



Dewhurst Gas Exploration Pilot Expansion

Response to Submissions

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I.0 Introduction

I.1 Background

Santos NSW (Eastern) Pty Ltd (Santos), as the coal seam gas (CSG) operator of Petroleum Exploration Licence (PEL) 238, is seeking consent to expand operations at the Dewhurst 13-18H and Dewhurst 26-31 pilots, and operate both expanded pilots for up to three years (the proposed activity). The proposed activity will occur at two pilot sites:

- the existing Dewhurst 13-18H Pilot, located on freehold land and Crown Land road reserve, approximately 25 kilometres south of Narrabri
- the proposed Dewhurst 26-31 Pilot, located in the Pilliga East State Forest, approximately 44 kilometres south of Narrabri.

The Dewhurst 13-18H Pilot is an existing pilot well set that comprises three vertical wells (Dewhurst 13, 14 and 15) and three single horizontal wells (16H, 17H and 18H). The proposed activity includes drilling an additional two horizontal wells at each of the Dewhurst 16H, 17H and 18H pilot wells to target additional coal seams, installing surface infrastructure (including a flare at Dewhurst 14) and operating the whole pilot set for up to three years.

Dewhurst 26-29 is a four well pilot approved under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Early construction activities and drilling of the four well pilot commenced at the end of 2013. It is proposed to add two additional wells, Dewhurst 30 and 31, to this pilot which are proposed to be drilled in the second or third quarter of 2014 should development consent be granted. The proposed activity includes drilling the two additional pilot wells (Dewhurst 30 and 31), installing surface infrastructure (including a flare at Dewhurst 28) and operating the six-well pilot for up to three years.

The proposed activity includes:

- Construction: site preparation activities at existing and new well lease areas; establishment of necessary equipment, temporary structures and facilities on the lease areas to enable drilling; re-entering three existing wells to convert single horizontal wells to triple-stacked horizontal wells at Dewhurst 13-18H; drilling one vertical well (Dewhurst 30) and one triple-stacked horizontal well (Dewhurst 31); construction of a flare at Dewhurst 14 and 28; and construction of associated surface facilities and gathering systems.
- Operation: operating the expanded Dewhurst 13-18H and Dewhurst 26-31 pilots for a period of up to three years, management of the water and gas produced during operation and general maintenance activities.
- Post operation and rehabilitation: decommissioning and rehabilitation of pilot wells and ancillary infrastructure, or suspension of wells for potential future use.

The proposed activity forms part of the proposed Energy NSW CSG Exploration and Appraisal Program (E&A Program). The E&A Program consists of a series of CSG exploration and appraisal activities within PEL 238 and PAL 2 including recommencing operation of a number of existing pilot wells, drilling and operating new pilot wells and constructing and operating water and gas management facilities to support the program.

A more detailed description of the proposed activity is found in Chapter 4 of the *Dewhurst Gas Exploration Pilot Expansion Environmental Impact Statement* (RPS, 2013a).

The proposed activity is 'State Significant Development' (SSD) to which Division 4.1 of Part 4 of the EP&A Act applies in accordance with the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

In accordance with the requirements of the EP&A Act, an Environmental Impact Statement (EIS) was prepared for the proposed activity (RPS, 2013a) and placed on public exhibition from 7 November to 9 December 2013. Public submissions were invited during this period.

1.2 Purpose of this report

There were 221 submissions received during the exhibition of the EIS. The Director-General of the Department of Planning and Infrastructure (DP&I) provided copies of the submissions to Santos. In accordance with section 85A of the *Environmental Planning and Assessment Regulation 2000*, the Director-General required Santos to address the issues raised in the submissions as considered necessary.

This Submissions Report documents and considers the submissions received on the EIS, and details Santos' responses to these submissions. The report also includes an update on consultations undertaken since preparation of the EIS, some clarifications on the proposed activity and the EIS, and a revised Statement of Commitments (SoC) in response to the issues raised in submissions.

Following consideration of the submissions, no significant changes to the design of the proposed activity as described in the EIS are proposed.

1.3 Structure of this report

This Submissions Report comprises the following chapters:

- Chapter 1: Introduction — outlines the background to the proposed activity and the purpose and structure of this report.
- Chapter 2: Consultation — provides an overview of the consultation and public display activities undertaken during and following the EIS exhibition period.
- Chapter 3: Overview of submissions — provides details of submissions received, the approach taken to consideration of submissions and the main issues raised.
- Chapter 4: Responses to issues raised in submissions — details the issues that were raised in the submissions and provides responses to the issues raised.
- Chapter 5: Revised Statement of Commitments — outlines changes to and additions to the draft SoC from the EIS.
- Chapter 6: References.

2.0 Consultation

2.1 Consultation during public exhibition period

The EIS was exhibited for 33 days, from 7 November 2013 to 9 December 2013. A range of exhibition and consultation activities were carried out during this period.

2.1.1 Public exhibition venues

The EIS was publicly exhibited at the following display locations:

- Department of Planning and Infrastructure, Information Centre, 23-33 Bridge Street, Sydney.
- Narrabri Shire Council, 46-48 Maitland St, Narrabri.
- Nature Conservation Council, Level 2, 5 Wilson Street, Newtown.

Hardcopies were also on public display for viewing at Santos' Narrabri shop front (Maitland Street, Narrabri) and Santos' Narrabri Operations Centre during business hours. During the exhibition period, the public was able to review the EIS, obtain information from display materials and seek further information from staff at these offices.

2.1.2 Project enquiries telephone line, email and websites

The project enquiries and information line (1800 071 278) and project email address (energy.nsw@santos.com) were monitored throughout the exhibition period. No specific phone calls or emails were received in relation to the EIS during this period.

The EIS was, and still is, available for electronic download on the Santos website:

<http://www.santos.com/exploration-acreage/new-south-wales/environment/environmental-approvals.aspx>
and the DP&I website: <http://majorprojects.planning.nsw.gov.au/page/>.

2.1.3 Distribution of EIS

Upon instruction from the DP&I, Santos provided copies of the EIS to the following Government agencies and special interest groups:

- Department of Planning and Infrastructure
- Narrabri Shire Council
- Division of Resources and Energy
- NSW Office of Coal Seam Gas (NSW OCSG)
- NSW Environment Protection Authority (NSW EPA)
- NSW Office of Environment and Heritage (NSW OEH)
- Namoi Catchment Management Authority (Namoi CMA)
- NSW Roads and Maritime Services (Roads and Maritime)
- Heritage Branch of NSW
- Department of Primary Industries (NSW Fisheries, NSW Office of Water and the Office of Agricultural Sustainability and Food Security)
- NSW Health – Hunter New England Health District (NSW Health)

- Nature Conservation Council
- NSW Rural Fire Service (NSW RFS)
- Forestry Corporation of NSW (Forestry NSW).

Santos also delivered a copy of the EIS to the Narrabri Local Aboriginal Land Council (Narrabri LALC).

2.1.4 Notification to key stakeholders

Information on the EIS and links to copies of the document and the process for making a submission were provided by email to key stakeholders in the November 2013 Monthly Activity Updates. These updates are provided to:

- Forestry NSW
- NSW Crown Lands Division (Crown Lands)
- Roads and Maritime Services
- Narrabri Shire Council
- Narrabri LALC
- Narrabri Community Consultative Committee (Narrabri CCC)
- neighbouring landholders to Leewood.

2.1.5 Advertisements

The exhibition was advertised by DP&I in a media release, as well as in the local Narrabri Courier newspaper.

2.2 Consultation following public exhibition

2.2.1 Project enquiries telephone line and email

The project enquiries and information phone line and email address have been maintained during preparation of this Submissions Report, and will be maintained during the assessment of the EIS by the DP&I and during construction and operation of the proposed activity, should development consent be granted. No specific phone calls or emails were received in relation to the EIS during the preparation of the Submissions Report.

2.2.2 Meetings and other consultation

Santos has continued consultation regarding the E&A Program and Narrabri Gas Project with key stakeholders since the end of the exhibition period. This has included:

- meeting with Narrabri Shire Council
- regular liaison with Forestry NSW
- Narrabri CCC update
- Aboriginal stakeholder forum
- landowner information sessions.

3.0 Overview of submissions

3.1 Respondents

3.1.1 Submissions

The DP&I received 221 submissions on the EIS. The full submissions can be viewed on DP&I's website at http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=6038. Of these submissions:

- 220 were received during the submissions period (7 November to 9 December 2013).
- One was received after the submissions period had closed, but was considered and responded to in this report.
- One individual made two submissions.
- One individual made a single submission on behalf of themselves and also the NSW Artesian BoreWater Users Association.

A summary of all submissions received, including a reference to key areas of concern, is provided in Appendix 1. In order to protect privacy, individual names of respondents have not been included.

3.1.2 Types of respondents

Submissions were received from a number of different respondents (refer to Appendix 1). Of these:

- 12 submissions were from government agencies – NSW OCSG, NSW EPA, NSW OEH, Roads and Maritime, Heritage Branch of NSW, NSW Fisheries, NSW Office of Agricultural Sustainability and Food Security, NSW RFS, NSW Office of Water, Crown Lands, Namoi CMA and NSW Health.
- One submission was from a council – Narrabri Shire Council.
- Eight submissions were from special interest groups – NSW Artesian BoreWater Users Association, Australian Water Campaigners, Friends of the Pilliga, Namoi Water, The Wilderness Society, No CSG Gilgandra District Inc, Northern Inland Council for the Environment and Economists at Large.
- 201 submissions were from community members (including the single joint submission with the NSW Artesian BoreWater Users Association).
- There were 102 submissions that contained versions of a form letter.

3.2 Approach to consideration of submissions

Each submission received was assigned a submission number by DP&I. The submissions were reviewed and individual issues raised within each response categorised. A response has been provided to each issue within this Submissions Report. Where similar issues have been raised in different submissions, a single response has been provided.

3.3 Overview of issues raised in submissions

This section summarises the issues raised by the government agencies, councils and the community. Responses to these issues are contained in Chapter 4.

3.3.1 Main issues raised by government agencies and councils

The key issues and comments raised by government agencies and councils are presented below.

3.3.1.1 [Fisheries NSW](#)

- Fisheries NSW advised no issues raised.

Noted - no further response required.

3.3.1.2 [Heritage Council of NSW](#)

- There are two unlisted heritage items on the Leewood property (p 179 of the EIS). There is no indication in the EIS as to whether these items are potentially of Local, State or National significance, or what the potential impact on these items might be. The Heritage Division recommends that the applicant be requested to provide a Statement of Heritage Impact (SHI) for the unlisted heritage items. The SHI should assess the potential impacts on the items, including impacts on their setting, and views and vistas. The SHI should also consider the potential for archaeological relics/deposits of Local or State significance. Strategies to mitigate any potential impacts should also be included in the EIS.
- General mitigation measures should include a site induction and toolbox talks to make project staff and contractors aware of their statutory obligations under the *NSW Heritage Act 1977*, in regard to archaeological relics.
- It is recommended that the EIS be referred to the NSW OEH in relation to the assessment of the Aboriginal cultural heritage elements of the EIS.
- It is recommended that the EIS be referred to the NSW OEH for assessment of the EIS in relation to the four threatened flora and 33 threatened fauna species, assessed in the document as being potentially, likely or known to occur in the affected area.

Responses to the non-Aboriginal cultural heritage comments are provided in Section 4.23.

The EIS has been referred to the NSW OEH in relation to biodiversity and Aboriginal cultural heritage aspects of the proposed activity. No further response required.

3.3.1.3 [NSW Crown Lands](#)

- Any fragmentation and diminution of native vegetation in the area should be avoided, particularly given the high numbers of threatened communities and species which rely upon this remnant intact vegetation.
- Any narrowing of the width of vegetated corridors between remnant vegetation patches should be avoided, and clearing of vegetation should not result in cleared spaces exceeding 80 metres - which would act as an impediment to the movement of native fauna.
- Development and maintenance of roads and service tracks has the potential to channel flows and disrupt the complex natural surface hydrology patterns of the impacted area. Increased sediment loading of surface water as a result of vegetation disturbance and vehicular traffic will also impact water quality.
- Light and noise pollution from additional well sites, and increased vehicle traffic will impact native fauna.
- Attachment B of the NSW Department of Primary Industries submission letter details a set of standard conditions that Crown Lands request be applied, as applicable, should the proposed activity be approved.

Recommended conditions of approval are noted.

Responses to other comments and issues are provided in Chapter 4.

3.3.1.4 [NSW Environment Protection Authority](#)

- Santos needs to submit a variation application to the NSW EPA to add the proposed activity to the Environment Protection Licence (EPL) application.
- Erosion and sediment controls should be implemented consistent with the guidelines, principles and

recommended minimum design standards contained in *Managing Urban Stormwater: Soils and Construction – Volume 1* (the Blue Book).

- The unsealed road network associated with the proposed activity should be managed and maintained consistent with the guidelines, principles and recommended minimum design standards contained in:
 - *Managing Urban Stormwater: Soils and Construction – Volume 2C Unsealed Roads*
 - *Erosion and sediment control on unsealed roads – A field guide for erosion and sediment control maintenance practices.*
- A Leak Detection and Repair program should be incorporated into the fugitive emissions monitoring program, conducted in accordance with *US EPA Method 21 - Determination of Volatile Organic Compound Leaks (40 CFR Part 60, Appendix A, Method 21)*.
- Santos should ensure that appropriate mitigation measures are in place to reduce construction and operational noise at nearby sensitive receptors.
- If approved, the NSW EPA recommends that DP&I incorporates noise limits at any sensitive receptor into the conditions as follows:
 - standard construction hours – 40 db(A) LA_{eq}(15mins)
 - outside standard construction hours – 35 db(A) LA_{eq}(15mins).

Responses to these comments are provided in Chapter 4.

In addition, NSW EPA provided the following subsequent comments via email on 16 December 2013 for consideration:

- The proposed groundwater monitoring plan would benefit from water quality monitoring of deeper water bearing formations.
- The Groundwater Technical Report in Appendix 3 of the EIS details that the drawdown within the shallowest targeted seam (Hoskissons Seam) by the Tintfield Pilot would extend underneath the overlying Lower Namoi Alluvium. It states that the residual drawdown within the seam is expected to exist for greater than 100 years after the succession of the E&A Program.
- The conceptual hydrogeological model indicates that the Black Jack sequence underlies the high beneficial use Lower Namoi Alluvial Groundwater Source. No monitoring of the stacked aquifers is proposed within the E&A Program area.
- Recommends that the proponent revises the groundwater monitoring program to include:
 - Monitoring of the ambient quality of the deeper groundwater sources intersected, influenced or accessed by the proposed activity.
 - Water level, pressure and quality monitoring at the nearby Tintfield Pilot for baseline data and ongoing throughout the E&A Program.
 - The groundwater monitoring plan be revised in consultation with the NSW Office of Water and the NSW EPA.

Responses to these comments are also provided in Section 4.12.

3.3.1.5 [NSW Health](#)

- In sections 3.2.1.1; 3.2.1.2 and 4.4.2.2 the EIS describes how produced water will be pumped to the Bibblewindi Water Transfer Facility (WTF) to provide a buffer prior to being transferred to the Leewood Produced Water Facility. In section 10.3 Santos says that '*No produced water from either Dewhurst 13-18H and Dewhurst 26-31 will be transferred to the existing ponds at the Bibblewindi WTF*'. This requires clarification.

- The Bibblewindi Water Transfer Tank is approximately five megalitres. It is not clear if this tank will be able to hold the additional produced water from Dewhurst 13-18H and Dewhurst 30/31. NSW Health notes that there has been a spill incident at this facility earlier in 2013.
- There is need for a spill incident management plan.
- There is a need for a clear indication of all drilling fluid additives to be used or to be available for use if required.
- There is need for an incident management plan in the event that particulate or gaseous emissions exceed emission standards.
- A range of social, cultural and economic factors have the potential to impact the physical and psychological health of the local population, and are considered in the EIS. An ongoing comprehensive community and stakeholder engagement program is essential to minimise negative impacts.

Responses to these comments are provided in Chapter 4.

3.3.1.6 NSW Office of Agricultural Sustainability and Food Security

- The proposed activity will have a low impact on agricultural production at a local, regional and state level. No recommendation of any special conditions of consent.

Noted - no further response required.

3.3.1.7 NSW Office of Coal Seam Gas

- As CSG is a prescribed mineral under the *Petroleum (Onshore) Act 1991*, the proponent is required to hold a Petroleum Appraisal Lease (PAL) granted by the OCSG in order to drill production test wells for CSG. The proposed activity is located within PAL 2 held by the proponent.
- Generally supports the proposed activity.
- Notes the current NSW OCSG development of the revised *Santos Narrabri Gas Field Produced Water Management Plan (PWMP)* in accordance with Condition 14 of PEL 238 and in consultation with NSW Office of Water.
- Notes the upcoming NSW OCSG revision of the *Santos Narrabri Gas Field Groundwater Monitoring and Modelling Plan (GMMP)* in accordance with Condition 13 of PEL 238 and in consultation with NSW Office of Water. This review will be undertaken pending the release of the NSW Office of Water guideline *Groundwater Modelling and Monitoring Plans - a guide for prospective mining and petroleum exploration activities*.
- Santos must prepare and implement a Rehabilitation Plan to the satisfaction of the NSW Minister for Resources and Energy. The Rehabilitation Plan must:
 - be prepared in accordance with NSW Trade and Investment guidelines and in consultation with relevant agencies and stakeholders
 - take into consideration the conditions within PEL 238 and the Permit to Occupy
 - be submitted to and approved by the NSW Minister for Resources and Energy prior to the commencement of activities
 - address all aspects of rehabilitation and decommissioning including final land use, rehabilitation objectives, strategic rehabilitation criteria, rehabilitation methodology and rehabilitation monitoring
 - remain consistent with or exceed the rehabilitation completion criteria standards in the document *Rehabilitation Completion Criteria, Dewhurst 22-25 and Dewhurst 26-29 Pilots* dated 6 November 2013, approved by OCSG on 8 November 2013
 - include a final landform plan that is consistent with the surrounding topography of the area, considers

natural drainage design and details the target vegetation/habitat outcomes for the proposed activity

- ensure decommissioning of wells is in accordance with the *NSW Code of Practice for Coal Seam Gas Well Integrity 2012* (DTIRIS, 2012).

The proposed activity is located within PEL 238, and not PAL 2.

Other comments noted, including the requirement for a Rehabilitation Plan - no further response required.

3.3.1.8 NSW Office of Water

- Insufficient information has been provided for the NSW Office of Water to assess the validity of the model and its suitability in making the required predictions. Santos should release detailed modelling reports/data for review by NSW Office of Water, including the report *Groundwater impact assessment for the Narrabri Gas Project, ESG* (Golder, 2011) along with any other relevant documentation that details the modelling and the data used. Any peer review documents should also be made available.
- Santos should provide sufficient water quality information to allow an assessment against the minimal impact consideration for water quality in the Aquifer Interference Policy (AIP) for affected water sources.
- Recommends that Santos present the rationale for the selection (or non selection) of the water quality parameters analysed and reported. The suite should include constituents that might be expected to be found in CSG waters.
- The following should be included as conditions of approval relating to drilling and well construction:
 - Santos must ensure the protection of the shallow formations i.e. the alluvium and the Great Artesian Basin (GAB) Southern Recharge during drilling by ensuring hydraulic isolation between sequences.
 - The drilling of the proposed exploration well is undertaken in accordance with the EIS.
 - The wells be designed and constructed in accordance with the *NSW Coal Seam Gas Code of Practice Well Integrity* (DTIRIS, 2012).
- A remedial action plan in the event of adverse impacts to the groundwater such as leakage and cross contamination between aquifers as a result of the drilling and well construction process as well as possible well failure into the future should be provided.
- In relation to the Bibblewindi water transfer and Leewood produced water facilities, Santos should:
 - provide a remedial action plan in the event of accidental contamination
 - undertake construction in accordance with the EIS
 - undertake monitoring in accordance with the PWMP
 - make monitoring data available to the NSW Office of Water on request.
- Santos should clarify the inconsistent reporting of locations for the proposed groundwater monitoring bores, provide further details on the monitoring program, and explain how the proposed monitoring program will address and reduce uncertainty and improve the predictions made by the groundwater flow model.
- Santos should measure and report the volume of water extracted from the pilot wells to NSW Office of Water.
- Appropriate water access licences (WALs) should be in place to account for any take of groundwater.
- Santos should submit a revised PWMP and GMMP for review by the NSW Office of Water.
- Attachment A (Part C) of the NSW Department of Primary Industries submission letter details a set of recommended conditions that NSW Office of Water request be applied should the proposed activity be approved.

Recommended conditions of approval are noted.

Responses to the other comments and issues are provided in Chapter 4.

3.3.1.9 NSW Office of Environment and Heritage

- Santos should make the following information available for agency and public review:
 - Habitat modelling undertaken for the Narrabri Gas Project (ELA, 2012) and habitat and fragmentation analysis, as referred to in the environmental assessment.
 - The mapped location of the entire Dewhurst 26-31 well set and associated infrastructure in relation to threatened species records.
- This proposed activity, and previous exploration activities within the Pilliga forests and the environmental assessments undertaken to date for individual components of the E&A Program, are considered to be lacking in their assessment and mitigation of indirect impacts.
- Santos should provide justification for their assessment of the likely level of indirect impacts in relation to native vegetation and fauna.
- Santos should provide further detail regarding the proposed mitigation measures to address indirect impacts including their likely efficacy.
- Any approval of the proposed activity by DP&I should include a requirement to develop and implement a monitoring program with the aim of quantifying the indirect impacts on flora and fauna associated with the proposed activity.
- NSW OEH has previously reviewed the cumulative impact assessment (ELA, 2013a) undertaken for the E&A Program. Broadly, outstanding concerns include:
 - the appropriateness of the scale of the assessment (the very large scale PEL238)
 - lack of details of the flora habitat modelling
 - lack of information on how habitat availability for threatened species has been assessed/estimated
 - cumulative indirect impacts have not been properly considered.
- The *Threatened Species Conservation Act 1995* (TSC Act) Cumulative Impact Assessment report (ELA, 2013a) be made available for public review.
- Santos should provide justification for the chosen study area for the cumulative impact assessment.
- The cumulative impact assessment should consider the likely area to be impacted by indirect impacts for all threatened species, and the significance of this impact on local populations of these species.
- Santos should provide a map depicting all components of the E&A Program cross-referenced with a list of the relevant environmental assessments and approvals.
- Santos should clarify which environmental assessment and approval covers the relatively recent clearing and upgrade of the 'Killara Road' and 'un-named road' depicted in Figure 3-5 of the EIS.
- NSW OEH expects all cumulative impacts of the E&A Program to be offset in the future. Therefore, as for all SSD proposals and in accordance with NSW OEH policy, NSW OEH encourages the provision of an offset for this proposed activity.
- Santos should calculate the offset quantum required to adequately offset the biodiversity impacts associated with the proposed activity, in accordance with the NSW Offset Principles or NSW OEH Interim Offset Policy.
- Any approval conditions for the proposed activity should contain the requirement to provide the calculated offset quantum within a broader biodiversity offset strategy developed as part of the Narrabri Gas Project.

Responses to these comments and issues are provided in Chapter 4.

3.3.1.10 NSW Roads and Maritime Services

- The following conditions of approval are recommended:
 - The intersection of X-Line Road and the Newell Highway should be upgraded to include an Auxiliary Left Turn Treatment Short and Basic Right Turn Treatment on a major road in accordance with Figures 8.3 and 7.5 Part 4A Austroads 2010 respectively and Roads and Maritime supplements. The intersection works should be designed and constructed to accommodate the largest vehicle accessing the intersections. Such designs shall be appropriate for the current speed zone of 110km/h.
 - Prior to the commencement of road works, the developer will be required to enter into a Works Authorisation Deed (WAD) with Roads and Maritime. Roads and Maritime Services will exercise its power under Section 87 of the *Roads Act 1993* (the Act) and/or the functions of the roads authority, to undertake road works in accordance with Sections 64 and 71 and/or Sections 72 and/or 73 of the Act, as applicable, for all works under the WAD.
 - The upgrade of the intersection of X-Line Road and the Newell Highway should be completed prior to the commencement of construction works associated with the proposed activity.
 - A Road Occupancy Licence is required prior to any works commencing within three metres of the travel lanes in the Newell Highway.
 - All access to the pilot should be via the intersection of X-Line Road and the Newell Highway. No other access from/to the state road network (Newell and Kamilaroi Highways) from/to the proposed activity area is permitted.

A response to these recommended conditions is provided in Section 4.18.

3.3.1.11 NSW Rural Fire Service

- The NSW RFS has reviewed the plans and documents received for the proposed activity and subsequently raise no concerns or issues in relation to bushfire.

Noted - no further response required.

3.3.1.12 Narrabri Shire Council

- The Council seeks Santos' ongoing efforts to ensure that a significant portion of the identified socio-economic benefits of the proposed activity will accrue in the local economy.
- There will be few socio-economic benefits realised within the local government area (LGA), however the socio-economic impacts of the proposed activity are small.
- The Council recognises the contributions Santos is making to the community and encourages ongoing local employment, social infrastructure provision and Santos' buy local program.
- The proposed construction mitigation measures appear adequate to minimise the risks of impacts occurring.
- The EIS does not state 'all chemicals used during drilling will be non-toxic', however similar statements remain in sections 8.2.2.2 and 17.3.2.
- There is no assessment of the impacts of the proposed activity on the existing groundwater quality, one of the areas of greatest community concern.
- An assessment of the impacts of drilling on groundwater quality needs to be undertaken to determine whether drilling fluids will be released to the environment at toxic concentrations.

- Further information on the conceptual groundwater model and the assumptions made in the groundwater modelling should be provided.
- A recent bore census covering all of the E&A Program needs to be provided and all bores within the potential drawdown area should be identified and potential impacts quantified.
- Further deep monitoring bores should be installed, or if they already exist, they need to be incorporated into the monitoring program and this needs to be described. The bores should be installed, monitored and sampled prior to the start of the proposed activity with sufficient time to collect baseline data prior to the start of operations - not sometime in the next 12 months. The monitoring should continue over the life of the proposed activity and until the pre-existing groundwater pressures and flows return.
- Further information is required to determine the adequacy of the monitoring program. The water quality monitoring program should include parameters indicative of contamination of groundwater by drilling fluids and vertical flow of groundwater.
- Further information on the baseline monitoring results and the proposed trigger values when contingency measures will be implemented should be provided, as well as the proposed feasible contingencies.
- Council must be provided with an opportunity to review and comment on the proposed groundwater monitoring program and any proposal for fracking.
- The start of the proposed activity should be conditional on the completion of the Biblewindi WTF.

Responses to these comments and issues are provided in Chapter 4.

3.3.1.13 Namoi Catchment Management Authority

- The Namoi CMA undertook an impact analysis against the *Namoi Catchment Action Plan 2010-2020* (CAP) thresholds and targets, and requirements of the *Extractive Industries Policy 2009* for the Namoi Catchment and the *Namoi CMA Biodiversity Offsets Policy 2011*. As a result of this analysis, Namoi CMA is satisfied that the proposed activity should:
 - have a negligible impact on CAP thresholds and targets
 - not impact upon any previously identified Aboriginal Cultural Heritage sites or objects
 - have a minor impact on biodiversity
 - have a negligible impact on surface water flow.
- The proposed mitigation and management measures for Aboriginal cultural heritage, surface water flow, groundwater quality, surface water quality and site rehabilitation are considered adequate.
- As the proposed activity will result in a loss of biodiversity, even after rehabilitation, offsets are required to mitigate that loss in accordance with the Namoi CMA Biodiversity Offsets Policy 2011.
- Acknowledges that appropriate measures have been undertaken to involve and consult with the Aboriginal community within the Narrabri LALC area and all other relevant stakeholders.
- Acknowledges that a thorough examination was undertaken by Santos in conjunction with the Aboriginal community within the Narrabri LALC's local area and all other relevant stakeholders and that no Aboriginal objects, sites, places of significance or culturally modified trees were identified within the two pilot sites or immediate surrounds.
- The Namoi CMA is satisfied with the procedures proposed for the protection and preservation of any Aboriginal Cultural Heritage sites of significance, as set out in Section 19.1.4 of the EIS.

