Expert Report for the IPC Hearing for the Narrabri Gas Project (SSD_6367) Outstanding biodiversity impact and offset issues

David C. Paull (MResSc, Dip Hum., UNE)

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Opening Statement

This report is a response to an expert brief provided to me by the Environmental Defenders Office acting on behalf of North West Alliance.

I have read and understood Part 31 Division 2 of the *Uniform Civil Procedure Rules 2005* (NSW) (UCPR) and the Expert Witness Code of Conduct (Code of Conduct) which govern the use of expert evidence in NSW Courts.

I have attempted, to the best of my ability, to address the following issues:

a) In your opinion, have the concerns raised in your previous submission to the Project been adequately addressed, including through any recommended Conditions of Consent? If not, please provide information on any remaining issues of concern.

b) Provide any further observations or opinions which you consider to be relevant.

The following documents have been accessed in the preparation of this report:

- Narrabri Gas Project EIS, including Appendix C Cumulative Impacts, Appendix J1 Ecology; Appendix J2 Biodiversity Assessment Report; Appendix V Rehabilitation;
- Narrabri Gas Project Response to Submissions, including Offset Strategy;
- GLNG Gas Field Development Project EIS;
- Department of Planning, Industry and Environment's Narrabri Gas Project Final Assessment Report and Draft Conditions of Consent;
- and references from the scientific literature.

Statements made in this report have been provided using my knowledge of the species and ecosystems of the Pilliga Forests gained over several decades and my understanding of gas field impacts derived from years of professional experience as a consultant and a regulator. A brief resume is attached to this document.

Contents

1. Summary

This is the largest onshore gas production field that has been proposed in NSW. Uncertainty about the location and scale of direct and indirect impacts and the offset arrangements has made a transparent assessment of the biodiversity impacts of this Project impossible. It would be fair to say the approach taken and the dearth of information on what will actually transpire *show the proponents and the government have failed to provide ecological information with a level of reliability sufficient for an informed judgment on the impacts.*

The Pilliga Forests constitute the most important refuge area for wildlife in western NSW, are a significant recharge area for the Great Artesian Basin and, as well as the high conservation-value remnant patches to the north of the forest, are part of a recognised National Biodiversity Hotspot containing high species diversity with endemic species *and high levels of ongoing threat, whose irreplaceability is of the highest order*.

In previous advice prepared in relation to this Project (on behalf of Upper Mooki Landcare Inc), I identified a number of significant deficiencies in how the Framework for Biodiversity Assessment (FBA) assessment methodology and the *NSW Biodiversity Offsets Policy for Major Projects* (2014) (NSW Offset Policy) was applied for terrestrial and aquatic ecological matters within the Environmental Impact Statement (EIS). A number of these deficiencies remain in the Department of Planning, Industry and Environment's (DPIE's) Assessment Report and within the recommended Conditions of Consent. These are detailed in this submission and summarised below:

1. **The scale of the direct impact** of the Narrabri Gas Project through vegetation removal is not certain. Figures provided by Santos are likely to be under-estimates.

2. **Santos' Field Development Protocol** does not exclude any sensitive ecosystems or EECs and allows an upper limit to clearing, rather than use of the 'avoidance principle'.

3. **The effect of 'indirect impacts'** of the Project has been grossly under-estimated and does not take into account the variety and magnitude of expected impact types. A number of threatened fauna species will be disproportionately impacted by indirect means which are **not accounted for in the FBA**. Key impacts include increases in feral predator activity, increasing isolation of bushland remnants, and increasing bushfire risk. All these factors contribute to increasing extinction risk for species such as the Black-striped Wallaby and Pilliga Mouse.

4. **Offsetting indirect impacts** is not mandatory in NSW and the DPIE did not include any consideration of these in their consent conditions. For development where these impacts are significant, such as the Narrabri Gas Project, the shortcomings of this policy approach are apparent. Offsets for indirect impacts are a factor to be considered under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and DPIE should have addressed these issues for consistency with the Assessment Bilateral Agreement with the Commonwealth.

5. **Cumulative impacts** considered by Santos only included those previously undertaken for gas infrastructure. Santos has not considered clearing from mining or forestry in or adjacent to the Project Area.

6. **The survey effort** undertaken for the EIS was insufficient or misplaced for some key threatened species, namely the Koala, Pilliga Mouse, Eastern Pygmy-possum and the Five-

clawed Worm-skink. This has inhibited an adequate assessment of impacts on these key species.

7. The proposed retirement of **ecosystem credits** comes with no feasibility assessment on suitability or availability, merely a desktop check of private lands. Santos' Offset Strategy is not consistent with NSW Offset Policy.

8. Retirement of **'species credits'** will be difficult given the Pilliga Forest is the largest, most intact remnant in the bioregion, and the most important core habitat for those locally-occurring, affected, threatened species.

9. The **DPIE rejected Santos'** claims on the validity of using rehabilitation and feral animal control to create biodiversity credits 'up front'. Other shortcomings of the ecological assessment and offset arrangements identified here provide little public surety that the ecological impacts of this Project have accurately described or adequately mitigated.

The DPIE, in its Assessment Report, alludes to the *Brigalow Belt and Nandewar Community Conservation Act 2005* (BBNCC Act) as a justification to proceed with the Narrabri Gas Project. While the BBNCC Act and associated Agreement allows for extractive industry development in state forests, principles of ecological sustainable development also apply to Zone 4 under the BBNCC Act and Agreement. While the DPIE does not consider that the application of the precautionary approach to this Project is necessary, as they do not consider there will be a risk of 'serious or irreversible environmental damage' arising from this Project, *a lack of information, along with the recognised biological significance of the Pilliga forests, is sufficient to indicate that the risk of serious or irreversible damage on ecosystems and species cannot be discounted. On this basis the Narrabri Gas Project should be rejected in its current form.*

2. Uncertainty of Magnitude of Direct Impacts

" *… actual clearing rates are expected to be much lower (250-630 hectares) depending on the final layout of the gas field, and are likely to be no greater than 70% of the worst-case predictions*." (DPIE Assessment Report).

The reason for this uncertainty in the actual extent of the directly impacted area, which was initially 988.8 ha in Table 49 of the Biodiversity Assessment Report (EIS, Appendix J2) (see below), now 250-630 hectares, is not clear. This has not been explained by DPIE other than to state that they were given certain assurances by Santos. As there isn't a layout plan the company can disclose, not only does the public and consent authority not know where the gas infrastructure will be located, there is uncertainty on the extent of impact. Not knowing these details prior to consent is inconsistent with the NSW Offset Policy .

Table 49: Direct impacts by infrastructure element

Location	Leewood	Bibblewindi	Bibblewindi to Leewood infrastructure corridor	Leewood to Wilga Park underground power line	The gas field	Ancillary	Total
Clearing required (ha)	0	16	26.7	0	920.6	25.5	988.8

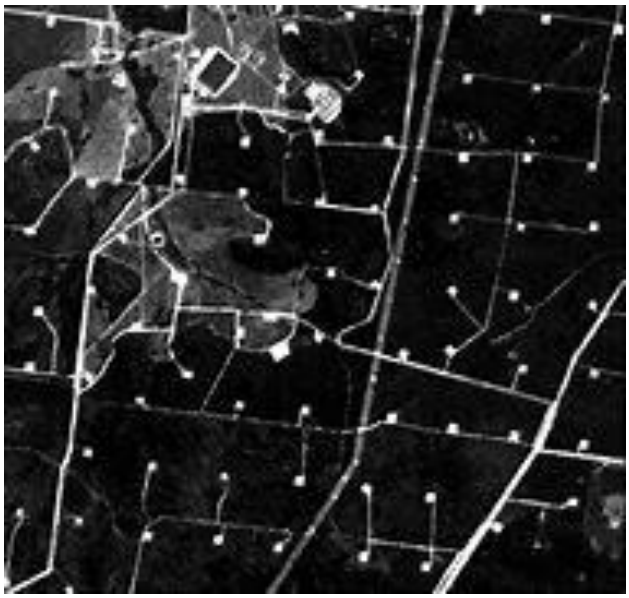
2.1 Access tracks

In the EIS, Santos claims the access tracks for new sets of gas wells are included within the figure given for the 'gas field' and not the 'ancillary' clearing of 25.5 ha, though how much of this total area tracks or well sites contribute is unclear. Given Santos is proposing 425 new paired well sites, claiming they will be 1 ha in size, 400 ha would seem to be a minimum figure without any new tracks or gathering pipelines (given some well sites outside the forest may not require clearing of native vegetation).

