APPLICATION OF THE CLIMATE VULNERABILITY INDEX: GONDWANA RAINFORESTS OF AUSTRALIA (QUEENSLAND SECTION)

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Authors

Jon C. Day[1], Ellen Weber[2], Todd Doyle[2], Vanessa Round[3,4], Kristin Heron[1] and Scott F. Heron[1,5]

Affiliations

[1] College of Science and Engineering, James Cook University, Townsville QLD 4811, Australia

[2] Department of the Environment, Tourism, Science and Innovation (DETSI)

[3] National Environment Science Program, Climate Systems Hub

[4] Climate Science Centre, Commonwealth Scientific and Industrial Research Organisation

[5] UNESCO Chair on Climate Change Vulnerability of Natural and Cultural Heritage

Publication date

November 2025

ISBN

978-1-923389-10-6

Citation

Day JC, Weber E, Doyle T, Round V, Heron K, Heron S (2025) Application of the Climate Vulnerability Index: Gondwana Rainforests of Australia (Queensland Section). *State of Queensland, Brisbane* and *Climate Vulnerability Index, Townsville*. 77 + *vii* pp.

Enquiries regarding this report should be addressed to:

- Department of the Environment, Tourism, Science and Innovation, Brisbane, Australia
- Climate Vulnerability Index, Townsville, Australia

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Inside cover: Entrance to the trail network at Binna Burra, Lamington National Park (*Todd Doyle/QPWS&P*)

CVI

VALUES-BASED | SCIENCE-DRIVEN | COMMUNITY-FOCUSED

APPLICATION OF THE CLIMATE VULNERABILITY INDEX: FOR GONDWANA RAINFORESTS OF AUSTRALIA (QUEENSLAND SECTION)

Queensland Government

Australian Government
Department of Climate Change, Energy, the Environment and Water

unesco Chair

JAMES COOK UNIVERSITY AUSTRALIA

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EXECUTIVE SUMMARY

Albert's lyrebird (*Menura alberti*)
Michael Snedic

EXECUTIVE SUMMARY

This report describes outcomes of a workshop that assessed the effects of climate change on the Gondwana Rainforests of Australia (Queensland Section) World Heritage property. This assessment was based on the collective understanding of the property values, the best-available climate science and the connections between the property and the community.

Climate change has been identified as the fastest growing threat to heritage places around the world; many heritage places are already experiencing significant negative impacts and degradation. Recent observed trends for a range of climate stressors are spatially variable and expected to continue as climate change intensifies.

The Queensland Department of the Environment, Tourism, Science and Innovation (DETSI) was successful in obtaining an Australian Heritage Grant from the Australian Government's Department of Climate Change, Energy, the Environment and Water (DCCEEW) to develop a Climate Adaptation Plan. The approved project schedule included: identifying climate change vulnerability and impacts; undertaking facilitated workshops to consider climate risks across the property; and prioritising actions for integration into park management (including species, fire, pest, visitor, monitoring and research and asset management). As part of that grant, DETSI contracted the developers of the Climate Vulnerability Index (CVI), Professor Scott Heron and Dr Jon Day, to conduct a climate vulnerability workshop for the Gondwana Rainforests of Australia (Queensland Section). Building upon the foundation of the values and the best available climate science and information on community connections, the CVI process consists of two phases that, respectively, assess the Key Values Vulnerability and the Community Vulnerability.

The Queensland section was added in 1994 to the existing World Heritage property on the UNESCO World Heritage List, in recognition of the outstanding natural values within remnant patches of rainforest in south-eastern Queensland. Today the serial World Heritage property includes parts of 40 reserves across two Australian States, extending from Main Range National Park in southeast Queensland to Barrington Tops National Park in northern New South Wales (NSW).

The CVI application for Gondwana Rainforests of Australia (Queensland Section) was undertaken during a workshop, conducted 7–10 April 2025 in the town of Warwick, on the western side of Main Range National Park. The workshop involved over 50 participants including from: management and governance agencies from local, state (Queensland and NSW) and federal levels; the three First Nations groups with rights and interests across the area (Githabul, Yuggera Ugarapul and Yugambeh-speaking Peoples); research and science institutions; recreation and tourism peak bodies; NGOs and conservation interests; and members of the Gondwana World Heritage Advisory Committee (Queensland Section).

The involvement of the First Nations participants in the workshop is especially acknowledged as they brought invaluable perspectives across their three areas of Indigenous interest that would otherwise not have been appropriately considered. Similarly, the NSW participants reminded the workshop of the importance of working collaboratively across the two jurisdictions encompassing the entire World Heritage property.

A Steering Group comprising officers from the DETSI (World Heritage Unit, QPWS&P State and Regional Planners) and the CVI team worked together over several months to plan the workshop and conduct several preparatory meetings. The Steering Group agreed that a list of six to eight key values was appropriate given that the CVI assessment is a rapid process. Through the pre-workshop meetings and during the CVI workshop, eight key values were identified: (1) Unique rainforest habitats; (2) Other significant habitat for biodiversity; (3) Important flora; (4) Important fauna; (5) Ongoing ecological and evolutionary processes; (6) Significant geomorphological features and processes; (7) Indigenous cultural heritage; and (8) Post-contact heritage.

These key values collectively provided the foundation for the CVI process to identify the three climate stressors most likely to impact each of the key values

of Gondwana Rainforests of Australia (Queensland Section). A diverse array of climate stressors was identified as of high importance for at least one key value. The three key climate stressors selected as the focus of the CVI assessment were:

- **Wildfire** (noting this stressor is a cumulative effect of multiple, interacting climate factors)
- **Precipitation trend**, and
- **Temperature trend**.

The effects on the key values of these key stressors have already been seen, while future impacts on heritage attributes have the potential to occur at different times depending on the stressors and their cumulative impacts.

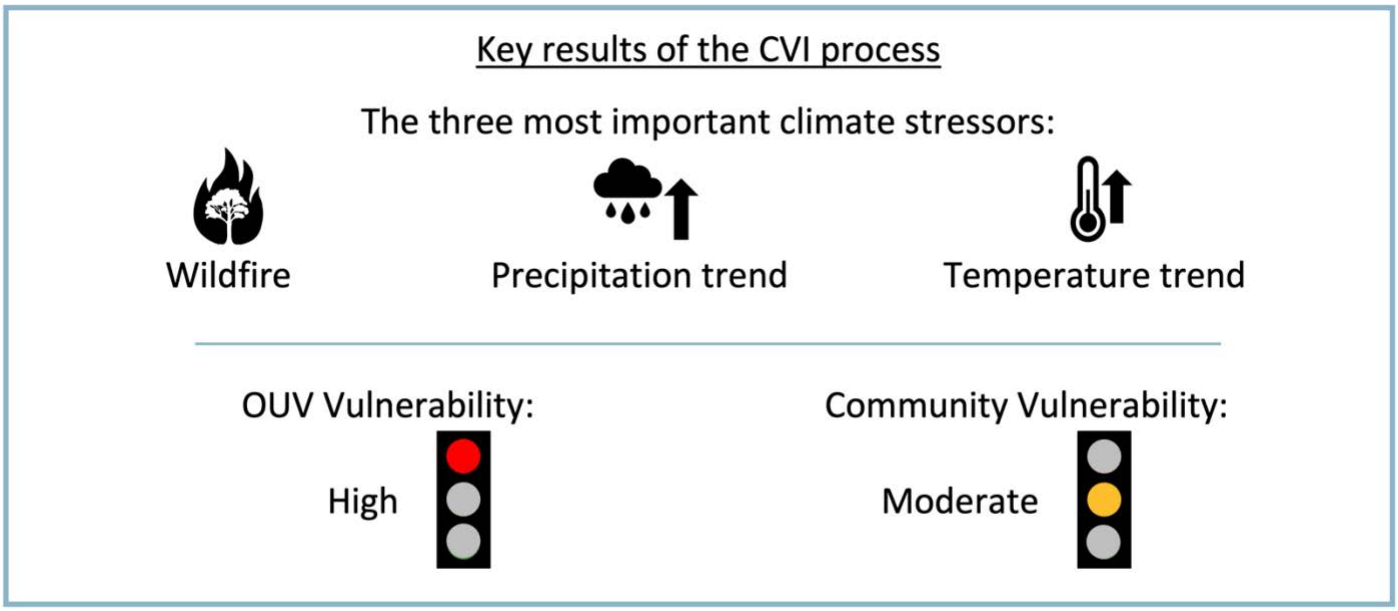
Through a series of presentations and interactive sessions during which participants made assessments, the CVI process was used to determine the **Key values Vulnerability** for the property as **High** (on a three-point scale, Low/Moderate/High). This indicates elevated risk of decline in or alteration of many of the values and attributes, including those that comprise the Outstanding Universal Value (OUV), reflecting risks to biodiversity and other heritage.

Eight key areas of economic activity connected with the property section were also considered, together with social and cultural connections to the property, in determining the potential impact upon the community from a decline in the key values. Through these assessments, the workshop determined the **Community Vulnerability** to be in the **Moderate** category.

These two assessments of vulnerability considered the adaptive capacity of the key values and their management, and of the community. Various adaptive strategies were discussed to mitigate potential impacts from the key climate stressors, including:

- First Nations partnerships for land management and decision-making
- Values-based fire management, including climate-focused, evidence-informed management of fuel loads
- Identifying and managing areas, including specific stressor-responses, as refugia
- Engineering pilot projects innovating adaptation options; e.g., identify, support and/or secure small-scale refugia, and
- Raising public awareness about climate change.

Participants also identified research opportunities and potential changes to policies to support more efficient and effective conservation and management.



A key message from the workshop participants was that the unprecedented 2019-20 fires across the World Heritage property (and beyond) may represent the onset of future periodic climate-driven disturbance events in rainforest environments. This may be comparable with the recurring coral bleaching events on the Great Barrier Reef during recent decades.

The CVI workshop represents a strong baseline and starting point for the continuing efforts to support management of the Gondwana Rainforests and the associated communities. Knowledge of the effects of climate change upon the Queensland section may be transferrable to support the management of other parts of the World Heritage property and beyond.

A combination of actions to address climate change (mitigation) and support climate adaptation will be essential to maintain the OUV of the World Heritage property. This includes urgent national and international action to substantially reduce greenhouse gas emissions to significantly lessen climate change impacts in the near-term, and to protect and preserve the heritage of the Gondwana Rainforests of Australia.

INTRODUCTION

Antarctic Beech, Lamington National Park
Nicholas Hill © QGov

1.1 Background to this report

This report outlines the application of the Climate Vulnerability Index (CVI) to assess the Queensland section of the Gondwana Rainforests of Australia World Heritage Area, one of five UNESCO World Heritage properties[1] in the State of Queensland, Australia.

The property is named for its geological and biological links to the ancient supercontinent Gondwana that existed in the southern hemisphere hundreds of millions of years ago. Erupting volcanoes subsequently shaped this area leaving behind the remnants of the ancient, massive, now extinct Tweed Volcano, the largest example of an erosion caldera anywhere in the world. Today, the largest and best stands of rainforest habitat remaining in this region include warm temperate, cool temperate, subtropical, littoral and dry rainforests. These areas are biodiversity hot spots, containing an amazing diversity of plants and animals, including many endemic and threatened species, along with remnant species from the ancient Gondwana as well as those recently evolved.

The Gondwana Rainforests of Australia are inscribed as a serial World Heritage property (total area, 366,500 hectares) spread over two jurisdictions — southeast Queensland and northeast New South Wales. The Queensland section (59,667 hectares, 16% of the property area) includes Lamington, Springbrook, Mount Chingee, Mount Barney and Main Range National Parks.

The First Nations peoples of the area have ancient and on-going relationships with these landscapes, which are a source of their physical and spiritual cultural practices. The land management practices and stewardship of First Nations peoples over countless generations have contributed to the unique values that exist today. The Queensland section is within the traditional lands of three First Nations groups – the Githabul, Yuggera Ugarapul and Yugambeh-speaking Peoples – who maintain their rights, interests and responsibilities across the area. These First Nations peoples have inextricable links with the environment, having protected, managed and received its rich natural resources for thousands of years.

Local threats are apparent in some locations, including incompatible land-use on adjacent properties, escaped fires, groundwater extraction, uncontrolled domestic animals, weeds, feral animals and pressure from residential and tourist development. Off-site activities such as clearing and erosion within upstream catchments may also be a potential threat to the attributes of the Outstanding Universal Value (OUV) in some parts of the property (Osipova et al., 2020).

This vulnerable natural landscape, modified by natural processes and human activities, continues to evolve. Among the main drivers of change are the variety of climatic conditions that have and will continue to change, as outlined in this report.

1.2 Overview of the Climate Vulnerability Index (CVI)

Climate change is the fastest growing global threat to a wide range of World Heritage properties (Osipova et al. 2017, 2020) and many properties have already been severely impacted. The severity of current climate impacts on individual areas varies, as do the range of climate stressors causing those impacts and the rate at which they are occurring. In most cases, impacts of climate change result in a degradation of the heritage values and attributes that collectively convey the OUV, the central concept for World Heritage properties and the basis for a property's inscription on the World Heritage List.

The Climate Vulnerability Index (CVI) is a systematic and rapid assessment tool that is values-based, science-driven and community-focused (Day et al. 2020). It was initially developed to assess the vulnerability of climate change upon all types of World Heritage properties – natural, cultural and

[1] The term World Heritage 'property' is the formal name in the international convention referring to a site or an area that is inscribed on the World Heritage List; however, terms such as World Heritage Site or World Heritage Area are colloquially used in other documents.

mixed – but is now being applied more widely and in different formats. The CVI is comprised of two phases assessing:

- **OUV Vulnerability** through use of a modified version of the IPCC vulnerability framework to evaluate the exposure, sensitivity, and adaptive capacity of identified key values of the property (i.e., the attributes that convey the OUV). Application of this process determines to what degree the key values may be impacted by three key climate stressors chosen to be the most relevant for that property, and
- **Community Vulnerability** through consideration of economic, social and cultural connections of the community associated with the property. The dependency of the community upon the property, and the capacity of the community to adapt to climate change-related decline in the key values are each evaluated.

Both assessments of vulnerability are highly relevant for key stakeholders, including site managers, management agencies and the community that lives in and around the property. Through its application, the CVI enables managers and stakeholders to consider climate change threats and what may be appropriate adaptive strategies for the management of their natural, cultural and community assets.

1.3 Why was the Queensland section of Gondwana Rainforests chosen for a CVI application?

Queensland has five World Heritage properties – K'gari, Great Barrier Reef, the Riversleigh component of Australian Fossil Mammal Sites (also in South Australia), Wet Tropics of Queensland, and Gondwana Rainforests of Australia (also in New South Wales). The Queensland Government, primarily through the Department of the Environment, Tourism, Science and Innovation (DETSI), is responsible for the state-wide coordination of World Heritage matters in Queensland. The Queensland Parks and Wildlife Service & Partnerships (QPWS&P) has primary responsibility for day to day on-ground management of the properties and recognises the importance and value of partnership with First Nations peoples. As climate change has become a critical factor for managing World Heritage properties, DETSI was keen to gain a deeper understanding the impacts of climate change, including any potential decline in or loss of World Heritage values.

In 2023, DETSI was successful in obtaining a grant through the Australian Heritage Grant program to deliver a Climate Adaptation Plan for the Gondwana Rainforests of Australia (Queensland Section). The overall objectives of the project were to facilitate integration of climate adaptation into World Heritage strategic planning and on-ground management activities; and to identify priority projects that maximise protection of the property's OUV and other values.

One of the key milestones (project activities) was to undertake a vulnerability assessment for the Queensland section of the property, and, with input from key stakeholders and experts, consider and prioritise key vulnerabilities and risks. The CVI co-developers, Professor Scott Heron and Dr Jon Day from James Cook University, Australia were engaged to apply the CVI for the Queensland section of the property.

GONDWANA RAINFORESTS OF AUSTRALIA

Angleheaded dragon at Goomburra, Main Range National Park
Robert Ashdown © QGov

2.1 Location and context

The World Heritage-listed Gondwana Rainforests of Australia (the property) covers 366,500 hectares in 41 separate reserves, mostly national parks in the Southeastern Queensland and NSW north-coast bioregions. This report is focused on the Queensland section of the property; however, some of the key themes and management responses outlined in this report are likely to be relevant to the New South Wales section of the property.

Most of the 59,667 hectares in the Queensland section of the property is located on or near the Great Escarpment, a dominant landscape feature that provides the steep, forested backdrop to the coastal plains. Land uses adjacent to the property section include other areas of national park, state forest, private property (including cleared or partly cleared farming land), crown land and residential area (e.g., as associated with the villages of Springbrook). Major population centres within 100 kilometres of the property include Brisbane, Ipswich and the Gold Coast (Figure 2.1).

The property extends through the four local government jurisdictions of the City of Gold Coast, Scenic Rim Regional Council, Lockyer Valley Regional Council and Southern Downs Regional Council. Across each of these local government councils, the property comprises less than 4% of the council area, with the exception of Scenic Rim for which the property covers 9.5% of the council area (Table 2.1).

The tangible and intangible values associated with land and water and the animal and plant communities are of great significance to First Nations peoples. They consider the Gondwana rainforests as a landscape of rich cultural value that extends across the Country of around 14 different First Nations groups, including a number with active and determined claims under the *Native Title Act 1993* (*Cwth*)[2]. The Queensland section

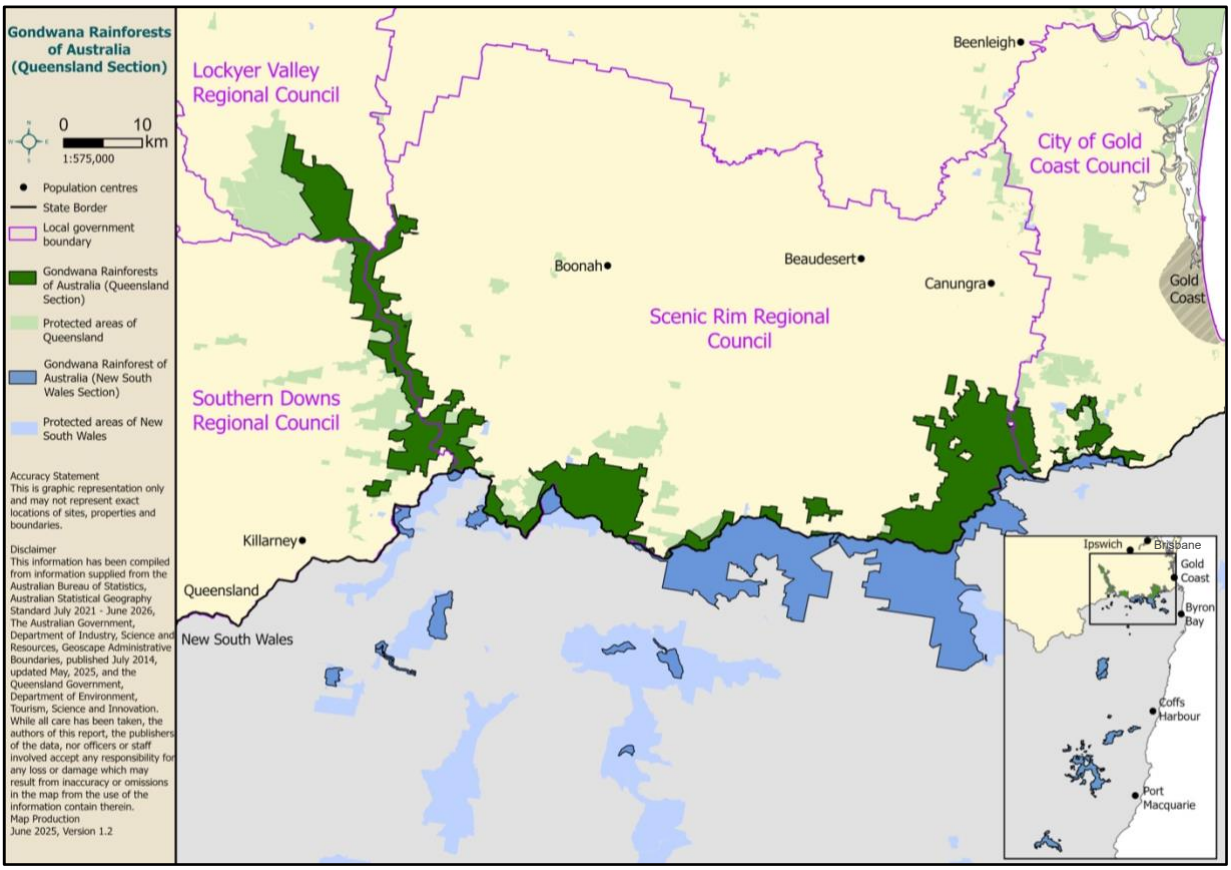


Figure 2.1 The boundary and extent of the Queensland section of the Gondwana Rainforests of Australia and the northern part of the New South Wales section (refer to the inset for the full extent of the property).

[2] https://www.austlii.edu.au/cgi-bin/viewdb/au/legis/cth/consol_act/nta1993147/

of the property falls within the Country of three First Nations groups that have active Native Title Claims (Figure 2.2):

- Yugambeh-speaking Peoples, represented by Danggan Balun (Five Rivers) People [Native Title Claim QC2017/007]
- Yuggera Ugarapul People [Native Title Claim QC2017/005]
- Githabul People (Waringh Waringh) [Native Title Claim QC2021/001].

Table 2.1 The four Local Government Areas (LGAs) that intersect with the Gondwana Rainforests of Australia (Queensland Section) and the proportion of each LGA that is World Heritage.

