

Notice of Meeting

Biodiversity Advisory Committee Meeting

An Biodiversity Advisory Committee Meeting of Byron Shire Council will be held as follows:

Venue	Conference Room, Station Street, Mullumbimby
Date	Thursday, 21 September 2023
Time	9.00am

Shannon Burt
Director Sustainable Environment and Economy

*I2023/1409
Distributed 14/09/23*



BYRON
SHIRE
COUNCIL

CONFLICT OF INTERESTS

What is a “Conflict of Interests” - A conflict of interests can be of two types:

Pecuniary - an interest that a person has in a matter because of a reasonable likelihood or expectation of appreciable financial gain or loss to the person or another person with whom the person is associated.

Non-pecuniary – a private or personal interest that a Council official has that does not amount to a pecuniary interest as defined in the Code of Conduct for Councillors (eg. A friendship, membership of an association, society or trade union or involvement or interest in an activity and may include an interest of a financial nature).

Remoteness – a person does not have a pecuniary interest in a matter if the interest is so remote or insignificant that it could not reasonably be regarded as likely to influence any decision the person might make in relation to a matter or if the interest is of a kind specified in the Code of Conduct for Councillors.

Who has a Pecuniary Interest? - a person has a pecuniary interest in a matter if the pecuniary interest is the interest of the person, or another person with whom the person is associated (see below).

Relatives, Partners - a person is taken to have a pecuniary interest in a matter if:

- The person’s spouse or de facto partner or a relative of the person has a pecuniary interest in the matter, or
- The person, or a nominee, partners or employer of the person, is a member of a company or other body that has a pecuniary interest in the matter.

N.B. “Relative”, in relation to a person means any of the following:

- (a) the parent, grandparent, brother, sister, uncle, aunt, nephew, niece, lineal descends or adopted child of the person or of the person’s spouse;
- (b) the spouse or de facto partners of the person or of a person referred to in paragraph (a)

No Interest in the Matter - however, a person is not taken to have a pecuniary interest in a matter:

- If the person is unaware of the relevant pecuniary interest of the spouse, de facto partner, relative or company or other body, or
- Just because the person is a member of, or is employed by, the Council.
- Just because the person is a member of, or a delegate of the Council to, a company or other body that has a pecuniary interest in the matter provided that the person has no beneficial interest in any shares of the company or body.

Disclosure and participation in meetings

- A Councillor or a member of a Council Committee who has a pecuniary interest in any matter with which the Council is concerned and who is present at a meeting of the Council or Committee at which the matter is being considered must disclose the nature of the interest to the meeting as soon as practicable.
- The Councillor or member must not be present at, or in sight of, the meeting of the Council or Committee:
 - (a) at any time during which the matter is being considered or discussed by the Council or Committee, or

- (b) at any time during which the Council or Committee is voting on any question in relation to the matter.

No Knowledge - a person does not breach this Clause if the person did not know and could not reasonably be expected to have known that the matter under consideration at the meeting was a matter in which he or she had a pecuniary interest.

Non-pecuniary Interests - Must be disclosed in meetings.

There are a broad range of options available for managing conflicts & the option chosen will depend on an assessment of the circumstances of the matter, the nature of the interest and the significance of the issue being dealt with. Non-pecuniary conflicts of interests must be dealt with in at least one of the following ways:

- It may be appropriate that no action be taken where the potential for conflict is minimal. However, Councillors should consider providing an explanation of why they consider a conflict does not exist.
- Limit involvement if practical (eg. Participate in discussion but not in decision making or vice-versa). Care needs to be taken when exercising this option.
- Remove the source of the conflict (eg. Relinquishing or divesting the personal interest that creates the conflict)
- Have no involvement by absenting yourself from and not taking part in any debate or voting on the issue as of the provisions in the Code of Conduct (particularly if you have a significant non-pecuniary interest)

Committee members are reminded that they should declare and manage all conflicts of interest in respect of any matter on this Agenda, in accordance with the [Code of Conduct](#).

RECORDING OF VOTING ON PLANNING MATTERS

Clause 375A of the Local Government Act 1993 – Recording of voting on planning matters

- (1) In this section, **planning decision** means a decision made in the exercise of a function of a council under the Environmental Planning and Assessment Act 1979:
- (a) including a decision relating to a development application, an environmental planning instrument, a development control plan or a development contribution plan under that Act, but
- (b) not including the making of an order under that Act.
- (2) The general manager is required to keep a register containing, for each planning decision made at a meeting of the council or a council committee, the names of the councillors who supported the decision and the names of any councillors who opposed (or are taken to have opposed) the decision.
- (3) For the purpose of maintaining the register, a division is required to be called whenever a motion for a planning decision is put at a meeting of the council or a council committee.
- (4) Each decision recorded in the register is to be described in the register or identified in a manner that enables the description to be obtained from another publicly available document and is to include the information required by the regulations.
- (5) This section extends to a meeting that is closed to the public.

OATH AND AFFIRMATION FOR COUNCILLORS

Councillors are reminded of the oath of office or affirmation of office made at or before their first meeting of the council in accordance with Clause 233A of the Local Government Act 1993. This includes undertaking the duties of the office of councillor in the best interests of the people of Byron Shire and the Byron Shire Council and faithfully and impartially carrying out the functions, powers, authorities and discretions vested under the Act or any other Act to the best of one's ability and judgment.

BYRON SHIRE COUNCIL

BUSINESS OF MEETING

1. APOLOGIES

2. DECLARATIONS OF INTEREST – PECUNIARY AND NON-PECUNIARY

3. ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

- 3.1 Confirmation of minutes from the 17 August meeting 6

4. STAFF REPORTS

Sustainable Environment and Economy

- 4.1 Identifying Open Forest Ecosystems for Ecological Restoration 13
4.2 Update on Work Carried Out by Byron Council's Bush Regeneration Team 70
4.3 Future Discussion Items for Biodiversity Advisory Committee 77

ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

Report No. 3.1 Confirmation of minutes from the 17 August meeting

5 **Directorate:** Sustainable Environment and Economy

File No: I2023/1331

10 **RECOMMENDATION:**

That the minutes of the Biodiversity Advisory Committee Meeting held on 17 August 2023 be confirmed.

15 **Attachments:**

1 Minutes 17/08/2023 Biodiversity Advisory Committee, I2023/1203 , page 8  

Report

The attachment to this report provides the minutes of the Biodiversity Advisory Committee Meeting of 17 August 2023.

Report to Council

- 5 The minutes will be reported to Council on 28 September 2023.

Minutes of Meeting

Biodiversity Advisory Committee Meeting

Venue	Byron Community College, 6/8 Burringbar St, Mullumbimby
Date	Thursday, 17 August 2023
Time	11:30am



BYRON SHIRE COUNCIL

ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

3.1 - ATTACHMENT 1

BYRON SHIRE COUNCIL

ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

3.1 - ATTACHMENT 1

BYRON SHIRE COUNCIL

BIODIVERSITY ADVISORY COMMITTEE MEETING MINUTES 17 AUGUST 2023

Minutes of the Biodiversity Advisory Committee Meeting held on Thursday, 17 August 2023

File No: I2023/1203

PRESENT: Cr S Ndiaye, Cr S Balson, Cr P Westheimer, Cr Lyon

Staff: Shannon Burt (Director Sustainable Environment and Economy)
Liz Caddick (Biodiversity Team Leader)
Caitlin Weatherstone (Project Officer-Koala)
Claudia Caliri (Biodiversity Projects Officer)
Arika McElroy (Minute Taker)

Community: Dave Rawlins (Brunswick Valley Landcare)
Lindsay Murray
James Jackson
Stephen Millard
David Milledge
Leonard Cronin

Cr Ndiaye (Chair) opened the meeting at 11:34 and acknowledged that the meeting was being held on Bundjalung Country.

ATTENDANCE VIA AUDIO-VISUAL LINK: NONE

APOLOGIES: Liana Joseph, Sharyn French (Manager Environmental and Economic Planning), Chloe Dowsett (Coast & Biodiversity Coordinator)

DECLARATIONS OF INTEREST – PECUNIARY AND NON-PECUNIARY: There were no declarations of interest.

BYRON SHIRE COUNCIL

ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

3.1 - ATTACHMENT 1

BYRON SHIRE COUNCIL

BIODIVERSITY ADVISORY COMMITTEE MEETING MINUTES

17 AUGUST 2023

ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

Report No. 3.1 **Confirmation of minutes from 20 April 2023 Biodiversity
Advisory Committee Meeting**

File No: I2023/775

Committee Recommendation:

**That the minutes of the Biodiversity Advisory Committee Meeting held on 20 April
2023 be confirmed.**

(Murray/Ndiaye)

The recommendation was put to the vote and declared carried.

*Note: The minutes of the meeting held on 20 April 2023 were noted, and the Committee
Recommendations adopted by Council, at the Ordinary Meeting held on 25 May
2023.*

BUSINESS ARISING FROM PREVIOUS MINUTES

There was no business arising from previous minutes.

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

Report No. 4.1 **Brunswick Valley Landcare Support Officer quarterly reports,
October 2022 to June 2023.**

File No: I2023/963

Committee Recommendation:

That the Biodiversity Advisory Committee note the report.

(Westheimer/Cronin)

The recommendation was put to the vote and declared carried.

Report No. 4.2 **Biodiversity and Agriculture Projects and Operations Update**

File No: I2023/498

Committee Recommendation:

**That the Biodiversity Advisory Committee notes the update on current projects and
programmes being undertaken by Council staff.**

(Jackson/Rawlins)

The recommendation was put to the vote and declared carried.

BYRON SHIRE COUNCIL

ADOPTION OF MINUTES FROM PREVIOUS MEETINGS

3.1 - ATTACHMENT 1

BYRON SHIRE COUNCIL

BIODIVERSITY ADVISORY COMMITTEE MEETING MINUTES

17 AUGUST 2023

Report No. 4.3 **Future Discussion Items for Biodiversity Advisory Committee**
File No: **I2023/624**

Committee Recommendation:

- 1. That the Biodiversity Advisory Committee notes the report.**
- 2. That the Biodiversity Advisory Committee invites David Milledge to provide comments on item 4.3 from the August meeting for discussion at a future meeting.**
- 3. That the Biodiversity Advisory Committee seeks a follow up response to item 4.2 from the April meeting agenda.**

(Ndiaye/Westheimer)

The recommendation was put to the vote and declared carried.

There being no further business the meeting concluded at 1:39pm.

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

Report No. 4.1 Identifying Open Forest Ecosystems for Ecological Restoration

5 **Directorate:** Sustainable Environment and Economy

Report Author: Lizabeth Caddick, Biodiversity Officer

File No: I2023/386

Summary:

10 This project, funded by a \$11,000 grant from NSW DPE Biodiversity Conservation Division, has mapped open forest ecosystems in Byron Shire that would benefit from the reintroduction of ecological fire management, using GIS, expert elicitation and ground truthing.

