

Mullaley Gas and Pipeline Accord Inc. Submission Objecting to the Narrabri Gas Project

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Introduction

Mullaley Gas and Pipeline Accord is an incorporated entity that represents community concerns of approximately 100 residents and businesses of Mullaley and surrounding districts. The Mullaley Gas and Pipeline Accord was established in 2010 after landholders were approached by the project manager of the proposed Narrabri to Wellington gas pipeline. Landholders knew little at that time about the issues pertaining to coal seam gas extraction but all agreed that they did not want a pipeline on their lands. All members of the Mullaley Gas and Pipeline Accord are involved in primary production and associated industries.

Mullaley Gas and Pipeline Accord is concerned to ensure that the Narrabri Gas Project is considered in the context of the real life issues that confront landholders, not as an abstract list of risks that the Assessment Report dismisses as insignificant. For Mullaley Gas and Pipeline Accord members, the risks described in the report - for example, those relating to well integrity, produced water treatment and disposal, contamination of groundwater - are not hypothetical

possibilities without consequence, rather they make the difference between operating a viable agricultural business and owning land that is next to worthless.

Spills and leaks

Dr. Geoffrey Thyne, a geologist who studies drilling at the Enhanced Oil Recovery Institute at the University of Wyoming, explained to the Checks and Balances Project¹,

.. There's certainly possibility of aquifer contamination based on flaws in the concrete casings of wells as well as the other uncertainties that lie underground. But it is above ground that you are handling millions of gallons of fluid at the surface. It is easy to spill. It happens all the time. Valves jam up, pipes break, this is not without hazard..

While the Assessment Report acknowledges that numerous public submissions raised concerns about surface spills contaminating soil and water, it accepts Santos' proposal to implement measures to minimise spills and leaks via various management plans and complying with relevant codes of practice. Likewise, the Water Expert Panel considers that Santos' proposed measures for spill management are appropriate.

It is the previous operator of the Project, Eastern Star Gas' history that reveals just how toxic produced water is to the environment. The well documented Bibblewindi spill that occurred on 25 Jun 2011 was reported as 10,000 litres of which 3,000 litres was recovered. That leak killed almost 2 hectares of vegetation and 9 years later is still being rehabilitated. If the 7,000 litres of produced water that was not recovered was evenly spread over the vegetation kill area it would amount to a mere 0.35mm in depth.

Reference:	595	Date:	25-Jun-2011 4:00	Workgroup:	OPS - Field	Responsible Organisation:	Eastern Star Gas
Description:	At approximately 04:00am on Saturday morning (25th July) an ABS 8inch cap on a pipeline transferring water from Bibblewindi POND-1 to the Water Treatment Plant burst causing liquid to spill within the bunded water treatment facility area. The water continued to pump into the bunded area, exceeding the bund wall due to a failure of an electronic fail switch, until approximately 09:00am when Dan Hawkins discovered the extent of the spill. It is estimated that approximately 10,000L of liquid exceeded the bund wall with TDS measuring 16,000ppm. The spill reached as far as Garlands Road (420 metres from the point source), with a temporary earth bund being constructed to contain the spill area. 3,000L was emptied from this bund area. Prior to the event a bund was constructed on Friday, 24th July which was able to hold a large majority of the spilt liquid however its was not fully effective as it was due to be sealed by contractors Monday morning (27th July).						

Santos have been an oil and gas producer since 1954 and they claim that they are good operators but their reports document the numerous spills, incidents and incurred fines. With 66 years experience in the industry, the last two decades have seen Santos operations in Australia result in hundreds of spills and leaks and dozens of fines for a range of infringements. From

¹http://www.neogap.org/neogap/2012/02/16/gas-patch-scientists-explainpermanently-contaminate-public-water_5-6-11/

Incidents and spills

		2010	2011	2012	2013	2014	2015
Uncontained hydrocarbon volume	m ³	18.7	65.9	66.7	385.5	20.0	382.4
Total number of hydrocarbon spills	> 10L	73	85	161	30	42	39
Uncontained non-hydrocarbon volume	m ³	-	-	873	1,426	2,957	2,279
Total number of non-hydrocarbon spills	> 10L	-	-	46	47	52	36
Number of fines for non-compliance with environmental regulations		3	6	14	17	12	3
Value of fines for non-compliance with environmental regulations	\$	6,000	12,000	35,000	34,800	72,000*	34,155

Notes: This includes \$52,500 imposed by the New South Wales Land and Environment Court for incidents that occurred at the Bibblewindi Water Treatment facility in 2011 while the site was under previous ownership and management.

