Annexure 2

Analysis of research on climate change and its impacts on Matters of National Environmental Significance under the EPBC Act

This Annexure has been prepared by Environmental Justice Australia on behalf of the Environment Council of Central Queensland. Except where otherwise provided, this document is to be read with the cover letter to Annexure 1 and Annexure 2, including the defined terms used in the cover letter.

The Environment Council of Central Queensland promotes the conservation, protection and enhancement of the natural environment in the Central Queensland region and elsewhere. ECoCeQ promotes awareness, lobbies, and is committed to taking advantage of any lawful right or privilege to raise awareness of environmental issues, since the environment on which we all depend has no voice with which to speak for itself.

Environmental Justice Australia is a leading non-profit public interest legal organisation in Australia. Our lawyers act on behalf of people and community organisations to safeguard health, to protect forests, rivers and wildlife, and to address climate change.

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Acknowledgement

We acknowledge the Traditional Custodians of the land and waters across Australia. We pay respect to their elders past and present, and pay tribute to the vital role First Nations peoples play in caring for Country across Australia.

Cover photograph:

Mount Solitary, Greater Blue Mountains World Heritage Property, New South Wales.

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A. Introduction

> “...impacted matters of national environmental significance include thousands of protected species, places and ecological communities.”

Kanangra-Boyd National Park, Greater Blue Mountains World Heritage Property, New South Wales. Photo: Erico Marcelino

1. This Annexure contains an analysis of the most up-to-date research regarding the climate system and climate change, and the physical impacts of climate change, to demonstrate that the Proposed Project has or will have, or is likely to have, a significant impact on numerous matters of national environmental significance (**MNES**) protected under Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (**EPBC Act**). Those impacted MNES include thousands of protected species, places and ecological communities. To that end, the purpose of this Annexure is to provide the factual and legal basis necessary for the Minister to revoke the controlled action decision setting out the controlling provisions for the Proposed Project[1] under s 78(1)(a) of the EPBC Act, and substitute a new decision under s 75(1) of the EPBC Act, which lists all MNES affected by climate change as controlling provisions.

2. The Annexure is structured as follows:

2.1 **Part B** summarises the most up-to-date research on the relationship between greenhouse gas emissions (**GHGs**) and climate change.

2.2 **Part C** summarises the most up-to-date research on the importance of limiting human-induced global warming by limiting cumulative GHG (especially CO_2) emissions.

2.3 **Part D** summarises the most up-to-date research on the physical effects of climate change in Australia.

2.4 **Part E** identifies, in light of the material summarised in **Pts B to D**, the likely significant impacts of climate change on MNES protected by Pt 3 of the EPBC Act. Namely:

(a) World Heritage properties are addressed in **Pt E.3**;

(b) National Heritage places are addressed in **Pt E.4**;

(c) the Great Barrier Reef Marine Park (which is a World Heritage property and a National Heritage place) is addressed in **Pt E.5**;

(d) Wetlands of international importance (listed under the Ramsar Convention) are addressed in **Pt E.6**;

(e) listed threatened species are addressed in **Pts E.8** (fauna) and **E.9** (flora);

(f) ecological communities are addressed in **Pt E.10**;

(g) listed migratory species are addressed in **Pt E.11**; and

(h) Commonwealth marine areas are addressed in **Pt E.12**.

B. Greenhouse Gas Emissions and Climate Change

> “In Australia, climate change is clearly observable... Fossil fuel combustion and extraction are the primary drivers of CO_2 and are substantial drivers of other greenhouse gas emissions.”

Open cut coal mine, New South Wales.

3. The Working Group I contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (**IPCC**), *Climate Change 2021: The Physical Science Basis* (**IPCC WGI**) (**Annexure 1, item 1**) establishes unequivocally that human actions have caused a global temperature increase since the late 19th century.[2] The effect of human activities is estimated to have caused approximately 1.1°C of global warming above pre-industrial levels.[3]

4. In Australia, climate change is clearly observable. The region has continued to warm, with more extremely high temperatures and fewer extremely low temperatures.[4] Australia has experienced an increase in air temperature over land by 1.4°C from 1910-2019, and an increase in sea surface temperature by 1.0°C from 1900-2019.[5] There have been more extremely hot days and fewer extremely cold days in most regions. Very high monthly maximum or minimum temperatures that occurred around 2% of the time in the past (1960-1989) now occur 11-12% of the time (2005-2019). Multi-day heatwave events have increased in frequency and duration across many regions since 1950. In 2019, the national average maximum temperature exceeded the 99th percentile on 43 days (more than triple the number in any of the years prior to 2000) and exceeded 39°C on 33 days (more than the number observed from 1960 to 2018 combined).[6]

5. The main way humans influence climate change is through increasing atmospheric concentrations of GHGs and aerosols.[7] Although carbon dioxide is the largest contributor, other gases also make substantial and increasing contributions.[8] The three dominant GHGs causing human-induced temperature increase are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).[9] Fossil fuel combustion and extraction are the primary drivers of CO_2 and are substantial drivers of other greenhouse gas emissions.[10]

6. The relationship between anthropogenic CO_2 emissions and global temperature has thus far been approximately linear, meaning that each 1000 gigatons of cumulative CO_2 emissions contributes to an approximate 0.45°C increase in temperature.[11] This near-linear relationship means that "[e]very tonne of CO_2 emissions adds to global warming."[12]

7. Further climate change is inevitable, with the rate and magnitude largely dependent on the emission pathway.[13] IPCC WGI modelled five illustrative emissions scenarios to cover the range of possible future development of anthropogenic drivers of climate change found in the scientific literature. Those scenarios were:[14]

   7.1 high and very high GHG emissions and CO_2 emissions that roughly double from current levels by 2100 and 2050, respectively (SSP3-7.0 and SSP5-8.5);

   7.2 intermediate GHG emissions and CO_2 emissions remaining around current levels until the middle of the century (SSP2-4.5); and

   7.3 very low and low GHG emissions and CO_2 emissions declining to net zero around or after 2050, followed by varying levels of net negative CO_2 emissions (SSP1-1.9 and SSP1-2.6).

8. The estimated changes in global surface temperature under each of these scenarios is summarised in the following table from IPCC WGI:

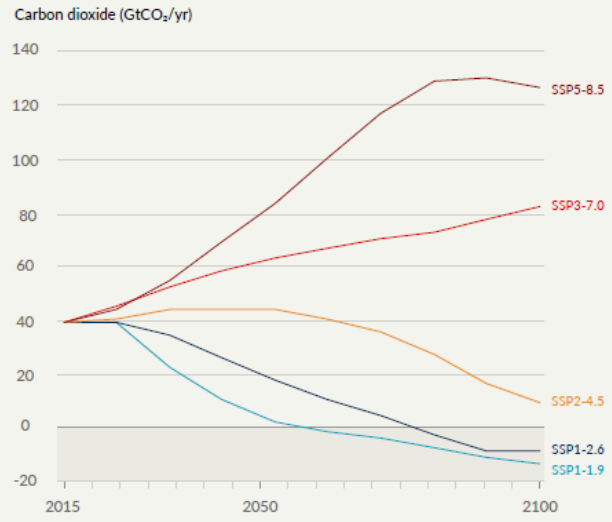
	Near term 2021–2040		Mid-term 2041–2060		Long term 2081–2100	
Scenario	**Best estimate (°C)**	**Very likely range (°C)**	**Best estimate (°C)**	**Very likely range (°C)**	**Best estimate (°C)**	**Very likely range (°C)**
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP1-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP1-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP1-8.5	1.6	1.2 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

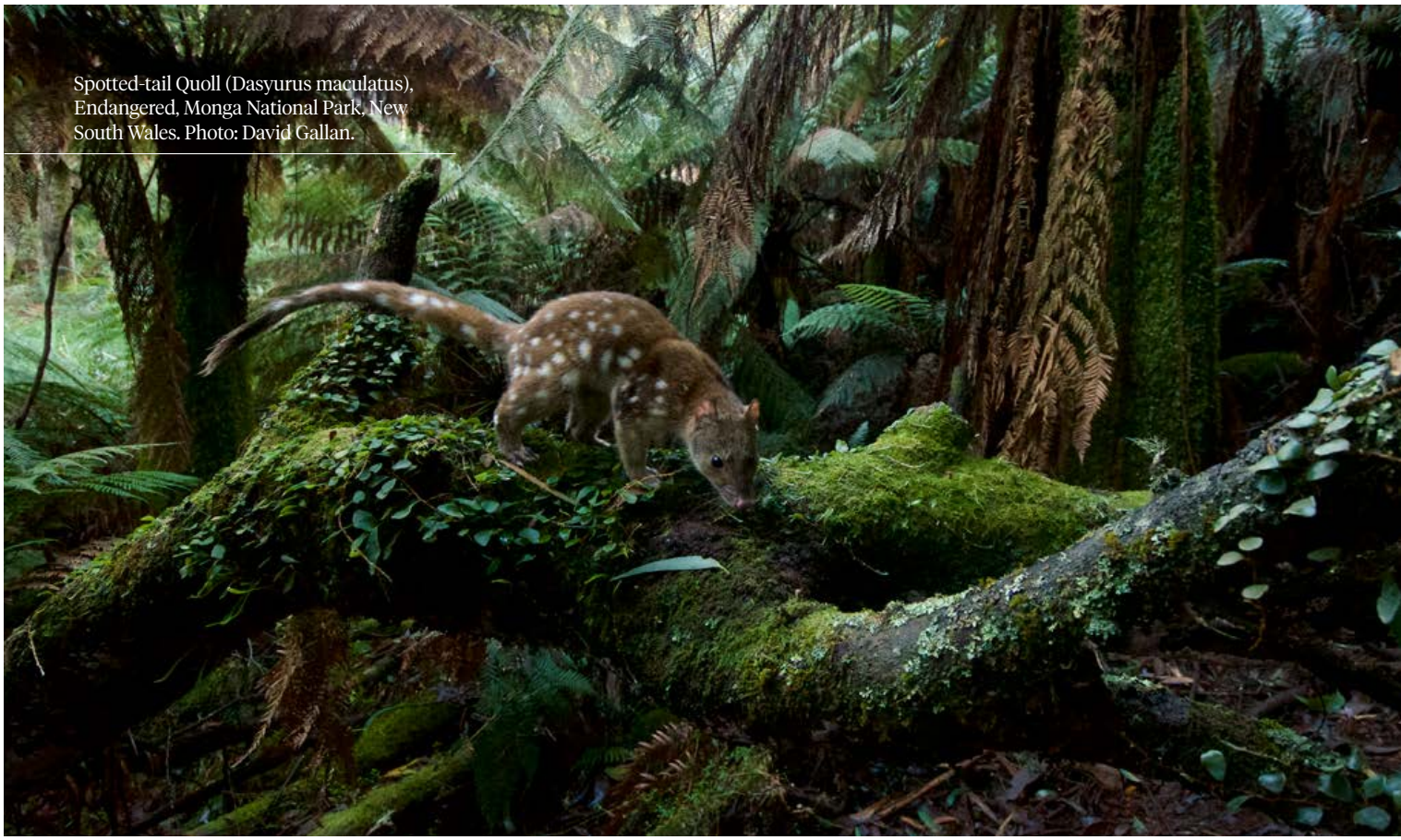
9. As can be seen, global warming is predicted under all of the scenarios. Only the very low GHG emissions scenario (SSP1-1.9) — which requires net zero CO_2 emissions by 2050 — is more likely than not to limit warming to 1.5°C. The higher GHG emissions scenarios lead to greater global warming, and the very high emissions scenario (SSP5-8.5) is estimated to result in a drastic long-term increase in global temperature by 4.4°C.

10. The near-linear relationship between cumulative anthropogenic CO_2 emissions and global warming means that reaching net zero anthropogenic CO_2 emissions is a requirement to stabilise human-induced global temperature increase at any level.[15] As expanded upon in Part D, the consequences of not limiting greenhouse gas emissions are grave.

11. Due to the near linear relationship between emissions and temperature increase, it was possible in the IPCC WGI to map the SSP scenarios by reference to annual CO_2 emissions (as well as for non-CO_2 emissions), as shown in the following graph):[16]

Carbon dioxide ($GtCO_2$/yr)





Spotted-tail Quoll (Dasyurus maculatus), Endangered, Monga National Park, New South Wales. Photo: David Gallan.

C. Limiting Climate Change

> "The continued installation of unabated fossil fuel infrastructure will "lock-in" greenhouse gas emissions; limiting global warming to 2°C or below requires a substantial amount of fossil fuels to remain unburned."

Dry river bed, Mutawintji National Park, NSW.

12. The Working Group III contribution to the IPCC's Sixth Assessment Report, *Climate Change 2022: Mitigation of Climate Change* (**IPCC WGIII**) (**Annexure 1, item 3**), found that total net anthropogenic GHG emissions have continued to rise during the period 2010-2019, as have cumulative net CO_2 emissions since 1850. Average annual GHG emissions during 2010-2019 were higher than in any previous decade.[17] Growth in anthropogenic emissions has persisted across all major groups of GHGs since 1990. By 2019, the largest growth in absolute emissions occurred in CO_2 from fossil fuels and industry.[18] In 2019, approximately 34% of total net anthropogenic GHG emissions came from the energy supply sector.[19]

13. IPCC WGIII modelled global emission pathways consistent with nationally determined contributions (**NDCs**) announced prior to COP26. It concluded that, under those pathways, warming will likely exceed 1.5°C during the 21st century, and would also make it harder after 2030 to limit warming to below 2°C.[20] This implies increased climate-related risk, and greater social and environmental risks. IPCC WGIII found that, if historical operating patterns are maintained, and without additional abatement:[21]

    13.1 Estimated cumulative future CO_2 emissions from existing fossil fuel infrastructure would, from 2018 until the end of its lifetime, amount to 660 [460–890] $GtCO_2$. They would amount to 850 [600–1100] $GtCO_2$ when unabated emissions from currently planned infrastructure in the power sector is included.

    13.2 In comparison, cumulative global net CO_2 emissions from all sectors of 510 [330–710] $GtCO_2$ until the time of reaching net zero CO_2 emissions is required in pathways that limit warming to 1.5°C (>50%) with no or limited overshoot, and 890 [640–1160] $GtCO_2$ in pathways that limit warming to 2°C (>67%).

14. IPCC WGIII found that, without a strengthening of policies beyond those that are implemented by the end of 2020, GHG emissions are projected to rise beyond 2025, leading to a median global warming of 3.2 [2.2 to 3.5]°C by 2100 (*medium confidence*).[22] All global modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot, and those that limit warming to 2°C (>67%), involve rapid and deep and in most cases immediate GHG emission reductions in all sectors.[23]

15. Decommissioning and reduced utilisation of existing fossil fuel based power sector infrastructure is a major option that can contribute to aligning future CO_2 emissions from the power sector with emissions in the assessed global modelled least-cost pathways.[24] The continued installation of unabated fossil fuel infrastructure will "lock-in" GHG emissions; limiting global warming to 2°C or below requires a substantial amount of fossil fuels to remain unburned.[25] In particular:[26]

    15.1 In modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot, the global use of coal, oil and gas in 2050 is projected to decline with median values of about 95%, 60% and 45% compared to 2019. In respect of the global use of coal, oil and gas without Carbon Capture and Storage, the projected decline is even greater, with median values of 100%, 60% and 70% in 2050.

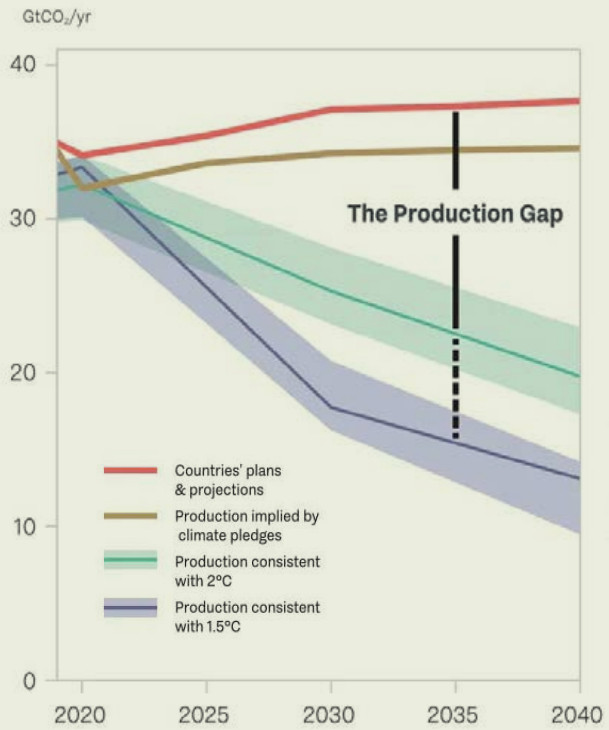
    15.2 In modelled pathways that limit warming to 2°C (>67%), the global use of coal, oil and gas in 2050 is projected to decline with median values of 85%, 30% and 15% compared to 2019.

16. In a similar vein to the findings of IPCC WGIII:

16.1 Recent modelling by Welsby et al, published in the peer-reviewed journal *Nature* (**Annexure 1, item 4**),[27] shows that to allow for a 50% probability of limiting warming to 1.5 ℃, nearly 60% of oil and fossil methane gas and 90% of coal must remain unextracted by 2050. In particular, Australia must leave unextracted up to 40% of oil reserves, 29% of fossil methane gas, and 95% of coal reserves to meet 1.5℃.

16.2 The United Nations Environment Programme (**UNEP**) *The Production Gap: 2021 Report* (**Annexure 1, item 5**) found that governments' plan to produce more than twice the amount of fossil fuels in 2030 than would be consistent with limiting warming to 1.5℃, and 45% more fossil fuels in 2030 than would be consistent with the median 2℃-warming pathway. The gap then grows wider beyond 2030, as countries' plans and projections continue upward, further departing from the low-carbon pathways. By 2040, countries' plans and projections show 190% more fossil fuels than would be consistent with the median 1.5℃ pathway, and 89% more than the median 2℃ pathway.[28] This is represented graphically in *The Production Gap: 2021 Report* as follows:[29]

Global fossil fuel production



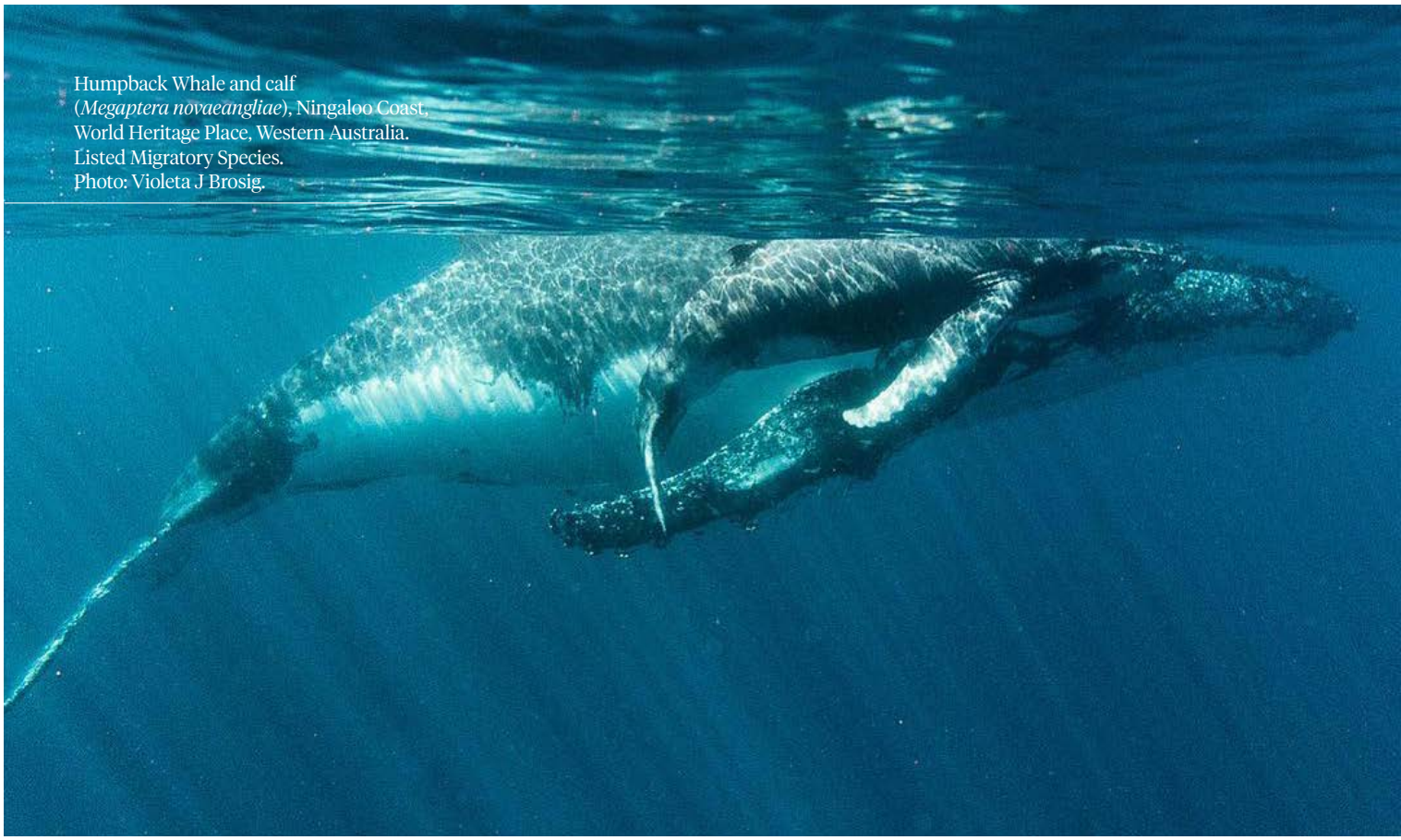
17. As explained in IPCC WGIII, Annex III, Working Group III evaluated a large range of scenarios:[30]

> *By the time of the AR6 Literature Acceptance deadline of IPCC WGIII (11th October 2021) the AR6 scenario database comprised 191 unique modelling frameworks (including different versions and country setups) from 95+ model families –, of which 98 globally comprehensive, 71 national or multi- regional, and 20 sectoral models – with in total 3,131 scenarios, summarized in Table II.4.-Table II.10. (global mitigation pathways), Table II.11. (national and regional mitigation pathways) and Table II.12. (sector transition pathways) below.*

18. These were then vetted for feasibility, as explained in Annex III, [3.1]. This is done to evaluate whether the scenario is technologically feasible. Numerous scenarios passed vetting. All scenarios assessed are contained in the publicly available AR6 Scenario Database.[31] Those that passed feasibility vetting, and which limit temperature increase to 1.5℃ degrees warming, included the International Energy Agency's *Net Zero by 2050 – A Roadmap for the Global Energy Sector* (**Annexure 1, item 9**).[32]

19. The foreword stated "[d]espite the current gap between rhetoric and reality on emissions, our Roadmap shows that there are still pathways to reach net zero by 2050. The one on which we focus is – in our analysis —the most technically feasible, cost-effective and socially acceptable".[33] This scenario entails no new oil and gas fields to be approved for development, and no new coal mines or mine extensions.[34]

20. It is important to note that we discuss this scenario by way of example only. There is a potentially unlimited range of feasible scenarios that could limit warming to 1.5℃ or well below 2℃. To reiterate, feasible means technologically feasible – whether such scenarios can be achieved depends on what decisions human beings worldwide are prepared to make, individually, but most importantly through governments and other institutions.



Humpback Whale and calf (*Megaptera novaeangliae*), Ningaloo Coast, World Heritage Place, Western Australia. Listed Migratory Species. Photo: Violeta J Brosig.

D. Physical Effects of Climate Change in Australia

> “The catastrophic 2019/2020 bushfires... burnt about 5.8 to 8.1 million hectares of forest in eastern Australia, resulting in the displacement of nearly 3 billion vertebrate animals.”

Koala (*Phascolarctos cinereus*), Endangered.
Photo: Kevin Bosc.

21. As made clear by the Working Group II contribution to the IPCC's Sixth Assessment Report, *Climate Change 2022: Impacts, Adaptation and Vulnerability* (**IPCC WGII**) (**Annexure 1, item 2**), there are numerous physical effects of climate change that are already observable in Australia. Widespread and severe impacts on terrestrial and freshwater ecosystems and species are already evident across the region (*very high confidence*).[35] These physical effects will increase as global warming continues, and will become more pronounced if there is a greater degree of warming. Even 1.5°C of warming results in an increasing occurrence of extreme weather events.[36] Every additional 0.5°C of global warming causes clearly discernible increases in the intensity and frequency of hot extremes, precipitation events, and agricultural and ecological droughts.[37] Many climate impacts will be more widespread at 2°C compared to 1.5°C global warming.[38]

22. The relevant findings in IPCC WGII in respect of specific physical effects of climate change in Australia are summarised below.

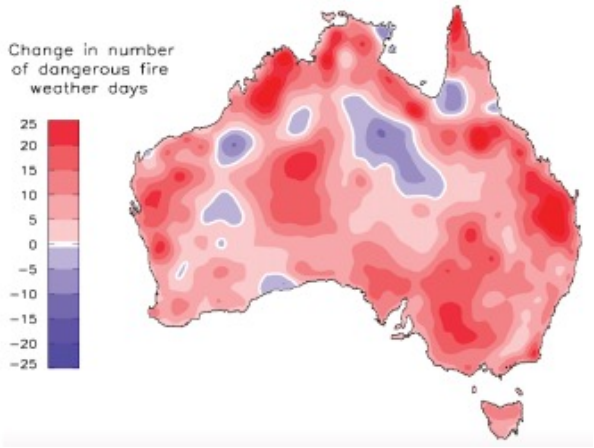
D.1 Fire

23. There has been observed an increase in the number of extreme fire weather days from July 1950 to June 1985 compared to July 1985 to June 2020, especially in the south and east, partly attributed to climate change. The frequency, severity and duration of extreme fire weather conditions have increased in southern and eastern Australia.[39] Extreme fire weather in 2019/2020 was at least 30% more likely due to climate change.[40]

24. Increased fire activity in southeast Australia associated with climate change has been observed since 1950 but trends vary regionally (*medium confidence*).[41] In Australia, the frequency and severity of dangerous fire weather conditions is increasing, with partial attribution to climate change (*very high confidence*) especially in southern and eastern Australia during spring and summer.

25. IPCC WGII predicts that, as part of further climate change, more extreme fire weather in southern and eastern Australia can be expected (*high confidence*).[42] Fire weather is projected to increase in frequency, severity and duration for southern and eastern Australia (*high confidence*), with projected increases in pyro-convection risk for parts of southern Australia and increased dry-lightning and fire ignition for southeast Australia.[43]

26. The following figure from IPCC WGII, at p 11-29, shows the changes in the annual (July to June) number of days that the Forest Fire Danger Index exceeded its 90th percentile from July 1985 to June 2020, relative to July 1950 to June 1985.



