DOC17/242270
SSD 6456

Mr Stephen O'Donoghue
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Department of Planning and Environment
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SYDNEY NSW 2001

Dear Stephen

Narrabri Gas Project (SSD 6456)

Thank you for your invitation for the Office of Environment Heritage (OEH) to comment on the exhibited Environment Assessment for the Narrabri Gas Project.

OEH understands that the proposal includes the undertaking, construction and operation of a range of exploration and production activities including:

- Exploration and appraisal activities including 30 core holes, approximately 10 chip holes and approximately ten sets of four-well pilots;
- Installation and operation of up to 850 individual production wells partnered to a maximum of 425 well sets;
- Gas and water gathering systems and in-field compression;
- A central gas processing facility;
- Water management, treatment and beneficial re-use facilities; and
- Supporting infrastructure such as power generation and distribution and operational management facilities.

OEH notes that the proponent has adopted a precautionary approach in a number of instances including:

- The modelling and adoption of an upper disturbance limit for Plant Community Types (PCTs);
- A 100 kilometre buffer applied to database searches;
- A buffer of 80 metres plus channel width applied to Bohena Creek (in excess of the 50 metre required); and
- An 80 metre buffer on 4th and 5th order streams (60 metre is required).

Attachment A provides detailed comments on biodiversity. **Attachment B** provided detailed comments on Aboriginal Cultural Heritage. **Attachment C** provides detailed comments on hydrology and flooding.

Should you require further information regarding issues that are the responsibility of the OEH please contact David Geering on 02 6883 5335 or david.geering@environment.nsw.gov.au .

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Yours sincerely

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22 May 2017

Contact Officer: David Geering
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ATTACHMENT A

OEH Comments

Biodiversity

The Biodiversity Assessment Report (BAR) is currently not fully consistent with the requirements of the Framework for Biodiversity Assessment (FBA).

Under the NSW Biodiversity Offsets Policy for Major Developments, the SEARs require the proponent to apply the FBA to assess impacts on biodiversity. The FBA contains the methodology to quantify and describe the impact assessment requirements, and offset guidelines that apply to all major projects.

The Bilateral Agreement between the Commonwealth and the State of New South Wales commits NSW to prepare an Assessment Report and recommendations to the Commonwealth on whether to approve an action that has been determined to be a controlled action by the Commonwealth Minister. Compliance to the FBA underpins the assessment made by OEH. Once the proponent has had the opportunity to respond to this submission, OEH will undertake the assessment of the project against the Bilateral Agreement.

OEH acknowledges the difficulty of fully complying with the FBA for a project with a conceptual footprint over a large study area. OEH also notes that the FBA and the associated Offsets Policy for Major Projects remain in transition. The following summarises a number of key requirements of the FBA that have not been fully addressed by the BAR or biodiversity offset strategy (BOS):

- The level of fauna survey effort undertaken has not been applied in full accordance with OEH guidelines
- The number of plot-based floristic surveys for some PCTs is less than required
- The FBA requires mapping to plant community types (PCT) according to the NSW PCT classification as described in the VIS Classification Database. The creation of novel PCTs such as 40X is not supported
- PCTs in similar broad condition state should be stratified into separate vegetation zones (based on condition differences)
- The site value score should be calculated for each vegetation zone and condition class combination
- Rehabilitation credits should be calculated as part of a BOS rather than reducing the impact credits generated by the project
- The BOS provided as part of the EIS does not provide the details required by the FBA.

All vegetation plot data should be used to validate the vegetation mapping to ensure the proposed PCT avoidance measures are correct.

1. The vegetation map should be validated against all vegetation plot data.

The calculation of the upper disturbance limits depends upon the accuracy of the vegetation map produced for the project. The vegetation map was first produced using a desktop process and was followed by field data collection at 327 locations. The floristic data collected at 20 per cent of those locations was then compared to the PCT mapped at those locations. The floristic data collected did not match the vegetation map at 11% of the locations analysed. The PCTs at these sites were corrected by the proponent however it is unclear if the corrections were made to the biometric data set or if the vegetation map was revised, or both. Both should be undertaken. Based on this sample analysis, it is likely that 11% (n = 29) of the remaining plots (n = 262) are incorrectly mapped. In addition the Vegetation Mapping report (ELA 2015) identifies that accuracy of the vegetation map is likely to be lower in some parts of the study area.

OEH has reviewed the Plant Community Type (PCT) allocations for all plot data that contained cover-abundance scores (n = 220) and focused on those PCT allocations that seemed the least

appropriate. Analysis using the Vegetation Information System (VIS) indicated that a better PCT match may be available for at least 16 vegetation plots (Table 2). The vegetation map should be validated against all vegetation plot data to ensure that the vegetation map is as accurate as possible and that the subsequent upper disturbance limits have been calculated using the best available data.

Table 2: Recommended PCT revisions

Plot No.	ELA Mapped PCT (BAR)	OEH recommended PCT revisions
141	398	405
178	88	35
184	88	397
191	401	418
197	401	88
201	401	418
206	397	418
208	401	88
210	88	397
215	88	398
217	397	78
218	397	399
222	401	399
248	401	405
282	55	35
297	408	202

Ranking and weighting of decision criteria used in the Ecological Sensitivity Analysis (ESA)

2. The rankings and weightings of the ESA should be reviewed and the ESA should be re-run.

The ESA has been used to guide avoidance of 'high' or 'moderate-high' ecological sensitive areas wherever possible with the relocation of infrastructure to 'low-moderate' or 'low' areas wherever possible. The ESA has also been used in the calculation of the upper disturbance limits.

The ESA report indicates that the decision criteria that underpins the ESA were identified through an internal workshop of EcoLogical Australia Pty Ltd ecologists and conservation planners. OEH has concerns with the rankings and weightings to some of the decision criteria.

OEH suggests that the rankings of all decision criteria are reviewed and a weighting reflecting the ranking is applied. OEH's recommended rankings and weightings are listed in Table 3.

Total ecosystem credit liability and offset liability.