In summary, over the six year period from 2010 to 2015 inclusive, Santos recorded 611 spills, which involved 939,200 litres of hydrocarbons and 7,535,000 litres of non hydrocarbons and received 55 fines for non-compliance with environmental regulations in at least three states. The types of incidents that resulted in the fines include:

- oil spills
- pollution incidents, failed to report one for 8 months
- wastewater spills at drilling site
- groundwater contamination with toxic heavy metals including arsenic, lead, chromium
- oil spills and other environmental breaches in Great Barrier Reef World Heritage Area
- discharges with high salt and ammonia into local waterways
- events involving the release of sewage, produced water or sediment into the surroundings
- death of fauna at an unfenced well site
- unauthorised land or vegetation clearing
- failing to implement an erosion and sediment control plan at a construction camp
- failure to handle fish in accordance with procedures.
- failing to report contamination and high salt levels due to contaminated water leaks at drilling site
- taking quarry material from a quarry site without the appropriate permit
- failing to fully implement sediment and erosion control plans
- failing to ensure a contractor complies with an authorisation
- surface ponding of irrigated treated effluent
- lack of endorsement of a purchased water allocation on a water use approval document
- release of produced water to land
- release of sediment into surface water

The most recently available reports show that over the three years from 2017 to 2019 Santos have received numerous fines and penalty infringement notices some of which are listed below:

² https://www.santos.com/wp-content/uploads/2020/02/2015_sustainability_report.pdf

- 15 February 2017, \$12,190 fine, penalty infringement notice for non-compliance with a Soils Management Plan. QLD Dept Environment & Heritage Protection³
- 4 May 2018, \$12,615 fine, penalty infringement notice for release of effluent to the environment. QLD Dept Environment & Science⁴
- Jul 2018, \$68,000 fine for 90,000L oil spill, unauthorised release of hydrocarbons to land near Charleville. QLD Dept Environment & Science⁵
- Oct 2018, \$1500 fine, penalty infringement notice for irrigating with wastewater without a water use approval at Leewood evaporative ponds, Narrabri. NSW EPA⁶
- March 2019, \$12,615 fine, penalty infringement notice for loss of pond hydraulic integrity QLD Dept Environment & Science⁷
- 27 June 2019, \$26,100 (2 fines), 2 penalty infringement notices for unauthorised release of contaminants to land and failure to operate measures, plant and equipment in a proper and effective manner. QLD Dept Environment & Science⁸
- 20 September 2019, \$13,055, penalty infringement notice for produced water release to a watercourse. QLD Dept Environment & Science⁹
- 8 November 2019, \$13,345, penalty infringement notice for the release of black smoke causing an environmental nuisance. QLD Dept Environment & Science¹⁰

Codes of practice and management plans do not prevent spills and leaks. Unlike the Water Expert Panel, we hold no confidence that the current regulatory framework for produced water management provides reassurance that the likelihood for potential harm to humans and the environment is low.

Well Integrity

The Assessment Report states that by ensuring that gas wells are drilled, operated and abandoned in accordance with the NSW Government's Code of Practice for Coal Seam Gas Well Integrity (Well Integrity Code) risk will be reduced to an 'acceptable' level. The Assessment Report seems to regard the Code as a guarantee of well integrity, rather than as a guide to reduce the risk of well integrity being compromised. The Assessment Report also states that the Well Integrity Code is due to be reviewed, which we can only assume means that although we are assured that the Code is 'best practice', there is nonetheless 'better' practice available.

³ <https://www.santos.com/wp-content/uploads/2020/02/2017-annual-report.pdf>

⁴ <https://www.santos.com/wp-content/uploads/2020/02/2018-annual-report.pdf>

⁵ <https://www.santos.com/wp-content/uploads/2020/02/2018-annual-report.pdf>

⁶ <https://www.epa.nsw.gov.au/news/media-releases/2018/epamedia181017>

⁷ <https://www.santos.com/wp-content/uploads/2020/02/2019-annual-report.pdf#page=1&zoom=auto,-485,780>

⁸ <https://www.santos.com/wp-content/uploads/2020/02/2019-annual-report.pdf#page=1&zoom=auto,-485,780>

⁹ <https://www.santos.com/wp-content/uploads/2020/02/2019-annual-report.pdf#page=1&zoom=auto,-485,780>

¹⁰ <https://www.santos.com/wp-content/uploads/2020/02/2019-annual-report.pdf#page=1&zoom=auto,-485,780>

Well Integrity Code is to protect land and water resources, particularly beneficial water aquifers, by ensuring gas, water and other fluids are contained inside the well casings and cannot leak into the surrounding strata and contaminate productive groundwater resources.”

