Pilliga Forest Cultural Values and Threats from Coal and Gas

MEHI CENTRE

MOREE ECOLOGICAL HOLISTIC INFORMATION CENTRE

BLANK INSIDE COVER

Contents

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Many thanks to all those who contributed to the content.

All photos by D.C. Paull unless otherwise stated.

Photos from cover page:
Top: Grasstrees, *Xanthorrhea acaulis*.
Bottom-left: *Indigophora australis* – common medicinal plant in the Pilliga.
Bottom-centre: Berries from Peach Heath *Lissanthe strigosa*.
Bottom right: Fruits and foliage of *Pittosporum angustifolium* 'Gumbi Gumbi'.

Our Forest

This report is dedicated to the traditional owners, elders and knowledge holders, past, present and future, and recognizes their long and ongoing custodianship with the Country known as the Pilliga, its land and waters.

The Pilliga forest is a place of powerful cultural significance, reminding us of the Dreamtime legend of the HairyMan. He has lived and survived in the Pilliga since time immemorial. The Pilliga is sacred land to the Gomeroi and Wailwan people, providing an abundance of foods, medicines and ochre and a great variety of useful resources in the rocks, plants and water.

'The HairyMan' by Victor Wright

The forest today is a pivotal link to our spiritual beliefs and our connection to Country, strengthened by songlines and stories, waiting and calling us back to Country to reawaken as a people through the resurgence and urgency of oral histories and protection of Country.

The ecosystem of the Pilliga replenishes the forest flora and fauna and cleans the water that fills our natural springs. For the Gomeroi, its primary job is to give and sustain life. Gomeroi are the custodians of the recharge waters for the Great Artesian Basin, the most important underground storage in Australia. Mother Earth delegated this responsibility to us as she did by appointing the HairyMan as the protector and custodian of the forest.

The story of the HairyMan is legendary among the greater Gomeroi Dreamtime stories. There is an unspoken respect for the Pilliga that still exists today, to the point where most Gomeroi people hold profound reluctance about entering the forest unless it is for cultural reasons. Cultural protocol and practice for Gomeroi people is to only hunt and gather enough for family and to leave the HairyMan some food or else he'll follow you.

Gomeroi and Wailwan people utilised the properties and resources of the forest extensively. As this report shows it was a supermarket for bush foods and medicines, tools, weapons and ceremonies. Ochre is abundant as are materials for traditional economical purposes. Because the forest is so large, and past usage not thoroughly understood today, it has yet to reveal all its secrets to modern

Australia. The Pilliga forest has made its mark on the Australian psyche on the whole and is infamous to the Gomeroi people because it is the keeper of the legend of the HairyMan.

With the respect due to the Gomeroi people of the Pilliga, who for centuries, have personally witnessed the presence of the HairyMan, do not dismiss the almighty being who physically exists within the forest as its appointed keeper. Gomeroi people have always held him in high regard and do not underestimate his power and strength.

Our knowledge of the forest came in handy for the white settlers, many of whom partnered into local Gomeroi families living in the area, who are still traditional owners to this day. Families made a living, helping the pastoralists and the timber-getters, as they tried to find their way in a colonial society. Nothing has changed. The Pilliga is still and always will be a place of enormous cultural significance and deserves more respect than what it is given.

The lies don't work anymore. We are the original people on Country never ceded. The forest is calling, now the people are listening. It is time to claim back what is ours.

Stories and traditional knowledge of the Pilliga are well known across Gomeroi Country through many family stories. Here is a story Polly Cutmore tells about her family and traditional connections with the Pilliga.

"*In 1964, my Mother travelled to Dubbo with my Grandparents, Maude and Bengallah Wright and told us a story about what happened on the way home to Moree. It was late at night and my Grandfather's car broke down in the middle of the Pilliga. The car needed water and the water bottle was empty due to the numerous stops to refill the radiator. My Mother recounted that my Grandmother, who would've been 60 years or more, retrieved the jerry can and walked off into the scrub to find water. It was pitch black with darkness, a vivid memory my Mother recalled, as being a young Mother herself and pregnant with her third child, she was very scared, mostly because of the location and the time of night.*

Both my Father and Grandfather stayed behind while my Grandmother walked off into the scrub to find water. Not only did she return with a jerry can full of water but she also held a porcupine in her other hand … just in case they broke down again and needed a feed!

My Mother always remembered and retold the story with awe as she admitted to being amazed by the old woman's knowledge of Country. Nanny Wright was brought up as a keeper of traditional practices and my Mother witnessed, first hand, her exceptional ways of the bush."

1. Introduction

This report was commissioned by the Moree Ecological Holistic Information (MEHI) Centre to inform Gomeroi people of the significance of the Pilliga Forest, its history, ongoing cultural significance and current threats.

The first part of the report looks at the cultural values of the forest. It starts with a brief history outlining the local Gomeroi ties to Country, the colonial occupation and use of the forest that followed. The next chapters look at the cultural values of the landscapes, water, plants and animals that give the forest its unique character. Emphasis is placed on the diversity and uses of cultural plants found in the forest. A summary of the available archaeological evidence on the extent and types of pre-contact usage of the forest is then provided.

The second part of the report looks at the threats posed to the forest by coal seam gas and underground coal mining. Both Santos and Whitehaven are planning to make major expansions of operations in the forest which will have significant impacts on the water and both the natural and cultural environment.

Impacts on groundwater by both operations are likely to be substantial, in terms of both contamination and water table drawdown. Water is the basis of all life, and any further impacts on our stressed water resources must be viewed with great concern. Both coal and gas activities will have a surface impact over large areas of the forest, to the detriment of the local plants and animals. Many of these have significant cultural values, for food, clothing and medicines and for spiritual connection to country. The Pilliga forest is the most significant refuge for these resources in Gomeroi.

Access to Country and water will be restricted if these companies have their way and impacts to cultural sites and artefacts could also be substantial. Underground mining can crack surface rock formations, endangering cultural sites, such as grinding grooves. Santos did little to investigate the cultural heritage of their project area, preferring to put that off until operations started, and playing down the significance of the forest.

Our colonial governments can't seem to think of any use for the forest other than to dig it up or cut it down. They can no longer be trusted and only Gomeroi people stating their claim over these lands, putting on notice our desire to look after Country, according to traditional knowledge, will stop the exploitation and theft for future generations.

You can take action. *Tell your family and friends, your Land Council, Local Government, Members of Parliament, both state and federal, they must end the colonial rape of our Country*.

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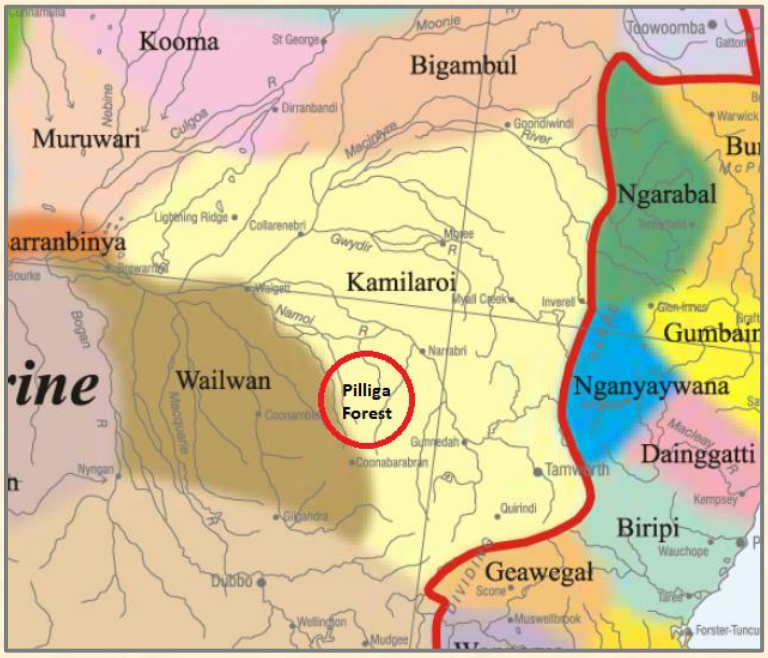
2. A brief history

The area known as the Pilliga Forest lies within the boundaries of two First Nations, the Gomeroi and the Wailwan nation to the west. While the precise location of 'nation' and clan-group boundaries today has become uncertain, usage of the forest is known in the oral histories of both nations and from the various clan-groups who have traditional links to the forest.

Location of Pilliga forest and First Nations



In this report we will refer to the First People as the Gomeroi Nation, respecting common use of the word, and will refer to the language spoken as Gamilaraay, acknowledging that differences in dialects, customs and resource use from Country to Country may have been substantial.

It is an indication of the importance of the forest for Gomeroi people that the term 'Pilliga' is thought to derive from the Gamilaraay word for spear, 'Bilaar'. This word is also similar to the Gamilaraay word for casuarina tree, 'Balaar' or as said today in common usage, 'Belah'. One species of oak tree, the Bull Oak *Allocasuarina leuhmanni* is widespread in the forest. The very dense wood and straight growth would have made ideal spears, as would a number of locally occurring wattle species. You will find Gamilaraay words used in this report in the Kamilaroi-Gamilaraay online dictionary: https://www.dnathan.com/language/gamilaraay/dictionary/GAMFL.HTM

We will deal with the traditional use of the forest and resources in more detail in later chapters. Evidence shows that our ancestors, the traditional and to some extent post-contact Gomeroi people valued the forest for tool manufacture, sources of ochre and food of many varieties as well as sites of

spiritual significance and initiation. Judging by the spread of artifacts in the forest, most of it was used in some form by First Nations people.

The impact of European settlement was a story of dispossession, murder and a breaking of the traditional lore over use of Country, and by the end of the 1830s, the Namoi, Castlereagh and many of the streams through the forest had been settled by pastoralists. One creek, Borah, was named after an initiation ground once found on land now private property. Other places where oral history identifies sites of ceremonial or spiritual significance include Salt Caves and Sandstone Caves.

Following European settlement and spread of the agriculturalists throughout Gomeroi Country, the New South Wales Government became aware of the timber value of the Pilliga forests and 'resumed' many of the original private runs that covered the area, for fear that the timber resource may be lost to over-zealous land-clearing. With the creation of the Forestry Commission in 1917, the Pilliga forests were made public lands. Prior to this timber reserves existed along the Namoi River, but the Pilliga lands were the first areas termed 'state forest' and managed as a public resource. Eventually public ownership covered the whole area we currently known as the Pilliga public forests, with some later additions.

The value of the Cypress Pine and Ironbark trees as timber opened up timber extraction in the forest for the next 100 years, only recently winding back with the mill closures in the 2000 to 2020 period. Work continues to be contracted out by Forestry Corporation. Since most of the older growth trees have been removed over this time, trees harvested now tend to be much smaller in size.

Despite colonial settlement, local Gomeroi families retain ties to Country and to the forest to this day. Since large areas of Country were reserved for forestry activities, local families played a significant role in working for the timber getters over the decades. The settlement of the forest and surrounds and some of the interactions with Gomeroi people are mentioned in Eric Rolls' (1981) history of the forest *A Million Wild Acres*. He recounts how some families established themselves around timber mills in the forest, such as Rocky Creek and Wooleybah Mills where they retained strong family ties. He relates the oral history of some of the workers from the mill at Wooleybah travelled to the hot water bore at 'Milchomi' for evening baths.

The Ruttleys derived their name from George Ruttley who settled on 'Arrarownie' on the Yaminbah and Borah Creeks in 1895. He also had a property on Rocky Creek but moved onto better soil on the old Coghill run, which was later abandoned. His sons, Syd, George, Bert and Arthur, lived and worked in the forest. Bert, in particular, spent his life with Gomeroi people, and was admired because of the traditional knowledge he had, though Rolls does not name his Gomeroi partner. Rolls recalls two sisters Maud and Ruby Ruttley, who, like other young Gomeroi women, often spent their time as housekeepers and nannies for the local landowers, while the men worked with timber. A descendent,

Uncle Sid Ruttley was a well-known forest identity, remembered today with a memorial campsite in the forest. Today, Ruttleys still live and work around the forest.

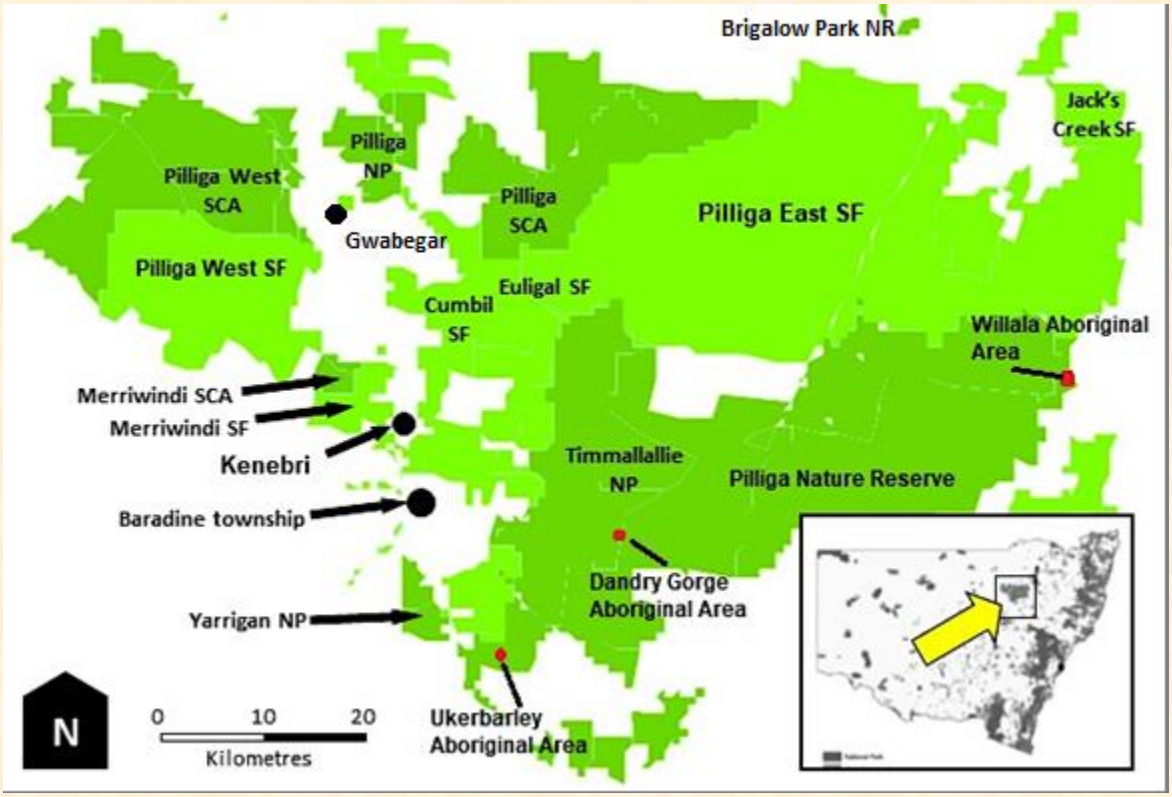
Ruttley family in Pilliga Forest (courtesy of H. Norman, 'Remembering and Remedying')

The Trindalls take their name from a family who settled Brigalow Creek around the turn of the 20th century, built a hotel and turned to sheep and timber, where they employed local Gomeroi families. One notable Gomeroi man, Billy Green, worked for the Trindalls for 40 years and was a famous character of the Pilliga bush, according to Rolls (1981). Bob Trindall, along with his brothers, whose father built the hotel at Cuttabri had Gomeroi partners and married into local Gomeroi families. These families worked in the forest throughout the 20th century. Today a descendent and traditional owner, Uncle Daniel Trindall, is remembered at 'Dan's Camp'. He lived and worked in the Pilliga, and later brought young men and boys to the camp on traditional business. Today the Trindalls, like the Ruttleys, still live in the area and maintain their connections to Country. Both families have been closely associated since colonial settlement. Ruttleys worked at the Trindall Mill and both families are almost certainly from the same clan-group, along with many others with English names and in various towns in the community today, the traditional owners of the Pilliga forest.

