THE WILDERNESS SOCIETY

Submission to the Narrabri Gas Project EIS

Attn: Executive Director Resource Assessments
Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

May 19, 2017
Dear Sir/Madam,

This is a submission to the Narrabri Gas Project. Application No. SSD 6456

The Wilderness Society objects to the proposed Narrabri Gas Project due to its significant environmental, social and economic impacts. The proposal contravenes the principles of Ecologically Sustainable Development (ESD) as outlined in the EP&A Act and should therefore be rejected.

Our submission outlines our concerns regarding the following key areas:

- Gamilaraay/ Gomeroi cultural heritage and consent
- Justification for the project – we do not need its gas
- Contribution to climate change and inadequate methane impact assessment
- Impacts and risks to water resources
- Waste management and salt legacy
- Impacts to groundwater dependent ecosystems
- Biodiversity and threatened species impacts
- Social and local economic impacts
- Bushfire risk

We further object on grounds of health impacts, air quality and inadequacy of these assessments, and risks and impacts for the Dark Sky of Siding Springs Observatory on Commonwealth Land.

We understand from the submission numbers to date that the level of interest and controversy regarding this project may be unprecedented in the history of the state. We urge you to take due time in consideration and thorough exploration of the issues raised.

If you would like to discuss any of the issues raised in this submission please do not hesitate to contact us naomi.crystal.hodgson@wilderness.org.au,glen,klatovsky@wilderness.org.au, or stacey.chilcott@wilderness.org.au.

Sincerely,

Naomi Hodgson Glen Klatovsky Stacey Chilcott



The Wilderness Society

Submission to the Environmental Impact Statement for the Santos Narrabri Gas Project

May 2017

Contents

Submission context

For over 40 years The Wilderness Society has campaigned to safeguard iconic Australian places and the wildlife and communities that depend on them. Our many successes include protection of the Tasmanian Wilderness, the Daintree Rainforest, Kakadu, Ningaloo Reef, Fraser Island, the Kimberley coast, and countless stands of old growth forest.

Our purpose is to protect, promote and restore wilderness and natural processes across Australia for the survival and ongoing evolution of life on Earth. Our vision is for an Australian society that protects and respects the natural world that sustains us.

Our organisational goal on climate change is to prevent dangerous global warming to no more than 1.5 degrees above pre-industrial levels by creating an Australian economy that helps rather than harms our climate.

Introduction

The Santos Narrabri Gas Project proposal outlined in the Environmental Impact Statement (EIS) currently on public exhibition directly threatens an iconic and unique wilderness area. The project risks the Pilliga forest's state and nationally significant biodiversity values as well as critical groundwater aquifers, including a groundwater recharge area for the Great Artesian Basin. If it proceeds, this gasfield would add unacceptable quantities of greenhouse gas emissions to our atmosphere, fuelling dangerous climate change. The Gamilaraay traditional owners of the forest have not offered their consent due to the project's impacts on their spiritual and cultural connections to Country. For these fundamental reasons The Wilderness Society is categorically opposed to Santos' proposal to construct a coal seam gasfield in the Pilliga forest.

The proposal involves the progressive development of a coal seam gasfield with up to 850 gas wells and 425 well pads over 25 years, with the construction and operation of gas processing and water treatment facilities, including:

- a central gas processing facility for the compression, dehydration and treatment of gas;
- a water management facility for the storage and treatment of produced water;
- an in-field gas compression and water management facility; and
- water and gas gathering pipelines and ancillary infrastructure.

The EIS lacks key information regarding the footprint and surface level impact of the project and omits essential detail in regards to management plans for a wide range of parameters, from social impacts to waste management. The EIS risk assessments are based on assumptions that the standard procedures will be followed and cumulative impacts and worst case scenarios are not addressed.

There is no genuine social or economic need for this project to proceed and there are more economical and reliable alternatives to coal seam gas as an energy source, alternatives that do not risk essential ecosystem functions necessary for a sustainable future.

Aboriginal heritage not adequately assessed and consent not obtained

The Pilliga is a sacred part of the traditional lands of the Gomeroi or Gamilaraay Traditional owners who maintain a strong and continuing connection with their Country.

The Pilliga is rich in Aboriginal cultural heritage and contains a large number and diversity of sites of significance for the Gamilaraay people.

Cultural heritage surveys undertaken to inform the EIS acknowledge some of these sites, however we have concerns about the mapping and modelling of the heritage assessment. We're also concerned that Aboriginal consultation was not undertaken in an appropriate way and we refer to the expert archaeological review submitted by Kuskie for further insight into these concerns.[1]

The approach taken by Santos to site its facilities with the intention of 'complete avoidance' of sites of cultural significance[2] fails to understand the landscape scale connection to Country and the holistic responsibility as protectors of Country that, as we have been told by countless Gamilaraay people, is intrinsic to their culture.

Gamilaraay people from across the region have been telling Santos they do not want their land sacrificed for coal seam gas.

Australia is a signatory to the United Nations Declaration on the Rights of Indigenous People; regulators in NSW have a responsibility to ensure that Free, Prior and Informed Consent is obtained before any mining project proceeds on Indigenous lands.

Justification for the project – we do not need its gas

Santos' states in the EIS chapter Strategic Context and Need that NSW *"is at risk of supply shortages and increasing prices".* It states that*"[t]he ability to procure and transport a sufficient quantity of gas, while maintaining an acceptable price for consumers, depends on the efficient development of these natural gas resources so that gas supply to the market can be increased."*

The Santos EIS refers to the Australian Energy Market Operator (AEMO) 2016 Gas Statement of Opportunities (GSOO) report and its calls for Narrabri to be developed to ease very minor projected domestic supply shortfalls. The 2016 document was superseded shortly after Santos lodged its EIS, with the release of the 2017 GSOO. As the 2017 GSOO is now the more relevant document we refer to that in our critique of the assumptions used in the EIS to underpin the strategic context and need for the project.

Our critique draws heavily on the findings of a recent report of May 2017, *A Short-lived Gas Shortfall*, by the University of Melbourne's Climate & Energy College by Forcey and McConnell. The references below are all drawn from this report.[3]

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[1] Kuskie P., South East Archaeology, May 2017. Narrabri Gas Project – Aboriginal Cultural Heritage Assessment – Expert Review. Appended to the North West Alliance submission.

[2] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 20: Aboriginal Heritage.*

There is no gas shortage to address

AEMO's 2017 GSOO said eastern Australia will run short of gas to supply the domestic market as well as all its export facilities if they run at full capacity, and singled out pushing Santos' destructive and expensive Narrabri coal seam gas scheme to boost production.

These statements by AEMO caused widespread alarm and led to calls by Federal Ministers to push for greater onshore gas development. Yet, AEMO's report said eastern Australia could have minor shortages of gas in three out of the next 13 years, with the biggest shortfall of 3.9 petrajoules of gas in 2020-21, 0.2 per cent of demand, or just 18 hours of gas supply. Then, just 11 days after releasing its annual gas report AEMO issued a statement cutting Australia's 2020-21 electricity demand and wiping out the overhyped gas shortfall.

Developing Narrabri Gas Project in response to a negligible and unlikely future gas shortage is a false "solution" to a gas price problem. Massive new fossil fuel projects are not an appropriate, sensible or future looking approach to addressing our energy needs. We do not need the Narrabri Gas Project to address an unlikely supply shortfall that can be addressed in multiple other ways.

Developing Narrabri Gas Project will not improve gas supply or price

Australia's gas production has more than doubled since 2015 yet gas prices have tripled. Gas prices keep going up even though we're producing more gas because it's being exported and the domestic price is linked to international prices.

- There are now 10,000 coal seam gas wells carving up the landscape in Queensland and NSW[4]
- Bass Strait gas is being diverted from Victoria to Gladstone for export
- Santos now buying 59 per cent of its gas to service its GLNG gas export terminal.[5]

Before LNG exports started from Gladstone in January 2015, eastern Australia had nearly the cheapest gas in the developed world at below $3 per gigajoule. Australian gas production has more than doubled from about 700PJ a year from before 2014 to 1900PJ in 2017. But wholesale gas prices have tripled since December 2011 when gas was below $3 per gigajoule to above $9/GJ now. Gas buyers are now saying suppliers are quoting $20/GJ and higher for long-term contracts.[6]

The production costs of gas from the Narrabri Project are among the most expensive in the east coast market (which now includes the gas produced to be exported from the Gladstone facilities).

Narrabri Gas would be more expensive than any of the gas Australia needs for all its domestic use and its export facilities for the next 20 years. Australia needs 39,460PJ for all its domestic use and its export facilities for the next 20 years, yet Narrabri gas is more expensive than 58,000PJ of Australia's gas reserves at $7.25 per gigajoule plus the cost of building a pipeline, which could raise the cost to above $9.25/GJ - more expensive than gas prices are now after having tripled since December 2011.

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[3] Forcey T. and McConnell D., May 2017. *The short-lived gas shortfall: A review of AEMOs warning of gas-supply 'shortfalls'* Climate & Energy College, University of Melbourne.
Available at: http://climate-energy-college.org/short-lived-gas-shortfall

[4] Ibid. p.11.

[5] Ibid. p.12.

[6] Ibid. Figure 5, p. 12.

According to figures from AEMO and from gas company AGL, gas from Santos' Narrabri Project would cost $7.25/GJ to produce plus the cost of building a pipeline, which could raise the cost to above $9.25/GJ - more expensive than gas prices are now after having tripled.[7]

Narrabri gas will not lower the price of gas in the domestic market.

> *AEMO's suggested new pipelines and new (expensive) gas fields are false "solutions". These massive fossil-energy infrastructure investments are not needed to address a supply shortfall that is very unlikely to occur. Furthermore, these investments will not reduce the wholesale price of domestic gas. New gas sources are expensive to produce, and in any case, in the sellers market that now prevails, domestic-wholesale gas prices are linked to international benchmarks*[8].

Assessment of alternatives

The analysis provided in chapter 8 Assessment of Alternatives, is superficial and disingenuous. While the EIS (8-1) states that its assessment focuses on the project alternatives, such as safety and efficiency of design, rather than the 'broader issues of gas supply and demand', which it's claimed, are addressed in chapter 3 (as discussed above). However, the Secretary's Environmental Assessment Requirements state that Santos must provide a "*justification as to why the proposed development is preferred over any other alternatives*[9]*."*

Santos does not underpin its assessments of alternatives on the foundational question of meeting a social or economic need for NSW or Australia. Santos argues the project will meet a need for affordable and reliable gas in NSW for households, businesses and the manufacturing sector, but does not provide a clear analysis of the project's capacity and likelihood to meet that need given the complexities of the east coast gas market and the high cost of extracting gas from Narrabri.

Even if there was a gas shortage it could be effectively solved

Even if there was a gas shortage of 3.9PJ, as the AEMO GSOO 2017 stated, it could be solved easily:

- 0.3% of expected gas exports could be diverted to the domestic market, and the Federal Government has just set up such a mechanism, the "Australian Domestic Gas Security Mechanism" if needed.[10]
- Increasing wind and solar generation by 0.9 per cent (less than 1%).[11]
- Using renewable biogas or biomethane, gas derived from biomass and municipal waste.[12]

A 2013 City of Sydney report said up to 50PJ of gas could be produced a year from sources located around Sydney, with Sydney Water saying up to 5 PJ/yr could be generated from its waste sources.[13]

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7 Forcey T. and McConnell D., May 2017. *The short-lived gas shortfall: A review of AEMOs warning of gas-supply 'shortfalls'* Climate & Energy College, University of Melbourne. *Figure 22, p.38 and p.39*
Available at: http://climate-energy-college.org/short-lived-gas-shortfall

8 Ibid. p.4.

9 Secretary's Environmental Assessment Requirements: SSD 14_6456
https://majorprojects.accelo.com/public/4e56cdc32b149d73599969571c9636f6/Narrabri%20Gas%20Project%20%20-%20%20SEARs.pdf

10 Forcey T. and McConnell D., May 2017. *The short-lived gas shortfall: A review of AEMOs warning of gas-supply 'shortfalls'* Climate & Energy College, University of Melbourne. p.23.

11 Forcey T. and McConnell D., May 2017. *The short-lived gas shortfall: A review of AEMOs warning of gas-supply 'shortfalls'* Climate & Energy College, University of Melbourne. p.23

12 Ibid. p.30

Its contribution to climate change is unacceptable

This proposal should be rejected due to its unnecessary contribution to dangerous climate change. The EIS Chapter 24: Greenhouse Gas contains many misleading statements and is based on flawed logic regarding climate impact assessment. The greenhouse gas assessment ignores a growing body of evidence that the fugitive emissions cancel out the lower emissions intensity of coal seam gas compared to coal fired electricity. The study also rests on an unfounded assumption there will be a 'net environmental benefit' through carbon abatement facilitated by the displacement of coal with gas from the project which is unlikely because renewable energy is now more affordable than gas meaning there is no need for gas as a transition fuel.

In general we can have no confidence in Santos' credentials regarding climate risk and supporting energy transitions. At the recent 2017 AGM, the Santos board recommended against a shareholder resolution aimed at improving climate resilience planning and transparency of reporting[14]. In a shocking admission, Santos Chairman Peter Coates revealed at the meeting that the company is working towards a pathway of 'four degrees' warming; assuring shareholders it is "very sensible and consistent with good value.[15]" This is in contradiction to written statements Santos has made in support of the Paris Agreement's goal of limiting warming to 1.5 to 2 degrees.[16] Santos concludes the EIS chapter 24 stating that " Natural gas can underpin the transition to a low carbon economy" yet a commitment to a four degree pathway shows that Santos does not genuinely believe there is a financially viable role for the company in a carbon constrained future – otherwise there would be no problem with detailing the company's plans within a 1.5 or 2 degree scenario.

The Carbon Budget and the incompatibility of new fossil fuel projects

The "global carbon budget" is a concept to describe the amount of greenhouse gases scientists model that human activities can emit to keep the planet within certain temperature increases, according to likely probabilities.

Using data compiled from the IPCC, the World Energy Council and Rystad Energy, Oil Change International concludes that humanity cannot allow the development of any new fossil fuel extraction projects. Indeed, even some existing fields and mines must be closed before their resources are fully exploited[17]. Under a "medium chance" 1.5 degrees warming scenario, 85% of known global fossil fuel reserves would remain unburnable. Under a "likely chance" 2 degrees scenario – 68% of these fossil fuels are unburnable. Similarly, Clade and Ekins results of a global analysis of reserves based on economic recoverability suggest that half of all existing gas reserves must remain unused between 2010 and 2050 to achieve the 2 degrees target.[18]

Australia is a signatory to the Paris Agreement – we have endorsed the global ambition of a 1.5 to 2 degree warming limit and the scientifically irrefutable reality that there is no way of addressing this crisis without keeping most of the world's known fossil fuel reserves in the ground. Opening new fossil fuel projects such as

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[13] Pigneri Attilio. Renewable Gases Supply Infrastructure, prepared for the Council of the City of Sydney. Tech. rep. Talent with Energy. url: http://www.cityofsydney.nsw.gov.au/__data/assets/pdf_file/0005/ 153284/Technical-Appendix-2-Renewable-Gases-Supply-Infrastructure-Talent-With-Energy.pdf.

