Namoi Water

Submission to the Review of Environmental Impact Statement –

Santos Narrabri Gas Project
2017

Photo : Lake Keepit

Namoi Water : Supporting sustainable water use in the Namoi Catchment and representing water users in the Peel, Upper and Lower Namoi Catchment Area

Executive Officer : Jon-Maree Baker

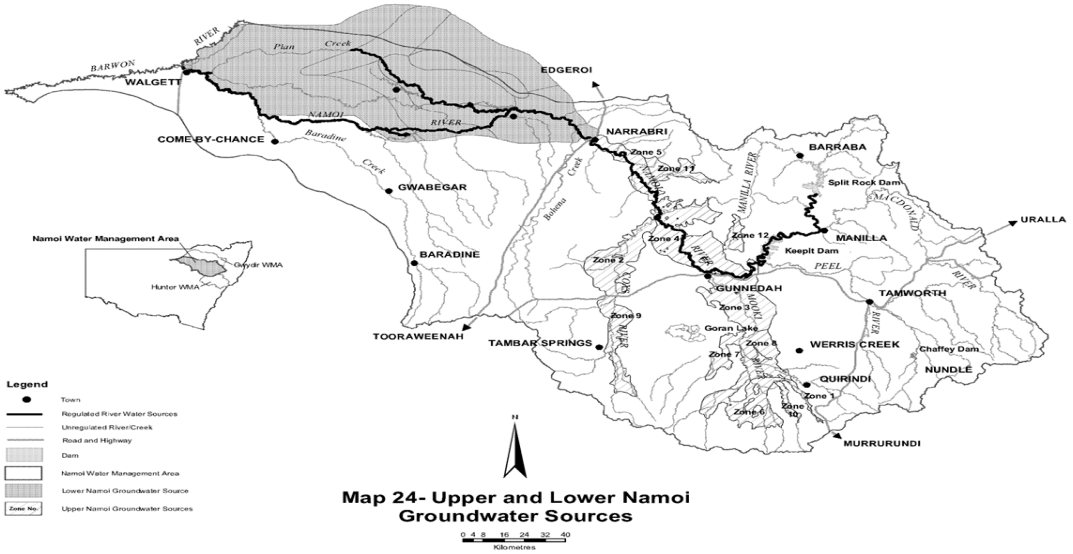
PO Box 548
Narrabri NSW 2390
PH: 02 67925222
EM: eo@namoiwater.com.au
Web: www.namoiwate.com.au

Introduction

Namoi Water represents Water Access licence holders in the Namoi Catchment, we are a non-profit, nonpolitical organization supporting our members to achieve a sustainable irrigation industry that meets the environmental, economic and social needs of our local communities. Namoi Water represents 800 members, entitlement holders within the catchment vary in size from single employee operations to businesses employing seventy employees. The crops grown range from grains and pulses, cotton, vegetables, intensive animal production, Lucerne and niche market food crops. The direct contribution to our economy is in excess of $800 million per annum. This is based on a secure supply of high quality irrigation water both surface and groundwater.

Namoi Water has a breadth of experience in relation to Water reform and assessment of water resources in relation to extractive industries impact. Water reform has occurred over the last two decades, the Achieving sustainable groundwater entitlement program reduced groundwater entitlements by 50% across the Upper and Lower Namoi. The comparison of Coal Seam Gas (CSG) to the Cotton Industry in terms of water use and social impact is erroneous and rejected by many Namoi Water members. This submission is made based on Namoi Water's current policy positions that are ratified at the Annual General Meeting each year. However we note that members are entitled to their individual views in relation to this project.

Namoi Catchment area Figure 1.



The shaded area on the map above is the Lower Namoi alluvial fan, the catchment commences below the town of Narrabri and a number of ephemeral streams flow into the Namoi River. Surface water flowing out of the Pilliga State Forest area can contribute substantial flows into the Namoi River. There are significant potential environmental impacts that could result from contamination of surface and groundwater in the NGP area and protection within the highly valuable surface and groundwater of the Upper and Lower Namoi and Great Artesian Basin water resources is critical.

Namoi Water for the past 10 years has been engaged in understanding the potential impact of both mining and coal seam gas development in the Namoi catchment. To this end the Namoi Water study was undertaken to assess cumulative impacts of extractive industries. This was not the end process but a collation of data to produce scenario testing to enable assessment. When combined with numerous other studies undertaken by the Namoi CMA, this and other data sources could be fed into the Namoi Cumulative Risk assessment tool. The critical thresholds identified for natural resource assets in the catchment action plan require a framework to test scenarios and develop cumulative risk statements and mapping. Namoi Water believes this framework offers the Department of Planning a transparent process to enable communities affected by the potential development of extractive industries, information to understand how both mitigated and unmitigated risks are assessed.

In 2013 Namoi Water in conjunction with NSW Irrigators Council undertook a study tour to Colorado to investigate if and how irrigation was co-existing with gas operations. The results of the tour raised a number of issues but in particular reinforced the need for independent assessment. In this manner Namoi Water recommends that the Department of Planning include a review process of independent experts with both positive and negative interpretations of CSG risks for the Narrabri Gas Project (NGP).

