

# IMPLEMENTATION OF THE ECOLOGICAL RESERVE IN THE CATCHMENTS ACTION PLANS

## Groundwater Reserve Determination Results

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Location: Leipoldtville Dutch Reform Church Hall  
Date: 26 July 2023

WATER IS LIFE - SANITATION IS DIGNITY

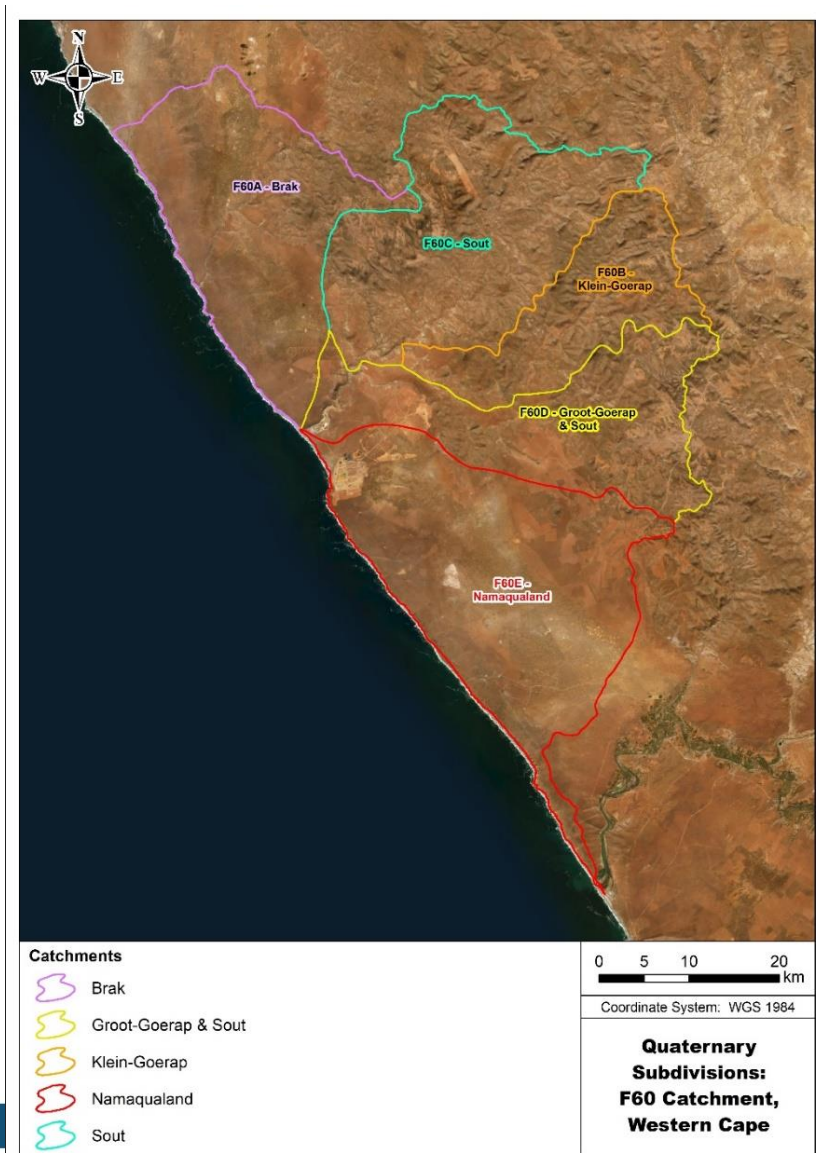
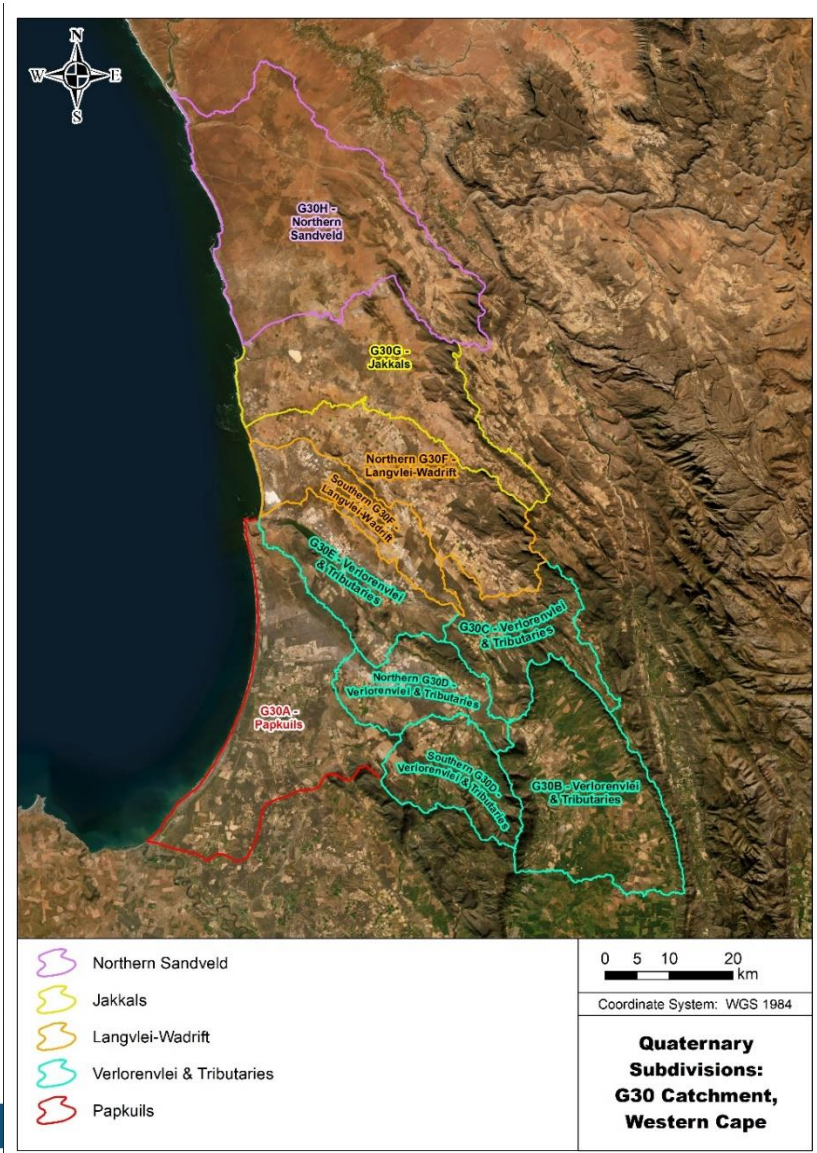


