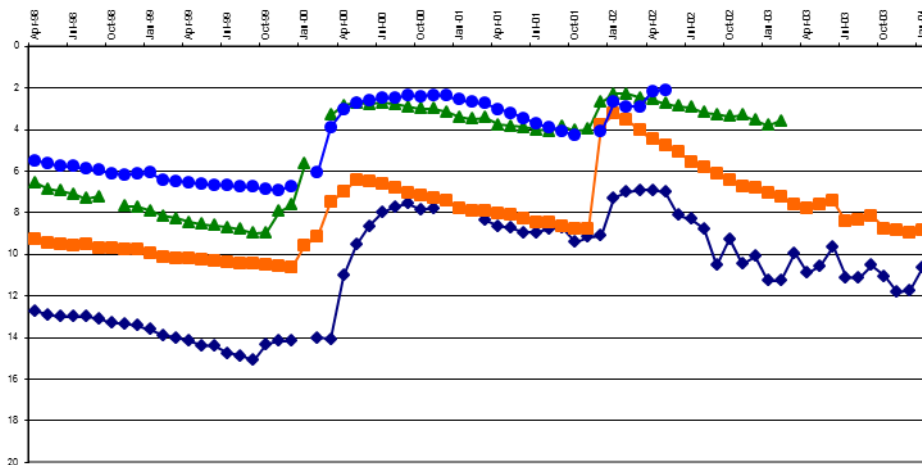


LIMPOPO REGION

QUARTERLY STATUS REPORT ON GROUNDWATER LEVEL TRENDS



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SEPTEMBER 2015**

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SUMMARY

The status of groundwater levels in the report reflects the situation at the end of the 3rd quarter of the hydrological year, midway through the dry season. Groundwater levels at 86% of stations monitored have declined since the start of the dry season. Comparison with the corresponding time last year indicates that water levels at 79% of the stations are currently lower than this time last year. Considering that it is only midway into the dry season this figure may increase by the end of the dry season. This figure was 35% and 32% for 2011-2012 and 2012-2013 at this point in time. The limited groundwater recharge the previous wet season is probably the major reason. Despite current lowering of water levels, the majority of groundwater level trends represent relative stable conditions fluctuating seasonally around a mean with an underlying slow declining trend present at some stations. The decline is considered a normal longer-term cycle and not a reason of concern at this stage. Two areas characterised by constant declining water levels with virtually no seasonal recharge can be recognised. One area is around Tolwe, Baltimore, Tom Burke and Beauty and is mostly farming area. The second area consists of the drainage area of the Koedoes, Middel, and Klein Letaba Rivers and northwards from Giyani up to the Masisi area. Though the current situation may not be a reason for concern these two areas can be potentially at risk if dry conditions persist. Forecast at this stage indicate a high probability of that due to the current El Niño situation.

Generally the status of groundwater levels is healthy. Comparison with long-term trends indicate that despite slow declining trends noted at some localities for a few years now, levels are still higher than that prior to 1996 which was a major recharge year ending a prolonged period of drought. Groundwater recharge in 2000 was extremely high in some areas.

1. BACKGROUND

The 3 months April, May & June represents the 3rd quarter of the hydrological year which is the first half of the dry season. Comparison is drawn between the situation at the start and end of the quarter as well as with the corresponding time the previous year in the different secondary drainage areas. Some long-term trends to provide a better perspective on the current status are also presented. Continuous data is not always available for all stations for a variety of reasons of which the lack of replacement instruments is currently the biggest challenge.

The distribution of the monitoring network is illustrated by **MAP 1**.

2. GROUNDWATER LEVELS

2.1. DIFFERENCE IN GROUNDWATER LEVELS; APRIL TO JUNE 2015.

April 2015 to June 2015

Total	190	Stations

With data	173	Stations	91.1%
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Water level			Average(m)	%
Down	149	Stations	0.68	86.13%
Up	24	Stations	0.33	13.87%
Na change	0	Stations		0.00%
No Data	17	Stations		100.00%

TABLE 1

The period from April to the end of June represents the first half of the dry season and groundwater levels are generally declining. The distribution of stations with higher or lower groundwater levels from April to the end of June 2015 is shown on **MAP 2**. Groundwater levels normally decline over the dry period and the map clearly indicate that most levels have declined. 86% of stations with data for the period indicate lower water levels with only 13.9% with higher water levels (**TABLE 1**)

2.2 DIFFERENCE IN GROUNDWATER LEVELS; JUNE 2014 TO JUNE 2015

June 2014 to June 2015

Total	190	Stations

With data	172	Stations	90.5%
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Water level			Average(m)	%
Down	136	Stations	1.25	79.07%
Up	36	Stations	0.87	20.93%
Na change	0	Stations		0.00%
No Data	18	Stations		100.00%

TABLE 2

The effect of the limited groundwater recharge the previous wet season is indicated by the large number of stations early in the dry season with lower water levels than the corresponding time last year. The distribution of stations with higher or lower groundwater levels from June 2014 to June 2015 is shown on **MAP 3**. 79% of

stations with data indicate lower groundwater levels than the corresponding time last year. 20.9% still have higher water levels (**TABLE 2**)

3 TYPICAL GROUNDWATER LEVEL TRENDS AND SOME DEVIATIONS FROM THE GENERAL TREND IN THE DIFFERENT SECONDARY DRAINAGE AREAS

The predominant general trend for each drainage area was identified as typical for the specific drainage currently. Some stations have been monitored for a long period of time and long-term data is available. The majority of monitoring stations is fairly new and has data for the past 5 to 10 years.

The positions of monitoring stations used for the graphs are indicated on **MAP 4**.

3.1 DRAINAGE A4 (GRAPHS 1 & 2)

Groundwater use in the A4 drainage mostly consists of domestic use as well as cattle and game farming which have little impact on the resource. Groundwater levels in this drainage are generally stable with some seasonal fluctuations. A slight declining trend is displayed at one station. Stations located in the Matlabas River drainage indicate good recharge during March-April 2014 as indicated by **GRAPH 1**. There are no notable deviations in the general stable trend except for more pronounced seasonal fluctuations at Alma and Rhenosterpoort presented on **GRAPH 2**.

3.2 DRAINAGE A5 (GRAPHS 3 & 4)

There are 10 monitoring stations in the A5 drainage, 5 of which indicate a stable trend with clear seasonal fluctuations **GRAPH 3**. Groundwater levels at the other 5 indicate a different trend with a constant decline in water levels which is the most pronounced at A5N0012 and A5N0016 as depicted on **GRAPH 4**. The decline at the other 3 stations is very small. The sharp declines as noted on **GRAPH 4** correspond with groundwater levels in the A6 drainage adjacent to this area and are considered to be due to irrigation abstraction and limited recharge in the previous wet season.

3.3 DRAINAGE A6 (GRAPHS 5 & 6)

The constant declining trend displayed on **GRAPH 5** represents that of a small area in the north west of the A6 drainage. This trend is discussed first as it is the area adjacent to the part of the A5 drainage with similar trends as mentioned above. This area will be discussed further under **POINT 6: AREA VULNERABLE TO DROUGHT**

Groundwater levels in the rest of A6 drainage mostly indicate seasonal fluctuations with underlying trends varying from slightly declining to stable around a mean to slightly rising **GRAPH 6**. For most of the drainage stable conditions is indicated.

3.4 DRAINAGE A7 (GRAPHS 7 & 8)

The general groundwater level trend in the A7 drainage is the same as for the A6 drainage as discussed above and is presented by **GRAPH 7**. Good recharge occurred in the northern part of the drainage along the Limpopo River during January 2013 and a number of stations still indicate very high water levels compared to the previous 6 to 8 years since monitoring started in that area. The water level at A7Klein Bolayi indicated on the graph is an example. Only one of the 44 monitoring stations in the A7 drainage indicates a notable decline. The groundwater level at A7N0660 (A7Langjan) has been declining steadily since monitoring started there in October 2010 and declined by 5 meters **GRAPH 8**. Large-scale irrigation occurs in the area.

3.5 DRAINAGE A8 (GRAPH 9)

Available data indicates stable water levels with varying seasonal fluctuations around a mean. The water level at A8Mudimeli has started to decline after the very high level recorded since January 2013 but is still above the original mean. The general status of groundwater in the drainage is healthy.

3.6 DRAINAGE A9 (GRAPH 10)

In contrast to the drainages discussed above, all groundwater levels are characterized by a steady declining trend since monitoring started in the drainage. Despite good recharge in the 2012 to 2013 wet season the decline continued after the event. Current water levels are mostly somewhat below than when monitoring started here in 2006. A lack of long-term data prevents evaluating the real situation as it is unknown what the starting levels presented, Abnormal highs, normal or already below normal? Indications are that groundwater in the area is subjected to normal outflow between sudden quick recharge events.

3.7 DRAINAGE B3 (GRAPH 11)

Long-term data is available for all 3 stations monitored in this drainage and is presented in **GRAPH 11**. Groundwater levels at both Settlers and Tuinplaas have always been heavily impacted by large-scale abstraction. The devastating effect of over abstraction from 2001 to 2008 can be clearly noted and the abstractors most probably experienced problems with yield where after water levels were allowed to recover for about 2 years. Unfortunately the pattern is repeating itself currently. Impact on the groundwater in the area of De Kuil is very low and the slow decline is considered a normal long-term trend. The decline has been 4 meters over 26 years.

3.8 DRAINAGE B5 (GRAPHS 12 & 13)

Groundwater level trends in the Sekhukhune area of the B5 drainage differ from the general trend displayed elsewhere **GRAPH 12**. Little seasonal fluctuation can be noted and the general trend the past 5 years since data is available mostly indicates a steady but slow decline. Long-term data for the Sekhukhune area is not available to enable evaluation of the status of the resource but monitoring will continue.

Trends in the rest of the drainage indicate stable to rising groundwater levels for the past 5 years **GRAPH 13**.

3.9 DRAINAGE B7 (GRAPH 14)

Monitoring data for 6 years is available for this drainage. Groundwater levels indicate some seasonal fluctuations with stable to slightly rising trends **GRAPH 14**.

3.10 DRAINAGE B8 (GRAPHS 15, 16 & 17)

A clear distinction can be made between groundwater level trends in the northern part drained by the Klein, Middel Letaba and Koedoes Rivers with that in the south drained by the Great Letaba River. Groundwater level trends in the northern part are marked by a steady decline **GRAPH 15**. The reason for the sharp decline in the groundwater level at B8Sikhunyane the past 4 months is probably due to new or increased abstraction in the area. The continued decline if viewed in conjunction with the current dry situation raises a concern for the area.

The groundwater level status in the southern part is much better and stable groundwater levels with clear seasonal recharge are indicated by **GRAPH 16**.

GRAPH 17 illustrates the difference in trends for the northern and southern parts.

3.11 DRAINAGE B9 (GRAPH 18)

All 3 stations in this drainage indicate a steady declining trend despite some seasonal recharge at 2 of them. The trend is similar to that in the adjacent part of the B8 and A9 drainages in that area.

4 SOME LONG-TERM GROUNDWATER LEVEL TRENDS

4.1 LONG-TERM GROUNDWATER LEVEL TRENDS IN THE B5, A7 AND A6 DRAINAGES (GRAPHS 19 - 21)

The trends displayed by **GRAPHS 19 TO 21** for the past 6 to 10 years is very similar to the majority of trends over this period and indicate seasonal fluctuations with trends varying from slightly rising to stable and slight declines. Comparing water levels this period with that prior to 1995 and 2000 it is clear that the current levels indicate a healthy status. The correlation of the short-term trends with that in other areas with no long-term data may indicate that the current status in such areas is also currently good.

5 FORECASTS (FIGURE 1)

The following excerpt was obtained from the South African Weather Services (<http://www.weathersa.co.za/home/seasonal>)



Seasonal Climate Watch September 2015 to January 2016

Date: Aug 21, 2015

1. Advisory

Most models are showing the strengthening of an El-Niño episode towards the spring season with the expectation to continue throughout the summer season. The forecasting system indicates enhanced probabilities for well above normal rainfall conditions over the north-eastern parts of the country during spring. However, going towards the summer season there are certain indicators which may promote chances for extreme dry conditions over most parts of the country. The likelihood of extreme warmer temperatures over most of South Africa is high. Other international forecasting systems also indicate a tendency of drier and warmer conditions for South Africa toward the summer season.

2. Recommendation

The likelihood of the country experiencing drier and warmer conditions toward the summer season is cautiously high. The condition may promote a regional or localized drought. It is highly recommended that medium- and shorter-range weather forecasts be monitored for the development of conditions that may alter or strengthen the expectation of the current forecast

3. State of Climate Drivers

Observations show that ENSO is currently in an El-Niño condition. Most of the forecast model's predictions indicate the strengthening of El Niño condition through the austral spring seasons and is expected continue towards the summer season. ENSO has a noticeable impact on the climate of our region during the austral summer season. The Indian Ocean Dipole (IOD) remains within the border of a neutral phase toward the spring and summer season. The IOD is found to influence rainfall activity in our region particularly during spring. The Southern Annular Mode (SAM) shows a tendency of a positive phase since the beginning of 2015 and is expected to remain in the same state for the coming few weeks. The SAM is found to affect South African climate conditions by regulating the south/north ward positioning of the mid-latitude Jet stream and transport of associated air masses from the southern Atlantic Ocean and its impact is pronounced in winter.

4. Climate forecast Details

4.1 Rainfall

The forecasting system indicates a mixture of above- and below normal rainfall conditions for the country indicated in the map below. Of note there is an indication that well above normal rainfall conditions may occur over the eastern parts of the country in spring. The forecast for late spring indicates mostly below-normal rainfall for most of the country and some mixed conditions for early summer (Figure 1).

From the above it is indicated that the Limpopo Province is likely to experience a dry season up to January 2016. If so it would have a negative impact on groundwater levels, especially in areas already indicating declining water levels.

6 AREAS VULNERABLE TO DROUGHT (MAP 5)

From groundwater level trends 2 areas that may be vulnerable to drought conditions and possibly be at risk if the current dry spell persist were identified and is indicated as areas "A" and "B" on **MAP 5**

Area "A": It was noted above that two adjacent areas in the A5 and A6 drainages indicate similar declining trends with 1 station in the A4 as well. Groundwater levels have been declining constantly but to different extent for some years now. Little groundwater recharge took place during this period and below normal rainfall was recorded the previous season. A major recharge event is needed for water levels to recover. If the coming season is a dry one as seem to be the forecast the situation may become a concern. It is mostly farming area and the impact would be an agricultural one if it does occur.