Fundamental to the review of the Environmental Impact Statement (EIS) is good baseline data to assess hydrogeological and water quality impacts. The produced water and bi products of the NGP also require thorough assessment as the significant risks associated with spills, contamination and disposal of waste products are high. In a report commissioned by the NSW Office of the Chief Scientist and Engineer at the University of NSW - Water Research Laboratory provided a background paper on groundwater resources in relation to coal seam gas production WRL technical report 2013/9 a key recommendation was that ;

"Uncertainties concerning the impacts of coal seam gas operations arise from the non-uniqueness problems described throughout this report and can be minimized through data collection. Best practice should include large data collection and modelling programs. The potentially large expense in collecting such data and modelling hydrogeological systems should not be used as a reason to not minimize uncertainties in potential groundwater responses".

Given this report informed the Chief Scientists Review recommendations in 2013/14 and this timeline coincided with the data collection activities undertaken by Santos to inform the NGP EIS, we are concerned that the bare minimum of requirements have been met. This is potentially the result of reduced financial capacity and the restructure of the Narrabri Gas project as a stand alone company and down grading of the project to a non-core asset. Nonetheless the quality of the data collection and absence of vertical hydraulic conductivity measurements in critical geological strata does not appear to meet the requirements for having undertaken good baseline therefore has produced uncertain estimations.

A number of independent hydrogeologists have stated the NGP EIS is missing considerable (detailed) information that would allow the project to be properly assessed and functionally this affects the

accuracy of predictions made in relation to water impact containing a significant number of uncertainties.

Key recommendation ;
Based on the information provided in the NGP EIS Namoi Water is unable to support the project proceeding at the time of submission due to the significant uncertainty of the predicted impacts on ground and surface water resources that our members rely upon. Detail regarding our assessment is tabled below.

Due to the short timeframe for the review of the EIS Namoi Water will be submitting additional information following receipt of new work that informs interconnectivity and impacts on the conceptual model assumptions.

Key issues regarding NGP relating to water impacts ;

1. A good risk analysis considers multiple conceptual geological models. The Santos EIS does not.
2. A good risk analysis would look at the hydraulic impact of a leaky well that hydraulically connects multiple formations. The EIS does not.
3. Faulting was dismissed without the hard data being presented. Therefore the Santos EIS does not adequately address hydraulic connectivity as a result of faulting.
4. Ground and surface water contamination is dismissed as being ameliorated by improved practices, despite repeated occurrences of spills in the project area. The Santos modelled assessment does not include adequate assessment of these risks.
5. There is a lack of hydrogeochemical data presented in the EIS. The hydrogeochemistry must be provided by the proponent as it informs analysis of natural connectivity.
6. No isotope data were presented in the EIS. This data informs groundwater residence time and allows additional assessment to be made regarding model assumptions.
7. The Santos EIS steady state model does not match the finer resolution Modflow models by Merrick (2001) and McNeilage (2006). This is a significant concern.
8. The proposed groundwater monitoring network is not fit for purpose. Many of the proposed monitoring wells are at the end of their lives.
9. Core analyses of the hydraulic properties of the rocks and short-term pump-test analyses underestimate the hydraulic connectivity of geological formations at the regional scale.
10. The groundwater monitoring network is not fit-for-purpose and there is insufficient monitoring sites used to determine local and regional impacts and the current dataset is an inadequate and misleading baseline.

Chapters reviewed by Namoi Water include ; Executive Summary, Chapter 11 Groundwater and Geology, Chapter 12 Surface water quality, Chapter 13 Hydrology and geomorphology, Chapter 31

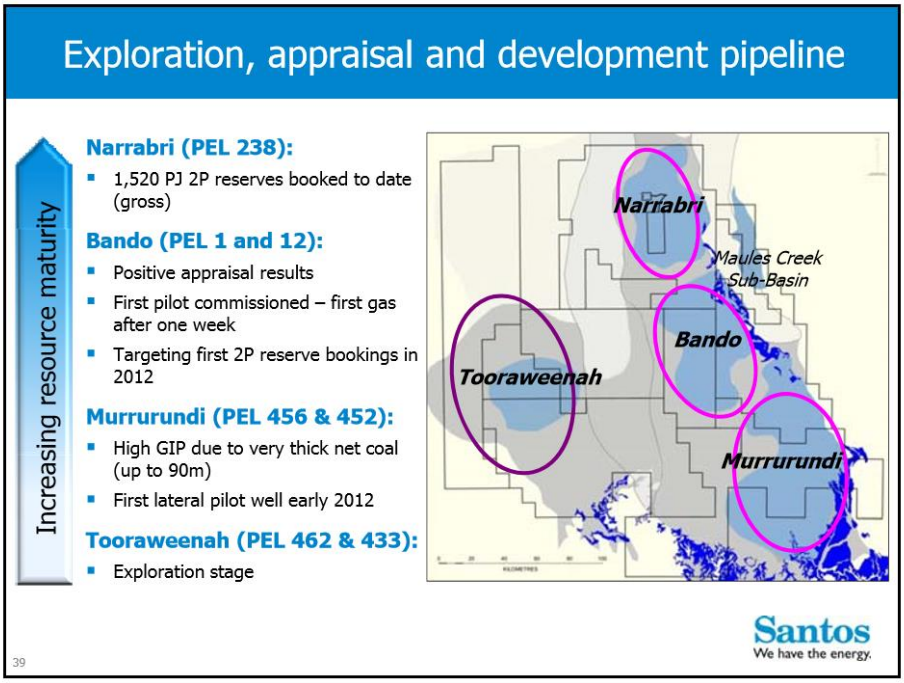
project Commitments, Chapter 32 Justification and conclusion. Appendix F, G3, G4 reports that relate to these Chapters have also been reviewed relative to their context to water.

