Province of British Columbia

Ministry of Environment

MEMORANDUM

To: Mr. H.I. Hunter, Chief
Hydrology Division

Date: April 16, 1980

File: 92 B/11-32

Fr: J.C. Foweraker, Head
Groundwater Section
Hydrology Division

Re: North Saanich - Memo-report on the effects of pumping by the Pendray Irrigation Well on other nearby well users, particularly within the Ardmore Subdivision.

The results of the monitoring program described in the above report (attached) show that the observation wells located within the Ardmore Subdivision except in one area, do not show any direct relationship to pumping from the Pendray well and in general the wells show only a season decline in water level of about 18 feet. The area, not covered by this generalization is located in the northeast part of the subdivision west of the Pendray well. Here Observation Well No. 238 which is located 3800 feet from the Pendray well showed a marked 33 foot drop in water level over this pumping period.

Further monitoring on the scale of the 1979 program is not warranted - however, a limited program should continue in the affected area and an index well should be retained within the subdivision as part of the observation well network.

J C Foweraker

J.C. Foweraker, Head
Groundwater Section
Hydrology Division

JCF/hw

Attachs.

Province of British Columbia
Ministry of Environment
WATER INVESTIGATIONS BRANCH

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Re: North Saanich - Report on the effects of pumping by the Pendray Irrigation Well on other nearby well users, particularly within the Ardmore Subdivision

INTRODUCTION

This memorandum is to provide a review of the background and subsequent 1979 program of monitoring undertaken by the Groundwater Section staff in the area surrounding the Pendray irrigation well and the Ardmore Subdivision. The results of this program are presented and discussed and recommendations are made regarding future work.

We acknowledge with thanks the cooperation and help extended by Mr. Pendray and all the well owners who assisted in a number of ways with this program.

BACKGROUND

The Pendray well is a 586 foot deep 8-inch diameter irrigation well located about 2000 feet southwest of the Victoria International Airport runway boundary (see map). The well lies to the east of the Ardmore Subdivision, and west of the town of Sidney.

The driller's log for the Pendray well shows a thickness of marine clays, sandy and gravelly sections overlying 5 feet of water bearing gravels. The well casing extends for 46 feet through this overburden material and has been driven a further 12 feet into the underlying granadiorite bedrock. A number of water bearing fractures in the bedrock were encountered during the drilling and the main zones lie between 500 feet and the bottom of the hole at 586 feet.

In 1978 Mr. Pendray retained the services of Brown, Erdman and Associates to evaluate the well performance and a pumping test was run for several days in June of that year, at a rate of 235 to 245 USgpm.

Early in January 1979, the Mayor of North Saanich Municipality sent a letter to the Minister of Environment in which concern was expressed at the possible effect that the continuous operation of the Pendray irrigation well would have on the individual wells serving existing properties within the Ardmore subdivision. This problem was the subject of a detailed discussion at a subsequent meeting with the Deputy Minister, Messrs. G. Westwood and J. Cummings of the Municipality of North Saanich. It was agreed at this meeting that further groundwater monitoring was necessary to determine the possibility of interference with Ardmore individual wells and a commitment was subsequently given by the Director, Water Investigations Branch to our Deputy Minister in a memo dated February 19, 1979, for our Groundwater Section staff to undertake this work.

PROGRAM

The following proposals were made and agreed to for the monitoring program to be undertaken by the Section on the Pendray well area and Ardmore Subdivision.

1. To meter the Pendray irrigation well and the Ardmore and Glen Meadows Golf Course irrigation wells for the quantities of groundwater pumped and the times of pump operation, it being recognized that all major producing wells in the area must be assessed if the effects of groundwater withdrawals are to be measured.

2. To monitor water levels in adjacent wells to the north, south, east and west of the Pendray well.

3. To undertake additional water level monitoring within the Ardmore Subdivision.

4. To establish some key observation wells with automatic water level recording equipment and housings.

5. To compile results and write a report.

RESULTS OF THE MONITORING PROGRAM

Well Location Map

The attached map shows the positions of the monitor wells; a blue color denotes a manually read well, yellow represents the locations of monitor wells fitted with automatic water level recorders. Water wells on which flow meters have been installed to measure the amount of groundwater withdrawals from wells are shown in red.

Pumped Wells

Our records show that the Pendray irrigation well was pumped in 1979 from June 14th to August 21st, except for a shut down period from July 17th to July 27th. In total 18,270,000 US gallons were pumped from the well during the irrigation season. Water quality in the Pendray well indicates the water is a sodium chloride type with T.D.S. of 500 m/l. During the pumping season chloride increased from 246 to 280 mg/l.

Two irrigation wells located in the Glen Meadows Golf Club pumped only 1,500,000 and 4,500,000 US gallons up to the end of the pumping period (September 12th). Also an irrigation well located on the Ardmore Golf Club pumped 2,398,812 US gallons during the season. Over to the east of the Pendray well are a number of wells used to pump water for the town of Sidney (see green colored well locations on the attached map). These wells pumped between 15 and 90 US gallons per minute during the April to August 1st period. Only one well near the Hughes observation well continued to pump through to October 1st, and at a rate of 15 US gallons per minute. There may also be additional irrigation wells to the north of this Sidney well which may have pumped during the irrigation season, however, we have no records to confirm this.

Observation Well No. 70 (Hughes Well)

This well is located 4600 feet southeast of the Pendray well (see map). The well is 175 feet deep and is reported to flow at 8 US gallons per minute. The Hughes well was fitted with an automatic water level recorder after the groundwater level dropped below ground surface. After the Pendray well ceased pumping on August 21st the water level in the Hughes well stabilized and then recovered briefly. Other factors which may have influenced the subsequent lowering of the Hughes well hydrograph in September, include precipitation in early September, the continual groundwater withdrawals from the nearby Sidney well which shut off on October 1st and the effects of other nearby irrigation wells in this general area which could not be monitored. The combination of these factors and the relative effects of each on the Hughes well hydrograph are difficult to define precisely and consequently no firm conclusion can be drawn as to the precise effects pumping the Pendray irrigation well may have had on the Hughes observation well.

Ardmore Subdivision

The observation wells in the Ardmore Subdivision have not shown any direct relationship to pumping in the Pendray well and generally speaking show a seasonal decline in groundwater levels of about 18 feet. Exceptions to this generalization, however, occur in the northeast part of the Ardmore Subdivision, as described below under (i) and (ii).

(i) Observation Well No. 238

This well is located 3,800 feet from the Pendray well and showed a marked 33 foot drop in water level during the pumping period of the

Pendray well. The well is 245 feet deep and is reported to have a yield of 75 gpm from rock fractures. It was equipped with a Stevens recorder from February 21, 1979 to July 30, 1979. There was a short period in May when the recorder was removed at the owner's request. Since the final removal of the recorder the well has been read manually.

On inspection of the hydrograph one can readily observe the influence of the Pendray irrigation well. After making an allowance for "lag time" we see there is a striking correlation between the decline in the hydrograph and the pumping times recorded in the Pendray well. There is also a close correlation with a short period of recovery when the Pendray well was shut off between July 17th and 27th. This period is followed by a further decline during the second pumping period between July 27th and August 21st, 1979.

The well then recovered steadily after the shutdown of the Pendray well and with the heavy rains experienced in December the water level responded rapidly.

The above data suggests there is a northwest-southeast zone of higher permeability reaching out from the Pendray well to the northeast corner of the Ardmore Subdivision where Observation Well No. 238 is located.

(ii) Observation Well No. 243

When drilled in 1934 this well was 60 feet deep and was reported to yield 500 gallons per hour from rock fractures. Over the years soil has filled the bottom part of the well as it had been left uncapped and the casing was cut off just below ground level. This may have closed off some of the well flow, although, a slug test showed it took water readily. On August 21, 1979, it was deepened to over 200 feet and a good flow was encountered. An inspection of the hydrographs for this well shows a rather steady decline of the water level from March to August 21st. After the well was deepened on August 21st, the water level declined even faster, which is shown by a steep slope to the graph. The hydrograph does show a steady rate of recovery from early September to early December. This may be due to precipitation early in September and later in October or we can theorize that it may be explained in part by the closing down of the Pendray well.

(iii) Observation Well No. 239

This well is 250 feet deep and is reported to yield 17 gpm from rock fractures. It is equipped with an automatic water level recorder. The hydrograph appears to display only a normal seasonal trend, and during the month of December the well recovered rapidly.