Acknowledgments of supported measures are noted - no further response required.

Responses to the biodiversity offsets comment is provided in Section 4.14.

3.3.2 Main issues raised by the community

The most common issues related to potential groundwater and biodiversity impacts, as well as bushfire risk and the assessment of socio-economic impacts. Other issues related to general objections to CSG both locally and as an industry, air quality, potential social impacts on health and community, and issues regarding Aboriginal cultural heritage, as listed below.

- Groundwater – This was the most common concern raised. Respondents were concerned with the perceived lack of baseline data underlying the numerical groundwater model, and hence its robustness as an impact assessment tool. Other issues included general concerns about potential impacts on groundwater resources in the area, including the GAB resulting from drilling, well integrity and ongoing operation of the wells; management of produced water; as well as the possible cumulative impact of any future CSG activities in the region.
- Biodiversity – A number of respondents oppose development in the Pilliga forest generally, with concerns regarding the impact on biodiversity. In addition, respondents were concerned with the perceived lack of baseline data and potential direct and indirect impacts to threatened species including the Pilliga Mouse, Eastern Pygmy Possum and Barking Owl.
- Bushfire risk – Respondents noted that there is already a high bushfire risk in the Pilliga forest. Concerns were raised that CSG activities within the Pilliga forest may create additional bushfire risks and that Santos appears not to have a clear bushfire strategy.
- Social and economic impacts – Respondents raised concerns about the economic analysis approach used; potential impacts on other land uses, such as agriculture; as well as the impact on general community cohesion. Some submissions also identified concerns about potential health impacts. Respondents also suggested that Santos does not have a social license to operate in the community.
- General objections to CSG – Respondents raised concerns about the industry relating to intergenerational equity and the precautionary principle. Concerns raised included substantial crossover with other issues listed here, including groundwater and air quality. Respondents claim the potential for ongoing piecemeal CSG development within the Pilliga forest will degrade the intrinsic value of the area.
- Cultural heritage – Respondents raised concerns over the perceived inadequacy of consultation with the Aboriginal community and general disregard for the Aboriginal cultural significance of the area.
- Air quality/greenhouse gases – Respondents raised concerns over the adequacy of fugitive emissions baseline data and monitoring, as well as the volume of greenhouse gas emissions arising from CSG activities.

4.0 Response to issues raised in submissions

This chapter contains responses to the issues raised in submissions to the EIS. Where appropriate, references to relevant sections of the EIS are contained in the responses.

As noted in Chapter 3, the submissions were reviewed individually and the issues categorised to assist with compilation of responses. Where relevant, issues were categorised according to the relevant chapter or section of the EIS. Where submissions raised the same or similar issues, a consolidated response was prepared. The issues raised are numbered under the relevant general heading and then a response to each issue is provided below next to its corresponding issue number.

4.1 General objections

4.1.1 Issue description

In summary, respondents raised the following general objections to the proposed activity:

- 1) The proposed activity is a direct long term threat to the health and wellbeing of land, water and air in this region and beyond. Respondents object to disruption of this fragile area by this activity. They believe that there is little benefit to the community, and that little consideration is given to the negative aspects of the proposed activity.
- 2) General concerns about the impacts on intergenerational equality and the future condition of the region.
- 3) A question was raised over the validity of scientific studies carried out by or on behalf of Santos.

4.1.2 Response

- 1) Santos is seeking consent to undertake an expansion of the Dewhurst Gas Exploration Pilot for the purposes of CSG exploration and appraisal. This proposed activity involves re-entering three existing wells to convert single horizontal wells to triple-stacked horizontal wells, drilling one vertical well and one triple-stacked horizontal well; and operation of the two pilots for up to three years only. On completion of operations, wells and ancillary infrastructure will either be decommissioned with lease areas rehabilitated or wells will be suspended. If exploration and appraisal activities confirm the CSG resource as commercially viable, any proposed production activities at this pilot site would be subject to further environmental assessment and government approvals.

The State forest area within which the Dewhurst 26-31 Pilot proposed activity is located is entirely within 'Zone 4' (Forestry, recreation and mineral extraction (State Forests)) Community Conservation Area (CCA) under the *NSW Brigalow and Nandewar Community Conservation Area Act 2005* (BNCCA Act). As mineral extraction is a permitted use in Zone 4, the proposed activity is considered consistent with the BNCCA Act. The *New England North West Strategic Regional Land Use Plan* (DP&I, 2012) identifies the two pilot sites and surrounding land as having high CSG resources and underground coal exploration potential.

The EIS includes investigation into a range of issues to determine the potential impacts of the proposed activity. This included commissioning groundwater, ecological, air quality, noise, traffic and economic and social technical studies, and drawing on information from technical specialists including geologists, drilling engineers and process engineers. Where appropriate, conservative scenarios were considered as part of the EIS, while a range of mitigation measures will be put in place to minimise or prevent any environmental degradation.

- 2) The proposed activity will not consume significant quantities of non-renewable resources or produce significant quantities of waste that will lead to long term environmental implications (refer to Table 2-1 of the EIS). Groundwater will be extracted but modelling indicates that this will have negligible impact on the upper aquifers including the Pilliga sandstone, registered bore users or groundwater dependent ecosystems (GDEs). Following drilling, lease areas will be rehabilitated back to approximately 30 by 30 metres in size. Drilling fluids, where possible, will be recycled for use at other drilling sites. In addition, the proposed activity is not located within Biophysical Strategic Agricultural Land (BSAL), and therefore will have negligible impact on agricultural land resources.

As discussed above, the two Dewhurst pilots are proposed to operate for up to three years only. If exploration and appraisal activities confirm the CSG resource as commercially viable, any production activities at this pilot site would be subject to further environmental assessment and government approvals.

- 3) It is standard practice that a project proponent undertakes impact assessment activities and prepares a report on the findings for Government assessment. This process incorporates impact assessment reports, undertaken by specialists in their chosen fields. An EIS has been undertaken by Santos to assess the potential impacts of the proposed activity in accordance with the EP&A Act. Santos has prepared the EIS in response to the Director-General Requirements (DGRs). Technical reports are reviewed by the applicable government agency for adequacy in addressing the DGRs. DP&I will assess the proposed activity and prepare an assessment report and the Planning Assessment Committee (PAC) will determine the application, as outlined in Figure 6-1 of the EIS.

4.2 Objections to the CSG industry

4.2.1 Issue description

Respondents raised general objections to the CSG industry, including the following:

- 1) Concerns that CSG development will be proposed for the Liverpool Plains, threatening existing industries such as agriculture.
- 2) CSG exploration should not be undertaken in the Pilliga, or anywhere in Australia. Concerns that the CSG industry is able to gain approval despite strict government controls and community opposition.

Scientific evidence suggests significant global and national impacts from the CSG industry. References were made to projects elsewhere (e.g. Tara, Qld and USA gas fields). Concerns about impacts to water quality, land, community and ecological balance of the area. CSG is considered to be an unsafe energy source and does not provide the claimed economic benefits.

- 3) CSG differs from other resource extraction, as exploration wells have the same environmental impacts as operational wells.

4.2.2 Response

- 1) Neither the proposed activity, nor the E&A Program that it is part of, is located on land classified as BSAL or Critical Industry Cluster (CIC). The Agricultural Impact Statement (AIS) that was undertaken for the EIS (Appendix 2 of the EIS) states that the E&A Program is not located on any agricultural land (major agricultural industries e.g. cropping, grazing, horticulture and plantations).

The proposed activity and the wider E&A Program are not located on the Liverpool Plains.

- 2) The natural gas industry is one of the most highly regulated industries in Australia. Over the last two years both the State and Federal governments have put in place a range of new measures designed to enhance the already extensive regulation. Before any work can take place, CSG activities in NSW, including those associated with exploration and appraisal, are subject to rigorous State and Federal government assessment and approvals processes to ensure impacts have been assessed and mitigated. An EIS or Review of Environmental Factors (REF) is prepared, which contains environmental, economic and social impact assessments of the proposed CSG activities.
- 3) The majority of environmental impacts occur during drilling and this is similar between exploration and production wells. The key difference is that an exploration well will only operate for up to three years whilst a production well could operate for longer.

4.3 Objections to fossil fuel industries

4.3.1 Issue description

- 1) Respondents are opposed to reliance on fossil fuels.

4.3.2 Response

- 1) As an Australian-owned oil and gas company, Santos believes that natural gas is a critical part of NSW's energy mix. Over one million NSW homes and businesses use natural gas for heating, cooking and commercial uses. In addition there are about 450 large industrial users of gas in NSW. Natural gas is critical for these small businesses and major industries, and cannot be easily or cost-efficiently substituted for an alternate energy source. Natural gas complements renewable energy sources, providing base load energy when conditions for renewable energy sources are sub-optimal (e.g. in the absence of adequate solar radiation).

NSW currently sources 95 per cent of its gas from interstate (Section 2.1 of the EIS). Contracted supplies are predicted to fall from 2014 and reach significantly low levels in 2017 due to a combination of factors including a strong demand for gas in other states, decreasing reserves and constraints on infrastructure. Santos supports the immediate development of an indigenous natural gas supply within NSW to:

- ensure adequate wholesale gas supply is available to NSW, resulting in reduced dependency on interstate supply and delivering security of supply for downstream NSW customers
- ensure future wholesale gas supply choices beyond Victorian supply, thus reinstating competition for energy retailers and encouraging increased competition for NSW gas customers
- facilitate the development of distribution networks in regional centres.

4.4 Scientific uncertainty

4.4.1 Issue description

- 1) The precautionary principal should be invoked and Santos' activities in the Pilliga forest halted until the scientific studies are completed, and the essential data and information made available to enable risks to be adequately addressed.
- 2) CSG activities should not be allowed to proceed within the region until the findings and recommendations of the Chief Scientist of NSW investigation into the NSW CSG industry have been published and discussed with the community.

4.4.2 Response

- 1) The natural gas industry is one of the most highly regulated industries in Australia and the proposed activity requires separate approvals from both the NSW and Federal governments.

The use of CSG for NSW energy needs is not new. CSG was extracted at the Sydney Harbour Colliery in Balmain in the early 1900s with production continuing into the 1940s. CSG production has occurred at Camden in NSW for over 12 years.

A precautionary approach was taken during the site selection process for the proposed activity (Table 2-1 of the EIS). Based on an environmental risk assessment and in combination with the DGRs, the EIS includes investigation into a range of issues to determine the potential impacts of the proposed activity. This included commissioning groundwater, ecological, air quality, noise, traffic and economic and social technical studies, and drawing on information from technical specialists including geologists, drilling engineers and process engineers. Where appropriate, conservative scenarios were considered as part of the EIS, while a range of mitigation measures will be put in place to minimise or prevent any environmental degradation.

- 2) Santos supports a robust regulatory framework that enables the sustainable and safe exploration and development of Australia's valuable and abundant reserves of gas for the benefit of all Australians. The natural gas industry is one of the most highly regulated industries in Australia and the proposed activity requires separate approvals from both the NSW and Federal governments.

The *Initial report on the Independent Review of Coal Seam Gas Activities in NSW* by the NSW Chief Scientist and Engineer was released in July 2013 and is available online at <http://www.chiefscientist.nsw.gov.au/coal-seam-gas-review/initial-report-july-2013>.

A number of technical studies have been included in the EIS, which have been undertaken to assess and address the potential environmental and social issues associated with both the proposed activity and the larger E&A Program.

4.5 Future development

4.5.1 Santos' future plans in the region

4.5.1.1 Issue description

- 1) Santos needs to be open and transparent about future development in the Pilliga, and larger Narrabri region.

4.5.1.2 Response

- 1) The proposed activity, as part of the E&A Program, is necessary for the ongoing exploration, appraisal and evaluation of the CSG hydrocarbon potential in PEL 238 and PAL 2. The E&A Program is proposed to occur over three years between 2014 and 2017. It will assist in gaining further knowledge of coal fines, gas composition and flow rates, the deliverability of the reservoir, and investigating well design, drilling and completion technologies. This information is essential to determine the location, extent, details and planning of a commercial gas production project within the areas of PEL 238 and PAL 2. The application for the proposed activity is seeking approval for that exploration and appraisal activity.

Since the EIS for the proposed activity was finalised, Santos has released information on a proposed future commercial gas production project, known as the Narrabri Gas Project.

The Narrabri Gas Project is proposed to include a gas field and a pipeline to transport the natural gas to the NSW market. The project could supply up to 50 per cent of NSW's natural gas needs, create 1,200 jobs during construction and up to 200 jobs during operation, contribute \$1.6 billion in royalty payments to NSW over the life of the project and \$160 million as part of the Regional Community Benefit Fund for regional programs and infrastructure.

The gas field is proposed to include:

- up to 850 production wells
- monitoring of wells to provide continual information about water and gas volumes and well site security
- a central water management and treatment facility to store and treat produced water for reuse
- a central gas processing facility to treat and compress the natural gas.

The Narrabri Gas Project will require preparation of a detailed EIS for petroleum production activities, development consent and the granting of a Petroleum Production Licence (PPL).

Further details of the Narrabri Gas Project can be found at <http://www.santos.com/exploration-acreage/new-south-wales/narrabri-gas-project.aspx>.

4.5.2 Cumulative impacts

4.5.2.1 Issue description

- 1) Project staging and REFs for individual pilots has not enabled a proper cumulative impact assessment to be undertaken. The cumulative impacts of all of the Pilliga gas exploration in the past, present and future should be considered in the EIS. Broader impacts of numerous gas fields should be assessed as the EIS does not sufficiently address cumulative impacts of the whole project with 1100 wells.
- 2) Cumulative impacts of the proposed activity with the Glasserton Project need to be addressed.

4.5.2.2 Response

- 1) The cumulative impact assessments presented in the EIS have taken into consideration existing, approved and currently proposed Santos' CSG activities for the E&A Program within the Pilliga forest, including existing infrastructure and recently approved activities. In particular, the ecological assessment has considered the clearing of vegetation that has occurred over the past 10 years by Eastern Star Gas (ESG). Any future exploration, appraisal or production activities beyond the E&A Program, including any application for the Narrabri Gas Project, will be assessed when the relevant applications are lodged. These assessments will continue to incorporate cumulative impact assessments.

A number of respondents referred to a proposed production program of 1100 wells in the region. This number originally comes from a previous ESG proposal, which was subsequently withdrawn.

In December 2013, Santos identified the proposed project area currently being considered for the Narrabri Gas Project. The project area is shown in the project factsheet, available on Santos' website: <http://www.santos.com/library/FACT%20SHEET%20Narrabri%20Gas.pdf>.

The information collected as part of the E&A Program will inform the nature and configuration of the future Narrabri Gas Project and needs to commence prior to construction of that project. The E&A

Program, which the proposed activity is part of, will occur over three years between 2014 and 2017 and during this time the Narrabri Gas Project will require preparation of a detailed EIS for petroleum production activities, development consent, the granting of a PPL and project financing.

- 2) The cumulative impacts of the E&A Program have been assessed as part of the EIS. The Glasserton pilot wells are located at Spring Ridge approximately 45 kilometres south of Gunnedah, and approximately 100 kilometres south-east of the E&A Program area. The Glasserton pilot wells are currently not operating. However, even if these wells were operational, it is unlikely there would be any cumulative impacts of these wells with the E&A Program given the significant distances between the two locations.

4.6 Need and justification

4.6.1 Gas shortage

4.6.1.1 Issue description

- 1) There is no shortage of gas; the implication that NSW does not have a secure supply of gas is incorrect. Demand for gas is dropping and there is enough natural gas in production already. Gas is available under large areas of Australia, including Western Australia and Bass Strait.

Household energy prices will not be alleviated within NSW by development of the CSG industry. Gas prices are rising due to construction of processing plants and export terminals in Queensland, and a desire to export CSG, not because of any impending shortage of supply. Concerns were also raised that gas will be used for export due to high demand and high prices, and not to supply NSW.

4.6.1.2 Response

- 1) As an Australian-owned oil and gas company, Santos believes that natural gas is a critical part of NSW's energy mix. Over one million NSW homes and businesses use natural gas for heating, cooking and commercial uses. In addition there are about 450 large industrial users of gas in NSW. Natural gas is critical for these small businesses and major industries, and cannot be easily or cost-efficiently substituted for an alternate energy source. Gas-fired power stations typically produce fewer emissions than coal-fired facilities per unit of electricity generated.

NSW currently sources 95 per cent of its gas from interstate (Section 2.1 of the EIS). Contracted supplies are predicted to fall from 2014 and reach significantly low levels in 2017 due to a combination of factors including an increase in demand for gas in other states (for domestic use and export in the form of liquefied natural gas (LNG)), decreasing reserves that existing NSW contracts draw from, and constraints on infrastructure.

With contracts expiring, NSW needs to either re-negotiate new contracts (where uncontracted supply is available) or develop its own reserves.

Santos supports the immediate development of an indigenous natural gas supply within NSW to:

- ensure adequate wholesale gas supply is available to NSW, resulting in reduced dependency on interstate supply and delivering security of supply for downstream NSW customers
- ensure future wholesale gas supply choices beyond Victorian and South Australian supply, thus reinstating competition for energy retailers and encouraging increased competition for NSW gas customers
- facilitate the development of distribution networks in regional centres.

4.6.2 Renewable energy sources

4.6.2.1 Issue description

- 1) Available renewable energy options should be explored over gas exploration and mining. Products from mining are temporary and finite and should be replaced with sustainable commodities. Climate change is considered a real threat.

4.6.2.2 Response

- 1) Natural gas is a critical part of NSW's energy mix. Over one million NSW homes and businesses use natural gas for heating, cooking and commercial uses. In addition there are about 450 large industrial users of gas in NSW. Natural gas is critical for these small businesses and major industries, and cannot be easily or cost-efficiently substituted for an alternate energy source. Natural gas complements renewable energy sources, providing base load energy when conditions for renewable energy sources are sub-optimal (e.g. in the absence of adequate solar radiation). It has been identified as a transitional fuel for power generation, with reduced greenhouse gas intensity compared with current coal-fired power generation (NSW Chief Scientist and Engineer, 2013).

4.7 Description of the Proposed Activity

4.7.1 Drilling fluid management

4.7.1.1 Issue description

- 1) The EIS states that the drilling fluid will be transported to the Fluid Treatment Facility (FTF) for treatment. But the amended development application (DA) for the FTF allowed the recycling of fluid only with no adding of outside material.
- 2) Table 4-9 of the EIS is confusing. In most cases there is more drilling fluid going off site than there is coming in, except for Dewhurst 30 and 31.

4.7.1.2 Response

- 1) The statement by the respondent is incorrect. The development consent for the Narrabri FTF allows for the mixing, storing and treatment of drilling fluids for use in the drilling of CSG exploration wells. This was outlined in the Statement of Environmental Effects (SEE) (RPS, 2013b) which accompanied the approved DA (available online at <http://www.santos.com/exploration-acreage/new-south-wales/environment/environmental-approvals.aspx>). The amendment to the DA only affected the storage of cement on the location originally proposed. It did not affect the operation of the FTF.
- 2) The volumes of drilling fluid to be transported to and from each well site presented in Table 4-9 of the EIS are estimates only. Dewhurst 16H, 17H and 18H are laterals which are to be drilled from existing wells. It is therefore likely that these wells will produce water while they are being drilled, which will be transported from site with the drilling fluid. Dewhurst 30 is a conventional vertical well, while Dewhurst 31 is a deviated well with a lateral section. Both these wells are likely to exhibit drilling fluid loss due to tank cleaning and formation of drill cuttings.

4.7.2 Hydraulic fracturing (fracking)

4.7.2.1 Issue description

- 1) Concerns were raised over the use of hydraulic fracturing (fracking), as other countries have banned the practice due to potential impacts on the environment.

Narrabri Shire Council must be provided with an opportunity to review and comment on any proposal for fracking.

4.7.2.2 Response

- 1) Fracking will not be undertaken as part of the proposed activity or the E&A Program (Section 9.2 of the EIS). The geology of the area indicates hydraulic fracturing will not increase gas flow rates. If additional geological data supported the use of hydraulic fracture stimulation to improve the gas flows in the future, a range of additional government approvals would be required and consultation would be undertaken.

4.7.3 Produced water management

4.7.3.1 Issue description

- 1) Concerns were raised that the EIS does not adequately explain the strategy for produced water management, including its treatment and use or disposal. The management and disposal of the extracted salts also requires better explanation. Santos does not have approval for any long-term sustainable management of the produced water.

No approval should be given until Santos has provided a detailed risk and water management plan that will be enforced by the NSW Government, addressing how Santos will deal with the produced water and salt from all their activities in the Pilliga forest. This plan must be available for public, government and independent scientific scrutiny.

- 2) It is unclear what volumes of water will be produced, but it is assumed they are large given the size of the Leewood ponds under construction.
- 3) The proposed activity is to commence prior to commissioning of the Leewood ponds. Until commissioned, water is stored onsite or trucked to an unknown location. Excessive handling of produced water increases the risk of spills.

Santos cannot guarantee the safe disposal of waste water. The threat from produced water spills is too great as Santos cannot guarantee that no leaks will occur.

- 4) Sections 3.2.1.1, 3.2.1.2 and 4.4.2.2 of the EIS describe how produced water will be pumped to the Bibblewindi WTF to provide a buffer prior to being transferred to the Leewood Produced Water Facility. However, Section 10.3 of the EIS states that '*no produced water from either Dewhurst 13-18H and Dewhurst 26-31 will be transferred to the existing ponds at the Bibblewindi WTF*'.
- 5) The Bibblewindi Water Transfer Tank is approximately five megalitres. It is not clear if this tank will be able to hold the additional produced water from the proposed activity. NSW Health notes that there has been a spill incident at this facility earlier in 2013.
- 6) In relation to the Bibblewindi water transfer and Leewood produced water facilities, Santos should undertake monitoring in accordance with the PWMP, and make this data available to the NSW Office of Water upon request.

- 7) Santos should submit a revised PWMP for review by the NSW Office of Water.

4.7.3.2 Response

- 1) Santos is continually striving for best practice in produced water management and will continue to work closely with communities, regulators and other key stakeholders to ensure the most appropriate options are pursued. The water transfer and treatment process for the proposed activity will be as follows (Section 4.4.2 of the EIS):
 - At each well, the lifted water produced will be pumped through the water gathering system to Bibblewindi WTF, via the Dewhurst Northern and Southern Water and Gas Flow Lines (under construction).
 - The Bibblewindi Water Transfer Tank located at the Bibblewindi WTF will be used to provide a short buffer (up to 24 hours) prior to the produced water being pumped to the Leewood Produced Water Facility via the Leewood Water Pipeline.
 - Once at the Leewood Produced Water Facility, produced water will be stored in one of the 300 megalitre ponds.

Produced water from the Leewood Produced Water Facility is proposed to be transported by road tankers to an appropriately licensed facility in the Sydney metropolitan area for treatment, reuse and/or disposal.

Santos is currently developing plans to treat produced water at the Leewood Produced Water Facility by reverse osmosis or other methods instead of transporting produced water from Leewood to a licensed facility.

Based on the extensive experience from Santos' CSG operations in Queensland, it is estimated around 80 per cent of the produced water could be made available for beneficial use e.g. agricultural activities and ecosystem replenishment. For CSG activities in the Pilliga, appropriate treatment levels and identification of options for using the beneficial water are being explored, with ongoing engagement with government agencies and the community.

Following adequate project definition and concept design Santos will apply for the appropriate environmental approvals and undertake the required environmental assessments for any water treatment facility or beneficial reuse option.

Activities within PEL 238 must be carried out in accordance with the conditions of the licence which have been approved by the Minister for Resources and Energy. Under Condition 14 of the PEL, a PWMP identifying storage of produced water at the Leewood Produced Water Facility has been developed by Santos, and approved by the NSW Government. If an application to treat produced water at the Leewood Produced Water Facility is submitted and approved, the PWMP will be revised in consultation with NSW Office of Water, for approval by NSW OCSG.

- 2) The estimated volumes of water to be extracted during operation of the Dewhurst 13-18H and Dewhurst 26-31 pilots are provided initially in Table 4-10 of the EIS, and again in Section 16.2.2. The estimated cumulative pilot extraction rates for the E&A Program are provided in Table 16-3 of the EIS.
- 3) The Leewood ponds are currently under construction, and will be operational prior to commencement of the Dewhurst 13-18H and Dewhurst 26-31 pilots. The ponds will be double lined and have a leak collection system. The liner system will comprise a primary polyethylene geomembrane liner, underlain by a leak detection system, underlain by a secondary liner. The

secondary liner will be underlain by 300 millimetres of smooth clayey material, free from obstructions or protrusions.

Produced water from the Leewood Produced Water Facility is proposed to be transported by road tankers to an appropriately licensed facility in the Sydney metropolitan area for treatment, reuse and/or disposal.

As outlined above, Santos is currently developing plans to treat produced water at the Leewood Produced Water Facility by reverse osmosis or other methods instead of transporting produced water from Leewood to a licensed facility, subject to environmental assessment and necessary approvals.

Any spills or leaks during operation will be contained and cleaned up immediately using a spill kit. Contaminated material (such as contaminated soil or absorbent materials) will be placed in a bag and removed from the site of the spill for disposal at a licensed waste facility. The SoC has been updated accordingly.

- 4) The statements in the EIS are correct. The existing Bibblewindi Water Treatment Facility was constructed by ESG to service its CSG pilot activities in the Pilliga forest. In December 2011, the Bibblewindi Water Treatment Facility was shut down pending a review of the existing water management infrastructure. Following extensive operational review of the water treatment infrastructure, in particular the water storage ponds, a program of remediation and rehabilitation was planned and is currently being implemented.

The produced water from the Dewhurst 13-18H and Dewhurst 26-31 pilots will be pumped through the water gathering system to a newly constructed tank located at the Bibblewindi WTF. It is not proposed to use the water storage ponds at Bibblewindi for the produced water from Dewhurst 26-31 or Dewhurst 13-18H. The Bibblewindi Water Transfer Tank is an approved structure, currently under construction in accordance with the *Leewood – Produced Water & Brine Management Ponds REF*, dated December 2012.

- 5) The Bibblewindi Water Transfer Tank located at the Bibblewindi WTF will be used to provide a short buffer (up to 24 hours) prior to the produced water being pumped to the Leewood Produced Water Facility via the Leewood Water Pipeline. It has been designed to accommodate water from the pilots within the E&A Program, however it is not designed to store water for long periods of time. The five megalitre capacity of the tank is appropriate for this purpose.

There was no spill incident at the Bibblewindi WTF during 2013. Santos Limited acquired ESG on 17 November 2011. In July 2012 ESG was issued two penalty infringement notices (PINs) for pollution incidents which occurred at the Bibblewindi Water Treatment Facility prior to November 2011. The details of these PINs are as follows:

- pollution of Bohena Creek on 11 March 2010 due to discharge of permeate, from the reverse osmosis (RO) plant at Bibblewindi, with electrical conductivity (EC) levels above background
- pollution of Bohena Creek on 25 November 2010 due to discharge of permeate, from the RO plant at Bibblewindi, with EC levels above background.