[14] ASX Santos Media Release, 6 March 2017: Resolutions under section 249N of the Corporations Act https://www.santos.com/media/3555/market-forces-resolution-asx.pdf

[15] https://www.theguardian.com/environment/2017/may/05/santos-admits-business-plan-based-4c-global-temperature-rise

[16] https://www.santos.com/media/3606/santos-statement-on-climate-change-disclosure.pdf

[17] Oil Change International, September 2016. The Sky's Limit: Why the Paris Climate Goals require a Managed Decline of Fossil Fuel Production. http://priceofoil.org/content/uploads/2016/09/OCI_the_skys_limit_2016_FINAL_2.pdf

[18] McGlade and Ekins, 2015. "The geographical distribution of fossil fuels unused when limiting global warming to 2 C, Vol 517, Nature 187, MacMillan Publishers Ltd, 8 Jan 2015

the Narrabri Gas Project is utterly at odds with the statutes of the Paris Agreement and with a safe future for the Australian environment and society.

Narrabri Gas is an unacceptable new source of greenhouse gas emissions

Santos' justification of the project in Chapter 24, based on its supposedly minor national and global greenhouse gas emissions, 0.2% and 0.002% respectively, denies the realities of the global carbon budget and the urgency of the transition to a zero carbon future. These percentages are significant additional emission point sources, and furthermore these figures only include the direct, Scope 1 emissions from the project's onsite operations (0.53 Mt C02e per annum), sidelining the inevitable impact of the end use of the gas.

Santos claims, on the one hand, "a net environmental benefit of the natural gas generated through the project" through greenhouse abatement by its theoretical displacement of coal whilst at the same time claiming that the "product use emissions by users of natural gas" are "beyond the control of the proponent"[19]. It claims the supposed (though refutable) greenhouse benefits of its end-use product whilst denying the associated responsibility. Santos estimates the total annual Scope 3 emissions for the project are 3.77Mt CO_2-e; as a percentage, to compare to the national greenhouse gas emissions, this is 0.72%. Therefore, as a comparison of scale, the total stated contribution of the Narrabri Gas Project is approximately 0.92% of Australia's emissions, although this figure does not include the significant and unknown quantities of fugitive emissions.

We recognise that it's likely the majority of the gas extracted from the Narrabri Gas Project will be exported and will not, therefore, be included in the National Greenhouse Accounts. However, the Principles of Ecologically Sustainable Development require that we make decisions for the wellbeing of our own people and environment as well those across the planet and future generations.

Santos states that downstream, Scope 3 emissions are the result of "consumer demand for electricity". Yet consumers demand and accept the most reliable and affordable energy source available. Now that renewable energy coupled with battery storage is widely considered to be a more affordable and reliable new electricity generation option, Santos cannot reasonably claim that its emissions are simply a result of consumer demand. There are low or zero emissions alternatives to meet energy market demands and the only cause of the emissions from the Narrabri Gas Project proposal will be Santos' or another company's determination to extract and sell the gas.

The project will not displace coal or lead to emission reductions

The EIS claims "*emissions for energy produced from the combustion of the natural gas delivered by the project will be nearly 50% less for electricity than is currently supplied to the NSW grid*"[20]. This statement is incorrect as it: a) fails to account for the significant contribution of fugitive methane emissions and it b) implies gas from the project will displace current coal fired electricity generation which is unlikely given current economic and technological realities. These two issues are discussed below.

The scale and uncertainty of unmeasured emissions from CSG

[19] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 24 Greenhouse Gas*, *p. 4.*
[20] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 24 Greenhouse Gas*, *p. 5.*

Methane is leaked through the production, transport, processing and use of coal seam gas. It is by the far the major component of natural gas, and it is 86-times more powerful than is CO2 per molecule in the atmosphere over the relevant twenty year timeframe (considering the timeline for emissions reductions required to limit warming to two degrees or less)[21], [22].

Since methane is such a powerful greenhouse gas, even small leakages of natural gas to the atmosphere have very large consequences on global warming. It's increasingly accepted that the full life-cycle assessment of CSG is likely to have the same or greater greenhouse impact as coal, per unit of energy, given the potency of methane and the scale of unmeasured methane emissions. A 2011 study showed that just 3.2% methane emissions compared to total gas production would cancel out any emissions benefits of gas over coal[23]. Other recent studies support these findings, indicating that CSC fugitive emissions as low as 2-3% may contribute to a GHG emission footprint 20−100% greater than coal on a 20-year horizon." [24,25]

A Melbourne Energy Institute report from 2016 details monitoring failures and underreporting of Australia's methane emissions from the CSG and LNG industry and finds that the scale of unmeasured emissions could lead to Australia's failure to reach its Paris climate commitments. The report found that Australia's reporting of unconventional gas emissions assumes that several potentially significant sources of methane to be zero and uses an inaccurate default fugitive emissions factor. The Australian Government applies a standard 0.5% factor to assess fugitive emissions from gas production while the gas industry itself claims rates of only 0.1% of production. These figures contrast with measured methane leakage between 2 to 17% of production at U.S. gasfields– up to 170% higher than Australian industry reports. The U.S. EPA has now revised its estimate of methane emissions from unconventional gas production to 1.4% of production[26].

The lack of direct measurements combined with the dearth of baseline data means the actual emissions from Australia's CSG sector are unknown. A CSIRO study into methane emissions only measured levels at the well heads, ignoring very significant potential leakage sites, despite the evidence of migratory emissions in the QLD gasfields in bubbling rivers and streams and gassy water bores[27],[28]. However the study acknowledges the need for further research and the extent of uncertainty in methane measurements from the sector.

In addition to inadequate direct measurement across the production chain, technological limitations can limit the accuracy of methane leakage estimations and may entirely miss the existence of possible 'super emitters'. The MEI report outlines the necessity for satellite and aircraft 'top-down', measurements to assess landscape

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21 http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

22 Melbourne Energy Institute, October 2016: A review of current and future methane emissions from Australian unconventional oil and gas production

23 Alvarez,R.A.,S.W.Pacala,J.J.Winebrake, W.L.Chameides and S. P. Hamburg (2012). "*Greater focus needed on methane leakage from natural gas infrastructure*." Proceedings of the National Academy of Sciences 109(17):6435-6440.

24 Tait, D. R., Santos, I. R., Maher, D. T., Cyronak, T. J. and Davis, R. J. (2013) 'Enrichment of radon and carbon dioxide in the open atmosphere of an australian coal seam gas field', Environmental Science and Technology, 47(7), pp. 3099–3104. doi: 10.1021/es304538g.

25 Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.

26 Melbourne Energy Institute, October 2016: A review of current and future methane emissions from Australian unconventional oil and gas production

27 Ibid.

28 Day, S., Connell, L., Etheridge, D., Norgate, T., Sherwood, N. (2012) Fugitive greenhouse gas emissions from coal seam gas production in Australia. CSIRO, Australia. Available at: http://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0010/559549/Fugitive-Greenhouse-Gas-Emissions-from-Coal-Seam-Gas-Production-in-Australia-CSIRO-report.pdf

scale emissions given the impossibility of direct measurement from every possible leakage site and of unknown migratory emissions sources (such as streams, or fissures in the earth) and 'super emitters' that can result from intentional or unintentional emissions, equipment and well failures.

Fugitive Methane Emissions have not been properly assessed

The Glossary in the EIS Appendix R describes fugitives as "*minor losses of gas that are assumed to occur from equipment and infrastructure. They are measured by applying legislative emissions factors*.[29]" This definition reveals two fundamental inadequacies in Santos' understanding and assessment of fugitive emissions; firstly that they are minor emission sources and secondly that it's acceptable to avoid field studies and direct emissions measurements.

The EIS fails to provide baseline methane measurements for across the project site and surrounding area. The Greenhouse Gas Assessment states that baseline methane levels will be comparable with existing uses in the area, which is basically the definition of the concept but provides no useful information.[30] The lack of baseline data has been as a key limitation to assessing the methane impact of existing gasfield in QLD[31] and it is unacceptable that any new gasfield region is opened without first establishing these baseline measures. The CSIRO 2012 study recommended at least one-year baseline should be established before a project begins to account for natural fluctuations in methane levels.[32]

A recent review into bubbling methane gas in the Condamine River, Queensland (central to highly productive CSG fields), concluded that the biogenic gas bubbling to the surface is from geologic sources, possibly from shallow coal seams. However, due to insufficient baseline data, the information to determine whether the gas migration pathways are natural or related to CSG activities is too limited. In the event that potential coal seam methane has surfaced as a suspected fugitive emission, particulate carbon stable isotopes should be used a traced to their origin using their thermogenic signature.[33] Additional studies show that measurements of isotopic signature gasses such as atmospheric Radon may provide insight into the point source of fugitive emissions from CSG.[34]

The EIS fails to provide an accessible figure to calculate approximate fugitive emissions and it's therefore difficult to compare with the aforementioned research about likely or possible fugitive factors. It is stated that Santos will use the API Compendium 2009 for fugitive emissions from pipeline and glycol dehydrator units and for general fugitive emissions (from well heads, gathering lines and processing) an emissions factor from the National Greenhouse and Energy Reporting (Measurement) Determination 2008 will be used[35],[36]. These accounting factors are complex equations and therefore do not enable a comparison with the percentage of

[29] Santos (2016) *Appendix R Greenhouse Gas Assessment – Narrabri Gas Project. p.5.*

[30] Ibid. p.17

[31] Melbourne Energy Institute, October 2016: A review of current and future methane emissions from Australian unconventional oil and gas production

[32] Day, S., Connell, L., Etheridge, D., Norgate, T., Sherwood, N. (2012) Fugitive greenhouse gas emissions from coal seam gas production in Australia. CSIRO, Australia. Available at: http://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0010/559549/Fugitive-Greenhouse-Gas-Emissions-from-Coal-Seam-Gas-Production-in-Australia-CSIRO-report.pdf

[33] Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.

[34] Tait, D. R., Santos, I. R., Maher, D. T., Cyronak, T. J. and Davis, R. J. (2013) 'Enrichment of radon and carbon dioxide in the open atmosphere of an australian coal seam gas field', *Environmental Science and Technology*, 47(7), pp. 3099–3104. doi: 10.1021/es304538g.

[35] API Compendium 2009. Available at: http://www.api.org/~/media/Files/EHS/climate-change/2009_GHG_COMPENDIUM.pdf

[36] https://www.legislation.gov.au/Details/F2016C00691/Html/Text#_Toc455152290 (Section 3.72)

fugitives to overall production (as described in the literature discussed above). We request that Santos reveals the percentage figure applied to calculate its fugitive emissions to enable the public to compare this with recent research.

The assessment seems to apply inconsistent factors for the annual calculation compared to the full project calculation. As a percentage of the total, the fugitive emission figures for the annual rates vary, at 0.2% for onsite or 0.38% for grid power[37]. Has there been a consistent factor applied to reach the total fugitive emission figures stated?

The EIS does not propose direct fugitive emissions measurement

Even if there were a standard methane calculation factor applied, this would not be adequate without additional direct emissions measurement, particularly given the probable underestimation in the standard emissions factors. The only reference Santos provides to direct measurement of fugitive emissions from the project is a single, vague statement: "a leak detection and repair program approved by the NSW Environmental Protection Agency will be implemented to identify and minimise fugitive emissions.[38]" Whilst it's appreciated that the NSW EPA will be required to approve the program, the lack of detail in this commitment regarding such a significant potential impact of the project is unacceptable. Santos must provide a detailed fugitive emissions monitoring plan, including the timing, proposed sites and technology to be employed, before any approval for this application is granted. The technology must include 'bottom up' and 'top down' assessment measures.

Risks of catastrophic infrastructure failure and methane leakage not properly assessed

We are also gravely concerned that the risks of catastrophic infrastructure failure leading to both contamination incidents and release of huge quantities of methane has not been properly assessed and adequate mitigation measures have not been proposed.

Gas is not needed as a transition fuel and is more expensive than renewables

The greenhouse gas assessment and its conclusion that the environmental risk regarding greenhouse gases is 'low' is based on an out-dated assumption that gas can contribute to a net reduction in greenhouse gases and that gas is a necessary transition fuel. The falling cost of battery storage and renewable energy technologies now means that gas-fired electricity is no longer required for the urgent transition to 100% renewable energy. As the Chief Financial Officer of Australia's largest electricity generator and gas retailer, AGL, recently stated, *"The energy transition we have all been anticipating will skip big baseload gas as a major component of the NEMs (national energy markets) base-load generation and instead largely be a case of moving from big coal to big renewable[39]."*

Of course AGL would not make such claims if there weren't technological and economic evidence to support these statements. Several recent studies have shown new renewable energy is now cheaper than new gas in providing reliable electricity generation– solar, wind and battery costs continue to fall at the same time the cost of gas is rising and increasing in volatility.

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[37] Santos (2016) *Appendix R Greenhouse Gas Assessment Narrabri Gas Project*, *p. 17.*

[38] Ibid. *p. 23.*

[39] AGL Energy Ltd. Brett Redmond CFO. May 2 107. *A future of storable renewable energy: Presentation to Macquarie Australia Conference 2017*

In March 2017, RepuTex, Australia's largest provider of energy and emissions market analysis released the results of a major study into the cost of energy provision which was backed by extensive consultation with over 45 electricity generators, industrial and commercial consumers and investors. The report, "*An Energy Trilemma: A cost curve for emissions reductions & energy storage in the Australian electricity sector* " thoroughly debunks the outdated assumptions regarding a role for gas as a transition fuel that Santos perpetuates in chapter 24 and throughout the EIS. The study analyses and compares energy technologies to establish which option can supply electricity at least cost and with greatest reliability. It concludes, following a full life cycle analysis, that wind and solar, coupled with battery storage is the least cost source of new electricity, it can provide reliable and instantaneous peaking generation and is available even if the sun is not shining or the wind is not blowing.[40]

Professor Jotzo from the Australian National University has advised the Government in a submission to the Finkel Review on Energy Security that "[i]t is important for policy at the federal level and state level not to encourage or facilitate excessive investment in gas-fired power generation…. The replacement of coal-fired power over coming decades can be based almost exclusively on renewable energy and this may turn out to be the cheapest option.[41]"

In April 2017, the Climate Council released a report, *Pollution and Price: The cost of investing in gas* which similarly determined that renewables plus storage is cost competitive with gas-fired generation and can provide a reliable, around-the-clock source of energy. It concluded that existing gas-fired generation should be thought of as "short-term, expensive, emergency backup as renewable energy and storage is rapidly scaled up" and that there is no place for any expansion of gas-fired electricity in pursuit of the 2-degree target. As well as being more expensive, further investment in gas-fired electricity would lock in decades of greenhouse gas emissions and is financially risky given that future regulation may result in higher costs or restrictions on emissions.[42]

Impacts and risks to water resources

The NSW CSG industry can learn from the extensive and damaging history from the CSG industry in QLD. As a response to the impacts due to the CSG industry, the Queensland's Office of Groundwater Impact Assessment (OGIA) was created by the Queensland Government in 2010. They have since released the 'Underground Water Impact Report for the Surat Cumulative Management Area', which outlines the variety of ways the CSG industry has permanently destroyed the landscape due to actions of the oil and gas industry. It should be noted that the OGIA is almost completely funded by petroleum and gas tenure holders with the Surat Catchment Management Authority.[43,44;45,46] A completely independent monitoring body for the CSG industry does not exist and should be instated if the NGP is to be approved.