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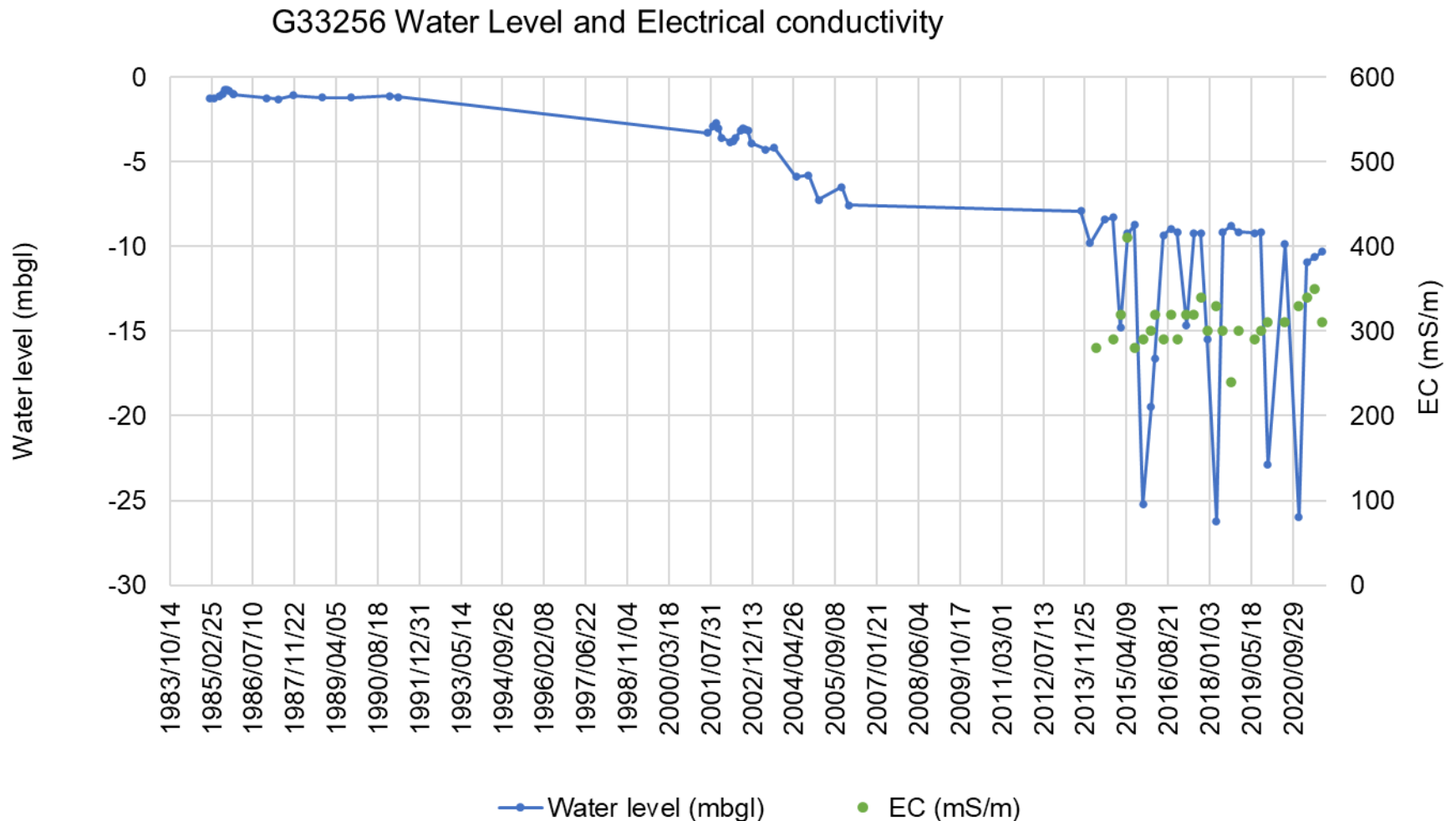
Department:  
Water and Sanitation  
**REPUBLIC OF SOUTH AFRICA**