Executive Summary (ES) Comments ;

Santos propose to develop their project on behalf of joint venture participants in the Gunnedah Oxley basin. It is noted by Department of Planning that the APA pipeline project will be taken into consideration as forming part of the assessment of the NGP. Namoi Water requests that the future development of 8 coal seam gas fields and presentations to Santos Shareholders should also be included in this assessment.

The broader PEL area (see attached map CSG PILLIGA 2012) opens the Namoi Catchment and broader region to expansion of CSG development and therefore substantial water impacts. The APA pipeline is estimated to cost over $500 million to construct and we assume that this level of investment will not be made based on the NGP 850 wells but on additional stages being approved by NSW Government.

The NGP is stated to be Stage I of Coal Seam Gas development in the Namoi catchment. The potential for progressive creep of approvals to be given over time based on these investment decisions is not considered best practice planning. In effect the proponent has presented to shareholders the resource has several CSG fields for development that invariably sit under strategic agricultural land and water resources. We strongly encourage NSW Government to reduce the exploration licences for Coal Seam Gas to give certainty to the region regarding the potential for significant impacts on water resources from this activity.



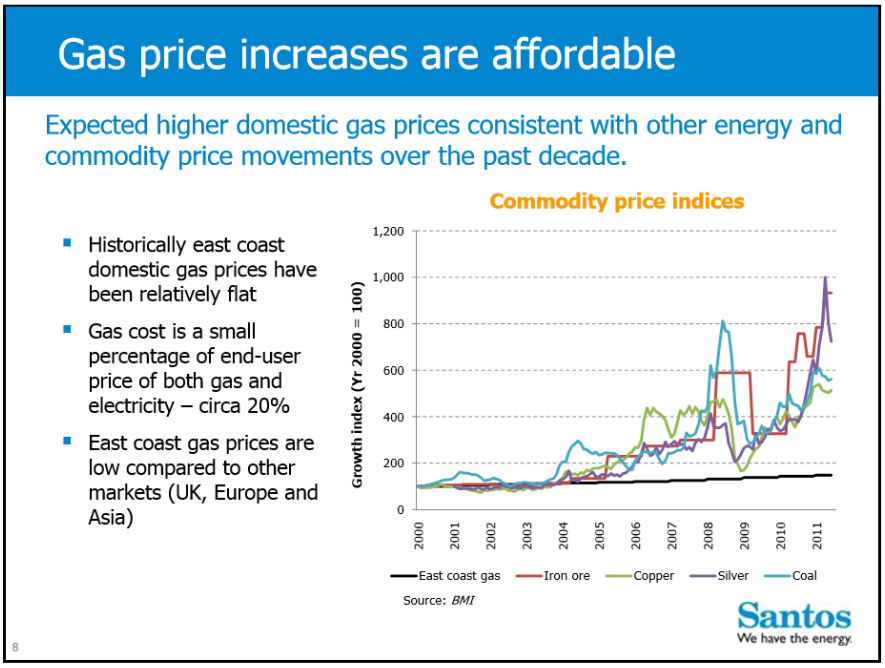
The justification for the project in the EIS states that a large proportion of the gas purchased by retailers in NSW is underpinned by long term contracts with gas producers in other states. Historically

approximately 40% of NSW supply comes from the Cooper Basin. As a result of the over development of LNG facilities developed in Qld (3 separate facilities approved at Gladstone by successive Qld Governments), the gas contracted from the Cooper Basin will no longer be available because Santos will be purchasing this to supply overseas markets due to the Santos owned Qld Gas fields not producing as predicted.

In a previous Shareholder presentation Santos Executives stated that there was likely to be an unprecedented increase in East coast gas demand by 2020, however the predicted demand has not eventuated. Retail gas demands from NSW have remained steady, in terms of the project justification the underlying impact of Qld's decision to allow unsustainable development of export facilities has resulted in NSW needing to reshape its continued long term gas supply. The risk of supply externally is stated to have limitations with a 1998 interruption used as an example. This insufficient given the known reserves.

Namoi Water asserts the EIS executive summary contains very poor justification for NSW development of CSG as valid reasons for approval of the NGP, particularly given the EIS does not adequately address risks to water resources.

In terms of cost of production the NGP will result in higher priced gas being supplied to NSW and given the companies own representations to shareholders suggesting that NSW can afford gas price increase resulting from this project and GLNG.



