GH 3277

A GEOHYDROLOGICAL INVESTIGATION IN THE LICHTENBURG AREA, BO-MOLOPO SUBTERRANEAN WATER CONTROL AREA.

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ABSTRACT

The dyke intruded, chert-rich dolomitic aquifer of the Lichtenburg area is extensively karstified. Zones of high transmissivity are associated with preferential solution along linear structures. Various dykes have partly compartmentalising effects, namely the Blaauwbaik, Elizabeth, Greeffslaagte, Hendriksdal and Paarl. Dykes are of diabase and are deeply weathered to depths in excess of 40 m. The southern extent of the dolomite has been investigated by exploration drilling.

Ground water balance calculations for a 340 km^2 area indicate : a gross rainfall recharge of 28% (9,5 % net, excluding evapotranspiration losses) of the mean annual rainfall of 612mm and a specific yield of 3%. Aquifer conditions within the dolomite are unconfined, locally varying to semi-unconfined and semi-confined under a thick cover of Karoo clays and mudstone. Transmissivity values within the dolomite have not been calculated. Pumping tests indicate that a transmissivity values for the Hendriksdal dyke is approximately 0,1 m^2/d and for other dykes of the order of 1m^2/d. A transmissivity value of some 0,4 m^2/d was calculated for the dolomite and lava formation under a cover of Karoo clay and recent calcrete.

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Field maps and raw data is collected in G.H.P. envelope no 666.

1. INDRODUCTION

Due to the paramount importance of ground water in the Bo-Molopo region for muncipal, industrial and agricultural water requirements the Bo-Molopo region was proclaimed a subterranean water control area (S.W.C.A.) in Government notice R1325 of the 30th August 1963. Administration and control on the useage and further development of ground water resources within the Bo-Molopo S.W.C.A. was assigned to the Directorate of Water Affairs.

The south-east sector of the Bo-Molopo S.W.C.A. was studied during this investigation and the primary objectives were :

- to prepare a regional ground water balance budget, with a view to
- ascertain whether or not scope for increased ground water development is available.

Secondary objectives were :

- to comment on the ground water supply available to Lichtenburg Municipality, and
- to comment on whether or not the continuation of Government control was necessary to safe-guard interests of primary ground water consumers

In order to fulfill the aims of the investigation it was necessary to collate, appraise and bring up to date all pertinent geological, geohydrological and geophysical information and to expand the existing data base by field investigations which included the drilling of exploration boreholes.

1.1 LOCATION OF STUDY AREA

The investigated area covers some 500 km^2 and extends east-west between the towns of Lichtenburg in the south and Bakerville in the north. The total area studied is between the lines of latitude 26^{o} 12S and 26^{o} 57'S and within the lines of longitude 25^{o} 59'E and 26^{o} 17'E. Map coverage is provided by the 1:50 000 topo-cadastral sheets : 2525DD Rooigronde; 2526CC Bakerville; 2526CD Lead Mine; 2625BB Itsoseng; 2626AA Lichtenburg and 2626 AB Twee Buffels. Farms surveyed are listed alphabetically in Appendix 1.

1.2 PREVIOUS WORK

Results of early geological mapping by the Geological Survey are published in the 1:250 000 geological map series; Zeerust, Sheet 5, (Hall et al 1910) and Lichtenburg, Sheet 54. (Von Backström et al 1952). The study area was completely remapped by Davies and Prévost (1978) and provisional maps at a scale of 1:50 000 have been compiled. Utilisation of remote sensing techniques during remapping enabled the dolomitic rock to be sub-divided and additional dykes and linear structural features to be identified. The results of the remapping north of latitude 26^{o}s have since been incorporated into the 2526 Rustenburg sheet (1981) of the 1:250 000 series geological maps.

Ground geophysical work in the area has been directed at :

- locating dyke positions,
- the relative age relationship between dykes, and
- unworked deposits of potentially diamondiferous gravels.

The Geophysics Division of the Geological Survey has been active in the study area with mainly gravity, ground magnetic and electromagnetic surveys (Darracott 1973, Day : 1976(b) + (c), 1977 (a), (b) + (c), 1979 (a) and 1980, De Wit 1978, Richards et al 1973 and Stettler 1979). Numerous magnetic surveys have also been carried out by the Department of Environment Affairs e.g.

Wessels 1974, Cogho 1982. Between 1979 and 1982 gravity and magnetic surveys have been undertaken over the main Bakerville gravel runs by Newmont S.A. Pty. Ltd. and Southern Sphere Pty. Ltd. the results obtained however are confidential.

Complete aeromagnetic coverage for the area is provided by the north-south flight of 1966 and the E.N.E. - W.S.W. flight of 1971. From the aeromagnetic data a map of the dykes in the Lichtenburg area was compiled (Richards and Day 1975, Day 1976a and Day 1977a).

Day (1981) combined the results of aeromagnetic, ground magnetics, geological information and remote sensing to revise dyke positions and form conclusions on the relationships between certain dykes.

Despite proclamation as a subterranean water control area in 1963 the study area has recieved no systematic geohydrological study instead it has always played a peripheral role to ground water investigations centred further west within the Grootfontein compartment. A water level map for 1959 was compiled by Gordon-Welch (1960). Remeasured water levels over part of the study area were presented by Bredenkamp (1964), Mulder (1974). Borehole surveys during 1966, 1971/74 and 1975 covered the area. Purpose drilled water level observation boreholes were drilled over the period 1975/76 and are monitored monthly. Few records of spring flow exist. Ground water abstraction quantities and water levels from or close to pumping boreholes have been kept by Lichtenburg Municipality (from 1960), Blue Circle Cement Pty. Ltd. (from 1966) and Anglo-Alpha Cement Pty. Ltd. (from 1977). A report on ground water conditions on the farms Dudfield 35IP and 57 IP was prepared by Australian Ground water Consultants Pty. Ltd. (A.G.C. 1974).

Further coverage of the study area is provided by :

- air photographs at a scale of 1:30 000 (Job no. 754, 1975) and 1:50 000 (Job nos. 759, 1975 and 770, 1976).
- infra red survey at 1:40 000 (1976), and
- enhanced colour landsat image at 1:250 000 dated at 03.11.1981.

2. PHYSIOGRAPHY

2.1 TOPOGRAPHY AND DRAINAGE

The studied area froms part of the Transvaal Highlands with elevations ranging from 1547 m in the north-east to less than 1450 m in the south. From the north-east of the study area the land surface slopes gently southwards and westwards. The topographic gradient increases sharply in the south to 1 in 200 where dolomitic rocks are covered by younger formations. The subdued relief of the dolomite outcrop, mean elevation approximately 1510 m, is broken by shallow circular and linear depressions with intervening broad residual hillocks rising to more than 1520 m.

The main part of the investigated area falls within the surface water shed C330 (Harts River System) while the north-west sector is part of the drainage basin D441 (Molopo River System). The area of dolomitic rock outcrop is virtually devoid of perennial surface water drainage. However springs which issue from the dolomitic rock form the headwaters of the south-westerly flowing Harts River.

2.2 CLIMATE AND VEGETATION

The Lichtenburg area falls within the northern steppe climatic zone of Southern Africa (Sn.). Precipitation occurs principally as the result of thunderstorms in summer and autumn. Rainfall stations no 472/281 replaced in 1972 by station no 472/279 have jointly been operating in Lichtenburg since 1903. From these records, for the hydrological years 1932/33 to 1981/82, the mean annual rainfall has been calculated as 612mm with a standard deviation of 178 mm. Total annual precipitation plotted as both bar graphs and as a curve of cumulative departure from the annual rainfall mean in Fig. 1 confirms the variability of the rainfall. A period of above average rainfall commenced in 1974/75 and since then below mean rainfall was only experienced in 1978/79, 1981/82 and 1982/83.

The natural vegetation cover of mainly pure grassveld types has been extensively modified by man in the southern area of study. Original vegetation has been replaced by arable lands and some grasslands. The main 'dry farming' crops being maize, sunflower and sorghum. Where irrigation is practised additional crops are lucerne, grass, wheat and market vegetables.

3. GEOLOGY

Only limited geological mapping was carried out during this investigation. Exploration drilling was commenced to : delineate the southwards extent of the dolomite; provide information on the Karoo cover and confirm dyke positions,

The distribution and relationship of the rock units present are shown in Enclosure 1 and 2 and Figures 2 and 3.

The Lichtenburg area forms part of the south-western flank of the Central Transvaal Basin. The Transvaal Sequence, represented in the studied area by the Black Reef Quartzite Formation and the Malmani Subgroup, rests unconformably on an eroded surface of lavas and sediments of the Ventersdorp Supergroup Rocks of the Transvaal Sequence dip gently northwards, up to 10°, and despite widespread fracturing, followed by partial silicification and dyke intrusion have suffered only minor structural disturbance. Lying unconformably on the older rocks are argillaceous sediments of the Karoo Sequence. Younger surface deposits of calcrete, gravel, alluvium, chert rubble and red soils obscure much of the solid geology.

3.1 VENTERSDORP SUPERGROUP

Allanridge Andesite Formation

Within the studied area these rocks do not crop-out. However the approximate position where they disappear northwards under a cover of Transvaal Sequence has been inferred from borehole records and recent exploration drilling.

Private boreholes Hr 13 (borehole records, Appendix 1), Dd 115 and Dd 116 (Australian Ground water Consultants 1974) and the exploration boreholes G35009 and G35010 all encountered lava under a cover of calcrete and clay. The deep exploration borehole Ug23, original number L1, (von Backström et al 1952) encountered lava at a depth of 785m, under a cover of dolomite, before drilling was stopped in lava at 1131 m.

In appearance the fresh lava varies between dark green-black, fine- to coarse grained varieties and light green, medium grained. Amygdales of calcite and jasper are sporadically developed. Tuffaceous zones are also present.

3.2 TRANSVAAL SEQUENCE

3.2.1 Black Reef Quartzite Formation

This formation does not outcrop in the study area. Examination of exposures in the slurry quarries of Pretoria Portland Cement Co. (Pty) Ltd. (Lat. 25°50'S., Long. 25°49'E). indicates that the upper part of the formation consists of some 10m. of brown -grey weathering mudstone (fresh, blue-black) with interbedded thin grey-green siltstone and quartzite horizons, underlain by a blue-coloured massively bedded quartzite (more than 1,5 m thick). Exploration borehole G35009, Fig. 5 and Appendix 2, penetrated similar material between the depths of 40 and 73m on Lichtenburg Townlands 27 IP.

3.2.2 Chuniespoort Group

Black and white aerial photographs combined with colour landsat imagery were employed by Davies and Prévost (1978) to subdivide the dolomite rock into formation level. The three lowermost formations of the Malmani subgroup (Lithostratigraphic terminology as of S.A.C.S. 1980) namely the Oaktree, Monte Christo and Lyttelton Formations are represented in the studied area. These formations are dominantly chemical sedimentary rocks composed of magnesium and calcium carbonates (dolomite).

Oaktree Formation

This formation rests conformably on the underlying Black Reef Quartzite Formation and attains a maximum thickness of over 100m. The Oaktree Formation is dominantly a dark coloured fine-grained dolomites, poor in chert and comparatively rich in iron and manganese (Davies and Prévost 1978). Mudstone layers/lenses are comparitively common throughout the formation eg. borehole log G35145, Fig. 7 and Appendix 2. An east-west striking chert marker horizon exists 3/4 of the way up the succession and is exposed at the trigonometrical beacon on Elandsfontein 34 IP.

Monte Christo Formation

This formation is up to 600m thick and is present over most of the studied area under a cover of residual chert rubble. Dolomites of the Monte Christo Formation are generally light in colour, medium-to coarse grained, rich in chert and comparitively poor in iron and manganese e.g. borehole logs G35002 and G35008 Fig. 4 and Appendix .2. Mudstone bands are present throughout. Mechanical sedimentary and organo-sedimentary structures are common with chertified oolites and ripple markes being particularly abundant in the lower part of the formation.

Lyttelton Formation

Crops-out in the north of the studied area and consists mainly of a chert - poor, dark grey, fine- to medium grained dolomite rich in iron and manganese. Mudstone layers are present.

3.3 KAROO SEQUENCE

Clays and mudstones assigned to the Karoo Sequence are well developed south of the dolomite outcrop. Outlies of Kaolinitic clay and carbonaceous shale have been reported in the sinkhole - Pienaars Pothole, Enclosure 1 - on Ruigtelaagte 353 JP (Davies et al 1978).

Geological logging of private boreholes eg Dd 105, Km 135 and Km 136 (Appendix 1) and Dd 115 (A. G.C., 1974) and the recently drilled exploration boreholes : G35001, G35009, G35010, G35017, G35030 and G35145 (Appendix 2, Figs. 2 to 7) indicate that a maximum thickness of some 30m of Karoo clays is present above the dolomite and lava. Red colour banded mudstones predominate but grey mudstones, sandstone and siltstone also occur. Boulders of quartzite, dolomite and chert in a matrix of grey mudstone are exposed in a railway cutting at latitutde 26°09'15"S. and longitude 26°11'19" E.

3.4 TERTIARY TO RECENT DEPOSITS

Superficial deposits locally over 20m thick obscure much of the bedrock outcrop,major types are :

Alluvial gravel - these deposits are occasionally stratified, usually very clayey and locally attain thicknesses of over 20m. The distribution of thick gravel deposits is related to solution of the underlying dolomite bedrock, de Wit 1981 and Stettler 1979.

Calcrete - over 20m thick is locally developed on Dudfield 35IP eg. borehole logs G35018 and Dd 105. Gravels and pebbles, mainly of dolomite and chert, are common within the calcrete. A progressive alteration with decrease in depth from weathered Karoo mudstone, through calcified mudstone to massive calcite was observed in borehole chips recovered from G35010, Hendriksrust 36 IP.

Alluvium - is found in spring and seepages areas and along stream courses. Deposits consist mainly of black organic clay, eg. log G35145. up to several metres thick. The organic material, locally compressed to peat, being derived from decomposed stands of reeds (Von Backström et al, 1952).

Residual chert and red soil - are extensively developed over much of the chert-rich dolomite. A thin cover of red silty sandy soil usually overlies a thicker cover (up to 6m in borehole G35015) of chert rubble with a matrix of silty clay and occasional manganese pellets. Where extensive leaching accompanied by sink hole development has taken places thicknesses of collapsed chert rubble can exceed 22 m (borehole G35028).

3.5 DYKES

Due to a cover of surface deposits and the deep weathering of dykes no outcropping dyke material has been discovered within the study area. The presence of dykes has been infered from lineations on aerial photographs combined with magnetic anomalies recorded by airborne and ground magnetic surveys. The position of dykes in Enclosure 1 and 2 is based on Day's interpretation (1976, 1981) after amendment to take account of recent findings by Cogho, Taylor and Newmont S.A. (Pty.) Ltd. (pes. comm. R. Smith).

Three basic trends of magnetic dyke are recognised :
- E.N.E. to W.S.W.
- N.N.W. to S.S.E., and
- N.E. to S.W.

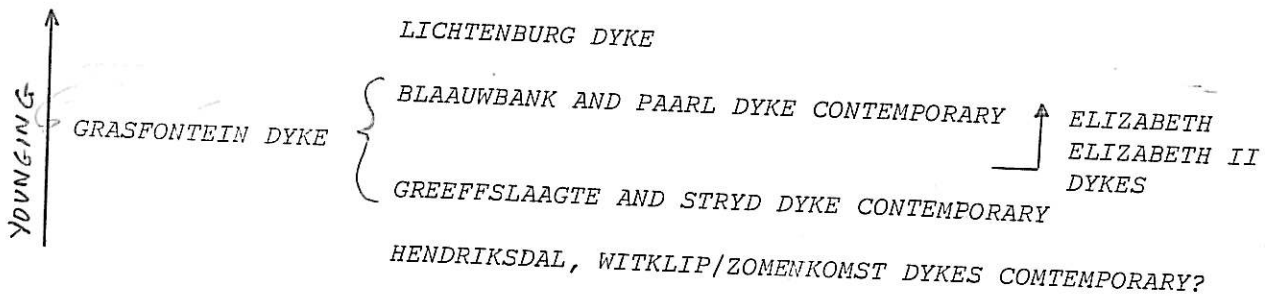
Throughout the Lichtenburg-Zeerust area the E.N.E. to W.S.W. dykes are better developed as regards frequency and length (Day, 1981) with NNW to SSE trending dykes often been intruded en-echelon.

Dyke material recovered both from exploration drilling by the Geological Survey (Davies & Prévost 1978, Stettler 1979) and from this investigation indicate that the ENE to WSW and NNW to SSE trending dykes drilled are composed of diabase. Borehole logs G35006, G35011 and G35014 reveal that up to 27m of yellow-brown clay(decomposed diabase) are developed above,(up to 14m)weathered and fractured diabase before fresh green-black diabase is reached at depths of 24 to 41m.

Diamond drilling by the Geological Survey, through the Grasfontein dyke encountered a sheared and silicified zone at a depth of some 120m (pers. comm. Stettler)

The composition of the NE-SW trending Hendriksdal dyke is somewhat different, borehole logs G35019, G35024 and G35025. Dyke material breaks down into a light greenish clay up to 28m thick containing globules of serpentinite. This clay covers up to 14m of serpentinised weathered dyke material before fresher though still partly altered, pyrˣbene-rich diabase is reached at depths of 40m plus. Sills and dykes of similar composition occur elsewhere in the Transvaal associated with the Bushveld intrusion (pers. comm. F. Waalraven, Geol. Surv.)

From an examination of lineation relationship and detailed magnetic grids over dyke intersection Day proposed the following provisional age relationship between certain dykes in the study area :



It is infered that all dykes are pre-Karoo though there is a possibility that the Lichtenburg dyke may be post-Karoo.

3.6 QUARTZ VEINS

In the north of the studied area positively weathering NNE to SSW trending quartz veins occur. There apparent disappearance to the south is probably related to a thicker development of residual soils and chert rubble obscuring outcrop. Some of the non-magnetic lineations may represent quartz veins. On Welverdiend 361 JP a quartz vein crops out along the some trend and some one kilometer further north than the disappearance of the magnetic anomaly associated with the Witklip dyke. On Elizabeth 357 JP the Grasfontein dyke is apparently displaced by a silicified fault zone. The centres of silicification are usually composed of massive and crystalline quartz, flanked by vuggy quartz and zones of leached silicified brecciated dolomite and chert. Thicknesses vary from more than 15m to less than 3m.

3.7 FRACTURES

Major dyke directions and quartz veining correlate closely with joint directions within the Malmani subgroup and also with present day regional stress fields in the study area(Day 1981).

The lack of marker horizons and the surface cover makes any faulting difficult to recognise and prove.

4. GEOPHYSICS

The location of all documented geophysical work is shown in Enclosure 2. Some typical dyke anomalies produced by this field investigation are presented in Fig. 8. Raw data and a complete set of magnetic profiles are collected in GHP envelope no 666.

The aims of the geophysical study were :

- to accurately delineate certain dykes in the study area, with a view to
- ascertain the width, depth of burial and inclination of these dykes,
- to locate sites for the test drilling of certain dykes, and
- to investigate certain photo lineations to determine their magnetic character.

During this investigation 88 magnetic traverses with a Chemtron proton magnetometer (Model G3) were carried out and two magnetic traverses using the Gionics electromagnetic instrument. A planned gravity survey to detect residual gravity lows within the dolomite was never realised.

Due to a lack of definite, information on the magnetic susceptibility of the dyke material extensive computer modelling of the field magnetic data has not been carried out. However, information on dyke width, depth and inclination as presented in Day 1981 has been included. Dyke interpretation methods presume uniformly magnetised, flat-topped, semi-infinite, parallel sided slabs with no remnant magnetisation. Dyke width estimates are related to assumed values of magnetic susceptibility. Depths to magnetic material must be regarded as minimum depths only as residual magnetite is generally present in the clay above fresher dyke material.

4.1 RESULTS

Elizabeth and Elizabeth II dyke - the position of this near vertical, north-south trending dyke was detected by magnetic traverses spaced some 500m apart. These dykes cause small scale symmetrical positive anomalies of some 60 nT (see Fig. 8 profile CT/82/048)clearly standing out in a flat background magnetic field. The en-echelon nature of the dyke intrusions was confirmed on La Rey Stryd 53IO and Hendriksdal 1IP and a previously unrecognised section was detected on Dudfield 35 IP. Interpretation of a profile on Greeffslaagte 33IP indicates a width of 47m and a depth of 24m (Day, 1981).

Grasfontein dyke - near vertical dyke, trending ENE to WSW causing a large positive anomaly of between 100 and 500 nT. A noticeable drop in background magnetic values across the dyke with values on the northern side being some 100 nT highter than the southern side. (Fig. 8, profile CT/82/048). Ground magnetic traverses confirm that this dyke is displaced by the silicified fracture on Elizabeth 357 JP.

Interpretation of dyke anomalies on Grasfontein 356 JP by de Wit (1981) gives width estimates ranging from 18 to 28m and a depth to magnetic material of 6 to 9m. Stettler (1979) calculated the width on Ruigtelaagte 353 JP as 37m with a depth of 14m. Exploration drilling by Stettler and Newmont S.A. (Pty) Ltd (pers. comm. R. Smith) suggests that fairly fresh diabase material is encountered at depths of 20m.

Zamenkomst dyke - a near vertical, NNW - SSE trending dyke with a sharp positive anomaly of over 600 nT in places (Fig. 8, profile CT/83/080).

Dyke parameters for Ruigtelaagte 353 JP. are widths ranging from 36 to 43m and depths varying between 13,5 and 18m (Stettler 1979). Exploration borehole G35014 encountered fresh diabase at 24m on Zamenkomst 4IP.

Traverse CT/83/065 confirms that the Zamenkomst dyke does not continue southwards to intercept the Blaauwbank dyke.

Witklip dyke - the northern portion of the near vertical NNW-SSE trending Witklip dyke is displaced some 2 km east of the Zamenkomst dyke. Magnetic anomalies over the Witklip and Zamenkomst dykes are similar. A large positive anomaly of some 350 nT was recorded by profile CT/83/068, Fig. 8.

Day (1981) interpreted a dyke width of 31m and a depth of 10m or Klipbankfontein 26 IP. Profile CT/83/067 was modelled by Taylor to give a dyke width of 20m depth of 15m and a vertical inclination. The exploration borehole G35011, Lichtenburg Townlands 27IP, penetrated fresh diabase at a depth of 42m.

Hendriksdal dyke - a NE-SW trending dyke with a low scale magnetic anomaly, less than 70 nT, (Fig. 8 profiles CT/83/081 and CT/83/088). Modelling by Day for a profile on Uitgevonde 355 JP produced a width of 22m and a depth of 8m. Drilling of the dyke revealed serpentinisation of the pyroxenes a process which produces secondary magnetite. Borehole logs (G35019, G35024 and G35025) indicate on Hendriksdal 1 IP and Houthaalddoorns 2IP a minimum width of 8m, depth to fresh material in excess of 40m and that the dyke dips steeply to the S.E.

Greeffslaagte dyke - a near vertical dyke, trending ENE-WSW and forming a large positive anomaly of some 500 nT. (Fig. 8, profile CT/83/075). A sharp step of some 300 nT is present across the dyke with a higher background magnetic field to the north. Dyke parameters as estimated by Day (1981) are :

- Greeffslaagte 33 IP width varying from 72 to 81 m and depths from 28 to 41m.
- Lichtenburg Townlands 27IP, width 45m. depth 25m.

Borehole G35006 penetrated fresh diabase at 31m.

Blaauwbank dyke - this near vertical ENE-WSW trending dyke produces a similar anomaly to the Greeffslaagte dyke with a positive anomaly of some 500 nT and a decrease in background magnetic values of some 100 nT to the south of the dyke. Exploration drilling by the Department of Environment Affairs on La Rey Stryd 53 IO - boreholes D4N092 to D4N095 ind. and 259 - revealed that the Blaauwbank dyke was more than 50m wide (but less than 135m) and that some 16m of clay was penetrated before weathered diabase was encountered.

Non-magnetic lineations

Several photo lineations were investigated magnetically. No distinct magnetic anomalies were detected within the generally high background noise levels of plus and minus 10 nT.

Electromagnetic profiles EM/83/01 and EM/83/02 were carried out on Lichtenburg Townlands 27IP near borehole G35005. The traverses detected a broad zone of conductive material coinciding with the topographic expression of the photo lineation i.e. the depression within which G35005 was drilled.

5. GEOHYDROLOGY

Information on the basic geohydrology of the studied area was collected from :

- borehole survey aimed primarily at assessing current ground water abstraction and measuring water levels,
- spring and stream flow measurements,
- exploration drilling and the monitoring of privately drilled boreholes,
- pump testing of certain boreholes,
- ground water sampling programme and the
- compilation and reinterpretation of existing data, including water level records.

This study provided the basic parameters for the ground water balance budget calculation. The information acquired will be useful for any future computer simulation of the dolomitic aquifer.

5.1 BOREHOLE SURVEY

Enclosure 1 shows the distribution, designation and partial classification of all known boreholes and spring/well pumping points in the Lichtenburg area with the following exception - only boreholes within the town of Lichtenburg which have provided relevant information have been shown. A complete list of farms surveyed is presented in Appendix 1 along with the raw data collected during the borehole survey.

5.1.1 Borehole Statistics

Within the study area some 750 boreholes and well points were located of which some 75% are registered with the Permits section of the Department of Environment Affairs (Fig. 9). Some 60% of the total number of boreholes in the area were pumped over the period 1981/1983. Of the 440 boreholes in use 75 (17%) are being heavily pumped. Of the 440 boreholes 13% are used to meet irrigation demand, 3% for municipal needs and 1% for industrial requirements.

Some 790 ha (or 1,6% of the study area of 500 km^2) were irrigated over the 1981/82 agricultural season (830 ha 1982/83) on 7 main cadastral farms (Fig. 10) viz : Dudfield 35IP, Elandsfontein 34IP, Greeffslaagte 33IP, Houthaalboomen 31IP, Houthaaldoorns 2IP, Klipbankfontein 26IP and Talene 25IP.

The total calculated ground water abstraction for 1981/82 was 11,5 $10^6 m^3$, which was used as follows :

- 56% for irrigation,
- 23% for municipal use,
- 14% for industrial use, and the remainding,
- 7% for domestic and stock consumption.

5.1.2 Borehole yields and relationship to Geology

The distribution of strong yielding boreholes, i.e. those used for irrigation, municipal and industrial use, shown in Enclosure 1 clearly illustrates that the dolomitic rock is the productive aquifer. Even under a cover of calcrete and Karoo rocks on Dudfield 35IP and Greeffslaagte 33IP high yielding boreholes can be developed in favourable locations where leaching of the underlying dolomite has occurred, generally above the 1480m contour line (Encl 18, Fig. 2 and 3).

Immediate yields from the dolomitic rock, including brecciated chert zones, can exceed 70 l/s eg. borehole Lt 4. Strong yielding boreholes are generally completed with 203mm casing to allow the easy installation of 152,127 or 101mm diameter pump cylinders, pumping rates are generally in excess of 20 l/s. Many strong yielding boreholes, not designated as such in Enclosure 1, are present within the main dolomite outcrop but because of poor or no soil cover cannot be utilised for irrigation. Exploration drilling has confirmed that adjacent to dykes and within some linear depressions, structually controlled preferrential solution of the dolomitic rock has occurred developing highly transmissive formation which yields strong supplies of groundwater to boreholes e.g. G35012, G35028. Where suitable soils are present within these structural depressions and an electric supply is available heavy pumpage can occur eg. on Houthaalboomen 31IP, borehole Hb11. Not all boreholes drilled into the dolomite have good yields eg. G35016, G35021 and G35026, boreholes which do not penetrate soluted or fractured zones below the rest water level have negligible blow yields.

Most boreholes penetrating the dolomite are generally shallow, i.e. less than 50m deep, and the main water intercepts are commonly made at depths of between 20 and 35m. While boreholes drilled into the lower part of the dolomite formation (the chert-poor Oaktree) below the 1480m contour line, with or without a cover of Karoo rocks and calcrete, generally have poor yields irrespective of depths drilled. Yields of 1 l/s may be considered good and even these low yields are generally encountered within the overlying calcrete eg. borehole logs G35009 and G35018, or Karoo mudstone eg C3N035 but also occasionally within the fractured dolomite eg. C3N032, G35017.

Boreholes within the lava have low yields. On Hendriksrust 36IP limited irrigation is practised from boreholes penetrating an upper productive weathered zone within the lava.

On Ruigtelaagte 353 JP the alluvial clayey gravels occasionally provide good yields of groundwater (pers. comm. E.Stettler, Geol. Survey and R. Smith, Newmont S.A. (Pty.) Ltd.).

5.1.3 Ground water abstraction

Some 4,5 $10^6 m^3$ pa 40%, of the estimated annual consumption of the Lichtenburg area is gauged. A list of 60 major abstraction points, including 12 belonging to Lichtenburg Municipality, that require the installation of flow meters is included in Appendix 1.

Monthly flow gauging of individual production boreholes has been carried out by Anglo Alpha Cement (Pty) Ltd. on Dudfield 35IP since 1977 and by Blue Circle Cement (Pty.) Ltd. in Lichtenburg Townlands 27 IP from 1965. Since 1961 Lichtenburg municipality has maintained records of the total volume of water sold. Irrigation borehole Gf5 is equipped with a flow meter and has been gauged monthly since June 1981. Records of the annual quantity of gauged groundwater are presented in Appendix 1, tabulated monthly consumption figures are available in GHP envelope no 666.

Abstraction for the other ground water consumers (Fig. 10 and Appendix 1) has been estimated from information supplied by individual farmers on irrigation schedules, pumping rates, hecterage under irrigation and number of crops grown annually. Where major irrigation is practised it has been assumed a cover of 60mm of water is required every 10 days for a crop growing period of 100 days. (pers. comm. - Agricultural and Technical Services, Lichtenburg). Provided pump capacity is sufficient it has been assumed that the 0,6 m of water per crop is provided solely from groundwater. Obviously this might be an overestimation of ground water pumpage for summer crops as rainwater undoubtable provides some of the growing crops water requirements. However the major irrigators spray irrespective of rainfall as precipitation cannot be relied on to arrive at the optimum time within the farmers irrigation schedule, particularly in years of below mean summer rainfall. The fact that the water needs for the large hecterage of lucerne have probably been under estimated at 1,2 m per year (for 200 day) perhaps balances the figures for irrigation requirements. Where pump capacity is clearly insufficient to meet irrigation requirements of 0,6 m per crop abstraction has been downwards adjusted to fit a maximum pumping schedule of 10 hours per day, 6 day/week, 3 months per year.

Domestic and stock requirements have been estimated using farmers figure. Annual yields of wind pumps have been arbitarily fixed at 250 m^3 overall results do not greatly affect the consumption of ground water.

The total annual ground water abstraction for the area was approximately 11,5 x $10^6 m^3$. during 1981/82 which was subdivided as follows :

Irrigation boreholes	6,5
Lichtenburg & Bakerville Municipal use	2,6
Anglo Apha (0,6) + Blue Circle (1,0)	1,6
Domestic and stock	0,8
TOTAL	11,5 $10^6 m^3$

A comparison of the present irrigated area with that listed by Mulder (1974) indicates that :

- on De Paarl 54 IO irrigation has virtually ceased, previously 300 ha.
- the irrigated area on Dudfield 35 IP has been drastically reduced from 350 to 50 ha.
- irrigation on Klipbankfontein 26 IP has remained steady at around 200 ha.
- irrigation on Greeffslaagte has increased from 235 to 310 ha.

If farmers were to fully utilise their allocated irrigation hecterage an additional 500 ha of land would be irrigated which would consume on extra 3.10^6 m^3 of ground water per annum (assuming one crop a year at 0,6 m of water per crop. The potential increase in irrigation area excludes any extension of irrigation on De Paarl 54 IO (300 ha allowed)and the Anglo Alpha options on Dudfield 35IP (225 ha).

5.2 SPRING FLOW

The ten springs issuing from the dolomitic rock in the study area are indicated in Enclosure 1 and Fig. 13, monthly flow readings on 8 springs and one stream (MP.6) are shown in Fig. 11 and tabulated in Fig. 12.

The total extrapolated annual spring flows for 1981/83 was calculated as 8 $10^6 m^3$. Flows of over 50 l/s are recorded from the springs; Klipbankfontein central and Uitgevonden north.

No permanent spring gauging stations are present and only sporadic flow measurements of the Lichtenburg spring have been made in the past, Hawkins et al 1954. During this investigations sites were selected for the installation of permanent gauging stations as reported on in "Sites for measuring spring flow in the vicinity of Lichtenburg" (Taylor, 07/12/1982). Spring measurements using a portable Ott flow recorder were instigated from June 1982 to May 1983. For some springs 12 month records of flow are available. The springs and maximum flow rates recorded were:

Elandsfontein 34IP

De la Rey	-	*no flow*
Elandsfontein	-	*3 l/s*
Elandsfontein east	-	*9 l/s*

Klipbankfontein 26IP

Klipbankfontein west	-	*29 l/s*
Klipbankfontein central	-	*110 l/s*
Klipbankfontein east	-	*25 l/s*
Klipbankfontein no 4	-	*5 l/s (visual estimate)*

Lichtenburg Townlands 27IP

Aslaagte	-	*49 l/s*
Lichtenburg Springs	-	*49 l/s*

Uitgevonden 355JP

Uitgevonden south	-	*26 l/s*
Uitgevonden north	-	*70 l/s*

Due to thick developments of reeds and unsuitable channelling around springs and seepage areas flow measurements were generally taken in man-made canals some distance from where springs issue. Further difficulties on estimating flow were caused by present day abstraction at De la Rey spring, Klipbankfontein east, Lichtenburg spring and Uitgevonden south. During the period of measurements the weak springs on Elandsfontein 34IP ceased to flow.

The Elandsfontein east stream was found to be artificially caused by pump Ef108 partially dewatering a roadstone quarry. The two springs on Uitgevonden 355JP result from ground water overflow at a dyke barrier, the Hendriksdal dyke, west of the dyke the springs dissappear recharging the dolomite through swallow holes - clearly visible at the Uitgevonden north spring. Other springs in the area appear on the surface where the ground surface is below the ground water level (Fig.2). The cover of alluvial and Karoo clays prevents much of this water seeping into the ground and recharging the dolomite.

Information provided by local residents (W.B. du Preez, Klipbankfontein 20IP, W. Austin, Bakerville) indicate that the presently strong flowing springs on Klipbankfontein and Uitgevonden did not (re) commence to flow strongly till after the heavy rains of 1975 (see fig. 1). Supporting evidence is provided by :

- *ground water level and water charge maps (Fig. 13 to 17)*
- *comparision of aerial photographs Job no 493 (1963) and Jobnos. 754 and 759 (1975) where dry conditions and minor flow are observed respectively*
- *farmers do not use the natural flow of springs within previously constructed irrigation canals but pump directly from excavated springs.*
- *some pumps installed on springs are now submerged eg. KM44 while other pumps have been raised eg. Ug. 1.*

Insufficient spring flow records exist to form conclusions on spring discharge fluctuations with rainfall. Fig. 11, indicates that for the period of record, there was a steep decrease in spring flows until the end of 1982, thereafter spring discharges increased slightly.

5.3 GROUND WATER LEVEL CONTOUR PATTERN

Contoured water level maps have been compiled for water level measurements made during the following periods :

- June 1959
- December 1971 to November 1974
- June/August 1982, and
- April/May 1983

The 1982 survey utilised the largest number of measurements, viz 200 meterings corresponding to a density of 1 measurement per 2,5 km^2, while the 1983 survey had the widest aerial distribution of control points due to :

- recently completed drilling programme and
- drilling of measuring holes in pump base plates.

Water level contour maps, with 5m contour intervals, for 1971-74 (fig. 15) and 1982 (Fig. 13) have been presented other original maps are available in GHP envelope no. 666. Raw water level data and levelled collar elevations are contained in Appendix 1 and GHP envelope no 666.

Despite the wide spacing of control points in certain areas, noteably along the Dudfield/Elandsfontein boundary and the lack of detailed information across certain dykes eg. the Hendriksdal and Paarl dykes on Greeffslaagte 33IP certain main features are evident.

- there is a general ground water high in the centre of the study area characterised by a virtually flat water level.
- within this central high a NE-SW trending ridge, or seperate mounds, of higher water level are developed across the farms Zomenkomst 4IP and Welverdiend 361 JP.
- Fig. 13 (1982) suggests that this central high can recieve ground water recharge from the eastern area of Welverdiend 361JP.
- there is a general water movement from the central high in a southerly and westerly direction.
- steep water level gradients of the order of 1 in 150 are developed in the south of the area, within the outcrop area of the Oaktree Formation Karoo lcay and calcrete.
- ground water seepage can feed the tributaries of the Harts River on Lichtenburg Townlands 27IP and Klipbankfontein 26IP.
- an abrupt drop in water levels, up to 20m on Uitgevonden 355JP declining to 10m on Hendriksdal 1IP, in a westerly direction across the Hendriksdal dyke (Fig. 3). Exploration drilling on Houthaaldoorns 2IP confirms that a 20m vertical drop in water levels is experienced within a maximum horizontal distance of 70m .
- a 10m drop in water levels also apparently occurs in a north-westerly direction across the Paarl dyke on Greeffslaagte 33IP and de Paarl 54IO.
- an additional 10m drop in water level occurs across the Blaauwbank dyke on Hendriksdal 1IP and La Rey Stryd 53IO.
- a westerly drop in water levels of 3m is recorded across the Elizabeth dyke on Elizabeth 357 JP.

- 1983 water level measurements (Fig. 13) indicate a 1,7m drop, to the south, across the Greeffslaagte dyke on Lichtenburg Townlands 27IP.

The presence of abrupt water steps across certain dykes indicates a degree of compartmentalisation of the dolomite is present, particularly in the western area, with some virtually impermeable dykes controlling the free movement of ground water. Virtually flat water levels within individual dolomite compartments indicate that the dolomite is extensively karstified and thus generally highly permeable. The sharp steepening of water level gradients to the south indicate that part of the Oaktree Formation, the Karoo clays and calcrete have relatively low values of transmissivity.

5.4 CHANGES IN GROUND WATER LEVEL

Conclusions on water level fluctuations and thus changes in ground water storage, have been made on

- a regional scale, from water level change maps, and
- a local scale, from monthly monitoring of observation borehole.

5.4.1 Water level change maps

3 maps have been presented viz :

- water level change map June 1959 to June/August 1982 (Fig. 14),
- water level change map 1971/74 to June/August 1982 (Fig. 16)
- water level change map June/August 1982 to April/May 1983 (Fig. 17).

Over the period 1959 to 1977 ground water levels rose and since 1977 (see section 5.4.2) have declined slightly.

The following conclusions are drawn from Fig. 14 and 16.

- water levels over the dolomite were at their lowest recorded in 1959

- large rises in water level up to 10m 1959 to 1982, and 5m, 1971/74 to 1982, occurred within the dolomite outcrop area. The highs being located east of Welverdiend 361JP and Witklip 6IP.

- after 1974/5 springs commenced to flow strongly due to the substantial rises in water levels in their source areas and around the springs e.g. Uitgevonden rise of 3 to 4m

- large rises in water levels up to 8m (since 1959), on parts of Dudfield 35IP, De Paarl 54IO and Greeffslaagte 33IP, indicate the recovery of water levels after a decline in pumpage and substantial recharge.

- where heavy abstraction is practised on Lichtenburg Townlands 27IP and Greeffslaagte 33IP only small rises in ground water levels have occurred.

- in the south of the area water levels rose from 1959 to 1971/74. Subsequent measurements indicate a fall in water levels or no real change. The substantial drop on part of Dudfield 57IP may be accounted for by heavy evaporation losses ($1{,}10^6 m^3$ pa) and pumpage from standing water in quarries.

Fig. 17 indicates :

- water levels have fallen over much of the dolomite outcrop by some 0,5m.

- where concentrated heavy abstraction is practised (and monitoring points are available) as on Lichtenburg Townlands 27IP, Klipbankfontein 26IP, Greeffslaagte 33IP, and Houhaalboomen 31IP water level drops of up to 4m have been recorded.

5.4.2 Ground water level observation

Within the confines of the studied area water level measurements are made at 35 boreholes of which 31 are serviced by the Division of Geohydrology. Eight boreholes are equipped with automatic chart recorders, 19 with HWK meters and at 4 boreholes measurements are made manually. Tabulated water level data for observation wells is contained in GHP envelope no.666.

Regular measurements of water levels at purpose drilled observation boreholes commenced from September 1975. Prior to the establishment of the observation borehole network intermittent water level measurements had been made since 1970 at several equipped private boreholes. Lichtenburg Municipality has monitored water levels in borehole C3N505 since 1960 and Blue Circle Cement (Pty) Ltd. in their pumping boreholes since 1966.

