



GISERA

Gas Industry Social and
Environmental Research Alliance

Water impacts of onshore gas development

NSW research update

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GISERA – Gas Industry Social and Environmental Research Alliance

Surface and Groundwater projects in NSW

Project 1. Impacts of Coal seam gas depressurization on the Great Artesian Basin (GAB) flux

Project 2. Improving groundwater models to better represent coal seam gas extraction impacts in the Namoi region

Project 3. Water contamination risk assessment on hydraulic fracturing in unconventional gas extraction

Project 4. Data-worth analysis and spatial design of groundwater monitoring networks in the Narrabri Gas Project area



Australian Government
Department of Industry,
Innovation and Science

Questions

Project 1. Risks of water quantity impacts to Great Artesian Basin aquifer? Risks of water being lost from the recharge areas of GAB?

Project 2. What volumes of water will be extracted over the life time of the gas project?

Project 3. Contamination risk due to well bore delamination?

Project 4. When and where to do ongoing monitoring for early detection of water quantity and quality impacts and to improve predictive reliability?

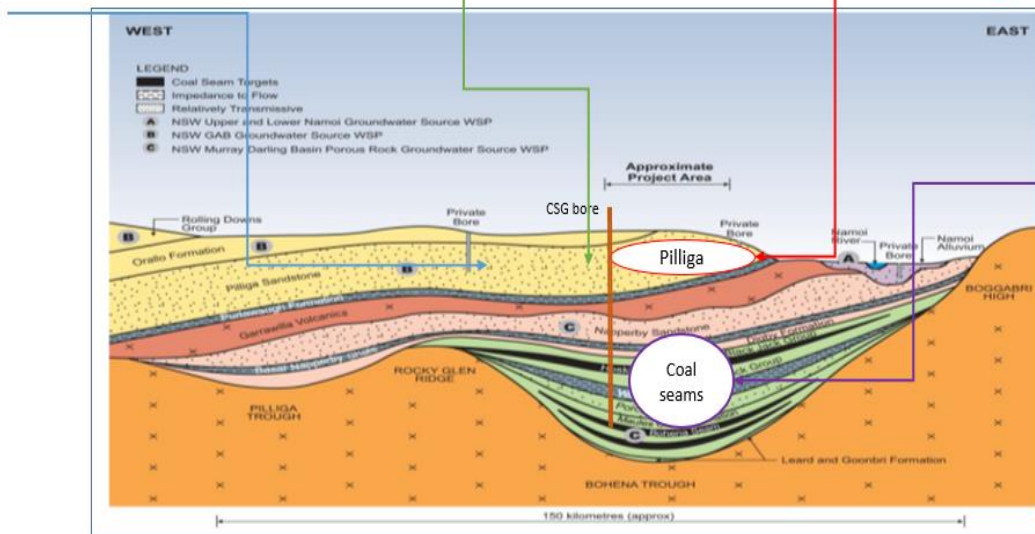
GISERA water research in the Namoi region

4 - Design of monitoring network:
Integrate data/knowledge to design optimal monitoring network

3 - Contamination risk assessment
1) Likelihood of potential contamination events

1 GAB Flux project:
1. Improved conceptual understanding of the groundwater interaction in Gunnedah/Surat Basins
2. Quantify probability extremes around GAB flux changes caused by CSG

