GH 3197

# A GEOHYDROLOGICAL INVESTIGATION IN THE VICINITY OF SCHWEIZER-RENEKE, WESTERN TRANSVAAL


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N.B. These maps were originally drawn to the scale of 1:50 000 (A0 size) and were reduced to a scale of approximately 1:150 000 (A3 size) for convenience. Copies of the original maps can be obtained from the Information Section on request.



## ACKNOWLEDGEMENTS

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Additionally I would like to express my appreciation to Mr E.H. Stettler of the Geological Survey for his assistance in the interpretation of the aeromagnetic maps.

# 1. INTRODUCTION

## 1.1 Objective

The primary objective of this investigation was to ascertain whether alternative sources of ground water of a potable quality could be obtained for use by the municipality of Schweizer-Reneke within a reasonable distance of the town.

Such sources could be used either to partially supplement the existing sources of municipal water in Wentzel Dam or to provide the bulk of the municipal water during periods of severe surface water shortage.

Areas of favourable ground water occurrence were to be delineated but at this stage no production boreholes were to be developed for immediate use by the municipality.

## 1.2 Location of study area

The main study area is confined within a 15 km radius of Schweizer-Reneke, an area of about 700 $km^2$. The total area investigated is located within the lines of latitude 27°02' and 27°24' south, and within lines of longitude 25° 10' and 25°32' east. Map coverage is provided by the 1:50 000 topo-cadastral sheets 2725 AA (Amalia); 2725 AB (Schweizer-Reneke); 2725 AC (Diewedraai); 2725 AD (Koosfontein); 2725 BA (Glaudina) and 2725 BC (Sewefontein). Farms surveyed are listed alphabetically in Appendix 1.

## 1.3 Previous work

Prior to this investigation the geology of the Schweizer-Reneke district was well known but little co-ordinated information was available on geohydrological conditions.

The Schweizer-Reneke area was geologically mapped by Van Eeden in 1934-35. The result of the mapping were published by the Department of Mines in 1962 on one of the 1:125 000 series of geological maps namely 2725A. An explanatory booklet (Van Eeden, 1963), with a short section on ground water, accompanied the published map.

The basic geohydrological information was provided by De Villiers (1961) from his experience of siting boreholes in the south-west Transvaal between 1949 and 1956. De Villiers proved that the electrical resistivity method contributed considerable improvement to the traditional techniques, namely dowsing, in borehole site selection on granite and quartzite but with less significant results being obtained from lavas and Karoo mudstones. The few chemical analyses that were published indicated high nitrate concentrations from sampled ground waters both in the granite (30 mg/l) and in the lava (80 mg/l) in the Schweizer-Reneke district.

Subsequent borehole siting assignments by the Geological Survey in the Schweizer-Reneke district were undertaken by Gordon-Welch (late 1950's) and Erasmus (mid-1960's). Few of the 30 borehole sites selected were subsequently drilled.

Water samples collected from municipal boreholes in Schweizer-Reneke in April 1980 were analysed and reported on by the Division of Chemical and Biological Services (1980). Organic pollution was inferred as the ground water was found to have a high concentration of nitrite and nitrate, plus a high faecal coliform bacteria count. Information on municipal boreholes drilled in 1979 was supplied by Cahi (1980).

Steyn (1980) conducted a short investigation into the ground water potential of part of the Schweizer-Reneke municipal area. Five boreholes sites were selected and reported on. The borehole Ss 11 (G32304) was at that stage incorporated into the municipal borehole field. (Borehole Ss 20 (G32303) should also now be included.)

Information on boreholes previously drilled by the Boring Services subdivision of the Department of Water Affairs was provided on DW56 completion forms.

Details on inflows, releases and evaporation losses from Wentzel Dam were obtained from the Division of Hydrology and details on various yield analyses were extracted from Planning Division File No. P330.

Complete aeromagnetic coverage was available from east-west flights flown in 1977 and 1978.

## 1.4 Background of investigation

Wentzel Dam with full supply capacity 5,29 X $10^6 m^3$ (1979) is usually capable of providing adequate supplies of surface water for municipal consumption in Schweizer-Reneke (0,53 X $10^6 m^3$ in 1979) in addition to supplying downstream irrigators (0,6 X $10^6 m^3$ in 1979). However as a result of reduced inflow into the dam due to subnormal rainfall over the dam catchment during the preceeding two years the dam storage at the end of 1979 was reduced to 20% of the full supply capacity. In anticipation of the situation worsening the municipality commissioned the development of a borehole field in the south-western portion of the town for the abstraction of ground water. By May 1980 a number of boreholes had been equipped and connected to the town water distribution system. Abstractions from Wentzel Dam were discontinued in May 1980.

To meet the town's municipal water requirements, namely 0,53 X $10^6 m^3$ per annum, it was planned to abstract ground water from this borehole field at an average rate of 22,6 l/s based on a pumping schedule of 18 hours per day. Declining borehole yields resulted in the visit of Steyn and Venter of this Division in August of that year. They noted that the continuous abstraction of ground water in this area was resulting in seriously declining ground water levels and established an observation borehole to monitor this decline. An additional abstraction borehole was established adjacent to the borehole field in an attempt to restore the required pumping rate. By November 1980 the pumping rate had declined to about 14 l/s when pumped for 20 hours per day and a water supply crisis was developing in Schweizer-Reneke. Fortunately heavy rains at the end of November resulted in the recovery of the dam level and surface water again became available from Wentzel Dam.

Since December 1980 there has been no serious municipal water supply problem in Schweizer-Reneke. However in view of the town's growing municipal water requirements and the possibility of further 'dry' periods occurring in the future this current geohydrological investigation was commissioned to identify other favourable water-bearing formations in reasonably close proximity to Schweizer-Reneke which could be capable of supplying all, or part, of the municipal water requirements.

It is envisaged that surface water and ground water be utilized conjunctively as conditions dictate. In other words during periods of above average rainfall and runoff of surface water that only surface water be utilized from Wentzel Dam, and that aquifers be allowed to recover. During periods of subnormal rainfall and surface runoff that ground water be used to meet the municipal water requirements. To this end a variable yield analysis on Wentzel Dam was undertaken by Langhout (Planning Report No. 330) utilizing 47 years of dam inflow and rainfall records. Three different scenarios were analysed. During the worst scenario a shortfall of surface water over a continuous period of 12 months would have to be supplied from ground water sources at a continuous pumping rate of 28,5 l/s. This would be sufficient to meet the municipal water requirements up to about the year 1990.

## 1.5 Approach of investigation

Initially the investigation was confined to land owned by the municipality. This was later expanded to an area confined within a 15 km radius of Schweizer-Reneke and detailed investigations were concentrated in more favourable areas. Accessibility and proximity to existing infrastructure was a consideration.

The initial exploration phase was aimed at producing a base map from a stereoscopic examination of areal photographs and from an interpretation of aeromagnetic, geological and topographic maps. The complied map effectively enable target areas to be delineated which could justify receiving more attention later. These areas were later subjected to detailed geological mapping and geophysical exploration, and exploration drilling was undertaken at some favourable sites.

To gain an insight of the regional ground water movement and quality, a ground water contour map was complied from ground water level measurements made during a restricted borehole survey and a ground water quality map was compiled from the results of chemical analyses undertaken on ground waters sampled in the area.

To estimate the possible potential of various water-bearing formations a number of aquifer tests were also undertaken.

The approach adopted was not to develop production boreholes at this stage for immediate use by the municipality but rather to delineate relatively limited areas which provided favourable conditions for the successful exploitation of ground water. Based on this report, and on other factors, the municipality would be in a better position to decide which areas could most economically be developed for the recovery of ground water for augmentation of the present municipal water supply.

## 2. MUNICIPAL WATER SUPPLY

### 2.1 General

Water for municipal consumption in Schweizer-Reneke has since the 1950's been supplied from Wentzel Dam apart for short periods. It is expected that for the foreseable future the dam will continue to provide the bulk of the municipal water requirements but not the entire requirements. This implies that supplementary supplies of municipal water will have to be supplied during periods of subnormal rainfall over the catchment when the dam is at a low level, ideally from ground water sources.

In 1980 the municipality had to provide domestic water for a total population of about 10 700 (Steyn, 1980). A population growth rate of about 3,5% is predicted for Schweizer-Reneke. The annual increase in rate of municipal water consumption is predicted to be about 5,2%. The annual predicted municipal water consumptions are shown in Table 1 below up to the year 2015.

TABLE 1: Water requirements to the year 2015

| Calender year | Water demand ($10^6 m^3$) | C.P.R. l/s | Calender year | Water demand | C.P.R. l/s |
|---|---|---|---|---|---|
| 1980 | 0,55* | 17,3 | 2000 | 1,52 | 48,2 |
| 85 | 0,71 | 22,5 | 05 | 1,95 | 61,8 |
| 90 | 0,91 | 28,8 | 10 | 2,51 | 79,5 |
| 95 | 1,18 | 37,4 | 15 | 3,24 | 102,7 |

(*not met) (C.P.R. = continuous pumping rate)

As yet there is very little industrial development and the largest water consumers are the two schools and the hospital. During 1979 the latter utilized 2,7% of the total municipal supply.

The marked seasonal demand for municipal water is clearly evident in Table 2 below.

TABLE 2: Monthly consumption pattern as a percentage of the annual water consumption

| | | | |
|---|---|---|---|
| January | 13 | July | 4 |
| February | 11 | August | 5 |
| March | 8 | September | 10 |
| April | 5 | October | 12 |
| May | 4 | November | 12 |
| June | 3 | December | 13 |

If the trends and seasonal demands continue it can be expected that by the year 2000 the peak demand for municipal water would require a continuous pumping rate of almost 75 l/s.

## 2.2 Availability and reliability of records

Available records on the quantities of surface water entering and being released from Wentzel Dam are incomplete. Useable records only exist for the period 1964 to 1981. Even for this period the record is incomplete. Table 3 and Fig. 15 show therefore only the minimum quantities of water released from the dam.

## 2.3 Wentzel Dam

Wentzel Dam is an earth wall dam constructed across the Harts River at a natural damming site between two low quartzite ridges. The dam has an upstream catchment of 9 220 $km^2$ over which a mean annual precipitation of 565 mm has been measured. The mean annual runoff from the catchment is estimated to be 37,0 X $10^6 m^3$. The present full supply capacity of the dam is estimated at 5,29 X $10^6 m^3$. At FSC (gauge plate reading 6,1 m) the area flooded behind the wall is 2 760 hectares. At FSC the maximum depth of water in the dam is 8,1 m and the average depth 1,9 m. Evaporation losses are very high estimated at 3,4 X $10^6 m^3$ annually for the period 1963/64 to 1979/80.

FIG. 15
G.H.P. 5656

BREAKDOWN OF WATER SUPPLIED BY WENTZEL DAM OVER THE PERIOD 1964 to 1981

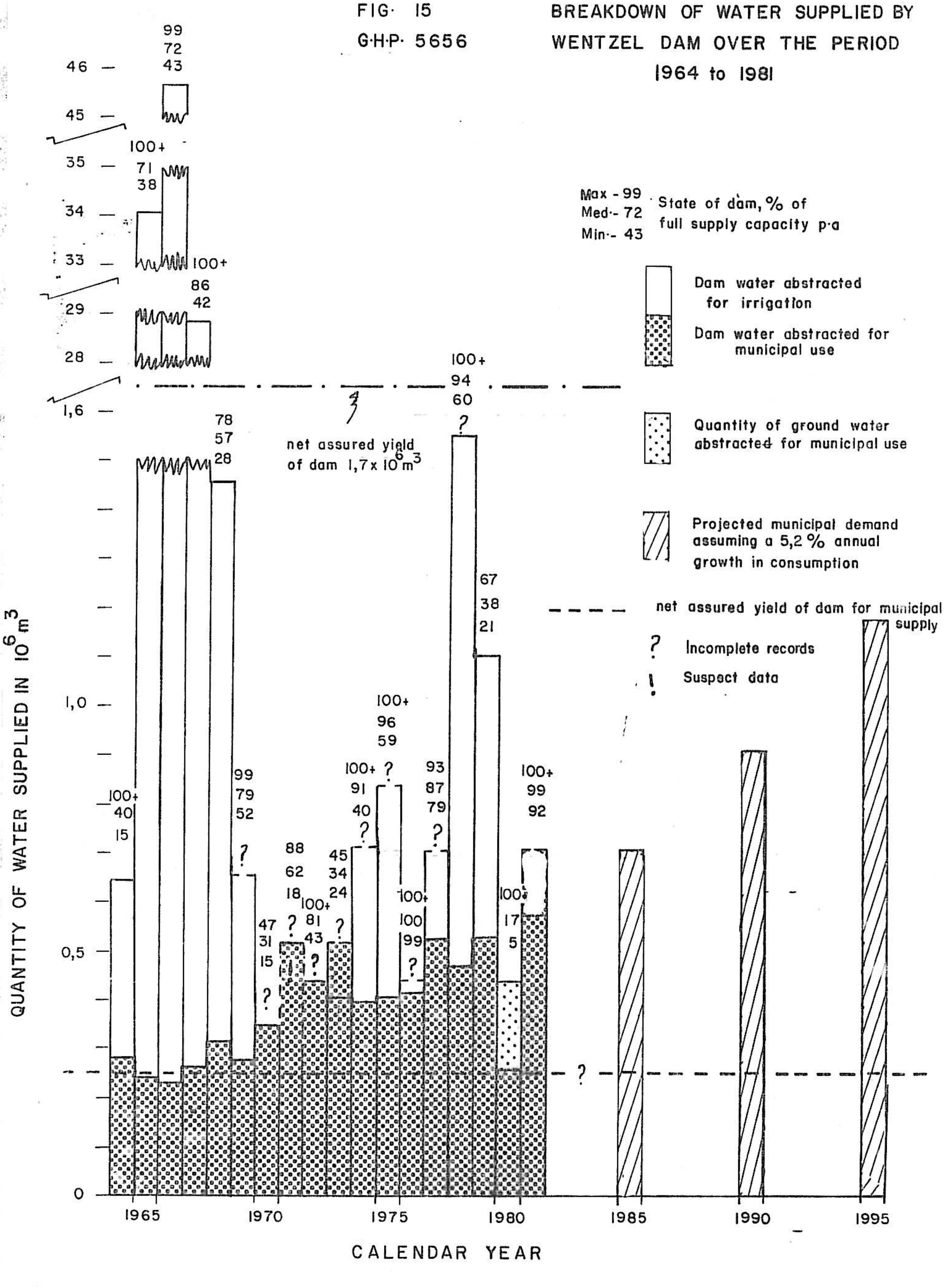


TABLE 3: Water releases from Wentzel Dam

| Calender year | Quantity of water released for irrigation $10^6 m^3$ | Number of months irrigation | Quantity of water released for Municipality $10^6 m^3$ | Schweizer-Reneke metered consumption $10^6 m^3$ |
|---|---|---|---|---|
| 1964 | 0,366 | 3 | 0,280 | no record |
| 1965 | 3,165 | 12 | 0,240 | no record |
| 1966 | 4,337 | 11 | 0,230 | no record |
| 1967 | 2,621 | 10 | 0,261 | no record |
| 1968 | 1,144 | 9 | 0,311 | no record |
| 1969 | (0,379) | 7 | 0,276 | no record |
| 1970 | no record | no record | 0,348 | 0,348 |
| 1971 | no record | no record | 0,517! | 0,343 |
| 1972 | no record | no record | 0,436 | 0,391 |
| 1973 | (0,109) | (2) | 0,404 | 0,404 |
| 1974 | (0,318) | (9) | 0,394 | 0,394 |
| 1975 | (0,436) | (6) | 0,401 | 0,405 |
| 1976 | (0,028) | (1) | 0,411 | 0,412 |
| 1977 | (0,178) | (2) | (0,421) | 0,523 |
| 1978 | (1,088) | (8) | 0,465 | 0,497 |
| 1979 | (0,573) | (6) | 0,528 | 0,529 |
| 1980 | NIL | NIL | 0,254 | 0,431* |
| 1981 | 0,139 | 3 | 0,511** | no record |

( ) incomplete records

! suspect record

* difference made up by ground water

** not including December 1981

A recent sounding survey undertaken by this Department indicated that the original volume of the dam has been significantly reduced as a result of sedimentation within the dam.

The dam was built at the request of the Transvaal Irrigation Board and apparently became fully operational on 1934. The original purpose of the dam was to supply via two canals (see Enclosure 1) water to the irrigation scheme situated downstream adjacent to the Hart River. In the mid-1950's surface water from the dam was also being used by the Schweizer-Reneke municipality to meet local demand. To safeguard the interest of the municipal water consumers a minimum low level was imposed below which no water was to be released for irrigation. The level was recently re-established at a gauge plate reading of 4 m corresponding to a dam volume of 1,39 X $10^6 m^3$ or 26% of the FSC. This minimum level still applies.

The quantities of water released annually from Wentzel Dam are given in Table 3 from 1964 and diagrammatically in Fig. 15.

## 2.4 Municipal water supply

Available records indicate that Wentzel Dam adequately supplied municipal water from 1964 to May 1980. During this period varying quantities of surface water were released for irrigation (Table 3 and Fig. 15).

For the first time on record abstraction from the dam was discontinued in May 1980 due to the poor quality of the water remaining in the dam. From May 5 to November 1980 Schweizer-Reneke was totally dependent on ground water (see section 1.4). During this period of seven months a municipal water shortage developed as only 0,177 X $10^6 m^3$ of ground water could be recovered from the shallow weathered granite near town. The borehole field consisting of six and later seven boreholes was located within an area of 15 hectares (for locations see Enclosure 1 and Steyn, 1980). The limited borehole records available are presented in Table 4.

TABLE 4: Borehole data, Schweizer-Reneke Municipality

| Borehole number | Date drilled | Depth (m) | Casing length (m) Ø 165 mm | First water strike (m) | Tested yield (l/s)* | Initial pumping rate (l/s) | Pumping period hours/ day |
|---|---|---|---|---|---|---|---|
| Ss2 | 1979 | 22,3 | 12 | 12,8 | 17,5 | 7,5 | 18 |
| Ss3 | 1979 | 22,8 | 12 | 13,0 | 16,1 | 5,0 | 18 |
| Ss5 | 1921 | 36,6 | ? | ? | ? | - | pumped occasionally |
| Ss6 | 1979 | 36,6 | ? | ? | 11,4 | 3,8 | 18 |
| Ss7 | 1979 | 39,6 | ? | ? | 3,8 | 2,6 | 18 |
| Ss8 | 1979 | 39,6 | ? | ? | 10,1 | 3,7 | 18 |
| Ss11 (G32304) | 1980 | 40,0 | ? | ? | 2,8 | 2? | pumped occasionally |

(*Tested yields are for pumping period of 8 hours in December 1979.)

Ss 11 was drilled and tested for 9 hours in July 1979 and integrated into the borehole field.

The aquifer failed to supply the anticipated quantity of municipal water for the following reasons:

(i) no recharge to the aquifer took place from the nearby Harts River, and

(ii) the storage for ground water within the weathered granite was insufficient to maintain a constant pumping rate of 17 l/s.

With the dam again filling and overflowing in December 1980 water could again be abstracted for municipal consumption. The borehole field is not at present in use but is maintained in a state of readiness. Ground water level measurements indicate that by April 1981 ground water levels had again recovered to normal.

2.4.1 Total supply available

The Division of Planning has calculated that the net assured yield of Wentzel Dam is 1,7 X $10^6 m^3$ annually, equivalent to a continuous pumping rate of 54 l/s. However if downstream irrigators utilized their full and rightful allocation only 0,25 X $10^6 m^3$ per annum would be available for municipal consumption by Schweizer-Reneke, equivalent to a continous pumping rate of about 8 l/s. Reference to Table 3 indicates that the Schweizer-Reneke municipality has abstracted considerably more than 0,25 X $10^6 m^3$ per annum for many years and that this state of affairs is expected to continue in the future particularly as more irrigators relinquish their quotas of irrigation water.

Extended pumping of ground water during 1980 demonstrated that only about 0,2 X $10^6 m^3$ is available to the municipality from the existing borehole field. If no competition was experienced from private boreholes to the south of the borehole field an additional 0,1 X $10^6 m^3$ of ground water may become available for municipal use.

If use is made of both Wentzel Dam and the borehole field the minimum quantity of water available annually to the municipality would be

$$(0,25 + 0,20) \times 10^6 m^3$$
$$= 0,45 \times 10^6 m^3$$

However it might be expected that for most years at least 0,5 X $10^6 m^3$ could be supplied from the dam plus the 0,2 X $10^6 m^3$ from ground water giving a total of available water of 0,7 X $10^6 m^3$, sufficient to about the year 1985.

In the case of total expropriation of the rights of downstream irrigators a potential supply of 1,9 X $10^6 m^3$ annually could be made available to the municipality sufficient to about the year 2005 assuming projections of water consumptions to be correct.

It is apparent that in the event of subnormal runoff into the dam again occurring, repeating the crisis condition of 1980, that the ground water available for exploitation at the municipal borehole field would be totally inadequate.

Further it is apparent that the estimates made previously of the quantities of ground water available for use at the existing borehole field were grossly in error.

2.4.2 Alternative solutions

As a potential water supply problem exists in Schweizer-Reneke several possible solutions can be proposed as to how the municipal water supply can be augmented. These are listed below, not in order of importance;

(i) increase the net assured yield of Wentzel Dam by raising the wall,

(ii) reduce the quantity of water released from Wentzel Dam to downstream irrigators, ultimately by expropriating all rights of irrigators,

(iii) improve the runoff characteristics of the Harts River catchment above Wentzel Dam,

(iv) pipe water from Bloemhof Dam,

(v) incorporate Schweizer-Reneke in the Orange Free State Goldfields water scheme,

(vi) use treated sewage effluent,

(vii) the development and utilization of available ground water resources in the area.

It is to this latter solution that this report is addressed, being the most feasible and immediate solution to the potential municipal water shortage in Schweizer-Reneke.

## 3. PHYSIOGRAPHY

### 3.1 Topography and drainage

The area investigated is part of the Highveld region with elevations varying between 1 270 and 1 400 m above M.S.L. The major drainage artery is the Harts River which conveys the only perennial surface water flow in the area. The general configuration of the topography might have been iniated during the Karoo glacial period.

Van Eeden (1963, p.5) has described the landscape as part of:

"....... a great, undulating plain diversified with low rounded hills or rises and hollows which differ little from one another and from the general plain in height."

Despite this low natural relief two major drainage basins exist in the study area, namely C330 (part of the Harts River system) and C325 (part of the Vaal River system), which are separated by a sometimes pronounced surface water divide. This ridge, trending approximately north-east to south-west (see Enclosure 2), forms the topographic high of the region with a maximum elevation of 1 397 m on Panfontein 58 HO. South and south-east of this divide the ground surface slopes very gently southwards with a gradient of $8 \times 10^{-4}$ on De Park 87 HO.

In the north-west of the area a very poorly defined drainage divide with an elevation of approximately 1 360 m separates the tributaries of the Dry Harts River from those of the Harts River to the south.

The Harts River draining south-westwards is characterised by a uniformly gentle gradient of approximately 1 X $10^{-3}$. The actual fall in elevation is from 1 313 m in the north-east to 1 270 m in the south-west over a distance of some 41 km.

The valley of the Harts River within the lava areas tends to be relatively narrow; slopes towards the river are of the order of 3 X $10^{-3}$. A gap some 300 m wide has been cut through the ridge formed by quartzites of the Bothaville Formation, north-east of Schweizer-Reneke where the Harts River manifests the phenomenon of superimposed drainage. Downstream of this gap the flood plain of the river basin becomes considerably wider, up to 1 000 m in places, as the Harts River meanders across the plain underlain by granite.

Throughout this area there is a clear relationship between geology, topography and drainage. East of Schweizer-Reneke Karoo mudstones overlie lava and form a high flat plain which has a very poorly defined drainage network and is thus subject to occasional water logging. This area is characterised by the development of numerous shallow pans or depressions some of which are incised up to 10 m below the local topography. Immediately east of Schweizer-Reneke, where the Karoo formations are absent, lava forms a better defined ridge but again surface drainage is poor.

The quartzite produces a small escarpment with the scarp slope often rising some 20 to 30 m above the surrounding plain. This ridge gives rise to several dip slope streams e.g. Hamburg Stream and occasional strike streams which follow the contact between the sedimentary rock and the overlying lava.

It is noticeable that the granite forms more rolling landscape which is well drained by numerous tributaries of the Harts River. (See minor catchments on Enclousure 2.)

Small hills rising some 20 m above the local landscape e.g. on Palachoema 64 HO, are caused by outliers of quartzite resting on granite.

## 3.2 Climate and vegetation

Schweizer-Reneke falls within the northern steppe climatic zone of Southern Africa (Sn.). This zone is characterised by very cold winters and excessively hot summers with precipitation occurring principally as the result of thunderstorms in summer and autumn. Rainface station No. 397/581 has been operating in Schweizer-Reneke since 1953. From these records, for the hydrological years 1953/54 to 1980/81, the mean annual rainfall has been calculated as 509,5 mm, with a standard deviation of 136,6 mm. Total precipitation plotted as both bar graphs and as a curve of cumulative departure from the rainfall mean in Fig. 16 confirms the variability of the rainfall. Subnormal rainfall in two consecutive years 1978/9 and 1979/80 was responsible for the water shortage experienced in the town during 1980.

The natural vegetation cover of Kalahari Thornveld invaded by Karoo has been extensively modified by man. However, natural vegetation types persist on quartzite, lava and some gravel outcrops e.g. on parts of Mimosa 61 HO, Rietput 60 HO and Schweizer-Reneke Townlands 62 HO. Elsewhere the original vegetation has been all but cleared and replaced by grasslands capable of supporting a higher livestock density or by arable lands. The main crop is maize with some groundnuts being grown on the more friable soils. Where water for irrigation is available lucerne, wheat and market vegetables are grown.

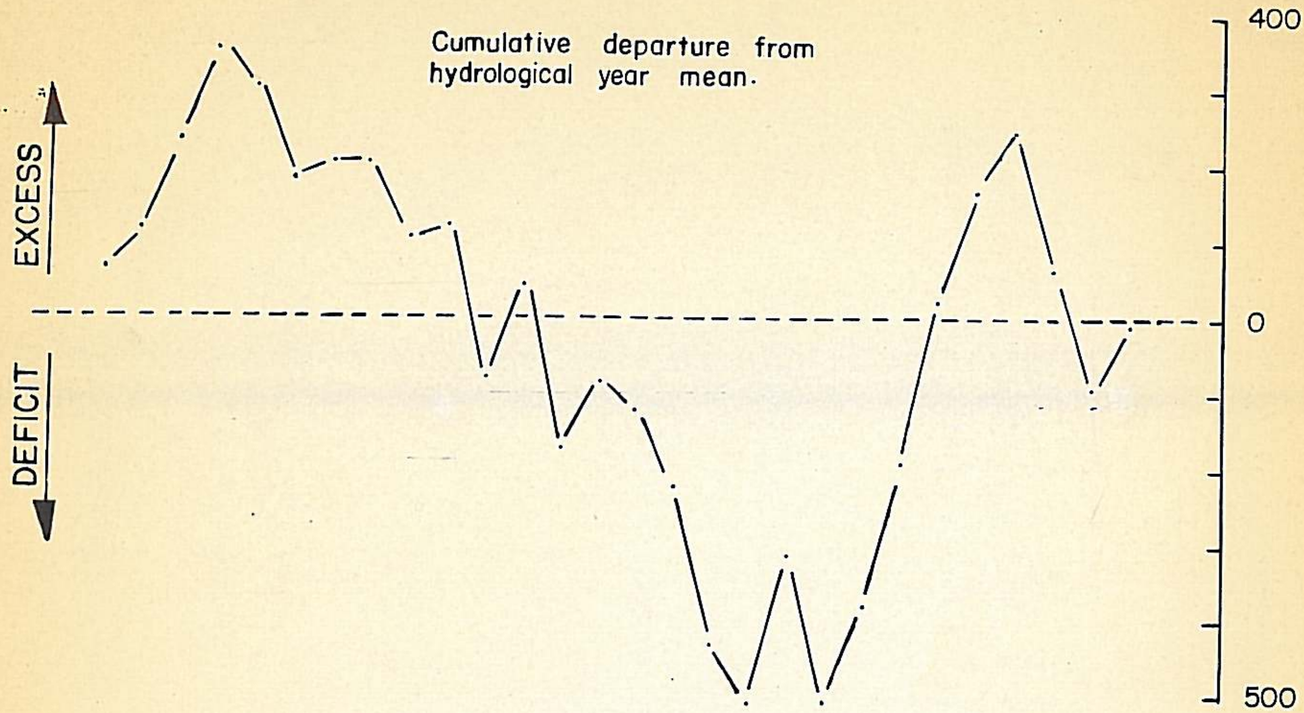
# 4. GEOLOGY

## 4.1 General

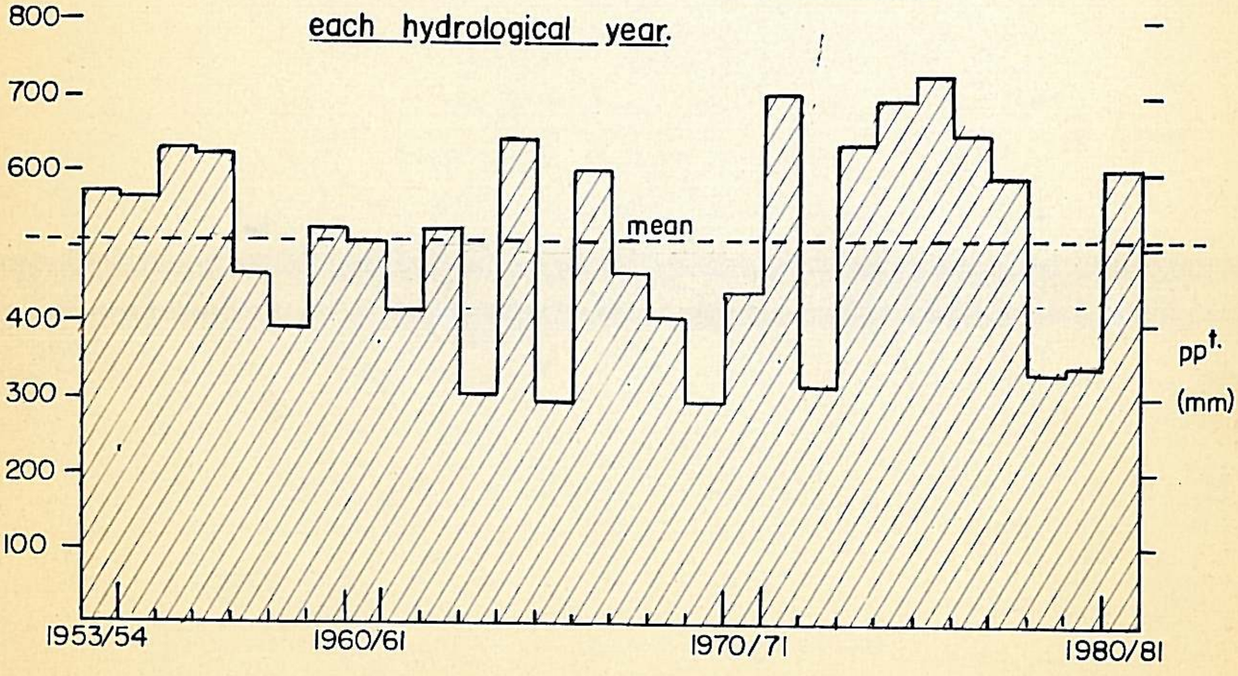
The distribution of the geological formations outcropping in the vicinity of Schweizer-Reneke is depicted in Enclosures 1 and 2 while the relationship between formations is shown by the cross-section in Fig. 17. Lithostratigraphic terminology is according to S.A.C.S. 1980.

FIG. 16 CHARACTERISTICS OF RAINFALL STATION

G.H.P. 5657 No. 397/581, SCHWEIZER — RENEKE POLICE STATION FOR THE HYDROLOGICAL YEARS 1953/54 TO 1980/81.




Histogram showing total precipitation in each hydrological year.




N.B. Hydrological year is from October to September.

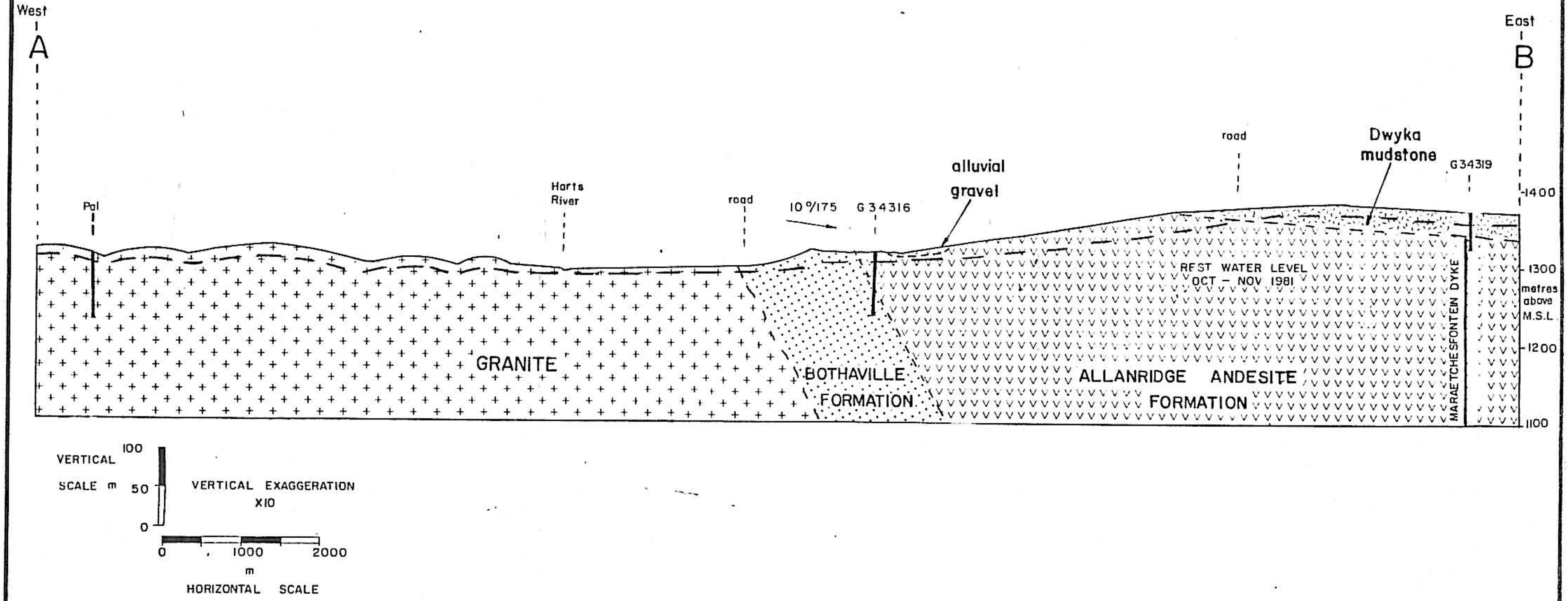
station altitude: 1280 m

mean precipitation = 509,5 mm

standard deviation 136,6 mm

FIG. 17
G.H.P. 5658

# GEOHYDROLOGICAL PROFILE OF SECTION LINE A-B




| HERSIENING / REVISION | | | | |
|---|---|---|---|---|
| HOD Nr./No | DATUM DATE | BESKRYWING DESCRIPTION | VIR FOR | W-WESE W.A. |

DIREKTORAAT VAN WATERWESE | DIRECTORATE OF WATER AFFAIRS

ADJUNK-DIREKTEUR-GENERAAL / DEPUTY DIRECTOR GENERAL

ONTWERP DESIGNED
GETEKEN DRAWN
INGENIEUR ENGINEER
NAGETREK TRACED RMKgosana 1/82
NAGESIEN CHECKED
INGENIEUR ENGINEER
GOEDGEKEUR / APPROVED
ASSISTENT HOOFINGENIEUR ASSISTANT CHIEF ENGINEER

REPUBLIEK VAN SUID AFRIKA
DEPARTEMENT VAN WATERWESE, BOSBOU EN OMGEWINGSBEWARING

REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF WATER AFFAIRS, FORESTRY AND ENVIRONMENTAL CONSERVATION

HOOFINGENIEUR / CHIEF ENGINEER
BEREKENINGSLÊER CALCULATIONS FILE
PROFESSIONELELÊER PROFESSIONAL FILE
TENDER Nr / No
KONTRAK Nr CONTRACT No
VEL/SHEET van of
ANDER Nr./OTHER No.
VEL/SHEET van of
GEREG. Nr./REG. No.

G.P.S. (8181)

The Archaean basement complex comprises rocks of the Swazian era that have been intruded and metamorphosed by younger siliceous magma. In the area studied older sedimentary sequences were deposited on the uneven, eroded floor of this basement and are now arranged quaquaversal to the central dome. The regional dip is fairly shallow being only 6 to 12° while local dips of up to 20 or 30° are caused by small scale antiforms and synforms. Extruded apparently conformable onto the sedimentary sequence were numerous, thick, mainly andesitic lava flows. During and after this period of volcanic activity tectonic movement commenced. This was responsible for the development of faulting and fracturing along north-south and north-east to south-west trending lines. Pre-Karoo diabase dykes were emplaced along some of the zones of structural weakness.

After subsequent intense glaciation in Karoo times sedimentary rocks, mainly argillaeous, were deposited unconformably across the exposed irregular rock floor of lava. These rocks are horizontally bedded indicating only minor earth movement since, however some fracturing and faulting with accompanying dyke intrusion, again with a dominant north-south trend, has occurred.

A long period of erosion then followed which has resulted in the present rock distribution, the accumulation of superficial deposits and the formation of soil.

## 4.2 Kraaipan Group

The main outcrop of this group occurs some 3 to 4 km west of the studied area on the farms Abelskop 75 HO and Goudplaats 96 HO. Dynamically and thermally metamorphosed sediments and lava constitute this group. These rocks are highly folded, faulted and fractured. The principal rock types developed are various kinds of schists (mainly chlorite-schists), quartzite (partly magnetic), chert, jaspelite, banded ironstone, amphibolite and lava.

Within the studied area small outcrops (xenoliths) of amphibolite and quartzite occur within the granite, e.g. on Mooilaagte 91 HO. Previous workers have assigned these to the Kraaipan Group. Similar rock types crop-out on Hamburg 82 HO and were also encountered in drilling on both Hamburg and Mimosa 61 HO.

The presence of sub-cropping Kraaipan Group rocks might be indicated by north-south trending intense magnetic gradients both north of Schweizer-Reneke and west of longitude 25° 15' E as indicated on the aeromagnetic map.

## 4.3 Archaean granite gneiss

These rocks occur west and south-west of Schweizer-Reneke. Borehole records and the presence of small inliers of granite indicate that granite subcrops below a thin cover of Ventersdorp Supergroup north of Schweizer-Reneke.

The granite generally exhibits only weak foliation, although occasionally strong foliation does occur. The granite gneiss varies in colour from grey-green to pink depending on the proportion of pink, orthoclase feldspar phenocrysts present. The rock is medium- to very coarse-grained with occasional aplitic and pegmatic phases. The major minerals invariably present are orthoclase feldspars, quartz and plagioclase feldspars. Muscovite, biotite, hornblende and pyroxenes also occur though their importance as rock-forming minerals is very variable. Occasionally they constitute up to 10% of the rock while at other times they are all but absent.

Feldspar have generally been altered to sericite, calcite, or chlorite. Within the zone of intense weathering generally less than 15 m, the ferromagnesian minerals and to a lesser extent the feldspars have been decomposed to form various clay minerals.

Within the granite gneiss are thin layers (xenoliths) of micaceous schists, pyroxenite-amphibolite and recrystalline quartz (e.g. on Hamburg 82 HO).

## 4.4 Ventersdorp Supergroup

Due to progressive overlap on the eroded, uneven Archaean basement only the uppermost formations of the Ventersdorp Supergroup outcrop. These are the lithostratigraphic units of the Bothaville and Allanridge Andesite Formations. Deep drilling indicates that younger lavas of the Platberg Group underlie the Bothaville Formation eastwards in the main basin e.g. borehole Sb 1 on Springbok 191 HO (Van Eeden 1963). North of Schweizer-Reneke, only a thin cover of Bothaville and Allanridge Andesite Formation is present covering a palaeo-topographic high.

### 4.4.1 Bothaville Formation

This formation forms a conspicuous topographic feature as it is composed of relatively resistant, dipping, sedimentary rocks. Although the Bothaville Formation is unconformable on the granite, the unconformity has not been observed in the field. The topmost contact with the overlying lava is sharp, but in certain localities e.g. G34315 (Fig. 10) intercalations of lava and quartzite occur indicating more or less contemporaneous lava effusions and sedimentation phases. (Van Eeden 1963.)

The thickness of this formation is probably in the order of 100 m. Borehole logs presented by Van Eeden (1963) show that a maximum drilled thickness of 124 m, dip about 10°, was encountered on Springbok 191 HO. During the present investigation the formation was never fully penetrated and the maximum thickness drilled was only 49 m, dip 6°, in G34314.

Van Eeden (1963) observed that the basal succession is characterised by conglomerates and grits.

Examination of rock exposures and drill cuttings demonstrate that the formation is composed principally of fine- to medium-grained arenites. The colour of these rocks is extremely variable ranging from milky-white through grey-green to lilac and purple-red. The degree of cementation is also extremely varied, in some cases the rock is an extremely hard quartzite while in other cases cementing material has disappeared and the rock is a friable sandstone. These changes in the degree of cementation occur rapidly vertically e.g. see Fig. 9 and less sharply horizontally, e.g. contrast Fig. 11 and Fig. 12.

The contrast in the relative hardness of these rocks may be partly explained by bedding joints and the effect of weathering. Quartzite units are generally well bedded, unit thickness generally 0,6 m, and demonstrate cross bedding with occasional ripple marks. The more friable zones are generally thinly bedded and occur both as thin units some 50 mm thick between quartzite bands, and as thicker units up to 2 m thick. Well cemented, fine-grained sandstones and siltstones also occur and have been locally quarried for floor and roofing tiles.

4.4.2 Allanridge Andesite Formation

This formation is principally composed of many separate flows of andesitic lava. The thickness of this succession increases rapidly down dip of the outcrop of the underlying sediments. On Springbok 191 HO this lava formation is some 480 m thick (Van Eeden 1963).

The lava is generally andesitic but occasionally rhyolitic. Thin bands of tuff and agglomerate are preserved between some lava flows.

Fresh lava ranges in colour from light grey-green through green to dark grey-blue and from very fine-grained to coarse-grained. Large amygdales of chalcedony and jasper, sometimes epidotised, are locally common. Black and greenish phenocrysts, up to 2 mm also occur.

Joints and fractures are often filled with silica, calcite and epidote. Weathering is extensive and fairly deep even where lava apparently crops out e.g. G34316 which was sited on outcrop. The weathering process produces abundant clay. Where more than 15 m of Karoo rock is present, the underlying lava is generally fresh and unweathered.

## 4.5 Karoo Sequence

Rocks of Karoo age (assigned to the Dwyka Formation and Ecca Group by previous workers) unconformably overlie much of the Allanridge Andesite Formation. The outcrop pattern preserved is the remnant of a much more extensive cover. Due to the easily erodable nature of these argillaceous rocks no exposure of Karoo rocks have been observed in the studied area. Information on the distribution of the Karoo must therefore be inferred from borehole records, aeromagnetic maps and aerial photographs. Thus the map presented in Enclosure 1 and 2 is subject to revision and must be treated with circumspect.

Drilling records indicate that on Geluk 56 HO the thickness of the Karoo rocks is some 50 m so that the lava/Karoo contact is at approximately 1 310 m above M.S.L. The thickness of Karoo encountered in G34319 was 33 m (contact at 1 350 m) and in G34318 was 6 m (contact at 1 330 m). These elevations indicate that the eroded surface of the lava is highly irregular and thus the thickness of the Karoo deposits should also be highly variable.

The formation encountered during supervised drilling was a monotonous sequence of greyish occasionally purplish mudstone which in part contain calcareous concretions and are finely laminated. Interbedded with the argillaceous rocks are rare thin sandstone layers. No diamactite was observed.

## 4.6 Superficial deposits

Much of the solid geology of the area is masked by varying thicknesses of superficial deposits which include soil, sand alluvium, river-terrace gravels and calcrete.

4.6.1 River-terrace gravels

Proved deposits have been shown separately in Enclosures 1 and 2. These deposits are found along the Harts River valley and old drainage courses. As these gravels have been extensively worked for their diamond content good exposures occur. Diggings show that the gravel usually directly overlies bedrock and that the gravel thickness is generally less than one metre but occasionally thicker, e.g. at Schweizer-Reneke. The gravel consists of mainly poorly size-sorted pebbles within a clay and silt matrix. Principal pebble types are fairly well rounded chert, chalcedony and jasper, derived from the lavas of the Ventersdorp Supergroup. Numerous pebbles and boulders of eluvial lava also occur. Occasional pebbles of granite and banded ironstone, when found within the lava subcrop, may be derived from the weathering of Karoo rocks. Stone artifacts have been found within the gravels on Hamburg 82 HO and Maraetchesfontein 54 HO.

4.6.2 Calcrete

Major occurences of outcropping calcrete have been indicated in Enclosures 1 and 2. The calcrete occurs in the form of hardpan calcrete, less than one metre thick, and as massive calcrete, up to 4,5 m thick, in river valleys and pans. This hard rock is generally white to cream in colour, fine-grained, pseudo-bedded and contains occasional fractures.

Downward migration of calcium rich solutions has caused the local calcification of underlying gravels and weathered bedrock.

4.7 Lineations

The interpretation of aerial photographs and aeromagnetic maps revealed the presence of some 280 km of traceable lineaments. These lineations represent structural features, i.e. faulting and fracture zones, some of which have been intruded by magmatic material.

The compass rose plot presented in Fig. 18 demonstrates the predominately north-south alignment of these features. The major lineation directions are 170° - 180° and 000 - 010° with another well developed set at 030 - 040°. Although east-west lineations are all but absent, an airborne magnetic survey with north-south flight paths may have revealed the presence of more features in this direction.

Exploratory drilling has been carried out on four of these features with the following results:

- three represent dykes of which two are magnetic and the other not, (Maraetchesfontein 54 HO and Schweizer-Reneke Townlands 62 HO), and

- one represents locally magnetic amphibolite-pyroxenite (Hamburg 82 HO).

For convenience of description two dykes have been locally named i.e. Townland Dyke and the Maraetchesfontein Dyke.

## 5. GENERAL GEOHYDROLOGY

Information for this section was obtained from the following sources:

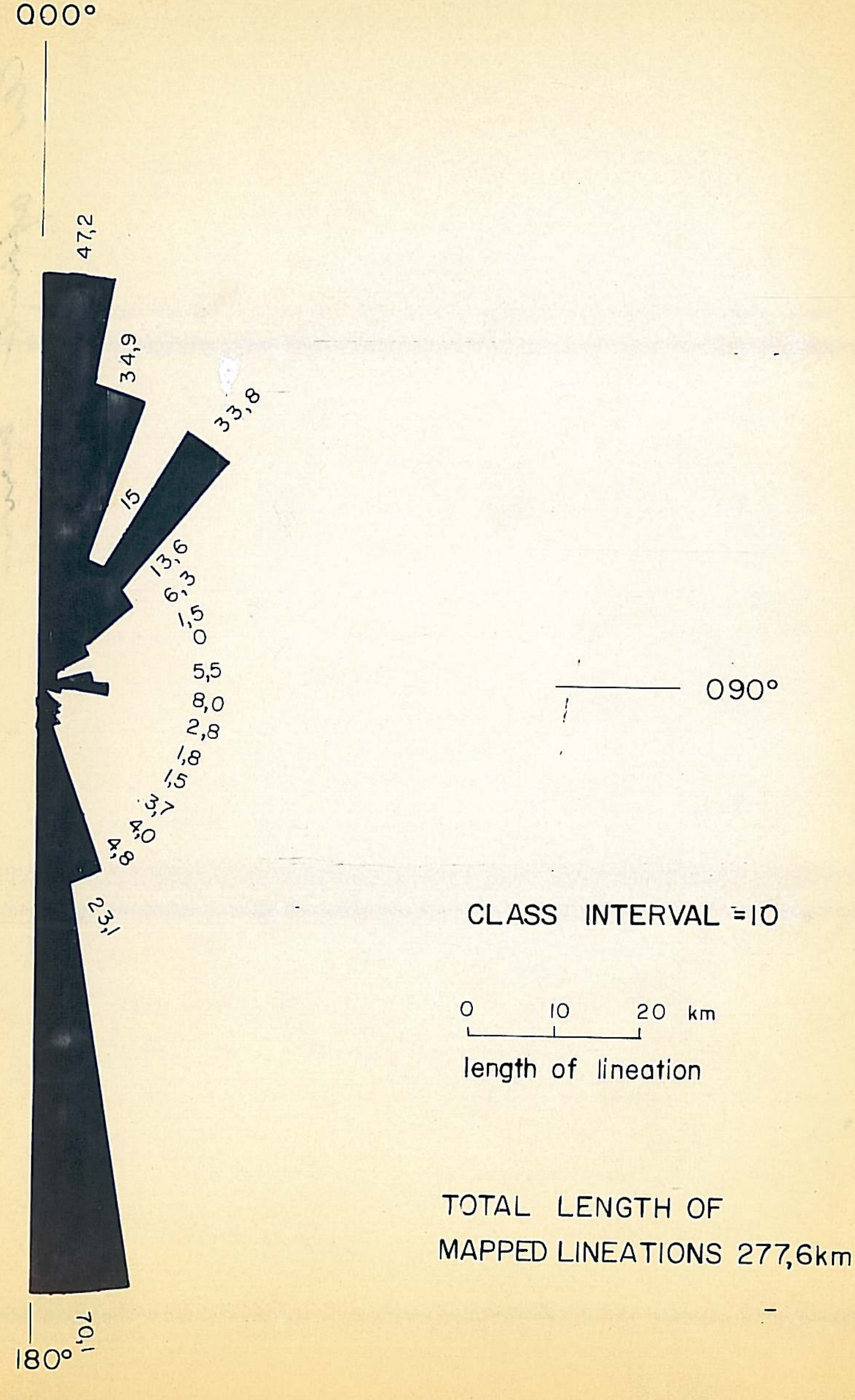
- records of the Boring Division of the Directorate of Water Affairs;

- Steyn and Venter (1980);

- partial borehole survey conducted by Bekker, Hoffmeyr and Taylor during August-December 1981 (borehole survey forms in Appendix 1);

- logging of 21 specifically drilled exploration boreholes, September-December 1981 (borehole profiles presented in Appendix 2 and Figs. 1 to 14).

FIG. 18 COMPASS ROSE PLOT OF VISIBLE LINEAR
GHP 5659 FEATURES PRESENT ON AERIAL PHOTOGRAPHS
AND AEROMAGNETIC MAPS



## 5.1 Water-bearing properties of aquifers

The rural population is dependent almost exclusively on ground water for domestic and stock watering purposes. In favourable areas ground water is used for irrigation (see para. 5.2). During 1980 ground water was used to augment the municipal water supply of Schweizer-Reneke.

Conclusions on the water-bearing properties of the aquifers present are based on the survey of 212 boreholes in the area and 21 exploration boreholes drilled in the present investigation (details summarised in Table 5).

