

GH4139

**IMPACT OF THE EAST DRIEFONTEIN GOLD MINE
ACTIVITY ON THE LEEUWPOORT VALLEY**

(HYDROGEOLOGICAL INVESTIGATION)

By

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SUMMARY

This investigation carried out to address the Mr Moolman's groundwater problem related to the East Driefontein gold mine activities in the area. The groundwater problem associated with dried up springs in the Leeuwpoot Valley. The purpose of this investigation was to identify the cause of dried up springs.

The water from this source was used for stock and flood irrigation by the local farmers living downstream of these springs. The springs were flowing in the past even with rainfall below the mean annual rainfall of 708 mm.

The Malmani dolomite and the Black Reef Formation (quartzite and conglomerate beds) at its base overlie the Ventersdorp andesitic lava and Witwatersrand Supergroup composed of quartzite, conglomerate (gold rich horizon) and shale. The sedimentary rocks (shale and quartzite) of Pretoria Group overlie the dolomite. The geological structure is dominated by a number of thrust and reverse faults

The study area is located within the Bank dolomite compartment and East Driefontein gold mine which is currently active in gold recovery. In order to recover the gold from the gold reef horizon, the Bank compartment was dewatered and resulted in lowering the hydraulic head in the dolomite and caused many sinkholes, drying up the Wonderfontein and Gemsbokfontein eyes.

A number of boreholes and one perennial spring were identified in the area and water from these sources has been used for domestic and stock water supply. Flow of the perennial spring and stream has been measured on a regular basis between October 1996 and May 2006.

The flow of perennial spring correlates with the local rainfall and dried up springs (2, 3, 4, and 5) could be related to the gold mining activities in the area and dewatering of the dolomite compartment.

The stream flow has been measured by the Department of Water Affairs and Forestry (DWAF) since 1996. The stream flow correlates with local rainfall over the catchments area of the Leeuwpoot Valley. A gradual decline in stream flow was observed since 2000, the flow of 5.67 L/s was measured in May 2006.

The quality of water from ground and surface water is in excellent condition and overall salinity (EC) does not exceed 13 mS/m.

The formation of springs are related to the structural geology (faulting) with a network of fracture and joint systems which feed the springs along the fault zones. Dewatering of Bank dolomite compartment and the present mining activities seems to be the cause of drying up the springs on the Moolman's property.

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IMPACT OF THE EAST DRIEFONTEIN GOLD MINE ACTIVITIES ON THE LEEUWPOORT VALLEY

(HYDROGLOGICAL INVESTIGATION)

1. INTRODUCTION

1.1 Background

The Gauteng Regional Office (Highveld Region) has received a letter from the Regional Director of PWV area, dated 05 September 1995, to address the Mr B Moolman's groundwater problem related to the East and West Driefontein gold mine activities in the area.

The groundwater problem was related to the dried up three springs on Mr Moolman's property. The site inspection was conducted to his property during late 1995 and field investigation commenced as early as January 1996. The water from this source was used for flood irrigation by the local farmers who were located downstream of these springs. The water right from this source was written in the Title Deeds of the property. The irrigated land can be identified from the aerial photographs.

There are a number of evidences that water from these springs were used for flood irrigation in the past prior to the East/West Driefontein gold mine activities in the area. These are:

- Existing build up earth dam to capture water from the springs No 2, 3, 4 and 5.
- Existing furrows (built up from stone and cement) and shallow earth canal to divert water from the earth dam to the irrigated land.

The above evidences can be observed in number of small holding alongside the Leeuwpoort Valley.

Due to lack of availability of records of spring flow, it was not possible to make any conclusions on the dried up springs. It was decided to conduct spring flow measurement at the existing perennial spring (Spring No 1) and stream flow for a few years and to correlate these flow measurements with local rainfall and make the final conclusions.

1.2 Locality

The Leeuwpoort Valley is a part of the cadastral farm Leeupoort 356 IQ, and is located at a distance of 7 km northeast of the town Fochville. The town of Cartonville is situated at a distance of 10 km on the northwest of the valley. The national road N12, Pochefstroom-Johannesburg crosses the Leeuwpoort valley.

The Leeuwpoot Valley is located within the Mooi River catchment area and has a natural stream flow through the year and joins the Loopspruit in the south.

The cadastral farm is divided into a number of small holdings (Plots) and they were used for residential and limited agricultural use. The groundwater (boreholes and springs) is the main source of water supply to the local community for drinking purpose in the area.

The Leeuwpoot Valley is situated in the Bank dolomite compartment and it is surrounded by a number of East Driefontein gold mine's shafts which are used for mining operation. The position of the Leeuwpoot Valley is shown on Map 1.

2. PURPOSE OF INVESTIGATION

The purpose of this investigation was to identify the cause of dried up springs that were flowing for a number of years prior to the East Driefontein gold mine activity in the area close to the Leeuwpoot Valley.

2.1 Method of investigation

In order to address the issue of dried up springs, the following steps were taken:

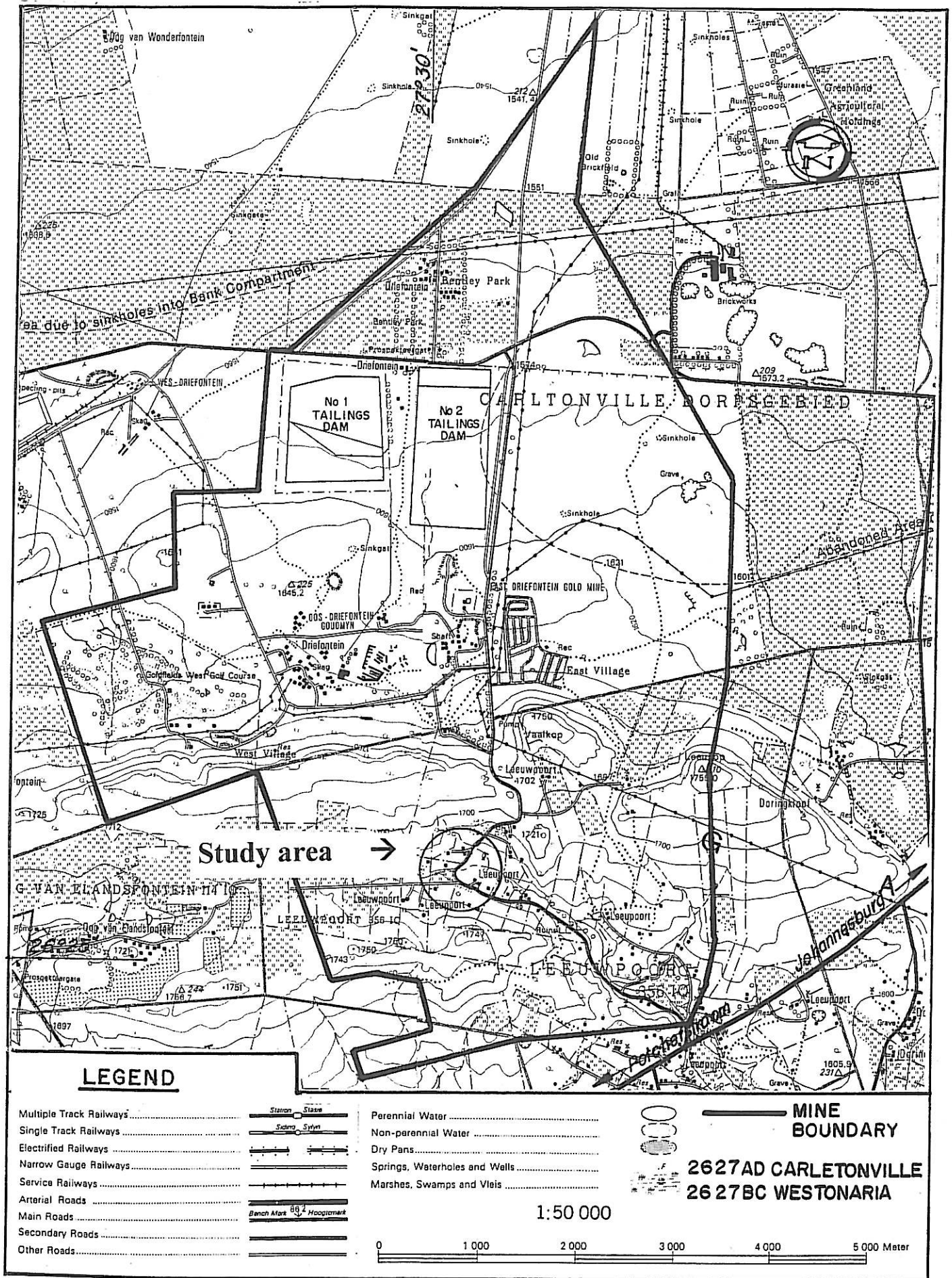
- To conduct a borehole census of the upper part of the Leeuwpoot Valley, area upstream of the Moolman's property;
- To collect the local rainfall data close to the Leeuwpoot Valley;
- To conduct flow measurement at the flowing spring (spring No 1);
- To conduct flow measurement at the dried up springs during flowing period,
- To conduct stream flow measurement in the valley close to the spring No 1 by constructing 90° V-notch.

3. EAST DRIEFONTEIN GOLD MINE ACTIVITY

Development of the East Driefontein gold mine activity, which is operating under Goldfield South Africa Limited, commenced during 1967/68. As results of some exploration drilling in the area, it was estimated that the mine would have a working life of some 35 years. The gold production which is the final milling process of the gold containing ore, required large quantity of water that could be obtained from 3 main sources, namely surface water, groundwater and sewage effluent water.

During late 1969, the DWAF approved issuing a permit to the East Driefontein gold mine to abstract groundwater from the Bank dolomite compartment for various supplies, industrial (mining process), domestic (within the mining activity area) and irrigation (supply to the Oberholzer Irrigation Board and Mr Brink family). The issued permit was valid for a period of 10 years.

Following groundwater abstraction from the Bank dolomite compartment, the permit application of the East Driefontein to make use of public water (Rand Water) for industrial use was also considered during early 1972.



Map 1. Locality Map (Source: SRK, East Driefontein EMPR, 1996)

The sewage effluent water was available in the mining area as early as the mining operation began and its demand was progressively increased. During early 1974, the mine made use of the purified sewage effluent in the plant.

From time to time the condition of water permit (s) was changed for different sources of water consumed by the mine during the mining operation.

The East Driefontein gold mine abstracts large quantity of groundwater to proceed for its mining operation. Based on the condition of water permit, the mine should supply groundwater abstraction figures to the DWAF on a regular basis, there are no continuous records of such data at the DWAF. Some abstraction figures are given below:

Average monthly (March to April 1974) : 189.9 Million litres
Annual groundwater abstraction: (1996): 1133 Million litres
Annual groundwater abstraction: (1997): 857 Million litres

3.1 Dewatering of the Bank dolomite compartment

The West Driefontein gold mine, which is currently operating in the Oberholzer dolomite compartment, was flooded during 1968. As results of underground flooding, it was decided to dewater the dolomite compartment and the various gold mine companies which were operating within the same compartment (Venterpost, West Driefontein, East Driefontein, Western Deep Level, Blyvooruitzicht and Doornfontein) proceeded to pump large quantity of water to surface.

This dewatering has resulted in drying up the Wonderfontein spruit as well as some permanent dolomite springs (Gemsbokfontein and Wonderfontein eyes). The other negative impacts of dewatering were occurrence of sinkholes and land subsidences in the area.

4. CLIMATE

The climate of the Leeuwoort Valley is within the Highveld Climatic zone with summer rain between 650 mm to 900 mm. Rainfall is generally in the form of thunderstorms and it occurs in summer months from October to March. The average daily summer temperature varies between 17° C and 27° C with a maximum of 38° C.

4.1 Rainfall

Rainfall is the main source of recharge to groundwater in this area. The rate of spring flow and fluctuation of groundwater levels are primarily controlled by the local rainfall/recharge. In order to study the cyclic nature of the rainfall and to correlate with spring flow, rainfall data of the West Driefontein gold mine rainfall station (collected by the West Driefontein gold mine) combined with Mr Moolman's rainfall data, collected on the Leeuwoort since 1991 were used for this investigation. These are, to some degree the reliable and closest rainfall stations to the Leeuwoort Valley.

The reliability of rainfall station was examined by rainfall mass curves. The rainfall mass curve is an accumulated rainfall values at a particular rainfall station and has a

wide range of application such as change in position of rain gauge, testing the reliability of data, adjusting rainfall records, storm-rainfall analysis and others.

The rainfall mass curves for both rainfall stations, West Driefontein (Figure A) and Moolman (Figure B) do not show a straight line due to various reasons (rainfall intensity, etc.). The rainfall data could be reliable to some degree in spite of the fact that their mass curves do not show a straight line.

The combined rainfall data of the two stations is shown in Figure 1. The mean annual rainfall of 712 mm and 708 mm are calculated at West Driefontein (1955 to 1997, 41 years) and Moolman (1991 to 2005, 15 years) rainfall stations respectively.

The 5-year moving average line in Figure 1 represents the cyclic nature of the rainfall. It is clear from this line that area experienced a dry period between 1956 and 1965 (10 years), 1982 and 1994 (12 years) and 2001 to present (2005). The extreme wet cycle occurred between 1976 and 1980 (5 years) and moderate wet cycle appeared between 1995 and 2000 (5 years).

Based on the 5-year moving average line it can be concluded that area could expect a few more years of low rainfall (+/- 4 years), up to 2009.

5. GEOLOGY

The rocks of Pretoria Group underlain the Leeuwpoort Valley consist of mainly shale and quartzite. The thickness of the strata reaches to a maximum of 500 m. The rocks of Pretoria Group overlie the Malmani dolomite and outcrops over the valley. The rocks strike eastwest and dip south with angles of varying from 18° to 32° (Map 2). According to the mine exploration boreholes (M1=E1T, M3 =E1L and others), the thickness of Pretoria Group varies in the Leeuwpoort Valley and a thickness of 334.06 m was recorded at M3, mine exploration hole.

The Malmani dolomite and the Black Reef Formation (quartzite and conglomerate beds) at its base overlie the Ventersdorp andesitic lava and Witwatersrand Supergroup composed of quartzite, conglomerate (gold rich horizon) and shale.

The geological structure at the mine (East Driefontein) is dominated by predominant north-south-easterly strike-slip fault (displacement parallel to the strike of the fault plane) which extends beyond the mine property. A numerous thrust or reverse faults are also associated with this regional faulting.

The valley is affected by a numerous faulting which resulted in forming a number of flowing springs. The valley itself with permanent flowing water is formed as a result of faulting (Map 3). The vertical extension of the faulting could reach not only the base of the Pretoria Group but passes through into the dolomite.

6. HYDROGEOLOGY (SPRINGS AND BOREHOLES)

A number of springs were identified within the study area and they are shown on Map 3. A few private boreholes were visited and groundwater from these boreholes is mostly used for domestic and stock water supply (Map 4). The depth of domestic

Figure A. Mass curve of rainfall - West Driefontein gold mine

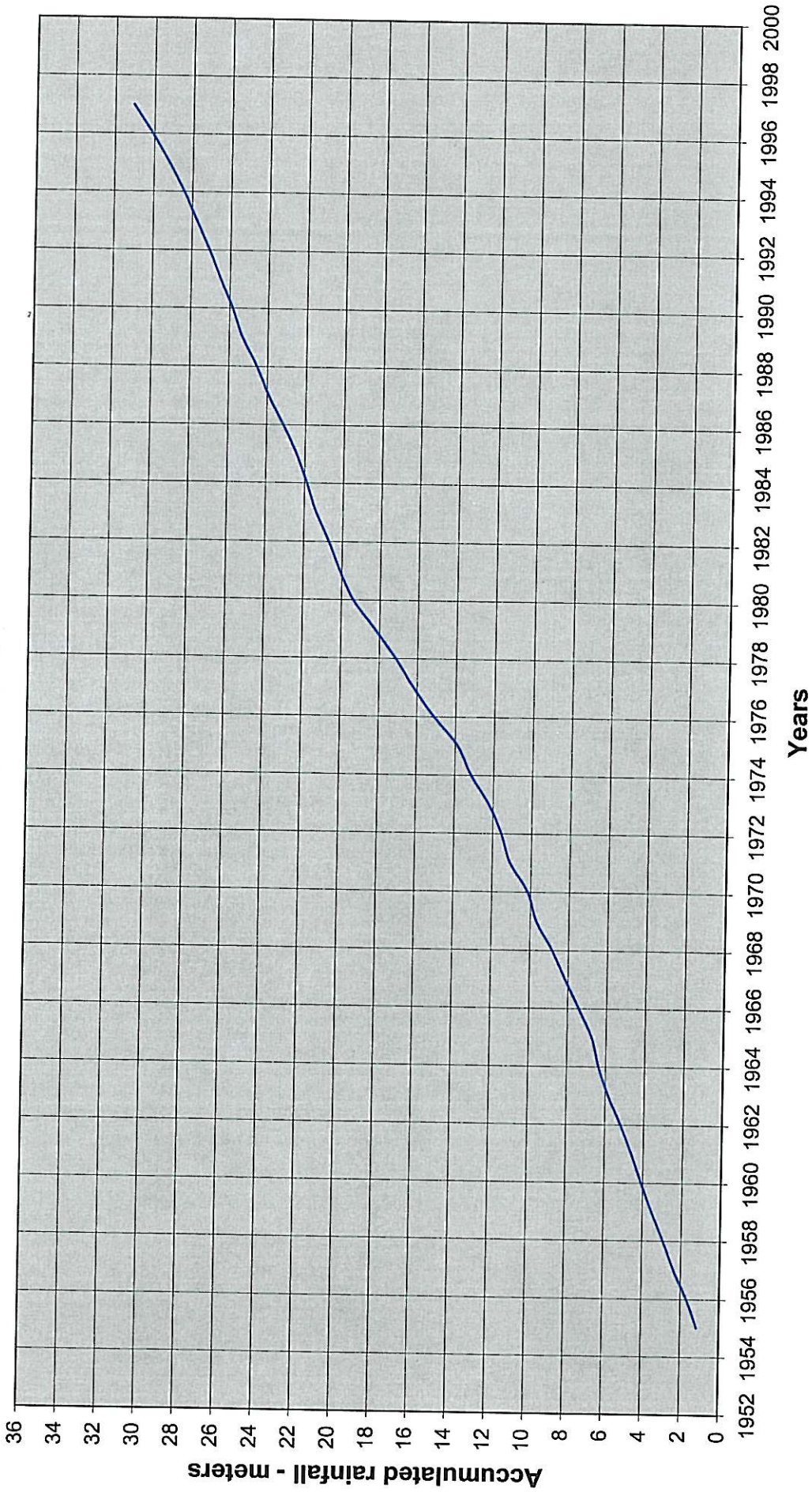


Figure B. Mass curve of rainfall - Leeuwpoot Valley (Moolman)

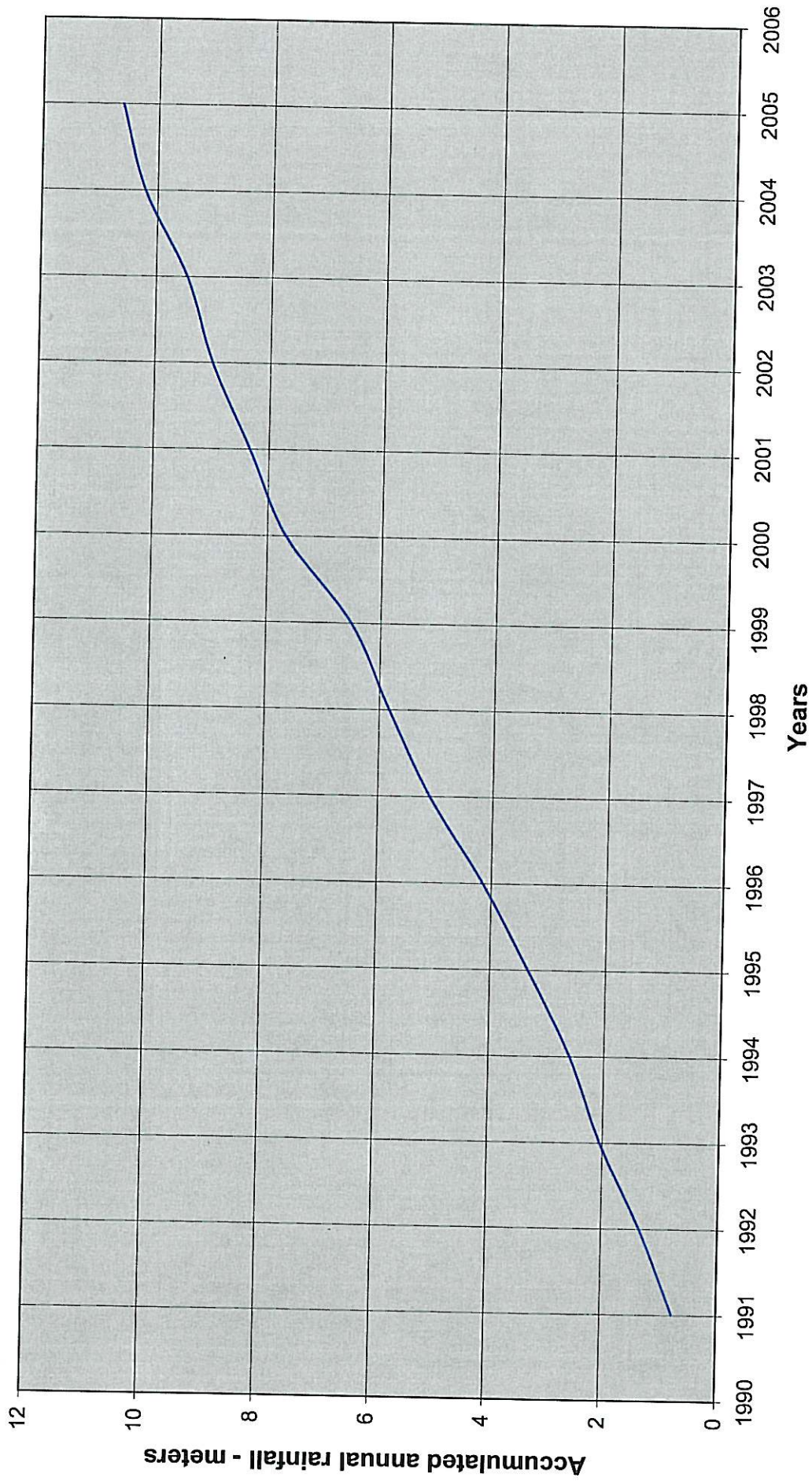
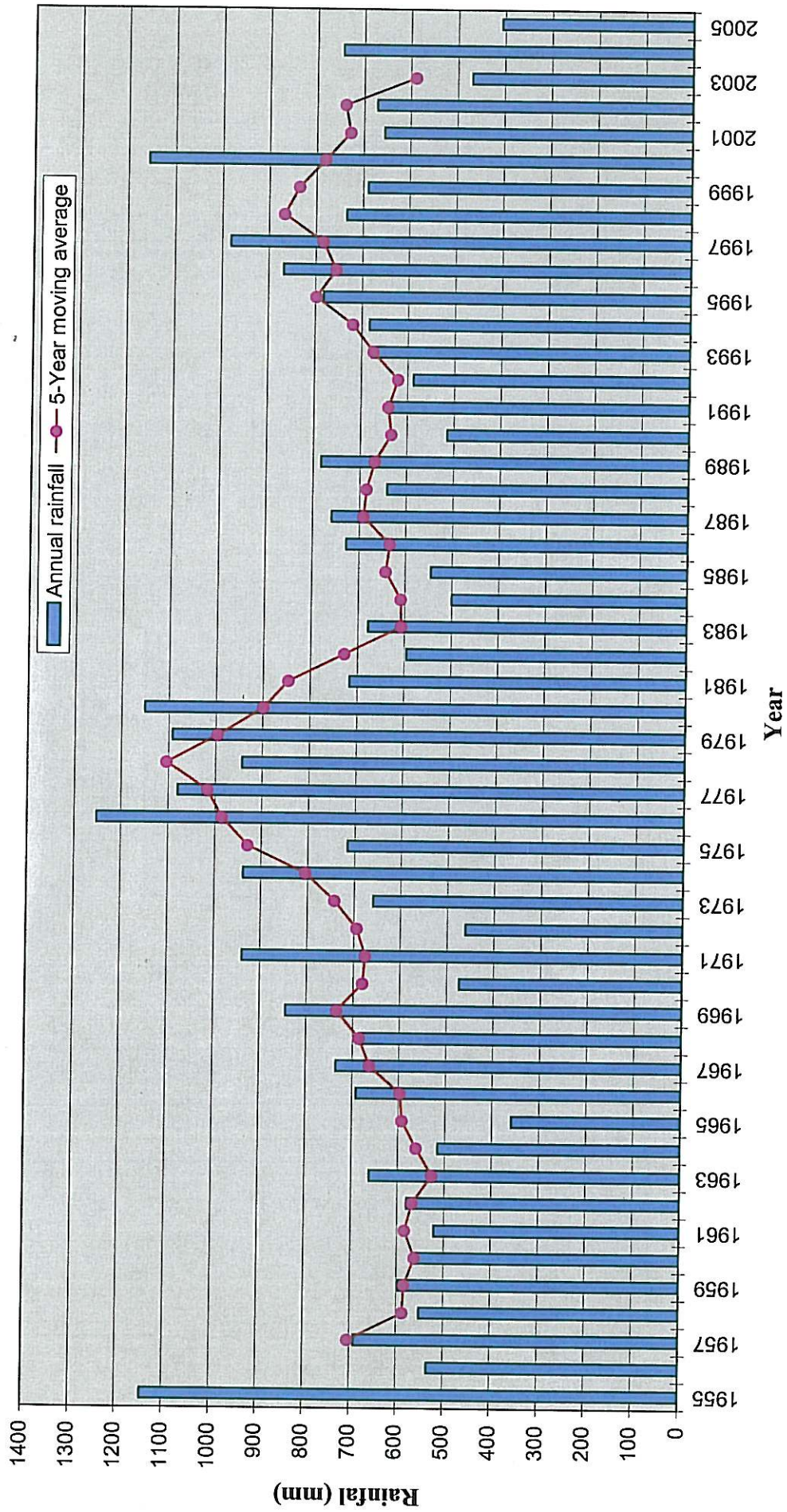
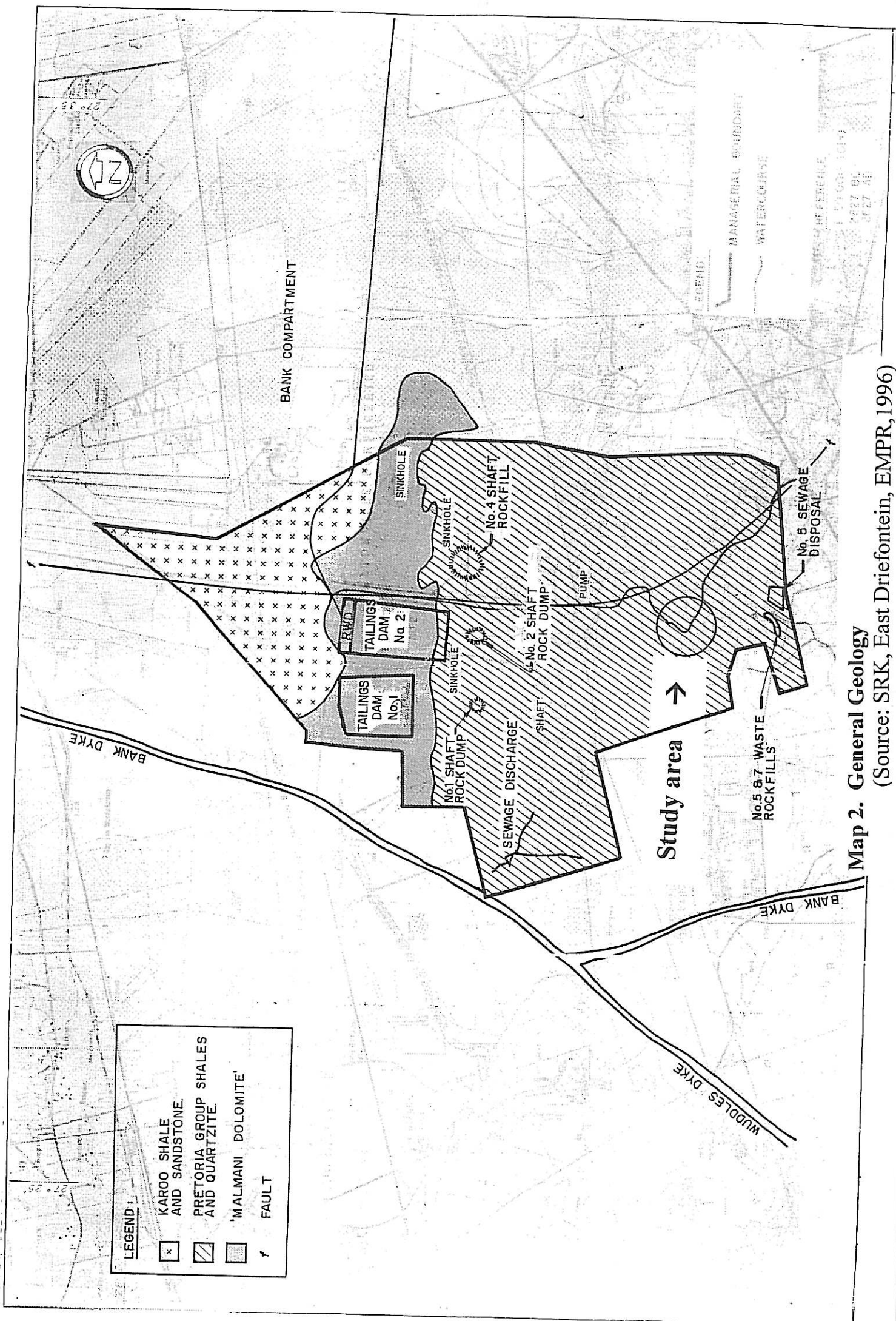


Figure 1. Combined annual rainfall and 5-year moving average for West Drifontein gold mine and Moolman rainfall stations (West Drifontein 1995 to 1997, Moolman 1998 to 2005)





LEGEND :

x	KAROO SHALE AND SANDSTONE.
▨	PRETORIA GROUP SHALES AND QUARTZITE.
▩	'MALMANI' DOLOMITE'
f	FAULT

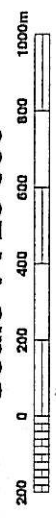
Map 2. General Geology
 (Source: SRK, East Driefontein, EMPR, 1996)