Area "B": Some very sharp declining water levels are present in this area and the situation is the same as noted for **Area "A"**: Groundwater use in this area however is mostly for communal domestic use which would have a serious impact should dry conditions persist.

7 IMPORTANCE OF GROUNDWATER MONITORING AND RESOURCE MANAGEMENT

The status of the resource cannot be visually observed and can only be recognized by water level monitoring and regular evaluation of the data. To prevent a situation where the groundwater user(s) only become aware of a problem when it is too late, continuous monitoring data is essential.

Information provided by groundwater monitoring data enables decision making with regard to management of the resource. In areas of potential concern steps to alleviate the problem can be taken in advance. Actions may include:

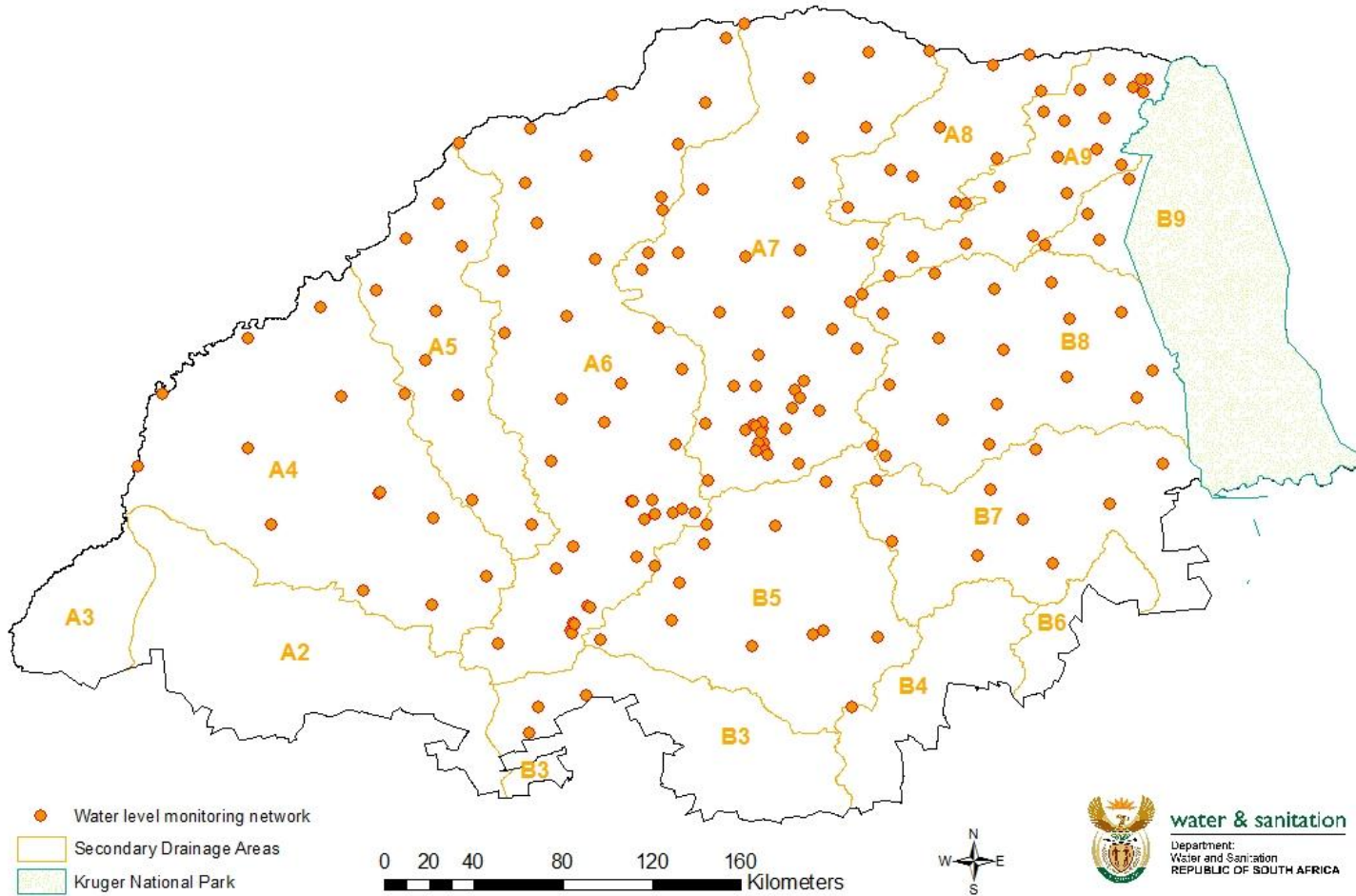
- Awareness programs to inform users of the situation
- Education in water saving methods
- Infrastructure maintenance to prevent leakages
- Identify and rectify wastages of water
- Explorations and assessment of additional/alternative sources
- Development of alternative sources

8 ACKNOWLEDGEMENT

South African Weather Services

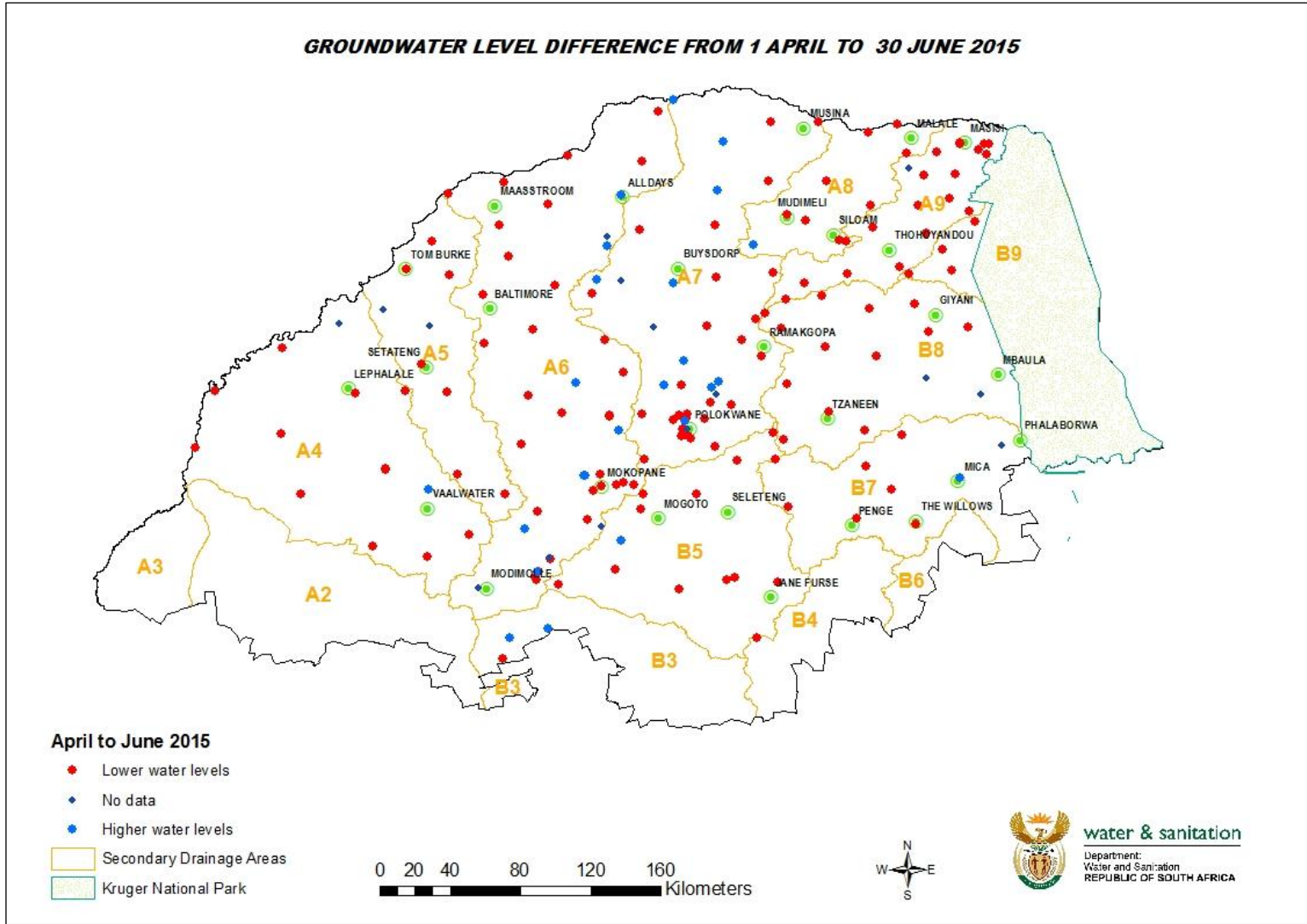
(<http://www.weathersa.co.za/climate>), (<http://www.weathersa.co.za/home/seasonal>)

