WD/OS/84/16 October 1984

The Hydrogeology of the Nyamazura Area.

by

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EPW File
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THE HYDROGEOLOGY OF THE NYAMAZURA AREA

1. INTRODUCTION

1.1 Background.

The development of the Nyamazura Intensive Resettlement area is being jointly funded by the Government of Zimbabwe and the British Government. The British funded Primary Water Supply Unit of the Ministry of Water Resource and Development were required to undertake an exercise of borehole drilling, cleaning and equipping to supply good quality domestic water supplies to a series of twelve villages located within the scheme area. This work was undertaken during July-September 1984, during which time a series of 13 holes were drilled (9 successfully) and 3 holes were cleaned out. All holes were equipped with hand operated Bush Pumps of local design. While undertaking the above work the opportunity was taken to make a fairly detailed assessment of the hydrogeological potential of the Basement Aquifer in the area (see Fig. 1).

1.2 Location.

The Nyamazura area is located some 40 kilometres west of Mutare in the Manicaland Province of Zimbabwe. The area encompasses some 10,830 hectares of farmland located north of Odzi primarily between the Odzi and Chingwandow rivers.

1.3 Topography.

The topography of the area is of gently undulating aspect with prominent hills to the west (Chenyamatsini 1320 metres), the north (south of Game Valley 1213 metres) and the north east (in Osbourne up to 1250 metres). The drainage pattern is rectalinear in form being developed upon primary structural lineations that trend NW-SE, NE-SW and N-S. The main rivers are the Chingwandow, Inyamazura and Odzi. Only the latter was flowing after 3 years of drought in September 1984.

1.4 Climate.

During the last 50 years annual precipitation has varied between a maximum of 1300 mm and a minimum of 370 mm (see Fig. 2) (average of 700 mm p.a.). During the period of 1982-84 the area has experienced drought conditions with annual rainfall of 550 mm or less. The rainy season usually lasts from 3-5 November until 28th March. Evapotranspiration rates are not known.

1.5 Vegetation.

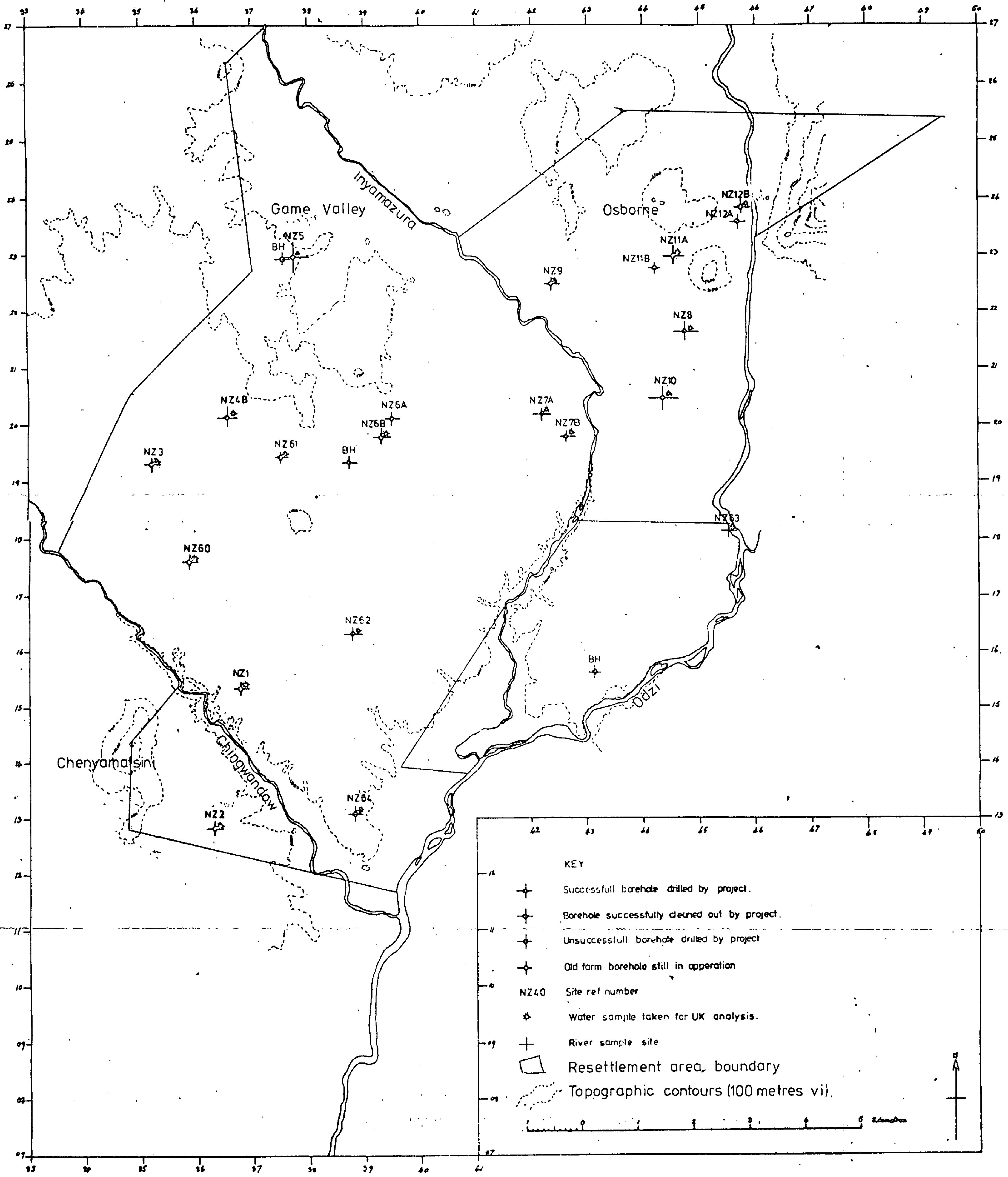
The natural vegetation of bush scrub has been replaced over much of the area by open grassland as a result of farming activities, primarily cattle ranching and the cultivation of tobacco and maize.

1.6 Population and Settlement.

The resettlement area encompasses a series of former commercial farms, now vacated. The proposed pattern of settlement within the Nyamazura area is described in detail within a report prepared by Agritex (June 1981). The PWSU were primarily concerned with the supply of domestic water to a series of 12 peripheral villages in which 400 plus families have been settled.

INYAMAZURA RESETTLEMENT SCHEME

Fig Nº 1 BOREHOLE LOCATION MAP



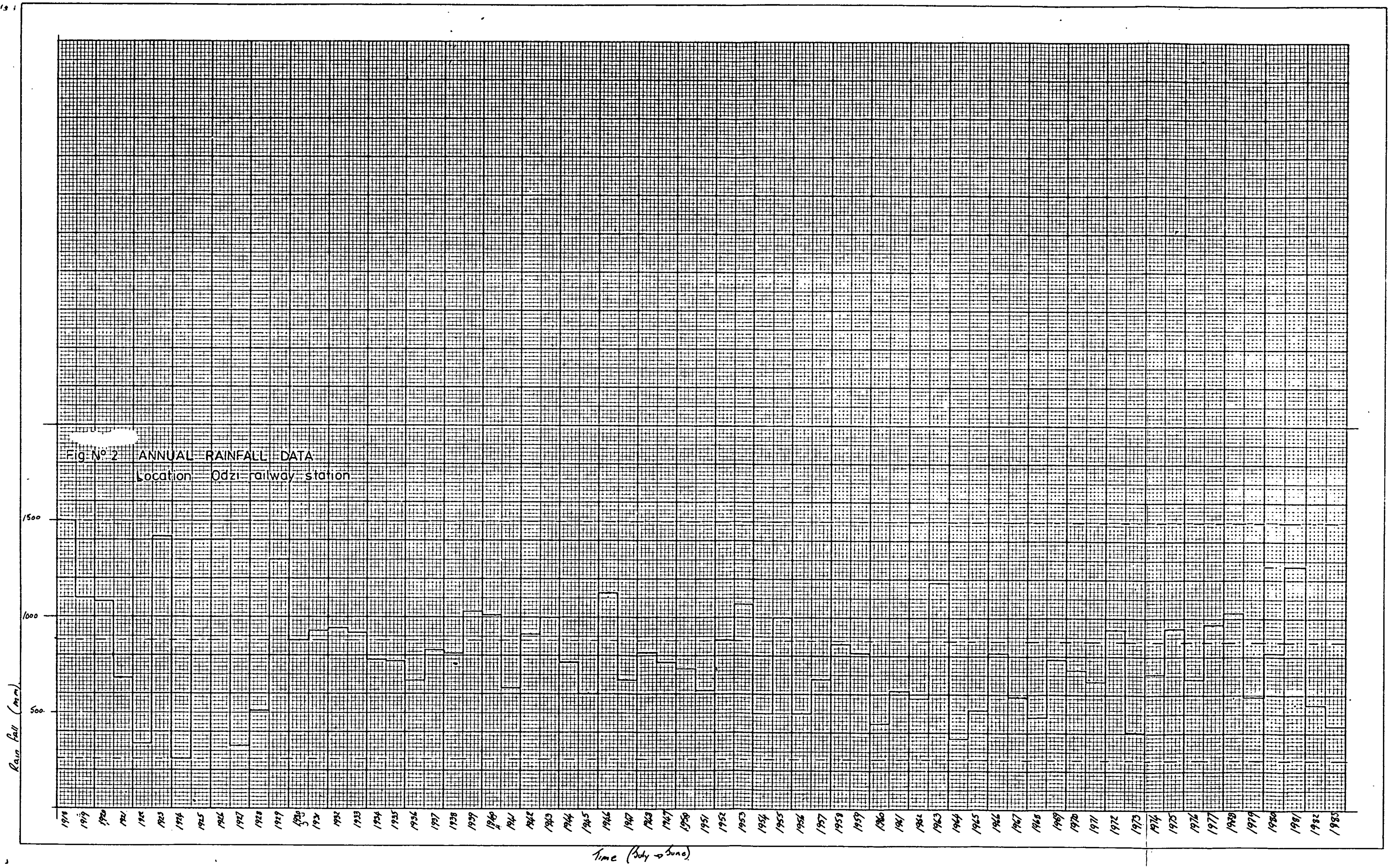


Fig. Nº 2 ANNUAL RAINFALL DATA
Location Odzi railway station

1.7 Aims of the Project.

The primary aim of the project is the provision of a source of good quality domestic water within 0.5 kilometres of each village at as low a cost as possible. During the project, opportunity was taken to conduct a fairly detailed hydrogeological investigation of the area that included the collection of sludge samples from each newly drilled hole, the test pumping of new and cleaned out holes and obtaining water samples for chemical analysis from new, cleaned out and old boreholes and as and when access permitted. It is hoped that the report produced will provide an additional insight into the occurrence of groundwater in Weathered Basement strata.

2. GEOLOGY

2.1 Introduction.

No detailed geological map of the Nyamazura Resettlement scheme exists. To obtain an understanding of the geology of the area two sources were consulted, i.e. the National Geological Map of Zimbabwe that provides an incomplete description of the geology of the area, and Swift (1972) which describes in detail the geology of the Odzi Gold Belt that lies adjacent to the southern margin of the area.

Additional data especially of a structural nature were derived from a study of topographic maps and aerial photography to locate linear fault/joint zones. During the project period geophysical surveys using EM and Wenner type resistivity arrays were used during the location of drill sites. The boreholes drilled yielded detailed geological data. Unfortunately no data whatsoever were forthcoming from the pre-project boreholes.

Details of the data sources used are presented in Appendix I.

Of prime interest to the project were a knowledge of rock types, depths of weathering and occurrence and nature of linear fault/joint fractures.

2.2 Pre-cambrian Basement Strata.

For the purpoes of this report the Basement Precambrian strata have been divided into two (see Fig. 3):-

(1) Granitic gneisses of the Older gneiss series and the younger granodiorite-adamalite series.

(2) Dolerite dykes and sills.

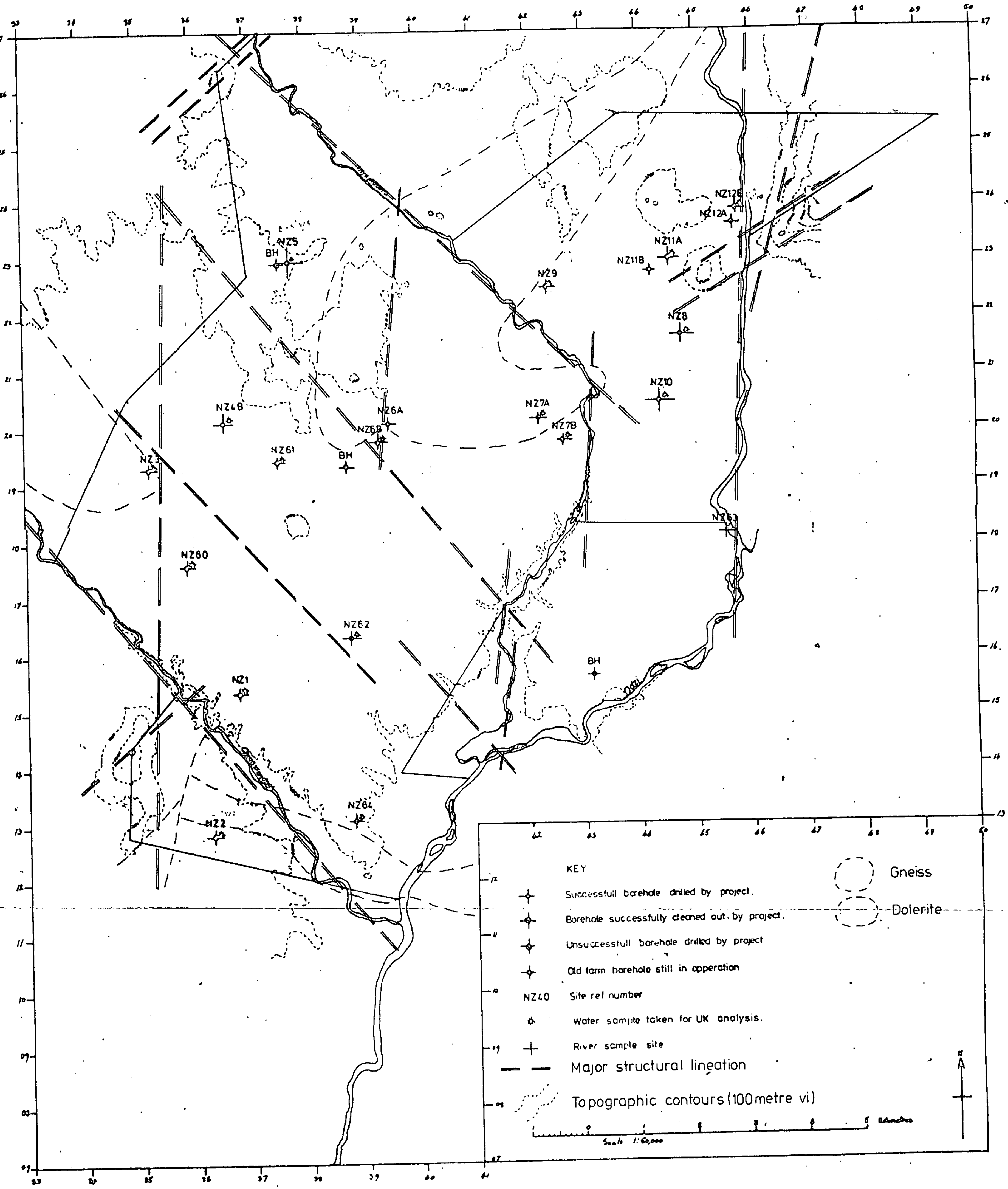
2.2.1 Precambrian granites and gneisses

Most of the area is underlain by granites and gneisses of Precambrian age. Except in the north east of the area the strata appear to be quite uniform in type being composed of white quartz and feldspar with varying proportions of mafic minerals. These rocks are usually quite coarse grained. Sometimes rock with predominantly pink feldspars occur commonly as vein material within the white granitic gneiss.

Within the north east corner of the area more schistic strata are found alternating with white to grey coarse grained gneiss. The schistose bands are

INYAMAZURA RESETTLEMENT SCHEME

Fig Nº 3 GEOLOGICAL MAP



commonly formed of dark green micaeous amphibolitic schists. Within the north east of the area these latter rocks form high hills whereas the rest of the area is underlain by the older granites and gneisses is topographically subdued.

2.2.2 Precambrian dolerites

Dolerites of Precambrian age occur along two east-west trending bands within the central and southern parts of the area. They commonly crop out as low ridges and occasionally high hills with a litter of rounded dark green dolerite blocks scattered at their margins. The soil cover developed upon these dolerite ridges has a characteristic bright brick red hue. These dolerites are younger than the surrounding granites and gneisses into which they have been intruded.

2.3 Structural Geology.

An analysis of topographic maps and aerial photography of the area has indicated the presence of a rectalinear series of fault/joint lineations that traverse the area. These lineations trend NW-SE, NE-SW and N-S, forming zones of weakness that are now followed by the main rivers of the area (see Fig. 3).

2.4 Borehole Siting.

Where new water supply boreholes were required to be drilled, geophysical methods were employed in association with aerial photograph interpretation, to locate the sites. Two geophysical methods were utilised:-

(1) Electrical resistivity utilising a Wenner spread arrangement.

(2) Electromagnetics (EM) using a 20 or 40 metre spread length.

The resistivity method is a well tried and proven method which suffers from several disadvantages:

(a) relatively slow survey speed compared with the EM method,

(b) lack of definition in the latter part of the curve made the calculation of depths of weathering difficult to undertake.

Therefore use was mainly made of the EM method with which rapid traversing of fairly large areas could be undertaken in relatively short periods. The contour maps produced can indicate lineations, zones of weathering, the presence of ferro-mag mineral rich rocks etc. Several examples of survey results obtained from the Nyamazura area are included in Appendix II.

Generally the higher the EM effect the greater the depth of weathering. Using this criteria three or more boreholes were located upon dolerite dykes and sills where the EM effect reflected the large amount of ferro-mag minerals present in the strata. Similarly high EM measurements (>25 millivolts) have also been obtained from amphibolitic gneisses and schists. Therefore the counterpart hydrogeologists undertaking the EM surveys were encouraged to undertake a grid survey of at least 6 lines at each site, to allow adequate contouring of the site, to note the soil colour at the site and the solid geology of and outcrops at site before selecting a drill site.

Reinterpretation of the results obtained from the surveys using the drilling results have indicated that:-

(1) Readings of <10 millivolts generally indicate the presence of hard to solid rock near surface.

(2) Readings of >20 millivolts indicate the presence of ferro-mag conductive minerals within the surface weathered layers derived from dolerites, amphibolitic gneisses or schists etc. and that additional data must be obtained about the solid geology before a drill site can be located.

(3) Readings of 10-20 millivolts can generally be regarded as good indications of adequate weathering although due regard has to be made to any other geological data derived from the area. If possible Electrical Resistivity VES probes should be undertaken at the favourable site.

Of the surveys detailed in Appendix II that at village 12 (NZ2) is typical of condition 3 where a successful borehole was drilled upon an EM effect of 14.5 millivolts. That at village 7 shows the contrast between high EM effects (>25 millivolts) measured over dolerite (where an unsuccessful borehole, NZ6A, had already been drilled) and the optimum levels of <20 millivolts obtained from a lineation that turned out to be a waterlogged zone of faulted granitic gneiss. The results of the survey at village 6 again shows the contrast between a dolerite (upon which an unsuccessful borehole, NZ7A, had already been drilled) and an area further downstream where a successful hole was drilled upon an EM effect of 11 millivolts. Various NW-SE trending lineations are also located. The last example was at village 1A where a borehole was drilled into an area where the EM effect was greater than 25 millivolts. This borehole was drilled into water bearing amphibolitic gneisses and schists whose EM effect is much the same as dolerite.

3. HYDROGEOLOGY

3.1 Introduction.

Prior to the start of the project ten boreholes had been located within the project area. No data existed from these or any unsuccessful borehole that may have been drilled in the area. No hydrogeological study had been made of the Nyamazura area or adjacent areas prior to the current study being undertaken. For the purposes of the current study hydrogeological data was obtained from thirteen holes drilled and three holes cleaned out during the study. Additional hydrochemical data were obtained from four still operational old farm boreholes.

3.2 Current Studies.

During the current study the following classes of data were collected.

(a) Geological data during borehole drilling.

(b) Aquifer parameter data during pumping tests.

(c) Hydrochemical data during pumping tests and spot sampling exercises.

These data were used to produce an idea of the nature of the weathered Precambrian Basement aquifers within the Nyamazura area.

3.3 Geological Data.

A series of thirteen boreholes were drilled using Dando cable tool percussion rigs and a Hands England HE20 down-the-hole hammer rig within the Nyamazura area. Where possible these holes were drilled to a minimum diameter of 152 mm (6 inch) and completed at 110 mm being lined from top to bottom with 110 mm diameter Protorite PVC casing and screen. This screen was gravel packed with a sanitary seal of cement being poured from ground surface to a depth of 5 metres above the pack material. During drilling, sludge samples were collected and logged geologically at one metre intervals. The driller recorded the relative hardness of the strata penetrated, changes in colour, location of fractures, changes in rest water levels and depths of zones of water production. The sludge samples collected were stored in glass sample bottles for future analysis. Geological logs, driller's logs and borehole construction logs are recorded and presented in Appendix III.

3.4 Pumping Test Data.

Of the sixteen boreholes drilled or cleaned out during this study twelve were subjected to one form or another of pumping test. At the initial hole to be tested, NZ4B, a 6-hour constant yield/drawdown test was undertaken followed by a 1 hour recovery test. Due to time constraints the constant yield/drawdown test was reduced to 3 hours duration with a one hour recovery test. Such a test procedure was used at NZ5, NZ8, NZ9, NZ10 and NZ6B. Reduced time period tests were conducted at NZ7A, NZ11A and NZ12A where poor yields were encountered during testing. Latterly in an attempt to reduce testing time even further a standardised bail test was introduced. This involved bailing the hole using cable tool percussion equipment for a period of 30 minutes and recording the maximum drawdown level and recovery over a 60 minute period. This form of test was undertaken at NZ6B, NZ11B and NZ12B. When plotted upon semi log paper the recovery data from the bail tests and from the longer term constant yield tests appear to be in fairly good agreement especially the long term data where the bail test results for $t/t' < 2$ are noted (see Fig. 4).

The constant yield/drawdown data were analysed using the Jacob Straight Line Method while the recovery data obtained from these and the bail tests were analysed using the Theis Recovery Method. In general there was good agreement between the results obtained from both methods once the effects of well storage had been overcome. The transmissivity values obtained from the bail tests were usually on the low side, there being insufficient "late" data available to allow adequate analysis of the results in most cases. The results are presented in Table 1, and in Appendix IV.

The results obtained indicated that the dolerite sills and dykes have very low transmissivities below their initial very weathered upper layers. T values of less than 0.1 m^2/day were recorded at three sites indicating that for throughflow analysis purposes the dolerites can be regarded as being impermeable blocks. Within the weathered basement complex aquifers T values were lowest within water shed areas, e.g. at NZ5 where T values of <10 m^2/day were recorded. T values increased down the hydraulic gradient to >20 m^2/day in the vicinity of the main rivers.

3.5 Hydrochemical Data.

Hydrochemical data were obtained from two primary sources:

(a) pH, temperature and conductance of groundwater pumped were measured at regular intervals during pumping tests.

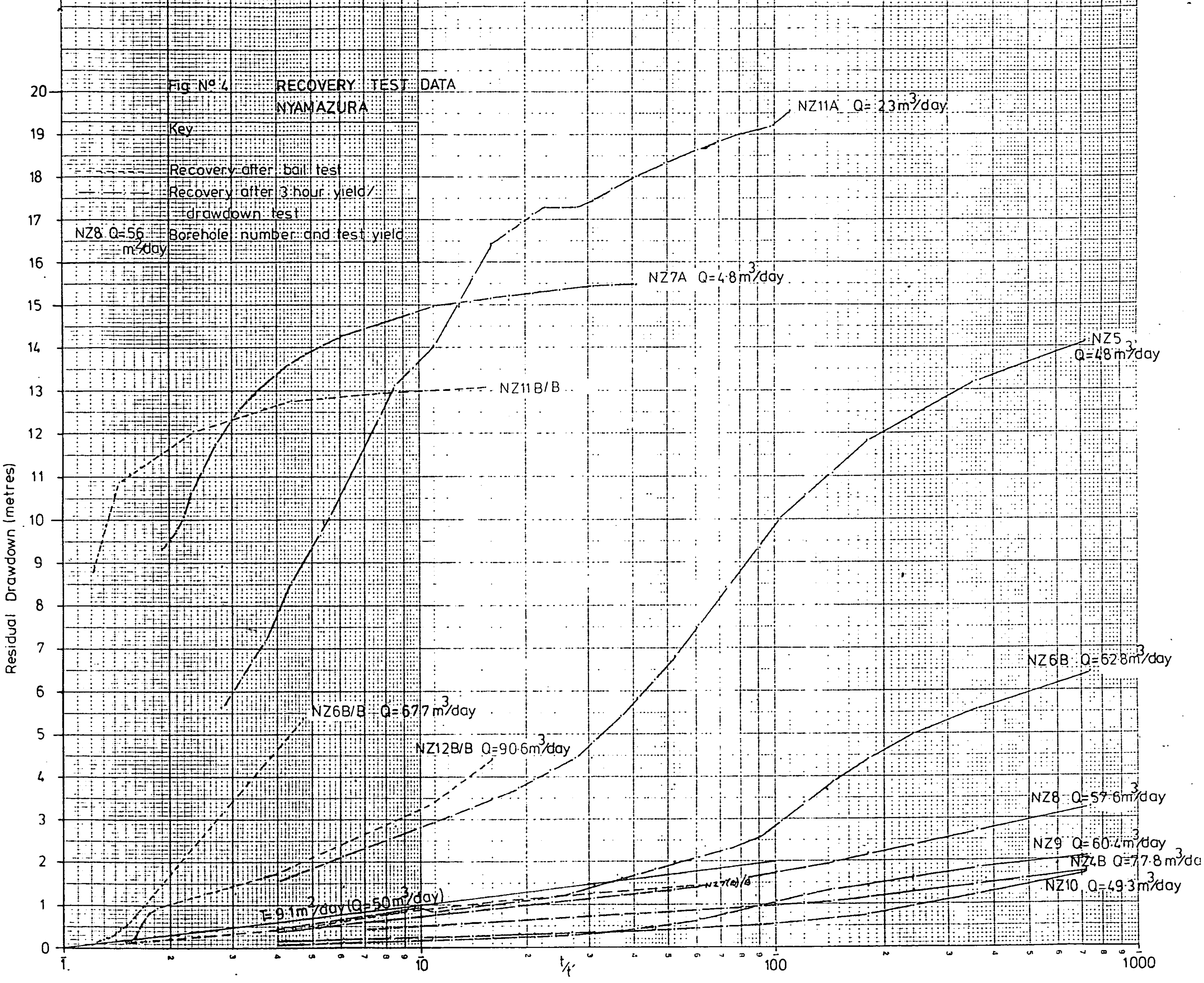


Fig Nº 4 RECOVERY TEST DATA NYAMAZURA

TABLE 1. PUMPING TEST RESULTS, JUNE-AUGUST 1984 - NYAMAZURA.

Borehole No.	Date	Type of Test	Test Duration (minutes)	Method of Analysis	Transmissivity (m^2/day)	Specific Capacity (m^3/day/m)
NZ4B	27-4-84	Yield/Drawdown	360	Jacob Straight Line	(1) 16.38	39.98
				" " "	(2) 24.73	
		Recovery	60	Theis Recovery	30.9	
NZ5	2-7-84	Yield/Drawdown	180	Jacob Straight Line	2.0	2.70
		Recovery	60	Theis Recovery	(1) 1.2	
				" "	(2) 3.6	
NZ7A	20-7-84	Yield/Drawdown	24	Jacob Straight Line	1.16	
		Recovery	60	Theis Recovery	0.048	
NZ8	10-7-84	Yield/Drawdown	180	Jacob Straight Line	8.43	14.08
		Recovery	60	Theis Recovery	(1) 5.64	
				" "	(2) 12.40	
NZ9	18-7-84	Yield/Drawdown	180	Jacob Straight Line	(1) 16.50	24.35
				" " "	(2) 31.59	
		Recovery	60	Theis Recovery	(1) 5.14	
				" "	(2) 44.23	
NZ10	11-7-84	Yield/Drawdown	180	Jacob Straight Line	(1) 13.9	19.74
				" " "	(2) 21.2	
		Recovery	60	Theis Recovery	(1) 5.82	
				" "	(2) 40.07	
NZ11A	16-7.84	Yield/Drawdown	115	Jacob Straight Line	(1) 1.2	0.77
				" " "	(2) 0.27	
		Recovery	60	Theis Recovery	(1) 1.3	
				" "	(2) 0.28	
NZ12A	17-7-84	Yield/Drawdown	35		Very small	
NZ6B	2-8-84	Yield/Drawdown	180	Jacob Straight Line	(1) 5.11	8.99
				" " "	(2) 8.85	
		Recovery	60	Theis Recovery	(1) 2.05	
				" "	(2) 5.23	
				" "	(3) 8.22	
		Bail Test Recovery	30/60	" "	1.25	
NZ7B	10-8-84	Bail Test Recovery	30/60	" "	10.26	33.92
NZ11B	31-7-84	Bail Test Recovery	30/60	" "	0.017	<6.28
NZ12B	9-8-84	Bail Test Recovery	30/60	" "	5.72	20.26

(b) A total of eighteen samples were taken from boreholes and the Odzi river for analysis in the UK. Groundwater pH, temperature, conductivity and bicarbonate content were determined at each sample site. Each sample was taken in two parts, one remained non-acidified while the other was acidified using concentrated hydrochloric acid. The results of these analyses are still awaited at the time of writing.

4. RESULTS

4.1 Nature of the Weathered Basement Aquifer System.

From the geological logs obtained from boreholes drilled in the area the typical sequence through the weathered zone from ground surface to solid rock would be a profile such as that illustrated in Fig. 5. Within this profile the upper weathered zone would develop within the zone of maximum water movement, i.e. rainfall recharging the aquifer passes through the zone and the water table oscillates within that zone during normal to wet climatic periods. Therefore minerals within this zone are subjected to wet-dry conditions and attack by recharge water when it is in its most acid condition. The resulting weathering is indicated by a breakdown of feldspars to clays with their removal from the near surface zone with runoff water and the oxidation of iron rich minerals with their redeposition in the near surface zone as ferricrete nodules or laterite bands.

Within the lower weathered zone the breakdown of minerals due to attack by low pH waters and wetting and drying cycles probably only takes place during near drought conditions when the water table is reduced in elevation. Within this zone ferromag minerals are initially oxidised and then removed upwards in solution by capilliary action to the upper zones. The feldspar minerals are sufficiently attacked by acid water to cause them to crack but not to form clays.

The lowest zone is the relatively unweathered zone where water is contained within joints within the strata. The pH of these waters appears to have increased during their passage down through the upper weathered zones to render them non corrosive.

Within the Nyamazura area the weathered zone appears to be thickest on subdued ridges, e.g. at NZ5 where the zone of water table oscillation is greatest. There the weathered zone is in excess of 30 metres thick. However at this site the transmissivity of the saturated zone of weathering is low due to the presence of much clay in the sequence.

The thinnest zones of weathering are developed adjacent to the main rivers where the zone of water table oscillation is thinnest. In the area between the ridges and the rivers the zone of weathering is commonly 20 metres or more thick (see cross sections NZ5-NZ10 and NZ2-NZ5 (Fig. 6 and 7).

Due to the small number of pumping tests undertaken within the Nyamazura area a comprehensive distribution map of transmissivity cannot be constructed. However there is some evidence to show that over much of the area the weathered Pre-cambrian Basement aquifer has a transmissivity of between 10 and 20 m^2/day.

What is evident is that the zone of weathering is enhanced along fault and prominent joint lineation zones, e.g. at NZ6B. Within the dolerites the upper weathered zone is evident to a great degree as seen in several boreholes where

Fig No. 5

Typical Weathered Rock Profile for Coarse Grained Feldspathic Granitic Gneisses

- Ground Surface

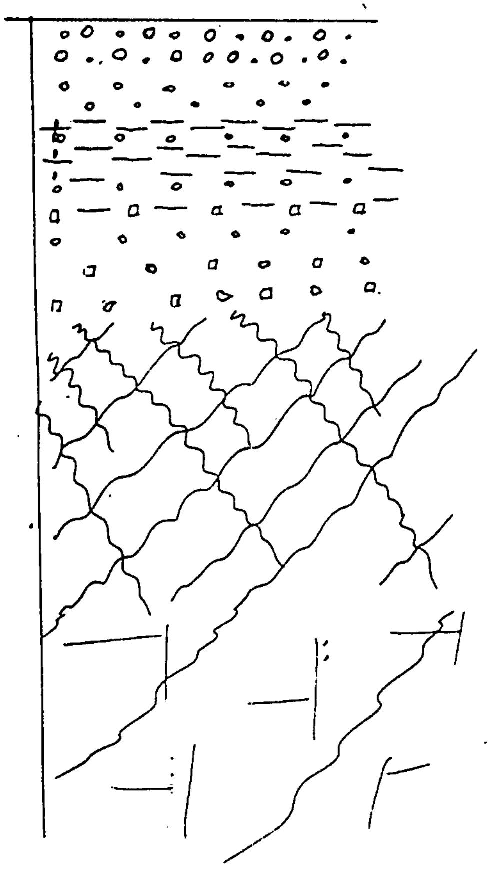
Upper Weathered Zone.	Orange quartz sand some red iron oxide (ferricrete). Orange quartz sand - some brown to grey sandy clay. Quartz sand weathered feldspars.
Lower Weathered Zone.	Weathered quartz and feldspar no 'mafic' minerals present. - Some green chloritisation Weathered quartz and feldspar, Orange oxidised mafic minerals present Slightly weathered quartz felspar and black mafic minerals.
Solid Unweathered Strata.	Un weathered granitic gneiss Some jointing.

pH increases with depth 7.0 → 8.5.