Water levels at C3N505, adjacent to pumping borehole Lt11, gradually declined from 13,5m in 1961 to 14,5 in 1965. When measurements resumed in 1967 ground water levels had risen to 13m and again declined slowly to 13,5m in 1973. Water levels rose to 12 m in 1974 and to 8m in 1978 since then water levels have fluctuated slightly to stand at 10,3m. (May 1983). The increase in water levels (3m from 1981 to 1983) is over a period when abstraction has steadily increased from some $0{,}8\ 10^6 m^3$ p.a. (1960) to $3{,}6\ 10^6 m^3$ p.a. (1982).

Boreholes C3N013 and C3N014 (production holes) had steady water levels at 3 to 4m over the period 1967 to 1974 whereafter water levels rose by 0,5m. By March 1976 water levels had risen by over 3m and free flowing conditons existed at these boreholes during March and April 1976 and again in February 1978. From 1978 to 1980 water levels fell to $\pm$2m below collar and have since fallen and remained steady at 5 to 6m the lowest water levels recorded at these boreholes.

Production borehole C3N015 had steady water levels ranging from 17 to 18m for 1968 to 1974 until a sudden rise occurred during 1974 (to 13 - 14m) followed by stable water levels until 1980 when water levels fell to 17 m.

Ground water hydrographs, presented in Figs. 18 to 21 (incl.) for the period 1975 to 1983 indicate that :

- *water levels mimic the general trend of precipitation when expressed as a curve of cumulative departure from the monthly rainfall mean.*
- *in early 1976 water levels were rising.*
- *water level peaks were experienced in 1977/78 and early 1981.*
- *water levels were generally highest in early 1978.*
- *since 1981 water levels have been declining steadily.*
- *water levels are generally up to 2m lower than in 1975 however some water levels eg. D4N136 (Fig. 20) are up to 2m higher.*
- *time lags of between 2 and 12 weeks e.g. compare C3N032 (Fig. 18) and D4N140 (Fig. 21), occur in water levels rises after heavy rainfall recharge.*
- *the steep fall and later recovery in water levels at borehole C3N086 during 1982.83 (Fig. 20) is not noticeable on other borehole hydrographs and is thus ascribed to pumping effects.*

5.4.3 *Conclusions*

The lowest and highest water levels on record were experienced in 1959 and 1978 respectively. Abrupt water level peaks occur after periods of heavy sustained rainfall (e.g. 430mm from November 1977 to January 1978) and are followed by a gradual decline in water levels. Water level highs were recorded during 1966/67, 1974/75 early 1976, early 1978 and 1981.

5.5 *DRILLING PROGRAMME*

The position of boreholes drilled are shown in Enclosure 1 and borehole logs are presented in Appendix 2, Figs. 4 to 7 and complete logs in GHP envelope no. 666.Rock chip samples are available for inspection at Pretoria Head Office.

From March to May 1983 28 exploration boreholes were drilled by two Rock Giant air percussion rigs supplied by Rustenburg Boring Inspectorate. The total meterage drilled was 1164m of which 640 m was cased with mainly 165mm diameter steel casing. For 83 working days an average drilling rate of 14m/d was recorded. A further two boreholes, namely G35029 and G35145 were drilled for the Pretoria Zoological Gardens.

Despite early curtailment due to shortage of time, the drilling programme achieved its major aims of

- locating the approximate position of the concealed contact between the Black Reef Quartzite Formation and the Malmani Subgroup,
- providing information on the depth to and the lithology of unweathered dyke material,
- monitoring any changes in ground water levels across certain dykes, namely the Blaauwbank, Hendriksdal, Greeffslaagte, Witklip and Zamenkomst dykes,
- providing sites for pump testing to enable estimates of potential ground water movement through leaky dyke boundaries to be made.
- investigating non-magnetic lineations
- providing additional sites for water-level measurements particularly on the Lichtenburg Townlands 27IP.

Drilling progress within the unleached dolomite, lava, calcrete and fresh dyke material is rapid, with drilling rates of up to 6 metre per hour.

Difficult drilling were caused by the saturated clays (both Karoo and decomposed dykes) which prior to casing block air vents in the drilling bit with mud cake. The foaming agent - Drill foam B - was partially successful in maintaining borehole side wall stability prior to the installation of final casing. However in several cases it was necessary to telescope the completion casing from 165 to 127 mm (diameter). Where extensive leached zones are encountered within the dolomite rock eg. G35015 air pressure is lost and no chips are recovered. A cable tool rig is required to complete these holes.

5.6 PUMPING TESTS

Pump tests were directed at solving the problem of estimating the quantity of ground water flow through the boundaries of the areas where water balance calculations were to be made.

Pumping procedures followed that described by Schafer (1980) for low yielding formations. The saturated section of the boreholes were either left uncased or fitted with perforated casing. Pumping was carried out using a nominal 51 or 76mm diameter pump cylinder. Boreholes were rapidly dewatered, less than 10mins, with the pumped water fed into a measuring tank. The recovery of the ground water level was then monitored until recovery was nearly complete.

The data collected enabled rough estimates of transmissivity (T) to be made, the unit adjusted constant factor being 15,3, double checking was carried out utilising the Theis Recovery analysis (Kruseman et al 1970)

Plotted curves are presented in Fig. 22 to 26 incl., and all raw data in GHP envelope 666. Despite some difficulties in achieving reasonable straight line fits the following transmissivity values have been calculated.

DYKES

BOREHOLE	DYKE	SCHAFFER	THEIS RECOVERY
G35006	Greeffslaagte	0,28.m^2/d	0,32 m^2/d
G35011	Witklip	no fit	1,34 m^2/d
G35014	Zamenkomst	1,22 m^2/d	2,03 m^2/d
G35024	Hendriksdal	0,13 m^2/d	0,11 m^2/d

SOUTHERN BOUNDARY (lava/dolomite/Karoo/calcrete)

BOREHOLE	SCHAFER	THEIS RECOVERY
G35009	0,53 m^2/d	0,58 m^2/d
G35010	0,16 m^2/d	0,32 m^2/d
G35017	0,38 m^2/d	0,45 m^2/d
G35018	0,48 m^2/d	0,60 m^2/d

An average T value of 1,04 m^2/d was accepted for calculating the general leakage of ground water through dykes. A lower figure of 0,12 m^2/d was assigned to the Hendriksdal dyke because of its clear damming effects on ground water levels (fig. 13). Where calcrete and Karoo clays cover lava and dolomitic rocks of the Oaktree Formation an average transmissivity value of 0,44 m^2/d was calculated.

For the boreholes tested the calculated T values predominantly reflect the transmissivity of the individual water-bearing layers intercepted. Where yields are comparatively high, more than 0,2 l/s, it is better practise to plain case the saturated clayey, comparatively non-water bearing sections of the borehole this would improve drilling speed and drilling conditions and would enable the borehole to be properly cleaned and would thus enable the pump cylinder to be set to a greater depth with less risk of clogging by clay and silt.

As initial recovery after pumping is very rapid (Fig. 22 and 23) and at early recovery time cascading water from higher sections of the borehole make measurement difficult with a conventional water level meter, it is suggested that a pressure transducer coupled to a chart recorder should be used.

5.7 HYDROCHEMISTRY

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, and
- to ascertain if pesticide and herbicide residues were present within ground water in areas of major irrigation.

Thirty-one borehole water samples and one spring water sample were collected and analysed for major element composition. Five litre water samples were collected in March 1983 from three boreholes, namely Dd20, Gl2 and Hs 6, for residual pesticide and herbicide determination - but as yet have not been analysed by the Institutde for Hydrological Research due to difficulties experiencing in acquiring formulation of certain products.

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 converted to milli-equivalents per littre (meg/l) and were plotted on the accompanying Durov diagram, Fig. 27.

Most ground waters are of good quality and apart from low fluoride levels (minimum recommended 0,7 mg/l) and locally high nitrate concentrations satisfy the drinking water criteria of the South African Bureau of Standards (Kempster et al 1980).

Ground waters are typically hard to very hard, moderately alkaline (maximum field pH 7,7) with a total dissolved solid content ranging from 280 to 560 mg/l.

Over the dolomitic rock outcrop water are predominantly calcuim and magnesium bicarbonates with Ca/Mg ratios of 1. Close to natural discharge areas, on Elandsfontein 34IP, Klipbankfontein 26IP and Lichtenburg Townlands 27IP, calcuim precipitation occurs and ground water types are magnesium bicarbonate with Ca/Mg ratios as low as 0,4. Ground water from the calcrete and Karoo clays overlying the lava and dolomitic is dominantly a Calcium bicarbonate type, Ca/Mg ratios as high as 1,9 with an increasing chloride percentage within the anion field.

Low total dissolved solid content combined with low chloride/bicarbonate ratios and low sulphate content all indicate that most ground waters are of fairly recent origin. The hydrogen sulphide gas released from ground water in the Witklip dyke, borehole G35011, during pumping suggest that ground water is there comparitively old and that little water movement within the dyke is taking place.

6. AQUIFER AND AQUIFER DEVELOPMENT

Primary and secondary aquifers occur in the Lichtenburg area. The most important aquifer present being the Karstified cherty dolomite formation (including brecciated chert).

The Ventersdorp lavas with the mudstones and quartzites of the Black Reef Quartzite Formation are only water-bearing in their uppermost weathered zones and from fractures where secondary openings have been developed. Where these formations underlie the dolomite they may be regarded as virtually impermeable and would thus constitute a base level to any solution within the dolomite.

Karoo mudstones and clays are poorly water bearing and function primarily as an aquiclude. Where well developed they cause aquifer conditions in the underlying lavas and dolomite to switch from unconfined to semi-confined or semi-unconfined.

Due to primary porosity and some secondary porosity caused by carbonate solution the calcretes are marignally water -bearing with unconfined conditions prevailing. Where saturated calcrete directly overlies weathered chert rubble and dolomite there would appear to be a direct hydraulic connection. (A.G.C. 1974).

Over most of the area the surface deposits, with the exception of calcrete, are unsaturated therefore they do not have signifance as aquifers but are important from the view of influencing infiltration from precipitation. Exceptions are :

- recent alluvial clay causes local confinement of the dolomite on Klipbankfontein 26IP eg. boreholes Km 6 and Km 118 fluctuating free flowing conditions,

- east of the Hendriksdal dyke the deeper gravel deposits are saturated water level measurements by Stettler (1979) indicates that the gravels are in direct hydraulic continuity with the leached dolomitic aquifer.

Boreholes drilled within dykes have obtained blow yields of up to 0,8 l/s (G35011) from weathered and fractured diabase. However the main importance of the dykes in the study area is related to their ability to control the free movement of ground water.

6.1 MALMANI SUBGROUP

The massively bedded and well jointed formations of the Malmani Subgroup are composed essentially of calcium and magnesium carbonate rocks i.e. dolomite (average CaO = MgO ratio of 1:0,67, Brink et al 1965) with up to 20% silica i.e. chert (occuring as both continuous sheets and nodules) and with mudstones being particularly common in the lower part of the subgroup.

Carbonate rocks are susceptible to corrosion and solution (Karstification) by infiltrating mildly acidic meteoric water which preferentially penetrates the dolomitic mass along joint surfaces and fracture places thereby enlarging openings and developing secondary porosity. Insoluble residues of chert, quartz, clay minerals, oxides and hydroxides of iron and maganese (wad) remain. This residual mass when undisturbed as in caves, is highly porous and compressible. With progressive solution of the dolomite and the lowering of the ground surface a mantle of weathered material, virtually in situ , covers the dolomitic bedrock.

Active carbonate solution is concentrated immediately below the ground water level in the phreatic zone (Brink et al 1965). Relict leached areas in the vadose zone with access to percolating rain water develop depositional features viz. travertine deposits, stalagmites, stalactites etc. lowering of water levels can cause collapse of the rock cover above a leached or cavernous zone and sinkholes to develop.

Morphological features related to extensive karst development are present within the dolomitic outcrop north of Lichtenburg. These features include :

- the presence of numerous depressions and sinkholes, both old and recent and of varying sizes and depth. (see Enclosure 1).

- *lack of surface drainage*

- *the disappearance of both the Uitgevonden South and the Uitgevonden North spring after crossing the Hendriksdal dyke on Uitgevonden 355JP.*

- *the extensive development of red soil (terra rossa) and residual chert.*

In addition excavations for alluvial diamonds has revealed numerous small scale karst features including lapies yamas and occasional caves (de Wit 1981).

Within the studied area a marked correlation exists between sinkhole development and depressions with structural features (Davies & Prèvost1978). This is the result of the development of initial surfaces depressions and possibly tributary drainage above joints, bedding plane openings, faults and fracture zones (sometimes silicified and often dyke intruded), which results in areas of surface run-off concentration which in turn increases local infiltration and solution of the carbonate bedrock along the openings (Milanovic 1981). By this process major karst channels and water conduits have been developed which are in turn fed by more numerous thinner fissures draining the adjacent areas of dolomite rock. Subsidence above the major conduits results in the accumulation of chert breccia rubble covered by red soil which is characteristically found adjacent to the ENE-WSW trending dykes in the Lichtenburg area. Due to comparatively good drilling success within the main area of dolomite outcrop very little information is available on the fractured and leached properties of the dolomite more than 50 m below ground level.

Recorded information suggests a maximum depth of leaching of 56m, 1443 amsl, on Grasfontein 356JP (de Wit 1981, borehole no.3) and 38m, 1460 amsl., at Ltl1 on Lichtenburg Townlands 27IP which correspond to saturated thicknesses of 28m and 27m respectively. The low yielding exploration borehole G35022, Houthaaldoorns 2 IP, penetrated a leached zone infilled with honeycombed chert and secondary calcium carbonate deposits at a depth of 47m, 1465 amsl, with a saturated thickness of 29m. The private strong yielding borehole Ef 68 was apparently drilled to a depth of 138m (1365 amsl) however no information on water intercepts are available.

As a result of poor water yields from the southern area, generally below the 1480m contour line, deep boreholes penetrating into the dolomite (Oaktree Formation) have been drilled. Records exist for 12 boreholes drilled between 90 and 153m deep. The general low yields suggest that the dolomite has not been extensively fractured and leached. However the good yields encountered by Kml18 (depth 91m, final elevation 1389m) and Dd 111 (depth 111m, elevation 1366m) indicate that fracturing and solution is sporadically developed.

Ground water conditions within the dolomite are generally unconfined though transitions to semi-confined and semi-unconfined conditions occur. Certain diabase dyke influence natural ground water flow and have a caused a degree of compartmentalisation within the dolomite.

Due to lateral inhomogenietics within the dolomite aquifer and pronounced anisotropic conditions a wide range of transmissivity values is encountered ranging from a low of less than 1 m^2/d to a high probably in excess of 10^3 m^2/d along certain major conduits (compare borehole logs G35023 and G35028, Appendix 2).

7. GROUND WATER POTENTIAL

=> In order to ascertain whether the primary ground water consumers such as Lichtenburg municipality could safety increase ground water abstraction the exploitable ground water potential of the following dolomitic areas has been estimated using a ground water balance budget :

- Lichtenburg/Bakerville area (Fig. 17)
- Lichtenburg 'Klipveld' area (Fig. 28)

It should be noted that :

- water levels are at present comparitively high and,
- few parameters in the ground water balance budget can be directly measured thus calculated figures are estimates only, where applicable attempts have been made to err on the conservature side.

The applied ground water balance equation is as follows :

Ground water inflow + infiltration from rainfall + return infiltration from irrigation equals surface outflow + ground water outflow + pumpage + direct evaporation from standing water + evapotranspiration - change in ground water storage.

7.1 LICHTENBURG/BAKERVILLE AREA (Fig. 17)

This is defined as a 338km^2 area enclosed by the Elizabeth, Hendriksdal, Grasfontein, Zamenkomst/Witklip dykes and to the south by the Black Reef Quartzite Formation.

7.1.1 Ground water budget

Over most of the area dolomitic rock outcrops is covered by an unsaturated cover of residual soils and alluvial gravels while over some 35% of the area dolomitic rock is covered by partially saturated Karoo clay and/or alluvium and/or calcrete.

The near impermeable Hendriksdal dyke with its sharp water level step, forms a natural barrier in the north-west of the area, permitting water movement from the area only. With present day ground water levels, ground water is assumed to be able to move freely through the other dyke boundaries similarily within the Lichtenburg/Bakerville area free movement of ground water is assumed to be possible across all dykes, despite some evidence of a step in ground water levels across the Greeffslaagte dyke on Lichtenburg Townlands 27IP.

Rainfall recharge will be calculated as the unknown in the water balance budget.

Ground water inflow

Ground water levels (Fig. 13) suggests that ground water movement into the compartment occurs through the eastern boundary, i.e. the Witklip/Zamenkomst dykes, between the Blaauwbank dyke in the south, and the Grasfontein dyke, in the north.

Assuming an average dyke transmissivity of 1,04 m^2/d (section 5.6) for a measured length of 8 km then the annual ground water movement is of the order of 3,0 $10^6 m^3$ (see Appendix 5 for water balance calculation).

Return infiltration from irrigation

Some 5.5 $10^6 m^3$ of ground water is being applied to silty and sandy soils for irrigation. It has been assumed that irrigation is efficently managed and that no return of irrigation water to ground water takes place.

Surface outflow

From Fig. 12, excluding the discharges of the Klipbankfontein springs, the average gauged flow of the springs draining the Lichtenburg/Bakerville area is 137,5 l/s which is equivalent to an annual discharge of some 4,3 $10^6 m^3$.

Ground water outflow

Water level measurements indicate that ground water outflow from the area occurs through the following boundaries :

- Hendriksdal dyke, utilising a transmissivity value of 0,12 m^2/d (section 5.6) and an effective measured length of 15,75 km, an annual leakage of 0,69 $10^6 m^3$ can be calculated.

- Southern boundary, where dolomite/quartzite/ lava are overlain by a cover of calcrete and Karoo clays. Using a transmissivity value of 0,44 m^2/d for a boundary length of 23km gives an annual figure of 3,69 $10^6 m^3$.

- eastern boundary, between the Klipbankfontein west spring in the north and the Black Reef Quartzite Formation boundary in the south. Using a transmissivity of 0,44 m^2/d due to a thick cover of Karoo clays over the Witklip dyke, and a boundary length of 5,75 km produces an annual leakage of 0,92 $10^6 m^3$ towards the Harts river.

By summing 0,69, 3,69 and 0,92 $10^6 m^3$ the annual ground water outflow from the area is calculated as 5,3.$10^6 m^3$.

Pumpage

The total estimated ground water abstraction from this area, for the period 1981.82 was 10,0.$10^6 m^3$ (Fig. 10) of which only 45% was gauged (section 5.1.3).

Direct evaporation from standing water

Ground water is exposed in some 1km^2 of cement and roadstone quarries principally on Lichtenburg Townlands 27IP. Records of average annual evaporation for the evaporation station C3E03, Barbespan, after the appropiate adjustment for evaporation from open water surfaces (see Appendix 5), indicate an annual average potential evaporation of some 1,7m per annum. For 1km^2 of open water an annual evaporation loss of 1,7.10^{6}m^3 is calculated.

Evapotranspiration

Following Cogho (1982) the lower limit of evapotranspiration was set at a ground water level of 5m a reasonable depth considering the lack of extensive tree cover over much of the region. During 1981/82 33km^2, mainly on the farm Elandsfontein 34IP, Klipbankfontein 25IP and Lichtenburg Townlands 27IP had water levels of less than 5m. The average annual rate of evapotranspiration was guess estimated at 1,2m, 70% of the average annual open water evaporation losses of 1,7m. (Wilson, 1974). For an area of 33km^2 this gives an annual evapotranspiration loss of 39,6.10^{6}m^3.

Change in storage

For an initial ground water balance equation average figures have been entered, where possible, and it assumed steady state conditions prevail with no change in storage.

Water Balance Budget

INPUT		*% of total*
Ground water inflow	*3,0.10^{6}m^3 p.a.*	*5%*
Infiltration from rainfall	*57,9*10^{6}m^3 p.a.*	*95%*
	60,9.10^{6}m^3 p.a.	
OUTPUT		
Surface outflow	*4,3.10^{6}m^3 p.a.*	*7%*
Ground water outflow	*5,3.10^{6}m^3 p.a.*	*9%*
Pumpage	*10,0.10^{6}m^3 p.a.*	*16%*
Direct evaporation	*1,7.10^{6}m^3 p.a.*	*3%*
Evapotranspiration	*39,6.10^{6}m^3 p.a.*	*65%*
	60,9.10^{6}m^3 p.a.	

** Infiltration from rainfall*

In order to balance the water budget presented above, with no change in ground water storage a rainfall recharge of 57,9 10^{6}m^3 p.a. is required. Equivalent for an area of 338km^2 to an annual cover of 171mm. Which represents 28% of the 50 year mean annual rainfall figure of 612mm. If current evaporation and evapotranspiration losses are substracted the net recharge is 9,5% of the mean rainfall.

Reasonable estimates of the parameters in the water balance equation have been made. The main difficulty being to quantify evaporation losses (a possible 65% of the output) which greatly influence any rainfall recharge calculations.

Mulder (1974) utilised a net annual rainfall recharge of 8% (no evapotranspiration calculations) for the Grootfontein compartment compared to 11% gross used by Cogho (1982). Results from the West Rand indicate recharge values of 8 to 27% (Fleischer 1981) with the high values occurring only when dewatering operations have created additional storage in the aquifer.

In comparison to rainfall recharge estimates produced for other regions, a 28% infiltration rate appears at first sight to be high but from field observations of the rapid drying out of the dolomitic area after heavy sustained rainfall is found to be reasonable. It is expected that recharge over the area underlain by thick Karoo clays will be substantially less than 28% thus within the dolomitic outcrop average infiltration rates will be more than 30%.

Any lowering of ground water levels in the south of the area will reduce evapotranspiration losses.

7.1.2 Specific yield

The average specific yield within the area was calculated by reworking the water balance equation using parameters for the 10 month period, July 1982 to April 1983, and including a change in storage component.

From the water level change contour map June/August 1982 to April/May 1983 (Fig. 17) 0,280 km^3 of rock was found to have been dewatered (see Appendix 5 for calculations).

Ground water and surface inflows and outflows for July 1982 to April 1983 were assumed to be constant at 10/12 of the annual figure. Pumpage was assessed at 9,6 $10^6 m^3$ (Appendix 5) as irrigation is mainly during the months of May and June. Rainfall was 434mm near full rainfall year, with an assumed infiltration rate of 28%, however due to possible soil moisture deficits and lower intensity & less frequencies of storms as compared to an 'average' year actual rainfall infiltration was probably less. During April 1983 standing water was only exposed over 0,4 km^2 and only some 28 km^2 had ground water levels of less than 5m (see 1983 ground water level contour map, GHP envelope 666).

The water balance budget to solve the change in storage is formulated as follows:

Change in storage = (input - output), where
INPUT

Groundwater inflow	2,5.$10^6 m^3$
Infiltration from rainfall	41,1.$10^6 m^3$
	43,6.$10^6 m^3$

OUTPUT

Surface outflow	$3{,}6.10^6 m^3$
Groundwater outflow	$4{,}4.10^6 m^3$
Pumpage	$9{,}6.10^6 m^3$
Direct evaporation	$0{,}7.10^6 m^3$
Evapotranspiration	$33{,}6.10^6 m^3$
	$51{,}9.10^6 m^3$

Thus a negative change in storage of $8{,}3\ 10^6 m^3$ *was experienced over the period July 1982 to April 1983. The volume of rock dewatered was* $0.280\ km^3$ *and as*

$$\text{specific yield} = \frac{\text{volume of water}}{\text{volume of dewatered rock}}$$

then the calculated specific yield is 2,96 or approximately 3%.

It must be noted that the calculated specific yield is greatly affected by the assigned values of evapotranspiration and rainfall infiltration and is an average figure for the dolomite and covering rocks throughout the water balance area. Local values on particularly well karstified dolomite may be expected to be significantly higher.

A comparison of the calculated yield of 3% with estimates for dolomitic rock elsewhere in South Africa indicates a similar order of magnitude. For ground water modelling of the nearby Grootfontein compartment Cogho (1982) successfully used a specific yield of 3 and 4%. In the West Rand Fleisher (1981) calculated specific yields 1,2 to 4% while in the Sishen area specific yields of 1,2% were estimated by Dziembowski (1982) Enslin and Kriel (1967) determined that during dewatering operations within the Venterspost compartment (West Rand) specific yield decreases exponentially with depth, from 9,1% at 61m to 1,3% at 146m.

7.1.3 *Volume of ground water in storage*

The maximum development of leached and fractured dolomite is up to 30m below present ground water levels (section 6.1). Deeper fractures and soluted zones undoubtable occur but have not been included in the storage estimate because of a lack of information in the deeper levels of the dolomite.

Storage calculations are made as follows :

volume of ground water = specific yield (area x saturated thickness)
$= 0{,}03\ (338.10^6 \times 30)$

Thus the volume of ground water in storage in the Lichtenburg/ Bakerville area is conservatively estimated at $300.10^6 m^3$*, which is some 5 times larger than the average annual rainfall recharge.*

7.2 LICHTENBURG 'KLIPVELD' AREA

This is defined as a 50 km^2 area enclosed by the Greeffslaagte, Witklip and Lichtenburg dykes with to the west the arbitary boundary of western border of Lichtenburg Townlands 27IP. This area includes the production borehole networks of Lichtenburg municipality and Blue Circle Cement (Pty) Ltd.

7.2.1 Ground water budget

Over 90% of the area the dolomitic rocks are covered by permeable residual deposits while over the remainder a cover of alluvial clay and/or calcrete and/or Karoo clays is developed.

With present day ground water levels (see Fig.13) ground water is presured to be able to flow freely through the dyke boundaries.

The Lichtenburg dyke has been choosen for convenience as the southern boundary, no other significance should be attached to it, as it occurs below a deep cover of Karoo clays (see Fig. 2).

Ground water inflow

Ground water levels (Fig. 13) suggest that the only ground water movement at present into the area is through the Greeffslaagte dyke. From the following water balance budget for steady state conditions, for an average rainfall year it appears that there is only minor ground water inflow (o,6.10^6 m^3 p.a.) through the area boundaries.

Infiltration from rainfall

For an area of 50km^2, mean rainfall of 612mm and recharge rate of 28% (7.1.1) infiltration is calculated as 8,6.$10^6$$m^3$.

Surface outflow

From fig. 12 the average gauged spring flow for the Lichtenburg springs and Aslaagte is 57,2 l/s equivalent to 1,8 10^6 m^3 p.a.

Ground water outflow

Water level contours (Fig. 13) indicate :

- ground water movement through the southern boundary. A transmissivity value of 0,44 m^2/d for a boundary lenght of 7km gives figure of 1,12.10^6 m^3 p.a.

- ground water movement through the eastern boundary, between the Klipbankfontein west spring and the Lichtenburg dyke, to the Harts River tributary. A transmissivity value of 0,44 m^2/d for a length of 2,5km is equivalent to 0,40.10^6 m^3 p.a.

The summed ground water outflow is 1,5.10^6 m^3 p.a.

Pumpage

The total estimated pumpage from the area is 4,2.10^6 m^3 p.a. of which some 85% is gauged.

Pumpage is very much centralised with $3,5.10^6 m^3$ p.a. being abstracted from an area of 0,8 km^2 on Lichtenburg Townlands 27IP.

Direct evaporation from standing water

Some 0,2 km^2 of standing water is exposed, allowing on evaporation rate of 1,7 m/p.a. some $0,3.10^6 m^3$ p.a. of water is lost.

Evapotranspiration

Ground water levels are within 5m of the surface over 1,2 km^2 of the area which for an evapotranspiration rate of 1,2m/p.a. releases some $1,4.10^6 m^3$ of ground water annually.

The ground water balance budget was solved to estimate ground water inflow into the area and the budget is as follows:

INPUT		% OF TOTAL
Ground water inflow	$0,6.10^6 m^3$ p.a.	7%
Infiltration from rainfall	$8,6.10^6 m^3$ p.a.	93%
	9,2	

OUTPUT		
Surface outflow	$1,8.10^6 m^3$ p.a.	20%
Ground water outflow	$1,5.10^6 m^3$ p.a.	16%
Pumpage	$4,2.10^6 m^3$ p.a.	46%
Direct evaporation	$0,3.10^6 m^3$ p.a.	3%
Evapotranspiration	$1,4.10^6 m^3$ p.a.	15%
	9,2	

The above water budget suggests that the calculated rainfall recharge of some 30% of average annual rainfall is of the right order of magnitude. A lower rainfall recharge would necessitate increased ground water inflow into the area and/or decline in storage.

7.2.2 Volume of ground water in storage

Utilising a saturated aquifer thickness of 30m and a specific yield of 3% (see sections 7.1.2. and 7.1.3) the volume of ground water in storage is conservatively estimated at $45.10^6 m^3$ which is some 5 times the estimated average annual recharge.

7.3 EXPLOITABLE GROUND WATER POTENTIAL

Water balance budget calculations indicate a recharge rate of some 28% of annual average rainfall and a specific yield of 3%. Conditions are highly favourable for substantially increased ground water abstraction from the dolomite aquifer.

Within the Lichtenburg/Bakerville area present pumpage, concentrated in the south, only accounts for some 16% of average annual recharge. Large losses are incurred through evapotranspiration from shallow ground water levels in the natural spring discharge areas on Elandsfontein 34IP. Lichtenburg 27IP and Klipbankfontein 26IP. Considerable scope for additional increases in pumping exists, provided the local aquifer conditions are sufficiently transmissive, and would have the beneficial effect of lowering ground water levels and the possibly adverse effect of reducing spring flows. The large volume of ground water presently in storage $300.10^6 m^3$ (30 times present abstraction) after the recent succession of years of above average rainfall (Fig. 1)can no doubt be successfully mined during a succession of years of below average rainfall.

Ground water level observations(section 5.4.2.) indicate that a rapid recovery of ground water levels may be expected after renewed heavy substained rainfall. Within dyke boundaries the dolomite aquifer is generally highly transmissive while at dykes boundaries locally reduced transmissivity values are applicable. It is expected that ground water mining, creating head differences across dykes, during periods of below average rainfall would induce substantial leakage through the bounding dykes ($1000 m^2/d$ per km),except the Hendriksdal dyke, and through the dykes within the area attracting ground water flow from the unexploited north to the south of the water balance area. The highly transmissive nature of the dolomite allied with its high storage and cover of calcrete and clays in the southern area suggests that any sinkhole development would be minimal.

7.3.1 Lichtenburg "Klipveld"area

During the course of this investigation, Lichtenburg municipality (population 20 000, 1981/82 ground water consumption $2,6.10^6 m^3$) requested guidance on the proposed expansion of the municipal borehole network to meet a projected year 2000 demand of $6.10^6 m^3$ p.a. (Special Task Division Dept. Env. Aff.).

Due to heavy demand over September-December 1982 the municipality had problems providing daily discharges of 13 000 m^2/d (average daily November consumption) from their recently equipped pumping borehole network of 8 boreholes with a combined potential supply capacity of 34 000 m^2/d, Rademeyer 1980. A drastic decline in yield was experienced from pumping boreholes, unfortunately this cannot be quantified as boreholes are not equipped with water flow meters. The local plummet in water levels from July 1982 to March 1983 is dramatically shown by hydrograph C3N086 (Fig. 20) which is located 30m west of Lt 3 within the northern cluster of boreholes. Nearly static regional water levels,the persistence of flow from Lichtenburg springs combined with continuing strong yields from the 3 Blue Circle Cement production boreholes (pers. comm. van Tonder, Chief Engineer, Blue Circle) suggested that water levels were locally lowered, particularly in the northern cluster around Lt 3, due to interference between the pumping boreholes.(see borehole sketch Rademeyer, 1980). The water level change map prepared for June/August 1982 to April/May 1983 (Fig. 17) does not indicate this centralised drawdown due to a lack of local measuring points, before the drilling of exploration boreholes and due to the fact that water levels had nearly fully recovered by May 1983.

The cone of depression on Lichtenburg Townlands 27IP (Fig. 17) is centred on Lt 4 where continuous development pumping had been practised for some 240 hours. The shape of the ground water depression suggests that production boreholes are connected to a north-south major conduit(s) and which are fed by intersection joints of lower transmissivity which form an effective drain within the dolomite area.

It is possible that as a result of this accelerated draining action a slight water step was created to the south of the Greeffslaagte dyke. Rainfall recharge of the dolomitic catchment accompanied by reduced domestic demand allowed water levels around the production boreholes to recover.

Water budget calculations indicate that for a year of average rainfall sufficient recharge should be available within the Lichtenburg 'Klipveld' area for pumpage to expand from the present day $4{,}2.10^6 m^3$ p.a. to a projected $7{,}6.10^6 m^3$ p.a. by the year 2000 (allowing only Lichtenburg Municipality to increase abstraction by $3{,}4.10^6 m^3$). For a succession of years of below average rainfall mining of ground water from the high storage (estimated at $45.10^6 m^3$) can take place with the dewatering of 1m of aquifer providing some $0{,}9.10^6 m^3$ of ground water. Any lowering of ground water levels can expect to induce significant additional ground water inflow, provided there is a negative head difference in favour of the Klipveld area. A potential inflow of $14{,}3.10^6 m^3$ p.a. has been calculated as follows.

- Greeffslaagte $2{,}8.10^6 m^3$ p.a. (Length 7,5 km, transmissivity $1 m^2/d$)
- Witklip dyke $2{,}4.10^6 m^3$ p.a. (effective length 6,5 km, Transmissivity $1 m^2/d$)
- Western boundary $9{,}1.10^6 m^3$ p.a. (effective lenght say 5km average transmissivity say $5 m^2/d$).

<u>Proposals</u>

Recommendations on achieving an average daily abstraction of 16 500 m^3/d (year 2000) are made. Peak period demands can be met by expanding pumping periods.

No additional abstraction boreholes should be established in the traditional municipal borehole clusters namely around Lt 3 and Lt 10. Where possible the pumping rates of these boreholes should be reduced. The decentralisation of the pumping boreholes will confer the following benefits :

- more efficient pumping of boreholes, with
- more efficient use of rainfall recharge to the aquifer, and
- maximisal ground water inflow recharge,
- more efficient use of aquifer storage with
- minimal sinkhole development risks

Proposals to better utilise the ground water resources are as follows (see Fig. 28) :

- *existing borehole cluster Lt 10, 11, 41 and 42 total maximum pumpingrate50 l/s for 12 hr/day will provide 2200 m^2/d*

- *existing borehole cluster Lt 3, 26, 27, 36, 37, 39 and 40 total maximum pumping rate 100 l/s for 12h/day will provide 4300m^2/d Due to mutual interference of boreholes certain pumps can be removed. Thus the total attainable yield from existing sources with minimal adverse effects is some 6500m^2/d or 2,4.10^6 m^3 p.a. approximately equal to present day requirements.*

- *the development of boreholes at Aslaagte Spring, Three or four boreholes should be capable of providing 100 l.s equivalent to 4300 m^2/d for a 12hr /day pumping period.*

- *the development of boreholes, in the west, in the vicinity of G35003. Three or four boreholes jointly yielding 100 l/s for a 12hr/day would provide 4300m^2/d. The pumping of which would encourage ground water flow into the area across the arbitary boundary.*

The development of these additional sources of supply along with existing supply points should provide some 1500 m^2/d or 5,5.10^6 m^3 pa. After exploration drilling and development have been carried out and pumping operations commenced, further recommendations can be made after a suitable set of records has been collected. At this stage it is not anticipated that the municipality will have to move further afield to more distant parts of the Townlands i.e. between the Greeffslaagte and Paarl dykes or the vicinity of G35028 to attain the volume of ground water required for municipal consumption.

8. SUMMARY

The main findings of this investigation which have been commented on in the report are :

- *the previously inferred southern extent to the limit of the Malmani subgroup has been partly defined*

- *the Black Reef Quartzite Formation has been drilled*

- *over much of Dudfield 35IP and Elandsfontein 34IP Karoo clays/mudstones underlie recent calcrete deposits.*

- *the positions of the Elizabeth/Elizabeth II and Grasfontein dykes have been located in the field using magnetic surveys*

- *the following dykes have been drilled: Blaauwbank, Greeffslaagte, Hendriksdal, Witklip and Zomenkomst.*

- *depths to fresh diabase varies from 24 to over 40m.*

- *the chert-rich dolomitic rock is extensively Karstified. Lack of karstification in the lower part of the Oaktree Formation (below 1480 m contour line) may be explained by the new development of karst under a cover of Karoo clay or the subsequent erosion of the karstified rock.*

- *zones of preferential solution, with generally high transmissivity values are associated with structural lineations*

- *structural lineations are often dyke intruded and/or partly silicified.*

- *some non magnetic lineations can be successfully identified in the field using electromagnetic surveys.*

- *within the 500 km^2 study area some 750 boreholes and well points were located.*

- *ground water consumption in the study area is only some 11,5.10^6 m^3, of which 56% is used for irrigation, 23% for municipal requirements and 14% for industry.*

- *since 1974 the area of irrigated area land has substantially declined in the west of the area.*

- *average monthly spring flow 1982/83 totals some 250 l/s. The major springs being Klipbankfontein Central and Uitgevonden North. In 1974 spring flow was minimal.*

- *mean annual rainfall at Lichtenburg over the period 1932/33 to 1981/82 was 612mm.*

- *the lowest ground water levels were recorded in 1959*

- *the highest ground water levels were recorded in 1978.*

- *at present water levels are declining slowly but are still considerably higher (5m in places) within the dolomite than water levels experienced in 1974.*

- *a period of heavy sustained rainfall (of the order of 350mm) is required to significantly recharge ground water,*

- *ground water inflow enters the study area from the NE,*

- *ground water outflow occurs from the NW, S and SSE parts of the area,*

- *a 20m drop in ground water levels occurs in a westerly direction across the Hendriksdal dyke. Small water steps are present across parts of the Blaauwbank, Elizabeth, Greeffslaagte and Paarl dykes.*

- *high water levels, allied with low topography and the near impermeable Hendriksdal dyke cause the Uitgevonden north and the Uitgevonden south springs to flow across the dyke before disappering into natural swallow holes in the west.*

- *the transmissivity of the Hendriksdal dyke was estimated at 0,1m^2/d*

- transmissivity values for other dykes being of the order of $1m^2/d$

- leakage through the southern boundary i.e. through dolomite and lava bedrock under a cover of clay and calcrete, was estimated using a transmissivity value of some $0,4m^2/d$.

- ground water are calcium and/or magnesium bicarbonate waters which are hard to very hard and moderately mineralised. Apart from local high concentrations of nitrate all waters are potable.

- water balance budget calculations indicate a gross rainfall recharge of 28% (net 9,5% excluding evapotranspiration) of mean annual rainfall and an average specific yield of 3%

- current evapotranspiration losses are high because of high ground water levels in natural spring discharge areas

- for the 340 km^2 Lichtenburg/Bakerville area the average annual rainfall recharge was estimated at 58 $10^6 m^3$ pa of which only $10.10^6 m^3$ pa was abstracted by pumpage. The volume of ground water in storage was estimated at 300 $10^6 m^3$

- for the $50km^2$ Lichtenburg Klipvled" area - the source of ground water for both Lichtenburg municipality and Blue Circle Cement (Pty) Ltd - the average rainfall recharge is some $8,6.10^6 m^3$ with a present day abstraction of $4,2\ 10^6 m^3$. The volume of ground water in storage was estimated at $45.10^6 m^3$.

- the estimated volumes of ground water in storage suggest that adequate ground water reserves are available to cope with present day demand through a period of low rainfall recharge. Additional ground water inflow may be induced through the boundaries of the water budget areas if a negative pressure head was to develop.

- ground water supply problems experienced by Lichtenburg municipality during September - December 1982 were due to poor pump lay out causing interference between adjacent pumping boreholes.

9. RECOMMENDATIONS

To answer the prescribed objectives of this investigation the following recommendations are made :

Water balance budget calculations indicate that adequate ground water is available within the dolomitic aquifer, even during periods of low rainfall, to comfortably supply all primary consumers. Scope for the expansion of the present ground water supply is available, an additional $10.10^6 m^3$ pa could probably be made available immediately with little adverse effects. The areas of possible water use growth for irrigation are limited to those areas that contain both suitable transmissive formation and suitable soils, mainly parts of Dudfield 35IP, de Paarl 54IO, Greeffslaagte 33IP and Hendriksdal 1IP. Only minor extensions of irrigation might be anticipated in other areas, even with the extension of ESCOM power to section of Houthaalboomen 31IP, Witklip 6IP and Zamenkomst 4IP.