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[40] RepuTex, March 2017. *An Energy Trilemma: A cost curve for emissions reductions & energy storage in the Australian electricity sector*

[41] Australian Financial Review, 5th May 2017. *Renewables beat gas as Transition Fuel for EIS* http://www.afr.com/news/politics/renewables-beat-gas-as-transition-fuel-for-eis-20170505-gvz19r

[42] Climate Council. April 2017. Pollution and Price: The cost of investing in gas by Andrew Stock, Professor Will Steffen, Greg Bourne, Petra Stock and Dr Martin Rice. Available at: https://www.climatecouncil.org.au/uploads/d15f6fc35d779951e8893693efdbbc10.pdf

[43] Towler, B., Firouzi, M., Underschultz, J., Rifkin, W., Garnett, A., Schultz, H., Esterle, J., Tyson, S. and Witt, K. (2016) 'An overview of the coal seam gas developments in Queensland', *Journal of Natural Gas Science and Engineering*. Elsevier B.V, 31(2016), pp. 249–271. doi: 10.1016/j.jngse.2016.02.040.

[44] Department of Natural Resources and Mines (2017) *Office of Groundwater Impact Assessment (OGIA) - Department of Natural Resources and Mines*.

[45] Office of Groundwater Impact Assessment and Department of Natural Resources and and Mines. (2016) *Underground water impact report for the Surat Cumulative Management Area*.

Environmental Protection and Biodiversity Act (EPBC), 1999

The NGP must be assessed under the EPBC Act,[47] 1999 if it is to be approved by the Commonwealth Environment Minister. We believe the project does not meet the standards outlined in the guidelines of section 24D of the EPBC Act, specifically falling short of reaching the 'water trigger' guidelines. In particular, the project's groundwater assessment does not adequately meet the checklist requirements published by the Independent Expert Scientific Committee (IESC) on Coal Seam Gas Mining Development. The following outlines the reasons we believe this project should not be awarded development approval.

Examination of Santos' assessment against the 'water trigger' guidelines

Section 11.6.5 of Santos' EIS outlines reasons why the NGP is "unlikely to cause a significant impact on water resource within the assessment area".[48] These reasons are specific to impacts to "water availability", "water quality" and "ecosystem functions".[49] As such, below is our response to why we have perceived water availability, water quality and ecosystem functions to be at risk and likely to be significantly impacted by the NGP.

Perceived water availability, water quality and ecosystem function impacts

Santos states:

> *The predicted impacts to the Gunnedah-Oxley Basin Groundwater Source in the project area are unlikely to be significant because water in the target coal seams has relatively low value with no known third-party users extracting water from the coal seams or surrounding source rocks for beneficial purposes*[50]

Our response to this statement:

Firstly and fundamentally, the EIS describes that, "water in the target coal seam has relatively low value".[51] This statement completely neglects Indigenous peoples' connection with Country, which is not limited to value placed on the "use" of the water by economic means, but strongly incorporates a spiritual connection with places their forbears have inhabited from previous generations.[52] This perspective of "low value" groundwater in the Gunnedah-Oxley Basin is exclusively viewed from an economic angle, which symbolises Santos' ongoing colonial attitude and actions toward land use in Australia.[53] From this perspective, we believe the NGP will alter the properties of the Gunnedah-Oxley Basin groundwater enough to significantly impact the "use" of Indigenous peoples' connection to Country, within and surrounding the proposed project area.

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46 Queensland Water Commission (2012) *Underground Water Impact Report for the Surat Cumulative Management Area*.

47 Australian Government (2016) 'Environment Protection and Biodiversity Conservation Act 1999', (1), pp. 1–409. Available at: https://www.legislation.gov.au/Details/C2016C00777/Download.

48 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-57).

49 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-57).

50 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-57).

51 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-1).

52 Connor, L. H. (2016) 'Energy futures, state planning policies and coal mine contests in rural New South Wales', *Energy Policy*. Elsevier, 99, pp. 237. doi: 10.1016/j.enpol.2016.05.026.

53 Norman, H. (2016) 'Coal Mining and Coal Seam Gas on Gomeroi country: Sacred lands, economic futures and shifting alliances', *Energy Policy*. Elsevier, 99(February), pp. 242–251. doi: 10.1016/j.enpol.2016.06.006.

The EIS describes that there are "no known third-party users extracting water from the coal seams or surrounding source rocks for beneficial purposes".[54] Santos directly contradicts this statement by directing the reader to statistics derived from the NSW Government's PINEENA (v4.1, October 2013), indicating that there are thousands of users extracting water from surrounding source rocks, including "approximately" 15 bores accessing water from the Gunnedah-Oxley Basin. The Groundwater Impact Assessment (GIA) Report acknowledges 4,682 registered bores within 30 kilometres of project boundary.[55] Bore usage percentage is also displayed in Figure 11-7,[56] with 79% of these bores contributing to "domestic", "stock watering" and "irrigation purposes", the remaining 21% of bores are used for "monitoring", "unknown" or "other" purposes, each contributing 7% to the total usage.[57] If unknown bores represent a percentage of the previously mentioned 4,862 bores, that accounts to lack information of 327 bores due to their "unknown use" within the 30km boundary of the project area. Without knowing if these bores fit into either of the stock, domestic, irrigation, or monitoring categories, Santos cannot be sure that the NGP will not significantly impact the functioning of these bores.

The GIA Report also states that there are a small number of bores (3%) at a depth of, or deeper than 150 metres.[58] The EIS states bores deeper than 150 metres are "most likely" within the Pilliga Sandstone, which is "typically between 150 to 300 metres thick in the project area".[59] The EIS does not state the "typical" depth of the Pilliga Sandstone outside the project area, where Figure 11-7 indicates there are many more bores deeper than 150 metres (Figure 11-7 is not clear enough to count the number bores deeper than 150 metres outside the project area but within the 30km boundary). Potentially 5 or more of these "unknown" bores are also considered to be more than 150 metres deep within the 30km boundary of the project area[60] (once again, it is difficult to ascertain if it is 6 bores due to the quality of the map). Outside the project area, at least 4 bores are noted to be of "unknown" use and at a depth of 150 metres, with one bore of "unknown" use located on the border of the project area.[61] Overall, there are countless bores reaching a depth of at least 150 metres within the project area and 30-kilometre boundary.

In summary, the GIA Report draws from a limited dataset, much of which was collected by Santos in its assumption that there will be no impact on bores within the depths of the GAB Groundwater Management Area.[62] The EIS does not present sufficient evidence to prove that bores and their associated industries are not at risk from significant impact resulting from changes to water availability, water quality and ecosystem function due to altered hydrogeological properties within the Gunnedah-Oxley Basin.

Santos states:

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54 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-57)
55 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-31)
56 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-33)
57 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-31)
58 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-31)
59 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-31)
60 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-31)
61 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology* (p11-31)
62 Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project (pp3-1 - 3-2)*.

The predicted impacts to the Gunnedah-Oxley Basin Groundwater Source in the project area are unlikely to be significant because the volume of water to be abstracted from the coal seams (average of 1.5 gigalitres per year) over the 95,000-hectare project area is approximately 1.3 per cent of the sustainable diversion limit of 114.5 gigalitres per year identified by the Commonwealth through the Murray Darling Basin Plan.

Our response to this statement:

The following outlines how Santos' EIS reveals significant impacts for water availability, water quality and ecosystem functions in its proposal to extract 1.5GL/yr of water for the NGP.

Impact to hydrogeological properties

The GIA considers the potential impact of a proposed extraction of 37.5 gigalitres of water over the 25 year assessment period from target coal seams in the Gunnedah Basin".[63] In the first two to four years, Santos require 3,650 units during peak water production, then it will drop to 1,500 units in the Gunnedah-Oxley Basin MDB Porous Rock Groundwater Source. For the Maximum Case with a predicted CSG water production of 87.1GL over the life of the gasfield – the largest predicted drawdown is 224 metres occurring between 2 & 500 years after the start of gas production for the Early Permian Formation. In the Late Permian Formation the predicted drawdown is 32.3m occurring up to 350 years after the start of gas production. The largest predicted drawdown for the Pilliga Sandstones is 0.6m between 190 & 200 years after the start and for the predicted drawdown for the Namoi alluvials is less than 0.5m.[64]

The GAB hydrogeological properties are highly complex and are vertically divided into several confined aquifers that are separated by aquitards. The second aquifer receives leakage water from the aquifers above and below.[65] The GIA covers a significant area of recharge beds of the GAB and some GAB management units that have outcrops that receive increased recharge volumes. The Gunnedah-Oxley Basin underlies the GAB strata and is not a significant source of water for stock and domestic supplies, although there are 15 bores recorded as accessing water from the Gunnedah-Oxley Basin. Smerdon & Ransley[66] have determined that the bottom of the GAB is an impermeable aquiclude strata, which means no water can penetrate lower into the Gunnedah-Oxley Basin. This is in line with previous research that states most leakage occurs as "distributed discharge upward from deeper higher pressure aquifers to shallow lower pressure aquifers".[67]

The EIS states that the Jurassic Permian hydrostratigraphic units have a hydrological response time of decades, centuries and possibly millennia. Santos makes clear that recovery of the basin (in areas where they have admitted to having insufficient data), will take a long and undefined amount of time to recover: *"Full recovery of the basin takes a long time because, as the groundwater pressure recovers, the induced changes in discharge and recharge get smaller with time*".[68] Furthermore, the impacts of climate change are varied and unknown,

[63] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.
[64] Crothers, T. (2017) 'Comments on Appendix F – Groundwater Impact Assessment (GIA) Report – Santos ' Narrabri Gas Project (NGP).', pp. 1–11.
[65] Zhou, Y. and Li, W. (2011) 'A review of regional groundwater flow modeling', *Geoscience Frontiers*. Elsevier B.V., 2(2), pp. 205–214. doi: 10.1016/j.gsf.2011.03.003.
[66] Smerdon, B. D., Welsh, W. D. and Ransley, T. R. (2012) 'Water resource assessment for the Carpentaria region: A report to the Australian Government from the CSIRO Great Artesian Basin Water Resource Assessment', (December). Available at: https://publications.csiro.au/rpr/download?pid=csiro:EP132681&dsid=DS4.
[67] Zhou, Y. and Li, W. (2011) 'A review of regional groundwater flow modeling', *Geoscience Frontiers*. Elsevier B.V., 2(2), pp. 205–214. doi: 10.1016/j.gsf.2011.03.003.
[68] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

partly because the effects have never been tested for a period of time long enough to know the true long term cumulative effects of both coal seam gas, climate change and the effects combined. With such long and varied response times, it is impossible for Santos to know impacts on groundwater properties such as water quality and quantity.

However, the GIA Report admits the NGP will contribute to a depletion of groundwater at depth within the target Gunnedah Basin coal seam to be a "rapid process" of an as yet undetermined amount.[69] For the Low Case with a predicted CSG water production of 35.5GL over the life of the gasfield, the largest predicted drawdown is 150metres in 1 to 300 years duration for the Early Permian Formation and a predicted 16 metres in the Late Permian Formation up to 300 years after the start of gas production.[70]

Section 6.12 of the GIA Report outlines the implications of these drawdown predictions in respect to the NSW Aquifer Interference Policy. The GIA Report suggests that because the predicted drawdown for the Upper & Lower Namoi alluvials is < 0.5m that the impacts are insignificant. The Report also suggests that as there are no impacts of > 0.5m for the Base Case and Low Case for the GAB Pilliga Sandstone aquifer that these impacts are also insignificant. For the Gunnedah-Oxley Basin where there are significant drawdowns on groundwater levels the GIA Report acknowledges that they will require licensing. However, in respect to the Water Trigger provisions of the EPBC Act – GIA Report argues that the poor quality of this water is sufficient reason to justify the EPBC Act Water Trigger provisions not being a applied. In respect to impacts of the NGP on all other groundwater sources, the GIA Report argued that their impacts were insignificant for consideration by the EPBC Act.[71]

Santos states:

> *Predicted impacts to the Southern Recharge Groundwater Source and Surat Groundwater Source of the GAB are unlikely to be significant because no drawdown greater than 0.5 metres is predicted in the Pilliga Sandstone only minor induced groundwater flow is predicted in the GAB*

Our response to this statement:

We believe it is likely that the groundwater sources and recharge zones of the GAB are likely to be significantly impacted by the NGP. Government hydrogeological mapping of the Great Artesian Basin (GAB) shows the project will be developed directly atop the most important inflow zone into the GAB in NSW.[72] Most of the recharge in the GAB occurs along the elevated eastern margin of the basin where its sandstones are exposed.[73] However, there are realistic fears the NGP will cause significant diversion of water from a recharge aquifer of the GAB, which is a water resource, relied upon by rural communities across western NSW. After stating that the NGP would not interfere with the recharge zone, Santos also states that "the recharge area corresponds broadly to the extent of the Upper Namoi Alluvium, where there is potential for groundwater in the alluvium

[69] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.
[70] Crothers, T. (2017) 'Comments on Appendix F – Groundwater Impact Assessment (GIA) Report – Santos ' Narrabri Gas Project (NGP).', pp. 1–11.
[71] Crothers, T. (2017) 'Comments on Appendix F – Groundwater Impact Assessment (GIA) Report – Santos ' Narrabri Gas Project (NGP).', pp. 1–11.
[72] Ransley, T. R., Radke, B. M., Feitz, A. J., Kellett, J. R., Owens, R., Bell, J., Stewart, G. and Carey, H. (2015) *Hydrogeological Atlas of the Great Artesian Basin*. doi: 10.11636/9781925124668.
[73] Zhou, Y. and Li, W. (2011) 'A review of regional groundwater flow modeling', *Geoscience Frontiers*. Elsevier B.V., 2(2), pp. 205–214. doi: 10.1016/j.gsf.2011.03.003.

to leak downward into the basin strata in subcrop areas".[74] As this is a known recharge zone for the GAB, the NGP is likely to cause long-term impacts with unknown consequences on ecosystems and crop production for future generations.