However, there can be no guarantee that complying with the code will actually prevent cross-aquifer contamination. The cement that is intended to seal the annulus between steel casing and surrounding geological formation undergoes both shrinkage and creep over a very long period of time. While shrinkage occurs both as a result of loss of free water and loss of water held in gel pores it is the latter that causes the change in the volume. Under drying conditions, the gel water is lost progressively over a long time while creep is the time-dependent deformation that occurs in concrete when it is subjected to load. Both shrinkage and creep result in loss of volume of the cement which may allow water to flow along the contact edge between the well casing and formation or, post abandonment, the casing and the well plug to other aquifers.

The NSW government claims in its “Code of Practice for Coal Seam Gas Well Integrity”¹¹ that:

Strict standards for casing and cementing well heads guarantee wells are built to maintain control at high pressures, prevent cross aquifer contamination and retain well integrity.

This is simply not true: there can be no guarantee that these standards will prevent cross aquifer contamination as the North American experience has shown. Dr Conrad Volz of University of Pittsburgh in 2011 stated in a presentation to the Checks and Balances Project:¹²

I think we lose sight of the fact that there are 10s of thousands of leaking wells in North America. 10s of thousands! Not a few. It doesn't matter whether they are hydraulically fractured or horizontal well, they leak! In fact, it is the way of all wells sooner or later that they are going to leak. They are going to leak because the cement shrinks. And when the cement shrinks it pulls away from the geological layer that it's sealed from. Then it serves a conduit straight up into the groundwater aquifers.

Naik and Kumar (2003)¹³ state,

Contact with certain aggressive chemicals, such as chlorides, sulphides, acids, carbon dioxide, and even water, causes the deterioration of the concrete. Such deterioration

¹¹http://www.resourcesandenergy.nsw.gov.au/_data/assets/pdf_file/0006/516174/Code-of-Practice-for-Coal-Seam-Gas-Well-Integrity.PDF

¹²http://www.neogap.org/neogap/2012/02/16/gas-patch-scientists-explainpermanently-contaminate-public-water_5-6-11/

¹³ Naik T.R., Kumar R. (2003) Concrete Structures for 1000 years of Lifespan - Part 1.Center For By-Products Utilization. Report no. CBU-2003-11 REP-506 Department of Civil Engineering and Mechanics College of Engineering and Applied Science The University of Wisconsin

involves either leaching of material (e.g., calcium hydroxide) from the concrete by a dissolution mechanism or by expansion of material inside the concrete.

Anderson et al (2013)¹⁴, list further reasons for well casing and concrete sealing of the annulus to fail and allow water movement between the toxic produced water contained within the coal seams and the water drawn for domestic, stock and irrigation use from overlying shallow aquifers or the Great Artesian Basin. They include:

The cement fill is permeable...The well casing fractures or corrodes... The cement cracks with time.. Fractures caused by in situ stresses.

Bacteria are already causing problems with coal seam gas well integrity in Queensland. Saltel Industries¹⁵ were brought in to repair two wells in 2016 due to severe corrosion. Saltel Industries found that,

This problem seems to be systemic in the region, and other operators might encounter similar issues. The client is one of Australia's leading natural gas producers, focused on developing Queensland's world-class onshore Coal Seam Gas (CSG) reserves. Some CSG wells in Chinchilla area (Queensland, Australia) must cope with severe and localized external corrosion developing at shallow depth. These corrosion cases are suspected to be caused by bacteria growing under specific pressure and temperature environments.

The Well Integrity Code suggests to operators that they should 'avoid cement shrinkage' and that they should 'consider' industry standards. There is no way of ensuring that cement shrinkage is avoided. The Well Integrity Code makes no reference to cement 'creep' - time-dependent deformation that occurs in concrete when it is subjected to load - which can also result in a separation of the cement from the geological formation allowing water to flow along the contact edge between the well casing and formation or, post abandonment, the casing and the well plug to other aquifers. Professor Peter Cook, chair of the Water Expert Panel also acknowledged in an email dated 5 June 2020, that 'there may be a breakdown over time of the materials forming the well casing, cement or final well plug' which would also compromise well integrity.

