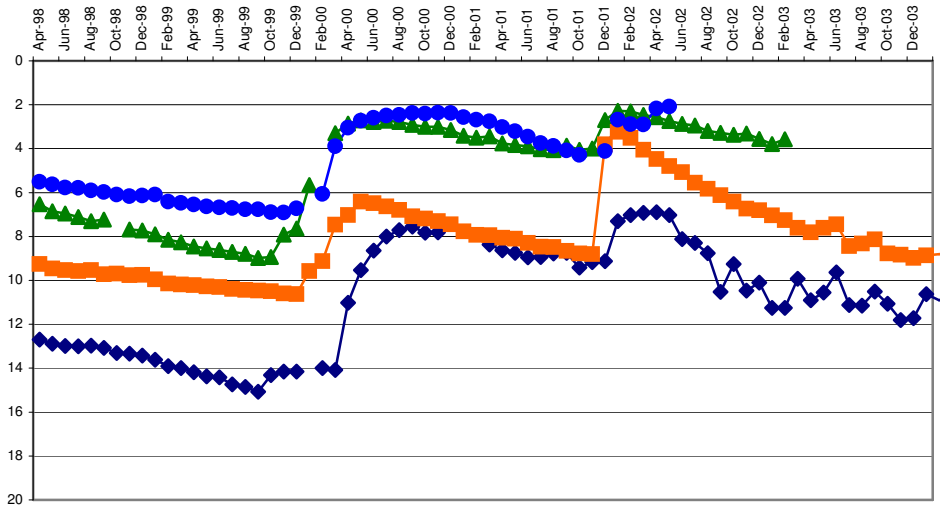
water & environment
Department:
Water and Environmental Affairs
REPUBLIC OF SOUTH AFRICA

LIMPOPO REGION
WATER REGULATION AND USE

STATUS REPORT ON MONITORING & GROUNDWATER LEVEL TRENDS MAY 2008 – MAY 2009



H VERSTER
JUNE 2009

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1) EXECUTIVE SUMMARY

Groundwater levels

Water level values for 1 May 2008 (corresponding time last year), 1 February 2009 (Midway through the past wet season) and 1 May 2009 (end of the wet season) were used for comparison in this report. The Stations in the Kruger National Park (KNP) were visited in May. Analyzing of the data will be done and reported on separately for the time being.

- Active stations to visit, including KNP = 195
- Stations visited and accessed = 190.
- Stations inaccessible due to wet conditions = 3
- Other access problems = 2
- Visited stations in A2 drainage not included in this report = 2
- Visited stations in KNP drainage not included in this report = 32

Comparison of water levels with the previous quarter: (February 2009 to May 2009)
Excluding the KNP stations, there are 161 active stations of which 156 were visited
Stations with data for the whole period available = 146 (93.6% of stations visited)

	No of stations	**% of stations**	**Average**
Water level down more than 1 m	8	5.5%	-3.3m
Water level down less than 1m	66	45.2%	-0.22m
Higher water levels more than 1m	12	8.2%	2.54m
Higher water levels less than 1m	60	41.1%	0.35m
No difference in water level			
Total	**146**	**100%**	**0.07m**

The above figures reflect the water level behavior from midway to the end of the past rainy season. From the figures it can be noted that the water level at 50.7% of stations have gone down during the latter part of the rainy season while 49.3% have gone up, indicating that recharge late in the rainy season did not occur throughout the Province.

Comparison of water levels before and after the rainy season: (November 2008 to May 2009)
Stations with data for the whole period available = 144 (92.3% of stations visited)

	No of stations	**% of stations**	**Average**
Water level down more than 1 m	3	2.1%	-2.84m
Water level down less than 1m	31	21.53%	-0.24m
Higher water levels more than 1m	49	34%	2.73m
Higher water levels less than 1m	61	42.36%	0.41m
No difference in water level			
Total	**144**	**100%**	**0.099m**

23.63% of the stations monitored indicate lower water levels after the rainy season while in 76.36% of cases the water level has gone up. The overall average water level differs only about 10cm of that before the rainy season.

Comparison of water levels with the corresponding time last year: (February 2008 to February 2009)

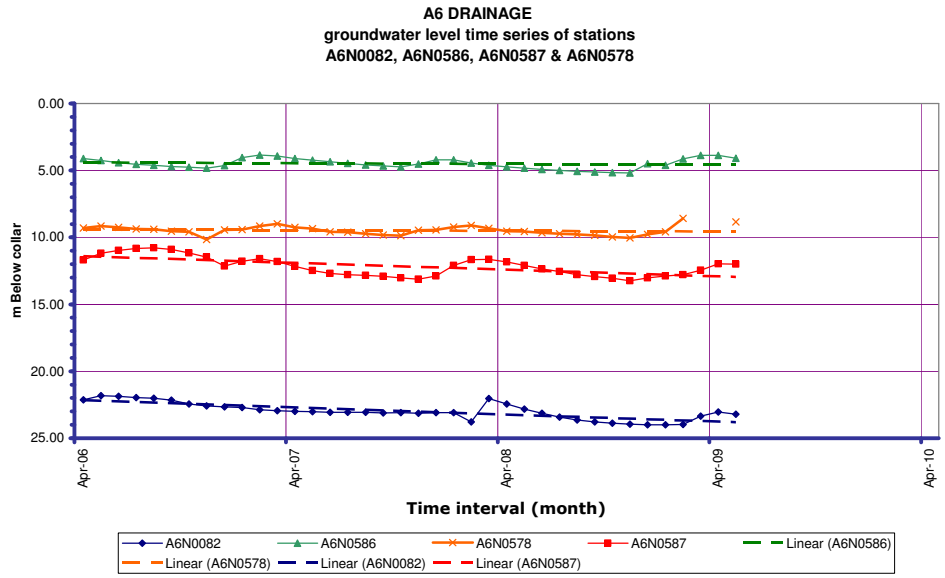
Stations with data for the whole period available = 132 (84.6% of stations visited)

	No of stations	% of stations	Average
Water level down more than 1 m	13	9.8%	-2.75m
Water level down less than 1m	58	43.9%	-0.41m
Higher water levels more than 1m	13	9.8%	3.99m
Higher water levels less than 1m	48	36.5%	0.34 m
No difference in water level			
Total	**132**	**100%**	**0.07m**

Data for the whole year is available for 132 stations, of these, 71 (53.7%) indicates lower water levels while 61 (46.3%) indicate higher water levels. Although a few more stations indicate lower water levels than those rising, the average water level overall is a negligible 7cm higher than the same time last year.

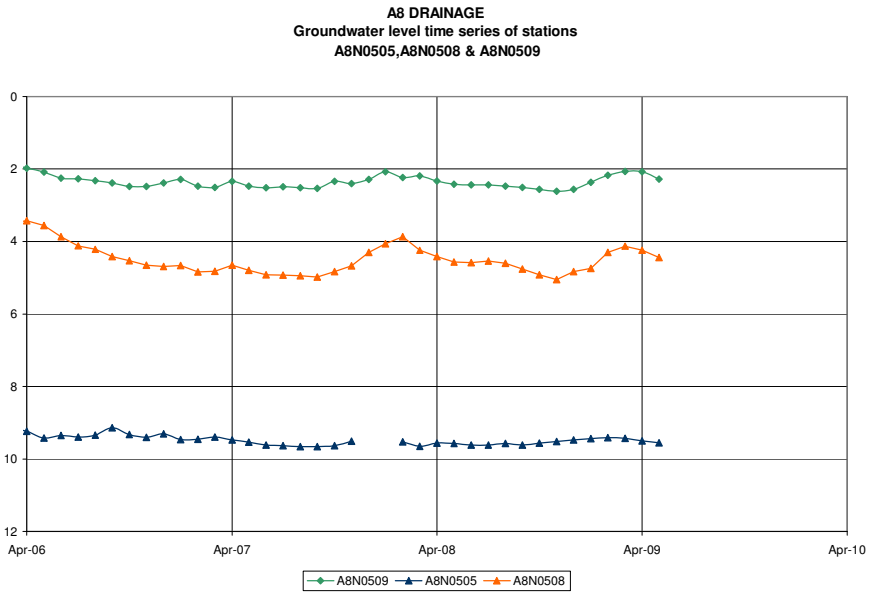
The constant slow declining trend throughout the region, despite some seasonal fluctuation, was noted in previous quarterly reports for some time now. The trend is still continuing and in an attempt to place a clearer perspective on it, some inset graphs is presented below.
The stations selected for the insets are considered to be representative of the behavior at the majority of stations in the respective drainages.

INSET 1 indicates the constant but slow declining trend at some stations in the A6 drainage over the past 3 years. Some seasonal rises are noticeable in the graphs but from the linear trend lines is can be seen that the general trend is downwards. Due to the difference in water levels at different stations the vertical scale needed to present all tend to subdue the picture a bit. The actual water levels indicate that the decline is mostly in the region of 1 to 2 m over the past 3 years.



INSET 1

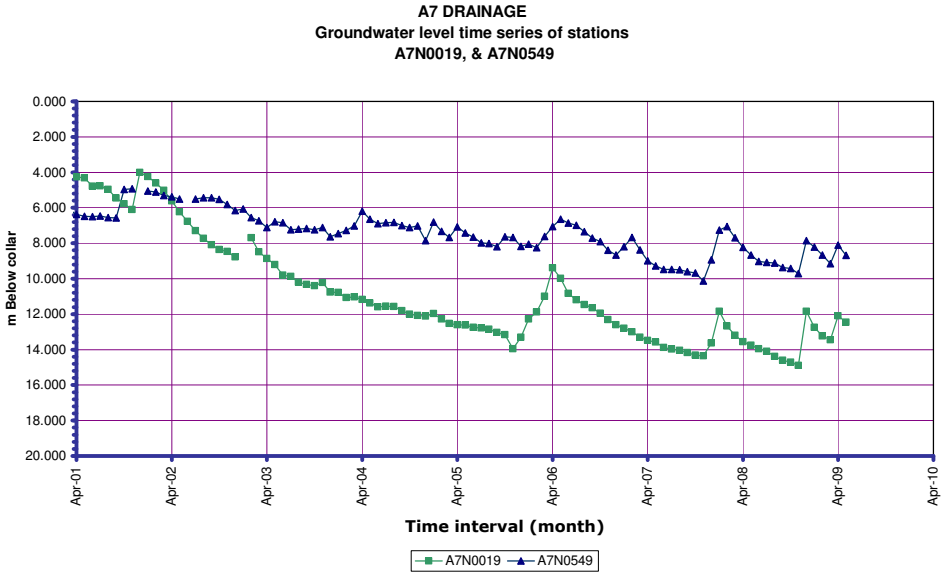
INSET 2 illustrates the same type of behavior in the A8 drainage over the past 3 years.



INSET 2

The above trend can generally be seen in graphs for all drainages with data for the past 3 years. Where longer term data is available the trend can clearly be noticed back to 2000 - 2001, the last major recharge event in most areas. The good correspondence in general water level behavior in different drainages over the past 3 years suggest that it will hold true for the previous couple of years as well.

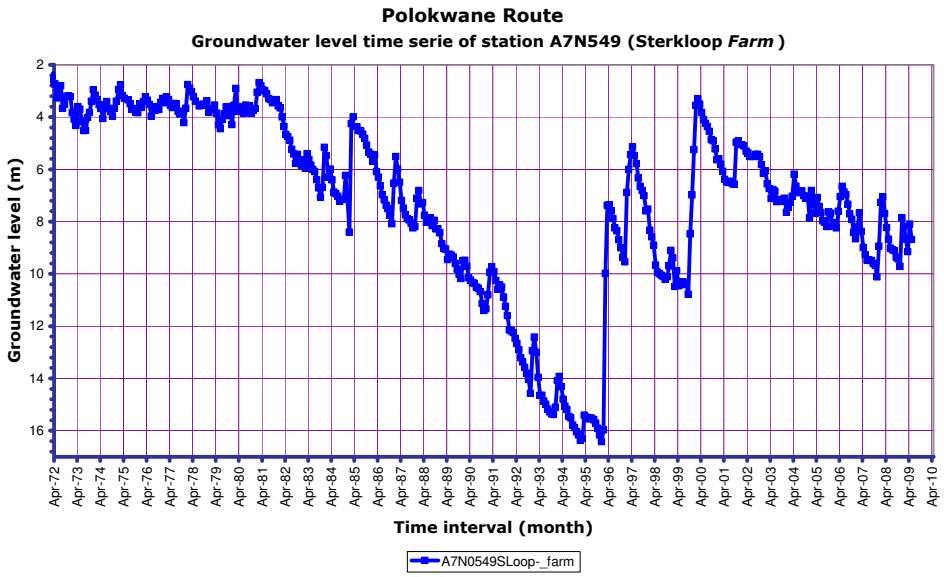
INSET 3 Illustrates the groundwater level trend of some stations in the A7 drainage since April 2001. Despite some seasonal rises, the trend continues downward. The average decline for this period may vary from 3 to 6 meters.



INSET 3

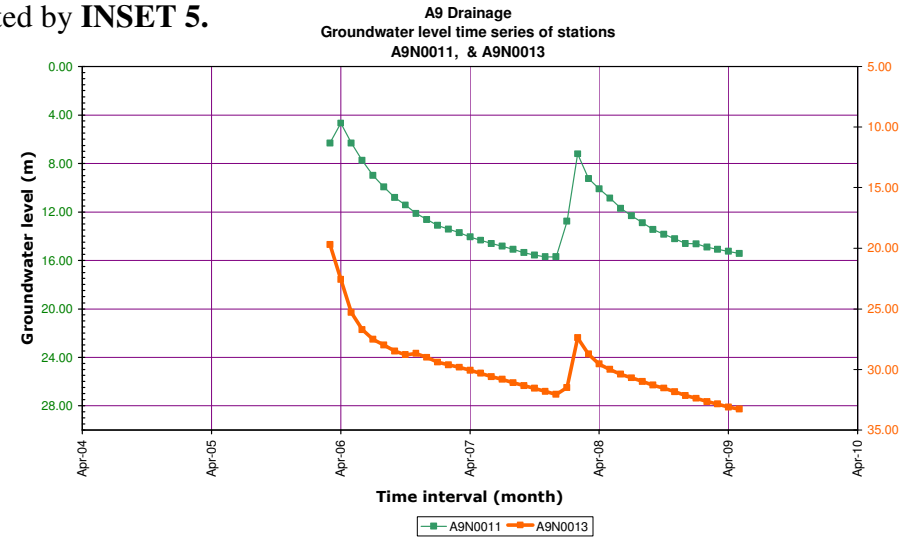
Viewing the above in isolation may give raise to serious concern. To get perspective on the situation the relation with long-term trends must be taken into consideration. To represent this, the water level trend as displayed at station A7N0549 is used as **INSET 4.**
*Note: This station was also used in **INSET 3** above to depict the short-term trend since 2001.*

INSET 4 clearly indicates that despite the general decline since 2001, the current situation still compares very favorable with the long-term. The water level in fact is currently, and has been for the past 8 years, in a better situation than the 10 years from 1990 to 2000.
As before, the general good correspondence in short-term behavior overall, support the assumption that it may be projected to the long-term as well.



INSET 4

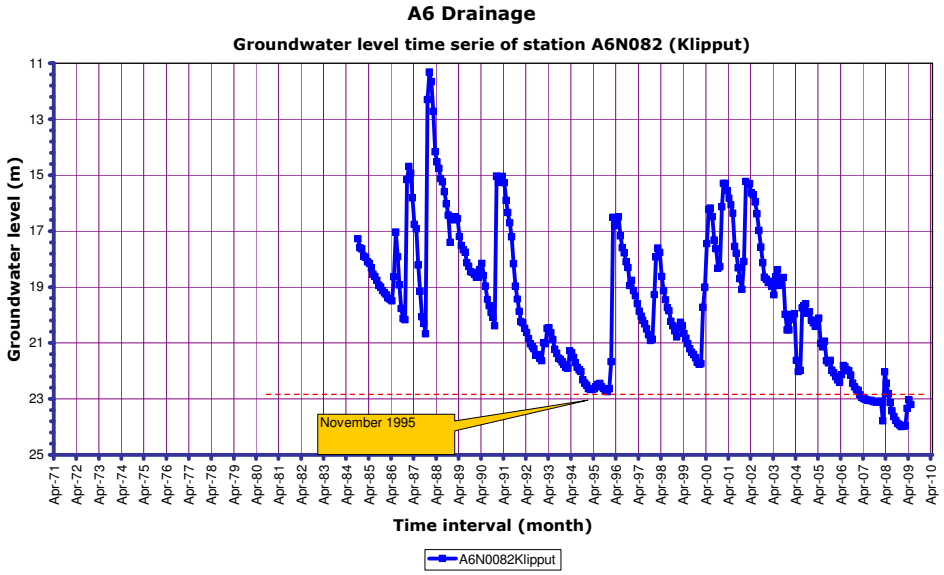
It was noted in the previous report that the current downward trend may be related to normal medium to long-term climatic cycles and should not raise undue concern. This is still considered to be the case.
There is however not enough long-term data available to really evaluate or understand this and complacency can not be afforded. The situation as described above refer to the general state of affairs over a large area and cannot be considered to represent local conditions which may differ and vary greatly depending on factors such as local rainfall events, water and land use patterns etc. A point in case is depicted by **INSET 5.**



INSET 5

The stations presented in above graph are located in the same area and levels have declined by 11 & 12m respectively over the past 3 years as opposed to the average of 1-2m elsewhere. This behavior is clearly in contrast to the general and warrants concern and special attention. There are some other stations deviating from the average decline but not as drastically as these. What is a matter of concern however is that almost all are located in the Mutale & Levhuvhu River drainages?

One other area that continues to raise concern is the area of station A6N0082 (Klipput) **INSET 6.**
This area is located between Mookgopong and Roedtan and the water level decline is far more rapid than the general trend. Since 2007 the level was mostly below the worst recorded in 1995.



INSET 6

The Tuinplaas-Settlers areas have been noted as areas of concern for quite some time now. Water levels have recovered very well the past year, 19m at Tuinplaas and 8m at Settlers, but are still far below long-term average for both stations.
As noted in every previous report, aquifer management is of utmost importance. The local effect of abstraction superimposed on the regional that is already declining may serve to increase the local rate of decline dramatically as seen in the above graphs. The importance of monitoring at aquifer level can not be over emphasized.

Considering the general trends on a regional scale for the past quarter as well as for the past year, some areas attract attention.

Last quarter; February to May 2009 (Midway to the end of the wet season) MAP 4

Two areas are clearly defined by the concentration of declining boreholes located in them. These areas are delineated on **MAP 4**. The decline is less than a meter at each station but fairly constant over large areas. The stations as discussed under **INSET 5** are located in the North eastern area delineated.

Past year; May 2008 to May 2009 MAP 5

For this period there is a more varied distribution of stations with rising or declining water levels. The north eastern area however again draws attention, especially the concentration of stations with more

than 1m decline in water level. Water levels in this area have been declining faster than the general trend overall. The area is densely populated and very reliant on groundwater.

Monitoring network

Extension of the monitoring network is currently halted due to lack of funds for the drilling section. The position of current and planned stations is depicted in **MAP 1**.

Registration of new stations on the national database is hampered by personnel shortages in Head Office and 9 new stations still have to be registered. The Kruger Park stations also still have to be registered.

Project monitoring at Matlala and Tshitale is continuing. **MAP 2**

Groundwater Quality Monitoring of the NGWQMP boreholes continues. **MAP 3**
Field verification of control sampling boreholes was done but sampling is halted due to laboratory problems and a lack of funds.

2) STATUS OF MONITORING NETWORK

No new stations were equipped the past quarter and the Limpopo Province's Groundwater Level Monitoring Network currently still consists of 195 active monitoring stations, including 34 in the KNP **(Map 1)**

190 Stations were visited during May 2009. 5 Stations could not be accessed for various reasons.

Site preparation has commenced for the phase 2 upgrading of existing stations.

The following project stations are monitored, 25 at Matlala, 4 at Tshitale and 16 at Taaibosch (Monitored by Head Office). **(Map 2)**

Regional and Head Office jointly service a total of 55 stations for the National Groundwater Quality Program in the Limpopo Province which is sampled bi-annually. **(Map 3)**

Sampling to verify the suitability of selected sites for extension of the National Groundwater Quality Monitoring network is still on hold due to budget constraints and laboratory problems.

3) DATA COLLECTION, EVALUATION AND REPORTING

Data was collected during May 2009 with the value for 1 May representing the end of the past rainy season. Comparisons were drawn between 1 May 2008, (Corresponding period the previous year) 1 February 2009 (Midway of the wet season) and 1 May 2009 (End of the past wet season) **(Maps 4 & 5)**

4) LIMPOPO WATER MANAGEMENT AREA.

The area consists of secondary drainage areas A4, A5, A6, A7 and A8.

4.1 A4 Drainage Area. (Matlabas, Mokolo Rivers)

There are 9 equipped stations in this drainage but very limited time series data is available so far. 2 Boreholes are still to be drilled and 1 existing project borehole around the town of Lephalale has to be identified and equipped.

Water level trends indicate some recharge but not all stations **(GRAPH 1)**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
Data for 6 stations is available, with 3 indicating rising and 3 a declining water levels. **(GRAPH 2)**

4.2 A5 Drainage Area. (Lephalale River)

There are 7 active stations of which 3 have hardly any time series data yet. The access problems to A5N0001 as well as the 3 project boreholes around it has been solved and loggers is to be installed before end of July 2009

Very little fluctuation in water level the past year indicated by available data **(GRAPH 3)**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
4 of the 5 stations with data indicate a slight decline **(GRAPH 4)**

Past year; May 2008 to May 2009
3 Of the 4 stations with data indicate declining levels over the past year **(GRAPHS 5 & 6)**

4.3 A6 Drainage Area. (Nile, Sterk, Mogalakwena & Dorps Rivers)

There are 39 monitoring stations in this drainage, 1 has caved in leaving 38 active.
Varying recharge indicated the past season. **(GRAPH 7)**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
Data for 36 stations is available. 13 Stations (38.24%) have lower levels and 21 stations (61.76%) indicate higher water levels. Overall an average decline of -0.01m was recorded for the period. **(GRAPHS 8 & 10)**

Past year; May 2008 to May 2009
Data for the whole year is available for 34 stations. 24 Stations (77.4%) indicate lower water levels than February last year and 7 stations (22.6%) indicate a rise in water levels. An overall decline of 0.02m was recorded over the past year **(GRAPH 9 & 10)**

Current average water levels are slightly above the long-term average values and 3.79m higher than the maximum average recorded, **(GRAPH 11)**

4.4 A7 Drainage Area. (Sand, Blood, Diep, Hout, Dwars & Brak Rivers)

There are 38 monitoring stations in this drainage.
Trends vary from slightly declining to stable or limited recharge. **(GRAPH 12)**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
Data is available for 37 stations of which 20 stations (54.1%) indicate higher water levels, while 17 stations (45.9%) indicate lower water levels. Overall a decline of -0.04m was recorded over this period **(GRAPHS 13&15).**

Past year; May 2008 to May 2009
Data is available for 34 stations, 16 (47.1%) Indicate lower water levels, average -0.31m. 18 Stations (52.9%) indicate higher water levels, average 0.88m. Overall a rise of 0.32m was recorded for the period **(GRAPHS 14&15)**.

Current average water levels are just below the long-term average but 3.04m above the lowest average recorded **(GRAPH 16).**

4.5 A8 Drainage Area ((Nwanedzi, Nzhelele Rivers)

11 Stations are monitored in this area but as for the previous reports, the data for the artesian station was not used.

Water level trends corresponds with other drainages discussed above **(GRAPH 17)**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
9 Stations with data, 6 stations indicate declining water levels, average -0.19 and 2 rising levels. 1 station has the same level **(GRAPHS 18 & 20)**.

Past year; May 2008 to May 2009
3 Stations indicate lower water levels and 5 higher water levels, average 0.69m **(GRAPHS 19 & 20)**.

An overall average rise of 0.335m was recorded over the past year **(GRAPH 20)**

5) LEVHUVHU-LETABA WATER MANAGEMENT AREA.

The area consists of secondary drainage areas A9, B8 & B9.

5.1 A9 Drainage Area. (Mutale, Levhuvhu Rivers)

This drainage has 18 monitoring stations.

Only 1 station indicated a considerable rise in water level early in the season but has since declined some again **(GRAPH 21).**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
Data is available for all stations. 13 indicate lower water levels; average -0.18m (The value for A9N0009 was discarded). 5 Indicate higher water levels, average 0.34m (**GRAPHS 22 & 24)**.

Past year; May 2008 to May 2009
16 Stations (88.89%) indicate lower water levels, average -1.04m and 2 stations indicate a higher water level (**GRAPHS 23&24**).

Overall an average decline of 0.865m was recorded over the area the past year.

5.2 B8 Drainage Area. (Groot, Middel & Klein Letaba Rivers)

14 Stations are monitored in this drainage.

The same general trend is displayed over the past year **(GRAPH 25).**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
Data is available for all stations. 7 Stations indicate lower water levels, average -0.15m, 7 stations indicate higher water levels, average 0.39m **(GRAPHS 26&28)**

Past year; May 2008 to May 2009
11 Stations indicate lower water levels, average -0.55m with 3 indicating higher levels, overall a decline of -0.29m was recorded(**GRAPHS 27&28)**

5.3 B9 Drainage Area. (Shingwidzi, Mphongolo Rivers)

4 Stations in this drainage but one is blocked and has to be re-drilled.
Only 1 station has indication of recharge this season **(GRAPH 29)**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
All 3 stations are declining **(GRAPHS 30 & 32).**

Past year; May 2008 to May 2009
All stations have lower water levels than the corresponding time last year, average -0.95m **(GRAPHS 31 & 32)**

6) OLIFANTS WATER MANAGEMENT AREA.

The part of this Water Management Area within the Limpopo Province mostly consists of the B3, B5 & B7 secondary drainage areas.

6.1 B3 Drainage Area. (Elands, Gotwane Rivers (Springbok flats area)

3 Stations are monitored in this area.

Considerable rise in water levels at B3N0001 & B3N0012 **(GRAPH 33)**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
All stations indicate higher levels with a significant rise of 9.1m at B3N0012 **(GRAPH 34)**

Past year; May 2008 to May 2009
All Stations indicate higher water levels with that at B3N0012 again considerable (**GRAPH 35)**

Despite the rising water levels at B3N0001 and B3N0012, the current water levels are still far below long-term average and is a reason for concern for some years now (**GRAPH 36)**

6.2 B5 Drainage Area. (Olifants, Nkumpi Rivers)

7 Stations are monitored in this drainage.

As in other drainages, a rise at some stations during the past season **(GRAPH 37)**

Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
3 Stations with declining water levels and 3 with rising **(GRAPHS 38 & 39)**

Past year; May 2008 to May 2009
The water level at B5N0055 sometimes reflects pumping effects of a nearby borehole that is sporadically used. At such times these levels are not taken into consideration, as is the case here. Of the rest, 2 stations indicate lower levels and 3 higher. Overall a decline of -1.27m was recorded the past year **GRAPHS 39 & 40)**

Current average water levels are above the lowest average recorded at stations with long-term data **(GRAPH 40)**

6.3 B7 Drainage Area (Olifants, Selati, Klaserie, Makhutswi Rivers)

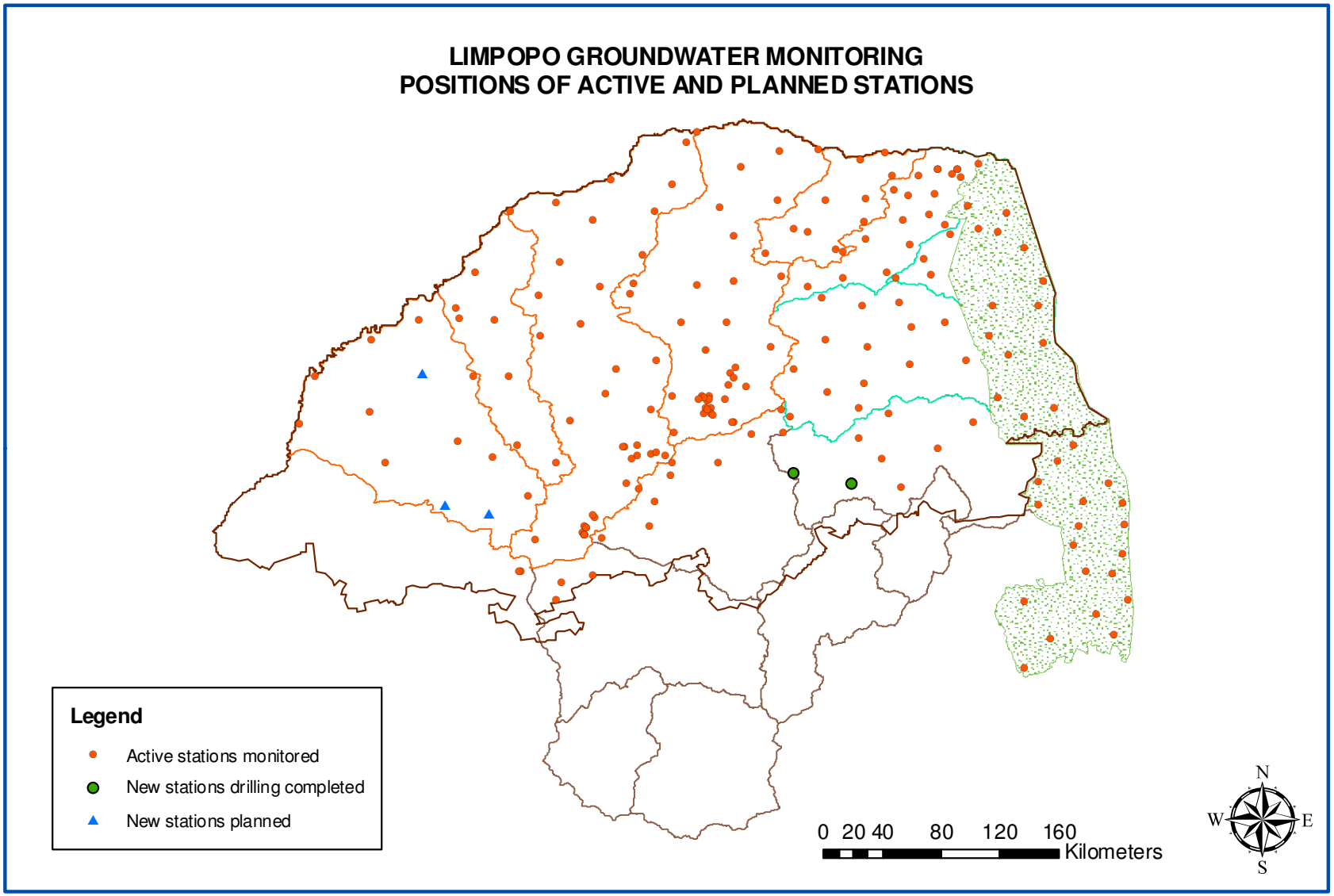
8 Stations are monitored in this drainage.