GOLD FIELDS LTD

Environmental

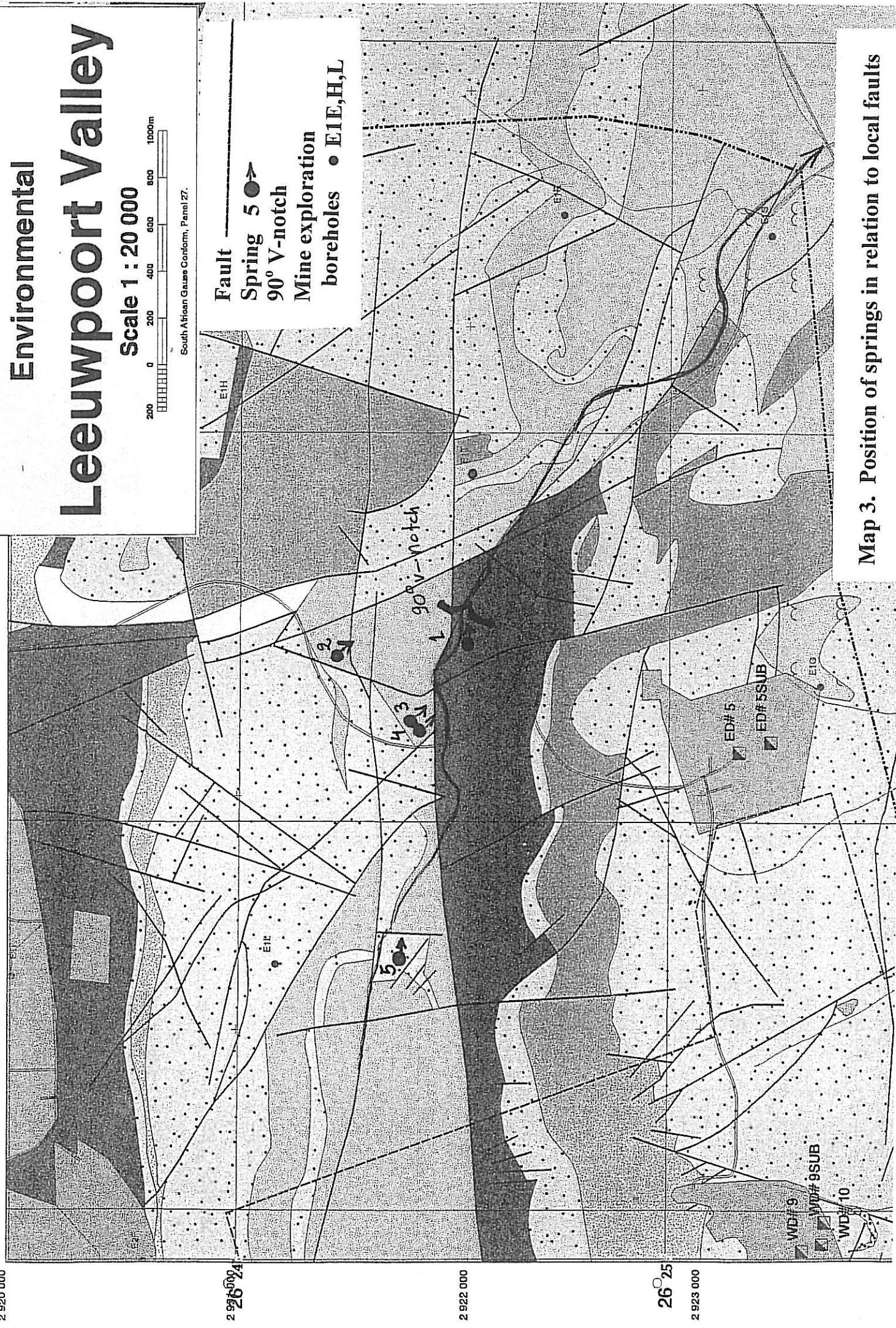
Leeuwpoot Valley

Scale 1 : 20 000

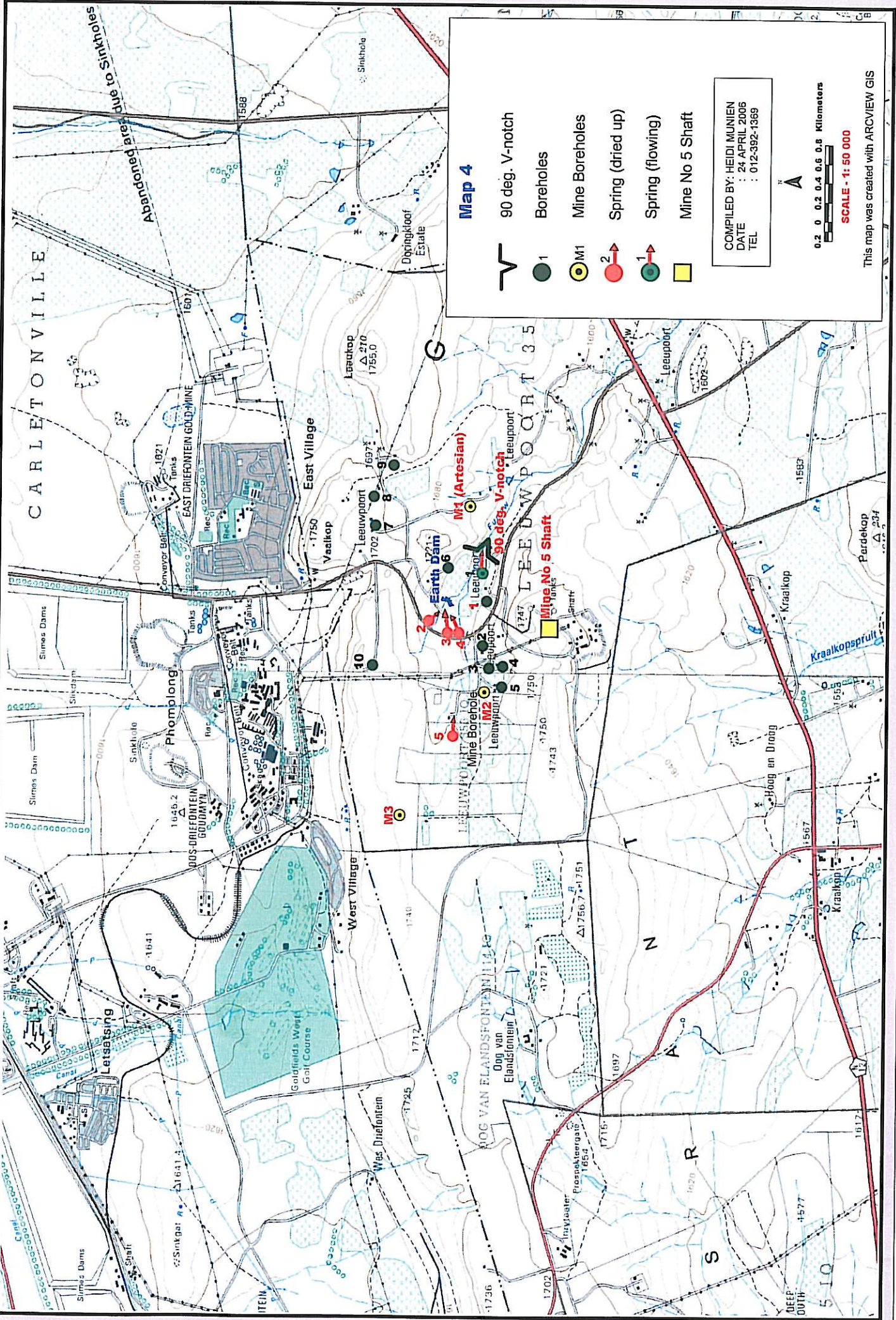


South African Gauss Conform, Panel 27.

- Fault ———
- Spring 5 ●→
- 90° V-notch ↘
- Mine exploration boreholes • EIE,H,L



Map 3. Position of springs in relation to local faults



Map 4

- 90 deg. V-notch
- Boreholes
- Mine Boreholes
- Spring (dried up)
- Spring (flowing)
- Mine No 5 Shaft

COMPILED BY: HEIDI MUNIEN
 DATE : 24 APRIL 2005
 TEL : 012-392-1369

0.2 0 0.2 0.4 0.6 0.8 Kilometers
SCALE - 1: 50 000

This map was created with ARCVIEW GIS

borehole varies between 30 m and 121 m with a water level between 3.4 m and 24 m below ground level. The mine exploration boreholes were also identified in the area and designated with M on Map 4.

During this investigation five springs were identified in the study area, of which one is permanently flowing (No 1) and the rest have been dried up due to underground mining activity and dewatered dolomite compartment in the catchment area of these springs.

Some hydrogeological data related to the boreholes and springs are presented in Table 1.

Table 1. Summary of the hydrogeological data related to boreholes and springs.

Point Identification	Condition of use	Equipment	Depth (m)	Rest Water Level (meter below collar)	Owner
Borehole 1 (LT-1) *	In use, D	Wind pump	?	?	Calitze
Borehole 2 (LT-2)	In use, D, S.	Wind pump	>36m	11.95 (29/05/96)	B Moolman
Borehole 3 (LT-3)	In use, D, I	Mono pump with electromotor	41.15		D F Oberlholzer
Borehole 4 (LT-4)	In use, D	Submersible pump	41.63		D F Oberlhozer
Borehole 5 (LT-5)	In use, D	Mono pump with electromotor			J Oberlholzer
Borehole 6 (LT-6)	In use, D, S	Mono pump With electromotor	30.00	14.27 (29/05/96)	D Moolman
Borehole 7 (LT-7)	In use, D	Submersible pump	60.00	23.88 (29/05/96)	B G Page
Borehole 8 (LT-8)	In use, D	Submersible pump		17.11 (29/05/96)	D van Heerden
Borehole 9 (LT-9)	In use, D	Submersible pump			?
Borehole 9 (LT-9)	In use, D	Mono pump with electromotor	121.00		Trappie de Souza
M1	Not in use, artesian	Not equipped, (natural flow is 0.2 L/s)	131.15		East Driefontein Gold Mine (exploration hole)
M2	In use, S	Mono pump, electromotor pump			East Driefontein Gold Mine (exploration hole)
M3	Not in use	Cased, closed	347.16		East Driefontein Gold Mine (exploration hole)
Spring 1	In use, D, S, I	Perennial (0.5 to 1.0 l/s)			B Moolman & local farmers
Spring 2		Dry			? & local farmers
Springs 3, 4 & 5		Dry			B Moolman & local farmers

* LT= Allocated to Leeuwpoort farm 356 IQ, D= Domestic, S= Stock, I= Irrigation

6.1 Springs

The springs are the main focus of this investigation. The natural spring usually occurs when the phreatic surface of groundwater intersects the ground surface. The springs are formed as a result of tectonic activity (faulting) and creating a conductive pathway for movement of groundwater. In order to enhance more flow from the spring, trenches were dug to a depth of 0.5 to 1.5 m into the ground. These can be observed at springs No 2, 3, 4 and 5.

The water from these springs was allocated to those who owned the property within and downstream of the Leeuwpoot Valley. The allocated volume to each servitude was registered at the Deeds Office. According to Mr B Moolman, these springs (1 to 5) were flowing since his parents settled in the Leeuwpoot farm in 1957 and reduction in spring flow gradually occurred when the East Driefontein gold mine began to recover the gold from the gold rich horizon beneath the dolomite.

Water from spring No 1 which is currently flowing, used by B Moolman for drinking purpose leads into a pool and finally flows into the natural stream. The position of these springs in relation to geological structures (faults) and catchment area are shown on Map 3 and 5 respectively.

6.2 Flow measurements and characteristics

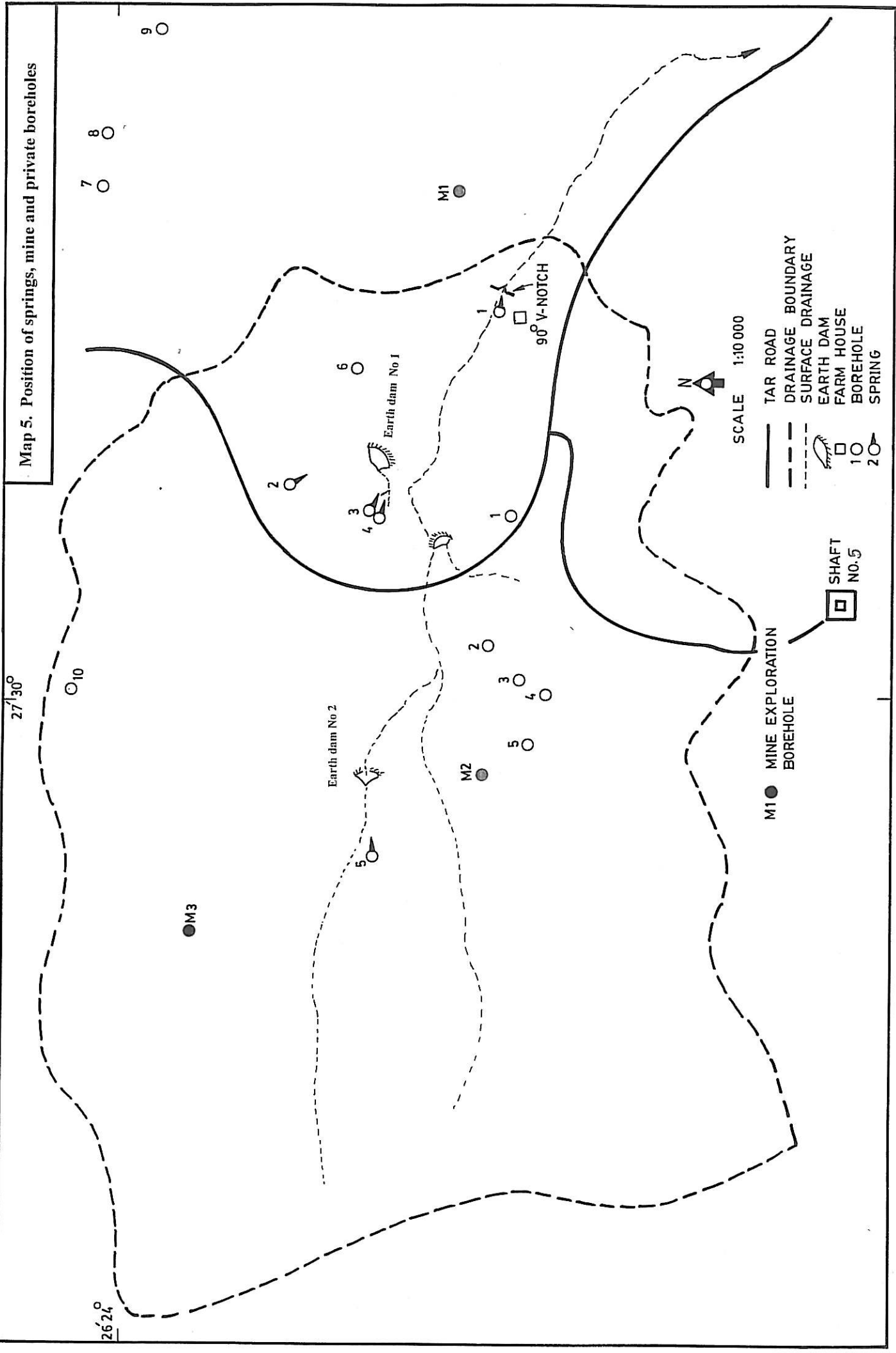
No quantitative flow measurement was made at any of these springs in the past. A continuous (weekly and monthly) volumetric flow measurement was made at the spring No 1 and occasionally at springs No 2 and 3 when flow was occurred. A number of factors affecting the spring discharge, these are:

- Permeability of rock formation and fault zone aquifers,
- Recharge of the aquifers, depending on the local rainfall,
- Catchment area of the spring.

The first two factors are not known and required more field investigation, and the catchment area was determined from the available maps. The catchment area was calculated by using ortho-photo map with a scale of 1:10 000. The spring No 1 and 90° V-notch are very close to each other and have the same catchment area. The catchment area of the springs and natural stream at measuring point, 90° V-notch are given below:

Spring No1	4.871 km ²
Spring No 2	0.035 “
Springs No 3 &4	0.043 “
Spring No 5	0.032 “
Stream at V-notch	4.871 “

Map 5. Position of springs, mine and private boreholes



Spring No 1

This is a perennial spring and has a largest catchment area compared with springs No 2, 3, 4 and 5. According to Mr Moolman, this spring has never been dry since he purchased this property in 1975.

The flow of this spring in relation to local rainfall (Moolman's rainfall data) is shown in Figure 2. It is clear that there is a relationship between the flow and the local rainfall. The pattern of the flow is harmonised with rainfall and it is a reflection of aquifer recharge. The flow of spring reached to 1.0 L/s during maximum rainfall periods of 1997, 1998 and early 2000. A general trend can be observed in the spring flow as from early 2000 to middle 2006 with occasional high flow due to high rainfall over its catchment area.

Spring No 2

This is a non-perennial spring at the time of investigation and has a small catchment area. This spring was also flowing in the past and water entered the earth dam No1 (Map 5). The spring dried up in 1970 and it started to flow during the high rainfall periods of 1997 (945 mm annual rainfall) and 1998 (734 mm annual rainfall). Mr Moolman estimated that the flow rate of this spring was between 0.3 L/s and 0.4 L/s. The spring was flowing with a rate of 4.54 L/s (May 1997) and dropped to 0.01 L/s (August 1997). The last flow was recorded at this spring during early 1999 (January) and from then no flow was observed.

From the flow/rainfall graph (Figure 3) it can be concluded that spring should had been flown when the annual rainfall was above or close to the mean annual rainfall of 708 mm (Moolman's rainfall data from 1991 to 2005). No flow was observed at this spring in spite of recorded high rainfall during 2000 (1156 mm annual rainfall) on the Moolman's property.

The analysis of rainfall cyclic pattern of the closest rainfall station (West Driefontein) indicates that wet period started as early as 1974 with annual rainfall of 938 mm and continued to 1981 (716 mm annual rainfall). The spring should have been flowing during this period in which the highest annual rainfall was recorded, but no flow was observed.

Springs No 3 and 4

These two springs are presently non-perennial springs and have small catchment areas. They are next to each other and they receive water from the same catchment area and sharing one geological structural (fault). The trenches were dug to enhance more flow from the eye. The highly weathered and fractured shale is visible on the wall of the trenches

These springs were also flowing in the past with a flow rate between 0.3 L/s and 0.4 L/s and water from these springs entered the earth dam No1 (Map 5). The springs were flowing between 1958 and 1965 (low rainfall period and prior to commencing gold recovery by the East Driefonteine gold mine in 1967/68) and their yields gradually declined and finally dried up in 1970. The flow at spring No 3 was observed

Figure 2. Flow at spring No1 in relation to local rainfall

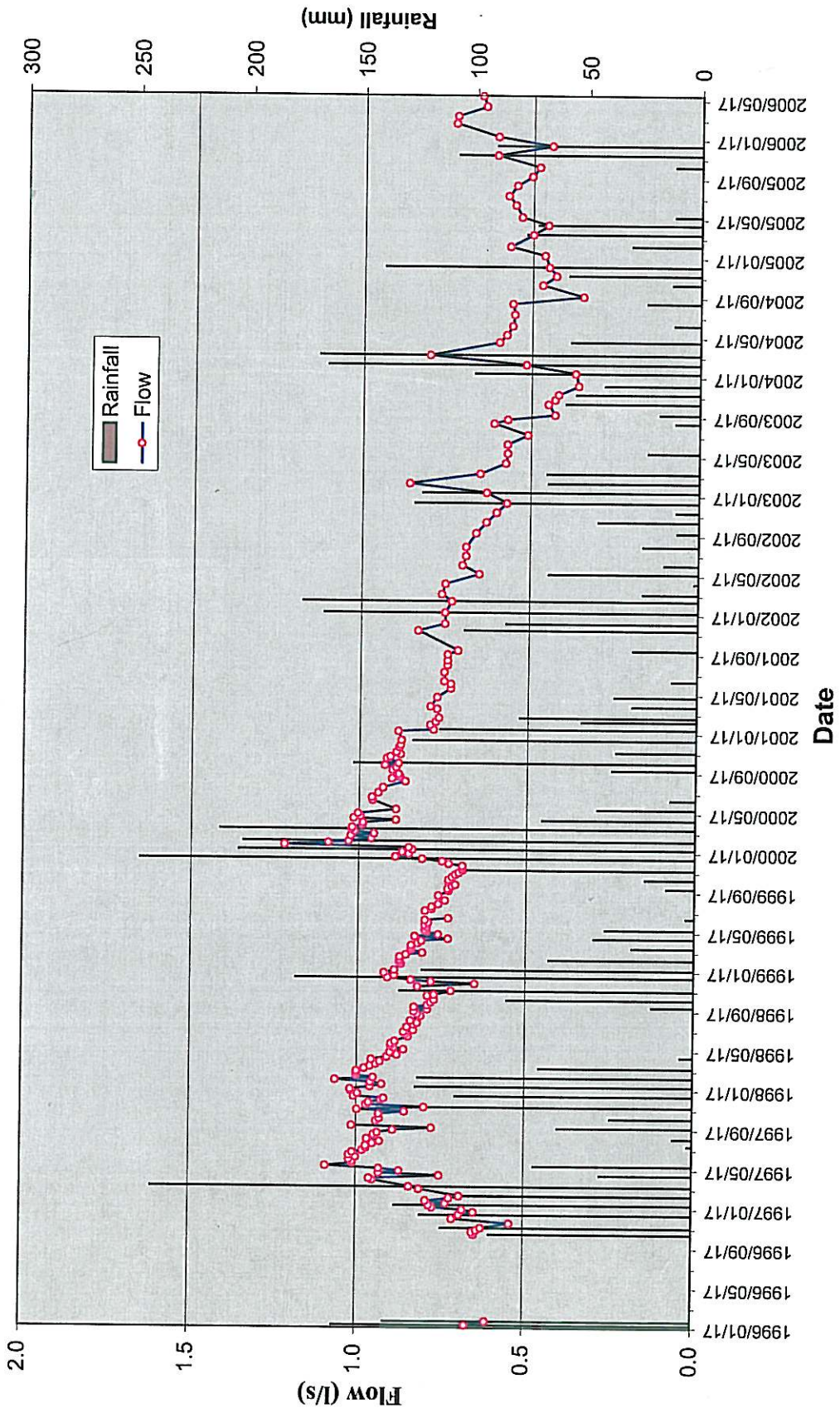
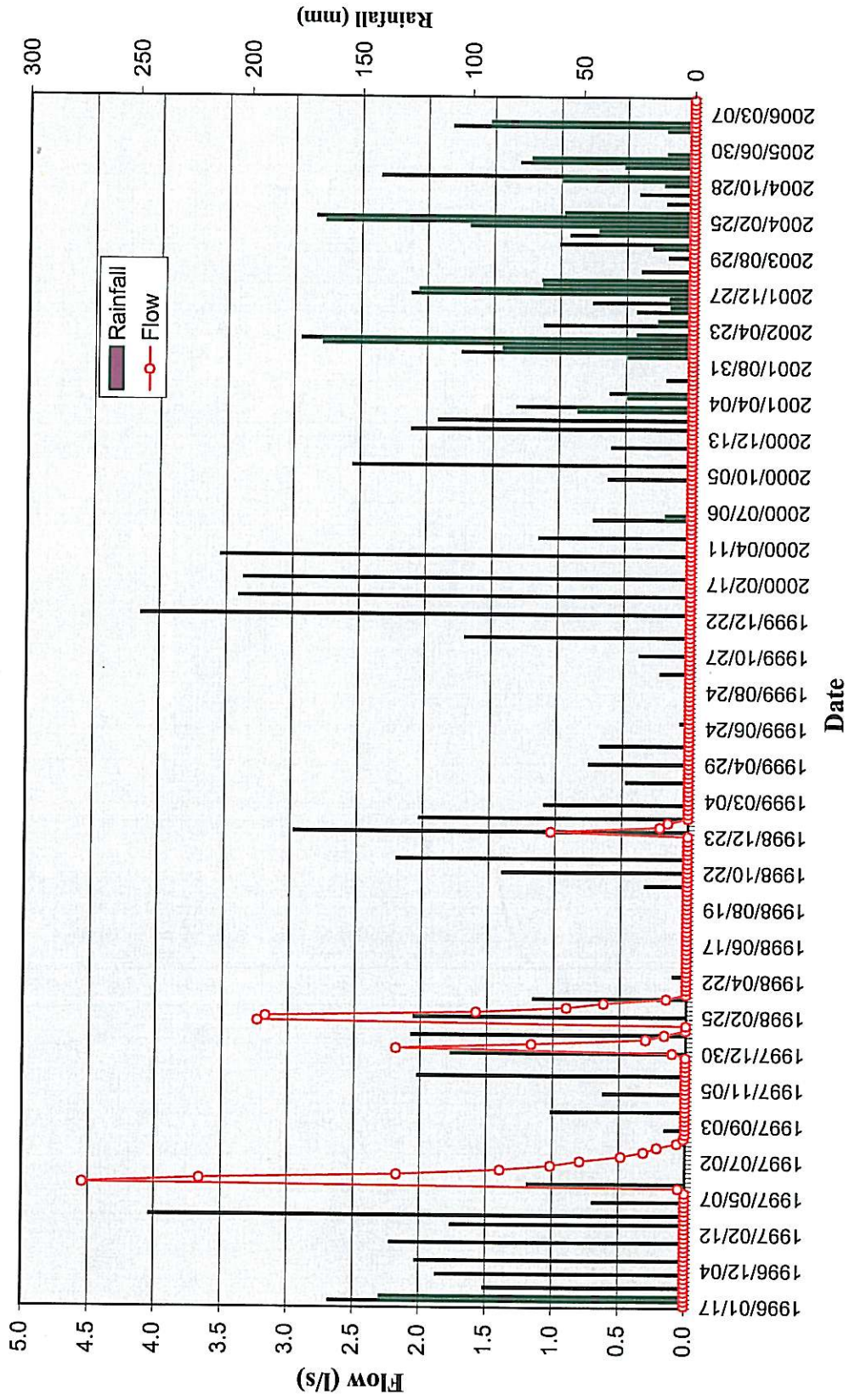


Figure 3. Flow at spring No 2 in relation to local rainfall



during the high rainfall periods of 1997 (945 mm annual rainfall), 1998 (734 mm annual rainfall) and 2000 (1156 mm annual rainfall) when the annual rainfall was exceeded the mean annual rainfall of 708 mm. The flow rate of spring No 3 with local monthly rainfall are shown in Figure 4.

It is evident from Figure 4 that there is a time lag between the rainfall and spring flow. The time lag is due to a time period which is required that unsaturated zone (fault zones and the host rock aquifers) becomes saturated. These phenomena can be observed in the late 1998 and early 2000.

Spring No 5

This spring is presently non-perennial spring and has a small catchment area. The forming of this spring is related to the faulting that is visible above the eye. Trenches were also dug to enhance the flow. This spring with a flow rate of 0.56 L/s was also flowing in the past and water from this source entered the earth dam No 2 (Map 5). Water from this earth dam was used for domestic and stock water supply. A decline in flow rate was noticed by Mr Moolman as early as 1978 and finally spring dried up in 1979. No flow was observed even during the high rainfall periods of 1997 (945 mm annual rainfall), 1998 (734 mm annual rainfall) and 2000 (1156 mm annual rainfall).

Dried up springs, a reasonable explanation

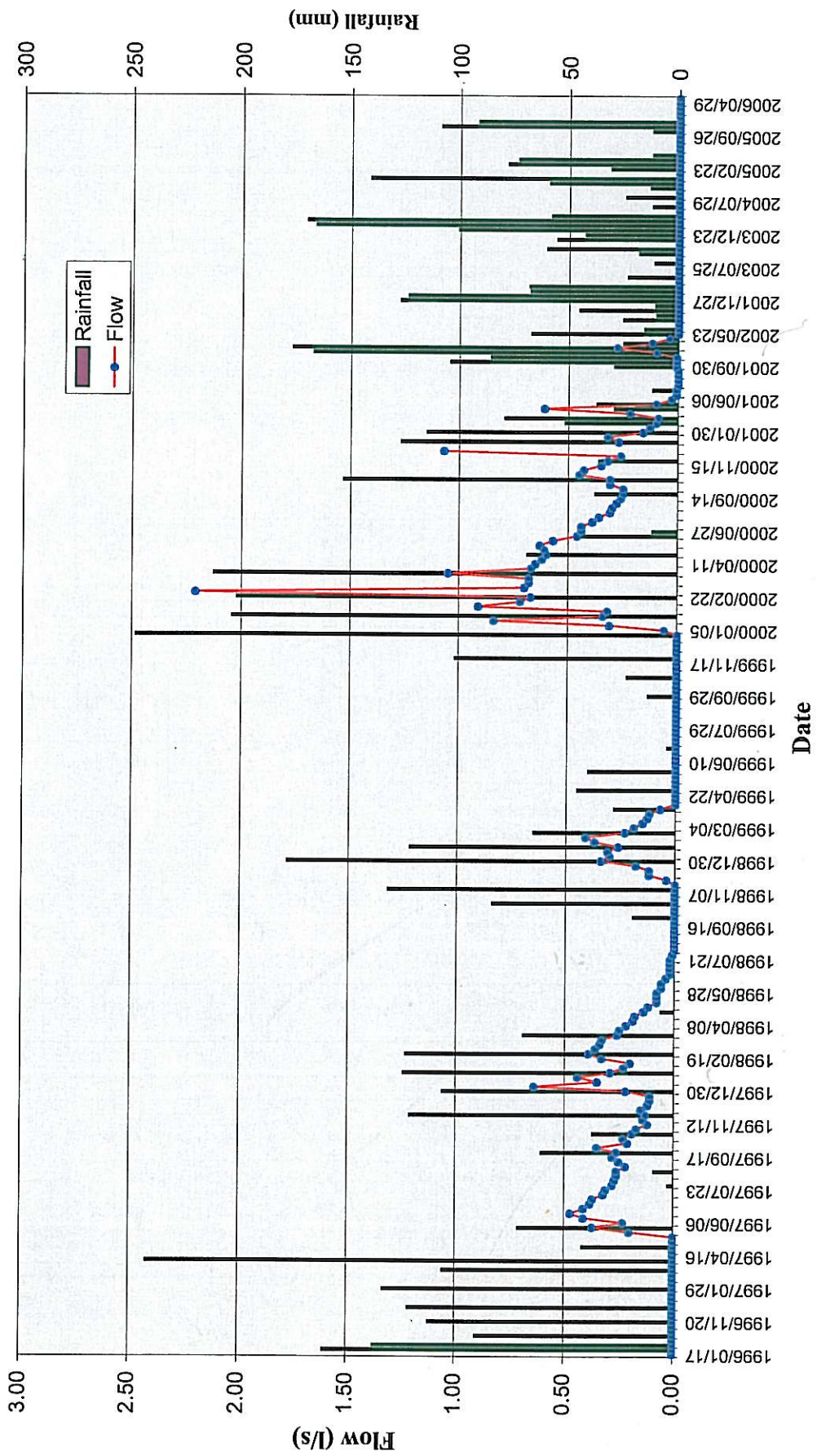
It can be concluded from the cyclic nature of the rainfall (Figure 1) that springs No 2, 3, 4, and 5 should not had been dried up due a fact that area went into a wettest rainfall period between 1977 and 1980 (943 mm to 1151 mm annual rainfall). These were periods in which the highest annual rainfalls were recorded. The annual rainfall between 1995 (745 mm annual rainfall) and 2000 (1151 mm annual rainfall) is higher than period between 1959 and 1965 (359 mm to 661 mm annual rainfall) when the above springs were flowing. This indicates that much of the recharged groundwater over the catchment area of these springs disappeared into underground environment (dewatered dolomite compartment).