Many parts of the forest were changed significantly from this history of timber removal, particularly by the loss of the larger trees, with over 80% of old ironbarks and cypress pine trees removed over large areas of forest (SFNSW 2000). Much of the regrowth through the forest today should be understood as a response by the forest to this loss of biomatter. Many areas of forest which did not have good timber have remained relatively intact, fire being the main habitat modifier in these areas.

The Pilliga Nature Reserve was dedicated in the 1950s as one of the first reserves in New South Wales, in recognition of its biodiversity and its value as a natural asset to the state. This area covers some 60,000 hectares and is, today, a little larger due to recent additions.

Current land tenure in the Pilliga Forest (based on image by Matthew Mo).



The Western Regional Assessment for the Brigalow Belt and Nandewar bioregions (1999 - 2002) saw major changes to the land management and tenure within the forest. Conducted by the NSW Government with oversight by the Commonwealth Resources Commission, it saw the creation of over 200,000 hectares of reserve estate, some national park, and some Aboriginal Areas but dominated by what is known as 'state conservation area', all under the jurisdiction of the *National Parks and Wildlife Act 1974*. State Conservation Areas have a dual role of providing conservation protection for ecosystems, while allowing mining and gas exploration activities, like state forests. State forest still covers over 200,000 hectares of the Pilliga, with another roughly 100,000 hectares of native vegetation found on adjacent private lands.

The resulting legislation from the Western Regional Assessment created the establishment of three Aboriginal Management Areas, Ukerbarley, Dandry Gorge and Willala, reserved in 2005 under the *Brigalow and Nandewar Community Conservation Area Act 2005*, because of their significant Aboriginal cultural heritage values. These areas are given the same protection as a nature reserve, prohibiting any mining activities. The Management Plan for the Willala Reserve (2005) clearly states:

"*The reserve is managed under a memorandum of understanding with the Gawambaraay Pilliga Co-management Committee. The committee includes Elders and representatives from Baradine, Coonabarabran, Gunnedah, Gwabegar, Narrabri and Pilliga Aboriginal communities."*

"The reserve contains a range of Aboriginal sites, including etchings, hand stencils, ochre quarries, grinding grooves and stone artefact scatters that are of significance to local Aboriginal communities."

This management plan now includes Dandry Gorge Aboriginal Area. A plan for Ukerbarley Aboriginal Area has not yet been prepared.

The recent transfers of large areas of forest to the national parks estate has seen timber removal cease in those parts of the forest for the first time in 100 years, allowing the recovery of the forest communities. Much of the forest today is in a regrowth state, with a mixed canopy of large and small trees. The biggest threat now to the health of the forest is from mining and gas extraction activities. There are petroleum and minerals licenses across the Pilliga, with areas of forest currently being used for coal extraction by Whitehaven and for gas by Santos. Both companies are seeking to expand their operations.

Dandry Gorge (NPWS)

3. The land

Location and geology

To appreciate the unique ecological and spiritual value of the Country, we need to understand the geology and how the landscape formed over millennia.

The Pilliga Forest lies within the Brigalow Belt South Bioregion (BBSB) of New South Wales, lying in the region known as the North-West Slopes, abutting the plains to the West and Range Country to the east. The 'bioregion' contains broadly similar physical, catchment and biological properties. In this case, the distribution of characteristic plant species, such as Brigalow, cypress pine and ironbark are a dominant biological feature.

In terms of geology, the Pilliga Forest is underlain by ancient fractured crystalline rocks covered by sedimentary layers deposited during the Triassic and Jurassic periods, millions of years ago. These Mesozoic sediments that dominate the bioregion form the south-eastern extremity of the Great Artesian Basin (GAB). The Pilliga Sandstones are a major intake bed for the GAB in New South Wales.

Much later in the Miocene epoch the area was subjected to volcanic activity and subsequent movements of the earth's crust, covering much of the bioregion with lava flows. The two main volcanoes active at this time were Warrumbungle and Kaputar. The subsequent 13 million years of weathering reduced these vast flows to a few resistant volcanic formations – Liverpool Range, Warrumbungle Range and Nandewar Range and many small conical hills. This weathering of the basalt ranges has produced the rich alluvium which has become the fertile floodplains now used extensively for cropping.

Elevation within the Pilliga Forest ranges from the high points associated with the Warrumbungle Range in the south from 1100m above sea level to approximately 480m above sea level with north facing slopes of approximately 12 degrees. The majority of the bioregion is relatively flat, particularly the Pilliga Outwash province, and has a slope of 0-10 degrees. Hillier areas also exist to the north-east of the forest, associated with the lower slopes of Mount Kaputar.

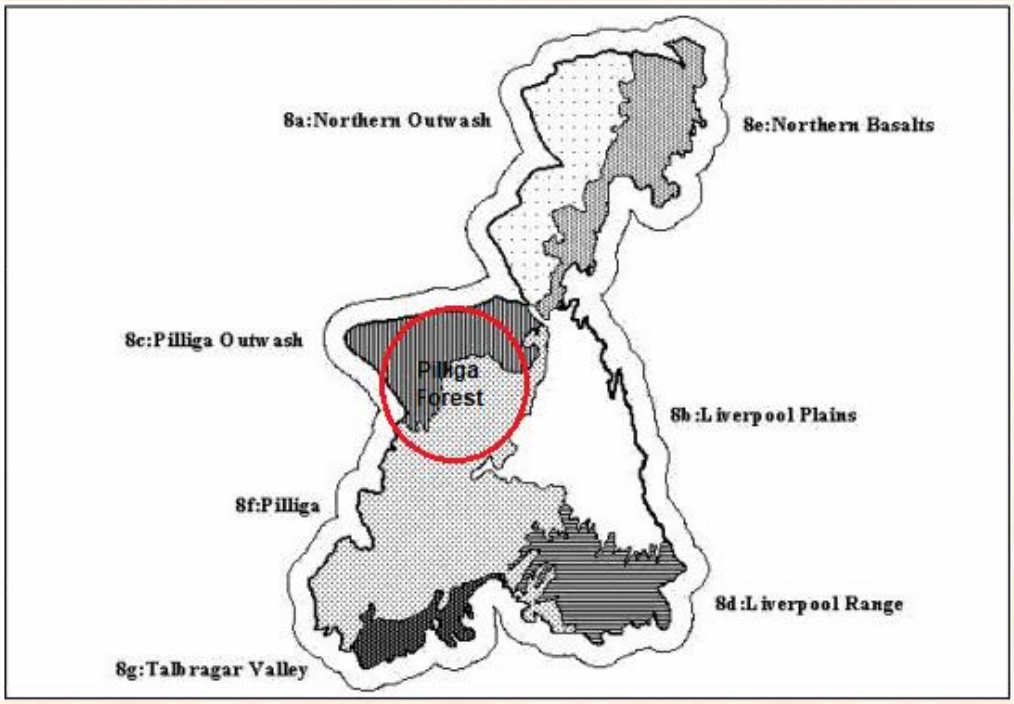
Land provinces

The Pilliga forest straddles two land 'provinces' (Morgan and Terrey 1992), with distinctive landscapes, distinctive water and food availability. These in turn would have affected traditional cultural use of the forest. The more eastern Pilliga Province is dominated by uplifted Mesozoic sandstone bedrock and the Pilliga Outwash Province is characterised by alluvial deposits, laid down over the millennia. Areas dominated by sandstone have relatively infertile soils and have tended to

retain their vegetation since settlement, while the lower volcanic flows areas to the north and east tend to be cleared.

These two quite distinct landforms supported different biological communities, hydrology and resources availability and would affect how First Nations people used these areas.

Land provinces in the Brigalow Belt South Bioregion (From NPWS 2002a)



Landforms of the Pilliga Outwash

The relatively flat Outwash province is mapped as being dominated by alluvium and alluvial terrace formations and can also be thought of as a series of intersecting alluvial fans formed by creeks draining from the Pilliga province towards the Namoi River.

The outwash has a gentle slope, which is still great enough to form a distinct boundary with the Namoi River floodplain and be above the level of inundation of that river. The Bohena Creek fan is identifiable because of the enormous area of 'Gilgai' (clay-pan depressions) formed on the alluvial surface. This was the largest area of continuous 'Gilgai' country observed in the bioregion. The 'Gilgai' form on the high points of the undulating landscape, while the low areas between are subject to overland flow from local runoff. The terrace of Baradine Creek also has substantial local runoff which joins the overflow from the creeks downstream of Gwabegar as the terrace becomes indistinct.

Between Baradine Creek and Coghill Creek and in the West Pilliga Forest the outwash surface has less overland flow and a more irregular surface formed by sand monkeys, claypans and small patches of

'Gilgai'. The sand monkeys are sand-filled ancient palaeo-channels (now raised above the level of the plain) which form a radiating pattern from each of the main creeks (Baradine, Etoo, Talluba, Coghill).

Landforms of the Pilliga Province

Except for the Warrumbungles which are volcanic, the landforms and soils of the Pilliga Sandstone Formation dominate the Pilliga Province area. In general, the relief is low, and soil-mantled slopes overwhelmingly dominate the surface. There are areas of high relief, such as the southern Pilliga forests and Warrumbungle foothills, where the valleys are deep and narrow. There are some distinct landform differences within the province depending on the rock type.

Within the Pilliga Sandstone geological formation there is a wide variety of rock type which has not been recognised in the geological mapping. The conspicuous sandstone and conglomerate beds of outcrop are only a part of the formation. There are extensive fine-grained sedimentary rocks (shales, or possibly lithic sandstones which weather to clay) and Jurassic volcanics which form both different soils and different landforms. The sandstone dominated areas tend to have narrow convex crests above colluvial footslopes and narrow alluvial valleys. Colluvial deposits are formed by weathered bedrock, without the influence of alluvial processes and are areas where useful rocks and ochres are found.

By contrast, the finer soils of the shales and basalts in higher relief of the Warrumbungles and Kaputar foothills have broader convex crests and longer, steeper slopes with very little colluvium to narrow valleys with small alluvial deposits. In lower relief areas, the shales and basalts form extensive gentle convex slopes, but with small areas of colluvium and alluvium. The landform units represented are common to both sandy and clayey areas, though the extents of each vary.

Pilliga West is flat country (courtesy M. Dahlem)

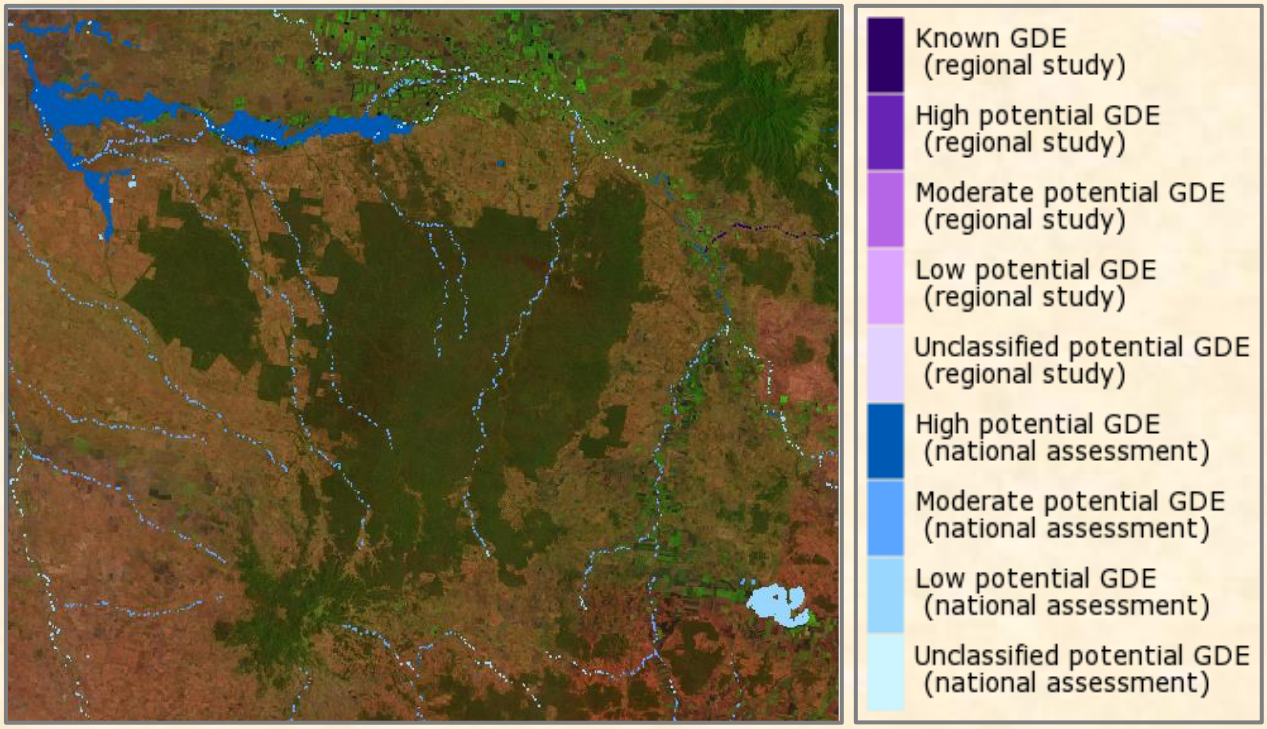
4. The water

Surface water systems

Water is the precious lifeblood for Gomeroi. Knowledge of water sources and the resources it provides, shape traditional life. The main river catchment which drains the Pilliga Forest is the Namoi River, with southern sections of the forest draining into the Castlereagh River catchment. What are known as the Warrumbungle and Garawilla ranges, which run west to east along the south of the forest, form a barrier for the two catchments.

The main streams feeding the Namoi are associated with the Bohena, Taluba, Etoo and Baradine Creek systems with several minor streams also flowing into the Namoi. These streams are generally dry and tend to flow following rainfall events. However, sources of groundwater discharge are present along the upper reaches of these sub-catchments, particularly in Yearinan, Dandry, Ukerbarley and Bohena Creeks. All of these streams have some groundwater influence as mapped in the Australian Groundwater Dependent Ecosystem Atlas and are associated with shallow alluvial aquifers.

Main streams and wetlands in the Pilliga GDE Atlas (Bureau of Metereology)



The Namoi River catchment covers by far the greatest area of the BBS bioregion (40%) and contains the largest number and area of identified wetlands of all catchments within the BBS.

The extent of wetland types in each of the two land provinces in the Pilliga are given below.

Pilliga Province	Pilliga Outwash province
Floodplain Wetlands 25 ha	Floodplain Wetlands 4,676 ha
Freshwater Lake (Old Harbour Lagoon) 132 ha	Freshwater Lake (Yarrie Lake) 61 ha
Reservoir 88 ha	Reservoir 260 ha
TOTAL 245 ha	TOTAL 4,998 ha

(From NPWS 2002a)

The large areas of floodplain wetland indicated above are those associated with the floodplain depression system to the north of the current forest, though wetlands occur in the north of the forest itself. These systems are also regarded as being 'moderately' groundwater dependent.

Other water features in the forest include a number of waterholes (below), located in claypans to the side of main streams. These are refuge areas not only for forest animals but also aquatic species such as freshwater mussels, an important source of food for Gomeroi people.