27. The catastrophic 2019/2020 bushfires produced impacts in every Australian State and Territory.[44] IPCC WGII notes that those fires burnt about 5.8 to 8.1 million hectares of forest in eastern Australia, resulting in the displacement of nearly 3 billion vertebrate animals, that 114 listed threatened species lost at least 50% of their habitat and that 49 listed threatened species lost 80% of their habitat (among other severe ecological impacts).[45] IPCC WGII further notes that the 2019/2020 fire season was at least 30% more likely than a century ago due to the influence of climate change.[46]

28. Recent fires have also severely impacted eastern rainforests, including significant Gondwana refugia.[47]

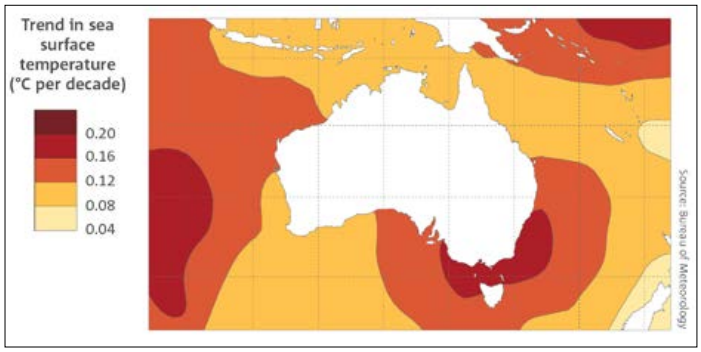
29. In southern Australia, some forest ecosystems (alpine ash, snowgum woodland, pencil pine, northern jarrah) are projected to transition to a new state or collapse due to hotter and drier conditions with more fires.[48]

30. Further fire risk analysis, based on data from the 2019/2020 bushfires, is provided at [138]-[142] below.

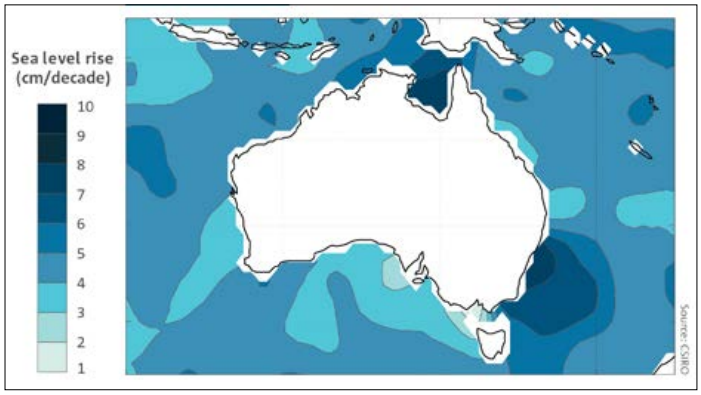
D.2 Ocean heatwaves and acidification

31. Climate change is having major impacts on Australia's oceans (*very high confidence*).[49]

32. Rising sea surface temperatures have exacerbated marine heatwaves, notably near Western Australia in 2011, the Great Barrier Reef in 2016, 2017 and 2020, and the Tasman Sea in 2015/2016, 2017/2018 and 2018/2019.[50] Rising ocean temperatures around Australia were mapped by the Commonwealth Scientific and Industrial Research Organisation (**CSIRO**) and the Bureau of Meteorology (**BOM**) in *State of the Climate 2020* (**Annexure 1, item 6**):[51]



33. The oceans around Australia are acidifying — the average pH of surface waters has decreased since the 1880s by about 0.1, representing an over 30% increase in acidity.[52] These changes have led to a reduction in coral calcification and growth rates on the Great Barrier Reef. The current rate of change is ten times faster than at any time in the past 300 million years. The following figure from *State of the Climate 2020* illustrates the change in the pH of surface waters around Australia between 1880-1889 and 2010-2019:[53]



34. IPCC WGII predicts further ocean acidification (*very high confidence*),[54] with the pH projected to drop by about 0.1 to 0.3 by 2090.[55]

35. Extensive changes in the life history and distribution of species have already been observed in Australia due to the impact of climate change on oceans (*very high confidence*). New occurrences or increased prevalence of disease, toxins and viruses are evident, along with heat stress mortalities and changes in community compositions. Extreme climatic events in Australia from 2011 to 2017 led to abrupt and extensive mortality of key habitat-forming organisms – corals, kelps, seagrasses, and mangroves – along over 45% of the continental coastline of Australia (*high confidence*).[56]

36. Future ocean warming, coupled with periodic extreme heat events, is projected to lead to the continued loss of ecosystem services and ecological functions (*high confidence*).[57]

D.3 Drought

37. IPCC WGII predicts that climate change will result in more drought in southern and eastern Australia (*high confidence*).[58]

38. A 2020 paper by Kirono et al[59] (**Annexure 1, item 8**) projected future drought hazard under Representative Concentration Pathway (**RCP**) 8.5, which represents a future with little curbing of emissions and projected mean temperature increase by 2100 of 2.6–4.8°C globally. Applying models based on both rainfall-based drought index and the Standardised Soil Moisture Index, the paper projected that Australia under climate change will spend more time in drought, have longer duration drought and more intense drought, and more so in the south-west and east than in the north.[60]

D.4 Rainfall extremes and flooding

39. Extreme rainfall intensity in northern Australia has been increasing (*high confidence*).[61] Hourly extreme rainfall intensities increased by 10–20% in many locations between 1966–1989 and 1990–2013. Daily rainfall associated with thunderstorms increased 13-24% from 1979-2016, particularly in northern Australia. Daily rainfall intensity increased in the northwest from 1950–2005 and in the east from 1911–2014, and decreased in the southwest and Tasmania from 1911–2010.[62]

40. IPCC WGII predicts increased rainfall intensity, with fewer tropical cyclones and a greater proportion of severe cyclones (*medium confidence*).[63] Extreme rainfall is projected to become more intense (*high confidence*), but the magnitude of change is uncertain.[64] Modelling studies project increases in flood magnitudes in northern and eastern Australia (*high confidence*).[65]

Lake Pamamaroo, Menindee Lakes System, New South Wales. Photo: Dean Lewins / AAP.

E. Likely Significant Impact on MNES

Jansz beach, Ningaloo Coast World Heritage Property. Photo: Violeta J Brosig.

E.1 Overview

41. This Part of the Annexure identifies, in light of the material summarised in Pts B to D above, the likely significant impacts of climate change on MNES protected by Pt 3 of the EPBC Act. It does so by reference to two sets of materials, which have been prepared with the input of, or by, relevant experts.

    41.1 The first set of materials comprises spreadsheets of data compiled from reviewing authoritative sources of information relevant to the protection of MNES, to identify whether that material shows climate change to pose a relevant risk to MNES (the spreadsheets are in **Annexure 2.1**). These spreadsheets of data were compiled using computer code prepared by Dr Isaac Peterson. An explanation of the process by which those spreadsheets of data were compiled is provided at [42]–[74] below. The relevant inferences and conclusions that, it is submitted, the Minister should draw from those data are summarised at [74], [76], [94], [103], [116], [121], [126], [131], and [137] below. To the extent relevant, this Part also summarises relevant findings of IPCC WGII, additional to those set out above.

    41.2 The second set of materials are spreadsheets and maps showing the overlap between the range of species protected by Pt 3 of the EPBC Act and the range of the 2019/2020 bushfires (**Annexure 2.3**). Fire is one particular physical effect of climate change that will massively harm MNES, including thousands of protected species and ecological communities, as well as heritage places, such as the Australian Alps National Parks and Reserves and Tasmanian Wilderness World Heritage Area. The data informing this material were also compiled using code designed by Dr Peterson. The processes by which the data were compiled and the maps created are summarised at [141]-[143] below. The relevant findings that, it is submitted, the Minister should make, based on these data and maps are summarised at [144] below.

E.2 Collation of data on impacts

E.2.1 ***Overview***

42. The data concerning impacts on MNES (**Annexure 2.1**) were compiled by a four-step process, namely:

    42.1 selection and collation of source materials;

    42.2 code analysis of source materials and population of spreadsheets;

    42.3 human review of spreadsheets; and

    42.4 cross-referencing of spreadsheet results against data from the International Union for Conservation of Nature (**IUCN**) Red List database (**IUCN Red List)** (version 2020-3 accessed on 21 December 2020).

43. For ease of review, an additional step was interposed between the steps identified at [42.3] and [42.4] above, to reformat the spreadsheets for the purpose of enhancing readability and accessibility. This additional step is summarised below at [63], although it did not involve any substantive change to the data resulting from the first four steps.

E.2.2 ***Summary of spreadsheets in Annexure 2.1***

44. The above steps, as detailed further below, produced the following spreadsheets, which, together, form **Annexure 2.1.A:**

    44.1 For **listed threatened species,**

    (a) a single PDF for all threatened species flora containing:

    (i) a spreadsheet for the Direct Climate results;

    (ii) a spreadsheet for the Implied Climate results;

    (iii) a spreadsheet for the Fire Impact results; and

    (b) a single PDF for all threatened species fauna containing:

    (i) a spreadsheet for the Direct Climate results;

    (ii) a spreadsheet for the Implied Climate results;

    (iii) a spreadsheet for the Fire Impact results; and

    (c) an Impact Data Table combining the results for threatened species flora and fauna, which includes:

    (i) a summary of the results at [44.1(a)-(b)];

    (ii) a summary of the IUCN cross-referencing exercise; and

    (iii) a summary of the results of the fire mapping exercise.

    (see also [115] and [120] below as to the listed threatened species addressed in these spreadsheets);

44.2 For **listed ecological communities**,

(a) a single PDF containing:

(i) a spreadsheet for the Direct Climate results;

(ii) a spreadsheet for the Implied Climate results;

(iii) a spreadsheet for the Fire Impact results; and

(b) an Impact Data Table, which includes:

(i) a summary of the results at [44.2(a)]; and

(ii) a summary of the results of the fire mapping exercise.

(see also [125] as to the listed ecological communities addressed in these spreadsheets);

44.3 For **listed migratory species**,

(a) a single PDF for all migratory species containing:

(i) a spreadsheet for the Direct Climate results;

(ii) a spreadsheet for the Implied Climate results;

(iii) a spreadsheet for the Fire Impact results; and

(b) an Impact Data Table, which includes:

(i) a summary of the results at [44.3(a)]; and

(ii) a summary of the IUCN cross-referencing exercise.

(see also [130] below as to the listed migratory species addressed in these spreadsheets);

44.4 For **World Heritage properties** and **National Heritage properties**,

(a) a single PDF for each property (see further [75] and [91] below) containing:

(i) a spreadsheet for the Direct Climate results;

(ii) a spreadsheet for the Implied Climate results;

(b) a spreadsheet for the Fire Impact results; and

(c) an Impact Data Table for all of the World Heritage properties, which includes:

(i) a summary of the results at [44.4(a)] for World Heritage Properties; and

(ii) a summary of the results of the fire mapping exercise.

(d) an Impact Data Table for all of the National Heritage properties, which includes:

(i) a summary of the results at [44.4(a)] for National Heritage properties; and

(ii) a summary of the results of the fire mapping exercise.

44.5 For **Ramsar wetlands** (see further [102] below as to the wetlands addressed in these spreadsheets):

(a) a single PDF containing:

(i) a spreadsheet for the Direct Climate results;

(ii) a spreadsheet for the Implied Climate results;

(iii) a spreadsheet for the Fire Impact results; and

(b) an Impact Data Table, which includes:

(i) a summary of the results at [44.5(a)];

(ii) a summary of the results of the fire mapping exercise.

(see also [102] below as to the wetlands addressed in these spreadsheets);

44.6 In relation to the **Great Barrier Reef**, there is a set of spreadsheets and results included in the World Heritage Properties (see [44.4]).

44.7 In relation to the **Commonwealth marine environment**,

(a) a single PDF for each reviewed Commonwealth marine region (South West, North West, North Temperate East and South East) (see further [133]–[137] below) containing:

(i) a spreadsheet for the Direct Climate results;

(ii) a spreadsheet for the Implied Climate results;

(iii) a spreadsheet for the Fire Impact results; and

(b) an Impact Data Table for all of the regions, which includes:

(i) a summary of the results at [44.7(a)]; and

(c) a single PDF in relation to all marine species (see further [135] below) containing:

(i) a spreadsheet for the Direct Climate results;

(ii) a spreadsheet for the Implied Climate results;

(iii) a spreadsheet for the Fire Impact results; and

(d) an Impact Data Table, which includes:

(i) a summary of the results at [44.7(c)]; and

(ii) a summary of the IUCN cross-referencing exercise.

44.8 **Annexure 2.1.B** contains the same types of spreadsheets listed above from [44.1] – [44.7], however these versions of the spreadsheets have had irrelevant rows removed, and reflect the reformatting described below at [63].

E.2.3 ***Detail of steps taken to produce Annexure 2.1***

45. The first substantive step — selection and collation of source materials — involved legal representatives of the Environment Council of Central Queensland Inc., namely solicitors from Environmental Justice Australia (**EJA**) identifying the most relevant and authoritative sources of information on the vulnerability of the MNES.

46. The following factors were used to select the material that formed part of this package of materials:

46.1 Whether the material had some significance within the regulatory framework (for example, conservation advices prepared pursuant to s 266B of the EPBC Act (**Conservation Advices**)).

46.2 Whether the material had some significance within State and/or Territory regulatory frameworks relating to the protection of, and the assessment of impacts on, MNES (for example, Management Plans prepared by a State government).

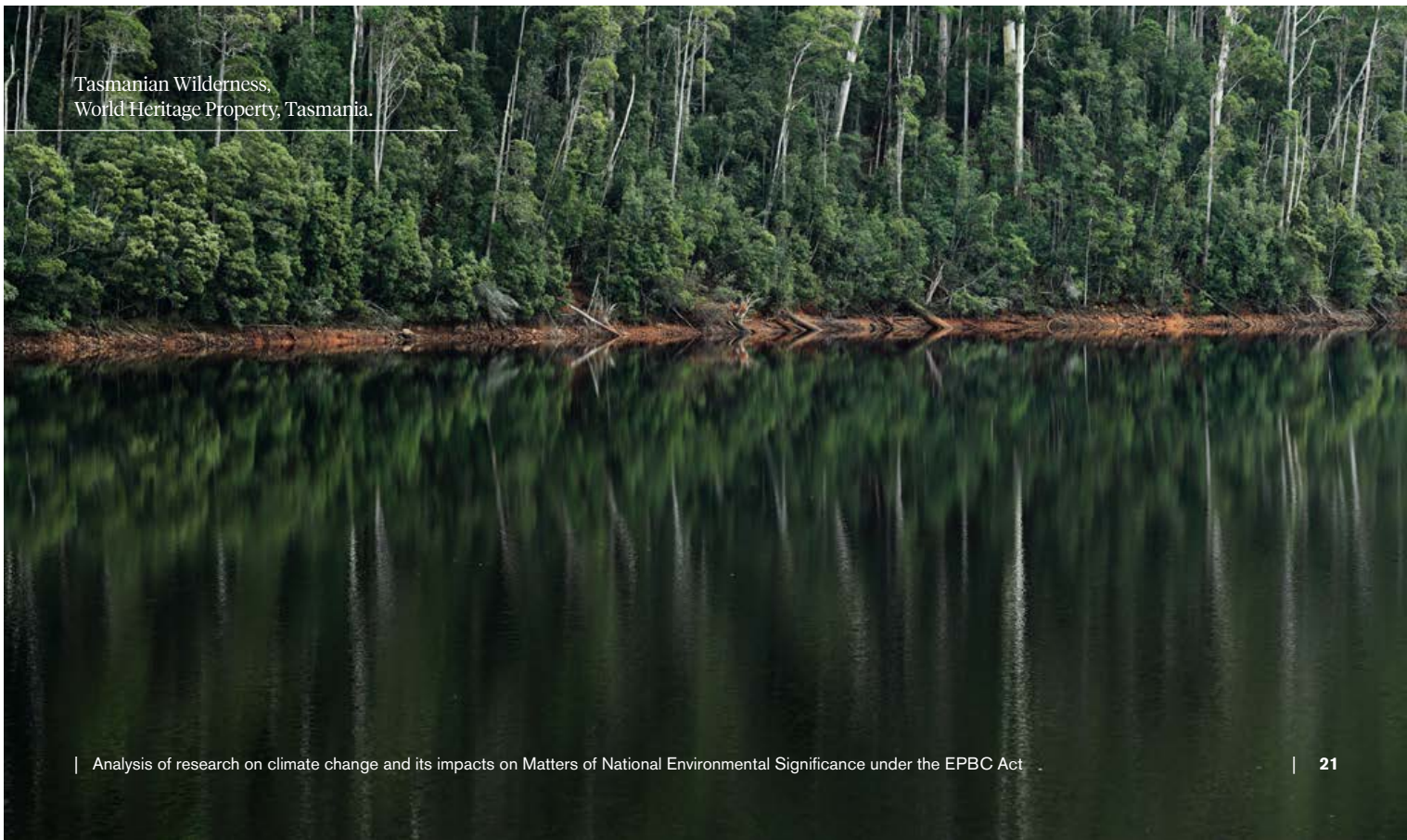
46.3 Whether the material had some significance within the international framework, with particular regard to treaties and conventions to which Australia is a State member (for example, reports submitted by Australia, as a State Party,[66] to the World Heritage Committee, pursuant to the *Convention Concerning the Protection of the World Cultural and Natural Heritage* (**World Heritage State Party Reports**).

46.4 The extent to which the relevant material informs the protection and regulation of MNES and relevant framework under the EPBC Act.

46.5 Whether the material is current.

46.6 Whether the material is updated at regular intervals.

47. Early investigations in the process of collating the source material in accordance with the above criteria indicated there is a vast amount of relevant material and that, for some MNES, new relevant research continues to be published. As such, decisions were made to limit the categories of documents included to those most immediately relevant. Further, in the time between the final collation of the package of materials and the finalisation of this reconsideration request, further relevant research has been published.



Tasmanian Wilderness, World Heritage Property, Tasmania.

48. The material ultimately selected to form this package, for each MNES, is summarised in the following table. A full list of the materials forming this cache is in **Annexure 2.2**.

Category of MNES	Source Material
Listed Threatened Species (Flora and Fauna)	• Conservation Advices. • Listing Advices (being advice provided to the Minister by the Threatened Species Scientific Committee). • IUCN Red List listing in relation to species.
Listed Ecological Communities	• Conservation Advices.
Listed Migratory Species	• Text from webpages drawn from the Species Profile and Threats Database (**SPRAT**), prepared by the Australian Government Department of Agriculture, Water and the Environment, and designed to "*provide information about species and ecological communities listed under the Environment Protection and Biodiversity Conservation Act 1999*".[67] • IUCN Red List listing in relation to species.
World Heritage Properties	• Management plans, fact sheets and related informational material and documents prepared by the Australian Government, or in lieu of the Australian Government, the relevant State or Territory government. • World Heritage Nomination materials submitted by the Australian Government to the World Heritage Committee pursuant to the World Heritage Convention. • World Heritage State Party Reports. • IUCN Conservation Outlook Assessments in relation to World Heritage Properties.
National Heritage Properties	• Management plans, fact sheets and related informational material and documents prepared by the Australian Government, or in lieu of the Australian Government, the relevant State or Territory government.
Ramsar Wetlands	• Ecological Character Descriptions prepared pursuant to the Convention on Wetlands of International Importance especially as Waterfowl Habitat (**Ramsar Convention**), in accordance with the EPBC Act and the National framework and guidance for describing the ecological character of Australian Ramsar wetlands.
Great Barrier Reef	• Management plans, fact sheets and related informational material and documents prepared by the Australian Government, or in lieu of the Australian Government, the relevant State or Territory government. • World Heritage State Party Reports. • IUCN Conservation Outlook Assessments.
Commonwealth Marine Environment (containing Listed Marine Species)	• Bioregional plans, Commonwealth marine environment report cards, Protected places report cards and species group report cards prepared pursuant to Part 12 of the EPBC Act. • IUCN Red List listing in relation to species.

49. It is important to note that this material is underinclusive. For example, it does not include Recovery Plans, which provide a rich source of additional information in the Department's possession, which would provide further evidence for the MNES already covered herein, and would very likely also provide material supporting inclusion of other MNES (or at least other species) in the list. Due only to limitations on time and resources, the process has been confined to the above materials.

50. The second step — the analysis of source materials and population of spreadsheets - was performed by Dr Peterson, through a code-driven text mining process that identified potential statements that acknowledge the impacts of climate change. A subsequent search was performed to identify statements on the impacts of fire. This code analysis was undertaken by reference to a set of rules (described below), and in accordance with a tiered approach, to ensure that the "scraping" process produced only the most relevant results.

51. In particular, the tiered approach was adopted in order to distinguish between search terms that:

    51.1 directly relate to climate change (referred to below as the **Direct Climate Set** of terms);

    51.2 implicitly relate to climate change (for example, terms denoting phenomena caused by climate change) (referred to below as the **Implied Climate Set** of terms); and

    51.3 relate to fire impacts specifically (referred to below as the **Fire Impact Set** of terms)

    (Together, the **Defined Sets**).

52. Fire has been a specific focus of this Annexure, because of the directness of its impacts on MNES and because of its particular significance for the Australian environment (as evidenced by the 2019/2020 bushfires, which were considered in IPCC WGII, as summarised above, and are considered further below). On that basis, it was considered useful for terms specifically relating to fire to be included in the Defined Sets.

53. The code analysis occurred in accordance with the rules set out at [54]-[57] below.

54. *First*, for each of the source materials for each MNES, the code scraped and identified search terms relating to each Defined Set. Those were:

Defined Set	Search Terms
Direct Climate Set	'climate', 'climatic', 'greenhouse', 'global'
Implied Climate Set	'weather', 'flood', 'drought', 'drying', 'ocean'
Fire Impact Set	'fire', 'burning', 'fuel'

55. *Second*, the code applied a "discriminator set", to ensure that only sentences containing one or more terms from the relevant Defined Set (for example, the Direct Climate Set) and the Discriminator Set were captured.[68] Namely:

Defined Set	Step 1: Search Terms plus	Step 2: Discriminator Set
Direct Climate Set	'climate', 'climatic', 'greenhouse', 'global'	'threat', 'alter', 'change', 'frequency', 'impact', 'risk', 'sensitive', 'extreme', 'increase', 'increasing', 'warming', 'heat', 'temperature'
Implied Climate Set	'weather', 'heat', 'flood', 'drought', 'temperature', 'drying', 'ocean'	'threat', 'alter', 'change', 'frequency', 'impact', 'risk', 'sensitive', 'extreme', 'increase', 'increasing', 'warming', 'heat', 'temperature'
Fire Impact Set	'fire', 'burning', 'fuel'	'threat', 'alter', 'change', 'frequency', 'impact', 'risk', 'sensitive', 'extreme', 'increase', 'increasing', 'warming', 'heat', 'temperature'

56. *Third*, the code applied a "subsequent rejection set", in order to exclude sentences and phrases that did not relate to climate impacts to MNES.[69] This included the following terms:

Defined Set	Step 1: Search Terms plus	Step 2: Discriminator Set plus:	Step 3: Subsequent Rejection Set
Direct Climate Set	'climate', 'climatic', 'greenhouse', 'global'	'threat', 'alter', 'change', 'frequency', 'impact', 'risk', 'sensitive', 'extreme', 'increase', 'increasing', 'warming', 'heat', 'temperature'	'Investigate', 'Assess', 'Department', 'Report', 'Advice', 'fireweed', 'map', 'minister', 'manage'
Implied Climate Set	'weather', 'heat', 'flood', 'drought', 'temperature', 'drying', 'ocean'	'threat', 'alter', 'change', 'frequency', 'impact', 'risk', 'sensitive', 'extreme', 'increase', 'increasing', 'warming', 'heat', 'temperature'	'Investigate', 'Assess', 'Department', 'Report', 'Advice', 'fireweed', 'map', 'minister', 'manage'
Fire Impact Set	'fire', 'burning', 'fuel'	'threat', 'alter', 'change', 'frequency', 'impact', 'risk', 'sensitive', 'extreme', 'increase', 'increasing', 'warming', 'heat', 'temperature'	'Investigate', 'Assess', 'Department', 'Report', 'Advice', 'fireweed', 'map', 'minister', 'manage'

57. *Finally*, in order to avoid double counting, for each Defined Set, the code excluded the search terms used for the other Defined Sets. Specifically, in relation to the:

    57.1 Direct Climate Set: only the Rejection Set was excluded.

    57.2 Implied Climate Set: in addition to the Rejection Set, the search terms for the Direct Climate Set ("climate", "climatic", "greenhouse", "global") and Fire Impact Set ("fire", "burning", "fuel") were excluded.

    57.3 Fire Impact Set: in addition to the Rejection Set, the search terms for the Direct Climate Set ("climate", "climatic", "greenhouse", "global") and Implied Climate Set ("weather", "heat", "flood", "drought", "temperature", "drying", "ocean") were excluded.

58. The results of the above search process were then used to populate Excel spreadsheets for each MNES, which were arranged as a series of lists.

59. The third step — human review of the spreadsheets — involved EJA manually reviewing each spreadsheet, in order to exclude results that did not support an inference relevant to this request. This third step did not involve any human inclusion of new information, only exclusion of irrelevant information, and was conducted because the product of the two previous steps was over-inclusive: the code included some information that was not relevant to this request.

60. To perform the process for the third step, outlined in [59], EJA reviewers were instructed that:

60.1 the purpose of the review was to determine and record whether each search result was relevant, in the sense of conveying the idea that a value, property, or other aspects of a MNES is, will be, or will potentially be vulnerable to or impacted by climate change or the physical effects of climate change;

60.2 the threshold questions to consider were whether the sentence or phrase, read in the context of the source material, included a climate change impact and, if so, whether the impact is currently affecting, will affect or potentially affect the MNES or an aspect of the MNES; and

60.3 if the answer to the questions stated at [60.2] above was "yes", then the reviewer was to put a "1" in the "Binary" or "Relevance" column of the table , and, if the answer was "no", then the reviewer was to put a "0" in that column. We emphasise that this procedure is a filtering process that retains a smaller set of potentially relevant statements and therefore does not introduce new material to the analysis.

61. The spreadsheets produced after the first three steps up to and including the human review process, as detailed above, were saved as PDFs and are labelled as "[MNES] – Irrelevant and relevant results" in **Annexure 2.1.A**. In each spreadsheet, the title of the relevant source material (for example, the Conservation Advice for a particular species) is identified in the "document" column and then relevant sentence(s) identified in the document appear in the "hits" column. There are two different formats for the spreadsheets:

61.1 In relation to the threatened species (flora and fauna) and ecological communities spreadsheets, the title of the relevant source material (for example, the Conservation Advice for a particular species) is identified in the "document" column and then relevant sentence(s) identified in the document appear in the "hits" column.

61.2 In relation to spreadsheets for all MNES aside from threatened species (flora and fauna) and ecological communities, the title of the relevant source material (for example, the Ecological Character Description for a particular wetland) is identified with a '$' symbol immediately before the document title, and the relevant sentence(s) identified in the document appears immediately below the document title.

62. The human review process was also used to enable EJA to identify any gaps, incoherence or formatting errors in the results produced by the code. During this third step, some adjustments were made to the code by Dr Peterson to ensure the code was operating as intended and producing results in accordance with the rules set out above. Where necessary, spreadsheets were reproduced and subjected to a further human review for relevance, as described above. At no stage was any of the text comprising the results in the spreadsheets manually altered. This is evident in Annexure 2.1.A where certain spreadsheets have no data (as no hits were picked up by the code), or have no relevant results (ie all of the results are labelled with a '0').

63. An additional step — reformatting — was undertaken (as foreshadowed above at [43]), solely to enhance the readability and accessibility of the spreadsheets. For the avoidance of doubt, the conclusions and inferences that Environment Council of Central Queensland Inc. submits that the Minister should draw from this data are available whichever version of the spreasheets the Minister considers (that is, before or after reformatting). On that basis, the reformatting step involved Dr Peterson using code to:

63.1 delete from the spreadsheets phrases marked, as part of step 3, with a "0" (ie to only retain statements marked with "1", and therefore as relevant);

63.2 then to remove altogether the binary markers inserted as part of step 3;

63.3 insert a number of columns, so that (from left to right):

(a) the "entity" column refers to the relevant MNES;

(b) the "document" column refers to the specific document in which the relevant phrase has been identified;

(c) the "numeric_reference" column chronologically orders the results that appear in the "reference" column; and

(d) the "reference" column identifies the relevant phrase identified in the source document.