On the other hand, dewatering of the dolomite compartment resulted in lowering of the hydraulic head in the dolomite and this has a negative impact on the upper aquifer (Pretoria Group) in which these springs are located. Major recharge of groundwater in the Pretoria Group (PG) rocks is lost into the dolomite via deep network of faults and fractures which are developed in the Pretoria Group. Over saturation of this network resulted in appearance of these springs. Under natural condition (without mining operation), the hydraulic pressure (head) of groundwater in the dolomite could create a hydraulic barrier against the vertical flow of groundwater from the upper aquifer (PG) into the dolomite. This hydraulic barrier could enhance the saturation of network of faults and fractures and consequently could keep the springs under natural flow condition.

6.3 Stream flow measurement

The above mentioned springs are located within the catchment area of the Leeuwpoot Spruit and no flow was recorded by the East Driefontein gold mine in the past as a

Figure 4. Flow at spring No 3 in relation to local rainfall



part of Mine's Environmental Management Programme (EMP). The stream in the Leeuwoort Valley has been flowing for a number of years and stream water has been used for domestic, stock and limited irrigation purposes by the local communities adjacent to the spruit. The spruit finally flows into the Loopspruit in the south. The flow of the perennial spring No1 entering the spruit at a short distance above the constructed 90°V-notch.

In order to monitor the stream flow accurately, a 90° V-notch was constructed across the spruit on a fresh rock outcrop with no weathering. This V- notch was built by Mr Moolman on his own finance and receiving technical support from the Department of Water Affairs & Forestry in spite of promised was given to him by the environmental section of the East Driefontein gold mine on financial support.

The East Driefontein gold mine should conduct surface and groundwater monitoring within the Leeuwoort Valley as a part of their responsibility on Environmental Management Programme, especially to monitor and manage both groundwater and surface water resources.

The average monthly stream flow with local monthly rainfall is shown in Figure 5. The graph indicates a correlation between the stream flow and the local rainfall. The maximum flow of 76.85 L/s (H=315 mm) was recorded on the 10th February 2000. A general trend can also be observed in the rate of stream flow and it began from middle of 2000 and continued to 2006. This trend corresponds with low rainfall over the catchment area of the 90° V-notch and correlates with the cyclic nature of the rainfall pattern (Figure1).

The behaviour of springs in response to aquifer recharge can be observed by plotting the spring flow data against time. This illustrated in Figure 6 and the springs and stream flow show seasonal fluctuation in response to rainfall recharge. A general trend exists in both spring discharge (No1) and stream flow rates.

7. WATER QUALITY

Water samples were collected from various sources for macro elements (drinking water group) and microbiological analyses within the Leeuwoort Valley during the filed investigation. This includes borehole, spring, stream flow (surface water) and rain water.

7.1 Groundwater

The results of chemical analyses of groundwater from selected boreholes, including two mine exploration boreholes (M1 and M2) are given in Table 2. In general, the groundwater obtained from boreholes can be described as fresh water type. The concentration of cations and anions are below the target water range for drinking water, set up by the Department of Water Affairs and Forestry (DAAF).

Figure 5. Stream flow in relation to local rainfall

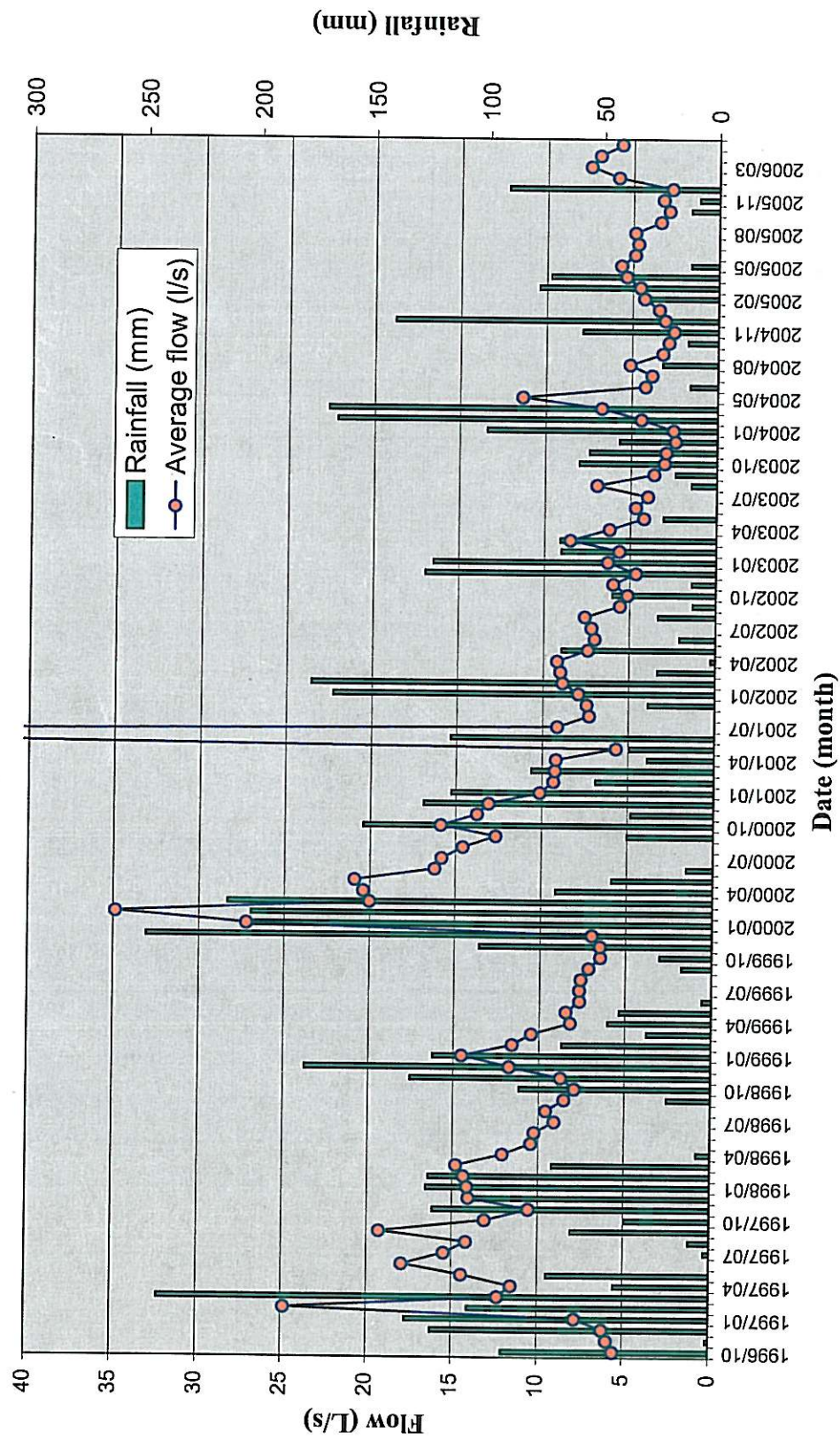


Figure 6. Spring discharge and stream flow

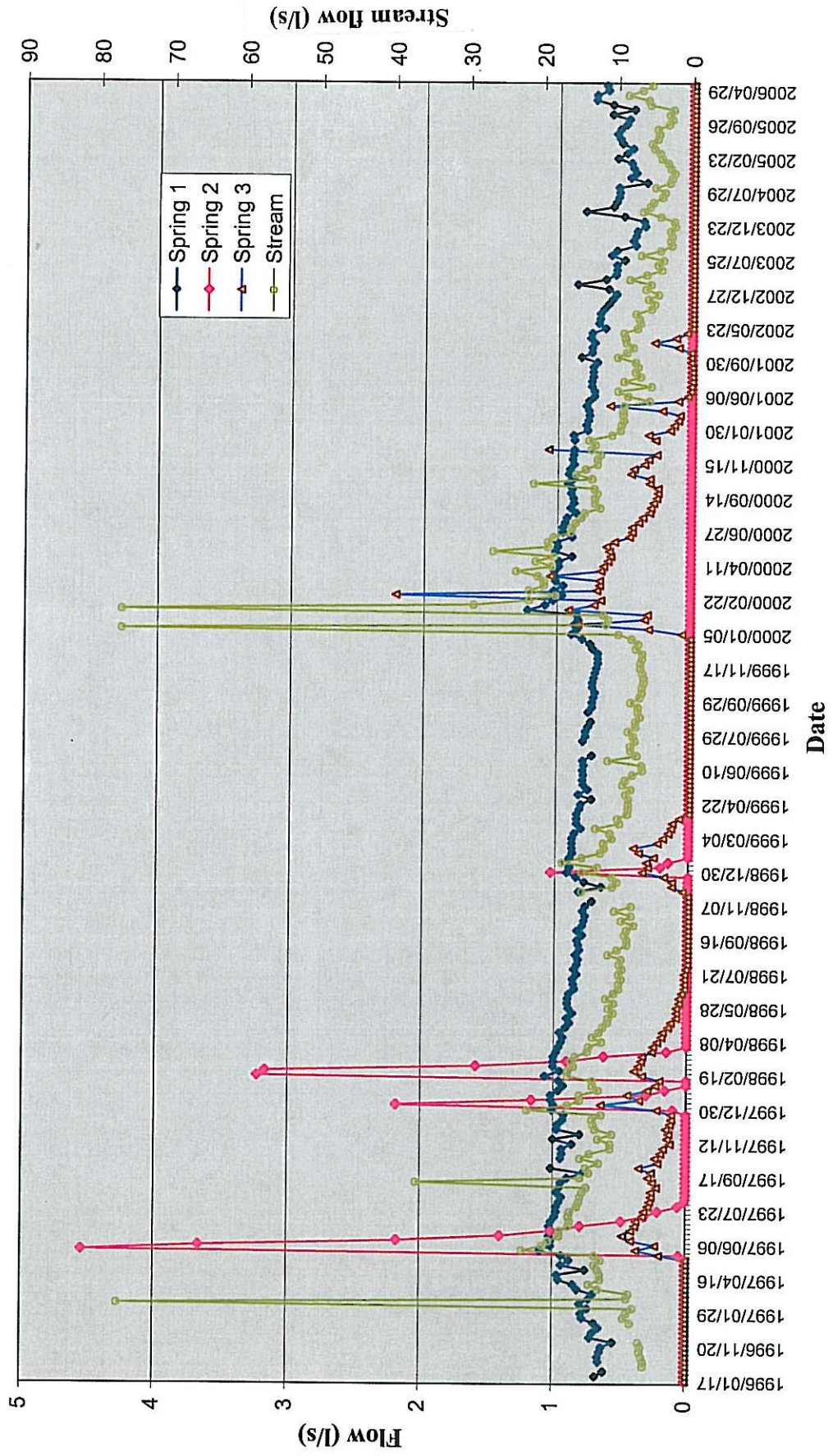


Table 2. Chemical water analyses for selected sources.

Source	EC mS/m	TAL mg/L	Cl mg/L	SO ₄ mg/L	Ca mg/L	Mg mg/L	Na mg/L	pH Unit	Sampling date
Spring No 1	8	27	<3	16	5.2	3.2	5.6	7.5	10/9/2003
Spring No 2	2.6	7	<10	<4	2	1	<2	6.5	16/3/2000
Spring No 3	3.4	8	<10	<4	2	1	2	7.1	16/3/2000
M1(mine)	16.7	72	<3	4	20	4	<2	8.3	24/1/1996
M2 (mine)	7	23	<3	<10	3	2.2	1.9	6.5	28/5/2002
LT 1	12.4	64	3	4	9	8	5	7.5	17/5/1996
LT 2	7	24	<3	<10	2.2	3.1	5.8	7.1	10/9/2003
LT 3	4.9	29	<3	<4	3	3	2	7.3	17/5/1996
LT 5	4.4	21	<3	4	3	3	2	7.5	23/5/1996
LT 6	3.3	15	<3	<4	3	1	<2	7	29/5/1996
LT 8	11.1	53	<3	<4	9	6	2	7.5	23/7/1997
Stream water at V-notch	7	25	<3	<10	3.4	3	2.6	6.9	28/5/2002
RW-1	7.1	19	<10	<4	4	3	3	7.6	16/3/2000
RW-2	7.6	6	<10	13	2	<1	<2	6.2	03/2/2000
TWQR (DWAF)	0-70	-	0-100	0-200	0-32	0-30	0-100	6-9	1996

**TAL = Total Alkalinity as calcium carbonate, RW = Rain Water,
TWQR = Target Water Quality Range (drinking water).**

This type of water (low ionic concentration) represents the Pretoria Group rock aquifer, especially the weathered/fractured shale and quartzite. Electrical conductivity (EC) measurement gives an indication of the total mineralisation of water in the aquifer system. In the Leeuwoort Valley, the EC values are very low and maximum value of 12.4 mS/m was recorded at borehole LT-1.

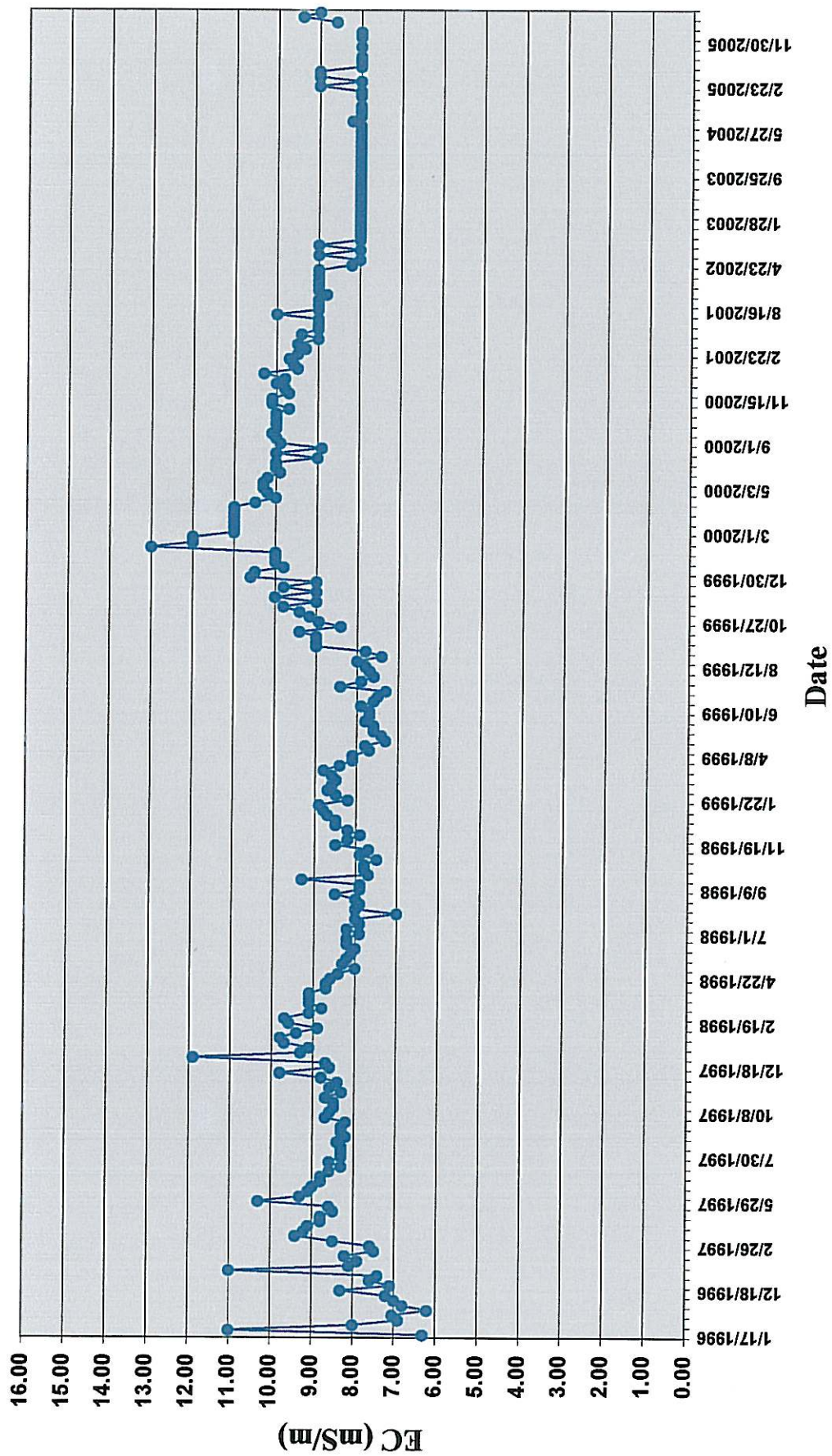
The two mine exploration boreholes, M1 and M2 which were drilled to the base of Pretoria Group (+/- 250 m at M1 and +/- 400 m at M2) groundwater does not show any mineralisation in spite of deeper circulation of groundwater. Mine exploration borehole M1 is an artesian with hydraulic pressure of a few meters above the ground, has an EC value of 16.7 mS/m.

Water quality of the springs is similar to borehole water. The highest EC value of 13 mS/m was recorded at spring No 1 on 10/02/2000 (see Appendix 2, Spring No 1). The variation of EC with time at spring No1 is given in Figure 7. The early data indicates some fluctuation in EC values which related to rainfall/recharge and flow pass environment (soil and geological condition of the spring catchment area).

7.2 Surface water

Water sample for surface water quality was taken at the surface flow measuring point (V-notch). The low ionic concentration of surface water is similar to groundwater and surface water is of good quality with no negative impact of the mining activity on the quality of surface water.

Figure 7. Variation of EC with time at Spring No 1



The maximum EC value of 9.4 mS/m was recorded (25/03/2004, Appendix 5) for surface water at the V-notch flow measuring point. The variation of EC with time for surface water is shown in Figure 8.

7.3 Rain water

Rain water sample was collected by Mr Moolman at close to his house for possible estimation of groundwater recharge to the Pretoria Group rock aquifer (shale and quartzite). The chemical analyses of two rain water samples (RW-1 and RW-2) indicate low concentration of major ions, but no exact value was given for chloride concentration. This could be due to detection limit of the lab's instrument. Sample RW-2 shows elevated sulphate (13 mg/l) that could be due to a number of factors, such as contamination of cloud with emission of sulphur gas from industrial activities.

7.4 Microbiological quality of water

A number of water samples were taken from various sources (spring, stream and borehole) for microbiological analysis. The results of these analyses are given in Table 3.

Table 3. Microbiological water analyses for selected sources.

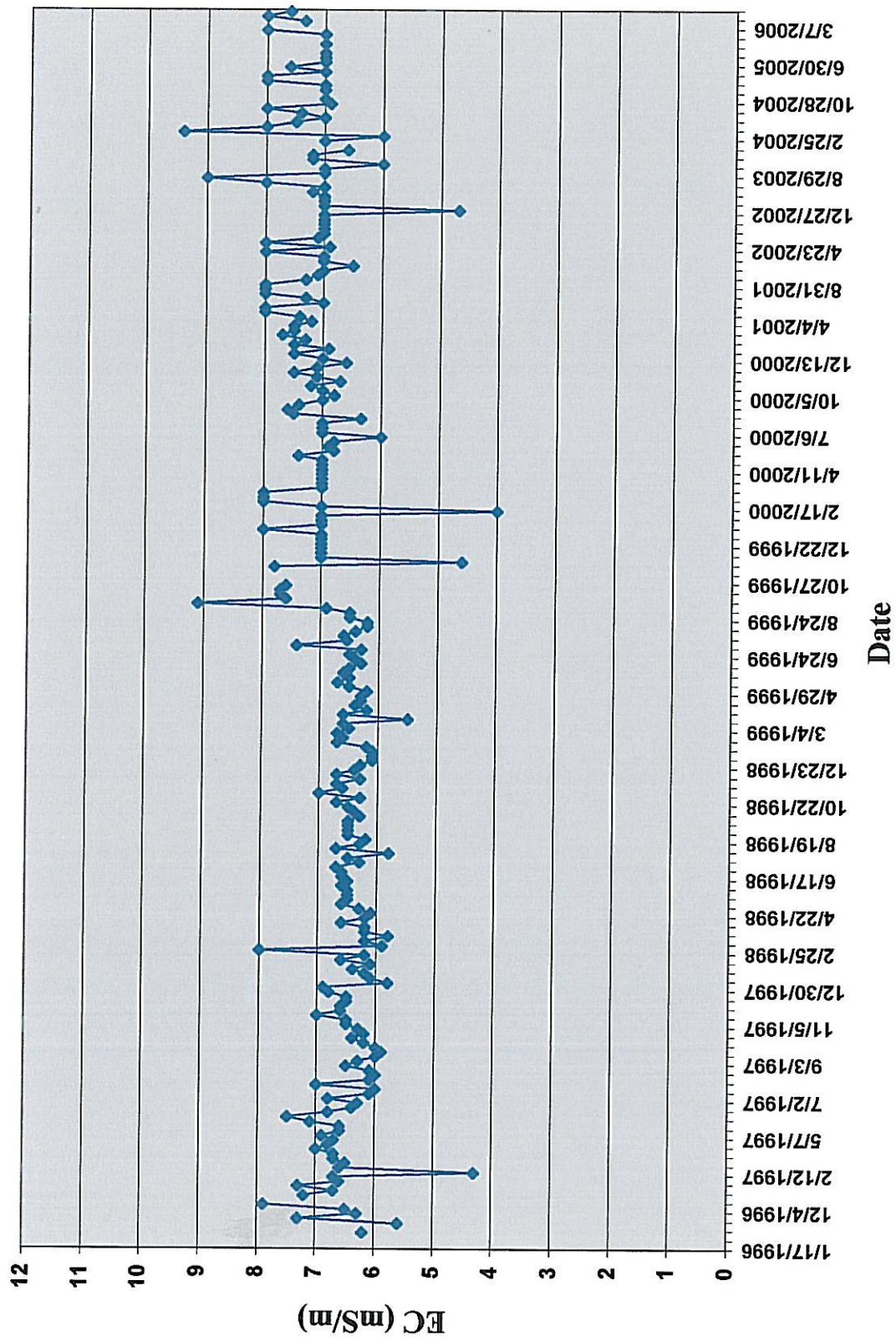
Date sampled	Source	E-Coli (cfu/100ml)	Faecal Coliforms (cfu/100ml)	Total Coliforms (cfu/100ml)	Heterotrophic Plate Count (cfu/100ml)	Faecal Streptococcus (cfu/100ml)	Remarks
28/05/02	LT-2	1	1	5	133	7	Borehole
08/10/02	LT-2	1	2	153	73	8	Borehole
12/11/02	LT-2	0	0	4	420	1 #	# 80ml
12/11/02	LT-2	0	0	8	270	0 *	* 60ml
28/01/03	LT-2	1	1	210	820	0	Borehole
10/09/03	LT-2	0	0	0	170	0	Borehole
11/11/03	LT-2	0	0	1	200	0	Borehole
28/05/06	M2	0	0	0	2140	0	Mine Borehole
10/09/03	Spring No 1	0	0	2	580	0	Spring
10/09/03	Stream water	400	360	480	10 800	7	V-notch
TWQR* DWAF		0-1 (counts/100ml)	0 (counts/100ml)	0-5 (counts/100ml)	0-100 (counts/1ml)		1996

*TWQR = Target Water Quality Range (drinking water)

With reference to the Table 3, Heterotrophic Plate Count for water from stream exceeded the recommended value by the DWAF.

Borehole LT-2 is currently supplying drinking water to a number of mine workers, living close to this borehole. The basic sanitation available to these mine workers is Pit Latrine. The seepage of this Pit Latrine will contaminate the borehole water (LT-2), especially during the rainy seasons. The elevated Total Coliforms and detection of E.Coli could be a trace of groundwater contamination from the Pit-Latrine.

Figure 8. Variation of EC in surface water at V-notch



6. Conclusions

The following conclusions can be made from this investigation:

- The springs are formed as a result of structural geology, faults and fed from the fault zones and weathered /fractured host rocks.
- Main source of groundwater recharge to the fault zone, weathered and fractured aquifers (rocks of Pretoria Group and dolomite) is the local rainfall.
- The fluctuation of spring flow is controlled by the local rainfall/recharge and there is a correlation between the spring flow and rainfall. This correlation is also visible for stream flow.
- Two dried up springs (No 2 and 3) started to flow after over-saturation of the fault zones and weathered/fractured host rocks as a results of a number of heavy rainy days.
- The impact of the gold mine activity, especially the dewatering could increase the hydraulic head in the dolomite, this in turns has an effect on the storage and flow pattern of groundwater in the upper aquifers (rocks of Pretoria Group and fault zone aquifers). This negative effect was observed in reduction of spring flow and drying up springs No 2, 3, 4 and 5.
- The quality of water from, borehole, spring and stream has not been impacted by the gold mining activity and water from these sources is of good quality with low salt content (low EC).
- The Pit Latrine could be source of microbiological groundwater pollution at borehole LT-2.

9. Recommendations

In order to keep the ecological condition of the Leeuwpoort Valley as well as water resources in a pristine condition prior to the gold mining activity the following are recommended.

Flow should be measured at the spring No 1 and at the V-notch (stream) on a monthly basis, usually during the last week of the month.

Collecting rainfall data within the Leeuwpoort Valley is essential and the rainfall data will be useful to correlate with flow at the spring and V-notch.

In order to rehabilitate the ecological condition of the area along the spring flow entering the the earth dams and to compensate the local communities who have the right to the spring water (springs No 2, 3, 4 and 5), the gold mine should release some quantity of potable water (+/-1.3 L/s) into the areas where the springs were flowing.

The accurate volume should be calculated from the rainfall data over the catchment area of each spring, applying scientific sound recharge value.

The quality of water from the spring and stream should be tested by means of EC measurement and occasional full chemical and bacterial analyses.

Borehole LT-2 is currently used to supply drinking water to the mine workers. This borehole should be protected and water must be monitored for possible microbiological contamination on a regular basis (monthly or bi-monthly).

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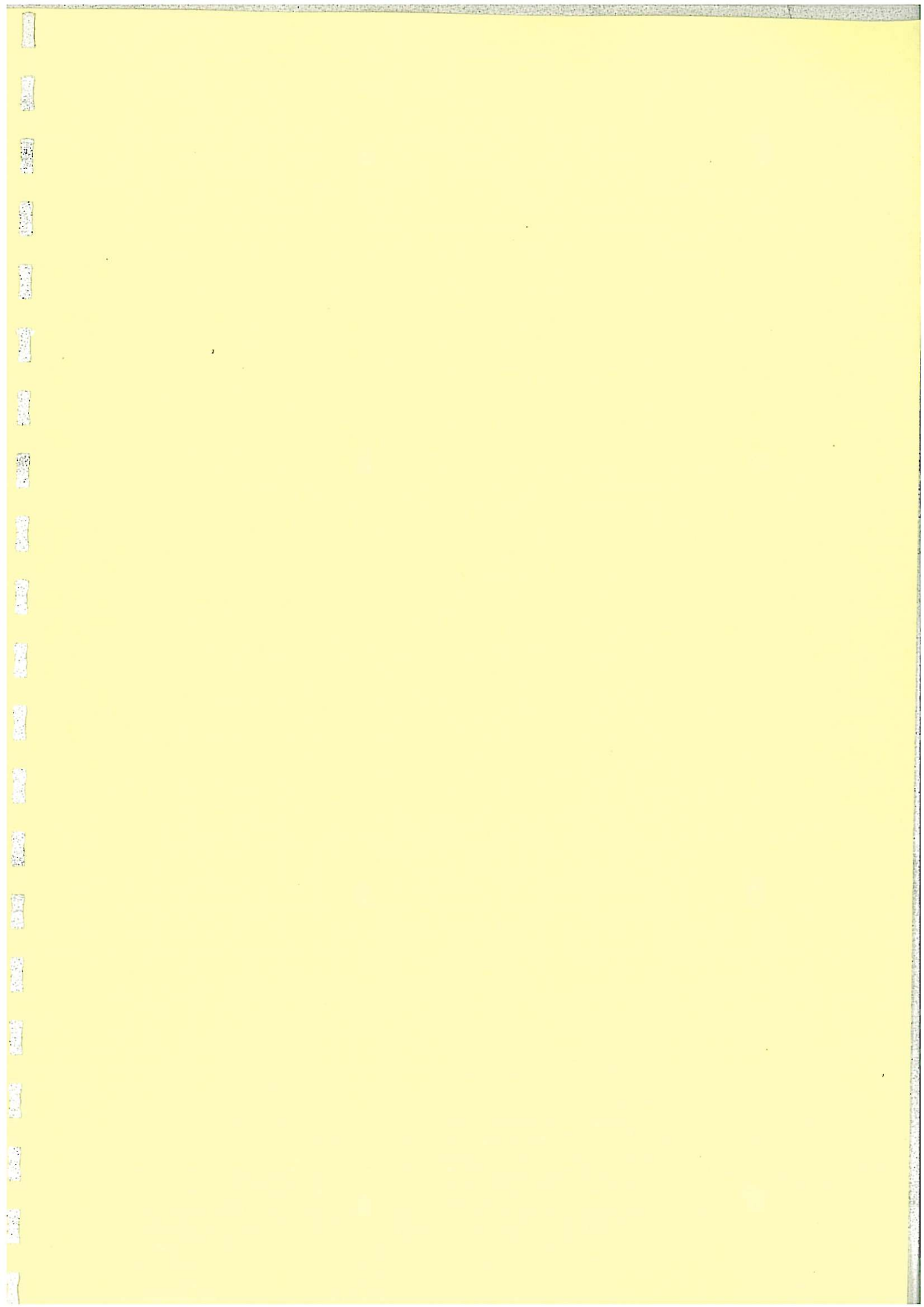
Geohydrological investigation of the groundwater conditions at West Driefontein, a Division of Driefontein Consolidated Ltd. Report No. WES\97\103, June 1998.

Gold Fields of S A Pty. Ltd.

Environmental Management Programme Report, East Driefontein, Report 196369/D by SRK, May 1996.

Moolman B.

Personal communication.



