focus on NRM research

Evaluating the extent of hydraulic connectivity

between the Condamine Alluvium, the Great Artesian Basin and the Walloon Coal Measures.

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What are you researching?

We recently completed a project evaluating the extent of hydraulic connectivity between the Condamine Alluvium, the great Artesian Basin and the Walloon Coal Measures.

The project analysed the chemistry of the groundwater from 30 boreholes throughout the Condamine Alluvium, near Cecil Plains, to see if there was a geochemical signature that would indicate natural groundwater movement between the Walloon Coal Measures (WCM), the overlying sedimentary rock layers of the Great Artesian Basin (GAB), and the Condamine Alluvium (CA).

We measured the major ion chemistry, isotopes to determine sources and age of the groundwater, the dissolved organic content, and the concentration and chemical signature of the methane emitted from the boreholes. We also mapped pathways of recharge and assessed the impact of abandoned leaky wells.

As an addition to the project we studied the microbiology of the groundwater and soil under different land uses and farming practices (refer to the separate project description for further details on the microbiological investigations).

What have you found?

Connectivity

Throughout the Cecil Plains portion of the CA the concentration of methane in the groundwater is low. At four sites the chemical signature of the methane indicated that it was probably sourced from the WCM. These four sites were isolated from each other. The combination of this spatial information and the low concentration of methane measured throughout the CA indicate that the extent of natural connectivity between the WCM and the CA is low. Comprehensive details have been published in our paper 'Assessing Connectivity Between an Overlying Aquifer and a Coal Seam Gas Resource Using Methane Isotopes, Dissolved Organic Carbon and Tritium' (accessible here: www.nature.com/articles/srep15996).

Recharge

It is clear from our research that ongoing access to groundwater will be related primarily to flood frequency. The chemistry of groundwater from irrigation bores throughout the Condamine Catchment indicates that recharge to aquifer depths from which groundwater is pumped occurs only following rainfall of at least 400 millimetres per month - yet this occurs on average once every four years.

Such rainfall is usually associated with extra-tropical lows in spring and autumn, and the remnants of tropical cyclones in summer. Contributions to groundwater recharge from irrigation deep drainage, rainfall over the wider landscape or river leakage under normal streamflow conditions are small and recharge from hard rock aquifer systems, in particular the Great Artesian Basin, is small. Floodwater is the primary, and in some places only, source of groundwater recharge.

Abandoned Leaky Wells

Throughout the Condamine catchment there are thousands of abandoned coal exploration wells. Many of these wells have either never been sealed or have failed due to aging infrastructure (eg. casing corrosion, subsidence, etc). The environmental impact of leaky decommissioned wells has been the subject of

much speculation. To assess this we modeled the impact that a leaky well may have on inter-aquifer flux. In the Condamine Catchment of southern Queensland we used the steady-state Analytic Element Method.

We showed that a single leaky well significantly contributes to inter aquifer water movement. Under pre-development head there is a natural upwards hydraulic gradient from the Walloon Coal Measures (WCM) to the Condamine Alluvium (CA), and a single leaky well (radius of 100 mm) is predicted to transfer 40 ML/a between the formations.

If the post-development head in the WCM is 50 metres below the CA (a conservative estimate based on CSG production modelling), then a single leaky well is predicted to transfer 263 ML/a from the CA to the WCM. Our modelling highlights the need to: 1) Investigate the potential impact of partly penetrating wells; 2) locate and remediate leaky abandon wells to prevent the movement of fluids between strata in areas of CSG developments.

New mobile methane surveys are being undertaken in April 2016 to extend the mapping of abandoned leaky wells throughout the Condamine Catchment.

Why is it important?

Each day tens to hundreds of mega-litres of co-produced groundwater will be extracted from the WCM associated with the production of gas. Over the next few decades this will lower the groundwater head (the water level measured in monitoring boreholes) firstly in the WCM, then in the adjacent formations of the GAB and then, depending on the extent of hydraulic connectivity, possibly in the CA.

To correctly model the potential impact of CSG developments on groundwater levels in the CA we need a good conceptual geological model of the region. In particular, we need to know where and to what extent there is hydraulic connectivity between the WCM and the CA. Groundwater geochemistry provides insights on the extent of this hydraulic connectivity.

Research outreach and impact

Our research is providing independent baseline information for the groundwater irrigation community.

The project team has presented the information to relevant government departments, to the wider scientific community involved in coal seam gas investigations, and to key staff in CRDC and Cotton Australia. Farmers involved in the project received a report on the quality of their groundwater, and comprehensive details on the water chemistry. This has provided many farmers in the region valuable baseline data.

Where do I go for more information?

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