64. The spreadsheets produced as part of this additional "reformatting" step interposed between steps three and four are labelled as "[MNES] – only relevant results" in **Annexure 2.1.B**.

65. The fourth substantive step involved the production of Impact Data Tables summarising results obtained for each MNES, and (for some MNES) the cross-referencing of spreadsheet results against the IUCN Red List.

66. For each category of MNES, Dr Peterson designed code that populated a separate set of tables (labelled as Impact Data Tables in **Annexure 2.1**) that summarises the results of steps 1-3 (as detailed above). One Impact Data Table was produced for each category of MNES. In each Impact Data Table:

66.1 the "entity" column refers to the relevant MNES;

66.2 the "file" column refers to the file name of the source document, as saved in the Annexure 2.2 (except for the World Heritage and National Heritage properties, where an "identifier" column is instead used to refer to the folder in Annexure 2.2 containing all the source documents relating to a specific property);

66.3 the "climate_direct" column is a binary column in which a "1" indicates that there are relevant results for the entity in the Direct Climate spreadsheet, and a "0" indicates that there are no such results;

66.4 the "climate_implied" column is a binary column in which a "1" indicates that there are relevant results for the entity in the Implied Climate spreadsheet, and a "0" indicates that there are no such results;

66.5 the "climate_implied not direct" column is a binary column in which a "1" indicates that there are relevant results for the entity in the Implied Climate spreadsheet but not the Direct Climate spreadsheet, and a "0" indicates that there are no such results;

66.6 the "fire" column is a binary column in which a "1" indicates that there are relevant results for the entity in the Fire Impact spreadsheet, and a "0" indicates that there are no such results; and

66.7 the "fire not climate" column is a binary column in which a "1" indicates that there are relevant results for the entity in the Fire spreadsheet but not the Direct Climate spreadsheet, and a "0" indicates that there are no such results.

67. The cross-referencing of spreadsheet results against the IUCN Red List was only undertaken for listed threatened species, listed migratory species and marine species.

68. The IUCN Red List is a comprehensive inventory of the conservation status of flora and fauna species and uses quantitative criteria to evaluate the extinction risk of thousands of species.[70] In particular, it evaluates species against 12 "threats", each with a number of sub-threats.[71] Relevantly for present purposes, Threat 11 (and its five sub-threats) concerns climate change and Threat 7.1 (and its three sub-threats) relates to fire (risk).

69. For this stage of analysis, Dr Peterson designed code that would identify, for each relevant species, where the IUCN Red List specifies that a relevant species is vulnerable to a specific (relevant) threat.[72] In this respect, the code relied on data drawn from the IUCN Red List as at December 2020.

70. Relying on that data, Dr Peterson's code was used to populate the Impact Data Tables for listed threatened species, listed migratory species and marine species with three additional columns titled "iucn_flag", "iucn_climate", and "iucn_fire". In those columns, the following results were recorded:

70.1 if the species is contained on the IUCN Red List, a "1" has been populated in the relevant entity-specific row under "iucn_flag";

70.2 if the species is not contained on the IUCN Red List, a "0" has been populated in the relevant entity-specific row under "iucn_flag";

70.3 if the IUCN Red List specifies that Threats 11.1, 11.2, 11.3, 11.4 or 11.5 (sub-threats to Climate) is a threat to a species, a "1" has been populated in the relevant entity-specific row under "iucn_climate";

70.4 if the IUCN Red List specifies that Threats 11.1, 11.2, 11.3, 11.4 and 11.5 (sub-threats to Climate) are not a threat to a species, a "0" has been populated in the relevant entity-specific row under "iucn_climate";

70.5 if the IUCN Red List specifies that Threat 7.1.1 (sub-threat to Fire) (or a sub-threat to Fire) is a threat to a species, a "1" has been populated in the relevant entity-specific row under "iucn_fire"; and

70.6 if the IUCN Red List specifies that Threat 7.1.1 (sub-threat to Fire) is not a threat to a species, a "0" has been populated in the relevant entity-specific row under "iucn_fire".

71. For all MNES aside from the marine environment and listed migratory species, the far right hand columns of the Impact Data Tables summarise the fire impact map results (discussed further below in **Part E.13**).

72. In relation to the Impact Data Table for Threatened Species, we further note that blank cells indicate that there was no Listing advice or Conservation Advice for the relevant species (or entity). For example, in the Impact Data Table at **Annexure 2.1.B.a**, the flora species, *Acanthocladium dockeri*, has a Listing Advice but not a Conservation Advice.

73. There are two sets of spreadsheets produced as part of this fourth substantive step and they are labelled as follows:

73.1 [MNES] Irrelevant and Relevant Results - Impact Data Tables in **Annexure 2.1.A** – this set shows all of the MNES entities prior to undertaking the reformatting step (at [63] above)

73.2 [MNES] Impact Data Table – only relevant results in **Annexure 2.1.B** – this set shows *only* entities with relevant results,[73] the list of which was produced after undertaking the reformatting step (at [63] above).

74. The sections that follow summarise the results for each MNES produced by the process set out above. In summary, it is submitted that these results demonstrate that climate change is likely, with a high degree of certainty, to impact each particular MNES for which relevant results have been identified.

E.3 Summary of impacts on World Heritage properties

75. Australia currently has 20 properties on the World Heritage List.[74] The data collation process described in Part E.2 reviewed documents relating to 17 of these 20 properties, and identified all of those properties[75] as likely to be impacted by climate change. Spreadsheets have been provided for those 17 properties, being:

Uluru Kata-Tjuta National Park, World Heritage Property, Northern Territory. Photo: Ondrej Machart.

- Budj Bim Cultural Landscape;
- Fossil Mammal Sites;
- Gondwana Rainforests of Australia;
- Great Barrier Reef;
- Greater Blue Mountains;
- Heard and MacDonald Islands;
- Kakadu National Park;
- K'gari (Fraser Island);
- Lord Howe Island;
- Macquarie Island;
- Ningaloo Coast;
- Purnululu National Park;
- Shark Bay;
- Tasmanian Wilderness;
- Uluru Kata-Tjuta National Park;
- Wet Tropics of Queensland; and
- Willandra Lakes Region.

76. When the spreadsheets for each of the relevant World Heritage properties are considered, together (where relevant) with other material provided with this request, the only inference from the source documents is that climate change is likely to impact the world heritage values of each of the properties. To illustrate this, we consider four properties: the Great Barrier Reef, the Wet Tropics of Queensland, Shark Bay and Kakadu. The purpose of the examples is to illustrate what the above steps demonstrate are irresistible inferences to be drawn from the source documents; they do not add to the information in the source documents in any way. A similar analysis can be undertaken for each of the remaining World Heritage properties for which spreadsheets have been provided. If the Minister considers that the relevant inferences may not be available in respect of any of the other World Heritage properties, then the Minister would need to be satisfied that the information set out in the spreadsheets produced by the steps described in Part E.2 does not support those inferences.

Francois Peron National Park, Shark Bay World Heritage Property, Western Australia. Photo: Jennifer Martin.

E.3.1 *Great Barrier Reef*

77. The Great Barrier Reef is a listed World Heritage property in respect of each of world heritage criteria (vii)-(x).[76] UNESCO notes that "[a]s the world's most extensive coral reef ecosystem, the Great Barrier Reef is a globally outstanding and significant entity".[77]

78. The grim picture of climate change impacts on the Great Barrier Reef world heritage area is also painted by the spreadsheet of relevant results for the Reef. Those results show that concerns about the impacts of climate change on the Reef have been voiced repeatedly over the years in the Australian Government's own reports to the World Heritage Committee, statements by the Great Barrier Reef Marine Park Authority (**GBRMPA**), and in IUCN Conservation Outlook Assessments (among other materials). For example:

78.1 The GBRMPA Outlook Reports in 2014[78] and 2019[79] each identified climate change as most serious threat to the Great Barrier Reef. The 2019 Outlook noted that impacts of climate change are becoming more severe and widespread.[80] It set out in detail the observed climate change impacts (especially increases in sea temperature) to date, and the impact of such changes on corals and other organisms.[81] It noted that the Region is particularly vulnerable to the pervasive influence of a rapidly changing climate.[82] The warnings in the Outlook Reports are echoed in the GBRMPA 2019 Position Statement:[83]

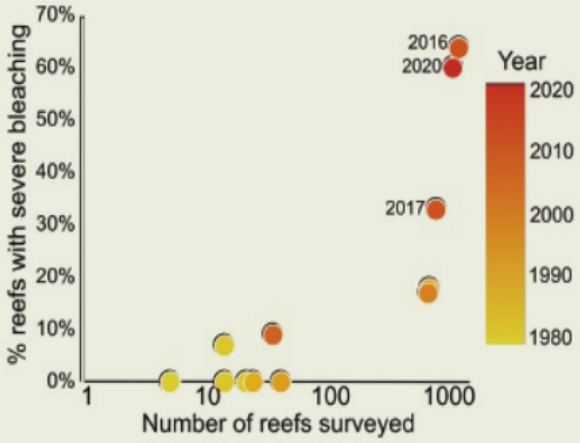
Climate change is the greatest threat to the Great Barrier Reef. Only the strongest and fastest possible actions to decrease global greenhouse gas emissions will reduce the risks and limit the impacts of climate change on the Reef. Further impacts can be minimised by limiting global temperature increase to the maximum extent possible and fast-tracking actions to build Reef resilience.

78.2 The Australian Government's report to the World Heritage Committee in 2019 identified climate change as the most serious and pervasive threat to the Reef.[84] The report identified that the long term outlook for the Reef's ecosystem had deteriorated from poor to very poor, and accelerated action to mitigate climate change was essential to turn around this outlook.[85]

78.3 The IUCN Conservation Outlook Assessment for the Reef in 2020 identified climate change as the biggest threat to the long-term conservation of the Great Barrier Reef and its Outstanding Universal Value. The threat from ocean acidification, temperature extremes and storms/flooding was graded as a "very high threat".[86]

79. The impact of climate change upon the Great Barrier Reef is also discussed extensively in IPCC WGII. IPCC WGII notes that the Great Barrier Reef is already severely impacted by climate change, particularly ocean warming, through more frequent and severe coral bleaching (*very high confidence*). In 2016 and 2017, the Great Barrier Reef experienced consecutive occurrences of the most severe coral bleaching in recorded history.[87] The 2016 bleaching event affected 90% of reefs.[88] The following figure from IPCC WGII records the variation in the severity of mass-bleaching episodes recorded on the Great Barrier Reef over 1980-2020:[89]

Severity of mass-bleaching episodes recorded on the Great Barrier Reef 1980–2020



80. Increased heat exposure also affects the abundance and distribution of associated fish, invertebrates and algae (*high confidence*). Thus, coral bleaching is an indicator of thermal effects on coral habitat, fauna and flora.[90]

81. Bleaching is expected to continue for the Great Barrier Reef, and Australia's other coral reef systems (*virtually certain*). Bleaching conditions are projected to occur twice each decade from 2035 and annually after 2044 under RCP8.5, and annually after 2051 under RCP4.5. Three degrees of global warming would result in over six times the 2016 level of thermal stress. Estimates of future levels of thermal stress suggest that limiting warming to 1.5°C would be insufficient to prevent more frequent mass bleaching events (*very high confidence*), although it may reduce their occurrence, and occurrences of warming events similar to 2016 bleaching could be reduced by 25%.[91]

82. Increases in cyclone intensity projected for this century, and other extreme weather events, will greatly accelerate coral reef degradation. Extreme weather events may contribute to an increased frequency and/or amplitude of crown of thorn starfish outbreaks, further reducing the spatial distribution of coral.[92]

E.3.2 ***Wet Tropics of Queensland***

83. The Wet Tropics stretch across the north-east coast of Australia for some 450km and are made up largely of tropical rainforests. It is a listed World Heritage place in respect of each of world heritage criteria (vii)-(x). UNESCO notes that "a key emerging threat to the integrity of the property is climate change, as with even a small increase in temperature, large declines in the range size for almost every endemic vertebrate species confined to the property are predicted."[93]

84. The spreadsheet for the Wet Tropics underscores the impact of climate change on the Wet Tropics, both to date and into the future:

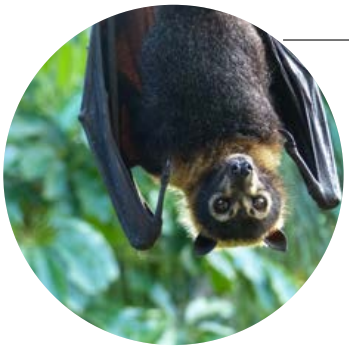
84.1 The IUCN Conservation Outlook Assessments in respect of the Wet Tropics in each of 2014, 2017 and 2020 identified the Wet Tropics as being particularly vulnerable to the impacts of climate change.

84.2 The 2020 IUCN Conservation Outlook Assessment stated that climate change will have severe effects on the Outstanding Universal Value of the site, particularly on animals with low temperature range tolerances and montane flora and fauna.[94]

84.3 The 2020 IUCN Conservation Outlook Assessment identified climate change as a major threat to the area's biodiversity: some keystone species are already critically endangered partly through climate change impacts (for example the spectacled flying fox from extreme temperature events), and cool adapted upland possum species and high altitude birds are being adversely impacted by existing changes in climatic conditions.[95]

84.4 The 2020 IUCN Conservation Outlook Assessment noted that anticipated increased frequency of extreme weather events from climate change will lead to more impacts on the superlative natural beauty of the area.[96]

85. IPCC WGII echoes these observations, noting that climate change impacts have already been observed in the Wet Tropics World Heritage Area. Namely, warming and the increasing length of the dry season have meant that some vertebrate species have already declined in both distribution area and population size, both earlier and more severely than originally predicted.[97]



Spectacled flying fox (*Pteropus conspicillatus*), Endangered, Far North Queensland.

Daintree River Valley, Wet Tropics of Queensland World Heritage Property, Queensland.

E.3.3 *Shark Bay*

Shark Bay, World Heritage Area, Western Australia.

86. Shark Bay sits at the most westerly point of the Australian continent. It is a listed World Heritage place in respect of each of world heritage criteria (vii)-(x). It has a number of exceptional natural features, including its stromatolites, and the Wooramel Seagrass Bank (one of the largest and most diverse seagrass beds in the world). The property is also renowned for its rich marine life.[98]

87. As can be seen in the spreadsheet for Shark Bay, the 2017 and 2020 IUCN Conservation Outlook Assessments for Shark Bay identify climate change as posing the largest threat to the site's World Heritage values, and states that that threat is expected to significantly increase.[99] Stromatolite growth is vulnerable to rising sea levels and climate events, and so this aspect of the site is becoming increasingly threatened.[100]

88. IPCC WGII observes that the observed climate-change related changes in the marine ecosystems of Australia include:

    88.1 the regional loss of seagrass in Shark Bay World Heritage Area due to high air and water temperatures during the 2011 heatwave;[101] and

    88.2 the dieback of temperate seagrass in Shark Bay, subsequently replaced by a tropical early successional seagrass with seagrass-associated megafauna (sea turtles) declining in health status.[102]

Stromatolites at Hamelin Pool, Protected Marine Nature Reserve in Shark Bay, Western Australia.

E.3.4 ***Kakadu National Park***

89. The World Heritage listing for Kakadu describes it as a living cultural landscape with exceptional natural and cultural values.[103] It is a listed World Heritage place in respect of World Heritage criteria (i), (vi)-(x). Of importance are its art sites, rock art and archaeological record, its vast expanse of Ramsar-listed wetlands which provides habitat for millions of waterbirds, its diversity of habitats, and its extensive and relatively unmodified natural vegetation and largely intact faunal composition. The property protects an extraordinary number of plant and animal species including over one third of Australia's bird species, one quarter of Australia's land mammals and an exceptionally high number of reptile, frog and fish species. Huge concentrations of waterbirds make seasonal use of the park's extensive coastal floodplains.

90. The spreadsheet for Kakadu illustrates the impact of climate change on Kakadu, both to date and into the future:

90.1 The 2020 IUCN Conservation Outlook Assessment states that climate change has the potential to affect almost all World Heritage values in the site.[104] Progressive saltwater intrusion into lowland wetlands as a result of climate change has already been observed and is having detrimental impacts on the site's values.[105] Extreme weather events recently caused large scale losses of mangroves within the site and in the broader region.[106] Saltwater intrusion will increasingly cause major changes in the composition, productivity, ecological dynamics and values of the site's significant lowland wetland assemblages.[107] The presence of invasive plant species that cause a dramatic increase in the intensity of fire, and thus threaten many natural values, will worsen under warmer temperatures.[108] The overall assessment provided by the Outlook states:[109]

Climate change is already having detrimental impacts on the site's values, mostly through nascent saltwater intrusion. These impacts will increase in severity and consequences over coming decades, with marked detriment to the site's biodiversity and cultural values.

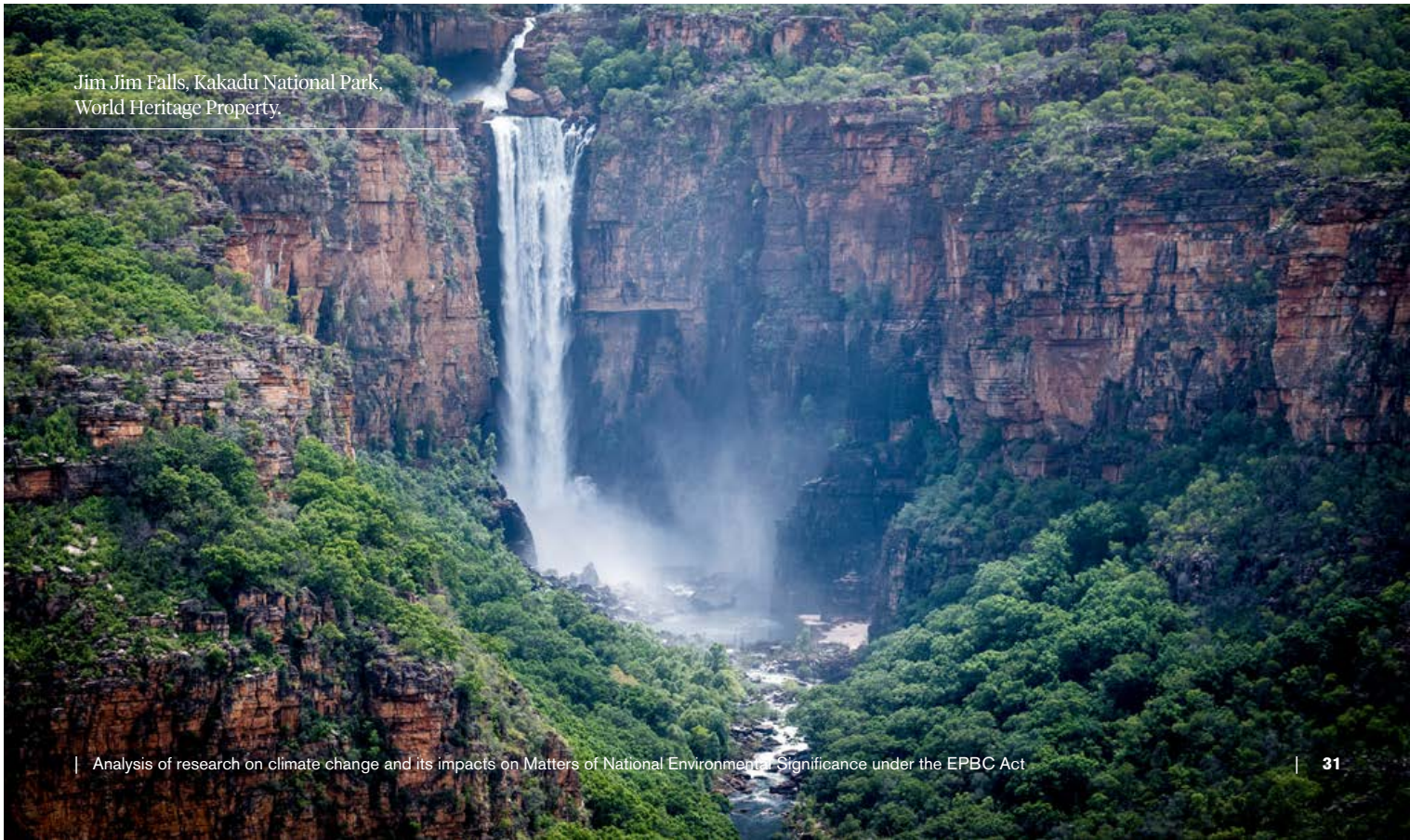
90.2 The 2016-2026 Kakadu Management Plan notes a number of threats to World Heritage values arising from climate change, including:

(a) the "highly significant" threat of climate change on cultural sites in coastal and lowland areas through rising sea levels and saltwater inundation;[110]

(b) the "highly significant" threat of sea-level rise on floodplain values, and of extreme weather events on coastal and riverine areas;[111]

(c) the "highly significant" threat of invasive species that increase the intensity of fires, a threat which is likely to be exacerbated by climate change;[112]

(d) increased frequency and intensity of fire arising from a drier and hotter climate has implications for fire sensitive vegetation communities and for rainforest which comprises many species intolerant of fire.[113]



Jim Jim Falls, Kakadu National Park, World Heritage Property.

E.4 Summary of impacts on National Heritage places

91. Australia currently has 119 National Heritage places listed on the Commonwealth Heritage List, comprising natural, Indigenous and historic heritage places. The data collation process described in Part E.2 focused on natural places and reviewed documents relating to 19 National Heritage places, six of which are also World Heritage properties. Each of the 13 National Heritage places that are not also World Heritage properties were identified as likely to be impacted by climate change.[114]

Mount Solitary, Greater Blue Mountains World Heritage Area, New South Wales.

92. Spreadsheets have been provided for the following National Heritage places:

- Australian Alps National Parks and Reserves;
- Dampier Archipelago;
- Elizabeth Springs;
- Glass House Mountains National Landscape;
- Grampians Greater Gariwerd National Park;
- Ku-ring-gai Chase National Park;
- Kurnell Peninsula Headland;
- Lesueur National Park;
- Porongurup National Park;
- Recherche Bay (NE Peninsula) Area;
- Stirling Range National Park;
- Warrumbungle National Park; and
- Witjira-Dalhousie Springs National Park.

93. The following National Heritage places are also World Heritage properties. For these places, we rely upon the World Heritage spreadsheets summarising the impacts of climate change on each of those places:

- Fraser Island (K'gari);
- Great Barrier Reef;[115]
- Greater Blue Mountains;
- Macquarie Island;
- Uluru-Kata Tjuta National Park; and
- Wet Tropics of Queensland.

94. Again, when the spreadsheets for the above National Heritage places are considered, the only inference from the source documents is that climate change is likely to impact the national heritage values of each of the places. We consider here two illustrative examples: the Australian Alps National Parks and Reserves; and the Grampians Greater Gariwerd National Park.

E.4.1 ***Australian Alps National Parks and Reserves***

95. The Australian Alps National Parks and Reserves was inscribed on the National Heritage List on 7 November 2008. It is listed for numerous criteria that recognise its outstanding landscape, plant diversity and cultural significance.

96. As can be seen from the spreadsheet for the Australian Alps, the Management Plans for a number of National Parks within the Australian Alps have recognised the threat of climate change to the values of the Australian Alps. The 2016 *Greater Alpine National Parks Management Plan* states, for example:[116]

96.1 Climate change is likely to exacerbate many of the existing threats to biodiversity (invasive plants, animals and pathogens) and has the potential to fundamentally change the parameters of ecosystems and viability of species.

96.2 The Parks are already facing challenges from a changing climate. Evidence of slow-onset changes has been mounting for several decades, and extreme weather is becoming more common, the most concerning of which are heatwaves and subsequent bushfires, heavy precipitation and storms.

96.3 The Alps Natural Ecosystem is considered particularly vulnerable to the impacts of climate change: the relatively low height of the Australian Alps compared with most mountain areas of the world means that species have little opportunity to migrate to higher altitudes, there is potential for invasive species and native herbivores – kangaroos and wallabies, which are currently absent from alpine areas – to extend uphill and there is limited knowledge about alpine species' ability to adapt. The Alps Natural Ecosystem contains many rare and endemic species and communities that take a long time to recover from bushfire.[117]

96.4 The Wet Forest and Rainforest Natural Ecosystem is also vulnerable to the impacts of climate change with the predicted increases in bushfire frequency and severity. The wet forests require periods of around 20 years between fires to allow the tree species to set seed.[118]

96.5 Increased temperatures will reduce the extent of alpine flora and fauna due to their limited opportunity to retreat to higher altitudes, and the decrease in the amount and duration of snow and subsequent lower runoff will also affect the population dynamics and survival of a number of mammals.

96.6 Climate change is likely to alter the attributes and availability of habitats, and magnify loss of habitat such as hollow bearing trees and existing threats including fragmentation and spread of invasive species.[119]

Snow Gum leaves (Eucalyptus pauciflora), Snowy Mountains, Kosciuszko National Park, New South Wales.

97. More recently, IPCC WGII has noted that loss of habitat for endemic and obligate species due to snow loss and increases in fire, drought and temperature has already been observed as an impact of climate change in the Australian Alps bioregion.[120] More specifically, those observed climate change impacts include:[121]

97.1 shifts in dominant vegetation (from severe winter drought and warming and climate-induced biotic interactions);

97.2 changing interactions within and among three key alpine taxa: the mountain pygmy-possum, the mountain plum pine and the bogong moth (from snow loss, fire, drought and temperature changes); and

97.3 the loss of snow-related habitat for alpine zone endemic and obligate species (from reduced snow cover).

98. Projected climate change impacts include a loss of alpine biodiversity in the south-east Australian Alps Bioregion due to less snow on snow patch Feldmark and short alpine herb-fields as well as increased stress on snow-dependent plant and animal species.[122]

Mountain pygmy-possum (*Burramys parvus*). Photo: Australian Alps collection Parks Australia. CC BY 3.0.

Bogong Moth (*Agrotis infusa*). Photo: Jean-Paul Ferrero.

Mount Feathertop, Australian Alps National Parks and Reserves, National Heritage Place, Victoria.

E.4.2 ***Grampians Greater Gariwerd National Park***

99. The Grampians Greater Gariwerd National Park was inscribed on the National Heritage List on 15 December 2006. It is listed for three criteria (a, d and e) that recognise its richness in fauna and flora, its rugged dramatic landscape and its rock art paintings.

100. As the spreadsheet for the Grampians Greater Gariwerd National Park demonstrates, the 2021 Management Plan for the Park recognises both the impact of climate change on the Park to date, and the risk it poses to the Park into the future. In particular, the Management Plan states:

100.1 The effects of climate change are already being experienced within the landscape through bushfires, more intense seasonal floods, longer dry spells and higher average temperatures. The frequency of extreme events is increasing, with droughts, complex fires, floods and landslides more prevalent in recent years.[123]

100.2 Potential consequences of climate change include changes to species abundance (including extinctions) and habitat distribution, impacts on key cultural species and accessible resources (e.g. Aboriginal food, medicine and fibre species) and changes to the physical environment (e.g. rainfall, stream-flow regimes, fire frequency).[124]

100.3 Climate change is a particular threat to small mammals that live in the heathlands of Gariwerd due to predicted lower rainfall and increased fire frequency. These conditions are expected to create heathland with more open vegetation, leaving small mammals more vulnerable to predators. Recent surveys have detected Southern Brown Bandicoot and Long-nosed Potoroo only within wetter heathland and scrub habitats, which are denser than more recently burnt, drier heathland areas, where past observations have been from more open woodland areas.[125]

100.4 Wetland and riparian health are also impacted by natural disturbances, such as bushfires and floods. The frequency and intensity of these events are exacerbated by climate change, resulting in excessive erosion, increased sediment transport and high nutrient loads. Altered water temperatures and reduced water quality can affect the health of aquatic species.[126]

Grampians Gariwerd National Park, National Heritage Place, Victoria.

