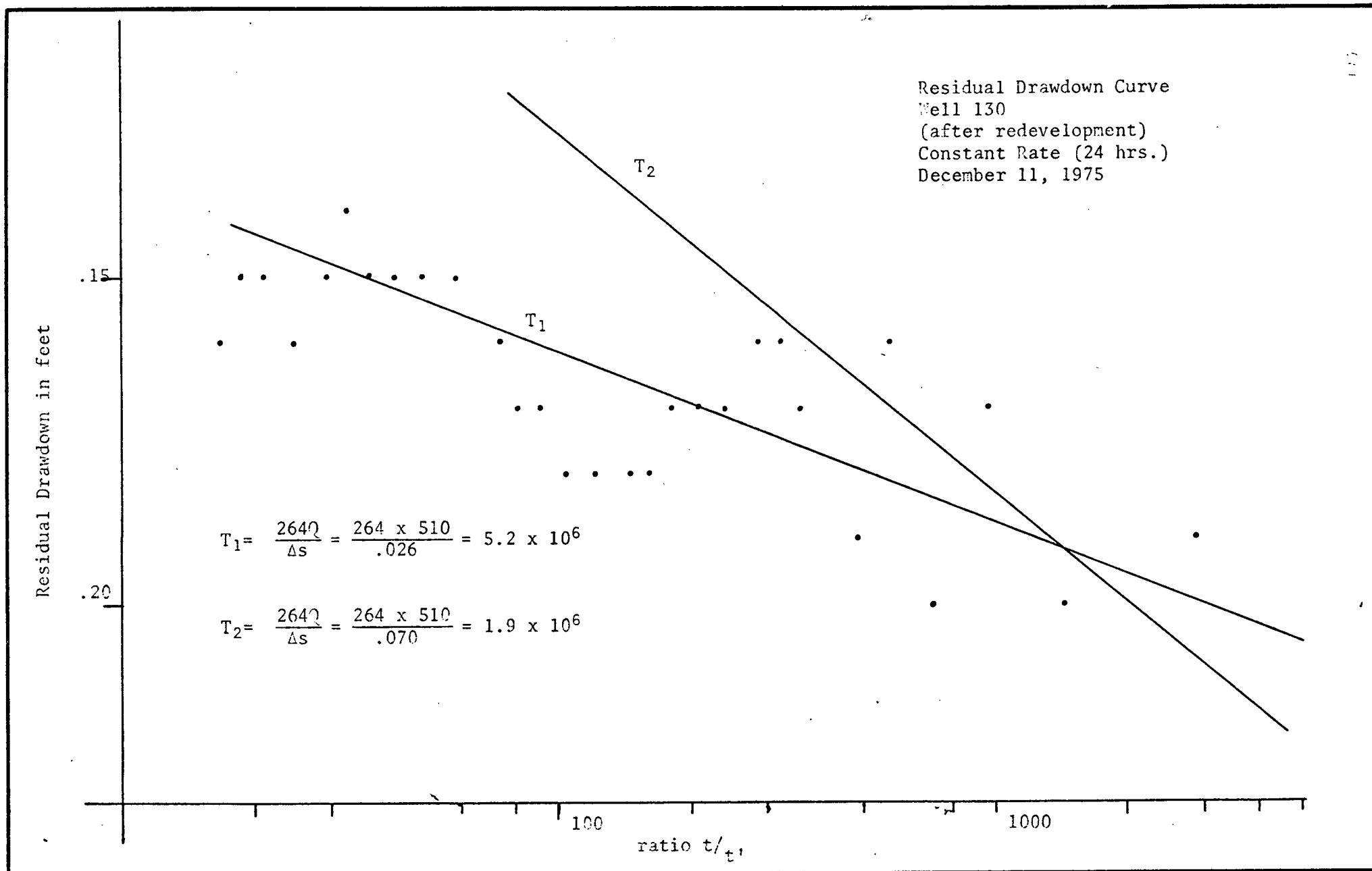
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TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B. C.

SCALE: VERT. As shown
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DATE
Dec. 1975

J.C. Foweraker

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DWG. No. 5 Appendix 5

APPENDIX V

9:30 7.61'

RECOVERY READINGS IN WELL NO. 130 AFTER
 "CONSTANT RATE" PUMPING TEST MIDDLE AQUIFER (AFTER REDEVELOPMENT)

Contract 60
 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B. C.

Date December 11, 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well (static = 4.29)	rdgs. by A. Kohut
930	1440					
930 ½	1440.5	0.5	2881	4.48	.19	
931	1441	1.0	1441	4.49	.20	
931 ½	1441.5	1.5	961	4.46	.17	
932	1442	2.0	720	4.49	.20	
932.5	1442.5	2.5	577	4.45	.16	
933	1443	3.0	481	4.48	.19	
933 ½	1443.5	3.5	412	4.52	.23	
934	1444	4.0	361	4.46	.17	
934 ½	1444.5	4.5	321	4.45	.16	
935	1445	5	289.4	4.45	.16	
936	1446	6	241	4.46	.17	
937	1447	7	206.7	4.46	.17	
938	1448	8	181	4.46	.17	
939	1449	9	161	4.47	.18	
940	1450	10	145	4.47	.18	
942	1452	12	121	4.47	.18	
944	1454	14	103.8	4.47	.18	
946	1456	16	91	4.46	.17	
948	1458	18	81	4.46	.17	
950	1460	20	73	4.45	.16	
955	1465	25	58.6	4.44	.15	
1000	1470	30	49	4.44	.15	
1005	1475	35	42.1	4.44	.15	
1010	1480	40	37	4.44	.15	
1015	1485	45	33	4.43	.14	
1020	1490	50	29.8	4.44	.15	
1030	1500	60	25	4.45	.16	
1040	1510	70	21.6	4.44	.15	
1050	1520	80	19	4.44	.15	
1100	1530	90	17	4.45	.16	
		100				

APPENDIX V

READINGS TAKEN ON OBSERVATION WELL NO. 131 DURING
"CONSTANT RATE" PUMPING TEST OF MIDDLE AQUIFER - 130 AFTER REDEVELOPMENT OF SCREEN

Contract #60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B. C.

Date Dec. 10-11, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 6.68)	REMARKS
9:30				
9:30 ½	½	7.36	.68	
9:31	1	7.38	.70	
9:31 ½	1½	7.38	.70	
9:32	2	7.38	.70	
9:32 ½	2½	7.38	.70	
9:33	3	7.38	.70	
9:33 ½	3½	7.42	.74	
9:34	4	7.44	.76	
9:34 ½	4½	7.44	.76	
9:35	5	7.44	.76	
9:36	6	7.45	.77	
9:37	7	7.45	.77	
9:38	8	7.45	.77	
9:39	9	7.45	.77	
9:40	10	7.45	.77	
9:42	12	7.45	.77	
9:44	14	7.45	.77	
9:46	16	7.45	.77	
9:48	18	7.46	.78	
9:50	20	7.46	.78	
9:55	25	7.46	.78	
1000	30	7.46	.78	
1005	35	7.46	.78	
1010	40	7.46	.78	
1015	45	7.46	.78	Changed charts 7.46 static
1020	50	7.46	.78	
1030	60	7.46	.78	Fe 0.25, Cond. 60 @ 11°C, LAB Sample Taken
1040	70	7.46	.78	Health inspector took sample
1050	80	7.46	.78	
1100	90	7.46	.78	Fe 0.15, Cond. 60 @ 11°C, H ₂ S Nil
1110	100	7.46	.78	
1200	150	7.48	.80	Fe 0.11 Cond. 60 @ 11°C.
1250	200	7.49	.81	pH 7.25
1340	250	7.50	.82	River gauge 2.48' (downstr.) Cond. 63 @ 11°C.
1430	300	7.50	.82	Fe 0.12 Cond. 60 @ 11°C.
1520	350	7.51	.83	
1610	400	7.52	.84	New observer W. Hodge
1700	450	7.525	.84	

APPENDIX V

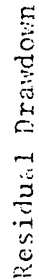
RECOVERY READINGS ON OBSERVATION WELL NO. 131 AFTER
 "CONSTANT RATE" PUMPING TEST ON WELL NO. 130 - MIDDLE AQUIFER AFTER REDEVELOPMENT OF SCREEN

Contract #60
 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B. C.

Date December 11, 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well in feet (static = 6.68)	Remarks
930	1440					
930 ½	1440.5	.5	2881	6.92	.24	
931	1441	1.0	1441	6.90	.22	
931 ½	1441.5	1.5	961	6.88	.20	
932	1442	2.0	720	6.89	.21	
932 ½	1442.5	2.5	577	6.88	.20	
933	1443	3.0	481	6.88	.20	
933 ½	1443.5	3.5	412	6.88	.20	
934	1444	4.0	361	6.88	.20	
934 ½	1444.5	4.5	321	6.88	.20	
935	1445	5.0	289.4	6.88	.20	
1050	1520	80.0	19	6.88	.20	

10



ratio t/t'

FILE No. 0239013 DWG. No. 6 Appendix

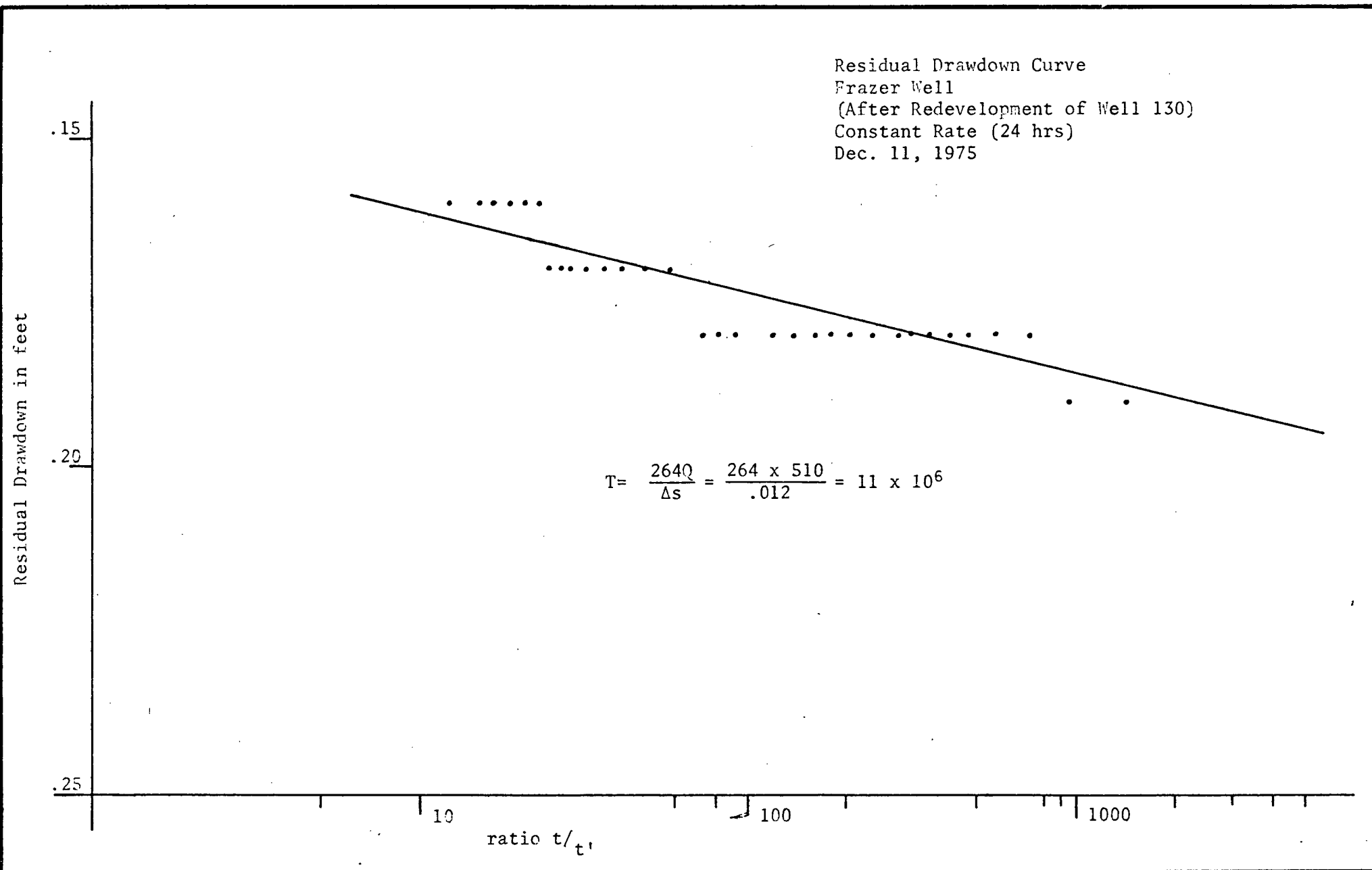
APPENDIX V

RECOVERY READINGS ON OBSERVATION WELL NO. FRASER AFTER
"CONSTANT RATE" PUMPING TEST ON WELL NO. 130 MIDDLE AQUIFER (AFTER REDEVELOPMENT)

Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B. C.