Trends is similar to that of the other drainages **(GRAPH 42)**

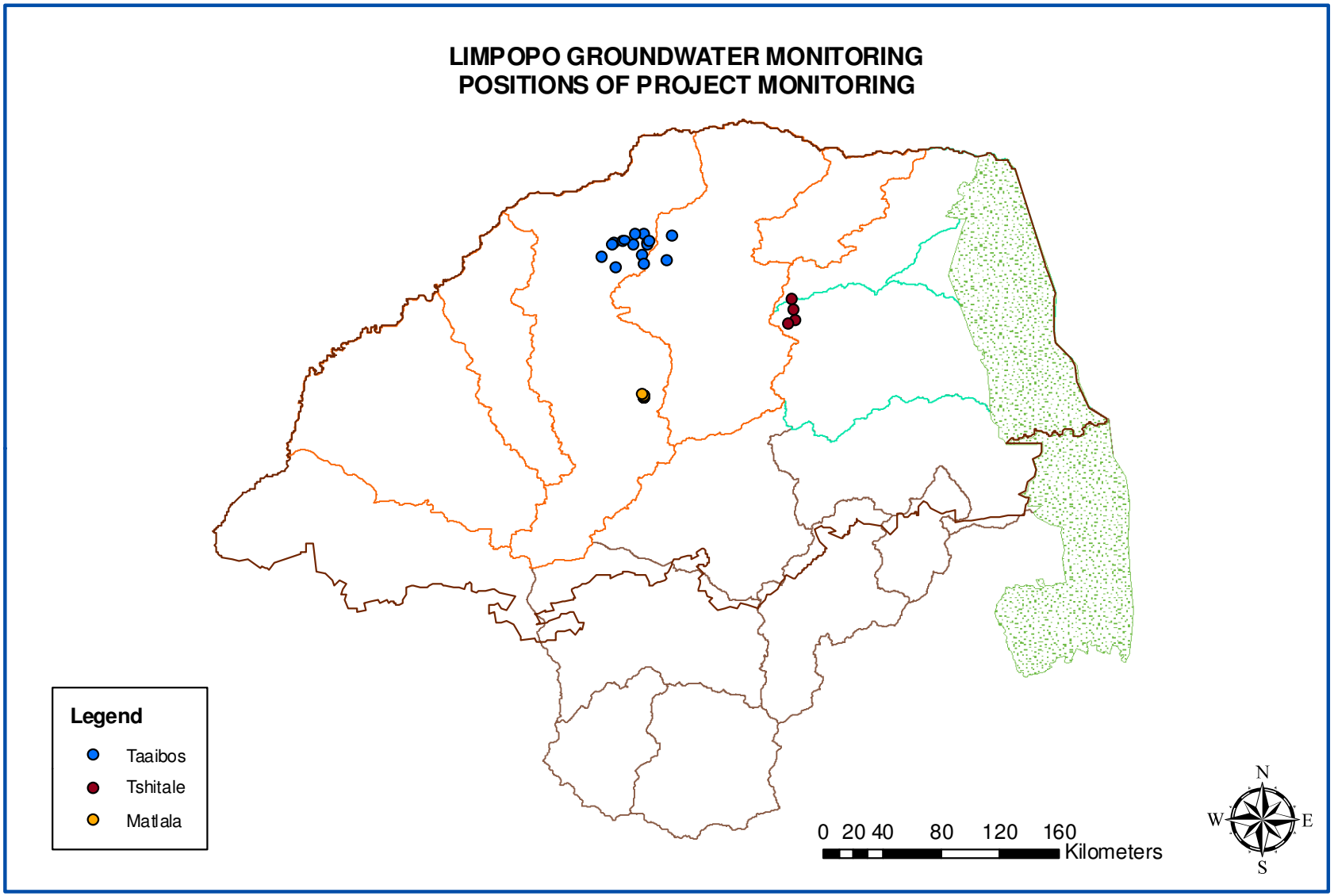
Comparison with previous levels:

Last quarter; February to May 2009 (Midway to the end of the wet season)
3 Stations indicate lower water levels; and 5 higher, average 0.32m **(GRAPHS 43 & 45)**

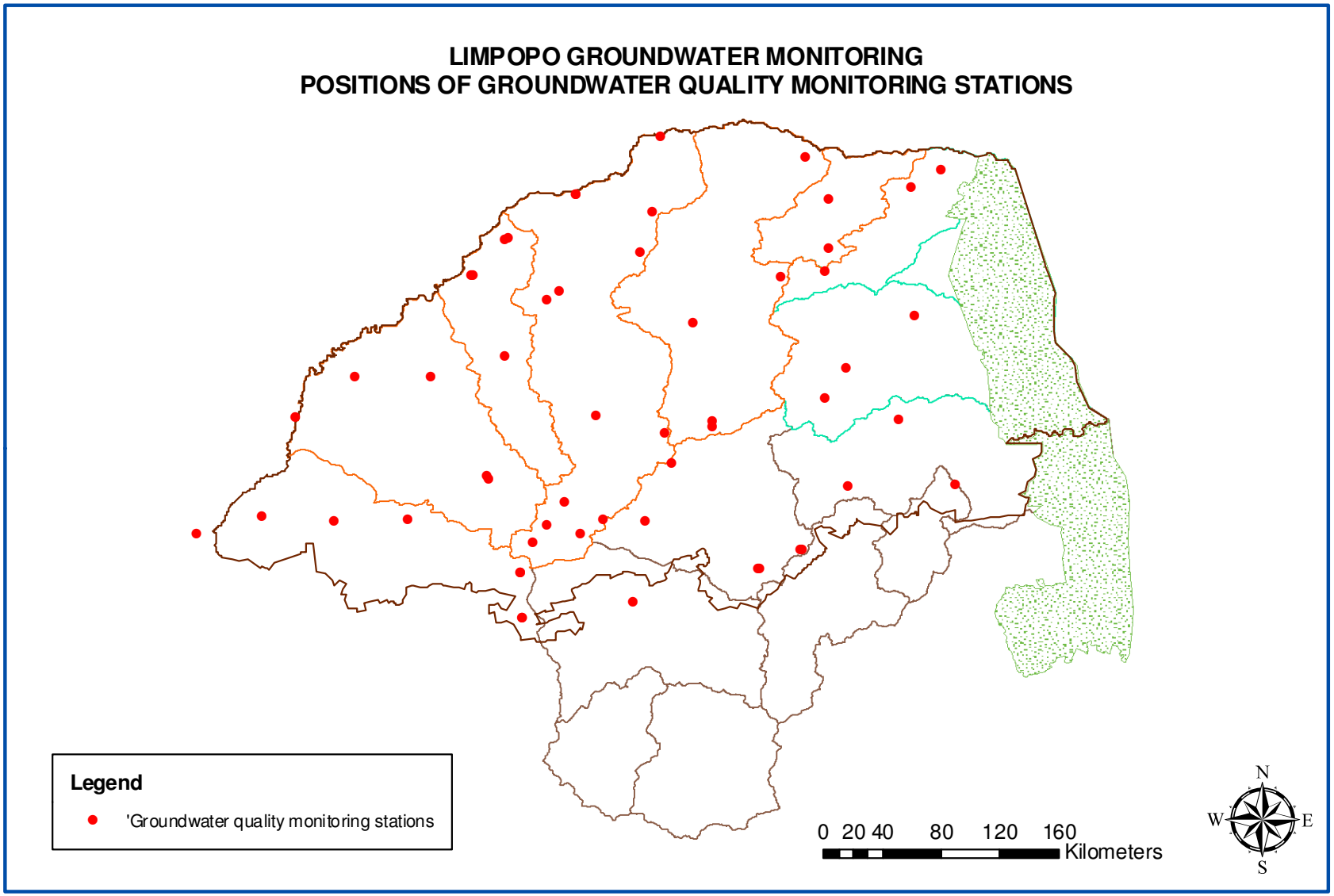
Past year; May 2008 to May 2009
As with previous period, 3 Stations indicate lower water levels and 5 higher. Overall a decline of -.022m was recorded **(GRAPHS 44 & 45)**.


LIMPOPO GROUNDWATER MONITORING
POSITIONS OF ACTIVE AND PLANNED STATIONS
Legend
Active stations monitored
New stations drilling completed
New stations planned
0 20 40 80 120 160
Kilometers
N
W
E
S

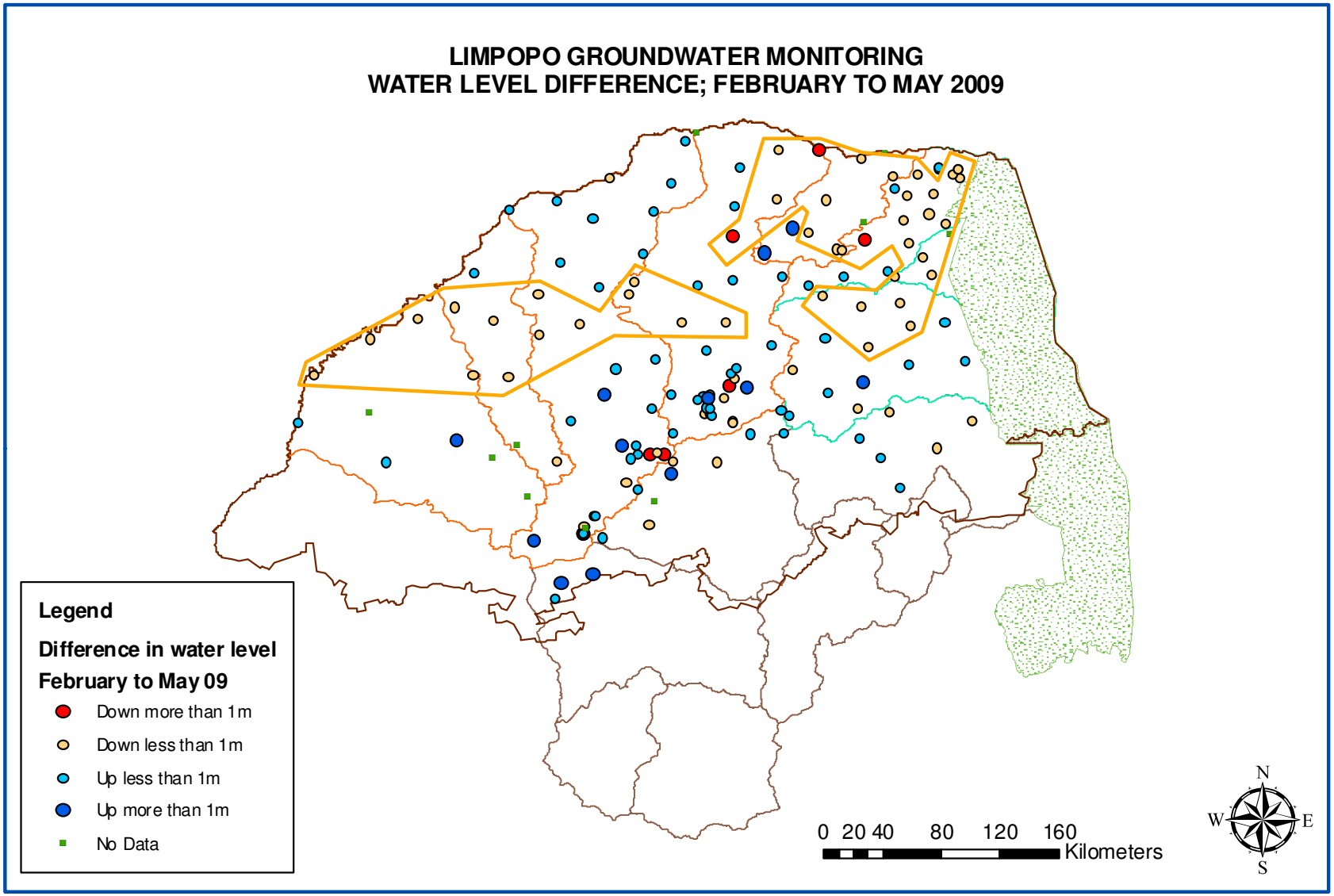
MAP 1


LIMPOPO GROUNDWATER MONITORING
POSITIONS OF PROJECT MONITORING
Legend
Taaibos
Tshitale
Matlala
0 20 40 80 120 160
Kilometers
N
W
E
S

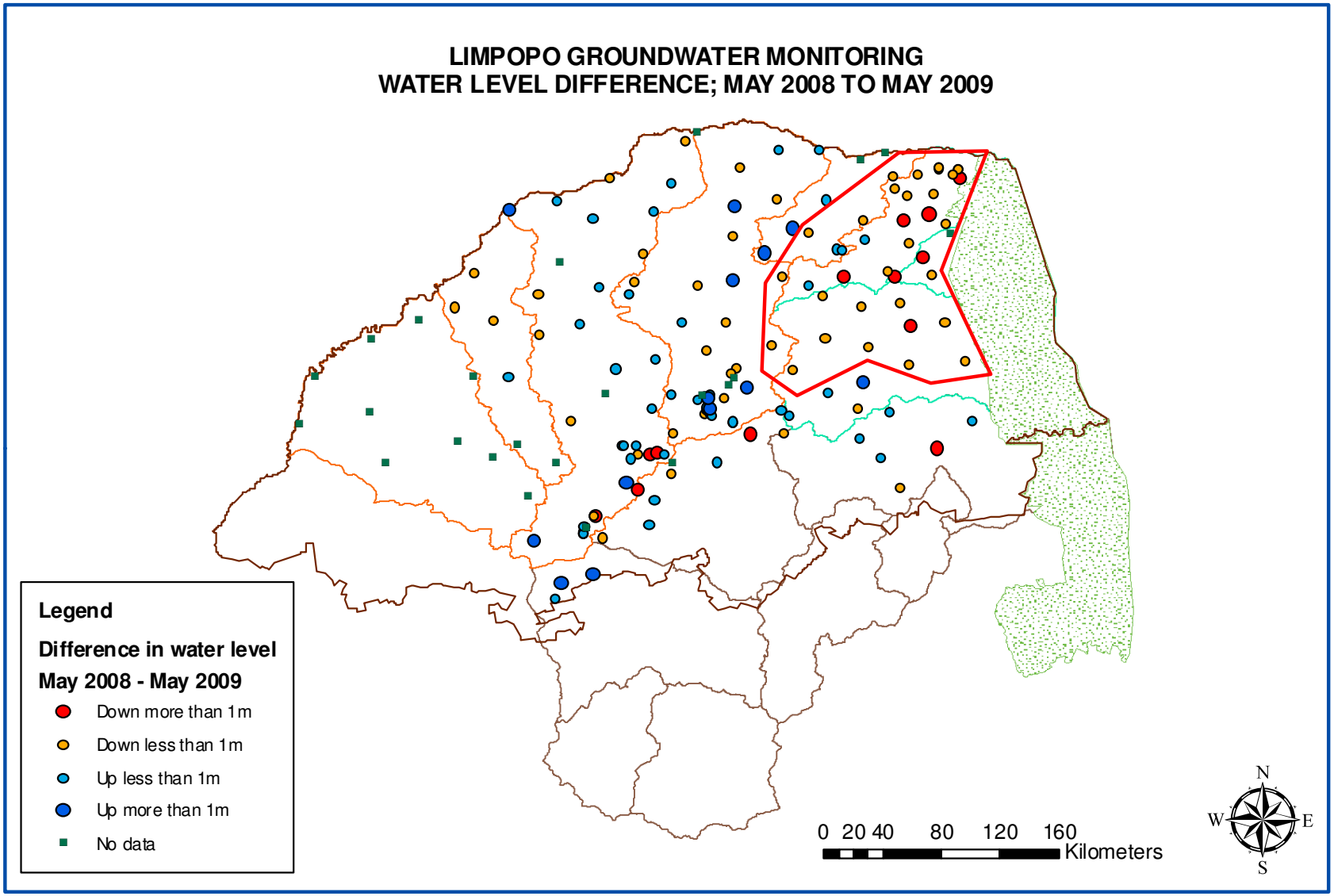
MAP 2


LIMPOPO GROUNDWATER MONITORING
POSITIONS OF GROUNDWATER QUALITY MONITORING STATIONS
Legend
'Groundwater quality monitoring stations
0 20 40 80 120 160
Kilometers
N
W
E
S

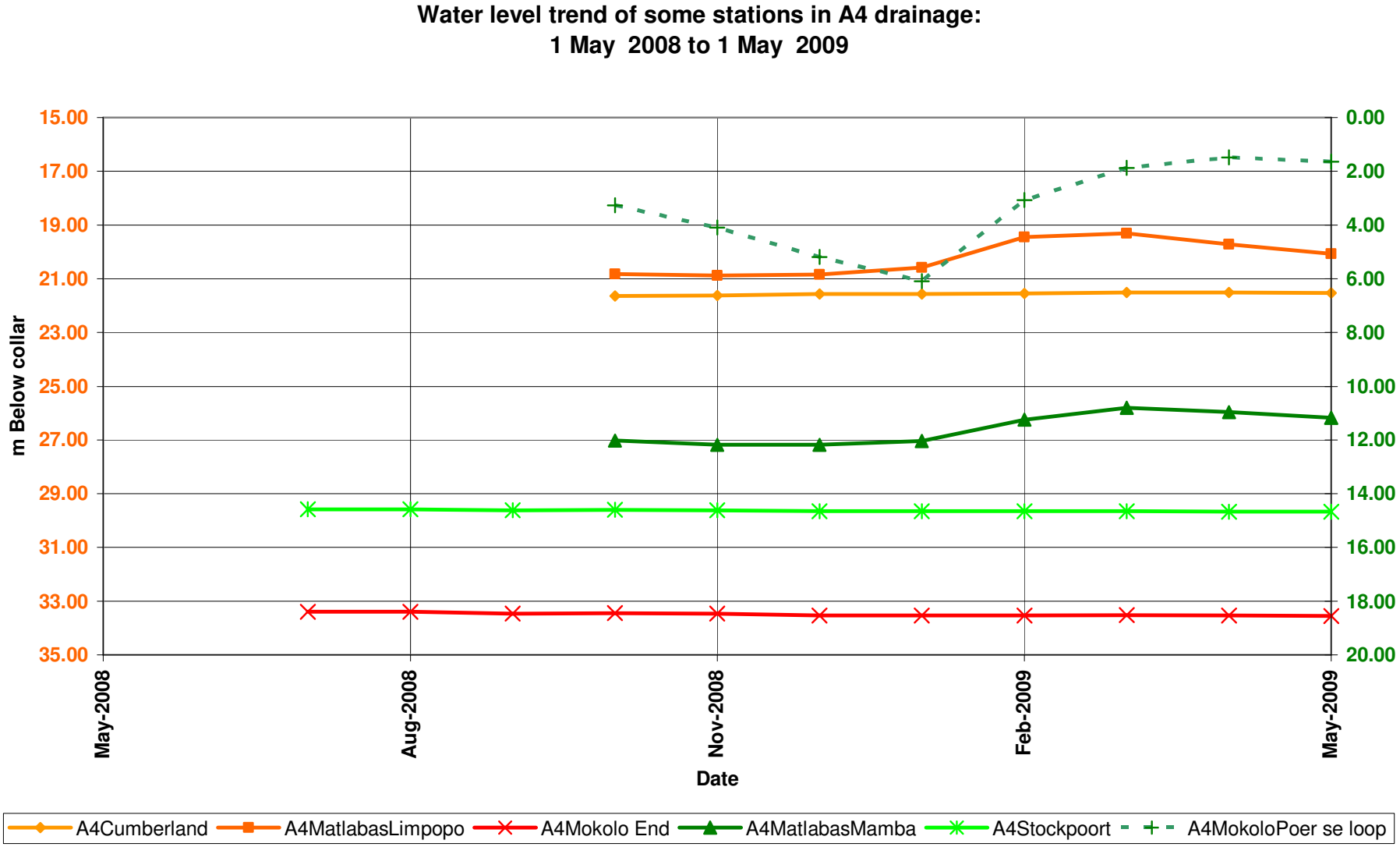
MAP 3


LIMPOPO GROUNDWATER MONITORING
WATER LEVEL DIFFERENCE; FEBRUARY TO MAY 2009
Legend
Difference in water level
February to May 09
Down more than 1m
Down less than 1m
Up less than 1m
Up more than 1m
No Data
0 20 40 80 120 160
Kilometers
N
W
E
S

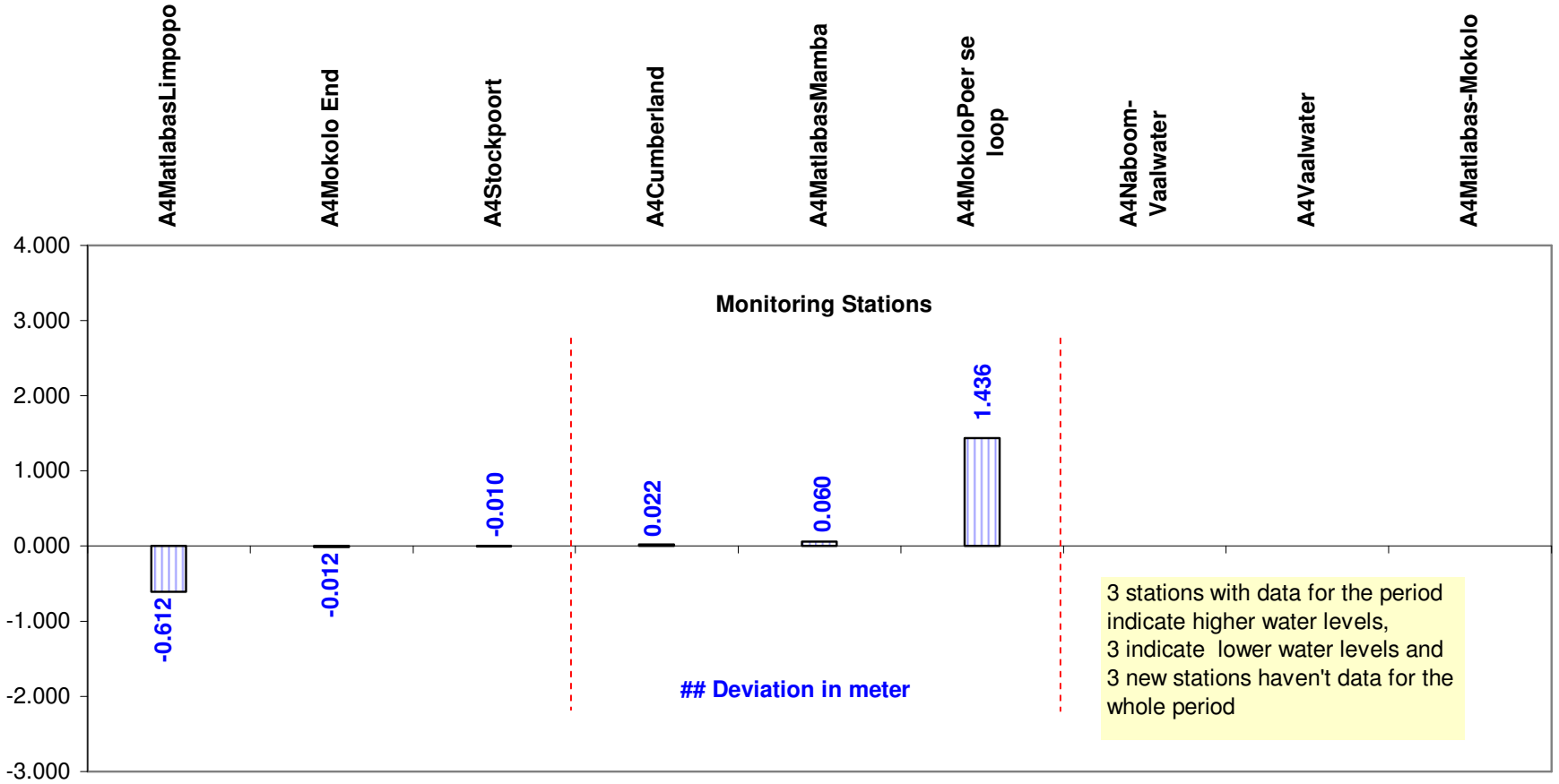
MAP 4


LIMPOPO GROUNDWATER MONITORING
WATER LEVEL DIFFERENCE; MAY 2008 TO MAY 2009
Legend
Difference in water level
May 2008 - May 2009
Down more than 1m
Down less than 1m
Up less than 1m
Up more than 1m
No data
0 20 40 80 120 160
Kilometers
N
W
E
S

MAP 5

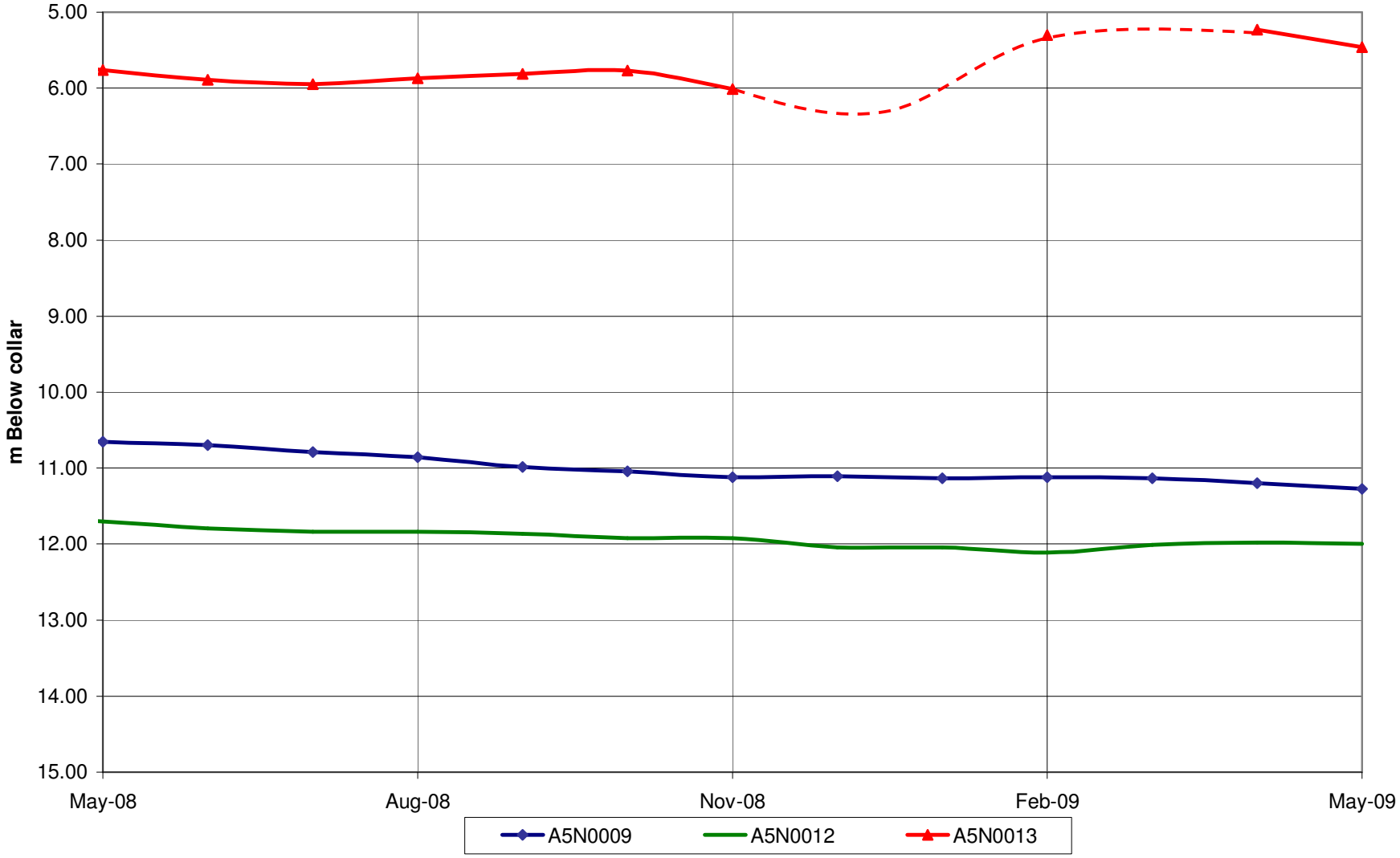

Water level trend of some stations in A4 drainage:
1 May 2008 to 1 May 2009
m Below collar
15.00
17.00
19.00
21.00
23.00
25.00
27.00
29.00
31.00
33.00
35.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
May-2008
Aug-2008
Nov-2008
Feb-2009
May-2009
Date
A4Cumberland
A4MatlabasLimpopo
A4Mokolo End
A4MatlabasMamba
A4Stockpoort
A4MokoloPoer se loop