Santos Limited publicly released a report in February 2012 relating to incidents at the Bibblewindi Water Treatment Facility arising from ESG's operations prior to 17 November 2011. In June 2013, proceedings were commenced in the Land and Environment Court against Santos NSW Pty Limited, formerly ESG, for breaches of the *Petroleum (Onshore) Act 1991* for notification and reporting failures relating to incidents which occurred prior to 17 November 2011 in relation to ESG's CSG operations within PAL 2. Santos NSW Pty Ltd pleaded guilty to four breaches of the *Petroleum (Onshore) Act 1991* on 20 September 2013 and the penalty hearing in the Land and Environment

Court was held on 18 December 2013. On 10 January 2014, the NSW Land and Environment Court imposed a fine of \$52,500 for the notification and reporting offences.

- 6) Santos is in agreement with this recommendation.
- 7) Activities within PEL 238 must be carried out in accordance with the conditions of the licence which have been approved by the Minister for Resources and Energy. Under Condition 14 of the PEL, a PWMP identifying storage of produced water at the Leewood Produced Water Facility has been developed by Santos, and approved by the NSW Government. If an application to treat produced water at the Leewood Produced Water Facility is submitted and approved, the PWMP will be revised in consultation with NSW Office of Water, for approval by NSW OCSG.

4.7.4 Rehabilitation

4.7.4.1 Issue description

- 1) No further drilling should be approved until Santos has verified that rehabilitation will enable the landscape to be returned to pre-drilling conditions.

Rehabilitation practices to date in the Pilliga forest have been largely unsuccessful - no regrowth after a year, dieback areas increasing, soil contamination taking 12 years to recover. Santos staff on a public bus tour on 25 October 2013 told members of the public that the kill areas would take around 50 years to regenerate.

4.7.4.2 Response

- 1) Santos has spent much of 2012 and the first quarter of 2013 rehabilitating and upgrading a number of CSG exploration sites in the Pilliga forest. The sites were acquired in November 2011, when Santos took over from ESG.

The operations in the Pilliga forest were shut down in December 2011 and Santos began a review of all existing sites.

Following this review, a detailed work program for the rehabilitation of sites in the Pilliga forest was formulated. Extensive testing was carried out and site specific rehabilitation plans were prepared to ensure each site is successfully remediated. To-date, Santos has committed more than \$17 million to remediation works and substantial progress has been made with rehabilitation of approximately 28 hectares of land throughout PEL 238 and PAL 2. Rehabilitation activities have included:

- reducing the size of existing well leases back to the minimum area required for operations
- plugging and abandoning, according to legislative requirements, wells that are no longer required for exploration and appraisal, and rehabilitating associated well leases
- rehabilitating a number of water storage ponds that are no longer required for exploration and appraisal activities
- rehabilitating vegetation dieback areas resulting from ESG's previous operations.

Rehabilitation has included soil remediation (where necessary in vegetation dieback areas), replacing topsoil, creating micro-relief, re-installing habitat features such as fallen timber and bush rock, natural re-establishment of slashed and cleared native vegetation, and direct seeding where

required. Rehabilitation activities have been undertaken in consultation with the NSW OCSG, Forestry NSW and NSW EPA.

Monitoring of existing rehabilitation activities has shown an overall average site value close to 45 per cent of nearby reference (control) sites after two years. The replacement of topsoil is producing encouraging results, with sites showing a high number of native species when compared to reference sites. Rehabilitation measures undertaken have been considered using adaptive management principles with monitoring informing future modifications to works and methodologies.

Rehabilitation works associated with the proposed activity will follow the methods developed for the existing rehabilitation activities.

4.7.5 CSG Infrastructure

4.7.5.1 Issue description

- 1) The start of the proposed activity should be conditional on the completion of the Bibblewindi WTF.
- 2) Santos should undertake construction of the Bibblewindi water transfer and Leewood produced water facilities in accordance with the EIS.

4.7.5.2 Response

- 1) The transfer tank located at the Bibblewindi WTF is currently under construction and will be completed prior to the operation of the proposed expanded Dewhurst 13-18H and 26-31 pilots.
- 2) The Bibblewindi water transfer tank and Leewood produced water facilities will be constructed in accordance with the *Leewood – Produced Water & Brine Management Ponds REF*, dated December 2012.

4.8 Community and stakeholder consultation

4.8.1 Consultation with the Aboriginal communities

4.8.1.1 Issue description

- 1) There is a Native Title claim over the proposed activity area and Santos must include the Gomeroi Native Title Claimants, Gomeroi Traditional Owners of the Pilliga and the Narrabri LALC in their consultation.

4.8.1.2 Response

- 1) Santos is actively engaging with the relevant Aboriginal groups regarding Native Title in parallel to the NSW environmental approval process. Santos will work towards an agreement with the native title parties in relation to the land in which it plans to operate and ensure that Aboriginal stakeholders share in the social and economic benefits of a CSG industry. Consultation with the Gomeroi Native Title Claimants, Gomeroi Traditional Owners of the Pilliga and the Narrabri LALC is described in Section 5.3.4.2 of the EIS.

4.8.2 Consultation with the local community

4.8.2.1 Issue description

- 1) Consultation with the residents of the Narrabri area has been inadequate. An ongoing comprehensive community and stakeholder engagement program is essential to minimise negative impacts.
- 2) The Coonabarabran and Baradine communities are ignored and advertisements for consultation appear in only the Narrabri and Gunnedah media.
- 3) Continued consultation with Narrabri Shire Council, particularly on proposed activity and schedule updates is requested.
- 4) Concerns raised by neighbouring landowner as to the adequacy of Santos' consultation, land access and complaints processes.

4.8.2.2 Response

- 1) Santos has developed a community engagement and consultation framework to specifically target the different needs and requirements of stakeholders and the community to inform and consult on the E&A Program and the CSG industry more broadly (Chapter 5 of the EIS). Santos is committed to undertaking ongoing community engagement and consultation. Specific consultation undertaken for the proposed activity includes:
 - a presentation at Narrabri Shire Council
 - Narrabri CCC updates including how to lodge a submission
 - monthly updates published in the Narrabri Courier
 - hard copies of the EIS on display at Narrabri Shire Council, Santos Narrabri Operations Centre and Santos Maitland Street shopfront.
- 2) The advertisement was undertaken in accordance with Section 89F of the EP&A Act, with the process hosted on the DP&I website. The E&A Program is located within the Narrabri LGA, therefore the focus of Santos' community engagement has been within this region. If, in the future, Santos was to expand their activities outside of this region, engagement with affected communities would be established. Communities outside the Narrabri LGA are able to access information, including environmental assessments of proposed works, through the Santos website and media announcements. The Project information line and the Narrabri shopfront are also available for anyone who is seeking further information on the proposed activity.
- 3) Santos has a program of consultation with stakeholders with a specific interest in local activities including local government representatives. Consultation through regular meetings with local government staff and elected representatives has occurred. Santos will ensure that these monthly discussions will continue to be offered, in line with its commitment to the council. In addition, quarterly Government Information Forums are held with invitations extended to local officers of NSW Government departments to provide information on projects and work schedules.
- 4) All complaints have been notified to the NSW OCSG and a response provided to the complainant.

4.9 Planning and statutory framework

4.9.1 Regulatory compliance

4.9.1.1 Issue description

- 1) Concern over past incidents by ESG including spills to Bohena Creek, and that existing infrastructure is not adequate to prevent further incidents occurring. Santos has no historical data that proves that spills and contamination have not occurred from 2009 through to present.

Santos is requesting approval for expansion of their activities before their prosecutions have been closed out.

- 2) A sediment and erosion plan has not been implemented for Dewhurst Northern Water and Gas Flow Lines currently under construction despite this being a requirement of the approval granted by the NSW OCSG. Conditions 4 and 7 for the flowline approvals note that creek crossings must be designed according to *NSW Guidelines for Controlled Activities*. Respondent asserts that no erosion and sediment controls were in place at Bohena Creek overflow on 30 November 2013.
- 3) Santos should clarify which environmental assessment and approval covers the relatively recent clearing and upgrade of the 'Killara Road' and 'un-named road' depicted in Figure 3-5 of the EIS.
- 4) There is no commitment by Santos to provide a bond, or no indication of how Santos or the government will make amends for the potential loss or contamination of water resources, particularly at an individual user level.

4.9.1.2 Response

- 1) Santos Limited acquired ESG on 17 November 2011. In July 2012 ESG was issued two PINs for pollution incidents which occurred at the Bibblewindi Water Treatment Facility prior to November 2011. The details of these PINs are as follows:
 - pollution of Bohena Creek on 11 March 2010 due to discharge of permeate, from the RO plant at Bibblewindi, with EC levels above background
 - pollution of Bohena Creek on 25 November 2010 due to discharge of permeate, from the RO plant at Bibblewindi, with EC levels above background.

Santos Limited publicly released a report in February 2012 relating to incidents at the Bibblewindi Water Treatment Facility arising from ESG's operations prior to 17 November 2011. In June 2013, proceedings were commenced in the Land and Environment Court against Santos NSW Pty Limited, formerly ESG, for breaches of the *Petroleum (Onshore) Act 1991* for notification and reporting failures relating to incidents which occurred prior to 17 November 2011 in relation to ESG's CSG operations within PAL 2. Santos NSW Pty Ltd pleaded guilty to four breaches of the *Petroleum (Onshore) Act 1991* on 20 September 2013 and the penalty hearing in the Land and Environment Court was held on 18 December 2013. On 10 January 2014, the NSW Land and Environment Court imposed a fine of \$52,500 for the notification and reporting offences.

Since ESG was acquired by Santos Limited on 17 November 2011, new management has been appointed to ESG and ESG has been renamed Santos NSW Pty Limited. The RO plant at Bibblewindi Water Treatment Facility (the subject of the incidents) ceased operation on 15 December 2011 and has been decommissioned. Santos has commenced rehabilitation of vegetation surrounding the Bibblewindi facility which was affected by the incidents. Alternative arrangements for managing existing produced water and produced water from recommencement of

operations have been progressed, and approval has been granted for the construction and operation of new water storage ponds at Leewood. The ponds at the Leewood Produced Water Facility will be double lined and will have a leak detection system. Refer to Section 3.2.1.2 of the EIS for further details of the Leewood ponds.

In addition, Santos has significant financial capital, and has many years of experience in undertaking exploration activities for CSG. As a result, it has developed an extensive understanding of the steps and measures that should be taken to prevent or minimise its impact on the environment, human health and safety when undertaking exploration activities. Santos seeks to conduct its activities in a way that avoids and minimises potential impacts on the environment.

- 2) Condition 4 of the Dewhurst Northern Water and Gas Flow Lines approvals state that '*construction activity within 40 metres of any watercourse...should be designed by a suitably qualified person, consistent with the NSW Guidelines for Controlled Activities (July 2012)*'.

Condition 7 of the Dewhurst Northern Water and Gas Flow Lines approvals state that '*a Sediment and Erosion Control Plan must be prepared and implemented...The plan should be prepared in accordance with the requirements for such plans outlined in Managing Urban Stormwater: Soils and Construction [the Blue Book]*'.

Santos has several key personnel trained in the Blue Book. The contractor carrying out the works for the flow lines also has key personnel trained in the Blue Book, and has an Erosion and Sediment Control Plan that is Blue Book compliant. Santos environment field staff closely monitor all contractors' activities, to ensure that Blue Book requirements are met.

The works being undertaken at the overflow section of the Bohena Creek crossing were temporary and were scheduled to be completed in a single day. The works were interrupted by protesters for approximately four hours, which prevented the works from being completed in one day. There was no rainfall forecast overnight or in the coming days, therefore it was determined that there was no need to install erosion and sediment controls overnight. Had rain been forecast, controls would have been implemented. The Blue Book states that no erosion and sediment control measures are to be implemented in a Creek flow path.

- 3) The owner of Lot 32 DP757104 undertook removal of native vegetation along 'Killara Road' and the 'un-named road' in late 2011. Approval was given by Crown Lands to undertake these works within Crown Road Reserves in a letter dated 19 October 2011. These works were independent of Santos' activities.
- 4) Under the *Petroleum (Onshore) Act 1991*, a security deposit must be provided to the government. This covers the full rehabilitation costs of the proposed activity, and is not released until the proposed activity works (including rehabilitation) have been completed satisfactorily.

A detailed monitoring program has commenced and will be continued throughout the duration of Santos' activities in the Narrabri region. The monitoring program will identify if impacts to the groundwater system are occurring. If impacts to highly productive groundwater sources are identified Santos' groundwater extraction activities in the localised area of the impact will cease, the issue investigated and appropriate mitigation and management measures will be implemented. In the event that Santos' operations are found to have impacted the capacity or quality of a useable aquifer, Santos has to adhere to 'make good provisions' under the AIP.

4.9.2 Commonwealth referral

4.9.2.1 [Issue description](#)

- 1) The proposed activity and the broader E&A Program will have a significant impact on Matters of National Environmental Significances (MNES) (Water Resources). Concerns that submission of individual CSG proposals within the area is an attempt to avoid the 'water trigger' for referral under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- 2) Concerns that the Federal Minister for Environment did not use the 'water trigger' and did not declare Santos' current activity in the Pilliga forest a 'controlled action'.

4.9.2.2 [Response](#)

- 1) Santos referred E&A Program activities within the Pilliga forest (including the proposed activity), to the Federal government for a decision under the EPBC Act in June 2013 (Section 6.3.1 of the EIS). On 1 October 2013, the Minister made the decision that the proposed action is not a controlled action if undertaken in a particular manner. The referral included an assessment of the potential cumulative impacts on the 'Water Resources from CSG development and large coal mining development'.
- 2) This is a matter for the Federal government. Santos' referral of the E&A Program under the EPBC Act included an assessment against the MNES 'water trigger' (water resource, in relation to CSG development and large coal mining development). The Commonwealth Minister for the Environment assessed the E&A Program and concluded the Santos' E&A Program is not a CSG development that has or is likely to have, a significant impact on water resources, provided it is carried out in accordance with particular requirements.

4.9.3 Policy

4.9.3.1 [Issue description](#)

- 1) Concerns were raised over the adequacy of the CSG exclusion zones that came into effect from 4 October 2013, which enforced a two kilometre buffer for new CSG activities across existing residential zones, as well as lands identified for future residential growth and CIC.

4.9.3.2 [Response](#)

- 1) This is a policy issue for the NSW Government to address.

4.9.4 Other regulatory comments

4.9.4.1 [Issue description](#)

- 1) Question as to whether the trigger to prepare an EIS (under the SRD SEPP) means that a development meeting the SRD SEPP criteria is likely to have a significant environmental impact.
- 2) Concern that Santos has escaped approval of this proposed activity by NSW EPA and instead is able to gain approval by the Planning Minister as it is classified as SSD under the SRD SEPP.
- 3) Work has commenced prior to the EIS submission period closing. The process is not transparent and is not consistent with how development is undertaken in NSW.

- 4) Santos will need to ensure that appropriate WALs are in place to account for any take of groundwater.
- 5) The granting of unrestricted use of groundwater for CSG extraction should not be allowed. It should be at the same cost as agricultural use.
- 6) Santos will need to submit a variation application to NSW EPA to add the proposed activity to the EPL application.

4.9.4.2 Response

- 1) The proposed activity is classified as SSD under the SRD SEPP and requires development consent from the Minister for Planning and Infrastructure under Part 4, Division 4.1 of the EP&A Act. Under Section 78A of the EP&A Act, an EIS is required for SSD. Consideration of whether the proposed activity is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats is required under Section 5A of the EP&A Act (known as the seven-part test) in order for a determining authority to issue a consent or approval under the EP&A Act. Seven-part tests have been undertaken to determine the likely significance of the proposed activity on relevant threatened species and their habitats. No significant impacts were identified.
- 2) The NSW Minister for Planning and Infrastructure is the consent authority for the proposed activity as it is classified as SSD under the SRD SEPP. The NSW EPA is not a consent authority for the granting of development consents under the EP&A Act. Rather, the NSW EPA is a referral body which reviews and provides advice on DAs and recommends conditions of consent to the relevant determining authority during the government's assessment process. The NSW EPA is also responsible for the issuing and administering of EPLs under the *Protection of the Environment Operations Act 1997* (POEO Act). The proposed activity is classified as a scheduled activity under the POEO Act and will require an EPL if development consent is granted.
- 3) No work has commenced for the Dewhurst Gas Exploration Pilot Expansion Project. Some work in the Pilliga forest has commenced for other components of the E&A Program which have been granted separate approvals.
- 4) Santos has currently applied for a 600 megalitre WAL to account for all take of water for the proposed activity, and will continue to work with the NSW Office of Water to ensure that it obtains all the necessary licenses for the E&A Program.
- 5) Santos is not exempt from water licensing requirements, which are clearly stated in the AIP; nor do they have unrestricted use. Approvals and licences required under the *Water Management Act 2000* are discussed in Section 6.2.3 of the EIS.
- 6) Santos will submit a variation application to the NSW EPA to vary its application for an EPL if development consent for the proposed activity is granted.

4.10 Environmental risk assessment

4.10.1 Issue description

- 1) The risk assessment is insufficient as there is no mention of the 23 reported hazardous incidents involving the spilling of produced water, no detail on the management of weeds, the *NSW Coal Seam Gas Code of Practice Well Integrity* (DTIRIS, 2012) would not mitigate risk to stygofauna, the bushfire risk is underestimated and the heritage risk assessment is lacking.

4.10.2 Response

- 1) The risk assessment provided in the EIS is considered to be appropriate, given the nature and scale of the proposed activity and the mitigation measures that will be adopted. The risk assessment process inherently takes into account past pollution incidents. The potential for leakage or spills, weed invasion, risks to stygofauna and bushfires were identified during the preliminary environmental risk assessment, shown in Tables 7-1 and 7-2, and considered in further detail in the impact assessment chapters of the EIS. The mitigation measures are appropriate to manage the identified risks e.g. produced water will be managed in a purpose built gathering and storage system including double lined ponds with leak detection system.

4.11 Land resources

4.11.1 Issue description

- 1) Concerns about the impact on the apiary industry.
- 2) The best food-producing lands and finest natural areas are at risk from CSG activity. The science tells us that CSG puts at risk the clean water and soil that is essential for food production.
- 3) The impacts of the proposed CSG field development in the Jacks Creek and Pilliga State Forests should be investigated, including the potential economic impact on forestry due to limiting the availability of timber in the region.
- 4) Erosion and sediment controls should be implemented consistent with the guidelines, principles and recommended minimum design standards contained in *Managing Urban Stormwater: Soils and Construction – Volume 1* (the Blue Book).

4.11.2 Response

- 1) The proposed activity at Dewhurst 13-18H is predominantly located on existing lease areas that are previously cleared, and hence do not harbour honey tree species (Section 8.2.1 of the EIS). In total, 0.24 hectares and 2.2 hectares of Narrow-leaved Ironbark – White Cypress Pine – Buloke tall open forest (containing potential honey trees) require clearing at Dewhurst 13-18H and Dewhurst 26-31, respectively. Due to the minimal clearance of potential honey trees and the availability of these trees in the surrounding vegetation, the proposed activity is anticipated to have a negligible impact on the apiary industry.

Section 7.1.1 of the AIS (Appendix 2 of the EIS) also determined that, due to the minimal disturbance of potential honey trees within the Pilliga forest, a low to negligible cumulative impact is anticipated on the apiary industry due to the E&A Program.

- 2) While the Dewhurst 13-18H pilot is located within a property used for agricultural activities, the proposed activity occurs within areas previously disturbed for CSG activities. In addition, no intensive agricultural activities are currently undertaken within the property, and the land on which it is located has low potential for commercial agricultural land use. All surface disturbance areas will be fully rehabilitated in consultation with the landowner, and as such there will be no permanent land capability reduction of agricultural resources.

As the proposed activity at Dewhurst 26-31 lies within a State forest, it will not prohibit any agricultural production within the region.

The two pilot sites are not located on or near BSAL and/or a CIC as defined in the *New England North West Strategic Regional Land Use Plan* (DP&I, 2012). The nearest mapped BSAL is approximately 10 kilometres east of Dewhurst 13-18H and no CIC has been identified in DP&I (2012).

Produced water from the wells is not from the productive aquifers accessed by farmers and the community. It comes from deep underground and is not used by farmers and the community due to its depth and high salinity. Santos has developed an extensive regional groundwater model that simulates groundwater flow and predicts groundwater drawdown. The Groundwater Impact Technical Report (Appendix 3 of the EIS) predicted the effect of the E&A Program on productive groundwater resources to be negligible.

- 3) Production forestry is mapped within PEL 238, incorporating State forest used for timber harvesting and nature reserves (Section 8.2.1 of the EIS). Timber harvesting within the Pilliga Scrub, including within the Jacks Creek or Pilliga East State forests has been reduced largely due to conservation efforts. Therefore such enterprises are not considered significant. The proposed activity footprint at Dewhurst 30-31 (3.52 hectares) is negligible when compared to the extent of State forest remaining (over 190,000 hectares), available for timber harvesting or conservation purposes.
- 4) Santos agrees with this recommendation; the SoC has been updated accordingly.

4.12 Groundwater

4.12.1 Baseline monitoring and data

4.12.1.1 Issue description

- 1) There is no baseline water study completed for the Pilliga groundwater systems. The aquifer monitoring bores required have not yet been constructed, which hinders the establishment of baseline criteria. The adequacy of the groundwater testing has not been demonstrated.

Baseline data must be established for a minimum of two years according to the NSW Office of Water's AIP.

- 2) There have been few studies on the hydrology and geology of the area with information being gathered from limited seismic surveys and bore logs.
- 3) The EIS states that the overall values of pH range from 6.81 to 11.2 and total dissolved solids (TDS) between approximately 300 and 6000 milligrams per litre. Santos took a groundwater sample from the submitter's bore on 22 March 2013, with measured pH of 6.02 and TDS of 114 milligrams per litre. The values provided in the EIS are not within the vicinity of the proposed activity, and don't represent baseline groundwater quality.

4.12.1.2 Response

- 1) Baseline groundwater monitoring has been undertaken for bores (including at private water bores and NSW Office of Water bores). The collated data from a number of sources over a period of time provides a groundwater monitoring dataset for the region. The data is included in the *Dewhurst Gas Exploration Pilot Baseline Surface and Groundwater Data Report*, attached as Appendix 2.

Monitoring was initiated within the Narrabri region in early 2012, focusing on collecting groundwater samples and static water levels from landholder bores in close proximity to the CSG activities. As this data is collected and assessed, it expands on baseline data and understanding by providing

greater spatial and temporal data resolution local to CSG activities. Seventy bores (mostly private farm bores) have been documented and groundwater samples analysed so far from within PEL 238 and PAL 2.

To support the development of a regional baseline dataset, Santos has collated historical data collected by ESG and publicly available information from the NSW Office of Water. Data gathered includes:

- produced water extraction rates from CSG pilot wells
- groundwater elevations from available NSW Office of Water aquifer monitoring bores
- produced water geochemical data from CSG pilot wells
- groundwater geochemical data from landholder bores.

As additional data is collected through Santos' ongoing environmental monitoring programs it will enable the expansion of this baseline dataset. The data will be used to assist in monitoring for any unexpected changes to overlying aquifers during the operation of the proposed activity.

The GMMP describes the purpose, objectives, rationale and approach for collecting and evaluating groundwater data within the E&A Program area. It also describes how collected groundwater data will be maintained and the process for using the data to assist in calibrating the regional groundwater model for the area. The GMMP has been prepared in consultation with the NSW Office of Water and approved by the NSW OCSG.

- 2) Santos has a detailed geological model constructed through the assimilation of available exploration well data, seismic and other geophysical survey data and outcrop geological mapping, conducted over the past 60 years covering the entire E&A Program area and therefore has detailed information on the depth of all formations, including aquifer units. This information is detailed in the *Narrabri Groundwater Model Report* (CH2M Hill, 2013), which has been submitted to the NSW Office of Water and DP&I.
- 3) The regional Gunnedah and Narrabri water quality information presented in the EIS pre-dates the sampling of the submitter's bore. Further details of baseline groundwater water quality data, including landholder bores sampled in PEL 238 and PAL 2 since 2012, is presented in the *Dewhurst Gas Exploration Pilot Baseline Surface and Groundwater Data Report* (Appendix 2). Data from the submitter's bore is incorporated into this report.

According to the Pinneena database (NOW, 2010), the submitter's bore is stated to have a total depth of 71 metres, and the target aquifer is the GAB. With a TDS of 114 milligrams per litre, the groundwater within the bore is considered to be 'fresh to brackish'. This is in line with the earlier findings for the GAB, as stated in Section 9.1.4 of the EIS.

4.12.2 Model conceptualisation, development and calibration

4.12.2.1 Issue description

- 1) The Conceptual Hydrogeological Model in Figure 9-1 appears to be incorrect, based on Santos' own data and other published geological maps. The conceptualisation of the hydrostratigraphic beds and how they interact with each other, including the aquitards and aquicludes, appears to be incorrect.
- 2) The model layers used to build the Groundwater Numerical Model are not representative of the shallow hydrostratigraphy.

- 3) The model is considered to be based on insufficient hydraulic data. The lack of information on the assumptions required for model development, in particular basic hydrogeological or geological data within the vicinity of the proposed activity, is of concern. Without this data it is hard for technical reviewers to provide informed comments as to whether the conclusions reached in the EIS are justifiable or not.

The groundwater model has been calibrated under steady state conditions, with the initial hydraulic heads being determined by this initial model and fed into the subsequent historical model.

The short comings of the model and the assumptions used give rise to concerns over the robustness of the results obtained, including the assessment of potential impacts of CSG activities on groundwater resources.

There should be thorough sampling and testing across the E&A Program area, including pump testing and water quality analysis, to enable modelling of regional groundwater flows and a comprehensive impact assessment of groundwater resources and GDEs in the Pilliga region. The additional data should be fed back into the numerical groundwater model, sensitivity analysis carried out and the model rerun.

- 4) This groundwater modelling for the proposed activity does not comply with the AIP. Section 3.2.3 of the AIP states that for SSD the predictions must be based on a complex modelling platform that is '*Calibrated against suitable baseline data and in the case of a reliable water resource for a minimum of two years*'. The Pilliga Sandstones that feed the GAB are a 'reliable water resource' and therefore Santos has not met this requirement.
- 5) The Maules Creek Formation is predicted to achieve 80 per cent recovery after ten years. This would appear to indicate hydraulic connectivity. Furthermore, rapid recovery after drawdown in both the Hoskissons and Maules Creek coal seams is shown, again appearing to indicate actual or potential hydraulic connectivity to aquifers. The Maules Creek Formation is listed as being a 'negligibly transmissive unit', an apparent contradiction to the rapid pressure recovery.
- 6) The proponent has not provided sufficient evidence of their groundwater model. Santos has stated that the data used in their groundwater model and associated report is commercial in confidence, however it should be made available for independent scrutiny.

The Groundwater Impact Technical Report (Appendix 3 of the EIS) states '*The findings of this report should be read in conjunction with the Narrabri Groundwater Model Report (CH2M HILL, 2013) which presents the basis for the creation of the groundwater flow model*', yet this report is not available.

Insufficient information has been provided for the NSW Office of Water to assess the validity of the model and its suitability in making the required predictions. Additional detailed modelling reports, including the report *Groundwater impact assessment for the Narrabri Gas Project*, ESG (Golder, 2011), should be submitted to NSW Office of Water for review, including any peer review.

- 7) Narrabri Shire Council seeks further information on the conceptual groundwater model and the assumptions made in the groundwater modelling.

4.12.2.2 Response

- 1) Figure 9-1 in the EIS is a schematic cross section and reflects the current conceptual understanding of geology and hydrostratigraphy in the E&A Program area (based on Santos geological model data and agreed with Santos geologists). Further detail to support the schematic cross section and descriptions used is provided in the Groundwater Impact Technical Report (Appendix 3 of the EIS).

