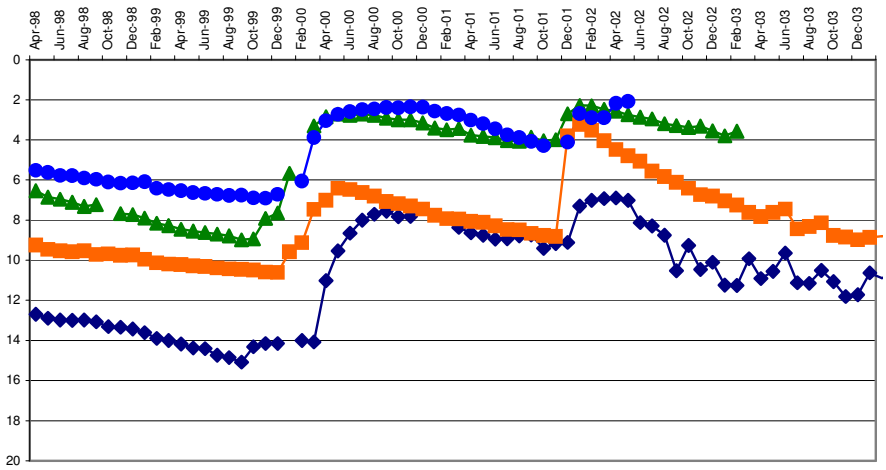
water affairs

Department:
Water Affairs
REPUBLIC OF SOUTH AFRICA

LIMPOPO REGION

DIRECTORATE
WATER REGULATION AND USE

STATUS REPORT ON
GROUNDWATER LEVELS
FEBRUARY 2010 – FEBRUARY 2011



H VERSTER
MARCH 2011

Data collection and processing* assisted by:
P F TSHELANE*
K MOREKGURE*
S C MUTHEIWANA
D A TLEANE

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SUMMARY

Despite fluctuations and a slow declining trend for some time now, the current water levels compare well with that recorded in the late 1970's. Most historical groundwater level monitoring stations in Limpopo date from the late 60's to the early 80's. From all stations with data for that period, the major recharge during 1976-7 is an outstanding feature and groundwater levels at the time represent the levels of an extremely good period. The water level at 18 of these stations still actively monitored, indicate that the level at only one station, A6Klipput, is significantly lower than during that period. This is due to heavy irrigation abstraction in that area since 2002. The situation at A6 Volspruit (GRAPH 2) serves to give some perspective on the current with historical water levels and is considered to give a good representation of the overall situation also at other stations. The graph of stations A7Sterkloop Waterland and A7Sterkloop Pump is also included as (GRAPH 8) to illustrate the fact.

1. BACKGROUND

This report gives a short oversight of the status and behavior of groundwater levels in the Limpopo Region over the past twelve months with focus on the effect of the past rainy season up to the 1st of February 2011. Some historic perspective is also given.

The distribution of monitoring stations used is given in (MAP1) This Office has only two monitoring points in the Crocodile west-Marico WMA but the data is not used for this report. There are a number of stations in the Olifants WMA, the data of which was used for the report but most are fairly new and has limited data available yet.

Monthly rainfall data from 126 rainfall recording stations distributed over Limpopo were supplied by the South African Weather Services (info@wearthersa.co.za) and is greatly appreciated.

2. THE PERIOD FEBRUARY 2010 TO FEBRUARY 2011

2.1. RAINFALL

The rainfall data was use to compile a rainfall distribution map representing the total rainfall received at each station over the past year. Lower rainfall, 160 to 600mm, was recorded along the western to northern Limpopo River border as well as in a small area bordering the Kruger National Park in the north east. The central and south eastern part of the province received higher rainfall ranging from 600 to 900 mm. The area along the escarpment from the south up to Thoyandou received high rainfall from 900mm to more than 1400mm with Tzaneen approximately in the middle of the highest rainfall area receiving above 1400mm (MAP 2)

2.2. COMPARISON BETWEEN RAINFALL AND PATTERNS IN GROUNDWATER LEVEL BEHAVIOUR (MAP 3)

The water level at some stations, especially in fractured aquifers, has normal 6-hourly and monthly cyclic rising and falling trends that may be as much as 15cm per day. Water seeping down the borehole wall, roots penetrating along the sides and calibration of equipment may affect the accuracy of hand measurements. Electronic data collected from loggers might require some drift correction but it is not done for closing errors less than 10 cm for reasons as stated above. Also, a difference of 10 cm is not considered significant when dealing with mostly reference conditions over a considerable time period. For these reasons, all differences less than 10 cm, either lower or higher, were ignored when compiling a map indicating the spatial distribution of stations with higher or lower water levels. It was found that these small differences completely overshadow the underlying bigger trend.

The positions, indicating either higher or lower levels were overlain on the rainfall distribution map. The few stations indicating lower groundwater levels despite being in the high rainfall area are all showing effects of local abstraction in the respective area. A few stations, especially along the Limpopo River in the north, have higher water levels despite receiving relative low rainfall. The differences in all cases are however small. These trends may indicate recharge from elsewhere and not from local rainfall.

In an attempt to delineate behavior patterns, polygons were drawn around groups of stations with the same trends as well as areas of no data or measuring stations. Generally a good correlation can be drawn between rainfall and groundwater level trends.

Using all data irrespective of the magnitude in difference, the following is the case from February to February:

- Stations with data for the year: 144
- Lower water levels: 52 (36.1%) Average: -0.5m lower
- Higher water levels: 92 (63.9%) Average: 1.37m higher
- 144 Stations overall: Average: 0.67m higher

3. THE PERIOD NOVEMBER 2010 TO FEBRUARY 2011

3.1. THE RESPONSE OF GROUNDWATER LEVELS TO RAINFALL RECEIVED (MAP 4)

The same principles and method were applied to compile a similar map focusing on the period from 1 November 2010 to 1 February 2011. The period represents the start to midway of the current rainy season. Due to the shorter period used the total rainfall is less and different ranges had to be used to gain a clear picture. The number of stations with water level differences of 10cm or less is considerable which account for the smaller number of stations depicted on this map compared to the total station distribution indicated on MAP 1.

Most of the stations indicate higher water levels since the start of the rainy season and this trend is mostly well represented over the Province. No discernable pattern can be found for those with lower water levels as it is scattered over the Province. The magnitude of difference can be seen on the map and is written in red. Most declines are very small and fall between 10 and 20cm. The names of stations indicating more significant decline was added to the map and can be explained as follows:

- Kromhoek: Water levels in the area are affected by pumping for the new Alldays groundwater supply water scheme. A time series graph for A6 Kromhoek is included as GRAPH 1. The effects of pumping especially since October 2010 can be clearly seen. Monitoring of this and some other stations in this area will have to done regularly.
- Vlakfontein: Water levels in the area are affected by pumping for community supply but not seriously.
- Papkuil: Water levels in the area are seasonally affected by pumping for irrigation.
- Seshego: Water levels in the area are affected by pumping by Polokwane Municipality.
- Volspruit: Water level at this station in the Nile River Valley is characterized by large seasonal fluctuations and the current decline is no reason for concern. A time series graph of A6 Volspruit is included as GRAPH 2.

The effect of high rainfall can be clearly seen from some values indicated on the map in the central high rainfall area. Rise in water levels vary from 2.95 to 6.26m.

The groundwater level response to rainfall is better illustrated in (GRAPHS 3 to 7) Rainfall and groundwater level response graphs were complied for some stations from different areas. The nearest rainfall station with data for all four months was used. The positions of rainfall and groundwater monitoring stations is depicted on (MAP 5)

Station B7Julesburg2 (GRAPH 3)
Rainfall data from the station “New Agatha Bos” some 26 km away that received 1343mm of rain over the four months was used. The water level at B7Julesburg2 rose by 2.9m and the relation between rainfall and water level is clear with the groundwater level starting to rise from the first rains.

Station B7Penge (GRAPH 4)

Rainfall data from the station "New Agatha Bos" some 49 km away was also used. The water level at B7Penge rose by 6.26m. The groundwater level started to rise later but then rose significantly.

Note that vertical scales of 5 and 10m for the water level were used for Julesburg and Penge respectively.

Station A5Setateng (GRAPH 5)
Rainfall data from the station "Villa Nora Police Station" less than 2km away that received 242.5mm of rain was used.
This station falls within the lower rainfall area that received 18% of the rainfall at the previous station but the same rising trend corresponding with rainfall can be seen although the water level only rose by 0.68m.