(iv) Observation Well No. 241

This well is 270 feet deep and is reported to yield 4 gpm from rock fractures. It is equipped with an automatic water level recorder. The hydrograph shows the water level declined over 8 metres in the May to August period. In the September to November period there was a few sharp

declines on the graph caused probably by pumping in the area. Whether this large decline of water level in the May to August period is just the normal water level trend or partly caused by interference from a well or other wells in the area is not known. No production wells are known to exist in the immediate area, and the graph changes appear to be out of phase with the pumping periods of Pendray's well.

Rapid recovery has taken place in December following early December rainfall.

(v) Observation Well No. 242

This well is 250 feet deep and is reported to yield 3.75 gpm from rock fractures. The well is read manually about once a month, and is located close to Observation Well No. 241 and the hydrograph is similar.

(vi) Observation Well No. 244

This well is 175 feet deep and is reported to produce 8 gpm from fractures in rock. It is only used during the summer months for the garden. The well is read manually about once a month. The hydrograph appears to display only a normal seasonal trend. The erratic slopes of the graph from July to October are probably due to the well being in use prior to some of the readings.

The well recovered rapidly in December due to precipitation.

(vii) Observation Well No. 245

This well is 245 feet deep and is reported to produce 4 gpm from rock fractures. The hydrograph may show only a normal seasonal trend, but there is a significant rise in the water level from August 21 (when Pendray's well was shut down) to early October. This may however, be in response to the rains which occurred in early September.

Other wells which could have affected this well are the Ardmore Golf Course wells which were pumped much of the summer: the 870' well of Ardmore Golf Course was pumped from approximately May 17 to late September at a rate that began at 17 Igpm and steadily declined over the summer to 11.5 Igpm. The Golf Course Clubhouse well was pumped steadily from approximately later June to late August or early September at a rate of about 10 Igpm at the start and declining over the summer to about 3 Igpm. There is, however, no obvious evidence of the pumping of these two wells from the hydrograph plot.

(viii) Observation Well No. 246

This well was drilled to 400 feet and is reported to produce 1.5 gpm from rock fractures. Manual readings are taken once a month.

This well is near Observation Well No. 239 and the hydrograph is much the same as it. It appears to display only a normal seasonal trend and neither Pendray's pumping or the pumping of the Ardmore Golf Course Wells seem to have created any noticeable decline in the water table in this area.

(x) Observation Well No. 252 (Anderson's Well)

This well is 94 feet deep and is reported to yield 1000 gph from rock fractures. The hydrograph declines up to August 21 when Pendray's well was shut off, then it shows a recovery period from there to the end of the year. As this well is near the coastline on the far side of the Ardmore area, from the Pendray well, it seems unlikely that it would be influenced from that well.

(x) Chemical Quality of Groundwater in the Ardmore Subdivision

Three chemical analyses of groundwater from the Environment Laboratory are available for the Ardmore subdivision. These show the groundwater quality to be very good for drinking water supplies though it may sometimes be hard. The total dissolved solids range from 236 to 336 ppm, hardness ranges from 105 to 228 ppm, chlorides and sulphates are both low (less than 23 ppm), iron and manganese combined is very small except in one sample where these are 0.32 ppm only just over the accepted upper limit of 0.3 ppm, and the groundwaters may be described as either sodium-calcium bicarbonate type or calcium-sodium bicarbonate type.

Well No. 237 Ocean Sciences Institute North Well

This well is 368 feet deep and is reported to yield 37 gpm from rock fractures. The well hydrograph clearly shows the influence of tides as evidenced by the repeated daily fluctuations of water level. The hydrograph also shows a distinct departure from the normal seasonal trend during the intervals when the Pendray well was pumping. The hydrograph is below the normal trend line for these intervals, but recovers briefly during the period when the Pendray well was shut down from July 17th to 27th, 1979.

The data suggest there is a zone of lesser permeability adjacent to the more highly permeable zone between the Pendray well and Observation Well 238 where the greatest influence due to pumping has been recorded.

Well No. 254 (Ocean Sciences Institute South Well)

This well is drilled in granite and it is 347 feet deep with an estimated yield of 6 US gallons per minute. An automatic water level recorder was installed after winter recharge was essentially complete and after the Pendray well had commenced pumping. The effects of the Pendray well pumping on this well are difficult to assess as pumping from the nearby OSI production wells is probably also affecting the hydrograph. However, when the Pendray well stopped pumping on August 24th the water level did stabilize briefly for a few days and then continued its downward trend.

CONCLUSIONS

In summary the observation wells on the Ardmore Subdivision have not shown any direct relationship to pumping from the Pendray well and in general the wells show a seasonal decline in water levels of about 18 feet. Exceptions to this generalization, however, do occur in the northeast part of the subdivision west of the Pendray well. Here Observation Well No. 238 and possibly Observation Well No. 243 show the influence of pumping from the Pendray well. Observation Well No. 238 which is located 3,800 feet from the Pendray well showed a marked 33 foot drop in water level over this pumping period. Outside the subdivision the only well that showed some effect from the pumping of the Pendray well was the Ocean Sciences Institute Observation Well No. 237. We can theorize on the basis of the data presented that there exists a central linear zone of higher permeability on which the Pendray well and the Observation Well No. 238 are located. We can also theorize that there exists a zone of lesser permeability, higher than the surrounding bedrock, but less than that of the central linear zone. In this outer zone are located Observation Wells Nos. 243 and 237. The hydrographs of these two wells suggest some influence from the Pendray well pumping but the data is open to different interpretations. There is insufficient information available to speculate further on the bedrock fracture permeability in this region at this time.

RECOMMENDATIONS

This monitoring program which has been in operation for a year has taken considerable staff time to implement. As the results only show a clear case of well interference from the Pendray well in one corner of the Ardmore Subdivision, further detailed monitoring of the remaining area is in our opinion not warranted. It would be worthwhile, however, to continue to monitor two representative observation wells (Nos. 240 and 239) within the subdivision to keep a record of groundwater fluctuations in the subdivision as a whole.

It is also recommended that the following two observation wells be retained and monitored to further study the zone of higher permeability which exists between the Pendray well and Observation Well No. 238.

1. Glen Meadows Observation Well No. 253

2. Ocean Sciences Observation Well No. 237 (OSI-North)

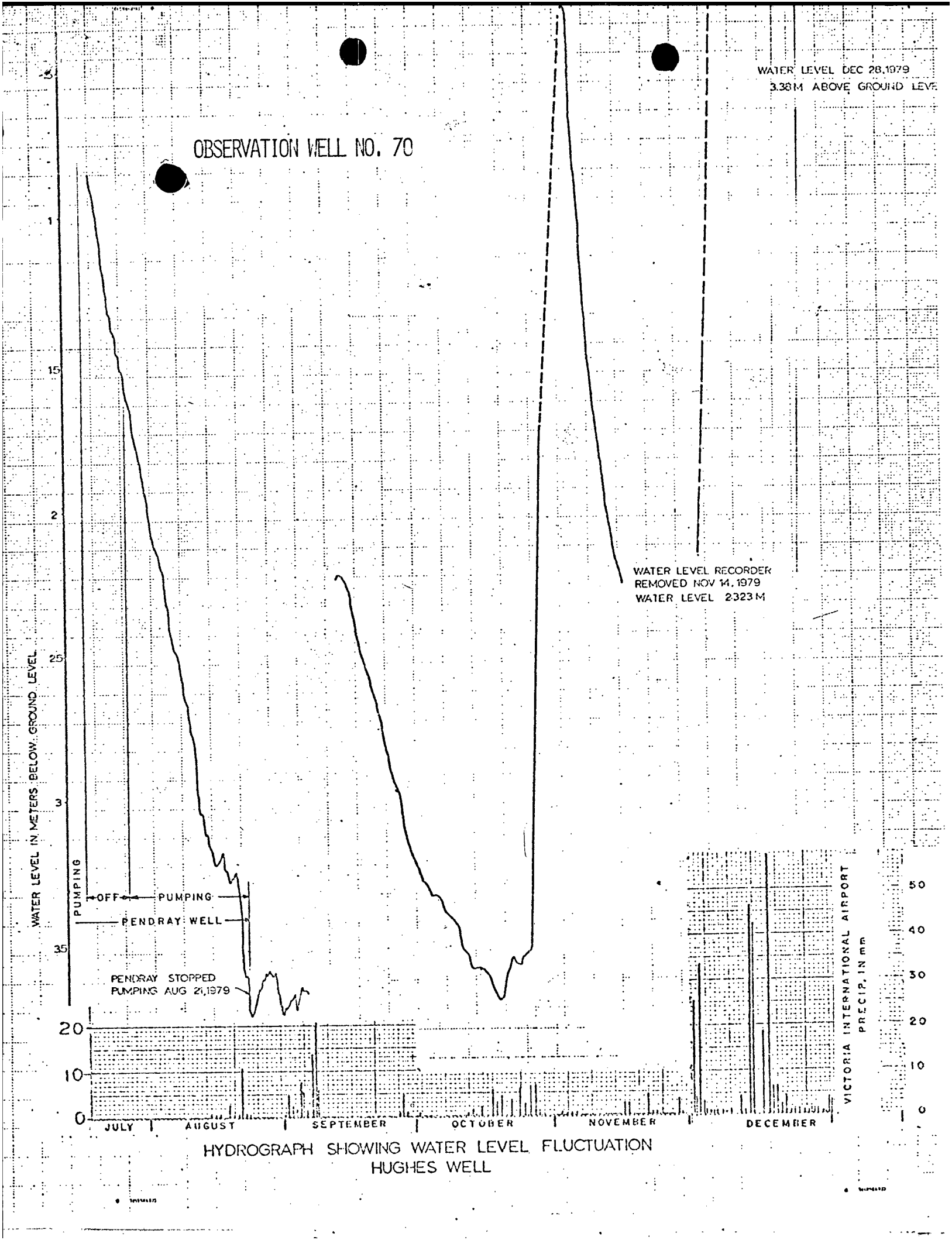
Further we should request Mr. Pendray's continued cooperation with this project and arrange for a meter to be installed on his well and a record of pumping times be kept.