Local Government Area	Size of LGA (hectares)	World Heritage area (hectares)	Percentage of LGA (%)
Scenic Rim Regional Council	424,300	40,366	9.5%
Southern Downs Regional Council	708,800	8,358	1.2%
Lockyer Valley	226,900	6415	2.8%
City of Gold Coast	137,600	4528	3.3%

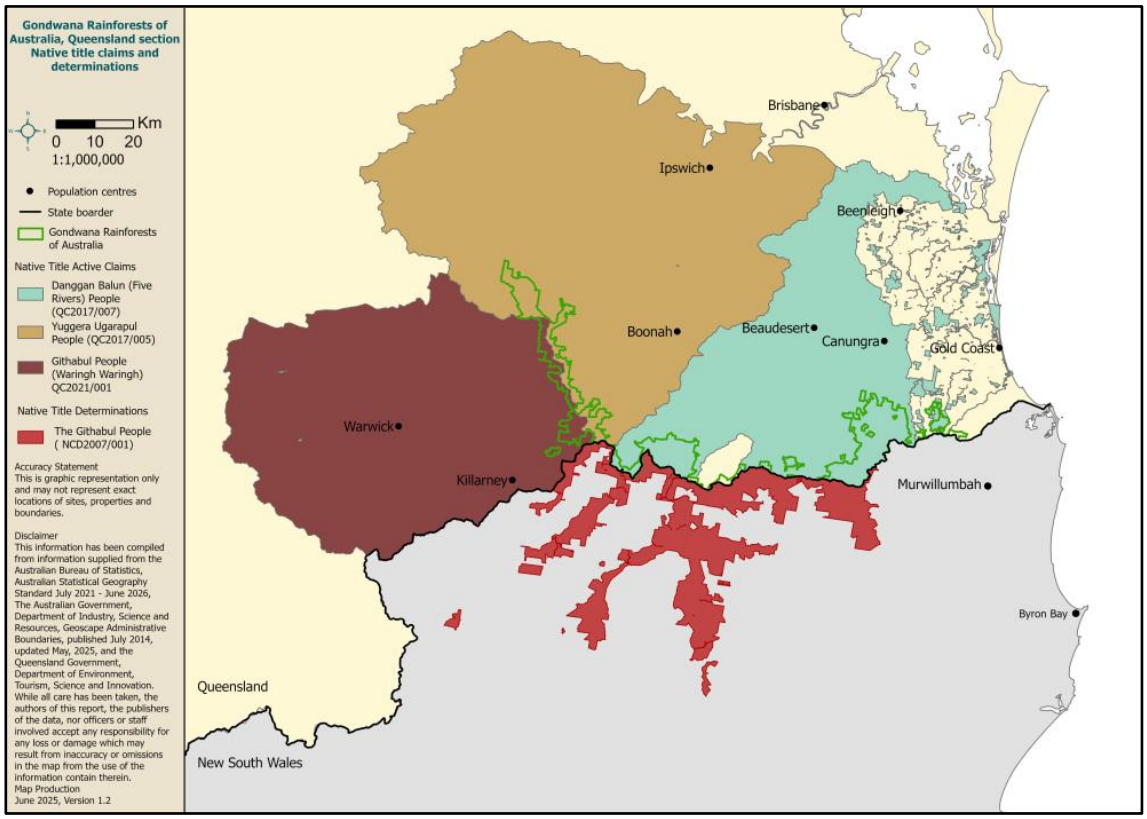


Figure 2.2 The boundary and extent of the three active Native Title Claims in Queensland and The Githabul People Determined Claim (NCD2007/001) in New South Wales.

2.2 The World Heritage property

The property's initial inscription in 1986, as the 'Australian East Coast Temperate and Sub-Tropical Rain Forest Parks', was in recognition of the outstanding natural values within remnant patches of rainforest in New South Wales (NSW). At that time, the property was listed for two of the ten World Heritage criteria reflecting major stages of the earth's evolutionary history; and significant ongoing geological processes and biological evolution[3].

The name was changed to 'Central Eastern Rainforest Reserves (Australia)' in 1994 when significant modifications to the boundary occurred and further sections were added to the serial property to include remnant rainforests on the Queensland side of the state border (Figure 2.1). This also included recognition under a third World Heritage criterion regarding important natural habitats for biological diversity. The property name was then changed again in 2007 to 'Gondwana Rainforests of Australia'.

Today, the serial property is inscribed under three World Heritage criteria[3] (summarised here):

(criterion *viii*) Outstanding examples representing major stages of earth's history

(criterion i*x*) Outstanding examples representing significant on-going geological and biological processes

(criterion *x*) Containing the most important and significant natural habitats for in-situ conservation of biological diversity.

The property today includes parts of 41 protected areas across two Australian States, extending from Main Range National Park in southeast Queensland to Barrington Tops National Park in northern NSW (Figure 2.1).

The Queensland section of Gondwana Rainforests of Australia is comprised of numerous fragmented areas with relatively convoluted boundaries (Figure 2.1), with the eastern two-thirds of the property section spread along the Queensland-NSW State border. These areas are managed on-ground as five distinct National Parks[4] under Queensland legislation, though not all of these are contiguous. Some areas are 'buffered' (e.g., certain adjacent areas are other national parks or state forests) but those adjacent protected areas are small in extent compared with the total area of the Queensland section of the property.

Overall, the property has a high ratio of boundaries to the total area within the reserves, which presents risks. There is a lack of connectivity between many of the 41 protected areas, and the relatively complex boundaries contribute to edge effects. The property abuts numerous landholdings with differing objectives and management regimes, so the range of adjacent land uses exacerbates threats, both to and from, the property.

Much of the Gondwana remnants are effectively 'islands' of high-altitude rainforest and lowland subtropical and dry vine forests surrounded by various land uses and threats. The edge effects at the long and complex boundaries mean that dispersed activities (such as beekeeping, broad acre cropping, weed treatment, changes in run-off patterns and broader ground water extraction) can have profound impacts upon the values in the World Heritage property and be difficult to manage.

Potential extensions to the property have been suggested to improve the connectivity between different components and to reduce the edge effects. Increased connectivity would improve resilience and enable greater protection of the OUV by providing more secure migration routes at times of wildfire and a means to recolonize following wildfire. As well as expanding the overall extent and consolidating the boundaries of the property, there is also a need to focus on connectivity across privately-owned landscapes by encouraging compatible land management, restoration and conservation zones on private lands.

2.3 Geology and geomorphology

The Gondwana Rainforests area is named for the ancient supercontinent Gondwana that existed in the

[3] The specific wording of the World Heritage criteria has changed over the years; the full wording of the criteria, applicable to the property today, is available at https://World Heritagec.unesco.org/en/faq/222

[4] Lamington, Springbrook, Mt Chingee, Mt Barney and Main Range National Parks

southern hemisphere hundreds of millions of years ago. This supercontinent is thought to have started to break up around 180 million years ago; present day Australia is one fragment when Australia separated from Antarctica and new continental margins developed. The margin that formed along Australia's eastern edge is characterised by an asymmetrical marginal swell that runs the length of eastern Australia from Victoria to North Queensland, parallel to the coastline. Ancient seabeds were uplifted to create elevated high country, also known as the Great Dividing Range, the erosion of which has resulted in the Great Escarpment as it appears today.

This eastern continental margin experienced volcanicity during the Cenozoic Era as the Australian continental plate moved over one of the planet's hotspots. The Gondwana Rainforests area provides outstanding examples of significant ongoing geological processes associated with volcanic activity in the Tertiary period. Volcanos erupted in sequence along the east coast resulting in the Tweed and Focal Peak (near the Queensland/NSW border) and Ebor and Barrington (further south in NSW) volcanic shields. This sequence of volcanos is significant as it enables the dating of the geomorphic evolution of eastern Australia through the study of the interaction of these volcanic remnants with the eastern highlands. The region also includes one of the best-preserved erosion calderas in the world.

Other outstanding examples of ongoing geomorphological processes include striking vertical cliffs, spectacular waterfalls, and other natural features that dominate the landscape. Examples in the Queensland section include Queen Mary Falls in Main Range National Park; Twin Falls, Purling Brook Falls and Natural Bridge in Springbrook National Park; and the views atop Morans Falls out across Morgana Creek gorge in Lamington National Park.

2.4 Biodiversity

There is a wide range of plant and animal lineages and communities with ancient origins in Gondwana. Gondwana Rainforests of Australia has a high diversity of plants and animals and provides habitat for more than 200 rare or threatened plant and animal species (at least 117 in Queensland), and about 150 endemic species (World Heritage Committee, 2012). Across the entire property, over 170 families, 695 genera and 1625 species of vascular plants have been recorded (IUCN 2020). Similarly, across the property, there are some 45 species of frogs, 110 species of reptiles and 31 species of bats (IUCN, 1994; World Heritage Committee, 2012). Many of these survive only within the property. Given new discoveries and more recent taxonomic changes, these figures are likely to be higher.

2.4.1 Flora

Gondwana Rainforests of Australia protects the largest and best stands of rainforest habitat remaining in this region. Many of the rare and threatened flora and fauna species are rainforest specialists and their vulnerability to extinction is due to a variety of factors, including the rarity of their rainforest habitat. The property protects many rainforest types including warm temperate, cool temperate, subtropical, littoral and dry rainforests. The area contains extensive subtropical rainforest and nearly all the world's Antarctic beech cool temperate rainforest, through which it provides a home for many rare and threatened plants and animals, including ancient life forms.

The property also protects large areas of other vegetation including a diverse range of heaths, rocky outcrop communities, forests and woodlands. The complex dynamics between rainforests and tall open forests particularly demonstrates the close evolutionary and ecological links between these communities.

Gondwana Rainforests of Australia preserves outstanding examples of the oldest elements of the world's ferns from the Carboniferous period; is one of the most significant centres of survival for ancient Auraucarians; and has an outstanding record of the evolution and spread of Angiosperms. Containing representatives of primitive plant families linked to the birth of flowering plants over 100 million years ago, the property preserves the best living examples of relict plant species that can trace their origins to the second wave of flowering plants. This wave led to

the most radical shift in the world's vegetation when the relatively depauperate conifer forests were overwhelmed by the diversity of flowering plants. Subtropical rainforests are the closest living analogue to the vegetation that followed this change and was widespread during the late Cretaceous/early Tertiary period - the 'golden age' of modern flora.

By the time of European settlement, rainforests covered only 1% of Australia's landmass and were restricted to refugia with suitable climatic conditions and protection from fire. Following European settlement, clearing for agriculture saw further loss of rainforests: only one-quarter of the rainforest present in Australia at the time of European settlement remains.

2.4.2 Fauna

Gondwana Rainforests of Australia provides habitat for many rare or threatened fauna, including the recently discovered black-tailed antechinus (*Antechinus arktos*; IUCN 2020). This species is known from three isolated subpopulations, at altitudes above 950 m above sea level, including in Queensland's Springbrook and Lamington National Parks (Threatened Species Scientific Committee, 2017). Species continue to be discovered in the property, as well as the re-discovery of two mammal species previously thought to have been extinct: the Hastings River Mouse (*Pseudomys oralis*) and Parma Wallaby (*Macropus parma*).

There is also an outstanding number of songbird species, including lyrebirds (Menuridae), scrub-birds (Atrichornithidae), treecreepers (Climacteridae) and bowerbirds and catbirds (Ptilonorhynchidae), belonging to some of the oldest lineages of passerines that evolved in the late Cretaceous period. Other threatened bird species include the Coxen's fig-parrot (*Cyclopsitta diophthalma coxeni*, probably extinct), the black-breasted button-quail (*Turnix melanogaster*) and the eastern bristlebird (*Dasyornis brachypterus*) (State Party of Australia, 1994).

Outstanding examples of other relict vertebrate and invertebrate fauna from ancient lineages linked to the break-up of Gondwana also occur in the property (World Heritage Committee, 2012). For example, relict species of reptiles include chelid turtles (*Emydura macquarii signata* and *Myuchelys latisternum*), the leaf-tailed gecko (*Saltuarius* spp.) and the southern angle-headed dragon (*Lophosaurus spinipes*). Relict frogs include all frogs in the Myobatrachidae (recently subdivided into Myobatrachidae and Limnodynastidae, with some authors recognising a third family Rheobatrachidae; Frost et. al., 2014) and Pelodryadidae families.

Relict invertebrates include fresh-water crayfish; land snails; velvet worms; a number of beetle families, including flightless carabid beetles; the Richmond birdwing (the second largest butterfly in Australia, *Ornithoptera richmondia*) and glow-worms (State Party of Australia, 1994; Hunter, 2004).

2.5 Connections to cultural heritage

The area that today is known as the Gondwana Rainforests of Australia encompasses the Country of various First Nations peoples. However, when initially listed as World Heritage in 1984, cultural values were not included (see Section 2.2). Similarly, when significant boundary modifications incorporated the Queensland section to the property in 1994 and when the Statement of Outstanding Universal Value was retrospectively adopted (in 2012), the First Nations peoples within the area were not mentioned.

However, the natural and cultural values of the area are intertwined. Cultural beliefs and practices have been shaped by the natural world; and the natural environment has been influenced, and continues to be influenced, by human activities and perceptions (e.g., McIntyre-Tamwoy 2005, 2008; RAIN 2014).

Today, the ancient and enduring relationships that First Nations people have with these landscapes is acknowledged by the managers of the property and, increasingly, by the broader community (though noting the reflection of First Nations participants that they consistently need to demonstrate their connection to place). The Country of three First Nations groups – the Yugambeh-speaking Peoples; the Yuggera Ugarapul People; and the Githabul People – lies partly within the Queensland section of the Gondwana Rainforests of Australia. The deep spiritual

and physical connections of these First Nations peoples to the land are increasingly being recognised, along with their cultural practices and responsibilities within the area.

In 2023, the Queensland and Commonwealth Governments agreed to enhance the participation of First Nations peoples in the governance and management of the Queensland section of the World Heritage property. Following a consultation process that involved First Nations peoples with rights and interests in the property, a more-inclusive Queensland advisory committee was appointed, which includes First Nations and community members, scientists and an independent Chair.

Building upon the above recognition, the CVI Steering Group agreed on the importance of 'Indigenous Cultural Heritage' being included as one of the key values to be assessed during the workshop.

Prior to the workshop, discussions were held with individuals from each of the three First Nations groups during on-Country visits. During those discussions, it was agreed that specific examples of attributes (tangible and intangible) were an appropriate way to undertake the initial assessment of the broad key value of Indigenous Cultural Heritage. It was also recognised, however, that many of the attributes, as well as Indigenous connections (rights, responsibility and purpose) exist across the entire landscape (i.e., Country), and only part of that landscape today is within the World Heritage property. Furthermore, many of the other key values that were proposed to be assessed as part of the CVI process (see Section 2.6) also encompass aspects of significance to First Nations peoples.

The following six groupings of specific examples of attributes (tangible and intangible) were agreed by the three First Nations groups as an appropriate way to assess the broad key value of Indigenous Cultural Heritage for the property as a whole:

Location-specific evidence of historic occupation

(i) *Tangible attributes* e.g., scar trees, rock art sites, bora rings, artefact scatters, rock wells, occupation sites/rock shelters, burial sites, place names, secret/sacred places/objects

(ii) *Intangible attributes* e.g., sacred sites (such as initiation sites, Women's Business, Men's Business, 'dangerous' sites), ceremonial places, healing waters

Broad-area examples of historic occupation

(i) *Tangible attributes* e.g., recognised resistance/conflict sites, recognised trading areas

(ii) *Intangible attributes* e.g., Dreaming/creation places, traditional pathways, song-lines, language

Contemporary use by Indigenous people

(i) *Tangible attributes* e.g., bush tucker/traditional foods; looking after Country (including fire management); species essential to pass on traditional knowledge (such as medicinal plants); species used to make traditional items (spears, nulla-nulla, dillies, nets, necklaces, etc.), artwork

(ii) *Intangible attributes* e.g., totemic species (plants & animals); links to ancestors

A cultural heritage database and a cultural heritage register have been established under the *Aboriginal Cultural Heritage Act 2003 (Qld)*[5]. The database provides a tool to help Aboriginal and Torres Strait Islander parties, researchers and other persons assess the Aboriginal and Torres Strait Islander cultural heritage values of particular areas. The register is publicly available and the examples provided above are typical of those described in the Queensland Government's online portal[6].

2.6 Identifying the values of Gondwana Rainforests of Australia World Heritage property

When formally listing an area as World Heritage under one or more natural criteria, IUCN (as the relevant Advisory Body for natural World Heritage), in conjunction with UNESCO, summarises the significant values and attributes for that property in an approved Statement of Outstanding Universal Value. The Statement of OUV for Gondwana Rainforests of

[5] https://www.legislation.qld.gov.au/view/html/inforce/current/act-2003-079
[6] https://www.culturalheritage.qld.gov.au/achris/public/home

Australia (Appendix 1), as provided on the property's UNESCO webpage[7], is a description of the property values and attributes benchmarked at the date of inscription on the World Heritage List. Being a static document, the approved Statement of OUV cannot be updated without again going through the official UNESCO nomination process.

2.6.1 The key values used in the CVI process

Prior to the CVI workshop for Gondwana Rainforests of Australia (Queensland Section), the CVI team identified excerpts from the Statement of OUV, which were grouped together to form a list of 'key values'. These key values are significant, with many internationally recognised as outstanding, and embody the Statement of OUV.

'Key values' is also a term used by Queensland Parks and Wildlife Service & Partnerships (QPWS&P) as part of their Values-Based Management Framework (VBMF). A values-based approach is used in their planning processes, beginning with an assessment of the park's values and the 'Levels of Service' required to manage these values effectively. Prioritised measurable objectives are set during this process and provide the basis on which performance is evaluated. Each park has a clearly articulated set of values that forms the basis of their systematic approach to park management. Aligned with the VBMF process, 28 World Heritage values were identified for the Gondwana Rainforests of Australia (Figure 2.3).

Through the process, it was recognised that neither the Statement of OUV nor the VBMF approach had acknowledged Indigenous cultural values, which are today regarded as significant for this property, as they are for most (if not all) World Heritage properties globally[8]. Furthermore, post-contact heritage was also recognised as an important component of the values.

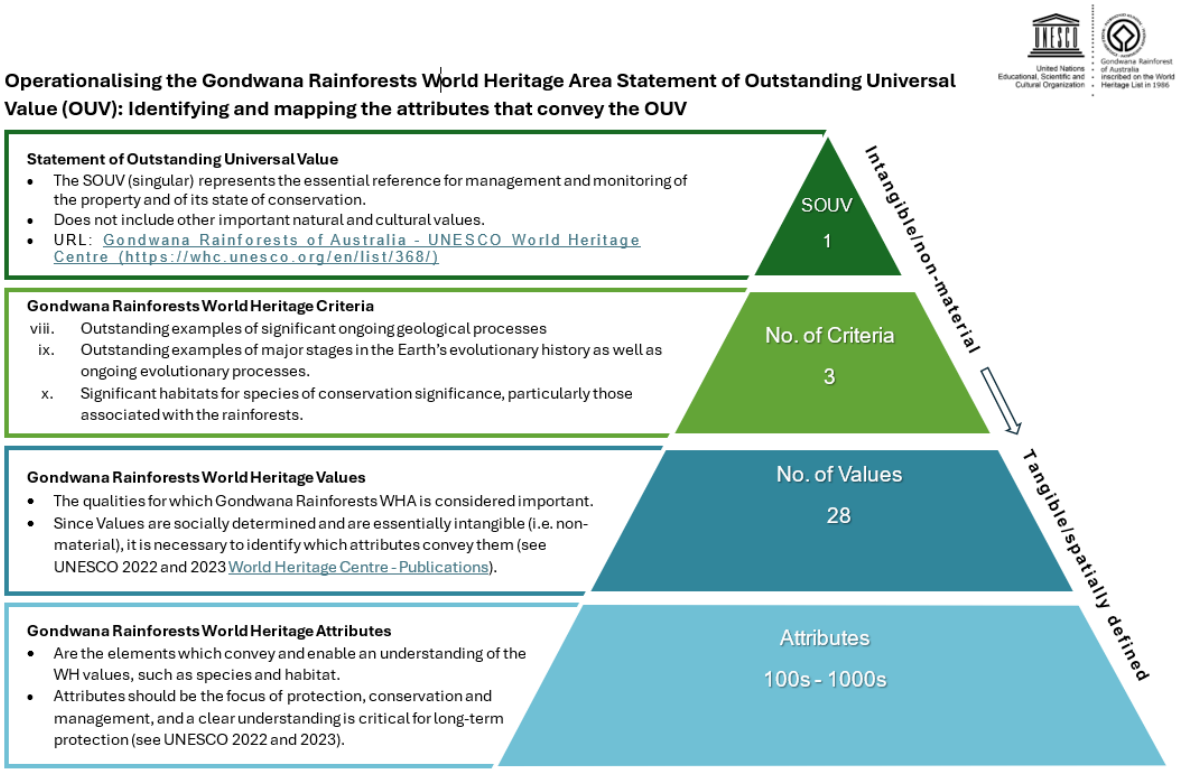


Figure 2.3 Depiction of the implementation of the Values-based Management Framework (VBMF) to the Gondwana Rainforests of Australia World Heritage property; the VBMF is used across Queensland parks as part of the systematic basis for park management.

[7] https://whc.unesco.org/en/list/368

[8] Currently, the UNESCO World Heritage List comprises 1,248 sites of Outstanding Universal Value recognised under one or more natural and cultural criteria. However, only 41 sites (3%) are recognised under both natural and cultural criteria, highlighting the challenge to recognise interconnections between nature and culture.

The Steering Group[9] for the workshop agreed that a list of 6–8 key values was appropriate for the rapid assessment within the CVI process. In consultation with DETSI experts, the Steering Group proposed seven key values for the Gondwana Rainforests of Australia (Queensland Section) to be used in the workshop. During the CVI workshop, participants recommended that an additional key value (#5 below) be included, resulting in the following eight key values:

1. Unique rainforest habitats
2. Other significant habitat for biodiversity
3. Important flora
4. Important fauna
5. Ongoing ecological and evolutionary processes
6. Significant geomorphological features and processes
7. Indigenous cultural heritage, and
8. Post-contact heritage

These eight key values collectively provided the foundation for the CVI process to identify the key climate stressors. Excerpts from the Statement of OUV provide exemplar descriptors for the key values (Table 2.2). Links to the World Heritage criteria and the key values within the VBMF process were mapped as part of this process (Appendix 2).

Attributes associated with the key values are the elements of a heritage place that convey its heritage/conservation values. These provide exemplars of the broad key values and there may be overlap between key values and their associated attributes (see Appendix 2). Attributes can be physical qualities, material fabric and other tangible features but can also be intangible aspects such as processes, social arrangements, cultural practices, associations and relationships that may also be reflected in the physical elements of the property. On-ground management is typically undertaken to address the highest priority attributes; increasingly the maintenance of intangible attributes is also being recognised.

Table 2.2 Excerpts from the Statement of Outstanding Universal Value (OUV) relating to each key value.

Key Value for Gondwana	Excerpts from the Statement of OUV
1. Unique rainforest habitats	the major remaining areas of rainforest in southeast Queensland
	The Gondwana Rainforests also provides the principal habitat for many threatened species of plants and animals
	the largest and most significant remaining stands of subtropical rainforest and Antarctic Beech (*Nothofagus moorei*) cool temperate rainforests in the world, the largest and most significant areas of warm temperate rainforest and one of only two remaining large areas of *Araucarian* rainforest in Australia
	the rainforests have been described as 'an archipelago of refugia, a series of distinctive habitats that characterise a temporary endpoint in climatic and geomorphological evolution'. The distances between these 'islands' of rainforest represent barriers to the flow of genetic material for those taxa which have low dispersal ability, and this pressure has created the potential for continued speciation.

[9] The Steering Group comprised officers from the DETSI (World Heritage Unit, QPWS&P State and Regional Planners) and the CVI team.

