



GROUND AND SURFACE WATERS

GISERA | Gas Industry Social and Environmental Research Alliance

Improving our understanding of connectivity between coal seams and aquifers

CSIRO researchers have completed a study that integrates airborne electromagnetic surveys, environmental tracers and geochemical modelling to refine the understanding of connectivity between coal seams and overlying aquifers in the Narrabri region of NSW.

Key points

- Community members are concerned about potential impacts on groundwater resources from proposed onshore gas development in the Narrabri region.
- This study was established to improve our knowledge of groundwater systems in the Gunnedah and Surat Basins in the Narrabri region.
- It focused in particular on understanding the potential for connectivity between coal seams and agricultural aquifers.
- The research addresses community concerns about the potential impacts of proposed onshore gas development on groundwater systems.
- Researchers adopted a multi-disciplinary approach that combines existing data with new targeted data to generate high-resolution 3D images.
- The study found that there is likely a high degree of hydraulic separation between deep coal seams and the Pilliga Sandstone Aquifer.

Image: The spectacular Sawn Rocks in Mount Kaputar National Park provide a fascinating glimpse of the complex volcanic forces that have shaped the Narrabri region landscape.

This project, conducted through CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA), was developed in response to community concerns about the potential for coal seam gas (CSG) activities in the Narrabri region to impact on important aquifers.

Researchers adopted a multi-disciplinary approach, which combined new and existing data, to address knowledge gaps that were identified in previous GISERA projects.

Narrabri Shire

The Narrabri Shire, in north-west NSW, covers approximately 13,000 square kilometres and is home to around 13,000 people with 6,000 living in the main town of Narrabri.

The shire is primarily a grazing and farming region, with irrigated cotton the main high-value crop in the region. The Pilliga Sandstone and the Namoi alluvium aquifers have significant cultural, environmental and economic values.

The Narrabri Gas Project

The NSW and Federal Governments approved the Narrabri Gas Project, proposed by energy company Santos, in late 2020. The project involves developing a coal seam gas field over 20 years with up to 850 gas wells and associated infrastructure. Santos has not yet made a decision to proceed with the project.



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Research methods

CSIRO's previous research into the groundwater systems in the Gunnedah and Surat Basins has generated important knowledge on the nature of these systems and the potential for connectivity between agricultural aquifers and primary targets for CSG development.

While no evidence of strong connectivity was found in previous studies, a number of knowledge gaps were identified. To address those gaps, in this project researchers adopted a multidisciplinary approach with six key components:

- geochronological analysis of igneous rocks
- mineralogical assessment of key aquifers, partial aquifers, aquitards (thick compacted layers of clay, silt or mud that act as a barrier for groundwater movement) and coal seams
- an airborne electromagnetic (AEM) survey to assess aquifer geometry and identify potential hydrogeological connectivity
- hydrochemical data collection to improve the availability of baseline data in the Gunnedah Basin aquitards and coal seams
- numerical modelling to integrate all geological, hydraulic, hydrogeological, hydrochemical and geophysical information
- refinement of hydrogeological models to assess the efficiency of different techniques for resolving key questions, and identifying opportunities for future work.

This comprehensive approach provided additional information on the potential for connectivity pathways between the CSG target units and adjacent groundwater systems, and reduced uncertainty about the potential drawdown at depth affecting aquifer pressure.

Key findings

The final project report, which can be accessed on the GISERA website, provides detailed findings for each of the six key components of the study.

The assessment of hydrochemistry and integration of multiple data sources confirmed that there is likely a high degree of hydraulic separation between deep coal seams and the Pilliga Sandstone in the south and east of the Narrabri Gas Project area.

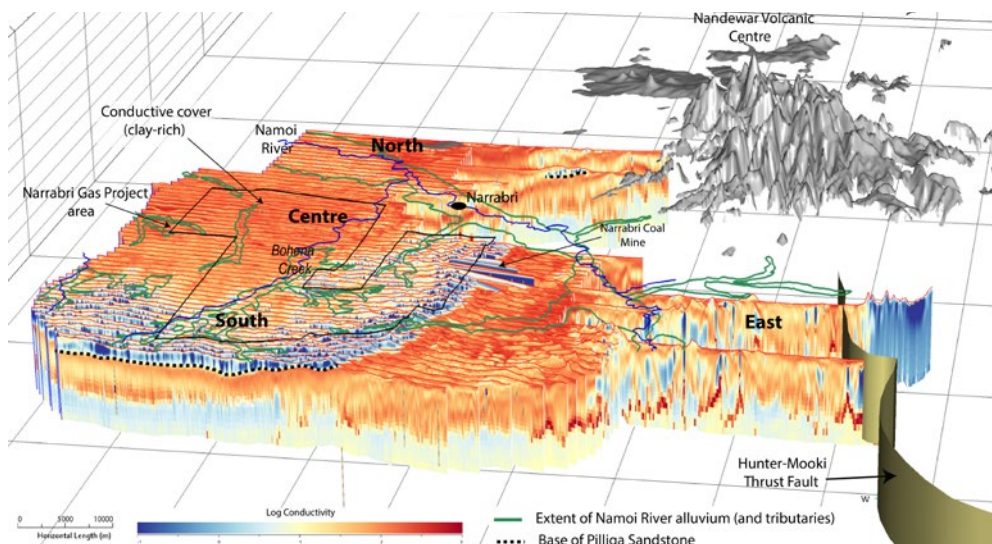
The integration of all geological, hydraulic, hydrogeological, hydrochemical and geophysical information through numerical modelling supported the hypothesis that the upper part of the Purlawaugh Formation forms an effective seal separating the Pilliga Sandstone from the underlying formations.

The geophysical and geological assessment indicates that volcanic intrusions are the major potential connectivity pathway, but their occurrence is mostly limited to below the Pilliga Sandstone in the Narrabri Gas Project area.

Hydrochemistry and tracers indicate that aquitards limit vertical connectivity throughout the east and south of the proposed CSG development area.

The Airborne Electromagnetic (AEM) survey yielded valuable insights to depths of up to approximately 400 m below ground surface. The AEM survey confirmed previous assumptions from seismic survey data that faults with significant displacements are unlikely to extend from the Gunnedah Basin into the Pilliga Sandstone.

Although the research has resolved multiple knowledge gaps identified by previous GISERA projects, these findings underscore the complexity of the hydrogeological system in the Narrabri region. The study highlights the necessity of future work to gather more baseline data, conduct analyses that will further reduce uncertainties, and continue refining conceptual models of groundwater connectivity.



More information

Read more [about this project](#)

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3D geophysical and geological interpretations of airborne electromagnetic (AEM) survey lines flown in the Narrabri region.

Further information | 1300 363 400 | gisera@csiro.au | gisera.csiro.au

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.