The numbers provided in the EIS suggest the extent of clearing associated with tracks and other linear infrastructure such as gathering lines has been under-estimated.

Santos states much of the access to sites will use existing roadworks, but this is uncertain if it's not clear where the wells will go. In practice however, my inspection of satellite imagery of previous gas fields within state forests demonstrate that this has been difficult to do.

Figure 1: Gas field near Dalby, Qld.



Santos has previously provided much more detail about what types of impact are to be expected within a 'gasfield'. In Santos' recent GLNG Gas Field Development Project EIS, for Stage 1 (Table 4-1), Santos states that a 2,500 well field would require about 6,800 km of track and 2,000 km of gathering lines. It is noted that access tracks are estimated to require the clearing of 1.5 - 3 ha/km of track and gathering lines 1-2.5ha/km. That's roughly twice the level of clearing associated with well sites.

Gathering and transmission pipelines are standard features of gasfield development as they connect well-sites to the arterial water and gas pipelines. These have been ignored in the Narrabri Gas Project EIS, which is further evidence that the extent of clearing in the EIS has been under-estimated.

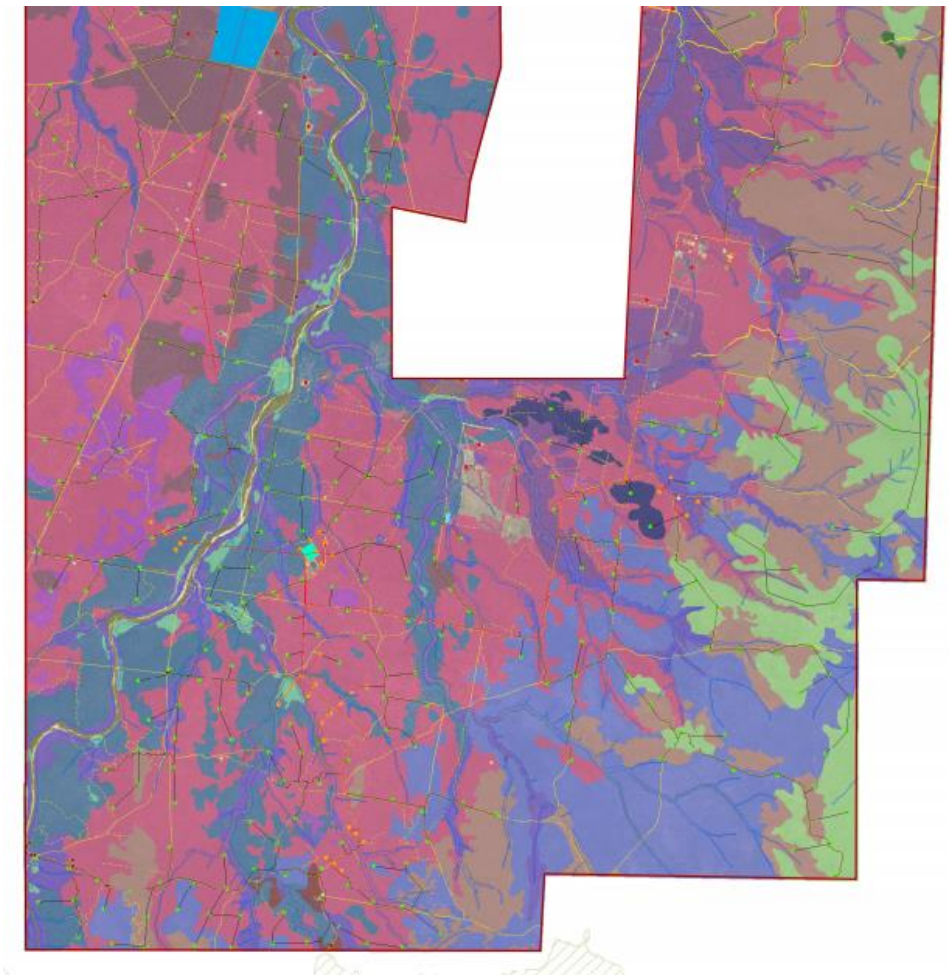
Table 4-1 GLNG Project approved gas field development

Project components	Approved units
Wells	2,650 wells
Gathering lines / transmission pipelines	Approximately 2,000 km
Nodal gas compression facilities	Up to 150 facilities
Hub gas compression facilities	Up to 12 centralised facilities
Water management facilities	Up to 5 desalination treatment facilities (each processing 10 megalitres (ML/day)
Access roads	Approximately 6,800 km

In the Project Description for the EIS, Santos presents an 'indicative layout' of the Narrabri field - (Figure 2). This figure also suggests the extent of new access roads will be a significant proportion of the total clearing within the forest itself, while not being as important outside the forest. Most new well sites in this figure are connected by new tracks, some lying parallel to existing roads.

The status of this indicative layout and how well it represents where an actual footprint may be expected is not clear and has not been clarified further by DPIE. It was not used to inform the biodiversity assessment for the Project, leading to further uncertainty regarding the direct impacts.

Figure 2: Indicative layout of gas field in the forest, showing anticipated extent of access tracks (from Santos EIS, Narrabri Gas Project, Chapter 6, Project Description).



2.2 Size of well sites

The suggestion that the 1 hectare size of the well sites as proposed by Santos is sufficient to accommodate two wells, is not consistent with works undertaken for their recently approved GLNG Gasfield Development (GFD) Project in Qld. This is Santos' most recent gasfield production approval. Information provided by Santos for the GFD Project (Table 4-4 below) shows single well sites have a cleared zone of 1.5 ha and multi-well sites have a size of 2.5 ha. Santos' well site descriptions for the Narrabri Gas Project suggest it will be attempting to utilise new advances in multi-well pad design, an approach which Santos has not undertaken before and for which there is considerable uncertainty connected with how close wells can be placed, a process which requires some prior appraisal (Abramov 2019).

If Santos does not currently have this information, the certainty of two wells safely fitting in a hectare area cannot be provided. This will have implications for the total development footprint and adds to the overall uncertainty of the direct impacts of the Project.

Table 4-4 GFD Project components' construction method, typical footprint and timeframes

Infrastructure components	Description	Construction method	Construction footprint	Construction timeframes
Well lease	• Drill rig • Chemical and fuel storage • Gas generator • Water storage • Mud pit (where required or a tank is used) • Flare and flare sump • Production well(s) • In-well pump • Gas/water separator (if required) • Metering facilities • Fencing and signage where appropriate.	Onsite construction using rotary or air lift drill.	Single well lease: 1.5 ha Multi-well lease: 2.5 ha.	Civil works: 30-60 days Drilling: 24 hours per day, 10-30 days per well Completions: 150 days Commissioning: 60 days.
Access tracks and roads	Graded or gravel roads, aligned to existing fences and tracks where practicable.	Onsite construction.	1.5-3 ha per km.	Civil works: 30-60 days
Gas and water gathering lines	• HDPE[1] (or other) pipeline, aligned to existing fences and access tracks, where practical • Signage.	Laid on ground, or buried in open cut/trench, with trenchless (directional) drilling for crossing sensitive areas.	1- 2.5 ha per km.	Up to 4 days per 500 m to clear, trench and bury line; plus up to 14 days for installation of vents, drains, manifolds, etc.
Gas and water transmission pipelines	• Steel (or other) pipeline, aligned to existing fences and access tracks, where practical • Medium to high pressure flow of water or gas • Signage.	Buried in open cut/trench or with trenchless (directional drilling) methods.	2.5-5 ha per km.	Up to 5 days per 500 m for surveying, clearing and supplies; 2 days per 2 km for trenching, laying and burying; plus 1-

Given the data Santos had access to, including accurate estimates of clearing it has previously used and an indicative gasfield layout, the fact that it has used an impact assessment approach that is entirely modelled and not based on any substantive data again detracts from the reliability of the biodiversity assessment undertaken for the Narrabri Gas Project.