Calculations indicate that Lichtenburg Municipality is very favourable placed as regards ground water supply. No problems are expected in providing a year 2000 supply of $6.10^6 m^3$ pa from the dolomite provided that the municipality properly distributes new production boreholes (section 7.3.1). It is recommended that borehole networks should be developed first at Aslaagte springs and secondly on the northwestern cadastral farm boundary near borehole

G35003. To avoid any contamination of ground water the survellainee and control of dumping should be effected on the two, flooded roadstone quarries just west of the townlands boundary on the Lichtenburg-Zeerust road.

Since proclamation of this area as a subteranean water control area in 1963, numerous boreholes have been drilled without prior permission (only 75% of boreholes registered) and irrigation is practised, particularly by minor irrigators (less than 10 ha) with scant regard to borehole permit conditions.

Considering that the area is difficult to 'police' from a ground water point of view, total ground water reserves appear to be more than adequate and only limited expansion of ground water useage is possible in areas with poorly transmissive formation, i.e. more or less below the 1480m contour line a relaxation of the borehole drilling and water use laws may be desirable. It is suggested that minor irrigators , less than 10 ha of land irrigated, should be allowed to irrigate without special permits but that irrigators who have more than 10 ha under water should be compelled to fix and maintain water flow meters by their boreholes, pay an annual levy to have their flow meters read and should submit annually to the Division of Geohydrology a statement indicating how much land was irrigated and for what purpose.

To enable a better understanding of geohydrological conditions in the Lichtenburg area the following work should be iniated/continued.

- 3 boreholes should be drilled on Greeffslaagte33 IP across the Hendriksdal and Paarl dykes to confirm any step in ground water levels

- one borehole should be drilled on Dudfield 35IP midway between boreholes Dd 20 and Dd 80 to monitor water levels in the area of heavy abstraction by Anglo Alpha Cement (Pty) Ltd.

- one borehole is required on the Elandsfontein/Dudfield boundary, near the main road, to enable water level contours to be drawn more precisely

- a replacement borehole for G35016 (Zomenkomst 4IP) is required.

- permanent flow gauging sites should be installed near the follwing 8 springs, Aslaagte, Lichtenburg, Springs, Klipbankfontein west, Klipbankfontein central, Klipbankfontein east, Klipbankfontein no.4, Uigevonden south and Uitgevonden north.

- water level observations should continue to be monitored at all Division of Geohydrology observation boreholes. However one of C3N524 or C3N525 can be removed.

- H.W.K. metres should be installed and read at the following sites on Lichtenburg Townlands 27IP to assist in ground water planning for Lichtenburg municipality boreholes G35002, G35003, G35004, G35005, G35007, G35008, G35012, G35013, G35028, G35029, G35030, Lt 27 (C3N08) and Lt 31 (if C3N086 Lt6 can no longer be read).

- H.W.K. metres should also be installed at the following boreholes : G35015, G35021, G35022, G35026 and G35027 to monitor any water level changes across dykes.

- *water flow meters should be installed on the main production boreholes as listed in Appendix 1.*

A regional gravity survey allied with geophysical logging of boreholes is required to accurately delineated across of leached dolomite and provide estimates of specific yield. The results of this geophysical work will enable ground water storage volumes to be revised.

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FIGURES

Fig. 9 BOREHOLE STATISTICS

FARM	TOTAL AREA			LICHTENBURG/BAKERVILLE WATER BALANCE AREA		
	No. of water bore-holes	No. of bore-holes in use	No. of permits issued to March 1983	No. of water bore-holes	No. of bore-holes in use	No of irrigation municipal and industrial boreholes in use 1981/82
Dudfield 35+57IP	120	48	90	79	36	4
Elandsfontein 34IP	109	65	100	109	65	13
Grasfontein 356JP	18	10	13	-	-	-
Greeffslaagte 33IP	29	16	28	29	16	9
Hendriksdal 1IP	18	11	14	9	6	1
Hendriksrust 36IP	14	10	11	-	-	-
Houthaalboomen 31IP	22	16	22	22	16	5
Houthaaldoorns 2IP	16	7	16	16	16	2
Klipbankfontein 26IP	136	87	128	37	28	7
Lichtenburg Town-lands 27IP	180	130	61	130	80	14
Prien 30IP	1	1	1	1	1	0
Ruigtelaagte *353JP			4	5	3	0
Schepunt 32IP	2	2	2	2	2	1
Talene 25IP	15	13	?	15	13	8
Uitgevonden * 355JP			8	5	5	1
Welverdiend 361JP	13	9	13	-	-	-
Witklip 6IP	10	5	10	1	1	0
Zamenkomst 4IP	17	12	17	17	12	0
TOTAL	720**	442	540	477	300	65

* only part of farm surveyed

** excludes 30 recently drilled exploration boreholes (Divis of Geohydrology and 13 private exploration boreholes shown in Enclosure 1.

FIG.10 : GROUND WATER ABSTRACTION AND AREAS UNDER IRRIGATION CLASSIFIED AS TO FARM

FARM	ESTIMATED ABSTRACTIONS 1981/1982 x103m^3		IRRIGATED AREA (ha) 1981/82	
	TOTAL AREA	WATER BALANCE AREA	TOTAL AREA	WATER BALANCE AREA
Dudfield 35+57IP	785	769	47	47
Elandsfontein 34IP	325	325	55	55
Elizabeth * 357JP	0,5	-	-	-
Grasfontein 356JP	39	-	-	-
Greeffslaagte 33FP	2933	2933	313	313
Hendriksdal 1IP	56	19	5	5
Hendriksrust 36IP	59	-	9	9
Houthaalboomen 31IP	689	689	59	59
Houthaaldoorns 2IP	483	483	80	80
Klipbankfontein 26IP	1883	594	180**	57
La Rey Stryd* 53 IO	0,5	-	-	-
Lichtenburg Townlands 27IP	3723	3698	-	-
Prien 30IP	0,3	0,3	-	-
Ruigtelaagte* 353JP	0,7	0,7	-	-
Scherpunt 32IP	102	102	13	13
Talene 25IP	316	316	26	26
Uitgevonden* 355JP	100	71	-	-
Welverdiend 361JP	7	-	-	-
Witklip 6IP	3	2	-	-
Zamenkomst 4IP	10	10	-	-
TOTAL	11515 or 11,5 x 10^6m^3	10012 or 10 x 10^6m^3	787	664

* Only part of farm surveyed

** 1982/83 extended to 220H.

FIG. 12 : TABULATED SPRING/STREAM FLOWS IN 1/s, LICHTENBURG 1982/83

DATE GAUGED / STATION	MP1	MP2	MP4+5	MP6	MP7	MP8	MP9	MP10	MP11	TOTAL GAUGED FLOW 1/s
22-23/06/82	17,3	104,3	42,0							(163,6)
29/07-05/08	16,9	89,4	49,4	9,2	29,2	48,6				(242,7)
30/08-01/09	25,1	110,3	34,4**	5,1	19,8	44,8				(239,5)
29-30/09	19,2	105,9	23,4**	1,0	15,3	41,5				(206,3)
03-05/11	11,5*	68,8	27,8**	0,4	30,4	28,3	3,0			(170,2)
29-30/11	17,4*	60,8	20,6**	0	5,6	12,3	0			(116,7)
23-28/12	10,9*	70,9	15,6**	0	1,4	11,4	0	26,0	68,8	205
17-18/01/83	12,6*	76,7	30,0**	0	16,8	35,9	0	22,8	70,4	265,2
21-22/2	9,9*	69,2	13,4	0	5,6	17,4	0	7,0	58,1	180,6
22-25/03	12,2*	76,8	17,8	0	11,3	38,3	0	16,0	55,8	228,2
20-22/04	10,7*	76,5	31,7	0	15,5	22,1	0	12,3	64,3	233,1
24-25/05	1,0*	89,9	17,5	0	14,0	31,3	0	11,5	58,4	223,6
TOTAL OF MONTHLY FLOWS (1/s)	164,7	999,5	323,6	15,7	164,9	331,9	3,0	95,6	375,8	
Av. MONTHLY FLOW (1/s)	13,7	83,3	27,0	1,4	15,0	30,2	0,4	15,9	62,6	249,5
ESTIMATED FLOW 1982/83 ($10^6 m^3$)	0,432	2,627	0,851	0,044	0,473	0,952	0,013	0,501	1,974	7,868

* AFFECTED BY PUMPING OF KM 10 N.B. EXCLUDES KLIPBANKFONTEIN NO.4 ESTIMATED DISCHARGE 5 1/s

** MP5

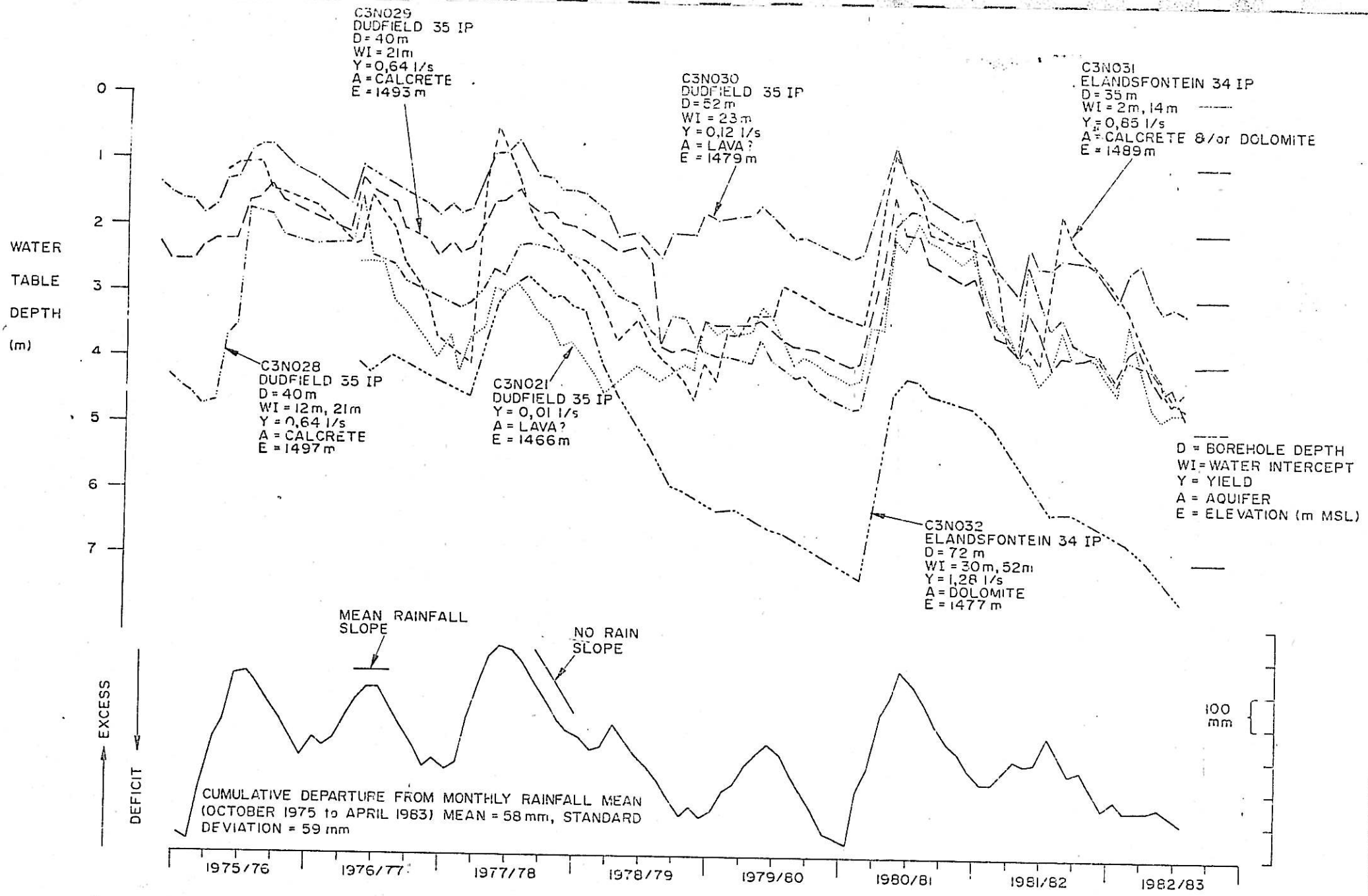


FIG. 18
GHP 6040

HYDROGRAPHS, LICHTENBURG AREA - C3N021 AND C3N028 TO C3N032 (INCL)

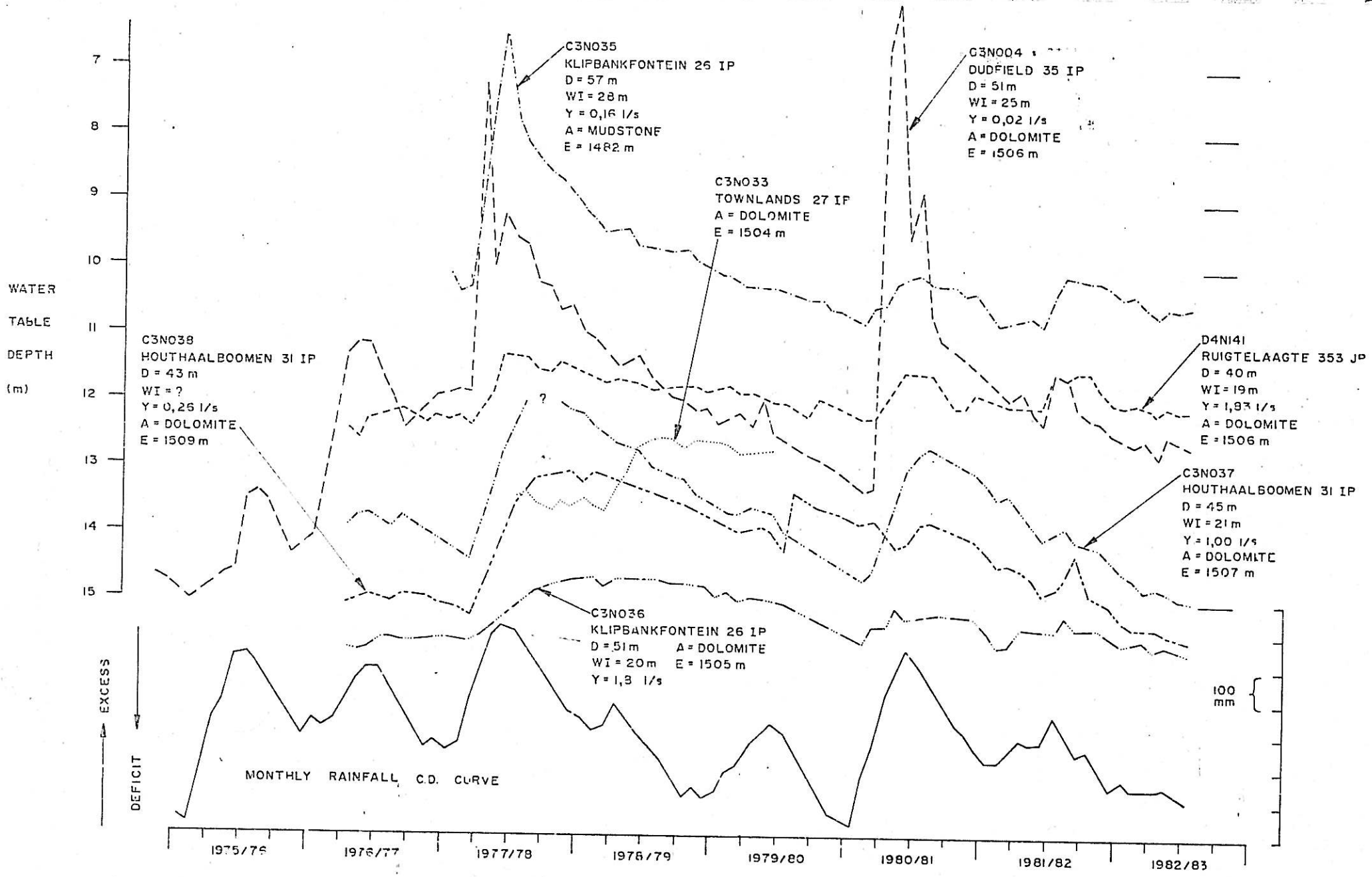


FIG. 19
GHP 6041

HYDROGRAPHS, LICHTENBURG AREA - C3N004, C3N033, C3N035 TO C3N038 (Incl.) & D4N141

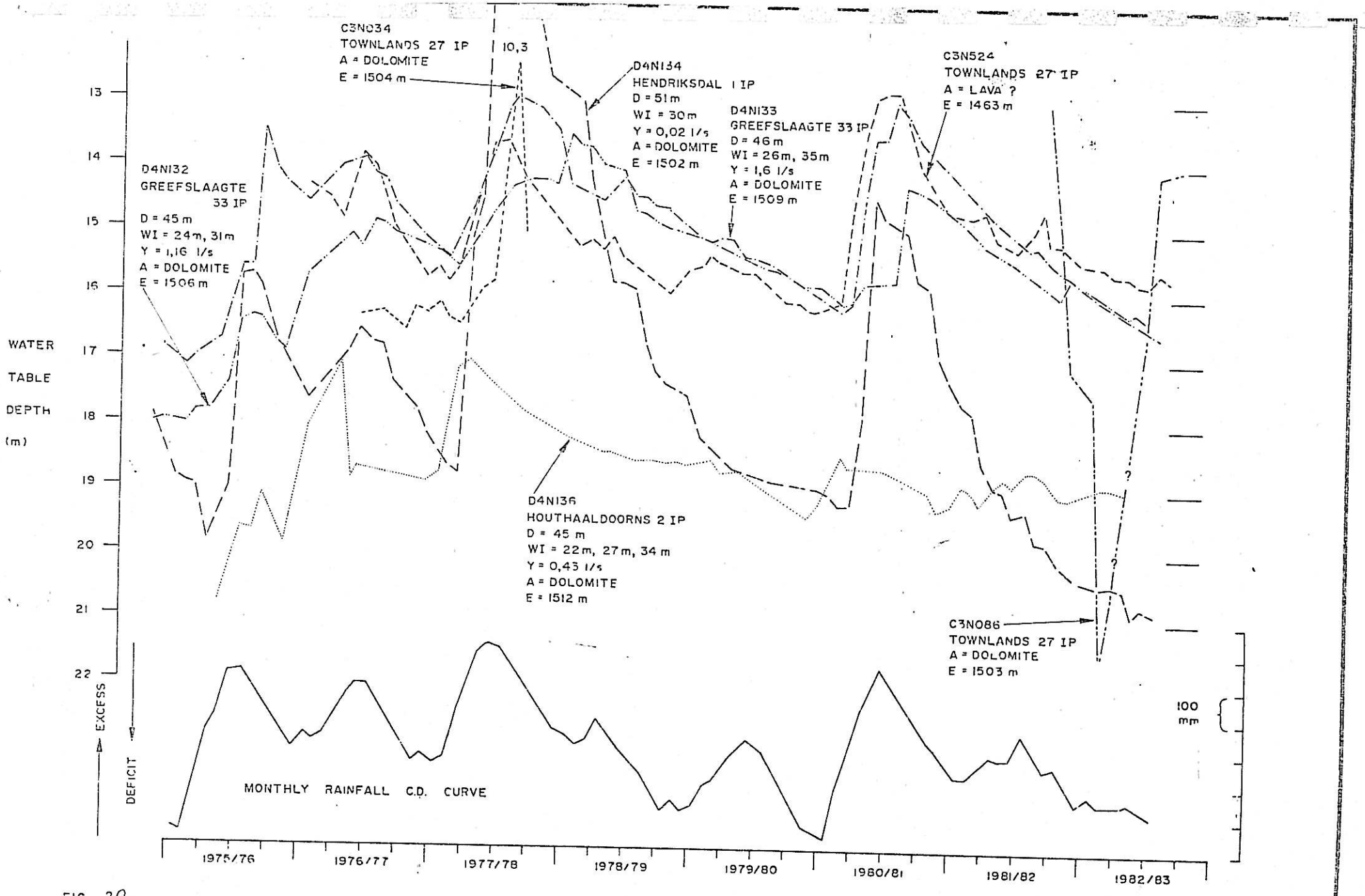


FIG. 20
GHP 6042

HYDROGRAPHS, LICHTENBURG AREA - C3N034, C3N086, C3N524, D4N132 to D4N134 (Incl.) AND D4N136

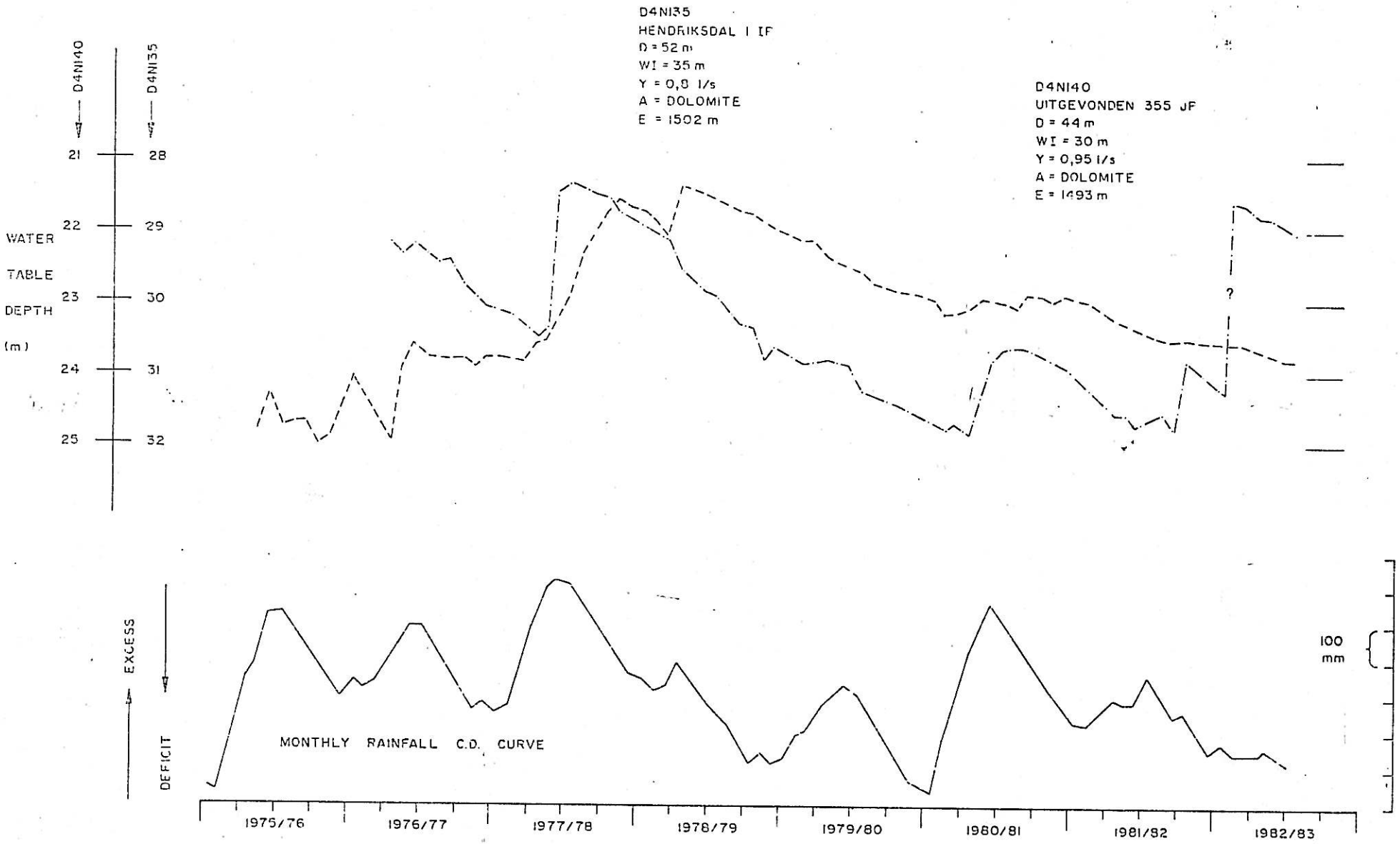
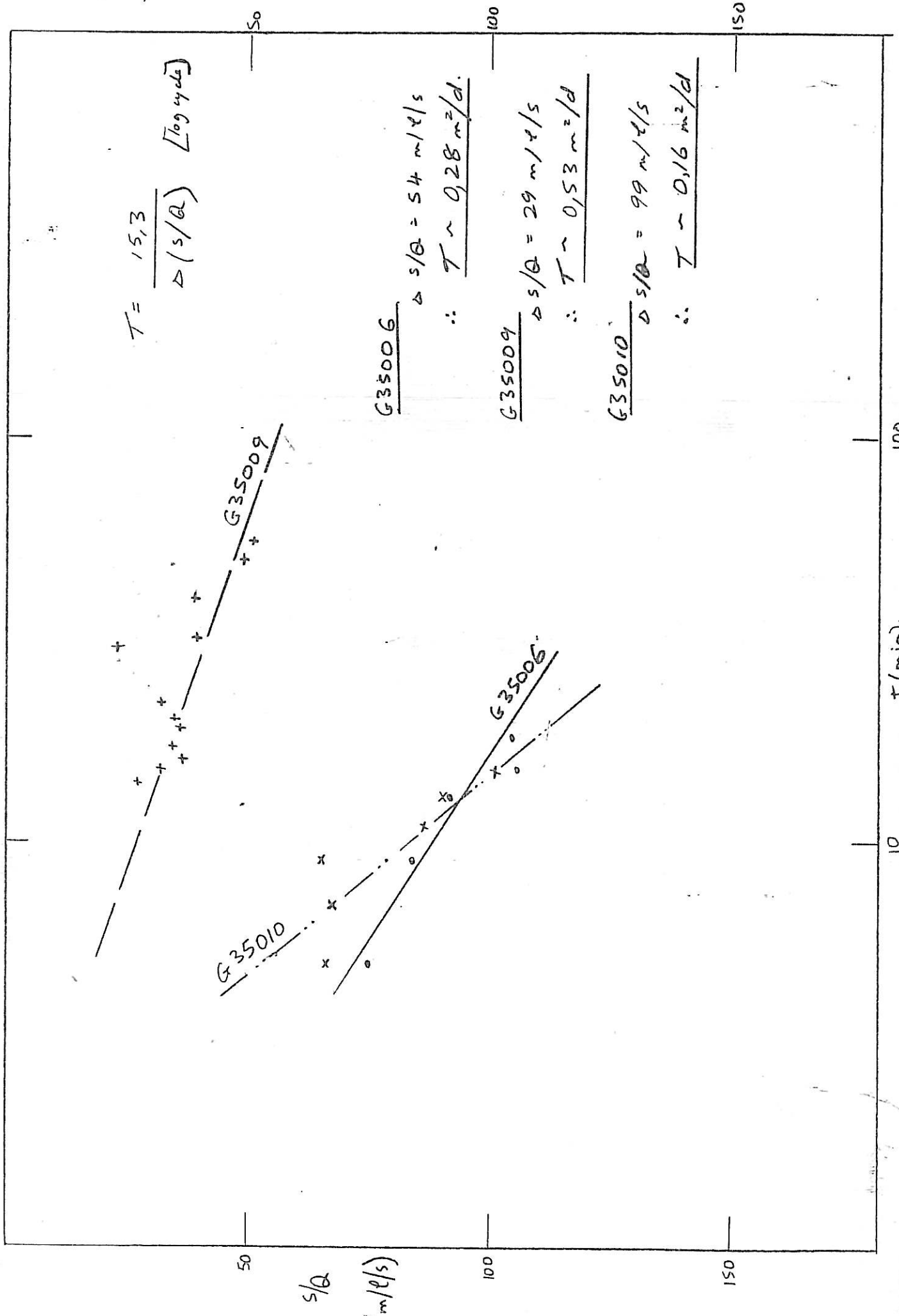


FIG. 21
GHP 6043

HYDROGRAPHS, LICHTENBURG AREA - D4NI35 AND D4NI40

FIG 22
GHP 6054

SCHAFER ANALYSIS – G35006, G35009 & G35010



$$T = \frac{15,3}{\Delta(s/Q)} \quad [\log \text{ cycle}]$$

G35006

$\Delta s/Q = 54$ m²/l/s

$\therefore T \sim 0,28$ m²/d.

G35009

$\Delta s/Q = 29$ m²/l/s

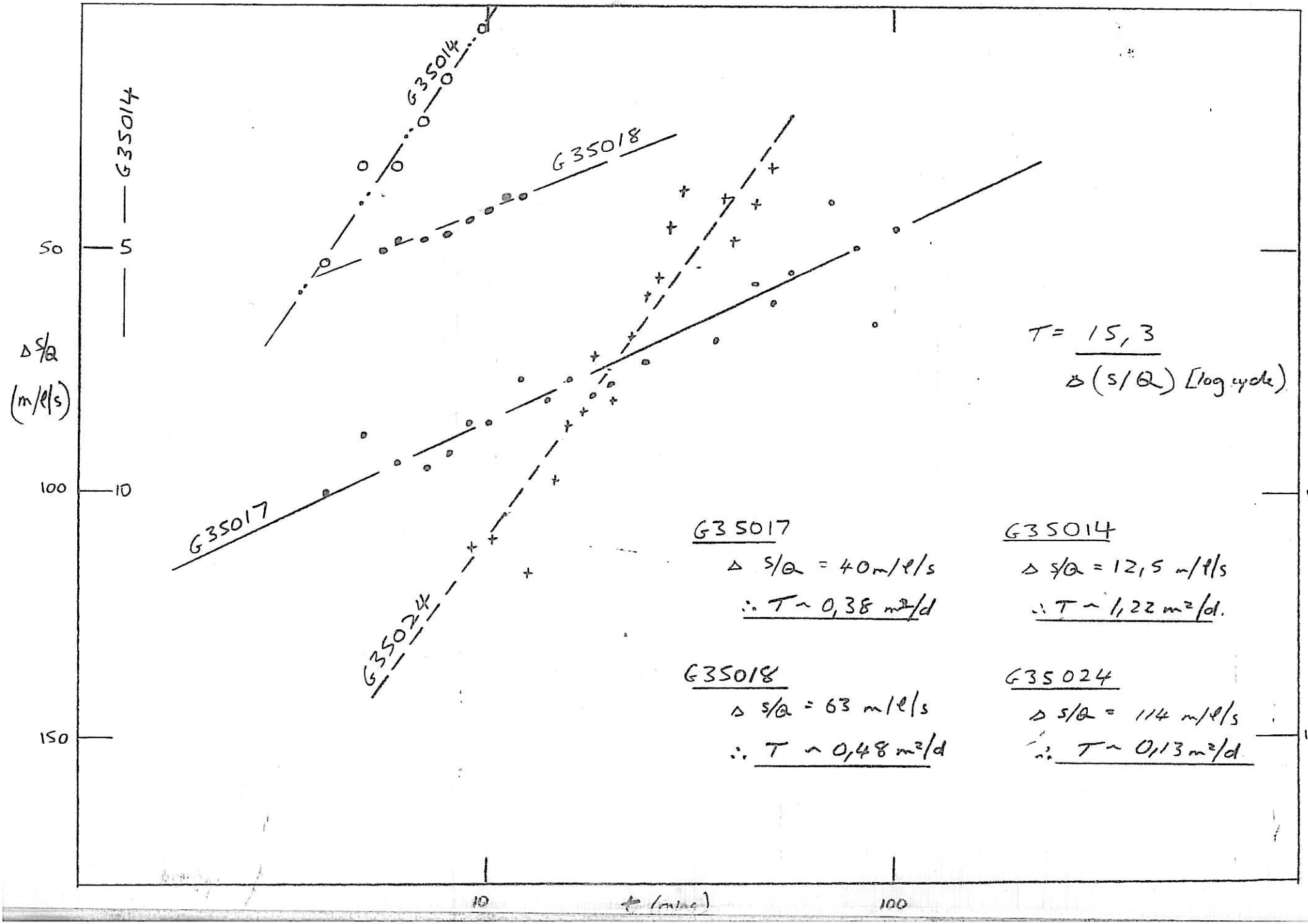
$\therefore T \sim 0,53$ m²/d

G35010

$\Delta s/Q = 99$ m²/l/s

$\therefore T \sim 0,16$ m²/d

FIG 23
GHP 6055 SCHAFER ANALYSIS – G35014, G35017, G35018 & G35024



$T = \frac{15,3}{\Delta(s/Q)\ [\text{log cycle}]}$

G35017

$\Delta s/Q = 40\ m/\ell/s$

$\therefore T \sim 0,38\ m^2/d$

G35014

$\Delta s/Q = 12,5\ m/\ell/s$

$\therefore T \sim 1,22\ m^2/d.$

G35018

$\Delta s/Q = 63\ m/\ell/s$

$\therefore T \sim 0,48\ m^2/d$

G35024

$\Delta s/Q = 114\ m/\ell/s$

$\therefore T \sim 0,13\ m^2/d$

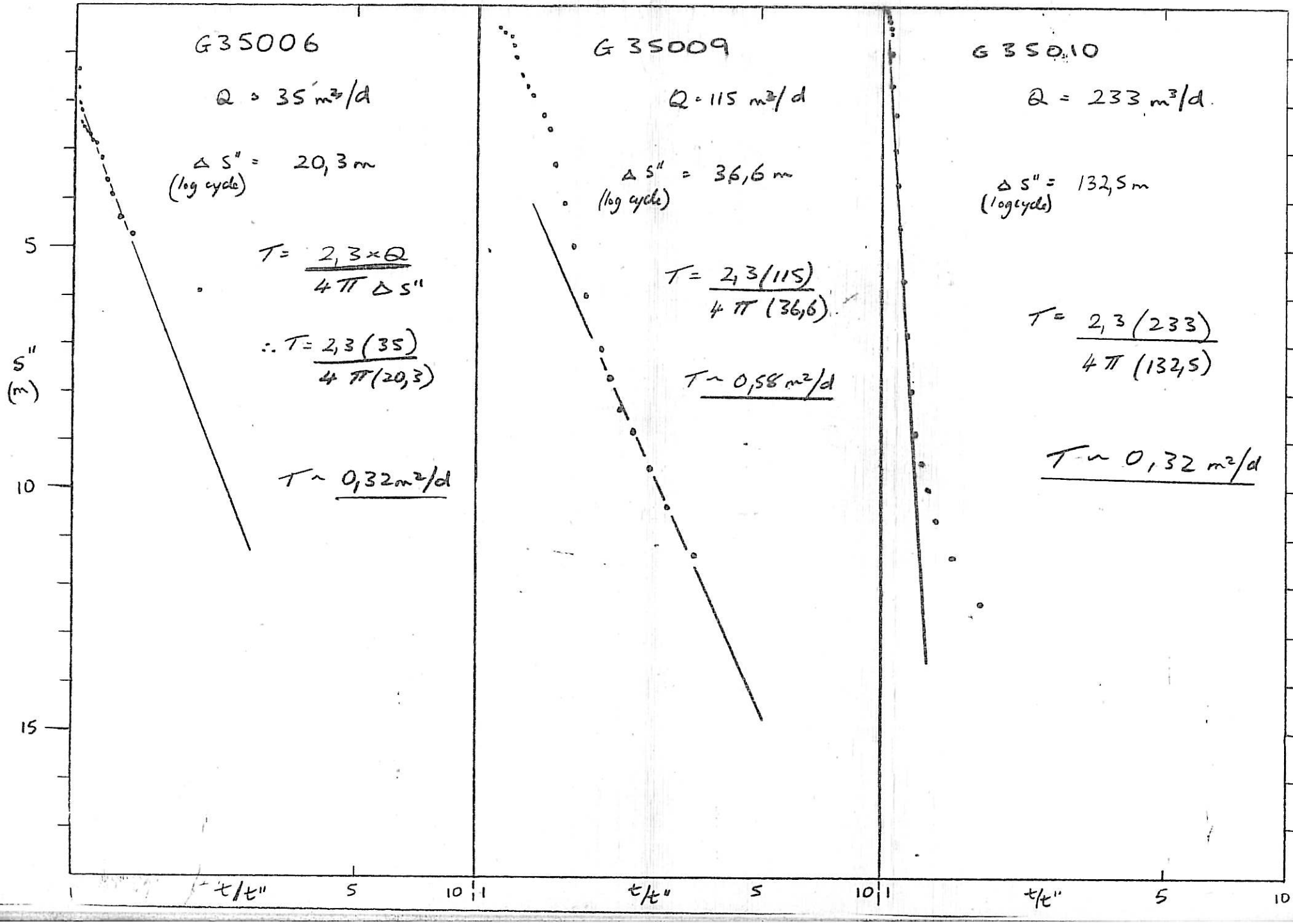


FIG 24
GHP 6056 THEIS RECOVERY PLOTS - G35006, G35009 & G35010

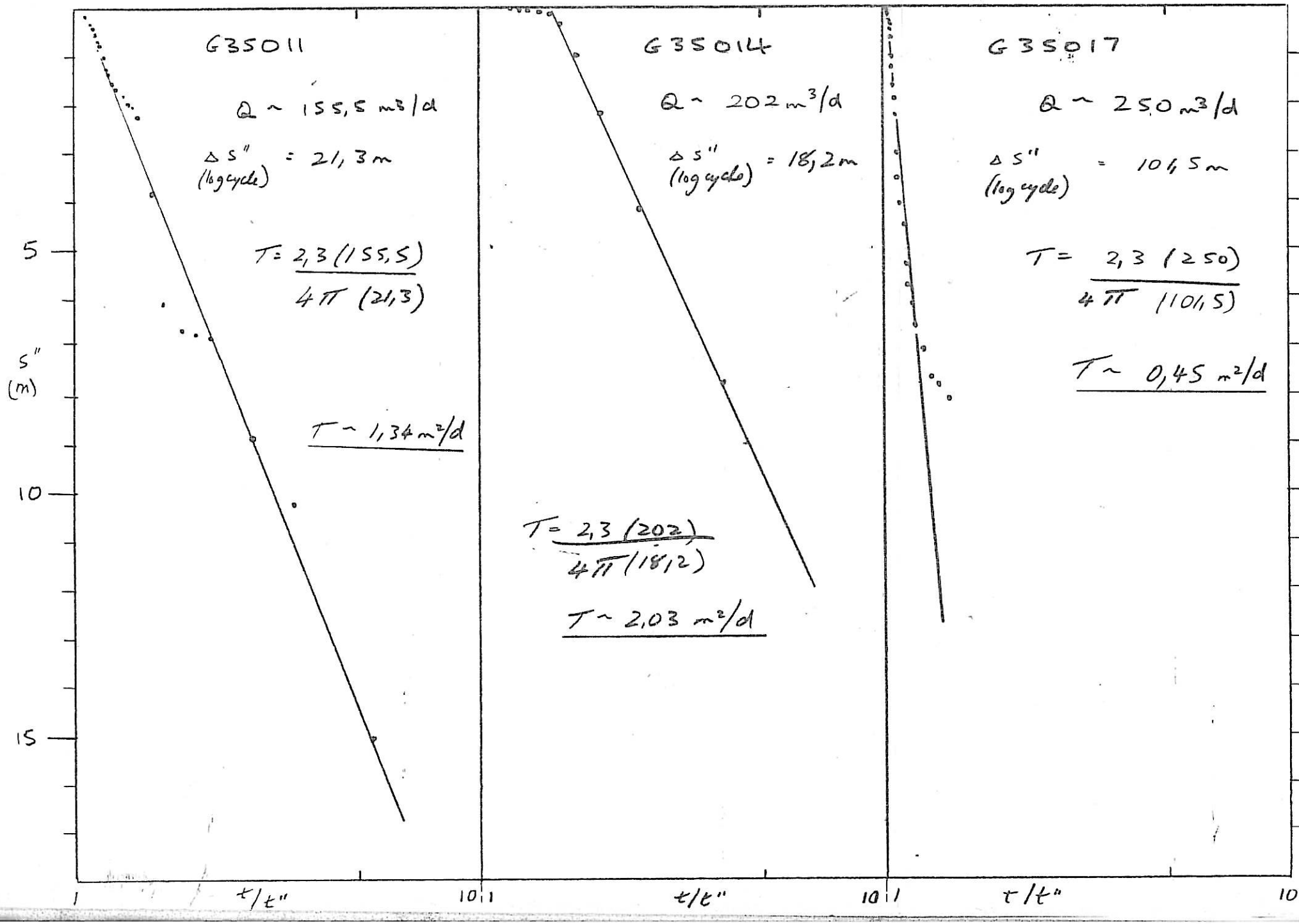
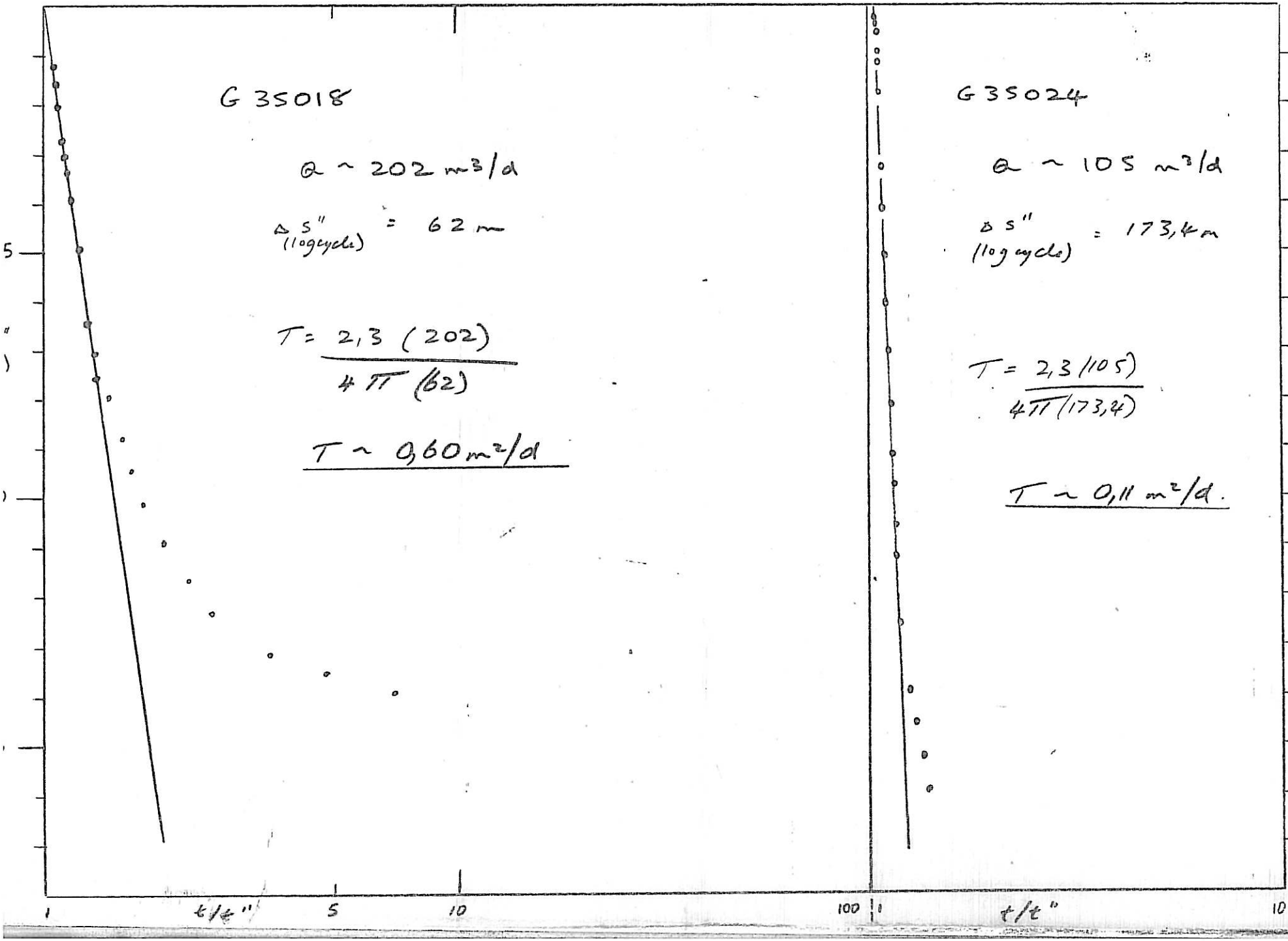


FIG 25
GHP 6057 THEIS RECOVERY PLOTS - G35011, G35014 & G35017

FIG 26
GHP 6058 THEIS RECOVERY PLOTS - G35018 & G35024



EXPANDED DUROV DIAGRAM

FIG 27 GHP 6059

GROUND WATER HYDROCHEMISTRY, LICHTENBURG AREA.