Key Value for Gondwana	Excerpts from the Statement of OUV
2. Other significant habitat for biodiversity	protects large areas of other vegetation including a diverse range of heaths, rocky outcrop communities, forests and woodlands. These communities have a high diversity of plants and animals that add greatly to the value of the Gondwana Rainforests as habitat for rare, threatened and endemic species
	provides the principal habitat for many species of plants and animals of OUV, including more than 270 threatened species as well as relict and primitive taxa
	joined by corridors of semi-natural habitats and buffers, compensation for small size and scattered fragments is being made through intensive management consistent with approved management plans and policy
3. Important flora	include the 'Age of the Pteridophytes' from the Carboniferous Period with some of the oldest elements of the world's ferns represented
	the 'Age of Conifers' in the Jurassic Period with one of the most significant centres of survival for *Araucarians* (the most ancient and phylogenetically primitive of the world's conifers)
	an outstanding record of the 'Age of the Angiosperms'. This includes a secondary centre of endemism for primitive flowering plants originating in the Early Cretaceous, the most diverse assemblage of relict angiosperm taxa representing the primary radiation of dicotyledons in the mid-Late Cretaceous
	a unique record of the evolutionary history of Australian rainforests representing the 'golden age' of the Early Tertiary, and a unique record of Miocene vegetation that was the antecedent of modern temperate rainforests in Australia
	a secondary centre of endemism for primitive flowering plants
	A wide range of plant and animal lineages and communities with ancient origins in Gondwana, many of Which are restricted largely or entirely to the Gondwana Rainforests, survive in this collection of reserves
4. Important fauna	Species continue to be discovered in the property including the re-discovery of two mammal species previously thought to have been extinct: the Hastings River Mouse (*Pseudomys oralis*) and Parma Wallaby (*Macropus parma*)
	… an outstanding number of songbird species, including lyrebirds (Menuridae), scrub-birds (Atrichornithidae), treecreepers (Climacteridae) and bowerbirds and catbirds (Ptilonorhynchidae), belonging to some of the oldest lineages of passerines that evolved in the Late Cretaceous
	outstanding examples of other relict vertebrate and invertebrate fauna from ancient lineages linked to the break-up of Gondwana also occur
5. Ongoing ecological and evolutionary processes	outstanding examples of major stages in the Earth's evolutionary history as well as ongoing evolutionary processes
	outstanding examples of … biological processes, and exceptional biological diversity
	complex dynamics between rainforests and tall open forest particularly demonstrates the close evolutionary and ecological links between these communities

Key Value for Gondwana	Excerpts from the Statement of OUV
6. Significant geomorphological features and processes	outstanding examples of major stages of the Earth's evolutionary history… provides outstanding examples of significant ongoing geological processes
	This eastern continental margin experienced volcanicity during the Cenozoic Era as the Australian continental plate moved over one of the planet's hot spots. Volcanoes erupted in sequence along the east coast resulting in the Tweed, Focal Peak, Ebor and Barrington volcanic shields. This sequence of volcanos is significant as it enables the dating of the geomorphic evolution of eastern Australia through the study of the interaction of these volcanic remnants with the eastern highlands.
	the erosion of which has resulted in the Great Divide and the Great Escarpment
	The Tweed Shield erosion caldera is possibly the best-preserved erosion caldera in the world, notable for its size and age
	All three stages relating to the erosion of shield volcanoes (the planeze, residual and skeletal stages) are readily distinguishable
7. Indigenous cultural heritage	No mention in approved Statement of OUV
8. Post-contact heritage	By the time of European settlement, rainforests covered only 1% of the landmass and were restricted to refugia with suitable climatic conditions and protection from fire. Following European settlement, clearing for agriculture saw further loss of rainforests and only a quarter of the rainforest present in Australia at the time of European settlement remains.

2.6.2 Interrelationships between the key values

The key values (KV) do not exist in isolation; there are commonalities and interrelationships between them. At a high level, they can be grouped as:

- habitat-focused: KV1 (*Unique rainforest habitats*) and KV2 (*Other significant habitat for biodiversity*)
- species-focused: KV3 (*Important flora*) and KV4 (*Important fauna*)
- process-focused: KV5 (*Ongoing ecological and evolutionary processes*) and KV6 (*Significant geomorphological features & processes*), and
- focused on heritage aspects: KV7 (*Indigenous Cultural Heritage*) and KV8 (*Post-contact Heritage*).

In terms of interrelationships between the key values, these may be (but are not automatically) equal in their influence upon one another. Some examples include:

- *Significant geomorphological features & processes* (KV6) provides the foundation for most other values
- *Ongoing ecological and evolutionary processes* (KV5) has strong linkages with the habitat- and species-focused KVs (KV1–KV4).
- The relationship between *Indigenous Cultural Heritage* and the other KVs is more complex. The extent to which First Nations people used or relied upon the habitat- and species-focused key values (KV1–KV4) was very significant (e.g., for bush tucker, medicinal plants). Spiritually, there has been a very strong interrelationship with all key values. In the other direction, the influence of *Indigenous Cultural Heritage* upon the other key values may be less clear, though noting use of fire in management as one example of influence.
- *Post-contact Heritage* (KV8) has been significantly influenced by the habitat- and species-focused key values (KV1–KV4), with perhaps less influence from the processes (KV5 & KV6) and Indigenous Cultural Heritage (KV7).

A visual depiction of these interrelationships (Table 2.3) is interpreted by considering influence upon the

key value in each row (listed down the left-hand side) from the key values in columns (italicised names; e.g., *…unique rainforest habitats*).

Within the World Heritage system, there is a growing interest in bridging the artificial divide between nature and culture to rethink natural and cultural heritage as interrelated and interdependent concepts, rather than as separate domains. While this poses policy and institutional complexities, it also presents opportunities for heritage practitioners and communicators at the management level.

Table 2.3 Interrelationships between key values of Gondwana Rainforests of Australia (Queensland Section)
Key: ✓✓ significant interrelationship; ✓ some interrelationship; -- minimal or no interrelationship.

	The extent to which each numbered key value** (in rows) **may have been influenced by …							
	…unique rainforest habitats	***…other significant habitat for biodiversity***	***…important flora***	***…important fauna***	***…ongoing ecological & evolutionary processes***	***…significant geomorphological features & processes***	***…Indigenous Cultural Heritage***	***…post-contact Heritage***
1. Unique rainforest habitats		✓✓	✓✓	✓	✓✓	✓✓	✓	✓✓
2. Other significant habitat for biodiversity	✓		✓✓	✓	✓✓	✓✓	✓✓	✓✓
3. Important flora	✓✓	✓✓		✓	✓✓	✓✓	✓	✓✓
4. Important fauna	✓✓	✓✓	✓✓		✓✓	✓✓	✓	✓✓
5. Ongoing ecological & evolutionary processes	✓	✓	✓✓	--		✓✓	✓	✓
6. Significant geomorph-ological features & processes	--	--	--	--	✓		--	✓
7. Indigenous Cultural Heritage	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓		✓
8. Post-contact Heritage	✓✓	✓✓	✓✓	✓	✓	--	✓✓	

2.6.3 Other Significant Property Values

In addition to the key values, stakeholders recognise that the World Heritage property invariably includes other significant values, whether they relate to heritage (tangible or intangible) or to other aspects (e.g., economic, social, spiritual, environmental, scientific). To distinguish these from the identified key values, these values are called other Significant Property Values (SPVs).

Other SPVs may be significant locally, regionally, nationally or internationally; and may also be recognised as 'significant' under legislation (e.g., National or State Heritage Lists/Registers) or through local or regional by-laws. SPVs may be considered just as important as the key values when it comes to management of the property and may require specific management actions to ensure the values are protected and/or conserved, especially as most other SPVs are also subject to impacts from stressors, including climate change.

Unlike key values, the list of other SPVs is dynamic and should be periodically amended as new species are discovered or the significance of an attribute is identified (e.g., economically, socially, culturally) or formally recognised (e.g., on a heritage register). If required, additional rows should be added.

An initial list of other SPVs for Gondwana Rainforests of Australia (Queensland Section) provides these values in broad groupings (e.g., biological diversity, aesthetic, historic/cultural, spiritual, economic, scientific values; see Appendix 3). Not all broad groupings necessarily apply in every World Heritage property; these groupings are provided to guide further development of the list. It may also be helpful for management purposes to prioritise the other SPVs within each group.

2.7 Evaluation of the condition and recent trend of the key World Heritage values

In the CVI process, the identified key values of the property are used as the basis for an assessment of the current condition and recent trend in one of the early plenary sessions of the workshop. This assessment is undertaken for two principal reasons:

- Discussing the key values is important as a foundational part of the CVI process to develop a shared understanding of these, which subsequently informs the prioritisation of the climate stressors in terms of their impacts upon the key values, and
- The assessment of 'current condition and recent trend' provides a baseline (typically, an already disturbed baseline) from which changes in the key values and associated attributes may be assessed in future years.

The CVI workshop participants had difficulty in reaching consensus on assessments of the current condition and recent trend for many of the key values. Foremost among the reasons for this was the expanse and complexity of the Queensland section, such that different areas were described as having different current condition and/or recent trend. Some participants commented that for some key values they intuitively focused on specific sections or aspects rather at the scale of the entire Queensland section. Another complicating factor for some participants was the use of the date of World Heritage inscription of the Queensland section (i.e., 1994) as the starting point for determining the trend, noting that this timepoint was already a 'disturbed baseline' and that many values had already markedly changed by that date.

The overriding view in the workshop was that the current condition of all eight key values was of concern. The level of that concern varied between attributes and their locations, as well as between participants, with differences ranging from 'Good with some concern' through to 'Significant Concern' and with some being of 'Critical' concern. Completing a comprehensive assessment of the current condition and recent trend for the eight key values in Gondwana during the workshop was not essential, given that workshop participants already had a sound understanding of the key values (i.e., the first rationale for this assessment, as noted above).

Following the workshop, an independent summary of the status and trend for many of the natural values

associated with the OUV was identified (Foley, 2021). This assessment drew upon the three published IUCN World Heritage Outlook Reports (Osipova et al. 2014, 2017, 2020) summarising the state and trend of nine World Heritage values in Gondwana (Table 2.4). In the IUCN Outlook Report, unless data deficient, state is reported in one of four categories [good, low concern, high concern, critical] and trend in one of three [improving, stable, deteriorating]. There is a degree of overlap of each of these nine values with key values used in the CVI workshop, though with the notable absence of cultural heritage values (key values 7 and 8). Nonetheless, this independent assessment provides a baseline against which changes to the natural values may be referenced.

Table 2.4 Values identified in the IUCN Outlook process for the entire Gondwana Rainforests of Australia World Heritage property and the assessed state and trend of each from the 2014 and 2017 Outlook reports; and for 2020 (after Foley 2021), together with their associated key values (KV) used in the CVI workshop.

Gondwana Rainforests of Australia values	CVI key value/s	2014		2017		2020	
		State	Trend	State	Trend	State	Trend
Outstanding examples of significant ongoing geological processes	KV 6	Good	Stable	Good	Stable	Good	Stable
Outstanding examples of relict plant species	KV 1,2	Data deficient	Stable	Data deficient	Stable	High concern	Deteriorating
Outstanding examples of relict and other vertebrate and invertebrate species	KV 4	Data deficient	Deteriorating	Data deficient	Deteriorating	High concern	Deteriorating
Outstanding examples of ongoing evolutionary processes	KV 5	Low concern	Stable	Low concern	Stable	High concern	Stable
Endemic and threatened plants	KV 1,2,3	Low concern	Stable	Low concern	Stable	High concern	Stable
Endemic and threatened mammals	KV 4	Data deficient	Deteriorating	High concern	Deteriorating	High concern	Deteriorating
Endemic and threatened birds	KV 4	Low concern	Deteriorating	High concern	Deteriorating	High concern	Deteriorating
Endemic and threatened frogs	KV 4	Critical	Deteriorating	Critical	Deteriorating	Critical	Deteriorating
Endemic and threatened reptiles	KV 4	Data deficient	Stable	Data deficient	Data deficient	Data deficient	Data deficient
OVERALL IUCN ASSESSMENT		GOOD WITH SOME CONCERNS		GOOD WITH SOME CONCERNS		SIGNIFICANT CONCERN	

MANAGEMENT AND USE OF GONDWANA RAINFORESTS OF AUSTRALIA (QUEENSLAND SECTION)

Queen Mary Falls,
Main Range National Park
Scott F. Heron, CVI

3.1 Management and Governance of the property

The complexity of tenure and various interests in the Gondwana Rainforests of Australia is outlined in Section 2 (see also Section 3.1.1). This is reflected in the management and governance of the property, which is subject to a range of legislation and supporting policies.

Australia ratified the World Heritage Convention[10] in 1974, which means there are obligations for Australia as the relevant 'State Party' under the convention. These obligations include the taking of "*…appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation*"[10] for Australia's World Heritage properties. The addition of the Queensland section to the Gondwana Rainforests of Australia property in 1994 (see Section 2.2 for the history of inscription) meant those obligations apply to the extended property.

In Gondwana Rainforests of Australia, a combination of national environmental legislation and various state laws provide the mechanisms to meet Australia's obligations. Australia therefore cooperates with the World Heritage Committee and its Advisory Bodies (including IUCN), using the Operational Guidelines[11] as guidance, to ensure the World Heritage values are protected and conserved, including from threats originating both inside and outside the property's boundaries.

Today, there is effective coordination between the Commonwealth Government and the Queensland and NSW governments regarding the Gondwana Rainforests of Australia. Similarly, there is effective liaison between the two state governments for the relevant national parks, particularly to support cross-jurisdictional management needs. The legal framework for the Queensland section of the property includes various pieces of national environmental legislation and state laws (outlined in Table 3.1).

Table 3.1 National and state legislation applying to the Gondwana Rainforests of Australia with a focus on the Queensland section.

<table>
<tr><th></th><th colspan="4">Queensland</th><th>New South Wales</th></tr>
<tr><th></th><th>National Parks and Conservation Parks</th><th>Rabbit Board paddocks</th><th>Correctional Centre lands</th><th>Road reserves</th><th>National Parks and Nature Reserves</th></tr>
<tr><td rowspan="4">State legislation</td><td colspan="4">Nature Conservation Act 1992
Aboriginal Cultural Heritage Act 2003
Environmental Protection Act 1994
Planning Act 2016
Biosecurity Act 2014</td><td rowspan="4">Various (7+) pieces of legislation</td></tr>
<tr><td rowspan="3"></td><td colspan="3">Land Act 1994
Vegetation Management Act 1999</td></tr>
<tr><td>Stock Route Management Act 2002</td><td>Corrective Services Act 2006</td><td>Transport Operations (Road Use Management Act 1995</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>National legislation</td><td colspan="5">Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
Environment Protection and Biodiversity Conservation Regulations 2000
Native Title Act 1993</td></tr>
</table>

[10] http://whc.unesco.org/en/conventiontext/
[11] http://whc.unesco.org/pg.cfm?cid=57

3.1.1 National legislation and policy

Australia's World Heritage properties are protected under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act, Cwth)*[12]. This Act provides automatic protection for World Heritage properties by ensuring that an assessment process is undertaken for proposed actions that will, or are likely to, have a significant impact on the World Heritage values of an inscribed property. This process allows the Commonwealth Minister for the Environment to grant or refuse approval for any proposed action, and to impose conditions on an action.

The *Native Title Act 1993 (Cwth)* (see footnote[2] in Section 2.1) and World Heritage listing can interact, particularly regarding Indigenous cultural heritage and development activities. While this Act primarily focuses on recognising and protecting native title rights and interests, it also includes provisions for cultural heritage protection and consultation processes related to future activities that might impact native title. World Heritage listings, under the World Heritage Convention, aim to protect cultural and natural heritage, and can overlap with areas where native title exists or is claimed.

3.1.2 State legislation and policy

The *Nature Conservation Act 1992 (Qld)*[13] is administered by the state of Queensland and provides protection to values declared as National Parks. The majority of the Queensland section of Gondwana Rainforests of Australia is National Park. The Queensland Parks and Wildlife Service & Partnerships (QPWS&P) is the agency primarily responsible for administration of this Act and for the day-to-day management of the property.

Planning for protected areas in Queensland is undertaken in accordance with the *Nature Conservation Act 1992.* In addition, the Values-Based Management Framework (VBMF; see Sections 2.6.1 and 3.2.1) applies an adaptive management approach for managing Queensland's protected areas, including World Heritage areas.

3.1.3 Co-operative management arrangements and community engagement

Cooperative arrangements between Queensland and New South Wales assist in the management of the property. These include intergovernmental cooperation through two cross jurisdictional committees; a Coordinating Committee, comprised of operational and policy managers; and a Management Committee comprised of senior executives. However, the 2019-20 wildfires demonstrated this coordination could be improved (see Case Study 1).

A Strategic Overview for Management of Gondwana Rainforests of Australia was developed in 2002 (DEH 2000). This document provides high-level policy and strategic direction across the entire property. The Queensland, NSW and Australian governments are working together to review and update the existing Strategic Overview, and a revised Strategic Management Framework for the Gondwana Rainforests of Australia is being prepared[14].

The Queensland Department of the Environment, Tourism, Science and Innovation's (DETSI) Gurra Gurra Framework 2020–2026 (DES 2020) and Queensland First Nations World Heritage Strategy (DES 2022) provide direction and guidance to work towards permanent and productive relationships with First Nations peoples across departmental business.

There is some collaboration between regional Natural Resource Management bodies (e.g., Southern Queensland Landscapes[15] and Healthy Land and Water in Queensland[16]), relevant local government authorities and various statutory bodies, each having different responsibilities for planning, managing landscapes and water and for enabling private land conservation.

[12] https://www.austlii.edu.au/cgi-bin/viewdb/au/legis/cth/consol_act/epabca1999588/
[13] https://www.legislation.qld.gov.au/view/html/inforce/current/act-1992-020
[14] https://www.dcceew.gov.au/parks-heritage/heritage/places/world/gondwana#resources
[15] https://www.sqlandscapes.org.au/
[16] https://hlw.org.au/

Case study 1. The 2019-2020 bushfires

Climate change impacts on fire regimes are emerging as a high-level threat to the property's Outstanding Universal Value and persistence of rainforests and rainforest dependant species.

In 2019-2020 extensive fires impacted 51% of the World Heritage property. The fires were preceded by a prolonged drought and a period of above average temperatures and below average rainfall (BoM 2019).

An assessment of the potential ecological impacts from the 2019-2020 bushfires on the Queensland Section of Gondwana Rainforests of Australia (Laidlaw et al. 2022) showed bushfires impacted approximately:

- 34% or 20,023 hectares (Figure CS3.1)
- 3,856 hectares of rainforest, and
- 13% of the total rainforest distribution within the World Heritage property.

In addition to the direct loss or degradation of habitat, the fire caused mortality of fire sensitive rainforest flora and fauna. A post-bushfire assessment for threatened species and other species with disjunct and relictual distributions within the property recommended prioritised recovery efforts for 14 vertebrates, seven invertebrates and 24 plants (Churchill et al. 2023). Key management recommendations included ongoing investment to mitigate the increasing risk of extinctions due to climate change related broad-scale natural disasters, such as bushfires.

Responding to concerns about the 2019-2020 bushfire impacts, UNESCO's World Heritage Committee requested a State of Conservation update for the property. In April

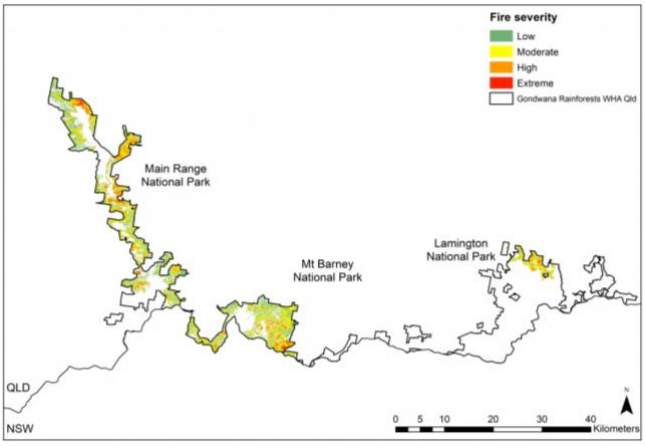


Figure CS3.1 Map of 2019-2020 bushfire severity and extent on Gondwana Rainforests of Australia (Laidlaw et al. 2022)

2020, the Australia government provided a State Party Report to the Committee. In response to ongoing concerns regarding bushfire recovery, further updates have been requested and provided in February 2021, December 2022, May 2023 and December 2024.

These reports indicate a compounding influence of predicted climate change impacts as higher temperatures and periods of prolonged drought further exacerbate fire risks. With this worsening of fire weather, bushfires are likely to be of higher intensity and bushfire seasons are likely to start earlier and last longer. This is decreasing the time in between fire seasons and may reduce opportunities for planned burning. The Queensland Government continues to support and implement bushfire recovery actions and use lessons identified from the 2019–20 bushfire season to inform bushfire preparedness as well as ongoing management (DCCEEW 2024).

The Queensland Government engages adjoining land holders through its Biodiversity Conservation Strategy[17]. The Great Eastern Range Initiative (GER Ltd, an independent non-profit) provides a framework and collaborative network and an active vision for achieving connectivity conservation (GER Annual Report, 2023). Since 2007, GER Ltd has become a network of more than 250 environmental non-profits, landcare and community groups, government agencies, First Nations organisations and research partners. Major investment comes in the form of the large volunteer workforce and citizen science program that monitor environmental condition and the impact of their work. However (as mentioned further in Sections 2.5 and 6.1), there is a need to engage more effectively with the First Nations people across the property and integrate their perspectives, culture connection and knowledge systems into overall management.

[17] https://www.qld.gov.au/environment/plants-animals/biodiversity/strategy

3.1.4 Queensland Gondwana World Heritage Advisory Committee

The Queensland Government established the Gondwana World Heritage Advisory Committee in 2023 as a mechanism to provide property-relevant advice to the Queensland and Australian Government ministers responsible for World Heritage. This includes matters relating to the identification, protection, conservation, presentation and transmission to future generations of Gondwana's cultural and natural heritage. The work of the Committee is influenced by the World Heritage Convention, which recognises the way in which people interact with nature and the fundamental need to preserve the balance between people and nature. In addition to these arrangements, the Queensland Government has policies to encourage community involvement in the management of their parks, including volunteer and citizen science programs.

3.2 Management and planning

The Queensland section of the property involves a complexity of land managers with interests in the property at different levels (Table 3.2). QPWS&P is the primary on-ground land managers for the majority (59,223 hectares) of Queensland section of the property, with the other remaining area overseen by other Queensland agencies.

3.2.1 Values-Based Management Planning

The Values-Based Management Framework (VBMF) is the primary mechanism for how QPWS&P manages protected estates across Queensland.

The VBMF has two key objectives:

- Establish an adaptive management approach that aligns planning and prioritisation with operational delivery
- Focus management effort on priorities by managing key values and (legal, moral and procedural) management obligations.

A key element of the success of the VBMF is the ability to strategically plan for the protection of key values associated with the parks; however, in order to protect these values, they must first be identified (see Section 2.6).

Table 3.2 Primary government and non-government organisations with interests in the property (indicative).

Level	Planning interest				
International	World Heritage Operational Guidelines				
Australian Government	Strategic Overview for Management (2000)				
Queensland Government (primarily through QPWS&P)	Main Range National Park	Mount Barney National Park	Lamington National Park	Mount Chingee National Park	Springbrook National Park
First Nations Groups	Githabul	Yuggera Ugarapul	Yugambeh-speaking Peoples		
NRM organisations	Southern Queensland Landscapes	Healthy Land and Water			
Local governments	Lockyer	Southern Downs	Scenic Rim	City of Gold Coast	

For the Queensland section of the property this includes Statutory management plans (as required under the *Nature Conservation Act 1992*[13]) and non-statutory action plans and work programs for all five national parks (see footnote [4] in Section 2.2).