DISTRIBUTION OF LIMPOPO GROUNDWATER LEVEL MONITORING NETWORK



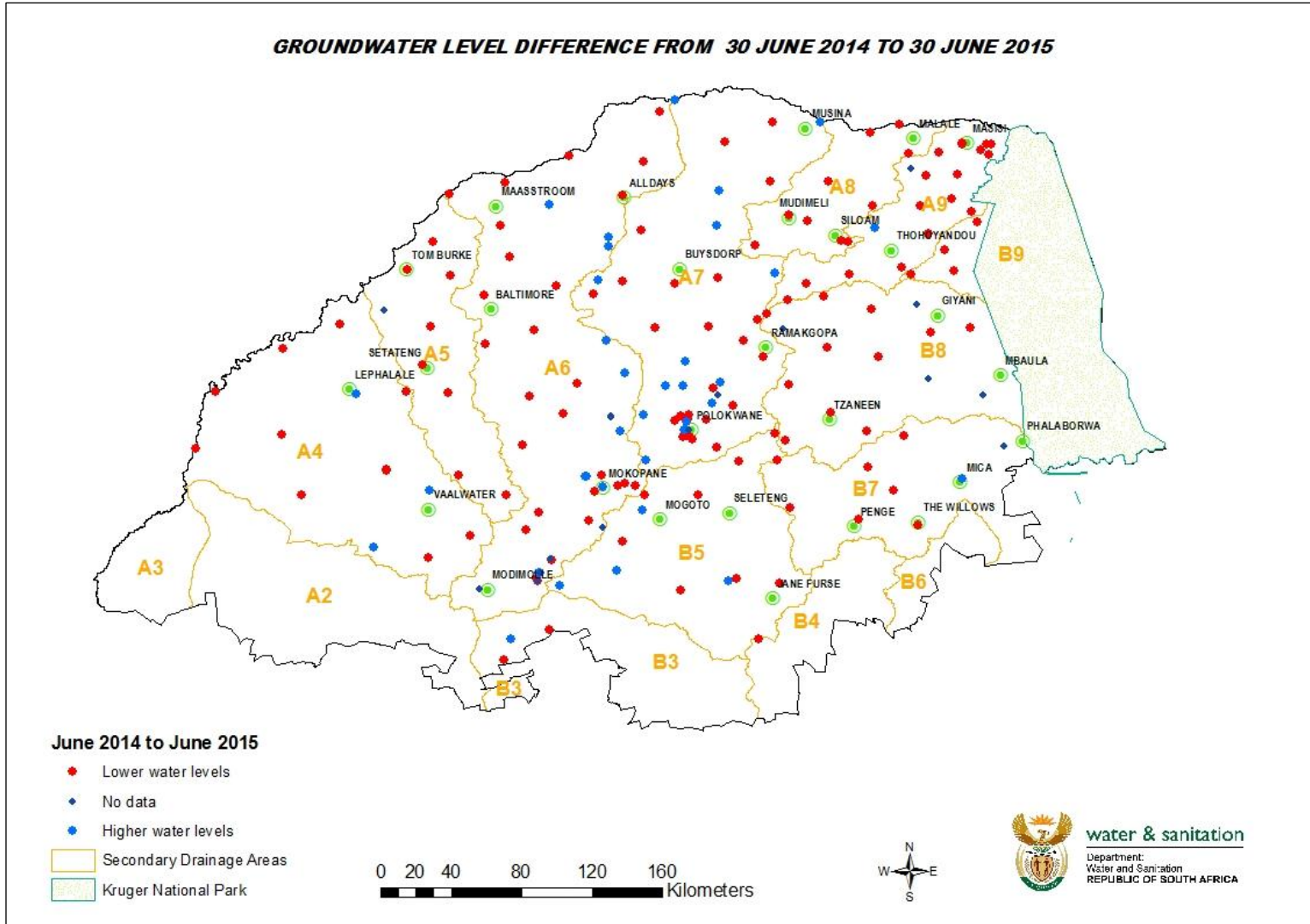
MAP 1

GROUNDWATER LEVEL DIFFERENCE FROM 1 APRIL TO 30 JUNE 2015



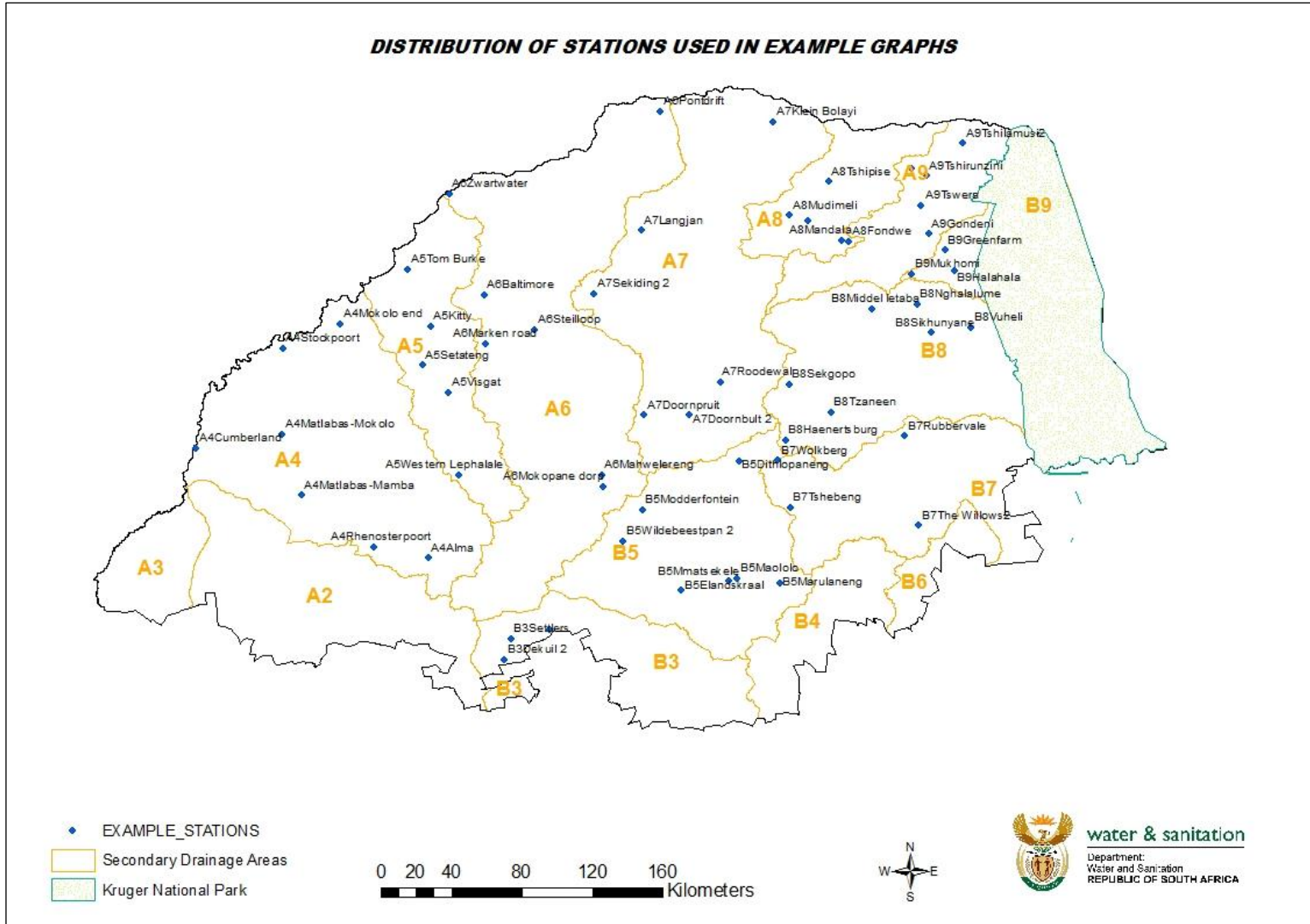
MAP 2

GROUNDWATER LEVEL DIFFERENCE FROM 30 JUNE 2014 TO 30 JUNE 2015



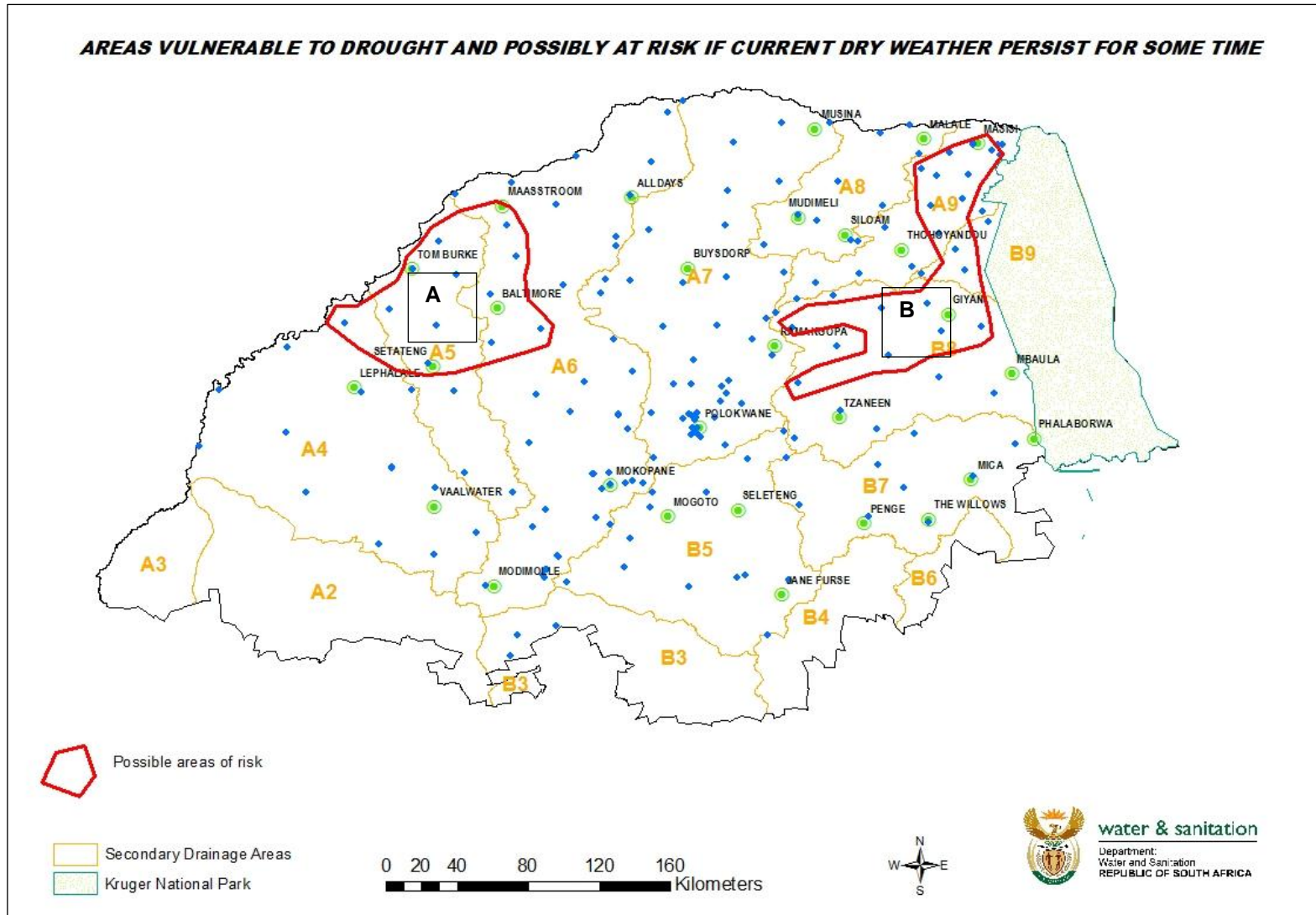
MAP 3

DISTRIBUTION OF STATIONS USED IN EXAMPLE GRAPHS

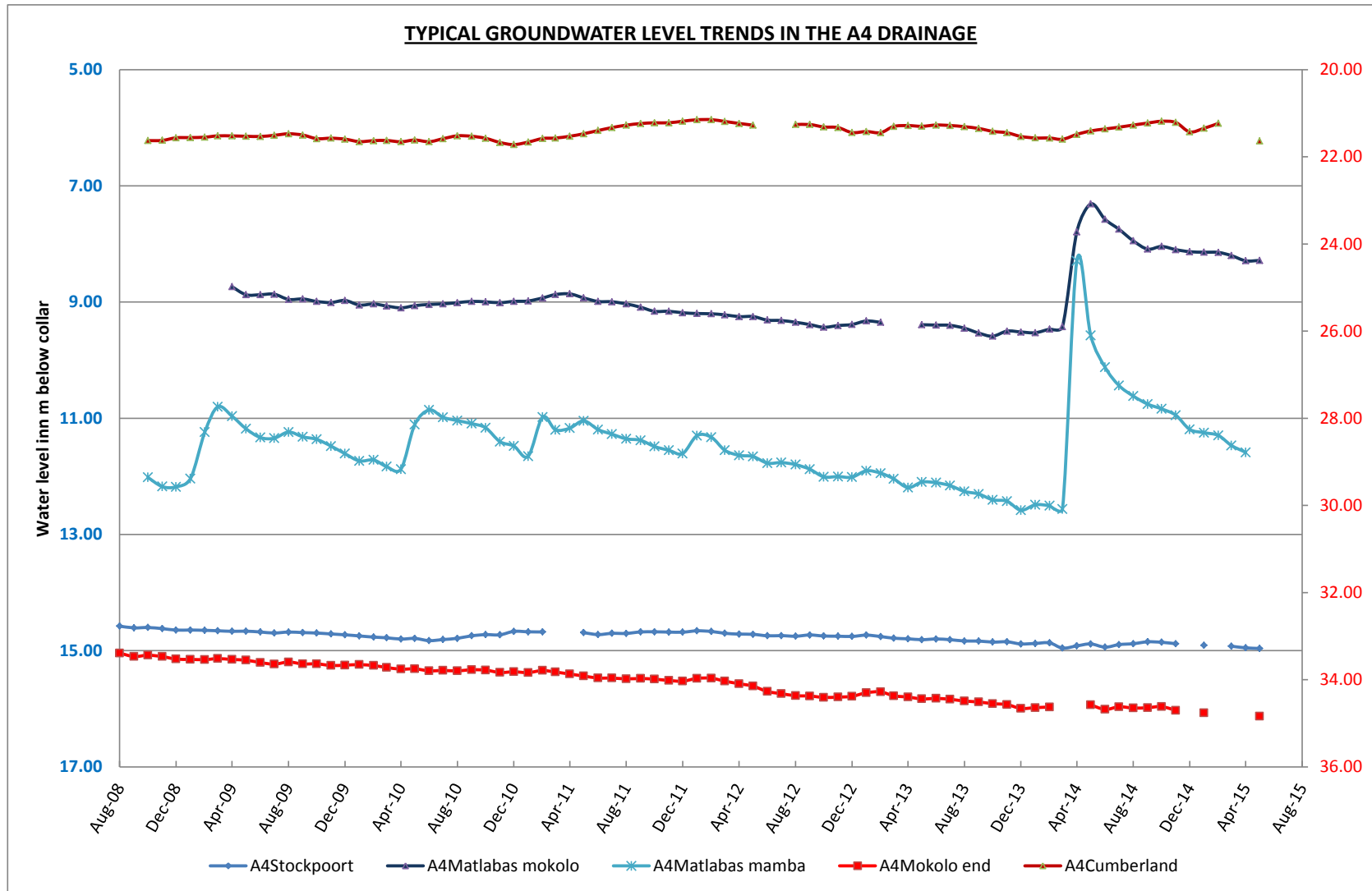


MAP 4

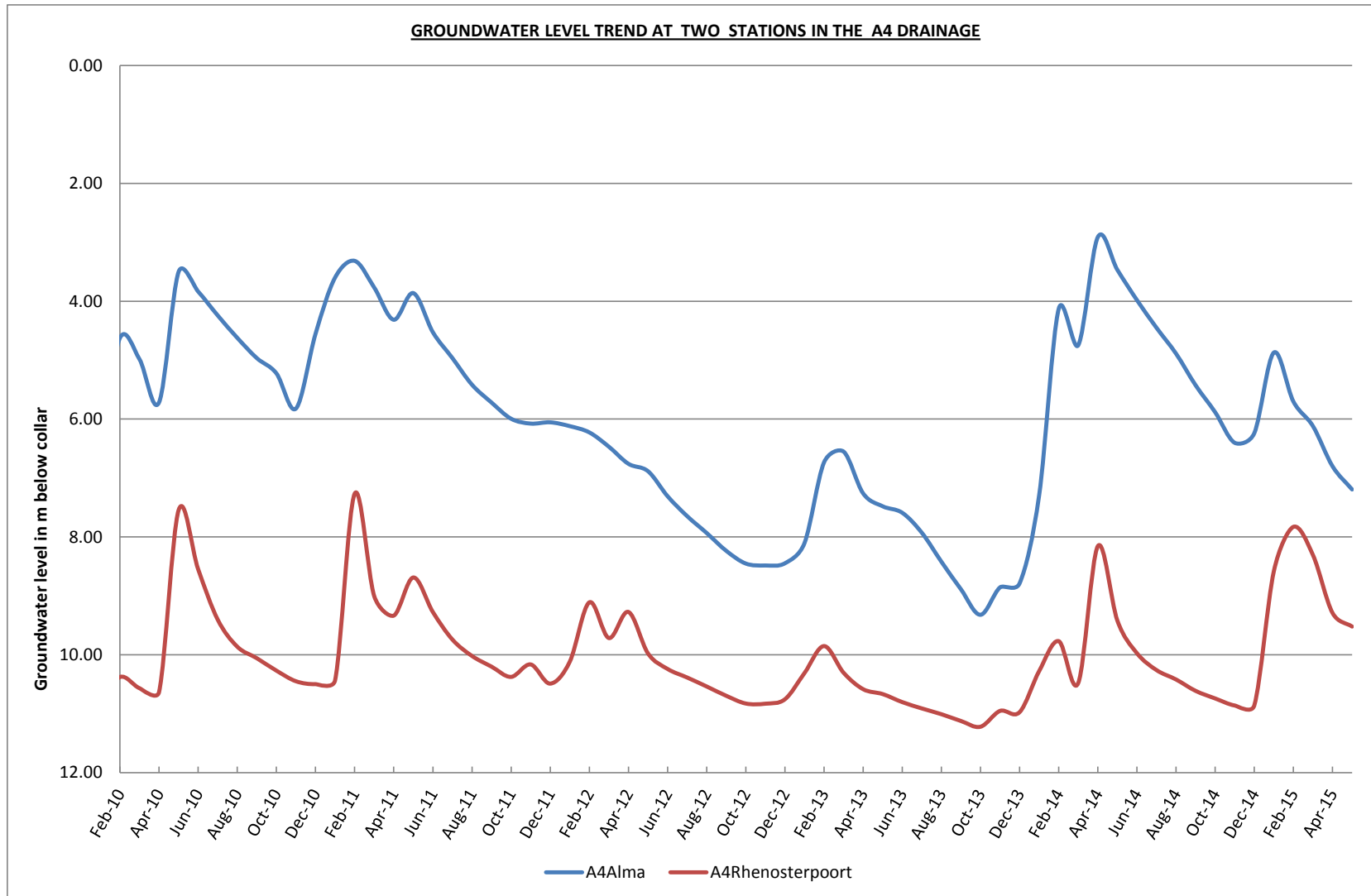
AREAS VULNERABLE TO DROUGHT AND POSSIBLY AT RISK IF CURRENT DRY WEATHER PERSIST FOR SOME TIME