The several potential causes of compromised well integrity are almost certainly one of the reasons that landholders with CSG infrastructure on their land cannot obtain public liability insurance. Given that insurers are expert assessors of risk and likely damage, the fact that it is not possible for a landholder to obtain public liability insurance must be seen as a red flag.

¹⁴ Anderson D. J., Rahman P.F., Davey E. K., Miller B.M., Glamore W. C. (2013). Background Paper on Groundwater Resources in Relation to Coal Seam Gas Production. Water Research Laboratory Technical Report 2013/09. November 2013 UNSW. Prepared for the Office of the NSW Chief Scientist and Engineer

¹⁵ <https://www.saltel-industries.com/case-study/case-study-saltel-patch-isolates-external-bacterial-corrosion/>

The Chief Scientist's review of CSG recommended (Recommendation 15) ¹⁶

That Government develop a plan to manage legacy matters associated with CSG. This would need to cover abandoned wells, past incomplete compliance checking, and the collection of data that was not yet supplied as required under licences and regulations. There will also need to be a formal mechanism to transition existing projects to any new regulatory system

This recommendation, along with most of the other recommendations of that report, has not been implemented.

Groundwater and Geology

The Water Expert Panel agrees with the Chief Scientist's recommendation 5, that "drilling is allowed only in areas where the geology and hydrogeology can be characterised adequately" and are not confident the structural setting of the Narrabri Gas Project meets the threshold of being "adequately characterised". However, they accept Santos's assurances about physical separation of aquifers by aquitards and that it is unlikely that faulting constitutes a major risk to the project. There is insufficient information to reach these conclusions due to the lack of detailed information about the deeper substrata and uncertainty of geological and hydrogeological conditions within and around the Narrabri Gas project area.

There is evidence to suggest it would be wrong to assume faulting is unlikely, according to Atkins (2002)¹⁷,

In New South Wales, coal seam methane production has not been operating long enough to identify any similar changes to groundwater levels caused by dewatering coal seam methane drillholes. However, in the petroleum producing Cooper Basin in South Australia long term petroleum production has produced disturbing results. The producing horizons are very similar to the target horizons in the Pilliga region, that is, coal bearing rocks of Permian age. In both areas this sequence is overlain by rocks of the Surat Basin, eg the Pilliga sandstones in the Pilliga region. Traditional theories have emphasised the separate nature of the older and younger rocks and also emphasised that lowering or interfering in any way with the deeper Permian aquifers would have absolutely no effect shallower groundwater resources widely used by agriculture . The results from the Cooper Basin however show that previously unknown and unsuspected faults are acting as conduits allowing water to drain from the upper aquifers of the Artesian Basin into the previously separate lower, Permian layers

Shallow groundwater is essential for groundwater dependent ecosystems. The Pilliga Forest itself is just such an ecosystem, as are waterholes and billabongs along creeks and drainage

¹⁶ http://www.chiefscientist.nsw.gov.au/_data/assets/pdf_file/0005/56912/140930-CSG-Final-Report.pdf

¹⁷ Atkins C. M. (2002) Environmental Hazards of Oil and Gas Exploration. Prepared for: National Parks Association of NSW Inc, Sydney

lines such as Bohena Creek which lie within the Narrabri Gas project area. The potential for the loss or contamination of aquifer and groundwater sources from coal seam gas activities is high. Numerous examples of such damage are to be found in Australia and overseas. The chemical makeup of the produced water presents a high risk to all water sources and this requires addressing. “Make good” clauses, bonds and penalties are inadequate given both the probability and high level of detriment in such an event.

Current understanding of geology and hydrogeology at local and regional scales is inadequate to protect the groundwater on which agricultural industries, groundwater dependent ecosystems and communities rely. Given the accepted ‘lack of detailed information’ the confidence expressed by the Water Expert Panel “that the geology and hydrogeology of the area is generally well-known at a regional scale” is misplaced. The Assessment Report simultaneously suggests that Santos be required to upgrade its groundwater model over time after the project has commenced while asserting that the current knowledge is adequate.

Until such time that we can comprehensively understand these underground systems and be able to accurately determine causation of any impacts the Chief Scientist’s recommendation 5, that “drilling is allowed only in areas where the geology and hydrogeology can be characterised adequately” should be observed and the Narrabri Gas Project prevented from proceeding.