15 The map will assist Council and Landcare Groups to identify future priority ecological restoration sites. It will also support the current Good Fire project (funded by InGrained foundation), which aims to build capacity for community to carry out eco-cultural burns in open forest types.

20 **RECOMMENDATION:**

1. That the Biodiversity Advisory Committee notes this report and Attachment 1 (E2023/26821)
2. That Open Ecosystem Restoration Potential mapping is added to Council's online mapping tool.

25 **Attachments:**

- 1 Open Ecosystem Restoration Priorities - Final Report - 25/08/2023, E2023/88318 , page 18 [1](#)



Report

Council's Biodiversity Conservation Strategy identifies the restoration of historical fire regimes as a key strategy for biodiversity conservation:

- 5 *Action 4.4 Identify priority open forest ecosystems requiring restoration through the reintroduction of fire*

10 Our high species diversity in Byron Shire reflects the historic high habitat diversity in the shire. The high diversity of landforms, soils and geology has, over time, created a diverse patchwork of different ecosystems, all of which are critical in maintaining this species diversity.

Many of Byron Shire's threatened fauna and flora rely on open-ecosystem habitats that are maintained by regular fire, including sclerophyll forests, heathlands and swamp forests. Today however, 95% of open-ecosystem habitat have now been fire-excluded for at least 50 years, leading to irreversible habitat decline and localised species extinctions.

- 15 In 2022, Council received a grant of \$11,000 from NSW DPE Biodiversity Conservation Division, to map the open forest ecosystems in Byron Shire that would benefit from the reintroduction of ecological fire management.

20 The report and maps (Attachment 1) were developed using a combination of GIS mapping & modelling, expert input via workshop, and rapid ground-truthing of key areas. Prioritisation used a conservation triage approach, prioritising areas in good condition and requiring minimal intervention over highly degraded areas requiring complex interventions.

25 The Restoration Potential maps presented in the report were developed using a combination of a) GIS mapping & modelling, b) expert input via workshop, and c) rapid ground-truthing of key areas. The maps developed show the potential for restoration using eco-cultural burning, from very high to low, in open forest ecosystems on Council and private land, based on vegetation (current & historical), soil type, exposure and recent fire (fire interval status).

This mapping will help Council plan, prioritise and seek funding for multi-property fire-restoration projects across private and Council-managed land throughout Byron Shire.

30 **Key issues**

Refer to Attachment 1 for more detail and maps.

- 35 • Around 50% of the plant and animal species in Byron Shire rely on open ecosystems for resources that are not provided by closed ecosystems, including tree hollows for arboreal mammals, parrots and forest owls, winter food supplies for flying foxes and nectivorous birds and habitat for shade-intolerant grasses, ferns and shrubs.

- Open forests on Byron Shire's flood plains have been disproportionately over-cleared for agriculture and are underrepresented in reserves.
- Open forest ecosystems are vulnerable to collapse in the absence of fire.
- Since European invasion, traditional burning has been extinguished from most open ecosystems in Byron Shire and the majority of these ecosystems are now overdue for fire to restore ecosystem health.
- As well as impacting survival of threatened species and ecological communities, fire exclusion encourages establishment of transformer weeds, changes in soil chemistry and canopy dieback (e.g. Bell Miner Associated Dieback).
- Fire exclusion can reduce CO₂ sequestration and standing carbon stocks.
- Fire exclusion from open forest ecosystems may also increase the risk of high intensity bushfire, threatening life and property and fire-sensitive rainforest ecosystems.
- The mapping done for this project is not fire hazard mapping and should not be used to identify bushfire risk or direct hazard reduction burns. This mapping identifies where there is a risk of an ecological community becoming degraded or transitioning to a different vegetation type if it remains unburnt, and also shows the sites that are most likely to respond well to use of ecological fire as a restoration tool.

Next steps

The restoration of historical ecological fire regimes is a key strategy for the conservation of open-ecosystem biodiversity in Byron Shire. The Restoration Potential Maps developed for this project will help plan and prioritise individual and multi-property fire-restoration projects across private and Council-managed land throughout Byron Shire. The mapping and background information can also be used to support grant applications for multi-property fire restoration projects in the Shire.

Council has recently worked with Jagun Alliance, Brunswick Valley Landcare and Zero Emissions Byron to deliver the Good Fire project, funded by the InGrained foundation. The Good Fire Project developed a Template for the planning and implementation of multi-property fire-restoration projects in the Shire. The new mapping, together with the Good Fire Template, can be used to support and guide ecological burning projects and to seek funding support to implement ecological restoration burns, in partnership with traditional practitioners.

Staff are continuing to work with Jagun Alliance, Brunswick Valley Landcare and Zero Emissions Byron to identify next steps towards seeking funding support to implement planned burns in high priority locations.

Strategic Considerations

Community Strategic Plan and Operational Plan

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.1

CSP Objective	CSP Strategy	DP Action	Code	OP Activity
3: Nurtured Environment We nurture and enhance the natural environment	3.1: Partner to nurture and enhance our biodiversity, ecosystems, and ecology	3.1.1: Native species - Use best practice land management to improve ecological resilience and reduce threats to biodiversity	3.1.1.9	Seek funding to implement the Biodiversity Conservation Strategy, Coastal Koala Plan of Management and Flying Fox Camp Management Plan.
3: Nurtured Environment We nurture and enhance the natural environment	3.2: Deliver initiatives and education programs to encourage protection of our environment	3.2.2: Environmental education and awareness - Coordinate and support environmental education to the community	3.2.2.1	Support Brunswick Valley Landcare to deliver the Land for Wildlife Program and biodiversity enquiries.
3: Nurtured Environment We nurture and enhance the natural environment	3.2: Deliver initiatives and education programs to encourage protection of our environment	3.2.3: Planning - Plan to improve the quality of the natural environment	3.2.3.4	Identify priority open forest ecosystems requiring restoration through the reintroduction of fire.

Recent Resolutions

N/A

Legal/Statutory/Policy Considerations

5 N/A

Financial Considerations

N/A

Consultation and Engagement

The priority restoration map was developed with input from six expert local ecologists and bush regenerators.

Open Ecosystem Restoration Priorities: Byron Shire LGA



February 2023

Prepared for Byron Shire Council

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Summary

Most of Byron Shire's threatened fauna species and many threatened flora rely on open-ecosystem habitats that are maintained by regular fire. Today however, 95% of open-ecosystem habitat has now been fire-excluded for at least 50 years, leading to irreversible habitat decline and localised species extinctions. To address this, Council's Biodiversity Conservation Strategy identifies the restoration of historical fire regimes as a key strategy for biodiversity conservation.

This report and mapping identify and prioritise open ecosystem areas suitable for the restoration of historical fire regimes. Prioritisation used a conservation triage approach, prioritising areas in good condition and requiring minimal intervention over highly degraded areas requiring complex interventions. The *Restoration Potential* maps presented here were developed using a combination of a) GIS mapping & modelling, b) expert input via workshop, and c) rapid ground-truthing of key areas. This mapping will help Council plan, prioritise and seek funding for multi-property ecological fire-restoration projects across private and Council-managed land throughout Byron Shire.

This report does not identify fuel loads or areas requiring hazard reduction burns for the protection of life and property. It only identifies sites where reintroduction of appropriate ecological burning is likely to facilitate ecological restoration.

Table of Contents

1	INTRODUCTION	4
1.1	Background.....	4
1.2	What are open ecosystems?	4
1.3	Ecological value of open ecosystems.....	5
1.4	The demise of fire in Byron Shire	8
1.5	Fire exclusion is a major threat to open ecosystem biodiversity values.....	9
1.6	Endangered Ecological Communities in Byron Shire threatened by low frequency fire	19
1.7	Fire exclusion reduces CO ₂ sequestration and reduced standing carbon stocks	19
2	PRIORITISING OPEN ECOSYSTEM RESTORATION IN BYRON SHIRE	20
2.1	Conservation triage.....	20
2.2	Mapping restoration condition classes across Byron Shire.....	22
3	MAPS	25
4	GUIDELINES FOR USING THE MAPS & REPORT.....	34
4.1	Guidelines for refining restoration priorities during project planning	34
4.2	Ground-truthing properties for restoration potential	35
4.3	Seeking funding for restoration projects	35
4.4	Implementation	35
5	REFERENCES	36
6	APPENDICES	42

List of Maps

Map 1 A. Fire Interval Status (2023) - Byron Shire Overview.	26
Map 1 B. Fire Interval Status (2023) (Main Arm – Federal).	27
Map 1 C. Fire Interval Status (2023) (Billinudgel – Tyagarah).	28
Map 1 D. Fire Interval Status (2023) (Belongil – Broken Head).	29
Map 2 A. Restoration Potential - Byron Shire Overview.	30
Map 2 B. Restoration Potential (Main Arm – Federal).	31
Map 2 C. Restoration Potential (Billinudgel – Tyagarah).	32
Map 2 D. Restoration Potential (Belongil – Broken Head).	33

1 INTRODUCTION

1.1 Background

Wildsite Ecological Services Pty Ltd (Wildsite) has been engaged by Byron Shire Council to prepare mapping and an accompanying report which identify and prioritise open ecosystem areas suitable for the restoration of historical ecological fire regimes. Council's Biodiversity Conservation Strategy (BCS) identifies fire exclusion as a key threat to the Shire's open forest biodiversity and identifies the restoration of historical ecological fire regimes as a key strategy for its conservation. The strategy also identifies the need to prioritise restoration investment towards areas where they will have the greatest conservation impact.

More specifically, this project seeks to address, in full or in part, several actions listed in the BCS including:

- 4.4** *Identify priority open forest ecosystems requiring restoration through the reintroduction of ecologically appropriate fire.*
- 1.11** *Conduct a review of Byron Shire's biodiversity values as a baseline for ongoing biodiversity monitoring, including fire frequency status.*
- 1.10** *Develop a priority restoration investment map that identifies key sites on private and public land requiring either protection or restoration, to assist in directing future Council and community restoration activities.*

Identifying priority areas will help to guide restoration investment for future council-led restoration projects, as well as those being planned by private landholders and community groups. The resulting maps will also assist in the development of funding applications for multi-property projects to restore ecologically appropriate fire. The restoration of historical fire regimes in Byron Shire provides a vital pathway to restore and conserve biodiversity, improve community bushfire safety, renew Aboriginal cultural practices and connection to Country, and restore ancient carbon sequestration pathways.

1.2 What are open ecosystems?

Open ecosystems are those ecosystems which are prone to burning and which need periodic fire to maintain their structure, composition and their place in the landscape. In Byron Shire, open ecosystems include all open forests (i.e. Eucalypt, Brush Box and Paperbark forests), heathlands and native grasslands (**Figure 1**). Conversely, closed ecosystems are those parts of the landscape that are protected from regular fire, usually resulting in the development of fire-sensitive closed forest (rainforest).