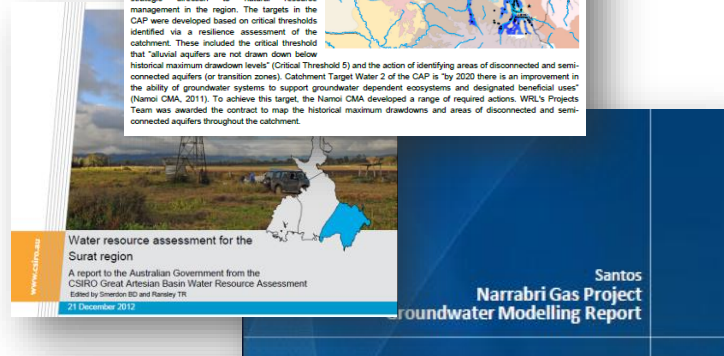
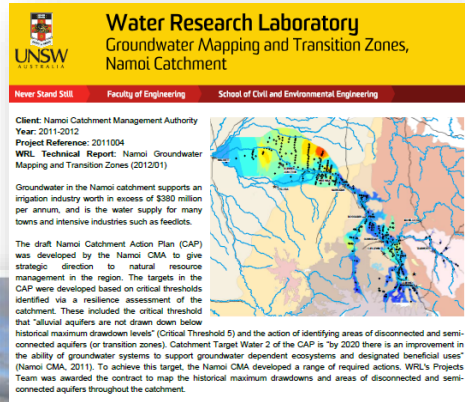
2 Upscaling reservoir processes to GW models research idea:
1) Improved understanding of drawdown propagation from the coal seams by upscaling reservoir processes



Cross section through the Surat and Gunnedah basins - CDM Smith (2014)

Background research

- SANTOS
 - Hydrochemical and isotopic assessment (Cresswell, 2014)
 - Santos LeapFrog model (groundwater)
- UNSW
 - research in the Namoi catchment
- **Bioregional Assessment**
 - Namoi subregion
- CSIRO
 - Great Artesian Basin Water Resources Assessment (2012)
 - Faults and Aquitards project
- DPI water studies



Groundwater numerical modelling for the Namoi subregion

Product 2.6.2 for the Namoi subregion from the Northern Inland Catchments Bioregional Assessment

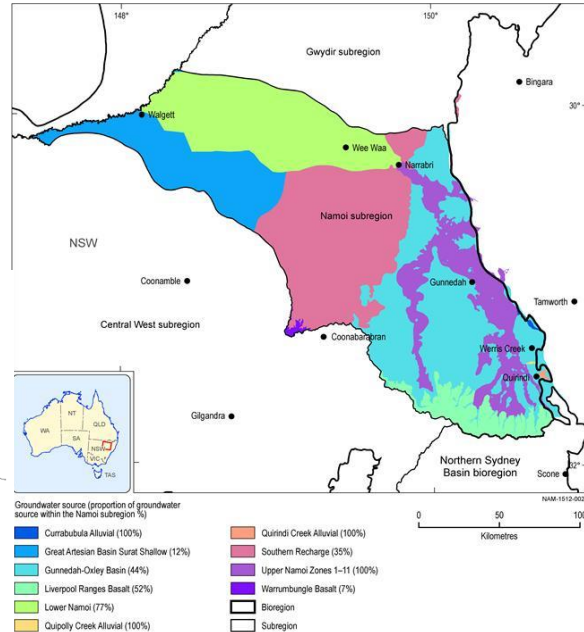
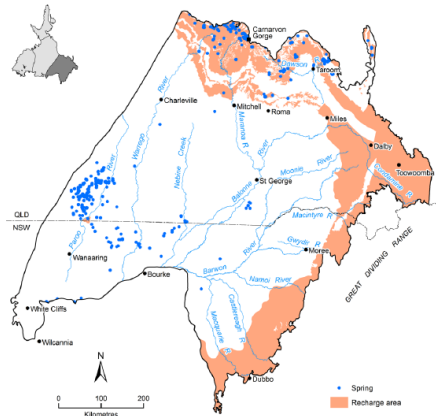
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For external review



Project 1 - GAB flux project

- Pilliga forest is part of the intake bed of GAB in NSW
- The groundwater source in this area is called the Southern Recharge Source (NSW Water Sharing Plan)