3. The total credit liability (direct impacts, indirect impacts and cumulative impacts) should be calculated correctly.

The Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS) provide inconsistent information around the total number of ecosystem credits required for the direct impacts of the NGP. The Biodiversity Offset Strategy (page 9) states that the direct impacts of the project require 58,813 ecosystem credits to be offset, while the BAR (pages xii and 125) indicates that 56,113 credits are required.

The BAR should indicate the total credit liability (comprising direct impacts, indirect impacts and cumulative impacts) prior to the consideration of the potential contribution of rehabilitation or offsets. The BAR does not indicate the offset liability of the areas identified for rehabilitation (586.66 hectares) and instead shows an incorrectly calculated impact value for rehabilitation areas.

Rehabilitation

4. OEH seeks to discuss the applicability of rehabilitation to the NGP and possible calculation methods.

The proponent has proposed to partially rehabilitate 586.66 hectares of disturbed land within 12 months of clearing vegetation.

The proponent has proposed an alternative method to calculate potential rehabilitation credits which. OEH seeks to discuss rehabilitation and possible calculation methods with DPE.

Additional avoidance of threatened ecological communities (TECs)

5. The proponent should seek to avoid Weeping Myall Woodland EEC, Fuzzy Box Woodland EEC, TSC Act listed Brigalow EEC and, EPBC listed Brigalow EEC in good condition.

The proponent has committed to avoiding all direct impacts to Carbeen Open Forest Endangered Ecological Community (EEC). The BAR indicates that the proponent proposes to impact up to 0.10 hectares of Weeping Myall EEC (PCT 27), 5.9 hectares of Fuzzy Box Woodland EEC (PCT 202), and 19.3 hectares of Brigalow EEC (PCT 35). As the proponent has the flexibility to locate infrastructure (well pads and associated infrastructure) to avoid key constraints, OEH recommends the proponent consider additional avoidance measures:

As there is 2,468 hectares of Brigalow EEC within the study area it is unlikely the proponent will be able to avoid all areas of Brigalow EEC. However OEH recommends that the proponent avoids impacts to the TSC Act listed Brigalow EEC areas (20.6 hectares in the study area) and EPBC Act listed Brigalow EEC in good condition areas (1,226.7 hectares in the study area) as much as possible. A further 1,220.6 hectares of EPBC Act listed Brigalow EEC in low and moderate condition occurs in the study area.

Proposed 70% reduction in the value of indirect credits.

6. The full credit value of indirect impacts from the buffers should be included in the project's total credit liability.

The proponent has calculated the credit value of indirect impacts to be 10% of a 10 metre buffer applied to all linear infrastructure and 10% of a 50 metre buffer for well pads, the Bibblewindi site, and the workers accommodation. The total number of credits was then multiplied by 0.3 based on an assumed maximum period of 30 years over which indirect impacts may occur. The full credit value of indirect impacts from the buffers should be included in the project's total credit liability.

Where the number of plots has not been satisfied, only the plot closest to benchmark should be replicated

7. Only data from the plot closest to benchmark (with the highest summed site attribute score) be replicated to make up the minimum number of plots required.

Fewer than the required number of plots were sampled for a number of PCTs. For example six plots were required for PCT 425, but only four plots were sampled. In this case the proponent replicated all four plots and entered a total of eight plots for the PCT. Replicating all plot data results in an averaging of the data for the PCT which may result in a reduced credit liability if the four plots where in poorer than average condition relative to the condition of the entire PCT zone.

OEH recommends that only data from the plot closest to benchmark (with the highest summed site attribute score) be replicated to make up the minimum number of plots required.

Where the number of plots for an individual derived native grassland PCT has not been satisfied the plot data from that PCT only should be replicated

8. Plot data for individual DNG PCTs should be duplicated to make up shortfalls identified in the credit calculator. Pooled data should only be used where no plot data for a DNG PCT was collected.

One hundred hectares was entered into the credit calculator for all derived native grassland vegetation zones and required a minimum of six plots to be entered for each DNG PCT to calculate the credit liability. However the actual area of each DNG PCT required four or less plots. The proponent collected 15 plots of DNG data from five of the six DNG PCTs to be impacted. The proponent entered the plot data from all 15 DNG plots for each DNG vegetation zone, resulting in an averaging of the data from several PCTs for each PCT.

Where there was some plot data but a shortfall of plot data for a DNG PCT, the proponent should have replicated the plot closest to benchmark (with the highest summed site attribute score) of that DNG PCT to make up the minimum number of plots required, rather than using all 15 plots from several PCTs.

Where there was no plot data for a DNG PCT (PCT 27), the proponent has correctly used the plot data of all 15 DNG plots.

Credits should be calculated for each vegetation zone and condition class combination

9. Each vegetation zone and condition class combination should be entered into the credit calculator to determine the credit liability of each combination.

Section 5.2 of the FBA requires the assessor to identify all PCTs on the development site and map these into vegetation zones. The assessor should stratify areas of the same PCT that are in a similar broad condition state into separate vegetation zones (based on condition differences). The site value score should be calculated for each vegetation zone and condition class combination. The credit calculator for the NGP currently includes only two condition classes for each vegetation zone; native vegetation and Derived Native Grassland (DNG). However Appendix E of the Vegetation Mapping Report identifies multiple vegetation zone condition classes (low, moderate and high) for most PCTs. The FBA requires each vegetation zone and condition class combination to be entered into the credit calculator to determine the credit liability of each combination.

Table 3: Recommended ESA revisions

Decision Criteria	Santos Rank	Santos Weight	OEH Recommended Rank	OEH Recommended Weight
EEC and locally significant communities	5	x3	5	x5
Identified threatened flora records	5	x3	5	x5
Distribution/density of threatened flora based on vegetation association	5	x3	5	x5
Areas of rare vegetation within region	4	x3	4	x4
Riparian corridors	4	x3	3	x3
Terrestrial biodiversity	4	x3	3	x3
Areas of high quality fauna habitat	3	x2	4	x4
Identified habitat for Pilliga mouse	5	x4	4	x4
Consolidated habitat	2	x2	2	x2

The study area provides potential habitat for the koala and impact credits for the koala should be calculated

10. Either further assessment and credit calculation of the impact on the koala is undertaken or an expert report is required to assess the likelihood of occurrence of the koala in the study area.