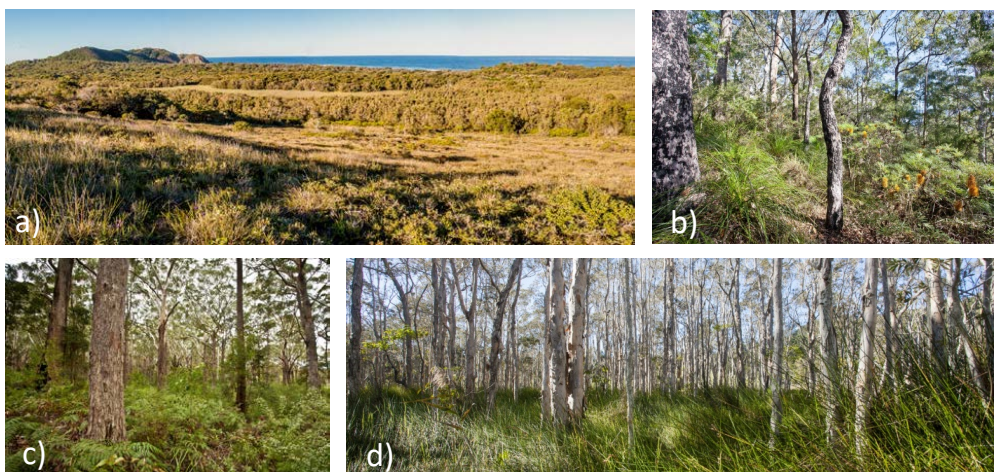


Figure 1. Examples of open ecosystems in Byron Shire: a) grassy clay heathland, (Byron Bay) b & c) heathy dry open forest (Koonyum Range, Broken Head) and d) forested wetlands (Skinners Shoot).

1.3 Ecological value of open ecosystems

While the enormous ecological value of our rainforests (closed ecosystems) is widely understood, few people realise that the Eucalypt Forests of NE NSW are also of global conservation significance ¹ and are recommended for listing as a world heritage area ². The main ecological values of open ecosystems can be summarised as four key values, as outline below.

- 1) **Open ecosystems provide unique habitat.** Around 50% of the plant and animal species in Byron Shire rely on open ecosystems for resources that are not provided by closed ecosystems. Habitat features unique to open ecosystems include:
 - Tree hollows of Eucalypts (and related genera) that provide crucial roosting & nesting resources for arboreal mammals, insectivorous bats, parrots and forest owls
 - Ample sunlight to support rich ground-layer communities of shade-intolerant grasses, sedges, ferns and heathy shrubs
 - Dense ground layer vegetation for nesting, shelter and foraging for small mammals, ground nesting birds, frogs and invertebrates
 - Seasonally abundant nectar of Eucalypts and Paperbarks crucial for nomadic nectivorous bird and flying-fox species
- 2) **Open ecosystems are ancient.** Like rainforests, many flora species in open ecosystems are of Gondwanan lineage and fossils reveal that Eucalypts, Banksias and their relatives have co-existed with fire for 50-90 million years ^{3,4}, probably sharing the landscape with dinosaurs. Open ecosystems have been shaped by fire for over 430 million years ⁵.
- 3) **Open ecosystems have been over-cleared & under-reserved.** The vast open forests that once dominated the region's productive floodplains and north-facing slopes were disproportionately cleared for agriculture. And few of the small, scattered remnants which survive today, are protected in conservation reserves.
- 4) **Open-ecosystems are extremely fragile and difficult to restore.** Open ecosystems are typically resilient to fire, but they often collapse with the removal of regular fire. And unlike bird-dispersed seeds of many rainforest plants, that can readily recolonise cleared lands, most open forest plants have very poor seed dispersal and require human help to recolonise where they have become locally extinct.

1.3.1 Threatened Species Values

The open ecosystems of Byron Shire provide crucial habitat for numerous threatened plants and animals and also include a number of endangered ecological communities. Around 75% (59) of all threatened fauna species found in Byron Shire use open ecosystem habitats, with 55% (43) being entirely dependent on open-ecosystems (**Figure 2**). In contrast, only 25% (20) of threatened fauna are restricted to rainforest and/or wet sclerophyll forests with rainforest understorey.

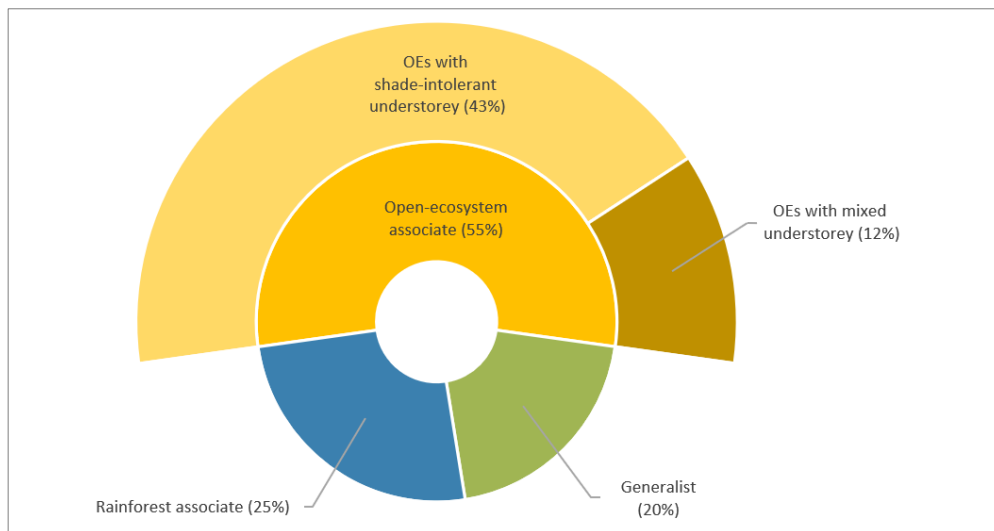


Figure 2. Habitat associations of threatened fauna recorded in Byron Shire. Rainforest associates are restricted to rainforest and wet sclerophyll forest with a rainforest understorey; open-ecosystem associates prefer sclerophyll forests and/or treeless ecosystems; generalists use both open-ecosystem and rainforest habitats.

Although 76% (54) of threatened flora species in Byron Shire are rainforest associates, open ecosystems still provide important habitat for the remaining 24% (17), including 14% (10) that are restricted entirely to open ecosystems. Examples of threatened species restricted to open ecosystems in Byron Shire are shown in **Figure 3**.

Open ecosystems also include a number of endangered ecological communities (*NSW Biodiversity Conservation Act 2016*) in Byron Shire, including:

- Subtropical Coastal Floodplain Forest
- Coastal Cypress Pine Forest
- Byron Graminoid Clay Heath
- Swamp Oak Floodplain Forest
- Swamp Sclerophyll Forest on Coastal Floodplains



Figure 3. Examples of threatened species restricted to open ecosystem habitats in Byron Shire. Species from top left: Koala (*Australian Koala Foundation*), Byron Bay Diuris (*Andy Baker*), Masked Owl (*Marc Anderson*), Squirrel Glider (*Canva NFP*), *Allocasuarina thalassoscopia*, Olongburra Frog (*Katrin Lowe*), Greater Glider (*Josh Bowell*), Rufous Bettong (*Eric Vanderduys*), Laced Fritillary (*L Matthews*), Little Lorikeet (*David Ongley*), Southern Swamp Orchid (*Andy Baker*), Glossy Black Cockatoo (*Duade Paton*).

1.4 The demise of fire in Byron Shire

Open ecosystems have evolved with fire for millions of years and at the time of European invasion, open ecosystems across Byron Shire would have been maintained by deliberate and skillful burning by Aboriginal custodians and also periodic wildfires. Over the last 50 years however, landscape fire has been largely extinguished from most open ecosystem areas in Byron Shire following the removal of Aboriginal burning and the rapid and effective suppression of most unplanned fires. Where fires still occur in open ecosystems, they are typically high intensity wildfires that occur under severe fire weather.

Because they have evolved with fire, open ecosystems need fire at regular intervals to stay healthy. The time needed between fires is different for different ecosystems and is known as the 'fire interval'. Some ecosystems, such as shrubby dry sclerophyll forest, require frequent fires, with a fire interval of 4-10 years, whereas the fire interval for wet sclerophyll forest with a rainforest understorey is 20-100 years.

Assessment of the current fire interval status in Byron Shire shows that most open ecosystems are extensively overdue for ecological fire to restore ecosystem health, including heathland (92%), dry open forest (82%) and swamp forest (95%) (**Figure 4**). Most wet sclerophyll forest (88%) is now due for ecological fire. These figures have been calculated by comparing the time elapsed since the last fire with the fire interval that best supports the vegetation type naturally occurring at that site (see **Appendix A** for methods). It is important to note that this is not an assessment of bushfire hazard or fuel loads. An area that is considered overdue for ecological fire does not necessarily indicate an increased risk of wildfire or the need for hazard reduction burning. Rather, it indicates that there is a risk of that ecosystem becoming degraded or transitioning to a less fire-adapted vegetation type (e.g. rainforest), if an ecological burn does not occur.

Overall, 95% of Byron Shire's open ecosystem areas have been fire-excluded for at least 50 years, and most open ecosystem areas are either overdue (34%) or due (58%) for fire. The distribution of the current fire interval status across Byron Shire's open ecosystems is shown in **Maps 1A-D**.

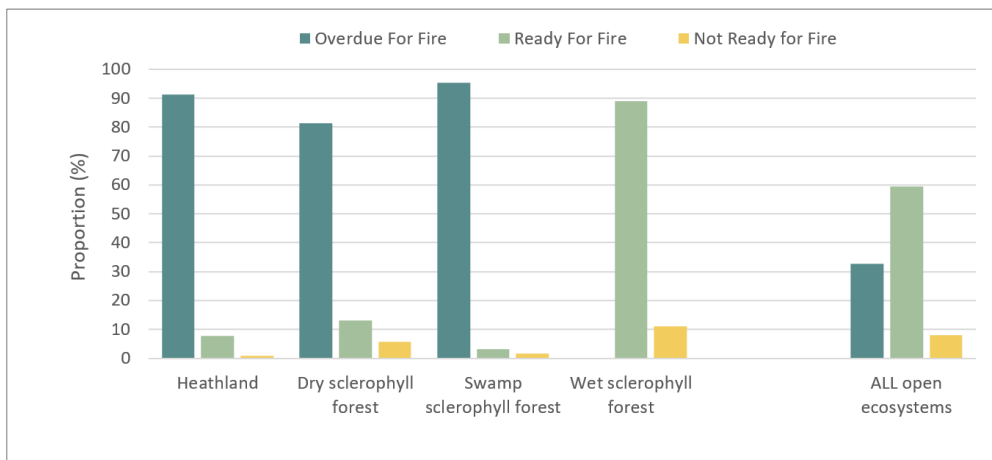


Figure 4. Current fire interval status of open ecosystems in Byron Shire.