GRAPH 1


A4 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009
A4MatlabasLimpopo
A4Mokolo End
A4Stockpoort
A4Cumberland
A4MatlabasMamba
A4MokoloPoer se loop
A4Naboom-Vaalwater
A4Vaalwater
A4Matlabas-Mokolo
4.000
3.000
2.000
1.000
0.000
-1.000
-2.000
-3.000
Monitoring Stations
-0.612
-0.012
-0.010
0.022
0.060
1.436
Deviation in meter
3 stations with data for the period indicate higher water levels,
3 indicate lower water levels and
3 new stations haven't data for the whole period

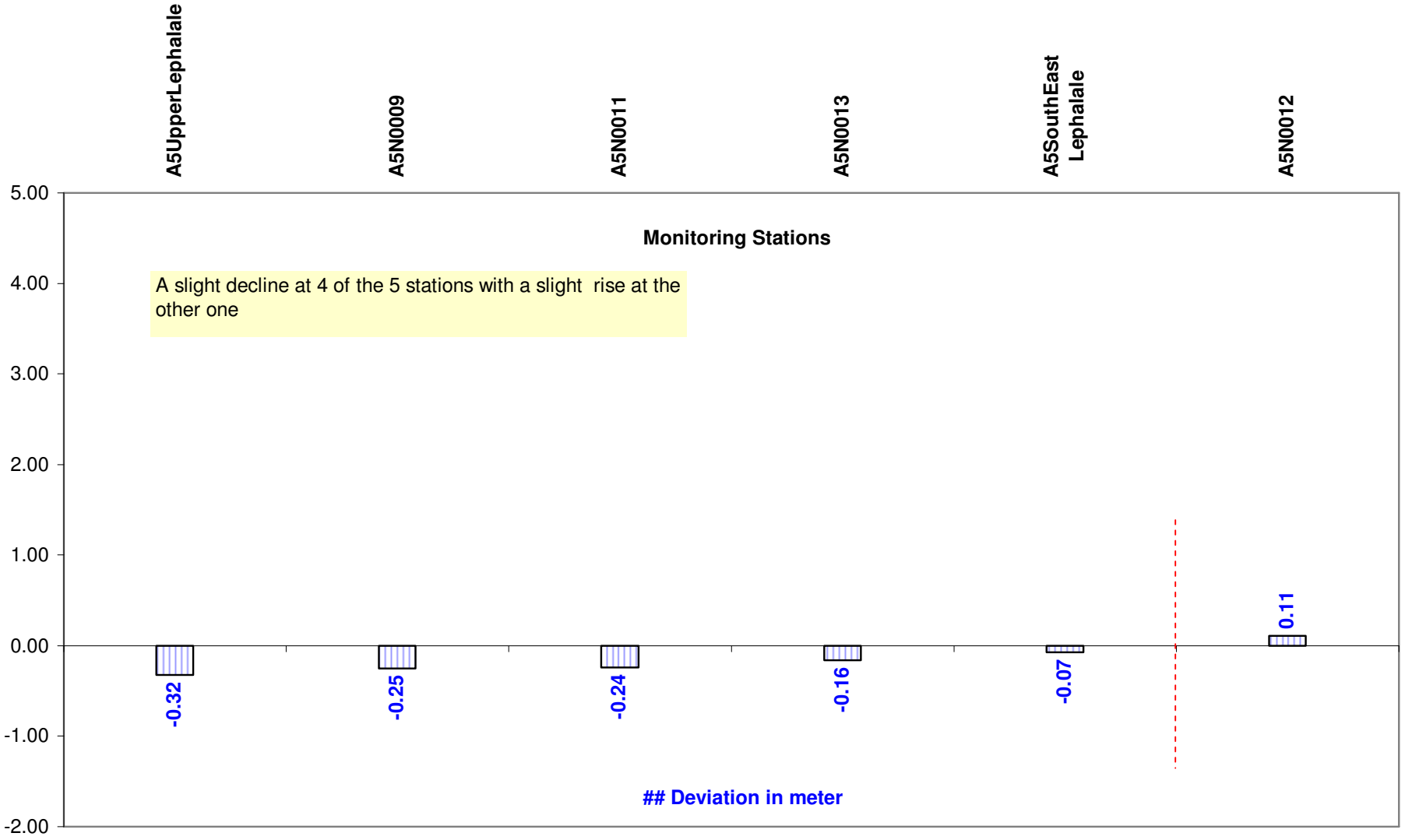
GRAPH 2

Comparison of water level trends at some stations in A5 drainage: 1 May 2008 to 1 May 2009



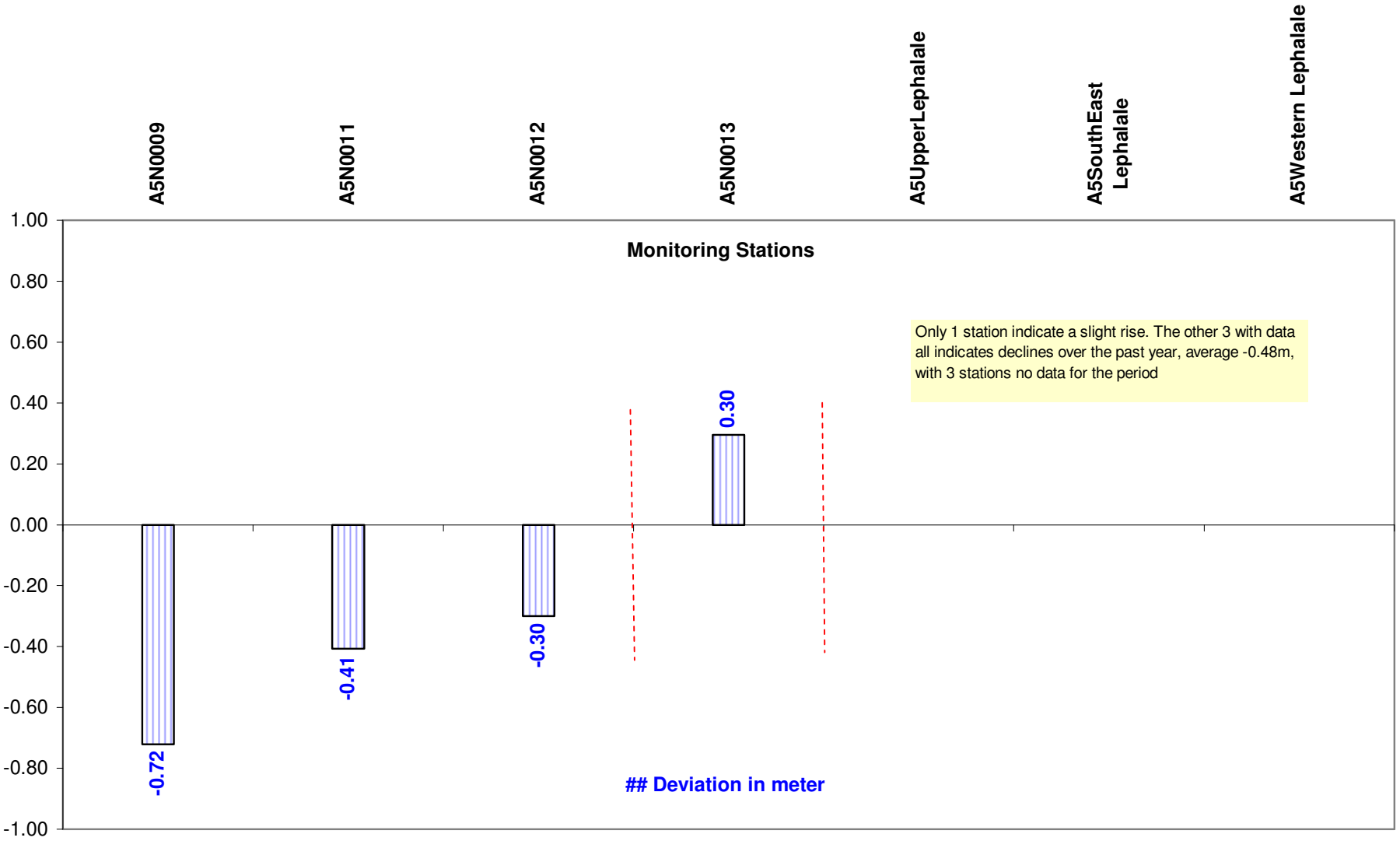
GRAPH 3

A5 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009

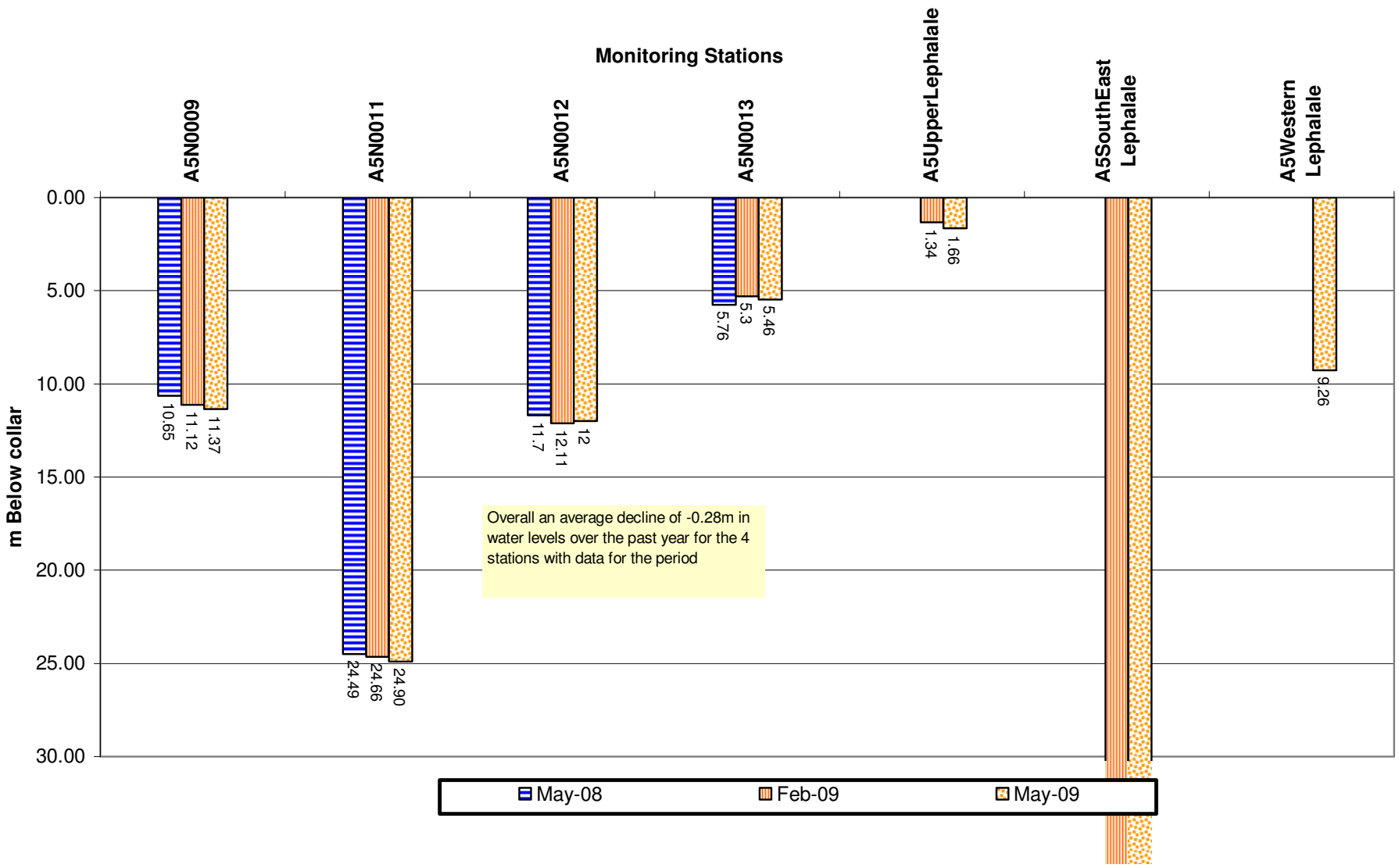


GRAPH 4

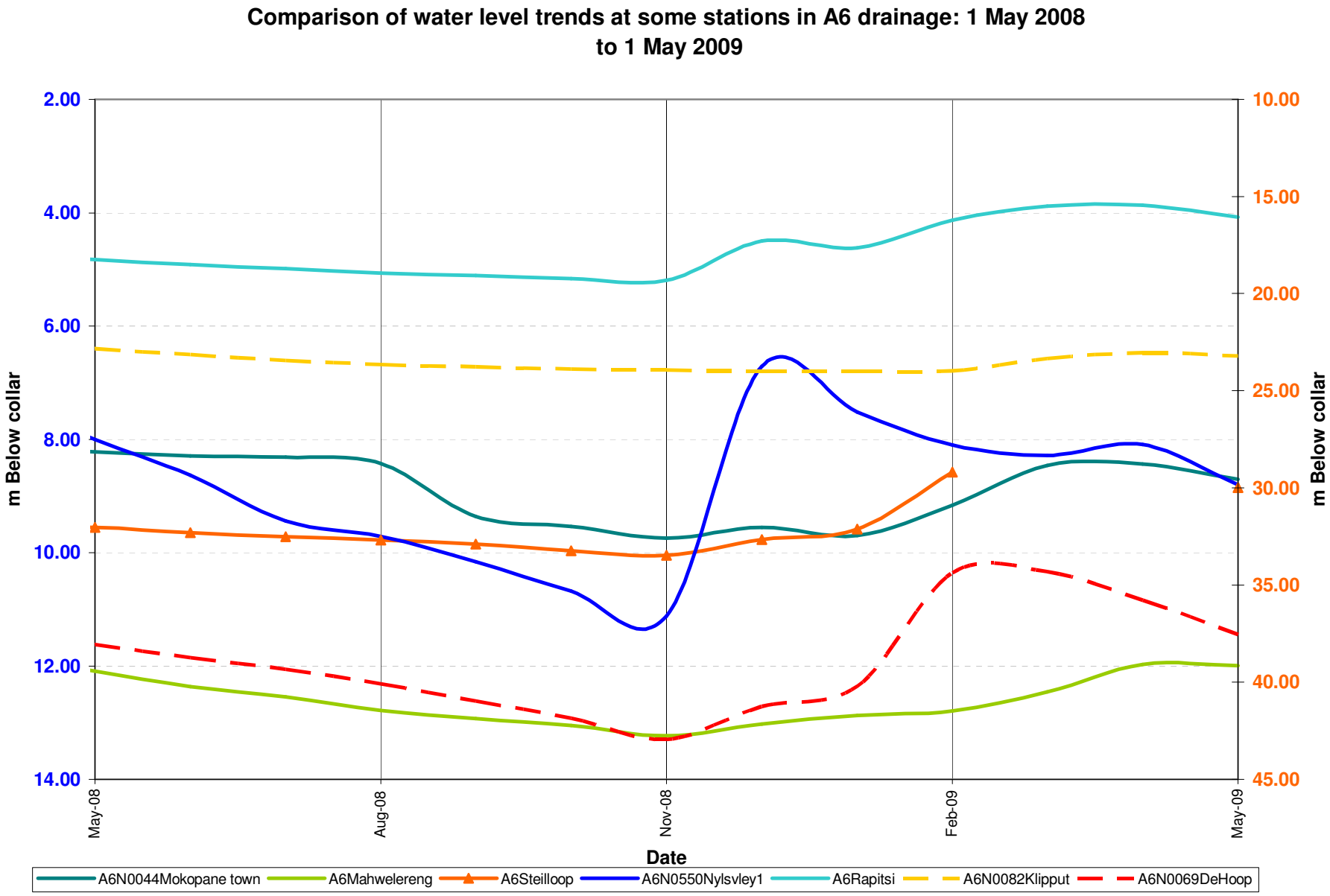
A5 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009



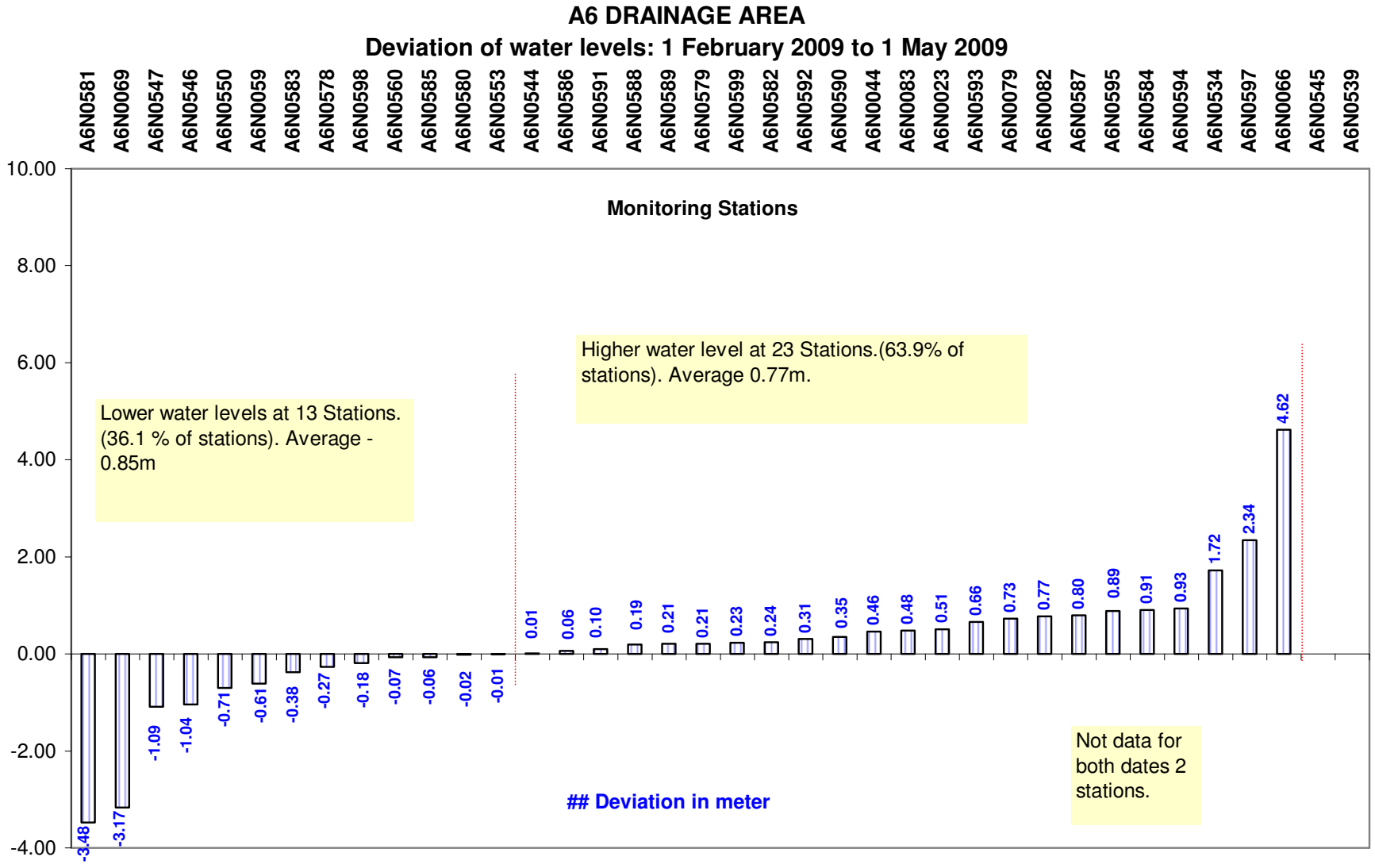
GRAPH 5


A5 DRAINAGE AREA
Comparison between water level depths : 1 May 2008,
1 February 2009 and 1 May 2009
Monitoring Stations
A5N0009
A5N0011
A5N0012
A5N0013
A5UpperLephalale
A5SouthEast Lephalale
A5Western Lephalale
m Below collar
0.00
5.00
10.00
15.00
20.00
25.00
30.00
10.65
11.12
11.37
24.49
24.66
24.90
11.7
12.11
12
5.76
5.3
5.46
1.34
1.66
9.26
Overall an average decline of -0.28m in water levels over the past year for the 4 stations with data for the period
May-08
Feb-09
May-09

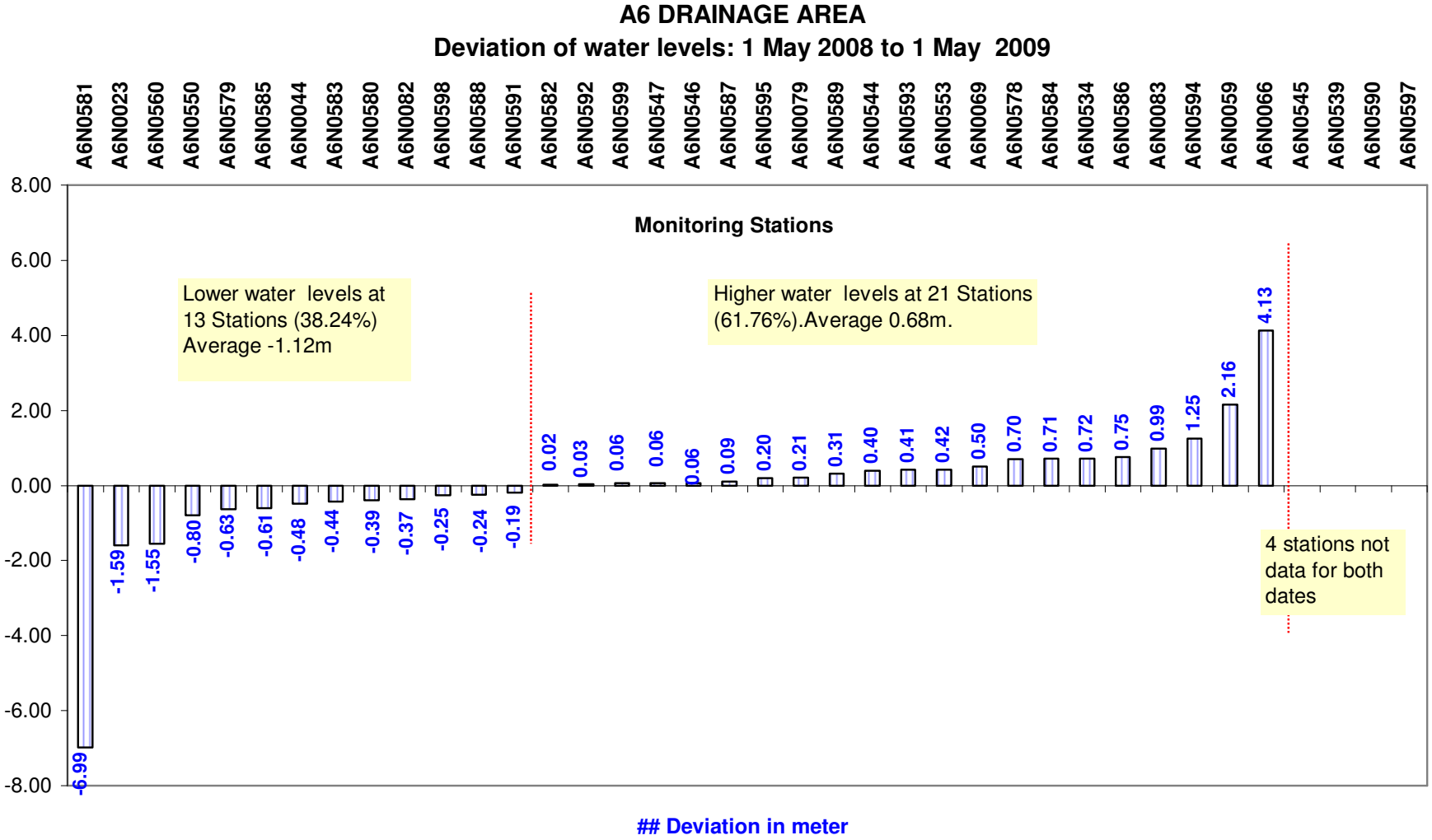
GRAPH 6


Comparison of water level trends at some stations in A6 drainage: 1 May 2008 to 1 May 2009
2.00
4.00
6.00
8.00
10.00
12.00
14.00
m Below collar
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
m Below collar
May-08
Aug-08
Nov-08
Feb-09
May-09
Date
A6N0044Mokopane town
A6Mahwelereng
A6Steilloop
A6N0550Nylsvley1
A6Rapitsi
A6N0082Klipput
A6N0069DeHoop

GRAPH 7

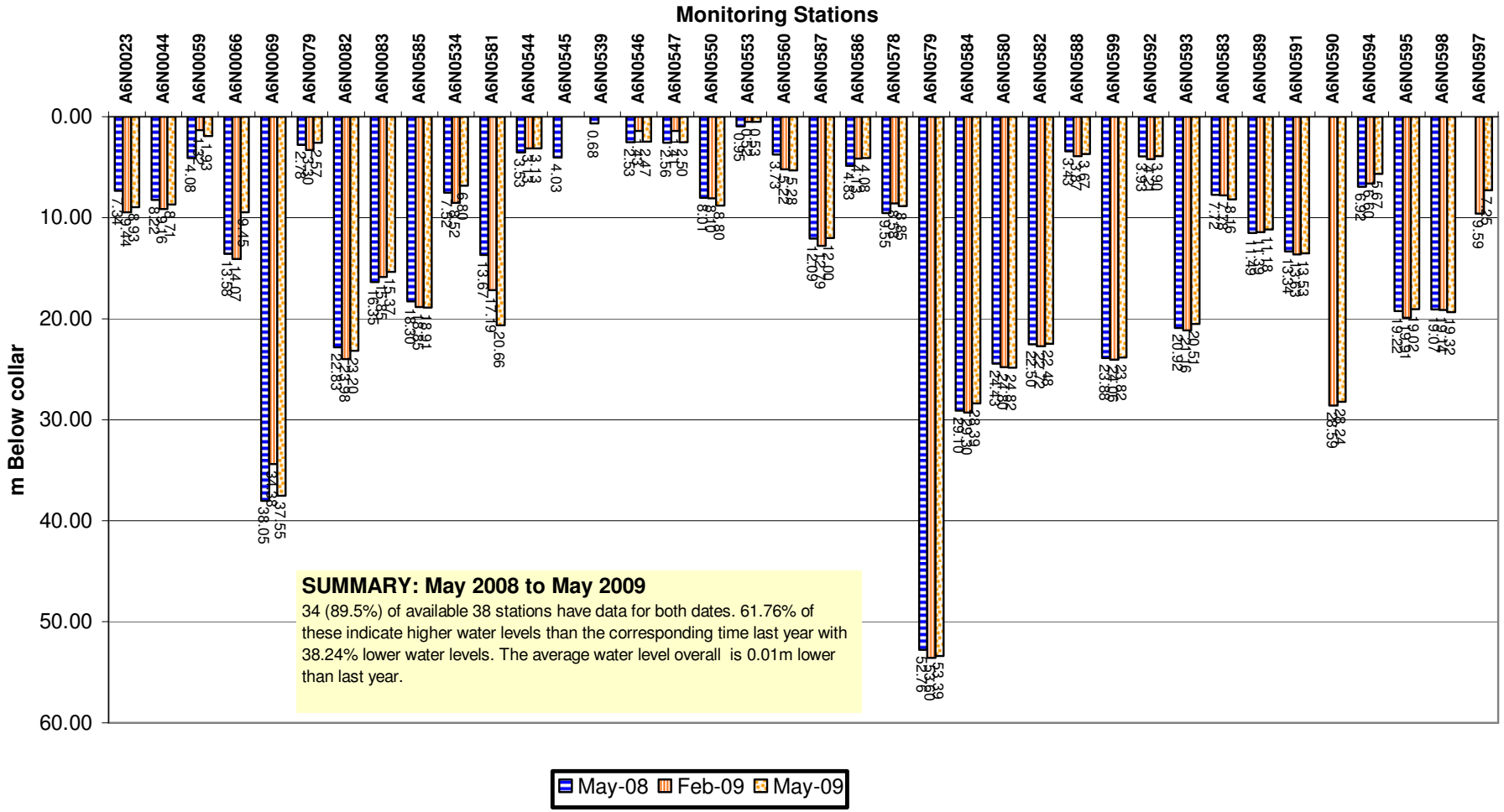

A6 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009
A6N0581
A6N0069
A6N0547
A6N0546
A6N0550
A6N0059
A6N0583
A6N0578
A6N0598
A6N0560
A6N0585
A6N0580
A6N0553
A6N0544
A6N0586
A6N0591
A6N0588
A6N0589
A6N0579
A6N0599
A6N0582
A6N0592
A6N0590
A6N0044
A6N0083
A6N0023
A6N0593
A6N0079
A6N0082
A6N0587
A6N0595
A6N0584
A6N0594
A6N0534
A6N0597
A6N0066
A6N0545
A6N0539
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
Monitoring Stations
Higher water level at 23 Stations.(63.9% of stations). Average 0.77m.
Lower water levels at 13 Stations. (36.1 % of stations). Average -0.85m
-3.48
-3.17
-1.09
-1.04
-0.71
-0.61
-0.38
-0.27
-0.18
-0.07
-0.06
-0.02
-0.01
0.01
0.06
0.10
0.19
0.21
0.21
0.23
0.24
0.31
0.35
0.46
0.48
0.51
0.66
0.73
0.77
0.80
0.89
0.91
0.93
1.72
2.34
4.62
Not data for both dates 2 stations.
Deviation in meter