Appendices

Appendix 1

Rainfall data and 5-year moving average rainfall

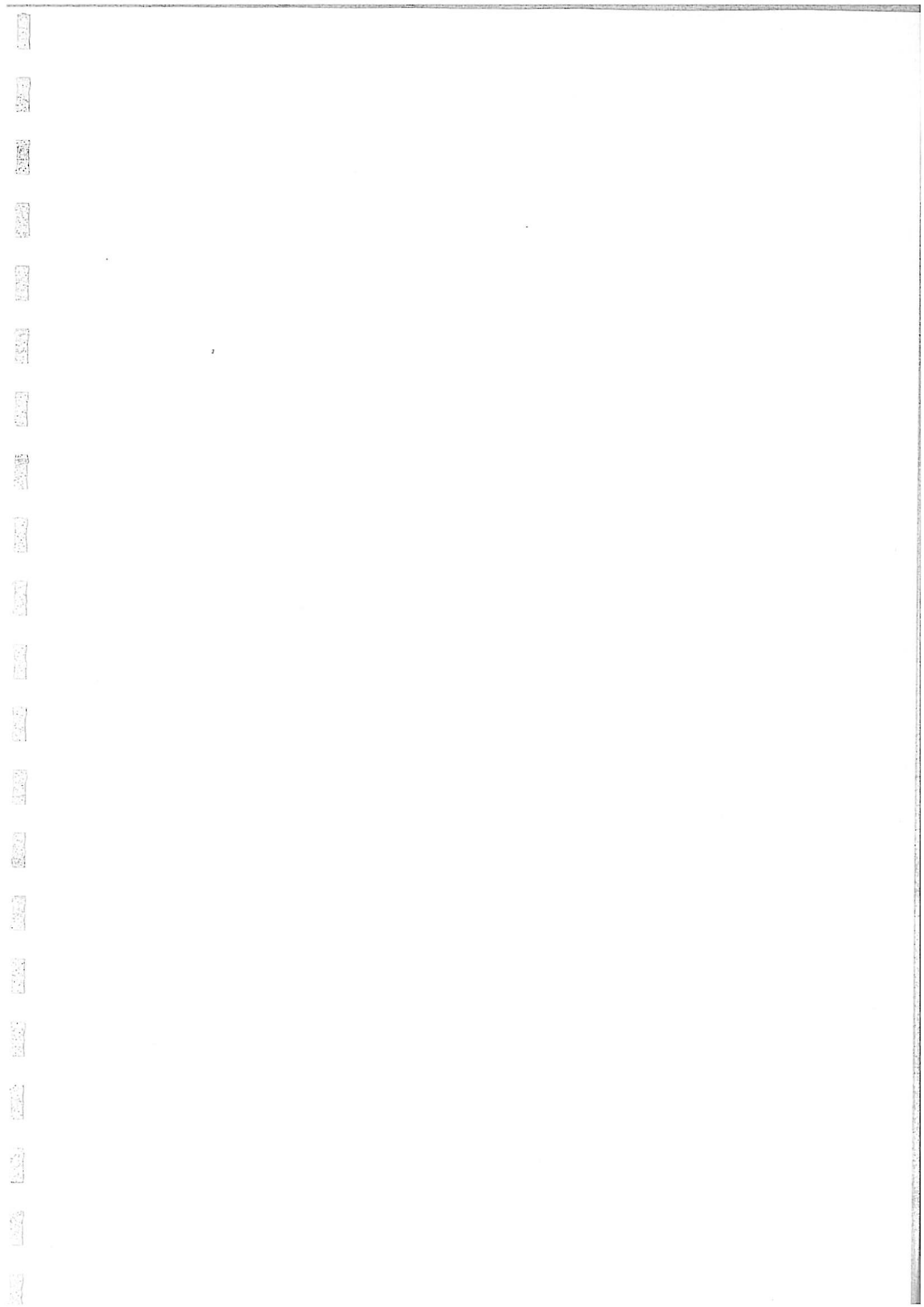
Rainfall data in mm, collected by Mr B Moolman within the study area.

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual (mm)	Cumulative annual rainfall in meter(s)
1991	209.0	128.0	136.5	0.0	0.0	13.5	0.0	0.0	17.0	48.0	35.0	163.5	753	0.753
1992	54.0	50.5	60.5	35.5	0.0	12.0	0.0	21.0	10.0	20.5	201.5	122.0	591	1.344
1993	82.5	43.5	58.0	32.0	1.0	0.0	0.0	4.0	2.5	260.0	89.0	126.0	699	2.043
1994	132.5	105.0	56.0	23.0	0.0	0.0	0.0	2.0	22.0	59.5	49.0	100.0	549	2.592
1995	90.0	64.0	117.5	57.5	0.0	0.0	0.0	0.0	8.0	121.0	140.3	146.0	745	3.337
1996	160.5	137.5	38.0	113.5	12.0	0.0	0.0	16.0	8.0	90.5	112.0	121.5	809	4.146
1997	133.0	105.5	242.0	41.5	71.0	0.0	2.5	9.0	60.5	37.0	121.0	106.0	945	5.091
1998	124.0	123.0	69.0	6.0	0.0	0.0	0.0	0.0	19.0	83.5	131.5	178.0	734	5.825
1999	121.5	65.0	28.0	45.0	40.0	4.0	0.0	0.0	13.0	22.5	101.5	248.0	689	6.514
2000	204.0	202.0	212.5	68.5	44.0	11.5	0.0	0.0	37.5	153.0	36.0	126.5	1156	7.670
2001	114.5	51.5	79.5	29.0	37.0	11.5	0.0	0.0	29.0	168.5	104.0	85.5	655	8.325
2002	167.0	176.5	25.0	2.0	67.0	15.5	0.0	25.0	10.0	45.0	10.5	127.0	671	8.996
2003	123.5	67.5	68.0	0.0	23.0	0.0	0.0	11.0	18.0	60.0	55.5	42.5	469	9.465
2004	100.5	166.0	170.0	58.0	0.0	12.0	0.0	24.0	0.0	13.0	59.0	141.0	744	10.209
2005	0.0	31.0	78.0	73.0	12.0	0.0	0.0	0.0	0.0	12.0	108.5	91.5	406	10.615

Year	Accu.Rainfall,m	Annual rain, mm	Year	Accu.Rainfall,m	Annual rain,mm
1955	1.146	1146	1991	0.753	753
1956	1.68	534	1992	1.344	591
1957	2.371	691	1993	2.043	699
1958	2.922	55	1994	2.592	549
1959	3.518	596	1995	3.337	745
1960	4.08	562	1996	4.146	809
1961	4.601	521	1997	5.091	945
1962	5.181	580	1998	5.825	734
1963	5.842	661	1999	6.514	689
1964	6.357	515	2000	7.67	1156
1965	6.716	359	2001	8.325	655
1966	7.407	691	2002	8.996	671
1967	8.142	735	2003	9.465	469
1968	8.827	685	2004	10.209	744
1969	9.671	844	2005	10.615	406
1970	10.144	473			
1971	11.083	939			
1972	11.544	461			
1973	12.203	659			
1974	13.141	938			
1975	13.856	715			
1976	15.108	1252			
1977	16.188	1080			
1978	17.131	943			
1979	18.223	1092			
1980	19.374	1151			
1981	20.09	716			
1982	20.685	595			
1983	21.363	678			
1984	21.863	500			
1985	22.408	545			
1986	23.135	727			
1987	23.894	759			
1988	24.535	641			
1989	25.318	783			
1990	25.832	514			
1991	26.475	643			
1992	27.062	587			
1993	27.739	677			
1994	28.422	683			
1995	29.204	782			
1996	30.072	868			
1997	31.053	981			

Moolman, Leeuwpoot Valley

Date	Annual rainfall (mm)	5-Year M. average (mm)		
1955	1146		West Drifontein	
1956	534			
1957	691	704		
1958	551	587		
1959	596	584		
1960	562	562		
1961	521	584		
1962	580	568		
1963	661	527		
1964	515	561		
1965	359	592		
1966	691	597		
1967	735	663		
1968	685	686		
1969	844	735		
1970	473	680		
1971	939	675		
1972	461	694		
1973	659	742		
1974	938	805		
1975	715	929		
1976	1252	985		
1977	1080	1016		
1978	943	1104		
1979	1092	996		
1980	1151	899		
1981	716	846		
1982	595	728		
1983	678	607		
1984	500	609		
1985	545	642		
1986	727	634		
1987	759	691		
1988	641	685		
1989	783	668		
1990	514	634		
1991	643	641		
1992	587	621		
1993	677	674		
1994	683	719		
1995	782	798		
1996	868	756		
1997	981	784	West Drifontein	
1998	734	867	Moolman	
1999	689	836	Moolman	
2000	1156	781	Moolman	
2001	655	728	Moolman	
2002	671	739	Moolman	
2003	469	589	Moolman	
2004	744		Moolman	
2005	406		Moolman	



Appendix 2

Spring No 1, spring flow and EC measurements

SPRING 1

GEOHYDROLOGICAL INFORMATION
LEEUWPOORT 356 IQ
SPRING 1 (BY THE HOUSE, WITH POOL)

Date	Flow (l/s) (Volumetric)	EC (WT) mS/m	Water Temp (°C)	EC (25 °C) mS/m	Local Rainfall	REMARKS
1997/12/10	0.963	9.80	18.50	8.40	-	-
1997/12/18	0.926	8.60	17.50	7.20	-	-
1997/12/23	0.918	8.70	17.50	7.30	-	-
1997/12/30	1.007	11.90	18.00	1.20	-	-
1998/01/07	0.996	9.30	18.00	8.10	-	-
1998/01/16	1.016	9.10	17.50	7.70	-	-
1998/01/21	1.018	9.70	19.00	8.80	-	-
1998/01/28	0.959	9.80	18.50	8.40	-	-
1998/02/05	0.924	9.40	18.50	8.10	-	-
1998/02/11	0.958	8.90	19.50	7.80	-	-
1998/02/19	1.063	9.60	17.50	8.30	-	-
1998/02/25	0.950	9.70	18.00	8.40	-	-
1998/03/04	1.001	9.10	18.50	7.80	-	-
1998/03/12	1.000	8.80	18.00	7.40	-	-
1998/03/18	1.000	9.10	18.50	7.90	-	-
1998/03/26	0.977	9.10	18.00	7.70	-	-
1998/04/02	0.960	9.10	18.50	7.70	-	-
1998/04/08	0.942	8.70	18.00	7.50	-	-
1998/04/15	0.930	8.70	17.50	7.30	-	-
1998/04/22	0.956	8.60	17.50	7.20	-	-
1998/04/29	0.910	8.40	17.50	7.00	-	-
1998/05/06	0.880	8.00	17.50	6.90	-	-
1998/05/13	0.900	8.30	17.00	7.00	-	-
1998/05/22	0.860	8.20	17.00	6.80	-	-
1998/05/28	0.890	8.10	17.00	6.70	-	-
1998/06/03	0.898	8.00	16.50	6.60	-	-
1998/06/10	0.897	8.20	16.50	6.80	-	-
1998/06/17	0.886	8.20	16.50	6.80	-	-
1998/07/01	0.847	7.90	16.50	6.50	-	-
1998/07/08	0.854	8.20	16.50	6.80	-	-
1998/07/15	0.860	7.90	16.50	6.50	-	-
1998/07/21	0.831	8.00	16.50	6.70	-	-
1998/07/30	0.850	7.00	16.50	6.50	-	-
1998/08/06	0.830	8.00	16.50	6.60	-	-
1998/08/12	0.820	7.90	16.50	6.50	-	-
1998/08/19	0.840	8.00	17.00	6.50	-	-
1998/09/02	0.810	8.50	17.00	6.38	-	-
1998/09/09	0.820	7.90	17.50	6.60	-	-
1998/09/16	0.830	7.90	17.00	6.60	-	-
1998/09/23	0.790	9.30	17.50	7.70	-	-
1998/09/30	0.830	7.70	17.50	6.50	-	-
1998/10/06	0.790	7.80	17.50	6.60	-	-
1998/10/14	0.780	7.80	17.50	6.60	-	-
1998/10/22	0.770	7.50	17.50	6.40	-	-
1998/11/04	0.790	7.90	18.00	6.80	-	Increase in flow due to local rain
1998/11/07	0.770	7.70	18.00	6.50	-	-
1998/11/19	0.720	8.50	17.00	7.10	-	-
1998/11/26		8.20	19.00	7.20	-	No flow measurement due to blocage of discharge pipe
1998/12/02	0.820	7.90	17.50	6.70	-	Increase in flow due to local rain
1998/12/11	0.650	8.20	18.00	7.10	-	-
1998/12/17	0.780	8.50	18.00	7.20	-	-
1998/12/23	0.840	8.50	17.50	7.20	-	-
1998/12/30	0.910	8.70	17.50	7.30	-	Increase in flow due to local rain
1999/01/06	0.890	8.80	18.00	7.20	-	-
1999/01/14	0.920	8.90	18.00	7.60	-	-

SPRING 1

GEOHYDROLOGICAL INFORMATION
 LEEUWPOORT 356 IQ
 SPRING 1 (BY THE HOUSE, WITH POOL)

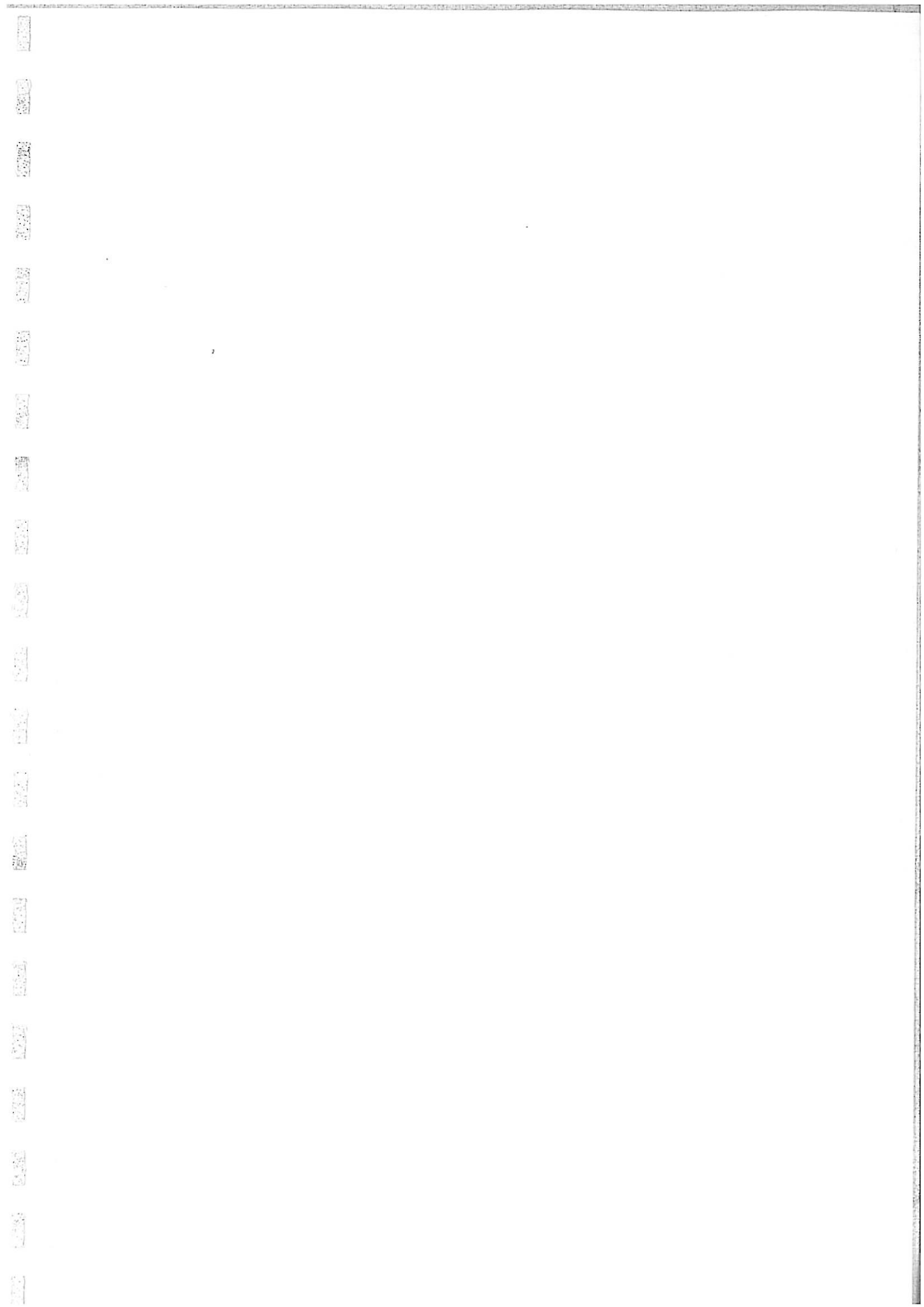
Date	Flow (l/s) (Volumetric)	EC (WT) mS/m	Water Temp (°C)	EC (25 °C) mS/m	Local Rainfall	REMARKS
1999/01/22	0.890	8.20	18.00	7.10	-	-
1999/02/10	0.870	8.50	18.50	7.30	-	-
1999/02/17	0.875	8.70		7.30	-	-
1999/02/23	0.874	8.60	18.00	7.40	-	-
1999/03/04	0.874	8.50	18.00	7.20	-	-
1999/03/11	0.856	8.60	18.00	7.30	-	-
1999/03/16	0.807	8.80	18.00	7.70	-	-
1999/03/25	0.840	8.40	18.00	7.20	-	-
1999/03/31	0.840	8.10	18.00	6.90	-	-
1999/04/08	0.840	8.10	18.00	6.90	-	-
1999/04/15	0.82	7.70	18.00	6.70	-	-
1999/04/22	0.81	7.80	18.00	6.70	-	-
1999/04/29	0.73	7.30	19.00	6.30	-	-
1999/05/06	0.83	7.40	17.00	6.30	-	-
1999/05/12	0.76	7.60	16.50	6.20	-	-
1999/05/20	0.79	7.60	17.00	6.40	-	-
1999/05/26	0.80	7.80	17.00	6.50	-	-
1999/06/03	0.79	7.70	17.00	6.20	-	-
1999/06/10	0.80	7.70	16.00	6.30	-	-
1999/06/17	0.79	7.90	16.00	6.60	-	-
1999/06/24	0.80	7.60	16.50	6.30	-	-
1999/06/30	0.73	7.50	15.00	6.00	-	-
1999/07/07		7.30	16.00	6.00	-	No flow measurement due to pumping
1999/07/14		8.40	16.00	6.80	-	No flow measurement due to pumping
1999/07/23	0.80	7.90	16.00	6.40	-	-
1999/07/29	0.78	7.60	16.00	6.20	-	-
1999/08/04	0.78	7.70	16.00	6.30	-	-
1999/08/12	0.76	7.80	16.50	6.40	-	-
1999/08/24	0.74	8.00	15.00	6.30	-	-
1999/09/01		7.40	15.50	6.00	-	No flow measurement due to pumping
1999/09/08	0.760	7.80	15.50	6.30		
1999/09/22	0.73	9.00	1.00	6.00		
1999/09/29	0.73	9.00	9.00	6.00		
1999/10/07	0.72	9.00	1.00	6.20		
1999/10/11	0.71	9.40	1.00	6.60		
1999/10/20	0.73	8.40	11.00	6.10		
1999/10/27	0.73	8.93				Flow measured by Moolman
1999/11/04	0.72	9.17				Flow measured by Moolman
1999/11/11	0.71	9.40				Flow measured by Moolman
1999/11/17	0.70	9.80	11.00	6.90		
1999/11/25	0.69	9.00	11.00	7.00		
1999/12/02	0.69	1.00	11.00	7.00		
1999/12/08	0.69	9.00	11.00	7.00		
1999/12/15	0.73	9.80	11.00	7.00		
1999/12/22	0.75	9.00	1.50	7.00		
1999/12/30	0.81	1.60	11.00	7.60		
2000/01/05	0.89	1.50	11.00	7.50		
2000/01/14	0.85	9.80	1.00	7.00		
2000/01/20	0.87	1.00	11.00	7.00		
2000/01/27	0.84	1.00	11.00	7.00		
2000/02/03	0.85	1.00	11.00	7.00		
2000/02/10	1.22	13.00	11.00	1.00		
2000/02/17	1.09	12.00	11.00	9.00		
2000/02/22	1.03	12.00	12.00	8.00		
2000/03/01	0.96	11.00	11.00	8.00		
2000/03/09	1.02	11.00	11.00	8.00		

SPRING 1

Date	Flow (l/s) (Volumetric)	EC (WT) mS/m	Water Temp (°C)	EC (25 °C) mS/m	Local Rainfall	REMARKS
2000/03/16	0.96	11.00	8.00	12.00		
2000/03/23	1.01	11.00	11.00	8.00		
2000/03/30	1.02	11.00	11.00	8.00		
2000/04/04	1.02	11.00	11.00	8.00		
2000/04/11	0.99	10.50	1.50	7.50		
2000/04/19	0.99	10.00	1.00	7.00		
2000/04/27	0.89	10.20	1.00	7.10		
2000/05/03	1.02	10.30	1.00	7.20		
2000/05/09	1.00	10.30	1.00	7.20		
2000/05/17	1.00	3.20	1.00	0.71		
2000/05/30	0.89	9.90	1.00	6.90		
2000/06/27	0.96	10.00	9.00	7.00		
2000/07/06	0.96	10.00	9.00	7.00		
2000/07/20	0.94	9.00	9.00	6.00		
2000/08/04	0.93	10.00	1.00	7.00		
2000/08/23	0.86	8.90	17.00			Using YSI EC meter
2000/09/01	0.90	9.90	1.00	7.00		
2000/09/07	0.88	10.00	1.00	7.00		
2000/09/14	0.88	10.10	1.00	7.00		
2000/09/27	0.90	10.00	1.00	7.00		
2000/10/05	0.89	10.00	1.00	7.00		
2000/10/12	0.92	10.00	1.00	7.00		
2000/10/18	0.88	10.00	1.00	7.00		
2000/11/02	0.92	9.70	1.50	6.90		
2000/11/07	0.91	10.10	1.50	7.20		
2000/11/15	0.88	10.10	1.50	7.20		
2000/11/21	0.89	9.70	11.50	7.10		
2000/12/06	0.88	9.80	11.00	7.00		
2000/12/13	0.88	10.00	11.00	7.00		
2000/12/20		9.80	1.00	6.70		No flow measurement , raining
2000/12/28	0.88	10.30	14.00	7.70		
2001/01/25	0.89	9.50	11.00	6.80		
2001/01/30	0.78	9.60	11.00	7.00		
2001/02/14	0.79	9.70	11.50	7.00		
2001/02/23	0.77	9.50	11.00	6.90		
2001/03/07	0.77	9.30	11.00	6.70		
2001/04/04	0.77	9.50	11.00	6.70		
2001/04/11	0.79	9.00	11.00	6.50		
2001/05/10	0.77	9.40	1.00	6.50		
2001/06/06	0.73	9.00	1.00	6.00		
2001/06/20	0.73	9.00	9.00	6.00		
2001/06/28	0.75	9.00	9.00	5.00		
2001/07/26	0.75	10.00	9.00	6.60		
2001/08/16	0.74	9.00	9.00	6.00		
2001/08/31	0.74	9.00	9.00	6.00		
2001/09/18	0.74	9.00	9.50	6.00		
2001/09/30	0.71	8.80	1.50	6.40		
2001/11/30	0.83	9.00	11.00	6.00		
2001/12/21	0.75	9.00	12.00	6.00		
2002/01/24	0.75	9.00	11.00	7.00		
2002/02/28	0.73	9.00	11.50	7.00		
2002/03/22	0.76	9.00	11.00	7.00		
2002/04/23	0.75	8.20	1.50	6.00		
2002/05/23	0.65	8.00	1.00	6.00		Low flow due to pumping
2002/06/19	0.70	9.00	9.50	6.00		
2002/07/18	0.69	8.00	9.00	6.00		
2002/08/15	0.69	9.00	9.00	6.00		
2002/09/26	0.66	8.00	10.50	6.00		
2002/10/30	0.63	8.00	1.50	6.00		
2002/11/28	0.60	8.00	11.00	6.00		Pumping stopped 3hrs prior to flow measurement
2001/12/27	0.57	8.00	11.50	6.00		
2003/01/28	0.63	8.00	11.00	6.00		

SPRING 1

Date	Flow (l/s) (Volumetric)	EC (WT) mS/m	Water Temp (°C)	EC (25 °C) mS/m	Local R.Fall	REMARKS
2003/02/25	0.86	8.00	11.00	6.00		
2003/03/27	0.65	8.00	1.50	6.00		Pumped in the morning prior to flow measurement
2003/04/29	0.58	8.00	11.00	6.00		Flow measured by Moolman
2003/05/29	0.57	8.00	9.00	5.00		
2003/06/26	0.57	8.40	9.00	5.60		
2003/07/25	0.51	8.40	9.00	5.60		
2003/08/29	0.61	8.00	9.00	5.00		
2003/09/10	0.57	8.00	9.00	5.00		
2003/09/25	0.43	8.00	10.00	5.00		
2003/10/28	0.45	8.00	11.00	5.00		
2003/11/26	0.42	8.00	12.50	6.00		
2003/12/23	0.36	7.60	12.50	5.70		
2004/01/29	0.37	8.00	11.00	6.00		
2004/02/25	0.52	10.00	11.00	7.00		
2004/03/25	0.80	11.60	11.00	8.40		
2004/05/04	0.60	8.00	10.00	6.00		
2004/05/27	0.58	8.00	11.00	6.00		
2004/06/24	0.56	8.00	9.00	5.00		
2004/07/29	0.55	8.20	9.00	5.50		
2004/08/31	0.56	8.00	9.00	5.00		
2004/09/22	0.35	8.00	10.00	5.50		
2004/10/28	0.47	8.00	10.00	6.00		
2004/11/25	0.43					
2004/12/22	0.45	8.00	12.00	6.00		
2005/01/27	0.47	8.00	12.00	6.00		
2005/02/23	0.57	9.00	10.00	6.00		
2005/03/31	0.50	8.00	12.00	6.00		
2005/04/29	0.46	9.00	10.00	6.00		
2005/05/24	0.53	9.00	10.00	6.00		
2005/06/30	0.55	8.00	9.50	6.00		
2005/07/28	0.57	8.00	9.50	6.00		
2005/08/29	0.55	8.00	8.00	6.00		
2005/09/26	0.50					
2005/10/25	0.48	8.00	10.50	6.00		
2005/11/30	0.61					
2005/12/29	0.45	8.00	13.00	6.00		
2006/01/26	0.61	8.00	11.00	6.00		
2006/03/07	0.73					
2006/03/30	0.73	8.50	17.70	7.40		
2006/04/29	0.64	9.40	10.00	6.60		
2006/05/31	0.65	9.00	10.00	6.00		
2006/06/29	0.64	9.00	9.00	6.00		
2006/07/26	0.07	9.00	9.50	6.00		
2006/08/31	0.64	9.00	4.00	5.00		
2006/09/21	0.64	8.00	10.00	6.00		
2006/10/26	0.60	9.00	11.00	6.00		
2006/11/30	0.60					Flow measured by Moolman
END	END	END	END	END		



Appendix 3

Spring No 2, spring flow and EC measurements

HYDROGEOLOGICAL INFORMATION						
LEEUWPOORT 356 IQ						
SPRING FLOW MEASUREMENT						
SPRING NO 2 (TAR ROAD)						
Date	Flow, l/s	EC=WT	EC (25C)	Water	Remarks	
Spring 2		mS/m	mS/m	Temp.(C)		
1996/01/17	0.00					
1996/01/25	0.00					
1996/02/06	0.00					
1996/10/16	0.00					
1996/10/31	0.00					
1996/11/07	0.00					
1996/11/13	0.00					
1996/11/20	0.00					
1996/12/04	0.00					
1996/12/18	0.00					
1996/12/30	0.00					
1997/01/08	0.00					
1997/01/15	0.00					
1997/01/22	0.00					
1997/01/29	0.00					
1997/02/04	0.00					
1997/02/12	0.00					
1997/02/19	0.00					
1997/02/26	0.00					
1997/03/19	0.00					
1997/03/26	0.00					
1997/04/16	0.00					
1997/04/21	0.00					
1997/04/30	0.00					
1997/05/07	0.00					
1997/05/14	0.00				Dry	
1997/05/21	0.05				Seepage	
1997/05/29	4.54	2.10	1.80	18.00		
1997/06/06	3.66	2.20	1.80	17.00		
1997/06/12	2.17	1.70	1.50	18.50		
1997/06/18	1.39	1.60	1.40	17.50		
1997/06/25	1.01	1.60	1.30	16.50		
1997/07/02	0.79	1.50	1.30	17.00		
1997/07/10	0.48	1.50	1.20	17.50		
1997/07/16	0.31	1.40	1.10	13.00		
1997/07/23	0.21	1.40	1.10	16.00		
1997/07/30	0.06	1.50	1.10	12.00		
1997/08/06	0.01	1.40	1.00	11.00	Seepage	
1997/08/13	0.00	1.80	1.60	18.50	Seepage	
1997/08/21	0.00	18.70	16.40	18.50	Seepage	
1997/09/03	0.00	1.70	1.40	15.00	Seepage	
1997/09/09	0.00				Dry	
1997/09/17	0.00				Dry	
1997/09/23	0.10	1.70	19.00	1.40	Seepage	
1997/10/01	0.01	1.60	23.00	1.60	Seepage	
1997/10/08	0.00				Dry	
1997/10/15	0.00					
1997/10/22	0.00					

