GOVERNMENT OF BRITISH COLUMBIA

MEMORANDUM

TO: A. P. Kohut
Senior Geological Engineer
Groundwater Section
Hydrology Division
Water Investigations Branch

FROM: N. T. Lomas
Engineering Aide
Groundwater Section

March 7 19 78

SUBJECT: Report on Alert Bay Production Well

OUR FILE: 92 L/10 #14

YOUR FILE:

The purpose of this report is to assess all the data obtained from the Alert Bay Production well during its first year of operation.

Background

The Alert Bay Production well was drilled and tested between August 1974 and May 1975. The well is centrally located on the east end of Cormorant Island, total area of 1.75 square miles, the possible recharge area for the well being estimated at 0.8 square miles (500 acres). The site is located close to the Alert Bay Airstrip, the well head elevation is 208.6 feet above mean sea level, the non-pumping water level being 203.5 feet below top of casing ie. five feet above mean sea level. The well log shows 3 feet of clay to surface then slightly cemented silty sand and gravel down to 155 feet, then coarser sand and gravel to 160 feet. From 160 feet down to the start of the aquifer at 307 feet various layers of fine clean sand and silty sand with clay lenses were encountered. A saturated area was recorded between the 213 foot and 230 foot interval. The continuous slot screen assembly is set between 324.7 feet and 357.7 feet. It is reported that this aquifer responds to barometric loading and is therefore confined, the confining layer being the compacted silty sand. No response to tidal fluctuations were noted however continuous hydrograph records were poor due to recorder malfunction caused by the low static water level.

System Operation

A submersible pump was installed in the well during the fall of 1976. Preliminary start up was in late September 1976, the well going into continuous operation early in October 1976. The pump is operating at a rate of 70 USgpm for approximately 70% of the time. Since the initial start to present date, a total of 37 million gallons has been pumped. Between January 31, 1977 and February 1, 1978 28 million gallons were used, this is equal to approximately 53 USgpm of continuous pumping.

Hydrograph Analysis

Since pumping started, water level readings have been taken on a daily basis. Pressure gauge readings in conjunction with electric well line readings were taken until March 1977 when only pressure gauge readings were taken. The inaccuracy of the pressure gauge readings necessitated reinstating the electric well line readings in October 1977.

E.N.L 16/3/78

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A copy of the hydrograph is attached. From the hydrograph it can be seen visually that there is no apparent decline in the water table. It can also be seen that there is very little fluctuation throughout the 16 month period of record. The greatest fluctuation appears in August 1977, this shows a change in water level of two feet. The fact that the graph shows an increase in water level during July 1977 indicates the unrealiability of these pressure gauge readings. For this and other reasons the writer has ignored any readings taken with the pressure gauge system. The greatest fluctuation noted with the electric well line appears to be in the area of 0.8 feet. This poses some questions, where does the aquifer receive its recharge? Is the seasonal response to rainfall so small that it is masked by pumping conditions, or is there little or no seasonal response?

If we assume a storage factor of 10^{-2} and an aquifer area equal to the local recharge area ~~is~~ 500 acres; then the amount of storage in 0.5 feet (possible seasonal response to rainfall) of aquifer is equivalent to 1.5 USgpm. As approximately 50 USgpm is presently being withdrawn with no water table decline it can be concluded that

not necessarily assumptions are not necessarily correct

(a) the storage factor is too low
(b) the real extent of the aquifer is very large
(c) recharge is from a source other than rainfall alone

From item (a) above, increasing the storage to 10^{-1} does not solve the problem. Having an aquifer of great enough extent (b) is unlikely unless the aquifer extends under the ocean floor. This leaves item (c) recharge from another source. It is the writers feeling that the possibility of a hydraulic connection between the aquifer and the sea should not be ruled out. If this were the case, using the theory of 40 feet of fresh water below sea level for every foot of water above sea level, then the approximate thickness of the fresh water lens would be 205 feet. Using a storage factor of 10^{-2} and an aquifer area of 500 acres, this gives a total of 340 million gallons of available fresh water. Using a storage factor of 10^{-1} this amounts to 3,400 million gallons of available fresh water.

If one should see changes in water quality even after one year.

Assuming that there is no recharge to this aquifer from rainfall it is probable that the fresh water lens will eventually be reduced and a change in water quality noticed. A decline in water table should also be noticed after a sufficient amount of fresh water has been withdrawn. Because of the number of variables affecting the reduction of this fresh water lens, it is difficult to forecast the time interval at which mining will become apparent.

Chemistry Analysis

During the intial drilling phases of the Airport well, several water samples were taken for analysis. One sample was taken in September 1976, the last one being taken in September 1977.