The DPIE states there is only a small area (around 1%) of clearing within the Narrabri Gas Project Area and only a very small area (around 0.2%) of clearing within the broader Pilliga Forest. However, as the evidence presented here shows, it may be significantly more.

While a number of the well sites may be placed in agricultural land to the north of the forest, even there Santos has provided estimates of clearing of small patches of remnant vegetation, including threatened Myall and Brigalow ecosystems. How well Santos has attempted to avoid sensitive ecosystems and habitats is dealt with in the next section.

3. Mitigating measures do not 'avoid' sensitive matters

3.1 Avoidance and Offset Policy

The Secretary's Environmental Assessment Requirements (SEARs) for this Project states that an assessment of the likely biodiversity impacts of the development:

- must be done in accordance with the FBA (OEH, 2014), unless otherwise agreed;
- must provide a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the Narrabri Gas Project over time if the Project is approved; and
- must provide a strategy to offset any residual impacts of the development in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014), unless otherwise agreed by OEH.

The NSW Offset Policy (2014) enshrines in its first principle the action of 'avoidance' as a first step for proponents to undertake when development footprints for major projects are being planned. Under the FBA, specific instructions for avoiding and minimising impacts on biodiversity requires proponents to clearly explain why impacts cannot be avoided or minimised any further.

However the modelled approach with 'upper disturbance limits' as proposed by Santos is at variance with the concept of avoidance and in some instances, the DPIE has allowed for an increase in the limit for some ecosystems in the recommended Conditions of Consent compared to the previous assessment, including the endangered Brigalow ecological community.

3.2 Field Development Protocol

Santos proposes to implement a 'Field Development Protocol' and an 'Ecological Scouting Framework' in order to minimise harm to biodiversity. It seeks to show flexibility in the location of well pads so that sensitive matters can be avoided, while at the same time admitting that complete avoidance of sensitive matters may not be always possible. While this may sound like due diligence, in fact Santos' Protocol will facilitate harm to sensitive matters by:

- not proposing to avoid any sensitive ecosystems, such as Groundwater Dependent Ecosystems (GDEs) and Threatened Ecological Communities (TECs);
- having clearance upper limits for all ecosystems, including EECs and key threatened species habitat, based on their relative abundance in the Project Area.

In other words, Santos on the one hand may be able to implement some design flexibility, but with established clearance allowances in the Protocol, it only has to avoid TECs to a certain extent.

Santos is proposing to clear three TECs; two of which are also Commonwealth listed:

- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains bioregions, including the Commonwealth-listed Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Fuzzy Box Woodland on alluvial soils of the South West Slopes, Darling Riverine Plains and Brigalow Belt South bioregions;
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray Darling Depression, Riverina and NSW South West Slopes Bioregions including the Commonwealth-listed Weeping Myall Woodlands.

The area of expected impact on the Weeping Myall TEC is relatively small (only 0.1 ha), though as it is confined to a small area of habitat in the north-west corner of the Project Area, it could have been avoided. The area of Brigalow TEC allowed to be cleared is more significant; in fact, the area to be cleared has increased in the recommended Conditions of Consent (19.3 ha) to what it was in the EIS (only 7.3 ha). This increase in allowable clearing appears to be contrary to the concept of 'avoidance' for sensitive ecosystems.

While most Brigalow patches in the Project Area may be small and some in a regenerating condition, their landscape and biodiversity importance should preclude any clearing at all. The two reserves in the Project Area are the largest in the Brigalow Belt South bioregion in NSW. Santos initially did not rule out clearing within the Brigalow Park State Conservation Area, an important refuge for the Black-striped Wallaby and the Spiny Peppercress. DPIE is proposing a condition to have a buffer around this reserve, but Santos only make a concession to 'sensitive areas' while making no such concession for TECs or threatened species habitat, areas also usually considered to be 'sensitive'. Fuzzy Box EEC is also a terrestrial GDE associated with the Bohena Creek alluvial system and is considered below.

3.2 Groundwater dependent ecosystems

Another particular concern is the clearing associated with tracks and pipelines that will traverse Bohena Creek and its associated riparian vegetation. The recommended Conditions of Consent have allowed clearing of 5.9 ha of endangered Fuzzy Box woodland, scattered the length of Bohena Creek in the Project Area along with the riparian Red gum - Rough-barked Apple woodland community, amounting to some 6.5 ha together. There are a further 32 ha in similar ecosystems on alluvial soils which can be cleared in the revised upper limits.

Santos' 'ecological sensitivity analysis' identifies this riparian, alluvial vegetation as having a 'high sensitivity'. Yet Santos is not proposing to avoid the most sensitive community, Fuzzy Box woodland. In addition, Santos did not undertake an assessment of whether this riparian vegetation falls into the category of being a 'High Priority GDE' as defined under the NSW Water Sharing Plans. Santos merely stated it wasn't listed as being such.

This is a failure of 'due diligence' as many water features in the Namoi Alluvium Water Sharing Plan have not been assessed. Santos' consultants also misrepresented the biodiversity values of these ecosystems - for example, they erroneously described the Bohena Creek system as being in a poor condition. The assessment undertaken by independent groundwater specialist (submission by Dr Serov, Stygoecologia) has shown in fact *the aquatic ecosystems in the Project Area have a 'high condition', with a high aquatic diversity with endemic species of stygofauna.*

In their aquatic assessments, Santos' consultants, EcoLogical, failed to identify the presence of a number of surface and aquifer-dependent invertebrates, one being freshwater mussels (Figure 3), key indicators of local diversity, water health and cultural significance.

Figure 3: Semi-permanent pool off Bohena Creek in the Project Area not assessed by Santos and freshwater mussels found at the site. (photos: D. Paull)

Had the Bohena Creek alluvial system (including above and underground water features) been assessed properly, it would have showed a high diversity, the presence of threatened communities and unique aquatic features, such as side stream pools and discharge zones, and it would have matched all the necessary criteria for being a 'high priority' under the Water Sharing Plan.

4. Inadequacy of Indirect and Cumulative Impact assessment

Indirect impacts can be much more significant impacts on wildlife in diffuse development layouts such as gas fields than in projects with a low edge to area ratio. These have been poorly considered in the EIS. This is mainly due to the fact that under the NSW Offset Policy, proponents are not required to offset their indirect or cumulative impact liability and impacts are not required to be quantified.

While SEARs from the NSW Government did not specifically require them, Santos calculated an indirect impact equivalent area and a credit liability. These, along with cumulative impacts, were added to the credit liability of the direct impacts in the EIS increasing the 'affected area' from 988.8 to 1,166.9 ha.

Assessment requirements under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* require consideration of indirect impacts when making impact assessments or calculating offset liability. The EPBC Act defines indirect impacts differently to NSW in that they are considered 'indirect consequences of actions' and are given equal weighting to direct impacts (https://www.environment.gov.au/resource/epbc-act-policy-statement-indirect-consequences-action-section-527e-epbc-act).