Given the study area's position in the landscape (relative to known koala populations in the western Pilliga and around Gunnedah), the history of sightings (including three in 2016 on the NSW Atlas of Wildlife - entered post lodgement of the EIS) and the presence of suitable habitat, the study area provides some known, and potential habitat for the koala. Further assessment and credit calculation of the impact on the koala is required.

Alternatively the proponent may prepare an expert report to assess the likelihood of occurrence of the koala in the study area.

The proposed koala research proposal is unlikely to comprise 10% of the total offset liability

11. The proponent should demonstrate what portion of the total offset package that the koala research proposal will comprise.

The proponent proposes a koala research proposal as an offset measure that would be capped at 10% of the total offset package. The koala research proposal suggested as a compensatory measure for the NGP is allowable as a supplementary measure but, in accordance with Appendix A of the Offsets Policy should be capped at 10% of the total offset. However given the total cost of the koala research proposal is $43,800 (see Appendix C of the BOS) it is likely to be well under 10% of the total cost of the offset package.

Further assessment of the spotted-tailed quoll and rufous bettong is required

12. Either an expert report be prepared to determine the likelihood of presence and area of occupation of the spotted-tailed quoll and rufous bettong, or they should be assumed to be present and species credits should be calculated.

The level of fauna survey effort has not been applied in full accordance with the OEH guidelines (DECC 2004). The BAR indicates that the size of the development site precludes the ability to completely identify all species that occur, however, justification is required for the level of survey for species that may occur but remained undetected.

There are two such species credit species, the rufous bettong and spotted-tailed quoll, which are in the BAR as not likely to occur within the development site, although potential habitat exists. The total survey effort for both species utilising terrestrial cage traps was 5% (for the study area 95,077 hectares) of that recommended in the OEH guidelines while the survey effort for terrestrial hair tubes/funnels was 23% of the OEH guidelines. Remote cameras were also used, but at a low density relative to the study area.

Given the cryptic nature of the two species and the potential that they may occur at very low densities within the development site, OEH recommends that either an expert report be prepared to determine the likelihood of presence and area of occupation of these species, or they be assumed to be present and species credits calculated.

The BAR does not indicate if *Myriophyllum implicatum* will be impacted by the NGP

13. The proponent is to identify and justify why *Myriophyllum implicatum* will or won't be impacted by the NGP.

The BAR identifies *Myriophyllum implicatum* as occurring in the study area however the BAR doesn't contain an assessment of the species likelihood to be impacted by the project. Table 16 of the BAR indicates that no further assessment of the species occurrence was required as the SEARs indicate that no further assessment is required for the species. The proponent has wrongly interpreted Attachment C of OEH's input into the SEARs. Attachment C provides a list of species which are specifically excluded from being considered *matters for further consideration*. As noted by the footnote to the table in Attachment C, further information, as detailed in section 9.2.5.2 of the FBA is not required for *Myriophyllum implicatum,* however assessment of impacts and offset requirements should still be included in the BAR for *Myriophyllum implicatum* in accordance with the FBA

OEH notes that the Environmental Impact Statement (EIS, Appendix J1) submitted with the NGP indicates that *Myriophyllum implicatum* will not be impacted by the project. A statement is needed from the proponent identifying and justifying why *Myriophyllum implicatum* will or won't be impacted by the NGP.

It is unclear how the impacts on *Lepidium aschersonii* and *Lepidium monoplocoides* have been calculated

14. The proponent is to describe the method undertaken to estimate the predicted impacts on *Lepidium aschersonii* and *Lepidium monoplocoides.*

The BAR identifies small impacts on *Lepidium aschersonii* and *Lepidium monoplocoides* but does not indicate how the impacts have been calculated. The Threatened Flora Modelling report indicates that modelling was not undertaken for these two species due to insufficient records and poor seasonal conditions during the surveys in which they were detected. A description of the method undertaken to estimate the impacts on both species is required.

A monitoring report framework is required to monitor and assess the proponents ability to achieve the proposed minimisation measures of not exceeding the proposed disturbance limits

15. The proponent should develop a monitoring report framework that documents the clearing of all PCTs and threatened flora and fauna habitat areas within the proposed upper disturbance limits.

The proponent should outline how they propose to monitor their clearing impacts and what procedures they will implemented if they identify that the upper disturbance limits for a PCT are about to be reached. The monitoring plan should nominate the frequency of reporting and the status of the monitoring, either on a disturbance basis (e.g. after each well is cleared) or a time interval (e.g. every 6 months). The proponent should also nominate an appropriate reporting method (e.g. on their website or to DPE).

A reporting framework should be developed to document individual site assessments and the results of the ecological scouting framework.

16. A reporting framework should be developed to document the individual site assessments and results of the ecological scouting framework

The proponent proposes an ecological scouting framework to minimise impacts on a range of biodiversity values during the selection of gas well and associated infrastructure locations in the field. A reporting framework is required that documents the individual site assessments undertaken and results of using the ecological scouting framework to avoid or maximise avoidance of the entities listed in Table 2 of Appendix G (ecological scouting framework) of the Biodiversity Offset Strategy (BOS). The reporting framework should outline, as a minimum, the type of reporting to be undertaken, the frequency of reporting and the location of reports (e.g. on the NGP website).

The proponent prepare a table that clearly identifies the impacts ‘carried forward’ from previous projects and to be offset under the NGP.

17. A table be provided that clearly shows which developments are carrying forward offset requirements and what the carried forward offset requirement is for each project.

While a figure was provided on 22 March 2017 by the proponent identifying the total area of projects with impacts ‘carried forward’, it did not identify the individual projects against which the individual entities require offsetting.

OEH is unable to review the proposed offset strategy as details of the strategy have not been provided in the EIS.