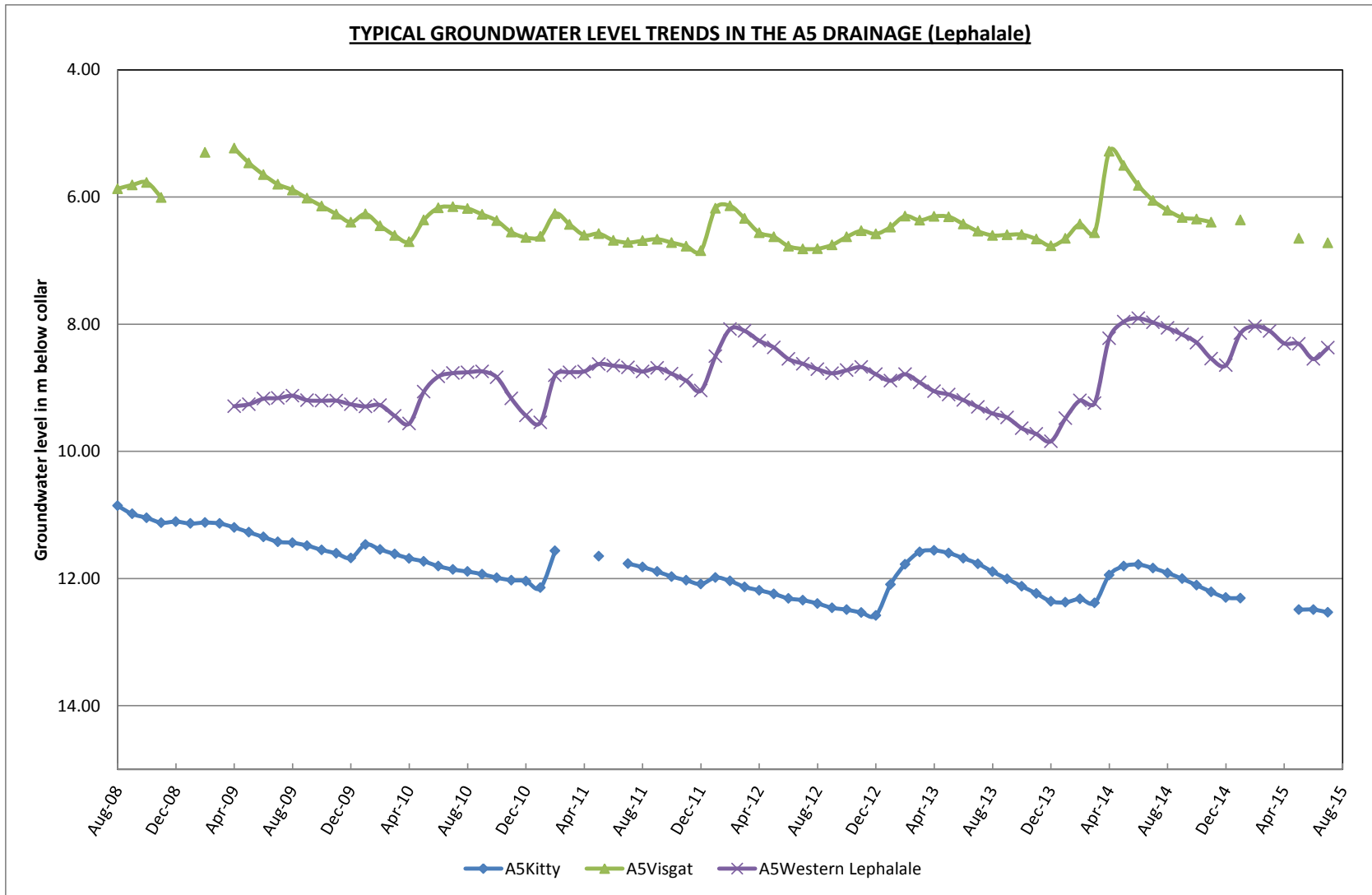
MAP 5



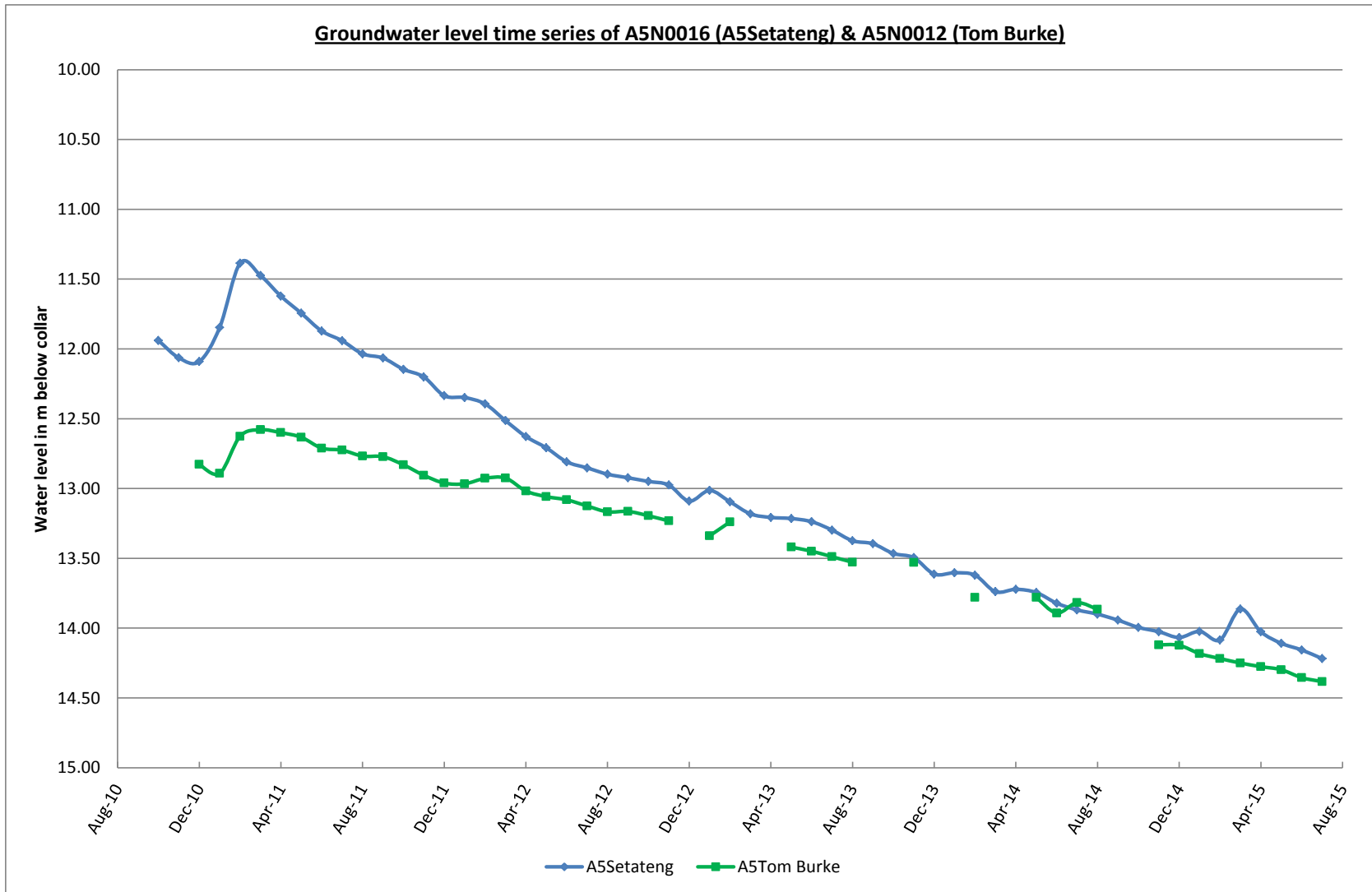
GRAPH 1



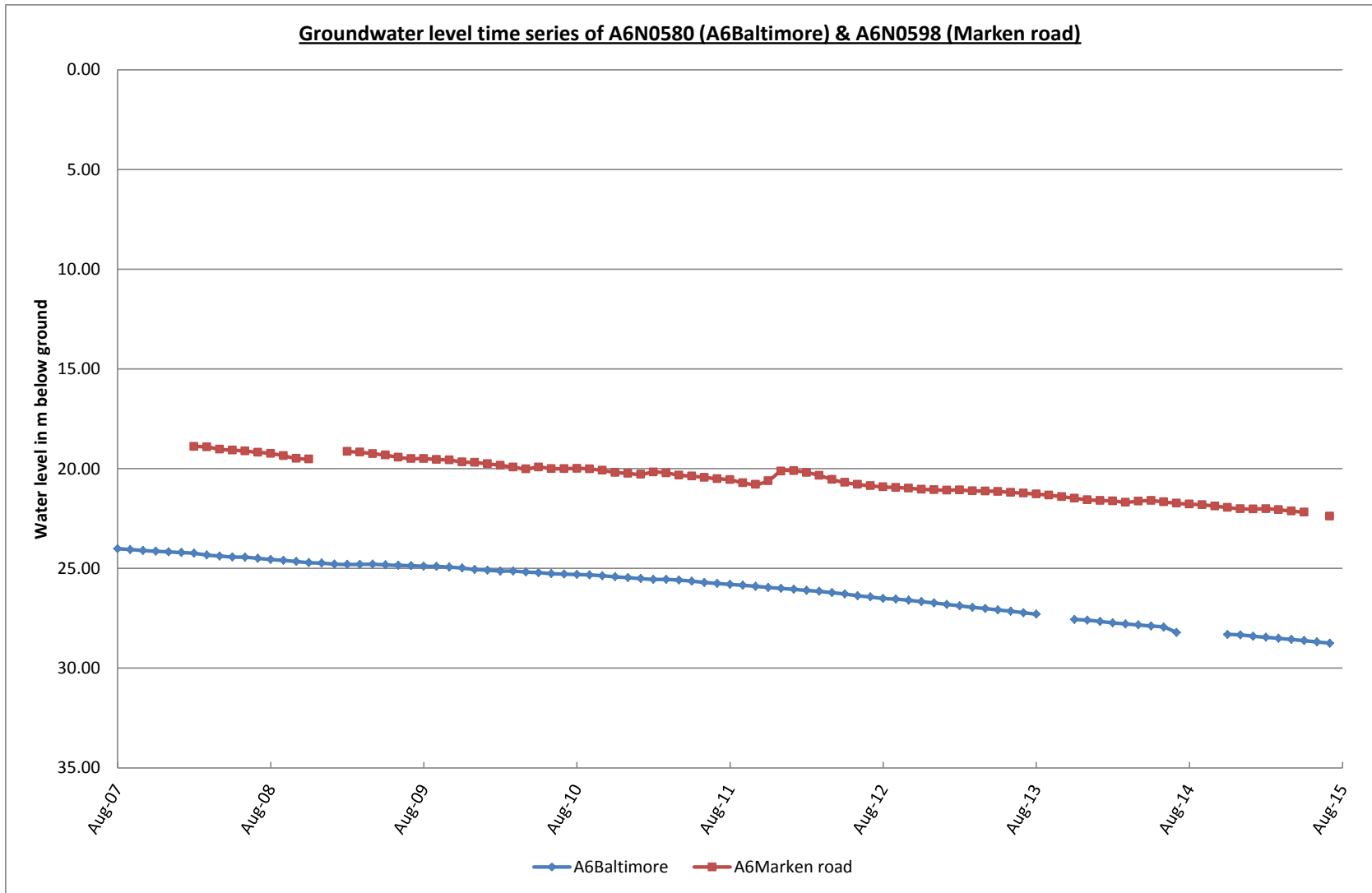
GRAPH 2



GRAPH 3

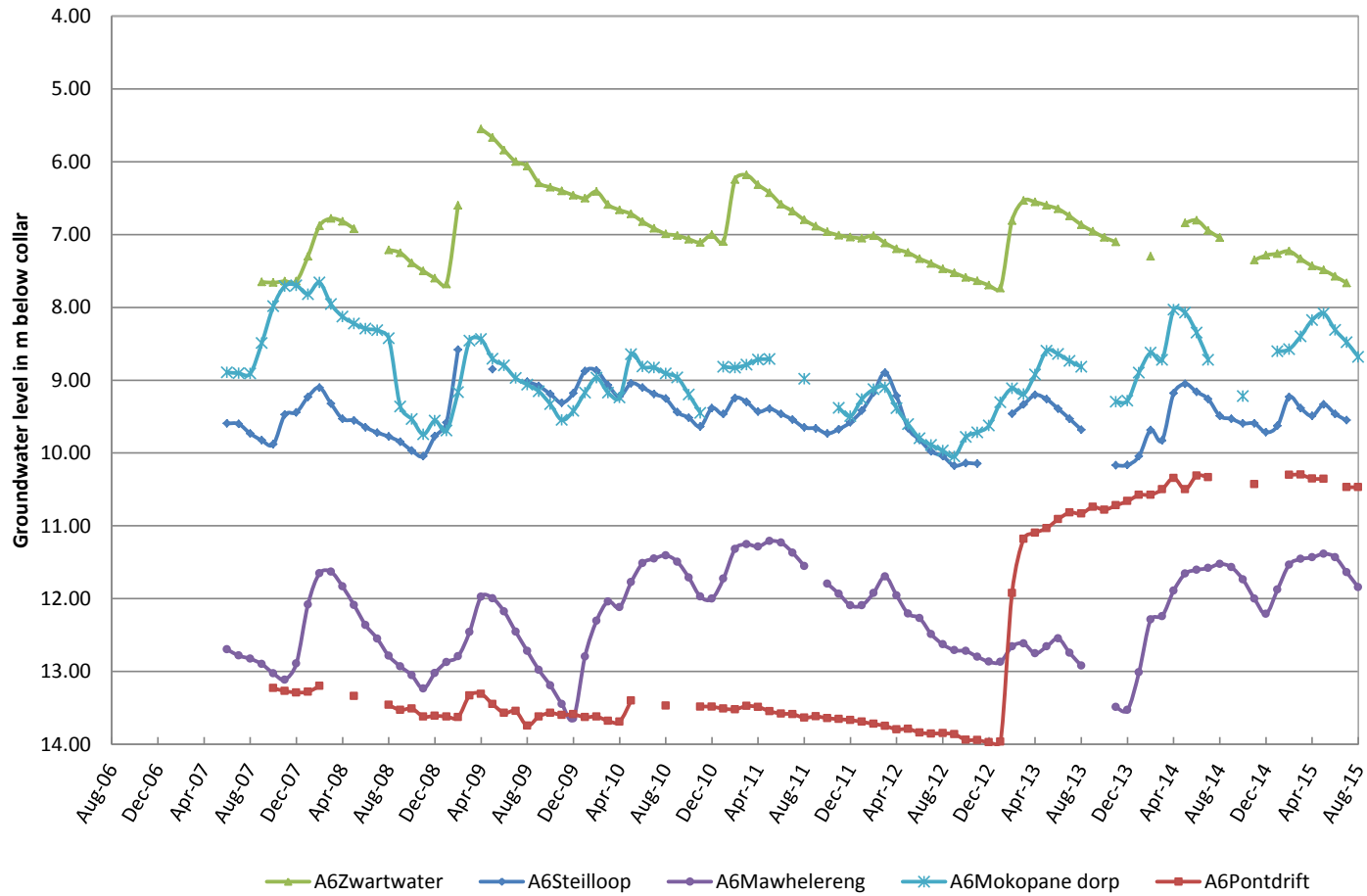