Table 3-1 of the Technical Report presents the hydrogeological classification of each model layer, and therefore each hydrostratigraphic unit. The litho-stratigraphy has been classified into significant transmissive units (STU) and less significant transmissive units (LSTU), probable negligibly transmissive units (PNTU) (restricting the transmission of groundwater) and negligibly transmissive units (NTU) (impeding groundwater flow). The purpose of these definitions is to recognise the relative significance of hydraulic properties of different units to the hydrogeological response of the system without attributing labels that carry generally-accepted but potentially inappropriate connotations, such as 'aquifer', 'aquitard' and 'aquiclude'. Hence a highly conductive, high-yielding stratum would be considered a typical example of a STU and a low-yielding stratum would be considered a LSTU.

- 2) The model was developed as a regional model to assess the impact of depressurisation of the target coal seam on the overlying formations. The focus of the model was not on the shallow system, but the groundwater system as a whole and the potential propagation of drawdown as a result of coal seam depressurisation. The model design and development was based on all information available at the time. The Bohena alluvium is modelled as Hydrostratigraphic Unit (HSU) 1 while the Pilliga Sandstone and Keelindi Beds are modelled as HSU10. Minimal information is available relating to the Keelindi Beds. On the basis of its characteristic lithologies, it has been subsumed into the underlying Pilliga Sandstone for the purpose of its inclusion in the hydrogeological conceptualisation and numerical groundwater flow model. Santos considers that the model developed is fit for purpose and is based on sufficient data to assess the likely impacts of the proposed activity.
- 3) The model is a Level 1 model, developed in accordance with the *Australian Groundwater Modelling Guidelines* (Barnett *et al.*, 2012), and is intended to provide the basis for an initial assessment of the responses of the system to hydraulic stress. Santos considers the level of data used in the model to be suitable for the level of assessment undertaken. As with the development of all scientific models, additional data will assist in model refinement.

A conservative approach, consistent with the precautionary principle, has been undertaken for all aspects of model design to ensure that the model is sensitive to the simulated hydraulic stress (CSG water extraction). Model construction used all baseline data available. In the absence of measured parametric data, values derived from relevant calibrated models in the locality were used. Extensive and targeted sensitivity analysis has been conducted to determine the significance of aspects of the model design and the hydraulic parameterisation of the model and ensure adequate conservatism.

Santos has drilled and installed seventeen new groundwater monitoring bores across eight locations, targeting the Upper and Lower Pilliga Sandstone, Orallo formation and Purlawaugh formation and one deep aquifer monitoring bore targeting strata surrounding the Black Jack and Maules Creek Coal measures. The data that will become available through ongoing monitoring will be used to refine and validate the model, in accordance with the *Australian Groundwater Modelling Guidelines* (Barnett *et al.*, 2012).

- 4) The groundwater numerical model has been calibrated in steady state using available data in accordance with the AIP and the *Australian Groundwater Modelling Guidelines* (Barnett *et al.*, 2012).

Data that will become available through ongoing monitoring will be used to refine and validate the model, in accordance with Barnett *et al.* (2012).

- 5) The fast initial recovery is mainly due to the minimal storativity of the Maules Creek Formation which means a small amount of water, during extraction or during recovery, results in a large change in head.
- 6) The *Narrabri Groundwater Model Report* (CH2M Hill, 2013) and peer review report have been submitted to NSW Office of Water and DP&I. Santos will continue to work with the NSW Office of Water to seek clarification on the comments they have made in their review and to respond to their concerns and questions.

The *Groundwater impact assessment for the Narrabri Gas Project*, ESG (Golder, 2011) has been updated as the *Narrabri Groundwater Model Report* (CH2M Hill, 2013), which has been provided to the NSW Office of Water.

- 7) Santos has approached the Narrabri Shire Council with the offer to meet and discuss various groundwater matters including numerical model conceptualisation and the monitoring program.

4.12.3 Potential impacts to groundwater resources

4.12.3.1 Issue description

- 1) The EIS has not provided an assessment of the impacts of the proposed activity (including drilling) on water quality. Sufficient water quality information should be provided to allow an assessment against the minimal impact consideration for water quality in the AIP for affected water sources. An assessment of the impacts of drilling on groundwater quality needs to be undertaken to determine whether drilling fluids will be released to the environment at toxic concentrations.

Concerns over the potential contamination of groundwater resources through leakages of chemicals used during drilling and cross-contamination between aquifers. Contamination could impact on the health of the community and environment, as well as create flow-on effects to local industries reliant on the groundwater resource. Santos cannot guarantee there is no risk of contaminating groundwater. Concerns that if groundwater becomes contaminated there is no system in place for remediation.

- 2) The EIS has not made clear what a 'significant decline' is and what impacts these are likely to have on GDEs. The Pilliga sandstone is highly porous and deeper depressurisation may have the potential to cause declines in the water table and significant impact on the overall flux of groundwater systems.
- 3) In Santos' referral of the E&A Program under the EPBC Act, CH2M Hill states that the cumulative groundwater impact assessment indicates that depressurisation of the target coal seam, as a result of pilot activities, results in a negligible decline in water levels (less than 0.5 metres) within the Namoi Alluvium and the Pilliga Sandstone groundwater sources. CH2M Hill now states that there will be no decline in groundwater levels.
- 4) Questions as to what basis is it claimed there would be no aquifer interference; and what is the predicted two metre decline in groundwater head based on, and how this prediction may relate to the proposed activity.
- 5) The Groundwater Impact Technical Report (Appendix 3 of the EIS) details that the drawdown within the shallowest targeted seam (Hoskissons Seam) by the Tintfield pilot would extend underneath the

overlying Lower Namoi Alluvium. It states that the residual drawdown within the seam is expected to exist for more than 100 years after the succession of the E&A Program.

- 6) Concerns that the potential impacts on groundwater due to CSG are not known. The development of a CSG industry threatens the local community as it risks impacting on the groundwater supply and quality. These impacts could be long-term. Santos cannot guarantee water supply will not be adversely affected as a result of CSG activities.
- 7) Questions whether Santos is trying to justify the water extraction by stating that the Namoi Upper and Lower Alluvium are not considered to underlie the proposed activity area.

4.12.3.2 Response

- 1) Sections 9.1.4 and 10.1.4 of the EIS presents a summary of water quality, while further details of baseline water quality data is presented in the *Dewhurst Gas Exploration Pilot Baseline Surface and Groundwater Data Report* (Appendix 2). Groundwater quality is also assessed as a construction impact in Section 9.3.1 of the EIS.

Wells will be designed and constructed in accordance with the *NSW Coal Seam Gas Code of Practice Well Integrity* (DTIRIS, 2012), as stated in Section 9.3.1 of the EIS. This Code of Practice includes mandatory requirements for well design, casing, cementing, wellheads and drilling fluids. Further to this, Santos will adopt best practice site environmental management measures to minimise the likelihood of accidental spillage, and have appropriate management and mitigation plans in place should a spill occur as outlined in Section 8.4 of the EIS, to contain and prevent environmental harm.

During drilling, the circulating drilling fluid will establish a wall cake (a low permeability 'skin' around the wall of the hole) and maintain pressure on the various aquifers intercepted. This will prevent the ingress of groundwater to the pilot well, mixing of groundwater between aquifers and discharge of groundwater to the surface. It will also limit the ingress of drilling fluid into the aquifers in the immediate vicinity of the pilot well.

The chemicals used in drilling have been assessed and determined to pose no long term risks to the environment. In accordance with Australian and International standards, a hazard assessment has been conducted on the chemicals used in drilling. The assessment is detailed in the *Drilling Fluid Risk Evaluation* report, attached as Appendix 3. This hazard assessment methodology assesses the persistence, bioaccumulation and toxicity (PBT) of chemicals to determine if chemicals could persistent or accumulate in the environment at concentrations that could pose risks to receptors. None of the chemicals used in drilling have been identified as PBT chemical.

The groundwater flow model confirms that during operation it is considered highly unlikely that the more saline water from the deeper water sources would have a pathway to migrate upwards. Potential impacts to surface water during both construction and operation of the proposed activity are provided in Section 10.2.2 of the EIS. Given the scale of the proposed activity, and the implementation of appropriate mitigation measures, these are considered to be minimal.

- 2) The Groundwater Impact Technical Report (Appendix 3 of the EIS) states the impact criteria for determining significance, based on the AIP. The aim of the cumulative groundwater model is to simulate the predicted impact caused by propagation of drawdown vertically upwards (leakage) following depressurisation of the coal seam. The results of modelling indicate no significant impact to the Pilliga Sandstone or overlying alluvial aquifer.

- 3) The Groundwater Impact Technical Report (Appendix 3 of the EIS) states in Section 4.1.2 that there is negligible predicted impact (defined as less than 0.5 metres) in the Namoi alluvium and the Pilliga Sandstone. It also states that there is no significant impact (defined as an impact greater than 0.5 metres) above the Triassic strata. This is documented in Table 4-1. Statements relating to there being no significant decline are present, in both the Groundwater Impact Technical Report and the EIS itself, however the definition of significance is consistent (greater than 0.5 metres) and clearly stated in the reports.
- 4) The Groundwater Impact Technical Report (Appendix 3 of the EIS) states that '*it is predicted that there will be aquifer interference*'. Section 4.3 presents the outcome of modelling in relation to the AIP. It states that the results of simulation of water extraction, and resultant propagation of drawdown, indicates a decline in head in the NSW Murray-Darling Basin Porous Rock Groundwater Source of greater than two metres, which denotes aquifer interference. The AIP considers the NSW Murray-Darling Basin Porous Rock Groundwater Source to be a 'less productive' groundwater source.
- 5) This statement is correct, however there is a succession of overlying low conductivity hydrostratigraphic units in between the depressurised target seams and the GAB/alluvial aquifers which will inhibit leakage and retard migration vertically. The Groundwater Impact Technical Report (Appendix 3 of the EIS) states that the Pilliga Sandstone and thus the overlying alluvial aquifer will not be significantly impacted (i.e. impact predicted to be less than 0.5 metres).
- 6) Santos acknowledges the sensitivity of the availability of groundwater as a resource within the region. A detailed monitoring program has commenced and will be continued throughout the duration of Santos' activities in the Narrabri region. The monitoring program will identify if impacts to the groundwater system are occurring. If impacts to highly productive groundwater sources (the Upper and Lower Namoi alluvium and the GAB) are identified, Santos' groundwater extraction activities in the localised area of the impact will cease, the issue investigated and appropriate mitigation and management measures will be implemented. In the event that Santos' operations are found to have impacted the capacity or quality of a useable aquifer, Santos will adhere to 'make good provisions' under the AIP.
- 7) The location of the Namoi Upper and Lower Alluvium aquifer system is determined based on a combination of geological maps, hydrogeological maps, local geological literature and geological data obtained from Santos, ESG and other bores.

4.12.4 Great Artesian Basin

4.12.4.1 Issue description

- 1) The Pilliga forest is a recharge area for the GAB and contributes surface water flows to the Murray-Darling Basin. Concerns that the GAB is at risk from proposed intensive CSG drilling, with potential declines in water quantity or quality which could have flow on effects to other industries. These impacts may not be easily fixed or compensated.
- 2) The statement in the EIS that all watercourses appear to be losing streams is an admission that these streams are connected to the aquifers below and are therefore a direct connection to the GAB. Contaminants or produced water discharges will be able to find their way into the GAB aquifer.

4.12.4.2 [Response](#)

- 1) Santos acknowledges that the Pilliga Sandstone which outcrops in parts of the Pilliga forest acts as a recharge bed for the GAB, and the need for due care when operating in the outcrop area. This has been reflected in the sensitivity of the receptor within the impact assessment. The groundwater impact assessment (Section 9.4 and Appendix 3 of the EIS) indicates that there will be negligible impact to the GAB due to the cumulative effects of the E&A Program.
- 2) While losing streams may be connected to aquifers below, in particular alluvial systems, the only direct connection with the GAB will be in cases where the Pilliga Sandstone outcrops directly underlying the alluvial systems. The only potential for this to occur is where the Bohena Creek transects the outcrop of the Pilliga Sandstone which is not near the proposed activity.

Santos will adopt best practice site environmental management measures to minimise the likelihood of accidental spillage, and have appropriate management and mitigation plans in place should a spill occur as outlined in Section 8.4 of the EIS, to contain and prevent environmental harm.

4.12.5 **Drilling techniques and well integrity**

4.12.5.1 [Issue description](#)

- 1) The *NSW Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS, 2012) guidelines is being relied upon by the NSW Government to ensure Santos does not contaminate the water resource. Santos, however, is only required to adequately seal off 'producing aquifers' from each other. The Bohena alluvial aquifer might not be a 'producing aquifer' but it is still a lower quality aquifer that will be connected to the Pilliga during drilling activities and therefore poses a risk of leaking lower quality water into the GAB aquifer.
- 2) The 'Triple Stacked' drilling of horizontal CSG wells through the casing of the existing wells poses great danger to the GAB and other aquifers as it is very difficult, if not impossible, to seal the junction between the casing and the lateral. This has the potential for leakage of gas and water both to the surface and between aquifers.

When questioned about sealing these junctions in July this year, the NSW Chief Scientist said she had been told by Santos that they had difficulty sealing these junctions known as Kick Off Points (KOPs).

- 3) There is evidence that well casings fail, with industry figures quoted by Josh Fox (documentary director) that 30 per cent of casings fail in 50 years. Other respondents claimed that seven per cent leaking immediately and 50 per cent within 20 years. If the casings fail there is a risk of leakage of produced water or gases into the overlying aquifers.
- 4) Question as to how horizontal wells can be drilled and remain wholly within the target coal seam.

4.12.5.2 [Response](#)

- 1) The GAB is classified as a beneficial aquifer, based on the definitions within the *NSW Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS, 2012), and will therefore be isolated with cement in accordance with the Code of Practice. Furthermore, the Bohena alluvium is an intermittent aquifer fed primarily by rainfall and therefore not considered to be of poor quality. In areas where the Bohena alluvium intercepts the Pilliga Sandstone, it provides a direct source of recharge to the GAB.

- 2) The fibreglass casing of the vertical well is intersected in a 6 1/8 inch hole size at depths well below the aquifers. There will be no impact on zonal isolation above the intersection point. Any formation washout will be minimal and localised at the immediate vicinity of the point of intersect. There are hundreds of metres of cemented casing between the intersect point and the aquifer, protecting the aquifer from annular gas migration.

During drilling, the circulating drilling fluid will establish a wall cake (a low permeability 'skin' around the wall of the hole) and maintain pressure on the various aquifers intercepted. This will prevent the ingress of groundwater to the pilot well, mixing of groundwater between aquifers and discharge of groundwater to the surface. It will also limit the ingress of drilling fluid into the aquifers in the immediate vicinity of the pilot well.

The wells will be designed and constructed in accordance with the *NSW Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS, 2012) (Sections 4.2.1 and 4.2.2 of the EIS). The Code of Practice established a best practice framework for well design, construction and maintenance, including for horizontal wells. It has undergone peer-review and been endorsed by the NSW Chief Scientist and Engineer. Complying with the Code of Practice is a condition of Santos' licence to explore in PEL 238, to ensure the proposed activity is undertaken safely and the groundwater is protected.

- 3) All Santos CSG wells are designed to ensure they are safe and prevent any interconnection between hydrocarbon bearing formations and aquifers and to ensure that gas is contained within the well and associated pipework and equipment without leaking. To achieve this, a completed well consists of three layers of steel casing and cement from total depth to surface. The cementing is pressure tested to ensure its integrity and that there is no gas migration. The casing strings and cement layers serve to maintain the well opening, isolate the coal seams from the overlying geologic formations and aquifers, and provide a conduit for fluids to flow from the formation to the ground surface. They also provide resistance to failure over time.

There is still some potential for casings to corrode or otherwise fail over time. To manage this, Santos regularly monitors and maintains all of its wells, and conducts routine operational visits to monitor well-head pressure and inspect casing and well-head equipment. If a problem is suspected, specific tests can be run such as corrosion logs. Where necessary, well casing can be repaired. Finally, once no longer required for operation, wells are decommissioned by plugging with cement from top to bottom in accordance with the *NSW Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS, 2012).

- 4) Directional surveys taken every nine to 10 metres allow the directional driller to plot the exact point at which the drill bit is in the well. This control is necessary to allow the bit to target the vertical well (casing diameter of 7 inch) at a distance of one kilometre away from where the rig is. In addition to locating the bit in the wellbore, wireline logging runs are conducted prior to the drilling of the lateral section to pin point the coal seam(s) that will be drilled plus the start and finish points of the lateral section. Logging tools are also run in the drilling assembly which allows the engineers on site and in the office to determine exactly what type of formation is being drilled at that moment in time. Finally, offset wells in the area give an idea of the way the formations 'dip' and this can also be used to predict where the coal seam runs.

4.12.6 Cumulative impacts

4.12.6.1 [Issue description](#)

- 1) The cumulative groundwater impact modelling does not assess the impacts of any proposed future production gas field developments.

- 2) No cumulative studies have been completed to determine the impact on the GAB.
- 3) The issue of maintaining water pressure in the aquifer is not considered in view of the cumulative impacts of water extractions. Impacts on water pressure and subterranean flow rates need to be considered.

4.12.6.2 Response

- 1) The numerical groundwater model used for the EIS assesses the cumulative impact of the operation of the six pilots that form the E&A Program including the proposed activity. The E&A Program relates to the proposed exploration and appraisal program within PEL 238 and PAL 2 over the next three years. Any future exploration, appraisal or production activities beyond the E&A Program, including the Narrabri Gas Project, will be modelled and assessed cumulatively as part of the environmental assessment which supports any applications for approval.

In December 2013, Santos identified the proposed project area currently being considered for the Narrabri Gas Project. The project is proposed to include a gas field and a pipeline to transport the natural gas to the NSW market. The gas field is proposed to include:

- up to 850 production wells
- monitoring of wells to provide continual information about water and gas volumes and well site security
- a central water management and treatment facility to store and treat produced water for reuse
- a central gas processing facility to treat and compress the natural gas.

Further details of the Narrabri Gas Project can be found at <http://www.santos.com/exploration-acreage/new-south-wales/narrabri-gas-project.aspx>. The cumulative impacts of the Narrabri Gas Project will be assessed as part of the environmental assessment of the Narrabri Gas Project.

- 2) The numerical groundwater model used for the EIS assesses the cumulative impact of the operation of the six pilots that form the E&A Program including the proposed activity. The cumulative impact assessment, provided in the Groundwater Impact Technical Report (Appendix 3 of the EIS), includes modelling and discussion of impacts to the GAB.
- 3) Changes in water pressures in the strata between the target seam and the surface are considered in the Groundwater Impact Technical Report (Appendix 3 of the EIS). Figures 4-1 to 4-10 in this report show how the water pressures/levels change with time in different hydrostratigraphic units as a consequence of the proposed cumulative water extraction. The results of the numerical groundwater modelling indicate that there will be no significant change in water level in the Pilliga Sandstone or the overlying alluvial aquifer.

The impacts on change in flow rates are presented in Figures 4-11 to 4-13 of Appendix 3 of the Groundwater Impact Technical Report. The results of the numerical groundwater modelling indicate that there is no significant change in flow rate within the Pilliga Sandstone or the overlying alluvial aquifer.

4.12.7 Registered bores

4.12.7.1 Issue description

- 1) Bore census information is not presented in the EIS to verify the conclusion that there are no known bores extending into the Gunnedah-Oxley Basin groundwater source in the E&A Program area. A bore census covering all of the E&A Program area should be provided.
- 2) All bores within the potential drawdown area should be identified and potential impacts quantified.

4.12.7.2 Response

- 1) Santos utilises groundwater data from registered bores which is publically available through the NSW Natural Resource Atlas (<http://nratlas.nsw.gov.au/wmc/custom/homepage/home.html>) or on the NSW Office of Water's *Pinneena 3.2 – New South Wales groundwater data archive*, the latest version of which was released in 2010.

Baseline groundwater data collation and monitoring has been undertaken for bores (including accessible private water bores and NSW Office of Water bores) in the vicinity of the E&A Program area as part of Santos' ongoing monitoring program. This information, including bore locality data, is presented in the *Dewhurst Gas Exploration Pilot Baseline Surface and Groundwater Data Report* (Appendix 2).

- 2) There are no known registered bores sourcing water from formations deeper than the Pilliga Sandstone in the E&A Program area (Section 4.6 of the Groundwater Impact Technical Report (Appendix 3 of the EIS)). The predicted impact on registered water supply bores is stated in Section 4.6 of the Groundwater Impact Technical Report.

4.12.8 Groundwater monitoring program

4.12.8.1 Issue description

- 1) A hydrology and water quality baseline monitoring program should be implemented as part of the program that covers all aquifers potentially impacted by CSG production, including shallow aquifers.
- 2) Narrabri Council requires further information to determine the adequacy of the monitoring program. The water quality monitoring program should include parameters indicative of contamination of groundwater by drilling fluids and vertical flow of groundwater. Council seeks that the monitoring suite includes: pH, EC, major ion, fluoride, silica, dissolved metals, nutrients, dissolved gases, hydrocarbons and isotopic analysis. Monitoring must be undertaken using sampling protocols that have been approved by an appropriate agency e.g. NSW OCSG. It is essential that the monitoring program including isotope testing be implemented before any further wells are constructed. As part of this program the process to rehabilitate and repair the damage to the aquifers needs to be included.
- 3) Further information on the baseline monitoring results and the proposed trigger values when contingency measures will be implemented should be provided to Narrabri Council, as well as the proposed feasible contingencies.
- 4) Narrabri Council must be provided with an opportunity to review and comment on the proposed groundwater monitoring program.
- 5) The NSW Office of Water recommends that Santos present the rationale for the selection (or non selection) of the water quality parameters analysed and reported. The suite should include constituents that might be expected to be found in CSG water.

6) The conclusion that there will be no significant impacts to groundwater pressure or flows will need to be confirmed as part of a rigorous groundwater monitoring program.

7) The frequency and extent of analysis of groundwater quality monitoring proposed is very basic.

Additional deep monitoring bores should be installed, or if they already exist, they need to be incorporated into the monitoring program. The bores should be installed with sufficient time to collect baseline data prior to the start of operations. The monitoring should continue over the life of the proposed activity as well as during recovery.

The NSW EPA recommends monitoring of the ambient quality of the deeper groundwater sources intersected, influenced or accessed by the proposed activity.

8) Inconsistent reporting of locations for the proposed groundwater monitoring bores between what is reported in the EIS and what was provided to the NSW Office of Water in the *Narrabri Gas Field Monitoring and Modelling Plan* should be clarified.

9) The conceptual hydrogeological model indicates that the Black Jack sequence underlies the high beneficial use Lower Namoi Alluvial Groundwater Source. No monitoring of the stacked aquifers is proposed within this region.

10) The NSW EPA recommends water level, pressure and quality monitoring at the nearby Tintfield Pilot for baseline data and ongoing throughout E&A Program.

11) The submitter requested to take water samples from the Dewhurst 13-18H Pilot but was denied.

4.12.8.2 Response

1) Santos has baseline groundwater monitoring data for the E&A Program area, which is presented in the *Dewhurst Gas Exploration Pilot Baseline Surface and Groundwater Data Report* (Appendix 2).

A GMMP has been prepared for the E&A Program in consultation with the NSW Office of Water and approved by NSW OCSG. The GMMP describes the purpose, objectives, rationale and approach for collecting and evaluating groundwater data within the E&A Program area. It also describes how collected groundwater data will be maintained and the process for using the data to assist in calibrating the regional groundwater model for the area.

2) Santos has offered to meet with the Narrabri Shire Council and discuss various groundwater issues, including numerical model conceptualisation and the monitoring program. As part of its ongoing monitoring, Santos undertakes water quality testing using analytical suites which include pH, EC, major ion, fluoride, silica, dissolved metals, nutrients, dissolved gases and hydrocarbons.

3) Water quality data from the surface water and groundwater monitoring network will be made available to the public via the Santos Water Portal (<http://www.santoswaterportal.com.au>).

The monitoring program discussed in Section 9.5.3 of the EIS has commenced and will continue throughout the duration of Santos' activities in the Narrabri region. The monitoring program will identify if impacts to the groundwater system are occurring. If impacts to highly productive groundwater sources are identified, Santos' groundwater extraction activities in the localised area of the impact will cease, the issue investigated and appropriate mitigation and management measures will be implemented. In the event that Santos' operations are found to have impacted the capacity or quality of a useable aquifer, Santos will adhere to 'make good provisions' under the AIP.

- 4) Santos has approached the Narrabri Shire Council with the offer to meet and discuss various groundwater issues, including numerical model conceptualisation and the monitoring program.

Activities within PEL 238 must be carried out in accordance with the licence which has been approved by the Minister for Resources and Energy. Under Condition 13 of the PEL, a GMMP has been developed by Santos, and approved by the NSW Government.

- 5) The water quality suite to be monitored includes all constituents which can be expected to be found in produced water. This is detailed in the E&A Program GMMP which was prepared in consultation with the NSW Office of Water and approved by NSW OCSG. The GMMP describes the purpose, objectives, rationale and approach for collecting and evaluating groundwater data within the E&A Program area.
- 6) Santos is in agreement with this statement.
- 7) As part of the E&A Program Santos is installing and operating a groundwater monitoring network to detect any changes in groundwater levels and water quality. A GMMP has been prepared for the E&A Program in consultation with the NSW Office of Water and approved by NSW OCSG. The GMMP describes the purpose, objectives, rationale and approach for collecting and evaluating groundwater data within the E&A Program area. It also describes how collected groundwater data will be maintained and the process for using the data to assist in calibrating the regional groundwater model for the area.

Santos has installed a regional deep aquifer monitoring bore (Dewhurst 8A) with pressure monitoring devices targeting the formations (Digby Formation, Arkarula Formation, Porcupine Formation and the top of the Maule's Creek Formation) in the likely zones of depressurisation overlying the targeted coal seams. This bore is strategically located at the eastern periphery of the Narrabri Gas Project area within the Permo-Triassic strata from which depressurisation originates. Potential changes to fluxes due to vertical propagation between Triassic and Jurassic hydrostratigraphic units will be captured in this monitoring bore. The depressurisation data will complement existing depressurisation data derived from within the laterally extensive appraisal pilot wells.

This monitoring bore will also act as a sentinel for impacts on GDE recharge springs at the Pilliga/Purlawaugh junction. Groundwater pressure and quality data for deep formations are also available from the existing pilot wells. The depressurisation of the coal seams will be constantly monitored with data being utilised to update and calibrate the groundwater model.

- 8) The information provided in the EIS takes precedence to that provided in the earlier *Narrabri Gas Field Monitoring and Modelling Plan*. Indicative groundwater monitoring bore locations were presented and discussed with the NSW Office of Water in the development of the *Narrabri Gas Field Monitoring and Modelling Plan*. The final locations of the bores are determined based on a number of factors, including review of hydrogeological data and accessibility issues.
- 9) The Black Jack sequence underlies the high beneficial use Lower Namoi Alluvial Groundwater Source to the east of the E&A Program area. However, Santos has installed aquifer monitoring bores in between the E&A Program area boundary and this location.
- 10) Noted. Santos will ensure this is reflected in the GMMP.
- 11) Santos' GMMP for the E&A Program describes the purpose, objectives, rationale and approach for collecting and evaluating groundwater data within that area and how that data calibrates regional groundwater behaviour.

Santos undertakes regular water monitoring across its operations. The results of this monitoring are made available on the Santos Water Portal (<http://www.santoswaterportal.com.au>).

4.12.9 Protection of water resources

4.12.9.1 Issue description

- 1) Due to the conclusion drawn from the numerical groundwater model that there will be no drawdown in the shallow aquifers, the EIS states that it is '*unnecessary to instigate mitigation measures beyond construction and operational environmental management controls*'. Question as to what would occur if the model is incorrect and there are no stated mitigation measures.
- 2) A remedial action plan in the event of adverse impacts to the groundwater such as leakage and cross contamination between aquifers as a result of the drilling and well construction process, as well as possible well failure into the future, should be provided.
- 3) A remedial action plan in the event of accidental contamination from the Bibblewindi water transfer and Leewood produced water facilities should be prepared.
- 4) An Emergency Response Plan to follow in the event of contamination of town water supply or bores, or the reduction in supply, should be provided.

