GreenCape

Industry brief
2021

Alternative Water Sources: **Sustainable Groundwater Use**

A guide for water users and businesses

Main Insights

- *Groundwater plays a strategic role in contributing to the country's water security, but can also be depleted.*
- *In order to promote sustainable use, groundwater users should go beyond the general legislative requirements by measuring water quality and water levels.*
- *Collecting data on groundwater level and quality is not just beneficial to the aquifer, but also makes business sense.*

Context

South Africa (SA) is a water scarce country that is characterised by extreme climatic conditions and evaporation rates that often exceed precipitation. The country is projected to have a 17% water supply deficit by 2030 (DWS, 2019). This can be mitigated by increasing water efficiency and diversifying water sources. By 2040, alternative sources such as desalinated seawater, water reuse, including treated acid mine drainage and increased groundwater usage, will make a significant contribution to SA's water mix reducing overreliance on surface water (DWS, 2019).

Groundwater is an essential water resource that is critical in contributing to the country's water security and universal access to water and sanitation. Nationally, the potential sustainable groundwater yield is ~7 500 million m^3/annum (DWS, 2019). The reliable yield from groundwater is ~2 785 million m^3/annum (~15%) and is mainly supplied by 37 groundwater water source areas, which overlap with key aquifers (DWS, 2019). Approximately, 64% of extracted groundwater is used for irrigation purposes, while ~8% is used for mining and domestic consumption. Over 280 cities and towns (~66% of SA), are solely or partially dependent on groundwater for domestic needs (Knuppe, 2011), while over 74% of the rural population is entirely dependent on groundwater (UN Water, 2006). However, awareness and better management of this resource is required in order to ensure its sustainability.

Electro magnetic
loop for aquifer surveys.
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Groundwater governance

Groundwater is a national asset that is regulated by the Department of Human Settlement, Water and Sanitation (DHSWS) on behalf of the national government. The enacted National Water Act (36 of 1998) (NWA) provides the legal framework for the effective and sustainable management of resources. The NWA recognises:

- Water resource management as the ultimate aim to achieve sustainable and equitable water use.
- Sustainability and equity as central guiding principles in the protection, use, development, conservation, and management of water resources.
- The necessity to protect the quality of water resources to ensure sustainability.

The NWA under Section 21 describes 11 different water use activities, with the pertinent ones to groundwater use being: abstraction of underground water, storing of water discharges and disposals of waste or water containing waste or water found underground, and any controlled activities which detrimentally impact water resources. Section 26 of the NWA limits the purpose, manner or extent of water use, and requires that the use of groundwater be monitored, measured, recorded and be registered with the responsible authority (RA). Groundwater use must be licensed unless it is listed in Schedule 1, is an existing lawful use (ELU), is permissible under a general authorisation (GA), or if the need for a water use licence (WUL) is waived.

Schedule 1	Generally, applies to low volume (reasonable) groundwater use, consistent with domestic use (non-commercial uses), recreational use, livestock watering, and for emergencies. Currently, this is capped at an average of 10 kl/day. Residents may use groundwater on their properties for reasonable domestic use without a licence or general authorisation [1]. However, water use entitlement under Schedule 1 does not supersede and is subject to limitation by any other law, ordinance, regulation or by-law set by the RA in that area, e.g. municipality, Water Management Area (WMA) and provincial government.
Existing Lawful Use	Legal groundwater use obtained before 1998 under the Water Act (54 of 1956) is considered as existing lawful use (ELU) and is subject to terms and registration under the NWA. Groundwater use that is neither registerable under Schedule 1 nor under ELU must be registered under a GA or apply for a WUL.
General Authorisation	General Authorisations (GAs) replace the need for a WUL in terms of Section 21 of the NWA as outlined in a Government Notice (GN). Conditions for issue of GA and WUL under Section 29d, *in the case of controlled activity*, GN 665 of 6 September 2013[2] specifies the management practices to prevent groundwater pollution. GN 131 of 17 February 2017[3] and GN 15 of 12 January 2018[4] requires the installation of a self-registering measuring device for groundwater abstracted for irrigation purposes, nationally and for commercial purposes in the Berg, Olifants and Breede Gouritz WMA, respectively. The user must keep a record of all the data obtained (at least monthly) from the water measuring device for at least five years. The data must be supplied to the RA on a monthly basis and/or on request. Section 29e of the NWA in the case of *taking or storage of water*, the current GN 38 of 2 September 2016[5] sets out the allowable groundwater abstraction rates (0, 45, 75, 150, 275, and 400 kl/hectare/annum) per drainage region. The City of Cape Town is subject to an abstraction limit of 400 kl/hectare/annum, with an exception of the northern region which is limited to 150 kl/hectare/annum (WWF, 2020). Additionally, no groundwater may be abstracted in terms of the GA within a 100 m radius from the delineated riparian edge of a water course/state dam, within a 500m radius from the boundary of a wetland/estuary/state dam wall/high ocean water mark. The free registration of a GA through DHSWS typically takes a few weeks and the responsible authority must acknowledge receipt of an application for registration within 30 days. Groundwater use that exceeds the limits posed by Schedule 1 and GA, requires licensing.
Water Use Licence (WUL)	A WUL applies if the water use activities cannot be covered under Schedule 1, ELU, or GA in accordance to Section 21 of the NWA. The government recently committed to ensuring that a WUL is issued within 90 days, an improvement from the previous ~300 days' timeframe[6].
By-laws	As indicated, municipalities may also regulate the purpose of groundwater use under their by-laws and water restrictions. In the case of the City of Cape Town, commercial entities wishing to embark on alternative water supply projects or being off the grid, i.e. off municipal supply, must apply to sink a borehole/well point and/or to become a Water Services Intermediary (WSI)[7].