E.5 Summary of impacts on Great Barrier Reef Marine Park

101. Nearly 99% of the Great Barrier Reef World Heritage Area is within the Great Barrier Reef Marine Park.[127] We therefore refer to and rely upon the discussion of the Great Barrier Reef under World Heritage properties, set out above at [77]-[82].

Coral near Heron Island, Great Barrier Reef Marine Park, Queensland.

Coral, Great Barrier Reef Marine Park, Queensland.

E.6 Summary of impacts on Ramsar wetlands

102. Australia currently has 66 Ramsar wetlands included on the List of Wetlands of International Importance listed under the Ramsar Convention. The data collation process described in Part E.2 reviewed documents relating to 53 Ramsar wetlands, 51 of which were identified as likely to be impacted by climate change.[128] The spreadsheets for this MNES address each of the following Ramsar wetlands:

Kakadu National Park, Ramsar wetland, Northern Territory. Photo: Karl Hedin.

- Apsley Marshes
- Ashmore Reef Commonwealth Marine Reserve
- Banrock Station Wetland Complex
- Barmah Forest
- Blue Lake
- Cobourg Peninsula
- Coongie Lakes
- Coral Sea Reserves (Coringa-Herald and Lihou Reefs and Cays)
- Corner Inlet
- East Coast Cape Barren Island Lagoons
- Edithvale-Seaford Wetland
- Eighty-mile Beach
- Elizabeth and Middleton Reefs Marine National Nature Reserve
- Fivebough and Tuckerbil Wetlands
- Flood Plain Lower Ringarooma River
- Forrestdale and Thomsons Lakes
- Ginini Flats Wetland Complex
- Gippsland Lakes
- Glenelg Estuary and Discovery Bay Wetlands
- Gunbower Forest
- Hattah-Kulkyne Lakes
- Hosnies Spring
- Interlaken (Lake Crescent)
- Jocks Lagoon
- Kakadu National Park
- Kerang Wetlands
- Kooragang
- Lake Albacutya
- Lake Gore
- Lake Pinaroo (Fort Grey Basin)
- Lake Warden System
- Lakes Argyle and Kununurra
- Lavinia
- Little Llangothlin Nature Reserve
- Little Waterhouse Lake
- Logan Lagoon
- Macquarie Marshes
- Moulting Lagoon
- Muir – Byenup System
- Myall Lakes
- Narran Lake Nature Reserve
- NSW Central Murray Forests
- Ord River Floodplain
- Paroo River Wetlands
- Peel-Yalgorup System
- Pitt Water-Orielton Lagoon
- Pulu Keeling National Park
- Roebuck Bay
- Shoalwater and Corio Bays Area
- The Dales
- Towra Point Nature Reserve
- Western District Lakes
- Western Port.

103. When these spreadsheets are considered, the only inference from the source documents is that climate change is likely to impact the relevant Ramsar wetland identified where, in the summary spreadsheet, a "1" appears in any of the following columns: "climate_direct", "climate_implied" or "fire". To illustrate this, we consider the following Ramsar wetlands: Lake Albacutya, Kerang Wetlands and Ginini Flats Wetland Complex. A similar analysis can be undertaken for each of the remaining Ramsar Wetlands listed in the above spreadsheets.

104. As to Lake Albacutya, the relevant Impact Data Table (see **Annexure 2.1.B.d**) contains a "1" in the "climate_direct", "climate_implied" and "fire" columns. The Ecological Character Description for Lake Albacutya relevantly indicates the following:

104.1 Climate change is a key threat to the ecological character of Lake Albacutya. Potential impacts include reduced frequency, duration and extent of flooding; interference with migration, reproduction, regeneration and recruitment processes; reduced habitat availability and quality for waterbirds; and declining eucalypt woodland health. The significance of the threat is classified as "high", the likelihood of impacts is "medium" and the timing of impacts is "short to long term".[129]

104.2 The vast majority of various climate change prediction models predict a significant decrease in run-off. This poses a severe threat to the hydrological regime of Lake Albacutya which is already impacted by river regulation.[130]

104.3 Climate change is identified as a potential threat to the representativeness of near-natural wetland and waterbird habitat embodied by Lake Albacutya, and which contribute directly to the Ramsar values of Lake Albacutya.[131]

104.4 Changes in the fire regime at Lake Albacutya, including frequency, intensity or season, can reduce the abundance and diversity of native vegetation resulting in a loss of fauna habitat.[132]

105. As to Kerang Wetlands, the relevant Impact Data Table (see **Annexure 2.1.B.d**) contains a "1" in the "climate_direct" and "climate_implied" columns. The Ecological Character Description for Kerang Wetlands relevantly indicates the following:

105.1 In summary, climate change is a likely medium to long-term threat to the Ramsar site. Its potential impacts include impacts to significant wetland types, hydrology, flora and fauna and waterbird breeding habitat.[133]

105.2 Climate change poses a threat to the drainage wetlands as higher temperatures and dryer conditions would lead to increases in evaporation rates, which affect salinity and groundwater levels.[134]

105.3 Significant climatic changes have the potential to change the character of the Ramsar site, specifically its hydrology and salinity (which has repercussions for vegetation and fauna communities and habitat). Climate change is expected to impact on all aspects of the water cycle of the region; reduced rainfall and hotter temperatures producing less water for rivers and storages, drier soils resulting in less run-off to waterways, and more evaporation occurring from rivers, channels and storages. With climate change there are likely to be more frequent and extended droughts, with longer dry spells and less frequent floods. The impact of this is that there will be less water for rivers and wetlands, irrigation use and a significant reduction in environmental flows. Extended drought will reduce the availability of waterbird habitat (through vegetation loss and reduced amounts of open water). Reduction of water volumes and flood frequency may also lead to stagnation of wetlands and changes to nutrient cycling. Climate change is a significant threat as it has the potential to cause degradation and lead to the reduction or loss of the critical services and benefits of the Ramsar site.[135]

106. As to Ginini Flats Wetland Complex, the relevant Impact Data Table (see **Annexure 2.1.B.d**) contains a "1" in the "climate_direct", "climate_implied" and "fire" columns. The Ecological Character Description for Ginini Flats Wetland Complex relevantly indicates the following:

106.1 Ginini Flats Wetland Complex is situated at the northern extreme of the climatic range for sphagnum bog wetlands in the Australian Alps. Given the wetland is already at the limit of climatic tolerance, the greatest threat to it relates to the global-scale process of climate change and the myriad impacts and potential positive feedback mechanisms that can occur. Climate change has the potential to alter all critical components and processes (for example hydrology, peat formation, vegetation, habitat availability, water quality, groundwater recharge), and thus the services that characterise the ecological character of the wetland.[136]

106.2 Fire results in changes to vegetation, peat formation, hydrology and water quality. Many impacts are medium term (for example decades) and have the potential to significantly affect the ecological character of the wetland.[137]

107. The risk assessment identified the greatest risks to the Ramsar site, with the most severe consequences associated with climate change.[138]

E.7 Summary of impacts on species and ecological communities — overview

108. IPCC WGII makes a number of relevant findings on the current and projected impacts of climate change on flora and fauna in Australia. These observations are broadly relevant to consideration of the impacts of climate change on MNES protected by ss 18-20A of the EPBC Act. Namely, IPCC WGII includes the following relevant findings.

109. Widespread and severe impacts on ecosystems and species are now evident across the Australasia region (*very high confidence*).[139] Climate impacts reflect both ongoing change and discrete extreme weather events[140] — such as those addressed in **Part D** above and the subject of the "Implied Climate Set" used to analyse the source materials for listed threatened species, ecological communities and listed threatened species (as addressed at [51]-[57] above).

110. Fundamental shifts are observed in the structure and composition of some ecosystems, with impacts on species including global and local extinctions, severe regional population declines, and phenotypic responses.[141] Climate change has synergistic and compounding impacts particularly in bioregions already experiencing ecosystem degradation, threatened endemics and collapse of keystone species.[142] In terrestrial and freshwater ecosystems, land use impacts are interacting with climate, resulting in significant changes to ecosystem structure, composition and function, with some landscapes experiencing catastrophic impacts.[143] The 2019/2020 bushfires had significant consequences for wildlife (considered further at [138]-[140] below) and flow-on impacts for aquatic fauna.[144]

111. The observed impacts on terrestrial and freshwater ecosystems and species, where there is documented evidence that these are directly[145] or indirectly[146] the result of climate change pressures, include:[147]

111.1 for the forest and woodlands of southern and southwestern Australia:

(a) drought-induced canopy die-back across a range of forest and woodland types (e.g. northern jarrah);

(b) local extirpations and replacement of dominant canopy tree species and replacement by woody shrubs due to seeders having insufficient time to reach reproductive age (Alpine Ash) or vegetative regeneration capacity is exhausted (Snow Gum woodlands);

(c) death of fire-sensitive tree species from unprecedented fire events;

111.2 for the Australian Alps bioregion and the Tasmanian alpine zones:

(a) shifts in dominant vegetation with a decline in grasses and other graminoids and an increase in forb and shrub cover in Bogong High Plains, Victoria;

(b) loss of snow-related habitat for alpine zone endemic and obligate species;

111.3 mass mortality of wildlife species, namely flying foxes (of which the grey-headed flying fox is listed as vulnerable, the spectacle flying fox is listed as endangered and the Christmas Island flying fox is listed as critically endangered[148]) and freshwater fish (of which several are listed as threatened, such as the *Galaxia rostarus*, which is listed in the critically endangered category[149]);

111.4 in respect of the koala (*Phascolarctos cinereus*), population declines and enhanced risk (the koala is considered further below);

111.5 in respect of birds, changes in body size, mass and condition and other traits linked to heat exchange.

Australian Snow Gums (*Eucalyptus pauciflora*), Australian Alps National Parks and Reserves, National Heritage Place, Victoria.

112. As to projected impacts, climate change is projected to become an increasingly dominant stress on biodiversity, with some ecosystems experiencing irreversible changes in composition and structure and some threatened species becoming extinct (*high confidence*).[150] Climate change will interact with current declines, heat-related mortalities, extinctions and disruptions for many species and ecosystems (*high confidence*).[151] Some impacts observed to date may be irreversible where projected impacts on ecosystems and species persists.[152]

113. The IPCC's indicative selection of projected climate change impacts on terrestrial and freshwater ecosystems in Australia includes:[153]

113.1 as to the floristic composition of vegetation communities, 47% of vegetation types have characteristic plant species at risk of their climatic tolerances being exceeded from increasing mean annual temperature by 2070;

113.2 for some south east Australian temperate forests:

(a) an increase in fire frequency prevents recruitment of obligate seeders, resulting in changing dominant species and vegetation structures, including long-lasting or irreversible shifts in formation from tall wet temperate eucalypt forests dominated by obligate seeder trees (e.g. Alpine Ash) to open forest or, worst case, to shrubland;

(b) declining rainfall and regolith drying, more unplanned, intense, fires and declining productivity places stress on tree growth and compromises biodiversity in the northern jarrah forest;

(c) population collapse and severe range contraction of slow-growing, fire-sensitive paleoendemic temperate rainforests species;

113.3 for Alpine ecosystems, loss of alpine vegetation communities and increased stress on snow-dependent plant and animal species, as well as changing suitability for invasive species;

113.4 for the Murray-Darling River Basin, reduced river flow and mass fish kills;

113.5 extinction likely within the next 20 years for 22 narrow range fish species; and

114. for freshwater taxa (freshwater fish, crayfish, turtles and frogs), substantial changes to the composition of faunal assemblages in Australian rivers, well before the end of this century, with suitable habitat area predicted to decrease for many crayfish and turtle species and nearly all frog species (of which several are listed as critically endangered, endangered or vulnerable[154]).

Koala (*Phascolarctos cinereus*), Endangered.

Menindee Weir Pool, Menindee Lakes, New South Wales. Photo: Graeme McCrabb

E.8 Summary of impacts on listed threatened species – fauna

115. As at 31 March 2022, Australia had 1,839 listed threatened species declared under s 178 of the EPBC Act, comprising both fauna and flora,[155] excluding listed threatened species in the extinct category and in the conservation dependent category.[156] The data collation process described in Part E.2 reviewed documents relating to 1,605 of those listed threatened species. Of the 401 fauna species included in that process, 366 were identified as likely to be impacted by climate change.[157] Spreadsheets have been provided for the following threatened fauna species, listed by reference to the subsections of s 18 that apply to them:

Numbat (*Myrmecobius fasciatus*), Endangered, Dryandra Woodlands, Western Australia.

115.1 **species that are extinct in the wild (s 18(1));**

- Galaxias pedderensis

115.2 **critically endangered species (s 18(2));**

- Acanthornis magna greeniana
- Adclarkia dawsonensis
- Advena campbellii
- Aipysurus apraefrontalis
- Aipysurus foliosquama
- Ammoniropa vigens
- Amytornis modestus obscurior
- Anthochaera phrygia
- Argynnis hyperbius inconstans
- Bidyanus bidyanus
- Brachionichthys hirsutus
- Calidris ferruginea
- Calidris tenuirostris
- Carcharias taurus (east coast population)
- Chalcophaps indica natalis
- Cherax tenuimanus
- Cinclosoma punctatum anachoreta
- Cophixalus concinnus
- Cophixalus hosmeri
- Cophixalus mcdonaldi
- Cophixalus monticola
- Cophixalus neglectus
- Crocidura trichura
- Cryptoblepharus egeriae
- Dryococelus australis
- Elseya albagula
- Engaewa pseudoreducta
- Engaewa reducta
- Epthianura crocea macgregori
- Euastacus bindal
- Euastacus dharawalus
- Galaxias rostratus
- Galaxias tantangara
- Geocrinia alba

Regent Honeyeater (*Anthochaera phrygia*), Critically Endangered. Photographer: Jss367, CC BY-SA 4.0.

- Glyphis glyphis
- Gudeoconcha sophiae magnifica
- Gymnobelideus leadbeateri
- Hesperocolletes douglasi
- Hoplogonus bornemisszai
- Hyridella glenelgensis
- Lasiorhinus krefftii
- Lathamus discolor
- Leioproctus douglasiellus
- Lepidodactylus listeri
- Lichenostomus melanops cassidix
- Limosa lapponica menzbieri
- Litoria castanea
- Litoria kroombitensis
- Litoria lorica
- Litoria myola
- Litoria nyakalensis
- Litoria spenceri
- Marginaster littoralis
- Mathewsoconcha grayi ms
- Mathewsoconcha phillipii
- Mathewsoconcha suteri
- Melanodryas cucullata melvillensis
- Micropathus kiernani
- Miniopterus orianae bassanii
- Mystivagor mastersi
- Nangura spinosa
- Neopasiphae simplicior
- Neophema chrysogaster
- Numenius madagascariensis
- Ogyris subterrestris petrina
- Ordtrachia septentrionalis
- Pedionomus torquatus
- Petrogale concinna concinna
- Pezoporus flaviventris
- Philoria frosti
- Phyllurus gulbaru
- Potorous gilbertii
- Pseudemydura umbrina
- Pseudocharopa ledgbirdi
- Pseudocharopa whiteleggei
- Pseudocheirus occidentalis
- Pseudococcus markharveyi
- Pseudophryne corroboree
- Pseudophryne pengilleyi
- Pterodroma arminjoniana
- Pterodroma heraldica
- Pteropus natalis
- Quintalia stoddartii
- Stiphodon semoni
- Taudactylus pleione
- Taudactylus rheophilus
- Thersites mitchellae
- Thymichthys politus
- Wollumbinia georgesi
- Zyzomys pedunculatus

115.3 **endangered species (s 18(3);**

- Accipiter hiogaster natalis
- Adclarkia cameroni
- Adclarkia dulacca
- Amytornis barbatus barbatus
- Amytornis dorotheae
- Amytornis merrotsyi pedleri
- Antechinus argentus
- Antechinus arktos
- Antipodia chaostola leucophaea
- Arctocephalus tropicalis
- Atrichornis clamosus
- Atrichornis rufescens
- Bellatorias obiri
- Bertmainius tingle
- Bettongia penicillata ogilbyi
- Bettongia tropica
- Botaurus poiciloptilus
- Burramys parvus
- Calidris canutus
- Callocephalon fimbriatum
- Calyptorhynchus baudinii (Zanda baudinii)
- Calyptorhynchus lathami halmaturinus
- Ceyx azureus diemenensis
- Charadrius mongolus
- Cophixalus aenigma
- Craterocephalus fluviatilis
- Crinia sloanei
- Cryptoblepharus gurrmul
- Cyanoramphus cookii

Male Orange-bellied Parrot (*Neophema chrysogaster*), Critically Endangered, Southwest Conservation Area, Tasmania. Photo: JJ Harrison.

- Cyclodomorphus praealtus
- Cyclopsitta diophthalma coxeni
- Cyrtodactylus sadleiri
- Dasyornis longirostris
- Dasyurus hallucatus
- Dasyurus maculatus (SE mainland population)
- Dasyurus viverrinus
- Dendronephthya australis
- Dermochelys coriacea
- Egernia stokesii badia
- Elseya lavarackorum
- Elusor macrurus
- Engaeus granulatus
- Engaeus martigener
- Engaeus spinicaudatus
- Engaewa walpolea
- Epthianura crocea tunneyi
- Erythrura gouldiae
- Euastacus bispinosus
- Eulamprus leuraensis
- Fregata andrewsi
- Galaxias auratus
- Galaxias fontanus
- Galaxias johnstoni
- Galaxias truttaceus (Western Australian population)
- Galaxiella nigrostriata
- Glyphis garricki
- Hippocampus whitei
- Hipposideros inornatus
- Hylacola pyrrhopygia parkeri
- Hypotaenidia philippensis andrewsi
- Hypotaenidia sylvestris
- Isoodon obesulus obesulus
- Lerista allanae
- Lerista nevinae
- Leucopatus Anophthalmus
- Liopholis guthega
- Liopholis slateri slateri
- Lissotes latidens
- Litoria booroolongensis
- Litoria littlejohni
- Litoria watsoni
- Lucasium occultum
- Maccullochella ikei
- Maccullochella mariensis
- Macquaria australasica
- Macronectes giganteus
- Malurus coronatus coronatus
- Manorina melanotis
- Melanotaenia eachamensis
- Melithreptus brevirostris magnirostris
- Meridolum maryae
- Mesembriomys gouldii gouldii
- Mesodontrachia fitzroyana
- Mixophyes fleayi
- Myrmecobius fasciatus
- Nannoperca oxleyana
- Nannoperca pygmaea
- Neochmia phaeton evangelinae
- Neochmia ruficauda ruficauda
- Neophoca cinerea
- Nesoptilotis leucotis thomasi
- Notomys aquilo
- Onychogalea fraenata
- Oreixenica ptunarra
- Papasula abbotti
- Paragalaxias mesotes
- Paralucia pyrodiscus lucida
- Parantechinus apicalis
- Pardalotus quadragintus
- Petaurus australis australis
- Petaurus australis Wet Tropics subspecies
- Petrogale coenensis
- Petrogale concinna canescens
- Petrogale concinna monastria
- Petrogale lateralis kimberleyensis
- Petrogale lateralis lateralis
- Petrogale persephone
- Pezoporus occidentalis
- Phaethon lepturus fulvus
- Phascolarctos cinereus (combined populations of Qld
- Philoria kundagungan
- Philoria richmondensis
- Phyllodes imperialis smithersi

Spotted-tailed Quoll (*Dasyurus maculatus*), Endangered.

- Placostylus bivaricosus
- Poephila cincta cincta
- Pommerhelix duralensis
- Potorous longipes
- Psephotus chrysopterygius
- Pseudomys fumeus
- Pseudomys oralis
- Pseudomys shortridgei
- Psophodes nigrogularis lashmari (Psophodes leucogaster lashmari)
- Psophodes nigrogularis nigrogularis
- Pteropus conspicillatus
- Rostratula australis
- Sarcophilus harrisii
- Semotrachia euzyga
- Sinumelon bednalli
- Sminthopsis psammophila
- Sterna vittata bethunei
- Stipiturus malachurus halmaturinus
- Stipiturus malachurus intermedius
- Stipiturus mallee
- Tachyglossus aculeatus multiaculeatus
- Taudactylus eungellensis
- Thalassarche cauta
- Thalassarche chrysostoma
- Thaumatoperla alpina
- Trioza barrettae
- Trisyntopa scatophaga
- Turdus poliocephalus erythropleurus
- Tyto novaehollandiae melvillensis
- Uperoleia mahonyi
- Zearaja maugeana
- Zyzomys palatalis

115.4 **vulnerable species (s 18(4));**

- Acanthophis hawkei
- Brachiopsilus ziebelli
- Calamanthus cautus halmaturinus (Hylacola cauta halmaturina)
- Calyptorhynchus banksii naso
- Chalinolobus dwyeri
- Coeranoscincus reticulatus
- Conilurus penicillatus
- Engaeus orramakunna
- Engaeus yabbimunna
- Epinephelus daemelii
- Galaxias parvus
- Hoplogonus simsoni
- Hoplogonus vanderschoori
- Idiosoma nigrum
- Isoodon obesulus nauticus
- Kumonga exleyi
- Lagorchestes hirsutus bernieri
- Lagorchestes hirsutus dorreae
- Liopholis pulchra longicauda
- Maccullochella peelii
- Macronectes halli
- Mixophyes iteratus
- Nannatherina balstoni
- Neoceratodus forsteri
- Nyctophilus corbeni
- Oreisplanus munionga larana
- Paragalaxias dissimilis
- Paragalaxias eleotroides
- Parvulastra vivipara
- Perameles gunnii Victorian subspecies
- Phascogale pirata
- Potorous tridactylus trisulcatus
- Pristis clavata
- Pristis zijsron
- Pseudomys novaehollandiae
- Pseudomys pilligaensis
- Pteropus poliocephalus
- Pycnoptilus floccosus
- Rhincodon typus
- Rhinonicteris aurantia (Pilbara form)
- Sternula nereis nereis
- Thalassarche melanophris
- Tympanocryptis condaminensis
- Tyto novaehollandiae castanops (Tasmanian population)
- Zyzomys maini

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*), Vulnerable.

116. When these spreadsheets are considered, the only inference from the source documents is that climate change is likely to impact the species where in the Impact Data Table, a "1" appears in any of the following columns: "climate_direct", "climate_implied", "climate_implied_not_direct", "fire", "fire_not_climate", "iucn_climate" or "iucn_fire". To illustrate this, we consider the Leadbeater's possum (*Gymnobelideus leadbeateri*), the koala (*Phascolarctos cinereus*), and the Eyre Peninsula southern emu-wren (*Stipiturus malachurus parimeda*), as examples of species listed as threatened in the critically endangered (EPBC Act, s 18(2)), endangered (EPBC Act, s 18(3)) and vulnerable (EPBC Act, s 18(4)) categories. A similar analysis can be undertaken for each of the remaining species for which spreadsheets have been provided with this request. The purpose of the examples is to illustrate what the above steps demonstrate are irresistible inferences to be drawn from the source documents; they do not add to the information in the source documents in any way. If the Minister considers that the relevant inferences may not be available in respect of any of the other species, then the Minister would need to be satisfied for themselves that the information set out in the tables produced by the steps does not support those inferences.

Leadbeater's Possum (*Gymnobelideus leadbeateri*), Critically Endangered. Photo: Steve Kuiter.

117. As to the Leadbeater's possum (*Gymnobelideus leadbeateri*) — which is listed as critically endangered — the relevant Impact Data Table (see **Annexure 2.1.B.a**) contains a "1" in the "climate_direct", "climate_implied", "fire" and "iucn_climate" columns. The Conservation Advice for the species relevantly indicates the following:

117.1 As to the risk posed by fire, extensive wildfire is a known threat to the species, with fire resulting in the direct mortality and loss of habitat of the species.[158] The frequency and intensity of wildfires are likely to increase under climate change scenarios, which predict increased rates of extreme climatic events.[159]

117.2 Collapse of hollow-bearing trees is also a known threat, the rate of which is relevantly influenced by other threats, such as fire.[160] The rate of collapse may also be affected by the effect of climate change on drought and fire.[161]

117.3 Climate change is a suspected future threat to the species, which may exacerbate existing threats (such as fire frequency and intensity).[162] Other effects may include reduced productivity and recruitment of habitat trees (Mountain Ash).[163]

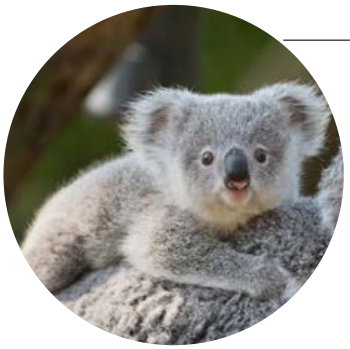
118. As to the koala (*Phascolarctos cinereus*) — which is listed as endangered in respect of the combined populations of Queensland, New South Wales and the Australian Capital Territory — the relevant summary table (see **Annexure 2.1.B.a**) contains a "1" in the "climate_direct", "climate_implied" and "fire" columns. Further, the IUCN Red List indicates that both climate change (Threat 11) and Fire (Threat 7.1) are threats to the species. The Conservation Advice for the species relevantly indicates the following:

118.1 The koala is threatened by wide-scale climate change drivers, which include the increased frequency and intensity of drought and high temperatures, the increasing prevalence of weather conditions which promote bushfire, and a shrinking of climatically suitable area.[164] Elevated CO_2 levels may also affect the nutritional value of foliage (that are part of the koala's diet), although further research is needed.[165]

118.2 Climate change drivers have resulted in a reduction in climatically suitable habitat.[166]

118.3 Forecasting models predict that a large area of koala habitat may be lost, accompanied by a large reduction in the koala population, under 2070 climate change projections.[167]

118.4 Modelling of future climate-suitable koala distribution indicates a further contraction by 2030 from the 2011 baseline as a direct result of climate change, of: 17 to 78% for Queensland;[168] 8 to 19% for New South Wales;[169] and 10% for the Australian Capital Territory.[170]



Koala (*Phascolarctos cinereus*), Endangered.

Eyre Peninsula southern emu-wren (*Stipiturus malachurus parimeda*). Vulnerable.
Photo: Marcus Pickett.

119. As to the Eyre Peninsula southern emu-wren (*Stipiturus malachurus parimeda*) — which is listed as vulnerable — the relevant summary table (see **Annexure 2.1.B.a**) contains a "1" in the "climate_direct", "climate_implied" and "fire" columns. The IUCN Red List indicates that climate change (Threat 11) is a threat to the species. The Conservation Advice for the species relevantly indicates the following:

119.1 Climate change is a threat, as the subspecies is considered likely to be exposed to increases in the frequency and intensity of fires as a result of climate change.[171]

119.2 Bushfire is a major potential threat, as it may cause widespread habitat loss.[172] High frequency fires remove vegetation cover used by the subspecies for concealment.[173] Over the last decade, bushfires have severely affected almost all known occupied sites, with the population at Koppio Hills lost in a bushfire in 2005.[174]

E.9 Summary of impacts on listed threatened species – flora

120. As at 31 March 2022, Australia had 1,839 listed threatened species declared under s 178 of the EPBC Act comprising both fauna and flora,[175] excluding listed threatened species in the extinct category and in the conservation dependent category.[176] The data collation process described in Part E.2 reviewed documents relating to 1,605 of those listed threatened species. Of the 1,204 species of flora included in that process, 1,048 were identified as likely to be impacted by climate change.[177] Spreadsheets have been provided for the following threatened flora species, listed by reference to the subsections of s 18 that apply to them:

Border Ranges lined fern (*Antrophyum austroqueenslandicum*). Critically endangered. Photo: Liu Weber.