Offsets under the Commonwealth's *EPBC Act Environmental Offset Policy* (2012) need to take account of unavoidable changes in habitat quality. The fact that the recommended Conditions of Consent do not take these impacts into account suggest the assessment has fallen short of the Commonwealth requirements and therefore does not meet the obligations of the Assessment Bilateral Agreement which NSW holds with the Commonwealth.

4.1 Extent of indirect impact under-estimated.

Santos has based its indirect impact area on a 'mitigated' outcome, that is taking into consideration mitigating actions. From the BAR (EIS, Appendix J2):

> To undertake this calculation, all site, downstream and facilitated impacts were compared and quantified where possible, firstly without mitigation measures, and then with proposed mitigation measures. A buffer surrounding infrastructure was calculated that would contain all indirect impacts, pre-mitigation. Within the indirect impact buffer, the level of impact is not linear as it will be generally greater closer to the impact source and as such the vegetation within the buffer is not considered to be 100% affected. To account for these factors, a formula was applied to the buffered area to account for the reduction in habitat quality within the indirect impact buffer. This formula was applied to two scenarios; without and with mitigation measures in place. Details of the calculations are presented in **Table 51** and **Table 52** below.
>
> The indirect impact values were then applied to each Plant Community Type, based on the ratio of direct impacts to each Plant Community Type. This allowed for a value of indirect impact to each Plant Community Type which could then be subsequently applied to fauna habitat types and threatened flora individuals.

So, within the 50m 'impact buffer zones' Santos is only claiming that 5m is the effective zone of impact for well pads and 1m for tracks and pipelines. From this a total indirect impact of 181 ha was calculated for the Narrabri Gas Project.

But this is a poor assessment of the potential extent of a range and extent of impacts which may arise from gas development. OEH stated in its EIS submission that the credit liability for indirect impacts should be calculated over the whole buffer area and not a 'likely maximum extent' as determined by Santos. In the past it has been the practice to use buffer widths to describe a likely extent of indirect impact. Santos however has used its own reduced 'extents' based on a number of quantified assumptions on the effectiveness of these mitigation measures. But what these mitigation measures are is not clear.

There has been relatively little work on indirect impacts from the oil and gas industry when its extent around the world is considered, with 2/3 of all work done in this area from North America. There are considerable gaps, with no known studies on the impacts of oil and gas activities on bats for example (Jones et al 2015). Jones et al (2015) found:

> " *… only 12 studies worldwide in which wildlife mortality from oil and natural gas development was investigated, these suggest that wildlife mortality may be a significant and underrepresented problem. Sources of mortality unique to oil and gas development include contamination from reserve pits and evaporation ponds used to store the by-products of drilling. Most regulations require these pits be netted to prevent entry by wildlife; however, this does not always occur. Studies have shown relatively high numbers of bird carcasses in pits, such as an average of 8.4 avian fatalities per unprotected reserve pit each year. In addition, massive avian mortality events have occurred as a result of gas flare stacks at refineries. Flare stacks and gas compressors, which emit heat, flames, and toxins, are common within oil and gas fields; however, no research has been performed on wildlife mortality associated with this infrastructure*."

What we know about indirect impacts expected in a diffuse gas field is listed below. Each has specific effects on a wide range of fauna and flora and has not been addressed in any detail in the EIS or Response to Submissions documents.

- ***Light pollution*** – Many of the facilities and well sites will be lighted throughout the night. Light will penetrate a considerable distance off the site and its impact on nocturnal species is

poorly understood. The " … *capacity of Polarised Light Pollution (PLP) to drastically increase mortality and reproductive failure in animal populations suggests that PLP should become a focus for conservation biologists and resource managers alike*". (Horvath et al 2009). Vehicles, drill rigs, flares and construction activities as well as security lighting all contribute to overall impact.

- ***Noise pollution*** – Particularly acute during construction phases which will be ongoing through the forest for many years as new sites are constructed, where heavy vehicles and testing operate through the day and night. Production wells also create noise around the clock, as well as noise from increased traffic to and from the well sites across the forest. The impacts on noise on wildlife have been studied to some extent, causing documented effects including "… *altered vocal behaviour to mitigate masking, reduced abundance in noisy habitats, changes in vigilance and foraging behaviour, and impacts on individual fitness and the structure of ecological communities*" (Shannon et al 2016).

- ***Harmful emissions*** (Volatile Organic Compounds). These by-products from flare stacks in particular are known to be toxic to humans, though as mentioned above, little is known on the effects on wildlife.

- ***Edge effect on vegetation***. A somewhat vague term encompassing the effects on wildlife and plants when given exposure to open, dusty and lighter environments associated with forest edges. What is being proposed is an unknown level of internal habitat fragmentation over 100,000 hectares of public forest. The Biometric Methodology employed attempts to take this into consideration by applying a 'linear infrastructure' model which assigns a landscape value score to developments with high levels of edge:area ratio. However, this approach only marginally changes overall credit liabilities and does not factor in the range of other impacts detailed here.

- ***Increased levels of weed invasion***. Poorly referenced in the EIS, but as reported in the Well Site Rehabilitation study undertaken by the Pilliga Environment Group (PEG 2018) there is considerable evidence of weed invasion at well sites throughout the study area, probably as a result of bringing in contaminated mulch or other materials onto sites or even from vehicles or people acting as vectors. Santos' weed control at sites seems to be "control following establishment" rather than through using avoidance techniques, as specified in typical weed control measures.

- ***Fragmentation of habitat***. Tracks and pipe easements vary in width, though even gaps in vegetation of a few metres is wide enough to inhibit the essential behavioural patterns of many species of small vertebrates and invertebrates. The fragmenting effects of tracks and roads on wildlife is well studied internationally, as Wilbert et al (2008) point out that there are "… *hundreds of scientific papers covered in the literature reviews … illustrate the preponderance of evidence that routes ranging from narrow dirt tracks to paved roads can and do have adverse affects on wildlife. In fact, habitat fragmentation from roads and other human infrastructure has been identified as one of the greatest threats to biological diversity worldwide*."
  For example the adverse effect on small birds is well documented, some species being edge-phobic tending to keep in cover and within the interior areas of remnant patches of vegetation (Ortega and Capen 2002). The author's radio-tracking studies on the Pilliga Mouse (Paull 2006) show it also avoided open spaces, including tracks and roads of any width while foraging, no doubt an anti-predator response, typical of many small mammals.

This species was found to significantly select habitat with a substantial low shrub cover (Paull 2009; Paull et al. 2017).

- ***Increased levels of feral animal predation***. As discussed further below in Example 2, establishing new tracks and gathering lines will increase the predator pressure on the local wildlife. We have considerable information on the adverse effects these pests have on native wildlife, being a key threatening process, though less information on the particular impact of these predators and their use of forest tracks and roads.

- ***Increased vehicle collisions***. Inevitable, as traffic movements throughout the forest are likely to increase throughout the life of the Narrabri Gas Project.

- ***Increased risk of bushfire and drought***. Flares themselves are a fire risk, particularly on windy days, made worse by Santos' policy of keeping flares on at all times, even during high fire danger warnings. Fires can also start through use of vehicles and plant or even by human accident. A gas field is no place for an uncontrollable wildfire, with potential point sources of further ignition further increasing its potential hazard to the forest and surrounding properties. As this industry is a known significant emitter of carbon molecules and contributor to global warming, the expected increase in the duration and severity of dry periods will only exacerbate overall fire risk in the future.

- ***Water and soil contamination***. Offsite spillage of produced water has occurred across a number of well sites in the forest over the years, resulting in areas of vegetation die-off at a number of sites. Despite efforts at rehabilitation by Santos, these areas are still under active management with low levels of success in terms of the establishment of stable ecosystems that bear a resemblance to the original community, with some sites 20 years following the contamination incidents showing little sign of ecosystem recovery (See images below from PEG 2018).