1 Local authorities may still require registration of boreholes or well points e.g. City of Cape Town
2 http://extwprlegs1.fao.org/docs/pdf/saf126916.pdf
3 https://cer.org.za/wp-content/uploads/1999/12/Taking-water-for-irrigation-purposes.pdf
4 https://www.greengazette.co.za/notices/national-water-act-1998-breede-gouritz-and-berg-olifants-water-management-areas-limiting-the-use-of-water-in-terms-of-item-6-of-schedule-6-of-the-act-for-urban-irrigation-and-industrial_20180112-GGN-41381-00015.pdf
5 https://cer.org.za/wp-content/uploads/2010/05/National-Water-Act-1998-36-1998-Revision-of-General-Authorisation-for-the-taking-20160902-GGN-40243-00538.pdf
6 https://www.dws.gov.za/Communications/Opinion%20Pieces/2020/Water-use%20licence%20a%20catalyst%20for%20growth%20and%20development.pdf
7 https://www.greencape.co.za/content/groundwater-application-process/

Sustainable use of groundwater

Sustainable groundwater use gives assurance that groundwater will be available for future generations. In some instances, groundwater storage has been established over many years of rainfall and although it can be considered a renewable resource, it can be depleted in the long term if not properly managed. Understanding the state (quantity and quality of available supply, and demand) of groundwater source areas is critical in groundwater management. The adage "you cannot manage what you do not measure" applies to the management of groundwater resources. Unmonitored abstraction and over-exploitation of groundwater persists and this poses a risk to the sustainability of the resource. In areas of large scale groundwater use, boreholes have been known to pump dry, some temporarily, due to lack of insight on the aquifer storage capacity and subsequent over abstraction.

Sustainable groundwater use requires effective management that goes beyond monitoring groundwater abstraction volume, and incorporate monitoring of water levels and quality. However, investment in resource management is often seriously neglected. In the absence of management, and with ongoing resource development, the consequences include contamination and salinization of groundwater, land subsidence, decreasing water tables and reduction in groundwater contribution to groundwater dependent ecosystems. If borehole yield (volume) and level is monitored together, the aquifer response to abstraction is better understood, enabling optimisation of pumping rates and duration.

Monitoring groundwater quality in abstraction boreholes assists in identifying changes in aquifer water chemistry, and the possible drawing in of water from adjacent aquifers or surface water features.

In an industrial setting, groundwater users abstracting from the same aquifer can cooperate, share data and take the necessary steps to ensure sustainable groundwater use. However, unregistered users do not appear on the Water use Authorisation and Registration Management System (WARMS), a centralised database for collecting and compiling groundwater use data. The unavailability of reliable data affects the confidence level of developed groundwater models that are helpful in predicting safe abstraction rates under different climatic conditions, and at different scenarios of water use, aquifer recharge and depletion. The establishment of a citizen science groundwater monitoring network, would support the development and calibration of a model for a specific groundwater resource area. For example, The Table Mountain Water Source Partnership formed in 2020, with the vision to improve water security through monitoring and management, to ensure water resources can continue to support people and the ecosystem in and around the Table Mountain Strategic Water Source Area. Specific focus is currently given to expand the understanding of groundwater use across Cape Town, and promote measuring, responsible management and sustainable use. The partnership aims to strengthen good governance of groundwater and collectively address key threats to water security.