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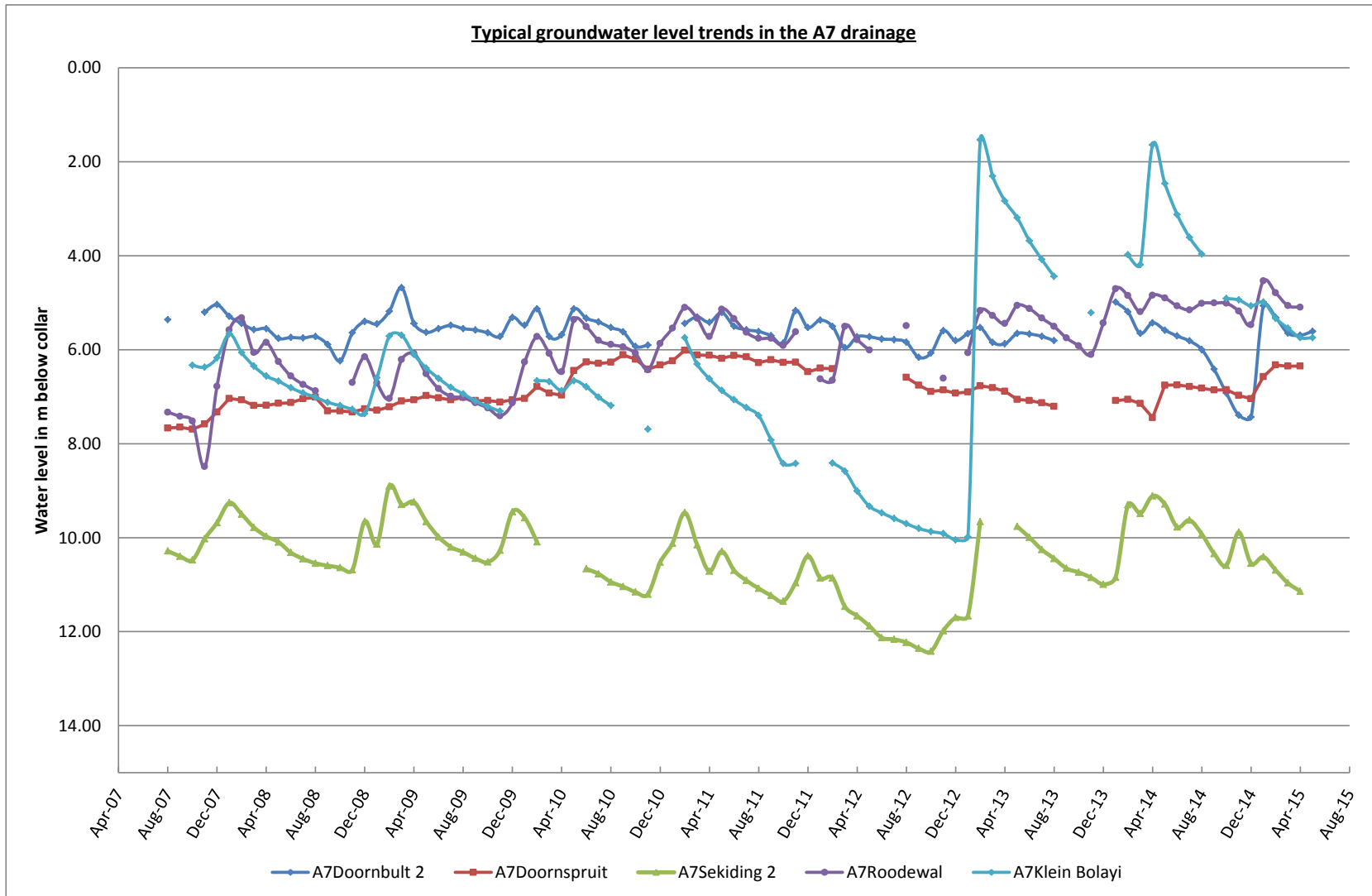


GRAPH 5

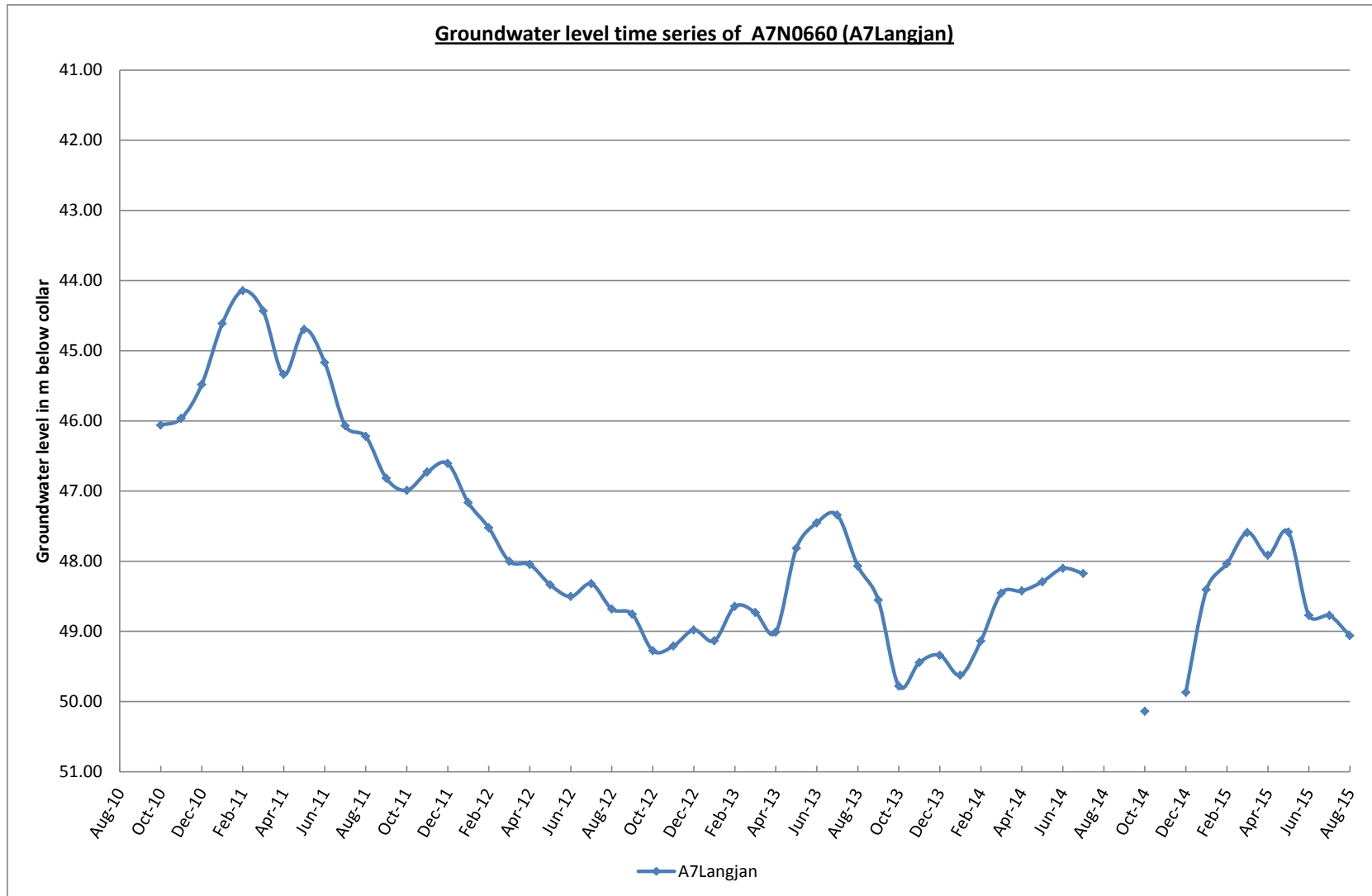
TYPICAL GROUNDWATER LEVEL TRENDS IN THE A6 DRAINAGE