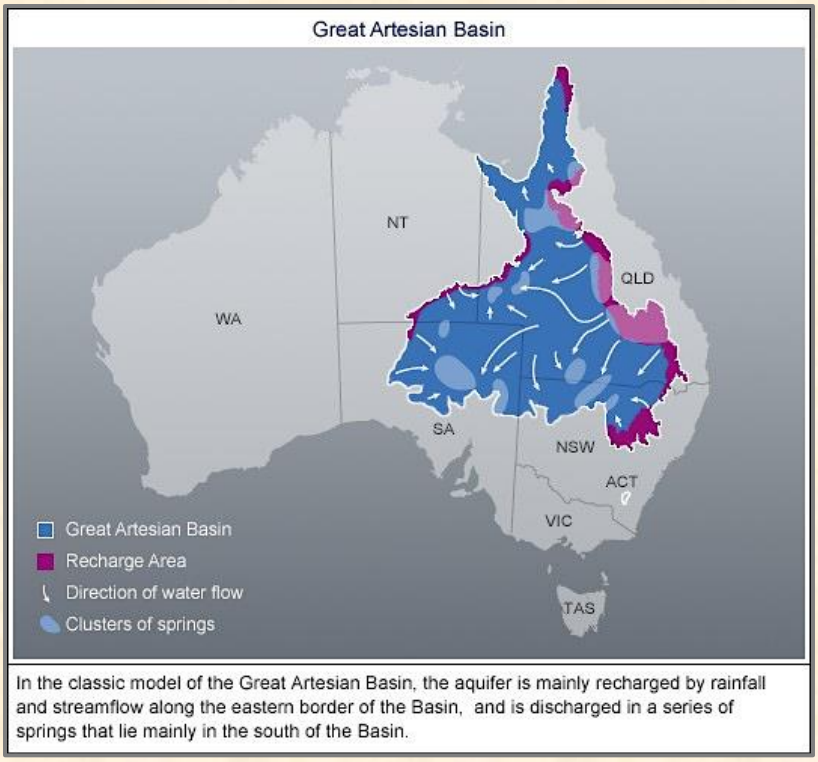
Left: Streamside clay-pan water hole. Right: Freshwater mussel.

Great Artesian Basin

The Great Artesian Basin (GAB), extends over approximately 1.7 million km^2 (or one fifth of the continent) and covers the majority of Queensland, and parts of the Northern Territory, South Australia and New South Wales.

The Pilliga Forest lies within the Surat Basin (a sub-basin of the GAB) in the south east of the GAB itself. The major aquifers of the GAB which fall within the Pilliga are the Upper and Lower Pilliga Sandstone Aquifers. Depth of sediments in the GAB within the majority of the BBS vary between 0 and 1,200 m, with outcropping of inflow sediments located along the Warrumbungle Range and north along the outcropping areas of the eastern Pilliga. Another important source of groundwater

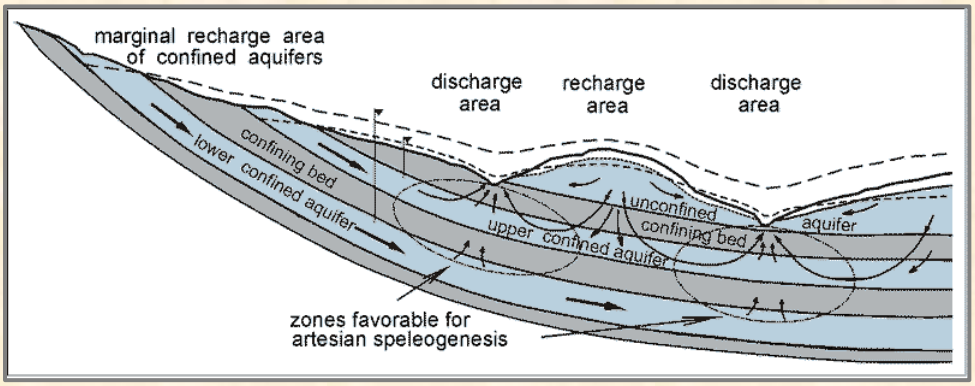
recharge is found within the Namoi alluvial sediments. Groundwater within the GAB flows from areas of higher topography towards lower areas to the west of the bioregion. A number of mound-springs are located to the north and west of the forest.



In the classic model of the Great Artesian Basin, the aquifer is mainly recharged by rainfall and streamflow along the eastern border of the Basin, and is discharged in a series of springs that lie mainly in the south of the Basin.

(From ABC Science)

The figure below is a fair representation of the Surat Basin recharge zone of the GAB. It shows the relationship between recharge and discharge areas, confined aquifers (Sandstone GAB layers), unconfined aquifers (alluvial surface layers) and the relationship between these. 'Speleogenesis' describes the process of the vertical inter-aquifer movement of water, despite the presence of 'confining beds' generally made of shales and claystone in this case (Kimchouk 2005). Key to this process is hydraulic pressure within the system. These are natural pathways which are susceptible to mining disturbance.

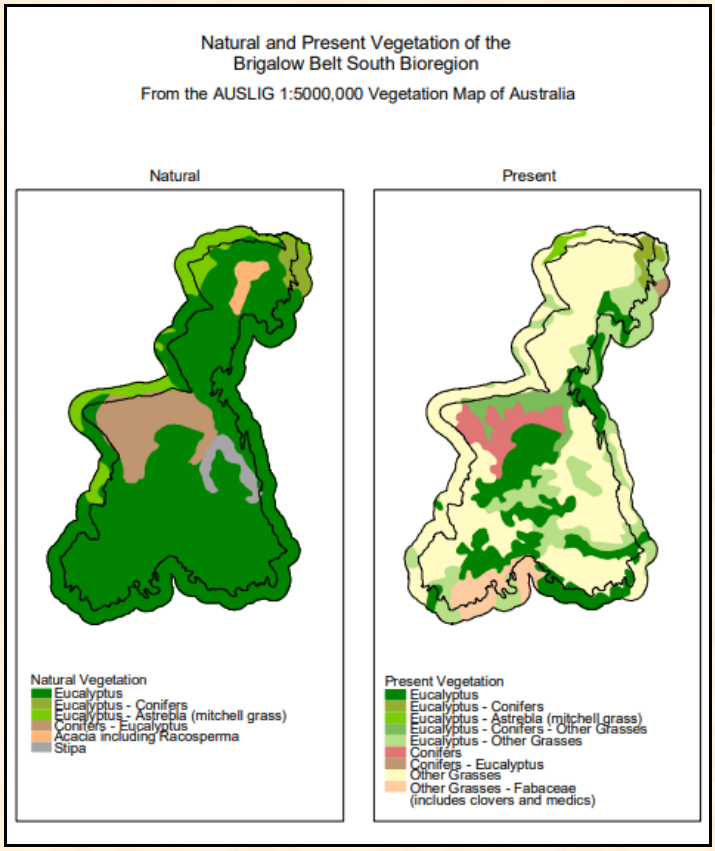


(from Kimchouk 2005)

5. Plant life

Changes since European settlement

The vegetation, its composition and distribution have changed considerably since colonial settlement of Gomeroi Country, mainly by a huge reduction in the extent of woody and grassland vegetation, and also by a change in the structure of the remaining vegetation.



(From NPWS 2002a)

The Australian Surveying and Land Information Group (AUSLIG) maps above show much of the Gomeroi Country within the BBS bioregion has lost much of its native vegetation since settlement, and has now mostly been developed for western agriculture, except for areas where there are rises in topography and the Pilliga forest. These are areas unwanted by European agriculturalists, with less favourable soils. In particular is the almost complete loss of large areas of native grassland and brigalow woodland, which remains today only in small, isolated patches.

Within areas that have remained covered with native vegetation, the mapping indicates that the quality of this vegetation has declined since settlement, particularly through the loss of understorey in the woodlands with better soils, leaving old eucalypts in what is known as ‘native canopy only’ ecosystems. The other major way remaining vegetation has changed is the loss of large eucalypts

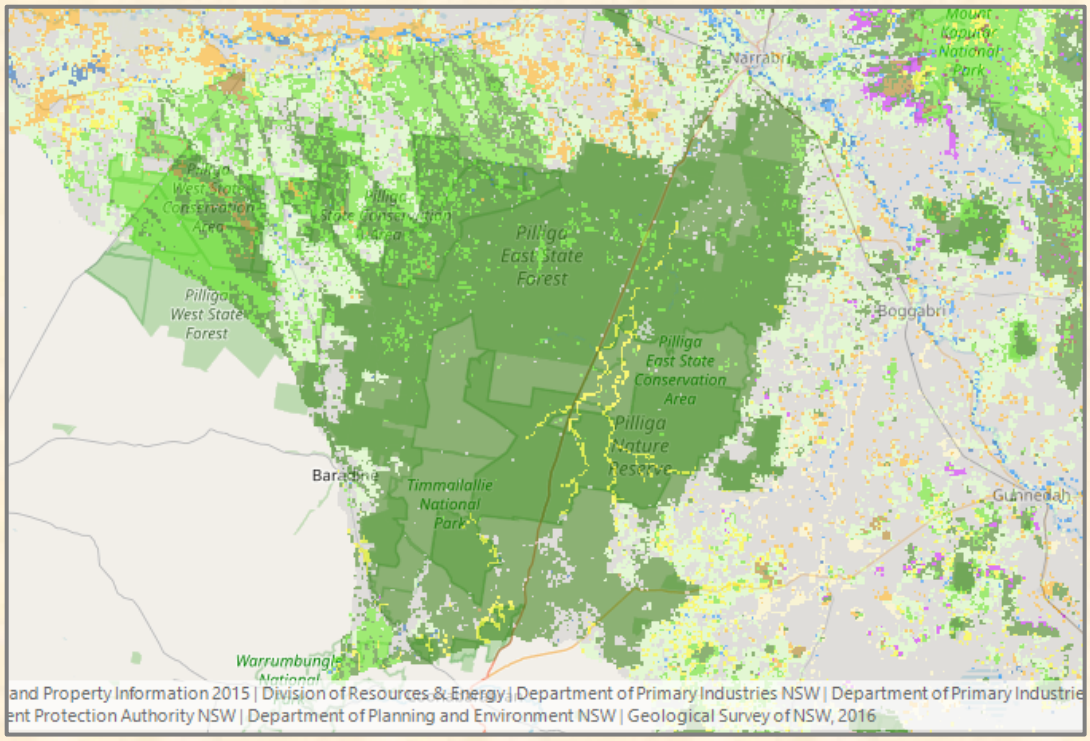
throughout the Pilliga forests, through forestry activities. This has left large areas of the forest dominated by many small-stemmed regrowth species like White Cypress Pine and Bull Oak.

Vegetation communities

Despite the land-clearing, logging and internal fragmentation of the forest, the Pilliga retains a high plant and ecosystem diversity to this day. Most of the vegetation boundaries within the forest have changed little since settlement, despite structural changes to the vegetation.

The vegetation of the Pilliga has been mapped and described by the NSW Government's SEED mapping and the Western Regional Assessment plant survey (NPWS 2002a). Current practice is to classify vegetation into 'classes' and 'types'. Classes reflect broad differences in the structure and landscape of vegetation, while Plant Community Types (PCTs) are distinct in terms of their plant species composition, though they may be structurally similar to other types.

Pilliga Vegetation (Keith) Classes



- Brigalow Clay Plain Woodlands
- North-west Alluvial Sand Woodlands
- Pilliga Outwash Dry Sclerophyll Forests
- Western Slopes Dry Sclerophyll Forests
- Western Slopes Grasslands
- Western Slopes Grassy Woodlands
- Eastern Riverine Forests
- Western Vine Thickets

Current mapping shows the Pilliga forest contains eight Vegetation Classes and over 50 Plant Community Types. Some of these types extend across the forest, such as the Narrow-leaf Ironbark –

White Pine – Bull Oak association, favoured by the timber industry, while others such as Green Mallee and wetlands, cover small, restricted areas.

Vegetation types in the Pilliga. Top left: Grassy box woodland. Top right: Shrub/grass ironbark forest. Bottom left: Melaleuca shrubland. Bottom right: Ridgetop shrubby bloodwood/ironbark forest.

Nine vegetation communities within the Pilliga forests are classified as being threatened in NSW under the *Biodiversity Conservation Act 2016*. These are listed in **Appendix 1**.

Plant species

A list of plant species from the Pilliga forest was obtained by conducting a search on the BioNet Atlas database, which holds records from a number of custodians. The searched area covers land around the boundary of the forest and so the list may include species from agricultural lands adjacent to the forest itself.

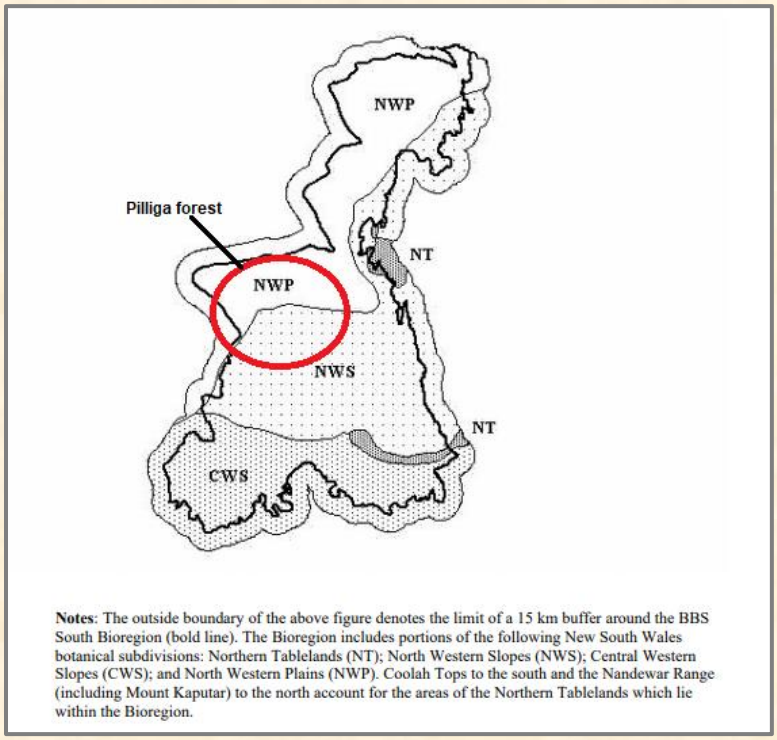
The search shows a list of 1513 plant species., including 257 exotic and 15 threatened species. A list of threatened flora and fauna is given in **Appendix 2**. Some families of plants are very diverse in the Pilliga, particularly *Asteracae* (daisies), *Chenopodiaceae* (salt-bushes), *Cyperacee* (sedges), *Fabaceae*

(native peas and wattles), *Myrtaceae* (eucalypts, paperbarks, tea-tree and bottle-brush) and *Poaceae* (grasses).

Many of the exotics picked up in the database search do not occur within the forest itself, particularly the crop pests. Weeds in the forest are generally in low abundance, mostly restricted to roadsides, disturbance sites and creek-lines.

Botanists have looked at the distribution of plant species and found broad patterns of similarity in terms of their distribution. These can be referred to as 'Botanical Divisions' as laid out by Harden (2000). The Pilliga straddles two such major divisions, the North West Slopes and the North West Plains.

Left: Botanical Divisions of the Brigalow Belt South bioregion (From NPWS 2002a); Right top: Pilliga Leek Orchid; Right bottom: Pilliga Wattle



Notes: The outside boundary of the above figure denotes the limit of a 15 km buffer around the BBS South Bioregion (bold line). The Bioregion includes portions of the following New South Wales botanical subdivisions: Northern Tablelands (NT); North Western Slopes (NWS); Central Western Slopes (CWS); and North Western Plains (NWP). Coolah Tops to the south and the Nandewar Range (including Mount Kaputar) to the north account for the areas of the Northern Tablelands which lie within the Bioregion.

This straddling of two biological zones helps explain the high plant diversity in the Pilliga Forests. There are at least three plant species with are restricted to the forest, the recently identified Pilliga Leek Orchid *Prasophyllum sp (Pilliga),* a Flax-Lilly *Dianella sp. aff. tarda 'Pilliga'* and the Pilliga Wattle *Acacia pilligaensis.* There is also a 'Pilliga Box' eucalypt, *Eucalyptus pilligaensis* though it is also found on the Liverpool Plains.

6. Important cultural plants

Sources

The Pilliga forest is a supermarket of tools, foods and medicines for Gomeroi people. Based on an examination of known information about bush foods and medicines throughout Australia, local knowledge and oral history, we have identified 274 plant species, varieties and sub-species of important cultural plants in the Pilliga Forest, or about 17% of all known plants in the forest. The cultural plant list was developed by constructing a 'big list' of known plant species, then checking records of possible useful species against botanical specimens found in the NSW PlantNet database to confirm presence.

The full list is presented in **Appendix 3**. Published sources used to identify the indigenous use of different plant species are detailed in the references. Possible useful species which are similar to other known cultural plants are included in this report. We have not included exotic species as the intention is to highlight the variety of useful indigenous plants as it was prior to colonisation.

