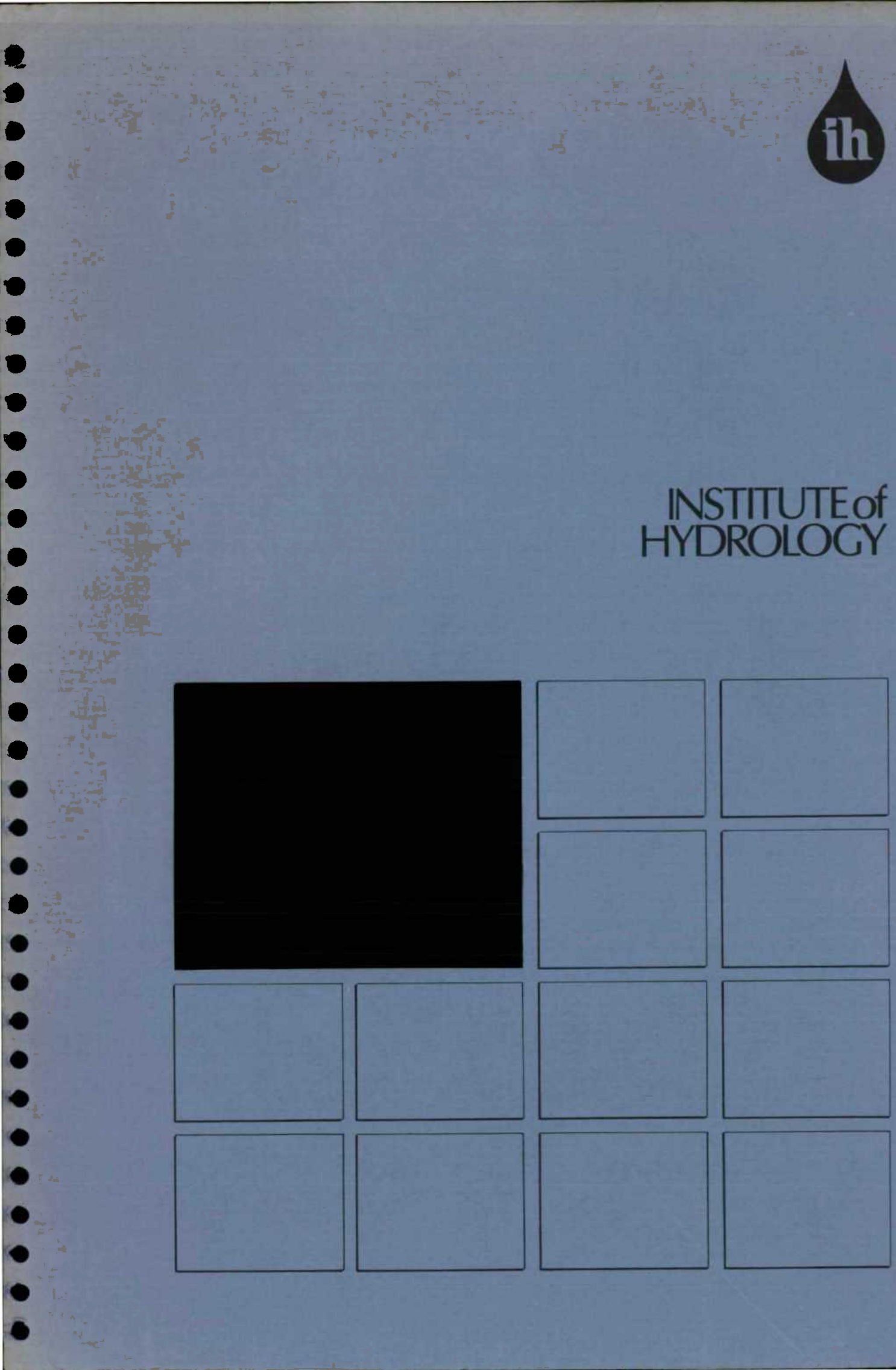

ih
INSTITUTE of
HYDROLOGY

Rb.

MOGADISHU WATER SUPPLY
EXPANSION

STAGE I

This report is prepared for

Sir Alexander Gibb and Partners (Africa)

Nairobi

Kenya

by

Institute of Hydrology

Wallingford

Oxon

UK

October 1982

INTRODUCTION

The area inland of Muqdisho bounded by the Balcad and Afgooye roads and the Shabeelle River formed the area examined in the water resources study [1]. The report recommended that a wellfield should be constructed close to the observation well MGQ2P on the Afgooye road.

Stage I consists of the construction of the first part of the wellfield with associated civil and electrical works. This report presents the results of the borehole construction and testing as given in Contract 1[2].

The wellfield is situated 17.5 km from Muqdisho on the Afgooye road and is eight production wells at 300 m intervals along a bearing of 055° from MGQ2P. In addition three observation wells were also drilled in the general area to determine lithology and water quality for both Stage I and the wellfield expansion of Stage II A.

The construction phase started in June 1981 and lasted for a year. However one production well, PW4B, has not been completed at the time of reporting and results will be issued as a separate appendix. The production wells have been given the reference numbers PW1 to PW8, with PW1 being nearest to the Afgooye road. The observation wells numbers are OW1 to OW3. In the event of a borehole being abandoned the rig was moved about 20 m and the hole redrilled with the reference having the suffix A then B.

The form of this report is such that the data collected during the contract period are presented as an appendix of computer listings at the rear of the report.

In order not to interrupt the text the figures referred to in Section 2 have been inserted between Section 6 and the Data Appendix.

[1] Muqdisho Water Supply Expansion: Groundwater Exploration and Modelling Studies, Institute of Hydrology, March 1980.

[2] Muqdisho Water Supply Expansion: Stage 1 Works - Contract No 1 Drilling of Production Wells, Sir Alexander Gibb & Partners (Africa), October 1980.

LITHOLOGY

The lithological logs were prepared from the inspection of samples taken every three metres from the drilling returns. Electric logs were also run for single point resistance (SPR) and self potential (SP) at each site. Because of problems with the logger it was not always possible to run a log in each hole, however logs were run at every site. At sites PW1B and PW2 gamma and casing collar location (CCL) logs were also run.

Figures 2.1A to 2.10B show the logs at each site drilled. The figure numbers suffixed A show the rate of penetration log, screen setting with rest water level and the main lithological divisions with descriptions; scales showing depth below ground level and elevation relative to sea level are included also. The rate of penetration shows the time taken to drill one metre, the wear on the drill bit is not taken into account. For example the decrease in drilling rate between 170 and 195 m in PW6A is due to bit wear not to change in formation. The figures suffixed B show the electric logs with rest water level marked for reference. The casing collar log on PW1B and PW2 gives a mark at each joint of casing, the quiet section at the bottom of the log represents the screen.

The electric logs of single point resistance and self potential exhibited no unusual characteristics. The general form of the logs is similar to those run in the same lithological sequence during the feasibility study. The gamma logs on PW1B and PW2 showed that there was natural activity with some peaks. These peaks tend to be characteristic of clay horizons although there was no evidence to support this from the drilling returns. As these are the only gamma logs for the area that we have seen it is not possible to determine how characteristic they are.

The aquifer comprises of buff coloured fine grained quartz sands which contain some medium sand. The subangular to rounded quartz grains are mostly set in a carbonate matrix which forms poorly to moderately developed cementing. These buff sands were shown in our previous work to pass laterally into marine limestones nearer to the coast indicating a marine origin.

The wellfield area is blanketed by red aeolian sands which have a thickness of 40 to 65 m. These sands lie well above the watertable and are generally uncemented although there was some cementing found at PW4, PW8 and to the south west at OW3A.

About 6 km to the northwest of the wellfield lies the flood plain of the Shabeelle. Observation well OW2 was drilled to a depth of 100 m in that area and proved 35 m of alluvial silts before passing into sands. The red sands were struck at 55 m below ground level, forming in that area the aquifer, and contained carbonate cementing. The silt and sandy silts above the red sands contained gypsum in the form of crystals and also some rounded fragments of carbonate material.

WELL DESIGN AND DEVELOPMENT

All the boreholes were drilled using direct circulation rotary methods. Initially a pilot hole was drilled and from the lithological and geophysical logs the position of the screen was determined. For the observation wells no reaming was carried out.

The pilot hole for the production wells was reamed out to accept the 254 mm (10 inch) internal diameter steel casing and 30 m of 203 mm (8 inch) wire wound stainless steel screen, which had a slot size of 0.38 mm (0.015 inch). A galvanised steel pipe 32 mm in diameter was secured to the outside of the casing with an elbow welded onto the casing just above the adaptor. This 32 mm pipe provides an external dipping facility. Figure 3.1 shows the dimensions of a typical production well.

Once the screen and casing had been placed correctly the annulus was filled with a filter pack to a level of 10 m above the top of the screen. The filter pack is a rounded quartz material graded from 0.3 mm to 2.0 mm (0.012 to 0.08 inch). This grading was derived from the grading of the uncemented aquifer material as shown in Figure 3.2. There are several methods of determing the filter pack grading and the curve we have chosen falls within the envelope of the other methods. A slightly coarser filter pack, which still fell within the limits, was used for wells PW3A, 4B, 7 and 8.

The observation wells were also constructed using steel casing and screen both of 102 mm (4 inch) diameter. However observation well OW2 was constructed using 102 mm plastic casing and slotted screen, the slot size being 0.4 mm.

Typical production well construction

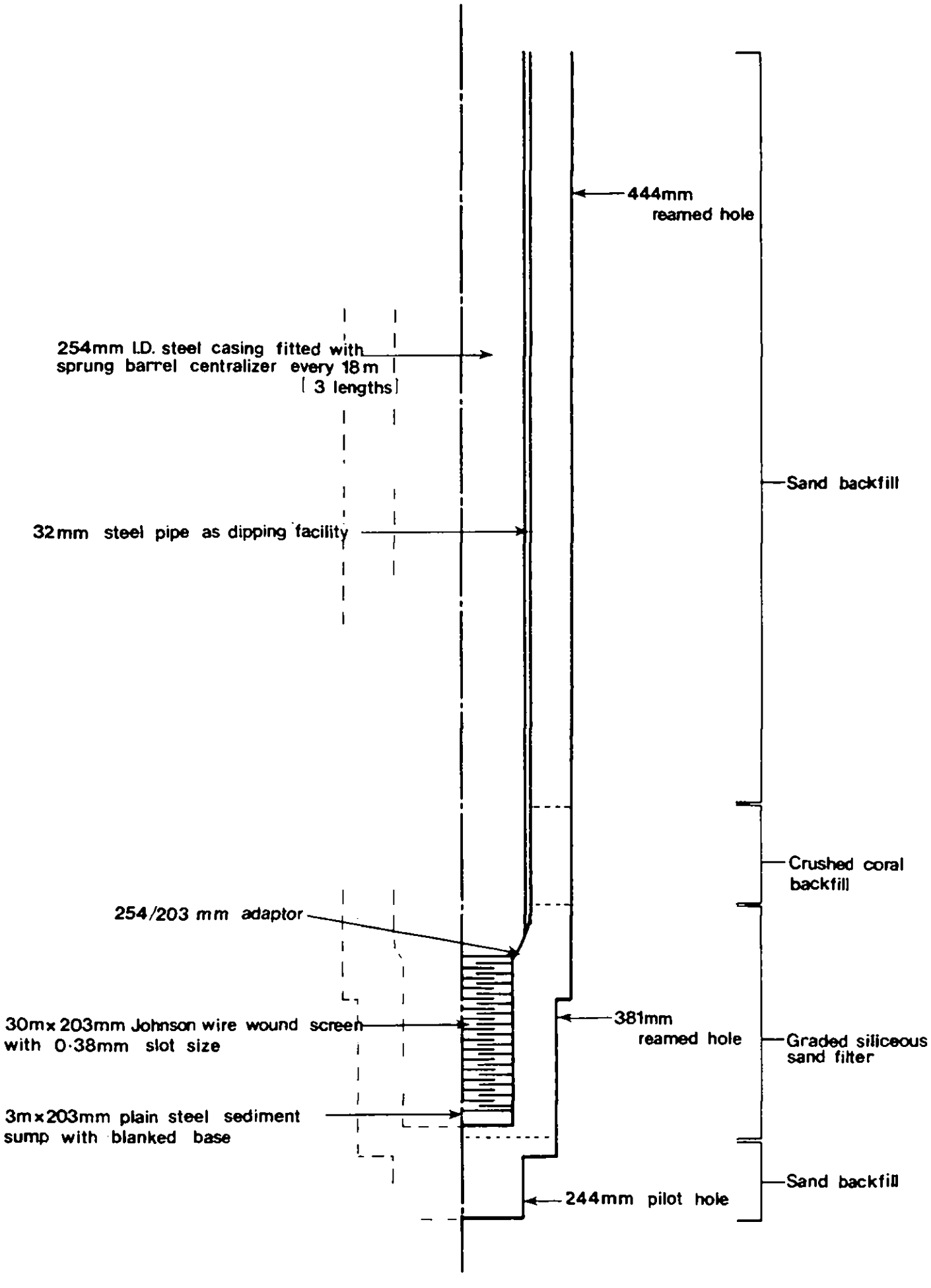


Figure 3·1

Filter pack grading curves

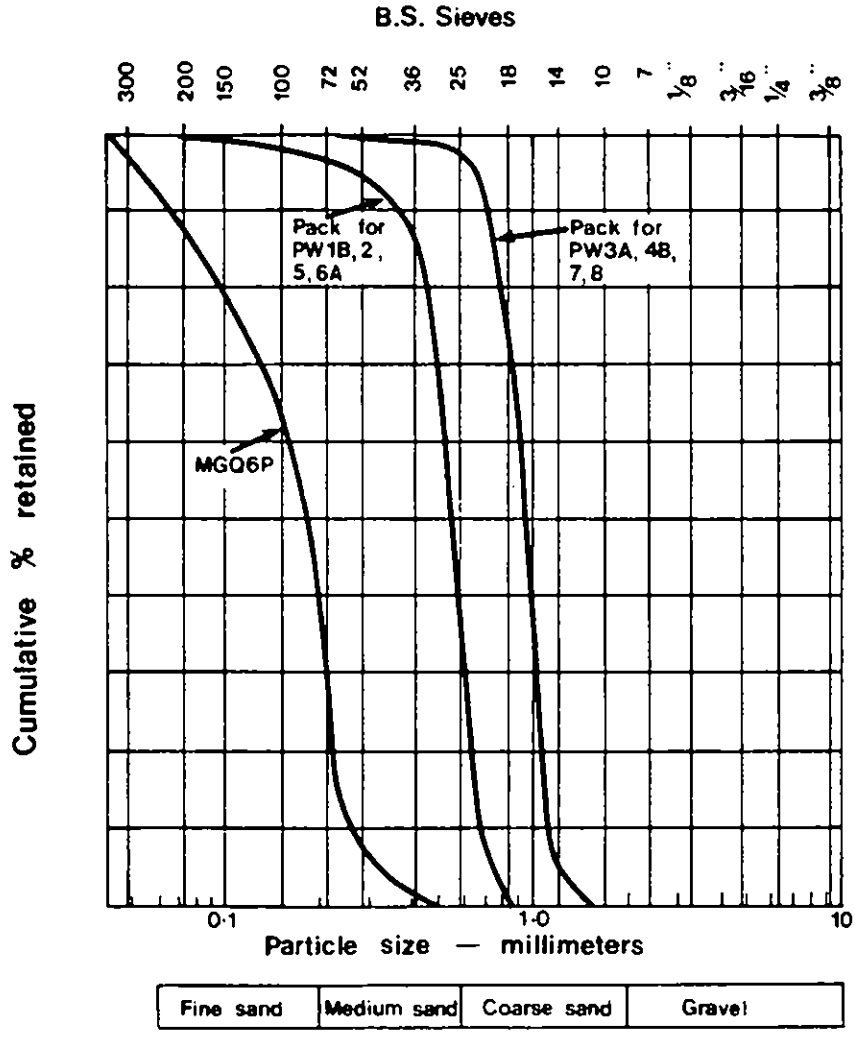


Figure 3·2

The drilling fluid used was Revert made by Johnson Well Screens Ltd. This fluid is an organic polymer which breaks down, looses it's viscosity, under bacteorological action or by using a suitable chemical. Because of the high ambient temperature the fluid would have broken down too quickly so that a temperature stabiliser also had to be used to maintain the drilling properties.

Following the construction of the wells, the wells have to be cleaned and developed so that the full potential can be realised. The development removes the effects of drilling by breaking down the drilling fluid coating the borehole walls and invading the aquifer and then removing the fines from the aquifer and filter.

The manufacturers of the drilling fluid specified a chemical breaker which causes the fluid to loose its cohesive properties. However because of the fine grained nature of both the aquifer and filter pack there was difficulty in getting the breaker into contact with the fluid. Initially a variety of standard methods were used but in later wells a combination of introducing the breaker with the filter pack and then jetting in additional breaker was more successful.

With organic polymers such as Revert some of the breakdown is caused by micro-organisms and the use of stabilisers in effect disinfects the drilling fluid. This then creates additional breaking problems as under normal circumstances the fluid would break down without any additional breaker needed, hence making it easier to remove invading fluid from the aquifer.

For the removal of the fines the best method adopted was that using the test pump and surging the well. It was not possible to develop the wells to the recommended one and a half times the production yield because of pump capacity limitations, however development up to $80m^3/hr$ took place until there was no further significant improvement in the drawdown characteristics, when the well was then tested.

The observation wells were firstly broken by the addition of breaker with the filter pack. Further breaker was then added to the well which was then airlifted. Airlifting continued until the sand content was at a minimum.

As the aquifer material is very fine grained the problem of sand entering the pumped well is a recurrent one in the area. However with the pack grading and screen slot size that we selected this problem appears to have been overcome. Because of the aquifer grading there is little chance of developing a natural pack around the screen. This means that unless there is a complete filter pack surrounding the screen then the well will always be producing some sand and indeed this is possibly the reason that wells PW3 and PW4 have had to be redrilled.

PUMP TESTING

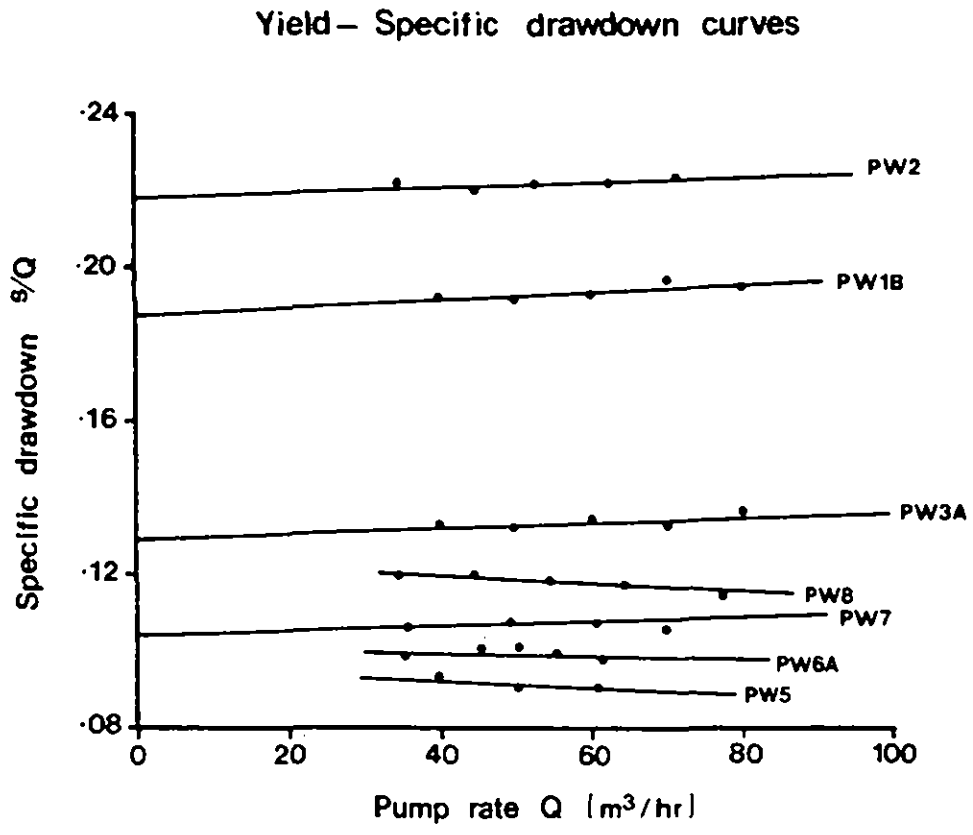
After there appeared to be no more significant improvement with development the production wells were test pumped. The testing consisted of step drawdown tests of either 4 or 5 stages each of two hours duration, these tests provide information on yield drawdown characteristics, borehole efficiency and also give an estimate of transmissivity.

It is possible to separate the total drawdown into aquifer loss which is caused by the resistance of the aquifer to flow, and the well loss which is caused by turbulent flow within and around the well. The well efficiency is defined as the aquifer loss expressed as a percentage of the total drawdown.

The results of the seven steptests are shown as specific drawdown and yield drawdown curves in Figure 4.1, the data and time drawdown plots for the tests are presented in the Appendix. Of these tests three, PW5, 6A and 8, could not be interpreted as they display a decrease in specific drawdown with an increase in discharge. This is an indication of incomplete development despite the extensive airlifting and pump development programme carried out.

Two wells were retested during the pumping programme. Initially PW2 had a yield of just over $10m^3/hr$ but after a long programme involving additional breaking as well as airlifting the yield was improved. The initial test is shown as a broken line. PW5 was also retested and although it showed an improvement it was still not fully developed.

Table 4.1 gives the well efficiencies for the four tests solved. These are all over 95% at the highest rate of pumping tested. This means that over 95% of the drawdown observed in the well is caused by the aquifer showing that the well design is correct.


