

Byron Shire Coastal Light Management Plan

2024



**BYRON
SHIRE
COUNCIL**

Table of Contents

Contact information	iv
Document control	iv
Accessibility.....	v
Acknowledgements	v
Executive summary	vi
List of Figures.....	vii
List of Tables.....	vii
Glossary	ix
Part 1: Background.....	1
1.1 Introduction.....	1
1.2 Scope, Purpose, Vision and Objectives of the CLPMP	3
1.3 Study Area -The Byron Coast	4
1.4 Artificial light	7
1.5 Stakeholder consultation.....	9
Part 2: Legislative and Regulatory Context.....	11
2.1 International Agreements.....	11
2.2 Commonwealth Legislation and Guidance	12
2.3 State Legislation and Guidance	13
2.4 Local Policy and Provisions	17
Part 3: Environmental impact assessment.....	25
3.1 Describe the project lighting.....	25
3.2: Describe wildlife	48
3.3: Impact assessment	63
Part 4: Prioritised action plan.....	80
4.1 Best practice lighting design principles	80
4.2 Management actions.....	82

Byron Shire Coastal Light Management Plan

Appendix A – BioNet records.....	93
Appendix B – Protected Matters Search Results	96
Appendix C – Stakeholder consultation	97
Appendix D – Best practice lighting design features	101
Appendix E – Lighting infrastructure audit checklist	102
Appendix F – Appropriate light fixtures	103
Light fitting Requirements	104
References.....	108
FOR MORE INFORMATION	113

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Prepared For: Byron Shire Council

Project Name: Byron Shire Coastal Light Management Plan

Tim Fitzroy & Associates Reference: 24/2023

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If you have trouble accessing any information provided in this document, or for more information or alternatives (read alternate text of figures, etc.), please speak with a Council staff member on (02) 6626 7000.

Acknowledgements

ACKNOWLEDGEMENT OF COUNTRY

In preparation of this document, Council acknowledges the traditional custodians of the land in Byron Shire, the Arakwal, Minjungbal and Widjabul Wia-bal Peoples of the Bundjalung Nation. People of the Bundjalung Nation lived in this area for thousands of years before arrival of non-Aboriginal people and retain a strong connection to Country and to the maintenance, protection and management of Aboriginal cultural values in the Shire.

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Byron Shire Council acknowledges the advice, guidance, data, and feedback provided by the following stakeholders:

- NSW National Parks and Wildlife Service;
- Australian Seabird & Turtle Rescue;
- Cape Byron Marine Park Authority (DPI);
- Byron Bird Buddies; and
- Plummer & Smith landscape architects.

Executive summary

Byron Shire Council is the recipient of a '*Reducing Light Pollution in Coastal Communities Grant*' from the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW). Artificial light has the potential to significantly disrupt coastal ecosystems, including stalling threatened species recovery from population decline and compromising the long-distance migrations of migratory species (DCCEEW, 2023).

The purpose of this Plan is to assess the impact of artificial light on threatened and/or migratory coastal fauna species protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the (NSW) *Biodiversity Conservation Act 2016* (BC Act). The Plan focusses on impacts that may arise from lighting infrastructure within Council managed lands. This Plan also extends its scope to consider other land tenures where opportunities exist for enhancing design and mitigating light pollution in urban areas. The Plan sets in place a prioritised action plan for the mitigation of identified issues. The DCCEEW '*National Light Pollution Guidelines for Wildlife*' have informed the development of this Plan.

The Byron coast comprises approximately 35 kilometres of land extending from the northern boundary with the Tweed Shire to its boundary with Ballina Shire in the south. Approximately 50% of this coastline is within or adjacent to 'unlit' and protected areas (national parks or marine estate), where natural darkness prevails. However, key urban centres located along the Byron coast present opportunities to ensure the operation of public lighting for safety or amenity does not negatively impact threatened or migratory fauna species where they may occur.

This Plan is presented in the following parts:

Part 1: Background - introduces the objectives of the Plan, the study area within the Byron Local Government Area (LGA) and the mechanisms by which artificial light can alter the survivorship, behaviour or reproductive output of threatened and/or migratory fauna species.

Part 2: Legislative and regulatory context - provides a summary of considerations for the management of artificial light and provision of lighting for public safety or amenity including Federal and State Acts and local policies and provisions.

Part 3: Environmental impact assessment - describes the methodology and results of a review of coastal lighting infrastructure within a portion of Council managed lands and assesses the potential for negative impacts to threatened and/or migratory fauna species or their habitats.

Part 4: Prioritised action plan - outlines how the priority issues will be addressed by a suite of management actions. The *Best Practice Lighting Design Principles* set out within the '*National Light Pollution Guidelines for Wildlife*' have been used as a framework for developing management actions relevant to the Byron coastal area.

A range of actions to reduce the impacts of coastal lighting has been recommended in this initial Plan. It is proposed the Plan is reviewed in five years to assess performance outcomes and review future opportunities for improvement.

List of Figures

Figure 1 Locality map of the northern coastal portion of the Byron LGA (a – northern boundary to Brunswick Heads, b – Brunswick Heads to Belongil Creek).....	5
Figure 2 Locality map of the southern coastal portion of the Byron LGA (a – Belongil Creek to Suffolk Park, b – Suffolk Park to the southern boundary)	6
Figure 3 South Golden Beach biodiversity features and lighting infrastructure	68
Figure 4 New Brighton biodiversity features and lighting infrastructure	69
Figure 5 Brunswick Heads biodiversity features and lighting infrastructure	72
Figure 6 Belongil Beach/Creek biodiversity features and lighting infrastructure.....	74
Figure 7 Byron Bay biodiversity features and lighting infrastructure	78
Figure 8 Main Beach Reserve, Byron Bay - lighting infrastructure and general recommendations	79

List of Tables

Table 1 Summary of NSW legislative and regulatory documents relevant to this Plan	13
Table 2 Summary of Byron Shire Council planning instruments and other management plans and strategies relevant to this Plan.	17
Table 3 Summary of lighting infrastructure within Council managed lands in the immediate coastal area of Byron LGA.	44
Table 4 Site inspection results – lighting environment of immediate coastal area of Byron LGA.	45
Table 5 Summary of threatened fauna habitat at key urban areas within the immediate coastal area of Byron LGA.	49
Table 6 Artificial lighting issues summary - potential impacts to threatened species at urban hotspot areas within the immediate coastal are of the Byron LGA.....	64
Table 7 Prioritised action plan to reduce the impact of artificial lighting on sensitive coastal environments (Note: key actions are subject to identification of resources and funding streams).....	83
Table 8 BioNet records of threatened fauna occurring within proximity (approximately 1km) to the Byron coastline.....	93

Byron Shire Coastal Light Management Plan

Table 9 Consultation outcomes: key points raised by stakeholders in relation to lighting and impacts on wildlife or sensitive areas on the coastline of the Byron Shire. 97

Table 10 Consultation outcomes: suggested actions for implementation of mitigation measures to reduce coastal lighting impacts on wildlife or sensitive areas on the coastline of the Byron Shire. 99

Table 11 Commercial luminaire types that are considered generally less disruptive for use near threatened species habitat, and those to avoid 103

Glossary

Artificial light is composed of visible light, ultraviolet (UV) and infrared (IR) radiation derived from an anthropogenic source.

Biologically relevant describes an approach, interpretation or outcome that considers the species to which it refers or factors in biological considerations.

Coastal area refers to the land and sea area bordering the shoreline.

Coastal zone (as per SECT 4 of the *Coastal Protection Act 1979*) means: (a) the area within the coastal waters of the State as defined in Part 10 of the Interpretation Act 1987 (including any land within those waters), and (b) the area of land and the waters that lie between the western boundary of the coastal zone (as shown on the maps outlining the coastal zone) and the landward boundary of the coastal waters of the State, and (c) the seabed (if any) and the subsoil beneath, and the airspace above, the areas referred to in paragraphs (a) and (b).

Cumulative light refers to increased sky brightness due to light emissions from multiple light sources (measured as **skyglow**).

EPBC Act is the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Light pollution refers to **artificial light** that alters the natural patterns of light and dark in ecosystems.

Light spill is the light that falls outside the boundaries of the object or area intended to be lit. Light spill is also called spill light, obtrusive light or light trespass. Spill light serves no purpose and, if directed above the horizontal plane, contributes directly to **artificial skyglow**.

Light sources are any mechanisms that emit **light** visible to humans and wildlife. There are many natural light sources—the moon, the sun, stars, lightning, fires, etc. However, for managing the impacts of light, this document primarily refers to **light sources** generated by human activities that are visible outdoors at night. Light sources include streetlights, building lights, façade lights, vehicular and vessel lights and others.

Natural skyglow is that part of the **skyglow** that is attributable to radiation from celestial sources and luminescent processes in the earth's upper atmosphere.

Skyglow is the brightness of the night sky caused by the cumulative impact of reflected radiation (usually visible light), scattered from the constituents of the atmosphere in the direction of observation. Skyglow comprises two separate components: **natural skyglow** and **artificial skyglow**.

This glossary has been adapted from the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023) and Byron Shire Council Coastal Zone Management Plans (not certified).

Part 1: Background

1.1 Introduction

Artificial light has the potential to significantly disrupt coastal ecosystems, including stalling the recovery of threatened species, and compromising the ability of migratory species to undertake long-distance migrations (DCCEEW, 2023). Artificial light is composed of visible light, ultraviolet (UV) and infrared (IR) radiation derived from an anthropogenic source which alters the natural patterns of light and dark in ecosystems, thereby becoming light pollution.

Byron Shire Council (Council) is the recipient of a '*Reducing Light Pollution in Coastal Communities Grant*' from the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW). The grant was awarded to Council to develop this Coastal Light Management Plan ('the Plan') to assess the impacts of light pollution on wildlife and provide guidance on managing artificial light within Byron Shire. The Plan focuses within the immediate coastal area of the Byron Local Government Area (LGA), for the benefit of threatened and/or migratory listed species protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the (NSW) *Biodiversity Conservation Act 2016* (BC Act). The DCCEEW '*National Light Pollution Guidelines for Wildlife*' (2023) have informed the development of this Plan. The guidelines provide practical information required to assess and manage the light pollution impacts on protected wildlife, and how to manage artificial light in sensitive ecological coastal environments. The *Best Practice Lighting Design Principles* set out within the guidelines have been used as a framework for developing recommendations relevant to lighting infrastructure within the Byron coastal area.

The Byron Shire coastal area extends from the Tweed-Byron Shire border in the Billinudgel Nature Reserve in the north, to the Byron-Ballina Shire border in the south (refer **Figure 1** and **2**). The focus of the Plan are the threatened marine and terrestrial species that occur within the immediate coastal fringe. The coastal environment considered is within approximately 500m inland from the top of sandy beaches, dune systems or edges of rocky headlands and includes river and creek entrances. Lighting infrastructure within the coastal area assessed within this Plan is restricted to Council owned or managed infrastructure within Council owned or managed land. This Plan also extends its scope to consider other land tenures where opportunities exist for enhancing design and mitigating light pollution in urban areas. Recommendations made within this report may be applied to the design of future development or retrofitting of lighting infrastructure of all tenures.

Council is developing Coastal Management Programs (CMPs) for its coastlines in accordance with the NSW Coastal Management Framework. CMPs set the long-term strategy for coordinated management of the coast with a focus on achieving the objects of the Coastal Management Act 2016. CMPs are prepared by local councils in consultation with their communities and relevant public authorities.

Development of a CMP is a 4 staged process with Council currently finalising Stage 2 preparation. Stage 2 technical studies confirm current knowledge on key issues and

Byron Shire Coastal Light Management Plan

concerns and fill information gaps that are critical to the development of management strategies and actions that will occur in the next stage (Stage 3).

The development of this *Coastal Light Management Plan* is not a designated CMP Stage 2 technical study, however information, outcomes and a series of recommendations of this Plan will be integrated into the CMPs as they progress.

As developments in lighting technology continue to advance, a review of this plan is recommended within five years.

1.2 Scope, Purpose, Vision and Objectives of the CLPMP

1.2.1 SCOPE

This Plan has been developed in accordance with the *National Light Pollution Guidelines for Wildlife* (DCCEEW, 2023). The scope of the Plan is to evaluate lighting infrastructure within Council managed lands in proximity to the Byron coastline and assess its impact on threatened and/or migratory fauna species listed in the EPBC Act and/or BC Act for which artificial light has been demonstrated to affect behaviour, survivorship, or reproduction.

Where appropriate and relevant to the objectives of the Plan, the scope extends to consider other land tenures where opportunities exist for enhancing design and mitigating light pollution impacts to threatened and/or migratory fauna species. Recommendations made within this report may be applied to the design of future development or retrofitting of lighting infrastructure of all tenures.

1.2.2 PURPOSE

The purpose of this Plan is to assess the impact of artificial light on state and federally listed threatened and migratory fauna species from Council managed infrastructure immediately adjacent to the coastline and set in place a prioritised action plan for the mitigation of identified issues, including:

- Identifying relevant stakeholders for engagement;
- Upgrading, replacing/retrofitting Council managed lighting infrastructure;
- Providing barriers between artificial light at night and the beach; and
- Managing the need for lighting as a public safety requirement.

1.2.3 VISION STATEMENT

To protect and improve the unique natural environment of the Byron Shire coastline by reducing the impact of artificial light on wildlife.

1.2.4 OBJECTIVES

The objectives of this Plan are to:

1. Identify light outputs within the coastal area with potential to impact threatened fauna species;
2. Examine opportunities to reduce the output of light with potential to impact threatened fauna species from lighting infrastructure within Council managed lands adjacent to the Byron coastline to a level that is as low as reasonably practicable;
3. Reduce the visibility of Council managed lighting infrastructure within areas of sensitive habitat; and
4. Balance the requirement for public safety, recreation and amenity while protecting and preserving the coastal environment.

1.3 Study Area -The Byron Coast

The Byron coast comprises approximately 35 kilometres of land extending from the northern boundary with the Tweed Shire to its boundary with Ballina Shire in the south. In addition to residential/urban use the Byron coastline is highly valued for recreation and is used intensively for beachgoing, surfing, other water sports and fishing.

The NSW North Coast is also the traditional 'country' of the Bundjalung people. Aboriginal communities and Traditional Owners within Byron Shire include the Arakwal people, the Widjabal people and the Minjungbal people.

The coastal area is renowned for its biological diversity and cultural heritage and values and supports many threatened species of conservation significance in New South Wales. The Byron Shire coastline includes sandy beaches, rocky headlands and platforms and river and estuary mouths. The traditional custodians of Byron Shire maintain close cultural connection to the land and water and wildlife. Vegetation types within the coastal area include seagrass, saltmarsh, mangroves, wetlands, swamp forest, maritime grassland, coastal dune forest, heathland, coastal floodplain forest, wet and dry sclerophyll forest, littoral rainforest and subtropical rainforests. Approximately 50% of the coastline is adjacent to existing protected areas managed by the NSW National Parks and Wildlife Service (NPWS), and much of the Byron coast is zoned part of the Cape Byron Marine Park managed by the Department of Primary Industries (DPI) (refer **Figures 1 and 2**).

The coastline supports differing levels of urban, commercial, industrial and rural development (e.g. undeveloped land, low intensity development and more intense urban development). Byron Bay township represents the most concentrated urban, tourist and commercial development within the shire where outdoor lighting intensity is at its most concentrated. Due to increasing popularity as a 'lifestyle' destination, the Byron coastline is subject to ongoing development pressure which may have significant implications with respect to the health of the natural coastal environment.

Urban areas within the Byron coastline include South Golden Beach, New Brighton, Brunswick Heads, Byron Bay, Suffolk Park and Broken Head. Protected areas within the Byron coastline include Billinudgel, Marshalls Creek, New Brighton, Brunswick Heads, Tyagarah and Broken Head Nature Reserves, Cape Byron State Conservation Area and Arakwal National Park. A Marine Protected Area, Cape Byron Marine Park, covers marine terrain below mean high water mark south from Brunswick Heads, and includes Marshalls Creek and Simpson Creek Sanctuary Zones, and Belongil Creek and Tallow Creek Special Purpose Zones.

Byron Shire Coastal Light Management Plan



Figure 1 Locality map of the northern coastal portion of the Byron LGA (a – northern boundary to Brunswick Heads, b – Brunswick Heads to Belongil Creek)

Byron Shire Coastal Light Management Plan

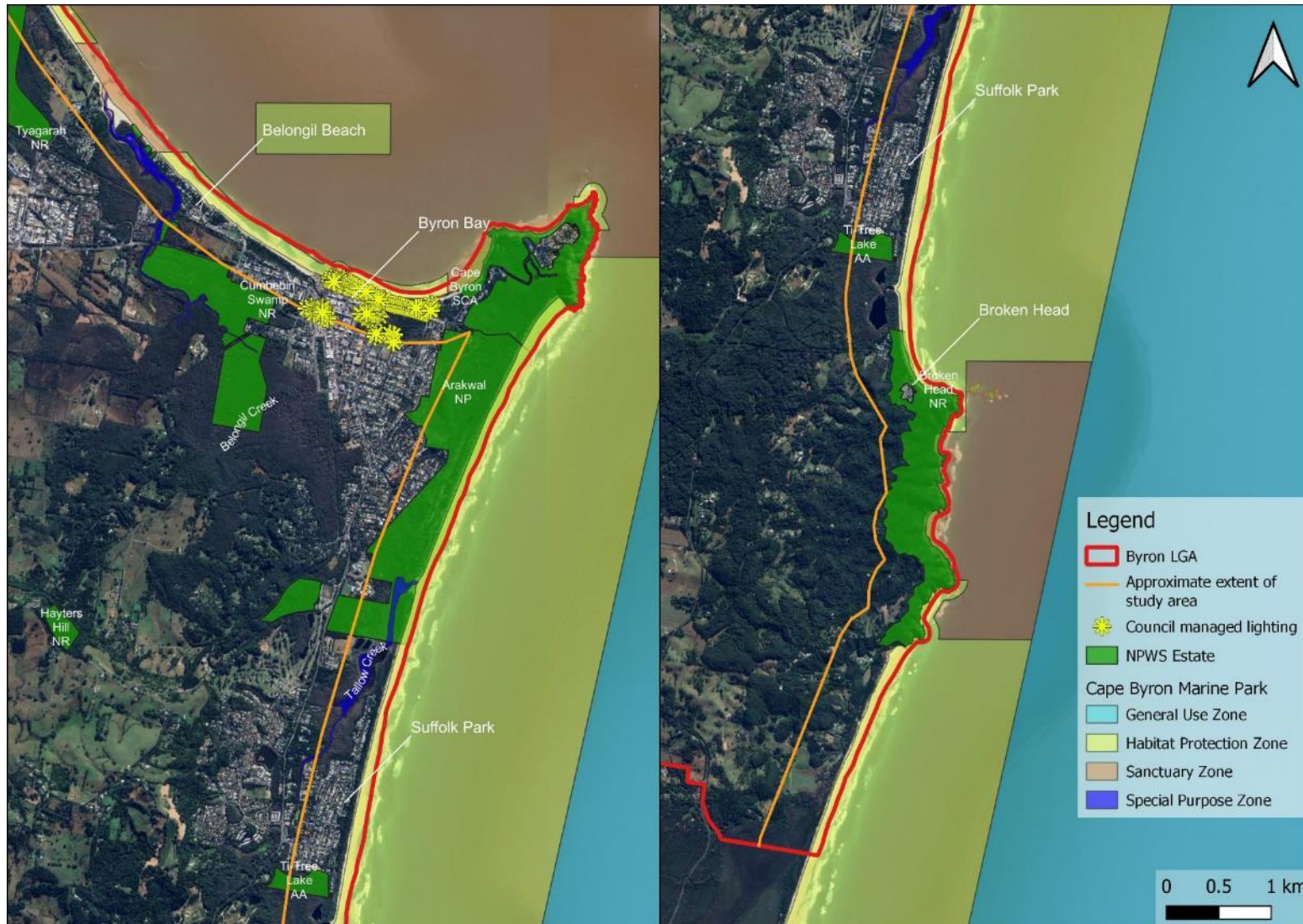


Figure 2 Locality map of the southern coastal portion of the Byron LGA (a – Belongil Creek to Suffolk Park, b – Suffolk Park to the southern boundary)

1.4 Artificial light

1.4.1 INTRODUCTION

Artificial light at night provides for human safety, amenity, convenience, and increased productivity or recreation, yet excess light at night is increasingly modifying natural light-dark regimes and has gained attention as an ecological threat (Gaston et al., 2013; Kamrowski, 2014). Artificial light that is excessive, inappropriate or poorly designed has the potential to reach into unwanted places and harm wildlife and ecosystems (DCCEEW, 2023). This is considered 'ecological light pollution' and a form of habitat modification and fragmentation (Longcore & Rich, 2004). Sources of ecological light pollution may include:

- Coastal developments (including residential, commercial, or industrial);
- Vehicle lights;
- Street lighting;
- Sporting facility lighting;
- Vessel lights (including deck and search lights); and
- Navigation aids and lighthouses.

Humans and wildlife do not experience light in the same way – light that appears dim to humans may be bright for some wildlife, while a person's view of a streetlight from street level may be different when viewed from below by a turtle, or above, by a bird (DCCEEW, 2023). Animals and plants use natural light indicators from the sun, moon and stars to time behaviour and life processes such as patterns of activity or rest, growth, reproduction, feeding and migration, and navigation over short and long distances (DCCEEW, 2023; Poot et al., 2008). Potential ecological harms from light pollution may include:

- Disorientation, misorientation, and poor navigation during long distance migrations or short distance wayfinding;
- Reduced suitability of habitat due to illumination;
- Attraction to artificial lights;
- Disturbed sleep or circadian rhythms;
- Changes to foraging behaviour and alterations to pollination or seed dispersal;
- Increased exposure to predators due to disrupted navigation or altered foraging or roosting behaviour; and
- Reduced survival and reproduction.

Impacts from light are described as 'positive phototaxis' where animals congregate around, or are misled towards, anthropogenic light sources (i.e. marine turtles), or 'negative phototaxis', where animals purposefully avoid habitat illuminated by artificial light (i.e. shorebirds) (DCCEEW, 2023; Syposz et al., 2021). Whole ecosystems can be negatively affected by the effects of light via fragmentation of suitable habitat, reduced pollination by nocturnal animals, disruption to food webs and the benefits afforded to invasive species including cats, foxes, and cane toads. These impacts can stall the recovery of threatened species or ecosystems (DCCEEW, 2023).

The extent to which animals respond to artificial light of different intensities, durations, and colours varies between species and species groups. The potential impacts of artificial light on threatened species recorded within the coastal area of the Byron LGA are discussed in detail in **Part 3** of this Plan.

The impacts of artificial light within coastal environments are likely to be exacerbated by other well-known threats to coastal ecology, including erosion, habitat loss and/or modification and the impact of residential, recreational, and industrial activities (Kamrowski, 2014).

1.4.2 NATIONAL LIGHT POLLUTION GUIDELINES FOR WILDLIFE

The *National Light Pollution Guidelines for Wildlife* (the Guidelines) (DCCEEW, 2023) are administered by the Australian Government (Federal) Department of Climate Change, Energy, the Environment and Water. The Guidelines provide users with the theoretical, technical and practical information required to assess whether artificial lighting is likely to affect wildlife, and the management tools to minimise and mitigate that effect. They apply to new projects, lighting upgrades and retrofitting, and where there is evidence of wildlife being affected by existing artificial light.

Best practice lighting design principles

The Guidelines recommend:

1. Always using best practice lighting design to reduce light pollution and minimise the effect on wildlife. Best practice lighting design incorporates the following design principles:
 - a. Start with natural darkness and only add light for specific purposes;
 - b. Use adaptive light controls to manage light timing, intensity and colour
 - c. Light only the object or area intended – keep lights close to the ground, directed, and shielded to avoid light spill;
 - d. Use the lowest intensity lighting appropriate for the task;
 - e. Use non-reflective, dark-coloured surfaces;
 - f. Use lights with reduced or filtered blue, violet and ultraviolet wavelengths.
2. Assessing the potential effects of artificial light on wildlife by undertaking an environmental impact assessment.

1.5 Stakeholder consultation

Stakeholder input to assess the impacts of artificial light on sensitive coastal environments was sought in the development phase of this Plan. Council engaged in stakeholder consultation to recognise identified issues with lighting infrastructure, to better understand the impacts of artificial light on target species, identify sensitive and important coastal environments for threatened species and discuss available management recommendations (refer **Appendix C** – Stakeholder consultation).

Stakeholders were invited to attend online meetings. Council's consultants, in conjunction with council staff, facilitated the online meetings. The meetings provided stakeholders with the opportunity to better understand the purpose and scope of the project and contribute valuable information.

Online meetings were held on the following dates:

- Project management meeting – 25 September 2023;
- External stakeholder meeting - 17 October 2023; and
- Internal stakeholder meeting (Council staff) - 18 October 2023.

Participants who were unavailable to join the meetings provided input by phone in October 2023.

A draft version of this Plan was shared with stakeholders to provide comment in January 2024.

1.5.1 PARTICIPANTS

Online meetings and phone calls were attended by representatives of the following groups, agencies or individuals:

- NSW National Parks and Wildlife Service (NPWS);
- Australian Seabird & Turtle Rescue;
- Cape Byron Marine Park Authority (DPI);
- Byron Bird Buddies
- Plummer & Smith landscape architects; and
- Council staff.

The following groups were invited to contribute:

- Arakwal Aboriginal Corporation

1.5.2 OUTCOMES

A summary of the outcomes from the two meetings is provided below (refer **Appendix C** for detailed summary). Key points raised in relation to lighting and impacts on threatened wildlife or sensitive coastal areas included:

- Description of likely threats to target species;
- Preference for the Plan to prioritise 'key urban centres' where the most significant potential for reducing light pollution exists.
- Acknowledgment of the substantial portion of the coastal area comprising protected areas that offer natural darkness along the Byron coast, which is beneficial for threatened and/or migratory species;
- There is a probable lack of community awareness of the collective impact of artificial light from various sources;
- Consideration must be given to public safety requirements; and
- Actions must also meet sustainability objectives.

Key points raised in relation to possible mitigation of lighting impacts included:

- Follow the Best Practice Lighting Design Principles for best outcomes;
- Explore community engagement opportunities;
- Council's planning instruments can provide policy and framework for managing development impacts;
- An emphasis on continued support for protected areas; and
- The importance of continued monitoring of lighting infrastructure as future upgrades or maintenance activities are carried out.

Part 2: Legislative and Regulatory Context

The Guidelines provide technical information to guide the management of artificial light for Commonwealth (EPBC Act) listed threatened and migratory species, species that are part of a listed ecological community, and species protected under state or territory legislation for which artificial light has been demonstrated to affect behaviour, survivorship or reproduction.

Regulatory considerations for the management of artificial light around wildlife have been considered here including the relevant Federal and State Acts concerning biodiversity in coastal or marine areas, and local policies and provisions including those concerning biodiversity, coastal zones, infrastructure, development and planning.

Light pollution is managed at the local council level through planning instruments, except where state/territory or Commonwealth environmental approvals require the management of light by a proponent.

2.1 International Agreements

Migratory seabird species in Australia are protected under international treaties and agreements including:

- The Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn Convention);
- The Ramsar Convention on Wetlands;
- The Agreement on the Conservation of Albatrosses and Petrels (ACAP); and
- The East Asian–Australasian Flyway Partnership.

The Australian Government has bilateral migratory bird agreements including:

- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA); and
- Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA).

Marine turtles in Australia are protected under international treaties and agreements including:

- Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn 1979);
- Convention on International Trade in Endangered Species of Flora and Fauna (CITES, Washington 1973); and
- CMS Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA, 2005).

In Australia, the EPBC Act gives effect to these international obligations (refer overleaf).

2.2 Commonwealth Legislation and Guidance

2.2.1 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The EPBC Act and regulations are Australia's main environmental regulation, referring to the living things, habitats and places that need protecting as 'Matters of National Environmental Significance' (MNES). The Act regulates any action that will have, or is likely to have, a significant impact on MNES, including listed threatened and migratory species, and threatened ecological communities. Any action likely to have a significant impact on MNES must be referred to the Australian Government for assessment.