GRAPH 8

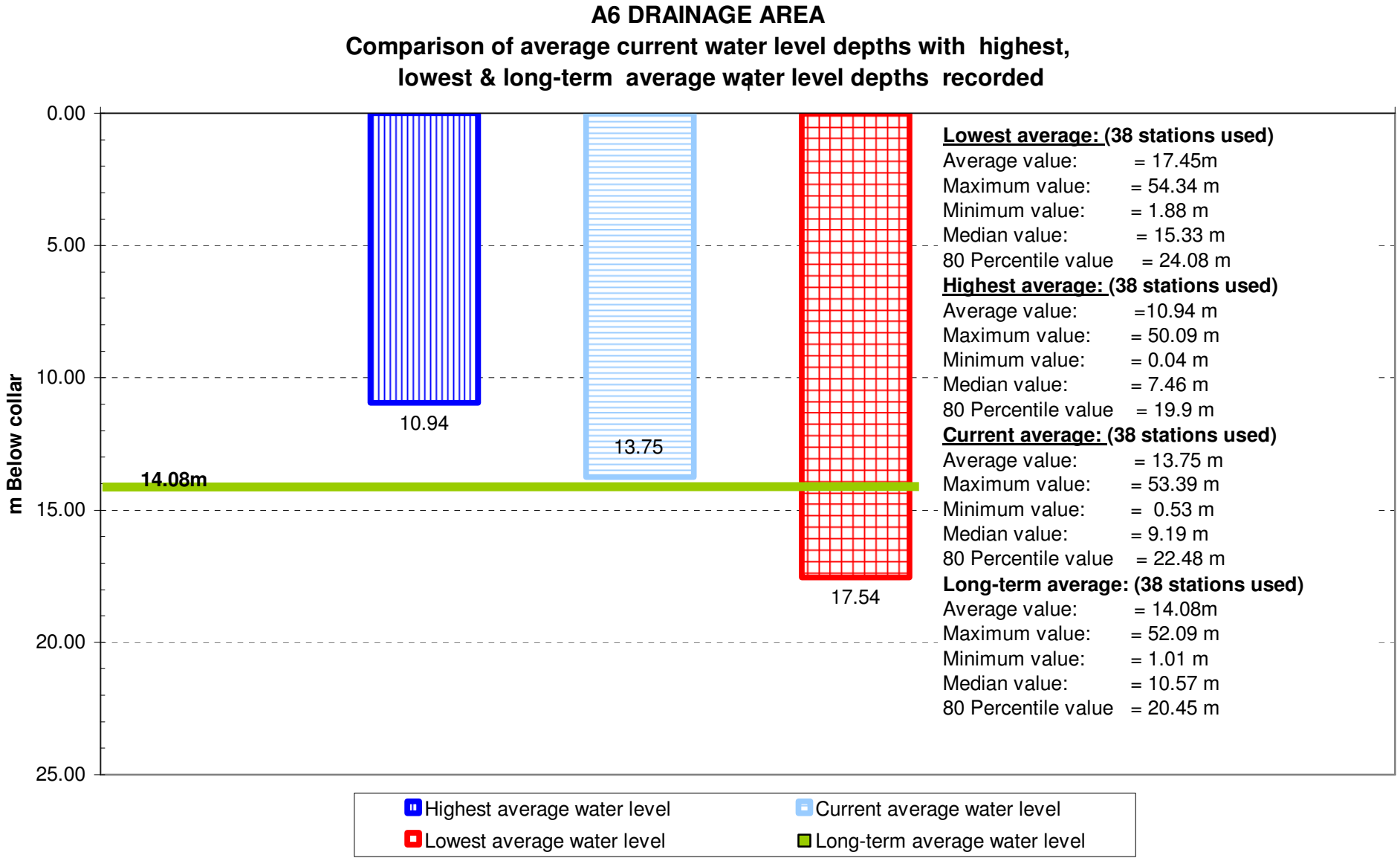

A6 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009
A6N0581 A6N0023 A6N0560 A6N0550 A6N0579 A6N0585 A6N0044 A6N0583 A6N0580 A6N0082 A6N0598 A6N0588 A6N0591 A6N0582 A6N0592 A6N0599 A6N0547 A6N0546 A6N0587 A6N0595 A6N0079 A6N0589 A6N0544 A6N0593 A6N0553 A6N0069 A6N0578 A6N0584 A6N0534 A6N0586 A6N0083 A6N0594 A6N0059 A6N0066 A6N0545 A6N0539 A6N0590 A6N0597
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
Monitoring Stations
Lower water levels at 13 Stations (38.24%) Average -1.12m
Higher water levels at 21 Stations (61.76%).Average 0.68m.
4 stations not data for both dates
-6.99 -1.59 -1.55 -0.80 -0.63 -0.61 -0.48 -0.44 -0.39 -0.37 -0.25 -0.24 -0.19 0.02 0.03 0.06 0.06 0.06 0.09 0.20 0.21 0.31 0.40 0.41 0.42 0.50 0.70 0.71 0.72 0.75 0.99 1.25 2.16 4.13
Deviation in meter

GRAPH 9

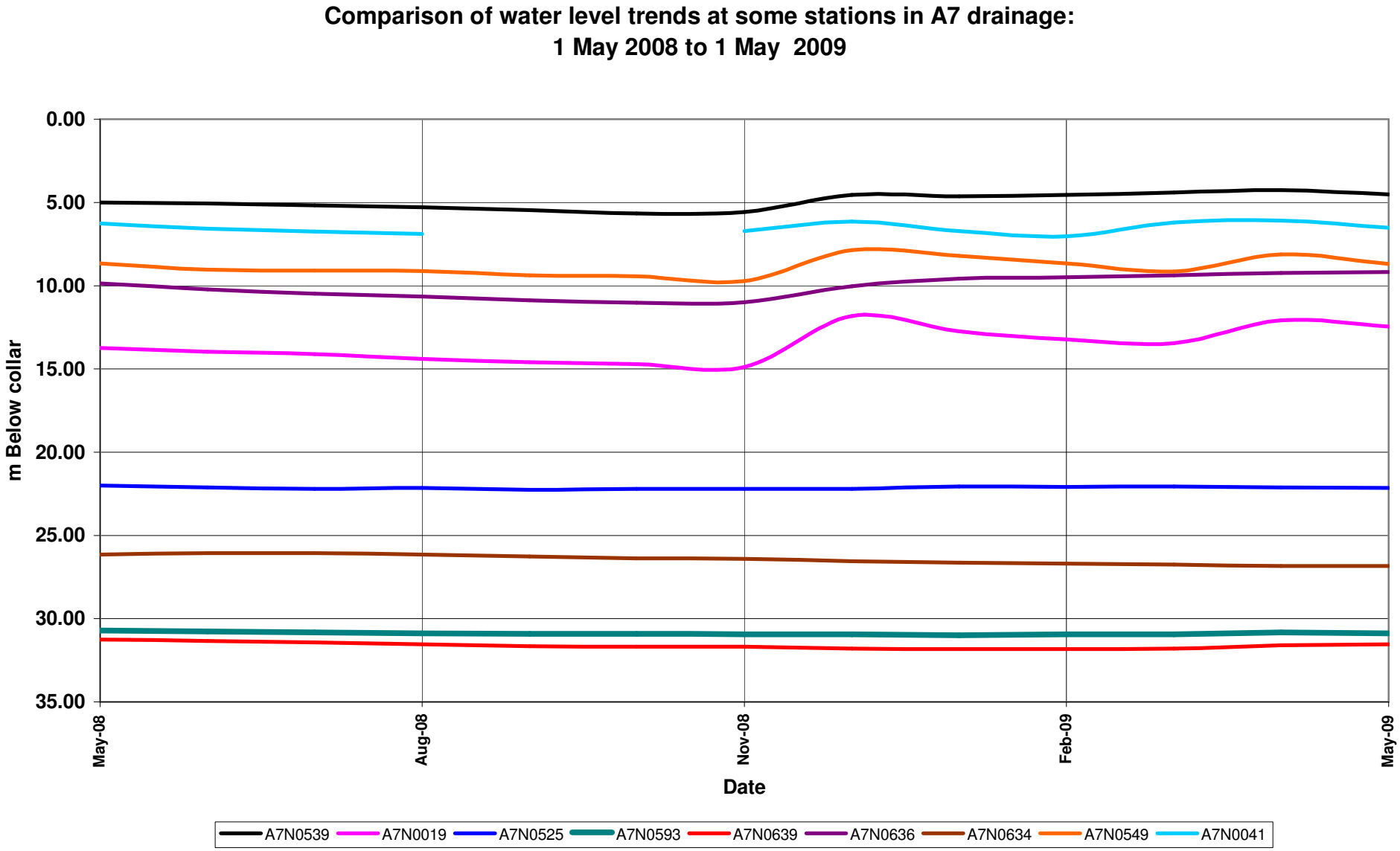
A6 DRAINAGE AREA
Comparison between water level depths: 1 May 2008, 1 February 2009, and 1 May 2009



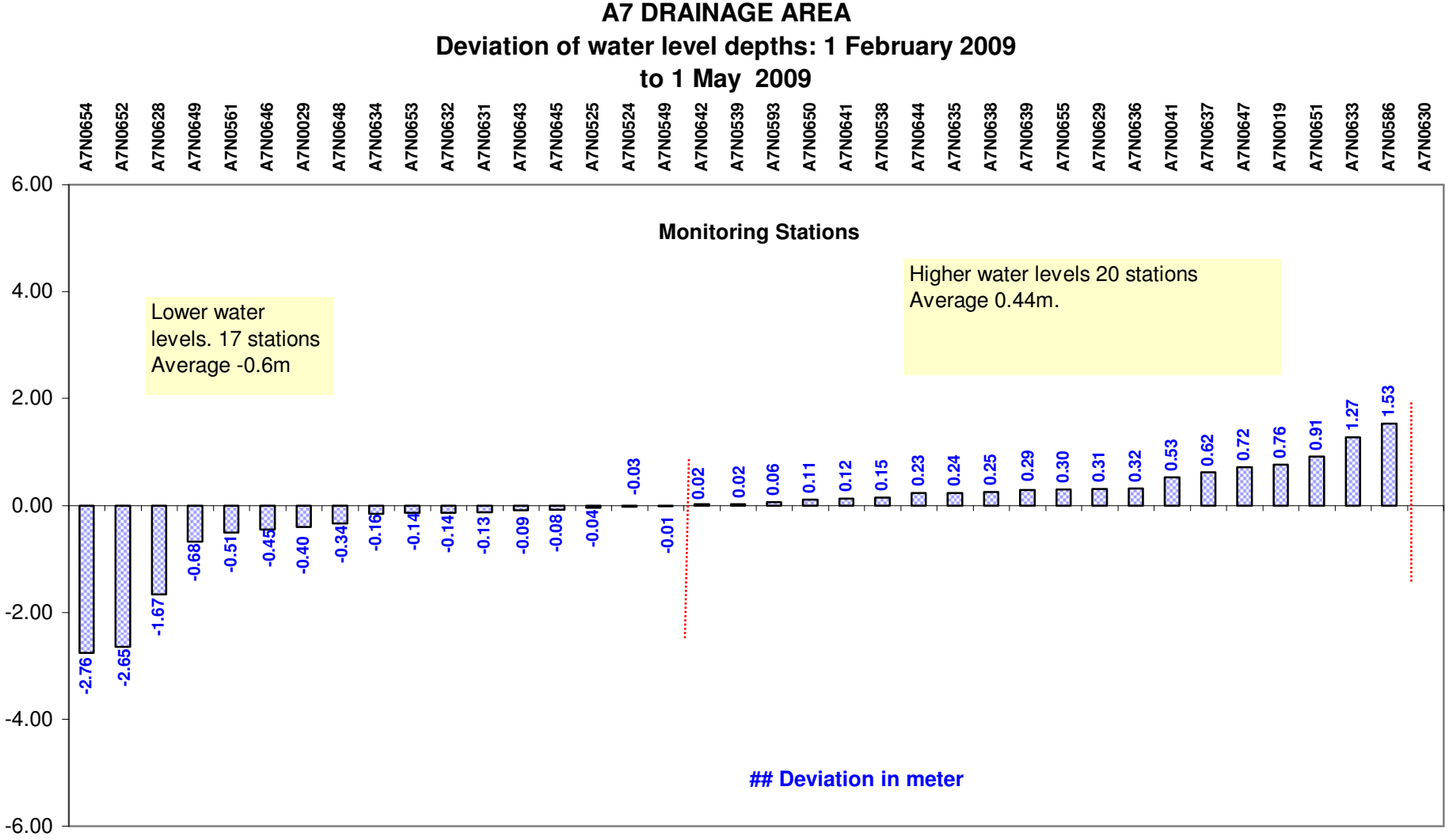
GRAPH 10


A6 DRAINAGE AREA
Comparison of average current water level depths with highest, lowest & long-term average water level depths recorded
m Below collar
0.00
5.00
10.00
15.00
20.00
25.00
10.94
13.75
14.08m
17.54
Lowest average: (38 stations used)
Average value: = 17.45m
Maximum value: = 54.34 m
Minimum value: = 1.88 m
Median value: = 15.33 m
80 Percentile value = 24.08 m
Highest average: (38 stations used)
Average value: =10.94 m
Maximum value: = 50.09 m
Minimum value: = 0.04 m
Median value: = 7.46 m
80 Percentile value = 19.9 m
Current average: (38 stations used)
Average value: = 13.75 m
Maximum value: = 53.39 m
Minimum value: = 0.53 m
Median value: = 9.19 m
80 Percentile value = 22.48 m
Long-term average: (38 stations used)
Average value: = 14.08m
Maximum value: = 52.09 m
Minimum value: = 1.01 m
Median value: = 10.57 m
80 Percentile value = 20.45 m
Highest average water level
Current average water level
Lowest average water level
Long-term average water level

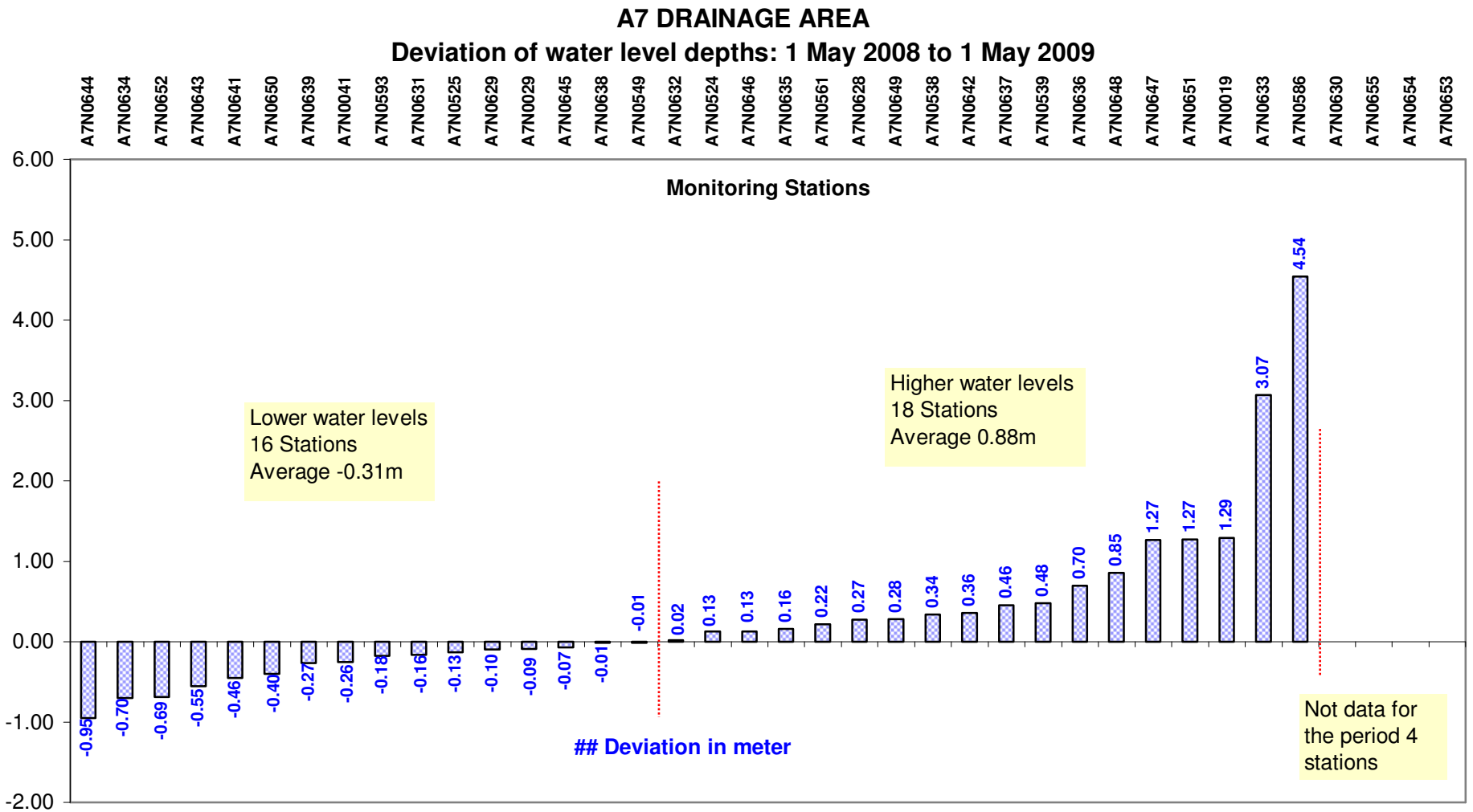
GRAPH 11


Comparison of water level trends at some stations in A7 drainage:
1 May 2008 to 1 May 2009
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
m Below collar
May-08
Aug-08
Nov-08
Feb-09
May-09
Date
A7N0539
A7N0019
A7N0525
A7N0593
A7N0639
A7N0636
A7N0634
A7N0549
A7N0041

GRAPH 12

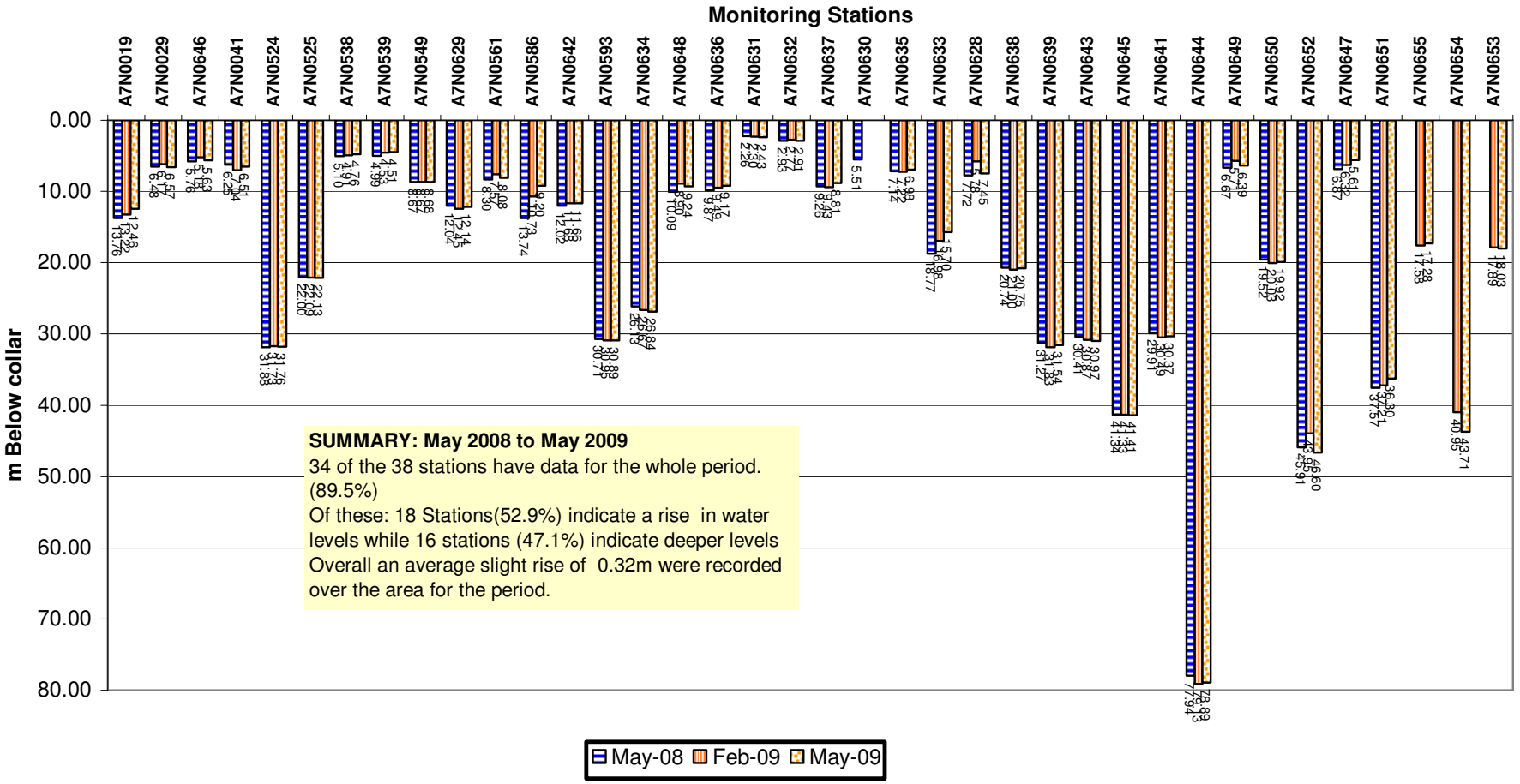

A7 DRAINAGE AREA
Deviation of water level depths: 1 February 2009
to 1 May 2009
A7N0654 A7N0652 A7N0628 A7N0649 A7N0561 A7N0646 A7N0029 A7N0648 A7N0634 A7N0653 A7N0632 A7N0631 A7N0643 A7N0645 A7N0525 A7N0524 A7N0549 A7N0642 A7N0539 A7N0593 A7N0650 A7N0641 A7N0538 A7N0644 A7N0635 A7N0638 A7N0639 A7N0655 A7N0629 A7N0636 A7N0041 A7N0637 A7N0647 A7N0019 A7N0651 A7N0633 A7N0586 A7N0630
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
Monitoring Stations
Lower water levels. 17 stations Average -0.6m
Higher water levels 20 stations Average 0.44m.
-2.76 -2.65 -1.67 -0.68 -0.51 -0.45 -0.40 -0.34 -0.16 -0.14 -0.14 -0.13 -0.09 -0.08 -0.04 -0.03 -0.01 0.02 0.02 0.06 0.11 0.12 0.15 0.23 0.24 0.25 0.29 0.30 0.31 0.32 0.53 0.62 0.72 0.76 0.91 1.27 1.53
Deviation in meter

GRAPH 13

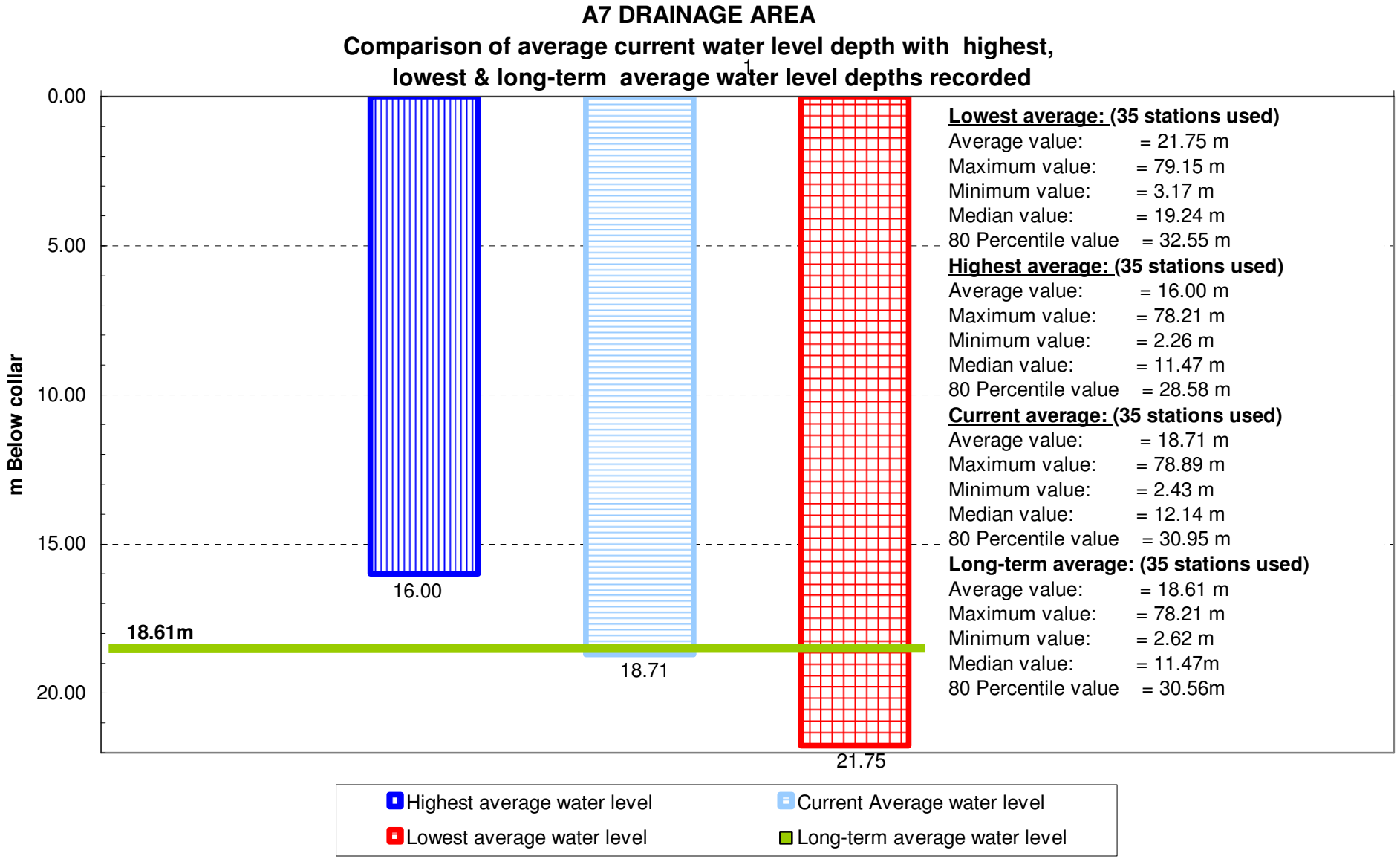

A7 DRAINAGE AREA
Deviation of water level depths: 1 May 2008 to 1 May 2009
A7N0644 A7N0634 A7N0652 A7N0643 A7N0641 A7N0650 A7N0639 A7N0041 A7N0593 A7N0631 A7N0525 A7N0629 A7N0029 A7N0645 A7N0638 A7N0549 A7N0632 A7N0524 A7N0646 A7N0635 A7N0561 A7N0628 A7N0649 A7N0538 A7N0642 A7N0637 A7N0539 A7N0636 A7N0648 A7N0647 A7N0651 A7N0019 A7N0633 A7N0586 A7N0630 A7N0655 A7N0654 A7N0653
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
Monitoring Stations
Lower water levels
16 Stations
Average -0.31m
Higher water levels
18 Stations
Average 0.88m
-0.95 -0.70 -0.69 -0.55 -0.46 -0.40 -0.27 -0.26 -0.18 -0.16 -0.13 -0.10 -0.09 -0.07 -0.01 -0.01 0.02 0.13 0.13 0.16 0.22 0.27 0.28 0.34 0.36 0.46 0.48 0.70 0.85 1.27 1.27 1.29 3.07 4.54
Deviation in meter
Not data for
the period 4
stations

GRAPH 14

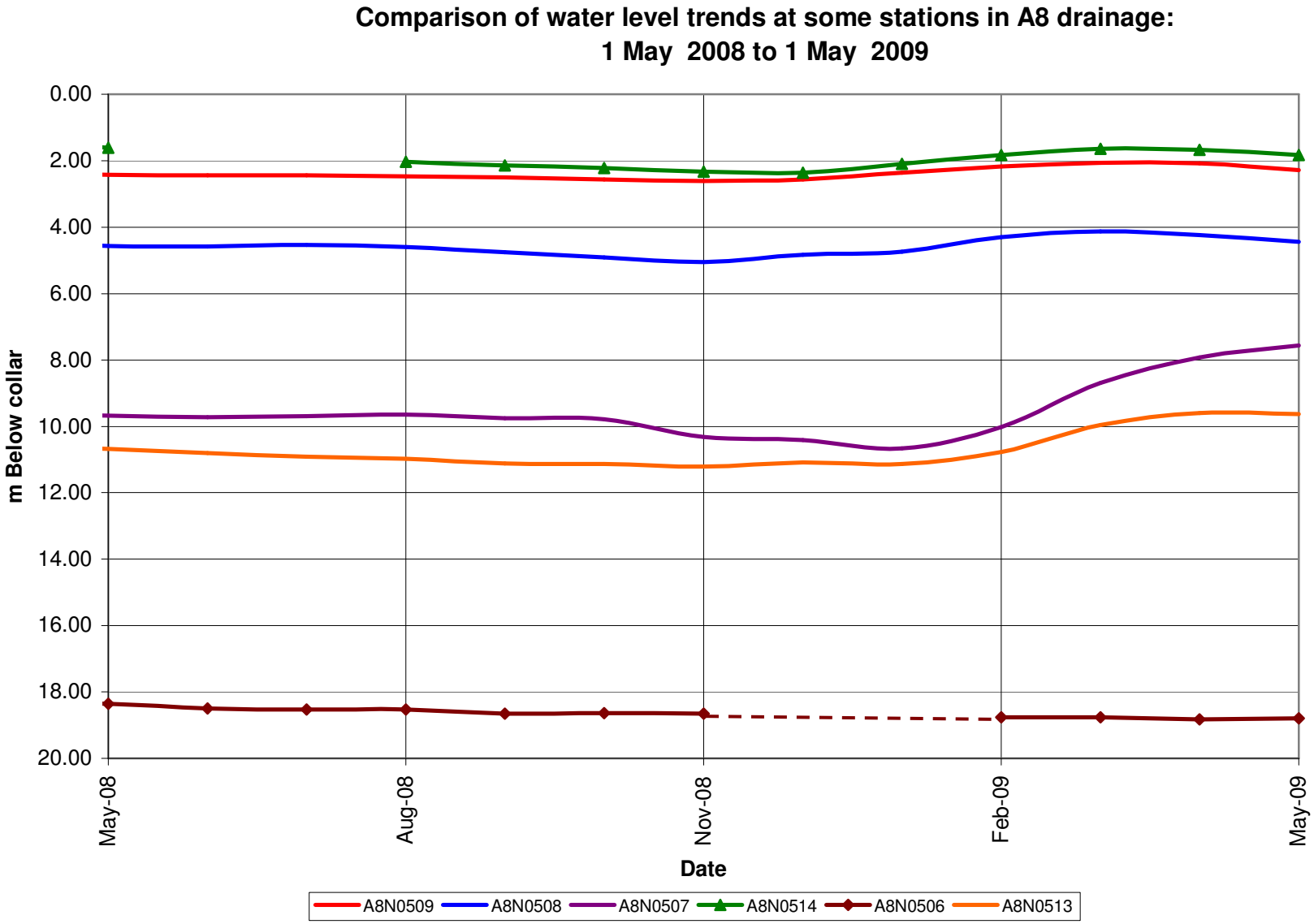
A7 DRAINAGE AREA
Comparison between water level depths: 1 May 2008, 1 February 2009 and 1 May 2009