Yield– Specific drawdown curves
·24
·20
·16
·12
·08
Specific drawdown s/Q
PW2
PW1B
PW3A
PW8
PW7
PW6A
PW5
0
20
40
60
80
100
Pump rate Q [m³/hr]

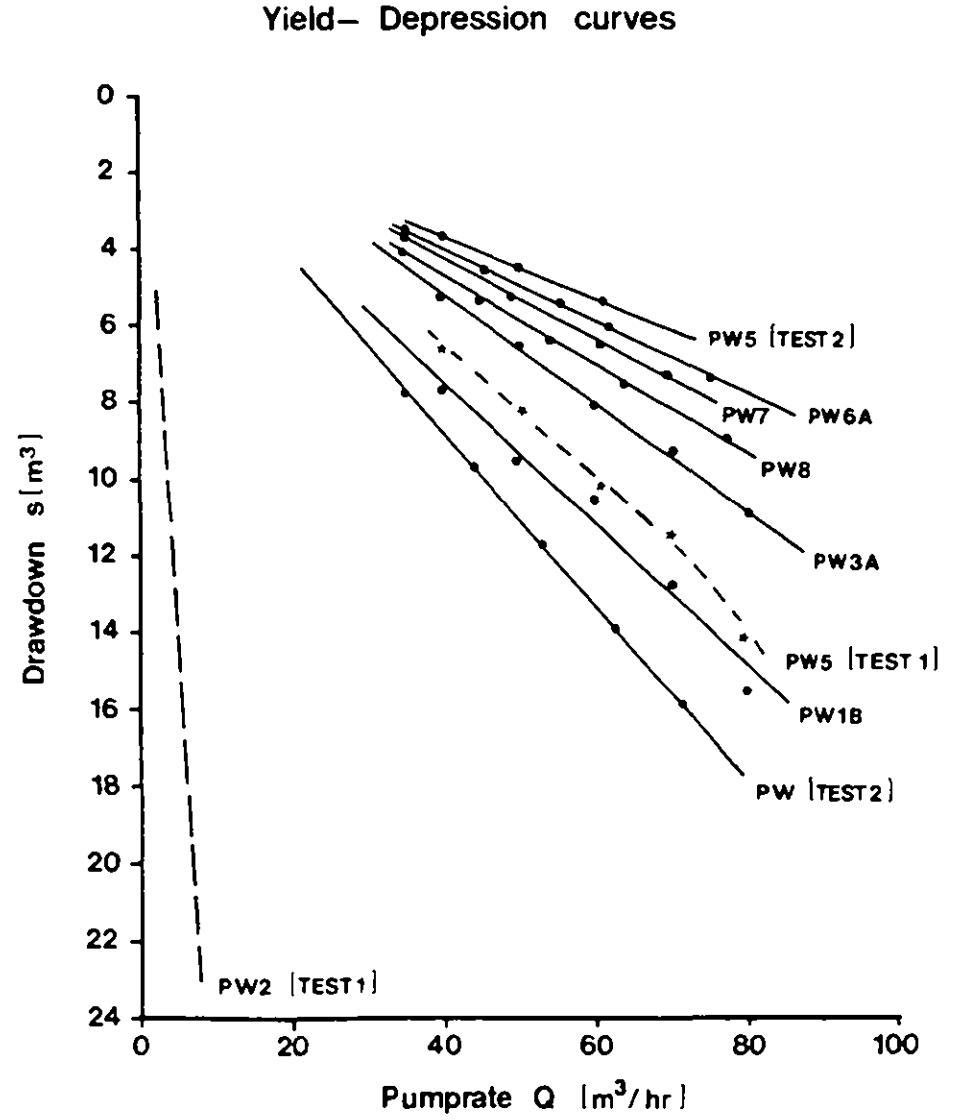

Yield– Depression curves
0
2
4
6
8
10
12
14
16
18
20
22
24
Drawdown s [m³]
PW5 [TEST 2]
PW7
PW6A
PW8
PW3A
PW5 [TEST 1]
PW1B
PW [TEST 2]
PW2 [TEST 1]
0
20
40
60
80
100
Pumprate Q [m³/hr]

Figure 4·1

Table 4.1

Well Efficiency and Transmissivity - Stage I Wells

	Discharge m^3/d	Efficiency %	Transmissivity m^2/d
PW1B	960	98	2520
	1200	97	
	1440	96	
	1680	96	
	1920	95	
PW2	833	99	1510
	1058	99	
	1270	99	
	1498	98	
	1704	98	
PW3A	960	98	1960
	1200	97	
	1440	96	
	1680	96	
	1920	95	
PW7	847	98	1560
	1178	97	
	1452	96	
	1668	96	

The reason for the difficulty in fully developing the wells probably lies with the very fine nature of the aquifer. As the filter pack is related to grain size of the aquifer it follows that a combination of thick pack with its fine grain sizes also prevents ready access to the drilling fluid coating the borehole walls. By introducing breaker with the filter pack some of this problem was overcome but not entirely and it then becomes a balance between achieving the best development within the most optimum time. As the drilling fluid will degrade with time there should be an improvement in the underdeveloped wells as time passes.

An estimate of the aquifer transmissivity is possible using Jacob's approximation for the first stage data. For the four tests which offered solutions the transmissivities fell within the range 1510 to 2520m^2/d which compares favourably with the regional value of 1960m^2/d assumed for the 1980 model studies.

WATER QUALITY

In the course of the construction water samples were taken from all three observation wells just before the airlift was completed. Pumped samples were also taken at the end of the steptests on production wells PW2, PW5, PW6A and PW8. These samples were subsequently analysed at IH for the major ions and electric conductivity. The pH values given were those recorded in the field at the time of sampling. There was a delay between sampling and analysis which may have had some effect on the calcium and bicarbonate values. The results, table 5.1, include a value for total dissolved solids (TDS) which is a computed value from the ion determinations instead of a direct measurement.

When compared with the chemistry of MGQ2P, also included in the table, taken in 1978, there is a significant increase in the concentrations of most ions particularly magnesium and sulphate. We have also compared the results with those from the coastal observation wells (MGQ1CP - 3CP). It seems almost certain that the mineralisation is not caused by saline intrusion as the sodium and chloride levels in the new results are relatively low.

In terms of potability the analysis are classed according to the WHO standards as given in Appendix C of our 1980 Report. In all cases the sulphate concentration and most of the total dissolved solids are higher

Table 5.1

Water Quality - Stage I Wells

(Ionic concentrations in milliequivalents per litre)

	OW1B	OW2	OW3A	PW2	PW5	PW6A	PW8
Date	15.12.81.	11.11.81.	11.12.81.	26.2.82.	26.10.81.	4.12.81.	21.12.81.
TDS mg/l	2803**	1312*	1866**	1540*	2169**	2689**	2208**
E.C. µs	3350	1500	2450	2000	2850	2800	2650
pH	8.0	8.2	7.9	7.7	7.8	7.8	
Ca	11.1**	4.4*	10.8**	10.5**	9.2*	11.6**	11.8**
Mg	13.5**	5.8*	11.5*	8.9*	11.5*	19.3**	22.2**
Na	15.7	8.7	5.7	3.5	12.6	9.6	4.8
K	0.3	0.1	0.3	0.3	0.2	0.2	0.4
HCO_3	5.3	3.5	7.1	6.2	7.3	7.1	6.7
SO_4	30.2**	11.5**	13.5**	12.5**	18.7**	26.0**	16.7**
Cl	7.3*	4.5	8.2*	3.9	5.4	8.7*	10.2*
NO_3	0.3	0.4	<0.1	0.2	0.2	<0.1	0.1

* indicates a concentration which exceeds WHO highest desirable level

** indicates a concentration which exceeds WHO highest permissible level

than the maximum permissible level with calcium, magnesium and chloride mostly greater than the highest desirable level. Generally the concentrations recorded suggest that the palatability of the groundwater may be impaired but should not necessarily be harmful.

WELLFIELD OPERATION

In view of the importance of a potable water supply additional monitoring should be undertaken to ensure that the response of the aquifer is as was predicated and that any deterioration in quality is detected at the earliest possible time.

For monitoring purposes the three observation wells drilled should be maintained and the water levels measured. Additional routine water level measurements should be taken at MGQ1P, 2P, 4P and 10P and at each production well. To compliment these data the volume of water abstracted from each well should also be recorded. The water levels should be measured monthly within the wellfield and every two months elsewhere, with the abstraction rates recorded weekly. These data will enable a check to be made on the behaviour of the wellfield against predictions. It is important to note that our models were based on an annual abstraction of 4.2 million m^3/year ($60m^3$/hr per well) for the Stage I wellfield.

Quality monitoring should be carried out on a routine basis of monthly electrical conductivity measurements of each well. At half yearly intervals water samples for major ion analysis should be taken from each well or if a rapid increase in conductivity is found. Annual conductivity profiles should be determined in all the observation wells where water levels are recorded. This should then give an indication if water of a different quality is being drawn into the wellfield area.

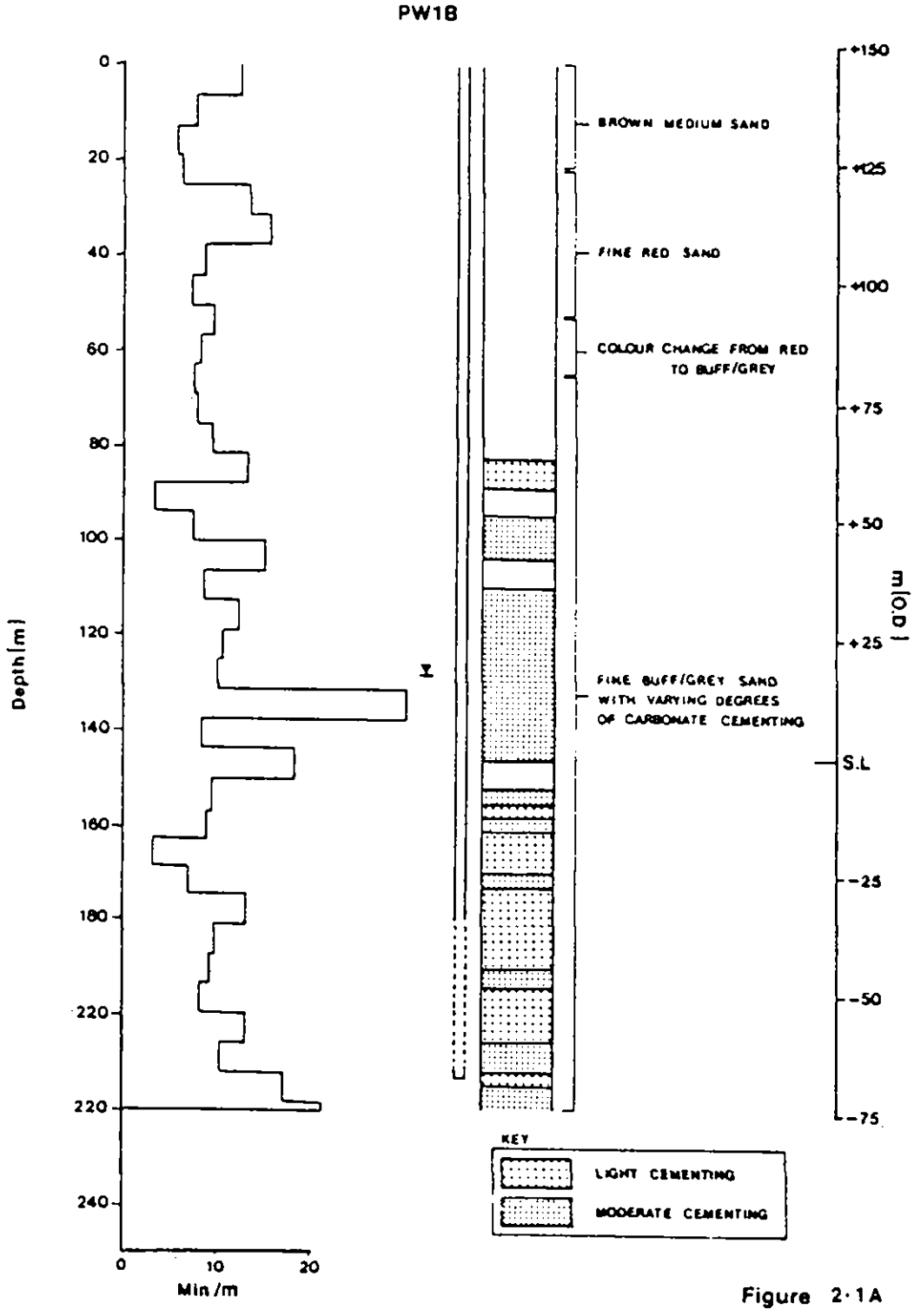
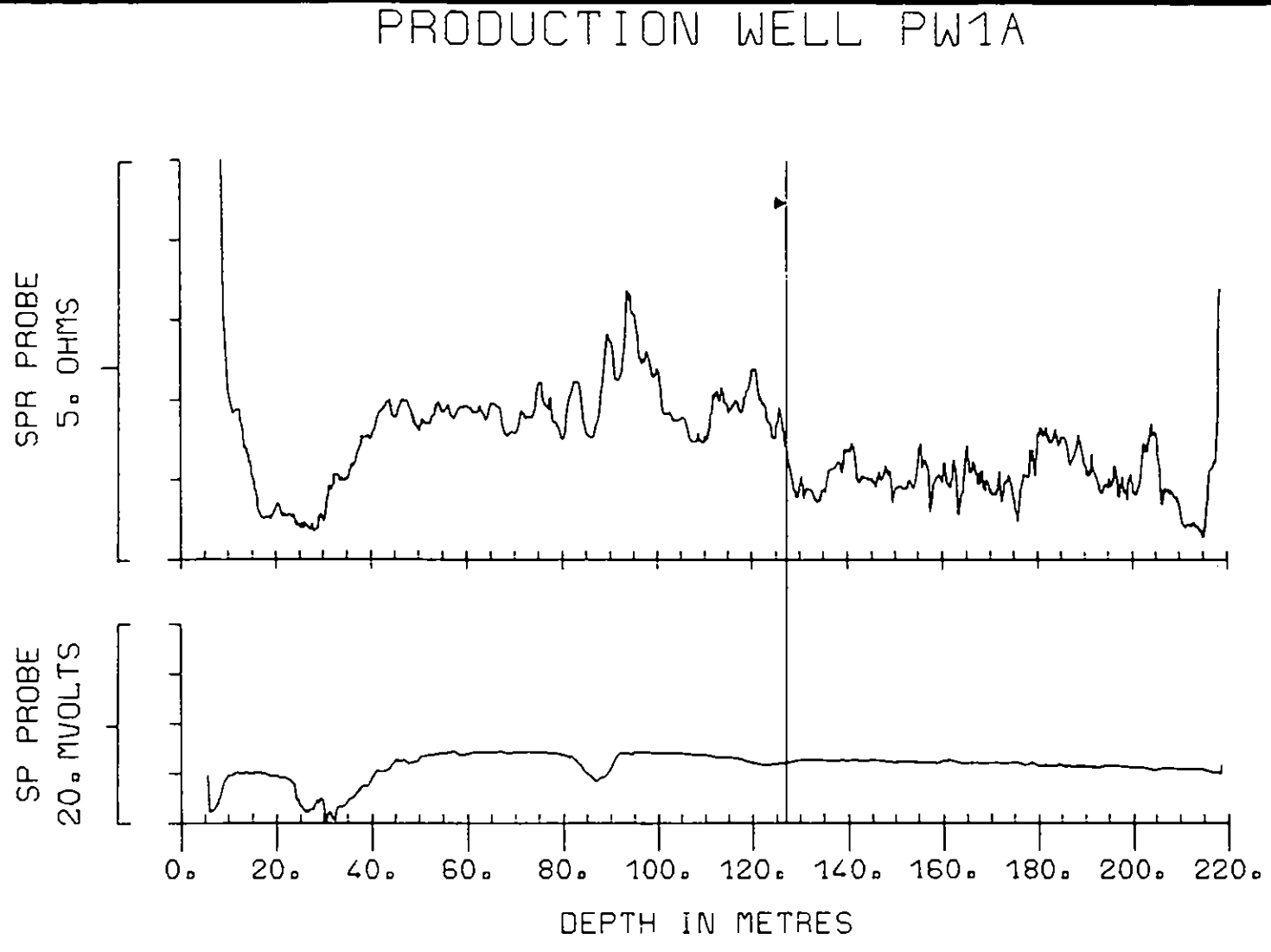

PW18
Depth (m)
0
20
40
60
80
100
120
140
160
180
220
220
240
0
10
20
Min/m
BROWN MEDIUM SAND
FINE RED SAND
COLOUR CHANGE FROM RED TO BUFF/GREY
FINE BUFF/GREY SAND WITH VARYING DEGREES OF CARBONATE CEMENTING
+150
+125
+100
+75
+50
+25
S.L
-25
-50
-75
m(o.d.)
KEY
LIGHT CEMENTING
MODERATE CEMENTING

Figure 2·1A


PRODUCTION WELL PW1A
SPR PROBE
5. OHMS
SP PROBE
20. MVOLTS
0.
20.
40.
60.
80.
100.
120.
140.
160.
180.
200.
220.
DEPTH IN METRES

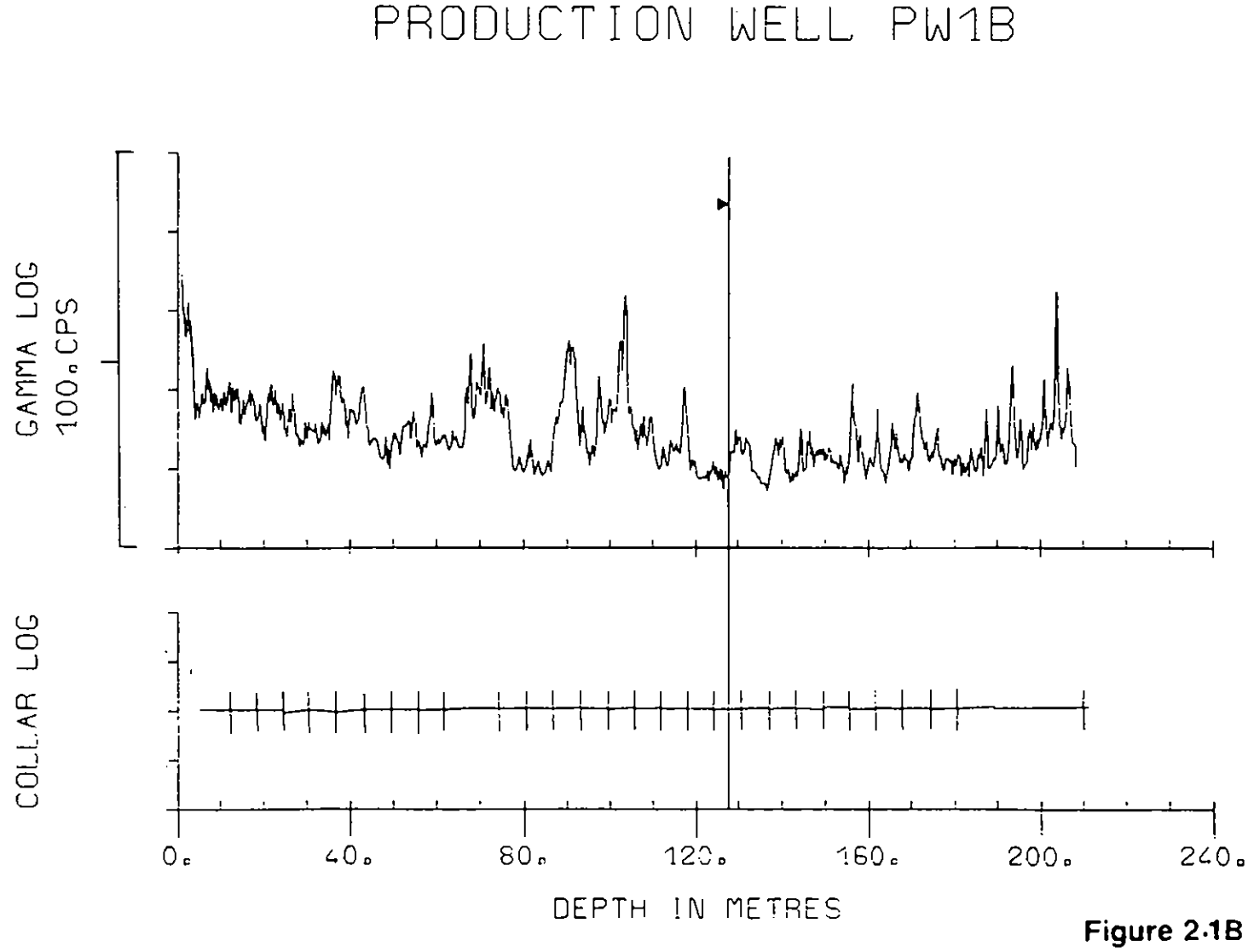

PRODUCTION WELL PW1B
GAMMA LOG
100. CPS
COLLAR LOG
0.
40.
80.
120.
160.
200.
240.
DEPTH IN METRES

Figure 2.1B

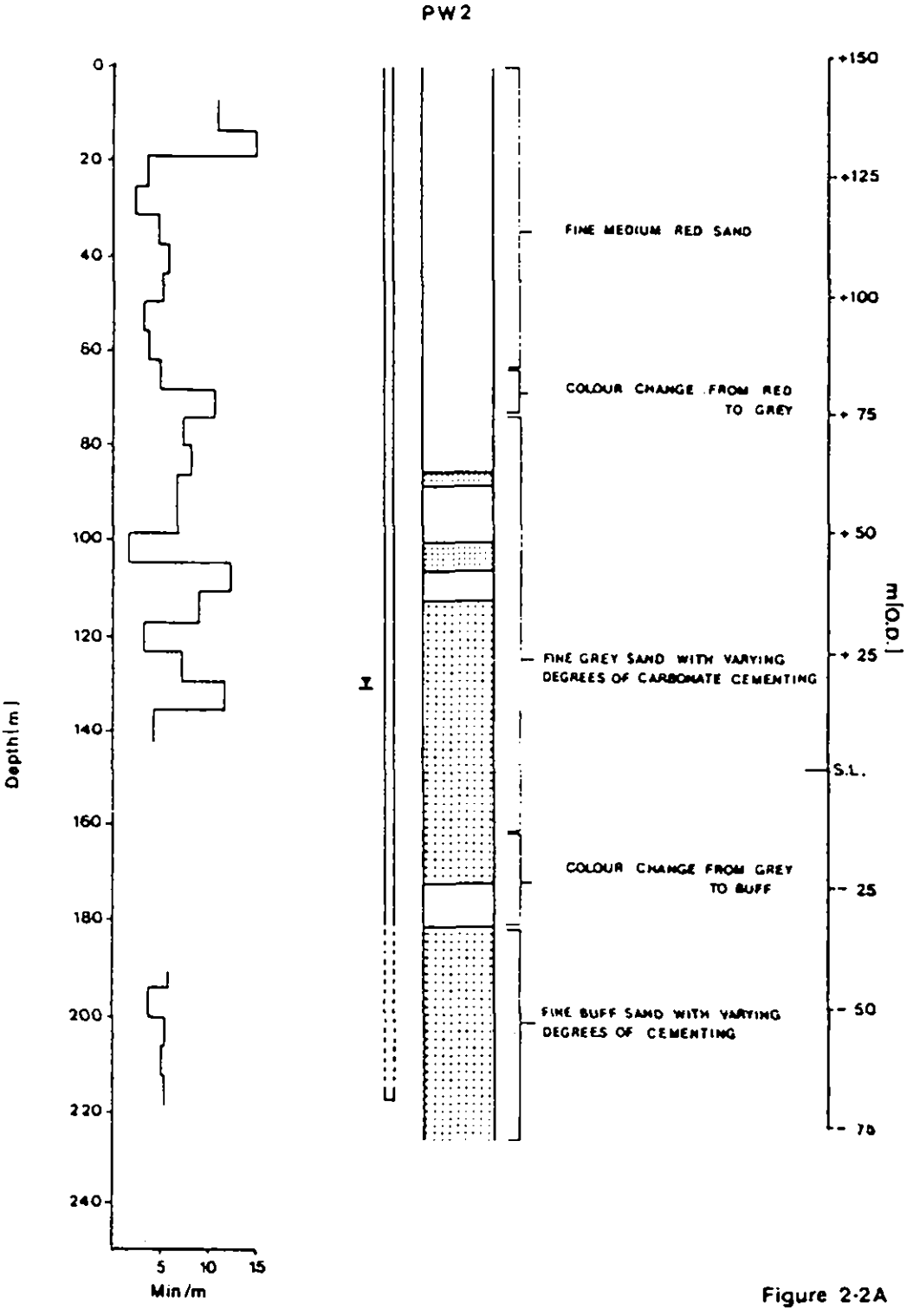

PW2
Depth(m)
0
20
40
60
80
100
120
140
160
180
200
220
240
5
10
15
Min/m
+150
+125
+100
+ 75
+ 50
+ 25
S.L.
- 25
- 50
- 75
m(o.d.)
FINE MEDIUM RED SAND
COLOUR CHANGE FROM RED TO GREY
FINE GREY SAND WITH VARYING DEGREES OF CARBONATE CEMENTING
COLOUR CHANGE FROM GREY TO BUFF
FINE BUFF SAND WITH VARYING DEGREES OF CEMENTING