A study of local bush foods and medicines was conducted as part of the Aboriginal Cultural assessment for the Western Regional Assessments (NPWS 2000b). Although a series of modelled maps predicting the likely regional location within the bioregion of some of these plant species has been produced, this information cannot be included as it is held by Narrabri Local Area Land Council under a confidentiality agreement with the NSW National Parks and Wildlife Service (NPWS).

Fruit and berries

75 species, sub-species or varieties of fleshy fruit or berry are known from the forest. One important family is the *Solanaceae*, or the nightshades, with a number of potentially useful species, including the Black-berry Nightshade, Potato-bush and Gooseberry. Most of these have a sweet palatable taste while some are bitter. Most are highly nutritious.

Other important groups include the mistletoe 'lolly-gobbles' (or 'baan' in Gamilaraay) and the heath berries of the family *Ericaceae*. The latter tend to have an autumn / winter fruiting period, complementing other fruits which are more available in spring and summer. Berries are considered small ('yawaar') to large ('gumi'), such as the widespread and high yielding heath, 'Five Corners' *Styphelia triflora*.

Fruits of Five Corners are green and fleshy

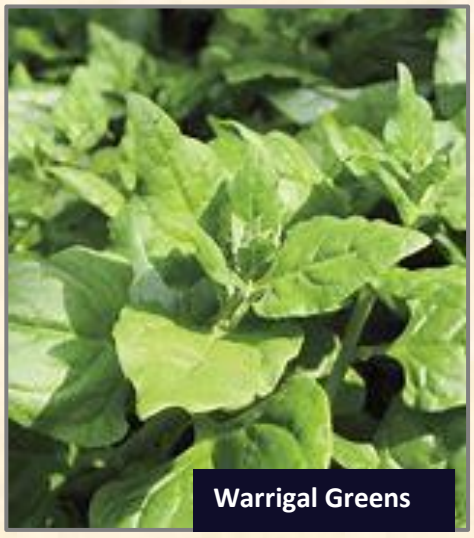
Other locally and seasonally important fruits include Quandong and Native Orange ('Bambul' in Gamilaraay), particularly on the western half of the forest, along with saltbushes and emu-bushes, the Native Olive and the blue-fruited, sweet Flax-lilies of the genus *Dianella,* common throughout the forest.

Roots and tubers

40 different likely root and tuber producing food species are known from the forest, nearly all of these have good verification from other sources. Important species for Gomeroi people are likely to have included the twining pea, *Glycine,* the Bracken Fern, the bulbous wild onion species *Bulbine*, the native carrots from the family *Apiaceae* and species from the family *Anthericaceae*, the Vanilla and Chocolate Lilies. The Wax-leaf Orchid *Glossodia* is the best of the orchids for edible roots.

Leaves and stems

There are only a few important green vegetables so far known from the Pilliga, particularly Warrigal Greens and the Native Wandering Jew species. One of these, *Commelina ensifolia* referred to as 'Scurvy Grass' by Europeans, was reportedly named because it was thought to prevented scurvy. All these plants could have provided valuable sources of Vitamin C as well as other minerals for Gomeroi people.


Warrigal Greens

Some species have nutritious portions of the lower leaf and stem including the Common Reed *Typha,* Bladey Grass *Imperatus* and the Mat-Rushes*, Gahnia* and *Lomandra* and were eaten extensively across New South Wales.

One well documented source of nutrition that is plentiful in the forest is the pith found at the base of grass tree stems *Xanthorrhea.* This nutritious substance could be eaten raw or cooked, when it takes on a delicious caramel flavour.

Seeds

There are a significant number (59 recorded species) of important seed providing plants for Gomeroi people in the forest. These were generally ground to produce a flour and cooked to make various types of cakes and breads. The three main types of seed which were used by Gomeroi people were wattles, grasses and the various 'Burrawang' cycad species.

Edible grass seeds were readily available and harvested, as recorded by Thomas Mitchell's notes from his expedition across the Namoi catchment, as recounted in *Dark Emu* by Bruce Pascoe (2018).

However, it seems that the large harvestable stands of these grasses naturally occurred on the heavier soils of the Gwydir and Liverpool Plains.

Three species harvested by First Nations people are known in around the Pilliga Forest. Two of these, Oat Grass *Themeda avenaceae* and Millet Grass *Panicum decompositum*, are not forest species and have been recorded in open areas surrounding the forest. The other, Kangaroo Grass *Themeda triandra* is a species which grows on a variety of soils and is common throughout the Pilliga forest. Other species of *Panicum* recorded in the forest could also be harvested for their seed.

Other species of grass are also known to produce good seed and are more restricted to wetter areas and alluvial soils, including Swamp Millet *Isachne globosa* and the native sorghum species, *Sorghum*.

Wattle *Acacia* are a diverse group of plants in the Pilliga forest producing large amounts of seed which can be eaten raw or processed and cooked to produce cakes. There are over 50 species of wattle from the Pilliga Forest and surrounds, and all are potentially useful. Small and prickly species have been excluded from the bush food list in **Appendix 2** and the 37 species which are large and capable of producing large amounts of seed are identified as being good bush foods here.


Wattle seed

Nardoo *Marsilea* (or 'Phaaduu') found in the forest, is a creeping fern particularly liking lower lying clay pans and box woodlands throughout the forest and adjacent country. When available, the sporocarp seed heads were gathered off the lower branches in great quantities by Gomeroi people.

Another important seed or nut widely used across Australia, and present in the Pilliga in a variety species, is the 'Burrawang' cycad, *Macrozamia.* The female cones can produce large amounts of carbohydrate though they must be processed first before eating to remove toxicity of the active ingredient *Macrozamin*. This generally involved a process of crushing, cooking and leaching in water. The raw nuts were sometimes used to poison waterholes to stun fish in some parts of Australia.


Banksia marginata

Nectar and sap

A number of plants produce large amounts of nectar and sap which can provide a nutritious sugary drink. *Myrtaceae*

are good nectar producers, particularly Bottle-Brush, Banksia and some trees like Scrub Apple *Angophora* and Bloodwood *Corymbia* also have luxurious flower growth. The two trees are also good producers of sap exuded from the trunks, a favourite food of the local possums. This sap is also a source of 'kino' used for tanning.

Medicines

First Nations people have drawn on a large number of plants for their medicinal properties, generally with some preparation. Plant material is very often bruised or pounded to use as a poultice or extracted with water to be taken internally, used as wash. Australian plants are particularly rich in aromatic species such as eucalyptus, tea-trees, boronias and mints, and these have always been considered especially suitable for treating respiratory diseases. The Australian bush is also well served with many alkaloid-rich species, the potential uses for some are still being investigated by western medicine.

Some 83 plant species and sub-species known from the Pilliga forest are known to have or may have active ingredients that have a therapeutic or a medicinal value. A number of species known to be toxic to stock are included as they may contain useful active ingredients, yet to be discovered.

One of the key groups for bush medicine are *Myrtaceae*, as the essential oils of this group have known antiseptic qualities. Today, Eucalyptus oil has been thoroughly commercialized, mostly found in lollies, mouthwash and used for aromatic purposes more so than strictly medicinally, but it continues to be used in traditional ways – as natural pain relief and for fever reduction. Eucalyptus has proven antibacterial and analgesic properties, and can therefore treat colds and respiratory problems, joint and muscle pain, and help with dental health, fungal infections and wounds. The scent is also a good natural insect repellent.

Some paper bark species (*Melaleuca*) in the Pilliga and most tea tree (*Leptospermum)*, grow in sand or clay around creeks, swampy and seasonally wet areas and are used in variety of traditional ways. The essential oil is one of the most widely known natural antiseptics in the world, being used as a mainstream pharmaceutical, consistently since the 1920s. Its oil is a widely-used, safe and effective antiseptic, with proven antimicrobial properties (anti-bacterial, anti-fungal and anti-viral). A recent study revealed that the anti-viral agents in Australian tea tree oil is a promising combative to recurring herpes. It is also an effective skincare treatment for blemishes and acne-prone skin. Hansen and


Tea-tree *Leptospermum polygalifolium*

Harsfall (2016) note in their handbook, *Noongar Bush Medicine*, that traditionally, the leaves and bark of tea tree were crushed and the vapour inhaled to treat headaches. It was also brewed as a tea for throat ailments and to relieve colds and was applied externally to wounds and superficial injuries.

The family *Rutaceae* contains the aromatic species of *Boronia,* a large Australian genus and common in the forest, whose plants have oil glands with highly fragrant flowers and are used in commercial oil and perfume production. Native Sandalwood *Santalum lanceolatum* also has strong perfume properties. The Wilga, another *Rutaceae*, also has aromatic leaves, and the leaves were reportedly chewed to alleviate tooth-ache. The black berries could be eaten.

Another widely distributed medicinal plant present in the forest, found in a number of varieties in the forest, is the Sticky Hopbush, *Dodonaea viscosa.* It is reported that this plant's leathery leaves could be boiled and applied to relieve ear-ache. It is also reported to be smoked and chewed for other pain relief and cleansing purposes. Native Tobacco *Nicotiana* was also often chewed with a catalytic agent (often acacia ash) for a social and calming effect (Symon 2005).

Other medicinal plants are found across a wide variety of plant families and have a wide variety of uses. Examples include, nettles *Urtica* (for paralysis), the Red Ash tree (soap), dock *Rumella* (insecticide), Lemon-scented Grass *Cymbopogon* (for fever and diarrhoea), native mint *Mentha* (insecticide), Emu-Bush *Eremophila* sp. (antibiotic), Fig *Ficus* (for itching) are examples.

Appearance of the outer bark of Quinine Tree

Two species regarded highly by Gomeroi people for their medicinal qualities are 'Gumbi Gumbi' *Pittosporum angustifolium* and Quinine Tree *Alstonia constricta*. Both are found in the Pilliga Forest, though not common. 'Gumbi Gumbi' has long been recognized as having anti-microbial properties. A recent study (Phan et al. 2020) found that saponins and polyphenols were the main bioactive compounds in the leaves with up to 4% per dry weight. The extracts of *P. angustifolium* leaves and stems showed strong antioxidant and antimicrobial activities, especially against *Candida albicans*. Traditional usage reports it as being used for a range of purposes, from the treatment of coughs and colds to eczema, milk let-down, cancers, as well as a combative for digestive disorders, chronic fatigue and even mental illnesses.

The inner bark of the Quinine Tree was used to make a liquid medicine that Gomeroi people used for a variety of purposes, kidney, lung and skin disease. Sap was used for diabetes. Scientific analysis of the active molecules in the bark extracts found it contains three key alkaloids Alstonine, Porphrine and Astonidine, and traces of others. The compound Alstonine was discovered in the Quinine Tree

and its properties are still being investigated but it is known the tree bark has an anti-protozoal action and a good treatment for malaria (Wright et al. 1993). It is also reported to be used to treat chronic diarrhoea, dysentery, fever and a variety of skin and internal injuries or infections. Roots of the plant are also known to be used for the same purposes.

Tools

The Pilliga is a huge resource for a range of materials. Only some of them have been identified here. Wood was a key material needed to make a variety of tools and weapons, from spears and axes, digging sticks, carrying dishes and shelter materials, to name some. Inner bark was used for shelter material, plant fibres were used as weaving materials, string and twine for nets and other purposes.

Favoured trees for making spears, as already mentioned, include the abundant young oak stems in the forest as well as the taller wattles which also provide good spear making material. Carrying dishes, or 'binguii' in Gamilaraay, were commonly carved from the trees of the box variety, as well as casuarina and ironbark trees are also known from the forest as bearing cultural scars.

For fibre, there were several sources available in the forest providing plenty of material for weaving bags and pouches and a variety of other uses. Native Flax was a common material used for weaving, though it prefers wetter areas, and not widely distributed in the forest now. But other alternatives existed, particularly the dried leaves of the rushes, *Lomandra, Juncus, Gahnia* and the Flax-lily *Dianella*, making a tough straw and are widely found in the forest. Tall grasses, such as Kangaroo Grass were also used. The fibres of some of these could be extracted to make finer strings suitable for nets. Another alternative for this purpose found in the forest include the Kurrajong tree and varieties of the Rice-Flower bushes *Pimelia*. The stems of these are dried and stripped for their tough, fine fibres.

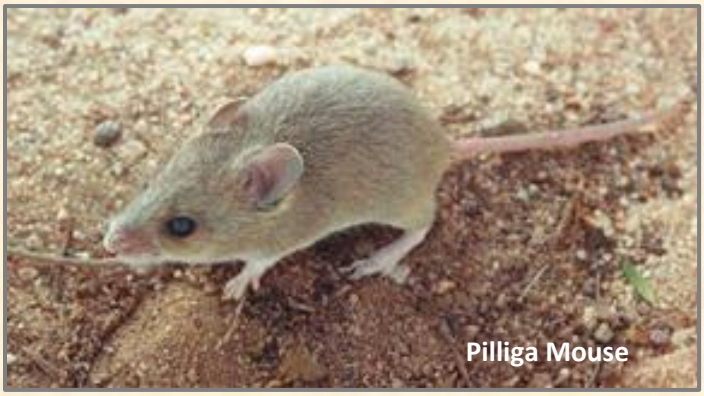
Other useful local plants include the bark of the swamp paperbark *Melaleuca ericifolia*, for a variety of purposes including shelter. The bark of other eucalypts was also utilised. Resin from the grasstree was widely used as an adhesive for tool-making, as were other resins from wattles.

Rice Flower *Pimelia sp.*

7. Animals

Past and present diversity

The Pilliga forests are an important refuge area for wildlife, containing remnant patches with high conservation-value, which are part of a recognised National Biodiversity Hotspot with a large number of species and high levels of ongoing threat, and whose irreplaceability is of the highest order. The animals of the Pilliga, like the plants, are a mix of inland and coastal species, similar to the composition of plant the community, and also with at least one known endemic (known only from the Pilliga region), the Pilliga Mouse *Pseudomys pilligaensis* which inhabits heathy areas, preferring to breed in habitat with a good, low cover of shrubs (Paull et al. 2014).


Pilliga Mouse

But like the native flora, there has been a significant change to the distribution and species composition of the locally occurring animal species in the Pilliga and in the region generally. Currently, the Pilliga fauna species list totals 396 species, including 21 exotics and 49 threatened species. This includes 240 native bird species, more than a quarter of the total number of birds in Australia, including waterbirds. This is a significant number of fauna species in total and does not include invertebrates, for which very little has been documented on their diversity or function in the local ecosystem. The fauna list was obtained by conducting a search on the BioNet Atlas database. A selected area was searched and may include species from agricultural and adjacent lands to the forest itself.

However, pre-European diversity was even higher. The pattern of fauna decline in the region (Paull and Date 1999) shows that the groups most adversely affected by extinction since colonial settlement were the small and medium sized ground dwelling species, such as rat kangaroos, bandicoots and native rodents. The long history of logging for timber in the forest over the last 100 years is likely to be the main cause of a decline in the abundance of hollow dependent species, such as possums and gliders in the forest (Paull and Kerle 2004).

A study of owl pellet remains from caves in the Pilliga (Ford and Aplin 2008) showed that a surprising diversity of small mammals occurred in the Pilliga prior to colonial settlement, including the Brown Bandicoot, Brush-tailed Phascogale, Hastings River Mouse, Eastern Chestnut Mouse and an unknown

species of Hopping Mouse *Notomys.* Evidence of a Hopping Mouse appeared in hair samples in 1993 (Paull and Date 1999), suggesting that the current suite of species in the forest is under-estimated.

Koala mother and young (M. Judd)

One of the most widely known of the Pilliga animals is the Koala. Following widespread culling during the 30s and 40s, it appears numbers were first noticed to be relatively common in the 80s, reaching a peak in the 90s (in their thousands) and thereafter declining again.

The Pilliga offers a relatively safe refuge for Koalas when conditions are right, particularly along the creeks and in heavier soil Box country, though numbers appear to be heavily impacted by drought. Today, relatively few Koalas persist in isolated pockets, most likely due to ongoing drought (Lunney et al. 2017).

Syncarida, *Psammaspididae*. (©P. Serov 2015).