Thirty-six private boreholes have yields reported by their owners in excess of 5 l/s (see Table 6) although only nineteen have been pumped at rates greater than 5 l/s (see Table 7). During 1981 only twelve boreholes were regularly being pumped in excess of 5 l/s. Five government boreholes drilled in 1981 had yields greater than 5 l/s.

| | | (Appendix 1) | 27° S | 25° E | (m) | Ø(m)xØ(mm) | (m) | | m above MSL | (1987) | Elevation | (See Encl. 1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2725AB335 G37603 | 138140/9 | Ss | 09' 55" | 03' 38" | 79 | 14x152 slots 10-12 m | - | seepage | 1 305$^{e}$ | - | - | do to 68,5 m then R | 5 m N of G-01 | Open |
| AB 349 G34301 | 138120/5 | ditto | ditto | ditto | 26 | - | - | seepage | - | - | - | do | EM 1/2 | Blocked |
| AB 350 G34302 | 138121/3 | ditto | ditto | ditto | 13 | - | - | - | - | - | - | do | 5 m W of G-01 | ditto |
| AB 351 G34303 | 138122/1 | ditto | ditto | ditto | 12 | - | - | - | - | - | - | do | 5 m W of G-02 | ditto |
| AB 352 G34304 | 138123/9 | ditto | ditto | ditto | 10 | - | - | - | - | - | - | do | 5 m W of G-03 | ditto |
| AB 353 G34305 | 138124/7 | ditto | ditto | 03' 37" | 14 | - | - | seepage | - | - | - | do | 10 m W of G-04 | ditto |
| AB 342 G34306 | 138125/5 | ditto | ditto | ditto | 54 | 6,1x165 | 38 | 0,1 | 1 305$^{e}$ | 8,28 (06/10) | 1 296,7 | R to 51 m then do | 5 m W of G-05 | Open |
| AB 343 G34307 | 138126/3 | Mn | 09' 05" | 10' 04" | 74,5 | 23,5x165 | 18 -<br>71 - | 0,1<br>11,0# | 1 342,294$^{1}$ | 7,79 (06/10) | 1 334,5 | Ra to 72 m then di? | EM 20 + M 32 | Open - production status |
| AB 344 G34308 | 138127/1 | ditto | 09' 05" | 09' 55" | 73 | 26,5x165 | 18 -<br>50 - | 0,1<br>6,0 | 1 341,620$^{1}$ | 7,63 (13/10) | 1 334,0 | Ra to 51 then di | EM 20 + M 32 | Open - production status |
| AB 345 G34309 | 13812/9 | ditto | 09' 03" | 10' 04" | 82,5 | 15,6x165 | 12 to 16 | 0,7 | 1 339,898$^{1}$ | 6,06 (19/10) | 1 333,8 | Ra | EM 19 + M 31 | Obs bh C3N047 |
| AB 263 G34310 | 138129/7 | Hg | 15' 07" | 17' 37" | 57 | 18x165 Slot 15-18 m. | 11 to 22 | 17,0* | 1 297$^{e}$ | 2,50 (21/10) | 1 294,5 | R with amphibolite | E.R.S. no 46 | Open production status |
| AB 265 G34311 | 138130/2 | ditto | ditto | ditto | 6 | 6,1x165 slots 2-6,1 | -<br>- | seepage | 1 297,152$^{1}$ | 2,74 (03/11) | 1 294,4 | Qc + R | 5 m E of G-12 | Open |
| AB 264 G34312 | 138131/0 | ditto | ditto | ditto | 41 | 18,3x165 slots 10,3 -18,3m | 12-13)<br>14 )<br>26<br>20 ) | Total 7,0 | 1 297,133$^{1}$ | 2,68 (03/11) | 1 294,5 | R with amphibolite | 30 m S of G-10 | Open |
| AB 251 G34313 | 138132/8 | ditto | 14' 55" | 17' 33" | 55 | 9x165 | 12)<br>15)<br>42 - | 2,2<br>0,6<br>Total 2,8 | 1 296,060$^{1}$ | 3,43 (03/11) | 1 292,6 | R with amphibolite | EM 15 + M 20<br>E.R.S. no 70 | Open<br>production status |
| AB 341 G34314 | 138133/6 | Ss | 09' 02" | 19' 44" | 73 | - | 17 -<br>41 -<br>48-52 | seepage<br>1,0<br>2,0<br>Total 3,0 | 1 306$^{e}$ | - | - | Ra to 24 m then Rb | E.R.S. no 174 | Collapsed site of production status |
| AB 337 G34315 | 138134/4 | ditto | 09' 20" | 20' 08" | 73 | 19x165 slots 12,9 to 19 m | 17 -<br>33 -<br>60 - | 2,0<br>0,9<br>1,4<br>Total 5,5* | 1 296$^{e}$ | 6,19 (12/11) | 1 289,8 | Ra to 28 m<br>Rb 28-32,5<br>Ra 32,5-39<br>then Rb | E.R.S. no 205 | Open production status |
| AB 340 G34316 | 138135/2 | Ma 61/ | 12' 18" | 20' 55" | 79 | 18,5x165 | 18 -<br>43 - | 0,1<br>1,5 | 1 314$^{e}$ | 12,91 (24/11) | 1 301,1 | Ra to 47 m then Rd | E.R.S. no 160 | Open |
| AB 339 G34317 | 138136/0 | ditto | 12' 20" | 20' 53" | 58 | 22x165 | 25 - | 3,0 | 1 314,6$^{e}$ | 13,75 (24/11) | 1 300,9 | Ra to 28 m then Rb | E.R.S. no 145 | Open |
| AB 346 G34318 | 138137/8 | Mn | 09' 01" | 25' 51" | 37 | 15x165 | 12 to 20 | 0,8 | 1 342,355$^{1}$ | 5,73 (30/11) | 1 336,7 | Qc to 5,5 m<br>K5, 5 - 12 m<br>then Ra | E.R.S. no 10 | Open |
| AB 336 G34319 | 138138/6 | Pn | 11' 36" | 25' 30" | 50 | 33x165 | - | seepage | 1 374$^{e}$ | 14,31 (04/12) | 1 359,2 | K to 33 then Ra | EM 24 + 29, M 41 and ERS Nos. 531 + 532 | Open |
| AB 338 G34320 | 138139/4 | Ma 61/ | 13' 57" | 19' 03" | 50 | 26x165 | 19<br>28)<br>29) | seepage<br>3,0 | 1 304$^{e}$ | 12,04 (04/12) | 1 292,0 | R with amphibolite | E.R.S. No. 294 | Open possible production status |

Yields = blow yields except for pumping yields as indicated as *; 1 = levelled e = estimated

TABLE 6: BOREHOLES WITH REPORTED YIELDS GREATER THAN 5 l/s CLASSIFIED ACCORDING TO FORMATION

N.B. ( ) = reported water strike (m)

| AQUIFER | R | Rb-R | Rb | Ra-Rb | Ra | Karoo-Ra | Karoo | Total |
|---|---|---|---|---|---|---|---|---|
| 5 to 9,9 l/s | 5 - Ma 61/2 (25-)<br>Ma 61/3 (25-)<br>Ma 61/10 (25-)<br>Ss 20 (30-)<br>G34312<br>(13 to 26) | 2 - Gn 2 (?)<br>Sl 2 (37-) | 1 - Je 1 (42) | 3 - Ma 61/9 (36-)<br>Rt 12 (30-)<br>G34315 (17,<br>33 + 60) | 3 - Lt 49/2 (30-)<br>Lt 49/4 (30-)<br>G34308 (50) | 4 - Dk 1 (23)<br>Mn 12 (17)<br>Sk 8 (58-)<br>Sk 9 (? ) | None | 18 |
| 10 to 14,9 l/s | 7 - Jl 3 (42)<br>Ma 61/1 (25-)<br>Pa 1 (36)<br>Rt 1 (30-)<br>Ss 4 (14 to 21)<br>Ss 5 (36-)<br>Ss 8 (39-) | None | None | None | 2 - Ln 1 (58)<br>G34307 (71) | 3 - Kl 2 (60)<br>Nt 86/2 (30)<br>Sk 5 (37-) | None | 12 |
| 15 to 19,9 l/s | 5 - Hg 1 (18)<br>Pa 5 (20)<br>Ss 2 (13 to 21)<br>Ss 3 (13 to 23)<br>G34310 (11 to 22) | 1 - Gn 1 (40-) | 1 - Rt 2 (?) | None | None | 2 - Sk 3 (46-)<br>Sk 4 (58-) | None | 9 |
| 20 to 24,9 l/s | None | None | None | None | None | 1 - Kl 1 (70) | None | 1 |
| Over 25 l/s | None | None | None | None | None | 1 - Sk 1 (58) | None | 1 |
| TOTAL | 17 | 3 | 2 | 3 | 5 | 11 | 0 | 41 |

TABLE 7: BOREHOLE THAT HAVE BEEN PUMPED IN EXCESS OF 5 l/s CLASSIFIED ACCORDING TO FORMATION

N.B. * boreholes pumped regularly in 1981 (total = 12)

| AQUIFER | R | Rb-R | Rb | Ra-Rb | Ra | Karoo-Ra | Total |
|---|---|---|---|---|---|---|---|
| 5 to 9,9 l/s | 8 - Ma 61/1*<br>Ma 61/2*<br>Ma 61/3*<br>Ma 61/10*<br>Rt 1*<br>Ss 2<br>Ss 3<br>Ss 20 | 1 - Gn 2* | 1 - Rt 2 | 1 - Ma 61/9 | 2 - Ln 1<br>Lt 49/2 | 1 - Mn 12* | 14 |
| 10 to 14,9 l/s | 1 - Hg 1 | 1 - Gn 1* | None | None | None | 2 - Kl 2*<br>Sk 1* | 4 |
| Over 15 l/s | 1 - Pa 5* | None | None | None | None | None | 1 |
| TOTAL | 10 | 2 | 1 | 1 | 2 | 3 | 19 |

### 5.1.1 Water-bearing status of the Archaean granite gneiss (R)

Within the area studied this formation can be generally regarded as a good aquifer capable of supplying adequate yields from shallow depths for domestic and stock watering purposes. Problems of water supply from this formation are experienced where extensive outcrops of unweathered granite occur, principally on the townlands and in the south-west of the area.

Of the 87 boreholes investigated 43% had yields reliably assessed as greater than 1,0 l/s (see Table 8) while 21% yielded more than 5 l/s.

Groundwater is usually abstracted from zones of weathering and fracturing at shallow depths (see Tables 5, 6 and 8). When weathered granite is either absent or unsaturated deeper boreholes (over 30 m) have been drilled with little success. The lack of success is due to fractures being generally absent at depths greater than 30 m. Locally quartz veins and pegmatites encountered in deeper drilling, may be fractured and may yield useful water supplies. Near surface fractured amphibolite-pyroxenite bands may improve the chances of obtaining adequate supplies of ground water. Experience gained during the drilling programme indicated that dyke contact zones do not appear to provide particularly favourable drilling sites.

### 5.1.2 Water-bearing status of the Bothaville Formation (Rb)

Primary pososity is virtually zero within these arenites thus the storage and movement of ground water is controlled by the presence of secondary openings, namely interconnected joints and fractures. Available borehole information suggests that the upper Bothaville arenites are better ground water yielders than the lower Bothaville arenites. This change in aquifer status is related to the fewer joint and fracture openings present in the lower part of the formation. The relative abundance of bedding plane joint and fracture openings in the upper sequence is tentatively correlated with deep chemical weathering (up to 80 m) accentuating differences between thinly and well-bedded arenaceous units.

Of the 11 boreholes drilled within the Bothaville Formation, 45% had yields in excess of 1 l/s and 18% greater than 5 l/s, while three boreholes were drilled well below the ground water level, without striking water. The drilling programme indicated that several individually low yielding water interceptions are generally made by boreholes drilled within this formation.

TABLE 8: BOREHOLE STATISTICS

| AQUIFER | R | Rb/R | Rb | Ra/Rb*** | Ra | Karoo/Ra | Karoo |
|---|---|---|---|---|---|---|---|
| No. of boreholes investigated | 87 | 8 | 11 | 11 | 61 | 55 | None located that have been drilled only within Karoo Formation |
| No. of boreholes in use | 63 | 8 | 3 | 7 | 46 | 38 | |
| Average depth of borehole (m) | 31 (54) | 43 ( 3) | 41 ( 7) | 61 ( 9) | 53 (23) | 50 (23) | |
| Average yield of boreholes 1/s* | 2,9 (74) | 3,9 ( 8) | 1,6 (10) | 3,5 (11) | 0,7 (41) | 2,4 (50) | |
| No. yielding 1 1/sec + | 37 | 5 | 5 | 8 | 12 | 24 | |
| No. yielding 1 1/sec + as % of total no. of boreholes | 43 | 63 | 45 | 73 | 20 | 44 | |
| Average depth of water interceptions (m) ** | 23 (30) | 38 ( 2) | 32 ( 3) | 42 ( 7) | 33 (21) | 38 (12) | |
| Average depth of water level below collar (m) | 7,7 (44) | 10 ( 3) | 13,5 ( 5) | 12 ( 6) | 10 (33) | 6,5 (34) | |

Average based on number of returns in brackets

* Windpump yields taken as 0,1 l/s, unless other information available and pumping yields of boreholes used rather than tested yield.

** In cases where multiple water interception reported deepest water interception used.

*** Average depth at which contract penetrated is 35 m (6 returns).

The highest yielding borehole Rt 2 was drilled into a fracture zone. It is expected that boreholes drilled into dyke contact zones and lineaments may have improved yields.

5.1.3 Water-bearing status of the Allanridge Andesite Formation (Ra)

Boreholes drilled exclusively within this formation generally have poor yields (see Table 8). Sixty-one boreholes have been investigated, of which only 20% yield more than 1,0 l/s and only 8% in excess of 5 l/s.

The water-bearing zone generally exploited in this formation is the weathered zone which is generally sufficiently permeable, at depths between 15 and 30 m, to produce yields of 0,1 to 1,0 l/s. Where the weathered zone is absent, unsaturated or produces insufficient ground water deeper drilling has often been successful in locating increased quantities of ground water in deep fractures e.g. borehole Ln 1-13 l/s at 58 m and Ma 61/6 - 2,5 l/s at 71,5 m. Some boreholes penetrating fracture zones associated with lava-dyke contacts have encountered good yields e.g. G34308 blow yield 6 l/s.

5.1.4 Water-bearing status of the Karoo Sequence

Within the area studied no boreholes were located that were drilled exclusively within the Karoo Sequence. It is expected that the mudstones are very poor aquifers and that their principal importance is their ability to store ground water, which under pumpage will leak into the underlying lava aquifer.

5.1.5 Water-bearing status of the alluvial deposits

Most of these deposits are not of importance as aquifers as they are thin and usually lie above the present zone of saturation. However the superficial deposits do function as efficient ground water recharge areas for the underlying water-bearing formations.

### 5.1.6 Influence of formational contacts on water-bearing status

Borehole statistics (Table 8) suggest that boreholes penetrating one of the three major lithological contacts viz arenite-granite, lava-arenite and mudstone-lava have generally higher average yields than those boreholes that are drilled exclusively in one formation. For this reason the water-bearing properties of these contact zones have been considered separately from the principal water-bearers enumerated above. These formational contact zones are discussed below:

Bothaville Formation - Archaean granite gneiss (Rb-R)

This contact zone seems to be a good water bearer. Of the eight boreholes investigated five yield more than 1 l/s and three in excess of 5 l/s.

Due to favourable topography the arenite-granite contact has been successfully exploited north of Schweizer-Reneke but elsewhere access to suitable drilling positions on this contact is difficult.

Allanridge Andesite Formation - Bothaville Formation (Ra-Rb)

The eleven recorded boreholes drilled through this contact have been fairly successful of which eight yield over 1 l/s and three in excess of 5 l/s.

The average depth at which the lithological contact has been penetrated is 35 m, however the depth of penetration does not seem to greatly influence borehole yields. Borehole logs, Fig. 9 to 12, illustrate that ground water has not been struck directly on the lithological contact.

Karoo Sequence - Allanridge Andesite Formation (Karoo-Ra)

As up to 50 m of Karoo mudstone overlie much of the lava subcrop the mudstone has had to be penetrated to obtain ground water supplies for domestic and stock watering purposes.

In many cases good success has been achieved. Fifty-five boreholes are recorded of which 44% yield more than 1 l/s and 20% in excess of 5 l/s.

These good overall results have been attained despite the absence of weathered underlying lava in areas with more than about 15 m of Karoo cover. Successful boreholes are due to the penetration of interconnected fracture networks within the otherwise fresh lava. The deepest depth of fracturing recorded is at borehole Kl 1 which intercepted some 23 l/s at a depth of 70 m.

TABLE 9: DETAILS ON PRINCIPAL GROUND WATER CONSUMERS, 1980/81 SEASON

| Farm | Owner | Distance from Schweizer-Reneke (Km) | Pumping boreholes | Pumping rate (l/s) | Pumping period (hours) | Total quantity of water abstracted $10^6 m^3$ | Irrigated area (hectares) | Member of irrigation scheme | Formation |
|---|---|---|---|---|---|---|---|---|---|
| Groenpan 23 HO | Le Roux | 14,5 | Gn 1<br>Gn 2<br>Gn 3 | 13,8<br>6,0<br>3,7 | - 2 900<br>variable<br>variable | 0,144 plus | 8,6 | No | Rb/R |
| Kameelkuil 88 HO | Van der Merwe | 18,0 | Kl 2 | 12,5 | 4 960 | 0,223 | 17 | No | Karoo/Ra |
| Lot 7 49 HO | Deale | 6,5 | Lt 49/2<br>Lt 49/4 | 6,0<br>4,0 | 2 000? | 0,072 | 3 | No | Ra |
| Mimosa 61 HO | Van Rensburg | 1,0 | Ma 61/1<br>Ma 61/2<br>Ma 61/3<br>Ma 61/10 | combined<br>25,0 * | Combined<br>1 300 *<br>plus | 0,117 * plus | 25,7 | Yes (Principal consumer) | R |
| Maraetches-fontein 54 HO | Viljoen | 12,5 | Mn 12 | 8,8 | 2 090 | 0,066 | 2,6 | No | Karoo/Ra |
| Palachoema 64 HO | Visser (now Roos) | 5,0 | Pa 4<br>Pa 5<br>Pa 6 | 2,5<br>15,0 (12,5) **<br>3,1 | 3 440<br>4 770<br>3 440 | 0,031)<br>0,258) 0,327<br>0,038) | 12 | Yes (not used since 1979) | R |
| Rietput 60 HO | Reyneke | 0,5 | Rt 1 | 10,0 (6) ** | 1 100 | 0,040 | 10 | Yes (not used since 1979) | R |
| Springbok 191 HO | L.T.R. Holdings | 17,5 | Sk 1 | 14,4 | 2 190 | 0,114 | 6,5 | No | Karoo/Ra |

* Actual pumping rate declined from mid 1980 to end 1980 and pumping period extended.

** Pumping rate declined from mid 1980 to end 1980, pumping period reduced.

## 5.2 Principal consumers of ground water during 1980/81

Table 9 provides information on ground water consumption by irrigators for the 1980/81 agricultural season (refer to Enclosure 1 for borehole locations and Appendix 1 for borehole data). The total quantity of ground water abstracted by the eight main irrigators during 1980/81 was approximately 1,1 X $10^6 m^3$.

Where owners noticed declining yields from boreholes during 1980 this has been noted in Table 9. However as most farmers do not regularly measure borehole discharges the "set" pumping rate has been used to calculate ground water abstractions. Seasonal consumption fluctuates depending on the frequency and intensity of rainfall events and the availability and reliability of irrigation water from Wentzel Dam.

The pumpage listed for irrigator Van Rensburg is the minimum average amount annually required from ground water. If water is unavailable from the Wentzel Dam, or the privately owned dam on the Harts River, (river point 4) additional ground water abstraction is required to meet irrigation requirements, estimated at some 0,4 $10^6 m^3/a$. Other former surface water users on Rietput 60 HO and Palachoema 64 HO now obtain their water requirements directly from ground water. In previous years ground water for irrigation has been pumped on Hamburg 82 HO and London 112 HO, boreholes Hg 1 and Ln 1 respectively. However this practise has now ceased for economic reasons. In the near future pumpage will probably commence on Palachoema 64 HO from boreholes Pa 1 and Pa 2.

## 5.3 Piezometry

A piezometric contour map, refer to Enclosure 2, was compiled with 10 m contour intervals from ground water level measurements made during the period September - December 1981. 139 measurements were made, of which 40 had to be made while windpumps were operational. The collar elevations of most boreholes were estimated from the relevant topocadastral maps, although a few boreholes were levelled (see Table 5 and Appendix 1). A geohydrological profile along section line A-B is shown in Fig. 17.

Despite the low density of measurements, namely one measurement per 6 $km^2$, and the absence of data from such critical areas as the Harts River valley and the Townland Stream valley, certain general observations can be made of the ground water conditions prevailing in late 1981, viz:

- ground water flow within the Harts River basin is from the major ground water divides, with a gradient of $1 \times 10^{-3}$, towards the central portion of the valley, from where ground water movement is in a south-westerly direction under a shallower hydraulic gradient of $1 \times 10^{-4}$;

- a ground water divide coincides with the Vaal-Harts surface water divide. South of this divide ground water movement is in a southerly direction with a shallow gradient in the order of $2 \times 10^{-4}$;

- the poorly defined surface water divide between the Dry Harts and Harts River catchments is not coincident with the ground water divide. North of the ground water divide ground water movement is in a north-westerly direction;

- piezometric contours indicate that effluent conditions prevailed in the channel of the Harts River, i.e. the Harts River was receiving discharge from the water table. Discontinuous stretches of standing water in the channel confirms this;

- dykes and other lineations do not appear to influence the direction of ground water flow.

5.4 Periodic water level measurements

The ground water levels in two boreholes are at present being monitored namely:

C3N046 (Schweizer-Reneke Townlands 62 HO) - monthly automatic water level recorder established in July 1980, an old municipal borehole Ss 4, and

C3N047 (Maraetchesfontein 54 HO) - H.W.K. meter read monthly, established in December 1981 on boreholes G34309.

As both observation boreholes have only been operational for a short period of time, no hydrographs have been compiled. Ground level measurements taken at the two recorder stations C2N046 and C2N047 are tabulated in Appendix 1.

Due to poor installation and servicing the data available from C3N046 prior to October 1981 should be viewed with circumspect. However the dewatering of the municipal well field is clearly shown by water level measurements in C3N046 as is the rapid recovery of the aquifer after municipal ground water pumpage ceased. Recent hydrographs show that there is a clear correlation between water level rises in C3N046 and surface water flow in the nearby Harts River (200 m distant with an elevation difference of 5 m).

The 0,77 m rise in water level recorded by C3N047 between October 1981 and February 1982 must presumably have been caused by recent rains in the area.

The reappearance of seepage points along the bed of the Hamburg stream, some 200 m west of G34313 and the flowing surface springs on Palachoema (S1) indicate that at the end of 1981 ground water levels were high and had completely recovered from the effects of subnormal rainfall over the period 1978-1980. This statement is further supported by the full recovery of those boreholes which experienced declining discharges during the latter half of 1980.

## 5.5 Drilling programme

Information on the exploration boreholes drilled is presented in Table 5, summarised borehole logs in Appendix 2, Figs 1 to 14, and complete borehole logs in G.H.P. envelope No. 635. Rock chip samples were collected during drilling and are available for inspection in Pretoria Head Office.

All boreholes were drilled using a Rock Giant air percussion rig supplied by the Vryburg Boring Inspectorate. Over the period 1981-09-21 to 1981-12-08 twenty-one boreholes were drilled in eight target areas. The combined meterage drilled was 1 017 m. For 57 working days this is equivalent to an average drilling rate of 18 m/d. 270,6 m of mainly 165 mm diameter steel casing was installed in the completed boreholes.

Of the 21 boreholes drilled five had yields in excess of 5 l/s while seven boreholes can be classed as potential production boreholes.

### 5.5.1 Drilling difficulties and recommendations

Progress was fairly rapid as drilling conditions were generally good. The weathered rock, particularly the granite, is rapidly drilled by air rig. In all cases steel casing had to be inserted during drilling to the weathered rock-fresh rock interface. Where necessary this casing was perforated on site using an oxy-acetylene cutter. Borehole G34314 had to be abandoned as near-surface broken lava was not adequately cased off. The test pumping of borehole G34310 indicated that if heavy pumping of G34310 is planned the borehole should be reamed and fitted with a gravel pack (see section 8.2.1 for details) to prevent sand pumping and consequent damage to pumping equipment.

Progress through Karoo mudstone was slow, by air rig, as mudcake continually blocked the air vents in the drilling bit. This formation required complete casing off.

Drilling rates through the various hard rocks encountered were fairly uniform. However the Bothaville Formation presented a special problem as the exceptionally hard quartzite units were found to significantly grind down and thus reduce the diameter of the drilling bit. Consequently the diameter of boreholes penetrating the Bothaville Formation progressively decreased with depth e.g. from 165 to 154 mm approximately in G34315. Units of friable sandstone occurring within the Bothaville Formation may require complete casing off or grouting. When drilled these units appear as sand and local drillers have reported that this sand can cause the partial collapse of boreholes and damage to pumping equipment.

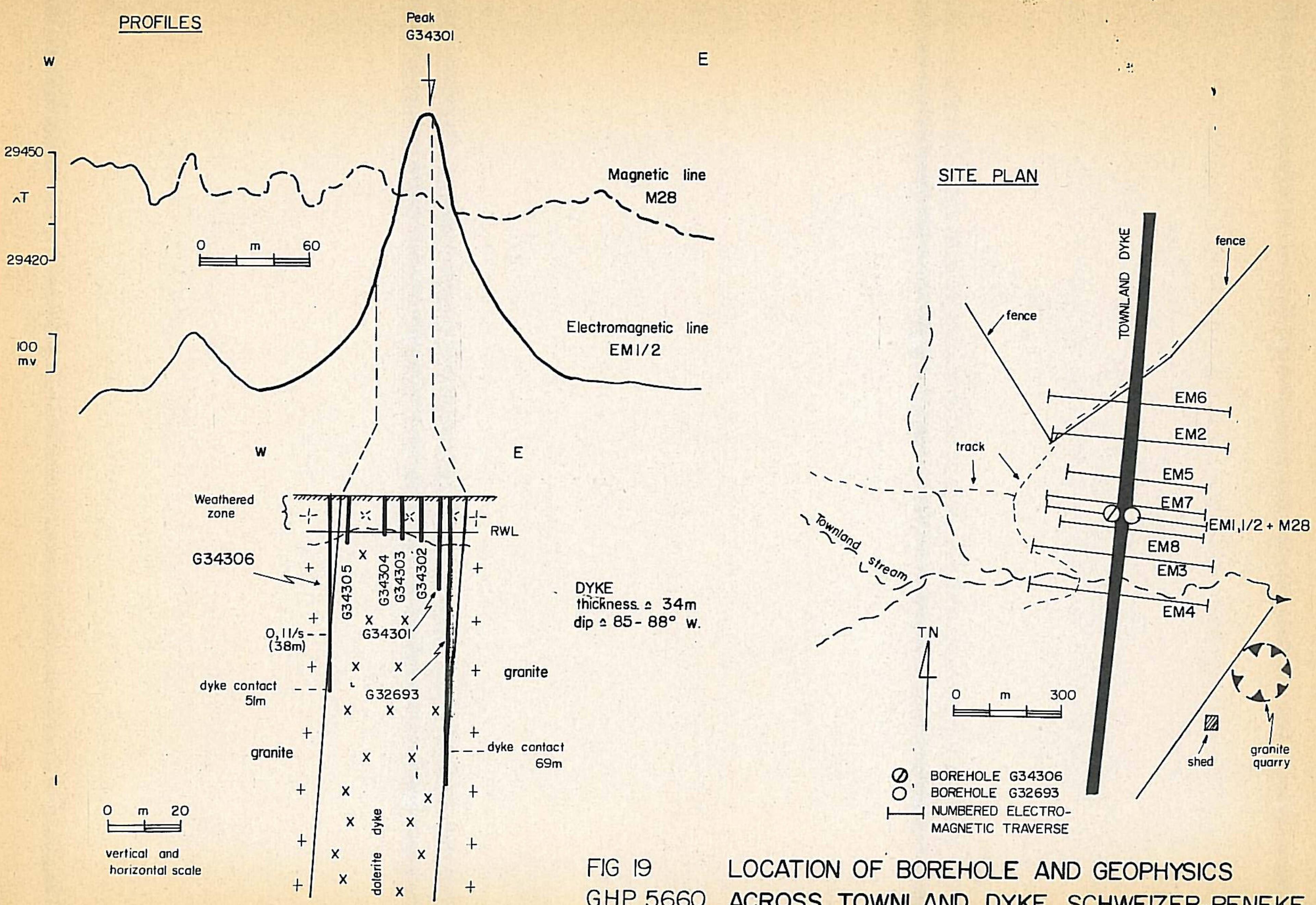



FIG 19 LOCATION OF BOREHOLE AND GEOPHYSICS

G.H.P. 5660 ACROSS TOWNLAND DYKE, SCHWEIZER-RENEKE TOWNLANDS 62 HO.

# FIG 20 LOCATION OF BOREHOLES AND GEOPHYSICS GHP 5666 ON PART OF HAMBURG 82HO

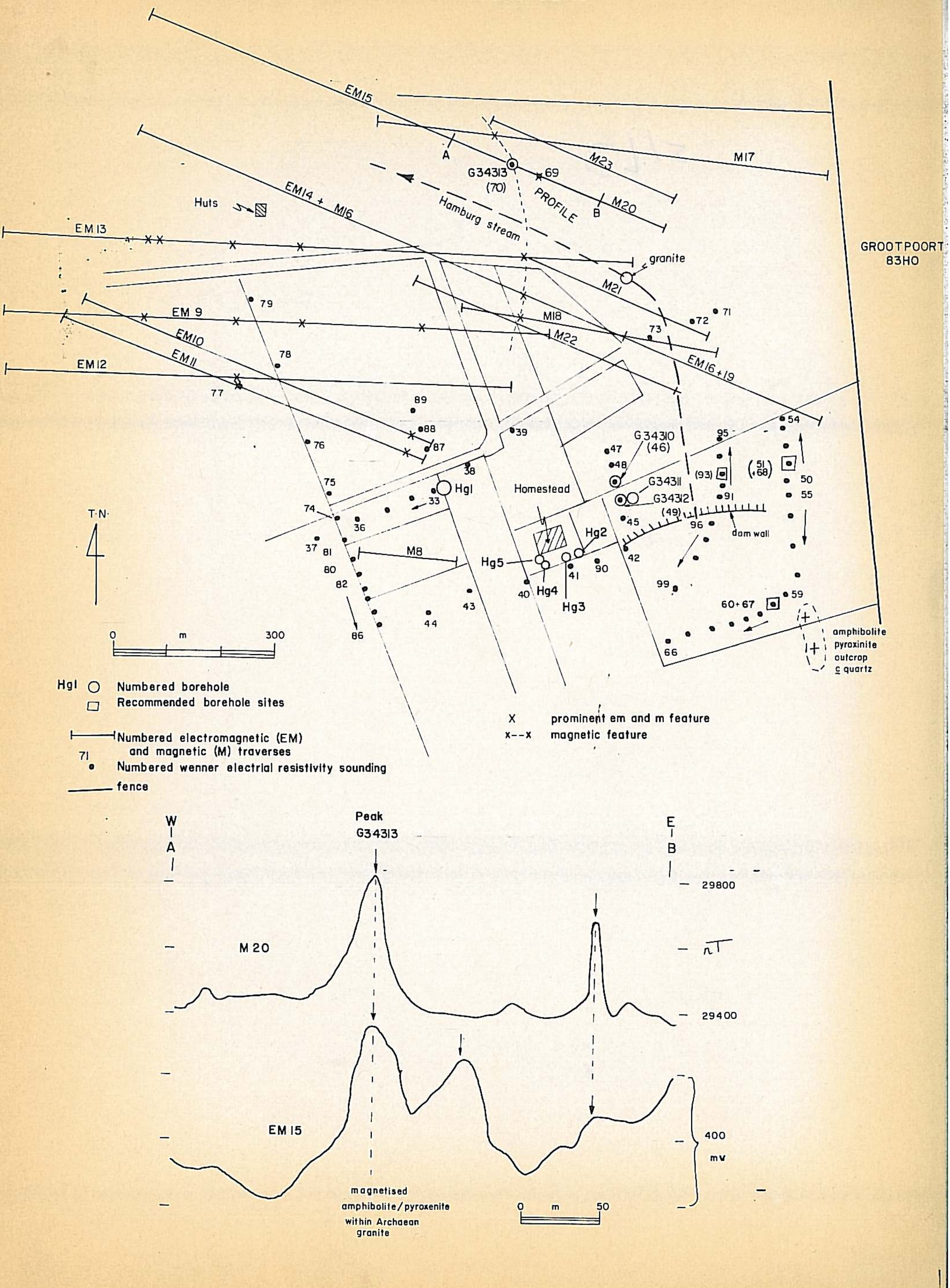
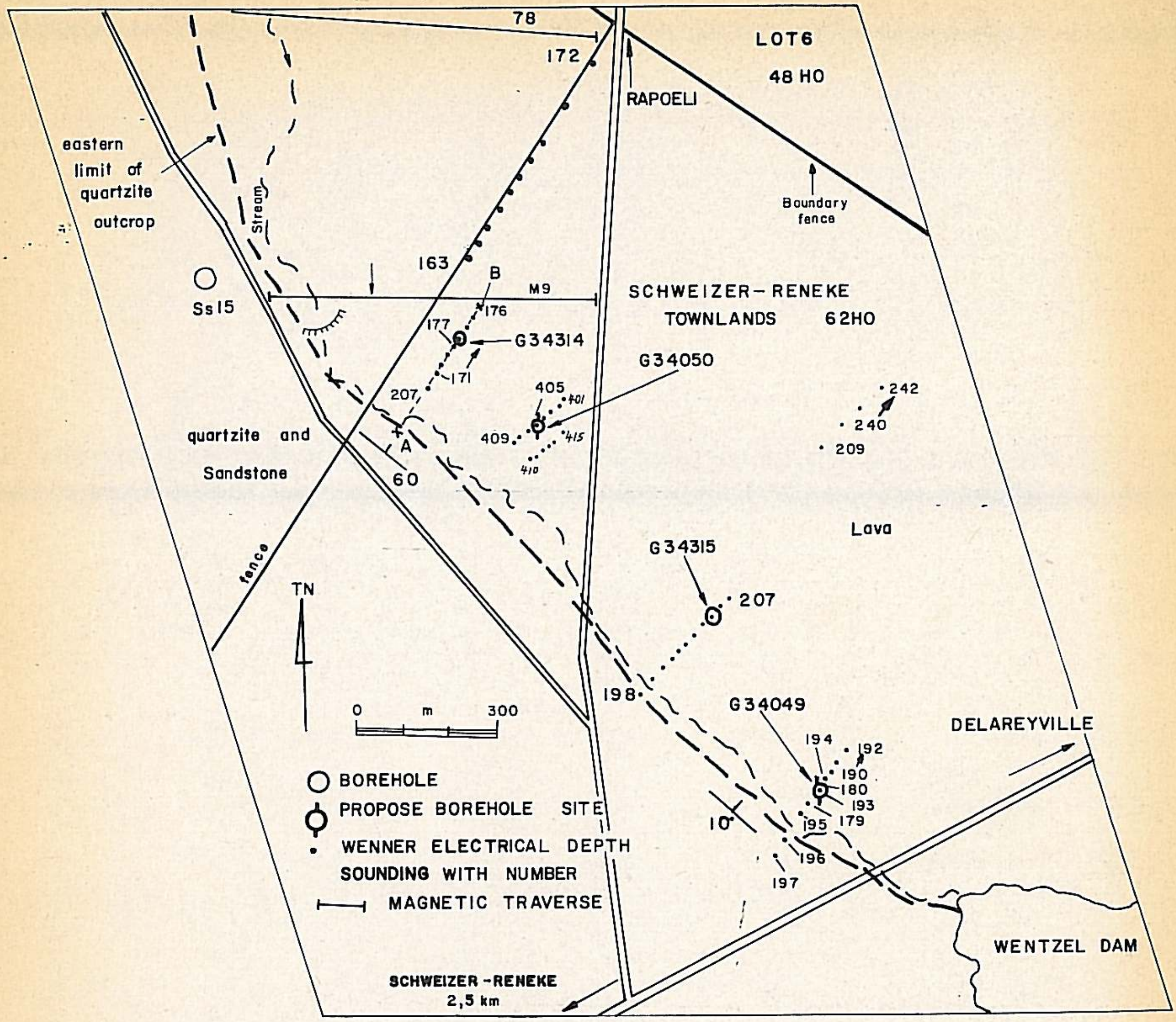
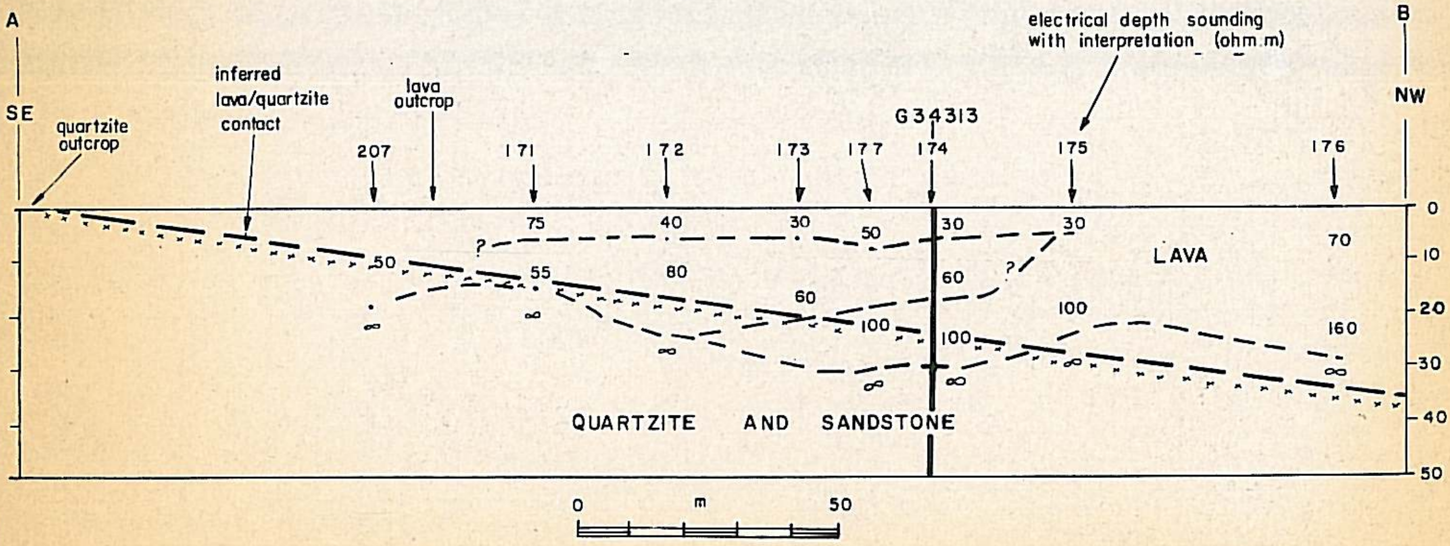


FIG. 21. LOCATION OF BOREHOLES AND GEOPHYSICS
G.H.P. 5667 ON LAVA/QUARTZITE CONTACT.
SCHWEIZER – RENEKE TOWNLANDS 62HO




GEOPHYSICAL PROFILE A-B

FIG. 22 LOCATION OF BOREHOLES AND GEOPHYSICS ON G.H.P. 5668 PART OF MARAETCHESFONTEIN 54HO.

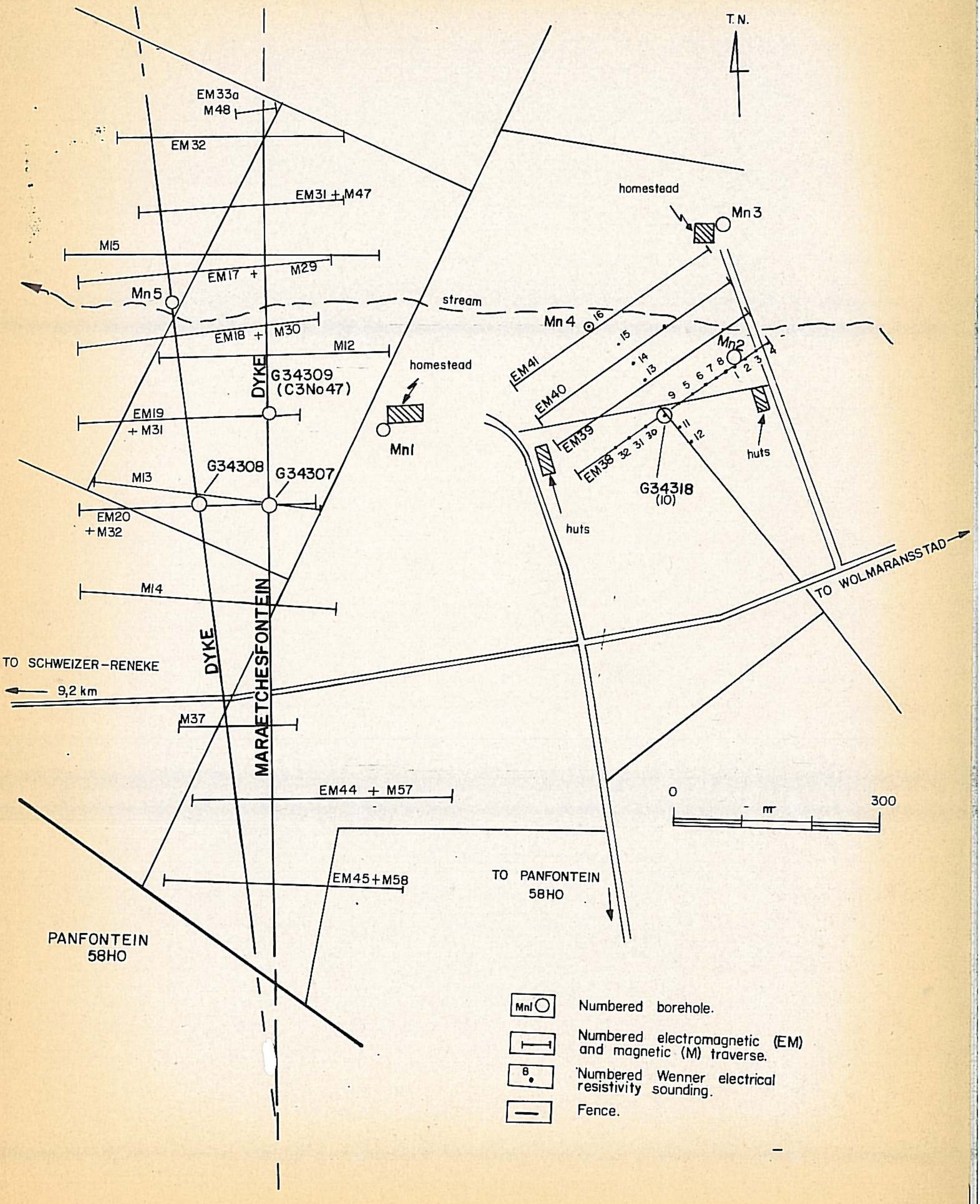
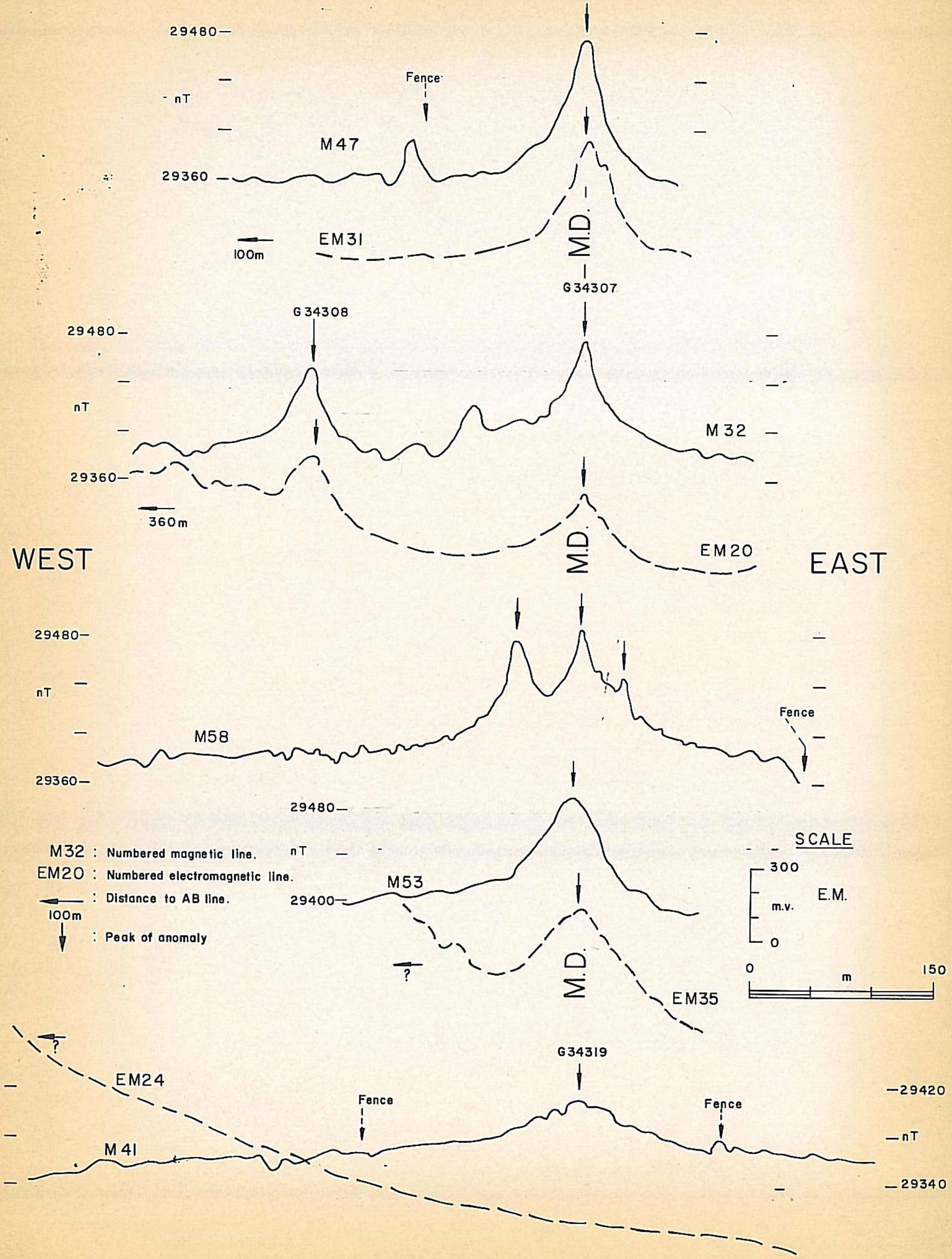


FIG. 23
G.H.P. 5669

# MAGNETIC AND ELECTROMAGNETIC PROFILES ACROSS MARAETCHESFONTEIN DYKE (MD) ON MARAETCHESFONTEIN 54HO AND PANFONTEIN 58HO



# 6. GEOPHYSICS

## 6.1 General

Surface geophysical techniques were employed to investigate the favourable areas for ground water occurrence which had been previously identified as target areas by the indirect methods mentioned in section 1.5. The results obtained were used to select sites for exploration drilling. The following geophysical work was undertaken in the course of the investigation:

- 59 ground-magnetic traverses
- 47 electromagnetic traverses, and
- 452 electrical resistivity depth soundings.

In addition 20 boreholes were electrically logged.

Enclosure 1 and Figs. 19 to 23 show the location of the geophysical work, while field measurements, curves and profiles are available for inspection in G.H.P. envelope No. 635.

## 6.2 Methods employed

Ground-magnetics - The Chemtron Proton Magnetometer (models G2 and G3) was used. These instruments measure the total magnetic field. Traverse lines were short, maximum length 1 300 m, and as they were rapidly completed no corrections were necessary for diurnal drift. Distances between stations were paced, one pace being approximately 1 metre. Station intervals were 10 paces which was reduced to 2,5 paces over features of interest. The magnetic method was useful in detecting lineaments caused by magnetic dykes and magnetised amphibolite-pyroxenite bands. It could also be used to detect the very approximate surface position of the lava-quartzite contact.

Electromagnetics - The Chemtron models G30 and G31 were used, current being supplied by a separate alternating current source. Traverse lengths of up to 800 m were made when field conditions permitted. Station intervals were similar to those employed for the magnetic traverses. The electromagnetic technique accurately located conductive lineaments, both magnetic and non-magnetic. It also indicated broad areas of weathering both within the granite and the lava.

Electrical resistivity depth soundings - The equipment available for making measurements of apparent electrical resistivity was the Gane-Enslin a/c field instrument. As the most appropriate information required was the relative depth to the underlying solid bedrock the Wenner electrode configuration was employed. Maximum spacings did not exceed 72 m and were commonly less than 42 m. The sounding curves produced were interpreted using the empirical method. The electrical resistivity method was successfully used to identify zones of deep weathering within the granite and the presence of Karoo mudstones. Limited success was achieved in identifying the lava-quartzite contact.

Borehole electrical resistivity logging - Resistivity readings were made using the Gane-Enslin instrument. A lateral electrode arrangement was employed with an M-N distance of 1 m. Boreholes were logged both down-hole and up-hole. The prime purpose of the logging was to check borehole logs, as deduced from drilling chips, with geophysical information. Where necessary corrections were made to lithological logs. Information was also provided on the resistivity ranges of the lithological formations present, see Table 10.

TABLE 10: TYPICAL ELECTRICAL RESISTIVITY RANGES OF GEOLOGICAL FORMATIONS

| Formation | Ohm.m |
|---|---|
| Karoo mudstone | 20 to 40 |
| lava, partly weathered | 400 to 1 200 |
| lava, fresh | 1 000 to 9 000 |
| quartzite | 500 to 8 000 |
| granite, weathered | 100 to 300 |
| granite, partly fractured | 250 to 600 |
| granite, fresh | 3 000 to 12 000 |
| amphibolite, fresh | 10 000 + |
| dolerite, fresh | 5 000 + |
| diabase, fresh | 2 000 + |

## 6.3 Results

### 6.3.1 Archaean granite gneiss

Townland stream valley - The electromagnetic technique was used to investigate a north-south, non-magnetic lineament on Schweizer-Reneke Townlands 62 HO. Profiles across this feature showed a prominent conductive zone flanked by minor subsidiary, positive anomalies (refer to Fig. 19). Exploration drilling (see Figs. 1 and 2) demonstrated that the prominent anomaly was caused by a dolerite dyke some 34 m thick, dipping at 85 to 88° to the west. This dyke was named the Townland Dyke.

Electrical resistivity depth soundings were carried out both upstream and downstream of the Townland Dyke. The maximum thickness of weathering detected was only 10 m, thus much of the weathered zone is currently above the present ground water table.

Ground-magnetic traverses were used to investigate a north-east to south-west trending low amplitude, positive aeromagnetic anomaly some 1 000 m east of the Townland Dyke. Traverses M10 and M11 failed to identify this feature on the ground however.

Hamburg 82 HO - Electromagnetic and magnetic work was initially concentrated on locating the north-south, low amplitude, positive, aeromagnetic feature that was initially thought to be associated with borehole Hg 1. South of Hg 1 a broad positive anomaly of some 80 nT amplitude was located by magnetic traverse M5. While north-west of Hg 1 a prominent narrow magnetic anomaly was located (refer to Fig. 20) the magnitude of which varied from 300 nT (M17) to over 1 200 nT (M18). Magnetic profiles indicated a steep dip to the west. A second smaller anomaly of some 250 nT was detected some 140 m to the east on Line M20. Magnetic measurements over an amphibolite outcrop indicated that this lithology was strongly magnetised. Exploration drilling (Fig. 8) on the peak of the large anomaly recorded by traverse M20 confirmed that this feature was caused by subcropping magnetised amphibolite-pyroxenite. Electromagnetic traverses detected a conductive zone coincident with the magnetic feature. Other broad electromagnetic anomalies are probably caused by areas of deep weathering within the granite.

Electrical resistivity soundings were used to locate the areas of deepest weathering. This was shown to be present in the valley of the Hamburg stream where depths of up to 30 m were interpreted from resistivity sounding curves. The successful borehole G34310, Fig. 6 was drilled on sounding No. 46 which indicated weathered material to 25 m with a resistivity value of some 115 ohm. m. Depicted on Fig. 20 are three recommended drilling sites.

Stream confluence, Mimosa 61 HO - The electrical resistivity sounding curves indicate that the granite is deeply weathered along the stream valleys. The depth of weathering confirmed by drilling (see Fig. 14) is up to 30 m with a corresponding saturated thickness of some 18 m. The resistivity range of the weathered rock is similar to that of Hamburg ie. 100 to 180 ohm.m.

Common boundary of Grootpoort 83 HO and Mimosa 61 HO - The possible northerly extension of a near vertical, north-south, dolerite dyke was investigated. Magnetic traverses indicated that the feature, if present, was non-magnetic. A positive electromagnetic anomaly recorded by profile EM 21 suggested that the dyke does continue northwards. However no further geophysical work was carried out across this dyke as access to the property was not permitted by the owner.

### 6.3.2 Contact between Bothaville and Allanridge Andesite Formations

Due to the low magnetic contrast and the low formational dip magnetic traverses were unsuccessful in locating the contact between lava and quartzite. The constant electrode spacing traverses on Rietput 60 HO were also unsuccessful in locating the contact. Therefore numerous electrical resistivity traverses lines were carried out across the approximate position of the formational contact and perpendicular to the expected strike. Sounding intervals were 25 to 30 m with AB lines aligned parallel to the strike.

The results obtained were somewhat variable. Where surface cover was thin, less than 2 m, sounding curves successfully located the formational contact by distinguishing solid quartzite from weathered lava overlying solid quartzite. The dip of the contact could not be assessed from the empirical interpretation of the two- and three-layer sounding curves.

Four boreholes (see Figs. 9 and 12) were drilled through the lava-quartzite contact where depth soundings indicated favourable weathering within the overlying lava. The results of this drilling, in collaboration with observed rock exposures, enabled the dip of the contact to be estimated. As the exploration drilling was moderately successful two proposed borehole sites have been selected on the townlands (see Fig. 21, sites No. G34049 and G34050).

### 6.3.3 Allanridge Andesite Formation, including areas covered by Karoo Sequence

Geophysics provided information on the following:

- depth of weathering within the lava
- depth to Karoo - lava contact, and
- lineations

The major lineation investigated was the Maraetchesfontein Dyke. This dyke forms a low amplitude, north-south, positive, aeromagnetic anomaly which extends for over 110 km with only minor offsets by later north-east to south-west faulting. Geological and geophysical evidence suggests that this dyke is pre-Karoo. Ground-magnetics indicate that anomalies of 60 to 300 nT are associated with this feature on Maraethesfontein 54 HO. The anomalies are well defined and suggest that the dyke dips very steeply (80 to 85°) to the west (see Fig. 22 and 23 for typical profiles). South of the farm Maraetchesfontein 54 HO the peak anomaly of some 60 nT becomes broader and less well defined as the magnetised dyke is buried under a progressively deeper cover of younger Karoo sediments.

Ground-magnetics on Maraethesfontein 54 HO located a second, near vertical dyke trending 170 to 350° (see Fig. 22) with an anomaly of up to 80 nT. South of the common border between Panfontein 58 HO and Maraetchesfontein 54 HO the two identified dykes converge/diverge (see Fig. 22 and 23).

Electromagnetic profiles north of EM 35 detected conductive zones associated with the dykes while south of EM 35 no anomalies were identified under the presumably greater thickness of Karoo mudstones. The electromagnetic anomalies coincide within 5 m with the peaks of the magnetic anomalies. Three boreholes were drilled on these peaks into the two dykes (see Figs. 22 and 23). Chips recovered from borehole G34308, Fig. 4, suggested that the anomalies were caused by diabase dykes. Borehole G34319, Fig. 13, was drilled on the broad magnetic feature recorded on Panfontein 58 HO and penetrated 33 m of Karoo strata before intersecting lava.

Electrical resistivity traverses in the vicinity of borehole Mn 2, indicated the presence of substantial thicknesses (up to 25 m) of conductive rock (20 to 25 ohm.m) overlying infinitely resistive rock. Exploration borehole G34318 demonstrated that the conductive layers were Karoo mudstone and weathered lava. Subsequently electrical resistivity soundings were used to identify areas where a cover of Karoo rocks is present.

### 6.3.4 Superficial deposits

Electrical resistivity soundings on Belvedere 47 HO and Schoondal 22 HO indicated that only a thin cover of superficial deposits and weathered material, less than 12 m, overly solid bedrock.

## 7. HYDROGEOCHEMISTRY

### 7.1 General

As only a limited number of chemical analyses of ground water were available prior to this investigation an extensive ground water sampling programme was initiated with the following objectives:

- to assess the general ground water quality and potability
- to identify areas with unpotable ground water, and
- to detect any charges that might occur in ground water quality during the pumping of potential production boreholes.

Seventy-one major element chemical analyses were performed on samples collected from 62 sources. Sixty-nine of the samples were collected from existing boreholes while the other two were sampled from the Harts River.

The distribution of the sampling sites are shown in Enclosure 2 while the results of chemical analyses are tabulated in Appendix 3. To facilitate comparisons of water chemistry, sample analyses reported in mg/l were coverted to milli-equivalents per litre (meq/l) and plotted on the accompanying Durov diagram, see Fig. 24 to 27.

## 7.2 Water quality and potability

Various chemical characteristics of the sampled ground water are summarised in Table 11. Most ground water are of good quality and with the exception of excessive nitrate concentrations satisfy the drinking water criteria of the South African Bureau of Standards (S.A.B.S.).

The majority of ground water are of the mixed cation - bicarbonate type ($M-HCO_3$). In only three ground water samples was a dominant cation found. However within the mixed cation field there is a tendency for ground water from the granite, Fig. 24, and from the lava overlain by Karoo mudstones, Fig. 27, to be more sodic than water obtained from the lava, Fig. 26, without a covering of Karoo. Anion types are more variable as bicarbonate ($HCO_3$), chloride (Cl) and nitrates ($NO_3$) are all important constituents. The presence of high nitrate concentrations and the difference in origin of nitrate and chloride justify the subdivision of the chloride-nitrate-fluoride field. Within this field a $NO_3$-Cl ratio of less than 1 is taken to designate a dominant chloride anion field, while a $NO_3$-Cl ratio in excess of a dominant nitrate anion field. Table 11 indicates that all aquifers can contain high nitrate concentrations (see also section 7.2.3). Low chloride-bicarbonate ratios and low sulphate concentrations indicate that most ground waters are of fairly recent origin.