The following documents provide guidance on determining whether an action is likely to have a significant impact on a matter protected under the EPBC Act:

- EPBC Act Significant Impact Guidelines 1.1: Matters of National Environmental Significance;
- EPBC Act Significant Impact Guidelines 1.2: Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies;
- Recovery plans and approved conservation advice for listed threatened species; and
- Approved wildlife conservation plans for listed migratory species.

The EPBC Act also lists a number of key threatening process (KTPs); however artificial light is not listed as a KTP within the Act.

2.3 State Legislation and Guidance

Table 1 provides a summary of New South Wales legislative and regulatory documents relevant to this Plan and its objectives. Consideration was given to the function of relevant environment and planning legislation and policy concerning the management of the coastal and marine environments, the protection of wildlife from artificial light, and the standards and requirements for lighting for the purpose of human safety and amenity.

Table 1 Summary of NSW legislative and regulatory documents relevant to this Plan

Plans and Strategies	Summary of Relevance to the CLMP
<p>NSW Marine Estate Management Strategy 2018-2028</p>	<p>The NSW Marine Estate Statewide Threat and Risk Assessment (TARA) identifies threats and underpins priorities identified in the NSW Marine Estate Management Strategy (2018-2028). Initiative 5 in the Strategy focuses on reducing threats to threatened and protected marine species. A priority threat is an intended activity or stressor with a high to moderate risk of causing significant harm.</p> <p><i>‘Foreshore and urban development’, ‘recreation and tourism’ and ‘boating and boating infrastructure’</i> are listed in the top 10 priority threats to marine biodiversity and ecosystem integrity and include references to artificial lighting.</p> <p>Examples of management actions provided include:</p> <ul style="list-style-type: none"> • <i>Amend development control plans to include requirements for a light pollution plan for development applications within a specified location or distance, such as 1 kilometre from the coastline, where deemed necessary by the consent authority.</i> • <i>Audit, assess and manage the impacts of artificial light on native wildlife, including marine turtles, seabirds and migratory shorebirds using the National Light Pollution Guidelines for Wildlife and revise lighting specifications for foreshore development to reduce urban glow.</i> • <i>Conduct a light audit based on the National Light Pollution Guidelines for Wildlife, and revise current infrastructure in sensitive habitat, nesting and roosting areas and sites used for passive recreation and ecotourism.</i>

Plans and Strategies	Summary of Relevance to the CLMP
	<ul style="list-style-type: none"> • <i>Develop policy or codes supporting responsible outdoor lighting principles and infrastructure revision to reduce urban glow and promote astro-tourism.</i> <p>The strategy also recognises the need to <i>minimise light pollution impacts in future developments to give space and capacity for migratory species as they adapt to new sites due to the effects of climate change and as some species recover and recolonise the coast</i> (NSW Government Marine Estate Management Authority, 2017).</p>
<i>Protection of the Environment Operations (POEO) Act 1997</i>	<p>The POEO Act is the main pollution law in NSW. Artificial light is not listed as a form of pollution in NSW, unlike in other jurisdictions which include light in its statutory definition of a pollutant, such as the ACT (<i>Environment Protection Act 1997, ACT</i>).</p>
<i>Biodiversity Conservation Act 2016 (BC Act)</i>	<p>The purpose of the BC Act includes to conserve biodiversity at the bioregional and state scales. Under this Act, a person who harms or attempts to harm an animal of a threatened species, an animal that is part of a threatened ecological community, or a protected animal, is guilty of an offence.</p> <p>Artificial light is not listed as a Key Threatening Process within the BC Act.</p>
<i>Coastal Management Act 2016</i>	<p><i>The objects of this Act are to manage the coastal environment of New South Wales in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State.</i></p> <p>Artificial light is not referred to explicitly within the <i>Coastal Management Act 2016</i>.</p> <p>The Act forms part of the newly established integrated coastal management framework which aims to have resilient coastal communities now and into the future. The Act outlines the requirements for the preparation of Coastal Management Programs (CMPs).</p> <p>The CM Act (and other relevant legislation) establishes specific roles and responsibilities for relevant Ministers, the NSW Coastal Council, public authorities and local councils, as well as providing opportunities for communities to participate when</p>

Plans and Strategies	Summary of Relevance to the CLMP
	preparing and implementing a Coastal Management Program (refer Table 2).
<i>Fisheries Management Act 1994 (FM Act)</i>	<p><i>The objects of this Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.</i></p> <p>This Act includes the object of conservation of threatened species, populations and ecological communities of fish and marine vegetation. Artificial light is not listed as a Key Threatening Process within the FM Act.</p>
<i>National Parks and Wildlife Act 1974</i>	<p>The objects of this Act are as follows—</p> <ul style="list-style-type: none"> a) the conservation of nature b) the conservation of objects, places or features (including biological diversity) of cultural value within the landscape c) fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation, d) providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.
<i>Environmental Planning and Assessment Act 1979</i>	<p>Relevant objects of the EPA Act include:</p> <p><i>(a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,</i></p> <p><i>(e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats,</i></p> <p>and</p> <p><i>(g) to promote good design and amenity of the built environment.</i></p> <p>Artificial light and impacts on wildlife are not described within the Act.</p>

Plans and Strategies	Summary of Relevance to the CLMP
	<p>Crime prevention through environmental design (CPTED), including lighting for public safety, is described in <i>Crime prevention and the assessment of development applications guidelines under section 79C of the Environmental Planning and Assessment Act 1979</i>.</p>

2.4 Local Policy and Provisions

Table 2 provides a summary of Council’s planning instruments, and other management plans and strategies relevant to this Plan and its objectives. Consideration was given to the function of relevant instruments concerning the management of the coastal and marine environments, the protection of wildlife from artificial light, and the standards and requirements for lighting for the purpose of human safety and amenity.

Table 2 Summary of Byron Shire Council planning instruments and other management plans and strategies relevant to this Plan.

Plans and Strategies	Summary of Relevance to the CLMP
<p>Byron Local Environmental Plan 2014 (Byron LEP 2014) and Byron Local Environmental Plan 1988 (Byron LEP 1988) for deferred matters</p>	<p>The Byron LEP is the main land use planning document for the Byron Shire. It designates what constitutes appropriate use of land, including setting land aside for conservation, development and recreation. Currently the Byron LEP does not have any specific controls in place relating to artificial lighting and impacts to wildlife.</p> <p>Light pollution can and often is regulated through planning controls. The current LEPs do not have specific controls in place for wildlife friendly lighting. An example of a code applicable to assessable development within sea turtle sensitive areas is the <i>Sea Turtle Sensitive Area Code – A Model Code for Local Government</i>, prepared by the Queensland Government (State of Queensland, 2019).</p>
<p>Byron Development Control Plan 2014 (Byron DCP 2014) and Development Control Plan No 1 (DCP 1988)</p>	<p>The Byron Shire Development Control Plan (DCP) provides planning and design guidelines and prescriptive measures to support the planning controls set out in the LEP. Prescriptive measures within the DCP with relevance to this plan include:</p> <p>Chapter B1: Biodiversity –</p> <p><i>17. Where the development envelope contains or adjoins known bush stone curlew habitat or microbat colonies, street lighting must be of a type that does not attract insects.</i></p> <p><i>18. Sports field lighting (or similar high intensity outdoor lighting) shall be designed to avoid light spill into natural areas.</i></p> <p><i>19. Development adjacent to beaches must prevent light arising from development spilling onto beaches to avoid potential impacts on shorebird and turtle behaviour (e.g. nesting).</i></p> <p><i>20. Where a vegetation or biodiversity conservation management plan is required, any measures or related</i></p>

Plans and Strategies	Summary of Relevance to the CLMP
	<p><i>conditions of consent to mitigate noise and lighting shall be incorporated into the management plan and implemented accordingly.</i></p> <p>Chapter D3: Rural tourist accommodation</p> <p><i>Night time lighting for outdoor recreational facilities such as tennis courts or sporting facilities is prohibited. All other external lighting should be limited to protect the dark night sky and the rural atmosphere of the locality (e.g. lighting located around pool areas).</i></p> <p>This wording could be modified to incorporate consideration to wildlife, and included in prescriptive measures relating to any/all coastal development.</p> <p>Chapter D6: Subdivision (D6.2.1)</p> <p>Chapter D6 of the Byron DCP states that street lighting is to comply with Australian Standard (AS) 1158. AS1158 specifies the performance and design requirements for roads, footpath and other external, public spaces. The controlling authority over the public space is responsible for determining the applicable lighting subcategory within the standard and that subcategory then references the relevant light technical parameters. The lighting design is required to comply with the light technical parameters which include:</p> <ul style="list-style-type: none"> • Average horizontal illuminance; • Point horizontal illuminance; • Illuminance uniformity; • Point vertical illuminance; and • Upward waste light ratio. <p>A number of different factors are considered by the lighting designer to achieve a design which is compliant with these parameters. These include:</p> <ul style="list-style-type: none"> • Luminaire IP rating and maintenance regime (to determine the correct Light Loss Factor); • Luminaire light output; • Luminaire light distribution; • Luminaire aim; • Luminaire upward waste light; • Luminaire positioning; • Luminaire spacing; • Luminaire mounting height; • Shading from surrounding features; • Reflectance of surrounding features; and

Plans and Strategies	Summary of Relevance to the CLMP
	<ul style="list-style-type: none"> • Ground reflectance. <p>AS1158 focuses on the minimum visual requirements to provide safe movement within the space. It does not take into consideration other stakeholders and external aspects such as energy consumption and surrounding natural wildlife. These aspects are covered in separate items within this report.</p> <p>Chapter B11: Planning for Crime Prevention (B11.2.3)</p> <p>Chapter B11 states lighting requirements as follows:</p> <p><i>a) achieve consistency in lighting to reduce contrast between shadows and illuminated areas;</i></p> <p><i>b) ensure lighting is directed towards pedestrian pathways and public spaces, taking into account the mature height of landscaping and other impediments;</i></p> <p><i>c) provide for ample lighting of common areas such as entrances, stairwells and parking areas;</i></p> <p><i>d) locate bright lights in heavily used spaces but ensure they do not create a ‘wall of darkness’ or create glare for pedestrians and motorists.</i></p> <p>There may be conflict between optimising the conservation value of darkness and the perception of public safety. Each location should be assessed on a site-by-site basis, with consideration also given to funding availability. In some instances, the best outcome for wildlife may not be acceptable to public safety requirements.</p>
<p>Byron Shire Community Strategic Plan 2032 (prepared under s.402 of the <i>Local Government Act 1993</i>)</p>	<p>The Byron Shire Community Strategic Plan, 2032 guides Council’s activities over ten years and is based on in-depth community engagement to understand the community’s collection vision, aspirations and priorities. The CSP is based around 5 community objectives underpinned with 25 strategies. Most relevant to this CLMP is Community Objective #3 ‘We nurture and enhance the natural environment. Linked strategies under this objective are:</p> <p><i>3.1 - Partner to nurture and enhance biodiversity, ecosystems and ecology</i></p> <p><i>3.3 - Protection the health of coastline, estuaries, waterways, and catchments</i></p>

Plans and Strategies	Summary of Relevance to the CLMP
<p>Byron Shire Council Delivery Program 2022 - 2026</p>	<p>Council’s Delivery Program turns the strategic objectives found in the Community Strategic Plan into actions. It is Council’s commitment to the community, outlining what it intends to do toward achieving the goals of the community strategic plan during its term of office. All plans, projects, activities, and funding allocations must be directly linked to the four-year DP. Relevant to this CLMP is:</p> <p><i>Activity 3.1.1 ‘Native Species’ - Use best practice land management to improve ecological resilience and reduce threats to biodiversity.</i></p> <p><i>Activity 3.3.1 ‘Coastal Management Program’ – Undertake Coastal Management Program planning and implementation.</i></p>
<p>Byron Shire Council Operational Plan (OP) 2023 - 2024</p>	<p>The Delivery Program is supported by an annual Operational Plan which details the individual projects and activities that will be undertaken each year to achieve the commitments of the Delivery Program. Relevant to this CLMP is:</p> <p><i>Activity 3.3.1.8 - Identify and evaluate management options and opportunities for addressing threats to the Byron Shire coastal zone and prepare Coastal Management Programs (CMPs – refer below).</i></p>
<p>Coastal Management Programs (currently in preparation)</p>	<p>Coastal management programs (CMPs) set the long-term strategy for the coordinated management of the coast, with a focus on achieving the objects and objectives of the Coastal Management Act 2016 (CM Act).</p> <p>CMPs identify coastal management issues and the actions required to address these issues in a strategic and integrated way.</p> <p>CMPs detail how and when those actions are to be implemented, their costs and proposed cost-sharing arrangements and other viable funding mechanisms.</p> <p>Council has commenced the preparation of CMPs for its coastline. The outcomes of this CLMP will be used to inform CMP preparation.</p>
<p>Byron Open Spaces Asset Management Plan 2020 – 2029</p>	<p>This plan demonstrates Council’s management of open space assets, compliance with regulatory requirements and proposed funding requirements to provide the required levels of service.</p> <p>Results of community engagement undertaken during preparation of the plan outlined clear preference for Council spending money upgrading existing infrastructure (rather than</p>

Plans and Strategies	Summary of Relevance to the CLMP
	<p>building new) with sports field lighting being the most nominated infrastructure for Council to invest funds.</p> <p>There are 344 light-poles listed as asset stock within this plan. Correspondence with Essential Energy regarding a bulk LED luminaire upgrade was undertaken in 2022.</p> <p>Council has recently systematically upgraded its street lighting. This project involved the bulk replacement of all existing streetlight bulbs to LED bulbs. The project began with a trial in Ocean Shores and has since been rolled out Shire-wide. There are 81 lights remaining of 1939 (as per staff comments Jan 2024). It is understood that no other lighting upgrades are planned.</p>
<p>Byron Shire Biodiversity Conservation Strategy 2020 – 2030 (Byron Shire Council, 2020)</p>	<p>The Byron Shire <i>Biodiversity Conservation Strategy 2020-2030</i> sets out a Strategic Framework and Action Plan to protect and enhance biodiversity within the Byron LGA. Specific actions with relevance to this plan relate to:</p> <ul style="list-style-type: none"> • threatened species habitat management; and • planning controls with respect to ‘Habitat Zones’.
<p>Byron Bay Town Centre Masterplan (Byron Shire Council, 2016)</p>	<p>Recommendations within the Town Centre Masterplan that relate to artificial lighting and coastal environments within the Byron LGA include:</p> <ul style="list-style-type: none"> • <i>Main Beach should be enhanced to form a seamless connection between Apex Park, Peace Park, Denning Park and Foreshore Park. A new play space and inter-generational zone should be sensitively integrated into the open space supporting a greater array of community uses for all ages.</i> • <i>Clarkes beach will remain a favourite spot for locals and tourists alike. The existing sand dune regeneration should continue, as well as improved opportunities for BBQ spaces, picnicking, public domain treatments, and car parking. The present character that is dominated by endemic vegetation and ‘bush tracks’ to the beach should be retained.</i> • <i>Swimming Pool and Car Park - Upgrade the existing swimming pool facilities and undertake feasibility studies of the foreshore car park to determine the appropriate use of the site in collaboration with Crown Land.</i> • <i>Surf Lifesaving Club - Work with Crown Land to prepare a detailed site investigation in upgrading the Surf Lifesaving Club that adequately supports the local lifesaving</i>

Plans and Strategies	Summary of Relevance to the CLMP
	<p><i>organisation as well as offering some commercial capacity such as a restaurant, beach-side café and community space.</i></p> <p>Mentions of lighting include:</p> <ul style="list-style-type: none"> • <i>Install lighting into public spaces to improve safety and nighttime use. Lighting can also be incorporated subtly into the streetscape and street furniture or used to define landscape features or buildings.</i> • <i>Lighting adds interest to public space and also extends usability into the night (with a visual image of embedded lighting into paving)</i>
<p>Byron Foreshore Concept Landscape Plan (Plummer and Smith, currently in preparation)</p>	<p>A key piece of the Byron Bay Town Centre Masterplan (2016) is redevelopment of the foreshore areas. The Byron Foreshore is iconic and plays a critical role in attraction of Byron Bay both nationally and internationally. The foreshore runs adjacent to the highly valued recreational assets – Main and Clarkes Beach and comprises a mix of parklands and assets that supports passive recreation, community clubs and commercial businesses and events.</p> <p>Council has engaged a consultant to develop a Concept Landscape Plan for the area that will guide future projects, development and activities on the foreshore as based on stakeholder and community engagement.</p> <p>The foreshore is a key area for Council management including lighting and infrastructure. The outcomes of the CLMP will be incorporated into this plan as relevant and will guide any upgrades and/or amendments to lighting within the foreshore area.</p>
<p>Cape Byron Marine Park (CBMP) Operational Plan (Marine Parks Authority, 2010).</p>	<p><i>The Cape Byron Marine Park Operational Plan details the strategies and management actions being undertaken by the Marine Parks Authority to meet key objectives focused on conservation of marine biodiversity including ecological processes, providing opportunities for ecologically sustainable use, and public appreciation, enjoyment and understanding of the marine park.</i></p> <p><i>The marine park extends approximately 37 kilometres from the northern training wall of the Brunswick River south to Lennox Head on the Far North Coast, from the mean high-water mark and upper tidal limits of coastal estuaries out to the three nautical mile limit of state waters. The 22,000 hectare park includes the tidal waters of the Brunswick River and its tributaries, Belongil Creek and Tallow Creek.</i></p>

Plans and Strategies	Summary of Relevance to the CLMP
	<p><i>Management actions have been organised under the following strategies to deliver on the key marine park objectives:</i></p> <ol style="list-style-type: none"> <i>1. Identification and adaptive management of threats to marine biodiversity and habitats;</i> <i>2. Protection of threatened species and endangered ecological communities;</i> <i>3. Assessing developments in and affecting the marine park to minimise impacts;</i> <i>4. Maximising voluntary compliance with the marine park zoning plan;</i> <i>5. Ecologically sustainable management of commercial activities;</i> <i>6. Delivering an ecological, social, cultural and economic research and monitoring program;</i> <i>7. Promotion of sustainable tourism and recreational uses; and</i> <i>8. Ensuring management is consistent with the cultural aspirations of Aboriginal people.</i> <p>Although artificial lighting is not explicitly mentioned within the CBMP Operation Plan, mitigation of lighting as a threat to marine biodiversity and habitats is consistent with <i>Objective 1 - To conserve marine biodiversity, marine habitats and maintain ecological processes in the marine park</i>, including:</p> <ol style="list-style-type: none"> <i>1. identification and adaptive management of threats to marine biodiversity and habitats; and</i> <i>2. protection of threatened species and endangered ecological communities.</i>
<p>Crown land 2031 – State Strategic Plan for Crown land (DPIE, 2021)</p>	<p>Crown Land that is dedicated or reserved that is managed by Council that is classified as ‘community land’ will be subject to Plans of Management developed by Council under both the <i>Crown Land Management Act 2016</i> and <i>Local Government Act 1993</i>. Crown land 2031 represents the 10-year vision for Crown land in New South Wales. It is the first State Strategic Plan for Crown land.</p>

Plans and Strategies	Summary of Relevance to the CLMP
Plans of management for public land	NPWS manages a substantial area of land within the study area. These areas are managed under various Plans of Management developed by NPWS. These plans identify their extent, values and sensitivities and provide extensive management information for the environment and community use of the areas.

Part 3: Environmental impact assessment

3.1 Describe the project lighting

3.1.1 METHODOLOGY

The following methodology was used to review lighting infrastructure at Council managed lands within the coastal area:

- Review of best practice lighting design described in the Guidelines
- Desktop review of lighting infrastructure (within Council managed lands) mapping layers to determine the location and number of individual lighting sources across the Byron coast and within proximity to the coastal area;
- Site inspection both during the day and at night to visually check lighting; infrastructure at Council managed lands within key coastal urban areas as identified by Council, including:
 - recording the placement, number, orientation and management of each lamp and lamp type; and
 - describing the surrounding light environment and potential issues that may arise from individual light sources.
- Make recommendations for improvements or modifications to lighting infrastructure in relation to best practice lighting design.

Site inspection of lighting infrastructure was completed for this Plan at the key urban areas of:

- South Golden Beach;
- New Brighton;
- Brunswick Heads; and
- Byron Bay, including Main Beach, Clarkes Beach and Belongil Beach.

Lighting infrastructure at Wategos Beach, Suffolk Park and Broken Head was reviewed by desktop. General recommendations described within this Plan are applicable to all areas within the LGA (refer Part 4).

3.1.2 LIMITATIONS

The methodology was limited to infrastructure on Council managed lands within approximately 500m of the coastline and did not include a detailed assessment of all street lighting or lighting from commercial, industrial, residential or other sources. This scope was extended to consider lighting of other land tenures where opportunities to improve lighting design were apparent.

The methodology was restricted to a general light audit and assessment and aimed to provide solutions that results in an overall reduction in artificial light visible to threatened wildlife. There are no generally agreed methods for measuring biologically relevant light for wildlife (Barentine 2019), as most conventional methods of measuring light are photometric,

quantifying only light most relevant to human perception. It is anticipated that new methods will become available that will meet the objectives of monitoring biologically meaningful light (DCCEEW, 2023). The methodology was also unable to consider skyglow. Future review of this document might incorporate these methods.

3.1.3 LIGHTING TENURE

The study area is comprised of a mixture of land tenure and land management arrangements; private freehold land (not specifically labelled), Council public land (community and operational land), Crown land (unreserved), land that is reserved or dedicated (called Crown Reserves and Crown Dedications), state conservation areas / national parks / nature reserves / Aboriginal Areas and marine park (refer **Figures 1 and 2**). Road reserves and railway lands are not depicted within figures. Due to scale mapping may contain some inaccuracies.

Most of the beach areas of the study area, below mean high water mark (MHW) that are not within national parks or nature reserves is unreserved Crown land owned by DPIE – Crown Lands. Most beach areas within the study area, above MHW that are not within national parks or nature reserves, are reserved or dedicated Crown Land owned by DPIE – Crown Lands with some but not all managed by Council.

Lighting management tenure is generally aligned with land tenure. Light infrastructure on Council managed lands is shown in **Figures 1 and 2**. In New South Wales, the electricity distributor Essential Energy owns and is responsible for the maintenance of most streetlights.

3.1.4 DETAILED LIGHTING ASSESSMENT RESULTS

3.1.4.1 MAIN BEACH TO CLARKES BEACH

The foreshore reserve from Main Beach to Clarkes Beach is a managed urban landscape including buildings, carparks, streets, paved footpaths, mown lawns and beach access points. The reserve is currently illuminated at night by pedestrian, carpark and street lighting. Historical land clearing and erosion has resulted in the absence of dune vegetation at the Jonson Street end of the reserve. Dune vegetation increases in width as the reserve continues towards Massinger Street.

Domestic and commercial lighting from the Byron Bay township beyond the foreshore area contribute to diffuse source skyglow. The area east of Massinger Street, towards The Pass, is less affected by point and diffuse sources of light.

Several lighting design issues have been identified at this location. Further consideration of impacts to threatened species due to inappropriate lighting design is included in **Part 3 Step 3 Impact assessment**.

Byron Bay Swimming Pool

Eight post-mounted flood lights are located within the Byron Bay Swimming Pool facility. Four are directed towards the beach (**Plate 1: L1**). These lights are operated on timer control - two lights remain on at night for security and public safety. This measure is required to discourage unauthorised entry into the pool outside of operating hours.

The following measures could be taken to limit impacts on coastal wildlife:

- a. Install shade shield fittings to control the light spillage into the carpark and reduce the amount of light being directed towards the beach.
- b. Replace metal halide fittings with purpose made LED fittings (one is already an LED fitting) to provide better distribution control and limit light spill towards the beach. Provide amber light LED source to further limit the impact.

Main Beach Seawall carpark

The carpark has four compact fluorescent post-mounted floodlights on the western side, facing the beach (**Plate 1: L2**). The fittings have an approximately 5-degree upward tilt. The luminaires are coloured white. Two were not illuminated at the time of evening survey. The floodlights support the night-time operation of security cameras mounted to the same poles and are required to operate through the night to enable camera views of the carpark and grassed area of Apex Park.

The following measures could be taken to limit impacts on coastal wildlife:

- a. Install shade shield fittings to control the light spillage into the carpark and reduce the amount of light being directed towards the beach.
- b. Replace metal halide fittings with purpose made LED fittings (one is already an LED fitting) to provide better distribution control and limit light spill towards the beach. Provide amber light LED source to further limit the impact.

- c. Installation of a physical barrier between the carpark and the beach such as plant screening or a low wall would increase the control efficiency and provide a barrier between the beach and vehicle headlights within the carpark.

Council are the owner/operator of the security cameras however the user of the surveillance equipment is the police. Consultation should be undertaken prior to any changes to the lighting being made that may impact the quality of the camera image.



Fishheads restaurant event spotlights

Two posts with floodlights directed towards the public carpark at Jonson Street, Main Beach, located outside Fishheads restaurant (refer **Plate 2: L3**). These lights have an almost horizontal aim with major light spill towards the beach.

Council operates these spotlights to illuminate areas of Main Beach and adjacent foreshore for *Schoolies weeks* (November/December) and New Year's Eve. The need for increased lighting was driven by safety concerns for participants of the Schoolies and New Year's events and for users of Apex Park and Main Beach Reserve. The proposal for installation of these lights was approved in 2010 and described an illuminated area of intertidal beach habitat of 1 hectare. An assessment of significance was undertaken (Fitzgerald, 2010), which concluded no population scale effects on threatened fauna were likely. It was recognised that an increase in artificial lighting has the capacity to degrade coastal habitats.

The provision of increased lighting at these locations was assessed for specific and limited use during the described periods. Observations of these spotlights remaining operational beyond the approved timing have resulted in concerns raised by Council staff and requests for review of their use.

The intention of these lights to provide supplementary lighting to the adjacent carpark and adjoining grassed area would be better achieved with localised fittings utilised with specific light distribution and downward facing aim.



Plate 2: Two posts with floodlights directed towards the public carpark at Jonson Street, located outside Fishheads restaurant are visible from the beach (L3).

Main and Clarkes Beach Foreshore

The most commonly recurring problem at Main Beach is the light fitting types and their unsuitability for light control. The light grey, post-top fittings with a circular head (Cree Edge) (refer **Plate 3: L4**) are used throughout the park areas and along the pathways. The fittings do not provide a physical shield/barrier to prevent spill light onto the beach and most are visible from the beach, projecting the majority of the light towards the beach.

Most of the luminaires in proximity to the top of the beach or where dune vegetation is sparse are fitted with amber light LED modules to reduce impacts to marine turtles. Luminaires along the pedestrian walkway adjacent to Bay Street and Lawson Street are

fitted with white light LED modules. Different optics are available for the fittings which provide some control of the light distribution.

Other problem light fixtures have been made redundant due to dune plantings and installation of new fencing limiting pedestrian access (refer **Plate 4: L5**). Other fixtures are sufficiently buffered from intertidal habitats by vegetation (refer **Plate 5: L6**) but may have impacts to terrestrial threatened species utilising dune vegetation.

The following measures could be taken to limit impact on coastal wildlife:

- Timer or motion sensor control to dim the lights when the public space is not being used.
- Replace all lights with fittings that are amber, or reduced UV white LED fittings.
- Replace the lights with fittings that have more directional distribution control.
- Replace the lights with bollard fittings to keep the light source lower to the ground and limit light spill; and
- Removal of light fittings that have been identified as redundant or not required.

