CSG submission

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SUBMISSION TO THE CHIEF SCIENTIST , NSW GOVERNMENT
REVIEW OF COAL SEAM GAS ACTIVITIES IN NSW

(TO BE PROVIDED IN CONFIDENCE)

I am the former Managing Director of Metgasco Limited, a company that was formed by geoscientists to investigate the unconventional hydrocarbon potential of the NSW portion of the Clarence Moreton Basin. I have approximately 16 years technical experience specifically in this area, most of which was focused on the Clarence Moreton Basin. In my former capacity I was amongst other things engaged in managing the supervision of drilling over 30 CSG exploration and trial production wells and 2 conventional wells and the collection of data supporting reservoir characterisation. Of this work all Well Completion Reports and supporting data were lodged with and are available from NSW DPI.

Although there are many CSG issues I would like to comment on, in the interest of timing I wish to in this submission confine my comments to what I perceive as an issue of nomenclature that has caused confusion and misunderstanding in the reporting on CSG activities. This relates to **public discussion concerning aquifers and the effect of CSG activities.** As an initial proposition the idea that "CSG activities are damaging aquifers" is something that should invite legitimate concern. That proposition however must be substantiated by supporting evidence and where it is not, should not be able to be used as a means of misrepresentation. That this either could have or might occur suggests that there needs to be a more informed and accurate dissemination of relevant technical information on geological basins and aquifers to the general public and that there should be a requirement to use technical definitions in an appropriate manner. Unless there is an improvement in the breadth and depth of terminology, this issue will be reduced to a simplistic ideological or political debate and the science will be secondary. However for the science to constructively inform the public there needs to be an improvement in the use of technical nomenclature to allow a more informed discussion through the popular terminology encountered in public discussion of this matter.

The starting point in assessing the effect of CSG on aquifers is the definition of an aquifer itself. I refer both the United States Geologic Survey (USGS) and Wikipaedia definitions as follows:

"An aquifer is a geologic formation, group of formations, or part of a formation that contains sufficient saturated, permeable material to yield significant quantities of water to wells and springs " (USGS)

"An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, or silt) from which groundwater can be extracted using a water well. " (Wikipaedia).

These are standard hydrology and geological definitions but do not provide enough clarity supporting public debate when used in the context of CSG and the opportunity cost of water co

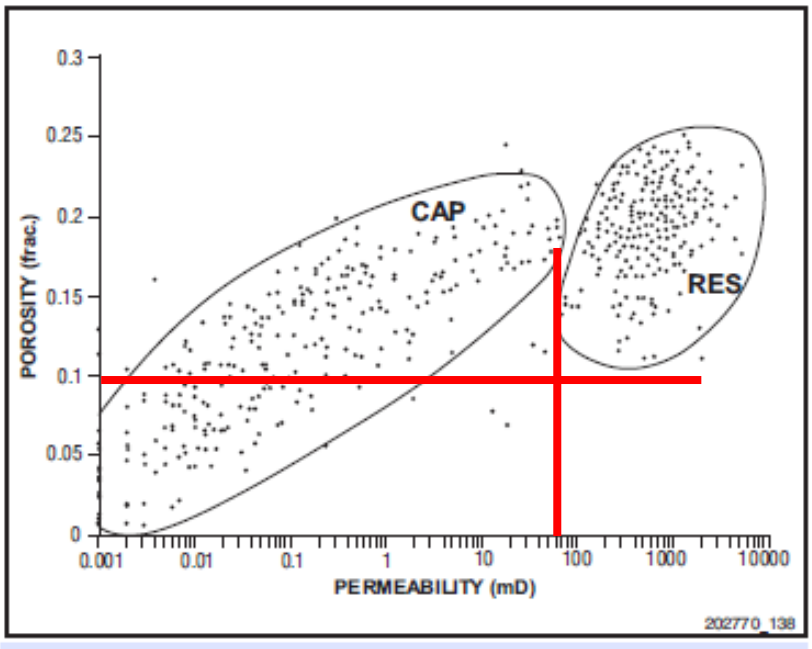
production or long term adverse potentiometric effects of substantial drawdown potentially leading to the claim of “damaging aquifers”.

For example most of the general community is unaware that almost all conventional oil and gas oil produced anywhere in Australia todate has occurred as a consequence of migration through or along and from aquifers. The public do not question conventional oil and gas production when it comes from deep saline and non potable aquifers but clearly when as it is claimed that CSG production comes from aquifers already used for say agriculture and that the CSG production process of which is causing “damage” than it is clear that there is a gap in the nature of knowledge or comprehension in what an aquifer is and then whether or not that aquifer has an important role in surface related ecosystems or activity. More broadly speaking there is a further issue with the perception that water in geological basins is somehow confined to drainage systems, the water table and “aquifers” when in fact water is distributed throughout a basin system including being present in rocks with very low porosity and permeability.