4.12.9.2 Response

- 1) During 2013 Santos drilled a network of shallow groundwater monitoring bores at eight locations in the vicinity of E&A Program activities. These bores are located to provide validation of the numerical model predictions, to measure departures from those predictions, and to provide an early warning system between sensitive receptors and the pilot sites.

Santos will undertake routine water level and quality monitoring in shallow groundwater across the region. The data that will become available through ongoing monitoring will be used to refine and validate the numerical groundwater model, in accordance with Barnett *et al.* (2012).

- 2) If impacts to highly productive groundwater sources are identified, Santos' groundwater extraction activities in the localised area of the impact will cease, the issue investigated and appropriate mitigation and management measures will be implemented. In the event that Santos' operations are found to have impacted the capacity or quality of a useable aquifer, Santos will adhere to 'make good provisions' under the AIP.
- 3) The tank at the Bibblewindi WTF and the ponds at the Leewood Produced Water Facility will have a leak detection system, while the ponds at the Leewood Produced Water Facility will also be double lined (Section 3.2.1.1 of the EIS). In the event of any spills or leaks Santos will employ its emergency response plan to manage and mitigate the situation.
- 4) The contamination or depletion of the town water supply is considered highly unlikely as a result of the E&A Program. This is particularly so considering that wells will be drilled and constructed in accordance with the *NSW Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS, 2012).

Santos' monitoring program will identify if impacts to the groundwater system are occurring. If impacts to highly productive groundwater sources are identified, Santos' groundwater extraction activities in the localised area of the impact will cease, the issue investigated and appropriate mitigation and management measures will be implemented. In the event that Santos' operations are found to have impacted the capacity or quality of a useable aquifer, Santos will adhere to 'make good provisions' under the AIP.

4.13 Surface water

4.13.1 Issue description

- 1) It is a misunderstanding to state that there is only intermittent water in the creeks. The water courses may be filled with sand but the water table is close to the surface. The ecosystems of the Pilliga forest depend on this water and contamination or depletion should not be risked. There is a risk of contamination of streams and rivers caused by spills of produced water due to interconnectivity of aquifers and their surface expressions.
- 2) The EIS states that Bohena Creek and its tributaries are ephemeral and do not form significant topographical features in the landscape. This is incorrect, as they form the most important drainage system in the eastern Pilliga. These ephemeral streams provide the same ecological and hydrological functions as perennial streams by moving water, nutrients, and sediment throughout the watershed. Intersecting these drainage lines with CSG infrastructure will impair their function in the landscape, impact biodiversity and affect all water users.
- 3) Page 4 of the EIS states that surface water quality samples will be taken monthly when water flows. Questions in what areas these samples will be taken as the Namoi River is not near the proposed activity.
- 4) Development and maintenance of roads and service tracks has the potential to channelise flows and disrupt the complex natural surface hydrology patterns of the impacted area. Increased sediment loading of surface water as a result of vegetation disturbance and vehicular traffic will also impact water quality.
- 5) The impact assessment needs to consider the direct pollution of streams from waste water discharge.
- 6) The EIS assumes that there will be no impact to registered surface water users because there aren't any. There are licensed water holders that have legal water rights to these ephemeral streams. Regardless of whether their works are developed or not, these water licence holders have a licence that is recognised under the *Water Management Act 2000*.
- 7) Figure 10-1 of the EIS is missing some first order streams which are found in the CH2MHill report.

4.13.2 Response

- 1) Section 9.1.1 of the EIS acknowledges the presence of perched aquifers in the alluvium (thin veneers associated with the more minor tributaries), which would have a level of interconnectivity with the ephemeral streams during periods of higher rainfall. Santos will adopt best practice site environmental management measures to minimise the likelihood of accidental spillage, and have appropriate management and mitigation plans in place should a spillage occur as outlined in Section 8.4 of the EIS, to contain and prevent environmental harm.
- 2) Santos accepts the significance of Bohena Creek within the local landscape.

All erosion and sediment controls will be in accordance with best practice measures contained within the Blue Book (Section 8.4.1 of the EIS). It is noted that volume 2C of the Blue Book provides guidelines, principles and recommended design standards for managing erosion and sediment control on unsealed roads in rural areas, forests, parks and other areas where traffic volumes are low. Implementation of controls listed in the Blue Book will enable maintenance of ecological and hydrological functions of the drainage lines in the vicinity of the proposed activity.

- 3) Santos has implemented a baseline surface water sampling plan for the Narrabri region. As part of this, field sampling was undertaken to determine background water quality for the sub-catchments in the study area. Those sample locations that are nearest to the proposed activity location are listed in Tables 10-5 and 10-6 of the EIS.

Due to the ephemeral nature of tributaries within the Namoi catchment, including Bohena Creek, some locations can only be monitored periodically (Section 10.1.5 of the EIS). The locations selected, upstream and downstream of the E&A Program activities, are therefore considered to be representative of the baseline water quality in the catchment. The sampling locations are shown in Figure 1 of *Dewhurst Gas Exploration Pilot Baseline Surface and Groundwater Data Report*, attached as Appendix 2.

- 4) The proposed activity involves a small area of vegetation clearing and surface disturbance (total footprint is 5.37 hectares and 3.52 hectares at Dewhurst 13-18H and Dewhurst 30/31, respectively). Erosion and sediment control measures will be installed at the site (including access tracks) in accordance with the Blue Book during construction, and until the site is stabilised.
- 5) There will be no discharge to local receiving waters within the vicinity of the proposed activity. Produced water will be temporarily stored in a water balance tank onsite before being transferred to the Leewood Produced Water Facility, via the Biblewindi WTF.
- 6) Potential impacts to surface water during both construction and operation of the proposed activity are provided in Section 10.2 of the EIS. Given the scale of the proposed activity, and the implementation of appropriate mitigation measures, impacts to surface waters and its users are considered to be minimal. Santos will adopt best practice site environmental management measures to minimise the likelihood of accidental spillage, and have appropriate management and mitigation plans in place should a spillage occur as outlined in Section 8.4 of the EIS, to contain and prevent environmental harm.
- 7) Noted. Figures 3-1 and 3-2 of the EIS include first order streams, and were referred to in Section 10.1.2 of the EIS when describing the local site drainage.

4.14 Biodiversity

4.14.1 Baseline monitoring

4.14.1.1 Issue description

- 1) There is insufficient baseline data on flora and fauna in regards to the long term impacts of CSG exploration in the Pilliga forest. Ecological surveys to establish parameters for maintaining the viability of threatened wildlife have not been carried out. The breeding status and population dynamics of the threatened species in the Pilliga are also poorly understood.

4.14.1.2 Response

- 1) More than 3,000 hours have been spent conducting ecological surveys in the north-east Pilliga forest since 2002. Surveys have been undertaken specifically for the purpose of establishing the baseline ecological values to assess the potential impact of CSG development.

4.14.2 Threatened species assessment

4.14.2.1 Issue description

- 1) Santos should make the following information available for agency and public review:
 - Habitat modelling undertaken for the Narrabri Gas Project (ELA, 2012) and habitat and fragmentation analysis, as referred to in the environmental assessment.
 - The mapped location of the entire Dewhurst 26-31 well set and associated infrastructure in relation to threatened species records.
- 2) Low number of threatened species identified compared with the high number of potentially occurring species.

4.14.2.2 Response

- 1) The habitat modelling undertaken for the Narrabri Gas Project is documented in *North-east Pilliga Forest – targeted threatened flora survey* (ELA, 2012) and is attached at Appendix 4.

The habitat fragmentation analysis is included as part of the Impact Assessment under the EPBC Act report (ELA 2013b; refer to Appendix 5) which is also publicly available on the Australian Government Department of Environment website: http://www.environment.gov.au/cgi-bin/epbc/epbc_ap.pl?name=current_referral_detail&proposal_id=6918.

The mapped location of the Dewhurst 26-31 pilot and associated infrastructure in relation to recorded threatened flora species is shown in Figure 1.

- 2) Survey effort undertaken for threatened species for the proposed activity meets the requirements of the draft *Threatened Biodiversity Survey and Assessment Guidelines* (DEC, 2004) and relevant EPBC survey guidelines (SEWPaC 2010a, SEWPaC 2010b, SEWPaC 2011).

The study area targeted for assessment incorporated all areas of direct and indirect impacts including a 10 metre buffer around the new Dewhurst 13-18H gathering system and the disturbance footprint for the construction of the Dewhurst 30 and 31 pilot wells and associated service corridors.

Due to the relatively small study area targeted for assessment, the single survey season of the assessment and the presence of only one vegetation community/fauna habitat type, the total number of threatened species observed is lower than the total number of threatened species known or considered likely to occur in the north-east Pilliga forest. Threatened species do not occur equally across all vegetation communities/habitat types, with many fauna species having specific habitat requirements and others being highly mobile reducing the chances of detection at any point in time.

To address this, the assessment took a conservative approach, utilising knowledge on the likely presence and habitat requirements of threatened species to assess the impacts of the proposed activity. The proposed activity was determined to not significantly affect any threatened species, population or ecological community.

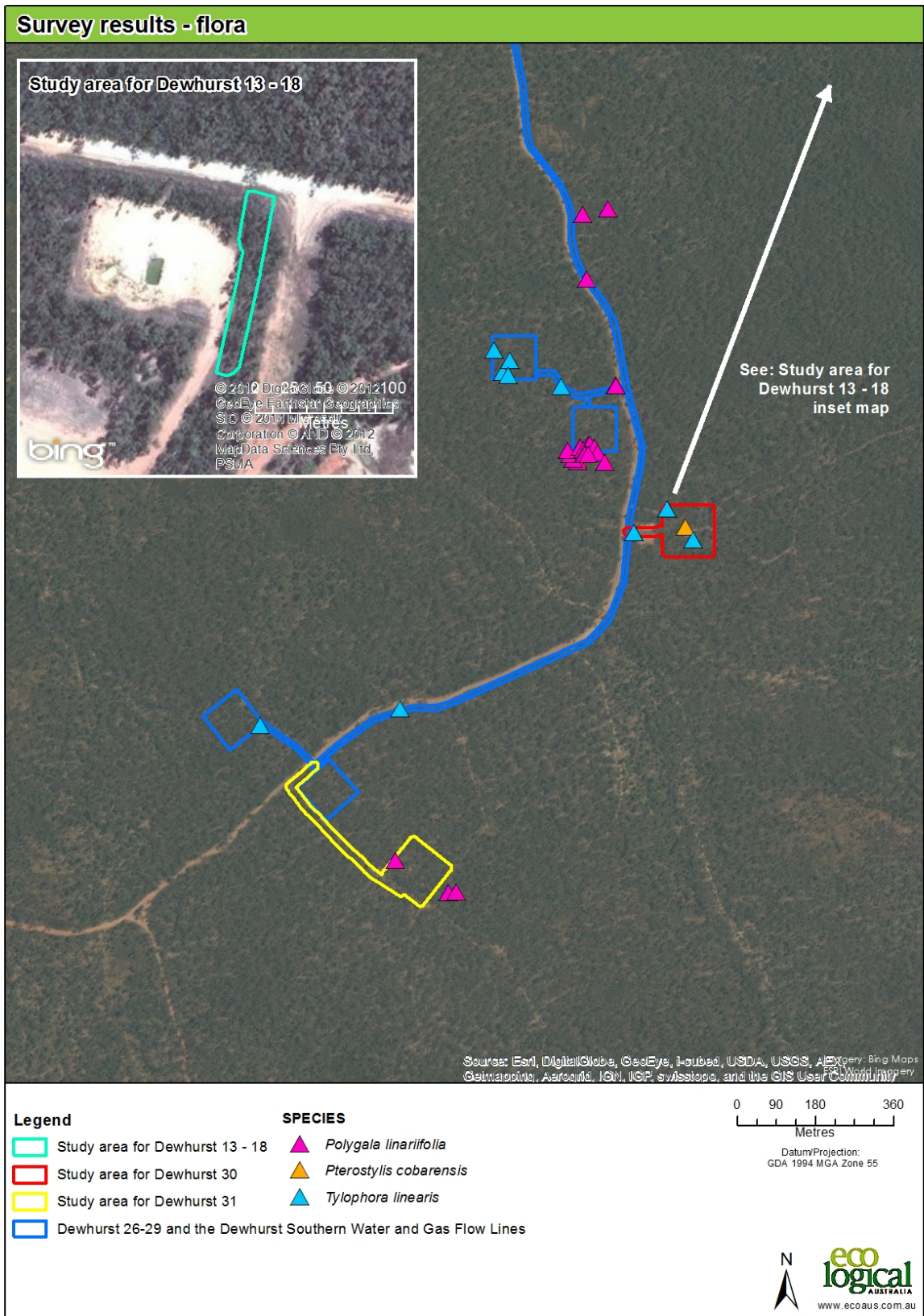


Figure 1 Threatened flora species recorded in the vicinity of Dewhurst 26-31 Pilot

4.14.3 Cumulative impacts

4.14.3.1 Issue description

- 1) The impacts from the proposed activity must be considered cumulatively against existing infrastructure in the Pilliga forest.
- 2) The TSC Cumulative Impact Assessment report (ELA, 2013a) should be made available for public review.
- 3) Santos should provide justification for the chosen study area for the cumulative impact assessment.
- 4) The cumulative impact assessment should consider the likely area to be impacted by indirect impacts for all threatened species, and the significance of this impact on local populations of these species.
- 5) Santos should provide a map depicting all components of the E&A Program cross-referenced with a list of the relevant environmental assessments and approvals.

4.14.3.2 Response

- 1) A detailed assessment of the E&A Program, including the proposed activity, and existing exploration and appraisal activities has been undertaken through the preparation of cumulative impact assessments under the Commonwealth EPBC Act and the NSW TSC Act (ELA, 2013a,b). These assessments are attached as Appendix 5 and 6 respectively.

CSG exploration and appraisal activities in the Pilliga forest from 2002 to present have resulted in the loss of approximately 175.5 hectares of vegetation which represents a loss of approximately 0.37 per cent of vegetation within the study area (defined as an area covering approximately 48,000 hectares and includes (in part) Pilliga East State Forest, Bibblewindi State Forest, Jacks Creek State Forest and Pilliga East State Conservation Area as well as Crown Land and privately owned land).

While there has been clearing of vegetation and loss to fauna habitats as a result of the exploration and appraisal activities, the total loss is not considered significant in relation to the amount of available habitat within the study area and region.

Given the relatively small amount of clearing as a proportion of available habitat, the current land uses and extent of rehabilitation (completed and proposed), exploration and appraisal activity impacts are not expected to significantly fragment or reduce the availability of habitat in a way which will adversely affect species within the study area.

A detailed fragmentation analysis was undertaken as part of the Impact Assessment under the EPBC Act report (including the proposed activity) (ELA 2013b; refer to Appendix 5). The analysis concluded that small number of additional short-term breaks across potential movement pathways was unlikely to significantly affect threatened species.

- 2) The TSC Act Cumulative Impact Assessment report (ELA, 2013a) is attached as Appendix 6. This report has been included as part of previous assessments (such as the *Dewhurst Northern Water and Gas Flow Lines REF*) and is therefore publicly available on the NSW Department of Trade & Investment, Resources and Energy website:
http://www.resources.nsw.gov.au/_data/assets/pdf_file/0007/470635/INW13-22390-Appendix-5_TSC-Act-Cumulative-Impact-Assessment.pdf

- 3) Justification for the chosen study area is contained within the TSC Act Cumulative Impact Assessment report (ELA 2013a; refer to Appendix 6).
- 4) The TSC Act Cumulative Impact Assessment report (ELA, 2013a; refer to Appendix 6) focuses primarily on the direct impact of existing and proposed exploration and production appraisal activities within PEL 238 and PAL 2. The report includes exploration activities undertaken from 2002 to present, many of which have resulted in relatively short-term impacts, are no longer operational and have been subsequently rehabilitated. As such, many indirect impacts (such as noise and light) only operated for a short period of time and are no longer impacting on biodiversity values. Other potential indirect impacts such as predation and weed invasion are not expected to have significantly increased as a result of the E&A Program.

The potential impact of fragmentation on biodiversity values was assessed in the Impact Assessment under the EPBC Act report (ELA, 2013b). The report concluded that habitat fragmentation is not likely to be a significant issue for the majority of threatened species as the existing exploration activities have not resulted in the splitting of contiguous habitat into two or more distinct patches. As such pollination for flora and dispersal mechanisms for fauna species are able to continue largely unimpeded.

The proposed activity results in the loss of 2.44 hectares of vegetation which adds to the cumulative total of approximately 237 hectares of vegetation cleared within PEL 238 and PAL 2 as a result of exploration and production appraisal activities. This equates to one per cent of the total vegetation cleared to date and much less than 0.01 per cent of the vegetation in PEL 238 and PAL 2. Therefore the cumulative impact of the proposed activity is not considered to be significant.

- 5) A map of all components of the E&A Program are contained within both the TSC Act Cumulative Impact Assessment report (ELA 2013a; refer to Appendix 6) and the Impact Assessment under the EPBC Act report (ELA 2013b; refer to Appendix 5).

4.14.4 Indirect impacts

4.14.4.1 Issue description

- 1) Indirect impacts such as noise, dust, light and fauna/vehicle road impacts on fauna during operation have not been adequately assessed.
- 2) Santos should provide justification for their assessment of the likely level of indirect impacts in relation to native vegetation and fauna.
- 3) Santos should provide further detail regarding the proposed mitigation measures to address indirect impacts including their likely efficacy.
- 4) It is recommended that any approval of the proposed activity by DP&I includes a requirement to develop and implement a monitoring program with the aim of quantifying the indirect impacts on flora and fauna associated with the proposed activity.

4.14.4.2 Response

- 1) Potential temporary indirect impacts such as noise, dust, light and fauna/vehicle road interactions were considered in Section 5.8 of the Ecological Assessment for the proposed activity (Appendix 6 of the EIS).

More specifically, the potential for indirect impacts on threatened species were considered in the assessment of significance under the TSC Act and EPBC Act (Appendix F and Appendix G of the Ecological Assessment, respectively).

- 2) The proposed activity has potential to indirectly impact on vegetation communities and flora and fauna species present in the study area through habitat fragmentation, sedimentation and erosion, introducing additional light, vehicle strike, changing microclimates, increases in noise, traffic and dust and encouraging weed invasion and feral animal predators.

Habitat fragmentation is considered to be minimal due to the nature of the proposed activity and the use of existing roads where possible to reduce fragmentation. No patches of habitat would be isolated as a result of the proposed activity.

Vegetation on the edge of the proposed activity will be subject to increased light, changes to microclimate, increased dust and risk of weed invasion. Mitigation measures proposed to minimise the effect of edge effects on native vegetation include progressive rehabilitation, sediment and erosion control and weed control.

The removal of vegetation and transport of soil would increase the risk of sedimentation and erosion potentially leading to increased sediment load in aquatic systems and dust formation. However these indirect impacts are addressed through mitigation measures such as appropriate sediment and erosion control measures to reduce their impact.

Increases in noise during construction and operation of the proposed activity have potential to indirectly impact fauna both within the study area and in adjacent habitat. The potential impacts of noise on fauna species are expected to be greatest at the centre of the well leases, with the potential impacts dissipating with distance from the point source. Potential noise impacts will be greatest during construction, with lesser impacts during operation. The indirect impacts of noise will cease on completion of the pilot (approximately three years duration).

In consideration of these factors and due to the small scale of the proposed activity and the expected duration (three years), a 10 metre buffer was applied to areas surrounding the proposed activity in which it is predicted that the majority of potential indirect impacts would be contained.

- 3) Table 1 provides further detail on the mitigation measures proposed in the Ecological Assessment (Appendix 4 of the EIS) and their expected efficacy.

Table 1 Efficacy of mitigation measures

Mitigation measure	Detail	Efficacy
All personnel should be informed of their responsibilities while working on site in relation to ecological values and undertake a site specific induction.	All staff are required to undertake a site-specific ecological induction before commencing work on site which includes details of all avoidance, minimisation and mitigation measures.	Minimisation of impacts to threatened species, populations and ecological communities through greater overall awareness of biodiversity values.
The site boundary should be clearly marked in the field to ensure all clearing and construction activities occur within the approved footprint.	Site boundaries are clearly marked with survey pegs, flagging tape or para-web netting depending on individual site requirements.	Minimisation of impacts such as accidental incursion during construction or over-clearing.
All access during the pre-construction, construction, operational and rehabilitation phases should be through existing roads and designated access tracks.	Access to the proposed activity is entirely via existing forestry roads and designated access tracks constructed for the proposed activity.	Minimisation of impacts such as noise, dust and accidental incursions into native vegetation.

Mitigation measure	Detail	Efficacy
Weed control measures should be in place during pre-construction, construction, operational and rehabilitation phases. These should include:		
The establishment of wash down points for vehicles to prevent the transportation of seeds and soil.	All vehicles and machinery arriving in Narrabri from other regions are washed down to remove seeds and soil.	The spread of weeds and pathogens from areas outside the region is minimised.
Inspections of all equipment (machinery, tools, vehicles) brought on site to ensure that all equipment is free of materials where practicable (such as soils and seeds).	All equipment is inspected to ensure it is free of soil and seeds. If equipment fails the inspection it is to be appropriately cleaned.	The spread of weeds and pathogens from areas outside the region is minimised.
Documentation and records that detail the use of wash down points and inspections.	Quality control to ensure inspections and wash downs are being undertaken.	The spread of weeds and pathogens from areas outside the region is minimised.
Measures to ensure that all weed growth is regularly and appropriately controlled in accordance with the <i>Noxious Weeds Act 1993</i> .	Regular inspections of the proposed activity area are undertaken.	Weed infestations are effectively control weed growth prior to weed infestations becoming established.
Removal of hollow bearing trees should be undertaken with the supervision of an ecologist and following the clearing procedure developed by Eco Logical and Santos.	The clearing procedure is a four step process which involves a planning phase, slashing shrub and ground layers, tapping hollow-bearing trees and removing hollowing bearing trees. The clearing procedure has been developed to minimise the impacts on hollow-dependant native fauna during clearing.	Minimisation of impacts to native fauna by providing multiple opportunities for fauna to disperse from the area prior to clearing.
Open trenches should be inspected twice daily by a suitably qualified fauna handler.	Inspections of open trenches are undertaken twice daily (morning and afternoon) to ensure no fauna have become entrapped. Any fauna that are found are relocated to adjoining areas.	Minimisation of impacts to native fauna by relocating trapped fauna into adjoining areas.
Appropriate sediment and erosion control measures should be installed and maintained as specified in the EIS.	Sediment and erosion control measures are installed in accordance with best practice measures e.g. the 'Blue Book'.	Sediment is contained within the construction footprint of the proposed activity and does not contaminate local drainage lines.
Only 'fauna friendly' exclusion fencing (without barbed wire) in accordance with Santos policies should be installed around well infrastructure.	'Fauna friendly' exclusion fencing prohibits the use of barbed wire to discourage native fauna from entering enclosed areas.	Minimisation of impacts to native fauna through ensnaring on barbed wire.
40 km/h speed limits will be implemented in the study area (i.e. lease areas and access tracks constructed for the activity). Otherwise the posted speed limit will apply.	Speed limits are reduced to 40km/hr allowing for greater visibility of native fauna and improved reaction times.	Minimisation of impacts to native fauna through vehicle strike.
The subject sites should be progressively rehabilitated as soon as practicable following best practice guidelines.	The well leases are progressively rehabilitated following initial construction restoring vegetation and habitat resources over the life of the proposed activity.	Indirect impacts of the proposed activity to adjoining areas are progressively lowered as vegetation is restored.

- 4) Due to the small scale of the proposed activity (2.44 hectares of vegetation clearance), a monitoring program aimed at quantifying the indirect impacts on flora and fauna is considered impractical. The small scale of the proposed activity will inhibit the ability to draw any meaningful conclusions from monitoring.

4.14.5 *Macropus dorsalis* (Black-striped Wallaby)

4.14.5.1 Issue description

- 1) Significance of the presence of *Macropus dorsalis* (Black-striped Wallaby) in the northern Pilliga forest. Concerns about the adequacy of assessment of wildfire, poisoning, predation and traffic collision on this species.

4.14.5.2 Response

- 1) The Black-striped Wallaby has been recorded in similar habitat adjacent to the study area and is considered likely to use the habitat present in the study area.

The removal of 2.44 hectares of potential habitat (primarily foraging and sheltering) for Black-striped Wallaby is considered relatively minor in the context of similar habitats available within the study region, constituting a loss of up to 0.01 per cent of available habitat for this species.

Threats to Black-striped Wallaby such as clearing, fragmentation, inappropriate fire regimes and predation are assessed in the impact assessment contained within Appendix F of the Ecological Assessment (Appendix 4 of the EIS).

Implementation of mitigation measures for the proposed activity such as appropriate traffic control, rehabilitation, minimisation of fragmentation, weed and feral animal control programs are considered sufficient in ensuring the proposed activity is unlikely to significantly impact this species.

4.14.6 *Pseudomys pilligaensis* (Pilliga Mouse)

4.14.6.1 Issue description

- 1) Concerns about impacts to Pilliga Mouse as a result of CSG exploration.
- 2) Presence of breeding habitat within the proposed activity area questioned.

4.14.6.2 Response

- 1) The proposed activity area does not contain core habitat for Pilliga Mouse, however during appropriate seasonal conditions and a population boom, the study area may be used as dispersal habitat for this species.

The proposed activity will result in the removal and/or modification of up to 2.44 hectares of potential dispersing habitat for the Pilliga Mouse. No breeding habitat for the Pilliga Mouse will be impacted as a result of the proposed activity. This loss is considered relatively minor in the context of similar habitats within the study region, constituting a loss of up to 0.01 per cent of available habitat for this species.

- 2) Recent studies undertaken by NICE and CUCCLG (2012) identified the Pilliga Mouse in a broader range of vegetation associations than previously known. Vegetation associations within the north-east Pilliga forest where Pilliga Mouse has been recorded are generally characterised by a high diversity, moderate density, low (less than one metre) sclerophyllous shrubby layer and sandy soils. The structure of vegetation where Pilliga Mouse has been previously recorded ranges from heathland to open forest.

Vegetation in the proposed activity area is consistent with the vegetation community Narrow-leaved Ironbark - White Cypress Pine - Buloke tall open forest on lower slopes and flats in the Pilliga Scrub and surrounding forests in the central north Brigalow Belt South Bioregion (Benson *et al.*, 2006). This vegetation community is a woodland to open forest with a canopy between eight and 20 metres with 15 – 20 per cent foliage cover. The understorey is sparse to grassy with less than five per cent cover of shrubs.

In consideration of the available information on Pilliga Mouse habitat requirements, the proposed activity area was determined not to constitute breeding habitat for the Pilliga Mouse.

4.14.7 *Nyctophilus corbeni* (South-eastern Long-eared Bat)

4.14.7.1 Issue description

- 1) *Nyctophilus corbeni* (South-eastern Long-eared Bat) is highly sensitive to edge effects with increased loss of habitat and increased fragmentation potentially significantly affecting this species.

4.14.7.2 Response

- 1) The proposed activity will lead to the loss of approximately 2.44 hectares of habitat for the South-eastern Long-eared Bat, which equates to less than 0.01 per cent of the available habitat within the study region. The cumulative loss of habitat for the South-eastern Long-eared Bat as a result of CSG activities in the Pilliga forest is approximately 237 hectares of foraging habitat which represents less than 0.05 per cent of the available habitat within the study region.