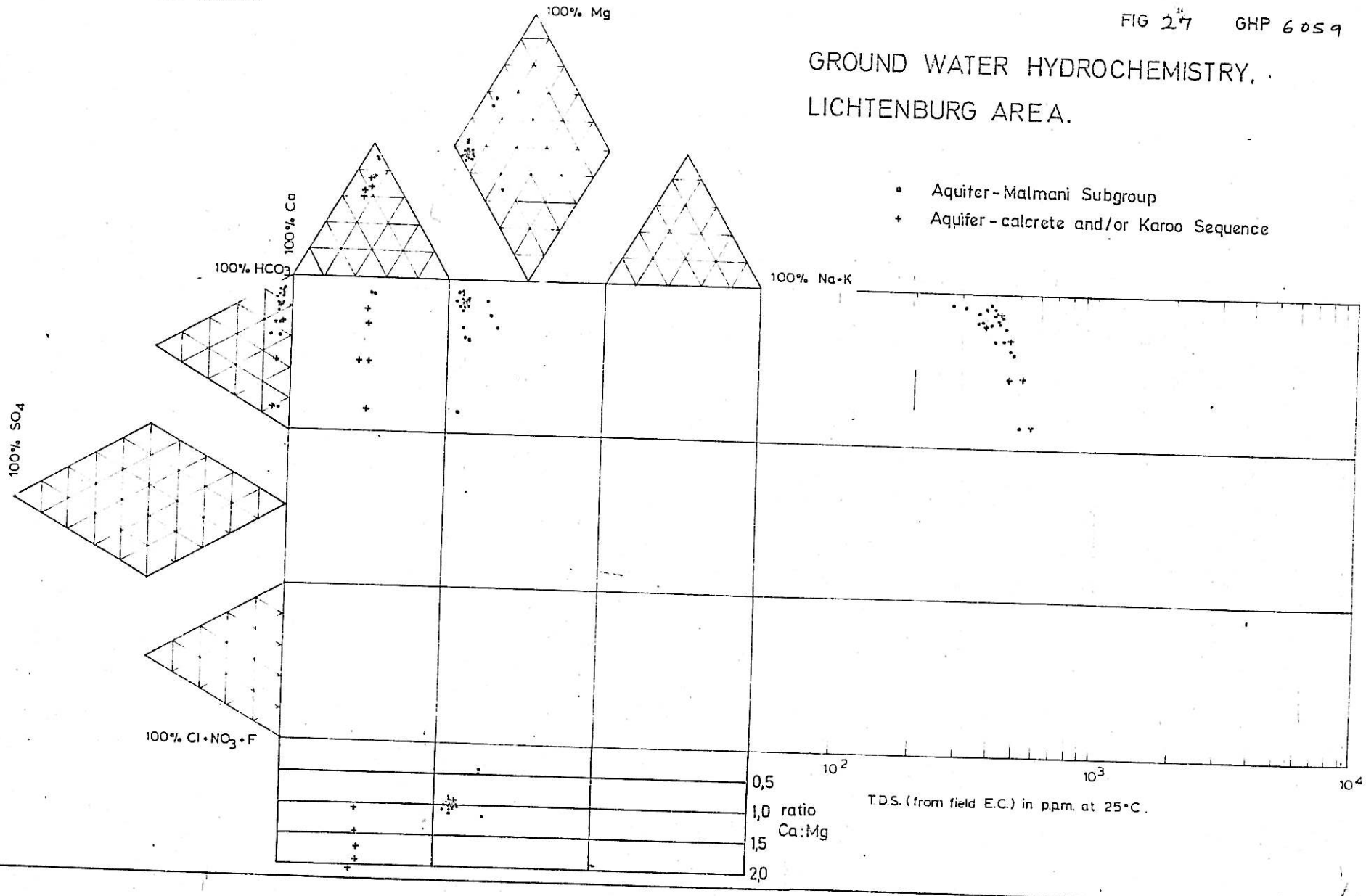
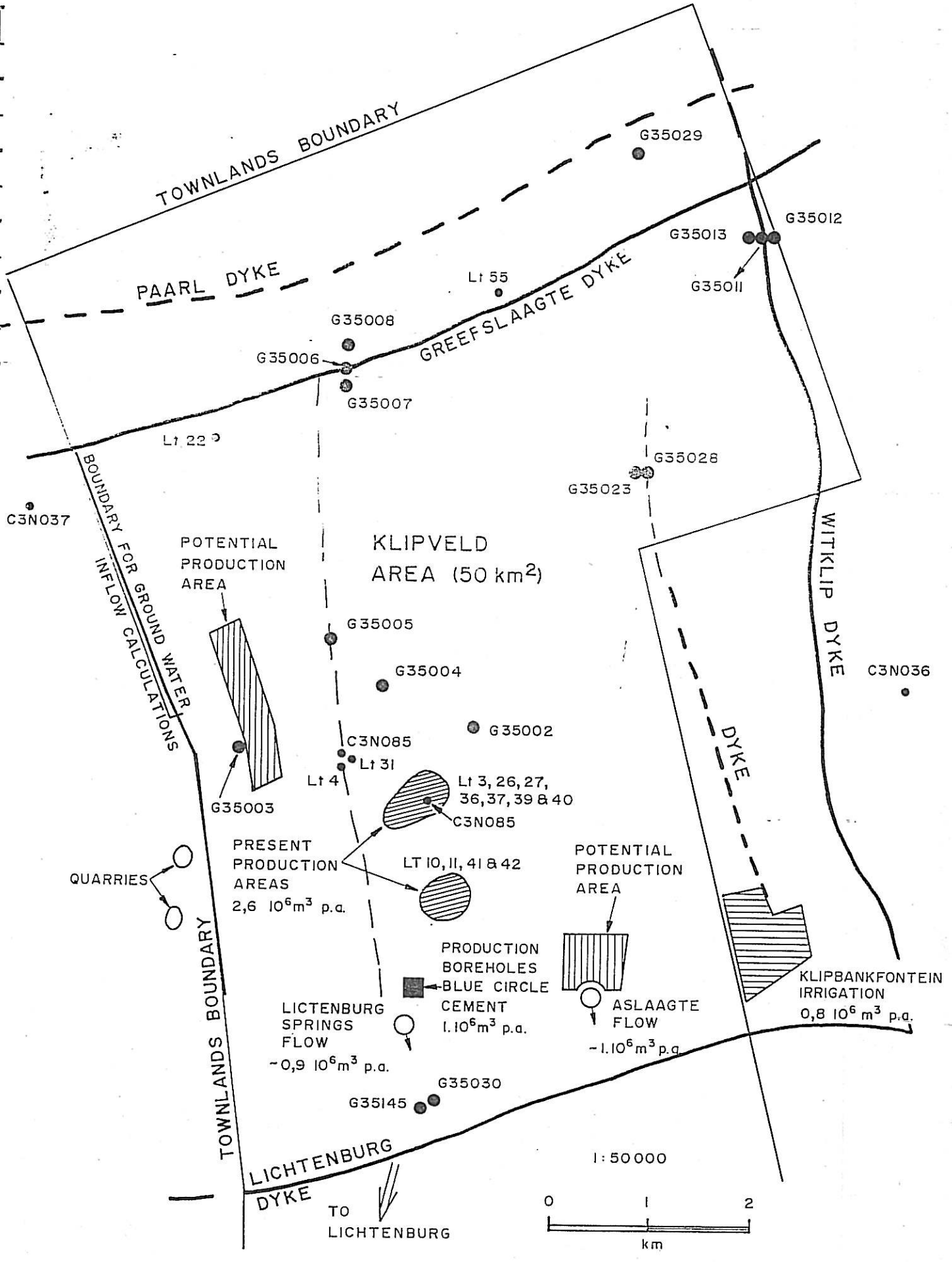


FIG. 28
G.H.P. 6060

LICHTENBURG KLIPVELD AREA - RECOMMENDED GROUND WATER PRODUCTION CENTRES



APPENDIX 1

1. *INDEX OF FARMS SURVEYED*
2. *COMPLETED BOREHOLE SURVEY FORMS*
3. *LIST OF BOREHOLES FOR WATER FLOW METER INSTALLATION*
4. *GAUGED ABSTRACTION :*

   LICHTENBURG MUNICIPALITY

   BLUE CIRCLE CEMENT (PTY.) LTD.

   ANGLO ALPHA CEMENT (PTY.) LTD.

   IRRIGATION BOREHOLE GL5.

INDEX OF FARMS SURVEYED

CADASTRAL FARM NAME	FARM NO.	BOREHOLE PREFIX
+De Paarl	54IO	Dp
Dudfield	35IP	Dd
Dudfield	57IP	
Elandsfontein	34IP	Ef
+ Elizabeth	357JP	E_3
Grasfontein	356JP	Gf
+*Graslaagte	37IP	Ge
Greeffslaagte	33IP	Gl
Hendriksdal	1IP	Hd
Hendriksrust	36IP	Hr
+*Hollaagte	8IP	He
Houthaalboomen	31IP	Hb
Houthaaldoorns	2IP	Hs
Klipbankfontein alias Manana	26IP	Km
+ Klipkuil	352JP	Kk
+ La Rey Stryd	53IO	Ls
Lichtenburg Townlands	27IP	Lt
Priem	30IP	Pm
+ Ruigtelaagte	353JP	Rl
Scherpunt	32P	Sp
Talene	25IP	Te
Uitgevonden	355JP	Ug
* Unie	24IP	Ue
Welverdiend	361JP	Wv
Witklip	6IP	Wi
Zamenkomst	4IP	Zk

* Farms outside boundaries of Bo-Molopo S.W.C.A.

+ Farms only partly surveyed by Taylor 1982/83

CADASTRAL FARM NAME DUDFIELD 35 IP + 57 IP (Dd) LICHTENBURG REGION

KAD. PLAASNAAM EN NR. GEBIED.

Notes: Gebruik	
S	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
+.F.B.	Quote farmer's units

Period of Survey / Periode van Opname JUNE-SEPT 1982

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 ha Total Area of Property	5 Water Use?	6 Pump Type	7 gph / l/s Tested field + date (if known)	8 l/s Pump rate Yield (Not W.P.)	9 1981/82 m³ Abstn. Quantities pumping periods (Not WP)	10 Surface under groundwater irrigation	11 Crop type	12 Measured M / collar projection (m)	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level datum date	Depth below collar (m)	Height abv. msl	Metres Bh. Total Depth	Water Strikes (Depth(s))	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
1	Botha, J	1		I	FILJO 4" tractor	62,5	25	42000	3,5	forage (grass) maize		1502,47 ℓ				31	19				
2	"	1	450	D	W.P. + RAPIDE ELECTRIC	1,4	1	4000	—			1502,73 ℓ				37	24				
3	"	1		none	W.P. 2"	2,5		0	—			1509,88 ℓ				26	23				PUMP BROKEN
4	Erasmus, J.L	R/G		S+I	W.P. 2"			250				1493,36 ℓ									
5	Tel. Lburg 5514	"	648	S+I	W.P 1½"	2,4		250	1,5	grass	M 0,28	1492,86 ℓ	16/07/82	4,14		46					30m. S.W. of Dd 4
6	"	"		D+S	W.P 1½"	1,9		250			M 0,30	1483,55 ℓ	"	4,86 *		19					CaCO₃ deposit on pump rods
7	"	R/G 7	1131	D+S	W.P 1½"			250			M 0,24	1484,71 ℓ	(14/4/72?)	3,22 *							
8	Van Rensburg, A.M.	3	570	D+S	MONO 2" ELECTRIC	6,3	5	3300	0			1504,09 ℓ				37					formerly 20ha irrigation.
9	Pretorius, B.J	11	413	none	none	3,8		0			M 0,70	1502,35 ℓ	05/11/82	9,97		34					Now blocked 1983.
10	Swart (Pretoria)	2		D+I	SANGUS 4" electric	28,8	25	108000	24	4ha - vegetable 20ha - maize		1504,02 ℓ		.		48					
11	"	2	436	none	WATERBOK 2" DIESEL	6,3		0								61					
12	"	2		none	none	25		0				1508,58 ℓ				75					formerly C7 Dd04 Now under railway
13	"	R/G 12	212	none	none	3,8		0				1500,48 ℓ				27					not located.
14	Kockemoer, B.O	4		D+S	Rapicle Turbine electric	0,38		1500				1498,44 ℓ				15					
15	P.Box 973 Lburg.	4	437	none	none			0				1505,70 ℓ									Blocked 20.3m casing
16	tel 5512	4		S	WP 2"			250			M 0,25	1505,81 ℓ	21/07/82	13,11		,					
17	"	4		none	STEWART + Lloyd 6"			0				1505,81 ℓ				43	INTAKE 15m ?				NO IRRIG = 1981/83.
18	ANGLO-ALPHA Pty	5		Industrial	STERKFONTEIN 5" ELECTRIC	50		with Dd80				1505,95 ℓ				21					Equipped c
19	Ltd (Trevedere)	5	358	I+D+S	6" TURBINE Elect.	75		590411	5							35					Flow Gauge 3
20	rented by H.J. Emsmus "	5		I	SANGUS 6" Elect.	75	71 l/s (14/03/1983)	1981/82		maize, sorghum.	0,30	1505,85 ℓ	JULY 1982	≈ 15m.		34	INTAKE 16m ?				" 4
21	"	5		none								1505,90 ℓ				31					" 1 not located
22	Erasmus, B.A	6		S	WP 2"	1	.	250			M	1483,20 ℓ				37					.
23	"	6	299			1,5		0				1478,68 ℓ				37					not located
24	"	6		D+S	WP 2"	1		250				1478,56 ℓ				37					
25	Reynecke, G.P.	R/G 8	144	S	WP 2"	0,63	.	250			M	1491,55 ℓ				37					LIABLE TO POLLUTION
26	Biesievlei 3112	31 (8)	48			0,56		0				1478,78 ℓ				40					not located.

ℓ = levelled prior to 1982 (mainly 1974).

ℓℓ = levelled & relevelled May-June 1983

* pumping

LICHTENBURG

CADASTRAL FARM NAME DUDFIELD cont.

KAD. PLAASNAAM EN NR.

REGION

GEBIED.

Use code	
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8.	Quote farmer's units

Period of Survey / Periode van Opname: JUNE - SEPT 1982

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 (ha) Total Area of property	5 Water Use?	6 Pump Type	7 (gph/ℓ/s) Tested field + date (if known)	8 Present Yield (Not WP)	9 (1981/82 m³) Abstn. Quantities Pumping periods (Not WP)	10 Surface under Groundwater Irrigation	11 Crop type	12 Measurable collar (M) / Project	13 (Metres) Collar Elev'n + Method of determination	14 Groundwater Level: date	Depth below collar (m)	Height abv msl	Bh. Total Depth (Metres)	Water Strikes (Depth(s))	T°C	T.D.S. (mS/m)	pH	Geology and Other Information
27	PRETORIUS, G	30 (8)	48	S	WP 1½"	0,38		250			M 0,32	1477,36 ℓ	28/07/82	6,91*		32					strong wind
28	CELLIERS, J.	9		D+S+I	WP + elect motor	0,19		250				1486,20 ℓ				67					
29	TR. L'BURG 5515	9		D+S+I	WP 2"	0,50		250			M	1486,05 ℓ				122					
30	"	9	421	S+I	WP 2"	0,44		250	6	grass		1484,99 ℓ				61					
31	"	9		none	none	0,22		0			M 0,09	1485,29 ℓ	21/07/82	11,04		58					
32	"	9		S+I	WP 2"	0,50		250				1486,12 ℓ				61					Tree roots blocking borehole
33	THEART, G.J.	32	561	D+S	WP 2"	0,1		250				1494,50 ℓ									
34	Tel 5511	32		D+S	WP 2"	0,1		250			M 0,23	1493,84 ℓ	21/07/82	15,34		16					
35	ANGLO ALPHA	13		D+S	WP	2,3		250				1496,67 ℓ	(1495,60 ℓℓ)			21					
36	CEMENT (Pty Ltd)	13	439	D+S	WP			250				1495,25 ℓ	(1495,36 ℓℓ)			13					DOLOMITE UNDER UP TO 6 m of CALCRETE.
37	?	13				0,19						1496,17 ℓ				21					not located
38	?	13				0,88						1494,97 ℓ				20					"
39	de BRUYN, PJ	R/G 14		D+S+I	Turb.	3,8		3000	1	grass		1491,95 ℓ				55					
40	"	R/G 14	226	D+S	WP	0,88		250				1493,95 ℓ				37					
41	"	R/G 14		D+S	WP	0,13		250				1492,96 ℓ				15					
42		15				1,0						1495,60 ℓ				31					not located
43		15		D+S	Submersible electric	1,0	1,0	2500	---		M 0,4	1491,08 ℓ	23/06/82	12,72		35					
44		15	463	none	none	1,1					M 0,2		"	3,85		41					
45		15		none	none	0,75						1488,77 ℓ				41					
46		15				3,1										96					not located
47		15				3,8										70					"
48	Anglo Alpha Cement	17		garden.	subm	2,8		10600			M 0,03	(1472,83 ℓℓ) 1472,46 ℓ	23/06/82	4,40		59					
49	Pty (Ltd).	17		none	none	2,8					M 0,23	1472,25 ℓℓ	"	4,56		59					
50	" C3N021	17	1297	none	none	0,1					M	1468,81 ℓ	(1465,87 ℓℓ) 08/07/82	3,87							in lava. C3N021
51	"	17		none	none	0,24															
52	"	17		none	none	0,24						1472,35 ℓ									

*pumping.

CADASTRAL FARM NAME DUDFIELD cont.
KAD. PLAASNAAM EN NR.

LICHTENBURG
REGION
GEBIED.

Notes: Column 5: Domestic "d", Stockwatering "S", Irrigation "I", Urban Use "T"; 4,7,8: Quote farmer's units

Period of Survey / Periode van Opname 06 – 09/82
Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. Nº	2 Name + address of owner	3 Part Nº / Plot Nº	4 (ha) Total Area of property	5 Water Use?	6 Pump Type	7 (gph/l/s) Tested yield + date (if known)	8 (Pump rate) Present Yield (Not WP)	9 (14/8/82 →) Abstrn. Quantities and pumping periods (Not WP)	10 Surface under groundwater irrigation	11 Crop type	12 (Measurable collar project) Surface under irrigation with other water source	13 (Metres) Collar Elev + Method of determination	14 Groundwater Level: date	Depth below collar (m)	Height abv. m.s.l.	Bh Total Depth (Metres)	Water Strikes (Depth(s))	T°C 15	T.D.S. (μS/cm)	p.H.	Geology and Other Information
53	Anglo Alpha Cement	17	}	none	none	0,30						1479,31 ¹									
54	(Pty) Ltd.	17	}	none	none		0,5														
55	ERASMUS, J.L.	19	}	D+S	SUBM ELECT	0,63		1300	1,5	garden veg.		1485,15 ¹				15					
56	"	19	} 433	D+S	WP 1½"			250			M 0,20	1483,93 ¹	16/07/82	4,39		15					UNABLE TO POLLUTION
57	GROBBELAAR	20	}	D+S	WP 1½" + Rapide (Diesel)			1000			M 0,08	1493,74 ¹	"	4,24		9					
58	"	20	} 154	none	none	0,19						1494,04 ¹				23					
59	"	20	}	none	WP 2"	975						1494,08 ¹				16					PUMP BROKEN.
60	MARAIS, J	21	188	D+S+I	SUBM ELECT.	0,56		1300	3 (with 95)	grass + veg	M	1494,41 ¹	(1494,63 ¹¹)			21					100 m south of Bh 95
61	?	22	226	S	W.P			250				1489,44 ¹				13					
62	TALJAARD, G	24	}	D	WP 1½	0,31		250			M 0,18	1479,01 ¹	16/07/82	5,45⁺		~37					
63	"	24	} 257	D	WP 1½	0,38		250				1477,80 ¹				~37					
64	"	24	}	none	Nat. TURB.	3,1					M 0,10	1466,59 ¹	16/07/82	2,21		~21					
65	GROBBELAAR, JB	27	}	D+S	WP 2"	0,56		250				1495,97 ¹				17					
66	Tel 5519 L'burg	27	} 361	D+S	RAP. TURB (Diesel)	0,65		1300				1493,71 ¹				43					N.B. 10 boreholes drilled N of main road to 135m yields very poor
67	?											1489,63 ¹									
68	?											1489,55 ¹									
69	GROBBELAAR, J.B.			none	none							1495,60 ¹									blocked.
81= 70	REYNEKE, G.P.			D+S	Waterbok 2" electr.	1,69		4000				1494,78 ¹				40					BOREHOLE ALLOCATED ALSO Bh 81.
71	?			none	none							1498,43 ¹									closed
72	?			S	WP			250			M 0,28	1499,10	23/06/82	4,25							
73	PRETORIUS, B.J.	11	413	D+S+I	Waterbok 2" Diesel	1,5		4000				1504,47 ¹									OLD WINDPUMP.
74	?											1476,31 ¹									
75	?			none	none							1489,14 ¹									NUMBER allocated twice.
76	PRETORIUS G.			none	Nat. Turb. diesel						M 0,38	1475,98 ¹	28/07/82	5,52							Entrance from Hibernia.
77	ANGLO ALPHA.	16	501	none	Turb.							1483,36 ¹	(1482,52 ¹¹)								
78	"											1476,71 ¹									not located.

⁺ pumping

4.

CADASTRAL FARM NAME DUDFIELD cont. LICHTENBURG REGION

KAD. PLAASNAAM EN NR. GEBIED.

Nr.	Gebruik	
5	Domestic	"d"
	Stockwatering	"S"
	Irrigation	"I"
	Urban Use	"T"
4.78	Quote farmer's units	

Period of Survey / Periode van Opname: 06-09/82

Map and or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. Bg. Nr. Nº	2 Name + address / Naam van Eienaar en adres of owner	3 Part Nº / Plot Nº	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (gph/l/s)	8 Present Yield (Not WP)	9 Abstn. Quantities Pumping periods (Not WP) (1981/82 m³)	10 Surface under groundwater irrigation (ha)	11 Crop type groundwater	12 M. Surface under irrigation with other water source	13 Collar Elev. + Method of determination (Metres)	14 Groundwater Level: date	Depth below collar (m)	Height abv. m.s.l.	Bh. Total Depth (Metres)	Water Strikes (Depth(s))	T°C 15	T.D.S. mS/m	p.H.	Geology and Other Information
79												1505,54 ᵗ									not located
80	ANGLO ALPHA CEMENT	5		I + Industry	TURB. 6"	56,3		with Dd 18,19+20								32					FLOW GAUGE no 2.
81	see 70	R/G 8																			
82	C3N028 } DEPT. ENV. AFF.			none	none	0,64 (1976)					M	1496,58 ᵗ	08/07/82	3,78		40	12m 21m				
83	C3N029			none	none	0,64 (1976)					M	1493,12 ᵗ	"	3,88		40	21				
84	C3N030			none	none	0,12 (1976)					M	1479,45 ᵗ	"	2,43		42	23				
85	C3N004			none	none	0,02 (1976)					M	1506,17 ᵗ	07/07/82	12,22		51	25				
86	DEPT. ENV. AFF.															30					DRILLED FOR PUMP TEST
87																30					BELVEDERE ?
88																30					no other INFO
89	ANGLO ALPHA CEMENT	O/B no 6 (A.G.C. 1974)		none	none	5,9 (1974)										50					BLOCKED 0-10m calcrete. 10-30 Dlm. 30-46 leached dlm 46-50 Fresh dlm.
90																					
91																					
92																					
93	BLUE CIRCLE CEMENT			none	none	7,0										42					UNDER RAILWAY.
94	ERASMUS, J.L.																				
95	MARAIS, J.	21	188	S + I	SUBM. ELECT.			1800	(3) with Dd 60	grass, minor veg.	M 0,00	1495,38 ᵗᵗ	16/07/82	4,72							LIABLE TO POLLUTION
96	KOEKEMOER, B.O.			S	WP 2"			250			M 0,10	1497,81 ᵗᵗ	"	6,31 +							light wind.
97																					
98																					
99																					
100				none	none																
101				D + S	sub						M 0,20	1495,03 ᵗᵗ	23/06/82	3,85							perhaps Dd44
102											M 0,25	1481,86 ᵗᵗ	"	4,53							
103	ANGLO ALPHA CEMENT.	R/B Jenis		none	none	5,9 (1974)					M 0,20	1480,29 ᵗᵗ	"	8,18		136					0-16 calcrt 16-42 clayey calc. 42-54 clay yellow 54 → Dlm.
104				D	WP + Rapide motor			250			M		09/05/83	5,98 + pumping							MARKED Dd 72

NEWLY NUMBERED BOREHOLES

CADASTRAL FARM NAME DUDFIELD cont. LICHTENBURG REGION.

KAD. PLAASNAAM EN NR. GEBIED.

Notes / Opmerkings: Column	
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
+7.8	Quote farmer's units

Period of Survey / Periode van Opname 06 - 09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (gph / l/s)	8 Present Yield (Not W.P.)	9 Abstrn. Quantities pumping periods (Not WP) (1981/82 m³)	10 Surface under groundwater irrigation (ha)	11 Crop type	12 Surface under irrigation with other water source (casing projection m)	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level: datum date	Depth below collar (m)	Height abv msl	Bh. Total Depth (Metres)	Water Strikes (Depth(s)) (Metres)	Opmerkings / 15 T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
105	ERASMUS, J.L.			none	none	0,25 Feb. 1983 (bailer test)						1489,16 ℓ				43	10 m →	Casing. 152 m slotted			0-30 m calcretes boulders 30-43 m Karoo red clay.
106	ANGLO-ALPHA (lessee D.Z. Jacobs)			none	none	0,38 Jan. 1983						1495,80 ℓ				13	1st - 5 m 2nd - 9 m				10 m E. of DA 35. 0-1 soil 1-6 m weath dlm. 6-13 m fresh dlm
107	THEART G.J.			none	none	0,48										153	98 - 0,48 ℓ/s				HARD DLM from 10 m (air rig)
108	"			none	none	0,38										124					HARD DLM from ~10 m (air rig)
109	"			none	none	none										34		sighted magnetically on Lichtenburg dyke.			0-21 m red clay 21-34 m Yellow clay.
110	ANGLO-ALPHA	O/B SAMIE	AUSTRALIAN GROUNDWATER CONSULTANTS 1974 (bracketing boreholes 110–118)	none	none	0,38 (1974)										135					0-29 calcrete 29-41 clay & calcrete 41 → dlm.
111	CEMENT Pty Ltd	O/B LINDA		none	none	12,1 (1974)										111					0-8 soil & calc. 8-49 calc. & clay 49 → dlm.
112	"	O/B GLENDA		none	none	nearly dry										135					0-18 soil & calc. 18-61 red clay. (K?) 61 → dlm.
113	"	O/B LINDA		none	none	4,4 (1974)										145					0-18 calc. 18-40 red clay K 40-145 dlm
114	"	O/B no 1		"	"	nearly dry										120					on DA103.
115	"	O/B no 2		"	"	1,4 (1974)										55					weath lava @ 44 m fresh lava from 48 m
116	"	O/B no 3		"	"	2,6 (1974)										68					weath. lava @ [illegible] m fresh lava from 65 m
117	"	O/B no 4		"	"	nearly dry										46					0-16 calc. 16-24 calc. & clay K? 24-30 red clay 30 m → Dlm
118	"	O/B no 5		"	"	nearly dry.										44					0-26 calc. 26-32 calc. & clay 32-38 red clay K? 38 → dlm.
119	"			INDUSTRY DEWATERING.	centrifugal			?													
120	DEPT. ENV. AFFAIRS. (Land owner ERASMUS J.L.)	G35018		none	none	0,13 (1983)						1489,44 ℓℓ	05/05/1983	4,35		37	8				0-19 calcrete 19 → dlm.

LICHTENBURG

CADASTRAL FARM NAME ELANDSFONTEIN 34 IP (Ef) REGION

KAD. PLAASNAAM EN NR. GEBIED.

Columns		
5	Domestic	"d"
	Stockwatering	"S"
	Irrigation	"I"
	Urban Use	"T"
4.7.5	Quote farmer's units	

Period of Survey / Periode van Opname: JUNE-SEPT 82

Map and/or Aerial Photo / Kaart en/of Lugfoto-verwysing

Field values.

1 Bh Nº	2 Name + address of owner	3 Part Nº / Plot Nº	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested Yield + date (if known) (gpk/l/s)	8 Pump Present Yield (Not W.P.)	9 Abstr. Quantities and Pumping periods (Not W.P.) (1981/82 m³)	10 Surface under Groundwater Irrigation (ha)	11 Crop type	12 Surface under irrigation with other water source (M / collar projects)	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level date	Depth below collar (m)	Height abv. msl	Bh. Total Depth	Water Strikes (Depth(s)) (Metres)	15 T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Ef 1	HUYSER, P.J.	3		none	none	0,13						1476,90				30					
Ef 2	Buite St.	3		S	W.P. 1½"	0,25		250			M 0,25	1476,73	29/07/82	6,81		33					
Ef 3	Tel L'burg 2501 "	3	46	D+S	TURB ELECT.	~0,88	0,75	4000				1477,10				31					
Ef 4	"	3		I	STERKFONTEIN 4" ELECTRIC	12,5		48000	4	grass		1476,41				31					subsidence under pump.
Ef 5	DU PREEZ, W.M.	"		I+St+D	SUBM ELECT.	9,4		36000	3	grass		1482,16				38					
Ef 6	Tel 2568	"		none		2,3						1482,48				122					not visited
Ef 7	DU PREEZ, A.J.J.	"	498	D+I	SUBM ELECT	19		36000	3	grass		1481,98				70					not located
Ef 8	SCHEBUSH, H.	19		D+S	"	77,5		12000	1	grass + veg.	M 0,10	1482,13	29/07/82	1,7		9					
Ef 9	MOLLER, F. Plot vallei Tel 5640	15		S	WP 3"	733		250				1488,61	(1488,28 (2))			11					
Ef 10	KRIGE, J.H.D.	7		D+S	SUBM ELECT			6000	2 (WITH Ef 12 + Ef 10?)	luxuriant garden	M 0,38	1485,75	(1485,28 (2)) 30/07/82	2,54		12	FONTAIN 1486,12 (MAY 1983)				BY SPRINGS FORMERLY USED FOR IRRIGATION
Ef 11	Tel L'burg 32/2	7		none	none	0,44						1486,59				40			ON SPRING at		POLLIE DE LA REY NG.K. COMPOUND 20m west of Ef 10
Ef 12	"	7	1916	D+S	Rupide Elect.	0,38		see Ef 10				1481,27				70	1st 15m 2nd 63m		DRILLED 1980 IRRIG. no 5773 LIBER. DYKE?		Blocked. {0-1 soil 1-10 decomposed + broken dolerite 10-72 diabase/dolerite}
Ef 13	"	7		none	WP						M 0,47	1481,08	30/07/82	6,09		61					
Ef 14	"	8				0,63						1475,26				52					
			112													,					not located
Ef 15	"	8				0,50						1475,25				40					
Ef 16	de VILLIERS, A.A.	24		none	none	0,75						1480,99				17					not located.
Ef 17	"	24	36	D	Rupide electric.	(0,38)	0,6	2000				1481,46				122					Drilled deeper from 36m
Ef 18	van ASWEGEN, D.B.	35	33	D+S	WP 2"	2,5?		250			M	1477,57				24	21				
Ef 19	WESSELS, J.C	36	63	D+S	W.P. 2"	0,25		250			M 0,20	1477,52	29/07/82	2,50*		37					
Ef 20	HOLDER, I.C.F.	33		none	none	0,25						1476,31				37					light wind
Ef 21	DUVENAGE, J.A	33	9	D+S	WP	0,31		250				1483,95				3.7					closed.
Ef 22	ROETS, W.J.			D+S	MONO 2" ELECT.	50		4000				1498,13				16					
Ef 23	"		212	none	WP 2"	25					M 0,20	1496,12	29/06/82	5,33		15					
Ef 24	"			S	WP 2½"	25		250				1498,46				17					ON DLM + CHERT OUTCROP. PUMP BROKEN
Ef 25	ZIET-ZIET BELEGGINGS (Edms) Bpk. P.Bus 315 L'BURG.	40	216	D+S	MONO 2" ELECT.	10		4000	0,5	vegetables.		1500,10				21					

* pumping.

LICHTENBURG

CADASTRAL FARM NAME ELANDSFONTEIN 34 IP REGION

KAD. PLAASNAAM EN NR. (Ej) GEBIED.

Helper Columns	
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname 06 – 09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. Nº	2 Name + address of owner	3 Part Nº Plot Nº	4 (ha) Total Area of property	5 Water Use?	6 Pump Type	7 (gph/l/s) Tested yield + date (if known)	8 (pump rate) Present Yield (Not W.P.)	9 (1981/82 m3) Abstn. Quantities and pumping periods (Not WP)	10 (ha) Surface under groundwater irrigation	11 Crop type	12 (M / collar project) Surface under irrigation with other water source	13 Metres Collar level + Meth. of determination	14 Groundwater Level: datum date	Depth below collar (m)	Height (m) abv. m.s.l.	Metres: Bh. Total Depth	Water Strikes (Depth(s))	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Ej 26	SWANEPOEL, S.W.J.	41	} 87	none	WP	0,5						1499,18 ¹				14					broken.
Ej 27	Tel L'burg 5418	41		none	WP 2"	1,6		250				1502,47 ¹				29					
Ej 28	"	41	87	D+S+I	Vetsak 2" Tub. Elect.	4,4	4	11 000	2	grass	collar under water	1502,48 ¹				14					
Ej 29	"	41		none	WP	5						1490,57 ¹				37		dewatering quarry			DAM fed by covering top of B'hole.
Ej 30	"	41				0,5						1490,29 ¹				8					not located.
Ej 31	BERRY	42	} 86	none	Centrifugal diesel	19						1485,31 ¹				18					formerly used for irrigat.?
Ej 32	"	42	86	D+S	Flato 2" ELECT.	3,1		4000	3	grass	M	1497,76 ¹	23/07/82	>10m.		15					
Ej 33	"	42		none	none	12,5						1489,61 ¹				9					
Ej 34	MAREE, A.J.	43	} 94	D+S+I	STERKFONTEIN 4" elect.	15,6	15	8000	1,5	grass		1498,83 ¹				32					
Ej 35	Tel L'burg 5422	43		D	Mono 2" elect.	12,5	12	6000	1,5	grass		1499,75 ¹				32	29-32				'cavity' 29 to 32m
Ej 36	Van DEVENTER, P.R.	54	} 10	D	WP 2"	1,8		} 6000	} 1,5			1481,97 ¹				37					
Ej 37	"	54	10	D+I	SUBM ELECT	1,5		6000	1,5	vegetables	M	1482,17 ¹				12					
Ej 38	"	54		D+I	"																
Ej 39	FOURIE, H.J.	53		none	none	0,13						1475,48 ¹									
Ej 40	"	55		none	none	0,75						1473,77 ¹	(1473,58 ¹ ²)								closed
Ej 41	VORSTER, S.W.J.	56	} 8,6	D+S	subm ELECT.	3,1		} 18000				1481,40 ¹				44					
Ej 42	Tel. L'burg 3153	56	8,6	I+S	"	0,88		18000	2	} grass,	M 0,31	1481,43 ¹	29/07/82	10,21		15					
Ej 43	"	56		I	STERKFONTEIN 3" ELECT	9,8		(20 hr/wk - 6 months)	6	} maize + the fruit		1480,89 ¹				46					
Ej 44	GELDENHUYS, A.J.B.	57	} 9,4	D+S+I	Centr. Elect.	>12,5		} 24 000	} 4	} grass + minor vegetables		1485,36 ¹				20					top portion excavation well in dlm rock?
Ej 45	"	57	9,4	I	Centr. Elect.	7,5		24 000	4			1481,89 ¹				9					
Ej 46	LUDICK, J.S.	58	9,4	D+S	STERKFONTEIN 2" PETROL	1,88		6000	1	veg + grass		1483,17 ¹				12					on dlm outcrop
Ej 47	POTGEITER	60	8,6	none	none	0,30					M 0,20	1486,74 ¹	(1486,54 ¹ ²) 23/07/82	3,15.		56					S m. east of Ej 102. old pumpshaft + B'hole.
Ej 48		62	8,6			0,38										43					not located
Ej 49	LICHKOR (Edms) Bpk.	63	8,6	S+Industrial	WP 2"	<0,1		250			M 0,10	1486,66 ¹	23/07/82	4,00*		24					fair wind.
Ej 50	? SMITH	65	} 9,4	D+S	WP	0,13		250	} 0,5 ≤ Ej 52			1482,69 ¹				37					
Ej 51	"	65	9,4	D+S	WP	0,38		250	0,5 ≤ Ej 52	vegetables		1482,79 ¹				40					

* pumping

COMPLETED BOREHOLE SURVEY SHEETS

CADASTRAL FARM NAME ELANDSFONTEIN 34 IP (EJ) — LICHTENBURG REGION

KAD. PLAASNAAM EN NR. — GEBIED.