GRAPH 15

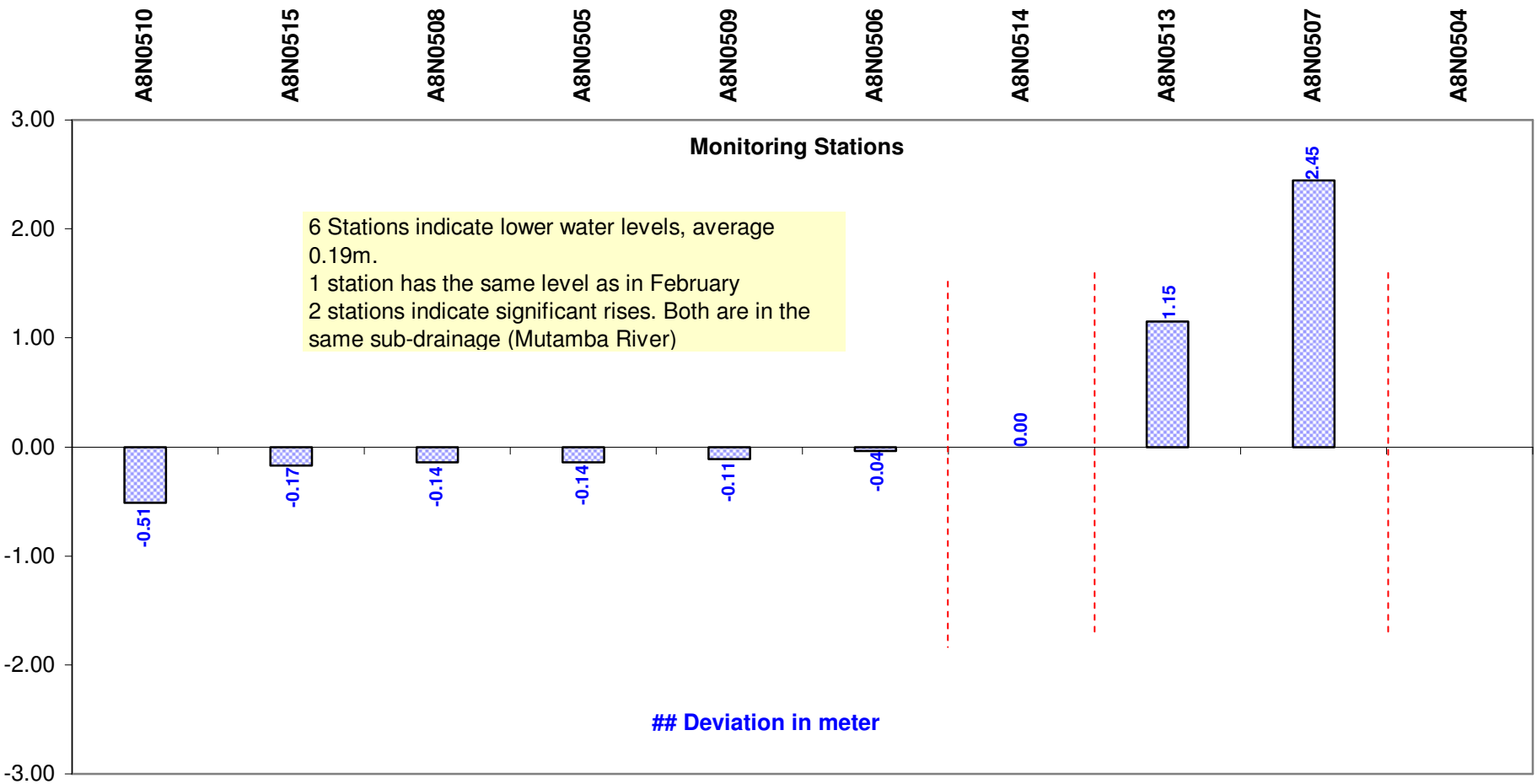

A7 DRAINAGE AREA
Comparison of average current water level depth with highest,
lowest & long-term average water level depths recorded
m Below collar
0.00
5.00
10.00
15.00
20.00
16.00
18.61m
18.71
21.75
Lowest average: (35 stations used)
Average value: = 21.75 m
Maximum value: = 79.15 m
Minimum value: = 3.17 m
Median value: = 19.24 m
80 Percentile value = 32.55 m
Highest average: (35 stations used)
Average value: = 16.00 m
Maximum value: = 78.21 m
Minimum value: = 2.26 m
Median value: = 11.47 m
80 Percentile value = 28.58 m
Current average: (35 stations used)
Average value: = 18.71 m
Maximum value: = 78.89 m
Minimum value: = 2.43 m
Median value: = 12.14 m
80 Percentile value = 30.95 m
Long-term average: (35 stations used)
Average value: = 18.61 m
Maximum value: = 78.21 m
Minimum value: = 2.62 m
Median value: = 11.47m
80 Percentile value = 30.56m
Highest average water level
Current Average water level
Lowest average water level
Long-term average water level

GRAPH 16

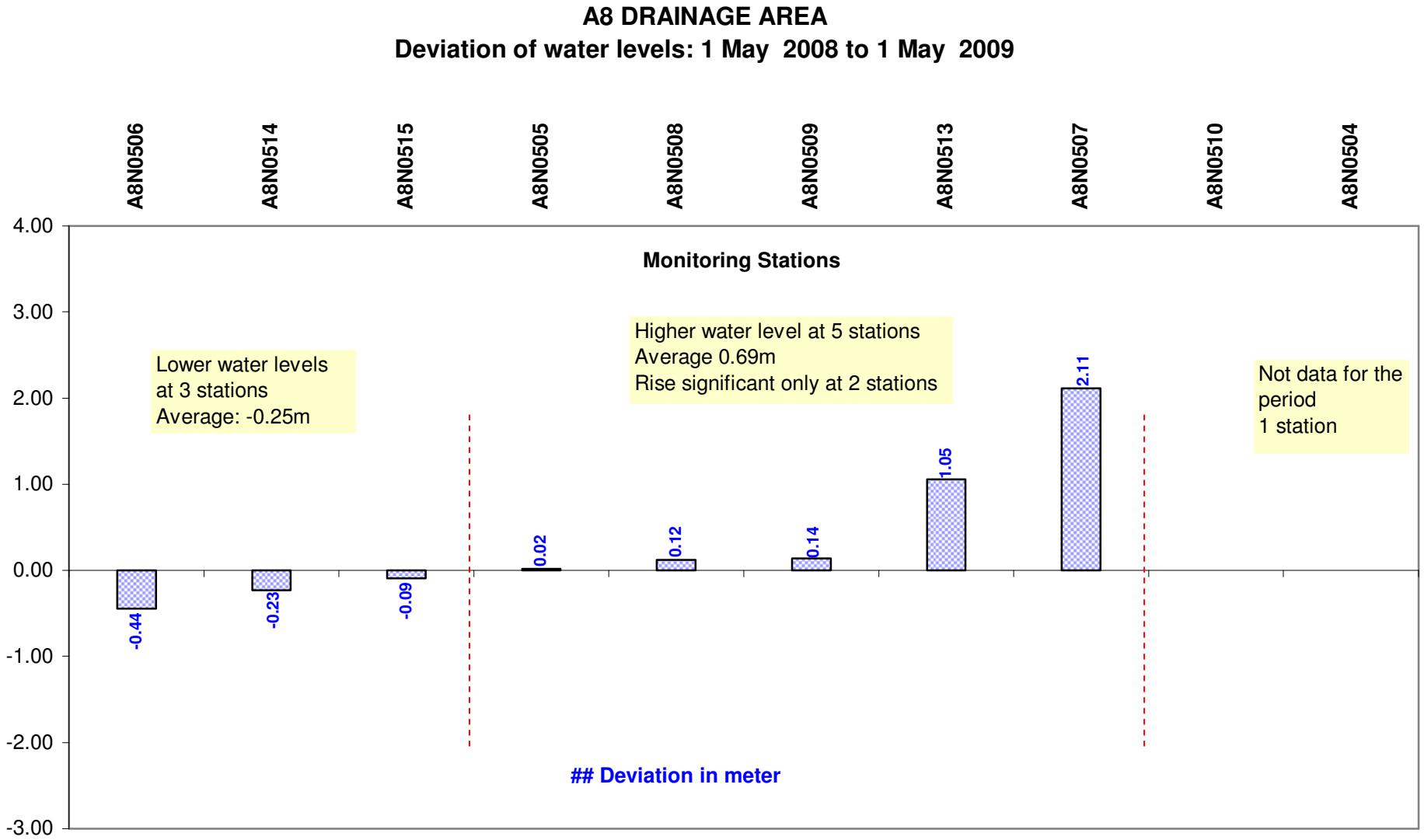

Comparison of water level trends at some stations in A8 drainage:
1 May 2008 to 1 May 2009
m Below collar
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
18.00
20.00
May-08
Aug-08
Nov-08
Feb-09
May-09
Date
A8N0509
A8N0508
A8N0507
A8N0514
A8N0506
A8N0513

GRAPH 17

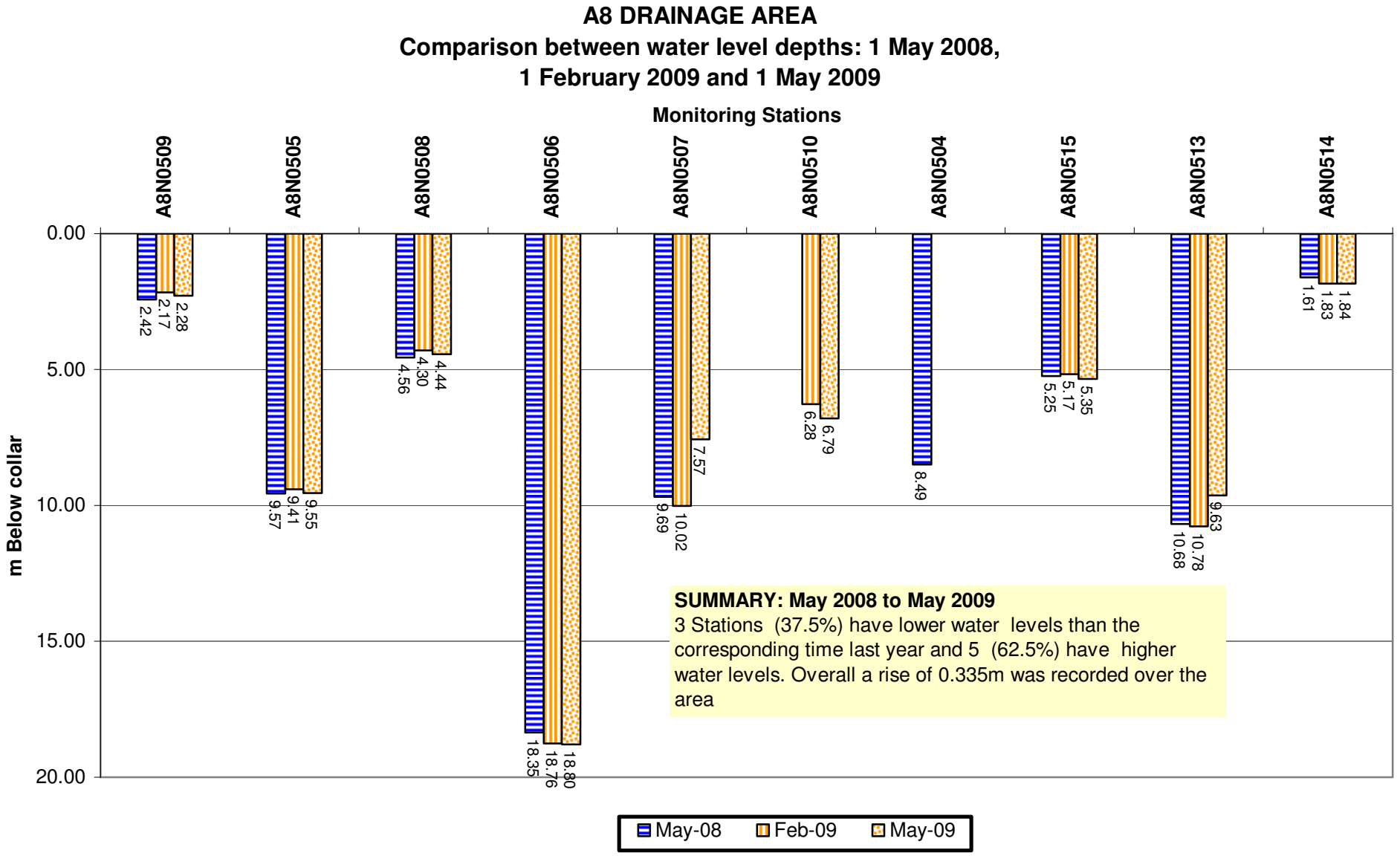
A8 DRAINAGE AREA
Deviation of water level depths: 1 February 2009 to 1 May 2009



GRAPH 18

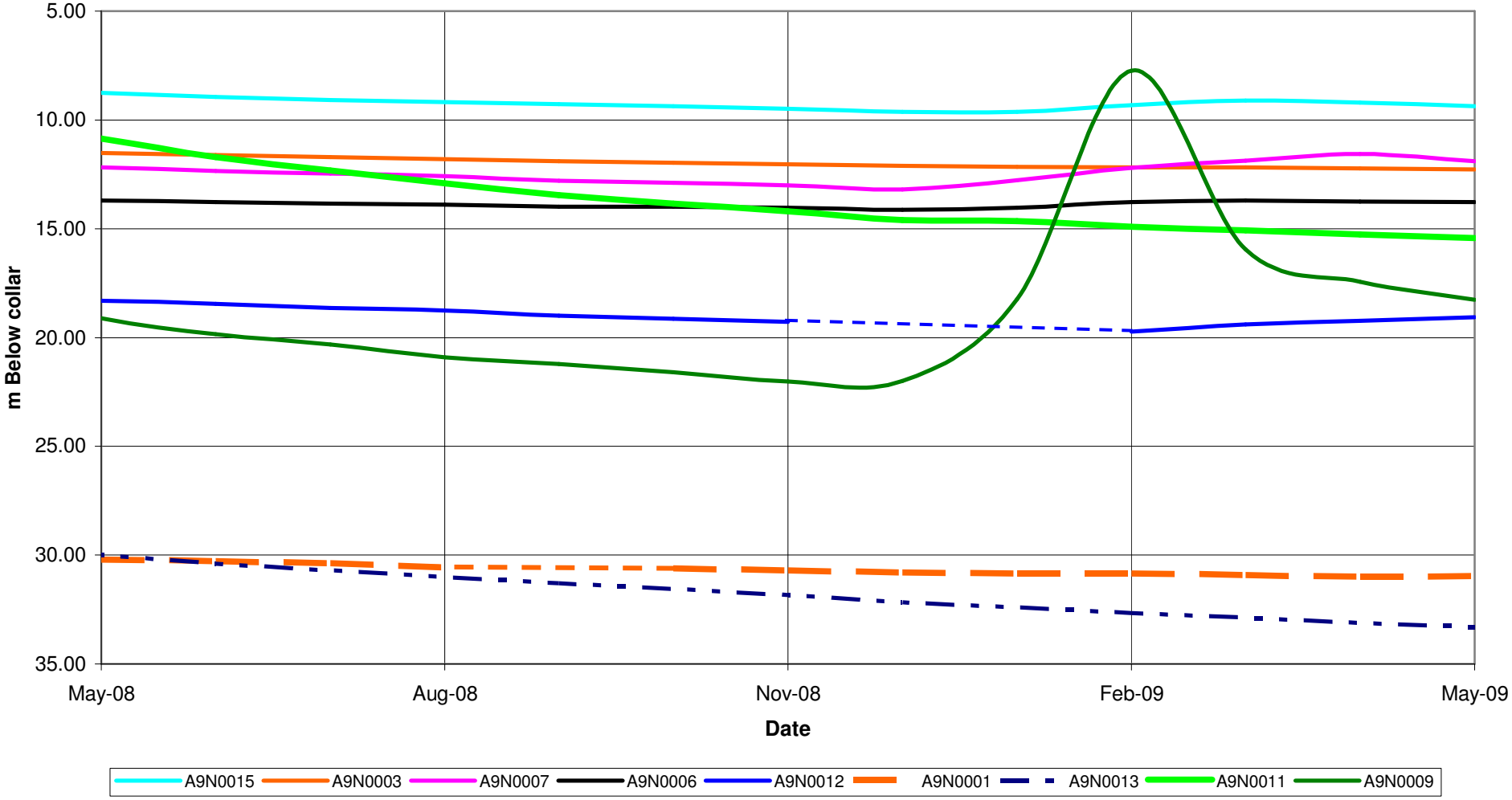

A8 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009
A8N0506
A8N0514
A8N0515
A8N0505
A8N0508
A8N0509
A8N0513
A8N0507
A8N0510
A8N0504
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
Monitoring Stations
Lower water levels
at 3 stations
Average: -0.25m
Higher water level at 5 stations
Average 0.69m
Rise significant only at 2 stations
Not data for the
period
1 station
-0.44
-0.23
-0.09
0.02
0.12
0.14
1.05
2.11
Deviation in meter

GRAPH 19


A8 DRAINAGE AREA
Comparison between water level depths: 1 May 2008,
1 February 2009 and 1 May 2009
Monitoring Stations
A8N0509
A8N0505
A8N0508
A8N0506
A8N0507
A8N0510
A8N0504
A8N0515
A8N0513
A8N0514
m Below collar
0.00
5.00
10.00
15.00
20.00
2.42
2.17
2.28
9.57
9.41
9.55
4.56
4.30
4.44
18.35
18.76
18.80
9.69
10.02
7.57
6.28
6.79
8.49
5.25
5.17
5.35
10.68
10.78
9.63
1.61
1.83
1.84
SUMMARY: May 2008 to May 2009
3 Stations (37.5%) have lower water levels than the corresponding time last year and 5 (62.5%) have higher water levels. Overall a rise of 0.335m was recorded over the area
May-08
Feb-09
May-09

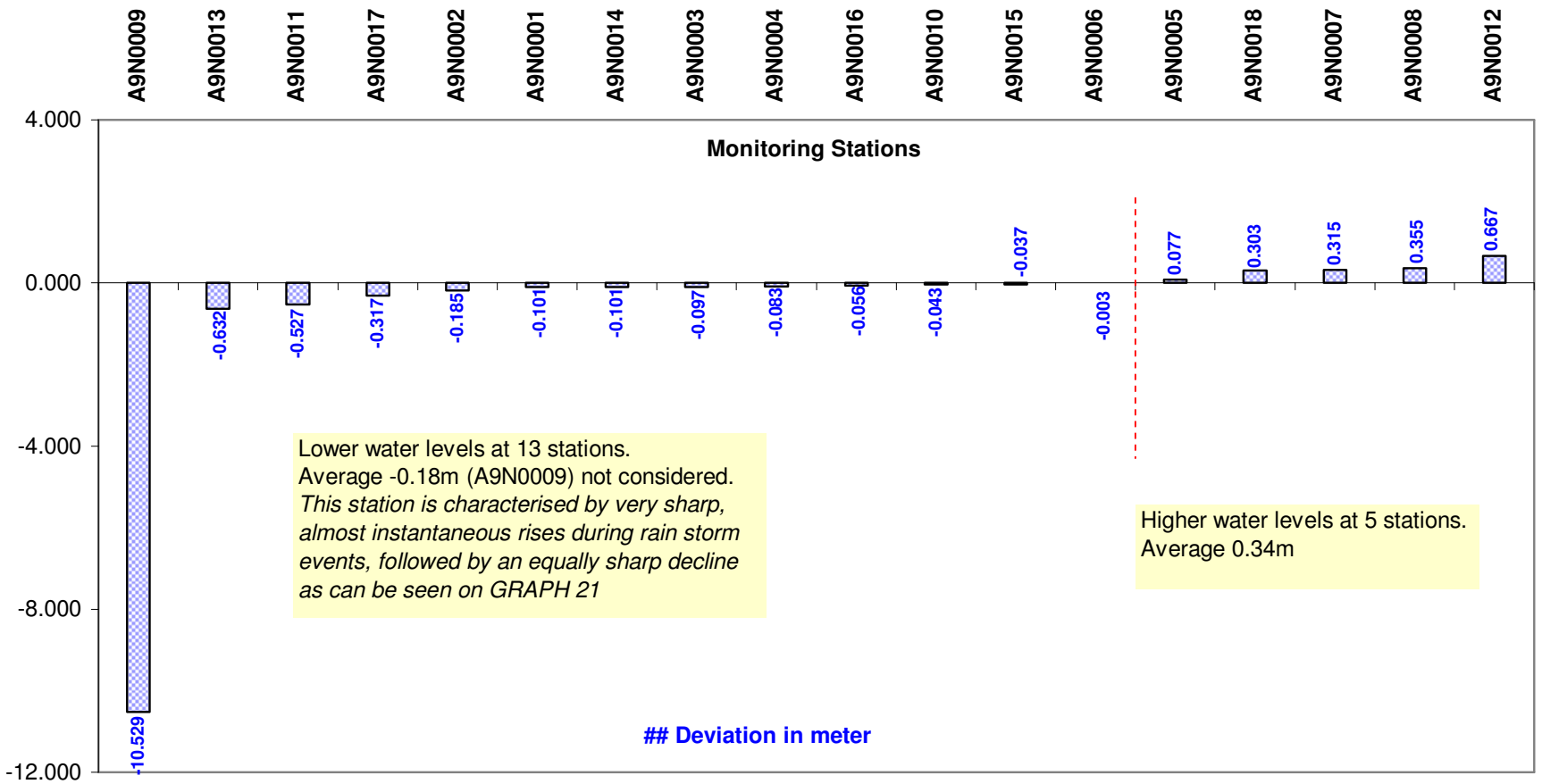
GRAPH 20

Comparison of water level trends at some stations in A9 drainage :
1 May 2008 to 1 May 2009

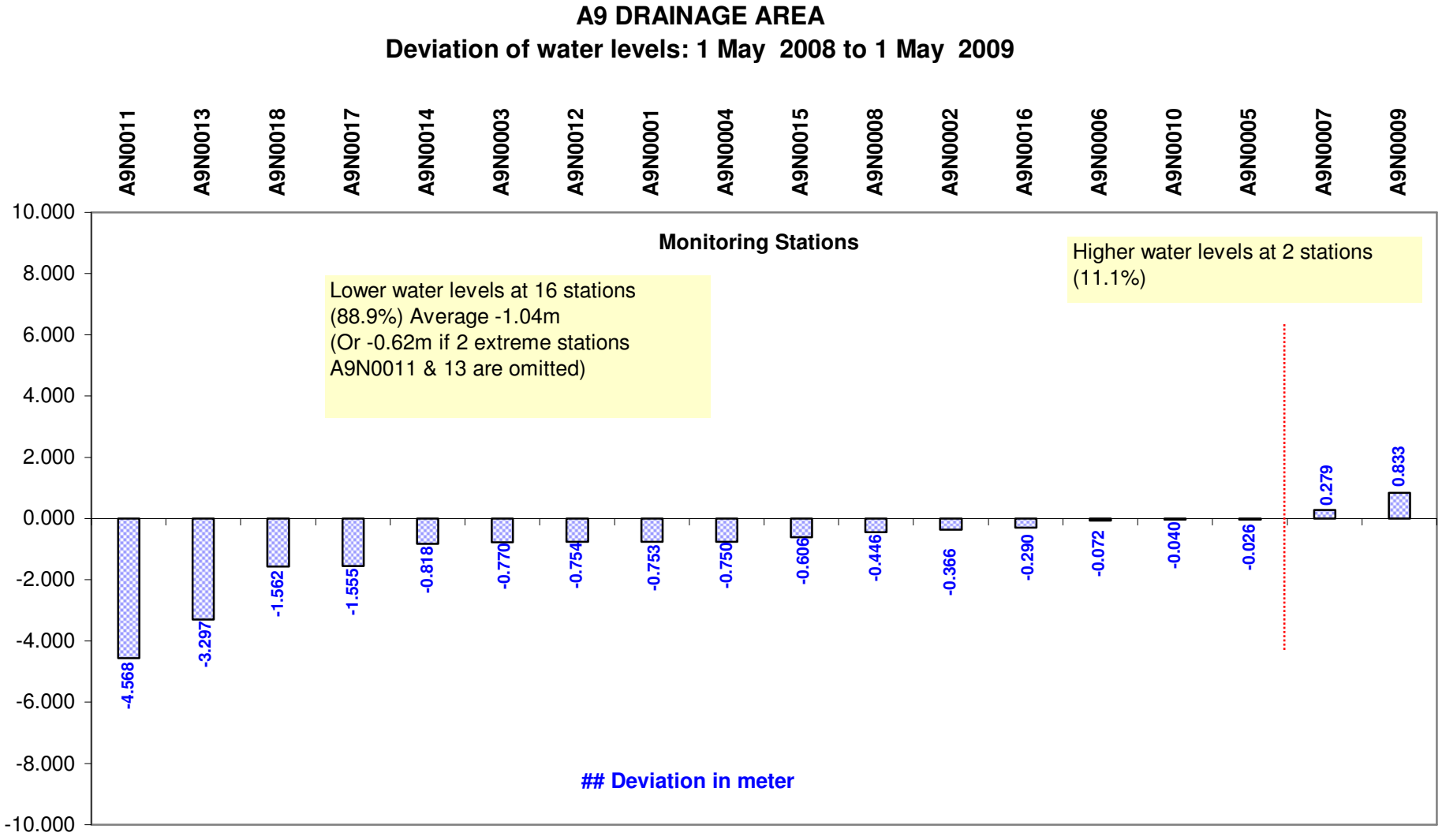


GRAPH 21

A9 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009

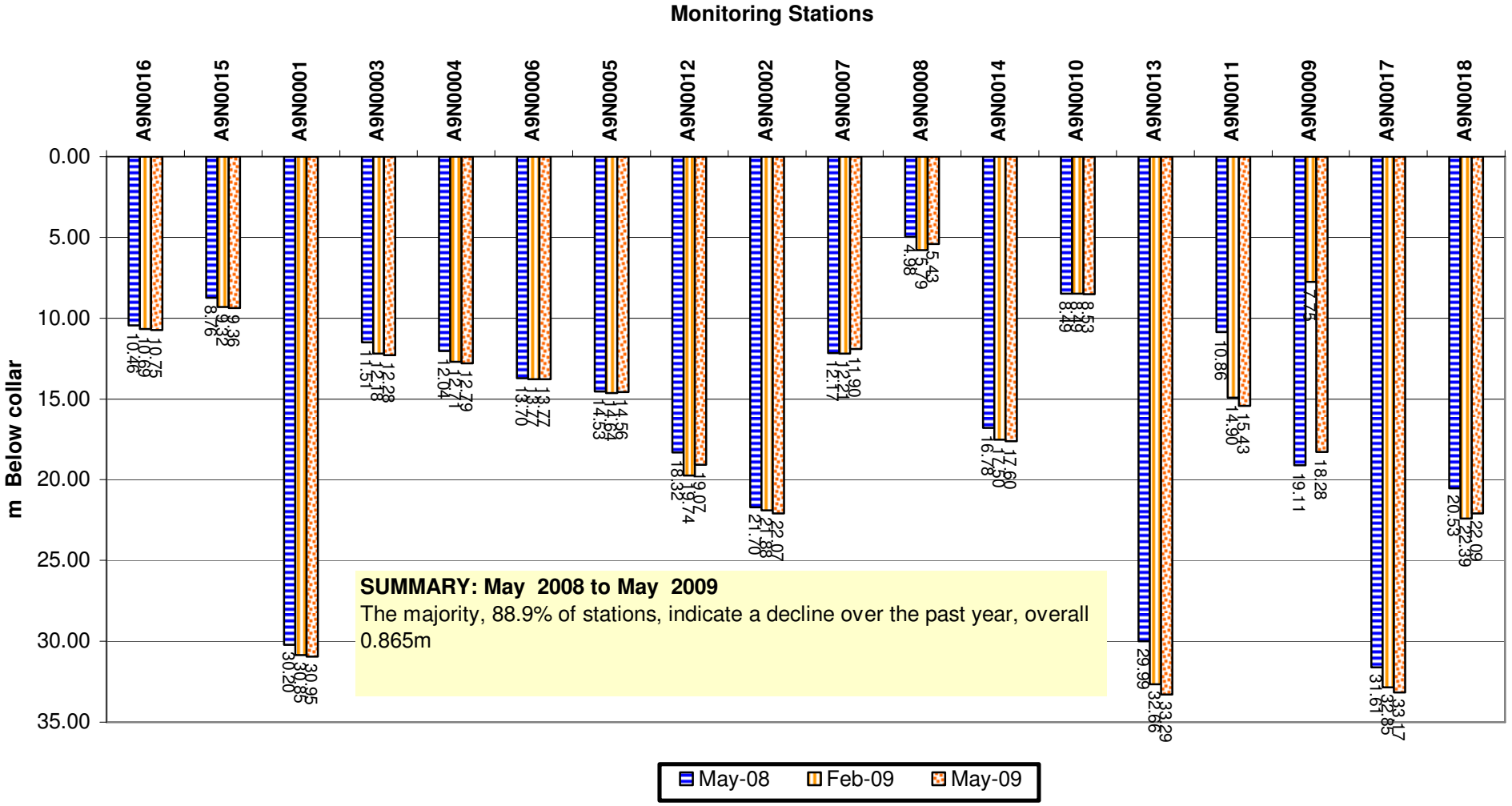


GRAPH 22


A9 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009
A9N0011
A9N0013
A9N0018
A9N0017
A9N0014
A9N0003
A9N0012
A9N0001
A9N0004
A9N0015
A9N0008
A9N0002
A9N0016
A9N0006
A9N0010
A9N0005
A9N0007
A9N0009
10.000
8.000
6.000
4.000
2.000
0.000
-2.000
-4.000
-6.000
-8.000
-10.000
Monitoring Stations
Lower water levels at 16 stations
(88.9%) Average -1.04m
(Or -0.62m if 2 extreme stations
A9N0011 & 13 are omitted)
Higher water levels at 2 stations
(11.1%)
-4.568
-3.297
-1.562
-1.555
-0.818
-0.770
-0.754
-0.753
-0.750
-0.606
-0.446
-0.366
-0.290
-0.072
-0.040
-0.026
0.279
0.833
Deviation in meter