Station A9Tshirunzini (GRAPH 6)
Rainfall data from the station "Folonhodwe" some 25 km away that received 493mm of rain used.
The water level did rise very slightly after December but is still 10cm lower than November.
The nature of the fractured aquifer of the Soutpansberg quartzite in this area place doubt on the role of local recharge of groundwater and some late recharge from the higher lying and higher rainfall area to the south may still manifest.

Note that the vertical scale for water level is 2.5m to enable the trend to be clear

Station A8Mabvete
Rainfall data from three different stations is used for comparison.

- Folonhodwe 19 km west that received 493mm of rain
- Tshipise 45km west that received 311mm of rain
- Teba Pafuri 75 km east that received 295mm of rain

Despite some good precipitation at the nearest station Folonhodwe in December the water level at this station keep the very slow declining trend. As with Tshirunzini, this cast some doubt about the importance of local recharge in this area.

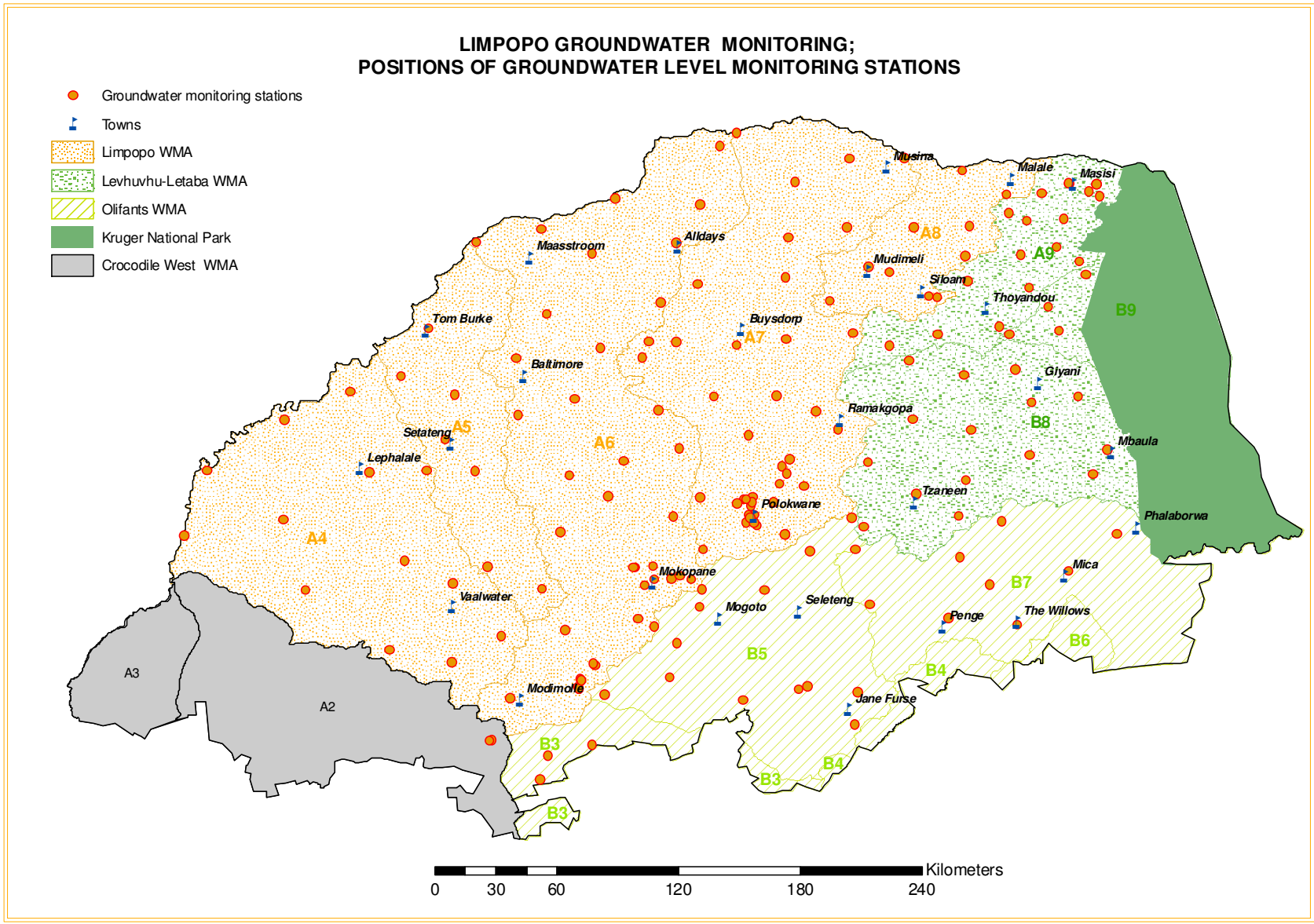
Note that the vertical scale for water level is only 0.25m to enable the trend to be clear

Using all data irrespective of the magnitude in difference the following is the case from November to February

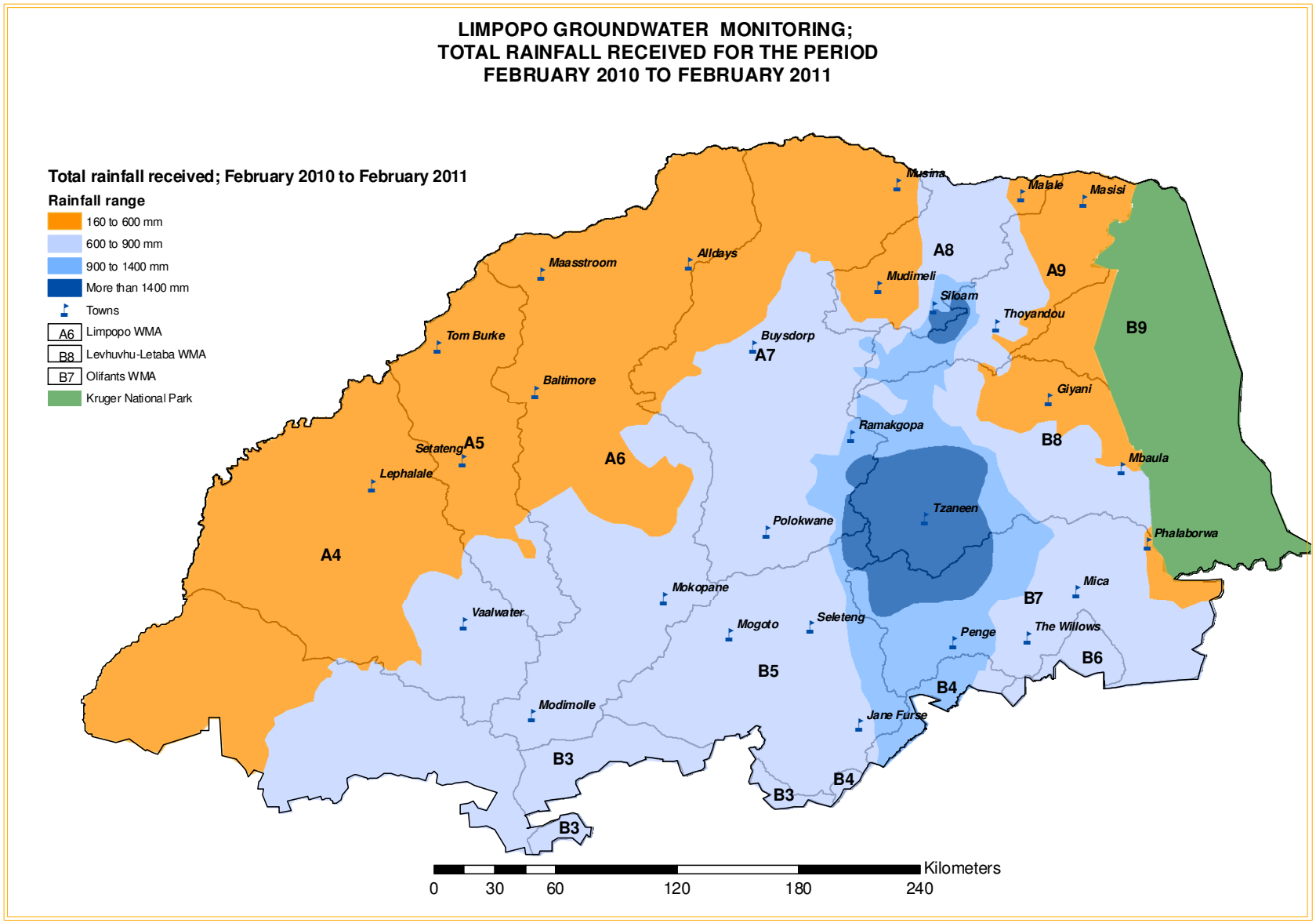
- Stations with data for the three months: 153
- Lower water levels: 40 (26.1%) Average: -0.24m lower
- Higher water levels: 113 (73.9%) Average: 1.27m higher
- 153 Stations overall: Average: 0.87m higher