Date December 11, 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well (static = 5.25)	Measured from top of 2"x4" board over well - deduct 1-5/8" to obtain geodetic el.
0930 hrs.	1440	0	0	5.50	.25	Static 5.50 @ 09:30 hrs.
	1440.5	1/2	2881	5.45	.20	
	1441	1	1441	5.44	.19	
	1441.5	1 1/2	961	5.44	.19	
	1442	2	720	5.43	.18	
	1442.5	2 1/2	577	5.43	.18	
	1443	3	481	5.43	.18	
	1443.5	3 1/2	412	5.43	.18	
	1444	4	361	5.43	.18	
	1444.5	4 1/2	321	5.43	.18	
	1445	5	289.4	5.43	.18	
	1446	6	241	5.43	.18	
	1447	7	206.7	5.43	.18	
	1448	8	181	5.43	.18	
	1449	9	161	5.43	.18	
0940 hrs.	1450	10	145	5.43	.18	
	1452	12	121	5.43	.18	
	1454	14	103.8	5.43	.18	
	1456	16	91	5.43	.18	
	1458	18	81	5.43	.18	
0950 hrs.	1460	20	73	5.43	.18	Fraser connected to well
	1465	25	58.6	5.42	.17	
	1470	30	49	5.42	.17	
	1475	35	42.1	5.42	.17	
010 hrs.	1480	40	37	5.42	.17	
	1485	45	33	5.42	.17	
	1490	50	29.8	5.42	.17	
	1495	55	27.1	5.42	.17	
	1500	60	25	5.42	.17	
01035 hrs.	1505	65	23.1	5.41	.16	
	1510	70	21.5	5.41	.16	
01050 hrs.	1520	80	19	5.41	.16	
01100 hrs.	1530	90	17	5.41	.16	
01110 hrs.	1540	100	15.4	5.41	.16	
01115 hrs.	1605	125	12.8	5.41	.16	



BRITISH COLUMBIA
 DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
 WATER RESOURCES SERVICE
 WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
 Contract 60
 Groundwater Research Project
 Cowichan River Aquifers
 Duncan, B. C.

SCALE: VERT. As shown
 HOR. As shown

DATE
 Dec. 1975

J.C. Foweraker

ENGINEER

FILE No. 0239013 DWG. No. 7 Appendix 5

APPENDIX NO. 6

"MIDDLE AQUIFER"

PUMPING TESTS

CORRECTED

WELL READINGS

AND

GRAPHICAL PLOTS

APPENDIX VI

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 130 AFTER REDEVELOPING

CONTRACT #60
GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS - DUNCAN, B.C.

Date: Dec. 10-11, 1975

Time	Time (t) Since Start of Pumping in Mins.	Depth to Water in Well from Top of Casing in Feet	Drawdown in Well in feet (static = 4.29)	Correction Factor	Corrected Reading
9:30					
9:30½	0.5	7.14	2.85		
9:31	1.0	7.04	2.75		
9:31½	1.5	6.95	2.66		
9:32	2.0	7.00	2.71		
9:32½	2.5	7.03	2.74		
9:33	3.0	7.10	2.81		
9:33½	3.5	7.23	2.94		
9:34	4.0	7.16	2.87		
9:34½	4.5	7.29	3.00		
9:35	5.0	7.23	2.94		
9:35	6.0	7.24	2.95		
9:37	7.0	7.24	2.95		
9:38	8	7.22	2.93		
9:39	9	7.27	2.98		
9:40	10	7.27	2.93		
9:42	12	7.28	2.99		
9:44	14	7.27	2.98		
9:46	16	7.25	2.96		
	18	7.25	2.96		
	20	7.24	2.95		
	25	7.30	3.01		
10:00	30	7.25	2.96		
	35	7.26	2.97		
	40	7.19	2.90		
	45	7.19	2.90		
	50	7.19	2.90		
	60	7.21	2.92		
	70	7.27	2.98		
	80	7.28	2.99		
	90	7.29	3.00		
	100	7.29	3.00		
1:00	150	7.29	3.00	-0.01	2.99
1:50	200	7.36	3.07	-0.01	3.06
2:40	250	7.36	3.07	-0.01	3.05
3:00	330	7.40	3.11	-0.01	3.10

APPENDIX VI

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 130
PUMP TEST AFTER REDEVELOPING - PAGE 2
PRODUCTION WELL

Date: Dec. 10, 1975

Time	Time (t) Since Start of Pumping in Mins.	Depth to Water in Well From Top of Casing in Feet	Drawdown in Well in Feet (static = 4.29)	Correction Factor	Corrected Reading
16:10	400	7.45	3.16	-.03	3.13
17:00	450	7.45	3.16	-.03	3.13
17:50	500	7.43	3.14	-.04	3.10
19:30	600	7.61	3.32	-.04	3.28
21:10	700	7.48	3.19	-.05	3.15
22:50	800	7.49	3.20	-.06	3.14
00:30	900	7.52	3.23	-.07	3.13
2:10	1000	7.58	3.29	-.07	3.22
3:50	1100	7.58	3.29	-.08	3.21
5:30	1200	7.62	3.33	-.09	3.24
7:10	1300	7.62	3.33	-.10	3.23
8:50	1400	7.65	3.36	-.11	3.25
9:25	1440	7.61	3.32	-.11	3.21

APPENDIX VI

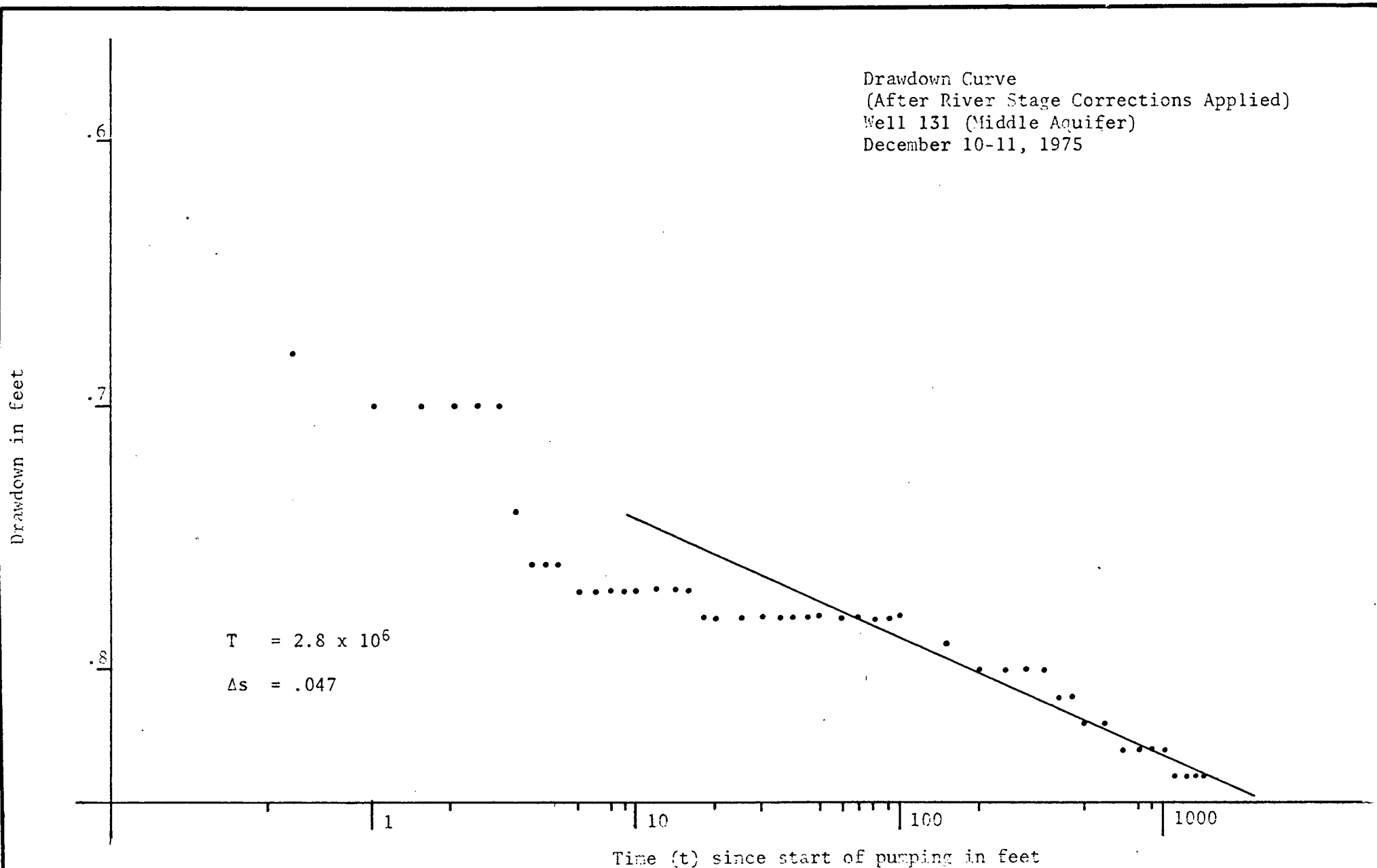
READINGS TAKEN ON OBSERVATION WELL NO. 131 DURING "CONSTANT RATE" PUMPING TEST OF MIDDLE AQUIFER 130 AFTER REDEVELOPMENT OF SCREEN

CONTRACT #60
GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS - DUNCAN, B.C.

Date: Dec. 10-11, 1975

Time	Time (t) Since Start of Pumping in Mins.	Depth to Water in Well from Top of Casing in Feet	Drawdown in Well in feet (static = 6.68)	Correction Factor	Corrected Reading
9:30					
9:30½	½	7.36	.68		
9:31	1	7.38	.70		
9:31½	1½	7.38	.70		
9:32	2	7.38	.70		
9:32½	2½	7.38	.70		
9:33	3	7.38	.70		
9:33½	3½	7.42	.74		
9:34	4	7.44	.76		
9:34½	4½	7.44	.76		
9:35	5	7.44	.76		
9:36	6	7.45	.77		
9:37	7	7.45	.77		
9:38	8	7.45	.77		
9:39	9	7.45	.77		
9:40	10	7.45	.77		
9:42	12	7.45	.77		
9:44	14	7.45	.77		
9:46	16	7.45	.77		
9:48	18	7.46	.78		
9:50	20	7.46	.78		
9:55	25	7.46	.78		
10:00	30	7.46	.78		
10:05	35	7.46	.78		
10:10	40	7.46	.78		
10:15	45	7.46	.78		
10:20	50	7.46	.78		
10:30	60	7.46	.78		
10:40	70	7.46	.78		
10:50	80	7.46	.78		
11:00	90	7.46	.78		
11:10	100	7.46	.78		
12:00	150	7.48	.80	-.01	.79
12:50	200	7.49	.81	-.01	.80

Time	Time (t) Since Start of Pumping in Mins.	Depth to Water in Well from Top of Casing in Feet	Drawdown in Well in feet (static = 6.68)	Correction Factor	Corrected Reading
13:40	250	7.40	.82	-.02	.80
14:30	300	7.50	.82	-.02	.80
15:20	350	7.51	.83	-.03	.80
16:10	400	7.52	.84	-.03	.81
17:00	450	7.525	.84	-.03	.81
16:50	500	7.54	.86	-.04	.82
19:30	600	7.545	.86	-.04	.82
21:10	700	7.56	.88	-.05	.83
22:50	800	7.57	.89	-.06	.83
00:30	900	7.58	.90	-.07	.83
02:10	1000	7.59	.91	-.08	.83
03:50	1100	7.60	.92	-.08	.84
05:30	1200	7.61	.93	-.09	.84
07:10	1300	7.62	.94	-.10	.84
08:50	1400	7.63	.95	-.11	.84
09:30	1440	-	-	-.11	.84
Pumping Stopped					



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B. C.

SCALE: VERT. As shown
HOR. As shown

DATE
Dec. 1975

J.C. Poweraker

ENGINEER

FILE No. 0287013 DWG. No. 1 Appendix 6

APPENDIX VI

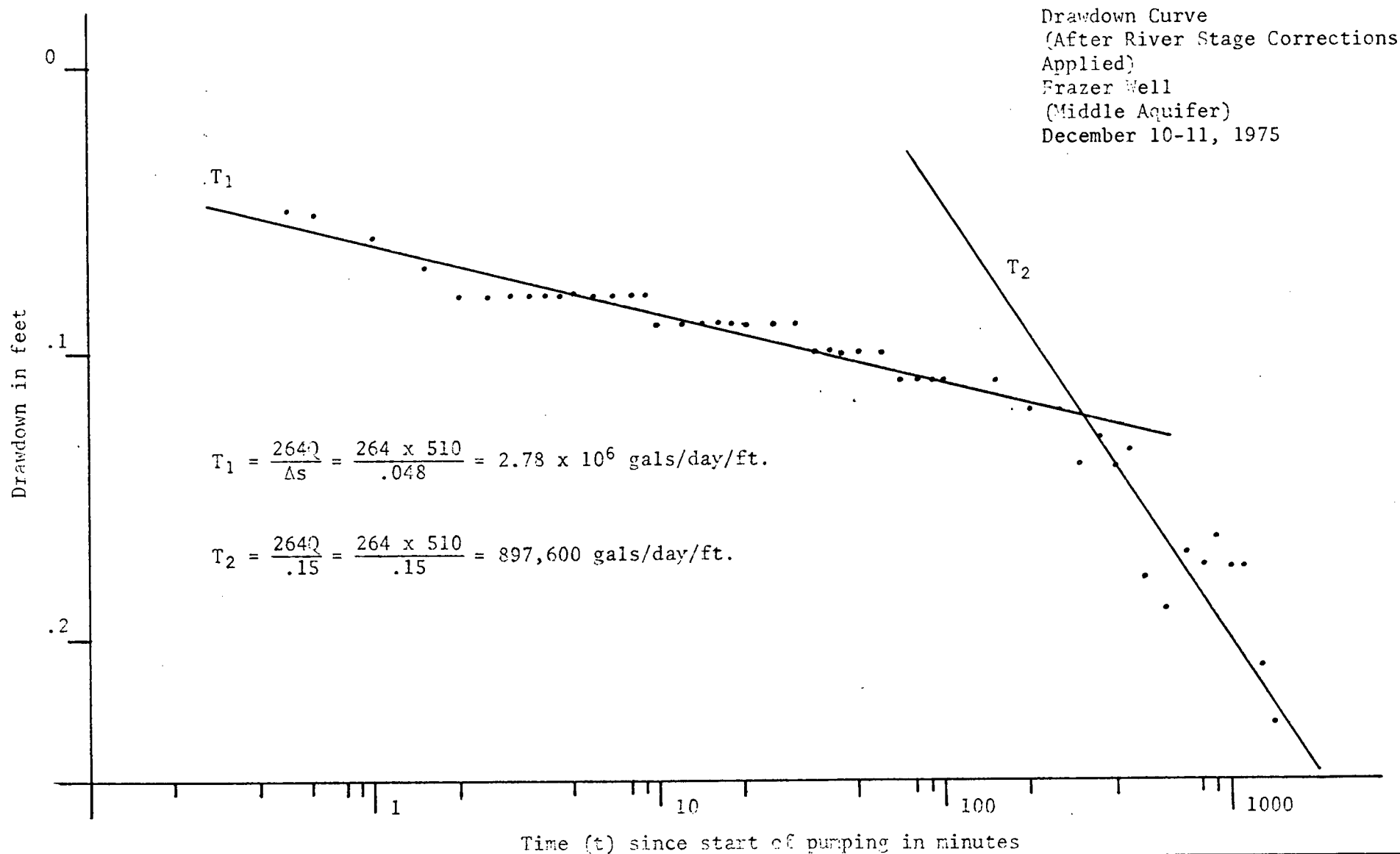
READING TAKEN ON OBSERVATION WELL NO. FRASER DURING
"CONSTANT RATE" PUMPING TEST OF MIDDLE AQUIFER -
AFTER REDEVELOPMENT OF WELL 130

CONTRACT #60
GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS - DUNCAN, B.C.