Management Plans and statements provide strategic management directions for managing the property's identified values. There is line of sight from these documents and non-statutory thematic strategies that guide park management actions. Information gathered from planning, combined with annual reporting data (e.g., park health checks), is used to prioritise funding from state-wide programs through to regional and park-level programs. A hierarchy of QPWS&P planning documents is provided in Appendix 4.

3.3 Economic and social context

The Gondwana Rainforests of Australia contribute directly and indirectly to the employment, income and output of the regional economy.

Tourism is a primary economic sector associated with the values of the property. It is estimated that 2 million people visit the property annually[18]. The Queensland section of the property is located within an easy driving distance (<200 km) of Queensland's most populated region, attracting many single- and multi-day visitors and providing outstanding settings for recreation and tourism. Diverse activities are enjoyed by local (domestic) and international travellers depending on the features and facilities within, or near to, individual National Parks (Table 3.3). Such visitors can be a boon to the local economy but can also present challenges through overcrowding and degradation at especially popular sites (see Case Study 2).

In 2008, the management of the entire Gondwana Rainforests of Australia was estimated to generate $14.5 million annually and 225 jobs, whilst visitation to the property was estimated to generate $158.1 million annually and 2,314 jobs (Gillespie Economics 2008). Day trip and overnight stays are popular, as are farm stays, wilderness lodges and guided tours to national parks. These provide an income for local communities.

As outlined in Section 2.1, the property intersects four Local Government Areas (Southern Downs, Scenic Rim, Gold Coast and Lockyer Valley). Each of these Local Government Areas acknowledges a variety of ways in which the property has a significant economic impact on its surrounding region. Natural assets are recognised as a driver of tourism activity in the region; for example, 7% of all visitors to the Southern Downs Region in 2016–2017 visited National Parks[19]. The Local Government Areas have embraced

Table 3.3 Examples of the wide range of activities undertaken by visitors in, and around, Gondwana Rainforests of Australia

Trail walking or hiking	4WD driving	Camping and other overnight stays	Indigenous heritage
Remote area bush walking	Sightseeing/ wildflower viewing	Water activities (e.g., swimming, canoeing, fishing)	Enjoying natural beauty
Mountain biking	Scenic driving/ picnicking	Outdoor education (school camps, Scouts, Guides)	Photography
Rock climbing	Wildlife viewing (especially birdwatching)	Food & wine experiences	Geological interests – fossicking

[18] https://environment.desi.qld.gov.au/management/world-heritage-areas/current/gondwana-rainforests
[19] https://www.sdrc.qld.gov.au/ArticleDocuments/1247/Tourism Research Report 2018.pdf.aspx

Case study 2 – Managing for change: Track and trail usage patterns in Gondwana Rainforests of Australia (Queensland Section)

Effective management of the property through climate change will require understanding of visitation to and use of the facilities that are provided. Data collected from walking tracks and trails in various national parks within the Queensland section of the property are informative but are currently insufficient to conclusively understand the trends and patterns of park visitation and usage. Data from electronic counters installed on walking tracks and trails reveal marked differences in visitation numbers between locations, influenced by the type of visitor experience and the distance from population centres.

Natural Bridge is easily accessible from the Gold Coast and provides the 'high-use' end of the visitor opportunity spectrum. Around 175,000 recorded visitors per annum in the past decade used the concrete paths and other amenities. In contrast, various wilderness bushwalking routes in remote parts of the parks are recommended for experienced bushwalkers only (e.g., the Mount Barney summit routes are not classified as walking tracks, taking up to 10 hours over very rugged terrain). Trailhead counter data for the South East Ridge of Mount Barney indicate an increasing trend since 2010, culminating in a two-fold increase in 2023 (to over 7,000 counts) from average numbers in 2019–2022 (3,400 counts).

During the workshop, several participants with expertise in ecotourism in national parks across the property suggested that their perception of a post-COVID-19 increase to visitation was not reflected in the track/trail counter data presented by QPWS&P. A Visitor Information Centre representative also reported a perceived increase in the usage of more-remote trails, while a business operator similarly conveyed concern of the recent usage and associated impacts at Mount Barney. Some park rangers (in both Queensland and NSW) indicated that vehicle numbers in carparks had increased in recent years, suggesting greater visitor numbers. These observations are consistent with national parks visitation across southeast Queensland post-COVID-19[§] and internationally (Geng et al 2025). Variations between these qualitative perceptions and the available quantitative counts will need to be resolved to better inform maintenance requirements and the sustainable management of related facilities.

Understanding visitor numbers and trends has important implications for management and maintenance for different types of paths and trails, particularly in the context of climate change (e.g., through synergistic impacts of usage with changing rainfall patterns and wildfire risk). The recent doubling of visitation on the South East Ridge summit route of Mount Barney, though small in absolute number, has marked implications for sustainable use in this remote wilderness area. In contrast, site hardened infrastructure at Natural Bridge is designed to support the high number of visitors. These represent different management requirements and challenges, particularly given the different effects of climate change. However, counter data should be considered indicative only due to the complexity in acquiring complete visitation data (e.g., multiple entry points to trails, counting stations can be walked around, vandalism of collection devices). Improvements in the current forms of visitor monitoring are recommended to enable collation of more accurate and comparable visitor data to help prioritise park management, especially when visitation impacts will interact with changes to climate-related threats (see Management implications in Section 6.3).

[§] https://www.abc.net.au/news/2022-08-26/queensland-national-parks-still-enjoying-covid-camping-boom/101371144

this advantage, aiming to improve the local tourism infrastructure around nature-based activities[20].

Intact green spaces, including those within the property, contribute to the provision of safe and reliable drinking water, as well as to flood mitigation. In the Gold Coast, where the population is over 600,000, these two factors have been valued at $1.8 billion and $324 million, respectively (from within and beyond the property boundary; Arold and Cheesman 2014). Additionally, the Lockyer region accounts for 19% of Queensland's annual vegetable production, a significant economic driver for the southeast Queensland region with an annual

[20] https://www.scenicrim.qld.gov.au/downloads/file/5753/nature-based-tourism-strategy-2023

production value of $260 million[21]. A healthy water catchment is key for the health and productivity of this region.

Green spaces are also a positive factor in the area's image, lifestyle and liveability. They play a role by indirectly promoting improved worker productivity, reduced absenteeism and improved property prices (C Change 2016). The value of open space to these aspects of the Gold Coast community was estimated at $3.6 billion per year. The City of Gold Coast is, understandably, keen to preserve and improve upon the existing open space. The other regions also acknowledge the value of their residents' access to national parks and the value that they bring to the region's lifestyle, offering a variety of walks and other nature experiences to residents and visitors[22].

[21] https://www.lockyervalley.qld.gov.au/repository/libraries/id:2eccbxg5l17q9su8pzhy/hierarchy/our-services/environment-and-pest-management/documents/Lockyer%20CAP_final.pdf

[22] https://www.sdrc.qld.gov.au/our-region/make-southern-downs-home/why-southern-downs/lifestyle

CLIMATE AND ITS INFLUENCE ON GONDWANA RAINFORESTS OF AUSTRALIA

Fire front on Mount Barney during the 2019-2020 event
Ben Blanche

4.1 Current climate

The east-west geographical orientation of the component areas of Gondwana Rainforests of Australia (Queensland Section) aligns with a spatial gradient in rainfall and temperature conditions.

Historically, rainfall has been consistently lower in the western portion than closer to the coast. Two weather station records provide rainfall information within the property section – at Cunningham's Gap, Main Range NP (the westernmost component of the World Heritage property in Queensland, altitude 680 m) and in Green Mountains NP (near the boundary between the Scenic Rim Regional Council and City of Gold Coast, altitude 916 m; Figure 2.1). These records began in 1976 and 1916, respectively.

Data from Cunningham's Gap reveal average annual rainfall for the period 1995-2014 was 1070 mm/year. This is around 30% less than that measured further east in Green Mountains NP (1600 mm/year for the same period). The seasonal variation in rainfall has a similar wet- and dry-season pattern. Monthly rainfall is more comparable at the two locations during the latter half of the year (July-December), with greater differences between the stations in the first half of the year.

Historical temperature records were not available for locations within the property section; however, data from nearby locations (Figure 2.1 and inset) illustrate the east-west spatial variability. Temperature data from Australia Bureau of Meteorology weather stations were compiled from Warwick (beyond the western extent of the property section, altitude 475 m; consistent data since 2001), Beaudesert (north of Green Mountains NP, altitude 48 m; since 2008) and Coolangatta (at the coast, altitude 4 m; consistent since 1994).

There is a clear seasonality in temperature at each location; however, there is variation in the relative temperature between sites at different times of year. Located inland and at altitude, Warwick experiences the coolest winter temperature amongst the three locations (Figure 4.1). While Beaudesert and Coolangatta have comparable daily maxima in winter (solid lines), overnight minima (dashed lines) are warmer on the coast (in winter and year-round). At the height of summer, daily maxima at Coolangatta are the coolest of the locations, consistent with moderation by the ocean. Whilst indicative of spatial patterns for the property section, variations with altitude and distance from the ocean are consistent with observed patterns in vegetation types[23].

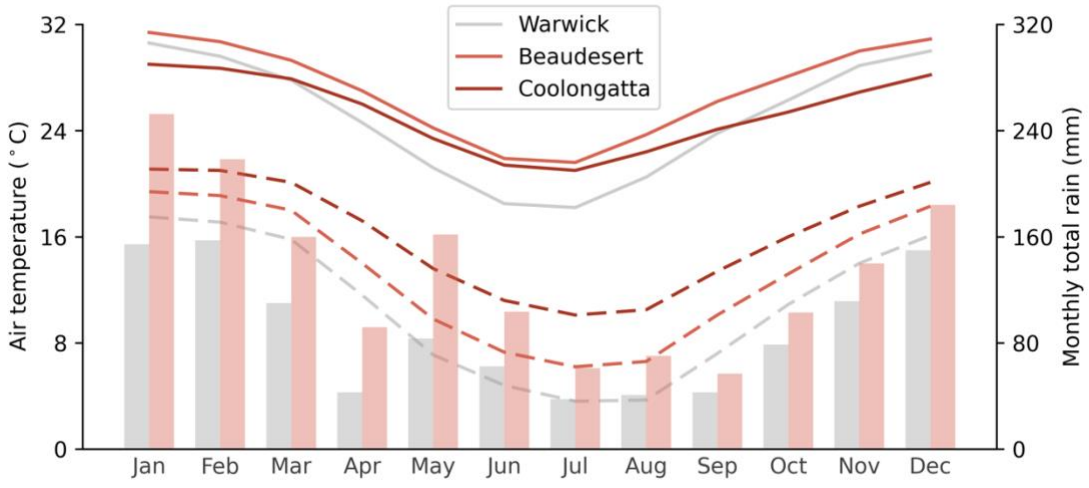


Figure 4.1 Monthly-averaged rainfall (columns) for the period 1995-2014 from data recorded at Cunningham's Gap (grey) and Green Mountains (green). Monthly-averaged daily maximum (solid lines) and daily minimum temperature (dashed lines) for the period 2008-2024 from data recorded at Warwick (grey), Beaudesert (dark green) and Coolangatta (light green).

[23] https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions

4.2 Observed climate trends

Long-term historical datasets of rainfall and surface air temperature from specific locations provide insight into century-scale changes.

Annual rainfall estimates[24] since 1900, averaged across the property section, reveal interannual and multidecadal variability but no consistent long-term trend over the course of the century (Figure 4.2, upper panel). There has been an apparent decline in annual rainfall since the 1980s, with most of this attributed to lower rainfall in the cooler seasons, especially June to August (Figure 4.2, lower panels).

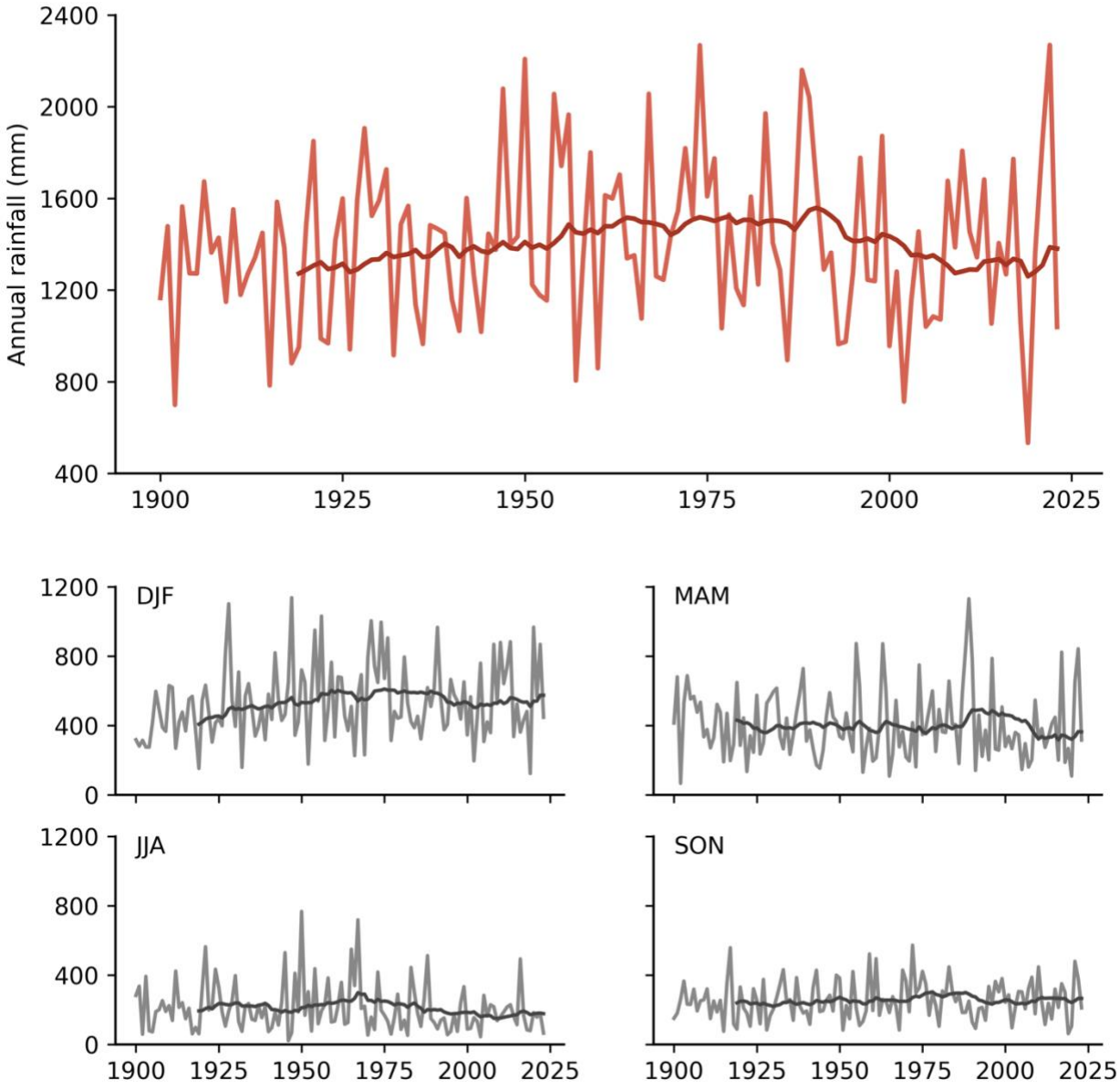


Figure 4.2 Historical estimates of rainfall across the Gondwana Rainforests of Australia–Queensland Section, 1900-2024. (upper) Annual totals; (lower) Seasonal totals for three-month periods (DJF: December January February, etc.). Extracted from the Australian Gridded Climate Dataset[24].

[24] http://www.bom.gov.au/climate/austmaps/about-agcd-maps

Long-term temperature data are scarce in the region, with the best available data from the Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT)[25] dataset. The closest station is at Amberley, near Ipswich (see Figure 2.1 inset) and approximately 45 km north of Boonah and 70 km from the nearest section of the World Heritage property. At the Amberley station, air temperature has steadily increased since the late-1960s at an average rate of 0.2°C/decade (Figure 4.3-upper). This is slightly below the average rate of warming over Queensland of approximately 0.3°C since the 1960s. Temperature over Queensland during the most recent decade (2015-2024) was 1.7°C higher than that from the earliest part of the record (1900-1930); and was 0.6°C higher than the 1995-2014 average, consistent with accelerated warming observed globally[26]. At Amberley station, the most recent decade (2015-2024) was 0.4°C warmer than the 1995-2014 average.

Associated with the observed warming has been an increase in the number of extreme warm events. At Amberly station, hot days (with daily maximum temperature >35°C; Figure 4.3-lower) have increased from the historical average of 11 days/year (1942-1994) to 16 days/year (1995-2014), with a further

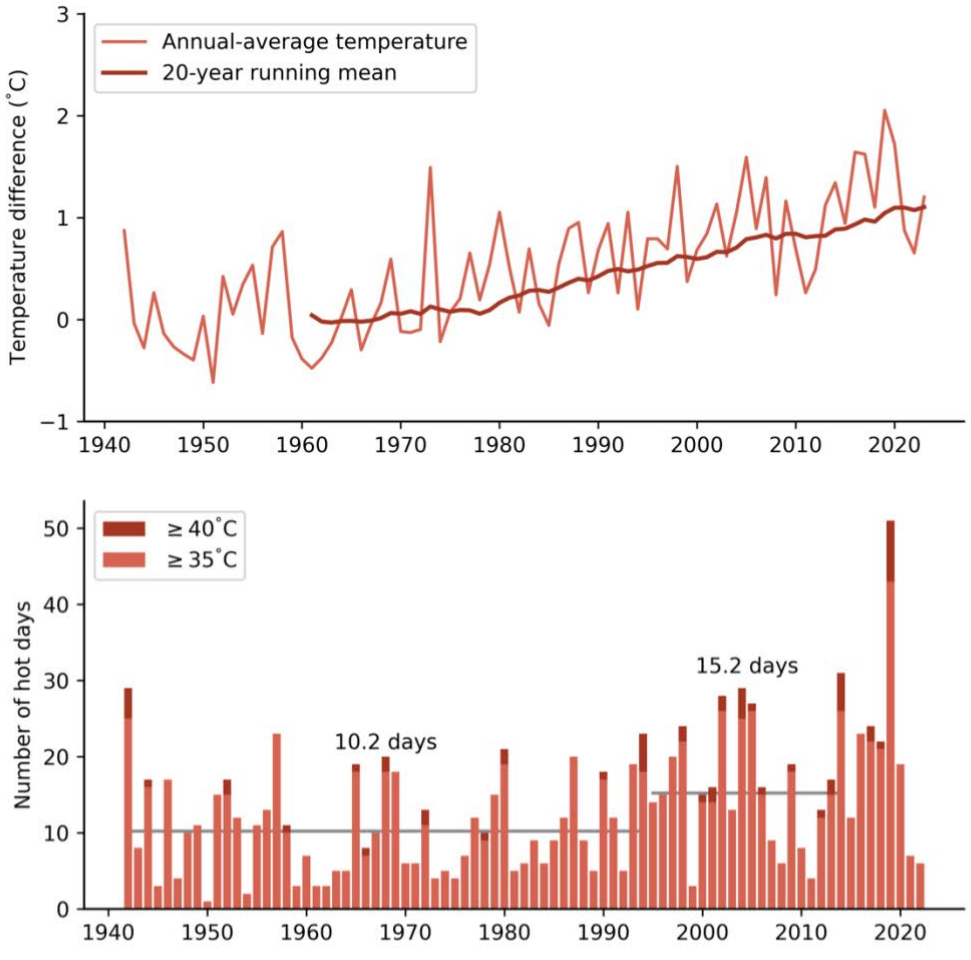


Figure 4.3 Historical temperature records at Amberley station, 1942-2022. (upper) Annual-average of surface air temperature; (lower) Annual number of hot days (maximum temperature >35°C), with average counts for 1942-1994 (10.2 days) and 1995-2014 (15.2 days, grey lines), and annual number of very hot days (maximum temperature >40°C).

[25] http://www.bom.gov.au/climate/data/acorn-sat/

[26] NOAA National Centers for Environmental Information, Monthly Global Climate Report for Annual 2024, published online January 2025, retrieved on May 12, 2025 from https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202413. DOI:https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ncdc:C00672

decade. Very hot days (>40°C) have also increased in frequency through the record.

Night-time temperature has also increased. The number of hot nights (daily minimum temperature >20°C) at Amberly station has increased from average historical counts of 36 days/year (1942-1994) to 45 days/year (1995-2014) and again to 54 days/year over the decade 2014-2023. There has been a corresponding decrease in the number of cold nights (<5°C) from the historical average of 65 days/year (1942-1994) to 52 days/year in 1995-2014, with little further change since then.

Note that Amberley station represents a slightly warmer climate with more hot days and nights than the World Heritage property. For instance, the Scenic Rim LGA, in which the World Heritage property sits, experiences roughly half as many days above 35°C as Amberley and higher altitude areas experience even less. Although the absolute number of days above 35°C may be less, the trend towards increasing numbers of hot days and nights is expected to be similar.

4.3 Future change

Climate projections from the Queensland Future Climate Dashboard[27] were used to inform future conditions for Gondwana Rainforests of Australia–Queensland Section. Locally-relevant projections for the Scenic Rim region were used, drawing on high-resolution (~10 km scale) regional climate modelling, downscaled from the latest generation of global climate modelling (Riahi et al. 2017). This generation of climate modelling was used for the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report (IPCC 2021). The Queensland Future Climate projections incorporate output from a suite of 11 climate models from which a range of possible future climate conditions can be discerned.

The focus of future climate projections discussed in the workshop was under a high-emissions shared socio-economic pathway (SSP) scenario, SSP3-7.0, in which fossil fuel emissions continue to increase, reaching roughly double present levels by 2100. Additional information was examined for some variables and future timeframes using a very high-emissions scenario that reflects continued expansion of fossil fuels (SSP5-8.5); and an emissions scenario under which emissions reduction is rapid, reaching net-zero global emissions around 2070 and sufficient to limit globally-averaged warming above pre-industrial levels to 2°C (SSP1-2.6).

Rainfall

Projected annual average rainfall in the property section continues to show high interannual variability in the future. Annual totals are projected to slightly decrease under SSP3-7.0 (median reduction by 10%), with the range of possible change from 21% drier to 5% wetter (10th and 90th percentiles, respectively). On average, all seasons are projected to experience drier conditions, with autumn (March-May) showing the greatest reduction among the seasons (by 16% for the multi-model median). Most models show agreement that autumn and winter will become drier; however, there is greater uncertainty (lowest model agreement) in summer and spring rainfall, with a larger range of possible changes spanning from decrease to increase. Noting variability between models, there is high agreement that there will be more time in extreme drought conditions than has historically occurred.

In contrast to the projected decrease in total rainfall, there is an expected increase in heavy rainfall events. The intensity of extreme daily rainfall is estimated to increase by 8%, and extreme hourly downpours to increase by 15%, for every 1°C of warming. The corollary to this is that the length of consecutive dry days is also projected to increase.