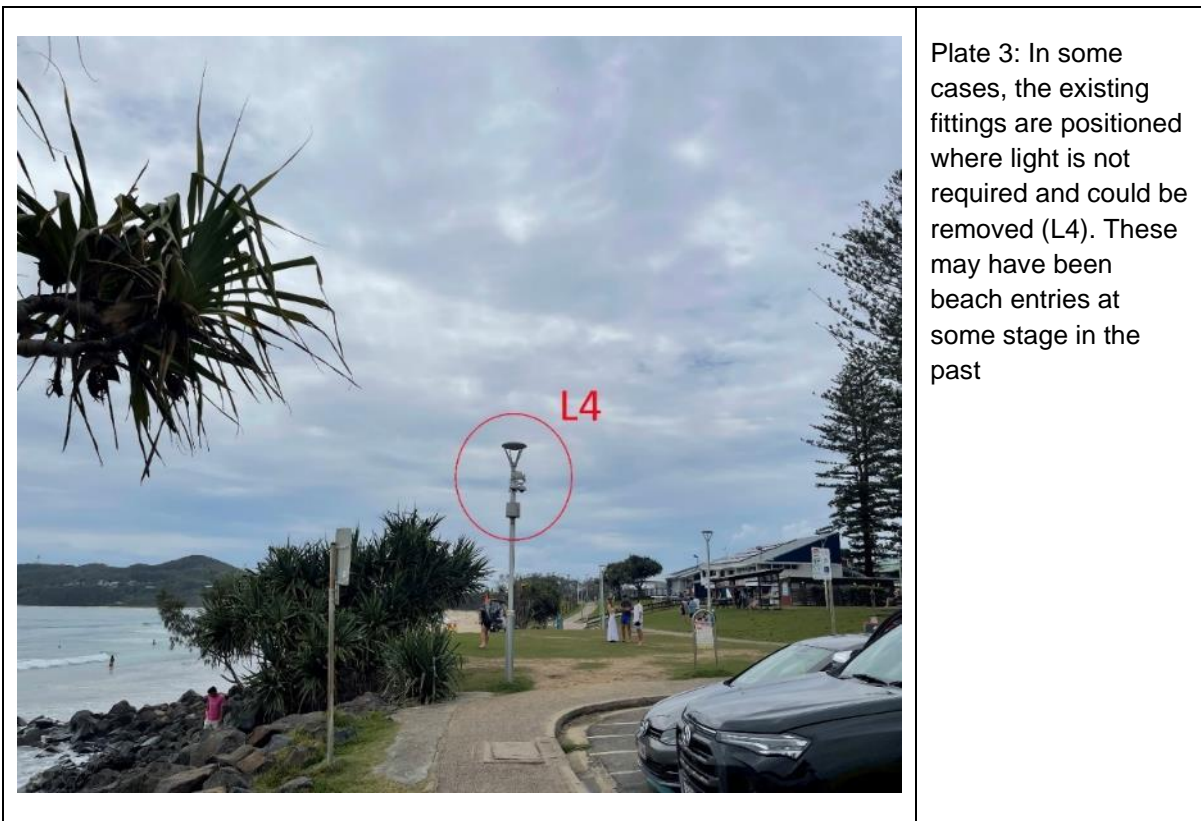
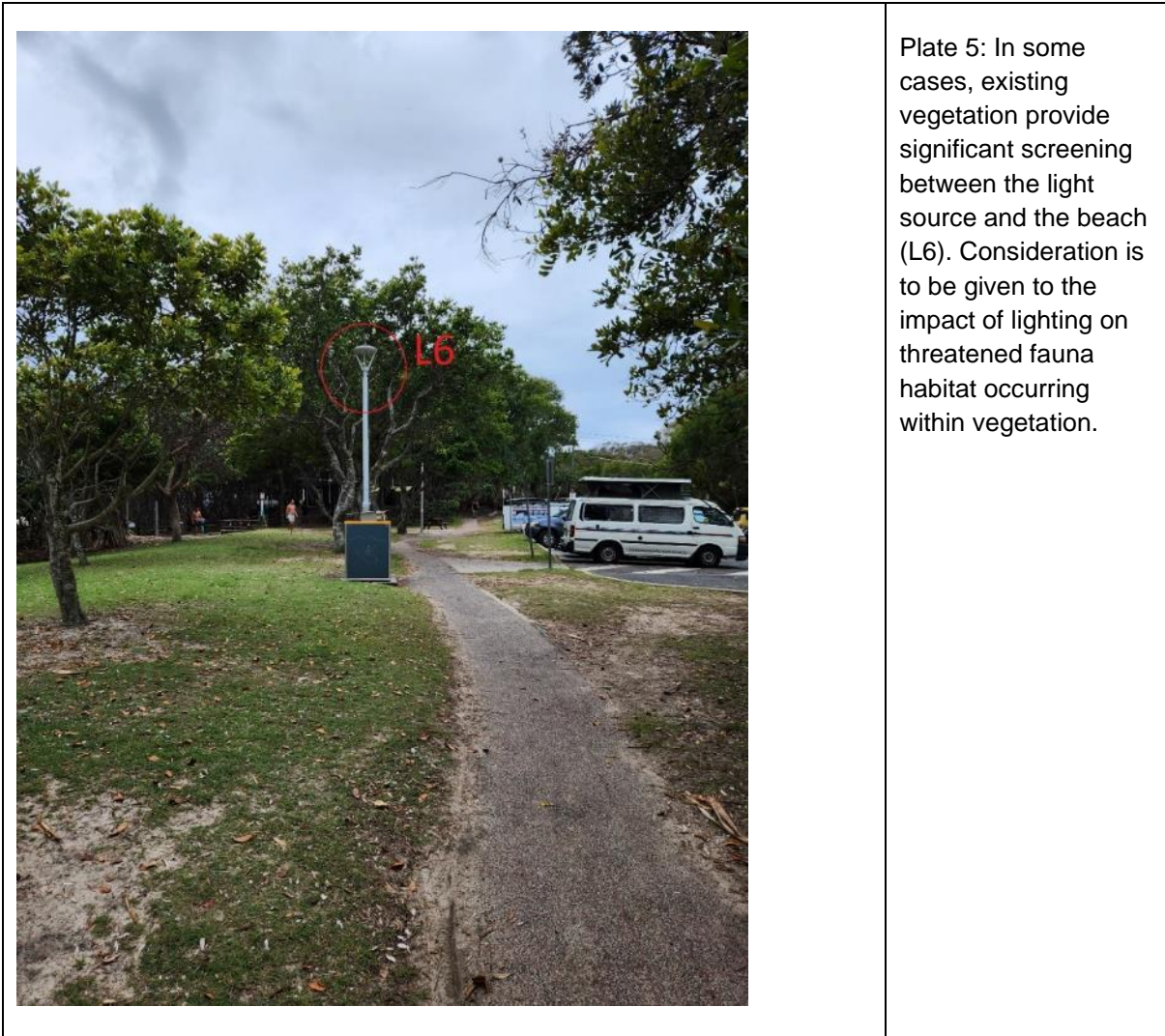




Plate 4: Foreshore plantings and new fencing have resulted in redundancy of some light fixtures (L5).



Byron Bay Surf Life Saving Club Floodlights

The Byron Bay Surf Life Saving Club has two roof mounted posts, with floodlights directed towards the beach (refer **Plate 6: L7**). The purpose of these lights is likely to illuminate the beach during night-time events.

An alternative, more suitable solution would be to provide mobile, temporary lighting. Utilised only during events, the lighting could be positioned near the water's edge and directed back towards the club. This would eliminate direct visibility of the light source from the ocean.



Plate 6: Roof mounted floodlights directed towards the beach at the Byron Bay Surf Life Saving Club (L7).

Bay Street South Carpark

The carpark currently has three light fittings providing light to the parking area and an additional fitting providing lighting to the adjacent grassed area. Two of these lights (one aiming at the carpark and one at the grassed area) are Essential Energy fittings mounted on old timber poles (refer **Plate 7: L8**). Both are providing spill light onto the beach.

As the Essential Energy light fittings are built for the purpose of road lighting, the light distribution from these is not suitable for directional aim onto a carpark and public space while also limiting the light spill onto other areas.

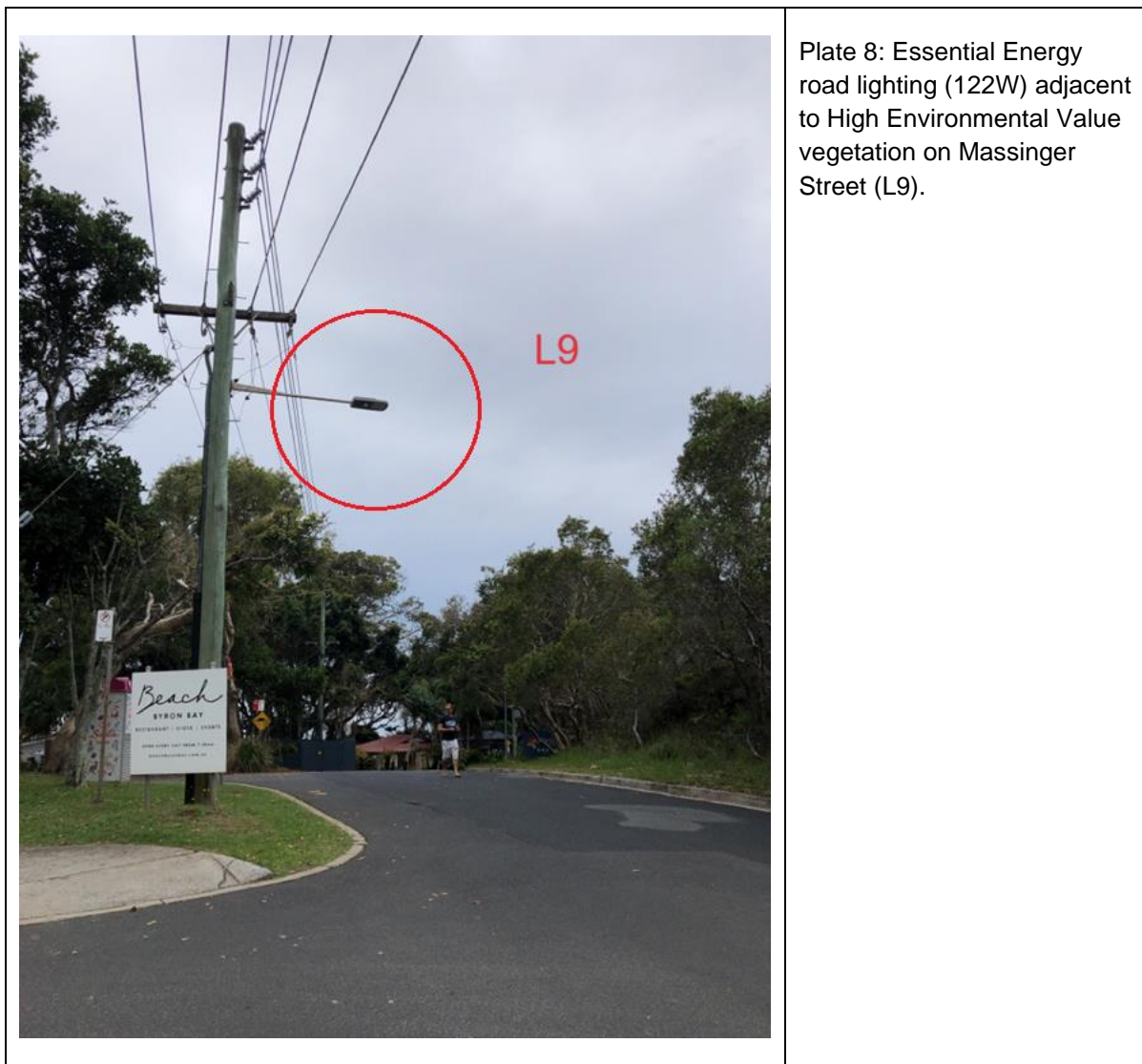
The ideal solution would be to remove these lights and install localised lighting in the desired locations with purpose selected fittings. Correspondence with Essential Energy is required to seek their concurrence to repurpose any of their infrastructure.



Plate 7: Essential Energy road light fixtures located in grassed area, distanced from intended purpose (L8).

Massinger Street road lighting

An Essential Energy light fitting adjacent to Clarkes Beach Park, is mounted on a timber pole approx. 11m above ground level (refer **Plate 8: L9**). The fitting is a 122W High Intensity Discharge (HIT) major road light. The fitting in its current configuration floods a large area with light, with no specific aim. This could be adjusted to provide light to the road only, with limited spill to the coastal area and adjacent HEV vegetation. To achieve this, the fitting could be replaced to a lower intensity, could be lowered on the timber pole, and a shield installed on the fitting. As the wattage may currently exceed the intensity required to be compliant in this area, a study would need to be carried out to determine if AS1158 compliance would be achieved with the potential alterations or if additional fitting/s would be required (also at lower wattage and mounting height). Correspondence with Essential Energy is required to seek their concurrence to repurpose any of their infrastructure.



3.1.4.2 BELONGIL BEACH

A total of 19 streetlights are located along Childe Street and Kendall Street in the Belongil locality. One Essential Energy light fitting at the Old Jetty Park is mounted on a timber pole approx. 11m above ground level (refer **Plate 9: L10**). This fitting is located high on dunes and lights the beach access path. As the Essential Energy light fitting is built for the purpose of road lighting, the light distribution from this fitting is not suitable for directional aim onto a carpark and public space while also limiting the light spill onto other areas. The purpose of the fitting, in its current configuration, seems to be to flood a large area with light, with no specific aim.

Several other Essential Energy light fittings located on Border Street are directed towards the beach. These fittings are situated lower than the dune level with a greater setback, however the top of some fittings remain visible from the beach.

A purpose-designed light solution for the Belongil Beach area including the removal and redesign of lighting fixtures visible from the beach is the ideal solution. Alternatively, these

fittings could be adjusted to provide light to the inland side of the dune only, limiting visibility from the beach. To achieve this, recommendations include:

- lowered the fittings on the existing poles;
- redirect fittings to face the carpark/road (away from the beach);
- installation of shields.

The dune behind the lighting, the vegetation on the north/western side and houses on the south/eastern side will also assist with shielding the light from the beach.



Plate 9: Essential Energy light fixture (L10) at highest point on the dunes, visible from the beach at New Jetty Park, Childe Street, Belongil.

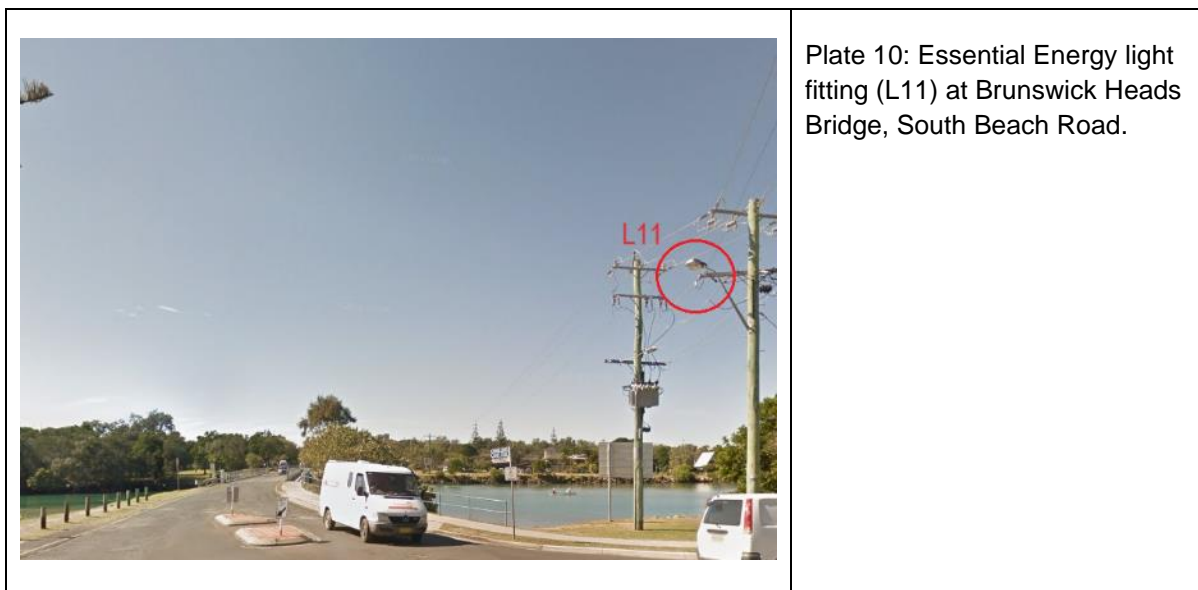
3.1.4.3 BRUNSWICK HEADS

The township of Brunswick Heads is located on the Brunswick River estuary, and adjacent to the southern arm of Simpsons Creek. Parts of the wider township abut sections of the Brunswick Heads and Tyagarah Nature Reserves. The township includes a small harbour and three caravan parks along the Brunswick River, popular with tourists. The beach area at Brunswick Heads is buffered from domestic and commercial lighting by extensive dune vegetation, however parts of the estuary are illuminated at night by pedestrian, carpark, street, residential and commercial lighting.

Brunswick Heads Bridge

The existing, timber pole mounted, Essential Energy light fitting at the intersection of South Beach Road, Mullumbimbi Street and Brunswick Terrace, is a major road fitting with a high intensity light output (refer **Plate 10: L11**). This fitting is located at the edge of Simpsons

Creek and creates excessive nuisance light spill. Multiple light fittings, one at each corner of the intersection, with lower wattages, would help mitigate light spill into the creek.



South Beach Road area

Several Essential Energy lights are located along South Beach Road.

Four tennis court floodlights are located at the Brunswick Heads Tennis Club (Council managed Crown Land) at the end of South Beach Road. The court reservation schedule ends at 11pm, but typically, court usage and the corresponding operation of floodlights rarely extend beyond 8:30pm.

Although streetlight fittings and two tennis court lights are east facing (towards the beach), sufficient screening is provided by vegetation to mitigate nuisance spill light towards the beach from the existing streetlights (refer **Plate 11: L12**). Illumination of vegetation is not desirable, however the occasional downward-facing light fittings in this location is unlikely to significantly illuminate this patch to the extent that wildlife are impacted.

The eastern side of the foot bridge over Simpsons Creek has an Essential Energy 17W LED fitting mounted on a timber pole (**Plate 12: L13**). This is a low wattage fitting and an overhead branch provides some screening between the fitting and Simpsons Creek, however illumination within the canopy of mature trees is not desirable. This fitting is within Council managed land.

The following measures are recommended:

- Lowering fitting (refer Plate 12: L13) on existing pole to avoid illumination of vegetation and reduce light spill into Simpsons Creek.
- Redirecting fitting away from creek; and
- Installation of shield between light fitting and creek.

Byron Shire Coastal Light Management Plan

Alternatively, the light could be replaced by a bollard light to achieve the purpose of lighting the end of the footbridge.



Plate 11: Essential Energy street lighting at South Beach Road (L12)



Plate 12: Low wattage light fitting (L13) illuminating canopy of mature tree adjacent to Simpsons Creek at the footbridge, Brunswick Heads.

Terrace Reserve

Terrace Reserve (Brunswick Heads) is managed by Reflections Holidays Parks (Reflections). Although the Reserve is not under the management of Council regarding land or lighting, an opportunistic audit was undertaken in response to the identification of several problematic light fittings. Reflections are not required to upgrade their lighting; however, Council may engage Reflections as a stakeholder to work towards a shared goal of reducing light pollution adjacent to Simpsons Creek. Reflections manage several holiday parks in the LGA (Terrace Reserve, Massy Greene and Ferry Reserve in Brunswick Heads and Byron Bay Holiday Park) as well as other recreation parks (Torakina Beach Reserve and Banner Park). These sites are located adjacent to Simpsons Creek, the Brunswick River or the beach and represent opportunities to reduce light spill to the beach or adjacent waterways.

The western side of the footbridge at Terrace Reserve has an Essential Energy timber pole with two lights, one facing the bridge (and Simpsons creek) and one facing the property adjacent to the carpark (**Plate 13: L14**). Both fittings are mounted at an approx. height of 9m. The light source from both fittings is in direct view of Simpsons creek. The adjacent carpark has two existing light fittings that provide sufficient lighting to meet the purpose of carpark lighting.

Additionally, the stage structure located in Terrace Reserve has two linear fluorescent lights mounted to the underside of the ceiling (refer **Plate 14: L15**). The spill from these lights to Simpsons Creek could be mitigated by providing a shield on the creek side of the roof. If not already implemented, installation of a timer setting, sensor, or push-button activation could also be installed.

A timber pole mounted light is located adjacent to the stairs which enter the creek (refer **Plate 15: L16**). The fitting is mounted at approximately 10m and is directed into the creek. A review of this fittings purpose and intention is recommended. If required at all, this fitting could be replaced with a low-level bollard light with motion sensor or push-button timer control.

Where opportunities to collaborate with Reflections Holiday Parks are identified, the following measures are recommended.

- The double fitting at the footbridge (refer **Plate 13: L14**) is replaced by a single fitting on landward side only.
- Redirection of existing fittings away from Simpsons Creek and lowering the height of the fitting on mounting pole to light only the area intended.
- Installation of shields between light fittings and Simpsons Creek, including installation of a shield on the stage patio roof.
- Installation of motion sensor or push-button timer controls for lights on recreation facilities; and
- Removal of potentially redundant lights adjacent to Simpsons Creek or replacement with bollard lights.

Note that correspondence with Essential Energy by Reflections Holiday Park is required for any upgrades to streetlight fittings.



Plate 13: Double light fitting with problematic light spill (L14) immediately adjacent to Simpsons Creek.



Plate 14: Terrace Park stage fluorescent lighting (L15) visible from Simpsons Creek.



3.1.4.4 SOUTH GOLDEN BEACH

The South Golden Beach residential area is located at the northern end of the Byron LGA, adjacent to the Billinudgel and New Brighton Nature Reserves and is intersected by Yelgun Creek. The area is comprised of low density, residential subdivisions, and an assortment of beachfront and creekfront properties.

Street light fixtures are operated by Essential Energy, however, are very low density across the area and are lighting the intended area appropriately, with minimal light spill. Future installation of street light fixtures should follow the Best Practice Guidelines.

Two examples of lighting in South Golden Beach are provided in **Plates 16 and 17 (L17 and L18)**.

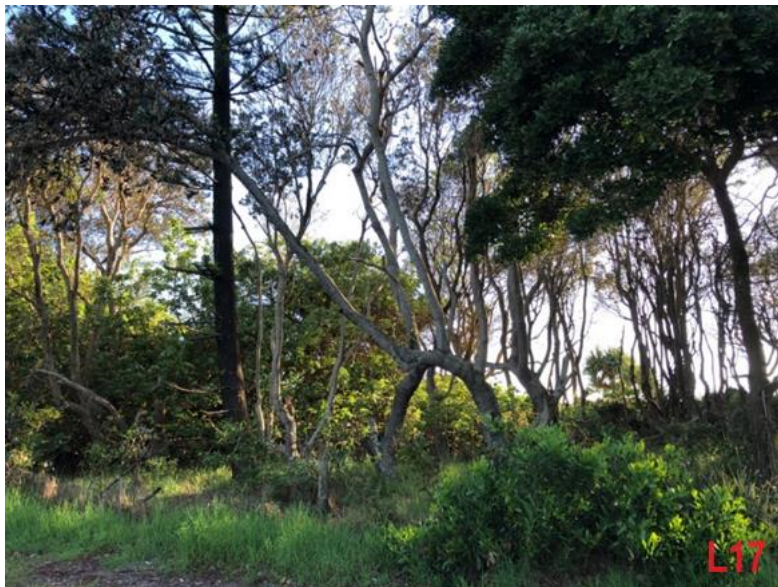


Plate 16: An Essential Energy pole-mounted streetlight is located on the road corner at the beach carpark on Pacific Esplanade. The height of the dunes and width of vegetation (pictured) provides a sufficient buffer between the beach and this light source. The direction (downfacing) and low wattage (18W) would provide very low-level illumination to adjacent vegetation, however, is considered low impact in the context of surrounding dark areas.



Plate 17: Essential Energy pole-mounted streetlight at the Helen Street footbridge over Yelgun Creek. There are few other streetlights in proximity to the creek. Some vegetation provides light screening between the creek and this light source. The direction (downfacing) and low wattage (18W) would provide low level illumination to the waterway and adjacent vegetation. Replacement of this light with a low-level bollard could be considered.

3.1.4.4 NEW BRIGHTON

The New Brighton residential area is located between Marshalls Creek, the Marshalls Creek and Brunswick Heads Nature Reserves and New Brighton Beach. Marshall’s Creek Nature Reserve and a pocket of littoral vegetation separate the New Brighton settlement from Ocean Shores and the Brunswick River.

Street light fixtures operated by Essential Energy are very low density across the area. Future installation of street light fixtures, where required, should follow the *Best Practice Guidelines*.

Four Essential Energy pole-mounted road lights are located on the northern side of Strand Avenue bridge over Marshalls Creek. These lights are low wattage (17W) LED fittings facing south, adjacent to, but directed away from a known flying-fox roost site. The direction and low wattage (17W) would provide very low-level illumination to adjacent vegetation and flying-fox roost, however, is considered low impact.

Several Essential Energy pole-mounted road lights are located on The Esplanade. The height of the dunes and width of vegetation provides a sufficient buffer between the beach and this light source. The direction (downfacing), low wattage (17W and 27W), and distance between fixtures (60-100m) provide very low-level illumination to adjacent vegetation and is considered low impact in the context of surrounding dark areas.

Byron Shire Coastal Light Management Plan

Table 3 Summary of lighting infrastructure within Council managed lands in the immediate coastal area of Byron LGA.

		South Golden Beach	Ocean Shores / New Brighton	Brunswick Heads	Belongil Beach and Creek	Byron Bay township inc. Clarkes Beach and Main Beach	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
Number of Council managed light sources by purpose	Pedestrian	0	0	0	0	138	0	0	0
	Street	0	0	0	0	0	0	0	0
	Sports	0	4	4	0	5	0	0	0
	Total	0	4	4	0	143	0	0	0

Note: Electricity distributor Essential Energy owns and is responsible for the maintenance of most streetlights within the shire.

Table 4 Site inspection results – lighting environment of immediate coastal area of Byron LGA.

	South Golden Beach	New Brighton	Brunswick Heads	Belongil Beach and Creek	Byron Bay township inc. Clarkes Beach and Main Beach	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
Width of vegetative buffer between beach and nearest street lighting	45m	Minimum 15m	20m	80m	0-40m	0-10m	Minimum 25m	100m
Artificial light source visible from adjacent beach or estuary	No	No	Yes	Yes (one fixture is located on the dunes)	Yes	Yes	No	No
Artificial light source visible from High Environmental Value (HEV) vegetation, wildlife corridors or known	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	South Golden Beach	New Brighton	Brunswick Heads	Belongil Beach and Creek	Byron Bay township inc. Clarkes Beach and Main Beach	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
threatened species habitat								
Are all light sources meeting their purpose/necessary?	Yes	Yes	Most	Most	No	Most	Yes	Yes
Identified light pollution issues	None	None	Yes – issues with lighting intensity, placement, lack of shields, and directional problems	One problem fixture identified on the dunes at Childe St.	Yes – issues with lighting intensity, placement, colour, lack of shields, and directional problems	Street lighting visible from beach	None	None
Possible mitigation	Not required.	Not required.	Request removal or adaption to fixtures by Essential	Request removal or adaption to fixture by Essential	Incorporation of Best Practice Guidelines in redevelopment	Request adaption to fixtures by Essential Energy to	Not required.	Not required.

	South Golden Beach	New Brighton	Brunswick Heads	Belongil Beach and Creek	Byron Bay township inc. Clarks Beach and Main Beach	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
			Energy to align with Best Practice Lighting Design	Energy to align with Best Practice Lighting Design	of lighting at Main Beach foreshore reserve (Byron Bay Foreshore Concept Landscape Plan)	align with Best Practice Lighting Design		

Note: Electricity distributor Essential Energy owns and is responsible for the maintenance of many streetlights – some of these lights were assessed where observed to have potential impacts to wildlife.

3.2: Describe wildlife

3.2.1 METHODOLOGY

The following methodology was used to describe threatened fauna species known or likely to occur within the immediate coastal area of the Byron LGA:

- Review of BioNet Atlas records of threatened or migratory species records occurring within the study area;
- Review of Council mapping layers including mapped wildlife corridors, High Environmental Value (HEV) vegetation and known flying-fox roosts;
- Review of published results of previous fauna surveys; and
- Review of records provided by local environmental agencies and groups including Australian Seabird & Turtle Rescue, Byron Bird Buddies, and NSW National Parks and Wildlife Service (some unpublished).

Threatened vertebrate species recorded in the immediate coastal area, and likely to occur in the intertidal or foredune habitats, were considered as potentially capable of being affected by coastal lighting.

