Uley South groundwater model

Summary of scenario work

Department for Environment and Water

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DEW Technical report 2024/7

Government of South Australia
Department for Environment and Water

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Acknowledgement of Country

We acknowledge and respect the Traditional Custodians whose ancestral lands we live and work upon and we pay our respects to their Elders past and present.

We acknowledge and respect their deep spiritual connection and the relationship that Aboriginal and Torres Strait Islanders people have to Country.

We also pay our respects to the cultural authority of Aboriginal and Torres Strait Islander people and their nations in South Australia, as well as those across Australia.

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Summary

A groundwater flow model has been developed for the Uley South Basin (DEW 2020a). This model has been used to help understand resource condition and run scenarios assessing future climate trends and groundwater extraction conditions. The model report includes a detailed assessment of the impact of conceptual and parameter uncertainty on model results and was externally reviewed (Middlemis 2019).

The model has been updated annually with new extraction and climate data and used to run various scenarios documented in six reports (DEW 2020b; DEW 2021a,b; DEW 2023a,b; DEW 2024a). Several of the scenario reports have been externally reviewed (Cook and Post 2021a,b; Cook 2024). A recent post-audit of the model has demonstrated it to be fit for purpose for ongoing use (DEW, 2024b).

The model scenarios generally show that a reduction in pumping to 3.5 GL/y mitigates the risk of adverse impacts on the groundwater resource (DEW 2020b, 2021b, 2023a,b). These impacts include seawater intrusion and reduced levels in extraction wells (which have historically been associated with increases in salinity). Under scenarios where extraction is reduced, there may be ongoing impacts to the resource associated with declining rainfall recharge from climate change (DEW 2023b).

Regardless of future pumping volumes, ongoing monitoring of the resource, updating of the modelling and assessment of trends will be crucial to managing the resource and reviewing water management strategies for the Eyre Peninsula.

1 Background

The Uley South Basin is the primary source for municipal water supply on the Eyre Peninsula. Concern over declining groundwater levels and increasing salinity in recent years has raised the risk profile in this basin. This has occurred in the context of groundwater extraction for public supply ceasing from the Tod Reservoir in 2002, the Robinson Basin in 2007 and the Polda Basin in 2008. Extraction from these sources was ceased due to rising salinity (and other contamination issues in the case of the Tod Reservoir).

Groundwater has also been obtained from the Uley-Wanilla and Lincoln lenses to supplement supply from Uley South to meet peak summer demand. However, 46% of observation wells in Uley-Wanilla are currently showing their lowest levels on record, while 45% of wells in the Lincoln lens are below average. Consequently, these lenses are highly unlikely to be able to continue to meet peak summer demand.

The status of the Uley South groundwater resource has been reported as 'average' for 2022/23 based on measured groundwater levels. The length of monitoring record among those wells ranges from 14 to 63 years. In 2022/23, the groundwater levels observed in 51% of the monitoring wells were in the mid-range of observations in their monitoring records (32% of wells report below average levels). However, over the past 20 years, groundwater levels in the Uley South aquifer have remained within less than 1 metre of a historical minimum levels which previously led to salinity increases in town water supply wells (DEW 2024b).

2 Groundwater model

2.1 Groundwater model development

SA Water collaborated with the Department for Environment and Water (DEW) to develop a groundwater flow model for the Uley South Basin to understand resource condition and run scenarios assessing risks from future climate and extraction scenarios (DEW, 2020a). In addition to simulating groundwater flow, the model simulates the position and movement of the seawater interface with the SWI2 package (Bakker et al 2013). The SWI2 package assumes a sharp interface between seawater and freshwater, and hence does not account for diffusion and dispersion.

This model has since been updated several times to include new metered extraction data and recharge information and run additional scenarios (DEW 2020b; DEW 2021a,b; DEW 2023a,b, DEW 2024b). These scenarios have tested multiple extraction configurations, extraction rates and assumptions regarding future rainfall recharge.

Results have shown that reduction in extraction to 3.5 GL/y mitigates the risk on seawater intrusion into the future. The 3.5 GL/y number is based on initial risk assessments for the basin and revised down from an earlier volume of 3.8 GL/y (Somaratne, 2019) which used a multi-criteria analysis.

This risk mitigation is in comparison to continued extraction of 5 G/y or higher. This includes scenarios in which recharge is low and continues to decline in line with RCP8.5 climate projections. The use of RCP8.5 projections is in line with recommendations in DEW's guide to climate change and risk assessment (DEW, 2022).

The seawater interface may continue to move inland as recharge declines regardless of reduced extraction and ongoing monitoring will be required to assess risks into the future.