Temperature

Annual-average air temperature in the property section is projected to increase to 1.4°C above the 1995-2014 recent baseline by ca. 2050 under SSP3-7.0, with an upper projected range of 1.9°C warmer. By the end of this century (ca. 2090), this high-emissions scenario suggests approximately 3.1°C warming above the baseline, with an upper range of

[27] https://www.longpaddock.qld.gov.au/qld-future-climate/dashboard-cmip6/

3.8°C warming. For comparison, the very high-emissions scenario (SSP5-8.5) indicates an end-of-century upper range temperature approximately 1°C greater than the high-emissions scenario (SSP3-7.0), whilst the lowest considered scenario (SSP1-2.6) would stabilise temperature around 1.1°C above 1995-2014 levels. For reference, the most recent decade (2015-2024) was already 0.6°C warmer than the 1995-2014 baseline.

As the climate changes, the number of hot days (daily maximum >35°C) is projected to increase under the SSP3-7.0 scenario from 7 days/year (1995-2014) averaged over the Scenic Rim LGA in which part of the World Heritage Property is located, to 12 days/year (ca. 2050), with as many as 19 days/year in the upper range of model output. By end-of-century (ca. 2090), an average of 23 hot days per year are projected (upper range of 36 days). The number of very hot days (>40°C) is projected to double and potentially triple by 2050. In conjunction with this, the number of hot nights (>20°C) is projected to increase from an average of 31 days/year (1995-2014) to around 56 days/year (ca. 2050) and to around 98 days/year (ca. 2090). Similarly, the number of cold nights (<5°C) is projected to decrease from 36 days/year to around 19 days/year (ca. 2050) and to around 8 days/year and possibly to zero (ca. 2090).

Fire weather

The occurrence of fire depends on a range of factors including weather conditions, fuel load, fuel dryness and ignition. Dangerous fire weather can be assessed by considering factors of rainfall, temperature, humidity, evaporation and wind, as well as a drought factors indicative of vegetation dryness. Changes to each of these factors translate to an increase in the number of dangerous fire weather days; e.g., through increased temperature or evaporation, or a decrease in humidity. The number of dangerous fire weather days has increased since the 1950s, with southeast QLD showing a particularly strong increase (BOM & CSIRO 2024). Harsher fire weather is projected in the future, although there is uncertainty about the magnitude of change and the frequency of high risk periods. Projected changes in fire weather do not automatically indicate an increase in fire frequency but do suggest that when fires occur they are likely to be more extreme.

Cloud level

Cloud base height is important for species that obtain moisture directly from clouds (rather than from rainfall). High-elevation rainforests in the property can receive up to 40% of their water requirement directly from clouds and fog (Narsey et al. 2020). The cloud base height is approximated by the 'lifting condensation level', which can be described as a function of temperature and relative humidity (Romps 2017). This relationship enables projections of cloud level based on projected temperature and relative humidity. By 2050, projected temperature increase and a slight decrease or little change in relative humidity, indicate an increase (to higher altitude) or little change in the cloud base height (Narsey et al. 2020). Larger changes (moving up the mountainsides) are expected further in the future (see Case Study 3).

Tropical cyclones

Tropical cyclone activity in the Australian region is highly variable year to year, however, there has been a slight decrease in observed cyclone frequency (Chand et al. 2019). Tropical cyclones have infrequently impacted the southeast Queensland region. In the future, whilst the frequency of cyclones may decrease, a greater proportion are projected to be of higher intensity. There is also higher confidence that the intensity of rainfall associated with cyclones is projected to increase in the future, meaning that when these extreme rainfall events do affect the region, they are likely to be more severe.

Summary

Projected changes to individual variables were presented during the workshop (by Dr Sarah Boulter) and summarised for subsequent use during and beyond the workshop (Table 4.1).

Case study 3. The impact of climate change on cloud forests in the Gondwana Rainforests of Australia

Projected changes in temperature, rainfall and relative humidity on the high-elevation forests in the Gondwana Rainforests are expected to affect key species (Narsey et al. 2020). These high-elevation rainforests receive up to 40% of their annual water requirement from clouds and fog, which indicates the importance of understanding cloud base height. Movement of the cloud base up or down the mountains due to climate change will have important conservation and management implications for rainforest species and communities.

By 2030, the Gondwana Rainforests can expect an increase in temperature and a slight decrease or little change in relative humidity (Narsey et al. 2020). Lifting condensation level (LCL), a proxy for cloud base height, shows increases (moving up the mountainsides) or little change. By 2050, projections indicate a further increase in temperature and slight decrease or little change in relative humidity. Rainfall changes are unclear. LCL projections show increases or little change. Around 2070, temperatures will continue to increase, relative humidity is expected to decrease and rainfall projections remain unclear. A range of LCL change is projected, with moderate increases expected (Narsey et al. 2020).

Initial findings suggest that even modest increases in LCL may have significant implications for cloud-water dependent species, especially those located at elevations adjacent to the current cloud base. Reduced cloud water inputs, especially during the dry season, may increase moisture stress beyond the tolerance of some species, resulting in community change. Observed patterns in canopy species recruitment may already be an indicator of this change. The impacts of these patterns are likely to be exacerbated under future climate change. These projections can inform future risk assessments for the Gondwana Rainforests of Australia, complementing other spatial tools used to assess and mitigate risk.

Table 4.1 Summary of historical and projected change to 2050 under SSP3-7.0 for climate variables and related factors, compiled for the CVI workshop. Where available, the range (10th to 90th percentile) of projected change is included.

	Air temperature	Hot days, Hot nights	Average rainfall	Extreme rainfall events	Cloud base height	Drought	Storms	Fire weather	Evaporation	Humidity
Observed changes	1.7°C since 1910; 0.6°C since 1995-2014.	Increase in hot days and nights observed.	High natural variability. Slight drying trend, mostly in the cooler seasons.			Several extreme droughts since 2000.		Fire penetrated rainforest. Increase In number of dangerous fire weather days since the 1950s.		Observed change in humidity unclear.
Projected change: 2050, SSP3-7.0	Continued increase +1.4°C (+1°C to +1.9°C).	Continued increase in frequency of hot days and hot nights.	Continue to be variable. Median projection: -10% drier; changes in both directions possible. (-21% to +5%). Projected drying greatest in autumn and winter (March to August).	Increased intensity: ~8% heavier for heavy rainfall days ~15% heavier for dourly downbursts.	Little change or slight raising of "Lifting Condensation Layer" (proxy for cloud base height).	Natural variability will continue. Increase in time spent in drought, especially extreme drought.	Tropical cyclones may become less frequent but expected to be more intense and with heavier rainfall.	Harsher fire-weather projected. Uncertainty about magnitude of change and frequency.	Evaporation is projected to increase +6% (-1% to +12%).	Slight decrease or little change in average humidity. -1% (-3% to +2%).

Confidence in projected change:

Very high	High	Medium	Low/uncertain

APPLYING THE CLIMATE VULNERABILITY INDEX

Giant Spear Lily at Main Range National Park
Ben Blanche

5.1 Applying the CVI

The Climate Vulnerability Index (CVI) is a systematic and rapid tool that was developed to assess the vulnerability to climate change for all types of World Heritage properties (natural, cultural and mixed). It considers the vulnerability of the Outstanding Universal Value (OUV) and of the associated community (local, national and international). The CVI framework (Figure 5.1) builds upon the vulnerability framework approach described in the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007). As the CVI was being developed, input was sought from many experts around the world, including from within the International Council on Monuments and Sites (ICOMOS) and the International Union for Conservation of Nature (IUCN), the two primary advisory bodies to the World Heritage Committee.

The CVI is applied through engagement with a diverse group of stakeholders and other experts, typically comprised of property managers, governance agency representatives, relevant academics and other scientists, community members and operators of related businesses. The significance of both lived and learned expertise is recognised and valued.

In the first phase, the OUV Vulnerability is determined by assessing the exposure, sensitivity and adaptive capacity with respect to prioritised climate stressors. The OUV Vulnerability becomes the exposure term to assess the vulnerability of the community associated with the property, combining with assessments of economic-social-cultural dependency (sensitivity) and adaptive capacity (Figure 5.1). A customised spreadsheet-based worksheet is used to determine outcomes based on user inputs. A more detailed outline of the CVI methodology is provided by Day et al. (2020).

The foundation for the CVI process is the Statement of OUV for a property (Appendix 1), from which key values are summarised (Table 2.2). The key climate stressors most likely to impact the key values (and attributes) are identified for a defined and agreed time scale (e.g., by 2050) from a list of possible stressors (Table 5.1). Once this foundation is established, the CVI process is initiated.

The assessment of OUV Vulnerability leads into the second phase, assessing the Community Vulnerability. This second assessment considers the impact on the community of a decline in the key values (i.e., it is not

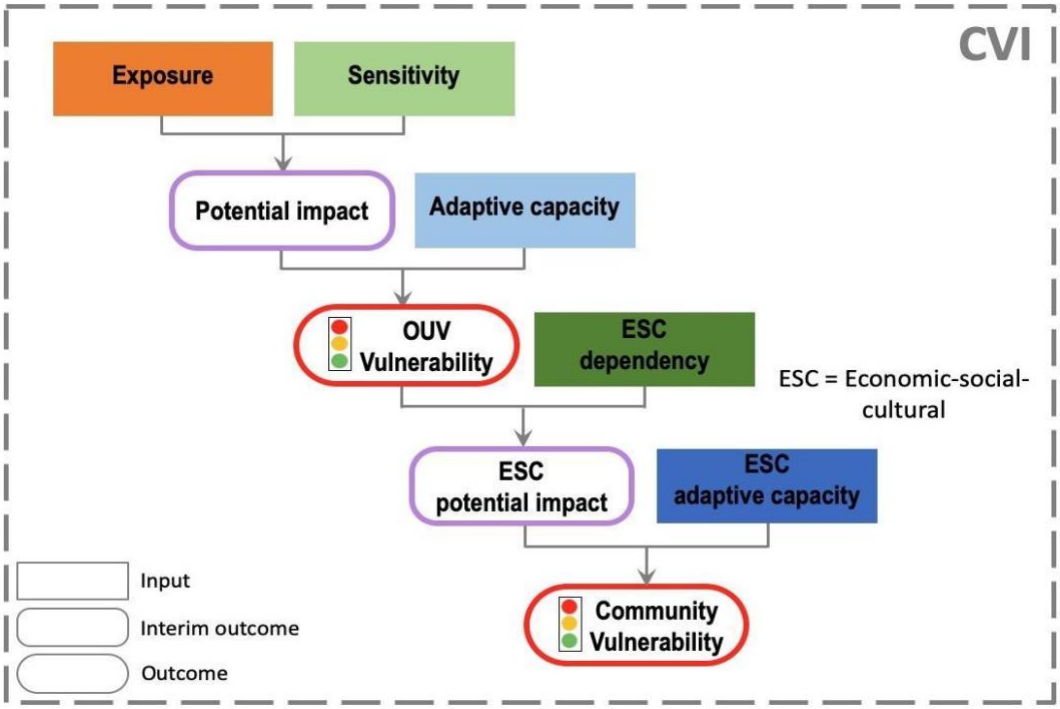


Figure 5.1 The CVI framework used to undertake rapid assessment of climate change vulnerability of World Heritage properties and the associated community. Adapted from Day et al. (2020).

evaluating direct impacts of climate change upon the community).

At the time of this report, the CVI had been applied in a diverse array of natural and cultural World Heritage properties in Africa, Australia and Europe[28].

5.2 Preparatory steps and the CVI workshop for Gondwana Rainforests of Australia (Queensland Section)

Prior to application of the CVI framework for the Gondwana Rainforests of Australia (Queensland Section), the following preparatory steps were undertaken:

- The Statement of OUV for the Gondwana Rainforests of Australia was analysed and distilled into five key values and their accompanying attributes; this list was further developed to become seven key values based on information from the Values-based Management Framework applied by QPWS&P; finally, during the workshop an eighth value was proposed and adopted to give the final list of eight key values (see Table 2.2)
- As the scope of the key values was beyond those described within the Statement of OUV (i.e., with the inclusion of Indigenous cultural heritage and Post-contact heritage; Section 2.6.1), the name 'OUV Vulnerability' was changed to 'Key values Vulnerability' for this application
- Background information was prepared by NESP/CSIRO partners outlining key aspects of climate change for the area (Section 4)
- A list of other Significant Property Values (SPVs) was commenced prior to the workshop, and continued during and following the workshop (see Section 2.6.3 and Appendix 3)
- An overview of information related to economic, social and cultural connections was compiled for presentation during the workshop, and
- A diverse array of 55 participants was identified by the Steering Group for the workshop (see list in Appendix 6).

The CVI workshop for the Gondwana Rainforests of Australia (Queensland Section) was conducted at two venues in Warwick, 7th–10th April 2025 (see workshop program in Appendix 5). Information presented during the workshop enabled the Key values Vulnerability (the broadened consideration from OUV Vulnerability) and the Community Vulnerability to be assessed. The workshop used six breakout groups to provide preliminary assessments that were then reported back to subsequent plenary sessions for discussion and synthesis. Outcomes for each component were recorded in a customised spreadsheet to determine the final results.

5.3 Key climatic stressors

A list of 15 climate stressors typically considered in the CVI process was provided to participants at the workshop (Table 5.1). This generic list includes climate stressors describing coastal and ocean processes (not relevant here) and relating to snow and ice. Two additional climate stressors (Cloud change, Wildfire) were determined as potentially relevant to the specific context of the Gondwana Rainforests of Australia (Queensland Section) and also considered. Participants analysed those stressors likely to have the greatest impact on each of the key values (Table 2.2). Queensland Government agency representatives had pre-selected the time scale to consider impacts as ca. 2050 and the future climate scenario for the assessment to be a moderate/high-emissions climate scenario (SSP3-7.0), consistent with climate risk assessments previously undertaken in Queensland.

The climate stressors were ranked by considering the top three stressors likely to impact each key value (Table 5.1; Figure 5.3). Selections of the top three stressors for each key value, undertaken in six breakout groups, were collated to identify Wildfire, Drought, Temperature trend and Precipitation trend as the climate stressors likely to have the greatest impact on the highest number of key values (Table 5.1).

After a lengthy discussion of these (that included recognition that there are connections between these

[28] https://cvi-heritage.org/resources

and with other climate stressors), the workshop participants selected the three key climate stressors to be considered in the CVI analysis for the Gondwana Rainforests of Australia (Queensland Section) as:

- Wildfire – W;
- Temperature trend – TT; and
- Precipitation trend – PT.

It is important to note that impacts from drought were considered through the projected changes in temperature and precipitation. Furthermore, some impacts from each of the three selected key climate stressors have already occurred to some degree, while future impacts related to these stressors may become apparent sequentially rather than contemporaneous.

Table 5.1 Climate stressors identified as likely to have the greatest future impact upon each of eight key values of the Gondwana Rainforests of Australia–Queensland section. Marked cells indicate that a climate stressor was in the top three responses (including equal-third) for each key value. Stressor impacts were assessed for ca. 2050 and a moderate/high-emissions (SSP3-7.0) climate scenario.

Key values of OUV	Climate stressors																
	Temperature trend (air and/or water)	Extreme temperature events	Precipitation trend	Intense precipitation events	Flooding (fluvial, pluvial)	Drought (severity, duration, frequency)	Mean wind trend	Storm intensity and frequency	Sea/lake ice change	Snow cover change	Sea level rise (trend)	Coastal flood	Storm surge	Coastal erosion	Changing currents	Wildfire	Cloud change
Unique rainforest habitats	x					x										x	
Other significant habitat for biodiversity			x			x										x	
Important flora	x		x			x											
Important fauna		x				x										x	
Ongoing ecological and evolutionary processes	x		x			x											
Significant geomorphological features and processes			x	x				x								x	
Indigenous cultural heritage	x		x	x		x										x	
Post-contact heritage				x				x								x	
Total	4	1	5	3	0	6	0	2	0	0	0	0	0	0	0	6	0

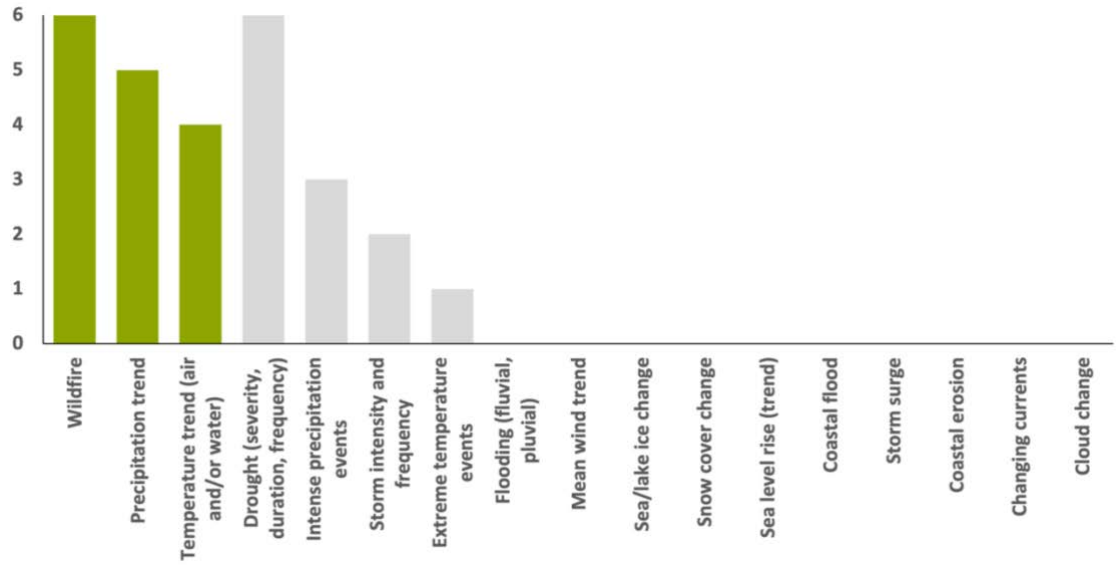


Figure 5.3 Histogram of the number of key values of the Gondwana Rainforests of Australia–Queensland section for which each of 17 climate stressors was among the top three likely to cause impacts (ca. 2050, moderate/high-emissions SSP3-7.0 scenario).

5.4 Key values Vulnerability

Assessments of **exposure** and **sensitivity** of the Queensland section of the property to each of the identified three key climate stressors were undertaken using a five-point categorical scale, adapted from categories used by IPCC and IUCN analyses (Day et al. 2020). Modifiers were applied to the initial assessments to include effects of temporal scale and trend (for exposure), and spatial scale and compounding factors (for sensitivity). Results from exposure and sensitivity assessments undertaken in breakout groups were synthesised in plenary.

Exposure to Temperature trend was initially assessed to be Very likely (>90%, highest category), while for Wildfire and Precipitation trend was assessed to be at the transition from Likely (67-90%) to Very likely. The inclusion of modifiers incremented the final Exposure assessment for all three key climate stressors to be in the Very likely category (Table 5.2). Participants noted spatial variability of current impacts and projected conditions across the five National Park components, as well as the varying level of uncertainty in projected conditions related to the key climate stressors.

Sensitivity of the key values to each of the key climate stressors was initially assessed as High (second highest category), indicating potential for loss or alteration of many key values. After including modifiers, this was maintained with respect to Wildfire and Temperature trend but incremented to the Very high category for Precipitation trend, indicating potential for major loss or substantial alteration of the majority of key values (Table 5.2). Compounding factors identified by participants included: land-use change (particularly encroaching development and other impacts at boundaries) and associated effects (e.g., cattle ingress); effects of invasive species (e.g., weeds outcompeting native species, increased toads and feral species); new disease impacts, including myrtle rust; post-disturbance breaks in the canopy and subsequent potential for wind throw; and tourism pressures, including increased visitor numbers (which can increase the spread of pathogens).

Table 5.2 Rapid assessment of Key values Vulnerability to identified three key climate stressors. Assessed values of exposure, sensitivity and adaptive capacity contribute to derived outcomes for potential impact and Key values Vulnerability. Colours correspond with elements of the CVI framework (Figure 5.1).

Key Climate Stressors:	Wildfire	Temperature trend (air and/or water)	Precipitation trend
Exposure	Likely	Very likely	Likely/Very likely
Temporal scale	Periodic	On-going	Frequent
Trend	Moderate increase	Moderate increase	Moderate increase
Exposure	**Very likely** ○○○○●	**Very likely** ○○○○●	**Very likely** ○○○○●
Sensitivity	High	High	High
Spatial scale	Localised/Extensive	Widespread	Widespread
Compounding factors	High probability	High probability	High probability
Sensitivity	**High** ○○○●○	**High** ○○○●○	**Very high** ○○○○●
Potential impact	**Extreme** ○○○●	**Extreme** ○○○●	**Extreme** ○○○●
Local management response	Low	Low	Low
Scientific/technical support	Low	Low	Low/Moderate
Effectiveness	Low	Low	Low
Adaptive capacity	**Low** ○●○○	**Low** ○●○○	**Low** ○●○○
OUV Vulnerability	**High** ○○●	**High** ○○●	**High** ○○●
Combined OUV Vulnerability	**High** ○○●		

The **adaptive capacity** of a system to respond to stress can reduce the potential impacts. Adaptive capacity of the OUV system was assessed for each key climate stressor by considering the levels of local management response and scientific/ technical support (four-point scale), as well as the effectiveness of these to address impacts from each stressor (four-point scale).

In breakout groups, workshop participants brainstormed adaptation strategies. Where similar ideas were proposed, these were subsequently grouped in plenary, resulting in 14 adaptation strategy groupings (Table 5.3).

The overarching perspective of the workshop participants was the importance of First Nations partnership in all aspects of decision making and implementation. There was strong recognition of the importance of planning at a landscape scale, including for connectivity between the component areas and the identification and protection of refugia, as well as the development of policy levers and partnerships that enable implementation. Actions to support water and groundwater flow were recognised as important, as was a values-based approach to fire management that is climate-focused and evidence-informed based upon all types of knowledge (i.e., traditional and modern science).

One of the brainstormed ideas was to improve monitoring and reporting; whilst this does not, in and of itself, activate any change to the identified threats, it is an essential component of management response to both understand the extent and severity of impacts and evaluate the effectiveness of actions that are undertaken. Other strategies involved protecting diversity through genetic identification and banking; and through translocation of species to projected refugia. Such refugia may also benefit from small-scale innovations that maintain favourable conditions in times of disturbance. Visitor management and education were also considered beneficial.

The 14 adaptation strategy groupings (Table 5.3) formed the basis of the adaptive capacity assessment. Notably, participants determined that each adaptation strategy was relevant to each of the three key climate stressors and to most, if not all, of the key values. In the rapid assessment process, the collective influence of all adaptation strategies was considered when assessing the adaptive capacity in regard to each key climate stressor. Whilst the breakout groups assessments of adaptive capacity were consistently higher for Wildfire than for the other two key climate stressors, the capacity was determined to be in the low category for all three stressors. When combined with the Potential impact, the Key values Vulnerability (three-point scale, low to high) was determined as high for each stressor; as a result, the **Key values Vulnerability** for the Queensland sector of the Gondwana Rainforests of Australia property was determined as **High** (Table 5.2). This is consistent with the IUCN World Heritage Outlook 3 assessment of high current threat from climate change and fire, as well as a very high potential threat from climate change (Osipova et al. 2020).