Figure 4: 'Bohena 3' in 2019 showing offsite spillage zone with recent plantings.

Figure 5: Bohena 2 produced water spill zone, twenty years following incident

The contents of produced water are reasonably well known, with Santos' data showing a large range of compounds from metals and organic compounds such as phenols and BTEX, many toxic to biological processes. Authors have suggested that the runoff from well sites poses a risk to the surrounding environment and surface waters that are *"…similar in many ways to those resulting from agriculture, silviculture, mining, and urban development*" (Allen Burton et al. 2014). Despite this, an industry-wide assessment of risk management of water in the onshore gas industry is hindered by a lack of data (Torres et al 2016). The possible persistence of these compounds in soils along with the poor quality of natural regeneration and persistence of weeds at well sites in fact makes them a long-term liability to the local ecosystem, wildlife and surface hydrology. *None of these issues have been acknowledged by Santos.*

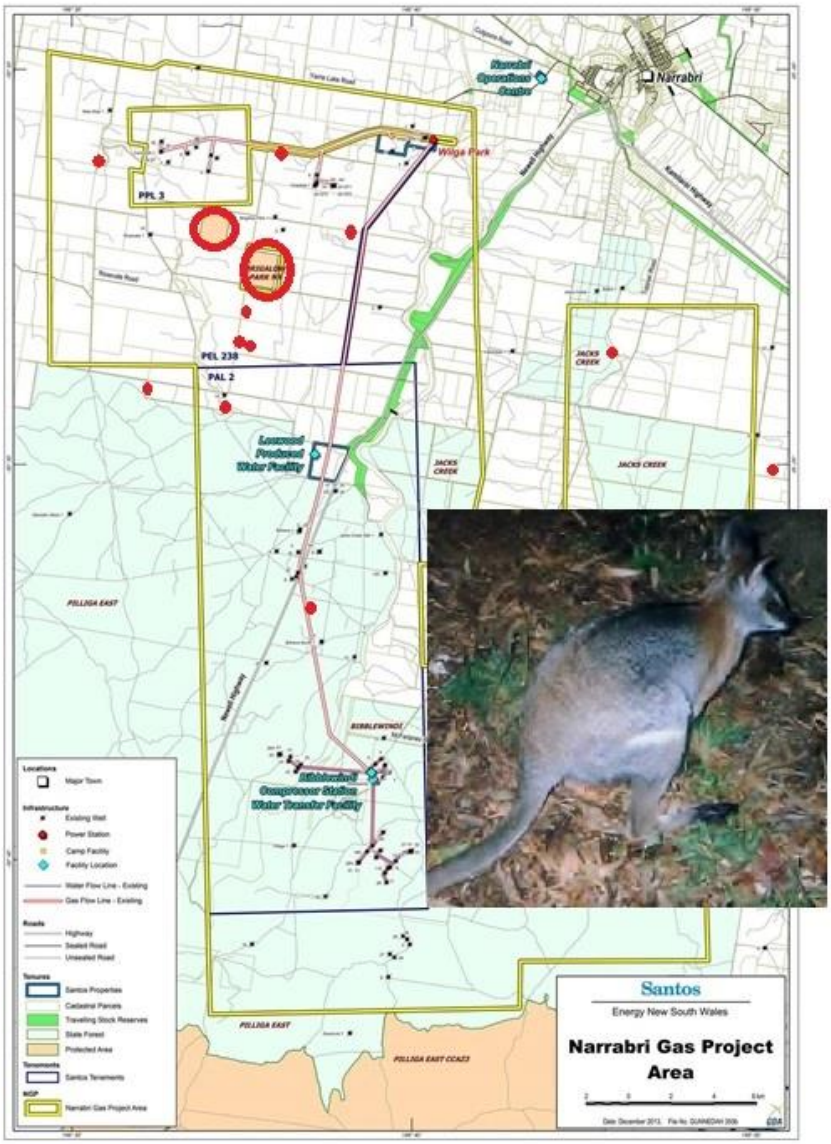
4.2 Example 1: Black-striped Wallaby

The local population of Black-striped Wallabies is largely confined to the two Brigalow Reserves to the north of Pilliga forest and in the north-eastern portions of the forest itself. Trail cam surveys undertaken by the community in 2011 (Landmark and TWS 2012) show that the portion of the forest closest to the reserves, in the vicinity of Bundock Creek, is an important corridor for dispersal. EcoLogical recorded this species 17 times mainly around the northern part of the forest and around the Brigalow Reserves.

This population or about 90% of the population's known distribution lies within the Project Area. The Black-striped Wallaby is found in the north east part of the Pilliga Forest and among Brigalow remnants to the north of the forest. It maintains a line of dispersal from the Forest to the Brigalow remnants through the vegetated Bundock Creek which flows out of the forest into private lands to the north. Figure 6 show the two important remnants which are preferred habitat for this species, the Brigalow Park Nature Reserve and State Conservation Areas. Recommended Conditions of Consent state that Santos should erect a '50 m buffer' around both. What this means in terms of fencing around these two reserves remains unclear, as indeed, are fencing arrangements throughout the gasfield.

However, what these animals will experience will be an industrialisation of their home range. Their ability to leave and disperse from these two brigalow patches could be hampered by the increase of indirect impacts around gas wells and sites, fencing, increased traffic and the array of other indirect impacts on these animals.

Figure 6: Black-striped wallaby distribution in relation to the study area.



Even though this species requires an offset for impacts of the development, this will be difficult to achieve as all parts of this population are likely to be affected by the Narrabri Gas Project. The status of this species in fire-ravaged areas in the NSW northern ranges is uncertain, increasing the importance of this isolated, western population.

While impacts on this species can be mitigated, the overall result of this development if allowed to proceed would likely increase the extinction-proneness of this already endangered, isolated and significant, endemic population.

4.3 Example 2: Pilliga Mouse, Eastern Pygmy-possum

Both these species are small terrestrial nocturnal mammals listed as a threatened species under the *Threatened Species Conservation Act 1997* and the *Biodiversity Conservation Act 2016.* The endemic Pilliga Mouse is a ground-dwelling species, the Pygmy Possum is semi-arboreal but spends most time close to the ground. Both are susceptible to fox predation as a fox scat analysis from the Pilliga has shown (Paull and Date 1999).

Feral cats are also an important conservation issues in the Pilliga, but much less is known about the ecology or feeding preferences of this species in the Pilliga. Based on the available literature it would be safe to assume they would be preying on a variety of small vertebrates and invertebrates. While surveys suggest numbers are not as high as foxes, they are distributed throughout the forest and use roads and creeks while foraging.

Figure 7: Left: Pilliga Mouse (endemic to the Pilliga Forest) and right: Eastern Pygmy Possum. (credits D. Paull/P. Spark)

Fragmenting the forest into a checkerboard pattern of tracks and well sites through core areas of habitat for these small animals will increase the predation pressure on these species for a number of reasons:

a) Most scientists agree that the nature and impact of predation by the cat, fox and dingo on native fauna are primarily determined by prey availability (May and Norton 1996). Roads and tracks increase the hunting success and therefore availability of prey. This was confirmed in a study which found that foxes preferentially use tracks, roads and creek-lines while foraging, spending up to 30% of night-time activity hunting along and near linear features (Meek and Saunders 2000). Increasing the extent of tracks and roads therefore effectively increases overall hunting pressure on local wildlife.

b) Prior to the last drought in 2016, foxes were very common throughout the forest. I recorded foxes at 70% of camera traps (N=100) in an unpublished study I conducted on behalf of the University of Wollongong. Forestry Corp and NPWS have been undertaking landscape scale baiting in the forest for many years, but this doesn't seem to have made an impression on the problem. Santos' proposal to boost a regional baiting program may in theory help with efforts around the forest edges as long as it is maintained, but it is unlikely to achieve better results within the forest. Baiting at these scales is becoming more problematic as evidence is mounting it is not leading to lasting results. Fox numbers may have been reduced as a result of the drought, though the wet start to this year is likely to see numbers increasing again. Increasing the distance of tracks in the forest will only lead to increasing hunting success for foxes.