A detailed fragmentation analysis was undertaken as part of the Impact Assessment under the EPBC Act report (including the proposed activity) (ELA, 2013b; refer to Appendix 5). The analysis concluded that a small number of additional short-term breaks across potential movement pathways was unlikely to significantly affect threatened species.

The proposed activity is considered unlikely to significantly affect the South-eastern Long-eared Bat as it is highly mobile and will be able to move across disturbed areas, the regional extent of suitable habitat is sufficient that the proposed activity will not result in the modification, removal or availability of habitat to the extent that it is likely to significantly impact on the species and that the regional extent of suitable roosting and breeding habitat is sufficient that the proposed activity will not result in the substantial disruption of elements of this species' breeding cycle.

4.14.8 *Phascolarctos cinereus* (Koala)

4.14.8.1 Issue description

- 1) The Ecological Assessment incorrectly states that there are no State Environmental Planning Policy (SEPP) 44 (Koala Habitat Protection) feed trees present.

4.14.8.2 Response

- 1) The study area as defined in the Ecological Assessment (Appendix 4 of the EIS) does not contain any tree species listed in Schedule 2 of SEPP 44 as feed tree species.

Eucalyptus conica (Fuzzy Box), a primary feed tree species is known to occur in the broader locality on the floodplain of Bohena Creek, but does not occur within the study area.

Neither *Eucalyptus pilligaensis* (Pilliga Box), *Eucalyptus chloroclada* (Dirty Gum) or *Eucalyptus blakelyi* (Blakely's Red Gum) were recorded in the study area. As such the study area is not considered to constitute potential Koala habitat and no further assessment was required.

4.14.9 Threatened flora

4.14.9.1 Issue description

- 1) No assessment was made of the extent of populations of threatened flora in the local area.

4.14.9.2 Response

- 1) Detailed targeted surveys have identified significant populations of threatened flora within the broader north-east Pilliga forest (ELA, 2012; refer to Appendix 4). Modelling predicts the existence of 122,713 *Polygala linariifolia*, 3,349,724 *Pterostylis cobarensis* and 183,908 *Tylophora linearis* individuals in the Pilliga and Pilliga Outwash CMA subregions (ELA, 2012; refer to Appendix 4).

The removal of one *Polygala linariifolia*, three *Pterostylis cobarensis* and three *Tylophora linearis*, would result in the reduction of less than 0.01 per cent of the predicted populations in the two modelled CMA subregions.

The proposed activity will result in the removal of a very small proportion of potential habitat for these species relative to available habitat across the Pilliga forest. Habitat for these species is widespread, with significant populations of *Pterostylis cobarensis* and *Tylophora linearis* identified outside of the study area including populations within State forests, National Parks, Nature Reserves and State Conservation Areas. Therefore, significant impacts to the lifecycle and important habitat to these species are unlikely to result from the proposed activity

Pterostylis cobarensis has been removed from the vulnerable category of the threatened species list under the EPBC Act, effective 14 December 2013. It is still listed as vulnerable under the TSC Act.

4.14.10 Invasive species and pathogens

4.14.10.1 Issue description

- 1) *Phytophthora* is already present at drilling sites.
- 2) The spread of weeds and *Phytophthora cinnamomi* into natural areas is likely to be exacerbated by increased traffic movements and inadequate vehicle hygiene. Mitigation measure of vehicles to be washed down where they have been exposed is not sufficient. Washdown should occur for all vehicles.

4.14.10.2 Response

- 1) *Phytophthora* has not been identified on any current Santos drilling sites.
- 2) The Ecological Assessment for the proposed activity (Appendix 4 of the EIS) includes weed control measures to be in place during pre-construction, construction, operational and rehabilitation phases, including:
 - the establishment of wash down points for vehicles to prevent the transportation of seeds and soil
 - inspections of all equipment (machinery, tools, vehicles) brought on site to ensure that all equipment is free of materials where practicable (such as soils and seeds)

- documentation and records that detail the use of wash down points and inspections
- Measures to ensure that all weed growth is regularly and appropriately controlled in accordance with the NSW *Noxious Weeds Act 1993*.

The proposed weed control measures will also assist in minimising the potential importation of *Phytophthora cinnamomi* through appropriate vehicle hygiene practices.

Weed monitoring will occur through all phases of the proposed activity and weed control will be undertaken as necessary.

4.14.11 Groundwater Dependent Ecosystems (including Stygofauna)

4.14.11.1 Issue description

- 1) More GDEs are present in the region than identified in the EIS.
- 2) The EIS states that sampling found the stygofauna to be poor, however a study by Serov in 2012 shows that there are unique stygofauna populations within the alluvial groundwater of the Pilliga East forest area. Landowners have also discovered stygofauna in the local bore network.
- 3) Stygofauna must be studied to determine and describe the species and community present and identify their conservation significance. There must be comprehensive baseline assessment of GDEs (including stygofauna), including the potential impacts of any drawdown. The stygofauna should be monitored regularly as a water quality indicator.

4.14.11.2 Response

- 1) GDEs are present throughout PEL 239, with three high priority GDEs listed within the NSW Office of Water database noted as occurring approximately 10 and 20 kilometres to the east of Dewhurst 13-18H and Dewhurst 26-31 pilots.

Notwithstanding, the cumulative groundwater impact assessment (Appendix 3 of the EIS) indicates that depressurisation of the target coal seam as a result of the E&A Program, including the proposed activity, will not produce a significant decline in water levels (greater than 0.5 metres) within the Namoi Alluvium and the Pilliga Sandstone groundwater sources. Consequently there is unlikely to be a significant impact on GDEs.

- 2) Section 11.3.5 of the EIS report acknowledges that stygofauna are known to occur within the Namoi River alluvial aquifer. This aquifer does not underlie the two pilot sites, but is a potential source of colonisation for stygofauna. Thin sedimentary aquifers associated with Bohena, Cowallah and Bibblewindi Creeks extend south into the Pilliga and are potentially suitable habitat for stygofauna.

Stygofauna may also be present in the shallower GAB sandstone aquifers present onsite, such as the Pilliga Sandstone. The suitability of these rock aquifers as stygofauna habitat diminishes with depth from the surface.

- 3) Stygofauna is unlikely to be present in the shallower GAB sandstone aquifers located within the proposed activity area, such as the Pilliga Sandstone (Section 11.3.5 of the EIS). For these to be suitable for stygofauna, they would have to be highly fractured or weathered enough to allow stygofauna movement and a sufficient flux of water, oxygen and organic matter. The suitability of these rock aquifers as stygofauna habitat diminishes with depth from the surface.

The deeper target coal seam aquifers are unlikely to contain stygofauna as:

- the space available for movement is reduced significantly with increasing depth
- there is an overall decline in water quality as depth from surface increases.

The proposed activity potentially poses the following threats to stygofauna:

- penetrating suitable habitat during drilling and the subsequent draining of the aquifer or contamination through trans-boundary flow between aquifers
- depressurisation of underlying aquifers causing a change in the physical structure of stygofauna habitat that may result in drainage or contamination from more saline water.

Further details are provided in *Pilliga Stygofauna Review – Santos Energy NSW Coal Seam Gas Exploration and Extraction Activities*, prepared by Eco Logical Australia (attached as Appendix 7).

Neither of the proposed wells requires drilling through alluvial aquifers, significantly reducing the potential for impact to stygofauna.

Provided drilling, operation and closure activities are undertaken in accordance with the relevant guidelines and legislation, the proposed CSG drilling and extraction activities are unlikely to pose a significant threat to any known or likely stygofauna habitat.

4.14.12 Biodiversity Offsets

4.14.12.1 [Issue description](#)

- 1) No offsets have been required for the development, with the cumulative impacts totalling 237 hectares.

Santos should be required to calculate the offset quantum required to adequately offset the biodiversity impacts associated with the proposed activity, in accordance with the Namoi CMA Biodiversity Offsets Policy 2011, NSW Offset Principles or NSW OEH Interim Offset Policy.

It is recommended that any approval conditions for the proposed activity contain the requirement to provide the calculated offset quantum within a broader biodiversity offset strategy developed as part of any future production project, or if such a project is not forthcoming, to be provided prior to decommissioning of the proposed activity.

4.14.12.2 [Response](#)

- 1) While the cumulative impact of CSG development (historic and present) in PEL 238 and PAL 2 is 237 hectares, the impact of the proposed activity is only 2.44 hectares. This equates to a loss of less than 0.1 per cent of the vegetation and habitat in the study region.

Following consideration of the avoidance, minimisation and mitigation measures proposed, offsetting was not considered necessary due to the relatively small magnitude of impact, the short timeframe of the operation of the proposed activity and the rehabilitation proposed following completion of operations.

Santos has committed to providing a suitable offset prior to the decommissioning of the proposed activity. This will include the appropriate quantification of the offset quantum required to adequately offset the biodiversity impacts associated with the proposed activity.

4.14.13 Pilliga conservation

4.14.13.1 Issue description

- 1) The Pilliga forest has significant biodiversity values which are threatened by CSG development and should be protected.
- 2) The proposed activity in the Pilliga East Forest was identified as Tier 1 biodiversity in the NSW Government Draft Strategic Regional Land Use Policy.

4.14.13.2 Response

- 1) In recognition of the high ecological and landscape value of the Pilliga forest, over 240,000 hectares of conservation reserve have been gazetted under the *National Parks and Wildlife Act 1974* (NPW Act) since the 1960s. The Pilliga Nature Reserve (83,000 hectares) was first reserved in 1968. Thirty years later, regional assessments of the Brigalow and Nandewar Bioregions (NPWS, 2000) culminated in the NSW Government's decision in 2005 to conserve an additional 160,000 hectares of CCA in the Pilliga region under the BNCCA Act. This area focuses on the central, southern and western extents of the Pilliga forest. Today, approximately half of the Pilliga forest is now reserved under the NPW Act, with the other half retained as State forest for commercial timber production, recreation and mineral extraction.

As part of the BNCCA Act, four CCA zones have been defined:

- Zone 1: Conservation and recreation (National Park)
- Zone 2: Conservation and Aboriginal culture (Aboriginal Area)
- Zone 3: Conservation, recreation and mineral extraction (State Conservation Area)
- Zone 4: Forestry, recreation and mineral extraction (State Forests).

Of the 240,00 hectares of reserve, a total of 146,000 hectares, including Pilliga Nature Reserve, four CCA Zone 1 reserves (National Parks) and two CCA Zone 2 reserves (Aboriginal Areas) are precluded from logging and mineral/petroleum exploration. Three CCA Zone 3 reserves (State Conservation Areas) totalling 94,000 hectares, were created to 'protect important conservation values in western NSW and ensure the long-term sustainability of the region's important timber, gas, minerals and apiary sectors'.

The State forest area within which the Dewhurst 26-31 Pilot proposed activity is located is entirely included within 'Zone 4' (Forestry, recreation and mineral extraction (State Forests)) under the BNCCA Act. As mineral extraction is a permitted use in Zone 4, the proposed activity is considered consistent with the BNCCA Act.

- 2) An overview of the NSW Government's *New England North West Strategic Regional Land Use Plan* (DP&I, 2012) is included in Section 2.2.3 of the EIS. The final version of the plan does not include mapping for biodiversity values.

4.14.14 Other biodiversity issues raised

4.14.14.1 Issue description

- 1) Concerns over the adequacy of consideration of construction footprints including access tracks and gathering systems.

- 2) Species Impact Statements (SIS) are recommended to assess the impact of the proposed activity on threatened species.
- 3) Biodiversity of this region is at risk from fugitive emissions and contamination from the CSG extraction process.
- 4) Concerns over the adequacy of Assessment of Significance (7 part test).

4.14.14.2 Response

- 1) The proposed activity requires the removal of approximately 2.44 hectares of vegetation which includes the establishment of two 10 metre wide service corridors (for access roads and gathering systems) to the Dewhurst 30 and 31 lease areas, establishing the Dewhurst 30 and Dewhurst 31 lease areas and constructing a new gas and water gathering system connecting all the wells within the Dewhurst 13-18H Pilot.

All of the works contained within the proposed activity will be contained within the areas identified in the EIS, and not exceed the clearance of 2.44 hectares of vegetation.

- 2) SIS are not required for SSD - Schedule 1, clause 2(1)(f) of the NSW *Environmental Planning and Assessment Regulation 2000*. However, cumulative impact assessments have been completed for threatened species and communities listed under the TSC Act and the EPBC Act (ELA 2013a,b; refer to Appendix 5 and 6) which found that the E&A Program, incorporating the proposed activity, is unlikely to significantly affect threatened species, populations and ecological communities.
- 3) Minor amounts of gas will be lost to the atmosphere as fugitive emissions during well development and operation, as well as from the gas gathering pipeline network and associated equipment. To assist in quantifying the extent of fugitive emissions across the E&A Program, a monitoring program, including baseline monitoring, will be implemented. The monitoring program will be conducted in the general area of the E&A Program to monitor any changes in methane levels as an indicator of fugitive emissions during operation.
- 4) The Assessment of Significance (7 part test) provides seven factors that need to be considered when assessing whether an action, development or activity is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

Appendix F of the Ecological Assessment (Appendix 4 of the EIS) provides an assessment of significance under the TSC Act for 33 threatened fauna species and four threatened flora species. Flora and fauna species were grouped for assessment with species that share similar ecological characteristics and those that are likely to be impacted in a similar manner by the proposed activity.

For each species group the potential impacts of the proposed activity were considered against the seven factors including impacts to life cycle, the importance and extent of habitat loss, fragmentation, critical habitat, recovery and threat abatement plans, and key threatening processes.

Each of these assessments concluded that the proposed activity is unlikely to have significant impacts on threatened species, populations or ecological communities.

4.15 Air quality

4.15.1 General concerns raised

4.15.1.1 Issue description

- 1) Recommendation of a peer review of the modelling used to ascertain the Nitrous Oxide conversions and modelling methodology described on page 16 of the Air Quality Impact Assessment (Appendix 5 of the EIS) to ensure these calculations are correct.
- 2) Air quality stations should be installed, and monitored by an independent authority.
- 3) There is need for an incident management plan in the event that particulate or gaseous emissions exceed emission standards.

4.15.1.2 Response

- 1) The DP&I and NSW EPA will review the Air Quality Impact Assessment in conjunction with the EIS.
- 2) As stated in Section 12.3 of the EIS, emissions of carbon monoxide (CO) and nitrogen dioxide (NO₂) can be expected from the combustion and flaring of gas onsite during operation. However these emissions are significantly below targets outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005) and impacts on air quality are predicted to be insignificant. It is therefore considered unnecessary to install air quality monitoring stations for this proposed activity.
- 3) The NSW EPA will require Santos to operate a Leak Detection and Repair Program for all relevant components of plant and equipment as a condition of the EPL.

4.15.2 Baseline data and monitoring

4.15.2.1 Issue description

- 1) The lack of suitable site-specific NO₂ data being available to quantify the existing ambient levels at the site is a concern. Using data from the Muswellbrook NSW EPA monitoring site is not appropriate for use in this EIS due to differing land uses. A suitable ambient monitoring station must therefore be set up in the vicinity of the proposed Pilliga gas field site before drilling commences.

Also need to acquire suitable site-specific CO data collection points to quantify the existing ambient levels at the site. Without these baselines, there will be no way to accurately measure or prove increasing levels as a result of the CSG drilling in the forest.

- 2) Santos has undertaken air quality/fugitive emissions monitoring at existing flares, however none were operating at the time.
- 3) A Leak Detection and Repair program should be incorporated into the fugitive emissions monitoring program, conducted in accordance with US EPA Method 21 - Determination of Volatile Organic Compound Leaks.
- 4) The baseline atmospheric methane data collection against which to assess any future potential fugitive emissions and Independent Health Impact Assessment (HIA) of north-west NSW to establish baseline health data and air quality information has not yet been conducted. Santos has not conducted baseline studies of air quality, to compare any potential and likely future fugitive methane emissions against pre-Dewhurst pilots.

4.15.2.2 Response

- 1) The Muswellbrook NSW EPA monitoring site is the closest available site for background ambient NO₂ data. Due to the presence of human activity, including residential areas, traffic, major highways and industry, the Muswellbrook monitoring location is likely to experience higher levels of NO₂ pollutants than the areas in the vicinity of the site, which is largely rural and undeveloped. Therefore the use of the Muswellbrook data to represent local ambient NO₂ levels in the air quality analysis for the proposed activity will result in an overestimation of the likely levels of total air pollutants (i.e. ambient level plus modelled impact level from the flare). These conservative total air pollutant levels were then compared against NSW EPA NO₂ criterion, and no exceedances were observed (Appendix 5 of the EIS).

Suitable site-specific CO data was not available to quantify the existing ambient levels at the site. Combustion activities are the cause of CO emissions and spatially there is very little such activity in the area apart from power generation, motor vehicles and wood heaters. Therefore, ambient concentrations of CO are expected to be low (i.e. <0.02 µg/m³ (8hour average)).

The air quality assessment for the proposed activity has been conducted using the best available information currently available and represents a conservative estimate of air quality impacts. The air quality assessment (Appendix 5 of the EIS) concluded that the additional air quality impacts arising from the proposed activity would be minor at the surrounding sensitive receptors and that change in air quality due to the proposed activity is unlikely to be detectable with the results showing that the levels would be well below the relevant criteria for the pollutants assessed. Therefore air quality monitoring at the site, which would necessitate localised baseline monitoring, has not been considered necessary as a mitigation measure for the proposed activity.

- 2) The aim of undertaking baseline atmospheric methane sampling is to gather pre-development methane data against which future sampling can be compared. Sampling will continue to be undertaken throughout the E&A Program.
- 3) Santos is aware that US EPA Method 21 has been used elsewhere in NSW for leak detection and repair programs in association with CSG operations. The US EPA Method 21 was developed prior to the availability of the current mobile Cavity Ring Down Spectrometer devices. A more robust and effective leak detection and repair program for pilot wells would be based on the use of this new technology, taking full advantage of the sensitivity of the device and its mobility. The SoC have been amended accordingly.
- 4) Santos and the University of Adelaide have been undertaking baseline atmospheric methane sampling with a Picarro Cavity Ring Down Spectrometer. The device is accurate to less than one part per million and takes a sample approximately every second. Sampling has been undertaken at existing and proposed CSG exploration and appraisal sites in PEL 238 and PAL 2 to gather baseline data. Samples have been taken while existing pilot wells have been shut in and before any drilling for the E&A Program had commenced. Santos is committed to continuing these studies to include sampling while the pilots are being operated. In the Gunnedah Basin more broadly the baseline sampling has been undertaken in proximity to a number of land uses and most intensively throughout PEL 238.

4.16 Greenhouse gases

4.16.1 Issue description

- 1) The flare and vent stack impacts should have been assessed as part of this EIS, despite being stated as an unlikely occurrence. If venting or flaring does take place, there should be exact measuring and reporting of the emissions.
- 2) Santos should provide an assessment of the potential cumulative greenhouse gas impacts of the production gas field. The EIS did not explain how the cumulative greenhouse impacts over time were to be assessed or measured.
- 3) Concerns raised about the potential risks the proposed activity, and CSG activities in general, pose to climate. It is considered that the CSG lifecycle emissions are equal to or worse than that of coal.

The latest studies of unconventional gas drilling from Harvard University suggest gas emissions from drilling and fracking are 50 per cent worse than previously thought. A 2012 study by researchers at the Southern Cross University found significant amounts of methane appeared to be leaking from the country's largest coal-seam field, near Condamine on Queensland's Western Downs.

- 4) Santos cannot guarantee there will be no leakage of methane, as it is widely accepted that it is virtually impossible to seal gas pipes and equipment.

4.16.2 Response

- 1) The GHG profile presented in Section 13.2 of the EIS included both direct emissions from the extraction of the gas (such as leakage, mud degassing, flaring and onsite power generation), and indirect emissions from the use of plant and equipment to establish the wells and transport personnel.

For the proposed activity, it will be necessary to flare the gas that cannot be used onsite. The wells will be tuned to reduce gas flow to the smallest amount feasible, and flaring will be used to avoid venting of the CSG. Santos will record each vent and flare event, which will inform both the voluntary (Annual Sustainability Reporting) and mandatory (National Greenhouse and Energy Reporting) GHG profiles.

- 2) The cumulative impacts of the E&A Program have been addressed in Section 13.4 of the EIS. This will be revisited as the confidence in the extractable-gas reserves and project certainty increases. Any future exploration, appraisal or production activities beyond the E&A Program, including any application for the Narrabri Gas Project, will be assessed when the relevant applications are lodged. These assessments will continue to incorporate cumulative impact assessments.

For any future development, Santos will continue to record each vent and flare event which will inform both the voluntary (Annual Sustainability Reporting) and mandatory (National Greenhouse and Energy Reporting) GHG profiles.

- 3) The Emission Factors provided in the National Greenhouse Account Factors (NGA Factors) (DCCEE, 2012) were applied, as shown in Table 13-1 of the EIS. DCCEE (2012) specifies a leakage factor for CSGs which has been applied, and accounts for the Global Warming Potential (GWP) of both methane and nitrous oxide as recognised by the Federal Government and the United Nations Framework Convention on Climate Change for reporting.

Santos believes that, if done correctly, CSG has an important part to play in the transition to a low-carbon economy. This means controlling leakage, understanding and responding to the geology of the area and properly sealing and rehabilitating the sites at the end of their productive life.

The established emission intensity from the combustion of CSG has been calculated to be 51.33 kilogram of CO₂^e per gigajoule (GJ) of gas (DCCEE, 2012). Bituminous coal is calculated to be 88.43 kilogram of CO₂^e per GJ. Based on this gigajoule for gigajoule, CSG is 40 per cent cleaner than coal (or 45 per cent when compared to brown coal). This is additional to any benefit gained from higher efficiency equipment used in the combustion process (where fewer GJs are needed to do the same amount of work or produce the same amount of power).

A growing body of domestic and international research is helping the industry to confirm and refine our understanding. Santos will continue to adapt management and operations processes in line with best practice as new information becomes available.

- 4) As stated in Section 13.5.2 of the EIS, regular monitoring and maintenance of equipment and pipes will occur to identify any leaks to minimise fugitive emissions. The fugitive emissions monitoring program for the E&A program area will include a leak detection and repair program using the Picarro Cavity Ring Down Spectrometer, as stated in the amended SoC (refer to chapter 5).

4.17 Noise

4.17.1 Issue description

- 1) Santos should ensure that appropriate mitigation measures are in place to reduce construction and operational noise at nearby sensitive receptors.
- 2) If approved, the NSW EPA recommends that DP&I incorporates noise limits at any sensitive receptor into the conditions as follows:
 - standard construction hours – 40 db(A) LA_{eq}(15mins)
 - outside standard construction hours – 35 db(A) LA_{eq}(15mins).
- 3) A submitter made a noise complaint to Santos on 12 November 2013 due to sleep disturbance from Santos' activities. The respondent is disappointed with ongoing problems with noise and how they are dealt with, and believes that there is no easily identifiable reporting line for incidents.

4.17.2 Response

- 1) Appropriate mitigation measures, as outlined in Section 14.5 and Appendix 6 of the EIS, will be implemented by Santos to reduce construction and operational noise at nearby sensitive receptors.
- 2) Santos' SoC for the proposed activities includes that '*during construction, feasible and reasonable work practices will be implemented with the aim to achieve LAeq 40 dB(A) noise levels during recommended standard construction hours and LAeq 35 dB(A) outside of these times*' (refer to Table 20-1 of the EIS).
- 3) Santos takes all complaints seriously. While it is unknown if the noises heard were from Santos' operations, the complaint was investigated and a response provided directly to the complainant within one week. A report on the complaint and response taken was also provided to the NSW OCSG in accordance with the requirements of PEL 238.

Santos' Project Information Freecall line is advertised via a number of sources, including within project factsheets, information material and in the contact information on the project website. The Freecall 1800 number is answered 24 hours per day 7 days per week where the public is able to

make a complaint or make enquiries on Santos' activities within the Narrabri region. The 1800 number is serviced by an external provider and details are passed on to Santos in a timely manner.

4.18 Traffic and Transport

4.18.1 Recommendations from Roads and Maritime

4.18.1.1 Issue description

- 1) The following conditions of approval are recommended:
 - The intersection of X-Line Road and the Newell Highway should be upgraded to include an Auxiliary Left Turn Treatment Short and Basic Right Turn Treatment on a major road in accordance with Figures 8.3 and 7.5 Part 4A Austroads 2010 respectively and Roads and Maritime supplements. The intersection works should be designed and constructed to accommodate the largest vehicle accessing the intersections. Such designs shall be appropriate for the current speed zone of 110km/h.
 - Prior to the commencement of road works, the developer will be required to enter into a Works Authorisation Deed (WAD) with Roads and Maritime. Roads and Maritime Services will exercise its power under Section 87 of the *Roads Act 1993* (the Act) and/or the functions of the roads authority, to undertake road works in accordance with Sections 64 and 71 and/or Sections 72 and/or 73 of the Act, as applicable, for all works under the WAD.
 - The upgrade of the intersection of X-Line Road and the Newell Highway should be completed prior to the commencement of construction works associated with the proposed activity.
 - A Road Occupancy Licence is required prior to any works commencing within three metres of the travel lanes in the Newell Highway.
 - All access to the pilot should be via the intersection of X-Line Road and the Newell Highway. No other access from/to the state road network (Newell and Kamilaroi Highways) from/to the proposed activity area is permitted.

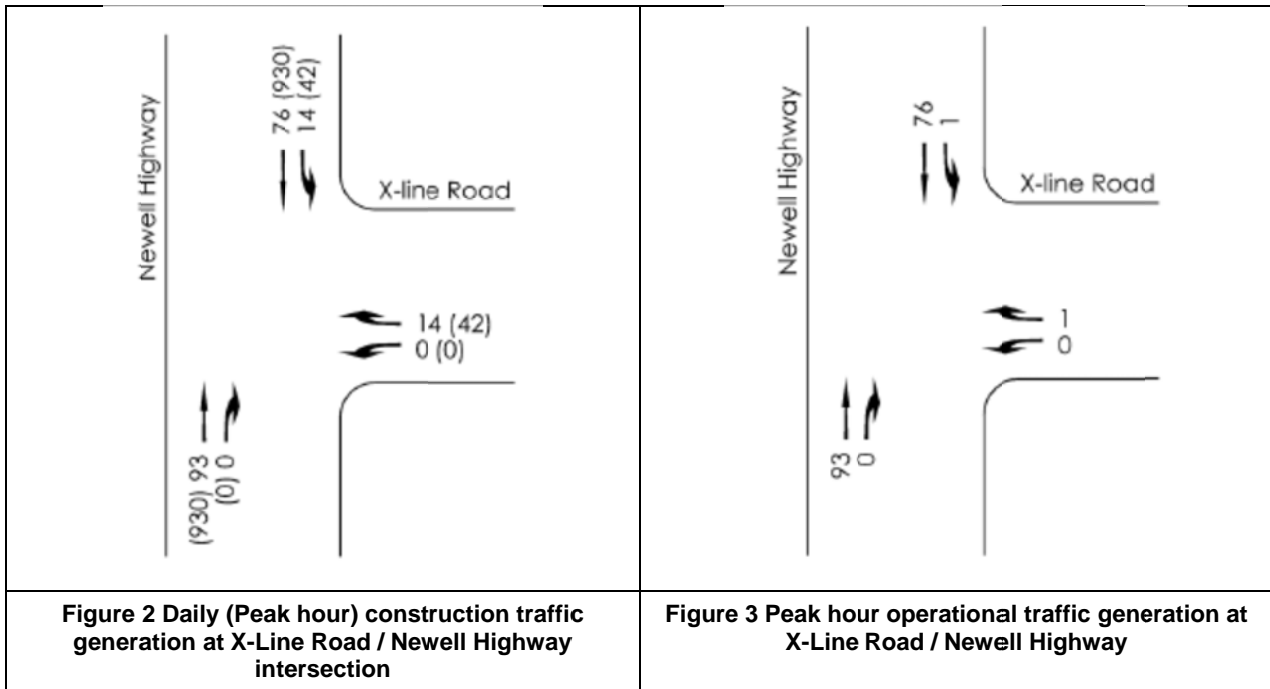
4.18.1.2 Response

- 1) Since the EIS was prepared Santos has undertaken a revised cumulative traffic assessment for the E&A Program based on more current information provided by the construction and drilling contractors and in consultation with the Roads and Maritime Services. The revised assessment is presented below.