5.5 Community Vulnerability

The assessment of Community Vulnerability considers the economic, social, and cultural (ESC) aspects of the community associated with the property using two metrics:

- **Dependency** reflects the extent to which a decline in World Heritage values may affect ESC indicators in the future. These effects can be positive or negative. Separate assessments for economic, social and cultural dependency are combined to give an overall ESC dependency.
- **Adaptive capacity** reflects the current level of capacity within each component to adapt in the face of a decline in World Heritage values due to key climate stressors and only has a positive directionality. As for dependency, separate assessments for economic, social and cultural adaptive capacity are combined to give an overall ESC adaptive capacity.

Assessments were undertaken in small breakout groups, which again resulted in a spectrum of responses for each group that was resolved in plenary.

Table 5.3 Strategies for adaptive capacity brainstormed during the workshop, noting the relevant key climate stressors (W: Wildfire; TT: Temperature trend (air and/or water); PT: Precipitation trend) and key values (numbered in Table 2.2) for each.

	Activities	Key climate stressors			Relevant key value/s							
		W	TT	PT	1	2	3	4	5	6	7	8
Adaptation strategies	First Nations partnership for land management and decision-making.	X	X	X								
	Landscape-scale planning (e.g., Biosphere reserve approach, connectivity, buffering).	X	X	X								
	Rebuild connectivity, tenure blind management, working with neighbours (e.g., local government, state, Traditional Owners). Engagement with all adjacent landowners and managers.	X	X	X								
	Identifying and managing areas, including specific stressor-responses, for refugia – inside World Heritage or developing new areas outside the protected area (vegetated or cleared, current or predicted).	X	X	X								
	Water and groundwater flow, health, quantity and quality; natural waterway maintenance, limit extraction.	X	X	X								
	Values-based fire management: (including responses and planning, research, climate-focused, evidence-informed, fuel reduction, integrating ways of doing this).	X	X	X								
	Reduce other stressors inside and outside the World Heritage property, such as cattle, feral/pest animals, weeds, disease.	X	X	X								
	Increasing compliance through existing mechanisms for environmental protection. Creates economic flow on effects to fund better management.	X	X	X								
	Improved monitoring and effective reporting.	X	X	X								
	Identify and bank genetics; genetic diversity needs to be stored both ex-situ and in-situ, especially for rare/threatened species.	X	X	X								
	Translocation of species to projected future refugia.	X	X	X								
	Engineering projects to pilot innovative adaptation options, such as (i) identify/support/secure small-scale refugia (e.g., use of sprinklers, underground powerlines); and (ii) windy roads to increase visitor experience. Using a scientific approach and creative thinking.	X	X	X								
	Visitor management strategy, including: caps on visitor numbers, improved visitor experience, promoting values of the area, activating the role of visitors to progress adaptation, promoting outdoor activities outside the World Heritage boundaries (e.g., Outdoor education, mountain biking, exercise).	X	X	X								
	Education and onboarding community in values and management to target a cultural change towards stewardship; e.g., Gondwana Guardians, NRM groups, NGOs.	X	X	X								

A specific scenario was provided to participants to guide assessment of likely climate change impacts on the economic, social and cultural aspects. The selected scenario elements, based on climate projections for ca. 2050 under a moderate/high-emissions projection scenario (SSP3-7.0; Section 4), were:

- Wildfire: fire weather is projected to be harsher in the future, with an increasing number of dangerous fire weather days and a longer fire-weather season (linked to changes in temperature, precipitation, humidity, evaporation and wind);
- Temperature trend: a projected air temperature increase of 1.4°C from 2025 levels, leading to 10–21 additional hot days, ~30 additional hot nights and ~11 fewer cold nights each year;
- Precipitation trend: a decline in annual average rainfall by ~10% – but highly variable and with uncertainty (projected rainfall ranges from a ~20% decline to a ~5% increase); intensity of extreme rainfall projected to increase (~12% for the temperature increase); time in extreme drought projected to double.

The economic component considers the economic effects on economic activities/business types that are directly associated with the World Heritage property (see Section 3.3). In preparation for the workshop, the Steering Group developed a list of eight such activities:

- Tourism (inside & associated/adjacent)
- Goods and services (e.g., shops, restaurants)
- Recreation
- Outdoor education
- Conservation management &/or governance
- Events & festivals
- Wineries & other agriculture
- Adjacent development

Participant responses to an online poll, conducted at the start of the third workshop day, ranked these business types by their dependence upon the key values. This analysis revealed activities related to Tourism and Conservation management and/or governance were the most dependent upon the key values, whilst Adjacent development and wineries and other agriculture were the least dependent (Figure 5.4).

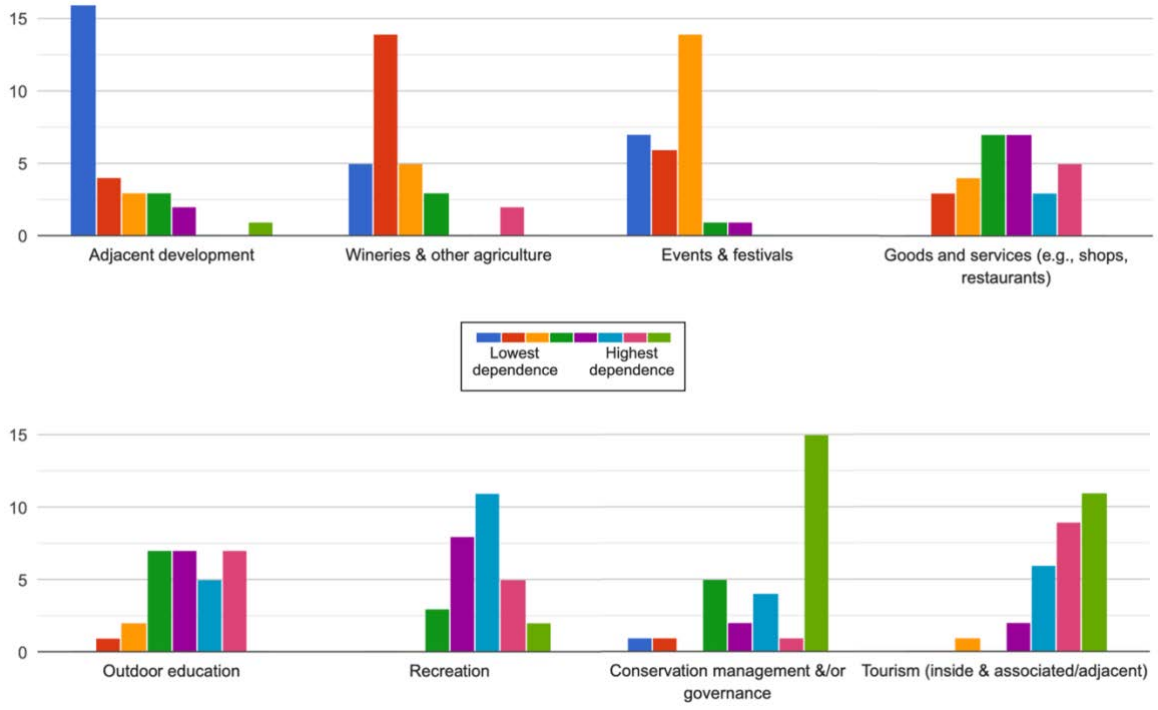


Figure 5.4 Participant rankings of eight business types by their dependence upon the key values of the Gondwana Rainforests of Australia–Queensland section.

Assessments of economic dependency and adaptive capacity were undertaken by each breakout group. Economic dependency was assessed for each business type on an eight-point scale with four categories from High-positive down to Minimal-positive, then four more categories from Minimal-negative down to High-negative; adaptive capacity was assessed only with a positive directionality with the four-point scale from High down to Minimal.

There was substantial variability between groups in some dependency assessments, including differing perceptions of the directionality (i.e., negative or positive). When synthesised in plenary, seven of the eight business types were assessed as likely to experience a low-negative economic effect, except for Outdoor education for which the dependency was assessed as moderate-negative.

Participants noted that climate-related disturbance events (e.g., wildfire, heavy rainfall) could greatly affect multiple business types. Overall, the economic dependency term was assessed as Low-negative (i.e., a negative impact at a low level).

The adaptive capacity assessments also varied between groups; once synthesised in plenary, assessments for the business types ranged from low capacity (Goods and services; and Conservation management &/or governance) to high capacity (Events & festivals; and Adjacent development), with an overall assessment of economic adaptive capacity as Moderate (Table 5.4). Participants expressed a perspective that many business types are generally positioned to adapt to changing circumstances, noting that Conservation management &/or governance relies heavily upon government funding and other support.

Intangible effects (e.g., social cohesion, aesthetics) were considered within the social and cultural components. An important distinction between these components is that social connections require a physical interaction with the property (i.e., a visit), whereas cultural connections can exist without a physical interaction. For each component, three groupings of people (local, domestic, and international) were considered to assess dependency and adaptive capacity. The definition for 'locals' was discussed in plenary, including consideration of the Country of the Traditional custodians and people living in nearby cities and regions that would self-define as local. The workshop applied a definition that locals would include people residing within approximately 75 km of any of the property components in the Queensland section.

Social indicators used to inform the assessments can be considered within four categories: Human capital; Social capital; Natural capital; and Built capital (after Costanza et al. 2007). Social dependency (eight-point scale, as for economic) assessments revealed variability between the breakout groups both in the assessments for each people grouping and the relative impact between the people groupings (i.e., whether locals would be more –or less– affected than internationals). These variabilities evoked discussion in plenary; however, it was most notable that all assessments (all breakout groups and all people groupings) identified a negative effect on social connections from a future decline in key values. These ranged from a loss of access and decline in experience when visiting the property to societal impacts from reduced water availability and reduction in overall well-being and sense of pride in the place. The overall social dependency assessment was at the Low-negative level (Table 5.4).

Social adaptive capacity responses (4-point scale, positive-only) indicated a generally high level of capacity, including changing the focus of a visit or changing to another location. However, for long-term locals, it was noted that whilst they may continue to visit the property despite changes to the values, their social connections may also be the most impacted amongst the people groupings. In contrast, most international visitors were considered to have a high capacity to choose a different destination. The overall assessment of social adaptive capacity was at the Moderate level (Table 5.4).

Regarding cultural connections, the Burra Charter (Australia ICOMOS 2013) recommends that "conservation of a place should identify and take into consideration all aspects of cultural and natural

Table 5.4 Rapid assessment of Community Vulnerability linked to the identified three key climate stressors. Assessed values of economic, social and cultural (ESC) dependency (sensitivity, ranging from negative to positive) and adaptive capacity contribute to derived outcomes for ESC potential impact and Community Vulnerability.

Economic	*Low-negative*
Social	*Low-negative*
Cultural	*Moderate-negative*
ESC dependency	[-] ○○●○ ***Low-negative*** ○○○○ [+]
ESC potential impact	**Moderate** ○●○
Economic	*Moderate*
Social	*Moderate*
Cultural	*Moderate*
ESC adaptive capacity	**Moderate** ○○●○
Community Vulnerability	**Moderate** ○●○

significance without unwarranted emphasis on any one value at the expense of others". Workshop participants brought differing perspectives from the rich diversity of their individual backgrounds and experiences. This included discussion of both Indigenous traditions, customs and ways of being and aspects of post-contact heritage. An important outcome from this was the desire shared by the participants for clarity in the use of terminologies, specifically that the use of the terms 'culture' and 'cultural' should only be in reference to Indigenous aspects, in contrast to use of 'post-contact heritage' to refer to non-Indigenous aspects. During the breakout sessions, most groups considered both Indigenous and post-contact aspects of these connections. One group provided separate assessments for both Indigenous and post-contact aspects, four groups combined these aspects in their assessments and one group only assessed post-contact heritage.

For the assessment process, cultural and post-contact heritage indicators were considered within four categories pertaining to: Self; People; Environment; and Pleasure/Purpose (after Marshall et al. 2019; Filep et al. 2024). Regarding the dependency assessment, breakout groups consistently evaluated a negative effect on all three people groupings, with greater impacts on locals (high-negative) than on domestic and international peoples (low-negative). The higher degree of pride in natural values of the property components for locals was specifically noted. Furthermore, the potential loss of totem plants and animals and impacts upon other culturally important species was noted to exacerbate the already high loss of Indigenous cultural connection to Country.

Participants also indicated that should a step-change decline in values occur (e.g., from a catastrophic fire event), this would have a greater impact upon both cultural and post-contact heritage connections than a gradual decline. When considering adaptive capacity, participants reported a low capacity of locals to adapt to a decline in key values, due to their stronger connection to place (as noted in the dependency assessment) and the difficulty in transferring this connection. This was in contrast to international peoples, for whom the adaptive capacity was assessed as high. Overall, cultural dependency was assessed as Moderate-negative, whilst the adaptive capacity was Moderate (Table 5.4).

Combining the three components, the overall ESC dependency was determined as Low-negative, which,

combined with the Key values Vulnerability (as the exposure term), resulted in the ESC potential impact being assessed as Moderate (three-point scale, low to high; Table 5.4). The combined ESC adaptive capacity was assessed as Moderate (second highest on a four-point scale, minimal to high). These outcomes determined the **Community Vulnerability** as **Moderate** (three-point scale, low to high; Table 5.4).

CONCLUSION

Albert River Circuit, Lamington National Park
Lightcapturer © QGov

6.1 Findings from the CVI process

Climate change is emerging as one of the greatest challenges for the protection of the World Heritage values of the Gondwana Rainforests of Australia (NESP 2019; Osipova et al. 2020). This workshop determined that significant effects on the key values, including those that comprise the Outstanding Universal Value (OUV) of the Queensland section, are anticipated.

By c.2050, projected changes to climate under a moderate-high emissions scenario (SSP3-7.0) include increased average temperatures across all seasons, more hot days and warm spells with a substantial increase in the temperature reached on hot days and hot nights, more intense storms and flooding, more time spent in drought (especially extreme drought), altered fire regimes, variable rainfall patterns and some changes, though minimal, to the lifting condensation layer (proxy for cloud base), mist availability and humidity. As a consequence, within the next 25 years there is the potential for loss or significant alteration of many key World Heritage values that comprise the OUV of the property. These are anticipated to include loss of at least some essential habitat areas (and associated impacts on fauna), potential loss of some floral taxa, further disruption to ecological connectivity across the component areas and, as a result of these, impacts upon Indigenous cultural and post-contact heritage.

6.1.1 Key values Vulnerability

Noting that a diverse array of climate stressors was identified as impacting one or more key values, the three key climate stressors identified to have the greatest potential impact on the heritage values of the Gondwana Rainforests of Australia (Queensland section) were:

i. Wildfire risk: Fire-weather is projected to be harsher in the future, although there is uncertainty about the frequency and intensity of wildfire events. Potential impacts from the increased wildfire risk by 2050 were assessed as **Extreme**, based on the assessments of:
   - Exposure **–** Very Likely (increasing number of dangerous fire weather days and longer fire-weather season, with a moderate increase over time); and
   - Sensitivity – High (impacting up to 50% of the total area of the property with a High probability that compounding factors will exacerbate the risk; this is linked to changes in temperature, precipitation, humidity, evaporation and wind.

ii. Temperature Trend: A projected air temperature increase of 1.4°C (1.0–1.9 °C) above the 1995–2014 baseline, with a significant increase in hot days per year (from historical counts of ~7 days/year up to ~19 days/year by 2050) and with ~30 additional hot nights and ~17 fewer cold nights (roughly half) per year, is based on a high level of confidence in the climate projections. Potential impacts from the increasing temperature trend by 2050 were assessed as **Extreme**, based on the assessments of:
   - Exposure **-** Very Likely (ongoing and with a moderate increase over time); and
   - Sensitivity – High (impacting the majority of the property with a Medium-High probability that compounding factors will exacerbate the trend).

iii. Precipitation Trend: Projections indicate a decline in annual average rainfall by ~10% – but highly variable and with uncertainty (ranges from ~20% decline to ~5% increase); that is projected to come in fewer, more-intense downpours, an increase in the intensity of short-duration, extreme rainfall events (~11% increase in daily totals for the projected temperature increase); time in extreme drought projected to double. Potential impacts from the variable precipitation trend by 2050 were assessed as **Extreme**, based on the assessments of:
   - Exposure **–** Likely-Very Likely (5-10 significant events/decade and with a moderate increase over time); and
   - Sensitivity – High (impacting the majority of the property with a High probability

that compounding factors will exacerbate the trend).

The fact that the potential impact from each of the three key climate stressors on OUV was assessed as **Extreme** is of concern. The workshop participants assessed the capacity to adapt in the face of potential impacts from each of the stressors as **Low** which led to the overall **Key values Vulnerability** of the Queensland section of the property to be determined as **High**.

6.1.2 Community Vulnerability

The combined dependency of the economic, social, and cultural aspects (e.g., considering the economic dependence of key business types upon the property, the local population's connection with the property), were each determined to be **Low-Negative** which led to a **Moderate** potential community impact. When combined with the High Key values Vulnerability, the assessed **Moderate** level of adaptive capacity across the ESC components determined the overall **Community Vulnerability** as **Moderate**.

6.2 Gaps identified during the workshop

In addition to the recommended adaptive strategies in Table 5.3, CVI workshop participants identified a number of topics for potential further investigation. Whilst many of these were outside the direct scope of the workshop, several may be influenced by or have implications for climate change impacts. These include:

- a need to clarify the differing climatic and habitat requirements for key species
- monitoring and analysis of environmental conditions to identify sources of change (e.g., climate change, visitation)
- changing societal usage patterns due to changing climate and consequent socio-economic impacts, and
- increasing the level of climate literacy of site managers and the broader community.

Other suggested topics for future consideration, including those beyond the climate change-focus of the workshop, are listed in Appendix 7.

Conservation decisions that respond to the threats of climate change begin with understanding the key areas of climate vulnerability. The research opportunities identified through the CVI process are a starting point and will require appropriate resourcing, as will the management activities informed by any research outcomes. Wherever possible, research opportunities should be closely linked to the priority management needs. Continuing to link research with management-relevant outcomes is essential.

6.3 Management implications – national and local

Climate change is emerging as one of the greatest challenges for the protection of the values of the Gondwana Rainforests of Australia (Queensland Section). It is predicted to amplify other threats, such as altered fire regimes, invasive species and pathogens, and fluctuating rainfall patterns. In the face of such threats, there is a need to accept that some attributes will decline and may even be lost, which must be considered when prioritising management decisions and resourcing response activities. However, the management issues and pressures may vary between reserves so differing management approaches are likely to be needed in different locations.

The CVI workshop highlighted the following key management implications for the Queensland section of the Gondwana Rainforests of Australia:

i. Greater involvement of First Nations in management

The enduring relationships that the three First Nations groups – the Yugambeh-speaking Peoples, the Yuggera Ugarapul People, and the Githabul People – have with the landscape is increasingly acknowledged by the managers of the property as well as by the broader community. This includes acknowledging the cultural connections that these groups have to 'Country', and that these connections span

generations. Consequently, there is a clear need to recognise that 'Indigenous Cultural Heritage' is a key value for the property. There is also a need to engage more effectively with the First Nations people across the Gondwana estates and integrate their perspectives, culture connection and knowledge systems into management. Acknowledging and facilitating the cultural practices of First Nations peoples in the area is an important step in reconciliation and recognising their connections (rights, interests and purpose).

The active involvement of participants from all three First Nations groups was fundamental to the success of this CVI workshop, and any future workshops must similarly ensure the involvement of all three groups. However, the sharing of Indigenous knowledge must be accompanied by shared benefits, recognition of cultural authority and a clear process to address intellectual property rights.

ii. Fire management

Building on (i) above, there needs to be more engagement with cultural fire practitioners. Within the World Heritage property, there are differing objectives for fire 'management', ranging from saving homes and other property to maintaining habitats. However, there is a disconnect with Indigenous rights, roles and responsibilities.

Approximately 34% of the Gondwana Rainforests (Queensland section) was burnt during the 2019–20 bushfires (Churchill et al., 2023; Case Study 1). Almost 4,000 hectares of rainforest was burned, which is of significant concern given that rainforests were generally considered resistant to fire and have not evolved to adapt to fire; elsewhere the ecological impacts from these wildfires varied across the property. The fires were preceded by a prolonged drought and were coincident with a period of above average temperatures and below average rainfall (Australian BOM Special Climate Statement 71). Consequently, the rainforest endured the cumulative effects of high temperatures, lower precipitation, fires and shortly after, floods that eroded soils.

Fire weather is projected to worsen over the coming decades; bushfires are likely to be of higher intensity, and bushfire seasons are likely to start earlier and last longer. This is decreasing the time in between fire seasons and may reduce opportunities for planned burning and the effective sharing of resources for fire-fighting.

The catastrophic wildfires of 2019-20 have demonstrated the vulnerability of the World Heritage values of the property to increased temperatures and drought conditions, and the devastating impacts of cumulative events. A key message from workshop participants was these fires were unprecedented across the World Heritage property (and beyond) and may represent the onset of future periodic climate-driven disturbance events in rainforest environments. This may be analogous to the onset of coral bleaching events in the Great Barrier Reef in recent decades which are now increasing in frequency and severity.

iii. Improved monitoring

A monitoring strategy has been published for the World Heritage property (Chester and Bushnell, 2005) but there is no overall coordinated monitoring program. Part of the challenge is obtaining agreement on indicators that are cost-effective in capturing changes to the attributes of OUV across the considerable extent of the components comprising the property. Another challenge is the need for increased resourcing to implement coordinated monitoring programs.

The varied impact of the fires of 2019-2020 and their longer-term impacts are still being evaluated and the capacity of many areas to recover is still to be understood. Of great concern is the apparent decline of amphibian species within the property and declines in indicator bird species and various plant species have also been reported. More comprehensive monitoring data, and analysis of this data, is needed for numerous species that contribute to the OUV of the property.

The management agencies have commissioned various monitoring strategies to help advise adaptive management actions. These studies are being

conducted by universities, State Herbaria, CSIRO, Australian Bureau of Meteorology, National Environmental Science Program (NESP), and non-government organisations; e.g., BirdLife Australia.

iv. Climate adaptation

Reducing the impacts of climate change on Australia's World Heritage properties through adaptation planning and building resilience must continue to be a key focus of the Australian Government. The government's NESP program is funding a project to develop a climate change adaptation plan for several of the Gondwana Rainforests of Australia reserves. The project is being co-designed with First Nations groups and involves consultation with multiple community groups, state and local governments to develop an online tool to assist with climate adaptation by local communities and government agencies (Sarah Boulter, pers comm).

v. Changes in use patterns

Increasing visitor numbers, tourism developments and the need for more visitor infrastructure were identified as substantial issues in some reserves. Post Covid-19, the use patterns for many areas has changed significantly, and today there are high levels of visitation in a number of the reserves (see Case Study 2). As climate change continues, visitation and related issues need to be managed to minimise compounding impacts, while supporting the visitor experience and the appreciation of values.

vi. Extensions to the World Heritage property

Some of the reserves within the property are very small; while there are nearby protected areas, often with the same or similar values, there is limited connectivity to these other areas. The area to boundary ratio of fragmented reserves increases exposure to threats such as fire, weeds and pathogen invasion, changes in the microclimate of otherwise intact rainforest, and potentially has negative impacts on natural ecological processes (including groundwater flows, and the altitudinal and latitudinal migration in response to climate change). Furthermore, these edge effects are exacerbated by the range of adjacent land uses and management regimes. The additive effect of many threats that originate in surrounding land uses can weaken the integrity of the rainforest and reduce its capacity to recover after fire or attack by pathogens.