Data presented in the GIA Report in Table 5.10 demonstrates that water extraction in the Namoi Catchment Area atop the proposed NGP field already exceeds the amount of water recharging these areas at a net loss of 18GL/y.[75] If the NGP is approved, this will put further stress on the Namoi Catchment and industries who currently rely on water from these aquifers. Groundwater depletion can alter the geological structure of the soil profile and lead to the creation of cracks and fissures that may also further enhance gas exchange.[76,77]

Santos states:

> *The predicted impacts to the Upper and Lower Namoi Groundwater Sources are unlikely to be significant because no drawdown greater than 0.5 metres is predicted in the Namoi Alluvium and negligible induced change in groundwater storage is predicted in the Namoi Alluvium (less than 0.02 gigalitres per year maximum rate of storage change*

Our response to this statement:

We contest that there is the potential for significant impacts to groundwater availability, quality and ecosystem functions to the Upper and Lower Namoi Groundwater Sources. The EIS describes the Namoi Alluvium as "good quality groundwater", which is why it features the "highest density of bores" in the area. There is a prediction that drawdown in the Pilliga Sandstone and Namoi alluvials will not exceed 0.5m. However, in eastern Australia, reports of losses of up to 20% in pumping pressure on properties where CSG activity has been taking place have been reported to North West Livestock Health and Pest Authorities.[78] The EIS predicts that a drawdown in the Pilliga Sandstone and Namoi alluvials will not exceed 0.5m. However, Santos states that it is already aware of observed declines in groundwater levels in the Upper and Lower Namoi Alluvium, where its project sits within the area of surface deposits of the Namoi River and its tributaries. In Tara, QLD, groundwater has been reported to drop by approximately 100 metres since the commencement of widespread CSG mining.[79] This has led to depressurisation in the aquifer and an increase the unsaturated soil volume that could consequently increase gas exchange with the atmosphere into the overlying or underlying formations, and nearby surface water zones.[80]

The report also addresses the estimated rates of total inflow and outflow from the Namoi Alluvium to be "around 135 to 172 gigalitres of water" per year. Those two figures differ by 37 gigalitres. Annual extraction

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[74] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.p.11-30

[75] Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.p.5-30

[76] Tait, D. R., Santos, I. R., Maher, D. T., Cyronak, T. J. and Davis, R. J. (2013) 'Enrichment of radon and carbon dioxide in the open atmosphere of an australian coal seam gas field', *Environmental Science and Technology*, 47(7), pp. 3099–3104. doi: 10.1021/es304538g.

[77] Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.

[78] Nigel Milan (2011) *Inquiry into Coal Seam Gas*. Available at: https://www.parliament.nsw.gov.au/committees/DBAssets/InquirySubmission/Summary/39561/Submission 0271.pdf.

[79] Tait, D. R., Santos, I. R., Maher, D. T., Cyronak, T. J. and Davis, R. J. (2013) 'Enrichment of radon and carbon dioxide in the open atmosphere of an australian coal seam gas field', *Environmental Science and Technology*, 47(7), pp. 3099–3104. doi: 10.1021/es304538g.p.3102

[80] Tait, D. R., Santos, I. R., Maher, D. T., Cyronak, T. J. and Davis, R. J. (2013) 'Enrichment of radon and carbon dioxide in the open atmosphere of an australian coal seam gas field', *Environmental Science and Technology*, 47(7), pp. 3099–3104. doi: 10.1021/es304538g.

records from the Namoi Alluvium held by NSW Department of Primary Industries has varied from 150- 300 gigalitres per year over the past 20 years. With this overall variation and unpredictable inflow/outflow from year to year, it is understandable that local community landholders and farmers have ongoing concerns about the preservation of aquifer integrity, including the threat of a permanent and irreplaceable depletion of the water table.[81]

Contamination Risks

We believe that the EIS does not present sufficient evidence to suggest a contamination event is low risk and would be remediated effectively, causing irreversible damage to water quality and ecosystem functions. The GIA acknowledges the complexity of groundwater aquifers, stating "the direction of flow across the base of alluvial sediments (Namoi Alluvium) containing groundwater is controlled by the difference in elevation between the water table in the alluvium and groundwater pressure in the underlying hydrostratigraphic units.[82]The Namoi Alluvium is classed with "significant transmissive units" and the Pilliga Sandstone as "relatively transmissive".[83] According to Santos' statement, "within the alluvial groundwater sources, the regional water table is topographically controlled and generally follows the fall of the land surface along the river and stream valleys".[84] The reader can assume contamination near waterways would also follow these contours, presenting itself in streams and rivers, which are accessed by third party users, as has previously occurred.[85] Due to the "significant transmissive units" in the Namoi Alluvium, any enhanced aquifer connectivity may possibly dewater aquifers surrounding the CSG target formation and/or deliver constituents within the coal seam water via groundwater transport into adjacent waterways.[86] The extent of a contamination event would be immeasurable and impossible to monitor and manage.

Santos state:

> "*the groundwater modelling results indicate that perceptible changes in water quality of groundwater sources potentially impacted by the project are unlikely due to the small volume and slow rate of induced flow between water sources."*

Our response to this statement:

The groundwater modelling and baseline data in the GIA Report and does not indicate that perceptible changes in the water quality of groundwater sources will cause an insignificant impact. Any useful groundwater model for groundwater resources assessment and management should simulate the whole groundwater basin.[87] The GIA Report is unspecific about the amount of water with which Santos plan to

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[81] Nigel Milan (2011) *Inquiry into Coal Seam Gas*. Available at: https://www.parliament.nsw.gov.au/committees/DBAssets/InquirySubmission/Summary/39561/Submission 0271.pdf.

[82] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

[83] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

[84] Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.p.11-39.

[85] Northern Inland Council for the Environment & The WIlderness Society (2012) *The Truth Spills Out: A Case Study of Coal Seam Gas Exploration in the Pilliga*. Available at: https://walloffrackingshame.files.wordpress.com/2012/06/the_truth_spills_out_final_may_2012_without_appendices.pdf.

[86] Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.

[87] Zhou, Y. and Li, W. (2011) 'A review of regional groundwater flow modeling', *Geoscience Frontiers*. Elsevier B.V., 2(2), pp. 205–214. doi: 10.1016/j.gsf.2011.03.003.

interact with. Santos does not have a control or sufficient evidence to compare changes that will occur to water levels, pressure and transmissivity within the coals seam. Section 5.3 of the GIA Report provides the reader with an overview of the "limited", "extremely variable" and "inconclusive" data representing hydrogeological properties of the consolidated layers within the Gunnedah Basin.[88,89] The EIS admits Santos had an absence of information in the deep strata hosting the target coal seams. Where models met an absence of reported field data, the models were based on existing calibrated dataset combined with published literature to determine the likely range of values of hydraulic conductivity in the GIA groundwater modelling.

The EIS states that groundwater models were based on "sparse" water table elevation measurements outside of the "alluvial areas" of the Gwydir, Castlereagh and Macquarie River alluvia. Accurate data pertaining to groundwater distribution, volume, discharge, recharge, precipitation infiltration, surface water leakage, irrigation return flow and lateral inflow are difficult to ascertain in a groundwater model and it is therefore no surprise that the GIA Report contains limited data in this area[90,91] but, relying on these models could easily lead to underestimations resulting in unanticipated changes to hydrogeological properties.

Numerous studies have reiterated the importance of conducting baseline research before gas extraction commences. In Australia, the literature lacks baseline data, the underlying reason why the NGP would operate at such high risk to human and ecosystem health if it were to be approved.[92,93,94,95,96] The GIA Water Monitoring Plan admits that uncertainties exist in the modelling predictions. Additionally, correct meteorological data, vegetation and soil characteristics are necessary to estimate net groundwater recharge from precipitation and infiltration. This can vary from year to year and season to season depending on the conditions that contribute to evapotranspiration of crops. An admitted lack of information present in the GIA Stygofauna assessment make correlations between GDEs and groundwater models redundant.

In summary, we believe the models do not accurately represent hydrogeological properties of the aquifers due to generalisations in the direction of hydraulic flow, insufficient water table elevation measurements, differences in annual extraction records and total inflow and outflow measurements, as well the substituted use of calibrated existing models with published data in the absence of required hydraulic connectivity field records. We therefore conclude that the NGP is likely to cause significant impacts to water availability, water quality and ecosystem functions.

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88 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

89 Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.

90 Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.

91 Zhou, Y. and Li, W. (2011) 'A review of regional groundwater flow modeling', *Geoscience Frontiers*. Elsevier B.V., 2(2), pp. 205–214. doi: 10.1016/j.gsf.2011.03.003.

92 Navi, M., Skelly, C., Taulis, M. and Nasiri, S. (2015) 'Coal seam gas water: potential hazards and exposure pathways in Queensland', *International Journal of Environmental Health ResearchOnline) Journal International Journal of Environmental Health Research*, 25(2), pp. 960–3123. doi: 10.1080/09603123.2014.915018.

93 Werner A., Vink S., Watt K., J. P. (2017) 'A Review of the Human Health Impacts of Unconventional Natural Gas Development', *Current Epidemiology Reports*, 4(1), pp. 38–45. doi: 10.1007/s40471-017-0097-9.

94 Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.

95 Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.

96 Stearman, W., Taulis, M., Smith, J. and Corkeron, M. (2014) 'Assessment of Geogenic Contaminants in Water Co-Produced with Coal Seam Gas Extraction in Queensland, Australia: Implications for Human Health Risk', *Geosciences*, 4(3), pp. 219–239. doi: 10.3390/geosciences4030219.

The GIA Report outlines that geological and hydrogeological data gathered from the groundwater-monitoring program during the development of the Narrabri Gas Field will be used to test modelling predictions and if necessary, will be used to improve the groundwater model. The Narrabri Gas Project should not be given development approval if Santos cannot accurately predict the impacts of development prior to commencement. The approval of this project, if unscientifically certain, is also unaligned with the principles of Ecologically Sustainable Development whereby, "the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making".[97] The use, conservation and enhancement of the community's resources and ecological processes on which life depends should be maintained and the total quality of life, now and in the future, can be increased.[98] Models should be used to assess and determine impact prior to their occurrence. All impacts should be considered; otherwise the project may incur unknown impacts. Furthermore, if Santos is anticipating unknown impacts that will be updated in its models after they occur, this should automatically warrant a project of this scale unsafe to proceed.

The EIS states that "published data on hydrogeological properties are not available on all formations present in the assessment area and the range of values available from field measurements typically represent a small number of measurements at a specific location; therefore, the results of such reviews should be carefully interpreted".[99] In other words, due to the absence of published information and limited sample studies, data must be carefully interpreted from which the groundwater models have been created. This does not provide us with confidence in Santos' abilities to safely undertake the NGP.

Concerns that the Santos' methodology is not supported by accurate modelling due to limitations in the quality and quantity of data are also based on the following reasons:

1. Climate change is likely to cause unprecedented variations over the next 30 years and beyond.
2. The impact of bushfires presents additional risk to flood zones and tributaries. It is known that heavy rainfall after a fire causes flooding due to reduced coverage of vegetation able to absorb rainfall. Santos has already been fined for under calculating the effects of flood in one of their treatment ponds, leading to wastewater spills in the adjacent creek.
3. Santos has not clearly stated what variations in "baseline" data compared with observed data during the NGP will lead to premature decommissioning of wells.

Legislative Obligations and Assessment Criteria

The Strategic Regional Land Use Plan for New England North West[100] states the natural environment in the region around the Gunnedah Basin Coal Fields are under increasing pressure from mining and coal seam gas developments and must be protected. As a result, Santos are required to abide by legislative requirements, which are discussed in Sections 2.0 and 2.2 of the GIA Report:

- Water Sharing Plans (WSP)
- NSW WSPs for GAB groundwater sources
- NSW WSPs for the Upper and Lower Namoi groundwater sources

[97] Harding, R. (2006) 'Ecologically sustainable development: Origins, implementation and challenges', *Desalination*, 187(1–3), pp. 229–239. doi: 10.1016/j.desal.2005.04.082.
[98] Department of the Environment and Energy (1996) 'National Strategy for Ecologically Sustainable Development - Part 1 Introduction'. Australian Government. Available at: http://www.environment.gov.au/about/esd/publications/strategy/intro.html#GoalsEtc.
[99] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.p.11-29
[100] NSW DPI (2012) *Strategic Regional Land Use Plan: New England North West*.

- WSP for the NSW MDB - Fractures rock groundwater sources
- WSP for the NSW MDB - Porous Rock groundwater sources

Water Sharing Plans

Santos claim that this project would operate within the arrangements for water use and sharing under the plans but Santos would need to meet the requirement for relevant state water approvals, licensing and management.

NSW WSPs for GAB groundwater sources

Santos may be required to demonstrate that the project will not result in or significantly increase the rate of inter-aquifer transfer from the Pilliga Sandstone groundwater to the underlying strata.[101,102] It should be noted this WSP does not indicate a cease to effect date as is written on other WSPs. There is also no mention of how Santos will be required to demonstrate this.

NSW WSPs for the Upper and Lower Namoi groundwater sources

Santos may be required to demonstrate that the project will not result in or significantly increase the rate of inter-aquifer transfer from the Upper and Lower Namoi groundwater sources to underlying strata.[103,104] It should be noted this WSP ceases to have effect on June 30, 2017. There is no mention of this in the GIA Report. There is also no mention of how Santos will be required to demonstrate this. Santos state that while the Upper Namoi and Lower Namoi Regulated River Water Sources Water Sharing Plan are not directly relevant to the project, the Water Sharing Plan would only apply if coal seam gas extraction or coal seam water management activities were found to have an impact on these surface water sources. The Upper Namoi and Lower Namoi Regulated River Water Sources Water Sharing Plan should already apply prior to commencement of the project if any impact is anticipated, not after an impact has already occurred.

WSP for the NSW MDB - Fractures rock groundwater sources

Santos may be required to demonstrate that the project will not result in or significantly increase the rate of inter-aquifer transfer from the Pilliga Sandstone groundwater to the underlying strata.[105,106] It should be noted this WSP ceases to have effect on July 1, 2022. There is no mention of this in the GIA Report. There is also no mention of how Santos will be required to demonstrate this.

WSP for the NSW MDB - Porous Rock groundwater sources

Santos may be required to demonstrate that the project will not result in or significantly increase the rate of inter-aquifer transfer from the Upper and Lower Namoi groundwater sources to underlying strata.[107,108,] It

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[101] NSW Government (2008) *Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources 2008 Order Contents*, *Water Management*.

[102] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

[103] NSW Government (2011) 'Water Sharing Plan for NSW Great Artesian Basin Shallow Groundwater'. Available at: http://www.water.nsw.gov.au/water-management/water-sharing/plans-commenced/water-source/great-artesian-basin-cap-rock-and-alluvial.

[104] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

[105] NSW Government (2013) 'Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011', (February 2013), pp. 1–39. Available at: http://www.legislation.nsw.gov.au/viewtop/inforce/subordleg+615+2011+cd+0+N/.

[106] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

[107] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

should be noted this WSP ceases to have effect on June 30, 2017. There is no mention of this in the GIA Report. There is also no mention of how Santos will be required to demonstrate this.

NSW Water Management Act 2000

Santos claims they will extract 1.5 gigalitres of water per year, over 25 years. It is a requirement of the NSW Water Management Act that all mining and petroleum activities that anticipate a take of more than 3 ML/y from a groundwater source to seek approval for a Water Access Licence. However, Santos will only be permitted to extract the water if there is a Water Access Licence in place it should be noted that the NSW Water Management Act was modified on May 3, 2017, after Santos released its EIS for the NGP. There is also no mention of how Santos' take will be independently monitored. At present, Santos has secured only part of the required licences in the Gunnedah-Oxley Basin water source (600 megalitres) to facilitate its exploration activities. For the peak of the water production period, it is anticipated that Santos will use a combination of purchased and leased shared components, which may include requesting the Minister to make a controlled allocation from the water source.