1.5 Fire exclusion is a major threat to open ecosystem biodiversity values

Fire and biodiversity issues arise when the fire regime (frequency, intensity, season, extent) at a location changes (i.e. deviates from historical trends) and leads to environmental change which is unsuitable for the original biodiversity. Regular fire is a crucial ecological process in open ecosystems and the long-term exclusion of fire from open ecosystems can lead to irreversible habitat decline and ultimately to its complete displacement by rainforest.

Fire exclusion is an important threatening process affecting open-ecosystems generally and is attributed to a wide range of detrimental ecological consequences in Australia and globally ⁶⁻⁹. Many ecological consequences relate to structural changes that occur with time since fire (e.g. canopy closure from increased woody plant cover), while others are not dependent on structural change, but relate to other processes including changing soil chemistry (e.g. increasing soil acidity or soil nitrogen) or a lack of fire-related cues for reproduction (e.g. heat, smoke).

Across open-ecosystems generally, low frequency fire and canopy closure is attributed to a range of consequences including:

1. Altered ecosystem structure
2. Localised decline and extinction of open-forest flora species
3. Localised decline and extinction of open-forest fauna species
4. Establishment of transformer weeds
5. Dieback of canopy dominants & open forest displacement
6. Increased risk of high intensity bush fire
7. Reduced CO₂ sequestration and reduced standing carbon stocks

1.5.1 Altered ecosystem structure

The changing structure and distribution of fire-dependent vegetation communities due to fire exclusion is a global phenomenon, being particularly well documented in North America ^{6,10,11}, South America ^{12,13}, Africa ^{14,15} and Australia ¹⁶⁻¹⁹.

Open (sclerophyll) forests are characterised by an 'open' tree canopy, above an understorey plant community of graminoids, forbs and shrubs ²⁰⁻²². These understorey plant communities contain the majority of open forest plant diversity, provide key forage, shelter and nesting habitat for fauna, and the fine fuel needed for frequent fires to maintain ecosystem structure and diversity ^{22,23}. In these systems, regular fire promotes high ground layer density and richness, by preventing competitive exclusion of grasses, forbs and shrubs by taller woody plants ^{24,25}. Without disturbance however, tree cover progressively increases, reducing light, water and nutrient availability for understorey plant species ²⁶⁻²⁹. Canopy closure and understorey declines in open forest can result from increased densities of either sclerophyll trees typical of open forest ³⁰⁻³², or from fire-sensitive rainforest pioneers expanding from nearby rainforest areas (rainforest invasion) ^{25,33}.

Rainforest invasion of fire-excluded open forests is a global phenomenon ^{6,12,13,34,35}, and has been widely reported along the coast and ranges of NSW and SE QLD ³⁶⁻⁴⁰. The potential for rainforest invasion of open forests is particularly high in regions of high rainfall ^{35,41}, low fire frequency and a moderate to high proportion of rainforest tree seed source areas.

A general model of rainforest invasion of fire-dependent open forests in the absence of fire ⁴²⁻⁴⁵ recognises that rainforest plants often recruit into the open forests in the interval between fires, but will again be removed or suppressed by regularly returning fires. However, with continued fire exclusion, further growth and recruitment of rainforest plants enables formation of a dense rainforest midstorey (Figure 5, Figure 6) ^{25,36}.



Figure 5. Comparison of a) typical and b) rainforest-invaded clay heathland (Byron Bay).



Figure 6. Comparison of typical and rainforest-invaded swamp sclerophyll forest: a) recently burnt (8 years since fire), and b) long-unburnt (>50 years since fire; Tyagarah).

Rainforest invasion in fire-excluded open forests may also be accelerated by global climate change through increased rainfall ⁴⁶, increased atmospheric humidity ⁴⁷, improved forest water-use efficiency ⁴⁸ and atmospheric CO₂ enrichment ^{49,50}.

With sufficient time without fire, rainforests may completely displace open forest, as remnant open-forest canopy trees senesce with age or decline prematurely in the unfavourable environment created by the developing rainforest subcanopy ⁵¹. Mechanisms of premature dieback of canopy trees is further outlined in **Section 1.5.5**.

1.5.1.1 THE POTENTIAL FOR RAINFOREST INVASION IN BYRON SHIRE

Although there has been no comprehensive assessment of the extent of open forests affected by rainforest invasion in Byron Shire, high rainfall and the widespread distribution of suitable soils and rainforest seed-source areas suggest that rainforest transition may be possible throughout many areas of fire-excluded open ecosystems. The potential for change in the Shire is indicated by analysis of recent vegetation mapping across the Shire (**Figure 7**). Since the 1990s, 77% of dry sclerophyll forest has transitioned to wet sclerophyll forest or rainforest following the invasion of rainforest pioneers in the absence of fire. A further 35% of wet sclerophyll forest has transitioned to rainforest over this period ⁵². All major soil types in the Shire readily support rainforest in a range of topographic positions sheltered from fire, including on exposed headlands, escarpments, and elevated sand dunes ^{53,54}. Hence the current trends of fire exclusion and rainforest invasion threaten open ecosystem biodiversity throughout the Shire.

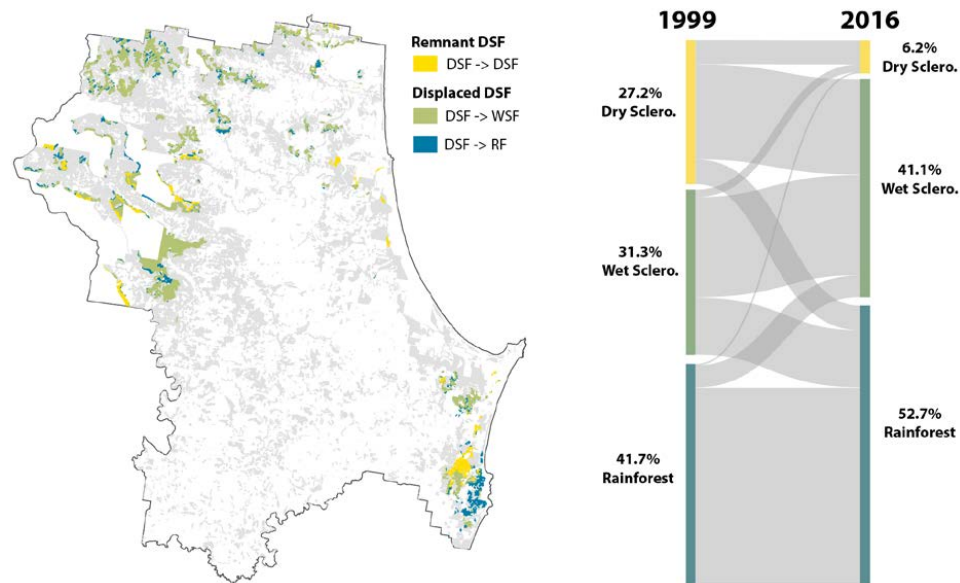


Figure 7. The distribution and extent of dry sclerophyll forest that transitioned to wet sclerophyll forest or rainforest between 1999 and 2016, primarily due to rainforest pioneer invasion. DSF – dry sclerophyll forest, WSF – wet sclerophyll forest, RF – rainforest.

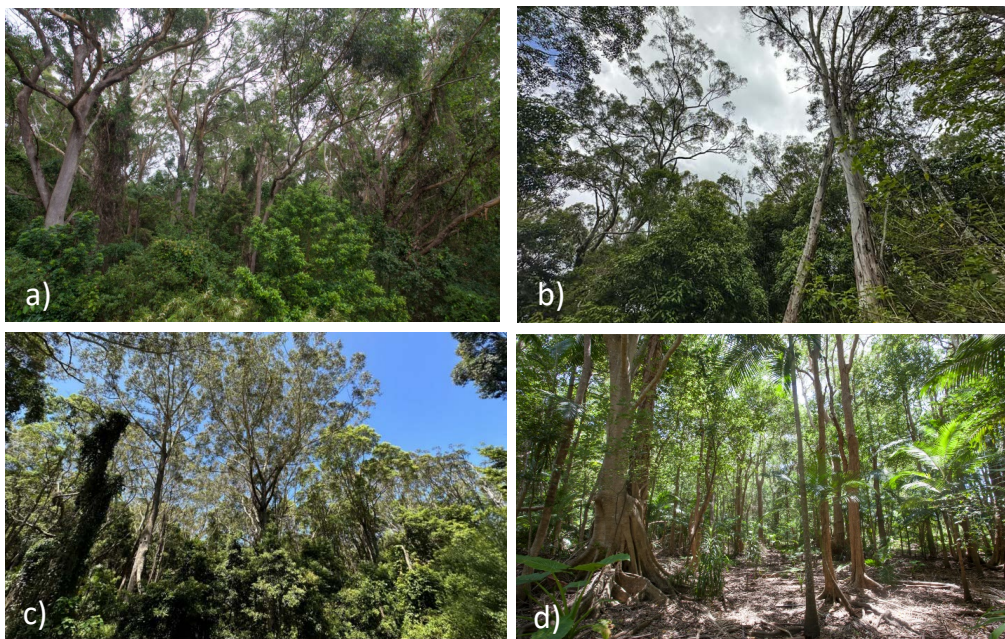


Figure 8. Examples of rainforest invasion in fire-excluded open forest in Byron Shire: a) heathy dry sclerophyll forest (Broken Head), b) grassy dry sclerophyll woodland (Montecollum) c) heathy dry sclerophyll forest (Skinners Shoot) and d) swamp sclerophyll forest (Tyagarah).

1.5.2 Localised decline and extinction of open-forest flora species

Several mechanisms of decline and localised extinction of open forest flora have been associated with fire-exclusion, including:

- Premature death of shade-intolerant understorey flora through shading (e.g. *Xanthorrhoea*, *Banksia*, *Themeda*, *Diuris*)^{40,55,56}.
- Failed reproduction and recruitment of flora requiring fire or bare-earth seed beds for germination (e.g. *Eucalyptus*, *Acacia*, *Banksia*)^{42,57,58}.

Most of the floristic diversity of open forests typically occurs in the ground layer²⁰ and is shade intolerant^{59,60}, making it vulnerable to displacement by dense rainforest midstorey vegetation. A recent study in fire-excluded dry sclerophyll forest on the NSW far north coast⁴⁰, found that rainforest pioneers had displaced over half of the understorey plant species, and reduced ground cover and density of dry forest specialists by ~90% (**Figure 9**). Significant understorey declines also occurred with increased sclerophyll midstorey cover following fire-exclusion, although losses were typically less than half that of rainforest-invaded sites over the same period.