18. A detailed BOS fulfilling all the requirements of the FBA should be submitted.

The BOS provided as part of the EIS does not fulfil the requirements of the FBA. The proponent has not demonstrated that they have undertaken ‘all reasonable steps’ before considering supplementary measures. A nil-tenure feral animal control strategy is proposed as a supplementary measure that would comprise one third of the total offset liability of the project. Details of this program are not provided however, the BOS suggests that control measures for dogs, foxes, feral cats, rabbits, pigs and goats may be included. The proponent should also demonstrate how the proposed management actions are above and beyond any feral animal management actions being undertaken by existing land managers.

In order for OEH to assess these measures a full project proposal with costings of all components is required.

A vegetation clearing window should be nominated that will minimise impacts to fauna species.

19. The proponent should identify and nominate a clearing window that would minimise impacts to fauna species.

OEH requests that the proponent nominate a clearing window for woodland and forest that will avoid key breeding or hibernation seasons for threatened bat and bird species known to occur in the development site. Other land disturbance activities (such as mulching, topsoil removal and the removal of regrowth in previously cleared areas) may occur year round.

It is unclear if treated water will be applied to forested areas

20. The proponent is to identify if treated water is to be applied to forested and rehabilitation areas, and if so, provide an assessment of the potential impacts on such areas.

The produced water management chapter of the EIS indicates that post stage 5 treated water would be suitable for a range of purposes including irrigating local soils in forested areas. There is no further mention of watering forested areas in the produced water management chapter and there is no mention of watering forested areas in the BAR.

OEH seeks clarification on whether treated water is to be used within forested and rehabilitation areas. If so, an assessment of the potential impacts of watering such areas should be undertaken.

The number of regent honeyeater impact credits is to be calculated as agreed by the proponent on 22 March 2017

OEH met with the proponent and ELA on 9 March 2017 in Sydney. Following discussion at the meeting the proponent agreed to calculate the offset requirement for the regent honeyeater using the PCTs associated with regent honeyeater as listed in the Threatened Species Profile Database (TSPD).

Additional minor issues

a) OEH does not support the creation of novel PCTs such as 40X. The FBA requires mapping to PCT according to the NSW PCT classification as described in the VIS Classification Database. As PCT 40X has been identified as most closely related to PCT 405, and has been assigned to PCT 405 and BVT NA390, OEH considers PCT 40X to be PCT 405. The proponent has calculated credits for PCT 40X by entering it into the credit calculator as PCT 405.

b) There are a number of issues that will require addressing in management plans including, but not restricted to:
    - Open trenches must be checked daily, not should be checked daily
    - Is there a need for glider crossings and habitat bridges (page 111 of BAR), and if so, where would they be positioned?
    - 1:1 replacement of hollows greater than 300 mm (page 111 of BAR). Replacement of smaller, usable hollows will also be required

c) BVT codes are not consistent across all documents

d) *Commersonia procumbens* is consistently referred to as *R. procumbens* throughout the documents

e) The habitat description of the Australasian bittern in Table 16 of the BAR is incorrect.

f) The habitat description of the rufous betting in Table 16 of the BAR is incorrect.

ATTACHMENT B

Aboriginal cultural heritage

A significant number of RAPs registered interest in the NGP

The interest among Aboriginal people in the NGP attracted a significant number of people (n = 556) from various community organisations and individual representations. OEH notes that the majority, if not all, identify as Gomeroi people. The proponent's analysis of the consultation results concern the domicile and geographic range of the RAPs and this shows that Aboriginal interest in the project is sourced from a wide geographical area. The OEH analysis of the consultation is focused on understanding the range of comments raised by the RAPs (including the proponent's responses) for context when considering the ACH assessment overall and the CHMP.

OEH have estimated 31 comments about the project proposal that are documented in the ACH assessment report (Appendix 1). Some comments are repeated multiple times by different individuals and organisations. OEH identify four broad themes that highlights the general range of comments raised by Aboriginal people about the project or, accepting of the ACH work undertaken by the proponent.

Submissions were made on the Cultural Heritage Management Plan (CHMP)

The CHMP is the process for how all Aboriginal site avoidance actions and mitigation activities will be facilitated through the life of the project. It also addresses the means of how Aboriginal community participation and decision making roles are built into those processes. As well as facilitating how disputes will be resolved between the RAPs and the proponent, the CHMP describes the method of how the Aboriginal Cultural Heritage Working Group, made up of a select group of Aboriginal representation, will be formed and function in steering ACH project objectives. The CHMP is a critical component for managing ACH over the life of the project which has been estimated to be 25 years. Unlike other management plans of major projects which facilitate Aboriginal site management activities over a much shorter time frame, the NGP plan is committed to a 25 year relationship with Aboriginal stakeholders.

Six separate submissions from the RAPs provide acceptance and support for the CHMP with one submission stating that the CHMP is better than other examples previously experienced in other major projects. Additionally, the submissions highlight a number of specific issues about the actions listed in the CHMP and include accepting or favourable responses towards the proposed Aboriginal Cultural Working Group or are comments seeking verification of the intended structure or machination of the Working Group.

OEH note that the proponent's responses confirm RAP expectations or allay concerns regarding the ACH Working Group structure, governance and function. Comments from the RAPs about Aboriginal site protection methods are equally responded to by the proponent in a similar fashion. Two documented RAP submissions reject the proposed CHMP desiring it to be recommenced and revisited as a consultation item. The reasons of concern are non-specific and tend to be general dissatisfaction and this sentiment is also directed towards the ACH assessment.

Submissions were made on the ACH assessment

The Aboriginal community's understanding of the ACH assessment is critical due to the complex nature of the development proposal whereby the precise location of the project's footprint remains unconfirmed. The OEH review examined the RAP submissions to assess if the methods of Aboriginal site avoidance and mitigation are understood and supported. The initial approaches proposed by the proponent for identifying and managing ACH relies significantly on interpretation of information available for the study area, and less on information obtained from ground assessments. Equally, OEH have examined the RAP submissions to assess their understanding on how the ACH assessment findings and the proposed CHMP management actions are linked.