# GROUNDWATER RESERVE DETERMINATION RESULTS:STUDY AREAS

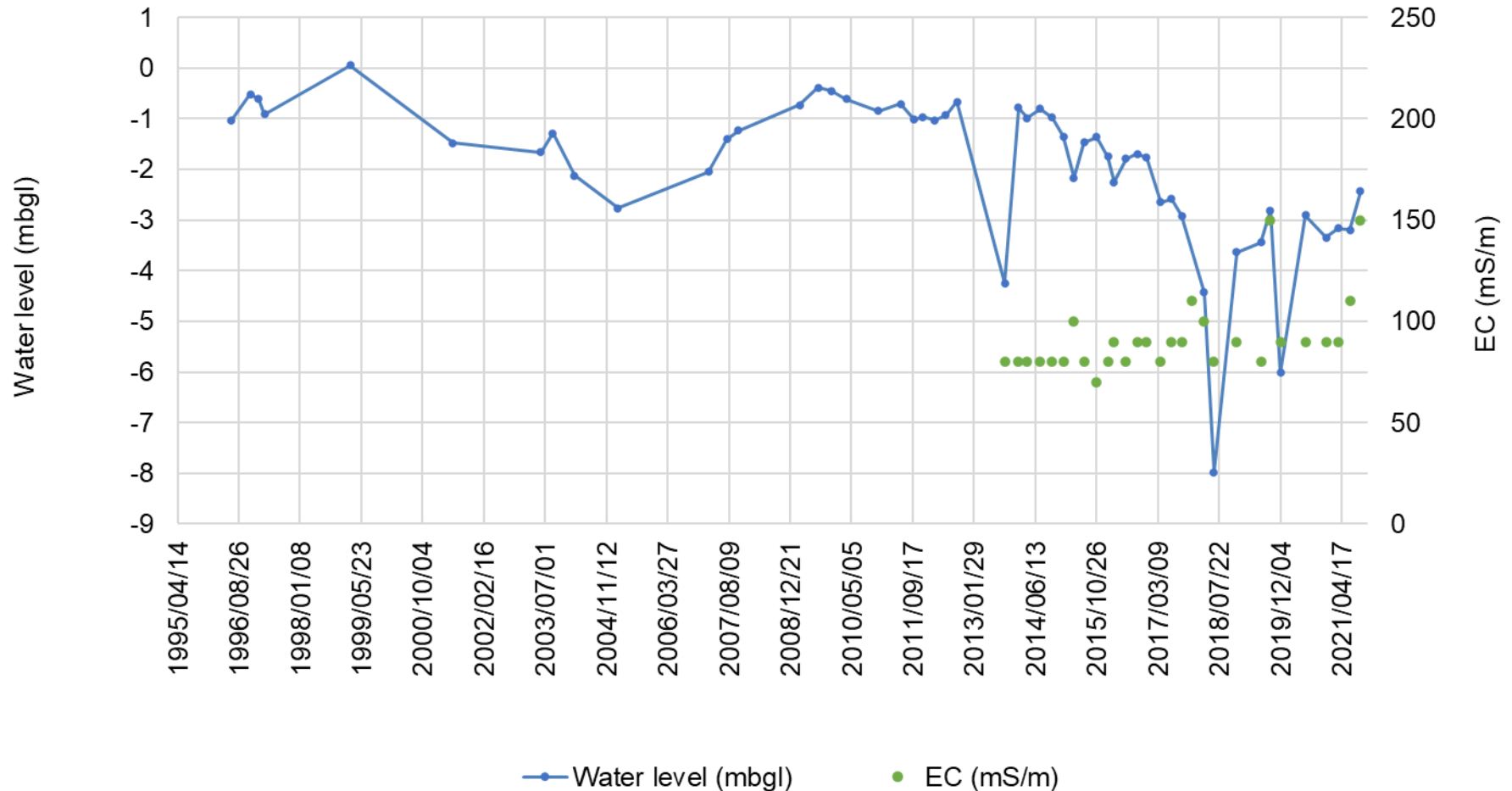


# GROUNDWATER RESERVE DETERMINATION RESULTS: DATA\_G30A

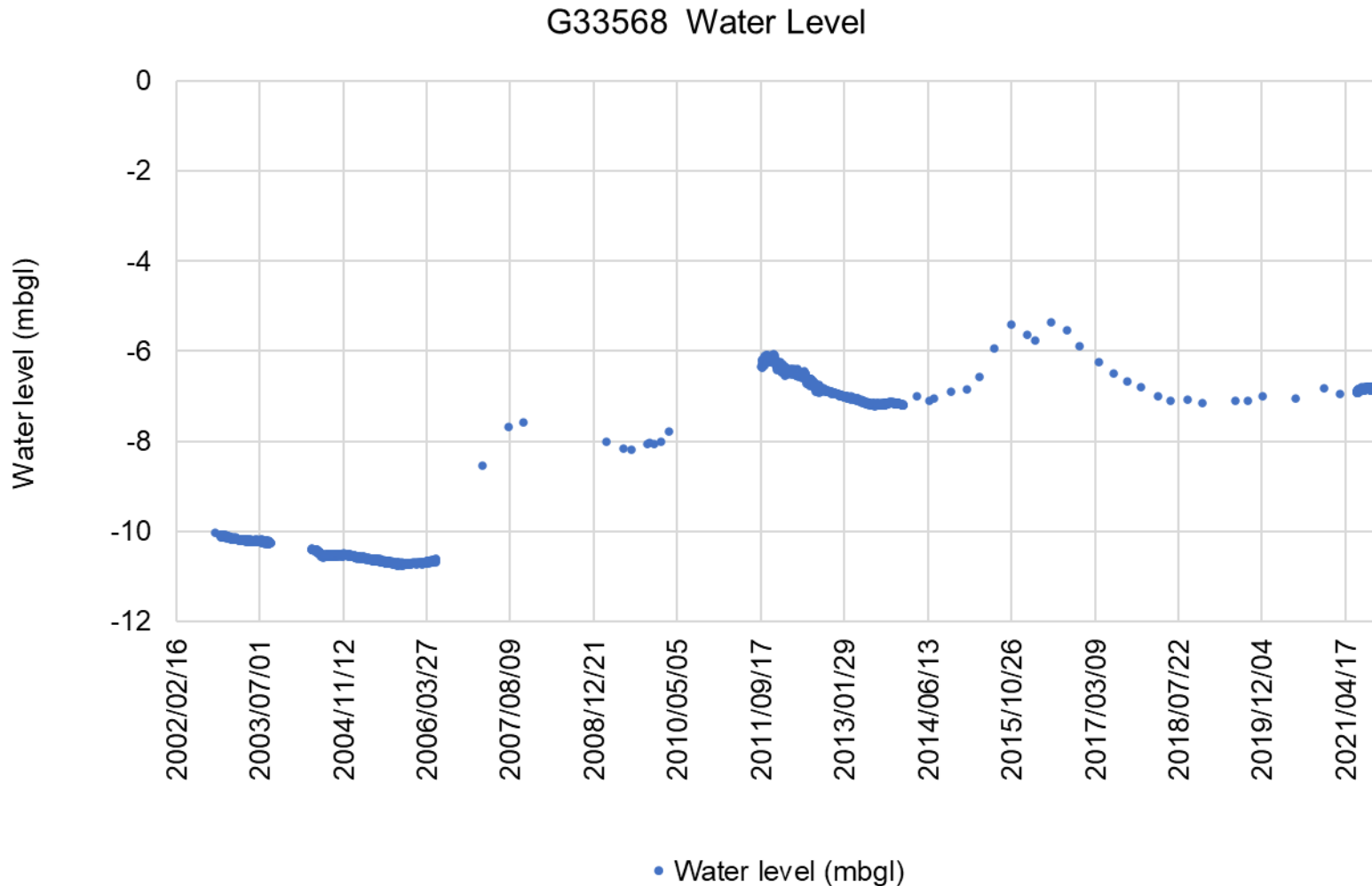


# GROUNDWATER RESERVE DETERMINATION RESULTS: DATA\_G30E

GEOSS V11 Water Level and Electrical conductivity

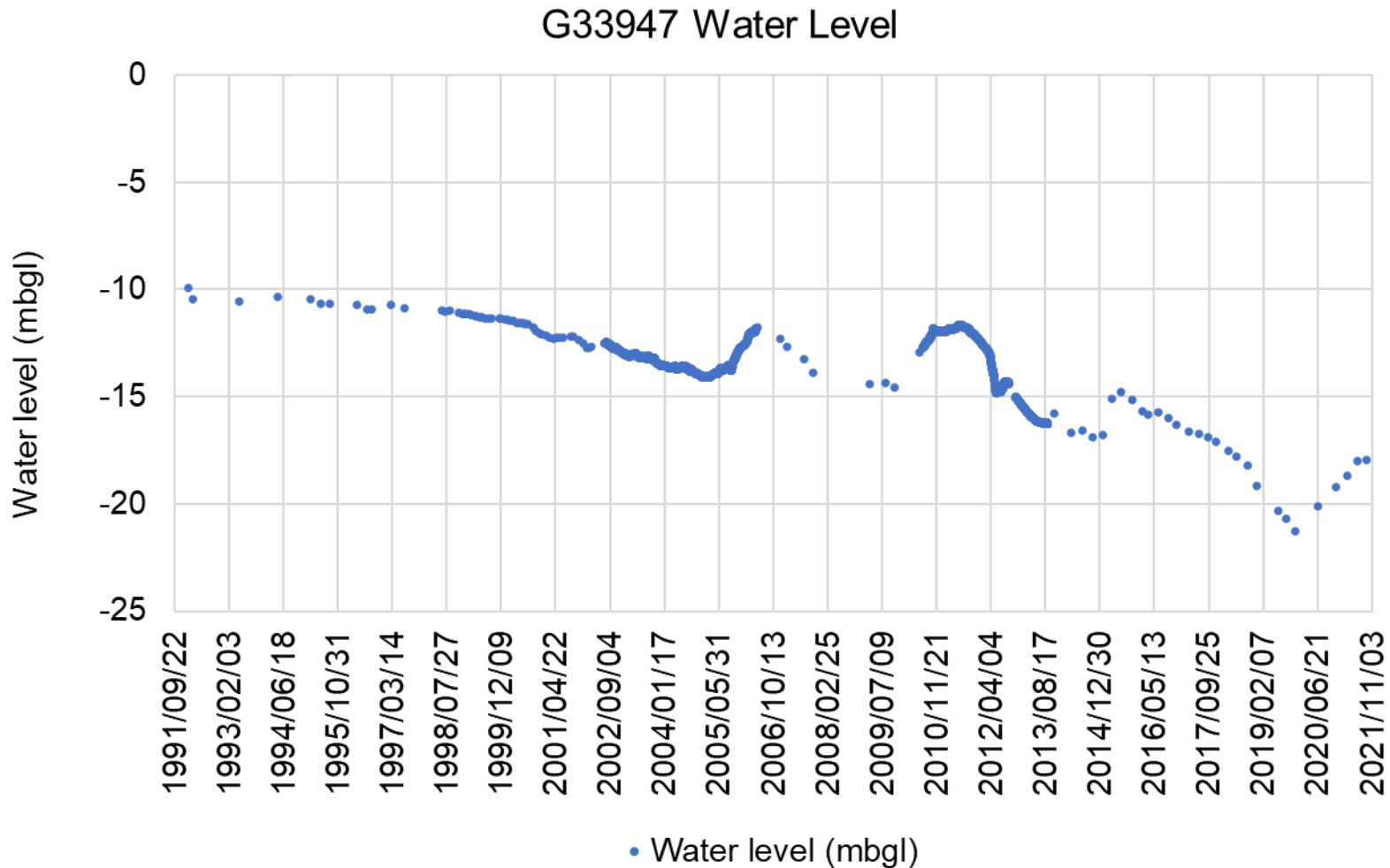


# GROUNDWATER RESERVE DETERMINATION RESULTS:DATA\_G30E

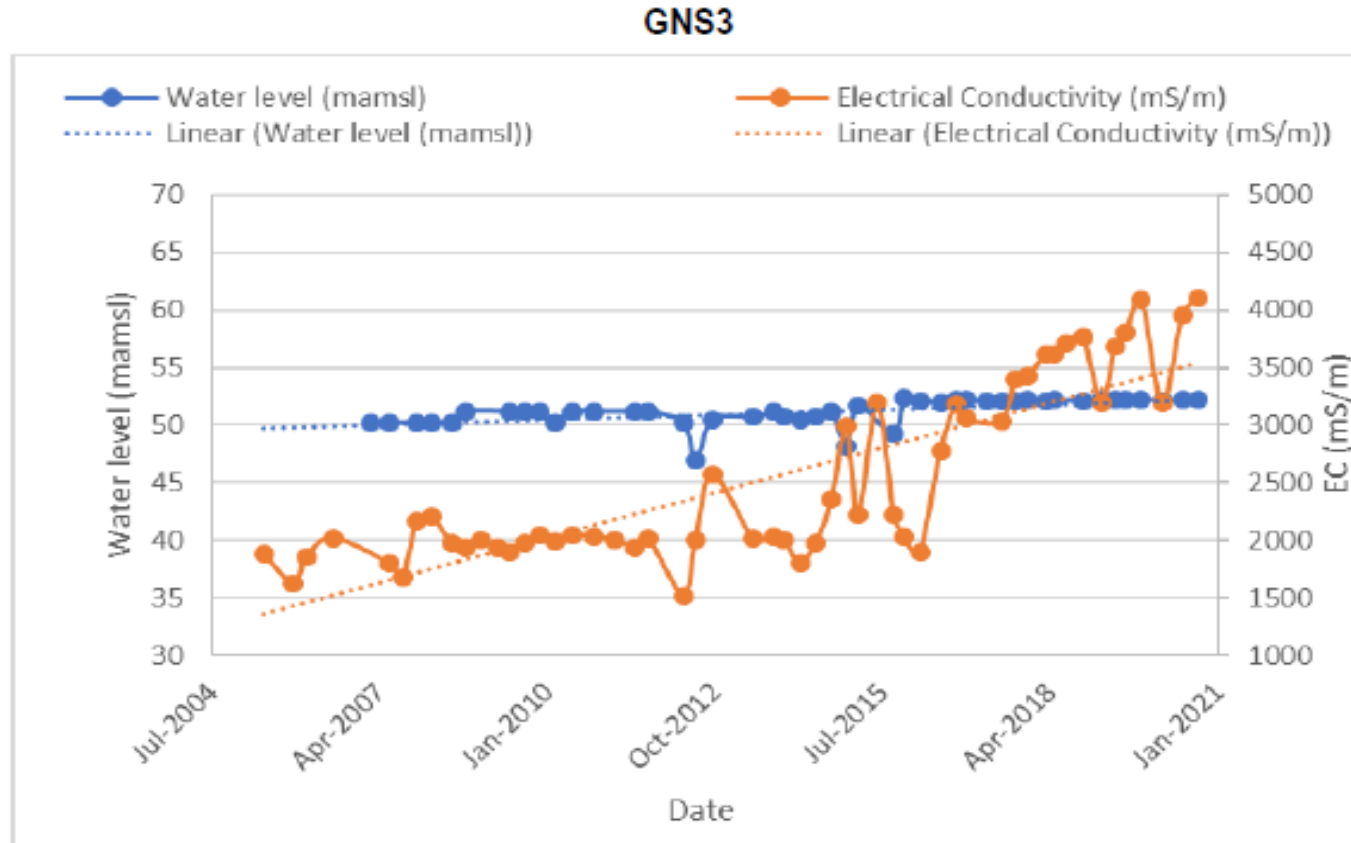