Effectively NSW is being priced out of the gas market by the same proponent whom would develop CSG at the risk of existing industry and water resources. In 2012 DomGas Alliance WA's peak energy user group conducted a report into the changes in the gas market. The report noted that manufacturing is facing significant challenges in global markets and the advantage to date has been low cost energy. This advantage is being lost overseas as major gas produces focus on maximizing LNG exports to China, Japan

and Korea supplying gas cheaper to the export market than here in Australia.

There has been substantial media on the current "Gas Crisis" created by the GLNG infrastructure. Australian Fin Review - "Australia's Gas industry is more Villain than local Hero", SMH – "Australia's Gas Industry has lost the trust of the public", Australia Fin Review -"Put brake on exports"

Federal Government intervention looms in relation to a domestic gas reservation policy and the regime proposed would mean that orders can only be issued against LNG exporters that are drawing more gas from the domestic market than they are putting into it. The only operator susceptible to this order would be the Santos-led GLNG project, which last quarter relied on third party suppliers for nearly 60% of its production.

The NGP is reported by Santos to supply 200 terrajoules of gas per day which is sufficient to provide NSW with a secure long term supply of energy and reduce the states reliance on contracts with interstate suppliers. NSW Government and Department of Planning are encouraged to provide transparency on the NSW current gas supply contract and scope for continued supplies from other sources into the medium future as part of this assessment process.

Namoi Water asserts that Santos have overstated gas projections from appraisal activities in Qld and as a result are now sourcing substantial amounts of their LNG supply from other sources. In this context the proponents knowledge of gas accumulations in the Namoi region are questioned. This also leads into the benefits that the project would provide to the community through economic output and income – if the expectation of gas resources fails to meet predictions, will there be continued "variation" to the project to infill and continue expansion into other PEL areas to bolster supply to justify the infrastructure investment of water treatment, pipelines etc.

The project proposes that 127 FTE will be provided in the Narrabri LGA, however this is highly questionable as the number of local jobs are a function of staff being transferred into the community rather than additional jobs being created. We request further detail on the jobs that will be created and filled locally for this project, the assumption of 224 FTE jobs created for the rest of NSW is also spurious. In direct comparison is the local recycling plant that now employs 50 people. This facility has been built using local investment, creates local jobs for the unskilled without fanfare and without a mickey mouse badge required.

The ES statement that the majority of Narrabri Community recognize the project will improve local prosperity, should not be used as endorsement of the NGP and is inaccurate. Local residents have a range of views and there is certainly no majority either way pro or against. Within Namoi Water's membership there are a diversity of views based on your risk/reward potential from the project. Those that stand to be first affected are against the project, those that are financially incentivized have a more positive view, either way all agree the fundamental priority is to ensure water resources that licence holders rely upon should be protected first and foremost.

Santos have advised that Landholder agreement will be sought for all wells on private land, however an important distinction should be made that this does not apply to infrastructure crossing either through or under holdings. This issue should be addressed by department of planning in the EIS review, there is clear precedent that all landholder impacts should have a process for redress through land access agreements and where an individual does not wish to have infrastructure through their property this should be respected by the proponent.

The Executive Summary (ES) states that the risk of spills and leaks of produced water affecting surface water quality was assessed to be low due to the design, construction, operation, management and monitoring of water infrastructure. There have been substantial spills, leaks, operation and poor monitoring of water infrastructure to date and there are significant environmental risks associated with the NGP. The environmental and human health risks were documented by the Chief Scientist, that despite best endeavors the interaction of technology failure and human mismanagement would result in risks.

These have not been adequately addressed by Santos in the EIS assessment. Namoi Water asserts the residual risk table in the ES is flawed and seeks Department of Planning provide a transparent and full risk assessment based on the project's environmental risks. If the project EIS does not address the risk pragmatically, the positive benefits will ultimately be outweighed by the negative impacts long term and the benefit quickly forgotten similar to the impact of Abestos mine near Barraba. This project needs Department of Planning and NSW Government to take the appropriate amount of time to collect sufficient data based on the Chief Scientists recommendations to make proper assessment. To date the EIS does not meet this requirement based on the following concerns.

Groundwater and Geology Report Comments:

Key to predicting the potential impact on groundwater resources is collection and analysis of data to inform the development of the conceptual model and development of a robust numerical model.
Questions to assess the information provided include; is there sufficient data to inform the model? Is the model too simple? Is it too complex? Is uncertainty analysis provided? Has the model been calibrated? How representative is the model?

Evaluation by DPI Water and other expert hydrogeologists and modelers of the work undertaken by Santos and their consultant CDM Smith should ensure the above questions have been answered to their satisfaction. Namoi Water is particularly interested in the data informing connectivity between the different geological layers and the transmissivity of these layers, and how this is represented in the model.

Namoi Water notes that Table 1.1 in the GG report is incorrect, the SDL's for alluvial water sources remain the same as current NSW Water Sharing Plan extraction limits. There is no proposed reduction for Upper and Lower Namoi Alluvium and the Eastern Porous Rock Gunnedah Oxley Basin has been reviewed under the Northern Basin Review provisions and is proposed to increase by 10 gl on the initial limit determined by the MDBA, some 80gl less than the volume expected by NSW Government.