Aquifer Interference Policy (AIP)

The AIP defines interference of an aquifer as: the penetration of an aquifer, the interference with water of an aquifer, the obstruction of the flow of water in an aquifer, the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations of the disposal of water taken from an aquifer. Under the AIP Santos must specify the volume of water that will be taken from the coal seam and how much water they will return through infiltration into the aquifer prior to project approval. Project approval will not be granted unless the Minister is satisfied that adequate arrangement are in force to ensure that no more than minimal harm will be done to a groundwater source or its dependent ecosystems.[109,110,111] Santos identifies that the potential impact of extracting water from the coal seam and during the CSG development phase depends on how much water they decide to remove and the source of the replacement for that water, yet the exact amount of water has not yet been determined. In this way, the public remain unaware of Santos' plans and do not have an opportunity to comment on Santos actions or the effects this may have on third party users after the closing submission period of the EIS.

NSW Strategic Regional Land Use Plan for the New England North West

This plan requires Santos to be assessed by an independent panel of experts, either on or within 2 km of strategic agricultural land against criteria on soil and groundwater source impacts as well as overall public benefit. Santos must pass this assessment before being awarded approval for the NGP.[112]

Due to the aforementioned reasons in this submission against the EIS section on Groundwater and Geology, we believe this action is likely to have a significant impact on a water resource as there is a real or not remote chance or possibility that it will directly or indirectly result in changes to:

- The hydrology of a water resource, and
- The water quality of a water resource

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[108] NSW Government (2013) 'Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011', (February 2013), pp. 1–39. Available at: http://www.legislation.nsw.gov.au/viewtop/inforce/subordleg+615+2011+cd+0+N/.

[109] NSW DPI (2013) *Assessing a proposal against the NSW Aquifer Interference Policy – step by step guide*.

[110] NSW Government (2012) *NSW Aquifer Interference Policy*.

[111] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

[112] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

That is of sufficient scale or intensity as to reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes, or to create a material risk reduction in utility occurring. We have analysed the assessment of the project against the 'water trigger' of the EPBC Act in Section 11.6 and have evaluated the risks that have already been presented. The Wilderness Society has determined that if these direct or indirect changes to hydrology or a water resource occur, the impacts will be significant and irreversible. Therefore, the Narrabri Gas Project cannot be considered a safe Action under the EPBC Act.

Well integrity

Additional to the impacts of groundwater extraction is the issue of gas well integrity. Gas well casings must be installed at coal seam depth to enable the flow of gas and water to the surface. The EIS acknowledges that the threat of contaminating surrounding aquifers through failing well casings is a possibility throughout the duration of the NGP. It should be noted that the GIS Report mentions, "each coal seam gas well carries the potential for inter-formational flows due to local failure of well casings on account of Earth movements within fault zones or the presence of swelling clays".[113] In the case that a well casing does fail, research has shown that groundwater may transport methane through geological units into overlying aquifers and adjacent surface waters.[114] This proven by the detection of methane isotopes in alluvial surface water samples that originated in confined aquifers.[115,116]

With consideration to this risk, the GIA concludes that "no significant risks to groundwater from drill holes and installation of coal seam gas wells and groundwater monitoring bores have been identified and residual significance of potential impacts from the Narrabri Gas Project on groundwater are "low".[117,118] Santos' assessment over the project's anticipated lifespan clearly neglects long term impacts on surface and groundwater environments that can occur after wells have been installed. The EIS points to no comprehensive strategy to ensure long-term well integrity, risking the water availability and quality to all third party users.

Waste management and Salt Legacy

We are concerned there will be significant impacts to water quality and ecosystem functions resulting from Santos' wastewater dispersal applications. Santos admits that there is a level of "uncertainty in the estimated volume of produced water from the seams based on potential variation in the porosity of the coals".[119] If Santos is unaware of the amount of water it will extract, it cannot be unaware of the final impact on the coal seam or of the final extracted amount of water that will require wastewater treatment and disposal. Capacity

[113] Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*, p.7-5.
[114] Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.
[115] Iverach, C. P., Cendón, D. I., Hankin, S. I., Lowry, D., Fisher, R. E., France, J. L., Nisbet, E. G., Baker, A. and Kelly, B. F. J. (2015) 'Assessing Connectivity Between an Overlying Aquifer and a Coal Seam Gas Resource Using Methane Isotopes, Dissolved Organic Carbon and Tritium', *Scientific Reports*. The Author(s), 5, p. 11. doi: 10.1038/srep15996.
[116] Zhou, Y. and Li, W. (2011) 'A review of regional groundwater flow modeling', *Geoscience Frontiers*. Elsevier B.V., 2(2), pp. 205–214. doi: 10.1016/j.gsf.2011.03.003.
[117] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.
[118] Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*, p.7-5.
[119] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology, p 11-19*.

of the wastewater treatment facilities could be under calculated without sufficient water extraction information.

Salt Management plan lacks essential details

At it's peak, during years 2 - 4 the NGP will create between 115 and 145 tonnes of salt every day, enough to fill more than two and a half B-double trucks. For each of these peak years, the project will create a waste legacy of at least 41,900 tonnes of salt. For the long-term average, Santos estimates creating 47 tonnes of salt waste every day, which is over one B-double truck each day and a total of over 17,000 tonnes each year. The total expected salt waste for the 25 year long projected is expected to be 430,500 tonnes. However, Dr Currell in his expert review of the surface and groundwater risks undertaken for the North West Alliance submission indicates that these volumes of salt may be underestimated by a factor of two based on previous analysis of the target coal seam[120].

It is of serious concern for the environment of NSW that Santos has not provided any specifics about its ultimate salt waste disposal plan other than stating it will be sent to 'licensed landfill.' Either Santos does not have an agreement with a licenced waste facility to receive these high volumes of salt waste or it has chosen to withhold this information for political reasons, knowing that local opposition is almost inevitable in whatever LGA the facility is located. CSG waste from AGL's now-abandoned operations at Gloucester has been rejected from two different facilities in the Hawkesbury region and in Newcastle after community concerns have been raised about the transport of waste and potential public health risks[121][122]. While these rejections were regarding wastewater, a similar level of concern can be expected from CSG salt wastes.

The NSW public has the right to know where Santos intends to dump this salt and the specific details of its ongoing management. Dr Currell questions the specifics of the salt brine waste management and we share his concerns. The EIS does not state the daily capacity intake of the licensed facility, the quantities able and required to be stored at Leewood awaiting transport to landfill, and most significantly, whether detailed chemical analysis and hazard assessment has been undertaken on the salt waste.[123]

Impacts from 'Beneficial Reuse' of produced water not properly assessed

Risks of irrigating with treated water not properly acknowledged

As a method of waste disposal, the EIS claims Santos will remediate alkaline water before dispersing it onto agricultural land. Santos describes the process as a beneficial reuse of treated produced water for crop irrigation on a suitable soil type, stating that it is likely to have similar impacts as the existing irrigated farms within the assessment area, with the potential benefit of additional local recharge to groundwater in the

[120] Currell, M. (2017) *'Review of Environmental Impact Statement – Santos ' Narrabri Gas Project.*', p.5. Appended to the North West Alliance submission.
[121] Sydney Morning Herald. April 16, 2015. *AGL's irrigation trial using CSG waste water found to be 'unsustainable'* http://www.smh.com.au/environment/water-issues/agls-irrigation-trial-using-csg-waste-water-found-to-be-unsustainable-20150416-1mmf82.html
[122] Sydney Morning Herald. February 17, 2015. *AGL loses second outlet for treating Gloucester CSG waste water* http://www.smh.com.au/environment/water-issues/agl-loses-second-outlet-for-treating-gloucester-csg-waste-water-20150217-13gxp7.html
[123] Currell, M. (2017) *'Review of Environmental Impact Statement – Santos ' Narrabri Gas Project.*', p.5. Appended to the North West Alliance submission.

irrigated area.[124,125] However, a recent study (funded by Santos) showed that treated coal seam water is not necessarily beneficial at all. Natural conditions play an important role in dictating if irrigation is a viable process to disperse treated wastewater. The study demonstrated that daylight hours, wind speed, evapotranspiration rate, and climate oscillation patterns combined with the accumulation of salts applied during irrigation can actually lead to increased soil sodicity.[126] During the period of experimentation, the field site received below-average regional rainfall and the reason this experiment revealed higher levels of sodicity in the soil was due to warmer and drier conditions than normal - a pattern we are headed for in northwest NSW. Drought events such as this are occurring more often, and a projected forecast for the area of north west NSW Australia shows hotter, drier summers and drier winters[127] with rainfall patterns becoming increasingly variable from year to year. In the drought-prone ecosystems of Australia, a dependence on the complex systems of underground aquifers are vital to rural productivity.[128,129]

This demonstrates Santos' plan to use irrigation as a means of wastewater dispersal will jeopardise the level of salinity in the root zone, significantly impacting crop production. Groundwater sources are barely sufficient to meet the needs of agriculture without additional pressure from the CSG industry.[130] Root zone salinity cannot be not jeopardised as a result of Santos' requirement to disperse its wastewater from the coal seam.

Unacceptable risks of the 'managed release' of treated CSG water to Bohena Creek

The proposal for wastewater dilution or 'managed release' of treated water into Bohena creek during flow rates of over 100 megalitres per day is a risky proposal that we believe has not been adequately assessed and risks damaging habitats surrounding and dependent on Bohena Creek. The managed release would dump up to 2.2 tonnes of salt into Bohena Creek per day (when flows are high enough).[131] This is a cost-effective way for Santos to dump its waste, risking contamination of the sensitive local surface and surface groundwater water systems and externalising its waste disposal costs onto the environment and society. Bohena Creek is a highly ephemeral creek and contaminants that are released into it may accumulate in its flow path if it does not 'flush out' or drain into other receiving waters.

The EIS states that Bohena creek is "relatively undisturbed" but the assessment adopts the default level of protection for "slightly to moderately disturbed systems" because it receives runoff from other areas that are disturbed[132]. Is Santos downgrading its classification of the environmental asset so they can loosen the operating conditions?

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124 Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.

125 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 11 Groundwater and Geology*.

126 Bennett, J. M. L., Marchuk, A., Raine, S. R., Dalzell, S. A. and Macfarlane, D. C. (2016) 'Managing land application of coal seam water: A field study of land amendment irrigation using saline-sodic and alkaline water on a Red Vertisol', *Journal of Environmental Management*. Elsevier Ltd, 184, pp. 178–185. doi: 10.1016/j.jenvman.2016.09.078.

127 NSW Office of Environment and Heritage (2014) *New England North West Climate change snapshot*.

128 Atkins, M. L., Santos, I. R. and Maher, D. T. (2015) 'Groundwater methane in a potential coal seam gas extraction region', *Journal of Hydrology: Regional Studies*. Elsevier B.V., 4, pp. 452–471. doi: 10.1016/j.ejrh.2015.06.022.

129 Bec, A., Moyle, B. D. and McLennan, C. lee J. (2016) 'Drilling into community perceptions of coal seam gas in Roma, Australia', *Extractive Industries and Society*. Elsevier Ltd., 3(3), pp. 716–726. doi: 10.1016/j.exis.2015.12.007.

130 Lloyd-Smith, M. and Immig, J. (2011) *Inquiry into Coal Seam Gas*. Available at: https://www.parliament.nsw.gov.au/committees/DBAssets/InquirySubmission/Summary/39561/Submission 0271.pdf.

131 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 12 Surface Water Quality*, p. 5.

132 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 12 Surface Water Quality*, p. 10.

The EIS ignores that Bohena Creek is a recognised surface groundwater ecosystem[133] and therefore fails to assess the risks to this system. It also fails to assess the impacts on connected catchments. The Bohena creek catchment area itself is an "estimated" 2000km^2. Figure 4-8 shows that tributaries to the Namoi River run through the McDonald/Manilla, Peel and Mook Sub-Catchments yet Santos, but the impacts of these catchments are not discussed in the Catchment Setting section of 4.4.2.[134] We're also concerned that there are no baseline surface water monitoring locations in the creek adjoining Bohena although the project area covers these creek catchments and there may be potential for contamination. Jacks Creek, Mollee and Bundook creek are all significantly within the project area, but are not being monitored.[135]

The EIS states that in accordance with the salinity targets, treated water released into Bohena creek would be estimated to be 357 microsiemens per centimetre, which is claimed to be of better quality than the 475 target for the Namoi catchment or the 550 target for Namoi (from NSW policy).[136] However it later states that Bohena creek is generally fresh. Its microsiemens are 216 per centimetre.[137] Therefore although it's stated that the treated water is less salty than Namoi River, it is far more saline than the receiving waters of Bohena creek.

Risks of surface water contamination incidents not properly assessed or mitigated

Coal seam gas operations bring inherent risk of toxic water spills with hundreds of potential spill sites dispersed across the landscape. The Narrabri Gas Project will introduce well over 850 potential sites for leaks and spills throughout the sensitive ecology and groundwater system of the Pilliga and surrounding farmland. Currell highlights that any surface level spills may damage the land and lead to shallow groundwater contamination of the water table aquifers.

Risks evidenced in the history of spills and leaks in the Pilliga are not adequately addressed

In the Pilliga, from exploration activities alone, there are documented incidents of spills and contamination incidents at every stage of the production cycle, including well heads, gathering lines and holding dams. A holding pond liner leaked at Bibblewindi Water Treatment facility resulting in the contamination of two shallow aquifers with uranium at 20 times safe levels as well as other toxic heavy metals. Santos was fined $1,500 from the NSW for this pollution incident. In 2011 a spill occurred at Bibblewindi when at least 10,000L of untreated produce water, contaminated with heavy metals such as arsenic, lead and chromium, salts and petrochemicals spilled into the adjacent forest and caused vegetation dieback which is still unremediated today. Please review the report "*The truth spills out: A Case Study of Coal Seam Gas Exploration in the Pilliga*"[138] and The Wilderness

[133] Ransley, T. R., Radke, B. M., Feitz, A. J., Kellett, J. R., Owens, R., Bell, J., Stewart, G. and Carey, H. (2015) *Hydrogeological Atlas of the Great Artesian Basin*. doi: 10.11636/9781925124668.

[134] Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project pp.4-13-15.*

[135] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 12 Surface Water Quality, Figure 12-4.*

[136] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 12 Surface Water Quality, p.4*

[137] Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 12 Surface Water Quality, p.19.*

[138] Northern Inland Council for the Environment & The WIlderness Society (2012) *The Truth Spills Out: A Case Study of Coal Seam Gas Exploration in the Pilliga*. Available at: https://walloffrackingshame.files.wordpress.com/2012/06/the_truth_spills_out_final_may_2012_without_appendices.pdf.

Society's submission to the *Performance of the NSW Environment Protection Authority (Inquiry) 2014* (Appendix A), for a thorough insight into the early spills and leaks of CSG exploration in the Pilliga and evidence that there was systemic mismanagement and obfuscation regarding public disclosure of these incidents. Matters outlined in these documents extend to early 2014 and despite some recent regulatory changes there is not sufficient evidence in the EIS that these incidents can be avoided, or adequately mitigated in the highly likely circumstance that there will be future spills.