Finally we should consider a new long term observation well in the northeast corner of the Ardmore Subdivision to replace Observation Well No. 238 which has been taken over by the owner, and Observation Well No. 243 which we will lose shortly. Besides providing further information on the effects of continued pumping of the Pendray well in this area, an observation well sited near Well No. 238 would help in the understanding of bedrock fracture permeabilities in Saanich, and assist our professional staff in their pilot project study of the hydrogeology of Saanich Peninsula.

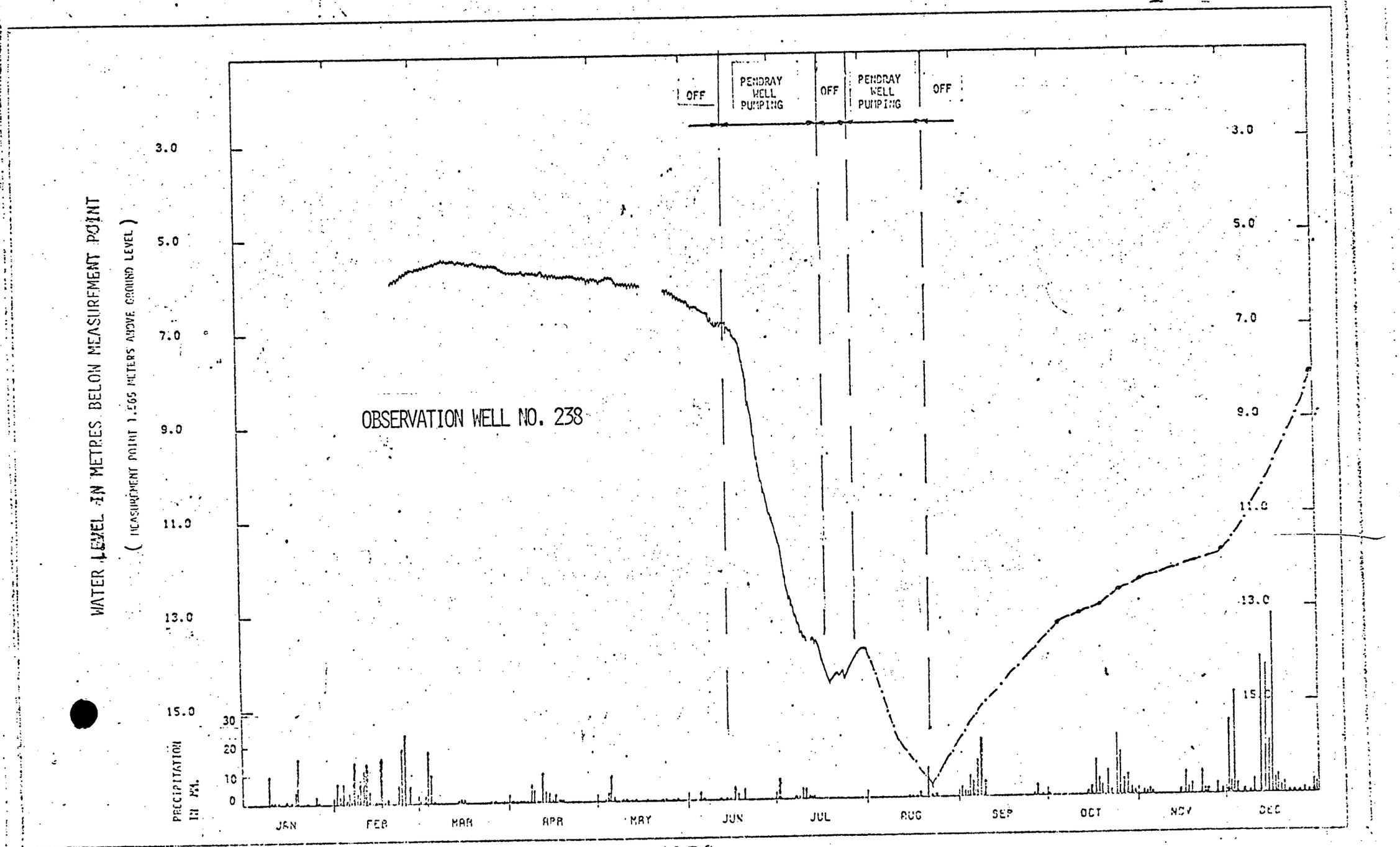
J.C. Foweraker, Head
Groundwater Section
Hydrology Division

JCF/hw

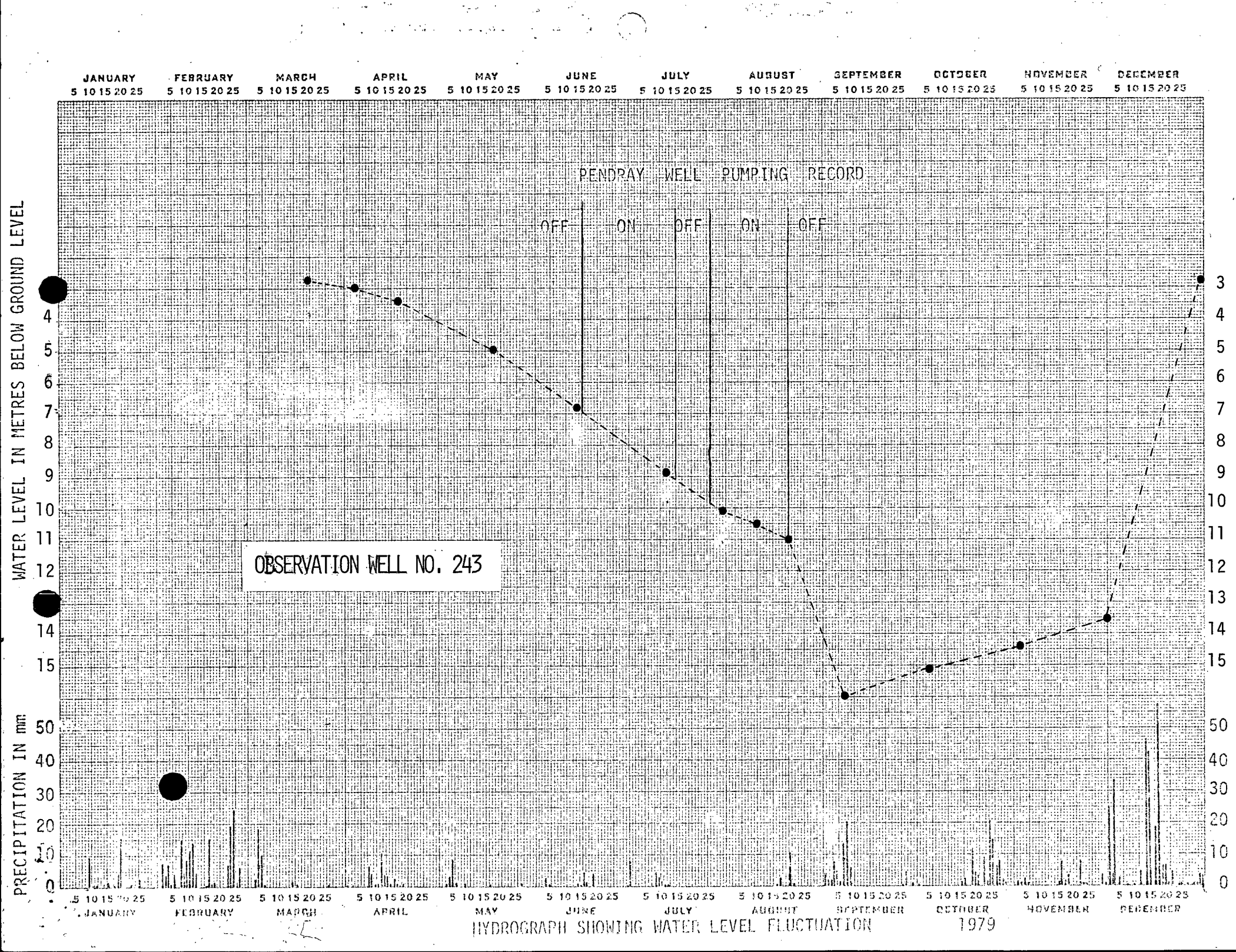
Attachs.