Column	
5	Domestic "d", Stockwatering "S", Irrigation "I", Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname: 07-09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. Nº	2 Name + address of owner	3 Part Nº / Plot Nº	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (gph / l/s)	8 Present Yield (Not W.P.) (approximate)	9 Abstr. pumping periods (Not WP) (1981/82 m³)	10 Surface under groundwater irrigation (ha)	11 Crop Type	12 Surface under irrigation with other water source (M / water project)	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level: date	Depth below collar (m)	Height abv m.s.l.	Bh. Total Depth (Metres)	Water Strikes (Depth(s))	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
EJ 52	? SMITH	65	}	D	WP	0,13		250	} ≤ EJ 50 + 51			1483,62 l				34					
EJ 53	GOUWS M.F.	67	} 21	none	none	0,63					M 0,33	1479,31 l	03/07/82	7,44		32					OPEN 165mm casing 5m W. of EJ 69
EJ 54	"	67		none	none	0,50										52					closed.
EJ 55	"	67		D	WP 1½	0,44		250	1 ≤ EJ 69 + EJ 70	vegetables	M	1479,00 l				40					28 m E. of EJ 53
EJ 56	"	67		D	SUBM ELECT	0,44		1000				1474,73 l				55					By homestead, behind Gouws home.
EJ 57	?	21				0,13															not located
EJ 58	MEINTJES	62	8,6	D	CENTRIFUGAL DIESEL	1,9		4000	1,5	0,5 - vegetables; 1,0 - Potgieter nursery		1480,33 l				12					By vlei: supplies Potgieter nursery
EJ 59	STRUMPHER, J.W	52	31	D	TURB ELECT.	25		2000				1481,66 l				58					10m N. of EJ 96
EJ 60	SMIT. L	61	} 9,4	none	W.P	0,44						1485,80 l				53					broken
EJ 61	"	61		D+S+I	TURB DIES.	5		5000	2,5	veg. + grass	M 0,10	1481,79 l	23/07/82	0,60		11					
EJ 62	PRETORIUS, A.P.	68	} 82	S	WP 2"	0,25		250				1481,99 l				32					
EJ 63	Tel 2844 L'burg	69		none	none	0,20					M 0,22	1484,01 l	30/07/82	1,88		32					165mm casing in maize field
EJ 64	"	28		none	none	0,20					M 0,22	1482,52 l	30/07/82	5,57		≈122					50m S.E. of EJ 76
EJ 65	"	28		none	none	5						1482,07 l				33					Blocked
EJ 66	"	28		S+D	WP 1½	0,38		250			M 0,10	1486,84 l	30/07/82	3,93+		33					light wind
EJ 67	?	22	} 97			0,10						1500,17 l									
EJ 68	MARAIS, J.D	23		D+S+I	SUBM ELECT.	~9,4	8	10 000	1	grass + veg.	M	1502,71 l	(1502,47 l)			138					
EJ 69	GOUWS, M.F.	67	} 21	D	WP 1½"	0,25		250	} ≤ EJ 55		M	1479,27 l				27					EJ 69 abandoned here?
EJ 70	"	67		D	SUBM ELECT.			250			M 0,30	1479,34 l	30/07/82	7,47							10m NNE of EJ 73
EJ 71	?											1472,28 l									not located
EJ 72	KRIGE, J.H.D.			D+S	NATURAL TURB DIESEL			1000	0,5	grass	M 0,26	1474,21 l	30/07/82	3,90							
EJ 73	STEYN			D	SUBM ELECT			3000	1,0	large garden		1479,59 l (1479,10 l)									
EJ 74	FOURIE, A.J.			I+S	WP 1½"			250	1,0 ≤ EJ 105	veg + fruit		1479,82 l (1479,26 l)									≈ 60m west of EJ 105
EJ 75	?											1481,97 l									not located
EJ 76	PRETORIUS, A.P.			none	none						M 0,28	1481,57 l	30/07/82	3,10							≈ 40m ENE of EJ 62
EJ 77	DE VILLIERS, A.			D+Industrial	WP 1½"			250			M 0,32	1486,11 l	29/07/82	3,25 + pumping							Stone crusher

CADASTRAL FARM NAME ELANDSFONTEIN 34 IP LICHTENBURG

KAD. PLAASNAAM EN NR. (EJ)

REGION

GEBIED.

Col.	
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey: Periode van Opname 06 - 09/82

Map and/or Aerial Photo. Kaart en/of Lugfotoverwysing

Field values.

1 Bh. Bg. Nº	2 Name + address / Naam van Eienaar en adres of owner	3 Gedeelte Nº Part Nº of Plot Nº	4 (ha) Area of property	5 Doel van watergebruik Water Use?	6 Tipe pomp Pump Type	7 (gph / l/s) Getoetste lewering Tested yield + date (if known)	8 (Pump rate) Huidige lewering Present Yield (Not WP)	9 (1981/82 m³) Onttrekkingshoeveelheid Abstr'n Quantities and pumping periods (Not WP)	10 (ha) Oppervlakte onder besproeiing uit grondwater Surface under groundwater irrigation	11 Soort gewasse onder besproeiing uit grondwater Crop type	12 (M) Oppervlakte onder besproeiing uit ander waterbronne Surface under irrigation with other water source	12 (calc / project)	13 (Metres) Hoogte van boorgatkraag + Metode van bepaling Collar Elev'n + Method of determination	14 Groundwater Level: Grondwatervlak datum date	Diepte onder kraag Depth below collar (m)	Hoogte bo seespieël Height (m) abv. m.s.l.	(Metres) Bh. Total Depth	Water Strikes (Depth(s))	15 Opmerkings T°C	T.D.S. µS/cm	pH	Geology and Other Information
EJ 78	HOLDER I.C.F.			D+S	TURBINE ELECT			2000	0,5	veg.	M.		1476,59									not located
EJ 79	?												1488,63									
EJ 80	KRIGE, J.H.D. (Tel. Makwassie 3511)			none	WP 1½"						M	0,15	1472,33	30/07/82	4,56							broken.
EJ 81	KRAFT, J.C.			D+S	WP 2"			250			M	0,12	1481,19	29/07/82	1,50							
EJ 82	"			S	WP 2"			250			M		1496,54	.								
EJ 83	?												1481,71									not located
EJ 84	?												1481,72									not located.
EJ 85	DU PREEZ A.J.			I+S+D	SUBM ELECT.			6000	2	grass.			1481,91									
EJ 86	?			S	WP			250					1481,02									
EJ 87	KRIGE J.H.D			S	W.P			250			M	0,11	1473,08	30/07/82	5,38							
EJ 88	?	}	not on original borehole map										1485,30									not located
EJ 89	?	}											1484,57									
EJ 90	?	}																				
EJ 91	DEPT. ENV AFFAIRS	C3N031		none	none	0,85 (1976)							1489,37	08/07/82	2,33		35	2+14m				
EJ 92	"	C3N032		none	none.	1,3 (1976)							1476,86	08/07/82	6,39.		72	30+52m				
EJ 93	?																					not located.
EJ 94	ZIETS-ZIETS BELEGGING Pty Ltd.	40		D+S	TURB 2" ELECT.	4,8	4	12000	1,5	garden.							30					Drilled 1981.
EJ 95	VAN ASWEGEN, D.B.			none	none	0,15					M	0,00	1479,96	29/07/82	2,18		30		DRILLED	JULY	1982	0-6m soil+calcrete 6-15m weath. Dlm. 15-> fresh Dlm.
EJ 96	STRUMPHER, J.W.			none	none	weak.					M.											Drilled (Dlm). April-May 1983.
EJ 97	VORSTER. S.W.J.			none	none.	weak.					M	0,00	1483,65	21/07/82	10,28		46.		DRILLED MAY-	JULY	1982.	2m soil 2m+ dlm, fresh
EJ 98	ZIETS-ZIETS BELEGGING Pty Ltd.			I	centrifugal elect.			6000	1	vegetables.	M		1486,97	29/06/82	0,90		5					excavated well on old spring.
EJ 99	ditto.			D+ Industrial	Centrif. elect.		.	1000 ?			M		1491,02	29/06/82	1,30	1488,55 (May 1983)						PUMP ON STONE CRUSHERS' QUARRY
EJ 100	VAN WYK.			D+Industrial	subm elect	.	0,13	1500					1488,55									DRILLED 9 'DRY HOLES' TO 91,5m IN DLM.
EJ 101	"			none	none			0														
EJ 102	POTGIETER			none	WP 1½						M		1486,38									Broken.
EJ 103	FOURIE, H.J.			I+S+D	Rapido turb elect.		2,5	15000	4	grass	M	0,00	1473,49	29/07/82	2,14							Liable to pollution.

LICHTENBURG

CADASTRAL FARM NAME ELANDSFONTEIN 34 IP **KAD. PLAASNAAM EN NR.** (Ef) REGION **GEBIED.**

5	Domestic "d" Stockwatering "S" Irrigation "I" Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname 06-09/82 10

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. Nº	2 Name + address of owner / Naam van Eienaar en adres	3 Gedeelte Nº Part Nº of Plot Nº / Plot Nº	4 ha Totale grootte / Total Area van eiendom of property	5 Doel van watergebruik / Water Use?	6 Tipe pomp / Pump Type	7 Gpts / l/s Getoetste lewering + datum / Tested field + date (if known)	8 Huidige lewering / Present yield (Not WP)	9 1981/82 m³ Onttrekkingshoeveelhede en pomptydperke / Abstn. Quantities and pumping periods (Not WP)	10 ha Oppervlakte onder besproeiing met grondwater / Surface under groundwater irrigation	11 Gewasse onder besproeiing / Crop type groundwater	12 M. Oppervlakte onder besproeiing met water uit ander bronne / Surface under irrigation with other water source	12 collar projects	13 Metres Kraaghoogte en Metode / Collar Elev'n + Method of determination	14 Groundwater Level: datum / date	Diepte onder kraag / Depth below collar (m)	Hoogte bo seevlak / Height abv. msl	Metres: Bh. Total Depth	Water Strikes (Depth(s))	15 T°C	T.D.S. µS/cm	p.H.	Opmerkings, Geology and Other information
Ef 104	DE WET. F.			Dr+S	SUBM ELECT.			4000	1,5	grass			1476,09 ℓℓ									
Ef 105	FOURIE A.J.		. .	Dr+S	RAPIDE WP 1½			1000	(1,0) (S / Ef 74)	fruit + veg	M	0,47	1480,57 ℓℓ	29/07/82	3,71							By reservoir.
Ef 106	PRETORIUS, A.P.			D	SUBM ELECT			4000	0,5	garden.	M	0,29	1481,44 ℓℓ	30/07/82	7,04							south of timescent
Ef 107	KRIGE, J.H.D.		.	D	SUBM ELECT.			6000	(20) (S Ef 10 + Ef 12)	holiday camp + luxuriant garden	M	−2,0	1482,90	30/07/82	0,00	1 May 1983 1482,81						Buite dele Rey NGK. Holiday camp
Ef 108	S+S. Stonecrushers.		discharged into dam.	Dewatering	CENTRIF -IGAL			?						.								Quarries.
Ef 109	DEPT. ENV. AFFAIRS. (land owner J.H.D. KRIGE)			none	none	9,3 (1983)							1480,80 ℓℓ	07/05/83	8,81		31	15.				0-1 calc; 1-11 Karoo...; 11-31 Dl...

GRASFONTEIN 35 6JP (Gf)

1 Bh. Nº	2 Name + address of owner	3 Plot Nº	4 Total Area	5 Water Use?	6 Pump Type	7 Tested field	8 Present yield	9 Abstn. Quantities	10 Surface under groundwater irrigation	11 Crop type	12 M.	12 collar projects	13 Collar Elev'n	14 date	Depth below collar	Height abv. msl	Bh. Total Depth	Water Strikes	T°C	T.D.S.	p.H.	Geology and Other information
Gf 1	COETZEE, J.H.	32 or A	} 527	D+S	W.P. trepde diesel			500					1500,64 ℓ									NEWMONT SA borehole 500m to SW.
Gf 2	(Soetmelkvlei)	F		none	open	22,5																not located
Gf 3	"	.		none	open																	not located.
Gf 4	VENTER, P.S.	1/G	} 118	D+S	Turb	22,5	6,3 } 1972.											33,5				not located 1982
Gf 5	" (Vermaas)	1/G		D+S	Rapide	22,5	6,3										37	33,5				not located ..
Gf 6	WESSELS, W.J.R	W	455	D+S	WP 2"			250			M		1501,84 ℓ									More than 5m of silt in borehole.
Gf 7	HURWITZ family	1/L	144	D+Industry	Mono 2" Diesel		6,3	3600			M	−0,07	1501,78 ℓℓ	12/11/82	30,53				for washing	grounds		Rented by Bredenkamp (Pitches)
Gf 8	BADENHORST, D.C.P.			S	WP 2"			250			M	0,17	1477,30 ℓ	18/11/82	8,19							
Gf 9	"			S+D	WP + vittek engine	12,5		1000														
Gf 10	"			D+S	Turb 2" & diesel	60	5:	3600														
Gf 11	WESSELS, W.J.R.	P		D+S	WP			250					1501,97 ℓ									} Key C.F. Nieman Greeff (slaughter)
Gf 12	Vermaas 011492-38	13 2/E		D+S	Mono 2" diesel		0,63	250					1494,05 ℓ									
Gf 13	PIENAAR, S			none	none	12,5	:						1491,93 ℓ									
Gf 14	not allocated.																					

LICHTENBURG

CADASTRAL FARM NAME GRASFONTEIN 356 JP (Gf) REGION

KAD. PLAASNAAM EN NR. GEBIED.

Col.	Use
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname 06-09/82

Map and or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. BG Nº Nº	2 Name + address / Naam van Eienaar en adres of owner	3 Part Nº / Plot Nº	4 (ha) Total Area of Property	5 Water Use?	6 Pump Type	7 (gph / l/s) Tested yield + date (if known)	8 Present Yield (Not W.P.)	9 (1981/82 m³) Abstn. Quantities, pumping periods (Not WP)	10 (ha) Surface under groundwater irrigation	11 Crop	12 M / collar projects – Surface under irrigation with other water source	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level: date	Depth below collar (m)	Height abv. m.s.l.	Metres: Bh. Total Depth	Water Strikes (Depth(s))	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Gf 15	Newmont SA (Pty) Ltd			none	none						M		25/7/82	>28 m		cased					ground dlm + chert.
Gf 16	"			none	none						M					uncased	exploration				30m W of Gf 15 ground dlm + chert
Gf 17	"			none	none						M					"	boreholes				30m W of Gf 16 ground Dlm + ch.
Gf 18	"			none	none						M					"					30m W of Gf 17 ground Dlm + chert
Gf 19	Southern Sphere Mining			D	SUBM ELECT.	4,95 (1981)	2,4	29200 (80 m³/dy).			M										
Gf 20	(Pty) Ltd			none	none						M 0,32	1501,50	25/07/82	30,16		40	1st-29,3 2nd-29,7	0-10m 10-40m	ground dlm + chert		CASED TO 40m ... 29-30 m.
Gf 21	"			none	none																
Gf 22	Hurwitz family			none	none																Caved in mud. adjacent to Gf 7.
Gf 23	Bezuidenhorst, D.C.P.			D+S	WP 1½"			250													10m N. of Gf 10.
Gf 24	not allocated																				
Gf 25	"																				
Gf 26	Newmont S.A.			none	none						M 0,00	1492,15	18/11/82	23,27							Dlm + chert No casing
Gf 27	(Pty) Ltd			none	none						M 0,10	1492,03	18/11/82	22,97			exploration		12m casing		35m S of Gf 26 dlm + ch.
Gf 28	"			none	none							1492,31					boreholes			casing, blocked	Dlm + chert 45m S of Gf 27
Gf 29	"			none	none							1492,51								uncased, blocked	Dlm + chert 37m S of Gf 28
Gf 30	"			none	none							1492,87						Blocked at 14m			GRASFONTEIN MKE - CASED 40m S of Gf 29
	GRASLAAGTE 37 IP.																				
Ge 1	Mouton, A.J.J			D+S	SUBM ELECT						M -0,01	1509,43	21/06/82	6,49							
	GREEFFSLAAGTE 33 IP (Gl)																				
Gl 1	Geldenhuys,	R/G	498	none		3,1										76	24				
Gl 2	D.B.F.	R/G		D+S+I	Stewart & Lloyd 6" elect	50		1272000		106 - Maize (one crop) 53 - lucerne/wheat (12 months)		1508,34				40	24				PUMP INTAKE 28m
Gl 3	Tel. Lbg 5460	R/G		D	Witbok 2" diesel	25						1509,15				40					
Gl 4		R/G		S+I	Vakuus 6" elect	75		840000	70	grass/lucerne (6 months)		1507,95				40					
												1506,76									

LICHTENBURG

CADASTRAL FARM NAME GREEFFSLAAGTE 33IP (GL)

KAD. PLAASNAAM EN NR.

REGION

GEBIED.

Notes: Columns	
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
+7,8	Quote farmer's units

Period of Survey / Periode van Opname 06 - 09/82

Map and/or Aerial Photo / Kaart en/of Lugfoto-verwysing

Field values.

1 Bh. Nº	2 Name + address of owner / Naam van Eienaar en adres	3 Part Nº / Plot Nº (Gedeelte Nr)	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested Yield + date (if known) (gph / l/s)	8 Present Yield (Not WP)	9 Abstrn. Quantities + Pumping periods (Not WP) (1981/82 m3)	10 Surface under groundwater irrigation (ha)	11 Crop type groundwater	12 Surface under irrigation with other water source	Collar projection	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level: date	Depth below collar (m)	Height abv. m.s.l.	Bh. Total Depth (Metres)	Water Strikes (Depth(s)) (Metres)	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
GL5	GEZDENHUYS, S.J.	1	}	DrI+S	Stewart + Lloyd 4"		July 1982 30,3	165 000	}				1510,05 ℓ	(1510,09 ℓℓ)			35	21				EQUIPPED WITH FLOW METER
GL6	L'burg 5525 (GL)	1	476	S	Subm Elect.		0,6	2000	35	lucerne	M	0,08	1507,23 ℓ	16/07/82	13,52		46	34				
GL7	"	1	}	DrI	S+L 4" elect.		35	165000	}				1507,66 ℓ				34	24				RMP INTAKE 23m.
GL8	TERREBLANCHE, B.D.	5	498	none	S+L 6" elect.	50 [illegible]							1507,47 ℓ				37	30				} formerly irrigated
GL9	L'burg 5457	5		none	Sterkfontein 4" tractor	25							1504,38 ℓ				30	19				} 77 ha.
GL10	GEZDENHUYS, D.B.F. GEZDENHUYS, J.C.A	6	495			10											40	26				not located.
GL11	NIEMAN, C.F.	7	477	D+I	Northison 4" elect.	25	20	3000 12 months sh/wk	2	Maize, grass			1507,44 ℓ				30					
GL12	Tel L'burg 5456	7		S+I	McEwan 4" elect.	20	17	72000 3 months 15h/dy 6 dy/wk	12	wheat			1505,30 ℓ				31	26				
GL13	COETZEE, J.A.	R/6 8	}	I	WP 2½"	0,8		250	1,5	Veg + fruit	M	0,31	1507,68 ℓ	15/07/82	13,99*		30	21				
GL14	Tel L'burg 5472	R/6 8	238	Dr S	WP 2"	0,2		250			M	0,16	1507,19 ℓ	15/07/82	15,52*		34	22				formerly irrigated 13 ha.
GL15	"	R/6 8	}	I	Sterkfontein 4" elect.	22,5		18000	3	Maize, potatoes			1506,97 ℓ				25	18				
GL16	COETZEE, L.H.	8	238	DrS+I	Mono 2" elect.	7,5		} 360 000	} 30	lucerne			1508,71 ℓ				33	24				intake 23m
GL17	Tel L'burg 5473	8		I	Sargus 4" elect.	52,5		}	}				1505,87 ℓ				33	21				
GL18	ROOTHAN, A.P. (Vlakfontein)	10	257	none	WP 2"								1509,82 ℓ	(1509,81 ℓℓ)			40	26				
GL19	BERGER, R	12.	343	DrS	WP 2"			250			M	0,10	1508,50 ℓ	15/07/82	15,49			20				
GL20	"	12	}	none	none																	Stoppered with fence post.
GL21	DEPT. ENV. AFF.	D4N133	OWNER T.P.A.	none	none	1,3 (1976)					M		1500,19 ℓ	07/07/82	15,55		48	21 37+44				[illegible] + chert.
GL22	"		Owner S.J. Geldenhuys	none	none												30		South of Greeffslaagte dyke?			0 to 30m clay, yellow shale
GL23	"			none	none						M	0,29	1510,11 ℓℓ	16/07/82	16,60		21	1-5 5-11 11-21	brown clay, clay + gravel, [illegible] + chert.			10m E of GL5
GL24	"			none	none						M	0,32	1510,10 ℓℓ	16/07/82	16,54		24					35m N of GL5
GL25	GELDENHUYS, S.J.			D	handpump?			100														Pump removed
GL26	DEPT ENV AFF	D4N132	OWNER T.P.A	none	none	1,2 (1976)					M		1506,21 ℓ	07/07/82	15,97		45	1st 24 2nd 31				dl + ch.
GL27	TERREBLANCHE, B.D.	5	498	DrS+I	Sterkfontein 2"			4000	1	forage												
GL28	ROOTHAN, A.P.	10	257	none	none			0	(GRANTED 60 H starts 1983	maize	M	0,24	1509,51 ℓℓ	10/11/82	16,93		~40					} DRILLED 1980
GL29	" (Vlakfontein)	10	257	none	none			0					1510,17 ℓℓ				~40					} 254 mm casing.

* pumping

LICHTENBURG

CADASTRAL FARM NAME HENDRIKSDAL 11P (Hd) REGION
KAD. PLAASNAAM EN NR. **GEBIED.**

5	Gebruik / Columns	
	Domestic	"d"
	Stockwatering	"S"
	Irrigation	"I"
	Urban Use	"T"
4.7.8	Quote farmer's units	

Period of Survey / Periode van Opname: 06-09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	Tested yield + date (if known) (gph / l/s)	Present yield (Not W.P.) (Pump rate)	9 Abstn. Quantities / Pumping periods (Not W.P.) (1981/82 m³)	10 Surface under groundwater irrigation (ha)	11 Crop type	12 Surface under irrigation with other water source (M.)	Collar projection	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level: date	Depth below collar (m)	Height abv. msl.	Bh. Total Depth (Metres)	Water Strikes (Depth(s)) (Metres)	Remarks	T°C	T.D.S. µS/cm	pH	Geology and Other Information
Hd 1	TERREBLANCHE, B.D.	R/G		S	WP 1½"	4,4		250			M	0,56	1494,43 ℓ	25/08/82	4,02*		18						
Hd 2	P.Bx 233	R/G		S	WP 1½"	0,3		250			M	0,23	1501,51 ℓ	25/08/82	19,32		32						light wind
Hd 3	L'burg 5463. "	R/G	2205	D+S	WP 1½"			250			M		1502,33 ℓ				37						
Hd 4	"	R/G		D	waterbok 3", trekker	5,6											34						
Hd 5	"	R/G		D+I+S	2" TURB elect.	6,9		18000	1,5	lucerne							36						
Hd 6	"	R/G		none	WP 1½"	0,3					M	0,00	(1504,81 ℓℓ) 1505,51 ℓ	25/08/82	11,58		46						pump broken
Hd 7	"			I	Hclw 3" Diesel	5,0		24 000	2	lucern, maize.							>30						
Hd 8	MAREE, D.A.	18		D+S	WP 2"			250					1506,45 ℓ										blocked @ 8m
Hd 9	29 Scholtz St, L'burg	18		D+S	WP 2"			250			M	0,32	1506,26 ℓ	25/08/82	13,51								Pump at 21m
Hd 10	"	18		D+S	WP 2"			250			M	0,16	1506,96 ℓ	"	12,83								
Hd 11	TERREBLANCHE, B.D			S	WP 2"			250			M	0,17	1499,27 ℓ	"	17,51								
Hd 12	DEPT. ENV. AFFAIRS	S/F DW134		none	none	0,02 (1976)					M		1502,16 ℓ	22/07/82	20,09		51	30					dlm-chert
Hd 13	"	S/F DW135		none	none	0,8 (1976)					M		1502,37 ℓ	22/07/82	30,49		52	35					dlm-chert.
Hd 14	TERREBLANCHE, B.D.			none	none						M	0,49	1504,20 ℓℓ	25/08/82	22,96								Drilled 1979.
Hd 15	"			D+S+I	TURB + WP			12000	1	vegetables													
Hd 16	"			I	TURB electric																		
Hd 17	DEPT. ENV. AFF.	G350/19		none	none	4 (1983)					M		1503,90 ℓℓ	10/05/83	22,60		43	37 38	Hendriksdal dyke				equipped 1983 0-25m dyke. 25-43 dlm
Hd 18	"	G350/24		none	none	0,1 (1983)					M		1503,16 ℓℓ	10/05/83	20,73		53	27?	"				0-53m diabase.
	(Hand B.D. Terreblanche)																						

HENDRIKSRUST 36 IP (Hr.)

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	Tested yield + date (if known) (gph / l/s)	Present yield (Not W.P.) (Pump rate)	9 Abstn. Quantities / Pumping periods (Not W.P.) (1981/82 m³)	10 Surface under groundwater irrigation (ha)	11 Crop type	12 Surface under irrigation with other water source (M.)	Collar projection	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level: date	Depth below collar (m)	Height abv. msl.	Bh. Total Depth (Metres)	Water Strikes (Depth(s)) (Metres)	Remarks	T°C	T.D.S. µS/cm	pH	Geology and Other Information
Hr 1	PRETORIUS G.	R/G		S	WP 2½"			250			M	0,10	1470,30 ℓ	28/07/82	7,30*								
Hr 2	Tel 5573 L'burg "	R/G	393	D+S+I	Waterbok 2" elect	5,6	5,6	≤ Hr 12, 10h/d, 200d/a		forage,			1473,12 ℓ				32						
Hr 3	"	R/G		D	WP 2"	3,1		54720		grass			1471,90 ℓ				24						

* pumping

LICHTENBURG

CADASTRAL FARM NAME HENDRIKSRUST 36 IP (Hr) REGION

KAD. PLAASNAAM EN NR. GEBIED.

5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4,7,8	Quote farmer's units

Period of Survey / Periode van Opname 06 - 09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. BG Nr Nº	2 Name + address / Naam van Eienaar en adres of owner	3 Part Nº / Plot Nº	4 ha Total Area of property	5 Water Use?	6 Pump Type	7 gph/l/s Tested Yield + date (if known)	8 l/min Rate Present Yield (Not WP)	9 1981/82 m³ Abstrn. Quantities, pumping periods (Not WP)	10 ha Surface Groundwater Irrigation	11 Crop Type	12 M / Collar ht Surface and/or irrigation with other water source	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level date	Depth below collar (m)	Height abv msl	Metres Bh. Total Depth	Water Strikes (Depth(s))	T°C	T.D.S. ms/m	p.H.	Geology and Other Information
Hr 4	PRETORIUS, G	R/G	}	none	none	3,1						1475,63 l				29					closed.
Hr 5	"	R/G	}	none	none	2,3						1471,99 l				29					
Hr 6	"	R/G	}	none	none	1,5						1472,24 l				21					blocked
Hr 7	THEART H.F.J	1	}	S	WP 2"	0,9		250				1472,16 l				40					
Hr 8	"	1	}	D+I+S	WP 2" + SUBM	0,44	0,4	2880	} 0,5	fruit, grass + veg	M 0,16	1468,60 l	28/07/82	18,99*		35					
Hr 9	"	1	} 402	D+I+S	WP 2"	0,5		250	}		M 0,05	1468,69 l	28/07/82	>20		40					
Hr 10	"	1	}	D+I	WP 1½"	0,21		250	} 1	fruit + grass	M 0,00	1467,87 l	28/07/82	11,10*		52					
Hr 11	"	1	}	D+S+I	WILSEZT ELECT.	0,38		250	}			1465,88 l				30					
Hr 12	PRETORIUS G	R/G		I	MONO 2" ELECT.		2	(see Hr 2)													
Hr 13	THEART H.F.J.	1		D+S+I	ELECT SUBM	0,38 (1983)	0,35	(2000)	c Hr 7 till.			1465,78 ll		.		91,5	1st - 50m 2nd - 70m	0-7 calcrete 7-14 weath lava 14-9 compact lava			Plan used to 1,5 m. drilled 1983
Hr 14	DEPT ENV AFF. (land owner Theart)	635010		none	none	0,38 (1983)					M	1469,44 ll	07/05/83	4,65		31	10 to 11m				0-10m calc 10-25m Mas(K) 25-31 Lava.

HOUTHAALBOOMEN 31 IP (Hb)

1 Bh. Nº	2 Name + address of owner	3 Part Nº	4 Total Area	5 Water Use?	6 Pump Type	7 Tested Yield	8 Present Yield	9 Abstrn. Quantities	10 Surface Groundwater Irrigation	11 Crop Type	12 Surface water	13 Collar Elev'n	14 date	Depth below collar	Height abv msl	Bh. Total Depth	Water Strikes	T°C	T.D.S.	p.H.	Geology and Other Information
Hb 1	MAREE, O.J.	4	198		WP & Rapide			250				1509,76 l									
Hb 2	Swartst 16.	3	199	none	none							1512,35 l									PLANS TO REOPEN 1983 FOR 3,5 ha GRASS
Hb 3	L'burg. Tel 3490	11	497	S	WP 2"			250				1512,39 l									
Hb 4	"	R/G	}	D+S	WP 2"			250				1503,22 l									
Hb 5	"	R/G	} 862	D+S	WP 2"			250				1507,46 l									
Hb 6	"	R/G	}	D+S	SUBM ELECT.	12		2000				1505,36 l									PREVIOUSLY 4 ha grass
Hb 7	"																				not located
Hb 8	MAREE, D.A.	9	194	S	WATERSOK 2" TRACTOR			1000				1506,64 l									rented by D.J.H. RALL
Hb 9	Schultz St. 29	R/G 1	192	none	WATERSOK 2" TRACTOR							1503,29 l									rented by (L'burg) J.A. KRUGER (H'boom)
Hb 10	L'burg Tel 2451	7	196	D+S+I	WP 1½"			250	0,5	vegetables		1507,66 l									rented by D.J.H. RALL

*pumping

LICHTENBURG

CADASTRAL FARM NAME HOUTHAALBOOMEN 31 IP (Hb) REGION

KAD. PLAASNAAM EN NR. GEBIED.

Note: Column	
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname 06-09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1	2	3	4 (ha)	5	6	7 (gph / l/s)	8 (hrs/day)	9 (1981/82 m³)	10 (ha)	11	14	12 (ha)	13 Metres	14 Groundwater Level			Metres		T°C	T.D.S. µS/cm	p.H.	
Bh. No / Bg. Nº	Name + address of owner / Naam van Eienaar en adres	Part No / Plot No / Gedeelte Nº of Plot Nº	Total Area of property / Totale grootte van eiendom	Water Use? / Doel van watergebruik	Pump Type	Tested Yield + date (if known)	Present Yield (Not W.P.)	Abstrn. Quantities and pumping periods (Not WP)	Surface under groundwater irrigation	Crop Type (groundwater)	Surface under irrigation with other water source		Collar Elev'n + Method of determination	datum date	Depth below collar (m)	Height above msl	Bh. Total Depth	Water Strikes (Depth(s))	Opmerkings			Geology and Other Information
Hb 11	NEL, J.H.	17	175	I + S	STEERENDEN 5" elect.		31,3	6 mths 12 h/d 6 d/wk – 552000	46	36 maize + peas (two crops) 10 lucerne (all year)			1505,46 ¹	(1505,95 ¹¹)			25	23				
Hb 12	BARNARD, J	20	21	D + S + I	WP 2"			6 mths 12 h/d 6 d/wk – 250	0,5	veg.			1505,40 ¹				27	24				
Hb 13	"	20		I	SANEUS 3", Diesel			10000	2,0	grass			1504,08 ¹				24	24				
Hb 14	STEENKAMP, D.J.	19	25	I	TURB 4" elect.			120000	10	[illegible]			1503,99 ¹				49	37				10m of oil in borehole.
Hb 15	Tel. Lbg 5404.	19		D + S + I	Sterkfontein 4" elect						M	0,2	1509,02 ¹	30/06/82	15,83		26	37				
Hb 16	NEL, J.H.	12	91	I	Waterbok 5" elect			s Hb11 + 32.					1508,47 ¹				26	23				
Hb 17	"	12		none	none								1505,64 ²				34	21				
Hb 18	renumbered Te 1																					
Hb 19	" Te 2																					
Hb 20	MAREE, O.J.			D + S	WP 2" + Lister diesel			1000			M	0,5	1511,54 ¹	01/07/82	19,27 *							Strong wind
Hb 21	PRETORIUS, S. (Tel. Lbg 5445)			D	Mono 2" diesel			1000					1503,75 ¹									
Hb 22	renumbered Te 3																					
Hb 23	" Te 4																					
Hb 24	" Te 5																					
Hb 25	not allocated ?																					
Hb 26	renumbered Te 6																					
Hb 27	" Te 7																					
Hb 28	" Te 8																					
Hb 29	" Te 9																					
Hb 30	DEPT. ENV. AFF.	owner TPA	(3N037	none	none	1,0 (1976)					M		1507,22 ²	08/07/82	14,14		45	?				
Hb 31	"		(3N038	none	none	0,26 (1976).					M		1508,72	08/07/82	14,88		43	?				
Hb 32	NEL, J.H.	17		I + D + S	Waterbok 2" elect.			2000	+ s Hb11 + 16		M	0,45	1505,22 ¹¹	01/07/82	11,64		23					• Hb11 pumping 15m to East.

HOLZAAGTE 8IP (He)

Bh. No	Name	3	4	5	6	7	8	9	10	11	14	12	13	date	Depth	Height	Total Depth	Water Strikes	T°C	TDS	pH	Geology
He 1	ESTERHUIZEN, W.J.			none	WP						M	0,42	1513,88 ¹¹	26/06/82	21,37							

* pumping

LICHTENBURG

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CADASTRAL FARM NAME HOUTHAALDOORNS 2 IP (Hs) REGION

KAD. PLAASNAAM EN NR. GEBIED.

5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname 06/09 / 1982

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

3 Bh No	2 Name + address of owner / Naam van Eienaar en adres	3 Part No of Plot No	4 ha Total Area of property	5 Water Use?	6 Pump Type	7 l/s Tested yield + date (if known)	8 Pump rate Present Yield (Not WP)	9 1981/82 m³ Abstn. Quantities pumping periods (Not WP)	10 ha Surface under groundwater irrigation	11 Crop Type groundwater	12 M Collar height Surface under irrigation with other water source	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level date	Depth below collar (m)	Height abv m.s.l.	Metres Bh Total Depth	Water Strikes (Depth(s))	15 T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Hs 1	MAREE, D.A	R/G	2138																		not located
Hs 2	29, Schultz St	R/G		D+S	WP 2"			250			M 0,47	1510,04	25/08/82	19,81*				)	Rented to Tex		Innelman + Tex (Outspan
Hs 3	L'burg	R/G		D+S	WP 2"			250			M	1512,45						}	cafe		L'burg).
Hs 4	"	R/G		D+S	WP 1½" + Rapid diesel			500			M 0,25	1509,15	01/07/82	15,65*				}	Rented to F.Roode		Doringkloof
Hs 5	SENSAKO	3	600	D+I	SANGUS 4" ELECT	>25		480 000	—	27 - Maize (one crop)						34	26				
Hs 6	"	3		D+I	STEWART LLOYD 6" ELECT	37,5			—	53 - Sunflower						40	27				100m S of no 5.)
Hs 7	"	3		none	none	12,5						1507,20				35	26				
Hs 8	WESSELS, W.J.R	1	648	D+S	MONO 2" diesel			1000				1511,98				37	29				
Hs 9	(Vermaas)	1		D+S	TURBINE (paraffin)	2,5 (1966)		1000								31	21				
Hs 10	DEPT. ENV AFF	owner T.P.A.		none	none																
Hs 11	"	owner SENSAKO	G35020	"	"	0,1 (1983)					M	1511,39	08/05/83	18,35		37	25?		BLYDUWSNS DYKE		5-10 m Dimensie 10m → Dlm.
Hs 12	"		G35021	"	"	0,1 (")					M	1512,01	"	18,03		31	26?				Dlm + chert
Hs 13	"		G35022	"	"	0,2 (")					M	1511,98	"	18,20		67	32→45				Dlm + chert.
Hs 14	"	owner WJR WESSELS	G35025	"	"	0,2 (")					M	1506,00	25/05/83	14,69		40	34	HENDRIKSDAL DYKE			0-40 m Diabase
Hs 15	"		G35026	"	"	0,1 (")					M	1505,97	"	36,53		49	?				Dlm + ch.
Hs 16	"		G35027	"	"	0,01 (")					M	1506,80	27/06/83	16,55		50	?				Dlm + ch

KLIPBANKFONTEIN ALIAS MANANA 26 IP (Km)

3 Bh No	2 Name + address of owner	3 Part No	4 Total Area	5 Water Use?	6 Pump Type	7 Tested yield	8 Present Yield	9 Abstn. Quantities	10 Surface under groundwater irrigation	11 Crop Type	12	13 Collar Elev'n	14 date	Depth below collar	Height abv m.s.l.	Bh Total Depth	Water Strikes	T°C	T.D.S.	p.H.	Geology and Other Information
Km 1	MEYER, N.J.G.	1	13	D+S	SUBM ELECT	1,9	1,5	4000			M 0,17	1489,30	22/06/82	7,15		27					
Km 2	Lichtenburg 5822	17	520	S	WP 2"			250			M 0,25	1505,26	18/06/82	15,09		24					
Km 3	"	17		none	none	12,5										11					not located
Km 4	"	17		I+S	STERK 4" elect	19	20	5 Km 9	40	lucerne		1492,71				32					
Km 5	"	17		I+S	SUBM ELECT	12,5	15	480 000				1486,68				24					

* pumping

LICHTENBURG

CADASTRAL FARM NAME KLIPBANKFONTEIN 26 IP REGION

KAD. PLAASNAAM EN NR. (Km) GEBIED.