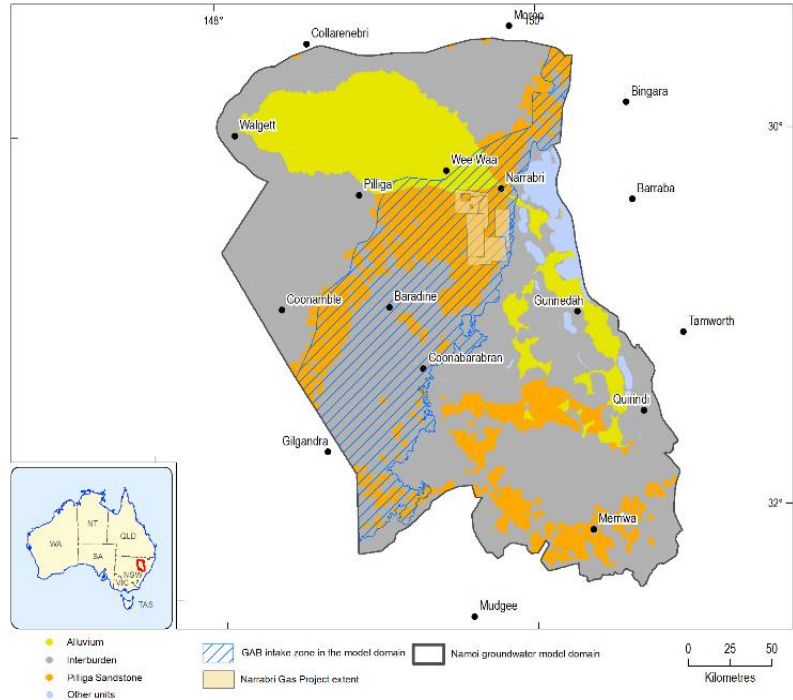


Pena-Arancibia et al. 2016 (Bioregional Assessment)

Smerdon and Ransley (Eds, 2012) Water Resources Assessment for the Surat region. CSIRO Great Artesian Basin Water Resources Assessment

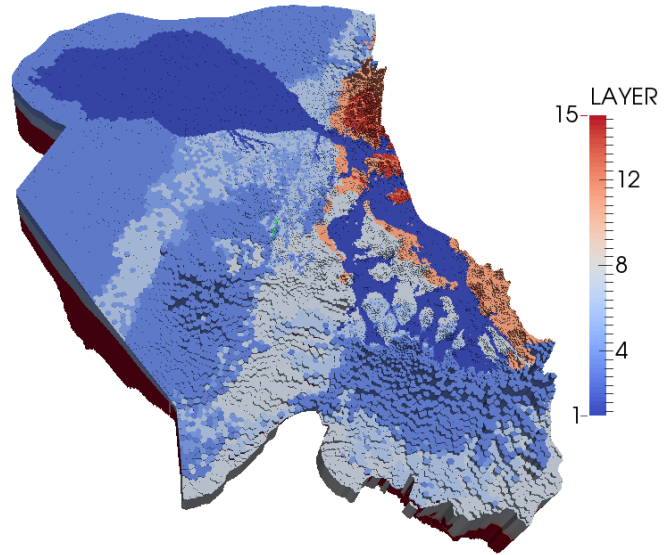
GAB flux project...

- Improve the conceptual understanding of recharge and groundwater connectivity in the Pilliga region – integrating information from existing conceptual and numerical models, hydrochemical data and new environmental tracer data
- Assess the probability extremes around CSG induced GAB groundwater head and flux changes using modelling and uncertainty analysis techniques