Weathering and decomposition of feldspar to clays increases towards the near surface

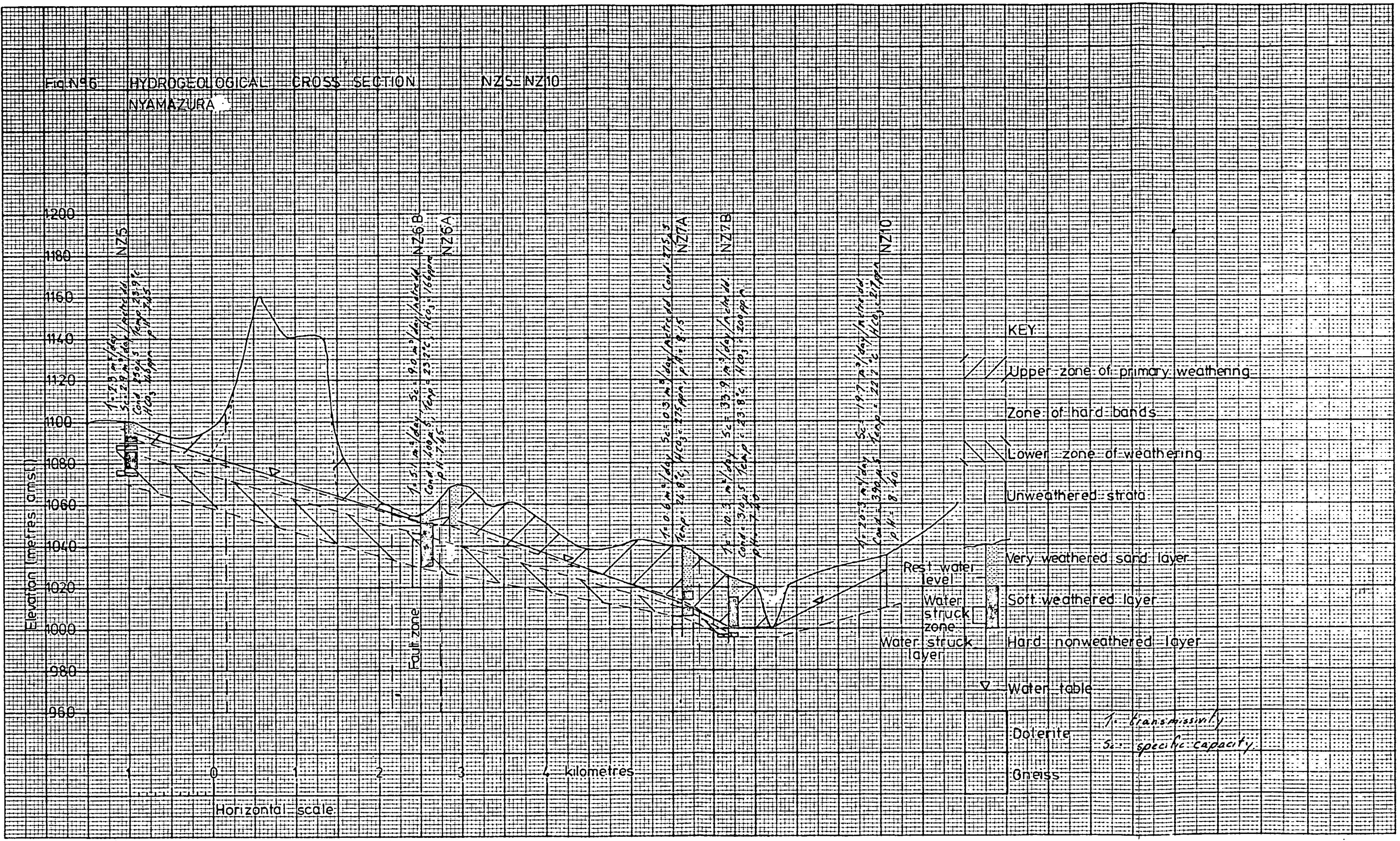
Ferro-mag minerals oxidised - pass into solution, transported upwards by capillary action and redeposited as ferricrete in near surface zone.

Transmissivity decreases with depth
<3 <10 10-20 >20
m²/day.



Key.
o - ferricrete
○ - Quartz.
□ - Feldspar.
= - Clay.
- Weathered gneiss.
Solid well jointed gneiss.

Fig N°6 HYDROGEOLOGICAL CROSS SECTION NZ5-NZ10
NYAMAZURA



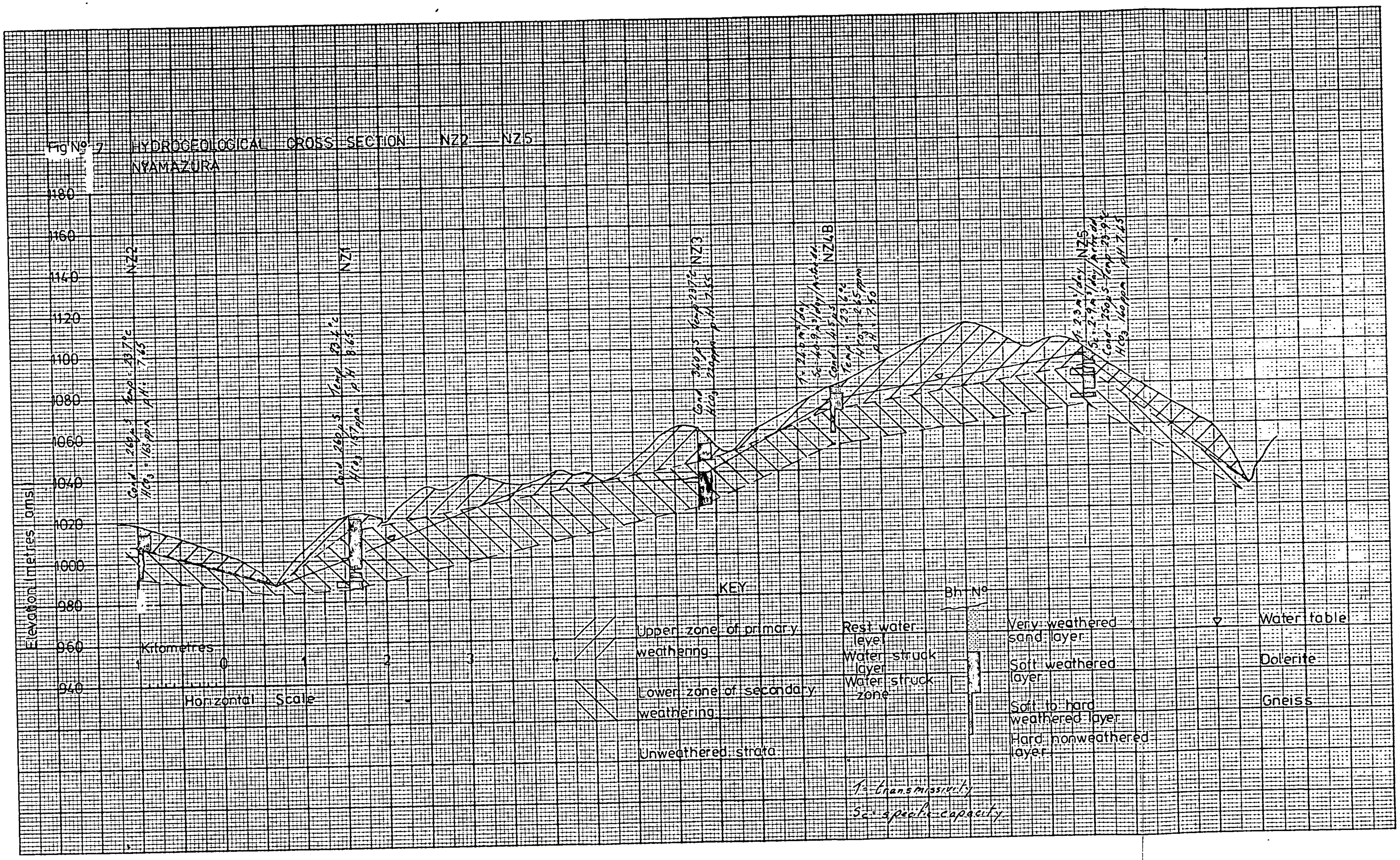


Fig No 7 HYDROGEOLOGICAL CROSS SECTION NZ2 — NZ5 NYAMAZURA the dolerite has decomposed to a green-brown sand. Below this upper layer however the dolerite remains quite solid with zero permeability except for very thin weathered zones which appear to coincide with the lower zone in the granitic gneisses. These thin weathered zones contain very small quantities of water and have very low permeabilities (e.g. NZ11B).

4.2 Groundwater Flow and Recharge.

Within the Nyamazura area groundwater flow is controlled by topography, structural lineations and impermeable dolerite masses, taking place mainly through the weathered Basement Complex aquifer zone (see Fig. 8). Groundwater appears to move from the ridge areas of recharge down dip towards the rivers into which it flows. This general pattern of flow is altered by major structural lineations and by runoff from dolerite hills as is indicated by the groundwater conductance distribution map (see Fig. 8). Rain water runs off the dolerite hills southeast of Game Valley to enter the weathered basement aquifer and flow due south to the Chingwandow valley to the south. Meanwhile the groundwater within the aquifer to the south east of the hills is much more static in nature as indicated by the higher groundwater conductivities recorded (>400 µS).

The hydrochemical results so far obtained would tend to support this view of groundwater flow in the Nyamazura area. pH values of <7.5 are found around the southern margin of the dolerite block to the south east of Game Valley indicating that runoff of rainfall water probably occurs from the dolerite block onto the granitic gneiss. pH is seen to increase down dip towards the Chingwandow valley in the direction of flow (see Fig. 9).

In the same area bicarbonate concentrations are lowest along the western margin of the same dolerite block supporting the view that groundwater flows from that area to the south.

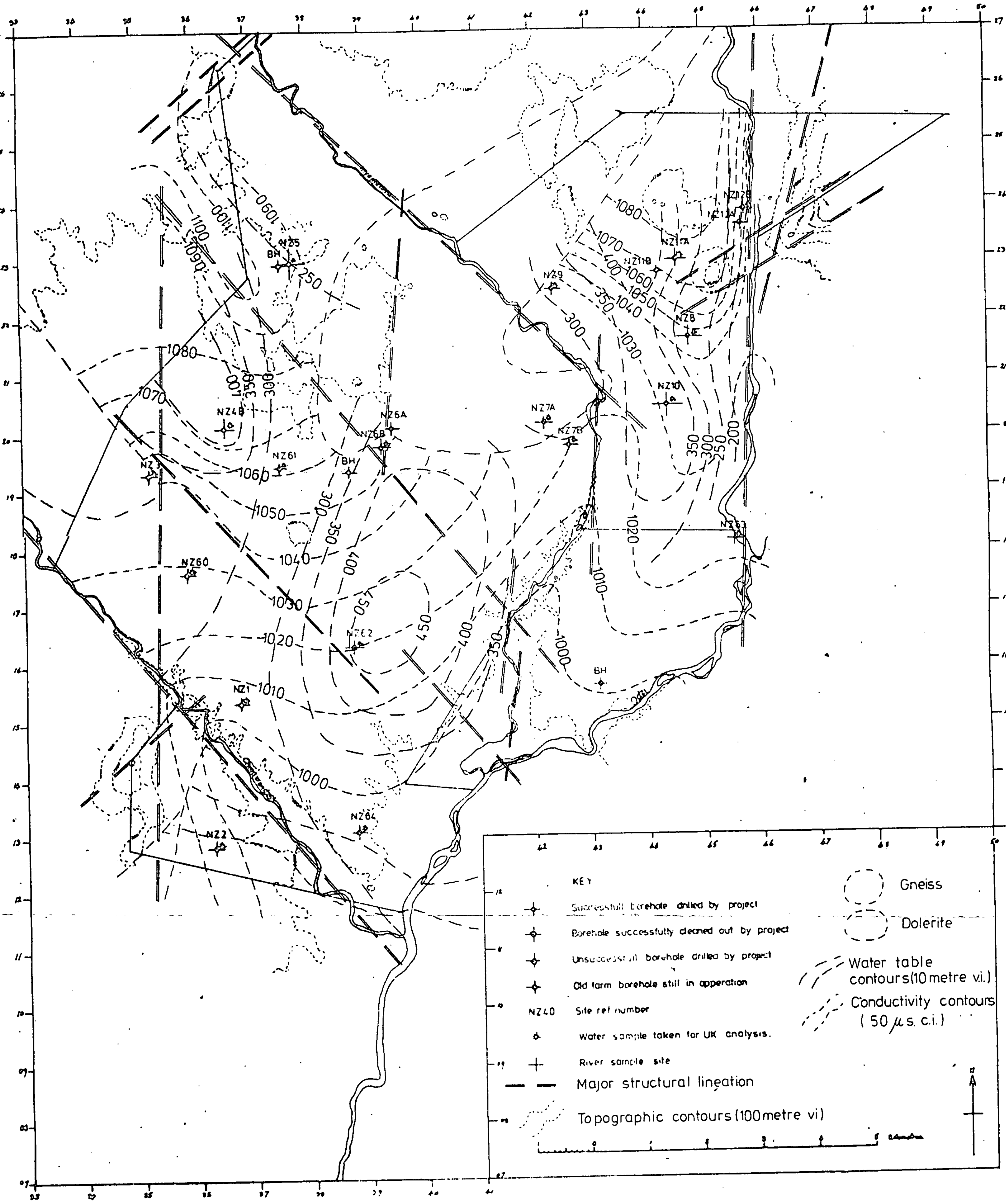
In the north east of the area transmissivity values are much less along the flanks of a steeply-sided ridge. Both pH and bicarbonate values increase rapidly down dip towards the Inyamazura river. Very low values are recorded to the east along the banks of the Odzi river probably due to mixing of groundwater and river water.

5. SUMMARY

The occurrence of groundwater within the Nyamazura area has been summarised in Fig. 10. The structural fault/joint lineations, major rivers and prominent dolerite masses are seen to have marked controlling influences upon the nature of groundwater flow in the area. Factors that control the degree of weathering of the Pre-cambrian Basement Complex aquifer include the climatic regime of the area and the susceptibility of the granitic gneiss formation to weathering especially the feldspar component.

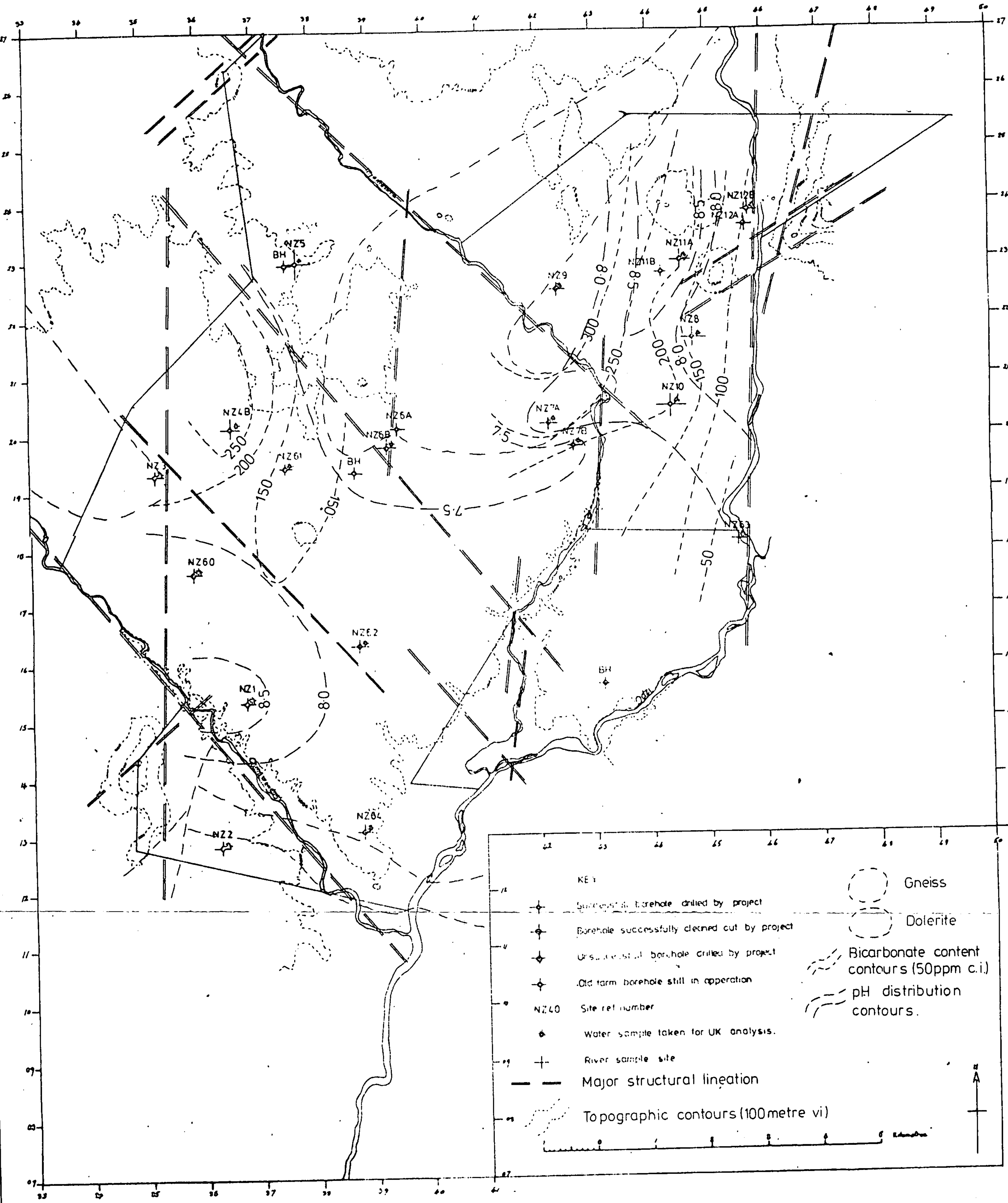
INYAMAZURA RESETTLEMENT SCHEME

Fig. Nº 8 HYDROGEOLOGICAL MAP



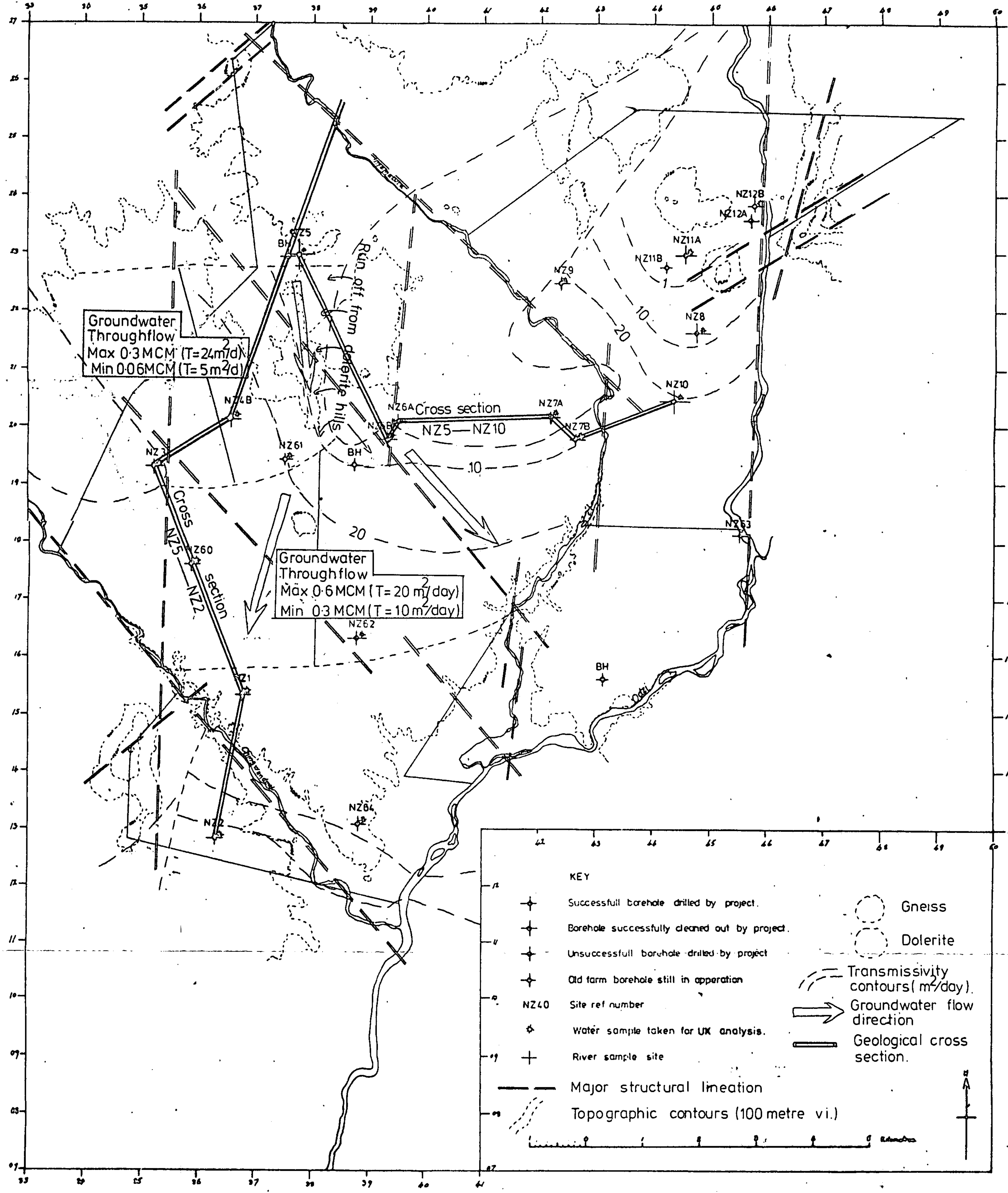
INYAMAZURA RESETTLEMENT SCHEME

Fig. Nº 9 pH AND BICARBONATE DISTRIBUTION CONTOUR MAP



INYAMAZURA RESETTLEMENT SCHEME

Fig Nº 10 POSSIBLE OCCURRENCE OF GROUNDWATER WITHIN THE WEATHERED BASEMENT STRATA



A general transmissivity of 10 to 20 m^2/day has been postulated for most of the Basement Complex aquifer system. Transmissivity is seen to increase radially to the south away from ther southern margin of the main dolerite masses. Groundwater gradients are fairly high. Throughflows of groundwater in the Nyamazura area have been calculated. In the north west of the area groundwater throughflow is of the order of maximum 0.3 MCM/annum to minimum of 0.06 MCM/annum. Within the central part of the area groundwater throughflow is estimated to be maximum 0.6 MCM/annum and minimum 0.3 MCM/annum (dependent upon the T value selected).

The hydrochemical data so far analysed indicate that the groundwaters of the Nyamazura are of good eough quality to be used for domestic and agricultural purposes. This situation could change when the detailed chemical analyses of the water samples obtained become available. The distribution of fluoride within the aquifer system is of particular interest.

Acknowledgements.

The author of this report J Davies (Hydrogeologist) would like to acknowledge:

(i) the kind help and assistance that he received from all his colleagues at the Ministry of Water Resources and Development particularly Mr D A Whitaker (PWSU Team Leader), Mr M Sharp (Drilling Supervisor) and Miss I A Richardson (PWSU Field Hydrogeologist),

(ii) the advice of and helpful discussions with Dr E P Wright (BGS) and Dr R Herbert (BGS),

(iii) the analytical expertise and advice of Miss J Cook (BGS),

(iv) the typing expertise and patience of Mrs C Cordery (BGS).

APPENDIX I

DATA SOURCES

1. Topographic maps.

Scale 1 : 50 000 ODZI 1832 C4, UMTALI 1832 D3

Scale 1 : 250 000 Mutare sheet SE-36-10.

2. Aerial Photography.

Umtali South 1975

579-586
660-670
744-752
824-828

3. Reports.

(a) Agritex, March 1983. INYAMAZURA Intensive Resettlement. Planning Branch, Dept. of Agriculture and Extension Services.

(b) Swift, W H (1972). The Geology of the Odzi Golden Belt. Bull. No. B45 Southern Rhodesia Geological Survey.

4. Geological Maps.

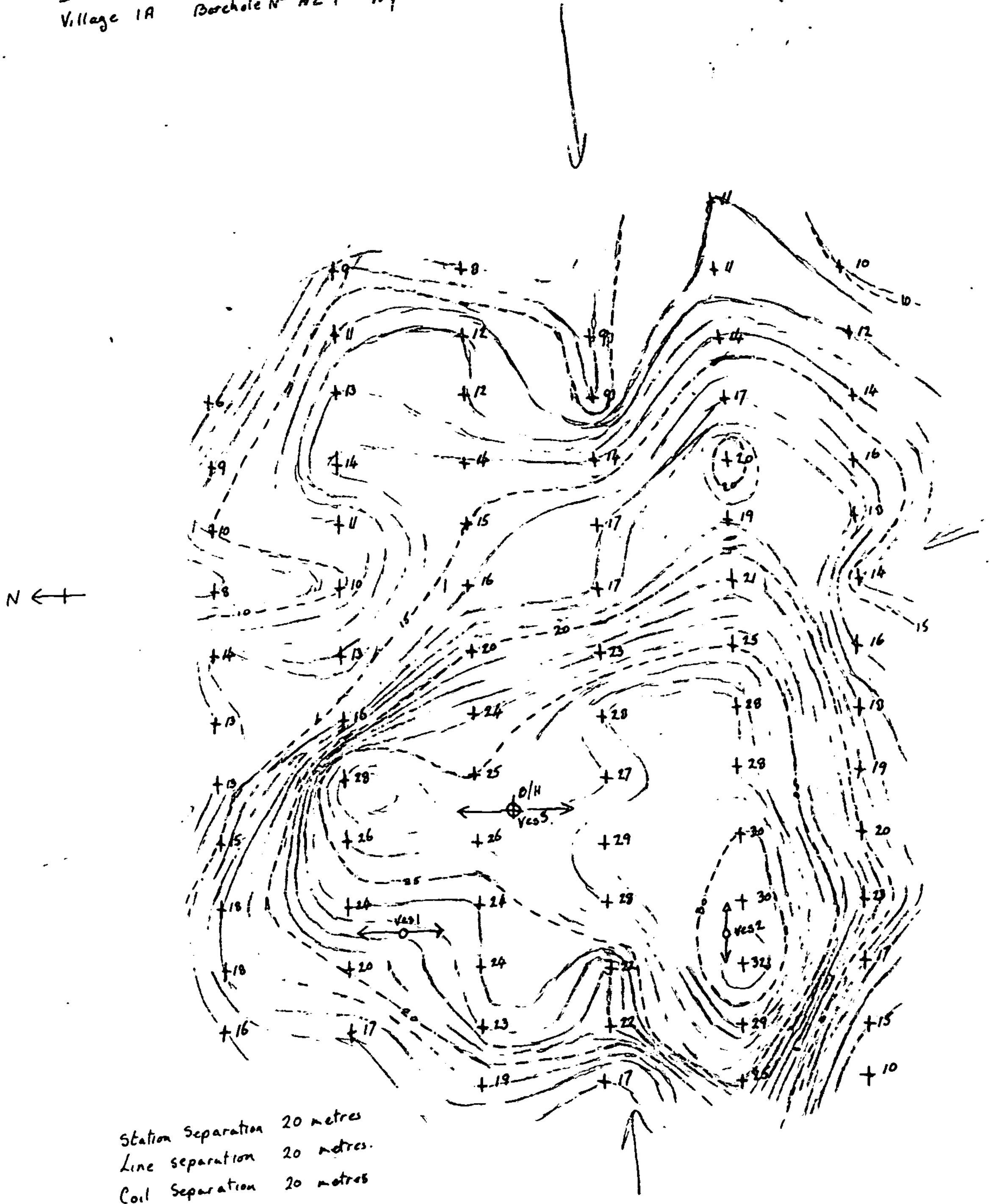
1 : 1 000 000 scale National Geological Map of Zimbabwe, 1977.

APPENDIX II

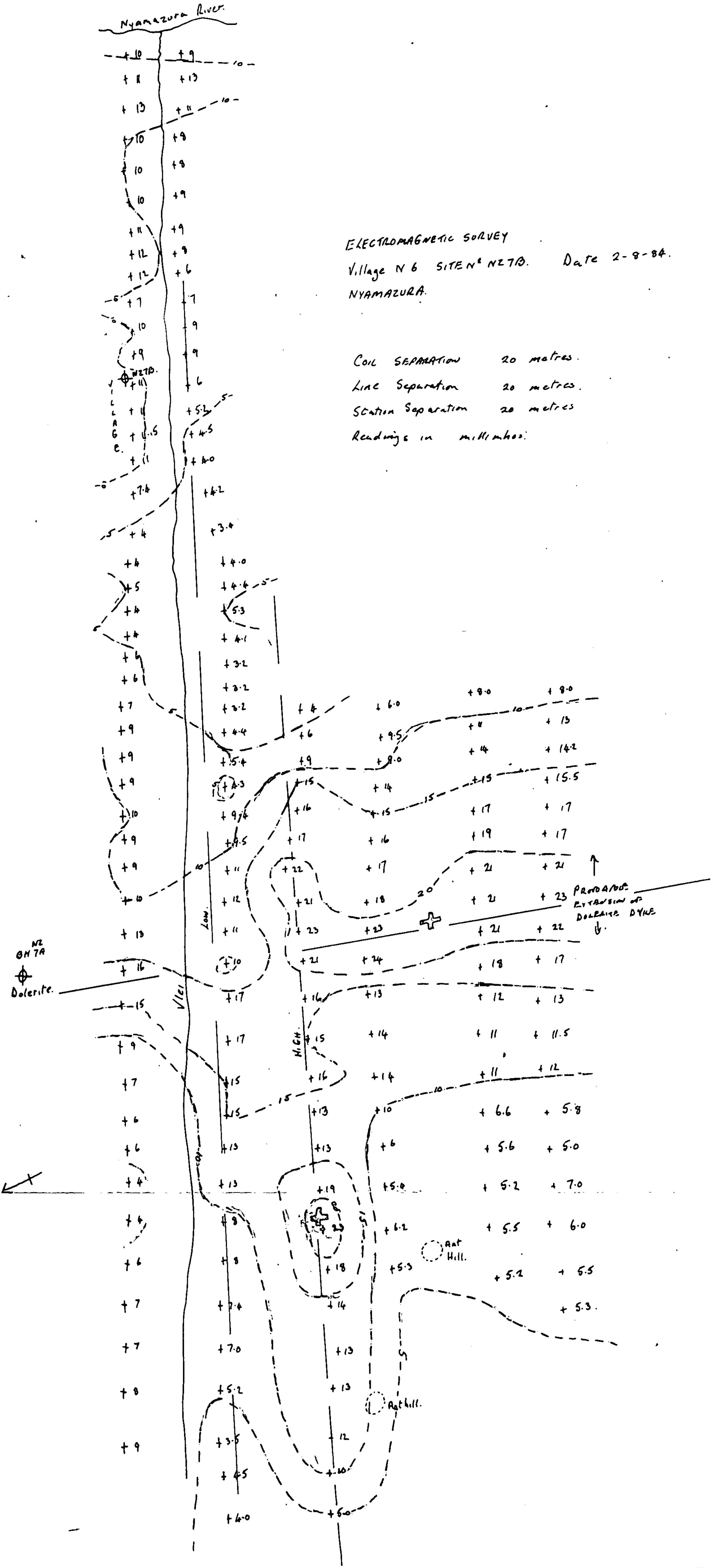
EM RESULTS

1.	Village No. 1A	Borehole No. NZ9
2.	Village No. 6	Borehole No. NZ7B
3.	Village No. 7	Borehole No. NZ6B
4.	Village No. 12	Borehole No. NZ2

ELECTROMAGNETIC SURVEY.
Village 1A Borehole No NZ9 Nyamazura Date 3/7/94.



Station Separation 20 metres
Line separation 20 metres.
Coil Separation 20 metres
Readings in millimhos.