Alluvial and unconsolidated sandstone aquifers in the Pilliga support a little known group of invertebrates, stygofauna. Species include a number of animals from different taxa including worms, arachnids and crustaceans (left).

Studies undertaken in the Pilliga (Serov 2017) show a high diversity with species found that were not previously known to science. The presence of these animals in your bore water indicates well oxygenated and healthy water for drinking.

Stygofauna persist in what is known as a 'groundwater dependent ecosystem'. The same aquifers which support these creatures also support surface alluvial ecosystems, found along the drainage lines throughout the forest. A key threat to these biodiversity refuges and the aquifers below is the contamination and water table drawdown predicted by coal and coal seam gas mining.

Significance for First Nations people

Gomeroi people relied heavily on animals as they provide key and culturally important food, clothing, tools and medicinal resources.

Animal totems are key animal foods utilised by Gomeroi people. All people are born into one of these groups, and to ensure against resource depletion, individuals are forbidden by lore to kill or eat their own totem. Besides providing meat, these animals were also important for their skins, sinews and oils. Goanna and echidna oils were highly valued for their healing properties. All of these species find refuge in the Pilliga forests.

Main Gomeroi animal totems (top left-clockwise): *Bandaar* (Kangaroo), *Dhinawan* (Emu), *Bigibila* (Porcupine, Echidna), *Yurandiali* (Sand Goanna).

Gomeroi people used a bigger variety of animals than just these four species however, with river resources featuring strongly in the diet, particularly for people living on the Castlereagh and Namoi Rivers which were important for fish (Golden Perch, Murray Cod, Silver Perch and Eel-tail Catfish) as well as invertebrates such as yabbies and mussels. Mussel shell was also used as ornaments and cutting utensils. There is one known mussel midden site on Bohena Creek in the AHIMS (Aboriginal Heritage Information System) database, just north of the Pilliga forest itself.

Other species known to have been used by First Nations people well represented in the Pilliga forests and surrounding country include ducks, Plains Turkeys, possums, wood-grubs, turtles and various other reptile and wallaby species.

8. Cultural sites

Extent of known information

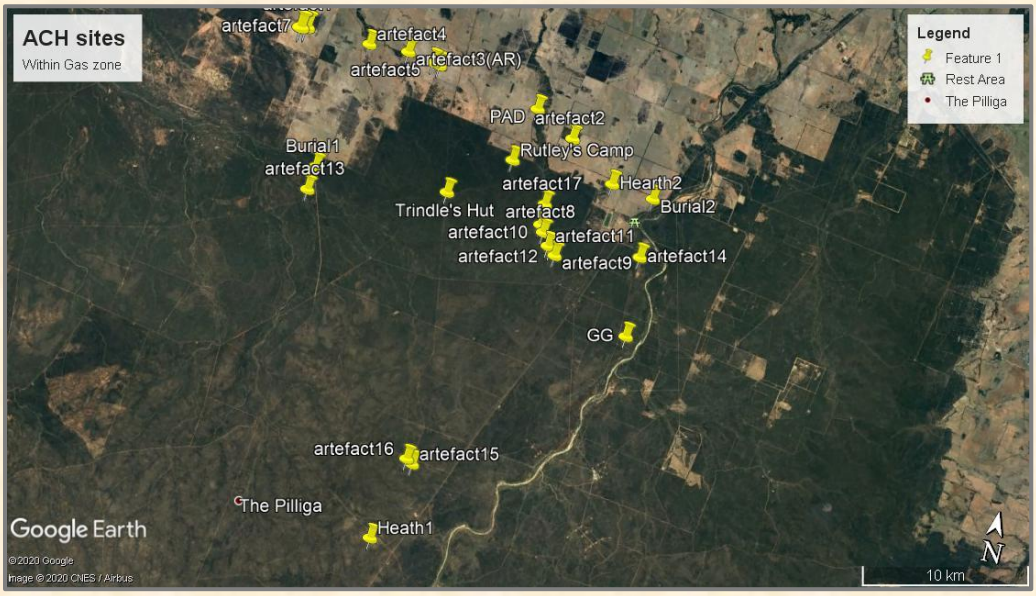
Known artefacts and special sites are found from across the forest, east to west, north to south. And given the low level of field investigation within the Pilliga more generally, it is likely that the forest still contains many more important sites, particularly as some areas have never been surveyed (NPWS 2002b).

Data on the cultural heritage from the Pilliga is held by the government's AHIMS database and NSW National Parks and Wildlife Service (NPWS), Land Councils, Inland Rail and companies Santos and Whitehaven, who have conducted their own surveys. The areas covered by these surveys are given a closer analysis here.

Site density

There were only 24 sites in the AHIMS database that lie within the gasfield project area. These are indicated in the figure below.

AHIMS database results from within of the gas project area (accessed November 2020)



With the addition of previously recorded data, particularly from the Western Regional Assessment ACH study (NPWS 2002b) provided to Narrabri LALC, the Santos ACH Assessment report shows that in total there are 268 known sites in Santos' lease area and 90 sites within the gas project area itself. The old NPWS data provided to Santos accounted for some 60 of these sites, this data has not been entered into the AHIMs database and the locations of these sites are currently not publicly available.

The Santos ACH report (CQCHM 2016) shows that while verification of some of the existing sites was undertaken, no general survey work was undertaken for their 2016 EIS. Evidence of only 90 sites across 100,000 ha of the project area is an improbably low density of sites for such a large and varied landscape and when compared to other mining archaeological surveys on a similar scale (Kuskie 2017).

Other important cultural heritage surveys in the Pilliga forest have been undertaken by Whitehaven for the Narrabri Underground Mine. Surveys undertaken by this company show a much higher density of sites than that recorded by Santos, with Whitehaven recording 121 sites over a 5,000 ha area of similar type of forest and adjacent land for their Stage 2 operations EIS. This is more than 20 times the density of sites documented by Santos.

Site Types

An analysis of the frequency of the different types of sites in the gasfield project area was provided in the Santos EIS (table below). Though limited, it shows a variety of sites types reflecting different types of usage include scar trees, isolated artefacts and artefact scatters, there are ceremonial sites, ochre manufacture sites, mussel shell midden on Bohena Creek, hearth and burial sites and grinding grooves in the forest and surrounding area.

Table 20-3 Types and number of sites identified in the data audit area and project area

Place type	Entire data audit area		Project area	
	Number	Percentage (%)	Number	Percentage (%)
Stone artefact scatter	121	45.1	17	18.9
Isolated stone artefact	81	30.2	31	34.4
Scarred tree	39	14.6	34	37.8
Grinding grooves	6	1.9	1	1.1
Historic camp	5	1.9	1	1.1
Hearth	3	1.1	1	1.1
Historic burial	2	0.7	1	1.1
Other historic place	2	0.7	1	1.1
Resource place	2	0.7	2	2.2
Aboriginal ceremony/historic burials	1	0.4	-	-
Ceremonial ring/scarred tree	1	0.4	-	-
Ochre source	1	0.4	-	-
Rock shelter/cave	1	0.4	-	-
Rock shelter / stone artefact scatter	1	0.4	1	1.1
Shell	1	0.4	-	-
Stone arrangement	1	0.4	-	-
Total	**268**		**90**	

(From CQCHM 2016)

Sites from Narrabri Underground Stage 2 area were generally scattered artefacts, though two 'camp sites' were identified showing signs of significant local usage, and one site containing axe grinding grooves.

Whitehaven detected a further 33 sites in their recent cultural surveys for their Stage 3 proposal, combined with the existing records from the AHIMS database. A total of sixty (60) Aboriginal cultural heritage sites were identified within the Stage 3 Investigation Area, "… *the majority of which are surface artefact sites, including thirty-six (36) surface artefact scatters, twenty-two (22) isolated artefacts, and two (2) grinding groove sites*" (Whincop Archeology, 2020). One of the grinding roove sites appears significant, containing 48 individual grooves in six clusters on a low outcrop of sandstone some distance from the nearest creek.

Other cultural artefacts known from the forest, well documented near Baradine are carved trees, 'dendroglyphs', said to be burial markers for important people, such as the one returned to Baradine from the Victorian Museum in 2010. Its provenance has been securely linked to the known original burial site of five identified men. It is believed that many more dendroglyphs from Gomeroi exist in various museums throughout Australia.

Patterns of landscape use

In their ACH Assessment, Santos used data to present a 'cultural sensitivity analysis' in their EIS. Santos' analysis is based on data and a similar analysis used by The Western Regional Assessment ACH study (NPWS 2002b). The original study is referenced here as it uses more information.

The NPWS study (2002b) found that watered or drainage line localities are a major contributing element influencing the distribution of cultural sites among landforms, but not the only factor. The results of the NPWS Aboriginal Cultural Heritage assessment established that cultural sites are most strongly linked with water features associated with the higher contoured terrain of the Goonoo and Pilliga State Forests and with floodplain edges in the Outwash province. Among the valley floor areas of the forests, there was a greater density of cultural sites, though significant numbers of cultural sites were also found in slope country containing colluvial, eroded soils. Different landscapes reflected different types of usage.

NPWS (2002b) reached some important conclusions:

1. Landforms can be used to assess the presence of Aboriginal heritage because particular landforms are usually linked with particular types of usage.
2. Once the links between landform and cultural heritage are identified, it is possible to work out the cultural management of landforms rather than looking for individual sites.

3. Aboriginal sites can occur in all landforms that exist in the Pilliga, and the highest density of sites are usually concentrated near specific features of watered, drainage and alluvial systems.
4. This does not mean that areas of more specialized or less frequent use were not as culturally significant.

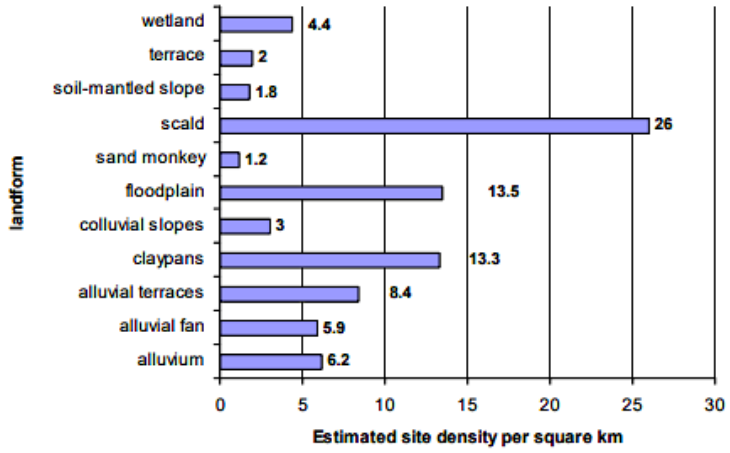
Cultural use of the land, as expected, varied between the two land provinces, though there were also similarities. Usage was gauged in terms of total number of sites per discrete landscape unit and in terms of site density, or number of sites per km^2 of unit. Extracts from the NPWS ACH Assessment's analysis of cultural landscape use are presented below.

Extracts on cultural usage within the Pilliga Outwash Province.
(From NPWS 2002b. Aboriginal Cultural Heritage Assessment. Appendix A [Landform Profiles])

Landform	Hectares mapped	Sites Count
Alluvial fan	35124	21
Alluvial plain	73020	31
Alluvial terraces	49415	42
Alluvium	65613	58
Claypans	2251	3
Colluvial slopes	6557	2
Floodplain	5149	7
Gilgai	1724	0
Lake	105	1
Lunette	116	20
Paleochannel	550	3
Rocky ground	30	0
Sand monkey	16130	2
Scald	384	1
Soil-mantled slope	27730	5
Terrace	4826	1
Wetland	2258	1
Yellow sand sheets	1	0

Landform and site association

Eighty-four percent of the Pilliga Outwash has mapped landform coverage. One hundred and ninety eight sites occur among many of the landforms providing a good indication of which landforms have the higher potential for sites. Calculated by size of landform area and the number of known sites, scald, claypan and floodplain landforms have very high site density. Scald and claypan belong to the Terrace group of landforms which adjoin the margins of the floodplain landform, an example is the Namoi floodplain complex. The Alluvial group of landforms, floodplain, alluvium, alluvial fan, wetland and alluvial terrace, have strong site association. A distinctive feature of the Pilliga Outwash province is that the Higher group of landform (colluvial slope, rocky groud and soil mantled slope) have very low site numbers. The high site concentration among landform type (lunette) has not been graphed because of the high site density calculated (1 724). Sampling occurred at one specific lunette landform which is small in area (116 ha) and where many sites were recorded.



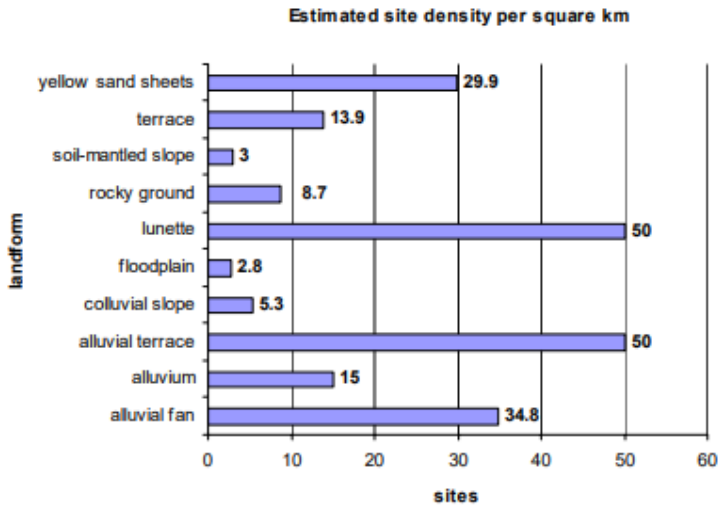
In both provinces, the highest density of sites encountered were in a specific landscape feature known as a 'lunette'. These are sandy dunes which can form to a large size, particularly on river bends, giving them a curved appearance. These special locations are found where Gomeroi lived over

a long time, with many people undertaking different activities, including camps, burials and tool-making over long periods of time.

The Pilliga Province recorded the highest density of artefacts in the alluvial terraces and alluvial fans associated with the main creeks in the forest and surrounds. These form particular features of the local drainage, resulting in a clustered scattering of artefacts in these systems. A large number of artefacts were also found in low order streams and adjacent slopes containing colluvial soils, though this landscape unit has a low overall site density due to its large extent. These areas supported many of the tool and ochre manufacturing sites and despite the low 'density' are important when considering the totality of resource requirements by Gomeroi people.

In contrast, the highest density of cultural usage within the Pilliga Outwash Province was found on clay-pans and 'scalds' (bare sandy areas, sometime eroded) associated with the terraced margins of the floodplain proper, but traditional cultural use within the alluvial areas was also significant.

Extracts on cultural usage within the Pilliga Province.
(From NPWS 2002b. Aboriginal Cultural Heritage Assessment. Appendix A [Landform Profiles])



	Total area of landform coverage (ha)	Sites
Rocky ground	32 062	2
Soil mantled		
Slope	343 906	106
Colluvium	115 498	62
Terraces	7 880	11
Alluvium	77 698	117
Alluvial		
Terraces	3 202	16
Lunette	198	1
Floodplain	6 936	2
Alluvial fan	287	1
Yellow sand sheet	1 002	3
Sand monkey	891	0

Landform and site association

A total of 34.4% of the Pilliga Province is covered by mapped landform coverage. Sixty-five percent of the Province remains unmapped. Two major forests are included in the mapped coverage, Goonoo and Pilliga (includes part of the NPWS Pilliga Nature Reserve). Combined, both forest cover an area of over 500 000 square hectares. Both forest were sampled for sites in Stage 1 (251 sites) and a strong site relationship with the Alluvial group of landforms established (RACD 2000 App:C). Stage 2 mapping connected the southern areas of the Goonoo forest to the Talbragar River and Talbragar Valley Province to highlight valley landforms (terrace, floodplain). Access to carry out site surveys to valley areas was achieved through Travelling stock routes and private properties. Alluvium and alluvial terrace landforms were also sampled for sites in the valley regions away from the forests. Both landform types have potential for high site density. Sites among soil mantled slope and colluvial slope show only a low site density, relative to the large area in size of each landform. A single lunette landform was identified in the Province and has a very high estimate of site density per square km. Despite only one site registered, the area is highly sensitive and many other sites are likely to be associated with this landform. Yellow sand sheet is a rare landform for the Province and occurs in the northern Goonoo forest region. The central areas of the province, which are dominated by undulating to hilly terrain (soil mantled slopes) are not mapped. Additional mapping of the Province is required.