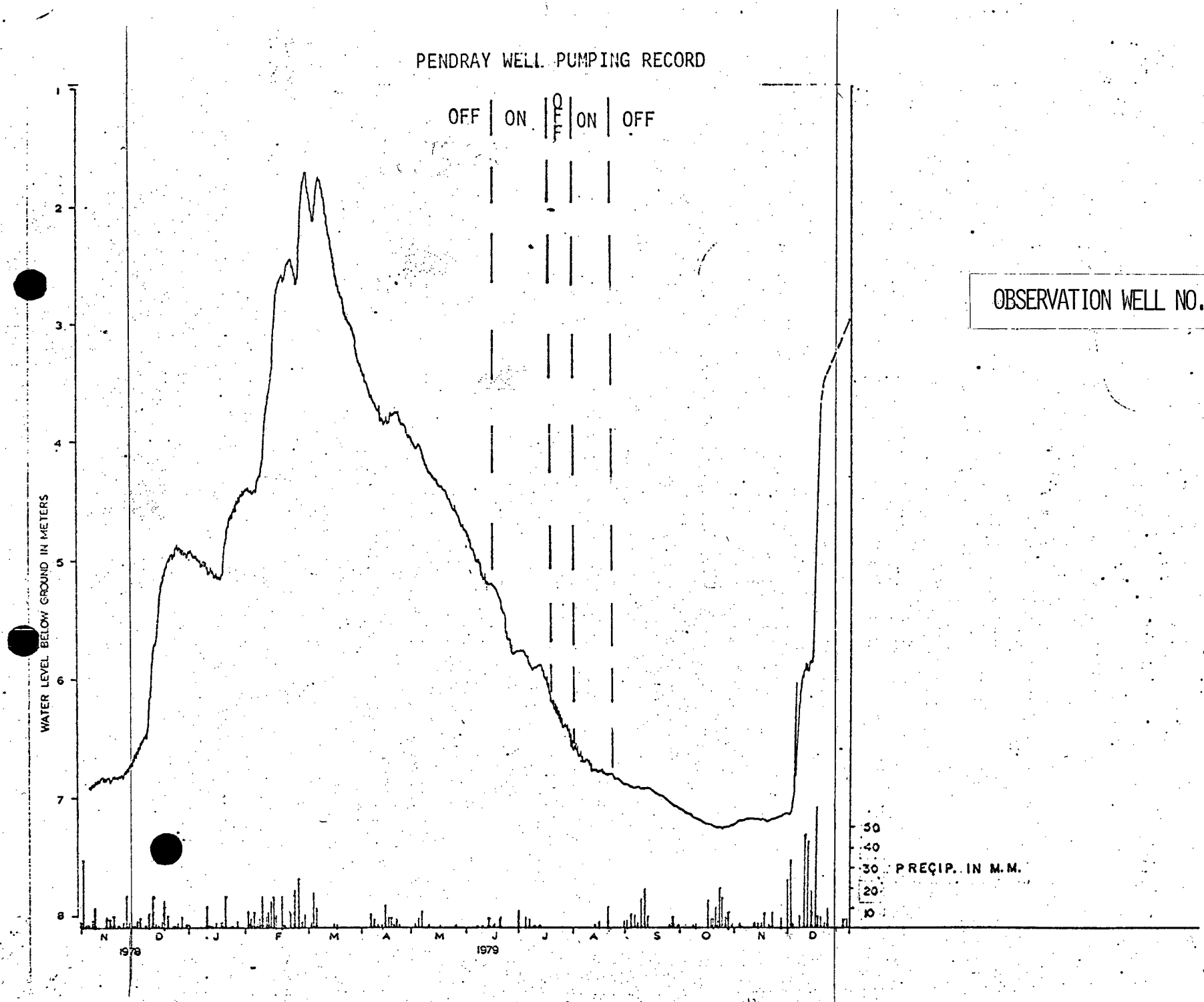
HYDROGRAPH SHOWING WATER LEVEL FLUCTUATION
HUGHES WELL