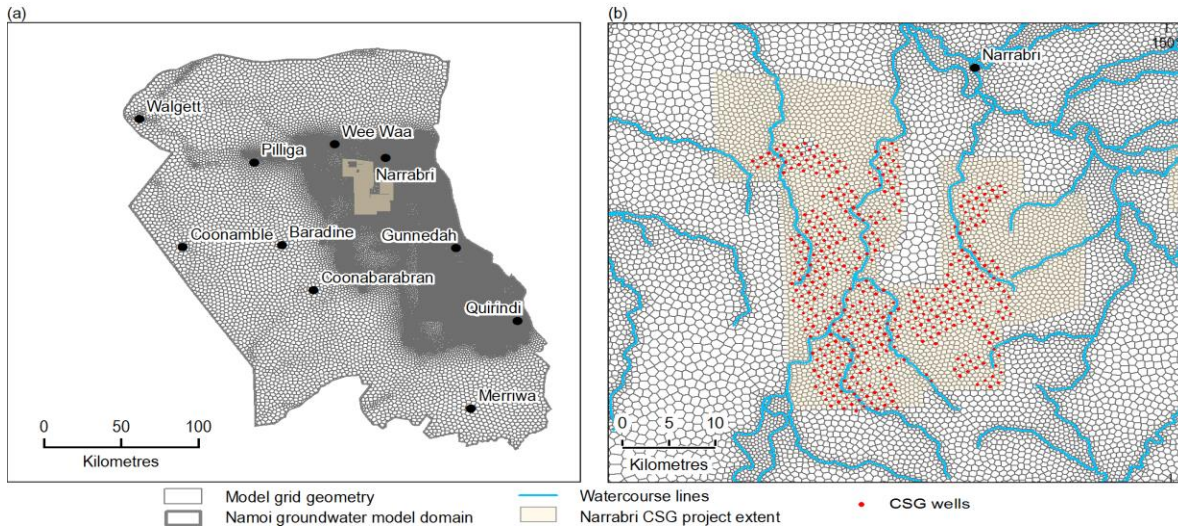
GAB flux project...

- Investing in measuring and analysing new data (environmental tracers and geochemistry data – *new measurements in the new DPI monitoring bores in the Pilliga area/ Santos' monitoring bores*)
- Integrating the knowledge derived from new data and ongoing work (OWS projects BA, FAM) into the conceptual understanding of the Surat and Gunnedah basins
- Testing hypotheses and accept/reject with high confidence potential impacts of CSG development on drawdown and GAB flux



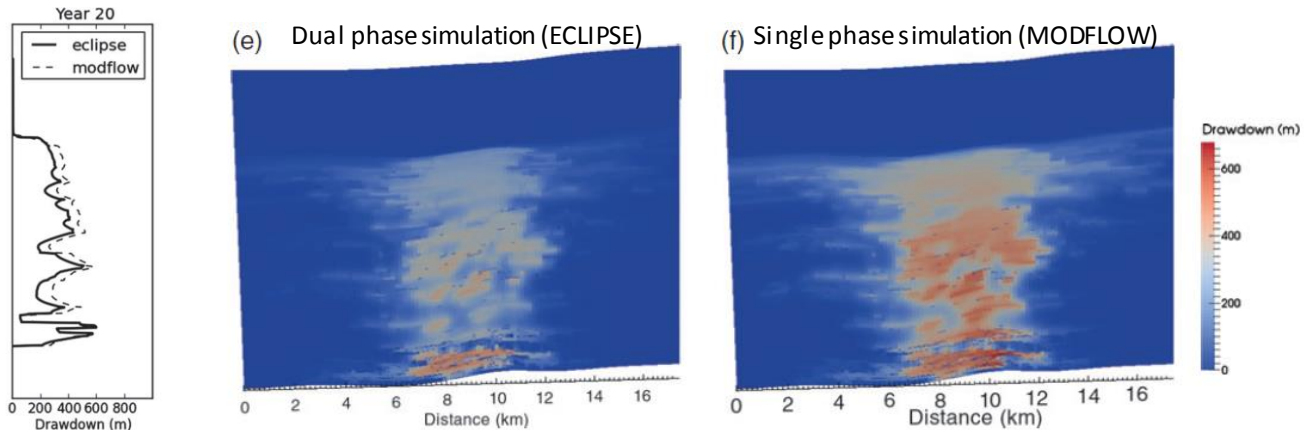
GAB flux project...