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On comparison of all the available analyses, it can be seen that there has been little change since pumping started. Only one parameter has increased, that being Total Alkalinity, all the others have dropped slightly or remained the same.

Schoeller plots were made for analysis from the Airport well, Huson well and Synod well. The results of these plots show that the chemical characteristics of the groundwater in all three wells are similar. The possibility exists that all these wells are in the same aquifer, not on the basis of chemistry alone, but also due to the fact that the static water level in all three wells are similar.

may or may not be true

Future Requirements

The present operation and monitoring appears to be adequate. Chloride content of the water is being tested weekly, using Hach chemicals, it is important to keep this up. It seems that water chemistry is the key factor affecting this well with its present demand. Complete chemical analysis has been done through the Government Laboratory on an annual basis, this assistance should be continued indefinitely.

The aquifer response to seasonal recharge due to rainfall appears to be small or non-existant. An increase in development of the Island would reduce the amount of recharge even more ie. increase the amount of run-off, and at the same time increase the demand on the system. Increased pumping rate or increased annual withdrawal are also factors which may affect long-term use. A careful watch should be kept on the pumping and non-pumping water levels.

not known must be recharge because W.L. is not declining

Recommendations

It would be advantageous to keep the pumping rate as close to system demand as possible. Using the reported well efficiency of 20%, a pumping rate of less than 125 USgpm would leave the pumping water level outside the well, above mean sea level. The present pumping rate of 70 USgpm appears to be ideal.

Monitoring of the system must be kept up with special emphasis on water levels and water quality. A complete chemistry analysis should be conducted annually. This service has beenddone through the Government Laboratory in Vancouver at our cost, and should be continued. Newly initiated sampling procedures may require an annual visit by a Groundwater staff member.

A sample of water from the Synod well, Huson well and Airport well could be taken for Isotope Analysis (O^{18} and Tritium). This could reveal interesting information as to the age and origin of the water (carbon dating may also be of interest, but may be expensive).

Finally for general information purposes the Huson well water level should be surveyed, along with the Hospital well and Synod well if time permits.

Nigel T. Lomas

N. T. Lomas

Attachment List:

Hydrographs: Airport well
Huson well

Water Chemistry Analysis: Airport well, September 1976 and September 1977

Schoeller Plots: Airport well, Synod well, Huson well

NTL/dmc

B.C. WATER RESOURCES SERVICE

WATER QUALITY REPORT FOR SAMPLE 615677W

TO: WATER INVESTIGATIONS BR
1106 COOK ST.
VICTORIA,B.C. V8V 3Z9

FOR SITE: 1400011 ALERT BAY AIRPORT WELL

SAMPLING DATE(S): SEP 30/76 1700 HRS TO SEP 30/76 1705 HRS
SAMPLE TYPE: FRESH WATER
SAMPLING DEPTH: 297
SAMPLED BY: W.I.B. - HYDROLOGY
DATE RECEIVED BY LABORATORY: OCT 05/76

0040101	PH	[illegible] K	0071701	RES:FILT,105C	118.
		REL UNIT			MG/L
0110101	SPECIFIC CONDUC	187.	0300101	COMP.DIL.COND.	193.
		UMHO/CM			UMHO/CM
1010101	ALKALINITY:PHNL	[illegible] K	1020101	ALKALINITY:TOT	[illegible] K
		MG/L			MG/L
1041702	CHLORIDE:DISSOL	9.6*	1070002	HARDNES.T:CACO3	67.*
		MG/L			MG/L
1091703	NITROGN:NO2 NO3	[illegible] K	1130101	NITROGN:KJELDAH	K
		MG/L			MG/L
1191703	PHOSPHORUS :TOT	[illegible] K	1211701	SULPHATE:DISSOL	8.3*
	DISSOLVED	MG/L			MG/L
2541702	CALCIUM	19.4*	2570304	IRON	<0.1
	DISSOLVED	MG/L		TOTAL	MG/L
2571802	IRON	K	2591701	MAGNESIUM	4.5
	DISSOLVED	MG/L		DISSOLVED	MG/L
2601801	MANGANESE	K	2641703	POTASSIUM	2.0
	DISSOLVED	MG/L		DISSOLVED	MG/L
2651703	SODIUM	10.4*			
	DISSOLVED	MG/L			

REMARKS:

Alkalinity:Total	65.3 mg/l
Alkalinity:Phenolpthalein	<0.5 mg/l
pH	8.3 rel units
Nitrogen, NO_2+NO_3	2.10 mg/l
Nitrogen,Kjeldahl	<0.01 mg/l
Phosphorus, Total Dissolved	0.030 mg/l
Manganese	<0.02 mg/l

Above parameters analyzed 5 October 1976

FOR ENVIRONMENTAL LABORATORY

SAMPLE NO. 615677W CONTINUED ON NEXT PAGE.