Notes: Column 5: Domestic "d", Stockwatering "S", Irrigation "I", Urban Use "T". 4.7.8: Quote farmer's units

Period of Survey / Periode van Opname: 06/09 - 1982

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. Bo. Nr. Nº	2 Name + address of owner / Naam van Eienaar en adres	3 Part Nº / Plot Nº	4 (ha) Total Area of Property	5 Water Use?	6 Pump Type	7 (gph / l/s) Tested Yield + date (if known)	8 (gph / l/s) Present Yield (Not W.P.)	9 (1981/82 m³) Abstr. Quantities and Pumping periods (Not W.P.)	10 (ha) Surface under groundwater irrigation	11 Crop Type groundwater	12 (M, ha) Surface under irrigation with other water source	13 Metres: Collar Elev'n + Method of determination	14 Groundwater Level: date	Depth below collar (m)	Height abv m.s.l.	Metres: Bh. Total Depth	Water Strikes (Depth(s))	15 T°C / Remarks	T.D.S. mS/cm	p.H.	Geology and Other Information
Km 6	MEYER, N.J.G	17	}	none	none						M 0,41	1489,38 ℓ	21/10/82	0,35		30					20 m N.E. of pumphouse
Km 7	"	17		none	none						M 0,50	1486,66 ℓ	29/7/82	1,07		15					
Km 8	"	17										1487,26 ℓ				15					not located
Km 9	"	17		I+S	SUBM electr	7,5	8	≤ Km 4 + S.	≤ Km 4+S			1488,51 ℓ				15					
10	"	17		I	TWO CENTRIFICALS.		20 ?		(extra 40 H 1982 →)	(maize/ lucerne)		1485,61 ℓ				15		ON KLIPBANK-FONTEIN EAST			EXTRA 40 Ha sprayed 1982→
11	PRINSLOO, P.F.	48	5	D	WP 2"	0,25 (1982)						1489,25 ℓ				76					
12	VILJOEN J J			D+S	SUBM ELECT	0,31		4000	0,5	veg.	M 0,42	1489,28 ℓ	22/06/82	14,29		56					
13	Tel L'burg 5531	54	154			5,2						1495,12 ℓ				41					} not located.
14	"	55				0,38						1479,12 ℓ				50					
15	VAN NIEKERK, J.E.	33	160	I	SANGUS 4" ELECT	44		132000	11	lucerne		1497,54 ℓ				37					
16	"					1,3						1493,36 ℓ				46	21 35	Irrig no 4	1363		Diabase to 46 m ?
17	MEYER, N.J.G	45	85	S	WP 2"	0,94		250			M 0,28	1493,11 ℓ	22/06/82	2,17		30					
18	?	8	13			3,8										55					} not located.
19	?	R/6/12	}			3,5										49					
20	DE BRUYN, T.	R/6 12		I+D+S	SUBM ELECT	4,4		} 30 000	1,5	grass	M 0,10	1495,94 ℓ	31/05/82	13,20		154					Borehole blocked by broken pump
21	"	"	298	D	"	0,56						1497,70 ℓ				70					
22	?	"				0,31										30					not located
23	MEYER, N.J.G	"		D	WP 1½"	3,8		250			M 0,16	1498,69 ℓ	24/06/82	11,95*		61					
24	"	"		I+D	SANGUS 4" ELECT	31	32	204000	17	lucerne.		1502,19 ℓ				41					Flow meter not working
25	"	"		S	WP & RAPIDE	56		250				1507,42 ℓ				30					
26	ROODT, H.J	9	41	D	SUBM ELECT	26		168 000	14	veg.	M 0,13	1491,76 ℓ	26/06/82	6,00		14					old WP. on hole
27	MEYER, N.J.G.	R/6 11	248	D+S	WP & RAPIDE	0,63		1500				1496,92 ℓ				55					
28	BARKHUIZEN, J	10	6	none	WP	0,63					M 0,27	1490,38 ℓ	24/06/82	14,06		75	56	IRRIG no 70	2355		Drilled 1958/59
29	"	R/6 15	} 154	D+S	WP 1½	strong		250			M 0,26	1503,41 ℓ	"	13,30		40					
30	"	R/6 15		S	WP 1½	"		250			M 0,16	1511,24 ℓ	"	19,07		32					
31	VAN DE WESTHUIZEN, G.H.S.	16	279	S	WP 1½	3,8		250			M 0,45	1505,86 ℓ	26/06/82	18,69*		30					Drilled 1961

* pumping

LICHTENBURG

CADASTRAL FARM NAME KLIPBANKFONTEIN 26 IP (Km) REGION

KAD. PLAASNAAM EN NR. GEBIED.

5	Domestic	"d"
	Stockwatering	"S"
	Irrigation	"I"
	Urban Use	"T"
4.7.8	Quote farmer's units	

Period of Survey: Periode van Opname 06 - 09 /1982

Map and/or Aerial Photo Kaart en/of Lugfotoverwysing

Field values.

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1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (gph/l/s)	8 Present Yield (Not WP) (l/s)	9 Abstn. Quantities and pumping periods (Not WP) (1981/82 m³)	10 Surface under groundwater irrigation (ha)	11 Crop type	12 Surface under irrigation with other water source (M / collar project)	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level: date	Depth below collar (m)	Height (m) abv. msl	Bh. Total Depth (Metres)	Water Strikes (Depth(s))	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Km 32	VAN DE WESTHUIZEN	G/S 16	3	D+S	WP	3,8		250				1498,61				27					
Km 33	"	22		D+S	SUBM ELECT	1,1	1	4000	1,0	veg + fruit	M	1496,94				61					PWL ~ 30 m dia WP
Km 34	?	"				0,25						1496,00									
35	?	"	31			0,31		.				1496,04									not located
36	BOTHA	"		S	WP 2"	0,38		250				1488,92	.								"
37	?	"										1489,23									Dwyka 16,4m then granite
38	DU PREEZ, WB	24		D	WP	0,38		250	0,5	veg.	M 0,20	1503,24	18/06/82	9,32*		70					not located
39	P. Box 246 "	"	86	S	WP	0,53		250			M 0,36	1500,86	"	4,32*		159	1st 21m 2nd 52m				Dwyka/granite 107m
40	"	"		D+I+S	SUBM ELECT	0,53		3000	0,5	fruit + veg	M 0,10	1502,25	"	4,36*		65					
41	?	25				0,38						1479,21		.		41					
42	GREEFF	"	34	D+S	SANGUS Elect.	12,5	12	2000	0,5	large garden		1479,20				85					not located
43	"	"		none	WP 2"	2,5					M 0,04	1473,61	18/06/82	5,00		50					
44	PRINSLOO, PF	27		I	CENTRIF DIESEL	>25		,				1488,02				43					Broken EXCAVATED SPRING
45	JOUBERT, JJ	"	86	D+S	MONO 2" TRACTOR	>25		1000				1505,01				37					
46	"	"		D+S	"	>25		1000				1494,66				30					
47	"	"		D+S	WP 2"	0,84		250			M 0,01	1493,68	24/06/82	12,25		55					
48	MAASBROEK	R/G 37	34	D+I+S	TURB 2" elect	7,5		84 000	7	grass, fruit + veg.		1500,97				55					
49	MEYER, NGJ	56	88	D	WP 1½"	0,15		250			M 0,18	1506,94	18/06/82	3,58*		34					
50	VAN DE MERWE SH	63		S	WP	0,15		250			M	1503,51				46					
51	P.Bus 366 "	"		S	WP	0,10		250			M	1503,64				46					
52	"	"		D+S	WP	0,08		250			M	1504,69				104					
53	"	"	230	D+S	SUBM ELECT	0,31		1000				1503,45				94					
54	"	"		D+S	"	0,25		1000								165					adjacent to Km 55
55	"	"		none	none	0,40						1503,32				168					Blocked by Km 52
56	"	62	190	D	WP	0,50		250			M 0,15	1505,82	21/06/82	5,96*		177					
57	"	"		D+S	WP	0,05		250			M 0,34	1505,19	"	1,81*		43					

* pumping

LICHTENBURG

CADASTRAL FARM NAME KLIPBANKFONTEIN 26IP REGION

KAD. PLAASNAAM EN NR. Km **GEBIED.**

5	Gebruik Columns	
	Domestic	"d"
	Stockwatering	"S"
	Irrigation	"I"
	Urban Use	"T"
4.7.8	Quote farmer's units	

Period of Survey / Periode van Opname 06/09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

19

1 Bh. No	2 Name + address of owner	3 Part No of Plot No	4 (ha) Total Area of property	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (l/s)	8 Present Yield (Not WP) (l/s)	9 Abstrn Quantities Pumping periods (Not WP) 1981/82 m³	10 (ha) Surface under groundwater irrigation	11 Crop type groundwater	12 (M) Surface under irrigation with other water source	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level date	Depth below collar (m)	Height above msl	Bh. Total Depth (Metres)	Water Strikes (Depth(s))	15 T°C	T.D.S. μS/cm	p.H.	Geology and Other Information
Km58	?	65	8,6									1479,17				41					not located
Km59	Roux H	66	8,6	D+S	WP 2"			250	0,5	grass		1480,06				34					
60	JACOBS J.J.	69	8,6	none	RAPIDE DIESEL	0,75						1482,04				37					
61	PARKER D	71	8,6	none	none	0,75					M 0,20	1485,08	18/06/82	3,67		44					
62	DREYER J.J	31		I+S	WP 1½"	0,75		250			M	1484,44				67					
63	"	"	8,6	I+D+S	SUBM ELECT	0,75		2000	3,4	grass and	M 0,15	1484,45	18/06/82	5,13		67					
64	"	"		I+S	WP 2"	0,75		250		vegetables		1485,48				61					
65	"	"		I+S	WP 2"	0,19		250			M	1485,39				61					
66	REICHEL C.R.N.	89	8,6	D+S	TURB 2" ELECT	1,00	0,63	1000			M	1508,42	23/06/82	>15m		69					
67	"	"		I	WATERBOK 3" ELECT	31	10	60000	5	fruit		1504,76				28					
68	?	74	8,6			0,88						1500,26				37					
69	?	75	8,6			1,00						1500,11				37					
70	BURGER, H.S.B.	70	8,6	D+I+S	MONO 3" ELECT	6,3		48000	8	grass + ½ ha fruit	M 0,00	1501,07	23/06/82	11,17		30					
71	VAN VUUREN, W.	78	8,6	D+S	RAPIDE DIESEL	1,0		3000				1503,34				49					
72	?	79	8,6			0,38						1502,87				53					
73	RAS, D	80	8,6	D	WATERBOK 2" ELECT	1,9		3000				1501,82				61					
74	?	82	8,6			0,04						1506,16				73					
75	FOURIE, P.A.C	86	8,6	D	RAPIDE DIESEL			2000				1507,35									
76	GELDENHUYS, J.A.	87	8,6	D+S	WP + Rapide	15,3		2000	0,5	vegetables		1507,24				67					
77	DU PREEZ, P.H.	R/6 13		D+S	WP 1½"	>6,3		250			M 0,17	1505,67	24/06/82	17,13		34					
78	"	"		S	WP 1½"	>6,3		250			M 0,40	1503,50	"	11,44		37					
79	"	"	977	D+I	S+L 4" elect.	12,5	20	156000	26	grass + vegetables		1502,45				37					
80	"	"		D	WP 2"	0,38		250			M 0,30	1499,90	24/06/82	9,24*		24	216	42	IRRIGAT		0-15 soil + rubble 15-24 Dlm.
81	"	"		S	WP 1½"	1,5		250				1499,67				37					
82	"	"		D	TURB elect.	1		3000				1499,90				37					
83	"	19		none	none	0,13						1492,64				30					closed.

*pumping

LICHTENBURG

CADASTRAL FARM NAME KLIPBANKFONTEIN 26IP REGION

KAD. PLAASNAAM EN NR. Km GEBIED.

Notes/Opmerkings	
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey: Periode van Opname 06-09/82

Map and/or Aerial Photo: Kaart en/of Lugfotoverwysing

Field values.

20

1 Bh. No	2 Name + address of owner	3 Part No Plot No	4 ha Total Area of property	5 Water Use?	6 Pump Type	7 gph / l/s Tested Yield + date (if known)	8 Pump rate Yield (Not W.P)	9 1981/82 m3 Abstr. Quantities and pumping periods (Not WP)	10 ha Surface under groundwater irrigation	11 Crop Type	12 M collar project. Surface under irrigation with other water source	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level date	Depth below collar (m)	Height abv. msl	Metres Bh. Total Depth	Water Strikes (Depth(s))	15 T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Km 84	Du PREEZ, PH	34	}	S	WP 2"	76,3		250			M 0,25	1507,01	24/06/82	14,96*		30					
Km 85	"	R/C 14	}	D+S	WP 2"	6,3		250			M 0,30	1505,65	"	15,47		36					
86	"	39	}	S	WP 2"	0,06		250			M 0,36	1498,68	21/06/82	16,72*		37					
87	VENTER, M	70	8,6	D+S	SUBM ELECT.	1,1		1000	0,5	grass + veg.	M 0,40	1482,90	18/06/82	10,96*							CYLINDER at 14m
88	GRAAFF, H.C.	41	8,6	D	WP 1½"	2,5		250	1 (S Km 108)	veg, grass + fruit	M 0,20	1490,82	24/06/82	3,58		9,5					
89	}																				
90	nos.																				
91	allocated																				
92	twice.																				
93	}																				
94	PRETORIUS J.G.	67	8,6	D+S	WP 1½"	0,31		250			M 0,35	1481,01	18/06/82	10,66*		20					
95	VAN DE WESTHUIZEN, N	68	8,6	D	WP	0,38		250				1469,12				41					
96	ADAMSON	88	26	D	NATIONAL TURB ELECT	3,8		4000	0,5	large garden.	M	1507,03	23/06/82			50					
97	?	52	34			3,8						1500,94				46					not located
98	CRONJE, P	85.	8,6	I+S	SANGUS 4" ELECT.		11,3	96000	8	grass		1504,97				58					
99	"	84	8,6	D	WATERBUK 2" elect		3,8	3000				1507,13									
100	"	83	8,6	D	ditto	1,5		3000			M 0,16	1503,54	23/06/82	12,51							
101	VAN NIEKERK, J.E.	33	160	D+S	WP 2"	44		250				1510,69									
102	JACOBS, J.J.	69 }	8,6	D+S	MONO 2" diesel	3,8	3,8	4000				1473,82									
103	"	69 }		none	none							1467,86									
104	PRETORIUS, J.G.	67	8,6	S+I	TUCBS 2" diesel	3,8	1,5	6000	1	grass		1479,88									pump removed, sucks air after 20 min.
105	POTGIETER, C.J.	65	8,6	D+S	ditto	2,5	2,5	3000	0,5	vegetable		1479,99				46					
106	VAN DE WESTHUIZEN	16	282	S	WP 1½"	3,8		250			M 0,32	1506,73	24/06/82	16,57*							
107	GRAAFF H.C.	41 }		none	none						M 0,20	1490,32	24/06/82	2,96							
108	"	"	} 8,6	none	Centrifugal							1486,42									EXCAVATED PUMP ON SPRING under WATER.
109	"	"	}	none	none							1486,62									

*pumping

LICHTENBURG

CADASTRAL FARM NAME KLIPBANKFONTEIN
KAD. PLAASNAAM EN NR. 26 I P (Km)

REGION
GEBIED.

Code	Use
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
4.7B	Urban Use "T"
	Quote farmer's units

Period of Survey: / Periode van Opname 06-09/82

Map and/or Aerial Photo. / Kaart en/of Lugfotoverwysing

Field values.

21

1 Bh. Nº	2 Name + address of owner	3 Part Nº Plot Nº	4 (ha) Total Area of property	5 Water Use?	6 Pump Type	7 (gph / l/s) Tested yield + date (if known)	8 (l/s) Present Yield (Not W.P.)	9 (1981/82 m³) Abstrn. Quantities and Pumping periods (Not WP)	10 (ha) Surface under groundwater irrigation	11 Crop type	12 (M / ha) Surface under irrigation with other water source	13 (Metres) Collar Elev'n + Method of determination	14 Groundwater Level: date	Depth below collar (m)	Height abv. m.s.l.	(Metres) Bh. Total Depth	Water Strikes (Depth(s))	T°C	T.D.S. mS/m	p.H.	Geology and Other Information
Km 110	?											1499,92 l									not located
Km 111	JOUBERT, J J	27	86	D+S	TURB DIESEL			3000	1	large garden		1489,49 l									
112	"	R/G		none	WP 2"						M 0,10	1472,99 l	31/08/82	2,61							pump broken
113	POTGIETER, CJ	15	8,6	none	none							1470,25 l									pump removed
114	VAN NIEKERK JE	33	160	D+S	WP 1½"			250				1499,13 l									
115	BARKHUIZEN, J	R/G 15	154	I+S	TURB 3" DIESEL	12,5		62000	5,2	barley/lucerne		1492,67 l									
116	"	10	6	D+S	SUBM ELECT	1,3		4000	9,5	fruit	M 0,27	1489,56 l	24/06/82	13,29							
117	MEYER, N.J.G	R/G 12	298	S	WP 2"			250			M 0,27	1509,68 l	22/06/82	18,66*							
118	"	9	41	none	none	62 (by Co-op)					M 0,00	1479,84 l	22/06/82	free flowing		91					free flow 0,3 l/s.
119	PARKER, D.	71	8,6	D+S	SUBM ELECT		0,25-0,38	3500	0,5	vegetables.	M	1483,49 l				67	~26				also old W.P.
120	ROODT, H.J.			D	"			4000			M 0,13		21/06/82	6,00							
121	GRAAFF, H.C.	41	8,6	none	none						M 0,20		24/06/82	2,96							
122	?	52	34			18,9 (1974)						1506,60 l									not located.
123	TEXEIRA, M	74	8,6	I+D	SANGUS 4" ELECT.		>20	≤Km 131 204 000	17 ≤Km 131	VEGETABLES		1502,51 l									
124	NIEMAND	79	8,6	D+I	RAPIDE elect.	10 (1974)		12 000	2	veg		1504,95 l									
125	VORSTER	81	8,6	D+I+S	MALCOMESS 3" elect	10		60000	5	grass/forage		1501,82 l									
126	DEPT. ENV. AFF.		G3N035	none	none	0,16 (1978)						1482,45 l	08/07/82	10,16		57	28				Mudstone? Karoo
127	"		G3N036	none	none	1,83 (1978)						1505,48 l	08/07/82	15,38		51	20				Dlm + chert.
128	VAN de WESTHUIZEN N.	68	8,6	none	CENTRIFUGAL electric												PUMPING FROM HARTS RIVIER. (adjacent to Km 55)				
129	VAN de MERWE SA	63	230	D+S	SUBM ELECT	1,3 (1981)		1000			M 0,01	1503,74 ll	21/06/82	5,69		238	116	BLASTED at 120m yield up from 0,5 to 1,3			0-41m yellow clay 41-146 gravel? 146 Dlm
130	VILJOEN, J J			D+S	"			≤Km 12			M 0,42	1489,16 ll	22/06/82	14,27							
131	TEXEIRA, M	74		I+D	SANGUS 4" elect		>20	≤Km 123		vegetables											
132	MEYER, N J G.			none	none						M 0,74	1488,25 ll	04/09/82	3,76							
133	DE BRUYN, T	R/G 12	7	none	"	0,5 (1982)			PLANS TO IRRIGATE 6 H of fruit 1983/84		M	1496,37 ll				55	1st 26m	DRILLED AUG-SEPT 1982 air rig			0-8m Karoo clay 8 → Dlm + ch.
134	"	R/G 12		none	"	0,4 (1982)					M	1497,59				32	1st 16m				0-11m Karoo clay 11m → Dlm + ch.
135	"	R/G 12		none	"	5,0 (1982)					M 0,35	1497,49 ll	14/09/82	8,32		29	1st 15m 2nd 25m-56				0-8m Karoo clay 8 → Dlm.
136	PARKER, D.			D+S	SUBM ELECT.	0,6 (1983)	0,4				M (-0,40)		09/05/83	4,70		79	1st -55m.	air rig March '83 casing 15m × 52m.			0-41m Karoo mudstone 41 → Dlm.

LICHTENBURG

CADASTRAL FARM NAME LICHTENBURG TOWN AND TOWNLANDS REGION

KAD. PLAASNAAM EN NR. 27 IP (Lt) GEBIED.

Nr.	Column
5	Domestic "d", Stockwatering "S", Irrigation "I", Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname: 06 - 09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

22

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 (ha) Total Area of property	5 Water Use?	6 Pump Type	7 (gph / l/s) Tested yield + date (if known)	8 (l/s) Present Yield (Not WP)	9 (1981/82 m³) Abstr'n Quantities pumping periods (Not WP)	10 (ha) Surface under Groundwater Irrigation	11 Crop Type	12 (collar height) Surface under irrigation with other water source	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level: date	Depth below collar (m)	Height above m.s.l.	Metres: Total Depth	Water Strikes (Depth(s))	15 T°C	T.D.S. mS/m	pH	Geology and Other Information
Lt 1	Municipality			S	WP			250			M 0,32	1504,21 ℓ	17/06/82	13,15*							FORMERLY C3N033
Lt 2	"			none	none																not located
Lt 3	"			T	SANGUS 6" ELECT.	53 (1970)		& OTHER T SUPPLIES. 2579000				1562,80 ℓℓ		(MUN no 3)			USED FROM 1975 → STANDING.	PUMP	RED CLAY PUMP INTAKE = 29m.		AFTER LEFT
Lt 4	"			none	TURB 6" ELECT	75		0				1500,38 ℓℓ		(MUN no F/11)	PUMPS SILT + CLAY.		REAMED AND EQUIPPED	PARTLY	CLEARED AFTER 240 hr PUMPING.		1982/83.
Lt 5	DEPT ENV. AFFAIRS			none	none							1498,00 ℓ									DRILLED 1975/76 AS OBS. B'HOLE FOR Lt 4.
Lt 6	"	C3N085		none	none						M 0,47	1500,99 ℓℓ									ditto.
Lt 7	?																				not located
Lt 8	DEPT. ENV AFFAIRS			none	none						M 0,35	1500,21 ℓℓ	07/06/82 02/03/82	9,40 9,59							DRILLED 1975/76 AS OBS B'HOLE FOR Lt 4.
Lt 9	"											1500,46 ℓ									not located
Lt 10	Municipality			T	SANGUS 8" ELECT.	53 (1958)		pumped				1497,22 ℓ	(1496,69 ℓℓ)				PUMP CYLINDER 37m				(MUN no 1)
Lt 11	"			T		28 (1959)		pumped.				1499,68 ℓ	(1499,17 ℓℓ)				ORIGINAL BOREHOLE.				(MUN no 2)
Lt 12	BLUE CIRCLE CEMENT	C3N013		INDUSTRIAL	SANGUS 4" ELECT		18 } JUNE 1982	} 907150			M		August '82	5,3			CYLINDER PUMP @ 12,2m }				
Lt 13	"	C3N014		"			15				M	1486,57 ℓℓ	August '82	5,5							40m NNW of Lt12.
Lt 14	Municipality			none	none							1488,10 ℓ									C3N506?
Lt 15	BLUE CIRCLE CEMENT	C3N015		INDUSTRIAL	STEENKAMP 4" ELECT		12 (JUNE 1982)	106690			M -0,72	(1504,98 ℓℓ) 1505,31 ℓ	17/06/82	13,83*		30,5					PUMP INTAKE 24,4m.
Lt 16	BOREHOLES (1974/75)											1457,83 ℓ									.
Lt 17												1474,52 ℓ									
Lt 18												1452,68 ℓ									blocked
Lt 19	PRIVATE TOWN SURVEY: 2 1st AV. BURGERSDORP			D	SUBM ELECT			250			M 0,35	(1455,27 ℓℓ) 1455,50 ℓ	04/05/82	4,11							
Lt 20												1475,74 ℓ									
Lt 21												1472,94 ℓ									
Lt 22	NATIONAL ZOOLOGICAL GARDENS			S	WP 2"			250			M 0,25	1502,00 ℓ (1501,29 ℓℓ)	03/08/82	8,92*							
Lt 23	GEOLOGICAL SURVEY								See Dowcett Report 1973 - 0222			1512,53 ℓ				21	DRILLED INTO DIABASE	(PARALLEL DYKE)			not located
Lt 24	"											1513,25 ℓ				23					not located
Lt 25	?																				not located
Lt 26	MUNICIPALITY	formerly C3N034		T	SANGUS 6" ELECT	32		pumped.				1504,40 ℓℓ				37					MUN no 6.

* pumping

23

CADASTRAL FARM NAME LICHTENBURG TOWNLANDS 27 I P (LE) REGION.

KAD. PLAASNAAM EN NR. GEBIED.

S	Domestic "d" / Stockwatering "S"
	Irrigation "I"
4.7.8	Urban Use "T" / Quote farmer's units

Period of Survey / Periode van Opname 06 - 09/82

Map and/or Aerial Photo / Kaart en/of Lugfoto verwysing

Field values.

1 Bh. No	2 Name + address of owner	3 Part No Plot No	4 Total Area of property (Ha)	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (gph / l/s)	8 Present Yield (Not WP) (Pump/Rate l/s)	9 Abstn. Quantities pumping periods (Not WP) (1981/82 m³)	10 Surface under groundwater irrigation (Ha)	11 Crop type	12 M / collar height — Surface under irrigation with other water source	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level date	Depth below collar (m)	Height abv msl	Metres Bh Total Depth	Water Strikes (Depth(s))	Remarks	T°C	T.D.S. µs/cm	p.H.	Geology and Other Information
Lt 27	DEPT ENV AFFAIRS	C3N086		none	none						M 0,18	1502,76 ll	07/06/82 03/08/82	12,44 17,25								OBSERVATION BOREHOLES
Lt 28	"			"	"							1503,26 l				16	not located					DRILLED 1975/1976
Lt 29	"			"	"							1503,76 l					not located					FOR PUMP TEST Lt 3
Lt 30	?																					not located
Lt 31	DEPT. ENV. AFFAIRS			none	none						M 0,67	1499,42 ll	07/06/82 03/08/82	5,94 9,06		48	0-23 weath. dlm + chert; 23-39 lea. chert dlm + ch.; 39-48 fresh dlm.					OBS B'HOLE 1975/76 TEST Lt 4
Lt 32	MUNICIPALITY	C3N505		none	none						M		03/06/83	10,40								3m North of Lt 10
Lt 33	"	C3N507		none	none						M	pumpbase 1487,02	03/08/82	below pump base plate 0,75								PUMP REMOVED ASLANGTE
Lt 34	LICHTENBURG GOLF CLUB / D.E.A.	C3N524		none	none						M	1463,04 ll	27/07/82	15,14								GOLF COURSE
Lt 35	" " / D.E.A.	C3N525		none	none						M	1462,66 ll	27/07/82	11,73								"
Lt 36	MUNICIPALITY			T	SAVAGUS ELECT	44 (1973)		pumped				1503,49 ll				46						MUN no 4
Lt 37	"			T		32 (1973)						1504,35 ll				41	pumps black clay occasionally					MUN no 5
Lt 38	not allocated																					
Lt 39	MUNICIPALITY			none	none	51 (1978)		0				1504,87 ll				49	ALCT HOLE REAMED to 25	DRILLED 1979 mm CASED				MUN no 7
Lt 40	"			T	"	51/1973		0				1503,29 ll					EQUIPPED	Oct 1982 →				MUN no 8
Lt 41	"			T	SAVAGUS (elect)	75 (1978)		pumped														MUN no 9
Lt 42	"			T		51 (1978)		0				1498,05 ll					EQUIPPED AS 3(?)					MUN no 10
Lt 43	" / FIRE STATION			none	WP						M 0,16	1480,42 ll	17/06/82	3,89								
Lt 44	J.J. PIENAAR 142, MELVILLE St.			D	WP 1¼"			250			M 0,00		04/06/82	7,61								
Lt 45	C. VAN ZYL 10, BUITEN St.			D	WP 1½"			250			M 0,05		"	7,38		27,5						PUMP INTAKE 15m.
Lt 46	72, DANIELL St.			D	WP 1¼"			250			M 0,50	1468,41 ll	"	6,14								
Lt 47	BUITEN St (between Metro & U Pryn'take t)			none	WP 1¼"						M 0,10	1460,83 ll	"	6,82								BROKEN
Lt 48	OPPOSITE 55 12th AV			none	WP 1½"						M 0,11	1465,47 ll	"	6,47								BROKEN
Lt 49	KLOPPER 91, 7th St			D	WP			250			M 0,33	1472,18 ll	"	5,63								.
Lt 50	BLUE CIRCLE CEMENT (Lovedale)			D	SUBM ELECT			2000			not											
Lt 51	"			DUST CONTROL TREES	CENTRIFICAL ELECT			} 5000			M		14/07/82	2,00								ON FLOODED CALCRETE QUARRY
Lt 52	"			D	SUBM ELECT						M											WELL BY NEW AGRIC. LIMEWORKS.

CADASTRAL FARM NAME LICHTENBURG TOWNLANDS 27 IP REGION.

KAD. PLAASNAAM EN NR. (Lt) **GEBIED.**

Column		
5	Domestic / Stodewatering	"d" / "S"
	Irrigation	"I"
	Urban Use	"T"
4.7.8	Quote farmer's units	

Period of Survey / Periode van Opname 06-09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 (ha) Total Area of property	5 Water Use?	6 Pump Type	7 (gph / l/s) Tested + date (if known)	8 (l/s) Present Yield (Not WP)	9 (1981/82 m³) Abstraction Quantities and pumping periods (Not WP)	10 (ha) Surface under Groundwater Irrigation	11 Crop Type	12 (M / other projects) Surface under Irrigation with other water source	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level date	Depth below collar (m)	Height (m) abv msl	Metres Bh. Total Depth	Water Strikes (Depth(s))	T°C / Opmerkings	T.D.S. µS/cm	p.H. / Geology and Other Information
Lt 53	MUNICIPALITY			I	CENTRICAL ELECT			40000		grass.										PUMPING FROM
Lt 54	?			D + Industrial	MONO 2" DIESEL			4000											EXCAVATED	LICHTENBURG SPRINGS WASHING DIAMOND-IFEROUS GRAVELS
Lt 55	NATIONAL ZOOLOGICAL GARDENS			S	WP 2"			250			M	0,05 1517,44 ll	03/08/82	22,47 *						
Lt 56	ESCOM (watershed depot).			D	SUBM ELECT			2000			M	0,20	12/11/82	13,06						
Lt 57	FARMERS COOP.			none	none						M	0,0 1480,66	20/08/82	3,70		30		Karoo	clay.	N.X. CORE. FOUNDATION SHALE
Lt 58	LICHTENBURG GOLFCLUB			none	none															
Lt 59	"			I	WP 3"			250		fairways.	M									INTAKE @ 40 m.
Lt 60	MAREE, DA 6, REPUBLIQUE ST.			none.	WP						M	0,38 1470,24 ll	23/08/82	4,40						
Lt 61	LE ROUX, Z.P. 24, GREEFF ST.			D	SUBM ELECT			1000			M	0,37 1476,64 ll	01/07/82	4,78		33,5	6			0-5m calcrete 5 → Karoo clay
Lt 62	MUNICIPALITY			none	none						M	0,28 1487,95 ll	29/11/82	4,87						
Lt 63	GEOL. SURV.			none	none				{ see Du Preez / Dorncott	1973 – 0222	}					27				DIABASE GREEFFSLAAGTE DYKE
Lt 64	" "			none	none											29				DLM.
Lt 65	BLUE CIRCLE CEMENT																			
Lt 66	DIRECTORATE OF PRISONS		G35001	(none)	(none)	0,1 (1983)					M	1471,29 ll	11/05/83	7,80		122	1st 9 2nd 55			0-6 Calc 6-27 Karoo + ? 27 → Dlm
Lt 67	DEPT. ENV. AFFAIRS		G35002	none	none	2,1 (1983)					M	1507,97 ll	27/04/83	17,64		38	1st-23 2nd-28			Dlm + chert.
Lt 68	"		G35003	"	"	1,0 (1983)					M	1503,66 ll	"	14,35		37	1st-10 2nd-20			Dlm + chert.
Lt 69	"		G35004	"	"	0,05 (1983)			—		M	(~1506,6)	27/04/83	17,60		42	30			"
Lt 70	"		G35005	"	"	>4 (1983)					M	(~1507,8)	"	19,36.		35	16 26 → 35			LEACHED DLM. WAD + CHERT NEEDS REDRILLING.
Lt 71	"		G35006	"	"	0,1 (1983)					M	(~1512,0)	"	20,05		34	24			DIABASE
Lt 72	"		G35007	"	"	>>3 (1983)					M	(~1510,8)	"	19,84		39	20-30 ? 32 →		GREEFF	SLAAGTE DYKE LEACHED DLM + CHERT
Lt 73	"		G35008	(")	(TO BE EQUIPPED WITH WINDPUMP BY NATIONAL ZOOLOGICAL GARDENS)	>1,5 (1983)					M	(~1513,14)	"	20,44		33	28			DLM + CHERT.
Lt 74	"		G35009	"	"	1,2 (1983)					M	1486,78 ll	09/05/83	3,43		31	5 7			0-5 Calc 5-40 Karoo 40-73 Black Reef
Lt 75	"		G35011	"	"	0,8 (1983)					M	1503,94 ll	15/04/83	15,72		46	27 39	Diabase	WITKLIP	73 → lava. DYKE
Lt 76	"		G35012	"	"	>> ?					M	1506,21 ll	"	17,41		37	18 21 →			DLM + CHERT NO RETURN CIRCULATION
Lt 77	"		G35013	"	"	>>4,5 (1983).					M	(~1503,66)	"	15,43		41	19, 21 21 →			DLM + CHERT LEACHED
Lt 78	"		G35023		"						M	1512,36 ll	(28/06/82)	DRY		37			No	DLM + CHERT RWL 2 months after drilling.

(~1506,6) Only peg levelled not casing collar.

* pumping.

CADASTRAL FARM NAME *LICHTENBURG TOWNLANDS 27 IP* REGION

KAD. PLAASNAAM EN NR. GEBIED.

Code	Use
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname 06-09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (l/s)	8 Present Yield (Not W.P.)	9 Abstr. Quantities pumping periods (Not WP) 1981/82 m³	10 Surface under groundwater irrigation	11 Crop Type groundwater	12 Surface under irrigation with other water source	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level date	Depth below collar (m)	Height above msl	Bh. Total Depth	Water Strikes (Depth(s))	Remarks	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Lt 79	DEPT ENV. AFFAIRS		635028	(none)	(none)	>>20 (1983)		(TO BE EQUIPPED WITH WIND PUMP			M BY NZG.)	1511,06 ll	11/5/83	19,94		38	22 22→					LEACHED DLM + CHERT.
Lt 80	NATIONAL ZOOLOGICAL GARDENS		635029	(none)	(none)	> 3 (1983)					M	1509,39	25/5/83	19,27		38	21 27					DLM + CHERT
Lt 81	DEPT ENV AFFAIRS		635030	none	none	?					M	1487,82	"	5,37		50	?					0-4 calc 4-21 Karoo clay 21→ dlm.
Lt 82	NATIONAL ZOOLOGICAL GARDENS		635145	(none)	(none)	0,43 (1983)					M	1484,33	"	2,39		50	18					3-8 Karoo 8→ Dlm.
	PRIEM 30 IP (Pm)																					
Pm 1	MAREE D.A.	R/G	26	D	WP							1503,39 l				18						
Pm 2	TRANSFERRED TO TALENE																					
Pm 3																						
Pm 4																						
Pm 5																						
	SCHERPUNT 32 IP (Sp)																					
Sp 1	CONRADIE, E.L.	Plaas	802		TURB ELECT.	15	15	102 000	13	9 - rye, corn, fruit (one crop) 4 - lucerne (all yr)						29,4	26					IRRIG? NO 29533
Sp 2	"	"				1		(0)			M 0,10	1503,60 l	14/07/82	13,50		49	- 21					RE-EQUIPPED 1983
																	DRILLED	MARCH	1943			3-26 Karoo clay 26-29 leached dlm 29-29,4 dlm
	TALENE 25 IP (Te)																					
Te 1	WOLMARANS F.G.A			D	WP2'			250				1504,18 ll										
Te 2	"			D+S+I	FILTO 3' ELECT	56 (1973)		20000	3	grass		1504,12 el					29	DRILLED 1973				PLANS TO EXPAND TO 6ha
Te 3	BORNMAN J.J.			D+S+I	STEIKFONTEIN 3' ELECT			20000	2,5	grass		1503,83 ll										CHICKEN FARM
Te 4	?				MONO 3' DIESEL							1503,92 ll										PUMP IN TAKE 18

LICHTENBURG

CADASTRAL FARM NAME TALENE 25 IP (Te)

KAD. PLAASNAAM EN NR.

REGION

GEBIED.

5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
4.7.8	Quote farmer's units

Period of Survey / Periode van Opname 06 – 09/82

Map and or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. No	2 Name + address of owner	3 Part No / Plot No	4 (ha) Total Area of property	5 Water Use?	6 Pump Type	7 (l/s) Tested yield + date (if known)	8 (Pump rate l/s) Present Yield (Not W.P.)	9 (1981/82 m³) Abstn. Quantities and pumping periods (Not W.P.)	10 (ha) Surface under groundwater irrigation	11 Crop Type	12 (M) Surface under irrigation with other water source	(Collar proj.)	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level date	Depth below collar (m)	Height abv. msl.	Metres Bh. Total Depth	Water Strikes (Depth(s))	15 T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Te 5	WESSELS			D+S+I	MONO 2" DIESEL			15000	1,5	grass			1503,41									
Te 6	KRUGER, J.A			D+S+I	MONO 3" ELECT			48000	3,5	grass + fruit			1503,75									+Maize 3ha. 1982.
Te 7	BOSMAN, F.A.			D+S+I	SANGUS 3", ELECT			48000	4	grass + fruit			1504,29									
Te 8	VAN DER HOFF, J.J			D+S+I	MONO 2" ELECTRIC	32,5		40000	1	veg + fruit	M	0,35	1503,35	30/06/82	12,75							
Te 9	NAUDE, F.J.	5		D+S+I	MONO 2" DIESEL			10000	3	grass			1505,16									
Te 10	FOURIE, A.P.F			S	WP 1½"			250			M	0,15	1502,16	29/06/82	11,67							
Te 11	DE VILLIERS			D+I	MONO ELECT			24000	2	grass + flowers.			1502,29									Nursery.
Te 12	KRUGER, J.A.			none	MONO 6" DIESEL								1499,92									WHEN ESCOM POWER FOR MAIZE.
Te 13	KOEGELENBERG, J			D+S+I	STERKFONTEIN 2", Diesel.			48000	4	grass, veg.			1500,97									
Te 14	FOURIE, A.P.F			D+S+I	TURB 4" ELECT			24000	2	grass, lucerne			1501,97									
Te 15	COETZEE, J			D+S+I	MONO 3" ELECT.			48000	4	grass	M		1503,18									
								VNIE 24 IP (Ve)														
Ve 1	Du PREEZ, W.B			none	WP 1½"			250														
Ve 2	"			S	WP 2"			250														
								WITKLIP 6 IP (Wi)		formerly WK												
Wi 1	SCHULENBERG, H.H.W	R/6	934	D+S	MONO 2" DIESEL	~7,5	2,5	500			M		1505,50				30	18				OIL IN BOREHOLE OLD W.P. on SITE
Wi 2	"	3	1033	none	none	~10,0							1510,95				37					blocked
Wi 3	"	3		none	none	~19							1505,94									blocked
Wi 4	SWANEPOEL	1	645	none	none						M			05/05/83	16,65							100m N of Wi 10
Wi 5	VAN ECK, D.R	2	877	D+S	WP 2"	20		250			M		1510,74				30	-21	-21			
Wi 6	" (Biesievlei)	2		none	open	20					M	0,18	1510,55	26/06/82	18,03		61	~21				5m E of Wi 5.
Wi 7	" 3131	2		S	WP 2"	5,6		250					1516,37				30	-21				

LICHTENBURG

CADASTRAL FARM NAME WITKLIP 6IP (Wi) cont.

KAD. PLAASNAAM EN NR.

REGION

GEBIED.

Column	
5	Domestic "d"; Stockwatering "S"; Irrigation "I"; Urban Use "T"
7.8	Quote farmer's units

Period of Survey / Periode van Opname 06-07/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

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Field values.

1 Bh. Nº	2 Name + address of owner	3 Part Nº of Plot Nº	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (l/s)	8 Present Yield (Not WP) (pump rate)	9 Abstn. Quantities, pumping periods (Not WP)	10 Surface under groundwater irrigation (ha)	11 Crop Type	12 Surface under irrigation with other water source (M)	Collar proj.	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level: date	Depth below collar (m)	Height abv msl	Bh. Total Depth (Metres)	Water Strikes (Depth(s))	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Wi 8	SWANEPOEL	1	695	S	MONO 2" DIESEL		500						1509,87									KEY FROM HDT.
Wi 9	"	1		none	none						M	0,20	1514,18	28/6/82	22,35							
Wi 10	"	1		D+Industry	MONO 2" DIESEL		500				M	0,10	1508,74	"	15,50							1m of oil in borehole

ZAMENKOMST 4 IP (ZK)

1 Bh. Nº	2 Name + address of owner	3 Part Nº of Plot Nº	4 Total Area of property (ha)	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) (l/s)	8 Present Yield (Not WP) (pump rate)	9 Abstn. Quantities, pumping periods (Not WP)	10 Surface under groundwater irrigation (ha)	11 Crop Type	12 Surface under irrigation with other water source (M)	Collar proj.	13 Collar Elev'n + Method of determination (Metres)	14 Groundwater Level: date	Depth below collar (m)	Height abv msl	Bh. Total Depth (Metres)	Water Strikes (Depth(s))	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Zk 1	TERREBLANCHE, B.D.	R/G	526	D+S	RAPIDE+ WP 1½"	20		2000					1510,02				21	18				
Zk 2	(Zoetmelkvlei)	S	526	S	WP 2"	11,2		250			M	0,10	1516,98	26/08/82	20,58		43	37				
Zk 3	KOEKEMOER, B.O.	1		D+S	E RAPIDE WP 2"	75		2000			M	0,20	1516,14	22/07/82	>21*					5 Zk3 + 4		
Zk 4	" (Duifield)	1		none	DEMING TURB	7,5							1514,67									FORMERLY 17ha IRRIG. BUT SINKHOLE at no 4).
Zk 5	"	1	1554	S	WP 2"			250			M	0,34	1514,42	22/07/82	21,2*							
Zk 6	"	1		S	WP 2"			250			M	0,05	1517,4?	"	24,84*							
Zk 7	"	1		S	WP 2"			250			M	0,33	1523,81	"	26,05							
Zk 8	SWANEPOEL, SW.J	R/G 2	428	D+S+I	MONO 2" DIESEL	2,5	1,5	2000	1	grass			1507,03				27	12				
Zk 9	" (Biesievlei)	R/G 2		D+S	WP 2"	0,2		250			M	0	1506,51	29/06/82	12,92		27	12				
Zk 10	VAN DYK P.J.	3	428	D+S	STERKFONTEIN 3" DIESEL	19		1000					1514,02				27	9 ?				FORMERLY 17ha IRRIG.
Zk 11	SWANEPOEL, P.	4	428	D+S	MONO 2" TRACTOR	1,5		500					1511,48				26					
Zk 12	BORNMAN J.J (Taba)	6	428	D+S	WP 1½"			500			M	0,42	1508,33	29/06/82	15,04*							
Zk 13	SWANEPOEL S.W.J	R/G 2	428	I	SANGUS 4" TRACTOR								1506,23									FORMERLY 3,5ha grass
Zk 14	KOEKEMOER B.O.	1	1554	S	WP 2"			250			M	0,20	1518,73	22/7/82	25,65		37	12				
Zk 15	DEPT. ENV AFF	Used formerly by B.D. Terreblanche	G35014	none	none	0,38 (1983)					M		1511,73 "	29/04/83	19,91		39	22				DIABASE ZAMENKOMST DYKE
Zk 16	"		G35015	none	none	≥4 (1983)					M		1512,50 "	"	20,73		37	23→				BLEACHED DLM + CHERT
Zk 17	"		G35016	none	none	dry					M		1512,95 "	04/05/83	none		31					SILP DLM + CHERT

* pumping

LICHTENBURG

CADASTRAL FARM NAME UITGEVONDEN 355 J P (Ug) REGION

KAD. PLAASNAAM EN NR. GEBIED.