120.1 **critically endangered species (s 18(2));**

- Abutilon julianae
- Acacia cochlocarpa subsp. velutinosa
- Acacia dangarensis
- Acacia equisetifolia
- Acacia leptoneura
- Acacia purpureopetala
- Acacia unguicula
- Acanthocladium dockeri
- Achyranthes arborescens
- Achyranthes margaretarum
- Andersonia annelsii
- Androcalva adenothalia
- Androcalva bivillosa
- Anthosachne kingiana subsp. kingiana
- Antrophyum austroqueenslandicum
- Asplenium listeri
- Asterolasia beckersii
- Atalaya brevialata
- Austrostipa jacobsiana
- Azorella macquariensis
- Banksia anatona
- Banksia aurantia
- Banksia fuscobractea
- Banksia serratuloides subsp. perissa
- Banksia vincentia
- Boehmeria australis subsp. australis
- Boronia inflexa subsp. torringtonensis
- Bossiaea fragrans
- Brachychiton sp. Ormeau
- Brachyscias verecundus
- Bruguiera x hainesii
- Caladenia actensis
- Caladenia anthracina
- Caladenia attenuata
- Caladenia campbellii
- Caladenia cremna
- Caladenia intuta
- Caladenia lindleyana
- Caladenia lodgeana
- Caladenia luteola
- Caladenia melanema
- Caladenia melanoma
- Caladenia pallida
- Caladenia pumila
- Caladenia saggicola
- Caladenia sp. Kilsyth South
- Caladenia sylvicola
- Caladenia tonellii
- Calectasia cyanea
- Callistemon megalongensis
- Callistemon purpurascens
- Callistemon wimmerensis
- Calochilus cupreus
- Calystegia affinis
- Cassinia tegulata
- Clausena excavata
- Clematis dubia
- Commersonia apella
- Conospermum galeatum
- Conostylis setigera subsp. dasys

- Corunastylis ectopa
- Corunastylis firthii
- Corunastylis insignis
- Corunastylis littoralis
- Corunastylis sp. Charmhaven
- Corybas sulcatus
- Darwinia foetida
- Dasymalla axillaris
- Daviesia glossosema
- Daviesia ovata
- Diuris flavescens
- Duma horrida subsp. abdita
- Eidothea hardeniana
- Elatostema montanum
- Elaeocarpus miegei
- Epacris graniticola
- Epacris limbata
- Epacris stuartii
- Eremophila glabra subsp. Scaddan
- Eremophila koobabbiensis
- Eremophila sp. Narrow leaves
- Eucalyptus recurva
- Eucalyptus sp. Cattai
- Euphorbia norfolkiana
- Euphrasia argute
- Euphrasia fragosa
- Euphrasia gibbsiae subsp. psilantherea
- Fontainea oraria
- Galium antarcticum
- Gastrolobium argyrotrichum
- Gastrolobium diabolophyllum
- Gastrolobium luteifolium
- Gastrolobium vestitum
- Gentiana bredboensis
- Grevillea brachystylis subsp. grandis
- Grevillea bracteosa subsp. howatharra
- Grevillea caleyi
- Grevillea hodgei
- Grevillea rivularis
- Grevillea scortechinii subsp. scortechinii
- Grevillea sp. Gillingarra
- Grevillea thelemanniana
- Grevillea wilkinsonii
- Guichenotia seorsiflora
- Gyrostemon reticulatus
- Haloragis platycarpa
- Hemigenia ramosissima
- Hibbertia abyssus
- Hibbertia circinata
- Hibbertia priceana
- Hibbertia puberula subsp. glabrescens
- Hibbertia sp. Toolbrunup (Hibbertia barrettiae)
- Hibbertia spanantha
- Hibbertia tenuis
- Hibiscus insularis
- Homoranthus bebo
- Homoranthus bruhlii
- Homoranthus elusus
- Hybanthus cymulosus
- Isopogon robustus
- Kardomia prominens
- Kunzea similis subsp. similis
- Lasiopetalum sp. Mount Caroline
- Lasiopetalum sp. Proston
- Latrobea colophona
- Leionema lamprophyllum subsp. fractum
- Lepidorrhachis mooreana
- Leucopogon sp. Flynn
- Leucopogon spectabilis
- Lomatia tasmanica
- Lysiosepalum abollatum
- Melicytus latifolius
- Meryta latifolia
- Myoporum obscurum
- Nematoceras dienemum
- Nitella parooensis
- Notelaea ipsviciensis
- Oberonia attenuata
- Paragoodia crenulata
- Persoonia pauciflora
- Phebalium daviesii
- Phebalium distans
- Phebalium speciosum
- Philotheca falcata
- Phlegmariurus squarrosus
- Phreatia limenophylax
- Pimelea bracteata
- Pimelea cremnophila
- Pimelea spinescens subsp. pubiflora
- Pimelea spinescens subsp. Spinescens
- Plinthanthesis rodwayi
- Pneumatopteris truncata
- Pomaderris delicata
- Pomaderris reperta
- Pomaderris vacciniifolia
- Pomaderris walshii
- Prasophyllum atratum
- Prasophyllum bagoense
- Prasophyllum castaneum
- Prasophyllum favonium
- Prasophyllum incorrectum
- Prasophyllum innubum
- Prasophyllum keltonii
- Prasophyllum laxum
- Prasophyllum limnetes
- Prasophyllum milfordense
- Prasophyllum murfetii

- Prasophyllum olidum
- Prasophyllum perangustum
- Prasophyllum pulchellum
- Prasophyllum robustum
- Prasophyllum sp. Wybong
- Prasophyllum stellatum
- Prasophyllum taphanyx
- Prostanthera albohirta
- Prostanthera clotteniana
- Prostanthera gilesii
- Prostanthera marifolia
- Prostanthera staurophylla
- Pterostylis bryophila
- Pterostylis commutata
- Pterostylis oreophila
- Pterostylis psammophila
- Pterostylis valida
- Pterostylis vernalis
- Pterostylis wapstrarum
- Ptilotus pyramidatus
- Pultenaea sp. Genowlan Point
- Reedia spathacea
- Reedia spathacea
- Rhizanthella gardneri
- Rhizanthella johnstonii
- Rhodamnia rubescens
- Rhodomyrtus psidioides
- Scaevola macrophylla
- Seringia exastia
- Solanum orgadophilum
- Sphaerolobium acanthos
- Spyridium fontis-woodii
- Stylidium amabile
- Stylidium applanatum
- Stylidium semaphorum
- Styphelia longissimi
- Synaphea sp. Fairbridge Farm
- Synaphea sp. Serpentine
- Tetratheca gunnii
- Tetratheca nephelioides
- Thelymitra adorata
- Thelymitra cyanapicata
- Thelymitra hygrophila
- Thelymitra kangaloonica
- Thynninorchis nothofagicola
- Veronica derwentiana subsp. homalodonta
- Verticordia apecta
- Wikstroemia australis
- Wollemia nobilis
- Zieria buxijugum
- Zieria exsul
- Zieria odorifera subsp. warrabahensis
- Zieria parrisiae

120.2 **endangered species (s 18(3);**

- Acacia aprica
- Acacia aristulata
- Acacia ataxiphylla subsp. magna
- Acacia brachypoda
- Acacia chapmanii subsp. Australis
- Acacia cretacea
- Acacia enterocarpa
- Acacia imitans
- Acacia meiantha
- Acacia pinguifolia
- Acacia porcata
- Acacia pygmaea
- Acacia recurvate
- Acacia ruppii
- Acacia spilleriana
- Acacia splendens
- Acacia subflexuosa subsp. capillata
- Acacia vassalii
- Acacia volubilis
- Acacia whibleyana
- Acacia wilsonii
- Acacia woodmaniorum
- Acronychia littoralis
- Adenanthos dobagii
- Adenanthos velutinus
- Alectryon ramiflorus
- Allocasuarina defungens
- Allocasuarina glareicola
- Allocasuarina portuensis
- Allocasuarina robusta
- Allocasuarina thalassoscopica

Wollemi Pine (*Wollemia nobilis*), Critically Endangered. Photo: Mendel Perkins Photography.

- Amyema plicatula
- Andersonia axilliflora
- Androcalva perlaria
- Androcalva rosea
- Apium prostratum subsp. Porongurup Range
- Aponogeton bullosus
- Aponogeton prolifer
- Archontophoenix myolensis
- Aristida granitica
- Asterolasia elegans
- Astrotricha roddii
- Atalaya collina
- Atriplex yeelirrie
- Austrostipa bronwenae
- Austrostipa wakoolica
- Baeckea kandos
- Banksia brownii
- Banksia ionthocarpa
- Banksia mimica
- Banksia montana
- Banksia pseudoplumosa
- Banksia rufa subsp. pumila
- Barbarea australis
- Bertya granitica
- Bertya ingramii
- Bertya tasmanica subsp. tasmanica
- Beyeria lepidopetala
- Blechnum norfolkianum
- Boronia capitata subsp. Capitate
- Boronia clavata
- Boronia exilis
- Boronia granitica
- Boronia repanda
- Boronia revolute
- Bossiaea peninsularis
- Bossiaea sp. Frankland
- Brachyscome muelleri
- Burmannia sp. Bathurst Island
- Caladenia amoena
- Caladenia arenaria
- Caladenia argocalla
- Caladenia atroclavia
- Caladenia audasii
- Caladenia barbarella
- Caladenia behrii
- Caladenia colorata
- Caladenia conferta
- Caladenia dienema
- Caladenia dorrienii
- Caladenia drakeoides
- Caladenia elegan
- Caladenia fulva
- Caladenia gladiolata
- Caladenia graniticola
- Caladenia granitora
- Caladenia hoffmanii
- Caladenia macroclavia
- Caladenia orientalis
- Caladenia rigida
- Caladenia robinsonii
- Caladenia tensa
- Caladenia thysanochila
- Caladenia williamsiae
- Centrolepis pedderensis
- Conospermum densiflorum subsp. unicephalatum
- Conostylis dielsii subsp. teres
- Conostylis drummondii
- Conostylis micrantha
- Coprosma baueri
- Coprosma pilosa
- Corchorus cunninghamii
- Correa eburnean
- Corunastylis brachystachya
- Craspedia preminghana
- Daphnandra johnsonii
- Darwinia acerosa
- Darwinia apiculata
- Darwinia polychroma
- Daviesia dielsii
- Daviesia euphorbioides
- Daviesia microcarpa
- Daviesia obovata
- Daviesia pseudaphylla
- Daviesia speciosa
- Decaspermum struckoilicum
- Dendrobium antennatum
- Dendrobium brachypus
- Dendrobium mirbelianum
- Dendrobium nindii
- Deyeuxia appressa
- Deyeuxia drummondii
- Dichanthium queenslandicum
- Diplazium pallidum
- Diplolaena andrewsii
- Dipodium campanulatum
- Dipodium pictum
- Diuris aequalis
- Diuris eborensis
- Diuris pedunculata
- Diuris purdiei
- Drakaea confluens
- Drakaea isolate
- Drummondita ericoides
- Elaeocarpus sedentarius
- Elaeocarpus williamsianus
- Endiandra cooperana
- Epacris barbata
- Epacris hamiltonii
- Eremochloa muricata
- Eremophila ciliata
- Eremophila denticulata subsp. trisulcata

- Eremophila glabra subsp. chlorella
- Eremophila nivea
- Eremophila pinnatifida
- Eremophila scaberula
- Eremophila subteretifolia
- Eremophila ternifolia
- Eremophila verticillata
- Eremophila viscida
- Eucalyptus alligatrix subsp. limaensis
- Eucalyptus brevipes
- Eucalyptus burdettiana
- Eucalyptus canobolensis
- Eucalyptus conglomerata
- Eucalyptus copulans
- Eucalyptus crenulata
- Eucalyptus crucis subsp. praecipua
- Eucalyptus cuprea
- Eucalyptus dolorosa
- Eucalyptus gunnii subsp. divaricata
- Eucalyptus imlayensis
- Eucalyptus impensa
- Eucalyptus insularis
- Eucalyptus largeana
- Eucalyptus leprophloia
- Eucalyptus macarthurii
- Eucalyptus morrisbyi
- Eucalyptus paludicola
- Eucalyptus pruiniramis
- Eucalyptus recta
- Eucalyptus sp. Howes Swamp Creek
- Eucalyptus x balanites
- Eucalyptus x phylacis
- Euphrasia collina subsp. muelleri
- Fimbristylis adjunct
- Frankenia conferta
- Frankenia parvula
- Frankenia plicata
- Gardenia actinocarpa
- Gastrolobium graniticum
- Gastrolobium hamulosum
- Gastrolobium humile
- Gastrolobium papilio
- Gaultheria viridicarpa
- Geniostoma huttonii
- Genoplesium baueri
- Genoplesium plumosum
- Genoplesium rhyoliticum
- Genoplesium tectum
- Gentiana baeuerlenii
- Gingidia rupicola
- Glyceria drummondii
- Goodenia arthrotricha
- Gossia gonoclada
- Grevillea acanthifolia subsp. paludosa
- Grevillea acropogon
- Grevillea althoferorum
- Grevillea batrachioides
- Grevillea beadleana
- Grevillea calliantha
- Grevillea christineae
- Grevillea corrugata
- Grevillea curviloba subsp. curviloba
- Grevillea curviloba subsp. incurva
- Grevillea dryandroides subsp. dryandroides
- Grevillea guthrieana
- Grevillea humifusa
- Grevillea iaspicula
- Grevillea infundibularis
- Grevillea maccutcheonii
- Grevillea masonii
- Grevillea maxwellii
- Grevillea mollis
- Grevillea molyneuxii
- Grevillea murex
- Grevillea obtusiflora
- Grevillea pythara
- Grevillea rara
- Habenaria maccraithii
- Hakea dohertyi
- Hakea pulvinifera
- Haloragis eyreana

Foote's Grevillea (*Grevillea calliantha*), Endangered. Photo: Jean and Fred Hort.

- Haloragodendron lucasii
- Helicteres macrothrix
- Hemiandra gardneri
- Hemiandra rutilans
- Hibbertia basaltica
- Homoranthus decumbens
- Hypocalymma angustifolium subsp. Hutt River
- Hypocalymma sp. Cascade
- Hypocalymma sylvestre
- Hypolepis distans
- Indigofera efoliata
- Irenepharsus trypherus
- Isopogon uncinatus
- Jacksonia pungens
- Jacksonia quairading
- Jacksonia velveta
- Kennedia lateritia
- Lambertia echinata subsp. echinata
- Lambertia echinata subsp. occidentalis
- Lambertia fairallii
- Lambertia orbifolia
- Lasiopetalum pterocarpum
- Lasiopetalum rotundifolium
- Lastreopsis calantha
- Lechenaultia laricina
- Leionema lachnaeoides
- Lepidium peregrinum
- Lepidosperma rostratum
- Leucochrysum albicans subsp. tricolor
- Leucopogon confertus
- Leucopogon gnaphalioides
- Leucopogon nitidus
- Leucopogon obtectus
- Leucopogon sp. Coolmunda
- Livistona mariae subsp. mariae
- Lychnothamnus barbatus
- Macadamia jansenii
- Marattia salicina (Ptisana salicina)
- Marianthus paralius
- Melaleuca sciotostyla
- Melaleuca sp. Wanneroo
- Melichrus sp. Gibberagee
- Melichrus sp. Newfoundland State Forest
- Microcarpaea agonis
- Micromyrtus grandis
- Microtis angusii
- Muehlenbeckia australis
- Muehlenbeckia tuggeranong
- Myriophyllum lapidicola
- Myrsine richmondensis
- Ochrosia moorei
- Olearia arckaringensis
- Olearia flocktoniae
- Olearia hygrophila
- Ornduffia calthifolia
- Pandanus spiralis var. flammeus
- Paracaleana dixonii
- Parsonsia dorrigoensis
- Patersonia spirifolia
- Pelargonium sp. Striatellum
- Pennantia endlicheri
- Persoonia hirsuta
- Persoonia micranthera
- Persoonia mollis subsp. maxima
- Petrophile latericola
- Phaius australis
- Phaius bernaysii
- Phalaenopsis amabilis subsp. Rosenstromii
- Pherosphaera fitzgeraldii
- Philotheca basistyla
- Philotheca freyciana
- Philotheca wonganensis
- Phlegmariurus carinatus
- Phlegmariurus dalhousieanus
- Phlegmariurus filiformis
- Phreatia paleata
- Pimelea axiflora subsp. pubescens
- Pimelea spicata
- Pimelea venosa
- Pityrodia sp. Marble Bar
- Planchonella costata
- Planchonella eerwah
- Plectranthus habrophyllus
- Plectranthus nitidus
- Plectranthus omissus
- Plectranthus torrenticola
- Plesioneuron tuberculatum
- Polyphlebium endlicherianum
- Polystichum moorei
- Pomaderris cocoparrana
- Pomaderris cotoneaster
- Prasophyllum amoenum
- Prasophyllum apoxychilum
- Prasophyllum crebriflorum
- Prasophyllum diversiflorum
- Prasophyllum goldsackii
- Prasophyllum petilum
- Prasophyllum pruinosum
- Prasophyllum secutum
- Prasophyllum suaveolens
- Prasophyllum subbisectum
- Prasophyllum tunbridgense
- Prostanthera junonis
- Pteris kingiana
- Pteris zahlbruckneriana
- Pterostylis despectans
- Pterostylis gibbosa
- Pterostylis lepida
- Pterostylis saxicola
- Pterostylis sinuata

- Pterostylis sp. Botany Bay
- Pterostylis sp. Hale
- Pultenaea elusa
- Pultenaea trichophylla
- Ranunculus prasinus
- Rhizanthella slateri
- Ricinocarpos brevis
- Ricinocarpos trichophorus
- Roycea pycnophylloides
- Sagina diemensis
- Samadera sp. Moonee Creek
- Sankowskya stipularis
- Schoenia filifolia subsp. subulifolia
- Senecio evansianus
- Solanum dissectum
- Solanum graniticum
- Solanum johnsonianum
- Solanum sulphureum
- Sphenotoma drummondii
- Spirogardnera rubescens
- Sporobolus pamelae
- Spyridium furculentum
- Spyridium lawrencei
- Stonesiella selaginoides
- Streblus pendulinus
- Stylidium asymmetricum
- Stylidium coroniforme subsp. amblyphyllum
- Stylidium coroniforme subsp. coroniforme
- Stylidium ensatum
- Symonanthus bancroftii
- Synaphea quartzitica
- Synaphea sp. Pinjarra
- Synaphea stenoloba
- Tectaria devexa
- Tetratheca deltoidea
- Tetratheca paynterae
- Thelymitra dedmaniarum
- Thelymitra epipactoides
- Thelymitra jonesii
- Thelymitra stellata
- Thomasia sp. Green Hill
- Toechima pterocarpum
- Toechima sp. East Alligator
- Trachymene scapigera
- Triplarina imbricata
- Triplarina nowraensis
- Trithuria occidentalis
- Triunia robusta
- Tylophora linearis
- Tylophora rupicola
- Tylophora woollsii
- Typhonium jonesii
- Typhonium mirabile
- Typhonium taylori
- Veronica parnkalliana
- Verticordia albida
- Verticordia densiflora var. pedunculata
- Verticordia fimbrilepis subsp. fimbrilepis
- Verticordia hughanii
- Verticordia pityrhops
- Verticordia plumosa var. vassensis
- Verticordia spicata subsp. squamosa
- Verticordia staminosa subsp. staminosa
- Verticordia staminosa var. cylindracea
- Vrydagzynea grayi
- Westringia kydrensis
- Wurmbea tubulosa
- Xanthorrhoea bracteata
- Xanthostemon formosus
- Xerothamnella herbacea
- Xylopia monosperma

Tarengo Leek Orchid (*Prasophyllum petilum*), Endangered, Australian Capital Territory. Photo: Tobias Hayashi, CC BY 3.0.

- Xylosma parvifolia
- Zehneria baueriana
- Zieria adenophora
- Zieria baeuerlenii
- Zieria bifida
- Zieria covenyi
- Zieria floydii
- Zieria granulata
- Zieria lasiocaulis
- Zieria prostrata

120.3 **vulnerable species (s 18(4));**

- Acacia ammophila
- Acacia anomala
- Acacia aphylla
- Acacia araneosa
- Acacia awestoniana
- Acacia axillaris
- Acacia bynoeana
- Acacia caerulescens
- Acacia carneorum
- Acacia constablei
- Acacia courtii
- Acacia crombiei
- Acacia curranii
- Acacia dangarensis
- Acacia denticulosa
- Acacia depressa
- Acacia deuteroneura
- Acacia eremophiloides
- Acacia flocktoniae
- Acacia forrestiana
- Acacia georgensis
- Acacia glandulicarpa
- Acacia grandifolia
- Acacia handonis
- Acacia lauta
- Acacia macnuttiana
- Acacia menzelii
- Acacia phasmoides
- Acacia praemorsa
- Acacia praetermissa
- Acacia pubescens
- Acacia pubifolia
- Acacia pycnostachya
- Acacia rhetinocarpa
- Acriopsis emarginata
- Acrophyllum australe
- Actephila foetida
- Adenanthos ellipticus
- Adenanthos pungens subsp. pungens
- Allocasuarina fibrosa
- Allocasuarina simulans
- Allocasuarina tortiramula
- Alloxylon flammeum
- Almaleea cambagei
- Ammobium craspedioides
- Amphibromus fluitans
- Andersonia pinaster
- Androcalva procumbens
- Angophora inopina
- Angophora robur
- Anigozanthos viridis subsp. terraspectans
- Anthocercis gracilis
- Apatophyllum olsenii
- Apium prostratum subsp. Porongurup Range
- Archidendron lovelliae
- Argyrotegium nitidulum
- Aristida annua
- Arthraxon hispidus
- Asperula asthenes
- Asplenium pellucidum
- Asplenium wildii
- Asterolasia nivea
- Asterolasia phebalioides
- Astrotricha crassifolia
- Atriplex infrequens
- Austrostipa metatoris
- Baloghia marmorata
- Baloskion longipes
- Banksia catoglypta
- Banksia goodii
- Banksia serratuloides subsp. serratuloides
- Banksia sphaerocarpa var. dolichostyla
- Banksia squarrosa subsp. argillacea
- Banksia verticillata
- Bertya calycina
- Bertya ernestiana
- Bertya opponens
- Bertya pinifolia
- Boronia adamsiana
- Boronia deanei
- Boronia galbraithiae
- Boronia gunnii
- Boronia hemichiton
- Boronia hippopala
- Boronia keysii
- Boronia umbellata
- Bosistoa transversa
- Bossiaea oligosperma
- Bothriochloa bunyensis
- Brachyscome papillosa
- Breynia macrantha
- Budawangia gnidioides (Epacris gnidioides)
- Bulbophyllum globuliforme
- Bulbophyllum gracillimum
- Bulbophyllum longiflorum
- Cadellia pentastylis
- Caladenia brumalis
- Caladenia bryceana subsp. cracens
- Caladenia christineae

- Caladenia concolor
- Caladenia Formosa
- Caladenia harringtoniae
- Caladenia ornate
- Caladenia versicolor
- Caladenia wanosa
- Caladenia woolcockiorum
- Calectasia pignattiana
- Callistemon kenmorrisonii
- Callistemon pungens
- Callitris oblonga
- Calophyllum bicolor
- Calotis glandulosa
- Calytrix gurulmundensis
- Canarium acutifolium
- Capparis thozetiana
- Cassinia rugata
- Cepobaculum carronii
- Chamelaucium sp. Cataby
- Chamelaucium sp. S coastal plain
- Clematis fawcettii
- Codonocarpus pyramidalis
- Colobanthus curtisiae
- Comesperma oblongatum
- Conospermum hookeri
- Coopernookia scabridiuscula
- Corokia whiteana
- Correa baeuerlenii
- Correa calycina
- Corybas dentatus
- Corybas montanus
- Corymbia clandestina
- Corymbia leptoloma
- Corymbia rhodops
- Corymbia xanthope
- Corynocarpus rupestris subsp. rupestris
- Cryptocarya foetida
- Cryptostylis hunteriana
- Ctenopterella blechnoides
- Cupaniopsis shirleyana
- Cupaniopsis tomentella
- Cycas cairnsiana
- Cycas platyphylla
- Cycas silvestris
- Cyclophyllum costatum
- Cyperus semifertilis
- Darwinia biflora
- Darwinia masonii
- Darwinia meeboldii
- Darwinia nubigena
- Darwinia squarrosa
- Daviesia discolor
- Daviesia elongata subsp. elongata
- Daviesia laevis
- Dendrobium bigibbum
- Dendrobium johannis
- Denhamia parvifolia
- Desmodium acanthocladum
- Deyeuxia pungens
- Deyeuxia pungens
- Dischidia litoralis
- Diuris drummondii
- Diuris micrantha
- Diuris ochroma
- Diuris praecox
- Diuris venosa
- Dodonaea rupicola
- Drakaea concolor
- Drakaea micrantha
- Drosera prolifera
- Drosera schizandra
- Drummondita longifolia
- Eleocharis keigheryi
- Eleocharis obicis
- Eleocharis papillosa
- Eleocharis retroflexa
- Endiandra hayesii
- Epacris sparsa
- Epilobium brunnescens subsp. beaugleholei
- Eremophila denticulata subsp. denticulata
- Eremophila prostrata

Leafless Rock Wattle (*Acacia aphylla*), Vulnerable. Photo: Danielle Langlois, CC BY 2.0.