Human Health Impacts

In 2012 Bamberger and Oswald¹⁸ stated,

Without rigorous scientific studies the gas drilling boom sweeping the world will remain an uncontrolled health experiment on an enormous scale.

By 2015 there were at least 685 peer-reviewed papers on the health implications of the unconventional gas industry. A review of the research literature published in 2016 by Hays and Shonkoff concluded that living in and near gasfields has a negative effect on human health.¹⁹ The peer-reviewed papers identify the health implications that landholders in and around the proposed Narrabri Gas Project area would be exposed to and that all stages of the development of a CSG field create air pollution risks as nitrogen oxides, volatile organic compounds, endocrine- disrupting chemicals and hydrogen sulphide are emitted. Potential impacts of these air pollutants on developing fetuses and children are particularly concerning. Numerous reports identify significant negative outcomes among infants of mothers with the highest exposure potential based on length of time exposed, distance from and/or density of wells. These

¹⁸ Bamberger M., Oswald R. E. (2012). Impacts Of Gas Drilling On Human And Animal Health. Human Health NEW SOLUTIONS, Vol. 22(1) 51-77, 2012

¹⁹ Hays J. and Shonkoff S.B.C. 2016. ‘Toward an Understanding of the Environmental and Public Health Impacts of Unconventional Natural Gas Development: A Categorical Assessment of the Peer-Reviewed Scientific Literature, 2009-2015’ *PLOS ONE* 11(4): e0154164.

outcomes include reduced average birth weight, increased prevalence of low birth weight, preterm births, high-risk pregnancies and birth defects. (Haswell and Bethmont 2016)²⁰

It is worth noting Steingraber's comment in 2010:²¹

At what point does preliminary evidence of harm become definitive evidence of harm? When someone says, "We were not aware of the dangers of these chemicals back then," whom do they mean by we?

There is now definitive evidence of harm and that the degree of harm increases as the distance between people and gasfields diminishes.

In October 2013 the NSW Government introduced CSG exclusion zones to make residential areas 'off limits' to new coal seam gas activity. In January 2014 the NSW Government added future residential growth areas, another seven rural villages across NSW, and the equine and viticulture critical industry clusters in the Upper Hunter to the exclusion zones. These exclusion zones ban new coal seam gas activity. New CSG exploration and development are also banned in a 2km buffer around these areas.

However, the NSW Government permits CSG wells to be placed as close as 200 metres from rural residences. Farmers necessarily live apart and not in clusters as do those people in villages, towns and cities. The Government has thereby created an underclass of people whose health will be sacrificed if the Narrabri Gas Project is approved.

The precautionary approach to CSG concerning health impacts should be adopted. This has been endorsed by Doctors for the Environment Australia, Public Health Association of Australia, The Climate Health Alliance and the National Toxics Network but has been largely ignored by the Chief Scientist herself. As the esteemed Australian Medical Association states, "if in doubt, turn CSG off". Do not approve the Narrabri Gas Project.

Aboriginal Cultural Heritage

The Assessment Report and the Recommended Conditions of Consent trivialise the Aboriginal view of Country. The proposed Aboriginal Cultural Heritage Management Plan states the applicant must

identify all known Aboriginal objects and Aboriginal places in the project area and include a statement of significance for each item.

The Narrabri Gas Project would desecrate Gomeroi Country (also referred to as Gamilaraay country). Gomeroi people view people and country as interdependent entities linked through

²⁰ Haswell M., Bethmont A. (2016) Health Concerns Associated with Unconventional Gas Mining in Rural Australia Rural and Remote Health 16:3825

²¹ Steingraber S. (2010) Living Downstream. Da Capo Press

landscape, through culture and through spiritual significance. As such there is no separation of nature and culture. There is a view based around landscape and connections, not just the presence or absence of artefacts. They have a powerful connection to the Pilliga as a whole, not isolated places within it.

Santos' plans for a total of seven gas fields in North West NSW would cover much of Gomeri Country which extends broadly from the Queensland/NSW border region to Tamworth, Aberdeen/Muswellbrook, Coonabarabran and Walgett. As the Traditional Owners of the Gomeri Nation, Gomeri People hold inherent rights in our country that were never traded, given or signed away.