5	Domestic / Huishoudelik	"d"
	Stock watering / Veesuiping	"S"
	Irrigation / Besproeiing	"I"
	Urban Use	"T"
4,7,8:	Quote farmer's units	

Period of Survey / Periode van Opname 06-09/83

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

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1 BH Nº	2 Name + address of owner / Naam van Eienaar en adres	3 Part Nº of Plot Nº / Gedeelte of Plot Nº	4 (ha) Total Area of property / Totale grootte van eiendom	5 Water Use? / Doel van watergebruik	Pump Type (pump rate)	7 (gph / l/s) Tested yield + date (if known)	8 Present yield (Not W.P.)	9 (1981/82 m³) Abstn. Quantities and pumping periods (Not W.P.)	10 (ha) Surface under groundwater irrigation	11 Crop Type	12 (M) Surface under irrigation with other water sources	13 Metres Collar Elev'n + Method of determination	14 Groundwater Level: datum date	Depth below collar (m)	Height abv. m.s.l.	Metres: Bh. Total Depth	Water Strikes (Depth(s))	15 T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Ug 1	DAHLIA HOF Pty Ltd MAREE, D.A.			T	CENTRIFUGAL PUMP		113 l/s	70000 (33 hr/wk)			M	1492,61 ᶜᶜ		watertafel →	1492,14 OVERFLOWING	(May 1983)	ON UITGEVONDEN	SPRING	SOUTH		SUPPLIES BAKERVILLE
Ug 2	BREDENKAMP			D+S	WP			250				1490,36 ᶜ									
Ug 3	"			S	WP			250				1500,75 ᶜ									
Ug 4	Tel Lbg 6415 SIEBERHAGEN, R.H.			D+S	TURB 2"			1000				1515,29 ᶜ									
Ug 5	DYKSTRA, G.G.			S	TURB			4000				1482,57 ᶜ									
Ug 6	MAREE, D.A.			D+S	WP			250			M (1490,71 ᶜᶜ)	1496,62 ᶜ	13/12/82	27,14*							
Ug 7	SIEBERHAGEN, R.H ?			S	WP			250			M	1491,44 ᶜ	01/07/83	19,41							
Ug 8	MAREE, D.A ?			D+S	CENTRIFUGAL			4000			M	1494,82 ᶜ					ON UITGEVONDEN NORTH	UNDER SPRING.			
Ug 9	DYKSTRA, G.G.			D+S	NORTHSUN TURB 2"			4000				1499,69 ᶜ									
Ug 10	MAR[illegible]S (?)			INDUSTRY	MONO 2"			8000				1491,21 ᶜ									DIAMOND GRAVEL WASHING
Ug 11	DEPT ENV AFF	T.P.A.	DAN139	none	none						M	1491,34	09/07/82	23,84							DLM + chert
Ug 12	"		DAN140	none	none	0,95 (19[illegible])					M	1493,40	09/07/82	21,47		44	30				DLM + chert.
Ug 13	not allocated																				
Ug 14	"																				ditto
Ug 15	"																				
Ug 16	"																				
Ug 17	"																				
Ug 18	"																				
Ug 19	"																				
Ug 20	SIEBERHAGEN, R.H.?			S	WP			250			M	1509,46 ᶜᶜ	01/07/82	17,03							
Ug 21	MAREE, D.A.			D+S	WP			250			M	1505,75 ᶜᶜ	04/5/83	14,06							
Ug 22	FOURIE ?			INDUSTRY	CENTRIFUGAL			?			M					ON UITGEVONDEN	SURFACE WATER.	NORTH			WASHING DIAMOND GRAVEL
Ug 23	GEOL SURV.			none	none					diamond hole		L1	see	Von Backström	1952						

* pumping

CADASTRAL FARM NAME WELVERDIEND 36/IP (WJ) LICHTENBURG REGION

KAD. PLAASNAAM EN NR. GEBIED.

Notes Columns	
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
+7,8	Quote farmer's units

Period of Survey / Periode van Opname: 06/-09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1 Bh. Nº	2 Name + address of owner	3 Part Nº Plot Nº	4 Total Area of property	5 Water Use?	6 Pump Type	7 Tested yield + date (if known) gph/l/s	8 Present Yield (Not WP) l/s	9 Abstr. Quantities and pumping periods (Not WP) 1981/82 m³	10 Surface under Groundwater Irrigation	11 Crop Type	12 Surface under Irrigation with other water source M	13 Collar Elev'n + Method of determination (Metres)	Groundwater Level: date	Depth below collar (m)	Height abv msl	Bh. Total Depth	Water Strikes (Depth(s))	Remarks	T°C	T.D.S. µS/cm	p.H.	Geology and Other Information
Wj 1	FOURIE, W			S+D	WP 2"			250			M	1516,45	29/06/82	21,94*								)
Wj 2	MAREE, D.A.?			S+D	RAPIDE + WP			500			M	1513,27		15,55*			+VISSER [illegible]					} light wind
Wj 3	MAREE, D.A.?			S	WP			250				1514,42										
Wj 4	?											1520,56										not located
Wj 5	MAREE D.A.?			D+S	MONO DIESEL			500				1521,36					Lugges [illegible]					Key from Kraal
Wj 6	"			D+S	TURB DIES	3" (STAGUS)		500				1515,26										
Wj 7	"			none	none							1515,25					contact [illegible]					blocked
Wj 8	"			D+S	WP			250				1522,67										KEY FROM HITBY Wj 6
Wj 9	"			S	WP			250				1516,75	04/05/83	22,41								
Wj 10	"			D+S	RAPIDE + WP			500				1523,77										KEY FROM KRAAL
Wj 11	not allocated																					
Wj 12	"																					
Wj 13	MAREE, D.A.?			S	WP			250			M	1517,50	29/06/82	22,43*								(IN OLD LAND NORTH OF 6/8 RD MARKER)
Wj 14	NEWMONT S.A. Pty Ltd			none	none							1512,02 ee					cased					
Wj 15	"			"	"						M	1512,50 ee	24/11/82	13,18			cased					50m E of 14
Wj 16	"			"	"						M	1512,29 ee	24/11/82	12,97			cased					55m E of 15
Wj 17	"			"	"							1512,56 ee					open	clays at	at 16m	dolerite		50m E of 16
	KLIPKUIL 352 JP. (Kk)																					
Kk 6	?			D+S+Industry	MONO 2" DIESEL			2000				1517,46										DIAMOND GRAVEL WASHING
Kk 7	?			S	NP						M	1505,97	04/05/83	11,67								
Kk 12	COETZER, O (Greefslaagte)			D+S+Industry	MONO 2" on old WP		1,5	2000			M	1515,14	"	20,83								DIAMOND GRAVEL WASHING

* pumping

LICHTENBURG

30

CADASTRAL FARM NAME RUIGTEZAAGTE 335 JP REGION

KAD. PLAASNAAM EN NR. Rl. GEBIED.

No.	Definition
5	Domestic "d"
	Stockwatering "S"
	Irrigation "I"
	Urban Use "T"
+7.8	Quota farmers units

Period of Survey / Periode van Opname 06-09/82

Map and/or Aerial Photo / Kaart en/of Lugfotoverwysing

Field values.

1	2	3	4	5	6	gph / l/s	8	1981/82 9	10	11	12	Metres 13	Groundwater Level 14			Metres		T°C 15	T.D.S. µs/cm	p.H.	
Bh. adv. Nº	Name + address Naam van Eienaar en adres of owner.	Farm Nº of Plot Nº Plot Nº	Total Area van eiendom of Property	Water Use?	Pump Type	Tested Yield + date (if known)	Present Yield (Not WP)	Abstn. Quantities and pumping periods (Not WP)	Surface under Groundwater Irrigation	Crop type Soort gewas onder grondwater	Surface under Irrigation With other water source	Collar Elevn + Method of determination	datum date	Depth below collar (m)	Height above collar abv m.s.l.	Bh. Total Depth	Water Strikes (Depth(s))	Remarks			Geology and Other Information.
Rl 4	?			D+S	WP			250			M	1512,45 '	30/06/82	21,24							
Rl 7	?			D+S	WP			250			M	1504,11 '	30/06/82	10,95							
Rl 8	?			none	none							1512,88 '									
Rl 9	?			Ind+S	TURB 2"			500				1510,25 '									DIAMOND GRAVEL WASHED
Rl 13	?	DTN/141		none	none	1,8 (1972)					M	1506,44 '	09/07/82	11,53		40	19				D Lm + clst.
Rl 30	GEOL SURV.			none	none			PUMP LENGED DEC 1982.			M	1509,01 "	30/06/82	15,03							

APPENDIX 1

LIST OF BOREHOLES FOR WATER FLOW METER INSTALLATION

DUDFIELD 35IP (N.B. 18, 19, 20 & 80 installed)

Dd1 approx 25 l/s - J. Botha
Dd10, approx 25 l/s - Swart
Dd119 up to 30 l/s - Anglo Alpha

ELANDSFONTEIN 34IP

Ef4 - 10 l/s - P.J. Huyser
Ef7 - 10 l/s - A.J.J. du Preez
Ef43 - 8 l/s - S.W.J. Vorster
Ef44 - 12 l/s - A.J.B. Geldenhuys
Ef108 - up to 30 l/s - S.& S Stonecrushes

GREEFSLAAGTE 33IP (N.B. G15 installed)

G12 - 50 l/s - D.B.F. Geldenhuys
G14 - 50 l/s - D.B.F. Geldenhuys
G17 - 30 l/s - S.J. Geldenhuys
G111 - 20 l/s - C.F. Nieman
G1 12 - 17 l/s - "
G1 15 - 20 l/s - J.A. Coetzee
G1 16 - 7 l/s - L.M. Coetzee
G1 17 - 30 l/s - "

HOUTHAALDOORNS 2IP

Hs 5 - 25 l/s - Sensako
Hs 6 - 30 l/s - Sensako

HOUTHAALBOOMEN 31IP

Hb 11 - 30 l/s - J.M. Nel
Hb 14 - 25 l/s - D.J. Steenkamp
Hb 15 - 25 l/s "
Hb 16 - 30 l/s - J.M. Nel

KLIPBANKFONTEIN 26IP

Km 4 - 20 l/s - N.J.G. Meyer
Km 5 - 15 l.s - "
Km 9 - 9 l/s - "
Km 10 - 20 l/s - "
Km 15 - 30 l/s - J.E. van Niekerk
Km 24 - 32 l/s - N.J.G. Meyer
Km 26 - 26 l/s - M.J. Roodt
Km 48 - 8 l/s - Haasbroek
Km 67 - 10 l/s - C.R.N. Reichel
Km 70 - 6 l/s H.S.B. Burger
Km 79 - 20 l/s - P.H. du Preez
Km 98 - 11 l/s - P. Cronje
Km 115 - 12 l/s - J. Barkhuizen
Km 123 - 20 l/s - M. Texeira
Km 125 - 10 l/s - Vorster
Km 131 - 20 l/s - M. Texeira

LICHTENBURG TOWNLANDS 27IP (N.B. 12, 13 and 15)

Lt 3 - 60 l/s - Lichtenburg Municipality
Lt 4 - 50 l/s "
Lt 10 - 60 l/s "
Lt 11 - 50 l/s "
Lt 26 - 50 l/s "
Lt 36 - 40 l/s "
Lt 37 - 45 l/s "
Lt 39 - 30 l/s "
Lt 40 - 40 l/s "
Lt 41 - 55 l/s "
Lt 42 - 30 l/s "
Lt 53 - 10 l/s "

SCHERPUNT 32 IP

Sp 1 - 15 l/s - E.L. Conradie

TALENE 25IP

Te 2 - 12 l/s - F.G.A. Wolmaraans
Te 6 - 10 l/s - J.A. Kruger
Te 7 - 10 l/s - F.A. Bosman
Te 9 - 8 l/s - F.J. Naude
Te 13 - 8 l/s - J. Koegelenberg
Te 14 - 16 l/s - A.P.F. Fourie
Te 15 - 8 l/s - J. Coetzee

UITGEVONDEN 355JP

Ug 1 - 11 l/s - Dahlia Hof (Pty) Ltd.

TOTAL NUMBER OF METERS = 59

GAUGED ABSTRACTION :

LICHTENBURG MUNICIPALITY

BLUE CIRCLE CEMENT (PTY.) LTD.

ANGLO ALPHA CEMENT (PTY.) LTD.

IRRIGATION BOREHOLE GL5

GAUGED ABSTRACTION BLUE CIRCLE CEMENT (PTY.) LTD.- LICHTENBURG

HYDROLOGICAL YEAR	BOREHOLE C3N013 (m^3)	C3N014 (m^3)	C3N013+ C3N014 (m^3)	C3N015 (m^3)	TOTAL C3N013, C3N014 AND C3N015 ($10^6 m^3$)
1965/66*	332 620*	304 670*	637 290*	0	0,63729*
1966/67	480 320	438 700	919 020	0	0,91902
1967/68	500 250	432 200	932 450	0	0,93245
1968/69	533 940	365 860	899 800	67 910	0,96771
1969/70	442 600	390 700	833 300	99 190	0,93249
1970/71	549 720	319 100	868 820	46 160	0,91498
1971/72	479 150	169 860	649 010	58 600	0,70761
1972/73	518 010	239 650	757 660	71 840	0,82950
1973/74	284 810	334 660	619 470	70 510	0,68998
1974/75	219 200	297 700	516 900	94 060	0,61096
1975/76	265 790	437 160	702 950**	59 980	0,76293**
1976/77	344 670	448 940	793 610	77 780	0,87139
1977/78	418 780	380 280	799 060	70 810	0,86987
1978/79	421 210	413 240	834 450	95 280	0,92973
1979/80	412 040	407 960	820 000	62 550	0,88255
1980/81	449 210	372 600	821 810	68 090	0,88990
1981/82	439 390	467 760	907 150	106 690	1,01384
1982/83***	329 630	380 700	710 330	98 680 0	0,80901***

METERING

* STARTED JANUARY 1966

** NO RECORD. AUGUST 1976

*** TOTAL TO JUNE INDISUE

0 ASSUMING 12000m^2 FOR DECEMBER 1982

ABSTRACTION - LICHTENBURG MUNICIPALITY

HYDROLOGICAL YEAR	TOTAL SPRING FLOW (A+B) EXCL. ASLAAGTE (m^3) $10^6 m^3$	BOREHOLE WATER PUMPED (m^3)	WATER USED FOR DOMESTIC (m^3)	TOTAL WATER OUTFLOWING ($10^6 m^3$)
1960/61	812 799 + 299 273 = 1,11	182 604	(369 255)*	1,29
1961/62	600 436 + 305 536 = 0,91	553 816	553 816	1,46
1962/63	350 290 + 290 965 = 0,64	597 718	0,60	1,24
1963/64	272 313 + 297 130 = 0,57	705 817	0,71	1,28
1964/65	164 952 + 214 110 = 0,38	777 999	0,78	1,16
1965/66	(65 248)+(108 675)=(0,17)*	(523 227)	(0,52)	(0,70)
1966/67	Moving	pumped	no record	
1967/68	199 091 + 182 862 = 0,38	1039 887	1,04	1,42
1968/69	(33 682)+ (29 590)=(0,06)	1213 474	1,21	(1,21)
1969/70****		1451 809	1,45	(1,45)

HYDROLOGICAL YEAR	ASLAAGTE PUMPED	BOREHOLE WATER PUMPED ($10^6 m^3$)	TOTAL ($10^6 m^3$ pm)
1970/71	0,831	1,769	2,600
1971/72	0,673	1,687	2,360
1972/73	0,673	1,795	2,468
1973/74*****	0,210	1,678	1,888
	LICHTENBURG MUNICIPALITY $10^6 m^3$		
	APPROX. AMOUNT PUMPED	QUANTITY SOLD + DEPARTMENTAL USE	
1974/75	1,646	1,600	
1975/76	1,785	1,701	
1976/77	1,826	2,211	
1977/78	2,250	2,288	
1978/79	1,817	2,373	
1979/80	2,226	2,43	
1980/81	2,661	2,411	
1981/82		2,579	
1982/83		(2,514) to June incl.	

* *from Oct 1961 Borehole water only used for domestic supply*

** *record to April 1966 only*

*** *flowing but not measured from December 1968*

**** *from August 1970 to 1977 includes pumpage for Anglo Alpha Cement (Pty.) Ltd.*

***** *no record for Aslaagte from October 1974*

GAUGED ABSTRACTION ANGLO ALPHA CEMENT (PTY) LTD - DUDFIELD

HYDROLOGICAL YEAR	TOTAL INDUSTRY (Dd18, Dd19, Dd20 & Dd80) ($10^6 m^3$)	TOTAL IRRIGATION (Dd18, 19, 20 & 80) ($10^6 m^3$)	TOTAL ABSTRACTION ($10^6 m^3$)	
1977/78	0,436 088	0,015 042	0,451 130	0,451
1978/79	0,303 447	0,024 652	0,328 099	0,328
1979/80	0,448 357	0,012 455	0,460 812	0,461
1980/81	0,589 406	0,019 878	0,609 284	0,609
1981/82	0,585 690	0,004 721	0,590 411	0,590
1982/83*	0,437 595*	0,007 315*	0,444 910*	

* to May 1983 (incl)

GAUGED ABSTRACTION IRRIGATION BOREHOLE GL5

HYDROLOGICAL YEAR	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL m^3
1980/81	2	?	?	?	5126			?		1	0	1040	1 6170
1981/82	0	9790	14499	11436	13077	29445		0	0	42880	4653	23882	15462 165124
1982/83	45188	9637	13695	37255	41085	35075	23835	21478					(227248)

To May 1983

Oct to May 1981/82 - 78 247 m^3 (0,078 x $10^6 m^3$)

ct to May 1982/83 - 227 248 m^3 (0,23 x $10^6 m^3$)

up to May 1983 (incl.)

APPENDIX 2

EXPLORATION BOREHOLE LOGS

LIST OF BOREHOLES FOR WATER

FLOW METER INSTALLATION

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 08/02/1983
COMPLETED 04/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. G-35001
BORING NO. 139848/7
CO-ORDINATES
Y LATITUDE 26° 09' 13"
X LONGITUDE 26° 09' 12"
COLLAR ELEVATION 1471,292 m
F.P. Elevation

W.I.(m)	Yield (l/s)	R.W.L. (m)
9	seepage	7,80 (11/05/83)
55	0,1	

Total Blow Yield (l/s) 0,1

HOLE 122 m
0 + 28 × 203 mm
28 to 122 × 165 mm

CASING 27,4 m × 165 mm, plain

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 6	6	Off-white calcrete
6 to 27	21	Red mudstone and clay
27 to 122	95	Mainly dark grey-blue, fine-grained, chert-poor dolomite with thin mudstone layers. Mainly fresh, unfractured. Thin quartz veining at 58m.

REMARKS:

1. Owner - Directorate of Prisons
2. Not regularly sampled
3. 6 to 27 m Karoo Sequence

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 271P
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 07/03/1983
COMPLETED 08/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. G-35002
BORING NO. 139849/8
CO-ORDINATES
Y LATITUDE 26° 05' 36"
X LONGITUDE 26° 10' 25"
COLLAR ELEVATION 1507,970 m
F.P. Elevation 1507,020 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
23	0,1	17,64 (27/04/83)
28	2,0	

Total Blow Yield (l/s) 2,1

HOLE 38 m
0 to 14 × 203 mm
14 to 38 × 165 mm

CASING 14,7m × 165mm, plain

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Soil and subsoil - dark brown sandy clay with bleached chert pebbles. Manganese concretions at 1m
2 to 7	5	Residual chert gravel with 20% brown clay
7 to 8,5	1,5	Dark brown manganese earth
8,5 to 9	0,5	Clay with chert and dolomite gravel
9 to 14	5	Weathered dolomite and clay alternating with layers of fairly fresh light grey chert
14 to 24	10	Weathered light grey; medium grained dolomite alternating with thinner bands of fresh, light grey-to translucent chert.
24 to 25	1	As above with thin layer of black mudstone
25 to 27	2	As 14 to 24 m
27 to 28	1	Fractured chert with brown staining.
28 to 33	5	Partly weathered, blue-grey, medium grained dolomite alternating with fresh dark grey chert. Some yellow and red clay
33 to 38	5	Partly weathered, blue-grey, medium- to fine grained dolomite alternating with fresh, dark grey chert

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 08/03/1983
COMPLETED 09/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35003
BORING NO. 139850/3
CO-ORDINATES
Y LATITUDE 26° 05' 44"
X LONGITUDE 26° 09' 00"
COLLAR ELEVATION 1503,655 m
F.P. Elevation 1503,141 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
10	Seepage	14,35 (27/04/83)
20	1,0	

Total Blow Yield (l/s) 1,0

HOLE 37m
0 to 24m × 203mm
24 to 37 × 165 mm

CASING 21m × 165 mm, plain

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 4	4	Red to light brown, silty sand with weathered chert gravel
4 to 7	3	Chert gravel with minor sandy clay
7 to 10	3	Dark brown manganese earth with chert gravel
10 to 19	9	Chert gravel with 10% dark brown clay - Mainly pebbles of chert with minor quartz, mudstone and dolomite
19 to 24	5	Leached dolomite with residual weathered chert and some orange - yellow clay
24 to 32	8	Weathered light grey-blue, fine- to medium grained dolomite, chert-poor. Thin (< 0,1 m) weathered, grey to red mudstone layers at 25, 29 and 31 m
32 to 37	5	Partly fractured, dark grey-blue, fine grained dolomite, chert-poor.

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 10/03/1983
COMPLETED 11/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35004
BORING NO. 139851/1
CO-ORDINATES
Y LATITUDE 26° 05' 15"
X LONGITUDE 26° 09' 40"
COLLAR ELEVATION approx 1506,6 m
F.P. Elevation 1505,782 m

W.I. (m)	Yield (l/s)	R.W.L. (m)
30	Seepage	17,60 (27/04/83)

HOLE 42 m
0 to 6 × 203 mm
6 to 42 × 165 mm

CASING 6,1 m × 165 mm, plain

Total Blow Yield (l/s) 0,05

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Pink silty sand with weathered chert gravel
2 to 6	4	Chert gravel and boulders with minor clay
6 to 13	7	Mainly fresh, dark grey-blue, fine-to medium grained dolomite with thin layers of fresh chert. Red stained dolomite from 9 to 12 m and decomposed chert band at 10,5 m
13 to 27	14	Fresh, dark grey, fine-grained dolomite, chert-poor. Red, pink and yellow stained fractures throughout.
27 to 36	9	Fresh, mid-grey blue dolomite, chert poor. Stained fractures throughout
36 to 37	1	Purple-grey, fine-grained dolomite with stained fracture surfaces
37 to 42	5	Fresh, dark grey-black, fine-grained dolomite, chert-free. Fracture surfaces 37 to 39 m.
		REMARKS:
		1. Casing collar not levelled, projects 0,82 m

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 14/03/1983
COMPLETED 16/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35005
BORING NO. 139852/9
CO-ORDINATES
Y LATITUDE 26° 05' 10"
X LONGITUDE 26° 09' 33"
COLLAR ELEVATION approx. 1507,8 m
F.P. Elevation 1506,476 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
16	seepage	19,36 (27/04/83)
26→35	>>4	

HOLE 35m
0 to 31 × 203 mm
31 to 35 × 165 mm

CASING 31,5m × 165mm
perf 28,5 to 31,5 m.

Total Blow Yield (l/s) Not determined as brown clay forming a thick sludge

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 6,5	6,5	Orange-red silty sand with weathered chert gravel
6,5 to 9	2,5	Yellow-brown, cherty silty sand with thin indurated clay layers
9-10	1	Buff, indurated clay.
10-18	8	Clayey chert gravels. Clays vary from brown to dark grey. Gravels are mainly angular, occasionally sub-rounded, with a low degree of sphericity and signs of pitting. Composition: >95% chert remainder vein quartz.
18-25	7	Chert gravel with white clay
25-35	10	Leached dolomite and chert horizon. Leaving pock marked, honeycomb and fairly fresh chert horizons alternating with residual dark grey-brown clayey silt. No dolomite. Some chert fragments have well preserved and etched oolites in sharp relief. Deposit virtually in situ.

REMARKS
1. Casing collar not levelled, projects 1,35m.
2. Borehole stopped at 35m in leached formation. Drilling should be continued by cable tool rig into hard formation
3. Water discoloured by clay.
4. Located on intersection of major north-south lineation and minor east west

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 17/03/1983
COMPLETED 18/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35006
BORING NO. 139853/7
CO-ORDINATES
Y LATITUDE 26° 03' 42"
X LONGITUDE 26° 09' 34"
COLLAR ELEVATION approx. 1512,0 m
F.P. Elevation 1511,029 m

W.I. (m)	Yield (l/s)	R.W.L. (m)
24	0,1	20,05 (27/04/83)

Total Blow Yield (l/s) 0,1

HOLE 34m
0 to 24 × 203mm
24 to 34 × 165mm

CASING
0 to 8m × 152mm, plain
8 to 34m × 127mm, perf.

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 3	3	Brown and pink silty clay with chert gravel.
3 to 4	1	Bright red clay with traces of relict structure (texture) - decomposed diabase.
4 to 5	1	Red-brown clay with relict structures - decomposed diabase
5 to 10	5	Biscuit brown clay with relict structures - decomposed diabase
10 to 20	10	Moist brown-green clay with relict structures - decomposed diabase.
20 to 24	4	Weathered and fractured fine-grained diabase with green-brown clay
24 to 27	3	Fractured and weathered green-black fine-grained diabase with brown stained fractures.
27 to 31	4	Fairly fresh, green-black, fine-grained diabase with occasional fractures
31 to 34	3	Fresh, green-black, medium grained diabase

REMARKS:
1. Drilled 25m South of Peak on magnetic line CT/83/075 - GREEFSLAAGTE DYKE
2 Casing collar not levelled, projects 1,0 m.

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 21/03/1983
COMPLETED 22/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35007
BORING NO. 139854/5
CO-ORDINATES
Y LATITUDE 26° 03' 45"
X LONGITUDE 26° 09' 34"
COLLAR ELEVATION approx. 1510,8 m
F.P. Elevation 1509,814 m

W.I. (m) Yield (l/s) R.W.L. (m)
20 to 30 m 2,8 (@ 30 m) 19,84 (27/04/83)
32 m → no return air circulation
Total Blow Yield (l/s) ≫ 3

HOLE 39 m
0 to 24 × 203 mm
24 to 39 × 165 mm

CASING 22 m × 165 mm
perf 4 to 22 m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Red-brown clayey silt
2 to 14	12	Weathered chert gravel with 40% red silty clay.
14 to 19	5	Chert gravel and cobbles with orange-brown clay.
19 to 32	13	Leached dolomite and chert horizon. Leaving pock marked, honeycomb, stained and fairly fresh chert horizons. No dolomite and no clay recovered (water clear)
32 to 37	5	No sample taken: Bit penetrates under weight of hammer and rods (5m in 30 secs). No return air circulation. Probably cavity and/or honeycomb chert
37 to 39	2	No return air circulation. Bit drilling rock, no sample.

REMARKS:

1. To be deepened by cable tool rig to recover samples of bedrock.
2. At 30 m - water clear
3. Located 100 m south of G35006
4. Casing collar not levelled, projects 1,0 m

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 271P
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 23/03/1983
COMPLETED 24/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35008
BORING NO. 139855/3
CO-ORDINATES
Y LATITUDE 26° 03' 34"
X LONGITUDE 26° 09' 34"
COLLAR ELEVATION Approx 1513,14
F.P. Elevation 1513,139 m m

W.I.(m) Yield (l/s) R.W.L. (m)
28 1 20,44 (29/04/83

HOLE 33m
0 to 12 × 203mm
12 to 33 × 165mm

CASING 11m × 165mm, plain

Total Blow Yield (l/s) see Remarks

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 1	1	Bright orange sandy silt with weathered chert gravel
1 to 7	6	Chert gravel with brown silty clay
7 to 10	3	Mid grey-blue to light grey, medium-grained dolomite with dark grey to translucent chert containing some fracture surfaces
10 to 15	5	Fresh, grey-blue, medium-grained dolomite with unfractured chert
15 to 17	2	Dolomite as above but with orange-yellow clay in joints
17 to 23	6	Fresh, mainly dark grey-blue, medium-to fine grained dolomite, speckled with "blebs" of recrystallised calcite (?), and chert with stained fractures at 21 to 22m
23 to 24	1	Fresh, light grey recrystalline dolomite with fresh chert
24 to 28	4	Mainly fresh with some orange-yellow clay in joints at 26 to 28m Mid grey-blue medium-grained dolomite with chert
28 to 31	3	Mid-to light grey medium grained dolomite with dark grey chert Leached dolomite and chert layer 28 to 29m with residual honeycomb chert
31 to 33	2	Fresh, as 17 to 23m
		REMARKS: 1. Approximately 200m north of G35006
		2 Will be pumped by National Zoological Gardens, Owner D.E.A
		3 Four hour pump test 12/04/1983 Yield of 1,5 l/s with pump set at 23m.

DRILLING RECORD

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 28/03/1983
COMPLETED 11/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35009
BORING NO. 139856/1
CO-ORDINATES
Y LATITUDE 26° 09' 13"
X LONGITUDE 26° 12' 06"
COLLAR ELEVATION 1486,778 m
F.P. Elevation 1486,678 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
5	0,1	3,43 (09/05/83)
7	0,5	
?		

Total Blow Yield (l/s) 1,2 @ 80m

HOLE 81m
0 to 45 × 203mm
45 to 81 × 165mm

CASING 45m × 165mm
perf 6 to 39m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Brown, clayey silty sand – soil
2 to 8	6	Impure grey, gravelly calcrete Pebbles subrounded with a low degree of sphericity, composition: blue quartzite, acidic rock and occasional chert
8 to 15	7	Weathered red, colour banded mudstone, drilled as saturated clay.
15 to 17	2	Weathered, pink medium to coarse grained sandstone. Poorly size sorted, grains angular to subrounded with a moderate degree of sphericity, composition ≈ 70% quartz, 30% lithics with a $CaCO_3$ cement.
17 to 25	8	Weathered, red, colour banded mudstone with some brown stained bedding? surfaces.
25 to 26	1	Weathered sandstone as 15 to 17m.
26 to 40	14	Weathered red-pink colour banded, bedded mudstone with cobbles of quartzite and a mafic igneous rock at 33 to 34 m
40 to 42	2	Weathered grey mudstone
42 to 48	6	Mainly grey-blue mudstone with thin bands of fresh, light grey-blue, fine-grained quartzite with occasional stained fractures
48 to 55	7	Alternations of grey, finely laminated mudstone with green-grey silicified siltstone and fine grained quartzite Occasional yellow-brown fracture surfaces

DRILLING RECORD

PROJECT *Lichtenburg (S.W.C.A.)*	BOREHOLE G-NO. 35009
FARM	BORING NO.
DRILLER *D.E.A.*	CO-ORDINATES
DRILLING METHOD *Air*	Y LATITUDE
COMMENCED	X LONGITUDE
COMPLETED	COLLAR ELEVATION
LOGGED BY *Taylor*	*F.P. Elevation*
W.I.(m) *Yield (l/s)* *R.W.L. (m)*	
	HOLE CASING

Total Blow Yield (l/s)

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
55 to 56	1	Blue, medium grained massive quartzite
56 to 66	10	Alternating layers of green-grey quartzite grey mudstone and poorly cemented pebbly sandstone. Pebbles up to 10 mm in diameter, well rounded with a medium degree of sphericity, composition: blue and white quartzite; red-pink granophyre and vein quartz (with inclusions). Matrix: sub-angular to sub-rounded, poorly cemented, composition: 75% quartz, 15% lithics and 10% pink feldspar
66 to 73	7	Alternating layers of laminated grey mudstone, fine-grained, false bedded sandstone and siltstone with well cemented pebbly sandstone (as 56 to 66 m)
73 to 80	7	Fresh, mainly dark green-black, medium-grained 'diabasic(?) lava with thin bands of light green medium-grained lava containing irregular shaped inclusions of white calcite
80 to 81	1	Fresh, very hard, green-black, coarse-grained lava.
		REMARKS: 8 to 40 m - Karoo Sequence
		40 to 73 m - Black Reef Quartzite Formation ?
		73 to 81 m - Allanridge Andesite Formation

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)

FARM Hendriksrust 36 IP

DRILLER D.E.A.

DRILLING METHOD Air

COMMENCED 12/04/1983

COMPLETED 13/04/1983

LOGGED BY Taylor

BOREHOLE G-NO. 35010 2626AA 473

BORING NO. 139857/9

CO-ORDINATES

Y LATITUDE 26° 10' 39"

X LONGITUDE 26° 06' 12"

COLLAR ELEVATION 1469,443

F.P. Elevation 1469, 304

W.I.(m)	Yield (l/s)	R.W.L. (m)
10 to 11	0,38	4,65 (07/05/83)

HOLE 31m
0 to 7 × 203mm
7 to 31 × 165mm

CASING 25m × 165mm
perf 7 to 25m

Total Blow Yield (l/s) 0,38

1. LITHOLOGICAL LOG

DEPTH	THICKNESS	DESCRIPTION
0 to 0,5	0,5	Brown, silty soil
0,5 to 10	9,5	Mainly white massive calcrete with grey clay layers and pebbles/boulders of chert and dolomite. 7 to 10 m red stained calcite veins ('beef' type)
10 to 18	8	Weathered, green-grey mudstone with gravel and boulders of red granite, white quartzite, dolomite and chert. Occasional veins of red-stained calcite
18 to 25	7	Weathered, thinly laminated green-grey mudstone with minor thin siltstone layers (< 10mm thick) and some red mudstone horizons. Occasional boulders and pebbles of red granite, white quartzite, dolomite and chert
25 to 31	6	Fresh, very hard lava. Fine grained dark green-black and medium-grained, green-grey. Amygdales of white calcite at 25 to 26m and 29 to 30m.

REMARKS :

10 to 25 m Karoo Sequence

25 to 31 m Allandale Andesite Formation

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 21 to 25/03/1983
COMPLETED 11 to 12/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35011
BORING NO. 139874/9
CO-ORDINATES
Y LATITUDE 26° 02' 29"
X LONGITUDE 26° 12' 02"
COLLAR ELEVATION 1503,943 m
F.P. Elevation 1503,622 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
27	0,1	15,72 (15/04/83)
39	0,7	

Total Blow Yield (l/s) 0,8

HOLE 46 m
0 to 20 × 203 mm
20 to 46 × 165 mm

CASING
0 to 20 m perf 165 mm, and
46 m × 127 mm
perf 18 to 46 m.

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 4	4	Orange-brown, clayey silty sand with chert gravel.
4 to 6	2	Dark brown clayey silt and manganese earth with minor chert gravel
6 to 11	5	Brown silty clay with 10% chert gravel
11 to 27	16	Yellow-brown clay with relict structures (textures), decomposed minerals and occasional fragments of weathered rock Decomposed diabase.
27 to 31	4	Highly weathered and fractured diabase with clay. Yellow stained fracture surfaces.
31 to 41	10	Weathered and fractured diabase with some clay. Abundant yellow-brown stained fracture surfaces
41 to 46	5	Fresh, unfractured, green-blue medium-grained diabase with visible pyroxenes and white feldspar.
		REMARKS
		1. Drilled into WITKLIP DYKE, 10 m West of Peak on magnetic line CT/83/068
		2 Strong smell of hydrogen sulphide from borehole water

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 28/03/1983
COMPLETED 29/03/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35012
BORING NO. 139875/7
CO-ORDINATES
Y LATITUDE 26° 02' 29"
X LONGITUDE 26° 12' 04"
COLLAR ELEVATION 1506,214 m
F.P. Elevation 1505,736 m

W.I.(m) Yield (l/s) R.W.L. (m)
18 0,5 (@ 20m) 17,41 (15/04/83)
21 → no return air circulation
Total Blow Yield (l/s) ?

HOLE 37m
0 to 12 × 203 mm
12 to 37 × 165 mm

CASING 22m × 165mm
perf. 16 to 22m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 5,5	5,5	Chert gravel and boulders with minor clay.
5,5 to 7	1,5	Chert gravel with manganese earth.
7 to 19	12	Leached dolomite and chert. Leaving residual, in situ?, partly fractured chert bands alternating with residue of yellow-green clay. Rare chips of dark grey, fine-grained dolomite
19 to 21	2	Fractured, pock marked, honey-combed chert with grey-green clay. Casing formation.
21 to 31	10	Bit penetrates under weight of hammer and rods. No return air circulation therefore no samples, and no water brought to surface. Highly porous formation - cavity and/or honeycomb leached chert
31 to 37	6	No return air circulation, hard formation drilled.

REMARKS:

1. Located 50m east of G35011

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 30/03/1983
COMPLETED 11/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35013
BORING NO. 139876/5
CO-ORDINATES
Y LATITUDE 26° 02' 29"
X LONGITUDE 26° 12' 07"
COLLAR ELEVATION approx 1503,66 m
F.P. Elevation 1502,691 m

W.I.(m) Yield (l/s) R.W.L. (m)
19 } 3 0,5 @ 21m 15,43 (15/04)
21 }
21 → 4,5 (@ 24m) with air pressure lost

Total Blow Yield (l/s) ≫ 4,5

HOLE 41m
0 to 35m × 203mm
35 to 41 × 165 mm

CASING 30m × 165mm
perf. 0 to 24 m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 1	1	Silty soil and manganese earth.
1 to 5	4	Brown manganocrete with chert pebbles
5 to 12	7	Chert gravel/boulders with up to 50% yellow-brown clay.
12 to 19	7	Leached dolomite and chert. Leaving residual (in situ?) chert layer with fractures, staining and pock marks and infilling of orange silty clay residue. No dolomite
19 to 37	18	Bit penetrates under weight of tools. Reduced return air circulation, no samples, most water not blown to surface. Highly porous formation, cavities, honeycombed (leached chert?
37 to 41	4	Hard formation

REMARKS,

1. Sited 80m west of G35011
2. Water clear
3. At 38 m, blocks of honeycombed and pock marked chert blown to surface along with white oolitic chert with the oolites etched by weathering/water flow.
4. Casing collar not levelled, projects 0,98m
5. Final 165mm casing should have been 0 to 18m plain 18 to 37m slotted

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Zamenkomst 4 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 13/04/1983
COMPLETED 19/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35014
BORING NO. 139877/3
CO-ORDINATES
Y LATITUDE 26° 00' 21"
X LONGITUDE 26° 10' 02"
COLLAR ELEVATION 1511,729 m
F.P. Elevation 1511,859 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
22	0,38	19,91 (29/04/83)

Total Blow Yield (l/s) 0,38

HOLE 39 m
0 to 18 × 203 mm
18 to 39 × 165 mm

CASING 17 m × 165 mm
perf. 2 to 17 m.