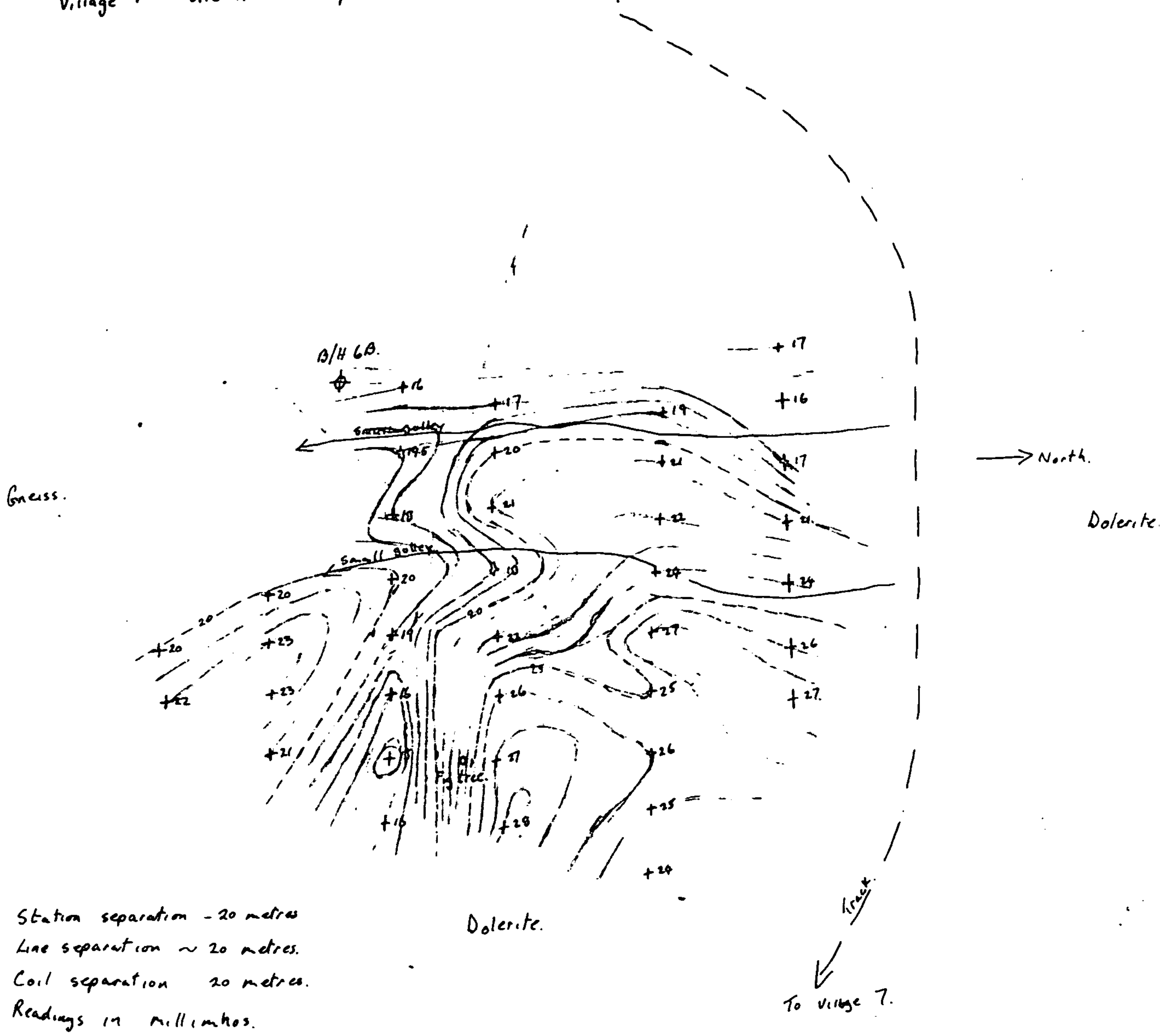


ELECTROMAGNETIC SURVEY
Village N 6 SITE Nº NZ7B. Date 2-8-84.
NYAMAZURA.

Coil SEPARATION 20 metres.
Line Separation 20 metres.
Station Separation 20 metres
Readings in millimhos.

ELECTROMAGNETIC SURVEY

Village 7   Site NZ 6B   Nyamazura.   Date 4/7/84.



Station separation - 20 metres

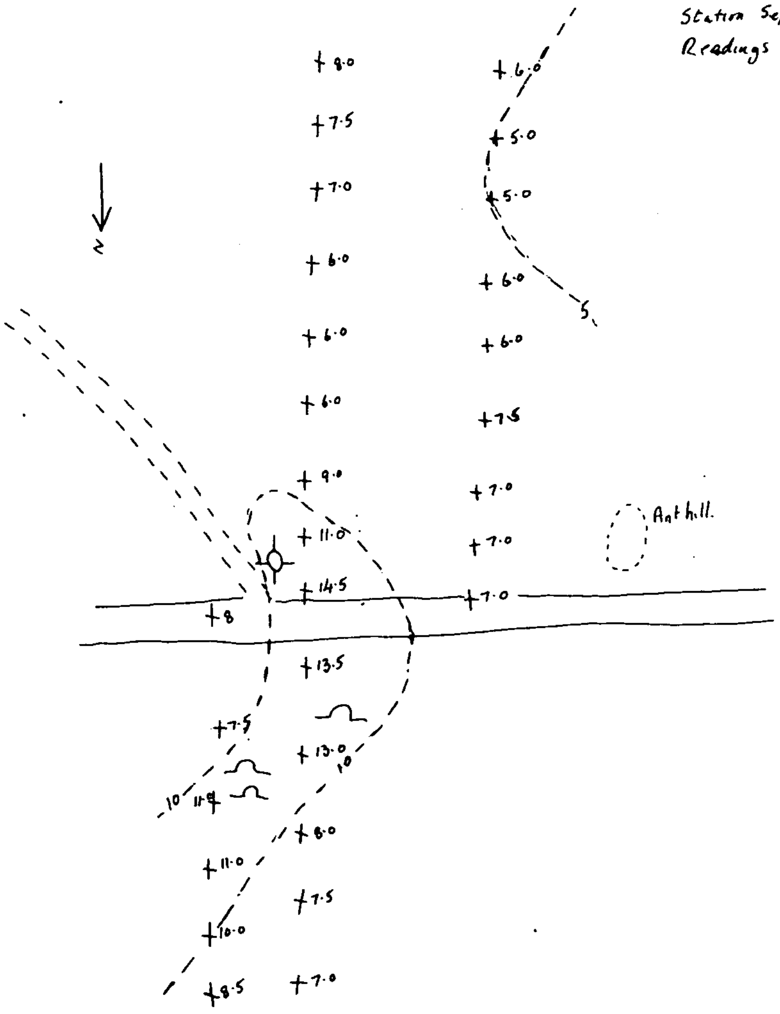
Line separation ~ 20 metres.

Coil separation 20 metres.

Readings in millimhos.

ELECTROMAGNETIC SURVEY.
Village 12 NZ2. NYAMAZURA 22-5-84

Coil separation 40 metres
Station Separation 20 metres.
Readings in millimhos.



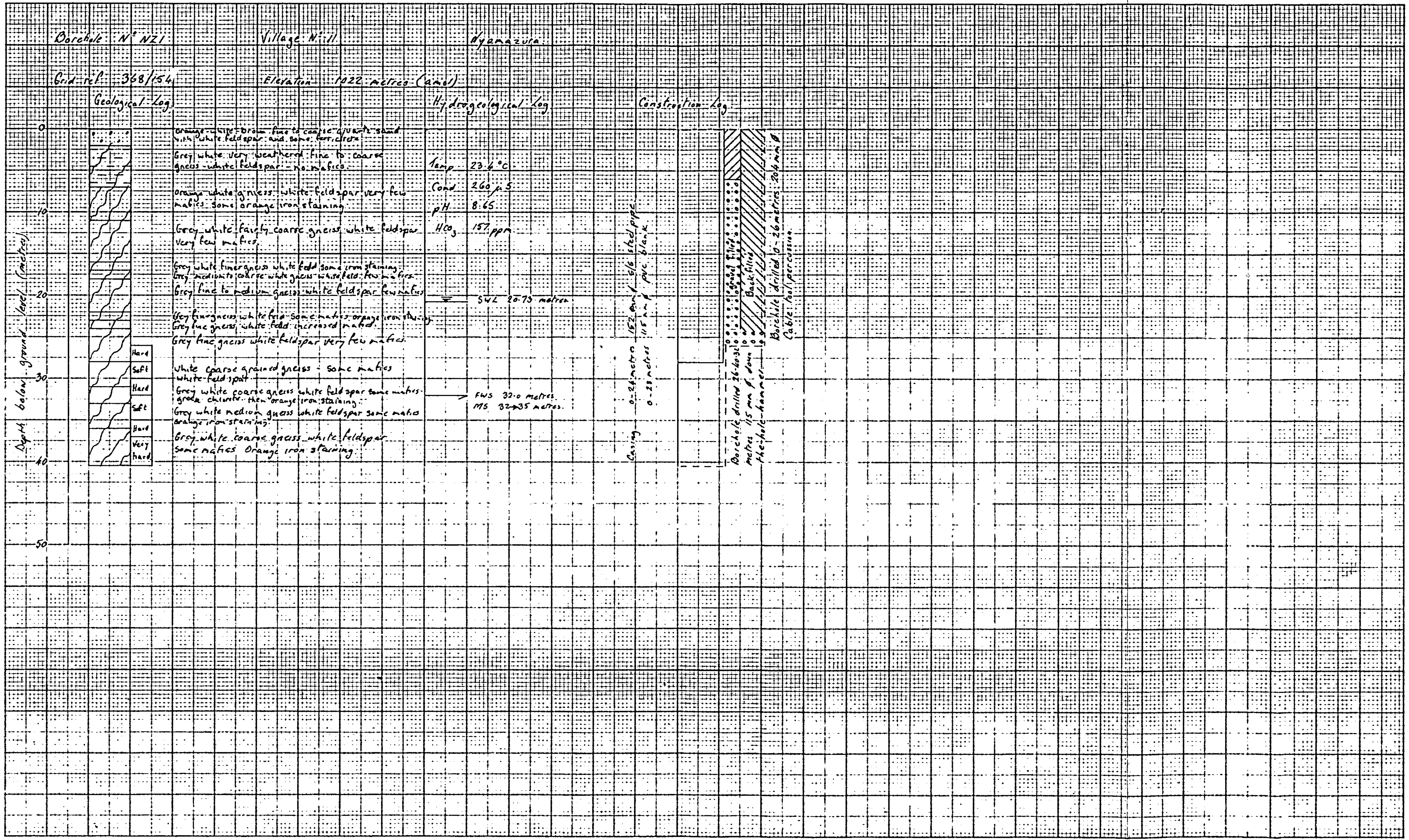
APPENDIX III

BOREHOLE LOGS

1 - NZ1
2 - NZ2
3 - NZ3
4 - NZ4A
5 - NZ4B
6 - NZ5
7 - NZ6A
8 - NZ6B
9 - NZ7A
10 - NZ7B
11 - NZ8
12 - NZ9
13 - NZ10
14 - NZ11A
15 - NZ11B
16 - NZ12A
17 - NZ12B

Borehole N° NZ1 Village N: 11 Nyamazura

Grid ref. 368/154 Elevation 1022 metres (amsl)



Orange-white-brown fine to coarse quartz sand with white feldspar and some ferricrete

Grey white very weathered fine to coarse gneiss - white feldspar - no mafics.

Orange white gniess white feldspar very few mafics some orange iron staining

Grey white fairly coarse gneiss white feldspar very few mafics.

Grey white finer gneiss white feld some iron staining
Grey medium to coarse white gneiss white feld: few mafics.
Grey fine to medium gneiss white feldspar few mafics

Grey fine gneiss white feld some mafics orange iron staining
Grey fine gneiss white feld increased mafics.
Grey fine gneiss white feldspar very few mafics.

White coarse grained gneiss - some mafics white feld spat

Grey white coarse gneiss white feld spar some mafics green chlorite then orange iron staining.

Grey white medium gneiss white feldspar some mafics orange iron staining.

Grey white coarse gneiss white feldspar some mafics Orange iron staining.

Temp 23.4 °C
Cond 260 μS
pH 8.65
HCO_3 157 ppm

SWL 20.75 metres

FWS 32.0 metres
MS 32→35 metres.

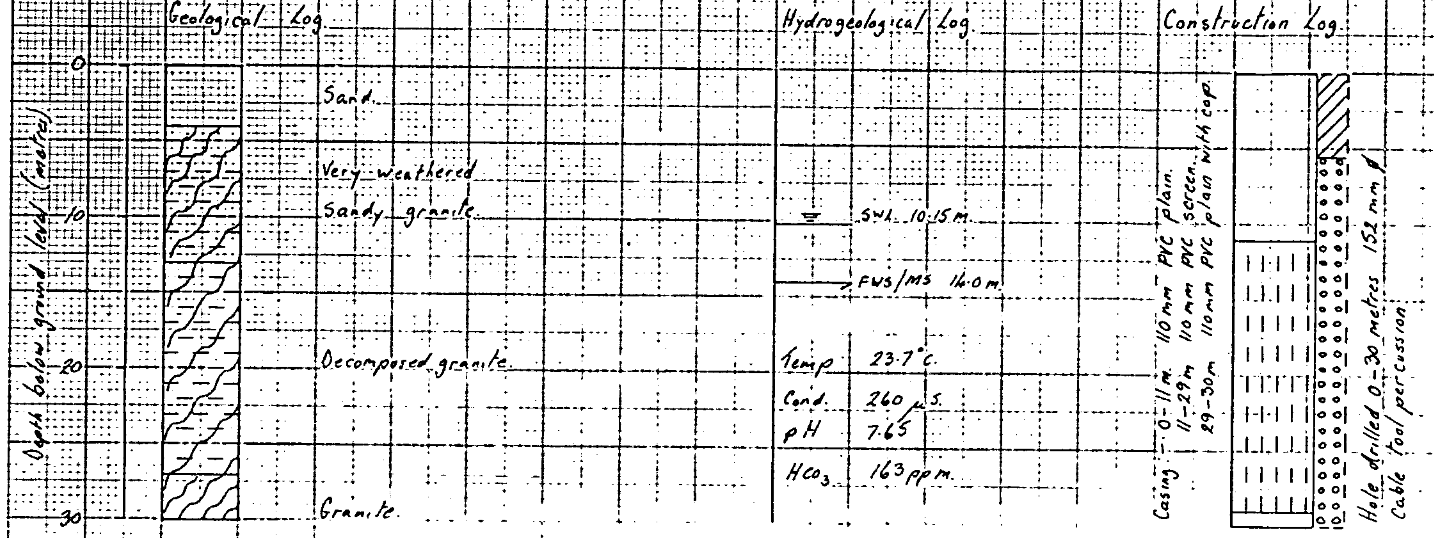
Casing 0-24 metres 162 mm ∅ steel pipe
0-28 metres 115 mm ∅ pvc blank

Borehole drilled 0-26 metres 204 mm ∅
Cable tool percussion.

Borehole drilled 26-40.32 metres 115 mm ∅ down the hole hammer

Borehole Nº NZ2 Village Nº 12 Nyamazura

Grid Ref. 363/128 Elevation 1018 metres (amsl)



Notes.

1. Rest water level during drilling.

Date	RWL (metres)
5-6-84	10-10
6-6-84	10-15
7-6-84	10-15
8-6-84	10-15.

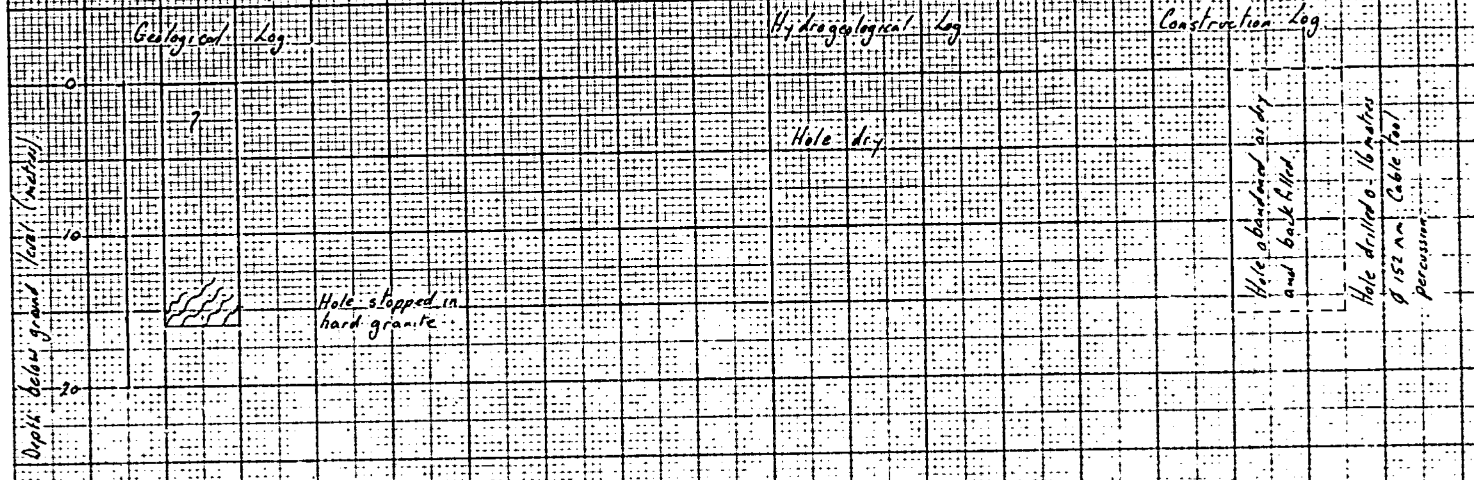
2. Bailer Tests. (5" Bailer).

Date.	RWL (m)	Nº of Bails.	Time Taken	Drawdown to:-
6-6-84	10-15	30	19 mins 5 secs.	18-30 m.
7-6-84	10-15	21	12 mins 9 secs.	14-60 m.

3. Hole developed for 15½ hours by pumping.

Borehole Nº NZ 4 A Village Nº 9 Nyamazura

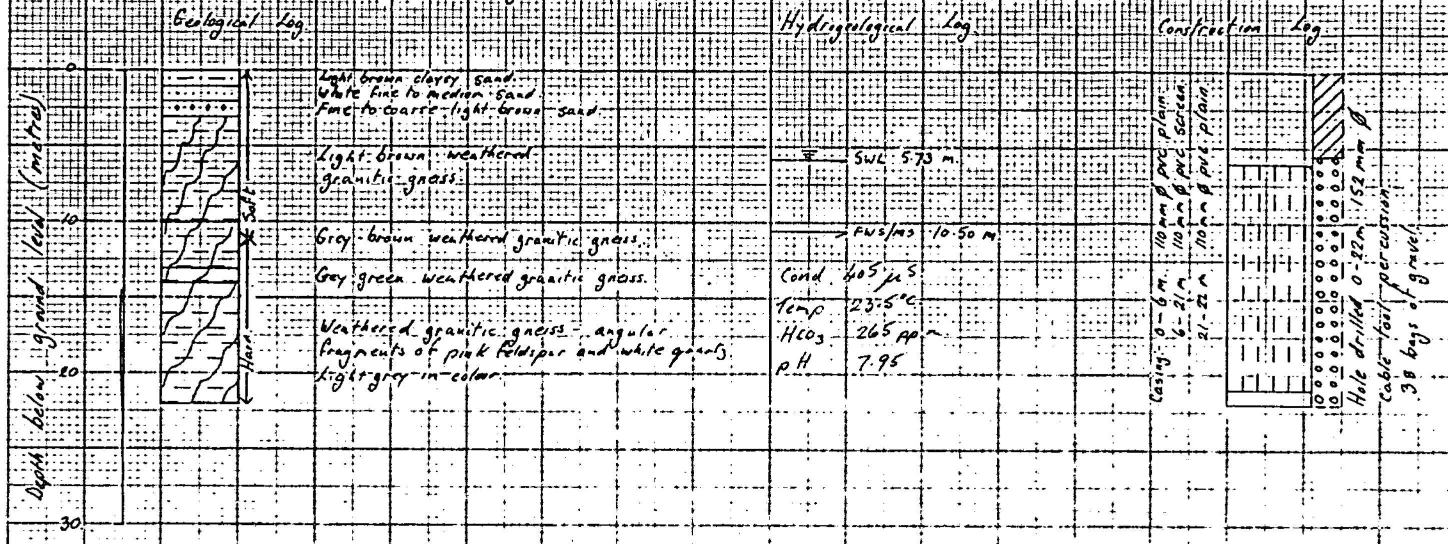
Grid ref. 365/202 Elevation 1075 metres (amsl)



Notes.

1. This hole was drilled at a site some 400 metres south of B/H Nº NZ 4B.

Borehole Nº NZ 4B Village Nº 9 Nyamazura Grid ref 365/201 Elevation 1080 metres (amsl)



Notes.

1. Rest water levels during drilling.

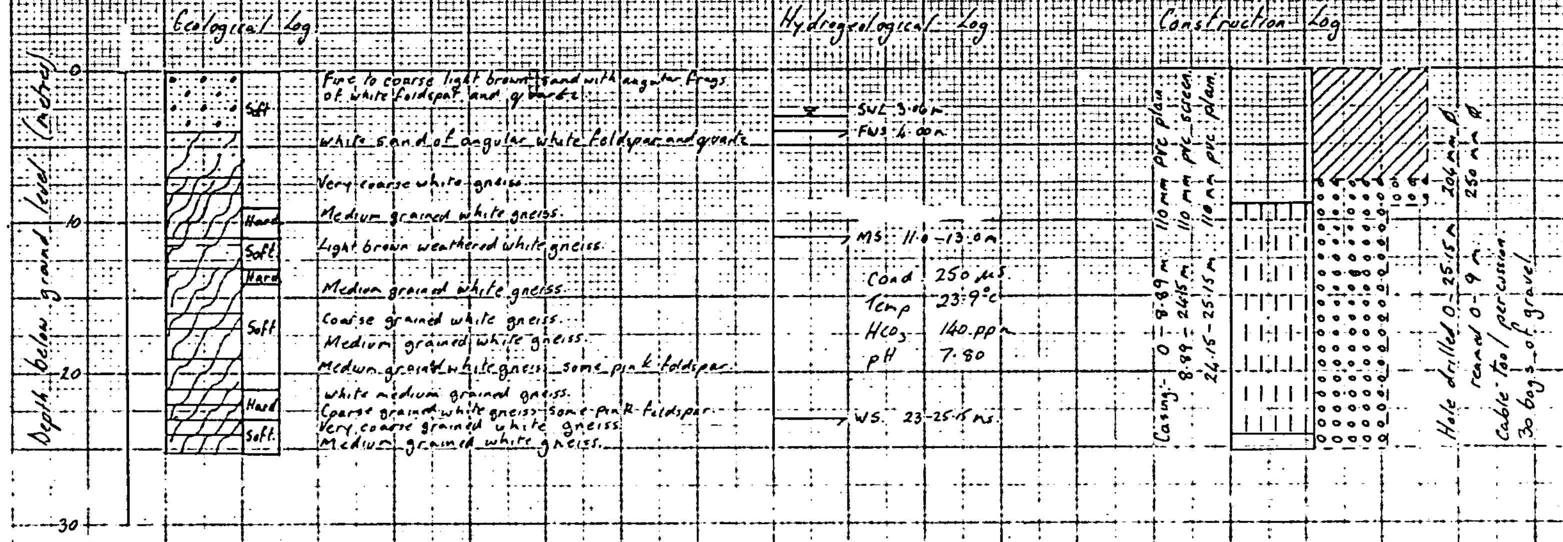
Depth (metres)	RWL (metres)
13	7.95 m.
18	6.31 m.
21	5.86 m.
22	5.92 m.

2. Bailer tests (37l bailer)

Depth.	RWL.	Nº of Bails.	Time taken.	Drawdown to
13	7.95	30	16 mins.	10.85.
18	6.31	20	10 mins	?

Borehole N° NZ 5 Village N° 5 Nyamazura

Grid ref 378/229 Elevation 1100 metres (amsl)



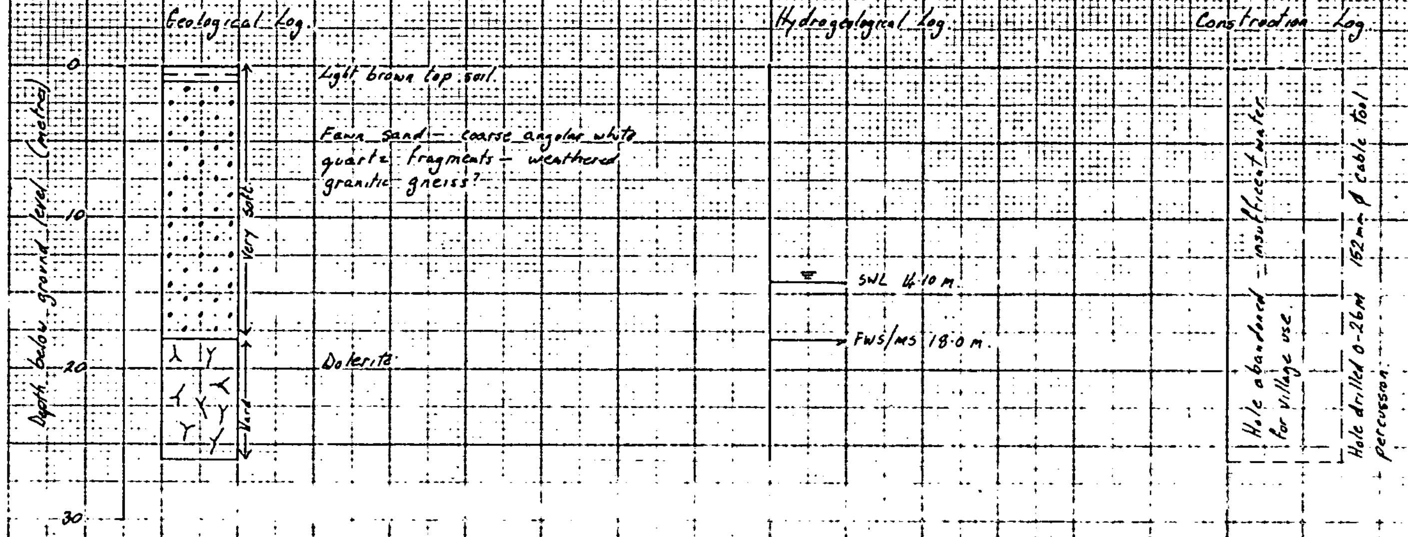
Notes

1. Rest water levels during drilling.

Date	depth (m)	RWL (m)
18-6-84	8-65	3-06
19-6-84	16-00	3-18
20 -6-84	21-00	3-06.
22-6-84	25.15.	3-10.

Borehole N^o NZ6A Village N^o 7 Nyamazura

Grid ref. 395/201 Elevation 1068 metres (amsl)



Light brown top soil.

Fawn sand – coarse angular white quartz fragments – weathered granitic gneiss?

Dolerite.

Hole abandoned – insufficient water for village use.

Hole drilled 0-26m 152mm ø cable tool percussion.

Notes.

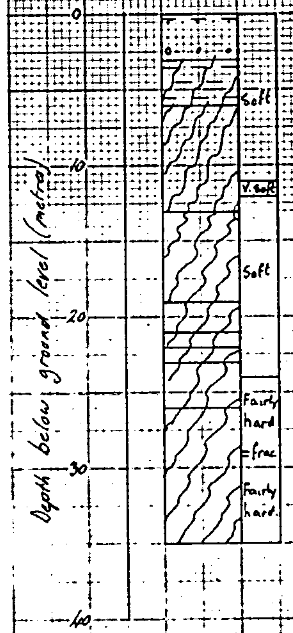
1. Rest water levels during drilling.

Date	RWL (metres)
26-6-84	14-40 m
28-6-84	14-10. m.

Borehole Nº NZ 68 Village Nº 7 Nyamazora

Grid ref. 393/198 Elevation 1055 metres (amsl)

Geological Log



Brown fine to coarse quartz sand increasing white feldspar with depth.

Very weathered orange-white gneiss with orange iron staining

Orange white coarse gneiss white feldspar few mafics orange iron staining

White gneiss with golden brown iron staining - coarse grained white feldspar and quartz.

white gneiss with white feldspar and quartz.

white gneiss - some pink feldspar.
white gneiss all white feldspar.
White gneiss with pink feldspar some light brown iron staining - coarser grained 25-26 m.

~~Grey~~ Grey pink gneiss NO mafics fairly coarse grained pink feldspar. Coarser grained below 32 metres.

Hydrogeological Log

SWL 2·67 metres

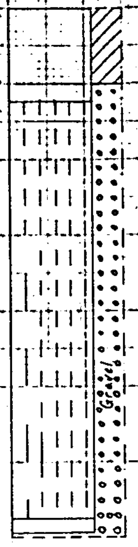
FWS 8·00 metres.

MS 11·00 metres onwards.

Cond	400 µS
Temp	23·2 °c
HCO_3	166 ppm
pH	7·45.

Construction Log

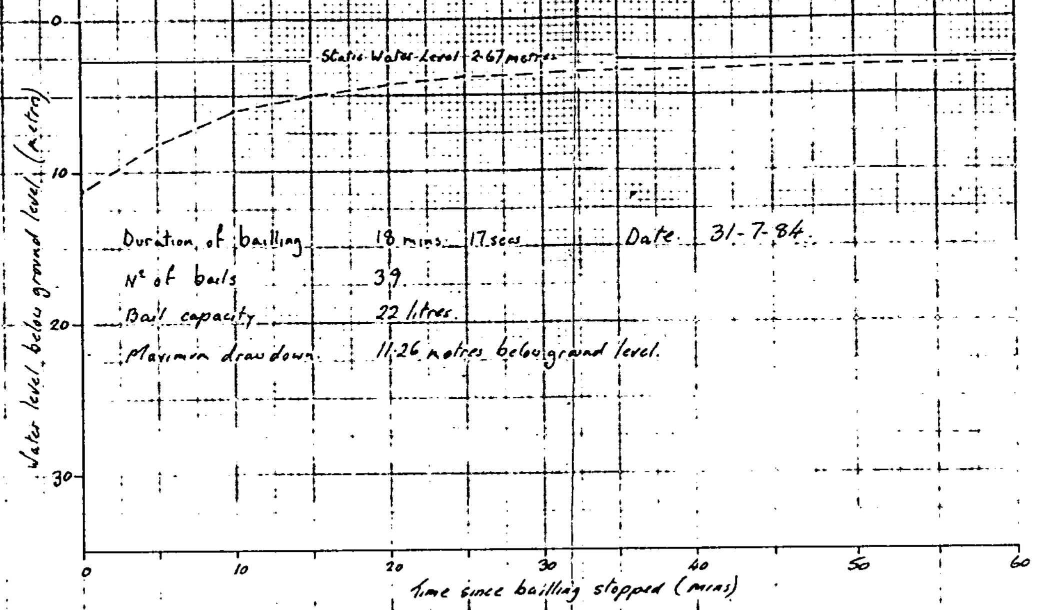
Casing 0 - 6·16 metres 110 mm Ø Blank pvc.
6·16 - 33·81 metres 110 mm Ø Screen pvc.
33·81 - 34·84 metres 110 mm Ø Sump pvc.



Borehole drilled 0 - 35 metres 152 mm Ø cable tool percussion.

Pump set at 28 metres

Recovery data.



Duration of bailling 18 mins 17 secs Date 31-7-84.
Nº of bails 39.
Bail capacity 22 litres.
Maximum drawdown 11·26 metres below ground level.

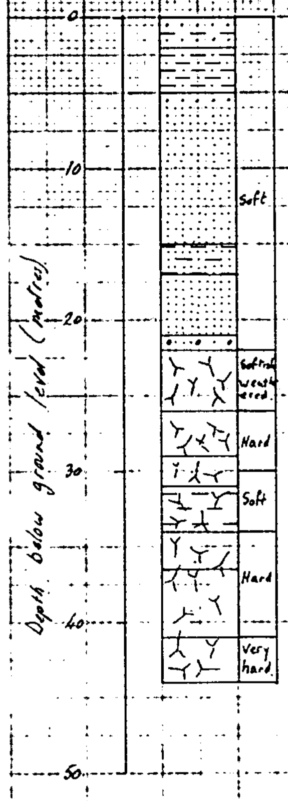
Borehole Nº NZ 7A

Village Nº 6 Nyamazwa

Grid ref 423/201

Elevation 1040 metres (amsl)

Geological Log



Grey medium sand with clay

Light brown sandy clay

Fine grained to medium grained brown sand with black, red and brown grains

Green/grey clayey fine sand.

Brown black fine grained sand. Red/Brown/Black grains.

Medium to coarse green black sand weathered dolerite.

Grey green ashy dolerite.

Dark green black dolerite.

Dark green black dolerite some light green frags chlorite or olivine.

Dark green black dolerite with clay bands.

Light green/black olivine? rich dolerite.
probably chlorite.

Hard black dolerite some chlorite.

Very hard black dolerite.

Hydrogeological Log

Short term pumping test 20-7-84

Drawdown 15-66 metres.

Yield 4.8 m³/day

Temp 24.8°C Cond 275 µS

pH 8.15 HCO₃ 275 ppm

SWL 27.70 m.