OCTOBER 20, 1977 ENVIRONMENTAL LABORATORY PAGE 1
MINISTRY OF THE ENVIRONMENT

WATER QUALITY REPORT FOR SAMPLE 718457W

TO: WATER INVESTIGATIONS BR
1106 COOK ST.
VICTORIA, B.C. V8V 3Z9

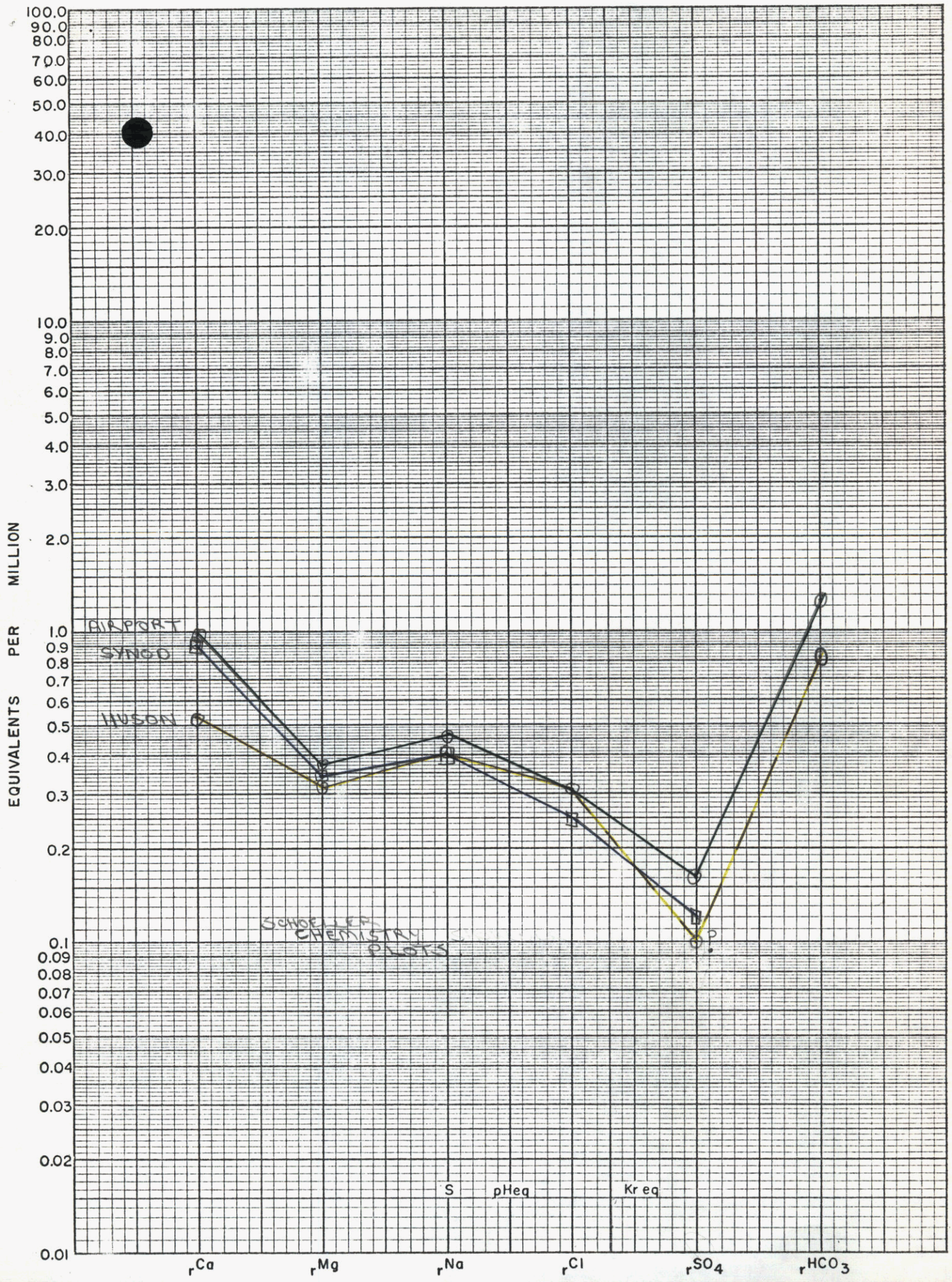
FOR SITE: 1400011 ALERT BAY AIRPORT WELL

SAMPLING DATE(S): OCT 4/77 0710 HRS
SAMPLE TYPE: FRESH WATER
SAMPLING DEPTH: 300
SAMPLED BY: W.I.B. - HYDROLOGY
DATE RECEIVED BY LABORATORY: OCT 06/77