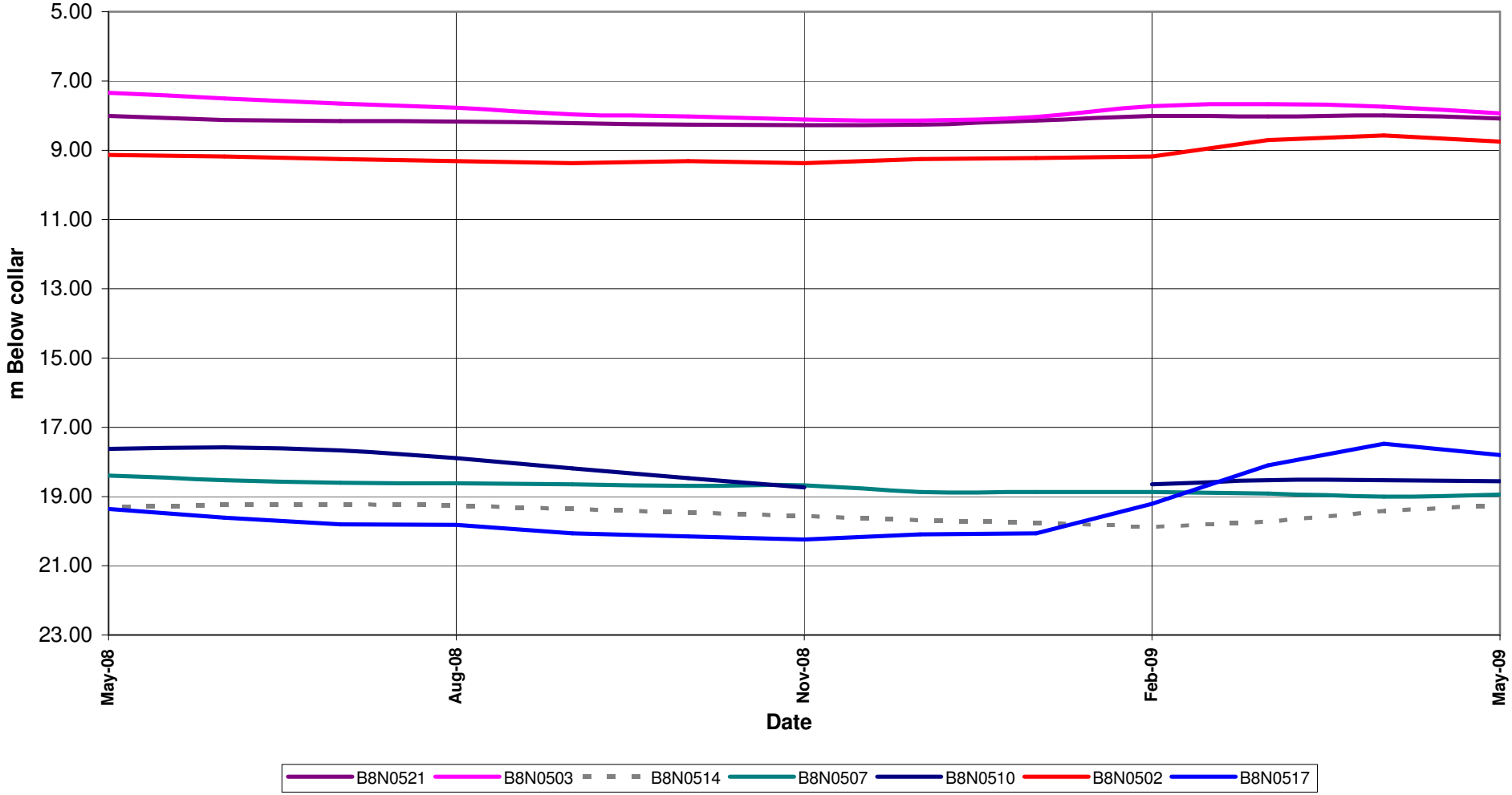
GRAPH 23

A9 DRAINAGE AREA
Comparison between water level depths: 1 May 2008,
1 February 2009 and 1 May 2009

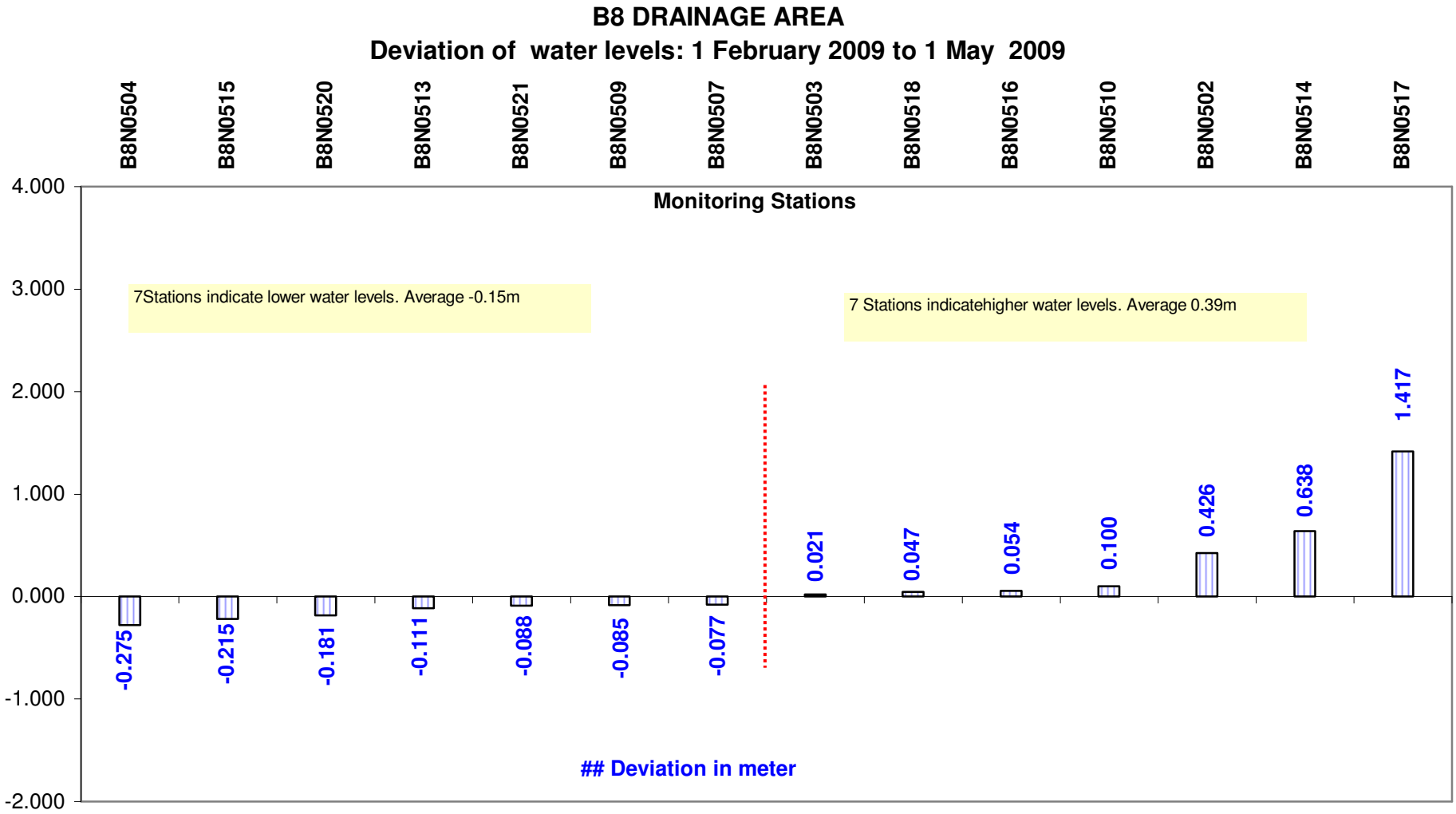


GRAPH 24

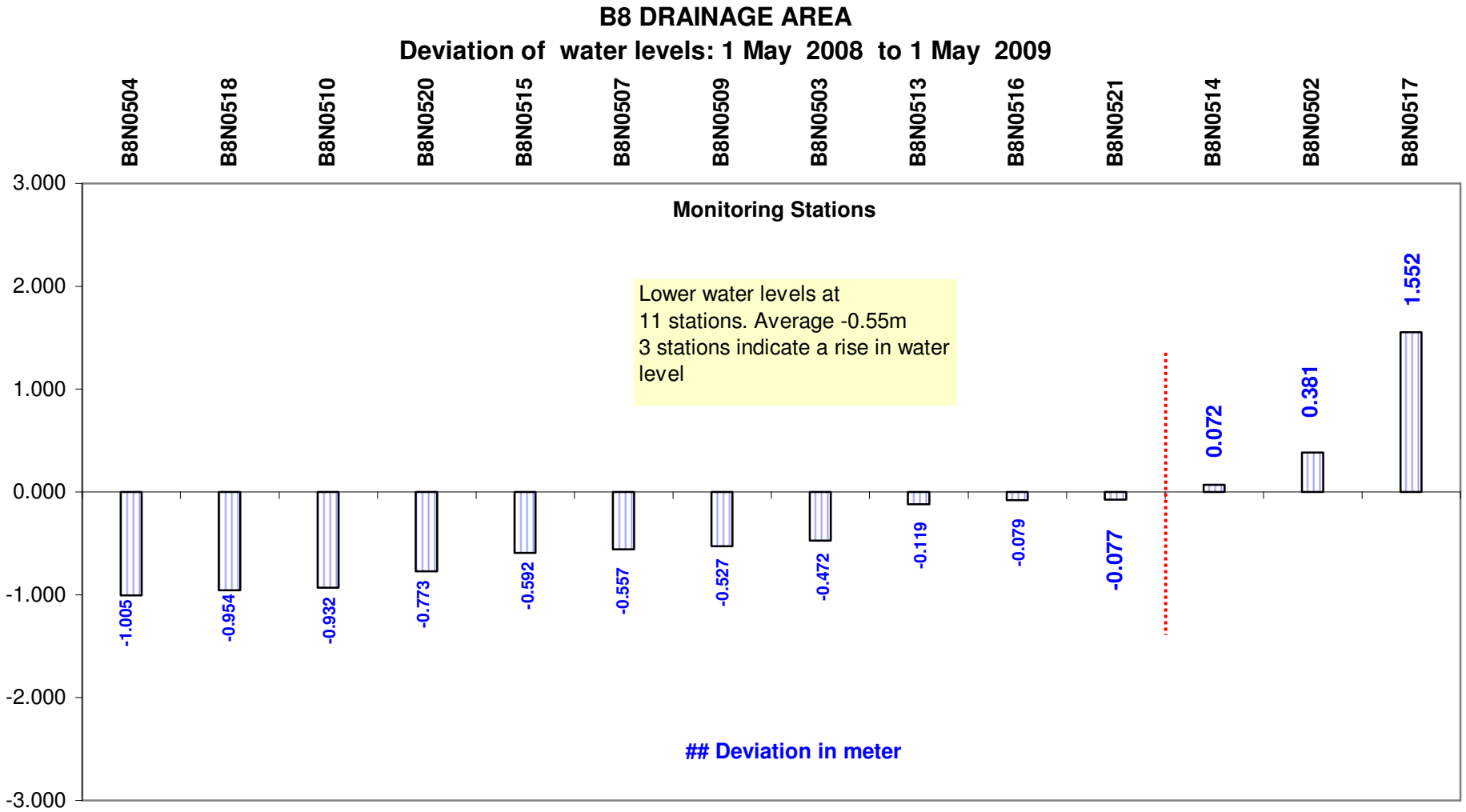
Comparison of water level trends at some stations in B8 drainage:
1 May 2008 to 1 May 2009



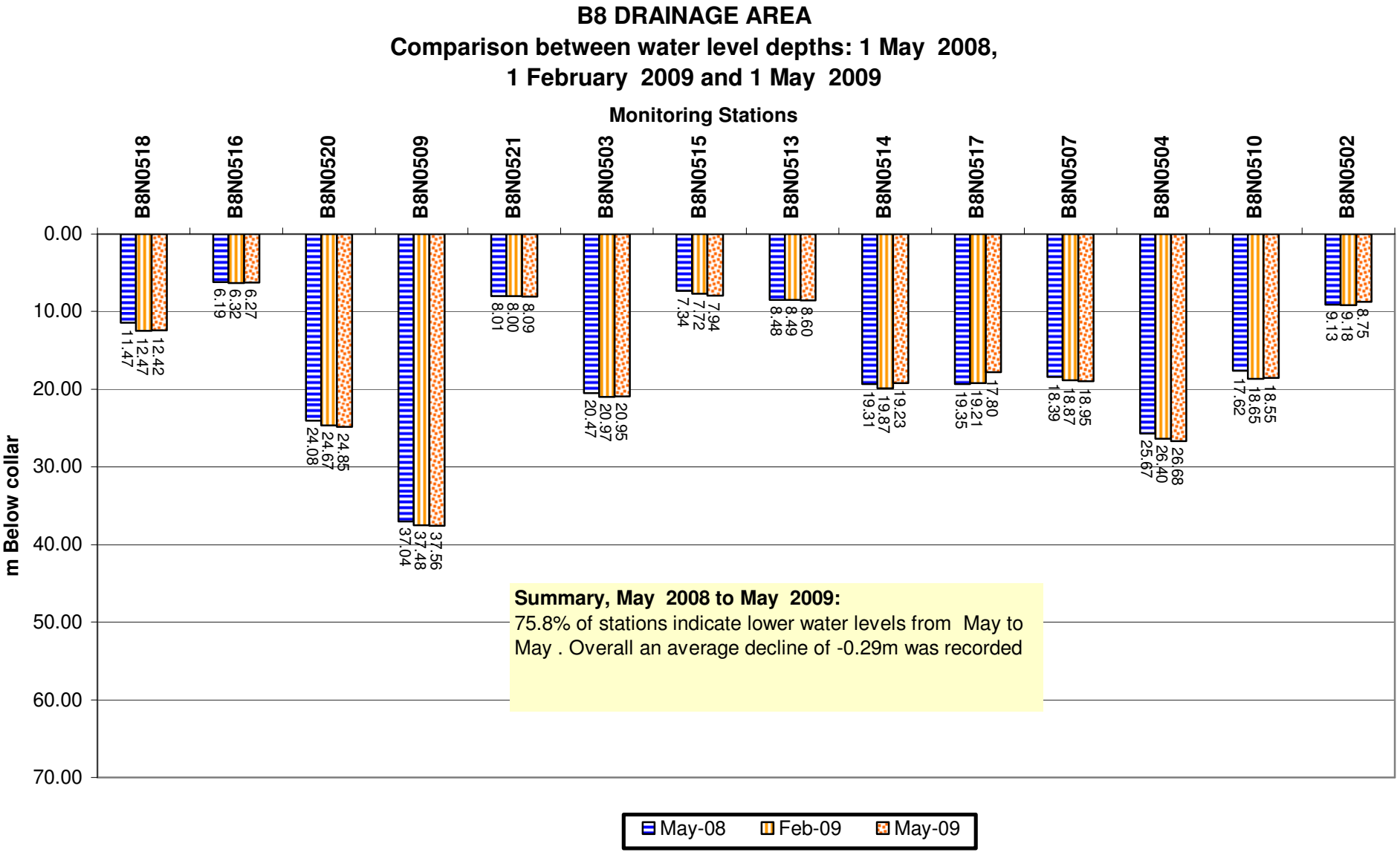
GRAPH 25


B8 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009
B8N0504
B8N0515
B8N0520
B8N0513
B8N0521
B8N0509
B8N0507
B8N0503
B8N0518
B8N0516
B8N0510
B8N0502
B8N0514
B8N0517
4.000
3.000
2.000
1.000
0.000
-1.000
-2.000
Monitoring Stations
7Stations indicate lower water levels. Average -0.15m
7 Stations indicatehigher water levels. Average 0.39m
-0.275
-0.215
-0.181
-0.111
-0.088
-0.085
-0.077
0.021
0.047
0.054
0.100
0.426
0.638
1.417
Deviation in meter

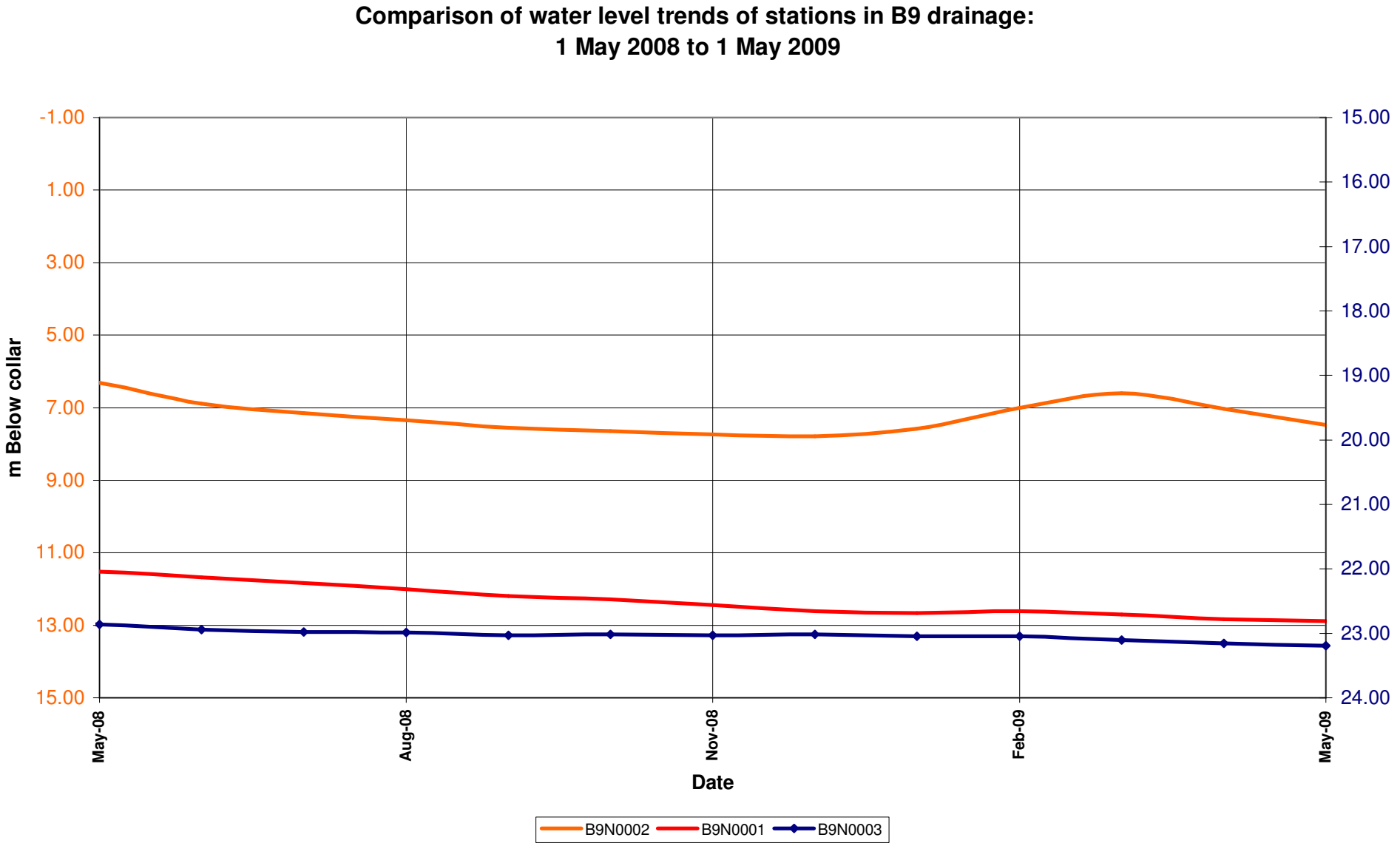
GRAPH 26


B8 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009
B8N0504
B8N0518
B8N0510
B8N0520
B8N0515
B8N0507
B8N0509
B8N0503
B8N0513
B8N0516
B8N0521
B8N0514
B8N0502
B8N0517
3.000
2.000
1.000
0.000
-1.000
-2.000
-3.000
Monitoring Stations
Lower water levels at
11 stations. Average -0.55m
3 stations indicate a rise in water level
-1.005
-0.954
-0.932
-0.773
-0.592
-0.557
-0.527
-0.472
-0.119
-0.079
-0.077
0.072
0.381
1.552
Deviation in meter

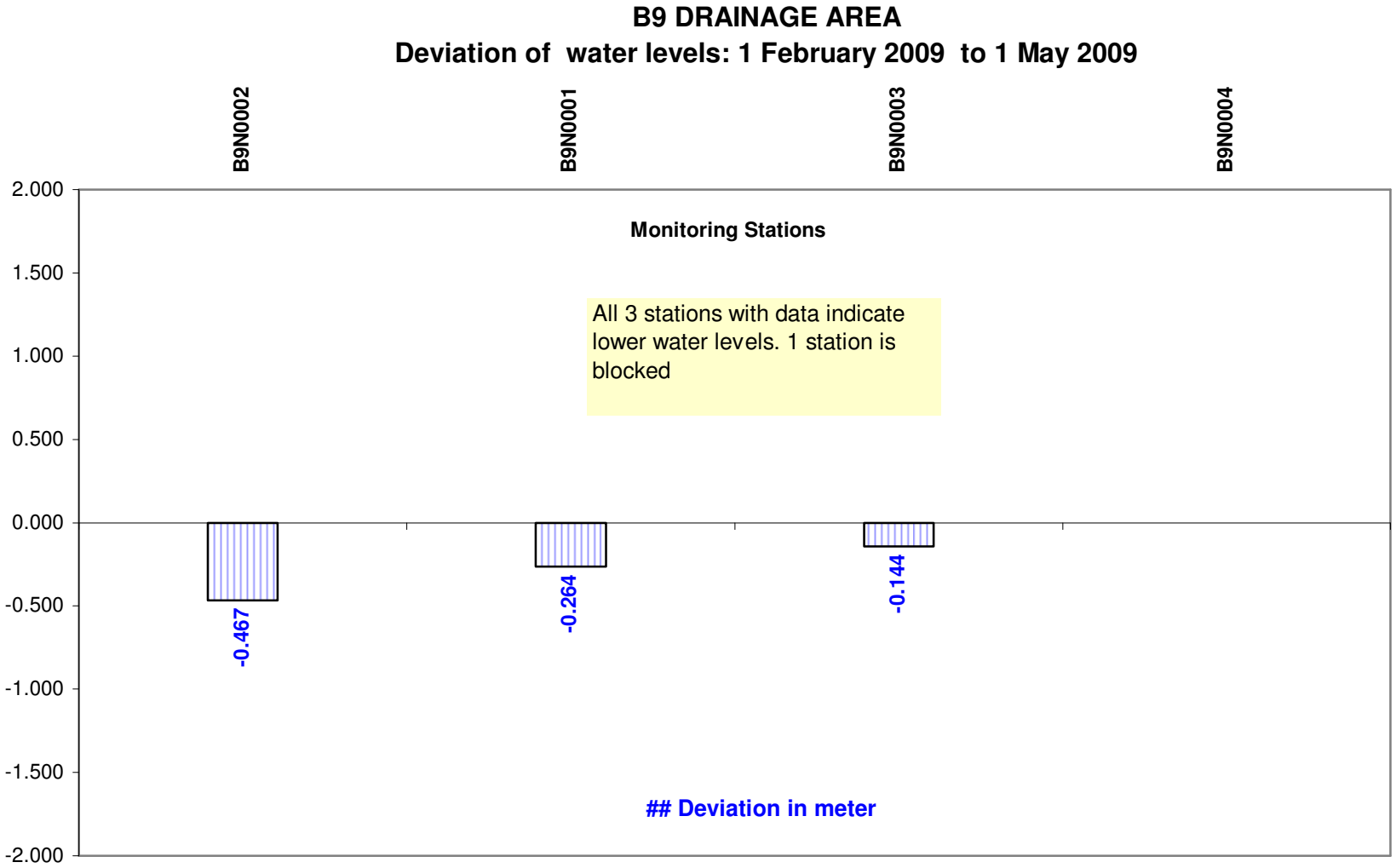
GRAPH 27


B8 DRAINAGE AREA
Comparison between water level depths: 1 May 2008,
1 February 2009 and 1 May 2009
Monitoring Stations
B8N0518
B8N0516
B8N0520
B8N0509
B8N0521
B8N0503
B8N0515
B8N0513
B8N0514
B8N0517
B8N0507
B8N0504
B8N0510
B8N0502
m Below collar
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
11.47
12.47
12.42
6.19
6.32
6.27
24.08
24.67
24.85
37.04
37.48
37.56
8.01
8.00
8.09
20.47
20.97
20.95
7.34
7.72
7.94
8.48
8.49
8.60
19.31
19.87
19.23
19.35
19.21
17.80
18.39
18.87
18.95
25.67
26.40
26.68
17.62
18.65
18.55
9.13
9.18
8.75
Summary, May 2008 to May 2009:
75.8% of stations indicate lower water levels from May to May . Overall an average decline of -0.29m was recorded
May-08
Feb-09
May-09

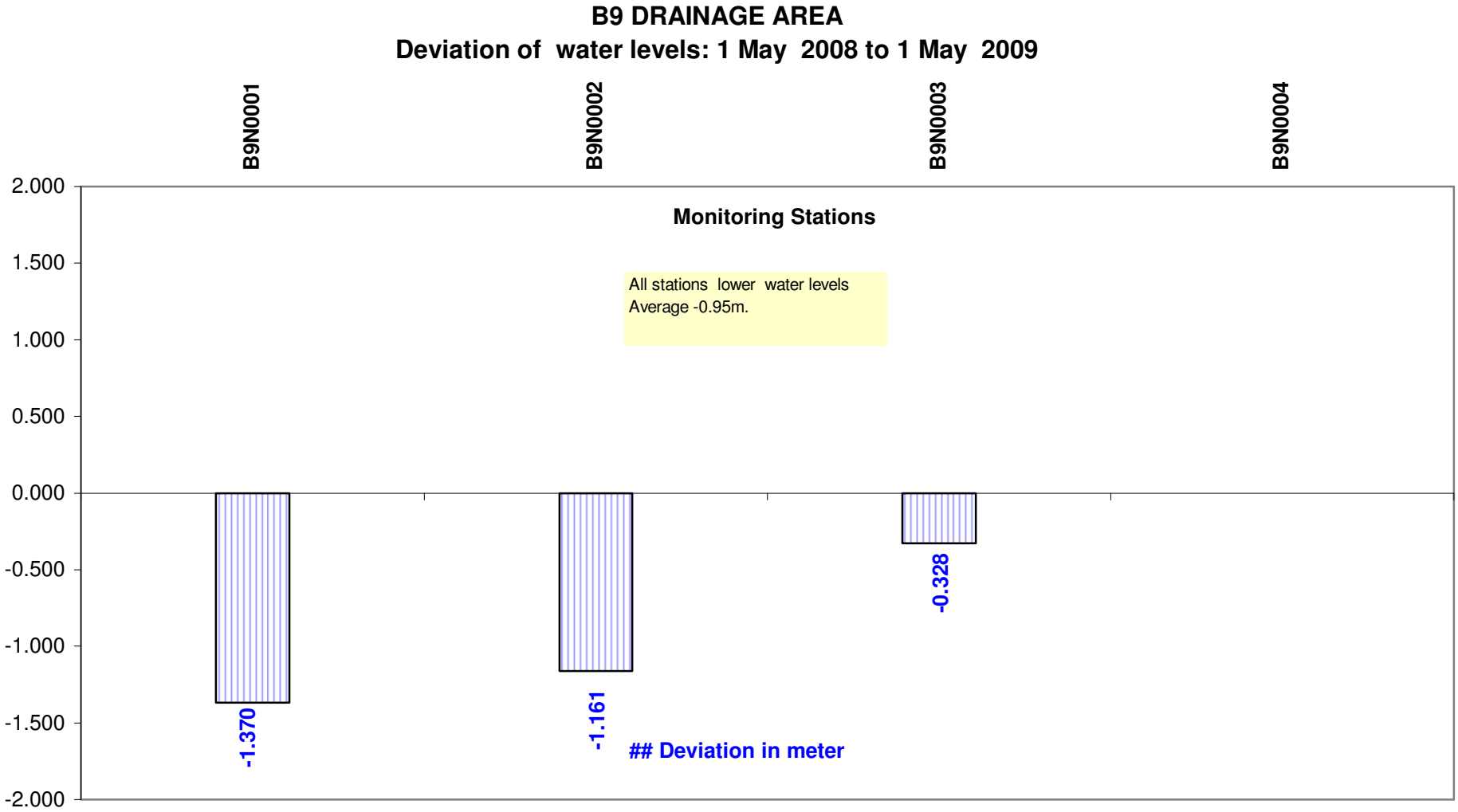
GRAPH 28


Comparison of water level trends of stations in B9 drainage:
1 May 2008 to 1 May 2009
-1.00
1.00
3.00
5.00
7.00
9.00
11.00
13.00
15.00
m Below collar
15.00
16.00
17.00
18.00
19.00
20.00
21.00
22.00
23.00
24.00
May-08
Aug-08
Nov-08
Feb-09
May-09
Date
B9N0002
B9N0001
B9N0003