4. ACKNOWLEDGEMENT

4.1 info@weathersa.co.za (Monthly rainfall data for Limpopo Province)

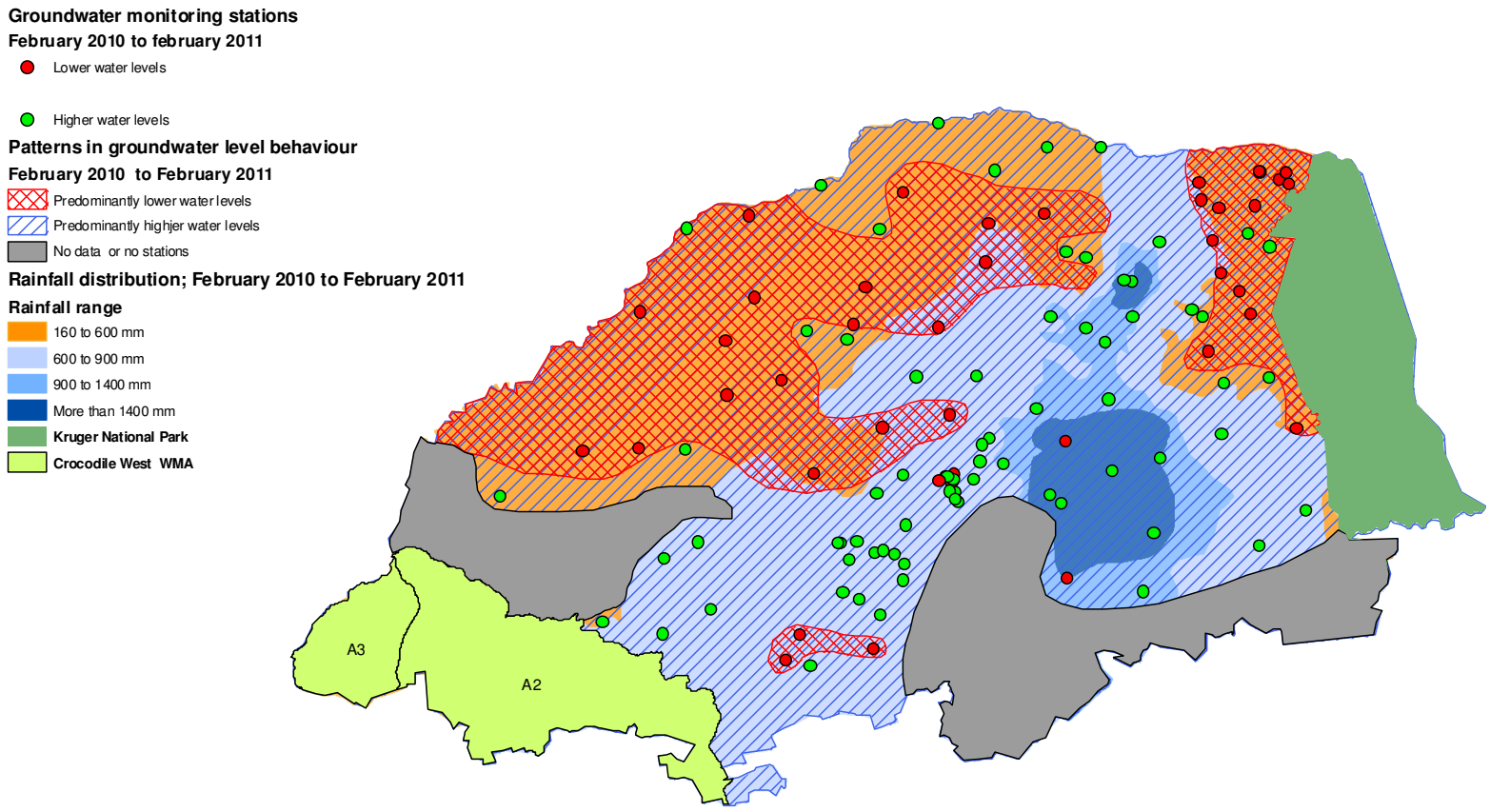

LIMPOPO GROUNDWATER MONITORING;
POSITIONS OF GROUNDWATER LEVEL MONITORING STATIONS
Groundwater monitoring stations
Towns
Limpopo WMA
Levhuvhu-Letaba WMA
Olifants WMA
Kruger National Park
Crocodile West WMA
Musina
Malale
Masisi
Maasstroom
Alldays
Mudimeli
Siloam
Thoyandou
Tom Burke
Buysdorp
Baltimore
Giyani
Ramakgopa
Setateng
Lephalale
Mbaula
Tzaneen
Polokwane
Phalaborwa
Mokopane
Mica
Vaalwater
Mogoto
Seleteng
Penge
The Willows
Modimolle
Jane Furse
A1
A2
A3
A4
A5
A6
A7
A8
A9
B1
B2
B3
B4
B5
B6
B7
B8
B9
Kilometers
0
30
60
120
180
240