- Eremophila rostrata
- Eremophila vernicosa
- Eucalyptus aggregata
- Eucalyptus alligatrix subsp. miscella
- Eucalyptus aquatica
- Eucalyptus argophloia
- Eucalyptus argutifolia
- Eucalyptus articulata
- Eucalyptus beaniana
- Eucalyptus benthamii
- Eucalyptus cadens
- Eucalyptus caleyi subsp. ovendenii
- Eucalyptus camfieldii
- Eucalyptus ceracea
- Eucalyptus coronata
- Eucalyptus crispata
- Eucalyptus crucis subsp. crucis
- Eucalyptus glaucina
- Eucalyptus hallii
- Eucalyptus infera
- Eucalyptus johnsoniana
- Eucalyptus kabiana
- Eucalyptus kartzoffiana
- Eucalyptus langleyi
- Eucalyptus lateritica
- Eucalyptus mckieana
- Eucalyptus merrickiae
- Eucalyptus mooreana
- Eucalyptus nicholii
- Eucalyptus paedoglauca
- Eucalyptus parramattensis subsp. decadens
- Eucalyptus parvula
- Eucalyptus platydisca
- Eucalyptus pulverulenta
- Eucalyptus pumila
- Eucalyptus raveretiana
- Eucalyptus rhodantha
- Eucalyptus robertsonii subsp. hemisphaerica
- Eucalyptus rubida subsp. barbigerorum
- Eucalyptus scoparia
- Eucalyptus steedmanii
- Eucalyptus strzeleckii
- Eucalyptus suberea
- Eucalyptus synandra
- Eucalyptus tetrapleura
- Eucalyptus virens
- Eucryphia wilkiei
- Euphorbia carissoides
- Euphrasia bella
- Euphrasia bowdeniae
- Euphrasia crassiuscula subsp. glandulifera
- Euphrasia eichleri
- Floydia praealta
- Fontainea australis
- Fontainea rostrata
- Fontainea venosa
- Gardenia psidioides
- Gastrolobium appressum
- Gastrolobium lehmannii
- Gastrolobium modestum
- Genoplesium vernale
- Gentiana wissmannii
- Germainia capitata
- Goodenia integerrima
- Goodenia quadrifida
- Graptophyllum ilicifolium
- Grevillea banyabba
- Grevillea bedggoodiana
- Grevillea brachystylis subsp. australis
- Grevillea celata
- Grevillea elongata
- Grevillea evansiana
- Grevillea flexuosa
- Grevillea floripendula
- Grevillea glossadenia
- Grevillea infecunda
- Grevillea kennedyana
- Grevillea montis-cole subsp. brevistyla
- Grevillea parviflora subsp. parviflora
- Grevillea quadricauda
- Grevillea raybrownii
- Grevillea rhizomatosa
- Grevillea shiressii
- Grevillea treueriana
- Hakea aculeata
- Hakea archaeoides
- Hakea fraseri
- Hakea maconochieana
- Hakea megalosperma
- Hakea trineura
- Haloragis exalata subsp. exalata
- Haloragis exalata subsp. velutina
- Helichrysum calvertianum
- Hensmania chapmanii
- Hexaspora pubescens
- Hibbertia crispula
- Hibbertia humifusa subsp. debilis
- Hibbertia humifusa subsp. erigens
- Hibbertia marginata
- Hibiscus brennanii
- Hibiscus cravenii
- Hicksbeachia pinnatifolia
- Homopholis belsonii
- Homoranthus darwinioides
- Homoranthus lunatus
- Homoranthus montanus
- Homoranthus porteri

- Homoranthus prolixus
- Hoya australis subsp. oramicola
- Hydriastele costata
- Hypocalymma longifolium
- Isopogon fletcheri
- Kardomia granitica
- Kelleria bogongensis
- Kennedia glabrata
- Kennedia retrorsa
- Kunzea cambagei
- Kunzea ericifolia subsp. Subulata
- Lasiopetalum joyceae
- Lasiopetalum longistamineum
- Lastreopsis walleri
- Lawrencia buchananensis
- Lechenaultia chlorantha
- Leiocarpa gatesii
- Leionema obtusifolium
- Leionema ralstonii
- Leionema sympetalum
- Lepidium pseudopapillosum
- Leptomeria dielsiana
- Leptospermum deanei
- Leptospermum thompsonii
- Leucopogon exolasius
- Leucopogon sp. Ongerup
- Limonium australe var. baudinii
- Limosella granitica
- Lindsaea pulchella var. blanda
- Livistona lanuginosa
- Lobelia gelida
- Logania diffusa
- Macadamia integrifolia
- Macadamia ternifolia
- Macadamia tetraphylla
- Macropteranthes montana
- Macrozamia conferta
- Macrozamia machinii
- Macrozamia occidua
- Macrozamia parcifolia
- Marsdenia brevifolia
- Marsdenia longiloba
- Marsdenia paludicola
- Medicosma elliptica
- Medicosma obovata
- Melaleuca biconvexa
- Melaleuca deanei
- Melaleuca kunzeoides
- Microcorys eremophiloides
- Microlepidium alatum
- Micromyrtus blakelyi
- Micromyrtus minutiflora
- Microtis globula
- Mitrella tiwiensis
- Myoporum cordifolium
- Myriophyllum coronatum
- Myriophyllum porcatum
- Myrmecodia beccarii
- Neisosperma kilneri
- Nematolepis frondosa
- Nematolepis rhytidophylla
- Nematolepis squamea subsp. coriacea
- Nematolepis wilsonii
- Neoastelia spectabilis
- Neoroepera buxifolia
- Newcastelia velutina
- Notelaea lloydii
- Olax angulata
- Olearia astroloba
- Olearia cordata
- Olearia pannosa subsp. pannosa
- Omphalea celata
- Oreogrammitis reinwardtii
- Owenia cepiodora
- Ozothamnus eriocephalus
- Ozothamnus reflexifolius
- Ozothamnus tesselatus
- Ozothamnus vagans
- Parsonsia larcomensis
- Paspalidium grandispiculatum

Biconvex Paperbark (*Melaleuca biconvexa*), Vulnerable.
Photo: Geoff Derrin, CC BY 4.0.

- Persicaria elatior
- Persoonia acerosa
- Persoonia bargoensis
- Persoonia glaucescens
- Persoonia marginata
- Persoonia mollis subsp. revoluta
- Petrophile nivea
- Phaius pictus
- Phaleria biflora
- Phebalium glandulosum subsp. eglandulosum
- Phebalium whitei
- Philotheca papillata
- Phlegmariurus lockyeri
- Phlegmariurus marsupiiformis
- Phlegmariurus tetrastichoides
- Phyllota humifusa
- Picris evae
- Pimelea curviflora var. curviflora
- Pimelea leptospermoides
- Pimelea pagophila
- Pityrodia augustensis
- Plectranthus gratus
- Plectranthus leiperi
- Pleuropappus phyllocalymmeus
- Poa sallacustris
- Polianthion minutiflorum
- Polyscias bellendenkerensis
- Pomaderris gilmourii var. cana
- Pomaderris pallida
- Pomaderris parrisiae
- Pomaderris pilifera subsp. talpicutica
- Pomaderris sericea
- Pomaderris subplicata
- Poranthera petalifera
- Prasophyllum colemaniae
- Prasophyllum fuscum
- Prasophyllum morganii
- Prasophyllum pallidum
- Prasophyllum wallum
- Prostanthera calycina
- Prostanthera cineolifera
- Prostanthera cryptandroides subsp. cryptandroides
- Prostanthera densa
- Prostanthera discolor
- Prostanthera galbraithiae
- Prostanthera nudula
- Prostanthera schultzii
- Prostanthera sp. Dunmore
- Prostanthera spathulata
- Prostanthera stricta
- Pseudocephalozia paludicola
- Pterostylis arenicola
- Pterostylis bicornis
- Pterostylis cucullata
- Pterostylis mirabilis
- Pterostylis pratensis
- Pterostylis pulchella
- Pterostylis ziegeleri
- Ptychosema pusillum
- Pultenaea aristata
- Pultenaea baeuerlenii
- Pultenaea glabra
- Pultenaea parrisiae
- Pultenaea parviflora
- Pultenaea pauciflora
- Pultenaea setulosa
- Pultenaea williamsoniana
- Ranunculus anemoneus
- Rhagodia acicularis
- Rhaphidospora bonneyana
- Rhaponticum australe
- Rhinerrhizopsis matutina
- Ristantia gouldii
- Romnalda strobilacea
- Rutidosis heterogama
- Rutidosis leiolepis
- Rytidosperma pumilum
- Samadera bidwillii
- Sannantha crenulata
- Sannantha tozerensis
- Sarcochilus fitzgeraldii
- Sarcochilus hartmannii

Nodding Rufoushood (*Pterostylis mirabilis*), Vulnerable.
Photo: Peter Wilkins, CC BY 3.0.

- Sarcochilus hirticalcar
- Sarcochilus weinthalii
- Sclerolaena blakei
- Sclerolaena walkeri
- Selaginella andrewsii
- Senecio megaglossus
- Senecio psilocarpus
- Solanum dunalianum
- Solanum karsense
- Sophora fraseri
- Spyridium coactilifolium
- Stachystemon nematophorus
- Stackhousia annua
- Stenanthemum pimeleoides
- Stylidium galioides
- Styphelia perileuca
- Swainsona murrayana
- Symplocos baeuerlenii
- Syzygium hodgkinsoniae
- Syzygium moorei
- Syzygium velarum
- Tasmannia glaucifolia
- Tecticornia bulbosa
- Tephrosia leveillei
- Tetraria australiensis
- Tetratheca aphylla
- Tetratheca harperi
- Tetratheca juncea
- Thelymitra mackibbinii
- Thelymitra matthewsii
- Thelymitra psammophila
- Thesium australe
- Thomasia glabripetala
- Thomasia montana
- Thryptomene wittweri
- Tomophyllum walleri
- Tribonanthes purpurea
- Trichanthodium baracchianum
- Triplarina nitchaga
- Tropilis callitrophilis
- Vanda hindsii
- Vappodes phalaenopsis
- Velleia perfoliata
- Veronica ciliolata
- Verticordia carinata
- Verticordia crebra
- Verticordia fimbrilepis subsp. australis
- Verticordia helichrysantha
- Westringia cremnophila
- Westringia davidii
- Westringia parvifolia
- Westringia rupicola
- Xanthorrhoea arenaria
- Xanthostemon oppositifolius
- Xerochrysum palustre
- Xerothamnella parvifolia
- Xyris exilis
- Zeuxine polygonoides
- Zieria citriodora
- Zieria collina
- Zieria murphyi
- Zieria obovata
- Zieria rimulosa
- Zieria tuberculata
- Zieria verrucosa

Waxy Sarcochilus (*Sarcochilus hartmannii*), Vulnerable.
Photo: cskk, CC BY 3.0.

121. As for the threatened fauna species, when the spreadsheets referred to immediately above are considered, the only inference from the source documents is that climate change is likely to impact the flora species where, in the summary spreadsheet, a "1" appears in any of the following columns: "climate_direct", "climate_implied", "climate_implied_not_direct", "fire", "fire_not_climate", "iucn_climate" or "iucn_fire". To illustrate this, we consider the Macquarie Cushions (*Azorella macquariensis*), Maxwell's Grevillea (*Grevillea maxwelli*) and the Sparse Heath (*Epacris sparsa*), as examples of species listed as threatened in the critically endangered (EPBC Act, s 18(2)), endangered (EPBC Act, s 18(3)) and vulnerable (EPBC Act, s 18(4)) categories. A similar analysis can be undertaken for each of the remaining species for which spreadsheets have been provided with this request. The purpose of the examples is to illustrate what the above steps demonstrate are irresistible inferences to be drawn from the source documents; they do not add to the information in the source documents in any way. If the Minister considers that the relevant inferences may not be available in respect of any of the other species, then the Minister would need to be satisfied for themselves the information set out in the tables produced by the steps does not support those inferences.

122. As to the Macquarie Cushions (*Azorella macquariensis*) — which is listed as critically endangered — the relevant Impact Data Table (see **Annexure 2.1.B.a**) contains a "1" in the "climate_direct" and "climate_implied" columns and the Conservation Advice includes climate change in the "Threats" section.[178]

123. As to Maxwell's Grevillea (*Grevillea maxwelli*) — which is listed as endangered — the relevant Impact Data Table (see **Annexure 2.1.B.a**) contains a "1" in the "fire", "fire_not_climate", "iucn_climate" and "iucn_fire" columns. The IUCN Red List indicates that both climate change (Threat 11) and Fire (Threat 7.1) are threats to the species. The Conservation Advice for the species identifies drought and fire as key threats to the species.[179] Drought reduces flowering, seed set, population recruitment and increases mortality, whereas too frequent fire would deplete the soil seed bank.[180]

124. As to the Sparse Heath (*Epacris sparsa*) — which is listed as vulnerable — the relevant summary table (see **Annexure 2.1.B.a**) contains a "1" in the "climate_direct", "climate_implied" and "fire" columns. The Conservation Advice for the species identifies both climate change and fire as threats to the species.[181]

Macquarie Cushions (*Azorella macquariensis*), Critically Endangered. Photo: Jane Gosden, CC BY 3.0.

Maxwell's Grevillea (*Grevillea maxwelli*). Endangered.

Sparse Heath (*Epacris sparsa*), Vulnerable. Photo: Allthingsnative, CC BY 4.0.

E.10 Summary of impacts on ecological communities

125. As at 31 March 2022, Australia had 91 listed threatened ecological communities declared under s 181 of the EPBC Act,[182] excluding the ecologicial communities in the 'vulnerable' category.[183] The data collation process described in Part E.2 reviewed documents relating to 77 of those listed threatened communities, of which 74 were identified as likely to be impacted by climate change.[184] Spreadsheets have been provided for the following listed threatened ecological communities, listed by reference to the subsections of s 18 that apply to them:

Blue Gum High Forest, Sydney Basin Bioregion, New South Wales.

125.1 **critically endangered communities (s 18(5)):**

- Blue Gum High Forest of the Sydney Basin Bioregion
- Central Hunter Valley eucalypt forest and woodland ecological community
- Clay Pans of the Swan Coastal Plain
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
- Coolibah-Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions ecological community
- Cumberland Plain Shale Woodlands and Shale- Gravel Transition Forest ecological community
- Drooping sheoak grassy woodland on calcrete of the Eyre Yorke Block Bioregion
- Eastern Suburbs Banksia Scrub of the Sydney Region
- Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion
- Eucalypt Woodlands of the Western Australian Wheatbelt
- Gippsland Red Gum (Eucalyptus tereticornis subsp. mediana) Grassy
- Grassy Eucalypt Woodland of the Victorian Volcanic Plain
- Hunter Valley Weeping Myall (Acacia pendula) Woodland
- Illawarra- Shoalhaven subtropical rainforest of the Sydney Basin Bioregion
- Illawarra and south coast lowland forest and woodland ecological community
- Iron-grass Natural Temperate Grassland of South Australia
- Kangaroo Island Narrow-leaved Mallee (Eucalyptus cneorifolia) Woodland
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community
- Lowland Grassy Woodland in the South East Corner Bioregion
- Lowland Native Grasslands of Tasmania ecological community
- Lowland Rainforest of Subtropical Australia
- Natural Damp Grassland of the Victorian Coastal Plains
- Natural Grasslands of the Murray Valley Plains ecological community
- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland
- Natural Temperate Grassland of the South Eastern Highlands
- Natural Temperate Grassland of the Victorian Volcanic Plain
- New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands
- Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia
- Plains mallee box woodlands of the Murray Darling Depression Riverina and Naracoorte Coastal Plain Bioregions
- River-flat eucalypt forest on coastal floodplains of southern New South
- Robertson Rainforest in the Sydney Basin Bioregion
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion
- Southern Highlands Shale Forest and Woodland of the Sydney Basin Bioregion

- Swamp Tea-tree (Melaleuca irybana) Forest of South-east Queensland
- Swamps of the Fleurieu Peninsula ecological community
- Tasmanian Forests and Woodlands Dominated by Black Gum or Brookers
- Tasmanian white gum (Eucalyptus viminalis) wet forest
- Thrombolite (microbialite) Community of a Coastal Brackish Lake (Lake Clifton)
- Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community
- Turpentine-Ironbark Forest in the Sydney Basin Bioregion
- Warkworth Sands Woodland of the Hunter Valley ecological community
- Western Sydney Dry Rainforest and Moist Woodland on Shale

125.2 **endangered communities (s 18(6)):**

- Alpine Sphagnum Bogs and Associated Fens ecological community
- Aquatic Root Mat Community in Caves of the Swan Coastal Plain
- Arnhem Plateau Sandstone Shrubland Complex ecological community
- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community
- Banksia Woodlands of the Swan Coastal Plain ecological community
- Brigalow (Acacia harpophylla dominant and co-dominant) ecological community
- Broad Leaf Tea-tree (Melaleuca viridiflora) Woodlands in High Rainfall Coastal North Queensland
- Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
- Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community
- Coastal Swamp Sclerophyll Forest of New South Wales and South-eastern Australia
- Coastal Upland Swamps in the Sydney Basin Bioregion
- Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain
- Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain
- Eastern Stirling Range Montane Heath and Thicket
- Eyre Peninsula Blue Gum (Eucalyptus petiolaris) Woodland
- Giant Kelp Marine Forests of South East Australia
- Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-east Australia
- Karst springs and associated alkaline fens of the Naracoorte Coastal Plain Bioregion
- Lowland tropical rainforest of the Wet Tropics
- Mallee Bird Community of the Murray Darling Depression Bioregion
- Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula
- Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin
- Perched wetlands of the Wheatbelt region with extensive stands of living sheoak and paperbark across the lake floor (Toolibin Lake)
- Poplar Box Grassy Woodland on Alluvial Plains
- Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion ecological community
- Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia
- Scott River Ironstone Association
- Shrublands and Woodlands of the eastern Swan Coastal Plain
- Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain
- Temperate Highland Peat Swamps on Sandstone
- Thrombolite (microbial) community of coastal freshwater lakes of the Swan Coastal Plain (Lake Richmond)
- Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion ecological community
- Upland Wetlands of New England Tablelands and Monaro Plateau
- Weeping Myall Woodlands ecological community

Coastal Swamp Sclerophyll Forest of New South Wales and South-eastern Australia.

126. As for the listed threatened species, when the spreadsheets for the listed threatened ecological communities are considered, the only inference from the source documents is that climate change is likely to impact the communities where, in the summary spreadsheet, a "1" appears in any of the following columns: "climate_direct", "climate_implied", "climate_implied_not_direct", "fire", "fire_not_climate", "iucn_climate" or "iucn_fire". To illustrate this, we consider the Eastern Suburbs Banksia Scrub of the Sydney Region and the Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland, as examples of listed threatened ecological communities in the critically endangered (EPBC Act, s 18(5)) and endangered (s 18(6)) categories. A similar analysis can be undertaken for each of the remaining communities for which spreadsheets have been provided with this request. The purpose of the examples is to illustrate what the above steps demonstrate are irresistible inferences to be drawn from the source documents; they do not add to the information in the source documents in any way. If the Minister considers that the relevant inferences may not be available in respect of any of the other communities, then the Minister would need to be satisfied for themselves that the information set out in the tables produced by the steps does not support those inferences.

127. As to the Eastern Suburbs Banksia Scrub of the Sydney Region — which is listed as critically endangered — the relevant summary table (see **Annexure 2.1.B.b**) contains a "1" in the "climate_direct", "climate_implied" and "fire" columns. The Conservation Advice for the community relevantly indicates the following:

127.1 Climate change and severe weather are a threat to the community, with the community considered to be particularly vulnerable to climate change.[185] Climate change projections for the region include higher average and maximum temperatures, substantially declining rainfall, particularly in the cooler months, as well as more compound extreme events such as drought, heat waves and an increase in days of dangerous fire weather.[186] As climate change shifts rainfall and temperature conditions, patches of the ecological community are likely to undergo changes in their species composition.[187]

127.2 Unsuitable fire regimes are also a threat to the community and are increased by climate change.[188] Climate change is likely to substantially increase weather conditions associated with substantial wildfires and exacerbate fire impacts, causing losses of large areas of native vegetation and fauna.[189]

128. As to the Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland — which is listed as endangered — the relevant summary table (see **Annexure 2.1.B.b**) contains a "1" in the "climate_direct", "climate_implied" and "fire" columns. The Conservation Advice for the community relevantly indicates the following:

128.1 Climate change is a significant threat to the community, and its impacts are likely to be played out in the community through interactions with other threatening processes, resulting in:[190]

(a) habitat loss and degradation;

(b) the projected hotter, drier, windier conditions associated with climate change extending the period of fuel drying and increasing rates of fire spread, which, together with more drought and/or hydrological changes, are likely to increase the impacts of fire;

(c) likely significant reduction in freshwater run-off to coastal rivers and streams within the range of the ecological community and less water available for the community, either through decreased flows and/or evaporative loss;

(d) intensified drought events, which increases the potential for water being diverted away from the community for consumptive use in response to water sharing arrangements;

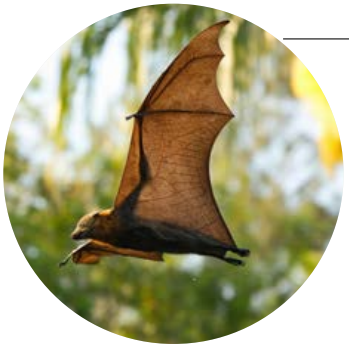
(e) major flooding events being more likely, which can be damaging to many florae and fauna of the community;

(f) freshwater areas that support the ecological community becoming more salinized as a result of sea level rise, which could lead to a change in the vegetation structure of affected areas;

(g) heat waves affecting functionally important fauna species of the community, such as seed and pollen dispersers like the Little Red Flying-fox and Grey-headed Flying-fox, which can suffer heat stress and lead to multiple deaths within a colony when temperatures exceed 42°; and

(h) increased impacts from invasive weeds and fauna, such as by allowing cane toads to spread further south.

129. Impacts caused by other threats to the community are likely to be exacerbated by climate change.[191]



Grey-headed Flying-fox (*Pteropus poliocephalus*), Vulnerable.
Photo: Andrew Mercer [CC BY 4.0]

E.11 Summary of impacts on listed migratory species (protected under international agreements)

130. As at February 2022, Australia had 165 migratory species listed on the migratory species list under s 209 of the EPBC Act.[192] The data collation process described in Part E.2 reviewed documents relating to 154 migratory species, 133 of which were identified as likely to be impacted by climate change.[193] Spreadsheets have been provided for the following listed migratory species:

- Acrocephalus orientalis
- Actitis hypoleucos
- Anous stolidus
- Anoxypristis cuspidata
- Apus pacificus
- Ardenna carneipes
- Ardenna grisea
- Ardenna pacifica
- Ardenna tenuirostris
- Arenaria interpres
- Balaenoptera bonaerensis
- Balaenoptera borealis
- Balaenoptera edeni
- Balaenoptera musculus
- Balaenoptera physalus
- Bulweria bulwerii
- Calidris acuminata
- Calidris alba
- Calidris canutus
- Calidris ferruginea
- Calidris melanotos
- Calidris ruficollis
- Calidris subminuta
- Calidris tenuirostris
- Calonectris leucomelas
- Caperea marginata
- Carcharhinus falciformis
- Carcharhinus longimanus
- Carcharodon carcharias
- Caretta caretta
- Cecropis daurica
- Cetorhinus maximus
- Charadrius bicinctus
- Charadrius dubius
- Charadrius leschenaultii
- Charadrius mongolus
- Charadrius veredus
- Chelonia mydas
- Chlidonias leucopterus
- Crocodylus porosus
- Cuculus optatus
- Dermochelys coriacea
- Diomedea amsterdamensis
- Diomedea antipodensis
- Diomedea dabbenena
- Diomedea epomophora
- Diomedea exulans
- Diomedea sanfordi
- Dugong Dugon
- Eretmochelys imbricata
- Eubalaena australis
- Fregata andrewsi
- Fregata ariel
- Fregata minor
- Gallinago hardwickii
- Gallinago megala
- Gallinago stenura
- Gelochelidon nilotica
- Glareola maldivarum
- Hirundapus caudacutus
- Hirundo rustica
- Hydrobates matsudairae
- Hydrobates monorhis
- Hydroprogne caspia
- Isurus oxyrinchus
- Isurus paucus
- Lagenodelphis hosei
- Lagenorhynchus obscurus
- Lamna nasus
- Lepidochelys olivacea
- Limicola falcinellus
- Limnodromus semipalmatus
- Limosa lapponica
- Limosa limosa
- Macronectes giganteus
- Macronectes halli
- Megaptera novaeangliae
- Mobula alfredi
- Mobula birostris
- Mobula eregoodoo
- Mobula mobular
- Mobula thurstoni
- Monarcha frater
- Monarcha melanopsis
- Motacilla cinerea
- Motacilla flava
- Myiagra cyanoleuca
- Natator depressus
- Numenius madagascariensis
- Numenius minutus
- Numenius phaeopus
- Oceanites oceanicus
- Onychoprion anaethetus
- Orcaella heinsohni
- Orcinus orca
- Pandion haliaetus

- Phaethon lepturus
- Phaethon rubricauda
- Phalaropus lobatus
- Philomachus pugnax
- Phocoena dioptrica
- Phoebastria immutabilis
- Phoebetria fusca
- Phoebetria palpebrata
- Physeter macrocephalus
- Plegadis falcinellus
- Pluvialis fulva
- Pluvialis squatarola
- Pristis clavata
- Pristis pristis
- Pristis zijsron
- Procellaria aequinoctialis
- Procellaria cinerea
- Procellaria conspicillata
- Procellaria parkinsoni
- Procellaria westlandica
- Rhincodon typus
- Rhipidura rufifrons
- Sousa sahulensis
- Spatula querquedula
- Stenella attenuata
- Stenella longirostris
- Stercorarius longicaudus
- Stercorarius maccormicki
- Stercorarius parasiticus
- Stercorarius pomarinus
- Sterna dougallii
- Sterna hirundo
- Sterna paradisaea
- Sterna sumatrana
- Sternula albifrons
- Sula dactylatra
- Sula leucogaster
- Sula sula
- Symposiachrus trivirgatus
- Thalassarche bulleri
- Thalassarche carteri
- Thalassarche cauta
- Thalassarche chlororhynchos
- Thalassarche chrysostoma
- Thalassarche eremita
- Thalassarche impavida
- Thalassarche melanophris
- Thalassarche salvini
- Thalassarche steadi
- Thalasseus bergii
- Tringa brevipes
- Tringa glareola
- Tringa incana
- Tringa nebularia
- Tringa stagnatilis
- Tringa totanus
- Tursiops aduncus
- Xenus cinereus

Whale Shark (*Rhincodon typus*), Endangered.

131. As for species and communities considered above, when the spreadsheets for the listed migratory species are considered, the only inference from the source documents is that climate change is likely to impact the species where, in the summary spreadsheet, a "1" appears in any of the following columns: "climate_direct", "climate_implied", "climate_implied_not_direct", "fire", "fire_not_climate", "iucn_climate" or "iucn_fire". To illustrate this, we consider the Leatherback Turtle (*Dermochelys coiacea*). A similar analysis can be undertaken for each of the remaining migratory species for which spreadsheets have been provided with this request. The purpose of the example is to illustrate what the above steps demonstrate are irresistible inferences to be drawn from the source documents; it does not add to the information in the source documents in any way. If the Minister considers that the relevant inferences may not be available in respect of any of the other migratory species, then the Minister would need to be satisfied for themselves that the information set out in the tables produced by the steps does not support those inferences.

Leatherback Turtles (*Dermochelys coriacea*), Endangered.

132. The relevant summary table for the Leatherback Turtle (*Dermochelys coiacea*) (see **Annexure 2.1.B.c**) contains a "1" in the "climate_direct", "iucn_flag" and "iucn_climate" columns. The IUCN Red List indicates that climate change (Threat 11) is a threat to the species. The Conservation Advice for this species relevantly indicates that possible impacts from climate change are likely to exacerbate current threats to the species, including as a result of increased air temperatures (above 30°C), which are likely to affect embryo development and sea level rise, which will impact nesting beach stability and foraging ground distribution.[194]

Eastern curlew (*Numenius madagascariensis*). Endangered. Migratory species.

E.12 Summary of impacts on Commonwealth marine areas

133. Commonwealth marine areas are divided into six marine park networks — the North, North-west, South-west, South-east, Temperate East and Coral Sea networks. Spreadsheets have been provided for five of these networks. Each spreadsheet contains a "climate_direct" sheet, a "climate_implied" sheet, and a "climate fire" sheet and are contained at **Annexure 2.1.B.g**. Consideration of each of these spreadsheets shows that climate change has been identified as an impact on each of these five marine park networks.[195]

Coral near Lizard Island, Great Barrier Reef Marine Park, Queensland.