Date: Dec. 10-11, 1975

Time	Time (t) Since Start of Pumping in Mins.	Depth to Water in Well from Top of Casing in Feet	Drawdown in Well in feet (static - 5.25)	Correction Factor	Corrected Reading
09:30	0	-	-		
09:30½	½	5.30	.05		
09:31	1	5.31	.06		
09:31½	1½	5.32	.07		
09:32	2	5.33	.08		
09:32½	2½	5.33	.08		
09:33	3	5.33	.08		
09:33½	3½	5.33	.08		
09:34	4	5.33	.08		
09:34½	4½	5.33	.08		
09:35	5	5.33	.08		
09:36	6	5.33	.08		
09:37	7	5.33	.08		
09:38	8	5.33	.08		
09:39	9	5.33	.08		
09:40	10	5.34	.09		
09:42	12	5.34	.09		
09:44	14	5.34	.09		
09:46	16	5.34	.09		
09:48	18	5.34	.09		
09:50	20	5.34	.09		
09:55	25	5.34	.09		
09:60	30	5.34	.09		
10:05	35	5.35	.10		
10:10	40	5.35	.10		
10:15	45	5.35	.10		
10:20	50	5.35	.10		
10:30	60	5.35	.10		
10:40	70	5.36	.11		
10:50	80	5.36	.11		
11:00	90	5.36	.11		
11:10	100	5.36	.11		
12:00	150	5.37	.12	-.01	.11

Time	Time (t) Since Start of Pumping in Mins.	Depth to Water in Well from Top of Casing in Feet	Drawdown in Well in feet (static = 5.25)	Correction Factor	Corrected Reading
12:50	200	5.38	.13	-.01	.11
13:40	250	5.39	.14	-.02	.12
14:30	300	5.41	.16	-.02	.14
15:20	350	5.41	.16	-.03	.13
16:10	400	5.42	.17	-.03	.14
17:00	450	5.41	.16	-.03	.13
17:50	500	5.47	.22	-.04	.18
19:30	600	5.48	.23	-.04	.19
21:10	700	5.47	.22	-.05	.17
22:50	800	5.46	.21	-.06	.15
00:30	900	5.46	.21	-.07	.14
02:10	1000	5.48	.23	-.08	.15
03:50	1100	5.48	.23	-.08	.15
05:30	1200	5.45	.20	-.09	.11
07:10	1300	5.56	.31	-.10	.21
08:50	1400	5.58	.33	-.10	.23
09:30	1440	5.50	.25	-.11	.14



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WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B. C.

SCALE: VERT. As shown
HOR. As shown

DATE
Dec. 1975

J.C. Poweraker

ENGINEER

FILE No. 0239013 DWG. No. 2 Appendix 6

APPENDIX VI

RECOVERY READINGS IN WELL NO. 130 AFTER "CONSTANT RATE" PUMPING TEST

MIDDLE AQUIFER AFTER REDEVELOPMENT

CONTRACT #60
GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS - DUNCAN, B.C.
Dec. 11, 1975

Time	Time (t) Since Start of	Time (t') Since Pumping	Value of t / t'	Depth to Water in Well From Top of Casing In Feet	Residual Drawdown In Well In Feet (static = 4.29)	Correction Factor	Corrected Reading
9:30	1440						
9:30½	1440.5	0.5	2881	4.48	.19	-.11	.08
9:31	1441	1.0	1441	4.49	.20	-.11	.09
9:31½	1441.5	1.5	901	4.46	.17	-.11	.06
9:32	1442	2.0	720	4.49	.20	-.11	.09
9:325	1442.5	2.5	577	4.45	.16	-.11	.05
9:33	1443	3.0	481	4.48	.19	-.11	.08
9:33½	1443.5	3.5	412	4.52	.23	-.11	.12
9:34	1444	4.0	361	4.46	.17	-.11	.06
9:34½	1444.5	4.5	321	4.45	.16	-.11	.05
9:35	1445	5	289.4	4.45	.16	-.11	.05
9:36	1446	6	241	4.46	.17	-.11	.06
9:37	1447	7	206.7	4.46	.17	-.11	.06
9:38	1448	8	181	4.46	.17	-.11	.06
9:39	1449	9	161	4.47	.18	-.11	.07
9:40	1450	10	145	4.47	.18	-.11	.07
9:42	1452	12	121	4.47	.18	-.11	.07
9:44	1454	14	103.8	4.47	.18	-.11	.07
9:46	1456	16	91	4.46	.17	-.11	.06
9:48	1458	18	81	4.46	.17	-.11	.06
9:50	1460	20	73	4.45	.16	-.11	.05
9:55	1465	25	58.6	4.44	.15	-.11	.04
10:00	1470	30	49	4.44	.15	-.11	.04
10:05	1475	35	42.1	4.44	.15	-.11	.04
10:10	1480	40	37	4.44	.15	-.11	.04
10:15	1485	45	33	4.43	.14	-.11	.03
10:20	1490	50	29.8	4.44	.15	-.11	.04
10:30	1500	60	25	4.45	.16	-.11	.05
10:40	1510	70	21.6	4.44	.15	-.11	.04
10:50	1520	80	19	4.44	.15	-.11	.04
11:00	1530	90	17	4.45	.16	-.11	.05
		100					

APPENDIX VI

RECOVERY READING ON OBSERVATION WELL NO. 131 AFTER CONSTANT RATE
PUMPING TEST ON WELL NO. 130 - MIDDLE AQUIFER AFTER REDEVELOPMENT OF SCREEN

CONTRACT #60
GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS - DUNCAN, B.C.
Dec. 11, 1975

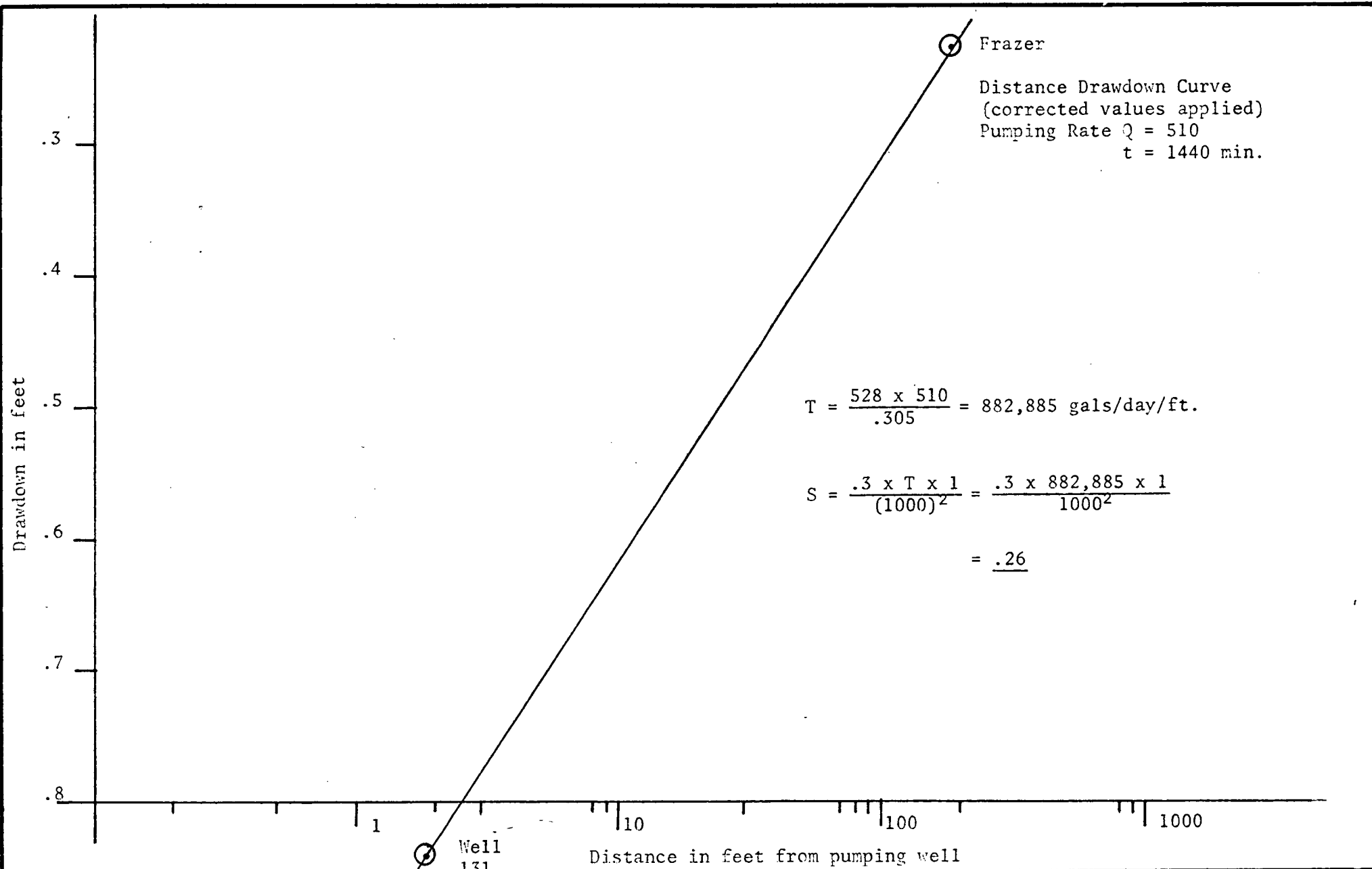
Time	Time (t) Since Pumping Started In Mins.	Time (t') Since Pumping Stopped In Mins.	Value of t / t'	Depth to Water In Well From Top of Casing In Feet	Residual Drawdown In Well In feet (static = 6.68)	Correction Factor	Corrected Reading
9:30	1440						
9:30½	1440.5	.5	2881	6.92	.24	-.11	.13
9:31	1441	1.0	1441	6.90	.22	-.11	.11
9:31½	1441.5	1.5	961	6.88	.20	-.11	.09
9:32	1442	2.0	720	6.89	.21	-.11	.10
9:32½	1442.5	2.5	577	6.88	.20	-.11	.09
9:33	1443	3.0	481	6.88	.20	-.11	.09
9:33½	1443.5	3.5	412	6.88	.20	-.11	.09
9:34	1444	4.0	361	6.88	.20	-.11	.09
9:34½	1444.5	4.5	321	6.88	.20	-.11	.09
9:35	1445	5.0	289.4	6.88	.20	-.11	.09
10:50	1520	80.0	19	6.88	.20	-.11	.09

APPENDIX VI

RECOVERY READINGS ON OBSERVATION WELL NO. FRASER AFTER CONSTANT RATE PUMPING TEST ON WELL NO. 130 MIDDLE AQUIFER AFTER REDEVELOPMENT

CONTRACT #60
GROUNDWATER RESEARCH PROJECT
COWICHAN RIVER AQUIFERS - DUNCAN, B.C.
Dec. 11, 1975

Time	Time (t) Since Pumping Started In Mins	Time (t') Since Pumping Stopped In Mins	Value of t / t'	Depth to Water In Well From Top of Casing In Feet	Residual Drawdown In Well In Feet (static = 5.25)	Correction Factor	Corrected Reading
					.14		
9:30	1440	0	0	5.50	.25		
	1440.5	½	2881	5.45	.20	-.11	.09
	1441	1	1441	5.44	.19	-.11	.08
	1441.5	1½	961	5.44	.19	-.11	.08
	1442	2	720	5.43	.18	-.11	.07
	1442.5	2½	577	5.43	.18	-.11	.07
	1443	3	481	5.43	.18	-.11	.07
	1443.5	3½	412	5.43	.18	-.11	.07
	1444	4	361	5.43	.18	-.11	.07
	1444.5	4½	321	5.43	.18	-.11	.07
	1445	5	289.4	5.43	.18	-.11	.07
	1446	6	241	5.43	.18	-.11	.07
	1447	7	206.7	5.43	.18	-.11	.07
	1448	8	181	5.43	.18	-.11	.07
	1449	9	161	5.43	.18	-.11	.07
9:40	1450	10	145	5.43	.18	-.11	.07
	1452	12	121	5.43	.18	-.11	.07
	1454	14	103.8	5.43	.18	-.11	.07
	1456	16	91	5.43	.18	-.11	.07
	1458	18	81	5.43	.18	-.11	.07
9:50	1460	20	73	5.43	.18	-.11	.07
	1465	25	58.6	5.42	.17	-.11	.06
	1470	30	49	5.42	.17	-.11	.06
	1475	35	42.1	5.42	.17	-.11	.06
10:10	1480	40	37	5.42	.17	-.11	.06
	1485	45	33	5.42	.17	-.11	.06
	1490	50	29.8	5.42	.17	-.11	.06
	1495	55	27.1	5.42	.17	-.11	.06
	1500	60	25	5.42	.17	-.11	.06
10:35	1505	65	23.1	5.41	.16	-.11	.05
	1510	70	21.5	5.41	.16	-.11	.05
10:50	1520	80	19	5.41	.16	-.11	.05
1:00	1530	90	17	5.41	.16	-.11	.05
1:10	1540	100	15.4	5.41	.16	-.11	.05
11:35	1605	125	12.8	5.41	.16	-.11	.05



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Contract 60
Groundwater Research Project
Cowichan River Aquifers
Duncan, B.C.