Four documented submissions are generally supportive of the ACH assessment report whilst several other submissions focus on specific content, for example, highlighting the importance of avoiding creeks, appropriateness of managing Aboriginal site data and, insistence that all 90 listed AHIMS sites within the project boundary are confirmed in the field and not just those sampled by the proponent (n = 40). Some RAPs indicate uncertainty about the survey methodology. The proponent responded by repeating the strategies and methods previously described in the ACH assessment report and the CHMP.

Two submissions refer to the management of Aboriginal site data sensitivity requesting that site information be concealed from public access. The strongest of these requests is from the Narrabri LALC. This request also extends to not placing new Aboriginal site data onto the OEH administered Aboriginal Heritage Information Management System (AHIMS) which, is a legal requirement under the National Parks and Wildlife Act 1974.

One submission raises a number of objections of the ACH assessment for example lack of assessment of the cumulative harm, limited input into significance assessment, inadequate information on the social, cultural and landscape contexts and, no assessment of archaeological and historical discussion and significance. The proponent's response rejects these claims and refers the RAP to the sections of the ACH assessment where these matters are addressed as per the project's Secretaries Environmental Assessment Requirements (SEARs) issued by DPE.

Submissions were made regarding ACH offsets

OEH identified a range of RAP comments about the proposed commitments to engage the Aboriginal community in a range of activities during and post-project construction. They follow along a general theme of an 'Aboriginal offset' of which there is no formal government policy to guide or instruct a proponent interested in engaging with the Aboriginal community (which does not include actions that qualify as mitigation). The SEARs do instruct the proponent to consider Aboriginal cultural values and cultural activities when selecting land for biodiversity offsets although that process is still on-going and OEH gives in principle support. Equally, OEH support the adoption of concepts that increase opportunities for Aboriginal people.

The proponents responses to issues include in some instances offsets which will aim to address (in part) some of the concerns regarding harm to ACH overall. The proposed offsets propose extending the theme of investigations of ACH values undertaken during the Brigalow Belt South Bioregion (BBSB) ACH assessment (RACD 2000 and 2002). Examples include undertaking additional historical and oral history and ethnobotanical investigations and servicing support for data management of sensitive information.

The proponent has also proposed an anthropological study to augment previous ACH work. For example, the BBSB ACH assessment included projects for Aboriginal consultation, historical archival and oral history gathering as well as cultural field surveys of the Pilliga forests (RACD 2000 & 2002). The assessment did not include an anthropological study. Anthropological research attempts to understand the family history of individuals, including their traditional descent to specific areas, relationship with other groups and individuals, language diversity and their relationship with traditional land owning groups.

The ACH assessment for the NGP also shows that the proponent is in discussion with the RAPs about integrating ACH values with biodiversity offsets and that potential land acquisition is also being entertained. Support from the RAPs isn't clear from examining the submissions but it is expected that there is general acceptance and that discussions along this theme are continuing. Overall the tone of the submissions indicates positive interest.

The proponent has complied with the ACH consultation requirements

Accepting the unique challenges for the proponent and the RAPs, OEH is satisfied with the consultation undertaken including the comprehensiveness of responses to issues raised in RAP submissions. The documented accounts of consultation with Registered Aboriginal Parties (RAPs)

indicates that the proponent has complied with the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010a).

Additional project updates to the RAPs are recommended

OEH recognises the challenge for the RAPs in this particular project to absorb large amounts of technical information and the proponent's efforts in disseminating the information to a significant number of people. Although the CHMP is committed to updating the RAPs throughout the life of the project some additional less formal and more frequent modes of communication may be warranted. OEH therefore recommends that the proponent prepare regular updates of the project's activities in addition to the formal arrangements of the CHMP, for example, information flyers and social media.

OEH has reviewed the ACH assessment report

OEH accepts that the NGP is unique to conventional major projects distinguished by the uncertainty of resource locality to inform placement of the construction footprint. The SEARs for the project therefore instructed the proponent to consider existing models of landform and Aboriginal site relationships as well as examining the documentation of Aboriginal historical archive and oral histories of the Pilliga, to augment the Secretary's general assessment requirements.

A site validation program identified that 55% of sites were confirmed in the field

OEH has reviewed the validation site program developed by the proponent which aimed to test the accuracy of known site information by sampling 40 of the 90 known records. The objective of the program was to inform the project on the suitability of information for developing appropriate ACH response areas when considering the placement of construction. The proponent reports that about 55% of the known records are accurate. The proponent highlights that the remaining percentage of errors are due mostly to pre-GPS technology and recorder error. As per the standard practice of undertaking ACH and compliance with the project SEARs the proponent developed a verification program. The results confirmed the necessity to ground truth records for assisting the ACH investigation of the distribution pattern of Aboriginal sites across the study area. OEH notes that the results of the verification program is likely to have been affected by dense groundcover concealing AHIMS sites records. OEH draw from the results the importance of site and landform relationships associated with water features, when developing appropriate land management planning for ACH for the NGP

The proponent's proposed pre-clearance survey method was trialled and was hindered by dense groundcover vegetation

In addition to the site validation program, the proponent carried out two field tests for the Dewhurst-Bibblewindi & Leewood pilot wells and infrastructure facilities as a way of trialling the "Santos Enhanced Survey Method" described in the EIS (Santos 2015: 120). The adequacy of the "Santos Enhanced Survey Method" that was used for the Leewood Dewhurst-Bibblewindi facilities generally follows the minimum standard of archaeological survey methods employed in NSW for example, DECCW (2010b). However the constraints of thickly vegetated ground cover that impeded survey adequacy for the Dewhurst-Bibblewindi facility have not been explored as an issue for the pending surveys to be undertaken post-project approval under the CHMP.

OEH's key observations of the proposed pre-clearance survey method are as follows:

- Testing of the survey method at the Dewhurst-Bibblewindi facility was significantly hampered by poor surface visibility created by dense vegetation compared to the surveys of the Leewood facility which is located on cleared pastoral lands (Santos 2015: 121-2).