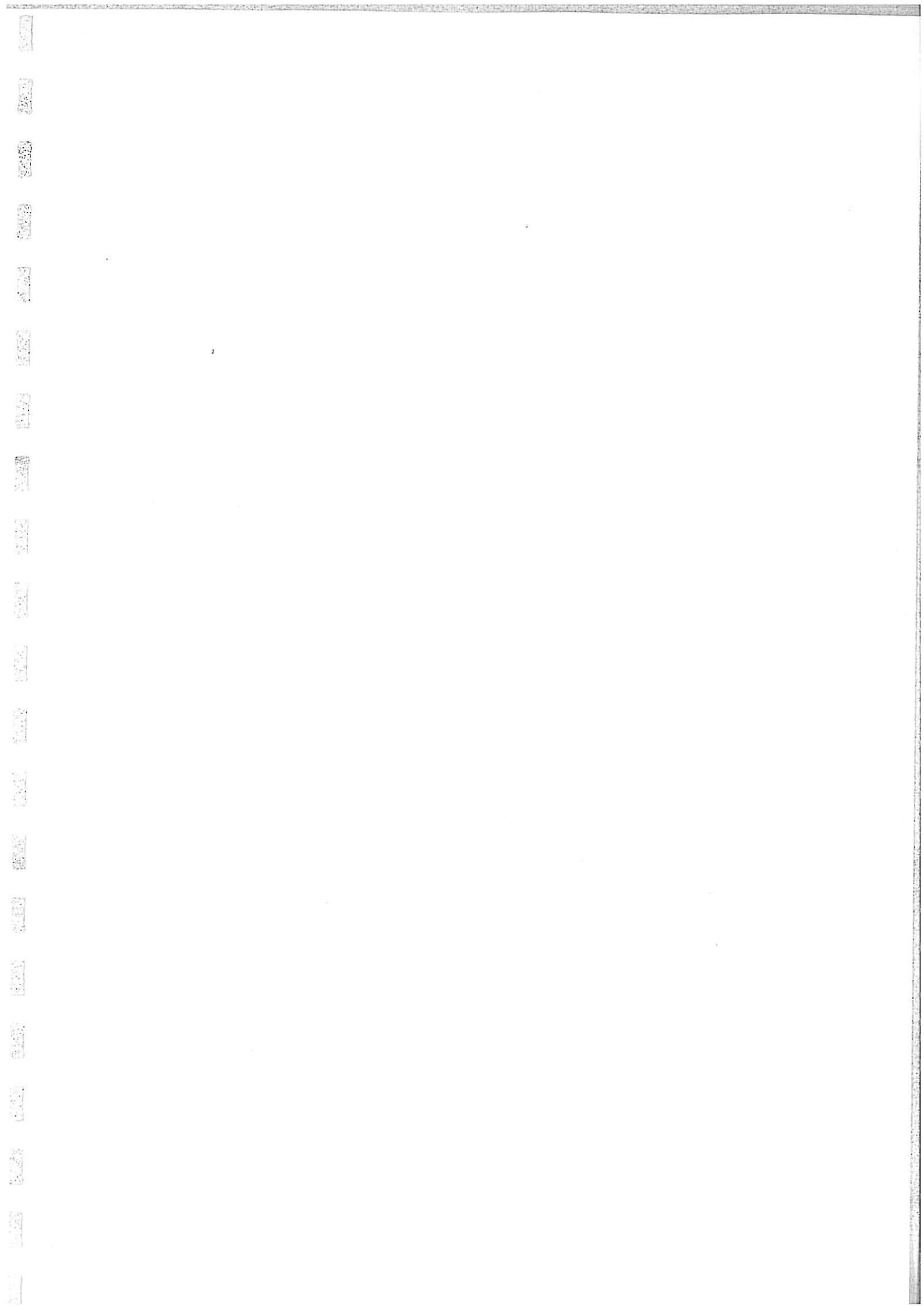
Data source

HYDROGEOLOGICAL INFORMATION						
LEEUVPOORT 356 IQ						
SPRING FLOW MEASUREMENT						
SPRING NO 2 (TAR ROAD)						
Date	Flow, l/s	EC=WT mS/m	EC (25C) mS/m	Water Temp.(C)	Remarks	
1997/11/05	0.00					
1997/11/12	0.00					
1997/11/19	0.00					
1997/11/26	0.00					
1997/12/04	0.00					
1997/12/10	0.00					
1997/12/18	0.00					
1997/12/23	0.00					Dry
1997/12/30	0.10	2.60	2.600	1900/01/25	Seepage, rained	
1998/01/07	2.18	2.60	1.800	1900/01/19		
1998/01/16	1.16	1.90	1.600	1900/01/19		
1998/01/21	0.30	2.00	1.800	1900/01/19		
1998/01/28	0.16	1.70	1.700	1900/01/25		
1998/02/05	0.01	1.50	1.500	1900/01/25	Seepage	
1998/02/11	0.00				Dry	
1998/02/19	3.23	2.10	1.800	1900/01/19		
1998/02/25	3.17	1.90	1.700	1900/01/20		
1998/03/04	1.58	1.60	1.500	1900/01/23		
1998/03/12	0.90	1.70	1.500	1900/01/19		
1998/03/18	0.62	1.40	1.400	1900/01/23		
1998/03/26	0.15	1.70	1.600	1900/01/21		
1998/04/02	0.01				Seepage	
1998/04/08	0.00				Dry	
1998/04/15	0.00					
1998/04/22	0.00					
1998/04/29	0.00					
1998/05/06	0.00					
1998/05/13	0.00					
1998/05/22	0.00					
1998/05/28	0.00					
1998/06/03	0.00					
1998/06/10	0.00					
1998/06/17	0.00					
1998/07/01	0.00					
1998/07/08	0.00					
1998/07/15	0.00					
1998/07/21	0.00					
1998/07/30	0.00					
1998/08/06	0.00					
1998/08/12	0.00					
1998/08/19	0.00					
1998/09/02	0.00					
1998/09/09	0.00					
1998/09/16	0.00					
1998/09/23	0.00					
1998/09/30	0.00					
1998/10/06	0.00					

HYDROGEOLOGICAL INFORMATION						
LEEUWPOORT 356 IQ						
SPRING FLOW MEASUREMENT						
SPRING NO 2 (TAR ROAD)						
Date		Flow, l/s	EC=WT	EC (25C)	Water	Remarks
Spring 2			mS/m	mS/m	Temp.(C)	
1998/10/14		0.00				
1998/10/22		0.00				
1998/11/04		0.00				
1998/11/07		0.00				
1998/11/19		0.00				
1998/11/26		0.00				
1998/12/02		0.00				
1998/12/11		0.00				
1998/12/17		0.00				
1998/12/23		0.00				Dry
1998/12/30		1.03	2.30	2.100	20.00	Increase of flow due to rain
1999/01/06		0.21	1.80	2.000	30.00	
1999/01/14		0.15	1.70	1.800	28.00	
1999/01/22		0.00				Dry
1999/02/10		0.00				
1999/02/17		0.00				
1999/02/23		0.00				
1999/03/04		0.00				
1999/03/11		0.00				
1999/03/16		0.00				
1999/03/25		0.00				
1999/03/31		0.00				
1999/04/08		0.00				
1999/04/15		0.00				
1999/04/22		0.00				
1999/04/29		0.00				
1999/05/06		0.00				
1999/05/12		0.00				
1999/05/20		0.00				
1999/05/26		0.00				
1999/06/03		0.00				
1999/06/10		0.00				
1999/06/17		0.00				
1999/06/24		0.00				
1999/06/30		0.00				
1999/07/07		0.00				
1999/07/14		0.00				
1999/07/23		0.00				
1999/07/29		0.00				
1999/08/04		0.00				
1999/08/12		0.00				
1999/08/24		0.00				
1999/09/01		0.00				
1999/09/08		0.00				
1999/09/22		0.00				
1999/09/29		0.00				
1999/10/07		0.00				

HYDROGEOLOGICAL INFORMATION						
LEEuwPOORT 356 IQ						
SPRING FLOW MEASUREMENT						
SPRING NO 2 (TAR ROAD)						
Date	Flow, l/s	EC=WT mS/m	EC (25C) mS/m	Water Temp.(C)	Remarks	
1999/10/11	0.00					
20 Oct-99	0.00					
1999/10/27	0.00					
1999/11/04	0.00					
1999/11/11	0.00					
1999/11/17	0.00					
1999/11/25	0.00					
1999/12/02	0.00					
1999/12/08	0.00					
1999/12/15	0.00					
1999/12/22	0.00					
1999/12/30	0.00					Dry
2000/01/05	0.14	3.70	3.20	19.00		
2000/01/14	0.53	3.00	2.00	11.00		
2000/01/20	0.37	3.00	2.00	11.00		
2000/01/27	0.01					Seepage
2000/02/03	0.02	6.00	5.00	19.00		
2000/02/10	0.91	7.00	5.00	11.00		
2000/02/17	5.40	3.00	2.00	13.00		
2000/02/22	0.76	2.40	1.90	15.00		
2000/03/01	0.67	4.00	2.00	11.00		
2000/03/09	4.06	2.40	2.00	13.00		
2000/03/16	2.93	2.00	1.50	14.00		
2000/03/23	2.19	2.00	1.50	14.00		
2000/03/30	1.79	2.00	1.50	13.00		
2000/04/04	2.10	2.10	1.50	12.00		
2000/04/11	2.05	1.90	1.40	12.50		
2000/04/19	1.59	2.00	1.40	13.00		
2000/04/27	1.24	2.10	1.40	10.00		
2000/05/03	1.41	1.80	1.30	12.00		
2000/05/09	2.53	3.00	1.70	13.00		
2000/05/17	1.25	2.20	1.60	13.00		
2000/05/30	0.76	1.90	1.20	12.00		
2000/06/27	0.26	2.00	1.00	6.00		
2000/07/06	0.20	2.00	1.00	4.00		
2000/07/20	0.00					Dry
2000/08/04	0.00					
2000/08/23	0.00					
2000/09/01	0.00					
2000/09/07	0.00					
2000/09/14	0.00					
2000/09/27	0.00					
2000/10/05	0.00					
2000/10/12	0.00					
2000/10/18	0.00					
2000/11/02	1.48	2.00				

HYDROGEOLOGICAL INFORMATION						
LEEUWPOORT 356 IQ						
SPRING FLOW MEASUREMENT						
SPRING NO 2 (TAR ROAD)						
Date	Flow, l/s	EC=WT	EC (25C)	Water	Remarks	
Spring 2		mS/m	mS/m	Temp.(C)		
2000/11/07	0.70	2.00				
2000/11/15	0.10					
2000/11/21	0.00					
2000/12/06	0.00					
2000/12/13	0.22	2.00				
2000/12/20	0.00				Dry	
2000/12/28	0.00				No flow was observed due to rain	
2001/01/25	0.00					
2001/01/30	0.00					
2001/02/14	0.00					
2001/02/23	0.00					
2001/03/07	0.00					
2001/04/04	0.00					
2001/04/11	0.00					
2001/05/10	0.00					
2001/06/06	0.00					
2001/06/20	0.00					
2001/06/28	0.00					
2001/07/26	0.00					
2001/08/16	0.00					
2001/08/31	0.00					
2001/09/18	0.00					
2001/09/30	0.00				DRy	
2001/11/30	0.15	4.30	3.10	1900/01/11		
2001/12/21	0.00				Dry	
2002/01/24	0.00					
2002/02/28	0.00					
2002/03/22	0.00					
2002/04/23	0.00					
2002/05/23	0.00					
2002/06/19	0.00					
2002/07/18	0.00					
2002/08/15	0.00					
2002/09/26	0.00					
2002/10/30	0.00					
2002/11/28	0.00					
2002/12/27	0.00					
2003/01/28	0.00					
2003/02/25	0.00					
2003/03/27	0.00					
2003/04/29	0.00					
2003/05/29	0.00					
2003/06/26	0.00					
2003/07/25	0.00					
2003/08/29	0.00					
2003/09/10	0.00					
2003/09/25	0.00					



Appendix 4

Spring No 3, spring flow and EC measurements

SPRING 3

**GEOHYDROLOGICAL INFORMATION (1 (SPRING FLOW & EC MEASUREMENTS)
LEEUWPOORT 356 IQ
SPRING 3 (TRENCHES)**

Date	Flow (l/s) (Volumetric)	EC (WT) mS/m	Water Temp (oC)	EC (25 oC) mS/m	Local R.Fall	REMARKS
1997/05/14						Dry
1997/05/21	0.20				-	Estimated flow
1997/05/29	0.37	4.10	14.00	3.60	-	-
1997/06/04	0.23	3.80	14.50	2.90	-	-
1997/06/12	0.41	3.70	16.00	3.00	-	-
1997/06/18	0.47	3.80	14.50	2.90	-	-
1997/06/26	0.41	3.60	15.50	3.00	-	-
1997/07/02	0.38	3.60	15.00	2.80	-	-
1997/07/10	0.37	3.30	16.00	2.70	-	-
1997/07/16	0.32	3.40	14.50	2.60	-	-
1997/07/23	0.31	3.40	16.50	2.80	-	-
1997/07/30	0.28	3.20	15.00	2.70	-	-
1997/08/06	0.27	3.40	14.00	2.60	-	-
1997/08/13	0.26	3.50	17.00	2.90	-	-
1997/08/21	0.26	3.30	18.00	2.80	-	-
1997/09/03	0.22	3.30	15.50	2.70	-	-
1997/09/09	0.25	5.00	15.00	5.70	-	-
1997/09/17	0.28	3.20	18.50	2.70	-	-
1997/09/23	0.26	3.50	17.50	2.90	-	-
1997/10/01	0.35	3.30	18.50	2.80	-	-
1997/10/08	0.21	3.20	17.50	2.70	-	-
1997/10/15	0.23	3.60	16.50	3.00	-	-
1997/10/22	0.19	3.20	17.50	2.70	-	-
1997/11/05	0.17	3.70	18.00	3.20	-	-
1997/11/12	0.12	3.40	18.00	2.90	-	-
1997/11/19	0.14	3.20	14.50	2.40	-	-
1997/11/26	0.13	3.30	16.50	2.70	-	-
1997/12/06	0.15	3.30	18.00	2.80	-	-
1997/12/10	0.12	3.40	19.50	2.90	-	-
1997/12/18	0.11	3.30	17.00	2.80	-	-
1997/12/23	0.11	3.50	17.50	2.90	-	-
1997/12/30	0.22	4.20	19.00	3.60	-	-
1998/01/07	0.64	3.80	18.00	3.30	-	-
1998/01/16	0.35	3.50	17.50	2.90	-	-
1998/01/21	0.44	3.30	19.00	2.80	-	-
1998/01/28	0.29	3.30	18.50	2.90	-	-
1998/02/05	0.23	3.30	18.50	2.80	-	-
1998/02/11	0.20	3.20	19.00	2.80	-	-
1998/02/19	0.33	3.20	17.50	2.80	-	-
1998/02/25	0.39	2.90	18.00	2.50	-	-
1998/03/04	0.36	2.90	18.50	2.50	-	-
1998/03/12	0.34	2.90	17.50	2.40	-	-
1998/03/18	0.33	2.70	18.50	2.40	-	-
1998/03/26	0.26	2.90	18.50	2.50	-	-
1998/04/02	0.25	2.70	18.00	2.30	-	-
1998/04/08	0.22	2.80	17.50	2.30	-	-
1998/04/15	0.19	2.80	17.00	2.30	-	-
1998/04/22	0.18	2.80	17.50	2.40	-	-
1998/04/29	0.14	2.80	16.50	2.30	-	-
1998/05/06	0.12	2.90	16.00	2.30	-	-
1998/05/13	0.08	2.90	23.00	2.20	-	-
1998/05/22	0.08	2.90	14.00	2.20	-	-

SPRING 3

GEOHYDROLOGICAL INFORMATION (SPRING FLOW & EC MEASUREMENTS)
 LEEUWPOORT 356 IQ
 SPRING 3 (TRENCHES)

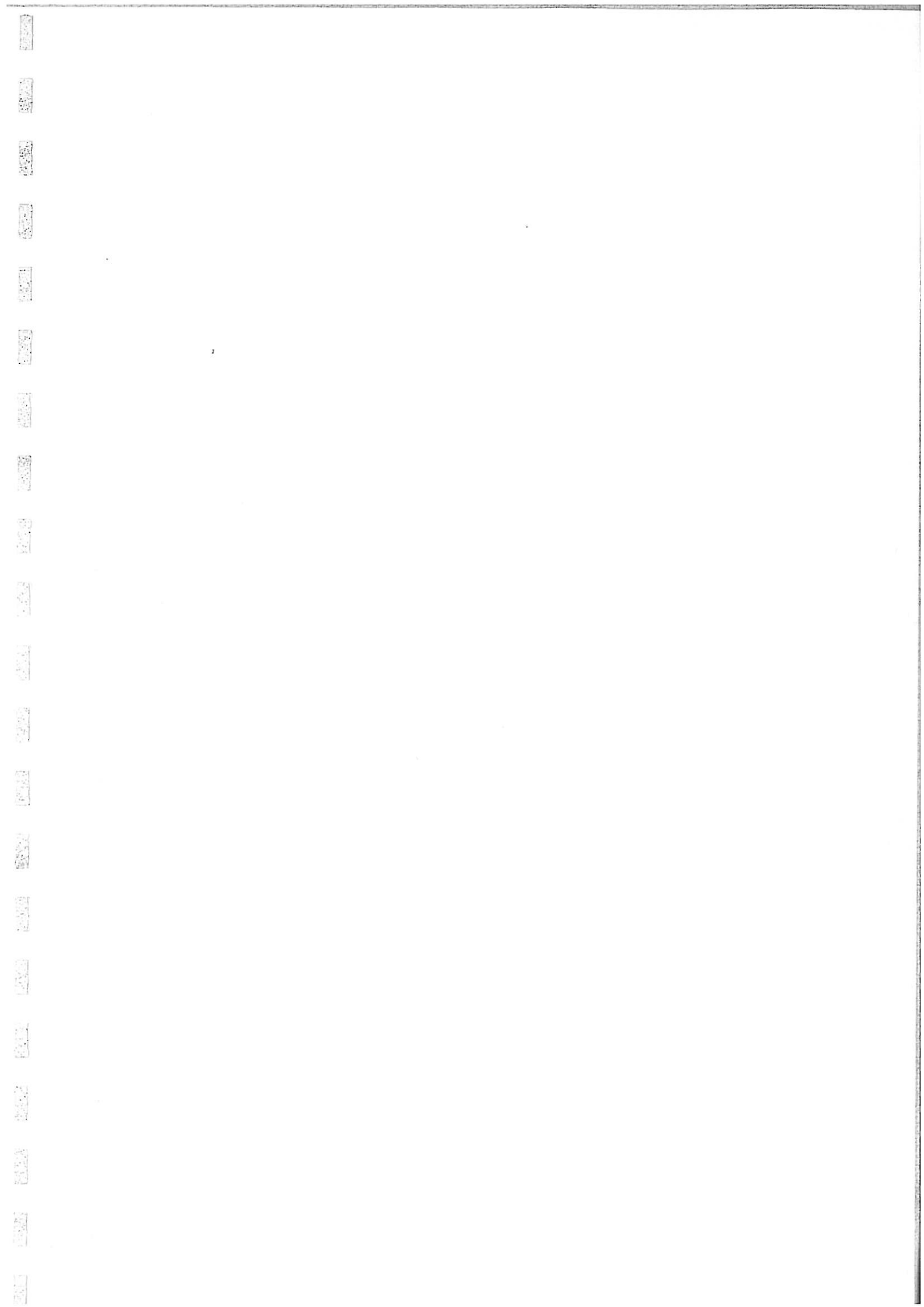
Date	Flow (l/s) (Volumetric)	EC (WT) mS/m	Water Temp (oC)	EC (25 oC) mS/m	Local R.Fall	REMARKS
1998/05/28	0.08	3.00	13.50	2.30	-	-
1998/06/03	0.06	2.80	10.50	2.10	-	-
1998/06/10	0.06	3.10	13.00	2.30	-	-
1998/06/17	0.04	3.20	10.50	2.30	-	-
1998/07/01	0.02	3.70	12.50	2.70	-	-
1998/07/08	0.02	4.10	9.00	2.70	-	-
1998/07/15	0.02	4.00	11.50	3.00	-	-
1998/07/21	0.02	4.10	9.00	2.80	-	-
1998/07/30	0.01	4.00	11.00	2.90	-	-
1998/08/06		4.00	11.50	2.90	-	Seepage
1998/08/12		-	-	-	-	Seepage
1998/08/19		-	-	-	-	Seepage
1998/09/02		-	-	-	-	Some moisture
1998/09/09		-	-	-	-	Some moisture
1998/09/16		-	-	-	-	-
1998/09/23		-	-	-	-	-
1998/09/30		-	-	-	-	-
1998/10/06		-	-	-	-	-
1998/10/16		-	-	-	-	-
1998/10/27		-	-	-	-	-
1998/11/06		-	-	-	-	-
1998/11/11		-	-	-	-	-
1998/11/26		-	-	-	-	-
1998/12/02	0.04	6.10	16.00	5.10		Rained in the area
1998/12/11	0.12	3.10	17.00	2.60	-	Rained in the area
1998/12/17	0.12	3.50	17.50	3.00	-	Rained in the area
1998/12/23	0.18	3.20	17.50	2.70	-	Rained in the area
1998/12/30	0.34	2.90	17.50	2.50	-	Rained in the area
1999/01/06	0.30	2.90	18.00	2.30	-	-
1999/01/14	0.31	2.70	18.50	2.30	-	-
1999/01/22	0.26	2.70	18.00	2.20	-	-
1999/02/10	0.37	2.60	18.50	2.50	-	-
1999/02/17	0.41	2.80	18.00	2.30	-	-
1999/02/23	0.23	2.70	18.50	2.50	-	-
1999/03/04	0.19	2.50	19.00	2.30	-	-
1999/03/11	0.15	2.60	18.00	2.10	-	-
1999/03/16	0.15	2.50	18.00	2.10	-	-
1999/03/25	0.13	2.50	18.00	2.20	-	-
1999/03/31	0.12	2.40	18.00	2.10	-	-
1999/04/08	0.07	2.70	19.00	2.30	-	-
1999/04/15					-	-
1999/04/22					-	-
1999/04/29					-	-
1999/05/06					-	-
1999/05/13					-	-
1999/05/20					-	-
1999/05/27					-	-
1999/06/03					-	-
1999/06/10						Dry
1999/06/17						
1999/06/24						

SPRING 3

Date	Flow (l/s) (Volumetric)	EC (WT) mS/m	Water Temp (oC)	EC (25 oC) mS/m	Local R.Fall	REMARKS
1996/06/30						
1999/07/07						
1999/07/14						
1999/07/23						
1999/07/29						
1999/08/04						
1999/08/12						
1999/08/24						
1999/09/01						
1999/09/08						
1999/09/22						
1999/09/29						
1999/10/07						
1999/10/11						
1999/10/20						
1999/10/27						
1999/11/04						
1999/11/11						
1999/11/17						
1999/11/25						
1999/12/02						
1999/12/08						
1999/12/15						
1999/12/22						
1999/12/30						Dry
2000/01/05	0.06	6.70	11.00	4.70		
2000/01/14	0.31	4.00	9.50	3.00		
2000/01/20	0.84	3.00	13.00	2.00		
2000/01/27	0.34	3.00	11.00	2.00		
2000/02/03	0.32	3.00	11.50	2.00		
2000/02/10	0.91	7.00	11.00	5.00		
2000/02/17	0.72	5.00	10.00	4.00		
2000/02/22	0.67	4.00	11.00	3.00		
2000/03/01	2.21	2.00	13.00	1.00		
2000/03/09	0.70	4.00	11.00	3.00		
2000/03/16	0.68	4.00	11.00	2.70		
2000/03/23	0.68	3.60	11.50	2.60		
2000/03/30	1.05	3.60	11.00	2.60		
2000/04/04	0.67	3.30	11.00	2.30		
2000/04/11	0.65	3.30	10.50	2.40		
2000/04/19	0.62	3.40	10.00	2.40		
2000/04/27	0.60	3.30	10.00	2.30		
2000/05/03	0.61	3.20	10.00	2.30		
2000/05/09	0.63	3.40	10.50	2.40		
2000/05/17	0.57	3.20	10.00	2.20		
2000/05/30	0.46	3.00	10.00	2.00		
2000/06/27	0.44	2.90	9.00	1.90		

SPRING 3

Date	Flow (l/s) (Volumetric)	EC (WT) mS/m	Water Temp (oC)	EC (25 oC) 2.00	Local R.Fall	REMARKS
2000/07/06	0.44	3.00	8.50	2.00		
2000/07/20	0.39	3.00	8.00	2.00		
2000/08/04	0.36	3.00	9.00	2.00		
2000/08/23	0.31	2.30	18.30			
2000/09/01	0.30	2.80	11.50	2.10		
2000/09/07	0.28	3.00	10.00	2.00		
2000/09/14	0.26	2.70	12.00	2.00		
2000/09/27	0.25	3.00	12.00	2.30		
2000/10/05	0.25	3.00	12.00	2.10		
2000/10/12	0.31	3.60	11.00	2.50		
2000/10/18	0.31	3.00	11.00	2.10		
2000/11/02	0.45	3.00	11.00	2.00		
2000/11/07	0.43	2.90	10.50	2.10		
2000/11/15	0.35	2.80	10.50	2.00		
2000/11/21	0.32	2.70	10.00	1.90		
2000/12/06	0.26	2.70	12.00	2.00		
2000/12/13	1.07	3.00	11.00	2.00		
2000/12/20					Rained, no	flow measurement
2000/12/28	0.27	3.00	14.00	2.30		
2001/01/25	0.32	5.50	10.50	3.90		
2001/01/30	0.16	2.70	12.00	2.00		
2001/02/14	0.13	2.70	11.50	1.70		
2001/02/23	0.10	3.10	11.00	2.30		
2001/03/07	0.09	2.80	13.00	2.10		
2001/04/04	0.22	5.50	11.00	6.00		
2001/04/11	0.61	2.80	11.00	1.90		
2001/05/10	0.10	3.00	9.00	3.00		
2001/06/06	0.03	2.70	7.00	1.80		
2001/06/20	0.01	2.50	8.00	1.60		
2001/06/28	0.01	3.00	8.00	2.00		0.003 l/s was measured
1905/06/23						Seepage
2006/07/26						Dry
2001/08/16						Dry
2001/08/31						Dry
2001/09/18						Dry
2001/09/30	0.01	7.80	11.00	5.70		0.014 l/s was measured
2001/12/21	0.01	3.00	12.00	2.00		0.0017 l/s was measured
2002/01/24	0.10	3.00	13.50	2.00		
2002/02/28	0.28	5.00	11.50	4.00		
2002/03/22	0.12	4.00	12.50	3.00		
2002/04/23	0.04	3.50	10.50	2.60		
2002/05/23						Dry
2002/06/19						Dry
2002/07/18						Dry
2002/08/15						Dry from this date to
2002/09/26						30/11/2006



Appendix 5

**V-notch, stream flow and EC measurements,
stream flow and rainfall**

STREAM

GEOHYDROLOGICAL INFORMATION
 LEEUWPOORT 356 IQ
 STREAM
 90 Deg. V-NOTCH

Date	Flow l/s	V-Notch H=m	EC (WT) (mS/m)	Water Temp °C	EC (25 °C) mS/m	Local R.Fall	REMARKS
1996/10/16	5.54	0.11	6.20	15.50	-	-	
1996/10/31	5.54	0.11	-	-	-	-	No EC measurement
1996/11/07	5.79	0.11	5.60	-	-	-	
1996/11/13	6.06	0.11	7.30	17.50	5.70	-	Rained on 12/11/96
1996/11/20	5.90	0.11	6.30	16.00	5.20	-	
1996/12/04	6.19	0.12	6.50	17.50	5.40	-	
1996/12/18	-	-	7.90	32.20	9.00	-	No flow measurement, water sample taken
1996/12/30	-	-	-	-	-	-	No flow and EC measurements
1997/01/08	-	-	7.20	18.50	5.90	-	No flow and EC measurements
1997/01/15	7.32	0.12	6.70	17.00	5.70	-	
1997/01/22	8.24	0.13	7.30	18.00	6.30	-	Rained on 20/01/1997
1997/01/29	7.85	0.13	6.60	17.50	5.50	-	
1997/02/04	7.03	0.12	6.70	18.00	5.60	-	
1997/02/12	76.85	0.32	4.30	18.50	3.60	-	
1997/02/19	7.85	0.13	6.60	18.00	5.60	-	
1997/02/26	7.58	0.13	6.50	18.00	5.60	-	
1997/03/19	11.71	0.15	6.70	17.00	5.70	-	
1997/03/26	12.92	0.15	6.70	17.00	5.50	-	
1997/04/16	11.43	0.15	7.00	15.00	5.50	-	
1997/04/21	11.43	0.15	6.80	15.50	5.40	-	
1997/04/30	11.71	0.15	6.70	13.50	5.10	-	
1997/05/07	12.20	0.15	6.90	15.00	5.40	-	
1997/05/14	11.32	0.15	6.60	13.00	5.00	-	
1997/05/21	12.23	0.15	6.60	14.00	5.10	-	
1997/05/29	22.00	0.19	7.10	11.00	5.30	-	
1997/06/04	19.23	0.18	7.50	10.50	5.40	-	
1997/06/12	18.50	0.18	6.80	12.50	5.10	-	
1997/06/18	17.00	0.17	6.40	11.50	4.60	-	
1997/06/25	17.00	0.17	6.30	12.00	4.50	-	
1997/07/02	15.73	0.17	6.80	11.50	4.80	-	
1997/07/10	15.56	0.17	6.10	13.50	4.60	-	
1997/07/16	15.73	0.17	6.00	11.00	4.30	-	
1997/07/23	15.56	0.17	7.00	12.50	5.10	-	
1997/07/30	14.65	0.16	6.10	13.50	4.60	-	
1997/08/06	14.35	0.16	6.00	11.50	4.30	-	
1997/08/13	14.20	0.16	6.10	13.50	4.60	-	
1997/08/21	13.91	0.16	6.50	15.00	5.20	-	
1997/09/03	13.34	0.16	6.30	15.00	4.90	-	
1997/09/09	36.50	0.23	6.00	15.50	4.80	-	
1997/09/17	14.20	0.16	5.90	15.50	4.80	-	
1997/09/23	13.05	0.16	6.00	16.00	4.90	-	
1997/10/01	13.48	0.16	6.20	17.00	5.20	-	
1997/10/08	11.71	0.15	6.40	16.50	5.30	-	
1997/10/15	14.20	0.16	6.20	16.00	5.10	-	Pumped from the spring No 1 prior to flow measurement
1997/10/22	12.92	0.15	6.30	17.00	5.30	-	
1997/11/05	10.20	0.14	6.50	18.00	5.60	-	No flow measurement due to pumping
1997/11/12	10.20	0.14	6.50	18.00	5.50	-	
1997/11/19	11.83	0.15	7.00	14.50	5.30	-	
1997/11/26	9.94	0.14	6.60	16.00	5.30	-	
1997/12/06	12.23	0.15	6.60	18.50	5.60	-	
1997/12/10	12.51	0.15	6.50	20.00	5.80	-	Increase in flow due to rain during second week of November
1997/12/18	12.64	0.15	6.50	17.00	5.50	-	