SCALE: VERT. As shown	DATE
HOR. As shown	Dec. 1975
J.C. Foweraker ENGINEER	
FILE No. 0239013	DWG. No. 3 Appendix 6

APPENDIX NO. 7

WATER QUALITY REPORTS

FOR

SAMPLES

OCTOBER 6, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 1

WATER QUALITY REPORT FOR SAMPLE 512485W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400120 GROUNDWATER SECTION 31 FT

SAMPLING DATE(S): SEP 16/75 1500 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 31

SAMPLED BY: W.I.B. - HYDROLOGIST

0040101	PH	6.6	0071701	RES:FILT.10SC	40.4
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	59.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	24.5	1041702	CHLORIDE:DISSOL	1.7
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	24.6	1091703	NITROGEN:NO2 NO3	0.12
		MG/L			MG/L
1211701	SULPHATE:DISSOL	L 5.0	2541702	CALCIUM	8.4
		MG/L		DISSOLVED	MG/L
2570304	IRON	0.4	2591701	MAGNESIUM	0.88
	TOTAL	MG/L		DISSOLVED	MG/L
2600303	MANGANESE	L 0.02	2641703	POTASSIUM	0.3
	TOTAL	MG/L		DISSOLVED	MG/L
2651703	SODIUM	1.6			
	DISSOLVED	MG/L			

REMARKS:

R. S. ...
FOR CHEMISTRY LABORATORY

OCTOBER 6, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 512485W

FIELD TEST RESULTS

0040102 PH

6.5
REL UNIT

0110102 SPECIFIC CONDUCT

65.
UMHO/CM

0130101 TEMP. SAMPLING

18.
DEG.C

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 1

WATER QUALITY REPORT FOR SAMPLE 512875W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLOGS
VICTORIA B C

FOR SITE: 1400120 GROUNDWATER SECTION 31 PT

SAMPLING DATE(S): SEP 24/75 1330 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 31

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.7	0071701	RES&FILT.105C	36.*
		REL UNIT			MG/L
0110101	SPECIFIC CONDC	60.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	25.2	1041702	CHLORIDE:DISSOL	1.8
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	24.5	1091703	NITROGN:NO2 NO3	0.08
		MG/L			MG/L
1211701	SULPHATE:DISSOL	15.	2541702	CALCIUM	8.5
		MG/L		DISSOLVED	MG/L
2570304	IRON	0.1	2591701	MAGNESIUM	0.8
	TOTAL	MG/L		DISSOLVED	MG/L
2590101	MAGNESIUM	0.8	2600301	MANGANESE	1.02
	TOTAL	MG/L		TOTAL	MG/L
2641703	POTASSIUM	0.2	2651703	SODIUM	1.7
	DISSOLVED	MG/L		DISSOLVED	MG/L

REMARKS:

FOR CHEMISTRY LABORATORY

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512875W

FIELD TEST RESULTS

0040102 PH

6.5
REL UNIT

0110102 SPECIFIC CONDUCT

65,
UMHO/CM

0130101 TEMP. SAMPLING

18.5
DEG.C

OCTOBER 1, 1975

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B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512486W

TO: WATER INVESTIGATIONS BR
WATER RES PARLNT BLDGS
VICTORIA B C

FOR SITE: 1400121 GROUNDWATER SECTION 19 FT

SAMPLING DATE(S): SEP 16/75 1500 HRS

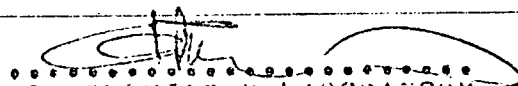
SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 19

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.6	0071701	RES:FILT.105C	36.4
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	60.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	25.3	1041702	CHLORIDE:DISSOL	1.8
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	25.1	1091703	NITROGEN:NO2 NO3	0.09
		MG/L			MG/L
1211701	SULPHATE:DISSOL.	15.	2541702	CALCIUM DISSOLVED	8.6
		MG/L			MG/L
2570304	IRON TOTAL	1.2	2591701	MAGNESIUM DISSOLVED	0.89
		MG/L			MG/L
2600303	MANGANESE TOTAL	0.04	2641703	POTASSIUM DISSOLVED	0.3
		MG/L			MG/L
2651703	SODIUM DISSOLVED	1.8			
		MG/L			

REMARKS:


FOR CHEMISTRY LABORATORY

SAMPLE NO. 512486W CONTINUED ON NEXT PAGE.

OCTOBER 1, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE S12486W

FIELD TEST RESULTS

0040102	PH	6.5	0110102	SPECIFIC CONDUCT	65.
		REL UNIT			UMHO/CM
0130101	TEMP. SAMPLING	18.			
		DEG.C			

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 1

WATER QUALITY REPORT FOR SAMPLE 512873W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400121 GROUNDWATER SECTION 19 FT

SAMPLING DATE(S): SEP 24/75 1330 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 20

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.7	0071701	RES:FILT.105C	36.*
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	60.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	25.1	1041702	CHLORIDE:DISSOL	1.7
		MG/L			MG/L
1070002	HARDNES,T:CaCO3	24.6	1091703	NITROGN:NO2 NO3	0.13
		MG/L			MG/L
1211701	SULPHATE:DISSOL	15.	2541702	CALCIUM DISSOLVED	8.5
		MG/L			MG/L
2570304	IRON TOTAL	0.1	2591701	MAGNESIUM DISSOLVED	0.82
		MG/L			MG/L
2590101	MAGNESIUM TOTAL	0.82	2600301	MANGANESE TOTAL	0.02
		MG/L			MG/L
2641703	POTASSIUM DISSOLVED	0.3	2651703	SODIUM DISSOLVED	1.6
		MG/L			MG/L

REMARKS:

FOR CHEMISTRY LABORATORY

SAMPLE NO. 512873W CONTINUED ON NEXT PAGE.

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512873W

FIELD TEST RESULTS

0040102 PH

6.5
REL UNIT

0110102 SPECIFIC CONDUCT

65.
UMHO/CM

0130101 TEMP. SAMPLING

18.5
DEG.C

OCTOBER 1, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512487W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400122 GROUNDWATER SECTION 39 FT

SAMPLING DATE(S): SEP 16/75 1500 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 39

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.7	0071701	RES:FILT.10SC	40.*
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	62,	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	26.2	1041702	CHLORIDE:DISSOL	1.8
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	26.3	1091703	NITROGN:NO2 NO3	0.08
		MG/L			MG/L
1211701	SULPHATE:DISSOL	1 5.0	2541702	CALCIUM DISSOLVED	8.9
		MG/L			MG/L
2570304	IRON TOTAL	3.4	2591701	MAGNESIUM DISSOLVED	0.98
		MG/L			MG/L
2600303	MANGANESE TOTAL	0.08	2641703	POTASSIUM DISSOLVED	0.3
		MG/L			MG/L
2651703	SODIUM DISSOLVED	1.8			
		MG/L			

REMARKS:

A. B. ...
FOR CHEMISTRY LABORATORY

SAMPLE NO. 512487W CONTINUED ON NEXT PAGE.

OCTOBER 1, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 512487W

FIELD TEST RESULTS

0040102	PH	6.5	0110102	SPECIFIC CONDUCT	70.
		REL. UNIT			UMHO/CM
0130101	TEMP. SAMPLING	15.			
		DEG.C			

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512871W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400122 GROUNDWATER SECTION 39 FT

SAMPLING DATE(S): SEP 24/75 1300 HRS
SAMPLE TYPE: FRESH WATER
SAMPLING DEPTH: 39
SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.7	0071701	RES:FILT.105C	42.4
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	62.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	26.	1041702	CHLORIDE:DISSOL	1.8
		MG/L			MG/L
1070002	HARDNES.T:CAC03	25.4	1091703	NITROGN:NO2 NO3	0.07
		MG/L			MG/L
1211701	SULPHATE:DISSOL	1.5	2541702	CALCIUM	8.8
		MG/L		DISSOLVED	MG/L
2570304	IRON	0.2	2591701	MAGNESIUM	0.83
	TOTAL	MG/L		DISSOLVED	MG/L
2590101	MAGNESIUM	0.83	2600301	MANGANESE	0.02
	TOTAL	MG/L		TOTAL	MG/L
2641703	POTASSIUM	0.2	2651703	SODIUM	1.8
	DISSOLVED	MG/L		DISSOLVED	MG/L

REMARKS:


FOR CHEMISTRY LABORATORY

SAMPLE NO. 512871W CONTINUED ON NEXT PAGE.

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512871W

FIELD TEST RESULTS

0040102	PH	7.	0110102	SPECIFIC CONDUCT	68.
		REL UNIT			UMHO/CM
0130101	TEMP. SAMPLING	15.			
		DEG.C			

OCTOBER 1, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512488W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400123 GROUNDWATER SECTION 11 FT

SAMPLING DATE(S): SEP 16/75 1700 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 11

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.7	0071701	RES:FILT.10SC	40.*
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	59.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	25.2	1041702	CHLORIDE:DISSOL	1.9
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	25.2	1091703	NITROGEN:NO2 NO3	0.09
		MG/L			MG/L
1211701	SULPHATE:DISSOL	15.0	2541702	CALCIUM DISSOLVED	8.5
		MG/L			MG/L
2570304	IRON TOTAL	1.9	2591701	MAGNESIUM DISSOLVED	0.96
		MG/L			MG/L
2600303	MANGANESE TOTAL	0.12	2641703	POTASSIUM DISSOLVED	0.4
		MG/L			MG/L
2651703	SODIUM DISSOLVED	1.9			
		MG/L			

REMARKS:

R. S. Sydnor
FOR CHEMISTRY LABORATORY

SAMPLE NO. 512488W CONTINUED ON NEXT PAGE.

OCTOBER 1, 1975

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B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512488W

FIELD TEST RESULTS

0040102	PH	7.	0110102	SPECIFIC CONDUCT	65.
		REL UNIT			UMHO/CM
0130101	TEMP. SAMPLING	21.			
		DEG.C			

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512870W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400123 GROUNDWATER SECTION 11 FT

SAMPLING DATE(S): SEP 24/75 1230 HRS

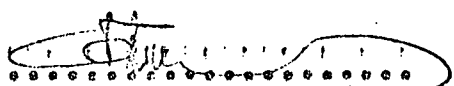
SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 14

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.8	0071701	RES:FILT.105C	36.*
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	61.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	25.5	1041702	CHLORIDE:DISSOL	1.7
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	25.4	1091703	NITROGN:NO2 NO3	0.09
		MG/L			MG/L
1211701	SULPHATE:DISSOL	L 5.	2541702	CALCIUM	8.8
		MG/L		DISSOLVED	MG/L
2570304	IRON	0.3	2591701	MAGNESIUM	0.84
	TOTAL	MG/L		DISSOLVED	MG/L
2590101	MAGNESIUM	0.84	2600301	MANGANESE	L 0.02
	TOTAL	MG/L		TOTAL	MG/L
2641703	POTASSIUM	0.3	2651703	SODIUM	1.7
	DISSOLVED	MG/L		DISSOLVED	MG/L

REMARKS:


FOR CHEMISTRY LABORATORY

SAMPLE NO. 512870W CONTINUED ON NEXT PAGE.

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 512870W

FIELD TEST RESULTS

0040102 PH

7.
REL UNIT

0110102 SPECIFIC CONDUCT

66.
UMHO/CM

0130101 TEMP. SAMPLING

19.
DEG. C

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

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WATER QUALITY REPORT FOR SAMPLE 512874W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400124 GROUNDWATER SECTION 35FT

SAMPLING DATE(S): SEP 24/75 1200 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 35

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.8	0071701	RES:FILT.105C	30.*
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	50.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	20.3	1041702	CHLORIDE:DISSOL	1.6
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	20.2	1091703	NITROGN:NO2 NO3	0.05
		MG/L			MG/L
1211701	SULPHATE:DISSOL	L 5.	2541702	CALCIUM	7.0
		MG/L		DISSOLVED	MG/L
2570304	IRON	L 0.1	2591701	MAGNESIUM	0.65
	TOTAL	MG/L		DISSOLVED	MG/L
2590101	MAGNESIUM	0.65	2600301	MANGANESE	L 0.02
	TOTAL	MG/L		TOTAL	MG/L
2641703	POTASSIUM	0.2	2651703	SODIUM	1.4
	DISSOLVED	MG/L		DISSOLVED	MG/L

REMARKS:


FOR CHEMISTRY LABORATORY

SAMPLE NO. 512874W CONTINUED ON NEXT PAGE.