Figure 2-2A

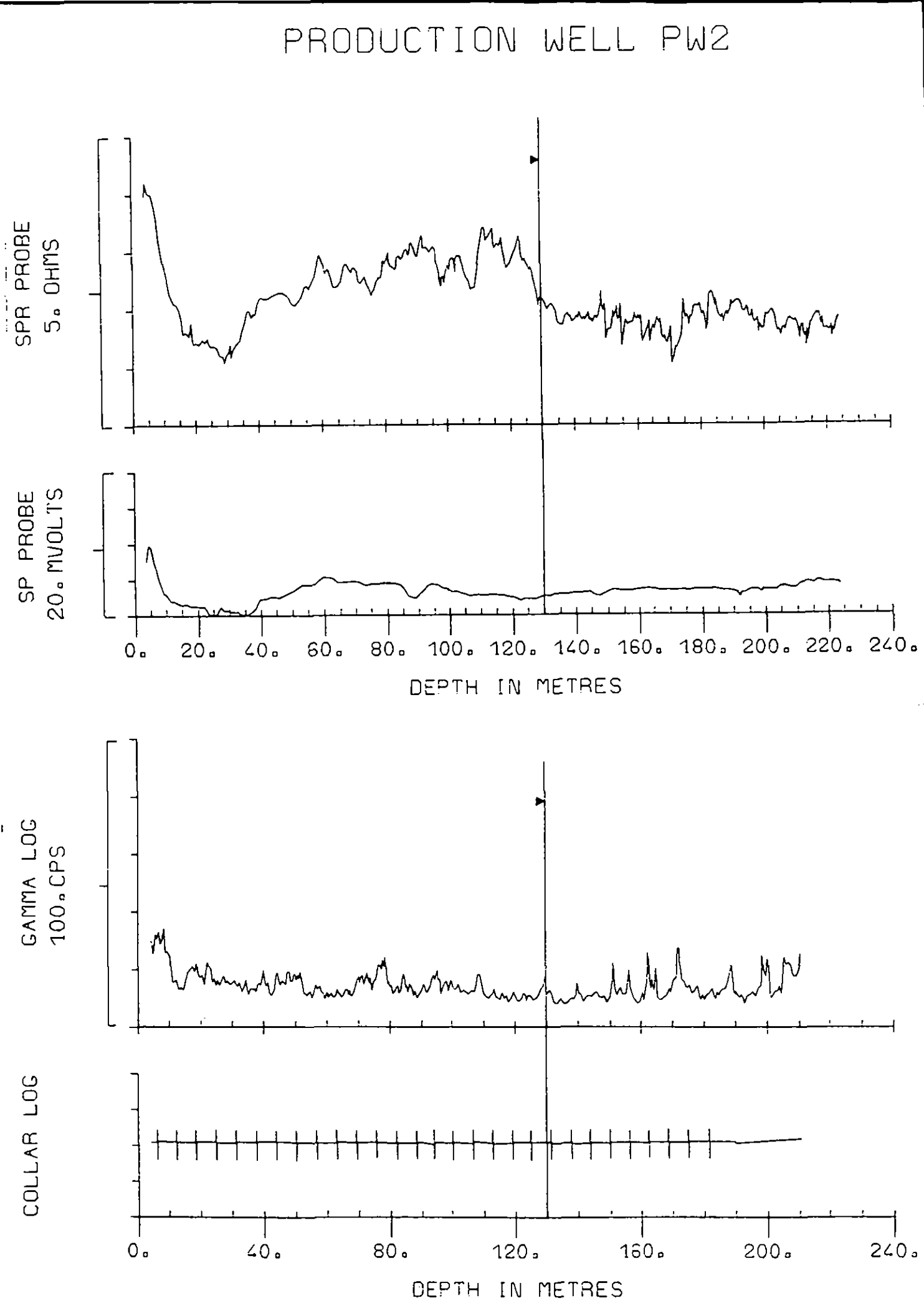

PRODUCTION WELL PW2
SPR PROBE
5. OHMS
SP PROBE
20. MVOLTS
0. 20. 40. 60. 80. 100. 120. 140. 160. 180. 200. 220. 240.
DEPTH IN METRES
GAMMA LOG
100. CPS
COLLAR LOG
0. 40. 80. 120. 160. 200. 240.
DEPTH IN METRES

Figure 2·2B

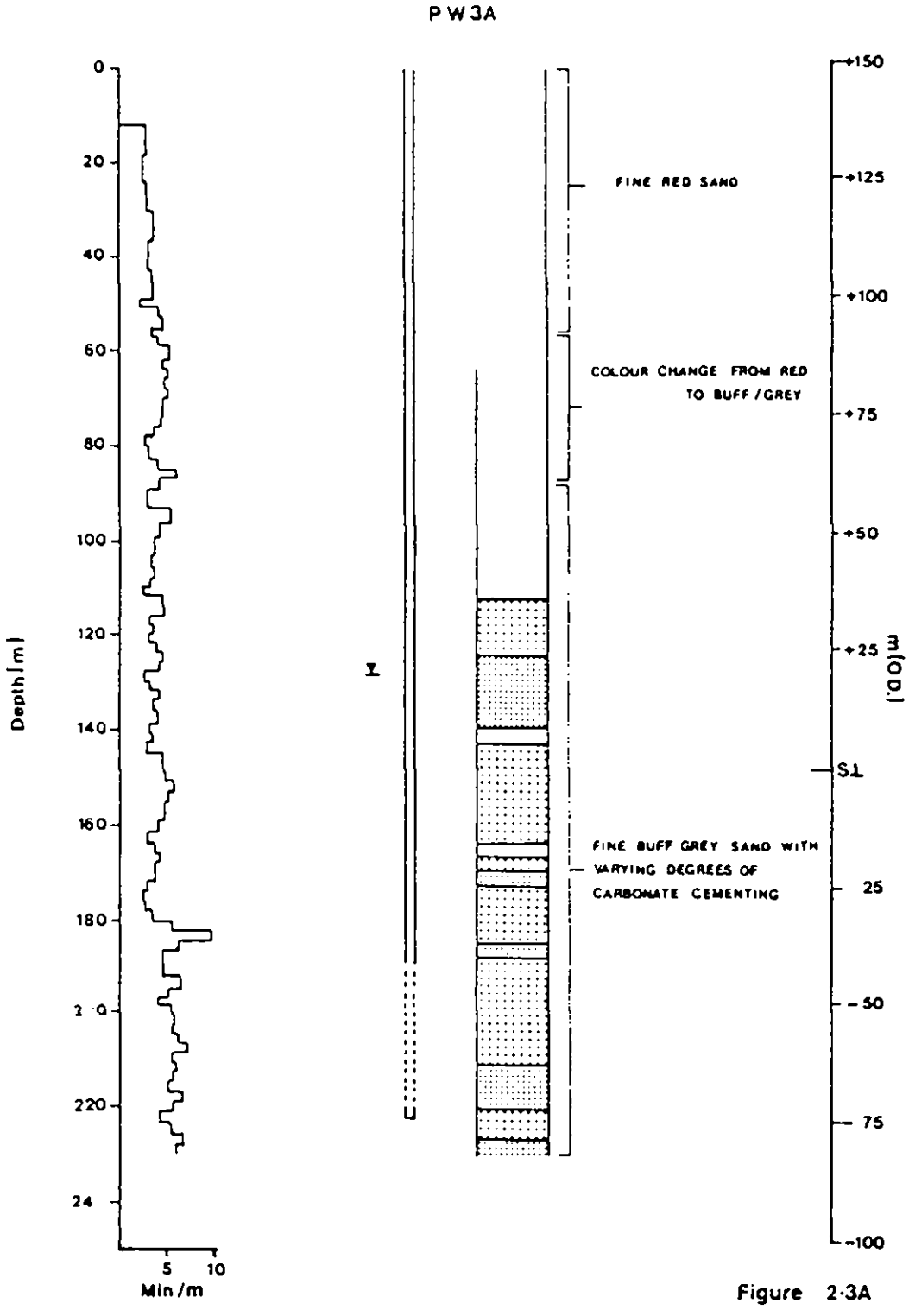

PW3A
Depth (m)
0
20
40
60
80
100
120
140
160
180
200
220
240
5
10
Min/m
FINE RED SAND
COLOUR CHANGE FROM RED TO BUFF/GREY
FINE BUFF GREY SAND WITH VARYING DEGREES OF CARBONATE CEMENTING
+150
+125
+100
+75
+50
+25
SL
25
-50
75
-100
m(OD)

Figure 2·3A

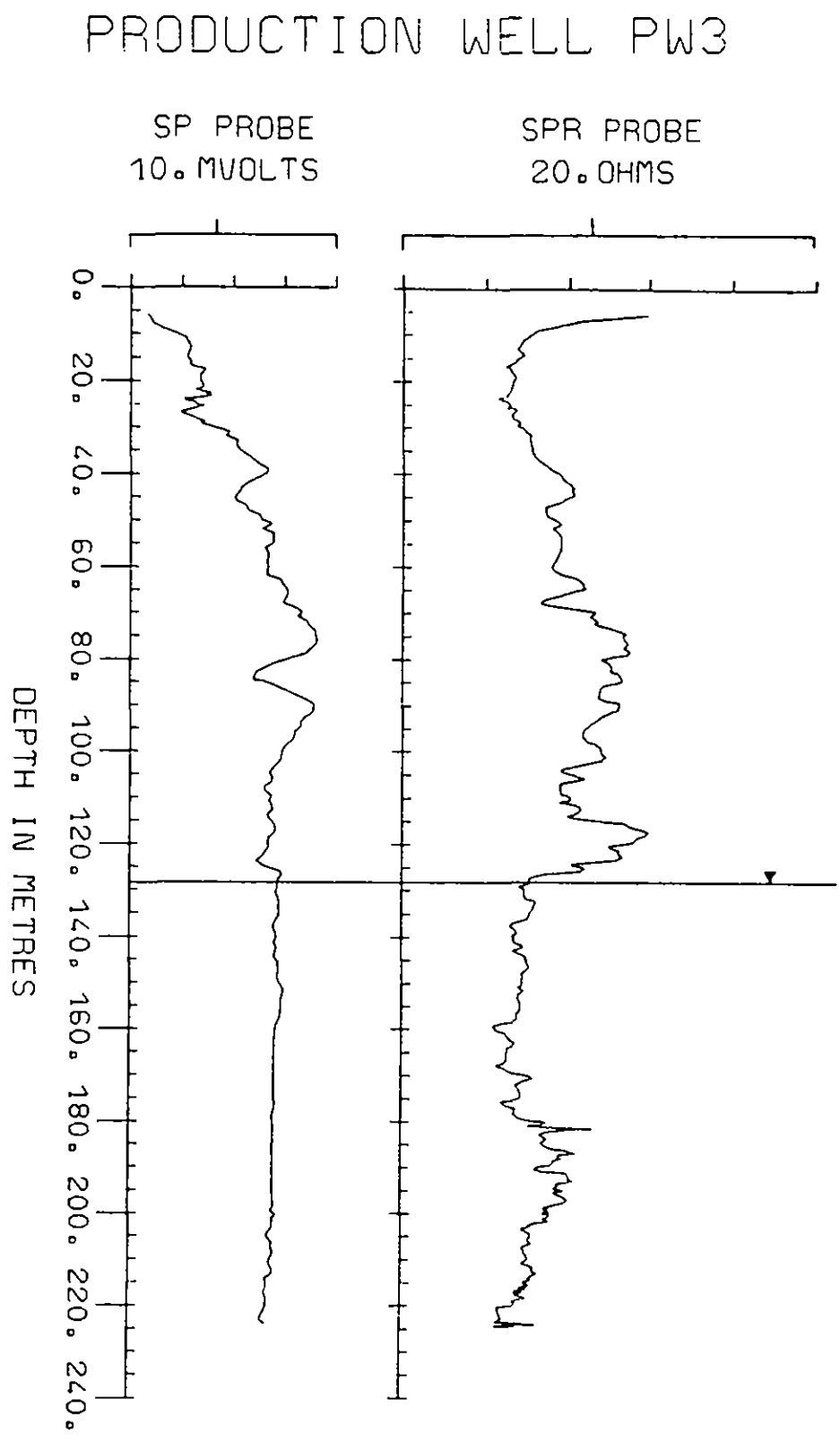

PRODUCTION WELL PW3
SP PROBE
10. MVOLTS
SPR PROBE
20. OHMS
0.
20.
40.
60.
80.
100.
120.
140.
160.
180.
200.
220.
240.
DEPTH IN METRES

Figure 2·3B

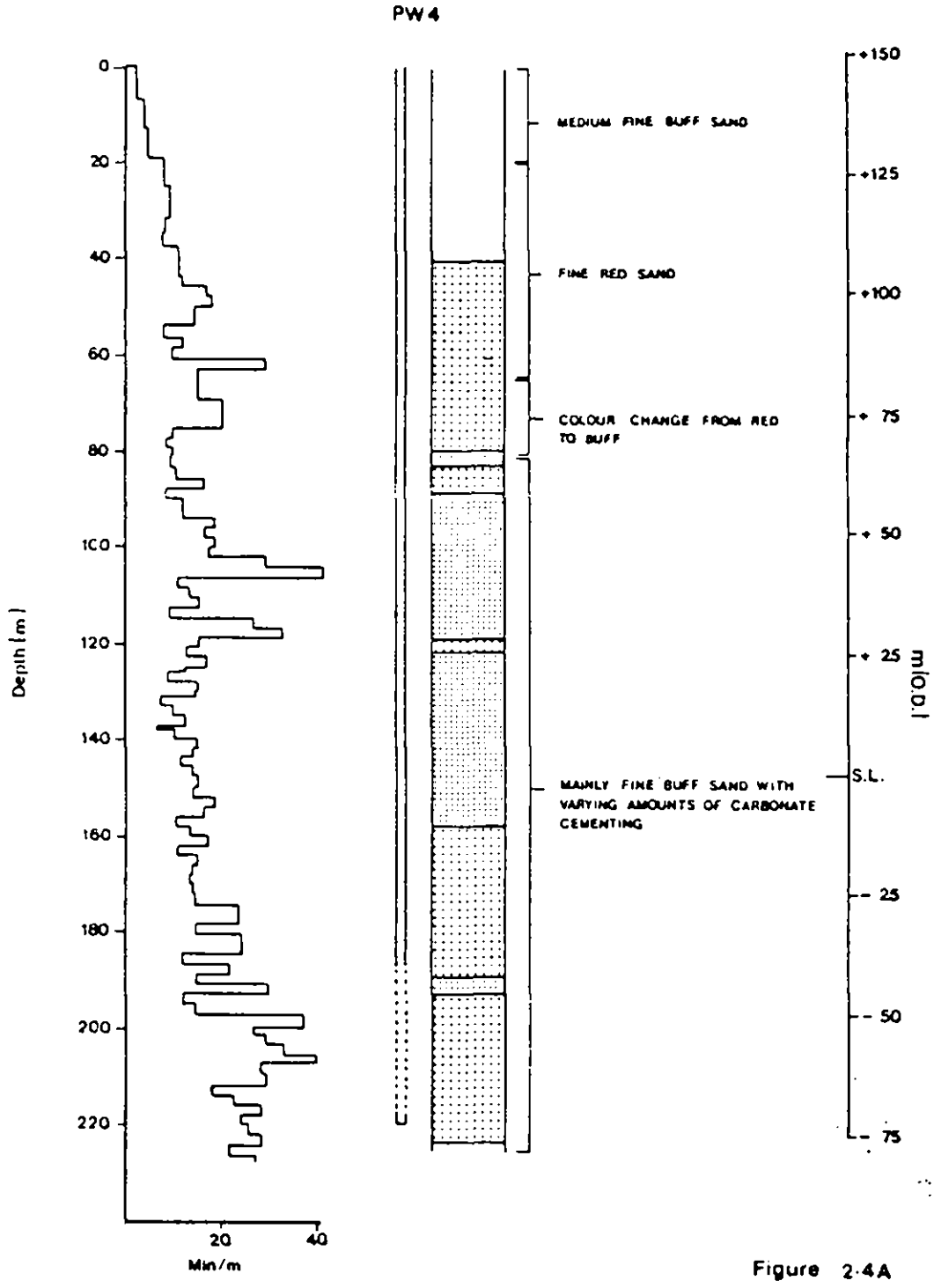

PW 4
Depth (m)
0
20
40
60
80
100
120
140
160
180
200
220
20
40
Min/m
MEDIUM FINE BUFF SAND
FINE RED SAND
COLOUR CHANGE FROM RED TO BUFF
MAINLY FINE BUFF SAND WITH VARYING AMOUNTS OF CARBONATE CEMENTING
+150
+125
+100
+ 75
+ 50
+ 25
S.L.
- 25
- 50
- 75
mOD