Risks and stakes of produced water spills in the Pilliga are high

Currell states that the risks of surface and groundwater contamination of the Narrabri Gas Project are particularly high, and the impacts potentially severe due to the unusually poor quality of the target coal seams and the unusually high quality of the shallow groundwater and surface water in the project area, which covers recharge areas of the Pilliga Sandstone, one of the main aquifers of the southern Great Artesian Basin.[139]

CSG water from the Pilliga has higher than normal rates of salinity –between 9g/L cited in chapter 7 of the EIS and an 18g average found from testing of the Bibblewindi Pilot Project, compared to an average of under 5g/L in the Surat and Bowen Basins of QLD. CSG produced water in the Pilliga also contains high levels of heavy metals, boron and fluoride.[140]

Spill rates from international evidence suggests the EIS underestimates contamination risks

Dr Currell points to a systematic review of the spill rates from unconventional gas operations in the U.S. The evidence shows that a spill or leak occurred at between 2 and 16% of all unconventional gas wells (with or without fracking and across a large dataset, representing all types of unconventional gas). If these rates were applied to the number of wells proposed for Narrabri we could expect between 15 and 136 spills at well sites across the gasfield over its operating life.[141]

No controls in place around third party use of treated water for irrigation and lack of control around treated water use within the Pilliga for dust suppression, fire-fighting

There seems to be inadequate information about regulations or risks to the third party user, Occupational Health and Safety requirements and their environmental monitoring of the site or the suitability of the site. If the soil on this site was not suitable this could risk aquatic life, groundwater and surface water. We don't believe there is enough information to approve the construction of (and the ability to operate) a treated water pipeline extending to the Leewood property boundary to transfer water to another location for irrigation by a third party (if required). There is also a lack of information of the impact of the medium effluent treated water on the roads within the Pilliga or for fire-fighting. There are a number of rare flora species that may be sensitive to salinity as well as creek crossing and sandy soils recharging the groundwater directly. More information is need on this external use.

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[139] Currell, M. (2017) *'Review of Environmental Impact Statement – Santos ' Narrabri Gas Project.*', p.3. Appended to the North West Alliance submission.
[140] Ibid. p.4.
[141] Ibid.

Groundwater Dependent Ecosystems

We are concerned that the NGP is likely to impact significantly on the functioning of groundwater dependent ecosystems. Additionally, we believe the NGP is likely to impact on Threatened Ecological Communities (TECs) listed under the Threatened Species Conservation Act 1995. The GIA Report determines that there are three separate types of Groundwater Dependent Ecosystems in the project area (GDEs):

- Type 1: includes the habitat of aquifers and caves,
- Type 2: includes ecosystems dependent on surfaced groundwater such as wetlands, lakes, seeps and springs; and
- Type 3: includes ecosystems dependent on groundwater in shallow water tables and aquifers.

The GIA Report identifies the number of each previously listed Type of GDE in the project area:

- Type 1: 0 GDEs
- Type 2: 9 "potential" GDEs
- Type 3: No exact listing of how many GDEs were found, but a statement determining that these GDEs were found in riparian areas of the streams in the Namoi Catchment.

Characteristic of GDEs listed in GIA Report:

- Type 1: None found

- Type 2: The GIA Report identifies that GDE Type 2 are of "low" ecological value and none support Matters of National Significance (MNES). It should be noted that every species in GDE Type 2 derive water from the Pilliga Sandstone or Namoi Alluvium.

- Type 3: Some of the Type 3 GDEs have been identified as "potential' Type 3 GDEs. It is worth noting that without determining exactly what "Type" of GDE this community falls under, the habitat specifics of a species cannot be determined, nor can the relationship between these species and other species that are potentially dependent on the presence of said "potential" Type 3 GDE.

The Petroleum (Onshore) Act 1991 recognises the danger to endangered species caused by mining activities.[142] Section 9(6) of the Act requires the Minister administering that Act to notify the Minister administering the Threatened Species Conservation Act 1995 of mining activities in prescribed circumstances.[143] Two TECs listed as endangered under the Threatened Species Conservation Act 1995 were found to be located within the riparian areas of Bohena Creek and its tributaries: Fuzzy Box Woodland and White Box tall woodland. It is listed that White Box tall woodland mapped in the north of the GDE study area corresponds to an area with moderate to high potential for Type 3 GDEs in the GDE atlas and that a potential of subsurface dependent GDEs correspond to the extent of the Pilliga forest and have a high potential for occurring in the GDE study area.[144,145,146] Finally, there was an absence of field data of the water use patterns of terrestrial vegetation, which is further complicated by the multiple sources of water available.[147]

[142] Lloyd-Smith, M. and Immig, J. (2011) *Inquiry into Coal Seam Gas*. Available at: https://www.parliament.nsw.gov.au/committees/DBAssets/InquirySubmission/Summary/39561/Submission 0271.pdf.
[143] NSW Government (2017) *Petroleum (Onshore) Act 1991 No 84*. Available at: All Papers/Other/Petroleum (Onshore) Act 1991 No 84 - Petroleum (Onshore) Act 1991 No 84.pdf.
[144] Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.p.5-5
[145] Bureau of Meteorology (no date) *GDE Atlas Home: Water Information: Bureau of Meteorology*. Available at: http://www.bom.gov.au/water/groundwater/gde/.

The GIA Report identifies that the water table at Ted's Hole and Coghill creek contains high quality water and shows Bohena Creek as an area of "moderate potential for interaction with surfaced groundwater. If wastewater is released into Bohena Creek enters the high quality groundwater, it has the potential to disturb existing physicochemical properties of deeper potential GDE habitats, especially as the water is considered to be highly transmissive. Sampling of bores and pits in the Bohena Creek Alluvium and several deep production bores in the Black Jack Group. No stygofauna were found to be present in the bore samples after two rounds of sampling. The assessment found that the project would have an extremely low risk, (despite a drop of up to 0.5 metres in alluvial water), of impacting stygofauna communities if they were in fact present.

Hardy Spring and Eather Spring (identified as farm dams) have been recognised by DPI as "high priority" GDEs due to the value of the groundwater source from which they originate. The risk of disturbing this ecosystem is considered "low", despite this groundwater source being connected with "good quality groundwater" alluvial groundwater. Stygofauna potential Type 3 communities may have some interaction with phreatophytic vegetation along the contours of the rivers and tributaries of Bohena Creek. Therefore disrupting the habitat identified, as Type 3 would inevitably disrupt type 2 communities, likewise, disrupting the water levels in habitats of Type 2 communities would disrupt communities in Type 3.

Table 5-1 presents a Summary of potential Type 2 GDEs.[148] The terminology used in the GDE column is not consistent with previously listed GDE Types and makes reading the table slightly difficult. Additionally, in several cells, the description within the Ecological evaluation is confusing. For example: "Likely sourced from the Pilliga sandstone. Generally considered to be of low value. Considered to be of high value due to water quality and limited contamination." This sentence structure is repeated several cells throughout the table without defining exactly what it is referring to as low value.

In summary, we dispute that potential impacts of all GDEs is not "unlikely" as a result of changes to hydraulic properties in the aquifers.[149] Section 6.3.2 of the GIS Report assessed risks to Potential GDEs on a model that assessed impacts of depleted groundwater pressure of up to 0.5 metres over an 800 year period.[150] It is too difficult to accurately produce a model that adequately assess changes that are likely to occur due to anthropogenic global warming, especially a model that projects 800 years into the future.[151] It is therefore impossible to believe that Santos would know for certain that cumulative impacts of CSG and global warming would not together influence potential communities of GDEs. Likewise, a risk assessment on these species cannot be properly completed if there is an "absence of field data", as the GIA Report suggests.

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146 Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.p.5-4
147 Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.p.5-10
148 Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.p.5-2
149 Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.p.6-8
150 Santos (2016) *Appendix F Groundwater Impact Assessment Narrabri Gas Project*.p.6-6
151 NSW Office of Environment and Heritage (2014) *New England North West Climate change snapshot*.

Biodiversity and Threatened Species Impacts

This Environmental Impact Statement needs to meet a set of requirements on minimising and managing the impacts on the ecology of the region in which the proposed development will take place.

Under the ESD principles required under the EP&A Act, this project needs to achieve the "conservation of biological diversity and ecological integrity". It requires use of the precautionary principle. In this case we have an EIS that fails to identify the sites of destruction and yet demands approval for these destructive activities.

In terms of the conservation of biological diversity and ecological integrity it is the view of the Wilderness Society that this EIS fails to meet the requirements of the EP&A Act.

The fact that the EIS fails to specifically identify where the gas wells will be placed makes adequate assessment of the adverse biodiversity impacts impossible. The level of uncertainty is too great. It is the view of the Wilderness Society that this EIS fails to meet the needs of the community concerned as long as it fails to identify the areas proposed for destruction.

What we do know however is that Santos is proposing to install and operate 850 gas wells on 425 pads and these wells and pads will detrimentally impact approximately 15% of the higher quality vertebrate habitat in the Pilliga forests and woodlands by:

- Increasing the fragmentation of a Commonwealth-listed Biodiversity Hotspot already under severe environmental stress;
- Creating wide and effectively permanent barriers to vertebrate movement with the construction of linear corridors and bushfire asset protection zones.
- This clearing and associated vehicle movements (project related and increased access more broadly) will increase predation of vulnerable species from introduced vertebrates including the Red Fox Vulpes vulpes, Feral Cat Felis catus and Feral Pig Sus scrofa.
- This clearing and associated vehicle movements will increase the spread of invasive plant species (noting it is our view the EIS fails on assessing invasive species as only noxious weeds were considered), further damaging the Biodiversity Hotspot and habitat for vulnerable species.
- Increasing sedimentation of ephemeral waterways and reduced surface water essential to the maintenance of many vertebrate populations;
- Industrialisation of the landscape with significant increases in vehicle movements, dust, noise and lighting;
- Continuing damage to high value riparian habitat;
- The substantial intensification of human activities in the region will increase pest vertebrate species including the Feral Pig and Feral Goat Capra hircus;
- The cumulative impacts of the now more intensive forestry operations (Niche Environment and Heritage 2014) and the reality of climate change impacts, particularly the loss of hollow-bearing trees[152], vegetation loss and increased fire frequency.[153]

These impacts are inadequately addressed in the EIS.

[152] Parnaby, H., Lunney, D., Shannon, I. and Flemming, M. (2011) 'Collapse rates of hollow-bearing trees following low intensity prescription burns in the Pilliga forest, New South Wales (vol 16, pg 209, 2010)', *Pacific Conservation Biology*, 16(4), p. 236. doi: 10.1071/PC100209.

[153] Lunney et al. submitted 2017

Context:

The Wilderness Society does not believe the proponent, Santos, has adequately acknowledged the ecological significance of the Pilliga forests and woodlands. The Narrabri Gas Project will clear close to 1,000 hectares of the Pilliga Forest, 1,000 hectares that is not even identified in this 7000 page EIS, fragmenting the largest temperate woodland in the state, a home to unique wildlife.

The Pilliga is the largest forest remaining in the heavily cleared wheat-sheep belt of NSW and makes up the largest component of a Western NSW biodiversity corridor spanning over 125kms from the Warrumbungles to Mount Kaputar National Park. Teeming with wildlife, the Pilliga forms part of the Brigalow Belt bioregion National Biodiversity Hotspot and it is a globally listed Important Bird Area.

In 2012, as part of the NSW Government's Strategic Land Use planning process, the Government mapped significant areas of the Pilliga Forest as 'Tier 1 Terrestrial Biodiversity', defining it as, "*Habitat for threatened plants and animals for which habitat loss due to mining and coal seam gas is likely to place them at risk of local extinction*," and, "*coal seam gas should be avoided because the identified natural values cannot sustain further significant loss*". They also class the areas as, "*Unlikely to be offset because of their rarity, extent uniqueness and importance*."

The Pilliga Forest, in particular the area of the forest earmarked by Santos for a coal seam gas field development, has been identified as having the highest value for conservation and repair within joint research undertaken in 2012 by the NSW Office Environment and Heritage and the University of Southern Queensland, as part of their 'Western Woodlands Way' report of 2012.

The north proposed project area for Santos' coal seam gas operations is home to a number of federally listed threatened species and Endangered Ecological Communities including the Koala, Pilliga Mouse, Narrow-leaved Tylophora and the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland.

The Pilliga Forest is a refuge for many plants and animals that are declining across Australia. The Pilliga has national conservation significance and is vital to the survival of federally and state threatened species including the Koala, Spotted-tail Quoll, Black-striped Wallaby, Pilliga Mouse and South-eastern Long-eared Bat. Coal seam gas exploration has already caused substantial damage to the forest and the progression to gas production could lead to local extinctions.

Nationally & State Listed Threatened Species

Pilliga Mouse

The Federal Government has stated that the Narrabri Gas Field has the potential to impact the Pilliga mouse through: direct habitat clearance, habitat fragmentation, vehicle strike and predation by pest species. They state that this could 'disrupt the breeding cycle and adversely affect habitat critical to the survival of the species'. There have been no baseline population surveys of this fragile little creature. The Wilderness Society believes that approving this gas field would likely breach the Environmental Protection and Biodiversity Conservation (EPBC) Act.

The Pilliga Mouse is endemic to the Pilliga Forest, and relies on habitats with a high species richness, moderate to low shrub cover, and a moist ground cover of plants, litter and fungi. A recent EPBC referral document for the new Narrabri Coal Seam Gas production project identified that "it is likely that the Project area [which

encompasses the same area as 'the action'] supports part of an important population of Pilliga Mouse given that the population within the project area is near the north eastern limit of the species population range, and the species is restricted to the Pilliga region of NSW."[154]

The future of the Pilliga Mouse is threatened by this project due to the spread of invasive predator species, and consequent increased rates of predation; the increased fragmentation from access tracks and dispersed clearance potentially creating unfavourable microclimates, open space, and traffic disturbances (in addition to existing tracks). The loss of habitat is significant.

There is limited knowledge of the species, and little to no assessment of the impacts on the species as a result of individual and cumulative projects undertaken to date. Using the precautionary principle under an ESD approach means the project should not be approved as this EIS fundamentally fails to assure us there is adequate knowledge and understanding of the current status of the Mouse or of an appropriate management regime.

Spotted-tail Quoll

The Spotted-tailed Quoll was recorded in the Pilliga in the 1990s. Whilst there is no recent evidence of the species, the rarity of this species would indicate a need for more substantive surveys.

The NSW Government threatened species profile recognizes the following threatening processes that can be considered likely to have a significant impact on the species:

- Loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development, logging and frequent fire[155]
- Loss of large hollow logs and other potential den sites[156]
- Competition for food and predation by foxes and cats.[157]

It is very difficult to make an informed assessment of the likely impact of coal seam gas operations on this species. The fragmentation of habitat, and the creation of access roads and cleared areas is likely to increase the accessibility of the area to competing predators. Again, using the precautionary principle in assessing this EIS, the project should be refused.[158]

Koala

The EIS fails to find koalas in the project zone. Yet Santos knows the NSW Office of Environment and Heritage (OEH) undertook a survey in November 2013 which identified Koala activity along Borah Creek just to the south of the gas field area. Earlier work also identified Koala activity in the northern parts of Bohena Creek, within the proposed gas field area.[159] The Wilderness Society believes the survey work undertaken for the EIS

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[154] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.

[155] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.

[156] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.

[157] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.

[158] NSW Government (2017) *Petroleum (Onshore) Act 1991 No 84*. Available at: All Papers/Other/Petroleum (Onshore) Act 1991 No 84 - Petroleum (Onshore) Act 1991 No 84.pdf.