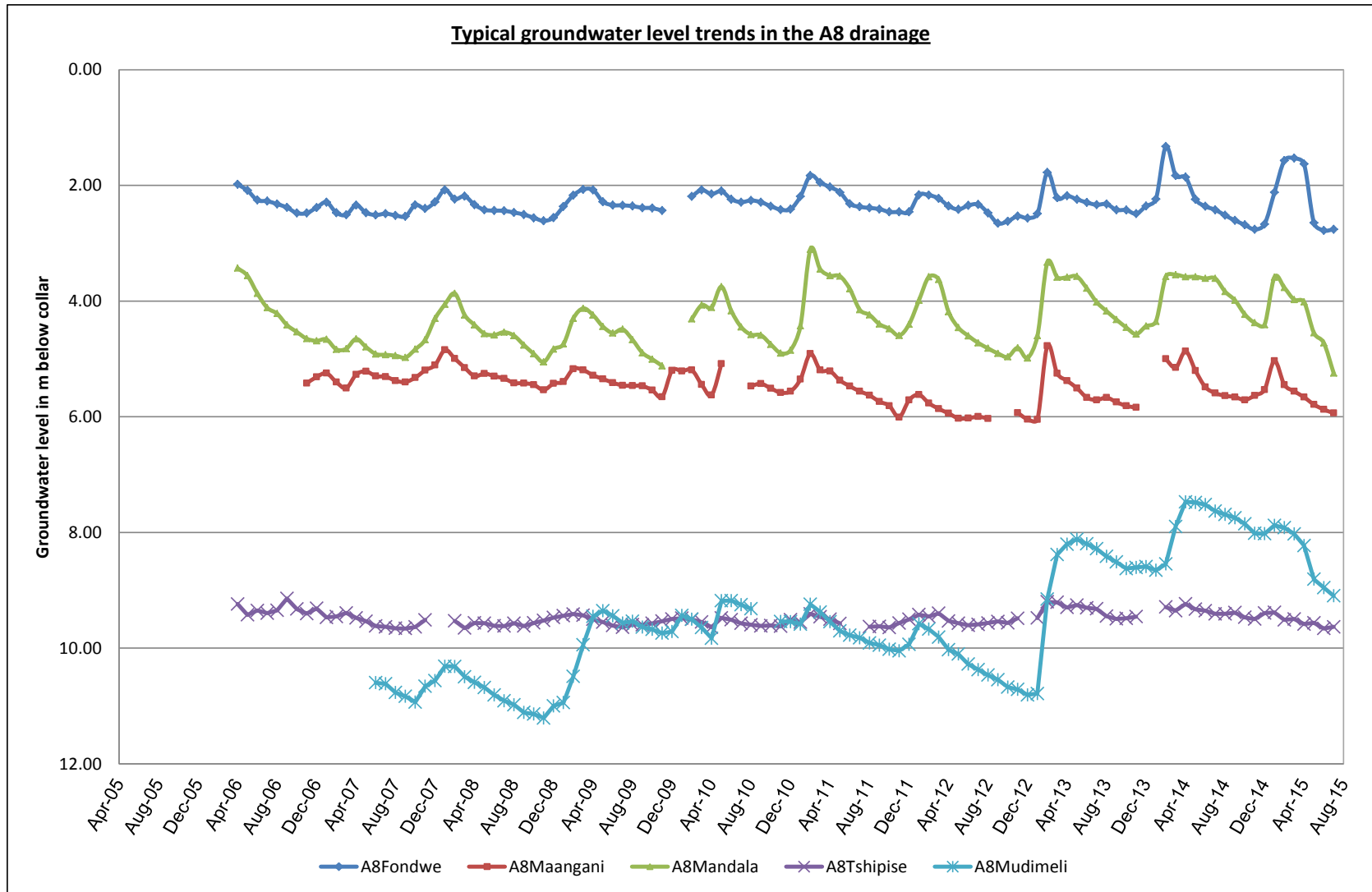
GRAPH 6



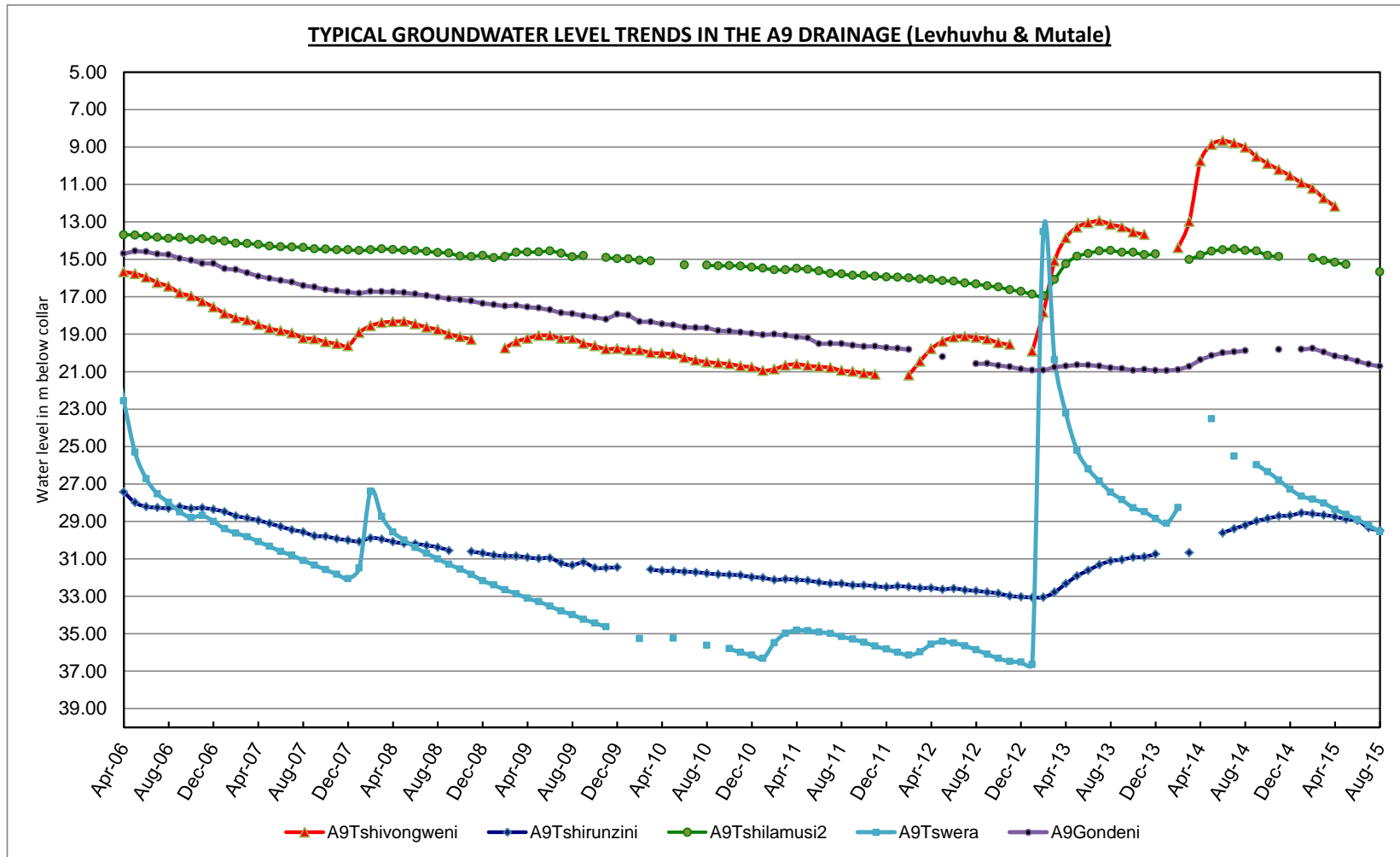
GRAPH 7



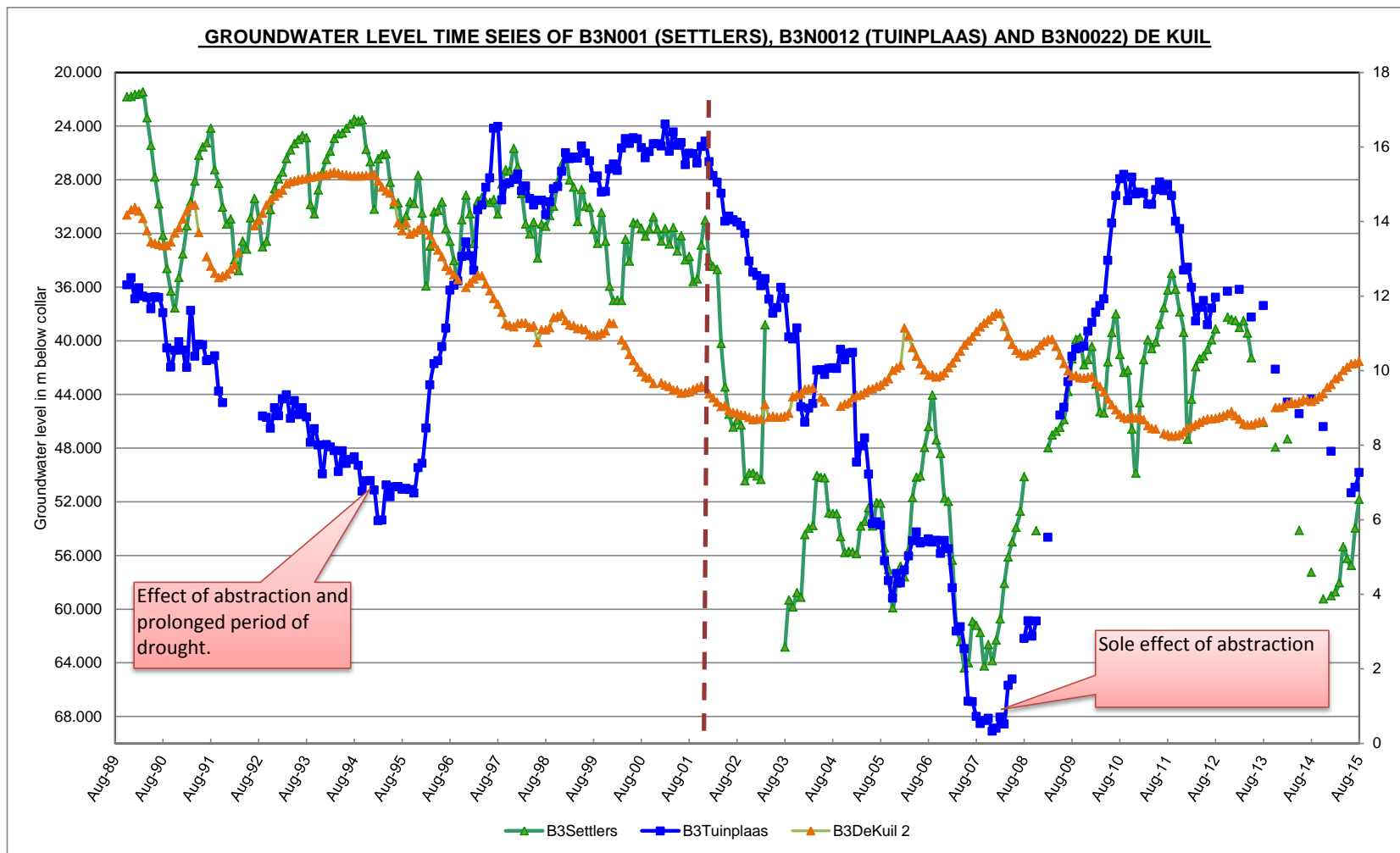
GRAPH 8



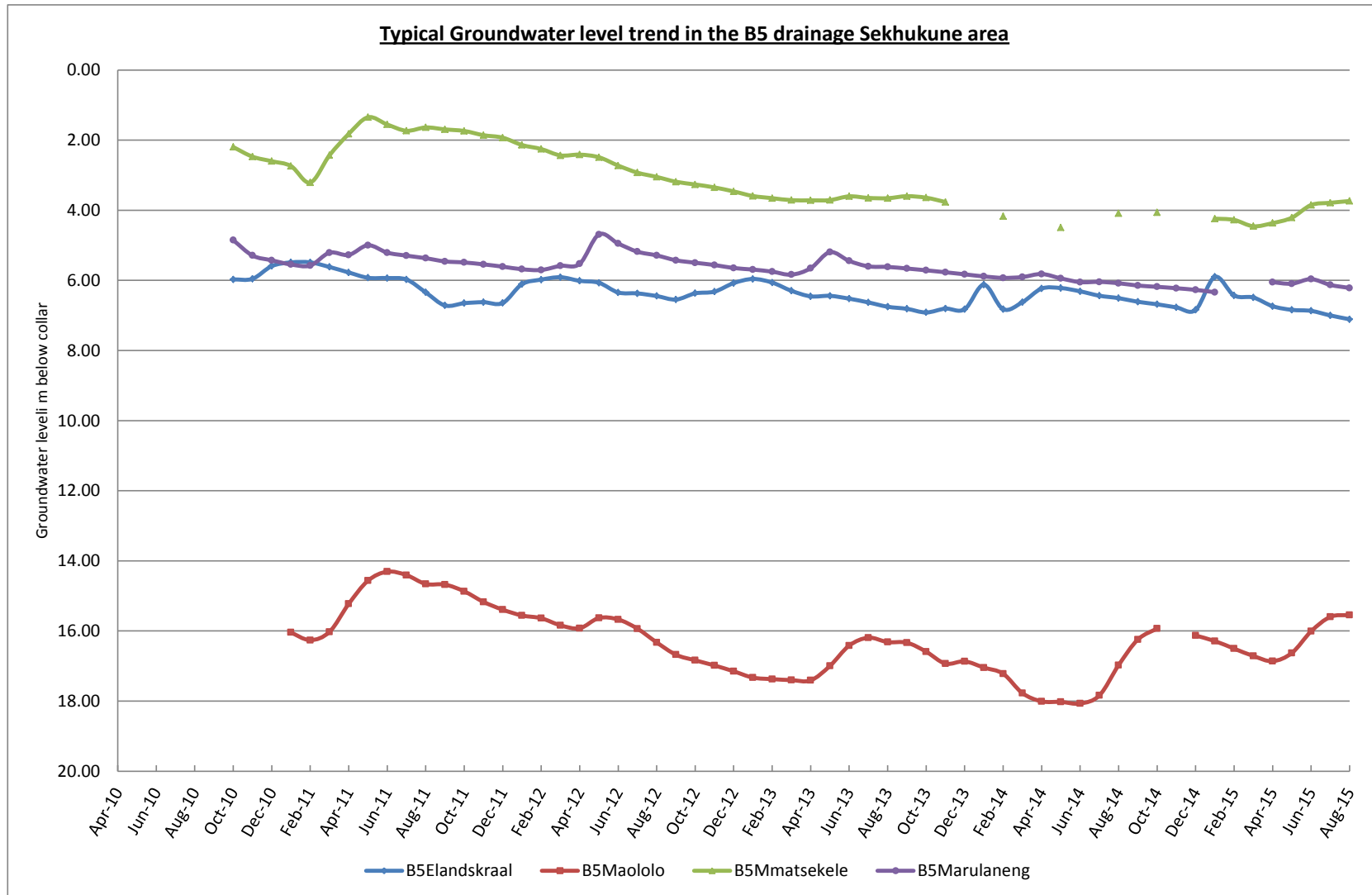
GRAPH 9



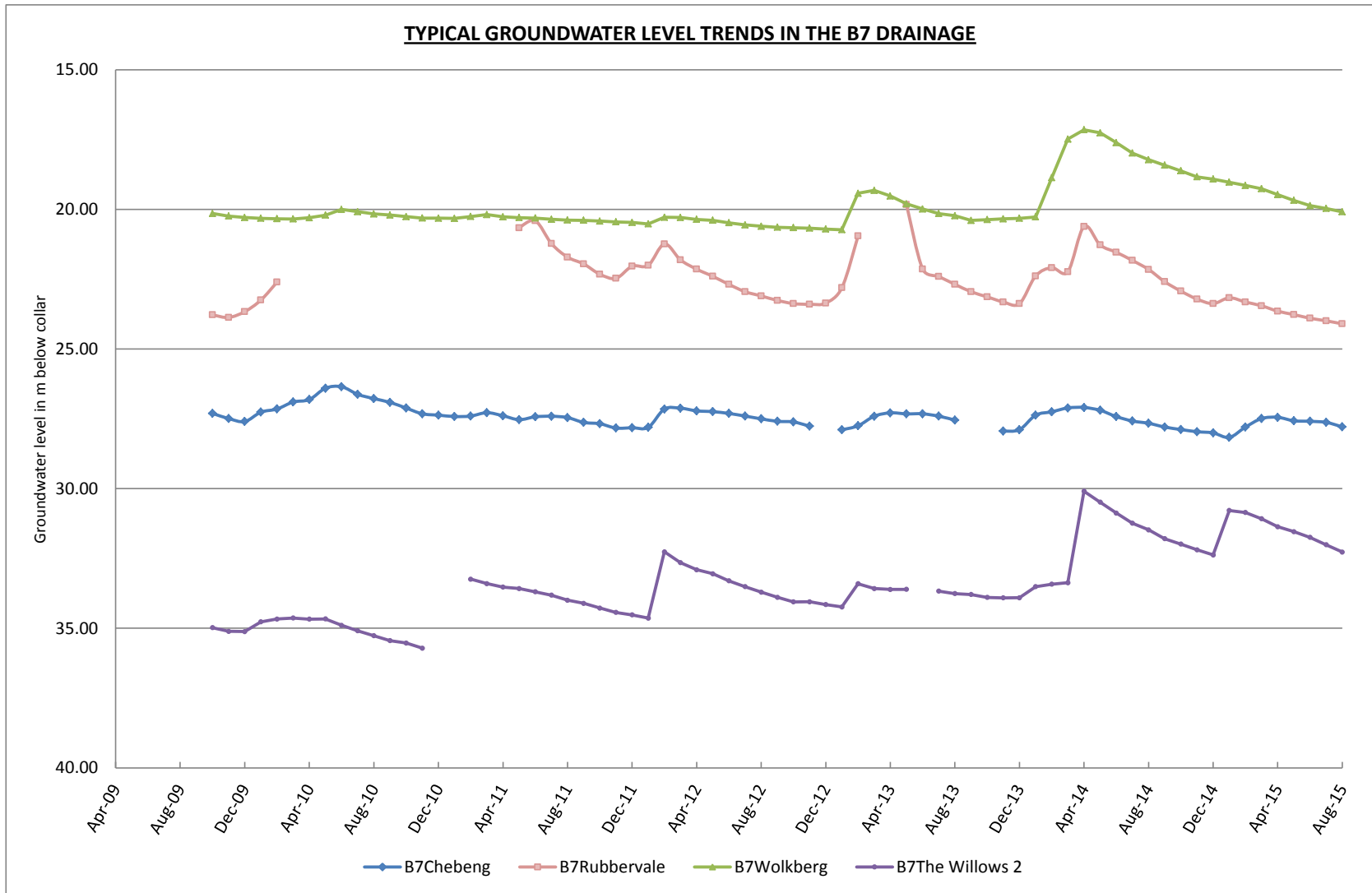
GRAPH 10



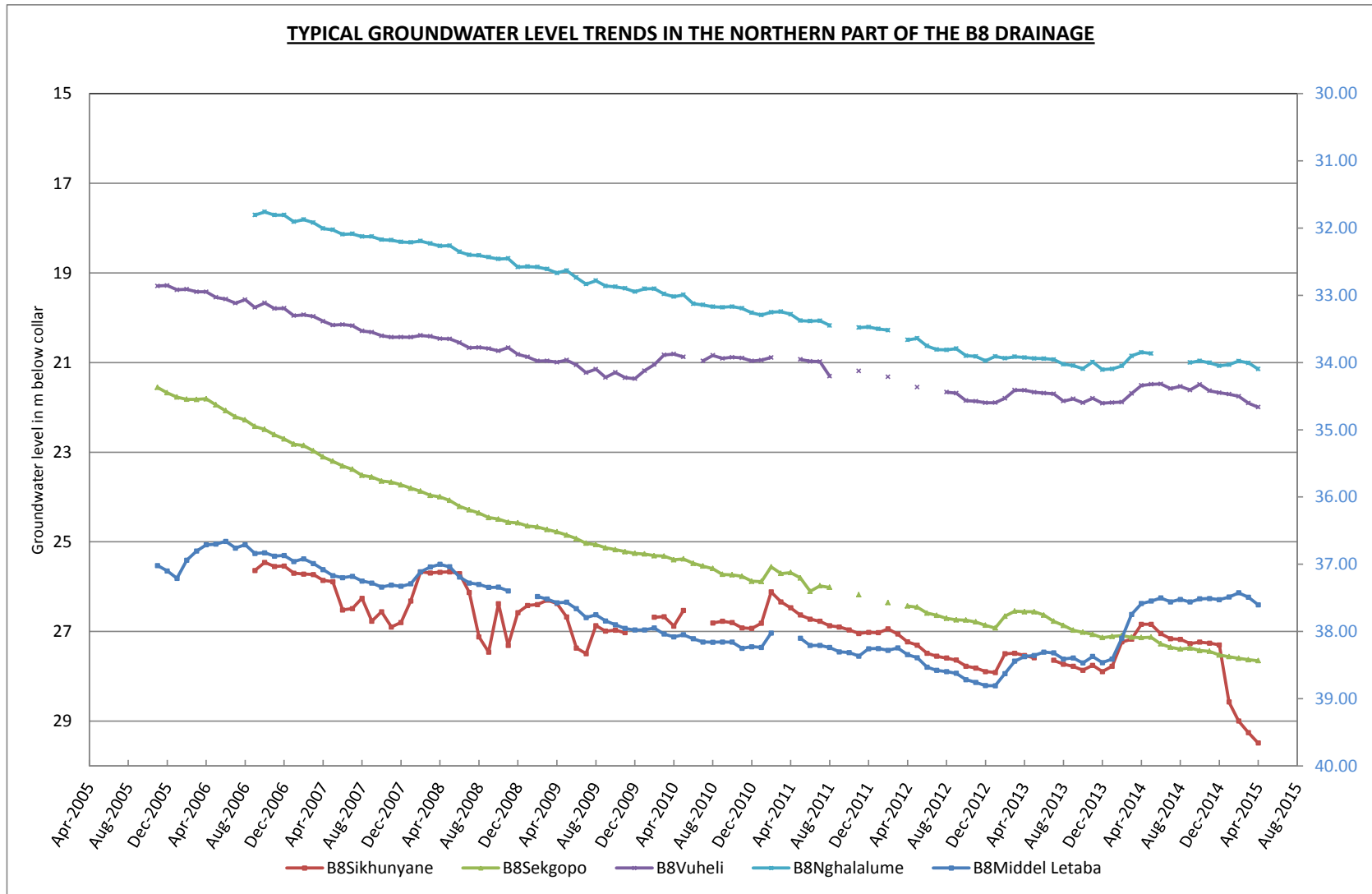
GRAPH 11