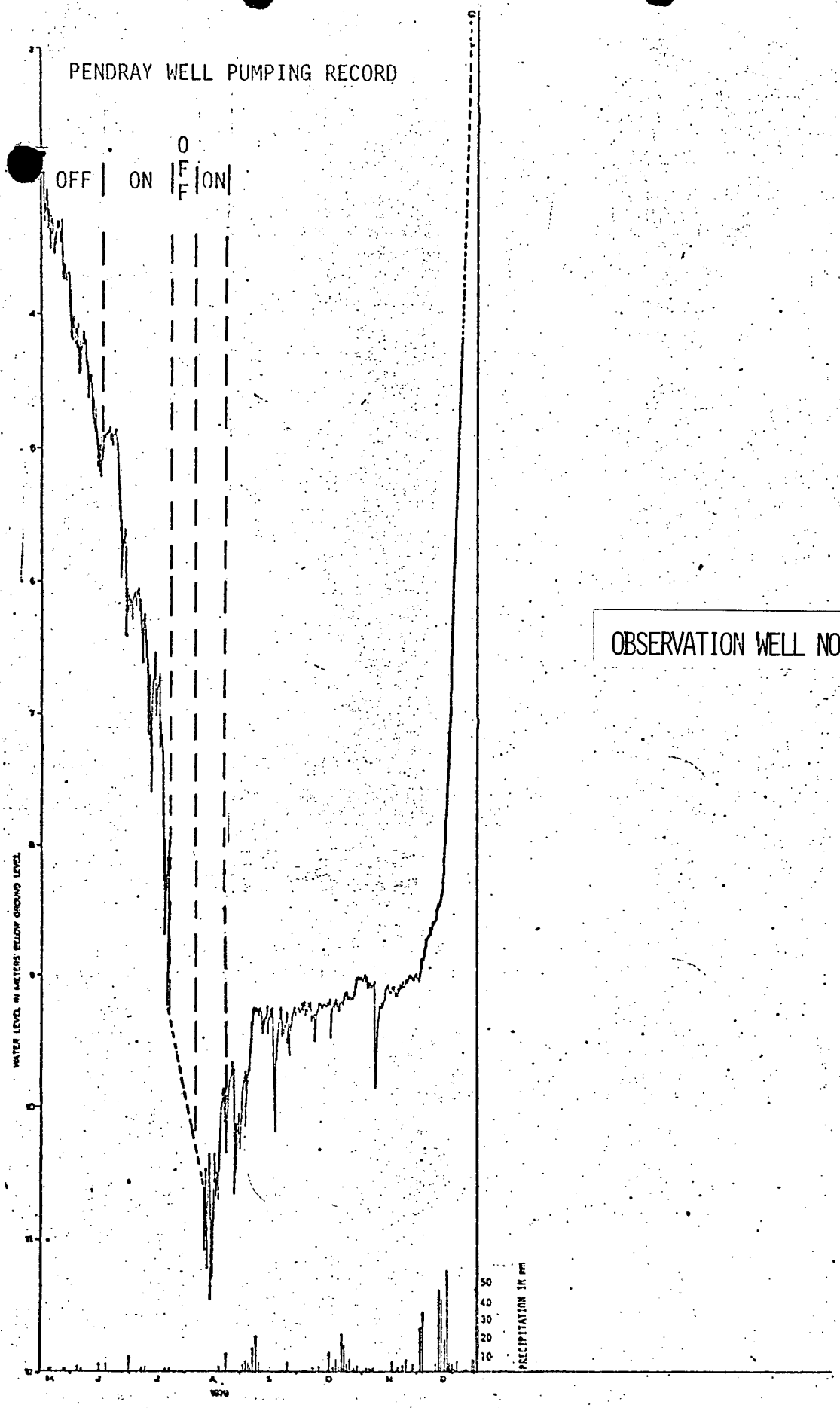

OFF
PENDRAY WELL PUMPING
OFF
PENDRAY WELL PUMPING
OFF
OBSERVATION WELL NO. 238
WATER LEVEL IN METRES BELOW MEASUREMENT POINT
(MEASUREMENT POINT 1.565 METERS ABOVE GROUND LEVEL)
3.0
5.0
7.0
9.0
11.0
13.0
15.0
PRECIPITATION IN MM.
30
20
10
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

1979



HYDROGRAPH SHOWING WATER LEVEL FLUCTUATION 1979


PENDRAY WELL PUMPING RECORD
OFF
ON
OFF
ON
OFF
OBSERVATION WELL NO. 239
WATER LEVEL BELOW GROUND IN METERS
1
2
3
4
5
6
7
8
50
40
30
20
10
PRECIP. IN M.M.
N
D
J
F
M
A
M
J
J
A
S
O
N
D
1978
1979