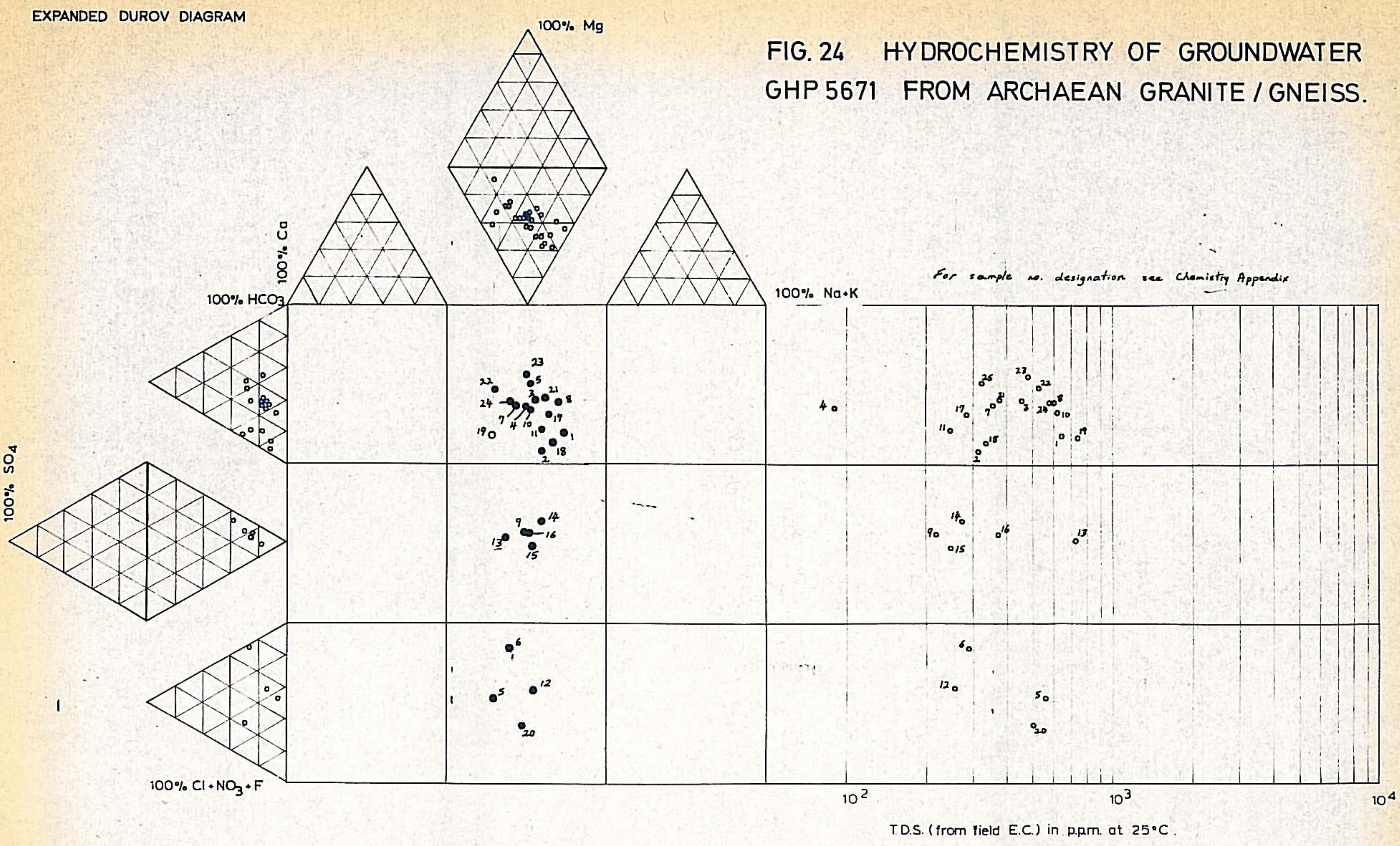
TABLE 11: SOME CHEMICAL CHARACTERISTICS OF THE WATER-BEARING FORMATIONS

| Formation | No. of boreholes sampled | Fig. No. | Water type cation-anion (where M = mixed) | T.D.S. (mg/l) field values min. med. max. | Total hardness (as $CaCO_3$) | Silica concentration mg/l | Nitrate range mg/l |
|---|---|---|---|---|---|---|---|
| Archaean granite gneiss | 25 | 24 | mainly $M-HCO_3$ with minor M-M, M-Cl and $M-NO_3$ | 88 454 869 | very variable soft to very hard | 20 to 30 | 3 to 184 $NO_3$ generally exceeds 45 but but not 102 |
| Granite-Bothaville | 1 | 25 | $M - HCO_3$ | 430 | hard | 17 | 52 |
| Bothaville | 3 | 25 | Variable $M-HCO_3$ M-M and $M-NO_3$ | 100 to 190 | soft to moderately hard | 20 to 26 | less than 12, except for JL 2 |
| Allanridge Andesite-Bothaville | 3 | 25 | $M-HCO_3$ | 330 to 380 | hard | 15 to 20 | below 36 |
| Allanridge Andesite | 18 | 26 | mainly $M-HCO_3$ with rare M-M, M-Cl, $Ca-HCO_3$ and $Ca-NO_3$ | 298 600 1 355 | mainly hard but ranges from moderately hard to very hard | ranges from 13 to 21 | 17 to 432 $NO_3$ generally exceeds 45 but not 102 |
| Karoo Sequence covering Allanridge Andesite | 10 | 27 | mainly $M-HCO_3$ and single $Na-HCO_3$ | 556 787 1 358 | hard to very hard | generally range from 13 to 21 | 25 to 79 50% of samples below 45 |
| Surface water - Harts River | 2 | 25 | $Na-HCO_3$ and Na-M | 230 to 490 | soft to moderately hard | below 3 | below 3 |

* Classification of hardness in mg/l $CaCO_3$
After Sawyer and Mc Carty 1978

| | |
|---|---|
| 0 - 75 | soft |
| 75 - 150 | moderately hard |
| 150 - 300 | hard |
| 300 + | very hard |

## FIG. 24 HYDROCHEMISTRY OF GROUNDWATER GHP 5671 FROM ARCHAEAN GRANITE / GNEISS.



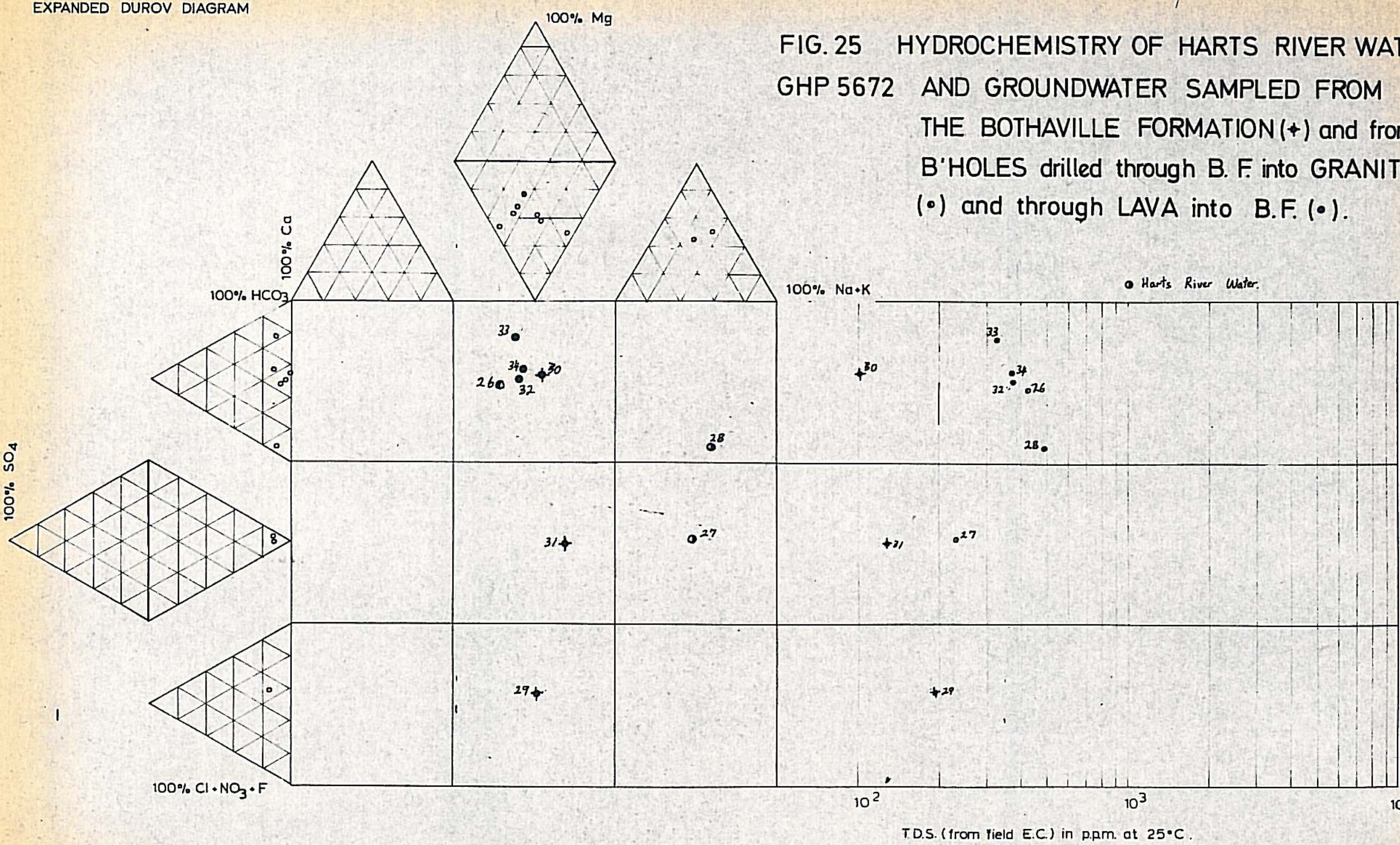
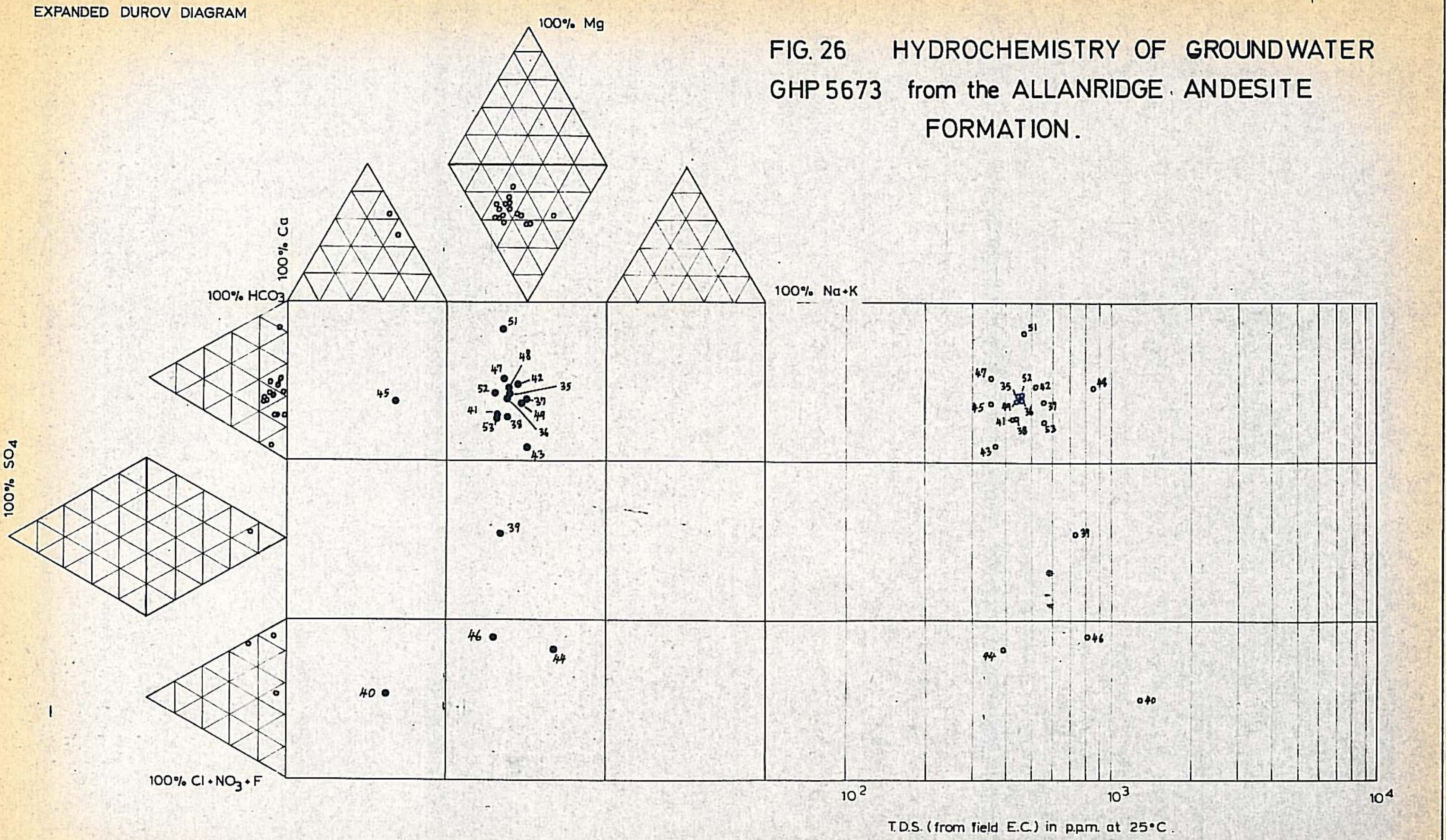



FIG. 25 HYDROCHEMISTRY OF HARTS RIVER WATER
GHP 5672 AND GROUNDWATER SAMPLED FROM THE BOTHAVILLE FORMATION (+) and from B'HOLES drilled through B. F. into GRANITE (∘) and through LAVA into B.F. (•).

FIG. 26 HYDROCHEMISTRY OF GROUNDWATER GHP 5673 from the ALLANRIDGE ANDESITE FORMATION.



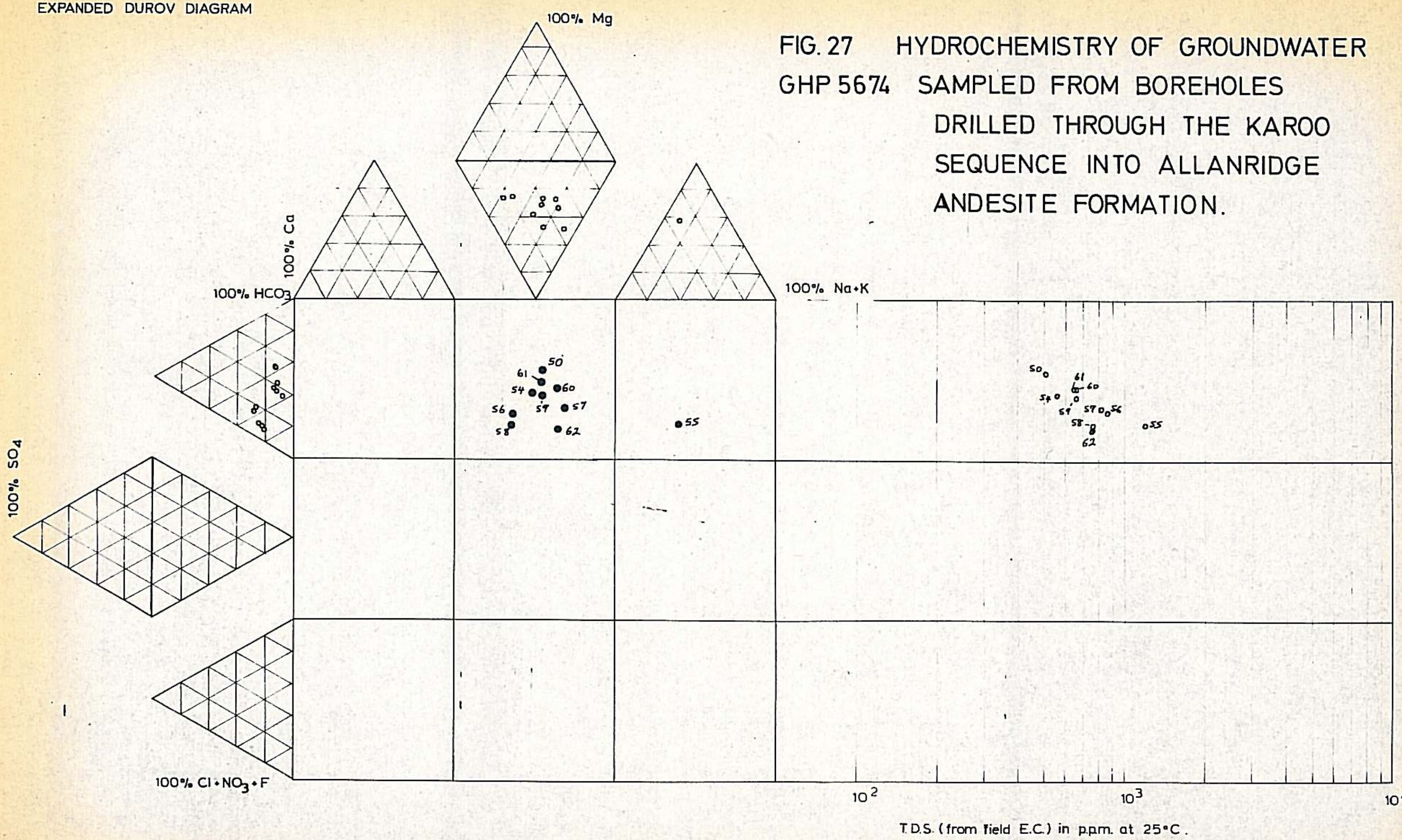



FIG. 27 HYDROCHEMISTRY OF GROUNDWATER
GHP 5674 SAMPLED FROM BOREHOLES DRILLED THROUGH THE KAROO SEQUENCE INTO ALLANRIDGE ANDESITE FORMATION.

### 7.2.1 Total dissolved solids

In all cases T.D.S. values are below 2 000 mg/l, the maximum permissible limit set by the S.A.B.S. Most ground waters are classified as fresh with T.D.S. less than 1 000 mg/l, but some more mineralised brackish waters occur within the lava, with or without the presence of a Karoo cover. Waters from the arenaceous rocks are only very weakly mineralised.

The Harts River was sampled in November 1981 after light rainfall. Surface water upstream of Wentzel Dam had T.D.S. values of 700 to 800 mg/l, i.e. only slightly higher than local ground water. T.D.S. values downstream of Wentzel Dam were considerably lower i.e. 230 to 490 mg/l. These values are slightly lower than the T.D.S. content generally found in the surrounding granite and thus probably represents ground water diluted by recent surface water run-off.

### 7.2.2 Total hardness

The recommended upper limit of the S.A.B.S. is 200 mg/l, while the maximum permissible limit is 1 000 mg/l. Reference to Appendix 3 and Table 1 indicates that for many waters the total hardness exceeds 200 mg/l, however in all cases it is less than 1 000 mg/l. Waters which are weakly mineralised can be classified as soft to moderately hard while more heavily mineralised waters are hard to very hard.

### 7.2.3 Nitrate concentrations

Groundwater nitrate concentrations are high throughout most of this area. Previous recorded chemical analyses suggest that this is <u>not</u> a new development (de Villiers 1961).

Sixty-two percent of the sampled ground waters have nitrate levels <u>in excess of 45 mg/l</u>, the maximum limit for drinking water set by the S.A.B.S. If this standard is strictly adhered to much of the ground water currently being consumed in this area by the rural population would be classified as unpotable. However if a maximum concentration of 102 mg/l (23 mg/l as N) reported by Kempster 1980 is considered acceptable for human consumption 95% of the waters sampled would be potable. To date no harmful effects (e.g. methemoglobinemia) caused by the consumption of high nitrate water have been reported from the Schweizer-Reneke district.

Nitrate, oxidised nitrogen and nitrite, can enter and pollute ground water by a number of mechanisms (Hern 1970), viz:

- leaching of nitrogeneous fertilisers applied to arable land,
- leaching of dung from livestock congregations,
- leaching from domestic sewage disposal systems and
- decomposition of nitrogen fixing leguminous plants.

All these mechanisms may be operating concurrently in the area studied. Once nitrate enters ground water it is highly mobile and travels with the local hydraulic gradient.

Actual nitrate levels vary considerably from less than 3 mg/l to an exceptional high of 432 mg/l reported for borehole Lt 91.

The areal distribution of nitrate concentrations are shown in Enclosure 2. This map indicates that nitrate levels are fairly uniform even over relatively large distances and down gradient of the ground water flow paths. Ground waters of low nitrate concentration are found on:

- the north-eastern portion of the Schweizer-Reneke Townlands 62 HO,

- Rietput 60 HO,

- east of the Maraetchesfontein Dyke in a north-south belt extending from Maraetchesfontein 54 HO to Nooitgedacht 86 HO, and

- along parts of the Harts River valley.

Low nitrate concentrations often appear to be related to a low level of farming activity where little or no fertiliser is applied to the land. This is particularly evident over the ground water recharge areas where quartzite and lava outcrop e.g. borehole Pe 1 with a $NO_3$ level of 9 mg/l. Exceptions to this generalisation are probably related to concentrations of livestock collecting around watering points e.g. Jl 2, $NO_3$ level of 63 mg/l. Relatively low nitrate levels on Nooitgedacht 86 HO and part of Maraetchesfontein 54 HO may be due to the presence of a thick mudstone cover locally retarding the downward migration of nitrate ions to the ground water table.

In 1981 nitrate levels in the municipal wells at Schweizer-Reneke were low, borehole Ss 2 - 11,3 mg/l, this is presumably due to dilution effects caused by recharge from the low nitrate waters present in the Harts River.

During the initial period of well useage in 1980, nitrate concentrations were high (53 to 174 mg/1 in Hattingh, 1980) but subsequently decreased with continuous pumpage. Part of the high nitrate may have been attributed to pollution from the sewage disposal method practised in the adjoining township.

Figure 27a shows nitrate concentration of ground water intercepted in documented boreholes and suggests that nitrate concentrations are high throughout the aquifers penetrated by the boreholes. However this cannot be confirmed as no progressive sampling of ground water has been undertaken during drilling.

## 7.3 Quality of ground water available from potential production boreholes

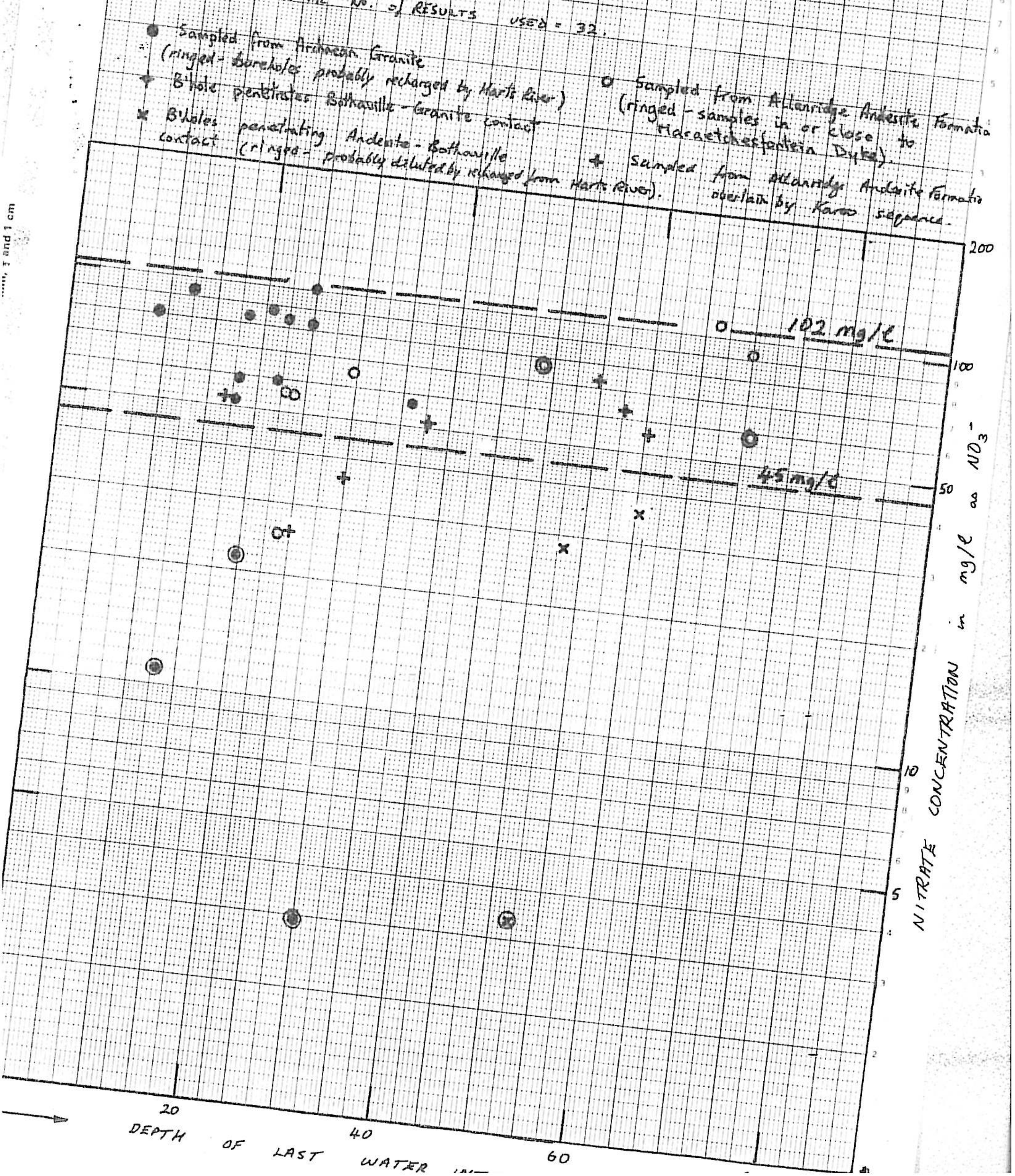
G34307 - Maraetchesfontein 54 HO (Analyses No. 49 and 67 to 71 in Appendix 3). This borehole was sampled when it was drilled and during subsequent pump testing when well head electrical conductivity (E.C.), temperature and pH were continuously monitored. Apart from the low values reflected by sample No. 71 values showed little variation. The T.D.S. content at 25°C was 470 mg/1 ($\pm$ 6%), well head temperature was 21°C with a pH of 7,2 (see Appendix 4 for further details). Similarily, apart from sample No. 71 with a lower T.H., the major ions showed little variation in concentration.

Ground water drained from the surrounding lavas towards G34307, in the Maraetchesfontein Dyke, are similar in composition to those waters sampled at G34307. However ground water to the east, under a Karoo mudstone cover, have substantially higher T.D.S. values at borehole Mn 2 as well as higher fluoride and lower nitrate concentrations.

It can be expected that under long-term pumping ground water abstracted at site G34307 will not deteriorate substantially in quality and will continue to provide hard water with a low fluoride content and a nitrate concentration slightly in excess of the current S.A.B.S. upper limit of 45 mg/1.

FIG 27a. PLOT OF NITRATE CONCENTRATION AGAINST DEPTH OF LAST WATER INTERCEPT.

GHP 5670



G34310 - Hamburg 82 HO (analyses No. 9,63 and 64) - Ground water was sampled during drilling and later pumping tests, while E.C., temperature and pH were regularly monitored. Field pH varied from 6,9 to 7,15 with a T.D.S. content at 25°C of 220 mg/l (± 7%) and a water temperature of 19°C.

Chemical analyses indicated that during pumping the percentage concentration of sodium and nitrate slowly increased. Nearby water samples are more highly mineralised and have higher T.H. and nitrate ion concentrations. Therefore it is to be expected that with extended pumpage similar rises in T.D.S., TH and nitrate ion concentration, will be expected at G34310. However this will depend to some extent on the surface water recharge contribution made by the low T.D.S. and nitrate (?) waters periodically flowing in the Hamburg stream. Despite slight changes in water chemistry the pumped water should be moderately hard with only nitrate levels exceeding S.A.B.S. limits.

Pa 1 - Palachoema 64 HO (Analyses No. 15, 65 and 66) - Three samples for analysis were taken during a 24-hour pump test. E.C. and temperature measurements were made regularly. An average T.D.S. content of 236 mg/l (± 2%) was calculated, well-head temperature was 19°C. Major ion composition remained fairly constant and showed only a consistent increase in T.H. (from 102 to 111 mg/l). It is expected that this trend will continue under pumping in the short term. Nitrate concentrations are expected to remain fairly constant at approximately 60 mg/l. This water can be classed as moderately hard and apart from slightly high nitrate levels is potable.

G34315 - Schweizer-Reneke Townlands 62 HO (Analysis No. 33) - During trial pumping this borehole was regularly monitored and indicated a T.D.S. of 330 mg/l, pH of 6,8 and a well-head temperature of 21°C. The water is hard and eminently potable with all chemical parameter tested falling within the limits set by the S.A.B.S. Potential ground water recharge waters have higher nitrate concentrations thus it might be expected that nitrate levels in this borehole might increase under long-term pumping. However this will depend on a number of factors including the relative ground water contribution made by the lava and the arenites and possible ground water recharge from the low nitrate waters in the Wentzel Dam.

Ss 20 (G32303) - Schweizer-Reneke Townlands 62 HO (Analysis No. 24) - This borehole is adjacent to the Wentzel Dam and has been pumped to supply water for the nearby caravan park. Major ion composition indicates that this water is potable with a low nitrate concentration. However when pumped a strong odour is emitted from the water thus bacteriological analysis is necessary before this water can be considered for domestic consumption. Borehole Ss 20 is partly recharged from water leaking through the flow of the dam, therefore periods of low surface recharge with the consequent concentration of chemical constituents in the dam water may render water pumped from this borehole untreatable, and therefore unpotable, at certain periods.

Pa 3 - Palachoema 64 HO (Analysis No. 16) - This borehole is heavily pumped to provide water for irrigation. Apart from high nitrate concentrations, approximately 90 mg/l, this moderately mineralised, moderately hard water is potable.

## 8. PUMPING TESTS

### 8.1 Introduction

As an integral part of this investigation test pumping was undertaken at four potential production boreholes namely G34307, G34310, G34315 and Pa 1. Constant rate tests were of two types; short duration tests (less than 1 000 mins.) and medium duration tests (1 000 to 10 000 mins.). In addition a 6-stage step-drawdown test was completed on borehole G34310 while a similar test on borehole G34315 had to be abondoned.

The objectives of the pumping tests were:

- to ascertain the production status of the tested boreholes, and when possible,
- to estimate transmissivity and storage parameters of the penetrated water-bearing formation,
- to calibrate the yielding capacity of the potential production well G34310,
- to monitor changes, if any, of ground water quality during pumping (refer to section 7.3), and
- to ascertain the influence of the geology on the movement of ground water.

All raw-pumping test data is presented in Appendix 4.

## 8.2 Archaean granite gneiss aquifer

### 8.2.1 Hamburg 82 HO

General - As borehole G34310 (Fig. 6) recorded a blow yield of some 10 l/s from weathered and fractured granite two observation boreholes, G34311 (Fig. 7) and G34312 (Fig. 7) were drilled 30 m to the south. Other boreholes utilised as piezometers during the tests were G34313 (Fig. 8), Hg 1 and Hg 2. Borehole locations are depicted in Fig. 20.

Prior to pump testing water levels were stable and thus no drawdown correction was necessary. The local ground water movement was north-west towards the Harts River with a hydraulic gradient of $6 \times 10^{-3}$. Ground water abstracted during pumping was fed via 90 m of 100 mm diameter outlet piping onto standing water in the nearby stream channel, from where it flowed downstream. Some return circulation of water may have taken place but this is considered to be insignificant as the actual stream bed is composed of thick black clay. During the constant rate test thunderstorms occurred and some 20 mm of rainfall was recorded.

Step-drawdown test on G34310 - This test consisted of 6 pumping stages of 100 min. duration each under discharge rates ranging from 4,29 to 16,84 l/s. The pumping test data was plotted on single logarithmic paper (Fig. 28) and interpreted using the Bierschenk method (1964). Results are presented in Table 12 and Fig. 29. The formation loss coefficient, B, is estimated to be $0,66 \times 10^{-2}$ $d/m^2$ and the well loss coefficient, C, is calculated as $3,4 \times 10^{-6}$ $d/m^5$. However these figures are approximate only as poor pump performance caused fluctuating discharges. Additionally the water level recovery noted during step 6 was the result of the well screen being partly blocked by coarse granitic sand. The specific discharge-drawdown plot in Fig. 9 indicates that the above calculated B and C values are only valid when water levels are above 15 m. Fig. 28 indicates that pumpage at a rate slightly in excess of 13,3 l/s for a period of 100 mins. lowers the water level to the upper limit of the well screen (set between 15 to 18 m). For a discharge rate of 13,3 l/s (at t = 100 min.) borehole efficiency is only 70%, the drawdown in the pumped well is 12,1 m of which 7,6 m is the result of formation losses and the remainder 4,5 m, is caused by well losses.

TABLE 12: WELL CALIBRATION G34310

| STEP | Q 1/s | Sw (t=100 min) (m) | Cumulative Sw (m) | Sw/Q ($X 10^{-2}$) | BQ | $CQ^2$ | $BQ+CQ^2$ | $\frac{BQ}{BQ+CQ^2}$ X 100% | Specific capacity $m^3/d/m$ drawdown for t=100 min |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4,29 | 2,90 | 2,90 | 0,784 | 2,44 | 0,47 | 2,91 | 84 | 127 |
| 2 | 8,40 | 3,60 | 6,50 | 0,897 | 4,79 | 1,79 | 6,58 | 73 | 111 |
| 3 | 9,87 | 1,70 | 8,20 | 0,961 | 5,63 | 2,47 | 8,10 | 70 | 104 |
| 4 | 13,31 | 3,80 | 12,00 | 10,43 | 7,59 | 4,50 | 12,09 | 63 | 96 |
| 5 | 16,84 | 5,80 | 17,80 | 12,23 | (9,60) | (7,20) | (16,80) | (57) | 82 |
| 6 | 14,54 | (-) 2,70 | 15,10 | 12,00 | (8,28) | (5,36) | (13,64) | (61) | 83 |
| Constant rate test | 13,14 | 11,44 | | [10,08] | [7,49] | [4,38] | [11,87] | [63] | 99 |

Where B = $0,66 X 10^{-2}$ days/$m^2$ and C = $3,4 X 10^{-6}$ days/$m^5$

Sw/Q = Specific drawdown, BQ = formation loss, $CQ^2$ = well loss and $\frac{BQ}{BQ+CQ^2}$ X 100% = well efficiency

[ ] interpolated values ( ) theoretical values

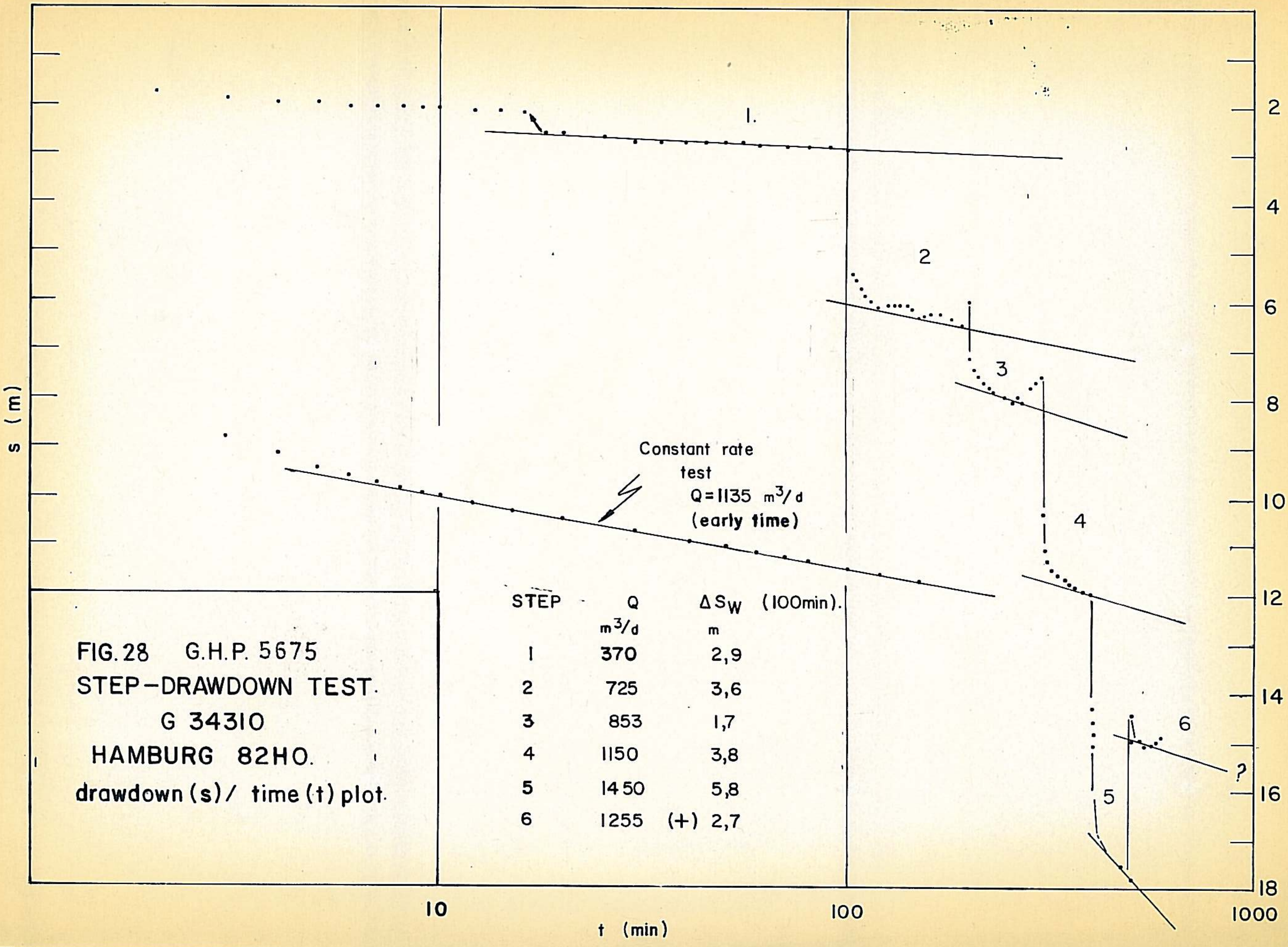
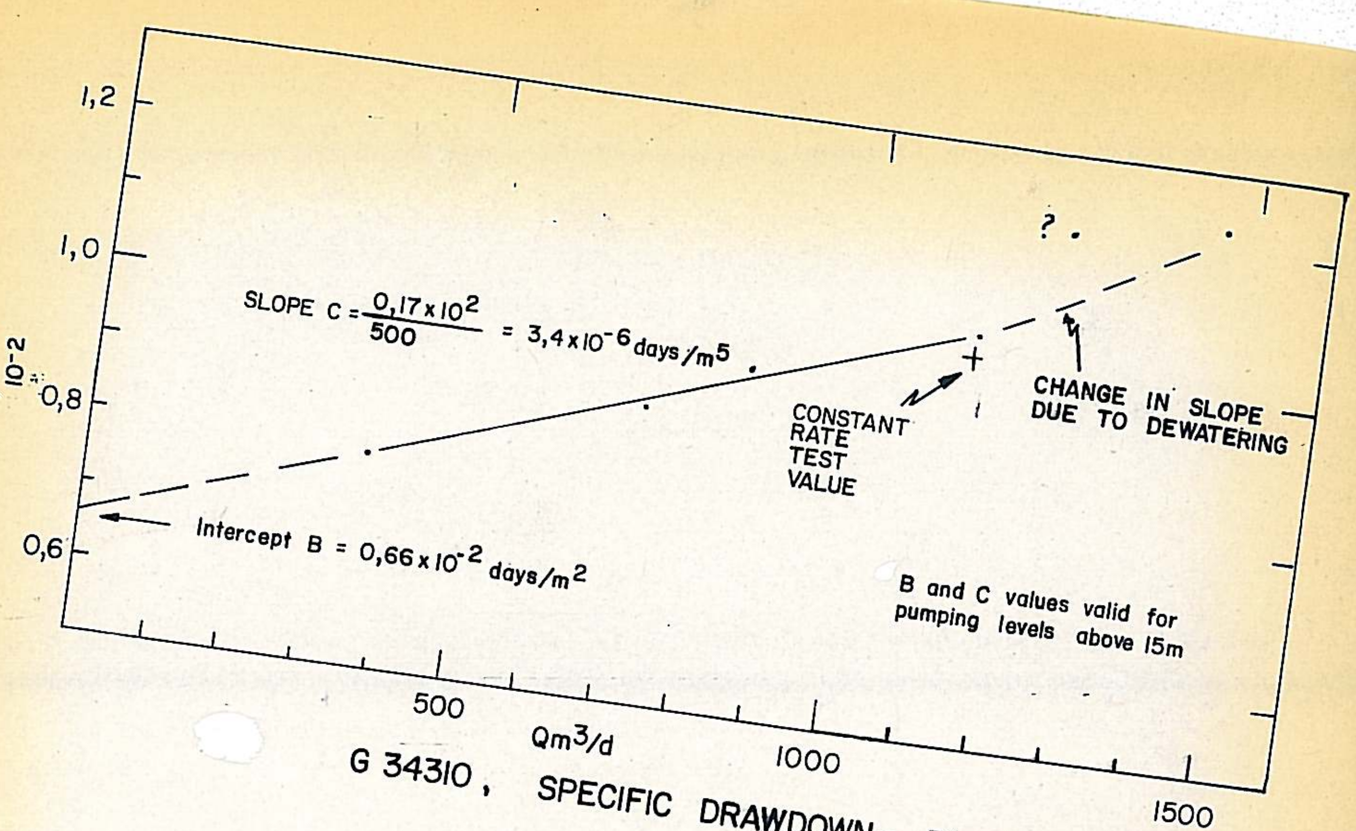



FIG. 28 G.H.P. 5675
STEP-DRAWDOWN TEST.
G 34310
HAMBURG 82HO.
drawdown (s) / time (t) plot.

| STEP | Q | $\Delta S_W$ (100min). |
|---|---|---|
| | $m^3/d$ | m |
| 1 | 370 | 2,9 |
| 2 | 725 | 3,6 |
| 3 | 853 | 1,7 |
| 4 | 1150 | 3,8 |
| 5 | 1450 | 5,8 |
| 6 | 1255 | (+) 2,7 |




G 34310, SPECIFIC DRAWDOWN— DISCHARGE PLOT

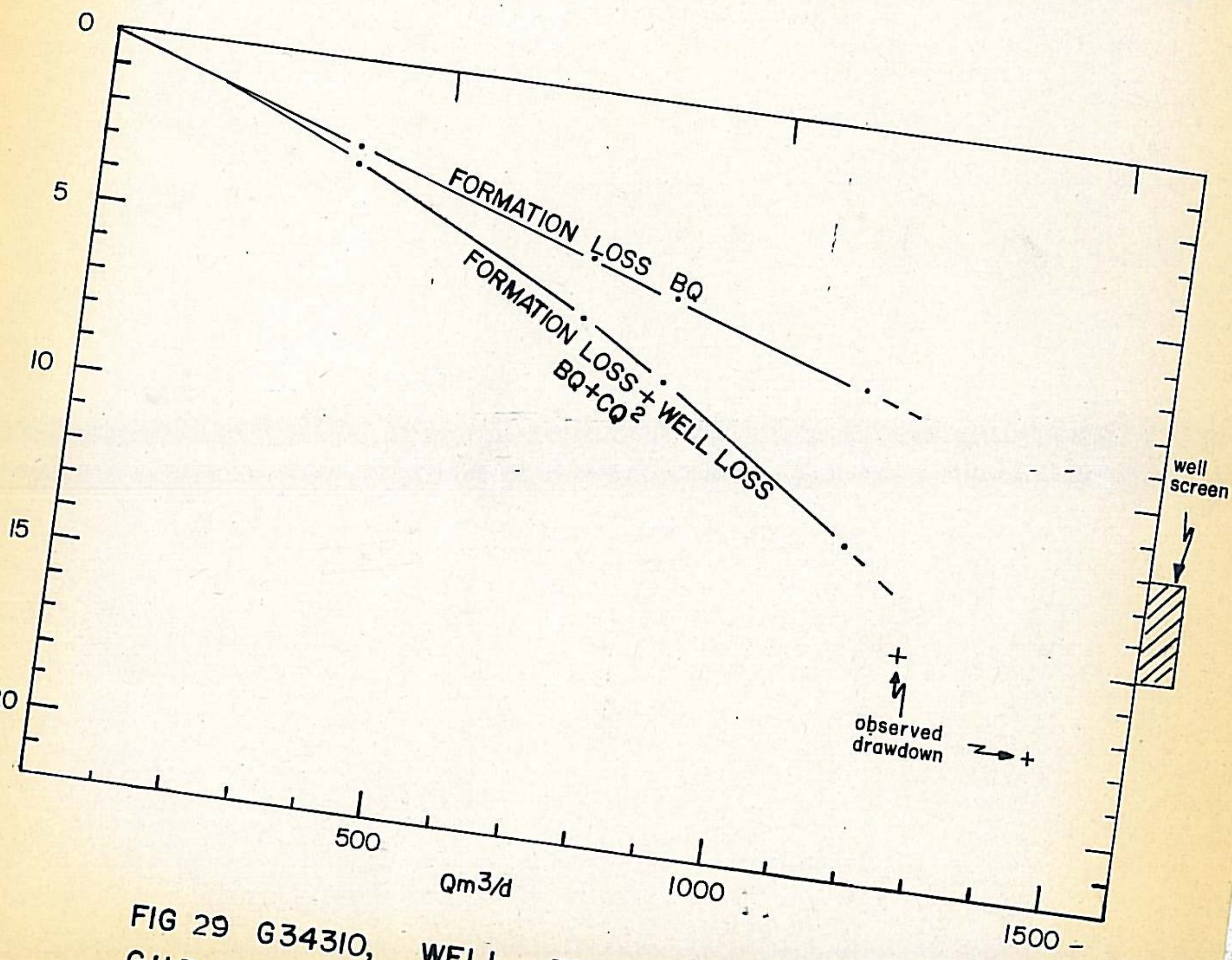



FIG 29 G34310, WELL EFFICIENCY DIAGRAM

G.H.P. 5676

Constant yield test at borehole G34310 - The pumping period was 7 135 min. with an average discharge rate of approximately 12,65 l/s (13,14 declining to 12,2 l/s and subsequently to 10,91 l/s). Coarse granitic material partially blocking the pump screen caused this decline in pumping rate and recovery of water levels in G34310 after 5 000 min. After the cessation of pumping the recovery of the water levels was monitored for some 6 000 min.

The drawdown (s) - time (t) curves have been plotted on double logarithmic paper and are presented in Fig. 30. Drawdown measurements indicate that the ground water flow to the borehole was at all times in an unsteady state. The appreciable drawdown observed in the covering layer of granitic sand (decomposed granite) by G34311 indicates that the aquifer type is semi-unconfined or unconfined.

The t-s curve for observation borehole G34312 was initially matched to the Theis curve for unconfined aquifers under unsteady conditions but produced a very low storage value ($1 \times 10^{-5}$) indicative of confined conditions. Consequently the t-s (observed) curve was fitted to the Boulton type curves for unsteady state flow in semi-unconfined aquifers with delayed yield (refer to Fig. 30 for co-ordinates) and the following hydraulic properties were calculated:

| | |
|---|---|
| average transmissivity (T) | 105 $m^2/d$ |
| effective specific yield (S) | $1{,}45 \times 10^{-3}$ |

The t - s' (corrected for well losses) curve for the pumped borehole, G34310, was fitted to the Theis curve and a T value of 153 $m^2/d$ was calculated. This figure is in fair agreement with that produced by G34312 when it is recalled that more favourable hydraulic conditions prevailing initially at the pumped borehole produced a higher blow yield.

No quantitative analyses could be carried out on the drawdown measurements made at boreholes G34311, G34313, Hg 1 and Hg 2.

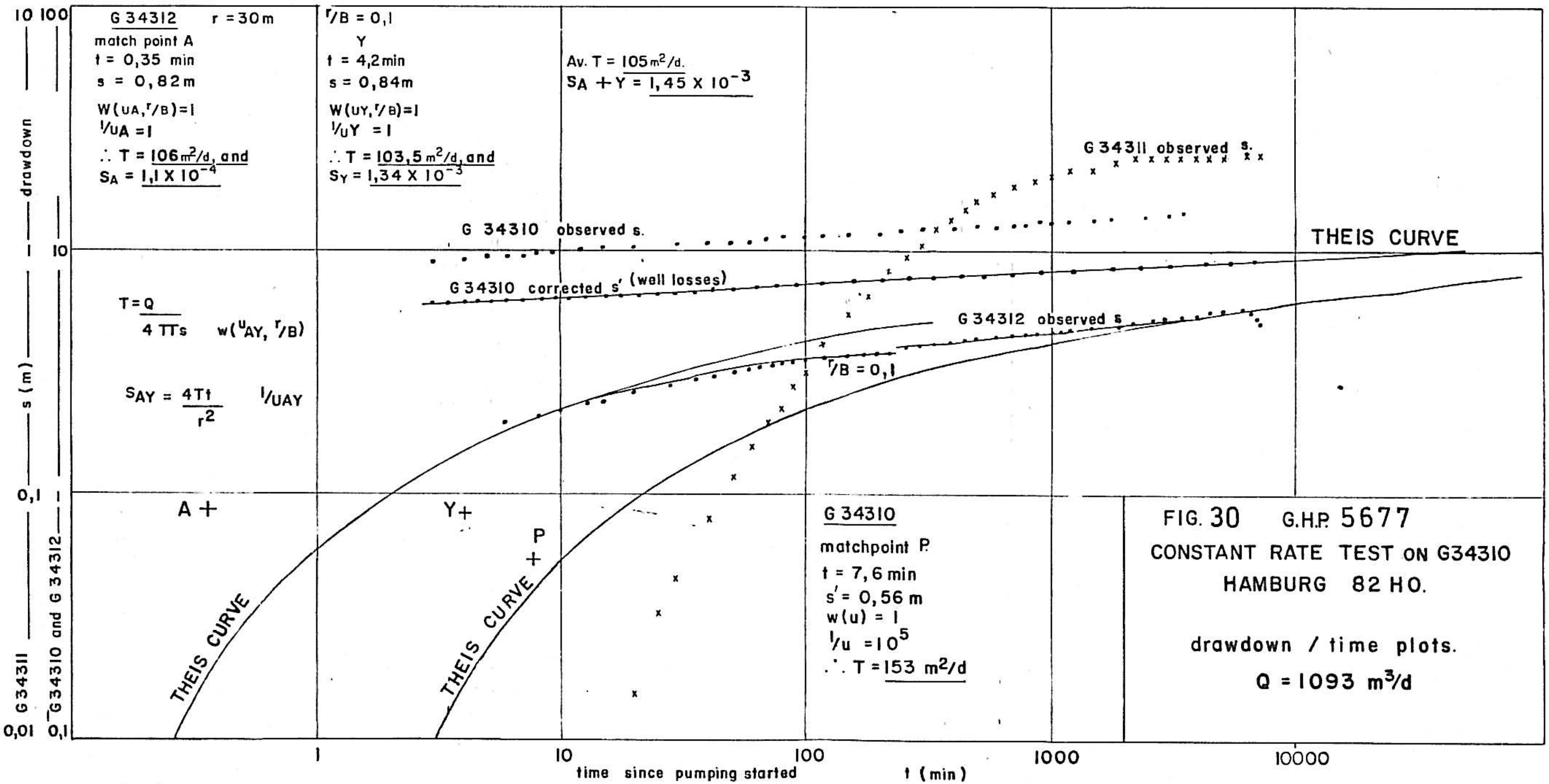



FIG. 30 G.H.P 5677
CONSTANT RATE TEST ON G34310
HAMBURG 82 HO.

drawdown / time plots.
$Q = 1093 \ m^3/d$

The recovery of the ground water levels after pumping ceased are shown in Fig. 31. Recovery was fairly rapid with water levels returning to within 0,5 m of original rest water levels some 5 800 min. after pumping stopped.

Results - Pumping test results indicate that aquifer conditions within the weathered and fractured granite aquifer are semi-unconfined with gravity drainage taking place from the overlying decomposed granite. Acceptable average hydraulic parameters are

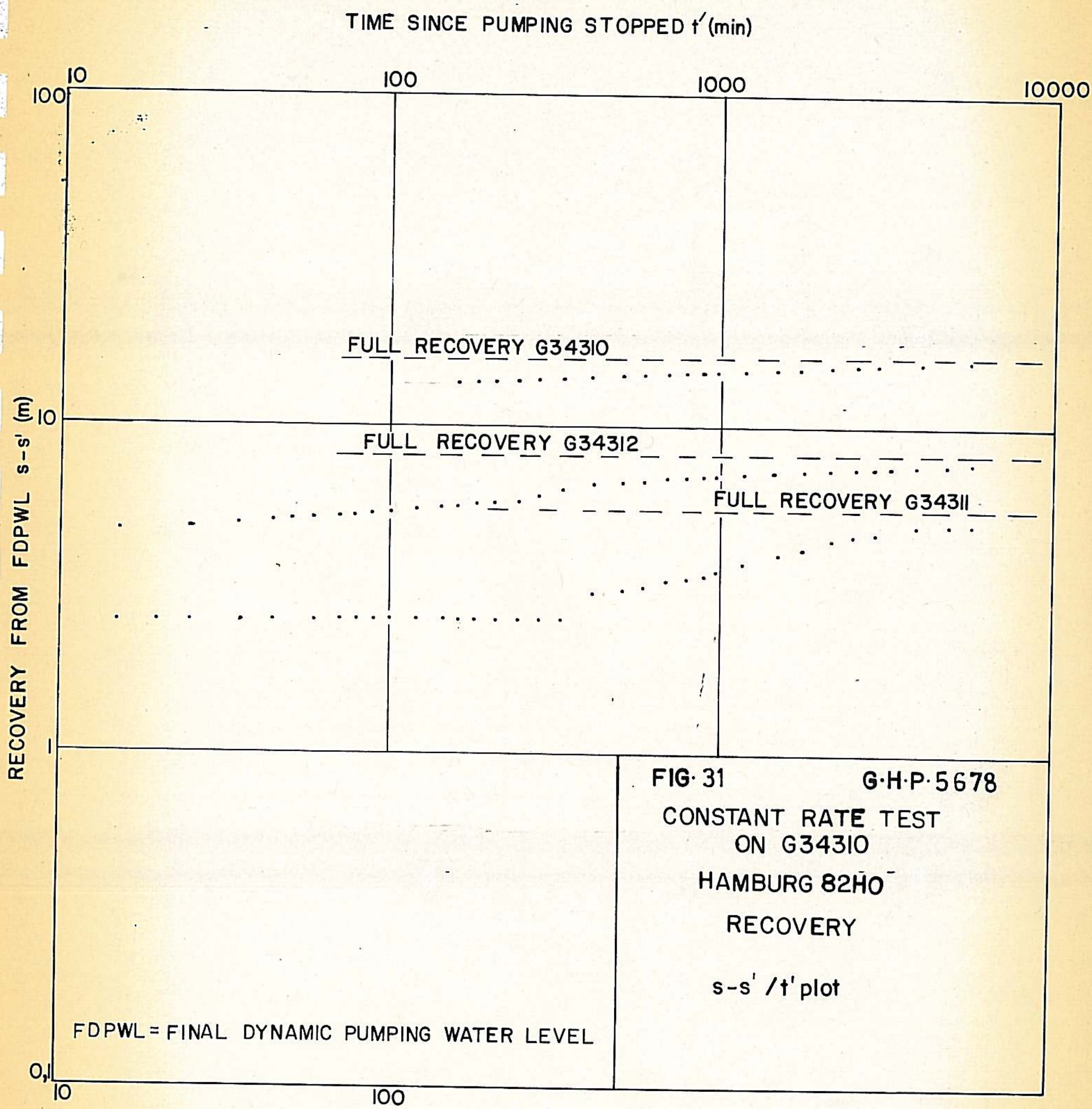
T 120 $m^2/d$
S $1,5 \times 10^{-3}$.

