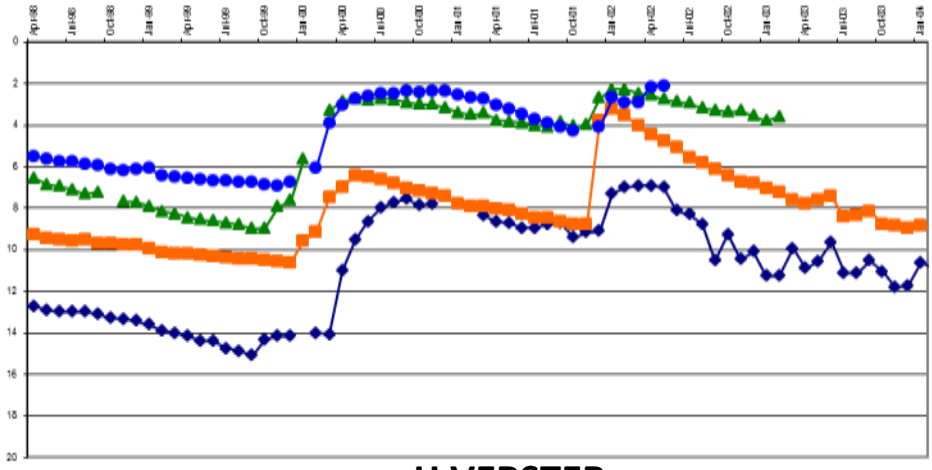
water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

LIMPOPO REGION

QUARTERLY STATUS REPORT ON GROUNDWATER LEVEL TRENDS



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DIRECTORATE
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JUNE 2017

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SUMMARY

The end of March, of which the status is discussed in the report, marks the end of the rainy season in Limpopo. Good rainfall occurred over most of the province during January 2017. The months of February and March were however disappointingly dry which resulted in very limited groundwater recharge for the season. Rainfall for the season as a whole varies from slightly below to slightly above normal. Some recharge did take place but groundwater levels at 64% of stations monitored indicate lower water levels than that of the corresponding time last year and 36% are higher. Available long-term data indicates that the status of the resource is still good in most areas. Total absence of recharge in some areas for up to 10 years now is a concern but no long-term data is available for these areas to accurately evaluate the situation. Over abstraction and poor, or no management, is causing severe stress on aquifers in some localities.

Monitoring data clearly reveals the impacts due to lack of groundwater management as well as that due to lack of recharge. The widespread dependency on groundwater as only source in the province stresses the importance of resource management. Corrective steps after aquifer failure is of little use to those without water. There is no “quick fix” for failed aquifers.

1 BACKGROUND

The status of groundwater levels as on 31 March 2017, the end the wet season, is discussed. Groundwater level data was collected during April and May 2017. Comparison is drawn between the status after and before the wet season as well as the corresponding time last year. Groundwater level trends are discussed per secondary drainage area and monitoring stations with similar groundwater level trends are grouped and delineated as an area. The distribution of the monitoring network is illustrated by (**FIGURE 1**)

2 GROUNDWATER LEVELS

Differences in groundwater levels for monitoring stations with data available for both dates in question is summarised below.

2.1 DIFFERENCE IN GROUNDWATER LEVELS; 1 OCTOBER 2016 TO 31 MARCH 2017

Data for both dates are available for 148 (76.7%) of all monitoring stations. Recharge the past wet season is indicated at 96 (64.9%) of these stations, where levels are higher than before the wet season. The levels at 52 stations (35.14%) are lower indicating a lack of recharge **(TABLE 1)**

The distribution of stations with lower or higher groundwater levels are indicated on **(FIGURE 2)**

Stations where no recharge is notable are distributed over the whole province. One area where a concentrated number of such stations occur can be recognised. It consists mainly of the A7 drainage and the northern part of the A8 drainage **(FIGURE 3)**

1 October 2016 to 31 March 2017	
Total stations visited	193

With data	148 Stations	76.7%

Water level	Number of stations	Average(m	%
Down	52 Stations	0.33	35.14%
Up	96 Stations	1.06	64.86%
No change	0 Stations		0.00%
No Data	45 Stations		
Total	**193**		**100.00%**

TABLE 1

2.2 DIFFERENCE IN GROUNDWATER LEVELS; 31 MARCH 2016 TO 31 MARCH 2017

Groundwater level data for the period is available for 181 (93.8%) of all stations. Lower groundwater levels than the corresponding time last year is indicated at 115 (63.5%) of stations with data available. The average decline is 1.m. **(TABLE 2)** Despite some recharge indicated at 64.8% of monitoring stations at the past season, is the majority of levels still lower than last year. Recharge was not sufficient to compensate for the drought impact. The distribution of monitoring stations with higher or lower groundwater levels is illustrated by (**FIGURE 4**)

31 March 2015 to 31 March 2016	
Total stations visited	193

With data	181 Stations	93.8%

Water level	Number of stations	Average(m	%
Down	115 Stations	-1	63.54%
Up	66 Stations	1.1	36.46%
No change	0 Stations		0.00%
No Data	12 Stations		
Total	**193**		**100.00%**

TABLE 2

3 GROUNDWATER LEVEL TRENDS IN THE DIFFERENT SECONDARY DRAINAGE AREAS

Groundwater level trends can differ over short distances but may also display similar trends over considerable distances or areas. Similar trends are not bound by surface drainage divides but is discussed per secondary drainage area. Monitoring stations displaying similar groundwater level trends, if present, are grouped to delineate areas in each secondary drainage. Trends at some stations does not conform with any other in the area due to various reasons such as local recharge events, abstraction impacts, stream flow interaction etc. Due to the large difference in depth to water level as well as the difference in magnitude of fluctuations it is difficult to present all figures on the same vertical scale for comparison purposes but an attempt was made to do so where possible.

3.1 DRAINAGE AREA A4

Two distinct trends concentrated in two areas can be recognised **(FIGURE 5)**

3.1.1 AREA 1

Area 1 is located in the downstream part of the drainage. Seasonal fluctuations are mostly absent or very limited. Groundwater levels indicate stable conditions with a very slow declining trend over time. The maximum decline recorded over 9 years of monitoring is 2meters and the status is still considered good **(FIGURE 6)**

3.1.2 AREA 2

This area is in the upstream part of the drainage. Very prominent seasonal fluctuations with no underlying rise or fall is displayed until January 2015. Where after, despite some recharge late in the 2015-16 season, levels kept declining. The water level at one station, A4 Mokolo Poerse Loop 2, recovered completely this season **(FIGURE 7)**

Groundwater level trend at A4 Southeast Lephalale differs from the above and is similar to that in area 1 of the A5 drainage as discussed below.

3.2 DRAINAGE AREA A5

Two areas of similar trends can also be noted here **(FIGURE 8)**

3.2.1 AREA 1

The area is located in the downstream part as well and displays a similar trend as that in the downstream of the A4 drainage, except that the decline in water levels are more prominent with a maximum decline of 4 meter. The lack in efficient recharge over a period of 9 years is a concern. Unfortunately is no long-term data available to make an accurate evaluation of the current status **(FIGURE 9)**

3.2.2 AREA 2

A stable condition with normal seasonal fluctuation is indicated by the water levels in the upstream area of the A5 drainage. The effect of no recharge the past two seasons is also notable here but the status is still considered good **(FIGURE 10)**

3.3 DRAINAGE AREA A6

In this drainage three different areas with similar groundwater level trends occurs **(FIGURE 11)**

3.3.1 AREA 1

Area 1, in the north western part of the drainage, displays a constant decline similar to that displayed in the adjacent part of the A5 drainage. As in the A5, is no long-term data available to make an accurate evaluation of the current status **(FIGURE 12)**

3.3.2 AREA 2

Area 2, is located in the north eastern part of the A6 drainage. Groundwater levels indicated stable conditions up to January 2013 after which a high rainfall event caused a considerable recharge. Some water levels are still at this high with some slowly returning to the original level and the status is considered healthy **(FIGURE 13)**

3.3.3 AREA 3

Area 3 consists of the southern half of the drainage. Groundwater levels in the area display seasonal fluctuations with stable conditions indicating a healthy status. The 2-year decline already noted can also be observed here **(FIGURE 14).**

3.4 DRAINAGE AREA A7

Four different groundwater level trends confined to specific areas were identified for the drainage **(FIGURE 15)**

3.4.1 AREA 1

Both stations are located next to the Limpopo River and display sudden sharp fluctuations which may be related to river flow as well as effects of abstraction at A7 Antonvilla **(FIGURE 16)**

3.4.2 AREA 2

Area 2 is located in the northern part of the drainage. Groundwater level trends corresponds with that of the adjoining area 2 of the A6 drainage. Levels rose sharply during February 2013 and some are still high above the starting levels **(FIGURE 17)**

3.4.3 AREA 3

The area make up the central part of the A7 drainage. Some rise in water levels in 2013 and again in 2014 can be noted but levels are generally declining **(FIGURE 18)**

3.4.4 AREA 4

Area 4 is the southern part of the drainage and is characterised by stable conditions with seasonal fluctuations. The status is considered a healthy one **(FIGURE 19)**

3.5 DRAINAGE AREA A8 (FIGURE 20)

Similar groundwater level trends are displayed by all but one station, A8 Mabvete, in this drainage The status of groundwater in this drainage is considered the most favourable in Limpopo. Stable groundwater levels with normal seasonal fluctuations characterise the situation in the A8 drainage **(FIGURE 21)**

At A8 Mabvete the situation differs and the trend displayed is a constant decline **(FIGURE 22)**

3.6 DRAINAGE AREA A9

Three areas were identified and two boreholes not conforming with any trend due to abstraction impacts **(FIGURE 23)**

3.6.1 AREA 1

Area 1 is located in the northern, down stream, part of the drainage. Groundwater levels in this area indicated a steady but slow decline for the first 8 years of monitoring. Similar to the corresponding areas in the northern A6 and A7 drainage, significant recharge occurred in February 2013 after which the groundwater levels started to decline again. Long-term monitoring data is unfortunately not available to assist in evaluating the current status with any measure of confidence **(FIGURE 24)**.

3.6.2 AREA 2

Area 2 is the central part of the A9 drainage and groundwater levels are characterised by sudden large rises followed by slower declines due to normal outflow. The area consist of steep parallel mountains divided by narrow valleys and quick recharge responses is evident. The past two year decline can also be noted here. The current status is considered healthy in this part **(FIGURE 25)**

3.6.3 AREA 3

As noted in Part 3, it is not always possible to use the same vertical scale as some trends may not be recognisable. Fluctuations in area 3 are not as large as in area 2 but for comparison the same vertical scale was used **(FIGURE 26)**. At a smaller scale the trends appear very similar. Groundwater level trends in area 3, in the upstream part of the drainage, display stable conditions with normal seasonal fluctuations with the past 2 year decline also notable.

3.7 DRAINAGE AREA B3 (FIGURE 27)

There are four monitoring stations in the B3 drainage, two of which is close together. Groundwater around Tuinplaas and Settlers is highly impacted while natural conditions is indicated at De Kuil **(FIGURE 28)** The status of groundwater around Tuinplaas and Settlers represents a highly stressed aquifer.

3.8 DRAINAGE AREA B4 (FIGURE 29)

Only one monitoring station is located in this drainage and the groundwater level fluctuate around the median value with a slight underlying declining trend. The water level is impacted upon by nearby abstraction for community water supply **(FIGURE 30)**

3.9 DRAINAGE AREA B5

Two areas were identified, area 1 consisting of the northern half of the drainage and area 2 in the south west corner. Monitoring in the southern part started recently and no time series data is available yet **(FIGURE 31)**

3.9.1 AREA 1

Prominent peaks in groundwater levels can be noted at the 2 stations located on a dolomitic aquifer, B5 Portugal and B5 Modderfontein. Water levels generally indicate some seasonal fluctuations with a slight underlying declining trend at some. The status is considered good **(FIGURE 32)**

Impact by abstraction on the groundwater in area 2 is high with that at the town of Roedtan very severe **(FIGURE 33)** . Abstraction towards Klipput is for irrigation purposes and, although very notable, not as severe.

3.10 DRAINAGE AREA B7 (FIGURE 34)

Similar trends are displayed at all but one station, B7 Mica. Groundwater levels indicate normal seasonal fluctuation and stable conditions generally. A decline over the past 2 years is also indicated here **(FIGURE 35)**

At B7 Mica groundwater level rose by more than 20 meter since 2010. The reason for this is attributed 2 factors. Firstly discontinuing of large scale abstraction for irrigation purposes. The subsequent recovery were secondly boosted and sustained by some good rainfall seasons and intense rainfall incidents **(FIGURE 36)**

3.11 DRAINAGE AREA B8

Contrary to the situation found in most drainages where different trends for the upstream and down stream areas are indicated, the B8 is dived by the 2 tertiary drainage areas, B82 in the north (Area 1)and the B81 in the south (Area 2) **(FIGURE 37)**

3.11.1 AREA 1

The area is drained by the Klein Letaba system before the confluence with the Great Letaba River. Groundwater level trends is characterised by a constant decline with no apparent seasonal recharge **(FIGURE 38)**

3.11.2 AREA 2

The area is drained by the Great Letaba River, groundwater levels display stable conditions with regular seasonal fluctuations. The groundwater level status is considered to be healthy in this area **(FIGURE 39)**

3.12 DRAINAGE AREA B9 (FIGURE 40)

There are 4 monitoring stations in this drainage with all indicating similar trends of a constant decline. Some seasonal fluctuations are present except at B9 Halahala **(FIGURE 41)** Long-term data necessary to evaluate the true status unfortunately does not exist.

4 RAINFALL

4.1.1 PERCENTAGE OF NORMAL RAINFALL; JULY 2016 TO MARCH 2017

Figure 1, compiled by the South African Weather Services indicate that rainfall varied from slightly below to slightly above normal over the province. No exceptional rainfall occurred in any area **(FIGURE 42)**

5 IMPORTANCE OF GROUNDWATER MONITORING AND RESOURCE MANAGEMENT

Data from the monitoring network indicate some local areas of concern such as the Klipput, Roedtan, Settlers and Tuinplaas areas used as examples but more exists. The situation in such areas clearly indicate a lack of sound management of the resource which cannot continue indefinitely. It should be borne in mind that the water resource currently being mismanaged and damage by over exploitation is the only resource in these areas. Complete failure would have dire consequences.

Sound groundwater management in areas identified where groundwater levels are characterised by constant declines and no apparent recharge over some years should also be a priority. Acting only after the damage is done would be of no use.

6 ACKNOWLEDGEMENTS

Percentage of normal rainfall: South African Weather Services: http://www.weathersa.co.za

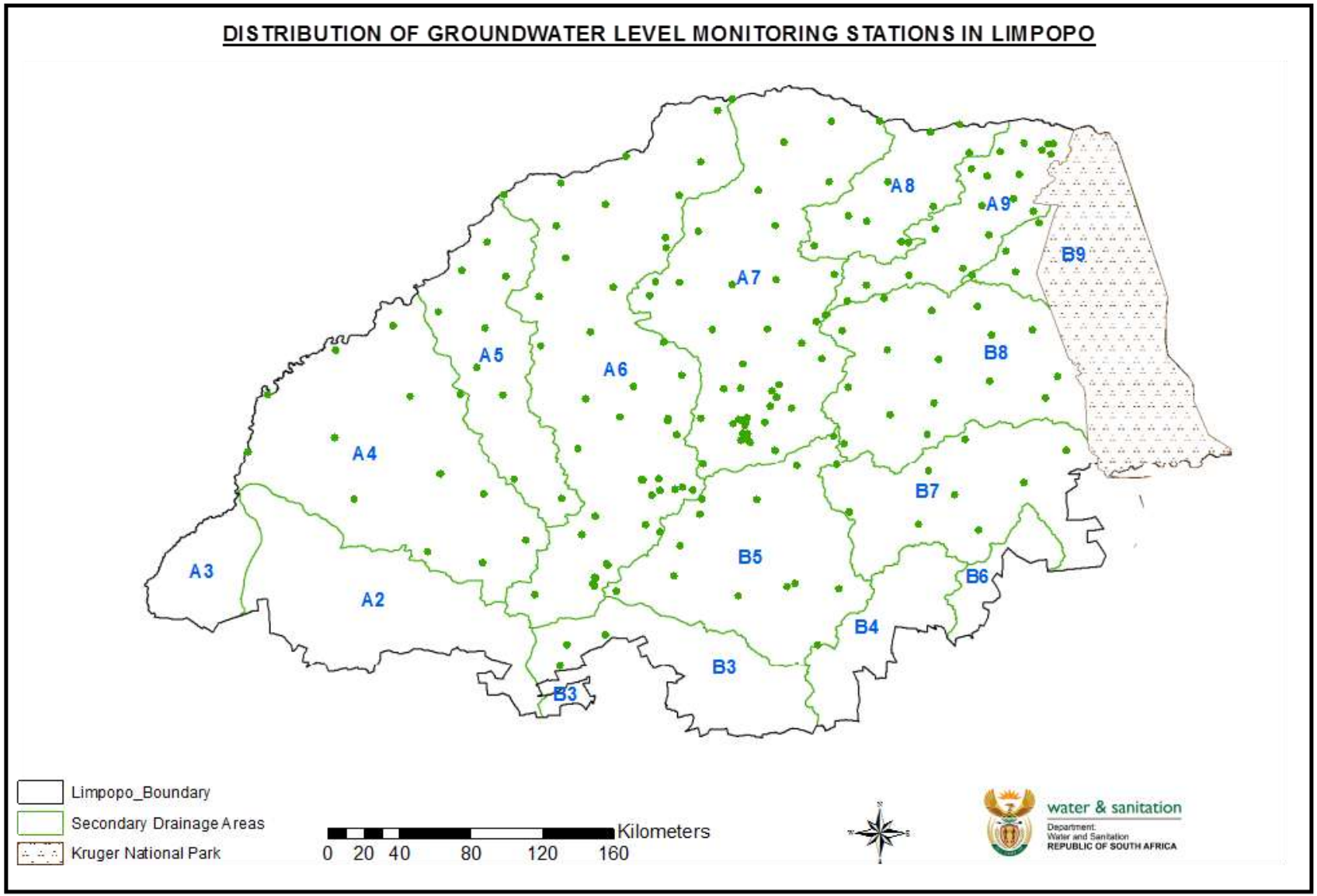
DISTRIBUTION OF GROUNDWATER LEVEL MONITORING STATIONS IN LIMPOPO
A8
A9
B9
A7
A5
A6
B8
A4
B7
A3
B5
B6
A2
B4
B3
B3
Limpopo_Boundary
Secondary Drainage Areas
Kruger National Park
0 20 40 80 120 160
Kilometers
water & sanitation
Department:
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FIGURE 1

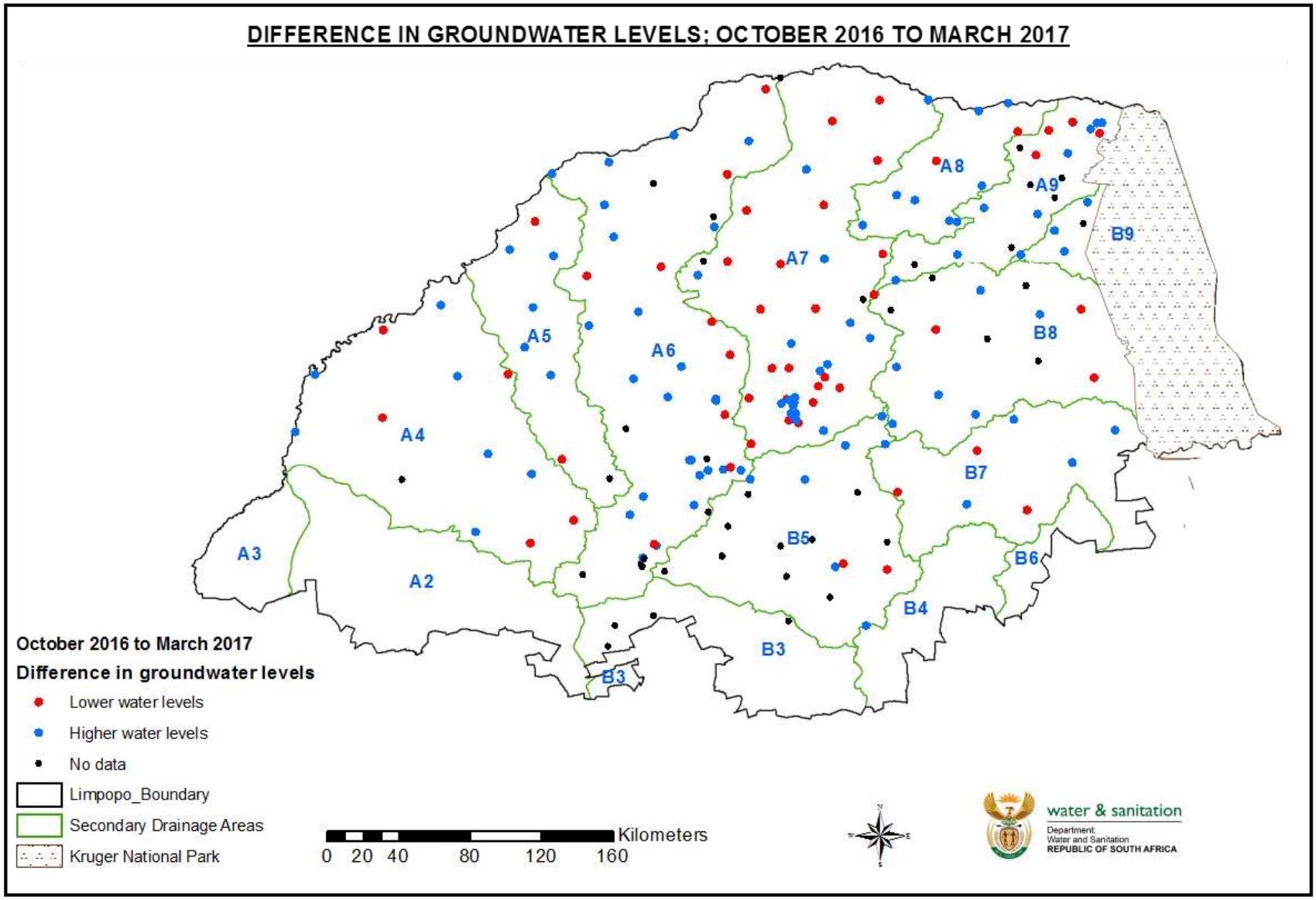
DIFFERENCE IN GROUNDWATER LEVELS; OCTOBER 2016 TO MARCH 2017
A8
A9
B9
A7
A5
A6
B8
A4
B7
B5
A3
A2
B6
B4
B3
B3
October 2016 to March 2017
Difference in groundwater levels
Lower water levels
Higher water levels
No data
Limpopo_Boundary
Secondary Drainage Areas
Kruger National Park
0 20 40 80 120 160
Kilometers
water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