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 512874W

FIELD TEST RESULTS

0040102 PH

7.
REL UNIT

0110102 SPECIFIC CONDUCT

50.
UMHO/CM

0130101 TEMP. SAMPLING

17.
DEG. C

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 1

WATER QUALITY REPORT FOR SAMPLE 512872W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400125 GROUNDWATER SECTION 36FT

SAMPLING DATE(S): SEP 24/75 1130 HRS
SAMPLE TYPE: FRESH WATER
SAMPLING DEPTH: 36
SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.8	0071701	RES:FILT.105C	36.8
		REL UNIT			MG/L
0110101	SPECIFIC CONDC	55.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	22.8	1041702	CHLORIDE:DISSOL	1.6
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	22.5	1091703	NITROGN:NO2 NO3	0.09
		MG/L			MG/L
1211701	SULPHATE:DISSOL	15.	2541702	CALCIUM	7.8
		MG/L		DISSOLVED	MG/L
2570304	IRON	0.2	2591701	MAGNESIUM	0.74
	TOTAL	MG/L		DISSOLVED	MG/L
2590101	MAGNESIUM	0.74	2600301	MANGANESE	0.02
	TOTAL	MG/L		TOTAL	MG/L
2641703	POTASSIUM	0.3	2651703	SODIUM	1.7
	DISSOLVED	MG/L		DISSOLVED	MG/L

REMARKS:

FOR CHEMISTRY LABORATORY

OCTOBER 9, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 512872W

FIELD TEST RESULTS

0040102 PH

7.
REL UNIT

0110102 SPECIFIC CONDUCT

60.
UMHO/CM

0130101 TEMP. SAMPLING

18.5
DEG.C

NOVEMBER 18, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 1

WATER QUALITY REPORT FOR SAMPLE 514527W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400130 GROUNDWATER SECTION 104FT

SAMPLING DATE(S): NOV 4/75 1730 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 104

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	7.4	0071701	RES:FILT.105C	58.
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	74.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	32.5	1041702	CHLORIDE:DISSOL	1.9
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	32.	1091703	NITROGN:NO2 NO3	L 0.02
		MG/L			MG/L
1211701	SULPHATE:DISSOL	L 5.0	2541702	CALCIUM DISSOLVED	9.2
		MG/L			MG/L
2570304	IRON TOTAL	0.4	2591701	MAGNESIUM DISSOLVED	2.2
		MG/L			MG/L
2590103	MAGNESIUM TOTAL	2.2	2600301	MANGANESE TOTAL	0.06
		MG/L			MG/L
2641703	POTASSIUM DISSOLVED	0.3	2651703	SODIUM DISSOLVED	2.5
		MG/L			MG/L

REMARKS:

M. Donlan

 FOR CHEMISTRY LABORATORY

NOVEMBER 18, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 514527W

FIELD TEST RESULTS

0040102	PH	7.75	0110102	SPECIFIC CONDUCT	80.
		REL UNIT			UMHO/CM
0130101	TEMP. SAMPLING	12.			
		DEG.C			

NOVEMBER 18, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 1

WATER QUALITY REPORT FOR SAMPLE 514528W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400130 GROUNDWATER SECTION 104FT

SAMPLING DATE(S): NOV 5/75 1200 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 104

SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	7.4	0071701	RES:FILT.105C	60.
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	75.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	33.5	1041702	CHLORIDE:DISSOL	2.0
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	32.	1091703	NITROGN:NO2 NO3	L 0.02
		MG/L			MG/L
1211701	SULPHATE:DISSOL	L 5.0	2541702	CALCIUM	9.2
		MG/L		DISSOLVED	MG/L
2570304	IRON	0.3	2591701	MAGNESIUM	2.2
	TOTAL	MG/L		DISSOLVED	MG/L
2590103	MAGNESIUM	2.2	2600301	MANGANESE	0.07
	TOTAL	MG/L		TOTAL	MG/L
2641703	POTASSIUM	0.3	2651703	SODIUM	2.5
	DISSOLVED	MG/L		DISSOLVED	MG/L

REMARKS:

McDon Par
FOR CHEMISTRY LABORATORY

NOVEMBER 18, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 514528W

FIELD TEST RESULTS

0040102	PH	7.75	0110102	SPECIFIC CONDUCT	80.
		REL UNIT			UMHO/CM
0130101	TEMP. SAMPLING	12.			
		DEG.C			

DECEMBER 29, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 1

WATER QUALITY REPORT FOR SAMPLE 516074W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B C

FOR SITE: 1400130

GROUNDWATER

152 FEET

SAMPLING DATE(S): DEC 10/75 1030 HRS

SAMPLE TYPE: FRESH WATER

SAMPLING DEPTH: 69

SAMPLED BY: W.I.D. - HYDROLOGY

0040101	PH	7.0	0071701	RES:FILT.105C	46.0
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	64.0	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	28.4	1041702	CHLORIDE:DISSOL	1.8
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	28.2	1091703	NITROGN:NO2 NO3	0.09
		MG/L			MG/L
1211701	SULPHATE:DISSOL	5.0	2541702	CALCIUM DISSOLVED	9.5
		MG/L			MG/L
2570304	IRON TOTAL	0.2	2591701	MAGNESIUM DISSOLVED	1.1
		MG/L			MG/L
2590103	MAGNESIUM TOTAL	1.1	2600303	MANGANESE TOTAL	0.02
		MG/L			MG/L
2641703	POTASSIUM DISSOLVED	0.1	2651703	SODIUM DISSOLVED	1.7
		MG/L			MG/L

REMARKS:


 FOR CHEMISTRY LABORATORY

DECEMBER 29, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 516074W

FIELD TEST RESULTS

0040102 PH

7.25
REL UNIT

0110102 SPECIFIC CONDUCT

60.
UMHO/CM

0130101 TEMP. SAMPLING

11.
DEG. C

DECEMBER 29, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

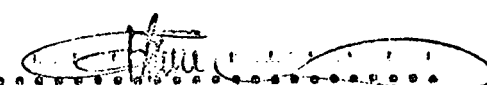
PAGE 1

WATER QUALITY REPORT FOR SAMPLE 516076W

TO: WATER INVESTIGATIONS BR
WATER RES PARLMT BLDGS
VICTORIA B CFOR SITE: 1400130 GROUNDWATER ^{69'} 152 FEETSAMPLING DATE(S): DEC 11/75 0930 HRS
SAMPLE TYPE: FRESH WATER
SAMPLING DEPTH: 69
SAMPLED BY: W.I.B. - HYDROLOGY

0040101	PH	6.9	0071701	RES:FILT.10SC	44.
		REL UNIT			MG/L
0110101	SPECIFIC CONDUCT	66.	0300101	COMP.DIL.COND.	N
		UMHO/CM			UMHO/CM
1020101	ALKALINITY:TOT	29.2	1041702	CHLORIDE:DISSOL	1.8
		MG/L			MG/L
1070002	HARDNES.T:CaCO3	28.7	1091703	NITROGN:NO2 NO3	0.09
		MG/L			MG/L
1211701	SULPHATE:DISSOL	1.5	2541702	CALCIUM	9.7
		MG/L		DISSOLVED	MG/L
2570304	IRON	0.1	2591701	MAGNESIUM	1.1
	TOTAL	MG/L		DISSOLVED	MG/L
2590103	MAGNESIUM	1.1	2600301	MANGANESE	0.02
	TOTAL	MG/L		TOTAL	MG/L
2641703	POTASSIUM	0.2	2651703	SODIUM	1.9
	DISSOLVED	MG/L		DISSOLVED	MG/L

REMARKS:


 FOR CHEMISTRY LABORATORY

SAMPLE NO. 516076W CONTINUED ON NEXT PAGE.

DECEMBER 29, 1975

ENVIRONMENTAL LABORATORY
B.C. WATER RESOURCES SERVICE

PAGE 2

WATER QUALITY REPORT FOR SAMPLE 516076W

FIELD TEST RESULTS

0040102 PH

7.25
REL UNIT

0110102 SPECIFIC CONDUCT

60.
UMHO/CM

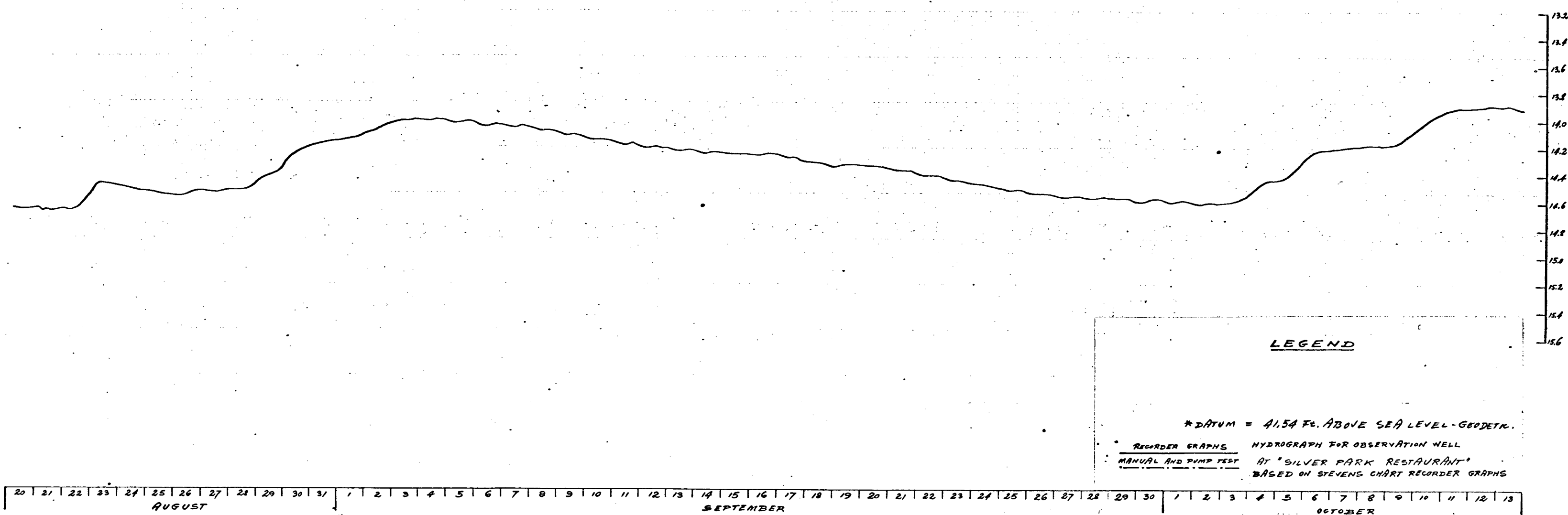
0130101 TEMP. SAMPLING

11.
DEG.C

APPENDIX NO. 8

HYDROGRAPHS FOR MONITOR WELLS COMPARED
WITH HYDROGRAPH BASED ON CALCULATED
WATER HEIGHTS OF THE COWICHAN RIVER NEAR
THE TEST WELL SITE AT DUNCAN, B. C.