Recommended borehole monitoring and management

To facilitate monitoring and informed management of a borehole, it is highly recommended that a borehole be equipped with the following monitoring infrastructure and equipment **(Figure 1)**:

1. Installation of a flow volume meter to monitor abstraction rates and volumes (compulsory).

2. Installation of a 32mm (inner diameter, class 10) observation pipe from the pump depth to the surface, closed at the bottom and slotted for the bottom 5 – 10m. This will allow for a window of access down the borehole which enables manual water level monitoring and can house an electronic water level logger. Some boreholes are quite narrow and even a 10 mm observation pipe will be useful as a 4 mm dip meter can be used to measure water levels, even though water levels cannot be electronically logged.

3. Installation of an electronic water level logger for automated water level monitoring. This can also be done via manual measurements at least monthly. The electronic logger is not a minimum requirement, but water level measurements must be taken. Water level loggers vary in price and functionality, costing between R5 000 and R11 000.

4. Installation of a sampling tap for water quality monitoring. Analyses will depend on groundwater use and the relevant parameters, but even monitoring just pH and EC (a measure of salinity) by means of a hand held device (~R 7 000) will provide an indication of water quality change.

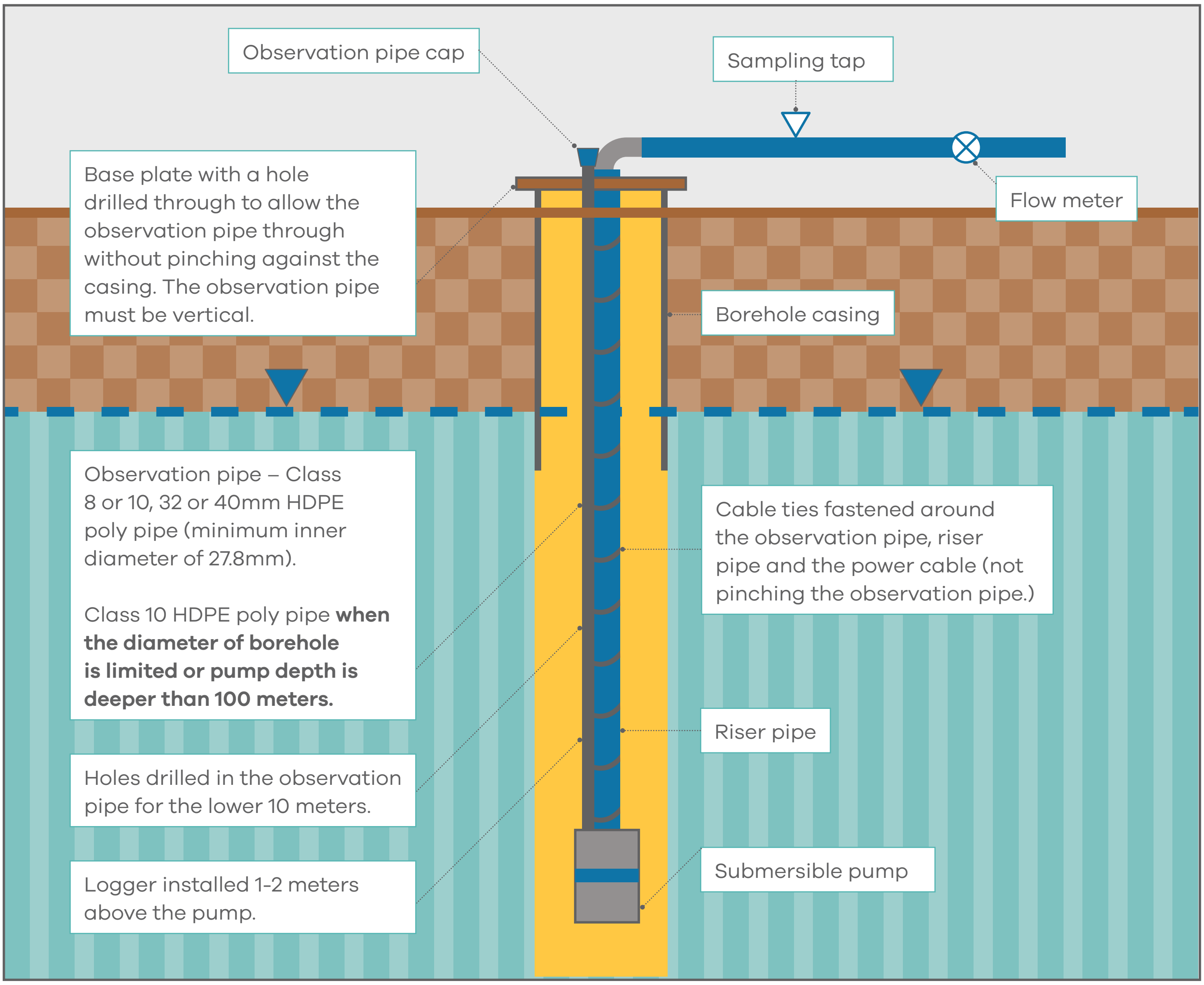

Figure 1: Diagram of a borehole equipped with an observation pipe, water level logger, flow meter and sampling top. Courtesy of GEOSS

Case Studies

During the recent drought in the Western Cape, industry sought to develop alternative water sources to ensure continuity of supply, and to alleviate pressure on the City of Cape Town's supply network. Two businesses that were able to successfully develop groundwater resources are Distell and Coca Cola Peninsula Beverages. In doing so they were able to improve their water security and support the greater community in avoiding the "Day Zero" scenario. Following the borehole design, drilling and construction, the boreholes were tested according to SANS 