[159] Forest, P., Belt, W., Inventory, N. W., Area, I. B., International, B., Owls, B., Pilliga, T., Belt, B., Bioregion, S., Government, F., Basin, G. A. and Basin, M.-D. (no date) 'The Pilliga'.

is inadequate with respect to koalas and the relatively recent sightings indicate both likely colonies and the precarious status of the species.

The difficulty finding koalas indicates a more significant problem. The status of koalas in NSW is declining rapidly and every effort should be taken by both the NSW and Commonwealth governments to protect koala colonies. Approving this project would contradict any serious effort to protect the koala.

South-eastern Long-eared Bat

The Pilliga, including the Pilliga East State Forest, is the recognised national stronghold of the South-eastern Long-eared Bat. Breeding occurs in tree hollows, and the species forages close to vegetation and around tree trunks, and within a limited range (several kilometres) of roosting sites. There are large areas of modelled high probability habitat in the eastern Pilliga Forest where the gas project is proposed.

There is strong evidence to show that larger, intact forest remnants are important to the species, with surveys in central western NSW showing 'a tenfold difference in relative abundance between trapping sites within large continuous forest remnants compared to small forest areas'. In particular, Turbill & Ellis (2006) found that 'While previously captured infrequently and in low numbers, recent surveys have revealed that the large remnants of woodland in the Goonoo, Pilliga West and Pilliga East study areas are a distinct stronghold in the distribution of the south-eastern form of N.timorensis'.

They concluded that “these larger remnants of box/ironbark/cypress woodland are needed to support high densities of N. timoriensis”. Other factors that have been implicated in describing its distribution within the scientific literature include warmer over-wintering areas, highly drained soils, and old-growth vegetation. 'Habitat loss may have not only removed Southeastern Long-eared Bat habitat such as roosting sites, but also potentially threatens the viability of remaining populations by fragmentation of remaining habitat (see below) and the impacts of dryland salinity.

While clearing for agriculture has been the greatest reason for clearing mallee and woodland habitat, additional threats are emerging that are targeting remaining areas of habitat, such as various open cut coal, natural gas and mineral sand mining proposals. Gas developments have already been recognised as a threat to this species, and the associated habitat fragmentation that the Eastern Star Gas exploration and pilot production program has caused must pose a similarly major threat.

The Draft Recovery Plan states that:
“Before European settlement, mallee and woodland habitats were extensive and nearly contiguous across inland eastern Australia.[160] However, clearing for agriculture has resulted in fragmentation of suitable habitat for this species. Trapping results and initial modelling strongly suggest this species is affected by fragmentation, with it displaying a preference for larger forest remnants [161]. Small isolated populations may be especially vulnerable to local extinction by a range of processes that may deplete the number of individuals or degrade the overall fitness of each population[162].

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[160] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.
[161] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.
[162] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.

Fragmentation of South-eastern Long-eared Bat habitats may also exacerbate other threats. For example, foxes and feral cats are probably more abundant near cleared land[163]; habitat fragments may be completely burnt by wildfire or control burns, potentially leading to local extinction where sources for recolonisation no longer exist; and fragmentation may increase the exposure of this bat to agrichemicals.

In addition, the reliance on tree hollows for breeding and roosting, and the limited range of individuals, would suggest that the species may be particularly sensitive to clearing in particular areas and to increased fire risk, with this being exacerbated given the long-term to permanent clearance of areas for infrastructure.

There is sufficient evidence available on the threats to the South-eastern Long-eared Bat to conclude that the proposed gas development is likely to have a significant impact on it.

Birds

The Pilliga forest is home to 240 bird species including Barking Owls, Turquoise Parrots, Regent Honey-Eaters and other threatened species. The Federal Government has stated that the Narrabri Gas Field could foreseeably 'contribute to the ongoing destruction of the Regent honeyeater habitat."

The intact expanse of mature trees and shrubby understorey make the Pilliga forest a haven for birdlife. The Santos gas field would extend over 98,000 hectares of the Pilliga forest with well pads, roads, water and gas pipelines fragmenting important bird foraging and feeding grounds.

The project area is also home to a number of threatened woodland birds such as the Brown Treecreeper, Grey-crowned Babbler and Diamond Firetail. The encroachment of Noisy Miners, weeds, feral animals caused by the fragmentation combined with noise and light pollution would render a huge portion of the Pilliga uninhabitable for these birds.

We would like to refer NSW Planning to the submission from Birds Australia for greater detail on birds impacted by the proposed gas development, however we would like to raise specific concerns on the future of the Regent Honeyeater if this project is approved.

Regent Honeyeater

There is likely to be a significant impact on the Regent Honeyeater. Given how little the population dynamics, distribution and foraging patterns of this species are understood, a precautionary approach must be applied and the EIS fails to assure the Wilderness Society that it either understands the status of the Regent Honeyeater in the project area and does not provide an adequate management approach to ensuring this lovely bird will be protected adequately.

The Regent Honeyeater is listed as a critically endangered species in NSW and it is considered to have suffered an incredibly severe decline in numbers. Every possible measure must be taken to protect habitat for the species. There are known breeding records very nearby to the project area, and there is no doubt the area provides habitat for the species. The lack of records is not surprising given the paucity of survey efforts and the size of the area. The Regent Honeyeater is highly mobile because it is heavily reliant on ephemeral flowering events, especially in poor years. The fact that the eastern Pilliga area is outside of the three known key

[163] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.

breeding areas, but that it is known to occasionally host breeding events, suggests that the area provides an important refuge site during drought years. This species will be affected by the direct loss of habitat, the increased fire frequency and intensity leading to the loss of mature, heavy-flowering trees, and the increased fragmentation to an important refuge habitat caused by the proposal. The impact will be significant.

Reptiles

The EIS failed to adequately assess the status of the endangered Five-clawed Worm Skink. This is another failure of the EIS to demonstrate adequate knowledge of this species and to provide an adequate response to the impacts of this development on the Skink were undertaken in April 2014.

Plant Species and Communities

The EIS fails to adequately address concerns that the development will fragment this region's forests and woodlands. The region includes the Critically Endangered White Box Yellow Box Red Gum Woodland and Derived Native Grassland along the Bohena/Yaminah/Borah Creek system. There are studies that have indicated the red gum Eucalyptus blakelyi as well as E. melliodora and E. albens are found throughout this floodplain and riparian system[164] and sometimes in association with E. conica and Angophora floribunda. These species are consistent with this system being Koala habitat.[165]

Socio-economic impacts are not properly assessed

Santos' social impact assessment is three years old and does not offer an adequate analysis of negative risks and impacts to the local community, whilst it inaccurately conflates economic benefits for a small minority as social benefits for the broader population.

The conclusion of Chapter 26, Social and Health that (apart from a medium impact on housing and accommodation for the operation phase) all residual social and health risks are either low, very low, or positive (including a very high positive for socio-economic impacts) are unfounded and represent a gross denial of evidence demonstrating serious negative social and health impacts seen at other CSG and resource development sites.

Methodological inadequacies in the Social Impact Assessment (SIA)

Professor Stewart Lockie, in his expert review on the SIA[166] suggests that key baseline data was excluded from the assessment.[167] Lockie concludes that there is insufficient evidence to assess the accuracy of impact claims and mitigation measures outlined in the SIA.

Inadequate cumulative impact assessment

Lockie notes the failure to assess the cumulative pressures from other proposed resource projects in the region. Cumulative pressures on labour and housing markets, demographic profile, social infrastructure,

[164] Milledge, D. and Blackmore, C. C. and U. C. C. and L. (no date) *National Significance: The ecological values of Pilliga East Forest and the threats posed by Coal Seam Gas mining*, *Management*.

[165] Department of Environment & Climate Change NSW (2008) *Recovery plan for the koala (Phascolarctos cinereus)*, *Distribution*.

[166] Lockie, S. (2017) *'Expert Report: Social Impact Assessment of the' Narrabri Gas Project.*'. Appended to the North West Alliance submission.

[167] Specifically, Lockie recommends incorporation of findings from the GISERA funded project *Social Baseline Assessment of the Narrabri Region of NSW in Relation to CSG Development#* and suggests that the Phase 2 outcomes of the project which have been available early in 2017 provide superior insight into community perceptions and expectations than provided in the EIS SIA.

community identity, stress and crime are all unassessed. Lockie cites his own published study regarding the CSG boom in Queensland where these key areas had interacting, cumulative impacts.[168] We cannot be confident of the severity of likely social impacts to Narrabri until this cumulative assessment is undertaken.

There is no analysis of post-closure impacts of the project. Potential impacts, such as loss of employment and demographic changes are stated but there are no details or mitigation measures described. Lockie argues this represents a failure to address the *Secretary's Environmental Assessment Requirements* (SEARs) to address "*all stages* of the development" and to follow best practice as described in documents referred to in the SEARs, which emphasise the importance of closure planning. There is reference to ongoing benefits from the Community Benefit Fund but there is no analysis of this positive impact, or mechanism described to achieve it.

Social impacts of FIFO workforce are not adequately assessed

The EIS argues the negative effects of the project workforce on the community values and housing of the town would be 'very low'. Appendix T1-60 states that 90% of the construction workforce and the entire drilling workforce will be FIFO or DIDO (residing over an hour drive from Narrabri). During the 3-4 year construction phase approximately 1,195 non-local people (predominantly men) would be employed for construction and drilling activities in the gasfield and would reside predominantly in workers accommodation in Narrabri with a smaller number at the driller's camp on Westport Road (nearly 900 men would rostered on at a time). For a township of just over 7,300 people this influx of men is significant and we argue the potential impacts on the community have not been adequately assessed or mitigated.

The 2013 Federal *Inquiry into the use of 'fly-in, fly-out' (FIFO) workforce practices in regional Australia* found large influxes of non-resident workers permanently affected the social fabric of regional centres and brought serious negative impacts to the cohesion, safety and amenity of communities.[169] It was found, through dozens of submissions from affected community groups, regional councils and individuals that anti-social behaviour increased, women felt unsafe walking alone, and other community values were eroded over time as costs of living increased and demographics shifted.

Strategies to achieve outcomes for Aboriginal people are not described

Lockie notes that while there is a stated commitment to 'maximise Aboriginal employment including for contractors' there are no details regarding mechanisms to achieve this outcome provided. Given the often poor record of resource extraction projects delivering any significant social benefits for Aboriginal Australians across the continent, it is unacceptable that detailed descriptions to support Aboriginal employment and other social benefits are omitted. Santos claims regarding the delivery of social benefits to the local Indigenous community are unsupported and experience from countless similar projects suggests these are hollow claims unlikely to eventuate.

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[168] Petkova, V., Lockie, S., Rolfe, J. And Ivanova, G. (2009) Mining developments and social impacts on communities: Bowen Basin Case Studies', Rural Society, 19(3): 211– 228. Available at: www.bowenbasin.cqu.edu.au/Petkova%20et%20al.%20Rural%20Society%2009.pdf

[169] The Parliament of the Commonwealth of Australia, February, 2013. House of Representatives Standing Committee on Regional Australia, Inquiry into the use of 'fly-in, fly-out' (FIFO) workforce practices in regional Australia: "*Cancer of the bush or salvation for our cities? Fly-in, fly-out and drive-in, drive-out workforce practices in Regional Australia*." Available at: http://www.aph.gov.au/Parliamentary_Business/Committees/House_of_Representatives_Committees?url=ra/fifodido/report.htm

Stress and community division is unacknowledged

The EIS refers to just one study (Cootes 2013) of farmers in the Condamine region of Queensland and concludes there is no evidence of stress and division resulting from the CSG. This conclusion is in blatant contradiction of direct contrary evidence. Both the GISERA Social Baseline Assessment mentioned above and another recent study by the University of Newcastle and the Department of Primary Industries[170] have specifically researched and documented current social division and angst in the Narrabri community regarding coal seam gas. The impacts on community identity and social well-being arising from resource projects in rural towns were also shown to be significant through the aforementioned 2013 Federal FIFO Inquiry. Lockie notes the importance of acknowledging existing disunity and mitigating appropriately for long term impacts. This omission is a clear inaccuracy of the SIA and demonstrates Santos' propensity to overlook real social impacts of its proposal.

Impacts to recreational values are not meaningfully addressed

The EIS notes that the Pilliga is a valued site for bushwalking, birdwatching, picnicking, camping and hunting.[171] It further contends that, after the construction period, these activities can resume amongst the roads, pipes and well pads of the gasfield. We consider this a preposterous contention and would argue that most users appreciate the forest partly for its aesthetic and 'wilderness' values and would not gain the same benefits from recreating amongst an industrialised gasfield. It also notes that the Yarrie Lake recreation area is highly valued by the local community, yet it does not acknowledge any negative socio-psychological impacts that may occur from the changed landscape with well pads drilled as close to 200m from the lake.

Impacts on local employment are not clearly or properly assessed

The jobs and economic claims in the Santos Narrabri Gas project EIS starkly contradict Santos's previous jobs claims from 2011 in modelling undertaken by Allen Consulting.[172] It is also at odds with recent research by the CSIRO/ GISERA looking at the economic impacts of CSG in QLD.[173]

Specifically, we have several questions regarding discrepancies of the jobs claims in the EIS and other research and modelling:

1. The 2011 Allen consulting report estimates that a much larger version of the Narrabri project (200PJ per year) would only employ only 16 people (direct and indirect) in the North Central Plains region that includes Narrabri LGA.[174] Yet the EIS claims that 127(direct and indirect) jobs will be created in Narrabri LGA alone (27-18). That's an approximately eightfold increase, for a smaller project.

2. The Santos EIS claims that there will only be very small jobs losses in agriculture as a result of CSG. This seems to contradict the experience in QLD where the CSIRO/ Gas Industry Social Environmental Research Alliance (GISERA) found there was 1.8 jobs agricultural jobs lost for every new CSG job. This is also referenced

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170 Askew M, Askland HH. 2016. Local Attitudes to Changing Land Use – Narrabri Shire. Summary Report. December 2016. Newcastle, NSW: The University of Newcastle, NSW Department of Primary Industries. Available at: https://www.newcastle.edu.au/__data/assets/pdf_file/0009/336726/CSRRF_Narrabri-Summary-Report_December-2016_240217_Web.pdf

171 Santos (2016) *Narrabri Gas Project, Environmental Impact Statement, Chapter 26 Social and Health, p 10.*

172 Allen Consulting Group 2011, The economic impacts of developing coal seam gas operations in Northwest NSW, Report prepared for Santos. Available at: http://www.acilallen.com.au/cms_files/acgeconomicimpactcoalseam2011.pdf

173 Mark Ogge, The Australia Institute. November 2015. Discussion Paper- *Be careful of what you wish for: The economic impacts of Queensland's unconventional gas experiment and the implications for Northern Territory policy makers.*

174 Allen Consulting Group 2011, The economic impacts of developing coal seam gas operations in Northwest NSW, Report prepared for Santos. Available at: http://www.acilallen.com.au/cms_files/acgeconomicimpactcoalseam2011.pdf (p.18. Table 3.1)

in the Office of the Chief Economist report on CSG.[175] If this were the case in Narrabri, the 127 new direct CSG jobs Santos claims it will create would result in 229 agricultural job losses in the region in contrast to the 22 jobs losses (0.29% of the total 7,700 Narrabri workforce) acknowledged in Table 27-6.