WATER LEVEL BELOW DATUM IN FEET

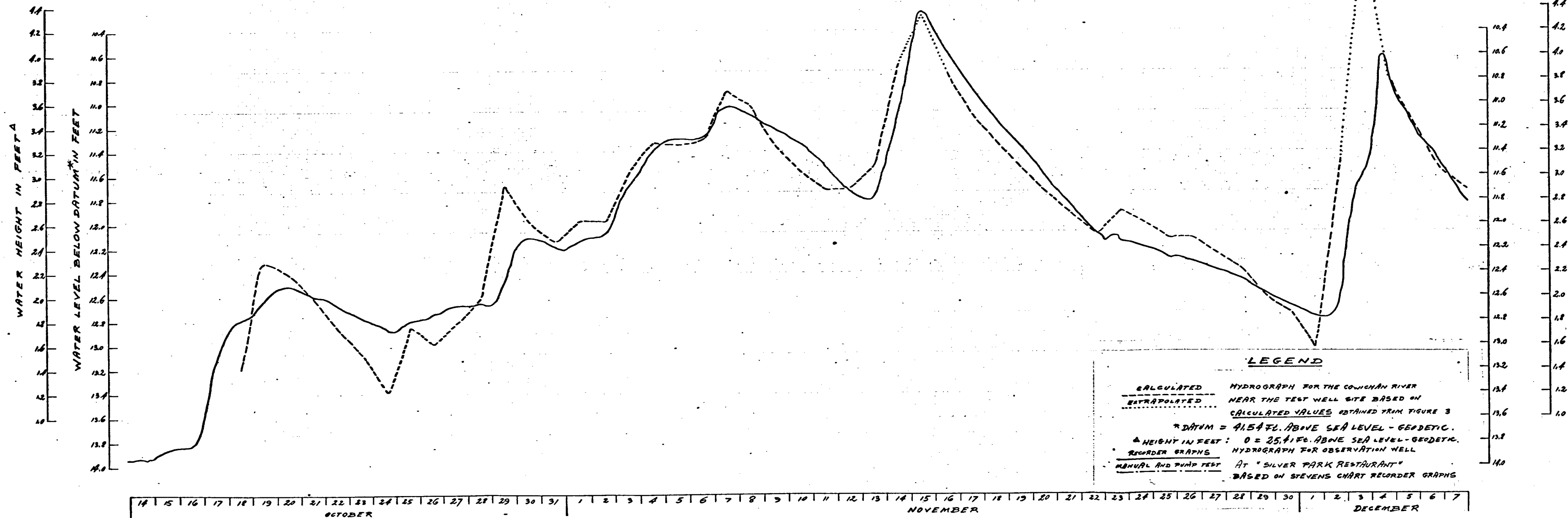


LEGEND

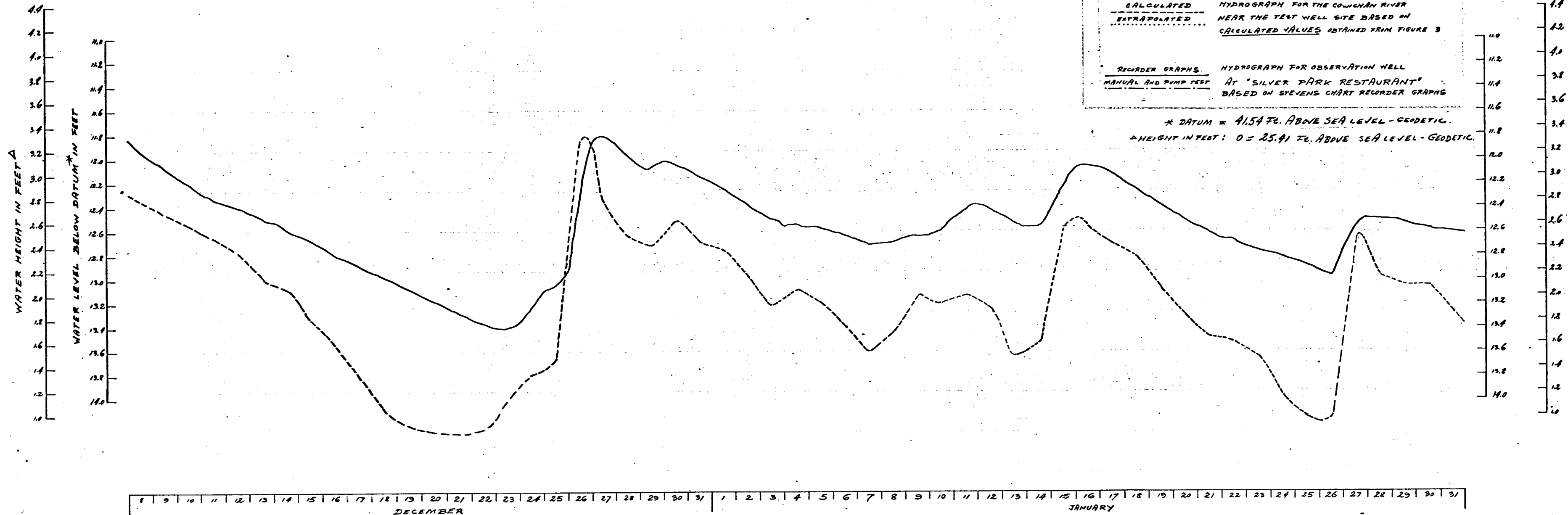
* DATUM = 41.54 FT. ABOVE SEA LEVEL - GEODETIC.

RECORDED GRAPHS HYDROGRAPH FOR OBSERVATION WELL
MANUAL AND PUMP TEST AT "SILVER PARK RESTAURANT"
BASED ON STEVENS CHART RECORDER GRAPHS

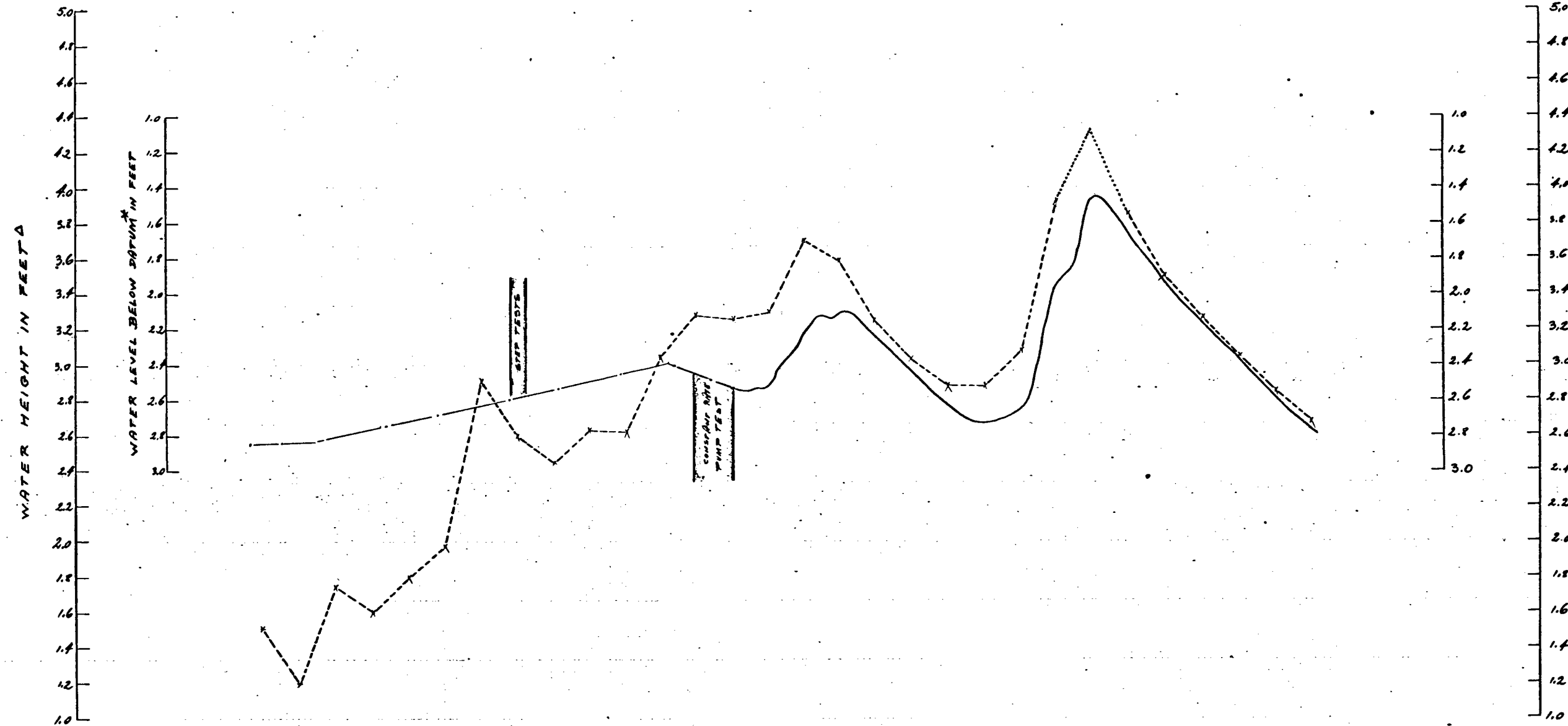
CONSTRUCTED AND DRAWN BY F. CHVOTKA	HYDROGRAPH FOR OBSERVATION WELL AT "SILVER PARK RESTAURANT" AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COMICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COMICHAN RIVER AQUIFERS DUNCAN B.C. J. FOWERAKER DATE FEB. 1976 FILE NO. 0239013
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CONSTRUCTED AND DRAWN BY F. C. WOTKA	HYDROGRAPH FOR OBSERVATION WELL AT "SILVER PARK RESTAURANT" AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.
	SCALE: VERT. AS SHOWN HOR. 1" = 1 DAY	DATE FEB. 1976	J. FOWLERAKER NO. 0239013 APP. 8, FIG. 3A



CONSULTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL AT "SILVER PARK RESTAURANT" AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.
	SCALE: VERT. AS SHOWN HOR. " "	DATE FEB. 1976	J. FOWERAKER ENGINEER FILE NO. 0239013



LEGEND

--- CALCULATED --- EXTRAPOLATED Hydrograph for the Cowichan River near Test Well Site
Based on calculated values obtained from Figure 3

--- RECORDED GRAPHS --- MANUAL AND PUMP TESTS Hydrograph for Observation Well 131
Based on Stevens Chart Recorder Graphs

* DATUM = 28.96 FT. ABOVE SEA LEVEL - GEODETIC.
Δ HEIGHT IN FEET: 0 = 25.41 FT. ABOVE SEA LEVEL - GEODETIC.

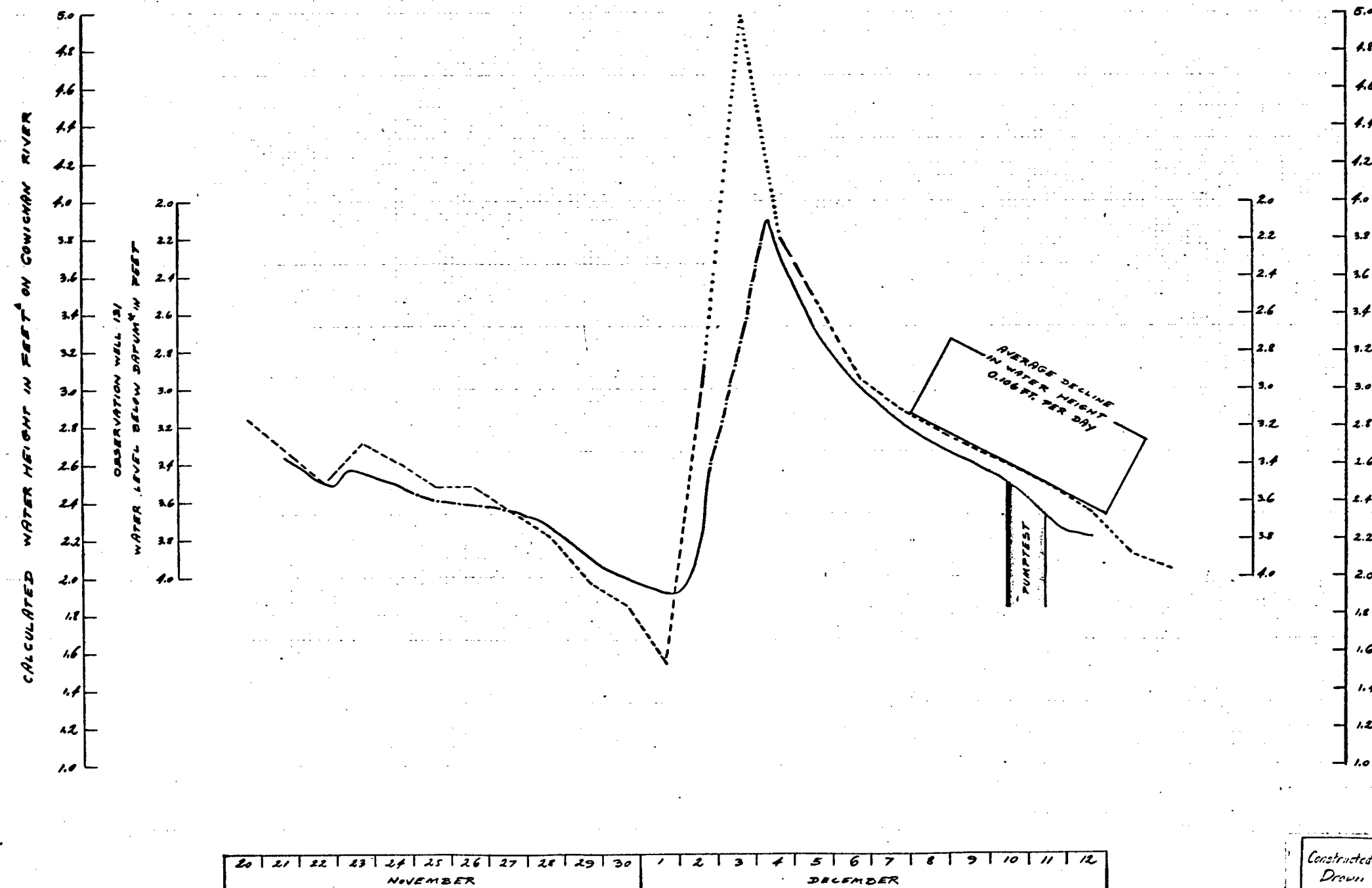
23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
OCTOBER NOVEMBER

Constructed and
Drawn by
F. CHWOTKA

Hydrograph for Observation Well 131
and
Hydrograph based on calculated water
heights of the Cowichan River near
the Test Well Site at Duncan B.C.

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Groundwater Research Project
Cowichan River Aquifers
Duncan B.C.
J. Foweraker
DEC. 1975
FIG. 2239013
FIGURE NO. 8



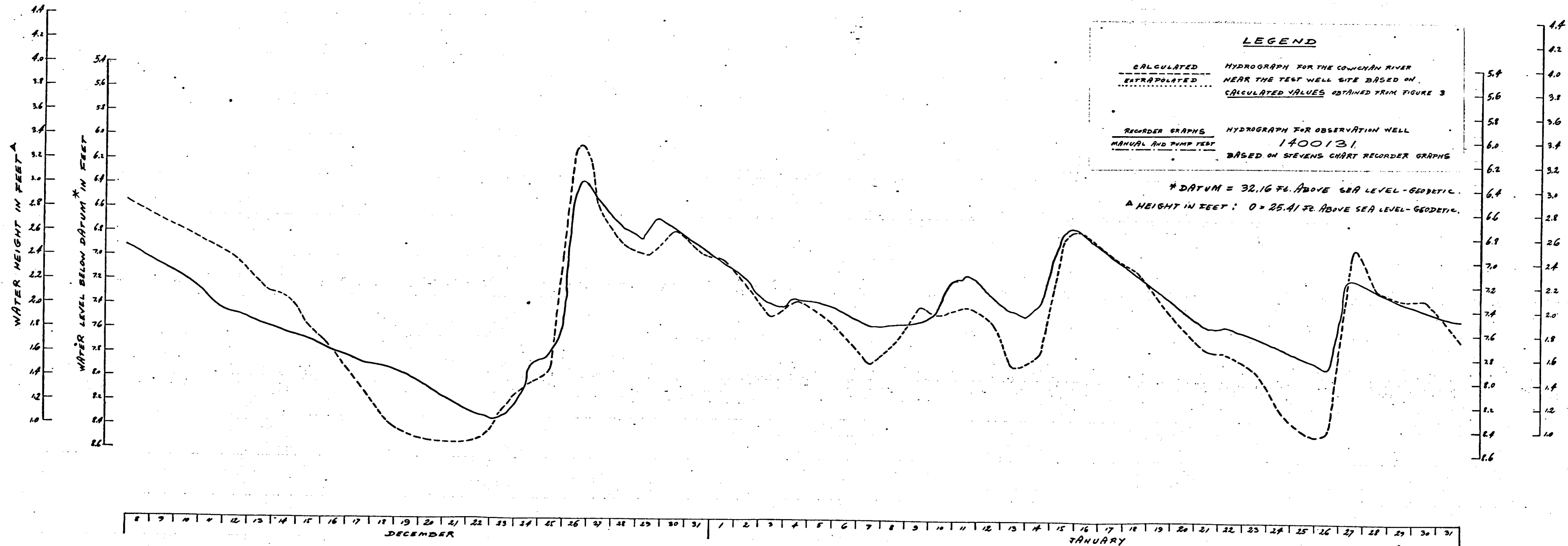
LEGEND

--- CALCULATED --- EXTENDED --- Hydrograph for the Cowichan River near Test Well Site
 Based on calculated values obtained from Figure 3