The favourable hydraulic properties of the aquifer, the fast recovery of water levels and the relatively high specific capacities (see Table 12) indicate that conditions are suitable for the establishment of a number of high yielding production boreholes. Borehole G34310 requires redesigning if it is to be utilised effectively as a production borehole capable of yielding an estimated 1 000 $m^3/d$ (11,6 l/s). The structural changes suggested to the well include increasing the final well diameter to 203 mm and installing a well screen from 18 to 22 m with a 10% open area and a suitably graded gravel pack.

8.2.2 Palachoema 64 HO

General - Boreholes Pa 1 and Pa 2 were drilled by Vryburg Boring Inspectorate in early 1981, borehole logs and site positions are shown in Fig. 32. Electrical resistivity depth soundings suggest that the main ground water supply in the pumped borehole, Pa 1, was struck in weathered granite above 24 m. Aquifer conditions were thought to be confined or semi-confined with overlying clayey decomposed granite (see Fig. 32) acting as an impervious or semi-pervious layer.

Regional ground water flow is to the south towards the Harts River with a gradient of $6 \times 10^{-3}$. Water levels monitored prior to testing were stable (change 5 mm in 4 days) and no rain fell during the pumping period.




FIG·31 G·H·P·5678

CONSTANT RATE TEST ON G34310

HAMBURG 82HO

RECOVERY

s-s′ /t′ plot

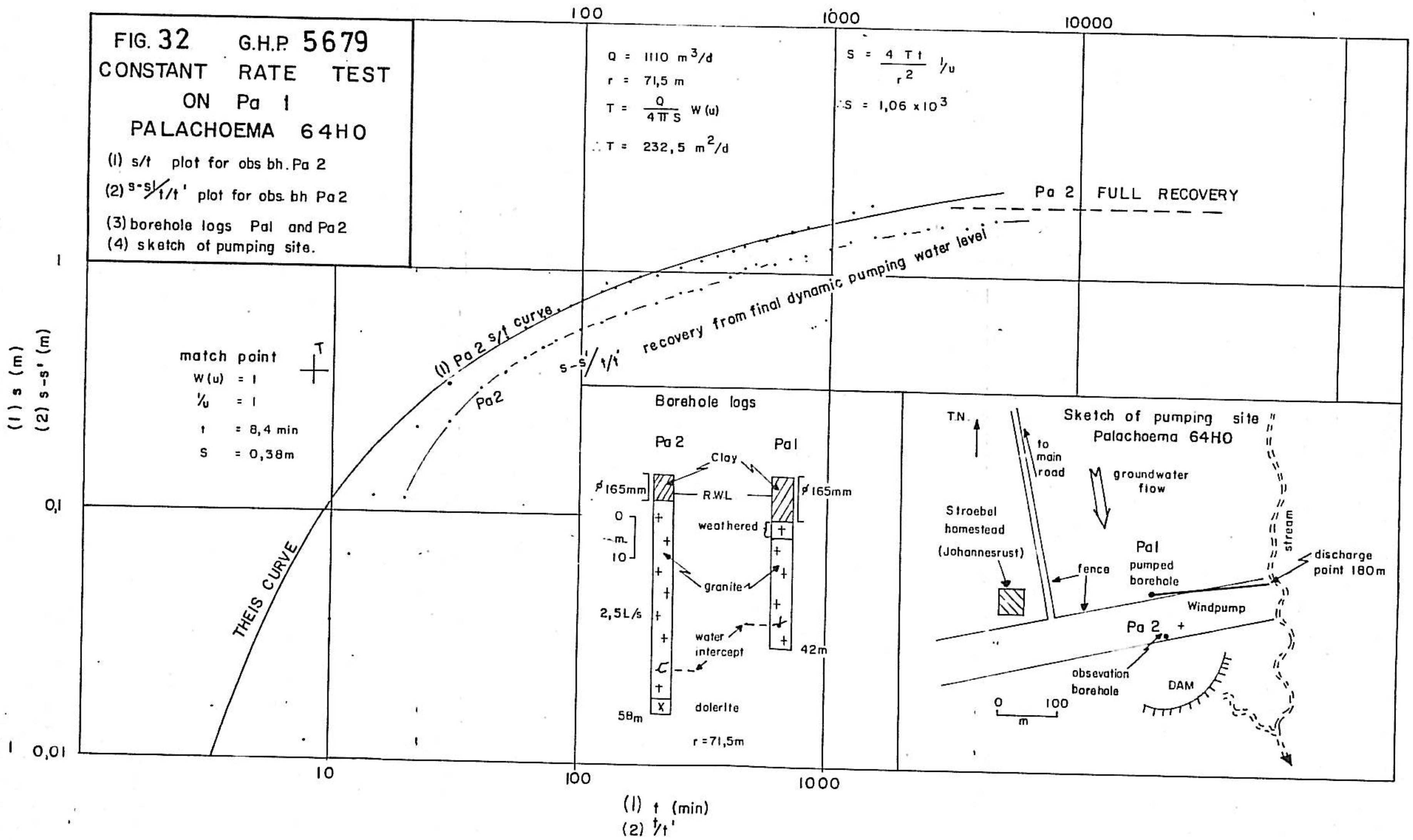



FIG. 32 G.H.P. 5679
CONSTANT RATE TEST
ON Pa 1
PALACHOEMA 64HO
(1) s/t plot for obs bh. Pa 2
(2) s-s'/t/t' plot for obs. bh Pa 2
(3) borehole logs Pa1 and Pa 2
(4) sketch of pumping site.

Constant yield test at Pa 1 - Borehole Pa 1 was pumped for 1 440 min. at an average discharge rate of 12,69 l/s (measured rate 12,87 to 12,64 l/s). As no water level measurements could be made in Pa 1 during pumping only drawdown data from observation borehole Pa 2 could be used for analysis. The t-s curve was matched to the Theis curve for unsteady state flow in confined aquifers (see Fig. 32 and Table 13) and the following hydraulic properties were estimated:

T 230 $m^2$/d
S 1,06 X $10^{-3}$

The observed t-s curve showed deviation from the Theis curve after 800 min. The S-value calculated is in the range, albeit only marginally normally associated with unconfined aquifer conditions, therefore some doubt must be placed on the initially suspected aquifer conditions.

Boreholes Pa 1 and Pa 2 showed a fairly rapid recovery, (see Fig. 32) after 4 500 min. water levels had risen to within 0,3 m of pre-pumping levels.

Results - The weathered and fractured probably semi-unconfined aquifer has favourable hydraulic properties for the establishment of production wells.

Borehole Pa 1 was shown to be capable of producing yields in excess of 1 000 $m^3$/d (11,6 l/s). However the actual pumping rate recommended would depend on the results of a step-drawdown test which was not undertaken because of inaccessibility into the borehole.

8.3 Borehole G34315 penetrating the lava-quartzite contact, Schweizer-Reneke Townlands 62 HO

General - Borehole G34315 recorded a blow yield of 4,3 l/s from 3 water interceptions in fractured lava and quartzite (refer to Fig. 10). This borehole was therefore pumped to ascertain the borehole yield. A step-drawdown test was attempted but failed as the

101 mm turbine pump available could not deliver water at the required low rate. Additionally water level measurements could only be made to some 17 m below the casing collar. No piezometers were available for drawdown measurements.

Before pumping water levels were stable. During both recovery phases light rain was recorded (approximately 5 mm). Groundwater movement is in a south-south-east direction with a relatively steep gradient of $1 \times 10^{-2}$. Abstracted ground water was discharged in a nearby stream (refer to Fig. 21 for location plan.)

Phase 1 - The pumping period was 180 min. with an average discharge of 5,78 l/s (6,02 l/s declining to 5,54 l/s). Drawdown measurements indicated that the pumping water level had dropped below the topmost water interception (17 m). For the first 50 min. the abstracted water was discoloured brown-red by suspended clay and silt. Recovery was fairly rapid after 205 min. water levels were within 0,27 m of the pre-pumping level. The Theis recovery method was applied and a transmissivity value of 70 $m^2$/d (see Fig. 33) was estimated.

Phase 2 - After 205 min. of recovery the borehole was tested again for 150 min. and the discharge rate declined from 7,13 l/s to 5,29 l/s. The recovery was monitored for 840 min. by which time water levels had returned to within 0,18 m of the pre-phase 1 water level (see Fig. 33).

Results - The two short tests indicate that the highest sustainable pumping rate of G34315 is probably of the order of 4 to 5 l/s. At this rate water levels are below the upper water strike in the lava.

Recovery from pumping is fairly rapid. A transmissivity value of 70 $m^2$/d was calculated but the value of this is not apparent in this complex, fissure flow, multiple aquifer.

8.4 Borehole G34307 penetrating the dyke system on Maraetchesfontein 54 HO

General - Borehole G34307 (Fig. 3) produced a blow yield in excess of 10 l/s from fractured formation associated with the Maraetchesfontein

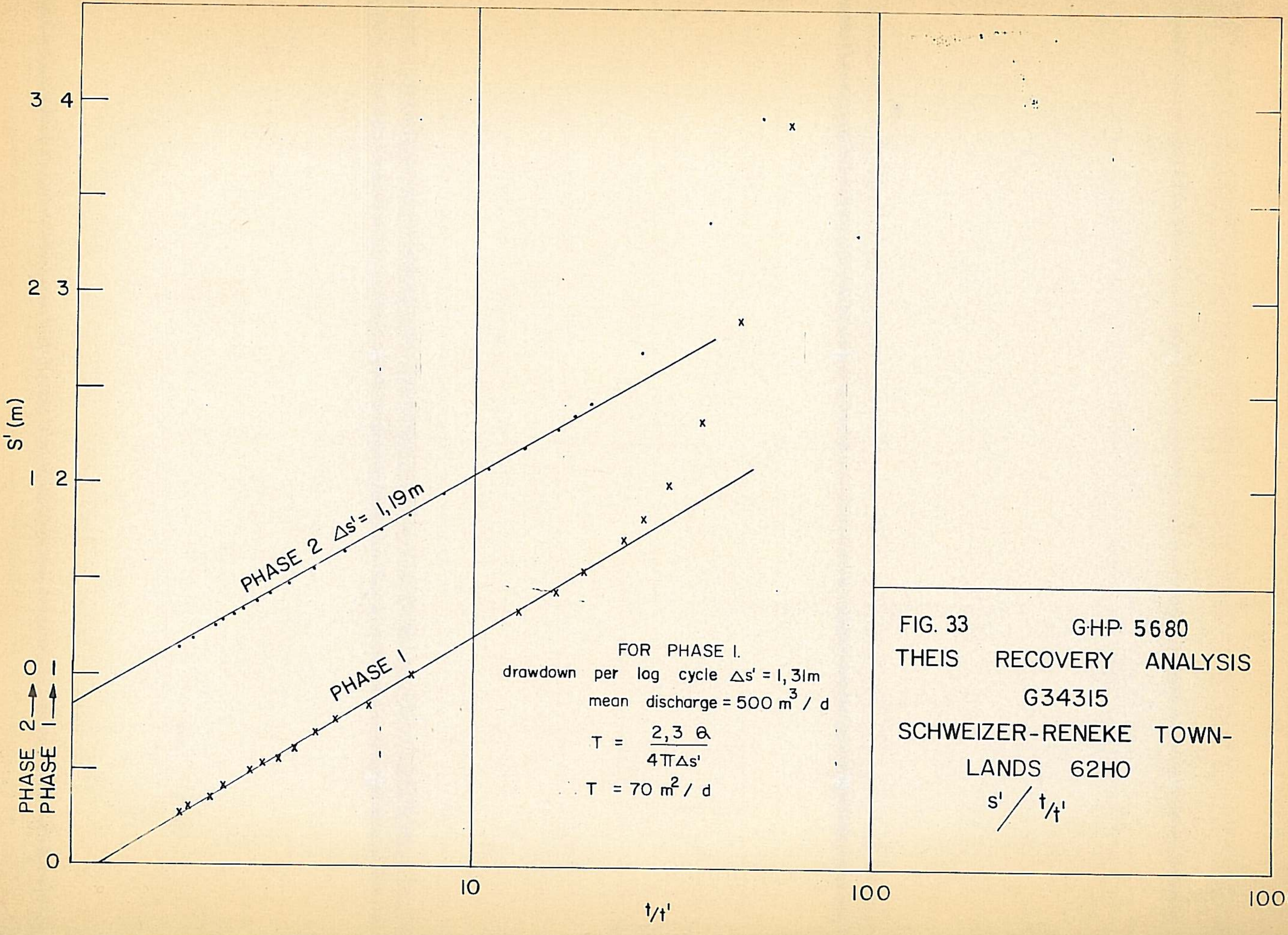



FIG. 33 G.H.P. 5680

THEIS RECOVERY ANALYSIS

G34315

SCHWEIZER-RENEKE TOWN-LANDS 62HO

s' / t/t'

Dyke. The additional boreholes G34308 (Fig. 9), G34309 (Fig. 10), G34318 (Fig. 13) and G34319 (Fig. 13) were later drilled (see Figs. 22 and 35) and were monitored during the 4-phase pump testing of G34307. (N.B. G34318 and G34319 were only measured during phase 4). Apart from phase 1 water level measurements could not be made in G34307.

Due to the expected conduit nature of the confined or semi-confined fractured aquifer it was expected that the pressure relief surfaces created by pumping would be ellipsoid with the maximum drawdown and hence transmissivity being along the line of the fracture system (see Fig. 35). The data obtained from pump testing was found to be unsuitable for quantitative analysis due to the lack of sufficient purpose-drilled observation boreholes and fluctuating yields from the pumped borehole.

The hydraulic gradient is $3 \times 10^{-3}$ with ground water flow in a west-north-west direction. The dykes within the lava have apparently no effect on the piezometric surface contour pattern (Enclosure 2). Prior to pumping phases 1 and 4 water levels were stable while prior to phases 2 and 3 water levels were still recovering. Light rainfall 2,5 mm, was recorded during phase 4 while heavy rainfall, some 35 mm, was experienced during the recovery from pumping phase 4.

During phases 1 to 3 the 101 mm turbine pump intake was set at 62 m while during phase 4 the replacement pump was installed to 64 m. Four hundred metres of outlet piping conveyed the abstracted water down-gradient of G34308 (see Fig. 35).

Phase 1 - Borehole G34307 was pumped for 480 min. at 7 l/s, a pressure transducer coupled to an analog chart recorder was used to monitor drawdown and recovery of the ground water in the pumped borehole. The irregular time-drawdown plot presented in Fig. 34 is the product of poor pump performance. Observation borehole G34309 responsed rapidly to the pumping of G34307 (see Fig. 34) and subsequently recovered fairly rapidly. The poor hydraulic connection between observation borehole G34308 and the pumped borehole is clearly shown by the continuous time-drawdown plot in Fig. 35.

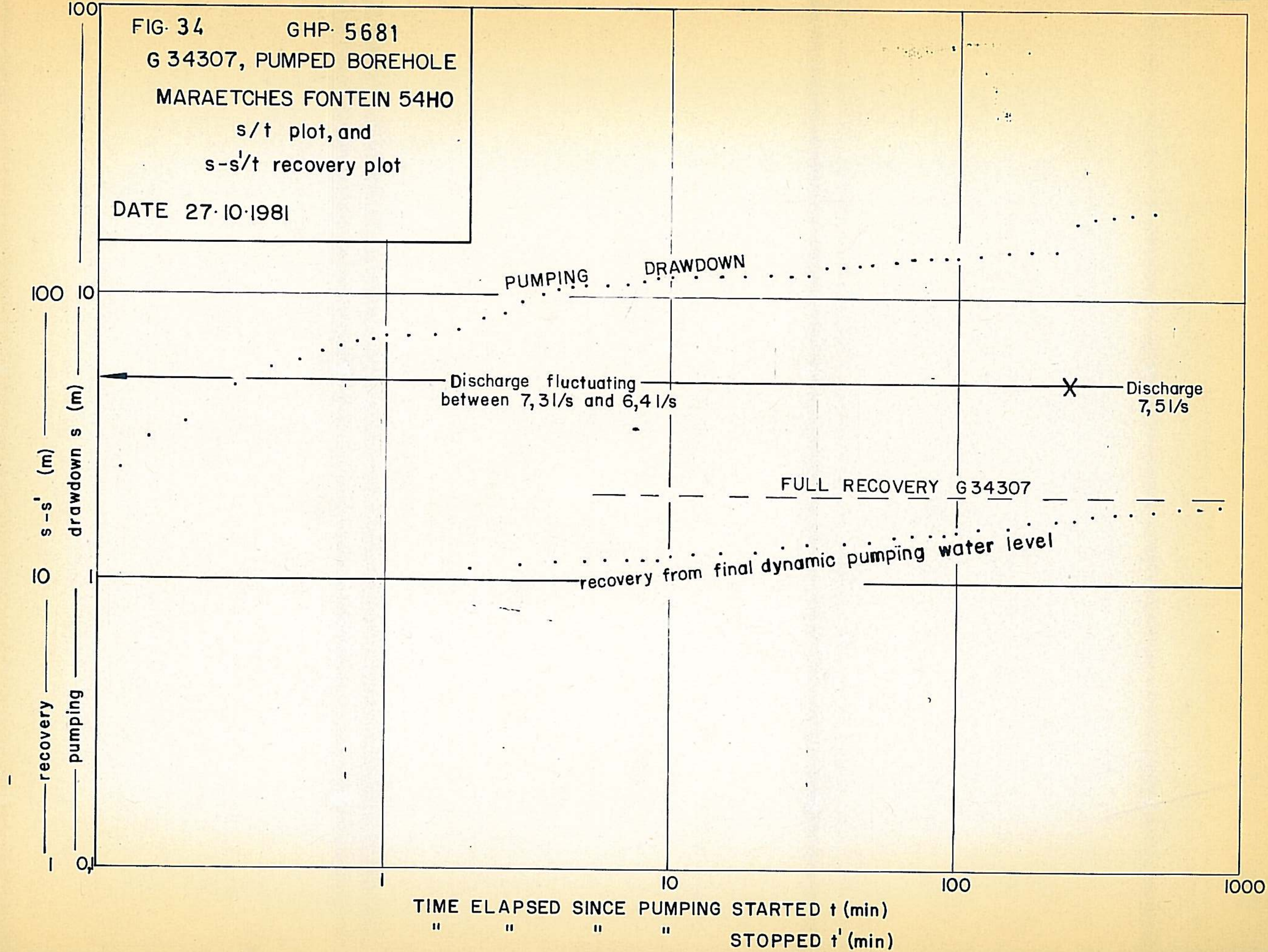
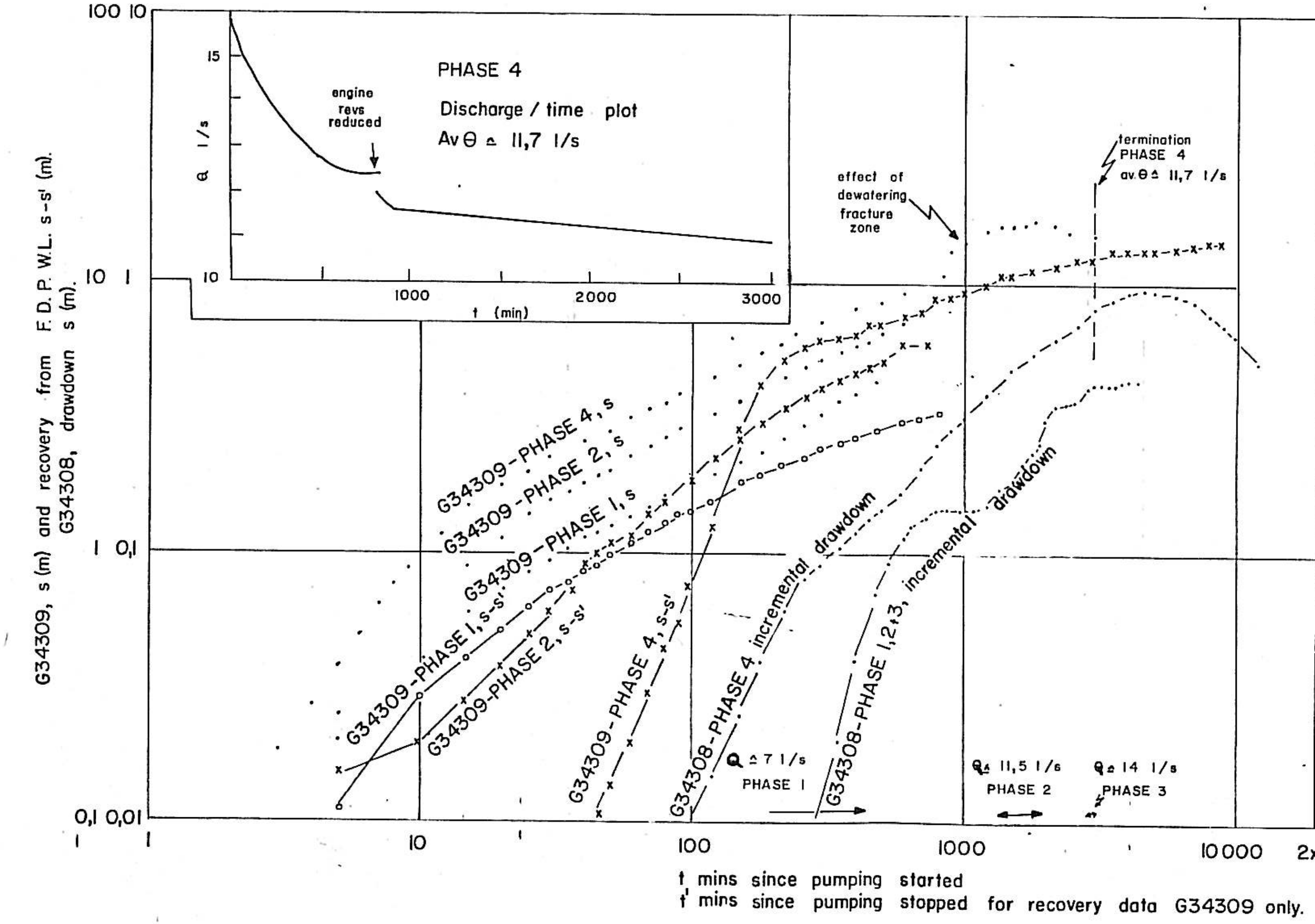


FIG. 34 GHP. 5681
G 34307, PUMPED BOREHOLE
MARAETCHES FONTEIN 54HO
s/t plot, and
s-s'/t recovery plot
DATE 27.10.1981
PUMPING DRAWDOWN
Discharge fluctuating between 7,3 l/s and 6,4 l/s
Discharge 7,5 l/s
FULL RECOVERY G 34307
recovery from final dynamic pumping water level
s-s' (m)
drawdown s (m)
recovery
pumping
100
10
1
0,1
1000
TIME ELAPSED SINCE PUMPING STARTED t (min)
" " " " STOPPED t' (min)



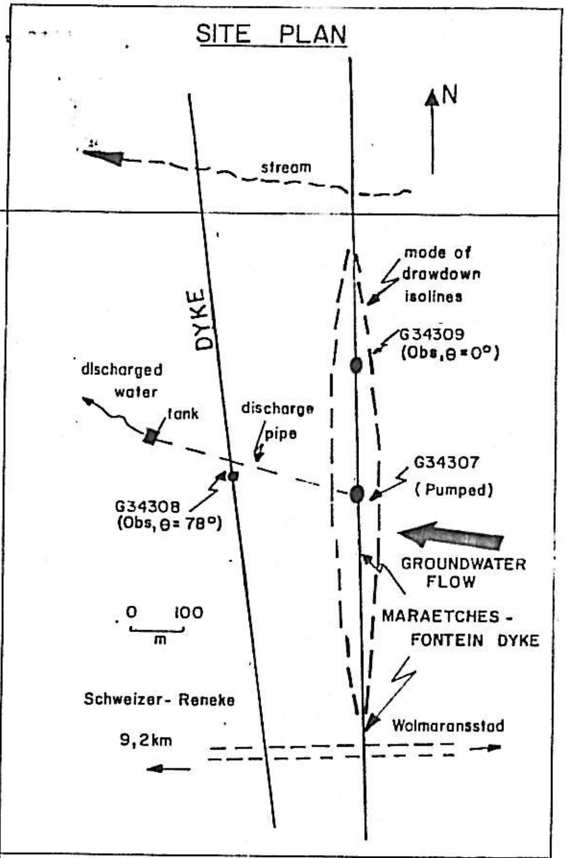




FIG. 35 G.H.P. 5682

PUMPED BOREHOLE G34307

MARAETCHESFONTEIN 54HO

PHASE 1 to 4

s/t and s-s'/t plots

for obs. b.h's G34308 and -9

and Discharge / time plot for

PHASE 4

Phase 2 - Prior to pumping, water levels in the boreholes G34307, G34308 and G34309 were 1,07, 0,145 and 0,97 m respectively below pre-phase 1 rest levels. The pumping period was 600 min. with an average discharge rate of 11,5 l/s. Recovery in G34307 and 8 was fairly rapid.

Phase 3 - Before pumping commenced water levels were considerably lower than pre-phase 1. The initial discharge rate was 15,82 l/s which declined to 12,1 l/s after 110 mins. Consequently the pumping test was terminated. At this stage poor pump performance was blamed for the declining yield.

Phase 4 - The pumping period was 3 000 min. at an average discharge rate of 11,7 l/s. Declining yields were experienced (see Fig. 35) and a pump adjustment was necessary after 720 min. to prevent overheating. Time-drawdown curves and recovery data are presented in Fig. 35. The drawdown pattern experienced in G34309 after 800 min. pumping illustrates the effect of dewatering the shallow fracture zone and the consequent change to unconfined conditions. After some 120 min. of pumping observation borehole G34308 responded. No response to pumping was detected in the distant piezometers G34318 and G34319. Water-level recovery in G34307 and G34309 was fair. For G34307 the water level was some 0,63 m below pre-pumping level after 7 600 min. of recovery.

Results - Observations made during the tests indicate:

- the maximum drawdown available in G34307 is 63 m (for a rest water level of 8 m), which reduces to 56 m if the pump intake is set at 64 m,

- a discharge rate greater than 850 $m^3$/d (approximately 10 l/s) is unlikely to be maintained for extended pumping periods. This is because the initial high discharges are provided by the partial dewatering of the fracture zone which is then replenished, at a lower rate, from interconnected fractures within the lava,

-

- apparently high well losses cause excessive drawdown in the pumped borehole,

- recovery is fairly rapid with over 90% of the drawdown recovered in a time period equivalent to that of the pumped period,

- the water bearing formation shows marked anisotrophy with zone of preferential transmissivity associated with fractures along the Maraetchesfontein Dyke,

- although it is considered that the aquifer is capable of supplying substantial quantities of ground water for use by Schweizer-Reneke, further tests and development of additional observation boreholes as outlined below are recommended to enable hydrological parameters to be calculated and thus optimum pumping rates and spacing between production boreholes to be determined namely,

- pumping of G34307 for 5 000 min. at a constant rate of 7 to 8 l/s after the installation of at least three additional observation boreholes namely,

- borehole No. 1 - 3 m west of G34309 to penetrate the fractured aquifer at a depth greater than 30 m,

- borehole No. 2, 40 m east of G34307, and perpendicular analyses to the dyke,

- borehole No. 3, some 1 000 m north of G34307, to penetrate the dyke at a depth greater than 30 m.

Pumping test interpretation may be possible using the type curves prepared by Gilding (1980) for fractured aquifers.

# 9. EXPLOITABLE GROUND WATER POTENTIAL

## 9.1 General

In order to ascertain whether the municipal water supply of Schweizer-Reneke could be augmented or supplemented from ground water sources when surface water supplies are inadequate (see section 2.1) an attempt has been made to quantify the exploitable ground water potential in the most favourable areas investigated in this report, making use of the limited geohydrological information obtained in the field. The estimates are at best considered to be only first estimates, and can be expected to be significantly in error. However an attempt has been made to err on the conservative side when making these estimates.

According to the variable yield analyses undertaken of Wentzel Dam it is evident that under the most adverse conditions of the third scenario ground water would be required to supplement surface water for a continuous period of up to twelve months during periods of surface water deficiency in order to meet the municipal water demand of Schweizer-Reneke. As already mentioned as supplementary supplies of ground water would be required during periods of subnormal rainfall, the recharge to ground water during these periods would be minimal. Any abstraction of ground water for extended periods would therefore depend largely on favourable ground water storage potential combined with good transmissive properties of the underlying geological formations.

In order not to seriously over-exploit the available ground water resources in any one area it would be advantageous to recover ground water from more than one location at a time, whenever ground water is required as a supplementary source of municipal water.

It will be possible to revise the first estimates of the exploitable ground water potential in the event of abstracting large quantities of ground water by continuously monitoring the long-term fluctuations of the ground water levels and by metering the quantities of ground water being abstracted.

In making these first estimates of the exploitable ground water potential in the vicinity of Schweizer-Reneke cognizance was taken of such factors as the potential recharge to the ground water systems, the storage potential of the systems for ground water and the potential yields of boreholes.

The following areas are considered favourable for the recovery of ground water on a scale sufficient for municipal use and will each be discussed in this chapter:

Schweizer-Reneke Townlands 62HO
Hamburg 82HO
Mimosa 61HO
Palachoema 64HO
Maraetchesfontein 54HO

9.2 Municipal owned land on Schweizer-Reneke Townlands 62HO

Pumping history during 1980 indicates that the established borehole field adjacent to the Harts River to the southwest of the town, can provide only 0,2 X $10^6 m^3$ of ground water annually without additional replenishment either from the river or from rainfall. Sufficient boreholes have already been established in the area and no opportunity exists for further development.

Due to unfavourable geohydrological conditions in the remainder of the townlands underlain by granite little scope exists for further development of ground water with the possible exception of immediately adjacent to Wentzel Dam where some leakage through the base of the dam could be expected. Borehole Ss 20 could provide about 0,1 X $10^6 m^3$ annually when pumped at 6 l/s for 12 hours per day.

The most promising water-bearing formations for development of ground water are expected to be the lava and quartzite formations located to the north of Schweizer-Reneke (see section 8.3). Boreholes penetrating both formations at suitable depths may be able to take advantage of considerable ground water storage within the fractured formations. The success of the two exploration boreholes G34314 and G34315 indicates that a number of relatively low-yielding borehole could be developed in this area. Fig. 21 indicates two further possible sites viz G34049 and G34050. The recharge to ground water from rainfall in this area (about 25 $km^2$) could be of the order of $0,5 \times 10^6 m^3$ annually. Four boreholes yielding 3 l/s each pumped for 12 hours a day could yield about $0,2 \times 10^6 m^3$ annually when the aquifer is initially fully recharged. Estimates of ground water storage, however, is not possible in these fractured formations. At present there is no abstraction of ground water in this area.

The total exploitable ground water potential in the Schweizer-Reneke Townlands is therefore estimated to be of the order of $(0,2 + 0,1 + 0,2) \times 10^6 m^3$ or, $0,5 \times 10^6 m^3$ annually.

## 9.3 Hamburg 82HO

Ground water contouring indicates that the geological formations around borehole G34310 are recharged by ground water moving in a north-westerly direction. Ground water abstraction in the Hamburg stream catchment during 1981 was low, probably of the order of $0,03 \times 10^6 m^3$. In the past the weathered and fractured granite aquifer has been exploited via borehole Hg 1 for irrigation purposes for several months a year. The maximum quantity of ground water that has been recovered from this borehole was probably less than $0,15 \times 10^6 m^3$ annually.

Assuming a 5% infiltration from rainfall over the catchment of about 60 $km^2$ the average annual recharge to ground water is estimated to be about $1,5 \times 10^6 m^3$. This is considerably more than the potential ground water storage in the catchment estimated at about $0,6 \times 10^6 m^3$. It is considered that at least $0,6 \times 10^6 m^3$ of ground water could be recovered from this catchment by judicious siting of production boreholes, which is equivalent to a continuous pumping rate of about 19 l/s. It would be reasonable to expect that boreholes G34310 (8 l/s), G34313 (2 l/s), Hg 1 (6 l/s) and a further

4 boreholes could provide at least 0,6 X $10^6 m^3$ annually when pumped for 12 hours per day. The additional boreholes would be spaced along a line parallel to the ground water contours as indicated in Fig. 20. Further sites could also be selected east and west of the Hamburg stream valley using geophysical methods to identify areas of maximum depth of weathering in the granite. This would increase the exploitable ground water potential beyond 0,6 X $10^6 m^3$ annually. The effect of heavy abstraction of ground water in this area would have the effect of lowering the ground water levels and so enhancing the opportunity of recharge from rainfall. Recharge could be increased further by constructing a dam in the Hamburg stream valley north of borehole G34310.

9.4 Palachoema 64HO

Boreholes Pa 4, 5 and 6 are currently pumped all the year round for irrigation purposes and are capable of a maximum combined delivery of about 18 l/s (refer to section 5.2). The weathered granite aquifer exploited has been proved to be reliable and productive. The maximum annual abstraction from these three boreholes is estimated to be about 0,3 X $10^6 m^3$ equivalent to a constant pumping rate of about 10 l/s. The fact that yields declined slightly in 1980 indicates that this is the maximum yield that can be relied upon. However some scope for further exploitation of ground water may exist however toward the western boundary of the property. The ground water is recharged mainly from direct rainfall recharge and flows in a south catchment south-easterly direction.

Borehole Pa 1 is located in a relatively unexploited sub-catchment to the west of boreholes Pa 4, 5 and 6. The ground water storage commanded by this borehole is estimated to be of the order of 0,15 X $10^6 m^3$ and the annual recharge is estimated to be about 0,4 X $10^6 m^3$. On catchment size considerations, the ground water potential is estimayed to be also about 0,3 X $10^6 m^3$.

The total exploitable ground water potential therefore on the property Palachoema is estimated to be approximately 0,60 X 106m3, equivalent to a continuous pumping rate of 19 l/s.

Additional production boreholes could be selected on the results of electrical resistivity soundings.

Ground water recovered from this area is conveniently situated for use in the Black residential townships located to the west of Schweizer-Reneke. An additional reservoir would probably be required.

9.5 Mimosa 61HO

It is considered that boreholes developed in the deeply weathered granite along the surface drainage courses in the vicinity of borehole G34320 could be capable of supplying an additional 0,2 X $10^6 m^3$ annually, equivalent to a continuous pumping rate of about 6 l/s.

Recharge and storage conditions in this area are not as favourable as at Hamburg and at Palachoema because of steep hydraulic gradients and comparatively deep ground water levels. Several possibly low-yielding boreholes similar to borehole G34320 could be developed yielding a maximum of 3 l/s each. At present virtually no ground water is being abstracted in the vicinity of borehole G34320. This area is conveniently near to Schweizer-Reneke.

9.6 Maraetchesfontein 54HO

The assessment of the exploitable ground water potential associated with the Maraetchesfontein dyke on the farms Maraetchesfontein and Panfontein is difficult. The fractured contact zone of the dyke, with evidently high transmissive properties but low ground water storage properties, is fed under pumping conditions from the adjoining lava formations with evidently low transmissive properties but relatively high ground water storage properties. The total extent of the influence of pumping borehole G34307 was not determined by the pumping test (see section 8.4) because of the linear configuration of the conduit system. It is estimated though that perhaps, as much as 0,5 X $10^6 m^3$ of ground water could be recovered annually from boreholes located along this feature.

Assuming a pumping rate of 8 l/s and 4 l/s respectively for boreholes G34307 and G34308 and a 12 hour per day pumping schedule a total of 0,2 X $10^6 m^3$/a could immediately be recovered. Further boreholes to the north and south of borehole G34307 could be sited following further geophysical work and additional pumping tests.

Deep fracturing within the lava indicates the ground water storage within the lava may be more extensive than that in fractured and weathered granite and may be a more reliable source during periods of subnormal rainfall. During the period of investigation no boreholes were known to be recovering ground water from the vicinity of the dyke and abstraction from the lava was low.

This area however is a considerable distance from Schweizer-Reneke and development costs may probably be prohibitive.

## 10. SUMMARY

The following are the main findings of the investigation and which have been previously referred to in this report:

(i) Wentzel Dam will remain the primary source of municipal water for Schweizer-Reneke. By the year 2000 the projected municipal water demand will be 1,52 X $10^6 m^3$ per annum equivalent to a constant pumping rate of 50 l/s, with seasonal peak demands rising to 75 l/s. Supplementary supplies of ground water will be required for continuous periods of up to 12 months during periods of subnormal rainfall.

More surface water could be made available from Wentzel Dam if the irrigation rights of the remaining downstream irrigators are expropriated. Repairs to the irrigation canal could significantly reduce conveyance losses.

(ii) The existing borehole field recovering ground water south of Schweizer-Reneke adjacent to the Harts River has been estimated to have an exploitable ground water potential of only $0,2 \times 10^6 m^3$, without additional ground water recharge from the Harts River.

(iii) The mean annual rainfall at Schweizer-Reneke from 1953 to 1981 was 509,5 mm/a. Subnormal rainfall over the period 1978-1980 was responsible for the water crisis developing in Schweizer-Reneke during 1980.

(iv) Regional ground water levels have fully recovered from the effects of the subnormal rainfall.

(v) Ground water flow within the Harts River basin is from the drainage divides to the environs of the Harts River and subsequently in a south-westerly direction with a shallow gradient of 1 in 10 000. South of the Vaal-Harts watershed ground water flow is to the south with a steeper gradient of 1 in 5 000.

(vi) The numerous dykes present in the investigation area, inferred from a study of aerial photographs and aeromagnetic maps, do not impede the movement of the regional ground water flow.

(vii) The principal geohydrologic units present are the granite-gneiss, quartzite-sandstone, lava, mudstones and various superficial deposits.

(viii) Apart from the mudstone and superficial deposits all geohydrological units are fairly easily developed by the rural population to provide adequate supplies of ground water for domestic and stock watering purposes. Borehole yields though are generally low, less than 2 l/s, and only 41 boreholes of the surveyed boreholes (including five recently drilled exploration boreholes) have reported yields in excess of 5 l/s. Regional ground water abstraction is therefore low in aggregate.

(ix) Irrigation from ground water resources is limited. During the agricultural season 1980/81 only twelve boreholes were pumped at rates in excess of 5 l/s from eight properties to provide about $1,1 \times 10^6 m^3$ for irrigation purposes. Yields from these boreholes were reasonably reliable but declined slightly in 1980 from boreholes receiving ground water from the granite.

(x) The most favourable geological formations for the recovery of ground water on a scale sufficient for a municipal supply are weathered zones within the granite and in the lavas (particularly near surface drainage courses), deep fractures within the lavas, and fractures associated with the quartzite-granite contact. It has been proved by exploration drilling that dyke-lava contact zones and lava-quartzite contacts are also capable of yielding good supplies of ground water.

(xi) Geophysical methods can be successfully applied to locate moderately yielding boreholes within weathered granite, dyke-lava contacts and possibly dyke-granite contacts. Geophysical methods can also be successfully employed to determine the presence of magnetized amphibolite bodies within the granite and to delineate those areas overlain by Karoo mudstones. Boreholes penetrating lava-quartzite contacts are best sited geologically.

(xii) Ground water in general is of good quality except for relatively high levels of nitrate. Ground water is only moderately mineralized. Mineralization is greater in Karoo formations and lavas than that from granite and quartzite.

Nitrate levels though generally high seldom exceed 102 mgm/l. Apart from ground water occurring in the granite of the Schweizer-Reneke Townlands, ground water remaining in other locations favourable for exploitation are only marginally high in nitrate concentrations. The chemical composition of the ground waters occurring in the area is characteristically not dominated by any particular cation or anion type.

(xiii) Pumping tests on borehole G34310, on Hamburg 82HO, indicate that this borehole is capable of supplying about 1 000 $m^3$/day during a 24-hour pumping schedule. The weathered and fractured granite is semi-confined and is partially fed by gravity drainage from the overlying less permeable decomposed granite. Transmissivity values average about 120 $m^2$/d.

(xiv) Borehole Pa 1, Palachoema 34HO, has been shown to be capable of yielding 1 000 $m^3$/d during a 24-hour pumping schedule. Conditions within the weathered granite are semi-confined or semi-unconfined. Transmissivity values average about 230 $m^2$/d.

(xv) Borehole G34325, Schweizer-Reneke 62HO, is probably capable of supplying 350 $m^3$/d. The multiple fracture system is probably semi-confined. A transmissivity value of 70 $m^2$/d was estimated from recovery data after a pump test.

(xvi) Borehole G34307, Maraetchesfontein 54HO, could possibly be capable of yielding 850 $m^3$/d. Ground water movement is by fissure flow along a preferrential zone of transmissivity namely the Maeretchesfontein dyke. Pumping tests did not permit the calculation of any geohydrologic parameters.

(xvii) Estimates of the exploitable ground water potential in favourable geological formations indicates that adequate supplies of ground water are available within a radius of 10 km of Schweizer-Reneke. Provisional estimates of these exploitable supplies are summarized below:

Schweizer-Reneke Townlands 62HO

° Borehole field Ss 2 to Ss 11, located 1 km from town centre

= $0,2 \times 10^6 m^3$

° Borehole Ss 20 adjacent to Wentzel Dam, located 2,8 km from town centre

= $0,1 \times 10^6 m^3$

° Area centred on borehole G34315, located about 4,0 km from town centre

= $0,2 \times 10^6 m^3$

Mimosa 61HO

Area centred on borehole G34320, located about 4,5 km from town centre

= $0,2 \times 10^6 m^3$

Hamburg 82HO

Area centred on borehole G34310, located about 7,5 km from town centre

= $0,6 \times 10^6 m^3$

Palachoema 64HO

° Area centred on borehole Pa 1, located about 7,7 km from town centre

= $0,3 \times 10^6 m^3$

° Area centred on boreholes Pa 4, 5 and 6, located about 6,4 km from town centre

= $0,3 \times 10^6 m^3$

Maraetchesfontein 54HO

Area centred on borehole G34307, located about 10 km from town centre
= $0,5 \times 10^6 m^3$

In total this gives an exploitable ground water potential of about $2,4 \times 10^6 m^3$.

This amount is sufficient to meet the projected municipal water demand of Schweizer-Reneke up to about the year 2010. However this potential is not all located in one area but in many areas within a radius of about 10 km of the town centre.

In chapter 11 some views are expressed on what approach should be adopted to integrate the available ground water resources into the present municipal water supply.

## 11. RECOMMENDATIONS

The results obtained from this geohydrological investigation, and as recorded in this report, indicate that sufficient ground water to supplement existing municipal water supplies during extended periods of surface water shortage cannot be met solely from ground water resources occurring on the municipal townlands. However adequate supplies of good quality ground water (apart from moderately high concentrations of nitrate) are available within various favourable geological formations within a 10 km radius of Schweizer-Reneke. The development of alternative ground water resources located at greater distances from Schweizer-Reneke namely on the farms Kameelkuil 88HO and Springbok 191HO, which are known to occur but which were not investigated at this stage, are not considered feasible options as supplementary supplies of municipal water.

As indicated in this report although the exploitable ground water potential is considerable, conservatively estimated at about 2,5 X 106m3, it is distributed over an extensive area around

Schweizer-Reneke in various geological environments. This fact does impose additional problems of a development and management nature. It is recommended that the ground water resources available to the municipality be integrated into the municipal water supply system in an ordered sequence based primarily on accessibility considerations. The various recommended phases of integration are enumerated below.

Develop fully the available ground water resources on the Schweizer-Reneke Townlands as previously reported on. This would make provision for about $0{,}5 \times 10^6 m^3$ of municipal water annually sufficient to meet a large proportion of the town's present municipal water demand.

This ground water could also be used to supplement the normal municipal supply from surface water sources during periods of peak demands experienced in early summer. This peak demand is expected to reach a continuous pumping rate of 75 l/s by the year 2000.

At a later stage and depending on the actual increase in demand for municipal water in Schweizer-Reneke, and also on the actual demands on the existing surface water resources made by downsteam irrigators a second phase of ground water development could be initiated. This would necessitate developing a number of production boreholes either on the farm Hamburg <u>or</u> on the farm Palachoema. Palachoema is located slightly nearer to the town centre and has the advantage of being at a higher elevation and is conveniently situated as a supply point for the Black residential township to the west of Schweizer-Reneke. Both Hamburg and Palachoema could supply an estimated $0{,}6 \times 10^6 m^3$ of ground water annually. Together with the ground water supplies developed in phase one a total supplementary excess of $1{,}0 \times 10^6 m^3$ annually could be developed sufficient to meet the municipal water demand of Schweizer-Reneke until beyond 1990.

It is accepted that the surface water resources in Wentzel Dam will continue to supply the bulk of the municipal water of Schweizer-Reneke and that the alternative sources of ground water will be made available only for short critical periods. In order to improve on the estimates made of the exploitable ground water potential in certain areas it is recommended that ground water be recovered at this stage for short periods to relieve the seasonal demands for municipal water. To achieve this improvement additional field data would need to be monitored. Ground water of high nitrate levels could successfully be blended with surface water from Wentzel Dam to achieve acceptable potable water quality standards.

Once a decision has been reached on the various options available to the municipality additional production boreholes can be sited and brought into service at reasonably short notice.

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# APPENDIX 1

1. Index of investigated farms surveyed.
2. Completed borehole survey forms.
3. Water levels in observation boreholes.

# APPENDIX 1

## INDEX OF INVESTIGATED FARMS

| CADASTRAL FARM NAME | FARM NUMBER | BOREHOLE PREFIX |
|---|---|---|
| Bellevue | 68 HO | Be 68/ |
| Belvedere | 47 HO | Be 47/ |
| Blyvooruitzigt | 51 HO | Bt |
| Damplaats | 38 HO | Ds |
| De Park | 87 HO | Dk |
| Doornplaats | 55 HO | Dt |
| Elim | 24 HO | Em |
| Geluk | 56 HO | Gk 56/ |
| Geluk | 81 HO | Gk 81/ |
| Groenpan | 23 HO | Gn |
| Grootpoort | 83 HO | Gt |
| Hamburg | 82 HO | Hg |
| Holpan | 59 HO | Hn 59/ |
| Jacobsdal | 25 HO | Jl |
| Jala Jala | 10 HO | Ja |
| Kameelkuil | 88 HO | Kl |
| Koppiesfontein | 52 HO | Kn 52/ |
| Krompan | 85 HO | Kn 85/ |
| London | 112 HO | Ln |
| Lot | 48 HO | Lt |
| Lot 25 | 9 HO | Lt 9/ |
| Lot 26 | 16 HO | Lt 16/ |
| Lot 22 | 17 HO | Lt 17/ |
| Lot 22 | 18 HO | Lt 18/ |
| Lot 20 | 19 HO | Lt 19/ |
| Lot 19 | 20 HO | Lt 20/ |
| Lot 49 | 39 HO | Lt 39/ |
| Lot 15 | 44 HO | Lt 44/ |
| Lot 16 | 45 HO | Lt 45/ |
| Lot 6 | 48 HO | Lt 48/ |
| Lot 7 | 49 HO | Lt 49/ |
| Lot 9 | 63 HO | Lt 63/ |
| Luciana | 43 HO | La |

| CADASTRAL FARM NAME | FARM NUMBER | BOREHOLE PREFIX |
|---|---|---|
| Maraetchesfontein | 54 HO | Mn |
| Mimosa | 61 HO | Ma 61/ |
| Mooilaagte | 91 HO | Me |
| Niekerksrust | 79 HO | Nt 79/ |
| Nooitgedacht | 86 HO | Nt 86/ |
| Palachoema | 64 HO | Pa |
| Panfontein | 58 HO | Pn |
| Pasop | 67 HO | Pp |
| Pieterville | 41 HO | Pe |
| Rietput | 60 HO | Rt |
| Schoondal | 22 HO | Sl |
| Schweizer-Reneke Townlands | 62 HO | Ss |
| Seringboomkop | 66 HO | Sp |
| Springbok | 191 HO | Sk |
| Vaalpoort | 84 HO | Vt |
| Weltrevreden | 28 HO | Wn |
| Zandfontein | 90 HO | Zn |
| Zorgvliet | 80 HO | Zt |

# COMPLETED BOREHOLE SURVEY FORMS

SCHWEIZER-RENEKE DISTRICT   FORMATIONS: Rb = Bothaville F. (sdst + qtzt). Pd = Karoo (mudstone) Ra = Allanridge Andesite R = Archaean GRANITE.

# KAD. PLAASNAAM EN NR.

Periode van Opname: SEPT-OCT-NOV-DEC. 1981

Kaart en/of Lugfotoverwysing 1:50000 SHEETS 2725AA (AMALIA) 2725AB (S-RENEKE) + 2725AD (KOOSFONTEIN) 2725AC (DIENEDAMI)

(1)

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp en(enjin) | 7 Getoetste lewering en datum (indien bekend) l/sec. | 8 Huidige leweringstempo (nie vir W.P.) l/sec. | 9 Onttrekkingshoeveelheid en pomptydperke (nie vir W.P.) m³ p.a. | 10 Oppervlakte onder besproeiing uit grondwater | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling (metres) | 14 Grondwatervlak: datum | diepte onder kraag (m) | hoogte bo seespieël (m) | METRES: B.H. Total Depth | Water Strike (Depths) | T.D.S. Opmerkings | T°C | T.D.S. ppm at 25° | Formation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FARM: BELLEVUE 68 HO (prefix Be 68/) | | | | | | | | | | | | | | | | | | | | | | |
| Be 68/1 | absent. | | | s | W.P. | | | | | | | 1300 e. | 10/11/1981 | 7,47 | 1292,5 | | | 910 | 21,0 | 658 | R. | |
| FARM: BELVEDERE 47 HO (prefix Be 47/) | | | | | | | | | | | | | | | | | | | | | | |
| Be 47/1 B/no 26995 (Oct. 1940). | O.E. SCRIBANTE | | | d+s | W.P. Pump intake at 36,5m. | 1,2 (1940) | | | | | | 1356 e | 11/11/1981 | 29,49 • | 1335,5 | ±46 | 39 | | | | 0-18m<br>18-36<br>36-48 | boulder and sdst<br>Rb<br>fresh R |
| FARM: BLYVOORUITZIGT 51 HO (prefix Bt) | | | | | | | | | | | | | | | | | | | | | | |
| B/no 136771/4 Bt 1 | D.J. NIEUWOUDT | | | n | o | 0,4 (APRIL 1981) | | | | | | 1348 e | 30/9/1981 | 8,715 | 1339,3 | 82 | 1st 23m 2nd 49m | drilled April 1981 Casing 10m × 165mm plain | | | 0-10<br>10-82 | weath Ra<br>fresh Ra |
| Bt 2 | ditto | | | d+s | t (Rapide) | | 0,6 | 10 hrs/day. 6 days/week. 6750 m³ p.a. | none | | | 1348 e | | n | | | | 610 | 20,2 | 450 | Ra. | |
| B/no 135774/8 Bt 3 | ditto | | | s | t (Rapide) | 0,4 (APRIL 1981) | 0,4 | 10 hrs/day. 6 days/week. 4500 m³ p.a. | | | | 1340 e | | n | | 48 | 27 | drilled April 1980 12 × 165mm plain casing | | | 0-12<br>12-48 | weath Ra<br>fresh Ra |
| Bt 4 | ditto. | | | s | W.P. | 0,1 | | | | | | 1340 e | | n | | | | | | | Ra | |
| Bt 5 | ditto | | | n. | W.P. | | | | | | | 1327 e | | g | | | | | | | Ra | |
| Bt 6 | administred by VOLKSKAS TRUST | | | s | W.P | | | | | | | 1348 e | 01/10/1981 | 13,07 | 1337 | | | | | | Ra | |
| Bt 7 | H.J. VAN DEN BERG | | | d | t (Mono) | 3,75 | | | | | | 1331 e | 13/10/1981 | ≈9,5 | 1321,5 | | | 625 | 20 | 461 | Ra | |
| Bt 8 | H.P.J. VILJOEN | | | n | o | | | | | | | 1340 e | 13/11/1981 | 6,3 | 1333,7 | | | | | | Ra | |
| FARM: DE PARK 87 HO (prefix Dk) | | | | | | | | | | | | | | | | | | | | | | |
| Dk 1 | J.A.G. VAN STRATEN | | | d | W.P. pump at 27,5m. | 6,0 | | | | | | 1341 e | 03/12/81 | ≈3,05 | 1338 | 30,5 | 1st 15m 2nd 23m | 800 | 22,0 | 568 | Pd/ Ra | casing 6,1m × 165mm |
| FARM: DAM PLAATS 38 HO (prefix Ds) | | | | | | | | | | | | | | | | | | | | | | |
| Ds 1 | BOTHMA | | | d | W.P. pump at 15m. | | | | | | | 1330 e | 27/11/1981 | 7,7 | 1322,3 | 18 m | | 425 | 19,5 | 316 | R | |
| Ds 2 | K. WHITE | | | d | W.P. | | | | | | | 1343 e | 27/11/1981 | 7,2 • | 1335,8 | | | | | * | R. | |

5: d - Domestic, s - Stock, l - irrigation. n - not in use, o - open

6: W.P. - Windpump, T - Turbine, P - pump not designated

* Temp correction 0,02 × °C - 25 and 0,67 × umhos @ 25°C

e estimated from topo. map.

l levelled height.