3.2.2 LIMITATIONS

Detailed fauna surveys to describe threatened fauna species that may be impacted by Council managed lighting infrastructure were not undertaken.

Threatened wildlife was restricted to vertebrate species due to limitations within published literature. It is expected that adoption of the recommendations made within this report will benefit whole systems.

Impacts of artificial lighting are difficult to separate from disturbance produced by human presence.

It is not known to what extent artificial lighting within the Byron LGA affect the local fauna or the suitability of habitats.

3.2.3 RESULTS

A summary of threatened fauna habitat at key urban areas within the immediate coastal area of Byron LGA is provided overleaf (refer **Table 5**).

Table 5 Summary of threatened fauna habitat at key urban areas within the immediate coastal area of Byron LGA.

		South Golden Beach	New Brighton	Brunswick Heads	Belongil Beach and Creek	Byron Bay including Clarkes Beach and Main Beach	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
Habitats present (Plant Community Type [PCT] class)		Intertidal zones, sandy beaches, coastal dunes, wallum sand heath, littoral rainforest, coastal swamp forest	Intertidal zones, sandy beaches, coastal dunes, saltmarsh, littoral rainforest, mangrove swamp, coastal swamp forest	Intertidal zones, sandy beaches, coastal dunes, wallum sand heath, littoral rainforest, mangrove swamp, coastal swamp forest	Intertidal zones, sandy beaches, coastal dunes, freshwater wetlands, mangrove swamp, coastal swamp forest coastal dune dry sclerophyll forest, littoral rainforest	Intertidal zones, sandy beaches, coastal dunes, wallum sand heath, coastal dune dry sclerophyll forest, littoral rainforest, coastal swamp forest and subtropical rainforest	Intertidal zones, sandy beaches, coastal dunes, wallum sand heath, clay heathlands, coastal dune dry sclerophyll forest, wet sclerophyll forest, littoral rainforest, coastal swamp forest and subtropical rainforest	Intertidal zones, sandy beaches, rocky headlands, coastal dunes, wet sclerophyll forest, littoral rainforest, and subtropical rainforest	Intertidal zones, sandy beaches, coastal dunes, saltmarsh, coastal dune dry sclerophyll forest, littoral rainforest, coastal swamp forest
Resident shorebirds	Foraging	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Roosting	Yes	Yes	Yes	Yes	Unknown	Unknown	Yes	Yes
	Nesting	No	No	Yes - Pied Oystercatcher,	Yes - Pied Oystercatcher,	No	No	No	No

Byron Shire Coastal Light Management Plan

		South Golden Beach	New Brighton	Brunswick Heads	Belongil Beach and Creek	Byron Bay including Clarks Beach and Main Beach	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
				Beach Stone-curlew	Beach Stone-curlew				
Migratory shorebirds	Foraging	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Roosting	Unknown	Unknown	Yes	Yes	No	Unknown	Unknown	Yes
	Nesting	No	No	No	No	No	No	No	No
Seabirds	Foraging	Yes - offshore	Yes - offshore	Yes - offshore	Yes - offshore	Yes - offshore	Yes - offshore	Yes - offshore	Yes - offshore
	Resting or roosting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Nesting	No	No	No	No – Little Terns recorded in breeding plumage - historical nesting records only (since >20 years)	No	No	No	No

Byron Shire Coastal Light Management Plan

		South Golden Beach	New Brighton	Brunswick Heads	Belongil Beach and Creek	Byron Bay including Clarkes Beach and Main Beach	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
Marine turtles	Nesting	Yes	Yes	Yes	Yes	Unlikely to be successful	Unlikely to be successful	Unlikely to be successful	Yes
Flying-foxes	Foraging	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Roosting	No	Yes – known roost north of Strand Avenue in Marshalls Ck Nature Reserve	No	No	Yes – known roost at Byron Skate Park, Middleton Street.	No	n/a - rocky headlands	No
Microbats	Foraging	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Roosting	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Threatened amphibians	Recorded	No	No	Yes	In adjacent Tyagarah NR and rail corridor outside of study area	Yes - Sandhills Crown Reserve	In adjacent Arakwal NP	No	Outside of study area

3.2.3.1 Marine Turtles

There are six species of marine turtles found in Australia. The sandy beaches of northern NSW are increasingly recognised as critical nesting habitat for two threatened species listed under the BC Act – the vulnerable Green Turtle (*Chelonia mydas*) and the endangered Loggerhead Turtle (*Caretta caretta*) (NSW Department of Planning and Environment, 2022). The National Conservation Values Atlas (DCCEEW) maps the north coast of NSW to lower central Queensland as a 'Biologically Important Area' for Loggerhead Turtles, including nesting habitat. The endangered Leatherback Turtle (*Dermochelys coriacea*) feeds in coastal waters from southern Queensland to the central coast of NSW. This species rarely breeds in Australia, although some historical nesting records occur in northern NSW (Tarvey, 1993). The Hawksbill (*Eretmochelys imbricata*), Flatback (*Natator depressus*), and Olive Ridley Turtle (*Lepidochelys olivacea*) have also been recorded foraging in the waters in northern NSW. There are no confirmed nesting records for these species within the study area.

There are nine different genetic stocks of Green Turtle, three of these occur in Queensland. Some genetic stocks nest locally in Australia, while others nest in other regions and countries. In Australia, the Loggerhead Turtle breeds on the mid-west coast of Western Australia, and in south-east Queensland and infrequently in NSW. Marine turtle nesting season in the Byron LGA occurs from early November to May, with hatchlings starting to emerge in January (Department of Planning and Environment, 2022).

It has been suggested that while nesting events are currently low density and sporadic across northern NSW, this region offers climate refugia where populations might survive into the future. Long, remote stretches of sandy beaches, where disturbance impacts and future development is unlikely, will become more important into the future (Department of Planning and Environment, 2022). The sandy beaches of the Byron coast provide suitable habitat for marine turtle nesting. Nesting attempts can occur at any location along the coast, however, the likelihood that a nest will be successful increases where some of the following general characteristics are met:

- no human disturbances for nesting female (for example - no dogs, beach fires or 4WDs on the beach);
- no (preferably) or low levels of artificial light;
- dune systems high enough for nests to be laid above the high-water mark and avoid high-tides, storm surges and sand erosion;
- healthy dune system with presence of native vegetation; and
- access to the beach without rocky platforms to cross, or obstacles such as jetties or sandbags (Australian Seabird & Turtle Rescue, 2023, personal communication).

Impacts of artificial lighting on marine turtles

Light pollution is identified as a high-risk threat in the *Recovery Plan for Marine Turtles in Australia 2017–2027* due to disruption of critical behaviours and potential for reduction in reproductive viability of turtle stocks (Commonwealth of Australia, 2017). The development of the National Light Pollution Guidelines for Wildlife was a key action identified within the recovery plan (DCCEEW, 2023).

Nesting marine turtles lay their eggs on sandy beaches after emerging from the ocean, following environmental cues to return to their natal beaches or regions to lay their own eggs. Less developed, darker beaches are favoured if available within their natal region (Price et al., 2018). Hatchling turtles emerge at night, typically as a clutch, and quickly move towards the ocean and swim offshore (Robertson et al., 2016). Elevated, dark silhouettes on land, and naturally brighter light from the seaward horizon are used as navigational cues to orient towards the ocean (Kamrowski, 2014; Pankaew & Milton, 2018; Price et al., 2018).

A challenge for persistence and recovery of threatened marine turtle species is the maintenance of suitable nesting sites despite increasing encroachment of human activity and development adjacent to nesting beaches (Kamrowski, 2014; Robertson et al., 2016). Many factors are known to influence nest site selection and hatchling turtle behaviour - the potential for adverse effects from artificial light at night on marine turtles is well-established within the published literature (Price et al., 2018). Artificial light at night primarily affects marine turtles by repelling female turtles from nesting on beaches with higher luminance (negative phototaxis), thus reducing the availability of suitable nesting sites, and by misorienting hatchlings towards artificial lighting as they emerge from their nests (positive phototaxis) (Fritsches, 2012). Recorded outcomes from mis- or disorientation of emerging hatchlings include thermal stress, dehydration, wasted energy from inefficient ocean-finding (i.e. crawling in circles or failing to find the sea) (Triessnig et al., 2012), higher exposure to predation (Pankaew & Milton, 2018) and an inability to orient while swimming offshore (Robertson et al., 2016). Beaches with few nests and inconsistent lighting sources have been understudied (Price et al., 2018). In dark, regional areas even distant lights (up to 18km), and cumulative skyglow (Pankaew & Milton, 2018) may repel nesting turtles and misorient hatchlings (Kamrowski, 2014).

The effect of artificial lighting on turtle behaviour varies by species, light fitting type, light source proximity to nesting areas, intensity of lighting, quantity of lighting sources and background natural light levels. Elevated lighting can be seen from the greatest distance, with blue, green, and white UV lights having the most harmful effects (DCCEEW, 2023; Robertson et al., 2016; Witherington & Bjorndal, 1991). A study of Loggerhead Turtle hatchlings in Queensland found that 'turtle-friendly' amber LED lights continued to compromise sea-finding ability, worsening with an increased number of lights, greater intensity and in the absence of moonlight (Robertson et al., 2016). Another Queensland study reported both Loggerhead and Flatback Turtle hatchlings can see and are attracted to light within the range of UV (365nm) to longer wavelength light (600nm). Flatback hatchlings appeared attracted by red lights at the longest wavelengths, while Loggerheads exhibit confusion, but not attraction, in response to red lights (694nm) (Fritsches, 2012). Other studies have reported that recommended low-pressure sodium lighting is visible to Loggerhead Turtles and can disrupt sea-finding ability or nest site selection at greater intensities (Witherington & Bjorndal, 1991).

Ensuring light sources emit the least disruptive, longer wavelength of amber/red is generally important, however the published literature indicates that installation of turtle-friendly coloured lighting, filtered LED lighting or low-pressure sodium lighting alone is not sufficient at preventing hatchling misorientation. Recommended strategies for managing artificial light at nesting beaches include prioritising natural darkness wherever possible by reducing the level of light reaching the beach. A coordinated approach to reducing light spill into nesting

habitat using directional lighting, modified timing of light activation, and increased dune or vegetative buffers, is required (DCCEEW, 2023).

3.2.3.2 Shorebirds

Shorebirds (sometimes called waders) are a diverse group of birds that feed by wading in shallow water or saturated sand on the shores of the ocean, lakes, or rivers. Their coastal and estuarine habitats in NSW are increasingly being affected by industry and urban development (DECCW, 2010). In Australia, shorebirds have three basic habitat requirements:

- roosting areas — used to rest at high tide when foraging habitats are unavailable
- foraging areas — used to feed/forage, to satisfy daily energy requirements
- nesting areas — used to nest and raise chicks (DECCW, 2010).

In northern NSW, several resident and migratory shorebird species utilise coastal and estuarine habitats for roosting, foraging, and nesting. 'Residents' remain in Australia year-round, while most 'migrants' visit the Australian coast from their breeding grounds in the northern hemisphere, peaking in abundance between August and April (DECCW, 2010). The beaches, wetlands and estuaries of the Byron coast provide suitable habitats for threatened resident and migratory shorebirds including sandpipers, curlews, plovers, stilts, snipe, godwits and oystercatchers (refer **Appendix A** – BioNet records).

Resident threatened shorebirds within the Byron LGA include the:

- Pied Oystercatcher;
- Sooty Oystercatcher; and
- Beach Stone-curlew.

Bush Stone-curlew has also been considered within this section as a threatened species located within the coastal area of the Byron LGA. Bush Stone-curlews are ground-dwelling nocturnal birds that reportedly exploit artificial light due to increase in insect abundance around light fittings. This species may be increasingly abundant in the Byron LGA as a result of breeding successes in the Tweed LGA.

Some non-breeding summer migrant species visiting the Byron LGA listed as threatened in NSW (BC Act) or Australia (EPBC Act) include:

- Curlew Sandpiper;
- Double-banded Plover;
- Bar-tailed Godwit;
- Pacific Golden Plover;
- Eastern Curlew;
- Whimbrel;
- Grey-tailed Tattler; and
- Black-winged Stilt.

Significant shorebird roosting, foraging and breeding sites are the Belongil Creek and estuary, the lower Brunswick River estuary and Tallow Creek. The Belongil estuary is

considered to be the most important roosting and breeding location for shorebirds and seabirds in Byron Shire (Byron Bird Buddies, n.d.).

Shorebirds typically feed on invertebrates found in or on intertidal habitats, mostly within soft sand and mud. The mudflats and sandflats within the Belongil Creek estuary system are not extensive, yet support a relatively high diversity of shorebirds annually (Alluvium, 2019). The mudflats of the Brunswick River estuary are more extensive, however the diversity of this system is reported as equal to, or slightly less than, that of the Belongil system (DECCW, 2010). As these feeding grounds are covered by high tides, shorebirds move to high-tide roosts, often resting in large numbers. High-tide roosts are often rocky headlands or shelves, mangroves, or artificial sites where disturbance is low, visibility to scan for predators is good and there is natural darkness. Belongil Creek, Brunswick River estuary and Tallow Creek all provide suitable high-tide roosts for shorebirds.

Shorebirds in the Byron LGA are not systematically or regularly counted. Regular monitoring is undertaken by Byron Bird Buddies and NPWS of known threatened shorebird nesting sites including counts of nest attempts and birds fledged. Various population studies have been undertaken in northern NSW to determine population counts of shorebirds, which are summarised within the *Shorebirds of Northern New South Wales* report (DECCW, 2010). Within this report, the Brunswick River and Belongil Creek estuaries were reported to be utilised by 10 migratory and five resident shorebird species (including four threatened species), with breeding records for the Pied Oystercatcher (Brunswick and Belongil) and Beach Stone-Curlew (Belongil only). Successful breeding of the Beach Stone-Curlew has been reported at Brunswick River estuary more recently (Byron Bird Buddies, 2023). Average 'summer' shorebird diversity was greatest at Belongil Creek (15 species) of all minor estuaries and ICOLLS within the report. The Cape Byron to Richmond River coastline section recorded 16 migratory shorebird species and four resident shorebird species (five threatened). The Mooball Creek to Cape Byron coastline section recorded seven migratory and five resident shorebird species (four threatened) (DECCW, 2010). This data may be representative of survey effort at the time of data collection. It is estimated that shorebird populations have declined at many sites (DECCW, 2010)

Pied Oystercatchers

In NSW, Pied Oystercatchers occupy beaches and inlets along the entire coast, however, the population is small. The NSW Department of Planning, Industry and Environment (DPIE) has estimated 200 oystercatcher breeding pairs remain in NSW, with <50 pairs estimated to forage, roost and spend the majority of the time on the beach (NSW Office of Environment and Heritage (OEH), 2019; Totterman, 2020). The Richmond River area of northern NSW, south of the Byron LGA, supports the largest number of these 'beach residents' in NSW (Totterman, 2020). Pied Oystercatchers are frequently observed feeding on beaches at Tyagarah, New Brighton, South Golden Beach and north to Wooyung. Birds are also seen foraging along Simpson Creek, Marshalls Creek and the Brunswick River at low tide, and at Suffolk Park at Tallow Creek and Taylor Lake outlets (Byron Bird Buddies, 2022). Pairs of Pied Oystercatchers breed regularly at Belongil Creek and the Brunswick River estuary. Eight Pied Oystercatcher chicks fledged from nests at Belongil and Brunswick estuaries from 2021 to 2022. Nesting activity has not been recorded within the Byron LGA beyond these locations, with the exception of one report in 2016 by a NSW NPWS staff member of a nest located on Tyagarah Beach (Byron Bird Buddies, 2022).

Beach Stone-curlew

There were estimated to be nine breeding pairs of the critically endangered Beach Stone-curlew in NSW in 2021. The breeding population in NSW is confined to the north coast; nesting attempts in the Byron LGA are therefore regionally important. This species is concentrated around estuaries within its range. A pair of Beach Stone-curlew have nested on the eastern side of Marshalls Creek at Brunswick Heads Nature Reserve since 2013. The pair reside inside a fenced enclosure, and were joined by a third bird in 2020 (Byron Bird Buddies, 2022). One Beach Stone-curlew fledged from a nest in Belongil estuary in 2021. Four birds were recorded at this site in 2022, including the banded fledgling. Despite nesting attempts (at both Belongil and Brunswick estuaries) another successful fledgling has not been recorded in the Byron LGA since 2021. Impacts from feral animals (foxes) and human disturbance, included presence of domestic dogs, is believed to be disrupting nesting attempts for this species.

Night-time behaviour of shorebirds in the Byron LGA is largely unknown or unrecorded. Occasional records of individual birds seen at night have been recorded (Byron Bird Buddies, 2023). Nocturnal foraging in shorebirds occurs regularly for some species. For the majority of species, foraging at night appears to be less preferred, and possibly used where energetic demands have not been met by daytime feeding (McNeil & Rodriguez, 1996).

Impacts of artificial lighting on shorebirds

Artificial light is listed as a threat to shorebirds within the '*Shorebirds of Northern NSW*' report produced for the Department of Environment, Climate Change and Water NSW (2010). In this report, artificial light was considered as a form of habitat modification, whereby changes in the characteristics of habitat reduced its utility for shorebirds. The threat was described as measurable by direct observation or able to be inferred by proximity of site to urban area (DECCW, 2010). Shorebirds typically forage in proximity to selected roost sites, to which they may be very faithful. Illumination of nocturnal roosts is likely to reduce the abundance of birds in suitable foraging areas located nearby, or require greater energy demands to access the nearest suitable roost (DCCEEWS, 2023). Most shorebirds avoid foraging at sites with artificial illumination (DCCEEWS, 2023), however some nocturnal foraging birds exploit well-lit areas (Dwyer et al., 2013; Fitzgerald, 2010). This seemingly beneficial increase in foraging area disadvantages prey and other shorebirds occupying the same foraging niche (Longcore & Rich, 2004) and increases exposure to predation or vehicle strike (Fitzgerald, 2010).

Artificial lighting is also recognised as a form of anthropogenic disturbance to shorebirds within the *Wildlife Conservation Plan for Migratory Shorebirds* (Commonwealth of Australia, 2015). Migratory shorebirds, while airborne, may be attracted by bright lights, and can alter their stopover selection in long-distance flights, choosing low-quality rest and feeding sites, which can affect successful migration. Roost sites with lower exposure to artificial light are selected more often, despite not being the most suitable sites in relation to nearby foraging areas (McLaren et al., 2018).

In designing appropriate lighting infrastructure sympathetic to shorebirds, lighting intensity is likely to be a more important influence than lighting colour, and the location and direction of light sources in relation to roosting and foraging areas should be considered. Shorebirds are

sensitive to short (blue/violet) wavelength light, with some able to detect UV light. In general, avoiding short wavelength light and keeping intensity as low as possible is most appropriate for shorebirds. Low or high pressure sodium vapour lighting or filtered LED or metal halide light types are considered suitable for use near migratory shorebird habitat (DCCEEW, 2023).

3.2.3.3 Seabirds

Seabirds occur within the marine environment, from coastal areas to the pelagic zone of the open seas, only coming to shore to nest (Dias et al., 2019). Most species nest in colonies and many undertake long annual migrations (DCCEEW, 2023). Seabirds in New South Wales include gulls, shearwaters, petrels, storm-petrels, albatross and terns. Commonly recorded threatened or migratory seabirds in the Byron LGA include Little Tern (*Sternula albifrons*), Common Tern (*Sterna hirundo*) and Crested Tern (*Thalasseus bergii*). A small number of White-winged Black Terns (*Chlidonias leucopterus*) are sometimes recorded locally (Byron Bird Buddies, 2022). Other threatened seabird species recorded in the Byron LGA are occasional records of beach-cast or rescued birds (refer **Appendix A** for full species list). For example, after storm events or during food shortages, dead birds are often found along the coast, including the migratory species' Short-tailed Shearwater (*Ardenna tenuirostris*) and Wedge-tailed Shearwater (*Ardenna pacifica*), which breed on islands off the NSW coast. Stranding events are believed to be due to starvation and exhaustion from the birds' migration from the northern hemisphere. The National Conservation Values Atlas (DCCEEW) maps the pelagic zone off the majority of the NSW and SEQ coast as a 'Biologically Important Area' under the EPBC Act for Flesh-footed Shearwater (*Ardenna carneipes*) and Black Petrel (*Procellaria parkinsoni*) foraging habitat.

Seabirds in the Byron LGA are not systematically or regularly counted. Regular monitoring is undertaken by Byron Bird Buddies and NPWS, including observation of species, records of the 'highest number' of each species seen and the timing of first observation of migratory species each year. Adult terns gather in large numbers at the Brunswick River and Belongil estuary mouths. Bird counts taken at the Belongil estuary in recent year recorded the highest numbers of terns of each species as 450 Crested Terns (April 2023), 99 Little Terns (Oct 2022) and 80 Common Terns (February 2022). Migrating in the Spring/Summer months, these species are numerous on the east coast of Australia. Terns generally exhibit diurnal behaviour, although there are records of Crested Terns following fishing trawlers at night to feed (Blaber et al., 1995).

Much of the coastal area of the Byron LGA provides 'loafing' habitat for threatened/migratory tern species, where birds exhibit resting behaviour, not connected with feeding or breeding. Flocks of birds can be observed loafing on sandy beaches, sandflats or mudflats of estuaries and sand islands or beaches of coastal lakes and rivers. Successful nesting by endangered migratory seabird species, Little Terns, at the Belongil Creek mouth has not been reported in approximately 30 years. This is despite continued presence recorded in high numbers during summer months and occasional birds observed in breeding plumage (Byron Bird Buddies, 2023). An area of the dunes south of the creek entrance is managed as a bird nesting area to encourage future breeding events (Alluvium, 2019). Other threatened seabirds recorded in the study area do not breed on the mainland of the Byron LGA. Many remain in the pelagic

zone for foraging and migration, and either breed on offshore islands, or at other sites on their migration path.

The Julian Rocks (Nguthungulli) Nature Reserve Plan of Management reports nesting by the migratory species' Crested Tern and Pacific Reef Heron (*Ardea sacra*) and roosting, loafing or foraging by several other migratory seabirds (Department of Environment Climate Change and Water (NSW), 2011). The reserve is located approximately two kilometres off-shore of Byron Bay. Exposure to storm events result in waves breaking over much of the 0.4 hectare surface of the rocks. This may result in rock surfaces being regularly unsuitable for nesting. The surface of the outcrop is mostly bare rock with little soil, providing insufficient habitat for burrowing seabirds such as shearwaters.

Impacts of artificial lighting on seabirds

Seabird attraction to artificial light is commonly observed in petrel and shearwater species, typically affecting fledglings, or adult birds near breeding colonies. Those that breed in burrows and nocturnally attend breeding colonies are most vulnerable (DCCEEW, 2023; Dias et al., 2019). The National Recovery Plan for albatrosses and petrels identifies an increase in artificial lighting from coastal development as a terrestrial threat from human disturbance (Commonwealth of Australia, 2022). Impacts to seabirds occurs where fledglings are grounded due to attraction to lights (Rodríguez et al., 2017), where attraction to light causes collisions with tall structures (Poot et al., 2008), where bright light sources attract or misorient migratory seabirds in flight, where lighting influences selection of poor quality stopover habitat (Longcore & Rich, 2004), or where adult nest attendance is reduced due to illumination (Cianchetti-Benedetti et al., 2018). Management actions in Victorian coastal regions to reduce upward light spill, and turn selected lighting off during seabird fledgling events, has been successful in reducing mass mortalities of Short-tailed Shearwaters (*Ardenna tenuirostris*) (Rodríguez et al., 2014; Rodríguez et al., 2017).

For seabirds, lighting intensity is likely to be a more important cue than lighting colour. Numerous conflicting reports describe the attractiveness of light wavelengths – seabirds are sensitive to both short (blue/violet) and long (orange/red) wavelength light. High Pressure Sodium or filtered LED to remove short wavelength light are recommended for use near shearwater colonies (DCCEEW, 2023). Alternative management actions such as buffering light spill or modifying the timing of lighting are most appropriate where species have varying sensitivities to light wavelengths or intensities.

An aim of the *National Light Pollution Guidelines for Wildlife* is to ensure that at important seabird rookeries, burrow usage remains constant, adults and fledglings are not grounded, and fledglings launch successfully (DCCEEW, 2023). Given there are no current important seabird rookeries within the Byron LGA, this species group are not considered to be significantly impacted by artificial light at its current levels and will not be assessed further within this Plan.

3.2.3.4 Bats

Several threatened bat species are known to occur within the immediate coastal area of the Byron LGA including 12 species of microbats and two species of megabats ('fruit bats' or flying foxes). Individual species are specific in their choice of roost sites, which may include

canopy vegetation (flying-foxes) or in tree hollows, caves, rock overhangs, tunnels or human made structures like bridges or culverts (microbats). Foraging sites also depend on the ecology of the species. All coastal vegetation types within the Byron LGA may be used as foraging habitats and contain a range of resources for all species.

Two threatened species of fruit bats (megabats) in the family Pteropodidae have been recorded in the coastal area of the Byron LGA. The grey-headed flying-fox (*Pteropus poliocephalus*) feeds on nectar, pollen, and fruit, and is listed as 'vulnerable' under both the EPBC Act and BC Act. The common blossom bat (*Syconycteris australis*), a small nectar-feeding bat, is listed as 'vulnerable' under the BC Act.

The number of flying-fox roosts (including the grey-headed flying-fox) in urban areas appears to be increasing (Department of Agriculture Water and the Environment (DAWE), 2021), with several known camps within the Byron LGA (Byron Shire Council, 2023). A known flying-fox roost containing Grey-headed Flying-foxes occurs on Middleton Street, Byron Bay, and has been occupied since at least 2012. Both Grey-headed and Black Flying-foxes roost at this location, and numbers are known to fluctuate from a few hundred to the maximum of 3,429 recorded in May 2017 (Greenloaning Biostudies, 2022). Another roost containing Grey-headed Flying-foxes was recorded in November 2023 within Marshalls Creek Nature Reserve (NPWS) at New Brighton, setback slightly north from the Strand Avenue bridge and footpath over Marshalls Creek. Both Grey-headed and Black Flying-foxes roost at this location, and an estimate count of at least 300 was recorded for the first time in November 2023 (Byron Shire Council, personal communication).

Impacts of artificial lighting on bats

Bats provide ecosystem services during nocturnal foraging, including pollination, seed dispersal and insect suppression (DCCEEW, 2023; Stone et al., 2015). As bats are adapted to the darkness of the night-time environment, they are vulnerable to artificial light. Reactions to light may be complex, and subsequent impacts can include delayed roost emergence, alterations to torpor timing, roost abandonment, and alterations to foraging and fragmentation of commuting pathways (Stone et al., 2015). Resulting impacts to ecological communities can include a reduction in the seed dispersal and pollination services provided by bats (Lewanzik & Voigt, 2014).

The impacts of artificial lighting on many bat species are not fully understood (DCCEEW, 2023) and responses to light differ between flying-foxes and fruit bats, as such these species groups have been discussed separately.

Microbats

Threatened microbats are diverse in habit, abundance, and ecology. Despite this, different species experience commonality in threats faced, including habitat loss or modification, roost disturbance (from noise or light), and predation by feral animals (DCCEEW, 2023).

Microbats either roost alone or form roosting colonies and forage nocturnally using echolocation for navigation and prey detection. Artificial light at microbat roost sites can interfere with natural cues for roost emergence, and result in roost abandonment or selection of suboptimal roosts (Stone et al., 2015). Insectivorous microbat species may miss peak

insect abundance due to delayed roost emergence. Alternatively, some microbat species can be attracted to an increased abundance of prey insects congregating around light sources. This may appear positive, however this alteration of prey availability can benefit some species and disadvantage others and alter insect community structure (Longcore & Rich, 2004).

Slow-flying insectivorous bats are more likely to be light averse, due to a higher perceived risk of predation and lower ability in catching insects in flight. Faster-flying insectivorous bats are possibly light tolerant, taking advantage of insects congregating around light sources.