The continued comparison of CSG water quantity with alluvial water sources demonstrates ongoing desperation by the proponent to link themselves to other industries that the general community understand. Groundwater in the Namoi underpins the irrigated production system and its value to the irrigation industry cannot be overstated. NSW Government have in place over 500 groundwater monitoring bores at 300 locations in the Upper and Lower Namoi system used to manage groundwater abstraction in line with extraction limits and rules within the Water Sharing Plan. Continued review of water sharing plan data occurs annually, with status reports developed independently by DPI Water presented to irrigators to inform progress of aquifer systems.
DPI Water developed the alluvial groundwater models and numerical models independently and continues to utilise rigorous assessment processes in dealings and management rules to manage the resource. Irrigators in the Lower Namoi voluntarily reduced their water entitlements prior to Achieving Sustainable Groundwater entitlement program and Irrigators themselves led the groundwater reform process, the Namoi in particular has funded numerous research studies to understand the complex groundwater systems and ensure their management continues to be sustainable.

NSW DPI noted in their presentations to the Santos NGP CCC that there were considerable data gaps and a lack of modelling characterization in the deeper systems. Inter aquifer connectivity is a key parameter to be improved from the proposed new monitoring program being implemented by NSW to look at surface and groundwater connectivity and conducting water quality assessments. NSW DPI Water staff also undertook to provide information to the community regarding the second location for a Deep Aquifer Monitoring Bore (DAMB) to be drilled given the first of the new monitoring bores was acknowledged as being drilled in a contaminated site located with 100 metres between fracked bores Bohena 5 and Bohena 4/4L. Therefore results of this proposed “independent” monitoring site are not a true baseline of water levels and quality, particularly as the aquifer and aquitard properties and connectivity which is likely to be compromised from the existing Coal Seam Gas well at the site. Namoi Water specifically requests additional information is provided to stakeholders regarding the second site selection and timeframe proposed for drilling of the baseline DAMB requested by stakeholders to be located up gradient of NGP.

Figure 11-1 also misrepresents the broader water resource issues. Upper and Lower Namoi Groundwater systems are recharging resources more closely associated with climatic conditions and abstraction. The Gunnedah Oxley Basin is a finite resource which fundamentally is not recharging in the same temporal manner, and therefore the share component of brackish water that is a bi-product and it’s minimal level of entitlement as percentage of the available resource is misleading and mischievous.

Table 11-3 represents Groundwater Allocations based on predicted water take, induced flow and share component requirement for the project in ML, we recommend this table should be reassessed based on the following concerns raised regarding deficiencies in the data and the conceptual model and therefore outputs of the numerical model.

The Santos report on page 11-29 states that in the absence of reported field data, published literature values of hydraulic conductivity and calibrated values from existing groundwater models have been used to determine the likely range of values for use in the groundwater modelling. In this regard the starting water balance model used in the Santos EIS does not match the water balance modelling that was used to inform the Water Sharing Plans. The Santos EIS model has too much artesian recharge into the Upper Namoi Alluvium, and too little recharge into the Lower Namoi Alluvium compared to the higher resolution work by Merrick (2001) and McNeilage (2006).

Merrick (2001) has 7.9 GL/y of input from artesian water into the lower Namoi, and McNeilage (2006) has zero artesian recharge into the upper Namoi alluvium (Appendix F Table 5.9, page 5-30). On page 6-33 the steady state model used as the starting point for all simulations in the Santos EIS only has 1.1 GL/y transferring from the Cretaceous aquitard sequence to the Lower Namoi Alluvium. This does not match Merrick (2001). That figure shows no other transfer from any other rock formations into the Lower Namoi Alluvium. Figure 6-18 does however show 8.57 GL/y (=0.26+7.2+0.81+0.11+0.19) of artesian recharge into the Upper Namoi Alluvium. This does not match McNeilage (2006).

In Noel Merrick's PhD thesis (UTS 2000) he states that the artesian recharge is in the eastern area of the Lower Namoi, this covers from Narrabri to Wee Waa (old zone 5). The groundwater model presented in that thesis has artesian recharge of 9.8 GL/year, and the total recharge for Zone 5 equal to 42.7 GL/year (for the period 1980 to 1994). That makes the artesian (GAB) contribution to Zone 5 = 9.8/42.7 * 100 = 23%. What additional data on the alluvial system and connectivity with the GAB does the proponent have to suggest the differences in the starting model water balance?