The impact of increased predation in the forest following high levels of internal fragmentation cannot be offset or mitigated in any meaningful way. The result being that these small species (including the Pilliga Mouse, Eastern Pygmy Possum and Black-striped Wallaby are likely to undergo increased risk of local extinction.

4.4 Cumulative Impacts underestimated

In their impact and offset calculations Santos has included all previous works on gas infrastructure which have occurred in the Project Area. However, a proper assessment of cumulative impacts should not restrict itself to the same kind of industry but consider all previous and likely future impact scenarios.

One such historic impact is that of forestry. Depletion of large trees of several species for timber across the Project Area over 100 years of forestry has had its impact on hollow availability for wildlife (Paull and Kerle 2004). Further reduction of hollow availability as a result of clearing through the forest by Santos has not accounted for this historic shortfall. This is pertinent to the many hollow-dependent species known in the Project Area including rare threatened species such as the Squirrel Glider, Barking Owl and South-eastern Long-eared Bat who will experience further habitat loss under the Santos proposal.

Whitehaven's Narrabri Underground Mine has disturbed considerable areas of forest at the surface with the construction of a considerable number of tracks and sites containing sump pits and de-gassing infrastructure. While not in the Project Area for the Narrabri Gas Project, it should be taken into account within the overall historic impact on forest habitats in the eastern part of the Pilliga.

5. Offsets Issues.

The DPIE states it is unlikely that the Narrabri Gas Project will have any significant biodiversity impacts or offsets, and that any residual impacts can be offset according to the NSW Offset Policy. However, given the uncertainties surrounding the adequacy of the consent conditions, in my opinion the propensity by Santos to provide poorly verified data is an exercise fraught with uncertainty.

5.1 Disproved claims

The Narrabri Gas Project will generate a requirement to 'retire' 66,630 ecosystem credits and 1.525 million species credits according to NSW Offset Policy .

The DPIE rightly rejected using a feral animal control program as a species offset measure as it is a standard measure which proponents should adopt as a matter of course. Likewise, a proposal to offset impact to Koalas with a Management Plan was rejected by the DPIE, particularly as the scope proposed by Santos fell way short of the mark of having benefit to the Koala.

What this means is that, as described above, the expected increase in impacts on small sensitive animals from feral animals' predation has not been offset. Nor have the impacts on Koalas been offset and nor is it indicated by the DPIE how the 30,000 credit liability for Koalas could be offset.

The DPIE also rejected the proposal by Santos that it should be awarded upfront credits for well-site rehabilitation. Evidence provided in the Santos Rehabilitation Strategy (Appendix V of EIS) with regard to the success of their rehabilitation program to date was contested by the submission to the EIS by the Pilliga Environment Group (2018), highlighting the failure of regeneration at well-sites to meet benchmarks. The DPIE proposed a condition of consent requiring that 70% of offsets be met by land-based measures prior to construction and 30% can be offset from rehabilitation if it can be proved to be effective, or some other means.

Increased fragmentation, indirect impacts and disruption to essential behavioural patterns will disproportionately affect small and medium sized vertebrates, those species most currently at risk in

the forest. *The offsets for indirect impacts were not addressed in the Assessment Report or in the recommended Conditions of Consent. It is therefore undeniable that indirect impacts have not been taken into account adequately in the offset arrangements and it is likely that these impacts also have not been, and arguably cannot be, offset.*

5.2 Land-based offsets

The DPIE has made it a requirement that Santos retire 70% of their credits prior to construction in the form of land-based offsets. The DPIE claims in its Assessment Report that Santos has demonstrated that there is more than enough land in the region that could be used to retire these credits. But no feasibility analysis has been undertaken to provide some surety on the availability of lands for agreements or their suitability to meet the specific requirements of the credits required.

The NSW Offset Policy outlines steps which should be demonstrated prior to any offset strategy being accepted.

Reasonable steps to locate like-for-like offsets include, in addition to consideration of any feasible sites known to the proponent, include:

- checking the biobanking public register and having an expression of interest for credits on it for at least six months;
- liaising with an OEH office (or Fisheries NSW office for aquatic biodiversity) and relevant local councils to obtain a list of potential sites that meet the requirements for offsetting;considering properties for sale in the required area;
- providing evidence of why offset sites are not feasible – suitable evidence may include:
- the unwillingness of a landowner to sell or establish a biobank site;
- the cost of an offset site itself should not be a factor unless it can be demonstrated the landowner is charging significantly above market rates.

It appears Santos has not taken these steps and has just relied on existing mapping products held by the NSW Government to provide an overall assessment of the extent of native vegetation on private lands. This has not provided any level of desired certainty that the required extents of vegetation types are actually available.

Coupled with this, there is a recognised level of inaccuracy in the state-wide Plant Community Type mapping (John Benson, pers. comm.). Offset strategies in past practice required some ground-truthing or verification of sites in order to verify desktop assessments. This approach is still necessary under the FBA and NSW Offset Policy under which this Project is submitted for approval.

Certainty has been further undermined by allowing Santos to claim a reduced footprint in the Assessment Report. *In doing so, DPIE has accepted that it cannot have any definite knowledge of the extent of impact upon any ecosystem identified by Santos, if at all, nor the feasibility of the offset strategy. This unique situation cannot be considered to be consistent with the NSW Offset Policy, which was constructed to promote achievable biodiversity outcomes.*

Many of the affected ecosystems have a distribution which is centred on the Pilliga and the surrounding remnants. Some, such as endangered Brigalow and Fuzzy Box or riparian communities, would certainly present availability issues due to their limited distribution in the region. Santos admits the feasibility of the strategy is unclear in its Offset Strategy (p. 18).

Santos is proposing to clear up to 45 ha of Brigalow woodland and 'derived grassland' requiring an offset in the order of some 350-400 ha if current guidelines on offset ratios are to be accepted.

But as the scientific determination (https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2000-2003/brigalow-belt-south-nandewar-darling-riverine-plains-endangered-ecological-community-listing) for this ecological community emphasises, " … *vegetation mapping of the northern wheatbelt has found that only 13,500 hectares remains of this community and that it is severely fragmented (D. Sivertsen & L. Metcalfe, pers. comm.)*".

Surviving Brigalow patches are usually small and linear along roadsides and the edges of paddocks where threats include ongoing logging for fence posts; road widening and invasion by weeds. Brigalow is poorly reserved; the 'Brigalow Park Nature Reserve', of 202 hectares, is the only patch of Brigalow with protection from mining and gas.

Judging by current status of this community, it is apparent that this quantity of Brigalow would be very difficult to find, and certainly does not exist in in the form of large remnants, the Brigalow Park reserves being the largest in NSW. Other patches may exist in Queensland, outside the NSW Offset Policy guidelines.

5.3 Species credits

Santos is required to retire 1.525 million species credits for the Project including:

- Various flora species – 30,000 individuals – approx. 1 million credits
- Black-striped wallaby (Endangered) – 989 ha of impact - 30,455 credits
- Eastern pygmy possum (Vulnerable) - 775 ha of impact - 17,950 credits
- Squirrel glider (Vulnerable) – 862 ha of impact - 21,952 credits
- Koala (Vulnerable) – 989 ha of impact - 30,454 credits

There is no clear way described in the EIS, the Response to Submissions or in the Assessment Report by the DPIE as to how these fauna species credits may be retired except by using 'habitat surrogates'. For the flora species, nearly all have the Pilliga and surrounding brigalow forests as their stronghold, with the Spiny Peppercress *Lepidium aschersonii*, which may suffer the loss of over 50,000 individuals, virtually restricted to small brigalow remnants and adjacent areas of the Pilliga in the Project Area.