The Assessment Report clearly illustrates that Santos' Narrabri Gas Project would prevent Gomeri People from carrying out their custodian and ownership rights in country, including their unique responsibility to care for land and water, the ecosystem and places of cultural significance. Ongoing access to the Pilliga in its current state is essential to allow Gomeri People continue cultural practices, maintain connection with the land and care for Country. An 850 well gasfield would destroy the ability of the Gomeri People to maintain that essential connection.

There can be no further desecration of Gomeri Country by Santos. Santos should be required to exit the Pilliga region enabling the future of the Gomeri People's culture and heritage in the area to be determined solely by the Gomeri People.

Social Licence

The Narrabri Gas Project would also have serious adverse social impacts. The claim in the Assessment Report that "any adverse social impacts of the Narrabri Gas Project can be mitigated to a large extent" is an incorrect assumption by people who don't know, understand or live in the region. The view that Santos can gain a social licence to operate when it has conspicuously failed to do so over more than a decade is ludicrous.

Santos does not have a 'social licence' to operate in the North West of NSW. This is clearly illustrated by the Gasfield Free Community Surveys. Over the last 8 years surveys have been diligently conducted by individual communities across our North West region. Community survey teams visited every house in their district, to invite residents to respond to the question "Do you want your land/road Gasfield Free?".

Mullaley was the first community in the North West NSW region to undertake the rigorous community based, neighbour to neighbour, surveys in December, 2012. The response recorded 98.5% of people answering "Yes". Since then, over 100 communities in the North West have overwhelmingly rejected any proposed industrialisation of their land and surrounding environs by the CSG industry. Our evidence is based on a comprehensive data set which was methodically collected and collated. Overall, 96% of all respondents want their homes, farms and communities Gasfield Free.

To express their determination and solidarity, these communities have subsequently declared themselves Gasfield Free 'by the will of the People' in an area covering 3.28 million hectares encircling the Project and involving all or part of 9 local government areas. Seven local government areas within the North West NSW region - Coonamble, Warrumbungle, Gilgandra, Moree Plains, Dubbo Regional, Warren and Walgett - have adopted various moratoriums banning coal seam gas exploration, mining and associated infrastructure in response to their community's stance. These councils cover an area of 8.57 million hectares with a number of surrounding councils also expressing concern.

UNESCO Geopark for Warrumbungle region

UNESCO Global Geoparks are unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development. Almost all of the designated Geoparks are in Europe, the United Kingdom and Asia; in spite of Australia's rich geological heritage there is no Global Geopark in Australia. The Geological Society of Australia considers the Warrumbungle area, comprising the Warrumbungle National Park, Sandstone Caves, the Pilliga, Macquarie Marshes and Coolah Tops, meets the criteria for a UNESCO Global Geopark and has begun intensive assessment of the region with a view to Pre-Aspiring UNESCO Global Geopark status.

A declaration of a UNESCO Geopark would draw attention to the unique landscape and serve as a drawcard for geotourism. The designation brings together tourism, education, science, culture, natural environment and geologists, providing the opportunity to market the region under the one brand. It would encourage visits to geological features, using geotrails, guided tours, geo-activities and patronage of visitor centres.

A Geopark would increase employment, educational opportunities and other flow on effects in the North West NSW without damaging the environment. It would permit economic growth with new sources of revenue while protecting the natural and cultural heritage of the area. Santos' planned gasfield industrialisation of our region, and of the Pilliga in particular, would undoubtedly risk this opportunity, rare in the world and unique in Australia, for international recognition of the connection between the geology of the area and its cultural and historical significance.

Light Pollution

Siding Spring Observatory (SSO) is an internationally important research facility using optical telescopes for astrophysics and astronomy. It hinges on collecting and analysing light that has travelled from galaxies, stars, nebulae and planets to Earth. SSO hosts over 50 telescopes used by over 30 Australian and international universities, institutions and private businesses using cutting edge technology.

Future plans for SSO include another 50 telescopes to be built on site within the next decade. All this is reliant on keeping the Dark-Sky Park status awarded in 2016 by the International Dark-Sky Association. If this area was to lose the Dark-Sky Park status the observatory

would not be replicated elsewhere in Australia, but moved to another part of the Southern Hemisphere.

Over the last 20 years SSO has experienced an increase in light pollution due to coal mining activities in the region. Since 2013 light emissions from the Santos gas field exploration have increased to the point that a single flare at Bibblewindi creates more light pollution than the entire town of nearby Coonabarabran with over 3500 people residing there.