9. Coal seam gas

Current extent of gas activities

Gas activities under the petroleum exploration license (PEL238) that covers the Pilliga forest have been carried out for over 20 years, by former owners Eastern Star and current owners Santos. Incidents over those 20 years and information from around the world, provide some indication of what sort of impacts we could expect from a much larger production field in the Pilliga and surrounding farmland.

Exploration activities for coal seam gas commenced in the Pilliga in 1998, with the drilling of the first 'Bohena' series of frack wells. Since then, some 70 exploration and 'appraisal' wells have been installed, both inside and outside the forest. Most of these are either capped or inactive, while about 20 wells are currently producing small amounts of gas for their Wilga Gas Production Facility near Narrabri. This production is currently allowable under their exploration license.

Current gasfield infrastructure in the forest (From CNES / Airbus 2021)

Now Santos intends to open up a production field of 850 new wells and have been granted Commonwealth and State conditional approvals. Santos is currently attempting to meet conditions

for their Phase 1 approval and to obtain a future act determination under Native Title so that they may secure a production license.

Santos has already constructed and operates two water and gas distribution and storage facilities, one north of the forest at 'Leewood' where water treatment is also caried out. There is another facility in the forest (Bibblewindi) where gas is also flared.

Left: Leewood holding ponds. Right: Bibblewindi facility.

Impacts of coal seam gas

Clearing and habitat fragmentation

Santos is proposing to clear about 1,000 ha for well sites, tracks and pipelines, throughout the forest. This will remove about 100 ha of Koala habitat, thousands of hollow-bearing trees and 300 ha of preferred habitat for the Pilliga Mouse. This will also result in a high level of internal fragmentation of the forest, increasing the penetration of weeds and exotic animals throughout the forest, particularly the fox, and affecting the movement of small sensitive species.

Left: Typical width of pipeline through the forests. Right: Well sites range from 1-2 ha in size.

Independent expert advice provided to the NSW Environmental Defenders Office (EDONSW 2020) has identified significant uncertainty about the location of Santos' gas infrastructure as well as the scale of direct and indirect impacts. This has made a proper assessment of the impacts of this Project prior to commencement impossible, as going ahead with the project will result in:

- increased fragmentation of a landscape already under severe environmental stress.
- increased sedimentation of intermittent waterways and the reduced availability of surface water essential to the maintenance of wildlife.
- increased disturbance from an increase in vehicle movements, dust, noise and lighting associated with gas mining operations.
- the worsening of existing impacts, such as the loss of hollow bearing trees, vegetation loss and increased fire frequency in the project area due to the combined effect of past intensive forestry operations and climate change.

There is a lot lacking in the way Santos presents the impact assessment in their 2016 Environmental Impact Statement (EIS). These are the main issues.

1. The scale of the direct impact of the project through vegetation removal is not certain. The figures provided by Santos are likely to be under-estimates.
2. The magnitude of 'indirect' or 'offsite' impacts 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 methodology. For example, the increase in feral predator activity in the gas field will result from the internal fragmentation.
3. Cumulative impacts have not been adequately considered.
4. The survey effort undertaken for the environmental assessment was insufficient and a proper assessment of impacts on these species has not been done.
5. Santos failed to establish the likely environmental consequences of the Project. They have not taken into account the precautionary principle or Intergenerational Equity, part of the statutory objectives of Ecological Sustainable Development (ESD).

Impacts on water

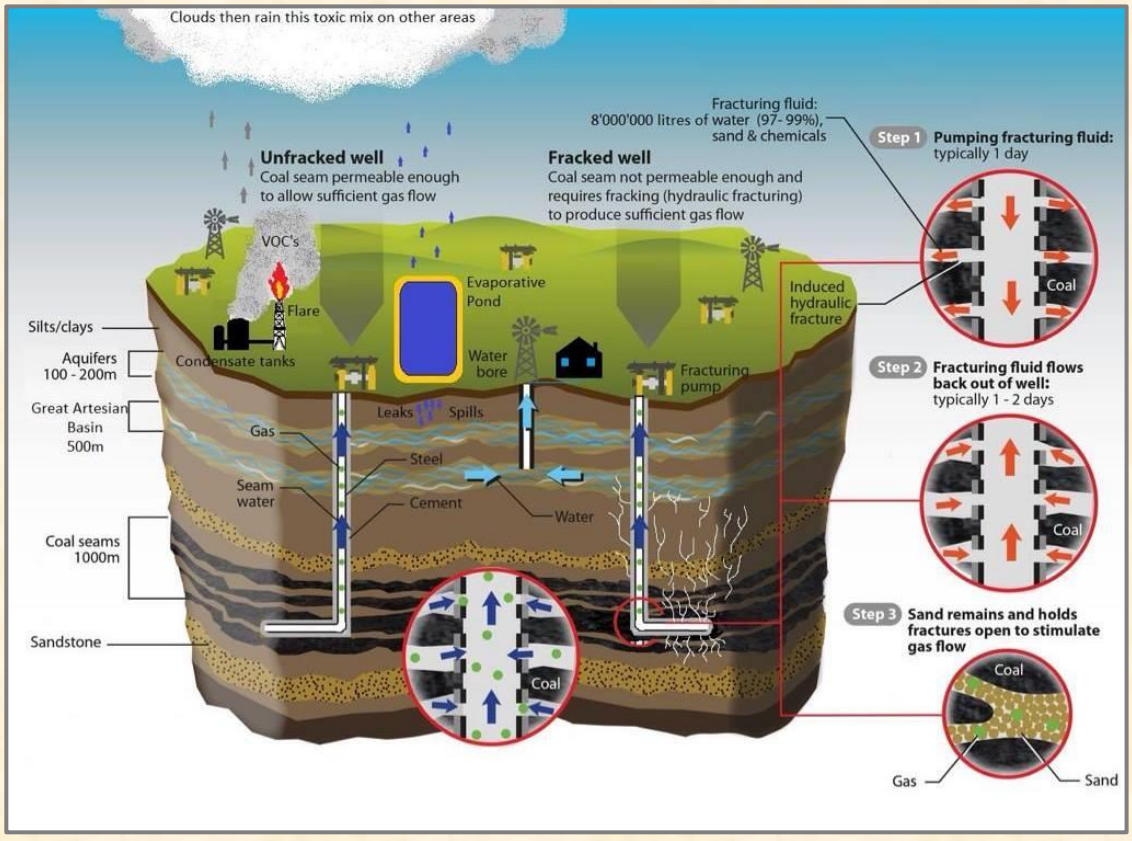
Water is our lifeblood. The mining of Coal Seam Gas (CSG) will have direct impacts on the quality of the water throughout the region. Coal seam gas is a methane gas found in coal seams at depths of approximately 300 to 1000 metres underground. The CSG is trapped underground by water pressure. To extract the gas, a well is drilled into the coal seam and the water is pumped out, depressurising the seam. This in turn stimulates gas formation. The water – known as 'produced water' – is then separated from the gas at the surface. CSG 'produced water' is contaminated with high levels of sodium, heavy metals and other trace elements, such as barium and boron and sometimes uranium.

The quantities of 'produced water' can be very large. Santos proposes to extract approximately 37.5 billion litres (GL) of water (up to 80 GL) during the life of the Project, or approximately 1.5 GL per

year. The 'produced water' generated at all CSG wells will be pumped through a network of water gathering lines and infield balance tanks and transported to water treatment facilities. This means that there will be hundreds of potential sites of contamination. Coal seams are less permeable than conventional gas systems and the gas does not flow as easily, which means that more wells are required to develop a CSG field than a conventional gas field.

The wells are drilled deep underground through different geological layers including the two main groundwater formations: (a) the Great Artesian Basin feeder beds, and (b) aquifers at the top of the saturated portion of bedrock which constitutes the water table. These aquifers supply important sources of water for agriculture and domestic use and are important recharge zones for the Great Artesian Basin.

The drilling, 'stimulation' and extraction of water in these coal seams by gas mining depressurizes the gas bearing coal formations but may also cause additional pathways for gas and water seepage between vertical layers to occur in the bedrock by increasing levels of localised fracturing of the bedrock. This is the mechanism by which predicted water table decline will occur, the magnitude of which however is not certain in industry groundwater assessments, mainly due to a lack of information. The Santos EIS is no exception.



While Santos and the NSW Government have judged that the new Production Field '*would not result in any significant impacts on people or the environment*' (DPIE Assessment Report 2020), there

remain important knowledge gaps in relation to groundwater risks. Important relevant information and data continues to be lacking or has not been considered – including published research with significant findings regarding inter-aquifer connectivity in sandstone aquifer systems.

In its assessment report, the NSW Government has adopted an approach that such issues can be dealt with after the Project approval. Such an approach is inconsistent with the precautionary principle, as groundwater damage is difficult to fix.

Groundwater contamination is a major environmental risk that requires careful management in any unconventional gas operation (Entrekin et al. 2011; Hamawand et al. 2013; Vengosh et al. 2014). The major pathways by which contamination of groundwater can take place are:

- contamination by wastewater (produced water) that is spilled, leaked or inappropriately managed as it is brought to the surface and subsequently stored, treated and transported;
- contamination due to well integrity failures, or legacy/abandoned boreholes, which allow gas and/or fluids to escape from gas reservoirs and cross-contaminate other aquifers.

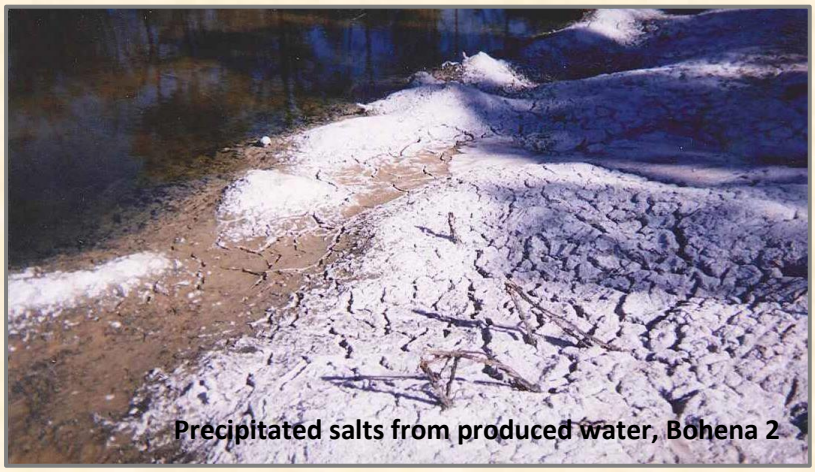
The risks associated with potential groundwater and/or surface water contamination with 'produced CSG water' are of particular significance in the Narrabri Project (in comparison with other gas projects), due to the unusually poor water quality associated with the Gunnedah Basin coal seams underneath the Project area, and the unusually high quality of the shallow groundwater and surface water in the Project area.

Spills or links of produced water onsite, on route to or during storage at the water treatment facilities, have already occurred in the Pilliga Forest on about 20 occasions, detrimentally affecting the surrounding land and shallow ground water in the uppermost unconfined water table aquifers and the surrounding vegetation.

Planted Rehabilitation on contaminated site at Bohena 3 (2020)

Attempts at rehabilitating well-sites throughout the forest with natural and planted vegetation have failed. A community study (PEG 2018) showed that routine activities at well-sites have resulted in the localised spillage of 'produced water', causing changes to soil chemistry harmful to local plant species. Soils in the Pilliga forests are very acidic, whereas soils at well sites were found to be neutral or alkaline, with little native ground storey, large numbers of weeds and a failure to increase tree numbers.

Santos has also failed to demonstrate how it will dispose of waste brine arising from the water treatment process, creating significant uncertainty about the environmental impacts of this disposal process. Independent expert evidence provided to the EDONSW shows that there is a significant risk of localised and down-stream environmental harm arising from this waste material.



Precipitated salts from produced water, Bohena 2

Based on international evidence and the previous leaks and spills that have occurred in the forest (including several substantial spills of 'produced water', and groundwater contamination), the size of the project and the number of wells and required infrastructure to collect, transport and store the 'produced water', there is a strong likelihood that further leaks and/or spills of 'produced water' will occur throughout the life of the project, risking contamination of shallow aquifers and surface water bodies in the area.

Evidence shows that Santos has underestimated the risk of waste-water spills and leaks, which leaves the Project vulnerable and poorly equipped to respond to the incidents that will inevitably arise. The combination of significant volumes of poor-quality water being produced and managed across hundreds of sites in the project area over a period of 25 years, and the impact on the high quality of the groundwater in the Pilliga Sandstone and alluvium, raises significant concerns about harmful environmental and water impacts.

Air pollution

Pollutants can be released into the air from gas field activities in a number of ways:

- fugitive greenhouse emissions from leaking pipes and wellheads
- gas released during flaring, a common practice to regulate gas flow.

The main constituents of gasfield emissions are greenhouse gases, mostly carbon monoxide and oxides of nitrogen. Santos is already the 20th largest emitter of greenhouse gases, reportedly releasing 5.8 million tonnes last year. By comparison, the Narrabri project alone would release around 5 million tonnes of greenhouse gases each year, making it the 54th largest emitter in the country. The gas field will create a fall-out zone of Volatile Organic Compounds, including particulate matter, sulfur dioxide and Polycyclic Aromatic Hydrocarbons, all of which are harmful to human, animal and plant health. Studies on people show toxic impacts – ignored in the latest Santos EIS.

10. Underground Coal

Current extent of mining activities

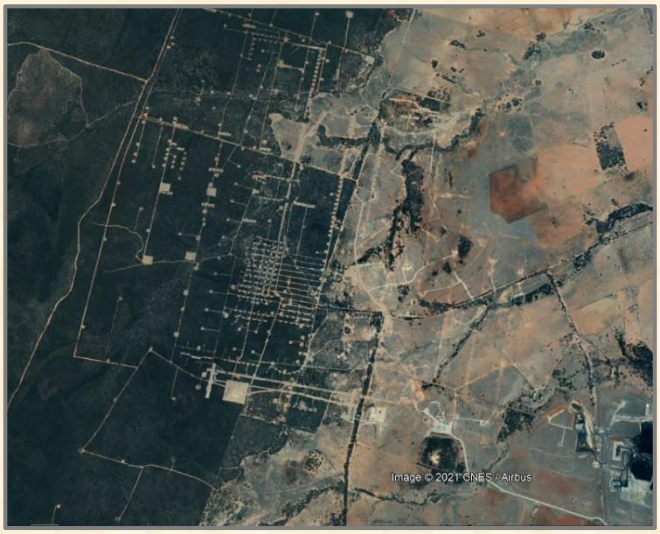
Longwall mining sets out to destroy the strata or underground layers of the land to extract coal. Whitehaven commenced their underground mining operations on the eastern side of the Pilliga forest with the implementation of their Stage 2 operations for their Narrabri Underground Mine in 2012. Whitehaven currently have 13 operational longwalls under the eastern edge of the Pilliga forest. In 2021, the NSW Department of Planning has recommended that their Stage 3 expansion to the south be approved, though final go ahead has not yet been given.

Left: Current location of longwalls. Right: Location of Stage 3 and Stage 2 Operations and below.

Impacts of longwall mining

Clearing and habitat fragmentation

Longwall underground mining creates considerable disturbance to the surface above the longwalls, involving a network of connecting tracks, sump pits and gas venting sites. At Narrabri, the Stage 2 development within the Pilliga state forest has resulted in high levels of surface disturbance (right).



The assessment of biodiversity impact for Stage 3 failed to consider the offsite impacts arising from this network of surface infrastructure, such as light, toxic gases, noises, sump pit leakage and internal forest fragmentation across the whole lease area covering approx. 4,800 hectares. It is also likely, as the works for Stage 2 show, that the extent of the proposed clearing has been under-estimated by Whitehaven.