- A combined total of 45 kilometres of walking surveys were undertaken across both facilities (14 kilometres for Dewhurst-Bibblewindi and 29 kilometres for Leewood). No sites were found

at Dewhurst-Bibblewindi and two unconfirmed quartz artefacts and two scarred trees at Leewood (Santos 2015: 122).

- OEH interpret the proponent's test survey as an exercise on how surveys will be conducted during the life of the project (under the CHMP). Whilst OEH accepts the methods proposed, generally, the results of the exercise have not been used to discuss strategies to overcome the difficulties encountered during the Dewhurst-Bibblewindi surveys especially as it is expected that a significant portion of gas development will be in heavily forested areas similar to that encountered during the Dewhurst-Bibblewindi trials.

Sensitivity mapping included non-site cultural values

The proponent has produced a sensitivity map showing the distribution of cultural heritage significance across the study area. The map is a relationship of known Aboriginal site records intersected with digitised landscape mapping. The map is augmented by a suite of non-site cultural values and historical records which the proponent has attempted to use for the purpose of highlighting the historical and contemporary intersection of Aboriginal lives with the Pilliga. This information has also been used in the ACH assessment to express the social and cultural connection of the forests to local Aboriginal people and includes information of plant species that have documented cultural use.

The cultural values are sourced from the BBSB ACH assessment project (RACD 2000 & 2002). The landscape descriptions are represented by polygons derived from the BBSB landforms of the Pilliga group of forests and state-wide Mitchell Landscape descriptions are used for study areas not covered by the BBSB landforms (areas north of the Pilliga forest). The proponent has adequately covered-off on the merits and weaknesses of both styles of mapping and has adequately raised the importance of the non-site values.

The ACH assessment challenges conventional approaches to delineate sensitive areas by introducing many of the non-site values that were documented from Aboriginal elders during the BBSB assessments (RACD: 2000, 2002) which, were recorded as examples of social, cultural and contemporary expressions of the Pilliga. Tangible evidence of Aboriginal heritage, "sites", is the normal approach to delineating sensitive areas but in this instance information is available from previous endeavours (unlike other major projects) which can be used to extend our understanding of cultural heritage landscapes generally. OEH supports the proponent's attempt to draw upon that information and express it in the sensitivity map.

The proponent has indicated that the sensitivity map should not be relied upon

The sensitivity mapped zones are complex. It consists of 9 categories of significance in three broad zones, each recommending separate management strategies. The sensitivity zones show the likelihood of Aboriginal site distribution among the ordered creek systems that intersect the study area.

The rationale describing the proponent's ACH significance of the study area is difficult to understand. The ACH assessment report drifts between various modes of assigning significance such as the relationship of sites with stream order (Santos 2015: 87), mapped landform & landscape units (Santos 2015: 83, 90), individual site type (Santos 2015: 98-104) but have for precautionary reasons assumed all sites to be of high significance (Santos 2015: 98). The proponent's broad interpretation of ACH highlights large areas as high in ACH significance but concludes that because of limitations of all available data, recommends that the sensitivity map attributes "*should not be viewed as being an accurate reflection or probable or even possible cultural landscape"* (Santos 2015: 90).

Landscapes with water features are likely to be the most sensitive ACH areas

OEH's interpretation of the proponent's site validation program, the facility field inspections and the documented summary of previous twenty-nine CSG projects (Santos 2015: 46-48) is that large areas of the Pilliga repeatedly show very low frequency patterns of Aboriginal sites especially among the

landform categorised as Soil Mantled Slope (which comprise approximate 30% of the study area). If this is correct threats from development activities to Aboriginal objects in these areas would be minimal. OEH therefore conclude this landform has a low ratio relationship with Aboriginal objects compared to landforms in the Pilliga that are dominated by pronounced waters features. Previous ACH investigations of the Pilliga (RACD 2000, Appleton 2009, AECOM 2011) highlight a close relationship between water and site location.

The proponent argues that the Soil Mantled Slope landform has seventy-five recorded places consisting of greater diversity of site type justifying it as a landform of high significance. It is unclear from the OEH review of the EIS if the ratio of sites per area (density) of Soil Mantled Slope landform was included in the determination of high significance. It is also unclear if the diversity of site types the proponent refers to are accurate due to the range of errors revealed in the site validation program (55% of sites were accurate).

The BBSB landform mapping that represent the lands around the various ordered creek systems (stream flow) offer the highest potential for Aboriginal sites and therefore logically the precautionary strategy for avoiding or minimising harm to Aboriginal sites is to avoid or limit development in these areas.

Despite consisting mostly of stone artefact scatters and likely affected by many years of land use attrition, these types of sites offer the clearest reference point and evidence of Aboriginal use for the area. Despite varying views on how heritage value sets are characterised for mapping purposes OEH consider that the basic mapping unit of landform offers an appropriate basis for identifying the distribution pattern of known sites from which to predict areas of high and low site density.

ACH sites will be avoided where possible

The proponent maintains that the project is sufficiently flexible to relocate infrastructure away from all known sites and any sites encountered during preclearance surveys using a range of buffers based on site type. The proponent proposes a precautionary approach to ensure mitigation of harm to ACH in instances where avoidance isn't possible. OEH accepts that a reasonable approach to the project is to apply a precautionary approach and therefore agrees with the proposal to undertake pre-clearance surveys for all areas of proposed development.

OEH accepts the proponent's commitment to avoid all known Aboriginal sites through an emplacement of buffers around sites, the distance of which follows a hierarchic system based on ordered creek flow. The landform, Soil Mantled Slope, is OEH's preferred location for gas well development due to the lower frequency and density of sites compared to the alluvium variety of landforms.

OEH inspection of the AHIMS data base indicates that descriptions of Aboriginal sites within the study area shows that isolated stone artefacts and stone artefact scatters are the dominate site type throughout the study area. Several Aboriginal scarred trees and axe grinding grooves are known for the study area but the proponent maintains that these sites will be avoided. Aboriginal sites conventionally regarded as highly sensitive will be avoided such as burials, carved trees and rock art sites.