10299-4:2003 guidelines to determine their yield. Furthermore, representative samples were analysed to establish the groundwater quality. This enabled the appropriate equipping of the boreholes (in terms of pumps, monitoring, storage and water treatment as required). Distell and Coca Cola Peninsula Beverages obtained their WULs, which prescribed the relevant monitoring and management measures. These businesses are great examples of how groundwater can provide a long term sustainable supply source that is both reliable and dependable.

Distell Monis 01

The Distell Monis borehole was equipped with an observation pipe, water level logger, flow meter and sampling tap (Figure 2). The installation is housed in a clean, open and secure environment to ensure the protection of the borehole and aquifer from contamination. Figure 4 illustrates the water level drawdown in the production borehole, relative to the maximum water level as determined during the yield testing. Quarterly manual water level measurements confirm the validity of the logger data, and through ongoing monitoring, the abstraction volume has been optimised (without compromising the sustainability of the resource or exceeding the licensed abstraction volume). By monitoring their borehole in this manner, Distell is able to manage its groundwater use in an informed manner, knowing that the supply source is sustainable into the future.

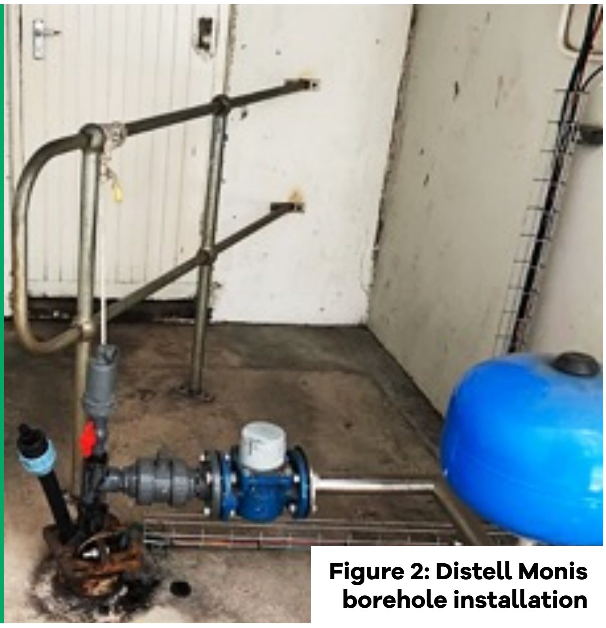

Figure 2: Distell Monis borehole installation

Coca Cola Peninsula Beverages 02

Coca Cola Peninsula Beverages monitor their boreholes in real time with telemetry, enabling immediate response to groundwater level and quality data. The installation is in a secure environment and the borehole is protected from contamination (Figure 3). Real time measurement of electrical conductivity (EC) and pH has been stable which, along with routine laboratory analysis checks, confirm that aquifer quality is as expected. Figure 5 indicates how pumping is managed over a one-month period to ensure the water level does not get drawn down below the maximum recommended level. The graph also illustrates the recovery of the borehole, and how the pumping schedule is managed.