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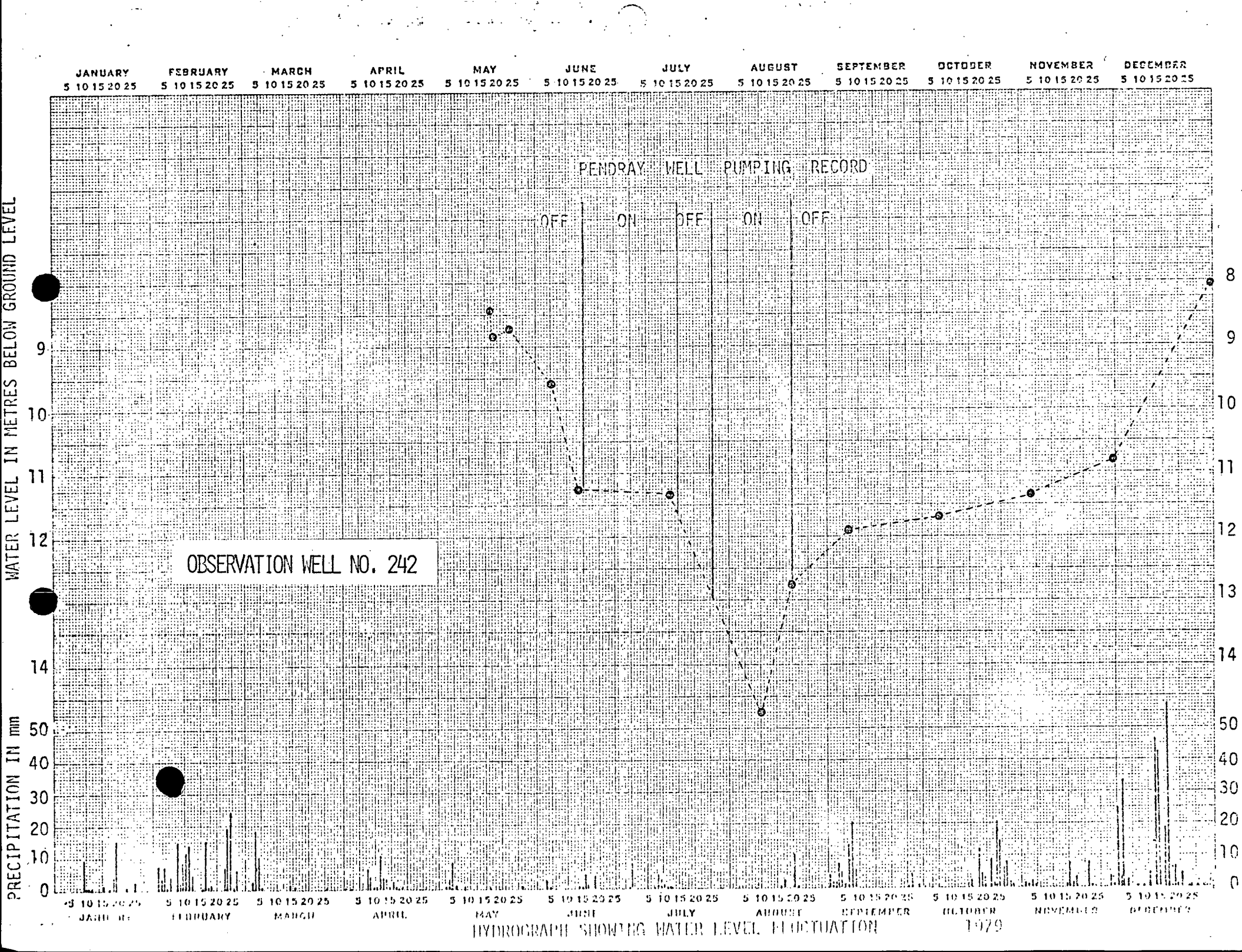
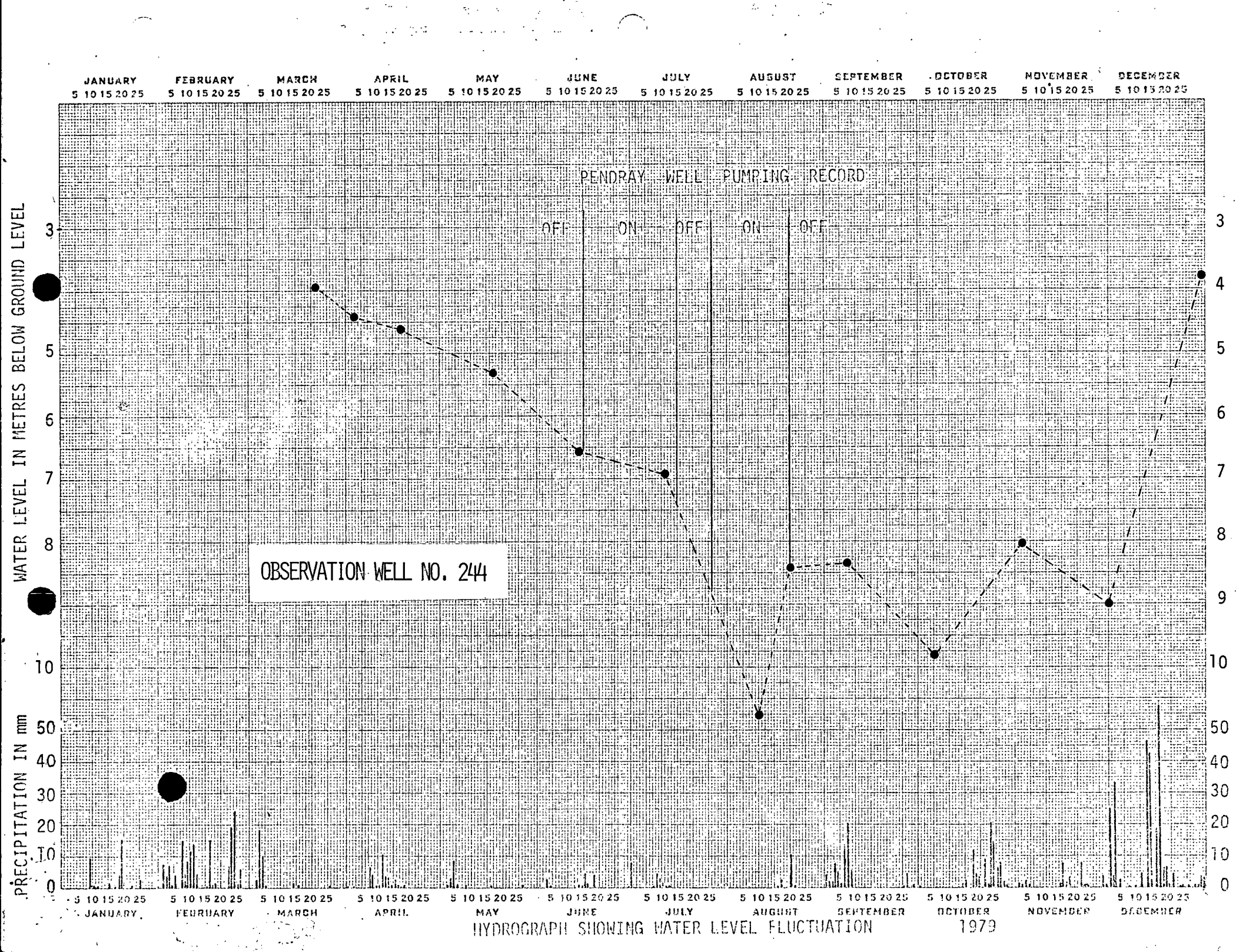
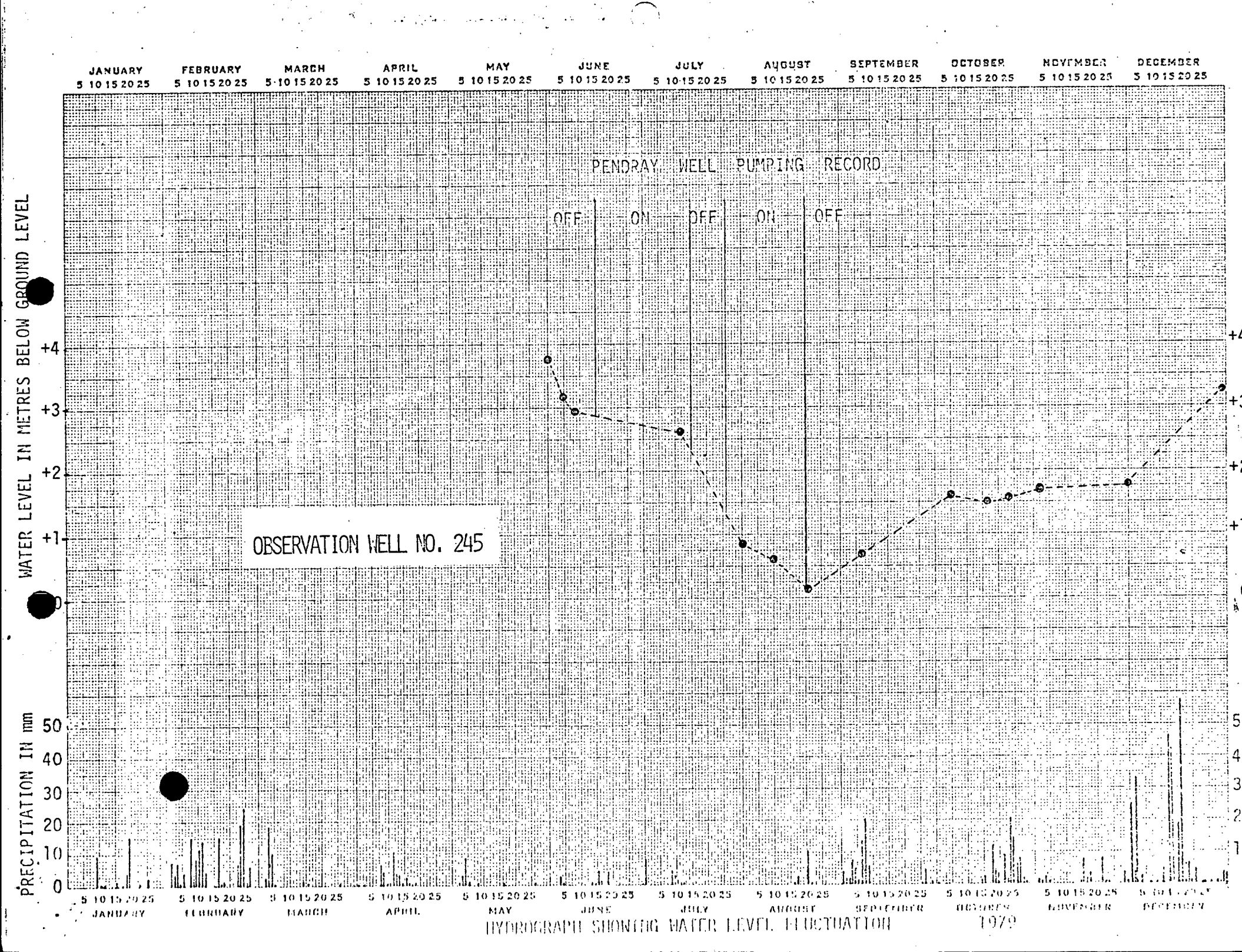
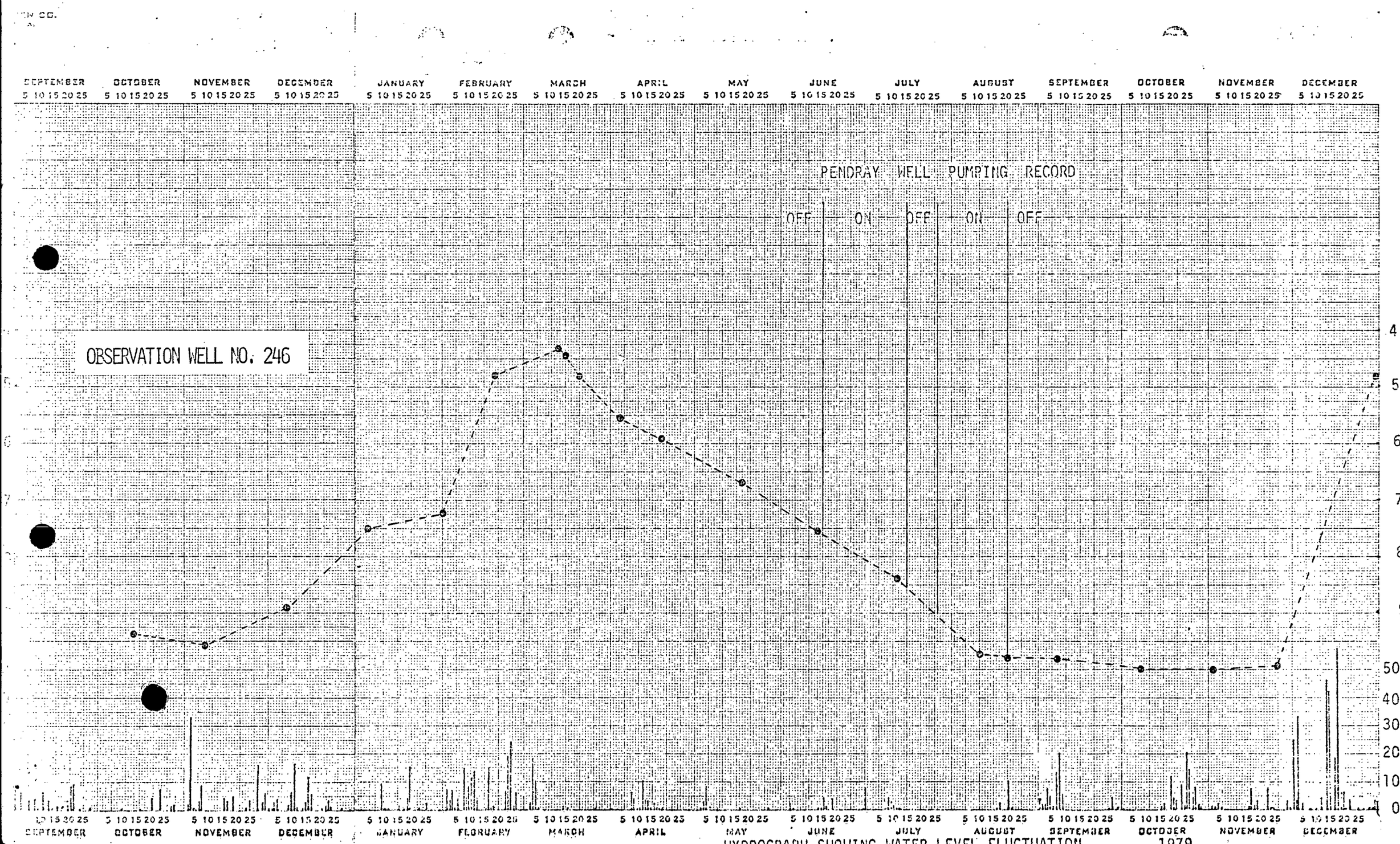