3. The EIS says that farming in the region would be impacted in value by up to only $ 243,000/ year (Appendix U1, Table 4.2). However CSIRO/ GISERA research that found farmers with CSG on their properties would lose on average $2.17 million dollars each.[176] How does Santos explain this discrepancy between the measured, actual impact in QLD and the low projected impact near Narrabri?

Lack of clarity regarding stated jobs in EIS

It is also unclear from the key associated with Table 26-7 how many additional roles will be created in Narrabri. It states the 50 'existing roles already within Narrabri' are the 'existing Narrabri Operations Team' yet also states the 44.5 positions for Narrabri and immediate region 'includes the existing Narrabri Operations team.'

Table 26-7 in the EIS is not clear, as further calculations are required to obtain the actual number of expected jobs. The following table provides actual numbers of jobs and was developed by the local group *People for the Plains* to assist in an easier analysis of impacts on their town. Only an additional 44-45 ongoing jobs will be available for people from within the local region (13% of the total 345 ongoing positions) and only 105 jobs will be available for the initial 3-4 year construction period (8%). Furthermore Santos has not provided any details about quotas or mechanisms to ensure these available positions are filled by local people.

Timeframe	Who will get the jobs?	Number	Percentage of total
Operational Phase	Existing Narrabri roles	50	14.5%
	New jobs for people from within Narrabri and a one-hour radius	44-45	13%
	People relocating to Narrabri	50	14.5%
	People to fill roles but live elsewhere (other regions or interstate – including 50 who will live in major capitals in admin roles, and ~150 who will be FIFO)	200-201	58%
	Total operational	345	
Construction Phase (3-4 years)	Narrabri and within a one-hour radius	105	8%
	FIFO: People to fill roles but live elsewhere (other regions or interstate)	1,195	92%
	Total construction	1,300	

[175] Fleming, D. A. and Measham, T. G. (2015), Local economic impacts of an unconventional energy boom: the coal seam gas industry in Australia. Aust J Agric Resour Econ, 59: 78–94. http://onlinelibrary.wiley.com/doi/10.1111/1467-8489.12043/full (p.29, Table 3)

[176] http://www.abc.net.au/news/2016-12-16/coal-seam-gas-mining-costs-farmers-millions-csiro-study-finds/8124834

Full costs are not included in the Cost-Benefit Analysis as required by the NSW Gas Plan

The cost benefit analysis provided in the EIS does not assess the full cost to the state as required by The Chief Scientist and Engineer's Recommendation 4 of the NSW Gas Plan, that the "*full cost to the Government of the regulation and support of the CSG industry be covered by the fees, levies, royalties and taxes paid by industry, and an annual statement be made by Government on this matter as part of the Budget process.*[177]"

While we commend the necessary regulatory improvements from the NSW Government in overseeing and monitoring this risky industry it is only appropriate when there is transparency about the associated costs so the public can be confident that the industry is not profiting at the expense of the taxpayers of NSW. All costs associated with the Department of Resources and Energy (DRE) management of CSG exploration, the Department of Planning and Environment's costs associated with the assessment of the application, the NSW EPA Gas Compliance Unit, the Narrabri Gas CCC, the Government funding for GISERA research, the Government contribution royalty rebate for Santos' contributions to the Community Benefit Fund, among many other costs must be included in the costs benefit analysis.

Bushfire risks assessment

We assessed Section 25: Hazard and risks section of Santos' EIS and conclude that it fails to comply with Section 2.4: Risk Criteria for Potentially Hazardous Development, of the NSW Government Hazardous Industry Planning Advisory Paper No 4 (HIPAP 4), Risk Criteria for Land Use Safety Planning.[178] The NGP is considered a potentially hazardous industry under the State Environmental Planning Policy No 33 - Hazardous and Offensive Development.[179] We believe Santos' NGP EIS Chapter 25 Hazards and risks, has failed to reach the risk Criteria for Land Use Safety Planning in section 2.4 of HIPAP 4. The following outlines our reasons this potentially hazardous industry should not be approved for development.

Flammable Gases

Table 25-1 of the EIS shows a Dangerous Good Screening Summary. The table shows that class 2.1L: Flammable gases are present above threshold in the Well pads and gas gathering lines, at Bibblewindi and at Leewood.[180] Santos states that it is too early to determine exactly what quantity of methane will be present at these sites. Santos must be required to provide a detailed assessment of the risks posed by locating methane in such a location and quantify the risks of a catastrophic fire resulting from methane combustion in the area. If the EIS does not state this information within the public consultation period, the public cannot make an informed decision regarding Santos' hazard reduction protocol.

Bushfires and fire bans

We believe that the risk of bushfires have been significantly overlooked in the EIS. Because of its highly flammable nature, infrastructure of the NGP could potentially cause or increase the size of a bush fire by:

177 Chief Scientist and Engineer, Final Report of the Independent Review of Coal Seam Gas Activities in NSW September 2014.
178 NSW Government (2011) 'Risk Criteria for Land Use Safety Planning', (4).pp.6-7
179 NSW Government (1992) 'State Environmental Planning Policy No 33 - Hazardous and Offensive Development (NSW)', (33), pp. 1–7.
180 Santos (2016) 'Narrabri Gas Project, Environmental Impact Statement, Chapter 25 Hazard and risk'.p25-5.

1. Starting a bushfire, most likely by leaf litter/debris passing through the flames, catching fire and then blowing into vegetated areas outside the prescribed buffer zone; or
2. Enhance an existing bushfire due to large quantities of flammable materials

On several occasions during Santos' exploration phase there has been a Total Fire Ban in the North Western fire region. During one particular event, a fire broke out disturbingly close to Santos' gas infrastructure. Santos was not required to turn off its gas flares, which is an action supported under Schedule 15 of the Rural Fires Act 1997.[181] The schedule details that if the fire is maintained in a manner that will prevent the escape of fire, sparks or other incandescent or burning material from the site of the gas exploration, it is exempt from a fire ban. However, we believe that keeping gas flares on during a Total Fire Ban day enhances the risk for the NGP as a Potentially Hazardous Development by not attempting to avoid this obvious avoidable risk, thereby failing to meet section 2.4 of HIPAP 4.[182]

Shutdown procedures listed in the EIS require electronic based technologies that are administered off site. A bushfire event limits the potential for these technologies to function properly, inevitably making it more difficult or even impossible to shut down technology associated with the NGP.

Threatened species and management of increased bushfire risk

There are a variety of ways in which Santos' approach to hazard management for the Narrabri Gas Project risks the integrity of the Pilliga forest and species that rely on the forest to survive through increasing the risk of bushfire in the region. The Pilliga Scrub, particularly the eastern section where the project area is located, is prone to severe, very hot fires, largely due to the high incidence of ironstone attracting lightning strikes.

Clearing associated with the development, increased vehicle movements, increased road access and increased weed infiltration all add to bushfire risk. The CSG development will dramatically increase ignition sources as well as extracting, transporting and storing a highly flammable gas (methane) in the project area. Santos does not appear to have a clear bushfire strategy, especially for gas flaring which cannot be shut down on catastrophic fire days.

The Pilliga is a core component of one of 15 National Biodiversity Hotspots and it is a globally listed Important Bird Area. The proposed project area is home to a number of federally listed threatened species and Endangered Ecological Communities including the Koala, Pilliga Mouse, Spotted-tail Quoll, Black-striped Wallaby, South-eastern Long-eared Bat, Narrow-leaved Tylophora and the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland.[183]

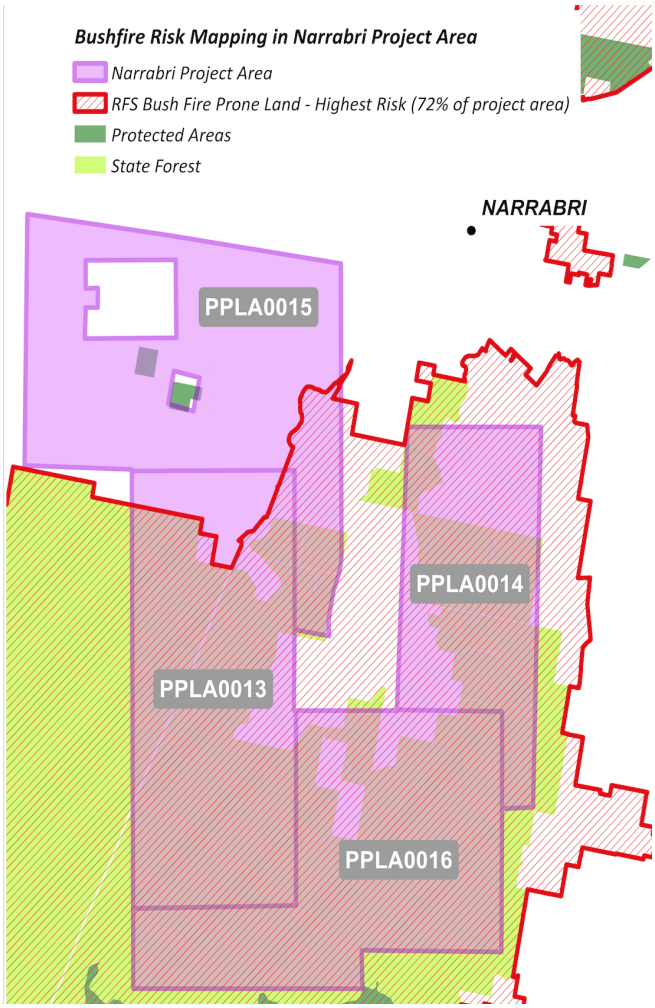
Furthermore, the Federal Government's own assessment concludes that ten endangered or vulnerable species and two endangered ecological communities are likely to be 'significantly impacted' by habitat clearing and fragmentation, and subsequent increased impacts from fire and feral animals. There is no assessment of any increased risk or consequences on threatened hollow dependent species due to the loss of hollow bearing trees from wildfire or as a result of hazard reduction burns conducted to protect the infrastructure of the NGP. Research has found average collapse rates of up to 25% for all trees and over 40% of old-growth trees after

[181] NSW Rural Fire Service (2013) 'Rural Fires Act 1997 No 65', 2013(65), pp. 1–92.
[182] NSW Government (2011) 'Risk Criteria for Land Use Safety Planning', (4).
[183] Australian Government (2016) 'Environment Protection and Biodiversity Conservation Act 1999', (1), pp. 1–409. Available at: https://www.legislation.gov.au/Details/C2016C00777/Download.

low intensity hazard reduction burns in these forests in the Pilliga.[184] However, these rates can be much higher in a higher intensity fire in bushfire season. Species such as the koala, pygmy possum, barking owl and microbats would suffer. Figure 1 shows a map sourced from the Rural Fire Service indicating that 72% of the NGP area is categorised as Vegetation Category 1: the "highest risk" of bushfires. Vegetation Category 1 has the highest combustibility and likelihood of forming a fully developed fire, including heavy ember production. This vegetation is dry sclerophyll forest, high fuel loads of up to 20-30 tonnes per hectare.

Management plan

The EIS recognises the risks to people within the site and outside the forest as a low to remote possibility of injury or consequence, but recognises the need to prepare a Bushfire Management Plan in consultation with the RFS. This should also include NPWS, Local Aboriginal Land Councils, and adjoining landholders. This is not included within the EIS document. Without this document, it is not possible to comment on the validity of Santos' on fire management assumptions confidently.



[184] Parnaby, H., Lunney, D., Shannon, I. and Flemming, M. (2011) 'Collapse rates of hollow-bearing trees following low intensity prescription burns in the Pilliga forest, New South Wales (vol 16, pg 209, 2010)', *Pacific Conservation Biology*, 16(4), p. 236. doi: 10.1071/PC100209.

Figure 1: Bushfire Risk map in Narrabri Gas Project area, indicates 72% of the project area is classed by the Rural Fire Service as Vegetation Category 1: the Highest Risk of bushfire (Courtesy: RFS and The Wilderness Society).

Gas flare height

Santos proposes six pilot flares (of flame height average of 4 metres) plus two safety flares, at Bibblewindi and Leewood. The standard safety flare height is approximately 1.5 metres for a fire stack, however, in Appendix Q (Landscape and Visual Assessment), Santos have claimed that these flames can be up to 30 metres tall. It should be noted this information was not included in the EIS or Appendix S, in the Hazard and Risk Assessment. We assume that Santos does not consider flares at a height of 30 metres worth addressing in the Hazards and risks section, even considering the high fuel load of the Pilliga scrub and the often hot, dry, windy conditions of Summer. Santos gas flaring presents a risk to people, the environment and farmland of north west NSW.

Recommendations

- That the proposal be rejected outright due to fundamental contravention of the Principles of Ecologically Sustainable Development as enshrined in the NSW EP&A Act.

- That landholders and Traditional Owner's rights to reject CSG projects and Stage Significant Projects should be recognised to ensure rural livelihoods, including their will to protect surface and groundwater and heritage values.[185]

- If the project is approved, it is only approved upon condition that Santos to pay the NSW Government to commission independent auditing to establish comprehensive baseline methane levels within and surrounding the project area.

- If the project is approved, it is only approved upon condition that Santos pays the NSW Government to commission independent methane level testing. The condition must stipulate that measurements are undertaken regularly and rigorously (across all points in the production chain) and publicly reported to enable external verification. The latest 'top down' and 'bottom up' technologies must be utilised to undertake this testing and there must be special care taken to ensure no 'super emitters' avoid detection. The testing must also involve the detection of isotopic signature gases to assist in accurate tracing to the point source.

- In the case this project is approved, we believe a safety precaution of monitoring gas flares on site during Total Fire Ban days is the only way to ensure that fires are spotted as soon as they occur. However, we would also advise that this recommendation is not a solution to the high fuel load and risks associated with the NGP overall, nor the safety of those on site.

- Santos must have an agreement with an appropriately licensed facility to manage this waste before any approval is granted. The waste management plan of the licensed facility must also be made available for public scrutiny and feedback before any approval is granted.

[185] Norman, H. (2016) 'Coal Mining and Coal Seam Gas on Gomeroi country: Sacred lands, economic futures and shifting alliances', *Energy Policy*. Elsevier, 99(February), pp. 242–251. doi: 10.1016/j.enpol.2016.06.006.

- That Santos provides a detailed chemical analysis and hazard assessment on the salt waste before assessment of the waste management component of the application is undertaken.

- That the Social Impact Assessment is updated according to pertinent studies undertaken since the EIS was prepared and to apply the forthcoming guidelines for Social Impact Assessment developed by the NSW Department of Planning and Environment. The new SIA must also include reference to CSIRO/GISERA studies on the socio-economic impacts of CSG (discussed above) and full economic modelling on local economic impacts.

- Before approval of the application is considered, the entirety of costs associated with regulating and assessing this industry must be accounted in the Cost-Benefit Analysis and covered by Santos. As stipulated in the Chief Scientist and Engineer's Recommendation 4 of the NSW Gas Plan, the "*full cost to the Government of the regulation and support of the CSG industry be covered by the fees, levies, royalties and taxes paid by industry, and an annual statement be made by Government on this matter as part of the Budget process.*"

- No approval should be granted without appropriate baseline data to reduce the chance of impact and improve chances of remediation.