# GROUNDWATER RESERVE DETERMINATION RESULTS: DATA\_G30F



# GROUNDWATER RESERVE DETERMINATION RESULTS:DATA\_F60E



# GROUNDWATER RESERVE DETERMINATION RESULTS: DATA\_SEEPAGE AREAS AND SPRING



**Matroozefontein\_G30D**

**Papkuils\_G30A**





# GROUNDWATER RESERVE DETERMINATION RESULTS: DATA\_SEEPAGE AREAS AND SPRING

Kruisfontein  
\_G30E





# GROUNDWATER RESERVE DETERMINATION RESULTS: DATA\_SEEPAGE AREAS AND SPRING

## Springs\_F60E

Analyses	F60C_BH	F60C_Spring	SANS 241-1:2015
pH (at 25 °C)	7.4	7.8	≥5 - ≤9.7 Operational
Conductivity (mS/m) (at 25 °C)	964.0	1184.0	≤170 Aesthetic
Total Dissolved Solids (mg/L)	6535.9	8027.5	≤1200 Aesthetic
Chloride (mg/L as Cl)	3199.9	3930.3	≤300 Aesthetic
Sulphate (mg/L as SO <sub>4</sub> )	489.46	615.94	≤250 Aesthetic ≤500 Acute Health
Total Alkalinity (mg/L as CaCO <sub>3</sub> )	75.10	143.60	N/A