MAP 1

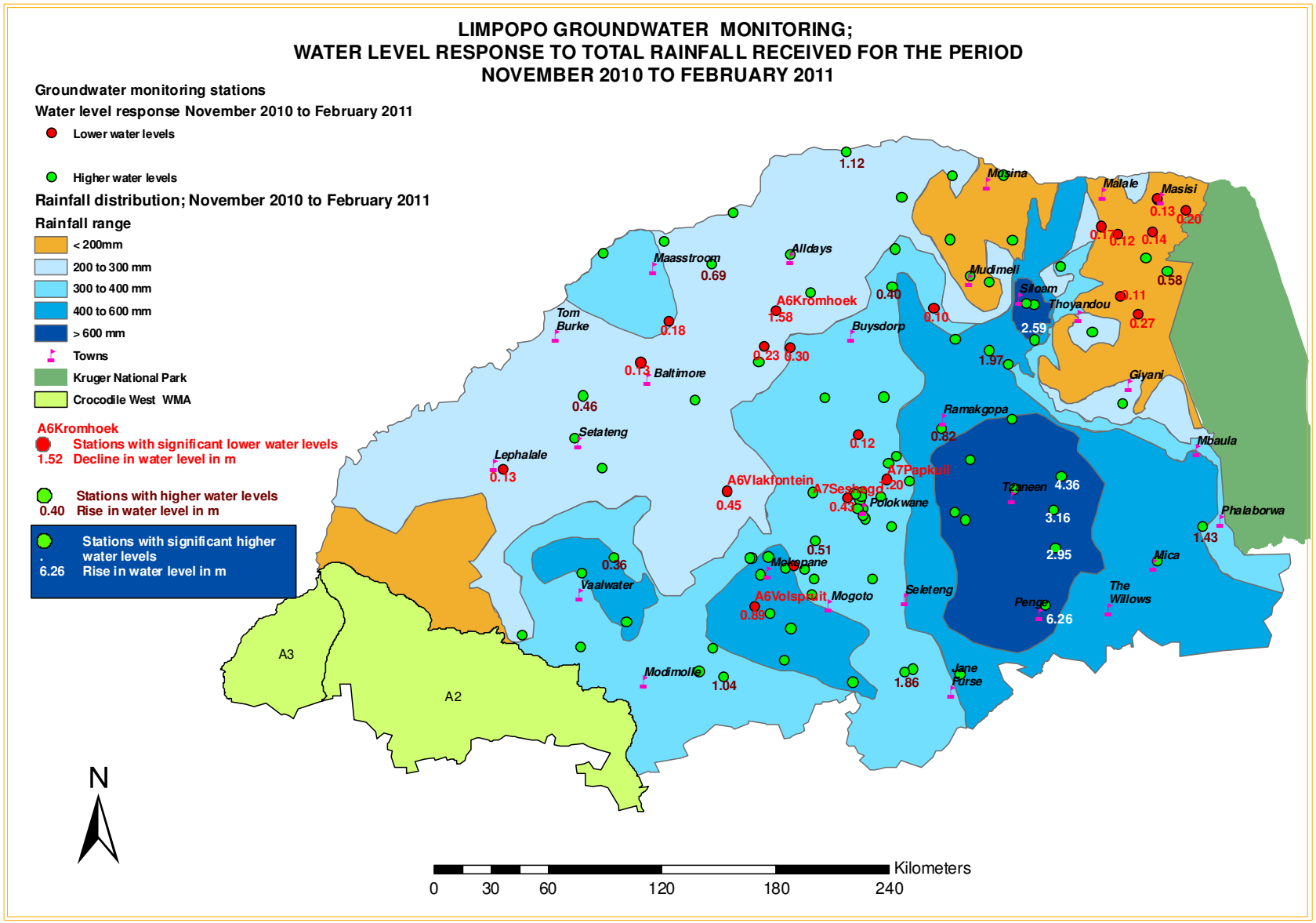

LIMPOPO GROUNDWATER MONITORING;
TOTAL RAINFALL RECEIVED FOR THE PERIOD
FEBRUARY 2010 TO FEBRUARY 2011
Total rainfall received; February 2010 to February 2011
Rainfall range
160 to 600 mm
600 to 900 mm
900 to 1400 mm
More than 1400 mm
Towns
A6 Limpopo WMA
B8 Levhuvhu-Letaba WMA
B7 Olifants WMA
Kruger National Park
Musina
Malale
Masisi
Maasstroom
Alldays
Mudimeli
Siloam
Thoyandou
Tom Burke
Buysdorp
Giyani
Baltimore
Ramakgopa
Setateng
Lephalale
Mbaula
Tzaneen
Polokwane
Phalaborwa
Mokopane
Mica
Vaalwater
Mogoto
Seleteng
Penge
The Willows
Modimolle
Jane Furse
A4
A5
A6
A7
A8
A9
B3
B4
B5
B6
B7
B8
B9
Kilometers
0
30
60
120
180
240

MAP 2

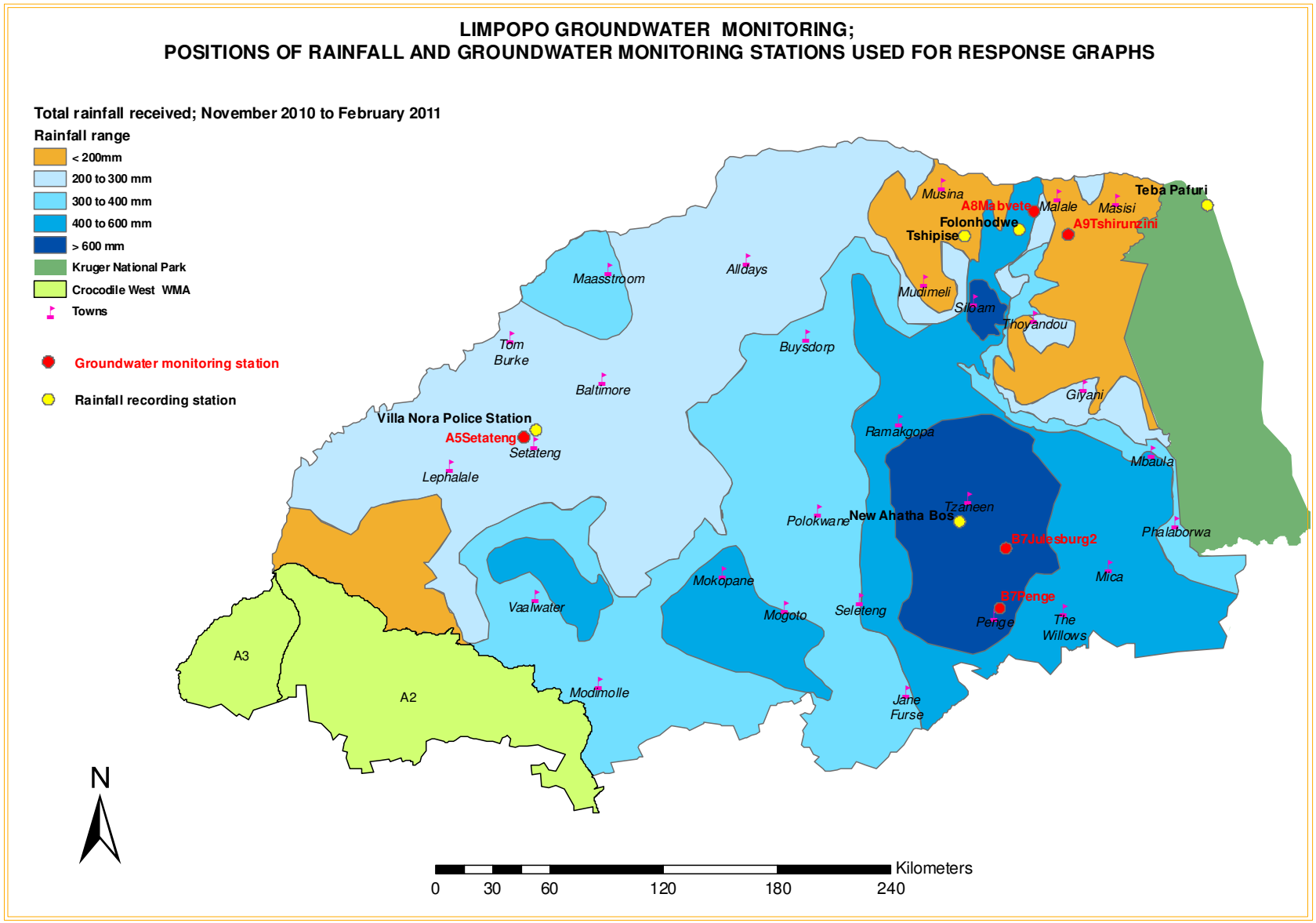
LIMPOPO GROUNDWATER MONITORING;
PATTERNS IN GROUNDWATER LEVEL BEHAVIOUR VERSUS TOTAL RAINFALL RECEIVED
FEBRUARY 2010 TO FEBRUARY 2011