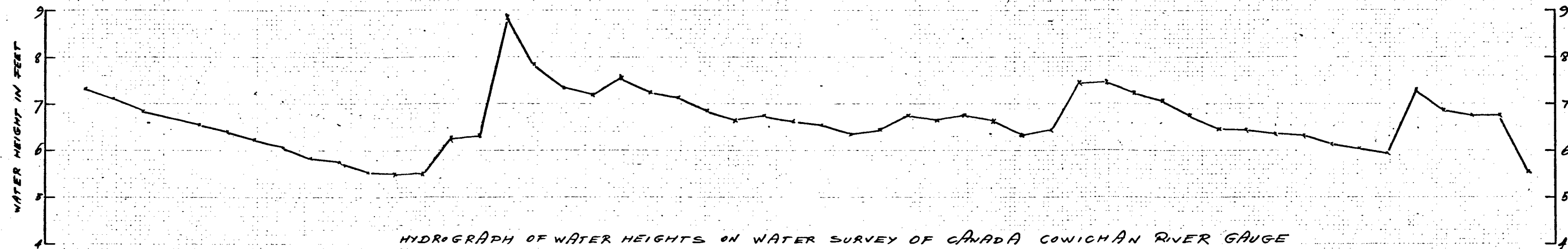
— RECORDER GRAPHS — PUMPTESTS — Hydrograph for Observation Well 131
 Based on Stevens Chart Recorder Graphs

* DATUM = 28.96 FT. ABOVE SEA LEVEL - GEODETIC.
 * HEIGHT IN FEET: 0 = 25.91 FT. ABOVE WA LEVEL - GEODETIC.

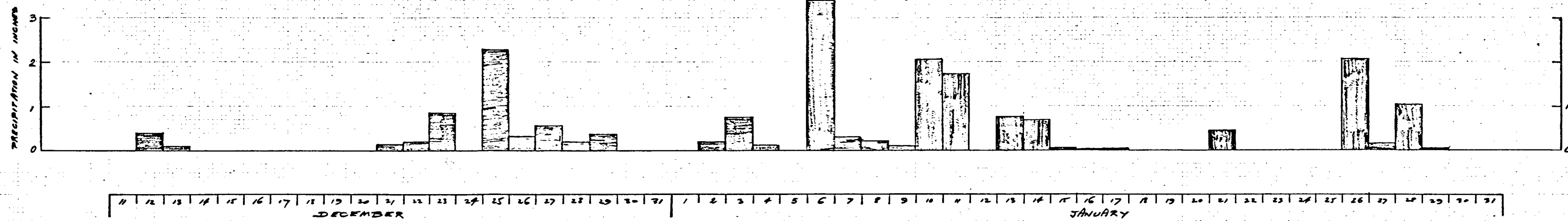
Constructed and Drawn by F. CHWOTKA	Hydrograph for Observation Well 131 and Hydrograph based on calculated water heights of the Cowichan River near the Test Well Site at Duncan B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	NO. ACCOMPANYING REPORT ON Groundwater Research Project Cowichan River Aquifers Duncan B.C.
		SCALE: VERT. 1" = 2.0' HORIZ. 1" = 1 DAY DATE: DEC 1975 FILE NO. 2232913	DATE: DEC 1975 FILE NO. 2232913 DRAWN BY: F. CHWOTKA



CONSTRUCTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL 1400131 AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.
	SCALE: VERT. AS SHOWN HOR. 1" = 1 DAY	DATE FEB. 1976	J. FOWERAKER ENGINEER



HYDROGRAPH OF WATER HEIGHTS ON WATER SURVEY OF CANADA COWICHAN RIVER GAUGE
NO: 84A011 NEAR DUNCAN, B.C.



COMPARISON BETWEEN WATER HEIGHTS IN THE COWICHAN RIVER, NEAR DUNCAN AND PRECIPITATION		BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON CONTRACT NO. 60 GROUND-WATER RESEARCH PROJECT COWICHAN RIVER GAUGES DUNCAN, B.C. J.C. FINERBAKER MONTH
SCALE: VERT. AS SHOWN	DATE: FEB. 1975	FILE NO. 0239013 INC. IN APP. 216.2		

WATER HEIGHT IN FEET

WATER LEVEL BELOW DATUM IN FEET

4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0

14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 1 2 3 4 5 6 7
OCTOBER NOVEMBER DECEMBER

LEGEND

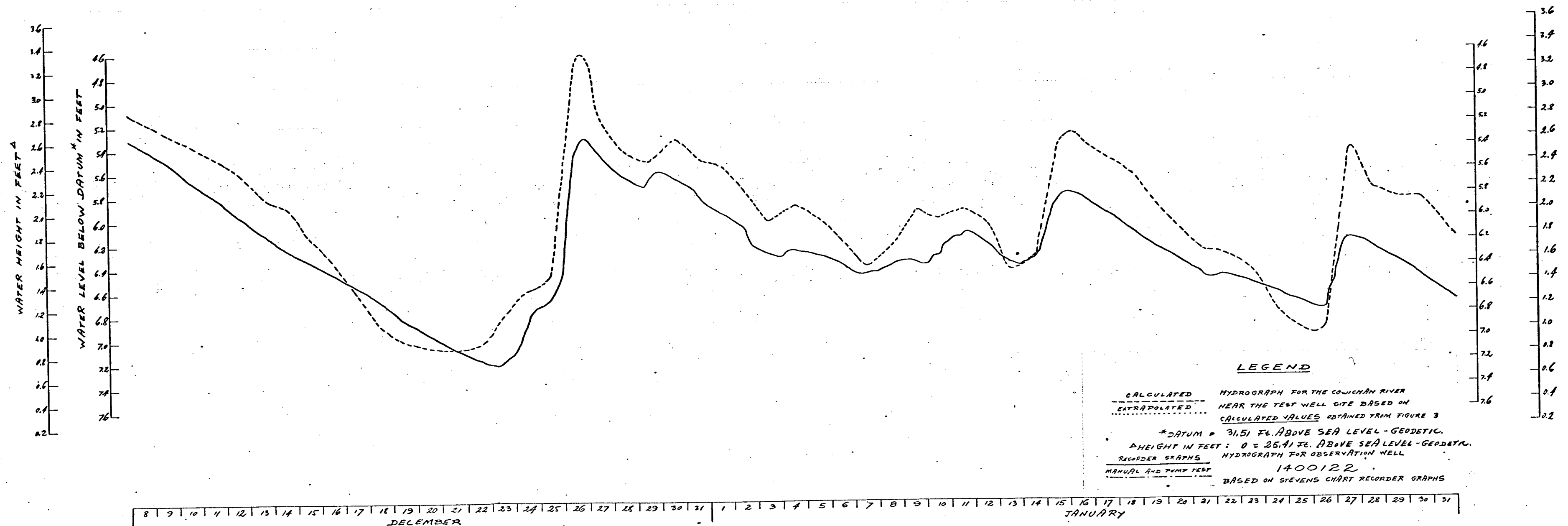
CALCULATED HYDROGRAPH FOR THE COWICHAN RIVER
NEAR THE TEST WELL SITE BASED ON
EXTRAPOLATED CALCULATED VALUES OBTAINED FROM FIGURE 3

* DATUM = 31.51 FEET ABOVE SEA LEVEL - GEODETIC.
Δ HEIGHT IN FEET: 0 = 25.41 FEET ABOVE SEA LEVEL - GEODETIC.
RECORDED GRAPHS HYDROGRAPH FOR OBSERVATION WELL

MANUAL AND PUMP TEST 1400122
BASED ON STEVENS CHART RECORDER GRAPHS

4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0

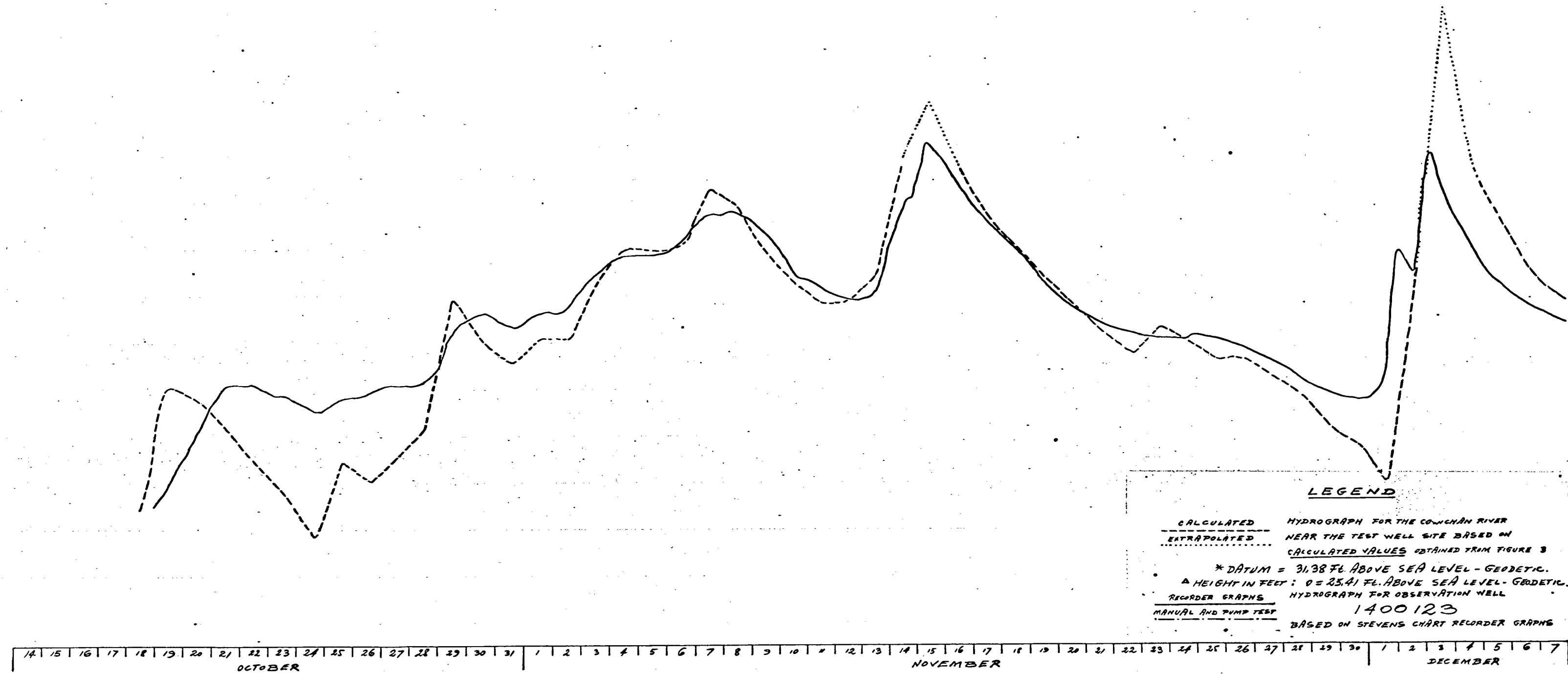
CONSTRUCTED AND DRAWN BY F. C. WOSKA	HYDROGRAPH FOR OBSERVATION WELL 1400122 AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH SCALE: VERT. AS SHOWN HORIZ. 1"	DATE FEB. 1976	TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C. J. FOWERAKER FILE NO. 0239013
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CONSTRUCTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL 1400122	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.
	AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	SCALE: VERT. AS SHOWN HOR. 1"	DATE FEB. 1976	INSNOR J. FOWERAKER 1:12 NO. 0239013

WATER HEIGHT IN FEET Δ

WATER LEVEL BELOW DATUM * IN FEET



CONSTRUCTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL 1400123 AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH SCALE: VERT. AS SHOWN DATE FEB. 1976	TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C. J. FOWERAKER 0239013 APP. 8, FIG. 5
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WATER HEIGHT IN FEET
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0