Figure 3: Coca Cola Peninsula Beverages borehole installation

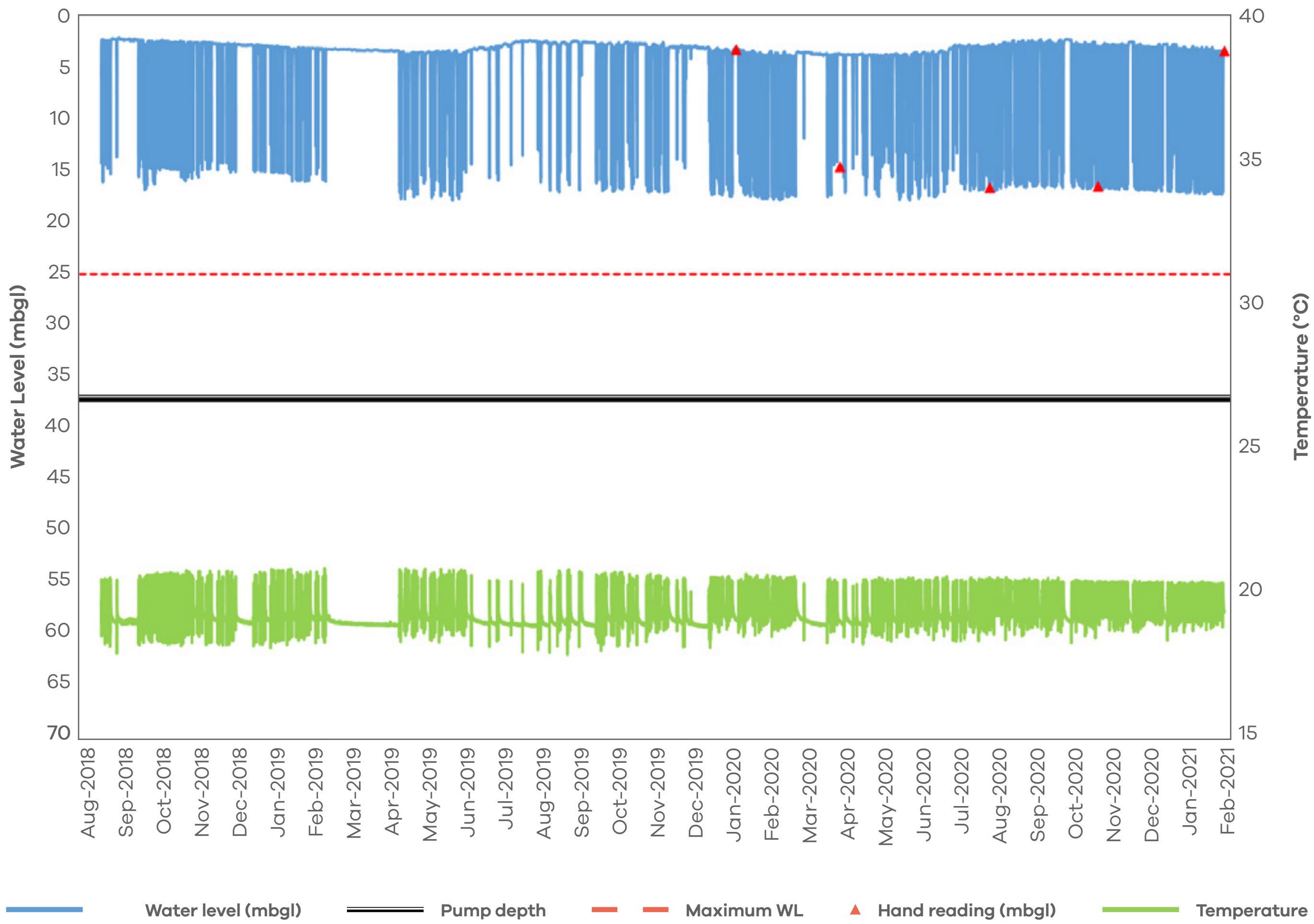

Figure 4: Graph showing water level and temperature at Distell Monis borehole installation