0040101	PH	8.3 REL UNIT	0071701	RES:FILT.105C	126. MG/L
0110101	SPECIFIC CONDUC	182. UMHO/CM	0300101	COMP.DIL.COND.	193. UMHO/CM
1010101	ALKALINITY:PHNL	L 0.5 MG/L	1020101	ALKALINITY:TOT	70.9 MG/L
1041702	CHLORIDE:DISSOL	9.2* MG/L	1070002	HARDNES.T:CACO3	65.4* MG/L
1091703	NITROGN:NO2 NO3	1.15 MG/L	1130101	NITROGN:KJELDAH	0.01 MG/L
1191703	PHOSPHORUS :TOT DISSOLVED	0.03* MG/L	1211701	SULPHATE:DISSOL	5.8 MG/L
2541702	CALCIUM DISSOLVED	19.1* MG/L	2570304	IRON TOTAL	0.2 MG/L
2571802	IRON DISSOLVED	L 0.1 MG/L	2591701	MAGNESIUM DISSOLVED	4.3* MG/L
2601801	MANGANESE DISSOLVED	L 0.02 MG/L	2641703	POTASSIUM DISSOLVED	1.6 MG/L
2651703	SODIUM DISSOLVED	10.3 MG/L			

REMARKS:

FOR ENVIRONMENTAL LABORATORY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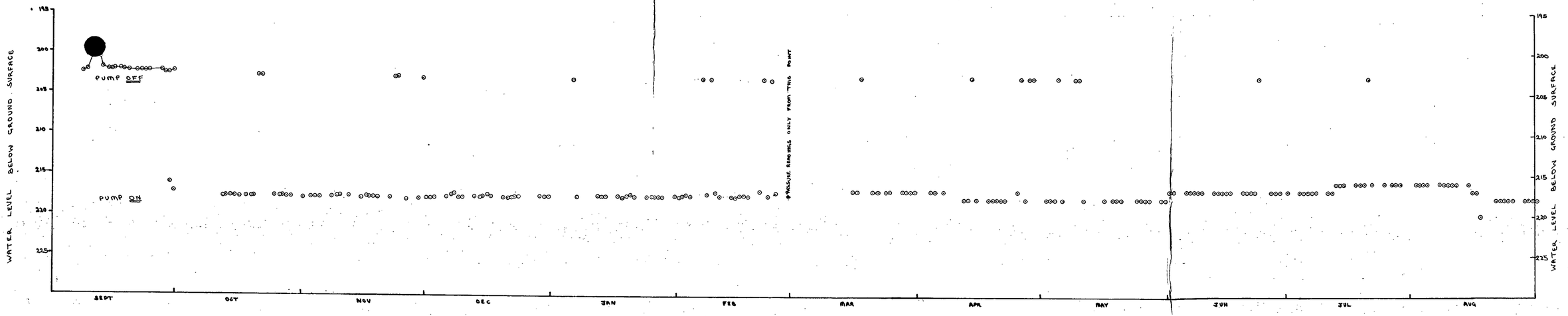
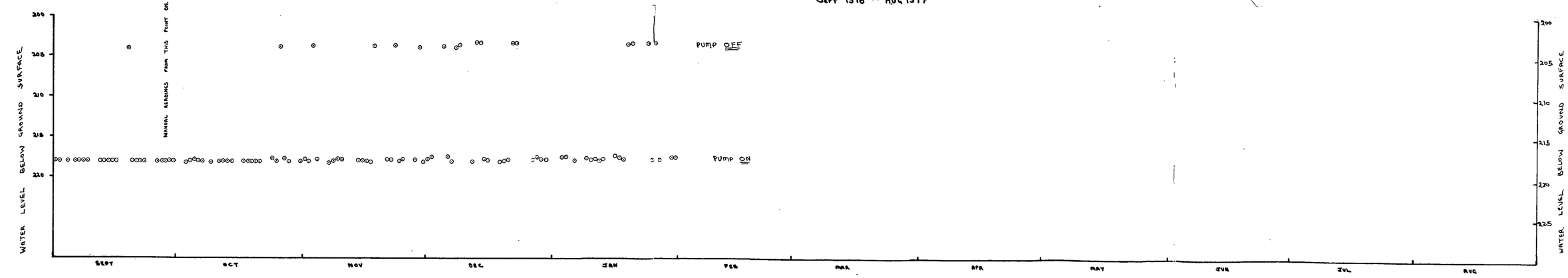


ALERT BAY PRODUCTION WELL #1
SEPT 1976 – AUG 1977



ALERT BAY PRODUCTION WELL #1
SEPT 1977 – AUG 1978

FIGURE 1