While flora species with persistent soil seed banks may remain on the site until the return of fire, taxa with only transient or canopy-stored seedbanks (e.g. many Xanthorrhoeaceae, Proteaceae and Myrtaceae) become locally extinct with the death of the standing plant population^{55,61}. The Bundjalung study⁴⁰ found 20% of displaced plants had no capacity for recovery due to the absence of both a soil seedbank and wide-dispersal capacity. And for a further 68% of displaced species, recovery was limited by the absence of one of these recovery mechanisms. A study of seed-bank longevity in open forests near Sydney, estimated that 'long-lived' seedbanks may be typically exhausted only 1–2 decades after adults have died, with the plants becoming locally extinct if fire-free intervals exceeded this threshold⁶².

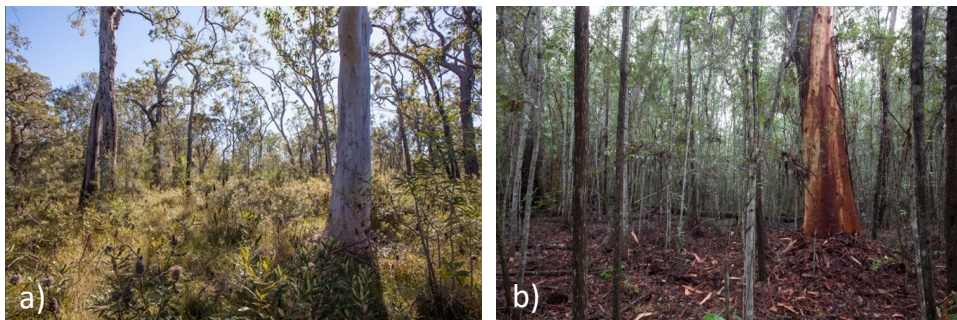


Figure 9. Displacement of understorey plant community in dry sclerophyll forest in Bundjalung National Park, showing a) regularly burnt forest (4 years since fire), and b) fire-excluded rainforest-invaded open forest 16 years after fire.

1.5.3 Localised decline and extinction of open-forest fauna species

In Australia, fire-exclusion has been attributed with the declining habitat suitability and displacement of mammals^{51,63–66}, birds^{25,38,67–69} and reptiles⁷⁰.

A range of mechanisms of fauna decline and localised extinction of open forest flora have been associated with low frequency fire, including:

- Loss of ground cover foraging, breeding and or sheltering resources as ground layer vegetation lost to canopy shading (e.g. Northern Bettong, Eastern Bristle Bird, Wallum Sedge Frog)^{38,64,71}
- Impeded foraging under canopy (e.g. bats, birds) through midstorey thickening (e.g. White-throated Tree Creeper, Large Bent-winged Bat)^{72,73}
- Reduced hollow formation by fire scarring of canopy trees^{74,75}
- Accelerated decay of woody debris in humid conditions under closed canopy⁷⁶
- Reduced ectotherm/homeotherm heating opportunities below closed canopy (e.g. Broad-headed Snake)⁷⁰

- Increased exposure to high severity wildfire due to fuel build up at both site- and landscape-scales (e.g. Koala) ^{77,78}
- Increased abundance of feral predators in long-unburnt vegetation with reduced ground layer vegetation (e.g. fox, cat) ⁷⁹
- Reduced age class diversity and structural formation diversity ^{80,81}
- Reduced habitat connectivity ⁸²

More specifically, rainforest invasion into Australian open forest has been shown to affect the habitat suitability and species diversity of mammals ^{64,66,73,83}, birds ^{25,67} and invertebrates ^{84,85}. A recent study of insectivorous bats in fire-excluded Eucalypt forest in Bundjalung National Park ⁷³ found that long-unburnt, rainforest-invaded forests had lower bat activity (63% lower) and species richness (35% lower) than recently burnt forests with a more open midstorey. The displaced bat species included several threatened species, which were no longer able to forage among the increased stem and foliage density of the invading rainforest trees.

1.5.4 Establishment of transformer weeds

Transformer weeds are invasive plants which can undermine the ecological processes that maintain the health of native ecosystems and the habitat of associated plants and animals. Numerous weed species are fire-sensitive, and like fire-sensitive rainforest trees, their establishment is favoured by fire-exclusion (e.g. Camphor Laurel, Privets, Devil's Fig, Umbrella Tree) (**Figure 10**). Like rainforest pioneers, these weeds have the potential to form a dense midstorey or canopy and can therefore have the same impacts in open ecosystems, such as displacement of flora & fauna. Accordingly, all weed species with the potential to develop a dense midstorey or canopy should be considered 'transformer' weeds. The transformative potential of these weeds includes to:

- displace open forest understorey plant communities and canopy trees through competition
- degrade or eliminate open forest fauna habitat
- disrupt the fire regime of open forests through altered fuel arrays and microclimate ⁸⁶⁻⁸⁸.



Figure 10. Examples of dense transformer weed infestations in dry sclerophyll forest in Byron Shire: a) Camphor Laurel (Goonengerry) and b) Umbrella Tree (Brunswick Heads). These transformer weeds are likely to replace dry sclerophyll forest trees without future fire, while the shade beneath the dense subcanopy is already transforming the community through suppression of ground layer vegetation and subsequent decline in floristic diversity, fauna habitat and ecosystem flammability.

1.5.5 Dieback of canopy dominants & open forest displacement

Fire exclusion and invading rainforest pioneers have been demonstrated to accelerate the decline of open forest canopy trees through:

- suppressed reproduction and recruitment of canopy trees beneath the dense midstorey ^{42,57,89}
- increased competition for soil water availability during droughts ^{90,91}
- alteration of ectomycorrhizal communities mediated by soil chemistry ^{92,93}
- facilitating Bell Miner Associated Dieback (BMAD) by providing critical nesting conditions for bell

miners⁹⁴⁻⁹⁶.

- locking up phosphorous and/or cations in rainforest litter and midstorey biomass²⁶

Most open forest canopy trees (e.g. *Eucalyptus*, *Corymbia*, *Lophostemon*, *Melaleuca*) are dependent on fire for recruitment and without future fires, existing adult trees may be the last of their kind on the site. The reproduction and recruitment of most open forest trees is cued to coincide with the reduced competition and increased availability of resources within gaps of the post-fire environment⁹⁷. Successful seedling establishment of open forest trees requires periodic understorey removal by fire and subsequent sun exposure of the bared soil in large gaps^{42,57} and also reduction of seedling pathogens and consumers⁸⁹.

Long-term fire exclusion can also have profound negative impacts on the health of existing trees, through changes in open forest soils, including altered pH, Nitrogen and water availability and alteration of mycorrhizal and other microbial communities^{26,91,93}. The development of a rainforest midstorey following fire-exclusion can further exacerbate these changes, and has been attributed to crown decline and premature mortality of dominant overstorey *Eucalyptus* trees^{91,98}. Rainforest development typically modifies the soil physical and chemical environment to favour invading rainforest trees at the expense of open forest canopy trees. The mechanisms accelerating crown decline include increased competition for soil water availability during droughts^{26,90} and locking up essential Phosphorous and/or cations in rainforest litter and midstorey biomass²⁶.

Bell Miners require a midstorey structure (dense cover at 2-6m in height) to nest and establish colonies^{95,99} and readily nest in many native understorey species other than the introduced *Lantana*¹⁰⁰. Thus, long-unburnt open forest with a dense midstorey of sclerophyll or rainforest trees provides ideal nesting habitat for Bell Miners^{94,96}. Once established, Bell Miner colonies encourage over-abundant psyllid populations, which can lead to Bell Miner Associated Dieback (BMAD) of open forest trees. BMAD is listed as a Key Threatening Process under the NSW *Biodiversity Conservation* Act and has caused the decline of tens of thousands of hectares of *Eucalypt* forest from south east Queensland to Victoria⁹⁶. The recent establishment of Bell Miner colonies in coastal Byron Shire (e.g. Yelgun, Mullumbimby), signals a high potential for Bell Miner Associated Dieback (BMAD) as an emerging threat to Byron's open forests.

With sufficient time without fire and advanced canopy dieback, rainforests may completely displace open forest⁵¹, as remnant open forest canopy trees senesce with age or decline prematurely in the unfavourable environment created by the developing rainforest subcanopy (**Figure 11**).



Figure 11. An area of swamp sclerophyll forest in Ewingsdale that has been fire-excluded for at least 70 years. Only old-growth Paperbarks remain on site a) with seedlings unable to recruit in the deep shade and deep litter. The Paperbark canopy b) is progressively being replaced by rainforest trees such as Bangalow Palms, Fig Trees and Pink Euodia.

1.5.6 Summary of ecological consequences of rainforest invasion

Figure 12 provides a brief summary of the ecological consequences of rainforest invasion.

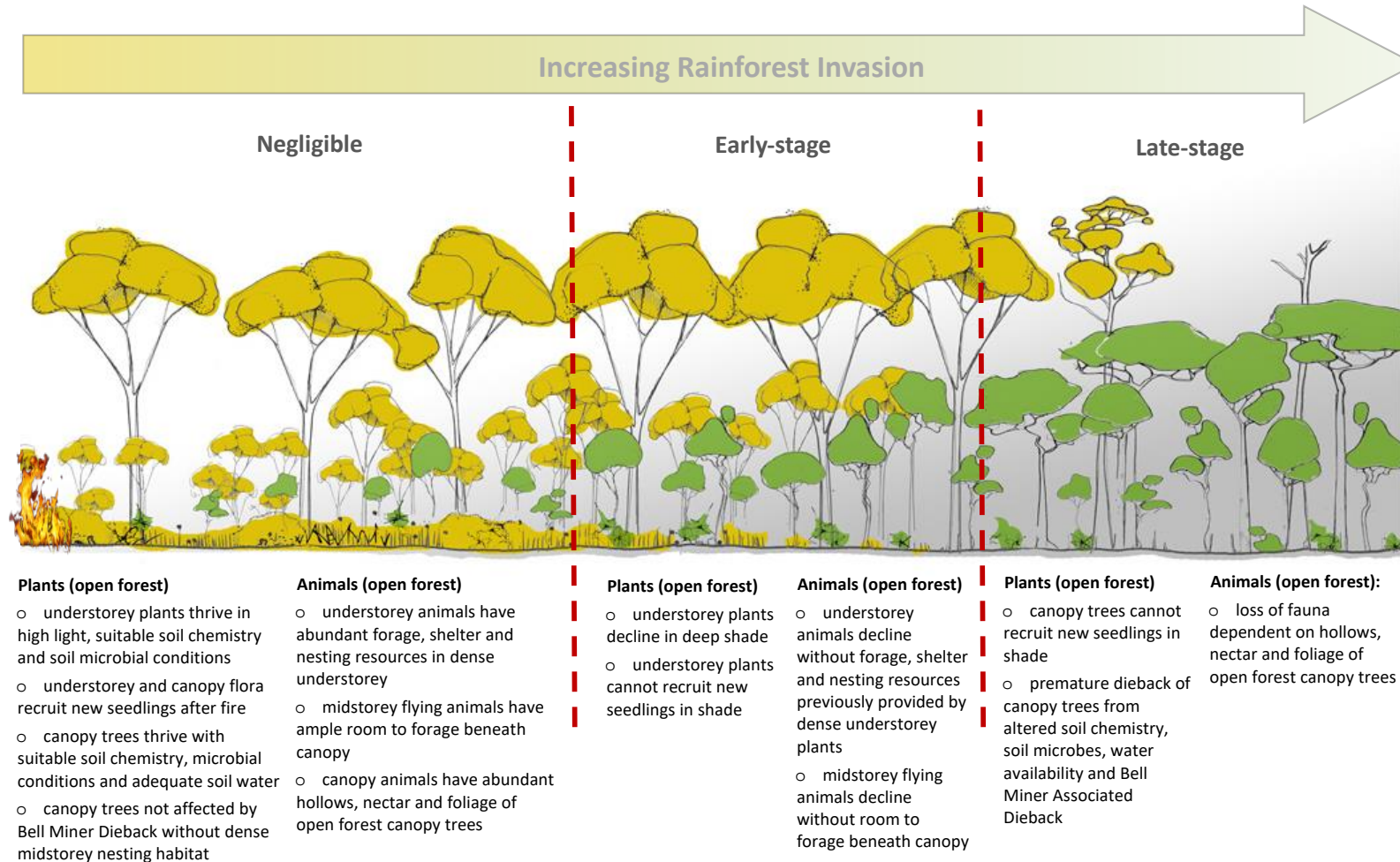


Figure 12. Summary of ecological consequences of fire exclusion and rainforest invasion on open forest biodiversity.