The fragmented nature of the Gondwana rainforest remnants means that activities outside the reserves can constitute a threat that require collaborative responses with other land and water managers and stakeholders. Efforts in the surrounding landscapes are growing with an increasing need to collaborate with adjacent land managers to reduce threats and boost connectivity wherever possible.

vii. Implications for the remainder of the serial property

Because of the similarities with the other parts of the serial property in NSW, together with participation in the workshop by representatives of that property section, outcomes of this workshop could inform vulnerability elsewhere (though not to the extent that a dedicated application of the CVI is likely to achieve). The NSW participants in the workshop reminded participants of the importance of working collaboratively across the entire World Heritage property.

The CVI workshop provides a baseline and a systematic 'building block' for continuing efforts to support management of the property and its associated communities. All outputs, including the potential adaptation strategies (section 5.6) and the identified gaps (section 6.2), will contribute to the next steps in this ongoing series of activities.

6.4 Lessons for other properties of heritage significance

The CVI application for Gondwana Rainforests of Australia (Queensland Section) demonstrates the value of a systematic process to identify key aspects of vulnerability to climate change. The CVI process is flexible and rigorous enough for wider applications, and it is possible that other heritage managers will find the format and process useful when considering the attributes and climate change challenges in other

locations where heritage needs protection and management.

The CVI has now been demonstrated across a diverse range of World Heritage properties to be a useful tool to assess climate vulnerability and to assist in identifying focus areas and opportunities to manage impacts to both the recognized values and the associated community. In addition to World Heritage properties, interest in applying the CVI to assist in strategic planning and/or research for other locations of significance continues to grow (e.g., Indigenous land and sea Country).

The urgency of responding to climate change has recently been demonstrated through unprecedented impacts upon the values and attributes in Australian World Heritage properties; e.g., significant coral mortality in the Great Barrier Reef, Ningaloo and Lord Howe Island Group, and wildfires devastating large areas of the Greater Blue Mountains and Tasmanian Wilderness. Increasingly, there is a need for planning and funding response capabilities whilst also taking greater action to reduce greenhouse gas emissions and atmospheric concentrations that are the primary drivers of climate change.

One potential opportunity is that similar World Heritage properties might benefit from a thematic analysis that could inform a systematic monitoring program. While the importance of addressing specific needs for each World Heritage property would remain, a thematically-based program has the potential to inform other heritage places that share similar values and/or are likely to comparable exposure to climate stressors.

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ACKNOWLEDGEMENTS

Ship Stern Circuit, Lamington National Park
Lightcapturer © QGov

The workshop Steering Group is extremely grateful to the many people who contributed to the success of the CVI project for the Gondwana Rainforests (Queensland Section), including:

- The World Heritage Unit, Queensland Department of the Environment, Tourism, Science and Innovation:
  - Ellen Weber, Principal Project Officer, for initiating and managing the CVI process to assess the climate vulnerability of the Gondwana Rainforests (Queensland Section)
  - Robert Harrison, Senior Policy Officer, for project support, including helping to develop the list of key values used in the CVI process, and especially for his contributions to the drafting of this report
  - Toni Thwaites, Executive Officer, who coordinated attendance of the workshop participants, their accommodation in Warwick and the workshop catering
  - Madeleine Steel, A/Senior Project Officer, for coordinating various logistics
- The First Nations group of Githabul People (Robbie Williams, Nathan Charles and Melissa Chalmers) for their respective 'Welcomes' to Githabul Country
- Queensland Parks and Wildlife Service & Partnerships (QPWS&P)
  - Sherri Tanner-McAllister, Principal Conservation Officer, Planning & Park Services for helping to develop the list of key values used in the CVI process
  - Todd Doyle, QPWS&P Planner, Planning and Evaluation team, for assistance in planning the workshop and for collating visitor data for National Parks as shown in the workshop
  - Mick Piper, Acting Principal Ranger QPWS&P, for his introduction to the workshop participants at Queen Mary Falls
- CSIRO and University of Tasmania (UTas)
  - Vanessa Round, Team Leader, CSIRO National Impacts Team, and Claire Mason (CSIRO) for collating the background information on climate science used during the workshop
  - Sarah Boulter (UTas) for presenting the climate science during the workshop
- All workshop participants (Appendix 6) who provided their time and expertise bringing a diverse range of perspectives to the workshop.
- Staff at the Southern Downs Regional Council (SDRC) for providing the workshop facilities at the Warwick Town Hall:
  - Bronwyn Small, SRDC Customer Service Officer, for wonderful assistance throughout the workshop planning and implementation
  - The IT staff at SDRC, for support during the workshop
- The CVI team from James Cook University:
  - CVI developers, Scott Heron and Jon Day, for the methodology used in the CVI process and their facilitation roles during the workshop
  - Kristin Heron for coordinating various workshop logistics, collating the social-economic information and note-taking during the workshop
- The caterers for the Warwick workshop:
  - Nerissa ('Noo') Shephard at One Table Café and Function Room for catering and the provision of a function room on Tuesday morning
  - Scott Morton at Cherry Tree Cafe for catering
- The Department of Climate Change, Energy, the Environment and Water for providing grant funding to support the project

APPENDICES

Albert River Circuit, Lamington National Park
Lightcapturer © QGov

Appendix 1. Statement of Outstanding Universal Value for Gondwana Rainforests of Australia
(Inscribed 1986; significant modifications to the boundaries 1994)

Brief synthesis

The Gondwana Rainforests of Australia is a serial property comprising the major remaining areas of rainforest in southeast Queensland and northeast New South Wales. It represents outstanding examples of major stages of the Earth's evolutionary history, ongoing geological and biological processes, and exceptional biological diversity. A wide range of plant and animal lineages and communities with ancient origins in Gondwana, many of which are restricted largely or entirely to the Gondwana Rainforests, survive in this collection of reserves. The Gondwana Rainforests also provides the principal habitat for many threatened species of plants and animals.

Criterion (viii): The Gondwana Rainforests provides outstanding examples of significant ongoing geological processes. When Australia separated from Antarctica following the breakup of Gondwana, new continental margins developed. The margin which formed along Australia's eastern edge is characterised by an asymmetrical marginal swell that runs parallel to the coastline, the erosion of which has resulted in the Great Divide and the Great Escarpment. This eastern continental margin experienced volcanicity during the Cenozoic Era as the Australian continental plate moved over one of the planet's hot spots. Volcanoes erupted in sequence along the east coast resulting in the Tweed, Focal Peak, Ebor and Barrington volcanic shields. This sequence of volcanos is significant as it enables the dating of the geomorphic evolution of eastern Australia through the study of the interaction of these volcanic remnants with the eastern highlands.

The Tweed Shield erosion caldera is possibly the best preserved erosion caldera in the world, notable for its size and age, for the presence of a prominent central mountain mass (Wollumbin/Mt Warning), and for the erosion of the caldera floor to basement rock. All three stages relating to the erosion of shield volcanoes (the planeze, residual and skeletal stages) are readily distinguishable. Further south, the remnants of the Ebor Volcano also provides an outstanding example of the ongoing erosion of a shield volcano.

Criterion (ix): The Gondwana Rainforests contains outstanding examples of major stages in the Earth's evolutionary history as well as ongoing evolutionary processes. Major stages represented include the 'Age of the Pteridophytes' from the Carboniferous Period with some of the oldest elements of the world's ferns represented, and the 'Age of Conifers' in the Jurassic Period with one of the most significant centres of survival for Araucarians (the most ancient and phylogenetically primitive of the world's conifers). Likewise the property provides an outstanding record of the 'Age of the Angiosperms'. This includes a secondary centre of endemism for primitive flowering plants originating in the Early Cretaceous, the most diverse assemblage of relict angiosperm taxa representing the primary radiation of dicotyledons in the mid-Late Cretaceous, a unique record of the evolutionary history of Australian rainforests representing the 'golden age' of the Early Tertiary, and a unique record of Miocene vegetation that was the antecedent of modern temperate rainforests in Australia. The property also contains an outstanding number of songbird species, including lyrebirds (Menuridae), scrub-birds (Atrichornithidae), treecreepers (Climacteridae) and bowerbirds and catbirds (Ptilonorhynchidae), belonging to some of the oldest lineages of passerines that evolved in the Late Cretaceous. Outstanding examples of other relict vertebrate and invertebrate fauna from ancient lineages linked to the break-up of Gondwana also occur in the property.

The flora and fauna of the Gondwana Rainforests provides outstanding examples of ongoing evolution including plant and animal taxa which show evidence of relatively recent evolution. The rainforests have been described as 'an archipelago of refugia, a series of distinctive habitats that characterise a temporary endpoint in climatic and geomorphological evolution'. The distances between these 'islands' of rainforest

represent barriers to the flow of genetic material for those taxa which have low dispersal ability, and this pressure has created the potential for continued speciation.

Criterion (x): The ecosystems of the Gondwana Rainforests contain significant and important natural habitats for species of conservation significance, particularly those associated with the rainforests which once covered much of the continent of Australia and are now restricted to archipelagos of small areas of rainforest isolated by sclerophyll vegetation and cleared land. The Gondwana Rainforests provides the principal habitat for many species of plants and animals of outstanding universal value, including more than 270 threatened species as well as relict and primitive taxa.

Rainforests covered most of Australia for much of the 40 million years after its separation from Gondwana. However, these rainforests contracted as climatic conditions changed and the continent drifted northwards. By the time of European settlement rainforests covered only 1% of the landmass and were restricted to refugia with suitable climatic conditions and protection from fire. Following European settlement, clearing for agriculture saw further loss of rainforests and only a quarter of the rainforest present in Australia at the time of European settlement remains.

The Gondwana Rainforests protects the largest and best stands of rainforest habitat remaining in this region. Many of the rare and threatened flora and fauna species are rainforest specialists, and their vulnerability to extinction is due to a variety of factors including the rarity of their rainforest habitat. The Gondwana Rainforests also protects large areas of other vegetation including a diverse range of heaths, rocky outcrop communities, forests and woodlands. These communities have a high diversity of plants and animals that add greatly to the value of the Gondwana Rainforests as habitat for rare, threatened and endemic species. The complex dynamics between rainforests and tall open forest particularly demonstrates the close evolutionary and ecological links between these communities.

Species continue to be discovered in the property including the re-discovery of two mammal species previously thought to have been extinct: the Hastings River Mouse (*Pseudomys oralis*) and Parma Wallaby (*Macropus parma*).

Integrity

The Gondwana Rainforests contains the largest and most significant remaining stands of subtropical rainforest and Antarctic Beech (*Nothofagus moorei*) cool temperate rainforests in the world, the largest and most significant areas of warm temperate rainforest and one of only two remaining large areas of Araucarian rainforest in Australia.

Questions related to the small size of some of the component parts of the property, and the distance between the sites for the long-term conservation and continuation of natural biological processes of the values for which the property was inscribed have been raised. However, noting that the serial sites are in reasonable proximity and are joined by corridors of semi-natural habitats and buffers, compensation for small size and scattered fragments is being made through intensive management consistent with approved management plans and policy.

Since inscription, there have been significant additions to the protected area estate in both New South Wales and Queensland in the region encompassing the Gondwana Rainforests. These areas have undergone a rigorous assessment to determine their suitability for inclusion in the property and a significant extension of the property is planned as indicated by the addition of the property extension to Australia's Tentative List in May 2010. In relation to ongoing evolution, the level of legislative protection provided for World Heritage properties will minimise direct human influence and enable the continuation of natural biological processes.

Protection and management requirements

Institutional arrangements for the protection and management of Gondwana Rainforests are strong. The property is made up of 41 reserves, almost all of which are within the protected area estate, and primarily managed by the Queensland Parks and

Wildlife Service & Partnerships, and the New South Wales National Parks and Wildlife Service. Both States have legislation relating to protected areas and native flora and fauna that provide protection for the values of the Gondwana Rainforests.

In 1993, Governments agreed to establish a Coordinating Committee, comprised of on-ground managers from these agencies and the Australian Government, to facilitate the cooperative management of the property at an operational level. A Technical and Scientific Advisory Committee and a Community Advisory Committee have also assisted with management advice since their establishment in 2002.

In 1994 when the property was extended, the World Heritage Committee requested the Australian authorities to complete the management plans of individual sites, particularly those within Queensland. Management plans have been produced for the majority of individual reserves within the property, and are in draft form or planned for the remainder.

In 2000 a Strategic Overview for Management for the Central Eastern Rainforest Reserves of Australia (now Gondwana Rainforests) World Heritage Area was published. This overarching document is a major element in guiding cooperative management by the three Governments in relation to the identification, protection, conservation, rehabilitation and presentation of the Gondwana Rainforests.

All World Heritage properties in Australia are 'matters of national environmental significance' protected and managed under national legislation, the *Environment Protection and Biodiversity Conservation Act 1999 (Cwth)*. This Act is the statutory instrument for implementing Australia's obligations under a number of multilateral environmental agreements including the World Heritage Convention. By law, any action that has, will have or is likely to have a significant impact on the World Heritage values of a World Heritage property must be referred to the responsible Minister for consideration. Substantial penalties apply for taking such an action without approval. Once a heritage place is listed, the Act provides for the preparation of management plans which set out the significant heritage aspects of the place and how the values of the site will be managed.

Importantly, this Act also aims to protect matters of national environmental significance, such as World Heritage properties, from impacts even if they originate outside the property or if the values of the property are mobile (as in fauna). It thus forms an additional layer of protection designed to protect values of World Heritage properties from external impacts.

On 15 May 2007, the Gondwana Rainforests of Australia was added to the National Heritage List; National Heritage is also a matter of national environmental significance under the EPBC Act.

The impacts of climate change and high levels of visitation, undertaking effective fire management, and mitigating the effects of invasion by pest species and pathogens present the greatest challenges for the protection and management of Gondwana Rainforests. Climate change will impact particularly on those relict species in restricted habitats at higher altitudes, where particular microclimatic conditions have enabled these species to survive. Management responses include improving the resilience of the property by addressing other threats such as inappropriate fire regimes and invasion by pest species, and trying to increase habitat connectivity across the landscape.

Appendix 2. List of key values (KVs) and attributes

List of key values (KVs) and attributes for Gondwana Rainforests of Australia used in the CVI workshop and their alignment to World Heritage (WH) values and the draft Values Based Management Framework (VBMF). ***Key value #5 was added during the Warwick workshop.***

Key values	Unique rainforest habitats	Other significant habitat for biodiversity	Important flora	Important fauna	Ongoing ecological and evolutionary processes*	Significant geomorphological features and processes	Indigenous cultural heritage	Post-contact heritage
	1	2	3	4	5	6	7	8
Focus	**Predominantly ecosystem focused**		**Predominantly species focused**		**Processes**		**Human-related heritage**	
Indigenous connection - Rights, responsibility and purpose								
VBMF KVs	• High altitude rainforests, cool temperate forest • High altitude rainforest, warm temperate forest • High altitude rainforest, upland subtropical forest • Lowland subtropical forest • Dry vine forest	• Catchment and Riparian • Eucalypt forest, wet sclerophyll forest and rainforest ecotones • Montane heath, shrubby woodland and open forests		• Eastern Bristlebird and habitat • Hastings River mouse and habitat		• The Tweed Caldera		• Lamington walking tracks • Springbrook State School • Main Range Spicers Gap Road • Main Range Pastoral Cultural Heritage (Glenn Rock – not in GRs).
WH criteria and values	Criterion ix: values ix(a)–ix(f)	Criterion x: values x(j), x(l)	Criterion ix: values ix(g)–ix(l); Criterion x: values x(f), x(g)	Criterion x: values x(a)–x(e), x(i)	Criterion ix	Criterion viii		
Tangible attributes	1. Cool temperate forest • cloud forests • Araucaria-Nothofagus forests 2. Warm temperate forest 3. Upland subtropical forest 4. Lowland subtropical forest 5. Dry vine forest 6. Riparian forests	1. Wet sclerophyll forests 2. Heaths 3. Open forests 4. Transition forests/ecotones	1. Rare and threatened species on the NCA, EPBC, IUCN lists (including orchids, ferns, gymnosperms and angiosperms) 2. Endemic species (when not covered by the other categories) 3. Ancient lineages – all taxonomies	1. Rare and threatened mammals[a] 2. Rare and threatened birds[b] 3. Rare and threatened frogs[c] 4. Rare and threatened reptiles[d] 5. Rare and threatened invertebrates[e] 6. Richmond birdwing and pelican spiders 7. Ancient lineages – all taxonomies[f] 8. vertebrate and invertebrate fauna from ancient lineages	*These attributes were not identified prior to or during the workshop; attributes may include:* 1. Connectivity 2. Fragmented refugia 3. Species showing genetic variability 4. McPherson-Macleay biodiversity overlap zone	1. The Tweed Caldera 2. Focal Peak 3. Main Range volcano 4. Rivers and creeks/waterfalls 5. Groundwater	1. Scar trees 2. Bora rings/Bora ground 3. Rock art/ sites 4. Artefact scatter 5. Rock wells 6. Occupation site/ rock shelter 7. Burial sites 8. Totemic species (flora & fauna) 9. Species for traditional items (e.g., spears, nulla-nulla, dillies, nets, necklaces) 10. Resistance/conflict sites 11. Traditional pathways	1. Lamington's walking tracks 2. Springbrook State School 3. Main Range Spicers Gap Road 4. Main Range Pastoral 5. Glow worm locations 6. Significant caves 7. Recreation opportunities 8. Ecotourism opportunities 9. Sites of historical significance (e.g., Stinson crash) 10. Scientific heritage? 11. Spectacular views/viewing opportunities

Examples of Important fauna (key value #4):

[a] Rare and threatened mammals: southern subspecies spotted-tailed quoll, Hastings River mouse, black-tailed antechinus

[b] Rare and threatened birds: Albert's lyrebird, rufous scrub-bird, plumed frogmouth, eastern bristlebird

[c] Rare and threatened frogs: cascade treefrog, Fleay's and giant barred frog, Tusked frog and red-and-yellow mountain frog

[d] Rare and threatened reptiles: burrowing three-toed snake-tooth skink, common death adder, rainforest cool-skink, Tryon's skink

[e] Rare and threatened invertebrates: *Euastacus* (crayfish)

[f] Ancient lineages – all taxonomies: oldest lineages of passerines (Order: Passeriformes)

Key values	Unique rainforest habitats	Other significant habitat for biodiversity	Important flora	Important fauna	Ongoing ecological and evolutionary processes*	Significant geomorphological features and processes	Indigenous cultural heritage	Post-contact heritage
	1	2	3	4	5	6	7	8
Focus	**Predominantly ecosystem focused**		**Predominantly species focused**		**Processes**		**Human-related heritage**	
Indigenous connection - Rights, responsibility and purpose								
Examples of intangible attributes	• Sounds of the rainforest • Smells of the undergrowth • Sense of place	• Smell of gums	• Connection to deep time	• Birdsong • Frog song		• Connection to deep time	• Ceremonial places/Healing waters • Dreaming/creation places • Sacred sites (e.g. Women's Business, Men's Business) • Looking after country • Link to ancestors • Songlines	• Spiritual • Wildness and wow-ness • Remoteness • Meditative state • Serenity and peacefulness

Appendix 3. Initial list of other Significant Property Values

When assessing climate vulnerability in WH properties, the CVI process focuses on the key values and recognises there are also other Significant Property Values (SPVs). Most property managers are aware that their World Heritage property invariably includes many significant values in addition to the key values, whether they are heritage values (tangible or intangible) or other values (e.g., economic, social, spiritual, environmental, scientific). These values may be significant locally, regionally, or nationally, and may also be considered 'significant' under legislation (e.g., National or State Heritage Lists/Registers) or even in local or regional by-laws.

Many of these other SPVs are just as important as the key values when it comes to management of the property and may require specific management actions to ensure the other SPVs are protected and/or conserved, especially as most other SPVs are also subject to impacts from stressors like climate change.

Below is an initial list of other SPVs for Gondwana Rainforests of Australia (Queensland Section); however, it is important to note:

1. This is an initial draft only to show there are many SPVs that are not otherwise listed in the Statement of OUV for Gondwana QLD.
2. Unlike the Statement of OUV which is a static document, the list of SPVs is dynamic and should be periodically updated by the property managers and planners. Anyone is able to contribute to this list of SPVs, and it is hoped the QPWS&P rangers and planners will periodically update the list. Over time, its real value will become more apparent if it is periodically updated in the light of more recent knowledge.

<u>Other Significant Property Values (SPVs)</u> that are locally, regionally, or nationally significant within Gondwana Rainforests of Australia World Heritage (Queensland Section) but not included in the Statement of OUV.