Flying-foxes

Flying-foxes, as frugivores and nectivores, rely heavily on vision and smell (Churchill, 2008) and may have a greater sensitivity to light (DCCEEW, 2023). The physiology of the flying-foxes eyes allows for function in varying light conditions (Ecosure, 2021). As pollen and seed dispersers, flying-foxes contribute to ecological processes within vegetation communities in the study area. Actions that improve foraging and roosting habitat for these species will have benefits to flora, ecological communities, and other fauna species as a result (Eby & Law, 2008).

Grey-headed flying-foxes exhibit irregular and complex migration patterns which appear to correspond with fruiting and flowering availability (DCCEEW, 2023). This species forages over extensive areas, flying as far as 40km to feed, moving freely among habitat types including fragmented urban landscapes (Department of Agriculture Water and the Environment (DAWE), 2021). An international study provides evidence that the foraging behaviour of frugivorous bats is negatively impacted by artificial light, reducing spatial foraging behaviour, selecting suboptimal foraging sites, and reducing seed dispersal in illuminated foraging habitats (Lewanzik & Voigt, 2014). Emergence from roost sites to begin foraging at dusk can also be altered by the presence of artificial light (Ecosure, 2021).

Many nationally important flying-fox roost sites are located in urban environments with high levels of artificial light, indicating a tolerance to illuminated roost sites (DCCEEW, 2023). A northern Queensland study by Tait et al. (2014) identified several possible drivers for increasing urban encampments of flying-foxes, specifically the spectacled flying-fox. Although not explicitly studied, it was suggested that urban areas may be attractive due to the ease of navigation afforded by landmarks and lighting within urban areas (Tait et al., 2014). The use of flood lights or strobe lighting as an 'active disturbance' management action undertaken by local government is occasionally successful, demonstrating some disturbance effects of lighting on these species. Effectiveness of these methods is reported as low and localised, usually resulting in flying-foxes habituating to the disturbance (State of Queensland, 2020).

Mitigation measures

Precautionary measures should be taken to minimise or eliminate artificial light exposure for all species given the uncertainty about species specific impacts in many cases (DCCEEW, 2023). Prioritising natural darkness near all habitat areas is the most effective strategy. Maintaining dark roosts and refuge sites, creating dark corridors from foraging habitat to roost habitat, reducing light intensity, ensuring light is directed away from important habitat

areas, and reducing light heights (below tree canopies). Using part-night lighting schemes can be an effective tool to reduce the duration of artificial light each night (DCCEEW, 2023; Lewanzik & Voigt, 2014). Narrow spectrum and longer wavelength lights at lower intensities are considered to have the least impact on most species (Stone et al., 2015). Some species are thought to be least affected by red wavelength illumination compared with white and green wavelength (DCCEEW, 2023).

3.2.3.5 Amphibians (frogs)

Threatened frog species recorded within the coastal area of the Byron LGA include the Wallum Froglet (*Crinia tinnula*) and Wallum Sedge Frog (*Litoria olongburensis*). These species are restricted to the acidic (pH < 6.0) wetland areas of coastal wallum habitats and are referred to as 'acid frogs' (Lewis & Goldingay, 2005). Habitats include heath, swamp and some woodland habitats that are characterised by acidic waters.

Adult acid frogs are insectivores while tadpoles forage on algae, sediment and biofilm covering submerged reed or sedge stems (Queensland Government, 2022). Breeding periods are autumn to early winter for the Wallum Froglet and spring, summer and autumn for Wallum Sedge Frog, however both species have been recorded to breed in all seasons following rain event (DCCEEW, n.d.; Queensland Government, 2022).

Acid frogs have suffered significant habitat loss and are threatened by further habitat degradation and disturbance. Other threats include predation by pigs, exotic disease and competition with other ecologically similar species (Meyer et al., 2006). A local study of road mortality reported these species disperse between habitats after rain events during which time they are highly susceptible to road strike after rain events (Goldingay & Brendan, 2006).

Impacts of artificial lighting on frogs

Light pollution can undermine the health of frogs across all life stages including the development and activity of larvae and behaviours of juveniles and adults (DCCEEW, 2023). For example, reduced hatching success and altered growth rates have been reported for some species (May et al., 2019). Known impacts of artificial light sources on amphibians is varied depending on species ecology and for many species the impacts are poorly understood. The impacts of artificial light on acid frogs has not been described within the scientific literature. However, given the dispersal behaviour of these species (Goldingay & Brendan, 2006) exposure to artificial light and subsequent impacts are likely to occur during dispersal or following rain events.

As with other species groups, an increased concentration of insect prey around light sources can attract nocturnal frog species. Although appearing beneficial, changes in foraging behaviours and increased movement towards light sources can result in increased risk of detection by predators or a greater risk of mortality by road strike (DCCEEW, 2023). Cane Toads are reported to exploit the increase in insect prey at light sources (Davis et al., 2015). Smaller native frog species exhibiting the same exploitative behaviour in the same location are likely to be exposed to a greater risk of predation by Cane Toads while congregating at a light source. Other reported impacts relate to breeding behaviours such as changes to call volume and rate, avoidance of artificial light leading to decreased mating opportunities and

mistimed breeding behaviours due to a change in perceived daylength (Baker & Richardson, 2006; Smit et al., 2022).

Mitigation measures

As with other species groups, where uncertainty exists around species specific impacts precautionary measures should be taken to minimise artificial light exposure (DCCEEW, 2023). Prioritising natural darkness adjacent to sensitive habitat areas is the most effective strategy if feasible. Installation of lighting that does not attract insects is preferred. Seasonal restrictions of lighting (such as dimming or turning off) are difficult to apply where acid frog life cycle events such as mating, spawning or dispersion may occur at any time. Where installation of lighting cannot be avoided consideration and offset actions can mitigate potential impacts, for example undertaking cane toad control within important habitat areas.

3.2.3.6 Terrestrial mammals

Most terrestrial mammals in the Byron LGA are nocturnal and begin foraging at or after dusk. Artificial light can affect mammals while resting, foraging or commuting. Impacts include reduced activity, altered foraging, and increased predation. It is generally acknowledged that further research is required to understand the extent and type of impact experienced by Australian terrestrial mammals. In general, effective light management for this species group are considered to be consistent with the Best Practice Lighting Design approach provided within the *National Light Pollution Guidelines for Wildlife* (DCCEEW, 2023). Assessment of the impacts of artificial lighting on terrestrial mammals is beyond the scope of this plan. However, it is assumed that the adoption of recommendations from this plan will benefit this group.

3.2.3.7 Plants and ecological communities

Artificial lighting has the capacity to interfere with normal plant function, altering growth, dormancy, flowering and photosynthesis, but effects vary between species, illumination type, season and weather conditions (reference). Indirect impacts to plants and ecological communities may arise from reduction in their suitability as resources or habitat and subsequent altered pollination and seed dispersal (Briggs, 2006)

Numerous threatened flora species and several threatened ecological communities occur within coastal Byron. The impacts of artificial lighting on plants and plant communities are poorly understood. It is not known to what extent illumination already affects these species or habitats. Assessment of the impacts of artificial lighting on plants, ecological communities, invertebrates and marine systems is beyond the scope of this plan. However, it is assumed that the adoption of recommendations from this plan will benefit wider systems.

3.3: Impact assessment

3.3.1 METHODOLOGY

Using information collated from steps one and two, the following methodology was used to assess the impact of Council managed lighting infrastructure on threatened fauna species known or likely to occur within the immediate coastal area of the Byron LGA:

- Comparison of amount and type of Council-managed light sources within key urban centres with known or potential threatened or migratory fauna species habitat;
- Consideration of likelihood that Council-managed light sources will cause an adverse response in threatened or migratory fauna species groups;
- Consideration of issues identified by internal Council stakeholders, local environmental agencies and groups including Australian Seabird & Turtle Rescue, Byron Bird Buddies, DPI Marine Estate Management Authority, NSW National Parks and Wildlife Service (some unpublished); and
- Consideration of potential for mitigation and management strategies to be implemented.

3.3.2 LIMITATIONS

The areas assessed within this Plan are those with the greatest amount of artificial light and therefore with high concentration development. These areas typically (but not always) have the lowest quality habitat for threatened fauna species, by virtue of their development and level of human disturbance. Optimal habitat for most threatened species is within or adjacent to the protected areas of the Byron LGA, making up over 50% of the Byron coast. These areas have less artificial light sources, as well as a lower abundance of other threats, including volume of recreational use and domestic animal visitation.

3.3.3 RESULTS

A summary of artificial lighting issues and potential impacts to threatened species at urban hotspot areas within the immediate coastal are of the Byron LGA is provided overleaf (refer **Table 6**).

Byron Shire Coastal Light Management Plan

Table 6 Artificial lighting issues summary - potential impacts to threatened species at urban hotspot areas within the immediate coastal are of the Byron LGA

	South Golden Beach	Ocean Shores / New Brighton	Brunswick Heads	Belongil Beach and Creek – Byron Bay	Clarkes Beach and Main Beach – Byron Bay	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
Summary of threatened species habitat within coastal Byron	<p>Marine turtles</p> <p>Microbat and megabat (flying-fox) foraging habitat)</p> <p>Shorebirds and seabirds forage, rest and roost</p>	<p>Flying fox roost north of Strand Avenue</p> <p>Marine turtles</p> <p>Microbat and megabat (flying-fox) foraging habitat)</p> <p>Shorebirds and seabirds forage, rest or roost</p>	<p>Key shorebird nesting, roosting and foraging habitat</p> <p>Marine turtles</p> <p>Microbat and megabat (flying-fox) foraging habitat)</p>	<p>Critical shorebird nesting, roosting and foraging habitat</p> <p>Marine turtles</p> <p>Microbat and megabat (flying-fox) foraging habitat)</p>	<p>Marine turtles</p> <p>Shorebirds and seabirds forage, rest or roost</p> <p>Microbat and megabat (flying-fox) foraging habitat)</p> <p>Wallum Froglet habitat at Sandhills Crown Reserve</p>	<p>Marine turtles</p> <p>Shorebirds and seabirds forage, rest or roost</p> <p>Microbat and megabat (flying-fox) foraging habitat)</p>	<p>Marine turtles</p> <p>Shorebirds and seabirds forage, rest or roost</p> <p>Microbat and megabat (flying-fox) foraging habitat)</p>	<p>Marine turtles</p> <p>Shorebirds and seabirds forage, rest or roost</p> <p>Microbat and megabat (flying-fox) foraging habitat)</p>
Assessment of issues identified with Council managed lighting infrastructure	<p>Low</p> <p>Essential Energy streetlighting low density and intensity at important habitat areas</p>	<p>Low</p> <p>Essential Energy streetlighting on Strand Avenue adjacent to flying fox roost, low density and intensity</p>	<p>Moderate</p> <p>Occasional problem light fixtures including inappropriate intensities, placement and light spill.</p>	<p>Low</p> <p>Council street lighting minimal. Occasional sources of lighting from private land tenure visible from beach.</p>	<p>High</p> <p>No buffer between lighting infrastructure and coast</p> <p>Occasional problem light fixtures including inappropriate</p>	<p>Moderate</p> <p>Several light fixtures visible from beach</p>	<p>Low</p> <p>Streetlighting low density</p>	<p>Low</p> <p>Essential Energy streetlighting low density and intensity at important habitat areas</p>

Byron Shire Coastal Light Management Plan

	South Golden Beach	Ocean Shores / New Brighton	Brunswick Heads	Belongil Beach and Creek – Byron Bay	Clarkes Beach and Main Beach – Byron Bay	Cape Byron and Wategos Beach	Broken Head	Suffolk Park including Tallow Beach and Creek
				One problem light fixture visible from the beach due to inappropriate placement.	intensities, colour, placement and light spill within foreshore reserve			
Assessment of risk to threatened species groups	Low – Lighting infrastructure unlikely to cause significant disturbance	Low – flying fox roost is newly recorded (2023) and dynamic Lighting infrastructure unlikely to cause disturbance	Moderate - Council managed lighting infrastructure may cause some disturbance	Low - Council managed lighting infrastructure unlikely to be a significant threat to nesting shorebirds	Moderate – high density of light sources likely to contribute to cumulative light source to adjacent habitats	Moderate - Council managed lighting infrastructure may cause some disturbance	Low - Council managed lighting infrastructure unlikely to be a significant threat	Low - Council managed lighting infrastructure unlikely to be a significant threat
Opportunities or necessity for mitigation	Not required	Not required	Moderate Future upgrades to follow <i>Best Practice Guidelines</i> and consider community engagement to raise profile of impacts of artificial lighting	Low Opportunities for community engagement to raise profile of impacts of artificial lighting	High Lighting upgrades at Main Beach Reserve and Sandhills Reserve to follow <i>Best Practice Guidelines</i>	Moderate Future upgrades to follow <i>Best Practice Guidelines</i> and opportunities for community engagement to raise profile of impacts of artificial lighting	Not required	Not required

3.3.3.1 SOUTH GOLDEN BEACH AND NEW BRIGHTON

Intertidal habitats and sandy beaches at South Golden Beach and New Brighton provide suitable habitat for nesting marine turtles, foraging shorebirds and seabirds (refer **Figure 3 and 4**). The potential for human disturbance to these habitats is concentrated near beach access points. Off-lead dog beaches north of the Pacific Esplanade, beach access points at South Golden Beach and adjacent to The Esplanade at New Brighton further reduce the suitability of habitat for threatened species. The suitability of potential habitat for threatened coastal species increases as disturbance and illumination reduces to the north (adjacent to Billinudgel Nature Reserve) and south (adjacent to New Brighton Nature Reserve), albeit to a lesser extent.

Streetlights and surrounding environments were assessed at Pacific Esplanade, South Golden Beach (Council managed Crown Land) and The Esplanade, New Brighton. The dune height, and height and width of littoral vegetation currently provides a sufficient buffer between the beach and nearby light sources. As a result, these streetlights are not visible from beach habitats, and impacts from individual light sources to marine turtles and foraging shorebirds is unlikely.

The vegetation buffering the coastline from the South Golden Beach and New Brighton residential zones is mapped littoral rainforest - HEV vegetation and partially mapped as a wildlife corridor. This vegetation provides suitable roost and foraging habitat for microbats and foraging habitat for megabats (flying-foxes). The low density and distance between individual light fittings, downfacing direction and low wattage result in low-level illumination to the edge of the vegetation corridor. Illumination is concentrated/pooled at the location of individual light fittings and is unlikely to cause fragmentation to a commuting corridor for these species. The potential reduction in foraging resources adjacent to each light fitting is minor in comparison to available foraging habitat within adjacent 'unlit' Billinudgel, Marshalls Creek, New Brighton and Brunswick Heads Nature Reserves where natural darkness prevails.

Yelgun Creek at South Golden Beach is designated as a Habitat Protection Zone within the Cape Byron Marine Park and partially mapped as a wildlife corridor. Most of Yelgun Creek is outside of the study area for this Plan but has been considered here as a wildlife corridor to the coastal area. The creek and riparian landscape in this location is highly modified and waterfront residences are the greatest contributor to artificial lighting. Street lighting is present at low densities (for example at the end of foot and vehicle bridges), providing low level illumination concentrated at individual fittings. Light spill from streetlights is buffered and softened by disturbed patches of swamp sclerophyll forest adjacent to Yelgun Creek within the South Golden Beach residential area.

Marshalls Creek at New Brighton is a designated Sanctuary Zone within the Cape Byron Marine Park, and mapped HEV vegetation and wildlife corridor. The creek and riparian landscape of mangrove swamp, saltmarsh and coastal swamp forest is within the Marshalls Creek Nature Reserve and mostly protected from artificial light sources with the exception of streetlights at the vehicle bridge at Strand Avenue and residences at River Street. The creek provides foraging habitat for threatened shorebirds and riparian vegetation and may represent marginal foraging habitat for threatened bat species. Minor light spill from occasional and well-spaced streetlighting is unlikely to significantly impact available habitat

in the context of surrounding protected areas. Streetlights also provide an opportunity for some species of microbats to alter foraging behaviour in response to higher prey availability at individual light fittings. This impact is expected to be minor due to the low density of light fittings and low wattage.

A flying-fox roost containing threatened Grey-headed Flying-foxes was recorded in November 2023 within Marshalls Creek Nature Reserve (NPWS) and is set back slightly north from the Strand Avenue bridge and footpath over Marshalls Creek. Flying-fox roost footprints are dynamic and known to shift throughout the riparian corridor. The currently occupied location is located immediately west of several residential properties and adjacent to existing street lighting at Strand Avenue. This roost location was newly recorded in 2023, indicating this species exhibits a tolerance (or possible preference) for illuminated or partially illuminated roost sites. Grey-headed Flying-foxes observed in a study of the effects of sports field lighting at Tom Kendall Oval, New Brighton exhibited a tolerance for illumination at some feed trees, however an overall preference for foraging in darker areas was observed (Fitzgerald, 2010). While existing street lighting has potential to delay roost emergence and reduce suitable foraging habitat for this species, the direction (south-facing) and low wattage (17W) of these lights provides very low-level illumination to vegetation adjacent to the flying-fox roost and is considered low impact. The potential reduction in foraging resources at this location due to illumination is minor in comparison to available foraging habitat within adjacent 'unlit' Marshalls Creek Nature Reserve and Brunswick Heads Nature Reserve.

The four sports-field floodlights located at the New Brighton Sports Field (Council managed land) were assessed on installation and have not been considered within this Plan.

Avoiding all potential impacts from low density public lighting in conjunction with providing compliant lighting for road and pedestrian safety is not always an achievable practical option. The South Golden Beach and New Brighton areas may be subject to future increase in light sources, where current low levels of street, pedestrian or park lighting may be considered insufficient. For future upgrades or installation of lighting, ecological assessments including 5-part test of significance (BC Act) must be undertaken, and consideration should be given to the *National Light Pollution Guidelines for Wildlife* and this Plan.

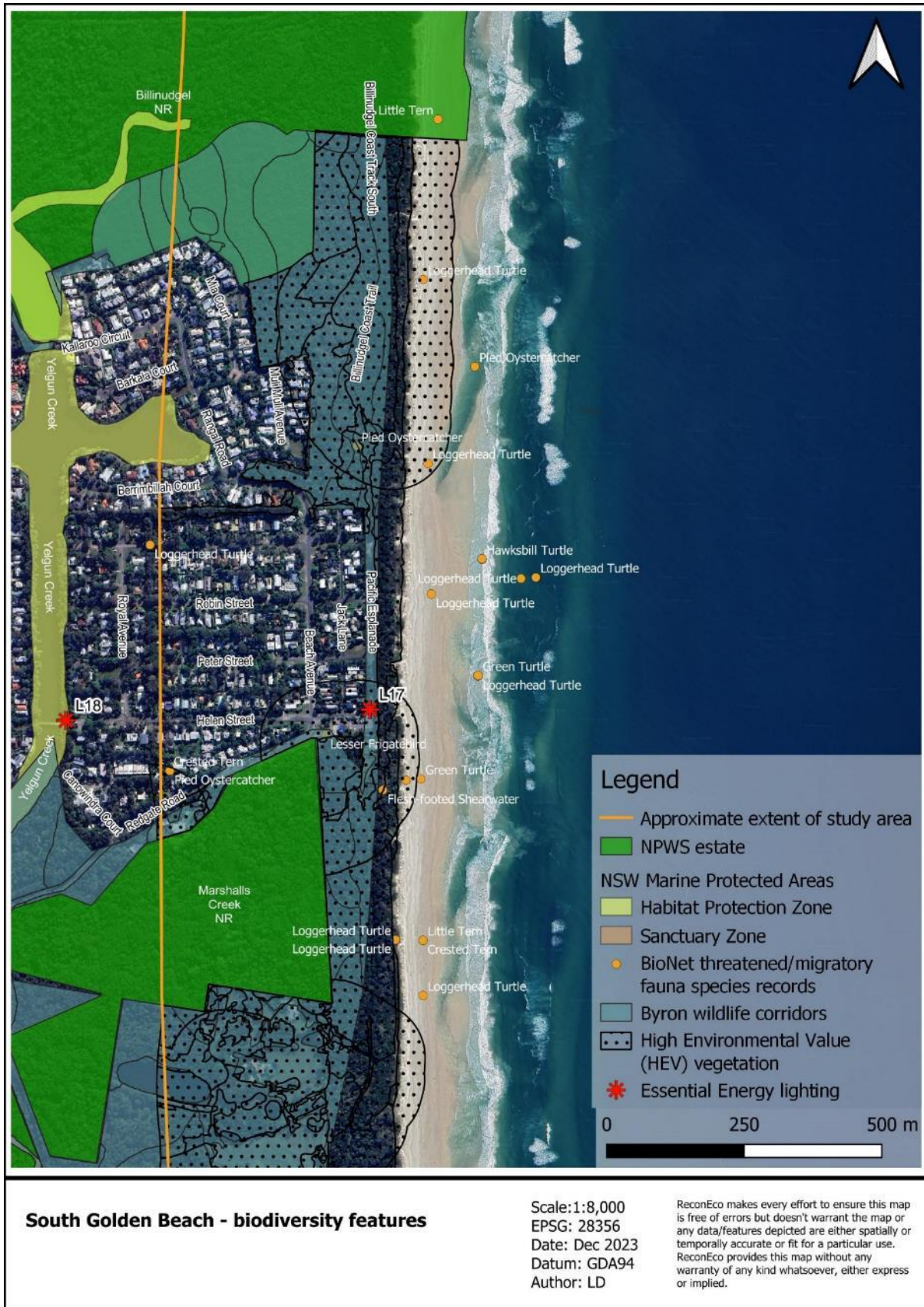


Figure 3 South Golden Beach biodiversity features and lighting infrastructure

Note: Sighting records of marine turtles shown at Fig. 3-7 do not represent nesting attempts.



Figure 4 New Brighton biodiversity features and lighting infrastructure

Note: Sighting records of marine turtles shown at Fig. 3-7 do not represent nesting attempts.

3.3.3.2 BRUNSWICK HEADS

Intertidal habitats and sandy beaches at Brunswick Heads provide suitable habitat for nesting marine turtles, foraging shorebirds and seabirds (refer **Figure 5**). Estuarine environments within the Brunswick River estuary also provide critical nesting habitat for threatened resident shorebirds and foraging habitat for resident and migratory shorebirds. The potential for human disturbance to these habitats is highly concentrated at the beach south of the Brunswick River mouth, and adjacent to the township along the banks of Simpsons Creek and the southern banks of the Brunswick River. An off-lead dog beach between the Brunswick Heads Surf Life Saving Club and Tyagarah Nature Reserve further reduces the suitability of habitat for threatened species. The suitability of potential habitat for threatened coastal species increases as disturbance and illumination reduces to the north (adjacent to Brunswick Heads Nature Reserve) and south (adjacent to Tyagarah Nature Reserve).

Streetlights and surrounding environments were assessed at South Beach Road (Council managed Crown Reserve), including the Brunswick Heads Bridge (vehicle) and footbridge. The dune height, and height and width of littoral vegetation adjacent to South Beach Road currently provides a sufficient buffer between the beach and nearby light sources. As a result, streetlights are not visible from beach habitats and impacts from individual light sources to marine turtles and foraging shorebirds is unlikely.

Vegetation buffering the coastline from street lighting and nearby residences is mapped as coastal dune dry sclerophyll forest (coastal banksia), HEV vegetation and a wildlife corridor. This vegetation provides suitable roost and foraging habitat for microbats and foraging habitat for megabats (flying-foxes). Minor light spill from occasional and well-spaced streetlighting on South Beach Road is unlikely to significantly impact available threatened bat habitat in the context of surrounding protected areas. Streetlights also provide an opportunity for some species of microbats to alter foraging behaviour in response to higher prey availability at individual light fittings. This impact is expected to be minor due to the low density of light fittings, down-facing direction, and low wattage.

Four tennis court floodlights are located at the Brunswick Heads Tennis Club (Council managed Crown Land) at the end of South Beach Road. The floodlights are not visible from the beach due to dune height and vegetation, however adjacent coastal banksia forest (HEV vegetation) is illuminated by these lights. Coast banksia dunal forest is a high-quality resource for the threatened species Grey-headed Flying-fox and Common Blossom Bat. Floodlight operation timing can extend to 11.30pm in line with court hire schedule but is typically finished by 8.30pm. Vegetation would remain unlit for most of the night. Illumination is concentrated/pooled at the location of the tennis courts and is unlikely to cause fragmentation to a commuting corridor for these species. The potential reduction in foraging resources adjacent to these fittings is minor in comparison to available foraging habitat within adjacent 'unlit' Brunswick Heads and Tyagarah Nature Reserves where natural darkness prevails.

Simpsons Creek is designated as a Habitat Protection Zone within the Cape Byron Marine Park, and functions as a wildlife corridor. The creek and riparian landscape in the township of Brunswick Heads is highly modified and waterfront commercial and residential activity is the greatest contributor to artificial lighting. Street lighting adjacent to the creek is present at

low densities (for example at the end of foot and vehicle bridges). Four examples of streetlight and park fittings were identified as problematic (as described in **Part 3: Step 1**) due to inappropriate pole heights, direction, lack of shields and lack of natural or human-made barrier between fittings and the waterway. These fittings are unlikely to result in a significant impact to critical habitat for threatened coastal species, however, are contributing to excessive light spill into a Habitat Protection Zone of the Cape Byron Marine Park. Management actions to address these fittings are recommended in **Part 4**.

Marshalls Creek is designated as a Sanctuary Zone and wildlife corridor and the Brunswick River is designated as a Habitat Protection Zone and wildlife corridor. The waterways and riparian landscapes of mangrove swamp, saltmarsh, coastal swamp forest and littoral rainforest north and west of Brunswick Heads are within the Brunswick Heads Nature Reserve and are mostly protected from artificial light sources. The Brunswick River estuary (including Marshalls Creek) provides important nesting habitat for threatened resident shorebirds (including Pied Oystercatcher and Beach Stone-curlew) and foraging habitat for resident and migratory shorebirds. These habitat areas are also utilised by threatened bird species, Bush Stone-curlews. Nesting and roosting habitats within the estuary are protected from artificial lighting by a break wall at the mouth of Marshalls Creek, and by river bends and islands further upstream. Reflections Holiday Parks (Massy Greene and Ferry Reserve) may contribute to artificial light in proximity to shorebird nesting habitat and represent a possible opportunity for engagement outside of Council-managed lands.

Upgrades to light fittings within Council managed lands in Brunswick Heads requires correspondence with Essential Energy. Upgrades to light fittings within land managed by Reflections Holiday Parks will require direct correspondence by Council.

For future upgrades or installation of new lighting, ecological assessments including 5-part tests of significance (BC Act) must be undertaken and consideration should be given to the *National Light Pollution Guidelines for Wildlife* and this Plan.

Byron Shire Coastal Light Management Plan



Brunswick Heads - biodiversity features

Scale: 1:8,000
 EPSG: 28356
 Date: Dec 2023
 Datum: GDA94
 Author: LED

ReconEco makes every effort to ensure this map is free of errors but doesn't warrant the map or any data/features depicted are either spatially or temporally accurate or fit for a particular use. ReconEco provides this map without any warranty of any kind whatsoever, either express or implied.

Figure 5 Brunswick Heads biodiversity features and lighting infrastructure

Note: Sighting records of marine turtles shown at Fig. 3-7 do not represent nesting attempts.

3.3.3.3 BELONGIL BEACH/BELONGIL CREEK

Estuarine habitats within Belongil Creek provide critical nesting habitat for threatened resident shorebirds and foraging habitat for resident and migratory shorebirds. Belongil Beach provides suitable habitat for nesting marine turtles, foraging shorebirds and seabirds (refer **Figure 6**). The potential for human disturbance to these habitats is concentrated at Belongil Beach and the creek outlet. An off-lead dog beach extends from Manfred Street in the northwest, east to the seawall at Wreck Beach, Byron Bay. The use of this dog beach (and occasional misuse - extending towards the Belongil estuary mouth where dogs are prohibited) further reduces the suitability of habitat for threatened species. The suitability of potential habitat for threatened coastal species increases as disturbance and illumination reduces to the north (adjacent to Tyagarah Nature Reserve). Belongil Creek is designated as a Special Purpose Zone within the Cape Byron Marine Park. Belongil Beach to the east of Border Street is Council managed Crown Land. Vegetation within the immediate locality is mapped as HEV, including freshwater wetlands, mangrove swamp, coastal swamp forest, dry sclerophyll forest and littoral rainforest. Wildlife corridors are mapped from Belongil Creek to the southwest.