MAP 3

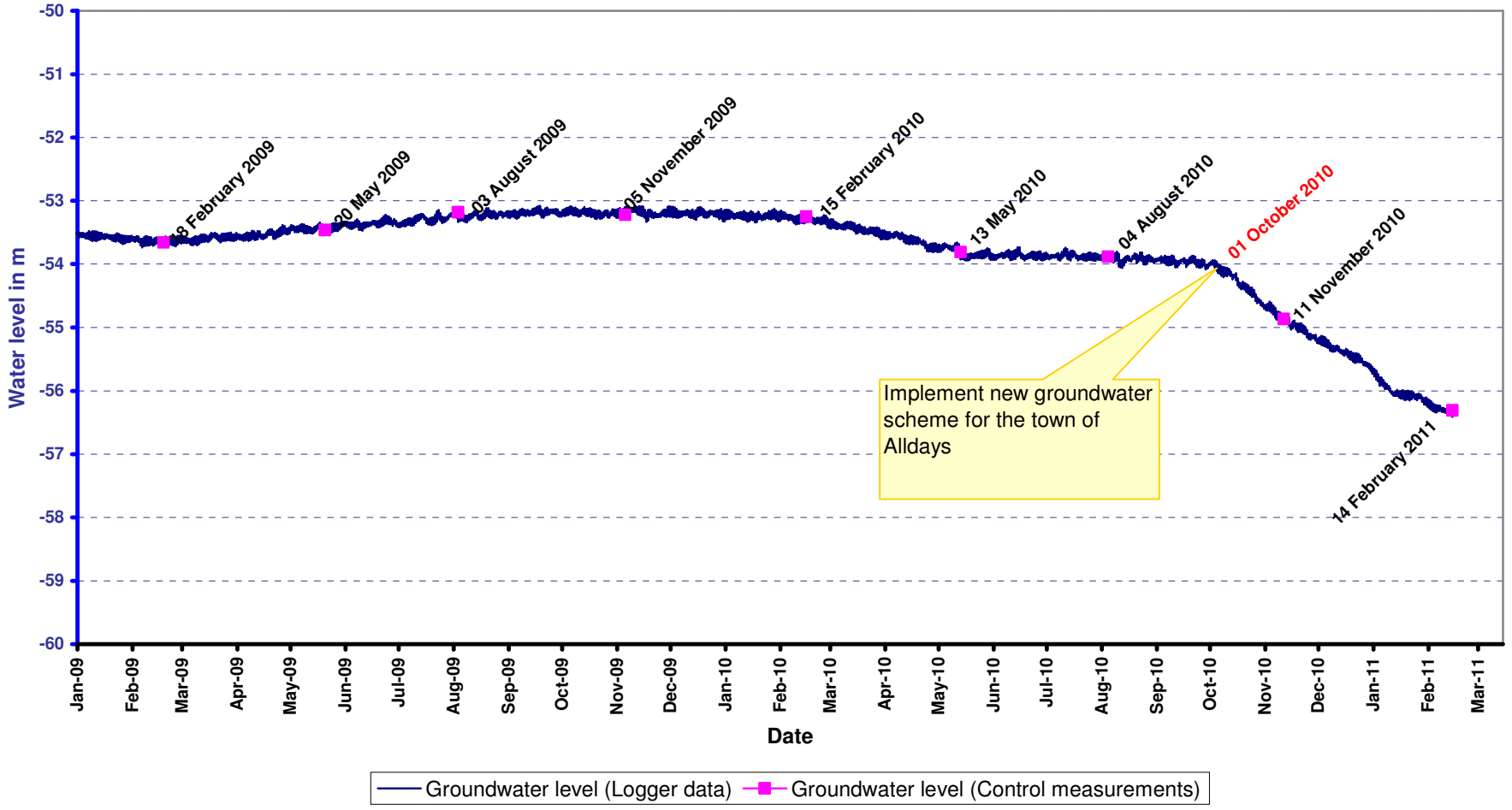

LIMPOPO GROUNDWATER MONITORING;
WATER LEVEL RESPONSE TO TOTAL RAINFALL RECEIVED FOR THE PERIOD
NOVEMBER 2010 TO FEBRUARY 2011
Groundwater monitoring stations
Water level response November 2010 to February 2011
Lower water levels
Higher water levels
Rainfall distribution; November 2010 to February 2011
Rainfall range
< 200mm
200 to 300 mm
300 to 400 mm
400 to 600 mm
> 600 mm
Towns
Kruger National Park
Crocodile West WMA
A6Kromhoek
Stations with significant lower water levels
1.52 Decline in water level in m
Stations with higher water levels
0.40 Rise in water level in m
Stations with significant higher water levels
6.26 Rise in water level in m
Musina
Malale
Masisi
Maasstroom
Alldays
Mudimeli
Siloam
Thoyandou
A6Kromhoek
Tom Burke
Buysdorp
Giyani
Baltimore
Ramakgopa
Setateng
Mbaula
Lephalale
A6Vlakfontein
A7Papkuil
A7Seshego
Polokwane
Tzaneen
Phalaborwa
Mica
Molepane
Vaalwater
A6Volspoit
Mogoto
Seleteng
Penge
The Willows
Modimolle
Jane Furse
A3
A2
N
Kilometers
0
30
60
120
180
240

MAP 4

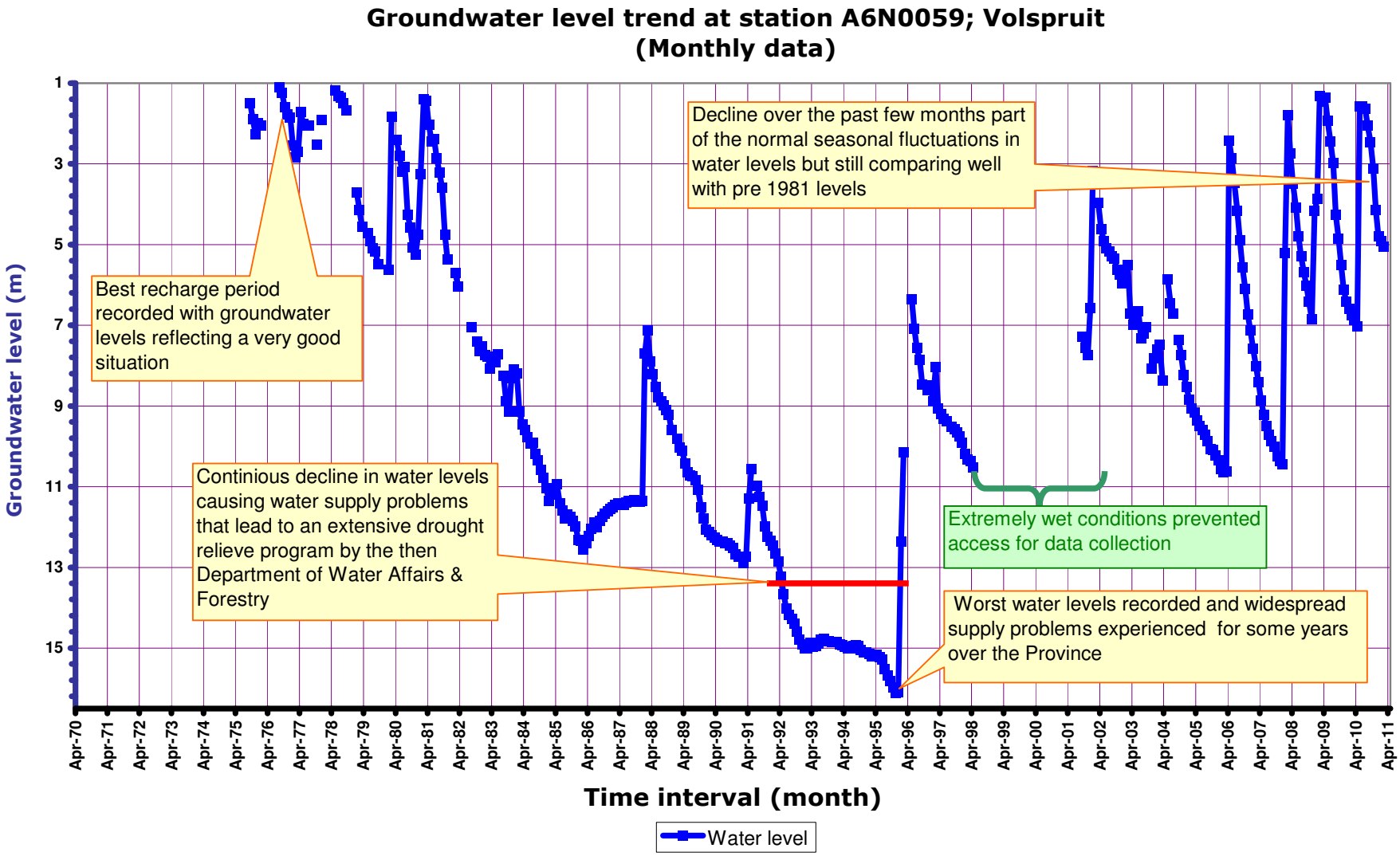

LIMPOPO GROUNDWATER MONITORING;
POSITIONS OF RAINFALL AND GROUNDWATER MONITORING STATIONS USED FOR RESPONSE GRAPHS
Total rainfall received; November 2010 to February 2011
Rainfall range
< 200mm
200 to 300 mm
300 to 400 mm
400 to 600 mm
> 600 mm
Kruger National Park
Crocodile West WMA
Towns
Groundwater monitoring station
Rainfall recording station
Musina
A8Mabyeto
Malale
Masisi
Teba Pafuri
Folonhodwe
A9Tshirunzini
Tshipise
Maasstroom
Alldays
Mudimeli
Siloam
Thoyandou
Tom Burke
Buysdorp
Baltimore
Giyani
Villa Nora Police Station
A5Setateng
Setateng
Ramakgopa
Mbaula
Lephalale
Tzaneen
New Ahatha Bos
Polokwane
B7Julesburg2
Phalaborwa
Mica
Mokopane
B7Penge
Vaalwater
Mogoto
Seleteng
Penge
The Willows
A3
A2
Modimolle
Jane Furse
N
Kilometers
0
30
60
120
180
240

MAP 5

Groundwater level trend at station A6N0579 Kromhoek
(Hourly data)