Sump Pit, Narrabri Underground Stage 2 area
(Courtesy, People for the People Flicker)

Subsidence

Subsidence is a common impact from longwall mining throughout Australia. It can result in the collapse of surface ecosystems resulting in depressions, cracks in the ground and cracking in rock formations, tree tilting and death and interruptions to surface hydrology. These impacts can be significant particularly in creek zones and areas of rock outcropping, where collapse of formations is possible. Subsidence can impact cultural sites where they are associated with rock. Two sites of grinding grooves located along drainage lines above proposed Longwalls 205 and 210 are susceptible to cracking if Stage 3 proceeds.

Water Impacts

Impacts on groundwater are likely, due to the interception of groundwater and mine infill water, which is expected to cause considerable water-table drawdown. The discharge of polluted water into local water-courses will also impact on surface water systems.

Mine	Total area (ha)	Coal extraction rate (Mt/yr)	Daily water use (m^3 /d)	Groundwater inflow (m^3 /d)
Narrabri LWM	3240	2.5 – 8.0	3000	200 – 3900

From ELA (2012)

Dewatering via pumping of Narrabri Coal Mine is undertaken on a daily basis due to its interception of Great Artesian Basin and coal seam feeder beds into the mine cavity. This is necessary for the mine to operate. The de-watering is projected to increase from 200 m^3 /d in 2011 to 3,900 in 2028, before falling after 2028 (ELA 2012). In total, the de-watering process is likely to have significant local drawdown impacts, the effects of which are measurable today. Narrabri Coal also discharges water into the local creek at different times.

There is estimated to be 0.4 ML/yr of groundwater inflows to each hectare of the longwall panel(s) (ELA 2012). This equates to some 3,200 GL over the life of the mine for Stage 2 alone.

With the approval and potential commencement of Stage 3, this dewatering is expected to:

- increase impact water availability for about 10 locally occurring water users
- potentially impact 500 ha of mapped BSAL (agriculturally significant)
- result in the potential loss of 161 ha of high priority Groundwater Dependent Ecosystems due to groundwater drawdown
- have subsidence impacts on the following watercourses:
    - o Kurrajong Creek (3rd order watercourse);
    - o Tulla Mullen Creek Trib1 (3rd order watercourse); and
    - o other minor 1st and 2nd order watercourses.
- cause post-mining reduction of base flow to the Namoi River of 200ML/pa.

Air pollution

Like Coal Seam gas mining, air pollution from underground coal mining causes the release of both greenhouse gases and volatile organic compounds, including particulate matter.

The total Green House Gas Emissions (GHGE) from this project if the Stage 3 operations proceed are calculated to be 482.3 Megatonnes (MT). This includes Scope 1, 2 and 3 emissions or average annual totals. This volume is more than 12 times the volume of emissions rejected by the Land and Environment Court in the February 2019 Rocky Hill decision (38.1Mt). Annual emissions just from mining the coal are huge and would place this mine at #50 on the list of Australia's 100 worst Scope 1 emitters of greenhouse gases in Australia.

Poor track record

Whitehaven has been given NSW Government approval for its Stage 3 expansion despite the poor track record of this company due to infringements of its pollution and license guidelines.

This recently resulted in the decision in the Land and Environment Court to make Whitehaven pay over $20 million dollars in fines for 19 breaches which they pleaded guilty for, including pollution in its existing operations and illegal clearing activities in its Stage 3 area. This resulted in a suspension of their exploration license. Despite this, the NSW Government has accepted their development application for Stage 3 and recommended its approval.

11. Time for action

"The Pilliga means more to me at the moment than it ever has in the past, you know, the Dreamtime stories, which itself and the land has been taken away from us."

Theresa Trindall.

The desecration of Gomeroi Country goes on unabated. None of this has been conducted with the consent of the knowledge keepers of Gomeroi traditional lore. The Pilliga forest is a refuge against the encroachment of colonial settlement. Its values remain strong to our people today, despite the decades of exploitation and cultural genocide.

The secrets of the forest remain for our people to learn and use. But the mining and gas companies have a different agenda.

If you want our water and natural resources to remain for future generations to use and enjoy, then now is the time to let your voice be heard.

Let the Colonial Governments know they do not have your consent to the destruction of our Country, water and cultural sites. Call your local Commonwealth, state and local government representatives and consent authorities, especially the ones below, and let them know.

Title	Minister	Phone
Commonwealth Minister for the Environment	The Hon Sussan Ley MP	(02) 6277 7920
Commonwealth Minister for Indigenous Australians	The Hon Ken Wyatt AM MP	(02) 6277 7780
NSW Minister for Planning and Public Spaces	The Hon Robert Stokes MP	(02) 8574 6707
NSW Minister for the Energy and the Environment	The Hon Matt Kean	(02) 8574 6150
NSW Minister for Aboriginal Affairs	The Hon Don Harwin	(02) 8574 7200
NSW Member for Northern Tablelands	The Hon Adam Marshall	(02) 6772 552 (Armidale) (02) 6752 5002 (Moree)

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13. Appendices

Appendix 1: Pilliga threatened ecological communities

[Results of Protected Matters search in area, North: -30.38 West: 148.62 East: 149.88 South: -31.23]

Common Name	NSW status	Comm. status
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	Endangered	Endangered
Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South Bioregions	Endangered	
Carex Sedgeland of the New England Tableland, Nandewar, Brigalow Belt South and NSW North Coast Bioregions	Endangered	
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Endangered	
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Endangered	Endangered
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	Endangered	Endangered
Pilliga Outwash Ephemeral Wetlands in the Brigalow Belt South Bioregion	Endangered	
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	Endangered	Endangered
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner.	Critically Endangered	Critically Endangered

Appendix 2: Pilliga threatened species

[Results of BioNet Search in area, North: -30.38 West: 148.62 East: 149.88 South: -31.23]

Flora

Family	Scientific Name	Common Name	NSW status	Comm. Status
Apocynaceae	*Tylophora linearis*		Vulnerable	Endangered
Brassicaceae	*Lepidium aschersonii*	Spiny Peppercress	Vulnerable	Vulnerable
Brassicaceae	*Lepidium monoplocoides*	Winged Peppercress	Endangered	Endangered
Cyperaceae	*Cyperus conicus*		Endangered	
Euphorbiaceae	*Bertya opponens*	Coolabah Bertya	Vulnerable	Vulnerable
Euphorbiaceae	*Monotaxis macrophylla*	Large-leafed Monotaxis	Endangered	
Fabaceae (Faboideae)	*Swainsona murrayana*	Slender Darling Pea	Vulnerable	Vulnerable
Haloragaceae	*^Myriophyllum implicatum*		Critically Endangered	
Malvaceae	*Commersonia procumbens*		Vulnerable	Vulnerable
Orchidaceae	*^Diuris tricolor*	Pine Donkey Orchid	Vulnerable	
Orchidaceae	*^Pterostylis cobarensis*	Greenhood Orchid	Vulnerable	
Poaceae	*Digitaria porrecta*	Finger Panic Grass	Endangered	
Polygalaceae	*Polygala linariifolia*	Native Milkwort	Endangered	
Rhamnaceae	*Pomaderris queenslandica*	Scant Pomaderris	Endangered	
Rutaceae	*Boronia granitica*	Granite Boronia	Vulnerable	Endangered

Fauna

Class	Scientific Name	Common Name	NSW status	Comm. status
Amphibia	*Crinia sloanei*	Sloane's Froglet	Vulnerable	Endangered
Reptilia	*Hoplocephalus bitorquatus*	Pale-headed Snake	Vulnerable	
Aves	*Leipoa ocellata*	Malleefowl	Endangered	Vulnerable
Aves	*Hirundapus caudacutus*	White-throated Needletail		Vulnerable
Aves	*Ephippiorhynchus asiaticus*	Black-necked Stork	Endangered	
Aves	*Botaurus poiciloptilus*	Australasian Bittern	Endangered	Endangered
Aves	*Circus assimilis*	Spotted Harrier	Vulnerable	
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	Vulnerable	
Aves	*^^Hamirostra melanosternon*	Black-breasted Buzzard	Vulnerable	
Aves	*Hieraaetus morphnoides*	Little Eagle	Vulnerable	
Aves	*^^Lophoictinia isura*	Square-tailed Kite	Vulnerable	
Aves	*Falco subniger*	Black Falcon	Vulnerable	
Aves	*Grus rubicunda*	Brolga	Vulnerable	
Aves	*Ardeotis australis*	Australian Bustard	Endangered	
Aves	*Burhinus grallarius*	Bush Stone-curlew	Endangered	
Aves	*^Calyptorhynchus lathami*	Glossy Black-Cockatoo	Vulnerable	
Aves	*^Lophochroa leadbeateri*	Major Mitchell's Cockatoo	Vulnerable	
Aves	*Glossopsitta pusilla*	Little Lorikeet	Vulnerable	
Aves	*^^Neophema pulchella*	Turquoise Parrot	Vulnerable	
Aves	*^^Polytelis swainsonii*	Superb Parrot	Vulnerable	Vulnerable
Aves	*^^Ninox connivens*	Barking Owl	Vulnerable	
Aves	*^^Tyto novaehollandiae*	Masked Owl	Vulnerable	
Aves	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	Vulnerable	
Aves	*Chthonicola sagittata*	Speckled Warbler	Vulnerable	
Aves	*Anthochaera phrygia*	Regent Honeyeater	Critically Endangered	Critically Endangered
Aves	*Epthianura albifrons*	White-fronted Chat	Vulnerable	
Aves	*Grantiella picta*	Painted Honeyeater	Vulnerable	Vulnerable
Aves	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	Vulnerable	

Class	Scientific Name	Common Name	NSW status	Comm. status
Aves	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	Vulnerable	
Aves	*Daphoenositta chrysoptera*	Varied Sittella	Vulnerable	
Aves	*Pachycephala inornata*	Gilbert's Whistler	Vulnerable	
Aves	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	Vulnerable	
Aves	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	Vulnerable	
Aves	*Petroica boodang*	Scarlet Robin	Vulnerable	
Aves	*Petroica phoenicea*	Flame Robin	Vulnerable	
Aves	*Stagonopleura guttata*	Diamond Firetail	Vulnerable	
Mammalia	*Dasyurus maculatus*	Spotted-tailed Quoll	Vulnerable	Endangered
Mammalia	*Phascolarctos cinereus*	Koala	Vulnerable	Vulnerable
Mammalia	*Cercartetus nanus*	Eastern Pygmy-possum	Vulnerable	
Mammalia	*Aepyprymnus rufescens*	Rufous Bettong	Vulnerable	
Mammalia	*Macropus dorsalis*	Black-striped Wallaby	Endangered	
Mammalia	*Petrogale penicillata*	Brush-tailed Rock-wallaby	Endangered	Vulnerable
Mammalia	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	Vulnerable	
Mammalia	*Chalinolobus dwyeri*	Large-eared Pied Bat	Vulnerable	Vulnerable
Mammalia	*Chalinolobus picatus*	Little Pied Bat	Vulnerable	
Mammalia	*Nyctophilus corbeni*	Corben's Long-eared Bat	Vulnerable	Vulnerable
Mammalia	*Vespadelus troughtoni*	Eastern Cave Bat	Vulnerable	
Mammalia	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	Vulnerable	
Mammalia	*Pseudomys pilligaensis*	Pilliga Mouse	Vulnerable	Vulnerable

Appendix 3. Pilliga cultural plants

Usage types: F (fruit, berry); T (tuber, root); L (leaf, stems); S (seed); N (nectar/sap); M (medicinal); C (tools).

'X' indicates known usage for that species; '?' indicates known toxicity to stock and possible medicinal use.

Family	Scientific Name	Common Name	Usage type						
			F	T	L	S	N	M	C
Aizoaceae	*Tetragonia tetragonioides*	Warrigal Greens			X				
Amaryllidaceae	*Crinum flaccidum*	Darling Lily		X					
Anthericaceae	*Arthropodium milleflorum*	Pale Vanilla-lily		X					
Anthericaceae	*Arthropodium minus*	Small Vanilla Lily		X					
Anthericaceae	*Arthropodium sp. B*			X					
Anthericaceae	*Caesia calliantha*			X					
Anthericaceae	*Caesia parviflora var. parviflora*			X					
Anthericaceae	*Dichopogon fimbriatus*	Nodding Chocolate Lily		X					
Anthericaceae	*Dichopogon strictus*	Chocolate Lily		X					
Anthericaceae	*Thysanotus tuberosus*	Common Fringe-lily		X					
Apiaceae	*Daucus glochidiatus f. C*	Native Carrot		X					
Apiaceae	*Daucus glochidiatus f. F*	Native Carrot		X					
Apiaceae	*Trachymene incisa subsp. corrugata*	Wild Parsnip		X					
Apocynaceae	*Alstonia constricta*	Quinine Tree						X	
Apocynaceae	*Marsdenia viridiflora subsp. viridiflora*	Native Pear	X	X					
Apocynaceae	*Parsonsia eucalyptophylla*							X?	
Asphodelaceae	*Bulbine alata*	Native Onion		X					
Asphodelaceae	*Bulbine bulbosa*	Bulbine Lily		X					
Asphodelaceae	*Bulbine semibarbata*	Wild Onion		X					
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting						X	
Asteraceae	*Cymbonotus lawsonianus*	Bear's Ear						X	
Capparaceae	*Capparis lasiantha*	Nepine	X						
Capparaceae	*Capparis mitchellii*	Native Orange	X						
Casuarinaceae	*Allocasuarina luehmannii*	Bulloak							X
Casuarinaceae	*Casuarina cristata*	Belah							X
Casuarinaceae	*Casuarina cunninghamiana*	River Oak							X
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	X						
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush	X						X
Colchicaceae	*Wurmbea biglandulosa*			X					
Commelinaceae	*Commelina cyanea*	Native Wandering Jew			X				
Commelinaceae	*Commelina ensifolia*	Scurvy Grass			X				
Commelinaceae	*Murdannia graminea*			X				X	
Convolvulaceae	*Convolvulus erubescens*	Pink Bindweed						X	
Convolvulaceae	*Evolvulus alsinoides var. decumbens*								
Convolvulaceae	*Evolvulus alsinoides var. villosicalyx*	Bindweed							
Cupressaceae	*Callitris endlicheri*	Black Cypress Pine						X	X
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine						X	X
Cyperaceae	*Cyperus betchei subsp. betchei*			X					
Cyperaceae	*Cyperus bifax*	Downs Nutgrass		X				X	
Cyperaceae	*Cyperus fulvus*	Sticky Sedge		X					
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge		X					
Cyperaceae	*Cyperus lucidus*	Leafy Flat Sedge		X					
Cyperaceae	*Gahnia aspera*	Rough Saw-sedge			X	X			X
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		X				X	
Ericaceae	*Acrotriche rigida*	Groundberry	X						
Ericaceae	*Astroloma humifusum*	Native Cranberry	X						
Ericaceae	*Leucopogon biflorus*		X						
Ericaceae	*Leucopogon muticus*	Blunt Beard-heath	X						