HYDROGRAPH SHOWING WATER LEVEL FLUCTUATION 1979


JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
5 10 15 20 25
PENDRAY WELL PUMPING RECORD
OFF
ON
OFF
ON
OFF
OBSERVATION WELL NO. 244
WATER LEVEL IN METRES BELOW GROUND LEVEL
PRECIPITATION IN mm
3
4
5
6
7
8
9
10
0
10
20
30
40
50
HYDROGRAPH SHOWING WATER LEVEL FLUCTUATION
1979


JANUARY 5 10 15 20 25
FEBRUARY 5 10 15 20 25
MARCH 5 10 15 20 25
APRIL 5 10 15 20 25
MAY 5 10 15 20 25
JUNE 5 10 15 20 25
JULY 5 10 15 20 25
AUGUST 5 10 15 20 25
SEPTEMBER 5 10 15 20 25
OCTOBER 5 10 15 20 25
NOVEMBER 5 10 15 20 25
DECEMBER 5 10 15 20 25
PENDRAY WELL PUMPING RECORD
OFF
ON
OFF
ON
OFF
WATER LEVEL IN METRES BELOW GROUND LEVEL
+4
+3
+2
+1
0
OBSERVATION WELL NO. 245
PRECIPITATION IN mm
50
40
30
20
10
0
5
4
3
2
1
HYDROGRAPH SHOWING WATER LEVEL FLUCTUATION 1979


SEPTEMBER 5 10 15 20 25
OCTOBER 5 10 15 20 25
NOVEMBER 5 10 15 20 25
DECEMBER 5 10 15 20 25
JANUARY 5 10 15 20 25
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MARCH 5 10 15 20 25
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AUGUST 5 10 15 20 25
SEPTEMBER 5 10 15 20 25
OCTOBER 5 10 15 20 25
NOVEMBER 5 10 15 20 25
DECEMBER 5 10 15 20 25
PENDRAY WELL PUMPING RECORD
OFF
ON
OFF
ON
OFF
OBSERVATION WELL NO. 246
4
5
6
7
8
50
40
30
20
10
0
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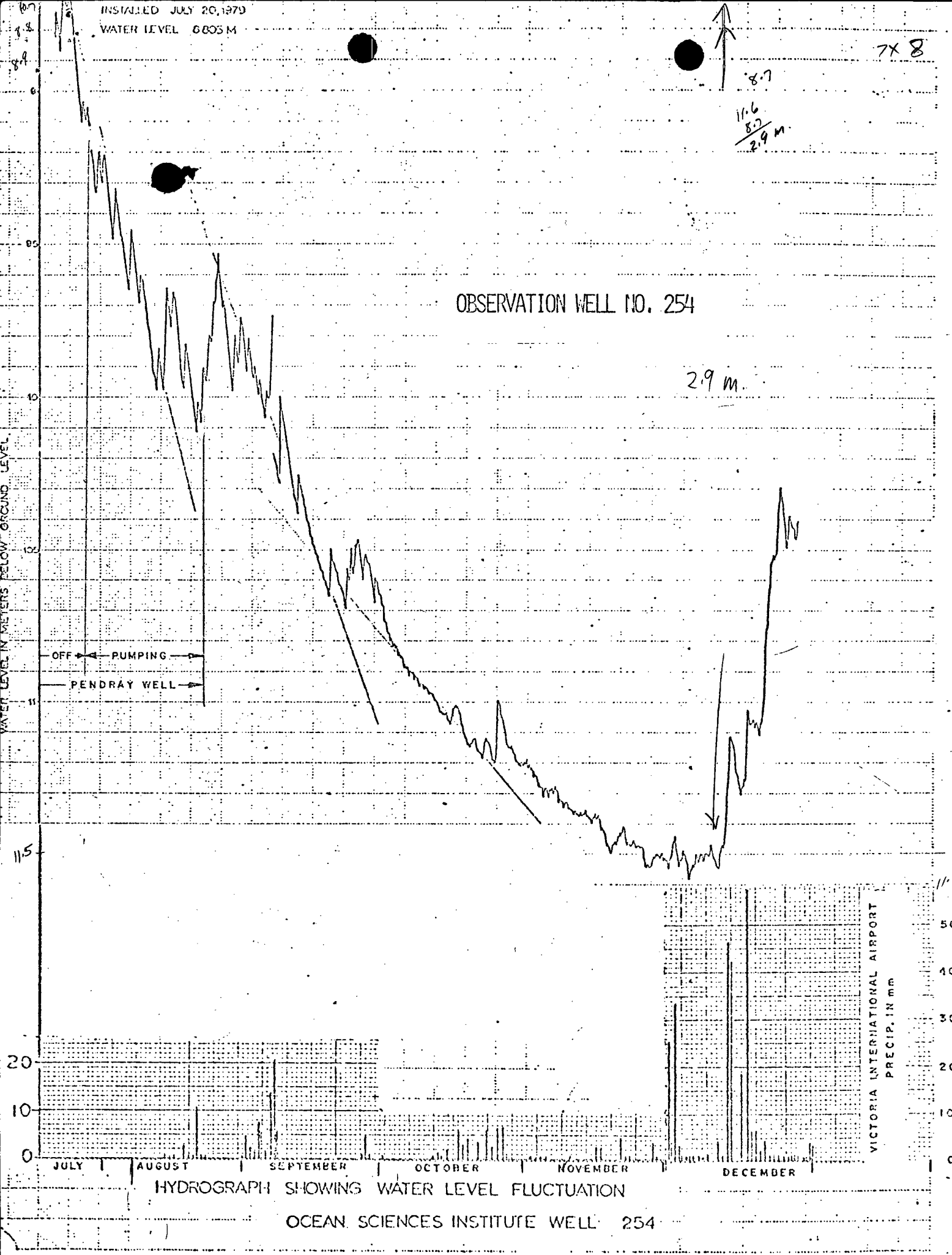
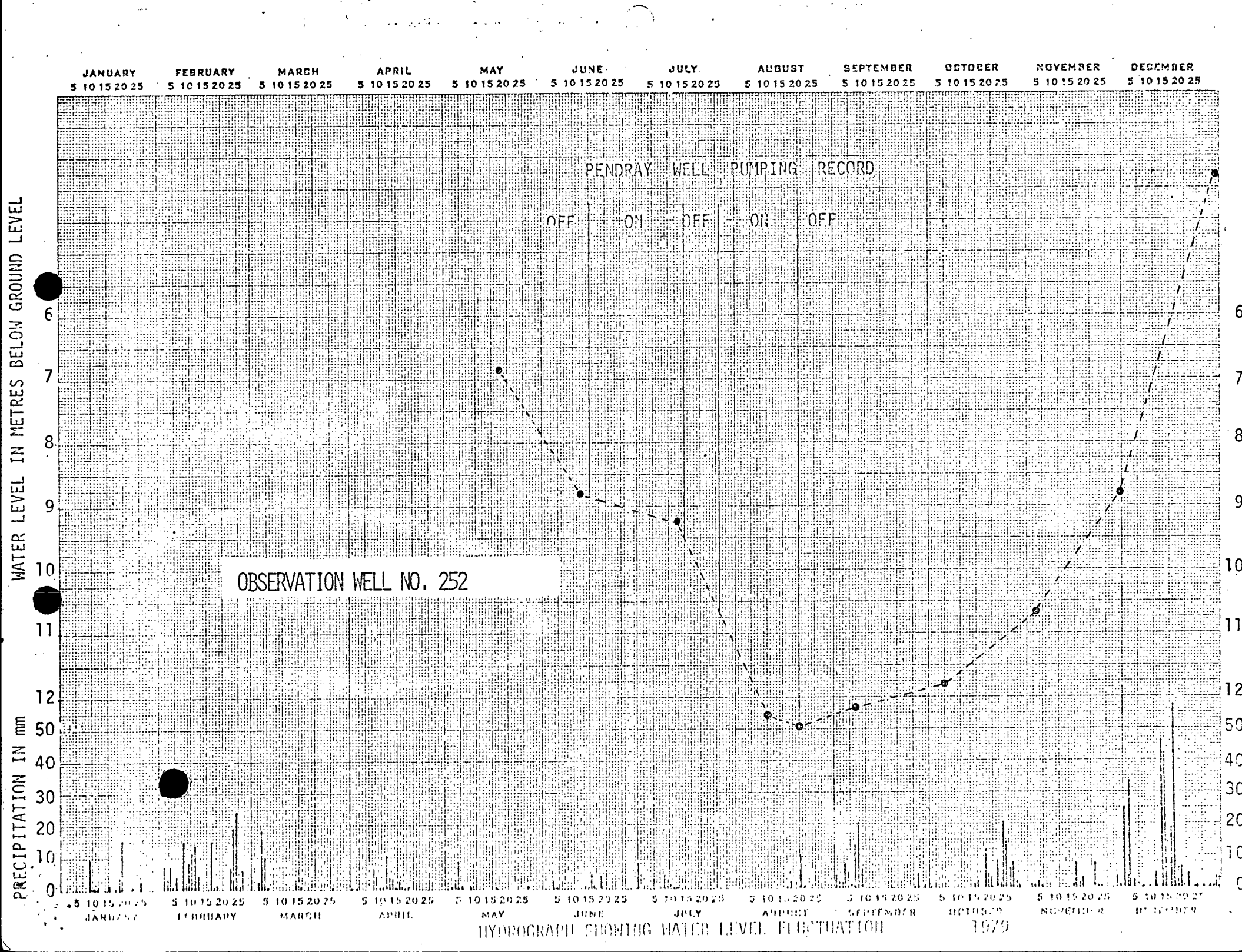