There are some key issues with this approach:

1. Offsetting land with potentially suitable habitat but where the species is absent is not directly helping that species.

2. As the DPIE confirmed, conducting surveys to establish baseline information is not offsetting any species impact.

3. The proposed gas field would be impacting a core area of habitat for many of these restricted and cryptic, threatened species. In my opinion there is just no offset of equitable value to the largest vegetation remnant on the north west. Species such as the Pilliga Eastern Pygmy-possum, the Spiny Peppercress, Pilliga Mouse and the Black-striped Wallaby are more or less confined to the Pilliga Forest and the public lands within the immediate vicinity. No public lands are available for offset under the NSW Offset Policy.

4. Santos has indicated that it could attempt some translocation of flora species, species for which such measures have not been attempted.

The DPIE said offsets could be found that are consistent with the NSW Project Offset Policy, however the DPIE's comments are referring to 'ecosystem credits' and no statement has been made specifically in relation to 'species credits'. *To claim species credits will be successfully retired would require some indication of how this is to be achieved. Failure by the Department to do so in the recommended Conditions of Consent indicates this question has not been resolved.*

6. Survey limitations

The EIS suffered from what appeared to be a lack of survey success for a number of key threatened species that occur in the Project Area. EcoLogical, the consultants who carried out Santos' ecological field work, surveyed according to recommended minimum requirements yet significantly under-reported several threatened species which occur in the Project Area. In addition, references regarding habitat preferences on key species were not adequately canvassed in the scientific literature. The combination of these issues has resulted in poor habitat and impact assessments in the Narrabri Gas Project EIS, which have persisted in the Assessment Report and recommended Conditions of Consent and have inhibited a more accurate assessment of their impact and offset requirements.

6.1 Pilliga Mice, Pygmy-possums and Black-striped Wallabies

Santos undertook two fauna survey periods to meet the requirements of the survey guidelines in 2011 and then again 2014. This was undertaken across different seasons and weather conditions. At the same time of the 2011 survey a Community Biodiversity Survey was organised within the Study Area (Landmark and TWS 2012) containing several wildlife experts with expertise in the Pilliga. The latter survey was conducted over one week in September and captured 24 Pilliga Mice and more Pygmy possums than the more extensive Santos surveys.

While direct comparisons are difficult given the different timeframes and intensities of the surveys, it would seem the general survey methodologies used by EcoLogical were inadequate to account for key cryptic and rare species. To exacerbate this problem, consultants EcoLogical did not ensure that a credible literature review of these species was undertaken.

As a result, the habitat preferences of these 'species credit' species are poorly defined in the EIS, making it difficult to predict impacts during site selection processes. In relation to the Black-striped Wallaby, Santos' consultants have lumped all habitats in the study area as being equally suitable, according to the offset liability, however no assessment of habitat preferences taking into account the scientific literature or movement patterns in the forest was undertaken for the EIS.

For the Eastern Pygmy-possum, the few records from Santos' ecological study and others captured during the Community Biodiversity Survey (Landmark and TWS 2012) suggest a different habitat preference to that described in the literature. While EcoLogical identified some potential resources for this species, no consideration has been given to the distribution or habitat preferences of the Pygmy-possum in the Project Area.

In relation to the Pilliga Mouse, Broombush *Melaleuca uncinata* habitats were not sampled adequately and so did not feature in the proponent's habitat model for this species. However, a check of the scientific literature (Paull 2009; Paull et al. 2014) would have shown this is a preferred type for this species and should have been identified as being so in the model.

6.2 Koala survey and assessment issues

In their general fauna surveys, Santos included the Koala in their survey design in a way consistent with the FBA Methodology. However, despite being a 'species credit' species, and given the critical state for local Koala populations in the Pilliga, Santos did not take due care to maximise detection for this species in its targeted survey (Niche 2014). This targeted survey actually spent little time in the Project Area (<10%) and focussed on the Baradine and Etoo Creeks where a thorough survey was undertaken. It is worth noting that this part of the Pilliga is regarded as the stronghold for the Koala in the Pilliga, and certainly has the highest density of historic records (BioNet 2018). However, despite the targeting of this area, only 14 animals were detected (Niche 2014) suggesting numbers of Koalas in the Pilliga were critically low in 2014.

As pointed out in the submissions from OEH, there were concerns that the survey in the Project Area did not include all habitat types selected by the Koala, particularly the Pilliga Box woodlands in the north of the forest. This species of tree is identified in the scientific literature as being important for the Pilliga Koalas (Kavanagh et al, 2007). Santos has still not acknowledged this, relying on the former *Statement Environmental Planning Policy No 44 - Koala Habitat Protection* (SEPP 44) to guide their determination of which tree species should be considered primary and secondary Koala feed trees. Using this old guide, which does not contain Pilliga Box (the new Koala SEPP does include this as a preferred species), cannot substitute for checking the existing scientific literature.

Despite this lack of targeted effort, Santos claimed there were no Koalas in the Project Area. Niche (2014) also stated that the habitat in the "… *development site is not considered to provide refuge habitat in times of contraction*".

Subsequent observations have challenged this contention. A koala survey detailed in a submission by Upper Mooki Landcare Inc identified one individual within the Narrabri Gas Project Area in November 2016 (Ethical Ecology 2016). Another detection dog survey conducted by OSWALD (2016) also detected scats only several months old in the Project Area (see reports attached). Koalas have been reported in the north of the forest in recent surveys by the Australian Wildlife Conservancy between 2016 and 2018 (Rod Kavanagh pers. comm.) and just to the east of the forest and along the forest edges at Willala (Sue Donaldson, pers. comm.) where sightings have been made this year. Santos' consultants however did not attempt to sample in these areas and have not attempted any further work on this species since 2014.

I made a statement at the recent NSW Upper House Koala Inquiry on the probability that the Pilliga Koalas may have declined to such an extent, and with severe drought conditions at the time, that they could be 'unviable'. However, as I have outlined, rather than teetering on extinction, recent observations show there are likely to be small populations immediately to the west and east of the Project Area, as well as others in other parts of the Pilliga (see update provided to the NSW Koala Inquiry Commission, appended to this report).

With the above-average wet conditions thus far in 2020, there is renewed hope of some recovery of numbers and possibly a return to known, historic areas of occupation, including within the Project Area.

While OEH recommendations regarding the proposed Koala Management Plan attempt to deal with these issues by requiring a baseline be established, questions about the current status of the Koala in the Project Area and just how the species credits for this threatened marsupial are to be 'retired' remain unanswered.

Given Santos' poor habitat assessment conducted for the Koala in their EIS and the current presence of individuals adjacent to the Project Area, Santos' claims that there is no refuge habitat or indeed Koalas in the Project Area are not substantiated.

6.3 Five-clawed Worm-skink.

This endangered species is typically found on the northern floodplains of the western slopes and has been severely affected by land clearing. Due to the close proximity of records, OEH decided this was a species for 'further consideration' under the FBA methodology. This is a species which is deemed to be potentially at risk of extinction should threatening processes proceed, equivalent to the concept of a matter which may suffer 'serious or irreversible harm' under existing legislation. For the worm-skink, this would entail clearing of vegetation and ground habitat, a key threatening process in NSW.

However, Santos did not give this skink further consideration (which would usually entail specific targeted surveys) due to their contention that the skink's habitat was *absent* in the Project Area due to the absence of 'cracking clays', to which this species was apparently restricted.

