LAND AND INFRASTRUCTURE

GISERA | Gas Industry Social and Environmental Research Alliance

Decision support framework for groundwater development scenarios

A research-based framework for managing future groundwater use in south east South Australia

This study developed and tested a decision support framework to improve management of groundwater resources in south east South Australia. The study was funded by the Federal and South Australian governments through the CSIRO's Gas Industry Social and Environmental Research Alliance.

Research results considered probable future groundwater use scenarios, from 2020 out to 2100, taking account of climate change and various future water use patterns for irrigation, forestry, onshore gas and other industries in the region.

Context

Onshore conventional gas development and operations in the Otway Basin in the south east of South Australia requires groundwater resources for the drilling and construction of wells.

Previous studies indicate that the conventional gas industry is unlikely to have a significant impact on groundwater resource quantity (Doble et al. 2020) or quality (Rassam et al. 2020).

However, the conventional gas industry operates within a region where the groundwater is highly allocated, demand is increasing, and climate change is expected to lead to a reduction in rainfall and groundwater recharge.

Increasing demands on available water resources and the requirement for sustainable development have implications for the amount of water available for agricultural and industrial uses in the future. This science-based decision support framework assists policy development and decision-makers to manage valuable regional water resources.

Stakeholder perspectives

The study investigated stakeholder perspectives on groundwater management and climate change adaptation, supported by the development and assessment of future climate scenarios incorporating changes to groundwater recharge, extraction and management.

Stakeholders represented landholders, forestry operations, irrigated agricultural businesses, onshore gas developers, environmental groups and government.

Key points

- Future predictions of groundwater recharge and drawdown were modelled from 2020 out to 2100.
- Projected future climate scenarios indicated a drying climate for the region.
- Groundwater modelling predicted a reduction in net recharge and corresponding decreases in water levels under all future climate scenarios.
- Corresponding changes in average groundwater level (drawdown) within the study area by 2100 ranged from 0.5m to 3.0m respectively from the wettest to driest scenarios.
- Increased extraction rates produced localised high levels of drawdown, while the effects of climate on drawdown were widespread.
- Projected decreases in groundwater levels are likely to affect wetlands and other high value groundwater dependent ecosystems as well as existing groundwater users.

CSIRO | Australian Government Department of Industry, Science, Energy and Resources | Queensland Government | NSW Government | Supported by Government of South Australia | Northern Territory Government | Australia Pacific LNG | QGC | origin | Santos

Groundwater scenarios

In consultation with stakeholders, various groundwater scenarios were developed to investigate changes in recharge and groundwater levels in the region, using plausible climate scenarios and associated changes in groundwater management and use.

Future predictions of potential groundwater recharge and groundwater drawdown were modelled for the period 2020 to 2100, with six-month summer and winter stress periods.

Relationships between net recharge and depth to groundwater were developed for wet, median and dry realisations of intermediate and high emissions futures, along with the current 2000-2020 baseline climate.

These realisations used global climate models tested by the Intergovernmental Panel on Climate Change (IPCC) and were calibrated to local climate data. The intermediate emissions future reflects the IPCC's representative concentration pathway RPC4.5 and the high emissions future reflects the IPCC's RPC8.5. Based on the IPCC's definition of uncertainties, by 2100 RCP 4.5 is very likely and RCP 8.5 is unlikely

Results

Projected future climate scenarios indicated a drying climate for the region.

Groundwater modelling in this study predicted a reduction in net recharge (reduction in gross recharge and increase in evapotranspiration sourced from groundwater) and corresponding decreases in water levels under all future climate scenarios.

Corresponding changes in average groundwater level (drawdown) within the study area by 2100 ranged from 0.5m to 3.0m respectively from the wettest to driest scenarios.

The increased rates of extraction produced localised high levels of drawdown, whereas the effects of climate on drawdown were more widespread across the model domain.

Any effects from additional groundwater pumping should be considered in combination with potential drawdown from climate change.

Carbon uptake

Inclusion of carbon uptake accounting in the groundwater model post-processing provided a means to combine water and carbon balances, and gave insights into the potential changes to carbon sequestration potential under future climates.

Carbon uptake was predicted to increase with milder future climates compared with current climates, if groundwater was available as a water source, but this increase is likely to be limited by higher temperatures and lower groundwater levels.

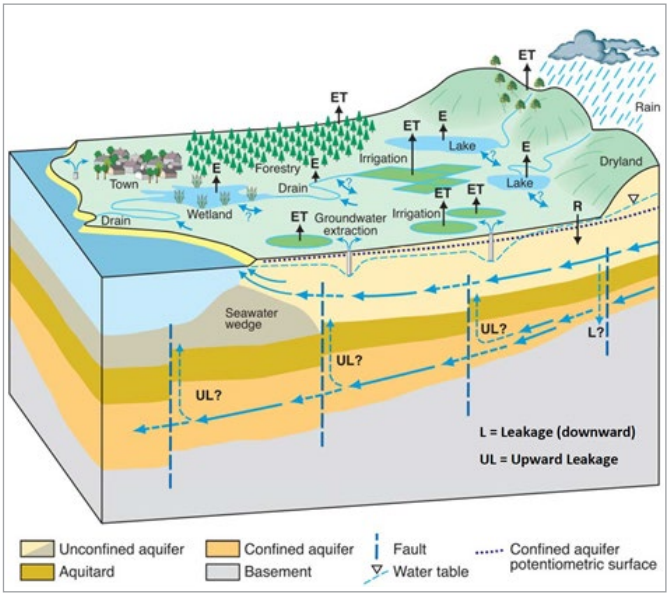

Figure 1: Geological and hydrogeological conceptual model of the South East (after Morgan et al. (2015))

Modifying drains

The study investigated the potential for modification of existing drains to retain water within the landscape and raise groundwater levels.

Modelling supported the idea that the infilling of drains could retain water in the landscape to offset current extraction rates. However, groundwater recovery was localised, and the volume of water retained is likely to be reduced under drier climates.

Stakeholder discussion

The findings from the modelling were presented to the stakeholders in a second workshop in June 2022.

Facilitated discussions helped understand stakeholder perspectives on future groundwater management and climate change adaptation, considering their individual and collective objectives and actions for management. The analysis indicated that while stakeholders from different sectors have distinct objectives and values for water, sustainable water management under a changing climate is a common purpose that all sectors shared.

Underpinning water allocation models with improved data and new knowledge generation was important to all groups.

More information

Read the final report

Find out more about GISERA's research in South Australia

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GISERA is a collaboration between CSIRO, Commonwealth and state governments and industry established to undertake publicly-reported independent research. The purpose of GISERA is to provide quality assured scientific research and information to communities living in gas development regions focusing on social and environmental topics including: groundwater and surface water, greenhouse gas emissions, biodiversity, land management, the marine environment, and socio-economic impacts. The governance structure for GISERA is designed to provide for and protect research independence and transparency of research.

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