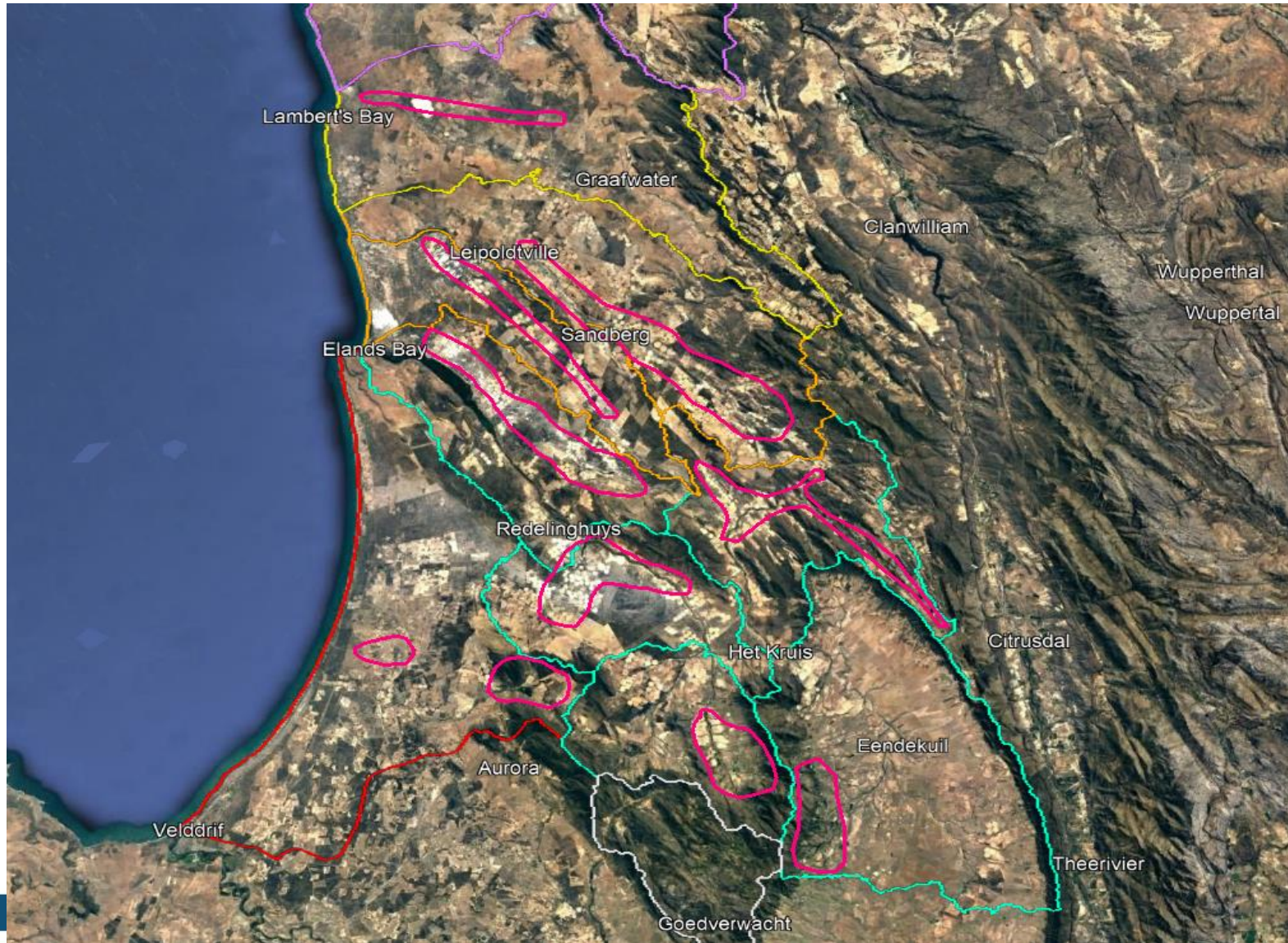


# GROUNDWATER RESERVE DETERMINATION RESULTS: IMPORTANT AQUIFERS

- Important aquifers have been delineated for the G30 catchments. Where possible, delineation was done on existing data.
- For two of the delineated areas, G30C\_Bobergvlei and Jansekraal and G30B\_Steenebrug, reports of declining water levels and very high abstraction amounts could not be verified due to a lack of access granted to existing boreholes.
- Subsequently, these areas have also been targeted during groundwater exploration and currently these are the areas that host the highest yielding boreholes as well as the highest reported groundwater abstraction volumes.
- Some of these areas, like the G30D\_Moutonshoek area, have been linked to the baseflow of the local rivers (Eilers et al., 2017 and Eilers, 2018).
- While other, like the G30D\_Matroozefontein and G30A\_Papkuil, are linked to extensive seepage areas that form an important contribution to surface water systems.
- The remaining important aquifers are linked to coastal catchments and the hypothesis of an upwelling of groundwater along fault zones that create paleochannel type of environments.



# GROUNDWATER RESERVE DETERMINATION RESULTS: IMPORTANT AQUIFERS





# GROUNDWATER RESERVE DETERMINATION RESULTS: RESULTS

Sub-catchments used to calculate recharge	River System	Area (km <sup>2</sup> )	MAP (mm)	Estimated Recharge (% of total annual flow)	Calculate d recharge (Mm <sup>3</sup> )	Total abstracted for Town supply (million m <sup>3</sup> )	Reserve (BHN + Springflow + Baseflow Contributions)	Total abstracted for irrigation (million m <sup>3</sup> )	Groundwater r Balance (million m <sup>3</sup> )
G30A1	Papkuils	131.1	292	3.5%	1.34				
G30A2	Papkuils	10.0	292	3.5%	0.10				
G30A_Groundwater	Lower	604.3	260	3.5%	5.50				
<b>G30A_Total</b>					<b>6.94</b>	<b>0</b>	<b>0.252981875</b>	<b>6.79956</b>	<b>-0.11070</b>
G30B1	Upper Kruismans	23.7	505	23.0%	2.75				
G30B1	Upper Kruismans	92.4	300	5.0%	1.39				
G30B2	Soutkloof	17.8	415	23.0%	1.69				
G30B2	Soutkloof	194.5	300	5.0%	2.92				
G30B3	Huis tributary	53.8	505	23.0%	6.25				
G30B3	Huis tributary	288.5	300	5.0%	4.33				
<b>G30B_Total</b>					<b>19.32</b>	<b>0.053676</b>	<b>3.5056685</b>	<b>2.1537</b>	<b>13.61017</b>
G30C1	Kleinvlei	64.3	404	23.0%	5.98				
G30C2	Jansekraal	62.6	404	23.0%	5.81				
G30C3	Bergvallei	218.2	383	3.5%	2.92				
<b>G30C_Total</b>					<b>14.72</b>	<b>0.074207</b>	<b>1.541531375</b>	<b>6.33080</b>	<b>6.76926</b>
G30D1	KA upper	64.8	517	23.0%	7.71				
G30D1	KA lower	55.1	366	5.0%	1.01				
G30D2	Hol upper	51.7	517	23.0%	6.15				
G30D2	Hol lower	102.6	366	5.0%	1.88				
G30D3	Matroosfontein	128.2	347	3.5%	1.56				
G30D4	Verlorenvlei	151.8	347	3.5%	1.84				
<b>G30D_Total</b>					<b>20.14</b>	<b>0.03798867</b>	<b>3.286462</b>	<b>10.53787</b>	<b>6.27765</b>