Street lights and surrounding environments were assessed at Kendall, Border and Childe Streets. Despite high levels of human use, Belongil Beach and Creek are not subject to high levels of artificial lighting from Council-managed infrastructure. Street lighting is present at low densities at the western end of Childe Street, providing low level illumination concentrated at individual fittings. Beachfront and creekfront residential dwellings are located either side of Childe Street. As a result, most streetlighting is not visible from the beach or creek, and the source of artificial light reaching either habitat area is from nearby residences, or the resort (Elements of Byron) at Bayshore Drive. These stakeholders represent an opportunity for engagement outside of Council-managed lands.

One Essential Energy light fitting at the New Jetty Park was identified as visible from the beach and intertidal area (refer **Part 3: Step 1**). This fitting is located high on dunes to light the beach access path, however, illuminates beyond its intended purpose. Several other light fittings to the east, on Border Street, are also visible from the beach. A high level of human disturbance at these beach access points reduces the suitability of the immediate beach area as nesting habitat for marine turtles. Light fittings located high on the dunes are undesirable due to visibility from the beach and potential negative impacts to distant marine turtle hatchlings. Management actions to address these inappropriate light fittings are recommended in **Part 4**.

Fragmented patches of vegetation within the Belongil residential and commercial area provide marginal suitable roost and foraging habitat for microbats or megabats (flying-foxes). Minor light spill from occasional and well-spaced streetlighting in this area is unlikely to significantly impact threatened bat habitat. Streetlights provide an opportunity for some species of microbats to alter foraging behaviour in response to higher prey availability at individual light fittings. This impact is expected to be minor due to the low density of light fittings.

Upgrades to street light fittings within the Belongil Beach area requires correspondence with Essential Energy.

Byron Shire Coastal Light Management Plan

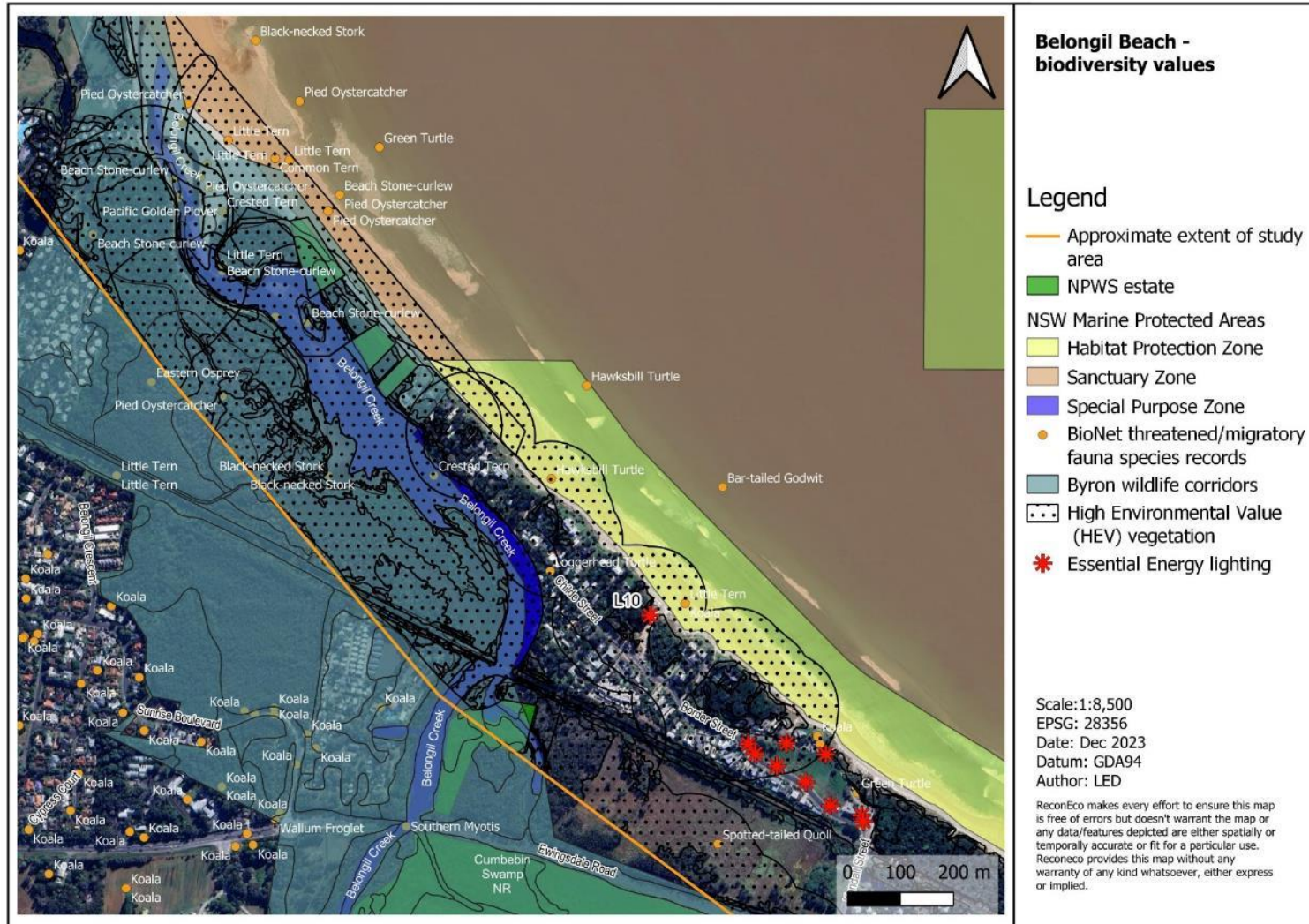


Figure 6 Belongil Beach/Creek biodiversity features and lighting infrastructure

Note: Sighting records of marine turtles shown at Figures 3 to 7 do not represent nesting attempts.

3.3.3.4 BYRON BAY – MAIN BEACH TO CLARKES BEACH

Intertidal habitats and sandy beaches from Main Beach to Clarkes Beach provide marginal habitat for nesting marine turtles and foraging shorebirds and seabirds due to high levels of human disturbance and the dynamic nature of the beach resulting in ongoing sand erosion and accretion (refer **Figure 7 & 8**). The potential for human disturbance to these habitats is high along the entire length of the foreshore reserve on the basis of very high levels of use and amenity; the most concentrated area of human activity (and lighting) in the Shire. The suitability of potential habitat for threatened coastal species increases as human disturbance and illumination reduce. For example, within Arakwal National Park and the Cape Byron State Conservation Area.

Main Beach to Clarkes Beach concept design

Concept design plans are currently being developed by Council to upgrade the Main Beach to Clarkes Beach foreshore area reserve (key assets and infrastructure), including proposed lighting upgrades. Lighting upgrades are anticipated to be recommended for current permanent and continuous night-time use. The light fitting types, locations, directions and intensities, or spatial extent of illumination are not yet determined. Where lighting is considered essential for safety, it must be designed to avoid unnecessary impacts to wildlife. Appropriate design measures and management actions consistent with the *National Light Pollution Guidelines for Wildlife* have been described in **Part 4** of this Plan to contain, limit, and direct light to the intended area while minimising excessive illumination and potential negative impacts to wildlife. Where these design measures are adopted, it is understood that the upgrade will not result in an increase in levels of night-time illumination within the foreshore reserve. When lighting type, levels and extent of illumination are determined in final design plans for the Main and Clarkes Beach foreshore reserve, an ecological assessment including 5-part tests of significance (BC Act) must be undertaken and consideration should be given to the *National Light Pollution Guidelines for Wildlife* and recommendations in this Plan.

An audit of current lighting infrastructure within the foreshore reserve from Main Beach to Clarkes Beach (Council managed Crown Land) identified several lighting issues. Despite the immediate area being suboptimal habitat for threatened species, the intended revisualisation of this foreshore reserve presents the greatest opportunity for reducing the cumulative impact of coastal lighting on threatened fauna species.

Vegetation in proximity to the foreshore reserve is mapped as HEV vegetation including wallum sand heath, coastal dune dry sclerophyll forest, littoral rainforest, coastal swamp forest and subtropical rainforest. Wildlife corridors are not mapped within the foreshore reserve. The width of littoral vegetation adjacent to the reserve varies from no vegetation at the western extent, to 40m in width at the eastern extent. Closer to Clarkes Beach, existing vegetation provides a sufficient buffer between the beach and nearby light sources. This vegetation may provide roost and foraging habitat for microbats and foraging habitat for megabats (flying-foxes). Light spill from white LED park lights along the footpath adjacent to Bay Street may reduce microbat and flying-fox foraging behaviour at the edge of littoral vegetation or where park lights have been identified as problematic (refer **Part 3: Step 1**). Light spill is unlikely to significantly impact available threatened bat habitat in the context of

surrounding protected areas. Increased foraging behaviour by some species is possible as a response to increased insect abundance around light fittings.

Several examples of streetlight and park light fittings were identified as problematic due to inappropriate locations, light colour, directions, lack of shields and lack of natural or human-made barrier between fittings and the coastal environment (refer **Part 3: Step 1**).

The highest density of artificial lighting visible from the beach area is at the Main Beach foreshore area and Apex Park. Current levels of human disturbance and lack of dune structure potentially cause a reduction in nesting attempts and increase the occurrence of non-nesting emergence of marine turtles at Main Beach (and Clarkes Beach) (Australian Seabird & Turtle Rescue, personal communication, [2023]). BioNet records indicate sporadic and low-density nesting attempts at beaches in this section of the LGA.

The *TurtleCare Sunshine Coast Operational Guidelines* (Queensland) outline the process applied for relocation of turtle nests if there is a low probability of successful hatchlings finding the sea and relocation is practical and possible. Accredited volunteers in Queensland can relocate clutches if there is obvious light pollution and/or high foot traffic (Sunshine Coast Council, n.d.). Light pollution is not listed in the NPWS Marine Wildlife Response Procedures however where light pollution may impact on marine turtle hatchlings NSW TurtleWatch and NPWS may discuss management options and consider relocation, if necessary, practical and possible. Despite the possibility of relocating clutches the priority is to employ lighting design that does not increase the cumulative brightness from land that may misorient turtle hatchlings in the immediate vicinity or many kilometres away. Artificial light is also contributing to excessive light spill into a Habitat Protection Zone of the Cape Byron Marine Park. Management actions to address these design issues and support the design of lighting upgrades within the foreshore reserve are recommended in **Part 4**.

A known flying-fox roost containing Grey-headed Flying-foxes occurs on Middleton Street and has been occupied since at least 2012. The continued occupation of this roost within a highly disturbed urban environment indicates this species has a tolerance (or possible preference) for illuminated or partially illuminated roost sites. A Review of Environmental Factors (REF) and lighting impact assessment was undertaken in 2022 in relation to installation of facility lighting for Jarjumirr Park (Byron Bay Skate Park), adjacent to the Middleton Street flying-fox roost. Lighting infrastructure at this location includes nine 12 metre poles, each with two luminaires (white LEDs of varying light intensities). Lighting is switched off at 9.30pm each night. Manual or automatic controls allow for lighting to be modified if required. The assessment determined that overall impacts on flying-foxes, microbats and other species from additional light sources were expected to be minor (Greenloaning Biostudies, 2022). The 'loss' of foraging resources at this location due to illumination is minor in comparison to available foraging habitat within adjacent 'unlit' vegetation. A recommendation was made within the REF to review the impact of the skate park lighting on the flying-fox roost 12 months after the facility opening. Results of this review may inform modification to lighting infrastructure at this location if impacts to flying-foxes are observed.

Sandhills Stormwater Management System Project

The Sandhills Crown Reserve is a large parcel of undeveloped land within the urban township of Byron Bay, under ownership of Crown Lands (however Council are currently negotiating tenure). A proposal is in the planning phase to establish artificial wetlands for stormwater management and the installation of associated infrastructure including access paths, landscape works, boardwalks and new lighting consisting of 23 streetlights. The proposal is located in the eastern half of the reserve (refer **Figure 7**).

Vegetation within the reserve is mapped as being of high environmental value (HEV) and consists of littoral rainforest, swamp oak swamp forest and paperbark swamp forest. Within the reserve, habitat for the Wallum Froglet occurs in Melaleuca swamps, sedge swamps and along drainage lines in sub-coastal wet heath (Planit Consulting, 2023). The Wallum Sedge Frog has more specialised habitat requirements than the Wallum Froglet (and has not been recorded at the site). Other threatened species recorded at the reserve include the Grey-headed Flying Fox and several threatened microbats (Large Bent-winged Bat, Little Bent-winged Bat and Southern Myotis) (Planit Consulting, 2023).

Streetlight locations, type and extent of illumination are to be determined in design plans for the Sandhills Stormwater Management System Project proposal. An independent ecological assessment including 5-part tests of significance (BC Act) is to be undertaken to assess potential impacts to threatened species resulting from the lighting proposal. Consideration should be given to the *National Light Pollution Guidelines for Wildlife* and the general recommendations made within this Plan.

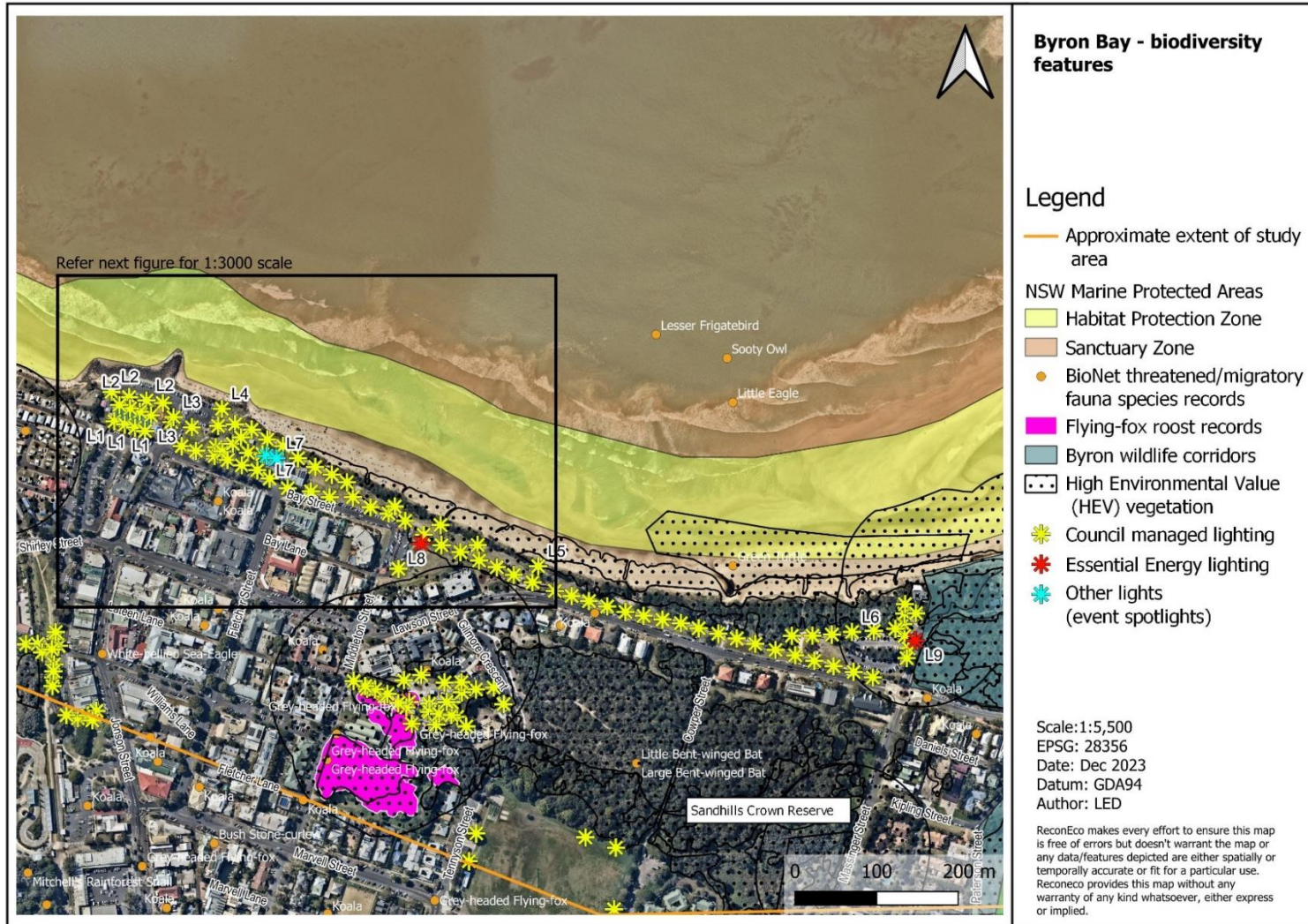


Figure 7 Byron Bay biodiversity features and lighting infrastructure

Note: Sighting records of marine turtles shown at Fig. 3-7 do not represent nesting attempts.

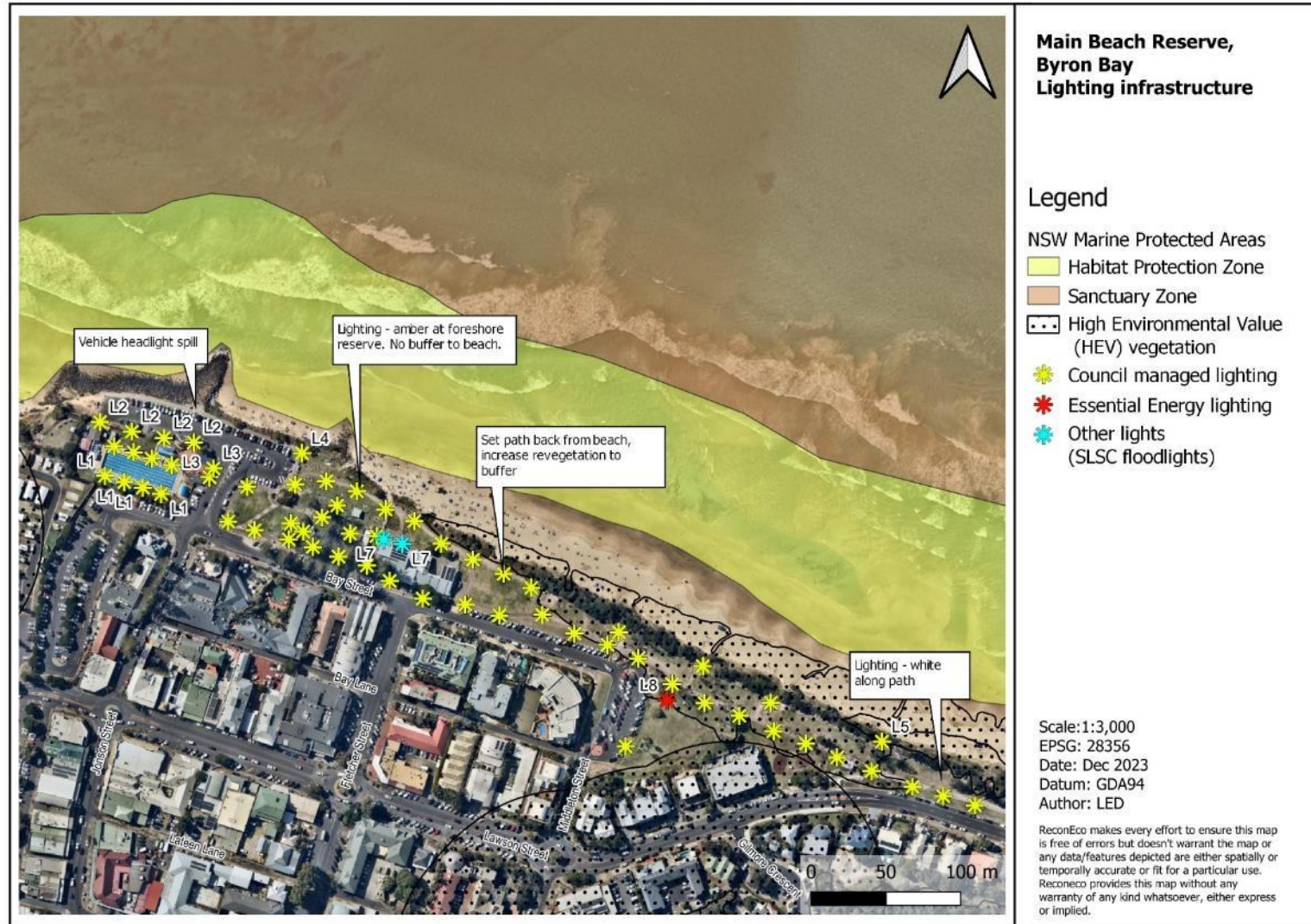


Figure 8 Main Beach Reserve, Byron Bay - lighting infrastructure and general recommendations

Part 4: Prioritised action plan

The following methodology was used to develop a prioritised action plan to reduce the impact of Council managed lighting infrastructure on threatened fauna species known or likely to occur within the immediate coastal area of the Byron LGA:

- Identify practical and sustainable actions and/or strategies that can be implemented within Council managed lands to manage light impacts;
- Identify priority areas for upgrade or improvement; and
- Consideration of the use of best practice lighting design principles.

The following section of the Plan provides guidance for how best to achieve the objectives stated within Part 1.

4.1 Best practice lighting design principles

The impacts of lighting infrastructure on wildlife must be considered early in the planning stage for any new proposed development or upgrade. A risk assessment approach should be taken - where the risk of impact on wildlife due to artificial lighting is removed as a priority, and impact reduction measures implemented as a secondary priority. The following approach is recommended during the design process:

1. Is lighting required for the situation, and if so, can the lighting extent be reduced? Lighting systems may be installed with the assumption that they are required as 'standard' practice. Each design case should be reviewed independently to determine if the space can be used or function effectively without the installation of a lighting system. The removal of artificial lighting and prioritisation of natural darkness is the best solution where possible.
2. Can the development be relocated to reduce the impact of lighting infrastructure on sensitive environments? The space may be positioned away from coastal areas, downhill from natural aspects or where natural screening can be utilised.
3. Are other, non-lighting elements able to be provided to provide shielding or buffering between the lighting system and the surrounding environment? These may include artificial screens or walls, or natural landscaping elements.

Once the above-mentioned design factors have been considered, the following design principles should be applied (refer overleaf).

The following design principles have been adapted from the *National Light Pollution Guidelines for Wildlife* (DCCEEW, 2023).

1) Start with natural darkness and only add light for specific purposes.

Use localised lighting systems which focus on specific areas, utilise aim and distribution techniques to limit spill light onto areas where light is not required.

2) Use adaptive light controls to manage light timing, intensity and colour.

Use dimming or sensor controls to limit the intensity and extent of light intrusion at times when the system is not required at peak performance.

3) Light only the object or area intended – keep lights close to the ground, directed, and shielded to avoid light spill.

Line of sight to a light source has a significant impact on wildlife and must be avoided wherever possible. Avoiding the impact of the light glow and reflection should also be removed or minimised as much as possible.

4) Use the lowest intensity lighting appropriate for the task.

When the principles in item 3 (above) are utilised, often this will result in lower intensity, more frequent lighting sources.

5) Use non-reflective, dark-coloured surfaces.

The light source is not the only impacting factor. Just like the light fitting's reflector, the different surfaces of the area being lit, will reflect the light potentially into environmentally sensitive areas.

6) Use lights with reduced or filtered blue, violet and ultraviolet wavelengths.

All light will have some impact on the surrounding, natural environment. When other lighting removal/reduction/mitigation measures have been considered and implemented, the impact can be further reduced by controlling the type of light which is being emitted.

4.2 Management actions

Management actions have been identified in **Table 7** overleaf. These actions include a range of responses to deliver on the objectives of this Plan (refer page 12), as follows:

1. Identify light outputs within the coastal area with potential to impact threatened fauna species;
2. Examine opportunities to reduce the output of light with potential to impact threatened fauna species from Council managed lighting infrastructure adjacent to the Byron coastline to a level that is as low as reasonably practicable;
3. Reduce the visibility of Council managed lighting infrastructure within areas of sensitive habitat; and
4. Balance the requirement for public safety, recreation and amenity while protecting and preserving the coastal environment.

Note: Implementation of management actions is reliant on funding allocation.

For future upgrades or installation of lighting, ecological assessments of confirmed lighting designs including 5-part test of significance (BC Act) must be undertaken, and consideration should be given to the *National Light Pollution Guidelines for Wildlife* and this Plan.

Table 7 Prioritised action plan to reduce the impact of artificial lighting on sensitive coastal environments (Note: key actions are subject to identification of resources and funding streams).

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
1. Ensure operation and maintenance of (and upgrades to) Council managed infrastructure avoids or prevents direct illumination of the beach, ocean, waterways or HEV vegetation in the coastal area at night and cumulative contribution to skyglow is reduced.	Monitor, minimise and switch off (where possible/appropriate) the use of large event spotlights at Main Beach Reserve during Schoolies Week and New Years Eve.	High	1-2 years	1, 2, 3, 4
	Undertake appropriate training for the BSC Asset Maintenance staff to ensure the appropriate operation and maintenance of lighting infrastructure within Council managed lands for the protection of threatened species.	High	1 year	1, 2, 3, 4
	All lighting infrastructure within Council managed lands adjacent to the beach, ocean, waterways or HEV vegetation in the coastal area to be redesigned or replaced to meet <i>Best Practice Lighting Design Principles for Wildlife</i> as upgrades or maintenance is required and where appropriate (refer Appendix D).	Ongoing (long-term)	3-5 years	1, 2, 3, 4

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
	Note: replacement of any lighting will be reliant on funding allocation via Council. Costing of lighting infrastructure is dependent on supplier.			
	<p>Ensure any new lighting requests are assessed prior to installation and comply with the relevant standards, policies or legislation taking into consideration pedestrian safety, road safety and building security.</p> <p>New lighting requests must achieve, but not over-exceed compliance requirements to a level where lighting intensity, placement or direction is excessive or inappropriate.</p>	Ongoing	n/a	4
	Engage with Essential Energy seeking review of compliance requirements for road/area lighting and upgrade light fittings (outside of Council managed lands) identified as problematic or redundant (refer Part 3: Step 1). This may only be possible/appropriate where AS1158 compliance can be achieved. Where modifications are proposed to road/area lighting systems, specific assessments may be required.	High	1 year	1, 4
2. Incorporate best practice lighting design principles into revisualisation of Main Beach to Clarkes Beach foreshore areas	Concept plans for the Main Beach to Clarkes Beach foreshore areas are to incorporate lighting that ensures avoidance, minimisation or elimination of artificial illumination of the beach, ocean or HEV vegetation at night. This includes:	High	1 year	2, 3, 4

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
	<ul style="list-style-type: none"> • Minimise the use and intensity of outside lighting required to achieve compliance and/or purpose. • Use light fitting types that are amber or reduced UV LED fittings where appropriate. • Install lighting fixtures that are: <ul style="list-style-type: none"> (a) shielded from the beach, ocean, waterways or HEV vegetation. (b) mounted as low as reasonably practical to avoid direct horizontal light or downwards glare onto the beach, ocean, waterways or HEV vegetation. Use bollard lighting along pathways where appropriate; and (c) directed downwards or away from the coast. • If appropriate, lights visible from the beach or ocean are fitted with light motion detection sensors and/or timers to ensure lighting is turned off when not required. • Install low walls or landscape buffers to prevent vehicle headlight or carpark lighting spill to the beach from the Main Beach Car Park (or any other carpark identified to have lighting spill). • Avoid impacts to established vegetation or regenerating vegetation in the vicinity of the foreshore reserve. • Remove light fittings that have been identified as redundant or not required. 			