GRAPH 29

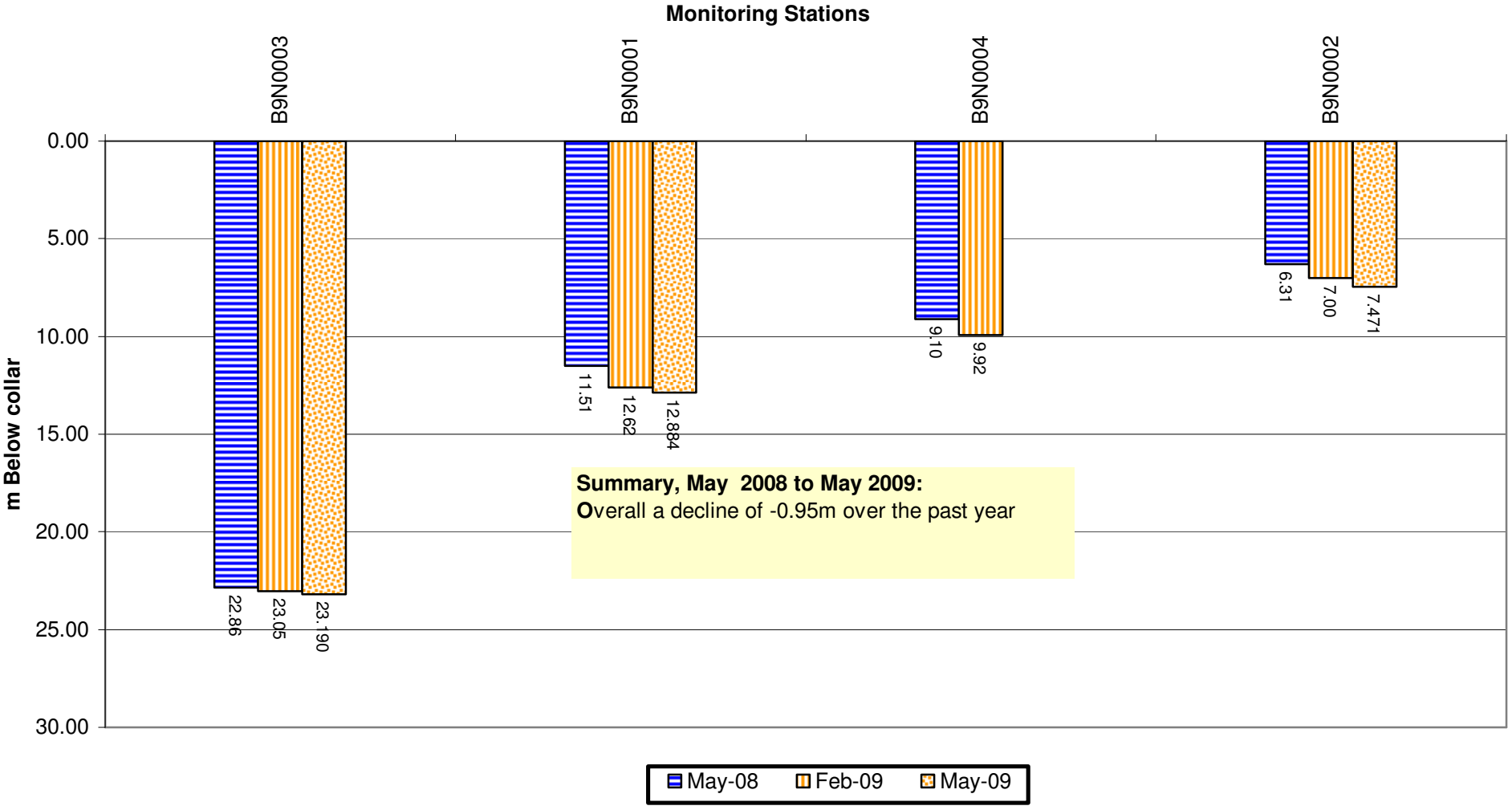

B9 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009
B9N0002
B9N0001
B9N0003
B9N0004
2.000
1.500
1.000
0.500
0.000
-0.500
-1.000
-1.500
-2.000
Monitoring Stations
All 3 stations with data indicate lower water levels. 1 station is blocked
-0.467
-0.264
-0.144
Deviation in meter

GRAPH 30

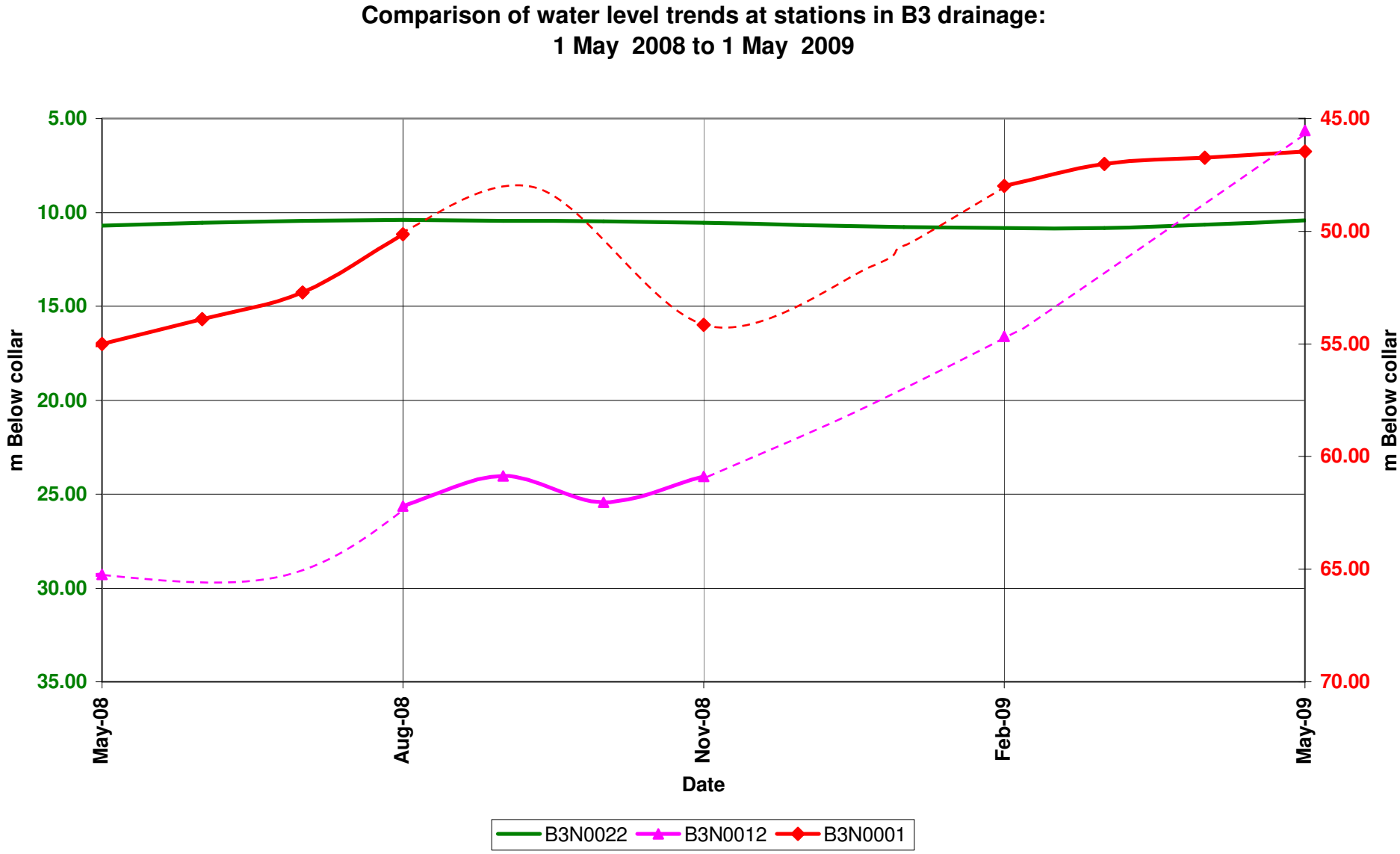

B9 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009
B9N0001
B9N0002
B9N0003
B9N0004
2.000
1.500
1.000
0.500
0.000
-0.500
-1.000
-1.500
-2.000
Monitoring Stations
All stations lower water levels
Average -0.95m.
-1.370
-1.161
-0.328
Deviation in meter

GRAPH 31

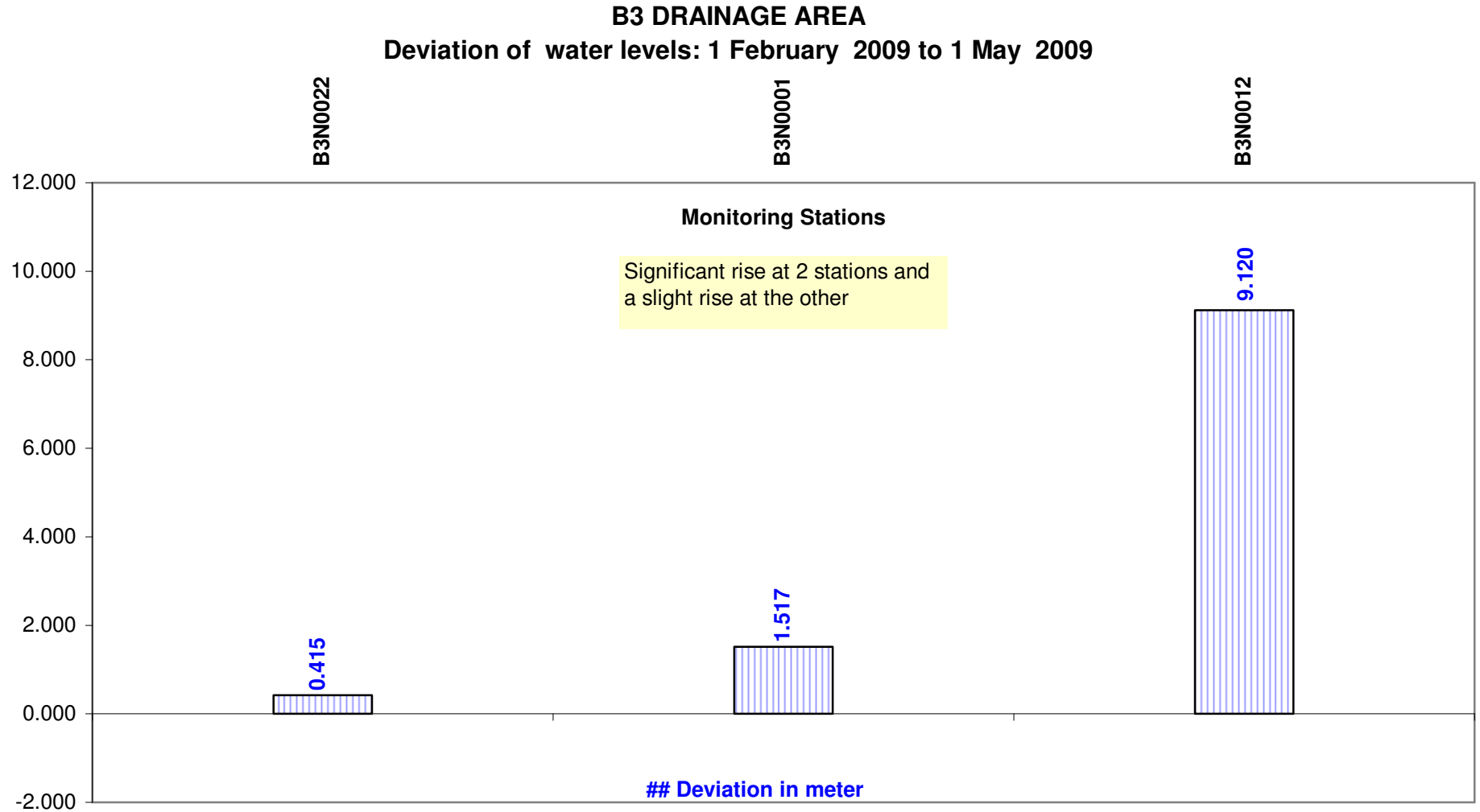
B9 DRAINAGE AREA
Comparison between water level depths: 1 May 2008, 1 February 2009 and 1 May 2009



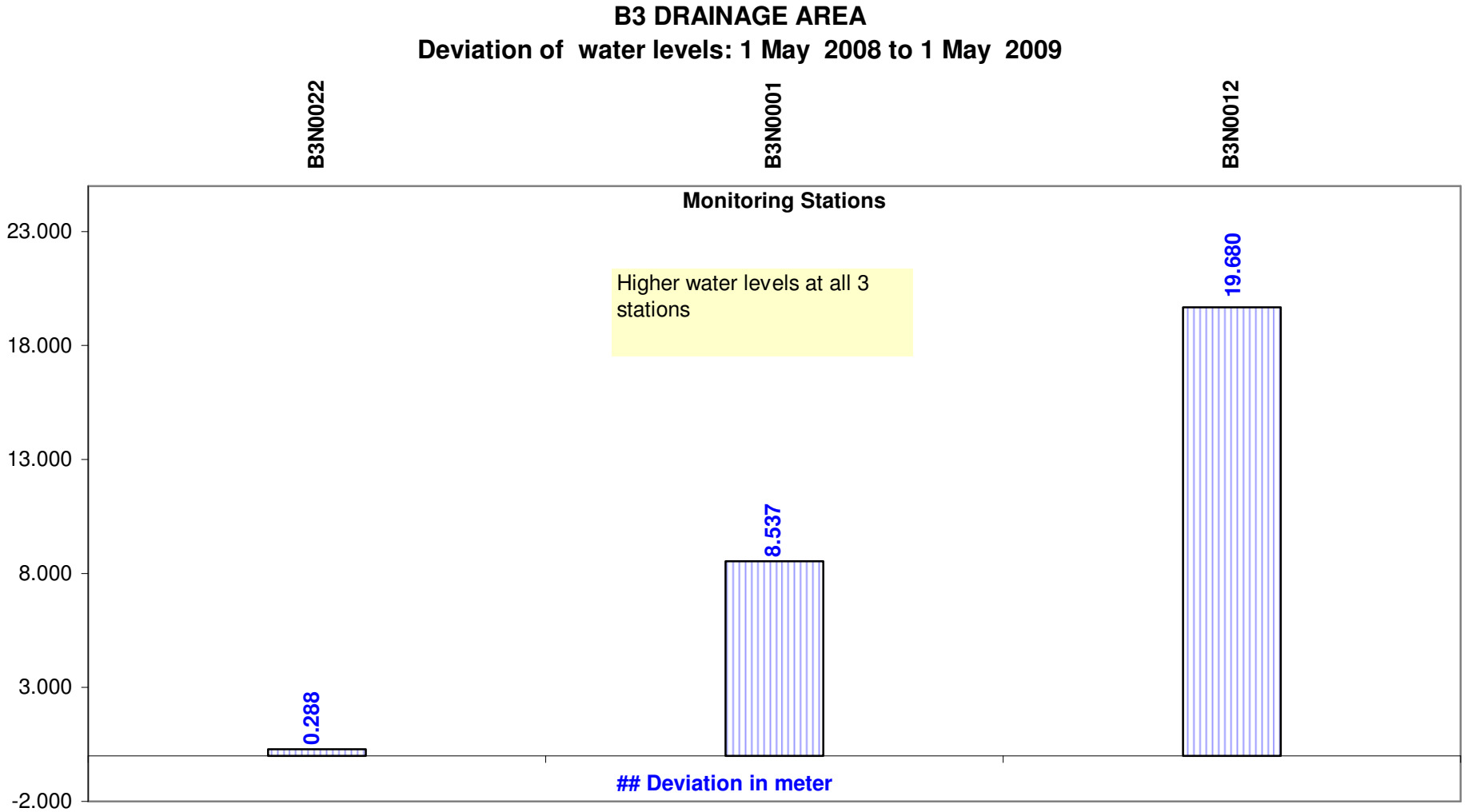
GRAPH 32


Comparison of water level trends at stations in B3 drainage:
1 May 2008 to 1 May 2009
5.00
10.00
15.00
20.00
25.00
30.00
35.00
m Below collar
45.00
50.00
55.00
60.00
65.00
70.00
m Below collar
May-08
Aug-08
Nov-08
Feb-09
May-09
Date
B3N0022
B3N0012
B3N0001

GRAPH 33

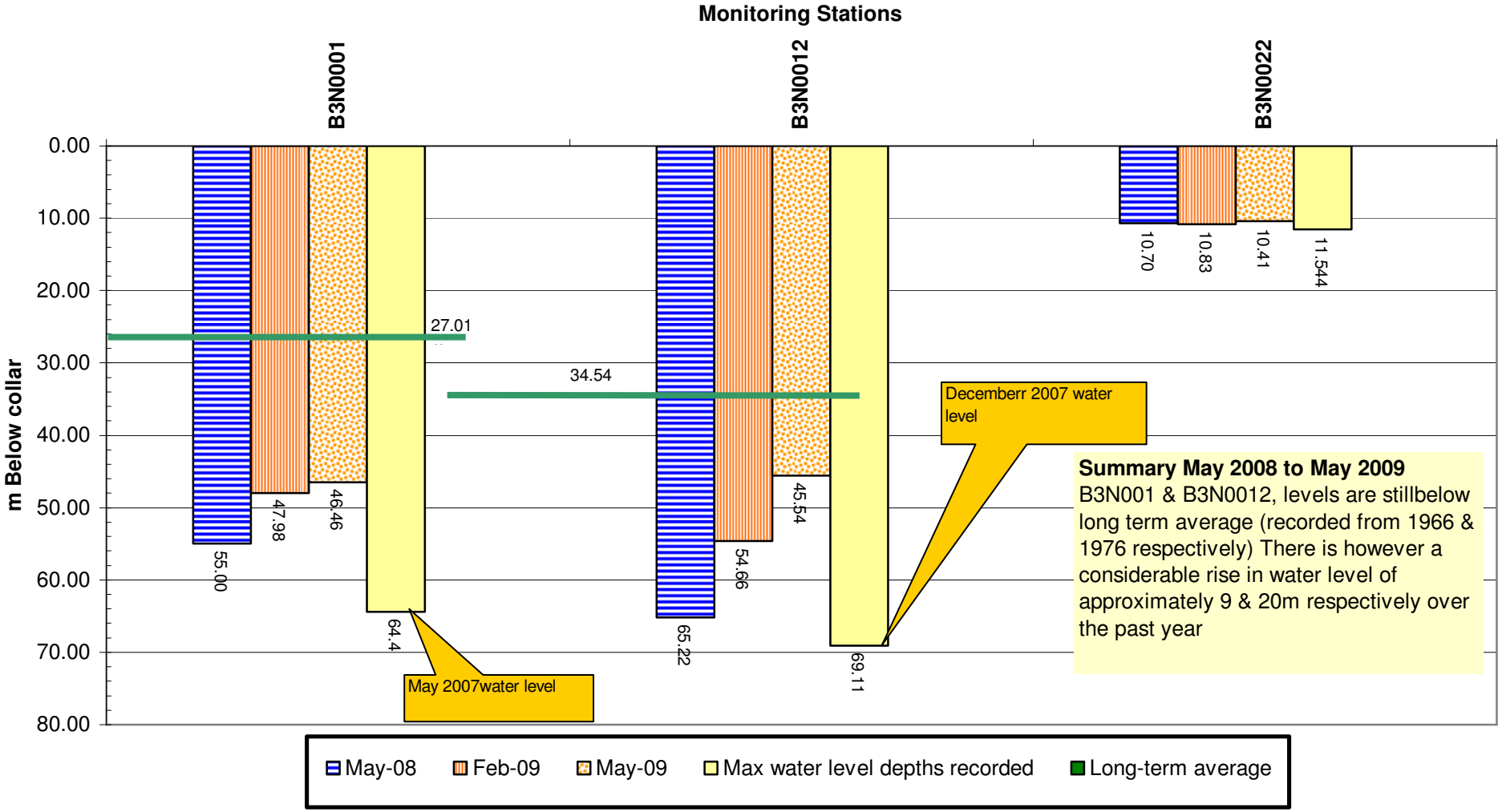

B3 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009
B3N0022
B3N0001
B3N0012
12.000
10.000
8.000
6.000
4.000
2.000
0.000
-2.000
Monitoring Stations
Significant rise at 2 stations and a slight rise at the other
0.415
1.517
9.120
Deviation in meter

GRAPH 34

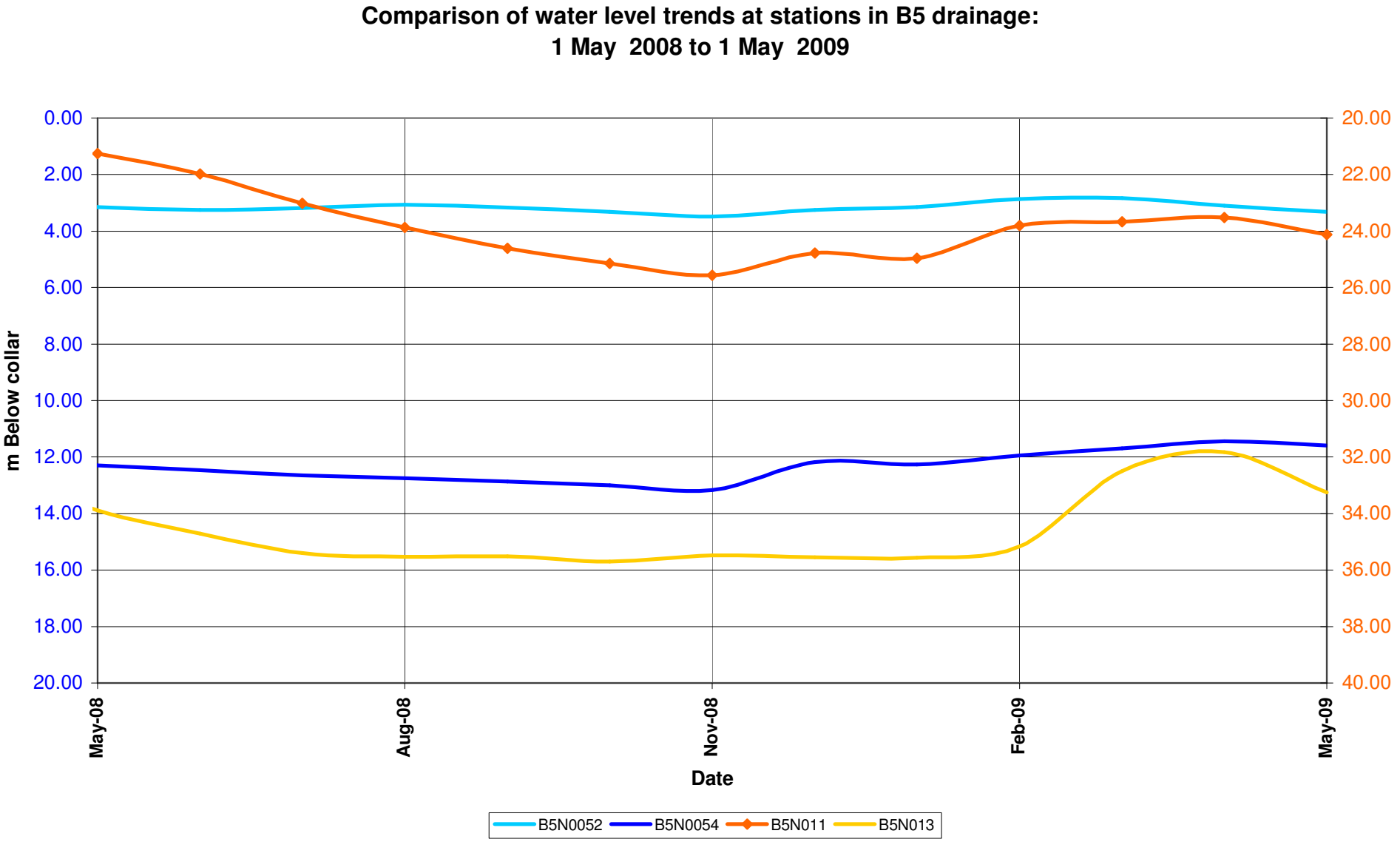

B3 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009
B3N0022
B3N0001
B3N0012
Monitoring Stations
23.000
18.000
13.000
8.000
3.000
-2.000
Higher water levels at all 3 stations
0.288
8.537
19.680
Deviation in meter

GRAPH 35

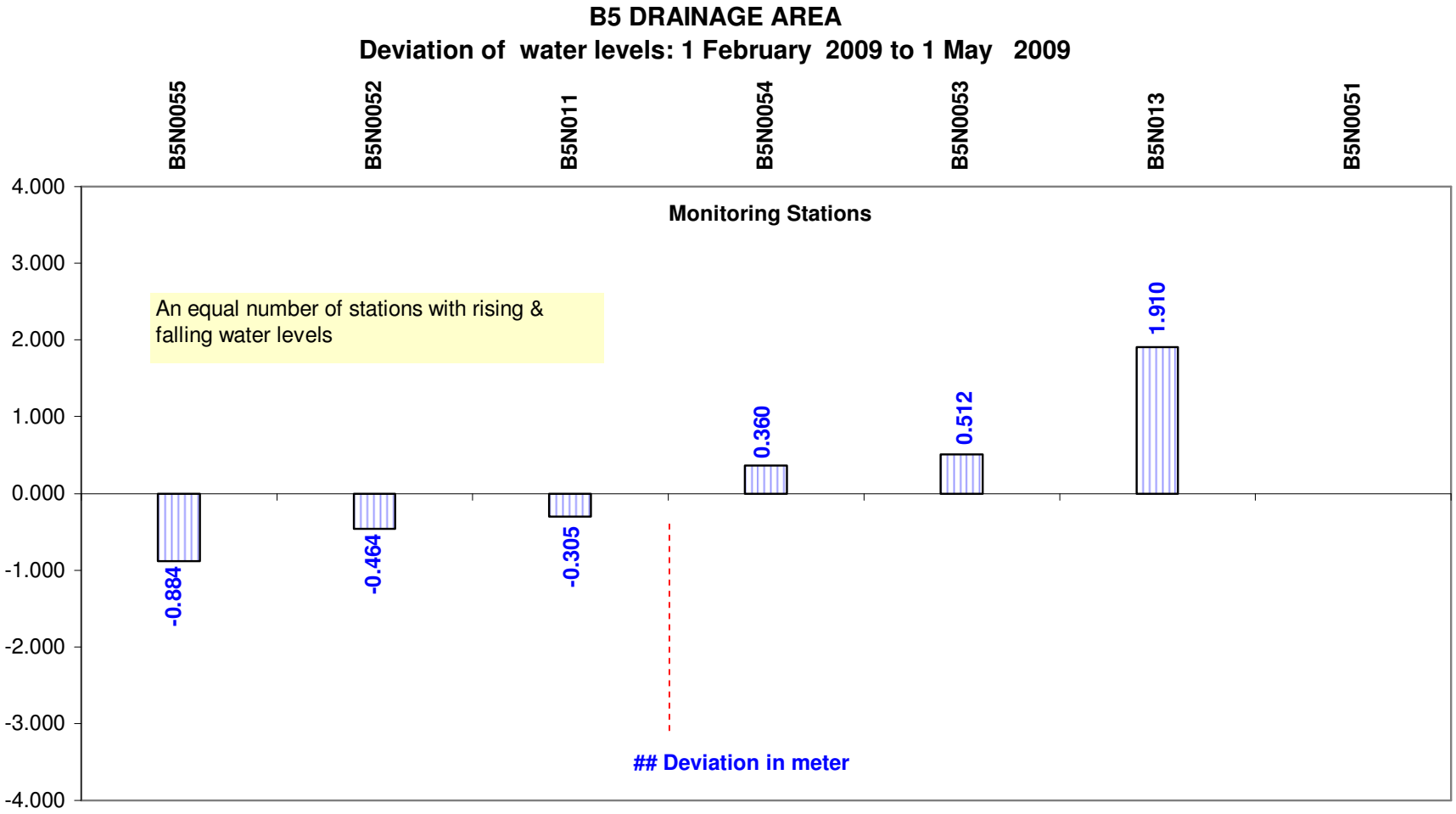
B3 DRAINAGE AREA
Comparison between water level depths: 1 May 2008
1 February 2009, 1 May 2009 and maximum depths recorded