FIGURE 2

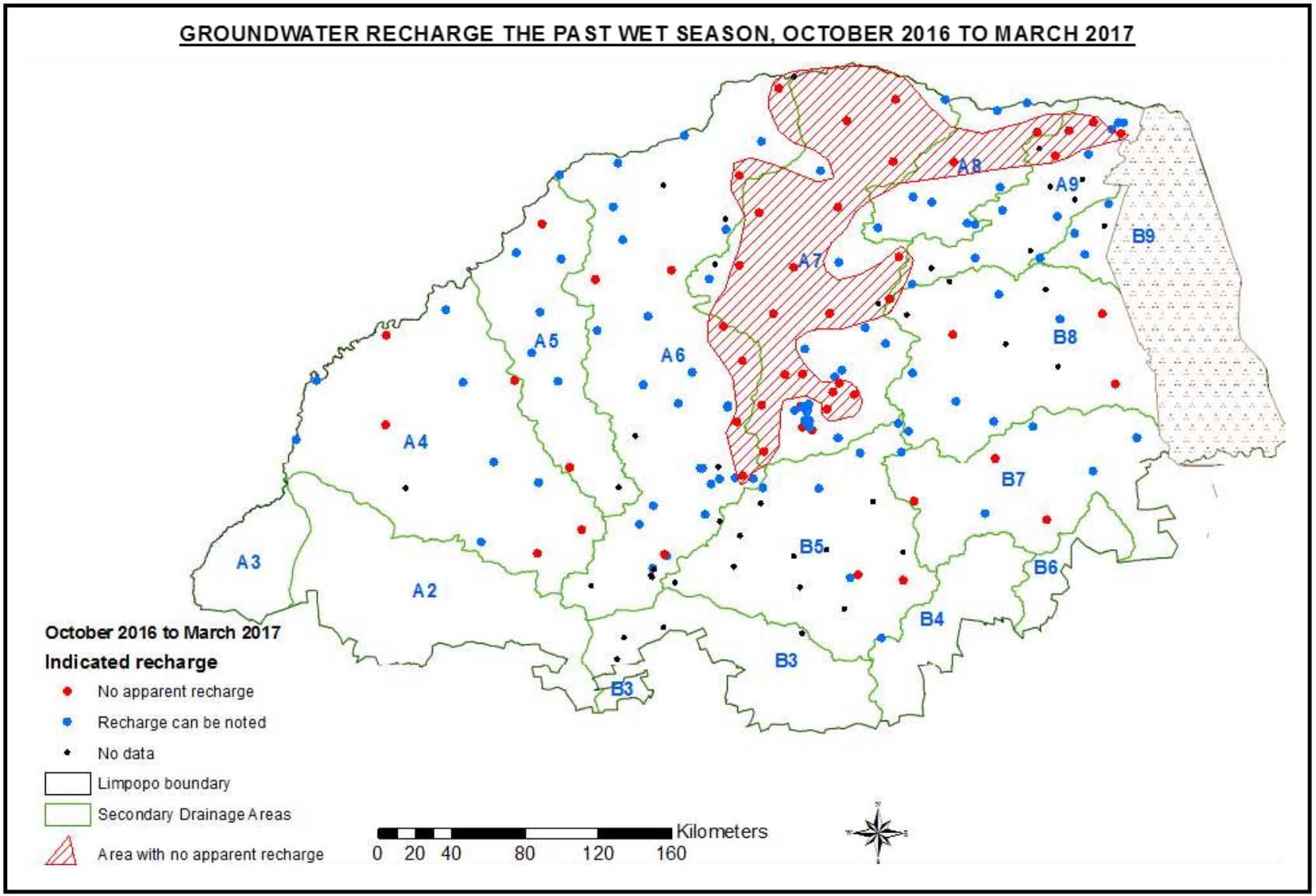
GROUNDWATER RECHARGE THE PAST WET SEASON, OCTOBER 2016 TO MARCH 2017
A8
A9
B9
A7
A5
A6
B8
A4
B7
B5
A3
B6
A2
B4
B3
B3
October 2016 to March 2017
Indicated recharge
No apparent recharge
Recharge can be noted
No data
Limpopo boundary
Secondary Drainage Areas
Area with no apparent recharge
Kilometers
0 20 40 80 120 160

FIGURE 3

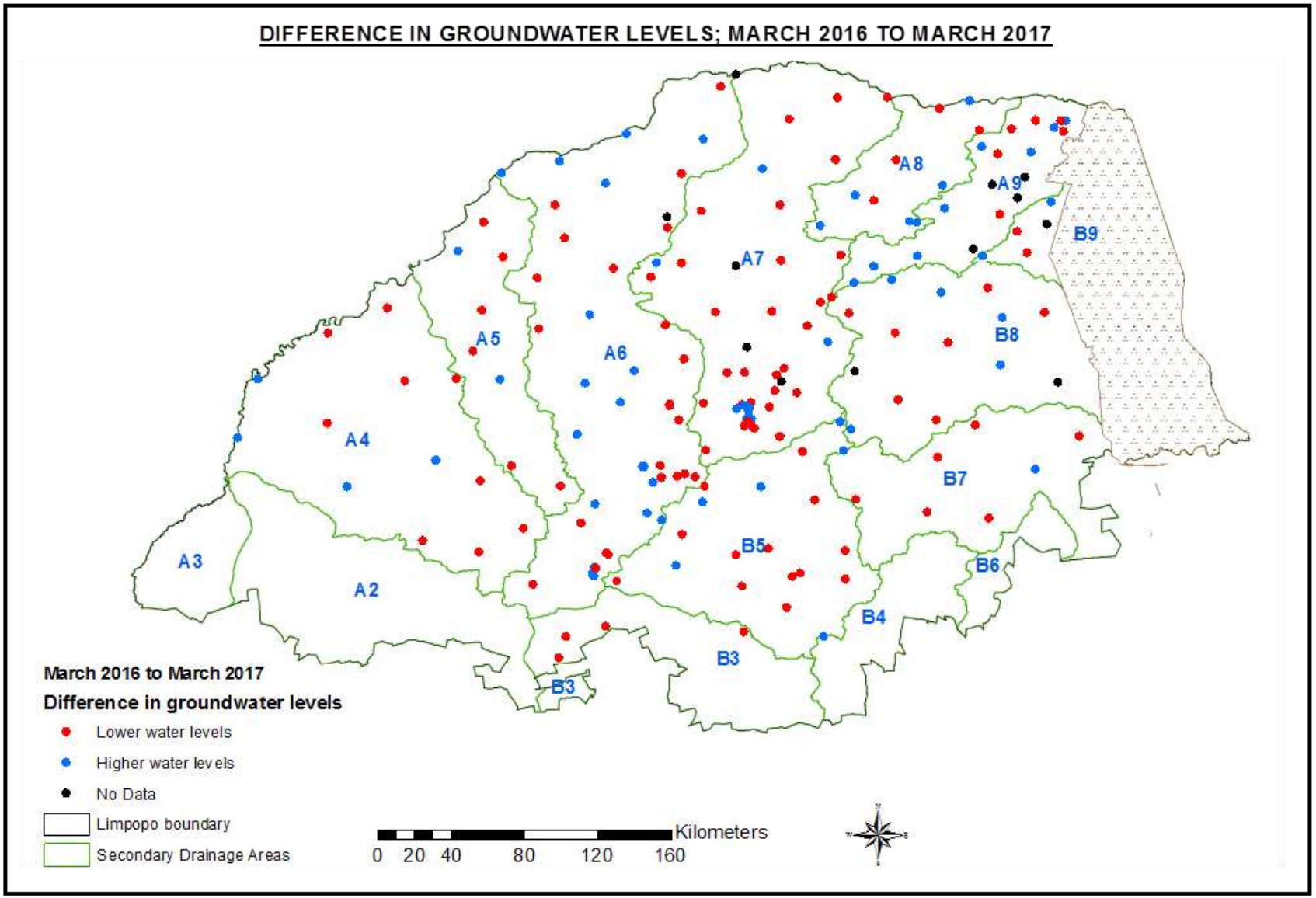
DIFFERENCE IN GROUNDWATER LEVELS; MARCH 2016 TO MARCH 2017
A8
A9
B9
A7
A5
A6
B8
A4
B7
B5
A3
B6
A2
B4
B3
B3
March 2016 to March 2017
Difference in groundwater levels
Lower water levels
Higher water levels
No Data
Limpopo boundary
Secondary Drainage Areas
Kilometers
0 20 40 80 120 160

FIGURE 4

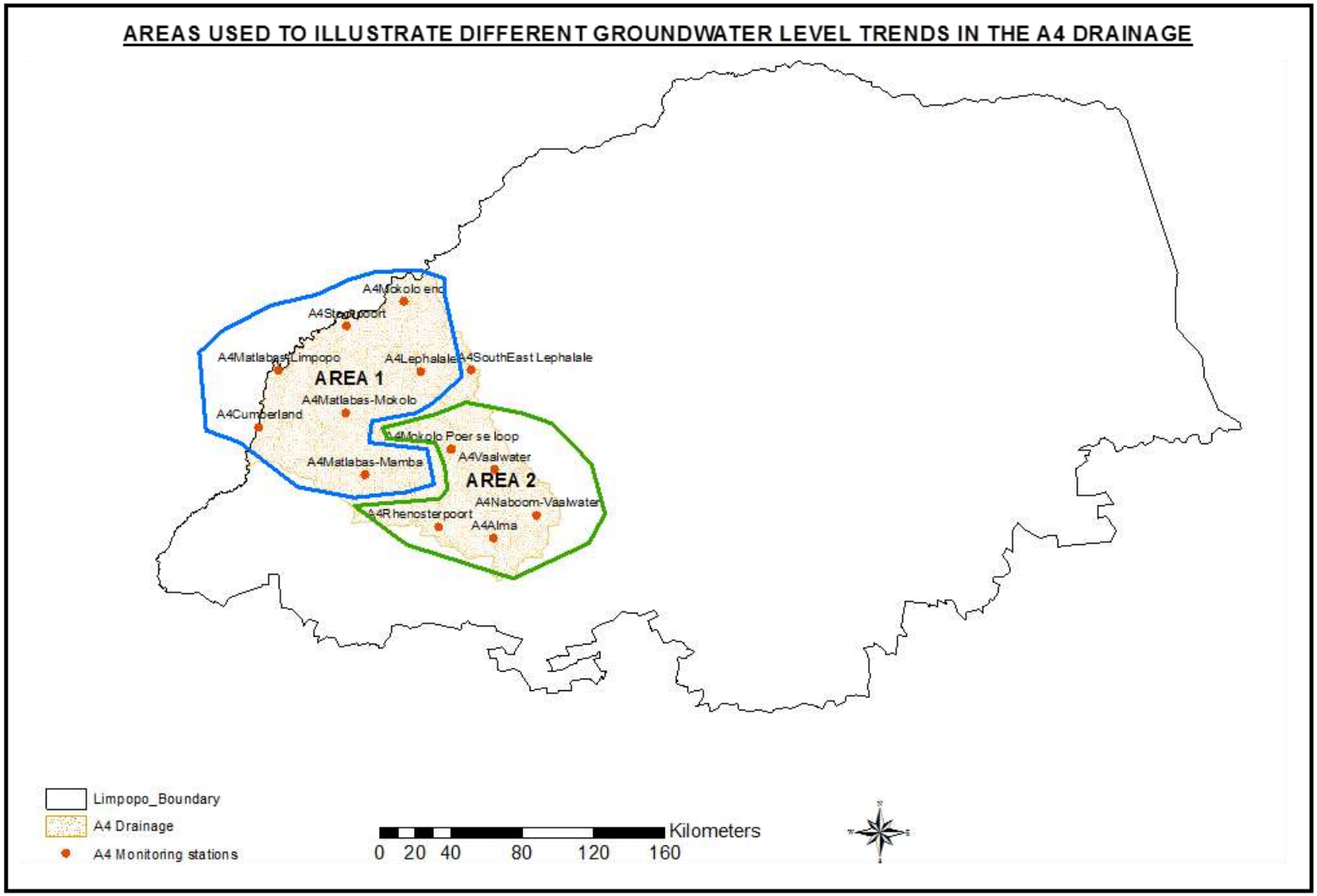
AREAS USED TO ILLUSTRATE DIFFERENT GROUNDWATER LEVEL TRENDS IN THE A4 DRAINAGE
A4Mokolo end
A4Steenkoort
A4Matlabas-Limpopo
A4Lephalale
A4SouthEast Lephalale
AREA 1
A4Matlabas-Mokolo
A4Cumberland
A4Mokolo Poer se loop
A4Vaalwater
A4Matlabas-Mamba
AREA 2
A4Naboom-Vaalwater
A4Rhenosterpoort
A4Alma
Limpopo_Boundary
A4 Drainage
A4 Monitoring stations
Kilometers
0 20 40 80 120 160

FIGURE 5

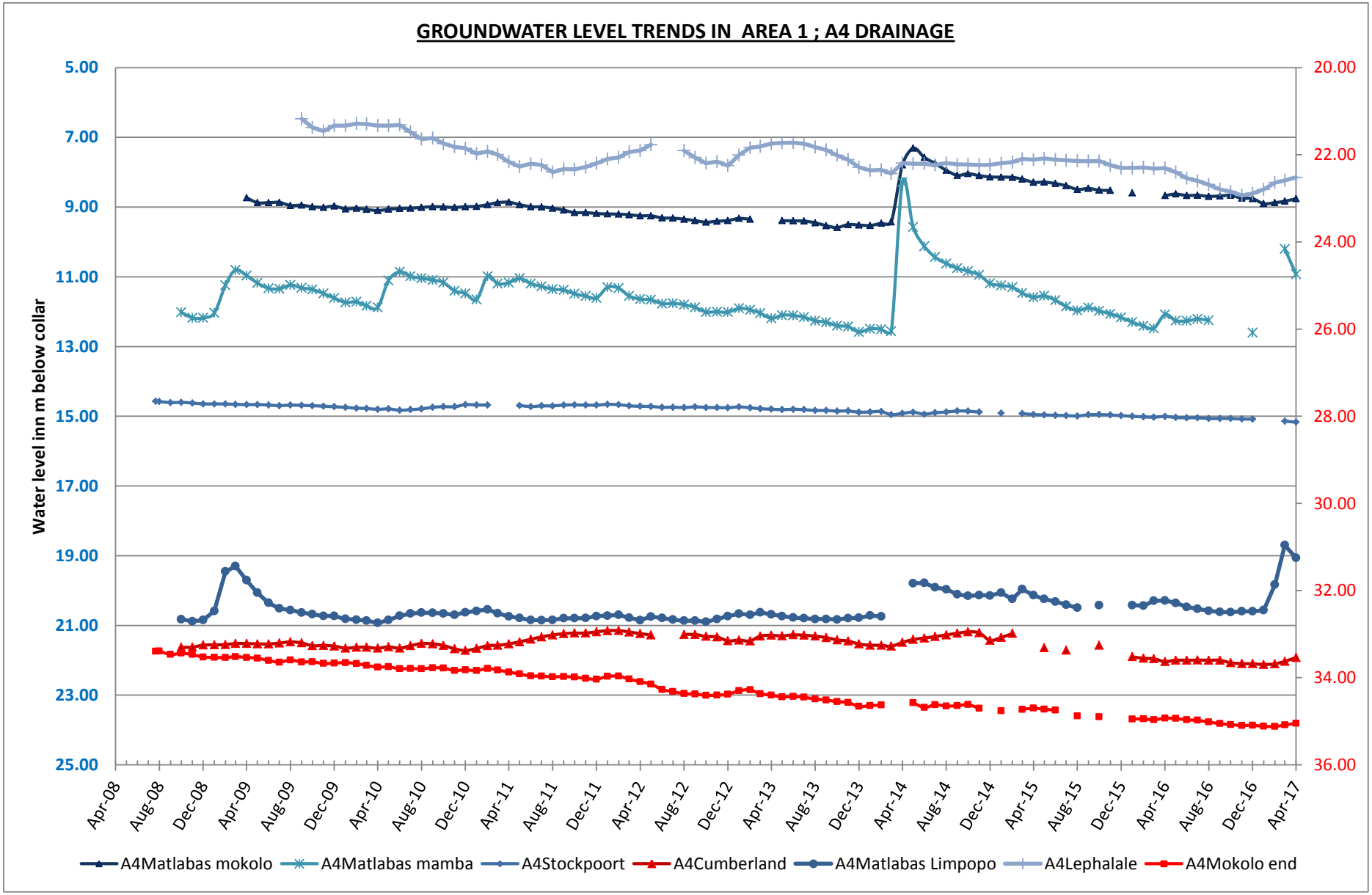
GROUNDWATER LEVEL TRENDS IN AREA 1 ; A4 DRAINAGE
Water level inn m below collar
5.00
7.00
9.00
11.00
13.00
15.00
17.00
19.00
21.00
23.00
25.00
20.00
22.00
24.00
26.00
28.00
30.00
32.00
34.00
36.00
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A4Matlabas mokolo
A4Matlabas mamba
A4Stockpoort
A4Cumberland
A4Matlabas Limpopo
A4Lephalale
A4Mokolo end

FIGURE 6

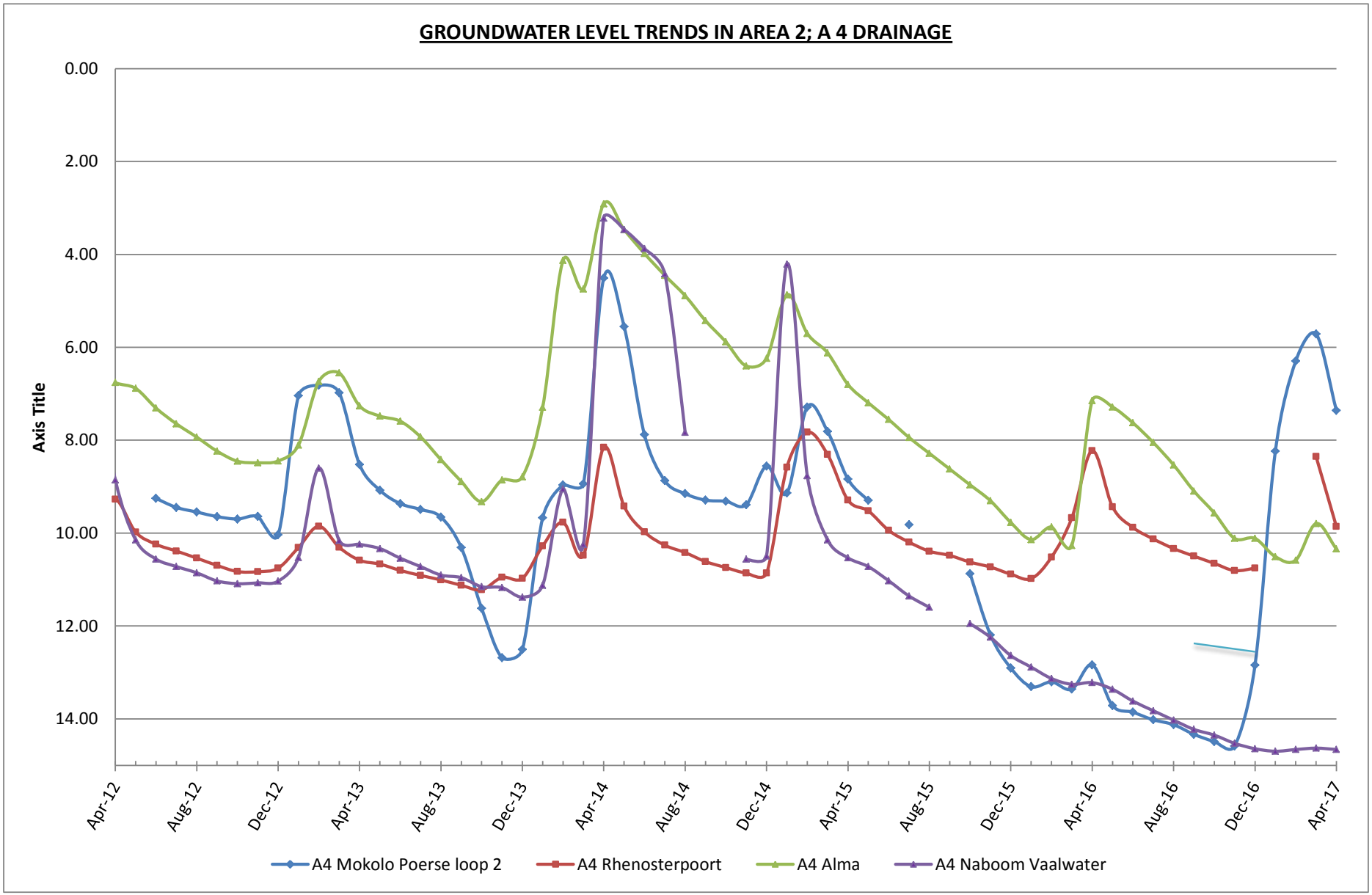
GROUNDWATER LEVEL TRENDS IN AREA 2; A 4 DRAINAGE
Axis Title
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A4 Mokolo Poerse loop 2
A4 Rhenosterpoort
A4 Alma
A4 Naboom Vaalwater

FIGURE 7

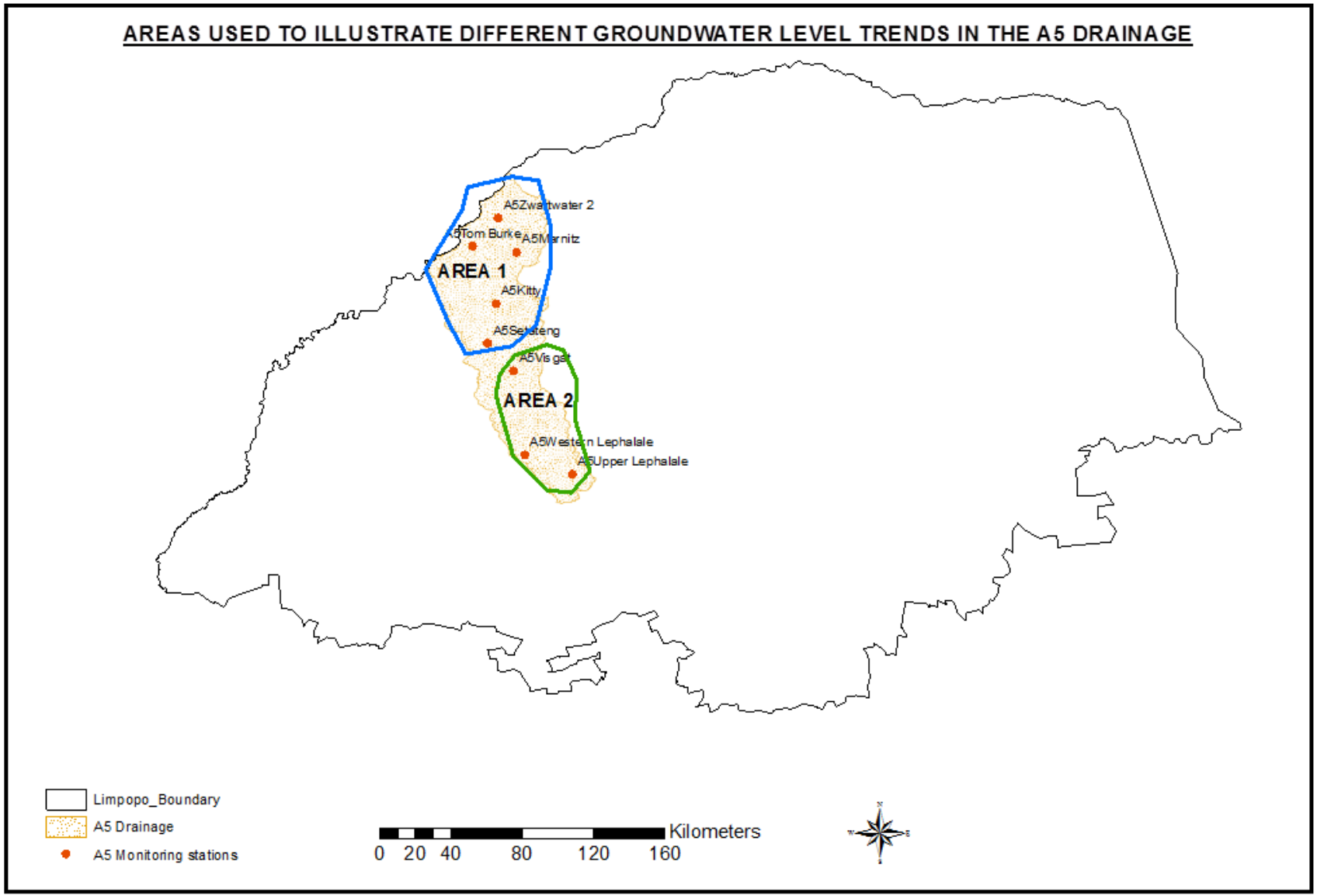
AREAS USED TO ILLUSTRATE DIFFERENT GROUNDWATER LEVEL TRENDS IN THE A5 DRAINAGE
A5Zwartwater 2
A5Tom Burke
A5Marnitz
AREA 1
A5Kitty
A5Sehateng
A5Visgat
AREA 2
A5Western Lephalale
A5Upper Lephalale
Limpopo_Boundary
A5 Drainage
A5 Monitoring stations
Kilometers
0 20 40 80 120 160