HYDROGRAPH SHOWING WATER LEVEL FLUCTUATION

OCEAN SCIENCES INSTITUTE WELL 254



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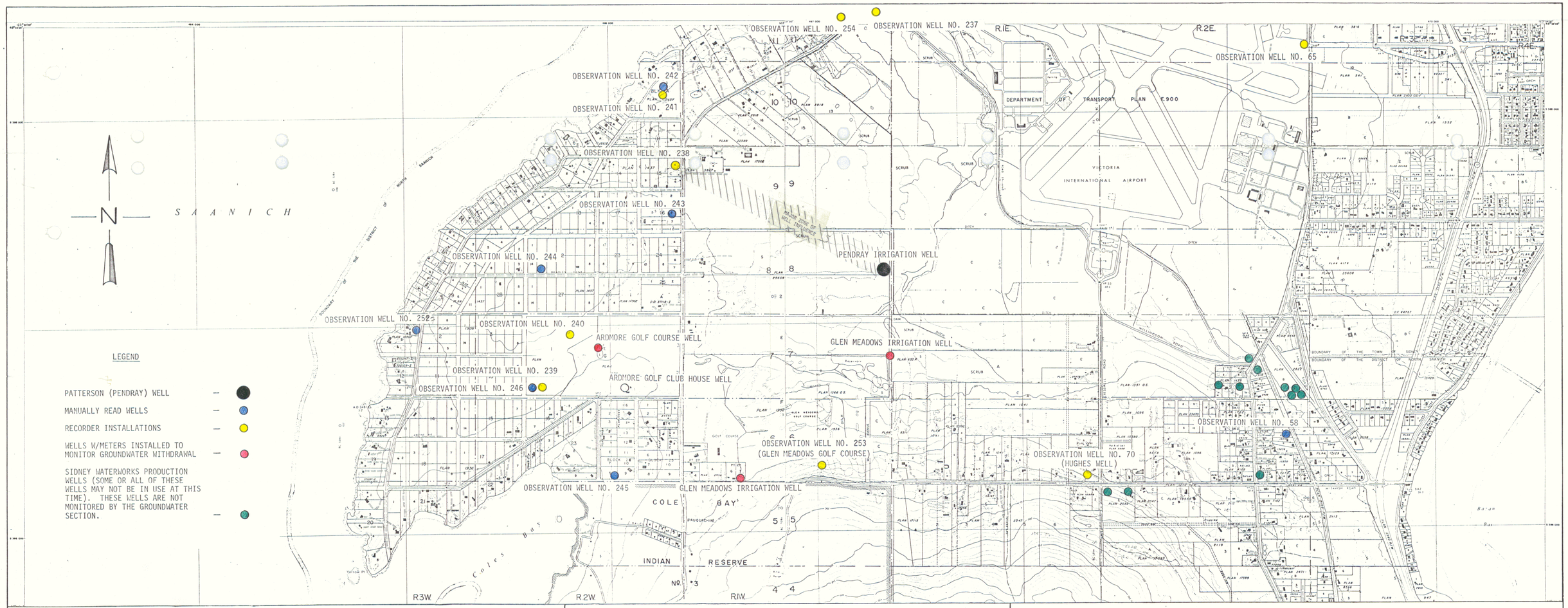
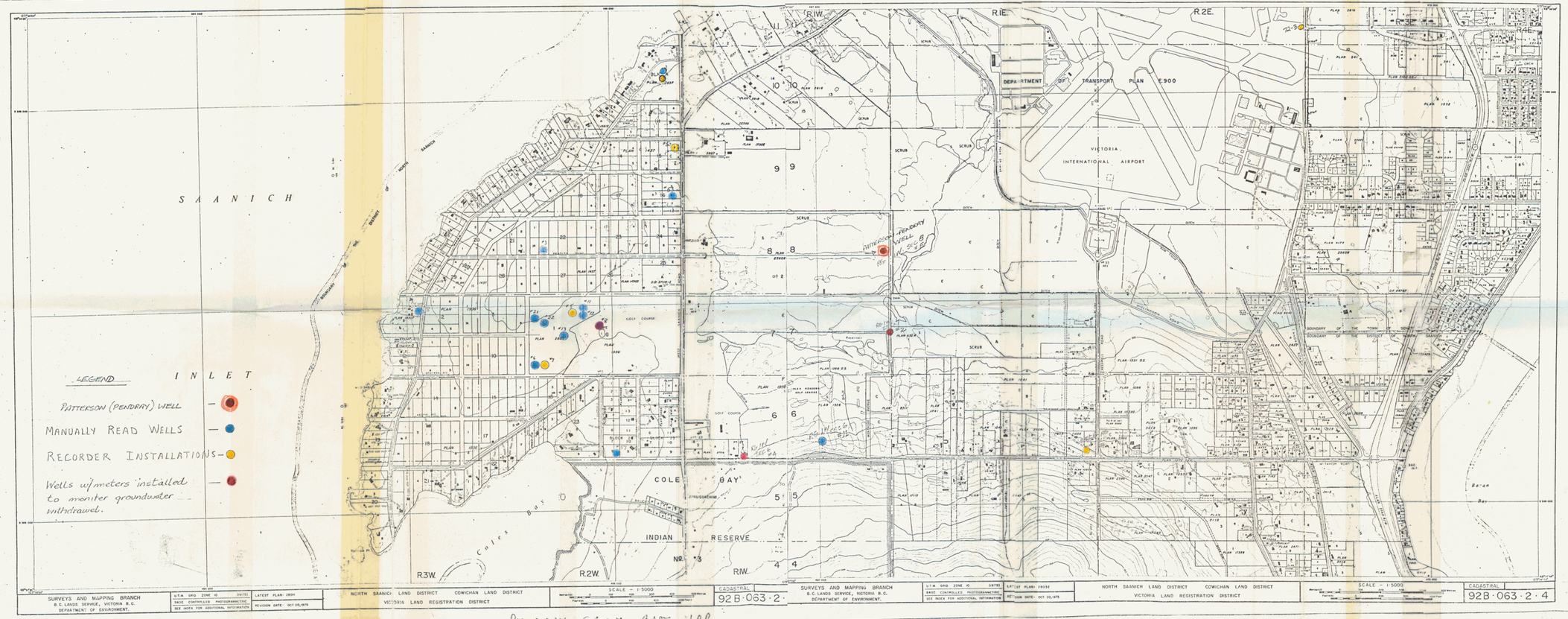


J.C. FOWERAKER
APRIL 9, 1980
FILE NO. 92B/11-32

MAP TO ACCOMPANY A REPORT ON THE EFFECTS OF PUMPING BY THE PENDRAY IRRIGATION WELL ON OTHER NEARBY WELL USERS, PARTICULARLY WITHIN THE ARDMORE SUBDIVISION

SCALE

BRITISH COLUMBIA
MINISTRY OF THE ENVIRONMENT
ENVIRONMENTAL AND ENGINEERING SERVICES
WATER INVESTIGATIONS BRANCH



PENDRAY STUDY BASE MAP