

Potential impacts on groundwater resources from conventional gas in the South East of SA

Rebecca Doble, Trevor Pickett, Russell Crosbie, Dennis Gonzalez, Sreekanth Janardhanan

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Project objectives

- Investigating potential impacts of conventional gas on groundwater resources
- Shallow GW and complex ET and recharge processes
- Probabilistic modelling required for risk assessment
- Emulation of net recharge with modified MODFLOW NetR





Project outcomes

- Maximum drawdown at Dombey and Haselgrove 4 under planned extraction scenario has a 95% chance of being less than 14 cm immediately adjacent the wells
- This is of the same magnitude as the seasonal changes in groundwater elevation
- Maximum drawdown at Nangwarry in the confined aquifer has a 95% chance of being less than 4 cm
- Recovery of groundwater head is rapid after cessation of pumping
- This drawdown is unlikely to impact assets
- Extraction rates for gas development wells are 3% of total summer extraction and 9% of annual extraction for child model extent



Child model development

















Child model development - MODFLOW





Drains

Obs wells

Net recharge emulation (R– ET_{gw})





Flux – depth to groundwater relationships





South Australian to 2015) Land Cover Layers (Willoughby et al., from Landsat (1987 2018).



Transient net recharge curves

- Six month summer and winter stress periods
- ET dominates during summer
- Recharge dominates during winter
- Effects are most obvious when GW is shallow





Seasonal net recharge







Effects of change in landscape









Scenarios and metrics

- For each gas well, extraction of 2 ML over 1 year
- Dombey and Haselgrove 4 from unconfined aquifer, Nangwarry from confined aquifer.
- Probabilistic prediction of drawdown at the gas well locations
- Particle tracking for input to unsaturated zone modelling



Groundwater heads at well locations





Drawdown from pumping





Histogram of summer extraction rates





Water balance – netR annual





Conclusions - water balance impacts

- Maximum drawdown at Dombey and Haselgrove 4 under planned extraction scenario has a 95% chance of being less than 14 cm
- Maximum drawdown at Nangwarry in the confined aquifer has a 95% chance of being less than 4 cm
- This is of the same magnitude as the seasonal changes in groundwater elevation
- This drawdown is unlikely to impact assets
- Recovery of groundwater head is rapid after cessation of pumping
- The proposed gas well extractions are 3% of the summer extraction rate within the child model extent and 9% of the annual extraction
- The proposed gas well extractions represent around 1.7% of the water balance outflows for one year



Conclusions – netR model development

- Net recharge emulation used to capture recharge and ET behaviour where groundwater is shallow
- netR functions coded into MODFLOW-NWT
- Seasonally changing application of netR has been demonstrated
- Similar computational effort as MODFLOW-NWT with unsaturated zone processes incorporated
- NetR model calibrated with PEST using stretch and shift parameters for netR curves
- Particle tracking was possible due to finer scale and detailed model





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Pinkerton Palm Hamlyn & Steen Pty Ltd (photo credit)

Rebecca Doble Senior Research Scientist

- t +61 8 8303 8705
- e Rebecca.doble@csiro.au
- w gisera.csiro.au