# GROUNDWATER RESERVE DETERMINATION RESULTS: RESULTS

Sub-catchments used to calculate recharge	River System	Area (km <sup>2</sup> )	MAP (mm)	Estimated Recharge (% of total annual flow)	Calculated recharge (Mm <sup>3</sup> )	Total abstracted for Town supply (million m <sup>3</sup> )	Reserve (BHN + Springflow + Baseflow Contribution s)	Total abstracted for irrigation (million m <sup>3</sup> )	Groundwater Balance (million m <sup>3</sup> )
G30E1	Kruisfontein	90.4	286	3.5%	0.91				
G30E2	Verlorenvlei	44.9	286	3.5%	0.45				
G30E3	Verlorenvlei	35.3	286	3.5%	0.35				
G30E4	Verlorenvlei	190.5	286	5.0%	2.72				
<b>G30E Total</b>					<b>4.43</b>	<b>0.443172</b>	<b>0.791505375</b>	<b>2.9434064</b>	<b>0.25440</b>
G30F1	Langvlei	194.2	352	3.5%	2.39				
G30F2	Lambertshoek	98.9	352	23.0%	8.01				
G30F3		397.8	236	3.5%	3.29				
G30F4		30.2	212	3.5%	0.22				
G30F_Groundwater_North		20.2	175	3.5%	0.12				
G30F_Groundwater_South		59.1	212	3.5%	0.44				
<b>G30F Total</b>					<b>14.47</b>	<b>0.98592</b>	<b>1.713247375</b>	<b>18.43323</b>	<b>-5.10282</b>
G30G1	Jakkals	134.4	268	xx	11.15				
G30G2	Peddies	49.4	268	23.0%	3.05				
G30G3		317.5	208	3.5%	2.31				
G30G4		21.7	138	3.5%	0.10				
G30G_Groundwater_West		89.8	138	3.5%	0.43				
G30G_Groundwater_East		44.2	208	3.5%	0.32				
<b>G30G Total</b>					<b>17.37</b>	<b>0.203213</b>	<b>0.670242125</b>	<b>3.616832</b>	<b>12.87576</b>
G30H1		580.8	204	3.5%	4.15				
G30H_Groundwater		495.4	138	3.5%	2.39				
<b>G30H Total</b>					<b>6.53</b>	<b>0</b>	<b>0.059102625</b>	<b>2.31426</b>	<b>4.16041</b>
F60A	Brak	386	103	3.5%	1.39	0	0.0010585		1.39047
F60B	Klein-Goerap	320	129	3.5%	1.44	0.183146	0.008513625		1.25314
F60C	Sout	622	114	3.5%	2.48	0	0.00406975		2.47771
F60D	Groot-Goerap	481	120	3.5%	2.02	0	0		2.02020
F60E		120	116	3.5%	0.49	0	0.000556625		0.48664
G10K_Groundwater_North		201.5	505	23.0%	23.40	0		unknown Z	23.32-XYZ

# GROUNDWATER RESERVE DETERMINATION

## RESULTS: RESULTS

- From the data, it was observed that currently only G30F came out with a negative water balance. Although this area has been flagged as a potentially over-abstracted area, other areas of concern have displayed a positive water balance. This is likely due to the high recharge value that was used for sub-catchments dominated by the TMG formations, which have displayed high recharge values during the latest studies done in the area.
- Although these studies were focused on the Moutonshoek (G30D) catchment, it was decided that the higher recharge linked to the fractured TMG outcrops displayed through these studies is more accurate than the regional GRAII recharge values. It is however possible that the recharge for the TMG outcrops outside of the G30D and G10K mountains can be lower and it is thus suggested that the calculations be updated once additional recharge studies, are completed.
- The recharge calculations are presented in multiple spreadsheets, to allow DWS to continually update the calculations as more data becomes available

# GROUNDWATER RESERVE DETERMINATION RESULTS: MONITORING RECOMMENDATION

- Springflow monitoring at Eendekuil, Kruisfontein, Papkuils and any significant springs identified. Matroozefontein spring data must be obtained from Bergrivier Municipality on a quarterly basis.
- No monitoring in F60 catchments, monitoring sites need to be included in the DWS monitoring network.
- For the G30 catchments, more monitoring sites needs to be included on the Mountains (the assumed recharge areas for these catchments)
- **Monitoring sites are also vitally needed in the Bergvallei, Kruismans and Jansekraal valleys, as no monitoring data could be obtained for these areas.**
- Important aquifers have been delineated to assist in guiding monitoring site areas, as well as delineating areas where baseflow and spring flow could be affected by groundwater abstraction



# GROUNDWATER RESERVE DETERMINATION RESULTS: MONITORING RECOMMENDATION

- The directive from the 2018 Government Gazette regarding the monitoring of groundwater abstraction volumes must be enforced and databases of abstraction data must be developed per catchment.
- For the northern G30 catchments not part of the Verlorenvlei system, it is recommended that isotope and inorganic sampling commences to investigate the link between the E10 and the coastal G30 catchments of the northern Sandveld. Baseflow and streamflow studies similar to what has been done for Verlorenvlei rivers is also recommended to occur through universities.
- G30E: During the drought of 2016-2018, it was reported that when this area of the upper Verlorenvlei wetland dried up completely, a small pool of water in the centre of the wetland area kept getting wet during the night and then dried during the day. This report could not be investigated as that portion of the wetland did not completely dry up during 2021 and 2022, but it would be recommended that if this occurs again, the pool is sampled. It would be difficult to sample (because of the mud layer), but could possibly be done with a drone.

# GROUNDWATER RESERVE DETERMINATION RESULTS: MONITORING RECOMMENDATION

Quaternary catchment	Aquifer Characteristics	Indicator	Description	Numerical Values			Monitoring Recommendations
				Range identified in NGA	Range identified in production boreholes	Recommended Limit	
G30A	Spring flow	Stream flow	Currently, the spring flow at Papkuils Seepage Area is not being monitored. This is a vital wetland and currently, the exact flow is unknown. The WARMS abstraction point linked to the spring is also seen as very conservative as the volume registered would not result in a wetland of this size.	-	n/a	Need to be determined from stream flow monitoring.	It recommended that this seepage area be installed with a spring flow infrastructure just before the stream goes under the road and that the water quality is also monitored on a quarterly basis. DWS monitoring needs to increase to include sites around spring
	Groundwater Levels	Groundwater level (mbgl)	Groundwater levels should be managed sustainably as to not allow water levels to drop below calculated critical water levels (obtained from yield test data). Where boreholes are located in areas that have been linked to baseflow, groundwater abstraction cannot take place if radius of influence is > 0.5m at stream location. Water levels should recover during wet season.	0.1 - 150	1 - 8.7	Should be maintained per borehole. In areas of groundwater-surface water interaction, groundwater flux to surface water must be maintained. Abstraction must decrease or stop if continued negative trend is observed. 1 mamsl (<10km from coast)	Currently limited DWS monitoring in this catchment. Monitoring boreholes must be identified. It is recommended that monitoring sites be identified in the delineated important aquifer area.
	Groundwater Abstraction	Abstraction rate (L/s)	Approved abstraction must allow for drought restrictions and be lowered when water levels in the area displays a continued declining trend and when baseflow and streamflow is impacted.	0.01 - 28	n/a	n/a	The 2018 Government Gazette regarding the monitoring of groundwater abstraction volumes must be enforced and databases of abstraction data must be developed per catchment