134. Taking the Temperature East Marine Region spreadsheet as an example, it shows that:

134.1 The Marine Bioregional Plan for the Temperate East Marine Region identifies climate change and associated large-scale effects (including shifts in major currents, rising sea levels, ocean acidification, and changes in the variability and extremes of climatic features such as sea temperature, winds, storm frequency and intensity) as a main driver and source of pressure on conservation values in the region.[196] These conservation values include various marine species (such as inshore dolphins, marine turtles, sharks and seabirds) as well as natural marine features (such as reefs, canyons and seamount chains).[197] Changes in sea temperature and ocean acidification as a result of climate change have been identified as pressures *of concern* to the Elizabeth and Middleton reefs.[198]

134.2 The Commonwealth Marine Environment Report Card for the Temperate East Marine Region notes:

(a) Sea level rise as a result of climate change has been rated *of potential concern* for Elizabeth and Middleton reefs: a sudden increase in sea level may change coral assemblages by altering light levels required for coral growth, particularly if the rise is associated with increased turbidity due to wave-induced erosion or deposition from increased storm frequency; consequently, rising sea levels may impact on shallow reef systems and the species that depend on them, such as seabirds and turtles that forage in these areas.[199]

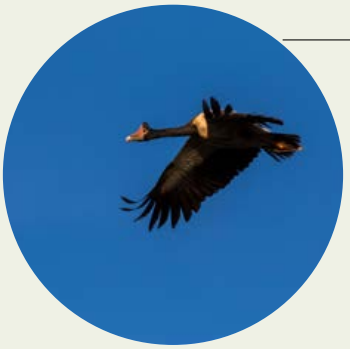
(b) Changing sea temperature is *of concern* for Elizabeth and Middleton reefs, and *of potential concern* to the remaining seven key ecological features of the region.[200] Key ecological features that support important aggregations of marine life and biodiversity at or near the sea surface are vulnerable to rising sea temperatures; for example, there are predictions of coral bleaching and large-scale mortality; changes in the distribution of pelagic fish, with species moving further south; and altered breeding success among seabirds.[201]

(c) Ocean acidification is *of concern* for Elizabeth and Middleton reefs, and *of potential concern* to the Tasmantid and Lord Howe seamount chains, Norfolk Ridge and the shelf rocky reefs.[202] Direct impacts of ocean acidification are expected to be most marked for organisms with calcareous skeletons, such as corals, plankton, molluscs and echinoderms. Increasing acidity reduces the ability of these organisms to form skeletal structures, which is likely to affect not only their ability to function within the ecosystem, but also the workings of the ecosystem itself. For Elizabeth and Middleton reefs, as well as the northern subtropical regions of the Tasmantid and Lord Howe seamount chains, it is likely that increased ocean acidity will reduce coral growth rates and resilience, making the reef systems more susceptible to erosion and disturbance from storms. Corals provide structural habitat complexity for a range of invertebrates and fish. Any impact on coral reef habitat is therefore likely to change the distribution and abundance of species that depend on them for food and shelter.[203]

Elizabeth and Middleton Reefs, Lord Howe Marine Park, IUCN protected area and Ramsar Wetland.

135. Further, under the EPBC Act, "environment" is defined to include ecosystems and their constituent parts.[204] This would include listed marine species under Chapter 5, Part 13, Division 4 of the EPBC Act: those are species for which the Minister is satisfied that listing is necessary to ensure the long-term conservation of the species, *and* the species occurs naturally in a Commonwealth marine area.[205] Therefore, an impact on a listed marine species will necessarily be an impact on the environment of a Commonwealth marine area. We have therefore also included the spreadsheets of data concerning listed marine species as set out above at [44.7].[206] The listed marine species covered by these spreadsheets are:

- Acalyptophis peronii
- Accipiter fasciatus
- Acentronura australe
- Acentronura larsonae
- Acentronura tentaculata
- Acrocephalus orientalis
- Acrocephalus stentoreus
- Actitis hypoleucos
- Aipysurus apraefrontalis
- Aipysurus duboisii
- Aipysurus eydouxii
- Aipysurus foliosquama
- Aipysurus fuscus
- Aipysurus laevis
- Amaurornis olivacea
- Anas acuta
- Anous minutus
- Anous stolidus
- Anous tenuirostris
- Anseranas semipalmata
- Anthus cervinus
- Anthus novaeseelandiae
- Aphrodroma brevirostris
- Aplonis metallica
- Aptenodytes patagonicus
- Apus affinis
- Apus pacificus
- Arctocephalus forsteri
- Arctocephalus gazella
- Ardea alba
- Ardea intermedia
- Ardenna bulleri
- Ardenna creatopus
- Ardenna gravis
- Ardenna grisea
- Ardenna pacifica
- Ardenna tenuirostris
- Arenaria interpres
- Biziura lobata
- Bubulcus ibis
- Bulbonaricus brauni
- Bulweria bulwerii
- Cacomantis flabelliformis
- Calidris acuminata
- Calidris alba
- Calidris alpina
- Calidris bairdii
- Calidris canutus
- Calidris falcinellus
- Calidris mauri
- Calidris melanotos
- Calidris minuta
- Calidris ruficollis
- Calidris subminuta
- Calidris subruficollis
- Calidris tenuirostris
- Calonectris leucomelas
- Campichthys galei
- Campichthys tricarinatus
- Campichthys tryoni
- Caretta caretta
- Catharacta maccormicki
- Catharacta skua
- Cereopsis novaehollandiae
- Chalcites basalis
- Chalcites lucidus
- Chalcites minutillus
- Chalcites osculans
- Charadrius asiaticus
- Charadrius bicinctus
- Charadrius dubius
- Charadrius mongolus
- Charadrius ruficapillus
- Charadrius veredus



Magpie Goose (*Anseranas semipalmata*), Northern Territory.

Spine-tailed Seasnake (*Aipysurus eydouxii*), Listed Marine Species. Photo: Ria Tan, CC BY-NC-ND 2.0.

- Chelonia mydas
- Chlidonias hybrida
- Choeroichthys brachysoma
- Choeroichthys cinctus
- Choeroichthys latispinosus
- Choeroichthys sculptus
- Choeroichthys suillus
- Coracina novaehollandiae
- Coracina papuensis
- Corvus mellori
- Corvus tasmanicus
- Corythoichthys amplexus
- Corythoichthys intestinalis
- Corythoichthys ocellatus
- Corythoichthys paxtoni
- Corythoichthys schultzi
- Cosmocampus howensis
- Coturnix pectoralis
- Crex crex
- Crocodylus johnstoni
- Crocodylus porosus
- Cuculus optatus
- Daption capense
- Dendrocygna arcuata
- Dermochelys coriacea
- Dicrurus bracteatus
- Diomedea amsterdamensis
- Diomedea antipodensis
- Diomedea dabbenena
- Diomedea epomophora
- Diomedea exulans
- Diomedea sanfordi
- Doryrhamphus janssi
- Doryrhamphus negrosensis
- Ducula bicolor
- Ducula concinna
- Dugong dugon
- Dunckerocampus dactyliophorus
- Egretta garzetta
- Egretta sacra
- Ephalophis greyae
- Eretmochelys imbricata
- Erythropitta erythrogaster
- Esacus magnirostris
- Eudyptes chrysocome
- Eudyptes chrysolophus
- Eudyptes pachyrhynchus
- Eudyptes robustus
- Eudyptes sclateri
- Eudyptula minor
- Eurostopodus argus
- Eurostopodus mystacalis
- Eurystomus orientalis
- Falco cenchroides
- Festucalex gibbsi
- Festucalex scalaris
- Filicampus tigris
- Forpus xanthopterygius
- Fregata andrewsi
- Fregata ariel
- Fregata minor
- Fregetta grallaria
- Fregetta tropica
- Fulmarus glacialoides
- Gallinago hardwickii
- Gallinago megala
- Gallinago stenura
- Garrodia nereis
- Gelochelidon macrotarsa
- Glareola maldivarum
- Gorsachius melanolophus
- Grallina cyanoleuca
- Gygis alba
- Haliaeetus leucogaster
- Haliastur indus
- Haliastur sphenurus
- Halicampus boothae
- Halicampus dunckeri
- Halicampus grayi
- Halicampus macrorhynchus
- Halicampus mataafae
- Halicampus nitidus
- Halobaena caerulea
- Heraldia nocturna
- Heteroscenes pallidus
- Himantopus himantopus
- Hippichthys heptagonus

Dugong (*Dugong dugon*), Listed Marine Species.

- Hippichthys penicillus
- Hippocampus abdominalis
- Hippocampus angustus
- Hippocampus bargibanti
- Hippocampus breviceps
- Hippocampus kelloggi
- Hippocampus minotaur
- Hippocampus spinosissimus
- Hippocampus subelongatus
- Hippocampus trimaculatus
- Hippocampus whitei
- Hippocampus zebra
- Hirundapus caudacutus
- Hirundo neoxena
- Hirundo rustica
- Histiogamphelus cristatus
- Hydrelaps darwiniensis
- Hydrobates leucorhous
- Hydrobates matsudairae
- Hydrophasianus chirurgus
- Hydrophis atriceps
- Hydrophis belcheri
- Hydrophis caerulescens
- Hydrophis coggeri
- Hydrophis curtus
- Hydrophis czeblukovi
- Hydrophis elegans
- Hydrophis gracilis
- Hydrophis inornatus
- Hydrophis kingii
- Hydrophis major
- Hydrophis melanosoma
- Hydrophis pacificus
- Hydrophis platurus
- Hydrophis stokesii
- Hydrophis vorisi
- Hydroprogne caspia
- Hydrurga leptonyx
- Hypotaenidia philippensis
- Hypselognathus horridus
- Hypselognathus rostratus
- Ixobrychus sinensis
- Larus atricilla
- Larus crassirostris
- Larus dominicanus
- Larus novaehollandiae
- Larus pacificus
- Larus pipixcan
- Larus ridibundus
- Lathamus discolor
- Laticauda colubrina
- Laticauda laticaudata
- Lepidochelys olivacea
- Leptoichthys fistularius
- Leptonychotes weddellii
- Limnodromus semipalmatus
- Limosa lapponica
- Limosa limosa
- Lissocampus caudalis
- Lissocampus fatiloquus
- Lissocampus runa
- Lobodon carcinophaga
- Macronectes giganteus
- Macronectes halli
- Maroubra perserrata
- Merops ornatus
- Micrognathus andersonii
- Micrognathus brevirostris
- Micrognathus micronotopterus
- Micrognathus natans
- Microphis manadensis
- Mirounga leonina
- Mitotichthys meraculus
- Mitotichthys mollisoni
- Mitotichthys semistriatus
- Mitotichthys tuckeri
- Monarcha frater
- Monarcha melanopsis
- Morus capensis
- Morus serrator
- Motacilla alba
- Motacilla cinerea
- Motacilla citreola
- Motacilla flava

White's seahorse (*Hippocampus whitei*). Listed marine species. Photo: John Turnbull Flickr CC BY-NC-SA 2.0.

- Myiagra cyanoleuca
- Nannocampus subosseus
- Natator depressus
- Neophema chrysogaster
- Neophema petrophila
- Neophoca cinerea
- Nettapus pulchellus
- Ninox novaeseelandiae
- Notiocampus ruber
- Numenius arquata
- Numenius madagascariensis
- Numenius minutus
- Numenius phaeopus
- Nycticorax caledonicus
- Nycticorax nycticorax
- Oceanites oceanicus
- Ommatophoca rossii
- Onychoprion anaethetus
- Onychoprion fuscatus
- Pachyptila belcheri
- Pachyptila crassirostris
- Pachyptila desolata
- Pachyptila salvini
- Pachyptila turtur
- Pachyptila vittata
- Pagodroma nivea
- Pandion haliaetus
- Papasula abbotti
- Parahydrophis mertoni
- Pelagodroma marina
- Pelecanoides georgicus
- Pelecanoides urinatrix
- Pelecanus conspicillatus
- Petrochelidon nigricans
- Petroica phoenicea
- Petroica rodinogaster
- Phaethon lepturus
- Phaethon rubricauda
- Phalacrocorax fuscescens
- Phalaropus fulicarius
- Phalaropus lobatus
- Phocarctos hookeri
- Phoebastria immutabilis
- Phoebetria palpebrata
- Phoenicopterus roseus
- Phonygammus keraudrenii
- Phoxocampus diacanthus
- Phyllopteryx taeniolatus
- Phylloscopus borealis
- Pitta versicolor
- Plegadis falcinellus
- Pluvialis dominica
- Pluvialis fulva
- Pluvialis squatarola
- Podargus papuensis
- Procellaria aequinoctialis
- Procellaria cinerea
- Procellaria parkinsoni
- Procellaria westlandica
- Pterodroma baraui
- Pterodroma cervicalis
- Pterodroma cookii
- Pterodroma externa
- Pterodroma heraldica
- Pterodroma incerta
- Pterodroma inexpectata
- Pterodroma lessonii
- Pterodroma macroptera
- Pterodroma mollis
- Pterodroma neglecta
- Pterodroma nigripennis
- Ptilinopus superbus
- Puffinus assimilis
- Puffinus gavia
- Puffinus huttoni
- Puffinus lherminieri
- Puffinus puffinus
- Pygoscelis adeliae
- Pygoscelis antarcticus
- Pygoscelis papua
- Radjah radjah
- Rallina fasciata
- Recurvirostra novaehollandiae
- Scythrops novaehollandiae

Fairy Prion (*Pachyptila turtur*), East of the Tasman Peninsula, Tasmania. Photo: JJ Harrison, CC BY-SA 3.0.

- Siokunichthys striatus
- Solegnathus dunckeri
- Solegnathus robustus
- Solegnathus spinosissimus
- Solenostomus cyanopterus
- Solenostomus paradoxus
- Spatula clypeata
- Spatula querquedula
- Spheniscus magellanicus
- Steganopus tricolor
- Stercorarius longicaudus
- Stercorarius parasiticus
- Stercorarius pomarinus
- Sterna dougallii
- Sterna hirundo
- Sterna paradisaea
- Sterna striata
- Sterna sumatrana
- Sterna vittata
- Sternula albifrons
- Sternula nereis
- Stigmatopora argus
- Stiltia isabella
- Sula dactylatra
- Sula leucogaster
- Sula sula
- Symposiachrus trivirgatus
- Tanysiptera sylvia
- Thalassarche bulleri
- Thalassarche carteri
- Thalassarche cauta
- Thalassarche chlororhynchos
- Thalassarche chrysostoma
- Thalassarche eremita
- Thalassarche impavida
- Thalassarche melanophris
- Thalassarche salvini
- Thalasseus bengalensis
- Thalasseus bergii
- Thalassoica antarctica
- Thinornis cucullatus
- Threskiornis aethiopicus
- Threskiornis moluccus
- Threskiornis spinicollis
- Todiramphus macleayii
- Todiramphus sanctus
- Trachyrhamphus longirostris
- Tringa brevipes
- Tringa glareola
- Tringa incana
- Tringa totanus
- Urocampus carinirostris
- Vanacampus margaritifer
- Vanacampus phillipi
- Vanacampus vercoi
- Xema sabini
- Xenus cinereus
- Zapornia pusilla
- Zapornia tabuensis
- Zosterops lateralis

136. We note, for completeness, that some listed marine species also fall into other MNES categories. For example, the Leatherback Turtle (*Dermochelys coiacea*) is a listed marine species as well as a listed migratory species, and in the latter capacity was considered above at [132].

137. Adopting the same method of analysis as has been applied above to species and communities, when the spreadsheets for the listed marine species are considered, the only inference from the source documents is that climate change is likely to impact the species, and thus the environment in a Commonwealth marine area, where, in the summary spreadsheet, a "1" appears in any of the following columns: "climate_direct", "climate_implied", "climate_implied_not_direct", "fire", "fire_not_climate", "iucn_climate" or "iucn_fire".

E.13 Summary of impacts of fire on species protected by Pt 3

138. As noted at [23]-[29] above, IPCC WGII makes a number of relevant findings on the impact of climate change on fire behaviour in Australia. As that report shows, the 2019/2020 bushfires are one example of how climate change is changing fire behaviour in a way that poses significant risks to protected species. Those fires prompted the Commonwealth's own Royal Commission into National Natural Disaster Arrangements (**Natural Disasters Royal Commission**), which made several relevant findings for present purposes.

139. In particular, on the significance of climate change to fire behaviour generally, the Natural Disasters Royal Commission found:[207]

> *Extreme weather has already become more frequent and intense because of climate change; further global warming over the next 20 to 30 years is inevitable. Globally, temperatures will continue to rise, and Australia will have more hot days and fewer cool days. Sea levels are also projected to continue to rise. Tropical cyclones are projected to decrease in number, but increase in intensity. Floods and bushfires are expected to become more frequent and more intense. Catastrophic fire conditions may render traditional bushfire prediction models and firefighting techniques less effective.*

140. On the impact of the 2019/2020 bushfires on MNES, the Natural Disasters Royal Commission found:[208]

> *The 2019-2020 bushfires have been described as an 'ecological disaster'. Fires affected tens of millions of hectares of land, covering native forests and grasslands that serve as wildlife habitat and house ecosystems. According to Professor Chris Dickman, Professor in Ecology at the University of Sydney, no bushfires on record have burnt more forest and woodland habitats within a season. The affected areas include sites that are recognised and protected under the EPBC Act for their significant ecological and heritage value:*
>
> - *World Heritage properties: six properties were affected, including extensive burnt area across the Gondwana Rainforests of Australia in QLD and NSW (54% burnt), Greater Blue Mountains Area in NSW (82% burnt) and the Budj Bim Cultural Landscape in Victoria.*
> - *National Heritage places: Multiple places were affected, with the Australian Alps National Parks and Reserves, Stirling Range National Park, and West Kimberley suffering the most significant impacts.*
> - *Wetlands of International Importance ('Ramsar Wetlands'): At least five wetlands were affected, with the Macquarie Marshes and Gwydir Wetlands, and Gippsland Lakes assessed as being at high-risk of long-term ecological damage.*

141. To illustrate one aspect of the profound impact of climate change on MNES protected by Pt 3 of the EPBC Act, we have sought to map the impact of the 2019/2020 bushfires on various MNES. The process by which that mapping occurred and the results are summarised below.

E.13.1 *Overview – collation of data on fire impacts*

142. In order to ascertain and illustrate the impact of changed fire behaviour on relevant MNES, data (as set out in the final four columns of the Impact Data Tables at **Annexure 2.1.A** and **Annexure 2.1.B**) were compiled using code designed by Dr Peterson. The process by which those data were compiled is as follows.

142.1 Dr Peterson undertook a process to perform a spatial analysis to determine the location or generalised distribution of certain MNES. For the purposes of this description, and in the final four columns of the Impact Data Tables in **Annexure 2.1.A** and **Annexure 2.1.B**, each single species, ecological community, Ramsar wetland area, heritage place or property, is referred to as an individual "entity".

142.2 The spatial data for each entity were obtained from the following sources:

(a) National Heritage Places: National Heritage List Spatial Database[209];

(b) World Heritage Properties: National dataset of Australian properties on the World Heritage List[210];

(c) Ramsar wetlands: National dataset of Australia's Ramsar Wetlands[211];

(d) Ecological communities: Australia - Ecological Communities of National Environmental Significance Distributions (public grids)[212];

(e) Listed threatened species: Australia - Species of National Environmental Significance Distributions (public grids)[213].

142.3 Spatial and proportional fire impact analyses were not conducted in respect of any Commonwealth Marine Environment, listed marine species within a Commonwealth Marine Environment nor listed migratory species.[214]

142.4 The spatial analysis for each entity is recorded in the column of the spreadsheets at **Annexure 2.1.A** and **Annexure 2.1.B** under the heading "entity_area". The data in this column corresponds to the total area of the estimated species range (comprising the union of the regions marked as "presence possible" and "presence likely").

142.5 An estimate of the fire impacts per entity for each of the datasets listed under [142.2] above was obtained by determining the spatial intersection of the region comprising each entity with the region of impact for the 2019/2020 bushfire season (as contained in the national dataset of burnt areas across Australia for the 2019/20 bushfire season: the National Indicative Aggregated Fire Extent Datasets)[215], resulting in the region of impact per entity.

142.6 An estimate of the area of the region of impact (defined here as the overlap region) per entity is recorded in the column under the heading "impact_area"'.

142.7 A subsequent calculation determined the impact ratio per entity as:

impact_ratio = impacted entity area / total entity area,

where it is noted that the impact ratio by definition lies between 0 and 1, with a low impact near the zero end of the range, and a high impact close to, and less than, unity.

142.8 The impact ratio per entity — being the proportion of the spatial intersection of each entity with the region of impact (i.e. the overlap area) — is recorded in the column under the heading "impact_proportion".

E.13.2 ***Overview — mapping of fire impacts***

143. The following fire impact maps (and explanatory material), produced following the process described at [142] above, are contained in **Annexure 2.3**. These maps were produced by Dr Peterson.

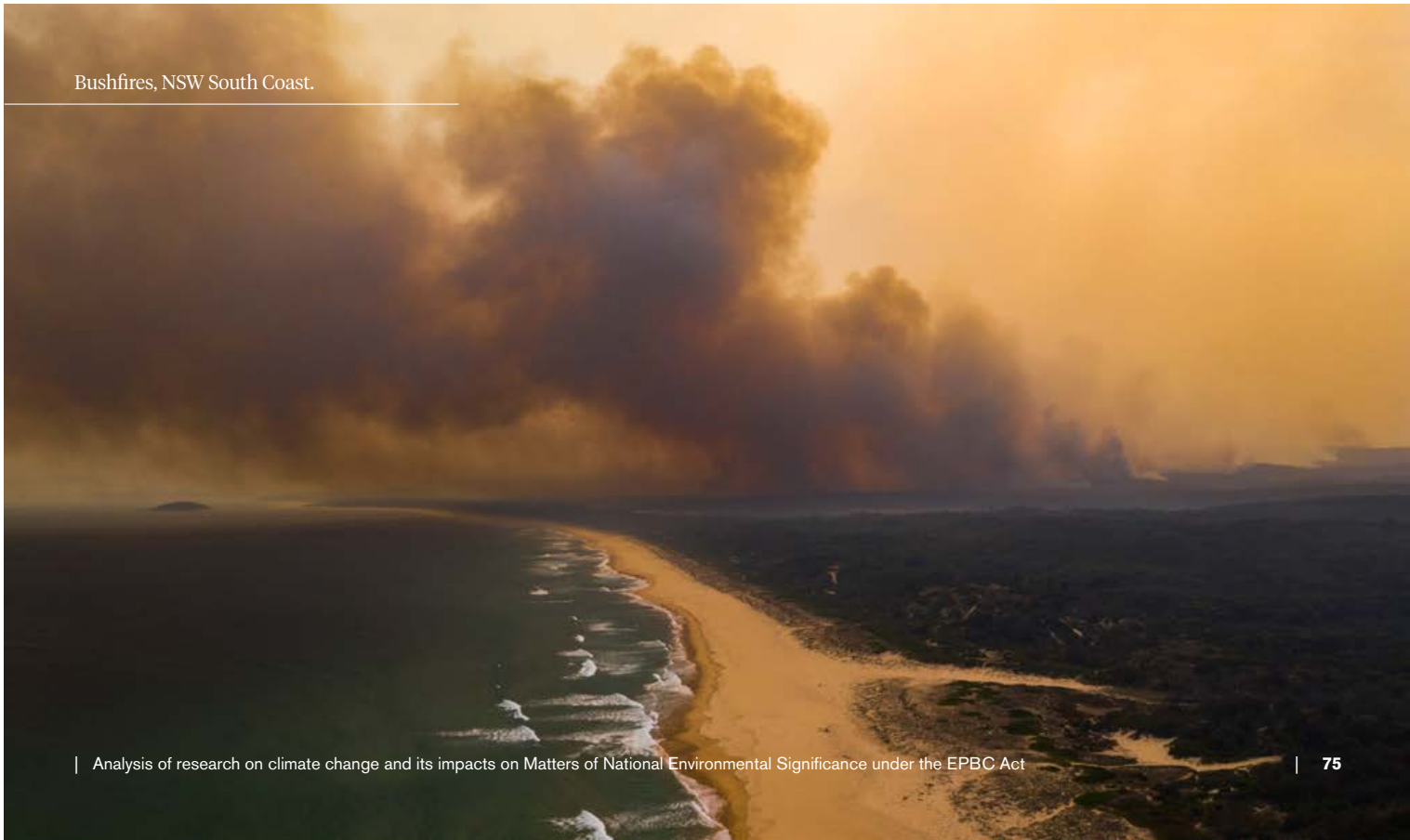
143.1 For National Heritage properties, World Heritage properties, Ramsar Wetlands and listed threatened ecological communities, the following documents are included in **Annexure 2.3** (for each MNES):

(a) One map of Australia per the MNES listed above (that is, one for National Heritage properties, one for World Heritage properties etc.), which shows, in different colours, the presence of MNES within each category. These maps also show, in a burgundy red color, the intersection of MNES with an area affected by the 2019/2020 fires. Wherever burgundy appears on these maps, that denotes one or more MNES within the relevant category that was affected by the 2019/2020 fires.

(b) The maps described at [143.1(a)] above are each accompanied, in a separate document, by a key that identifies the MNES whereby each colour — except burgundy — in the map denotes (one key for each of the National Heritage properties, World Heritage properties, Ramsar Wetlands and listed threatened ecological communities).

(c) A further, close-up, map showing the impact of the 2019/2020 fires on the most impacted MNES within each category. So, for example, the listed threatened ecological community that was most impacted by the 2019/2020 fires was the Lowland Grassy Woodland in the South East Corner Bioregion. The map for that community shows that the 2019/2020 fires had a devastating impact on the range of this particular community. Indeed, the ecological communities Impact Data Table in **Annexure 2.1.B.b** shows, in row 72, that the "impact_proportion" for the Lowland Grassy Woodland in the South East Corner Bioregion is 0.689.

143.2 For listed threatened species, because there is significant overlap between the range of listed threatened species, it was determined that the clearest way to depict the impact of the 2019/2020 fires on those species would be to produce a set of three "heat maps". The "heat maps" show, in a colour gradient of orange, the concentration of species affected by the 2019/2020 fires. The scale of these maps is such that they measure the number of impacted taxonomies at each geolocation. Hence, a score of 30 can be interpreted as the impacts on at least 30 species at that geolocation.



Bushfires, NSW South Coast.

143.3 In accordance with the key at the bottom of these maps, the greater the concentration of species affected by the 2019/2020 fires, the darker the shade of orange/red shown on the maps. Wherever there is a colour shown on these maps, it reflects the intersection of one or more listed threatened species with an area affected by the 2019/2020 fires. To that end, there are three "heat maps" for listed threatened species included in **Annexure 2.3**:

(a) A map showing the impact of the 2019/2020 fires on all listed threatened species:

(i) for which the results of the text data mining exercise (summarised in the Impact Data Tables in **Annexure 2.1**) indicated there is documented evidence supporting fire as a potential threat to that species; and/or

(ii) that were listed on the IUCN Red List as threatened by increase in fire frequency/ intensity (i.e. the IUCN threat 7.1.1) (recorded in the columns headed "iucn_fire" in the relevant spreadsheet at **Annexure 2.1.B).**

(b) A map showing the impact of the 2019/2020 fires on listed threatened species not falling into either of the categories at [143.3(a)(i)] and [143.3(a)(ii)] above, but which were nevertheless impacted by the 2019/2020 fires (that is, notwithstanding that fire has not, to date, been identified as a threat to the species).

(c) A map showing the combined results of the maps described at [143.3(a)] and [143.3(b)] above.

E.13.3 ***Summary of relevant impacts of fire on MNES***

144. Based on the material summarised at [3]-[30] and [138]-[143] above and the data and maps in **Annexure 2.3** (as summarised at [141]-[143] above), the following conclusions are inescapable:

144.1 Climate change is likely to significantly impact any MNES where there is a "1", in the relevant spreadsheets in **Annexure 2.1.B**, in the "fire", "fire_not_climate", "iucn_ climate" or "iucn_fire" columns.

144.2 The 2019/2020 fires had a significant impact on any MNES where there is a number greater than "0" in the "impact_proportion" column of the relevant spreadsheet in **Annexure 2.1.B**. The maps included in **Annexure 2.3** provide a powerful indication of how desctructive and extensive fire can be.

144.3 The frequency, severity and duration of fire behaviour in Australia will increase over time as climate change continues (and intensifies).

144.4 All of the MNES referred to at [144.1] and [144.2] above will be affected by climate change.

145. Consistently with the requirements of the regulatory scheme, including the precautionary principle, the Minister should make the findings set out at [144] above.

Endnotes

1 Except where otherwise provided, this document is to be read with the cover letter to **Annexure 1** and **Annexure 2**, including the defined terms used in the cover letter.