FWS 34.0 m.

MS 34-38 m.

WS 40.0 m

Construction Log

Hole drilled 0-44 m 204 mm ø cable tool percussion.

Hole abandoned and back filled.

Bore hole N° NZ73

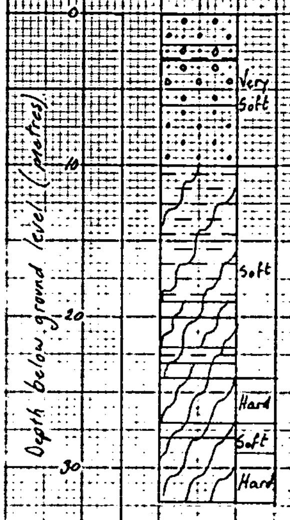
Village N° 6

Nyamazura

Grid ref. 426/197

Elevation 1045 metres (and)

Geological Log



Golden brown medium - coarse angular sand - no clay.
Golden-brown medium - V. coarse clayey sand.
Golden brown medium to very coarse angular to sub-angular sand grit and small pebbles. Some limonite @5-6m.
Golden brown medium to very coarse angular sand of iron stained quartz and white feldspar.
Very weathered white gneiss - brown iron staining medium grained NO mafics, white feldspar.
Orange iron staining reduced with depth.
White-pink coarse grained gneiss no mafics pink feldspar.
White gneiss - white feldspar no mafics. Some pink feldspar 21-22 m.
Weathered white gneiss coarse grained few mafics.
White medium grained gneiss 25% mafics white feldspar.
Very hard white medium grained gneiss. white feldspar - Some pink feldspar. Very few mafics.
White med-coarse gneiss white feldspar no mafics.
Grey fine gneiss white feldspar few mafics. Some orange iron staining.

Hydrogeological Log

Temp	24.2°C
Cond	320 μs
pH	7.35.
H.CO$_3$	200 ppm

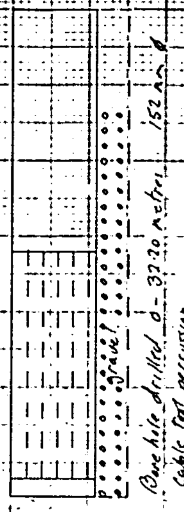
SWL 24.78 metres.

FWS 28.0 metres

WS 29.0 metres.

Construction Log

Casing. 0 - 16 metres 110 mm ø blank pvc
16 - 31 metres 110 mm ø screen pvc
31 - 32.20 metres 110 mm ø sump pvc



Bore hole drilled 0 - 32.20 metres 152 mm ø
Cable tool percussion

Recovery Data

Duration of bailing 30 mins 7 secs Date 10/8/84.

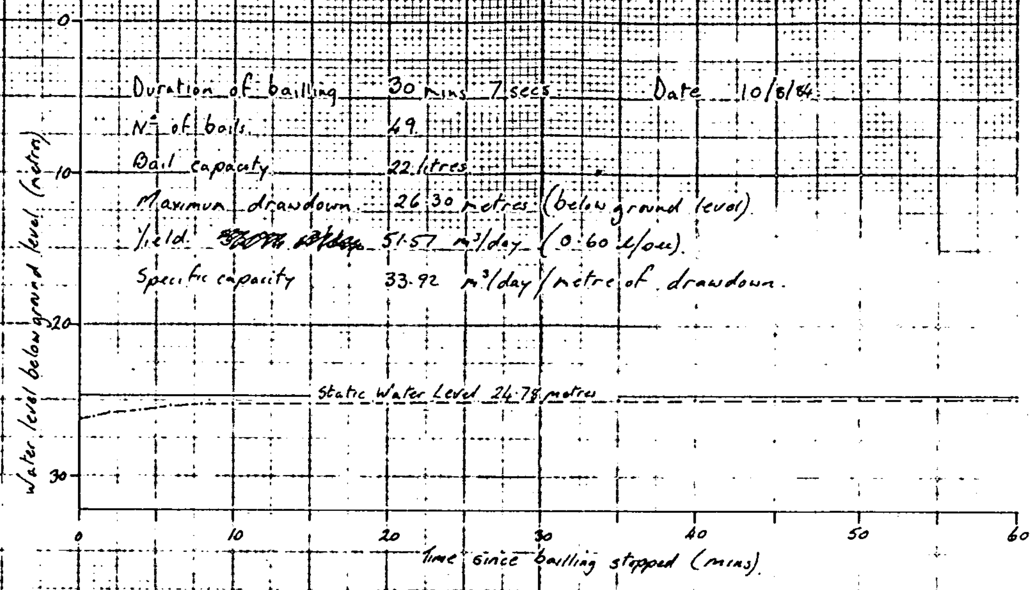
N° of bails 49.

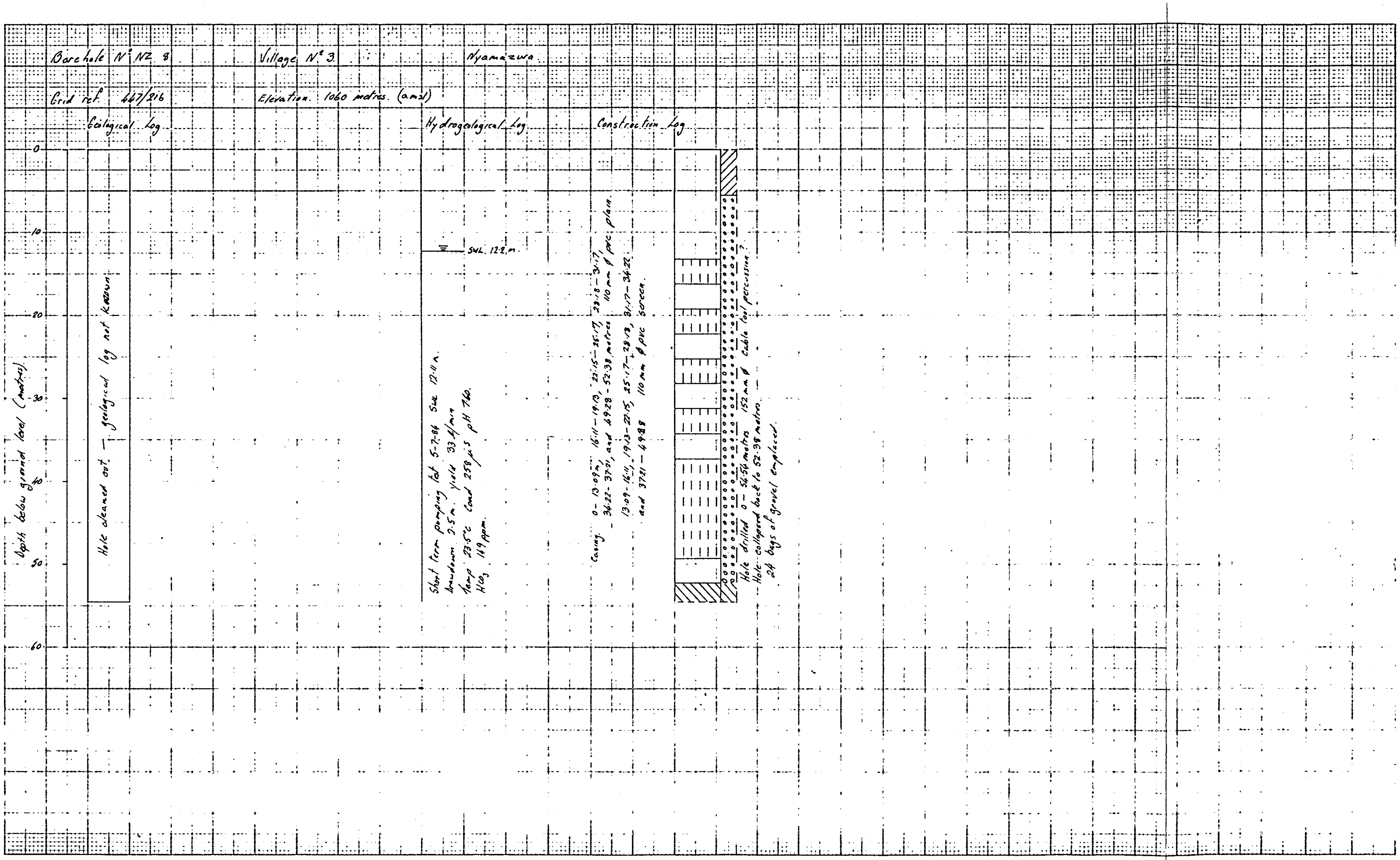
Bail capacity 22 litres

Maximum drawdown 26.30 metres (below ground level)

Yield [illegible] 51.57 m³/day (0.60 l/sec).

Specific capacity 33.92 m³/day/metre of drawdown.





Borehole No NZ 8

Village No 3 Nyamazwa.

Grid ref. 447/216

Elevation. 1060 metres. (amsl)

Hole cleaned out – geological log not known.

Short term pumping test 5-7-86 SWL 12.11 m.
Drawdown 2.5 m. Yield 33 l/min
Temp 23.5°c Cond 258 μS pH 7.60.
HCO3 149 ppm.

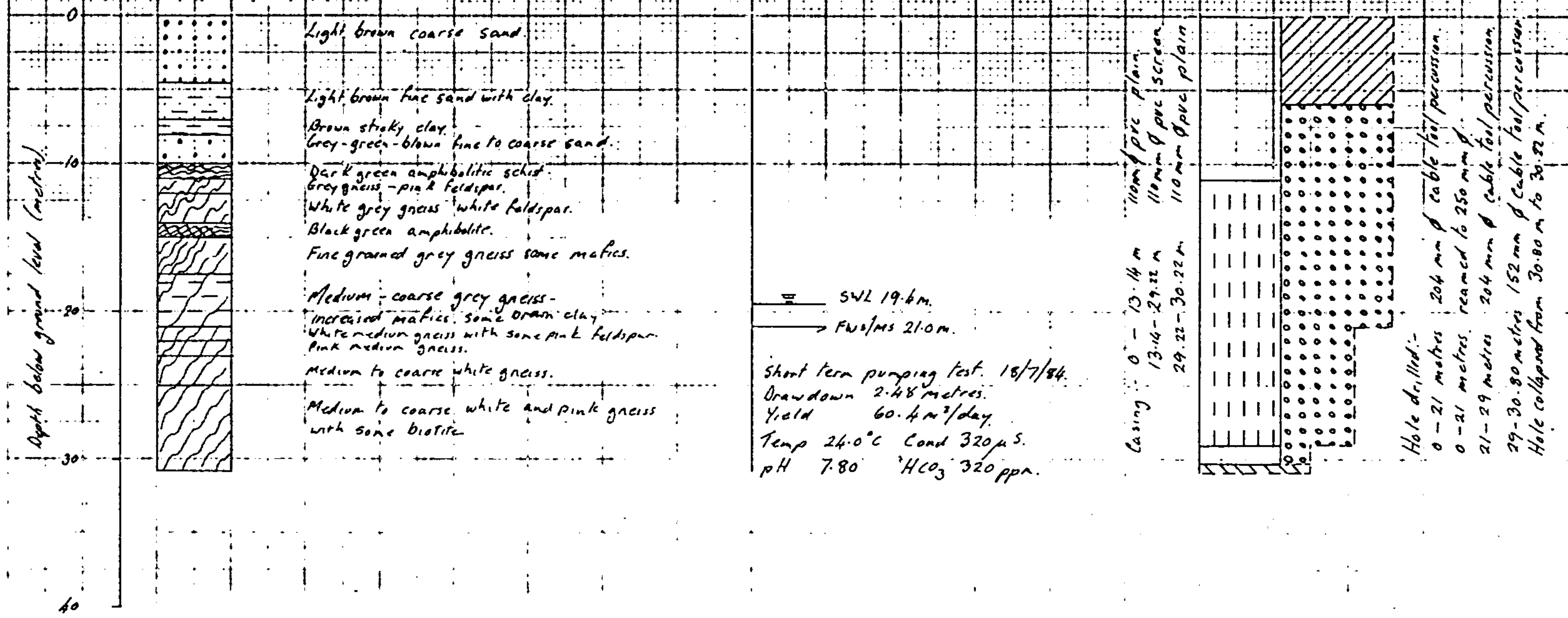
Casing. 0 – 13.09 m, 16.11 – 19.13, 22.15 – 25.17, 28.18 – 31.17,
34.22 – 37.21, and 49.28 – 52.38 metres 110 mm ø pvc plain.
13.09 – 16.11, 19.13 – 22.15, 25.17 – 28.18, 31.17 – 34.22,
and 37.21 – 49.88 110 mm ø pvc screen.

Hole drilled 0 – 54.54 metres 152 mm ø Cable tool percussion?
Hole collapsed back to 52.38 metres.
24 bags of gravel emplaced.

Borehole Nº NZ 9 Village Nº 1A Nyamazura

Grid ref 424/225 Elevation 1045 metres (amsl)

Geological Log Hydrogeological Log Construction Log



Light brown coarse sand.

Light brown fine sand with clay.

Brown sticky clay.

Grey-green-blown fine to coarse sand.

Dark green amphibolitic schist.

Grey gneiss - pink feldspar.

White grey gneiss white feldspar.

Black green amphibolite.

Fine grained grey gneiss some mafics.

Medium - coarse grey gneiss - increased mafics. Some brown clay

White medium gneiss with some pink feldspar.

Pink medium gneiss.

Medium to coarse white gneiss.

Medium to coarse white and pink gneiss with some biotite

SWL 19.6m.

FWS/MS 21.0m.

Short term pumping test. 18/7/84.

Drawdown 2.48 metres.

Yield 60.4 m³/day.

Temp 24.0°C Cond 320 µS.

pH 7.80 HCO₃ 320 ppm.

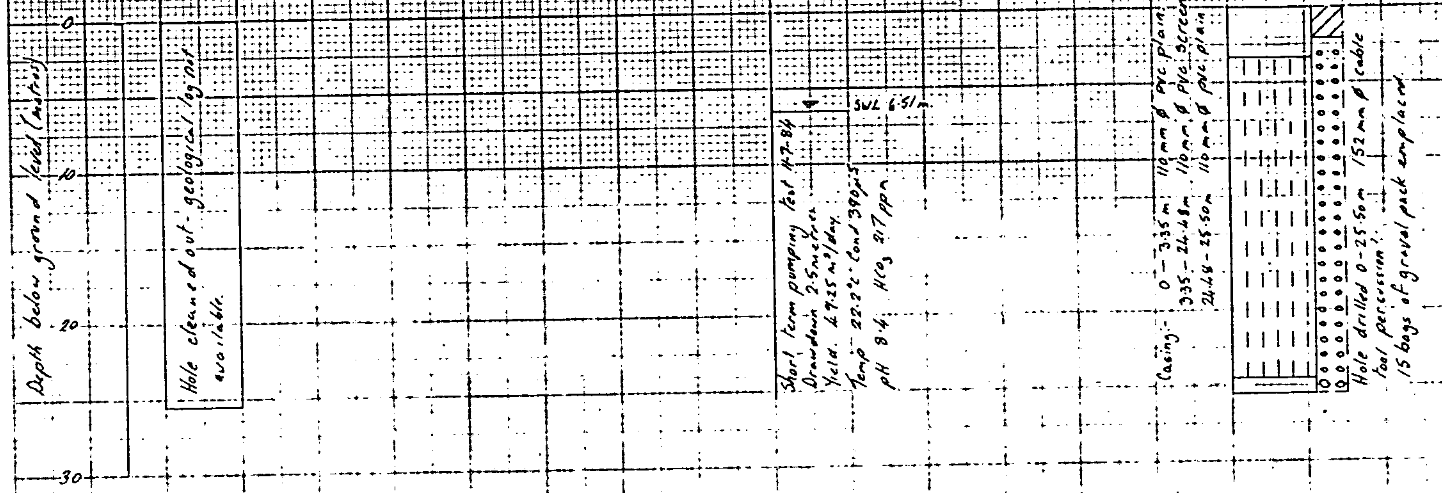
Casing: 0 - 13.14 m 110 mm ø pvc plain.
13.14 - 29.22 m 110 mm ø pvc screen
29.22 - 30.22 m 110 mm ø pvc plain

Hole drilled:-
0 - 21 metres 204 mm ø cable tool percussion.
0 - 21 metres reamed to 250 mm ø.
21 - 29 metres 204 mm ø cable tool percussion.
29 - 30.80 metres 152 mm ø cable tool percussion
Hole collapsed from 30.80 m to 30.72 m.

Borehole Nº NZ10 Village Nº 4 Nyamazora

Grid ref 666/206 Elevation 1035 metres (amsl)

Geological Log Hydrogeological Log Construction Log



Hole cleaned out - geological log not available.

Short term pumping test 11-7-84
Drawdown 2.5 metres
Yield. 49.25 m³/day.
Temp 22.2°C Cond 390 µS
pH 8.4 HCO3 217 ppm

Casing:- 0 – 3.35 m 110 mm Ø pvc plain
3.35 – 24.48 m 110 mm Ø PVC Screen
24.48 – 25.50 m 110 mm Ø pvc plain

Hole drilled 0 – 25.50 m 152 mm Ø cable
tool percussion.
15 bags of gravel pack emplaced

Borehole No NZ4A.

Village No 2

Nyamazura

Grid ref. 465/229

Elevation 1077 metres (amsl)

Geological Log

Hydrogeological Log

Construction Log

Depth below ground level (metres)

0

10

20

30

40

50

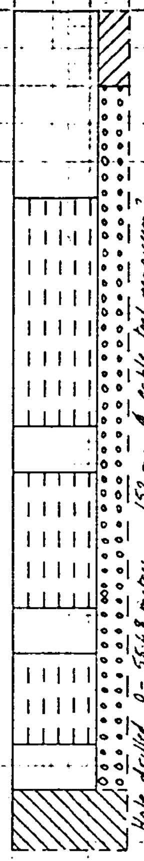
60

Hole cleaned out - Geological Log not available.

SWL 4.19 m.

Short term pumping test 16-7-84.
Drawdown ~ 20.23 metres. Yield ~ 23 m³/day
Temp 22.6°C Cond 325 µS. pH 8.7
HCO₃ 225 ppm.

Casing. 0 - 12.34 m, 27.44 - 30.46 m, 39.50 - 42.47 m and 48.61 - 51.57 m
110 mm ø pvc plain flush joint.
12.34 - 27.44 m, 30.46 - 39.50 m, and 42.47 - 48.61 m
110 mm ø pvc screen flush joint.

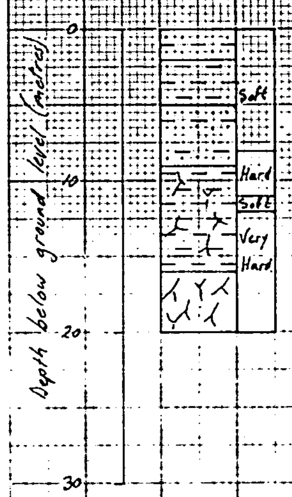


Hole drilled 0 - 55.48 metres. 152 mm ø cable tool percussion?
Hole collapsed back to 51.57 m. after cleaning
Hole abandoned 17/7/84 but left open for possible future use.

Borehole Nº NZ 11 B. Village Nº 2. Nyamazura.

Grid ref. 462/228. Elevation. 1075 metres (amsl.)

Geological Log



Light brown sand clayey in parts.

Light brown clayey sand - Some black brown sand

Dark brown/black medium sand with little clay

Black green weathered dolerite - Some calcite 10-11m, Very weathered 12-13

Hard brown black dolerite.

Hydrogeological Log

SWL 6·10 metres.

→ Fws/mS 11-00 metres.

Temp 26·2°C

Cond. 420µS

pH 8·75.

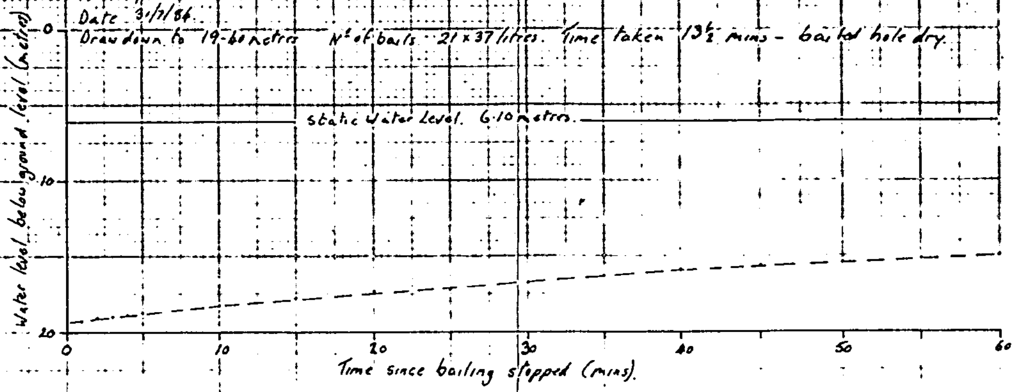
Construction Log.

Borehole drilled 0-20 metres
204 mm ø cable tool percussion

Recovery Data After 30 min Bail Test

Date 31/7/84.

Drawdown to 19·60 metres Nº of bails 21 x 37 litres. Time taken 13½ mins - bailed hole dry.



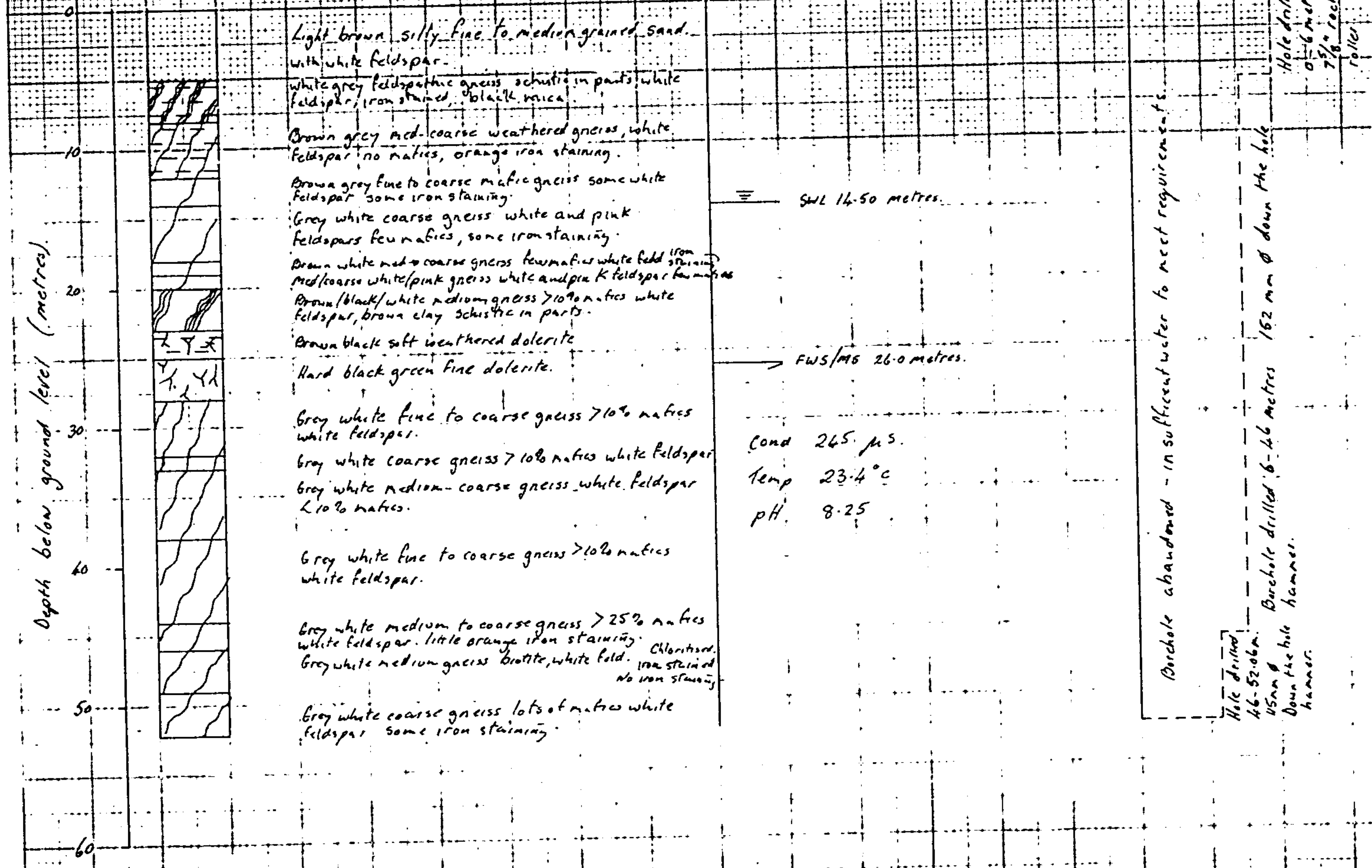
Bore hole N° NZ 12A

Village N° 1B

Nyamazura.

Grid ref. 457/235

Elevation 1057 metres (amsl)



Geological Log

Light brown silty fine to medium grained sand. with white feldspar.

white grey feldspathic gneiss schistic in parts white feldspar, iron stained, black mica

Brown grey med-coarse weathered gneiss, white feldspar no mafics, orange iron staining.

Brown grey fine to coarse mafic gneiss some white feldspar some iron staining.

Grey white coarse gneiss white and pink feldspars few mafics, some iron staining.

Brown white med to coarse gneiss few mafics white feld iron staining

Med/coarse white/pink gneiss white and pink K feldspar few mafics

Brown/black/white medium gneiss >10% mafics white feldspar, brown clay schistic in parts.

Brown black soft weathered dolerite

Hard black green fine dolerite.

Grey white fine to coarse gneiss >10% mafics white feldspar.

Grey white coarse gneiss > 10% mafics white feldspar

Grey white medium-coarse gneiss white feldspar <10% mafics.

Grey white fine to coarse gneiss >10% mafics white feldspar.

Grey white medium to coarse gneiss > 25% mafics white feldspar. little orange iron staining. Chloritised. iron stained

Grey white medium gneiss biotite, white feld. No iron staining

Grey white coarse gneiss lots of mafics white feldspar some iron staining.

Hydrogeological Log

SWL 14.50 metres.

FWS/MS 26.0 metres.

Cond 245 µS.

Temp 23.4 °C

pH. 8.25

Construction Log

Hole drilled 0-6 metres 7 5/8" rock roller

Borehole drilled 6-46 metres 162 mm Ø down the hole hammer.

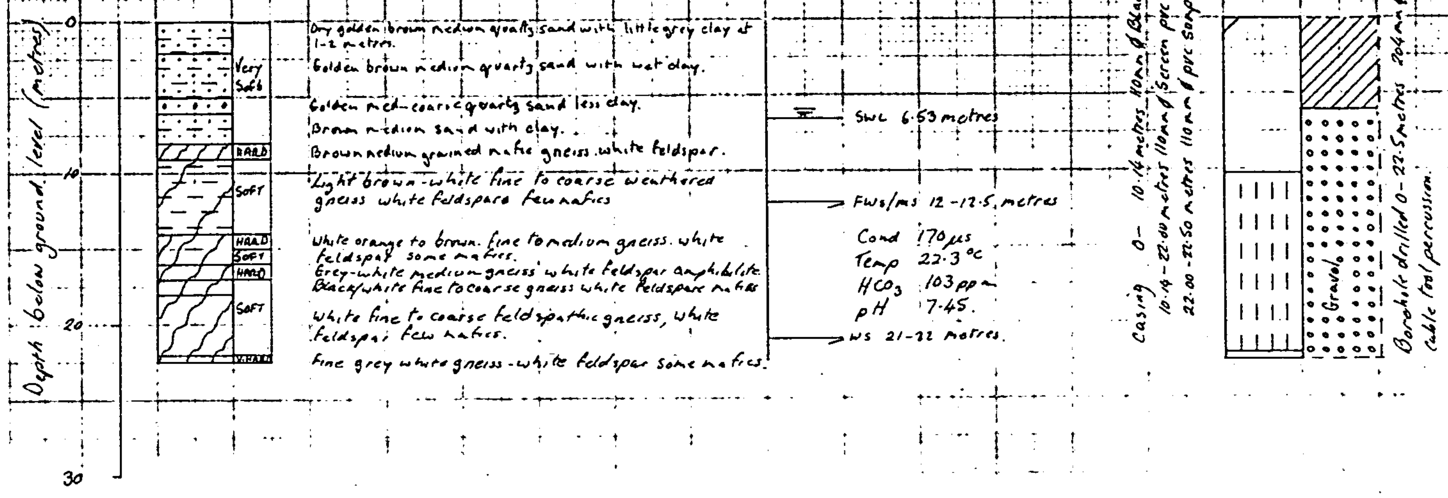
Hole drilled 46-52.06 m. 45 mm Ø Down the hole hammer.

Borehole abandoned - insufficient water to meet requirements.

Borehole Nº NZ12B. Village Nº 1B. Nyamazura.

Grid ref. 459/239 Elevation. 1067 metres (amsl).

Geological Log. Hydrogeological Log. Construction Log.



Dry golden brown medium quartz sand with little grey clay at 1-2 metres.

Golden brown medium quartz sand with wet clay.

Golden med-coarse quartz sand less clay.

Brown medium sand with clay.

Brown medium grained mafic gneiss. white feldspar.

Light brown-white fine to coarse weathered gneiss white feldspars few mafics

White orange to brown. fine to medium gneiss. white feldspar some mafics.

Grey-white medium gneiss white feldspar amphibolite.

Black/white fine to coarse gneiss white feldspars mafics

White fine to coarse feldspathic gneiss, white feldspar few mafics.

Fine grey white gneiss-white feldspar some mafics.

SWL 6.53 metres

FWs/ms 12-12.5 metres

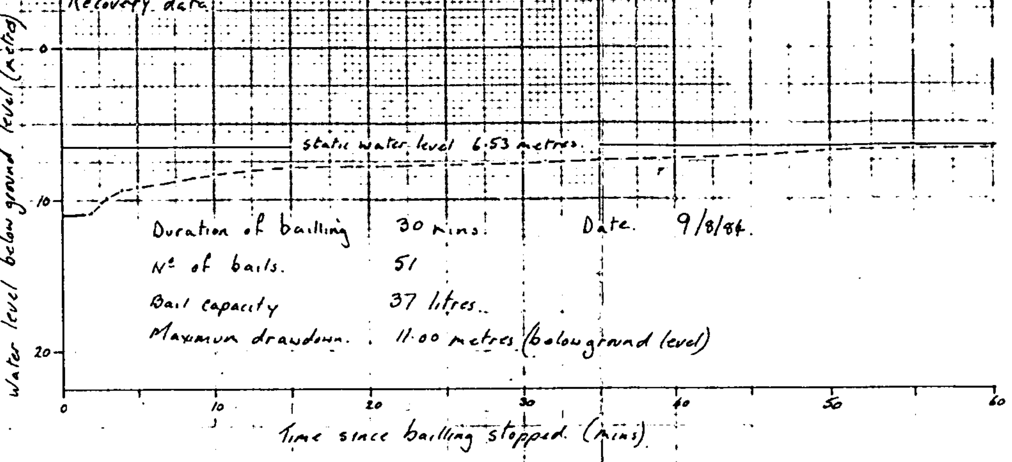
Cond 170µs
Temp 22.3 °C
HCO_3 103ppm
pH 7.45.

WS 21-22 metres.

Casing 0- 10.14 metres 110mm Ø Blank pvc
10.14-22.00 metres 110mm Ø Screen pvc
22.00-22.50 metres 110mm Ø pvc Sump.

Borehole drilled 0-22.5 metres 204mm Ø
cable tool percussion.

Recovery data



Duration of bailling 30 mins. Date. 9/8/84.
Nº of bails. 51
Bail capacity 37 litres.
Maximum drawdown. 11.00 metres (below ground level)

APPENDIX IV

PUMPING TEST DATA

Borehole No.	Village No.
NZ4B	9
NZ5	5
NZ6B	7
NZ7A	6
NZ7B	6
NZ8	3
NZ9	1A
NZ10	4
NZ11A	2
NZ11B	2
NZ12A	1B
NZ12B	1B

Constant Yield Pumping Test

Borehole No NZ 4 (B) Date 27-4-84

Time test started 11-00 am. Pump cylinder @ 19.64m. Reciprocating Pump.