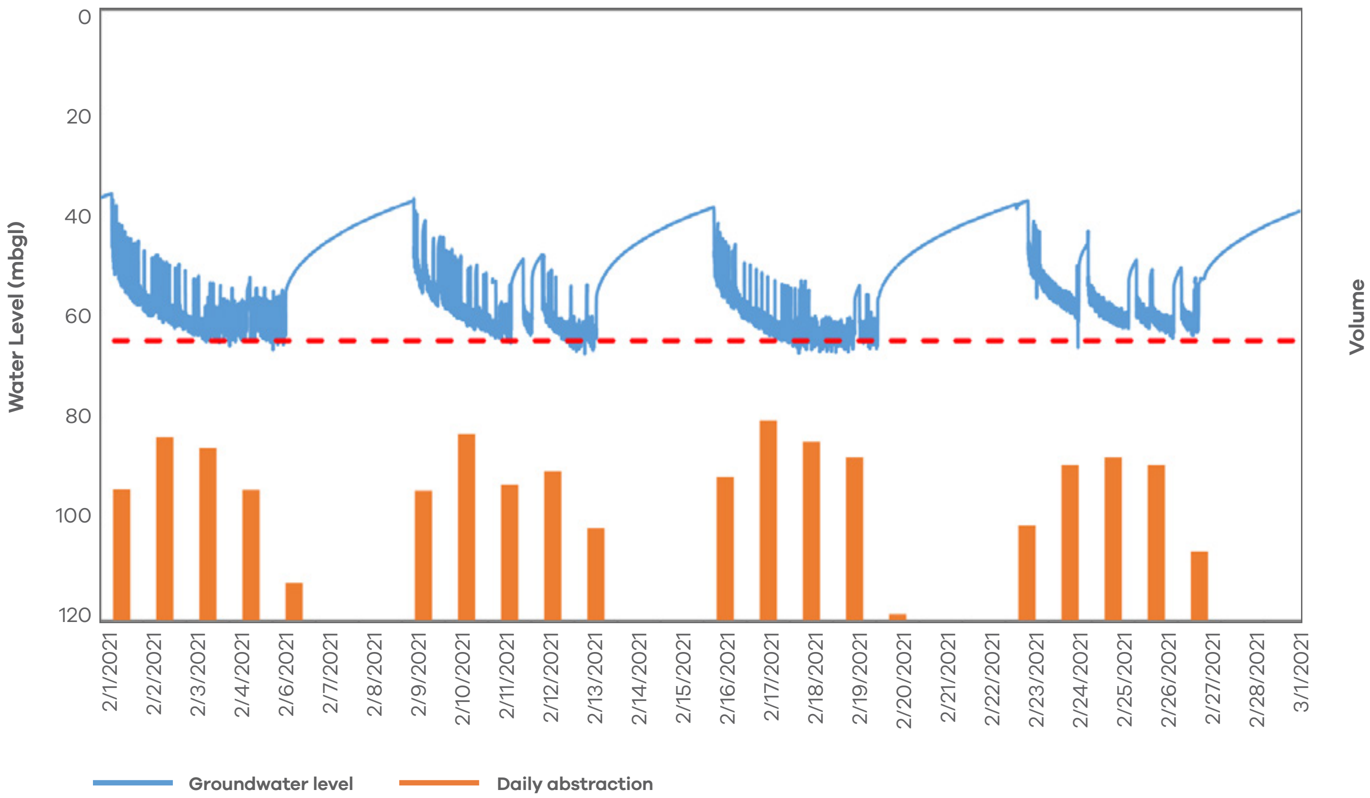

Figure 5: Graph showing water level response with daily abstraction at Coca Cola Peninsula Beverages borehole installation

Conclusion

Groundwater is an increasingly important resource for meeting the country's water needs. It is imperative that as we increase our reliance upon it, that we use it in a sustainable manner. To this end, it makes both environmental and business sense to manage it through careful monitoring. There are multiple success stories that showcase the benefit of taking a scientific approach towards monitoring and, which ultimately results in sustainable use of groundwater.

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Next steps

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