2.2 Model scenarios

Various scenarios have been run since the model was constructed assessing the impact of different extraction and climate assumptions. Most recently, scenarios have been run assessing the impact of pumping 5.5 GL/y into the future, assuming low rainfall recharge and climate change impacts on rainfall recharge in line with RCP8.5 climate projections (DEW 2024a). For comparison, the same scenario has been run with extraction reduced to 3.5 GL/y at the start of 2024. Results for groundwater level for both scenario are presented in Figure 2.1. Under the low recharge and climate change scenario, groundwater levels show continued decline. However, declines are pronounced when extraction is 5.5 GL/y.

Figure 2.2 shows the position of the seawater interface in a coastal well, SLE069. When pumping 5.5 GL/y, the elevation of the seawater interface rises by ~7.5m in the well, while pumping 3.5 GL/y the interface rises by 4.45m.

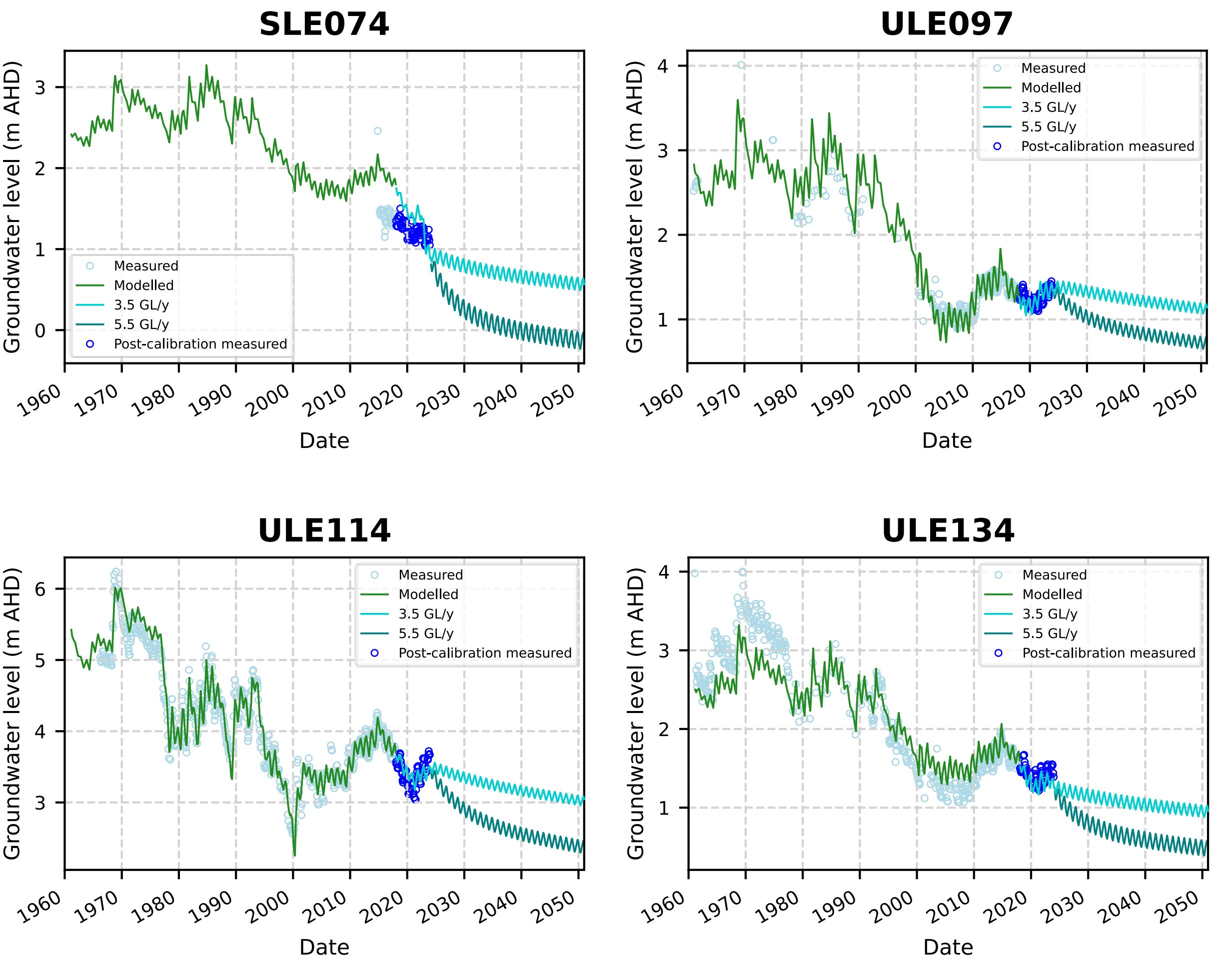

Figure 2.1. Measured vs modelled groundwater levels for scenarios

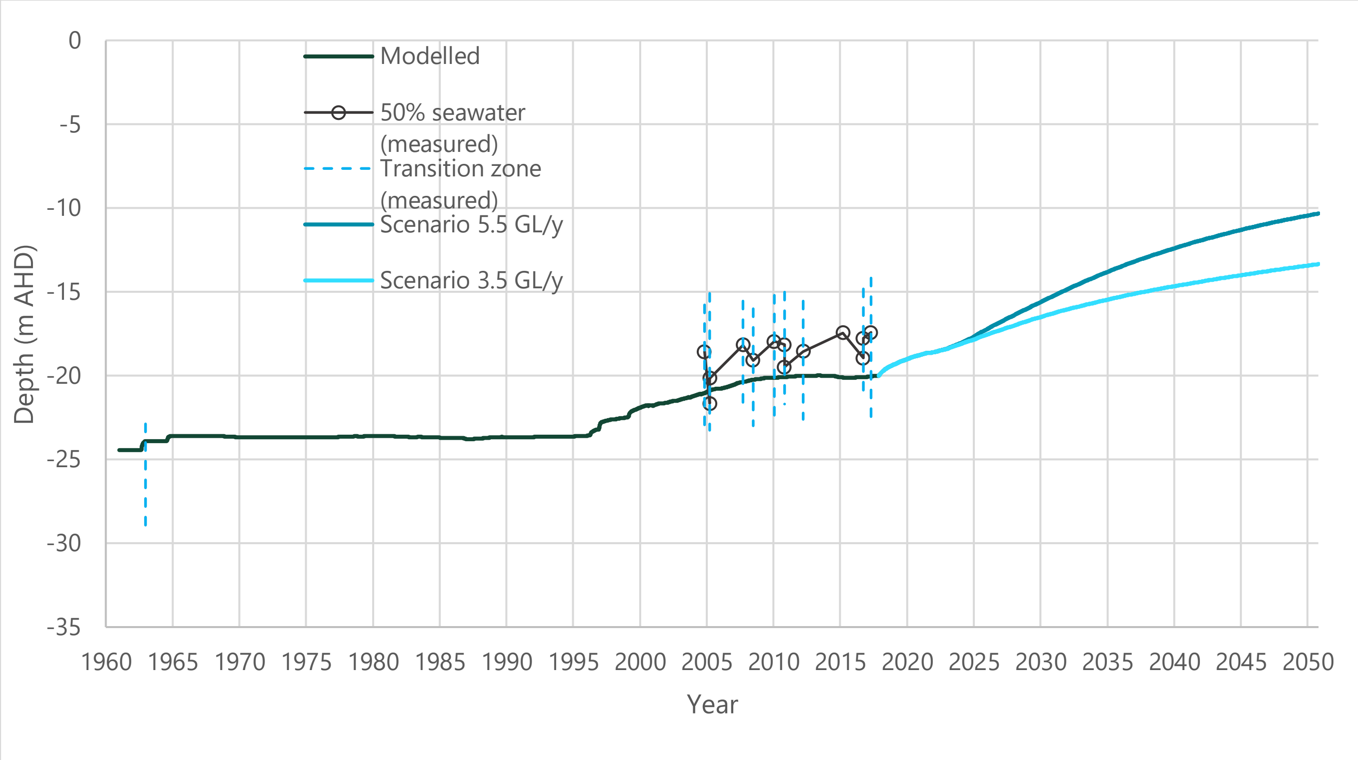

Figure 2.2. Modelled position of the seawater interface in a coastal observation well for both scenarios

3 Conclusions and recommendations

The Uley South groundwater model was developed to provide an understanding of groundwater resource condition and run scenarios assessing future climate trends and groundwater extraction conditions. The model has been updated annually and used to run several scenarios over the past 4 years assessing the impact of different extraction and climate conditions. Results generally show that reduction in pumping to 3.5 GL/y mitigates the risk of groundwater level decline and seawater intrusion.

Under assumptions of low rainfall-recharge and climate change impacts, groundwater levels may continue to decline and seawater intrusion may continue to occur. Given that the Uley South basin is extremely responsive to annual rainfall, it is critical that ongoing monitoring and, if needed, modelling is used to provide updates on the condition of the groundwater resource.

If rainfall continues to decline in future it may be necessary to further revise the extraction volume below 3.5 GL/y; however, this could occur through review timelines associated with the Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas.

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