OEH suggested additions to the pre-clearance survey method

1. All areas of proposed ground disturbance will be subject to pre-clearance surveys (surface inspections) as described in the proponent's CHMP with the following proposed additional modifications:

1.1 The proponent will ensure that a qualified archaeologist is present during the pre-clearance surveys to assist the pre-clearance teams in determining the presence or absence of Aboriginal objects.

1.2 Test excavations are to be used to determine the presence or absence of subsurface objects in areas associated with water features, for example, (but not limited to) creeks.

1.3 The specific location of test excavations will be based on the proponent developing a rationale that adequately guides the subsurface test excavation program to determine subsurface potential for Aboriginal objects.

1.4 The proponent will ensure that construction works in areas away from water features consist of a monitoring program to determine presence or absence of Aboriginal objects. For example inspection of graded surfaces created during vegetation clearing.

1.5 The test excavation program will be referred to OEH and the DPE appointed ACH expert for review.

1.6 The proponent will notify the RAPs of the test excavation program and monitoring program.

1.7 Alternatively, the proponent can undertake test excavations in the style of the methods proscribed in the Code of Archaeological Practice (DECCW 2010b).

Subsurface investigation could also be considered as part of the proposed pre-clearance surveys, including for the following reasons:

- The investigation of a subsurface archaeological investigation will offer more data to interpret the characteristics of Aboriginal sites.

- It is unknown what volume of archaeological material exists below the surface in the Pilliga forests and whether higher frequencies and densities of stone artefacts are concealed or if the current surface findings of low frequency of artefacts is indicative of the archaeological record.

- The findings of Leard State Forest archaeological subsurface investigations conclude very high surface artefact ratios to subsurface artefact numbers in some instances. Understanding if similar or different patterns occur in the Pilliga expands our knowledge of ACH as well as measuring the impacts from the project over time.

Cultural Heritage Management Plan (CHMP)

OEH agrees with the submissions from the RAPs that the CHMP is suitable and an appropriate working document that clearly outlines the tasks and measures to avoid and mitigate harm to Aboriginal objects. OEH acknowledge the proponent's commitment that the CHMP will be reviewed and amended in consultation with the Aboriginal community during the life of the project (Santos 2016: 8).

OEH anticipates as the project progresses that amendments to the plan are feasible as information about Aboriginal site patterns relative to the construction locations becomes clearer and the systems in place to investigate and manage ACH become more intuitive. It is also expected that the early stages of the project will be the most productive in clarifying and testing the management protocols for ACH and that the CHMP will be amended as knowledge of those processes is gained.

OEH supports the proposed annual review because there remains some uncertainty about the data issues raised by the proponent and the complexity of the sensitivity mapping. An annual review will

also support the compliance and statutory perspectives of government authorities and be productive for refining management strategies over time including the sensitivity mapping.

Known Aboriginal sites will be buffered to minimise impacts

The CHMP re-states the strategy proposed in the ACH assessment report for managing 90 known Aboriginal sites documented for the study area. Zone 1b graduated buffer approach places reasonable distances away from known Aboriginal objects although the logic of those distances are not explored in the CHMP or the ACH assessment report other than there will be opportunities to modify the distances as information about the Aboriginal site becomes clearer during the field assessment.

The buffers proposed by the proponent are accepted but with the understanding that some buffer distances will change as more information is gained about the site. A potential issue is how artefact scatter site boundaries will be determined for estimating the appropriate buffer distance. This is considered a difficult undertaking in a forested landscape if for example project infrastructure attempts to negotiate areas near creek lines. The proponent has indicated that subsurface testing will form part of the pre-clearance inspection but in a limited capacity and refer to the methods proscribed in the OEH code of archaeological practice (DECCW 2010b).

As noted above, OEH encourages the proponent to consider subsurface testing in areas where artefact scatters are most likely to occur. OEH would also accept an alternative method of approach to that stated in the code if it is considered more effective for addressing the specific challenges of operating in a forested landscape where known artefact frequencies per site are generally low and in some instances dispersed over wide areas.

An Aboriginal cultural heritage working group (ACHWG) will be established

OEH supports this proposal.

All Aboriginal sites recorded during the project will be registered on AHIMS

Any new sites discovered during the assessment (as defined as an Aboriginal object under the *National Parks and Wildlife Act 1974*) must be registered on the OEH Aboriginal Information Management System (AHIMS). OEH note that the proponent, through the listed actions of the CHMP, is committed to that undertaking.

Offset sites will be assessed for ACH values

OEH support the proponent's recommendation to investigate the ACH values of lands for the purpose of securing land in perpetuity for Aboriginal ownership. The proposal does not offer the locations where the investigations will occur therefore, OEH is available to discuss with DPE and the proponent, the merits of areas for potential acquisition for the Aboriginal community's considered opinion. If a proposal is known to, and supported by the Aboriginal community, OEH offer in principle support.

References

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Appleton, J. (2009). *Narrabri Longwall Stage 2 Project: Aboriginal Heritage Assessment*. Whitehaven Coal, Sydney.

Roberts, C. (1991). *Investigation of the Aboriginal archaeological resources of the Pilliga Forests*. Unpublished report to the Forestry Commission of NSW.

RACD (2000). *Aboriginal cultural heritage assessment for the Goonoo and Pilliga Forest Stage 1 Brigalow Belt South Bioregion Assessment*.

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Santos (2015). *Aboriginal Cultural Heritage Assessment*. Appendix N1 of the Narrabri Gas Project Environmental Impact Assessment.

Santos (2016). *Cultural Heritage Management Plan*. Appendix N2 of the Narrabri Gas Project Environmental Impact Assessment.

DECCW (2010a). *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*. Department of Environment, Climate Change and Water NSW.

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ATTACHMENT C

Hydrology

The study area does not fall within an area covered by a Council Floodplain Risk Management Plan and/or a rural Floodplain Management Plan. The key issue is whether the flood impacts and associated risks caused by the NGP are of minimal significance and mitigation strategies can be developed as part of the ongoing design process to ensure local impacts can be and are adequately mitigated. OEH is of the view that the assessments undertaken and reported in the referenced documentation meet this objective.