Time (mins)	Water level (metres)	Drawdown (metres)	Yield: per 5 gals	Temp °C	Cond µS	pH			
55.	5.913								
57.	5.915.								
11-00	Pump Test	started.							
00-15	6-11	0-195							
00-30	6-19	0-275							
00-45	6-25	0-345							
1-00	6-33	0-415							
-15	6-40.	0-495							
1-30	6-45	0.535							
2-00	6.56.	0.655							
2-30	6.62	0.715							
3-00	6.67	0.765							
3-30	6-73	0.825							
4-00	6-80	0.895							
30	6-82	0.915							
5-00	6.87	0.965	27 secs.						
	6.91	1.005							
6-00	6.92	1.015							
00	6.99	1.035							
8-00	7.00	1.095							
9-00	7.07	1.165		23.8	420				
10-00	7.10	1.195							
11-30	7.13	1.225							
12-00	7.15	1.245				7.25			
14-00	7.19	1.285							
16-00	7.22	1.315							

Constant Yield Test (Cont) Borehole Nº NZ4(B).

e (ns)	Waterlevel (Metres)	Drawdown (metres)	Yield Secs per 5gals	Temp °C	Cond µS	pH.
-00	7.23	1.325				
-00	7.28	1.375	25½			
-00	7.34	1.435				
-00	7.37	1.465	26	23.7	420	7.45
35-00	7.42	1.515				
40-00	7.445	1.54				
45-00	7.48	1.575				
50-00	7.50	1.595				
55-00	7.52	1.615				
60-00	7.53	1.625	25	23.8	420	7.25
80-00	7.59	1.685				
9-00	7.61	1.705	25	23.8	420	7.25
-00	7.65	1.745				
-00	7.68	1.775	25	23.8	420	7.35
-00	7.71	1.805	25	23.6	420	7.45
-00	7.74	1.835	26	23.6	420	7.45
-00	7.78	1.875	25½	23.6	420	7.45
240-00	7.79	1.885	25	23.6	420	7.45
270-00	7.81	1.905	26	23.6	420	7.45
300-00	7.83	1.925	26	23.6	415	7.45
330-00	7.85	1.945	25	23.6	415	7.50
60-00	7.86	1.955				

Pumping test stopped at 17-00

Recovery Pumping Test.

Borehole Nº NZ4(B). Date 27-4-84.

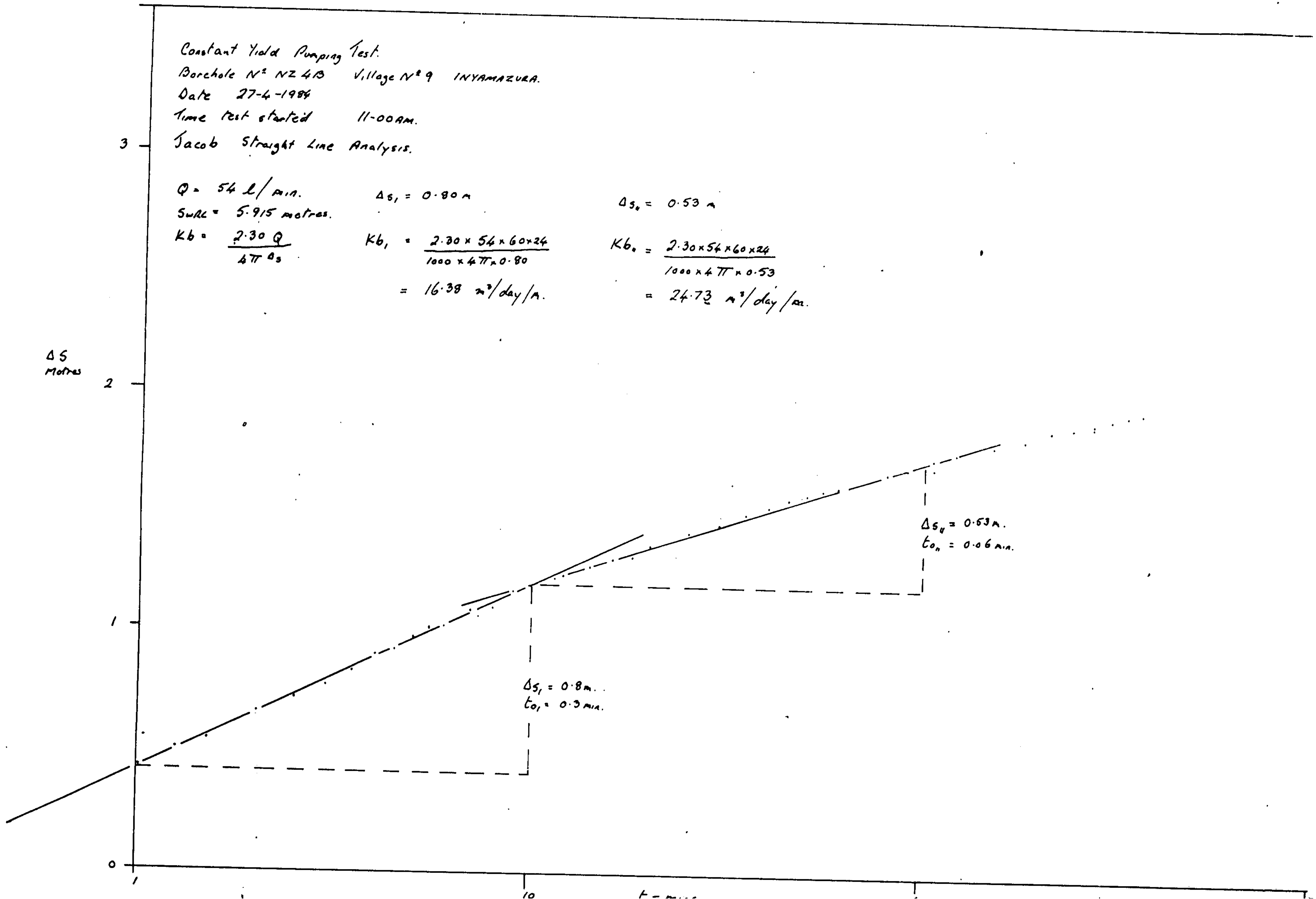
Time test started - 11-00 pump stopped at 17-00.

Pump Cylinder At 19-64 m bgl. Static water rest level before test 5.915 metres.

Maximum water level when pump stopped 7.86 metres below ref. point (1.945m)

Ref point - top of pvc casing 10 cms agl.

me since stopped mins)	Water level (metres.)	S-S' Recovery (metres)	Residual Drawdown (metres)	t/t'	Time since pump stopped (mins)	Water level (metres)	S-S' Recovery (metres)	Residual Drawdown (metres)	t/t'
0-15	7.72	0.14	1.805	1441	20-00	6.55	1.31	0.635	19
0-30	7.68	0.18	1.765	721	25-00	6.51	1.35	0.595	15.4
0-45	7.48	0.38	1.565	481.	30-00	6.48	1.38	0.565	13
1-00	7.37	0.49	1.455	361.	35-00	6.455	1.405	0.54	11.3
1-30	7.22	0.64	1.305	241	40-00	6.43	1.43	0.515	10
2-00	7.09	0.77	1.175	181	45-00	6.41	1.45	0.495	9
2-30	7.00	0.86	1.085	145	50-00	6.39	1.47	0.475	8.2
3-00	6.94	0.92	1.025	121	55-00	6.375	1.485	0.46	7.5
-30	6.90	0.96	0.985	103.9	60-00	6.36.	1.50	0.4485	7.
-00	6.87	0.99	0.955	91	Measurements stopped at 60 mins (18-00).				
-30	6.84	1.02	0.925	81					
00	6.82	1.04	0.905	73					
-00	6.78	1.08	0.865	61					
-00	6.74	1.12	0.825	52.4					
-00	6.72	1.14	0.805	46.					
-00	6.70	1.16	0.785	41					
10-00	6.68	1.18	0.765	37					
12-00	6.64	1.22	0.725	31					
14-00	6.615	1.245	0.695	26.7					
16-00	6.591	1.269	0.676	23.5					
18-00	6.57	1.29	0.655	21					



Constant Yield Pumping Test.

Borehole Nº NZ 4B Village Nº 9 INYAMAZURA.

Date 27-4-1984

Time test started 11-00AM.

Jacob Straight Line Analysis.

Q = 54 ℓ/min.

SWRL = 5.915 metres.

$Kb = \frac{2.30\,Q}{4\pi\,\Delta s}$

$\Delta s_1 = 0.80\,m$

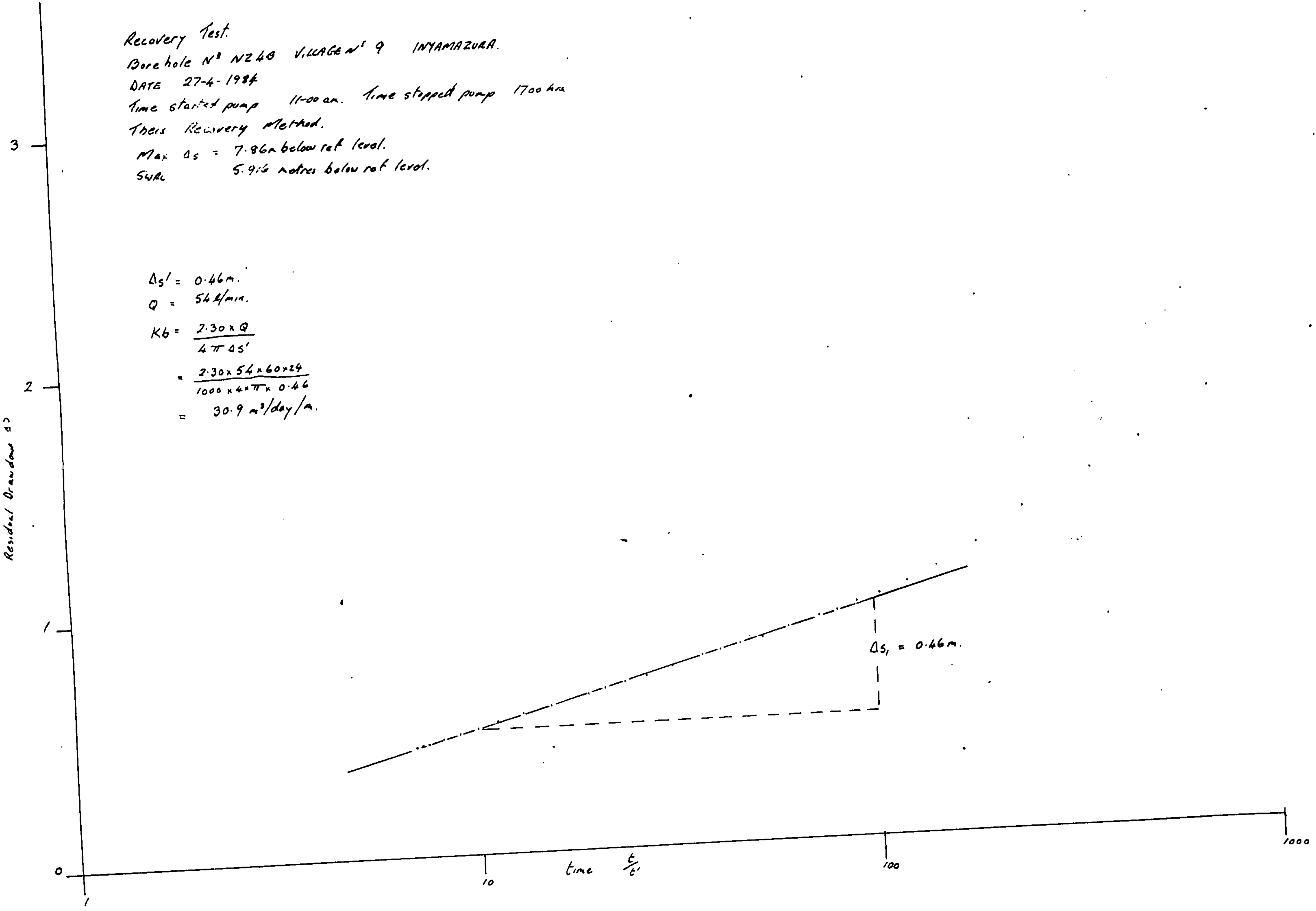
$Kb_1 = \frac{2.30 \times 54 \times 60 \times 24}{1000 \times 4\pi \times 0.80}$

$= 16.38\ m^3/day/m.$

$\Delta s_n = 0.53\,m$

$Kb_n = \frac{2.30 \times 54 \times 60 \times 24}{1000 \times 4\pi \times 0.53}$

$= 24.73\ m^3/day/m.$



Recovery Test.

Bore hole Nº NZ40 VILLAGE Nº 9 INYAMAZURA.

DATE 27-4-1984

Time started pump 11-00 am. Time stopped pump 1700 hrs

Theis Recovery Method.

Max Δs = 7.86m below ref level.

SWL 5.916 metres below ref level.

$\Delta s' = 0.46m.$

$Q = 54 \ell/min.$

$$Kb = \frac{2.30 \times Q}{4\pi \Delta s'}$$

$$= \frac{2.30 \times 54 \times 60 \times 24}{1000 \times 4 \times \pi \times 0.46}$$

$$= 30.9 \ m^3/day/m.$$

Constant Yield Pumping Test.

Borehole N° NZ5. VILLAGE 5 IN YAMAZURA.

DATE 2-7-84.

Time Test Started 13-00 hrs.

Pump cylinder ~ 24 metres below ref. point.

Ref point top of casing 0·60 m above ground level.

Pump used - Dando operated single action reciprocating pump.

me	SWRL (m)	
11-54	3·665 m.	— before pump erected.
12-50	3·965	water level still recovering after 5 minute yield test to set pump yield.
12-53	3·920	
12-55	3·89	
12-57	3·88	

me (mins)	SWL (m)	D.D. (m)	Yield secs/5gal	Temp °C	Cond µS	pH
00-15	5·52	1·855				
00-30	6·22	2·555				
01-00	7·00	3·335	34·5	24·0	260	7·15
1-15	7·48	3·815				
1-30	8·02	4·355	32	24·0	240	
2-30	8·89	5·225	32	23·8	240	
3-00	9·31	5·645				
3-30	9·62	5·955				
4-00	9·68	6·015				
4-30	9·66	5·995				
5-00	9·73	6·065				
6-00	9·78	6·115				
7-00	9·96	6·295				
8-00	10·46	6·795				
9-00	10·98	7·215				

Constant Yield Test (Cont) Borehole Nº NZ5 Village Nº 6

TIME	W.L.	D.D.	YIELD	Temp.	Cond	pH.
10-00	11.56	7.895	32			
12-00	12-30	8.635				
14-00	12.87	9.105				
16-00	13-37	9.605				
18-00	13.76	10.095				
20-00	14.04	10.375				
25-00	14.59	10.825	32	23.8	240	7.25
30-00	15.08	11.315	32			
35-00	15.62	11.955	31			
40-00	16.00	12.335				
45-00	16.46	12.795	32			
50-00	16.76	13.095				
55-00	17.10	13.435	33	24	230	7.3
60-00	17.25	13.585	32			
74-00	17.80	14.135	32	24	230	7.45
80-00	Dipper could not pass		32			
90-00	beyond 17.80 metres —		32			
100-00	pipe socket in the way.		32	24	230	7.45
1100	Continued to measure		32			
120-00	yield until that declined		33			
125-00	and then stabalised —		34			
130-00	took this to be an		34.5			
135	indication of a steady		~~3~~ 35.5			
140	state yield?		35			
145			36			
150			36			
155			36.5			
160			36.75			

Time(mins)	Yield secs/5gal.	(Continued)
165	36.5	
170	36.5	
175	36.5	
180	Test pump stopped	

Recovery Test.

Borehole N^o NZ5 Village N^o 5 INYAMAZURA. Date 2-7-84.

Borehole diameter 110 mm ø. Raising Main. 2" ø C-I s/s pipe.

No water leakage from foot valve.

Time pump test started 13-00 hrs.

Time pump stopped 16-00 hrs.

Pump cylinder at 24 metres below ref point.

Static water level before start of test. 3·665 metres (b ref point)

Maximum water level when pump stopped 20-22 metres. (brp)

e since ump stopped: (Mins)	Water level. (metres)	Recovery (S,-S,) (Metres)	Residual draw-down: (Metres)	Time since test started / Time since pump stopped.		t/t_1
				~~1441~~	~~721~~	
00 - 15	17-80		14.135	~~1441~~	~~361~~	721
00 - 30	16-88		13.215	~~721~~	~~241~~	361
00 - 45	16-00		12.335	~~481~~	~~181~~	241
1-00	15-50		11.835	~~361~~	~~145~~	181
1-15	14-75		11.085	~~289~~	~~121~~	145
1-30	14-26		10.595	~~241~~	~~103.9~~	121
1-45	13-80		10.135	~~206.7~~	~~91~~	103.9
2-00	13-00		9.335	~~181~~	~~73~~	91
2-30	12-10		8.435	~~145~~	~~61~~	73
3-00	11-20		7.535	~~121~~	~~52.4~~	61
3-30	10-50		6.835	~~103.9~~	~~46~~	52.4
4-00	9-95		6.285	~~91~~	~~41~~	46
4-30	9-50		5.835	~~81~~	~~37~~	41
5-00	9-10		5.435	~~73~~	~~31~~	37
6	8-50		4.835	~~61~~	~~26.7~~	31
7	8-11		4.445	~~52.4~~	~~23.5~~	26.7
8	7-83		4.165	~~46~~	~~21~~	23.5
9	7-62		3.955	~~41~~	~~19.~~	21.

Recovery Test (conts) B/H Nº N.Z5 Village Nº 5. Date 2-7-84

ime since p stopped. (mins)	Water level (Metres)	Recovery (s-s') (Metres)	Residual Drawdown. (Metres)	t/t'.	
10	7.43		3.765	~~39~~	19
12	7.16		3.495	~~36~~	16
14	6.94		3.275	~~26.7~~	13.9
16	6.75		3.085	~~23.5~~	12.25
18	6.60		2.935	~~21~~	11
20	6.48		2.815	~~19~~	10
25	6.22		2.555	~~15.4~~	8.2
30	6.04		2.375	~~13~~	7
35	5.80		2.135	~~11.3~~	6.1
40	5.62		1.955	~~10~~	5.5
45	5.50		1.835	~~9~~	5
50	5.41		1.745	~~8.2~~	4.6
55	5.32		1.655	~~7.5~~	4.3
60	5.25		1.585	~~7.0~~	4

End of measurements.

20.22
3.665
16565

Q = 47.3 m³/day

Recovery Test   Borehole N° NZ 5   Village N° 5   INYAMAZURA
Date 2-7-84   Theis Recovery Method.
Time pump started   13-00
Time pump stopped.   16-00
Maximum Drawdown   ~ 20-00 metres.
SWRL   3·665 metres.
Q = 48 m³/day.

$$Kb = \frac{2\cdot30 \times Q}{4\pi \Delta s'}$$

for $\Delta s' = 3\cdot4$ m

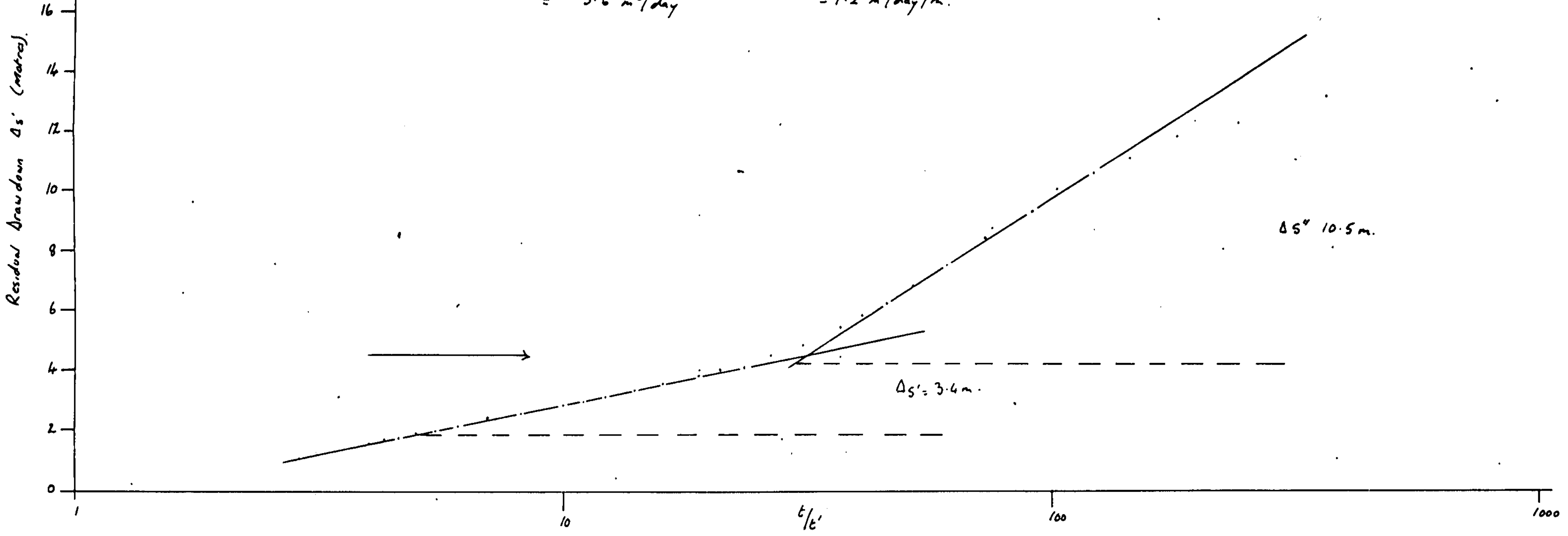
$$Kb' = \frac{2\cdot30 \times 48}{4\pi\, 3\cdot4}$$

$= 3\cdot6$ m²/day

for $\Delta s'' = 10\cdot5$ m.

$$Kb'' = \frac{2\cdot30 \times 48}{4\pi \times 10\cdot5}$$

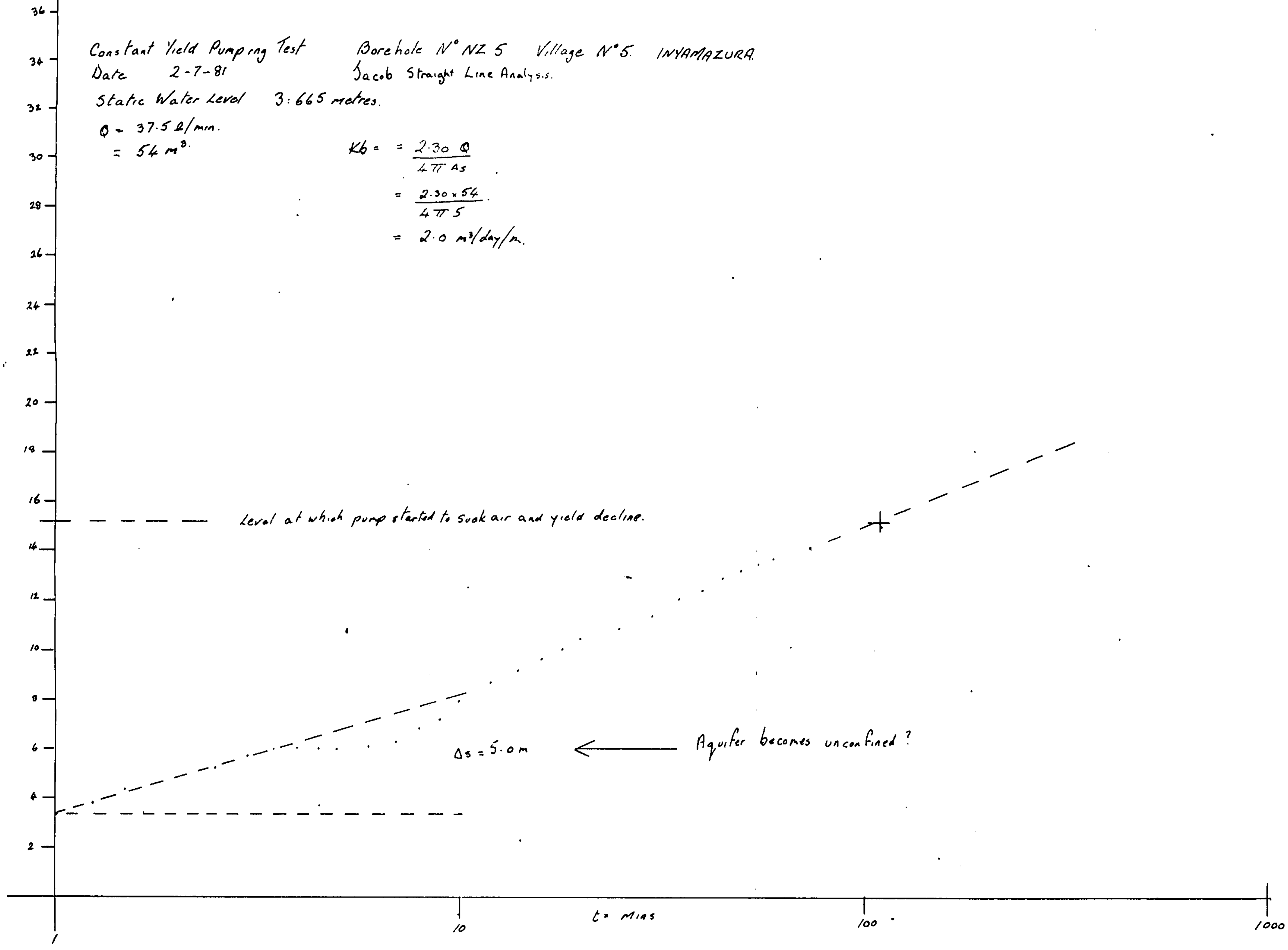
$= 1\cdot2$ m²/day/m.



Constant Yield Pumping Test Borehole N° NZ 5 Village N° 5. INYAMAZURA.
Date 2-7-81 Jacob Straight Line Analysis.
Static Water Level 3:665 metres.

$Q = 37.5\ \ell/min.$
$= 54\ m^3.$

$$Kb = \frac{2.30\ Q}{4\pi\ \Delta s}$$
$$= \frac{2.30 \times 54}{4\pi\ 5}$$
$$= 2.0\ m^3/day/m.$$



Constant Yield Pumping Test.

Borehole No NZ6B. Village No 7 Nyamazura. 2-8-84.

Time Test Started. 11-30 am.

Pump Cylinder Depth. 31-82 metres.

Ref point - 0·15 m. agl.

Pump used - Dando operated single action reciprocating pump.

Time	Rest Water Level (metres below ref point)
7-00 am.	2·82
11-05	3-07
11-10	3-05
11-15	3-03
11-20	3-02
11-25.	3-00
11-29	2-99.

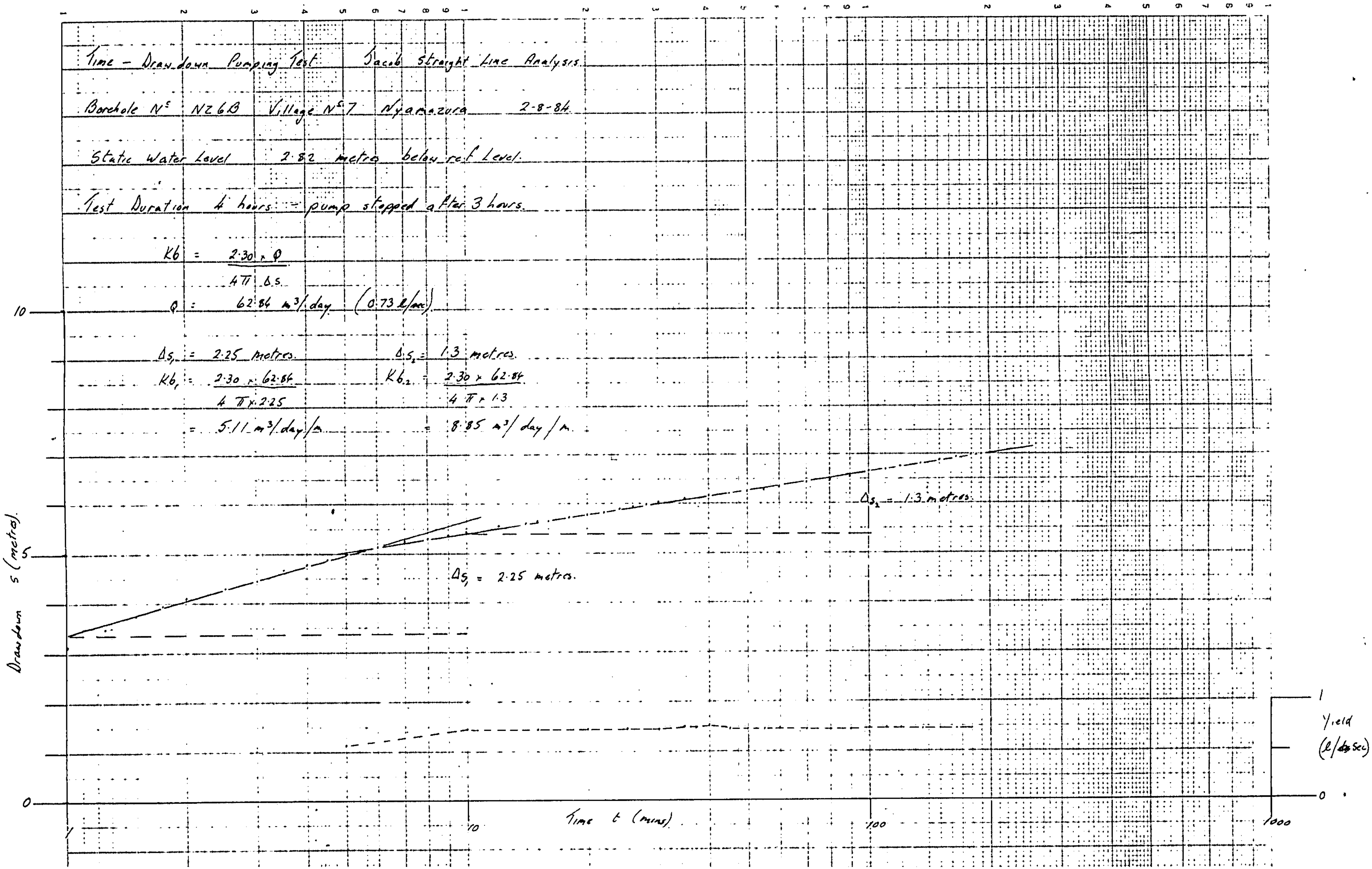
Time (mins)	Water Level (metres)	Drawdown (metres)	Yield (Secs/20l)	~~Yield~~ Temp. (°C)	Conductivity μs	pH.
0-15	4-23	1-41				
0-30	4-85	2-03				
0-45	5-56	2-74				
1-00	5-95	3-13				
1-15	6-30	3-48				
1-30.	6-58	3-76				
1-45	6-76	3-94				
2	6-92	4-10				
2-30	7-12	4-30				
3	7-28	4-46				
3-30	7-50	4-68				
4	7-60.	4-78				
4-30	7-70	4-88				

onstant Yield Pumping Test. Borehole N° NZ6B Village N° 7 2-8-84 (cont'd).

ime (mins)	Water Level. (metres)	Drawdown. (metres)	Yield (Secs/20 l)	Temp (°C)	Conductivity µS.	pH —
5	7-80	4-98	32-3	23.2	360	6-65
6	7-96	5-14				
7	8-05	5-23				
8	8-12	5-30				
9	8-19	5-37				
10	8-25	5-43	27-3	23.2	390	7-35
12	8-37	5-55				
14	8-43	5-61				
15	8-46	5-65	27-4	23.2	390	7-45
16	8-485	5-665				
18	8.54	5-72				
20	8-60	5-78	27.5	23.2	390	7-55
22	8-655	5-835				
24	8-72	5-90	27.4	23.2	390	7-55
26	8-76	5-94				
28	8-79	5-97				
30	8-84	6-02	27-3	23.2	390	7-55
35	8-94	6-12		23.2		
40	8-99	6-17	26-5	23.2	390	7-60
45	9-03	6-21	27-5	23.2		
50	9-08	6-26	27-3	23.2	400	7.60
55	9-11	6-29	27-5	23.2	390	7.55
60	9-16	6-34	27-1	23.2	400	7.60
70	9-24	6-42	27-5	23.2	390	7-35
80	9-29	6-47	27-5	23.2	410	7-35
90	9-38	6-56	27-5	23.2	380	7-35
100	9-46	6-64	27-0	23.2	400	7-35

Constant Yield Pumping Test. Borehole Nº NZ6B Village Nº 7 2-8-84 (contd)

Time (mins)	Water Level (metres)	Drawdown (metres)	Yield Secs/20l	Temp (°C)	Conductivity µS	pH —
110	9-51	6-69	26-9	23-2.	390	7-40
120	9-575	6-755	27-0	23-2	400	7-45
135	9-63	6-81	27-2	23-2	390	7-30
150	9-70	6-88	27-4	23-2	390	7-40
165	9-76	6-94	27-0	23-2.	400	7-45
177½	9-78	6-96				
179	9-80	6-98				
180	9-81.	6-99.	27-3.	23-2	400	7-45.
HCO_3	166 ppm					



Time - Drawdown Pumping Test   Jacob Straight Line Analysis.

Borehole N^o NZ6B   Village N^o 7   Nyamazura   2-8-84.

Static Water Level   2.82 metres below ref Level.

Test Duration 4 hours - pump stopped after 3 hours.

$$Kb = \frac{2.30 \times Q}{4\pi\ \Delta s}$$

Q : 62.84 m³/day (0.73 l/sec)

Δs_1 = 2.25 metres.

$$Kb_1 = \frac{2.30 \times 62.84}{4\pi \times 2.25}$$

= 5.11 m³/day/m

Δs_2 = 1.3 metres.

$$Kb_2 = \frac{2.30 \times 62.84}{4\pi \times 1.3}$$

= 8.85 m³/day/m.