Family	Scientific Name	Common Name	Usage type						
			F	T	L	S	N	M	C
Ericaceae	*Lissanthe strigosa subsp. subulata*	Peach Heath	X						
Ericaceae	*Melichrus erubescens*	Ruby Urn Heath	X						
Ericaceae	*Melichrus urceolatus*	Urn Heath	X						
Ericaceae	*Styphelia triflora subsp. B*	Five Corners	X						
Ericaceae	*Styphelia triflora subsp. D*	Five Corners	X						
Euphorbiaceae	*Chamaesyce drummondii*	Caustic Weed						X	X
Faboideae	*Glycine canescens*	Silky Glycine		X					
Faboideae	*Glycine clandestina*	Twining glycine		X					
Faboideae	*Glycine latifolia*			X					
Faboideae	*Glycine pacifica*			X					
Faboideae	*Glycine stenophita*			X					
Faboideae	*Glycine tabacina*	Variable Glycine		X					
Faboideae	*Glycine tomentella*	Woolly Glycine		X					
Faboideae	*Hardenbergia violacea*	False Sarsaparilla		X				X	X
Faboideae	*Indigofera adesmiifolia*	Tick Indigo						X	
Faboideae	*Indigofera australis*	Australian Indigo						X	
Faboideae	*Swainsona galegifolia*	Smooth Darling Pea							X
Geraniaceae	*Erodium crinitum*	Blue Crowfoot		X	X	X			
Geraniaceae	*Geranium retrorsum*	Cranesbill Geranium		X					
Geraniaceae	*Geranium solanderi var. solanderi*	Cranesbill Geranium		X					
Haemodoraceae	*Haemodorum planifolium*							X	
Haemodoraceae	*Haemodorum tenuifolium*							X	
Lamiaceae	*Ajuga australis*	Austral Bugle						X	
Lamiaceae	*Mentha diemenica*	Slender Mint						X	
Lamiaceae	*Mentha satureioides*	Native Pennyroyal						X	
Lamiaceae	*Plectranthus parviflorus*							X	
Lauraceae	*Cassytha glabella f. glabella*		X						
Lauraceae	*Cassytha melantha*		X						
Lauraceae	*Cassytha pubescens*	Downy Dodder-laurel	X						
Lauraceae	*Cassytha racemosa f. muelleri*		X						
Linaceae	*Linum marginale*	Native Flax						X	X
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush			X				
Loranthaceae	*Amyema bifurcata*		X						
Loranthaceae	*Amyema cambagei*	Needle-leaf Mistletoe	X						
Loranthaceae	*Amyema linophyllum subsp. orientale*		X						
Loranthaceae	*Amyema maidenii subsp. angustifolia*		X						
Loranthaceae	*Amyema maidenii subsp. maidenii*		X						
Loranthaceae	*Amyema miquelii*	Box Mistletoe	X						
Loranthaceae	*Amyema miraculosum subsp. boormanii*		X						
Loranthaceae	*Amyema pendula subsp. longifolia*		X						
Loranthaceae	*Amyema pendula subsp. pendula*		X						
Loranthaceae	*Amyema quandang var. quandang*	Grey Mistletoe	X						
Loranthaceae	*Dendrophthoe glabrescens*		X						
Loranthaceae	*Lysiana exocarpi subsp. exocarpi*		X						
Loranthaceae	*Lysiana exocarpi subsp. tenuis*		X						
Loranthaceae	*Lysiana subfalcata*		X						
Loranthaceae	*Muellerina bidwillii*		X						
Loranthaceae	*Muellerina eucalyptoides*		X						
Malvaceae	*Brachychiton populneus*	Kurrajong				X		X	X
Malvaceae	*Hibiscus sturtii var. sturtii*	Hill Hibiscus				X			
Marsileaceae	*Marsilea drummondii*	Common Nardoo				X			

Family	Scientific Name	Common Name	Usage type						
			F	T	L	S	N	M	C
Marsileaceae	*Marsilea hirsuta*	Short-fruited Nardoo				X			
Marsileaceae	*Marsilea mutica*					X			
Mimosoideae	*Acacia burrowii*	Burrow's Wattle				X			
Mimosoideae	*Acacia buxifolia subsp. buxifolia*	Box-leaved Wattle				X			
Mimosoideae	*Acacia buxifolia subsp. pubiflora*	Box-leaved Wattle				X			
Mimosoideae	*Acacia caroleae*					X			
Mimosoideae	*Acacia cheelii*	Motherumbah				X			
Mimosoideae	*Acacia conferta*	Crowded-leaved Wattle				X			
Mimosoideae	*Acacia cultriformis*	Knife-leaved Wattle				X			
Mimosoideae	*Acacia dealbata*	Silver Wattle				X			
Mimosoideae	*Acacia deanei subsp. deanei*	Deane's Wattle				X			
Mimosoideae	*Acacia deanei subsp. paucijuga*	Green Wattle				X			
Mimosoideae	*Acacia decora*	Western Silver Wattle				X			
Mimosoideae	*Acacia doratoxylon*	Currawang				X			
Mimosoideae	*Acacia gladiiformis*	Sword Wattle				X			
Mimosoideae	*Acacia hakeoides*	Hakea Wattle				X			
Mimosoideae	*Acacia harpophylla*	Brigalow				X			
Mimosoideae	*Acacia havilandiorum*	Haviland's Wattle				X			
Mimosoideae	*Acacia homalophylla*	Yarran				X			
Mimosoideae	*Acacia implexa*	Hickory Wattle				X			
Mimosoideae	*Acacia ixiophylla*					X			
Mimosoideae	*Acacia juncifolia*	Rush-leaved Wattle				X			
Mimosoideae	*Acacia leiocalyx subsp. leiocalyx*	Curracabah				X			
Mimosoideae	*Acacia leucoclada subsp. leucoclada*					X			
Mimosoideae	*Acacia lineata*	Streaked Wattle				X			
Mimosoideae	*Acacia mariae*					X			
Mimosoideae	*Acacia melvillei*	Yarran				X			
Mimosoideae	*Acacia montana*	Mallee Wattle				X			
Mimosoideae	*Acacia neriifolia*	Silver Wattle				X			
Mimosoideae	*Acacia oswaldii*	Miljee				X			
Mimosoideae	*Acacia pendula*	Weeping Myall, Boree				X			
Mimosoideae	*Acacia penninervis var. penninervis*	Mountain Hickory				X			
Mimosoideae	*Acacia pilligaensis*	Pilliga Wattle				X			
Mimosoideae	*Acacia polybotrya*	Western Silver Wattle				X			
Mimosoideae	*Acacia salicina*	Cooba						X	X
Mimosoideae	*Acacia sertiformis*					X			
Mimosoideae	*Acacia spectabilis*	Mudgee Wattle				X			
Mimosoideae	*Acacia stenophylla*	River Cooba				X			
Mimosoideae	*Acacia subulata*	Awl-leaved Wattle				X			
Mimosoideae	*Acacia uncinata*	Gold-dust Wattle				X			
Moraceae	*Ficus coronata*	Creek Sandpaper Fig	X					X	
Moraceae	*Ficus rubiginosa f. glabrescens*		X						
Moraceae	*Ficus rubiginosa f. rubiginosa*		X						
Myoporaceae	*Eremophila debilis*	Amulla	X						
Myoporaceae	*Eremophila deserti*	Turkeybush	X						
Myoporaceae	*Eremophila glabra*	Tar Bush	X						
Myoporaceae	*Eremophila longifolia*	Emu-bush	X					X	
Myoporaceae	*Eremophila mitchellii*	Budda	X					X	
Myoporaceae	*Myoporum montanum*	Western Boobialla	X						
Myrtaceae	*Angophora floribunda*	Rough-barked Apple					X	X	X
Myrtaceae	*Callistemon brachyandrus*	Prickly Bottlebrush					X		
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush					X		
Myrtaceae	*Callistemon rigidus*	Stiff Bottlebrush					X		
Myrtaceae	*Callistemon sieberi*	River Bottlebrush					X		

Family	Scientific Name	Common Name	Usage type						
			F	T	L	S	N	M	C
Myrtaceae	*Corymbia trachyphloia subsp. amphistomatica*						X	X	X
Myrtaceae	*Eucalyptus albens*	White Box						X	X
Myrtaceae	*Eucalyptus camaldulensis*	River Red Gum						X	X
Myrtaceae	*Eucalyptus conica*	Fuzzy Box						X	X
Myrtaceae	*Eucalyptus macrorhyncha*	Red Stringybark						X	X
Myrtaceae	*Eucalyptus melliodora*	Yellow Box						X	X
Myrtaceae	*Eucalyptus microcarpa*	Western Grey Box							X
Myrtaceae	*Eucalyptus pilligaensis*	Narrow-leaved Grey Box						X	X
Myrtaceae	*Eucalyptus populnea subsp. bimbil*	Bimble Box						X	X
Myrtaceae	*Kunzea parviflora*							X	
Myrtaceae	*Leptospermum divaricatum*							X	
Myrtaceae	*Leptospermum parvifolium*							X	
Myrtaceae	*Leptospermum polyanthum*							X	
Myrtaceae	*Leptospermum polygalifolium subsp. transmontanum*							X	
Myrtaceae	*Leptospermum sphaerocarpum*							X	
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark							X
Myrtaceae	*Melaleuca thymifolia*							X	
Myrtaceae	*Melaleuca uncinata*	Broombush						X	
Nyctaginaceae	*Boerhavia dominii*	Tarvine		X				X	
Oleaceae	*Notelaea microcarpa var. microcarpa*	Native Olive	X						
Oleaceae	*Notelaea microcarpa var. velutina*	Native Olive	X						
Orchidaceae	*Cymbidium canaliculatum*	Tiger Orchid			X			X	
Orchidaceae	*Glossodia major*	Waxlip Orchid		X					
Oxalidaceae	*Oxalis exilis*			X	X				
Oxalidaceae	*Oxalis perennans*			X	X				
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	X						X
Phormiaceae	*Dianella longifolia*	Blueberry Lily	X						X
Phormiaceae	*Dianella revoluta var. revoluta*		X						X
Phormiaceae	*Dianella revoluta var. vinosa*		X						X
Phormiaceae	*Dianella sp. aff. tarda 'Pilliga'*		X						X
Phormiaceae	*Stypandra glauca*	Nodding Blue Lily						X	
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	X						
Pittosporaceae	*Bursaria spinosa subsp. spinosa*	Native Blackthorn						X	
Pittosporaceae	*Pittosporum angustifolium*	Butterbush, Gumbi Gumbi						X	
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	X						
Poaceae	*Cymbopogon refractus*	Lemon-scented Grass						X	X
Poaceae	*Imperata cylindrica*	Blady Grass			X				
Poaceae	*Isachne globosa*	Swamp Millet				X			
Poaceae	*Panicum decompositum*	Native Millet				X			
Poaceae	*Panicum effusum*	Hairy Panic				X			
Poaceae	*Panicum queenslandicum var. queenslandicum*	Yabila Grass				X			
Poaceae	*Phragmites australis*	Common Reed			X				X
Poaceae	*Sorghum halepense*	Johnson Grass				X			
Poaceae	*Sorghum leiocladum*	Wild Sorghum				X			
Poaceae	*Themeda avenacea*	Native Oatgrass				X			
Poaceae	*Themeda triandra*	Kangaroo Grass				X			
Polygonaceae	*Rumex brownii*	Swamp Dock						X	
Polygonaceae	*Rumex crystallinus*	Shiny Dock						X	
Polygonaceae	*Rumex tenax*	Shiny Dock						X	
Portulacaceae	*Portulaca oleracea*	Pigweed		X	X	X			

Family	Scientific Name	Common Name	Usage type						
			F	T	L	S	N	M	C
Proteaceae	*Banksia marginata*	Silver Banksia					X		
Proteaceae	*Persoonia sericea*	Geebung	X					X	X
Ranunculaceae	*Clematis glycinoides var. glycinoides*							X	
Ranunculaceae	*Clematis microphylla*	Small-leaved Clematis						X	
Rhamnaceae	*Alphitonia excelsa*	Red Ash						X	
Rhamnaceae	*Ventilago viminalis*	Supple Jack						X	X
Rosaceae	*Rubus parvifolius*	Native Raspberry	X						
Rutaceae	*Boronia anethifolia*							X	
Rutaceae	*Boronia bipinnata*							X	
Rutaceae	*Boronia glabra*	Sandstone Boronia						X	
Rutaceae	*Boronia granitica*	Granite Boronia						X	
Rutaceae	*Boronia ledifolia*	Sydney Boronia						X	
Rutaceae	*Boronia microphylla*	Small-leaved Boronia						X	
Rutaceae	*Boronia occidentalis*							X	
Rutaceae	*Boronia rosmarinifolia*							X	
Rutaceae	*Boronia warrumbunglensis*							X	
Rutaceae	*Geijera parviflora*	Wilga	X					X	X
Santalaceae	*Exocarpos aphyllus*	Leafless Ballart						X	
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	X					X	
Santalaceae	*Santalum acuminatum*	Sweet Quandong	X					X	
Santalaceae	*Santalum lanceolatum*	Northern Sandalwood	X					X	
Sapindaceae	*Dodonaea viscosa subsp. angustifolia*							X	
Sapindaceae	*Dodonaea viscosa subsp. angustissima*	Narrow-leaf Hop-bush						X	
Sapindaceae	*Dodonaea viscosa subsp. cuneata*	Wedge-leaf Hop-bush						X	
Sapindaceae	*Dodonaea viscosa subsp. cuneata x spatulata*							X	
Sapindaceae	*Dodonaea viscosa subsp. mucronata*							X	
Sapindaceae	*Dodonaea viscosa subsp. spatulata*	Broad-leaf Hopbush						X	
Solanaceae	*Nicotiana simulans*							X	
Solanaceae	*Nicotiana suaveolens*	Native Tobacco						X	
Solanaceae	*Physalis hederifolia*	Sticky Cape Gooseberry	X						
Solanaceae	*Physalis ixocarpa*	Ground Cherry	X						
Solanaceae	*Solanum amblymerum*		X						
Solanaceae	*Solanum americanum*	Glossy Nightshade	X						
Solanaceae	*Solanum brownii*	Violet Nightshade	X						
Solanaceae	*Solanum campanulatum*		X						
Solanaceae	*Solanum cleistogamum*		X						
Solanaceae	*Solanum coactiliferum*	Western Nightshade	X						
Solanaceae	*Solanum ellipticum*	Velvet Potato Bush	X						
Solanaceae	*Solanum esuriale*	Quena	X						
Solanaceae	*Solanum ferocissimum*	Spiny Potato-bush	X						
Solanaceae	*Solanum jucundum*		X						
Solanaceae	*Solanum linearifolium*	Mountain Kangaroo Apple	X						
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	X						
Solanaceae	*Solanum opacum*	Green-berry Nightshade	X						
Thymelaeaceae	*Pimelea curviflora var. divergens*								X
Thymelaeaceae	*Pimelea curviflora var. sericea*								X
Thymelaeaceae	*Pimelea linifolia subsp. collina*								X
Thymelaeaceae	*Pimelea linifolia subsp. linifolia*								X
Thymelaeaceae	*Pimelea micrantha*	Silky Rice-flower							X

Family	Scientific Name	Common Name	Usage type						
			F	T	L	S	N	M	C
Thymelaeaceae	*Pimelea microcephala subsp. microcephala*	Shrubby Rice-flower	X						X
Thymelaeaceae	*Pimelea neo-anglica*	Poison Pimelea					X?		
Thymelaeaceae	*Pimelea pauciflora*								X
Thymelaeaceae	*Pimelea simplex subsp. simplex*								X
Thymelaeaceae	*Pimelea stricta*	Gaunt Rice-flower							X
Thymelaeaceae	*Pimelea strigosa*	Slender Rice Flower							X
Thymelaeaceae	*Pimelea trichostachya*								X
Ulmaceae	*Trema tomentosa var. aspera*	Poison Peach						X	
Urticaceae	*Urtica incisa*	Stinging Nettle						X	
Urticaceae	*Urtica urens*	Small Nettle						X	
Vitaceae	*Clematicissus opaca*	Pepper Vine	X					X	
Xanthorrhoeaceae	*Xanthorrhoea acaulis*	Stemless Grass Tree			X		X		X
Xanthorrhoeaceae	*Xanthorrhoea australis*				X		X		X
Xanthorrhoeaceae	*Xanthorrhoea glauca subsp. angustifolia*				X		X		X
Xanthorrhoeaceae	*Xanthorrhoea glauca subsp. glauca*				X		X		X
Xanthorrhoeaceae	*Xanthorrhoea johnsonii*	Johnson's Grass Tree			X		X		X
Zamiaceae	*Macrozamia diplomera*					X			
Zamiaceae	*Macrozamia glaucophylla*					X			
Zamiaceae	*Macrozamia heteromera*					X			
Zamiaceae	*Macrozamia plurinervia*					X			
Zamiaceae	*Macrozamia polymorpha*					X			
Zamiaceae	*Macrozamia secunda*					X			