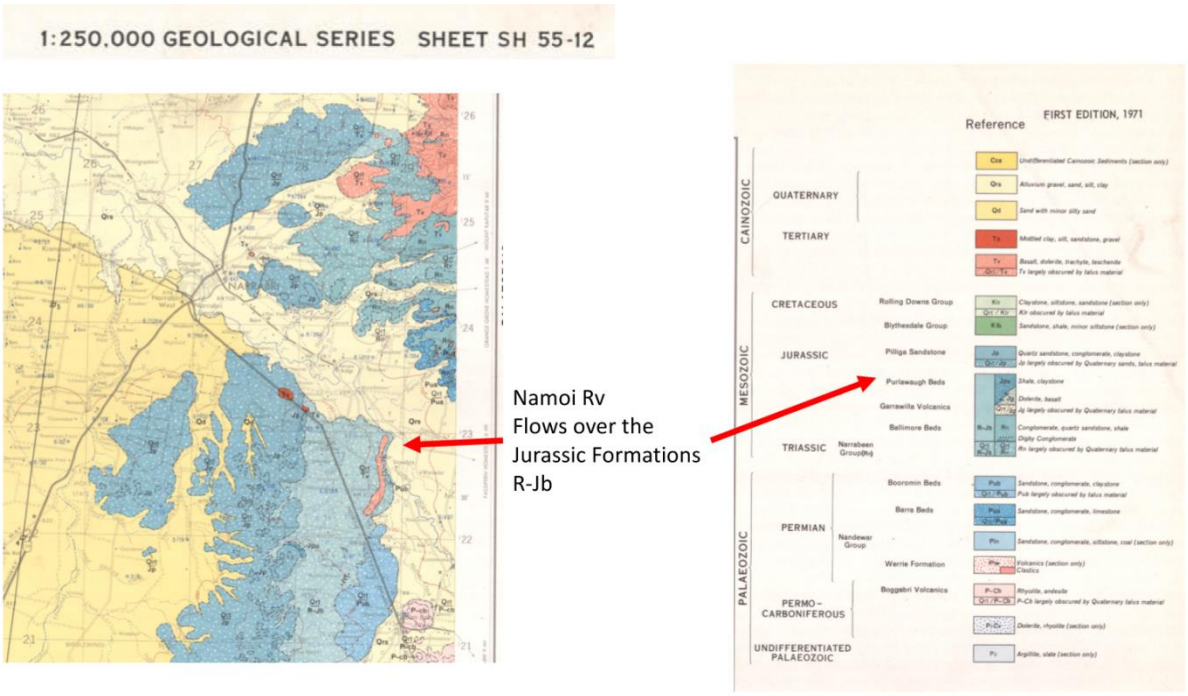
These differences should be fully explored in the assessment of the EIS Groundwater conceptual model by DPI Water and expert panel.

The Santos Groundwater Report states ;

"Whilst there is connectivity between the Namoi River and Namoi alluvium, there is no direct connection between the Namoi River and the GAB or Gunnedah Basin. Connection between the Namoi Alluvium and Pilliga Sandstone aquifer of the GAB occurs 10 to 15 kilometres northeast of the project area but both of these sources are hydrologically isolated from the target coal seam for the project by thick sequences of intervening aquitards (Section 11.4.2)".

The map below clearly shows this statement to be incorrect.

The 1:250,000 geological map the Namoi Rv flows over the Purlawaugh Formation.



The Santos EIS does not consider the Purlawaugh Formation as part of the Great Artesian Basin. However, the Namoi Water Study on page 16 (pdf page 46) has: "GAB – GAB, Pilliga Sandstone and Purlawaugh Formation". Both of these formations are Jurassic in age, and the Pilliga Sandstone conformably overlies the Purlawaugh Formation - they are hydraulically connected.

In the Santos EIS Appendix F - Groundwater Impact Assessment 1 of 2
The report states: *"The Purlawaugh Formation, which is positioned beneath the Pilliga Sandstone is considered to be negligibly transmissive"*. But in Table 5-2 has the Hydraulic Conductivity ranging from 0.001 to 0.41 K [m/d], which overlaps with the range for the Pilliga Sandstone 0.029 to 0.19. The hard data does not support the assertions in the groundwater report regarding connectivity.

Regarding this part of the statement : *"Connection between the Namoi Alluvium and Pilliga Sandstone aquifer of the GAB occurs 10 to 15 kilometres northeast of the project area but both of these sources are hydrologically isolated from the target coal seam for the project by thick sequences of intervening aquitards (refer to Section 11.4.2)*."

Santos has not provided the hydro geochemistry in the EIS to demonstrate with hard data that these are aquitards. The aquitards are inferred based on lithological descriptions and limited measurements ref Table 5-2. Santos have based their low risk of groundwater impacts due to two aquitard layers protecting the overlying GAB Pilliga Standstone and alluvial aquifers. This is more a function of thickness of the aquitard than any detailed information regarding transmissivity. The baseline data presented for the Gunnedah Oxley Basin aquitards (Digby and Napperby Formations) and Great Artesian Basin Jurrasic aquitard (Purlawaugh Beds) are questioned as to their statistic validity due to the sample size.

As the weight of protection rests with these formations we request additional data is collected to ensure that the dataset is statistically viable (6 samples per bore) to ensure these units are sufficiently represented in the model. This information is not new, nor is it unexpected in its request as it was included in several submissions at the referral process in 2013. At that time limited hydraulic data on hydro stratigraphic units was presented and request was made to both regulatory reviews (both State and Federal) to include pump testing and additional groundwater analysis detail. The initial conclusion in 2013 with minimal data appears to have been replicated in the final documents, without addressing detailed weaknesses of the protocols proposed at the time.

