

# Groundwater characteristics in the Beetaloo Sub-basin

This project collected and analysed groundwater samples from the Beetaloo Sub-basin to create a baseline data set which can be used to measure the potential impacts caused by proposed shale gas exploration activities.

## KEY POINTS

- The Scientific Inquiry into Hydraulic Fracturing in the Northern Territory has recommended a regional water assessment, starting with the Beetaloo Sub-basin.
- This study establishes baseline data for the area, sampling groundwater from 25 bores.
- Samples have been analysed to provide a snapshot of groundwater geochemistry.
- Estimates of groundwater recharge, flow rates and age are being finalised.
- This study improves understanding of the recharge mechanism of the Cambrian Limestone Aquifer in onshore gas exploration permit areas.

## Results

- Regional groundwater flow is broadly south to north.
- Electrical conductivity of Cambrian Limestone Aquifer groundwater for most bores is within the acceptable limit for potable water.
- Concentrations of metals, dissolved methane, and hydrocarbon compounds are within Australian Drinking Water Health Guidelines (2017).
- Based on monitoring results, groundwater within the permit areas is suitable for irrigation and livestock purposes.
- Study results are reported in detail to the public and available on the GISERA website.

## Community concerns

The recent Scientific Inquiry into Hydraulic Fracturing in the Northern Territory highlighted community concerns about the potential of the onshore gas industry to affect the quality and quantity of groundwater. Groundwater is important for agriculture, tourism, and community water supplies.

The inquiry also highlighted insufficient baseline data for aquifers in the Beetaloo Sub-basin. Without baseline data, any potential impacts from gas exploration are more difficult to quantify.

The inquiry final report recommends that *'before any further production approvals are granted, a regional water assessment with a focus on surface and groundwater quality and quantity (recharge and flow) be conducted for any prospective shale gas basin, commencing with the Beetaloo Sub-basin'*.

## The Beetaloo Sub-basin

The Beetaloo Sub-basin lies south-east of Katherine, spanning an area of about 30,000 square kilometres. One of the most prospective areas for shale gas in Australia, it contains an estimated prospective resource of 178,200 petajoules (PJ) of gas.

The Cambrian Limestone Aquifer system is the major aquifer in the Wiso, Georgina and Daly basins among which the Beetaloo Sub-basin is situated (Figure 1, overleaf).

## Objectives of this project

This project provides the community and regulators with information on the baseline concentrations of various compounds in the groundwater of important aquifers in the Beetaloo Sub-basin. Research outcomes are useful to the NT Government in developing water allocation plans should exploration or development go ahead. This is the first stage of a larger project that will improve understanding of the groundwater system of the Beetaloo Sub-basin.

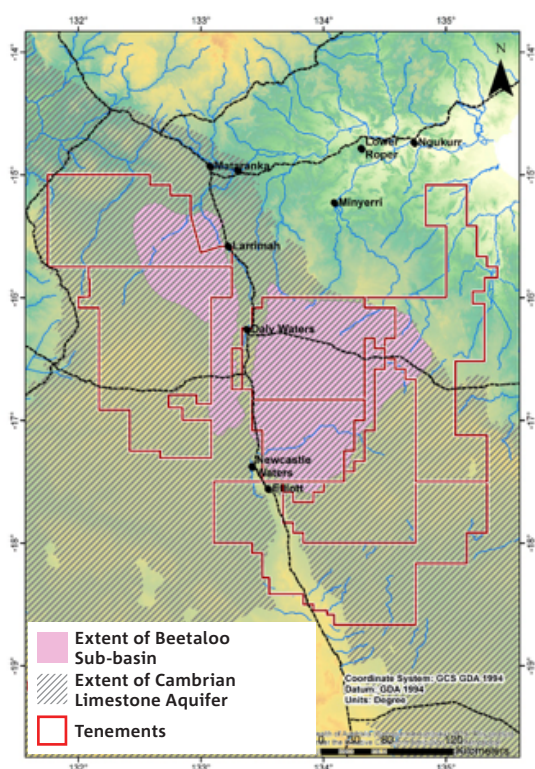


Water is an important resource.

## Collecting groundwater samples from bores

During October and November 2018, researchers collected groundwater samples from 25 bores in the study area. Bore locations and access were determined in consultation with the NT Government and landholders, with assistance from gas industry teams on the ground.

Bores that intersect the Cambrian Limestone Aquifer were sampled to evaluate the groundwater flow velocity, recharge rate and the source of recharge.



**Figure 1. Map of Cambrian Limestone Aquifer (the major aquifer in the Wiso, Georgina and Daly basins) showing the Beetaloo Sub-basin.**

### More information

Find out more about [the project Inquiry final report](#)  
About the [Beetaloo Sub-basin](#)

## Geochemical analysis

Using the groundwater samples collected, researchers examined the physical chemistry of the water and measured water quality parameters such as dissolved methane, methane isotopes, alkalinity, metals, hydrocarbons, phenols, radiation, and BTEXN (benzene, toluene, ethylbenzene, xylenes and naphthalene).

### Results

- Regional groundwater flow is broadly from south to north. The observed flow direction and hydraulic gradient are similar to previously reported studies for the Cambrian Limestone Aquifer.
- The conductivity of the groundwater in the Cambrian Limestone Aquifer shows good to poor quality water with average electrical conductivity values (735  $\mu\text{S}/\text{cm}$  – 1946  $\mu\text{S}/\text{cm}$ ) for most of the bores within the acceptable limit for potable water.
- Most of the groundwater samples showed metal, dissolved methane and hydrocarbon compound concentrations were within the Australian Drinking Water Health Guidelines (2017). Long term monitoring of these bores is required to understand seasonal variations.
- Based on the June 2015 – November 2018 groundwater monitoring results, groundwater within the permit areas are suitable for irrigation and livestock purposes.
- Three monitoring bores have naturally occurring radionuclide concentrations that exceed the World Health Organisation guidelines (2017) for drinking water quality and would require further investigation for identification of individual radionuclides.

## Estimating groundwater recharge, flow velocity and age

Groundwater samples are being analysed for a range of naturally occurring environmental tracers to determine the age of groundwater and the recharge sources. Variations in recharge rates, recharge mechanisms, and groundwater flow directions in the Cambrian Limestone Aquifer are being evaluated. Likely pathways for water recharge and potential pathways for groundwater connection between different aquifers in the Beetaloo Sub-basin will also be identified. The age distribution and the flow dynamics of the aquifer will be incorporated into groundwater models for the area.

The concentrations / isotopic ratios of the various environmental tracers present in the water samples will be reported in detail and made available to the public.

## What are environmental tracers?

Some compounds that occur naturally in groundwater can be used to determine the origin and age of groundwater because their concentrations vary in a predictable way over time.

Environmental ‘tracers’ such as tritium, sulfur hexafluoride, chlorofluorocarbons, carbon-14 and helium are commonly used to identify the presence of groundwater that is ‘young’ (>50 years), ‘old’ (1000–10,000 years), or ‘very old’ (>20,000 years). The concentrations of these tracers are in parts per billion, occur naturally in groundwater and pose no human health risk.

## Project funding

This research project is co-funded by the Australian and Northern Territory Governments, the CSIRO, Origin and Santos.

### ABOUT CSIRO’s GISERA

The Gas Industry Social and Environmental Research Alliance (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, 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. Visit [gisera.csiro.au](http://gisera.csiro.au) for more information about GISERA’s governance structure, projects and research findings.