FIGURE 8

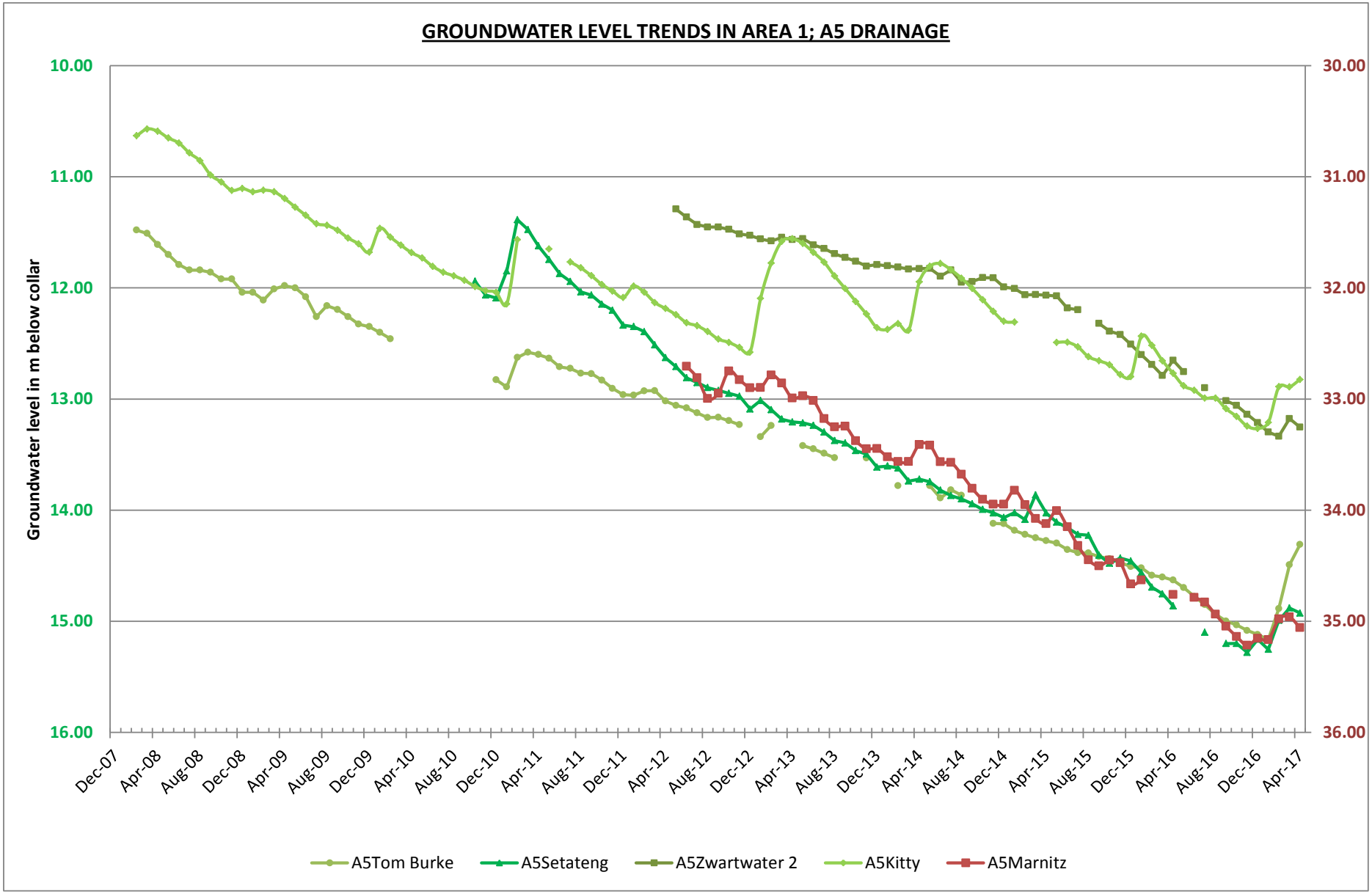
GROUNDWATER LEVEL TRENDS IN AREA 1; A5 DRAINAGE
Groundwater level in m below collar
10.00
11.00
12.00
13.00
14.00
15.00
16.00
30.00
31.00
32.00
33.00
34.00
35.00
36.00
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A5Tom Burke
A5Setateng
A5Zwartwater 2
A5Kitty
A5Marnitz

FIGURE 9

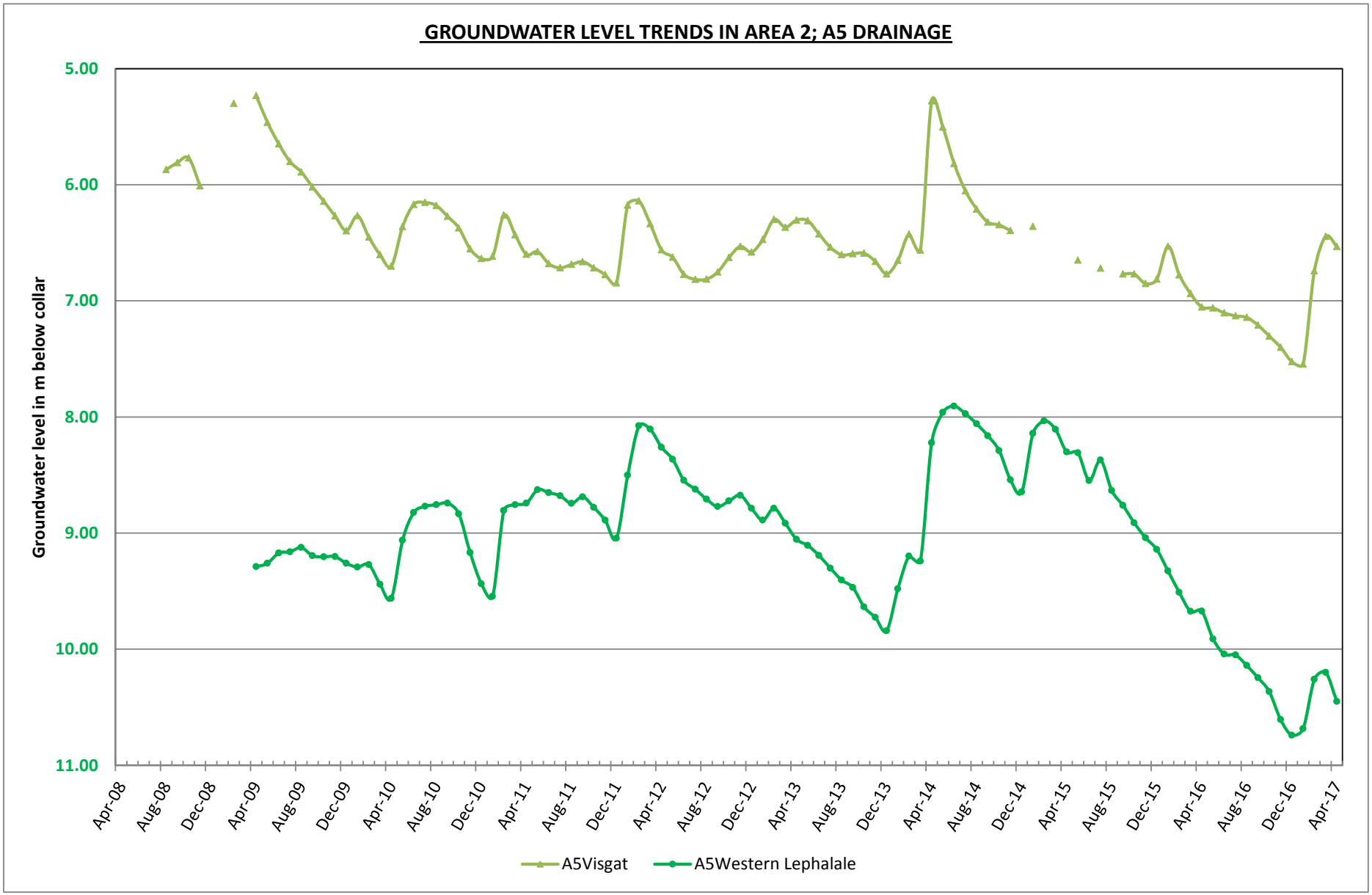
GROUNDWATER LEVEL TRENDS IN AREA 2; A5 DRAINAGE
Groundwater level in m below collar
5.00
6.00
7.00
8.00
9.00
10.00
11.00
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A5Visgat
A5Western Lephalale

FIGURE 10

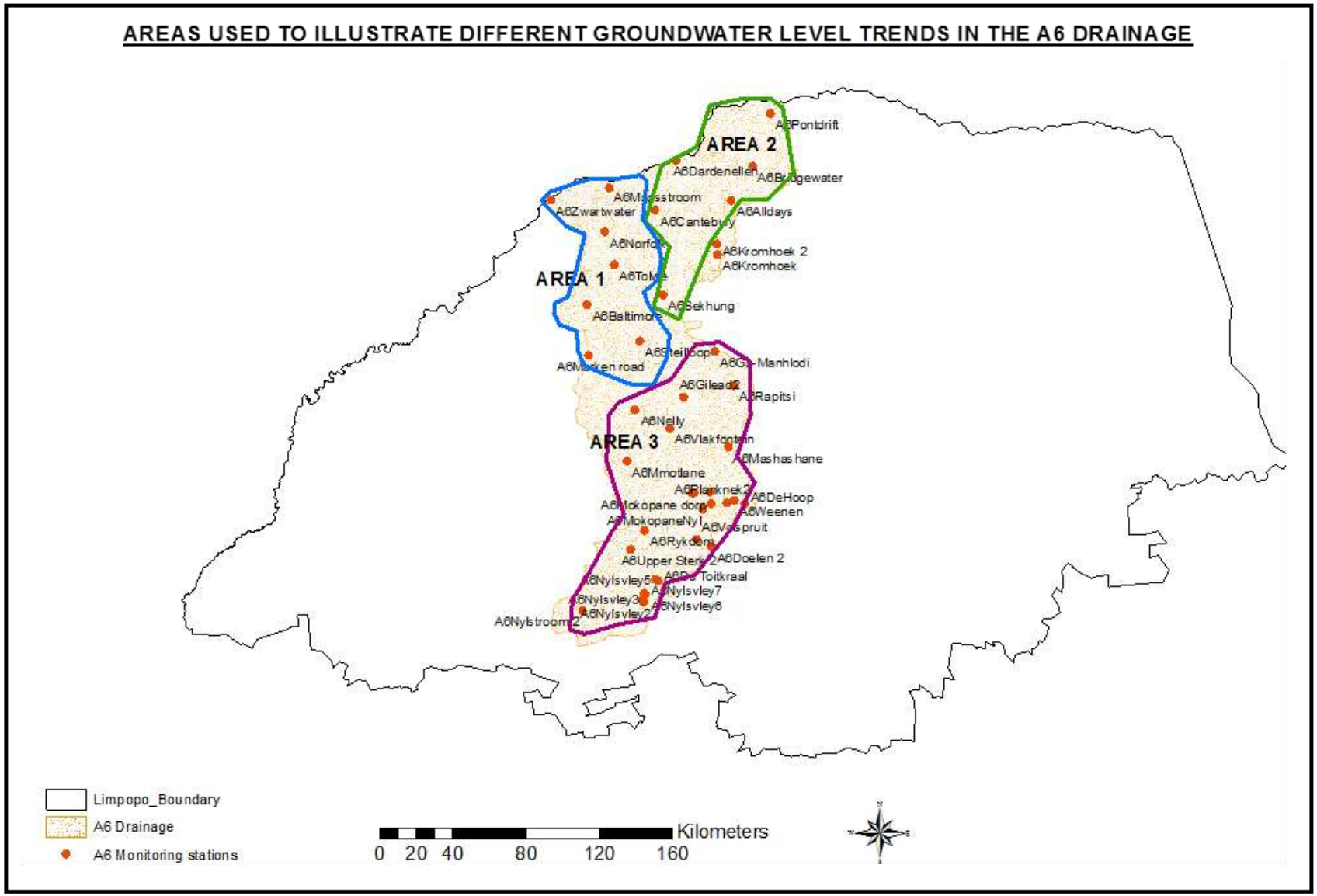
AREAS USED TO ILLUSTRATE DIFFERENT GROUNDWATER LEVEL TRENDS IN THE A6 DRAINAGE
AREA 1
AREA 2
AREA 3
A6Pontdrift
A6Dardenellen
A6Bridgewater
A6Zwartwater
A6Alldays
A6Cantebury
A6Kromhoek 2
A6Kromhoek
A6Sekhung
A6Baltimore
A6Steilloop
A6Gilead2
A6Rapitsi
A6Nelly
A6Vlakfontein
A6Mashashane
A6Mmotlane
A6Blaaknek2
A6DeHoop
A6Mokopane dorp
A6Weenen
A6MokopaneNyl
A6Volspruit
A6Rykdom
A6Upper Steps 2
A6Doelen 2
A6Nylsvley7
A6Nylsvley8
A6Nylsvley2
A6Nylstroom 2
Limpopo_Boundary
A6 Drainage
A6 Monitoring stations
Kilometers
0 20 40 80 120 160

FIGURE 11

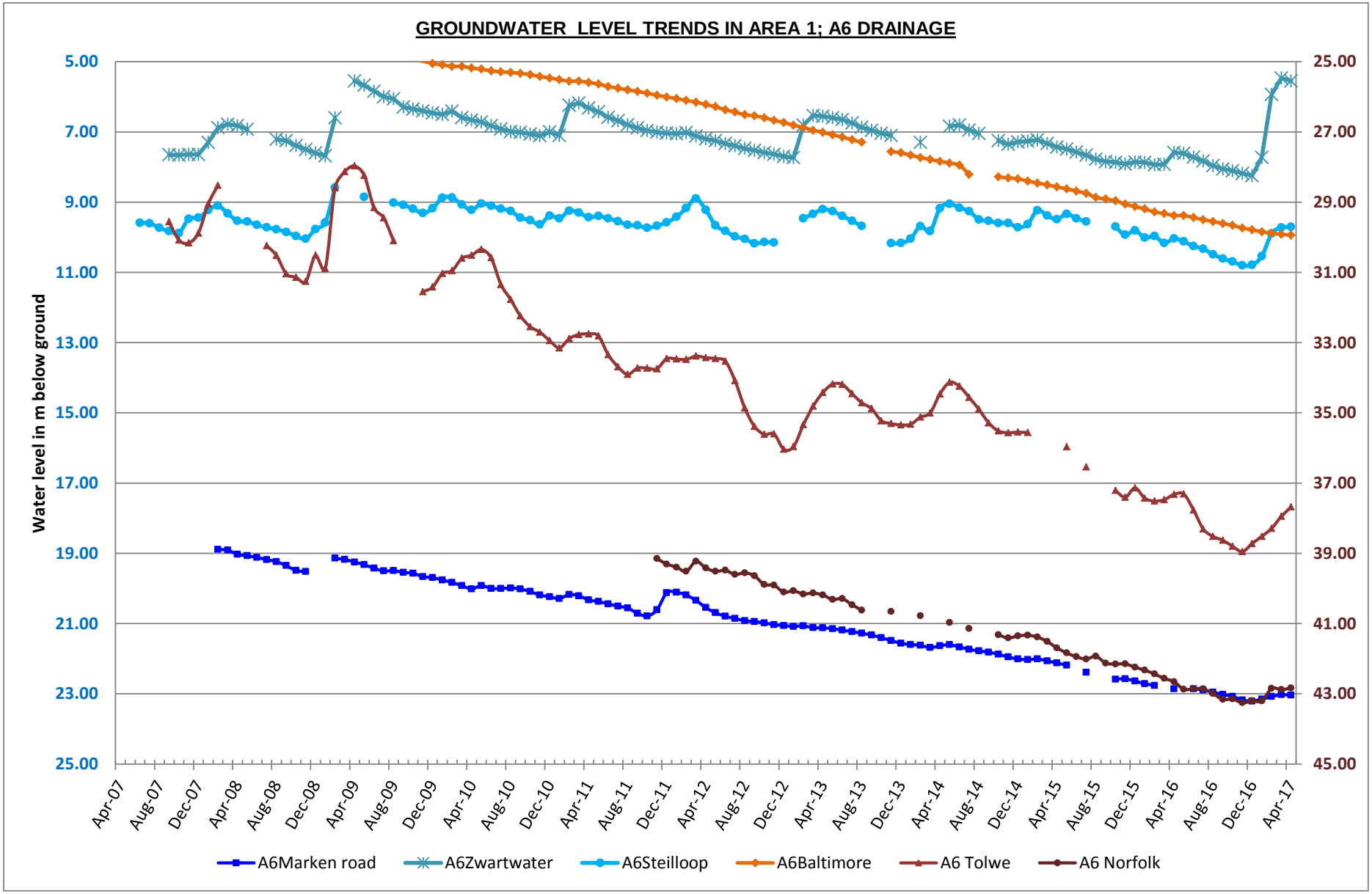
GROUNDWATER LEVEL TRENDS IN AREA 1; A6 DRAINAGE
Water level in m below ground
5.00
7.00
9.00
11.00
13.00
15.00
17.00
19.00
21.00
23.00
25.00
25.00
27.00
29.00
31.00
33.00
35.00
37.00
39.00
41.00
43.00
45.00
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A6Marken road
A6Zwartwater
A6Steilloop
A6Baltimore
A6 Tolwe
A6 Norfolk

FIGURE 12

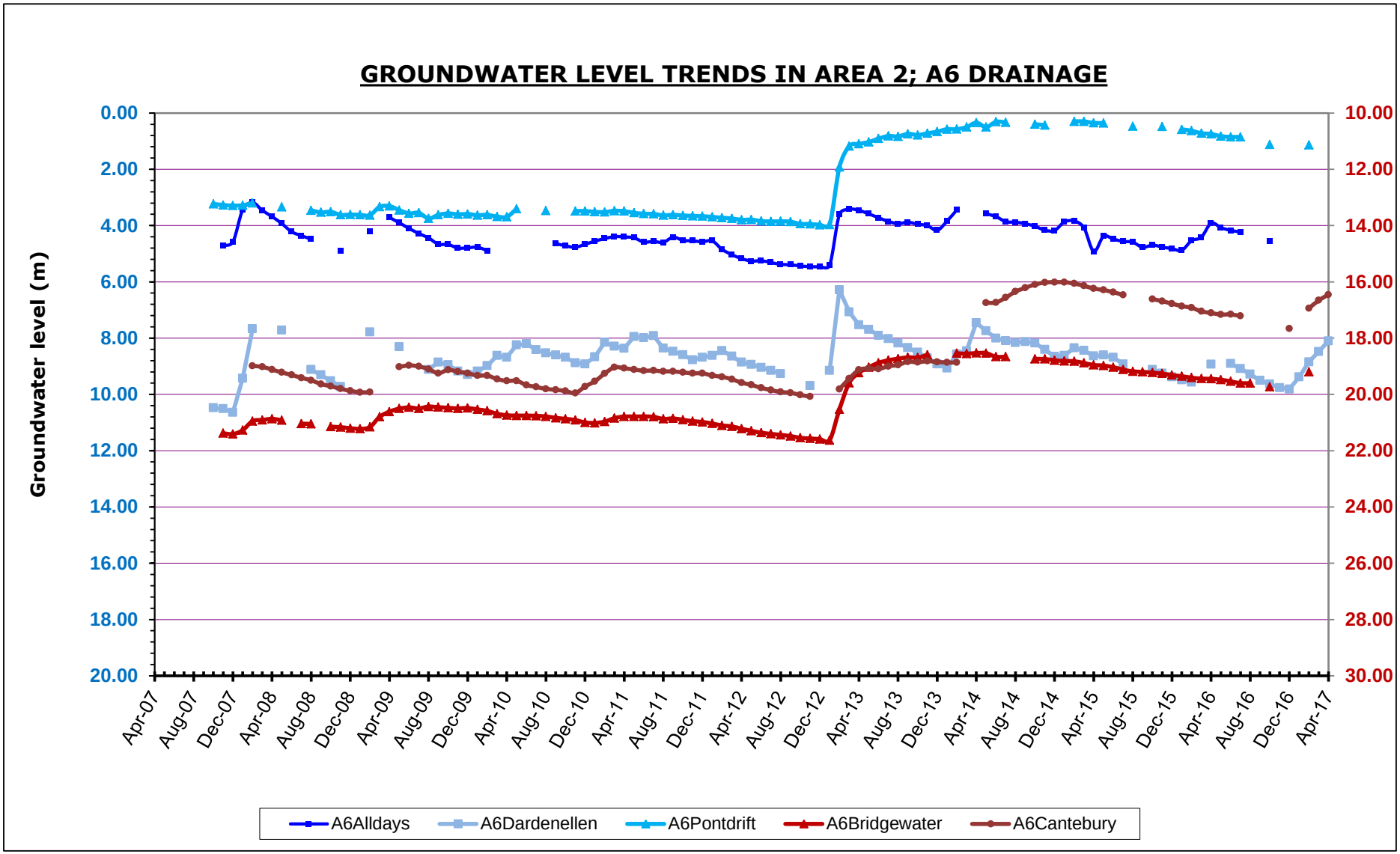
GROUNDWATER LEVEL TRENDS IN AREA 2; A6 DRAINAGE
Groundwater level (m)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
26.00
28.00
30.00
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A6Alldays
A6Dardenellen
A6Pontdrift
A6Bridgewater
A6Cantebury

FIGURE 13

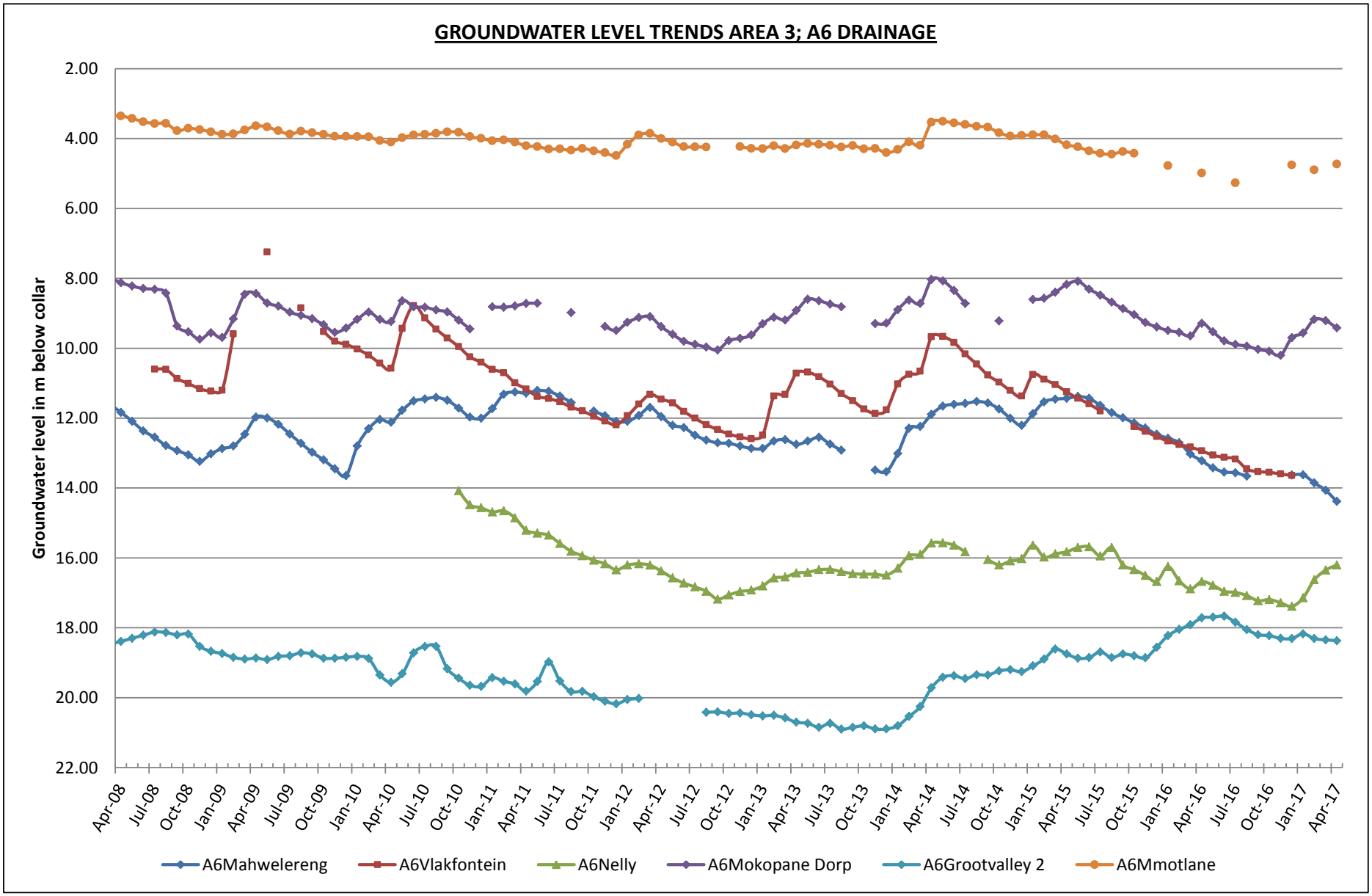
GROUNDWATER LEVEL TRENDS AREA 3; A6 DRAINAGE
Groundwater level in m below collar
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
22.00
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
A6Mahwelereng
A6Vlakfontein
A6Nelly
A6Mokopane Dorp
A6Grootvalley 2
A6Mmotlane