The Key issues raised in 2013 included;

1. The conceptual diagram of the hydrogeology was at odds with the geological/topographic maps.
2. The initial conceptual idea of hydro stratigraphic beds interact with each other is an area of weakness lacking data/detail, particularly as this information informs the numerical model and results in poor confidence levels of model predictions.
3. The Pilliga Sandstone aquifer as a medium sensitivity receptor – the Pilliga sandstone aquifer recharge beds are limited regional and therefore would qualify for high sensitivity status.
4. Drawdown of the Pilliga sandstone leaky confided to confined aquifer is significant when pumping commences. When the potentiometric surface is lower than the Bohena Alluvial unconfined aquifer water table the leakage form the alluvial aquifer down to the Pilliga via Keelindi beds would have an effect on the water quality of the Pilliga sandstone aquifer and lower of water levels in the Bohena alluvial aquifers meaning domestic bores could strata to produce lower quality water.
5. The absence of any ground trothing of the numerical models hydraulic parameters and the process by which the numerical model was developed does not give confidence the model outputs are robust. (source Groundwater solutions International report on the Referral EIA)

This project cannot proceed without this information – Santos have had substantial time to do the work required and generate this information to address identified issues, either they have done the work and have not provided the detail in the EIS or the work has not been completed to a satisfactory standard to address potential impacts on valuable groundwater supplies. **Namoi Water specifically requests the above key points are addressed in the review and that the hydro geochemistry detail is provided in a report to stakeholders as an addendum to allow additional assessment to occur.**

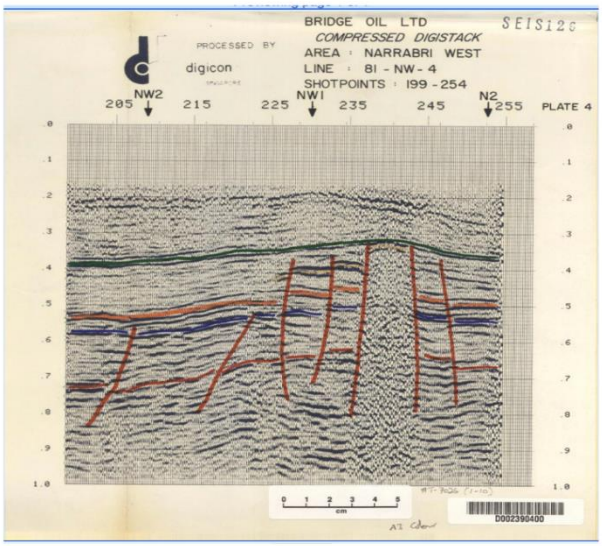
The Santos report states on page 11-25 that from the seismic data, no evidence has been found of large post Jurassic age faults that displace Permian age and Triassic age strata, with the amount of displacement being less than 100 m. The EIS concludes that where present surface faulting and displacement in the Jurassic age strata is found to be minor.

Hydraulic connectivity between the coal seams and the GAB Pilliga Sandstone or Namoi alluvium could occur through gaps in confining layers, faulting or connection at the interface. Connectivity through the Jurassic and Permian units is most likely to be via fracture networks and faults the information that informs this assessment is critical. Namoi Water specifically asks that the

Department of Planning and DPI Water review the matter of connectivity through faulting in detail as part of the assessment process.

A sample copy of part of the Narrabri Faulting Study is provided below showing faulting.

REPORT DOCUMENT SS126 Report Identification number R00021480 Seismic survey final report.



Surface Water:

Namoi Water does not support managed releases of treated water into Bohena creek. This unregulated creek is highly ephemeral and the likelihood of 100 ML per day flow occurring in the intervals required for release is unrealistic within the first four years of the project life. Further despite treatment processes the CSG treated water is likely to have different chemistry to the natural surface water. The potential impacts from the introduction of treated waste water to both surface and groundwater needs to be assessed against differences in pH, alkalinity and sodicity.

Any proposed water treatment system and the monitoring and evaluation of this activity must have strict controls in place and include regular monitoring by the EPA. The negligence of previous exploration activities has been taken into account in the review recommendations by the Chief Scientist, and as a result NSW Government made welcome changes to the regulatory oversight including the appointment of the EPA as the lead regulator. Regardless of these changes the assessment of impact on the hydrology does not appear to consider any outcome where contamination from produced water occurs. We request that additional work should be done based on potential for surface water contamination to occur as the EIS lacks detail and support data to assess risks.

As water is a bi-product of Coal Seam Gas extraction and in real terms for the proponent is a waste product and extraction serves only to depressurize the coal seam area and allow gas to flow. The management of this environmental risk needs to be carefully assessed given its proximity to the Namoi River, Unregulated creeks and streams and Groundwater resources. A good example of impacts to be avoided can be seen resulting from the rapid expansion of CSG in Queensland to service the three over capitalized GLNG plants. Coal Seam Gas uses over 65 00 ML/a of groundwater (ref Qld GFC) but

expected to average 95,000 ML/a over the life of the industry. The impact of this extraction is a decline in the surrounding bores by more than the trigger threshold (2-5m depending on the type of aquifer), over the life of these projects approximately 500 bores are predicted to be affected triggering make good provisions. This is the water that some landholders directly rely upon and given the relative poor track record of make good provisions is considered a failure of regulatory process.

Further comment is made in relation to the monitoring of surface water impacts in sections below.