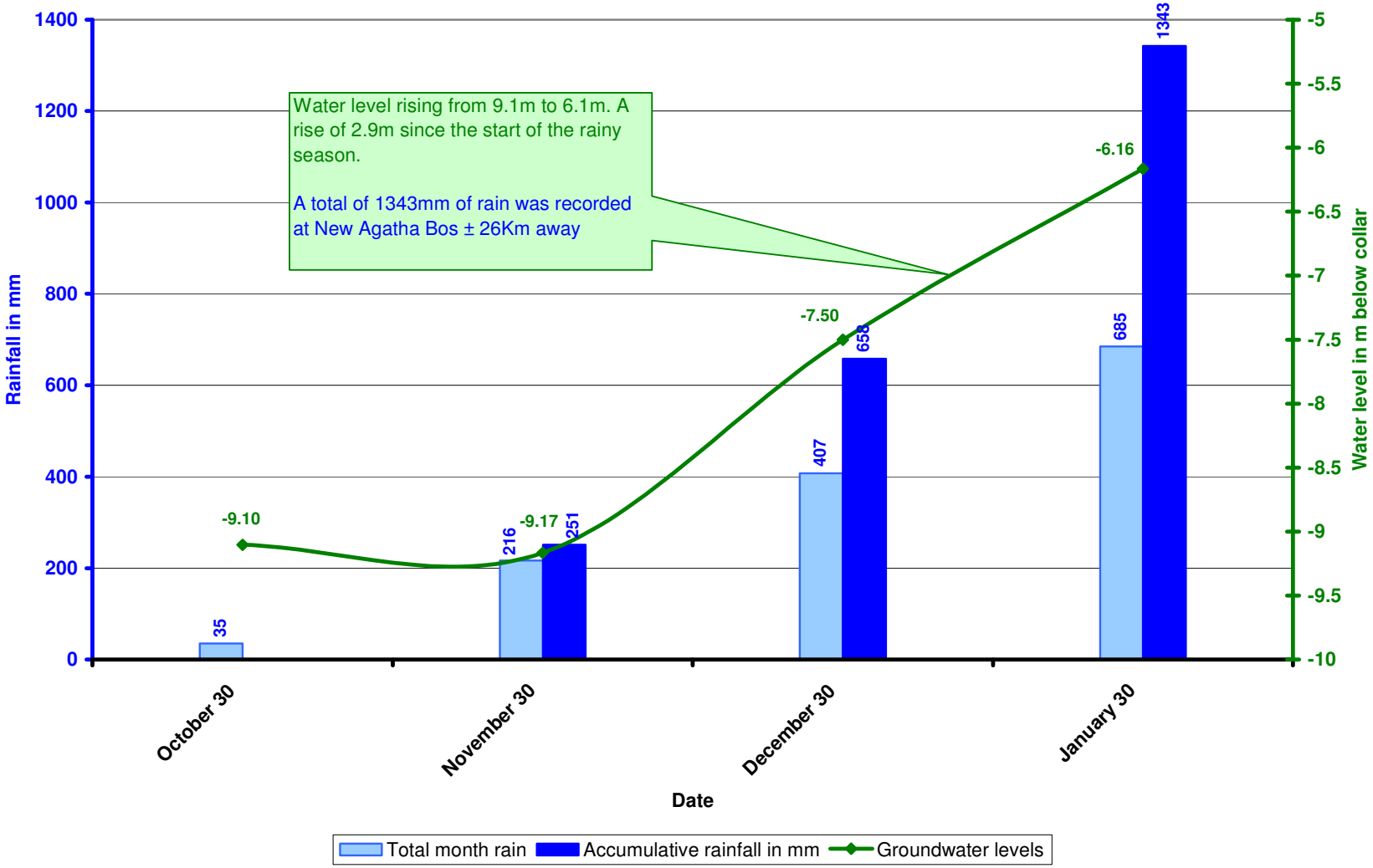


GRAPH 1


Groundwater level trend at station A6N0059; Volspruit
(Monthly data)
Groundwater level (m)
1
3
5
7
9
11
13
15
Best recharge period recorded with groundwater levels reflecting a very good situation
Decline over the past few months part of the normal seasonal fluctuations in water levels but still comparing well with pre 1981 levels
Continious decline in water levels causing water supply problems that lead to an extensive drought relieve program by the then Department of Water Affairs & Forestry
Extremely wet conditions prevented access for data collection
Worst water levels recorded and widespread supply problems experienced for some years over the Province
Apr-70
Apr-71
Apr-72
Apr-73
Apr-74
Apr-75
Apr-76
Apr-77
Apr-78
Apr-79
Apr-80
Apr-81
Apr-82
Apr-83
Apr-84
Apr-85
Apr-86
Apr-87
Apr-88
Apr-89
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Apr-05
Apr-06
Apr-07
Apr-08
Apr-09
Apr-10
Apr-11
Time interval (month)
Water level

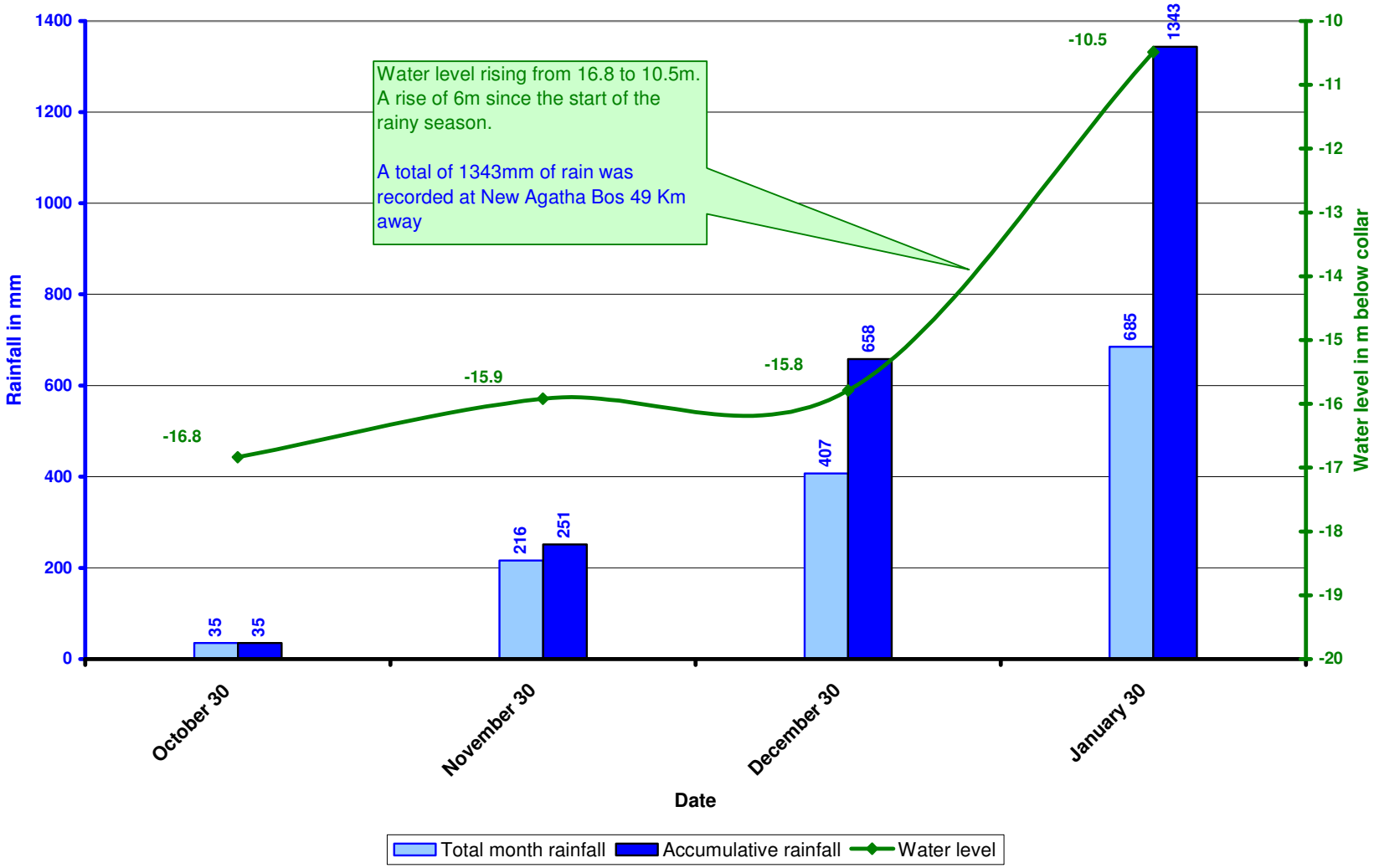
GRAPH 2

Groundwater level response at Station B7N0005 Julesburg 2 to rainfall at New Agatha bos rainfall station

