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31 August 2017

The Hon Justice Rachel Pepper
Chair, Scientific Inquiry into Hydraulic Fracturing
Hydraulic Fracturing Taskforce
GPO Box 4396 Darwin NT 0801
email fracking.inquiry@nt.gov.au

Dear Justice Pepper

Thank you for your letters dated 31 July 2017, 14 August 2017 and 18 August 2017 regarding the Hydraulic Fracturing Inquiry Information Requests.

CSIRO's responses to the three information requests are attached. Should you wish to discuss any aspect of this information please contact myself or [redacted] on [redacted] or email [redacted]

Yours sincerely

Dr Damian Barrett
Research Director – Onshore Gas
CSIRO
email [redacted]

<u>Attachments</u>
Attachment 1 Response to Information Request of 31 July 2017
Attachment 2 Response to Information Request of 14 August 2017
Attachment 3 Response to Information Request of 18 August 2017

ATTACHMENT 2

CSIRO RESPONSE TO INFORMATION REQUEST OF 14 AUGUST 2017

1. How was it determined that “<2% of sampled water is younger than 1960”?

Groundwater flow velocity and direction were evaluated by sampling environmental tracers in 23 wells along two north-south transects in the Surat Basin in 2015. Environmental tracers included major ions, stable isotopes of the water molecule (18-O/2-H), 14-C, 36-Cl, noble gases, SF6, and tritium. Tracer distribution along these two transects was interpreted using several model conceptualisations of the geochemical and hydrogeological environment. Interpretation of the combined tracer data and model allowed construction of an ‘age distribution function’ for groundwater in the Hutton and Precipice Sandstone aquifers (that is the proportion of water in different age classes). The results of this research demonstrated that a small proportion of the water (<2%) was likely less than 50 years old.

Reference: Suckow, A., Taylor, A., Davies, P. and Leaney, F. (2016) *Geochemical Baseline Monitoring*. Canberra. CSIRO. Available at: https://gisera.org.au/project/geochemical-baseline-monitoring/.

2. The slide states that “Interpretation of age dating tracers requires detailed model of flow system”. Was this done for this study? If so, could details of the model be provided?

Yes. This study incorporated a groundwater flow model along the two north-south transects described above. Different conceptualisations of the groundwater flow model were considered including a simple single value for aquifer porosity, a more complex two-value aquifer porosity, a ‘stagnant’ compartment of groundwater adjacent to a high porosity/high flow compartment and localised oxidation of organic carbon. These conceptualisations were compared against tracer data and the most plausible model conceptualisation selected. These results are reported in full detail in Appendix A of the CSIRO report Suckow *et al.* (2016) listed below.

Full details of the geologic model, tracer sampling and model interpretation are provided in the following references:

Suckow, A, Taylor, A, Davies, P, Leaney, F, (2016) Geochemical Baseline Monitoring. Final Report for the Gas Industry Social and Environmental Research Alliance (GISERA), CSIRO, Australia.

Sreekanth, J, Moore, C (2015) CSG Water Reinjection Impacts: Modelling, Uncertainty and Risk analysis; Groundwater flow and transport modelling and uncertainty analysis to quantify the water quantity and quality impacts of a coal seam gas produced water reinjection scheme in the Surat Basin, Queensland. Final Report for the Gas Industry Social and Environmental Research Alliance (GISERA), CSIRO Land and Water Flagship.

3. Please provide further information on the following statements:

“Double porosity assumption: Most groundwater flow occurs over ~5-10% thickness of the aquifer”.

This statement is derived from the CSIRO report Suckow *et al.* (2016) which states: “Under the double porosity assumption, most of the groundwater flow in the Hutton occurs over a small thickness of the aquifer (possibly as low as 5-10% based on previous studies on the transmissivity of this aquifer) with the other areas representing more or less stagnant zones.” In other words, the most plausible interpretation of tracer data from water samples in this region of the Surat Basin, based on the model conceptualisations described above, is that recharge of the Hutton Aquifer occurs over a small area possibly as low as 5-10% of the outcropping and sub cropping area of the aquifer.

"A derived value is 452 ML/y, or 2.7% of current estimated recharge rate estimated".

This statement is derived from the CSIRO report Suckow *et al.* (2016) which states: "This derived value is 452 ML/y, or 2.7% of the recharge rate estimated using chloride mass balance. Thus, most of the recharge to the Hutton Sandstone is probably diverted to shallower flow paths discharging close to the recharge areas. This process ('rejected recharge') is a common feature of GAB aquifers."

4. Please comment on whether the above findings, as well as the comment that the recharge rate using stable isotopes was only 3% of the previously estimated recharge rate, are likely to be applicable to the Cambrian Limestone Aquifer in the Beetaloo Sub-basin.

The statement that the actual recharge of the Hutton Aquifer in Queensland may be approximately 3% of the currently assumed recharge rate is specific to this region of Queensland and is based on interpretation of data and models by CSIRO researchers. These results are not generalisable to the Cambrian Limestone Aquifer in the Beetaloo Sub-basin. However, the methodology used in the Surat Basin study represents current best practice groundwater hydrogeology and is generally applicable to Cambrian Limestone Aquifer. These methods can be applied to improve knowledge of recharge and groundwater dynamics in the Beetaloo Basin freshwater aquifer system.