Well Integrity:

Well integrity remains a risk to the resource with some most recent studies quoting figures of 2-16% of wells drilled have some form of spill or leakage of wastewater has occurred. Despite assurances from Government regarding the completion of drilling and casing to meet the current NSW Code of Practice for Coal Seam Gas Wells, the fundamental need for monitoring cannot be understated. Pressure testing for integrity is essential as cement shrinkage can occur leading to cracks in the cement casings.

Pearce 2005 Report on Well Bore Integrity noted the following data gaps;

- frequency of failure: there is insufficient information available from regulators or oil and gas operators, water bore owners, or the coal industry to enable the frequency of failures to be estimated, either within bores or between bores of a similar or different type. A key contributing factor to this is the commercial sensitivity and inconsistent definitions of failure classes.
- mechanisms for failure: there are many mechanisms that can result in bore failure. However, little is known about how these failure mechanisms should be classified, or the detailed processes that ultimately lead to failure
- criteria for failure: there is a need to clearly define criteria against which failure can be judged
- consequences of failure: the consequences of bore integrity failure for water resources, both in terms of quantity and quality, are dependent on a variety of factors including the location of the bores, their depth, the surrounding groundwater resources, the purpose of the bore, its age and construction materials, and the rigour of its monitoring and maintenance program. However, detailed consequence assessments for water resources could not be readily identified in the literature.

In the context of coal seam gas extraction and coal mining, investigations of cumulative issues associated with multiple incidents of bore failure could not be readily identified in the literature.

Despite the proponent's assurances that the resource does not need fracking, Namoi Water is concerned that in many cases scavenger companies take over projects at the end of their productive life, and the issue of fracking if not addressed as part of this review will be an area of substantial risk to groundwater resources in the future.

Treated water management :

The water extracted from the Narrabri Project coal seams is an extremely poor quality water, defined as brackish and is not fit for use for the purpose of stock and domestic or irrigation supplies. Treatment of CSG water results in bi-products, the brine and treated water and waste from the treatment process. How NSW Department of Planning regulate the management and disposal is critical to the protection of water resources relied upon by local community. This is not a new issue to the CSG industry and despite some 50 years of CSG extraction this issue remains today one of the critical issues.

"The disposal of co-produced water has proved to be the biggest environmental problem associated with exploitation of coal seam methane fields in the USA. Although the quantity and quality of the water can vary enormously between coal basins." (Clarke, 1996)

Primarily the volumes of water are obtained from the estimates within the numerical models, the produced water ranges between 30 000 ml to as high as 81 000 ml based on an uncalibratred dataset. The TDS estimates of the brine suggest that approximately the range of salt between 9 g/l as stated in the EIS – 18 g/l estimated by Khan and Kordek 2014. This would mean double the salt production, with the potential for 40 000 – 80 000 tonnes of salt produced per year. Critical to the issue of produced waste is the identification and transport to a suitable facility and how much will be stored at Leewood and over what timeframe? Several occurrences of CSG ponds/dams and infrastructure such as bunding being overtopped due to the high intensity rainfall events in the region. If suitable management processes are not in place prior to the project commencing Namoi Water suggests that this is a show stopper assessment area.

Functionally the salt/brine disposal at commencement of the project is as important as having a pipeline to transport the gas to market.

Namoi Water also notes that re-injection has been tried in some specific areas in Qld and indeed Forcenergy Australia trialed Water disposal by re-injection in Pel 238 very early on in the project development. Namoi Water suggests that clear recommendations be established regarding the unsuitability of the NGP area geology for reinjection, further that as it is currently unassessed that any illegal reinjection will be pursued with substantial penalties imposed.

Water Monitoring :

The monitoring network for groundwater includes both shallow groundwater and alluvial monitoring bores, with the proposal that wells will be converted to monitoring bores over the life of the project. The network of 10 monitoring bores across the 95 000 ha of the project are needs careful assessment for adequacy to determine in a timely manner any contamination or impacts on groundwater pressure change as a result of the various resource units reaching a new equilibrium over time.

There has been minimal acceptance by the proponent of the groundwater contamination from the spills and leakage that occurred previously, much time and effort has been spent to imply this was within natural variation. Unless a proper baseline is established within the broader project area with sufficient

monitoring to determine changes in groundwater chemistry and pressure the department cannot assure the community impacts can be managed over time due to CSG extraction.

Other issues;

Cost Benefit analysis (CBA) of the NG coal seam gas proposals must take into account the long term impacts on water resources at the worst case scenario. The lack of detailed assessment of the impact from the broader resource extraction in the NGP puts NSW at risk to irreversible damages and functionally make good provisions will be limited in their ability to ameliorate impacts. There must be continuation of the "no regrets approach" to CSG activities, a comprehensive CBA should address risks of potential damages. Water impacts are implied in the CBA to be indirect – yet the CSG detrimental impact can be quantified and should be recognized within any CBA assessment. Given the Aquifer interference policy is not a regulation, the protection of water resources and assessment must be validated and compressive.

Namoi Water anticipates additional research that is essential to the assessment of the groundwater impacts of this project will be available in the next two weeks and we will be making an additional submission to the Department of Planning regarding this important work.