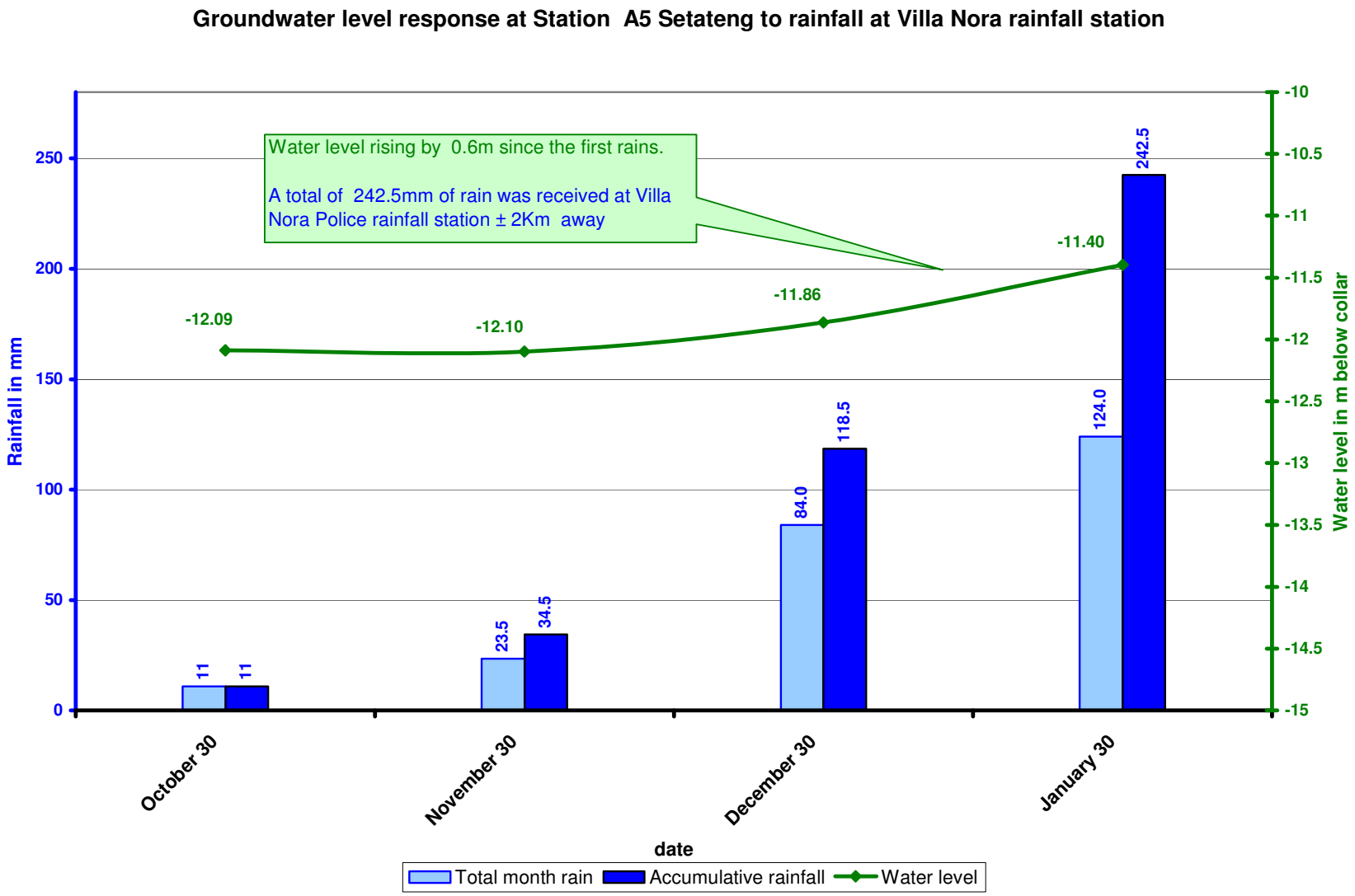


GRAPH 3

Groundwater level response at Station B7 Penge to rainfall at New Agatha Bos rainfall station

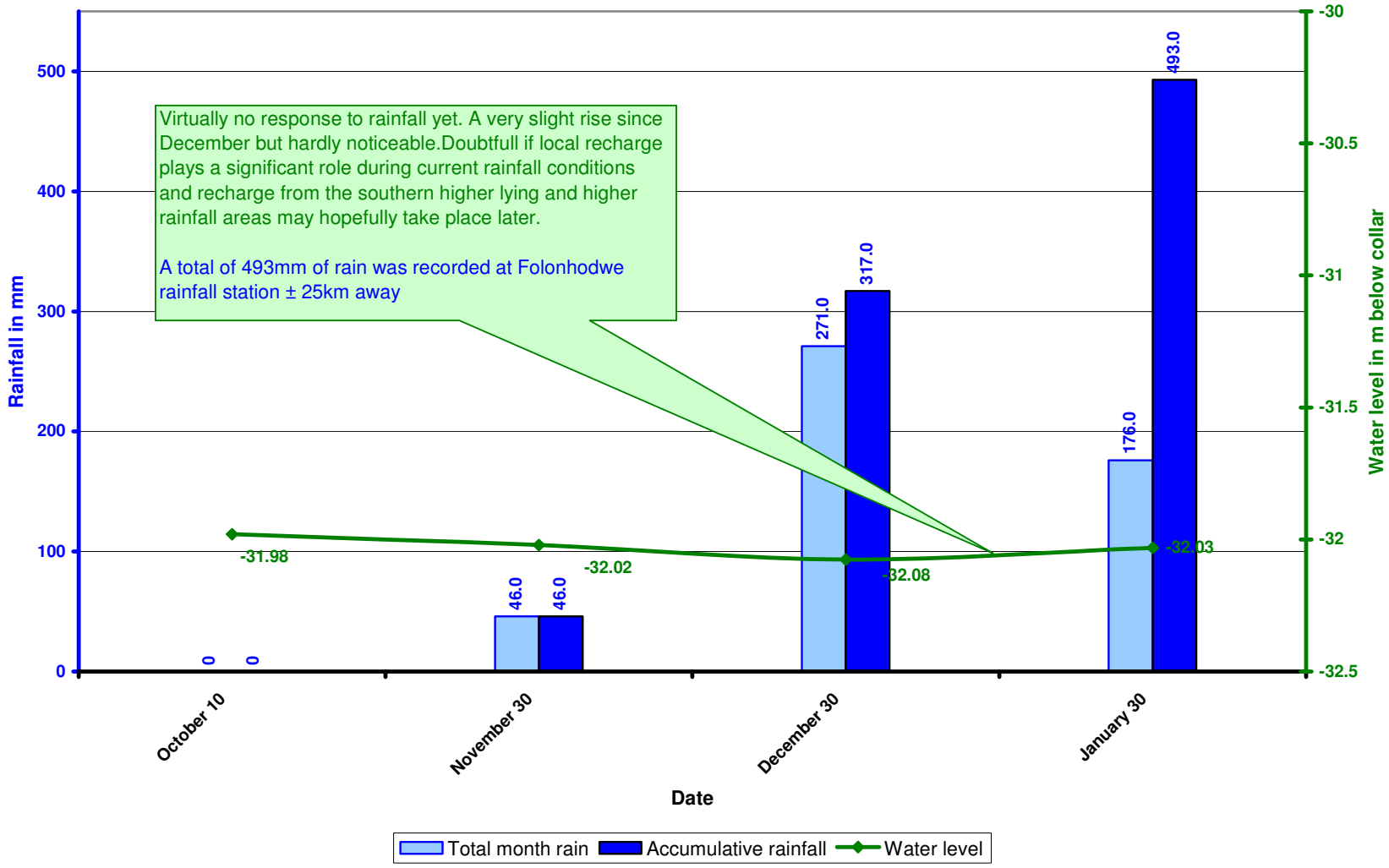


GRAPH 4


Groundwater level response at Station A5 Setateng to rainfall at Villa Nora rainfall station
Water level rising by 0.6m since the first rains.
A total of 242.5mm of rain was received at Villa Nora Police rainfall station ± 2Km away
Rainfall in mm
Water level in m below collar
250
200
150
100
50
0
-10
-10.5
-11
-11.5
-12
-12.5
-13
-13.5
-14
-14.5
-15
-12.09
-12.10
-11.86
-11.40
11
11
23.5
34.5
84.0
118.5
124.0
242.5
October 30
November 30
December 30
January 30
date
Total month rain
Accumulative rainfall
Water level