# GROUNDWATER RESERVE DETERMINATION RESULTS: CONCLUSIONS

- G30: Groundwater use is extensive, drop in water levels observed, important aquifers have been delineated where monitoring needs to be focused. Baseflow, seepage areas and springs does seem to be targeted. Abstraction is VERY localised, so even if water balance is positive, baseflow component seems to have been removed through over-abstraction of these areas in some catchments. Monitoring sites in recharge areas and springs are vitally needed. Additional studies have been recommended.
- F30: Close to reference conditions, but vulnerable to pollution from mines. No data for these areas, monitoring needs to be put into place. Sampling of surface water is needed, could ask community leaders (Lepelsfontein), farmers, municipality (Bitterfontein) and mines to assist with this as flow events are sudden and area is very remote.

**Thank You**





# GROUNDWATER RESERVE DETERMINATION RESULTS: CONCLUSION

- G30A (Papkuils):
  - Although some boreholes displayed a drop in water levels, others stayed more or less stable, pointing to localised drawdown due to high abstraction volumes. More boreholes are reportedly being drilled near the Papkuils river channel, so abstraction could be targeting surface water and baseflow.
- G30B (Upper Kruismans):
  - All the abstraction is also focused on one area and could be affecting the baseflow of the upper Kruismans tributaries much more than accounted for in this catchment. More groundwater data is needed to confirm potential groundwater over-abstraction and abstraction from baseflow for the southwestern corner of this catchment.

# GROUNDWATER RESERVE DETERMINATION

## RESULTS:CONCLUSION

- G30C (Bergvallei):
- Localised groundwater abstraction is perceived to be high for this catchment. Boreholes are drilled into the stream bed and large orchards are planted within the riparian zone and drainage. Abstraction seems to thus be focused on the baseflow and thus even though the water balance gave a positive value for this catchment, the current abstraction could likely be impacting the baseflow and surface water systems to a negative degree.
- G30D (Lower Kruismans,Krom-Antonies and Hol):
- The upper Krom-Antonies have been linked to the surrounding aquifers and thus the abstraction could be impacting the baseflow as many of the production boreholes are reported to be located adjacent to the river or seepage areas. Because of high rainfall and the proven high recharge in the TMG, this catchment could still have a positive water balance even though abstraction is high. The concern, however, is that groundwater linked to baseflow is being targeted and thus having an impact on the surface water.

# GROUNDWATER RESERVE DETERMINATION

## RESULTS:CONCLUSION

- G30E (Verlorenvlei):
- The abstraction volumes linked to town supply and the irrigation of potatoes should be correct, although high nitrates in certain areas could be seen as an indicator of over-irrigation due to high summer temperatures and wind. If more accurate abstraction figures are obtained, the irrigation figure used could be termed conservative. Another point of note is that the Kruisfontein Springs does not have any flow values, and the WARMS values used could be found to be very conservative. An average drop in the groundwater levels of about 2m could also be observed in the long-term monitoring data for boreholes located around the wetland. Abstraction in this catchment is focused on one paleo channel type structure that includes the Kruisfontein spring.



# GROUNDWATER RESERVE DETERMINATION RESULTS: CONCLUSION

- G30F (Langvlei and Wadrift):
  - This area has been calculated as having a negative water balance in the current study as well as the previous reserve calculated in 2012. This is mainly due to the large areas of irrigation as well as the high volume (when compared to the rest of the Sandveld) linked to the town supply. Water levels for this area do show a drop and with the drying up of the lower Wadrift wetland having been linked to over-abstraction of groundwater, the negative water balance could be shown to be accurate for the area.
- G30G (Jakkals):
  - This catchment displays a high positive water balance. This is due to the high recharge of the TMG observed in G30D being used for the upper Peddies and Jakkals catchments. It is recommended that studies be done for the Langvlei, Jakkals and Papkuils to investigate baseflow and recharge for these systems. When more site-specific recharge values become available, this calculation should be updated.

# GROUNDWATER RESERVE DETERMINATION RESULTS:CONCLUTION

- G30H (Sandlaagte):
- Monitoring sites are not abundant, but the data available do display stable water levels, apart from one borehole located adjacent to the Sandlaagte river and just upstream of Strandfontein. The town reportedly does not use groundwater, but the drop could be linked to a potential abstraction nearby or be linked to the baseflow of the river.
- All G30:
- A positive water balance may be misleading as the abstraction of groundwater does seem to be focused on rivers and springs and thus could be impacting the baseflow and surface flow of systems to a very high degree, even though the water balance is positive.

# GROUNDWATER RESERVE DETERMINATION RESULTS: CONCLUSION

- F60 catchments (Namaqualand/Sout and Brak):
- For all of these water balances, the perceived abstraction is very low. Data could not be obtained to link the groundwater and surface water systems and it is recommended that sampling must occur to investigate these systems.
- Although the data was very limited, low-flowing springs are still present and inhabitants noted that they have not observed a drop in water level. Although groundwater availability and quality are considered to be much lower and poorer than the G30 catchments, the local communities are still reliant on the groundwater for non-drinking domestic purposes and animal drinking water for most areas.
- Because abstraction and use are linked to very low-yield boreholes and springs, and drop in water level and change in quality could have a detrimental effect across the area. It is thus recommended that any proposed mining activity, or any other proposed activity that could impact the groundwater in that, be closely evaluated, based on site-specific conditions, before any decision is made to approve such an activity.