GRAPH 12

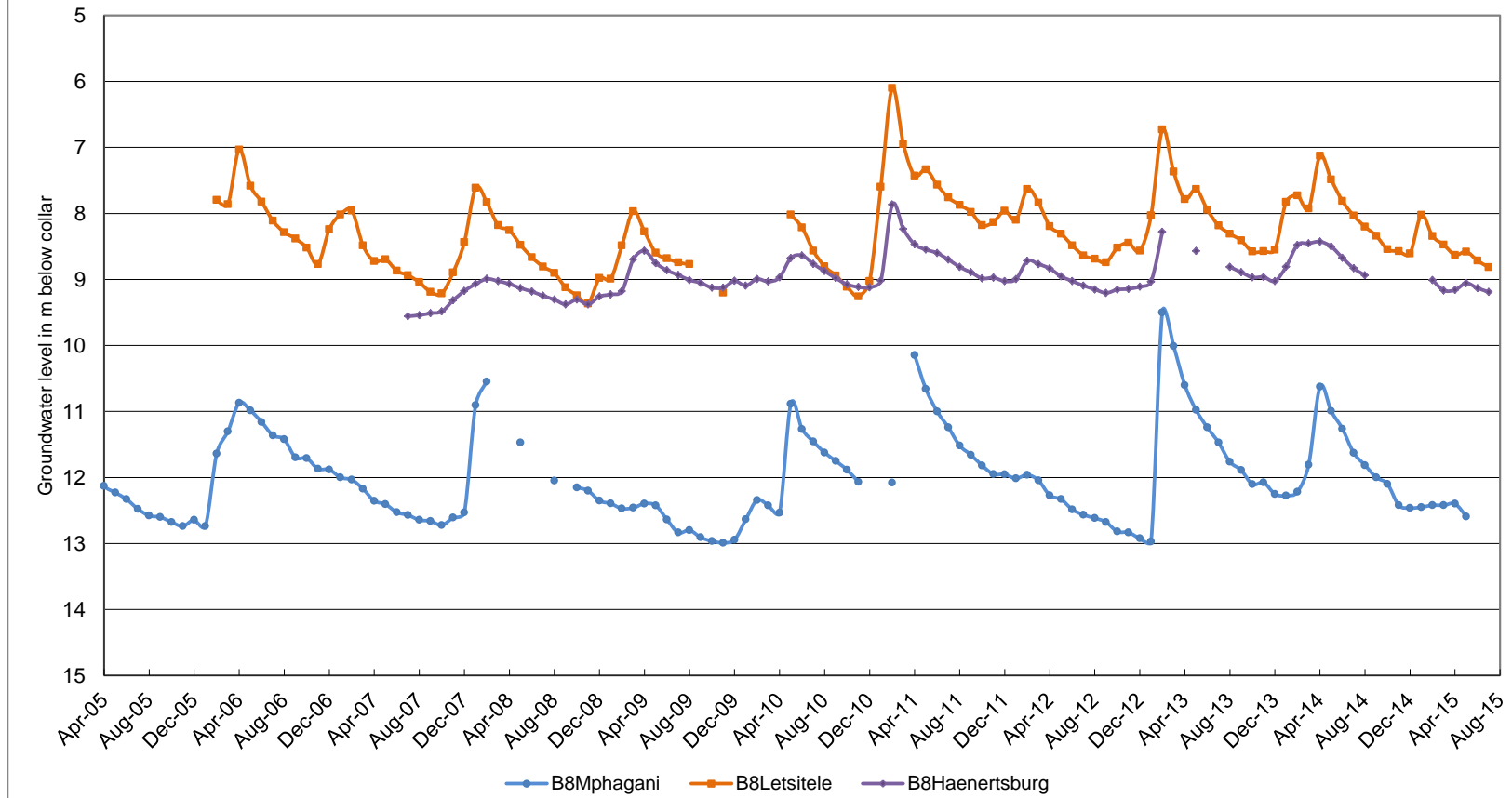


GRAPH 14

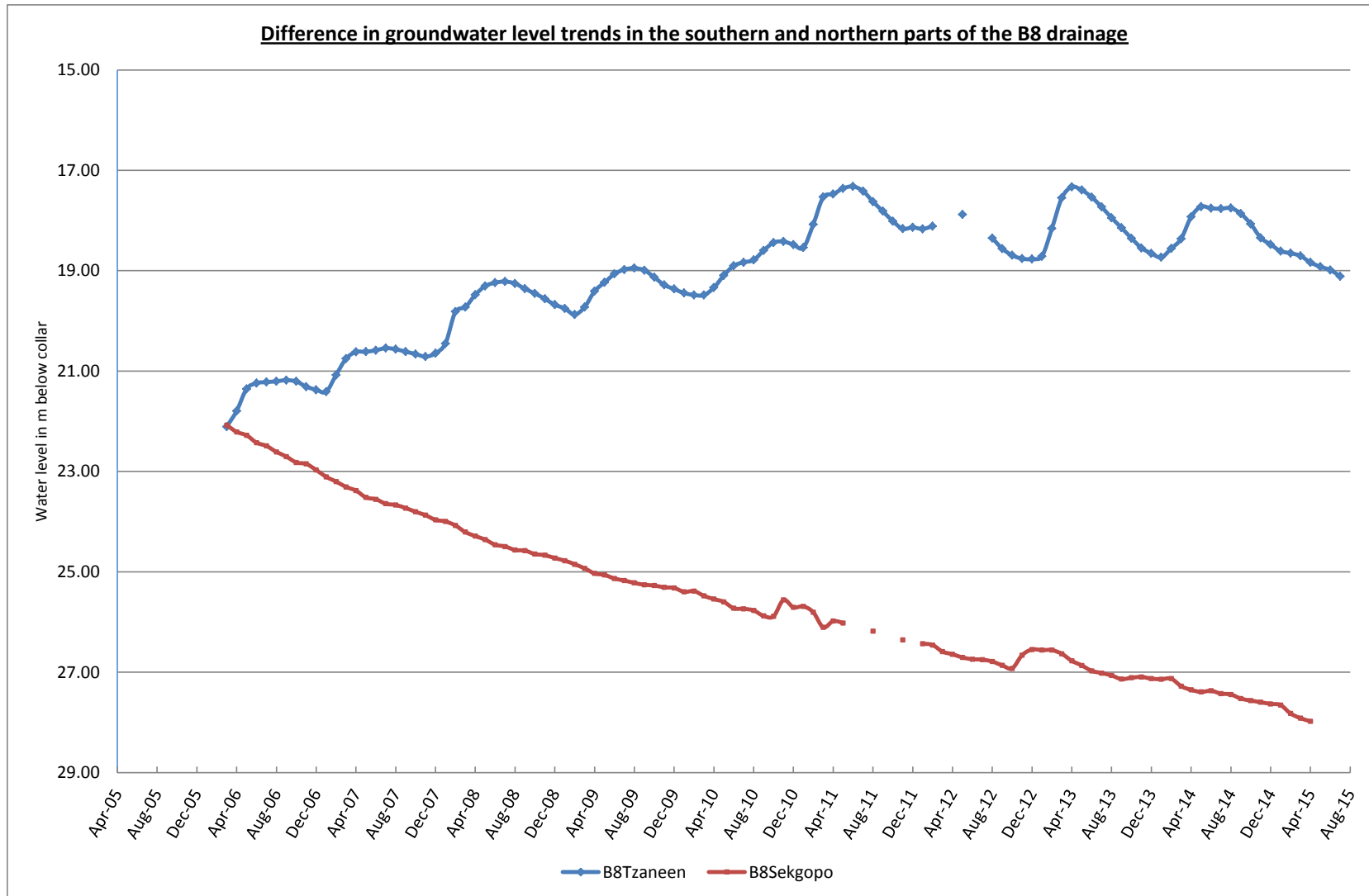


GRAPH 15

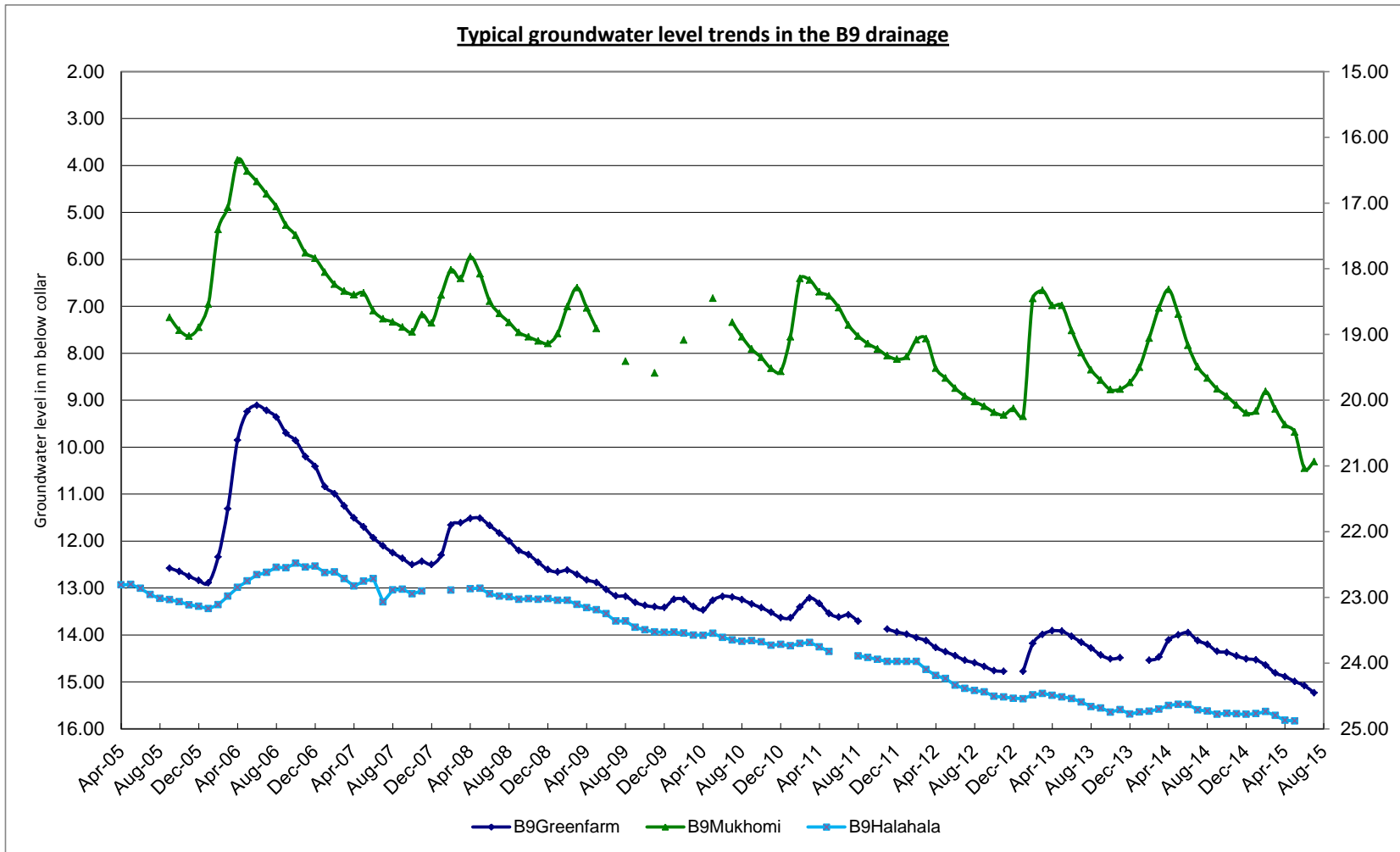
TYPICAL GROUNDWATER LEVEL TRENDS IN THE SOUTHERN PART OF THE B8 DRAINAGE



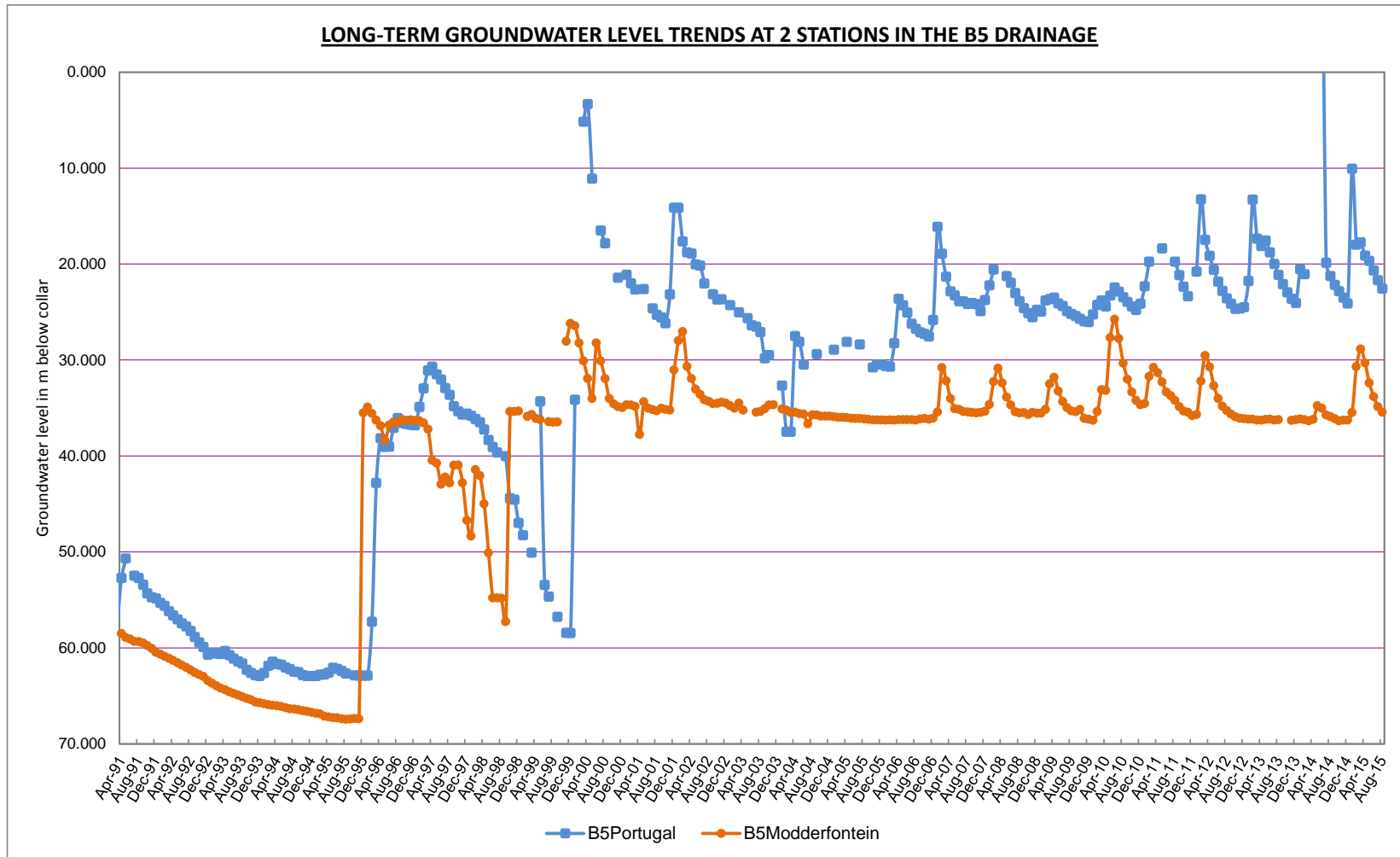
GRAPH 16



GRAPH 17