- Report on “Uncertainty analysis of and GAB flux and water balance changes induced by CSG development through Narrabri Gas Project” to be published on GISERA website soon
- In the next stage of the project we are doing the field work and analysis for environmental tracers to improve the understanding of recharge



Project 2 – Improving representation of reservoir modelling processes

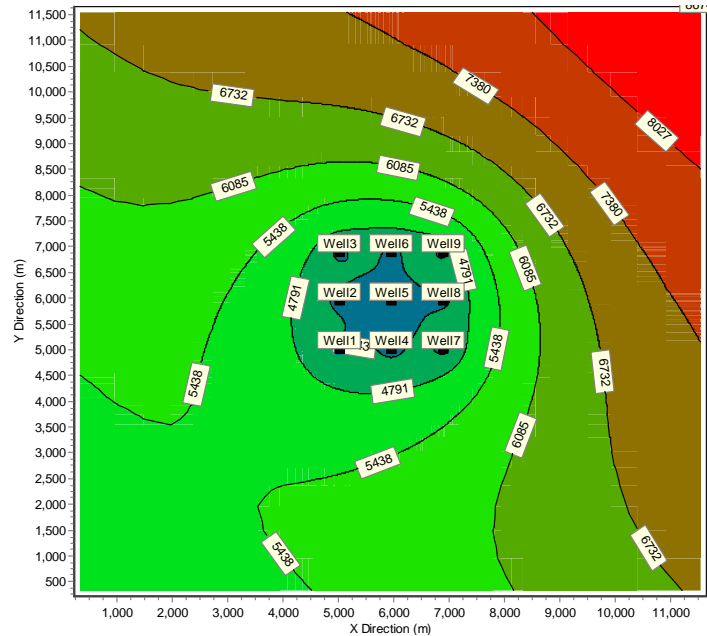
- Past studies by CSIRO (2015) and Queensland Government (2016) have developed methods for improved representation of dual phase flow in regional scale groundwater models
- This project will develop and apply a similar method for assessing and refining the prediction of impacts from Narrabri Gas Project
- This study will address the gaps around ‘the veracity of the reservoir modelling and associated groundwater abstraction rates’ that IESC has highlighted recently.



Simulated drawdown in the Walloon Coal Measures after 20 years Moore et al. (2015)

Improving representation of reservoir modelling processes...

- CSG production involves a complex coupling of groundwater and gas flow across the well field
- It is difficult to represent these processes in regional groundwater models
- Previous work identified a relationship between saturation and pressure (Herckenrath et al. 2015)
- This project will evaluate this approach for the Namoi and incorporate this into regional groundwater modelling

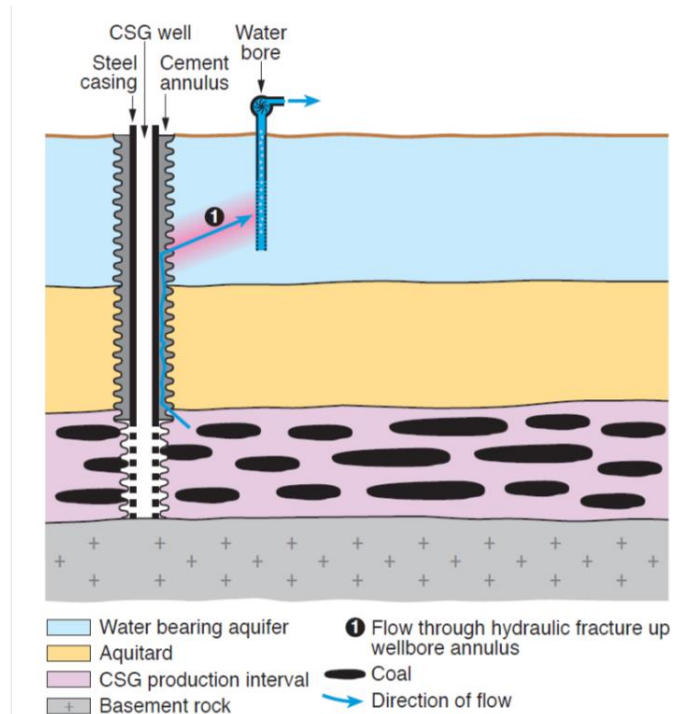


SIMED II predictions of pore pressure in kPa around a producing well field

Connell et al. (2016)