I think it is important for the regulatory authorities to take the lead in improving the definitional terminology relevant for CSG related activities particularly in the matter of water co production. I offer following a personal opinion on how the technical data can support an improvement in the definitional basis of terminology used in discussion about CSG.

The first matter at hand is determining what constitutes an aquifer and then consequently the social/economic/biophysical implications of that aquifer determining it the character of say a “Sensitive Acquifer” from the perspective of connection to surface use and effect. The US system incorporates the expression USDW (Underground Source Drinking Water) which may be an improvement. In terms of either USDW or “usable” water there are a sufficient number of existing systems (eg SAR’s ratio) that allow further appropriate discrimination and I make no further comment here

Both the USGS and Wikipaedia definitions incorporate the word permeability, something that is not heard of or rarely used in the public debate despite its technical relevance. Data from the Eromanga basin can be used to provide geological and hydrological definitions as to what constitutes and aquifer versus what is not:



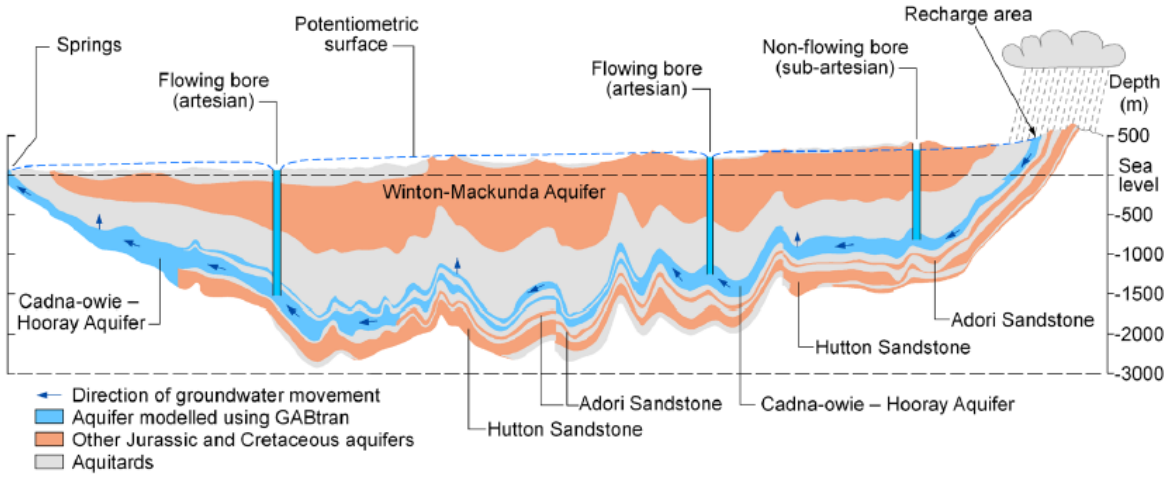
Source (EM Alexander and PB Boult, Petroleum Geology of SA Vol 2: Eromanga Basin)

The data suggests that from the use of the expression or word permeability that reservoirs containing permeabilities of approximately more than 50md (and a corresponding porosity >10%) possess some of the requisite characteristics of an “aquifer”.

The above graph includes data from the following units:

Poolawana facies
Algebuckina Sandstone
Hutton Sandstone
Birkhead Formation
Namur Sandstone
Murta formation and McKinlay Member
Wyandra Sandstone Member of the Cadna Owie Formation
Coorikiana Sandstone

Yet as the diagram from CSIRO below shows, only one of these reservoirs – the Cadna Owie Formation is shown as the most important aquifer in the GAB:



Source : CSIRO – The GAB and CSG April 2012

The reason appears to be that of lateral continuity and water quality. Clearly where a Formation contains "usable" water or bears some importance to interconnectivity AND has lateral continuity AND has the permeability/porosity characteristics described above than it meets the definition of a "Sensitive Aquifer". Where for example such as with the Hutton Sandstone that there is not broadscale lateral continuity (acting in a more confined manner) and contains non potable water or non usable water, than it has the character resembling a more "non sensitive aquifer" and the terminology or phraseology should adjusted accordingly. Otherwise the position arises where the community hears the word aquifer and applies a single mental construct without understanding significant and important differences.