STREAM

GEOHYDROLOGICAL INFORMATION
 LEEUWPOORT 356 IQ
 STREAM
 90 Deg. V-NOTCH

Date	Flow l/s	V-Notch H=m	EC (WT) (mS/m)	Water Temp °C	EC (25 °C) mS/m	Local R.Fall	REMARKS
1997/12/23	11.43	0.15	6.80	17.50	5.60	-	-
1997/12/30	21.43	0.19	6.90	19.00	5.00	-	-
1998/01/07	15.96	0.17	5.80	18.00	5.10	-	-
1998/01/14	14.35	0.16	6.10	18.00	5.30	-	-
1998/01/21	14.35	0.16	6.20	19.00	5.50	-	-
1998/01/28	11.83	0.15	6.40	18.50	5.40	-	-
1998/02/05	12.64	0.15	6.10	18.50	5.20	-	-
1998/02/11	12.64	0.15	6.60	19.50	5.90	-	-
1998/02/19	16.03	0.17	6.20	16.50	5.10	-	-
1998/02/25	16.03	0.17	8.00	18.50	6.70	-	-
1998/03/04	15.26	0.17	5.90	18.50	5.10	-	-
1998/03/12	15.56	0.17	6.20	17.50	5.10	-	-
1998/03/18	15.00	0.16	5.80	17.50	4.90	-	-
1998/03/26	13.34	0.16	6.20	18.50	5.30	-	-
1998/04/02	13.19	0.16	6.20	18.00	5.20	-	-
1998/04/08	11.43	0.15	6.60	16.50	5.40	-	-
1998/04/15	12.64	0.15	6.20	15.50	5.00	-	-
1998/04/22	11.83	0.15	6.10	15.50	5.00	-	-
1998/04/29	11.32	0.15	6.30	15.00	5.00	-	-
1998/05/06	10.67	0.14	6.60	15.00	5.10	-	-
1998/05/13	10.56	0.14	6.50	13.00	4.80	-	-
1998/05/22	9.90	0.14	6.50	13.00	4.90	-	-
1998/05/28	10.56	0.14	6.50	13.00	5.00	-	-
1998/06/03	9.90	0.14	6.60	12.00	4.80	-	-
1998/06/10	10.94	0.14	6.50	13.50	4.80	-	-
1998/06/17	9.90	0.14	6.60	12.00	4.80	-	-
1998/07/01	9.24	0.14	6.60	12.50	5.00	-	-
1998/07/08	9.24	0.14	6.70	12.00	4.80	-	-
1998/07/15	8.90	0.13	6.30	13.00	4.70	-	-
1998/07/21	9.24	0.14	6.50	13.50	4.90	-	-
1998/07/30	8.81	0.13	5.80	8.50	4.90	-	-
1998/08/06	9.15	0.13	6.70	14.00	5.10	-	-
1998/08/12	8.90	0.13	6.30	14.00	4.90	-	-
1998/08/19	10.67	0.14	6.20	15.50	5.10	-	-
1998/09/02	9.49	0.14	6.50	15.00	5.20	-	-
1998/09/09	8.17	0.13	6.50	15.50	5.10	-	-
1998/09/16	8.17	0.13	6.50	15.50	5.20	-	-
1998/09/23	8.49	0.13	6.50	17.00	5.40	-	-
1998/09/30	8.24	0.13	6.30	17.50	5.20	-	-
1998/10/06	7.25	0.12	6.40	17.50	5.40	-	-
1998/10/14	8.90	0.13	6.50	17.00	5.40	-	-
1998/10/27	7.62	0.13	6.70	17.00	5.60	-	-
1998/11/04	9.84	0.14	6.30	18.00	5.40	-	-
1998/11/11	7.62	0.13	7.00	18.00	5.90	-	Increase in flow due to removing grass and wood at the V-notch
1998/11/19	-	-	6.60	17.00	5.40	-	-
1998/11/26	-	-	6.70	19.50	5.80	-	Flow diverted into the pipe beneath the V-notch, no flow measurement
1998/12/02	14.35	0.16	6.30	16.50	5.20	-	Flow diverted into the pipe beneath the V-notch, no flow measurement
1998/12/11	10.20	0.14	6.70	17.50	5.30	-	Muddy due to local rain
1998/12/17	9.59	0.14	6.40	18.50	5.50	-	-
1998/12/23	10.20	0.14	6.30	18.00	5.30	-	-
1998/12/30	14.35	0.16	6.10	17.50	5.10	-	High flow due to early morning rain
1999/01/06	12.20	0.15	6.10	19.00	5.30	-	-
1999/01/14	17.00	0.17	6.10	19.00	5.30	-	-
1999/01/22	14.35	0.16	6.20	19.00	5.40	-	-

STREAM

GEOHYDROLOGICAL INFORMATION
 LEEUWPOORT 356 IQ
 STREAM
 90 Deg. V-NOTCH

Date	Flow l/s	V-Notch H=m	EC (WT) (mS/m)	Water Temp °C	EC (25 °C) mS/m	Local R/Fall	REMARKS
1999/02/10	11.83	0.15	6.70	19.50	5.70	-	-
1999/02/17	11.32	0.15	6.60	18.50	5.40	-	-
1999/02/23	11.43	0.15	6.70	19.00	5.70	-	-
1999/03/04	10.30	0.14	6.50	19.00	5.60	-	-
1999/03/11	10.56	0.14	6.60	18.00	5.70	-	-
1999/03/16	12.51	0.15	5.50	18.00	6.50	-	-
1999/03/25	9.30	0.14	6.60	18.00	5.70	-	-
1999/03/31	9.59	0.14	6.20	18.00	5.30	-	-
1999/04/08	8.25	0.13	6.40	18.00	5.40	-	-
1999/04/15	8.17	0.13	6.30	18.00	5.50	-	-
1999/04/22	8.17	0.13	6.30	18.00	5.40	-	-
1999/04/29	8.17	0.13	6.20	18.00	5.30	-	-
1999/05/06	8.49	0.13	6.50	15.00	5.10	-	-
1999/05/12	7.85	0.13	6.70	14.00	5.10	-	-
1999/05/20	8.90	0.13	6.50	15.00	5.10	-	-
1999/05/26	8.57	0.13	6.60	14.00	5.00	-	-
1999/06/03	7.62	0.13	6.50	14.00	5.00	-	-
1999/06/10	6.30	0.13	6.30	13.00	4.80	-	-
1999/06/17	6.40	0.13	6.40	13.00	4.80	-	-
1999/06/24	10.94	0.14	6.50	14.00	4.90	-	High flow reading due to opening blocked V-notch
1999/06/30	7.03	0.12	6.30	12.00	4.60	-	-
1999/07/07	7.85	0.13	7.40	9.00	4.90	-	-
1999/07/14	7.93	0.13	6.55	13.00	4.95	-	-
1999/07/23	7.32	0.12	6.60	14.00	5.10	-	-
1999/07/29	7.55	0.12	6.40	13.50	4.80	-	-
1999/08/04	8.25	0.13	6.20	13.00	4.70	-	-
1999/08/12	7.25	0.12	6.20	15.00	4.90	-	-
1999/08/24	7.25	0.12	6.50	11.00	4.60	-	-
1999/09/01	6.67	0.12	6.50	12.00	4.70	-	-
1999/09/08	6.96	0.12	6.90	15.00	5.40	-	-
1999/09/22	6.96	0.12	9.10	9.50	6.00	-	-
1999/09/29	7.93	0.13	7.60	7.00	4.80	-	High flow due to local rain
1999/10/07	6.74	0.12	7.70	10.50	5.50	-	-
1999/10/11	6.46	0.12	7.70	10.50	5.60	-	-
1999/10/20	6.46	0.12	7.60	9.00	5.20	-	-
1999/10/27	6.19	0.12				-	No EC measurement
1999/11/04	6.19	0.12				-	No Ec measurement
1999/11/11	6.40	0.12				-	No Ec Measurement
1999/11/17	6.67	0.12	7.80	12.00	5.70	-	-
1999/11/25	6.67	0.12	4.60	11.00	3.20	-	-
1999/12/02	6.40	0.12	7.00	12.00	5.00	-	-
1999/12/08	6.40	0.12	7.00	15.00	5.00	-	-
1999/12/15	7.25	0.12	7.00	12.50	6.00	-	-
1999/12/22	6.96	0.12	7.00	11.00	5.00	-	-
1999/12/30	7.85	0.13	7.00	13.00	5.00	-	-
2000/01/05	9.60	0.14	7.00	12.00	5.00	-	-
2000/01/14	76.85	0.32	8.00	10.00	5.50	-	Over flowing due to heavy rain
2000/01/20	11.32	0.15	7.00	12.00	5.00	-	-
2000/01/27	11.05	0.15	7.00	12.50	5.00	-	-
2000/02/03	11.71	0.15	7.00	12.00	5.00	-	-
2000/02/10	76.85	0.32	4.00	12.00	3.00	-	Over flowing due to heavy rain
2000/02/17	29.20	0.21	7.00	11.00	5.00	-	-
2000/02/22	21.75	0.19	8.00	13.00	6.00	-	-
2000/03/01	18.19	0.18	8.00	12.00	6.00	-	-
2000/03/09	21.75	0.19	8.00	12.00	6.00	-	-
2000/03/16	19.77	0.18	7.00	13.00	5.00	-	Water sample, RW-1(14:00)
2000/03/23	19.77	0.18	7.00	12.00	5.00	-	-
2000/03/30	20.63	0.19	7.00	12.00	5.00	-	-
2000/04/04	23.49	0.20	7.00	10.00	5.00	-	Rained early morning
2000/04/11	18.70	0.18	7.00	8.00	4.00	-	-

STREAM

Date	Flow l/s	V-Notch H=m	EC (WT) (mS/m)	Water Temp °C	EC (25 °C) mS/m	Local R.F.all	REMARKS
2000/04/19	20.87	0.19	7.00	9.00	5.00		Rained on 17/04/2000
2000/04/27	18.50	0.18	7.00	9.00	4.70		
2000/05/03	26.60	0.21	7.40	8.00	4.70		Rained on 2/5/2000
2000/05/09	19.23	0.18	6.80	8.00	4.50		
2000/05/17	19.23	0.81	6.90	7.00	4.40		
2000/05/30	18.50	0.18	6.80	6.00	4.30		
2000/06/27	16.20	0.17	6.00	10.00	4.00		
2000/07/06	16.03	0.17	7.00	6.00	4.00		
2000/07/20	15.56	0.17	7.00	5.00	4.00		
2000/08/04	14.80	0.16	7.00	7.00	4.00		
2000/08/23	14.35	0.16	6.35	16.60			
2000/09/01	12.20	0.15	7.50	8.00	4.80		
2000/09/07	12.92	0.15	7.60	8.00	4.90		
2000/09/14	12.92	0.15	7.40	10.00	5.00		
2000/09/27	12.63	0.15	7.00	9.00	5.00		
2000/10/05	13.05	0.16	6.80	12.00	5.00		
2000/10/12	21.19	0.19	7.00	9.00	5.00		
2000/10/18	13.34	0.16	7.20	10.50	5.10		
2000/11/02	15.56	0.17	6.70	11.00	4.50		
2000/11/07	14.20	0.16	7.10	10.00	4.90		
2000/11/15	12.64	0.15	7.50	11.00	5.40		
2000/11/21	12.64	0.15	7.10	11.50	5.00		
2000/12/06	12.20	0.15	6.60	14.00	5.10		
2000/12/13	13.48	0.16	7.00	12.00	5.00		
2000/12/20	12.92	0.15	7.50	10.00	5.20		
2000/12/28	13.77	0.16	6.90	14.00	5.10		
2001/01/25	10.67	0.14	7.50	12.00	5.50		
2001/01/30	9.59	0.14	7.30	13.00	5.50		
2001/02/14	9.49	0.14	7.70	12.00	5.70		
2001/02/23	9.15	0.13	7.50	12.00	5.40		
2001/03/07	9.24	0.14	7.50	12.00	5.40		
2001/04/04	9.24	0.14	7.20	10.50	5.20		
2001/04/11	9.15	0.13	7.40	10.00	5.10		
2001/05/10	5.70	0.13	8.00	8.00	5.00		
2001/06/06	8.60	0.13	8.00	7.00	5.00		
2001/06/20	9.94	0.14	7.00	5.00	5.00		
2001/06/28	5.50	0.14	7.30	5.50	4.50		
2001/07/26	9.15	0.13	8.00	5.50	4.00		
2001/08/16	6.96	0.12	8.00	6.00	5.00		
2001/08/31	7.62	0.13	8.00	7.50	5.00		
2001/09/18	7.25	0.12	7.30	9.00	4.80		
2001/09/30	7.62	0.13	7.10	12.00	5.30		
2001/11/30	10.03	0.14	7.00	12.00	5.00		
2001/12/21	8.81	0.13	6.50	12.00	5.00		
2002/01/24	7.93	0.13	7.00	14.00	5.40		
2002/02/28	8.87		7.00	12.00	5.00		Volumetric measurement
2002/03/22	9.00		8.00	10.50	6.00		Volumetric measurement
2002/04/23	9.20		6.90	9.00	4.70		Volumetric measurement
2002/05/23	7.41		8.00	8.00	5.11		Volumetric measurement
2002/06/19	7.00		7.10	7.00	4.50		Volumetric measurement
2002/07/18	7.20		7.00	5.00	4.00		Volumetric measurement
2002/08/15	7.60		7.00	8.00	4.00		Volumetric measurement
2002/09/26	5.56		7.00	10.50	5.00		Volumetric measurement
2002/10/30	5.13		7.00	10.50	5.00		Volumetric measurement
2002/11/28	5.96						Volumetric measurement, no EC measurement
2002/12/27	4.64		4.70	15.00	5.20		Volumetric measurement
2003/01/28	6.29		7.00	12.00	5.00		Volumetric measurement
2003/02/25	5.63		7.00	13.00	5.00		Volumetric measurement
2003/03/27	8.49	0.13	7.00	10.50	5.00		
2003/04/29	6.20	0.15	7.20	10.00	4.90		
2003/05/29	4.21	0.98	7.00	6.00	4.00		
2003/06/26	4.70	0.10	8.00	5.00	4.00		
2003/07/25	4.00	0.10	9.00	5.00	5.00		
2003/08/29	6.96	0.12	7.00	4.00	4.00		
2003/09/10	4.43	0.10	7.00	7.50	5.00		
2003/09/25	2.87	0.08	6.00	12.00	5.00		

GEOHYDROLOGICAL INFORMATION

LEEUWPOORT 356 IQ

STREAM (90° V-NOTCH)

Date	Average flow (l/s)	Rainfall (mm)	REMARKS
1996/10	5.54	90.5	
1996/11	5.917	1.2	
1996/12	6.19	121.5	
1997/01	7.803	133	
1997/02	24.827	105.5	
1997/03	12.315	242	
1997/04	11.52	41.5	
1997/05	14.43	71	
1997/06	17.933	0	
1997/07	15.446	2.5	
1997/08	14.153	9	
1997/09	19.273	60.5	
1997/10	13.078	37	
1997/11	10.543	121	
1997/12	14.048	106	
1998/01	14.123	124	
1998/02	14.335	123	
1998/03	14.79	69	
1998/04	12.082	6	
1998/05	10.423	0	
1998/06	10.247	0	
1998/07	9.086	0	
1998/08	9.573	0	
1998/09	8.512	19	
1998/10	7.923	83.5	
1998/11	8.73	131.5	
1998/12	11.738	178	
1999/01	14.517	121.5	
1999/02	11.575	65	
1999/03	10.452	28	
1999/04	8.19	45	
1999/05	8.453	40	
1999/06	7.658	4	
1999/07	7.663	0	
1999/08	7.583	0	
1999/09	7.13	13	
1999/10	6.463	22.5	
1999/11	6.483	101.5	
1999/12	6.972	248	
2000/01	27.205	204	
2000/02	34.878	202	
2000/03	20.022	212.5	
2000/04	20.39	68.5	
2000/05	20.89	44	
2000/06	16.2	11.5	
2000/07	15.795	0	
2000/08	14.575	0	
2000/09	12.668	37.5	
2000/10	15.86	153	
2000/11	13.76	36	

2000/12	13.093	126.5	
2001/01	10.13	114.5	
2001/02	9.32	51.5	
2001/03	9.24	79.5	
2001/04	9.195	29	
2001/05	5.7	37	
2001/06	80.013	115	
2001/07	9.15	0	
2001/08	7.29	0	
2001/09	7.435	29	
2002/01	7.93	167	
2002/02	8.87	176.5	
2002/03	9	25	
2002/04	9.2	2	
2002/05	7.41	67	
2002/06	7	15.5	
2002/07	7.2	0	
2002/08	7.6	25	
2002/09	5.56	10	
2002/10	5.13	45	
2002/11	5.96	10.5	
2002/12	4.64	127	
2003/01	6.29	123.5	
2003/02	5.63	67.5	
2003/03	8.49	68	
2003/04	6.2	0	
2003/05	4.21	23	
2003/06	4.7	0	
2003/07	4	0	
2003/08	6.96	11	
2003/09	3.65	18	
2003/10	3.05	60	
2003/11	2.975	55.5	
2003/12	2.42	42.5	
2004/01	2.55	100.5	
2004/02	4.43	166	
2004/03	6.74	170	
2004/05	11.35	0	
2004/06	4.21	12	
2004/07	3.84	0	
2004/08	5.12	24	
2004/09	3.22	0	
2004/10	2.87	13	
2004/11	2.58	59	
2004/12	3.1	141	
2005/01	3.45	0	
2005/02	4.31	31	
2005/03	4.56	78	
2005/04	5.36	73	
2005/05	5.67	12	
2005/06	4.88	0	
2005/07	4.7	0	
2005/08	4.88	0	
2005/09	3.41	0	
2005/10	2.91	12	
2005/11	3.26	8.5	

2005/12	2.74	91.5	
2006/01	5.86	0	
2006/03	7.47	0	
2006/04	6.94	0	
2006/05	5.67	0	

Appendix 6

Chemical and microbiological data

Appendix 6.1

Spring No 1 (SP-1, LTS1, LT-Spring)

Appendix 6.2

Spring No 2 (SP-2)

Appendix 6.3

Spring No 3 (SP-3, LTS3)

Appendix 6.4

Rain water (RW-1, RW-2)

Appendix 6.5

Stream water (LT-Spruit, stream flow, base flow)

Appendix 6.6

Private and mine boreholes (Refers to Maps 4 & 5 and Table 1)

M1- Mine borehole

M2- Mine borehole (LT3)

LT1-Borehole 1 (Private)

LT2-Borehole 2 (LT5, Private, Leeuwpoort wind pump)

LT5-Borehole 5, LT6-Borehole 6, LT8-Borehole 8 and

LT10-Borehole 10 (Private)

Appendix 6.1

Spring No 1 (SP-1, LTS1, LT-spring)

SOURCE ID : SAMPLE
 SAMPLING METHOD: GRAB WATER SAMPLE

SAMPLING DATE : 17-JAN-96/12:10:00

REFERENCE NO : IWQS 190
 PRESERVATIVE : HgCl2

VARIABLE: PH
 CODE: 0001101
 UNIT: mg/l
 RESULT: 7.2 <

VARIABLE: NH4 - N
 CODE: 0007106
 UNIT: mg/l
 RESULT: 0.04 <

VARIABLE: ND3*NO2-N
 CODE: 0007107
 UNIT: mg/l
 RESULT: 0.27 <

VARIABLE: F
 CODE: 0009101
 UNIT: mg/l
 RESULT: 0.1 <

VARIABLE: IAL AS CaCO3
 CODE: 0010101
 UNIT: mg/l
 RESULT: 34 <

VARIABLE: NA
 CODE: 0011101
 UNIT: mg/l
 RESULT: 2

VARIABLE: MG
 CODE: 0012101
 UNIT: mg/l
 RESULT: 4

VARIABLE: SI
 CODE: 0014105
 UNIT: mg/l
 RESULT: 5.7

VARIABLE: SO4
 CODE: 0016104
 UNIT: mg/l
 RESULT: 4 <

VARIABLE: CL
 CODE: 0017104
 UNIT: mg/l
 RESULT: 3 <

VARIABLE: K
 CODE: 0019101
 UNIT: mg/l
 RESULT: 1.3 <

VARIABLE: CA
 CODE: 0020101
 UNIT: mg/l
 RESULT: 6 <

VARIABLE: EC
 CODE: 0101101
 UNIT: mS/m
 RESULT: 8.8 <

VARIABLE: IDS
 CODE: 0103101
 UNIT: mg/l
 RESULT: 60 <

F04 - F
 0015104
 mg/l
 0.009

Spring No1

HRI - ANALYSIS REPORT

DATE: 03-FEB-96

SOURCE ID: SFOOR12
 SAMPLING METHOD: GRAB WATER SAMPLE
 SAMPLING DATE: 17-JAN-96/12:10:00
 REFERENCE NO.: IWOS-190
 PRESERVATIVE: Unpreserved

VARIABLE:	AL	U	CR	MIN	FE	NI	CU	ZN
CODE:	0015106	0025106	0024106	0025106	0026106	0028106	0029106	0030106
UNIT:	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT:	< 0.020	< 0.003	< 0.003	< 0.001	< 0.003	< 0.004	< 0.004	< 0.003

VARIABLE:	AS	MO	BA	PB
CODE:	0037106	0042106	0056106	0087106
UNIT:	mg/l	mg/l	mg/l	mg/l
RESULT:	< 0.050	< 0.006	0.015	0.020

Spring No1

HRI - ANALYSIS REPORT

DATE: 21-FEB-96

SOURCE ID : SAMPLE
 SAMPLING METHOD: GRAB WATER SAMPLE

SAMPLING DATE : 24-JAN-96/09:10:00

REFERENCE NO : IWQS 298
 PRESERVATIVE : HgCl2

VARIABLE:	PH	NH4 - N	NO3+NO2-N	F	IAL AS CaCO3	NA	MG	SI	PO4 - P
CODE :	0001101	0007106	0007107	0009101	0010101	0011101	0012101	0014105	0015104
UNIT :		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT :	7.4 <	0.04	0.32	0.1	4.6	2	5	5.3	0.016

VARIABLE:	SO4	CL	K	CA	EC	IDS
CODE :	0016104	0017104	0019101	0020101	0101101	0103101
UNIT :	mg/l	mg/l	mg/l	mg/l	ms/m	mg/l
RESULT :	< 4	3	0.8	8	11.1	79

Spring flow via PVC pipe into
 the main pool of spring No 1.

HRI - ANALYSIS REPORT

DATE: 21-FEB-96
 REFERENCE NO: IWQS 295
 PRESERVATIVE: HgC12

SOURCE ID: SAMPLE GRAB WATER SAMPLE
 SAMPLING METHOD: GRAB WATER SAMPLE
 SAMPLING DATE: 24-JAN-96/13:15:00

VARIABLE:	PH	NH4 - N	NO3+NO2-N	F	IAL AS CAC03	NA	MG	SI	PO4 - P
CODE:	0001101	0007106	0007107	0009101	0010101	0011101	0012101	0014105	0015104
UNIT:		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT:	7.1	< 0.04	0.31	0.1	32	2	3	5.6	0.012
VARIABLE:	SD4	CL	K	CA	EC	IDS			
CODE:	0016104	0017104	0019101	0020101	0101101	0103101			
UNIT:	mg/l	mg/l	mg/l	mg/l	mS/m	mg/l			
RESULT:	< 4	3	0.9	5	8.8	56			

Spring flow at the base of
 the main pool of Spring No 1.

SOURCE ID: SAMPLE GRAB WATER SAMPLE
 SAMPLING METHOD: GRAB WATER SAMPLE
 SAMPLING DATE: 25-JAN-96/13:00:00

VARIABLE:	PH	NH4 - N	NO3+NO2-N	F	IAL AS CAC03	NA	MG	SI	PO4 - P
CODE:	0001101	0007106	0007107	0009101	0010101	0011101	0012101	0014105	0015104
UNIT:		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT:	7.9	< 0.04	0.58	0.1	35	3	6	6.5	0.016
VARIABLE:	SD4	CL	K	CA	EC	IDS			
CODE:	0016104	0017104	0019101	0020101	0101101	0103101			
UNIT:	mg/l	mg/l	mg/l	mg/l	mS/m	mg/l			
RESULT:	12	5	1.2	8	12.5	79			

Spring No1

**DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES**

ANALYSIS REPORT

Project title: AD HOC SAMPLES
Project id: ADHOCK

Report no. 275
Date sample Rec.: 15-JUL-97

Major inorganic determinands

Sample id: 97351234
Sample source id: SAMPLE
Sample date: 02-JUL-97
Preservative: HgCl2

Reference: 3-(SPRING)
Time: 10:55:00
Sampling depth:
Sample desc: WATER

Spring No1

Determinand code	Determinand	Detection limit	Result	Unit
0001101	pH	2	6.8	
0007106	NH4 - N	.04	< 0.04	mg/l
0007107	NO3 + NO2-N	.04	0.34	mg/l
0009101	F	.1	0.1	mg/l
0010101	TAL as CaCO3	4	40	mg/l
0011103	Na	2	3	mg/l
0012101	Mg	1	5	mg/l
0014105	Si	.4	6.4	mg/l
0015104	PO4 - P	.005	0.007	mg/l
0016104	SO4	4	5	mg/l
0017104	Cl	3	< 3	mg/l
0019103	K	.3	0.3	mg/l
0020101	Ca	1	8	mg/l
0101101	EC	1	9.6	mS/m
0103101	TDS	1	74	mg/l

Client name: MR. FAYAZI
Client address: PRIVATE BAG X 8007
HENNOPSMEER 0046
FAX 6722885

Client identification no: FAYA
Contact person: MR. FAYAZI

Phone no: 672 2900
Fax no:

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

Test report no. 00/279

Programme title:	AD HOC SAMPLES	Reference:	SP-1
Sample id:	00634451	Time:	10:00:00 14:15
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	16-MAR-2000	Sample desc:	WATER
Sample received:	05-APR-2000	Preservative:	HgCl ₂
Date finalised:	25-MAY-2000		

Method number	Determinand	Detection limit	Result
0001101	pH	2	7.6 pH units
0007003	Kjeldahl nitrogen as N	0.04	0.17 mg/l
0007106	Ammonium as N	0.04	< 0.04 mg/l
0007107	Nitrate + nitrite as N	0.04	0.36 mg/l
0009101	Fluoride as F	0.1	0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	39 mg/l
0011103	Sodium as Na	2	3 mg/l
0012101	Magnesium as Mg	1	5 mg/l
0014105	Silicon as Si	0.4	6.0 mg/l
0015003	Total phosphate as P	0.005	0.006 mg/l
0015104	Ortho phosphate as P	0.005	0.005 mg/l
0016104	Sulphate as SO ₄	4	< 4 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	0.4 mg/l
0020101	Calcium as Ca	1	8 mg/l
0101101	Electrical Conductivity (25 C)	1	10.6 mS/m
0103101	TDS	1	71 mg/l

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

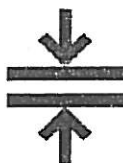
Test report no. 01/831

Programme title:	AD HOC SAMPLES	Reference:	LTS-1
Sample id:	01611963	Time:	09:30:00
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	30-JAN-2001	Sample desc:	WATER
Sample received:	31-JAN-2001	Preservative:	HgCl2
Date finalised:	21-FEB-2001		

Method number	Determinand	Detection limit	Result
0001101	pH	2	6.8 pH units
0007003	Kjeldahl nitrogen as N	0.04	0.47 mg/l
0007106	Ammonium as N	0.04	< 0.04 mg/l
0007107	Nitrate + nitrite as N	0.04	0.15 mg/l
0009101	Fluoride as F	0.1	< 0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	37 mg/l
0011103	Sodium as Na	2	3 mg/l
0012101	Magnesium as Mg	1	4 mg/l
0014105	Silicon as Si	0.4	4.8 mg/l
0015003	Total phosphorus as P	0.005	0.011 mg/l
0015104	Ortho phosphate as P	0.005	0.006 mg/l
0016104	Sulphate as SO4	4	6 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	0.4 mg/l
0020101	Calcium as Ca	1	7 mg/l
0101101	Electrical Conductivity (25 C)	1	9.0 mS/m
0103101	TDS	1	71 mg/l



SANAS



T0082

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Laboratory Services

P.O.Box 13106
NORKEM PARK
1631

Certificate of analysis

Client:	Department of Water Affairs, M. Fayazi	No:	2002/06/20
Address:	Private Bag X995, PRETORIA, 0001	Tel No:	012-392-1382
Date Sampled:	28/05/2002	Date certificate completed:	11/06/2002
Date Sample received:	28/05/2002	Date Analysed:	29/05-06/06/2002

Sample description: Water

Analysis results

<u>Sample no.</u>	<u>ERWAT no.</u>	<u>Container description</u>
[1] LT-2 11:45	02EX05/29/072	2L Plastic Bottle / 250ml Sterilised Glass Bottle
[2] LT-3 12:15 M2	02EX05/29/073	2L Plastic Bottle / 250ml Sterilised Glass Bottle
[3] LT-Spruit 12:40 (V-notch)	02EX05/29/074	2L Plastic Bottle
[4] X LT-Spring 12:30 Spring No1	02EX05/29/075	2L Plastic Bottle

CHEMICAL ANALYSIS

<u>DETERMINAND</u>	<u>Sample No.1</u>	<u>Sample No.2</u>	<u>Sample No.3</u>	<u>Sample No.4</u>
Conductivity (mS/m)	7	7	7	8
Total Dissolved Solids (mg/L)	28	44	56	72
Total Alkalinity (mg/L CaCO ₃)	25	23	25	31
Chloride (mg/L Cl ⁻)	<3	<3	<3	<3
Fluoride (mg/L F ⁻)	<0.1	<0.1	<0.1	<0.1
Calcium (mg/L Ca)	2.5	3.0	3.4	4.7
Magnesium (mg/L Mg)	3.2	2.2	3.0	3.1
Potassium (mg/L K)	0.6	1.0	0.4	0.3
Sodium (mg/L Na)	2.2	1.9	2.6	2.0
Ammonia Nitrogen (mg/L N)	<0.1	<0.1	<0.1	<0.1
Nitrate Nitrogen (mg/L N)	0.2	0.4	0.6	0.7
Orthophosphate (mg/L P)	0.1	<0.1	0.1	0.1
pH	6.4	6.5	6.9	6.7
Sulphate (mg/L SO ₄)	<10	<10	<10	<10

MICROBIOLOGICAL ANALYSIS

<u>DETERMINAND</u>	<u>Sample No.1</u>	<u>Sample No.2</u>
E.coli (cfu/100ml)	1	0
Faecal Coliforms (cfu/100ml)	1	0
Total Coliforms (cfu/100ml)	5	0
Heterotrophic Plate Count (cfu/1ml)	133	2140
*Faecal Streptococcus (cfu/1ml)	7	0

*Not "SANAS" Accredited

Signed :

Alison Chapman, Laboratory Manager

Date : 11/06/2002

Page 1 of 2

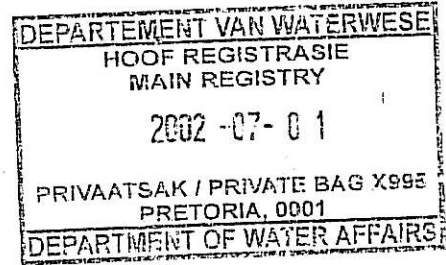
*Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Accreditation Schedule for our laboratory.

All results and information relating will be treated in a confidential manner. The results relate only to samples tested according to the clients request. This certificate shall not be reproduced except in full without the written approval of the Executive Manager, Erwat Laboratory Services.