FIGURE 14

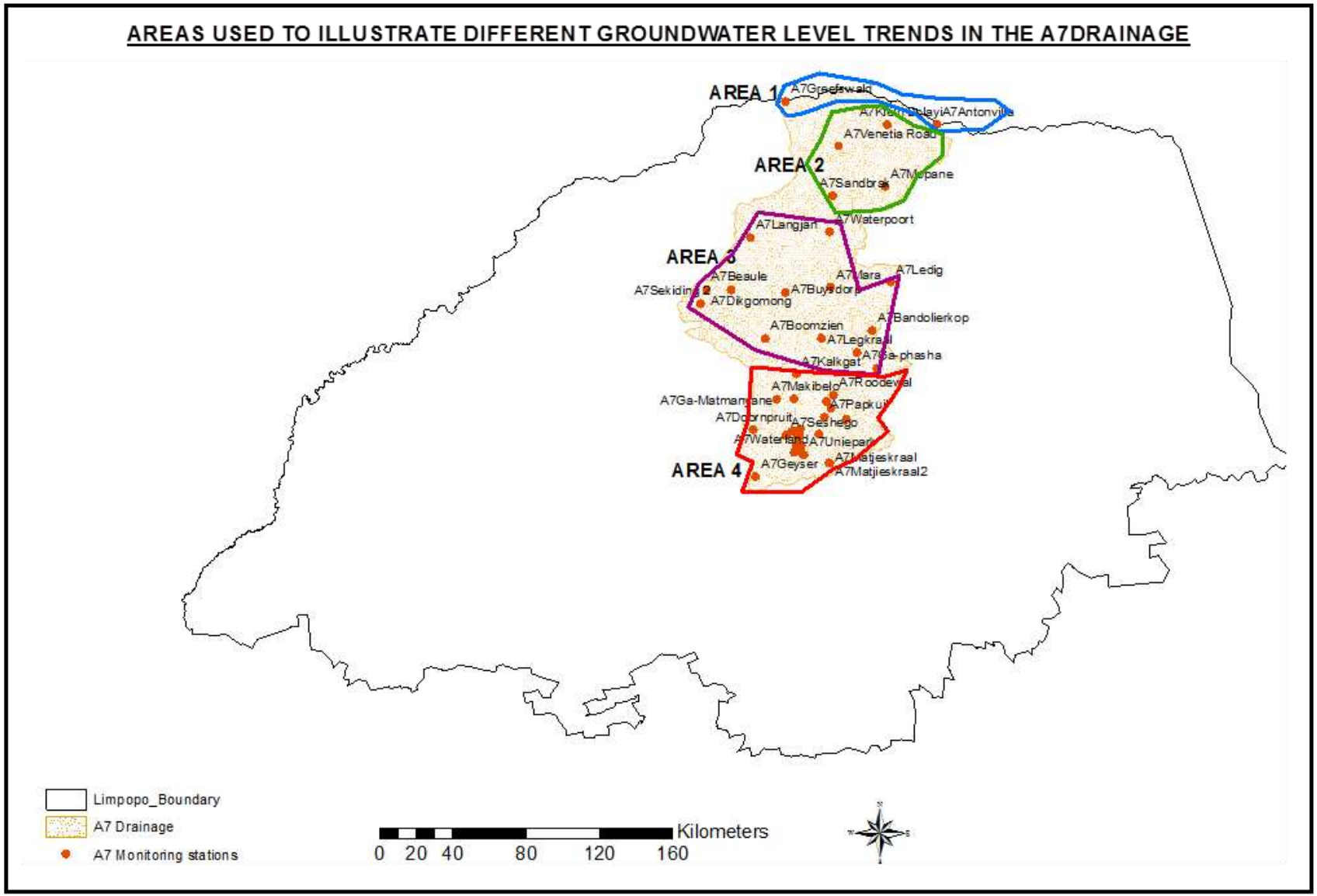
AREAS USED TO ILLUSTRATE DIFFERENT GROUNDWATER LEVEL TRENDS IN THE A7DRAINAGE
AREA 1
AREA 2
AREA 3
AREA 4
A7Venetia Road
A7Sandbrak
A7Mopane
A7Waterpoort
A7Langjan
A7Beaule
A7Ledig
A7Sekiding
A7Dikgomong
A7Boomzien
A7Legkraal
A7Kalkgat
A7Rooderaal
A7Makibelo
A7Papkuil
A7Doornpruit
A7Seshego
A7Geyser
A7Matjeskraal
A7Matjieskraal2
Limpopo_Boundary
A7 Drainage
A7 Monitoring stations
Kilometers
0 20 40 80 120 160

FIGURE 15

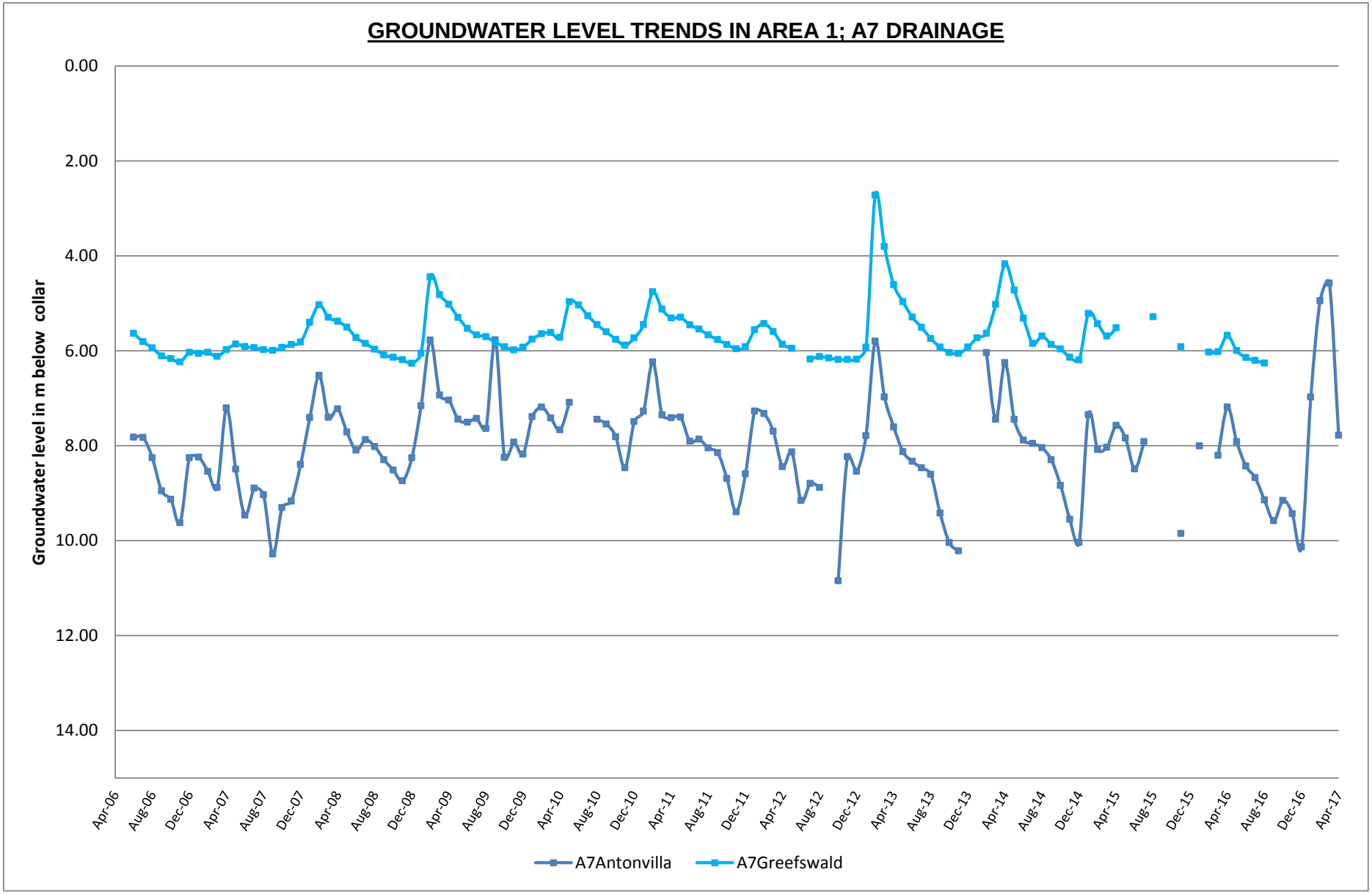
GROUNDWATER LEVEL TRENDS IN AREA 1; A7 DRAINAGE
Groundwater level in m below collar
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A7Antonvilla
A7Greefswald

FIGURE 16

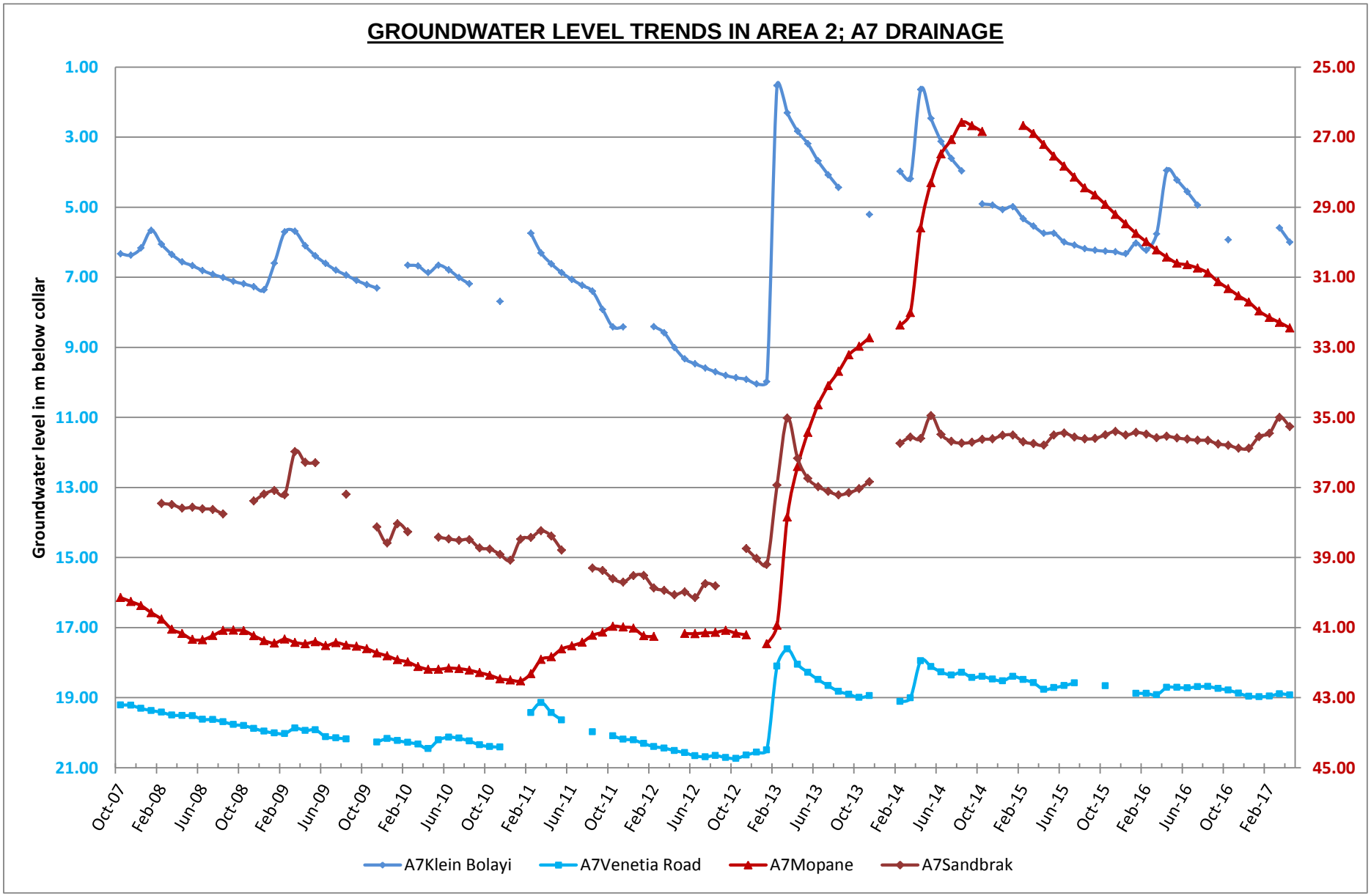
GROUNDWATER LEVEL TRENDS IN AREA 2; A7 DRAINAGE
Groundwater level in m below collar
1.00
3.00
5.00
7.00
9.00
11.00
13.00
15.00
17.00
19.00
21.00
25.00
27.00
29.00
31.00
33.00
35.00
37.00
39.00
41.00
43.00
45.00
Oct-07
Feb-08
Jun-08
Oct-08
Feb-09
Jun-09
Oct-09
Feb-10
Jun-10
Oct-10
Feb-11
Jun-11
Oct-11
Feb-12
Jun-12
Oct-12
Feb-13
Jun-13
Oct-13
Feb-14
Jun-14
Oct-14
Feb-15
Jun-15
Oct-15
Feb-16
Jun-16
Oct-16
Feb-17
A7Klein Bolayi
A7Venetia Road
A7Mopane
A7Sandbrak

FIGURE 17

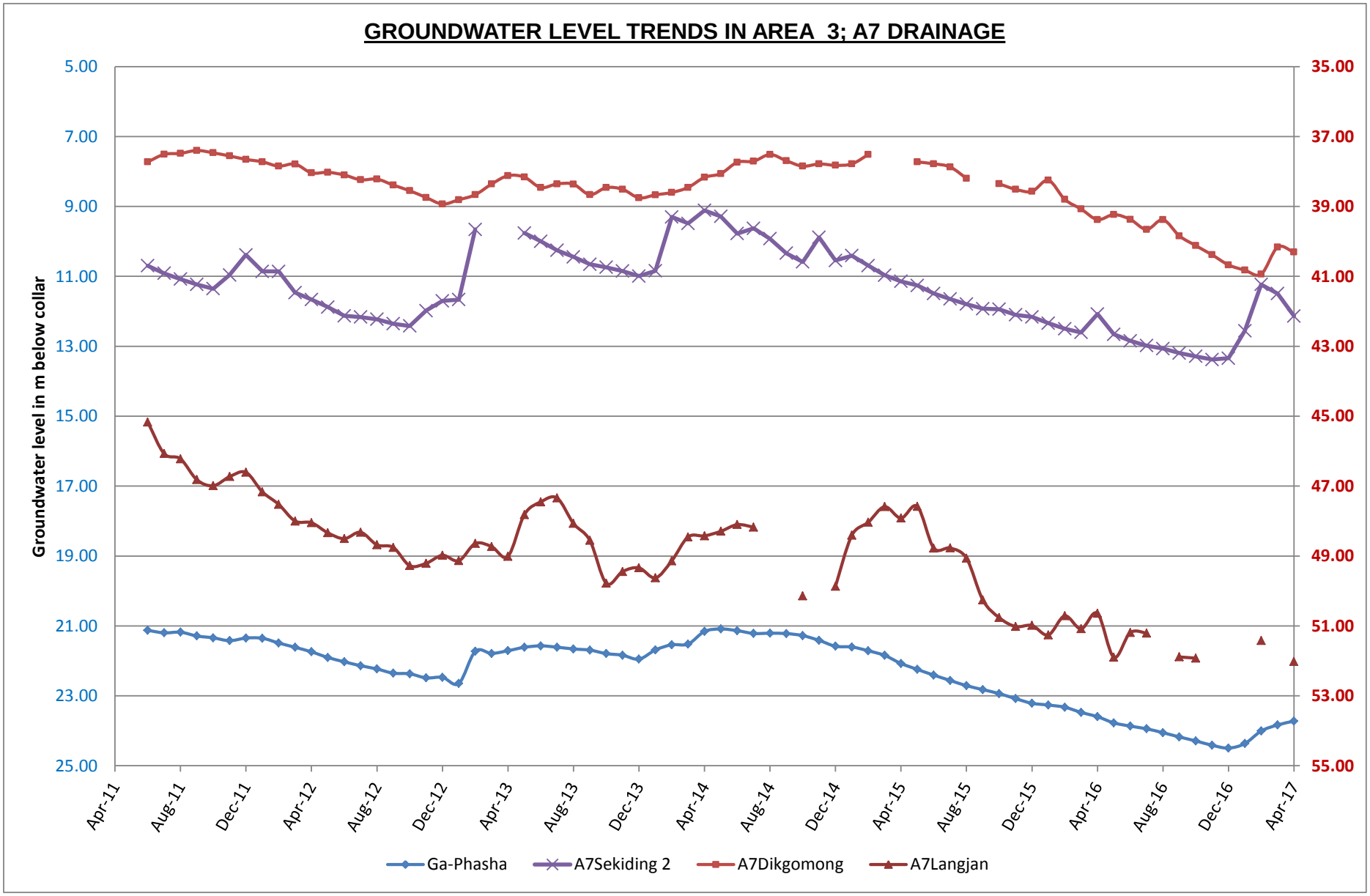
GROUNDWATER LEVEL TRENDS IN AREA 3; A7 DRAINAGE
Groundwater level in m below collar
5.00
7.00
9.00
11.00
13.00
15.00
17.00
19.00
21.00
23.00
25.00
35.00
37.00
39.00
41.00
43.00
45.00
47.00
49.00
51.00
53.00
55.00
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
Ga-Phasha
A7Sekiding 2
A7Dikgomong
A7Langjan

FIGURE 18

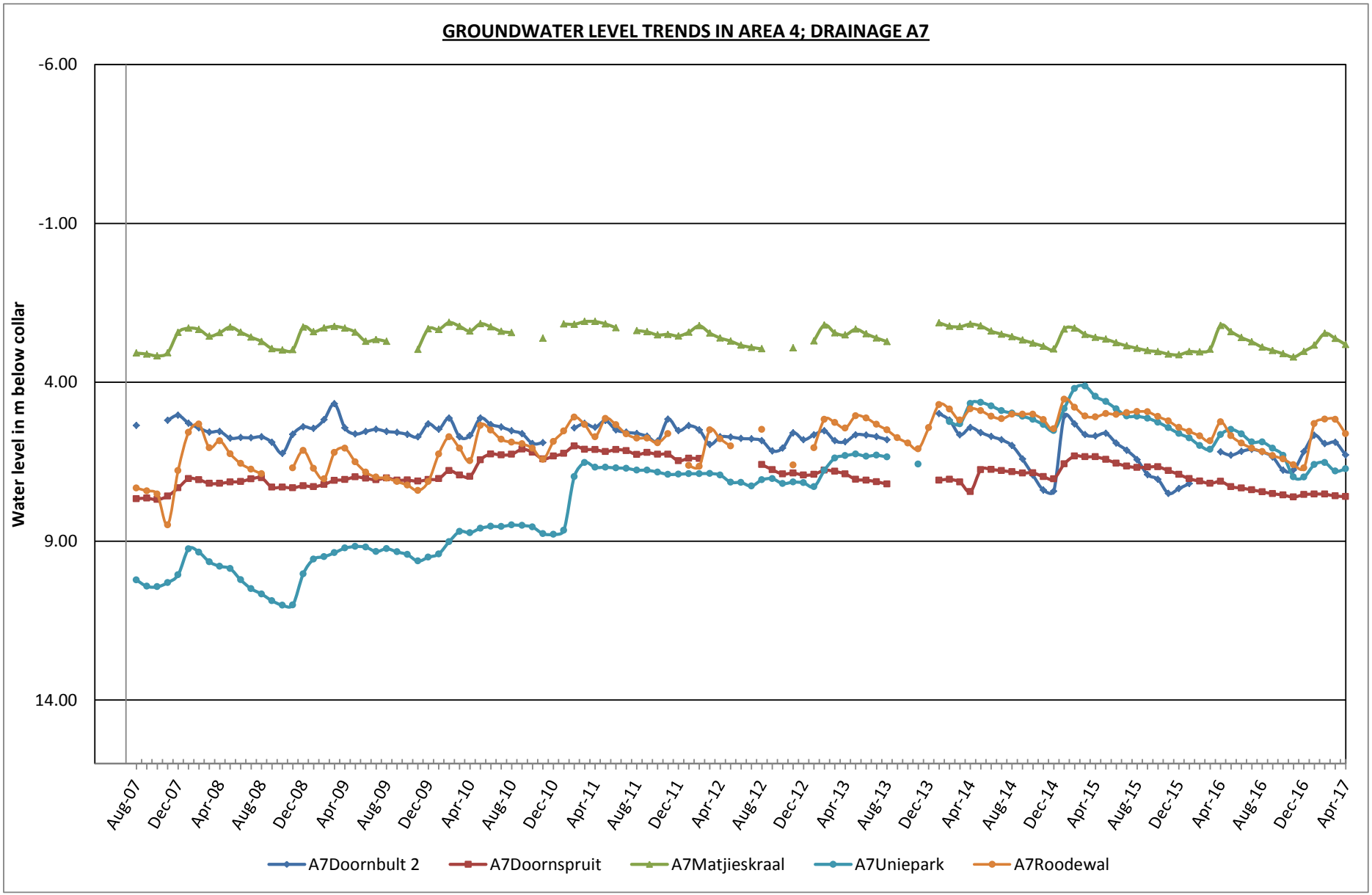
GROUNDWATER LEVEL TRENDS IN AREA 4; DRAINAGE A7
Water level in m below collar
-6.00
-1.00
4.00
9.00
14.00
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A7Doornbult 2
A7Doornspruit
A7Matjieskraal
A7Uniepark
A7Roodewal