Broad groupings of SPVs	**Key SPVs** (list, and briefly describe, in a prioritised order based on significance)	**Additional information or examples of SPVs**	**Justification** *Why is the value significant?* *Locally, regionally or nationally?*
Biological diversity *(e.g., other flora, fauna, or habitats of significance not in the Statement of OUV)*	rare or threatened mammals	*e.g. southern subspecies of the Spotted-tailed quoll; Black-tailed antenchinus, parma wallaby, bats?*	*Nature Conservation Act*
	rare or threatened birds	*e.g., Albert's lyrebird, Rufous scrub-bird, Plumed frogmouth, Pale-yellow Robin, Double-eyed Fig-parrot, Black-breasted Button quail*	*Nature Conservation Act*
	rare or threatened frogs	*e.g., Cascade treefrog, Fleay's and giant barred frogs, Tusked frog, Red-and-yellow mountain frog*	*Nature Conservation Act*
	rare or threatened reptiles	*e.g., Burrowing three-toed snake-tooth skink, Common death adder, Rainforest cool-skink, Tryon's skink*	*Nature Conservation Act*

Broad groupings of SPVs	Key SPVs (list, and briefly describe, in a prioritised order based on significance)	Additional information or examples of SPVs	Justification *Why is the value significant?* *Locally, regionally or nationally?*
Biological diversity *(cont.)*	rare or threatened plants	*e.g., Bunya Mountains Bluegrass (or Satin-top Grass), Austral Toadflax, Boulder Orchid*	*Nature Conservation Act*
	endemic species *"…significant centres of endemism (including) cool temperate rainforest, subtropical rainforest, warm temperate rainforest, dry rainforest, wet sclerophyll forest, montane heathlands and rocky outcrops. …".*	*Gondwana rainforest crayfish, Nightcap oak, Antarctic beech, Logrunner*	*Taxonomic revision for the Logrunner (e.g., Boles 2007) shows this species is confined to Gondwana Rainforests.*
	ancient lineages – all taxonomies	*Ferns, conifers, flowering plants*	
	Insects (e.g., spiders, beetles, bugs)	*148 insect species identified (see here)*	
	other invertebrates	*e.g., Brown Turban Pinwheel Snail, Angular Flamed Pinwheel Snail, Velvet worms*	*Nature Conservation Act?*
Aesthetic values or phenomena *(e.g., any special scenic qualities, locations or phenomena that are significant)*	spectacular views/ stunning natural beauty/viewing opportunities	*Scenic Rim lookouts, vistas, rivers, creeks, waterfalls, Natural Bridge*	
	glow worm locations		
	wildflower viewing		

Broad groupings of SPVs	Key SPVs (list, and briefly describe, in a prioritised order based on significance)	Additional information or examples of SPVs	Justification *Why is the value significant?* *Locally, regionally or nationally?*
Economic values *(e.g., provide income or employment opportunities through tourism, fishing, or other commercial activities, etc.)*	ecotourism opportunities	*e.g., sunset tours, bush tucker tours*	
	scenic drives, day trippers	*Key locations*	
	groundwater		
	Binna Burra resort	*Not part of the WHA but closely related*	*Queensland Heritage Register*
	Spicers Gap resort	*Not part of the WHA but closely related*	
Recreational values *(e.g., provide for recreational activities like wildlife viewing, hiking, camping, etc.)*	national park walking tracks	*e.g., well-marked tracks, mountain scrambles, multi-day walks, boardwalks/walkways*	
	recreation opportunities	*e.g., picnicking, bushwalking/hiking, rock climbing, birdwatching, swimming, mountain biking, fishing*	
	wildlife photography & landscape photography		
	water-based activities	*rock-pools, swimming holes,*	
	remote area camping. wilderness experience		
Historic/ cultural values *(e.g., features or locations that represent history or enable traditions or ways of life to continue, etc.)* *Include key place names, European history*	Spicers Gap/ Main Range Road		*Added to Queensland Heritage Register in 1999.*
	Cunningham's Gap	*Allan Cunningham Monument*	
	sites of historical significance (e.g., 1937 Stinson plane crash)	*More info on Stinson crash here*	
	Historical records of Palmer (1880s)		
	Forestry history (1870 - 1920s)		
	significant caves		

Broad groupings of SPVs	Key SPVs (list, and briefly describe, in a prioritised order based on significance)	Additional information or examples of SPVs	Justification *Why is the value significant?* *Locally, regionally or nationally?*
Indigenous/ Traditional Custodians/ First Nations values *(e.g., specific features or locations that represent history, stories, totems, lore, traditions, etc.)*	Location-specific evidence of historic occupation	*e.g., scar trees, rock art/sites, bora rings/ bora ground, artefact scatter, rock wells, occupation site/rock shelter, other significant cultural sites and objects*	
	Broad-area examples of historic occupation	*e.g., recognised resistance/conflict sites, recognised trading areas*	
	Contemporary use by Indigenous people	*e.g., bush tucker/ traditional foods, looking after Country (including fire management), species essential to pass on traditional knowledge (such as medicinal plants), Totemic species (plants & animals), species used to make traditional items (spears, nulla-nulla, dillies, nets, necklaces, etc.)*	
	Intangible evidence of historic connection	*e.g., sacred areas (e.g., for initiation, Women's Business, Men's Business, danger-places), Dreaming/creation places, traditional pathways, song-lines, ceremonial places, healing waters*	
Learning/ Scientific values *(e.g., opportunities for formal and informal education, scientific research, outreach, nature interpretation, etc.)*	specific sites of scientific heritage	*e.g., understanding the impacts of climate change on cloud forests*	
	formal education centres	*Maroon Outdoor Education Centre* *The Binna Burra Environmental Education Centre (EEC) closed in 1999/2000*	

Spiritual/ Philosophical fulfilment *(e.g., areas that are sacred, religious, or are of spiritual significance, etc.)*	wildness (and wow-ness!)		
	spiritual feelings		
Health/ Therapeutic values *(e.g., areas that enable people to feel better physically or mentally, etc.)*	meditative state		
	serenity & peacefulness		
	fresh, clean air		
Other/Special places *(if places are special, state reason why e.g. other PA designations, NP, Ramsar, EBSA)*	Former Springbrook State School	*"… a significant example of the late settlement of the Gold Coast hinterland, a social centre for the Springbrook community, and representative of early 20th-century Queensland school design (constructed 1911)..".*	*Added to Queensland Heritage Register, August 2003*
	Pastoral Leases	*e.g., Main Range Pastoral Lease*	
	Restricted Access Areas (access is restricted to protect sensitive natural or cultural resources, ensure public safety, or manage specific activities).	.	

Appendix 4. QPWS&P VBMF hierarchy

Heirarchy of Queensland Parks and Wildlife Service & Partnerships (QPWS&P) strategic and operational planning documents related to the Gondwana Rainforests of Australia (Queensland Section).

Hierarchy of planning documents			
	QPWS&P Statutory Management Instruments	• Sets strategic management direction • Identifies key values and their condition • Identifies threats to values	Strategic direction
	QPWS&P Resource Information	• Sits alongside the management instrument • Tells a story about the park	
	QPWS&P Thematic Strategies	• Sets management objectives and links strategic direction to on-ground actions • Core themes include: pest; fire; monitoring and research; and visitor management	Operational delivery
	QPWS&P Action Plans and Work Programs	• Sets on-ground actions to achieve the management objective (e.g., planned burn)	

Appendix 5. CVI workshop program, 7th–10th April 2025

Day 1 – Monday 07 April 2025 *(start 11:00)*

1. Welcome to Country; welcome to the workshop; Introduction to Gondwana Rainforests of Australia (Queensland Section) and context setting.
2. Overview of workshop aims; use of plenary and breakout-group sessions; basic logistics; parking lot; Steering Group introduction.
3. Introductions of participants.

AIM 1: Understand the Climate Vulnerability Index (CVI) framework and its application to Gondwana Rainforests.

4. Brief overview of the CVI process.

AIM 2: Understand the significant values that comprise the OUV for Gondwana Rainforests; and assess condition and trend. Discuss other Significant Property Values (SPVs).

5. Ensure all participants are aware of the Statement of OUV for Gondwana Rainforests of Australia and how the table of key values and attributes were derived from the Statement of OUV.
6. Undertake high-level assessment of current condition of key values and the recent trend in those values (i.e., since the date of inscription, 1994).
7. Discuss other values that are significant at a local/regional scale (i.e., other SPVs) but are not part of OUV.

AIM 3: Background info on Gondwana Rainforests and climate change. Understand future climate change scenarios.

8. Introduction to climate change globally, regionally and locally.
9. Provide overview of regional and local climate change.

Wrap up discussion, review Day 1; preview Day 2

Day 2 - Tuesday 08 April 2025

AIM 4: Assess the climate stressors impacting the values of Gondwana Rainforests and select key climate stressors.

10. Show list of climate stressors – check for (i) understanding; and (ii) timescales. Demonstrate selection of top three climate stressors impacting each key value.
11. Using the list of climate stressors provided, small groups brainstorm what are the top three climate stressors impacting the key values.
12. Bring outputs from #11 back to plenary and ensure all participants agree on which climate stressors are impacting the key values and their attributes.

Field trip (13:00–17:00).

Day 3 - Wednesday 09 April 2025

AIM 5: Evaluate vulnerability of the key values to key climate stressors, considering exposure, sensitivity and adaptive capacity for a selected climate scenario.

13. Introduce process for exposure, including detail of categories, and review modifiers.
14. Participants in breakout groups assess the exposure term and modifiers for each of the three key climate stressors.
15. Bring outputs from #14 back to plenary and discuss any variation in assessments of exposure.
16. Introduce process for sensitivity, including categories and modifiers, and review potential impact matrix that combines sensitivity with exposure. Remind all of climate scenario for analysis.
17. Participants in breakout groups assess the sensitivity and modifiers for the key climate stressors.
18. Bring outputs from #17 back to plenary and discuss any variation in assessments of sensitivity. Review the potential impact matrix that combines sensitivity with exposure.
19. Introduction to adaptive capacity (intrinsic and extrinsic) and brainstorming task to identify existing strategies used to mitigate climate-related impacts and potential adaptive capacities.
20. Participants in breakout groups brainstorm existing adaptation strategies used to mitigate climate-related impacts and potential adaptive

capacities, identifying which key climate stressors and key values these respond to.

21 Bring outputs from #20 back to introduce adaptive capacity assessment. Prioritise extrinsic adaptation strategies in terms of feasibility. Introduce adaptive capacity assessment.

22 Participants in breakout groups assess the adaptive capacity for the key climate change stressors.

23 Bring outputs from #22 back to plenary and discuss any variation in assessments of adaptive capacity (thus determining the OUV Vulnerability).

24 Plenary discussion of assessments of exposure, sensitivity and adaptive capacity and resulting OUV Vulnerability.

AIM 6: Consider economic, social and cultural dependencies (sensitivity) and adaptive capacity, to determine Community Vulnerability.

25 Revisit process for analysing economic, social and cultural (ESC) dependency. Review the ESC potential impact matrix that combines these. Revisit process for analysing economic, social and cultural adaptative capacity.

26 ESC overview for Gondwana Rainforests.

27 Discussion of business types for analysis and introduction to economic breakout groups.

28 Participants in breakout groups assess the economic dependency and adaptive capacity for Gondwana Rainforests (Queensland Section).

29 Bring outputs from #28 back to plenary and discuss any variation in assessments of economic dependent and adaptive capacity.

Wrap up discussion, review Day 3; preview Day 4

Day 4 – Thursday 10 April 2025 *(end 12:30)*

30 Introduction to social dependency breakout groups.

31 Participants in breakout groups assess the social dependency and adaptive capacity for Gondwana Rainforests.

32 Bring outputs from #31 back to plenary and discuss any variations of social dependencies and corresponding adaptive capacities.

33 Introduction to cultural dependency breakout groups.

34 Participants in breakout groups assess the cultural dependency and adaptive capacity for Gondwana Rainforests.

35 Bring outputs from #34 back to plenary and discuss any variation in assessments of cultural dependencies and corresponding adaptive capacities (thus determining Community Vulnerability).

AIM 7: Summary, feedback and next steps.

36 Summarise outcomes from workshop and present final analysis.

37 Discussion of items placed in the 'parking lot' during the workshop.

38 Discussion of next steps.

39 Receive feedback from participants on CVI framework and workshop process.

40 Complete workshop evaluation forms; receive other feedback from participants.

41 Thanks and close.

Appendix 6. Workshop participants

Workshop Steering Group members indicated by *.

Members of Gondwana World Heritage Advisory Committee (Queensland Section) indicated by ‡.

Name	Role	Organisation/Affiliation
Amy Blow	Traditional Owner	Yugambeh-speaking Peoples
Amy Mclaren	Assistant Director, World and National Heritage Branch	Department of Climate Change, Energy, the Environment and Water
Angie Saville-Balsamo	Senior Project Officer	Queensland Parks and Wildlife Service & Partnerships, DETSI
Carla Catterall	Emeritus Professor	Griffith University
Carla Wilson	Manager	World Heritage Unit, DETSI
Caroline Grayson	Senior Project Officer, State Planning	Queensland Parks and Wildlife Service & Partnerships, DETSI
Claire Mason	Research Fellow	University of Tasmania
David Jinks	Resident, botanist and conservation volunteer	Gold Coast Botany ‡
Denzal Summers	Traditional Owner	Yuggera Ugarapul
Diana Fisher	Associate Professor	University of Queensland
Dom Courtney	Executive Officer	Outdoors Queensland
Eddie Jebreen	Executive Director	Coastal Biodiversity and Information, DETSI
Edward Morgan	Senior Research Fellow	Griffith University
Eliza Tompkins		Ecotourism, DETSI
Ellen Weber*	Principal Project Officer	World Heritage Unit, DETSI
Estafania Arteaga Valdivia	Sustainability and Climate Change Specialist	City of Gold Coast
Germaine Paulson	Traditional Owner	Yugambeh-speaking Peoples
Gill Brown	Director	Queensland Herbarium and Biodiversity Science, DETSI

Name	Role	Organisation/Affiliation
Grant Periott	Principal Environmental Research & Development	Department of Environment, Heritage & Resilience, City of Gold Coast
Innes Larkin	Business operator	Mt Barney Lodge ♯
James Watson	Professor	University of Queensland
Jean Marc Hero	Adjunct Professor	University of the Sunshine Coast ♯
Jeffrey Blow	Traditional Owner	Yugambeh-speaking Peoples
Jon Day*	CVI co-developer; Adjunct Principal Research Fellow	James Cook University
Justin Mallee	Assistant Project Officer Threatened Species	New South Wales National Parks and Wildlife Service
Kaori van Baalen	*Information withheld by request*	
Kristin Heron	Research Assistant	James Cook University
Kruze Summers	Traditional Owner	Yuggera Ugarapul
Kruze Summers Jnr	Traditional Owner	Yuggera Ugarapul
Laura Ryan	Community member	♯
Liz Gould	Conservation biologist, natural resource management professional	Connect4Conservation ♯
Lucy Reading	Associate Professor	Queensland University of Technology
Luisa Williams	Senior policy officer	Department of Climate Change, Energy, the Environment and Water
Madeleine Steel	A/Senior Project Officer	World Heritage Unit, DETSI
Marc Hockings	President	Wildlife Queensland
Melinda Laidlaw	Science Leader	Queensland Herbarium and Biodiversity Science, DETSI ♯
Melissa Chalmers	Traditional Owner	Githabul
Michael Piper	Senior Ranger	Queensland Parks and Wildlife Service & Partnerships, DETSI

Name	Role	Organisation/Affiliation
Michael Mahony	Emeritus Professor	University of Newcastle
Nathan Charles	Traditional Owner	Githabul
Noel Scott	Adjunct Professor	Edith Cowan University ‡
Rob Williams	Traditional Owner	Githabul
Robert Harrison*	Senior Policy Officer	World Heritage Unit, DETSI
Robert Kooyman	Honorary Research Fellow	Macquarie University ‡
Rosemary Hill	Environmental scientist and GWHAC Chair	‡
Sarah Boulter	Associate Professor	University of Tasmania
Scott Filmer		New South Wales National Parks and Wildlife Service
Scott Heron*	CVI co-developer; Professor of Physics and UNESCO Chair	James Cook University
Serena Love	Director/ Principal Archaeologist	4 Corners Heritage ‡
Shaylene Saltner	Traditional Owner	Yuggera Ugarapul
Sherri Tanner-McAllister	Principle Conservation Officer	Queensland Parks and Wildlife Service & Partnerships, DETSI
Simone Maynard	Conservation Manager	National Parks Association of Queensland
Todd Doyle*	Senior Project Officer	Queensland Parks and Wildlife Service & Partnerships, DETSI
Toni Thwaites	Executive Officer, Gondwana (Qld section)	World Heritage Unit, DETSI
Tricia Waters	Gondwana Rainforests Executive Officer	New South Wales National Parks and Wildlife Service

Appendix 7. Participants' topics for further consideration

During the workshop, several participants raised topics of interest (whether individually or broadly) that they suggested may warrant further consideration. Many of these were outside the direct scope of the workshop and therefore placed in a 'parking lot' for subsequent consideration.

These topics are listed below, as recorded during the workshop (with minor subsequent editing, intended to clarify the meaning). Noting that only some relate to climate change, the items within this compilation are presented here as they may be useful to guide future activities:

- Additional attributes to be considered including ecological processes, evolutionary processes, intangible heritage value
- Fungi should be added to attributes
- Clarify the differing climatic and habitat needs of key species (aggregated in the attributes listed)
- Gondwana's critical role in migration pathways and nomadic species; and how these may change under future climate scenarios
- Need to gather ecological data of changes from specific monitoring programs
- Clarify use of "cultural" terminology. In an Australian Indigenous context? Ancestral culture
- A gap and an opportunity: Valuation of ecosystem services by World Heritage subject matter experts and demonstrate this to visitors. Needs familiarity and framework Integrity is not linked to above. Have button "Tap to donate to parks" - especially linked to info. Feasibility needed for this
- Ecotourism – estimate overall value and where the dollars end up. We need to do 'a deep dive' into this data.
- For tourism/recreation analysis - possibility to use AI to gather internet data. For example, search for businesses in the area that mention World Heritage, ecotourism or National Park and are family-owned. Might be able to get "comprehensive lists". This might also work for recreation and meet-up groups?
- All five local government areas linked to the Gondwana parks should have economic assessment data. There are tourism groups (independent of, funded by regional councils) that would have relevant data as well.
- Springbrook visitor numbers and the reasons for those numbers?
- Feasibility analysis: why and how they come, experience sought?
- Are we assessing visitor experience and whether that influences their view of the environment? Does a visit to a NP positively affect a person's attitude towards the environment? For adults, we predict, the influence is neutral. For kids, we predict the influence is positive.
- User pays for the use of parks is not happening in Queensland. This could bring some benefit to special management areas
- Proposal of user pays system likely to impact most of those with the least capacity to pay. It will also open a serious 'can of worms' politically and may divert resourcing towards enforcement and away from much needed actions
- What is the impact of 'Happy hiker' groups and other large groups that venture into the WH National Parks?
- What is the impact of trail runners in National Parks?
- Clarify the importance of bird tourism (thought to be huge); its popularity is directly related to the health of the OUV
- 'Campify', 'Airbnb', 'Hipcamp' … explosion of informal accommodation is not well monitored. What is its impact?
- Local residents tend to be the most harmful to the parks. How can we quantify this impact?
- There is a holistic value to these National Parks. We need to be able to look at things holistically, rather than try to break things down into discrete bits
- Education and interpretive options - also a holistic value

- There is an opportunity to better incorporate World Heritage values into Outdoor education activities, to complement hiking and other skills development
- Proposal for training packages for younger generation
- The workshop highlighted the value of climate literacy for all WH managers and the importance of fostering a baseline level of competency in climate change.

Appendix 8. Glossary of terms and acronyms

Adaptive capacity	The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences
Angiosperm	A plant that produces flowers and bears seeds in fruits
Anthropogenic	Resulting from or produced by human activities
Auraucarian	Evergreen coniferous trees of the a genus *Auracaria*
Carboniferous period	The geological period from about 360 to 299 million years ago
Cenozoic Era	Earth's current geological era, representing the last 66 million years of Earth's history
Citizen science	The collection of (typically) environmental data by members of the general public, usually in collaboration with professional scientists
Climate	The composite or generally prevailing expected weather conditions of a region (e.g., temperature, air pressure, humidity, precipitation, sunshine, cloudiness, winds) throughout the year, averaged over a series of years
Climate change	A change in the pattern of weather, and related changes in oceans and land surfaces, occurring over time scales of decades or longer
Climate projection	A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based upon simulations by climate models. Projections from the Coupled Model Intercomparison Project Phase 6 (CMIP6), which include societal decisions and effects are referred to in this report.
Community	A social unit (usually a group of people) with a shared socially-significant characteristic, such as place, set of norms, culture, religion, values, customs, or identity
Compounding factors	Interacting stressors (both climate and non-climate) whose combined effect (synergy) is greater than the sum of individual effects
Country	From an Indigenous perspective, Country refers to the lands, waterways, mountains, plains and seas; and the connection to place and all that it holds (people, plants and animals)
Cretaceous	The geological period that lasted from about 143.1 to 66 million years ago
Culture	A way of life of a group of people--the behaviors, beliefs, values, and symbols that they accept, generally without thinking about them, and that are passed along by communication and imitation from one generation to the next
Current condition and recent trend	Assessment of the present status of values and their attributes; and how that has changed since the time of recognition (e.g., since World Heritage inscription)
Exposure	A measure of the contact between a system (whether physical or social) and a stressor
Extreme weather event	A weather event that is rare at a particular place and time of year. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of the observed probability
Fire risk	The combination of the likelihood of a fire hazard becoming a fire and the potential consequences if a fire does occur
First Nations peoples	Peoples who have identified themselves or have been identified by a representative (for example, their parent or guardian), as being of Aboriginal and/or Torres Strait Islander origin
Green space	An area of grass, trees or other vegetation set apart for recreational or aesthetic purposes in an otherwise urban environment
Intangible attributes	Non-physical aspects that represent heritage values, including folklore, customs, beliefs, traditions, knowledge, language and senses
Intergovernmental Panel on Climate Change (IPCC)	The United Nations body, established in 1988, for assessing the science related to climate change; it was created to provide policymakers with regular scientific assessments on climate change, its implications, and potential future risks, as well as to put forward adaptation and mitigation options. The IPCC is the most authoritative international body on climate science and is an essential component of the world's response to climate change.
Littoral	Situated on the shore of the sea or a lake

Mitigation (of climate change)	A human intervention to reduce emissions or enhance the sinks of greenhouse gases (GHGs). Mitigation measures in climate policy are technologies, processes or practices that contribute to mitigation, for example renewable energy technologies, waste minimisation processes, public transport commuting practices, etc.
Myrtle rust	A fungal disease which attacks soft, actively growing leaves, shoot tips and young stems
Restoration (in an environmental context)	Involves human interventions to assist the recovery of an ecosystem that has been previously degraded, damaged, or destroyed
Restoration (in a cultural heritage context)	Involves human interventions to authentically maintain the values of cultural heritage that has been degraded, damaged or destroyed
Sensitivity	The degree to which a system is affected, either adversely or beneficially, by climate variability or change
Tangible attributes	Physical artefacts that represent heritage values
Tertiary period	The geological period that began about 66 million years ago and ended about 2.6 million years ago
Weather	The state of the atmosphere – its temperature, humidity, wind, rainfall and so on – over hours to weeks

CCRT	Current condition and recent trend
CVI	Climate Vulnerability Index
Cwth	Commonwealth (referring to the Australian Commonwealth)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth agency)
DETSI	Department of the Environment, Tourism, Science and Innovation (Queensland agency; formerly Department of Environment, Science and Innovation, DESI, and Department of Environment and Science, DES)
ICOMOS	International Council on Monuments and Sites
IPCC	Intergovernmental Panel on Climate Change
IPE	Intense precipitation events
IUCN	International Union for Conservation of Nature
KVs	Key values
LCL	Lifting condensation level (referring to cloud)
LGA	Local Government Area
NP	National Park
NSW	New South Wales
OUV	Outstanding Universal Value
PT	Precipitation trend
QLD	Queensland
QPWS&P	Queensland Parks and Wildlife Service & Partnerships
RCP	Representative Concentration Pathway
SPVs	(Other) Significant Property Values
SSP	Shared Socioeconomic Pathway
TT	Temperature trend
UNESCO	United Nations Educational, Scientific and Cultural Organization
VBMF	Values-based Management Framework
W	Wildfire
WH	World Heritage

CVI

Queensland Government

JAMES COOK UNIVERSITY AUSTRALIA

Australian Government
Department of Climate Change, Energy, the Environment and Water

Mount Barney is a place of significance for Traditional Custodians of the region that encapsulates and represents the geological, ecological and biodiversity values of the World Heritage property.