1.5.7 Increased risk of high intensity bush fire

1.5.7.1 FUEL ACCUMULATION & INCREASED HIGH INTENSITY BUSH FIRES

Australian open forests are among the most fire-prone ecosystems on earth¹⁰¹ and under conditions of severe fire weather and high fuel accumulation, resulting crown fires are typically beyond human fire suppression capabilities. Fires consume fuel, and the exclusion of fire is widely recognised to allow fuel accumulation and increased vertical and horizontal continuity of fuels, thereby increasing forest flammability and maximising the threat of catastrophic wildfire impacting both fire-sensitive conservation values and endangering human lives and property.



Figure 13. High intensity wildfire in open Eucalypt forest in coastal NSW. Dan Himbrechts/EPA.

Fire intensity and extent is largely governed by the volume and continuity of understorey vegetation, particularly surface fuels (i.e. leaf, twig & bark litter), near-surface fuels (i.e. grasses & low shrubs) and elevated fuels (i.e. tall shrubs and saplings). With increasing time since fire, these layers progressively accumulate fuel, increasing the likelihood of intense bush fires in fire-excluded vegetation (except rainforest). Fuel accumulation is most rapid in the decade after fire, although fuels in all layers can continue to increase for several decades⁷⁸. By increasing the total fuel load and allowing ongoing structural development of the fuel bed, fire exclusion increases the rate of spread, flame height and intensity of bush fires, as well as the number and distance of spot fires⁷⁸. This relationship of increasing flammability with time since fire underpins the practice of hazard reduction burning, which is the primary tool for reducing the risk of high intensity bush fires worldwide.

1.5.7.2 BIODIVERSITY VALUES VULNERABLE TO HIGH INTENSITY WILDFIRE

Fire-sensitive rainforest

Fires that spread through open forest usually self-extinguish upon reaching the rainforest boundary, where fuels are usually too damp to burn. However, particularly hot and dry bushfire seasons can cause rainforest fuels to dry out, allowing fires to penetrate rainforest margins and damage their fire-sensitive conservation values. The impact of fires on rainforest increases with fire intensity, with high intensity fires capable of deeper penetration and more severe and extensive scorching of the rainforest canopy. The risk of high intensity rainforest fires is increased where adjoining open forest has accumulated high fuel loads, making the wildfire more difficult to control and increasing its capacity to preheat and dry fuels along the rainforest margin ahead of the fire front.

Although most rainforest plant species can survive and recover from wildfire through resprouting^{102,103}, crown scorching temporarily forces open the rainforest canopy, profoundly changing the habitat structure until the canopy can close over again following years of recovery. Prior to canopy recovery, likely impacts of fire penetration on threatened fauna include:

- temporary loss of foraging resources (e.g. rainforest tree fruit for rainforest pigeons)
- temporary loss of dense roosting habitat for rainforest pigeons and the Queensland Blossom Bat
- temporary loss of rainforest litter for Mitchell's Rainforest Snail

Open forest values

Although open forests are generally adapted to fire, high intensity wildfires can have more severe impacts on open forest fauna than low intensity surface fires, including:

- increased death of less mobile canopy fauna such as koalas
- temporary reduction of foraging resources for fauna dependent on open forest tree nectar, foliage, seeds or insects
- increased loss of tree hollows and large fallen logs
- more extensive loss of refuge areas and habitat resources across the landscape

The impact of crown fires has been relatively well documented for koalas, although similar impacts are likely for other fauna that utilise the open forest trees. High-intensity canopy fires pose a serious threat to koalas, particularly in areas of fragmented habitat. High intensity canopy fires can cause death or injury of koalas¹⁰⁴. Koalas which survive the initial canopy fire may still succumb to starvation following widespread canopy scorch¹⁰⁵, or dog attack and road mortality as animals move in search of unburnt habitat¹⁰⁶.

Resource depletion from intense bush fires is short-term for koalas, and individuals surviving in unburnt refuge areas, may recolonise burnt habitat and utilise resprouting trees within months of the fire for both food and shelter¹⁰⁶. However, in fragmented habitat, high-intensity bush fires have the potential to eliminate koalas from isolated patches of koala habitat, and if the fragmentation limits koala movement across the landscape, repopulation of previously burnt areas after habitat recovery may be restricted or impossible.

Finally, an emerging wildfire-related threat to biodiversity is dense midstorey regrowth following fires that impact previously long-unburnt forests. In these forests, long fire-free periods allow dense accumulation of rainforest pioneer seedbanks, including bird dispersed wattles, which then germinate *en masse* with high intensity fire. This was widely observed in open forests of the Nightcap following the 2019-20 wildfires. Before the fires, rainforest pioneer tree density in some dry open forest sites was estimated to be relatively sparse (c. 2-10m spacing). Postfire however, rainforest pioneer sapling densities have increased dramatically in some areas (c. 0.3 – 1m spacings) (**Figure 14**). So while these fires initiated promising restoration of dry open forests, dense postfire regrowth of rainforest pioneer saplings in many areas threatens to eliminate shade-intolerant ground layer communities and the fauna habitat they provide.



Figure 14. Dense regrowth of rainforest pioneers saplings only 18 months after the 2019-20 fires in dry open forest adjoining Nightcap National Park. Invading rainforest pioneers include *Androcalva fraseri* (left) and *Acacia melanoxylon* (right).

Swamp sclerophyll forest (increased risk of peat fires)

Swamp forests subject to seasonal inundation often accumulate peat (partially decayed, densely packed organic matter) in their soils. During extended dry periods, lowered water tables allow the peat to dry and become vulnerable to ignition. Once ignited, peat fires can burn below the ground surface and in severe cases, extensive soil subsidence and / or burning of tree roots can cause widespread tree collapse (Figure 15).



Figure 15. Widespread collapse of Paperbark forest caused by peat fire in late 2009 on the western shore of Cudgen Lake ¹⁰⁷.

1.6 Endangered Ecological Communities in Byron Shire threatened by low frequency fire

Low frequency fire has been specifically identified as the primary threat from altered fire regimes for a number of fire-dependent endangered ecological communities that occur in Byron Shire (**Table 1**).

Table 1. Fire-dependent Endangered Ecological Communities of Byron Shire with identified threats associated with low frequency fire as defined in the community profile ¹⁰⁸.

Endangered Ecological Community	Threats Associated with Low Frequency Fire (DPE 2021)
<i>Byron Graminoid Clay Heath</i>	Low frequency fire can cause canopy closure, which shades out ground layer flora communities and fauna habitat.
<i>Coastal Cypress Pine Forest</i>	Low frequency fire can cause canopy closure, which shades out ground layer flora communities, displaces fauna habitat and prevents gap creation required for regeneration of the dominant species
<i>Subtropical Coastal Floodplain Forest</i>	Low frequency fire can cause canopy closure, which shades out ground layer flora communities, displaces fauna habitat and encourages Bell Miner.
<i>Swamp Oak Floodplain Forest</i>	Low frequency fire can cause canopy closure, which shades out ground layer flora communities and fauna habitat. Too frequent fire can simplify ground layer vegetation through loss of flora species.
<i>Swamp Sclerophyll Forest on Coastal Floodplains</i>	Low frequency fire can cause canopy closure, which shades out ground layer flora communities and fauna habitat.

1.7 Fire exclusion reduces CO₂ sequestration and reduced standing carbon stocks

Fire exclusion disrupts long-term sequestration of charcoal

Landscape fires are often mistaken as a source of CO₂ emissions, yet recent research shows that landscape fires can in fact facilitate sequestration of vast amounts of carbon as charcoal and ash ^{109,110}. Fires in open-ecosystems usually only burn plant material that has grown since the last fire, and as plants regrow before the next fire, all the CO₂ that was released as smoke is again removed from the atmosphere – a carbon neutral loop ¹¹¹. However, fires also create vast amounts of charcoal and ash that is transferred to long term storage in soils, wetlands or marine deposits. Crucially though, to regrow leaves, twigs and bark that were lost to charcoal, plants must draw all required CO₂ directly from the atmosphere – not the soil – resulting in net CO₂ transfer from atmosphere to long-term sinks with each fire. Worldwide, this transfer pathway is vast and it is estimated that landscape fires generate 250 megatons of pyrogenic char annually ¹¹⁰. The exclusion of fire disrupts this important carbon sequestration pathway.

Rainforest invasion & CO₂ emission feedbacks

Increased CO₂ has been found to accelerate canopy closure by accelerating tree growth rates ^{50,112} in a process called ‘CO₂ fertilisation’. Indeed, in northern Australia, rainforest expansion into open forest can occur even where fire frequencies have increased ⁵⁰. These observations are consistent with past periods of high global atmospheric CO₂ - ‘greenhouse worlds’ – in which rainforest dominated much of the world ⁷, including the period when vast rainforests dominated Gondwana.

Old growth Eucalypt forests are the most carbon-rich ecosystems in Australia, due to the sheer size and density of large old Eucalypts and the persistence of their large logs on the ground. Where Eucalypt forests transition to rainforest, the replacement of these giants with smaller less carbon-rich trees and the rotting of the large logs can result in CO₂ emissions of ~250 tons per hectare ¹¹³.

2 PRIORITISING OPEN ECOSYSTEM RESTORATION IN BYRON SHIRE

2.1 Conservation triage

The *Biodiversity Conservation Strategy* identifies the need to prioritise restoration investment towards areas where they will have the greatest conservation impact. This project uses a *conservation triage* approach, which prioritises areas that are in *good condition* and *require minimal intervention* over highly *degraded areas* that require *multiple interventions* that are complex and/or resource intensive. By using this approach, open ecosystem areas in good condition can be rapidly secured from further decline, before progressively moving on to restore increasingly degraded areas as resources become available.