FIGURE 19

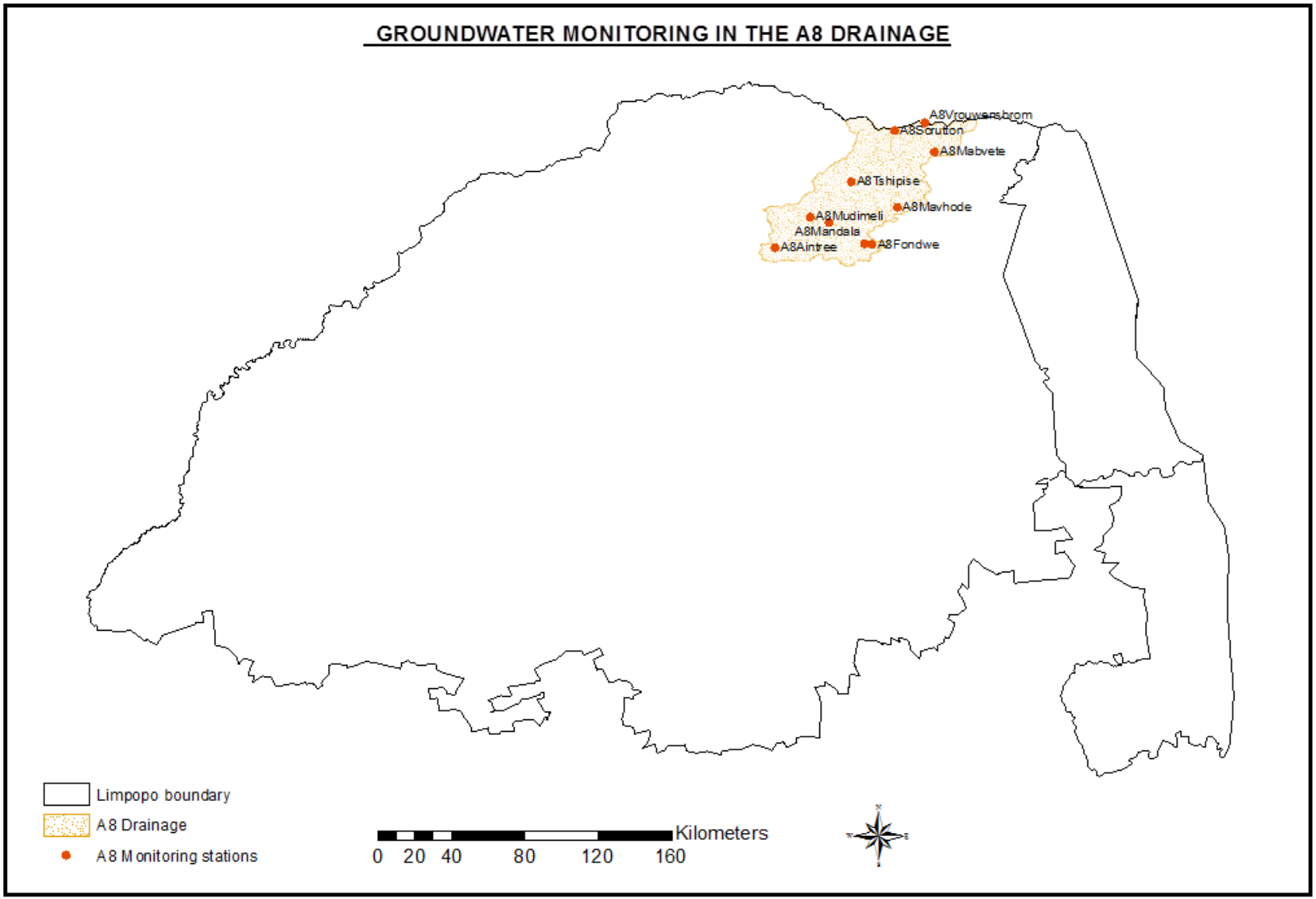
GROUNDWATER MONITORING IN THE A8 DRAINAGE
A8Vrouwensbrom
A8Scruton
A8Mabvete
A8Tshipise
A8Mavhode
A8Mudimeli
A8Mandala
A8Aintree
A8Fondwe
Limpopo boundary
A8 Drainage
A8 Monitoring stations
0 20 40 80 120 160
Kilometers

FIGURE 20

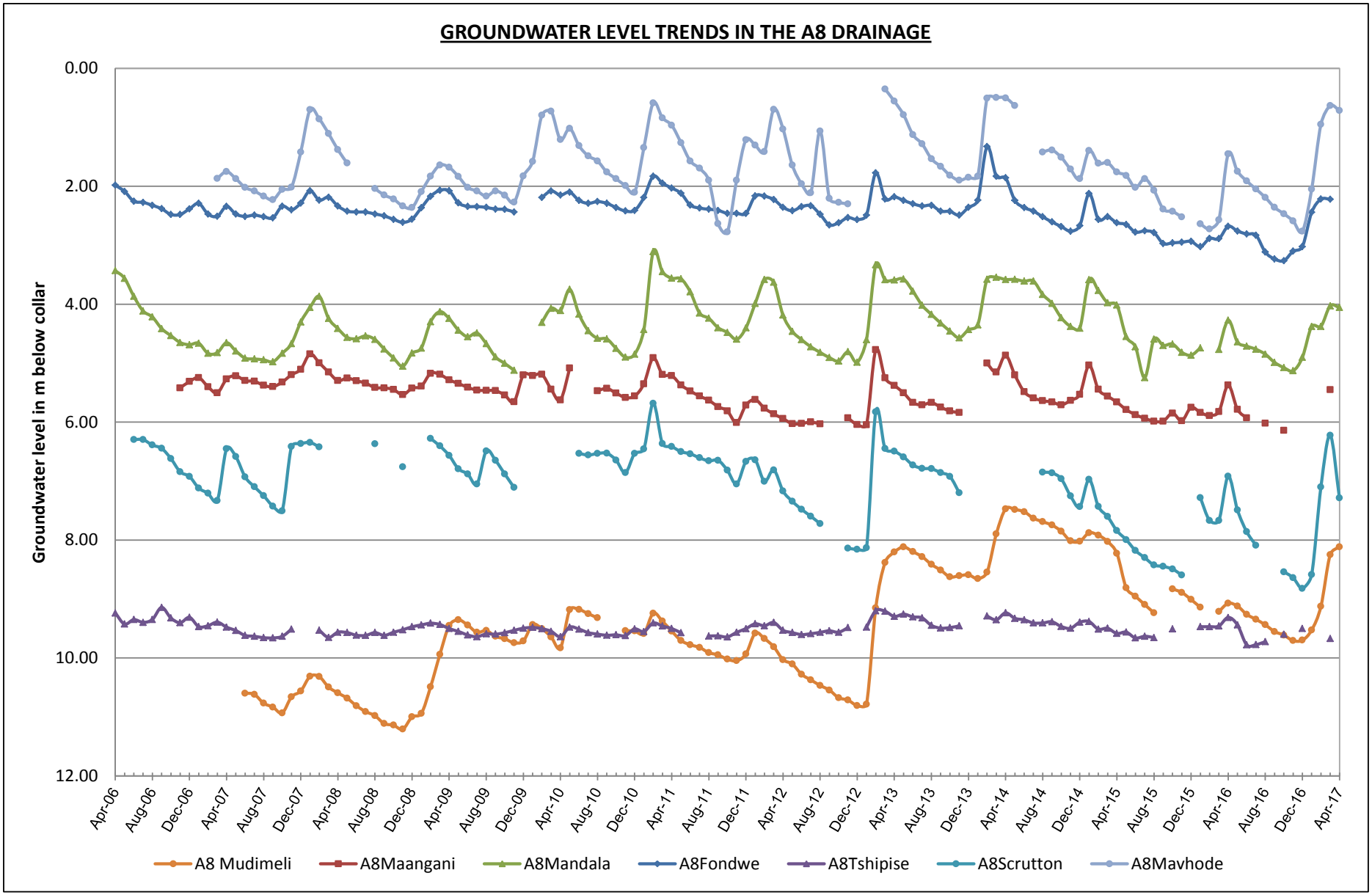
GROUNDWATER LEVEL TRENDS IN THE A8 DRAINAGE
Groundwater level in m below collar
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A8 Mudimeli
A8Maangani
A8Mandala
A8Fondwe
A8Tshipise
A8Scrutton
A8Mavhode

FIGURE 21

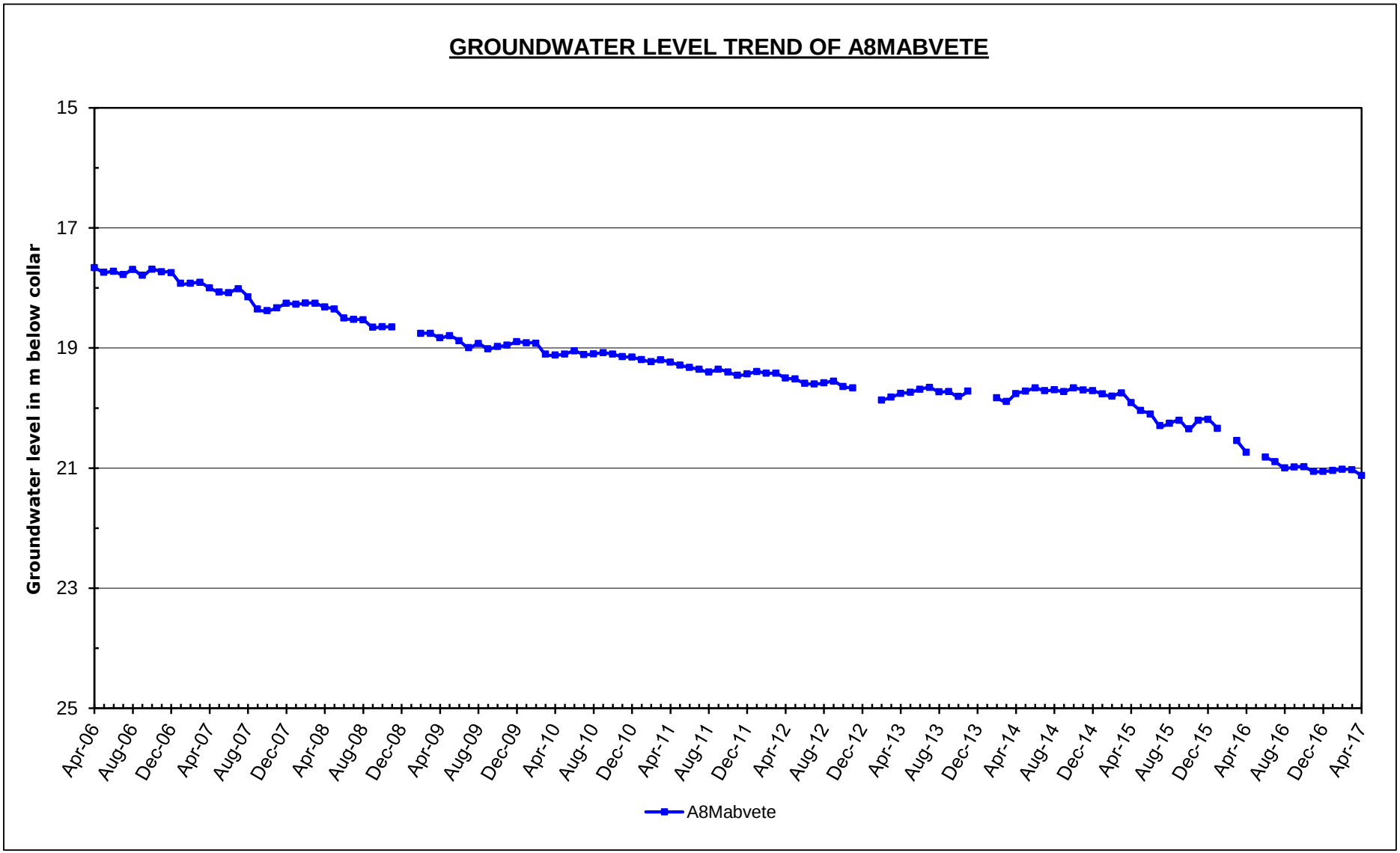
GROUNDWATER LEVEL TREND OF A8MABVETE
Groundwater level in m below collar
15
17
19
21
23
25
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A8Mabvete

FIGURE 22

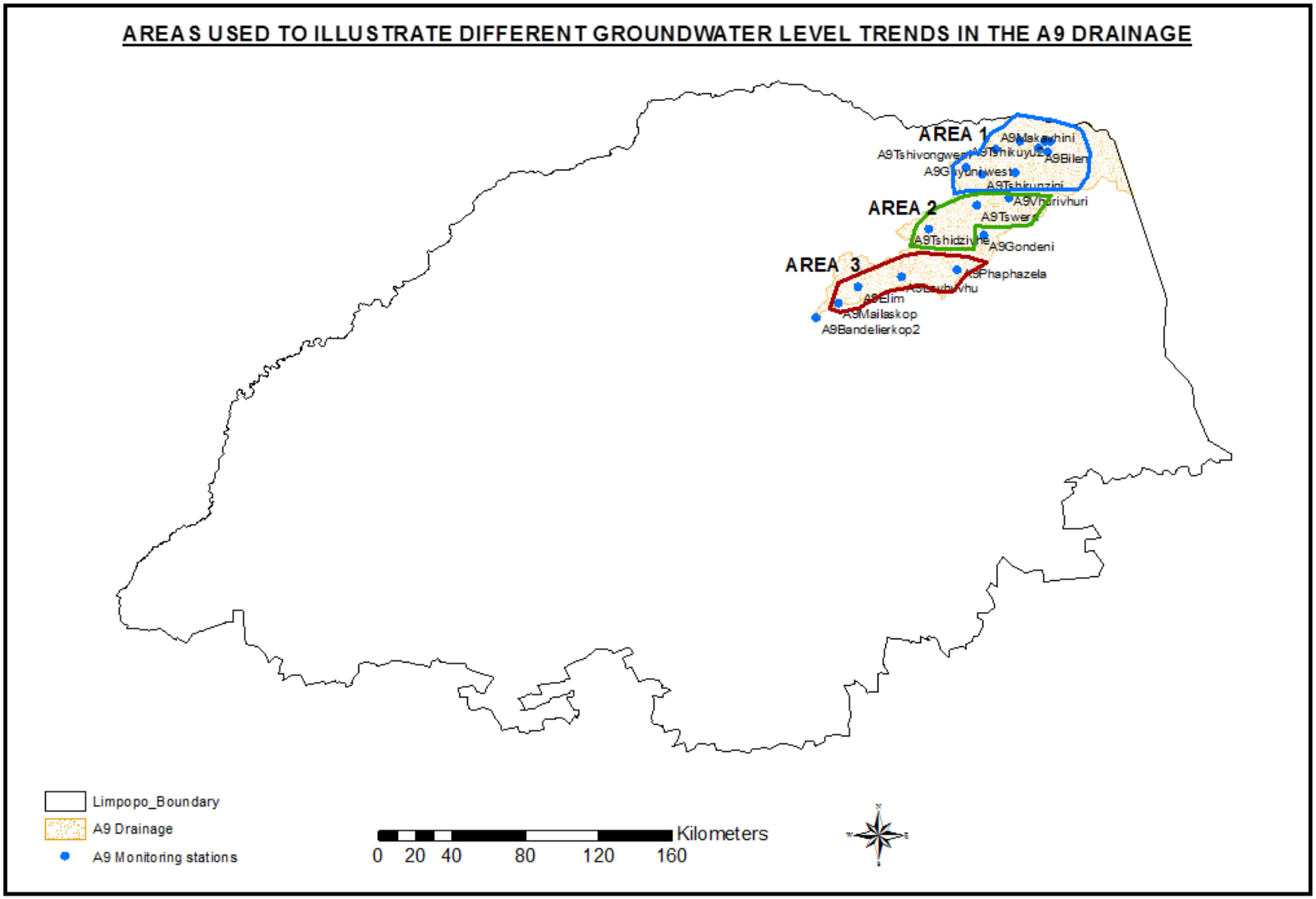
AREAS USED TO ILLUSTRATE DIFFERENT GROUNDWATER LEVEL TRENDS IN THE A9 DRAINAGE
AREA 1
AREA 2
AREA 3
A9Makwhini
A9Tshivongwe
A9Tshikuyu2
A9Bilen
A9Gyani west
A9Tshirunzini
A9Vharivhuri
A9Tswer
A9Tshidzivhe
A9Gondeni
A9Phaphazela
A9Elim
A9Mailaskop
A9Bandelierkop2
Limpopo_Boundary
A9 Drainage
A9 Monitoring stations
Kilometers
0 20 40 80 120 160

FIGURE 23

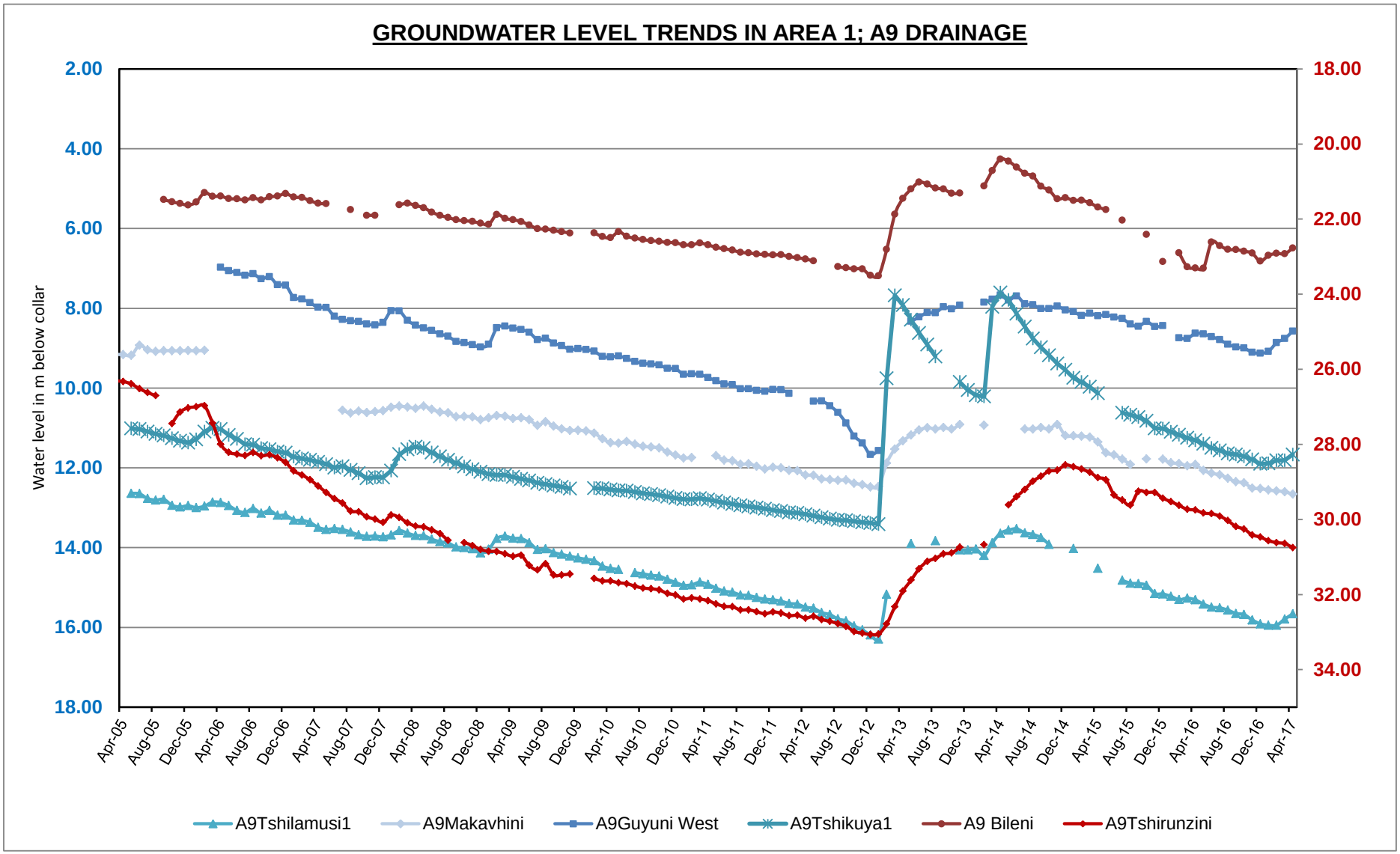
GROUNDWATER LEVEL TRENDS IN AREA 1; A9 DRAINAGE
Water level in m below collar
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
18.00
20.00
22.00
24.00
26.00
28.00
30.00
32.00
34.00
Apr-05
Aug-05
Dec-05
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A9Tshilamusi1
A9Makavhini
A9Guyuni West
A9Tshikuya1
A9 Bileni
A9Tshirunzini

FIGURE 24

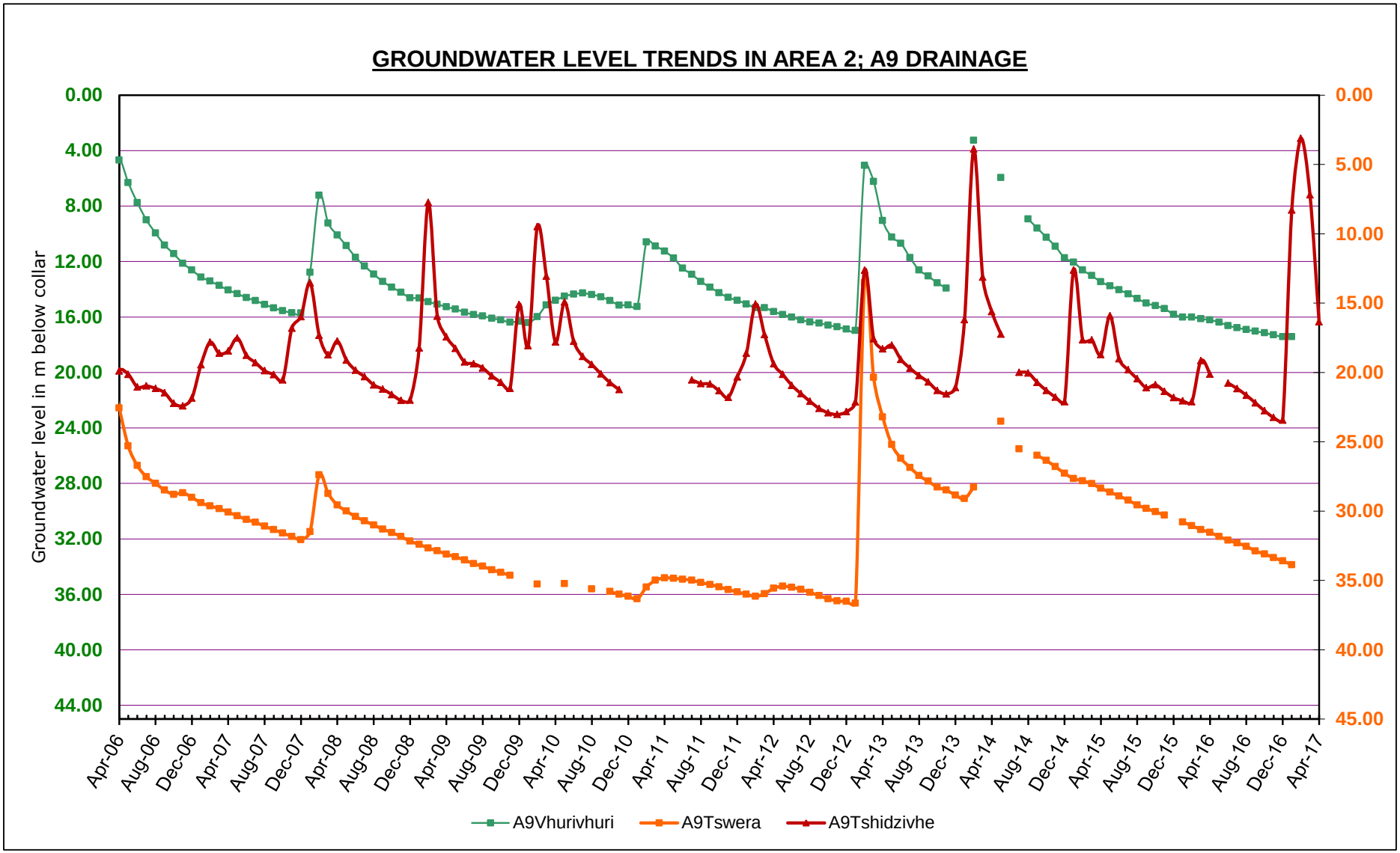
GROUNDWATER LEVEL TRENDS IN AREA 2; A9 DRAINAGE
Groundwater level in m below collar
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
36.00
40.00
44.00
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A9Vhurivhuri
A9Tswera
A9Tshidzivhe