• pump running.

n - not measurable

g - grease in borehole.

formations.

Pd - Dwyka

Ra - Allanridge andesite F. (Ventersdorp lava)

SCHWEIZER-RENEKE DISTRICT

# KAD. PLAASNAAM EN NR. GEBIED.

d - domestic
s - stock
i - irrigation
n - not in use.

e = estimated from topo. map.

Periode van Opname SEPT – DEC. 1981

Kaart en/of Lugfotoverwysing 1:50000 Sheets. 2725AA, 2725AB, 2725AC + 2725 [illegible]

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp enjin | 7 Geloriste lewering en datum (indien bekend) ℓ/sec. | 8 Huidige leweringstempo (m vir W.P.) ℓ/sec. | 9 Onttrekkingshoeveelheid en pomptydperke (nie vir W.P.) m³ p.a. | 10 Oppervlakte onder besproeiing uit grondwater | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling (m.) | 14 Grondwatervlak datum | 14 diepte onder kraag (m) | 14 hoogte bo seespieël (m) | TDS uS/cm | T°C | TDS mg/l 25°C | 15 Formation / Opmerkings | BH. Total depth (metres) | Water strike (metres) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FARM : ELIM | 24 HO | (PREFIX Em) | | | | | | | | | | | | | | | | | | |
| Em 1 | absent | | | s. | W.P | | | | | | | 1361 e | 11/11/1981 | 9,47• | 1351,5 | 635 | 22,5 | 447 | Ra ? | | |
| Em 2 | " | | | n | 0 | | | | | | | 1358 e | ditto | 3,6 | 1354,4 | | | | Ra ? | 38 | |
| | FARM : GELUK | 56 HO | (PREFIX GK 56/) | | | | | | | | | | | | | | | | | | |
| Gk 56/1 | A.J.S. Lock. | | | s | P | 2,5 | 2,0 | | | | | 1359 e | 13/11/1981 | n. | | | | | Pd ? + Ra | | |
| Gk 56/2 | A. Jacobs | | | s | wP | | | | | | | 1366 e | ditto | 7,16• | 1358,8 | | | | Pd ?+Ra. Pd to 20 or 20m | | 32m… |
| Gk 56/3 | J.T.R. Holdings ? | | | s | w.P. | | | | | | | 1369 e | ditto | 19,96• | 1349 | | | | Pd?+Ra. | | |
| Gk 56/4 | ditto ? | | | d. | w.P. | | | | | | | 1365 e | ditto | 12,78 | 1352, | | | | ditto | | |
| Gk 56/5 | ditto ? | | | n | 0 | | | | | | | 1366 e | ditto | 7,3 | 1358,7 | | | | ditto | | |
| Gk 56/6 | W.H. Van Graan | | | n | o | ±0,38 | | | | | | 1360 e | ditto | 13,08 | 1347 | | | | ditto casing 6-9m. | 52 | |
| Gk 56/7 | J.T.C. Holdings. | | | s | | | | | | | | 1357 e | ditto | 7,41• | 1349,6 | | | | ditto. | | |
| | FARM : GELUK | 81 HO | (PREFIX GK 81/) | | | | | | | | | | | | | | | | | | |
| Gk 81/1 | absent. | | | n | o | | | | | | | 1282 | 30/11/1981 | 8,67 | 1273,3 | | | | R | 9,7 | |
| Gk 81/2 | A.J.S. Roos | | | s | w.P | | | | | | | 1329 | ditto | 2,96 | 1326 | | | | R | 21 | 17 |
| Gk 81/3 | ditto | | | s. | w.P. | 1 | | | | | | 1323 | ditto | 9,68• | 1313,3 | 630 | 20,5 | 460 | R | 29 | 18 |
| Gk 81/4 | absent | | | s | w.P. | | | | | | | 1301 | ditto | 4,01 | 1247 | | | | R | | |
| | FARM : DOORNPLAAT | 55 HO | (PREFIX Dt) | | | | | | | | | | | | | | | | | | |
| Dt1 | absent. | | | d+s | P | | ±3 | | | | | 1356 | | n | | | | | Pd? + Ra | | |
| Dt2 | J.A.J. Viljoen | | | d+s | T | | 1 | | | | | 1357 | 30/10/88 | 6,212 | 1350,8 | | | | Pd?+Ra. | | |

WP - Windpump
T - Turbine

• pump running
n not measurable

Pd = Dwyka Mudstone + till
Ra = Allanridge andesite Formation
Rb - Bothaville Formation (sediments)

# KAD. PLAASNAAM EN NR.

d = domestic
s = stock
i = irrigation
n = not in use.

# GEBIED.

l = levelled
e = estimated from topo. map

Periode van Opname SEPT - DEC. 1981

Kaart en/of Lugfotoverwysing 1: 50000 SHEETS 2725AA, AB, AC + AD.

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp enjin(e) | 7 Getoetste lewering en datum (indien bekend) l/sec | 8 Huidige leweringstempo (nie vir W.P.) l/sec | 9 Onttrekkingshoeveelheid en pomptydperke (nie vir W.P.) m³/a | 10 Oppervlakte onder besproeiing uit grondwater | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling (metres) | 14 Grondwatervlak: datum | 14 Grondwatervlak: diepte onder kraag (m) | 14 Grondwatervlak: hoogte bo seespieël (m) | METRES: DEPTH (B/HOLE) | METRES: WATER INFLOW | 15 TDS (mg/l) | 15 T°C | 15 EC at 25°C | 15 Formation | Opmerkings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FARM | GROENPAN | 23 HO | (Prefix Gn) | | | | 142000 | | | | | | | | | | | | | | |
| Gn 1 | G. LE ROUX | | | d+i+s | t | 19 | 13,75 | mid Aug - mid Nov + mid Dec - mid Feb. 6 days/wk 22hr/day | 8,6 hectares | wheat | | 1355 e | | n | | 39,5 | | 640 | 25,0 | 429 | Rb/R | |
| Gn 2 | ditto | | | d+i+s | | | 6 | | | ditto | | 1355 e | | n | | | | | | | Rb/R | |
| Gn 3 | ditto | | | d+i+s | | | 3,75 | | | ditto | | 1355 e | | n. | | | | | | | Rb/R | |
| Gn 4 | G.S. LOCK | | | d+s | W.P | 0,38 pipes at 40m. | | | | | | 1372 e | 11/11/1981 | 14,38° | 1357,6 | 43,0 | 37 | | | | | |
| | FARM | GROOTPOORT | 83 HO | (PREFIX Gt) | | | | | | | | | | | | | | | | | | |
| Gt 1 | J.G.H. BADENHORST | | | i+s | W.P. | | | | | | | 1319 e | 16/11/1981 | 31,5° | 1287,5 | | | 125 | 21,5 | 90 | R | |
| Gt 2 | D. NEL | | | d | W.P. | | | | | | | 1330 e | 27/11/1981 | 21,6° | 1308,4 | | | 830 | 23,0 | 578 | R | |
| Gt 3 | A.J. FOURIE | | | d+S | o? | | | | | | | 1340 e | 02/12/1981 | flowing | | 9 | | | | | Rb | BY SPRING. flowing? |
| Gt 4 | BÖHME | | | n | o | | | | | | | 1310 e | 17/11/1981 | 16,0 | 1294 | | | | | | R | slight bleeding!! |
| Gt 5 | Absent | | | s | w.p | | | | | | | 1330 e | 27/11/1981 | 20,8° | 1309,2 | | | | | | R | |
| | FARM | HAMBURG | 82 HO | (PREFIX Hg) | | | | | | | | | | | | | | | | | | |
| Hg 1 | Mrs BEKKER | | | i+s | T | 20 | 12,5 | 1 hour/dy. 4 dy/wk 9000 m³/a | | | | 1300,542 l | 17/11/1981 | 7,935 | 1292,605 | 18,9 | 18,3 | 410 | 21,0 | 297 | R | 0-16m weathered 16-18,4 fresh 18,4-18,9 fractured |
| Hg 2 | ditto | | | n | | | | | | | | 1299,468 l | 17/11/1981 | 4,475 | 1294,993 | | | | | | R | |
| Hg 3 | ditto | | | i+s | W.P | 10 | | | | | | 1300 e | | n | | | | | | | R | |
| Hg 4 | ditto | | | i+s | W.P. | 5 | | | | | | 1300 e | | n | | | | | | | R | |
| Hg 5 | ditto | | | d | P | | 3 | | | | | 1300 e | | n. | | | | | | | R | |
| Hg 6 | Absent. | | | d+s | ? | | | | | | | 1290 e | | | | | | 515 | 23,0 | 359 | R | |
| Hg 7 | Absent | | | d+s | W.P. | | | | | | | 1300 | 16/11/1981 | 13,65 | 1286,4 | | | | | | R | |
| Hg 8 | M.J. FOURIE | | | d+s | W.P. | 0,28 | | | | | | 1287 e | 16/11/1981 | 8,74 | 1278,3 | 39,5 | 14; 27-18; 21-23 | | | | R | Pump at 21m 2m casing |
| Hg 9 | Absent. | | | s | W.P. | | | | | | | 1304 e | | | | | | | | | R | |
| Hg 10 | J.' HALLATT | | | d | W.P. | | | | | | | 1310 e | 01/12/81 | 12,62° | 1297,4 | | | 850 | 23,0 | 604 | R | |
| Hg 11 | FOURIE | | | s | W.P. | | | | | | | 1327 e | 01/12/81 | 18,58 | 1308,4 | | | | | | R | |

WP - windpump
T - Turbine
n - not determined

° pump running
n not measurable.

R.b - Bushveld ... (?)
Rn = Alkaline granite (?)

SCHWEIZER – RENEKE DISTRICT (4)

# KAD. PLAASNAAM EN NR.

# GEBIED.

e = estimated from topo-map. Periode van Opname SEPT – DEC 1981.

Kaart en/of Lugfotoverwysing 1:50000 sheets 2725 AA, AB, AC + AD.

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp (enjin) | 7 Getoetste lewering en datum (indien bekend) ℓ/sec | 8 Huidige leweringstempo (nie vir W.P.) ℓ/sec | 9 Onttrekkingshoeveelheid en pomptydperke (nie vir W.P.) m³ p.a. | 10 Oppervlakte onder besproeiing uit grondwater | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling (metres) | 14 Grondwatervlak: datum | 14 diepte onder kraag (m) | 14 hoogte bo seespieël (m) | 15 metres: RJ depth | Water strikes | TDS | T°C | TDS @ 25°C | Formation | Opmerkings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FARM : HOLPAN 59 HO (PREFIX Hn 59/) | | | | | | | | | | | | | | | | | | | | | | |
| Hn 59/1 | J.H. FOURIE | | | s | W.P | | | | | | | 1362 e | 16/11/1981 | 5,20 | 1356,8 | | | | | | Pd/Ra | |
| Hn 59/2 | ditto | | | d+s | P | 2,5 | | | | | | 1371 e | 16/11/1981 | 15,00 | 1356 | | | 2400 | 22,5 | 1690 | Pd/Ra | |
| FARM : JALA JALA 10 HO (PREFIX Ja) | | | | | | | | | | | | | | | | | | | | | | |
| Ja1 | A.J.J. JORDAAN | | | n | o | | | | | | | 1313 e | 07/10/1981 | 4,603 | 1308,4 | | | | | | Ra | |
| Ja 2 | ditto | | | n | o | 0,4 | | | | | | 1334 e | 07/10/1981 | 6,473 | 1329,5 | | | | | | Ra | govt. drilled 152mm casing |
| Ja 3 | ditto | | | n | o | | | | | | | 1336 e | 07/10/1981 | 7,180 | 1328,8 | | | | | | Ra | govt. drilled 152mm casing |
| Ja 4 | ditto | | | d | W.P. | | | | | | | 1336 e | | | | | | | | | Ra | |
| FARM : JACOBSDAL 25 HO (PREFIX Jl) | | | | | | | | | | | | | | | | | | | | | | |
| Jl 1 (B/W 136779/8) | S. BLIGNAUT | | | n | o | 5 (June 1981) | | | | | | 1380 e | 10/11/1981 | 12,40 | 1367,6 | 50 | 42 | | | | Rb | CASING 49,9 x 127mm |
| Jl 2 | ditto | | | s | W.P | 1,3 | | | | | | 1379 e | 10/11/1981 | 12,30 | 1366,7 | | | 270 | 21,5 | 194 | Rb | PIPES 30m. |
| Jl 3 (B/w 136697/5) | ditto | | | s | P | 10 (June 1981) | | | | | | 1378 e | 27/11/1981 | 7,850 | 1370 | 52 | 42 | | | | R | CASING 15m x 165mm 0-10m clay, 10-26 [illegible] 26-52 fresh granite |
| | | | | | | | | | | | | | | | | | | | | | | pegmatite, qtz fdspr at 42m |
| FARM : KAMEELKUIL 88 HO (PREFIX KL) | | | | | | | | | | | | | | | | | | | | | | |
| KL1 (110433) | L.S. VILJOEN | | | n | o | * 23 (1972?) | | drilled May 1971 | | | | 1338 e | 03/12/1981 | 4,780 | 1333,2 | 87 | 70 | | | | Pd/Ra | To 11,5m? CASING 12m x 11,5[illegible] |
| Kl 2 | A.J. VAN DER MERWE | | | d+i+s | t | 137,5 | 12,5 | 14hr/dy Aug–Mei, and Jan–Feb 24 hrs, 10hr/dy Rest of yr. ⇒ 220 000 | 17 hectares | maize + groundnuts | | 1340 e | | n | | 62 | 1st 44m, 2nd 60,5m | 800 | 24,0 | 547 | Pd/Ra | To 30m? PUMP @ 60m |
| Kl 3 | ditto | | | s | W.P. | 1,9 | | | | | | 1339 e | | n | | 30 | 25 | | | | Pd/Ra | PUMP @ 24m. |
| Kl 4 | ditto | | | s | | 0,4 | | | | | | 1339 e | | n | | 91,5 | 30m | | | | Pd/Ra | |
| Kl 5 | ditto | | | s | | | | | | | | 1338 e | 03/12/1981 | 8,23° | 1329,8 | | | | | | Pd/Ra | |
| Kl 6 | absent | | | s. | W.P | | | | | | | 1338 e | 03/12/1981 | 5,7 | 1332,3 | | | | | | Pd/Ra | |
| FARM : KOPPIESFONTEIN 52 HO (PREFIX Kn 52/) | | | | | | | | | | | | | | | | | | | | | | |
| Kn 52/1 | VAN TONDER | | | d | W.P | | | | | | | 1332 e | 13/11/1981 | 6,94° | 1325 | | | 1000 | 20,0 | 737 | Ra | PUMP at 12m. |

* test pumped by Agrico Machinery (S-R). for 3 days at rate 22,5 to 25 ℓ/sec. Pump set at 70 m.

° pump running.

...WEL... REVIVAL DISTRICT (E)

# KAD. PLAASNAAM EN NR.

# GEBIED.

e - estimated from topo map.

Periode van Opname SEPT- DEC 1981

Kaart en/of Lugfotoverwysing 2725 AA, AB, AC + AD.

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp en(enjin) | 7 Getoetste lewering en datum (indien bekend) l/sec | 8 Huidige leweringstempo (nie vir W.P.) l/sec | 9 Onttrekkingshoeveelheid en pomptydperke (nie vir W.P.) m³/a | 10 Oppervlakte onder besproeiing uit grondwater hectares | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling m. | 14 Grondwatervlak datum | diepte onder kraag m | hoogte bo seespieël m | metres Dr. Depth | Water Strike | 15 TDS mg/l | T°C | EC mS/m | Formation | Opmerkings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FARM : | KROMPAN | | 85 HO | | (PREFIX Kn 85/) | | | | | | | | | | | | | | | | |
| Kn 25/1 | FOURIE | | | s | W.P. | | | | | | | 1349 e | 02/12/1981 | 3,13 | 1345,9 | | | | | | Pd/? Ra. | |
| | FARM : | LUCIANA | | 43 HO | | (PREFIX La) | | | | | | | | | | | | | | | | |
| La 1 | Absent. | | | n | o | | | | | | | 1375 e | 27/11/1981 | 3,0 | 1372 | | | | | | R | DRILLED 1981. |
| | FARM : | LONDON | | 112 HO | | (PREFIX Ln) | | | | | | | | | | | | | | | | |
| Ln 1 | D.E.H. PUTTER (IRRIG. No 111658.) | | | s | T | 13 (1971) | 6 | | | | | 1318 e | 25/10/1971 | 6,3 | 1311,7. | 77,5 | 1st 4,11 2nd - 58m. | | | | Ra. | FORMERLY USED FOR IRRIGAT. 1975-1977. |
| | FARM : | LOT | 48 HO | | (PREFIX Lt) | | | | | | | | | | | | | | | | | |
| Lt 1 | K. OLIVIER | | | s | P | | | | | | | 1379 e | 27/11/1981 | 27,7 | 1351,3 | | | | | | Ra | |
| | FARM : | LOT | 25 | 9 HO | | (PREFIX Lt. 9/) | | | | | | | | | | | | | | | | |
| Lt 9/1 | A.J.J. JORDAAN | | | s | W.P. | | | | | | | 1345 e | 12/11/1981 | 7,46° | 1337,5 | | | 1700 | 18,0 | 1300 | Ra? | |
| | FARM : | LOT | 26 | 16 HO | | (PREFIX Lt 16/) | | | | | | | | | | | | | | | | |
| ~~Lt 16/1~~ | ~~P. GOOSEN~~ | | | d. | W.P. | 1,25 | | | | | | | 12/11/1981 | 9,5° | | ~~21~~ | ~~12~~ | | | | Ra | PUMP at 15m. |
| Lt 16/1 | A J.J. JORDAAN | | | n | o | 0,3 | | | | | | 1327 e | 12/11/1981 | 6,3 | 1320,7 | | | | | | Ra | |
| Lt 16/2 | H.B. SMITH | | | d | W.P. | 0,19 | | | | | | 1315 e | ditto | | | 24 | 24 | 600 | 21,5 | 430 | Ra | 6m CASING PUMP at 18m. |
| Lt 16/3 | ditto. | | | d+s | P | 0,5 | | | | | | 1317 e | ditto. | 12,4 | 1304,6 | 66 | 20 | | | | Ra (main at 6m.) | 6m CASING. PUMP at 21m. |
| (IRRIG. No. 87604) | FARM : | LOT | 22 | 17 HO | | (PREFIX Lt 17/) | | | | | | | | | | | | | | | | |
| Lt 17/1 | R.A. ERASMUS | | | d | W.P. | 0,3 (1963) | | | | | | 1338 e | 12/11/1981 | 10,29° | 1327,7 | 31 | 21 | | | | Ra | 6m CASING. DRILLED: 1963. |
| | FARM : | LOT | 20 | 19 HO | | (PREFIX Lt 19/) | | | | | | | | | | | | | | | | |
| Lt 19/1 | Absent | | | s | W.P. | | | | | | | 1314 e | 12/11/1981 | 33,8° | 1280 | | | | | | Ra | |
| Lt 19/2 | Absent | | | s | W.P. | | | | | | | 1325 e | 12/11/1981 | 12,89 | 1312,1 | | | 735 | 22,5 | 517 | Ra | |
| | FARM : | LOT | 19 | 20 HO | | (PREFIX Lt 20/) | | | | | | | | | | | | | | | | |
| Lt 20/1 | F. STRAUSS | | | d | | | | | | | | 1348 e | 11/11/1981 | 15,58 | 1332,4 | | | 390 | 23,5 | 269 | Ra? Pb? R.? | |
| Lt 18/1 | P. GOOSEN | | | d | W.P. | 1,25 | | | | | | 1313 e | 12/11/1981 | 9,5° | 1303,5. | 21 | 12 | | | | Ra | PUMP at 15m. |
| | FARM : | LOT | 22 | 18 HO | | (PREFIX Lt 18/) | | | | | | | | | | | | | | | | |

° pump running.

HU 2ER :NE L RIC (6)

# KAD. PLAASNAAM EN NR.　　　GEBIED.

e - estimated from topo map.

Periode van Opname SEPT - DEC 1981

Kaart en/of Lugfotoverwysing 1: 50000 SHEETS 2725 AA, AB, AC + AD.

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp en enjin | 7 Getoetste lewering en datum (indien bekend) l/sec | 8 Huidige leweringstempo (nie vir W.P.) l/sec | 9 Onttrekkingshoeveelheid en pompydperke (nie vir W.P.) m3 p.a. | 10 Oppervlakte onder besproeiing uit grondwater | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | FARM : | LOT | 49 | 39 HO | (PREFIX Lt 39/) | | | | | | |
| Lt 39/1 | K. OLIVIER | | | s | W.P. | | | | | | |
| | FARM : | LOT | 15 | 44 HO | (PREFIX Lt 44/) | | | | | | |
| G 22542 Lt 44/1 | S. STRYDOM | | | d | T | 4,2 (1967) | | | | | |
| | FARM : | LOT | 16 | 45 HO | (PREFIX Lt 45/) | | | | | | |
| Lt 45/1 | H. DEALE | | | n | O | was 7,5 | | | | | |
| | FARM : | LOT | 6 | 48 HO | (PREFIX Lt 48/) | | | | | | |
| Lt 48/1 | Absent. | | | s | W.P. | | | | | | |
| | FARM | LOT | 7 | 49 HO | (PREFIX Lt 49/) | | | | | | |
| Lt 49/1 | Absent | | | s | P | | | | | | |
| Lt 49/2 | DEALE | | | i+s | W.P+P | 7 | 6 | 9 hr/dy 6 month/y | 3 HECTARES | MARKET VEGETABLES | |
| Lt 49/3 | DEALE | | | d | W.P | | | | | | |
| Lt 49/4 | DEALE | | | i+s | P | 6 | 4 | 2 hr/dy 6 months ⇒ 72000 | | | |
| | FARM | LOT | 9 | 63 HO | (PREFIX Lt 63/) | | | | | | |
| Lt 63/1 | M. VAN DE VENTER. | | | d | W.P. | 0,9 (1967) | | | | | |
| Lt 63/2 | T.J. KOTZE | | | d | P | | 1 | 3 hrs/dy | | | |
| | FARM | MIMOSA | | 61 HO | (PREFIX Ma 61/1) | | | | | | |
| Ma 61/1 | Chris Van Rensburg | | | d+i+s | P | 15 ? | | COMBINED PUMPAGE 25 l/sec.* i: 4 hr/dy 6 mths/yr ⇒ 110 000 m³/a. | 25,7 hectares of lucerne for dairy cattle | LUCERNE. | ADDITIONAL ABSTRACT from ① irrigation canal from Wentzel Dam ② weir + dam on Harts river. |
| Ma 61/2 | ditto | | | i+s | P | | | | | | |
| Ma 61/3 | ditto | | | i+s | P | | | | | | |
| Ma 61/10 | ditto | | | i+s | P | | | | | | |
| Ma 61/4 | L.T.R. HOLDINGS | | | n | O | | | | | | |
| Ma 61/5 | J.C. GOOSEN. | | | s | W.P | | | | | | |
| Ma 61/6 | W.J. STRYDOM | | | d | P | 2,5 | | | | | |
| Ma 61/7 | VORSTER | | | d+s | W.P | 0,5 (OCT 1981) | | | | | |
| Ma 61/8 | Mc DONALD | | | n | O | | | | | | |
| Ma 61/9 | L.T.R HOLDINGS | | | i+s | T | | 8,75 | | 0,5 HECTARE | MARKET VEGETABLES | |

| 1 BG Nr | 13 Bekhoogte en Metode van bepaling m | 14 Grondwatervlak datum | 14 diepte onder kraag m | 14 hoogte bo seespieël m | 15 (metres) DEPTH BH. | WATER STRIKES | TDS | Temp | EC mS/m | Opmerkings | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lt 39/1 | 1355 e | 27/11/1981 | ^ | | | | 960 | 19,0 | 720 | Ra | |
| Lt 44/1 | 1343 e | 03/12/1981 | ^ | | 43 | 1st-21 2nd-25 | 770 | 23,0 | 537 | R | SELECTED BY W. AFFAIRS 1967 |
| Lt 45/1 | 1369 e | 11/11/1981 | 22,7 | 1346,3 | 42,7 | 25 | | | | Rb | CASING 6 m |
| Lt 48/1 | 1297 e | 12/11/1981 | 15,25° | 1281,7 | | | | | | Ra | |
| Lt 49/1 | 1338 e | 12/11/1981 | 23,2 | 1314,8 | | | | | | Ra | |
| Lt 49/2 | 1321 e | ditto | 19,28° | 1301,7 | 45 | 30 | | | | Ra | |
| Lt 49/3 | 1321 e | ditto | 51,44° | 1269,6° | | | 530 | 24,5 | 359 | Ra | |
| Lt 49/4 | 1321 e | ditto | ^ | | 45 | 30 | | | | Ra. | |
| Lt 63/1 | 1330 e | 10/11/1981 (1967) | 12,1° (5,5 m.) | 1317,9 | 18 | ±15 | 340 | 29,5 | 248 | R | |
| Lt 63/2 | 1340 e | 10/11/1981 | 6,74 | 1333,3 | 24,4 | | 385 | 25,5 | 257 | R | PUMP AT 18 m CASING 12 m. |
| Ma 61/1 | 1291 e | 09/1981 | ^ | | <30 m | | 1050 | 20,5 | 767 | R | |
| Ma 61/2 | 1291 e | ditto | ^ | | <30 m | | | | | R | |
| Ma 61/3 | 1291 e | ditto | ^ | | <30 m | | | | | R | |
| Ma 61/10 | 1291 e | ditto. | ^ | | <30 m | | | | | | |
| Ma 61/4 | 1381 e | 16/11/1981 | 8,01 | 1373 | 31 | | | | | Ra | |
| Ma 61/5 | 1372 e | 16/11/1981 | 24,16° | 1347,8 | | | | | | Ra | |
| Ma 61/6 | 1371 e | 16/11/1981 | 26,34 | 1344,7 | 84 | 71,5 | 1100 | 20,0 | 810 | Ra | CASING 6,7 m PUMP 58 m. LAVA AT 6,7 m. |
| Ma 61/7 | 1338 e | 03/11/1981 | 24,49 | 1313,5 | 49 | 41 | | | | Ra/Rb | PUMP AT 41 m CONTACT ± 33,5 m |
| Ma 61/8 | 1292 e | 27/11/1981 | 8,54 | 1283,5 | 18 | | | | | R | |
| Ma 61/9 | 1326 e | | | | 36,5 | | | | | Ra/Rb. | PUMP SET AT 36 m OLD BOREHOLE |

* total dropped during dry period 1979-1980.

° pump running

x DRILLED OCT. 1981.

LAT LEK [?] SNE [?] I 1C7 [?]

(7)

# KAD. PLAASNAAM EN NR.

# GEBIED.

* = lev. [?]
e estimated from Topo map.

Periode van Opname SEPT - DEC. 1981

Kaart en/of Lugfotoverwysing 1: 50000 SHEETS 2725 AA, AB, AC + AD.

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp en(enjin) | 7 Getoetste lewering en datum (indien bekend) l/sec | 8 Huidige leweringstempo (nie vir W.P.) l/sec | 9 Onttrekkingshoeveelheid en pompiydperke (nie vir W.P.) m³ p.a. | 10 Oppervlakte onder besproeiing uit grondwater hectares | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling m | 14 Grondwatervlak: datum | 14 diepte onder kraag m | 14 hoogte bo seespieël m | 15 Depth bh. | 15 Water strike | 15 TDS Opmerkings | 15 T°C | 15 Ec mS/m 25°C | Geol. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FARM: MOOILAAGTE | | 9140 | (PREFIX Me). | | | | | | | | | | | | | | | | | | |
| Me 1 | J.J. ROOS | | | s | W.P. | 1,25 | | | | | | 1373 e | 27/11/1981 | 19,6* | 1353,4 | 37 | | | | | R | CASING 12 m PIPES 21 |
| | FARM: MARAETCHESFONTEIN | | 5440 | (PREFIX Mn) | | | | | | | | | | | | | | | | | | |
| Mn 1 | A.J.S. LOCK | | | n. | 0 | | | | | | | 1342,417 l | 24/10/1981 | 6,286 | 1336,131 | | | | | | Ra | BLOCKED AT 7,6 m |
| Mn 2 | ditto | | | s+d | W.P. | strong (?3) | | FORMERLY PUMPED BY T.P.A. FOR 3 MONTHS. WITH 4" PUMP | | | | 1340,745 l | 24/10/81 | 5,79 | 1334,955 | 27,4 | | 1550 | 18,5 | 1170 | Ra | Pd to 10 m? CASING 6,1 m? |
| Mn 3 | ditto | | | n. | W.P. | | | | | | | 1342,882 l | 21/09/81 | 4,85 | 1338,0 | | | | | | Ra | with Pd? |
| B no 20200 Mn 4 | ditto | | | d+s | P | 2,5 (1935) | 2 | | | | | 1339, e | | ^ | | 41 | | | | | Ra | DRILLED 1935. |
| Mn 5 | ditto | | | s | W.P. | 0,2 | | | | | | 1334,843 l | 21/09/81 | 10,20* | 1324,6 | | | | | | Ra Pd | |
| Mn 6 | ditto | | | n | W.P. | ±0,2 | | | | | | 1347 e | | ^ | | | | | | | Ra? | |
| Mn 7 | ditto | | | s | P | | | | | | | 1357 e | 21/09/1981 | 4,15 | 1352,9 | | | | | | Pd? Ra | |
| Mn 8 | ditto | | | s+d | W.P. | | | | | | | 1349,356 l | 21/09/1981 | 4,51 | 1344,8 | | | | | | Pd? Ra | |
| ~~Mn 9~~ | ~~ditto~~ | | | ~~s~~ | ~~W.P.~~ | | | | | | | ~~1349 e~~ | ~~30/09/81~~ | ~~8,455~~ | ~~1344,5~~ | | | | | | ~~Ra~~ | |
| Mn 10 | G.F. BADENHORST | | | s | W.P. | | | | | | | 1340,087 l | 29/09/81 | 12,70* | 1327,4 | | | 500 | 20,5 | 365 | Ra | |
| Mn 11 | ditto | | | s | W.P. | | | | | | | 1355 e | 29/09/81 | ^ | | | | | | | Ra | |
| Mn 12 | B.No 20464 M.D. VILJOEN | | | i+s+d | T | 5 (1935!) | 8,8 | 20 hrs/day, 6 d/wk 4 months ⇒ 66000 | 2,6 | vegetables + cattle feed. | none. | 1354 e | 30/09/81 | ^ | | 26,5 | 17 | 1150 | 19 | 825 | Pd - 0-20 m? weath. Ra 20-26,0 m fresh Ra 26 m | |
| Mn 13 | ditto | | | s | W.P. | | | | | | | 1356 e | 30/09/81 | ^ | | | | | | | Pd/Ra? | |
| Mn 14 | ditto | | | s | W.P. | | | | | | | 1355 e | 30/09/81 | ^. | | | | | | | Pd/Ra? | |
| Mn 15 | G.F. BADENHORST | | | d+s | W.P.+P | | | | | | | 1321 e | 30/09/81 | ^ | | | | 750 | 19,2 | 560 | Ra | |
| Mn 16 | ditto | | | d+s | W.P. | | | | | | | 1321 e | " | ^ | | | | | | | Ra | |
| Mn 17 | ditto. | | | s | W.P. | | | | | | | 1322 e | " | ^ | | | | | | | Ra. | |
| Mn 18 | D.J. NIEUWOUDT | | | s | W.P. | | | | | | | 1320 e | " | ^ | | | | | | | Ra | |
| Mn 19 | P.F. BLIGNAUT | | | | | 0,15 (1964) | | | | | | 1344 e | 10/01/1967 | ±13,7 | 1330,3 | 24 | 21 | | | | Ra | Rust in Ehole 30/01/81. |
| Mn 20 | ditto. | | | | | 0,25 (Jan 1967) | | | | | | 1344 e | 10/01/1967 | ±13,7 | 1330,3 | 46 | 24 | | | | Ra | |
| Mn 21 | A.J.S. LOCK. | | | n | 0 | 1,0 (1970!) | | | | | | 1359 e | 23/09/81 | 6,095 | 1352,9 | 41 | 20 | | | | Ra | DRILLED BY WATER AFFAIRS |
| | FARM: NIEKERKSRUST 7940 (PREFIX Nt 79/) | | | | | | | | | | | | | | | | | | | | | |
| Nt 79/1 | Absent | | | d | W.P. | | | | | | | 1300 e | 30/11/1981 | 7,000 | 1293 | | | 390 | 22,5 | 294 | R | |

* pumping.

SCHWEIZER RENEKE DISTRICT.

# KAD. PLAASNAAM EN NR.

# GEBIED.

e estimated from topo. map

Periode van Opname SEPT-DEC 1981

Kaart en/of Lugfotoverwysing 1: 50000 SHEETS 2725 AA, AB, AC & AD.

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp en enjin | 7 Grootste lewering en datum (indien bekend) l/sec | 8 Huidige leweringstempo (nie vir W.P.) l/sec. | 9 Onttrekkingshoeveelheid en pomptydperke (nie vir W.P.) m3/ann. | 10 Oppervlakte onder besproeiing uit grondwater hectares | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling m. | 14 Grondwatervlak: datum | 14 diepte onder kraag m | 14 hoogte bo seespieël m | 15 metres: Depth bh. | 15 W. strike | 15 TDS (Opmerkings) | 15 T°C | 15 Ec mS/m 25° | 15 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FARM : NOOITGEDACHT | 86 HO | (PREFIX NE86) | | | | | | | | | | | | | | | | | | | |
| NE86/1 | L.T.R. HOLDINGS | | | s | W.P. | | | | | | | 1355 e | 11/11/1981 | 6,98 ° | 1348 | | | 1125 | 21,5 | 807 | Pd/Ra | |
| NE86/2 | G.F. MULLER | | | d | P | 12,5 | | | | | | 1351 e | 02/12/1981 | ^ | | 33,5 | 30 | | | | Pd/Ra | CASING - 6, PIPES - 3 |
| NE86/3 | ditto | | | d. | W.P | 0,75 | | | | | | 1350 e | 02/12/81 | 6,42 ° | 1343,6 | 30 | 24 | 700 | 21,0 | 507 | Ra | CASING - 6, PIPES - 27 |
| NE86/4 | Absent. | | | s | W.P | | | | | | | 1352 e | 02/12/81 | 2,95 ° | 1349 | | | | | | Pd/Ra | |
| | FARM : PALACHOEMA | 64 HO | (PREFIX Pa) | | | | | | | | | | | | | | | | | | | |
| Pa 1 | C. STROEBEL | B/no 1367/69/1 | | n | o | 13 (04/11/81) | | | | | | 1307 e | 04/11/1981 | 4,512 | 1302,5 | 42. | 36. | 330 | 21,2 | 238 | R | 0-15 weathered CAS 11m x 15.. |
| Pa 2 | ditto. | B/no 130770/6. | | n | o | 2,5 (March 81) | | | | | | 1307 e | 04/11/1981 | 4,625 | 1302,4 | 58. | 47 | | | | R | 0-6 weathered CAS 6m x 15.. |
| Pa 3 | W. ROOS | PUMPING SCHEDULE FOR PREVIOUS OWNER W. VISSER. | | d | W.P. | 2,25 | | | | | | 1321 e | 10/11/1981 | 11,3 | 1309,7 | 30,5 | 21 | 410 | 17,5 | 398 | R | CAS - 9,1m x 152mm |
| Pa 4 | ditto | | | i | P | 2,5 | 2,5 | 17 hr/dy; 6dy/wk. = 30 840 | TOTAL 0,31 x 10^6 m3 p.a. | 12 HECTARES MARKET VEG. + LUCERNE | | 1320 e | 30/09/81 | 12,43 | 1308,6 | 30,5 | 20 | | | | R | CAS 6,1 ø 152mm |
| Pa 5 | ditto | | | i +s+d | T | 20 | 15 [12,5] | 3 months 24hr/dy. 9 months - 11 hr/dy, 6 dy/wk = 246 ... | | | | 1320 e | | | | 30,5 | 20 | | | | R | CAS 12,2 ø 152mm |
| Pa 6 | ditto | | | i +s+d. | T | 5 | 3,1 | 11 hr/dy 6 dy/wk = 387.. | | | | 1320 e | | ^ | | 30,5 | 20 | | | | R | CAS 12,2 ø 152mm |
| Pa 7 | Mrs BEKKER | | | s | W.P. | | | | | | | 1296 e | 10/11/1981 | | | | | 400 | 21,5 | 287 | R | |
| Pa 8 | H.J. KLEYNHANS | | | d+s+i | P | | 1,25 | 6 hrs, 2dy/wk. = 2840 p.a. | 0,5 | vegetables. | | 1315 e | 10/11/1981 | | | 17 | 9 ? | 450 | 19,5 | 335 | R. | CASING - 12m PIPES - 12 |
| Pa 9 | A.J.S. ROOS | | | d | W.P. | | | | | | | 1310 e | 10/11/1981 | 9,5 ° | 1300,5. | | | | | | R | |
| | FARM : PIETERVILLE | 61 HO | (PREFIX Pe) | | | | | | | | | | | | | | | | | | | |
| Pe 1 | K. OLIVIER. | | | d | W.P. | | | | | | | 1391 e | 27/11/1981 | | | 88 | | 165 | 21 | 102 | Rb | PIPES: 24m |
| | FARM : PANFONTEIN | 58 HO | (PREFIX Pn). | | | | | | | | | | | | | | | | | | | |
| Pn 1 | A.J.S. LOCK | | | d+s | P | 1,3 ' | | | | | | 1355 e | 30/09/81 | ^ | | ^ 30 | | 980 | 18,0 | 749 | Pd/Ra | CASING = 21m. |
| Pn 2 | ditto | | | d+s | P | 2,5 ' | | | | | | 1358 ' e | | | | | | | | | Pd/Ra | |
| Pn 3 | ditto | | | n | o | | | | | | | 1357 e | 21/09/81 | 5,25 | 1351,7 | | | | | | Pd/Ra | |
| Pn 4 | ditto. | | | s | W.P. | | | | | | | 1349 e | 30/09/81 | 8,455 | 1340,5 | | | | | | Pd/Ra | |
| Pn 5 | BGG. TERREBLANCHE | B/no 123863/0 | | n | o | 1,0 (Feb 1979) | | | | | | 1359 e | 02/11/81 | 6,95 | 1352. | 51 | 30 | | | | Pd?/Ra | 0-11m weathered or Pd ? |

' during dry period 1979-1980

* PUMP HAD TO BE RESTED FOR ONE DAY WEEK AS YIELD DECLINING TO 12,5 l/sec.

° pump running.

e estimated from topo. map

# KAD. PLAASNAAM EN NR.

# GEBIED.

Periode van Opname SEPT - DEC 1981

Kaart en/of Lugfotoverwysing 1: 50000 SHEETS 2725 AA, AB, AC + AD

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp (enjin) | 7 Grootste lewering en datum (indien bekend) l/sec. | 8 Huidige leweringstempo (nie vir W.P.) l/sec | 9 Onttrekkingshoeveelheid en pomptydperke (nie vir W.P.) m³ p.a. | 10 Oppervlakte onder besproeiing uit grondwater hectares | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling m | 14 Grondwatervlak datum | 14 diepte onder kraag m | 14 hoogte bo seespieël m | 15 Depth bh. metres | 15 W. strike | 15 TDS (Opmerkings) | 15 T° | 15 EC (25c) | 15 | 15 Opmerkings |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FARM : VAN FONTEIN 58 HO (PREFIX Pn) | | | | | | | | | | | | | | | | | | | | | |
| Pn 6 | B.G.G. TERREBLANCHE B/ro | | 12365/6 | d | Hand pump | 0,13 (March 1977) | | | | | | 1379 e | 01/10/81 | n. | | 72 | 50 | | | | Bl/Ra | 0-12 shale 12-24 sdst 24 m ... |
| Pn 7 | ditto | | | s | W.P. | ---- | | | | | | 1379 e | 01/10/81 | n. | | | | | | | Pd/Ra | |
| Pn 8 | ditto. | | | d | W.P. | 1,2 | | | | | | 1378 e | 01/10/81 | 15,43° | 1362,6 | 61 | | | | | Bl/Ra | w.h. |
| Pn 9 | A.J. VAN ZYL | | | s | W.P. | | | | | | | 1378 e | 13/11/1981 | 18,10° | 1359,9 | | | 900 | 21,0 | 651 | Pd/Ra | |
| Pn 10 | B.G.G. TERREBLANCHE | | | s+d | W.P. | 0,9 | | | | | | 1372 e | 13/11/1981 | 11,81 | 1360,2 | 55 | | 780 | 21 | 564 | Pd/Ra | PIPES to 43m. |
| | FARM : PA SOF 67 HO (PREFIX Pp) | | | | | | | | | | | | | | | | | | | | | |
| Pp 1 | Absent. | | | d+s | W.P. | | | | | | | 1300 e | 10/11/1981 | 3,74 | 1296,3 | | | | | | R | |
| | FARM : RIETPUT 60 HO (Prefix Rt). | | | | | | | | | | | | | | | | | | | | | |
| Rt 1 | J.C. REYNEKE | | | i | T | | 10 (6)* | 12 hr/dy. 3 mths/yr. } 34000 | 10 | Lucerne + fodder | none. | 1293 e | 30/09/1981 | ^ | | 30 | | 980 | 17,5 | 755 | R | PUMP at 12m. |
| Rt 2 | ditto | | | i | T | 18,8 (1965) | 6 | 2 hr/day 3 dy/wk. } 6700 m³ p.a. | 0,5 | vegetables. | | 1303 e | " | ^ | | | | | | | Rb | DRILLED 1965, GOVT. R.G. |
| Rt 3 | ditto | | | d+s | W.P. | | | | | | | 1293 e | " | 4,38° | 1288,6 | | | | | | R | |
| Rt 4 | ditto | | | d+s | W.P. | | | | | | | 1300 e | " | ^ | | | | | | | Rb | |
| Rt 5 | ditto | | | ^ | . o | | | | | | | 1293 e | " | 1,93 | 1291,1 | | | | | | R: | B.hole brackish. |
| Rt 6 | ditto. | | | i | T | | | pumped irregularly | | | | 1293 e | " | ^ | | | | | | | R? | |
| Rt 7 | H.J. BOONZAAIER ? | | | s | W.P. | | | | | | | 1343 e | | ^ | | | | | | | Ra | |
| Rt 8 | ditto. ? | | | d+s | P | | | | | | | 1343 e | | ^ | | | | | | | Ra. | |
| Rt 9 | JACOB. | | | s | W.P. | | | | | | | 1372 e | 01/10/1981 | 14,83° | 1357,2 | | | | | | Pd/Ra. | |
| Rt 10 | Absent. | | | d | W.P. | | | | | | | 1349 e | 16/11/1981 | 31,45 | 1317,5 | 55 | | | | | Ra | |
| Rt 11 | Absent. | | | s+i | P | | 1 | | 0,5. | | | 1323 e | 13/11/1981 | ^ | | | | 620 | 18,0 | 474 | Ra | |
| Rt 12 | D.J. PRETORIUS. | | | s+(i)* | P | 8,8. | | | | | | 1300 e | | ^ | | 30m. | | | | | Ra/Rb. | PUMP STUCK. |

* previously.

* during dry spell 1979-1980 yield only 6 l/sec. & pumped only 8hr/dy since recovered.

^ pump running.

# KAD. PLAASNAAM EN NR.

# GEBIED.

e - estimated from topo. maps.

Periode van Opname: SEPT – DEC 1981

Kaart en/of Lugfotoverwysing: 1:50000 SHEETS 2925 AA, AB, AC + AD.

| 1 BG. Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr | 4 Totale grootte van eiendom | 5 Doel van watergebruik | 6 Tipe pomp en(enjin) | 7 Getoetste lewering en datum (indien bekend) l/sec | 8 Huidige leweringstempo (nie vir WP) l/sec | 9 Onttrekkingshoeveelheid en pomptydperke (nie vir WP) $m^3$/ha | 10 Oppervlakte onder besproeiing uit grondwater hectares | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Boorhoogte en Metode van bepaling m | 14 Grondwatervlak: datum | 14 diepte onder kraag m | 14 hoogte bo seespieël m | 15 Diepte bh. m | 15 W. stk | 15 TDS, ontledings | 15 T°C | 15 EC mS/m 25°C | 15 Formasie | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FARM : SPRINGBOK 191 HO (PREFIX SK) | | | | | | | | | | | | | | | | | | | | | |
| Sk 1 | J.TR. HOLDINGS | | | i + d | T | 27,5* | 14,4 | 24 h/d, 6 h/y/-k ... 6,11 × $10^6$ | 6,5 (20)* | wheat | ~ | 1352 e | 08/12/1981 | n | | 58 m | | 890 | 20,5 | 650 | Pd (Karoo) to 12 m → Ra. | drilled 1984? Pipe 58 / CASING 11 m × 127 |
| Sk 2 | ditto original hole (30 cm E of SK1) | | | n | o | | | | | | | 1352 e | 04/12/1981 | 10,000 | 1342 | 42 m. | | | | | | |
| Sk 3 | ditto | | | n | o | 15 (?) | | verbal information from son of former owner Du Plessis (Police station) & renter Munnik. | | | | 1356 e | | | | 46 | | | | | Pd/Ra | |
| Sk 4 | ditto | | | n | o | 17,5 (?) | | | | | | 1356 e | | | | 58 | | | | | Pd/Ra | |
| Sk 5 | ditto | | | n | o | 7,5 | | | | | | 1353 e | | | | 37 | | | | | Pd/Ra | |
| Sk 6 | ditto | | | n | o | 3 | | | | | | 1353 e | | | | | | | | | Pd/Ra | |
| Sk 7 | ditto | | | n | o | 3 | | | | | | ~~1357~~ 1353 e | | | | | | | | | Pd/Ra | |
| Sk 8 | ditto | | | n | o | 5 | | | | | | 1354 e | | | | 58 | | | | | Pd/Ra | |
| Sk 9 | ditto | | | n | o | 5 | | | | | | 1354 e | | | | | | | | | Pd/Ra | |
| Sk 10 | W.C. STRAUSS | | | n | o | | | | | | | 1354 e | 16/11/1981 | 4,40 | 1349,6 | 48 | | | | | Pd/Ra. | See Borehole Records 722249 [illegible] |
| | FARM : SCHOONDAL 22 HO (PREFIX SL) | | | | | | | | | | | | | | | | | | | | | |
| Sl 1 | Absent | | | n | W.P. | | | | | | | 1357 e | 11/11/1981 | 8,18 | 1348,8 | | | | | | Rb/R | |
| Sl 2 | D.F. KRIEK | | | d | W.P. | 5 | | | | | | 1350 e | 12/11/1981 | 8,07• | 1349,9 | 37 | | | | | Rb/R | PIPES 29 m |
| | FARM : SERINGBOOMKOP 66 HO (PREFIX SP). | | | | | | | | | | | | | | | | | | | | | |
| Sp 1 | J.G. VAN ZYL | | | d | W.P. | | | | | | | 1314 e | 10/11/1981 | 30,5• | 1283,5 | | | | | | R | |
| Sp 2 | ditto | | | d | W.P. | | | | | | | 1295 e | 10/11/1981 | 15,67• | 1279,3 | | | 695 | 20,5 | 508 | R | |
| Sp 3 | ditto | | | s | W.P. | | | | | | | 1298 e | 10/11/1981 | 33,8• | 1264,2 | | | | | | R | |
| Sp 4 | ditto | | | n | o | | | | | | | 1314 e | 10/11/1981 | 4,36 | 1309,6 | | | | | | R | |
| Sp 5 | Absent | | | s | W.P. | | | | | | | 1331 e | 10/11/1981 | 3,07 | 1327,9 | | | 525 | 21,0 | 380 | R | |

x Pumped in 1975? for 3 months, 24 hr/dy at 27,5 l/sec ?

* 1979-1980.

• pump running.

SCHWEIZER-RENEKE DISTRICT

GH 3148

# KAD. PLAASNAAM EN NR.

# GEBIED.

e estimated from topo map.

Periode van Opname SEPT – DEC 1981.

Kaart en/of Lugfotoverwysing 1:50 000 sheets 2725 AA, AB, AC + AD.

| 1 BG Nr | 2 Naam van Eienaar en adres | 3 Gedeelte Nr of Plot Nr (Stryd Vander Nr) | 4 Totale grootte van eiendom (Municipal Nr) | 5 Doel van watergebruik | 6 Tipe pomp en(enjin) | 7 Getoetste lewering en datum (indien bekend) l/sec | 8 Huidige leweringstempo (vir WPI) l/sec | 9 Onttrekkingshoeveelheid en pomptydperke (vir WPI) m³/p.a. | 10 Oppervlakte onder besproeiing uit grondwater hectares | 11 Soort gewasse onder besproeiing uit grondwater | 12 Oppervlakte onder besproeiing uit ander bronne | 13 Bekhoogte en Metode van bepaling m. | 14 Grondwatervlak: datum | 14 diepte onder kraag (m) | 14 hoogte bo seespieël (m) | 15 Bh. Total Depth metres | 15 Water strikes | 15 TDS. Opmerkings | 15 Tc | 15 TDS ppm 25°C | 15 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FARM SCHWEIZER – RENEKE TOWNLANDS 62HO (PREFIX SS) | | | | | | | | | | | | | | | | | | | | | | |
| SS 1 | MUNICIPALITY. | 1 | | n | o | 3,8 (1970?) | | | | | | | | | | 27,4 | | - | | | R | DRILLED 1970 |
| SS 2 | ditto | 2 | 3 | M | P | *17,5 (Dec 1979) | 7,5 | | | | | | | | CASING 12 m? | (27,3) | 1st – | | | | | NOV-DEC |
| SS 3 | ditto | 3 | 4 | M | P | *16,1 (Dec 1979) | 5,0 | PUMPED | | | | | 01/10/81 | | | 27,3 | 12,8 | 730 | 20,2 | 538 | R | 1979 |
| SS 4 | ditto | C3NO146 4 | 2 | n | o | *14,9 (Dec 1979) | | JAN TO NOVEMBER | | | | | 29/10/1981 | 7,070 | CASING 12 m 1282,9. | 22,8 | 1st 13 m | | | | R | |
| SS 5 | ditto | 5 | 1 | M | P | *18,2? (Dec 1979) | Pumped occasionally | 1980. | | | | 1290 e | 02/11/1981 | 6,812 | | 21,3 | 1st – 13,7 m | CASING 12 m. | | | R | RE... |
| SS 6 | ditto | 6 | 6 | M | P | 11,4 (Dec 1979) | 3,8 | | | | | | | | | 36,6 | | | | | R | 1921 |
| SS 7 | ditto | 7 | | M | P | 3,8 (Dec 1979) | 2,6 | TOTAL ABSTRACTED | | | | | | | | 36,6 | | | | | R | NOV – DEC |
| SS 8 | ditto | 8 | 7 | M | P | 10,1 (Dec 1979) | 3,7 | PERIOD 5th MAY TO 30th NOV 1980 | 13 l/s | for 12 hr/day | | | | | | 39,6 | | | | | P | 1979 |
| SS 9 | ditto | . | 5 | | | | | | | for 210 days. | | | | | | 39,6 | | | | | R | |
| SS 10 | ditto | . | | | | | | IS 0,177240 ×10⁶ m³ | | | | | | | | | | | | | R | |
| SS 11 | ditto | G32304 | | | | 2,8 (July 1980) | | | | | | | | | | | | | | | R | |
| SS 12 | ditto | 9 | | n | o | 3,8. | | | | | | | | | | 40 | | | | | R | JULY 1980. |
| SS 13 | ditto. | 10 | | n | o | 1,9 | | | | | | | | | | 36,6 | | | | | R | closed & cemented |
| SS 14 | ditto | | | d+s | w.P. | | | | | | | | | | | 45,7 | | | | | R | welded top |
| SS 15 | ditto | | | s | w.P. | | | | | | | 1306 e | 26/10/1981 | ~ | | | | | | | R | |
| SS 16 | ditto | | | d+s | w-P. | | | | | | | 1317 e | 08/10/1981 | 4,085 | 1312,9 | | | | | | Rb | |
| SS 17 | Absent. | | | d | w.P. | | | | | | | 1310 e | 06/10/81 | ~ | | | | 640 | 18 | 489 | R | |
| SS 18 | FOURIE (MOREDOU) | | | d+s | P | | | | | | | 1368 e | 11/11/1981 | ~. | | | | 175 | 21 | 127 | Rb/R? | |
| SS 19 | A.J.S. Roos | | | s | w.P. | | | | | | | 1329 e | 11/11/1981 | 11,57 | 1317,4 | | | | | | R. | |
| SS 20 | MUNICIPALITY | G32303 | | CARAVAN PARK | P | 6,9 (July 1980) | | | | | | 1316 e | 06/10/1981 | ~. | | | | | | | R. | |
| | | | | | | | | | | | | 1298 e | 08/10/1981 | 3,255 | 1294,7 | 30 | | 800 | 20 | 590 | R? | CASING PROTECTS 1,22 m |
| SS 21 | ditto | G32300 | | n | b | 1,1 (1980) | | DRILLED | | | | | | | | 48 | | | | | Rb | |
| SS 22 | ditto | G32301 | | n | b | 'dry' | | 1980 | | | | | | | | 24 | | | | | Rb | |
| SS 23 | ditto | G32302 | | n | b | 'dry' | | | | | | | | | | 54 | | | | | | |
| SS 24 | ditto | | | n | b | 1 | | | | | | | | | | | | | | | Rb | |
| SS 25 | Kriek | | | n | b | 'dry' | 3 | DRILLED 1981 | | | | | | | | 60 | | | | | Rb; Rb to 30; 30 to 60 diabase. | |

M = municipal supply
b = blocked

* Pumped for Shaw 1979 by Cahi, de Vries and Brink (consultants) of Pta.