For the restoration of historical, ecologically-appropriate fire frequency, broad condition (restoration potential) classes include:

- **Good condition:** dense native ground-layer of shade-intolerant grasses/sedges, heathy shrubs and/or ferns; generally open canopy/midstorey with minor shading effects on the ground layer
- **Moderate condition:** moderately dense to patchy native ground-layer of shade-intolerant grasses/sedges, heathy shrubs and/or ferns; generally open canopy/midstorey with moderate shading effects on the ground layer
- **Poor condition:** sparse or absent ground layer of shade-intolerant plants; generally closed canopy/midstorey with widespread deep shading effects on the ground layer

Indicators to identify these restoration potential classes, and likely interventions required for their restoration, are further illustrated in **Figure 16**. Note that these condition classes relate to dry sclerophyll, swamp sclerophyll and grassy/ferny wet sclerophyll forest only. Forest classes with a naturally dense rainforest midstorey/subcanopy are not suitable for restoration using planned fire.

The efficiency and conservation impact of restoring ecological fire regimes is also influenced by additional factors, such as site access, landowner support, neighbouring tenure, weediness and contribution to wildlife corridors. However, the relative importance of these factors varies with project objectives, scale and location. For example, peri-urban bushland may be prioritised wherever it provides a hazard reduction benefit, while hinterland areas may be prioritised where they contribute to wildlife corridors. Accordingly, the Shire-wide mapping presented here is limited to identifying restoration potential based on condition classes alone. Guidelines to further refine prioritisation at the project planning stage are further discussed in **Section 4.1**.

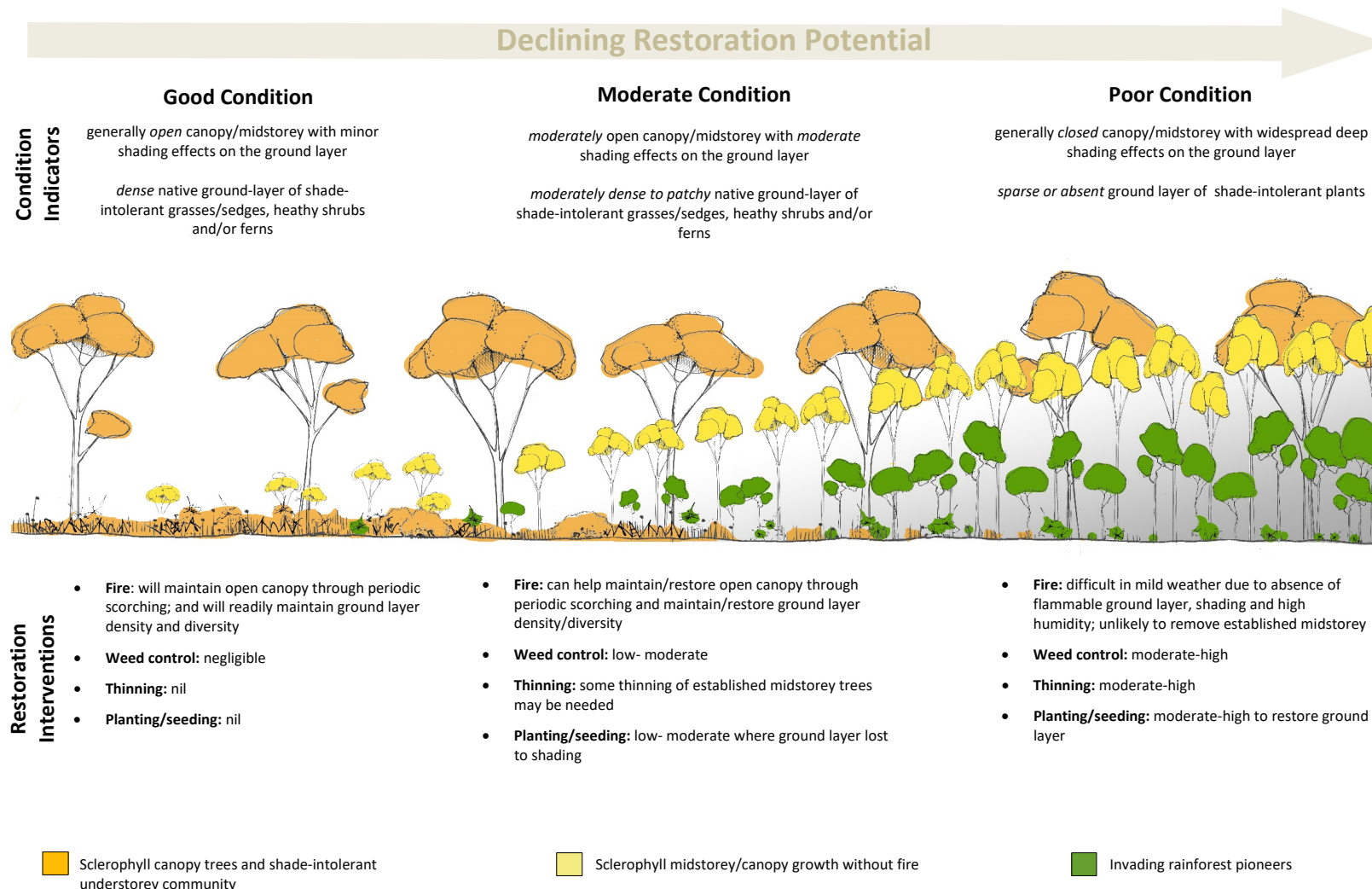


Figure 16. Restoration condition indicators and likely restoration interventions for open ecosystem condition classes.

2.2 Mapping restoration condition classes across Byron Shire

The 'Restoration Potential' maps (**Maps 2A-D**) show the *likelihood* of sites having open-ecosystem areas in *good-moderate condition* and were developed using a combination of:

- 1) GIS mapping & modelling
- 2) expert input via workshop
- 3) rapid ground-truthing of key areas

2.2.1 GIS mapping & modelling

Overview

Around 95% of Byron Shire's open ecosystem areas have been fire-excluded for at least 50 years, resulting in widespread canopy closure and subsequent elimination of shade-intolerant ground layer communities. Despite this decline, shade-intolerant ground layer communities still persist under certain conditions throughout the Shire. The likelihood of open-ecosystem areas retaining this ground layer is determined by the i) vegetation type attributes (e.g. canopy cover and understorey type), and ii) the rate of postfire canopy closure, as determined by plant growth resources at a site (e.g. water availability, soil nutrients).

Accordingly, restoration potential was modelled using existing mapping datasets including vegetation (current & historical), soil type, exposure and recent fire. The overall process and rationale for the modelling is explained below, with more detailed attribute classification given in **Appendix A**. While it is acknowledged that past disturbances such as clearing and grazing also have a major influence on ecosystem structure, inclusion of these factors into the model was precluded by the absence of suitable mapping data.

Mapped Vegetation Attributes

The analysis was limited to open ecosystem formations (i.e. heathlands; dry, swamp and wet sclerophyll forests) as mapped in Council's current vegetation mapping dataset (ByronVeg2021_VIS 5109) and occurring on all tenures (private and public), except National Parks estate. All open ecosystem vegetation from the dataset was broadly grouped into formations, before each of the 80 PCT communities (PCT_comm) were assigned to preliminary restoration potential classes (high, moderate, low) within their formation group by expert assessment of the community description, landscape position and known/likely relationship to fire (including postfire trajectory). For example 'Wallum Banksia dry heathland on coastal sands' was classed 'HEATHLAND HIGH' as it is known to be relatively resistant to canopy closure and ground layer loss. While 'Coast Wattle shrubland on coastal foredunes' was classed 'HEATHLAND LOW' due to its limited relationship to fire, typically sparse ground layer and tendency to develop into taller forest. See **Appendix B** (Table B1) for classification of all current PCTs.

A historical vegetation dataset (2007_BSC_Veg), mostly mapped from 1991 aerial photography and 1999 ground truthing, was also used in the analysis to identify historical areas of sedgeland, heathland and dry sclerophyll forest. Within these historical formations, each vegetation community (VC_Desc) was similarly assigned to preliminary restoration potential class by expert assessment. Historical formations were typically used in the final model to elevate the final restoration potential class wherever heathland or sedgeland had recently transitioned to forested wetlands and where dry sclerophyll forest had recently transitioned to wet sclerophyll forest. See **Appendix B** (Table B2) for classification of all historical PCTs.

Plant growth resources (rate of postfire canopy closure)

Tree density and the shading of the ground layer (i.e. canopy closure) generally increase with time since the last fire. However, the rate at which canopy closure occurs depends on the available plant growth resources of the site, particularly soil nutrients and water availability. For example in dry sclerophyll forest, canopy closure may take >50 years since the last fire on an exposed site on poor

soils but may occur in only 8 years on a more sheltered site on rich soils.

Growth conditions were modelled across the Shire using the soil landscape mapping of Morand^{114,115} and an analysis of exposure (aspect, slope, landscape position) derived from a digital elevation model. Broadly, soil landscapes were assigned to preliminary restoration potential classes, including VERY HIGH (sand, coarse metasediments), HIGH (rhyolitic, fine metasediments), MODERATE (estuarine, swamp) and LOW (basaltic, alluvial). See **Appendix B** (Table B3) for classification of all soil landscapes to preliminary restoration potential classes. Exposure was classed as HIGH (slopes < 5% OR N-NW aspects of 245° > 90°) and LOW (S aspects of 90° > 245° AND slopes > 5%).

Recent Fire

Recent fire (<10 yrs) was added as an additional factor in the model to help identify areas likely to have had their historical structure restored by recent wildfires. This factor was applied by expert assessment only to locations with more open vegetation (current or historical) and/or more exposed landscape positions.

Final Restoration Potential Model

The final model was derived by combining all preliminary restoration potential classes for vegetation (current & historical), soil type, exposure and recent fire. Development of the final model involved multiple draft iterations, which were each compared with areas of known condition in different parts of the Shire to identify any required refinements to the model. The final model included 74 unique combinations of preliminary classes **Appendix B** (Table B4), with some illustrative examples given in

Table 2. Examples of class combinations used in the final restoration potential model. DSF – dry sclerophyll forest, WSF – wet sclerophyll forest.