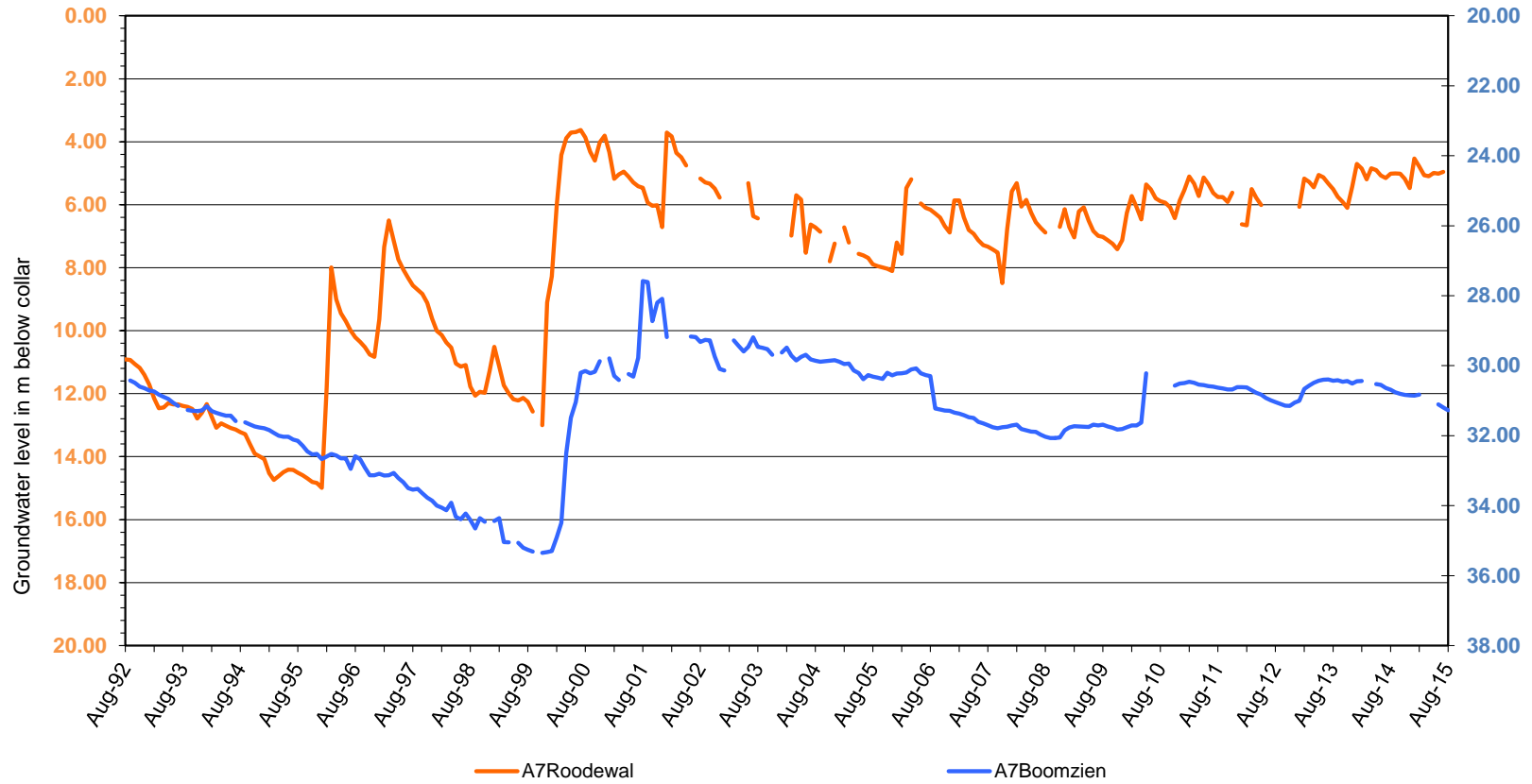


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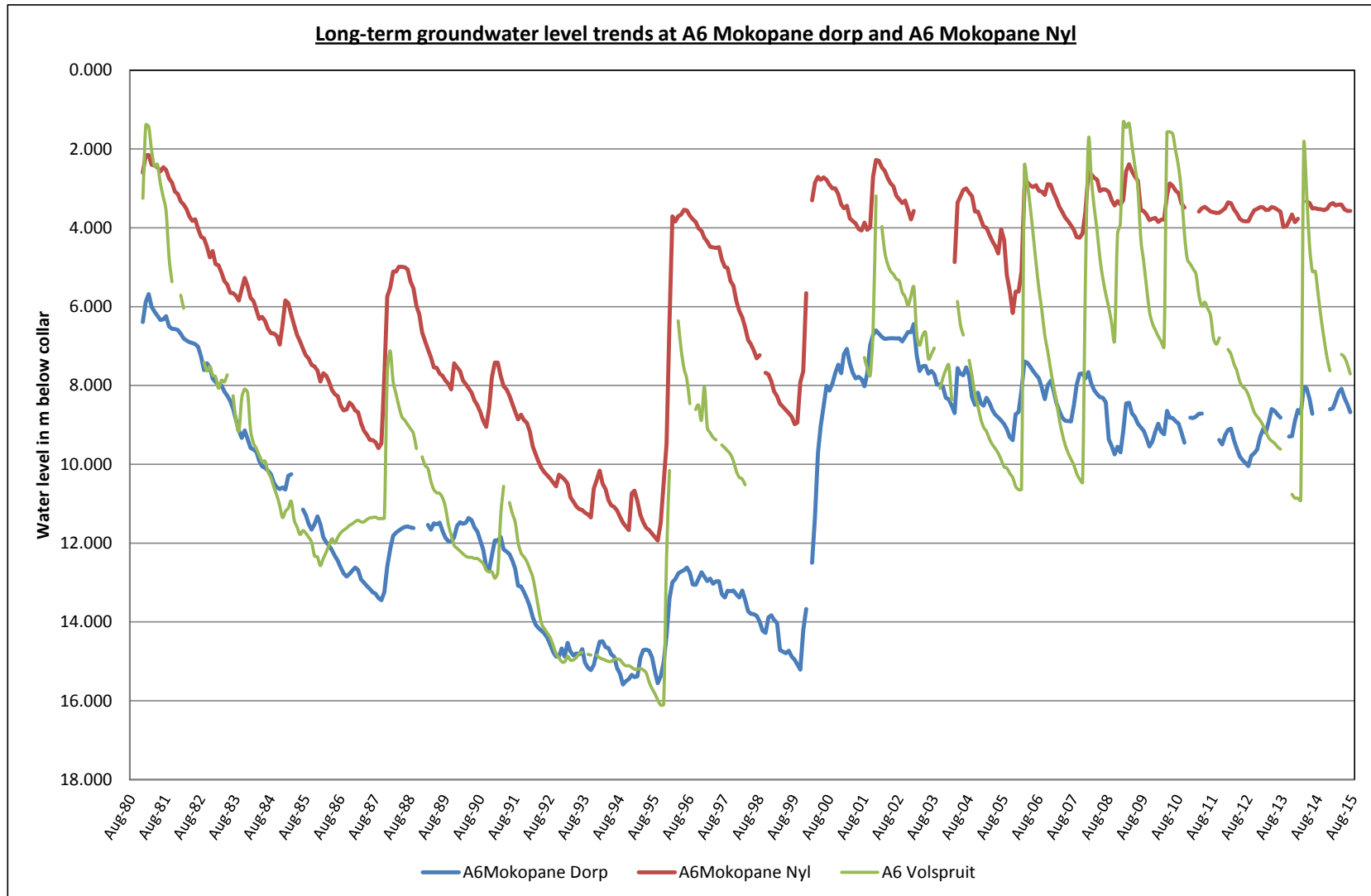


GRAPH 19

Long-term groundwater level trends at two stations in the A7 drainage



GRAPH 20



GRAPH 21

SEASONAL FORECASTS

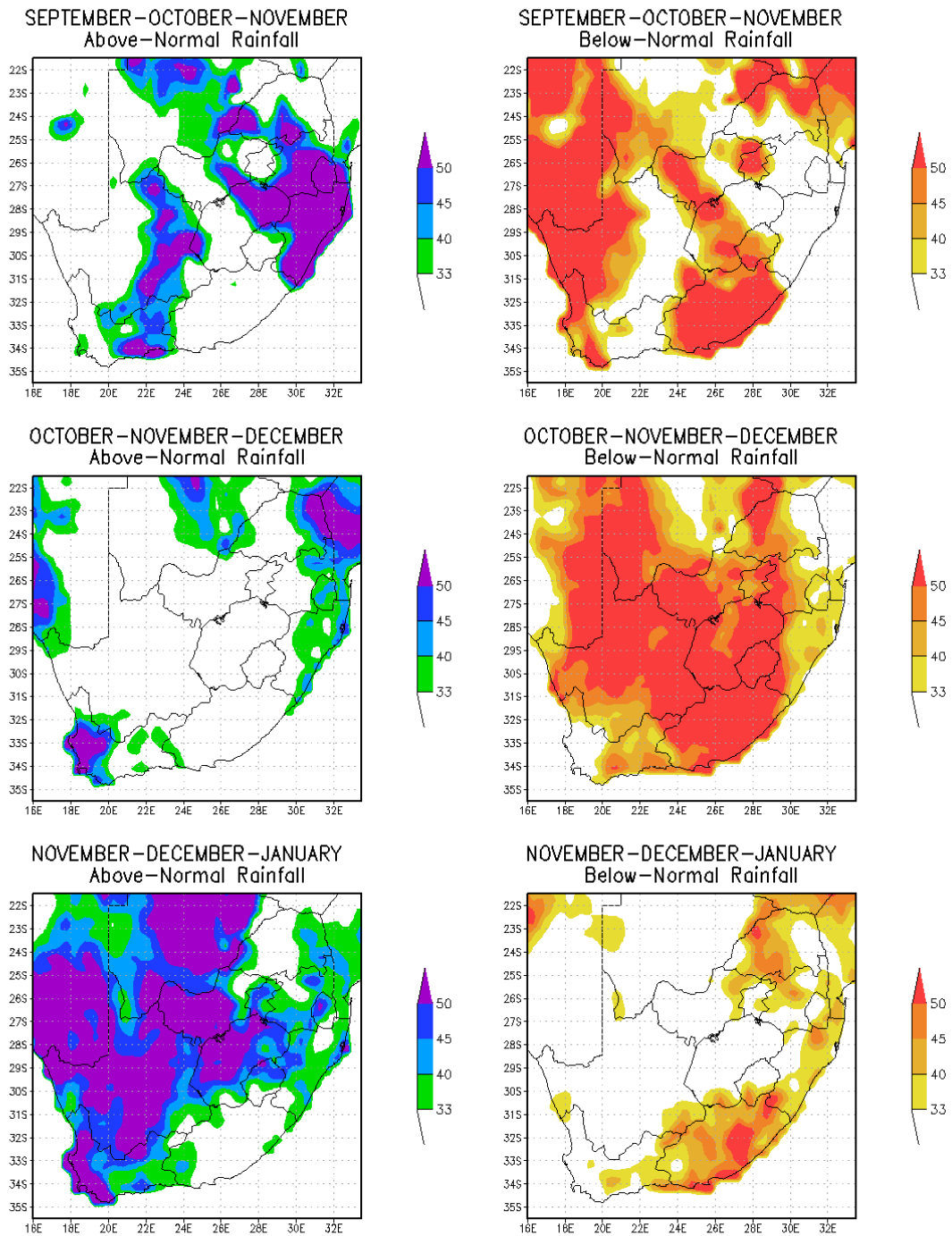


FIGURE 1