FIGURE 25

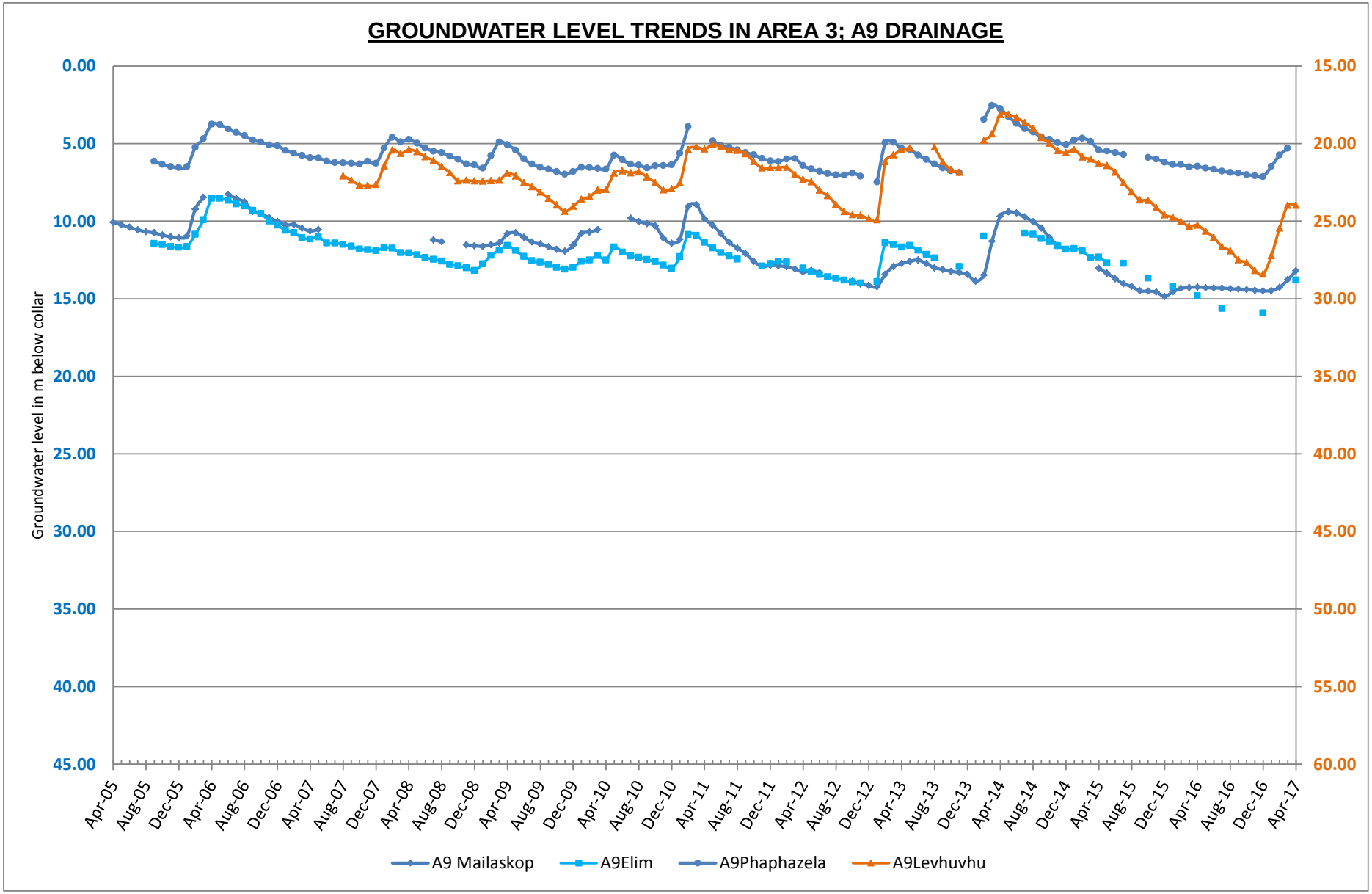
GROUNDWATER LEVEL TRENDS IN AREA 3; A9 DRAINAGE
Groundwater level in m below collar
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
Apr-05
Aug-05
Dec-05
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
A9 Mailaskop
A9Elim
A9Phaphazela
A9Levhuvhu

FIGURE 26

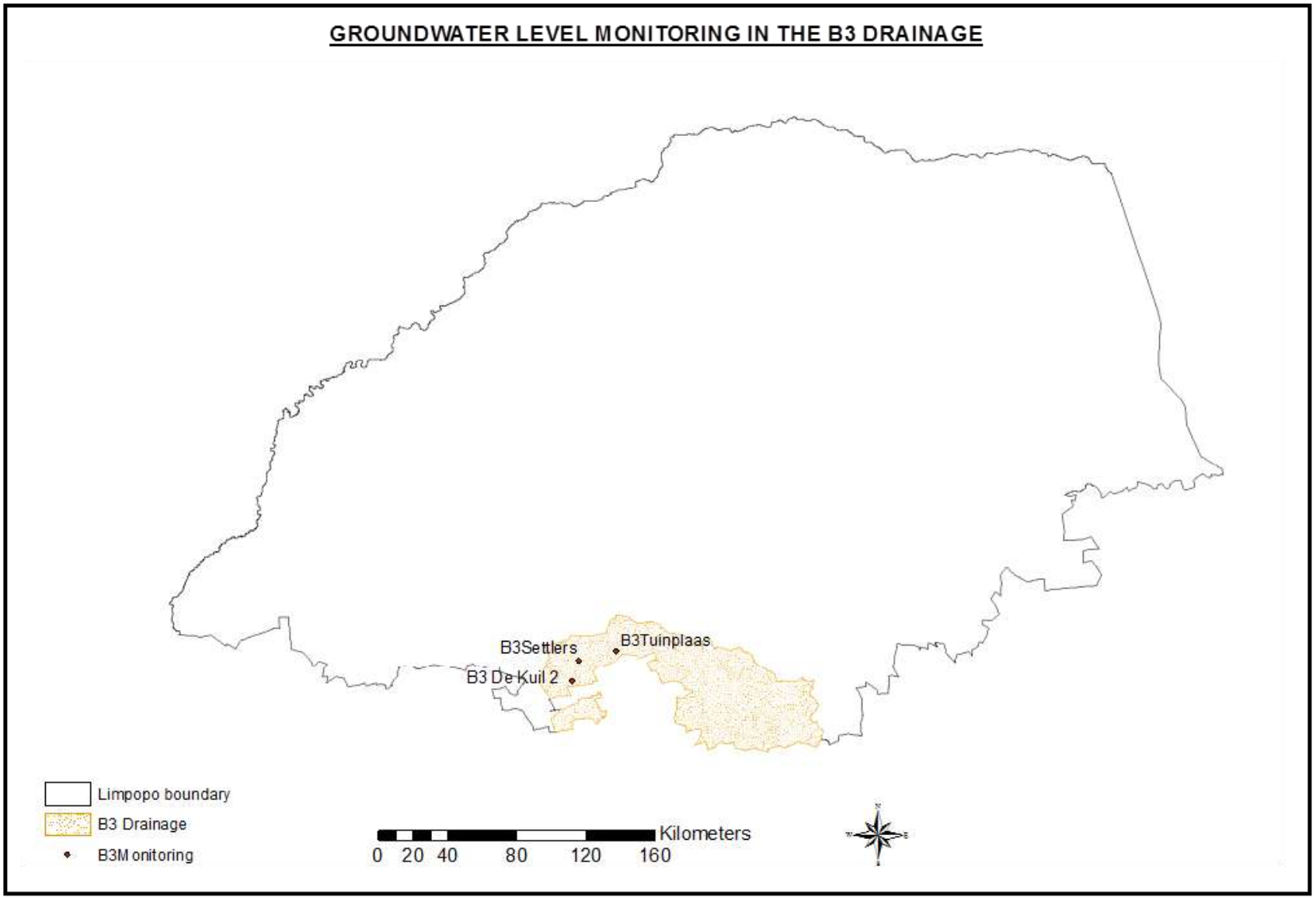
GROUNDWATER LEVEL MONITORING IN THE B3 DRAINAGE
B3Settlers
B3Tuinplaas
B3 De Kuil 2
Limpopo boundary
B3 Drainage
B3Monitoring
Kilometers
0 20 40 80 120 160

FIGURE 27

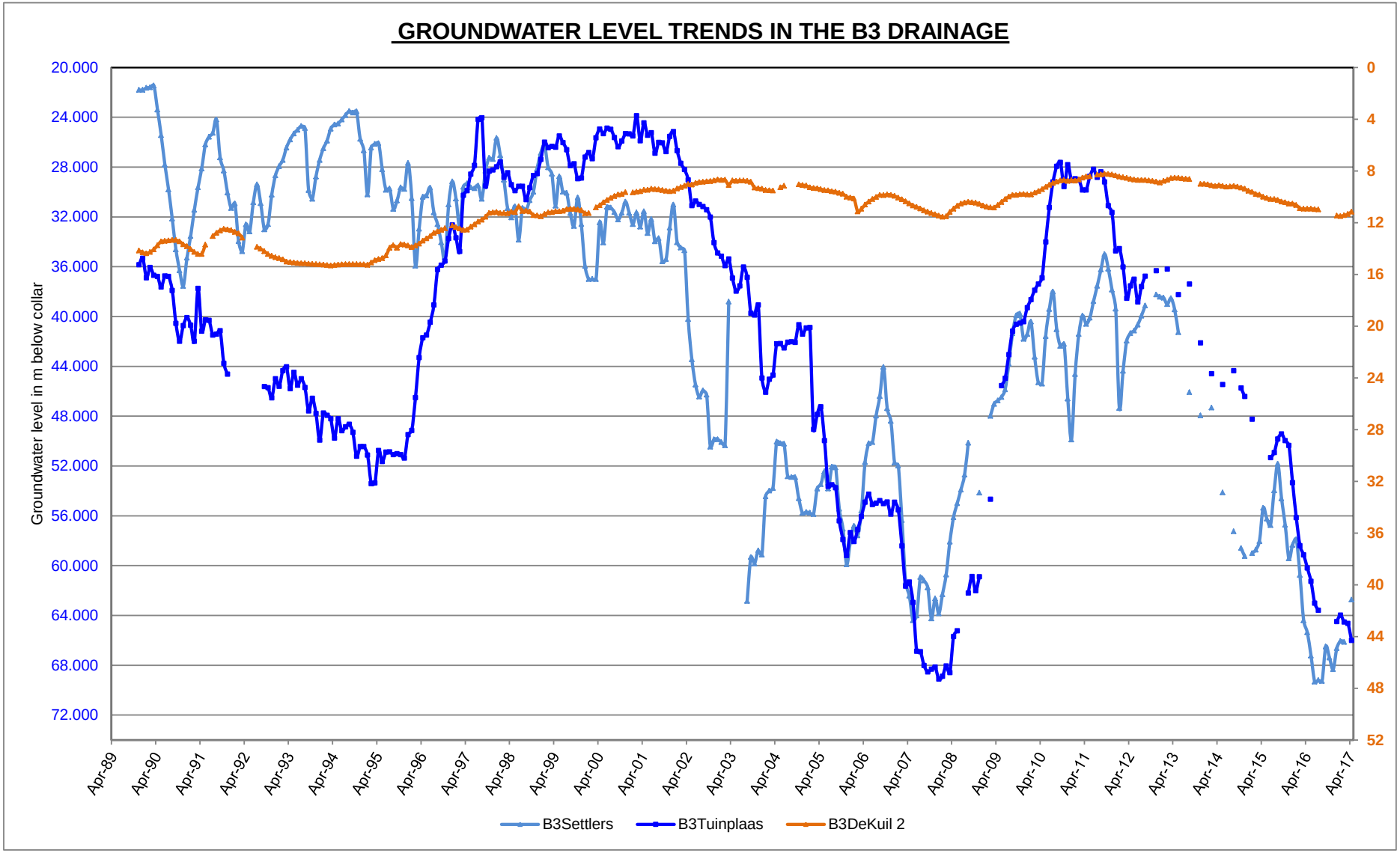
GROUNDWATER LEVEL TRENDS IN THE B3 DRAINAGE
Groundwater level in m below collar
20.000
24.000
28.000
32.000
36.000
40.000
44.000
48.000
52.000
56.000
60.000
64.000
68.000
72.000
0
4
8
12
16
20
24
28
32
36
40
44
48
52
Apr-89
Apr-90
Apr-91
Apr-92
Apr-93
Apr-94
Apr-95
Apr-96
Apr-97
Apr-98
Apr-99
Apr-00
Apr-01
Apr-02
Apr-03
Apr-04
Apr-05
Apr-06
Apr-07
Apr-08
Apr-09
Apr-10
Apr-11
Apr-12
Apr-13
Apr-14
Apr-15
Apr-16
Apr-17
B3Settlers
B3Tuinplaas
B3DeKuil 2

FIGURE 28

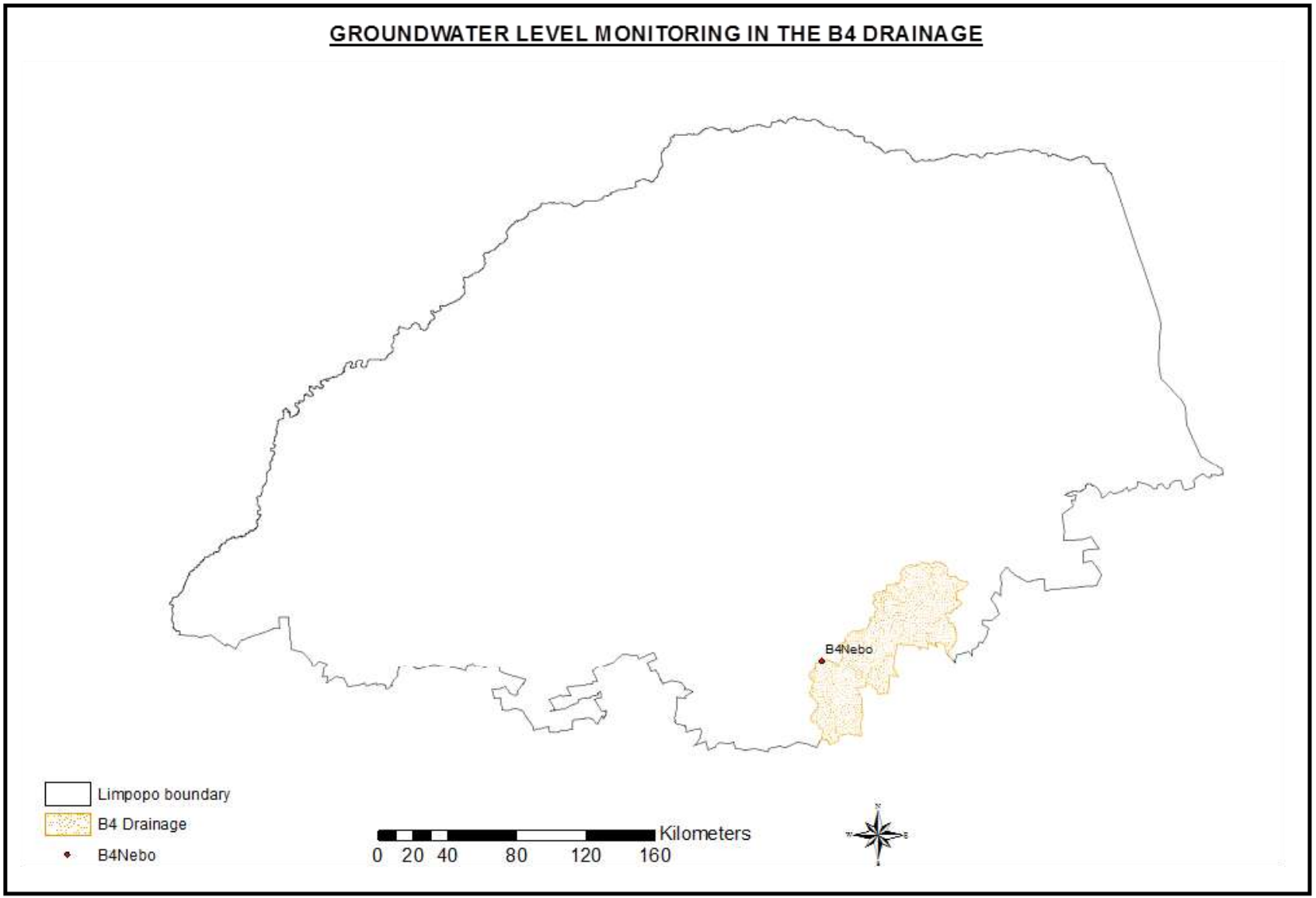
GROUNDWATER LEVEL MONITORING IN THE B4 DRAINAGE
B4Nebo
Limpopo boundary
B4 Drainage
B4Nebo
0 20 40 80 120 160
Kilometers

FIGURE 29

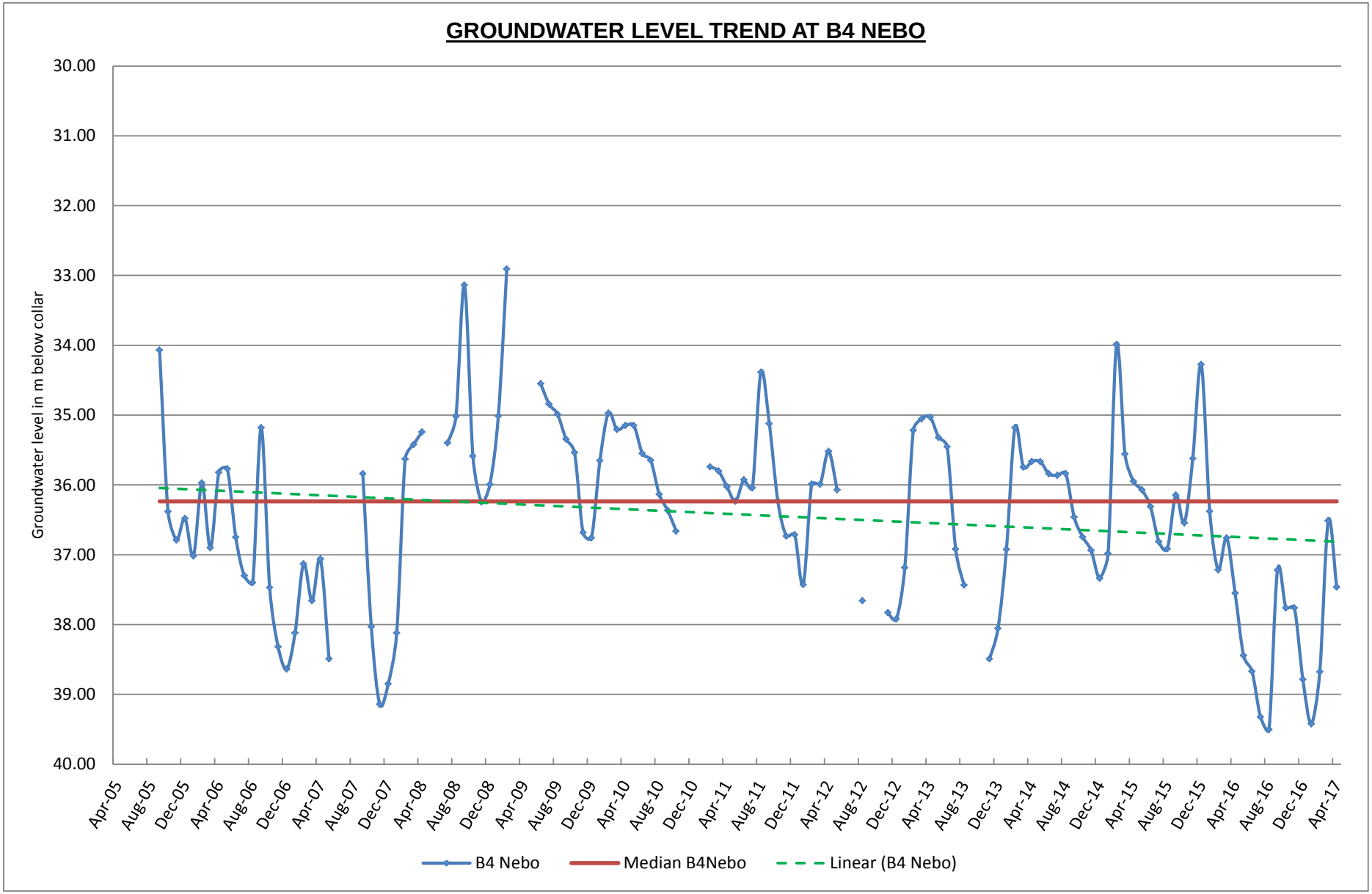
GROUNDWATER LEVEL TREND AT B4 NEBO
Groundwater level in m below collar
30.00
31.00
32.00
33.00
34.00
35.00
36.00
37.00
38.00
39.00
40.00
Apr-05
Aug-05
Dec-05
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
B4 Nebo
Median B4Nebo
Linear (B4 Nebo)

FIGURE 30

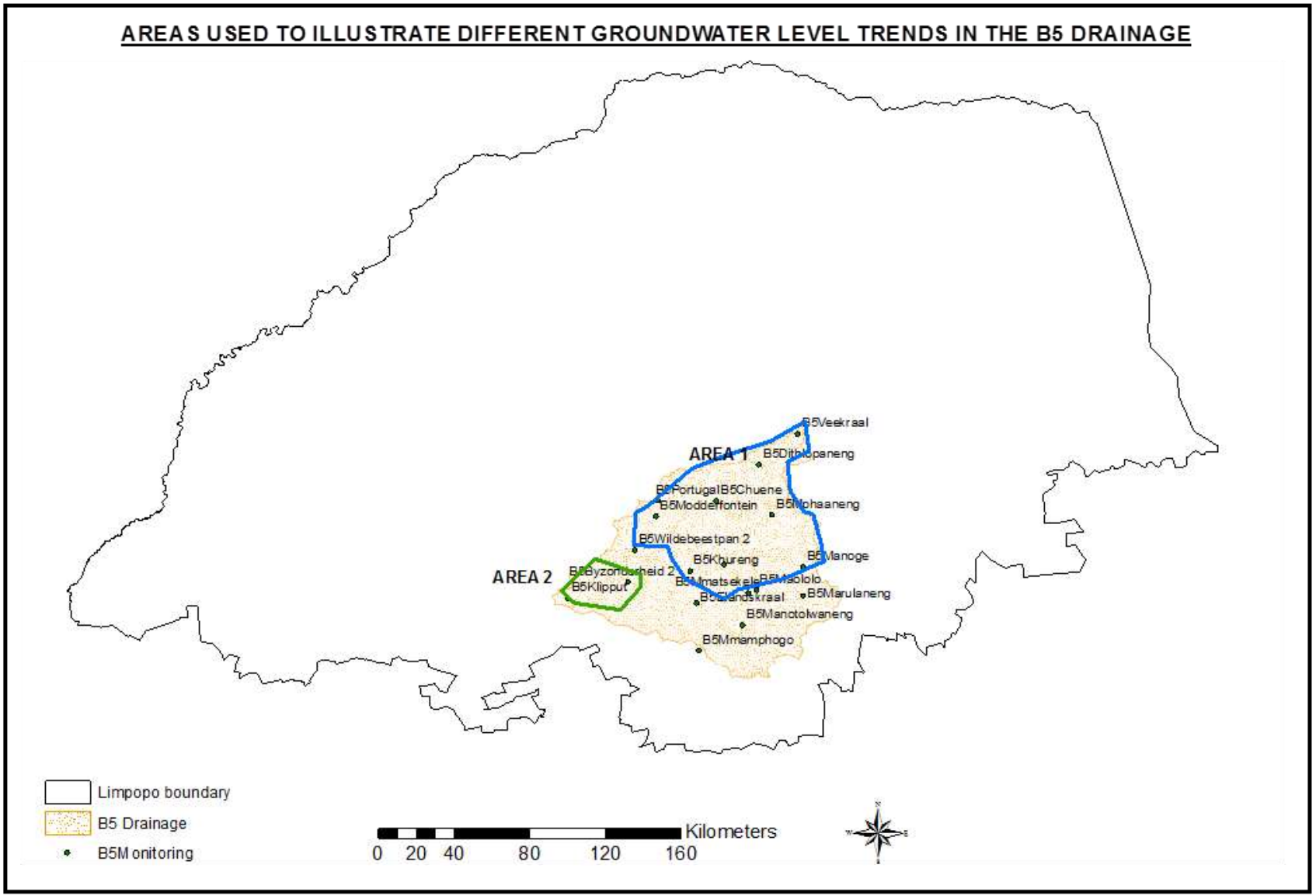
AREAS USED TO ILLUSTRATE DIFFERENT GROUNDWATER LEVEL TRENDS IN THE B5 DRAINAGE
AREA 1
AREA 2
B5Veekraal
B5Ditholopaneng
B5PortugalB5Chuene
B5Moddelfontein
B5Mphaaneng
B5Wildebeestpan 2
B5Khureng
B5Manoge
B5Byzondersheid 2
B5Klipput
B5Imatsekele
B5Mabololo
B5Sandskraal
B5Marulaneng
B5Manotolwaneng
B5Mmamphogo
Limpopo boundary
B5 Drainage
B5Monitoring
Kilometers
0 20 40 80 120 160