Santos have plans to increase the number of pilot flares and construct 50 metre high stacks for two safety flares, with the flame reaching 30 metres in height. Progression of the Narrabri Gas Project would further compromise the research carried out at SSO, halt further expansion at the site and could ultimately force the closure of this internationally renowned research facility.

Cost Benefit Analysis

The assessment of the Narrabri Gas Project as approvable on economic grounds is also deeply flawed. For example, the Assessment Report acknowledges that the assessment does not include 'consideration of externalities (i.e. consequential benefits and costs) associated with the project (for example, loss of agricultural production or downstream greenhouse gas impacts).' The Report relies on the Cost-Benefit Analysis completed by GHD to conclude that the benefits of the project outweigh its costs.

However, some of the assumptions and calculations of direct and indirect costs of agricultural production impacts are inadequate, and fail to consider factors that are key to members of the Murrumbidgee Gas and Pipeline Accord, and to other rural landholders. First, the cost-benefit analysis does not provide for impact on agricultural land which will continue long after extraction of coal seam gas has finished. Second, the analysis assumes that when agricultural land is no longer needed for the construction phase of the project it will immediately return to the prior level of agricultural production. Similarly, the analysis assumes that land will immediately return to its previous level of production at the end of the operational phase of the project. The calculations assume that agricultural production recovers instantaneously. In fact, CSG infrastructure on agricultural land disturbs the soil surface through compaction, soil mixing and layer inversion. Soil compaction reduces both crop and pasture growth as the increased bulk density reduces air permeability and water infiltration and compaction persists for a considerable period of time. Other cost shifting to farmers is not considered within the cost benefit analysis. Costs not accounted for include the decrease in land values during the construction and operation phases, ongoing rehabilitation costs borne by the property owner post the operational phase and loss of revenue to agricultural service providers.

Properties that host coal seam gas infrastructure suffer reduction of land value due to severance and injurious affectation. This has a negative impact on succession planning on farms and reduces the level of borrowing available from financial institutions. Any agricultural producer within the project area that holds a business debt prior to the reduction in their land value will find their loan value ratio increase which may result in concurrent increase in interest rates and or the inability to extend debt level.

Cumulative Impacts

The expansion of extractive industries has been identified as a key driver of change for the Namoi Catchment, with five existing coal mines, two proposed coal mines and the proposed Narrabri Gas Project. In spite of these multiple projects, the Assessment Report claims

there is limited scope for cumulative impacts with the Narrabri Gas Project as it is the only coal seam gas project in the region and there are unlikely to be any significant interactions with the coal mines in the area, including the Narrabri underground mine which is located on the eastern border of the project.

A high-quality method for assessing the cumulative impacts of the multiple projects exists in the form of the Namoi Cumulative Risk Assessment Tool (NCRAT), which was commissioned by the Namoi Catchment Management Authority.

NCRAT was developed specifically to assess the cumulative impacts across nine natural resource assets in the catchment: soils, land use, surface water, groundwater, vegetation extent, vegetation type, vegetation condition (intactness), landscape connectivity and threatened species. It provides a way to develop a spatially interactive cumulative risk assessment tool that could be used to explore the potential cumulative impacts and is consistent with the Australian Standard for Risk Assessment and incorporates the critical thresholds identified in the Namoi Catchment Action Plan.

In addition, the NCRAT provides a precautionary method rather than the reactive approach currently being proposed by the Assessment Report and in the recommended conditions of Consent. The NCRAT specifically addresses the cumulative impact of development activities on water, land and the environment, and is more comprehensive and therefore more sustainable.

It is essential that sophisticated cumulative risk assessment of the Narrabri Gas Project occurs in light of existing and proposed coal mines. Only in this way will the precautionary principle be given a voice, making sustainable agriculture possible.

Conclusion

The Assessment Report is deeply flawed: it lacks crucial information; fails to deal with important issues; relies on an inadequate modelling of groundwater impacts; makes misleading claims; and contains internal contradictions. For these reasons the assessment of potential environmental, social and economic impacts contained in the Assessment Report cannot be regarded as complete or accurate, and the Report's recommendation of the Narrabri Gas Project as 'approvable' must be rejected.

The public hearings into the Narrabri Gas Project have clearly shown that it is not required for NSW energy security, will not lower gas prices, and risks the water security of some of the best agricultural land in Australia. There is no reason for approving the Narrabri Gas Project that doesn't stand up to the most basic scrutiny, and every reason for rejecting this hazardous and unnecessary proposal.