Figure 2·4A

PRODUCTION WELL PW4

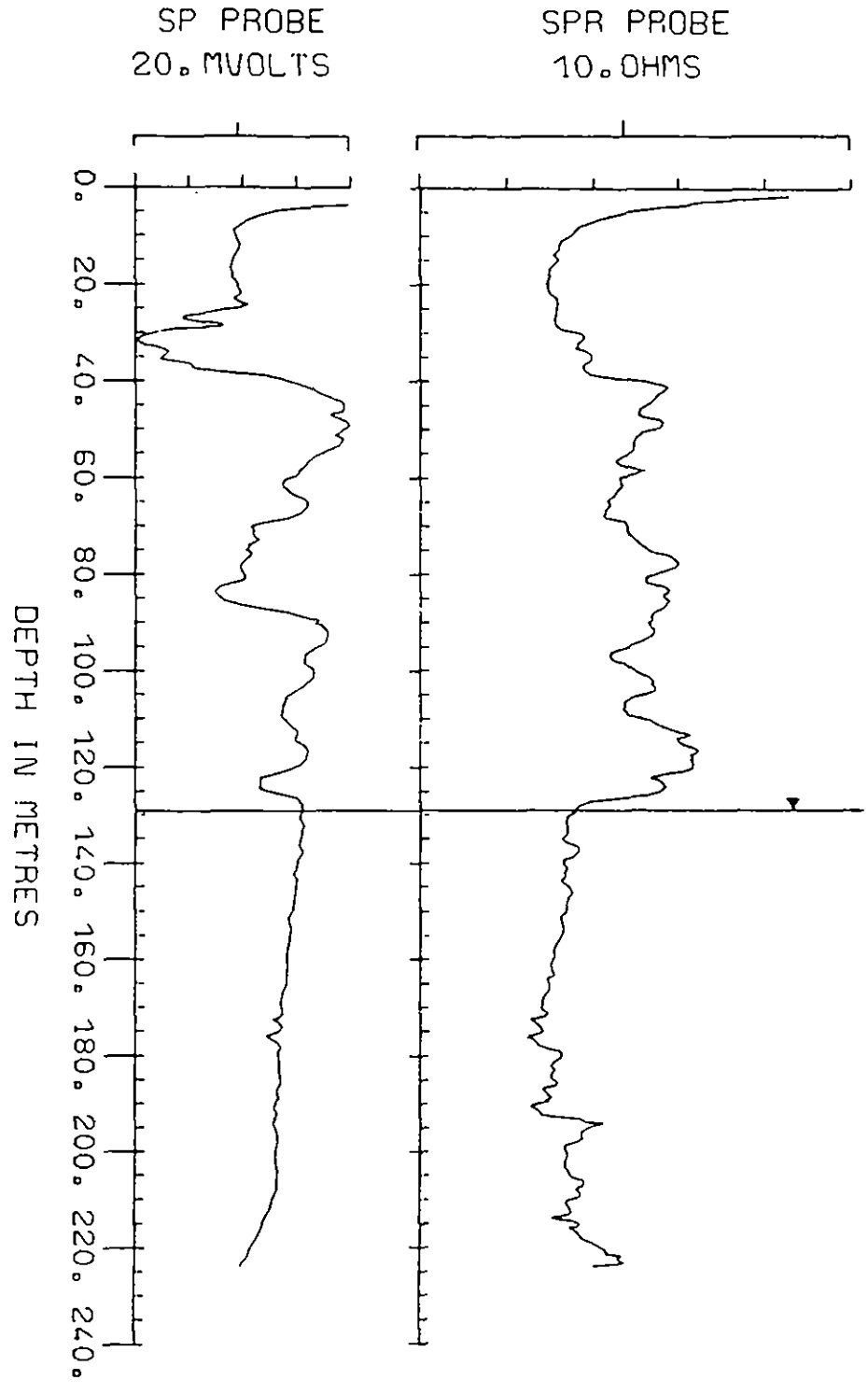


Figure 2-4B

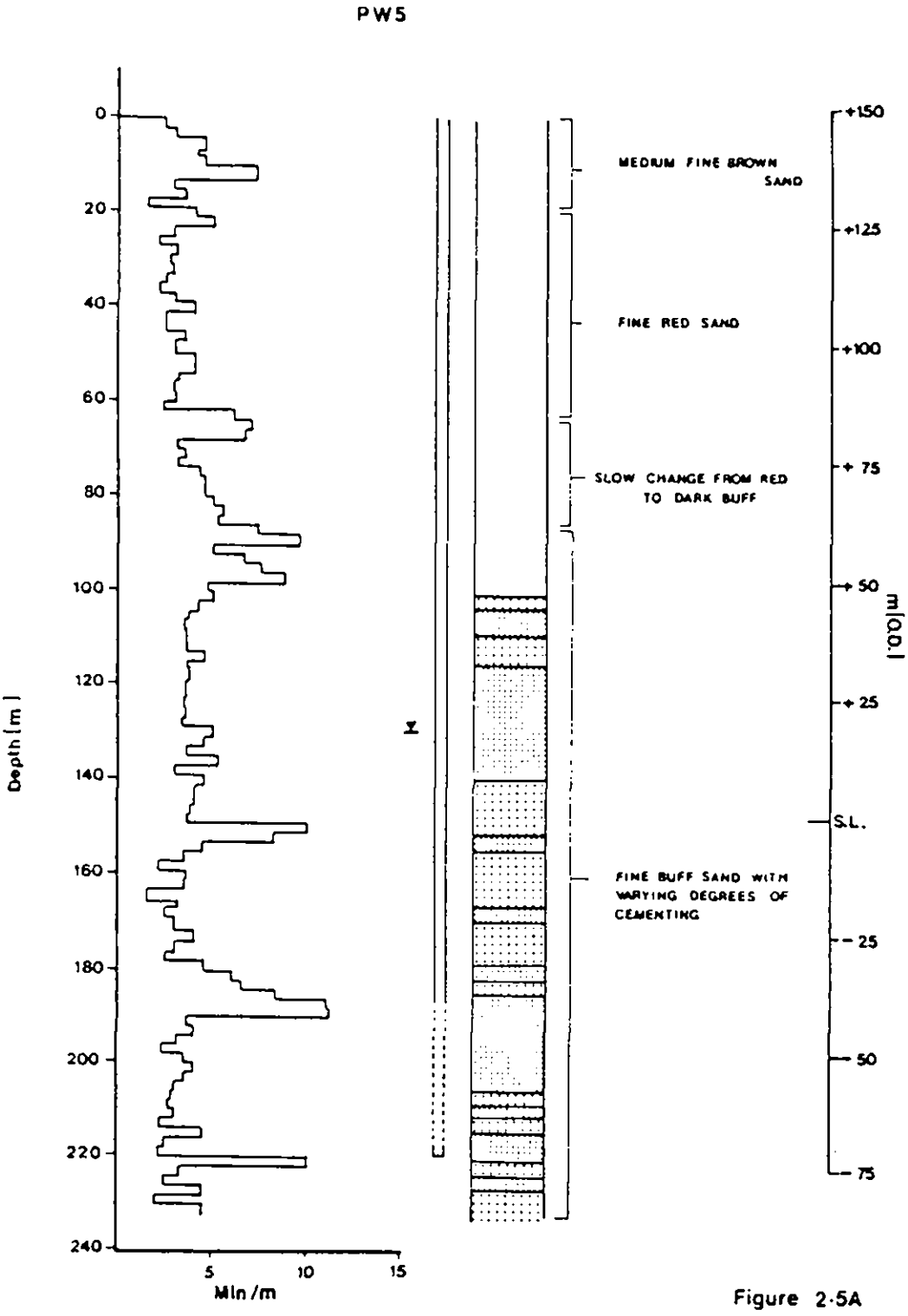

PW5
Depth [m]
0
20
40
60
80
100
120
140
160
180
200
220
240
5
10
15
Mln/m
MEDIUM FINE BROWN SAND
FINE RED SAND
SLOW CHANGE FROM RED TO DARK BUFF
FINE BUFF SAND WITH VARYING DEGREES OF CEMENTING
+150
+125
+100
+ 75
+ 50
+ 25
S.L.
- 25
- 50
- 75
m [O.D.]

Figure 2·5A

PRODUCTION WELL PW5

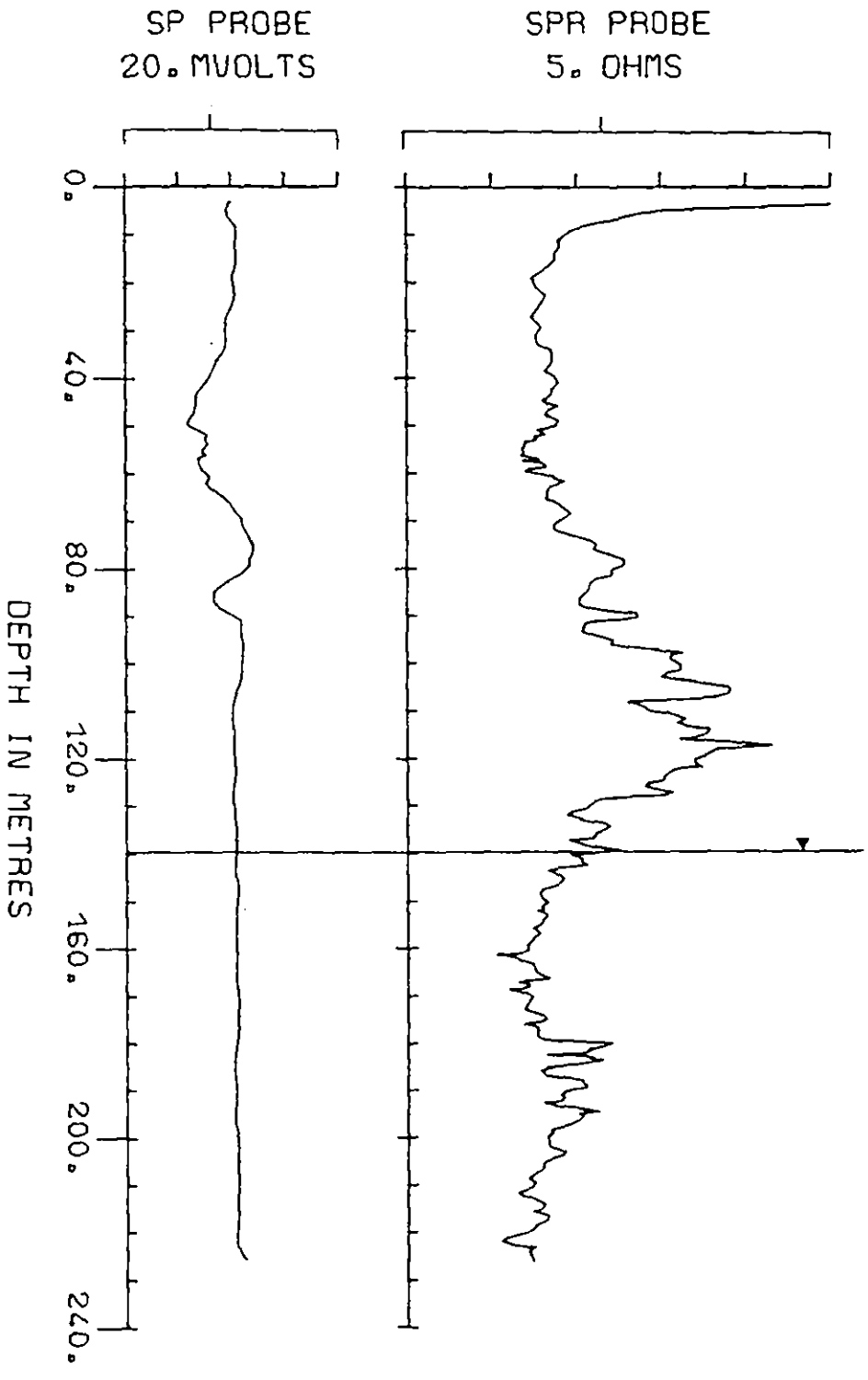


Figure 2.5B

PW6A

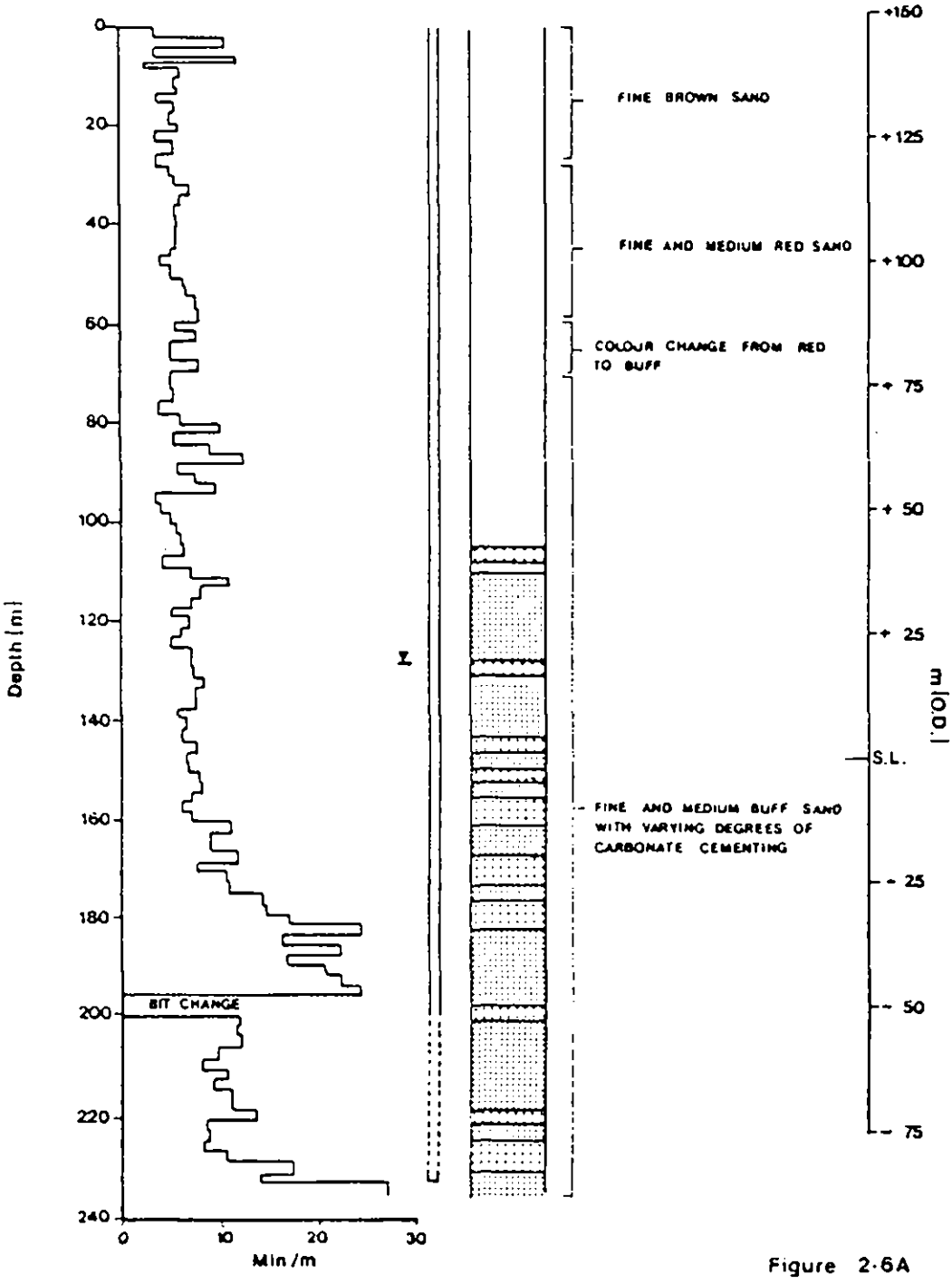


Figure 2·6A

PRODUCTION WELL PW6

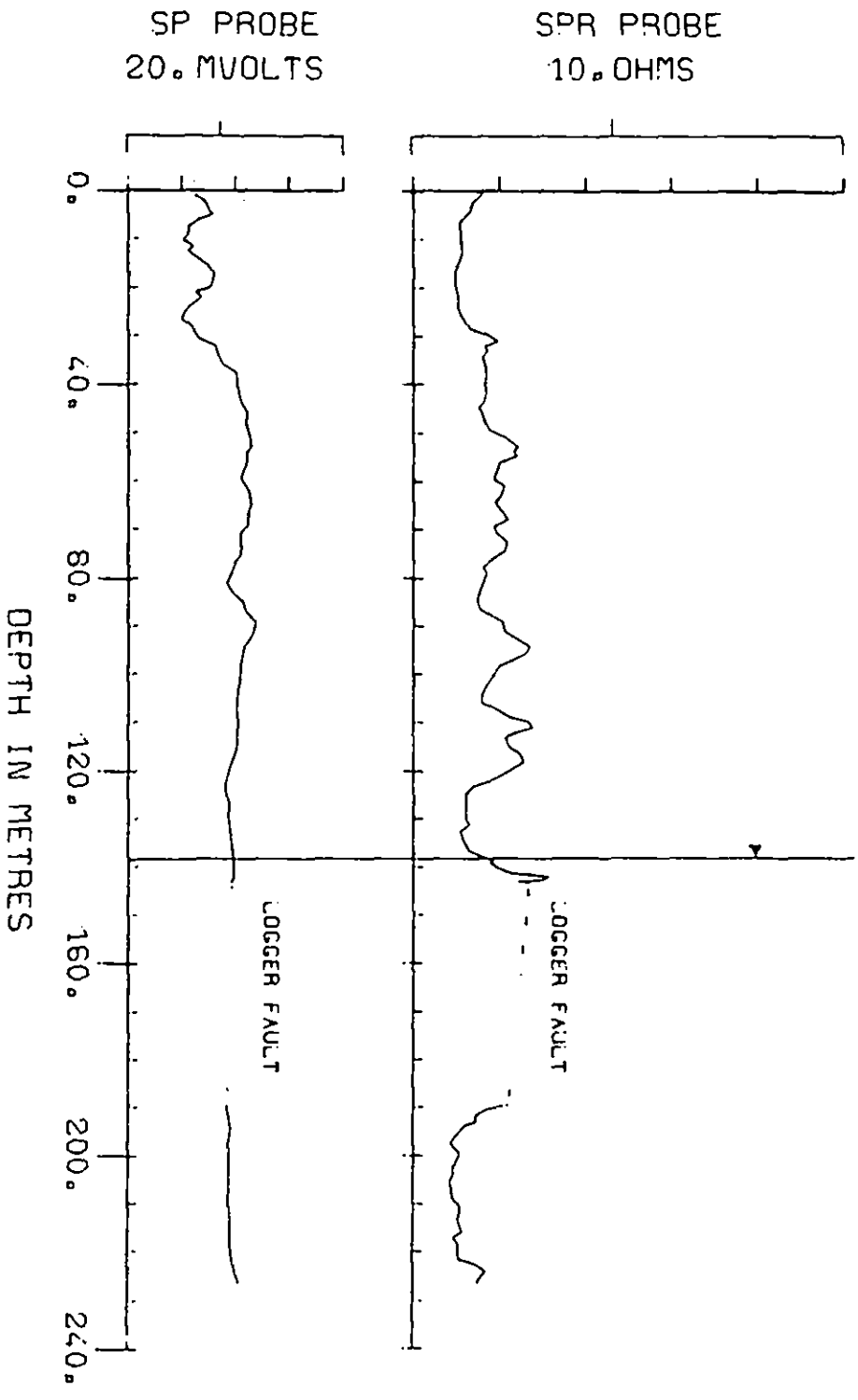


Figure 2·6B

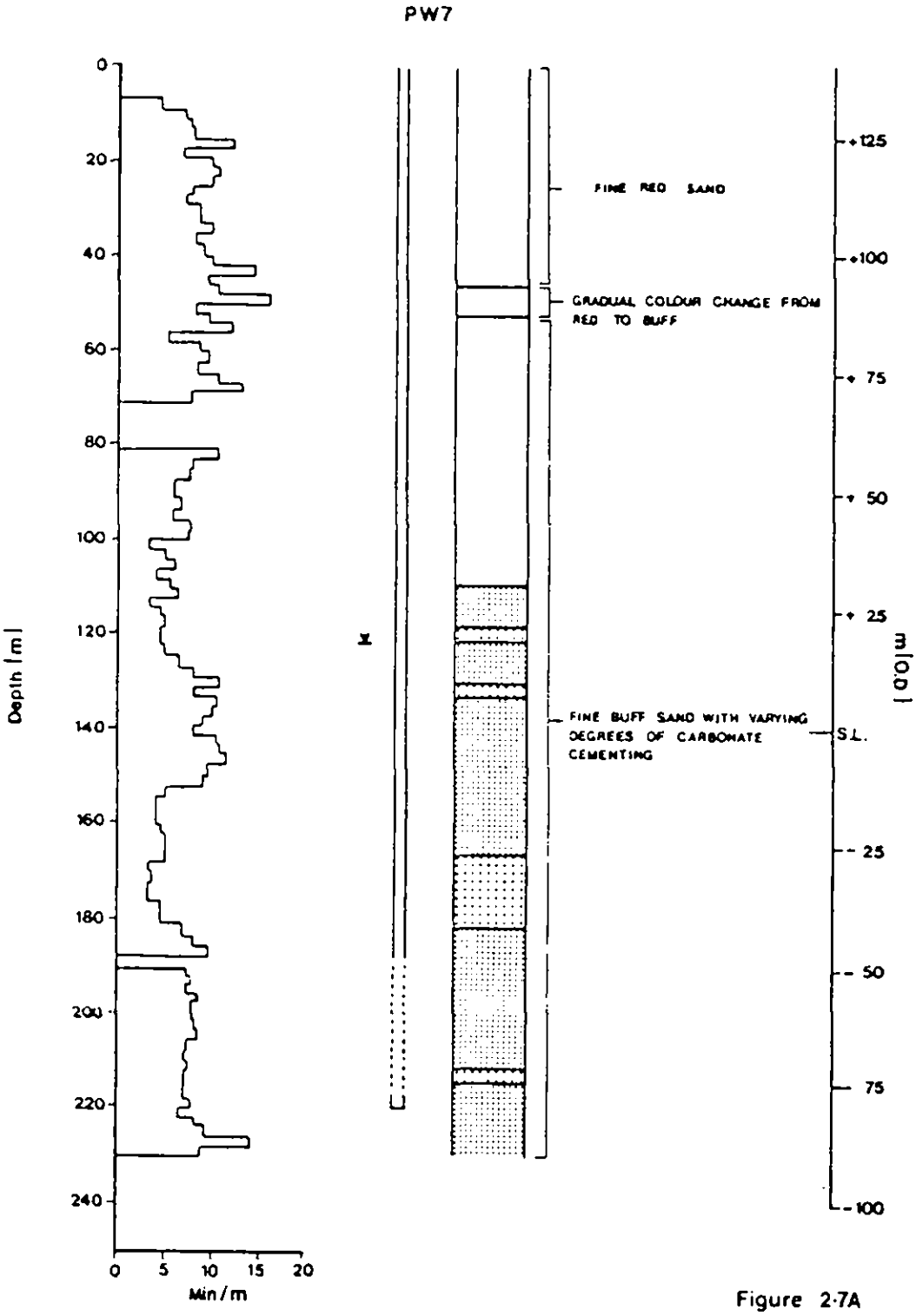

PW7
Depth (m)
0
20
40
60
80
100
120
140
160
180
200
220
240
0 5 10 15 20
Min/m
FINE RED SAND
GRADUAL COLOUR CHANGE FROM RED TO BUFF
FINE BUFF SAND WITH VARYING DEGREES OF CARBONATE CEMENTING
S.L.
+125
+100
+ 75
+ 50
+ 25
- 25
- 50
- 75
-100
m (OD)