Recovery Test.

Borehole No NZ6B Village No 7 Nyamazura 2-8-84

Pump Cylinder Depth 31-82 metres.

Rest Water Level 2-82 metres below ref point.

Ref. Point 0-15 metres above ground level.

Pump used - Dando operated single action reciprocating pump.

Maximum drawdown. 6-99 metres.

Yield 0.73 l/sec. 62.84 m³/day

me since p stopped (mins.)	Water Level. (metres)	Residual Drawdown. (metres)	Recovery (metres)	t/t' —
0-15	9-09	6-42	0-57	721
-30	8-40	5-58	1-41	361
-45	7-80	4-98	2-01	241
1-00	7-23	4-41	2-58	181
-15	6-70	3-88	3-11	145
1-30	6-17	3-41	3-58	121
1-45	5-77	2-95	4-04	103.9
2	5-49	2-57	4-42	91
2-30	5-10	2-28	4-71	73
3	4-92	2-10	4-89	61
3-30	4-76	1-96	5-03	52-4
4	4-63	1-81	5-18	46
4-30	4-52	1-70	5-29	41
5	4-44	1-62	5-37	37
6	4-26	144	5-55	31
7	4-09	1-27	5-72	26.7
8	4-00	1-18	5-81	23-5
9	3-945	1-125	5-865	21
10	3-89	1-07	5-92	19

Recovery Test. Borehole N° NZ 6B. Village N° 7 Nyamazura 2-8-84. (Cont'd)

me since ump stopped. (mins)	Water Level. (metres)	Residual Drawdown (metres)	Recovery (metres)	t/t''
12	3-815	0-995	5-995	16
14	3-76	0-96	6-03	13-9
16	3-72	0-90	6-09	12-3
18	3-69	0-83	6-16	11
20	3-73	0-91	6-08	10
21	3-745	0-925	6-065	9-6
22	3-725	0-905	6-085	9-2
23	3-695	0-875	6-115	8-8
24	3-67	0-85	6-14	8-5
26	3-62	0-80	6-19	7-9
28	3-585	0-765	6-225	74
30	3-55	0-73	6-26	7
35	3-48	0-66	6-33	6-1
40	3-43	0-61	6-38	5-5
45	3-38	0-56	6-43	5
50	3-33	0-51	6-48	4-6
55	3-30	0-48	6-51	4-27
60	3-27	0-45	6-54	4

Bail Test.

Borehole N° NZ6B. Village N° 7. Nyamazura 31-7-84.

Rest water level. 2-80 metres. below ground level.

Capacity of bailer 22 litres.

N° of Bails. 39.

Time taken. 18 mins 17 secs.

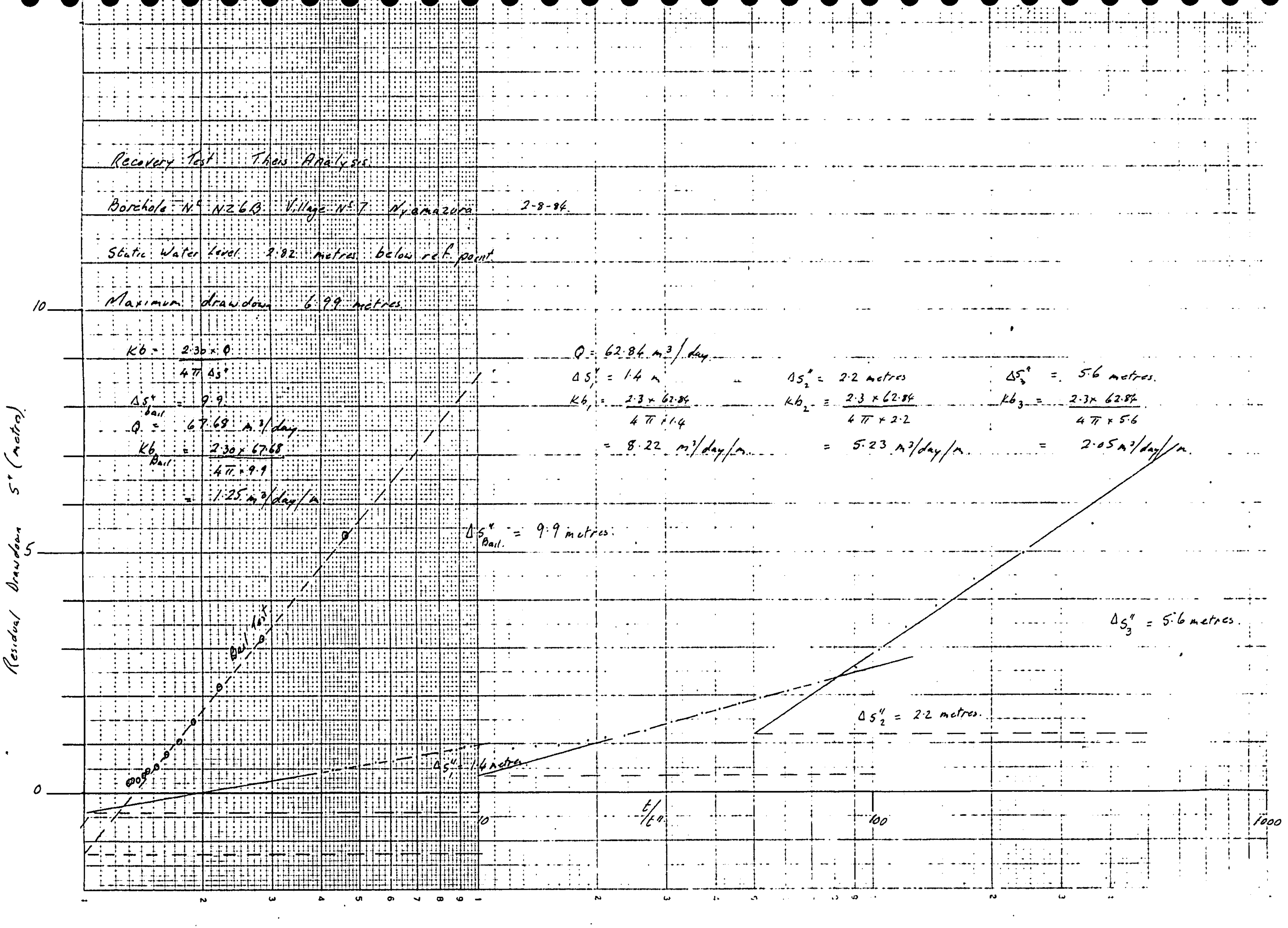
Drawdown. 11-26 metres (5-46 metres)

Amount of water bailed. 858 litres

Average yield. 47.0 l/min (0.78 l/sec)

Recovery

me after ing stopped (ins)	Water Level (metres)	Residual Drawdown (metres)	Recovery. (metres)	t/t"
5	8-15	5-35	0-11	4-65
10	6-00	3-20	2-26	2-825
15	5-00	2-20	3-26	2.22
20	4-28	1-48	3-98	1.9
25	3-84	1-04	4-42	1.73
30	3-60	0-80	4-66	1.61
35	3-36	0-56	4-90	1.52
40	3-25	0-45	5-01	1.46
45	3-16	0-36	5-10	1.41
50	3-08	0-28	5-18	1.37
55	3-04	0-24	5-22	1.33
60	3-00	0-20	5-26	1.30



Recovery Test Theis Analysis.

Borehole Nº NZ6B Village Nº 7 Nyamazura 2-8-84.

Static Water Level 2.82 metres below ref. point.

Maximum drawdown 6.99 metres.

$Kb = \frac{2.30 \times Q}{4\pi\ \Delta s'}$

$\Delta s'_{bail} = 9.9$

$Q = 67.68\ m^3/day$

$Kb_{Bail} = \frac{2.30 \times 67.68}{4\pi \times 9.9}$

$= 1.25\ m^3/day/m$

$Q = 62.84\ m^3/day$

$\Delta s'_1 = 1.4\ m$

$Kb_1 = \frac{2.3 \times 62.84}{4\pi \times 1.4}$

$= 8.22\ m^3/day/m$

$\Delta s''_2 = 2.2$ metres

$Kb_2 = \frac{2.3 \times 62.84}{4\pi \times 2.2}$

$= 5.23\ m^3/day/m$

$\Delta s''_3 = 5.6$ metres.

$Kb_3 = \frac{2.3 \times 62.84}{4\pi \times 5.6}$

$= 2.05\ m^3/day/m$

Constant Yield Pumping Test.

Borehole Nº NZ 7A. Village Nº 6. NYAMAZURA.

Date 20-7-84.

Time test started 10-30 Am.

Pump Cylinder Depth ~ 43 metres.

Ref point 10 cms agl.

Pump used - Dando operated single action reciprocating pump.

Time	SWRL (metres)	
10-19	27-77	Waterproducing zones. :-
10-26	27-77	34 - 38 metres.
10-29.	27-77.	40 metres.

Hole diamet~~s~~er 204 mm (8")

Time (Mins)	WaterLevel (metres)	Drawdown (metres)	Yield. (Secs/20l.)	Temperature (°C)	Conductivity µs.	pH.
0-15	27-90	0.13				
0-30	27-98	0.21				
0-45	27-09	0.32				
1-00	28-~~2~~22.	0.45				
1-15	28-39	0.62				
1-30	28-54	0.77				
1-45	28-67	0.90				
2-00	28-82	1.05				
2-30	29-10	1.33				
3-00	29-51	1.74				
-30	29-92	2.15				
-00	30-26	2.49				
-30	30-69	2.82				
5 00	31-13	3.36				
	32-03	4.26				

Constant Yield Test — Borehole Nº NZ 7 Village Nº 6 NYAMAZURA 20-7-84 (Cont'd)

Time (mins)	Water level (metres)	Drawdown (metres)	Yield (Secs/20 l)	Temperature (°C)	Conductivity µs	pH
7	32-81	5·04				
8	33-31	5·54				
9	33-68	5·91				
10	34-06	6·29				
11	34-55	6·78				
12	35-02	7·25				
14	36-00	8·23				
16	36-82	9·05				
18	38-24	10·47				
20	41-05	13·28				
2	43-43	15·66				
4.	43-43.	15·66.				

Pump stated sucking air @ 43-43 after 22 minutes of pumping. Yield dropped dramatically. Most of water produced during test was taken directly from storage within the 8" ϕ well.

Recovery Test.

Borehole N° NZ 7 Village N° 6. NYAMAZURA.

Date 20-7-84

Time test started - 10-30 hrs.

Time pump stopped 11-30 hrs.

Pump cylinder at ~ 43 metres below g l.

Rest water level. 27-77 metres.

Ref point ; 10 cms' a gl.

Maximum drawdown experienced. 15-66 metres.

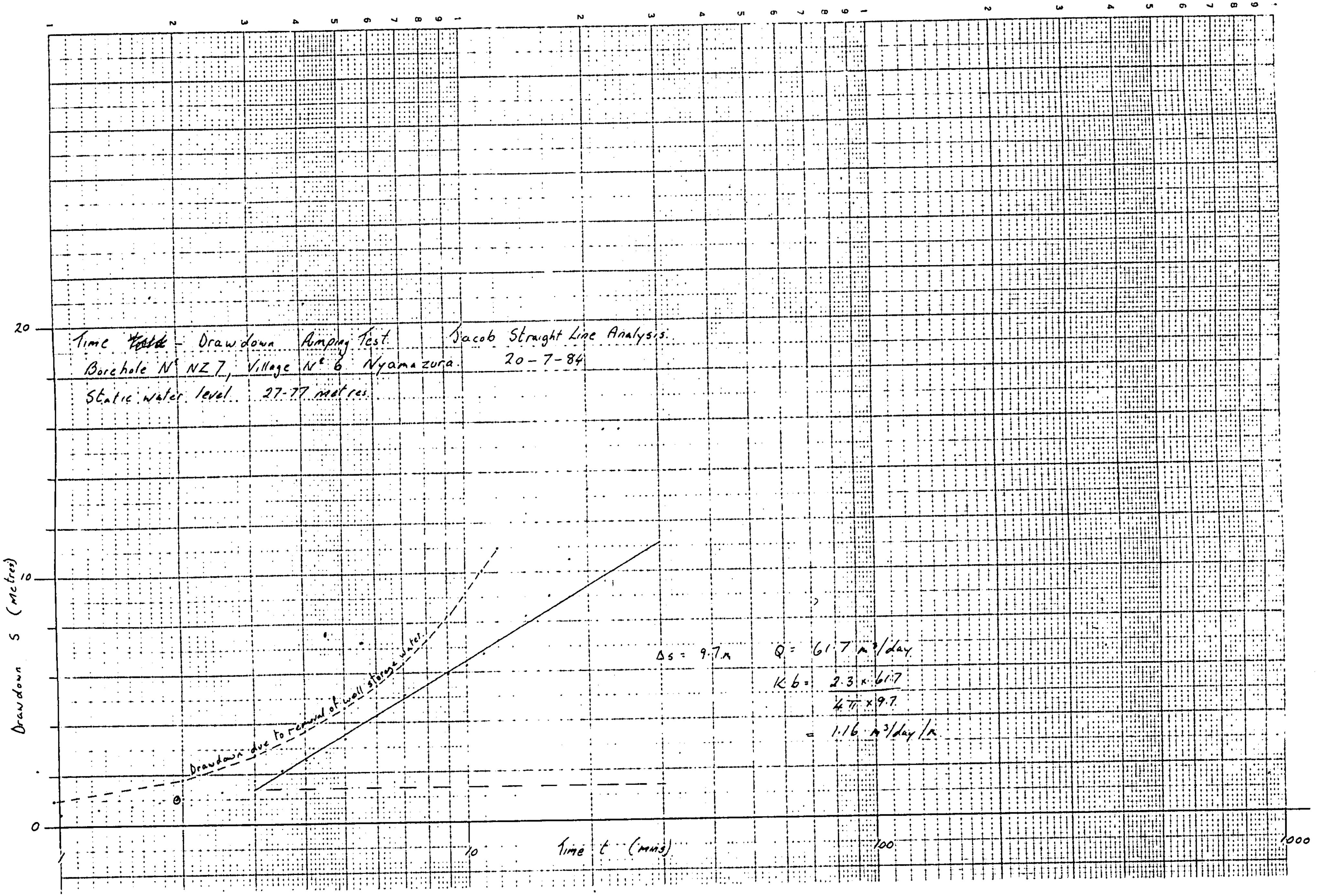
Yield.

ime since p stopped. "(mins)	Water level. (metres)	Residual Drawdown. (metres)	Recovery. (metres.	t/t'.
-15				
30				
45				
00.	44-45	16-68?	-	
,5				
-30	43-25	15-48	0-18	41
-45	43-22	15-485	0-21	35.3
2-00.	43-19	15-42	0-24	31
2-30	43-12	15-35	0-31	25
3-00	43-05	15-28	0-38	21
3-30	42 99	15-22	0-44	18.14
4-00	42-92	15-15	0-51	16
4-30	42-86	15-09	0-57	14.3
5	42-80	15-03	0-63	13
6	42-68	14-91	0.75	11
7	42-56	14-79	0.87	9.57
8	42-44	14-67	0.99	8.5

Water running into well →

Recovery Test. Borehole No NZ 7 Village No 6 NYAMAZURA 20-7-84 (Cont'd

Time since pump stopped. t' (mins)	Water level (metres)	Residual Drawdown. (metres)	Recovery. (metres)	t/t"
9	42-32	14-55	1.11	7.7
10	42-20	14-43	1.23	7
12	41-98	14-21	1.45	6
14	41-78	14-01	1.55	5.29
16	41-58	13-81	1.35	4.75
18	41-37	13-60	2.06	4.33
20	41-13	13-36	2.30	4
22	40-95	13-18	2-48	3.73
24	40-75	12-98	2-68	3
26	40-52	12-75	2.81	3.31
28	40-30	12-53	3.13	3.14
30	40-09	12-32	3.34	3
35	39-52	11-75	3.91	2.7
40	38-92	11-15	4.51	2.5
45	38-39	10-62	5.04	2.3
50	37-84	10-07	5.59	2.2
55	37-50	9-73	5.93	2.1
60	37-30	9-53	6.13	2
65.	37-09.	9-32	6.34.	1.92.



Time - Drawdown Pumping Test. Jacob Straight Line Analysis.

Borehole Nº NZ 7, Village Nº 6 Nyamazura. 20 - 7 - 84

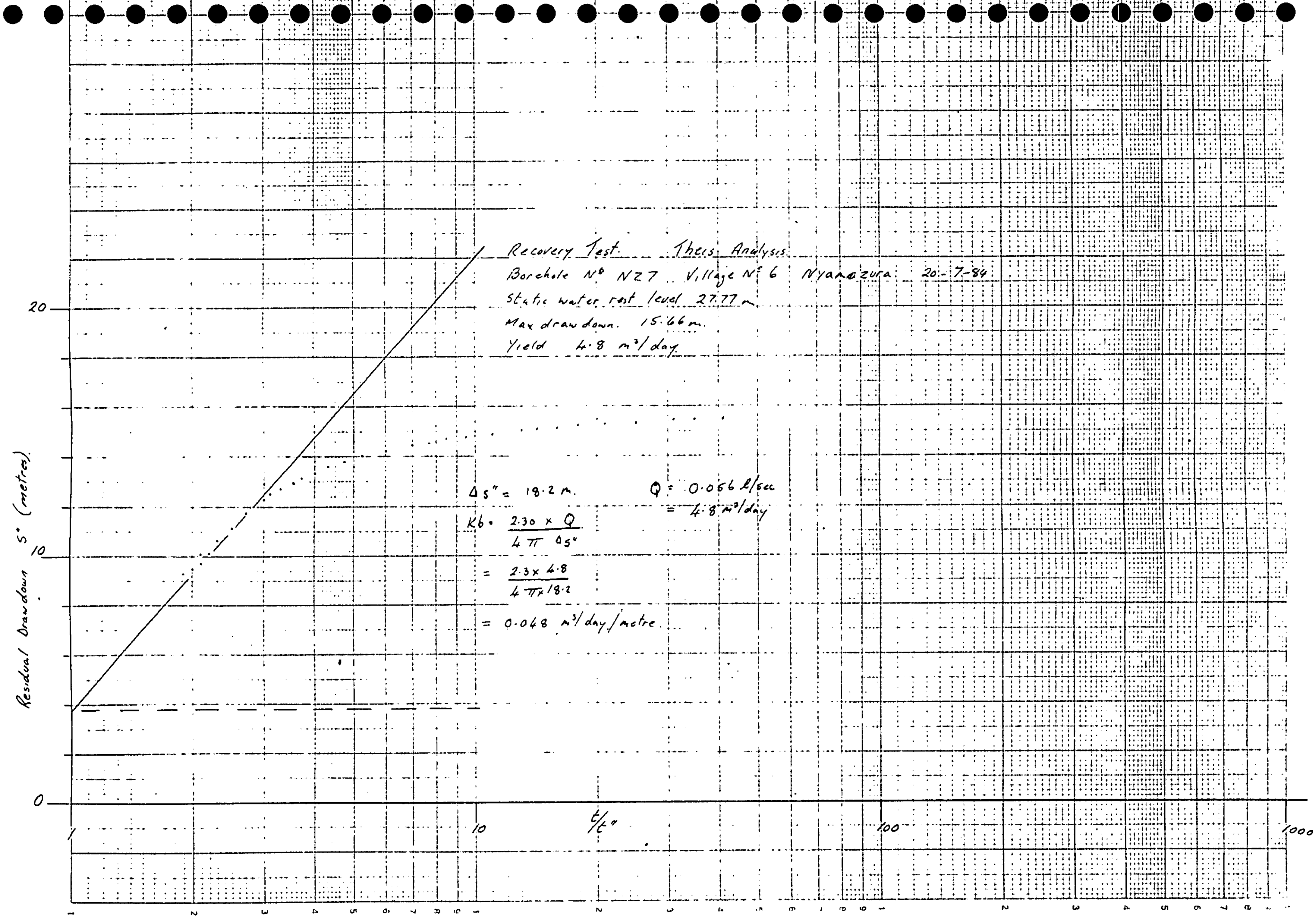
Static water level. 27-77 metres.

$\Delta s = 9.7m$

$Q = 61.7\ m^3/day$

$Kb = \frac{2.3 \times 61.7}{4\pi \times 9.7}$

$= 1.16\ m^3/day/m$



Recovery Test. Theis Analysis.
Borehole Nº NZ7 Village Nº 6 Nyanazura 20-7-84
Static water rest level 27.77 m
Max draw down. 15.66 m.
Yield 4.8 m³/day

$\Delta s'' = 18.2$ m.

$Kb = \frac{2.30 \times Q}{4\pi \; \Delta s''}$

$= \frac{2.3 \times 4.8}{4\pi \times 18.2}$

$= 0.048$ m³/day/metre

$Q = 0.066$ l/sec
$= 4.8$ m³/day

Bail Test.

Borehole Nº NZ7B. Village Nº 6. Nyamazura. 10-8-84.

Rest water level. 24·78 metres (bgl)

Capacity of bailer 22 litres.

Nº of bails 49.

Time taken 30 minutes.

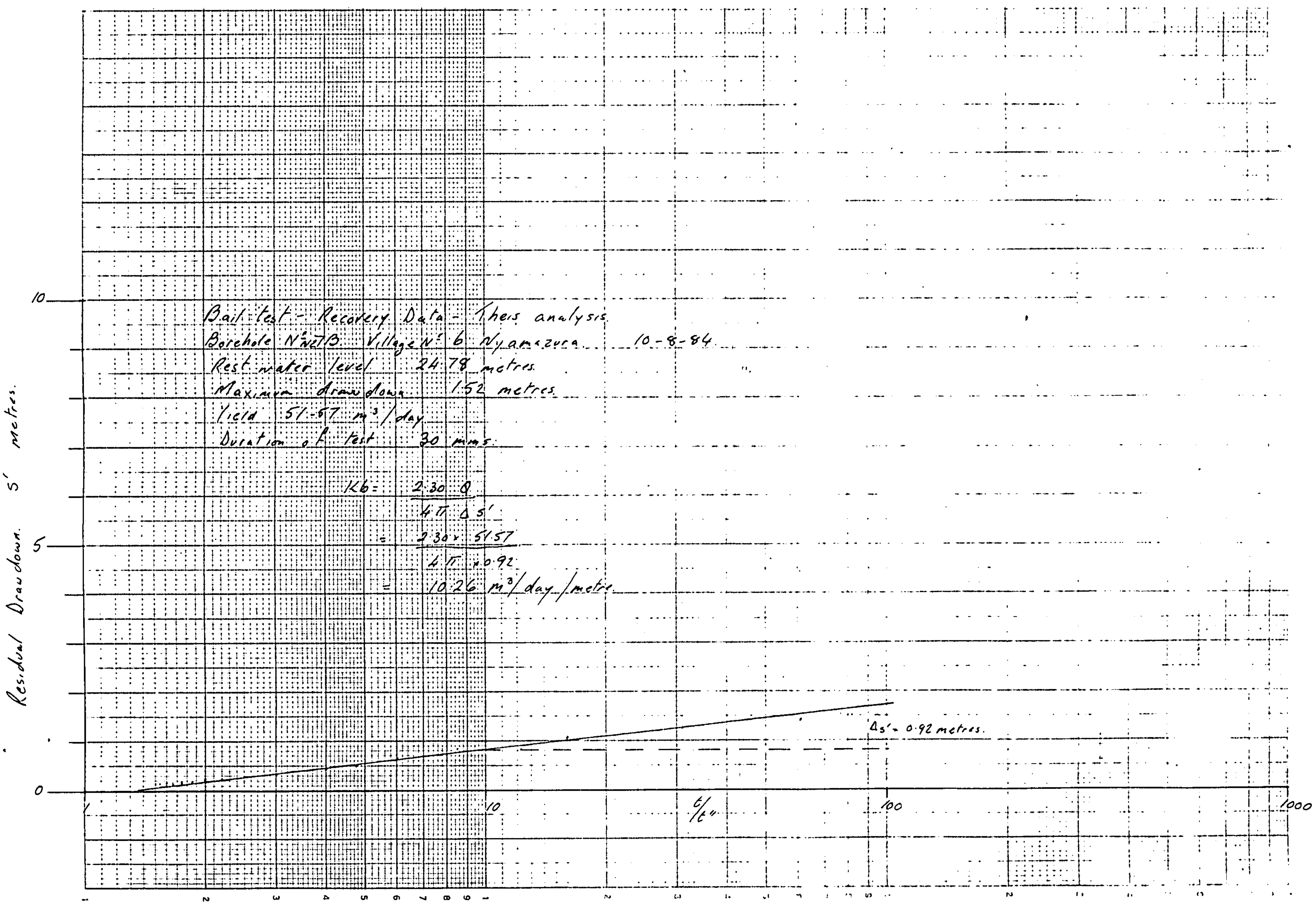
Drawdown. 1·52 metres.

Amount of water bailed. 1·078 m^3.

Yield. 0·60 l/sec 51·57 m^3/day

Specific capacity 33-9·2 m^3/day / metre of draw down.

Time after bailing stopped. (mins)	Water Level. (Metres)	Residual Drawdown. (metres)	Recovery. (metres)	t/t".
0-30	26-20	1-42	0-10	61
1-00	26-05	1-27	0-25	31
2	25-86	1-08	0-44	16
4	25-61	0-83	0-69	8·5
6	25-41	0-63	0-89	6
8	25-28	0-50	1-02	4·75
10	25-21	0-43	1-09	4.
15	25-13	0-33	1-19	3.
20	25-06	0-28	1-24	2·5
25	25-02	0-24	1-28	2·2
30	25-00	0-22	1-30	2
35	24-96	0-18	1-34	~~1·75~~ 1·86.
40	24-95	0-17	1-35	1-75
45	24-94	0-16	1-36	1-67
50	24-93	0-15	1-37	1-60
55	24-92	0-14	1-38	1-55
60	24-91	0-13.	1-39.	1-5.



Bail test – Recovery Data – Theis analysis
Borehole Nº 27B Village Nº 6 Nyamazura 10-8-84
Rest water level 24·78 metres.
Maximum drawdown 1·52 metres.
Yield 51·57 m³/day
Duration of test 30 mins.

$$Kb = \frac{2{\cdot}30\ Q}{4\pi\ \Delta s'}$$

$$= \frac{2{\cdot}30 \times 51{\cdot}57}{4\pi \times 0{\cdot}92}$$

$$= 10{\cdot}26\ m^3/day/metre$$

Constant Yield Pumping Test

Village N° 3 Inyamazura. Bore hole N° NZ 8.

Date. 10-7-84.

Cylinder at 33 metres. $Q = 57.6$ m³/day

Yield measured as the number of seconds to fill a 20 litre capacity bucket.

Time	Water level.	Date
11-29 am.	12-11 m.	5-7-84
13-25	12-10 m	10-7-84
13-28	12-09 m	10-7-84
13-29.	12-095 m	10-7-84.

Pumping Test Started at 13-30.

Time after pump started (min.)	Water level. (metres)	Drawdown. (metres)	Yield. (Secs/20 litres)	Cond. µs.	Temp °C.	pH.
0.15	13-13	1.03	31.6			
0-30	13-47	1.37				
0-45	13-76	1.66				
1-00	13.92	1-82				
1-15	14.02	1.92				
1-30	14.17	2.07				
1-45	14.22	2.12				
2-00	14.33	2.23				
2-30	14-40	2-30				
3-00	14-50	2-40				
3-30	14-59	2-49.				
4-00	14-69	2-59				
4-30	14-75	2-65				
5-00	14-80	2-70	29.2	270	23.4	7.35
6	14-92	2-82				
7	14-99	2-89				
8	15-05	2-95				

Constant Yield Pumping Test Borehole Nº NZ8 (cont'd).

Time after pump started (min).	Water level. (metres.	Drawdown. (metres)	Yield (Secs/20 litres)	Cond µS.	Temp °C	pH.
9	15-11	3-01				
10	15-16	3-06	28.6			
12	15-24	3-14				
14	15-31	3-21	29.5			
16	15-37	3-27.				
18	15-43	3-33				
20	15-47	3-37	29.7	265	23.4	7.75
22	15-51	3-41				
24	15-54	3-44	29.6			
26	15-58	3-48				
28	15-61	3-51				
30	15-63	3-53	29.4	265	23.2	7.85
35	15-66	3-56				
40	15-69	3-59				
45	15-77	3-67	29.2	265	23.4	7.70
50	15-82	3-72	~~30.0~~	~~265~~	~~23.4~~	~~7.85~~
55	15-84	3-74				
60	15-87	3-77	30.0	265	23.4	7.85
70	15-91	3-81	~~[illegible]~~ 29.8	260	23.4	7.90
80	15-98	3-88				
90	16-04	3-94	30.1	255	23.4	8.00
100	16-07	3-97	29.9	255	23.4	8.05
120	16-12	4-02	30.0	255	23.2	8.05
150	16-16	4-06	30.3	255	23.2	8.00
180	16-19	4-09.	30.6	255	23.2	7.85
		HCO_3 —	149 ppm			

Recovery Test

Village N° 3. Inyamazura Borehole N° N2 8.

Date 10-7-84.

Cylinder at 33 metres below ground level.

Rest water level. 12-10 metres.

Maximum drawdown of 4-09 metres to 16-19 metres.

Yield 0·67 l/sec. 57·6 m³/day.

Time since pumped stopped (mins)	Water level (metres)	Residual Drawdown (metres)	Recovery (metres)	t/t,
0 - 15	15-38	3-28	0-81	721
0 - 30	14-83	2-73	1·36	361.
0 - 45	14-45	2-35	1·74	241.
1 - 00	14-27	2-17	1·92	181
1 - 15	14-08	1-98	2·11	145
1 - 30	13·94	1-84	2·25	121
1-45	13-84	1-74	2·35	103·9
2-00	13·75	1-65	2·44	91
2-30	13-62	1-52	2·57	73
3-00	13-53	1-43	2·66	61.
3-30	13-46	1-36	2·73	52·4
4-00	13-40	1-30	2·79	46
4-30	13-36	1-26	2·83	41
5-00	13-32	1-22	2·87	37
6	13-24	1-14	2·95	31
7	13-19	1-09	3·00	26·7
8	13-145	1-045	3·045	23·5
9	13-105	1-005	3·085	21
10	13-07	0-97	3·12	19
12	13-005	0-905	3·185.	16.

Time since pump stopped (mins.)	Water level. (metres)	Residual Drawdown (metres)	Recovery (metres)	t/t'
14	12-95	0-85	3·24	13·9
16	12-915	0-815	3·275	12·25
18	12-875	0-775	3·325	11
20	12-84	0-74	3·35	10
22	12-81	0-71	3·38	9·2
24	12-795	0-695	3·405.	8·5
26	12-76	0-66	3·43	7·9
28	12-735	0-635	3·455	7·4
30.	12-715	0-615.	3·475	7
35	12-665	0·565	3·535	6·1
40	12-625	0-525	3·575	5·5
45	12-59	0-49	3·60	5
50	12-56	0-46	3·63	4·6
55	12-53	0-43	3·66	4·3
60	12-51	0-41.	3·69	4.

Recovery Test   Borehole Nº NZ 8   Village Nº 3   Inyamazura.

Date 10-7-84   Theis Recovery Method.

Time pump started 13-30

Time pump stopped. 16-30

Maximum Drawdown. 4-09 metres.

SWRL 12-10 metres.

Q = 57.6 m³/ day.

$$Kb = \frac{2{\cdot}30 \times Q}{4\pi\ \Delta s}.$$

for $\Delta s' = 0{\cdot}85m$.