The E&A Program will be conducted over the next two to three years and will include an overlap of several construction activities. Works associated with the E&A Program includes site preparation, drilling and surface facilities at pilot wells, with access generally via X-Line Road. Traffic generation will be higher in the earlier years while pilot wells for the E&A Program are drilled. In the latter years, the pilots will be in operation and traffic will reduce.

Access to the forest via Westport Road will be discouraged to reduce impacts to sensitive receivers along this road. Movements associated with relocating the drill rig between sites and drillers travelling between the drillers' camp and site will all occur within the Pilliga forest.

For the E&A Program, the X-Line Road/ Newell Highway intersection will need to accommodate up to 84 vehicles per day (two-way) and up to 28 vehicles during a site activity peak hour throughout construction works. This includes approximately 14 vehicles turning left into X-Line Road and 14 vehicles turning right out of X-Line Road (refer Figure 2).



The maximum projected 84 vehicles per day will only occur when equipment is delivered to well lease areas immediately after drilling. This will occur on approximately 10 to 15 occasions in the six month period to June 2014, with less than 60 vehicles anticipated on a typical day during the same period. Once works associated with the Leewood site and the Bibblewindi WTF are complete, approximately 46 vehicles per day will use the X-Line Road/Newell Highway intersection, with 26 vehicles on a typical day.

During operation (from Q4 2014 to Q1 2015) of the E&A Program, traffic volumes will significantly decrease (refer Figure 3).

It has been agreed with Roads and Maritime Services that the 169 vehicles per hour (two-way) as collected by Roads and Maritime Services in April 2012 is representative of current Newell Highway traffic volumes and has been adopted for the purposes of this assessment.

With the highest average peak hour of 169 vehicles on the Newell Highway, and 76 northbound vehicles, The Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* determines a range for an appropriate left turn treatment as follows:

- 0-80+ left turning vehicles per hour - Basic Left Turn Treatment
- 80+ left turning vehicles per hour - Auxiliary Left Turn Treatment Short.

Based on the estimate of 14 left turning vehicles in any peak hour, the cumulative traffic generation at X-Line Road would not trigger the requirement for an auxiliary left turn treatment.

No vehicles would be required to turn right into X-Line Road from the Newell Highway. As such, a channelised right turn treatment would also not be required.

Accordingly, Santos does not propose to upgrade the intersection of X-Line Road/Newell Highway apart from sealing the first 30 metres. As construction traffic will be required to use X-Line Road in preference to Westport Road, Santos also does not propose to upgrade Westport Road.

Santos confirms that access to the pilot shall primarily be via the intersection of X-Line Road and the Newell Highway. All access to Westport Drillers Camp shall be via the intersection of Westport Road and the Newell Highway. No other access from/to the state road network (Newell and Kamilaroi Highways) from/to the proposed activity area is proposed. The SoC have been amended accordingly.

4.18.2 Other issues raised

4.18.2.1 Issue description

- 1) The EIS states that Westport and Killara Road are unsealed Forestry roads but these are unsealed Narrabri Shire Council roads SR60 and SR65.
- 2) The unsealed road network associated with the proposed activity should be managed and maintained consistent with the guidelines, principles and recommended minimum design standards contained in:
 - *Managing Urban Stormwater: Soils and Construction – Volume 2C Unsealed Roads*
 - *Erosion and sediment control on unsealed roads – A field guide for erosion and sediment control maintenance practices.*
- 3) Traffic speeds are currently higher than 20 kilometres per hour and there is an increased potential for roadkill.
- 4) The EIS underestimates the traffic volumes required during construction. The longer pilot operation phase brings the average down. For example, the Ensign 967 drill rig currently at Dewhurst 22-25 takes 45 semi-trailers to move over approximately 4.5 days. There will be a significant, long term increase in the number of traffic movements far greater than the number stated in the EIS.

4.18.2.2 Response

- 1) Santos acknowledges that Westport and Killara Road are unsealed Narrabri Shire Council roads SR60 and SR65. Santos has regular ongoing engagement with the Council to ensure that they are up to date with all Santos' activities within their LGA.
- 2) Santos will manage and maintain the unsealed road network in line with the Permit to Occupy issued by Forestry NSW, the land access agreement with the land owner of Lot 32 DP 757104 and the PEL 238 conditions. The SoC have been amended accordingly.
- 3) Santos' SoC for the proposed activities include the following to assist in monitoring speed limits of employees and reducing fauna strike (Table 20-1 of the EIS):
 - Construction and operational vehicles/plant will only travel on the designated access tracks. Site speed limits will be imposed to reduce the potential of fauna strike and to reduce dust generation.
 - An in-vehicle monitoring system (IVMS) will be fitted to all Santos vehicles.
- 4) The estimated traffic volumes for the construction and operational phases of the proposed activity were modelled separately, as outlined in the Traffic and Transport Assessment report (Appendix 7 of the EIS). Section 4.5 of this report states that '*for the construction of the two pilot wells, the estimated traffic generation has been calculated based on the daily vehicle movements associated with workers and construction vehicles during each activity as detailed below and summarised in Table 4.1.*' The anticipated construction vehicle volumes, as well as the underlying calculation assumptions, are provided in Section 4.5 of the Traffic and Transport Assessment report.

Santos' Operations team confirmed that the construction traffic volumes associated with drill rig movements in the E&A Program area are similar to those estimated in Table 15-2 of the EIS.

4.19 Waste

4.19.1 Issue description

- 1) Santos should publish a clear ongoing strategy for managing waste, prior to commencement of the proposed activity.
- 2) One respondent raised a number of questions over waste management processes including drilling fluid management and treatment of produced water, including:
 - Will the drilling waste be tested or will it be transported off site prior to testing?
 - Will waste be tested and to what standard?
 - Will solids be treated and if not, what does Santos intend to do with the solids?
 - What happens when the water treatment facility is not operational?

4.19.2 Response

- 1) Prior to commencement of the proposed activity, a waste management plan will be developed based on the waste reduction hierarchy of avoid, reduce, reuse, recycle, recover, treat and dispose outlined in the *NSW Waste Avoidance and Resource Recovery Strategy 2007* (DECC, 2007). During construction, the management of the drilling fluid and drill cuttings will be undertaken as outlined in Section 16.4.1 of the EIS. Throughout the proposed activity, Santos will adopt best practice site environmental management measures in compliance with the POEO Act and *Protection of the Environment Operations (Waste) Regulation 2005* to minimise waste and potential impacts associated with waste generation and disposal.
- 2) Drilling fluids will be continuously reused throughout the drilling process. Once drilling of the wells is complete, drilling fluid will be transported to the Fluid Treatment Facility (FTF) for treatment, as outlined in Section 4.3.7.5.

The water transfer and treatment process for the proposed activity will be as follows (Section 4.4.2 of the EIS):

- At each well, the lifted water produced will be pumped through the water gathering system to Bibblewindi WTF, via the Dewhurst Northern and Southern Water and Gas Flow Lines (under construction).
- The Bibblewindi Water Transfer Tank located at the Bibblewindi WTF will be used to provide a short buffer (up to 24 hours) prior to the produced water being pumped to the Leewood Produced Water Facility via the Leewood Water Pipeline.
- Once at the Leewood Produced Water Facility, produced water will be stored in one of the 300 megalitre ponds.

Produced water from the Leewood Produced Water Facility is proposed to be transported by road tankers to an appropriately licensed facility in the Sydney metropolitan area for treatment, reuse and/or disposal.

Santos is currently developing plans to treat produced water at the Leewood Produced Water Facility by reverse osmosis or other methods instead of transporting produced water from Leewood to a licensed facility.

In answer to the specific questions posed:

- Drilling fluid will be tested at a number of points including once a new batch of fluid is mixed, prior to loading fluid onto a truck, and prior to returning used drilling fluid for recycling. At the rig site the drilling fluid is sampled at least twice every 24 hours; each sample is tested and the results reported on the Daily Drilling Fluid Report. Bulk sampling will be carried out on all fluid received into the FTF daily.
- Drilling fluids will be tested to API 13B-1/ISO 10414-1 *Recommended Practice Standard Procedure for Field Testing Water-Based Drilling Fluids*. Drill cuttings will be tested against the criteria detailed in *Resource Recovery Exemption for Naturally Excavated Material* issued by the EPA on 19 October 2012 (refer to section 4.3.7.6 of the EIS). Any waste generated at the FTF will be disposed of by a suitably licensed contractor.
- Drill cuttings management is outlined in section 4.3.7.6 of the EIS. Any solids that are precipitated from the drilling fluid at the FTF will be placed in a skip bin and removed by an appropriately licenced contractor as solid waste. Santos' current produced water management approach involves storage of produced water at the Leewood Produced Water Facility and transport to an appropriately licenced facility for treatment and management of waste products including solids.
- Santos is currently investigating options to treat produced water at the Leewood Produced Water Facility. Any proposal for a water treatment facility would be the subject of a separate application. Any future facility would have adequate storage to allow operation of wells to continue during routine maintenance of water treatment plant. In the event that this storage is reaching capacity, wells could be temporarily suspended from operating until the issue is resolved.

4.20 Hazards

4.20.1 Bushfire risk

4.20.1.1 Issue description

- 1) Bushfire is a major concern in this area as the Pilliga forest is highly susceptible to fires. Activities associated with CSG could increase the risk of bushfires. Santos does not appear to have a clear bushfire strategy, and should complete a full fire assessment.
- 2) Concerns that Santos is allowed to operate in such a vulnerable area with a large risk of fire from flaring, particularly as flares are exempt from fire ban. It is understood that they cannot be shut down in the event of catastrophic fire conditions, or if shut down there is a risk of explosion.
- 3) Reports that Santos blocked NSW RFS access to parts of the Pilliga during the recent bushfire period.
- 4) Concerns about the incremental number of flares to be installed as more and more pilot wells are proposed in this fire-prone area.
- 5) The current pilot production well site has not been inspected and signed off by the NSW RFS. Community members are concerned that fuel loads both onsite and in the surrounding forest are of dangerously high levels.

4.20.1.2 Response

- 1) Santos has a Bushfire Management Plan that provides direction for Santos' operations on how to prepare for, manage and respond to the risk of bushfire in the area of operations. It outlines the statutory requirements of occupiers of land to prevent bushfires and provides information about Santos' bushfire season preparedness tasks that includes hazard reduction, potential ignition source management, establishment and maintenance of asset protection zones, permit requirements for high risk activities and staff and contractor education. Santos also has an Emergency Response Plan that details actions required in the event of a bushfire incident or emergency.

Santos continues to consult and work with NSW RFS and Forestry NSW on best practice bushfire management practices, shared learnings and implement agreed practices. NSW RFS has acknowledged that CSG activities in the Pilliga forest are not considered to be a fire hazard (Narrabri Courier, 21 January 2014).

- 2) Mitigation measures, outlined Section 17.5.2 of the EIS, will be implemented to minimise the risk of fire from flaring. These include design aspects to limit the risk of ignition such as:
 - Acceptable radiation limits for various locations at the flare site will be determined based on the *American Petroleum Institute (API) 521 Standard* (API, 2007) and *AS 60079.10.1 – Classification of Areas – Explosive Gas Atmospheres*.
 - Within the sterile zone, a high-density polyethylene (HDPE) liner will be laid, covered with approximately 300 millimetres of compacted soil and blue metal aggregate.

The pilot infrastructure does allow for the ability to remotely shut in wells at the well head, while the gas pipelines are buried at least half a metre below ground

- 3) Santos continues to consult and work with NSW RFS and Forestry NSW to ensure the safety of all users of the Pilliga forest. Santos has not restricted access to the Pilliga forest by authorised officers of the RFS.

A temporary exclusion area was enacted by Forestry NSW immediately surrounding one of Santos' work sites, under the provisions of the *Forestry Regulation 2012* (Part 2, Division 1, Clause 7), to ensure the safety of Santos staff, contractors and members of the public.

- 4) Any infrastructure required for future exploration, appraisal or production activities beyond the E&A Program, including the Narrabri Gas Project, will be proposed and assessed at a later stage. These assessments will incorporate cumulative impact assessments, and additional approvals will be required by both State and Federal government.

All flares will be designed to limit the risk of ignition and in accordance with the appropriate Australian and International standards including *American Petroleum Institute (API) 521 Standard* (API, 2007) and *AS 60079.10.1 – Classification of Areas – Explosive Gas Atmospheres*.

- 5) The NSW RFS has reviewed the plans and documents received for the proposed activity and subsequently raised no concerns or issues in relation to bushfire (refer to Section 3.3.1.11 of this Submissions Report).

4.20.2 Chemical risks

4.20.2.1 Issue description

- 1) The EIS does not explore the impact that the loss of chemicals through lost circulation fluid will have on the aquifers. While many CSG companies state they use food based polymers, these are often removed or cleaned up using acid-based products which also has potential for increased risks.
- 2) Concerns that drilling fluid and additives have the potential to contaminate groundwater. Santos has not agreed to full disclosure of all chemicals they will use. There is a need for a clear indication of all drilling fluid additives to be used or that are to be available for use if required.
- 3) EIS does not state 'all chemicals used during drilling will be non-toxic', however similar statements remain in Sections 8.2.2.2 and 17.3.2.

4.20.2.2 Response

- 1) During drilling, the circulating drilling fluid will establish a wall cake (a low permeability 'skin' around the wall of the hole) and maintain pressure on the various aquifers intercepted. This will prevent the ingress of groundwater to the pilot well and discharge of groundwater to the surface. It will also limit the ingress of drilling fluid into the aquifers in the immediate vicinity of the pilot well.

The chemicals used in drilling have been assessed and determined to pose no long term risks to the environment. In accordance with Australian and International standards, a hazard assessment has been conducted on the chemicals used in drilling. The assessment is detailed in the *Drilling Fluid Risk Evaluation* report, provided as Appendix 3. This hazard assessment methodology assesses the PBT of chemicals to determine if chemicals could persist or accumulate in the environment at concentrations that could pose risks to receptors. None of the chemicals used in drilling have been identified as PBT chemical.

As noted in the submission, drilling fluids use primarily food products such as sugar and starch-based products. These compounds are biodegradable in the formation and surplus drilling fluid (prior to cementing) is generally flushed to surface with water.

Chemicals that may be used in the drilling process or held on site during the drilling process and their purposes are summarised in Table 4-8 of the EIS. Since preparation of the EIS, it has been identified that some additional chemicals may be required for use in drilling. These are identified in Table 2.

Table 2 Drilling chemical additives in addition to those listed in the EIS (RPS, 2013a)

Chemical trade name	Description	Purpose
Rheoben NT (Bentonite, Maxigel, Aus-Gel, Trugel 13A. Gel)	Water absorbent clay. Montmorillonite. Naturally occurring clay mineral in Australia.	Thickens the mud so it can carry the drilled rock out of the hole. Also forms a 'wall cake' on the side of the hole to prevent mud from leaching into the ground.
SAPP (Disodium Pyrophosphate)	Sodium Acid Pyro Phosphate	Used with Citric Acid to free pipe from side of the hole. Also used to clean bentonite from the hole when finished.

- 2) Under Part 4.5 of the *NSW Coal Seam Gas Code of Practice Well Integrity* (DTIRIS, 2012) the name, type, CAS number and quantity of each chemical used on each well throughout the life of the well must be recorded.

Chemicals that may be used in the drilling process or held on site during the drilling process and their purposes are summarised in Table 4-8 of the EIS and Table 2 above.

- 3) The chemicals used in drilling have been assessed and determined to pose no long term risks to the environment. In accordance with Australian and International standards, a hazard assessment has been conducted on the chemicals used in drilling. The assessment is detailed in the *Drilling Fluid Risk Evaluation* report, provided as Appendix 3. This hazard assessment methodology assesses the PBT of chemicals to determine if chemicals could persist or accumulate in the environment at concentrations that could pose risks to receptors. None of the chemicals used in drilling have been identified as PBT chemical.

4.21 Social and economic

4.21.1 Analysis approach

4.21.1.1 Issue description

- 1) The EIS focuses on the results of a multiplier model (also known as an input-output model) of the proposed activity's economic impacts, rather than a cost benefit analysis. Bodies such as the ABS, the Productivity Commission and the NSW Land and Environment Court have labelled this approach as 'biased', 'abused' and 'deficient' (ABS, 2011; Gretton, 2013; Preston, 2013). None of the model's assumptions or inputs are discussed, and almost none of the model's results are presented.
- 2) The EIS does not fulfil the DGRs for assessment of the proposed activity, which include a requirement for 'an assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community'. The assessment that has been undertaken doesn't take into account any costs of the proposed activity, only benefits. The short term benefits do not outweigh the potential long term costs to both the environment and community. Specific guidelines for cost benefit analysis of mining and CSG projects were issued by NSW Treasury in conjunction with the Department of Planning last year (NSW Treasury, 2012).

4.21.1.2 Response

- 1) It is recognised that there will always be differing points of view between economic practitioners that prefer a cost benefit approach and those that prefer an input-output model. The strengths and weaknesses of each approach are largely a matter of professional judgement with both seeking to quantify and qualify the larger scale impacts associated with major projects.

In this instance a cost benefit analysis for the proposed activity is not considered appropriate as the detailed operational costs and the regional, state and national benefits are not apparent at the exploration scale. They will become apparent if and when the application is made to transition the E&A Program into the Narrabri Gas Project.

As the scale of the proposed activity is small, it is not expected to significantly alter the economic base of the region. The proposed activity will generate further economic benefit through the local community and the wider economy. This occurs through an economic multiplier effect. This is a circular effect related to the creation of additional jobs, which in turn creates more income and thus demand for products and services in the local economy.

In order to determine the direct and indirect benefits of the proposed activity RPS have devised an Input-Output model calculating economic and employment multipliers for different industries. The multipliers have been calculated in line with the methodology prescribed by the Australian Bureau of Statistics (ABS) in *Information Paper Australian National Accounts Introduction to Input-Output*

Multipliers (Cat No 5246.0). The calculations use data from *Australian National Accounts: Input-Output Tables - Electronic Publication, 2007/08 Final* (Cat No. 5209.0.55.001), namely Tables 5 and 20.

RPS has adopted a Direct Allocation-based Demand Model approach for calculating Output and Employment multipliers. The direct allocation of imports to the relevant industries means that domestic employment yields from additional expenditure are not overstated, as they are in the case of the indirect allocation of imports.

Capital investment in Dewhurst 13-18 and Dewhurst 30-31 is \$11.355 million and \$3.865 million, respectively. This equates to a total capital investment of \$15.22 million for the proposed activity. Based on this capital investment the proposed activity is estimated to generate up to \$8.1 million in output multiplier effect (i.e. additional demand). This effect will lead to the creation of up to an additional 24 indirect jobs in the local and wider economy as part of this multiplier effect. It should be noted that these are preliminary projections and provide an indication of the potential additional economic and employment benefits the proposed activity may have based on current inputs.

While the proposed activity relies on a number of fly-in fly-out (FIFO) workers, this will still benefit the local and regional economy in a number of ways. The Westport drillers camp is serviced by local people and provisions, including food and fresh produce which are sourced locally. FIFO workers are also estimated to generate a local expenditure of approximately \$25 per person per day on local businesses. This expenditure on local goods and services ensures that the benefits of the FIFO workforce of the proposed activity are passed along to local businesses and are not confined wholly to the mining services sector.

In terms of sourcing local materials and contractors for the proposed activity Santos has estimated that a further approximate \$0.8 million will be spent on vehicle maintenance and leases, fuel and locally based contractors. This expenditure is likely to contribute both to the Narrabri economy and the wider northwest NSW region.

No existing jobs will be lost as a direct result of the proposed activity. This includes employment opportunities in the agricultural industry which has historically been one of the main economic drivers both for Narrabri and the surrounding northwest NSW region.

- 2) The guidelines issued by NSW Treasury for mining and CSG projects states that '*the Strategic Regional Land Use Policy provides that an optional cost benefit analysis can be undertaken for SSD proposals for mining or petroleum (including CSG) that have passed the Gateway process*'. It does not state that it is a mandatory requirement for all SSD proposals.

Accordingly, the approach undertaken in the EIS is considered appropriate given the scale of the proposed activity and the available information. As the scale of the proposed activity is small, it is not expected to significantly alter the economic base of the region. The proposed activity will generate further economic benefit through the local community and the wider economy. No existing jobs will be lost as a direct result of the proposed activity.

The socio-economic benefits as a result of the proposed activity will not be extensive, however the potential socio-economic costs of the proposed activity are also small. The potential positive and negative effects of the proposed activity on the economic and social fabric of Narrabri and its surrounding communities are summarised in Table 18-1 of the EIS. The analysis indicates that the proposed activity will have a generally neutral or positive impact on the community.

4.21.2 Employment

4.21.2.1 Issue description

- 1) The EIS identifies that during construction 11.2 Full Time Equivalent (FTE) positions (of which it is proposed that 4.2 are FIFO) during construction and only two FTE positions during operations. The EIS then applies an economic multiplier to create a further 16 indirect jobs. However as the EIS states that the employees to be housed at the Drillers Camp at Westport (for the 15 weeks of the construction phase and are likely to be specialised personnel) this multiplier effect will be reduced. It is therefore unlikely that a significant portion of the identified benefits of the proposed activity will be accrued in the local community.

4.21.2.2 Response

- 1) The economic benefit of the proposed activity was calculated using an Input-Output model calculating economic and employment multipliers for different industries. The multipliers have been calculated in line with the methodology prescribed by the ABS in *Information Paper Australian National Accounts Introduction to Input-Output Multipliers* (Cat No 5246.0). The calculations utilise data from *Australian National Accounts: Input-Output Tables - Electronic Publication, 2007/08 Final* (Cat No. 5209.0.55.001), namely Tables 5 and 20.

While the proposed activity relies on a number of FIFO workers, this will still benefit the local and regional economy in a number of ways. The Westport drillers camp is serviced by local people and provisions, including food and fresh produce which are sourced locally. FIFO workers are also estimated to generate a local expenditure of approximately \$25 per person per day on local businesses. This expenditure on local goods and services ensures that the benefits of the FIFO workforce of the proposed activity are passed along to local businesses and are not confined wholly to the mining services sector.

4.21.3 Public access

4.21.3.1 Issue description

- 1) Santos has closed large areas of the Pilliga State Forest to all but Santos personnel and contractors. This is permitted under the *Forestry Act 2012*; however it does pose safety risks as the roads to the south are an escape route in case of emergency and allow linking with other roads leading east and west.
- 2) The Crown land roads which are subject to the enclosure permit had been locked and had fallen trees placed over them, preventing access since 2009 until 7 November 2013. This contravenes the *Crown Lands Act 1989* and the *Roads Act 1993*. This road needs to remain open for use in the event of an emergency as it is the only road north from the area and links with other roads east of the area.

4.21.3.2 Response

- 1) Santos has not closed large areas of the Forest. Forestry NSW was requested to enact a temporary exclusion area immediately surrounding one of Santos' work sites, under the provisions of the *Forestry Regulation 2012* (Part 2, Division 1, Clause 7), to ensure the safety of Santos staff, contractors and members of the public. The exclusion zone was marked by signage only and did not incorporate any physical barriers. Emergency access was therefore maintained at all times.

- 2) The matter was rectified within five working days on notification from Crown Lands on 29 October 2013 that the gate was to be unlocked. Santos, at its own cost, also rectified the obstruction to the road that was not related to Santos activities and had been in place since 2011.

4.21.4 Impacts on the community

4.21.4.1 Issue description

- 1) Developing industrial gas fields within the rural landscape will potentially damage rural areas, impact on long-term agricultural practices and force unwanted change onto communities. It will industrialise an agricultural area and destroy the tourist industry.

Mining and extractive industries are unsustainable in the long term, whereas agriculture and tourism has the ability to support this region indefinitely. The sustainability of the forestry industry should be assessed for a CSG field involving hundreds of cleared pads.

- 2) There is community opposition to CSG by farmers. The Narrabri community has not given Santos a social license to operate. A number of communities across the Liverpool Plains have been surveyed with results showing that greater than 90 per cent of residents do not want CSG, particularly in such important ecosystems as the Pilliga forest.
- 3) Ongoing contractor forums to inform local businesses of opportunities associated with the proposed activity are encouraged.

Santos should seek to procure at least 50 per cent of goods and services from local, and in particular locally-owned, businesses.

4.21.4.2 Response

- 1) While the Dewhurst 13-18H pilot is located within a property used for agricultural activities, the proposed activity at this site occurs within areas previously disturbed for CSG activities. In addition, no intensive agricultural activities are currently undertaken within the property, and the land on which it is located has low potential for commercial agricultural land use. The proposed activity at Dewhurst 26-31 is being undertaken within a State forest, it will not prohibit any agricultural production within the region. The proposed activity will have negligible impacts to agricultural land as discussed in Section 8.2.1 of the EIS and the accompanying AIS (Appendix 2 of the EIS).

Based on groundwater modelling, with best practice mitigation measures in place the proposed activity should have negligible impacts on groundwater resources. The cumulative E&A Program is also predicted to have minimal impact on land resources, being predominantly located within State forest, and not being located on land classified as BSAL or CIC.

Although production forestry is mapped within PEL 238 and PAL 2, there are minimal exotic plantations. Rather, these areas include State forest used for timber harvesting and nature reserves. Timber harvesting within the Pilliga forest has been reduced largely due to conservation efforts; therefore any impact on such enterprises are not considered significant. Additional clearance due to the E&A Program has a very small extent within the State forest (less than 50 hectares), when compared to the extent of the State forest in the Pilliga region (over 190,000 hectares).

- 2) Santos continues to work hard to maintain a social licence, with a commitment to transparent communication and ongoing engagement with the community. Santos has a long history of working with regional communities and understands that the community has concerns about the industry.

Issues raised are addressed through the community engagement and consultation framework, and by making information about the E&A Program readily available through:

- community shopfronts in both Narrabri and Gunnedah
 - conducting regular site tours of the operations and holding regular information sessions throughout the assessment process.
- 3) Santos will continue operating ongoing contractor forums to inform local businesses of opportunities associated with the E&A Program, wherever the opportunity arises to ensure that local contractors, businesses and community groups can benefit from the E&A Program where possible. Santos is a member and active participant of the Narrabri Chamber of Commerce.

4.22 Aboriginal cultural heritage

4.22.1 Issue description

- 1) Respondents were disappointed that Aboriginal Heritage requirements were taken out of the DGRs.
- 2) The Gomeroi Traditional Owners of the Pilliga Forest have an ongoing connection to the Pilliga Forest through 'song-lines', sacred sites, bush-medicine and cultural practices. There is concern that the proposed activity will damage the cultural heritage of this area. To not include an Aboriginal Cultural Heritage assessment is denying the rights of the Gomeroi Nation to have their traditional knowledge considered as part of this proposed activity.

4.22.2 Response

- 1) This was a decision based on the inherent risk to Aboriginal heritage acknowledging that archaeological field surveys were undertaken at the proposed Dewhurst 13-18H Pilot gathering system (31 January 2013) and the Dewhurst 30 and 31 lease areas (14 November 2012). The inspections were consistent with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. The proposed drilling and surface construction activities at Dewhurst 13-18H are contained within existing lease pads and access tracks that were previously cleared and the ground prepared for CSG activity.
- 2) Archaeological field surveys were undertaken by RPS at the proposed Dewhurst 13-18H Pilot gathering system (31 January 2013) and the Dewhurst 30 and 31 lease areas (14 November 2012), as stated in the EIS. The inspections were consistent with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. The proposed drilling and surface construction activities at Dewhurst 13-18H are contained within existing lease pads and access tracks that were previously cleared and the ground prepared for CSG activity.