2 IPCC WGI, Chapter 3, p 4.

3 IPCC, "Climate change widespread, rapid, and intensifying – IPCC" https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/ (9 Aug. 2021) ("The report shows that emissions of greenhouse gases from human activities are responsible for approximately 1.1°C of warming since 1850-1900").

4 See the contribution of Working Group II to the IPCC's Sixth Assessment Report, *Climate Change 2022: Impacts, Adaptation and Vulnerability* (**IPCC WGII**), Chapter 11, p 11-9.

5 IPCC WGII, Chapter 11, p 11-11, Table 11.2a.

6 IPCC WGII, Chapter 11, p 11-11, Table 11.2a.

7 IPCC WGI, Summary for Policy Makers, p SPM-11.

8 CSIRO, Australian Government, Bureau of Meteorology, "State of the Climate 2020", p 19 (2020) http://www.bom.gov.au/state-of-the-climate/documents/State-of-the-Climate-2020.pdf.

9 IPCC WGI, Chapter 6, pp 6, 11.

10 IPCC WGI, Chapter 6, pp 6, 19, 36.

11 IPCC WGI, Summary for Policy Makers, p SPM-28.

12 IPCC WGI, Summary for Policy Makers, p SPM-28.

13 IPCC WGII, Chapter 11, p 11-14.

14 IPCC WGI, Summary for Policy Makers, p SPM-15.

15 IPCC WGI, Summary for Policy Makers, p SPM-28. CO_2 emissions have a dominant role in future warming in each of the scenarios modelled by IPCC WGI: at p SPM-13. Other key non-CO_2 greenhouse gas drivers of emissions include methane, nitrous oxide and sulphur dioxide.

16 IPCC WGI, Summary for Policy Makers, p SPM-16.

17 IPCC WGIII, Summary for Policy Makers, p SPM-4.

18 IPCC WGIII, Summary for Policy Makers, p SPM-4.

19 IPCC WGIII, Summary for Policy Makers, p SPM-7.

20 IPCC WGIII, Summary for Policy Makers, pp SPM-17 to SPM-18.

21 IPCC WGIII, Summary for Policy Makers, p SPM-19.

22 IPCC WGIII, Summary for Policy Makers, p SPM-21.

23 IPCC WGIII, Summary for Policy Makers, p SPM-32.

24 IPCC WGIII, Summary for Policy Makers, pp SPM-19 to SPM-20.

25 IPCC WGIII, Summary for Policy Makers, p SPM-36.

26 IPCC WGIII, Summary for Policy Makers, p SPM-32.

27 Welsby, Price, Pye and Ekins, 'Unextractable Fossil Fuels in a 1.5°C World' (2021) 597 *Nature* 230. An author correction was published on 25 January 2022 but this did not substantively alter the figures set out in this paragraph. A copy of the correction has been included in Annexure 1, item 4A.

28 UNEP, *The Production Gap: 2021 Report* (2021) 14.

29 UNEP, *The Production Gap: 2021 Report* (2021) 3.

30 IPCC WGIII, Annex III, II-68.

31 <https://data.ene.iiasa.ac.at/ar6/#/login?redirect=%2Fworkspaces>.

32 International Energy Agency, *Net Zero by 2050 – A Roadmap for the Global Energy Sector (October 2021, 4*th ed) (**IEA NZE**); IPCC WGIII, Annex III, II-74.

33 IEA NZE, 3.

34 IEA NZE, 152.

35 IPCC WGII, Chapter 11, p 11-19.

36 IPCC WGI, Summary for Policy Makers, p SPM-19.

37 IPCC WGI, Summary for Policy Makers, pp SPM-19 to SPM-24.

38 IPCC WGI, Summary for Policy Makers, pp SPM-23, SPM-32.

39 IPCC WGII, Chapter 11, p 11-9.

40 IPCC WGII, Chapter 11, p 11-12.

41 IPCC WGII, Chapter 11, p 11-27.

42 IPCC WGII, Chapter 11, pp 11-4, 11-14.

43 IPCC WGII, Chapter 11, p 11-28.

44 Final Report, Royal Commission into National Natural Disaster Responses, 28 October 2020 (Annexure 1, items 7 and 7A), p 5. The relevant findings of that royal commission are considered further at 135-138- below.

45 IPCC WGII, Chapter 11, p 11-28.

46 IPCC WGII, Chapter 11, p 11-28.

47 IPCC WGII, Chapter 11, p 11-28.

48 IPCC WGII, Chapter 11, p 11-22.

49 IPCC WGII, Chapter 11, p 11-32.

50 IPCC WGII, Chapter 11, p 11-32.

51 CSIRO and BOM, *State of the Climate 2020*, 10.

52 IPCC WGII, Chapter 11, p 11-12.

53 CSIRO and BOM, *State of the Climate 2020*,15.

54 IPCC WGII, Chapter 11, p 11-4.

55 IPCC WGII, Chapter 11, p 11-17.

56 IPCC WGII, Chapter 11, p 11-32.

57 IPCC WGII, Chapter 11, p 11-32.

58 IPCC WGII, Chapter 11, pp 11-4, 11-14.

59 Kirono et al, 'Drought projects in Australia: Updated results and analysis of model simulations' (2020) 30 *Weather and Climate Extremes* 100280.

60 Kirono et al, 'Drought projects in Australia: Updated results and analysis of model simulations' (2020) 30 *Weather and Climate Extremes* 100280, 5, 8.

61 IPCC WGII, Chapter 11, p 11-45.

62 IPCC WGII, Chapter 11, p 11-11.

63 IPCC WGII, Chapter 11, p 11-4.

64 IPCC WGII, Chapter 11, p 11-45.

65 IPCC WGII, Chapter 11, p 11-45.

66 Australia ratified the World Heritage Convention on 22 August 1974. United Nations Educations, Scientific and Cultural Organization (UNESCO), *Conventions – Australia* (Web Page, 21 February 2022) <https://en.unesco.org/countries/australia/conventions>.

67 Australian Government Department of Agriculture, Water and the Environment, *Species Profile and Threats Database*, (Web Page, 21 February 2022) <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.

68 Alternatively, only one or more terms from the Implied Climate Set and Discriminator Set was captured OR only one or more terms from the Fire Impact Set and Discriminator Set was captured.

69 For example, the purpose of the "subsequent rejection set" was to filter out sentences and phrases such as, "We acknowledge the contribution of the Minister for Climate Change" which does not capture climate impacts to a relevant MNES.

70 IUCN, *IUCN Red List of Threatened Species*, (Web Page, 21 February 2022), https://www.iucn.org/resources/conservation-tools/iucn-red-list-threatened-species.

71 IUCN, Threats Classification Scheme (Version 3.2), (Web Page, 21 February 2022), https://www.iucnredlist.org/resources/threat-classification-scheme.

72 Note, Dr Peterson designed a code that picked up specific sub-species, whereas the IUCN Red List identifies threats at the head species level so there may be in some cases a slight inconsistency between the IUCN Red List Database and spreadsheets produced by Dr Peterson, the result being that the spreadsheets are underinclusive of identifying all potential threats.

73 The 'relevant results' include those where relevant results (ie a '1') was marked for the third 'human review' step (see [59]-[60] above), or if the entity had a relevant 'IUCN flag' in the fourth step (see [65]-[73] above), or if the entity was affected by the 2019/20 bushfires (as described further below in Part E.13).

74 Department of Agriculture, Water and the Environment, *Australia's World Heritage List <https://www.awe.gov.au/parks-heritage/heritage/places/world-heritage-list>*.

75 Determined based on 'relevant results' as described above at n 73.

76 As discussed below at [101], the Great Barrier Reef World Heritage property substantially overlaps with the Great Barrier Reef Marine Park, which is a MNES in and of itself.

77 <https://whc.unesco.org/en/list/154/>.

78 GBRMPA, *Outlook Report 2014* (2014), v, 264; Annexure 2.1.B.e, World Heritage – Great Barrier Reef – only relevant results, p 1, numeric ref 4.

79 GBRMPA, *Outlook Report 2019* (2019), v, 90, 185, 257; Annexure 2.1.B.e, World Heritage – Great Barrier Reef – only relevant results, p 8, numeric ref 88.

80 GBRMPA, *Outlook Report 2019* (2019), 186; Annexure 2.1.B.e, World Heritage – Great Barrier Reef – only relevant results, p 14, numeric ref 133.

81 GBRMPA, *Outlook Report 2019* (2019), 161-167.

82 GBRMPA, *Outlook Report 2019* (2019), 165.

83 GBRMPA, *Position Statement – Climate Change* (2019), 1. Annexure 2.1.B.e, World Heritage – Great Barrier Reef – only relevant results, p 18, numeric ref 185.

84 Department of the Environment and Energy, *State Party Report on the State of Conservation of the Great Barrier Reef World Heritage Area (Australia)* (2019), 3, 12; Annexure 2.1.B.e, World Heritage – Great Barrier Reef – only relevant results, p 20, numeric ref 226.

85 Department of the Environment and Energy, *State Party Report on the State of Conservation of the Great Barrier Reef World Heritage Area (Australia)* (2019), 12; Annexure 2.1.B.e, World Heritage – Great Barrier Reef – only relevant results, p 21, numeric ref 230.

86 IUCN, *Great Barrier Reef: 2020 Conservation Outlook Assessment* (finalised 2 December 2020), 5-6, 7; Annexure 2.1.B.e, World Heritage – Great Barrier Reef – only relevant results, p 19, numeric ref 198.

87 IPCC WGII, Chapter 11, p 11-32.

88 IPCC WGII, Chapter 11, p 11-38.

89 IPCC WGII, Chapter 11, p 11-40 (Figure Box 11.2.2).

90 IPCC WGII, Chapter 11, p 11-38.

91 IPCC WGII, Chapter 11, p 11-38.

92 IPCC WGII, Chapter 11, p 11-38.

93 <https://whc.unesco.org/en/list/486/>.

94 IUCN, *Wet Tropics of Queensland: 2020 Conservation Outlook Assessment* (finalised 2 December 2020), 3; Annexure 2.1.B.e, World Heritage – Wet Tropics of Queensland – only relevant results, p 3, numeric ref 36.

95 IUCN, *Wet Tropics of Queensland: 2020 Conservation Outlook Assessment* (finalised 2 December 2020), 5; Annexure 2.1.B.e, World Heritage – Wet Tropics of Queensland – only relevant results, p 4, numeric ref 43, 44.

96 IUCN, *Wet Tropics of Queensland: 2020 Conservation Outlook Assessment* (finalised 2 December 2020), 13; Annexure 2.1.B.e, World Heritage – Wet Tropics of Queensland –only relevant results, p 6, numeric ref 5.

97 IPCC WGII, Chapter 11, p 11-21, citing Moran, Turton and Hill, *Adaptation Pathways and Opportunities for the Wet Tropics NRM Cluster Region — Volume 2 (2014)*; Hoffmann et al, 'Impacts of Recent Climate Change on Terrestrial Flora and Fauna: Some Emerging Australian Examples' 44(1) *Austral Ecology* 3-27.

98 <https://whc.unesco.org/en/list/578/>.

99 IUCN, *Shark Bay, Western Australia: Conservation Outlook Assessment 2017* (finalised 10 November 2017) at 4; IUCN, *Shark Bay, Western Australia: 2020 Conservation Outlook Assessment* (finalised 2 December 2020), 4; Annexure 2.1.B.e, World Heritage – Shark Bay – only relevant results, p 1, numeric ref 5, 10.

100 IUCN, *Shark Bay, Western Australia: 2020 Conservation Outlook Assessment* (finalised 2 December 2020), 7; Annexure 2.1.B.e, World Heritage – Shark Bay – only relevant results, p 2, numeric ref 14.

101 IPCC WGII, Chapter 11, p 11-36, citing Strydom et al, 'Too Hot to Handle: Unprecedented Seagrass Death Driven by Marine Heatwave in a World Heritage Area' (2020) 26(6) *Global Change Biology* 3525-3538.

102 IPCC WGII, Chapter 11, p 11-36, citing Strydom et al, 'Too Hot to Handle: Unprecedented Seagrass Death Driven by Marine Heatwave in a World Heritage Area' (2020) 26(6) *Global Change Biology* 3525-3538.

103 <https://whc.unesco.org/en/list/147/>.

104 IUCN, *Kakadu National Park: 2020 Conservation Outlook Assessment* (finalised 8 December 2020), 6; Annexure 2.1.B.e, World Heritage – Kakadu – only relevant results, p 2, numeric ref 18.

105 IUCN, *Kakadu National Park: 2020 Conservation Outlook Assessment* (finalised 8 December 2020), 4; Annexure 2.1.B.e, World Heritage – Kakadu – only relevant results, p 1, numeric ref 5, 16..

106 IUCN, *Kakadu National Park: 2020 Conservation Outlook Assessment* (finalised 8 December 2020), 6.

107 IUCN, *Kakadu National Park: 2020 Conservation Outlook Assessment* (finalised 8 December 2020), 6, 8.

108 IUCN, *Kakadu National Park: 2020 Conservation Outlook Assessment* (finalised 8 December 2020), 5; Annexure 2.1.B.e, World Heritage – Kakadu – only relevant results, p 2, numeric ref 22.

109 IUCN, *Kakadu National Park: 2020 Conservation Outlook Assessment* (finalised 8 December 2020), 9.

110 Director of National Parks, *Kakadu National Park Management Plan 2016-2026* (2016), 52; Annexure 2.1.B.e, World Heritage – Kakadu – only relevant results, p 2, numeric ref 31.

111 Director of National Parks, *Kakadu National Park Management Plan 2016-2026* (2016), 68; Annexure 2.1.B.e, World Heritage – Kakadu – only relevant results, p 3, numeric ref 32.

112 Director of National Parks, *Kakadu National Park Management Plan 2016-2026* (2016), 72.

113 Director of National Parks, *Kakadu National Park Management Plan 2016-2026* (2016), 92-93; Annexure 2.1.B.e, World Heritage – Kakadu – only relevant results, p 5, numeric ref 12.

114 Determined based on 'relevant results' as described above at n 73.

115 As discussed below at [97], the Great Barrier Reef substantially overlaps with the Great Barrier Reef Marine Park, which is a MNES in and of itself.

116 Parks Victoria, *Greater Alpine National Parks Management Plan* (August 2016), 34-35; Annexure 2.1.B.f, National Heritage – Australian Alps National Parks and Reserves – only relevant results, p 2, numeric ref 21; p 9 numeric ref 1; p 3 numeric ref 28.

117 Parks Victoria, *Greater Alpine National Parks Management Plan* (August 2016), 45.

118 Parks Victoria, *Greater Alpine National Parks Management Plan* (August 2016), 48; Annexure 2.1.B.f, National Heritage – Australian Alps National Parks and Reserves – only relevant results, p 10, numeric ref 5.

119 Parks Victoria, *Greater Alpine National Parks Management Plan* (August 2016), 53; Annexure 2.1.B.f, National Heritage – Australian Alps National Parks and Reserves – only relevant results, p 3, numeric ref 25.

120 IPCC WGII, Chapter 11, p 11-68.

121 IPCC WGII, Chapter 11, pp 11-20 to 11-21.

122 IPCC WGII, Chapter 11, p 11-23. See also at p 11-79.

123 Parks Victoria, *Greater Gariwerd Landscape Management Plan* (November 2021), ix, 77; Annexure 2.1.B.f, National Heritage – Grampians Greater Gariwerd NP – only relevant results, p 1, numeric ref 3.

124 Parks Victoria, *Greater Gariwerd Landscape Management Plan* (November 2021), 76.

125 Parks Victoria, *Greater Gariwerd Landscape Management Plan* (November 2021) at 77; Annexure 2.1.B.f, National Heritage – Grampians Greater Gariwerd NP – only relevant results, p 1, numeric ref 3.

126 Parks Victoria, *Greater Gariwerd Landscape Management Plan* (November 2021) at 77; Annexure 2.1.B.f, National Heritage – Grampians Greater Gariwerd NP – only relevant results, p 3, numeric ref 29.

127 See <https://www.gbrmpa.gov.au/the-reef/heritage/great-barrier-reef-world-heritage-area/differences-between-the-marine-park-and-the-world-heritage-area2>.

128 Determined based on 'relevant results' as described above at n 73.

129 Ecological Character Description, Lake Albacutya Ramsar Wetland (2010), 27, 130; see, Annexure 2.1.B.d, Ramsar Wetlands – Lake Albacutya – only relevant results, p 24-25.

130 Ecological Character Description, Lake Albacutya Ramsar Wetland (2010), 28, 32, 54, 132-134; see, Annexure 2.1.B.d, Ramsar Wetlands – Lake Albacutya – only relevant results, p 24-26, numeric ref 216-222; 228; 230; 232; 239.

131 Ecological Character Description, Lake Albacutya Ramsar Wetland (2010), 98; Annexure 2.1.B.d, Ramsar Wetlands – Lake Albacutya – only relevant results, p 26, numeric ref 235.

132 Ecological Character Description, Lake Albacutya Ramsar Wetland (2010), 139; Annexure 2.1.B.d, Ramsar Wetlands – Lake Albacutya – only relevant results, p 83, numeric ref 54, 56.

133 Ecological Character Description, Kerang Wetlands Ramsar Site (May 2011), 78; Annexure 2.1.B.d, Ramsar Wetlands – Kerang Wetlands – only relevant results, p 14, numeric ref 108; 109.

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134 Ecological Character Description, Kerang Wetlands Ramsar Site (May 2011), 78; Annexure 2.1.B.d, Ramsar Wetlands – Kerang Wetlands – only relevant results, p 15, numeric ref 118.

135 Ecological Character Description, Kerang Wetlands Ramsar Site (May 2011), 81-82; see, Annexure 2.1.B.d, Ramsar Wetlands – Kerang Wetlands – only relevant results, pp 13-18; 63-64.

136 Ecological Character Description, Ginini Flats Wetland Complex Ramsar Site (December 2010), 45; Annexure 2.1.B.d, Ramsar Wetlands – Ginini Flats Wetland Complex – only relevant results, p 34, numeric ref 340, 341.

137 Ecological Character Description, Ginini Flats Wetland Complex Ramsar Site (December 2010), 45; see, also, Annexure 2.1.B.d, Ramsar Wetlands – Ginini Flats Wetland Complex – only relevant results, p 87-88.

138 Ecological Character Description, Ginini Flats Wetland Complex Ramsar Site (December 2010), 51.

139 IPCC WGII, Chapter 11, p 11-19.

140 IPCC WGII, Chapter 11, p 11-19.

141 IPCC WGII, Chapter 11, p 11-19.

142 IPCC WGII, Chapter 11, p 11-22.

143 IPCC WGII, Chapter 11, p 11-19.

144 IPCC WGII, Chapter 11, p 11-20.

145 For example, where species thermal tolerances are exceeded: IPCC WGII, Chapter 11, p 11-20.

146 For example, through changed fire regimes: IPCC WGII, Chapter 11, p 11-20.

147 IPCC WGII, Chapter 11, pp 11-20 to 11-22.

148 Australian Government Department of Agriculture, Water and the Environment, *Species Profile and Threats Database* (Web Page, 10 May 2022), https://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl.

149 Australian Government Department of Agriculture, Water and the Environment, *Species Profile and Threats Database* (Web Page, 20 March 2022), https://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl#fishes_critically_endangered.

150 IPCC WGII, Chapter 11, p 11-22.

151 IPCC WGII, Chapter 11, p 11-22.

152 IPCC WGII, Chapter 11, p 11-19.

153 IPCC WGII, Chapter 11, p 11-24-25.

154 Australian Government Department of Agriculture, Water and the Environment, *Species Profile and Threats Database*, (Web Page, 20 March 2022): <https://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl#frogs_critically_endangered>; <https://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl#frogs_endangered>; <https://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl#frogs_vulnerable>.

155 Declaration under s 178, s 181, and s 183 of the EPBC Act - List of threatened species, List of threatened ecological communities and List of threatening processes, Compilation no. 193, 31 March 2022.

156 These are not protected by Part 3 – see EPBC Act, s 34 (item 8A).

157 Determined based on 'relevant results' as described above at n 73.

158 Conservation Advice, Gymnobelideus leadbeater (effective 22 June 2019), 4.

159 Conservation Advice, Gymnobelideus leadbeater (effective 22 June 2019), 5; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 19, numeric ref 185.

160 Conservation Advice, Gymnobelideus leadbeater (effective 22 June 2019), 4; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 19, numeric ref 188.

161 Conservation Advice, Gymnobelideus leadbeater (effective 22 June 2019), 15; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 92, numeric ref 187.

162 Conservation Advice, Gymnobelideus leadbeater (effective 22 June 2019), 5; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 19, numeric ref 186.

163 Conservation Advice, Gymnobelideus leadbeater (effective 22 June 2019), 5.

164 See generally: Conservation Advice, Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (effective 12 February 2022), 14-17; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 40, numeric ref 399.

165 Conservation Advice, Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (effective 12 February 2022), 18.

166 Conservation Advice, Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (effective 12 February 2022), 5; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 39, numeric ref 390.

167 Conservation Advice, Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (effective 12 February 2022), 6; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 39, numeric ref 391.

168 Conservation Advice, Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (effective 12 February 2022), 7; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 39, numeric ref 392.

169 Conservation Advice, Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (effective 12 February 2022), 7.

170 Conservation Advice, Phascolarctos cinereus (Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory (effective 12 February 2022), 9.

171 Conservation Advice, Stipiturus malachurus parimeda (effective 17 December 2013), 2; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 55, numeric ref 553.

172 Conservation Advice, Stipiturus malachurus parimeda (effective 17 December 2013), 2; Annexure 2.1.B.a, Threatened Species Fauna – only relevant results, p 131, numeric ref 623.

173 Conservation Advice, Stipiturus malachurus parimeda (effective 17 December 2013), 2.

174 Conservation Advice, Stipiturus malachurus parimeda (effective 17 December 2013), 2.

175 Declaration under s 178, s 181, and s 183 of the EPBC Act - List of threatened species, List of threatened ecological communities and List of threatening processes, Compilation no. 193, 31 March 2022.

176 These are not protected by Part 3 – see EPBC Act, s 34 (item 8A).

177 Determined based on 'relevant results' as described above at n 73. We note that there is one species which is present in the 'Threatened Species – Flora' results spreadsheets, Elaeocarpus miegei, that is not also included in the Threatened Species (Flora and Fauna) impact data tables. An isolated issue with the way that this single species was identified by the code written by Dr Peterson resulted in it not being included in the species impact data tables, as described at [66]. On 28 June 2022, Dr Peterson confirmed that the issue was isolated to this species and provided the reason for its omission from the impact data tables. Consistent with the process described in Part E.2, source documents from which the results for this species are drawn are included in Annexure 2.2.

178 Conservation Advice, Azorella macquariensis (effective 13 July 2010), 2.

179 Conservation Advice, Grevillea maxwellii (effective 1 October 2008), 2.

180 Conservation Advice, Grevillea maxwellii (effective 1 October 2008), 2; Annexure 2.1.B.a, Threatened Species Flora – only relevant results, p 49, numeric ref 80.

181 Conservation Advice, Epacris sparsa (effective 26 March 2008), 1; Annexure 2.1.B.a, Threatened Species Flora – only relevant results, p 11, numeric ref 94; p 99, numeric ref 386.

182 Declaration under s 178, s 181, and s 183 of the EPBC Act - List of threatened species, List of threatened ecological communities and List of threatening processes, Compilation no. 193, 31 March 2022.

183 These are not protected by Part 3 – see EPBC Act, s 34 (item 8A).

184 Determined based on 'relevant results' as described above at n 73.

185 See generally: Conservation Advice, Eastern Suburbs Banksia Scrub of the Sydney Region (effective 8 December 2021), 22-23.

186 Conservation Advice, Eastern Suburbs Banksia Scrub of the Sydney Region (effective 8 December 2021), 22; Annexure 2.1.B.b, Ecological Communities –only relevant results, p 29, numeric ref 294.

187 Conservation Advice, Eastern Suburbs Banksia Scrub of the Sydney Region (effective 8 December 2021), 22-3.

188 Conservation Advice, Eastern Suburbs Banksia Scrub of the Sydney Region (effective 8 December 2021), 1, 21-22; see, also, Annexure 2.1.B.b, Ecological Communities – only relevant results, p 77-78.

189 Conservation Advice, Eastern Suburbs Banksia Scrub of the Sydney Region (effective 8 December 2021), 23;Annexure 2.1.B.b, Ecological Communities – only relevant results, p 39, numeric ref 372.

190 See generally: Conservation Advice, Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland (effective 8 December 2021), 25-6, 56-7.

191 Conservation Advice, Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland (effective 8 December 2021), 20, 50, 56; Annexure 2.1.B.b, Ecological Communities –only relevant results, p 39, numeric ref 371.

192 Declaration under s 209 of the EPBC Act - List of migratory species, Compilation no. 15, 21 October 2020.

193 Determined based on 'relevant results' as described above at n 73. Where species in the migratory species spreadsheets appear twice, this is due to these species names having two listings on the Species Profile and Threats Database and, therefore, both listings were scraped and results included by the data collation processes described in Part E.2 of this Annexure.

194 Conservation Advice, Dermochelys coriacea (effective 17 December 2008), 2.

195 Determined based on 'relevant results' as described above at n 73.

196 Marine Bioregional Plan, Temperature East Marine Region (2012), 27; Annexure 2.1.B.g, Marine Environment – Temp East Marine Region – only relevant results, p 3, numeric ref 24.

197 Marine Bioregional Plan, Temperature East Marine Region (2012), 30-37.

198 Marine Bioregional Plan, Temperature East Marine Region (2012), 66.

199 Commonwealth Marine Environment Report Card, Temperate East Marine Region (2012), 21.

200 Annexure 2.1.B.g, Marine Environment – Temp East Marine Region – only relevant results, p 6, numeric ref 60.

201 Commonwealth Marine Environment Report Card, Temperate East Marine Region (2012), 21.

202 Annexure 2.1.B.g, Marine Environment – Temp East Marine Region – only relevant results, p 6, numeric ref 61.

203 Commonwealth Marine Environment Report Card, Temperate East Marine Region (2012), 23.

204 EPBC Act s 528 (definition of "environment").

205 EPBC Act s 250(1).

206 Based on Declaration under s 248 of the EPBC Act - List of marine species, 4 August 2000 as at 26 January 2022.

207 Final Report, Royal Commission into National Natural Disaster Responses, 28 October 2020, [23]. As to the impact of climate change on fire behaviour in Australia, see also [2.4], [2.18]-[2.36], [2.51]-[2.58], [16.11]-[16.13].

208 Final Report, Royal Commission into National Natural Disaster Responses, 28 October 2020, [16.11]-[16.13] (citations omitted).

209 Department of Agriculture, Water and the Environment, Environmental Datasets <http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B6C54FE6C-2773-47C6-8CBC-4722F29081EF%7D>.

210 Department of Agriculture, Water and the Environment, Environmental Datasets http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B6C54FE6C-2773-47C6-8CBC-4722F29081EF%7D.

211 Australian Government Datasets https://data.gov.au/dataset/ds-dga-8f4b957c-a5af-42c2-86bc-1bf967675f3f/details?q=Ramsar%20download.

212 Department of Agriculture, Water and the Environment, Environmental Datasets http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B184A3793-2526-48F4-A268-5406A2BE85BC%7D.

213 Department of Agriculture, Water and the Environment, Environmental Datasets http://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B337B05B6-254E-47AD-A701-C55D9A0435EA%7D.

214 This was determined based on a common sense that these categories of MNES would not be impacted by the 2019-20 bushfires.

215 Department of Agriculture, Water and the Environment, Environmental Datasets https://www.environment.gov.au/fed/catalog/search/resource/details.page?uuid=%7B9ACDCB09-0364-4FE8-9459-2A56C792C743%7D.