Project 3 - Groundwater contamination risk assessment

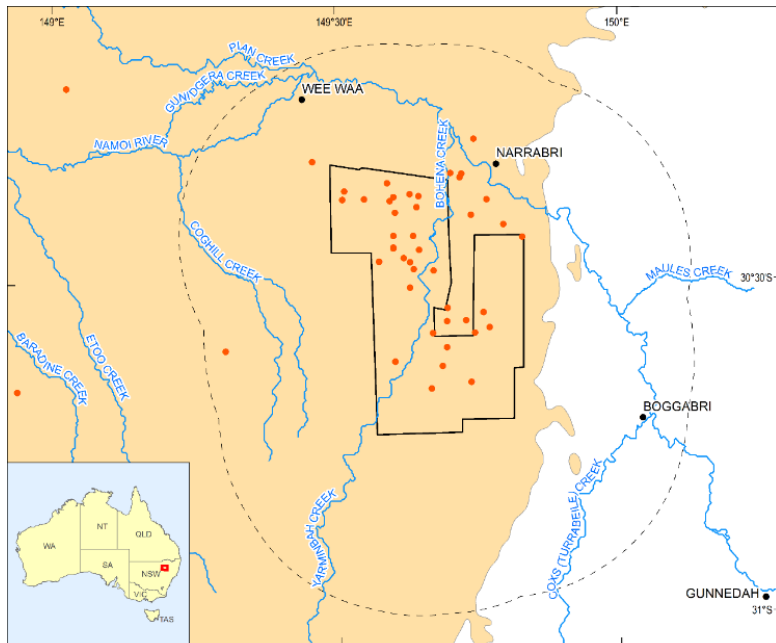
- Probability of groundwater contamination from well bore delamination
- Potential impacts to local water resources
- The study will use mathematical models that account for the characteristics of the well bore annulus and geological formations and hydraulic pressure around the well to compute the probability of contamination



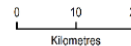
Pandurangan et al. (2016)

Project 4 – Data-worth and monitoring network design

- Monitoring of water quantity and quality impacts
- Sentinel monitoring
- Minimising prediction uncertainty
- Data-worth analysis
- Probabilistic modelling of drawdown changes and travel times