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 3,5	3,5	Sandy silty clay with weathered chert gravel
3,5 to 11	7,5	Buff - yellow clay, dry, with rotten pyroxene crystals (pseudomorphs). Decomposed diabase.
11 to 16	5	Buff - yellow gritty clay, dry - with chips of yellow-brown weathered diabase and pyroxene. Highly weathered diabase
16 to 21	5	Weathered diabase. Blue crumbly diabase with brown fracture stains and clay.
21 to 24	3	Fractured, blue-grey to blue-black, fine-grained diabase Brown to dark brown staining on fractures
24 to 39		Fresh, unfractured, blue-green, medium grained diabase. Pyroxenes and feldspars visible.

REMARKS:

1. Drilled into ZAMENKOMST DYKE, sited on peak magnetic anomaly line CT/83/080

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Zamenkomst 4 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 20/04/1983
COMPLETED 21/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35015
BORING NO. 139878/1
CO-ORDINATES
Y LATITUDE 26° 00' 23"
X LONGITUDE 26° 09' 57"
COLLAR ELEVATION 1512,498 m
F.P. Elevation 1511,758 m.

W.I. (m) 23
Yield (l/s) 4 (bit raised to 21m)
R.W.L. (m) 20,73 (29/04/83)
HOLE 37m 0 to 13 × 203mm 13 to 37 × 165mm
CASING 13m × 165mm, plain.

Total Blow Yield (l/s) ≥ 4 (air pressure lost)

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 6	6	Brown silty clay and weathered chert gravel and boulders.
6 to 19	13	Light blue-grey, medium-to coarse grained dolomite with white, translucent chert. Mainly fresh, unfractured. Yellow-green stained fractured chert at 17 to 19m.
19 to 22	3	Dark grey-blue, coarsely recrystalline dolomite containing 'blebs' of clear dolomite/calcite? crystals and chert. Black and brown stained fractures 21 to 22m
22 to 28	6	Bit penetrates under weight of tools. No return air circulation, no sample. Highly porous formation - cavities? Honeycombed leached chert
28 to 37	9	Hard formation, no sample.

REMARKS.

1. Sited 100 m west of G35014
2. When drill bit raised to 21m 4 l/s of clear water blown out

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Zamenkomst 4 IP.
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 22/04/1983
COMPLETED 25/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35016
BORING NO. 139879/9
CO-ORDINATES
Y LATITUDE 26° 00' 19"
X LONGITUDE 26° 10' 05"
COLLAR ELEVATION 1512,946 m
F.P. Elevation 1511,946 m

W.I.(m) Yield (l/s) R.W.L. (m)
none none none (29/04/83)
31,72 (04/05/83)

HOLE 31m
0 to 14 × 203mm
14 to 31 × 165mm

CASING 13m × 165mm, plain

Total Blow Yield (l/s) none

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 1	1	Pink silty sand with weathered chert gravel
1 to 6	5	Dark brown clayey silt with 20% weathered chert gravel.
6 to 13	7	Sample powdered by reamer – dolomite and light brown clay?
13 to 25	12	Light grey medium-to coarsely crystalline dololomite alternating with light grey to translucent chert. Formation apparently fresh with fracture staining at 13 to 14m, 18 to 19m, 21 to 22m and 23 to 24m
25 to 31	6	Mid-grey medium-crystalline dolomite with chert. Fresh, apparently unfractured
		REMARKS:
		1. Sited 100m east of G35014

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Elandsfontein 34IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 14/04/1983
COMPLETED 19/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35017
BORING NO. 139858/7 2626AA 418
CO-ORDINATES
Y LATITUDE 26°09' 39"
X LONGITUDE 26° 05' 49"
COLLAR ELEVATION 1480,799
F.P. Elevation 1480,663

W.I.(m)	Yield (l/s)	R.W.L. (m)
15	0,13	8,81 (07/05/83)

Total Blow Yield (l/s) 0,13

HOLE 31m
0 to 25 × 203mm
25 to 31 × 165mm

CASING 25m × 165mm
perf. 7 to 19m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 1	1	Off-white calcrete with grey-brown clay layer.
1 to 6	5	Indurated, red-brown silty clay, dry.
6 to 7,5	1,5	Indurated, light brown silty clay, dry.
7,5 to 11	3,5	Hard, indurated reddish clay, dry.
11 to 20	9	Blue-grey to dark grey-blue, fine grained dolomite with no visible chert. Fresh formation with occasional brown stained fracture surfaces
20 to 21	1	Weathered pink-grey mudstone with brown stained fracture surfaces flanked by multicoloured, medium grained, bidicciated and recrystallised dolomite with brown stained fractures.
21 to 31	10	Mainly dark blue-grey, medium-to fine grained, fresh, chert-free dolomite with occasional brown stained fracture surfaces. Thin (< 0,1m) grey, fairly fresh mudstone layer at 30 m.

REMARKS:
1. 1 to 11m - Karoo Sequence
2. Borehole covered by manhole, level peg by railway fence, 10 m to west

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Dudfield 35 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 20/04/1983
COMPLETED 21/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35018
BORING NO. 139859/S
CO-ORDINATES
Y LATITUDE 26° 09' 45"
X LONGITUDE 26° 01' 13"
COLLAR ELEVATION 1489,435 m
F.P. Elevation 1489,312 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
8	0,13	4,35 (05/05/1983)

Total Blow Yield (l/s) 0,13

HOLE 37m
0 to 13 × 203 mm
13 to 37 × 165 mm

CASING 13 m × 165 mm
perf. 3 to 13 m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 0,5	0,5	Brown silty soil
0,5 to 7	6,5	Massive, white, fine-grained calcrete with yellow-brown (joint?) stainings and blue-black dendritic markings
7 to 19	12	Massive, off-white, fine-grained calcrete with yellow-brown (joint?) staining and blue-black dendritic markings throughout. Pink calcrete occurs at 11 to 12 m and sporadically from 12 to 19 m
19 to 37	18	Mainly dark grey-blue, medium-grained, chert-poor, fresh dolomite, rarely: light grey medium-to coarse grained and dark grey-black fine-grained dolomite. Brown stained fractures 19 to 21 m, 28 to 29 m and 33 to 35 m

REMARKS:

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Houthaaldoorns 2IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 26/04/1983
COMPLETED 27/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35020 2626 AA 426
BORING NO. 139880/4
CO-ORDINATES
Y LATITUDE 26° 02' 29"
X LONGITUDE 26° 06' 02"
COLLAR ELEVATION 1511,385 m
F.P. Elevation

W.I. (m)	Yield (l/s)	R.W.L. (m)
25?	0,1	18,35 (08/05/83)

Total Blow Yield (l/s) 0,1

HOLE 37m
0 to 13 × 203mm
13 to 37 × 165mm

CASING 13m × 165mm, plain

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Orange-brown silty sand with weathered chert gravel
2 to 5,5	3,5	Chert gravel and boulders with minor dark grey clay.
5,5 to 10	4,5	Yellow-green dry clay with relict structures and hydrated feldspars and altered pyroxenes Decomposed diabase.
10 to 21	11	Mainly medium-grained, bright red to fawn brown, mottled dolomite with stained and translucent chert. Dark brown stained fracture surfaces throughout
21 to 27	6	Fawn-brown: dolomite and chert, with grey, limey clay, ; green stained travertine and at 24 to 26m honeycombed, pock marked and leached chert.
27 to 29	2	Yellow-brown, fine-grained dolomite
29 to 34	5	Mid-grey, fine-grained dolomite and chert with orange stained fractures
34 to 37	3	Light grey, medium-grained dolomite and chert with occasional stained fractures

REMARKS:

1. Intersected BLAAUWBANK DYKE, sited 10m south of magnetic peak line CT/183/086
2. Fixed peg not levelled, casing projects 1,05 m.

DRILLING RECORD

SHEET OF

PROJECT *Lichtenburg (S.W.C.A.)*

FARM *Houthaaldoorns 2IP*

DRILLER *D.E.A.*

DRILLING METHOD *Air*

COMMENCED 27/04/1983

COMPLETED 27/04/1983

LOGGED BY *Taylor*

BOREHOLE G-NO. 35021 2626AA 427

BORING NO. 139881/2

CO-ORDINATES

Y LATITUDE 26° 02' 29"

X LONGITUDE 26° 06' 02"

COLLAR ELEVATION 1512,014m

F.P. Elevation

W.I.(m)	*Yield (l/s)*	*R.W.L. (m)*
20?	0,1	18,03 (08/05/83)

Total Blow Yield (l/s)

HOLE 31m
0 to 18 × 203mm
18 to 31 × 165mm

CASING 31m × 127mm, perf. 25 to 31m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 5	5	Weathered chert gravel and boulders with silty clay
5 to 26	21	Yellow-brown, fine-grained, mottled dolomite and chert with occasional fractures
26 to 31	5	Green mottled, dolomite and chert with some grey, fine-grained dolomite and chert. Fresh, apparently unfractured.

REMARKS:

1. Drilled 10 m south of G35020.
2. Fixed peg not levelled, casing projects 0,74 m
3. At drilling no other casing available.

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Houthaaldoorns 2IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 28/04/1983
COMPLETED 03/05/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35022 2626AA 428
BORING NO. 139882/0
CO-ORDINATES
Y LATITUDE 26° 02' 25"
X LONGITUDE 26° 06' 00"
COLLAR ELEVATION 1511,980 m
F.P. Elevation

W.I.(m)	Yield (l/s)	R.W.L. (m)
32	Seepage	18,20 (08/05/83)
32 to 45	0,2	
Total Blow Yield (l/s)	0,2	

HOLE 67m
0 to 24 × 203 mm
24 to 67 × 165 mm
CASING 24 m × 165 mm, plain

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 1	1	Brown silty soil
1 to 4	3	Weathered chert gravel and boulders with 20% silt and clay
4 to 13	9	Dark grey-brown clayey silt and minor chert sand
13 to 25	12	Yellow clayey silt with thin red clay horizons between 17 and 25 m
25 to 42	17	Yellow-brown, green and light grey, fine to medium grained, mottled dolomite and chert. Occasional dark brown stained fracture surfaces
42 to 45	3	Leached horizon. Yellow clayey travertine deposits with pure white secondary calcium carbonate and honeycombed & pock marked and leached fractured chert.
45 to 47	2	Dark grey-blue, fine-grained dolomite and chert with orange stained fracture surfaces
47 to 57	10	Light grey to green-grey, medium-grained dolomite with chert. Fresh apparently unfractured
57 to 67	10	Dark grey-blue fine- to medium grained dolomite with chert Fresh, unfractured
		REMARKS:
		1. Drilled 100m north of 635020
		2. Fixed peg not levelled, casing projects 0,95m

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 04/05/1983
COMPLETED 06/05/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35023 2626 AA 461
BORING NO. 139883/8
CO-ORDINATES
Y LATITUDE 26°04' 13"
X LONGITUDE 26° 11' 23"
COLLAR ELEVATION 1512,362 m
F.P. Elevation 1511,355 m

W.I.(m) Yield (l/s) R.W.L. (m)
NONE NONE NONE (28/06/83)

HOLE 37 m
0 to 31 × 203 mm
31 to 37 × 165 mm

CASING 14m × 165mm
perf 8 to 14 m.

Total Blow Yield (l/s) NONE

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 5	5	Brown silty clay with weathered chert gravel
5 to 10	5	Chert gravel with light brown silty clay
10 to 15	5	Drilled as brown stained heavily weathered, heavily fractured, leached dolomite
		Fresh surfaces dark grey, fine grained,
		chert-poor.
15 to 31	16	Light grey medium grained dolomite
		with chert. Fresh apparently unfractured
31 to 36	5	No return air circulation, no sample
		Highly porous zone + cavity but DRY
36 to 37	1	Hard formation, no sample
		REMARKS:
		1. Sited on western flank of north-south,
		non-magnetic lineation

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Hendriksdal 1 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 27/04/1983
COMPLETED 04/05/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35024 2626AA 412
BORING NO. 139812/1
CO-ORDINATES
Y LATITUDE 26° 02' 54"
X LONGITUDE 26° 02' 11"
COLLAR ELEVATION 1503,164 m
F.P. Elevation 1502,974 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
27 ?	0,1	20,73 (10/05/83)

Total Blow Yield (l/s) 0,1

HOLE 53m
0 to 40m × 165mm
40 to 53m × 127mm

CASING 40m × 127mm
perf. 18 to 40m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 3	3	Red-brown silty sand with chert gravel
3 to 5	2	Indurated brown clay with grains of green mineral
5 to 15	10	Light green-brown clay, dry, with relict structures. Highly decomposed diabase
15 to 26	11	Light green clay with globules of green stained mineral (calcite ?). Decomposed diabase
26 to 33	7	Highly weathered yellow-brown diabase with altered feldspars and pyroxenes. Small globules of green stained mineral
33 to 40	7	Fairly fresh, blue, fine to medium-grained diabase veined by thin (up to 5mm) green stained calcite veins
40 to 53	13	Fresh, green-blue, medium-grained diabase veined by calcite. No open fractures

REMARKS.

1. Drilled into HENDRIKSDAL DYKE, sited 13m east of magnetic peak line CT/83/1081

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Houthaaldoorns 2IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 06/05 → 17/05/1983
COMPLETED 22/06 → 23/06/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35025 2626 AA 423
BORING NO. 139813/9
CO-ORDINATES
Y LATITUDE 26° 00' 41"
X LONGITUDE 26° 04' 19"
COLLAR ELEVATION 1506,002 m
F.P. Elevation 1506,234 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
15	Seepage	14,69 (25/05/83)
34	0,2	

Total Blow Yield (l/s) 0,2

HOLE 40m
0 to 34 × 165mm
34 to 40 × 127mm

CASING 34m × 127mm
perf. 19 to 34 m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 1	1	Orange-brown silty sand
1 to 4,5	3,5	Weathered chert gravel and silty sand
4,5 to 7	2,5	Red-brown clay - decomposed diabase ?
7 to 13	6	Light greenish, dry clay with relict structures - highly decomposed diabase
13 to 14	1	Highly weathered layer of mainly hydrated(?), green mineral
14 to 28	14	Light green, saturated clay with globules of green mineral and some calcite crystals - decomposed diabase.
28 to 33	5	Light green saturated clay with occasional chips of yellow brown diabase. Highly weathered
33 to 40	7	Fractured and weathered, blue-grey medium- to coarsely crystalline diabase with prominent green mineral, pyroxene and white plagioclase
		REMARKS:
		1. Drilled into HENDRIKSDAL DYKE, 15m west of magnetic peak line CT/83/088
		2. Not drilled into fresh dyke material

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Houthaaldoorns 2 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 16/05/1983
COMPLETED 17/05/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35026 2626AA 424
BORING NO. 139814/7
CO-ORDINATES
Y LATITUDE 26° 00' 41"
X LONGITUDE 26° 04' 19"
COLLAR ELEVATION 1505,973 m
F.P. Elevation 1505,420 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
?	0,1	36,53 (25/05/83)
		36,28 (26/06/83)

Total Blow Yield (l/s) 0,1

HOLE 49m
0 to 13m × 203 mm
13 to 49m × 165mm

CASING 13m × 165mm, plain

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Orange-brown silty sand
2 to 8	6	Weathered chert gravel with 20% brown clay
8 to 11	3	Light-brown clay with chert gravel
11 to 14	3	Dark brown silty sand with minor chert gravel.
14 to 17	3	Chert gravel with 40% brown silty clay.
17 to 20	3	Light grey-blue, medium-to coarsely grained dolomite with chert and occasional brown stained fractures
20 to 27	7	Mid blue-grey, medium-grained dolomite with minor chert; Fresh appearance, unfractured
27 to 32	5	Dark grey-black, coarse-grained, chert-free dolomite. Stained fractures at 30 to 32m
32 to 36	4	as 20 to 27m
36 to 38,5	2,5	as 27 to 32m, but unfractured
38,5 to 40	1,5	Dark grey to translucent, fresh, unfractured chert with rare chips of dolomite
40 to 49	9	Dark grey-blue, medium-grained dolomite with chert. Fresh, unfractured.

REMARKS

Drilled 73m north west of 635025

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Hendriksdal 1 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 25/04/1983
COMPLETED 27/04/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35019
BORING NO. 139860/3
CO-ORDINATES
Y LATITUDE 26° 02' 54"
X LONGITUDE 26° 02' 11"
COLLAR ELEVATION 1503,903 m
F.P. Elevation 1502,943

W.I.(m) 37, 38 | Yield (l/s) 4 | R.W.L. (m) 22,60 (10/05/83)

Total Blow Yield (l/s) 4

HOLE 43m
0 to 25 × 203mm
25 to 43 × 165 mm

CASING 25m × 165mm, plain.

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Red-brown silty soil with chert gravel
2 to 3	1	Brown clayey silt
3 to 4,5	1,5	Partly indurated brown silty clay with chert gravel
4,5 to 16	11,5	Light green-brown clay, dry, with relict structures
		Highly decomposed diabase
16 to 20	4	Light green clay with globules of green stained mineral
		(calcite ?), dry. Decomposed diabase.
20 to 25	5	Highly weathered brown-yellown diabase with
		hydrated feldspar, altered pyroxenes and thin
		veins (2 to 4mm thick) of calcite
25 to 26	1	Dark black dolomite and chert with some
		red staining
26 to 37	11	Light grey, medium-to coarse grained
		dolomite with light grey and dark grey
		chert Fresh, apparently unfractured
37 to 39	2	As above but fractured with thin band
		of grey weathered mudstone and green
		stained travertine
39 to 43	4	Mid-grey medium grained dolomite and
		chert. Fresh, apparently unfractured

REMARKS

1. Drilled into HENDRIKSDAL DYKE, sited 5m east of magnetic peak line CT/83/091

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 06/05/1983
COMPLETED 10/05/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35028 2626 AA 462
BORING NO. 139884/6
CO-ORDINATES
Y LATITUDE 26° 04' 13"
X LONGITUDE 26° 11' 23"
COLLAR ELEVATION 1511,061 m
F.P. Elevation 1511,032 m

W.I.(m) Yield (l/s) R.W.L. (m)
22 1 19,94 (11/05/83)
22→ (Main water 31 to 36m) 20 *
Total Blow Yield (l/s) ⇒ 20 (air pressure lost)

HOLE 38m
0 to 24 × 203mm
24 to 38 × 165mm

CASING 28m × 165mm, plain.

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Orange-brown silty sand with weathered chert gravel
2 to 7	5	Weathered chert gravel with orange to brown clay
7 to 10	3	Chert gravel with 30% yellow-brown clay
10 to 14	4	Chert gravels and cobbles with minor clay.
14 to 16	2	Manganese earth
16 to 22	6	Chert gravel and cobbles with minor clay.
22 to 38	16	Leached dolomite and chert, in situ?. Honeycombed pock marked, etched (oolites in sharp relief), leached fractured and stained chert bands with orange clay at 22 to 24 m and grey clay below. Chert blocks 4cm × 6cm × 4cm blown out Driller reports bit penetrates most rapidly at 31 to 35m No dolomite

REMARKS.

1. Drilled 35 m west of G 35023 in the centre of a north-south trending lineation
2. Hard formation not penetrated.
3. Three hour pumptest 11/05/1983. Pump set at 26,5 m. Pump rate 1 l/s for 40 mins, clear water pumped, drawdown 9,06 m Pump rate 6,3 l/s (maximum of pump) for 140 mins, final drawdown 0,51m, water clearing but still containing grey clay
4. Owner D.E.A but will be used for stock watering by National Zoological Gardens

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Houthaaldoorns 2IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 18/05 → 18/05/1983
COMPLETED 20/06 → 21/06/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35027 2626 AA 425
BORING NO. 139815/S
CO-ORDINATES
Y LATITUDE 26° 00' 45"
X LONGITUDE 26° 04' 23"
COLLAR ELEVATION 1506,797
F.P. Elevation

W.I.(m) ?
Yield (l/s) ?
Seepage
R.W.L. (m) 16,55 (25/05/83)
after deepening - 3½,25 (27/06/83)
Total Blow Yield (l/s) 0,01

HOLE 50m
0 to 12 × 203 mm
12 to 50 × 165 mm
CASING 12m × 165mm, plain

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 3	3	Orange-brown silty sand with weathered chert gravel
3 to 6	3	Chert gravel and silty sand.
6 to 11	5	Clayey, silty sand with minor chert gravel
11 to 13	2	Chert gravel and grey-green clayey silty sand
13 to 18	5	Dark blue-grey, medium-to coarse grained dolomite with minor chert. Fresh, unfractured
18 to 19	1	Blue, fine-to medium grained dolomite and minor chert with brown stained fractures
19 to 25	6	Light grey-blue, medium-to coarse grained dolomite with chert; Fresh, unfractured
25 to 32	7	Blue-black, fine-to medium grained dolomite with minor chert Fresh, unfractured
32 to 39	7	Light grey, coarse grained dolomite and chert, fresh, unfractured
39 to 41	2	Mainly translucent chert, fresh unfractured
41 to 50	9	Light blue-grey, coarse-grained dolomite with translucent chert Fresh, unfractured

REMARKS:
1. Drilled 100m south east of G35025
2 Fixed point peg not levelled, casing projects 0,96 m.

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 11/05/1983
COMPLETED 13/05/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35029
BORING NO. 139885/4
CO-ORDINATES
Y LATITUDE 26° 02' 22"
X LONGITUDE 26° 11' 18"
COLLAR ELEVATION 1509,394 m
F.P. Elevation 1509,102 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
21	0,3	19,27(25/05/83)
27	2,7	

Total Blow Yield (l/s) > 3,0

HOLE 38 m
0 to 19 × 203 mm
19 to 38 × 165 mm

CASING 19 m × 165 mm, plain

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 2	2	Orange-brown silty sand with weathered chert gravel.
2 to 10	8	Dark brown silty clay with 50% chert gravel. Some gravel well rounded with low to medium degree of sphericity. Composition: mainly chert but also rare, well rounded pebbles of agate and jaspar
10 to 19	9	Light grey-blue, medium crystalline dolomite with chert. Apparently fresh and unfractured
19 to 26	7	Dark grey-blue, medium crystalline dolomite with fractures at 21 to 22 m.
26 to 33	7	Partly leached dolomite and chert zone. Sample mainly honeycombed, pock marked stained and fractured chert. Also minor chips of fresh translucent chert, grey leached dolomite and ruggy pitted quartz (31 to 32 m).
33 to 38	5	Light grey, medium-crystalline dolomite with translucent chert. Fresh, unfractured.

REMARKS

1. Sited between Greefslaagte and De Paard Dykes and close to photo-lineations
2. Drilled for National Zoological Gardens (owners)

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27 IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 13/05/1983
COMPLETED 18/05/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35030 2626 AA 460
BORING NO. 139886/2
CO-ORDINATES
Y LATITUDE 26° 07' 39"
X LONGITUDE 26° 10' 09"
COLLAR ELEVATION 1487,817m.
F.P. Elevation 1487,339 m

W.I.(m)* Yield (l/s) R.W.L. (m)
NONE NONE 5,37 (25/05/83)

HOLE 50 m
0 to 22m × 203mm
22 to 50m × 165mm

CASING 22m × 165mm, plain

Total Blow Yield (l/s) NONE

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 4	4	White-to cream calcrete
4 to 11	7	Pink-yellow clay - highly weathered mudstone
11 to 14	3	Yellow clay — highly weathered mudstone
14 to 21	7	Red weathered mudstone
21 to 25	4	Light grey, medium-grained, chert-poor dolomite.
25 to 50	25	Mid grey-blue, fine-to medium grained, chert-poor dolomite. Fresh and mainly unfractured. Fractured and pitted chert blown out at ? m.

REMARKS.

1. 4 to 21m - Karoo Sequence.
2. Samples partly washed away by heavy rain before logging.

DRILLING RECORD

SHEET OF

PROJECT Lichtenburg (S.W.C.A.)
FARM Lichtenburg Townlands 27IP
DRILLER D.E.A.
DRILLING METHOD Air
COMMENCED 19/05/1983
COMPLETED 23/05/1983
LOGGED BY Taylor

BOREHOLE G-NO. 35145
BORING NO. 139887/0
CO-ORDINATES
Y LATITUDE 26°07'40"
X LONGITUDE 26°10'07"
COLLAR ELEVATION 1484,327 m
F.P. Elevation 1484,130 m

W.I.(m)	Yield (l/s)	R.W.L. (m)
18	0,43	2,39 (25/05/83)

Total Blow Yield (l/s) 0,43

HOLE 50m
0 to 18m × 203mm
18 to 50 × 165mm

CASING 18m × 165mm
perf 12 to 18m

1. LITHOLOGICAL LOG

DEPTH (m)	THICKNESS (m)	DESCRIPTION
0 to 1	1	Dark black clay
1 to 3	2	Bright yellow clay with some chert pebbles.
3 to 8	5	Red, colour banded, finely laminated, weathered mudstone.
8 to 17	9	Light grey, medium-grained dolomite and chert Fractured?
17 to 25	8	Mid grey-blue, fine-to medium grained, chert-poor dolomite. Mainly fresh and unfractured but with stained fractures at 22m
25 to 26	1	Dark grey-black, fresh mudstone
26 to 38	12	Mid grey-blue, fine-to medium grained chert-poor dolomite. Mainly fresh, unfractured but with stained fractures at 35 to 36m and fresh white vein quartz 36 to 38m.
38 to 39	1	Dark grey-black, fresh mudstone with minor white, massive vein quartz.
39 to 43	4	Mid grey-blue, fine-to medium grained, chert poor dolomite. Fresh, unfractured
43 to 50	7	Light grey-blue, medium-grained, chert-poor dolomite. Stained fractures 45 to 46m, otherwise fresh and unfractured

REMARKS:

1. Drilled 150m west of 635030
2. 3 to 8m Karoo Sequence
3. Owner National Zoological Gardens

APPENDIX 3

WATER CHEMISTRY DATA

Appendix. Chemical analyses of groundwater samples . costituentsin mg/l .

BH. No.	H. no. 8340/	Date 1983	FIELD T °C	Ca	Mg	Na	K	HCO_3	SO_4	Cl	Nitrate as N	F	Si	Lat. 26°	Long. 26°	FIELD PH unit		E.C. mg/k. Lab	E.C. mg/k. Field @ 25°C	FORMATION
Dd 4	2312	16/03	22,0	92	27	13	1,6	293	17	25	14,33	0,3	16,4	01' 05"	09' 23"	7,35		449	463	Qc
Dd 20	2299	"	20,0	72	28	9	2,1	322	10	6	4,85	0,3	14,2	01' 04"	07' 14"	7,15		322	376	Pe/Vmm
Dd 27	2338	"	20,5	95	30	13	0,8	371	10	24	4,03	0,4	19,7	03' 48"	10' 10"	7,15		449	465	Qc/?
Dd 33	2320	"	21,0	89	37	15	0,9	345	24	29	11,98	0,4	12,2	04' 40"	08' 49"	7,05		507	523	Qc/Pe
Dd 96	2304	"	22,5	64	23	11	1,3	176	15	54	8,22	0,2	16,1	02' 01"	08' 57"	7,25	?	308	561	"
Ef 69	2401	17/03	22,0	49	52	7	0,2	237	20	47	10,46	0,4	20	08' 33"	07' 26"	7,10		416	539	"
Ef 98	2419	"	20,0	26	39	4	0,6	237	15	5	9,73	0,1	15	07' 07"	08' 36"	7,20		267	405	Vmo
Gl 2	2207	14/03	22,0	28	37	4	0,5	219	14	6	3,52	0,2	14	01' 07"	05' 39"	7,35		270		Pe/Vmm
Gl 7	2215	"	22,0	83	44	13	0,7	258	14	43	26,01	0,2	13,4	02' 53"	04' 26"	7,25		501		"
Gl 27	2192	"	22,0	60	34	7	1,2	312	10	4	4,16	0,1	12,2	00' 49"	06' 19"	7,15		366		"
Gf 6	2388	17/03	22,0											00' 25"	03' 05"	7,10			394	Vmm
Hb 11	2265	15/03	24,5	55	39	6	0,6	324	10	4	4,91	0,1	10,8	03' 30"	07' 11"	7,05		404	394	Vmo
Hd 2	2396	17/03	23,0	28	41	3	0,6	245	9	3	5,19	0,1	11,1	02' 27"	02' 08"	7,35	?	237	447	Vmm
Hr 7	2346	16/03	22,0	68	45	11	1,6	396	10	8	2,49	0,5	11,6	05' 53"	10' 18"	7,20		416	429	Qc/Pe/P
Hs 2	2231	15/03	20,5	71	43	16	1,8	356	12	36	4,60	0,1	9,6	01' 44"	04' 41"	7,15		462	472	Vmm
Hs 6	2257	"	21,0	62	38	7	0,7	312	10	6	9,28	0,1	11,6	03' 47"	05' 14"	7,15		416	403	"
Kk 12	2354	17/03	20,5	47	28	5	0,7	261	9	1	0,90	0,1	8,0	25° 57' 08"	10' 32"	7,30		287	279	Qa/Vmm
Km 26	2150	14/03	21,0	67	40	6	1,2	363	11	3	4,95	0,1	10,3	11' 26"	01' 17"	7,20		417		Pe/Vmm
Km 77	2134	"	22,0	70	40	7	1,2	363	13	3	4,01	0,1	9,9	12' 21"	04' 40"			408		Vmm
Km 94	2118	"	21,0	61	31	40	1,9	354	21	23	3,53	0,2	14,2	14' 12"	07' 59"	7,20		436		Pe/Vmc
SPRING 'FON'	2126	"	21,0	29	41	4	0,5	246	12	10	3,54	0,3	10,6	14' 25"	06' 16"	7,70		281		AT H.P. 2.

Appendix.

Chemical analyses of groundwater samples : , constituents in meq/l (epm).

BH No.	Ratio Ca/Mg	Ca	Mg	Na	K		Total cations	% Ca	% Mg	% Na+K	HCO_3	SO_4	Cl	NO_3	F		Total anions	% HCO_3	% SO_4	% Sum Cl+NO_3+F	% $\frac{\text{cat-anions}}{\text{cat+anions}} \times 100$
Dd 4	2,07	4,591	2,220	0,565	0,041		7,417	61,9	29,9	8,2	4,802	0,354	0,705	1,023	0,016		6,900	69,6	5,1	25,3	3,6
Dd 20	1,56	3,593	2,303	0,391	0,054		6,341	56,7	36,3	7,0	5,278	0,208	0,169	0,346	0,016		6,017	87,7	3,5	8,8	2,6
Dd 27	1,92	4,741	2,467	0,565	0,020		7,793	60,8	31,7	7,5	6,081	0,208	0,677	0,288	0,021		7,275	83,6	2,9	13,6	3,4
Dd 33	1,46	4,441	3,043	0,652	0,023		8,159	54,4	37,3	8,3	5,655	0,500	0,818	0,855	0,021		7,849	69,6	5,1	25,3	3,6
Dd 96	1,69	3,194	1,891	0,478	0,033		5,596	57,1	33,8	9,1	2,885	0,312	1,523	0,587	0,011		5,318	54,2	5,9	39,9	2,5
Ef 69	0,57	2,445	4,276	0,304	0,005		7,030	34,8	60,8	4,4	3,885	0,416	1,325	0,747	0,021		6,394	60,8	6,5	32,7	4,7
Ef 98	0,40	1,297	3,207	0,174	0,015		4,693	27,6	68,3	4,1	3,180	0,312	0,141	0,052	0,005		3,690	86,2	8,5	5,3	≥12,0≤
Gl 2	0,46	1,397	3,043	0,174	0,013		4,627	30,2	65,8	4,0	3,590	0,291	0,169	0,251	0,011		4,312	83,3	6,7	10,0	3,5
Gl 7	1,14	4,142	3,618	0,565	0,018		8,343	49,6	43,4	7,0	4,229	0,291	1,213	1,857	0,011		7,601	55,6	3,8	40,5	4,7
Gl 27	1,07	2,994	2,796	0,304	0,031		6,125	48,9	45,6	5,5	5,114	0,208	0,113	0,297	0,005		5,737	89,1	3,6	7,2	3,3
Gf 6																					
Hb 11	0,86	2,745	3,207	0,261	0,015		6,226	44,1	51,5	4,4	5,311	0,208	0,113	0,351	0,005		5,988	88,7	3,5	7,8	1,9
Hd 2	0,41	1,397	3,372	0,130	0,015		4,914	28,4	68,6	3,0	4,016	0,187	0,085	0,371	0,005		4,664	86,1	4,0	9,9	2,6
Hr 7	0,92	3,393	3,701	0,478	0,041		7,613	44,6	48,6	6,8	6,491	0,208	0,226	0,178	0,026		7,129	91,1	2,9	6,0	3,3
Hs 2	1,00	3,543	3,536	0,696	0,046		7,821	45,3	45,2	9,5	5,835	0,250	1,015	0,328	0,005		7,433	78,5	3,4	18,1	2,5
Hs 6	0,99	3,094	3,125	0,304	0,018		6,541	47,3	47,8	4,9	5,114	0,208	0,169	0,662	0,005		6,158	83,0	3,4	13,6	3,0
Kk 12	1,02	2,345	2,303	0,217	0,018		4,883	48,0	47,2	4,8	4,278	0,187	0,028	0,064	0,005		4,562	93,8	4,1	2,1	3,4
Km 26	1,02	3,343	3,289	0,261	0,031		6,924	48,3	47,5	4,2	5,950	0,229	0,085	0,353	0,005		6,622	89,6	3,5	6,4	2,2
Km 77	1,06	3,493	3,289	0,304	0,031		7,117	49,1	46,2	4,7	5,950	0,271	0,085	0,286	0,005		6,597	90,2	4,1	5,7	3,8
Km 94	1,19	3,044	2,549	1,739	0,049		7,381	41,2	34,5	24,2	5,802	0,437	0,649	0,252	0,011		7,151	81,1	6,1	12,8	1,6
SPRING [illegible]	0,4	397	312	4			4,9	28	30		4,[illegible]	0,291	0,282	0,81	0,016		4,786	83,9	6,1	10,0	1,7

Appendix. Chemical analyses of groundwater samples ; costituents in mg/l.

BH. No.	H. no. 8340/	Date 1983	FIELD T°C.	Ca	Mg	Na	K	HCO_3	SO_4	Cl	Nitrate as N	F	Si	Lat. 26°	Long. 26°	FIELD pH unit		E.C. mg/l Lab	E.C. mg/l Field @ 25°C	FORMA
Lt 4	2176	14/03	22,0	64	44	7	0,5	368	13	5	3,06	0,1	8,2	09'35"	05'46"	7,10		350		Vmm
Lt 4	2273	15/03	21,0	63	44	6	0,6	369	12	5	2,92	0,1	8,3	"	"	7,10		419	424	Vm-v
Lt 22	2281	"	20,5	66	35	6	1,0	337	10	2	2,85	0,1	11,3	08'46"	04'08"	7,10		378	372	"
Lt 53	2168	14/03	22,0	66	40	8	0,9	362	12	4	2,62	0,1	10,1	10'00"	07'21"	7,140		405		Vmo
Lt 55	2184	"	22,0	66	39	7	0,7	366	10	1	1,55	0,1	9,9	10'29"	03'20"	6,95		391		Vm/
Te 6	2427	17/03	25,5	24	14	5	0,7	111	9	3	4,00	0,0	13,0	06'17"	06'50"	7,40	?	163	462	"
Ug 1	2223	15/03	20,5	64	38	8	0,7	351	10	3	1,70	0,1	8,9	25° 59'26"	05'35"	7,10		383	400	"
Ug 6	2370	17/03	21,5	54	30	4	0,5	280	9	2	1,55	0,1	6,7	25° 58'21"	03'50"	7,30		312	308	"
Wd 1	2362	"	20,5	26	34	4	0,7	237	8	3	1,63	0,1	9,1	25° 57'49"	10'18"	7,10		316	350	"
Wi 1	2142	14/03	21,0	72	42	8	0,8	371	12	9	3,99	0,1	9,8	11'26"	01'17"	7,20		419		"
Zk12	2249	15/03	21,5	61	38	6	0,8	346	10	7	3,58	0,1	9,5	02'01"	07'35"	7,15		346	398	"

Appendix.

Chemical analyses of groundwater samples , constituents in meq/l (epm).

BH No.	Ratio Ca/Mg	Ca	Mg	Na	K		Total cations	% Ca	% Mg	% Na+K	HCO_3	SO_4	Cl	NO_3	F		Total anions	% HCO_3	% SO_4	% Sum Cl+NO_3+F	% $\frac{\text{cat.-anion}}{\text{cat.+anion}} \times 100$
Lt 4	0,88	3,194	3,618	0,304	0,013		7,129	44,8	50,8	4,4	6,032	0,271	0,114	0,219	0,005		6,668	90,5	4,1	5,5	3,3
Lt 4	0,87	3,144	3,618	0,261	0,015		7,038	44,7	51,4	3,9	6,048	0,250	0,141	0,209	0,005		6,653	90,9	3,8	5,3	2,8
Lt 22	1,14	3,293	2,878	0,261	0,026		6,458	51,0	44,6	4,4	5,524	0,208	0,056	0,204	0,005		5,997	92,1	3,5	4,4	3,7
Lt 53	1,00	3,293	3,289	0,348	0,023		6,953	47,4	47,3	5,3	5,933	0,250	0,113	0,187	0,005		6,488	91,4	3,9	4,7	3,5
Lt 55	1,03	3,293	3,207	0,304	0,018		6,822	48,3	47,0	4,7	5,999	0,208	0,028	0,109	0,005		6,349	94,5	3,3	2,2	3,6
Te 6	1,04	1,198	1,151	0,217	0,018		2,584	46,4	44,5	9,1	1,819	0,187	0,085	0,286	0,000		2,377	76,5	7,9	15,6	4,2
Ug 1	1,02	3,194	3,125	0,348	0,018		6,685	47,8	46,7	5,5	5,753	0,208	0,085	0,121	0,005		6,172	93,2	3,4	3,1	4,0
Ug 6	1,09	2,695	2,467	0,174	0,013		5,349	50,4	46,1	3,5	4,589	0,187	0,056	0,111	0,005		4,948	92,7	3,8	3,5	3,9
Wd 1	0,46	1,297	2,796	0,174	0,018		4,285	30,3	65,3	4,5	3,885	0,167	0,085	0,116	0,005		4,258	91,2	3,9	4,8	0,3
Wi 1	1,04	3,593	3,454	0,348	0,020		7,415	48,5	46,6	5,0	6,081	0,250	0,254	0,285	0,005		6,875	88,5	3,6	7,9	3,8
Zk 12	0,97	3,044	3,125	0,261	0,020		6,450	47,2	48,4	4,4	5,671	0,208	0,197	0,256	0,005		6,337	89,5	3,3	7,2	0,9

APPENDIX 4

1. *VOLUME OF ROCK DEWATERED CALCULATIONS*

2. *EVAPORATION DATA*

VOLUME OF ROCK DEWATERED : OVER PERIOD JUNE/AUG. 1982 TO APR/MAY 1983

APPENDIX 4

WATER LEVEL CHANGE CONTOUR INTERVAL (m)	0,01-0,50	0,51-1,00	1,01-1,50	1,51-2,00	2,01-2,50	2,51-3,00	3,01-3,50	3,51-4,00	TOTAL
AREA WITHIN W.L. CHANGE CONTOUR INTERVAL (km^2)	113,225	126,225	59,125	24,225	10,275	3,200	1,350	0,450	338,075km^2
AVERAGE WATER LEVEL CHANGE (m)	0,25	0,75	1,25	1,75	2,25	2,75	3,25	3,75	
VOLUME OF ROCK DEWATERED (km^3)	0,028306	0,094669	0,073906	0,042394	0,023119	0,008800	0,004388	0,001688	0,277270km^3

0,28 km^3 of rock dewatered

EVAPORATION DATA

STATION C3EO3 BARBERSPAN, symons reservoir operated by Dept. of Env. Affairs.

	O	N	D	J	F	M	A	M	J	J	A	S	
NO. OF MONTHS READ PRIOR TO 1981/82	18	21	21	22	20	21	21	21	21	21	20	20	
AVERAGE MONTHLY EVAPORATION FROM (mm) 5 PAN	236,9	224,0	258,8	228,1	173,5	162,7	123,9	101,5	82,9	97,2	134,9	199,8	2024,2
CONVERSION FACTOR FROM 5 PAN TO OPEN RESERVOIR	0,81	0,87	0,83	0,82	0,66	0,88	0,86	0,90	0,94	0,85	0,87	0,83	Av. 0,84
ADJUSTED EVAPORATION FROM OPEN WATER (mm)	191,9	194,9	21,48	187,0	114,5	143,2	106,6	91,4	77,9	82,6	117,4	165,8	1688