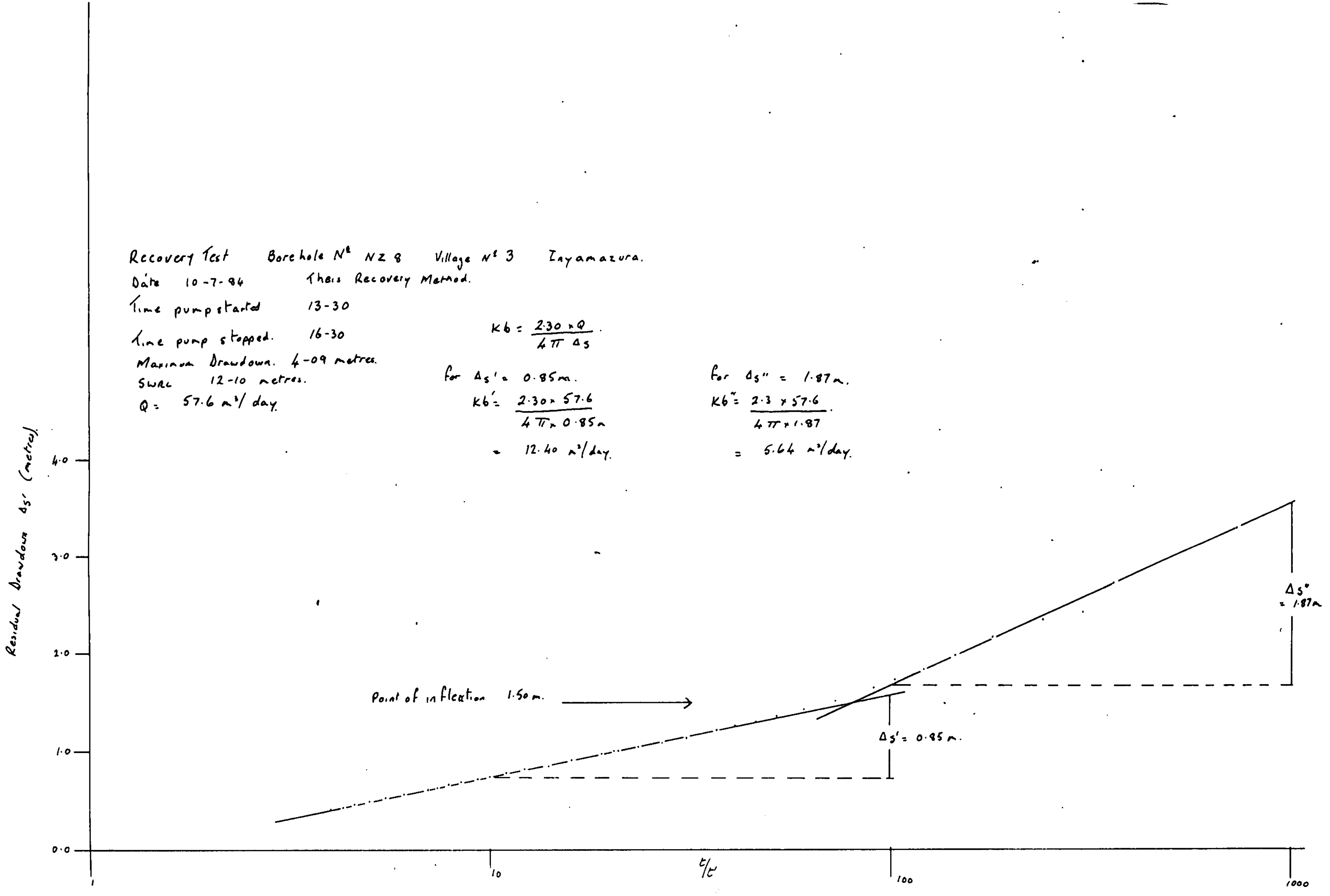
$$Kb' = \frac{2{\cdot}30 \times 57{\cdot}6}{4\pi \times 0{\cdot}85m}$$

$$= 12{\cdot}40\ m^3/day.$$

for $\Delta s'' = 1{\cdot}87m$.

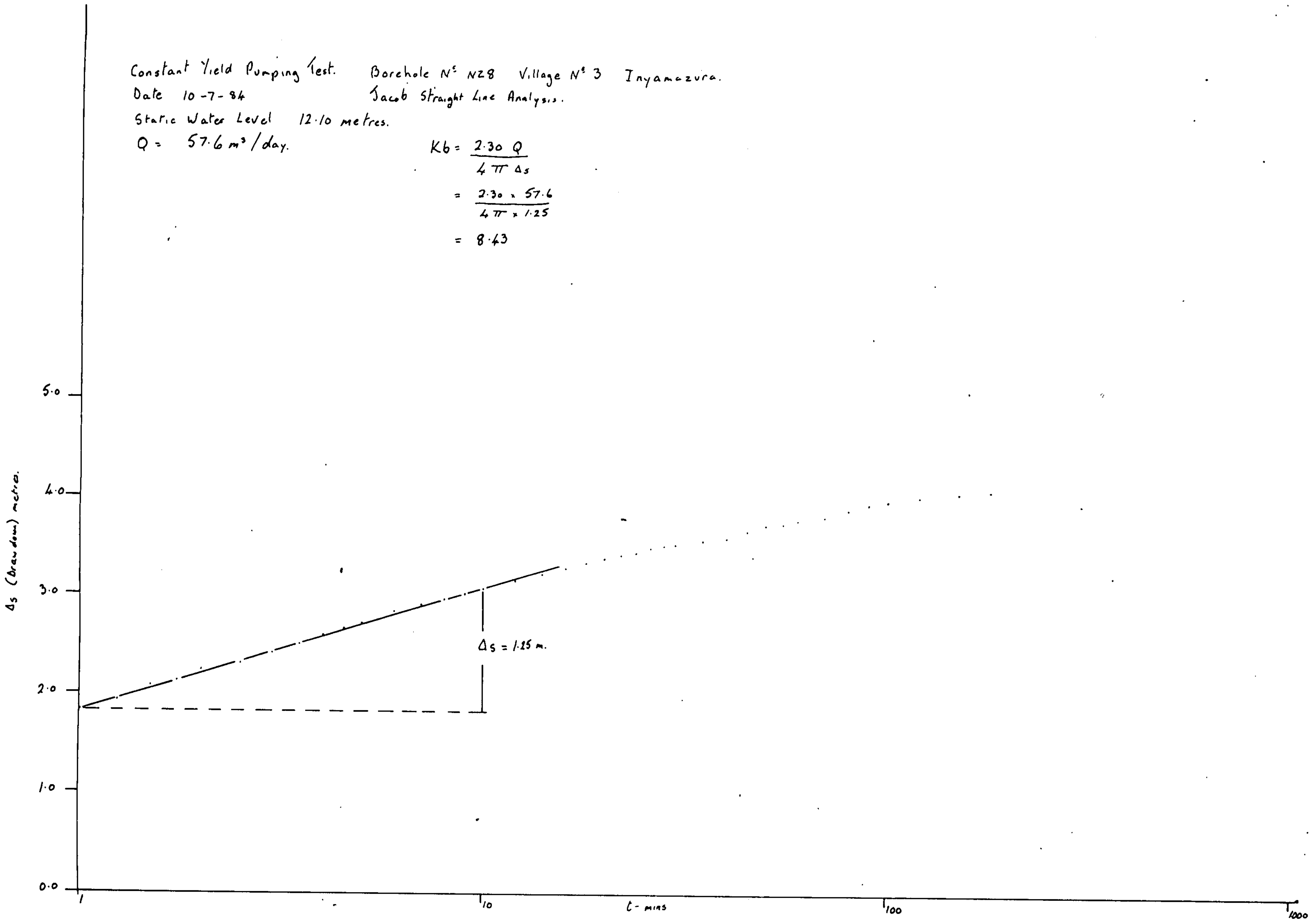
$$Kb'' = \frac{2{\cdot}3 \times 57{\cdot}6}{4\pi \times 1{\cdot}87}.$$

$$= 5{\cdot}64\ m^3/day.$$



Constant Yield Pumping Test. Borehole Nº NZ8 Village Nº 3 Inyamazura.
Date 10-7-84 Jacob Straight Line Analysis.
Static Water Level 12·10 metres.
$Q = 57{\cdot}6\ m^3/day.$

$$Kb = \frac{2{\cdot}30\ Q}{4\pi\ \Delta s}$$
$$= \frac{2{\cdot}30 \times 57{\cdot}6}{4\pi \times 1{\cdot}25}$$
$$= 8{\cdot}43$$



Constant Yield Pumping Test.

Borehole Nº NZ 9 Village Nº 1 A Inyamazura 18-7-84.
Time test started 13-00 hrs.
Pump cylinder 28.50 metres below ground level.
Ref point ~ 30 cms agl.
Pump used - Dando operated single action reciprocating pump.

Time	SWL (m)
1242	16-09
12-44	16-10
12-49	16-09
12-52	16-09
12-55	16-09
12-58	16-09

Hole depth 30.80 metres.

Time (mins)	Water level (metres).	Drawdown (metres)	Yield (Secs/20 l).	Temp (°C)	Conductivity µS	pH.
0-15	16-86	0-77				
- 30	17-15	1-06				
0-45	17-31	1-22				
1	17-41	1-32	29.7	24.2	340	7.8
1-15	17-45	1-36				
1-30	17-50	1-41				
1-45	17-53	1-46				
2	17-63	1-54				
2-30	17-64	1-55				
3	17-70	1-61				
3-30	17-74	1-65				
4	17-78	1-69				
4-30	17-86	1-75				
5	17-94	1-77	29.0	24.2	340	8.00
6	17-97	1-85				

Constant Yield Pumping Test. NZ9 18-7-84 (Contd)

Time (mins)	Water level (metres)	Drawdown (metres)	Yield (Secs/20 l)	Temp °c.	Conductivity µs.	pH.
7	17-97	1.88				
8	18-05	1.915				
9	18-045	1.955				
10	18-065	1.975	28.5	24.0	335	8.05
12	18-115	2.025				
14	18-16	2.07	28.5	24.0	335	8.05
16	18-187	2.097				
18	18-205	2.115				
20	18-23	2.14	28.5	24.0	335	8.05
22	18-25	2.16				
24	18-27	2.17	28.6	24.0	330	8.05
26	18-28	2.19				
28	18-29	2.20				
30	18-302	2-21	28.6	24.0	330	8.05
35	18-345	2.255	28.6	24.0	330	8.05
40	18-37	2.28	28.6	24.0	335	8.10
45	18-39	2-30	28.5	24.0	325	8.05
50	18-405	2-315	28.6	24.2	325	8.05
55	18-42	2-33	28.6	24.0	330	8.05
60	18-432	2-342	28.6	24.0	325	8.05
65	18-45	2-36				
70	18-45	2-36	28.5	24.0	325	8.05
75	18-46	2-37				
80	18-48	2-39	28.6	24.0	320	8.00
85	18-465	2-375				
90	18-46	2-37	28.6	23.8	320	7.70

Constant Yield Pumping Test: N29. 18-7-84 (cont'd)

Time (mins)	Water level (metres)	Drawdown (metres)	Yield (Secs/200)	Temp °C	Conductivity μs	pH
100	18.49	2.40	28.4	23.8	320	7.70
110	18.51	2.42	28.8	24.0	320	7.75
115	18.51	2.42				
120	18.511	2.421	28.7	24.0 ~~320~~	320	7.75
			(130) 28.7	24.0	320	7.75
140	18.54	2.45	28.6	240.	320	7.80
			(150) 28.5	24.2	315	7.85
160	18.545	2.455	28.5	24.0.	320	7.80
			(170) 28.4	24.2	315	7.85
177	18.565	2.475				
180	18.570	2.48	28.5	24.2	315	7.85

HCO_3 — 200ppm @ 160 mins.

Recovery Test.

Bore hole Nº NZ 9 Village Nº 1A Inyanzura. 18-7-84.

Pump cylinder at 28°50 m. below ground level.

Rest water level. 16-09 metres. (below ref point)

Ref point 30 cms. above ground level.

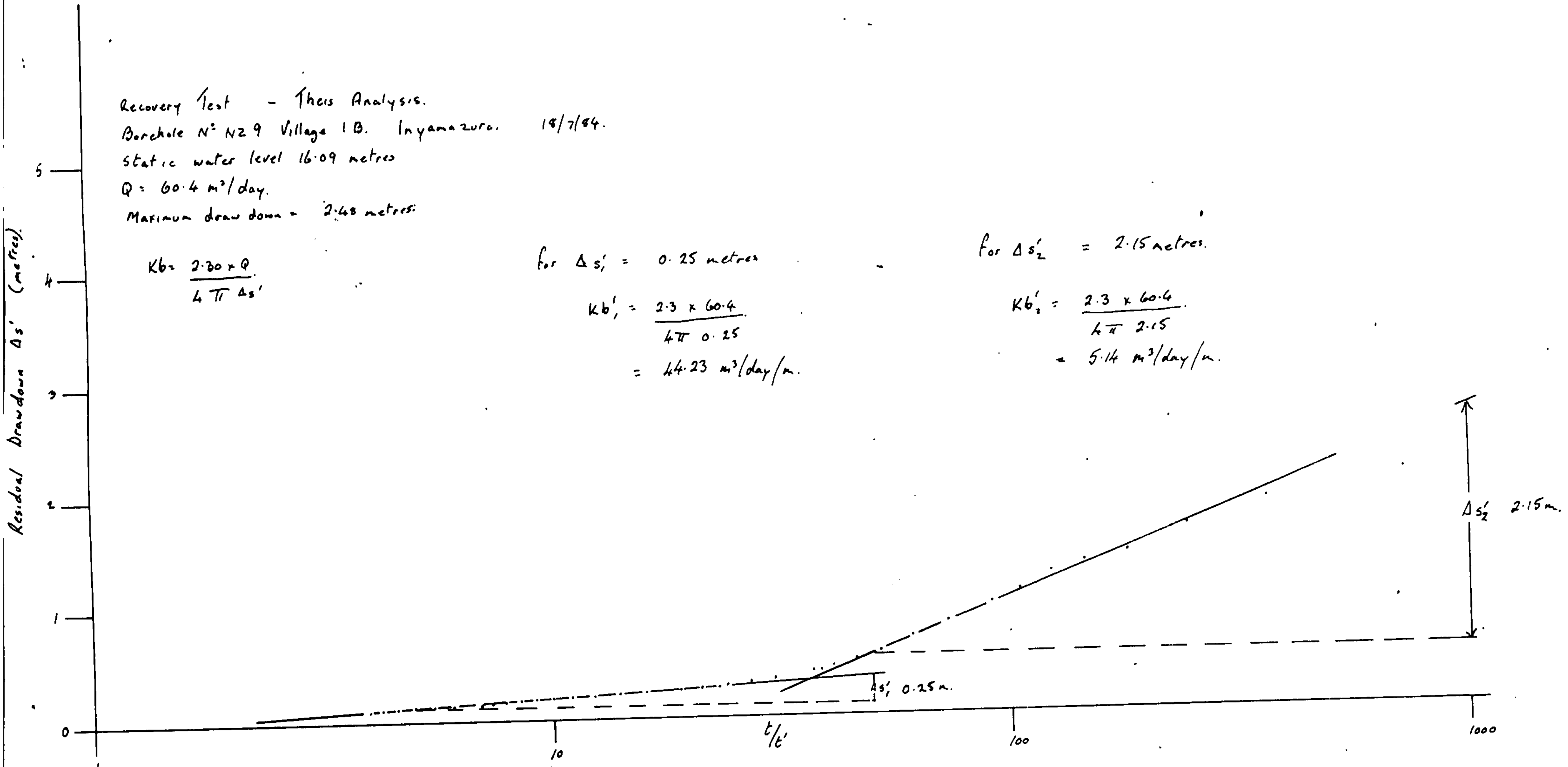
Maximum drawdown. 2.28 metres.

Yield. 0.699 l/sec 60.4 m³/day.

e since p stopped. (mins)	Water Level (metres)	Residual Drawdown. (metres)	Recovery (metres)	t/t₁
				~~721~~
- 15	18-18	2-09.	0-39	~~361~~ 721
- 30	17-95	1-86	0-62	~~241~~ 361
- 45	17-72	1-63	0-85	~~181~~ 241
	17-49	1-40	1-08	~~145~~ 181
- 15	17-43	1-34	1-14	~~121~~ 145
- 30	17-32	1-23	1-25	~~103.9~~ 121
- 45	17-16	1-07	1-41	~~91~~ 103.9
2	17-05	0-96	1-52	~~73~~ 91
2 - 30	16-89	0-80	1-68	~~61~~ 73
3	16-76	0-67	1-81	~~52.4~~ 61
3 - 30	16-64	0-55	1-93	~~46~~ 52-4
4	16-57	0-48	2-00	~~41~~ 46
4 - 30	16-52	0-43	2-05	~~37~~ 41
5	16-48	0-39	2-09	~~31~~ 37
6	16-42	0-33	2-16	~~26.7~~ 31
7	16-33	0-293	2-287	~~23.5~~ 26-7
8	16-36	0-27	2-21	~~21~~ 23-5
9	16-34	0-25	2-23	~~19~~ 21
10	16-328	0-238	2-242	~~16~~ 19
12.	16-305.	0-215	2-265.	16

Recovery Test. NZ 9 Village No 1A 18-7-84 (cont'd)

Time since pump stopped. (mins)	Water level. (metres)	Residual Drawdown. (metres)	Recovery. (metres)	t/t1 ~~139~~
14	16-29	0-20	2-28	~~12.25~~ 13.9
16	16-278	0-188	2-292	12.25
18	16-27	0-18	2.30	11
20	16-26	0-17	2.31	10
22	16-25	0-16	2.32	9.2
24	16-245	0-155	2.325	8.5
26	16-239	0-149	2.331	7.9
28	16-23	0-14	2.34	7.4
30	16-225	0-135	2.345	7
35	16-214	0-124	2.356	6.1
40	16-204	0-114	2.366	5.5
45	16-20	0-11	2.37	5
50	16-19	0-10	2.38	4.6
55	16-184	0-094	2.386	4.27
60	16-18	0-09	2.39	4



Recovery Test - Theis Analysis.
Borehole N° NZ9 Village 1B. Inyamazura. 18/7/84.
static water level 16·09 metres
Q = 60·4 m³/day.
Maximum draw down = 2·48 metres.

$$Kb = \frac{2{\cdot}30 \times Q}{4\pi\, \Delta s'}$$

for $\Delta s'_1$ = 0·25 metres

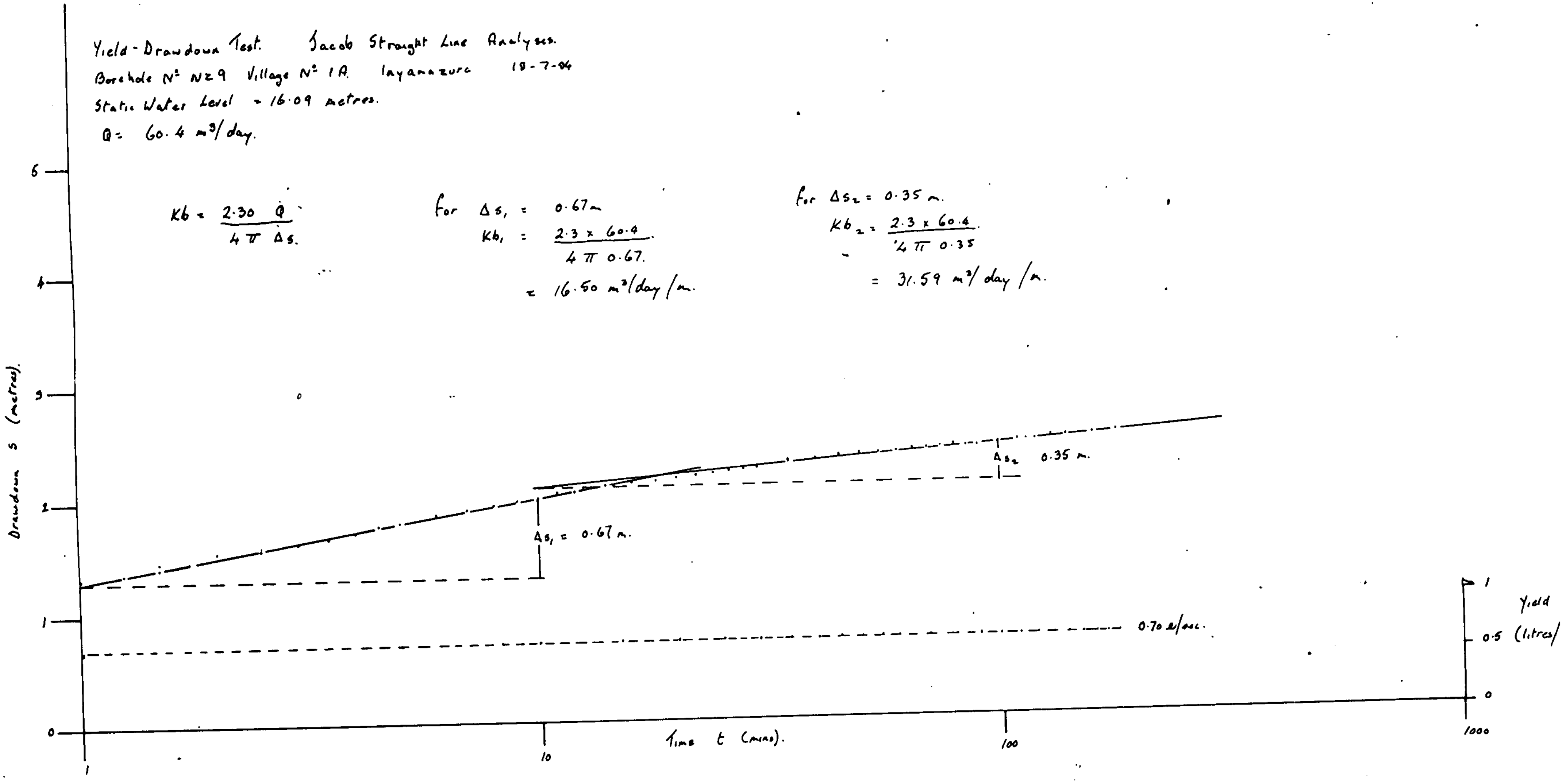
$$Kb'_1 = \frac{2{\cdot}3 \times 60{\cdot}4}{4\pi\ 0{\cdot}25}$$

$= 44{\cdot}23$ m³/day/m.

for $\Delta s'_2$ = 2·15 metres.

$$Kb'_2 = \frac{2{\cdot}3 \times 60{\cdot}4}{4\pi\ 2{\cdot}15}$$

$= 5{\cdot}14$ m³/day/m.



Yield-Drawdown Test. Jacob Straight Line Analyses.
Borehole N° NZ9 Village N° 1A. Iayanazure 18-7-84
Static Water Level = 16.09 metres.
Q = 60.4 m³/day.

$$Kb = \frac{2.30\ Q}{4\pi\ \Delta s.}$$

for $\Delta s_1 = 0.67$ m

$$Kb_1 = \frac{2.3 \times 60.4}{4\pi\ 0.67.}$$

$$= 16.50\ m^3/day/m.$$

for $\Delta s_2 = 0.35$ m.

$$Kb_2 = \frac{2.3 \times 60.4}{4\pi\ 0.35}$$

$$= 31.59\ m^3/day/m.$$

Constant Yield Pumping Test.

Village Nº 4 IN'YAMAZURA. Borehole Nº NZ 10

Date 11-7-84.

Cylinder at 25·5 metres below ground level.

Yield measured in number of seconds to fill a 20 litre capacity bucket.

Time	Water level.
14-11	6·88 metres.
14-14	6·88 metres.

Q = 49·25 m³/day.

Pumping test started at 14-15.

after pump started (mins)	Water level (metres)	Drawdown (metres)	Yield (Secs/20ℓ)	Cond µS.	Temp °C	pH.
-15	7-74	0-86				
-30	8-07	1-19				
-45	8-31	1-43				
1-00	8-39	1-51				
1-15	8-50	1-62				
1-30	8-54	1-66				
1-45	8-60	1-72				
2-00	8-65	1-77				
2-30	8-73	1-85	33·9			
3-00	8-76	1-88				
3-30	8-79	1-91				
4-00	8-825	1-945				
4-30	8-86	1-98				
5	8-88	2-00	33·6			
6	8-905	2-025				
7	8-93	2-05				
8	8-96	2-08				
9	8-97	2-09				

Constant Yield Test. NZ10 Cont'd

Time after pump started (mins)	Water level (Metres)	Drawdown (Metres)	Yield (Secs/20l)	Cond µS	Temp °C	pH
10	8-99	2-11	33.2	410	22.6	7.45
12	9-025	2-145	~~33.2~~	~~400~~	~~22.6~~	~~7~~
14	9-05	2-17	34.0			
16	9-07	2-19				
18	9-085	2-205				
20	9-09	2-21	33.9	390	22.6	7.95
25	9-125	2-245	34.1			
30	9-15	2-27	34.2	400	22.6	8.~~1~~05
35	9-165	2-285	34.4			
40	9-19	2-31	34.4	400	22.6	8.10
45	9-21	2-33	34.2			
50	9-20	2-32	34.2	400	22.4	8.20
55	9-23	2-35	34.2			
60	9-23	2-35	34.2	400	22.4	8.20
70	9-22	2-34	34.6	395	22.4	8.25
80	9-245	2-365	34.4	395	22.2	8.45
90	9-265	2-385	34.4	395	22.2	8.50
100	9-275	2-395	34.4	395	22.2	8.50
110	9-29	2-41	34.5	390	22.0	8.50
120	9-30	2-42	34.5	390	22.0	8.45
150	9-35	2-47	34.6	390	22.2	8.35
130	9-375	2-495	34.5	390	22.2	8.40

HCO_3^- = 217 ppm

Recovery Test.

Village N° 4. Inyamazura. Borehole N° NZ10.

Date. 11-7-84.

Cylinder at 25.5 metres below ground level.

Rest water level 6.88 metres.

Maximum draw down 2.495 metres to 9.375 metres.

Yield. 0.57 l/sec. 49.25 m³/day.

Time since pump stopped (mins).	Water level (Metres)	Residual Drawdown (Metres).	Recovery (Metres).	t/t₁
0-15	8-60	1-72	0.775	721
0-30	8-10	1-22	1.275	361
0-45	7-83	0-95	1.545	241
1-00	7.66	0-78	1.715	181
1-15	7-56	0-68	1.815	145
1-30	7-49	0-61	1.885	121
1-45	7-44	0-56	1.935	103.9
2-00	7-405	0-525	1.970	91
2-30	7-36	0-48	2.015	73
3-00	7-33	0-45	2.045	61
3-30	7-31	0-43	2.065	52.4
4-00	7-29	0-41	2.085	46
4-30	7-275	0-395	2.100	41
5-00	7-26	0-38	2.115	37
6	7-24	0-36	2.135	31
7	7-22	0-34	2.155	26.7
8	7-21	0-33	2.165	23.5
9	7-195	0-315	2.180	21
10	7-19	0-31	2.185	19
12.	7-17.	0-29	2.205	16

Recovery Test   Borehole Nº. NZ10.   (~~[illegible]~~ Cont'd)

e since pump stopped. (mins.)	Water level. (metres).	Residual Drawdown (metres.	Recovery	t/t1.
14	7.156	0-276	2.219	~~26.7~~ 13.9
16	7.143	0-263	2.232	~~23.5~~ 12.25
18	7.135.	0-255.	2.240	~~21.~~ 11
20	7.127	0-247	2.248	~~19~~ 10
25	7.11	0-23	2.265	~~15.4~~ 8.2.
30	7.10	0-22.	2.275	~~13~~ 7
35	7.09	0-21	2.285	~~11.3~~ 6.1
40	7.08.	0.20	2.295	~~10~~ 5.5
45	7-07	0-19	2.305	~~9~~ 5
50	7-06	0-18	2.315	~~8.2~~ 4.6
55	7-06	0-18	2.315	~~7.5~~ 4.3
60.	7-055	0.175.	2.320.	~~7~~ 4.

Constant Yield Pumping Test   Borehole N° NZ 10   Village N° 4 Inyanazura.

Date 11-7-84   Jacob Straight Line Analysis.

Static Water Level 6·88 metres.

$Q = 49.25\ m^3/day.$

$$Kb = \frac{2.30\ Q}{4\pi\ \Delta s}.$$

$\Delta s' = 0.65m.$

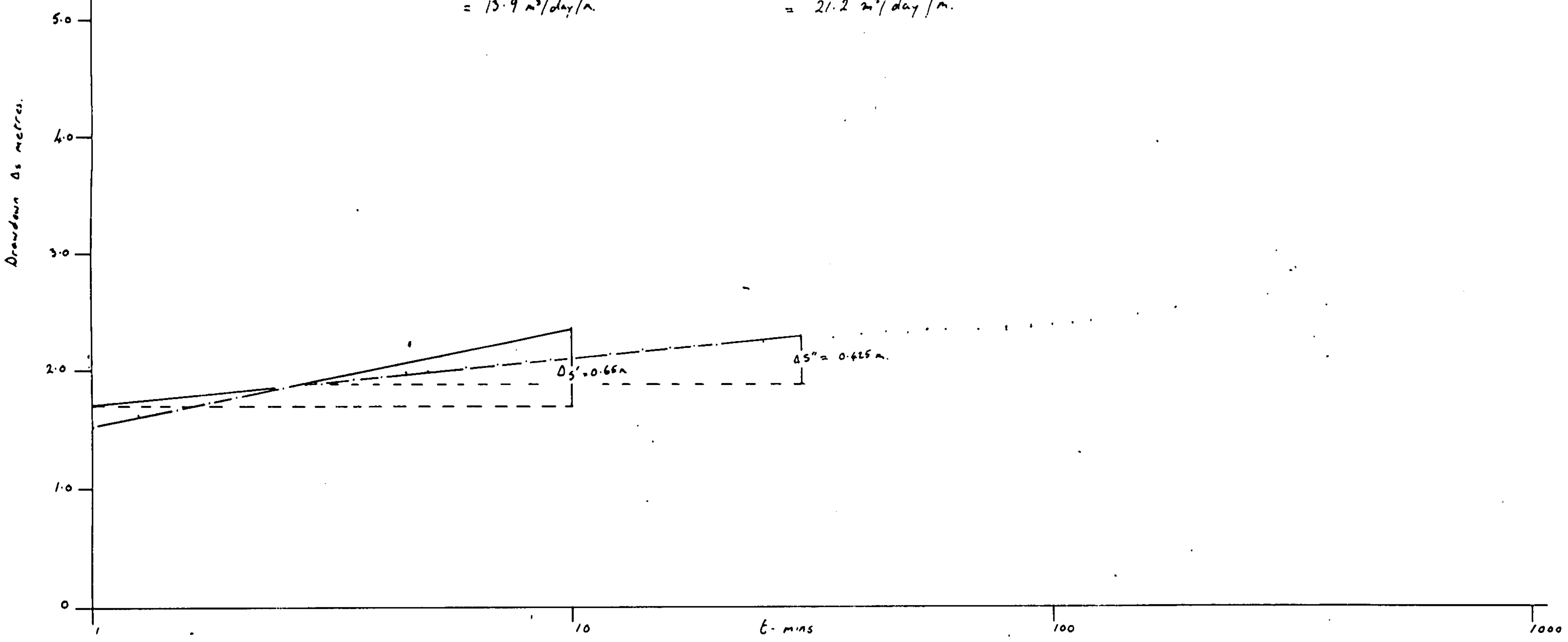
$$Kb' = \frac{2.30 \times 49.25}{4\pi \times 0.66}.$$

$= 13.9\ m^3/day/m.$

$\Delta s'' = 0.425m.$

$$Kb'' = \frac{2.30 \times 49.25}{4\pi \times 0.425}$$

$= 21.2\ m^3/day/m.$



Recovery Test Borehole Nº NZ 10 Village Nº 4 Inyamazura.

Theis Recovery Method.

Date 11-7-84

Time pump started 14-15

Time pump stopped 17-15

Maximum Drawdown 2.495 metres.

Static Water Rest Level 6.88 metres.

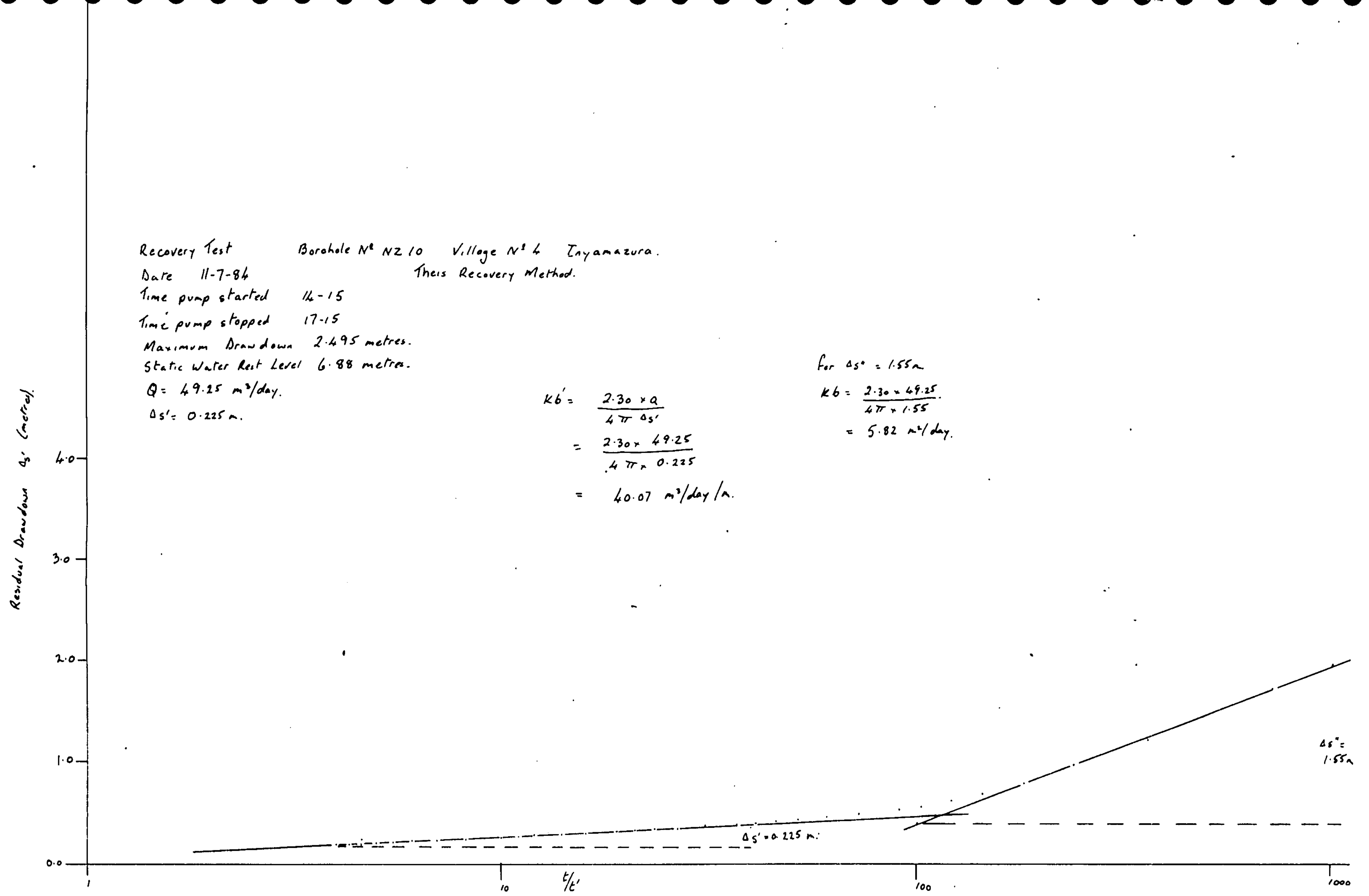
$Q = 49.25$ m³/day.