East Rand Water Care Company (Association incorporated in terms of Section 21) Reg. No. 1992/005753/06
Bapsfontein Road, Kempton Park, ☎ 13106, Norkem Park 1631, Republic of South Africa
☎ +27 11 929-7000 ☎ +27 11 929-7031 e-mail: mail@erwat.co.za, website: www.erwat.co.za

Department of Water Affairs
Private Bag X995
PRETORIA
0001



Attention : M Fayazi

26 June 2002

Dear Sir

CERTIFICATE OF ANALYSIS

We enclose our certificate of analysis No. 2002/06/20 for the analysis of sample/s submitted to our laboratories on 28 May 2002.

Sub-contract / Referral results:

Sample name	ERWAT no.	Silica (mg/L Si)
LT-2 11:45	02EX05/29/072	5.7
LT-3 12:15 M2	02EX05/29/073	5.0
LT-Spruit 12:40 (V-notch)	02EX05/29/074	5.7
X LT-Spring 12:30 Spring No1	02EX05/29/075	6.7

Should you have any queries regarding the above please do not hesitate to contact the undersigned.

Yours faithfully

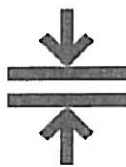
ALISON CHAPMAN
Laboratory Manager

Directors : Ms.M.M. Twala (Chairman); N.P. Twala (Managing Director); M.G.H. Akoon;
E.V. Magerman; Ms. N. Dube; T.J. Molla; Ms. S.C. Marx

Member of:
International Water Association (IWA)
Water Environment Federation (WEF)
Water Institute of Southern Africa (WISA) - Patron



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Laboratory Services

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1631

Certificate of analysis

Client:	Department of Water Affairs, M. Fayazi	No:	2003/09/111
Address:	Private Bag X995, PRETORIA, 0001	Tel No:	012-392-1382
Date Sampled:	10/09/2003	Date certificate completed:	17/09/2003
Date Sample received:	11/09/2003	Date Analysed:	11-16/09/2003
Sample description:	Water		

Analysis results

Sample no.	ERWAT no.	Container description
[1] X Spring no1 12H30	03EX09/11/090	2L Plastic Bottle / 500ml Sterilized Glass Bottle
[2] Leccupoort Windpump 12H55	03EX09/11/091	2L Plastic Bottle / 500ml Sterilized Glass Bottle
[3] Leccupoort V-Notch 12H10	03EX09/11/092	2L Plastic Bottle / 500ml Sterilized Glass Bottle
[4] QC		

CHEMICAL ANALYSIS

DETERMINAND	Sample No.1	Sample No.2	Sample No.3	Sample No.4
Conductivity (mS/m)	8	7	6	17
Total Dissolved Solids (mg/L)	76	54	30	302
Total Alkalinity (mg/L CaCO ₃)	27	24	23	496
Chloride (mg/L Cl)	<3	<3	<3	97
Fluoride (mg/L F)	0.1	0.1	0.1	0.4
Calcium (mg/L Ca)	5.2	2.2	3.5	30.5
Magnesium (mg/L Mg)	3.2	3.1	3.0	20.0
Potassium (mg/L K)	0.4	0.5	0.5	10.1
Sodium (mg/L Na)	5.6	5.8	6.5	39.1
Cadmium (mg/L Cd)	<0.04	<0.04	<0.04	1.01
Chromium (mg/L Cr)	0.03	1.23	<0.03	0.96
Copper (mg/L Cu)	<0.03	<0.03	<0.03	0.99
Lead (mg/L Pb)	0.13	0.13	0.16	1.05
Manganese (mg/L Mn)	0.04	0.12	0.04	0.96
Nickel (mg/L Ni)	<0.06	0.56	<0.06	1.02
Zinc (mg/L Zn)	0.09	0.06	0.06	1.01
Aluminium (mg/L Al)	0.1	0.2	0.1	0.9
Ammonia Nitrogen (mg/L N)	<0.1	0.1	0.1	5.2
Nitrate and Nitrite Nitrogen (mg/L N)	0.5	0.8	0.1	5.1
Orthophosphate (mg/L P)	0.1	0.1	0.1	5.0
pH	7.5	7.1	7.2	4.0
Sulphate (mg/L SO ₄)	16	<10	<10	101

MICROBIOLOGICAL ANALYSIS

DETERMINAND	Sample No.1	Sample No.2	Sample No.3
Faecal Coliforms (cfu/100ml)	0	0	360
Total Coliforms (cfu/100ml)	2	0	480
Heterotrophic Plate Count (cfu/1ml)	580	170	10800
*Faecal Streptococcus (cfu/1ml)	0	0	7
E.Coli (cfu/100ml)	0	0	400

*Not "SANAS" Accredited

All quality control results were within the acceptable control limits.

Signed :
Alison Chapman, Laboratory Manager

Date : 23/09/2003
Page 1 of 1

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Appendix 6.2

Spring No 2 (SP-2)

**DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES**

ANALYSIS REPORT

Project title: AD HOC SAMPLES
Project id: ADHOCK

Report no. 275
Date sample Rec.: 15-JUL-97

Major inorganic determinands

Sample id: 97351210
Sample source id: SAMPLE
Sample date: 02-JUL-97
Preservative: HgCl2

Reference: 1-(SPRING) **Spring No 2**
Time: 11:20:00
Sampling depth:
Sample desc: WATER

Determinand code	Determinand	Detection limit	Result	Unit
0001101	pH	2	6.0	
0007106	NH4 - N	.04	0.05	mg/l
0007107	NO3 + NO2-N	.04	0.19	mg/l
0009101	F	.1	< 0.1	mg/l
0010101	TAL as CaCO3	4	< 4	mg/l
0011103	Na	2	< 2	mg/l
0012101	Mg	1	< 1	mg/l
0014105	Si	.4	2.6	mg/l
0015104	PO4 - P	.005	0.030	mg/l
0016104	SO4	4	< 4	mg/l
0017104	Cl	3	< 3	mg/l
0019103	K	.3	< 0.3	mg/l
0020101	Ca	1	1	mg/l
0101101	EC	1	1.9	mS/m
0103101	TDS	1	14	mg/l

Client name: MR. FAYAZI
Client address: PRIVATE BAG X 8007
HENNOPSMEER 0046
FAX 6722885

Client identification no: FAYA
Contact person: MR. FAYAZI

Phone no: 672 2900
Fax no:

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

Test report no. 00/279

Programme title:	AD HOC SAMPLES	Reference:	SP-2
Sample id:	00634463	Time:	10:00:00 12:30
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	16-MAR-2000	Sample desc:	WATER
Sample received:	05-APR-2000	Preservative:	HgCl2
Date finalised:	25-MAY-2000		

Method number	Determinand	Detection limit	Result
0001101	pH	2	6.5 pH units
0007003	Kjeldahl nitrogen as N	0.04	0.17 mg/l
0007106	Ammonium as N	0.04	< 0.04 mg/l
0007107	Nitrate + nitrite as N	0.04	0.24 mg/l
0009101	Fluoride as F	0.1	< 0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	7 mg/l
0011103	Sodium as Na	2	< 2 mg/l
0012101	Magnesium as Mg	1	1 mg/l
0014105	Silicon as Si	0.4	2.8 mg/l
0015003	Total phosphate as P	0.005	0.006 mg/l
0015104	Ortho phosphate as P	0.005	< 0.005 mg/l
0016104	Sulphate as SO4	4	< 4 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	< 0.3 mg/l
0020101	Calcium as Ca	1	2 mg/l
0101101	Electrical Conductivity (25 C)	1	2.6 mS/m
0103101	TDS	1	18 mg/l

Appendix 6.3

Spring No 3 (SP-3, LTS3)

**DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES**

ANALYSIS REPORT

Project title: AD HOC SAMPLES
Project id: ADHOCK

Report no. 275
Date sample Rec.: 15-JUL-97

Major inorganic determinands

Sample id: 97351222
Sample source id: SAMPLE
Sample date: 02-JUL-97
Preservative: HgCl2

Reference: 2-(SPRING)
Time: 11:30:00 **Spring No 3**
Sampling depth:
Sample desc: WATER

Determinand code	Determinand	Detection limit	Result	Unit
0001101	pH	2	6.6	
0007106	NH4 - N	.04	0.07	mg/l
0007107	NO3 + NO2-N	.04	0.23	mg/l
0009101	F	.1	< 0.1	mg/l
0010101	TAL as CaCO3	4	15	mg/l
0011103	Na	2	2	mg/l
0012101	Mg	1	1	mg/l
0014105	Si	.4	4.7	mg/l
0015104	PO4 - P	.005	0.070	mg/l
0016104	SO4	4	< 4	mg/l
0017104	Cl	3	< 3	mg/l
0019103	K	.3	0.5	mg/l
0020101	Ca	1	4	mg/l
0101101	EC	1	4.1	mS/m
0103101	TDS	1	32	mg/l

Client name: MR. FAYAZI
Client address: PRIVATE BAG X 8007
HENNOPSMEER 0046
FAX 6722885

Client identification no: FAYA
Contact person: MR. FAYAZI

Phone no: 672 2900
Fax no:

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

Test report no. 00/279

Programme title:	AD HOC SAMPLES	Reference:	SP-3
Sample id:	00634475	Time:	10:00:00
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	16-MAR-2000	Sample desc:	WATER
Sample received:	05-APR-2000	Preservative:	HgCl2
Date finalised:	25-MAY-2000		

Method number	Determinand	Detection limit	Result
0001101	pH	2	7.1 pH units
0007003	Kjeldahl nitrogen as N	0.04	0.17 mg/l
0007106	Ammonium as N	0.04	0.06 mg/l
0007107	Nitrate + nitrite as N	0.04	0.42 mg/l
0009101	Fluoride as F	0.1	< 0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	8 mg/l
0011103	Sodium as Na	2	2 mg/l
0012101	Magnesium as Mg	1	1 mg/l
0014105	Silicon as Si	0.4	4.8 mg/l
0015003	Total phosphate as P	0.005	0.021 mg/l
0015104	Ortho phosphate as P	0.005	0.005 mg/l
0016104	Sulphate as SO4	4	< 4 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	0.3 mg/l
0020101	Calcium as Ca	1	2 mg/l
0101101	Electrical Conductivity (25 C)	1	3.4 mS/m
0103101	TDS	1	20 mg/l

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

Test report no. 01/831

Programme title:	AD HOC SAMPLES	Reference:	LTS-3
Sample id:	01611975	Time:	10:00:00
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	30-JAN-2001	Sample desc:	WATER
Sample received:	31-JAN-2001	Preservative:	HgCl ₂
Date finalised:	21-FEB-2001		

Method number	Determinand	Detection limit	Result
0001101	pH	2	6.7 pH units
0007003	Kjeldahl nitrogen as N	0.04	0.14 mg/l
0007106	Ammonium as N	0.04	< 0.04 mg/l
0007107	Nitrate + nitrite as N	0.04	< 0.04 mg/l
0009101	Fluoride as F	0.1	< 0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	10 mg/l
0011103	Sodium as Na	2	< 2 mg/l
0012101	Magnesium as Mg	1	< 1 mg/l
0014105	Silicon as Si	0.4	3.9 mg/l
0015003	Total phosphorus as P	0.005	0.023 mg/l
0015104	Ortho phosphate as P	0.005	0.005 mg/l
0016104	Sulphate as SO ₄	4	< 4 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	0.3 mg/l
0020101	Calcium as Ca	1	2 mg/l
0101101	Electrical Conductivity (25 C)	1	2.7 mS/m
0103101	TDS	1	23 mg/l

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Trace Metals

Test report no. 01/811

Programme title:	AD HOC SAMPLES	Reference:	LTS-3
Sample id:	01612098	Time:	10:00:00
Sample source id:	TRME03	Sampling depth:	0 m
Sample date:	30-JAN-2001	Sample desc:	WATER
Sample received:	01-FEB-2001	Preservative:	Unpreserved
Date finalised:	08-FEB-2001		

Method No.: 2010

Determinand code	Determinand	Detection limit	Result
0005106	B - dissolved	0.014	< 0.014 mg/l
0013106	Al - dissolved	0.059	0.155 mg/l
0023106	V - dissolved	0.005	0.019 mg/l
0024106	Cr - dissolved	0.006	< 0.006 mg/l
0025106	Mn - dissolved	0.003	< 0.003 mg/l
0026106	Fe - dissolved	0.006	0.076 mg/l
0028106	Ni - dissolved	0.009	0.027 mg/l
0029106	Cu - dissolved	0.019	< 0.019 mg/l
0030106	Zn - dissolved	0.005	< 0.005 mg/l
0038106	Sr - dissolved	0.003	0.011 mg/l
0042107	Mo-dissolved	0.023	< 0.023 mg/l
0048106	Cd - dissolved	0.005	< 0.005 mg/l
0056106	Ba - dissolved	0.003	< 0.003 mg/l
0082106	Pb - dissolved	0.054	< 0.054 mg/l

Appendix 6.4

Rain water (RW-1, RW-2)

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

Test report no. 00/279

Programme title:	AD HOC SAMPLES	Reference:	RW-1
Sample id:	00634440	Time:	10:00:00
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	16-MAR-2000	Sample desc:	WATER
Sample received:	05-APR-2000	Preservative:	HgCl ₂
Date finalised:	25-MAY-2000		

Method number	Determinand	Detection limit	Result
0001101	pH	2	7.6 pH units
0007003	Kjeldahl nitrogen as N	0.04	0.26 mg/l
0007106	Ammonium as N	0.04	0.06 mg/l
0007107	Nitrate + nitrite as N	0.04	0.43 mg/l
0009101	Fluoride as F	0.1	0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	19 mg/l
0011103	Sodium as Na	2	3 mg/l
0012101	Magnesium as Mg	1	3 mg/l
0014105	Silicon as Si	0.4	4.9 mg/l
0015003	Total phosphate as P	0.005	0.014 mg/l
0015104	Ortho phosphate as P	0.005	0.011 mg/l
0016104	Sulphate as SO ₄	4	< 4 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	0.6 mg/l
0020101	Calcium as Ca	1	4 mg/l
0101101	Electrical Conductivity (25 C)	1	7.1 mS/m
0103101	TDS	1	42 mg/l

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

Test report no. 00/319

Programme title:	AD HOC SAMPLES	Reference:	RW-1
Sample id:	00638651	Time:	10:00:00
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	04-APR-2000	Sample desc:	WATER
Sample received:	18-APR-2000	Preservative:	HgCl2
Date finalised:	13-JUN-2000		

Method number	Determinand	Detection limit	Result
0001101	pH	2	5.9 pH units
0007003	Kjeldahl nitrogen as N	0.04	0.44 mg/l
0007106	Ammonium as N	0.04	0.23 mg/l
0007107	Nitrate + nitrite as N	0.04	0.06 mg/l
0009101	Fluoride as F	0.1	< 0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	< 4 mg/l
0011103	Sodium as Na	2	< 2 mg/l
0012101	Magnesium as Mg	1	< 1 mg/l
0014105	Silicon as Si	0.4	< 0.4 mg/l
0015003	Total phosphate as P	0.005	0.038 mg/l
0015104	Ortho phosphate as P	0.005	0.026 mg/l
0016104	Sulphate as SO4	4	< 4 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	< 0.3 mg/l
0020101	Calcium as Ca	1	< 1 mg/l
0101101	Electrical Conductivity (25 C)	1	< 1.0 mS/m
0103101	TDS	1	9 mg/l

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

Test report no. 00/279

Programme title:	AD HOC SAMPLES	Reference:	RW-2
Sample id:	00634499	Time:	10:00:00
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	03-FEB-2000	Sample desc:	WATER
Sample received:	05-APR-2000	Preservative:	HgCl2
Date finalised:	25-MAY-2000		

Method number	Determinand	Detection limit	Result
0001101	pH	2	6.2 pH units
0007003	Kjeldahl nitrogen as N	0.04	3.95 mg/l
0007106	Ammonium as N	0.04	2.00 mg/l
0007107	Nitrate + nitrite as N	0.04	1.49 mg/l
0009101	Fluoride as F	0.1	0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	6 mg/l
0011103	Sodium as Na	2	< 2 mg/l
0012101	Magnesium as Mg	1	< 1 mg/l
0014105	Silicon as Si	0.4	0.6 mg/l
0015003	Total phosphate as P	0.005	0.150 mg/l
0015104	Ortho phosphate as P	0.005	0.058 mg/l
0016104	Sulphate as SO4	4	13 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	1.0 mg/l
0020101	Calcium as Ca	1	2 mg/l
0101101	Electrical Conductivity (25 C)	1	7.6 mS/m
0103101	TDS	1	38 mg/l

Appendix 6.5

Stream water (LT-Spruit, stream flow, base flow)

SOURCE ID : SAMPLE GRAB WATER SAMPLE
 SAMPLING METHOD : GRAB WATER SAMPLE
 SAMPLING DATE : 17-JAN-96/12:15:00
 REFERENCE NO : IQS 191
 PRESERVATIVE : HgCl2

VARIABLE:	FH	NH4 - N	NO3+NO2-N	F	TAL AS CaCO3	NA	MG	SI	PO4 - P
CODE:	0001101	0007106	0007107	0009101	0010101	0011101	0012101	0014105	0015104
UNIT:		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT:	7.2	< 0.04	0.46	< 0.1	29	2	4	4.3	< 0.005

VARIABLE:	SO4	CL	K	CA	EC	IDS
CODE:	0016104	0017104	0019101	0020101	0101101	0103101
UNIT:	mg/l	mg/l	mg/l	mg/l	mS/m	mg/l
RESULT:	5	< 3	1.1	5	8.6	56

Stream flow (V-notch)

***** END OF REPORT *****

SOURCE ID : SPOOR12 SAMPLING DATE : 17-JAN-96/12:15:00 REFERENCE NO : IMQS-191
 SAMPLING METHOD: GRAB WATER SAMPLE PRESERVATIVE : Unpreserved

VARIABLE	AL	U	CR	MN	FE	NI	CU	ZN
CODE	0013106	0023106	0024106	0025106	0026106	0028106	0029106	0030106
UNIT	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT	< 0.020	< 0.003	< 0.003	0.026	0.079	< 0.004	< 0.004	< 0.003

VARIABLE	AS	SR	MO	CD	BA	FB
CODE	0033106	0038106	0042106	0048106	0056106	0082106
UNIT	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT	< 0.050	< 0.001	< 0.006	< 0.001	0.010	< 0.020

Stream flow (V-notch)

***** END OF REPORT *****

SOURCE ID : SAMPLE : 24-JAN-96/11:00:00 REFERENCE NO. : 1MDS 300
 SAMPLING METHOD : GRAB WATER SAMPLE PRESERVATIVE : HgCl2

VARIABLE: PH NH4 - N NO3+NO2-N E IAL AS CaCO3 NA MG SI P04 - P
 CODE : 0001101 0007106 0007107 0009101 0010101 0011101 0012101 0014105 0015104
 UNIT : mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l
 RESULT : 7.1 0.06 0.42 0.1 32 2 4 4.3 0.017

VARIABLE: SO4 CL K CA EC IDS
 CODE : 0016104 0017104 0019101 0020101 0101101 0103101
 UNIT : mg/l mg/l mg/l mg/l mS/m mg/l
 RESULT : < 4 1.4 5 8.5 63

Stream flow (V-notch)

CHIEF TO :

SOURCE ID : SAMPLE SAMPLING DATE : 26-JAN-96/10:40:00 REFERENCE NO : TWS 297
 SAMPLING METHOD : GRAB WATER SAMPLE PRESERVATIVE : HgCl2

VARIABLE:	PH	NH4 - N	NO3+NO2-N	F	IAL-AS-CACD3	NA	MG	SI	F04 - P
CODE:	0001101	0007106	0007107	0009101	0010101	0011101	0012101	0014105	0015104
UNIT:		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT:	6.6	< 0.04	0.08	0.1	11	2	1	2.6	0.025
VARIABLE:	SO4	CL	K	CA	EC	IDS			
CODE:	0016104	0017104	0019101	0020101	0101101	0103101			
UNIT:	mg/l	mg/l	mg/l	mg/l	ms/m	mg/l			
RESULT:	7	3	2.7	2	3.3	31			

Stream flow at 400m
 upstream of spring No 1.

**DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES**

ANALYSIS REPORT

Project title: AD HOC SAMPLES
Project id: ADHOCK

Report no. 275
Date sample Rec.: 14-JUL-97

Major inorganic determinands

Sample id: 97351246
Sample source id: SAMPLE
Sample date: 02-JUL-97
Preservative: HgCl2

Reference: NO.4 (BASE FLOW)
Time: 10:45:00
Sampling depth:
Sample desc: WATER

Stream flow (V-notch)

Determinand code	Determinand	Detection limit	Result	Unit
0001101	pH	2	7.1	
0007106	NH4 - N	.04	0.08	mg/l
0007107	NO3 + NO2-N	.04	0.47	mg/l
0009101	F	.1	0.1	mg/l
0010101	TAL as CaCO3	4	22	mg/l
0011103	Na	2	3	mg/l
0012101	Mg	1	3	mg/l
0014105	Si	.4	5.4	mg/l
0015104	PO4 - P	.005	0.017	mg/l
0016104	SO4	4	7	mg/l
0017104	Cl	3	3	mg/l
0019103	K	.3	0.6	mg/l
0020101	Ca	1	5	mg/l
0101101	EC	1	7.1	mS/m
0103101	TDS	1	51	mg/l

Client name: MR. FAYAZI
Client address: PRIVATE BAG X 8007
HENNOPSMEER 0046
FAX 6722885

Client identification no: FAYA
Contact person: MR. FAYAZI

Phone no: 672 2900
Fax no:



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(011) 929-7031

Laboratory Services

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NORKEM PARK
1631

Certificate of analysis

Client:	Department of Water Affairs, M. Fayazi	No:	2002/06/20
Address:	Private Bag X995, PRETORIA, 0001	Tel No:	012-392-1382
Date Sampled:	28/05/2002	Date certificate completed:	11/06/2002
Date Sample received:	28/05/2002	Date Analysed:	29/05-06/06/2002

Sample description: Water

Analysis results

Sample no.	ERWAT no.	Container description
[1] LT-2 11:45	02EX05/29/072	2L Plastic Bottle / 250ml Sterilised Glass Bottle
[2] LT-3 12:15 M2	02EX05/29/073	2L Plastic Bottle / 250ml Sterilised Glass Bottle
[3] LT-Spruit 12:40 (V-notch)	02EX05/29/074	2L Plastic Bottle
[4] LT-Spring 12:30 Spring No1	02EX05/29/075	2L Plastic Bottle

CHEMICAL ANALYSIS

DETERMINAND	X			
	Sample No.1	Sample No.2	Sample No.3	Sample No.4
Conductivity (mS/m)	7	7	7	8
Total Dissolved Solids (mg/L)	28	44	56	72
Total Alkalinity (mg/L CaCO ₃)	25	23	25	31
Chloride (mg/L Cl ⁻)	<3	<3	<3	<3
Fluoride (mg/L F ⁻)	<0.1	<0.1	<0.1	<0.1
Calcium (mg/L Ca)	2.5	3.0	3.4	4.7
Magnesium (mg/L Mg)	3.2	2.2	3.0	3.1
Potassium (mg/L K)	0.6	1.0	0.4	0.3
Sodium (mg/L Na)	2.2	1.9	2.6	2.0
Ammonia Nitrogen (mg/L N)	<0.1	<0.1	<0.1	<0.1
Nitrate Nitrogen (mg/L N)	0.2	0.4	0.6	0.7
Orthophosphate (mg/L P)	0.1	<0.1	0.1	0.1
pH	6.4	6.5	6.9	6.7
Sulphate (mg/L SO ₄)	<10	<10	<10	<10

MICROBIOLOGICAL ANALYSIS

DETERMINAND	Sample No.1	Sample No.2
E.coli (cfu/100ml)	1	0
Faecal Coliforms (cfu/100ml)	1	0
Total Coliforms (cfu/100ml)	5	0
Heterotrophic Plate Count (cfu/1ml)	133	2140
*Faecal Streptococcus (cfu/1ml)	7	0

*Not "SANAS" Accredited

Signed : 

Alison Chapman, Laboratory Manager

Date : 11/06/2002

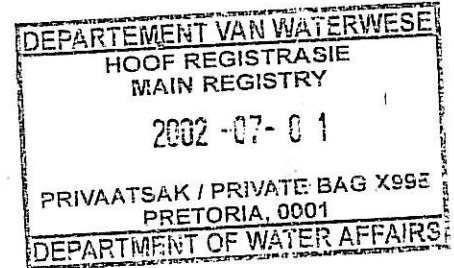
Page 1 of 2

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Department of Water Affairs
 Private Bag X995
 PRETORIA
 0001



Attention : M Fayazi

26 June 2002

Dear Sir

CERTIFICATE OF ANALYSIS

We enclose our certificate of analysis No. 2002/06/20 for the analysis of sample/s submitted to our laboratories on 28 May 2002.

Sub-contract / Referral results:

Sample name	ERWAT no.	Silica (mg/L Si)
LT-2 11:45	02EX05/29/072	5.7
LT-3 12:15 M2	02EX05/29/073	5.0
X LT-Spruit 12:40 (V-notch)	02EX05/29/074	5.7
LT-Spring 12:30 Spring No1	02EX05/29/075	6.7

Should you have any queries regarding the above please do not hesitate to contact the undersigned.

Yours faithfully

ALISON CHAPMAN
 Laboratory Manager

Directors : Ms.M.M. Twala (Chairman); N.P. Twala (Managing Director); M.G.H. Akoon;
 E.V. Magerman, Ms. N. Dube; T.J. Motla; Ms. S.C. Marx

Member of
 International Water Association (IWA)
 Water Environment Federation (WEF)
 Water Institute of Southern Africa (WISA) - Patron

Appendix 6.6

Private and mine boreholes (Refers to Maps 4 & 5 and Table 1)

M1- Mine borehole

M2- Mine borehole (LT3)

LT1-Borehole 1 (Private

LT2-Borehole No 2 (LT5, Private, Leeuwoort wind pump)

LT5-Borehole 5

LT6-Borehole 6 (Private)

LT8-Borehole 8 (Private)

LT10-Borehole 10 (Private)

SOURCE ID : SAMPLE GRAB WATER SAMPLE
 SAMPLING METHOD : GRAB WATER SAMPLE
 SAMPLING DATE : 24-JAN-96/11:35:00
 REFERENCE NO : IWQS 294
 PRESERVATIVE : H9C12

VARIABLE : PH
 CODE : 0001101
 UNIT :
 RESULT : 8.3 <

VARIABLE : NH4 - N
 CODE : 0007106
 UNIT : mg/l
 RESULT : 0.04

VARIABLE : NO3+NO2-N
 CODE : 0007107
 UNIT : mg/l
 RESULT : 0.09

VARIABLE : F
 CODE : 0007101
 UNIT : mg/l
 RESULT : 0.1

VARIABLE : IAL AS CACO3
 CODE : 0010101
 UNIT : mg/l
 RESULT : 72 <

VARIABLE : NA
 CODE : 0011101
 UNIT : mg/l
 RESULT : 2

VARIABLE : MG
 CODE : 0012101
 UNIT : mg/l
 RESULT : 4

VARIABLE : SI
 CODE : 0014105
 UNIT : mg/l
 RESULT : 6.6

VARIABLE : CA
 CODE : 0020101
 UNIT : mg/l
 RESULT : 20

VARIABLE : K
 CODE : 0019101
 UNIT : mg/l
 RESULT : 0.9

VARIABLE : CL
 CODE : 0017104
 UNIT : mg/l
 RESULT : 3

VARIABLE : SD4
 CODE : 0016104
 UNIT : mg/l
 RESULT : 4

VARIABLE : IDS
 CODE : 0103101
 UNIT : mg/l
 RESULT : 122

VARIABLE : EC
 CODE : 0101101
 UNIT : mS/m
 RESULT : 16.7

M1 (Mine exploration hole, artesian)

PD4 - P
 0015104
 mg/l
 0.012

REPORT REFERENCE NO : 961846
 PROJECT IDENTIFICATION NO : ADHOCK
 CLIENT IDENTIFICATION NO : FAYA

Page: 2

INSTITUTE OF WATER QUALITY STUDIES - ANALYSIS REPORT

Date: 26-JUN-96

SOURCE ID :
 SAMPLING METHOD :

SAMPLING DATE : 17-MAY-96/15:00:00

REFERENCE NO :
 PRESERVATIVE :

LT-5
 HgCl2

VARIABLE: PH
 CODE: 0001101
 UNIT: mg/l
 RESULT: 7.3

HH4 - N
 0007106
 mg/l
 < 0.04

NO3-N
 0007107
 mg/l
 0.10

F
 0009101
 mg/l
 < 0.1

IAL AS
 0010101
 mg/l
 29

MA
 0011101
 mg/l
 2

MG
 0012101
 mg/l
 3

SI
 0014105
 mg/l
 4.2

PO4 - P
 0015105
 mg/l
 0.011

VARIABLE: SO4
 CODE: 0016104
 UNIT: mg/l
 RESULT: < 4

LL
 0017104
 mg/l
 < 3

K
 0019101
 mg/l
 < 0.3

CA
 0020101
 mg/l
 3

EC
 0101101
 mS/cm
 4.9

IDS
 0103101
 mg/l
 47

M1 (Mine exploration hole, artesian)

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES

Major Inorganic Determinands

Test report no. 00/279

Programme title:	AD HOC SAMPLES	Reference:	M2
Sample id:	00634487	Time:	10:00:00
Sample source id:	ADHOCK	Sampling depth:	0 m
Sample date:	16-MAR-2000	Sample desc:	WATER
Sample received:	05-APR-2000	Preservative:	HgCl2
Date finalised:	25-MAY-2000		

Method number	Determinand	Detection limit	Result
0001101	pH	2	7.5 pH units
0007003	Kjeldahl nitrogen as N	0.04	0.10 mg/l
0007106	Ammonium as N	0.04	< 0.04 mg/l
0007107	Nitrate + nitrite as N	0.04	0.09 mg/l
0009101	Fluoride as F	0.1	0.1 mg/l
0010101	Alkalinity as calcium carbonate	4	19 mg/l
0011103	Sodium as Na	2	2 mg/l
0012101	Magnesium as Mg	1	2 mg/l
0014105	Silicon as Si	0.4	4.4 mg/l
0015003	Total phosphate as P	0.005	0.011 mg/l
0015104	Ortho phosphate as P	0.005	< 0.005 mg/l
0016104	Sulphate as SO4	4	< 4 mg/l
0017104	Chloride as Cl	10	< 10 mg/l
0019103	Potassium as K	0.3	0.6 mg/l
0020101	Calcium as Ca	1	4 mg/l
0101101	Electrical Conductivity (25 C)	1	5.2 mS/m
0103101	TDS	1	34 mg/l



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(011) 929-7031

Certificate of analysis

Client:	Department of Water Affairs, M. Fayazy	No:	2002/06/20
Address:	Private Bag X995, PRETORIA, 0001	Tel No:	012-392-1382
Date Sampled:	28/05/2002	Date certificate completed:	11/06/2002
Date Sample received:	28/05/2002	Date Analysed:	29/05-06/06/2002

Sample description: Water

Analysis results

<u>Sample no.</u>	<u>ERWAT no.</u>	<u>Container description</u>
[1] LT-2 11:45	02EX05/29/072	2L Plastic Bottle / 250ml Sterilised Glass Bottle
[2] LT-3 12:15 ← M2	02EX05/29/073	2L Plastic Bottle / 250ml Sterilised Glass Bottle
[3] LT-Spruit 12:40 (V-notch)	02EX05/29/074	2L Plastic Bottle
[4] LT-Spring 12:30 Spring No1	02EX05/29/075	2L Plastic Bottle

CHEMICAL ANALYSIS

<u>DETERMINAND</u>	<u>Sample No.1</u>	<u>Sample No.2</u>	<u>Sample No.3</u>	<u>Sample No.4</u>
Conductivity (mS/m)	7	7	7	8
Total Dissolved Solids (mg/L)	28	44	56	72
Total Alkalinity (mg/L CaCO ₃)	25	23	25	31
Chloride (mg/L Cl ⁻)	<3	<3	<3	<3
Fluoride (mg/L F ⁻)	<0.1	<0.1	<0.1	<0.1
Calcium (mg/L Ca)	2.5	3.0	3.4	4.7
Magnesium (mg/L Mg)	3.2	2.2	3.0	3.1
Potassium (mg/L K)	0.6	1.0	0.4	0.3
Sodium (mg/L Na)	2.2	1.9	2.6	2.0
Ammonia Nitrogen (mg/L N)	<0.1	<0.1	<0.1	<0.1
Nitrate Nitrogen (mg/L N)	0.2	0.4	0.6	0.7
Orthophosphate (mg/L P)	0.1	<0.1	0.1	0.1
pH	6.4	6.5	6.9	6.7
Sulphate (mg/L SO ₄)	<10	<10	<10	<10

MICROBIOLOGICAL ANALYSIS

<u>DETERMINAND</u>	<u>Sample No.1</u>	<u>Sample No.2</u>
E.coli (cfu/100ml)	1	0
Faecal Coliforms (cfu/100ml)	1	0
Total Coliforms (cfu/100ml)	5	0
Heterotrophic Plate Count (cfu/1ml)	133	2140
*Faecal Streptococcus (cfu/1ml)	7	0

*Not "SANAS" Accredited



Signed :

Alison Chapman, Laboratory Manager

Date : 11/06/2002

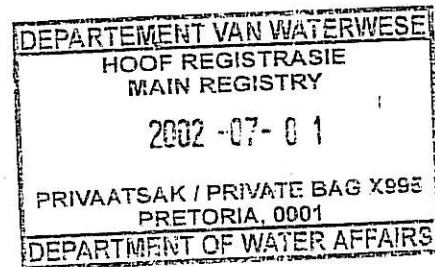
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Department of Water Affairs
 Private Bag X995
 PRETORIA
 0001



Attention : M Fayazi

26 June 2002

Dear Sir

CERTIFICATE OF ANALYSIS

We enclose our certificate of analysis No. 2002/06/20 for the analysis of sample/s submitted to our laboratories on 28 May 2002.