No Aboriginal objects, sites, places of significance or culturally modified trees were identified within the site or immediate surrounds. The potential for any previously unidentified Aboriginal objects or sites to be located within the site or immediate surrounds is considered to be nil to low.

Despite the perceived low potential for impact, a number of mitigation measures were provided in the SoC (Table 20-1 of the EIS) to reduce the potential for any impacts on Aboriginal cultural heritage.

4.23 Non-Aboriginal cultural heritage

4.23.1 Issue description

- 1) There are two unlisted heritage items on the Leewood property (p 179 of the EIS). There is no indication in the EIS as to whether these items are potentially of Local, State or National significance, or what the potential impact on these items might be. The Heritage Division recommends that the applicant be requested to provide a SHI for the unlisted heritage items. The SHI should assess the potential impacts on the items, including impacts on their setting, and views and vistas. The SHI should also consider the potential for archaeological relics/deposits of Local or State significance. Strategies to mitigate any potential impacts should also be included in the EIS.
- 2) General mitigation measures should include a site induction and toolbox talks to make project staff and contractors aware of their statutory obligations under the NSW *Heritage Act 1977*, in regard to archaeological relics.

4.23.2 Response

- 1) The two unlisted heritage items identified at the Leewood property (two pits which formed part of the Sydney University Giant Air-shower Recorder (SUGAR) array) will not be impacted upon by the proposed activity. As stated in the *Aboriginal and Historic Heritage Due Diligence Report, Leewood Ponds Activity Area, Leewood NSW* (RPS, 2012), at this stage Santos has no intention to modify, damage or destroy the SUGAR station on the Leewood property. In the event that any part of the SUGAR station will be impacted, further investigation under the *Heritage Act 1977* should be undertaken prior to works. This may include the preparation of a SHI.
- 2) Santos' current site inductions include details of appropriate mitigation measures to protect cultural heritage, as well as the reporting requirements in the event of finding any previously unidentified cultural heritage items (both Aboriginal and non-Aboriginal). The SoC have been updated accordingly.

4.24 Health

4.24.1 Issue description

- 1) Concerns about the risks the proposed activity poses to the health and wellbeing of humans and wildlife. Experiences from Tara (Qld) and USA indicate that the environmental health impacts from CSG activities are too concerning to allow in NSW.

4.24.2 Response

- 1) Adverse health related issues are not anticipated.

The air quality impact assessment (Appendix 5 of the EIS) determined that air quality issues during both construction and operation were negligible. Produced water will not be used for dust suppression during the proposed activity.

The drilling fluids do not contain petroleum oil or chemicals with benzene, toluene, ethylbenzene, and xylenes (BTEX) constituents as ingredients. In accordance with the standard drilling process, wells are constructed with the aquifer systems isolated by casings and cement from the underlying target coal sequences. A surface casing (extending through any shallow aquifers) is established and cemented prior to advancement of drilling into the deeper coal units. This surface casing eliminates

the potential for impact from constituents present within the coal during drilling or operation of the well.

Unlike conventional petroleum reservoirs, which contain heavier petroleum hydrocarbon fractions, CSG is primarily methane and does not contain heavier petroleum gases such as BTEX. Sampling and analysis of the CSG in the area has confirmed that the gas is dominated by methane (approximately 96 per cent by weight) and does not contain heavy petroleum gases.

Reference has been made in submissions to allegations of health impacts from CSG operations located near Tara in Queensland in respect of emissions and the use of produced water for dust suppression.

Queensland Health investigated these allegations and its report found no evidence of any link between CSG operations and claimed health impacts from residents. 'Based on the clinical and environmental monitoring data available for this community risk assessment, a clear link cannot be drawn between health complaints by some residents of the Tara region and impacts of the local CSG industry on air, water and soil within the community' (Queensland Health, 2013). A copy of the report is available at <http://www.health.qld.gov.au/publications/csg/documents/report.pdf>.

An independent medical practitioner has also carried out an investigation with similar results. The report of the investigation noted 'CSG is also released during coal mining, thus coal miners have been and are regularly exposed to CSG in the course of their work. Despite regular monitoring of the health of coal miners both in Queensland and internationally, no health effect from potential exposure to methane has been recognised... The relationship between symptoms and potential exposure to chemicals involved in the production of CSG remains unclear' (Adam, 2013). A copy of the report is available at <http://www.health.qld.gov.au/publications/csg/documents/appx2.pdf>.

5.0 Revised Statement of Commitments

The EIS for the Dewhurst Gas Exploration Pilot Expansion identified a range of environmental outcomes and management measures that would be required to avoid or reduce the environmental impacts of the proposed activity.

After consideration of the issues raised in the public submissions, the draft Statement of Commitments for the proposed activity (refer to Chapter 20 of the EIS) has been revised. Should the proposed activity be approved, the revised commitments will guide the subsequent phases of the associated works.

The revised Statement of Commitments, including commitments relating to the key issues described in the Director-General's Requirements is provided in Table 3. Modified commitments are shown in **bold** and *italics*.

Table 3 Statement of Commitments

Item	Commitment
Activity type	The Dewhurst Gas Exploration Pilot Expansion (proposed activity) includes the expansion of operations at the Dewhurst 13-18H and Dewhurst 26-31 pilots, and operation of both pilots for up to three years. Works at Dewhurst 13-18H involve re-entering three existing wells to convert single horizontal wells to triple-stacked horizontal wells. Works at Dewhurst 26-31 involve the construction of two additional wells on new lease areas to expand the pilot from four to six wells.
Location	The proposed activity is within Petroleum Exploration Licence (PEL) 238, on private and Crown land (Dewhurst 13-18H) and within the Pilliga East State Forest (Dewhurst 26-31).
Hours of operation	Hours of operation will be up to 24 hours a day, seven days a week.
Activity duration	Approximately 5-6 months construction/drilling and up to 3 years for operation of the wells.
Proposed commencement date	Works are scheduled to commence in the second quarter of 2014.
Maximum area of disturbance	8.89 ha (Dewhurst 13-18H – 5.37 ha; Dewhurst 30/31 – 3.52 ha)
Rehabilitation commitments and timeframes	Pilot well decommissioning and rehabilitation of the well lease areas and access tracks will occur within 6 months of abandonment where practical. Pilot wells and ancillary infrastructure will be decommissioned and lease areas rehabilitated as outlined in Section 4.5 of the Environmental Impact Statement (EIS).
Stakeholder consultation	<ul style="list-style-type: none"> ▪ Community consultation will be undertaken in accordance with Chapter 5 of the EIS. ▪ Advice will be provided to relevant landowners that may be impacted by the activity 14 days prior to the proposed activity commencing. ▪ Narrabri Shire Council will be consulted on a monthly basis where appropriate. ▪ Updates on the proposed activity will be provided to the Narrabri Community Consultation Committee. ▪ Advertisements will be placed in the local media of the up-coming exploration and drilling activities. ▪ The local police will be notified of the proposed drilling activities and provided with a road traffic plan specifying the route, time and location of the drilling rig 14 days prior to the drilling rig mobilising to site.
Land resources	<p>Construction</p> <ul style="list-style-type: none"> ▪ Excess topsoil and subsoil generated during site preparation activities will be stockpiled onsite and used as backfill following completion of drilling. ▪ Stockpiles will be managed according to best management practices such as the measures outlined in <i>Managing Urban Stormwater: Soils and Construction</i> (Landcom, 2004) ('the Blue Book'). ▪ Erosion and sediment controls will be implemented where necessary during construction activities, in accordance with the guidelines, principles and recommended minimum design standards contained in <i>Managing Urban Stormwater: Soils and Construction – Volume 1 (the Blue Book)</i>. These controls will be maintained until disturbed areas of the site are stabilised. ▪ The quantity of chemicals, fuels and oils stored onsite will be minimised, where practicable.

Item	Commitment
	<ul style="list-style-type: none"> ▪ All additives, chemicals, fuels and oils stored onsite will be kept in an appropriately secured, bunded storage shed in accordance with the relevant Safety Data Sheet (SDS). ▪ Where there is a risk of contamination pits will be lined or material will be stored in surface tanks or metal bins. ▪ An SDS register of all chemicals used or stored onsite will be maintained. ▪ Maintenance of vehicles, plant and equipment will occur offsite at an appropriately licensed facility unless deemed necessary and appropriate to conduct such maintenance onsite. ▪ Any spills or leaks will be contained and cleaned up immediately using the spill kit. Contaminated material (such as contaminated soil or absorbent materials) will be placed in a bag and removed from site for disposal at a licensed waste facility. ▪ Plant and equipment will be inspected daily to ensure these are properly maintained. <p>Operation</p> <ul style="list-style-type: none"> ▪ Ongoing management and maintenance of remaining infrastructure onsite will occur, including water transfer area and well heads. ▪ The gathering system water pressure will be monitored. Should line failure occur between the wells to the transfer tanks at Dewhurst 14 and Dewhurst 28, operation of the well will be suspended until the problem is rectified. ▪ The two pilot sites will be rehabilitated in accordance with Section 4.5 of the EIS. ▪ <i>Any spills or leaks during operation will be contained and cleaned up immediately using a spill kit. Contaminated material (such as contaminated soil or absorbent materials) will be placed in a bag and removed from the site of the spill for disposal at a licensed waste facility.</i>
Groundwater	<p>Construction</p> <ul style="list-style-type: none"> ▪ The wells will be designed and constructed in accordance with the <i>NSW Coal Seam Gas Code of Practice Well Integrity</i> (DTIRIS, 2012). ▪ Drilling and installation operations, well control, waste management and abandonment procedures for the pilot wells will be in accordance with accepted industry practices and in accordance with the processes outlined in the EIS. ▪ A driller that holds the relevant qualifications as defined by the NSW Office of Water will be onsite during drilling of the top hole until the surface casing is set, cemented, and pressure tested. During this time, there will be 24 hour coverage by one person working the day shift and on call at site during the night. This will ensure that the appropriate knowledge of water legislation and regulation in NSW and technical skills are employed to avoid impacts to surface and groundwater sources. ▪ Excessive drilling fluid losses will be cured by loss circulation material (cellulose material such as sawdust or other benign naturally occurring substances, as required) to ensure most fluids return to the surface. ▪ Santos will make reasonable endeavours to seek permission (from landowners) to access registered groundwater bores within 2 km of the two pilot sites to undertake groundwater monitoring prior to drilling, to establish baseline conditions, and on completion of drilling, to determine if there are any impacts. Where access to bores is granted (and the bore is functioning), monitoring will include water level measurements and water quality observations in the field, and sampling for analysis by an accredited laboratory. <p>Operation</p> <ul style="list-style-type: none"> ▪ The volume of water extracted from the pilot wells will be monitored. ▪ Pressure gauges will be fitted to the pilot wells, and monitored remotely through a supervisory control and data acquisition (SCADA) system. Should pressure change due to a leak, the pilot wells will be shut down immediately and the affected area investigated.

Item	Commitment
	<ul style="list-style-type: none"> ▪ The groundwater monitoring program will be implemented. ▪ In line with monitoring during drilling, Santos will make reasonable endeavours to seek permission (from landowners) to continue monitoring of registered groundwater bores within 2 km of the two pilot sites to determine if there are any impacts to aquifers. ▪ The wells will be decommissioned as soon as they are no longer required.
Surface water	<p>Construction</p> <ul style="list-style-type: none"> ▪ Water will not be extracted from nearby watercourses, including Mount Pleasant Creek, Tuppiari Creek, Cowallah Creek or Jacks Creek. ▪ The existing diversion bund at Dewhurst 13-18H will be maintained on the up-slope side of the lease areas to divert clean water around the work area. ▪ Diversion bunds will be installed and maintained for the Dewhurst 30 and 31 lease areas. ▪ Drilling fluids will be contained in surface tanks which will be regularly inspected and maintained. ▪ Water that drains to the cellar pit will be circulated with the drilling fluid throughout the drilling process. ▪ Should any formation fluid rise through the well, it will be captured in the waste fluid tank and will be removed to a licensed waste facility that is able to accept liquid waste for disposal or treatment. ▪ Drilling fluids will be transported to and from site by an appropriately licensed contractor. ▪ Fuel and lubricants will be stored onsite only when necessary and maintained offsite whenever possible. ▪ Wastewater generated through general site activities will be removed by an appropriately licensed contractor for disposal at a licensed facility or treated to an appropriate quality prior to discharging. ▪ All areas storing or handling fuel, fuel using equipment, and chemicals will be bunded in accordance with <i>Australian Standard 1940–2004; The Storage and Handling of Flammable and Combustible Liquids</i> or other relevant guidelines. ▪ Weather forecast will be monitored and in the event that prolonged, severe wet weather or flooding is predicted, works will cease and plant, machinery and any chemicals will be secured and bunded. ▪ A minimum freeboard of 300 mm will be maintained for any tanks containing liquid waste. <p>Operation</p> <ul style="list-style-type: none"> ▪ The surface infrastructure at the lease areas will be regularly inspected. ▪ The surface water monitoring program will be implemented.
Biodiversity	<ul style="list-style-type: none"> ▪ Micro-siting of lease areas and service corridors locations will be undertaken at Dewhurst 30 and 31 during detailed design and pre-clearance survey stage to minimise impacts on the ecological communities and species. ▪ Clearing of hollow-bearing trees will be avoided where possible. ▪ While clearing or disturbance to vegetation occurs, a fauna spotter/catcher will be onsite to supervise works. ▪ Hollow logs removed from the disturbance areas are to be relocated to habitats adjacent to the lease areas under supervision from the fauna/spotter catcher. Fauna sensitive clearing techniques will be implemented, including vibrating the bucket on large trees (particularly hollow-bearing trees) prior to clearing, and dismantling large trees. ▪ The site boundary will be clearly demarcated to ensure that plant and vehicles keep within the approved area of disturbance. ▪ The two pilot sites will be rehabilitated in accordance with Section 4.5 of the EIS. ▪ Construction and operational vehicles/plant will only travel on the designated access tracks. Site speed limits will be imposed to reduce the

Item	Commitment
	<p>potential of fauna strike and to reduce dust generation.</p> <ul style="list-style-type: none"> ▪ Prior to earthworks, noxious weeds present onsite will be removed or treated with herbicide to help prevent or reduce their spread. ▪ Weed management measures will be undertaken; including wash down of all plant and machinery (including vehicles) in accordance with legislative requirements to prevent the spread of weeds and pathogens. ▪ Weed monitoring will occur throughout all phases of the proposed activity. Weed removal will be carried out as necessary.
Air quality	<ul style="list-style-type: none"> ▪ Dust will be suppressed as required by spraying water along the access tracks and lease areas. ▪ Site speed limits will be imposed to minimise dust generated by vehicle movements. ▪ Loose, dust generating materials will be covered when transported to and from site. ▪ Vehicles, plant and equipment will be regularly maintained to ensure they are in good operating condition. ▪ Vehicles, plant and machinery will be turned off when not in use rather than left idling. ▪ Rehabilitation works, including landform establishment, will occur within six months of abandonment.
Greenhouse Gases	<p>Construction</p> <ul style="list-style-type: none"> ▪ Retain timber and woody debris cleared during site preparation (excluding merchantable timber identified by Forestry NSW) for use in rehabilitation to assist in re-establishing carbon sink. ▪ Energy efficient equipment and processes will be used where possible. ▪ Water based drilling fluids will be used. ▪ Appropriate monitoring of emissions and consumables will be undertaken for legislative reporting requirements (such as to inform National Greenhouse and Energy Reporting Scheme (NGERS) calculations). <p>Operation</p> <ul style="list-style-type: none"> ▪ Regular monitoring and maintenance of equipment and pipes will occur to identify any leaks to minimise fugitive emissions. ▪ A fugitive emissions monitoring program will be implemented in the Energy NSW CSG Exploration and Appraisal Program (E&A Program) area, incorporating a leak detection and repair program using the Picarro Cavity Ring Down Spectrometer. ▪ Appropriate monitoring of emissions and consumables will be undertaken for legislative reporting requirements (such as to inform NGERS calculations).
Noise	<ul style="list-style-type: none"> ▪ Forestry NSW, the private landowner at Dewhurst 13-18H and the next two nearest sensitive receivers will be notified prior to the proposed activity commencing. ▪ During construction, feasible and reasonable work practices will be implemented with the aim to achieve LA_{eq} 40 dB(A) noise levels during recommended standard construction hours and LA_{eq} 35 dB(A) outside of these times. ▪ During operation, in the event that the residence located 500 m south of the Dewhurst 13-18H Pilot (RR4) is to be re-occupied, monitoring will be undertaken to confirm operational noise levels at this location. If noise monitoring determines that levels are above noise criteria, an agreement will be negotiated with the landowner, or further feasible and reasonable mitigation measures will be implemented to reduce noise levels.

Item	Commitment
Traffic and Transport	<ul style="list-style-type: none"> ▪ Vehicles will not travel at speeds greater than 80 km per hour along unsealed roads (including within the forest) unless otherwise signed. ▪ Heavy vehicle activity passing through residential areas will be confined to standard construction hours (7.00 am to 6.00 pm Monday to Friday, 8.00 am to 1.00 pm Saturday). ▪ All site staff and delivery drivers will receive the appropriate induction (consistent with Santos policies), which will include driver protocols and identification of any local hazards. ▪ An in-vehicle monitoring system (IVMS) will be fitted to all Santos vehicles. ▪ Construction vehicle movements will be restricted to designated routes to/ from site via the Newell Highway. ▪ Construction vehicle activity will be managed and controlled in the vicinity of the two pilot sites. ▪ Any damage to roads caused by construction activities will be repaired at Santos cost in accordance with the Permit to Occupy, land access agreement or the PEL 238 conditions. ▪ Access to the Dewhurst 13-18H and Dewhurst 26-31 pilots shall primarily be via the intersection of X-Line Road and the Newell Highway.
Waste	<ul style="list-style-type: none"> ▪ Management of drilling fluids and drill cuttings in accordance with principles outlined in Sections 4.3.7.5 and 4.3.7.6. ▪ Management of waste, including its transport, will comply with the <i>Protection of the Environment Operations Act 1997</i> (POEO Act) and <i>Protection of the Environment Operations (Waste) Regulation 2005</i> (POEO (Waste) Regulation). ▪ The Waste Management Plan will be implemented, that will be based on the waste reduction hierarchy of avoid, reduce, reuse, recycle, recover, treat and dispose. ▪ General site waste will be segregated according to their classifications under the <i>Waste Classification Guidelines</i> (DECCW, 2009) and stored in bins or skips within a designated waste transfer point within the lease area prior to transportation for disposal. ▪ Regulated waste will be collected by licensed contractors for off-site disposal. General and recyclable waste will be transported to local council landfill and recycling facilities. ▪ Following completion of cementing, excess fluids and cement slurries will be segregated in steel waste tanks and removed and disposed of by a licensed waste disposal company. ▪ Sewage waste will be removed from site by a licensed contractor for treatment and disposal, as required. ▪ The type and volume of all waste removed from site will be recorded. ▪ All staff and contractors will be made aware of waste management procedures during the site induction and through toolbox talks. ▪ Chemical, fuel and oil containers will be managed according to the SDS or manufacturers' directions to avoid potential impacts to the environment or human health.
Hazards	<p>Construction</p> <ul style="list-style-type: none"> ▪ Site safety protocols, incident management and emergency procedures will be implemented during the construction and drilling works. ▪ The two pilot sites will be kept in a clean and tidy manner during site preparation, drilling activities and operation of the pilot wells. ▪ Chemicals and potentially hazardous substances will be used and stored according to regulatory requirements including the <i>Work Health and Safety Act 2011</i>. ▪ Any dangerous goods will be transported according to regulatory requirements under the <i>Dangerous Goods (Road and Rail Transport) Act</i>

Item	Commitment
	<p>2008.</p> <ul style="list-style-type: none"> ▪ Chemical, fuel and oil containers will be managed according to the SDS or manufacturers' directions to avoid potential impacts to the environment or human health. <p>Operation</p> <ul style="list-style-type: none"> ▪ The flare at Dewhurst 14 will be designed to limit the risk of ignition. Acceptable radiation limits for various locations at the flare site will be determined based on the <i>American Petroleum Institute (API) 521 Standard (API, 2007)</i> and <i>AS 60079.10.1 – Classification of Areas – Explosive Gas Atmospheres</i>. ▪ Within the sterile zone, a high-density polyethylene (HDPE) liner will be laid, covered with approximately 300 mm of compacted soil and blue metal aggregate. ▪ Where feasible best practice bushfire risk management will be implemented. ▪ All statutory obligations for bushfire management will be met. ▪ An education program for staff and contractors regarding the risks from bushfires in consultation and collaboration with relevant stakeholders will be implemented.
Social and Economic	<ul style="list-style-type: none"> ▪ Consultation activities will occur in accordance with Chapter 5 of the EIS. ▪ Continued contribution to the local sponsorship program. ▪ Implementation of a buy local program.
Other	<ul style="list-style-type: none"> ▪ Project staff and contractors will be made aware of their statutory obligations to protect Aboriginal cultural heritage objects under the <i>National Parks & Wildlife Act 1974</i>, through the site induction and toolbox talks. ▪ All works will be undertaken to comply with Part 6 of the NPW Act. ▪ If any previously unidentified Aboriginal cultural heritage objects are identified during works, then such in the immediate area will cease, the area will be cordoned off and the NSW Office of Environment and Heritage (NSW OEH) Enviroline 131 555 will be contacted. A suitably qualified archaeologist will be contacted so that the site can be assessed and managed in accordance with relevant legislative and policy requirements. ▪ In the event that skeletal remains are uncovered, then works in the immediate area will cease, the area will be cordoned off and the NSW Police will be contacted. Should the NSW Police determine that the material is not recent, the NSW OEH Enviroline 131 555 and relevant Aboriginal stakeholders will be contacted to determine an action plan for the management of the skeletal remains prior to works re-commencing. ▪ If any previously unidentified potential non-Aboriginal cultural heritage material is identified during construction or drilling, then works in the immediate area will cease, the area will be cordoned off and the NSW OEH Heritage Branch will be contacted. A suitably qualified archaeologist will be contacted so that the site can be assessed and managed. ▪ Site inductions will include details of appropriate mitigation measures to protect cultural heritage, as well as reporting requirements in the event of finding any previously unidentified cultural heritage items (both Aboriginal and non-Aboriginal).

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7.0 Terms and abbreviations

Enter any acronyms or units throughout the document in the table below:

ABS	Australian Bureau of Statistics
AIP	Aquifer Interference Policy
AIS	Agricultural Impact Statement
API	American Petroleum Institute
BNCCA Act	<i>Brigalow and Nandewar Community Conservation Area Act 2005 (NSW)</i>
BSAL	Biophysical Strategic Agricultural Land
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CAP	<i>Namoi Catchment Action Plan 2010-2020 (Namoi CMA, 2011)</i>
CCA	Community Conservation Area
CIC	Critical Industry Cluster
Crown Lands	NSW Crown Lands Division
CSG	Coal seam gas
CUCCLG	Coonabarabran and Upper Castlereagh Catchment and Landcare Group
DA	Development application
dB(A)	A-weighted decibels – an expression of the relative loudness of sounds in air as perceived by the human ear
DCCEE	Commonwealth Department of Climate Change and Energy Efficiency
DEC	NSW Department of Environment and Conservation
DECC	NSW Department of Environment and Climate Change
DECCW	NSW Department of Environment, Climate Change and Water
DGRs	Director-General's Requirements
DP&I	NSW Department of Planning and Infrastructure
DTIRIS	NSW Department of Trade and Investment, Regional Infrastructure and Services
E&A Program	Energy NSW CSG Exploration and Appraisal Program
EC	Electrical conductivity
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EP&A Act	<i>Environmental Planning and Assessment Act 1979 (NSW)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
EPL	Environment Protection Licence
ESG	Eastern Star Gas
FIFO	Fly-in fly-out
Forestry NSW	Forestry Corporation of New South Wales
FTE	Full Time Equivalent
FTF	Fluids treatment facility
GAB	Great Artesian Basin
GDE	Groundwater Dependent Ecosystem
GJ	Gigajoule
GMMP	Groundwater Monitoring and Modelling Plan
GWP	Global warming potential

HDPE	High-density polyethylene
HIA	Health Impact Assessment
HSU	Hydrostratigraphic Unit
IVMS	In vehicle monitoring system
KOP	Kick-off points
LA _{eq}	Logarithmic average noise level from all sources
LGA	Local government area
LNG	Liquefied natural gas
LSTU	Less significant transmissive unit
MNES	Matter of National Environmental Significance
Namoi CMA	Namoi Catchment Management Authority
Narrabri CCC	Narrabri Community Consultation Committee
Narrabri LALC	Narrabri Local Aboriginal Land Council
NGA Factors	<i>National Greenhouse Accounts Factors</i> (DCCEE, 2012)
NGERS	National Greenhouse Energy Reporting Scheme
NICE	Northern Inland Council for the Environment
NOW	NSW Office of Water
NO ₂	Nitrogen dioxide
NPW Act	<i>National Parks and Wildlife Act 1974</i> (NSW)
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NSW EPA	NSW Environment Protection Authority
NSW RFS	NSW Rural Fire Service
NSW Health	NSW Health – Hunter New England Local Health District
NSW OCSG	NSW Office of Coal Seam Gas
NSW OEH	NSW Office of Environment and Heritage
NTU	Negligibly transmissive unit
PAC	Planning Assessment Committee
PAL	Petroleum Assessment Lease
PBT	Persistence, bioaccumulation and toxicity
PEL	Petroleum Exploration Licence
PIN	Penalty infringement notice
PNTU	Probable negligibly transmissive unit
POEO Act	<i>Protection of the Environment Operations Act 1997</i> (NSW)
POEO (Waste) Regulation	<i>Protection of the Environment Operations (Waste) Regulation 2005</i>
PPL	Petroleum Production Licence
Proposed activity	Dewhurst Gas Exploration Pilot Expansion
PWMP	Produced Water Management Plan
REF	Review of Environmental Factors
RO	Reverse osmosis
Roads and Maritime	NSW Roads and Maritime Services

RPS	RPS Australia East Pty Ltd
Santos	Santos NSW (Eastern) Pty Ltd
SCADA	Supervisory control and data acquisition
SDS	Safety Data Sheet
SEE	Statement of Environmental Effects
SEPP	State Environmental Planning Policy
SEWPaC	Department of Sustainability, Environment, Water, Populations and Communities (Commonwealth)
SHI	Statement of Heritage Impact
SIS	Species Impact Statement
SoC	Statement of Commitments
SRD SEPP	<i>State Environmental Planning Policy (State and Regional Development) 2011</i>
SSD	State Significant Development
STU	Significant transmissive unit
SUGAR	Sydney University Giant Air-shower Recorder
TDS	Total dissolved solids
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>
WAD	Works Authorisation Deed
WAL	Water access licence
Wall cake	Low permeability 'skin' around the wall of the hole.
WTF	Water transfer facility

Appendix I

List of submissions received

Appendix 2

Dewhurst Gas Exploration Pilot Baseline Surface and Groundwater Data Report

Appendix 3

Drilling Fluid Risk Evaluation

Appendix 4

North-East Pilliga Forest - Targeted Threatened Flora Survey

Appendix 5

Energy NSW CSG Exploration and Appraisal Program – Impact Assessment under the EPBC Act

Appendix 6

PEL 238 – TSC Act Cumulative Impact Assessment

Appendix 7

Pilliga Stygofauna Review – Santos Energy NSW CSG Exploration and Extraction Activities