Figure 2·7A

PRODUCTION WELL PW7

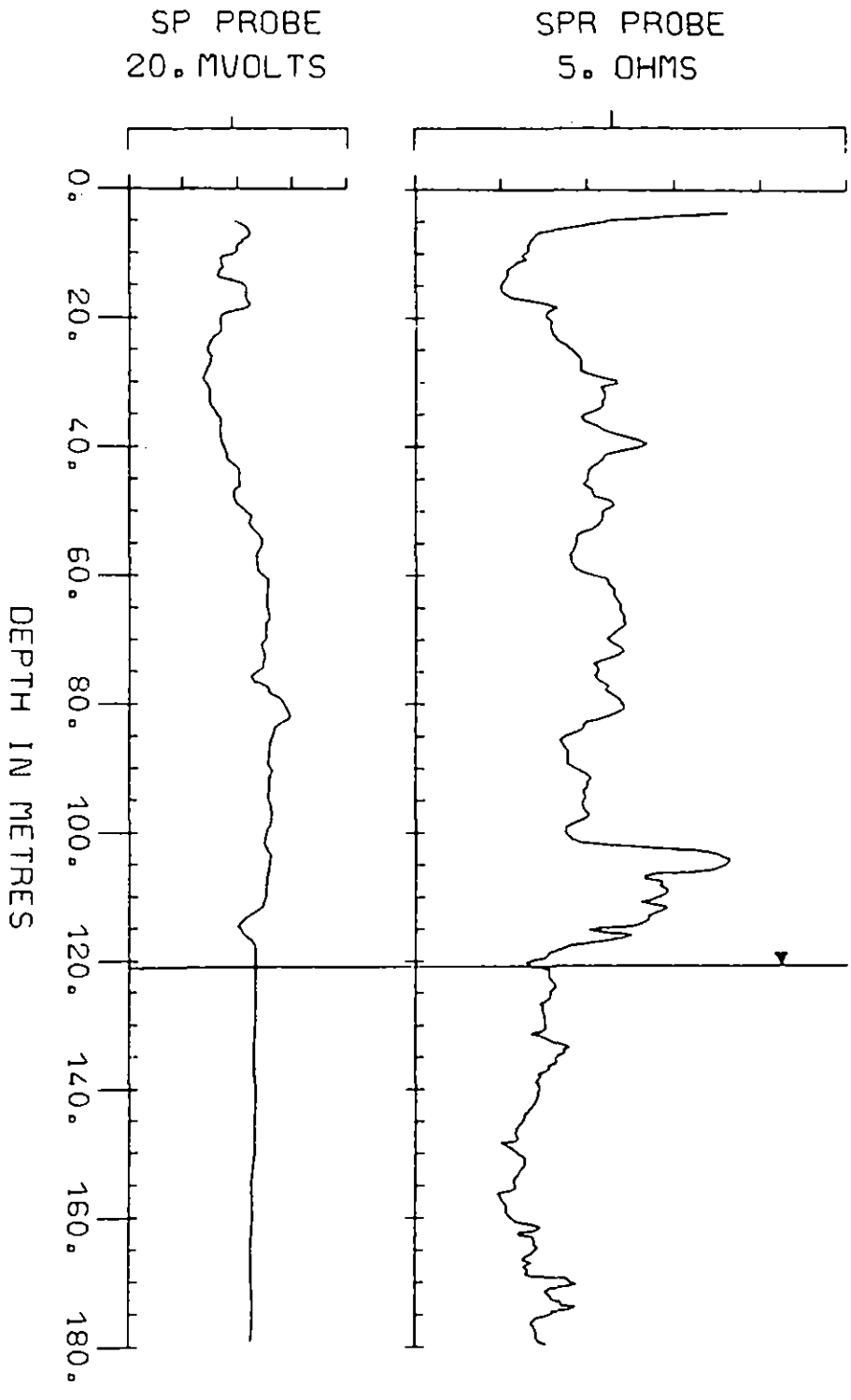


Figure 2·7B

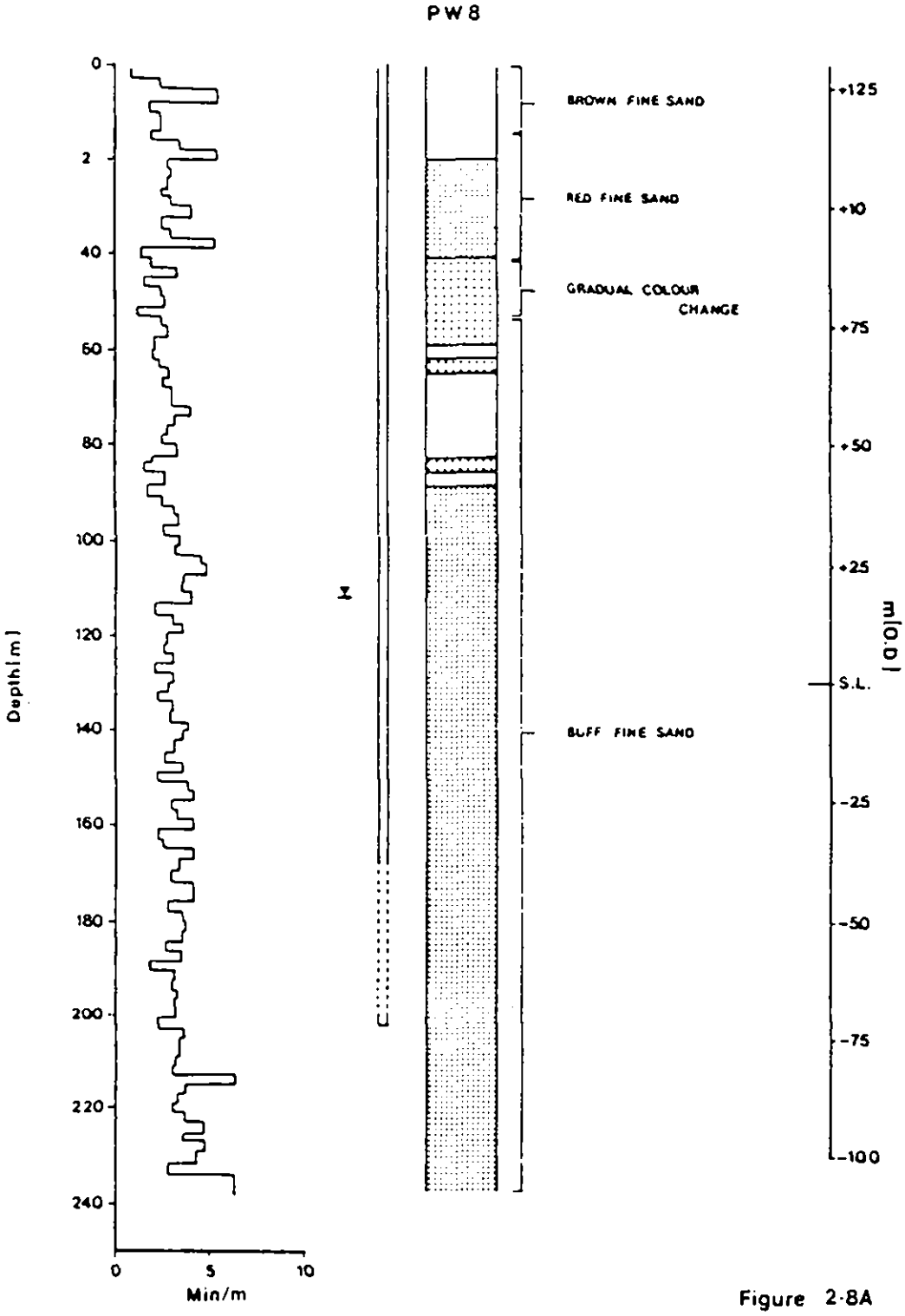

PW 8
Depth(m)
0
2
40
60
80
100
120
140
160
180
200
220
240
0
5
10
Min/m
BROWN FINE SAND
RED FINE SAND
GRADUAL COLOUR CHANGE
BUFF FINE SAND
+125
+10
+75
+50
+25
S.L.
-25
-50
-75
-100
m(O.D.)

Figure 2-8A

PRODUCTION WELL PW8

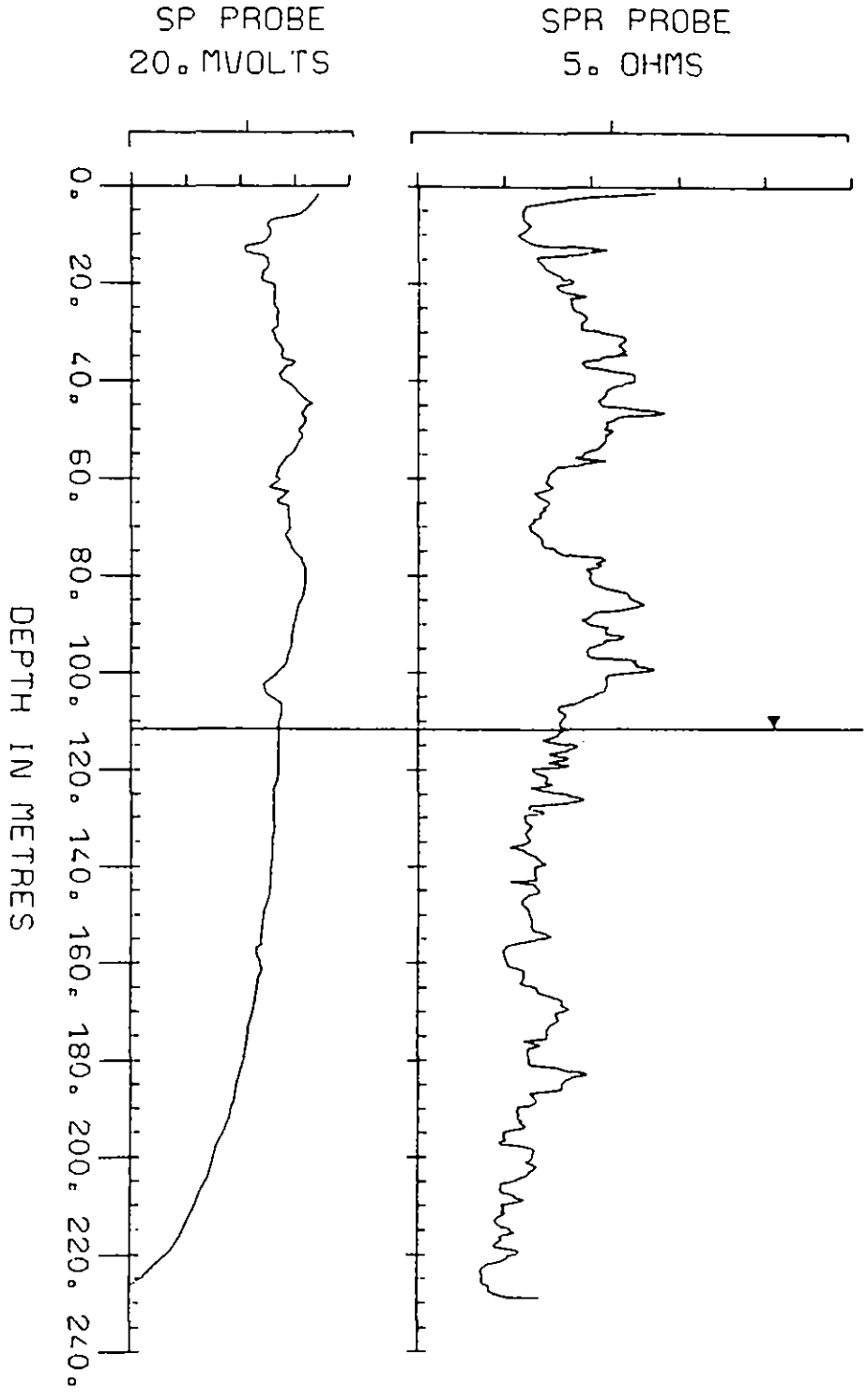


Figure 2·8B

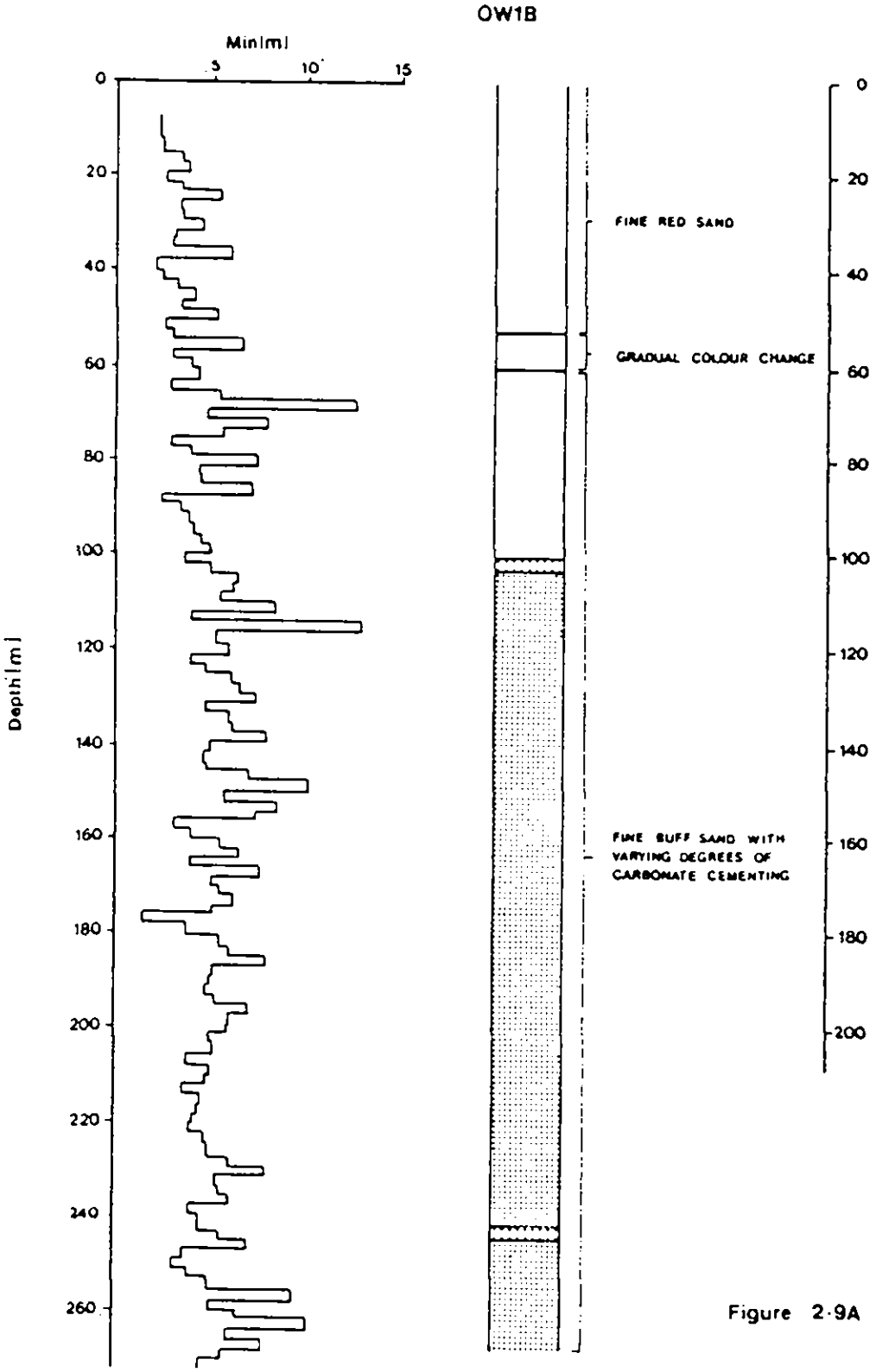

OW1B
Min(m)
0
5
10
15
Depth(m)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
FINE RED SAND
GRADUAL COLOUR CHANGE
FINE BUFF SAND WITH VARYING DEGREES OF CARBONATE CEMENTING

Figure 2·9A

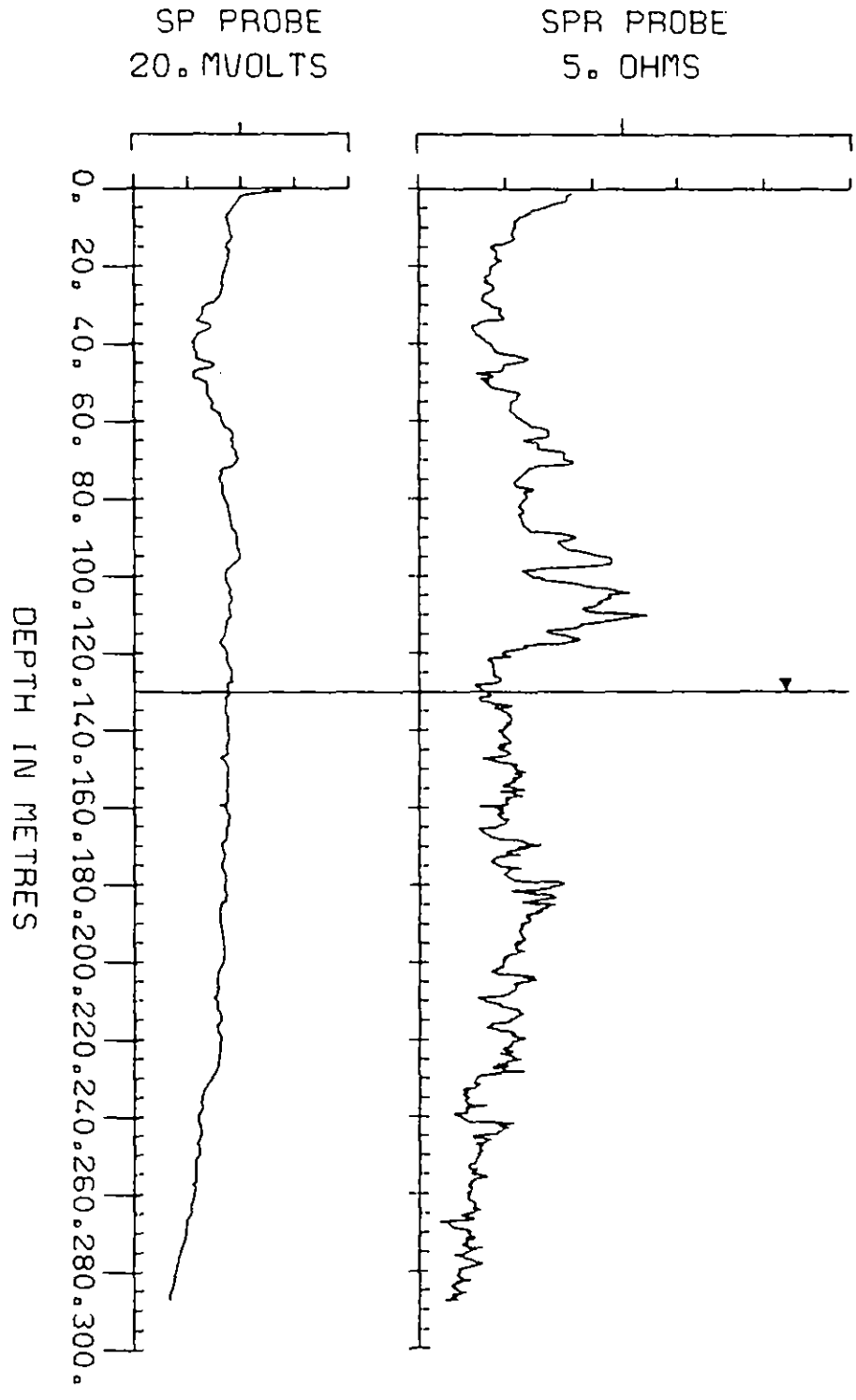

OBSERVATION WELL OW1A
SP PROBE
20. MVOLTS
SPR PROBE
5. OHMS
0. 20. 40. 60. 80. 100. 120. 140. 160. 180. 200. 220. 240. 260. 280. 300.
DEPTH IN METRES

Figure 2.9B

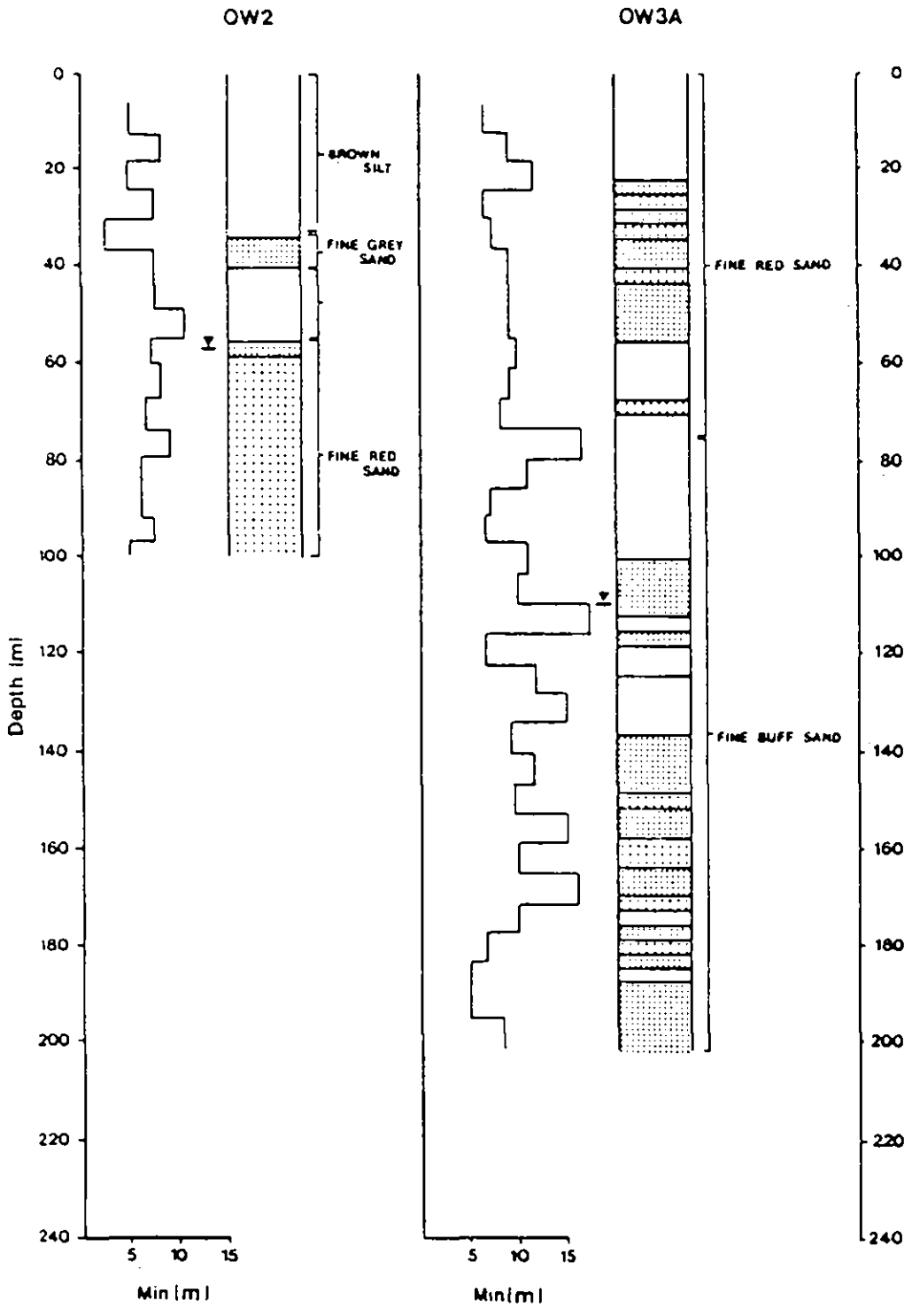

OW2
OW3A
Depth (m)
0
20
40
60
80
100
120
140
160
180
200
220
240
BROWN SILT
FINE GREY SAND
FINE RED SAND
FINE RED SAND
FINE BUFF SAND
5
10
15
Min (ml)
Min (ml)