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
	<p>(refer Appendix D for best practice lighting design features, and Appendix F for suitable light fixtures and costings).</p> <p>Note: development of the foreshore area will require an ecological assessment including 5-part test of significance (BC Act) and a lighting assessment to review final determined lighting design. Consideration should be given to the National Light Pollution Guidelines for Wildlife and this Plan.</p>			
<p>3. Incorporate <i>best practice lighting design principles</i> into lighting installation proposal for Sandhills Crown Reserve as part of the Sandhills Stormwater Management System Project</p>	<p>Lighting design for the Sandhills Stormwater Management System Project is to incorporate lighting that ensures avoidance, minimisation or elimination of artificial illumination of HEV vegetation or known threatened species habitat at night. This includes:</p> <ul style="list-style-type: none"> • Minimise the use and intensity of outside lighting required to achieve compliance with pedestrian streetlighting standards and/or purpose. • Adjustable lighting heads should be set to reduce light spill into adjacent areas of habitat to the maximum extent possible. • Use of lights with no more than 4000K Correlated Colour Temperature (CCT). • Lights should be permanently set to motion sensing settings to reduce light at the site when the site is not being visited to 	<p>High</p>	<p>1 year</p>	<p>2, 3, 4</p>

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
	<p>the maximum extent possible (whilst taking into account safety and compliance requirements).</p> <p>Note: installation of streetlighting will require an ecological assessment including 5-part test of significance (BC Act) to consider potential impacts of determined lighting design. Consideration should be given to the National Light Pollution Guidelines for Wildlife and this Plan.</p>			
4. Limit new access tracks through dune vegetation.	<p>No new beach access points or tracks through dune vegetation are established unless the access is designed to reduce opportunities for light spill within threatened fauna species habitat and:</p> <p>(a) is required to enhance public access to the beach or</p> <p>(b) there is no net increase in the number of access points, with any replaced accesses fenced off and revegetated.</p>	Ongoing	n/a	2, 3, 4
5. Encourage implementation of dune management actions with a focus on increasing dune vegetation height and health to act as a buffer to artificial light from any source reaching the beach.	<p>Landscape buffers are required to be designed, constructed and maintained in accordance with the following principles:</p> <p>(a) plant species selected are appropriate for the location, drainage and soil type, and require minimal ongoing maintenance</p>	High	1-5 years	2, 3, 4

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
	<p>(b) plant selection includes a range of species to provide variation in form, colour and texture to contribute to the natural appearance of the buffer</p> <p>(c) planting density results in the creation of upper, mid and understory strata</p> <p>(d) tufting plants, vines and groundcovers are planted</p> <p>(e) where adjoining the edge of native vegetation or watercourse understorey, shrubs and vines are used to bind the buffer edges against degradation and weed infestation.</p> <p>Note: planting density should aim to maximise the blocking of light spillage between land and the beach or ocean, however, should not be the only action undertaken to mitigate light pollution. High level illumination of vegetation is not desirable.</p>			
6. Identify light outputs from other sources with potential to impact threatened fauna species.	Undertake diurnal and nocturnal audits of artificial light sources outside of Council managed land tenure located within the immediate coastal area (refer Appendix E for audit checklist).	Moderate	1-2 years	1
	Undertake diurnal and nocturnal audits of artificial light sources arising from Council managed lands across the entire Byron LGA – i.e. beyond the immediate coastal area audited within the scope of this report (refer Appendix E for audit checklist).	Low	3-5 years	1

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
7. Community engagement.	<p>Engage landholders and land managers to consider their contribution to artificial light. Possible opportunities include:</p> <ul style="list-style-type: none"> • Raise public awareness of artificial lighting and mitigation strategies in the lead up to and during turtle nesting season or shorebird nesting season via: <ul style="list-style-type: none"> ○ Seasonal campaigns (e.g. ‘Turn off the lights for turtles’). ○ Social media posts; and ○ Letterbox drops to residences located adjacent to sensitive habitat areas • Make targeted contact with residential or commercial stakeholders as identified within Strategy 5 to invite consideration of contribution to artificial light and provide mitigation suggestions. 	Moderate	1-2 years	1, 4
	<p>Consider grant opportunities to provide beachfront landholders or managers with acceptable light fixtures, shields, or other mitigation strategies to reduce sources of artificial light outside of Council managed lands.</p>	Low	3-5 years	1
8. Planning and policy.	<p>Incorporate specific development control provisions into the Byron Development Control Plan (DCP). Ensure appropriate</p>	High	On review of Byron DCP	2, 3, 4

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
	<p>development control in support of natural darkness wherever possible, including:</p> <ul style="list-style-type: none"> a) a requirement to assess any new lighting or development to take into consideration the recommendations outlined within this Plan and the <i>National Light Pollution Guidelines for Wildlife</i>, including the implementation of the Best Practice Lighting Design; b) application of specific controls to development located adjacent to the beach, ocean, waterway, NPWS estate, or Cape Byron Marine Park. c) a requirement that development provides for natural or artificial buffers that: <ul style="list-style-type: none"> i. protect the edges of existing native vegetation or any other areas of environmental significance; and ii. screen the development (including associated artificial light) to a level where it is not visible from the beach or ocean. 			
	<p>Incorporate relevant outcomes, considerations and/or actions in this Plan into the development of Coastal Management Programs for the Byron Shire Coastline.</p>	Ongoing	On finalisation of CMPs	2, 3, 4
	<p>Seek and incorporate feedback from relevant stakeholders relating to artificial lighting into conditions of consent for</p>	Ongoing	n/a	2, 3, 4

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
	development applications. Possible stakeholders may include NPWS, Marine Parks Authority or Australian Seabird & Turtle Rescue.			
9. Review, monitoring and auditing.	Undertake an audit of lighting infrastructure within Council-managed lands in 2029 to ensure development, future maintenance, and upgrades to lighting infrastructure remains consistent with the objectives of the <i>Byron Shire Coastal Light Management Plan 2024</i> (refer Appendix E). Repeat lighting infrastructure audits every five years.	High	5 years	1, 2, 3, 4
	Engage a suitable qualified lighting engineer to undertake a technical review of lighting infrastructure in 2029. Consultation should determine suitability of infrastructure in the context of technological advances that may become available into the future. Review lighting infrastructure technologies every five years.	Moderate	5 years	1, 2, 3, 4
	Undertake regular correspondence with NSW NPWS, Marine Parks Authority, Australian Seabird & Turtle Rescue and Byron Bird Buddies for identification and adaptive management of impacts of lighting infrastructure on threatened coastal species.	Ongoing	n/a	1, 2, 3, 4
	Undertake liaison with other Councils with LGA boundaries at the east coast of Australia to collaborate, share information,	Moderate	1-2 years	1, 2, 3, 4

Action	Output	Priority	Timing	Objectives met (see p.12 or 89)
	receive guidance in relation to artificial light management and associated impacts to wildlife.			
10. Habitat mapping.	<p>Undertake spatial mapping of shorebird roost, foraging and nesting sites and key areas for marine turtle nesting, to enable future site and threat prioritisation so it can be readily used for planning and conservation projects.</p> <p>Mapping of key habitat areas would provide a useful resource to guide the application of planning instruments where they refer to impacts of artificial lighting resulting from proposed developments (Strategy 7).</p>	Moderate	3-5 years	2

High: Action should be implemented as soon as possible due to impact on threatened fauna. These actions are imperative to the objectives of the Plan.

Moderate: Action is of moderate priority and necessary to achieve the objectives of this Plan but is not urgent. These actions should be considered within an appropriate timeframe after high priority actions have been achieved or if an opportunity arises, such as securing grant funding.

Low: Action is desirable to achieve management objectives but not currently a priority. These actions should be considered within an appropriate timeframe after other actions have been implemented or if an opportunity arises, such as securing grant funding.

Ongoing: Action is a priority to be undertaken throughout regular operations.

Appendix A – BioNet records

Table 8 BioNet records of threatened fauna occurring within proximity (approximately 1km) to the Byron coastline

Scientific Name	Common Name	NSW status	Comm. status
Amphibians			
<i>Crinia tinnula</i>	Wallum Froglet	V	
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V
<i>Litoria olongburensis</i>	Olongburra Frog	V	V
Reptiles			
<i>Caretta caretta</i>	Loggerhead Turtle	E	E
<i>Chelonia mydas</i>	Green Turtle	V	V
<i>Eretmochelys imbricata</i>	Hawksbill Turtle		V
<i>Dermochelys coriacea</i>	Leatherback Turtle	E	E
Birds			
<i>Lophoictinia isura</i>	Square-tailed Kite	V	
<i>Pandion cristatus</i>	Eastern Osprey	V	
<i>Tyto longimembris</i>	Eastern Grass Owl	V	
<i>Tyto novaehollandiae</i>	Masked Owl	V	
<i>Tyto tenebricosa</i>	Sooty Owl	V	
<i>Calyptorhynchus lathami lathami</i>	South-eastern Glossy Black-Cockatoo	V	V
<i>Actitis hypoleucos</i>	Common Sandpiper		C,J,K
<i>Amaurornis moluccana</i>	Pale-vented Bush-hen	V	
<i>Anous stolidus</i>	Common Noddy		C,J
<i>Apus pacificus</i>	Fork-tailed Swift		C,J,K
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	V	J,K
<i>Ardenna grisea</i>	Sooty Shearwater		J
<i>Ardenna pacifica</i>	Wedge-tailed Shearwater		J
<i>Ardenna tenuirostris</i>	Short-tailed Shearwater		C,J,K
<i>Arenaria interpres</i>	Ruddy Turnstone		C,J,K
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper		C,J,K
<i>Calidris canutus</i>	Red Knot		E,C,J,K
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	CE,C,J,K
<i>Calidris melanotos</i>	Pectoral Sandpiper		J,K
<i>Calidris ruficollis</i>	Red-necked Stint		C,J,K
<i>Calidris tenuirostris</i>	Great Knot	V	CE,C,J,K

Byron Shire Coastal Light Management Plan

Scientific Name	Common Name	NSW status	Comm. status
<i>Calonectris leucomelas</i>	Streaked Shearwater		C,J,K
<i>Carterornis leucotis</i>	White-eared Monarch	V	
<i>Circus assimilis</i>	Spotted Harrier	V	
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	
<i>Esacus magnirostris</i>	Beach Stone-curlew	CE	
<i>Fregata ariel</i>	Lesser Frigatebird		C,J,K
<i>Fregata minor</i>	Great Frigatebird		C,J
<i>Gallinago hardwickii</i>	Latham's Snipe		J,K
<i>Gelochelidon nilotica</i>	Gull-billed Tern		C
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	
<i>Gygis alba</i>	White Tern	V	
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V	
<i>Haematopus longirostris</i>	Pied Oystercatcher	E	
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	
<i>Hieraaetus morphnoides</i>	Little Eagle	V	
<i>Hirundapus caudacutus</i>	White-throated Needletail		V,C,J,K
<i>Hydroprogne caspia</i>	Caspian Tern		J
<i>Irediparra gallinacea</i>	Comb-crested Jacana	V	
<i>Ixobrychus flavicollis</i>	Black Bittern	V	
<i>Lichenostomus fasciocularis</i>	Mangrove Honeyeater	V	
<i>Limosa lapponica</i>	Bar-tailed Godwit		C,J,K
<i>Macronectes giganteus</i>	Southern Giant Petrel	E	E
<i>Macronectes halli</i>	Northern Giant-Petrel	V	V
<i>Numenius madagascariensis</i>	Eastern Curlew		CE,C,J,K
<i>Numenius phaeopus</i>	Whimbrel		C,J,K
<i>Onychoprion fuscata</i>	Sooty Tern	V	
<i>Phaethon rubricauda</i>	Red-tailed Tropicbird	V	C,J
<i>Phoebetria fusca</i>	Sooty Albatross	V	V
<i>Pluvialis fulva</i>	Pacific Golden Plover		C,J,K
<i>Pluvialis squatarola</i>	Grey Plover		C,J,K
<i>Podargus ocellatus</i>	Marbled Frogmouth	V	
<i>Procelsterna cerulea</i>	Grey Ternlet	V	
<i>Pterodroma leucoptera leucoptera</i>	Gould's Petrel	V	E
<i>Pterodroma neglecta neglecta</i>	Kermadec Petrel (west Pacific subspecies)	V	V
<i>Pterodroma nigripennis</i>	Black-winged Petrel	V	
<i>Pterodroma solandri</i>	Providence Petrel	V	
<i>Ptilinopus magnificus</i>	Wompoo Fruit-Dove	V	

Byron Shire Coastal Light Management Plan

Scientific Name	Common Name	NSW status	Comm. status
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V	
<i>Stercorarius pomarinus</i>	Pomarine Jaeger		C,J,K
<i>Sterna hirundo</i>	Common Tern		C,J,K
<i>Sternula albifrons</i>	Little Tern	E	C,J,K
<i>Thalassarche bulleri</i>	Buller's Albatross		V
<i>Thalasseus bergii</i>	Crested Tern		J
<i>Todiramphus chloris</i>	Collared Kingfisher	V	
<i>Tringa brevipes</i>	Grey-tailed Tattler		C,J,K
<i>Tringa incana</i>	Wandering Tattler		J
<i>Tringa nebularia</i>	Common Greenshank		C,J,K
<i>Tringa stagnatilis</i>	Marsh Sandpiper		C,J,K
Mammals			
<i>Arctocephalus forsteri</i>	New Zealand Fur-seal	V	
<i>Arctocephalus pusillus doriferus</i>	Australian Fur-seal	V	
<i>Chalinobus nigrogriseus</i>	Hoary Wattled Bat	V	
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E
<i>Dugong dugon</i>	Dugong	E	
<i>Eubalaena australis</i>	Southern Right Whale	E	E
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V	
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	
<i>Myotis macropus</i>	Southern Myotis	V	
<i>Nyctophilus bifax</i>	Eastern Long-eared Bat	V	
<i>Phascolarctos cinereus</i>	Koala	E	E
<i>Planigale maculata</i>	Common Planigale	V	
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V
<i>Pseudomys gracilicaudatus</i>	Eastern Chestnut Mouse	V	
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V
<i>Syconycteris australis</i>	Common Blossom-bat	V	
Invertebrates			
<i>Argynnis hyperbius</i>	Laced Fritillary	E	CE
<i>Thersites mitchellae</i>	Mitchell's Rainforest Snail	E	CE

V = Vulnerable, E = Endangered, CE = Critically Endangered

Migratory species: C = CAMBA, J = JAMBA, K = ROKAMBA

Appendix B – Protected Matters Search Results



Australian Government

Department of Climate Change, Energy,
the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 21-Dec-2023

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar)	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	116
Listed Migratory Species:	68

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <https://www.dcceew.gov.au/parks-heritage/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	13
Commonwealth Heritage Places:	2
Listed Marine Species:	99
Whales and Other Cetaceans:	14
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	14
Regional Forest Agreements:	1
Nationally Important Wetlands:	1
EPBC Act Referrals:	14
Key Ecological Features (Marine):	None
Biologically Important Areas:	10
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area

[\[Resource Information \]](#)

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
Commonwealth Marine Areas (EPBC Act)	In feature area

Listed Threatened Ecological Communities

[\[Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area	In feature area
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community likely to occur within area	In feature area
Grey box-grey gum wet forest of subtropical eastern Australia	Endangered	Community may occur within area	In feature area
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area	In feature area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area	In feature area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In feature area
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions	Endangered	Community likely to occur within area	In feature area

Listed Threatened Species

[\[Resource Information \]](#)

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.

Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
null			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Mordacia praecox Non-parasitic Lamprey, Precocious Lamprey [81530]	Endangered	Species or species habitat likely to occur within area	In feature area
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat known to occur within area	In feature area
Cyclopsitta diophthalma coxeni Coxen's Fig-Parrot [59714]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat may occur within area	In feature area
FISH			
Epinephelus daemeli Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]	Endangered	Species or species habitat likely to occur within area	In feature area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
FROG			
Assa darlingtoni Pouched Frog [1965]	Vulnerable	Species or species habitat known to occur within area	In feature area
Litoria olongburensis Wallum Sedge Frog [1821]	Vulnerable	Species or species habitat known to occur within area	In feature area
Mixophyes fleayi Fleay's Frog [25960]	Endangered	Species or species habitat likely to occur within area	In feature area
Mixophyes iteratus Giant Barred Frog, Southern Barred Frog [1944]	Vulnerable	Species or species habitat known to occur within area	In feature area

INSECT

Scientific Name	Threatened Category	Presence Text	Buffer Status
Argynnis hyperbius inconstans Australian Fritillary [88056]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Phyllodes imperialis smithersi Pink Underwing Moth [86084]	Endangered	Species or species habitat known to occur within area	In feature area
MAMMAL			
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat known to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Notamacropus parma Parma Wallaby [89289]	Vulnerable	Species or species habitat may occur within area	In feature area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
<u>Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)</u>			
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area	In feature area
<u>Potorous tridactylus tridactylus</u>			
Long-nosed Potoroo (northern) [66645]	Vulnerable	Species or species habitat known to occur within area	In feature area
<u>Pseudomys novaehollandiae</u>			
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area	In feature area
<u>Pteropus poliocephalus</u>			
Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In feature area
<u>Xeromys myoides</u>			
Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area	In feature area
PLANT			
<u>Acronychia littoralis</u>			
Scented Acronychia [8582]	Endangered	Species or species habitat known to occur within area	In feature area
<u>Allocasuarina thalassoscopica</u>			
[21927]	Endangered	Species or species habitat known to occur within area	In feature area
<u>Amyema plicatula</u>			
[81879]	Endangered	Species or species habitat may occur within area	In buffer area only
<u>Arthraxon hispidus</u>			
Hairy-joint Grass [9338]	Vulnerable	Species or species habitat known to occur within area	In feature area
<u>Baloghia marmorata</u>			
Marbled Baloghia, Jointed Baloghia [8463]	Vulnerable	Species or species habitat likely to occur within area	In feature area
<u>Bosistoa transversa</u>			
Three-leaved Bosistoa, Yellow Satinheart [16091]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bulbophyllum globuliforme Miniature Moss-orchid, Hoop Pine Orchid [6649]	Vulnerable	Species or species habitat may occur within area	In feature area
Coleus nitidus listed as Plectranthus nitidus Nightcap Plectranthus, Silver Plectranthus [91380]	Endangered	Species or species habitat may occur within area	In buffer area only
Corokia whiteana [17820]	Endangered	Species or species habitat known to occur within area	In feature area
Cryptocarya foetida Stinking Cryptocarya, Stinking Laurel [11976]	Vulnerable	Species or species habitat known to occur within area	In feature area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area	In feature area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat known to occur within area	In feature area
Davidsonia jerseyana Davidson's Plum [67219]	Endangered	Species or species habitat known to occur within area	In feature area
Davidsonia johnsonii Smooth Davidsonia, Smooth Davidson's Plum, Small-leaved Davidson's Plum [67178]	Endangered	Species or species habitat known to occur within area	In feature area
Diospyros mabacea Red-fruited Ebony, Silky Persimmon, Ebony [18548]	Endangered	Species or species habitat may occur within area	In feature area
Diploglottis campbellii Small-leaved Tamarind [21484]	Endangered	Species or species habitat known to occur within area	In feature area
Elaeocarpus williamsianus Hairy Quandong [8956]	Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Endiandra floydii Floyd's Walnut, Crystal Creek Walnut [52955]	Endangered	Species or species habitat known to occur within area	In feature area
Endiandra hayesii Rusty Rose Walnut, Velvet Laurel [13866]	Vulnerable	Species or species habitat known to occur within area	In feature area
Floydia praealta Ball Nut, Possum Nut, Big Nut, Beefwood [15762]	Vulnerable	Species or species habitat known to occur within area	In feature area
Fontainea australis Southern Fontainea [24037]	Vulnerable	Species or species habitat known to occur within area	In feature area
Fontainea oraria Coastal Fontainea [24038]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Gossia fragrantissima Sweet Myrtle, Small-leaved Myrtle [78867]	Endangered	Species or species habitat known to occur within area	In feature area
Hicksbeachia pinnatifolia Monkey Nut, Bopple Nut, Red Bopple, Red Bopple Nut, Red Nut, Beef Nut, Red Apple Nut, Red Boppel Nut, Ivory Silky Oak [21189]	Vulnerable	Species or species habitat known to occur within area	In feature area
Isoglossa eranthemoides Isoglossa [16663]	Endangered	Species or species habitat may occur within area	In buffer area only
Leichhardtia longiloba listed as Marsdenia longiloba Clear Milkvine [91911]	Vulnerable	Species or species habitat known to occur within area	In feature area
Macadamia integrifolia Macadamia Nut, Queensland Nut Tree, Smooth-shelled Macadamia, Bush Nut, Nut Oak [7326]	Vulnerable	Species or species habitat known to occur within area	In feature area
Macadamia tetraphylla Rough-shelled Bush Nut, Macadamia Nut, Rough-shelled Macadamia, Rough-leaved Queensland Nut [6581]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ochrosia moorei Southern Ochrosia [11350]	Endangered	Species or species habitat known to occur within area	In feature area
Owenia cepiodora Onionwood, Bog Onion, Onion Cedar [11344]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pedleya acanthoclada listed as Desmodium acanthocladum Thorny Pea [93275]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat known to occur within area	In feature area
Randia moorei Spiny Gardenia [10577]	Endangered	Species or species habitat known to occur within area	In feature area
Rhodamnia maideniana Smooth Scrub Turpentine [20665]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Rhodomyrtus psidioides Native Guava [19162]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Sarcochilus fitzgeraldii Ravine Orchid [19131]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Sophora fraseri [8836]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Symplocos baeuerlenii Small-leaved Hazelwood, Shrubby Hazelwood [19010]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Syzygium hodgkinsoniae Smooth-bark Rose Apple, Red Lilly Pilly [3539]	Vulnerable	Species or species habitat known to occur within area	In feature area
Syzygium moorei Rose Apple, Coolamon, Robby, Durobby, Watermelon Tree, Coolamon Rose Apple [12284]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Vincetoxicum woollsii listed as Tylophora woollsii [40080]	Endangered	Species or species habitat likely to occur within area	In feature area
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Coeranoscincus reticulatus Three-toed Snake-tooth Skink [59628]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding known to occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area
SHARK			
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Congregation or aggregation known to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
SNAIL			
Thersites mitchellae Mitchell's Rainforest Snail [66774]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat likely to occur within area	In feature area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area	In feature area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area	In feature area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In feature area
Sternula albifrons Little Tern [82849]		Breeding likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Migratory Marine Species			
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding known to occur within area	In feature area
Dugong dugon Dugong [28]		Species or species habitat may occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat known to occur within area	In feature area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat may occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area	In feature area
Sousa sahalensis as Sousa chinensis Australian Humpback Dolphin [87942]		Species or species habitat known to occur within area	In feature area
Migratory Terrestrial Species			
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat known to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area	In feature area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area	In feature area
Tringa brevipes Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
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Communications, Information Technology and the Arts - Australian Postal Corporation

Commonwealth Land - Australian Postal Commission [11303]	NSW	In feature area
Commonwealth Land - Australian Postal Commission [11267]	NSW	In buffer area only

Communications, Information Technology and the Arts - Telstra Corporation Limited

Commonwealth Land - Australian Telecommunications Commission [11304]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11301]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11300]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11296]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11299]	NSW	In feature area
Commonwealth Land - Australian Telecommunications Commission [11266]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [11302]	NSW	In feature area
Commonwealth Land - Australian Telecommunications Commission [14482]	NSW	In buffer area only
Commonwealth Land - Telstra Corporation Limited [15601]	NSW	In feature area

Unknown

Commonwealth Land - [14475]	NSW	In feature area
Commonwealth Land - [14476]	NSW	In feature area

Commonwealth Heritage Places [\[Resource Information \]](#)

Name	State	Status	Buffer Status
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Historic

Byron Bay Post Office	NSW	Listed place	In feature area
Cape Byron Lighthouse	NSW	Listed place	In feature area

Listed Marine Species [\[Resource Information \]](#)

Scientific Name	Threatened Category	Presence Text	Buffer Status
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Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]		Species or species habitat likely to occur within area	In feature area
Ardenna pacifica as Puffinus pacificus Wedge-tailed Shearwater [84292]		Breeding known to occur within area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Breeding likely to occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area	In feature area
Charadrius ruficapillus Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea antipodensis gibsoni as Diomedea gibsoni Gibson's Albatross [82270]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In feature area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In feature area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area	In feature area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat known to occur within area	In feature area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area	In feature area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Stercorarius antarcticus as Catharacta skua Brown Skua [85039]		Species or species habitat may occur within area	In feature area
Sterna striata White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Breeding likely to occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Species or species habitat may occur within area	In feature area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding known to occur within area	In feature area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area	In feature area
Fish			
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area	In feature area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area	In feature area
Corythoichthys ocellatus Orange-spotted Pipefish, Ocellated Pipefish [66203]		Species or species habitat may occur within area	In feature area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area	In feature area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area	In feature area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area	In feature area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area	In feature area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area	In feature area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area	In feature area
Hippocampus kelloggi Kellogg's Seahorse, Great Seahorse [66723]		Species or species habitat may occur within area	In feature area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area	In feature area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area	In feature area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse [66240]	Endangered	Species or species habitat likely to occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Micrognathus andersonii Anderson's Pipefish, Shortnose Pipefish [66253]		Species or species habitat may occur within area	In feature area
Micrognathus brevis thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area	In feature area
Microphis manadensis Manado Pipefish, Manado River Pipefish [66258]		Species or species habitat may occur within area	In feature area
Solegnathus dunckeri Duncker's Pipehorse [66271]		Species or species habitat may occur within area	In feature area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Solenostomus paradoxus Ornate Ghostpipefish, Harlequin Ghost Pipefish, Ornate Ghost Pipefish [66184]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area	In feature area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Mammal			
Dugong dugon Dugong [28]		Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding known to occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hydrophis elegans Elegant Sea Snake, Bar-bellied Sea Snake [1104]		Species or species habitat may occur within area	In feature area
Hydrophis platurus as Pelamis platurus Yellow-bellied Sea Snake [93517]		Species or species habitat may occur within area	In feature area
Hydrophis stokesii as Astrotia stokesii Stokes' Sea Snake [93510]		Species or species habitat may occur within area	In feature area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area	In feature area

Whales and Other Cetaceans [[Resource Information](#)]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Sousa sahalensis Australian Humpback Dolphin [87942]		Species or species habitat known to occur within area	In feature area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Arakwal	National Park	NSW	In feature area
Ballina	Nature Reserve	NSW	In buffer area only
Billinudgel	Nature Reserve	NSW	In feature area

Protected Area Name	Reserve Type	State	Buffer Status
Broken Head	Nature Reserve	NSW	In feature area
Brunswick Heads	Nature Reserve	NSW	In feature area
Cape Byron	State Conservation Area	NSW	In feature area
Cape Byron	Marine Park	NSW	In feature area
Cumbebin Swamp	Nature Reserve	NSW	In feature area
Hayters Hill	Nature Reserve	NSW	In buffer area only
Jinangong	Nature Reserve	NSW	In buffer area only
Julian Rocks Nguthungulli	Nature Reserve	NSW	In feature area
Marshalls Creek	Nature Reserve	NSW	In feature area
Tyagarah	Nature Reserve	NSW	In feature area
Wooyung	Nature Reserve	NSW	In buffer area only

Regional Forest Agreements [\[Resource Information \]](#)

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State	Buffer Status
North East NSW RFA	New South Wales	In feature area

Nationally Important Wetlands [\[Resource Information \]](#)

Wetland Name	State	Buffer Status
Billinudgel Nature Reserve	NSW	In feature area

EPBC Act Referrals [\[Resource Information \]](#)

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Harvest Estate, West Byron Urban Release Area, Ewingsdale Road, Byron Bay, NSW	2018/8166	Controlled Action	Post-Approval	In feature area
Installation of three swing moorings in Byron Bay	2002/717	Controlled Action	Completed	In feature area
Residential Development at Pacific Pines Estate, Lennox Heads	2007/3585	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
Byron Shire Council Sewage Treatment Plant Upgrade	2000/48	Not Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
construction of two sports fields, car park, amenities block and access road fro	2004/1376	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Koala Beach Estate -Stage 7	2003/1306	Not Controlled Action	Completed	In feature area
North Byron Parkland Cultural Events, NSW	2017/7973	Not Controlled Action	Completed	In buffer area only
Residential dwelling, 26 Shelley Drive	2004/1362	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
Byron Bay Town Centre Bypass	2019/8562	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Byron Shire Bioenergy Facility	2021/8969	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Cultural Events Site at Yelgun, NSW	2012/6475	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Proposed Upgrade to 17km of the Pacific Highway	2009/5103	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
Breeding program for Grey Nurse Sharks	2007/3245	Referral Decision	Completed	In feature area
Biologically Important Areas				
Scientific Name		Behaviour	Presence	Buffer Status
Dolphins				
Sousa chinensis				
Indo-Pacific Humpback Dolphin [50]		Foraging	Likely to occur	In buffer area only
Tursiops aduncus				
Indo-Pacific/Spotted Bottlenose Dolphin [68418]		Breeding	Known to occur	In feature area
Tursiops aduncus				
Indo-Pacific/Spotted Bottlenose Dolphin [68418]		Breeding	Likely to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Marine Turtles			
Caretta caretta Loggerhead Turtle [1763]	Internesting	Likely to occur	In feature area
Caretta caretta Loggerhead Turtle [1763]	Nesting	Known to occur	In feature area
Seabirds			
Ardenna carneipes Flesh-footed Shearwater [82404]	Foraging	Known to occur	In feature area
Procellaria parkinsoni Black Petrel [1048]	Foraging	Likely to occur	In feature area
Sharks			
Carcharias taurus Grey Nurse Shark [64469]	Foraging	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In buffer area only
Whales			
Megaptera novaeangliae Humpback Whale [38]	Foraging	Known to occur	In feature area
Bioregional Assessments			
SubRegion	BioRegion	Website	Buffer Status
Clarence-Moreton	Clarence-Moreton	BA website	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Appendix C – Stakeholder consultation

Table 9 Consultation outcomes: key points raised by stakeholders in relation to lighting and impacts on wildlife or sensitive areas on the coastline of the Byron Shire.