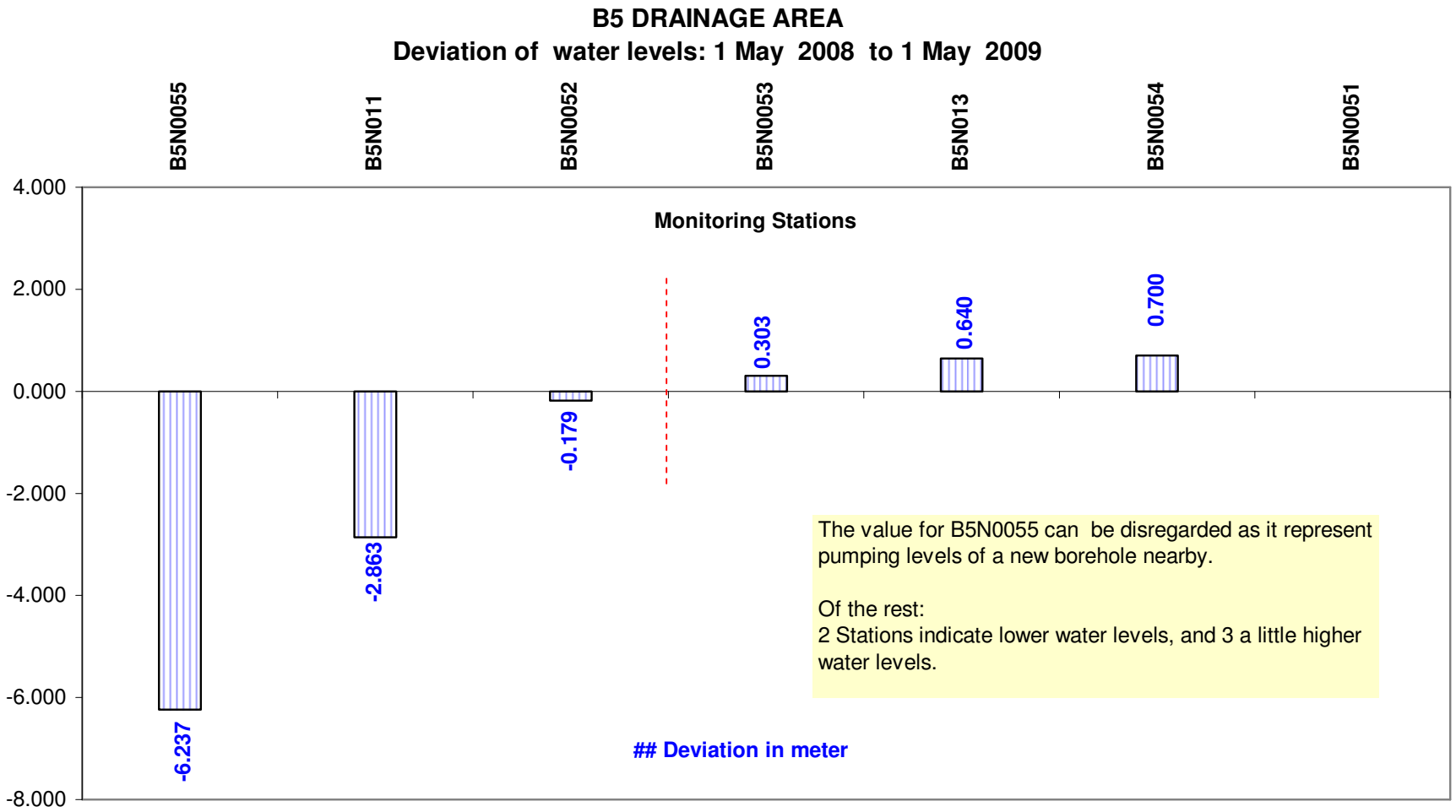
GRAPH 36


Comparison of water level trends at stations in B5 drainage:
1 May 2008 to 1 May 2009
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
May-08
Aug-08
Nov-08
Feb-09
May-09
Date
B5N0052
B5N0054
B5N011
B5N013

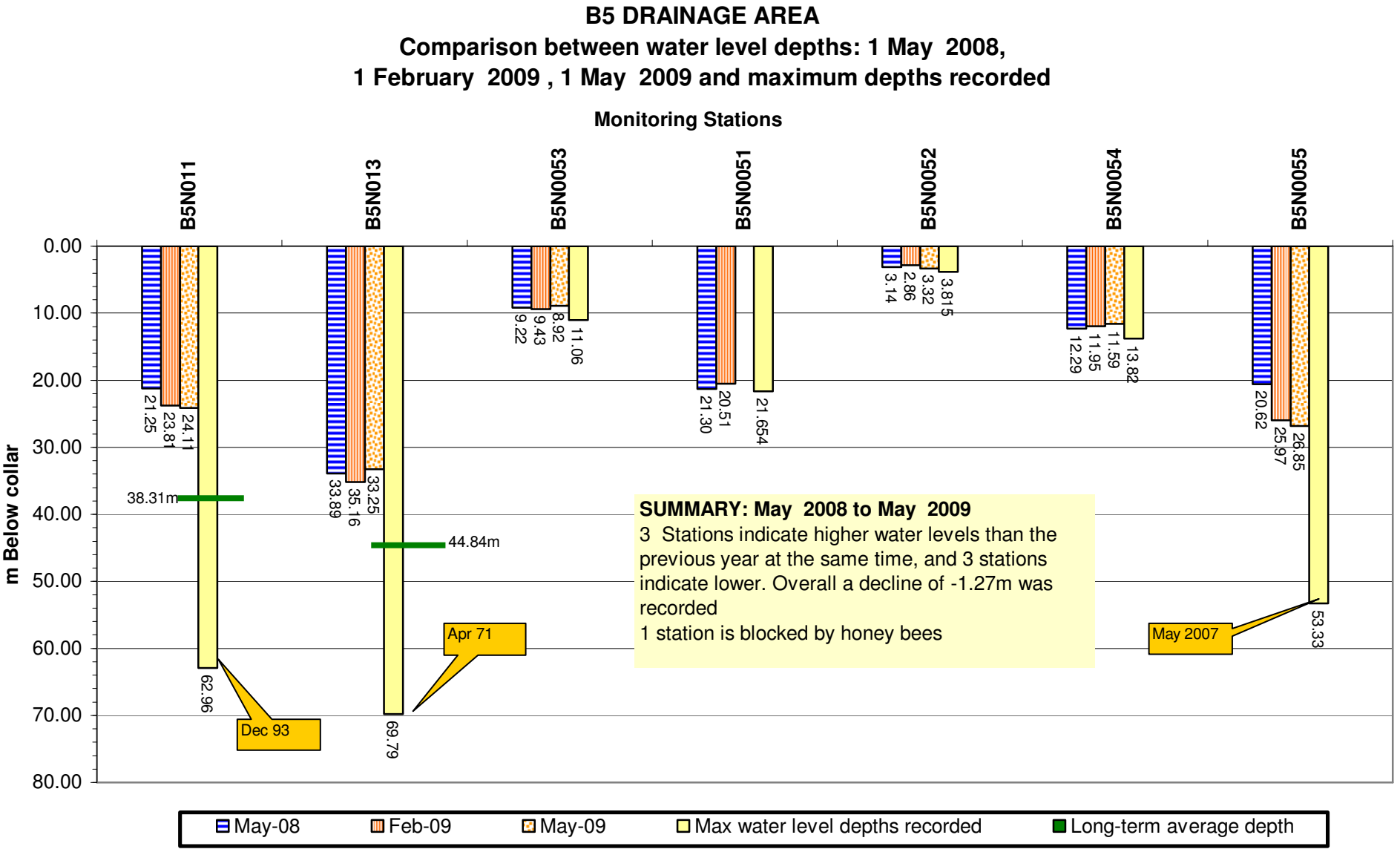
GRAPH 37


B5 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009
B5N0055
B5N0052
B5N011
B5N0054
B5N0053
B5N013
B5N0051
4.000
3.000
2.000
1.000
0.000
-1.000
-2.000
-3.000
-4.000
Monitoring Stations
An equal number of stations with rising & falling water levels
-0.884
-0.464
-0.305
0.360
0.512
1.910
Deviation in meter

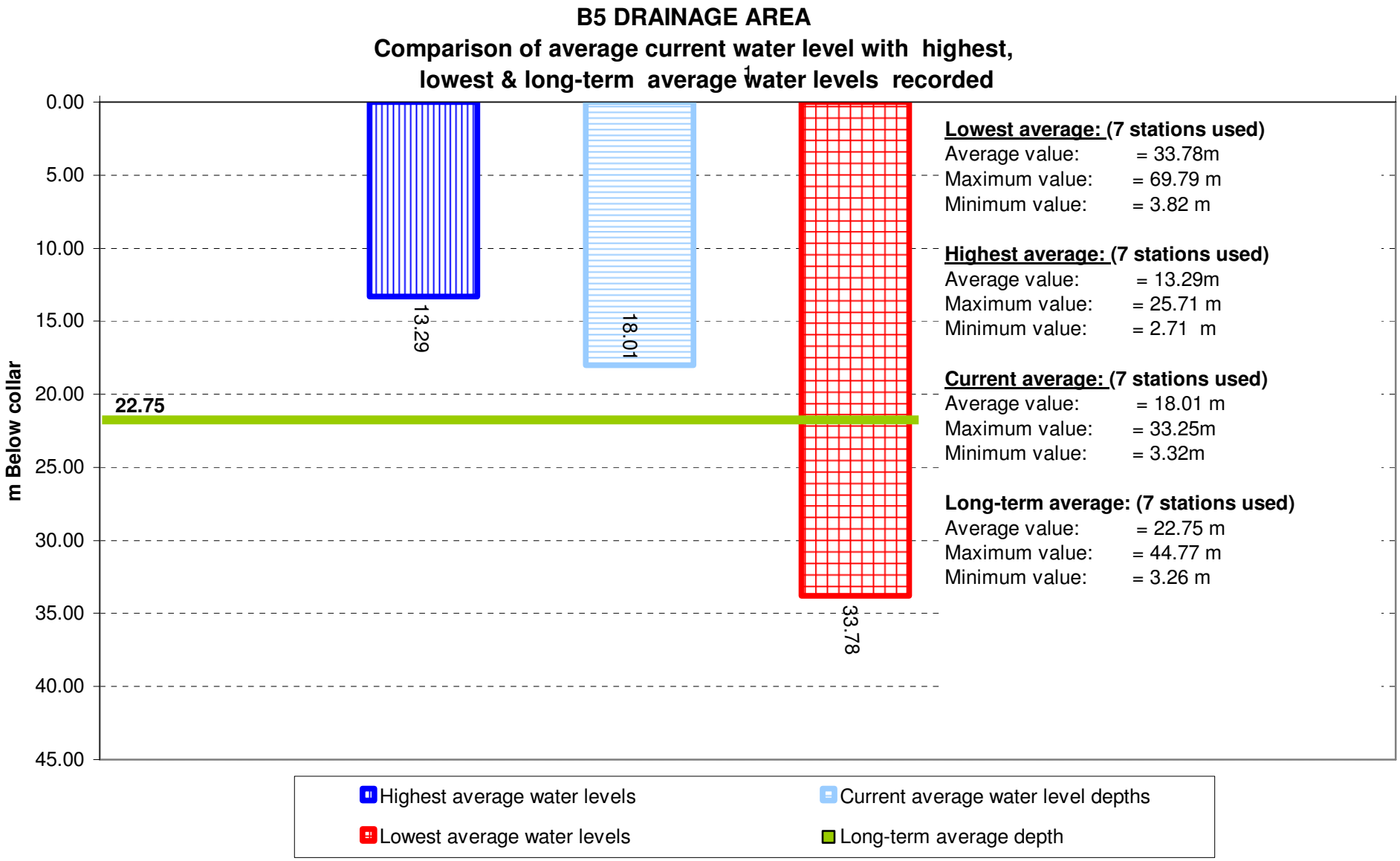
GRAPH 38


B5 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009
B5N0055
B5N011
B5N0052
B5N0053
B5N013
B5N0054
B5N0051
4.000
2.000
0.000
-2.000
-4.000
-6.000
-8.000
Monitoring Stations
0.303
0.640
0.700
-0.179
-2.863
-6.237
The value for B5N0055 can be disregarded as it represent pumping levels of a new borehole nearby.
Of the rest:
2 Stations indicate lower water levels, and 3 a little higher water levels.
Deviation in meter

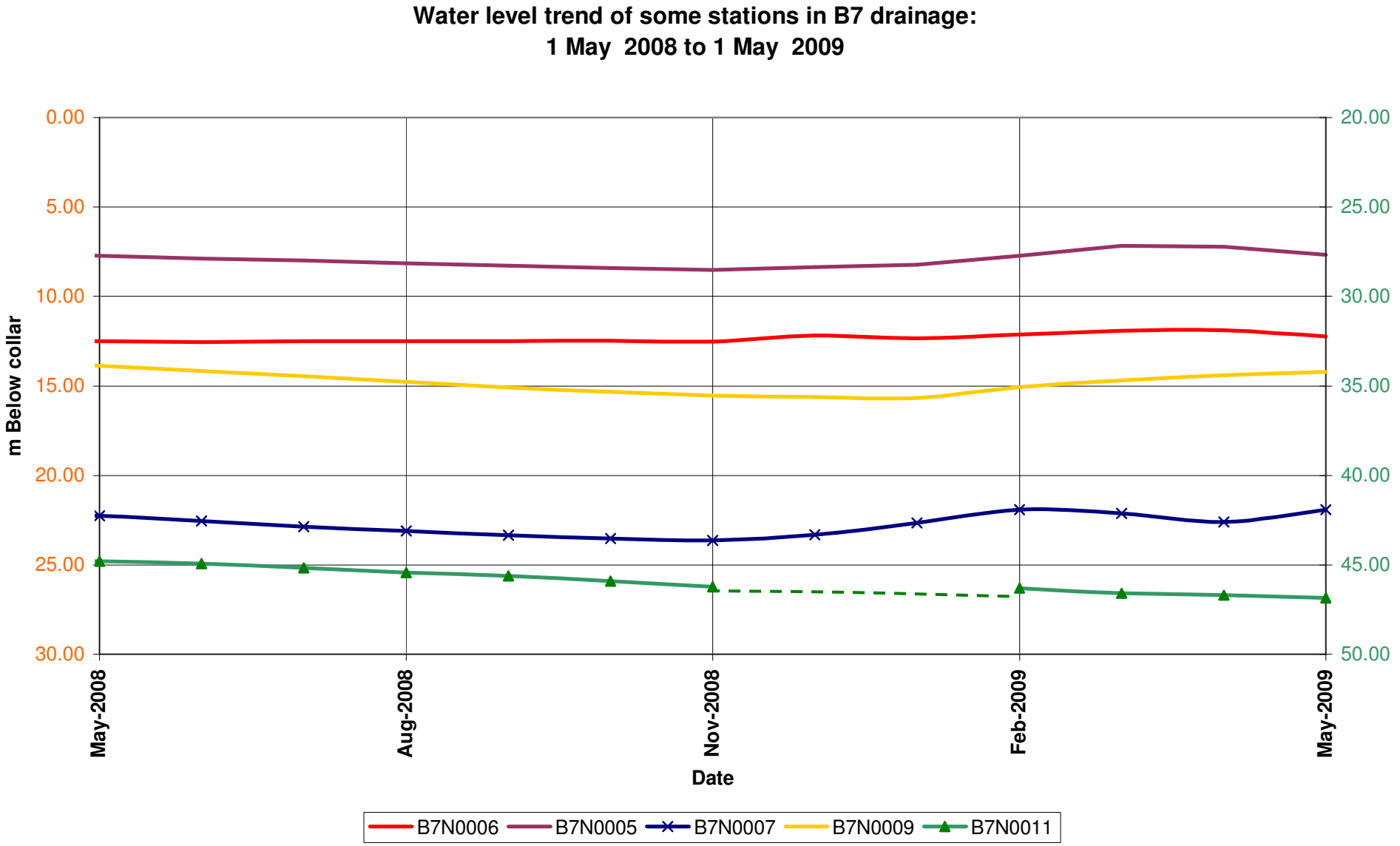
GRAPH 39


B5 DRAINAGE AREA
Comparison between water level depths: 1 May 2008,
1 February 2009 , 1 May 2009 and maximum depths recorded
Monitoring Stations
B5N011
B5N013
B5N0053
B5N0051
B5N0052
B5N0054
B5N0055
m Below collar
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
21.25
23.81
24.11
62.96
38.31m
Dec 93
33.89
35.16
33.25
69.79
44.84m
Apr 71
9.22
9.43
8.92
11.06
21.30
20.51
21.654
3.14
2.86
3.32
3.815
12.29
11.95
11.59
13.82
20.62
25.97
26.85
53.33
May 2007
SUMMARY: May 2008 to May 2009
3 Stations indicate higher water levels than the previous year at the same time, and 3 stations indicate lower. Overall a decline of -1.27m was recorded
1 station is blocked by honey bees
May-08
Feb-09
May-09
Max water level depths recorded
Long-term average depth

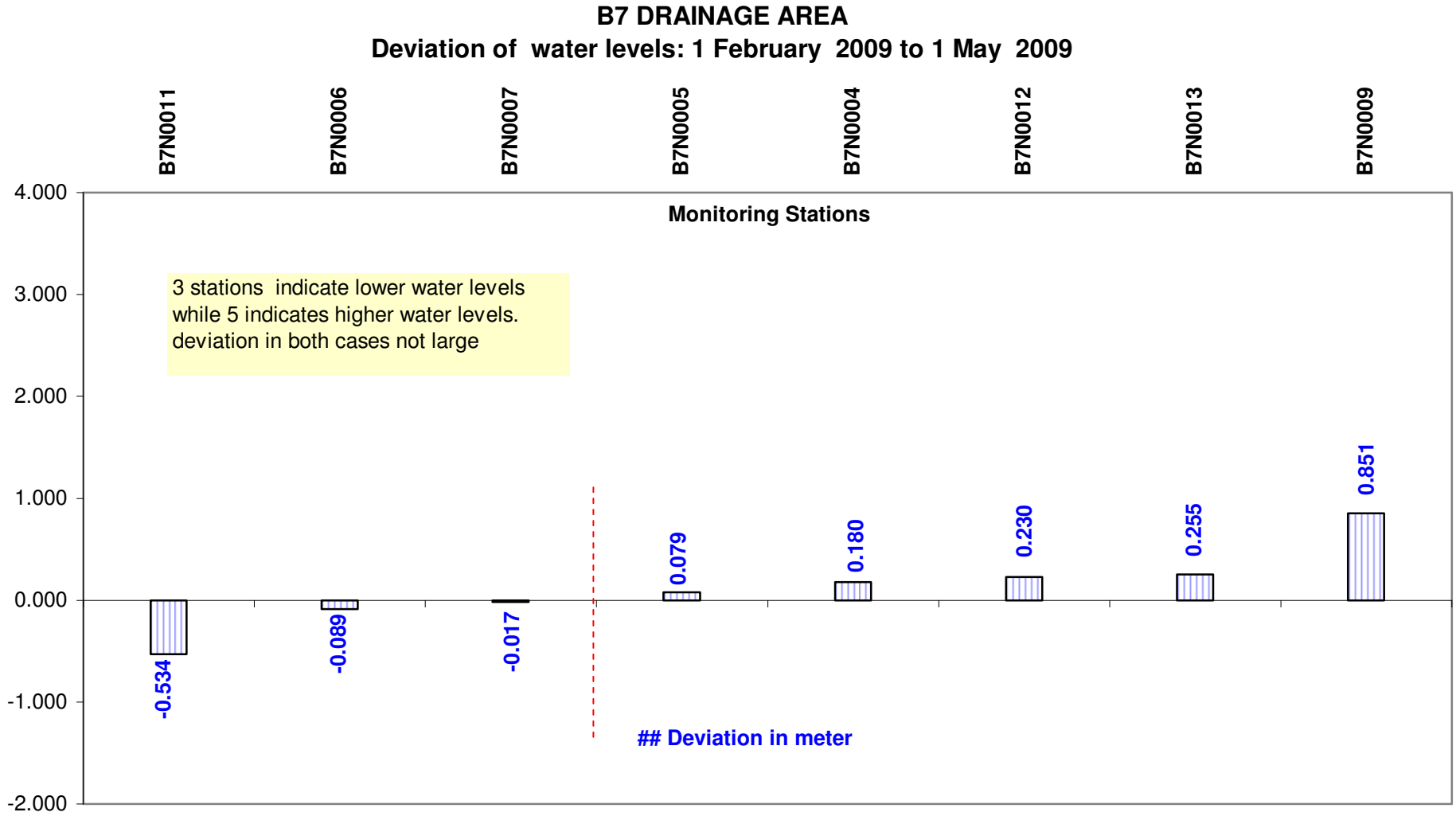
GRAPH 40


B5 DRAINAGE AREA
Comparison of average current water level with highest,
lowest & long-term average water levels recorded
m Below collar
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
22.75
13.29
18.01
33.78
Lowest average: (7 stations used)
Average value: = 33.78m
Maximum value: = 69.79 m
Minimum value: = 3.82 m
Highest average: (7 stations used)
Average value: = 13.29m
Maximum value: = 25.71 m
Minimum value: = 2.71 m
Current average: (7 stations used)
Average value: = 18.01 m
Maximum value: = 33.25m
Minimum value: = 3.32m
Long-term average: (7 stations used)
Average value: = 22.75 m
Maximum value: = 44.77 m
Minimum value: = 3.26 m
Highest average water levels
Current average water level depths
Lowest average water levels
Long-term average depth

GRAPH 41

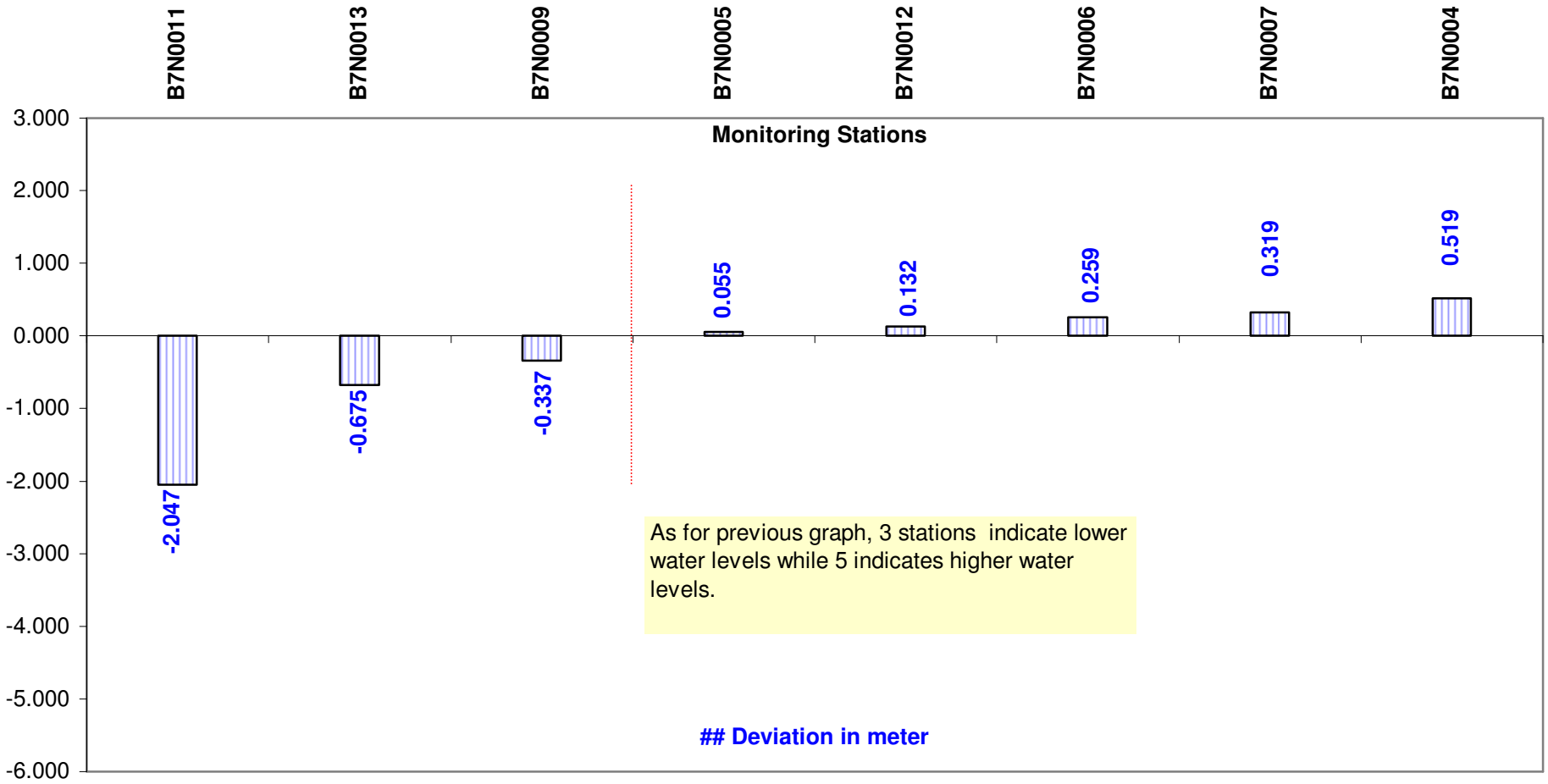

Water level trend of some stations in B7 drainage:
1 May 2008 to 1 May 2009
m Below collar
0.00
5.00
10.00
15.00
20.00
25.00
30.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
May-2008
Aug-2008
Nov-2008
Feb-2009
May-2009
Date
B7N0006
B7N0005
B7N0007
B7N0009
B7N0011

GRAPH 42

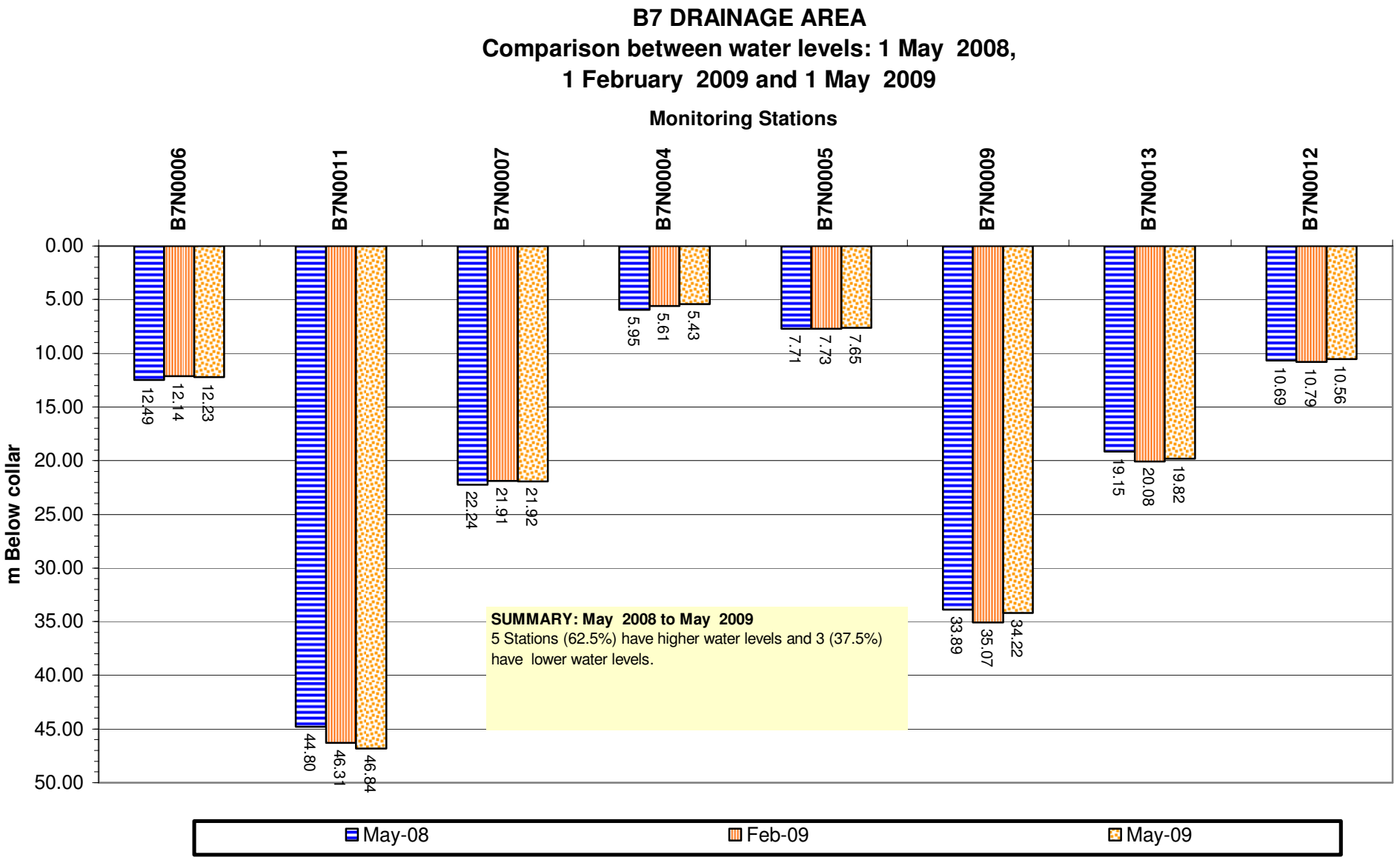

B7 DRAINAGE AREA
Deviation of water levels: 1 February 2009 to 1 May 2009
B7N0011
B7N0006
B7N0007
B7N0005
B7N0004
B7N0012
B7N0013
B7N0009
4.000
3.000
2.000
1.000
0.000
-1.000
-2.000
Monitoring Stations
3 stations indicate lower water levels
while 5 indicates higher water levels.
deviation in both cases not large
-0.534
-0.089
-0.017
0.079
0.180
0.230
0.255
0.851
Deviation in meter

GRAPH 43

B7 DRAINAGE AREA
Deviation of water levels: 1 May 2008 to 1 May 2009



GRAPH 44


B7 DRAINAGE AREA
Comparison between water levels: 1 May 2008,
1 February 2009 and 1 May 2009
Monitoring Stations
B7N0006
B7N0011
B7N0007
B7N0004
B7N0005
B7N0009
B7N0013
B7N0012
m Below collar
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
12.49
12.14
12.23
44.80
46.31
46.84
22.24
21.91
21.92
5.95
5.61
5.43
7.71
7.73
7.65
33.89
35.07
34.22
19.15
20.08
19.82
10.69
10.79
10.56
SUMMARY: May 2008 to May 2009
5 Stations (62.5%) have higher water levels and 3 (37.5%) have lower water levels.
May-08
Feb-09
May-09

GRAPH 45