There are, however a number of issues whilst not impacting on this finding that need to be considered. These relate to the OEH SEARS dealing with Flood Planning Levels (FPL's) and Flood Planning Areas (FPA's); and the determination of hydraulic and hazard categories within the study area and determination of floodway's in particular.

The primary objective of the NSW Government's Flood Prone Land Policy is to reduce the impacts of flooding and flood liability on individual owners and occupiers of flood prone property and to reduce the private and public loses resulting from floods. The 2005 Floodplain Development Manual (the Manual) has been prepared in accordance with such policy and it is the standard document used consistently across the State to develop flood studies.

The FPL and FPA (definitions and associated mapping) needs a review

The Manual (Glossary page 21) and Council's LEP defines both FPL – are combinations of flood levels and freeboards selected for floodplain risk management purposes and FPA and the area of land below the FPL and thus subject to flood related development controls. Council's LEP defines the FPL based on the 1% AEP (Annual Exceedance Probability) level and 0.5 metre freeboard. The mapped FPA therefore is equivalent to the extent of the 1% AEP flood level plus an allowance for 0.5 metre freeboard. The documentation however adopts a FPL equivalent to the 1% AEP flood level (with no allowance for freeboard). The FPL and FPA (definitions and associated mapping) needs to be reviewed to ensure it is consistent with the Manual and Council's LEP.

Any deviation from the FPL and FPA defined in Council's LEP will require a planning proposal to be prepared and submitted to Government for consideration.

There are a number of minor tributaries (bordering on being treated as major overland flow paths) which pass through the study area and the two development sites, particularly Leewood. These areas are relatively flat and drainage channels are not obvious. In these situations the typical FPL and FPA adopted for land subject to mainstream flooding (in this case from Bohena Creek) may be excessive in terms of height and more importantly extent. Once the revised FPA mapping is undertaken there may be an opportunity to revisit the FPL/FPA for lands subject to major overland flow. A number of options have been developed to address these cases as part of the current Floodplain Risk Management Program. Any deviation from the FPL and FPA defined in Council's LEP will require a planning proposal to be prepared and submitted to Government for consideration.

A low hazard floodway needs to be defined

The current hazard mapping is based on "depth/velocity" criteria defined in the Manual as being provisional pending consideration of the other factors contributing to flood hazard. These other factors are detailed in the Manual. It would have been ideal for the assessment undertaken by GHD to consider the impact of the other factors contributing to hazard and whether they would result in any changes to the provisional hazard categories. OEH would expect that such an assessment would not have led to any changes in hazard categories across the study area.

One of the key categories is the definition of the floodway. The floodway is generally defined (Manual Glossary page 22) as those areas of the floodplain where a significant discharge of water occurs during floods. The floodway for the study area has been defined as being equivalent to the extent of the 1% AEP high hazard zone. This option was chosen to be regionally consistent with investigations

recently carried out at Narrabri. Unfortunately, there is no “one size fits all” when it comes to defining floodway’s however in relatively flat terrain in western NSW in general and the study area in particular the inclusion of high hazard within the definition eliminates potential floodway’s in low hazard areas. This is of particular importance when looking at the Leewood area where flood behaviour is dominated by low hazard conditions and as such no floodway is defined. OEH suggests that a Low Hazard floodway needs to be defined. The localised impacts from the development on the western side of the Leewood development is a consequence of the low hazard floodway being impaired – refer to Fig 13-15 and 13-17 in Chapter 13. A Low Hazard floodway needs to be defined.

Additional minor issues

There are a number of comments on the “Flood Study” which while not likely to impact on the findings of the assessment should be considered.

Appendix A – Flood Study

- Figure 2-1. The legend shows rainfall and gauging station markers which do not appear on the figure itself.

- Section 3.6 – (a) 1998 event. The Bohena gauge was installed on 21 May 1995 and the largest event to have been recorded occurred on 5 May 1998 (GH 3.2 metre and peak flow of approximately 500 cumecs). The highest gauging at the site occurred on 28 July 1998 with a GH of approximately 3 metres and a flow of approximately 420 cumecs. The rating curve at the gauge has been extrapolated as a straight line on a log scale. Hence there is a reasonable degree of confidence in the recorded 1998 hydrograph at the gauge. It is unclear as to how the adopted pluviograph was determined. The pluviograph patterns at Narrabri West and Gunnedah appear to better represent the relatively fast rising hydrograph recorded at the gauge. The pluviograph shape was not tested as part of the sensitivity assessments. The adoption of the time lag as a calibration parameter is not usual as is the magnitude of the adopted velocities. It is not likely that time lag velocities would exceed 1 metre/second and values of 4 metres/second are highly questionable. Time lags are generally determined by looking at velocities from hydraulic models or simple manning’s calculations. Further it may have been better to utilise the Bx factor as the key calibration parameter. Placing the 1998 event into design context is also of interest. The design peak flows presented in Table 3-2 suggest the 1998 event is significantly smaller than a 10% AEP event and as such may not be that representative of 1% AEP type conditions.

- Section 3.8. There is no reference to the Aerial Reduction Factors and design rainfall losses adopted.

- Section 4.1. The modelling approach involves rain on grid for the study area TUFLOW model with upstream inflows from the RAFTS-XP catchment model. A majority of the inflow nodes are from local catchments and as such the adoption of 24 hour storm duration results for these catchments is likely to underestimate the peak flows. These smaller catchments would more than likely have higher peak flows for shorter duration storm events commensurate with their catchment areas.

- Section 4.3.2. How well are the channels and major overland flow paths defined in the 2D hydraulic model based on a 20m grid size?

- Section 4.3.6, dot point 2. Refer to earlier comment regarding inflow hydrographs from small localised catchments i.e. critical storm durations are likely to be significantly less than 24 hours.

- Section 5.1. Note trimming of depth and velocities in the text, generally to remove “noise” from the mapping, these criteria however are not reflected in the figures where depth and velocity in the legends commence at 0.

- Section 5.1. Reference to 10 metre grid size. Should this be 20 metre?