# KAD. PLAASNAAM EN NR.

# GEBIED.

e estimated from topo. map

Periode van Opname

Kaart en/of Lugfotoverwysing

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | | | 15 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BG Nr | Naam van Eienaar en adres | Gedeelte Nr of Plot Nr | Totale grootte van eiendom | Doel van watergebruik | Tipe pomp enjin | Getoetste lewering en datum (indien bekend) l/sec | Huidige leweringstempo (nie vir WP) l/sec | Onttrekkingshoeveelheid en pomptydperke (nie vir WP) | Oppervlakte onder besproeiing uit grondwater | Soort gewasse onder besproeiing uit grondwater | Oppervlakte onder besproeiing uit ander bronne | Bekhoogte en Metode van bepaling m. | Grondwatervlak datum | diepte onder kraag (m) | hoogte bo seespieël (m) | drilled depth | water strike | TEC Opmerkings | Tz | TDS | [illegible] | |
| | FARM : | VAAL POORT | | 84 HO | | (PREFIX Vt) | | | | | | | | | | | | | | | | |
| Vt 1 | Absent | | | s | W.P | | | | | | | 1372 e | 02/12/81 | 17,13• | 1354,9 | | | | | | Pd/Ra? | Pd upto 10m |
| Vt 2 | ditto | | | n | 0 | | | | | | | 1363 e | 02/12/81 | 24,28 | 1338,7 | 74 | | | | | Ra | |
| Vt 3 | ditto. | | | s | W.P | | | | | | | 1380 e | 02/12/81 | 5,35 | 1374,7 | | | | | | Ra | |
| Vt 4 | F.J. MYBURGH | | | s | W.P. | | | | | | | 1362 e | 02/12/81 | 6,23 | 1355,8 | | | | | | Pd/Ra? | Pd. up to |
| Vt 5 | ditto. | | | s | W.P. | | | | | | | 1363 e | 02/12/81 | 3,50 | 1359,5 | | | | | | Pd/Ra? | 10m |
| Vt 6 | T.E. PIETERSE | B/no.123221/6. | | d+s | P | 1,0 (DEC 1976) | | | | | | 1372 e | 02/12/81 | 10,70 | 1361,3 | 76 | 70 | 650 | 23,5 | 449 | Ra | DRILLED DEC 1976 CASING 6 metres PIPES at 75m |
| | FARM : | WELTREVREDEN | | 28 HO. | | (PREFIX Wn) | | | | | | | | | | | | | | | | |
| Wn 1 | J.F. SCHOLTZ | | | n | 0 | | | | | | | 1364 e | 27/11/81 | 15,73 | 1348,3 | | | | | | Rb | |
| | FARM : | ZANDFONTEIN | | 90 HO | | (PREFIX Zn) | | | | | | | | | | | | | | | | |
| Zn 1 | LOMBAARD | | | s | W.P | 1,0 | | | | | | 1372 e | 01/12/81 | 10,40 | 1361,6 | 61,5 | 53. | 530 | 23,5 | 366 | Ra/Rb? | CASING - 6 PIPES - 37 |
| Zn 2 | Absent. | | | s | W.P. | | | | | | | 1356 e | 02/12/81 | 11,70 | 1344,3 | | | 790 | 22 | 561 | Ra | |
| | FARM : | ZORGVLIET | | 80 HO | | (PREFIX Zt) | | | | | | | | | | | | | | | | |
| Zt 1 | A. SCHOLTZ | | | s | W.P. | 3,25 | | | | | | 1304 e | 01/12/81 | 8,23 | 1295,8 | 34,5 | 1st - 17m 2nd - 33 | | | | R | CASING - 33 PIPES - 18m |
| Zt 2 | W.J. REYNEKE | | | d+s | W.P. | 0,25 | | | | | | 1300 e | 01/12/81 | 42,0 | 1258 | 67 | 37(?) | | | | R | CAS - 12m PIPES - 61m |
| Zt 3 | N. FOURIE | | | s | W.P | 1,2 | | | | | | 1391 e | 01/12/81 | 12,04• | 1279 | | | | | | R | |
| Zt 4 | ditto | | | d | W.P. | 0,5 | | | | | | 1316 e | 01/12/81 | n | | | | 445 | 21,0 | 322 | R | |

• pump running.

# WATER LEVELS IN OBSERVATION BOREHOLES

| C3NO 46 (Ss 4) Monthly automatic recorder | | C3NO47 (G34309) H.W.K. meter | |
|---|---|---|---|
| Date | Water level (m) | Date | Water level (m) |
| 30/07/1980 | 16,3 | 19/10/1981 | 6,06 |
| 30/08/ | 17,9 | 24/10/ | 6,00 |
| 02/10/ | 17,0 | 03/12/ | 6,09 |
| 03/11/ | 19,3 | 15/01/1982 | 5,80 |
| 26/11/ | 19,8 | 13/02/ | 5,32 |
| 13/01/1981 | 13,0 | | |
| 02/02/ | 12,1 | | |
| 03/03/ | 11,6 | | |
| 01/04/ | 7,2 | | |
| 01/10/ | 6,54 | | |
| 12/10/ | 6,44 | | |
| 02/11/ | 6,81 | | |
| 27/11/ | 7,07 | | |
| 08/12/ | 6,94 | | |
| 08/01/1982 | 7,3 | | |
| 08/02/ | 7,5 | | |

# APPENDIX 2

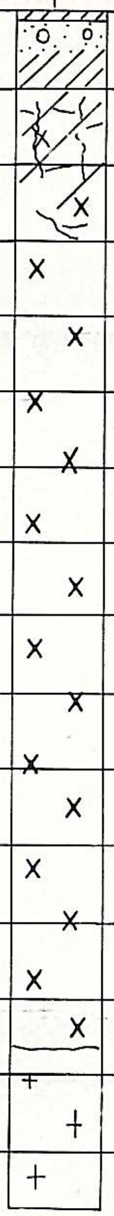
## EXPLORATION BOREHOLE LOGS

G32693 and G34306 to G34320

FIG. I G 32693

CASING GEOHYDROLOGY DEPTH PROFILE. DESCRIPTION

| Casing | Depth (m) | Profile | Description |
|---|---|---|---|
| PLAIN 152 mm | 0 | | OVERBURDEN, SAND WITH GRAVEL |
| | | | CLAY, YELLOW |
| PERFORATED | 10 | | DOLERITE, BROWN-BLUE, CLAYEY, HEAVILY WEATHERED. |
| 14 | | | DOLERITE, GREEN-GREY, FRESH, FRACTURED |
| | 20 | | |
| | 30 | | DOLERITE, GREEN-BLACK, MEDIUM- TO COARSE-GRAINED UNIFORM, FRESH UNFRACTURED |
| | 40 | | |
| | 50 | | |
| | 60 | | BASALT, GREEN-BLACK, FINE-GRAINED, CHILLED MARGIN 67 to 68,5m FRESH, UNFRACTURED |
| | 70 | | GRANITE, GREY-GREEN, MEDIUM-COARSE GRAINED FRESH, UNFRACTURED CONTAINS : FELDSPAR (75 %), QUARTZ (20%) AND RARE BIOTITE AND HORNBLENDE (<5%) |
| | 79 | | |

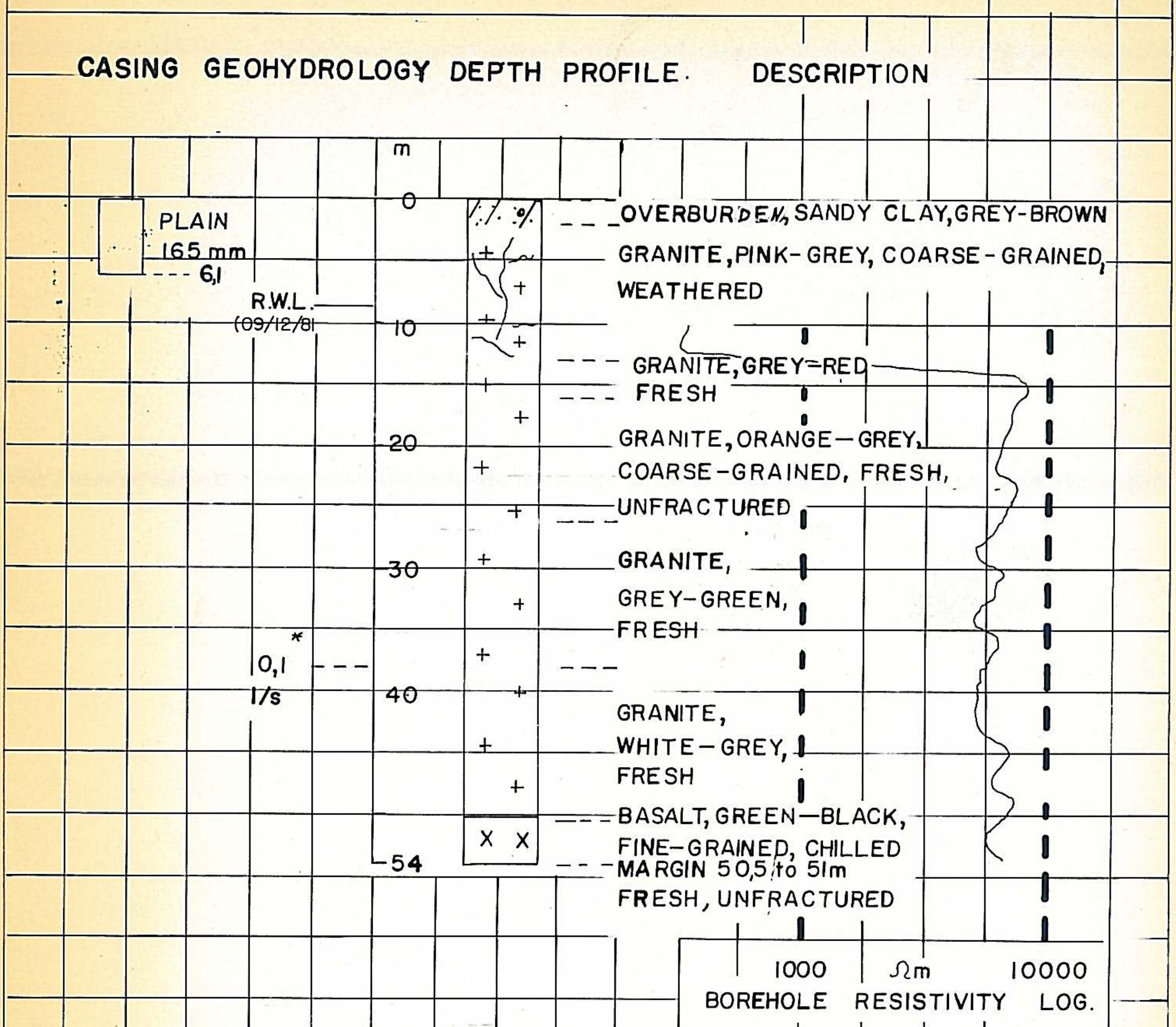


N.B. 1. BOREHOLE DRY

2. DOLERITE DYKE

G.H.P. 5642

FIG. 2 G 34306




N.B. 1. * BLOW TEST YIELD

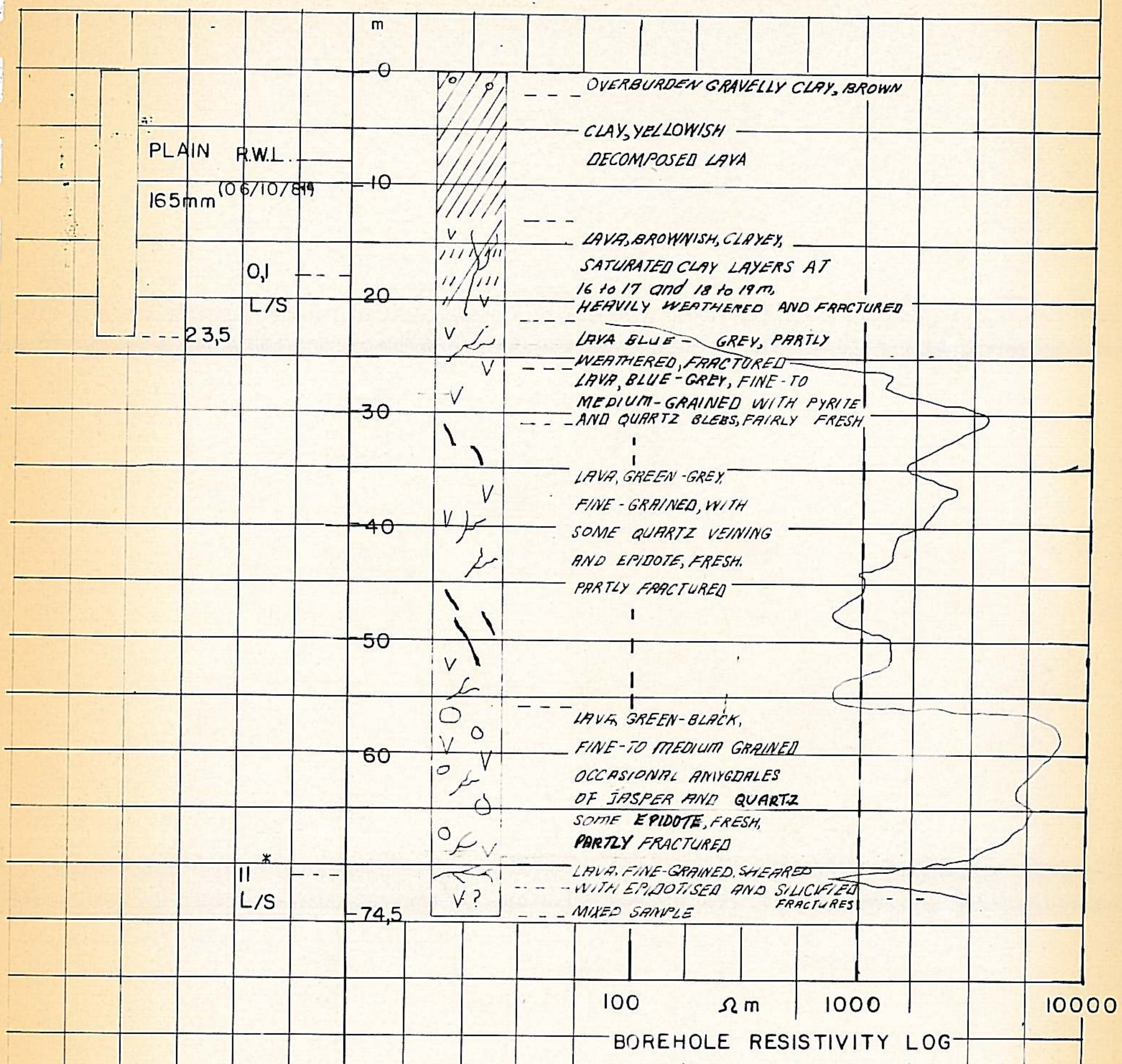
2. DECREASE IN FERRO - MAGNESIUM MINERALS WITHIN THE GRANITE FROM ≃ 15 % at 14 m to < 2% at 50m

3. BASALT DOLERITE DYKE.

G.H.P. 5643

FIG. 3 G 34307

CASING GEOHYDROLOGY DEPTH PROFILE. DESCRIPTION




N.B.

i * PUMPING RATE

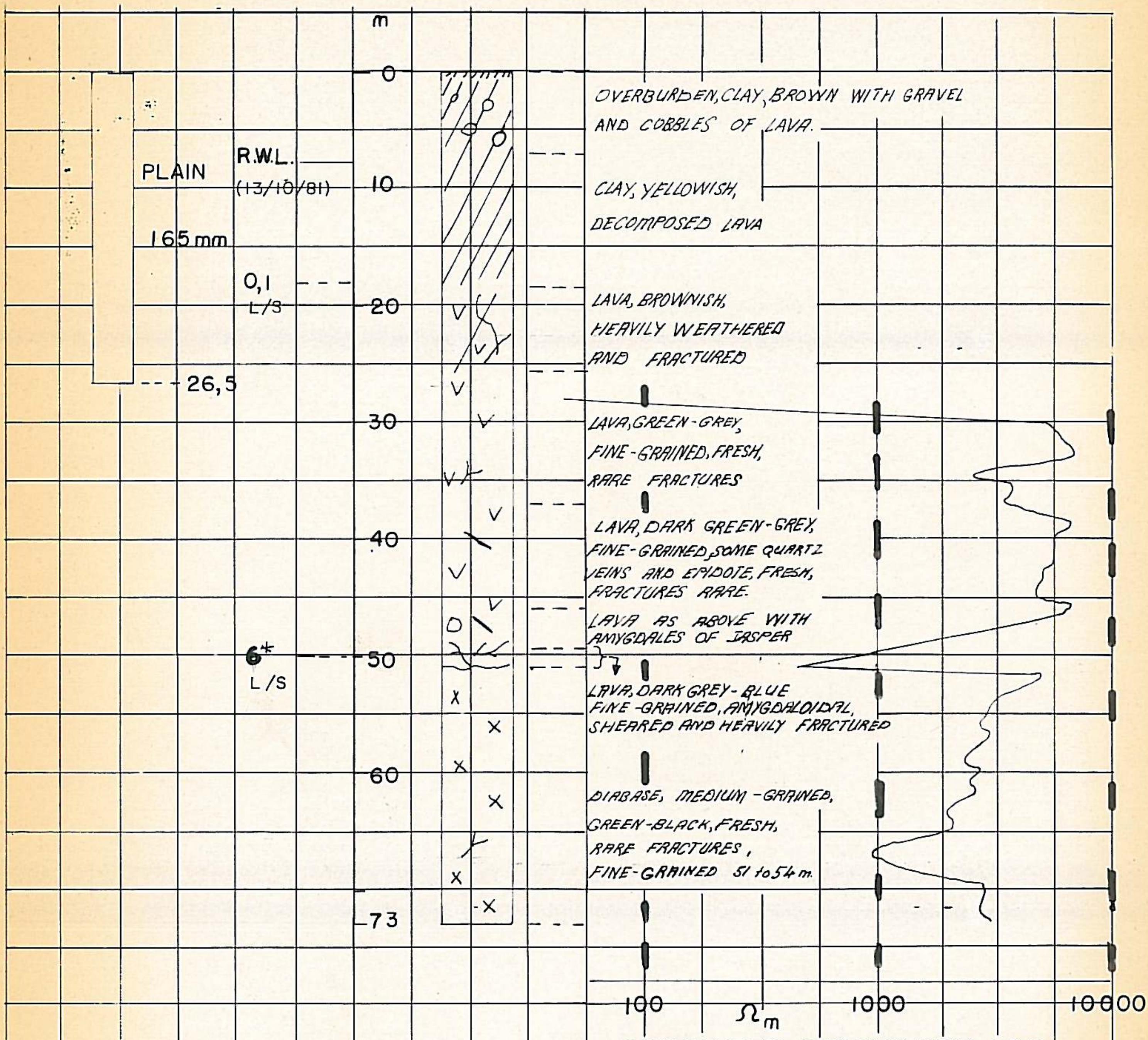
2 \ QUARTZ VEINING

3 ALLANRIDGE ANDESITE FORMATION

G.H.P 5644

FIG.4 G 34308

CASING GEOHYDROLOGY DEPTH PROFILE. DESCRIPTION




BOREHOLE RESISTIVITY LOG

NB 1. * BLOW TEST YIELD

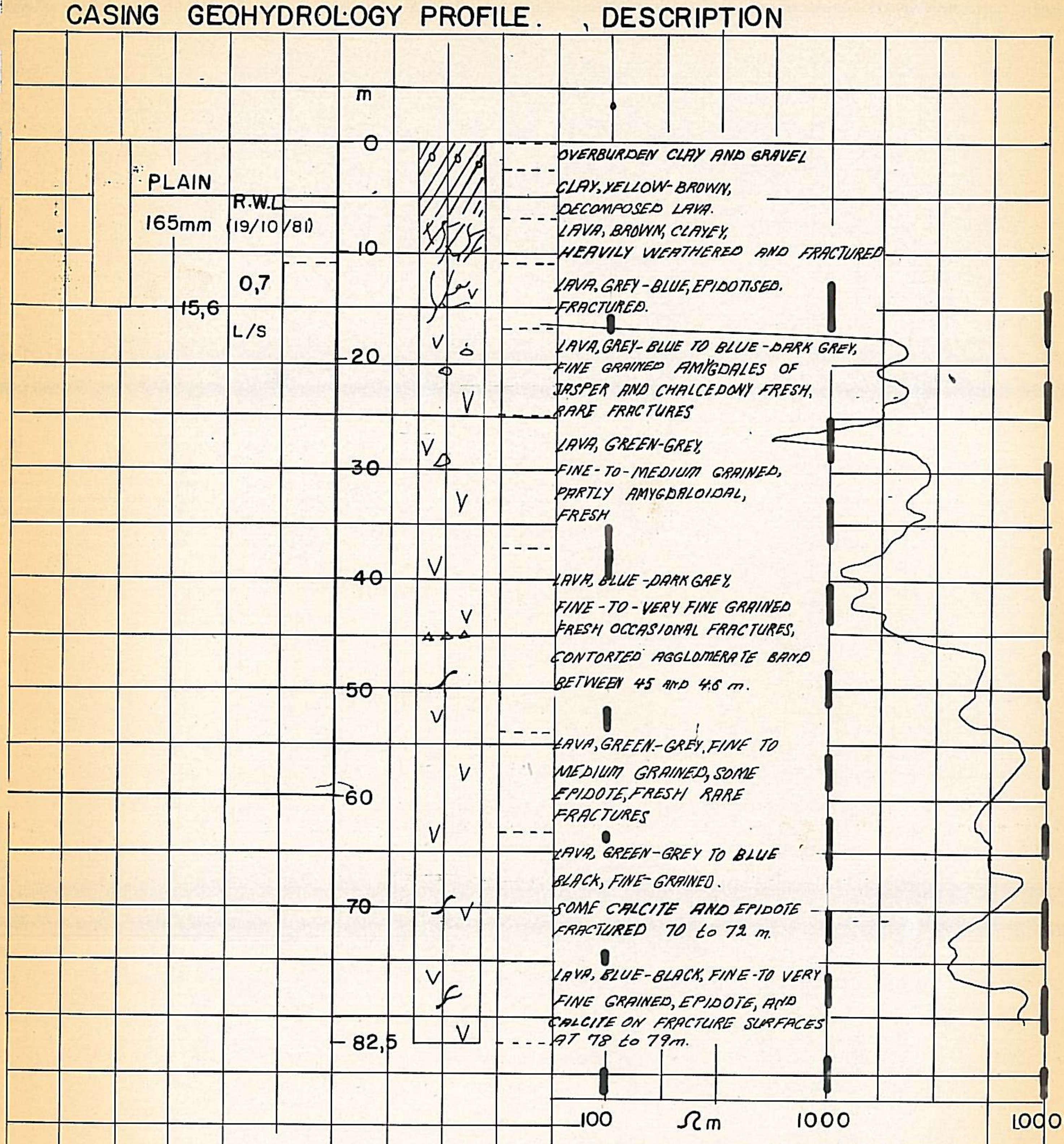
2. \ QUARTZ VEINS

3. LAVA BELONGS TO THE ALLANRIDGE ANDESITE FORMATION

4. DIABASE DYKE

G.H.P. 5645

FIG. 5 G 34309

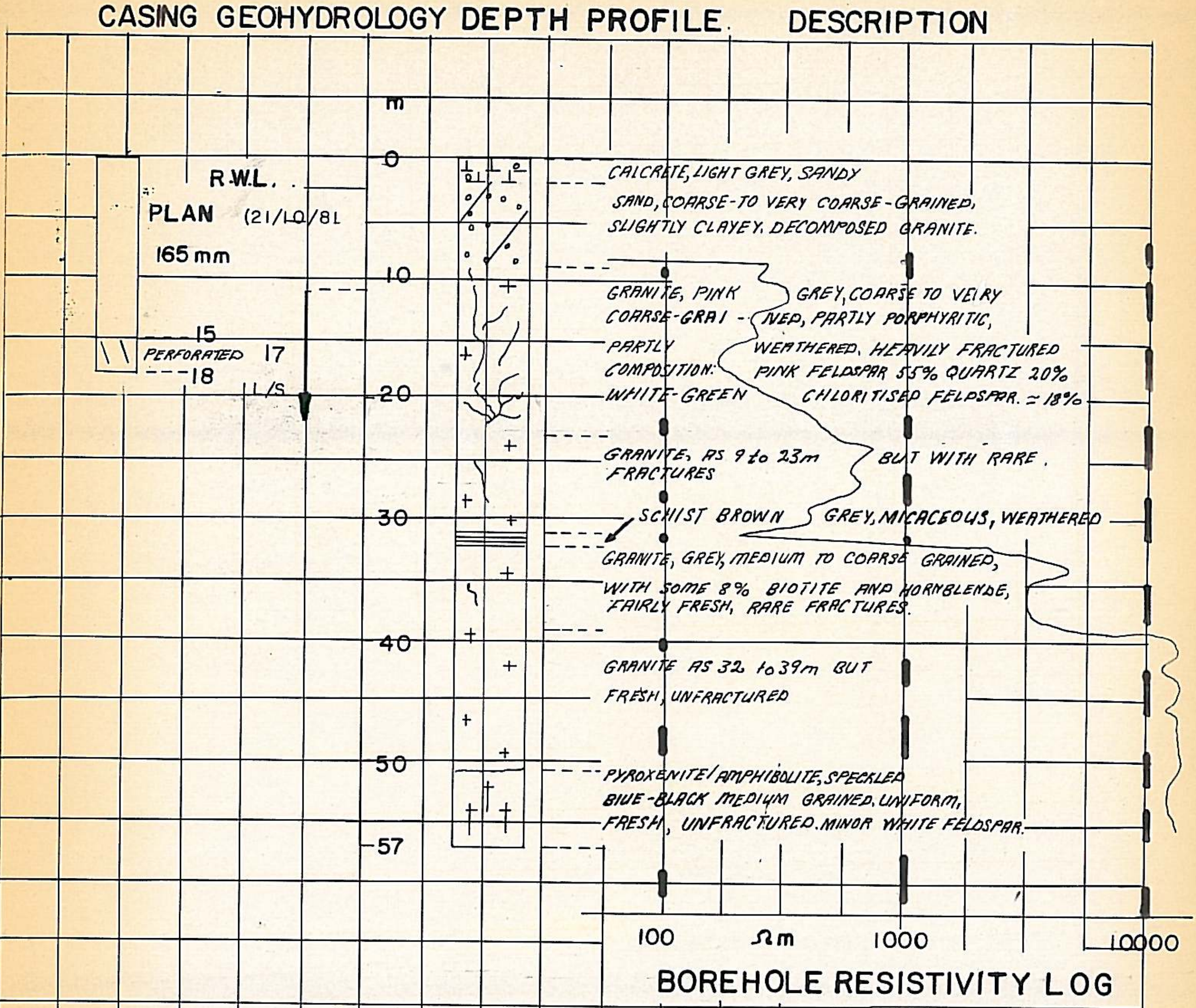



BOREHOLE RESISTIVITY LOG

N.B. 1. BLOW YIELD
2. ⁄ CALCITE VEINING
3. ALLANRIDGE ANDESITE FORMATION

G.H.P. 5646

FIG.6 G 34310




NB 1. MAXIMUM PUMPING RATE FOR STEP-DRAWDOWN TEST

2. MAIN WATER 18 to 22 m

G.H.P. 5647

FIG. 7

# G 34312

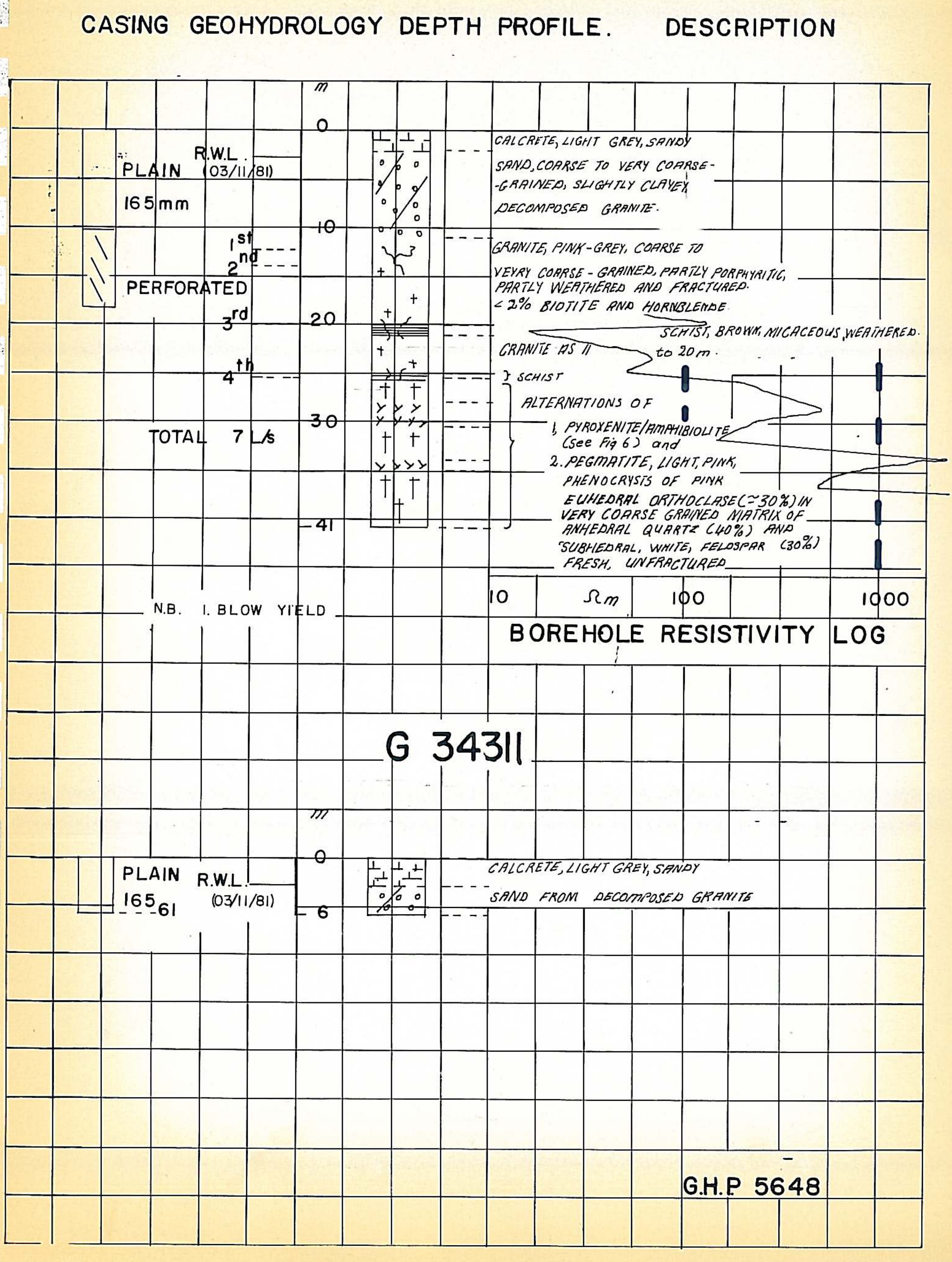
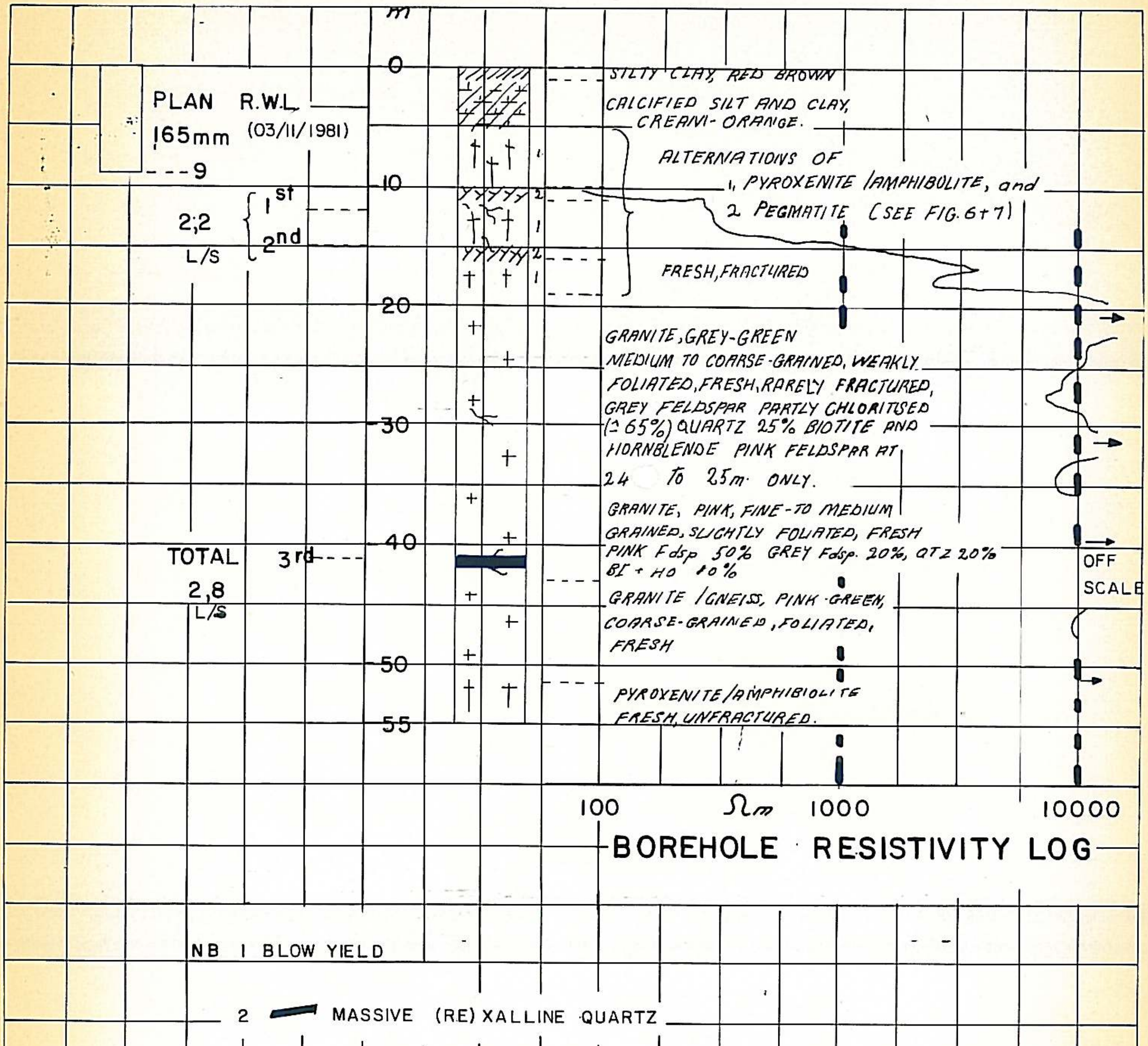

CASING GEOHYDROLOGY DEPTH PROFILE. DESCRIPTION
m
0
10
20
30
41
PLAIN 165 mm
R.W.L. (03/11/81)
1st
2nd
PERFORATED
3rd
4th
TOTAL 7 L/s
CALCRETE, LIGHT GREY, SANDY
SAND, COARSE TO VERY COARSE-GRAINED, SLIGHTLY CLAYEY, DECOMPOSED GRANITE.
GRANITE, PINK-GREY, COARSE TO VEYRY COARSE-GRAINED, PARTLY PORPHYRITIC, PARTLY WEATHERED AND FRACTURED.
< 2% BIOTITE AND HORNBLENDE
SCHIST, BROWN, MICACEOUS, WEATHERED to 20m.
GRANITE AS 11
} SCHIST
ALTERNATIONS OF
1. PYROXENITE/AMPHIBIOLITE (See Fig 6) and
2. PEGMATITE, LIGHT, PINK, PHENOCRYSTS OF PINK EUHEDRAL ORTHOCLASE (≃30%) IN VERY COARSE GRAINED MATRIX OF ANHEDRAL QUARTZ (40%) AND SUBHEDRAL, WHITE, FELDSPAR (30%)
FRESH, UNFRACTURED
10
Ωm
100
1000
BOREHOLE RESISTIVITY LOG
N.B. I. BLOW YIELD
G 34311
m
0
6
PLAIN 165 61
R.W.L. (03/11/81)
CALCRETE, LIGHT GREY, SANDY
SAND FROM DECOMPOSED GRANITE
G.H.P 5648

FIG. 8

# G 34313

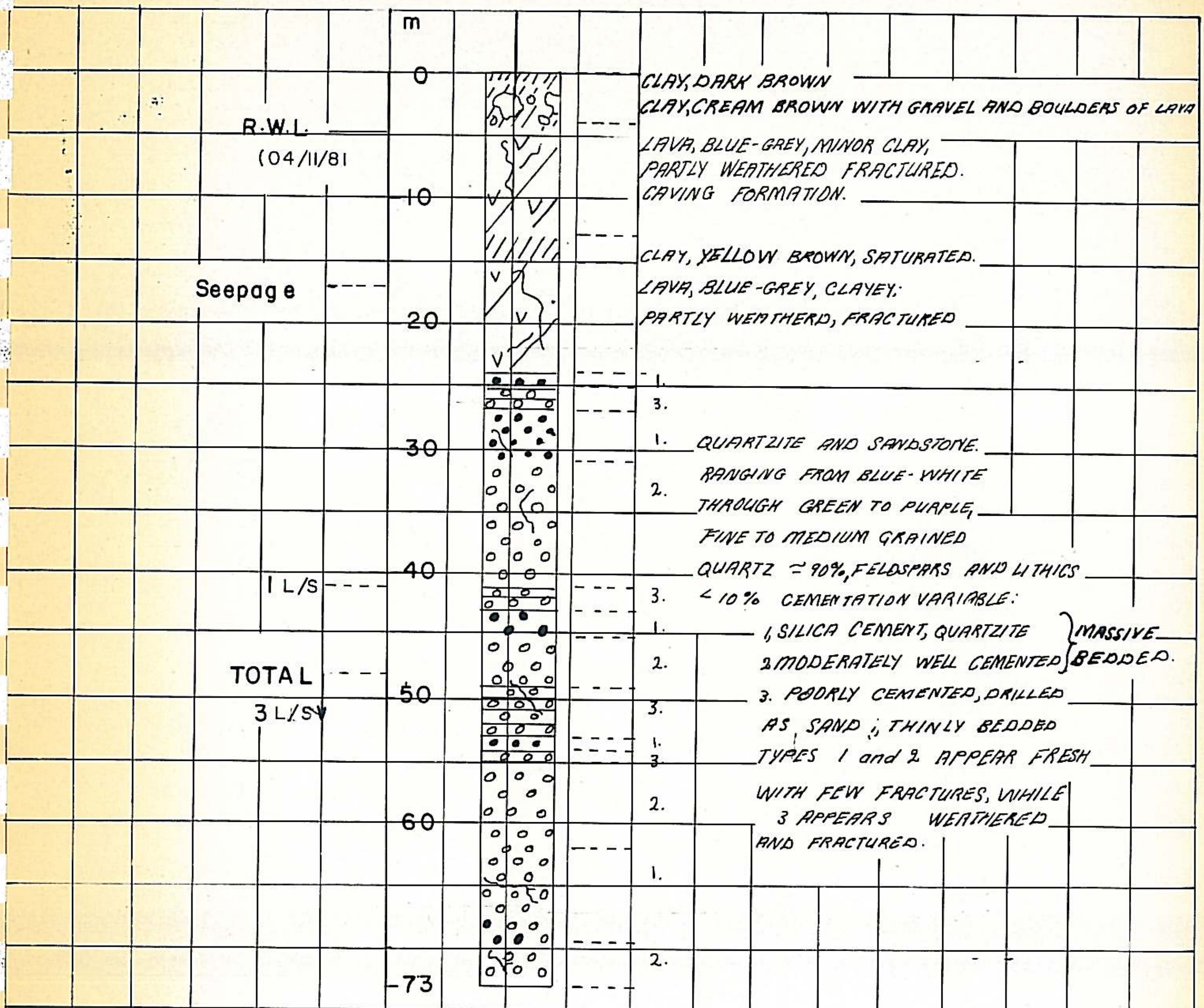
CASING GEOHYDROLOGY DEPTH PROFILE. DESCRIPTION




G.H.P. 5649

FIG. 9 G 34314

# GEOHYDROLOGY DEPTH PROFILE. DESCRIPTION



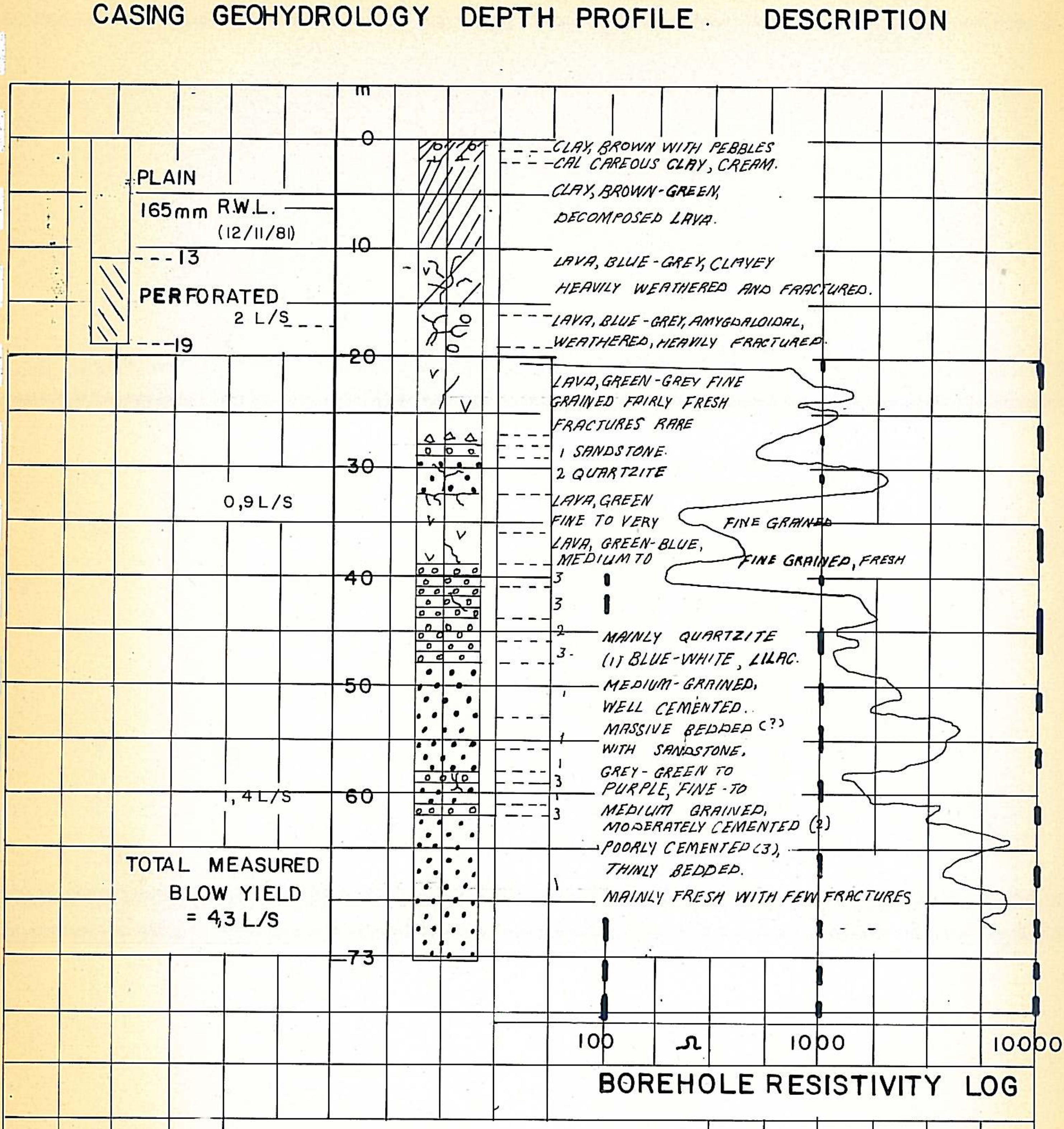

NB

1 BOREHOLE COLLAPSED
2 BLOW YIELD
3 LAVA: ALLANRIDGE ANDESITE FORMATION
4 SEDIMENTS: BOTHAVILLE FOMATION

G.H.P. 5650

FIG.10

# G 34315




NB

1 PUMPING RATE 5,5 L/S AFTER 6 HOURS

2 LAVA: ALLANRIDGE ANDESITE FORMATION

3. SEDIMENTS: BOTHAVILLE FORMATION

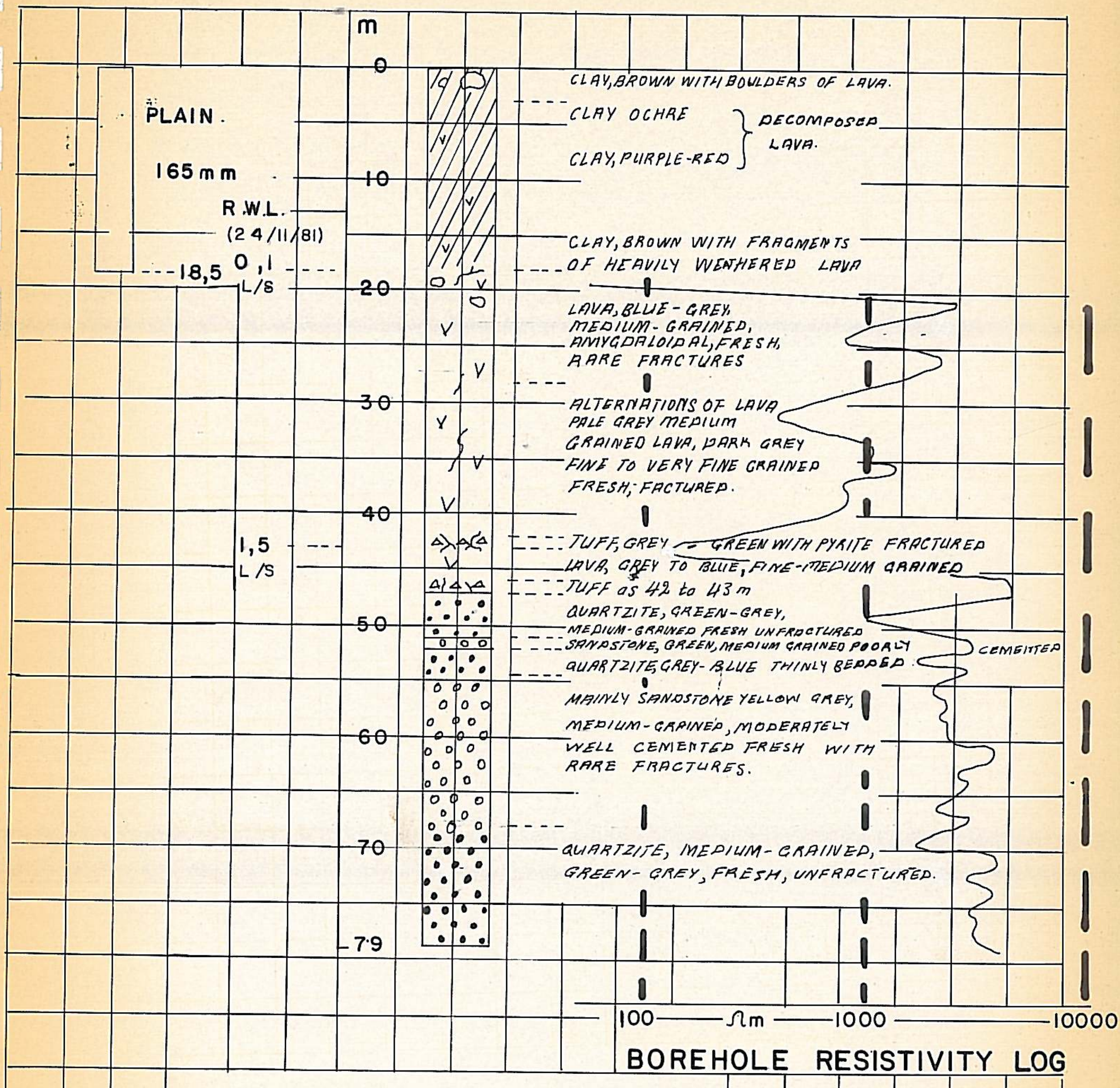
4 △ △ TUFF, GREY - GREEN

G.H.P. 5651

FIG. II

# G 34316

CASING GEOHYDROLOGY DEPTH PROFILE. DESCRIPTION



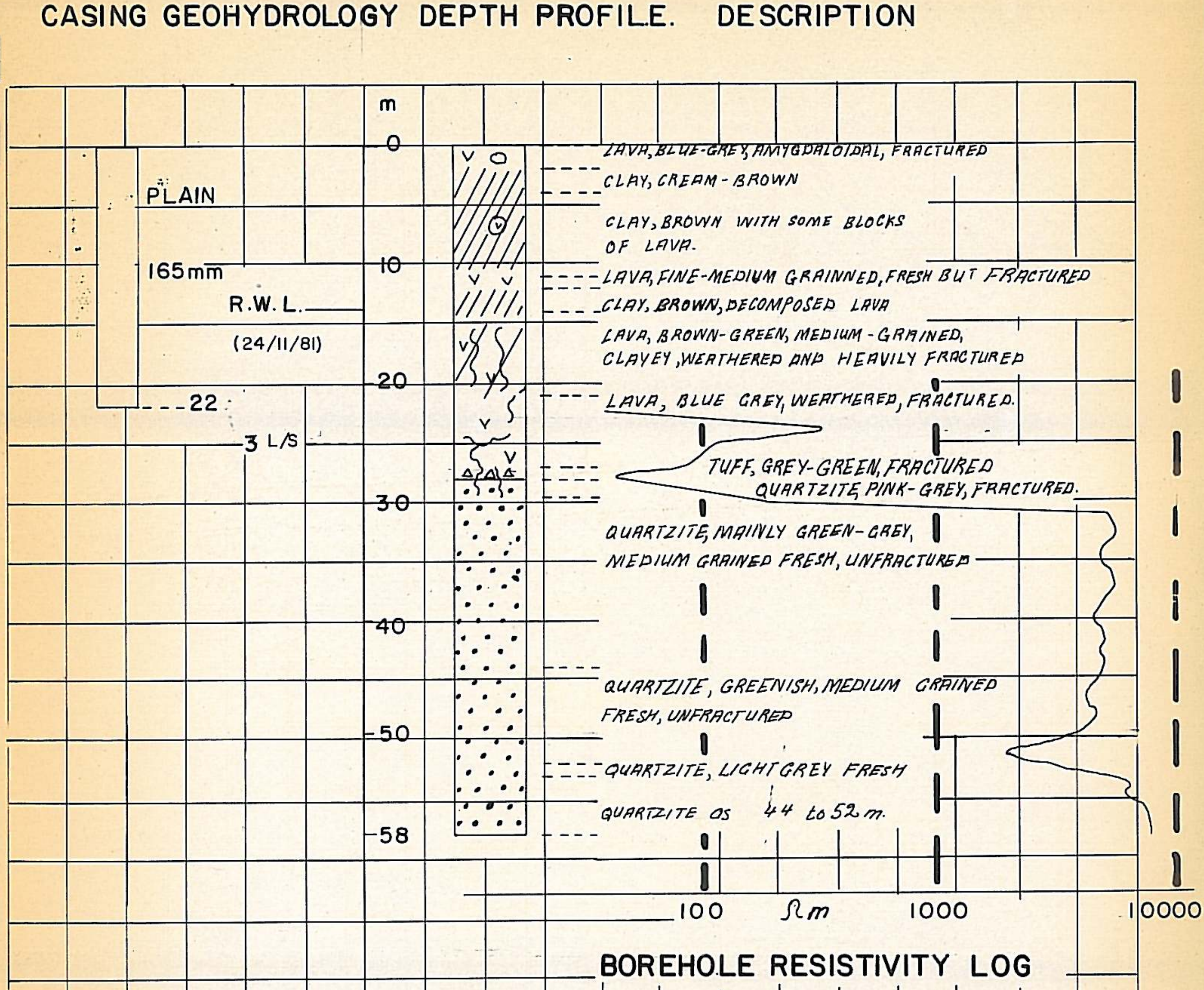

N.B. 1. BLOW YIELD

2. LAVA: ALLANRIDGE ANDESITE FORMATION

3 SEDIMENTS: BOTHAVILLE FORMATION.

G.H.P 5652

FIG. 12 G 34317




N.B. 1 BLOW YIELD

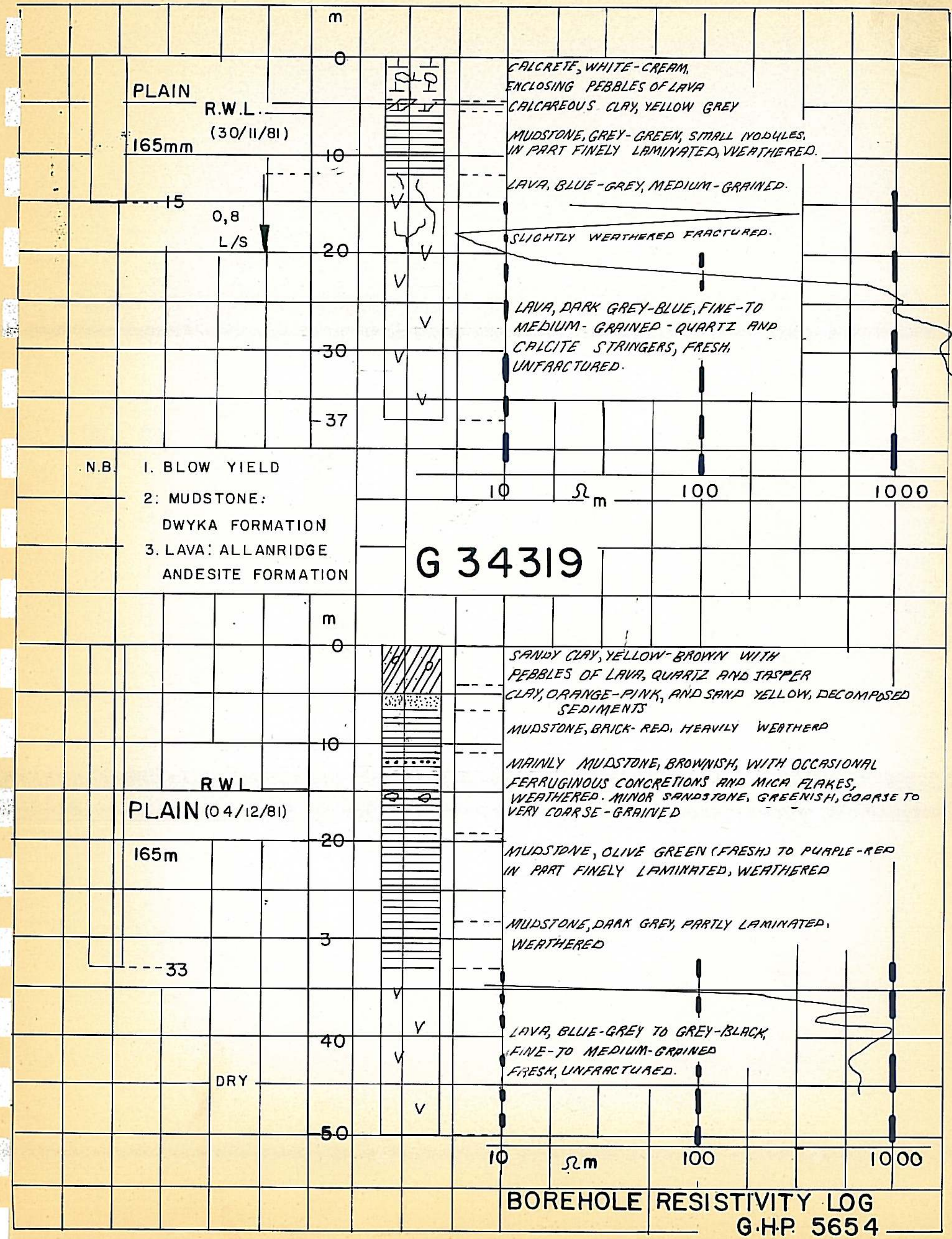
2. LAVA: ALLANRIDGE ANDESITE FORMATION

3. SEDIMENTS : BOTHAVILL FORMATION

G.H.P. 5653

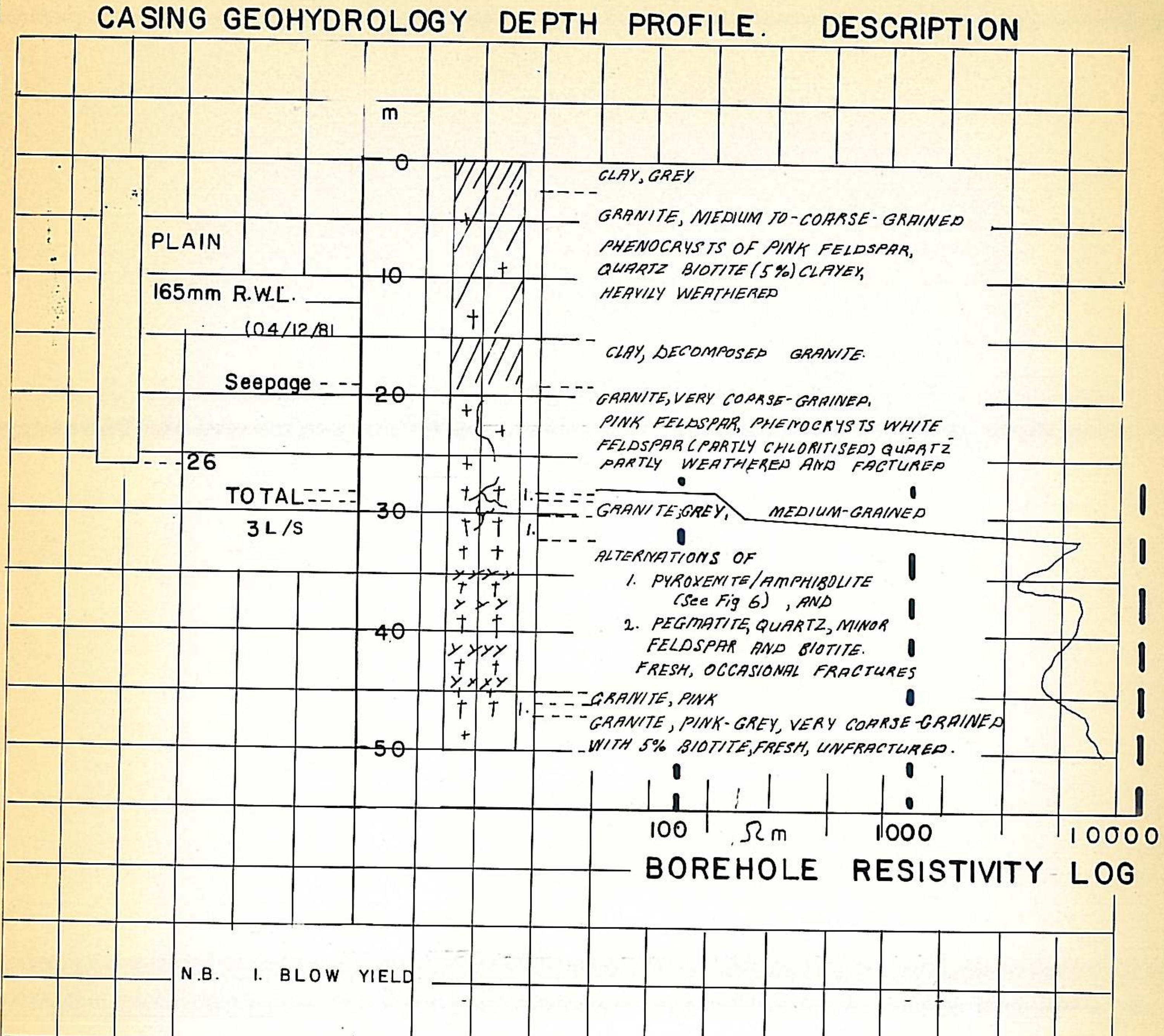
FIG. 13 G 34318

CASING GEOHYDROLOGY DEPTH PROFILE. DESCRIPTION




G.H.P. 5654

FIG. 14 G 34320




G.H.P. 5655

# APPENDIX 3

## WATER CHEMISTRY DATA

No. ON FIGS.

CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FROM ARCHAEAN GRANITE / GNEISS — F-B1 OGNVRV

PLOTTED ON FIG.

CATION AND ANION COMPOSITION IN MG PER LITRE — F-B1 OGNVRV

| No. | SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | TDS | SI | PH | E COND | DATE (1981) | H/no 8141– |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BE68/1 | 111.90 | 8.70 | 48.80 | 36.32 | 205.72 | 46.12 | 344.98 | 100.65 | 0.92 | 37.27 | 529.94 | 735.66 | 25.48 | 7.60 | 0.0 | 10/11 | 4745 |
| 2 | DS1 | 43.33 | 1.30 | 29.80 | 11.47 | 85.89 | 11.68 | 138.60 | 35.68 | 0.05 | 52.49 | 238.50 | 324.40 | 25.04 | 7.00 | 0.0 | 27/11 | 5937 |
| 3 | GK81/3 | 57.73 | 1.87 | 43.32 | 30.43 | 133.35 | 28.74 | 281.40 | 26.48 | 0.27 | 58.51 | 395.40 | 528.75 | 22.34 | 7.60 | 0.0 | 01/12 | 6014 |
| 4 | GT1 | 10.63 | 2.16 | 10.28 | 4.98 | 28.04 | 6.26 | 59.14 | 4.58 | 0.20 | 17.39 | 87.57 | 115.62 | 20.45 | 6.30 | 0.0 | 16/11 | 5018 |
| 5 | GT2 | 30.54 | 3.01 | 60.86 | 44.33 | 138.73 | 8.17 | 123.70 | 159.56 | 0.20 | 65.77 | 357.40 | 496.14 | 15.65 | 7.80 | 0.0 | 01/12 | 6056 |
| 6 | HG1 | 24.23 | 3.51 | 32.31 | 18.24 | 78.29 | 23.09 | 84.10 | 17.39 | 0.25 | 84.14 | 208.97 | 287.26 | 23.05 | 6.70 | 0.0 | 20/11 | 4999 |
| 7 | HG6 | 39.04 | 1.01 | 43.81 | 21.22 | 105.08 | 14.98 | 221.98 | 26.81 | 0.51 | 43.73 | 308.01 | 413.09 | 23.70 | 7.20 | 0.0 | 12/11 | 4931 |
| 8 | HG9 | 95.86 | 3.03 | 48.19 | 34.69 | 181.76 | 28.06 | 385.10 | 63.40 | 0.64 | 39.48 | 516.68 | 698.45 | 26.94 | 8.10 | 0.0 | 01/12 | 6048 |
| 9 | G34310-3 | 24.89 | 2.66 | 22.32 | 13.54 | 63.41 | 20.57 | 81.61 | 5.72 | 0.46 | 59.05 | 167.41 | 230.82 | 23.16 | 6.70 | 0.0 | 20/11 @ 1810. | 4981 |
| 10 | LT44/1 | 64.98 | 2.23 | 54.90 | 30.13 | 152.23 | 28.96 | 324.50 | 37.86 | 0.40 | 83.08 | 474.80 | 627.04 | 23.00 | 8.20 | 0.0 | 03/12 | 6111 |
| 11 | LT63/1 | 34.26 | 4.43 | 24.24 | 11.52 | 74.44 | 22.08 | 110.80 | 13.06 | 0.50 | 43.07 | 189.51 | 263.96 | 20.84 | 6.90 | 0.0 | 10/11 | 4753 |
| 12 | LT63/2 | 31.56 | 2.23 | 23.86 | 11.52 | 69.16 | 10.79 | 48.02 | 21.85 | 0.21 | 93.13 | 174.00 | 243.17 | 27.79 | 6.40 | 0.0 | 10/11 | 4761 |
| 13 | MA61/1 | 69.19 | 2.74 | 97.25 | 53.93 | 223.10 | 70.52 | 297.72 | 134.87 | 0.68 | 101.67 | 605.46 | 828.57 | 24.28 | 7.40 | 0.0 | 30/09 | 2696 |
| 14 | NT79/1 | 33.62 | 2.67 | 23.22 | 15.31 | 74.81 | 37.93 | 114.70 | 20.03 | 0.23 | 44.75? | 217.64 | 292.46 | 23.21 | 7.30 | 0.0 | 30/11 | 5995 |
| 15 | PA1-3 | 29.48 | 2.53 | 24.24 | 12.39 | 68.63 | 13.67 | 88.17 | 19.56 | 0.23 | 57.36 | 178.99 | 247.63 | 28.27 | 6.80 | 0.0 | 05/11 @ 0650. | 3935 |
| 16 | PA3 | 40.41 | 3.12 | 39.59 | 22.42 | 105.53 | 29.47 | 147.83 | 22.70 | 0.35 | 87.91 | 288.26 | 393.80 | 26.36 | 7.10 | 0.0 | 10/11 | 4698 |
| 17 | PA7 | 43.18 | 2.74 | 26.17 | 13.54 | 85.63 | 7.50 | 164.91 | 18.41 | 0.46 | 49.84 | 241.12 | 326.75 | 24.03 | 7.10 | 0.0 | 10/11 | 4711 |
| 18 | PA8 | 53.74 | 2.39 | 30.39 | 12.39 | 98.91 | 14.01 | 147.79 | 17.26 | 0.68 | 81.31 | 261.05 | 359.96 | 28.88 | 7.10 | 0.0 | 10/11 | 4703 |
| 19 | RT1 | 69.93 | 1.51 | 121.66 | 46.93 | 240.02 | 93.81 | 386.08 | 126.01 | 0.62 | 22.53 | 629.05 | 869.08 | 13.02 | 7.50 | 0.0 | 30/09 | 2646 |
| 20 | SP2 | 50.19 | 2.98 | 50.34 | 26.06 | 129.57 | 46.64 | 43.40 | 68.07 | 0.18 | 183.39 | 341.68 | 471.25 | 28.76 | 6.50 | 0.0 | 10/11 | 4729 |
| 21 | SP5 | 59.49 | 2.85 | 39.21 | 15.88 | 117.43 | 23.56 | 227.68 | 26.95 | 0.52 | 41.43 | 320.14 | 437.57 | 24.02 | 7.30 | 0.0 | 10/11 | 4737 |
| 22 | SS2 | 43.16 | 3.89 | 75.75 | 37.87 | 160.67 | 53.65 | 344.03 | 48.96 | 0.58 | 11.28 | 458.50 | 619.17 | 21.97 | 7.50 | 0.0 | 01/10 | 2701 |
| 23 | SS16 | 63.37 | 1.76 | 56.77 | 30.37 | 152.27 | 33.35 | 336.68 | 32.29 | 0.76 | 25.89 | 428.97 | 581.24 | 32.08 | 7.30 | 0.0 | 01/10 | 2727 |
| 24 | SS20 | 56.39 | 2.80 | 67.37 | 43.40 | 169.95 | 53.62 | 341.58 | 74.49 | 0.45 | 2.92 | 473.06 | 643.02 | 18.30 | 7.20 | 0.0 | 01/10. | 2735 |
| 25 | ZT4 | 34.14 | 4.13 | 28.07 | 15.92 | 82.26 | 29.24 | 47.60 | 30.44 | 0.22 | 128.23 | 235.73 | 317.99 | 25.59 | 7.00 | 0.0 | 01/12 | 6006 |

45,00 – SABS Limits. max.
102,00 – Max conc. for drinking water TR108.

MILLI-EQUIVALENTS PER LITRE AND IONIC BALANCE — F-B1 OGNVRV

| SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | I/BAL | NO3/CL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE68/1 | 4.867 | 0.222 | 2.435 | 2.986 | 10.512 | 0.960 | 5.654 | 2.838 | 0.048 | 0.601 | 10.102 | -1.557 | 0,21 | F-B1 OGNVRV |
| DS1 | 1.884 | 0.033 | 1.487 | 0.943 | 4.348 | 0.243 | 2.271 | 1.006 | 0.002 | 0.846 | 4.370 | 0.126 | 0,84 | F-B1 OGNVRV |
| GK81/3 | 2.511 | 0.047 | 2.161 | 2.502 | 7.223 | 0.598 | 4.612 | 0.746 | 0.014 | 0.943 | 6.915 | -1.441 | 1,26 | F-B1 OGNVRV |
| GT1 | 0.462 | 0.055 | 0.512 | 0.409 | 1.440 | 0.130 | 0.969 | 0.129 | 0.010 | 0.280 | 1.519 | 0.613 | 2,17 | F-B1 OGNVRV |
| GT2 | 1.328 | 0.076 | 3.036 | 3.645 | 8.088 | 0.170 | 2.027 | 4.499 | 0.010 | 1.061 | 7.768 | -1.407 | 0,24 | F-B1 OGNVRV |
| HG1 | 1.054 | 0.089 | 1.612 | 1.500 | 4.256 | 0.480 | 1.378 | 0.490 | 0.013 | 1.357 | 3.720 | -3.265 | 2,77 | F-B1 OGNVRV |
| HG6 | 1.698 | 0.025 | 2.186 | 1.745 | 5.655 | 0.311 | 3.638 | 0.756 | 0.026 | 0.705 | 5.438 | -1.136 | 0,93 | F-B1 OGNVRV |
| HG9 | 4.169 | 0.077 | 2.404 | 2.852 | 9.505 | 0.584 | 6.311 | 1.787 | 0.033 | 0.636 | 9.354 | -0.598 | 0,36 | F-B1 OGNVRV |
| G34310-3 | 1.082 | 0.068 | 1.113 | 1.113 | 3.378 | 0.428 | 1.337 | 0.161 | 0.024 | 0.952 | 2.903 | -3.129 | 5,91 | F-B1 OGNVRV |
| LT44/1 | 2.826 | 0.057 | 2.739 | 2.477 | 8.101 | 0.602 | 5.318 | 1.067 | 0.021 | 1.340 | 8.350 | 1.056 | 1,26 | F-B1 OGNVRV |
| LT63/1 | 1.490 | 0.113 | 1.209 | 0.947 | 3.760 | 0.459 | 1.816 | 0.368 | 0.026 | 0.694 | 3.365 | -2.493 | 1,89 | F-B1 OGNVRV |
| LT63/2 | 1.372 | 0.057 | 1.190 | 0.947 | 3.567 | 0.224 | 0.787 | 0.616 | 0.011 | 1.502 | 3.141 | -2.749 | 2,44 | F-B1 OGNVRV |
| MA61/1 | 3.009 | 0.070 | 4.852 | 4.435 | 12.367 | 1.468 | 4.879 | 3.803 | 0.035 | 1.640 | 11.827 | -1.865 | 0,43 | F-B1 OGNVRV |
| NT79/1 | 1.462 | 0.068 | 1.158 | 1.259 | 3.948 | 0.789 | 1.879 | 0.564 | 0.012 | 0.721 | 3.968 | 0.118 | 1,28 | F-B1 OGNVRV |
| PA1-3 | 1.282 | 0.064 | 1.209 | 1.018 | 3.575 | 0.284 | 1.445 | 0.551 | 0.012 | 0.925 | 3.218 | -2.281 | 1,68 | F-B1 OGNVRV |
| PA3 | 1.757 | 0.079 | 1.975 | 1.843 | 5.657 | 0.613 | 2.422 | 0.640 | 0.018 | 1.418 | 5.113 | -2.928 | 2,22 | F-B1 OGNVRV |
| PA7 | 1.878 | 0.070 | 1.305 | 1.113 | 4.367 | 0.156 | 2.702 | 0.519 | 0.024 | 0.803 | 4.206 | -0.940 | 1,55 | F-B1 OGNVRV |
| PA8 | 2.337 | 0.061 | 1.516 | 1.018 | 4.934 | 0.291 | 2.422 | 0.486 | 0.035 | 1.311 | 4.548 | -2.181 | 2,70 | F-B1 OGNVRV |
| RT1 | 3.041 | 0.038 | 6.070 | 3.859 | 13.010 | 1.953 | 6.327 | 3.553 | 0.032 | 0.363 | 12.230 | -2.635 | 0,10 | F-B1 OGNVRV |
| SP2 | 2.183 | 0.076 | 2.511 | 2.143 | 6.914 | 0.971 | 0.711 | 1.919 | 0.009 | 2.958 | 6.569 | -1.656 | 1,54 | F-B1 OGNVRV |
| SP5 | 2.587 | 0.072 | 1.956 | 1.305 | 5.923 | 0.490 | 3.731 | 0.759 | 0.027 | 0.668 | 5.677 | -1.261 | 0,88 | F-B1 OGNVRV |
| SS2 | 1.877 | 0.099 | 3.779 | 3.114 | 8.871 | 1.116 | 5.638 | 1.380 | 0.030 | 0.182 | 8.348 | -2.214 | 0,13 | F-B1 OGNVRV |
| SS16 | 2.756 | 0.045 | 2.832 | 2.497 | 8.132 | 0.694 | 5.518 | 0.910 | 0.039 | 0.417 | 7.580 | -2.460 | 0,46 | F-B1 OGNVRV |
| SS20 | 2.452 | 0.071 | 3.361 | 3.569 | 9.455 | 1.116 | 5.598 | 2.100 | 0.023 | 0.047 | 8.886 | -2.330 | 0,02 | F-B1 OGNVRV |
| ZT4 | 1.485 | 0.105 | 1.400 | 1.309 | 4.300 | 0.608 | 0.780 | 0.858 | 0.011 | 2.068 | 4.327 | 0.153 | 2,41 | F-B1 OGNVRV |

ARCHAEN GRANITE / GNEISS CONT.

MILLI-EQUIVALENTS PER LITRE OF CATIONS AND ANIONS
EXPRESSED AS PERCENTAGES OF THE TOTAL CATIONS AND THE TOTAL ANIONS
AND VARIOUS RATIOS (NA=NA+K CL=CL+NO3+F)

F-B1 OGNVRV
F-B1 OGNVRV
Co-ordinates F-B1 OGNVRV

| SAMPLE | NA | CA | MG | SO4 | HCO3 | CL | CL/HCO3 | MG/CA | NA/CA | NA/CL | NA/CAT | ALK/CAT | SAR | THARD as $CaCO_3$ | LAT 27°S | LONG 25°E | F-B1 OGNVRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BE68/1 | 48.42 | 23.16 | 28.41 | 9.50 | 55.96 | 34.52 | 0.50 | 1.22 | 1.99 | 1.71 | 0.46 | 0.51 | 2.95 | 271.31 | 14'20" | 11'13" | F-B1 OGNVRV |
| DS1 | 44.11 | 34.19 | 21.69 | 5.56 | 51.97 | 42.45 | 0.44 | 0.63 | 1.26 | 1.87 | 0.43 | 0.55 | 1.70 | 121.60 | 10'25" | 11'30" | F-B1 OGNVRV |
| GK81/3 | 35.42 | 29.92 | 34.64 | 8.65 | 66.69 | 24.65 | 0.16 | 1.15 | 1.16 | 3.36 | 0.34 | 0.64 | 1.64 | 233.38 | 15'07" | 14'35" | F-B1 OGNVRV |
| GT1 | 35.94 | 35.61 | 28.43 | 8.57 | 63.77 | 27.65 | 0.13 | 0.79 | 0.90 | 3.58 | 0.32 | 0.64 | 0.68 | 46.16 | 14'48" | 19'38" | F-B1 OGNVRV |
| GT2 | 17.37 | 37.54 | 45.07 | 2.18 | 26.09 | 71.71 | 2.21 | 1.20 | 0.43 | 0.29 | 0.16 | 0.82 | 0.72 | 334.38 | 16'00" | 19'00" | F-B1 OGNVRV |
| HG1 | 26.87 | 37.88 | 35.24 | 12.92 | 37.05 | 50.02 | 0.35 | 0.93 | 0.65 | 2.14 | 0.24 | 0.73 | 0.84 | 155.73 | 15'07" | 17'31" | F-B1 OGNVRV |
| HG6 | 30.48 | 38.65 | 30.85 | 5.73 | 66.89 | 27.36 | 0.20 | 0.79 | 0.77 | 2.24 | 0.30 | 0.69 | 1.21 | 196.71 | 14'14" | 17'32" | F-B1 OGNVRV |
| HG9 | 44.68 | 25.29 | 30.01 | 6.24 | 67.47 | 26.28 | 0.28 | 1.18 | 1.73 | 2.33 | 0.43 | 0.55 | 2.57 | 263.07 | 15'48" | 16'43" | F-B1 OGNVRV |
| G34310-3 | 34.06 | 32.97 | 32.96 | 14.74 | 46.06 | 39.18 | 0.12 | 0.99 | 0.97 | 6.71 | 0.32 | 0.65 | 1.02 | 111.45 | 15'07" | 17'37" | F-B1 OGNVRV |
| 4/1 | 35.59 | 33.81 | 30.58 | 7.22 | 63.69 | 29.08 | 0.20 | 0.90 | 1.03 | 2.64 | 0.34 | 0.64 | 1.75 | 261.07 | 08'20" | 15'16" | F-B1 OGNVRV |
| 3/1 | 42.64 | 32.16 | 25.19 | 13.66 | 53.96 | 32.37 | 0.20 | 0.78 | 1.23 | 4.04 | 0.39 | 0.57 | 1.43 | 107.93 | 10'57" | 13'10" | F-B1 OGNVRV |
| 63/2 | 40.07 | 33.36 | 26.55 | 7.15 | 25.05 | 67.79 | 0.78 | 0.79 | 1.15 | 2.22 | 0.38 | 0.59 | 1.32 | 106.98 | 10'08" | 14'10" | F-B1 OGNVRV |
| A61/1 | 24.90 | 39.23 | 35.86 | 12.41 | 41.25 | 46.32 | 0.77 | 0.91 | 0.62 | 0.79 | 0.24 | 0.75 | 1.39 | 464.75 | 12'12" | 03'53" | F-B1 OGNVRV |
| NT79/1 | 38.76 | 29.34 | 31.88 | 19.89 | 47.37 | 32.72 | 0.30 | 1.08 | 1.26 | 2.58 | 0.37 | 0.61 | 1.33 | 120.98 | 16'36" | 11'48" | F-B1 OGNVRV |
| PA1-3 | 37.67 | 33.82 | 28.49 | 8.84 | 44.89 | 46.26 | 0.38 | 0.84 | 1.06 | 2.32 | 0.35 | 0.62 | 1.21 | 111.51 | 12'39" | 14'53" | F-B1 OGNVRV |
| PA3 | 32.48 | 34.92 | 32.59 | 11.99 | 47.38 | 40.61 | 0.26 | 0.93 | 0.88 | 2.74 | 0.31 | 0.67 | 1.27 | 191.11 | 11'45" | 16'15" | F-B1 OGNVRV |
| PA7 | 44.60 | 29.89 | 25.49 | 3.71 | 64.25 | 32.03 | 0.19 | 0.85 | 1.43 | 3.61 | 0.43 | 0.55 | 1.70 | 121.06 | 14'05" | 15'30" | F-B1 OGNVRV |
| PA8 | 48.61 | 30.73 | 20.65 | 6.41 | 53.25 | 40.32 | 0.20 | 0.67 | 1.54 | 4.80 | 0.47 | 0.51 | 2.07 | 126.86 | 11'50" | 14'40" | F-B1 OGNVRV |
| RT1 | 23.67 | 46.65 | 29.66 | 15.96 | 51.73 | 32.29 | 0.56 | 0.63 | 0.50 | 0.85 | 0.23 | 0.76 | 1.36 | 496.90 | 11'30" | 05'34" | F-B1 OGNVRV |
| SP2 | 32.67 | 36.32 | 30.99 | 14.78 | 10.82 | 74.39 | 2.69 | 0.85 | 0.86 | 1.13 | 0.31 | 0.67 | 1.43 | 232.93 | 14'10" | 13'46" | F-B1 OGNVRV |
| SP5 | 44.91 | 33.03 | 22.04 | 8.63 | 65.72 | 25.63 | 0.20 | 0.66 | 1.32 | 3.40 | 0.43 | 0.55 | 2.02 | 163.25 | 10'43" | 12'05" | F-B1 OGNVRV |
| SS2 | 22.28 | 42.60 | 35.10 | 13.37 | 67.53 | 19.08 | 0.24 | 0.82 | 0.49 | 1.35 | 0.21 | 0.77 | 1.01 | 344.98 | 11'52" | 04'09" | F-B1 OGNVRV |
| SS16 | 34.45 | 34.83 | 30.71 | 9.15 | 72.79 | 18.04 | 0.16 | 0.88 | 0.97 | 3.02 | 0.33 | 0.65 | 1.68 | 266.72 | 09'45" | 02'55" | F-B1 OGNVRV |
| SS20 | 26.69 | 35.55 | 37.74 | 12.56 | 63.00 | 24.43 | 0.37 | 1.06 | 0.72 | 1.16 | 0.25 | 0.73 | 1.31 | 346.81 | 10'08" | 04'46" | F-B1 OGNVRV |
| ZT4 | 36.98 | 32.56 | 30.44 | 14.06 | 18.02 | 67.90 | 1.10 | 0.93 | 1.06 | 1.73 | 0.34 | 0.63 | 1.27 | 135.60 | 17'32" | 14'30" | F-B1 OGNVRV |

CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FROM BOREHOLES PENETRATING BOTHAVILLE FORMATION / GRANITE CONTACT (#), BOTHAVILLE FORMATION (X), ALLANRIDGE ANDESITE F. / BOTHAVILLE CONTACT (✓) AND FOR SURFACE WATER SAMPLES FROM HARTS RIVER (H). F-B1 OGNVRV

No. on FIGS — PLOTTED ON FIG.

CATION AND ANION COMPOSITION IN MG PER LITRE F-B1 OGNVRV

| Mark | SAMPLE | No. on FIGS | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | TDS | SI | PH | E COND | DATE (1981) | H/no. 8141 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| # | GN1 | 26 | 37.67 | 1.24 | 65.46 | 21.52 | 125.88 | 11.49 | 263.11 | 21.75 | 0.36 | 51.52 | 348.23 | 474.12 | 16.62 | 7.60 | 0.0 | 09/11 | 4957 |
| (H) | H3 | 27 | 42.66 | 4.50 | 9.56 | 8.58 | 65.30 | 8.88 | 95.00 | 48.98 | 0.20 | 2.61 | 155.67 | 220.97 | 2.88 | 7.00 | 0.0 | 30/11 | 6022 |
| (H) | H4 | 28 | 107.12 | 7.71 | 12.40 | 20.43 | 147.66 | 20.53 | 212.30 | 96.47 | 1.10 | 1.32 | 331.72 | 479.38 | 1.42 | 7.40 | 0.0 | 30/11 | 6030 |
| x | JL2 | 29 | 20.29 | 2.33 | 17.29 | 9.51 | 49.41 | 9.12 | 39.64 | 25.47 | 0.27 | 62.85 | 137.35 | 186.77 | 20.35 | 6.60 | 0.0 | 11/11 | 4787 |
| x | PE1 | 30 | 15.19 | 1.88 | 11.98 | 6.51 | 35.55 | 0.00 | 76.60 | 7.47 | 0.24 | 8.94 | 93.25 | 128.81 | 24.26 | 6.70 | 0.0 | 27/11 | 5987 |
| | SS17 | 31 | 17.69 | 3.31 | 10.28 | 5.26 | 36.54 | 5.00 | 50.38 | 21.82 | 0.14 | 11.64 | 88.98 | 125.52 | 26.06 | 6.30 | 0.0 | 11/11 | 4779 |
| | G34314 | 32 | 34.28 | 1.31 | 44.48 | 23.00 | 103.07 | 7.97 | 239.13 | 24.07 | 0.29 | 35.54 | 307.00 | 410.07 | 16.96 | 7.70 | 0.0 | 05/11 | 3943 |
| | G34315 | 33 | 36.30 | 0.84 | 44.57 | 20.62 | 102.33 | 11.96 | 252.58 | 13.31 | 0.36 | 3.14 | 281.35 | 383.68 | 19.50 | 7.10 | 0.0 | 25/11 | 5000 |
| | ZN1 | 34 | 35.96 | 2.32 | 38.26 | 26.92 | 103.46 | 16.70 | 250.20 | 21.26 | 0.22 | 27.71 | 316.09 | 419.55 | 15.51 | 8.10 | 0.0 | 01/12 | 6064 |

45,00 SABS. max. limit

MILLI-EQUIVALENTS PER LITRE AND IONIC BALANCE F-B1 OGNVRV

| SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | I/BAL | NO3/CL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GN1 | 1.638 | 0.031 | 3.266 | 1.769 | 6.706 | 0.239 | 4.312 | 0.613 | 0.018 | 0.831 | 6.014 | -3.462 | 1,36 | F-B1 OGNVRV |
| H3 | 1.855 | 0.115 | 0.477 | 0.705 | 3.153 | 0.184 | 1.557 | 1.381 | 0.010 | 0.042 | 3.175 | 0.143 | 0,03 | F-B1 OGNVRV |
| H4 | 4.659 | 0.197 | 0.618 | 1.680 | 7.155 | 0.427 | 3.479 | 2.720 | 0.057 | 0.021 | 6.706 | -2.133 | 0,01 | F-B1 OGNVRV |
| JL2 | 0.882 | 0.059 | 0.862 | 0.782 | 2.587 | 0.189 | 0.649 | 0.718 | 0.014 | 1.013 | 2.585 | -0.007 | 1,41 | F-B1 OGNVRV |
| PE1 | 0.660 | 0.048 | 0.597 | 0.535 | 1.842 | 0.000 | 1.255 | 0.210 | 0.012 | 0.144 | 1.622 | -1.663 | 0,69 | F-B1 OGNVRV |
| SS17 | 0.769 | 0.084 | 0.512 | 0.432 | 1.799 | 0.104 | 0.825 | 0.615 | 0.007 | 0.187 | 1.740 | -0.445 | 0,30 | F-B1 OGNVRV |
| G34314 | 1.491 | 0.033 | 2.219 | 1.891 | 5.635 | 0.165 | 3.919 | 0.678 | 0.015 | 0.573 | 5.352 | -1.494 | 0,85 | F-B1 OGNVRV |
| G34315 | 1.579 | 0.021 | 2.224 | 1.695 | 5.520 | 0.249 | 4.139 | 0.375 | 0.018 | 0.050 | 4.833 | -3.784 | 0,13 | F-B1 OGNVRV |
| ZN1 | 1.564 | 0.059 | 1.909 | 2.213 | 5.746 | 0.347 | 4.100 | 0.599 | 0.011 | 0.446 | 5.506 | -1.251 | 0,74 | F-B1 OGNVRV |

MILLI-EQUIVALENTS PER LITRE OF CATIONS AND ANIONS F-B1 OGNVRV
EXPRESSED AS PERCENTAGES OF THE TOTAL CATIONS AND THE TOTAL ANIONS F-B1 OGNVRV
AND VARIOUS RATIOS (NA=NA+K CL=CL+NO3+F) F-B1 OGNVRV

| SAMPLE | NA | CA | MG | SO4 | HCO3 | CL | CL/HCO3 | MG/CA | NA/CA | NA/CL | NA/CAT | ALK/CAT | SAR | THARD as $CaCO_3$ | Co-ordinates LAT. 27°S | LONG. 25°E | OGNVRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GN1 | 24.90 | 48.70 | 26.38 | 3.97 | 71.69 | 24.32 | 0.14 | 0.54 | 0.50 | 2.67 | 0.24 | 0.75 | 1.03 | 252.00 | 03'10" | 19'25" | OGNVRV |
| H3 | 62.49 | 15.12 | 22.37 | 5.82 | 49.02 | 45.15 | 0.88 | 1.47 | 3.89 | 1.34 | 0.58 | 0.37 | 2.41 | 59.17 | 15'18" | 13'29" | OGNVRV |
| H4 | 67.87 | 8.64 | 23.47 | 6.37 | 51.88 | 41.74 | 0.78 | 2.71 | 7.53 | 1.71 | 0.65 | 0.32 | 4.34 | 115.03 | 15'47" | 11'08" | OGNVRV |
| JL2 | 36.41 | 33.34 | 30.23 | 7.34 | 25.12 | 67.53 | 1.10 | 0.90 | 1.02 | 1.22 | 0.34 | 0.63 | 0.97 | 82.30 | 05'50" | 15'35" | OGNVRV |
| PE1 | 38.48 | 32.45 | 29.06 | 0.00 | 77.35 | 22.64 | 0.16 | 0.89 | 1.10 | 3.13 | 0.35 | 0.61 | 0.87 | 56.70 | 05'52" | 14'03" | OGNVRV |
| SS17 | 47.46 | 28.50 | 24.03 | 5.98 | 47.44 | 46.57 | 0.74 | 0.84 | 1.50 | 1.25 | 0.42 | 0.52 | 1.11 | 47.31 | 07'55" | 17'07" | OGNVRV |
| G34314 | 27.05 | 39.38 | 33.56 | 3.10 | 73.22 | 23.67 | 0.17 | 0.85 | 0.67 | 2.19 | 0.26 | 0.72 | 1.04 | 205.71 | 09'43" | 20'03" | OGNVRV |
| G34315 | 28.99 | 40.28 | 30.71 | 5.15 | 85.64 | 9.20 | 0.09 | 0.76 | 0.70 | 4.20 | 0.28 | 0.71 | 1.12 | 196.14 | 09'20" | 20'08" | OGNVRV |
| ZN1 | 28.25 | 33.22 | 38.52 | 6.31 | 74.47 | 19.21 | 0.14 | 1.15 | 0.81 | 2.60 | 0.27 | 0.71 | 1.08 | 206.31 | 18'36" | 20'45" | OGNVRV |

NO. ON FIGS.

CHEMICAL ANALYSES OF GROUNDWATER SAMPLES *FROM ALLANRIDGE ANDESITE FORMATION UNDER COVER OF KAROO SEQUENCE.*
*PLOTTED ON FIG.*

CATION AND ANION COMPOSITION IN MG PER LITRE — F-B1 OGNVRV

| NO. ON FIGS. | SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | TDS (lab) | SI | PH (lab) | E COND | DATE (1981) | H. no. V (lab) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 | KL2 | 60.21 | 4.39 | 61.56 | 30.68 | 156.83 | 22.08 | 333.54 | 39.33 | 0.43 | 55.28 | 450.66 | 607.50 | 16.61 | 7.90 | 0.0 | 09/11 | 81414965 |
| 55 | MN2 | 245.01 | 11.28 | 64.00 | 71.00 | 391.29 | 109.31 | 633.60 | 198.17 | 1.83 | 24.74 | 967.65 | 1358.94 | 30.72 | 7.80 | 0.0 | 29/09 | 81412638 |
| 56 | MN12 | 68.53 | 4.95 | 105.43 | 59.81 | 238.72 | 65.52 | 371.16 | 180.92 | 0.39 | 51.52 | 669.51 | 908.23 | 12.24 | 7.70 | 0.0 | 30/09 | 81412654 |
| 57 | NT86/1 | 135.44 | 4.93 | 75.74 | 43.05 | 259.15 | 72.10 | 450.80 | 120.75 | 0.80 | 13.14 | 657.59 | 916.75 | 16.50 | 7.80 | 0.0 | 16/11 | 81414907 |
| 58 | PN1 | 55.31 | 3.41 | 99.54 | 54.77 | 213.02 | 58.22 | 374.88 | 119.56 | 0.69 | 36.29 | 589.64 | 802.67 | 14.12 | 7.60 | 0.0 | 30/09 | 81412662 |
| 59 | PN9 | 83.35 | 6.31 | 66.25 | 44.67 | 200.58 | 15.58 | 426.26 | 76.58 | 0.44 | 42.40 | 561.26 | 761.84 | 20.74 | 7.60 | 0.0 | 13/11 | 81414892 |
| 60 | PN10-1 | 48.44 | 5.09 | 73.89 | 41.74 | 169.16 | 23.90 | 357.47 | 35.09 | 0.14 | 79.01 | 495.61 | 664.77 | 13.32 | 7.90 | 0.0 | 14/10 | 8141-3862 |
| 61 | PN10-2 | 51.60 | 4.45 | 73.75 | 39.19 | 168.99 | 27.78 | 368.37 | 28.26 | 0.31 | 67.19 | 491.91 | 660.90 | 17.42 | 7.70 | 0.0 | 13/11 | 81414884 |
| 62 | SK1 | 80.53 | 5.70 | 48.19 | 36.66 | 171.08 | 43.43 | 286.80 | 74.03 | 0.82 | 61.83 | 466.91 | 637.99 | 13.13 | 8.20 | 0.0 | 08/12 | 81415979 |
| | + NT 86/3 (50). | | | | | | | | | | | | | | | | | |
| | S.A.B.S. LIMITS | | | | | | | | | 1,50 | 45,00 | | | | — | | | |
| | MAXIMUM CONC. | 1000,00 | 2000,00 | 300,00 | 200 | | 500,00 | 610,00 | 1000,00 | 2,40 | 102,00 | | 2000 | | — | | | |

} DRINKING WATER CRITERIA.

MILLI-EQUIVALENTS PER LITRE AND IONIC BALANCE — F-B1 OGNVRV

| SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | I/BAL | $NO_3/Cl$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | F-B1 OGNVRV |
| KL2 | 2.619 | 0.112 | 3.071 | 2.523 | 8.326 | 0.459 | 5.466 | 1.109 | 0.022 | 0.891 | 7.949 | -1.638 | 0,80 | |
| MN2 | 10.657 | 0.288 | 3.193 | 5.839 | 19.979 | 2.275 | 10.384 | 5.588 | 0.096 | 0.399 | 18.744 | -3.109 | 0,07 | F-B1 OGNVRV |
| MN12 | 2.981 | 0.126 | 5.260 | 4.918 | 13.287 | 1.364 | 6.083 | 5.101 | 0.020 | 0.831 | 13.401 | 0.361 | 0,16 | F-B1 OGNVRV |
| NT86/1 | 5.891 | 0.126 | 3.779 | 3.540 | 13.337 | 1.501 | 7.388 | 3.405 | 0.042 | 0.212 | 12.549 | -2.619 | 0,06 | F-B1 OGNVRV |
| PN1 | 2.405 | 0.087 | 4.967 | 4.504 | 11.964 | 1.212 | 6.144 | 3.371 | 0.036 | 0.585 | 11.349 | -2.176 | 0,17 | F-B1 OGNVRV |
| PN9 | 3.625 | 0.161 | 3.305 | 3.673 | 10.766 | 0.324 | 6.986 | 2.159 | 0.023 | 0.684 | 10.177 | -2.229 | 0,32 | F-B1 OGNVRV |
| PN10-1 | 2.107 | 0.130 | 3.687 | 3.432 | 9.357 | 0.497 | 5.858 | 0.989 | 0.007 | 1.274 | 8.627 | -3.035 | 1,29 | F-B1 OGNVRV |
| PN10-2 | 2.244 | 0.113 | 3.680 | 3.222 | 9.261 | 0.578 | 6.037 | 0.796 | 0.016 | 1.083 | 8.513 | -3.138 | 1,36 | F-B1 OGNVRV |
| SK1 | 3.503 | 0.145 | 2.404 | 3.014 | 9.068 | 0.904 | 4.700 | 2.087 | 0.043 | 0.997 | 8.733 | -1.386 | 0,48 | F-B1 OGNVRV |

MILLI-EQUIVALENTS PER LITRE OF CATIONS AND ANIONS — F-B1 OGNVRV
EXPRESSED AS PERCENTAGES OF THE TOTAL CATIONS AND THE TOTAL ANIONS — F-B1 OGNVRV
AND VARIOUS RATIOS (NA=NA+K CL=CL+NO3+F) — F-B1 OGNVRV

| SAMPLE | NA | CA | MG | SO4 | HCO3 | CL | CL/HCO3 | MG/CA | NA/CA | NA/CL | NA/CAT | ALK/CAT | SAR | THARD as $CaCO_3$ | CO-ORDINATES. LAT. 27°S | LONG. 25°E | OGNVRV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KL2 | 32.80 | 36.89 | 30.30 | 5.78 | 68.76 | 25.45 | 0.20 | 0.82 | 0.85 | 2.36 | 0.31 | 0.67 | 1.56 | 279.96 | 18'33" | 27'40" | OGNVRV |
| MN2 | 54.78 | 15.98 | 29.22 | 12.14 | 55.40 | 32.45 | 0.53 | 1.82 | 3.33 | 1.90 | 0.53 | 0.45 | 5.01 | 451.97 | 08'57" | 10'55" | OGNVRV |
| MN12 | 23.38 | 39.59 | 37.01 | 10.17 | 45.39 | 44.42 | 0.83 | 0.93 | 0.56 | 0.58 | 0.22 | 0.76 | 1.32 | 509.37 | 09'35" | 12'27" | OGNVRV |
| NT86/1 | 45.11 | 28.33 | 26.54 | 11.96 | 58.87 | 29.16 | 0.46 | 0.93 | 1.55 | 1.73 | 0.44 | 0.54 | 3.07 | 366.27 | 14'47" | 26'42" | OGNVRV |
| PN1 | 20.83 | 41.51 | 37.64 | 10.67 | 54.13 | 35.18 | 0.54 | 0.90 | 0.48 | 0.71 | 0.20 | 0.79 | 1.10 | 473.92 | 10'46" | 11'19" | OGNVRV |
| PN9 | 35.17 | 30.70 | 34.12 | 3.18 | 68.64 | 28.16 | 0.30 | 1.11 | 1.09 | 1.67 | 0.33 | 0.64 | 1.94 | 349.24 | 12'28" | 25'50" | OGNVRV |
| PN10-1 | 23.91 | 39.40 | 36.68 | 5.76 | 67.90 | 26.32 | 0.16 | 0.93 | 0.57 | 2.12 | 0.22 | 0.76 | 1.11 | 356.26 | 11'26" | 23'53" | OGNVRV |
| PN10-2 | 25.46 | 39.73 | 34.79 | 6.79 | 70.92 | 22.28 | 0.13 | 0.87 | 0.60 | 2.81 | 0.24 | 0.74 | 1.20 | 345.42 | ditto | ditto. | OGNVRV |
| SK1 | 40.23 | 26.51 | 33.24 | 10.35 | 53.82 | 35.82 | 0.44 | 1.25 | 1.45 | 1.67 | 0.38 | 0.59 | 2.12 | 271.18 | 14'50" | 30'49" | OGNVRV |

## CHEMICAL ANALYSES OF GROUNDWATER SAMPLES — *REPEAT SAMPLES FROM HIGH YIELDING BOREHOLES* F-B1 OGNVRV

### CATION AND ANION COMPOSITION IN MG PER LITRE E-B1 OGNVRV

| | SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | TDS | SI | PH | E COND | DATE 1981 | TIME | H no. 8141 — |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 63 | G34310-1 | 22.11 | 2.71 | 26.56 | 15.29 | 66.66 | 20.50 | 94.07 | 9.23 | 0.33 | 56.17 | 180.30 | 246.97 | 26.40 | 6.90 | 0.0 | 20/10 | 1015 | 3870 |
| 64 | G34310-2 | 23.57 | 2.31 | 22.70 | 12.96 | 61.54 | 22.14 | 77.86 | 7.34 | 0.45 | 57.14 | 164.93 | 226.47 | 23.11 | 6.70 | 0.0 | 11/11 | 0825 | 4973 |
| 65 | PA1-1 | 30.16 | 2.51 | 22.31 | 11.24 | 66.22 | 10.66 | 80.15 | 17.17 | 0.32 | 61.08 | 169.38 | 235.60 | 28.29 | 6.70 | 0.0 | 04/11 | 0722 | 3919 |
| 66 | PA1-2 | 28.80 | 2.27 | 23.08 | 11.53 | 65.68 | 14.53 | 82.85 | 19.02 | 0.24 | 56.43 | 173.07 | 238.75 | 28.54 | 6.70 | 0.0 | 04/11 | 1830 | 3927 |
| 67 | G34307-1 | 47.73 | 4.00 | 55.56 | 29.69 | 136.98 | 33.06 | 257.81 | 32.94 | 0.55 | 64.58 | 388.94 | 525.92 | 15.77 | 7.80 | 0.0 | 01/10 | 1310 | 2719 |
| 68 | G34307-2 | 46.27 | 2.97 | 58.39 | 28.47 | 136.10 | 28.24 | 260.00 | 34.18 | 0.32 | 59.31 | 382.05 | 518.15 | 15.96 | 7.60 | 0.0 | 27/10 | 1045 | 3888 |
| 69 | G34307-3 | 47.71 | 3.23 | 58.79 | 28.47 | 138.20 | 25.81 | 264.03 | 34.06 | 0.36 | 58.03 | 382.29 | 520.49 | 15.83 | 7.80 | 0.0 | 28/10 | 1610 | 3896 |
| 70 | G34307-4 | 46.99 | 3.24 | 57.99 | 28.78 | 137.00 | 26.72 | 262.83 | 33.95 | 0.36 | 60.11 | 383.97 | 520.97 | 15.59 | 7.70 | 0.0 | 29/10 | 0940 | 3901 |
| 71 | G34307-5 | 48.93 | 3.69 | 30.91 | 27.88 | 111.41 | 25.95 | 211.40 | 33.76 | 0.36 | 59.36 | 330.83 | 442.24 | 17.43 | 8.00 | 0.0 | 03/12 | 1200 | 5961 |

see also – G34310/3 (9)
Pa / 3 (15)
and G34309/6 (49)

45,00 – S.A.B.S max. limit.
102,00 – Max. Conc. for DRINKING WATER (TR108).

### MILLI-EQUIVALENTS PER LITRE AND IONIC BALANCE F-B1 OGNVRV

| SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | I/BAL | NO3/CL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | F-B1 OGNVRV |
| G34310-1 | 0.961 | 0.069 | 1.325 | 1.257 | 3.613 | 0.426 | 1.541 | 0.260 | 0.017 | 0.906 | 3.152 | -2.970 | 3,48 | F-B1 OGNVRV |
| G34310-2 | 1.025 | 0.059 | 1.132 | 1.065 | 3.282 | 0.460 | 1.276 | 0.206 | 0.023 | 0.921 | 2.889 | -2.600 | 4,47 | F-B1 OGNVRV |
| PA1-1 | 1.311 | 0.064 | 1.113 | 0.924 | 3.413 | 0.221 | 1.313 | 0.484 | 0.016 | 0.985 | 3.021 | -2.555 | 2,04 | F-B1 OGNVRV |
| PA1-2 | 1.252 | 0.058 | 1.151 | 0.948 | 3.410 | 0.302 | 1.357 | 0.536 | 0.012 | 0.910 | 3.119 | -1.879 | 1,70 | F-B1 OGNVRV |
| G34307-1 | 2.076 | 0.102 | 2.772 | 2.441 | 7.392 | 0.688 | 4.225 | 0.928 | 0.028 | 1.041 | 6.913 | -2.243 | 1,12 | F-B1 OGNVRV |
| G34307-2 | 2.012 | 0.075 | 2.913 | 2.341 | 7.343 | 0.587 | 4.261 | 0.963 | 0.016 | 0.956 | 6.786 | -2.630 | 0,99 | F-B1 OGNVRV |
| G34307-3 | 2.075 | 0.082 | 2.933 | 2.341 | 7.433 | 0.537 | 4.327 | 0.960 | 0.018 | 0.936 | 6.780 | -3.084 | 0,98 | F-B1 OGNVRV |
| G34307-4 | 2.044 | 0.082 | 2.893 | 2.366 | 7.387 | 0.556 | 4.307 | 0.957 | 0.018 | 0.969 | 6.810 | -2.723 | 1,01 | F-B1 OGNVRV |
| G34307-5 | 2.128 | 0.094 | 1.542 | 2.292 | 6.058 | 0.540 | 3.464 | 0.952 | 0.018 | 0.957 | 5.933 | -0.627 | 1,02 | F-B1 OGNVRV |

### MILLI-EQUIVALENTS PER LITRE OF CATIONS AND ANIONS EXPRESSED AS PERCENTAGES OF THE TOTAL CATIONS AND THE TOTAL ANIONS AND VARIOUS RATIOS (NA=NA+K CL=CL+NO3+F)

F-B1 OGNVRV
F-B1 OGNVRV
F-B1 OGNVRV

| SAMPLE | NA | CA | MG | SO4 | HCO3 | CL | CL/HCO3 | MG/CA | NA/CA | NA/CL | NA/CAT | ALK/CAT | SAR | THARD as $CaCO_3$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G34310-1 | 28.53 | 36.67 | 34.79 | 13.53 | 48.90 | 37.55 | 0.16 | 0.94 | 0.72 | 3.69 | 0.26 | 0.71 | 0.84 | 129.23 | F-B1 OGNVRV |
| G34310-2 | 33.03 | 34.50 | 32.46 | 15.95 | 44.16 | 39.88 | 0.16 | 0.94 | 0.90 | 4.95 | 0.31 | 0.66 | 0.97 | 110.01 | F-B1 OGNVRV |
| PA1-1 | 40.31 | 32.61 | 27.07 | 7.34 | 43.47 | 49.18 | 0.36 | 0.83 | 1.17 | 2.70 | 0.38 | 0.59 | 1.29 | 101.96 | F-B1 OGNVRV |
| PA1-2 | 38.43 | 33.76 | 27.80 | 9.69 | 43.52 | 46.77 | 0.39 | 0.82 | 1.08 | 2.33 | 0.36 | 0.61 | 1.22 | 105.07 | F-B1 OGNVRV |
| G34307-1 | 29.46 | 37.50 | 33.02 | 9.95 | 61.12 | 28.92 | 0.21 | 0.88 | 0.74 | 2.23 | 0.28 | 0.70 | 1.28 | 260.90 | F-B1 OGNVRV |
| G34307-2 | 28.44 | 39.67 | 31.88 | 8.66 | 62.78 | 28.54 | 0.22 | 0.80 | 0.69 | 2.08 | 0.27 | 0.71 | 1.24 | 262.95 | F-B1 OGNVRV |
| G34307-3 | 29.03 | 39.46 | 31.49 | 7.92 | 63.82 | 28.25 | 0.22 | 0.79 | 0.70 | 2.16 | 0.27 | 0.70 | 1.27 | 263.95 | F-B1 OGNVRV |
| G34307-4 | 28.79 | 39.17 | 32.03 | 8.16 | 63.25 | 28.57 | 0.22 | 0.81 | 0.70 | 2.13 | 0.27 | 0.71 | 1.26 | 263.23 | F-B1 OGNVRV |
| G34307-5 | 36.69 | 25.46 | 37.84 | 9.10 | 58.39 | 32.50 | 0.27 | 1.48 | 1.37 | 2.23 | 0.35 | 0.63 | 1.53 | 191.90 | F-B1 OGNVRV |

ALLANRIDGE ANDESITE FORMATION cont.

MILLI-EQUIVALENTS PER LITRE OF CATIONS AND ANIONS
EXPRESSED AS PERCENTAGES OF THE TOTAL CATIONS AND THE TOTAL ANIONS
AND VARIOUS RATIOS (NA=NA+K CL=CL+NO3+F)

| SAMPLE | NA | CA | MG | SO4 | HCO3 | CL | CL/HCO3 | MG/CA | NA/CA | NA/CL | NA/CAT | ALK/CAT | SAR | THARD as $CaCO_3$ | Co-ordinates: LAT. 27°S | LONG. 25°E | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BT2 | 25.42 | 41.03 | 33.54 | 5.12 | 69.02 | 25.84 | 0.11 | 0.81 | 0.58 | 3.41 | 0.24 | 0.74 | 1.07 | 277.83 | 06'58" | 09'59" | F-B1 OGNVRV |
| BT7 | 27.30 | 39.58 | 33.10 | 4.50 | 68.36 | 27.12 | 0.11 | 0.83 | 0.67 | 3.55 | 0.26 | 0.72 | 1.26 | 291.21 | 05'35" | 25'03" | F-B1 OGNVRV |
| DK1 | 36.81 | 34.18 | 28.99 | 8.02 | 66.22 | 25.74 | 0.22 | 0.84 | 1.01 | 2.43 | 0.34 | 0.63 | 1.84 | 278.87 | 17'36" | 27'40" | F-B1 OGNVRV |
| EM1 | 24.50 | 37.50 | 37.99 | 2.86 | 35.67 | 61.45 | 1.32 | 1.01 | 0.64 | 0.54 | 0.24 | 0.75 | 0.99 | 243.30 | 05'12" | 17'38" | F-B1 OGNVRV |
| KN52/1 | 27.75 | 41.53 | 30.70 | 12.83 | 46.67 | 40.49 | 0.59 | 0.73 | 0.64 | 1.01 | 0.26 | 0.72 | 1.53 | 432.46 | 05'05" | 27'15" | F-B1 OGNVRV |
| LT9/1 | 17.24 | 52.25 | 30.49 | 3.53 | 25.14 | 71.31 | 1.38 | 0.58 | 0.32 | 0.50 | 0.16 | 0.82 | 1.17 | 821.58 | 02'18" | 20'52" | F-B1 OGNVRV |
| LT16/2 | 24.57 | 41.51 | 33.91 | 5.32 | 61.26 | 33.40 | 0.29 | 0.81 | 0.57 | 1.45 | 0.23 | 0.75 | 0.99 | 244.08 | 05'35" | 24'08" | F-B1 OGNVRV |
| LT19/2 | 30.86 | 38.35 | 30.77 | 6.30 | 72.54 | 21.15 | 0.09 | 0.80 | 0.79 | 4.88 | 0.30 | 0.69 | 1.50 | 289.33 | 06'32" | 22'10" | F-B1 OGNVRV |
| T20/1 | 36.18 | 35.31 | 28.49 | 5.49 | 53.25 | 41.24 | 0.22 | 0.80 | 0.99 | 3.10 | 0.35 | 0.63 | 1.25 | 130.20 | 05'20" | 05'22" | F-B1 OGNVRV |
| 39/1 | 42.70 | 26.59 | 30.70 | 13.51 | 35.78 | 50.70 | 1.11 | 1.15 | 1.58 | 1.07 | 0.42 | 0.57 | 2.28 | 241.34 | 07'52" | 11'25" | F-B1 OGNVRV |
| 49/3 | 21.65 | 51.91 | 26.42 | 6.42 | 66.01 | 27.56 | 0.13 | 0.50 | 0.40 | 2.49 | 0.21 | 0.78 | 0.81 | 226.07 | 07'37" | 21'30" | F-B1 OGNVRV |
| A61/6 | 24.47 | 45.10 | 30.42 | 5.11 | 42.09 | 52.79 | 0.94 | 0.67 | 0.52 | 0.61 | 0.23 | 0.75 | 1.39 | 493.16 | 14'22" | 23'25" | F-B1 OGNVRV |
| MN10 | 24.16 | 37.53 | 38.30 | 3.41 | 74.20 | 22.38 | 0.13 | 1.02 | 0.62 | 2.53 | 0.23 | 0.75 | 0.94 | 228.13 | 08'15" | 24'33" | F-B1 OGNVRV |
| MN15 | 24.66 | 39.57 | 35.76 | 4.22 | 72.21 | 23.56 | 0.13 | 0.90 | 0.59 | 2.56 | 0.23 | 0.75 | 1.14 | 335.14 | 08'38" | 08'41" | F-B1 OGNVRV |
| G34307-6 | 31.07 | 38.10 | 30.81 | 7.49 | 65.57 | 26.93 | 0.20 | 0.80 | 0.78 | 2.31 | 0.29 | 0.68 | 1.37 | 253.66 | 09'05" | 10'04" | F-B1 OGNVRV |
| NT86/3 | 39.01 | 33.26 | 27.72 | 6.38 | 74.46 | 19.14 | 0.17 | 0.83 | 1.09 | 2.89 | 0.36 | 0.60 | 1.81 | 232.10 | 15'25" | 28'35" | F-B1 OGNVRV |
| RT11 | 28.25 | 42.30 | 29.43 | 2.13 | 90.07 | 7.79 | 0.04 | 0.69 | 0.66 | 7.69 | 0.27 | 0.71 | 1.33 | 292.16 | 09'46" | 22'25" | F-B1 OGNVRV |
| VT6 | 23.81 | 41.54 | 34.63 | 0.56 | 61.06 | 38.37 | 0.24 | 0.83 | 0.55 | 1.66 | 0.23 | 0.76 | 0.97 | 255.25 | 17'19" | 22'22" | F-B1 OGNVRV |
| ZN2 | 26.53 | 43.23 | 30.23 | 0.32 | 64.03 | 35.64 | 0.20 | 0.69 | 0.60 | 2.13 | 0.25 | 0.73 | 1.18 | 281.96 | 18'03" | 23'20" | F-B1 OGNVRV |

No. ON FIGs.