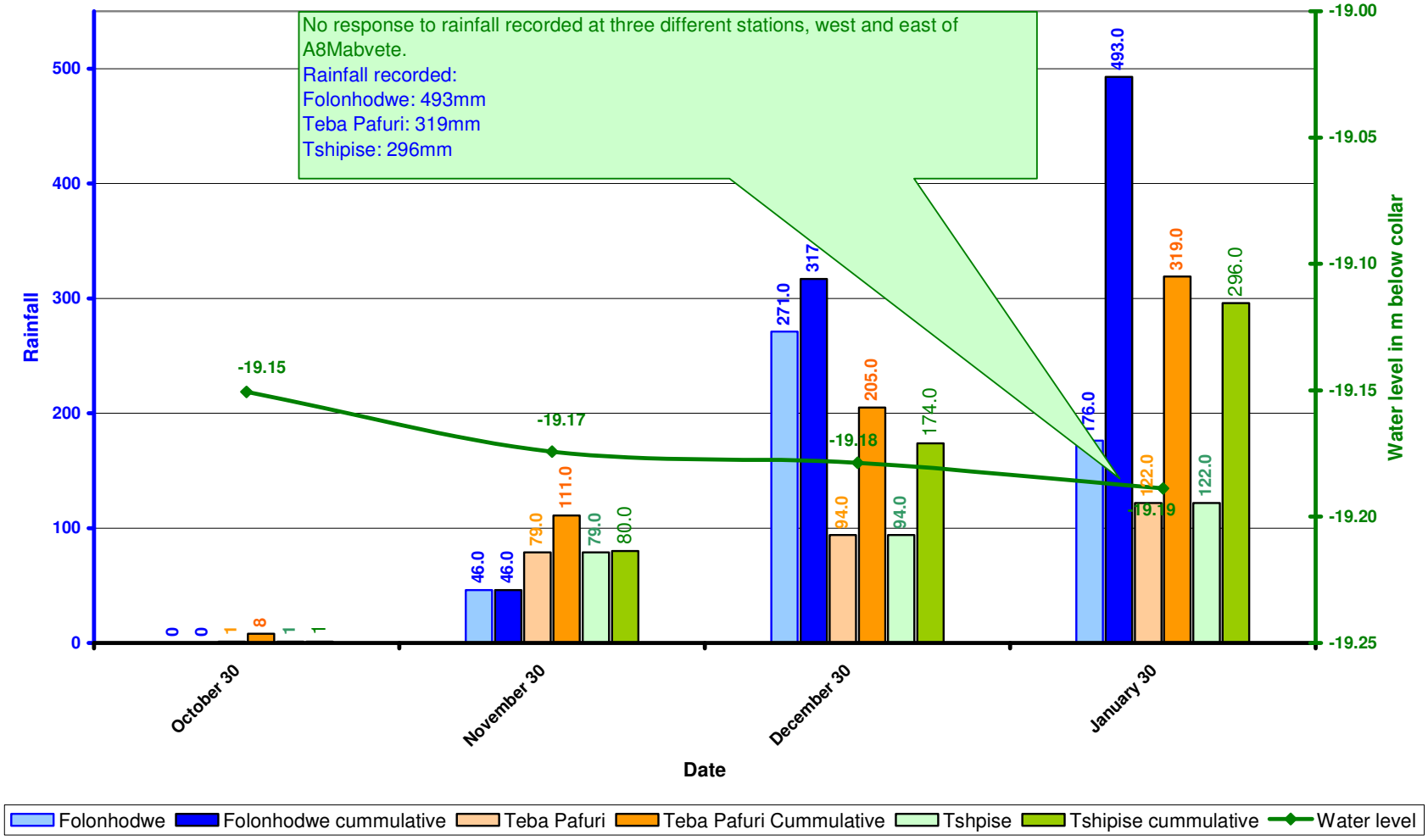
GRAPH 5

Groundwater level response at Station A90001 Tshrunzini to rainfall at Folonhodwe rainfall station



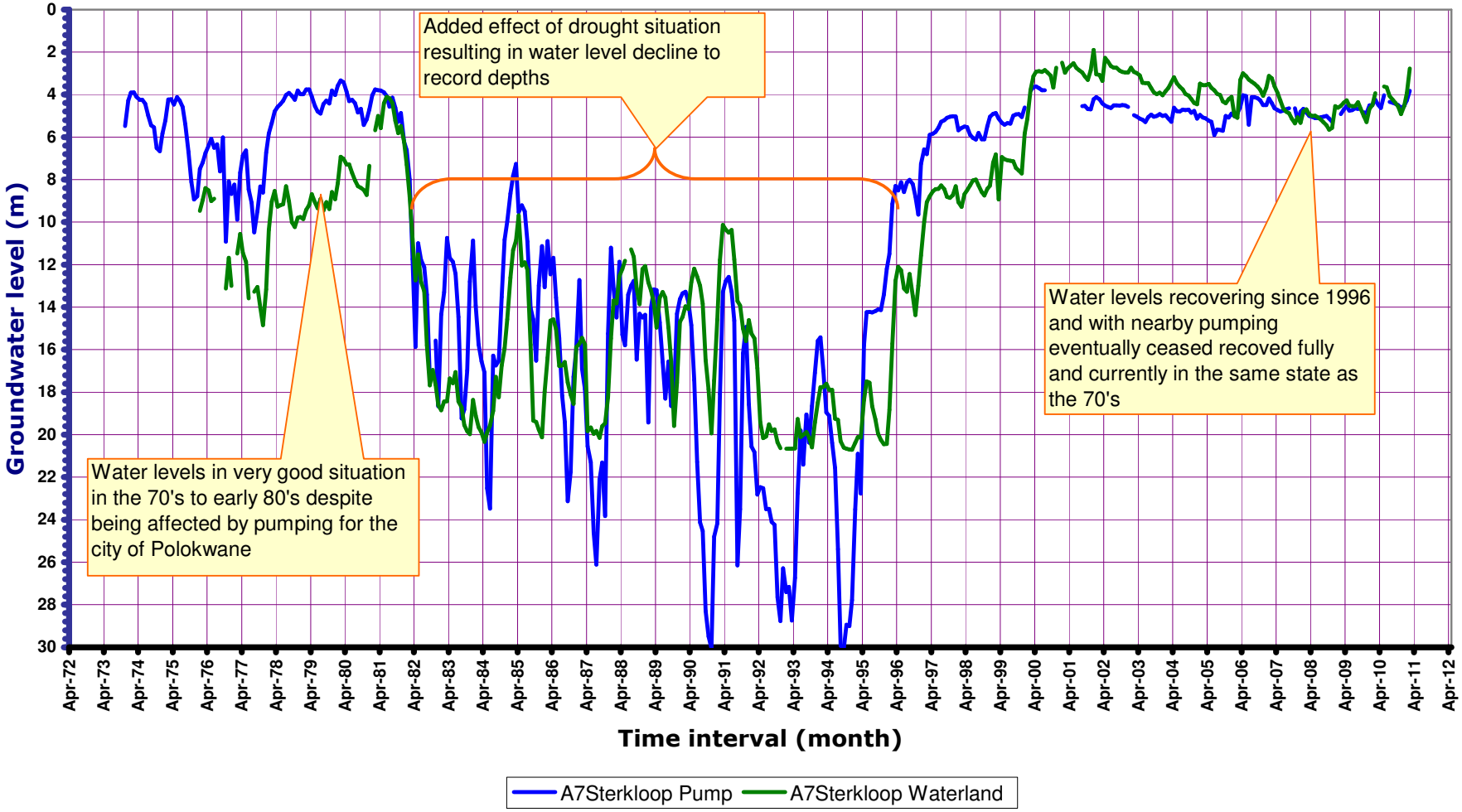
GRAPH 6

Groundwater level response at station A8N0506 Mabvete to rainfall at stations Folonhodwe, Tshipise and Teba Pafuri



GRAPH 7

Groundwater level trend at stations A7N0538; Sterkloop pumpstation and A7N0569; Sterkloop Waterland



GRAPH 8