FIGURE 31

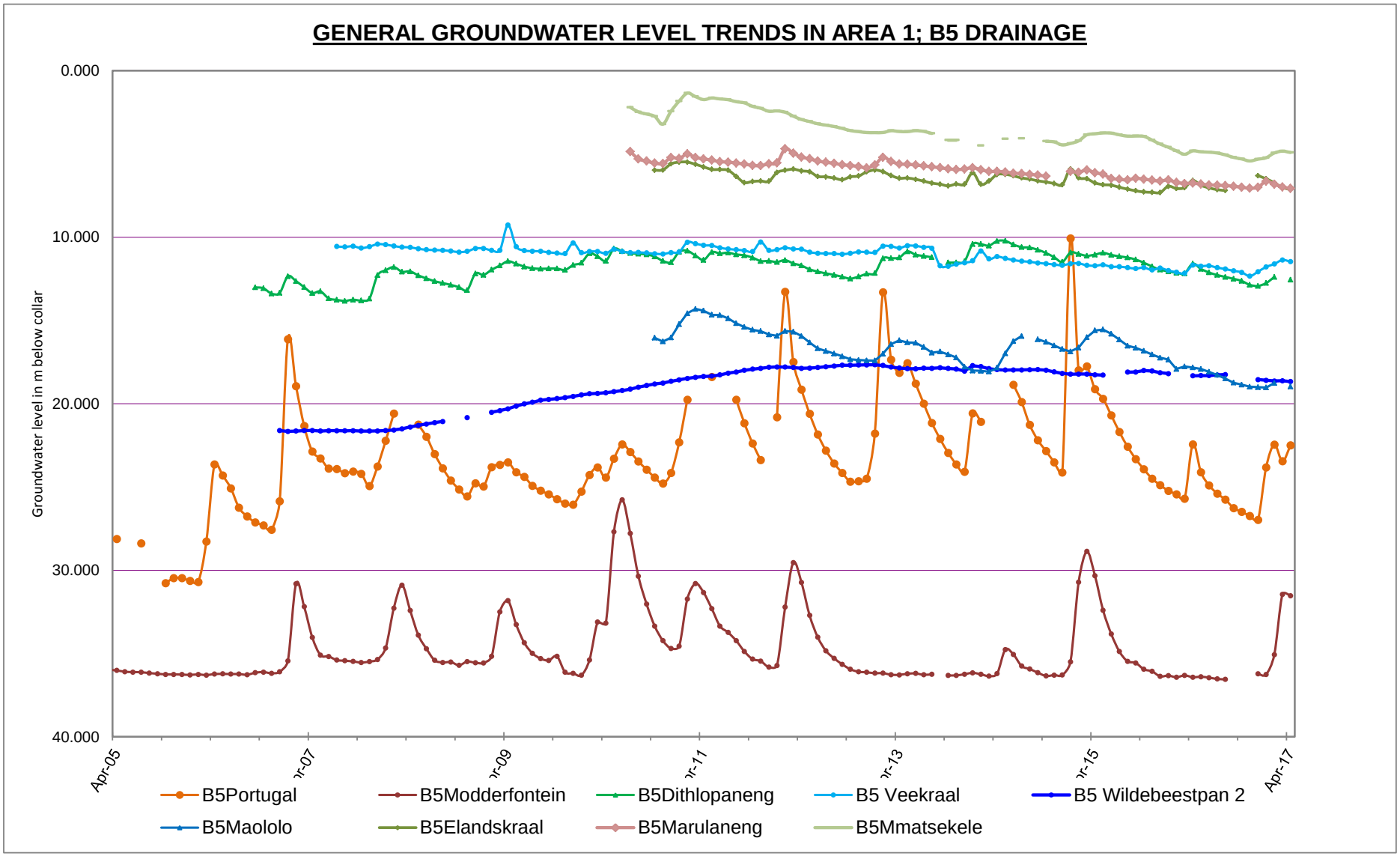
GENERAL GROUNDWATER LEVEL TRENDS IN AREA 1; B5 DRAINAGE
Groundwater level in m below collar
0.000
10.000
20.000
30.000
40.000
Apr-05
Apr-07
Apr-09
Apr-11
Apr-13
Apr-15
Apr-17
B5Portugal
B5Modderfontein
B5Dithlopaneng
B5 Veekraal
B5 Wildebeestpan 2
B5Maololo
B5Elandskraal
B5Marulaneng
B5Mmatsekele

FIGURE 32

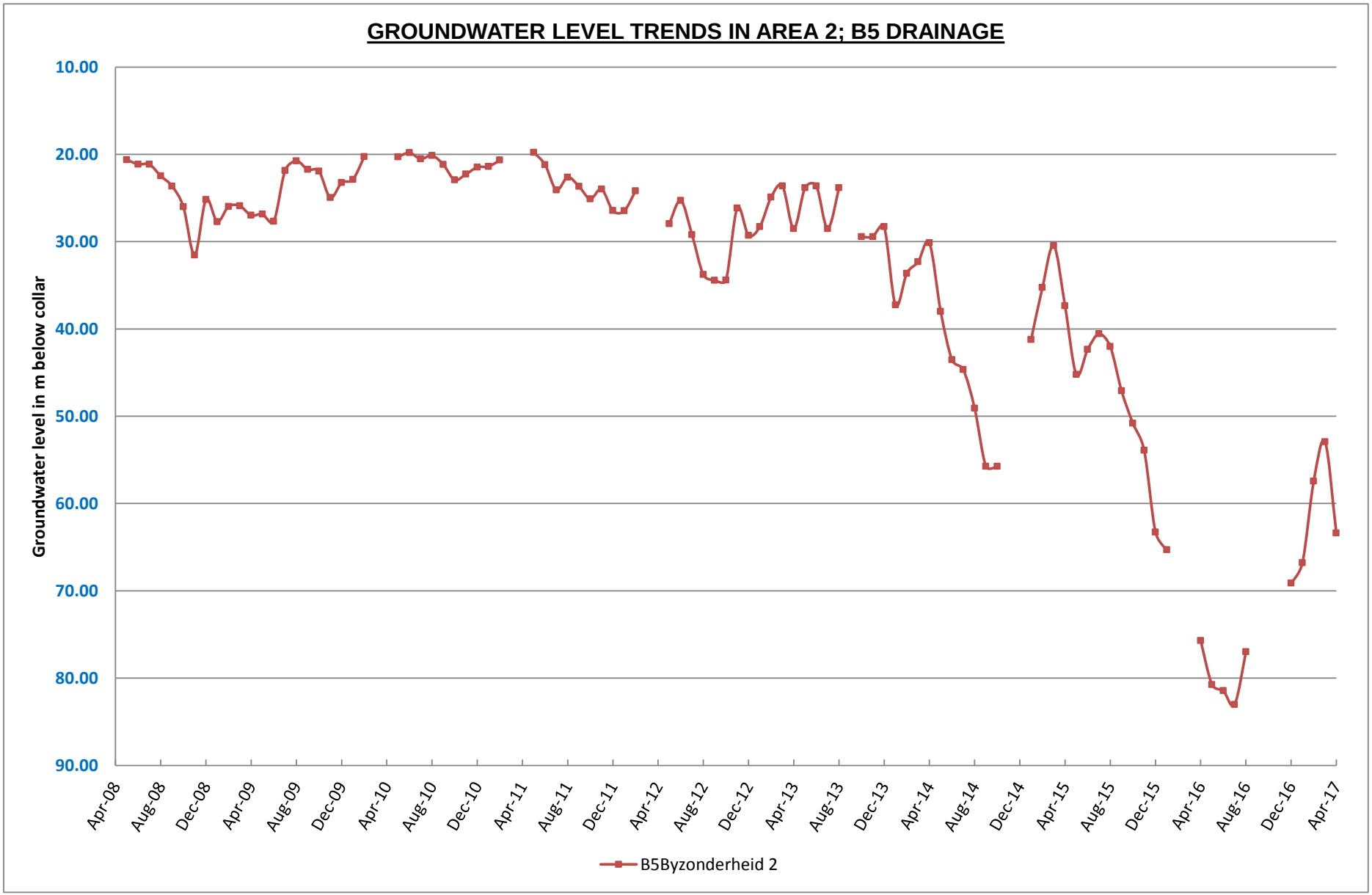
GROUNDWATER LEVEL TRENDS IN AREA 2; B5 DRAINAGE
Groundwater level in m below collar
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
B5Byzonderheid 2

FIGURE 33

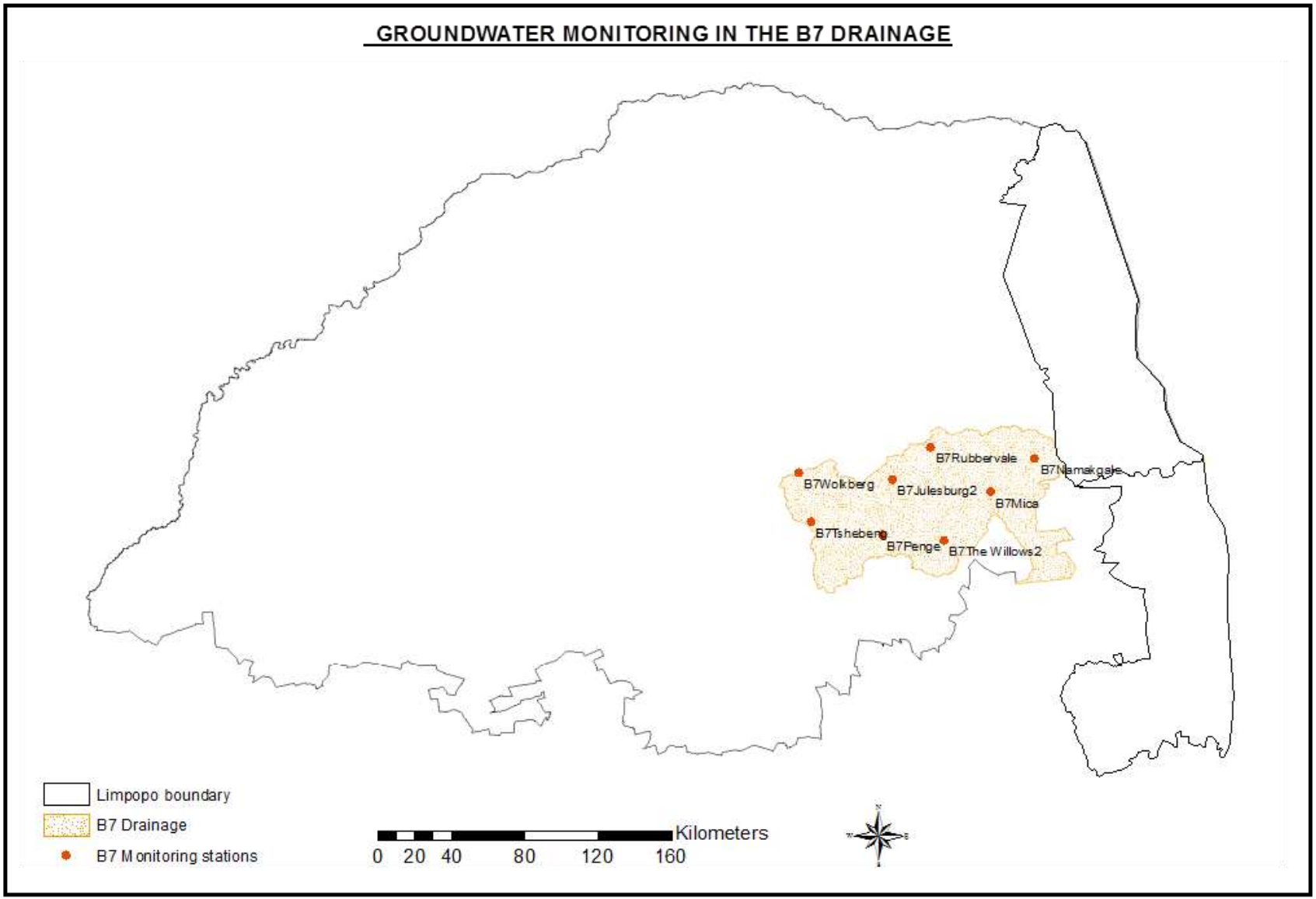
GROUNDWATER MONITORING IN THE B7 DRAINAGE
B7Rubbervale
B7Namakgale
B7Wolkberg
B7Julesburg2
B7Mica
B7Tshebeng
B7Penge
B7The Willows2
Limpopo boundary
B7 Drainage
B7 Monitoring stations
Kilometers
0 20 40 80 120 160

FIGURE 34

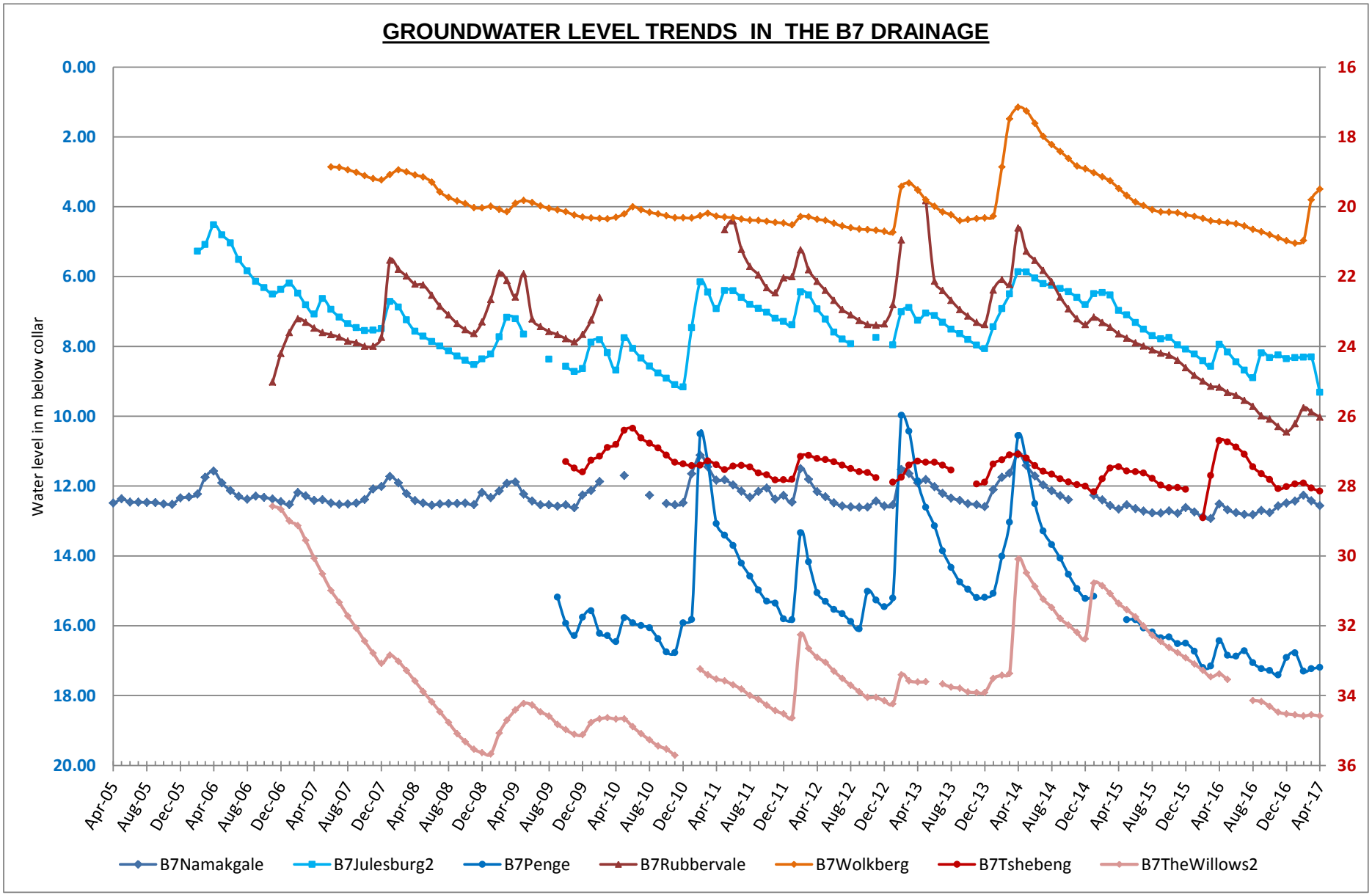
GROUNDWATER LEVEL TRENDS IN THE B7 DRAINAGE
Water level in m below collar
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
16
18
20
22
24
26
28
30
32
34
36
Apr-05
Aug-05
Dec-05
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
B7Namakgale
B7Julesburg2
B7Penge
B7Rubbervale
B7Wolkberg
B7Tshebeng
B7TheWillows2

FIGURE 35

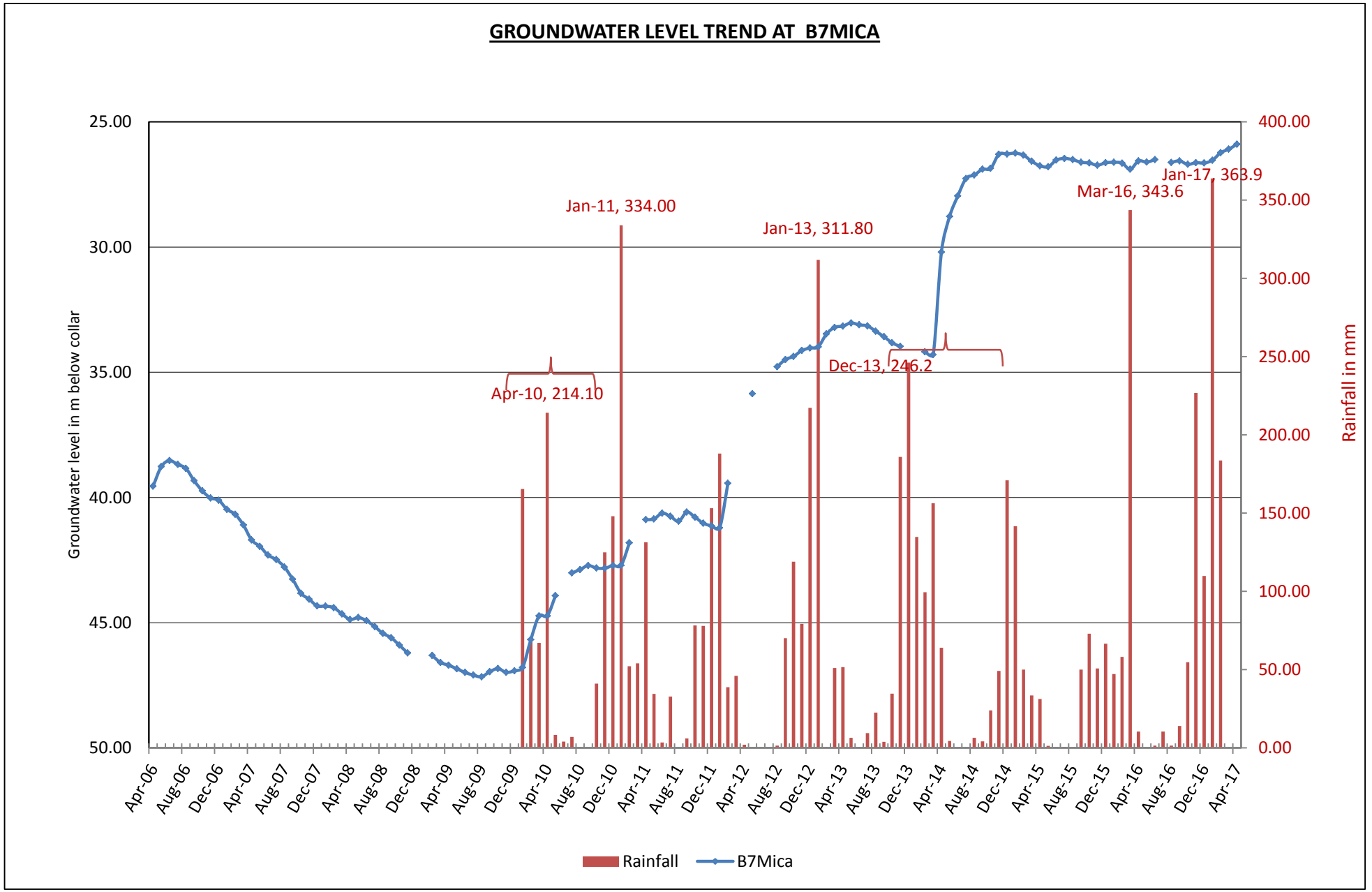
GROUNDWATER LEVEL TREND AT B7MICA
Groundwater level in m below collar
Rainfall in mm
25.00
30.00
35.00
40.00
45.00
50.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Jan-11, 334.00
Jan-13, 311.80
Mar-16, 343.6
Jan-17, 363.9
Apr-10, 214.10
Dec-13, 246.2
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
Rainfall
B7Mica