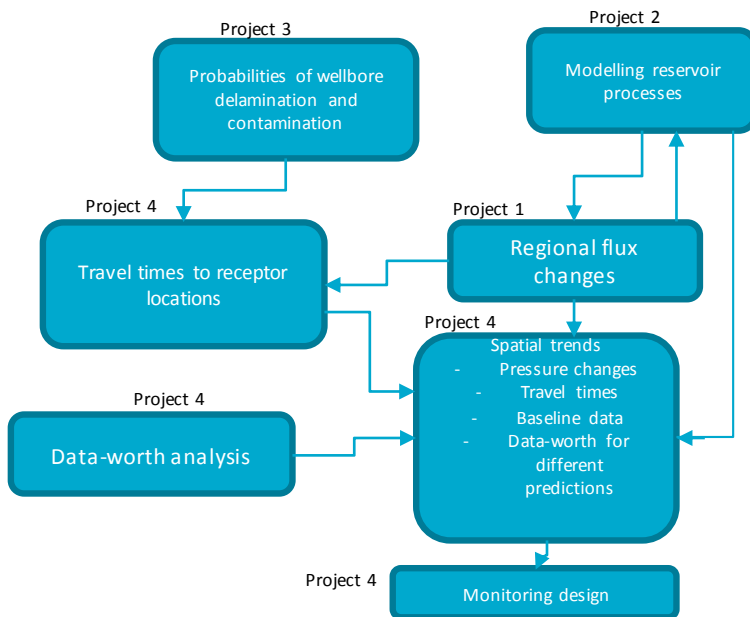


Great Artesian Basin Groundwater Monitoring Locations

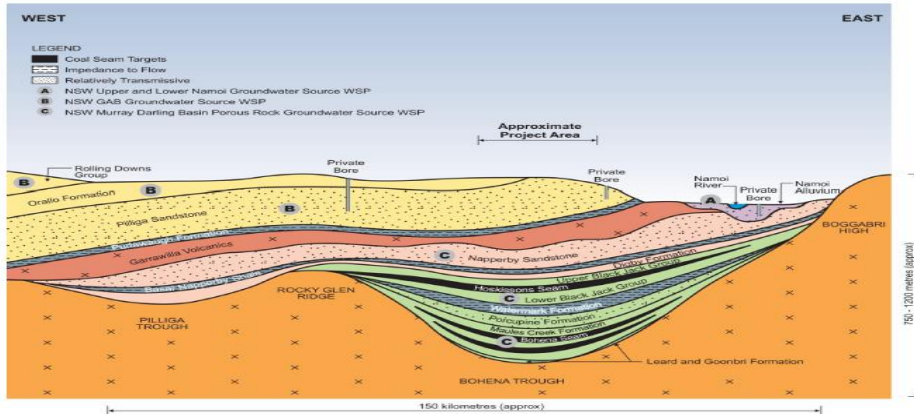


Integrated approach for impact assessment and monitoring

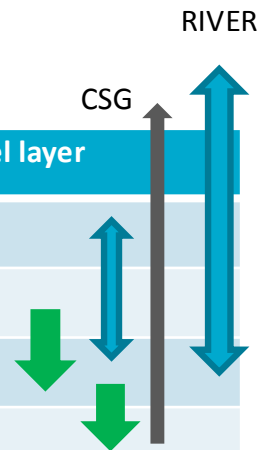
- The improved understanding of the processes and uncertainties in different scales will be integrated to provide comprehensive assessment of risks and monitoring strategies



Zonation of the numerical model layers and hydrostratigraphic units for evaluation of flux changes

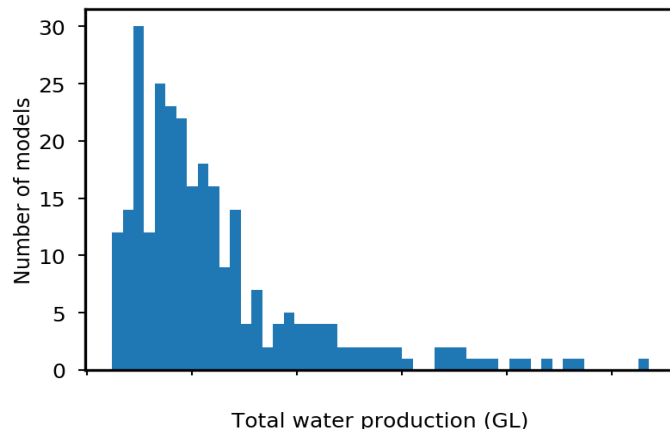


Zone No:	Basin	Formation type	Model layer
Zone 1	Namoi alluvium	alluvium	1 - 2
Zone 3	Surat Basin	Inter-burden	3 - 5
Zone 6	Surat Basin	Pilliga Sandstone	6
Zone 8	Gunnedah Basin	Inter-burden and coal	7 - 15



Distribution of simulated CSG water production across 500 model runs

- Water production rates are not hard-wired as a boundary condition in the model
- Instead, the model simulates the water production for a given depressurization target
- Accounts for the uncertainty in CSG water production



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Thank you

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