However, this is not the case, due to the following reasons:

1. A Five-clawed Worm-skink was found just to the north east of the Project Area (BioNet Atlas record) on soils which were not cracking clays, but on the edge of the alluvial black soil zone which extends to the forest itself. This specimen was confirmed as it was handed to OEH in Dubbo.

2. Data on this species in fact suggest the limiting factor is not cracking clays (it does not live in cracks). Rather, it is found on a variety of 'black' or alluvial soils in paddocks usually with scattered trees and logs and is found in a number of different vegetation communities. It is generally detected sheltering under fallen logs and wood debris (P. Spark, pers. comm.). An accurate habitat description is given in the Government's threatened species website. https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10055

3. EcoLogical undertook routine herpetological surveys across the Project Area so that minimum requirements under the FBA were met. Even though no special effort was allocated to finding worm-skinks, the herpetological survey section of the Terrestrial Ecological report (NGP EIS, Appendix J1) remarked that several sites were in fact suitable for this species, contradicting assertions made in Santos' summaries and in DPIE's Assessment Report.

It seems this is yet another species overlooked by Santos. Even though Santos was notified it must give it 'further consideration', Santos clearly failed in its statutory obligation to do so. Under the NSW Offset Strategy, 'matters for further consideration' require additional consideration by the determining authority before any offset strategy can be finalised. The consent authority also has the options to make any of the following recommendations:

- *the project cannot proceed with that particular impact in place;*
- *the project will need to be modified to reduce the impact before it can proceed;*
- *the project can proceed with additional offsets, supplementary measures or other actions to be undertaken to mitigate the impact.*

Figure 8: Anomalopus mackayi | Dalby area, QLD |@ Anders Zimny | Flickr

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8. Attachment 1: Letter to NSW Legislative Assembly Portfolio Committee No. 7

29 July 2020
David Paull
Po Box 67, Coonabarabran
NSW 2357

Cate Faehrmann
Chair
Portfolio Committee No. 7 – Planning and Environment.
Koala populations and habitat in New South Wales
New South Wales Parliament. Legislative Council.

RE: New Information regarding current status of Pilliga Koalas.

Hello Cate,

I wish to provide an update to the Committee on the status of Koalas in the Pilliga. Good conditions this year has seen a spike in the number of records from landowners and carers from around the Pilliga forest. These are detailed below.

At the Gunnedah hearing I made the following comment:

From 1.15 *- "I was unfortunately witness to the decline of the Pilliga population, once one of the largest populations in the State. Numbers vary about how big that was and now it is probably, I would say, a completely unviable population. Populations out here are not only highly exposed to land clearing and habitat change but also to climate change and the lax restrictions in terms of vegetation management on private lands."*

It was generally accepted that Koala numbers were very low across its historic distribution in the Pilliga in the period 2013-2016 (Lunney et al 2017). The 2017-19 period then saw a quite severe drought across NSW which had severe impacts on vegetation and water availability in the Pilliga forests. This further highlighted concerns for the future of the Pilliga Koalas.

However, 2020 has been very wet, with over 600 mm falling in the first six months of the year across the forest and sightings of Koalas have increased. This has renewed hopes that there could be some recovery in the numbers in the Pilliga.

There appears to be evidence of three or four small populations, of unknown status but appearing healthy, across the forest.

One population in the southern sections of the Nature Reserve and surrounding private lands appears to be stable, with a number of sightings throughout the drought. Two were bought into care due to burn injuries from a bushfire in the Dandry area in December 2019. These have recovered, thanks to local carer, Sue Brookhouse. Sue has been keeping Koala records of sightings from the Coonabarabran area and these animals are likely be part of the wider Castlereagh/Warrumbungle population, partially displaced by the Warrumbungle NP fires of 2012.

Others and myself have recently seen Koalas around Baradine, near the centre for the forest area. This has always been a stronghold for this species with animals once spread up and down the fertile Baradine and Etoo Creek areas. Current status of this population is uncertain.

There have been scattered reports of Koalas in the northern section of the forest, with a record from Bundock Creek which I reported from surveys I undertook in November 2016, and others recorded in surveys conducted by the Australian Wildlife Conservancy between 2016-2019 in the area of Pilliga National Park. This region of the forest has large areas of heavier soils associated with wetlands and box forest and offer one of the best refuges for Koalas in the Pilliga.

The last known area where Koalas have been seen active in the last year is on private and public land just to the east of East Pilliga boundary. They have been sighted recently from a state forest called Kerringle in the south to the Willala area to the north. Local landowners, Sue and Malcolm Donaldson and other landowners have seen Koalas an several occasions throughout the last six months on private land and suspect they are also using the lands of the adjacent Pilliga forest, which provides suitable habitat including White Box.

Western NSW Koalas have suffered serious declines throughout their range. A key issue is lack of information on the status of many of these populations. There has not been a survey of the Pilliga forest for Koalas since ones I conducted in 2016, but there ***does need to be a concerted effort to undertake an urgent assessment of the current status and distribution of the Pilliga animals.***

Rather than being 'non-viable' there appears to be some hope of partial recovery if conditions continue to improve. However, numbers are still very low and the meta-population should be regarded as being 'endangered'.

I ask the committee take note of this update to the statement I made to the Committee in February.

I can supply the contact details of persons mentioned here, who have agreed to substantiate any statement made.

Thank you

David Paull

<u>Reference</u>

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LEFT: Recovering Pilliga Koala prior to release this year (courtesy Sue Brookhouse), RIGHT: One of several individuals seen at 'Willala' on eastern boundary of Pilliga Forest (courtesy Malcolm and Sue Donaldson).

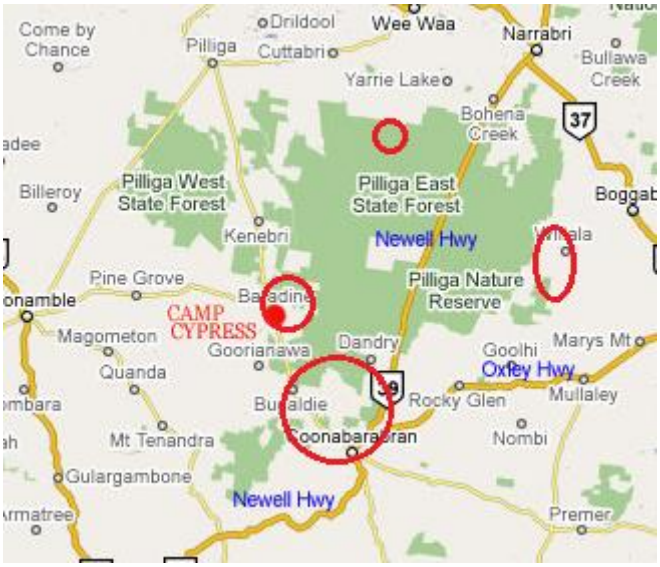

Figure showing approximate locations of individuals seen over last few years.

9. Attachment 2: Brief Resume.

In the 32 years I have been a professional ecologist, a great proportion has been spent researching the ecology of the fauna and ecosystems of the Pilliga region. My expertise regarding the wildlife of the Pilliga includes:

- Eight articles published in peer-reviewed scientific journals specifically about the wildlife of the Pilliga and the Brigalow Belt (attached).

- Organised, lead, analysed, and reported on the two largest biodiversity surveys conducted in the Pilliga prior to the work by Santos, by State Forests (1993-96) and the Western Regional Assessment (1999-00, Stage 1).
- Conducted considerable research into specific fauna species in the Pilliga, including Koala, and small mammals, undertaking a Research Master's degree on the ecology of the Pilliga Mouse and the Common Dunnart.
- Have conducted and participated in several community-based biodiversity surveys, including the monitoring of vegetation rehabilitation at gas well sites.
- An accredited Biobanking Assessor with the NSW Government (2008-16).

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