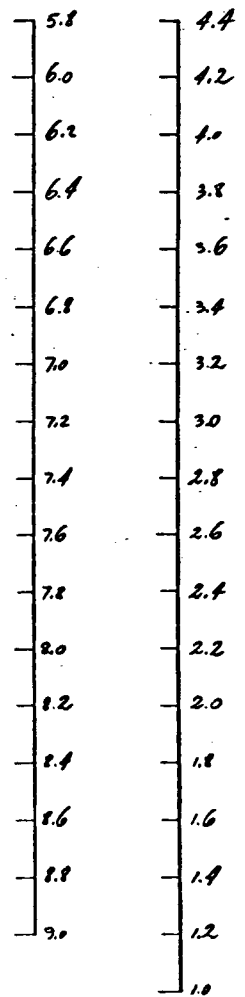
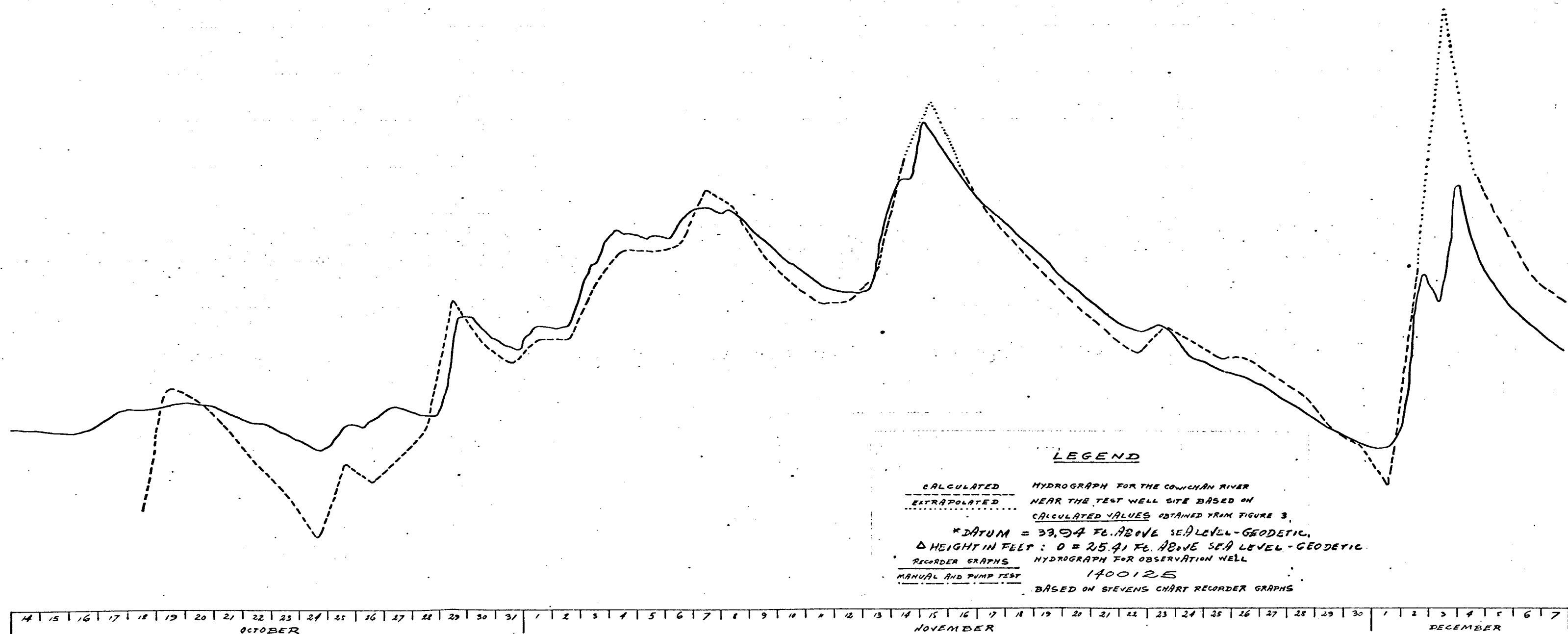
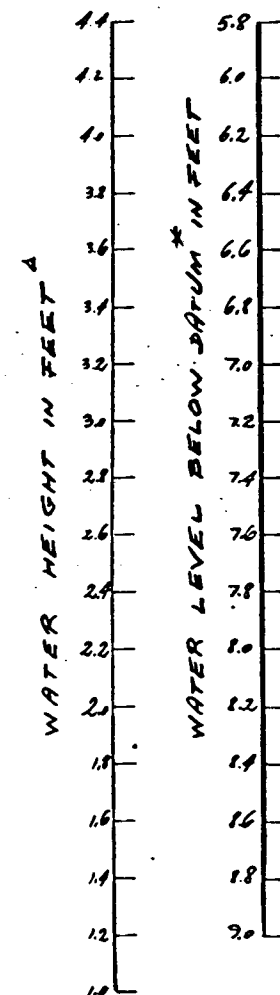
WATER LEVEL BELOW DATUM IN FEET
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
-1.6
-1.8
-2.0
-2.2
-2.4
-2.6
-2.8
-3.0
-3.2
-3.4
-3.6
-3.8
-4.0
-4.2
-4.4
-4.6
-4.8
-5.0
-5.2
-5.4
-5.6
-5.8
-6.0
-6.2
-6.4
-6.6
-6.8
-7.0

1 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
DECEMBER JANUARY

LEGEND
CALCULATED HYDROGRAPH FOR THE COWICHAN RIVER
EXTRAPOLATED NEAR THE TEST WELL SITE BASED ON
CALCULATED VALUES OBTAINED FROM FIGURE 3
RECORDER GRAPHS HYDROGRAPH FOR OBSERVATION WELL
MANUAL AND PUMP TEST 1400123
BASED ON STEVENS CHART RECORDER GRAPHS
* DATUM = 31.38 FT. ABOVE SEA LEVEL - GEODETIC.
A HEIGHT IN FEET : D = 25.41 FT. ABOVE SEA LEVEL - GEODETIC.

4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
-1.6
-1.8
-2.0
-2.2
-2.4
-2.6
-2.8
-3.0
-3.2
-3.4
-3.6
-3.8
-4.0
-4.2
-4.4
-4.6
-4.8
-5.0
-5.2
-5.4
-5.6
-5.8
-6.0
-6.2
-6.4
-6.6
-6.8
-7.0

CONSTRUCTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL 1400123 AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.	
		SCALE: VERT. AS SHOWN HOR. 1"	DATE FEB. 1976	J. FOWERAKER ENGINEER FILE NO. 0239013 DWG. No. APP. 8 FIG. 5 A	



LEGEND

SOLID LINE: CALCULATED HYDROGRAPH FOR THE COWICHAN RIVER NEAR THE TEST WELL SITE BASED ON CALCULATED VALUES OBTAINED FROM FIGURE 3.

DASHED LINE: RECORDER GRAPHS HYDROGRAPH FOR OBSERVATION WELL 1400125 BASED ON STEVENS CHART RECORDER GRAPHS.

DOTTED LINE: MANUAL AND PUMP TEST

*DATUM = 33.94 FT. ABOVE SEA LEVEL - GEODETIC.
 Δ HEIGHT IN FEET: 0 = 25.41 FT. ABOVE SEA LEVEL - GEODETIC.

CONSTRUCTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL 1400125 AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.
		SCALE: VERT. AS SHOWN HORIZ. 1" = 1 DAY	DATE FEB. 1976	ENGINEER J. FOWERAKER FILE NO. 0239013

WATER HEIGHT IN FEET
34
32
30
28
26
24
22
20
18
16
14
12
10
9.8

WATER LEVEL BELOW DATUM IN FEET
7.0
7.2
7.4
7.6
7.8
8.0
8.2
8.4
8.6
8.8
9.0
9.2
9.4
9.6
9.8

8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
DECEMBER

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
JANUARY

LEGEND

CALCULATED
EXTRAPOLATED

HYDROGRAPH FOR THE COWICHAN RIVER
NEAR THE TEST WELL SITE BASED ON
CALCULATED VALUES OBTAINED FROM FIGURE 3

RECORDER GRAPHS
MANUAL AND PUMP TEST

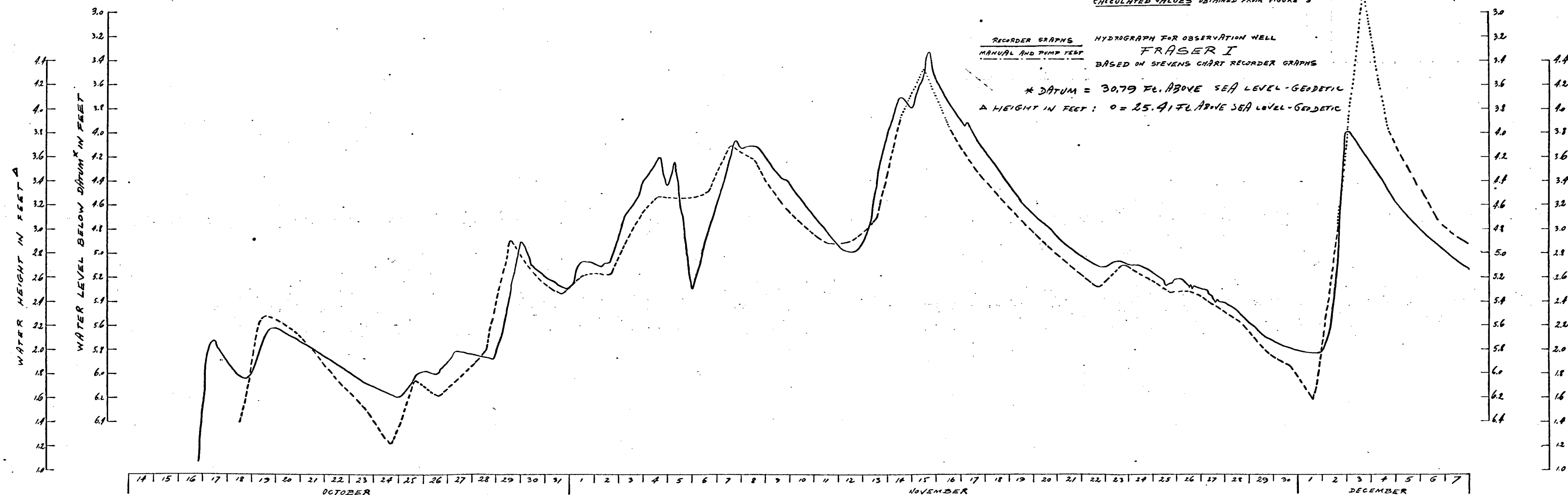
HYDROGRAPH FOR OBSERVATION WELL
1400125
BASED ON STEVENS CHART RECORDER GRAPHS

* DATUM = 33.94 FT. ABOVE SEA LEVEL - GEODETIC
Δ HEIGHT IN FEET : 0 = 25.41 FT. ABOVE SEA LEVEL - GEODETIC

7.0
7.2
7.4
7.6
7.8
8.0
8.2
8.4
8.6
8.8
9.0
9.2
9.4
9.6
9.8

3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0

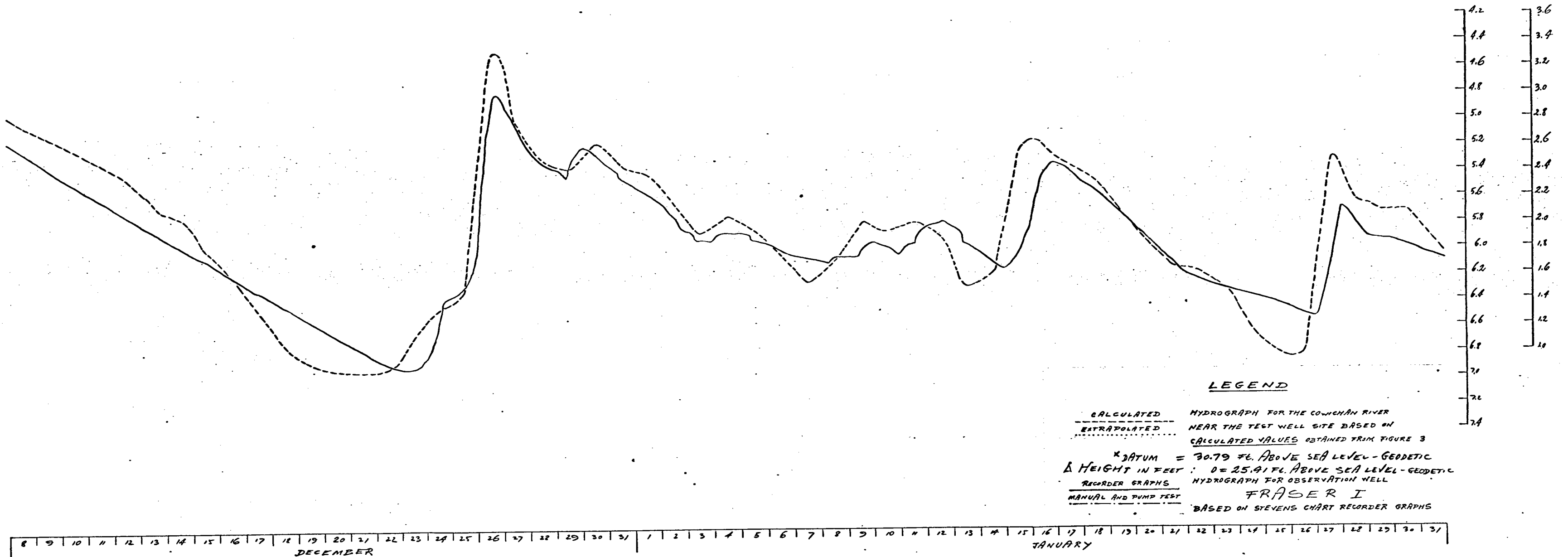
CONSTRUCTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL 1400125 AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.	
		SCALE: VERT. AS SHOWN HOR. 1" = 1 DAY	DATE FEB. 1976	J. FOWERAKER FILE NO. 0239013 APR. 1976, FIG. 6A	



CONSTRUCTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL FRASER I AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.
	SCALE: VERT. AS SHOWN HOR. 1" = 1 DAY	DATE FEB. 1976	J. FOWERAKER ENGINEER

WATER HEIGHT IN FEET A

WATER LEVEL BELOW DRYUM IN FEET *



CONSTRUCTED AND DRAWN BY F. CHWOTKA	HYDROGRAPH FOR OBSERVATION WELL FRASER I AND HYDROGRAPH BASED ON CALCULATED WATER HEIGHTS OF THE COWICHAN RIVER NEAR THE TEST SITE AT DUNCAN B.C.	BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	TO ACCOMPANY REPORT ON GROUNDWATER RESEARCH PROJECT COWICHAN RIVER AQUIFERS DUNCAN B.C.
	SCALE: VERT. AS SHOWN HOR. 1"	DATE FEB. 1976	FILE NO. 0239013 SHEET NO. 1 OF 1 FIG. 7A