Sub-contract / Referral results:

Sample name	ERWAT no.	Silica (mg/L Si)
LT-2 11:45	02EX05/29/072	5.7
X LT-3 12:15 M2	02EX05/29/073	5.0
LT-Spruit 12:40 (V-notch)	02EX05/29/074	5.7
LT-Spring 12:30 Spring No1	02EX05/29/075	6.7

Should you have any queries regarding the above please do not hesitate to contact the undersigned.

Yours faithfully

ALISON CHAPMAN
 Laboratory Manager

Directors : Ms.M.M. Twala (Chairman); N.P. Twala (Managing Director); M.G.H. Akoon;
 E.V. Magerman; Ms. N. Dube; T.J. Motla; Ms. S.C. Marx

Member of:
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 Water Environment Federation (WEF)
 Water Institute of Southern Africa (WISA) - Patron

REPORT REFERENCE NO : 961866
 PROJECT IDENTIFICATION NO : ADHOCK
 CLIENT IDENTIFICATION NO : FAYA

Page: 1
 Date: 26-JUN-96

INSTITUTE OF WATER QUALITY STUDIES - ANALYSIS REPORT

SOURCE ID : LT-1
 SAMPLING METHOD: HgC12
 REFERENCE NO : LT-1
 PRESERVATIVE : HgC12
 SAMPLING DATE : 17-MAY-96/11:00:00
 REFERENCE NO : 0012101
 PRESERVATIVE : 8

LT-1

VARIABLE: PH
 CODE: 0001101
 UNIT: mg/l
 RESULT: 7.5

VARIABLE: NH4 - N
 CODE: 0007106
 UNIT: mg/l
 RESULT: 0.05

VARIABLE: NO3+NO2-N
 CODE: 0007107
 UNIT: mg/l
 RESULT: 0.20

VARIABLE: F
 CODE: 0009101
 UNIT: mg/l
 RESULT: 0.1

VARIABLE: TAL AS CACO
 CODE: 0010101
 UNIT: mg/l
 RESULT: 64

VARIABLE: NA
 CODE: 0011101
 UNIT: mg/l
 RESULT: 5

VARIABLE: MG
 CODE: 0012101
 UNIT: mg/l
 RESULT: 8

VARIABLE: SI
 CODE: 0014105
 UNIT: mg/l
 RESULT: 8.1

VARIABLE: F04 - F
 CODE: 0015104
 UNIT: mg/l
 RESULT: 0.008

VARIABLE: SO4
 CODE: 0016104
 UNIT: mg/l
 RESULT: 4

VARIABLE: CL
 CODE: 0017104
 UNIT: mg/l
 RESULT: 3

VARIABLE: K
 CODE: 0019101
 UNIT: mg/l
 RESULT: 2.4

VARIABLE: CA
 CODE: 0020101
 UNIT: mg/l
 RESULT: 9

VARIABLE: EC
 CODE: 0101101
 UNIT: mS/m
 RESULT: 12.4

VARIABLE: TPC
 CODE: 0103101
 UNIT: mg/l
 RESULT: 111

SOURCE ID : LT-2
 SAMPLING METHOD: HgC12

SOURCE ID : LT-2
 SAMPLING METHOD: HgC12
 REFERENCE NO : LT-2
 PRESERVATIVE : HgC12
 SAMPLING DATE : 17 MAY-96/11:40:00
 REFERENCE NO : 0012101
 PRESERVATIVE : 3

LT-2

VARIABLE: PH
 CODE: 0001101
 UNIT: mg/l
 RESULT: 7.4

VARIABLE: NH4 - N
 CODE: 0007106
 UNIT: mg/l
 RESULT: < 0.04

VARIABLE: NO3+NO2-N
 CODE: 0007107
 UNIT: mg/l
 RESULT: 0.22

VARIABLE: F
 CODE: 0009101
 UNIT: mg/l
 RESULT: < 0.1

VARIABLE: TAL AS CACO
 CODE: 0010101
 UNIT: mg/l
 RESULT: 25

VARIABLE: NA
 CODE: 0011101
 UNIT: mg/l
 RESULT: 2

VARIABLE: MG
 CODE: 0012101
 UNIT: mg/l
 RESULT: 3

VARIABLE: SI
 CODE: 0014105
 UNIT: mg/l
 RESULT: 4.6

VARIABLE: F04 - F
 CODE: 0015104
 UNIT: mg/l
 RESULT: 0.009

VARIABLE: SO4
 CODE: 0016104
 UNIT: mg/l
 RESULT: < 4

VARIABLE: CL
 CODE: 0017104
 UNIT: mg/l
 RESULT: < 3

VARIABLE: K
 CODE: 0019101
 UNIT: mg/l
 RESULT: < 0.3

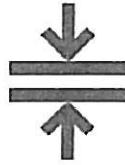
VARIABLE: CA
 CODE: 0020101
 UNIT: mg/l
 RESULT: 3

VARIABLE: EC
 CODE: 0101101
 UNIT: mS/m
 RESULT: 4.8

VARIABLE: TDS
 CODE: 0103101
 UNIT: mg/l
 RESULT: 45



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Certificate of analysis

Client:	Department of Water Affairs, M. Fayazi	No:	2003/11/151
Address:	Private Bag X995, PRETORIA, 0001	Tel No:	012-392-1382
Date Sampled:	11/11/2003	Date certificate completed:	21/11/2003
Date Sample received:	12/11/2003	Date Analysed:	12-20/11/2003

Sample description: Water

Analysis results

<u>Sample no.</u>	<u>ERWAT no.</u>	<u>Container description</u>
[1] Leeuwpoot Windpump 14:00	03EX11/13/070	2L Plastic Bottle / 500ml Sterilized Glass Bottle
[2] QC		


CHEMICAL ANALYSIS

<u>DETERMINAND</u>	<u>Sample No.1</u>	<u>Sample No.2</u>
Conductivity (mS/m)	6	17
Total Dissolved Solids (mg/L)	54	304
Total Alkalinity (mg/L CaCO ₃)	22	49
Chloride (mg/L Cl ⁻)	<3	98
Fluoride (mg/L F ⁻)	<0.1	0.4
Calcium (mg/L Ca)	2.3	30.2
Magnesium (mg/L Mg)	2.4	19.7
Potassium (mg/L K)	0.5	10.1
Sodium (mg/L Na)	4.5	40.0
Iron (mg/L Fe)	<0.05	1.00
Ammonia Nitrogen (mg/L N)	0.9	4.9
*Total Kjeldahl Nitrogen (mg/L N)	<1.0	4.7
Nitrate Nitrogen (mg/L N)	6.3	-
Nitrite Nitrogen (mg/L N)	<0.1	<0.1
Orthophosphate (mg/L P)	<0.1	5.1
*Total Phosphorus (mg/L P)	<1.0	5.3
pH	6.1	4.0
Sulphate (mg/L SO ₄)	<10	102

MICROBIOLOGICAL ANALYSIS

<u>DETERMINAND</u>	<u>Sample No.1</u>
Faecal Coliforms (cfu/100ml)	0
Total Coliforms (cfu/100ml)	1
Heterotrophic Plate Count (cfu/1ml)	200
*Faecal Streptococcus (cfu/100ml)	0
E.Coli (cfu/100ml)	0

*Not "SANAS" Accredited

Signed : 
Alison Chapman, Laboratory Manager

Date : 24/11/2003

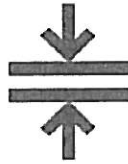
Page 1 of 1

*Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Accreditation Schedule for our laboratory.

All results and information relating will be treated in a confidential manner. The results relate only to samples tested according to the client request and are subject to an estimated uncertainty of measurement of ±3 standard deviation. This certificate shall not be reproduced except in full without the written approval of the Executive Manager, Erwat Laboratory Services.



SANAS



T0082

Accredited Testing Laboratory

Tel: (011) 929-7014

(011) 929-7000

Fax: (011) 929-7065

(011) 929-7031

Laboratory Services

P.O.Box 13106
NORKEM PARK
1631

Certificate of analysis

Client: Department of Water Affairs, M. Fayazi
Address: Private Bag X995, PRETORIA, 0001
Date Sampled: 10/09/2003
Date Sample received: 11/09/2003
Sample description: Water
No: 2003/09/111
Tel No: 012-392-1382
Date certificate completed: 17/09/2003
Date Analysed: 11-16/09/2003

Analysis results

Table with 3 columns: Sample no., ERWAT no., Container description. Includes samples for Spring no1, Lecupoort Windpump, Lecupoort V-Notch, and QC.

CHEMICAL ANALYSIS

Table with 5 columns: DETERMINAND, Sample No.1, Sample No.2, Sample No.3, Sample No.4. Lists various chemical parameters like Conductivity, Total Dissolved Solids, etc.

MICROBIOLOGICAL ANALYSIS

Table with 4 columns: DETERMINAND, Sample No.1, Sample No.2, Sample No.3. Lists microbiological parameters like Faecal Coliforms, Total Coliforms, etc.

*Not "SANAS" Accredited

All quality control results were within the acceptable control limits.

Signed : [Signature]

Alison Chapman, Laboratory Manager

Date : 23/09/2003
Page 1 of 1

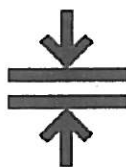
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Fax: (011) 929-7065

(011) 929-7031

Certificate of analysis

Client:	Department of Water Affairs, M. Fayazi	No:	2003/01/098
Address:	Private Bag X995, PRETORIA, 0001	Tel No:	012-392-1382
Date Sampled:	28/01/2003	Date certificate completed:	31/01/2003
Date Sample received:	29/01/2003	Date Analysed:	29-31/01/2003

Sample description: Borehole


Analysis results

Sample no.	ERWAT no.	Container description
[1] Wind Pump Leeuwpoort (28/1) 10h00	03EX01/29/224	500ml Glass Bottle

MICROBIOLOGICAL ANALYSIS

DETERMINAND	Sample No.1
E.coli (cfu/100ml)	1
Faecal Coliforms (cfu/100ml)	1
Total Coliforms (cfu/100ml)	210
Heterotrophic Plate Count (cfu/1ml)	820
*Faecal Streptococcus (cfu/1ml)	0

***Not "SANAS" Accredited**

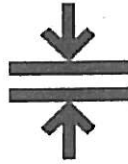
Signed : 
Alison Chapman, Laboratory Manager

Date : 31/01/2003
Page 1 of 1

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 Accredited Testing Laboratory

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Fax: (011) 929-7065
 (011) 929-7031

Certificate of analysis

Client:	Department of Water Affairs, M. Fayazi	No:	2002/11/108
Address:	Private Bag X995, , PRETORIA, 0001	Tel No:	012-392-1382
Date Sampled:	12/11/2002	Date certificate completed:	18/11/2002
Date Sample received:	13/11/2002	Date Analysed:	13-15/11/2002

Sample description: Water


Analysis results

<u>Sample no.</u>	<u>ERWAT no.</u>	<u>Container description</u>
[1] Leewpoort, Wind Pump - 15:30 (1 mins)	02EX11/13/076	200ml Sterilized Glass Bottle
[2] Leewpoort, Wind Pump - 15:40 (10 mins)	02EX11/13/077	200ml Sterilized Glass Bottle

MICROBIOLOGICAL ANALYSIS

DETERMINAND	<u>Sample No.1</u>	<u>Sample No.2</u>
E.coli (cfu/100ml)	0	0
Faecal Coliforms (cfu/100ml)	0	0
Total Coliforms (cfu/100ml)	4	8
Heterotrophic Plate Count (cfu/1ml)	420	270
*Faecal Streptococcus (cfu/80ml)	1	-
*Faecal Streptococcus (cfu/60ml)	-	0

*Not "SANAS" Accredited

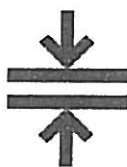
Signed : 
 Alison Chapman, Laboratory Manager

Date : 18/11/2002
 Page 1 of 1

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(011) 929-7000

Fax: (011) 929-7065
(011) 929-7031

Laboratory Services

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NORKEM PARK
1631

Certificate of analysis

Client:	Department of Water Affairs, M. Fayazi	No:	2002/10/080
Address:	Private Bag X995, PRETORIA, 0001	Tel No:	012-392-1382
Date Sampled:	08/10/2002	Date certificate completed:	16/10/2002
Date Sample received:	09/10/2002	Date Analysed:	09-11/10/2002

Sample description: Borehole Water

Analysis results

Sample no.	ERWAT no.	Container description
[1] Leeuwpoot Wind Pump	02EX10/09/074	500ml Sterilized Glass Bottle

DETERMINAND


*E.coli (cfu/100ml)
Faecal Coliforms (cfu/100ml)
Total Coliforms (cfu/100ml)
Heterotrophic Plate Count (cfu/1ml)
*Faecal Streptococcus (cfu/1ml)

MICROBIOLOGICAL ANALYSIS

Sample No.1

1
2
153
73
8

*Not "SANAS" Accredited

Signed : 

Alison Chapman, Laboratory Manager

Date : 16/10/2002
Page 1 of 1

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REPORT REFERENCE NO : 961866
 PROJECT IDENTIFICATION NO : ADHOCK
 CLIENT IDENTIFICATION NO : FAYR

Page: 2
 Date: 26 JUN 96

INSTITUTE OF WATER QUALITY STUDIES - ANALYSIS REPORT

SOURCE ID :
 SAMPLING METHOD :
 SAMPLE :
 SAMPLING DATE :
 REFERENCE NO :
 PRESERVATIVE :

LT-5

VARIABLE: PH
 CODE: 0001101
 UNIT: mg/l
 RESULT: 7.3

VARIABLE: NH4 - N
 CODE: 0007106
 UNIT: mg/l
 RESULT: < 0.04

VARIABLE: NO3+NO2-N
 CODE: 0007107
 UNIT: mg/l
 RESULT: 0.10

VARIABLE: F
 CODE: 0009101
 UNIT: mg/l
 RESULT: < 0.1

VARIABLE: TAL AS CACD
 CODE: 0010101
 UNIT: mg/l
 RESULT: 2.9

VARIABLE: NA
 CODE: 0011101
 UNIT: mg/l
 RESULT: 2

VARIABLE: MG
 CODE: 0012101
 UNIT: mg/l
 RESULT: 3

VARIABLE: SI
 CODE: 0014105
 UNIT: mg/l
 RESULT: 4.2

VARIABLE: F04 - P
 CODE: 0015104
 UNIT: mg/l
 RESULT: 0.011

VARIABLE: SD4
 CODE: 0016104
 UNIT: mg/l
 RESULT: < 4

VARIABLE: CL
 CODE: 0017104
 UNIT: mg/l
 RESULT: < 3

VARIABLE: K
 CODE: 0019101
 UNIT: mg/l
 RESULT: < 0.3

VARIABLE: CA
 CODE: 0020101
 UNIT: mg/l
 RESULT: 3

VARIABLE: EC
 CODE: 0101101
 UNIT: mS/cm
 RESULT: 4.9

VARIABLE: TD5
 CODE: 0103101
 UNIT: mg/l
 RESULT: 47

SOURCE ID :
 SAMPLING METHOD :
 SAMPLE :
 SAMPLING DATE :
 REFERENCE NO :
 PRESERVATIVE :

LT-6

VARIABLE: PH
 CODE: 0001101
 UNIT: mg/l
 RESULT: 7.5

VARIABLE: NH4 - N
 CODE: 0007106
 UNIT: mg/l
 RESULT: < 0.04

VARIABLE: NO3+NO2-N
 CODE: 0007107
 UNIT: mg/l
 RESULT: 0.66

VARIABLE: F
 CODE: 0009101
 UNIT: mg/l
 RESULT: < 0.1

VARIABLE: TAL AS CACD
 CODE: 0010101
 UNIT: mg/l
 RESULT: 21

VARIABLE: NA
 CODE: 0011101
 UNIT: mg/l
 RESULT: 2

VARIABLE: MG
 CODE: 0012101
 UNIT: mg/l
 RESULT: 3

VARIABLE: SI
 CODE: 0014105
 UNIT: mg/l
 RESULT: 7.2

VARIABLE: F04 - P
 CODE: 0015104
 UNIT: mg/l
 RESULT: 0.006

VARIABLE: SD4
 CODE: 0016104
 UNIT: mg/l
 RESULT: 4

VARIABLE: CL
 CODE: 0017104
 UNIT: mg/l
 RESULT: < 3

VARIABLE: K
 CODE: 0019101
 UNIT: mg/l
 RESULT: < 0.3

VARIABLE: CA
 CODE: 0020101
 UNIT: mg/l
 RESULT: 3

VARIABLE: EC
 CODE: 0101101
 UNIT: mS/cm
 RESULT: 4.4

VARIABLE: TD5
 CODE: 0103101
 UNIT: mg/l
 RESULT: 43

REPORT REFERENCE NO: 961R66
 PROJECT IDENTIFICATION NO: ADHOCK
 CLIENT IDENTIFICATION NO: FAYA

Date: 26-JUN 96

INSTITUTE OF WATER QUALITY STUDIES - ANALYSIS REPORT

LT-8
 HgC12

Page: 3

SOURCE ID: SAMPLE SAMPLING DATE: 29-MAY-96/12:40:00 REFERENCE HQ: PRESERVATIVE: LT-8

VARIABLE:	PH	NH4-N	NO3+NO2-N	F	IAL AS CACO	HA	MG	SI	PO4-P
CODE:	0001101	0007107	0007107	0007101	0010101	0011101	0012101	0014105	0015104
UNIT:	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
RESULT:	7.0	< 0.04	0.20	< 0.1	15	< 2	1	6.1	0.008

VARIABLE:	SO4	CL	K	EC	LD5
CODE:	0016104	0017104	0019101	0101101	0103101
UNIT:	mg/l	mg/l	mg/l	ms/m	mg/l
RESULT:	< 4	< 3	< 0.3	3.3	32

***** END OF REPORT *****

**DEPARTMENT OF WATER AFFAIRS AND FORESTRY
INSTITUTE FOR WATER QUALITY STUDIES**

ANALYSIS REPORT

Project title: AD HOC SAMPLES
Project id: ADHOCK

Report no. 374
Sample finalised: 06-AUG-97

Major inorganic determinands

Sample id:	97368271	Reference:	BH-10	
Sample source id:	SAMPLE	Time:	09:00:00	LT-10
Sample date:	23-JUL-97	Sampling depth:		
Preservative:	HgCl2	Sample desc:	WATER	

Determinand code	Determinand	Detection limit	Result	Unit
0001101	pH	2	7.5	
0007106	NH4 - N	.04	< 0.04	mg/l
0007107	NO3 + NO2-N	.04	0.19	mg/l
0009101	F	.1	< 0.1	mg/l
0010101	TAL as CaCO3	4	53	mg/l
0011103	Na	2	2	mg/l
0012101	Mg	1	6	mg/l
0014105	Si	.4	10.9	mg/l
0015104	PO4 - P	.005	< 0.005	mg/l
0016104	SO4	4	< 4	mg/l
0017104	Cl	3	< 3	mg/l
0019103	K	.3	0.5	mg/l
0020101	Ca	1	9	mg/l
0101101	EC	1	11.1	mS/m
0103101	TDS	1	88	mg/l

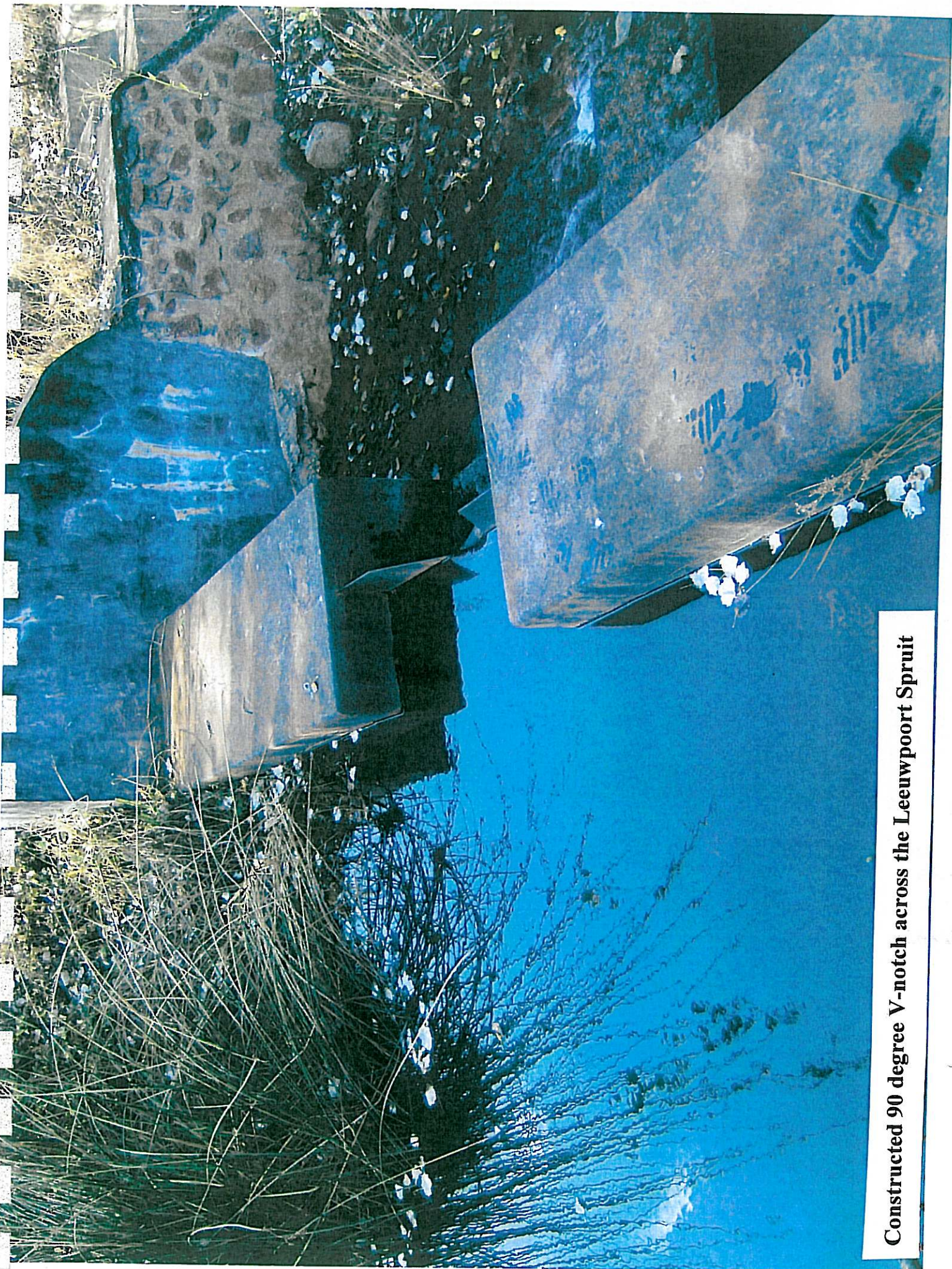
Client name: MR. FAYAZI
Client address: PRIVATE BAG X 8007
HENNOPSMEER 0046
FAX 6722885

Client identification no: FAYA
Contact person: MR. FAYAZI

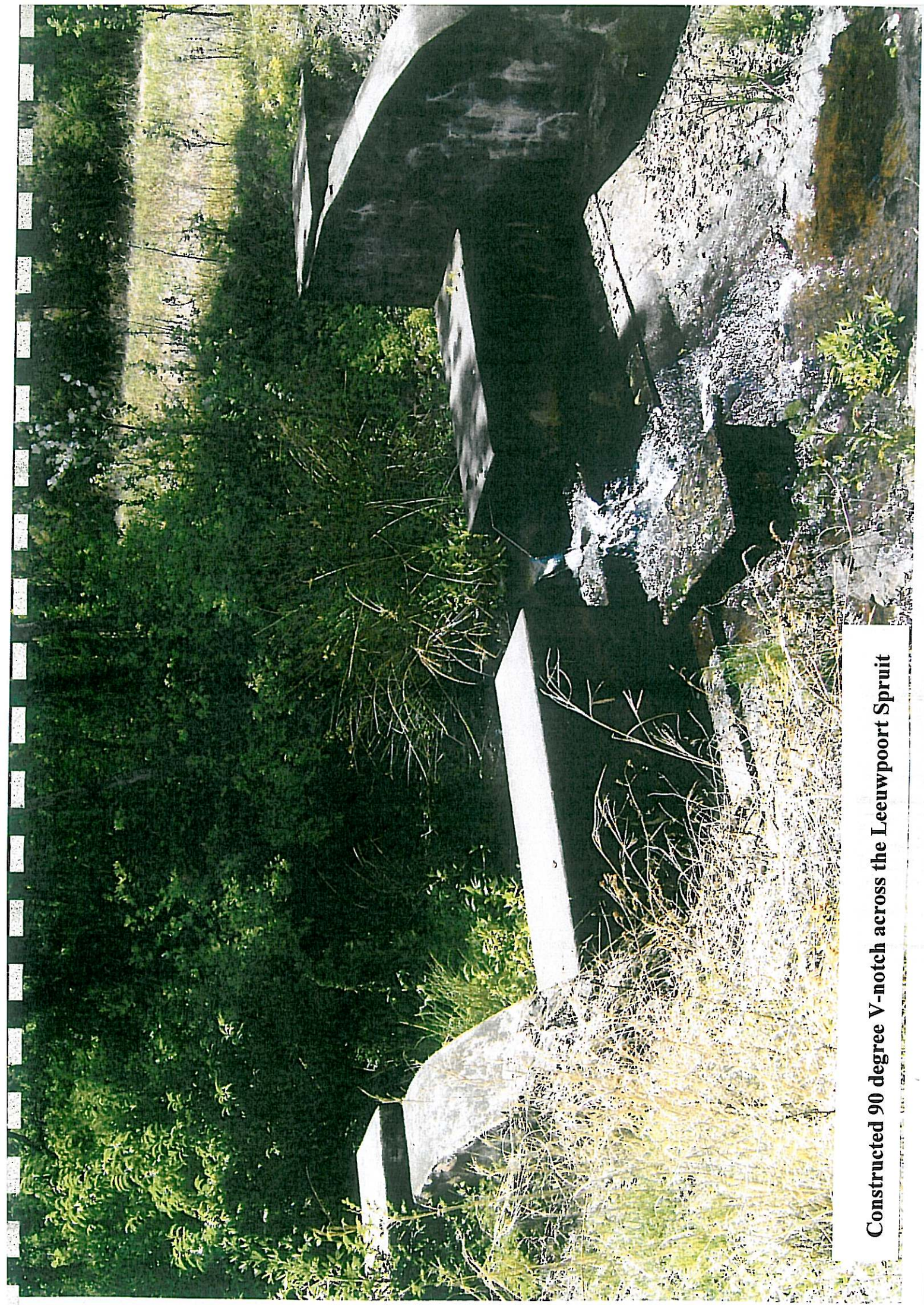
Phone no: 672 2900
Fax no:

Appendix 7

**Photos showing constructed 90 degree V-notch across the
Leeuwpoort Spruit, discharge measuring point at
spring Nos 1, 2, 3 and view of spring No 4 (Dry)**



Constructed 90 degree V-notch across the Leeuwpoort Spruit



Constructed 90 degree V-notch across the Leeuwpoort Spruit



Constructed 90 degree V-notch across the Leeuwpoort Spruit

Discharge measuring point at Spring No 1.





Discharge point at Spring No 2.



Discharge point at Spring No 2.



Discharge point at Spring No 2.



**Discharge point at Spring No 2,
water used for washing.**



Measuring flow at Spring No 2.



Measuring flow at Spring No 2



Discharge point at Spring No 3.



Discharge point at Spring No 3.



View of Spring No 4 (Dry).



Discharge point at Spring No 3.