$\Delta s' = 0.225$ m.

$$Kb' = \frac{2.30 \times Q}{4\pi\ \Delta s'} = \frac{2.30 \times 49.25}{4\pi \times 0.225} = 40.07 \text{ m}^3/\text{day}/\text{m}.$$

for $\Delta s'' = 1.55$m

$$Kb = \frac{2.30 \times 49.25}{4\pi \times 1.55} = 5.82 \text{ m}^2/\text{day}.$$



Constant Yield Pumping Test

Borehole N° NZ 11A Village N° 2 INYAMAZURA.

Date 16-7-84

Time Test Started 15-00 hrs.

Pump Cylinder 24·62 metres below ground level.

Dipper would not pass beyond 23·72 metres - top of the cylinder.

Ref point 0·50 cms agl.

Pump used - Dando operated single action reciprocating pump.

Time	SWRL (m).
14-18	4-17
14-43	4-17
14-49	4-17

Time (mins).	Water level. (metres)	Drawdown (metres.)	Yield. (Secs/20 litres)	Temp °C	Conductivity µS	pH
0 - 15	6-00	1-83.	24	23·8	340	7·7
0 - 30	6-93	2-76.				
0 - 45	7-62	3-45				
1	8-33	4-16.				
1 - 15	8-97	4-80				
1 - 30	9-50	5-33				
1 - 45	9-96	5-89				
2	10-24	6-07				
2 - 30	11-04	6-87				
3	11-82	7-65				
3 - 30	12-37	8-20				
4	12-97	8-80.				
4 - 30	13-32	9-15				
5	13-66.	9-45	29	23·0		

Constant Yield Test NZ 11 16/7/84 cont'd

Time (mins.)	Water level (metres)	Drawdown (metres)	Yield (Secs/20 litres)	Temp (°c)	Conductivity (µs	pH
5-30						
6	14-49	10-32				
6-30						
7	15-31	11-14				
8	16-10	11-93				
9	17-08	13-91				
10	18-50	14-33	34	22.8	330	7.9
12	18-64	14-47				
13	19 21	15-64				
14	20-02	15-85				
15		15	35	22.6	300	8.05
16	20-83	16-66				
18	21-05	16-88				
20	21-48	17-31	36	22.6	300	8.4
22	22-77	18-60				
24	23-35	19-16				
25	23-72	19-55	35.4	22.6	310	8.4
30			34.8			
35			55			
40			59.8	22.6	325	8.2
45			62.5			
50			62.6	22.4	325	8.67
55			62.6	22.6	330	8.70
60			62.6	22.6	330	8.70
65			64.7	22.6	330	8.75
75			65.5	22.6	343	8.85
80			65.8	22.6	330	8.95
85			68.0	22.6	330	8.95
95			68.6	22.6	330	8.94

Constant Yield Test NZ11 16/7/84 (cont'd).

e ns)	Water level (metres)	Drawdown (metres)	Yield (Secs/20litres)	Temp (°c)	Conductivity (μs)	pH.
100			71	22.6	340	8.98
105			71.6	22.6	330	8.85
110			73.0	22.6	330	8.85
115			74.5	22.6	330	8.85

Recovery Test.

Borehole Nº NZ 11 Village Nº 2. Inyamazura.

Date 16-7-84.

Pump cylinder at 24.62 metres below ground level.

Rest Water level 4·17 metres (below ref. point)

Ref point 50 cm. above ground level.

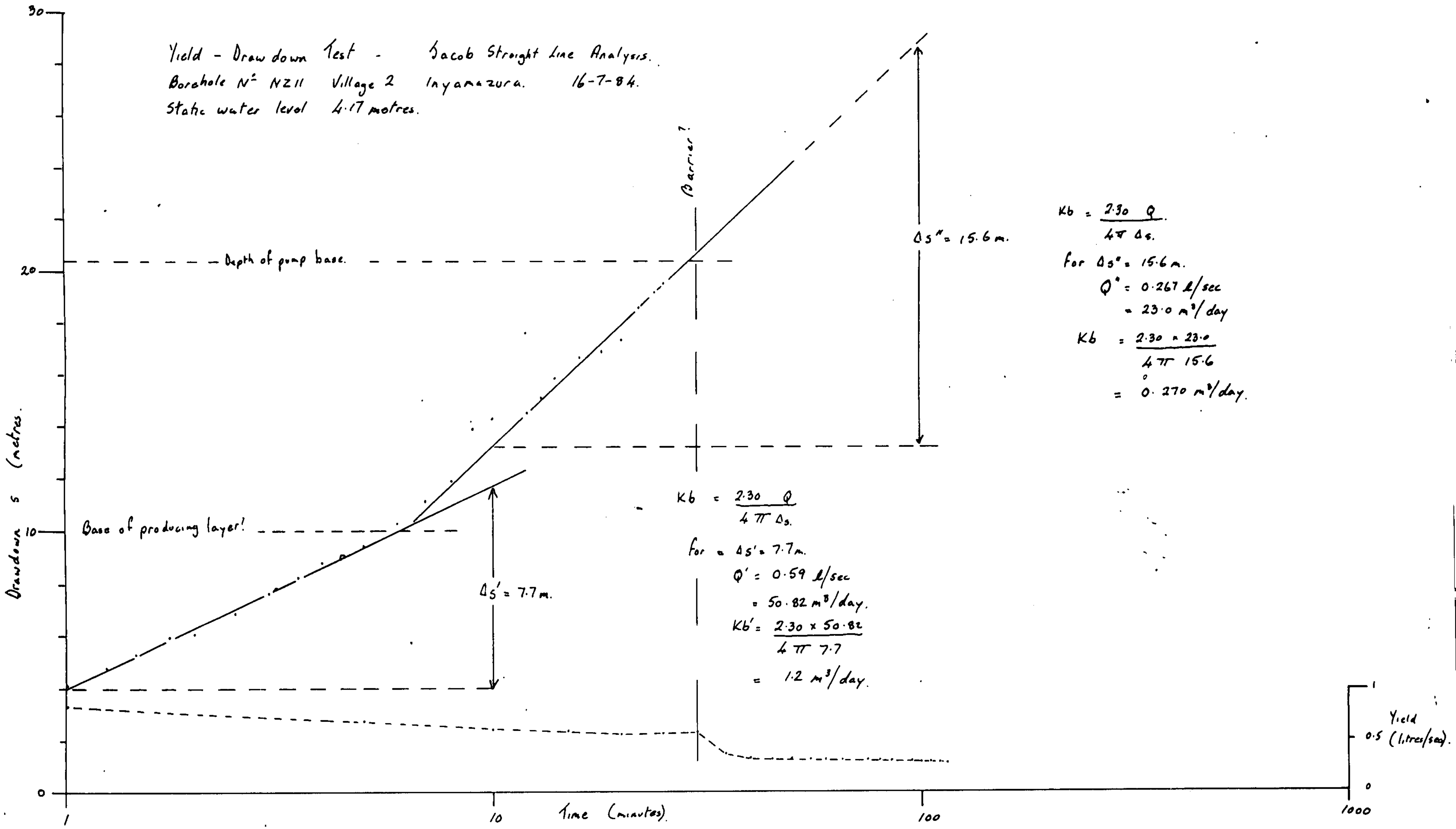
Maximum drawdown. ÷ about 20·23 metres.

Yield - variable.

Time since pump stopped (Mins)	Water level (metres)	~~[illegible]~~ Residual drawdown (metres)	Recovery (metres)	t/t'
0 - 15				481.
0 - 30				241
0 - 45				161.
1 - 00				121
1·05	23·72	19·55		110·1
1.15	23-36	19·19		97
1-30	23-19	19-02		81
1-45	23-00	18-83		69.6
2-00	22-81	18-64		61
2-30	22-49	18-32		49.
3	22-18 ~~[illegible]~~	18-01		41
3 -30	21-88	17-71		35.3
4	21-62	17-45		31
4-30	21-46	17-29		27.7
5	21-455	17-285		25
5-30	21-45	17-28		22.8
6	21-30	17-13		21
6-30	21-10	16-93		19.5
7.	20-99.	16-72		18.1

Recovery Test B/H N= NZ 11 16-7-84 (Cont'd)

Time since pump stopped (mins)	Water level (metres)	Residual Drawdown (metres)	Recovery (metres)	t/t'
8	20-60	16-43		16
9	19-85	15-68		14.3
10	19-13	14-96		13
12	18-20	14-03		11
14	17-72	13-55		9.6
16	17-30	13-13		8.5
18	16 54	12-37		7.7
20	–	–		
22	–	–		
24	–	–		
26	14-20	10-03		5.6
27	14-10	9-93		5.4
28	13-90	9-73		5.3
30	13-53	9-36		5.0
35	12-74	8-57		4.4
40	12-01	7-84		40
45	11-32	7-15		3.7
50	10-89	6-72		3.4
55	10-48	6-31		3.2
60	10-14	5-97		3.0
65	9-81	5-64		2.8
8-00 Am (17/7/84)	4-60	0-43.		



Yield - Drawdown Test - Jacob Straight Line Analysis.
Borehole Nº NZ11 Village 2 Inyamazura. 16-7-84.
Static water level 4.17 metres.

$$Kb = \frac{2{\cdot}30 \quad Q}{4\pi\ \Delta s.}$$

For $\Delta s'' = 15{\cdot}6$ m.

$$Q'' = 0{\cdot}267\ \ell/\text{sec}$$

$$= 23{\cdot}0\ m^3/\text{day}$$

$$Kb = \frac{2{\cdot}30 \times 23{\cdot}0}{4\pi\ 15{\cdot}6}$$

$$= 0{\cdot}270\ m^3/\text{day}.$$

$$Kb = \frac{2{\cdot}30 \quad Q}{4\pi\ \Delta s.}$$

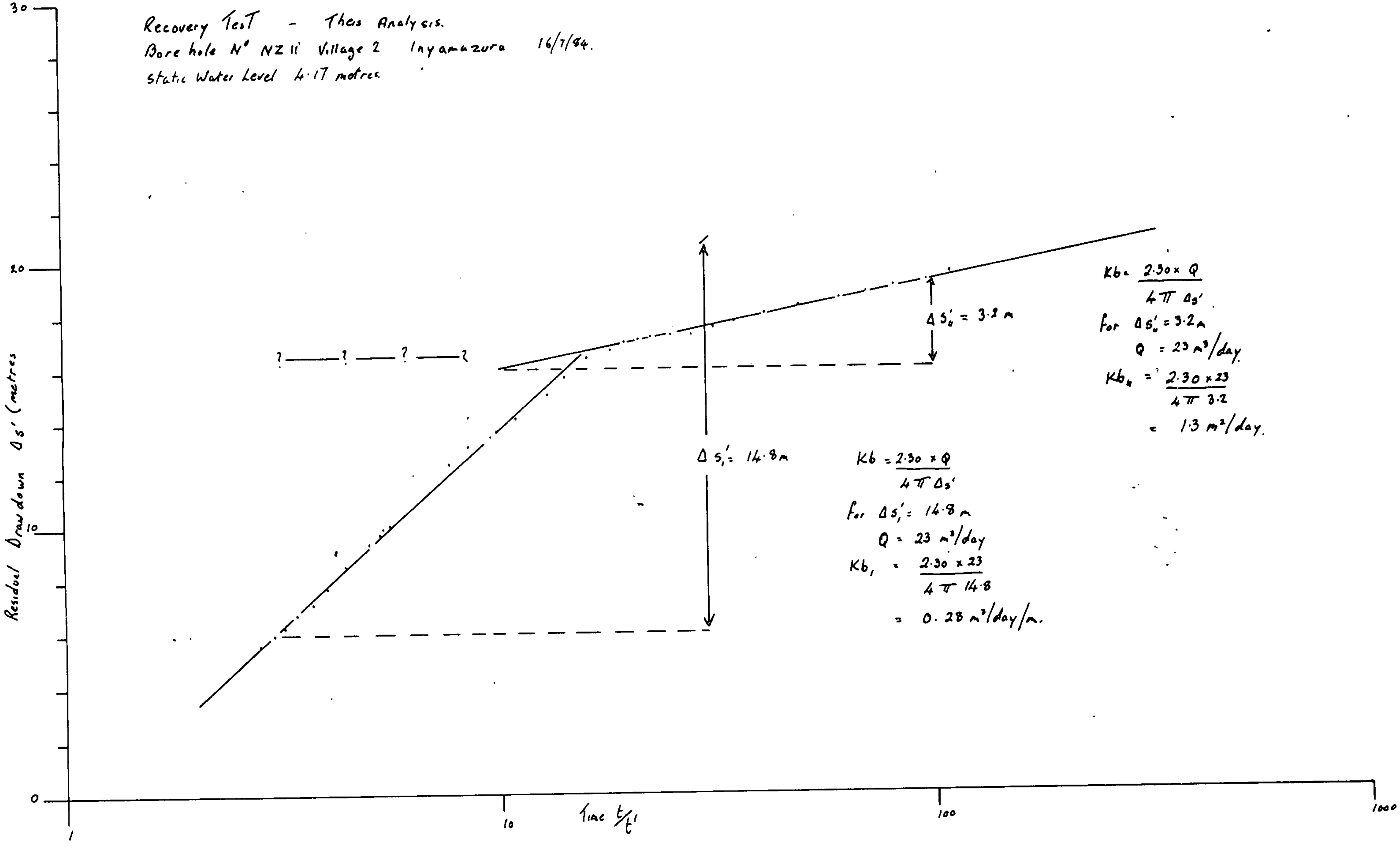
For a $\Delta s' = 7{\cdot}7$ m.

$$Q' = 0{\cdot}59\ \ell/\text{sec}$$

$$= 50{\cdot}82\ m^3/\text{day}.$$

$$Kb' = \frac{2{\cdot}30 \times 50{\cdot}82}{4\pi\ 7{\cdot}7}$$

$$= 1{\cdot}2\ m^3/\text{day}.$$



Recovery Test - Theis Analysis.
Bore hole N° NZ 11 Village 2 Inyamazura 16/7/84.
static Water Level 4·17 metres.

$Kb = \dfrac{2.30 \times Q}{4\pi \Delta s'}$

for $\Delta s'_u = 3.2$ m

$Q = 23$ m³/day

$Kb_u = \dfrac{2.30 \times 23}{4\pi\ 3.2}$

$= 1.3$ m²/day.

$Kb = \dfrac{2.30 \times Q}{4\pi \Delta s'}$

for $\Delta s'_1 = 14.8$ m

$Q = 23$ m³/day

$Kb_1 = \dfrac{2.30 \times 23}{4\pi\ 14.8}$

$= 0.28$ m²/day/m.

Bail Test.

Borehole Nº NZ 11 B Village Nº 2 Nyamazura 31-7-84

REST WATER LEVEL. 6-20 metres.

Capacity of bailer 37 litres.

Nº of bails. 21.

Time taken. 13 mins 30 secs.

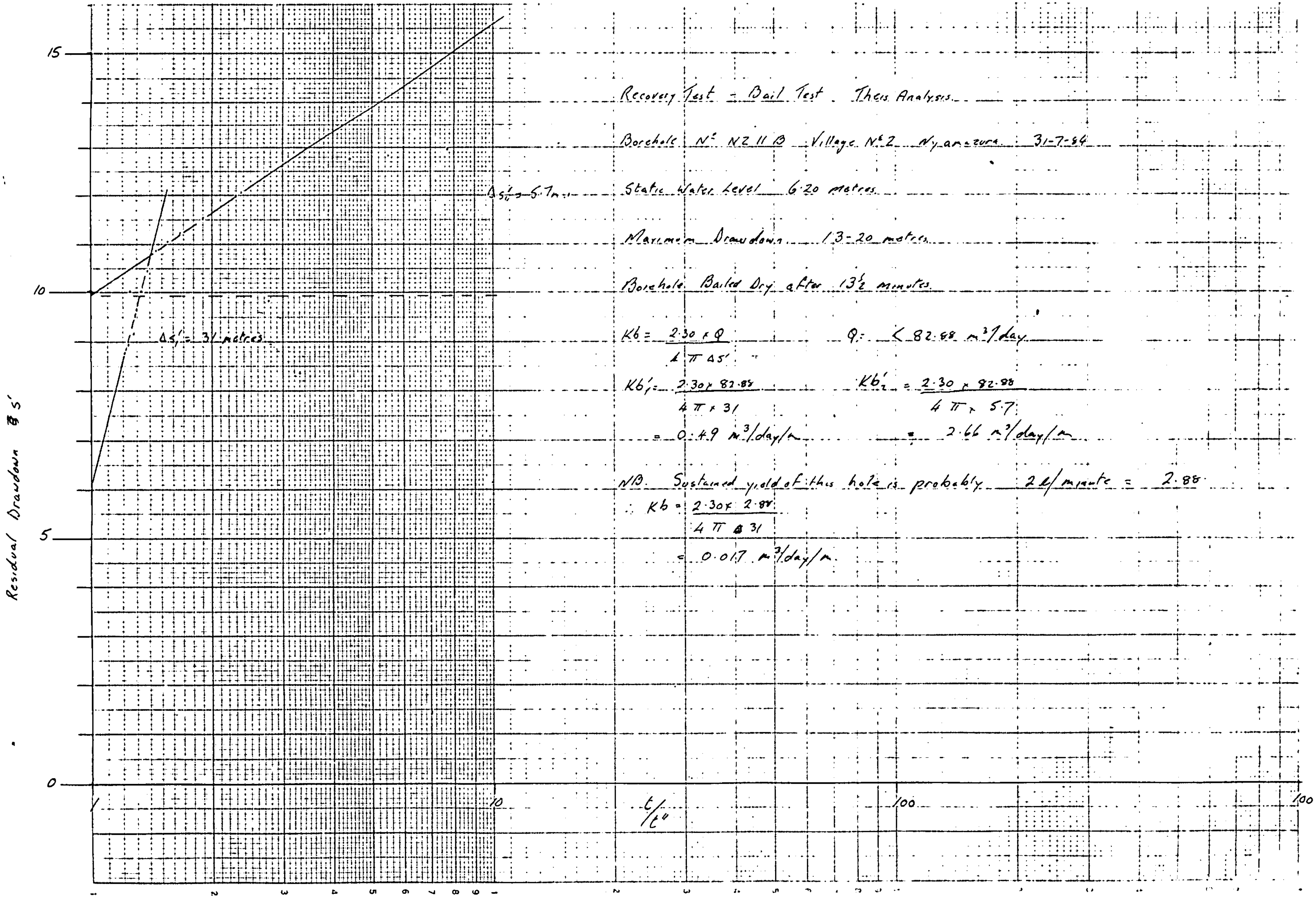
Draw down. 13-20 metres.

Amount of water bailed. 777 litres.

Yield 0·96 l/sec. 82·88 m^3/day. — NB well bailed dry after $13\frac{1}{2}$ minutes!

Specific capacity - less than 6·28 m^3/day/metre of drawdown;

Time after bailing stopped (mins.)	Water level (metres)	Residual Drawdown. (metres)	Recovery (metres)	t/t''
1	19-28	13-0 8	0-12	14·50
2	19-14	12-94	0-26	7.75
3	19-03	12-83	0-37	5.5
4	18-91	12-77	0-43	4.38
5	18-79	12-59	0-61	3·7
10	18-26	12-06	1-14	2·35
15	17-73	11-53	1-67	1·9
20	17-41	11-21	1-99	1·[illegible]675
25	17-27	11-07	2-13	1.54
30	17-07	10-87	2-33	1.45
35	16-65	10-45	2-75	1·39
40	16-20	10-00	3-20	1.34
45	15-85	9-65	3-55	1.30
50	15-48	9-28	3-92	1.27
55	15-15	8-95	4-25	1.25
60	14-99	8-79.	4-41	1.225



Recovery Test = Bail Test. Theis Analysis.

Borehole N° NZ 11 B Village N° 2 Nyamazura. 31-7-84

Static Water Level 6.20 metres.

Maximum Drawdown 13-20 metres.

Borehole Bailed Dry after $13\frac{1}{2}$ minutes.

$Kb = \frac{2.30 \times Q}{4 \pi \Delta s'}$ Q: < 82.88 m^3/day

$Kb'_1 = \frac{2.30 \times 82.88}{4 \pi \times 31}$ $Kb'_2 = \frac{2.30 \times 82.88}{4 \pi \times 5.7}$

$= 0.49$ m^3/day/m $= 2.66$ m^3/day/m

NB. Sustained yield of this hole is probably 2 ℓ/minute = 2.88

$\therefore Kb = \frac{2.30 \times 2.88}{4 \pi \times 31}$

$= 0.017$ m^3/day/m.

Constant Yield Pumping Test

Bore hole N° NZ 12 A Village N° 1B NYAMAZURA.

Date 17-7-84

Time test started 15-30 hrs.

Pump cylinder depth 30 metres with 1½" pipe with foot valve to 40 metres.

Ref point — at ground level.

Pump used:- Dando operated single action reciprocating pump.

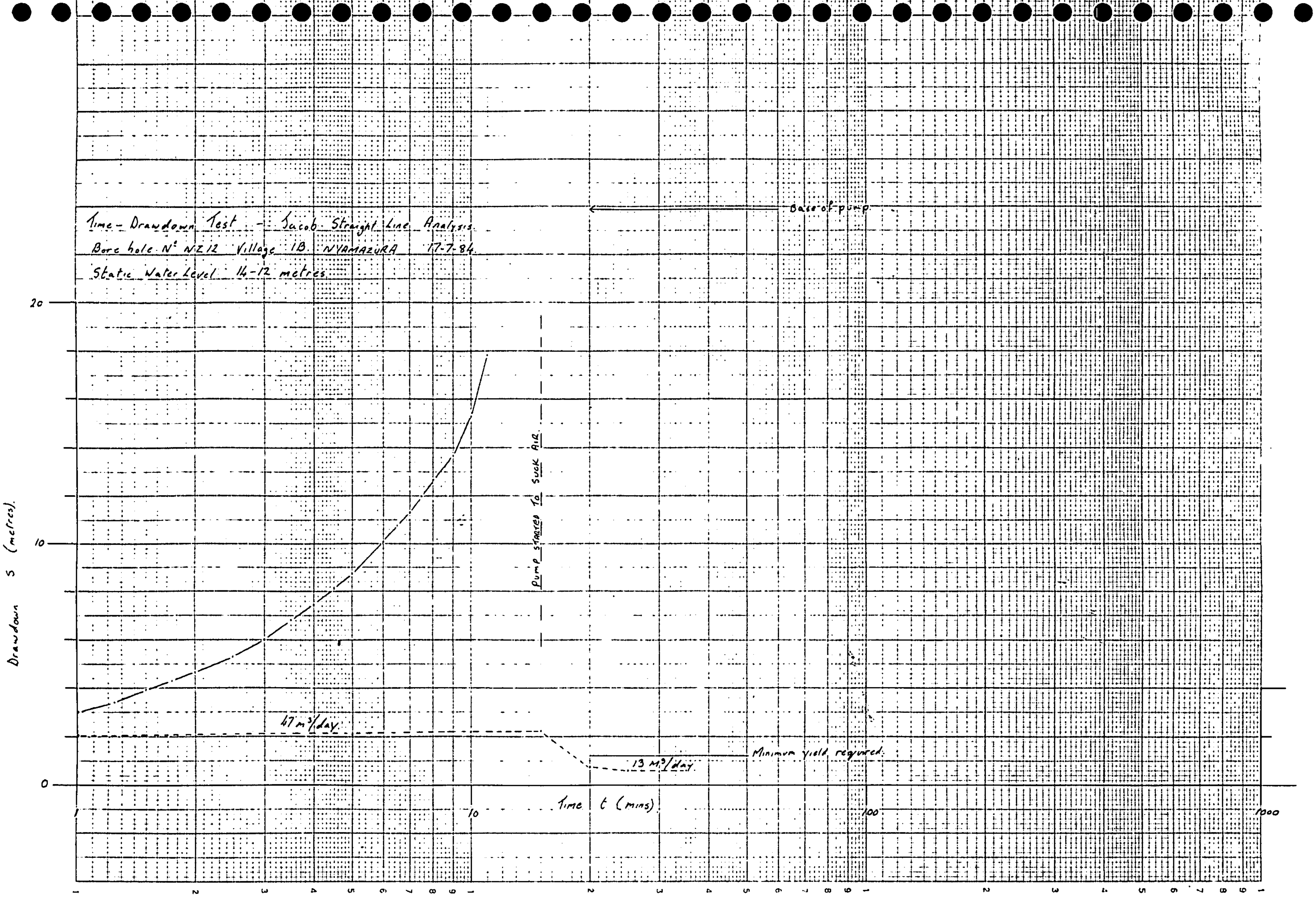
Time	SWRL (metres).	Time	SWRL	Time	SWRL
15-14	14-04	13-25	14-12	13-55	14-12
15-29	14-12	13-35	14-12		
13-20	14-13	13-45	14-12		

Time (mins)	Water level (metres)	Drawdown. (metres)	Yield. (Secs/20 ℓ)	Temp. (°C)	Conductivity µS	p.H.
0-15	15-77	1-65	38-7	23.4	310	8-25
0-30	16-12	2-00				
0-45	16-72	2-60				
1-00	17-13	3-01				
1-15	17-53	3-41				
1-30	18-06	3-94				
1-45	18-40	4-28				
2-00	18-73	4-61				
2-30	19-45	5-33				
3-00	20-13	6-01				
3-30	20-94	6-82				
4-00	21-55	7-43				
4-30	22-27	8-15				
5	22-90	8-78	37.5	23.4	310	7.95
6.	24-20	10-08				

Constant Yield Pumping Test. Borehole NZ12. Village 1B. 17-7-84 (cont'd).

Time (mins)	Water level (metres)	Drawdown (metres)	Yield (Secs/20l)	Temp. °C	Conductivity µs	pH –
6-30	24-89	10-77				
7	25-48	11-36				
7-30	26-09	11-97				
8	26-80	12-68				
9	27-80	13-68				
10	29-40	15-28	36.4	23.6	300	7.85
12	32-00	15-88				
15	Dipper stuck under base of first cylinder.		35.6	23.6	240	7.85
20			107-06	23.6	240	7.85
25			133-05			
30			137	23.4	245	8.25
35			133-04	23.4	245	8.25

Test stopped at 16-10 hrs, due to large drawdown and lack of water.



Time - Drawdown Test - Jacob Straight Line Analysis.
Bore hole N° NZ12 Village 1B. NYAMAZURA 17-7-84.
Static Water Level 14-12 metres.

Bail Test.

Borehole Nº NZ 12B. Village Nº 1B Nyamazura. 9-8-84.

Rest water level. 6-53 metres.

Capacity of bailer. 37 litres

Nº of bails. 51.

Time taken. 30 minutes.

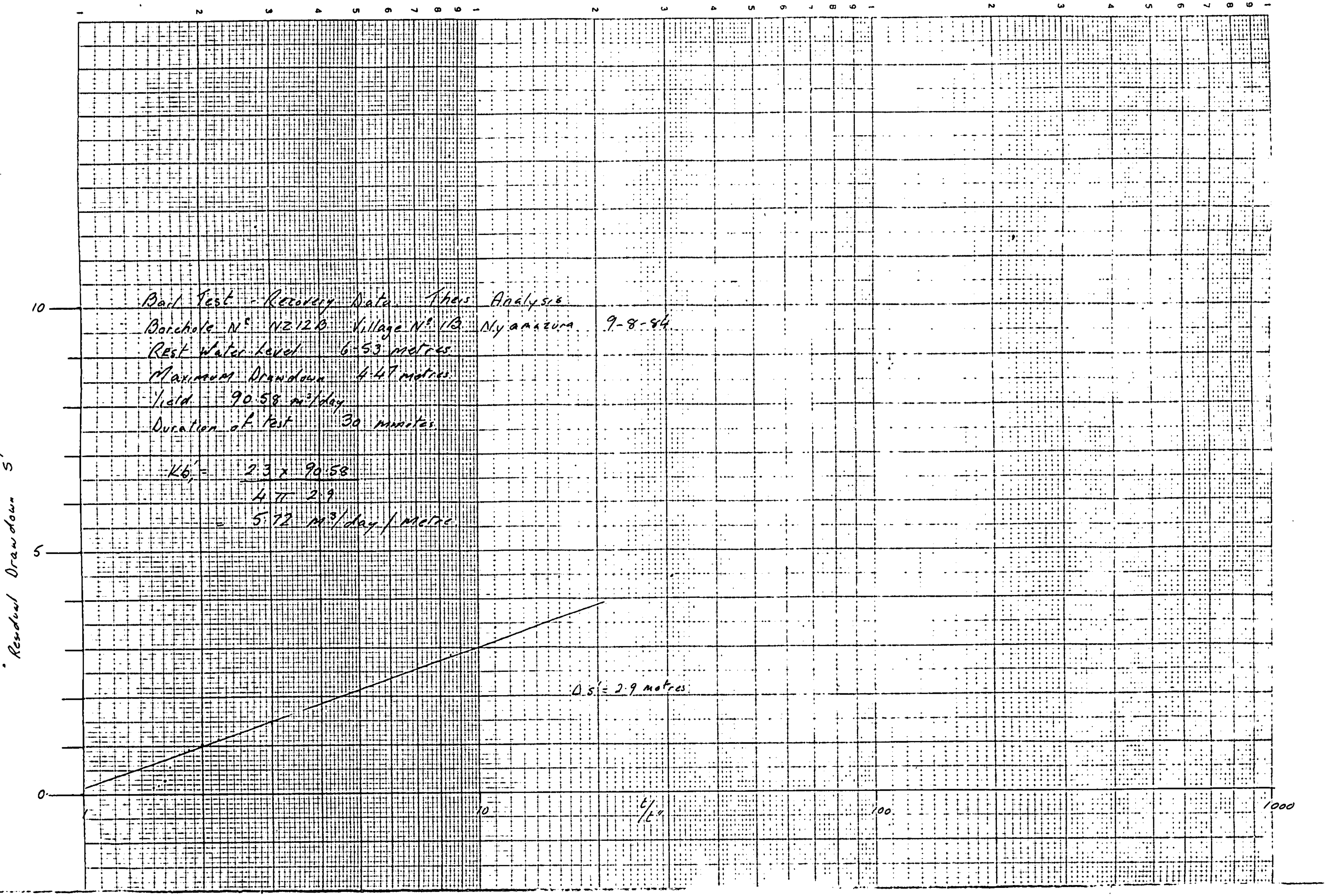
Draw down. 4-47 metres.

Amount of water bailed. 1·887 m^3.

Yield. 1·05 l/sec. 90·58 - m^3/ day

Specific capacity 20·26 m^3/ day / metre of drawdown.

Time after bailing stopped. (mins.)	Water level. (metres)	Residual Drawdown. (metres)	Recovery. (metres)	t/t'
1	10-98	4-45	0-02	31
2	10-96	4-43	0-04	16
3	9-94	3-41	1-06	11
4	9-37	2-84	1-63	8.5
5	9-12	2-69	1-78	7
10	8-27	1-74	2-73	4
15	7-98	1-45	3-02	3
20	7-80	1-27	3-20	2.5
25	7-67	1-14	3-33	2.2
30	7-56	1-03	3-44	2
35	7-46	0-93	3-54	1.86
40	7-35	0-82	3-65	1.75
45	7-11	0-58	3-89	1.67
50	6-82	0-29	4-18	1.60
55	6-72	0-19	4-28	1.55
60	6-68	0-15	4-32	1.50



Bail Test - Recovery Data Theis Analysis
Borehole Nº NZ12B Village Nº 1B Nyamazura 9-8-84
Rest Water Level 6.53 metres
Maximum Drawdown 4.47 metres
Yield 90.58 m³/day
Duration of test 30 minutes

$$Kb_1' = \frac{2.3 \times 90.58}{4\pi\ 2.9}$$
$$= 5.72\ m^3/day/metre$$

$\Delta s' = 2.9$ metres