Key points	Explanation
Threats to target species	<p>Marine turtles –</p> <p>Impacts from artificial light on nesting marine turtles and their hatchlings within the Byron Shire is considered likely by key stakeholders. Nesting female marine turtles are easily distracted by light sources, and hatchlings orient to the lowest brightest horizon.</p> <p>Council has been provided with descriptions of nesting characteristics and encouraged to consider lighting impacts on areas with high quality nesting characteristics.</p>
	<p>Birds (shorebirds and seabirds) –</p> <p>Impacts from artificial lighting on birds within the Byron Shire has not been observed by key stakeholders. The preference is for Council to focus on the management of other key threats to sea and shorebirds including unauthorised beach access points, pressure of high visitation at key roost/nest sites, lack of animal control (domestic dogs) on beaches, and predation by feral animals.</p> <p>Council is encouraged to further investigate the impact of artificial lighting on threatened bird species despite no observed changes.</p> <p>Recorded observations of threatened bird species were provided.</p>
	<p>Bats –</p> <p>Consideration should be given to roost and foraging sites for the Grey-headed Flying-fox, Common Blossom Bat and various species of microbats with reference to mapping layers of HEV vegetation and wildlife corridors.</p>
Focus areas	<p>Sensitive ecological areas have been recorded along the entire coastline, particularly for highly mobile species and marine species.</p>
	<p>Focus areas are better viewed as ‘key urban centres’ rather than ‘sensitive ecological areas’ due to the extent of protected areas providing valuable habitat and the greatest opportunity for improvement within key urban centres.</p>

Key points	Explanation
	<p>All species will benefit from improvements made to artificial light infrastructure despite species specific sensitivities and no recorded changes in behaviour for some species groups.</p>
	<p>Upgrades to Council managed public spaces are subject to the development of concept plans and detailed design plans. The preference in designing these public spaces is to mitigate impacts on wildlife.</p>
<p>Artificial light from sources of various lighting tenure</p>	<p>There is likely to be a lack of community understanding of contribution to artificial lighting arising from various sources.</p>
<p>Strengths of the Byron Shire coastline</p>	<p>Natural darkness is currently preserved along much of the Byron Shire coastline due to the extent of protected areas.</p>
	<p>Dune vegetation provides a buffer from point sources of artificial light at several of the urban centres.</p>
<p>Public safety</p>	<p>Key areas in Byron Bay have essential lighting requirements for public safety and reduction of lighting will be difficult. Consider alternative mitigation measures to reduce light spill, such as a reduction in height of poles, vegetation buffers, and shielding of light sources.</p>
<p>Sustainability</p>	<p>Upgrading of Council managed lighting infrastructure must consider energy use and sustainability objectives in installation and operation of lighting upgrades.</p>
<p>Lighting tenure</p>	<p>Owners of lighting infrastructure visible from sensitive areas, including the beach, need to be identified and engaged with.</p>

Table 10 Consultation outcomes: suggested actions for implementation of mitigation measures to reduce coastal lighting impacts on wildlife or sensitive areas on the coastline of the Byron Shire.

Suggested mitigation measures	Explanation
<p>Best practice lighting design principles in development or retrofitting of existing lighting infrastructure</p>	<p>Adjustment of lighting intensity, height, colour, timing, shields, and source, with consideration given to:</p> <ul style="list-style-type: none"> • Specific species sensitivities to lighting qualities (orange/red colour spectrum preferred). • Implementation and maintenance costs. • Requirements for public safety. • Compliance for prescribed lighting.
	<p>Start with no / low impact lighting for dark sky and work upwards.</p>
<p>Community engagement</p>	<p>Development of shareable resources including best practice lighting design principles and recommendations for mitigating light pollution that can be applied by private landholders (particularly caravan parks) to follow Council's lead.</p>
	<p>Citizen scientists collect data on key threats to marine turtles through Turtle Watch, including artificial light and the source. Data collected through the program can inform Council of identified light pollution issues and guide adaptive management.</p>
	<p>A simple management action may be to undertake a social media campaign to:</p> <ul style="list-style-type: none"> • Raise awareness of community contribution to artificial light at night and share simple mitigation strategies to encourage wildlife sympathetic lighting practice. • Share best practice lighting design principles. • Generate interest in volunteer sign-ups to Turtle Watch to increase data collection on artificial light pollution at the Byron coast.
	<p>Consider nesting seasons for sensitive species and encourage community action within important periods.</p>
	<p>Support Landcare or Dunecare groups to establish or improve vegetation buffers between artificial light sources and sensitive coastal environments, where appropriate.</p>

Suggested mitigation measures	Explanation
Planning instruments	Key stakeholders are supportive of stronger actions or provisions within Council's planning instruments that prevent, mitigate, or offset an increase in artificial light that may arise from new development.
	Where consultation is sought from land managers of protected areas, feedback must be considered for incorporation into consent conditions for new developments that are predicted to result in an increase of artificial light or light spill into protected areas (for example, into National Parks or Marine Parks estate).
Support for protected areas	An emphasis on ensuring natural darkness within high conservation value areas, sensitive ecological areas, and protected areas, such as sanctuary zones, or nature reserves.
Monitoring	Detailed skyglow assessments can provide more information about artificial light as an emerging threat to wildlife.
	Lighting infrastructure audit can be undertaken at regular intervals to ensure maintenance of lighting infrastructure remains compliant with wildlife friendly objectives.
	Where infrastructure has been installed adjacent to, or near, known threatened species habitat, regular monitoring to consider impacts is required.

Appendix D – Best practice lighting design features

– Best practice lighting design

Natural darkness has conservation value in the same way as clean water, air and soil and should be protected through good-quality lighting design.

The following simple management principles can be used to reduce light pollution:

- 1) Start with natural darkness and only add light for specific purposes.
- 2) Use adaptive light controls to manage light timing, intensity and colour.
- 3) Light only the object or area intended – keep lights close to the ground, directed, and shielded to avoid light spill.
- 4) Use the lowest intensity lighting appropriate for the task.
- 5) Use non-reflective, dark-coloured surfaces.
- 6) Use lights with reduced or filtered blue, violet and ultraviolet wavelengths.

The application of best practice lighting design for all outdoor lighting is intended to reduce skyglow and minimise the effects of artificial light on wildlife.

Lighting objectives

At the outset of a lighting design process, the purpose of artificial lighting should be clearly stated, and consideration should be given as to whether it is required at all.

Exterior lighting for public, commercial or industrial applications is typically designed to provide a safe working environment. It may also be required to provide for human amenity or commerce. Conversely, areas of darkness, seasonal management of artificial light, or minimised skyglow may be necessary for wildlife protection, astronomy or dark-sky tourism.

Lighting objectives will need to consider the regulatory requirements and Australian standards relevant to the activity, location and wildlife present.

Objectives should be described in terms of specific locations and times at which artificial light is necessary. Consideration should be given to whether colour differentiation is required and whether some areas should remain dark – either to contrast with lit areas or to avoid light spill. Where relevant, wildlife requirements should form part of the lighting objectives.

A lighting installation will be deemed a success if it meets the lighting objectives (including wildlife needs) and areas of interest can be seen by humans clearly, easily, safely and without discomfort.

The following are general principles for lighting that will benefit the environment and local wildlife and reduce energy costs.

Principles of best practice lighting design

Good lighting design incorporates the following design principles. They are applicable everywhere, especially in the vicinity of wildlife.

1. Start with natural darkness

The starting point for all lighting designs should be natural darkness (Figure 9). Artificial light should only be added for specific and defined purposes, and only in the required location and for the specified duration of human use. Designers should consider an upper limit on the amount of artificial light and only install the amount needed to meet the lighting objectives.

Figure 9 Start with natural darkness

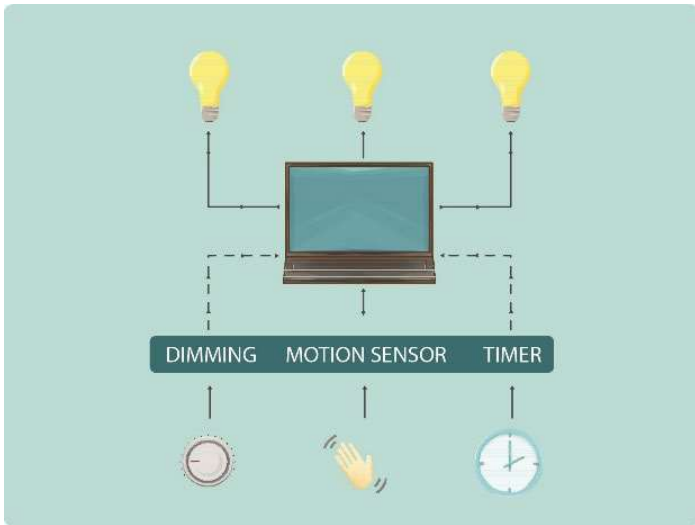


In a regional planning context, consideration should be given to designating 'dark places' where activities that involve outdoor artificial light are prohibited under local planning schemes.

2. Use adaptive controls

Recent advances in smart control technology provide a range of options for better controlled and targeted artificial light management (Figure 10). For example, traditional industrial lighting should remain illuminated all night because high-pressure sodium, metal halide and fluorescent lights have long warm-up and cool-down periods. This could jeopardise operator safety in the event of an emergency. With smart-controlled LED lights, plant lighting can be switched on and off instantly and activated only when needed – for example, when an operator is physically present at the site.

Figure 10 Use adaptive controls to manage light timing, intensity and colour



Smart controls and LED technology allow for:

- remotely managing lights (computer controls)
- instantly switching lights on and off
- controlling light colour (emerging technology)
- dimming, timers, flashing rate, motion sensors and well-defined directivity of light.

Adaptive controls should maximise the use of the latest lighting technology to minimise unnecessary light output and energy consumption.

3. Light only the intended object or area – keep lights close to the ground, directed and shielded

Light spill is light that falls outside the area intended to be lit. Light that spills above the horizontal plane contributes directly to artificial skyglow, while light that spills into adjacent areas on the ground (also known as light trespass) can be disruptive to wildlife in adjacent areas. All light fittings should be located, directed and shielded to avoid lighting anything but the target object or area (Figure 11). Existing lights can be modified by installing a shield.

Figure 11 Lights should be shielded to avoid lighting beyond the target area or object

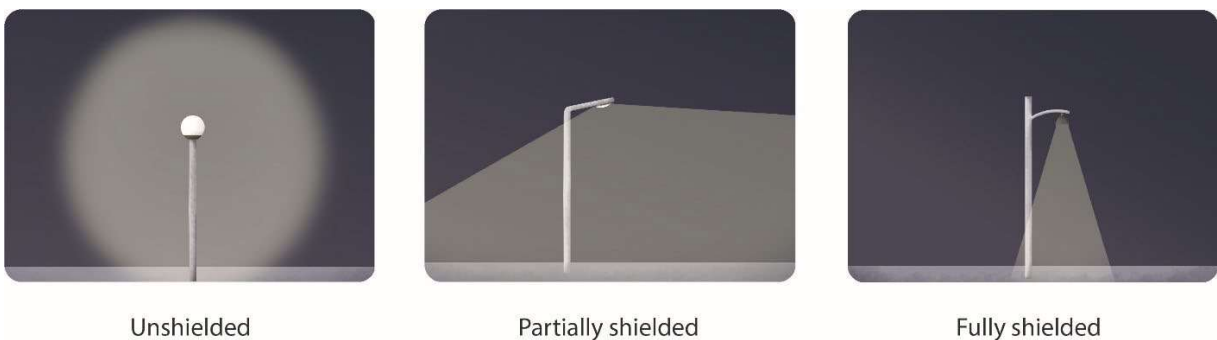


Figure adapted from Witherington and Martin (2003).

Lower height lighting that is directional and shielded can be extremely effective. Light fixtures should be located as close to the ground as possible and shielded to reduce skyglow (Figure 12).

Figure 12 Walkway lighting should be mounted as low as possible and shielded

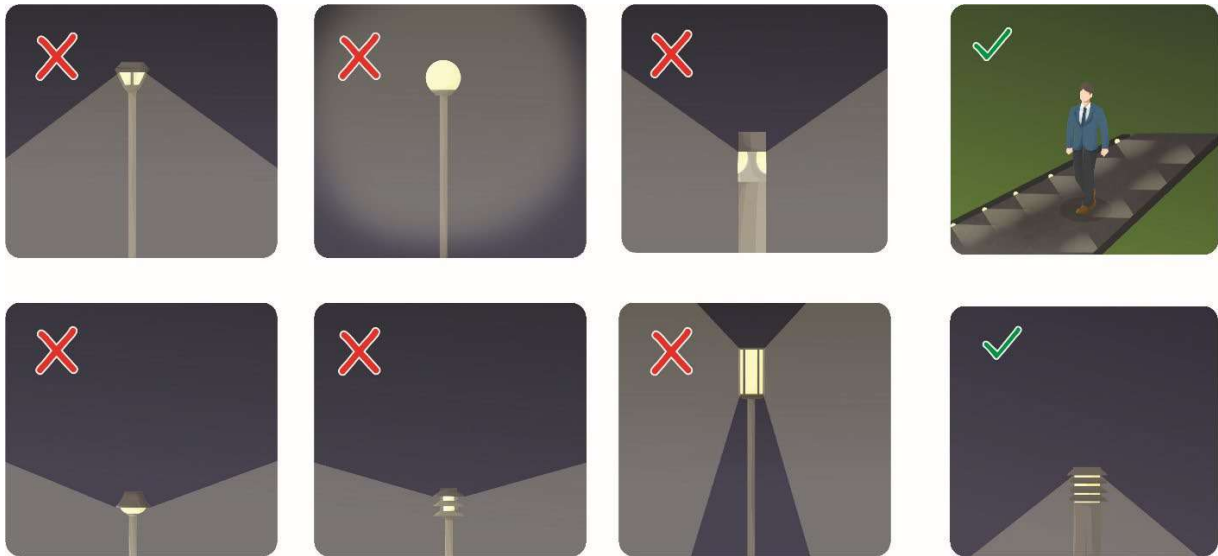


Figure adapted from Witherington and Martin (2003).

Artificial light can be prevented from shining above the horizontal plane by ensuring the luminaire is mounted horizontally relative to the ground and not at an angle, or mounted on a building so that the structure prevents the light shining above the horizontal plane – for example, recessing a light into an overhanging roof eave. When determining the angle of mounting, consideration should be given to the reflective properties of the receiving environment.

If an unshielded fitting is to be used, consideration should be given to the direction of the light and the need for some form of permanent physical opaque barrier that will provide the shielding requirement. This can be a cover or part of a building (Figure 13). Care should be taken to also shield light-coloured adjacent surfaces, to prevent excessive reflected light from adding to skyglow.

Figure 13 Lighting should be directed to ensure only the intended area is lit

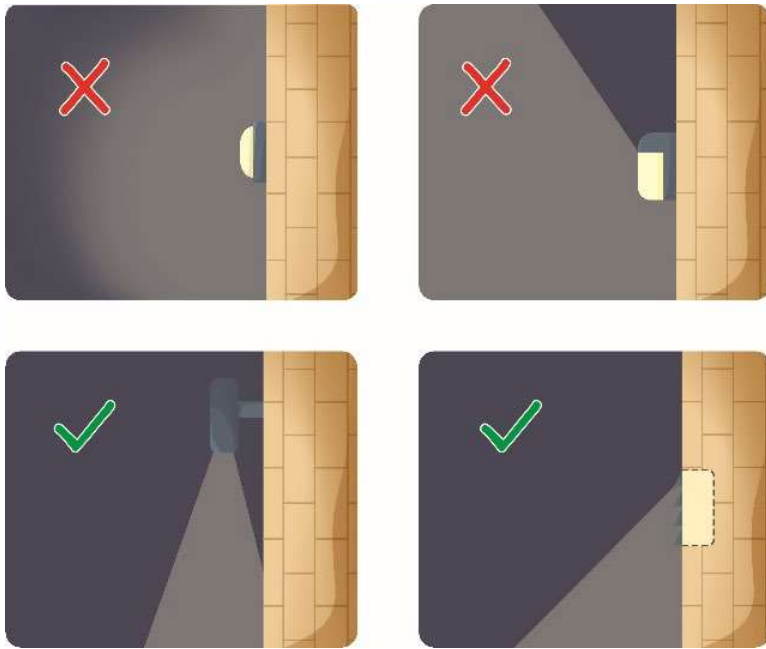


Figure adapted from Witherington and Martin (2003).

Consideration should also be given to blocking light spill from internal light sources. This should include block-out blinds or shutters for transparent portions of a building, including skylights, and use of glass in windows and balconies with reduced visible light transmittance values.

4. Use appropriate lighting

Lighting intensity should be appropriate for the activity. Starting from a base of no lights, use only the minimum number and intensity of lights needed to provide safe and secure illumination for the area at the time required to meet the lighting objectives. The minimum amount of light needed to illuminate an object or area should be assessed during the early design stages and only that amount of light installed. For example, Figure 14 provides options from best to worst for lighting a parking area.

Figure 14 Lighting options for a parking area



Figure adapted from Witherington and Martin (2003).

Off-the-shelf lighting design models

Computer design engineering packages that do not include wildlife needs and only recommend a standard lighting design for general application should be avoided or, if used, modified to suit the specific project objectives, location and risk factors.

Consider the intensity of light produced rather than the energy required to make it

Improvements in technology mean that new bulb types produce significantly greater amounts of light per unit of energy. For example, LED lights produce between 2 and 5 times the amount of light produced by incandescent bulbs. The amount of light produced (lumen), rather than the amount of energy used (watt) is the most important consideration in ensuring that an area is not over lit.

Consider re-evaluating security systems and using motion sensor lighting

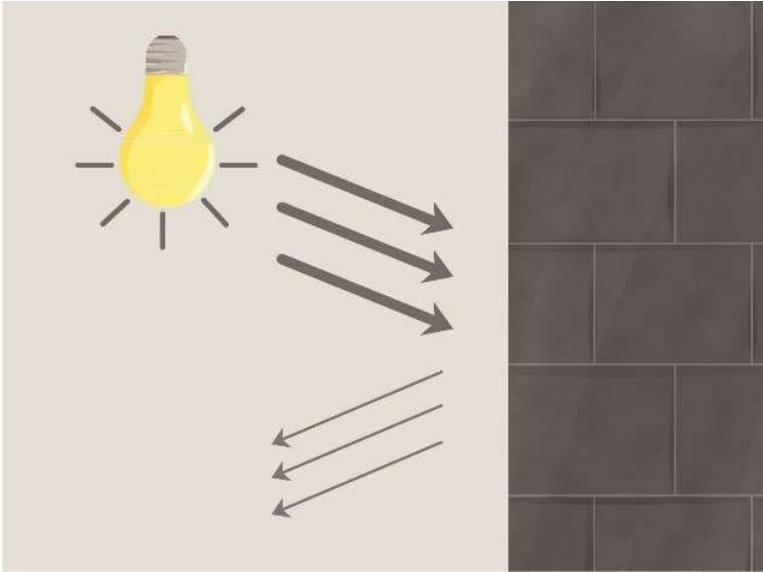
Technological advances mean that techniques such as computer-managed infrared tracking of intruders in security zones is likely to result in better detection rates than a human observer monitoring an illuminated zone.

Use low-glare lighting

High-quality, low-glare lighting should always be a strong consideration regardless of how the project is to be designed. Low-glare lighting enhances visibility for the user at night, reduces eye fatigue, improves night vision and delivers light where it is needed.

5. Use non-reflective, dark-coloured surfaces

Light reflected from highly polished, shiny or light-coloured surfaces such as white painted infrastructure, polished marble or white sand can contribute to skyglow. For example, alternatives to painting storage tanks with white paint to reduce internal heating should be explored during front-end engineering design. In considering surface reflectance, the need to view the surface should be taken into consideration, as darker surfaces will require more light to be visible. The colour of paint or material selected should be included in the artificial light management plan.

Figure 15 Use non-reflective dark-coloured surfaces

6. Use lights with reduced or filtered-out blue, violet and ultraviolet wavelengths

Short-wavelength light (blue) scatters more readily in the atmosphere and therefore contributes more to skyglow than longer wavelength light. Further, most wildlife are sensitive to short-wavelength (blue/violet) light (for detailed discussion see Appendix B – What is light and how does wildlife perceive it?). Generally, only lights with little or no short wavelength (400 nm to 500 nm) violet or blue light should be used, to avoid unintended effects. Where wildlife are sensitive to longer wavelength light (for example, some bird species), consideration should be given to wavelength selection on a case-by-case basis.

When determining the appropriate wavelength of light to be used, all lighting objectives should be considered. If good colour rendition is required for human use, then other mitigation measures such as tight control of light spill, use of head torches, or timers or motion sensors to control lights should be implemented.

It is not possible to tell how much blue light is emitted from an artificial light source by the colour of light it produces (see Light-emitting diodes in Appendix B). LEDs of all colours, particularly white, can emit a large amount of blue light, and the correlated colour temperature (CCT) only provides a proxy for the blue light content of a light source. Consideration should be given to the spectral characteristics (spectral power distribution curve) of the lighting to ensure short-wavelength (400 nm to 500 nm) light is minimised.

Appendix E – Lighting infrastructure audit checklist

The following list can be used as a guide to audit existing lighting infrastructure and consider potential negative impacts to wildlife.

Location notes

- Location – address, locality, park/reserve name

Light fitting description

- Light purpose: road, park, pedestrian, carpark, sports field etc.
- Mounting
 - Type: pole, bollard, in-ground, building etc.
 - Height
- Number of globes
- Light type: LED, high pressure sodium vapour, fluorescent etc.
- Wattage (if known)
- Light colour
- Light intensity (if able to measure using lux meter)
- Shield description, if any
- Direction facing (compass bearing, or up/down-facing etc).
- Maintenance notes
- Obvious issues

Light environment description

- Proximity to beach, ocean or waterway
- Visibility from beach, ocean or waterway
- Presence of natural or human-made buffer between light source and sensitive environment
- Proximity to vegetation and vegetation description
- Describe light penetration into patch of vegetation
- Presence of reflective surfaces
- Wildlife present: flying-fox roost, shorebirds foraging etc.

Lighting issues

- Observed issues: light spill, damage, redundant fitting etc.
- Frequency/density of light fittings in locality

Photograph

- Light fitting
- General environment

Appendix F – Appropriate light fixtures

Table 11 Commercial luminaire types that are considered generally less disruptive for use near threatened species habitat, and those to avoid

Light type	Shorebirds	Seabirds	Marine turtles	Bats	Terrestrial mammals
Low pressure sodium vapour	Suitable	Suitable	Suitable	Suitable	Suitable
High pressure sodium vapour	Suitable	Suitable	Suitable	Not suitable	Not suitable
Filtered LED ^a	Suitable	Suitable	Suitable	Suitable	-
Filtered metal halide ^a	Suitable	Suitable	Suitable	Suitable	-
Filtered white LED ^a	Suitable	Suitable	Suitable	Suitable	-
LED with appropriate spectral properties for species present	Suitable	Suitable	-	-	-
PC amber	-	-	Suitable	Suitable	Suitable
Amber LED	-	-	Suitable	Suitable	Suitable
White LED	Not suitable	Not suitable	Not suitable	Not suitable	Not suitable
Metal halide	Not suitable	Not suitable	Not suitable	Not suitable	Not suitable
White fluorescent	Not suitable	Not suitable	Not suitable	Not suitable	Not suitable
Halogen	Not suitable	Not suitable	Not suitable	Not suitable	Not suitable
Mercury vapour	Not suitable	Not suitable	Not suitable	-	Not suitable

Adapted from DCCEEW (2023) *National Light Pollution Guidelines for Wildlife*. Where information is missing it was not provided within the National Guidelines.

^a 'Filtered' means LEDs can be used only if a filter approved by the manufacturer is applied to remove the problematic wavelength light for the target species.

Light fitting Requirements

BASIC REQUIREMENTS FOR LIGHT FITTINGS

The light distribution of the light fitting should be directed and focused on the area to be lit with a cut-off to avoid light spilling into other areas. This is best achieved with:

- a flat fitting or one where the light source is recessed into the fitting enclosure.
- specific LED optics where the ideal shape of the light throw can be selected for lighting intent.
- Amber light source where appropriate. This option may not be suitable for all lighting situations, for example, locations which require a higher lighting colour temperature for human clarity of vision for security or driver safety reasons.
- Additional shielding either at the rear of the fitting or at the rear of each LED.

The following Light fittings are capable of providing the above-mentioned features:

ARCHITECTURAL LIGHT FITTINGS

Fittings which are suitable for areas where aesthetics are of high importance.

Verbatim Lighting

Neri Antares post top lights



Neri Antares Range

Neri Nebula post top lights and bollards



Neri Nebula Range

Neri post top lights and bollard lights



Neri Pictor Range

WE-EF Lighting

German designed architectural fittings, manufactured in Germany and Thailand, assembled in Australia. These fittings are suitable for areas where aesthetics are of high importance.

AFL100 post top lights



WE-EF AFL100 Range

PSY Bollard



WE-EF PSY Range

UTILITY LIGHT FITTINGS

Fittings suitable for applications where aesthetics are less critical and a more economical solution is desired.

Sylvania Schreder

StreetLED MK3 post top lights



StreetLED2 Pathway Visor
(Rear and Front)

StreetLED2 Glare
Shield Visor (Rear)

StreetLED2 Glare
Shield 360° Visor
(Rear, Front, Side)

StreetLED2 Louvre



Sylvania StreetLED

Philips Lighting

Road Flair



Philips Road Flair

CONTROL REQUIREMENTS

Advanced lighting control. This may include timing control or motion sensor control to dim the light or change the light's colour temperature during times when the space is not being fully utilised by human activity.

The control options range from basic functions for all fittings to smart, individual functions at each light fitting.

Basic Control

A timer can be installed at the switchboard, to control on/off operation of a group or groups of lights. The time selection can be adjusted by maintenance staff as required. The timer can operate together with daylight sensors, whether located at the switchboard or at each individual fitting.

Advanced Control

All of the above-mentioned post top fittings have the ability to be controlled individually on timer, daylight control (digital, astronomical data), motion sensor. These controls can be utilised to switch the fittings on/off, dim light and/or change the colour temperature of the light source.

In the case of the We-ef fittings, the speed of the transition between light levels and/or colours can also be controlled. For example, a fitting can be instantly switched to full brightness and a white light when motion is detected, and then the light level can dim and transition to amber light slowly over a predetermined period of time.

Advanced control of bollard fittings is typically not available but can be arranged if installed near an architectural post top light fitting. In this arrangement, the control hardware for the bollard would be installed inside the post top fitting with connecting cabling between the two fittings.

UV WAVELENGTH CONTROL

Some fittings can be tuned to reduce the amount of short wavelength (UV) light emitted from the luminaire while maintaining the desired colour temperature. Distribution curve diagrams may be available from suppliers and used to determine the most appropriate lighting.

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