CHEMICAL ANALYSES OF GROUNDWATER SAMPLES *FROM ALLANRIDGE ANDESITE FORMATION.* F-B1 OGNVRV

*PLOTTED ON FIG.*

CATION AND ANION COMPOSITION IN MG PER LITRE F-B1 OGNVRV

| No. | SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | TDS | SI | PH | E COND | DATE (1981) | H/no ? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | 8141 — |
| 35 | BT2 | 41.35 | 3.68 | 61.22 | 30.37 | 136.61 | 17.04 | 291.66 | 18.68 | 0.41 | 76.97 | 404.76 | 541.38 | 18.71 | 7.60 | 0.0 | 30/09 | 2688 |
| 36 | BT7 | 49.48 | 1.31 | 63.51 | 32.23 | 146.52 | 16.16 | 311.62 | 21.48 | 0.38 | 86.84 | 436.48 | 583.01 | 20.98 | 7.50 | 0.0 | 13/11 | 4868 |
| 37 | DK1 | 70.67 | 6.76 | 60.43 | 31.10 | 168.95 | 32.67 | 342.30 | 44.72 | 0.32 | 55.95 | 475.96 | 644.92 | 13.69 | 8.10 | 0.0 | 03/12 | 6098 |
| 38 | EM1 | 35.62 | 1.11 | 48.41 | 29.75 | 114.88 | 8.32 | 131.55 | 101.25 | 0.33 | 52.18 | 293.63 | 408.52 | 19.90 | 6.90 | 0.0 | 11/11 | 4800 |
| 39 | KN52/1 | 73.49 | 4.83 | 99.58 | 44.67 | 222.56 | 69.73 | 322.05 | 111.87 | 0.56 | 86.49 | 590.70 | 813.27 | 18.57 | 7.60 | 0.0 | 13/11 | 4876 |
| 40 | LT9/1 | 77.25 | 2.43 | 207.77 | 73.58 | 361.03 | 32.46 | 293.50 | 235.92 | 0.32 | 432.30 | 994.50 | 1355.53 | 18.58 | 7.70 | 0.0 | 12/11 | 4818 |
| 41 | LT16/2 | 35.62 | 1.56 | 53.80 | 26.67 | 117.64 | 15.13 | 221.09 | 37.79 | 0.25 | 55.59 | 329.85 | 447.50 | 17.49 | 7.60 | 0.0 | 12/11 | 4842 |
| 4 | LT19/2 | 58.77 | 0.97 | 64.29 | 31.30 | 155.33 | 23.49 | 343.33 | 18.57 | 0.31 | 68.25 | 453.95 | 609.28 | 17.19 | 7.70 | 0.0 | 12/11 | 4839 |
| | LT20/1 | 32.91 | 1.72 | 28.86 | 14.13 | 77.61 | 10.16 | 124.98 | 16.35 | 0.37 | 68.56 | 220.42 | 298.04 | 20.78 | 6.90 | 0.0 | 11/11 | 4795 |
| 4 | LT39/1 | 81.65 | 1.68 | 44.86 | 31.43 | 159.61 | 53.64 | 180.40 | 117.15 | 0.59 | 53.03 | 404.81 | 564.43 | 13.97 | 7.80 | 0.0 | 27/11 | 5945 |
| 45 | LT49/3 | 28.21 | 0.85 | 60.00 | 18.53 | 107.59 | 17.61 | 229.79 | 17.42 | 0.22 | 66.31 | 331.35 | 438.94 | 16.00 | 7.90 | 0.0 | 12/11 | 4826 |
| 46 | MA61/6 | 71.24 | 3.69 | 117.94 | 48.28 | 241.14 | 31.01 | 324.49 | 178.28 | 0.31 | 100.79 | 634.88 | 876.03 | 18.56 | 7.60 | 0.0 | 16/11 | 4923 |
| 47 | MN10 | 32.65 | 1.27 | 45.22 | 28.00 | 107.13 | 9.13 | 251.77 | 19.86 | 0.39 | 41.16 | 322.31 | 429.45 | 17.01 | 7.30 | 0.0 | 29/09 | 2620 |
| 48 | MN15 | 48.33 | 3.54 | 70.51 | 38.66 | 161.04 | 16.69 | 362.44 | 29.06 | 0.56 | 67.54 | 476.29 | 637.33 | 15.36 | 7.50 | 0.0 | 30/09 | 2670 |
| 49 | G34307-6 | 50.30 | 3.81 | 56.17 | 27.56 | 137.83 | 25.51 | 283.40 | 33.51 | 0.40 | 58.38 | 401.20 | 539.04 | 17.43 | 8.20 | 0.0 | 03/12 @ | 5961 |
| 50 | NT86/3* | 63.53 | 7.98 | 50.70 | 25.64 | 147.85 | 22.08 | 327.00 | 33.87 | 0.41 | 24.87 | 408.23 | 556.08 | 12.99 | 8.00 | 0.0 | 03/12 0730 | 6103 |
| 51 | RT11 | 52.31 | 0.95 | 69.00 | 29.13 | 151.39 | 7.75 | 415.60 | 10.49 | 0.39 | 16.90 | 451.13 | 602.52 | 15.66 | 7.60 | 0.0 | 13/11 | 4850 |
| 52 | VT6 | 35.79 | 1.48 | 55.75 | 28.20 | 121.22 | 1.71 | 235.00 | 33.07 | 0.23 | 91.49 | 361.50 | 482.72 | 17.30 | 7.90 | 0.0 | 01/12 | 6080 |
| 53 | ZN2 | 45.82 | 1.63 | 66.45 | 28.20 | 142.10 | 1.10 | 277.60 | 33.06 | 0.22 | 98.49 | 410.47 | 552.57 | 17.02 | 8.00 | 0.0 | 02/12 | 6072 |

* occurs with Karoo cover.

45,00 - SABS max limit.

102,00 - max limits for drinking water TR108

MILLI-EQUIVALENTS PER LITRE AND IONIC BALANCE F-B1 OGNVRV

| SAMPLE | NA | K | CA | MG | T CAT | SO4 | HCO3 | CL | F | NO3 | T ANS | I/BAL | NO3/CL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | F-B1 OGNVRV |
| BT2 | 1.798 | 0.094 | 3.054 | 2.497 | 7.445 | 0.354 | 4.780 | 0.526 | 0.021 | 1.241 | 6.925 | -2.432 | 2,36 | F-B1 OGNVRV |
| BT7 | 2.152 | 0.033 | 3.169 | 2.650 | 8.005 | 0.336 | 5.107 | 0.605 | 0.019 | 1.400 | 7.470 | -2.407 | 2,31 | F-B1 OGNVRV |
| DK1 | 3.074 | 0.172 | 3.015 | 2.557 | 8.820 | 0.680 | 5.610 | 1.261 | 0.016 | 0.902 | 8.470 | -1.468 | 0,72 | F-B1 OGNVRV |
| EM1 | 1.549 | 0.028 | 2.415 | 2.446 | 6.440 | 0.173 | 2.156 | 2.855 | 0.017 | 0.841 | 6.043 | -1.980 | 0,29 | F-B1 OGNVRV |
| KN52/1 | 3.196 | 0.123 | 4.969 | 3.673 | 11.963 | 1.451 | 5.278 | 3.154 | 0.029 | 1.395 | 11.309 | -2.319 | 0,44 | F-B1 OGNVRV |
| LT9/1 | 3.360 | 0.062 | 10.367 | 6.051 | 19.841 | 0.675 | 4.810 | 6.652 | 0.016 | 6.973 | 19.129 | -1.767 | 1,05 | F-B1 OGNVRV |
| LT16/2 | 1.549 | 0.039 | 2.684 | 2.193 | 6.467 | 0.315 | 3.623 | 1.065 | 0.013 | 0.896 | 5.914 | -2.790 | 0,84 | F-B1 OGNVRV |
| LT19/2 | 2.556 | 0.024 | 3.208 | 2.574 | 8.363 | 0.489 | 5.627 | 0.523 | 0.016 | 1.101 | 7.757 | -2.673 | 2,11 | F-B1 OGNVRV |
| LT20/1 | 1.431 | 0.043 | 1.440 | 1.162 | 4.077 | 0.211 | 2.048 | 0.461 | 0.019 | 1.106 | 3.846 | -1.392 | 2,40 | F-B1 OGNVRV |
| LT39/1 | 3.551 | 0.042 | 2.238 | 2.584 | 8.418 | 1.116 | 2.956 | 3.303 | 0.031 | 0.855 | 8.263 | -0.658 | 0,26 | F-B1 OGNVRV |
| LT49/3 | 1.227 | 0.021 | 2.993 | 1.523 | 5.766 | 0.366 | 3.766 | 0.491 | 0.011 | 1.069 | 5.705 | -0.315 | 2,18 | F-B1 OGNVRV |
| MA61/6 | 3.098 | 0.094 | 5.885 | 3.970 | 13.049 | 0.645 | 5.318 | 5.027 | 0.016 | 1.625 | 12.633 | -1.374 | 0,32 | F-B1 OGNVRV |
| MN10 | 1.420 | 0.032 | 2.256 | 2.302 | 6.011 | 0.190 | 4.126 | 0.560 | 0.020 | 0.664 | 5.561 | -2.339 | 1,19 | F-B1 OGNVRV |
| MN15 | 2.102 | 0.090 | 3.518 | 3.179 | 8.890 | 0.347 | 5.940 | 0.819 | 0.029 | 1.089 | 8.226 | -2.838 | 1,33 | F-B1 OGNVRV |
| G34307-6 | 2.188 | 0.097 | 2.802 | 2.266 | 7.354 | 0.531 | 4.644 | 0.944 | 0.021 | 0.941 | 7.083 | -1.253 | 1,00 | F-B1 OGNVRV |
| NT86/3 | 2.763 | 0.204 | 2.529 | 2.108 | 7.606 | 0.459 | 5.359 | 0.955 | 0.021 | 0.401 | 7.197 | -1.875 | 0,42 | F-B1 OGNVRV |
| RT11 | 2.275 | 0.024 | 3.443 | 2.395 | 8.138 | 0.161 | 6.811 | 0.295 | 0.020 | 0.272 | 7.562 | -2.576 | 0,92 | F-B1 OGNVRV |
| VT6 | 1.556 | 0.037 | 2.781 | 2.319 | 6.695 | 0.035 | 3.851 | 0.932 | 0.012 | 1.475 | 6.307 | -1.899 | 1,58 | F-B1 OGNVRV |
| ZN2 | 1.993 | 0.041 | 3.315 | 2.319 | 7.669 | 0.022 | 4.549 | 0.932 | 0.011 | 1.598 | 7.105 | -2.606 | 1,70 | F-B1 OGNVRV |

# APPENDIX 4

## PUMPING TEST DATA

HAMBURG 82 HO

G34310 Pumped borehole

Start 0700, 11/11/1981 Shutdown 1700, 11/11/1981

R.W.L. 2,673 m Pump intake 22 m Pumping period 600 min.

| Step | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Av. Q 1/s | 4,29 | 8,40 | 9,87 | 13,31 | 16,84 | 14,54 |
| Mins. elapsed from start of step | | Drawdown (m) | | | | |
| 1 | 1,547 | 5,177 | 7,197 | 10,322 | 14,229 | 14,477 |
| 2 | 1,749 | 5,382 | 7,277 | 10,702 | 14,373 | - |
| 3 | 1,851 | 5,489 | 7,297 | - | 14,523 | - |
| 4 | 1,930 | 5,577 | 7,297 | 11,002 | 14,839 | 15,057 |
| 5 | 1,977 | 5,597 | 7,322 | 11,060 | 15,027 | 15,127 |
| 6 | 2,019 | 5,656 | 7,387 | 11,112 | 15,207 | - |
| 7 | 2,049 | 5,693 | 7,427 | 11,182 | - | - |
| 8 | 2,068 | 5,757 | 7,513 | 11,222 | 15,182 | - |
| 9 | 2,078 | 5,769 | 7,490 | 11,247 | 16,102 | - |
| 10 | 2,099 | 5,822 | 7,444 | 11,280 | | 14,987 |
| 12 | 2,116 | 5,980 | 7,577 | 11,299 | | 14,982 |
| 14 | 2,145 | 6,038 | 7,705 | 11,337 | | 14,967 |
| 16 | 2,169 | 6,074 | 7,769 | 11,355 | Turbulence | 14,885 |
| 18 | 2,537 | 5,922 | 7,807 | 11,400 | too high | 14,942 |
| 20 | 2,593 | 6,130 | 7,797 | 11,439 | for | 14,982 |
| 25 | 2,667 | 6,065 | 7,777 | 11,499 | readings | 15,022 |
| 30 | 2,705 | 6,083 | 7,842 | 11,590 | | 15,017 |
| 35 | 2,730 | 6,075 | 7,832 | 11,612 | | 15,027 |
| 40 | 2,764 | 6,100 | 7,947 | 11,654 | | 15,037 |
| 45 | 2,779 | 6,248 | 7,995 | 11,667 | | 15,027 |
| 50 | 2,799 | 6,387 | 8,032 | 11,752 | | 15,067 |
| 55 | 2,824 | 6,277 | 8,030 | 11,764 | | 15,100 |
| 60 | 2,864 | 6,257 | 7,970 | 11,810 | | 15,090 |
| 70 | 2,877 | 6,214 | 8,001 | 11,842 | 17,540 | 14,860 |
| 80 | 2,875 | 6,317 | 7,757 | 11,902 | - | 14,930 |
| 90 | 2,896 | 6,467 | 7,675 | 11,962 | - | - |
| 100 | 2,930 | 5,981 | 7,517 | 11,980 | 17,800 | 14,860 |

G34310 - Measurements of discharge rates and water quality

| Time since start of pumping (min) | Discharge rate (1/s) | pH | T.D.S. mg/1 @ 25°C |
|---|---|---|---|
| 22 | 4,34 | 7,1 | 220 |
| 48 | 4,26 | | |
| 85 | 4,26 | | 219 |
| 122 | 8,35 | | |
| 148 | 8,41 | 6,9 | 221 |
| 175 | 8,31 | | |
| 193 | 8,51 | | |
| 220 | 10,00 | | |
| 242 | 10,00 | 6,9 | 221 |
| 285 | 9,60 | | |
| 322 | 13,33 | | |
| 352 | 13,33 | 7,05 | 230 |
| 392 | 13,26 | | |
| 425 | 16,74 | | |
| 450 | 17,14 | 7,05 | 230 |
| 475 | 16,74 | | |
| 495 | 16,74 | | |
| 522 | 14,57 | | |
| 547 | 14,46 | 6,90 | 225 |
| 575 | 14,55 | | |
| 595 | 14,57 | | |

Well head water temperature is 20,5 to 21,5°C

HAMBURG 82 HO

G34310 Pumped borehole, G34311 + G34312 Observation boreholes

Start 0900, 17/11/1981 Shutdown 0755, 22/11/81. Pumping period 7 135 min.
Pump intake 17,7 m

| | G34310 | | G34311 | G34312 |
|---|---|---|---|---|
| | R.W.L 2,680 m | | R.W.L 2,996 m | R.W.L 2,865 m |
| | | | r = 30 m | r = 30 m |
| Time elapsed since pumping started, t (min.) | s (m) | corrected drawdown s'(m) | s (m) | s (m) |
| 2 | – | | no change | 0,460 |
| 3 | 8,840 | 5,66 | " | – |
| 4 | 9,167 | 5,87 | " | 1,452 |
| 5 | 9,402 | 6,02 | " | – |
| 6 | 9,582 | 6,13 | " | 1,944 |
| 7 | 9,707 | 6,21 | " | – |
| 8 | 9,802 | 6,27 | " | 2,095 |
| 9 | 9,903 | 6,34 | " | – |
| 10 | 9,982 | 6,39 | " | 2,195 |
| 12 | 10,145 | 6,49 | 0,002 | 2,375 (13 min) |
| 15 | 10,300 | 6,59 | 0,005 | 2,400 |
| 20 | 10,452 | 6,69 | 0,015 | 2,605 |
| 25 | – | 6,83 | 0,033 | 2,805 (28) |
| 30 | 10,676 | 6,83 | 0,046 | 2,975 (36) |
| 40 | 10,875 | 6,96 | 0,078 | 3,065 (43) |
| 50 | 10,984 | 7,03 | 0,120 | 3,160 |
| 60 | 11,100 | 7,10 | 0,157 | 3,235 (58) |
| 70 | 11,195 | 7,16 | 0,191 | 3,305 (65) |
| 80 | 11,240 | 7,19 | 0,239 | 3,420 |
| 90 | – | – | 0,281 | 3,465 (88) |
| 100 | 11,440 | 7,32 | 0,318 | 3,495 |

| Time elapsed since pumping started, t (min.) | G34310 R.W.L 2,680 m s (m) | corrected drawdown s'(m) | G34311 R.W.L 2,996 m r = 30 m s (m) | G34312 R.W.L 2,865 m r = 30 m s (m) |
|---|---|---|---|---|
| 120 | 11,568 | 7,40 | 0,420 | 3,597 |
| 150 | 11,708 | 7,49 | 0,554 | 3,715 |
| 180 | - | - | 0,670 | 3,805 |
| 200 | 11,90 | 7,64 | - | - |
| 220 | - | - | 0,838 | 3,920 |
| 260(250) | 12,086 | 7,74 | 0,960 | 4,010 |
| 300 | 12,295 | 7,87 | 1,097 | 4,075 |
| 350 | - | - | 1,255 | 4,145 |
| 400 | 12,440 | 7,96 | 1,385 | 4,215 |
| 450 | - | - | 1,499 | 4,285 |
| 500 | 12,655 | 8,10 | 1,604 | 4,390 |
| 600 | 12,775 | 8,18 | 1,766 | 4,480 |
| 700 | 12,890 | 8,25 | 1,886 | 4,530 |
| 800 | 13,040 | 8,35 | 1,976 | 4,620 |
| 900 | 13,125 | 8,40 | 2,017 | 4,670 |
| 1 000 | - | - | 2,057 | 4,705 |
| 1 200 | 13,250 | 8,48 | 2,134 | 4,805 |
| 1 500 | 13,473 | 8,62 | 2,219 | 4,975 |
| 1 800 | 13,698 | 8,77 | 2,258 | 5,110 |
| 2 200 (2 400) | 13,892 | 8,89 | 2,310 | 5,215 |
| 2 600 (2 730) | 14,160 | 9,06 | 2,340 | 5,255 |
| 3 000 | 14,303 | 9,15 | 2,382 | 5,355 |
| 3 500 (3 400) | 14,395 | 9,21 | 2,419 | 5,422 |
| 4 000 (4 200) | 14,805 | 9,48 | 2,464 | 5,612 |
| 4 500 | - | - | 2,476 | 5,671 |
| 5 000 | 14,420 | 9,23 | 2,511 | 5,641 |
| 6 000 | 14,300 | 9,15 | 2,531 | 5,701 |
| 6 500 (6300) | 14,120 | 9,04 | 2,546 | 5,696 |
| 7 000 | - | - | 2,556 | 5,396 |
| 7 135 | 13,320 | 8,52 | 2,577 | 5,290 |

G34310 - Discharge and water quality measurements

| t (min) | Q l/sec | pH | T.D.S. mg/l @ 25°C |
|---|---|---|---|
| 65 | 13,14 | | |
| 240 | 13,04 | | |
| 370 | 12,97 | 6,90 | 235 |
| 485 | 12,97 | 7,05 | 232 |
| 660 | 12,90 | | |
| 1 260 | 12,74 | 7,15 | 217 |
| 1 515 | 12,81 | | |
| 1 910 | 12,74 | 6,95 | 224 |
| 2 220 | 12,67 | | |
| 2 700 | 12,77 | 7,05 | 221 |
| 3 170 | 12,67 | 7,00 | 228 |
| 3 465 | 12,67 | 6,90 | 221 |
| 4 160 | 12,59 | | |
| 4 320 | 12,63 | 7,10 | 221 |
| 4 680 | 12,63 | | |
| 4 990 | 12,54 | 7,10 | 226 |
| 5 610 | 12,41 | | 220 |
| 5 990 | 12,31 | | |
| 6 120 | 12,24 | | |
| 6 315 | 12,20 | | 219 |
| 7 080 | 10,91* | | |

*pump cylinder screen partially blocked

Mean discharge 12,65 l sec, 1 093 $m^3/d$

Well head water temperature 19 to 21°C

Observation boreholes

| G34313 | | Hg 1 | | Hg 2 | |
|---|---|---|---|---|---|
| R.W.L. 3,610 m | | R.W.L. 7,935 m | | R.W.L. 4,415 m | |
| r = 480 m | | r = 315 m | | r = 118 m | |
| t (min) | s (m) | t (min) | s (m) | t (min) | s (m) |
| 1 295 | 0,005 | 26 | 0,005 | 17 | |
| 2 700 | + 0,025 | 108 | 0,013 | to | fluctuation |
| 4 200 | 0,047 | 158 | 0,010 | 7 135 | of 0,005 m - |
| 5 640 | 0,072 | 210 | 0,035 | | no response |
| 7 135 | 0,055 | 260 | 0,013 | | to pumping |
| | | 307 | 0,020 | | of G34310 |
| | No clear | 410 | 0,023 | | |
| | response | 510 | 0,025 | | |
| | to pumping | 590 | 0,038 | | |
| | of G34310 | 710 | 0,050 | | |
| | | 820 | 0,065 | | |
| | | 905 | 0,055 | | |
| | | 1 195 | 0,040 | | |
| | | 1 510 | 0,060 | | |
| | | 1 810 | 0,040 | | |
| | | 2 740 | 0,060 | | |
| | | 3 005 | 0,060 | | |
| | | 3 410 | 0,060 | | |
| | | 4 190 | 0,085 | | |
| | | 4 410 | 0,088 | | |
| | | 4 840 | 0,070 | | |

Recovery measurements

| t' (min) | t/t' | G34310 R.W.L. 2,680 m F.D.P.W.L. 16,000 m s' (m) | Recovery from F.D.P.W.L. (m) | G34311 R.W.L. 2,996 m F.D.P.W.L. 5,573 s' (m) | Recovery from F.D.P.W.L. (m) | G34312 R.W.L. 2,865 m F.D.P.W.L. 8,155 s' (m) | Recovery from F.D.P.W.L. (m) |
|---|---|---|---|---|---|---|---|
| 5 | 1 428 | 8,835 | 7,165 | 2,566 | 0,007 | 3,910 | 4,245 |
| 7 | 1 020 | probe jammed | | 2,566 | 0,007 | 3,690 | 4,465 |
| 10 | 715 | - | - | 2,566 | 0,007 | 3,490 | 4,665 |
| 15 | 477 | - | | 2,566 | 0,007 | 3,330 | 4,825 |
| 25 | 286 | - | | 2,566 | 0,007 | 3,205 | 4,950 |
| 35 | 204 | - | | not measurable | | 3,020 | 5,135 |
| 45 | 160 | - | | no change | | 2,900 | 5,255 |
| 60 | 120 | - | | no change | | 2,885 | 5,270 |
| 71,4 | 101 | - | | no change | | 2,885 | 5,270 |
| 80 | 90 | - | | no change | | 2,885 | 5,270 |
| 90 | 80 | - | | no change | | 2,820 | 5,335 |
| 103 | 70 | - | | no change | | 2,710 | 5,445 |
| 121 | 60 | - | | no change | | 2,635 | 5,520 |
| 146 | 50 | - | | no change | | 2,510 | 5,645 |
| 161 | 45 | 2,315 | 13,685 | no change | | 2,460 | 5,695 |
| 182 | 40 | 2,230 | 13,770 | no change | | 2,382 | 5,773 |
| 210 | 35 | 2,145 | 13,855 | no change | | 2,287 | 5,868 |
| 245 | 30 | 2,055 | 13,945 | no change | | 2,192 | 5,963 |
| 285 | 26 | 1,970 | 14,030 | no change | | 2,112 | 6,043 |
| 340 | 22 | 1,865 | 14,135 | no change | | 1,747 | 6,408 |
| 418 | 18 | 1,745 | 14,255 | 2,545 | 3,028 | 1,627 | 6,528 |
| 510 | 15 | 1,645 | 14,355 | 2,471 | 3,102 | 1,527 | 6,628 |
| 600 | 12,9 | 1,580 | 14,420 | 2,396 | 3,177 | 1,457 | 6,698 |
| 700 | 11,2 | 1,490 | 14,510 | 2,246 | 3,327 | 1,372 | 6,783 |
| 800 | 9,9 | 1,425 | 14,575 | 2,181 | 3,392 | 1,312 | 6,843 |
| 900 | 8,9 | 1,370 | 14,630 | 2,091 | 3,482 | 1,262 | 6,893 |
| 1 000 | 8,1 | 1,315 | 14,685 | 2,021 | 3,552 | 1,207 | 6,948 |
| 1 200 | 6,95 | 1,230 | 14,770 | 1,796 | 3,777 | 1,127 | 7,028 |
| 1 500 | 5,8 | 1,195 | 14,805 | 1,528 | 4,045 | 1,047 | 7,108 |
| 1 800 | 4,96 | 1,058 | 14,942 | 1,329 | 4,244 | 0,923 | 7,232 |
| 2 200 | 4,24 | 0,993 | 15,007 | 1,148 | 4,425 | 0,853 | 7,302 |
| 2 600 | 3,74 | 0,918 | 15,082 | 1,017 | 4,556 | 0,808 | 7,347 |
| 3 000 | 3,4 | 0,857 | 15,143 | 0,937 | 4,636 | 0,800 | 7,355 |
| 4 000 | 2,8 | 0,747 | 15,253 | 0,794 | 4,779 | 0,707 | 7,448 |
| 5 000 | 2,4 | - | - | 0,707 | 4,866 | 0,642 | 7,513 |
| 5 800 | 2,23 | 0,592 | 15,408 | 0,584 | 4,989 | 0,552 | 7,603 |

PALACHOEMA 64 HO

Pa 1 (B/no 136769/1) Pumping borehole
Pa 2 (B/no 136770/6) Observation borehole
Start 0705, 04/11/1981 Shutdown 0705, 05/11/1981
Rest water levels: Pa 1 - 4,512 m; Pa 2 - 4,625 m
Pump intake 35 m Pumping period 1 440 min, r = 71,5 m

Discharge and water quality measurements - Pa 1

| Time since pumping started, t (min) | Discharge rate (l/s) | T.D.S. mg/l @ 25°C |
|---|---|---|
| 17 | 12,87 | 235 |
| 40 | 12,87 | |
| 62 | 12,87 | |
| 110 | 12,75 | 235 |
| 140 | 12,87 | |
| 197 | 12,87 | |
| 265 | 12,87 | 232 |
| 315 | 12,87 | 234 |
| 375 | 12,64 | 237 |
| 435 | 12,64 | 234 |
| 545 | 12,64 | 238 |
| 625 | 12,64 | 234 |
| 685 | 12,64 | 239 |
| 775 | 12,64 | 232 |
| 1 335 | 12,64 | 240 |
| 1 425 | 12,64 | 237 |

Well head water temperature is 19,2 to 21°C
Mean discharge 12,69 l/s - 1 110 $m^3$/d
No water level measurements could be made in Pa 1

Pa 2 - Drawdown data

| t (min) | drawdown (s) (m) | t (min) | s (m) |
|---|---|---|---|
| 7 | 0,002 | 200 | 0,955 |
| 8 | 0,012 | 250 | 1,030 |
| 10 | 0,037 | 300 | 1,103 |
| 12 | 0,068 | 350 | 1,180 |
| 15 | 0,120 | 405 | 1,225 |
| 22 | 0,229 | 450 | 1,287 |
| 30 | 0,333 | 550 | 1,367 |
| 40 | 0,438 | 600 | 1,407 |
| 50 | 0,518 | 700 | 1,487 |
| 60 | 0,578 | 800 | 1,558 |
| 70 | 0,628 | 1 000 | 1,684 |
| 80 | 0,671 | 1 200 | 1,799 |
| 90 | 0,707 | 1 440 | 1,910 |
| 100 | 0,747 | | |
| 120 | 0,801 | | |
| 135 | 0,845 | | |
| 170 | 0,927 | | |

Recovery measurements

| t' (min) | t/t' | Pa 1<br>R.W.L. 4,512 m<br>F.D.P.W.L. not measurable<br>s' (m) | Pa 2<br>R.W.L. 4,625 m<br>F.D.P.W.L. 6,535 m<br>s' (m) | Recovery from F.D.P.W.L. (m) |
|---|---|---|---|---|
| 20 | 73 | 3,198 | 1,795 | 0,115 |
| 30 | 49 | 2,822 | 1,675 | 0,235 |
| 40 | 37 | 2,627 | 1,585 | 0,325 |
| 50 | 29,8 | 2,469 | 1,535 | 0,375 |
| 60 | 25 | - | 1,485 | 0,425 |
| 70 | 21,6 | - | 1,440 | 0,470 |
| 80 | 19 | - | 1,395 | 0,515 |
| 100 | 15,4 | 2,013 | 1,345 | 0,565 |
| 120 | 13 | - | 1,295 | 0,615 |
| 130 | 12,1 | 1,771 | - | - |
| 150 | 10,6 | - | 1,255 | 0,655 |
| 170 | 9,5 | 1,683 | - | - |
| 200 | 8,2 | 1,590 | 1,180 | 0,730 |
| 250 | 6,8 | 1,483 | 1,106 | 0,804 |
| 300 | 5,8 | 1,350 | 1,075 | 0,835 |
| 400 | 4,6 | - | 0,965 | 0,945 |
| 450 | 4,2 | 1,126 | 0,900 | 1,010 |
| 500 | 3,9 | 1,145 | 0,833 | 1,077 |
| 600 | 3,4 | 1,055 | 0,815 | 1,095 |
| 700 | 3,06 | 1,165 | 0,765 | 1,145 |
| 800 | 2,8 | 0,930 | 0,718 | 1,192 |
| 1 000 | 2,44 | 0,830 | 0,640 | 1,270 |
| 1 200 | 2,2 | 0,745 | 0,580 | 1,330 |
| 1 500 | 1,96 | 0,665 | 0,508 | 1,402 |
| 2 000 | 1,72 | 0,520 | 0,422 | 1,488 |
| 2 500 | 1,58 | 0,500 | 0,387 | 1,523 |
| 2 800 | 1,51 | 0,415 | 0,347 | 1,563 |
| 3 500 | 1,41 | 0,333 | 0,345 | 1,565 |
| 4 000 | 1,36 | 0,328 | 0,295 | 1,615 |
| 4 500 | 1,32 | 0,303 | 0,255 | 1,655 |

## SCHWEIZER-RENEKE TOWNLANDS 62 HO

G34315 Pumped borehole

25/11/1981 Phase 1 Start 0825 Shutdown 1125 Pumping period 180 min.
Phase 2 Start 1450 Shutdown 1720 Pumping period 150 min.
R.W.L. prior to Phase 1: 6,282 m, R.W.L. prior to Phase 2 6,550 m.
Pump intake at 64 m. Cascading water entering at 16 m made water level measurements taken during pumping unreliable.

### DISCHARGE MEASUREMENTS

| Phase 1 Time since pumping started (min) | Discharge (l/s) | Phase 2 t (min) | Discharge (l/s) |
|---|---|---|---|
| 12 | 6,02 | 5 | 7,13 |
| 30 | 5,95 | 15 | 6,21 |
| 50 | 5,85 | 35 | 6,05 |
| 70 | 5,81 | 65 | 5,90 |
| 100 | 5,71 | 95 | 5,45* |
| 125 | 5,58 | 135 | 5,37 |
| 165 | 5,54 | 148 | 5,29 |

* engine revs decreased

Recovery measurements

| Phase 1 Residual drawdown s" (m) | t/t' | Time since pumping stopped t' (min) | Phase 2 t/t' | | s' (m) |
|---|---|---|---|---|---|
| 5,833 | 91 | 2 | 76 | | 4,053 |
| 3,913 | 61 | 3 | 51 | | 2,940 |
| 2,883 | 46 | 4 | 38,5 | | 2,392 |
| 2,368 | 37 | 5 | | | - |
| 2,028 | 31 | 6 | 26,4 | | 1,702 |
| 1,843 | 26,7 | 7 | 22,4 | | 1,552 |
| 1,723 | 23,5 | 8 | 19,8 | | 1,447 |
| - | - | 9 | 17,7 | | 1,365 |
| 1,558 | 19 | 10 | 16 | | 1,300 |
| 1,453 | 16 | 12 | 13,5 | | 1,193 |
| 1,333 | 13 | 15 | 11 | | 1,077 |
| 1,193 | 10 | 20 | 8,5 | | 0,955 |
| - | - | 25 | 7 | | 0,848 |
| 0,986 | 7 | 30 | 6 | | 0,771 |
| 0,853 | 5,5 | 40 | 4,8 | | 0,650 |
| 0,758 | 4,6 | 50 | 4 | | 0,555 |
| 0,688 | 4 | 60 | 3,5 | | 0,485 |
| 0,623 | 3,6 | 70 | 3,14 | | 0,425 |
| 0,578 | 3,25 | 80 | 2,9 | | 0,397 |
| 0,533 | 3 | 90 | 2,7 | | 0,337 |
| 0,498 | 2,8 | 100 | 2,5 | | 0,303 |
| - | - | 110 | 2,36 | | 0,280 |
| - | - | 120 | 2,25 | | 0,250 |
| 0,420 | 2,4 | 127 | - | | - |
| 0,356 | 2,2 | 150 | 2 | | 0,182 |
| 0,298 | 2 | 180 | 1,8 | | 0,142 |
| 0,268 | 1,9 | 205 | - | | - |
| - | - | 840 | 1,18 | (+) | 0,090 |

MARAETCHESFONTEIN 54 HO

G34307 Pumped borehole

Phase 1 Start 1 000, 27/10/1981 Shutdown 1 800, 27/10/1981

R.W.L. 7,80 m Pump intake 62 m Pumping period 480 min.

| G34307 | Drawdown | | Recovery | |
|---|---|---|---|---|
| | | F.D.P.W.L. = 19,99 m | | |
| t (min) | s (m) | t' (min) | s' (m) | s-s' (from F.D.P.W.L.) (m) |
| 0,1 | 2,14 | 1 | 9,33 | 10,66 |
| 0,12 | 2,45 | 2 | 9,03 | 10,96 |
| 0,15 | 3,14 | 3 | 8,80 | 11,19 |
| 0,2 | 3,60 | 4 | 8,57 | 11,42 |
| 0,3 | 4,74 | 5 | 8,42 | 11,57 |
| 0,4 | 5,51 | 6 | 8,26 | 11,73 |
| 0,5 | 5,81 | 7 | 8,19 | 11,80 |
| 0,6 | 6,24 | 8 | 8,11 | 11,88 |
| 0,7 | 6,58 | 9 | 8,03 | 11,96 |
| 0,8 | 6,73 | 10 | 7,93 | 12,06 |
| 0,9 | 6,98 | 12 | 7,76 | 12,23 |
| 1,0 | 7,16 | 15 | 7,54 | 12,45 |
| 1,2 | 7,04 | 20 | 7,34 | 12,65 |
| 1,5 | 7,04 | 25 | 6,96 | 13,03 |
| 1,8 | 7,42 | 30 | 6,81 | 13,18 |
| 2,2 | 8,11 | 40 | 6,43 | 13,56 |
| 2,6 | 8,42 | 50 | 6,04 | 13,95 |
| 3,0 | 9,18 | 60 | 5,78 | 14,21 |
| 3,5 | 9,82 | 70 | 5,51 | 14,48 |
| 4,0 | 10,25 | 80 | 5,32 | 14,67 |
| 4,5 | 10,40 | 90 | 5,05 | 14,94 |
| 5,0 | 10,63 | 100 | 4,90 | 15,09 |
| 6,0 | 10,86 | 120 | 4,59 | 15,40 |
| 7,0 | 10,99 | 150 | 4,13 | 15,86 |
| 8,0 | 11,02 | 180 | 3,83 | 16,16 |

G34307 Drawdown Recovery

F.D.P.W.L. = 19,99 m

| t (min) | s (m) | t' (min) | s' (m) | s-s' (from F.D.P.W.L.) (m) |
|---|---|---|---|---|
| 9,0 | 11,09 | 220 | 3,44 | 16,55 |
| 10 | 11,25 | 260 | 3,06 | 16,93 |
| 12 | 11,35 | 300 | 2,75 | 17,24 |
| 15 | 11,55 | 350 | 2,48 | 17,51 |
| 18 | 11,66 | 400 | 2,30 | 17,69 |
| 22 | 11,84 | 480 | 1,99 | 18,00 |
| 26 | 11,74 | 600 | 1,65 | 18,34 |
| 30 | 11,93 | 700 | 1,38 | 18,61 |
| 35 | 12,47* | 833 | 1,07 | 18,92 |
| 40 | 12,70 | | | |
| 45 | 12,82 | | | |
| 50 | 12,93 | | | |
| 60 | 13,01 | | | |
| 70 | 13,16 | | | |
| 80 | 13,39 | | | |
| 100 | 13,62 | | | |
| 120 | 13,92 | | | |
| 150 | 14,15 | | | |
| 180 | 14,31 | | | |
| 220 | 14,46 | | | |
| 260 | 18,05** | | | |
| 300 | 18,97 | | | |
| 350 | 19,05 | | | |
| 400 | 19,35 | | | |
| 480 | 19,99 | | | |

Discharge measurements

| t (min) | Q 1/s |
|---|---|
| 15 | 6,89 |
| 45 | 7,27 |
| 80 | 7,06 |
| 120 | 6,67 |
| 180 | 6,49 |
| 240 | 6,37 |
| 300 | 7,50 |
| 360 | 7,58 |
| 450 | 7,42 |

Av Q = 7 1/s

Water quality 465 mg/1 (at 25°C)

T°C = 21° to 23°

* increase in Q

** pump adjusted

MARAETCHESFONTEIN 54 HO

G34307 Pumped borehole

G34307 - Recovery

G34309 - Observation borehole

R.W.L. 8,018 m

F.D.P.W.L. 15,128 m

| Phase 2 "R.W.L." 8,870 m | | Phase 3 "R.W.L." 10,678 m | Phase 2 - drawdown and recovery | | | |
|---|---|---|---|---|---|---|
| s' (m) | t' (min) | s' (m) | s (m) | t and t' (min) | s' (m) | s-s' (m) |
| | 2 | 9,265 | | | | |
| | 3 | 8,683 | 0,25 | 5 | 6,96 | 0,15 |
| | 4 | 8,149 | 0,51 | 10 | 6,91 | 0,20 |
| | 5 | 7,952 | 0,89 | 15 | 6,83 | 0,28 |
| | 6 | 7,570 | 1,11 | 20 | 6,73 | 0,38 |
| | 7,5 | 7,079 | 1,39 | 25 | 6,61 | 0,50 |
| | 10 | 6,827 | 1,56 | 30 | 6,51 | 0,60 |
| | 13 | 6,283 | 1,69 | 35 | 6,36 | 0,75 |
| | 15 | 6,154 | 1,80 | 40 | 6,26 | 0,85 |
| 13,000 | 20 | 5,869 | 1,90 | 45 | 6,15 | 0,96 |
| 12,550 | 25 | - | 2,01 | 50 | 6,06 | 1,05 |
| 12,135 | 30 | 5,207 | 2,25 | 60 | 5,95 | 1,16 |
| 11,460 | 40 | 4,822 | 2,44 | 70 | 5,73 | 1,38 |
| 10,902 | 50 | 4,309 | 2,65 | 80 | 5,57 | 1,54 |
| 10,750 | 60 | 3,900 | 2,83 | 90 | 5,39 | 1,72 |
| 10,047 | 70 | 3,664 | 3,00 | 100 | 5,23 | 1,88 |
| 9,632 | 80 | 3,410 | 3,26 | 120 | 4,94 | 2,17 |
| 8,942 | 100 | 2,989 | 3,67 | 150 | 4,54 | 2,57 |
| 8,335 | 120 | 2,626 | 4,08 | 180 | 4,10 | 3,01 |
| 7,575 | 150 | 2,179 | 4,53 | 220 | 3,69 | 3,42 |
| 6,600 | 200 | 1,627 | 4,89 | 260 | 3,34 | 3,77 |
| 5,788 | 250 | - | 5,20 | 300 | 3,05 | 4,06 |
| - | 335 | 0,643 | 5,58 | 350 | 2,75 | 4,36 |
| - | 460 | 0,097 | 5,91 | 400 | 2,47 | 4,64 |
| 1,808 | 855 | | 6,18 | 450 | 2,26 | 4,85 |
| | | | 6,49 | 500 | 2,09 | 5,02 |
| | | | 7,11 | 600 | - | - |
| | | | | 660 | 1,49 | 5,62 |

Discharge and water quality measurements

| Phase 2 | | | Phase 3 | |
|---|---|---|---|---|
| t (min.) | Q (1/s) | T.D.S. mg/1 at 25°C | t (min.) | Q (1/s) |
| 20 | 11,8 | | 10 | 15,82 |
| 90 | 11,8 | | 20 | 17,17 |
| 150 | 11,6 | | 27 | 15,82 |
| 220 | 11,43 | | 47 | 12,5 |
| 310 | 11,10 | | 55 | 14,08 |
| 435 | 10,90 | 518 | 73 | 13,71 |
| 460 | 11,60* | | 105 | 12,1 |
| 530 | 11,33 | 474 | 110 | shutdown |
| 540 | 11,42* | | Av. Q = | 14 1/s |
| 580 | 12,30* | | | |
| 600 | shutdown | | | |

Average Q = 11,5 1/s

* pump adjusted

MARAETCHESFONTEIN 54 HO

G34307 Pumped borehole

Phase 1 Start 1 000 27/10/1981 Shutdown 1 800, 27/10/1981

Phase 2 Start 0 830 28/10/1981 Shutdown 1 830, 28/10/1981

Phase 3 Start 0 845 29/10/1981 Shutdown 1 035, 29/10/1981

Pumping periods Phase 1: 480 min. Phase 2: 600 min Phase 3: 110 min.

G34308 - Observation b.h.

R.W.L. = 7,418 m r = 230 m

G34309 - Observation b.h.

R.W.L. - 7,048 m F.D.P.W.L. 14,158 m

r = 243 m

| Continuous time from start of Phase 1 (min) | Drawdown (s) (m) | Phase 1: Drawdown and recovery t (min) | s (m) | t' (min) | s' (m) | s-s' (m) |
|---|---|---|---|---|---|---|
| 5 - 180 | rise in W.L. by | 5 | 0,20 | | 4,21 | 0,11 |
| | 0,005 m | 10 | 0,40 | | 4,02 | 0,30 |
| 220 | 0,002 | 15 | 0,60 | | 3,92 | 0,40 |
| 260 | 0,005 | 20 | 0,72 | as | 3,80 | 0,52 |
| 300 | 0,010 | 25 | 0,83 | for | 3,70 | 0,62 |
| 350 | 0,020 | 30 | 0,93 | column | 3,61 | 0,71 |
| 400 | 0,040 | 35 | 1,03 | t | 3,54 | 0,78 |
| 480 | 0,070 | 40 | 1,12 | | 3,48 | 0,84 |
| 490 | 0,075 | 45 | 1,19 | | 3,41 | 0,91 |
| 520 | 0,085 | 50 | 1,25 | | 3,34 | 0,98 |
| 540 | 0,092 | 60 | 1,37 | | 3,24 | 1,08 |
| 570 | 0,100 | 70 | 1,49 | | 3,15 | 1,17 |
| 610 | 0,112 | 80 | 1,61 | | 3,04 | 1,28 |
| 650 | 0,125 | 90 | 1,71 | | 2,97 | 1,35 |
| 690 | 0,130 | 100 | 1,80 | | 2,91 | 1,41 |
| 740 | 0,135 | 120 | 1,97 | | 2,76 | 1,56 |
| 790 | 0,145 | 150 | 2,18 | | 2,54 | 1,78 |
| 880 | 0,145 | 180 | 2,38 | | 2,39 | 1,93 |
| 980 | 0,145 | 220 | 2,63 | | 2,22 | 2,10 |
| 1 080 | 0,145 | 260 | 2,98 | | 2,06 | 2,26 |

G34308 - Observation b.h.
R.W.L. = 7,418 m   r = 230 m

G34309 - Observation b.h.
R.W.L. - 7,048 m   F.D.P.W.L. 14,158 m
r = 243 m

| Continuous time from start of Phase 1 (min) | Drawdown (s) (m) | Phase 1: Drawdown and recovery t (min) | s (m) | t' (min) | s' (m) | s-s' (m) |
|---|---|---|---|---|---|---|
| 1 180 | 0,150 | 300 | 3,29 | | 1,91 | 2,41 |
| 1 340 | 0,178 | 350 | 3,60 | | 1,76 | 2,56 |
| 1 500 | 0,185 | 400 | 3,90 | | 1,65 | 2,67 |
| 1 650 | 0,218 | 480 | 4,32 | | 1,47 | 2,85 |
| 1 800 | 0,238 | | | 600 | 1,26 | 3,06 |
| 1 900 | 0,253 | | | 700 | 1,14 | 3,18 |
| 2 000 | 0,313 | | | 830 | 0,97 | 3,35 |
| 2 200 | 0,353 | | | | | |
| 2 400 | 0,360 | | | | | |
| 2 600 | 0,366 | | | | | |
| 2 875 | 0,412 | | | | | |
| 3 000 | 0,427 | | | | | |
| 3 200 | 0,430 | | | | | |
| 3 400 | 0,422 | | | | | |
| 3 600 | 0,427 | | | | | |
| 3 800 | 0,437 | | | | | |
| 4 000 | 0,437 | | | | | |
| 4 330 | 0,434 | | | | | |

N.B Phase 2 pumping 1 350 to 1 950 min.
Phase 3 pumping 2 895 to 3 005 min.

MARAETCHESFONTEIN 54 HO

G34307 Pumped borehole

Phase 4 Start 0 706, 01/12/1981 Shutdown 0 906, 03/12/1981

Pump intake 64 m Pumping period 3 000 min.

G34307 - Recovery

R.W.L. 7,795 m

| t' (min) | s' (m) | t' (min) | s' (m) |
|---|---|---|---|
| 329 | 14,360 | | |
| 1 368 | 6,120 | 4 000 | 1,980 |
| 1 700 | 5,060 | 5 000 | 1,480 |
| 2 000 | 4,350 | 6 000 | 1,140 |
| 2 500 | 3,460 | 7 000 | 0,860 |
| 3 000 | 2,815 | 7 680 | 0,630 |

Discharge and water quality measurements

| t (min) | Q (1/s) | pH | T.D.S. mg/1 @ 25°C | t (min) | Q 1/s | pH | T.D.S. mg/1 @ 25°C |
|---|---|---|---|---|---|---|---|
| 35 | 15,29 | | | 1 494 | 11,39 | | |
| 64 | 14,94 | | | 1 554 | 11,34 | | |
| 124 | 14,37 | 7,2 | 464 | 1 614 | 11,43 | | |
| 184 | 14,06 | | | 1 674 | 11,43 | | |
| 244 | 13,64 | | | 1 734 | 11,34 | | 476 |
| 304 | 13,33 | | | 1 854 | 11,25 | | |
| 364 | 13,31 | | | 1 914 | 11,25 | | |
| 424 | 12,86 | | | 1 974 | 11,16 | | |
| 484 | 12,81 | | | 2 034 | 11,16 | | 488 |
| 534 | 12,86 | | | 2 094 | 11,25 | | |
| 594 | 12,63 | 7,45 | 474 | 2 154 | 11,11 | | |

| t (min) | Q (1/s) | pH | T.D.S. mg/1 @ 25°C | t (min) | Q 1/s | pH | T.D.S. mg/1 @ 25°C |
|---|---|---|---|---|---|---|---|
| 654 | 12,41 | | | 2 814 | 10,91 | | |
| 714 | 12,46 | | | 2 874 | 10,86 | 7,2 | 441 |
| 789 | * | | | 2 904 | 10,91 | | 455 |
| 804 | 12,00 | | | 2 934 | 10,91 | | |
| 1 374 | 11,43 | | | 2 994 | 10,91 | | |
| 1 434 | 11,46 | | | | | | |
| | | | | Av Q = | 11,7 1/s | | |

* Engine revs reduced

G34318 r = 1 250 m
R.W.L. = 5,735 m

No change during pumping of G34307

MARAETCHESFONTEIN 54 HO

G34307 Pumped borehole

Phase 4 Start 0 706, 01/12/1981 Shutdown 0 906, 03/12/1981

Pump intake 64 m Pumping period 3 000 mins.

| G34308 | | G34309 | | | | |
|---|---|---|---|---|---|---|
| R.W.L. = 7,590 m | | R.W.L. = 6,092 m | | F.D.P.W.L. = 21,225 m | | |
| r = 230 m | | r = 243 m | | | | |
| t (min) | s (m) | t (min) | s (m) | t' (min) | s' (m) | s-s' (m) |
| 90 | 0,005 | 3 | 0,180 | 20 | 15,100 | 0,035 |
| 100 | 0,010 | 4 | 0,268 | 25 | 15,095 | 0,040 |
| 120 | 0,015 | 5 | 0,373 | 30 | 15,085 | 0,050 |
| 150 | 0,025 | 6 | 0,500 | 35 | 15,070 | 0,065 |
| 180 | 0,040 | 7 | 0,628 | 40 | 15,055 | 0,080 |
| 220 | 0,060 | 8 | 0,753 | 45 | 15,030 | 0,105 |
| 260 | 0,080 | 9 | 0,863 | 50 | 14,995 | 0,140 |
| 300 | 0,090 | 10 | 0,968 | 60 | 14,940 | 0,195 |
| 350 | 0,105 | 12 | 1,152 | 70 | 14,830 | 0,305 |
| 400 | 0,120 | 15 | 1,455 | 80 | 14,685 | 0,450 |
| 450 | 0,135 | 20 | 1,753 | 90 | 14,590 | 0,545 |
| 500 | 0,145 | 25 | 1,953 | 100 | 14,380 | 0,755 |
| 600 | 0,165 | 30 | 2,203 | 120 | 13,840 | 1,295 |
| 700 | 0,210 | 40 | 2,516 | 150 | 12,500 | 2,635 |
| 800 | 0,255 | 50 | 2,831 | 180 | 10,900 | 4,235 |
| 900 | 0,285 | 60 | 3,128 | 220 | 9,920 | 5,215 |
| 1 000 | 0,315 | 70 | 3,358 | 260 | 9,450 | 5,730 |
| 1 200 | 0,395 | 80 | 3,608 | 300 | 9,130 | 6,005 |
| 1 500 | 0,485 | 90 | 3,828 | 350 | 8,840 | 6,295 |
| 1 800 | 0,545 | 100 | 4,058 | 400 | 8,600 | 6,535 |
| 2 200 | 0,625 | 120 | 4,443 | 450 | 8,300 | 6,835 |
| 2 600 | 0,705 | 150 | 4,973 | 500 | 8,070 | 7,065 |
| 3 000 | 0,800* | 180 | 5,478 | 600 | 7,570 | 7,565 |

G34308

R.W.L. = 7,590 m

r = 230 m

| t (min) | s (m) |
|---|---|
| 3 500 | 0,880 |
| 4 000 | 0,930 |
| 4 300 | 0,945 |
| 4 500 | 0,950 |
| 5 000 | 0,935 |
| 6 000 | 0 910 |
| 7 000 | 0,860 |
| 8 000 | 0,770 |
| 9 000 | 0,700 |
| 10 000 | 0,640 |
| 12 000 | 0,510 |

*pump shutdown

G34309

R.W.L. = 6,092 m F.D.P.W.L. = 21,225 m

r = 243 m

| t (min) | s (m) | t' (min) | s' (m) | s-s' (m) |
|---|---|---|---|---|
| 210 | 5,943 | 700 | 7,030 | 8,085 |
| 240 | 6,328 | 800 | 6,560 | 8,575 |
| 300 | 7,033 | 900 | 6,145 | 8,990 |
| 400 | 7,903 | 1 000 | 5,745 | 9,390 |
| 500 | 8,451 | 1 200 | 5,135 | 10,000 |
| 600 | 9,030 | 1 500 | 4,345 | 10,790 |
| 740 | 9,960 | 1 800 | 3,785 | 11,350 |
| 840 | 10,721 | 2 200 | 3,225 | 11,910 |
| 900 | 13,193 | 2 600 | 2,805 | 12,330 |
| 1 000 | 14,543 | 3 000 | 2,480 | 12,655 |
| 1 200 | 15,943 | 3 500 | 2,125 | 13,010 |
| 1 350 | 16,310 | 4 000 | 1,880 | 13,255 |
| 1 500 | 16,621 | 4 500 | 1 665 | 13,470 |
| 1 680 | 16,948 | 5 000 | 1,510 | 13,625 |
| 1 800 | 17,098 | 6 000 | 1,195 | 13,940 |
| 2 100 | 16,810 | 7 000 | 1,005 | 14,130 |
| 2 400 | 15,723 | 8 000 | 0,860 | 14,275 |
| 3 000 | 15,135 | 9 000 | 0,680 | 14,455 |