FIGURE 36

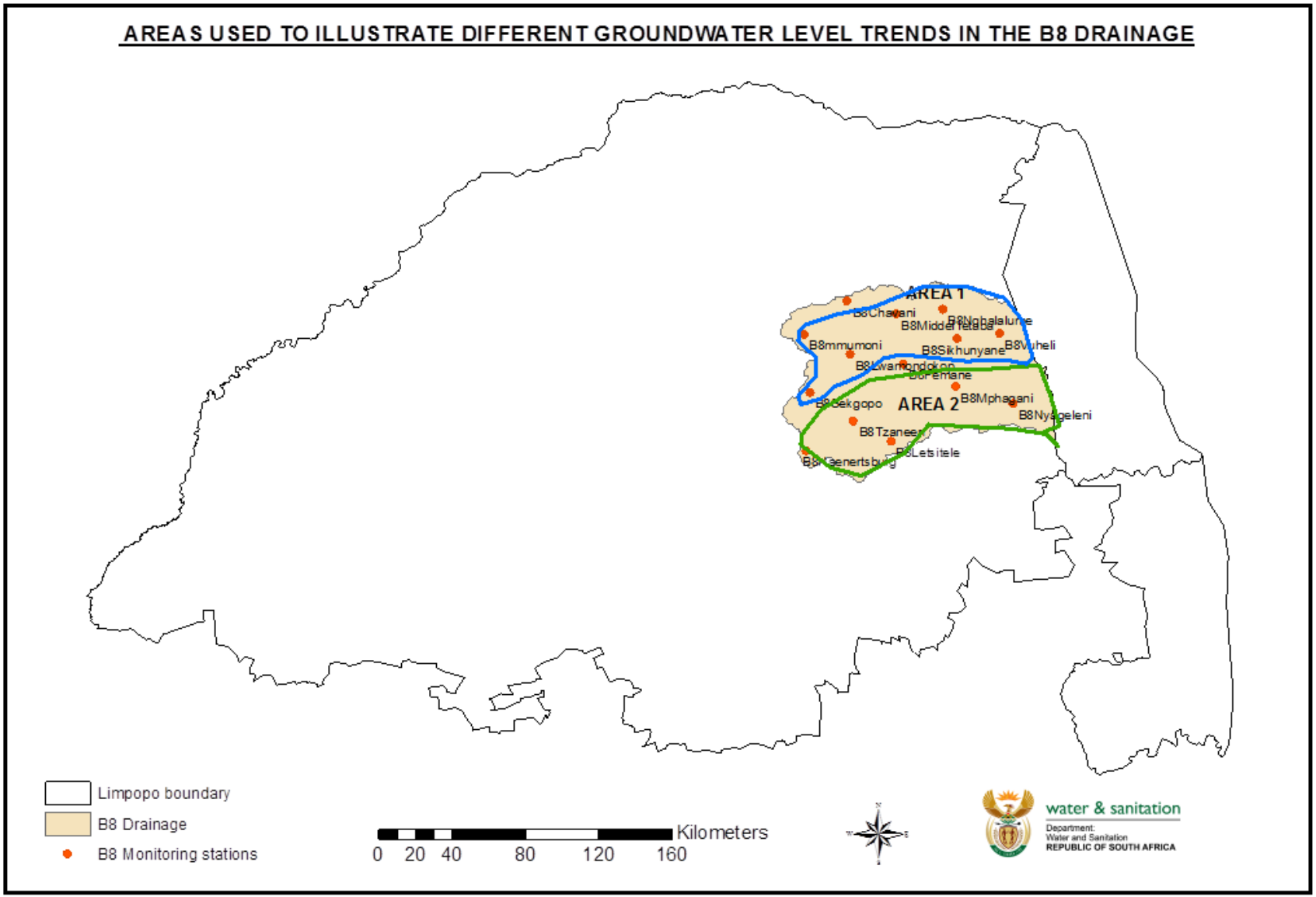
AREAS USED TO ILLUSTRATE DIFFERENT GROUNDWATER LEVEL TRENDS IN THE B8 DRAINAGE
AREA 1
AREA 2
B8Chaani
B8Nghalalume
B8Middelfontein
B8mmumoni
B8Sikhunyane
B8Vuheli
B8Lwamondokop
B8Phemane
B8Sekgopo
B8Mphagani
B8Nyagelen
B8Tzaneen
B8Letsitele
Limpopo boundary
B8 Drainage
B8 Monitoring stations
Kilometers
0 20 40 80 120 160
water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

FIGURE 37

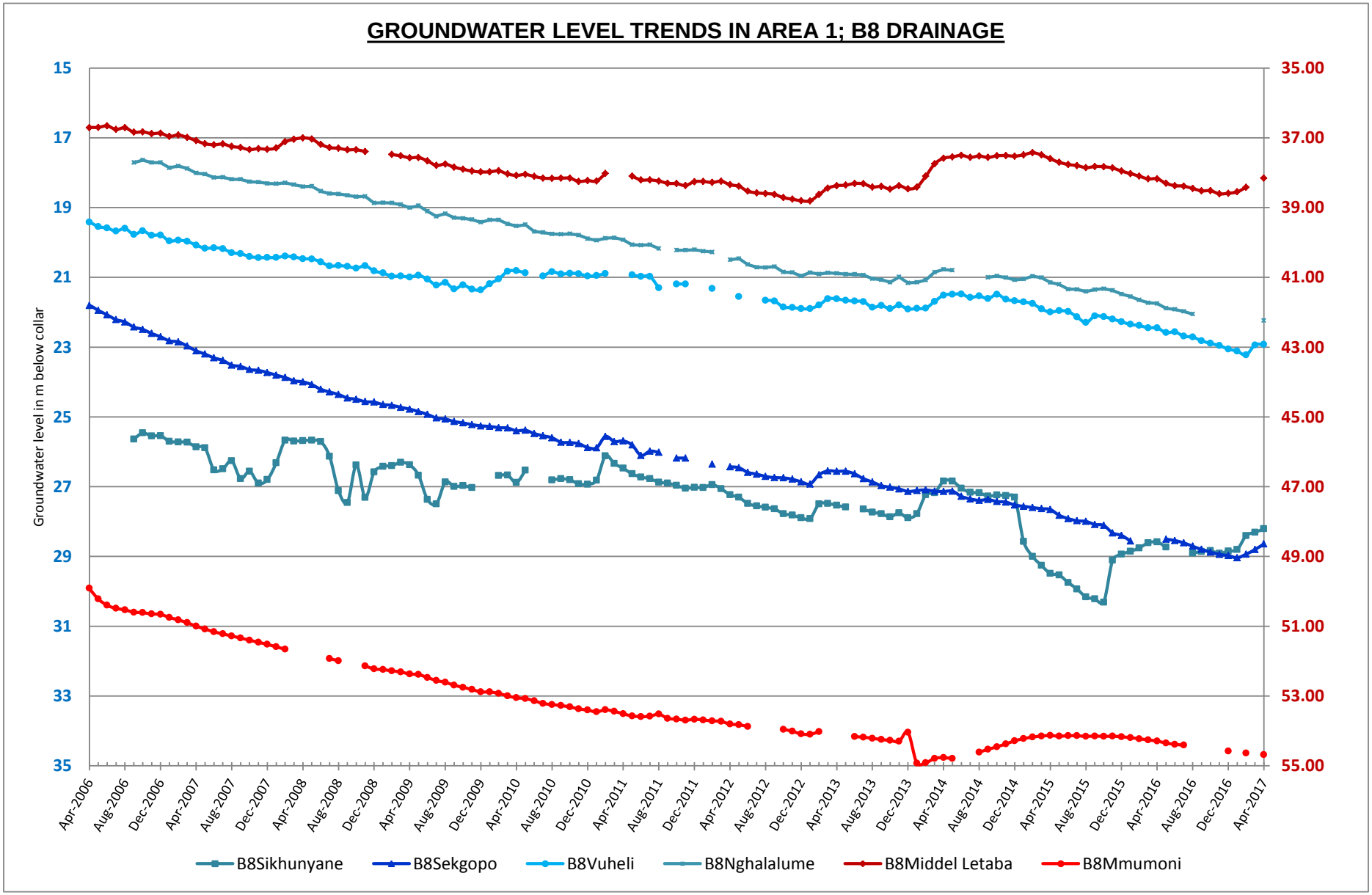
GROUNDWATER LEVEL TRENDS IN AREA 1; B8 DRAINAGE
Groundwater level in m below collar
15
17
19
21
23
25
27
29
31
33
35
35.00
37.00
39.00
41.00
43.00
45.00
47.00
49.00
51.00
53.00
55.00
Apr-2006
Aug-2006
Dec-2006
Apr-2007
Aug-2007
Dec-2007
Apr-2008
Aug-2008
Dec-2008
Apr-2009
Aug-2009
Dec-2009
Apr-2010
Aug-2010
Dec-2010
Apr-2011
Aug-2011
Dec-2011
Apr-2012
Aug-2012
Dec-2012
Apr-2013
Aug-2013
Dec-2013
Apr-2014
Aug-2014
Dec-2014
Apr-2015
Aug-2015
Dec-2015
Apr-2016
Aug-2016
Dec-2016
Apr-2017
B8Sikhunyane
B8Sekgopo
B8Vuheli
B8Nghalalume
B8Middel Letaba
B8Mmumoni

FIGURE 38

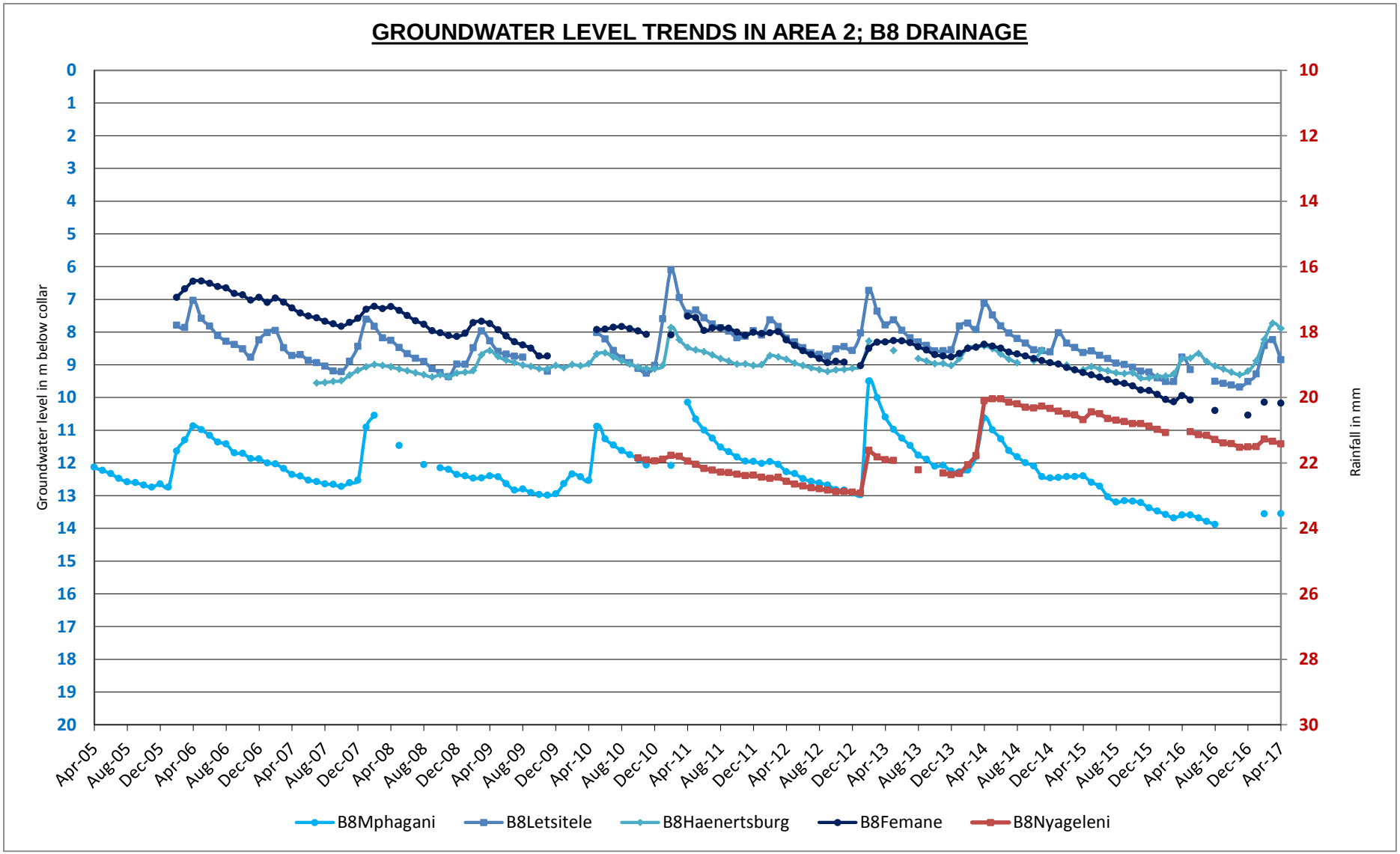
GROUNDWATER LEVEL TRENDS IN AREA 2; B8 DRAINAGE
Groundwater level in m below collar
Rainfall in mm
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
10
12
14
16
18
20
22
24
26
28
30
Apr-05
Aug-05
Dec-05
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
B8Mphagani
B8Letsitele
B8Haenertsburg
B8Femane
B8Nyageleni

FIGURE 39

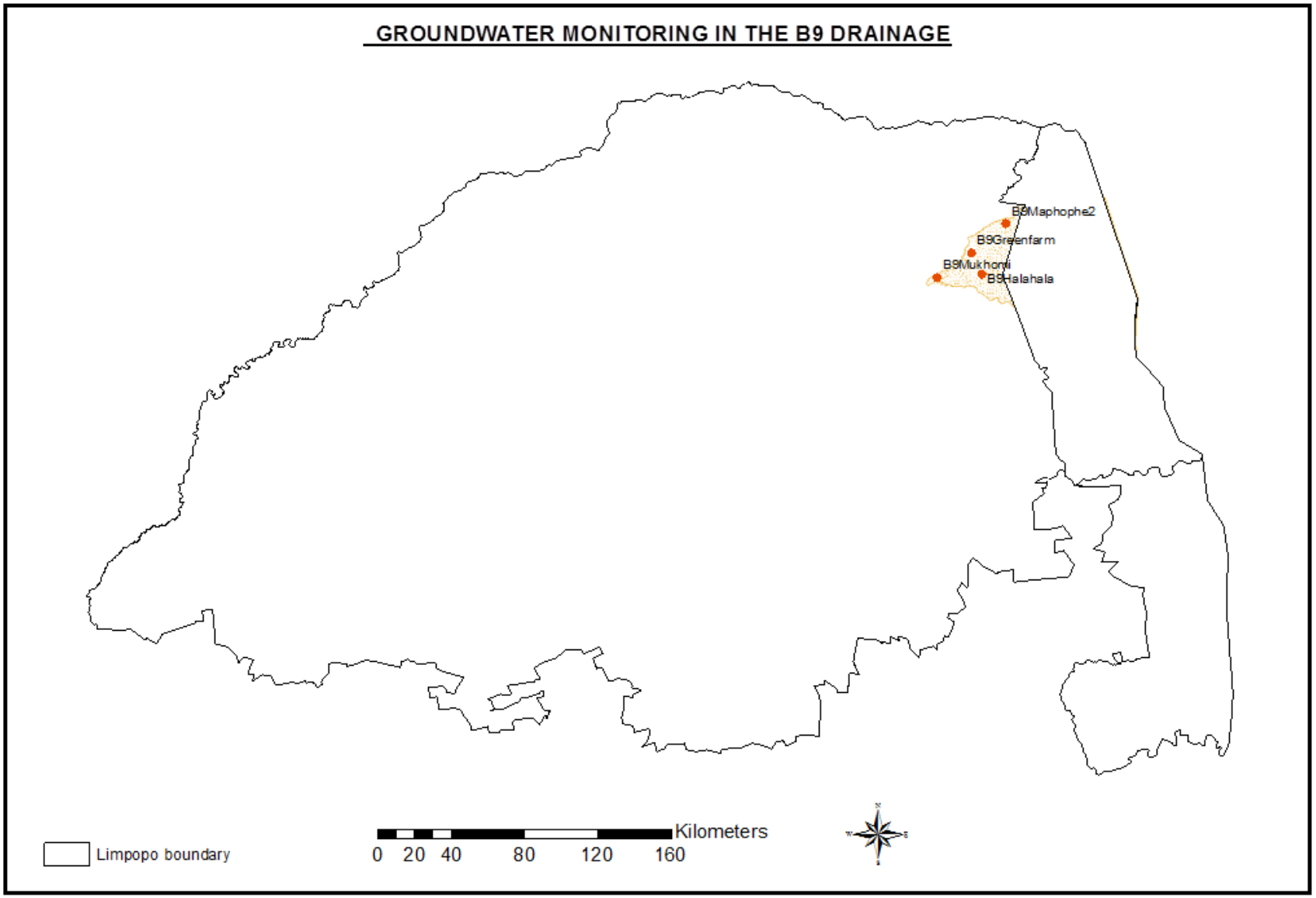
GROUNDWATER MONITORING IN THE B9 DRAINAGE
B9Maphophe2
B9Greenfarm
B9Mukhomi
B9Halahala
Limpopo boundary
Kilometers
0 20 40 80 120 160

FIGURE 40

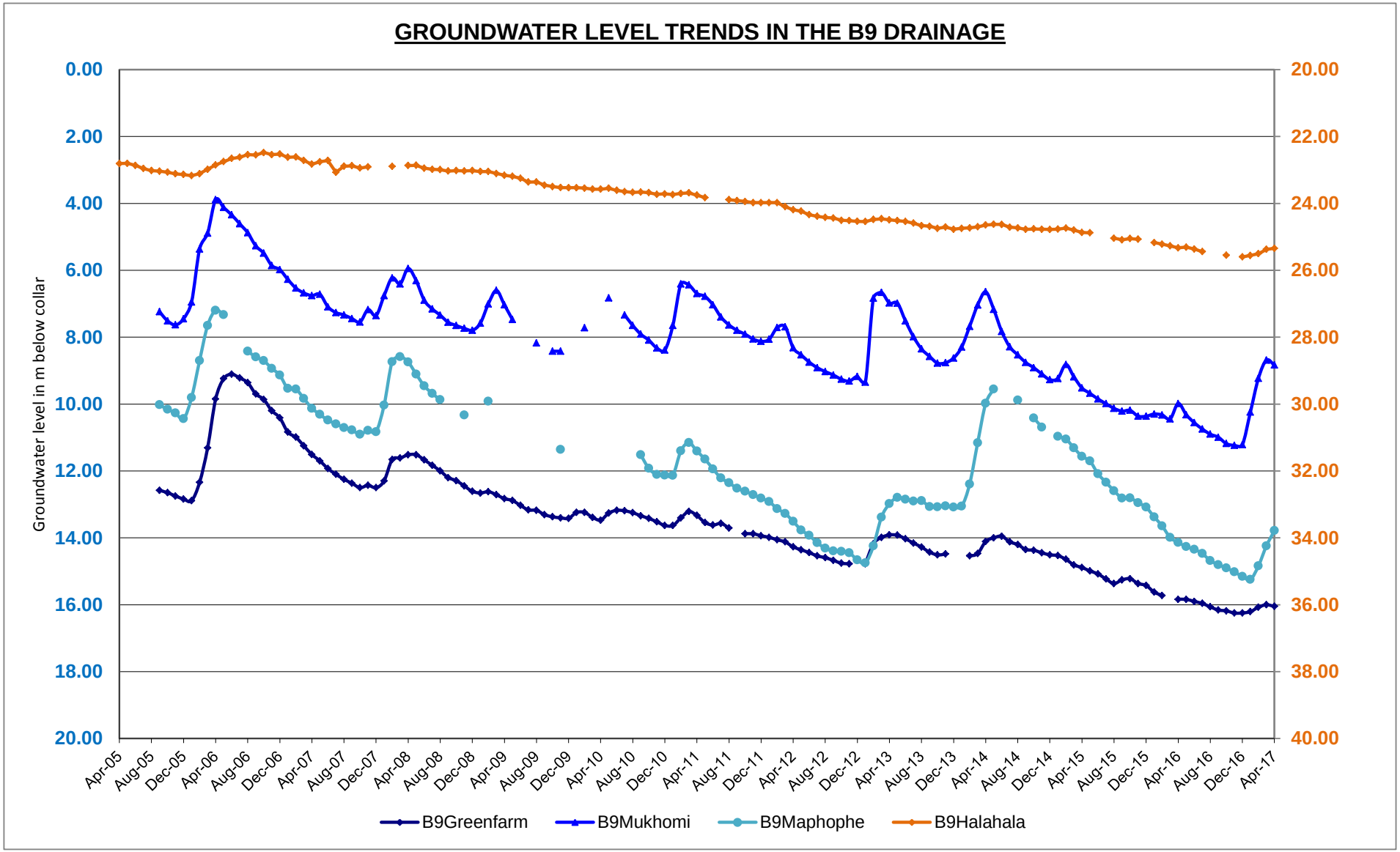
GROUNDWATER LEVEL TRENDS IN THE B9 DRAINAGE
Groundwater level in m below collar
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
20.00
22.00
24.00
26.00
28.00
30.00
32.00
34.00
36.00
38.00
40.00
Apr-05
Aug-05
Dec-05
Apr-06
Aug-06
Dec-06
Apr-07
Aug-07
Dec-07
Apr-08
Aug-08
Dec-08
Apr-09
Aug-09
Dec-09
Apr-10
Aug-10
Dec-10
Apr-11
Aug-11
Dec-11
Apr-12
Aug-12
Dec-12
Apr-13
Aug-13
Dec-13
Apr-14
Aug-14
Dec-14
Apr-15
Aug-15
Dec-15
Apr-16
Aug-16
Dec-16
Apr-17
B9Greenfarm
B9Mukhomi
B9Maphophe
B9Halahala

FIGURE 41

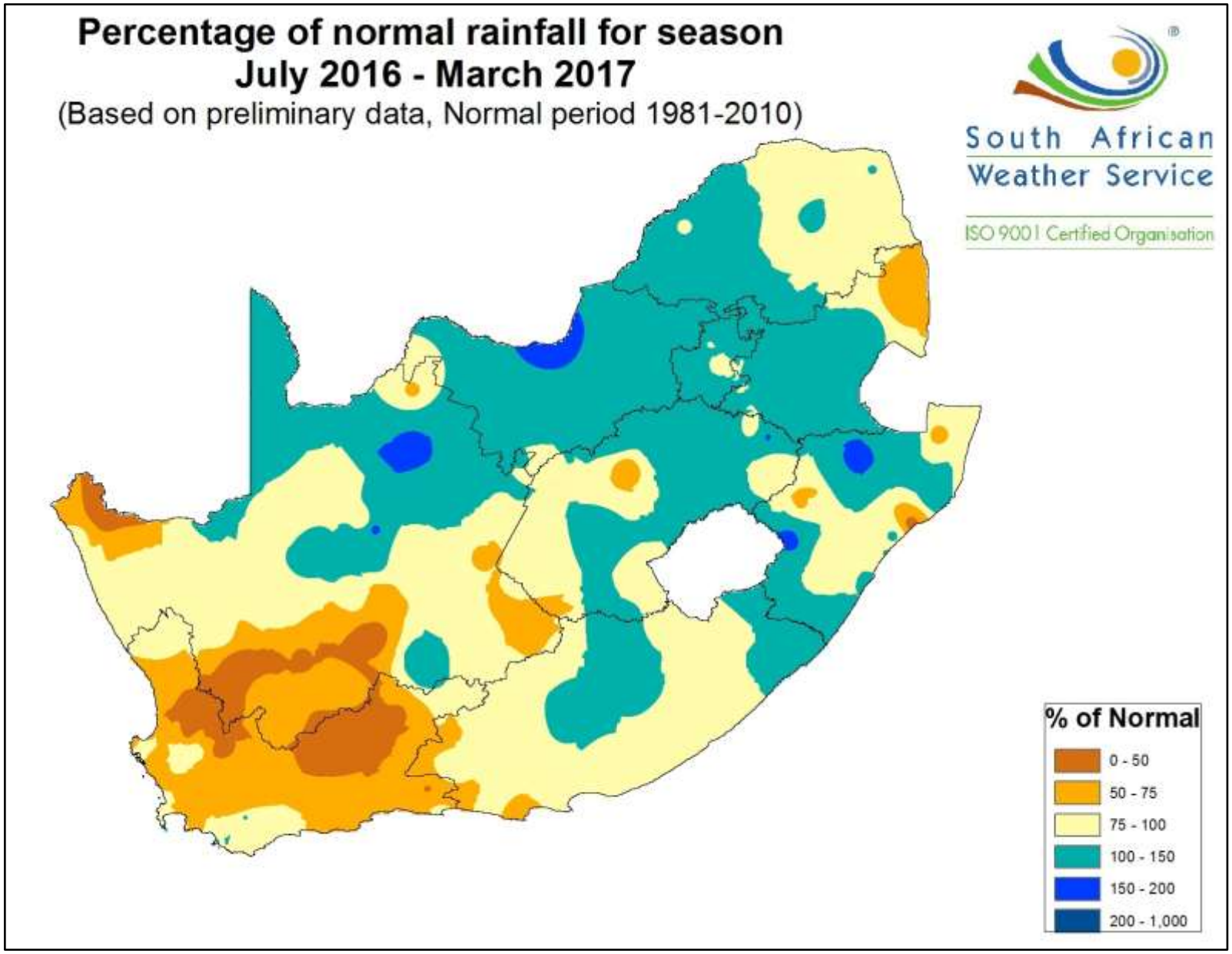
Percentage of normal rainfall for season
July 2016 - March 2017
(Based on preliminary data, Normal period 1981-2010)
South African
Weather Service
ISO 9001 Certified Organisation
% of Normal
0 - 50
50 - 75
75 - 100
100 - 150
150 - 200
200 - 1,000

FIGURE 42