Figure 2·10A

OBSERVATION WELL OW2

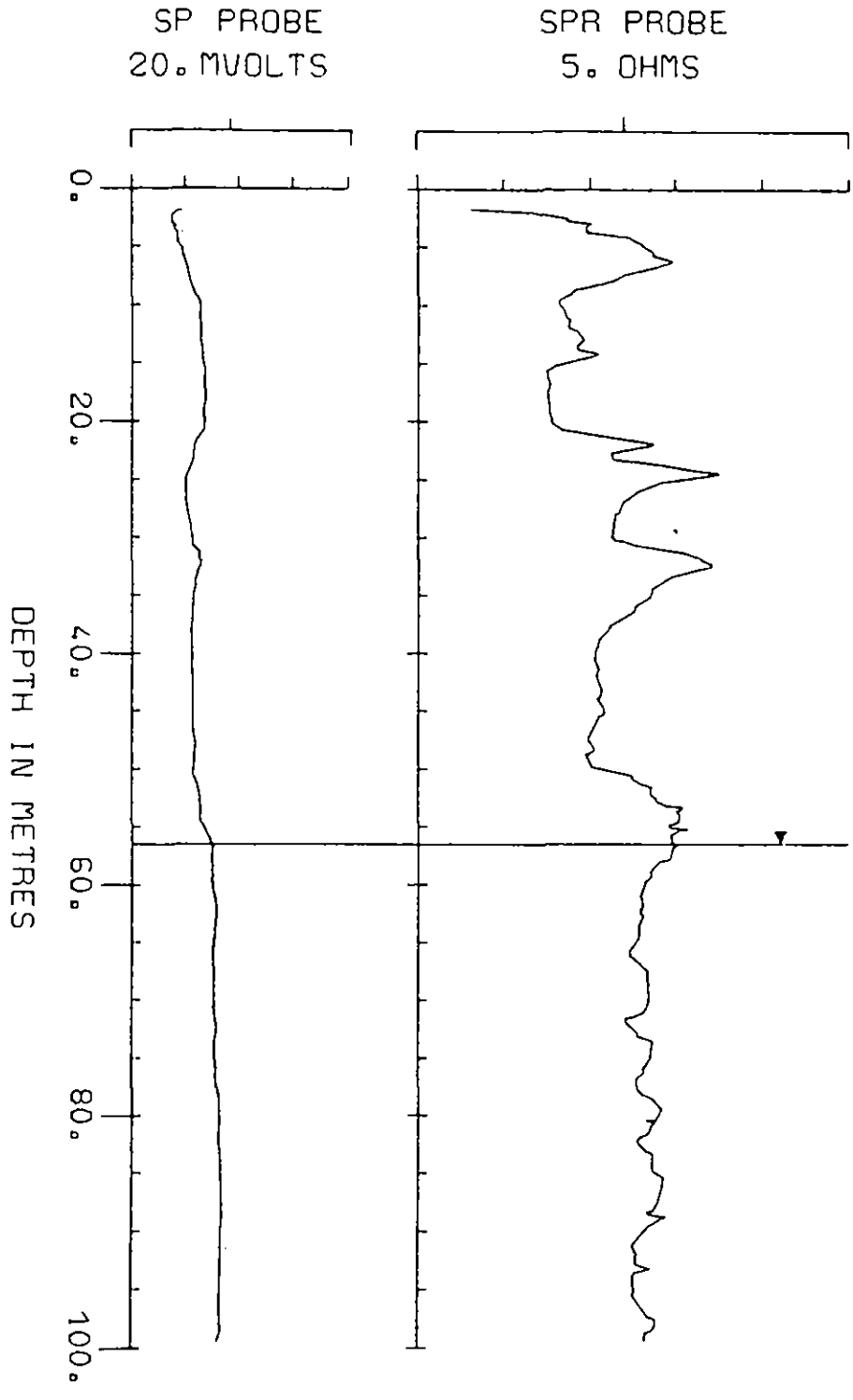


Figure 2·10B

OBSERVATION WELL OW3

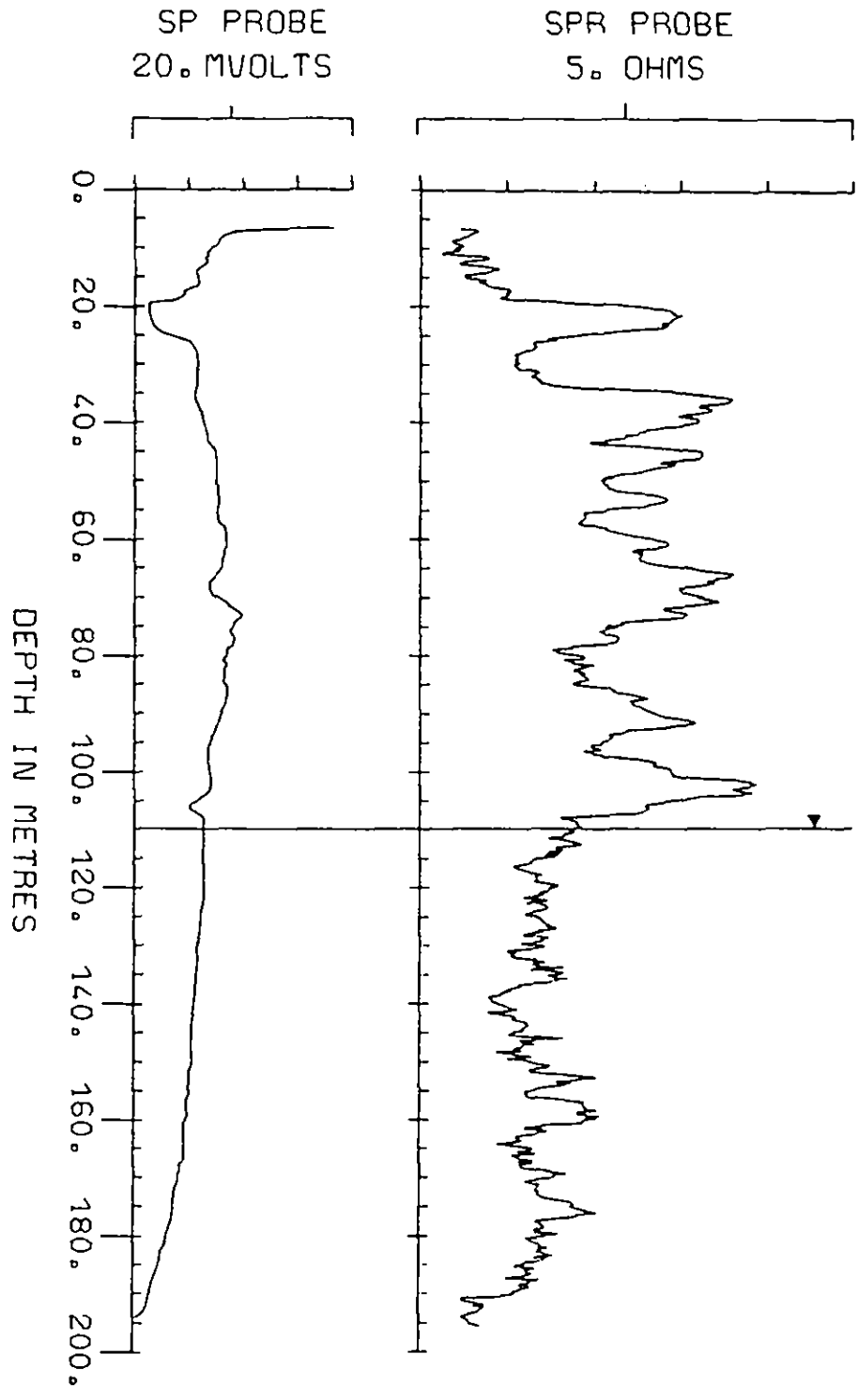


Figure 2-10B

DATA APPENDIX

This appendix presents the data collected during the Stage I construction period. It has been divided into three sections

Well location and construction details

Pump test data

Water levels

The well location list gives details of the grid reference, well number and a brief description of the location. The site summary lists the construction details such as the depth of the screens.

Pump test data present the data in graphical form and as lists of time drawdown numbers, the pump rates are given at the head of each site.

The water level listing presents the depth to water measurements taken at each site between May 1981 and April 1982. The station called 'River' gives the Shabeelle stage levels at the old road bridge Balcad.

All computer lists are given in order of ascending grid reference. Details of the wells shown in the water level list but not in the well location are to be found in Appendix A of our 1980 report. All grid references have been taken off the NA-38 series of maps.

MUQDISHO WATER SUPPLY
STAGE I
SITE LOCATION INDEX

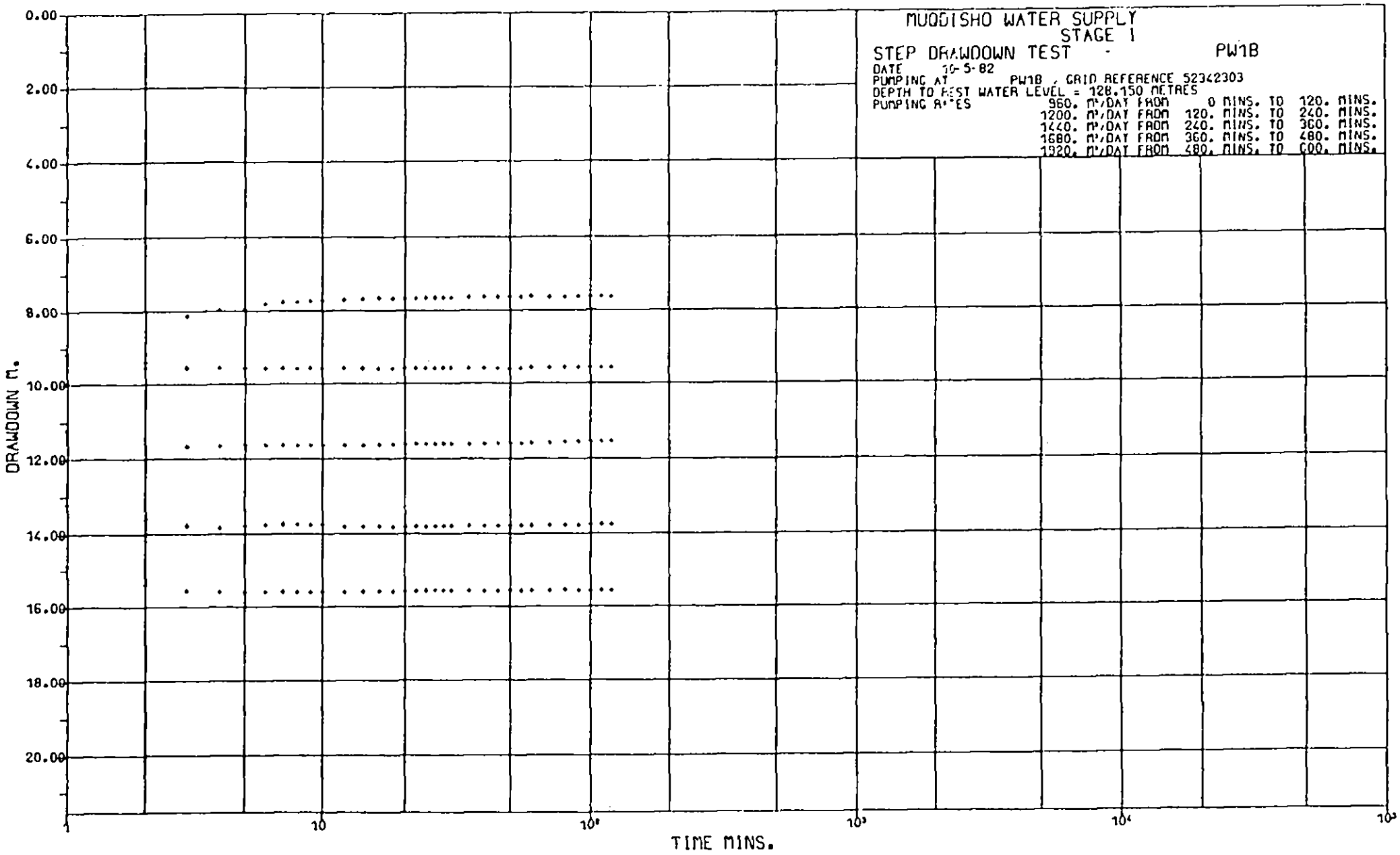
GRID REF	WELL NUMBER	
51472334	OW2	OBS. WELL 4.3KM SE OF AFGOOYE
51912296	OW3-	OBS. WELL 4.5KM WEST OF PW1B
52342316	PW1B	PROD. WELL 150M NE OF AFGOOYE RD.
52362306	PW2	PROD. WELL 450M NE OF AFGOOYE RD.
52402307	PW3A	PROD. WELL 750M NE OF AFGOOYE RD.
52422310	OW1B	OBS. WELL 80M FROM PW5
52432311	PW5	PROD. WELL 1050M NE OF AFGOOYE RD.
52462313	PW6A	PROD. WELL 1530M NE OF AFGOOYE RD.
52492315	PW7	PROD. WELL 1950M NE OF AFGOOYE RD.
52502317	PW8	PROD. WE 2250M NE OF AFGOOYE RD.

MUQDISHO WATER SUPPLY
STAGE I
SITE SUMMARY

GRID REF	51472554	191295	52342303	52362305	52402307
WELL NUMBER	DW2	DW3	PW1B	PW2	PW3A
BASIN			1	1	1
AQUIFER			2	2	2
SOURCE			3	3	3
CONTRACTOR	MOWLEM/WDA	MOWLEM/WDA	MOWLEM/WDA	MOWLEM/WDA	MOWLEM/WDA
CONSTR. DATE	NOV	DEC 81	7 AUG 81	28 AUG 81	11 APR 82
DEPTH	100.000	202.300	218.500	221.000	230.500
DATUM	0.000	128.300	145.800	148.300	146.200
CASING TYPE	PLASTIC	STEEL	STEEL	STEEL	STEEL
DIAMETER	0.132	0.102	0.254	0.254	0.254
SCREEN TYPE	0.4MMSLOT	WRAPR	0.4MMWIRE	0.4MMWIRE	0.4MMWIRE
DIAMETER	0.132	0.102	0.203	0.203	0.203
SCREENS					1
DEPTH 1	73.000	92.0	141.000	181.000	190.000
LENGTH 1	15.000	.000	50.000	33.000	30.000

MUQDISHO WATER SUPPLY
STAGE I
SITE SUMMARY

GRID REF	[illegible]	[illegible]	2462313	52482315	52502317
WELL NUMBER	DW1	PW3	PW5A	PW7	PW8
BASIN			1	1	1
AQUIFER			2	2	2
SOURCE			3	3	3
CONTRACTOR	MOWLEM/WDA	MLEM/WDA	MOWLEM/WDA	MOWLEM/WDA	MOWLEM/WDA
CONSTR. DATE	DEC	SEP	[illegible] OCT 91	11 NOV 91	3 DEC 91
DEPTH	306.000	252.000	237.000	187.000	237.000
DATUM	140.500	14 .200	140.900	140.200	130.200
CASING TYPE	STEEL	STEEL	STEEL	STEEL	STEEL
DIAMETER	0.10?	.254	0.254	0.254	0.254
SCREEN TYPE	MMWIRE	4MMWIRE	0.4MMWIRE	0.4MMWIRE	0.4MMWIRE
DIAMETER	0.102	[illegible]	0.203	0.203	0.203
SCREENS					
DEPTH 1	250.	[illegible]	199.000	235.000	169.600
LENGTH 1	12.0	0.000	30.000	30.000	30.000


MUODISHO WATER SUPPLY
STAGE 1
STEP DRAWDOWN TEST - PW1B
DATE 19-5-82
PUMPING AT PW1B , GRID REFERENCE 52342303
DEPTH TO REST WATER LEVEL = 128.150 METRES
PUMPING RATES
960. M³/DAY FROM 0 MINS. TO 120. MINS.
1200. M³/DAY FROM 120. MINS. TO 240. MINS.
1440. M³/DAY FROM 240. MINS. TO 360. MINS.
1680. M³/DAY FROM 360. MINS. TO 480. MINS.
1920. M³/DAY FROM 480. MINS. TO 600. MINS.
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
DRAWDOWN M.
1
10
10²
10³
10⁴
10⁵
TIME MINS.

MUODISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST - PUMPED WELL

PUMPING AT PW18 GRID REF. 52342303

DATE OF TEST 10 5 82

PUMPING RATES (M**3/DAY) :

960.0	FROM	0.0 MINS TO	120.0 MINS
1200.0	FROM	120.0 MINS TO	240.0 MINS
1440.0	FROM	240.0 MINS TO	360.0 MINS
1680.0	FROM	360.0 MINS TO	480.0 MINS
1920.0	FROM	480.0 MINS TO	600.0 MINS

REST WATER LEVEL 126.150 METRES BELOW DATUM

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
1.0	7.950	125.0	9.560
2.0	9.550	126.0	9.560
3.0	8.120	127.0	9.570
4.0	7.950	128.0	9.570
5.0	7.950	129.0	9.560
6.0	7.740	130.0	9.570
7.0	7.760	132.0	9.570
8.0	7.750	134.0	9.570
9.0	7.720	136.0	9.580
10.0	7.710	138.0	9.580
12.0	7.700	140.0	9.570
14.0	7.680	142.0	9.570
16.0	7.650	144.0	9.570
18.0	7.660	146.0	9.580
20.0	7.680	148.0	9.570
22.0	7.650	150.0	9.560
24.0	7.650	155.0	9.580
26.0	7.660	160.0	9.570
28.0	7.650	165.0	9.580
30.0	7.640	170.0	9.590
35.0	7.630	175.0	9.580
40.0	7.620	180.0	9.570
45.0	7.620	190.0	9.560
50.0	7.620	200.0	9.550
55.0	7.620	210.0	9.560
60.0	7.610	220.0	9.560
70.0	7.610	230.0	9.560
80.0	7.630	240.0	9.560
90.0	7.610	241.0	11.230
100.0	7.620	242.0	11.600
110.0	7.610	243.0	11.670
120.0	7.620	244.0	11.650
121.0	9.170	245.0	11.630
122.0	9.540	246.0	11.640
123.0	9.550	247.0	11.640
124.0	9.550	248.0	11.640

(CONTINUED)

MODDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST - PUMPED WELL

PUMPING AT PW1S GRID REF. 52342303

DATE OF TEST 10 5 82

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
249.0	11.640	383.0	13.800
250.0	11.640	390.0	13.800
252.0	11.640	395.0	13.790
254.0	11.650	400.0	13.790
256.0	11.640	405.0	13.790
258.0	11.620	410.0	13.790
260.0	11.620	415.0	13.790
262.0	11.610	420.0	13.790
264.0	11.610	430.0	13.780
266.0	11.610	440.0	13.780
268.0	11.610	450.0	13.780
270.0	11.610	460.0	13.760
275.0	11.620	470.0	13.760
280.0	11.610	480.0	13.760
285.0	11.600	481.0	14.350
290.0	11.590	482.0	15.400
295.0	11.600	483.0	15.580
300.0	11.600	484.0	15.600
310.0	11.590	485.0	15.620
320.0	11.570	486.0	15.610
330.0	11.560	487.0	15.620
340.0	11.560	488.0	15.620
350.0	11.550	489.0	15.620
360.0	11.550	490.0	15.610
361.0	13.220	492.0	15.620
362.0	13.610	494.0	15.610
363.0	13.720	496.0	15.610
364.0	13.640	498.0	15.610
365.0	13.780	500.0	15.600
366.0	13.760	502.0	15.600
367.0	13.750	504.0	15.590
368.0	13.750	506.0	15.570
369.0	13.760	508.0	15.580
370.0	13.750	510.0	15.590
372.0	13.620	515.0	15.590
374.0	13.610	520.0	15.600
376.0	13.610	525.0	15.590
378.0	13.620	530.0	15.580
380.0	13.620	535.0	15.590
382.0	13.610	540.0	15.590
384.0	13.810	550.0	15.580
386.0	13.800	560.0	15.570

(CONTINUED)

MUDDISHO WATER SUPPLY

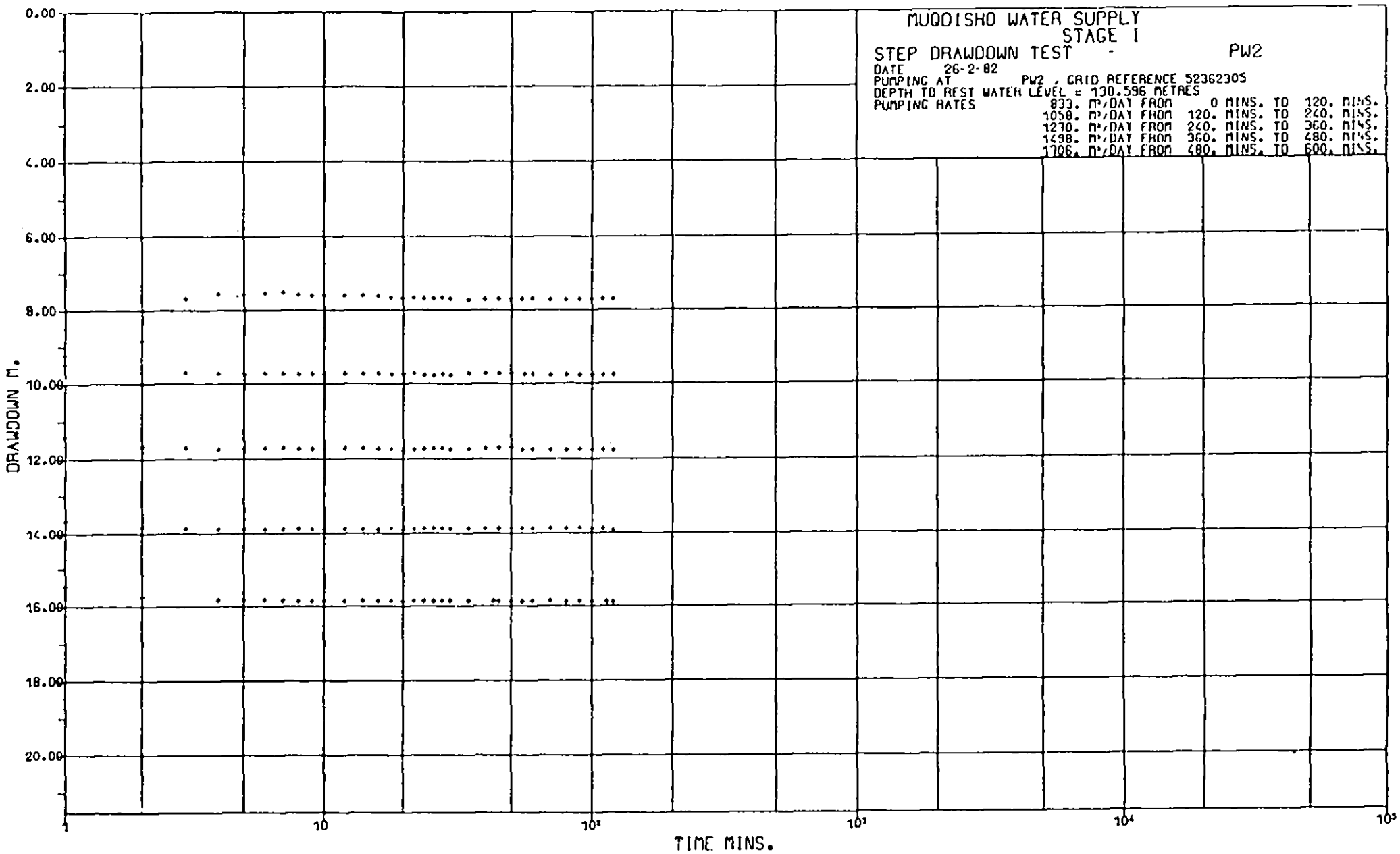
STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW15 GRID REF. 52342303

DATE OF TEST 10 5 82

TIME(MINS)	DRAWDOWN(M)
570.0	15.530
580.0	15.590
590.0	15.580
600.0	15.580


MUQDISHO WATER SUPPLY
STAGE I
STEP DRAWDOWN TEST - PW2
DATE 26-2-82
PUMPING AT PW2 , GRID REFERENCE 52362305
DEPTH TO REST WATER LEVEL = 130.596 METRES
PUMPING RATES
833. M³/DAY FROM 0 MINS. TO 120. MINS.
1058. M³/DAY FROM 120. MINS. TO 240. MINS.
1270. M³/DAY FROM 240. MINS. TO 360. MINS.
1498. M³/DAY FROM 360. MINS. TO 480. MINS.
1706. M³/DAY FROM 480. MINS. TO 600. MINS.
DRAWDOWN M.
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
1
10
10²
10³
10⁴
10⁵
TIME MINS.

MUQDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST - PUMPED WELL

PUMPING AT PW2 GRID REF. 52362305

DATE OF TEST 26 2 82

PUMPING RATES (M**3/DAY) :

832.8	FROM	0.0 MINS TO	120.0 MINS
1053.4	FROM	120.0 MINS TO	240.0 MINS
1269.6	FROM	240.0 MINS TO	360.0 MINS
1497.6	FROM	360.0 MINS TO	480.0 MINS
1706.4	FROM	480.0 MINS TO	600.0 MINS

REST WATER LEVEL 130.56 METRES BELOW DATUM

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
1.0	9.230	125.0	9.720
2.0	8.220	126.0	9.720
3.0	7.690	127.0	9.740
4.0	7.560	128.0	9.740
5.0	7.570	129.0	9.740
6.0	7.540	130.0	9.740
7.0	7.520	132.0	9.730
8.0	7.530	134.0	9.730
9.0	7.600	136.0	9.750
10.0	7.600	138.0	9.740
12.0	7.610	140.0	9.740
14.0	7.600	142.0	9.720
16.0	7.620	144.0	9.770
18.0	7.640	146.0	9.780
20.0	7.630	148.0	9.740
22.0	7.670	150.0	9.770
24.0	7.690	155.0	9.720
26.0	7.690	160.0	9.720
28.0	7.660	165.0	9.720
30.0	7.690	170.0	9.720
35.0	7.750	176.0	9.740
40.0	7.710	180.0	9.740
45.0	7.700	190.0	9.770
50.0	7.690	200.0	9.760
55.0	7.700	210.0	9.770
60.0	7.690	220.0	9.770
70.0	7.720	230.0	9.770
80.0	7.720	240.0	9.760
90.0	7.710	241.0	11.420
100.0	7.710	242.0	11.660
110.0	7.710	243.0	11.690
120.0	7.710	244.0	11.730
121.0	9.470	245.0	11.720
122.0	9.690	246.0	11.710
123.0	9.690	247.0	11.700
124.0	9.720	248.0	11.730

(CONTINUED)

MUSDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST - PUMPED WELL

PUMPING AT PW2 GRID REF. 52362305

DATE OF TEST 26 2 82

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
249.0	11.730	386.0	13.860
250.0	11.730	390.0	13.860
252.0	11.710	395.0	13.860
254.0	11.700	400.0	13.850
256.0	11.730	405.0	13.860
258.0	11.730	410.0	13.860
260.0	11.760	415.0	13.860
262.0	11.750	420.0	13.860
264.0	11.730	430.0	13.860
266.0	11.720	440.0	13.860
268.0	11.710	450.0	13.850
270.0	11.740	460.0	13.870
275.0	11.730	470.0	13.870
280.0	11.710	480.0	13.910
285.0	11.700	481.0	15.460
290.0	11.690	482.0	15.750
295.0	11.760	480.0	15.310
300.0	11.740	484.0	15.330
310.0	11.750	485.0	15.330
320.0	11.760	486.0	15.330
330.0	11.740	487.0	15.340
340.0	11.750	488.0	15.360
350.0	11.760	489.0	15.860
360.0	11.770	490.0	15.860
361.0	13.650	492.0	15.860
362.0	13.820	494.0	15.850
363.0	13.850	496.0	15.860
364.0	13.860	498.0	15.860
365.0	13.870	500.0	15.870
366.0	13.880	502.0	15.860
367.0	13.870	504.0	15.860
368.0	13.860	506.0	15.870
369.0	13.870	508.0	15.860
370.0	13.870	510.0	15.860
372.0	13.860	515.0	15.860
374.0	13.870	520.0	15.870
376.0	13.880	525.0	15.860
378.0	13.850	530.0	15.870
380.0	13.880	535.0	15.880
382.0	13.870	540.0	15.860
384.0	13.860	550.0	15.860
386.0	13.860	560.0	15.880

(CONTINUED) MUCDISHO WATER SUPPLY

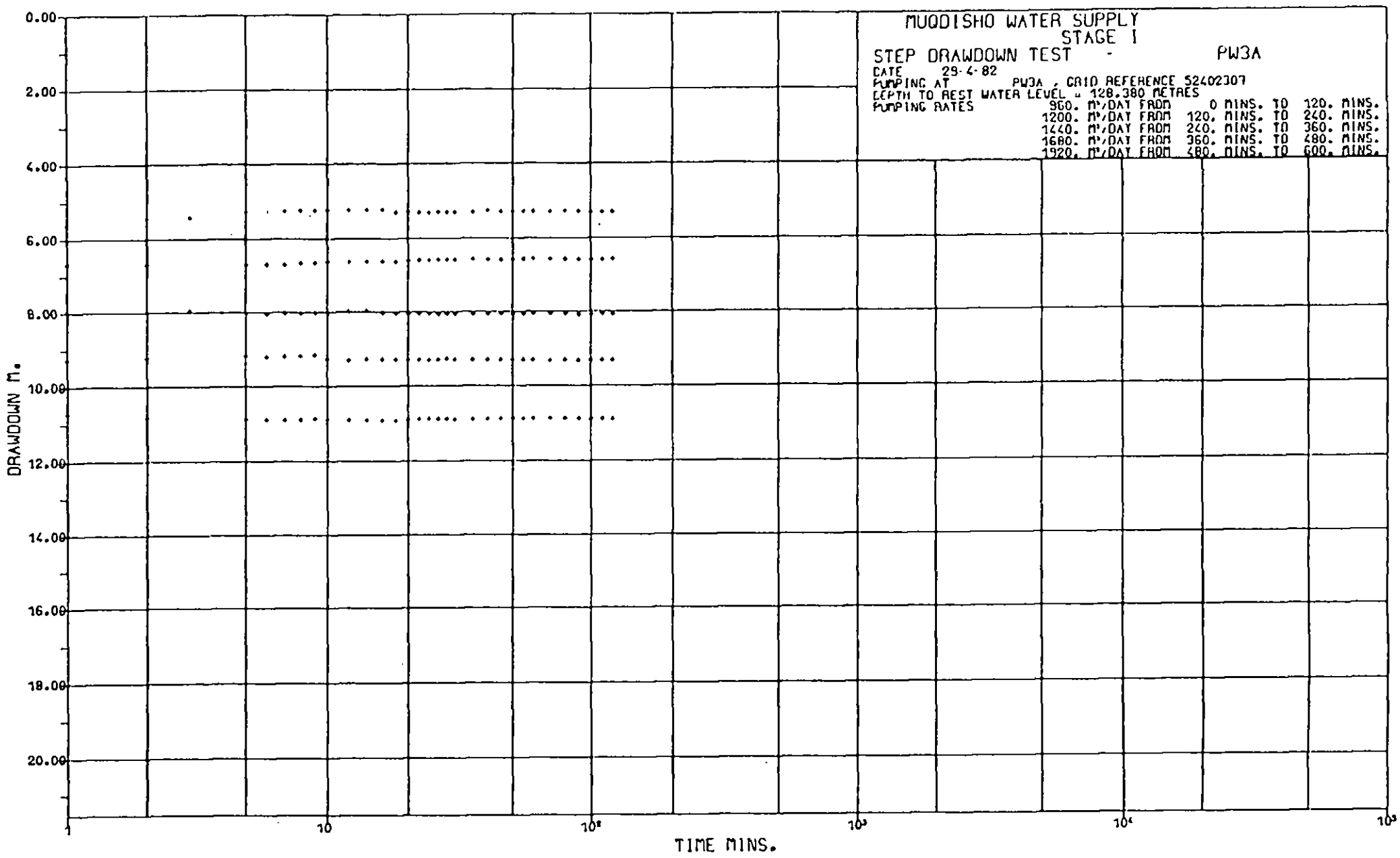
STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW2 GRID REF. 52362305

DATE OF TEST 26 2 82

TIME(MINS)	DRAWDOWN(M)
570.0	15.370
580.0	15.380
594.0	15.390
600.0	15.390


MUODISHO WATER SUPPLY
STAGE 1
STEP DRAWDOWN TEST - PW3A
DATE 29-4-82
PUMPING AT PW3A , GRID REFERENCE 52402307
DEPTH TO REST WATER LEVEL = 128.380 METRES
PUMPING RATES
960. M³/DAY FROM 0 MINS. TO 120. MINS.
1200. M³/DAY FROM 120. MINS. TO 240. MINS.
1440. M³/DAY FROM 240. MINS. TO 360. MINS.
1680. M³/DAY FROM 360. MINS. TO 480. MINS.
1920. M³/DAY FROM 480. MINS. TO 600. MINS.
DRAWDOWN M.
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
1
10
10²
10³
10⁴
10⁵
TIME MINS.

MUDDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW3A GRID REF. 52402307

DATE OF TEST 29 4 82

PUMPING RATES (M**3/DAY) :

960.0 FROM	0.0 MINS TO	120.0 MINS
1200.0 FROM	120.0 MINS TO	240.0 MINS
1440.0 FROM	240.0 MINS TO	360.0 MINS
1680.0 FROM	360.0 MINS TO	480.0 MINS
1920.0 FROM	480.0 MINS TO	600.0 MINS

REST WATER LEVEL 128.380 METRES BELOW DATUM

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
1.0	5.620	125.0	6.700
2.0	5.450	126.0	6.690
3.0	5.420	127.0	6.700
4.0	5.340	128.0	6.660
5.0	5.270	129.0	6.650
6.0	5.270	130.0	6.620
7.0	5.260	132.0	6.630
8.0	5.240	134.0	6.620
9.0	5.240	136.0	6.620
10.0	5.230	138.0	6.630
12.0	5.230	140.0	6.600
14.0	5.230	142.0	6.590
16.0	5.220	144.0	6.590
18.0	5.310	146.0	6.580
20.0	5.290	148.0	6.580
22.0	5.320	150.0	6.580
24.0	5.320	155.0	6.570
26.0	5.300	160.0	6.580
28.0	5.300	165.0	6.580
30.0	5.310	170.0	6.570
35.0	5.310	175.0	6.570
40.0	5.260	180.0	6.560
45.0	5.300	190.0	6.570
50.0	5.290	200.0	6.570
55.0	5.290	210.0	6.580
60.0	5.290	220.0	6.590
70.0	5.300	230.0	6.590
80.0	5.280	240.0	6.580
90.0	5.290	241.0	7.960
100.0	5.320	242.0	7.980
110.0	5.310	243.0	7.940
120.0	5.310	244.0	8.000
121.0	6.670	245.0	8.010
122.0	6.680	246.0	8.030
123.0	6.660	247.0	8.010
124.0	6.670	248.0	8.020

(CONTINUED)

MUDDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW3A GRID REF. 52402307

DATE OF TEST 29 4 82

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
249.0	8.010	388.0	9.280
250.0	8.000	390.0	9.290
252.0	7.970	395.0	9.300
254.0	7.960	400.0	9.300
256.0	8.020	405.0	9.300
258.0	8.030	410.0	9.300
260.0	8.050	415.0	9.310
262.0	8.040	420.0	9.310
264.0	8.040	430.0	9.320
266.0	8.050	440.0	9.310
268.0	8.050	450.0	9.320
270.0	8.050	460.0	9.320
275.0	8.060	470.0	9.320
280.0	8.050	480.0	9.320
285.0	8.060	481.0	10.700
290.0	8.070	482.0	10.810
295.0	8.060	483.0	10.840
300.0	8.050	484.0	10.860
310.0	8.050	485.0	10.860
320.0	8.060	486.0	10.870
330.0	8.070	487.0	10.880
340.0	8.080	488.0	10.880
350.0	8.060	489.0	10.350
360.0	8.070	490.0	10.370
361.0	9.270	492.0	10.390
362.0	9.220	494.0	10.390
363.0	9.220	496.0	10.900
364.0	9.190	498.0	10.900
365.0	9.170	500.0	10.890
366.0	9.210	502.0	10.870
367.0	9.190	504.0	10.860
368.0	9.180	506.0	10.870
369.0	9.160	508.0	10.870
370.0	9.270	510.0	10.380
372.0	9.300	515.0	10.380
374.0	9.260	520.0	10.370
376.0	9.240	525.0	10.360
378.0	9.280	530.0	10.350
380.0	9.290	535.0	10.360
382.0	9.240	540.0	10.360
384.0	9.300	550.0	10.350
386.0	9.300	560.0	10.360

(CONTINUED)

MUQDISHO WATER SUPPLY

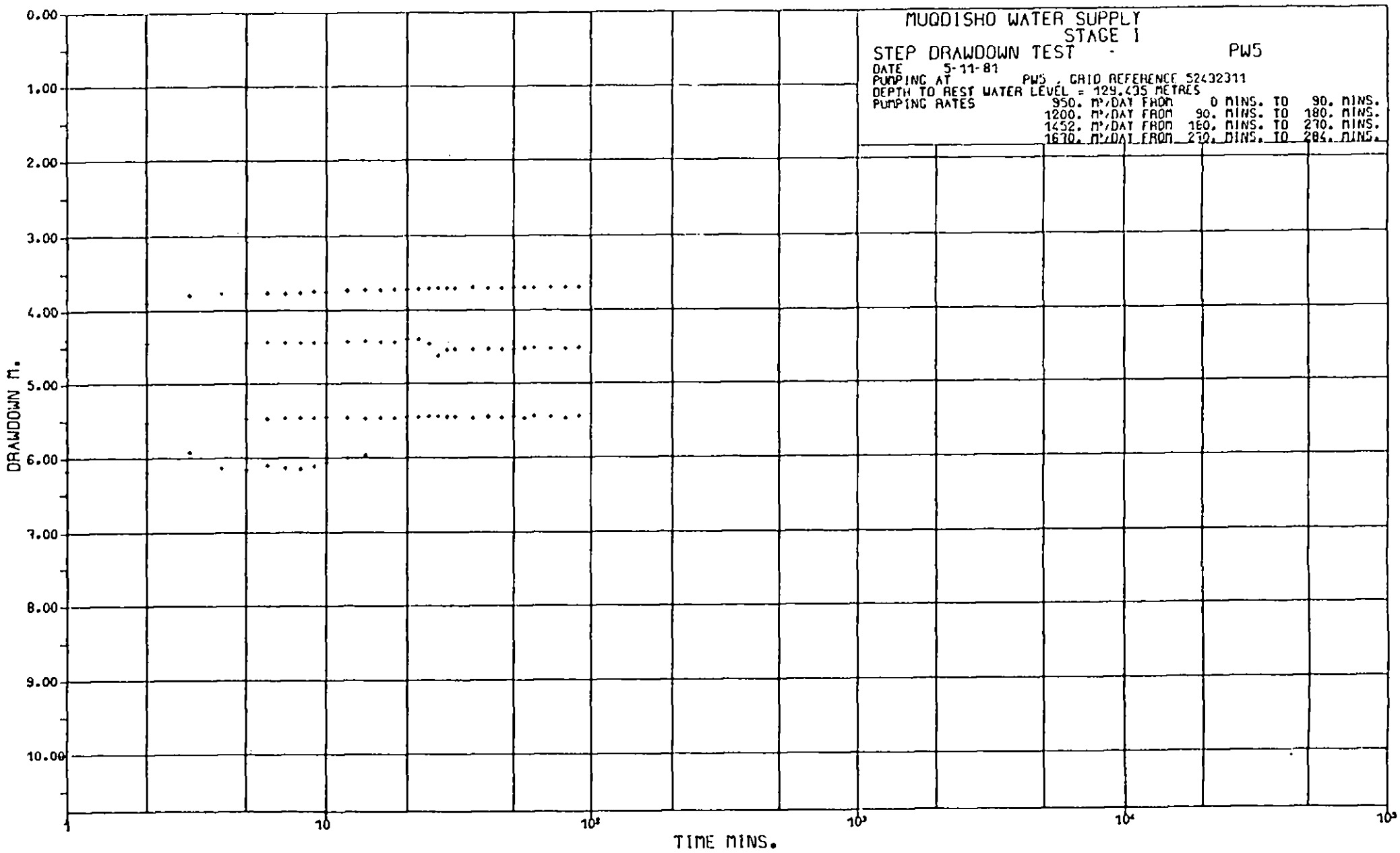
STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW3A GRID REF. 52402307

DATE OF TEST 29 4 82

TIME(MINS)	DRAWDOWN(M)
570.0	10.260
580.0	10.300
590.0	10.370
600.0	10.380


MUQDISHO WATER SUPPLY
STAGE 1
STEP DRAWDOWN TEST - PW5
DATE 5-11-81
PUMPING AT PW5 , GRID REFERENCE 52432311
DEPTH TO REST WATER LEVEL = 129.435 METRES
PUMPING RATES
950. M³/DAY FROM 0 MINS. TO 90. MINS.
1200. M³/DAY FROM 90. MINS. TO 180. MINS.
1452. M³/DAY FROM 180. MINS. TO 270. MINS.
1670. M³/DAY FROM 270. MINS. TO 284. MINS.
DRAWDOWN M.
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
1
10
10²
10³
10⁴
10⁵
TIME MINS.

MUQDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW5 GRID REF. 52432311

DATE OF TEST 5 11 81

PUMPING RATES (M**3/DAY) :

950.4	FROM	0.0 MINS	TO 90.0 MINS
1200.0	FROM	90.0 MINS	TO 180.0 MINS
1452.0	FROM	180.0 MINS	TO 270.0 MINS
1670.4	FROM	270.0 MINS	TO 284.0 MINS

REST WATER LEVEL 129.435 METRES BELOW DATUM

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
1.0	4.480	93.0	4.430
2.0	3.890	99.0	4.430
3.0	3.790	100.0	4.430
4.0	3.750	102.0	4.420
5.0	3.760	104.0	4.410
6.0	3.760	106.0	4.420
7.0	3.770	108.0	4.420
8.0	3.760	110.0	4.380
9.0	3.740	112.0	4.380
10.0	3.747	114.0	4.460
12.0	3.730	116.0	4.520
14.0	3.720	118.0	4.540
16.0	3.720	120.0	4.530
18.0	3.710	125.0	4.530
20.0	3.720	130.0	4.530
22.0	3.710	135.0	4.530
24.0	3.700	140.0	4.530
26.0	3.700	145.0	4.520
28.0	3.700	150.0	4.510
30.0	3.700	160.0	4.520
35.0	3.690	170.0	4.520
40.0	3.700	180.0	4.510
45.0	3.700	181.0	5.510
50.0	3.690	182.0	5.520
55.0	3.690	183.0	5.500
60.0	3.700	184.0	5.490
70.0	3.690	185.0	5.470
80.0	3.690	186.0	5.470
90.0	3.690	187.0	5.460
91.0	4.580	188.0	5.460
92.0	4.430	189.0	5.460
93.0	4.430	190.0	5.450
94.0	4.440	192.0	5.460
95.0	4.430	194.0	5.470
96.0	4.420	196.0	5.460
97.0	4.420	198.0	5.460

(CONTINUED) MUDDISHO WATER SUPPLY

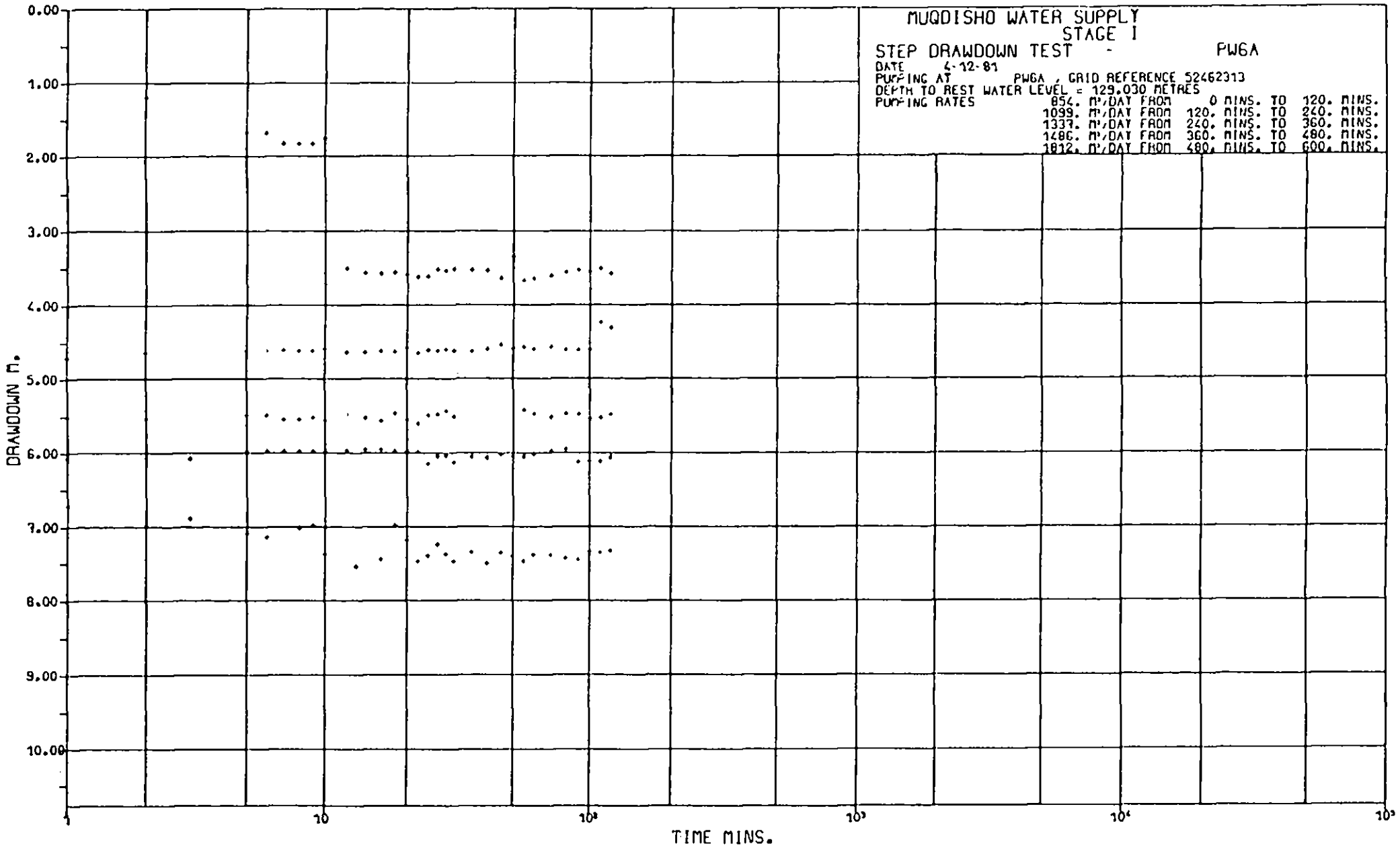
STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW5 GRID REF. 52432311

DATE OF TEST 5 11 S1

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
200.0	5.450	270.0	5.440
202.0	5.450	271.0	6.170
204.0	5.440	272.0	6.130
206.0	5.440	273.0	5.920
208.0	5.450	274.0	6.130
210.0	5.450	275.0	6.160
215.0	5.470	276.0	6.100
220.0	5.450	277.0	6.130
225.0	5.450	278.0	6.150
230.0	5.440	279.0	6.110
235.0	5.470	280.0	6.060
240.0	5.440	282.0	6.000
250.0	5.450	284.0	5.960
260.0	5.470		


MUQDISHO WATER SUPPLY
STAGE I
STEP DRAWDOWN TEST - PW6A
DATE 4-12-81
PUMPING AT PW6A , GRID REFERENCE 52462313
DEPTH TO REST WATER LEVEL = 129.030 METRES
PUMPING RATES
854. M³/DAY FROM 0 MINS. TO 120. MINS.
1099. M³/DAY FROM 120. MINS. TO 240. MINS.
1337. M³/DAY FROM 240. MINS. TO 360. MINS.
1486. M³/DAY FROM 360. MINS. TO 480. MINS.
1812. M³/DAY FROM 480. MINS. TO 600. MINS.
DRAWDOWN M.
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
1
10
10²
10³
10⁴
10⁵
TIME MINS.

MUDDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST - PUMPED WELL

PUMPING AT PW6A GRID REF. 52462313

DATE OF TEST 4 12 81

PUMPING RATES (M**3/DAY) :

854.4 FROM	0.0 MINS TO	120.0 MINS
1099.2 FROM	120.0 MINS TO	240.0 MINS
1336.8 FROM	240.0 MINS TO	360.0 MINS
1466.6 FROM	360.0 MINS TO	480.0 MINS
1512.0 FROM	480.0 MINS TO	600.0 MINS

REST WATER LEVEL 129.030 METRES BELOW DATUM

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
2.0	1.190	127.0	4.600
3.0	1.590	128.0	4.610
5.0	1.670	129.0	4.610
6.0	1.680	130.0	4.580
7.0	1.920	132.0	4.630
8.0	1.820	134.0	4.630
9.0	1.820	136.0	4.610
10.0	1.750	138.0	4.620
12.0	3.500	140.0	4.570
14.0	3.560	142.0	4.640
16.0	3.570	144.0	4.600
18.0	3.550	146.0	4.610
20.0	3.580	148.0	4.590
22.0	3.610	150.0	4.610
24.0	3.610	155.0	4.620
26.0	3.510	160.0	4.590
28.0	3.530	165.0	4.550
30.0	3.510	170.0	4.580
35.0	3.520	175.0	4.560
40.0	3.530	180.0	4.590
45.0	3.630	190.0	4.560
50.0	3.540	200.0	4.600
55.0	3.660	210.0	4.600
60.0	3.630	220.0	4.590
70.0	3.600	230.0	4.220
80.0	3.550	240.0	4.290
90.0	3.520	241.0	5.510
100.0	3.540	242.0	5.530
110.0	3.600	243.0	5.550
120.0	3.570	244.0	5.520
121.0	4.710	245.0	5.490
122.0	4.630	246.0	5.460
123.0	4.620	247.0	5.540
124.0	4.600	248.0	5.540
125.0	4.610	249.0	5.510
126.0	4.610	250.0	5.550

(CONTINUED)

MUDDISHO WATER SUPPLY

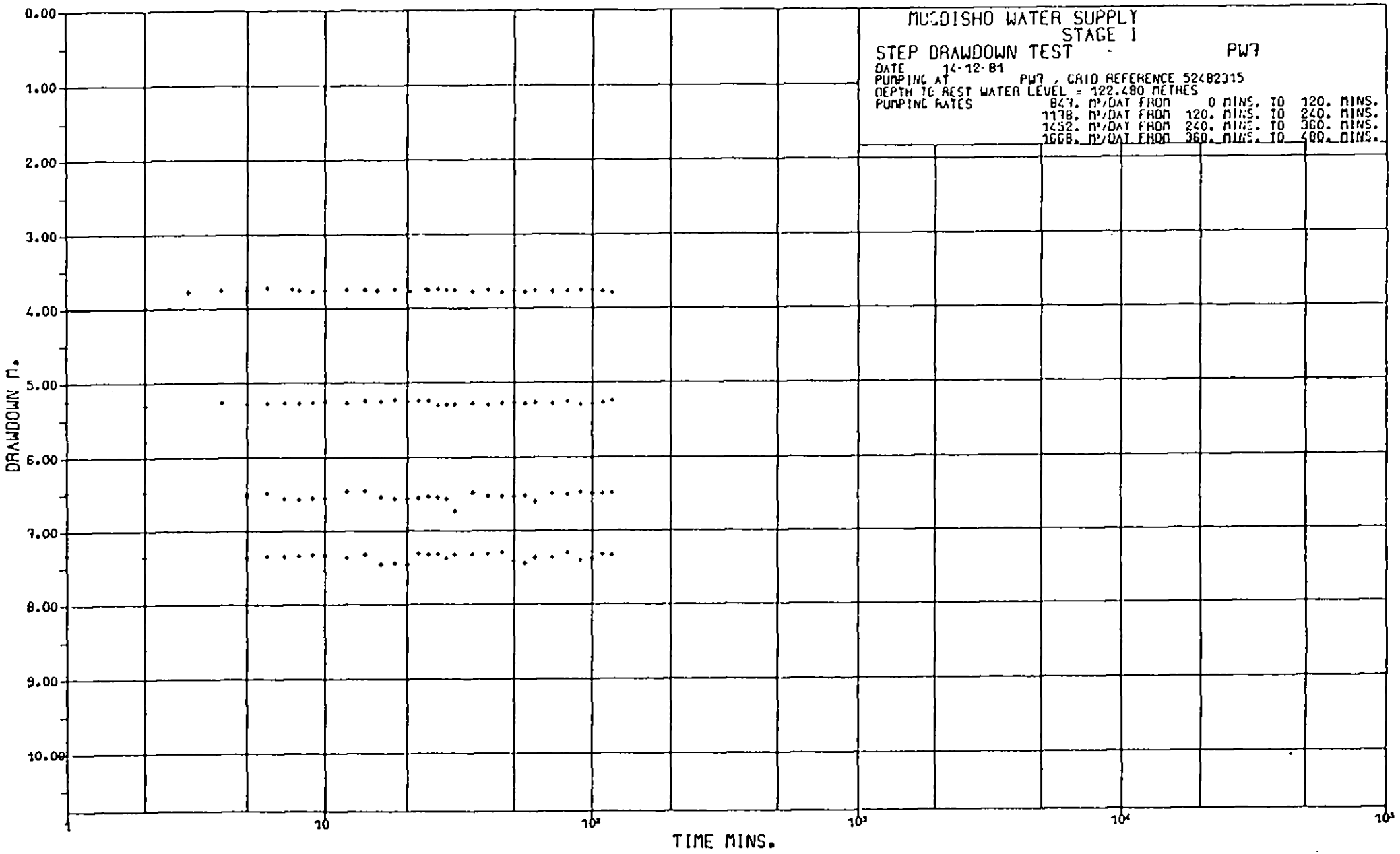
STAGE I

STEP DRAWDOWN TEST — PUMPED WELL

PUMPING AT PW6A GRID REF. 52462313

DATE OF TEST 4 12 81

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
252.0	5.470	410.0	6.040
254.0	5.520	415.0	6.050
256.0	5.560	420.0	6.010
258.0	5.450	430.0	5.970
260.0	5.540	440.0	5.950
262.0	5.600	450.0	6.120
264.0	5.480	460.0	6.110
266.0	5.470	470.0	6.110
268.0	5.420	480.0	6.060
270.0	5.500	481.0	6.720
275.0	5.520	482.0	6.970
295.0	5.410	483.0	6.390
300.0	5.460	484.0	6.660
310.0	5.510	485.0	7.080
320.0	5.460	486.0	7.130
330.0	5.470	487.0	7.550
340.0	5.530	488.0	7.310
350.0	5.520	489.0	6.980
360.0	5.470	490.0	7.370
361.0	6.070	493.0	7.540
362.0	6.060	494.0	7.490
363.0	6.070	496.0	7.440
365.0	5.970	498.0	6.970
366.0	5.970	500.0	7.170
367.0	5.970	502.0	7.470
368.0	5.970	504.0	7.390
369.0	5.970	506.0	7.230
370.0	5.970	508.0	7.370
372.0	5.960	510.0	7.470
374.0	5.950	515.0	7.340
376.0	5.950	520.0	7.500
378.0	5.970	525.0	7.350
380.0	5.970	530.0	7.400
382.0	5.980	535.0	7.470
384.0	6.140	540.0	7.380
386.0	6.040	550.0	7.380
388.0	6.030	560.0	7.430
390.0	6.120	570.0	7.450
395.0	6.050	580.0	7.330
400.0	6.060	590.0	7.350
405.0	6.020	600.0	7.320


MUGDISHO WATER SUPPLY
STAGE I
STEP DRAWDOWN TEST - PW7
DATE 14-12-81
PUMPING AT PW7 , GRID REFERENCE 52482315
DEPTH TO REST WATER LEVEL = 122.480 METRES
PUMPING RATES
847. M³/DAY FROM 0 MINS. TO 120. MINS.
1178. M³/DAY FROM 120. MINS. TO 240. MINS.
1452. M³/DAY FROM 240. MINS. TO 360. MINS.
1608. M³/DAY FROM 360. MINS. TO 480. MINS.
DRAWDOWN M.
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
1
10
10²
10³
10⁴
10⁵
TIME MINS.

MUQDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW7 GRID REF. 52482315

DATE OF TEST 14 12 81

PUMPING RATES (M**3/DAY) :

347.2	FROM	0.0 MINS TO	120.0 MINS
1179.4	FROM	120.0 MINS TO	240.0 MINS
1452.0	FROM	240.0 MINS TO	360.0 MINS
1008.0	FROM	360.0 MINS TO	480.0 MINS

REST WATER LEVEL 122.480 METRES BELOW DATUM

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
1.0	4.650	125.0	5.260
2.0	3.980	126.0	5.270
3.0	3.770	127.0	5.270
4.0	3.750	128.0	5.270
5.0	3.750	129.0	5.260
6.0	3.720	130.0	5.250
7.5	3.740	132.0	5.270
8.0	3.760	134.0	5.240
9.0	3.770	136.0	5.250
10.0	3.760	138.0	5.230
12.0	3.750	140.0	5.250
14.0	3.730	142.0	5.240
15.5	3.760	144.0	5.240
16.0	3.740	146.0	5.300
20.5	3.770	148.0	5.290
23.5	3.740	150.0	5.290
24.0	3.750	155.0	5.280
26.0	3.740	160.0	5.290
28.0	3.750	165.0	5.270
30.0	3.760	170.0	5.270
35.0	3.780	175.0	5.280
40.0	3.750	180.0	5.270
45.0	3.790	190.0	5.260
50.0	3.760	200.0	5.250
55.0	3.780	210.0	5.290
60.0	3.760	220.0	5.280
70.0	3.770	230.0	5.270
80.0	3.760	240.0	5.240
90.0	3.750	241.0	6.470
100.0	3.750	242.0	6.470
110.0	3.770	243.0	6.480
120.0	3.790	245.0	6.490
121.0	5.240	245.0	6.520
122.0	5.300	246.0	6.480
123.0	5.290	247.0	6.560
124.0	5.260	248.0	6.570

(CONTINUED)

MUDDISHO WATER SUPPLY

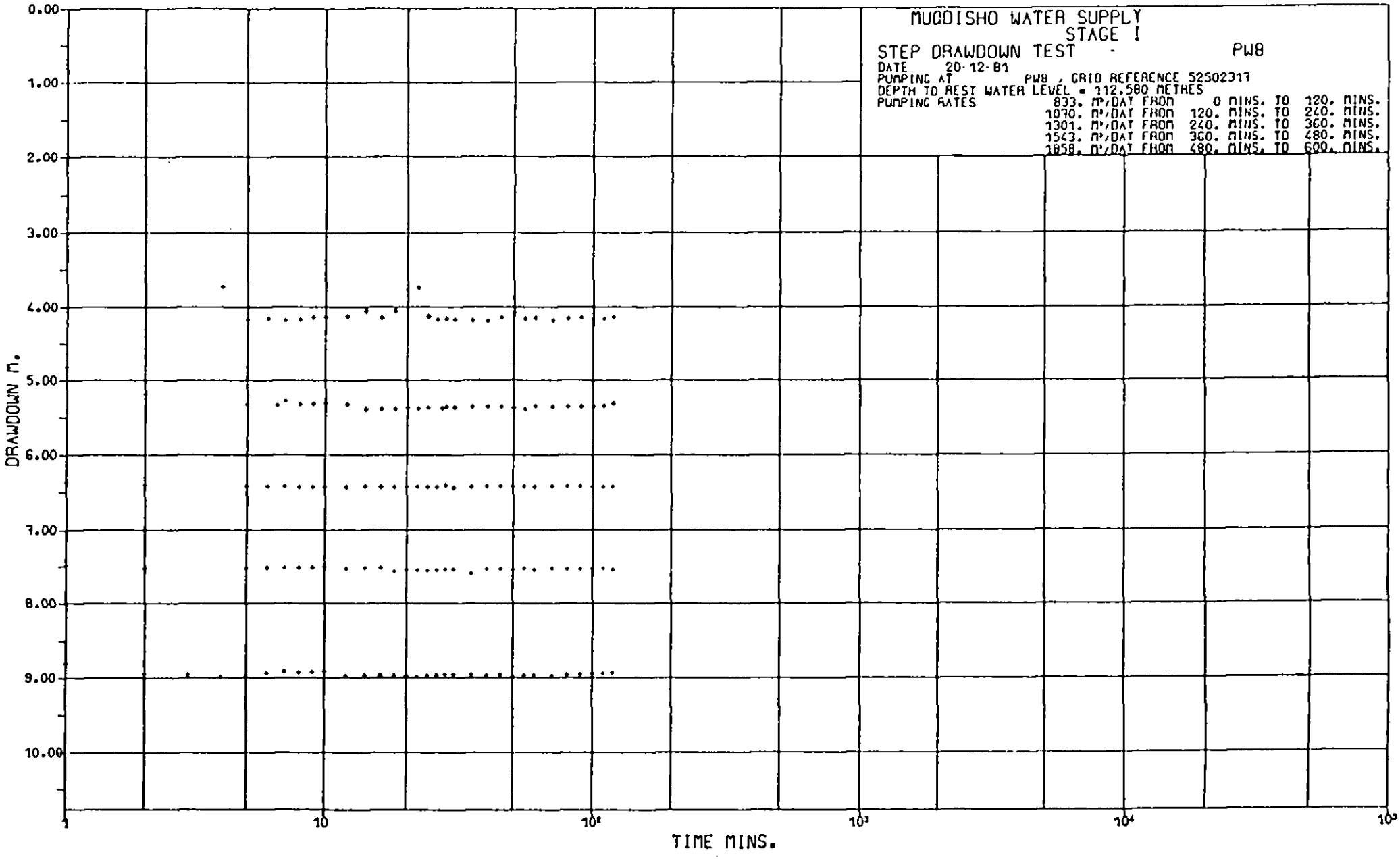
STAGE I

STEP DRAWDOWN TEST - PUMPED WELL

PUMPING AT PW7 GRID REF. 52482315

DATE OF TEST 14 12 81

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
249.0	6.550	365.0	7.360
250.0	6.550	366.0	7.340
252.0	6.460	367.0	7.350
254.0	6.450	368.0	7.340
256.0	6.540	369.0	7.320
258.0	6.550	370.0	7.330
260.0	6.560	372.0	7.360
262.0	6.550	374.0	7.320
264.0	6.530	376.0	7.460
266.0	6.540	378.0	7.440
268.0	6.560	380.0	7.460
270.0	6.730	382.0	7.300
275.0	6.480	384.0	7.320
280.0	6.520	386.0	7.310
285.0	6.520	388.0	7.370
290.0	6.530	390.0	7.320
295.0	6.520	395.0	7.320
300.0	6.500	400.0	7.310
310.0	6.490	405.0	7.290
320.0	6.500	410.0	7.410
330.0	6.470	415.0	7.440
340.0	6.440	420.0	7.360
350.0	6.490	430.0	7.360
360.0	6.490	440.0	7.300
361.0	7.320	450.0	7.400
362.0	7.360	460.0	7.380
363.0	7.320	470.0	7.320
364.0	7.350	480.0	7.330


MUCDISHO WATER SUPPLY
STAGE I
STEP DRAWDOWN TEST - PW8
DATE 20-12-81
PUMPING AT PW8 , GRID REFERENCE 52502317
DEPTH TO REST WATER LEVEL = 112.580 METRES
PUMPING RATES
833. M³/DAY FROM 0 MINS. TO 120. MINS.
1070. M³/DAY FROM 120. MINS. TO 240. MINS.
1301. M³/DAY FROM 240. MINS. TO 360. MINS.
1563. M³/DAY FROM 360. MINS. TO 480. MINS.
1858. M³/DAY FROM 480. MINS. TO 600. MINS.
DRAWDOWN M.
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
1
10
10²
10³
10⁴
10⁵
TIME MINS.

MUQDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST PUMPED WELL

PUMPING AT PW3 GRID REF. 52502317

DATE OF TEST 20 12 81

PUMPING RATES (M**3/DAY) :

332.3	FROM	0.0 MINS	TO 120.0 MINS
1070.4	FROM	120.0 MINS	TO 240.0 MINS
1300.3	FROM	240.0 MINS	TO 360.0 MINS
1543.2	FROM	360.0 MINS	TO 480.0 MINS
1657.6	FROM	480.0 MINS	TO 600.0 MINS

REST WATER LEVEL 112.360 METRES BELOW DATUM

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
4.0	3.730	126.0	5.320
5.0	4.150	129.0	5.310
6.0	4.150	130.0	5.300
7.0	4.170	132.0	5.320
8.0	4.160	134.0	5.380
9.0	4.130	136.0	5.380
10.0	4.130	138.0	5.380
12.0	4.120	140.0	5.360
14.0	4.050	142.0	5.370
16.0	4.140	144.0	5.360
18.0	4.050	147.0	5.370
20.0	3.770	148.0	5.350
22.0	3.740	150.0	5.360
24.0	4.120	155.0	5.350
26.0	4.150	160.0	5.350
28.0	4.150	165.0	5.350
30.0	4.150	170.0	5.360
35.0	4.170	175.0	5.330
40.0	4.130	180.0	5.340
45.0	4.130	190.0	5.350
50.0	4.070	200.0	5.350
55.0	4.160	210.0	5.350
60.0	4.140	220.0	5.350
70.0	4.170	230.0	5.340
80.0	4.150	240.0	5.310
90.0	4.130	241.0	6.360
100.0	4.150	242.0	6.400
110.0	4.150	243.0	6.410
120.0	4.150	244.0	6.400
121.0	4.220	245.0	6.420
122.0	5.120	246.0	6.420
123.0	5.340	247.0	6.420
124.0	5.340	248.0	6.430
125.0	5.320	249.0	6.430
126.0	5.330	250.0	6.430
127.0	5.270	252.0	6.430

(CONTINUED)

MUQDISHO WATER SUPPLY

STAGE I

STEP DRAWDOWN TEST - PUMPED WELL

PUMPING AT PWS GRID REF. 52502317

DATE OF TEST 20 12 81

TIME(MINS)	DRAWDOWN(M)	TIME(MINS)	DRAWDOWN(M)
254.0	6.420	400.0	7.540
256.0	6.430	405.0	7.540
258.0	6.430	410.0	7.550
260.0	6.430	415.0	7.530
262.0	6.420	420.0	7.550
264.0	6.430	430.0	7.530
266.0	6.430	440.0	7.540
268.0	6.410	450.0	7.540
270.0	6.440	460.0	7.540
275.0	6.430	470.0	7.530
280.0	6.420	480.0	7.550
285.0	6.420	481.0	8.300
290.0	6.420	482.0	8.940
295.0	6.420	483.0	8.950
300.0	6.430	484.0	8.930
310.0	6.420	485.0	8.960
320.0	6.420	486.0	8.930
330.0	6.420	487.0	8.910
340.0	6.430	488.0	8.920
350.0	6.430	489.0	8.920
360.0	6.430	490.0	8.910
361.0	7.490	492.0	8.970
362.0	7.530	494.0	8.960
363.0	7.520	496.0	8.960
364.0	7.520	498.0	8.960
365.0	7.530	500.0	8.970
366.0	7.520	502.0	8.980
367.0	7.520	504.0	8.960
368.0	7.520	506.0	8.960
369.0	7.520	508.0	8.950
370.0	7.510	510.0	8.950
372.0	7.530	515.0	8.950
374.0	7.520	520.0	8.960
376.0	7.520	525.0	8.950
378.0	7.570	530.0	8.970
380.0	7.550	535.0	8.960
382.0	7.550	540.0	8.960
384.0	7.560	550.0	8.970
386.0	7.580	560.0	8.950
388.0	7.540	570.0	8.950
390.0	7.540	580.0	8.940
395.0	7.500	590.0	8.940

MUDDISHO WATER SUPPLY
DEPTH TO WATER LISTING
1981/1982 DATA

GRID REF	SITE N	DATE	DEPTH TO WATER (METRES)
51472334	CW2	13 NOV 81	56.7
51912293	DW34	13 DEC 81	110.3
52092356	MGQ4P	29 AUG 81	58.6
52122342	MGQ3P	29 AUG 81	57.0
52322302	MGQ2P	24 MAY 81	123.7
		7 AUG 81	126.716
		13 AUG 81	126.733
		1 OCT 81	126.751
		19 JAN 82	126.741
		13 APR 82	126.734
52422313	DW16	16 DEC 81	130.2
52512470	MGQ13P	AUG 81	60.3
52762333	MGQ10P4	29 AUG 81	101.4
		13 APR 82	101.377
53292418	[illegible]	11 MAY 81	105.3
		7 SEP 81	105.372
		15 APR 82	105.369
53822529	MGQ1P	30 MAY 81	55.4
		7 SEP 81	55.406
		8 MAR 82	55.833
		27 MAR 82	55.941
		17 APR 82	55.939
54162322	DQ3P	25 MAY 81	62.0
		12 SEP 81	62.061
		15 APR 82	62.157
54252350	114	7 APR 82	69.3
54302359	121	8 APR 82	71.5

MUDDISHO WATER SUPPLY
DEPTH TO WATER LISTING
1981/1982 DATA

GRID REF	SITE	DATE	DEPTH TO WATER (METRES)
54342310	14??	25 MAY 81	69.3
		12 SEP 81	69.346
		15 APR 82	69.295
54352571	RIVER	2 MAY 81	6.3
		13 MAY 81	6.340
		5 MAR 82	4.000
		27 MAR 82	3.960
		17 APR 82	4.500
54442389	15?-MB.	25 MAY 81	62.9
		12 SEP 81	62.757
		15 APR 82	63.013
54442456	MB87?	13 MAY 81	107.5
54552327	MB22C?	25 MAY 81	32.9
		12 SEP 81	32.878
		15 APR 82	32.765
54712315	MB91C?	25 MAY 81	13.8
		12 SEP 81	13.869
		15 APR 82	13.768
55022437		13 MAY 81	63.3
		12 SEP 81	63.369

Institute of Hydrology Wallingford Oxfordshire OX10 8BB
Telephone Wallingford (STD 0491) 38800 Telegrams Hycycle Wallingford Telex 849365 Hydrol G

The Institute of Hydrology is a component establishment of the Natural Environment Research Council