There may be other more useful technical mechanisms or variables (such as transmissivity) for establishing the differences which in the interest of brevity I have not discussed, but the principle should be clear as would be the consequences. Where CSG is being extracted from a reservoir that meets the criteria for a "Sensitive Aquifer" than there should be a regulatory framework that provides assurance that prevents an Operator from acting in a manner that would expose itself to the claim that "CSG activities are damaging aquifers". And conversely where CSG is being extracted from a reservoir that DOES NOT meet the criteria for "Sensitive Aquifer" (or even non sensitive aquifer) than there should be a regulatory framework that can clearly reject the claim that " CSG activities are damaging aquifers". Such a situation has been allowed to occur with the WCM in the Surat basin where the parameters of permeability/porosity, lateral continuity and on occasion usability can fall within the definitional allowance of aquifer (with the consequent chain of regulatory frameworks) but then without any basis in regulatory frameworks or operating practice is then applied to the same geological formation in other areas that have different technical characteristics.

Further to this rationale is the location of known CSG reservoirs in the Walloon Coal Measures of the Clarence Moreton Basin in NSW. The geology of the CMB is now reasonably well known. Major papers that cover both the geology and exploration activity include that by Wells, A.T., & O'Brien, P.E. (Editors), 1994, and by Geological Survey of NSW (Ingram and Robinson),1996, (Brown Casey et al),1996. The most recent work and that which provides the best starting point is the recent paper

by Doig and Stanmore (The Clarence Moreton Basin in NSW ; geology, stratigraphy and coalseam gas characteristics EABS Sym IV 2012) for the geology of this basin.

As measured in numerous down hole tests and included in Well Test reports submitted to the DPI, the permeability of coalseams in the Walloon Coal Measures in the CMB are between about 0.1-10mD (millidarcy) compared to by way of comparison to conventional gas reservoirs in the Eromanga of >50mD. At this level of permeability the WCM cannot be characterised as an aquifer by any measure. Geologically/hydrologically it is an Aquitard with definitions as follows:

Aquitard, which is a bed of low permeability (Wikipaedia)

Aquitard - A confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer; a leaky confining bed. It does not readily yield water to wells or springs, but may serve as a storage unit for ground water (USGS)

The Stanmore and Doig paper indicates that exploration and evaluation of the basin to date shows that the Walloon Coal Measures in the CMB are:

> On a regional basin scale, the WCMs are considered to be an aquitard as a consequence of the generally low permeability and storative capacity. Likewise, the overlying Maclean Sandstone Member and underlying Koukandowie Formation, the later comprising siltstone and minor sandstone, are expected to act as aquitards or aquicludes at depths below any near surface groundwater system influence.

This character of the WCM in the CMB indicates that gas production will only occur through creating satisfactory (Kh – ie permeability x length) – through either horizontal drilling and or stimulation (fraccing) methods and that water co production is likely to be modest, consistent with the production testing and data collected to date.

Therefore reference to the WCM in the CMB as an “aquifer” is incorrect and to assert so can be deliberately misleading. There exists other examples of this such as the inappropriate use of the word “Toxic” or “Prime Agricultural Land” and from a public policy perspective this is not unimportant. It is in principle no different to laws on false and misleading advertising or product safety standards.

In summary I suggest a basis for conceptually adjusting the nomenclature to ensure that the ability to communicate the geology and hydrology be improved:

Term	Sensitive Aquifer	Non Sensitive Aquifer	Sensitive (?) Aquitard	Non Sensitive Aquitard
Permeability/Porosity	>50md,>10%	>50md,>10%	<50md, 10% (?)	>50md, 10% (?)
Water Quality	SARs ? TDS ?	SAR's ? TDS ?	SAR's ? TDS ?	SAR's ? TDS ?
Lateral Continuity	Extensive	Confined ?	-	-
Other Factors	Surface/ecosystem	interconnection	interconnection	-

It may well be that there exist better methods or systems for this and consideration of which should be encouraged. As mentioned above and repeated, the importance of this description is that it is up to the regulatory authorities to embed appropriate terms in both regulations and operating practice such that this becomes the common terminology used in public discussion. The accompanying descriptions obviously need to be communicated with broader descriptions of the geology and basin hydrodynamics to allow added perspective to provide the community a more informed view of the nature of reservoirs that are being produced for oil and gas and the implications for surface ecosystems and any studies, practices or regulations that are therefore required to ensure minimal interference with surface ecosystems or where demonstrated as necessary to avoid exploitation of such a reservoir.

That information needs to be determined in a transparent manner and needs to be delivered by the necessary or relevant authority at both the state and local or community level in public forums and be technically relevant for the local area. It is not until members of the community are informed by the relevant authorities in person at a community level that there can be community confidence that CSG activities are being conducted properly.

David Johnson