Formation (Existing)	Formation (Historical)	Soil Landscape	Exposure	Recent Fire	Restoration Potential
DSF (high)	-	very high	high	-	HIGH
DSF (high)	-	high	low	no	MOD
DSF (high)	-	low	low	no	LOW
WSF (low)	DSF OR heathland	high	high	yes	HIGH
WSF (low)	-	moderate	-	-	LOW

2.2.2 Expert input via workshop

The modelled restoration potential was further refined by an expert workshop held at Byron Shire Council on November 29, 2022. Workshop participants included vegetation management experts with extensive experience in Byron Shire (see below). Representatives from the *Tweed Byron Local Aboriginal Land Council* and *Bundjalung of Byron Bay Aboriginal Corporation (Arakwal)* were also invited to participate in the workshop. Participants were provided with draft maps and background information one week before the workshop and were asked to identify any known or potential restoration areas not identified in the draft mapping. Workshop participants included:

- Andy Erskine
(Byron Shire Council)
- David Filipczyk
(Byron Shire Council)
- Dr. Joanne Green
(EarthScapes Consulting)
- Stuart McDonald
(Northern Rivers Ecological)
- Annette McKinley
(Landmark Ecological Services)
- John McVicar
(Byron Shire Council)
- David Milledge
(Landmark Ecological Services)
- Dave Rawlins
(Bush Regenerator)

Additional known and potential areas were contributed by Dr. Andy Baker based on previous field observations.

2.2.3 Rapid ground-truthing of key areas

The final step in producing the restoration potential maps involved rapid ground truthing of key areas throughout the Shire over six days between November 30 and December 22, 2022. Survey was generally limited to areas visible from the public road network.

2.2.4 Final Restoration Potential Classes

The final *Restoration Potential* classes (**Maps 2A-D**) were derived by combining *modelled*, *expert* and *surveyed* potential classes. Overall, *modelled* potential formed the basis, but could be superseded by *expert* or *survey* potential, with *expert* potential also being superseded by *survey* (**Table 3**).

Table 3. Derivation of final restoration potential classes.

Model	Expert	Survey	Final Potential Class
Any class	Any class	High	VERY HIGH
High	-	-	HIGH
Any class	High	-	HIGH
Any class	Moderate	-	MODERATE
Moderate	-	-	MODERATE
Low	-	-	LOW
Any Class	Any Class	Low	LOW

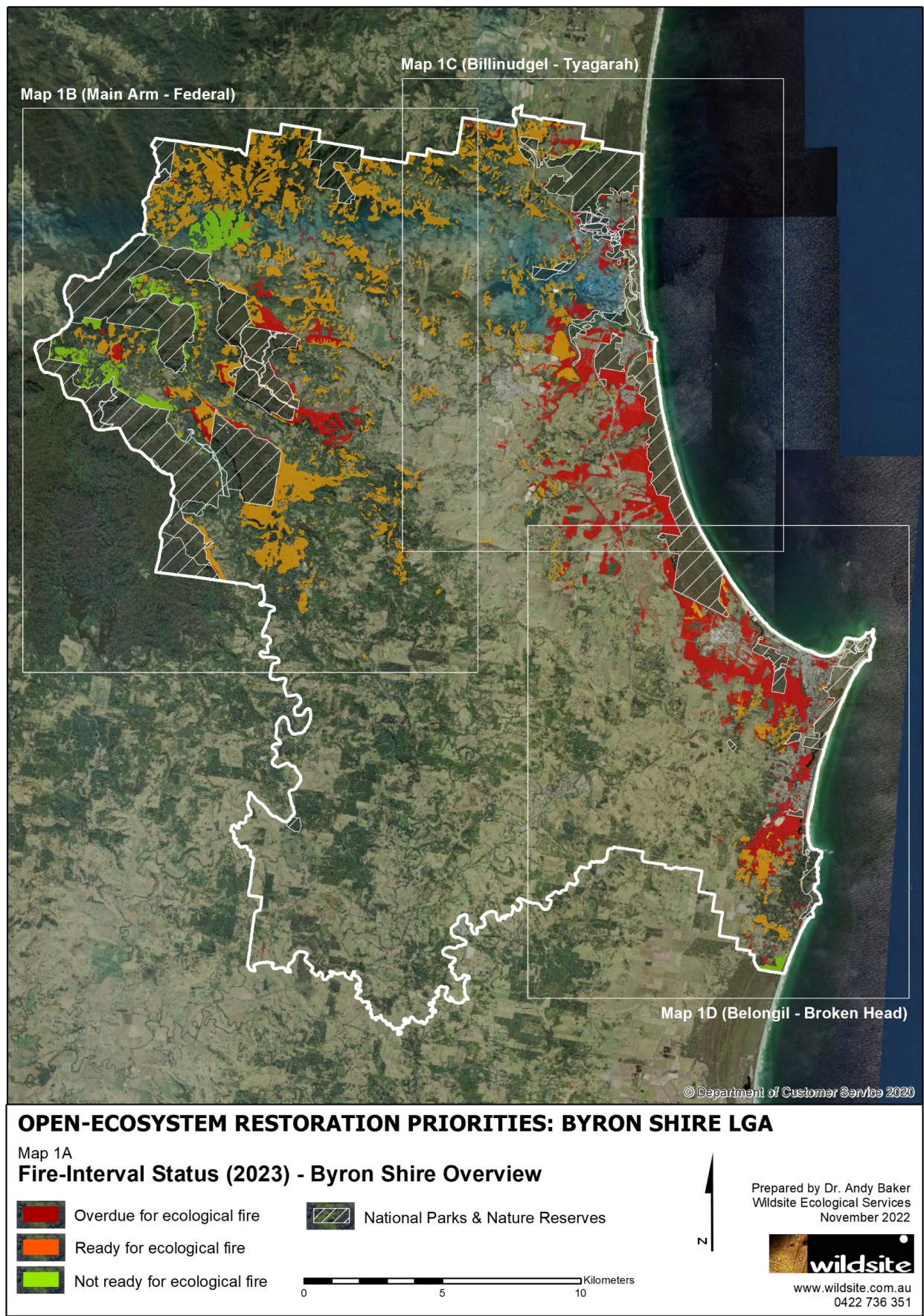
3 MAPS

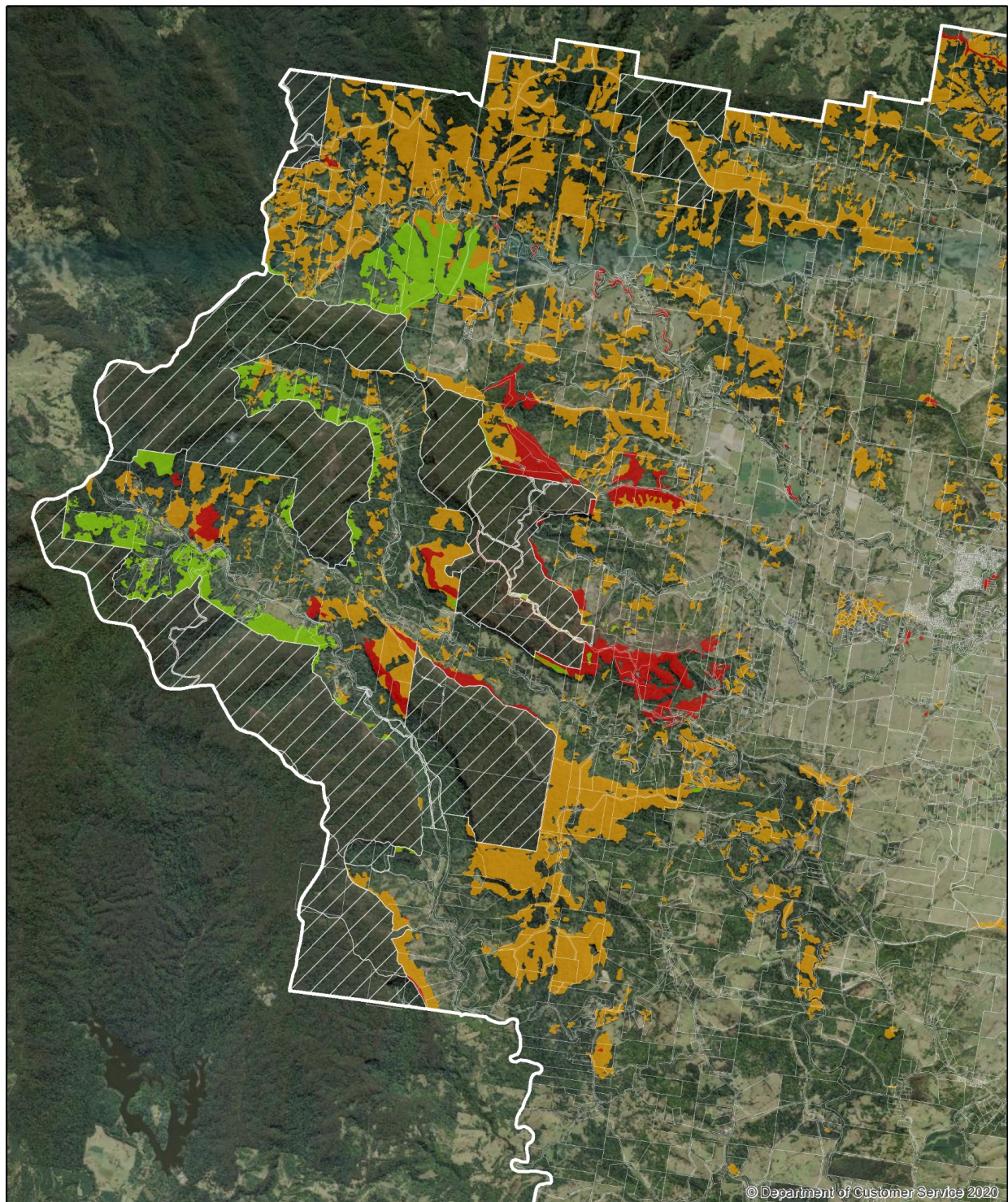
Fire Interval Status - Maps 1A-D

The *Fire Interval Status* maps show a comparison of the time since fire and the ecologically appropriate fire interval for the vegetation type naturally occurring at any particular site. Recommended fire intervals for mapped vegetation formations are given in Appendix A (Table A2). So, areas shown in red as 'overdue for ecological fire' are areas where the time since fire is longer than the recommended fire interval that is needed to maintain the health of the vegetation type occurring at that site. It is important to note that this is not a fuel load or bushfire hazard assessment map. The category 'overdue for ecological fire' does not necessarily indicate that there is an elevated bushfire risk or that hazard reduction burning is necessary. The category 'overdue for ecological fire' indicates that there is a risk of the vegetation at this site becoming degraded and potentially transitioning into a less fire-adapted vegetation type.

Open Ecosystem Restoration Priorities – Maps 2A-D

The *Open Ecosystem Restoration Priorities* maps show the likelihood of sites having open-ecosystems in *good-moderate condition* and therefore where restoring historical ecological fire regimes is likely to yield the greatest conservation impact. Areas shown in red as 'very high' potential are areas which are known or likely to have retained a dense ground layer of grass-like plants, heathy shrubs and/or ferns, which can carry ecological fire, and also benefit and recover quickly following ecological fire. These areas are likely to require minimal restoration intervention other than fire. Conversely, 'low' restoration potential indicates areas that are known or likely to have lost their previously dense ground layer, which makes applying ecological fire more difficult and also reduces the capacity of the ecosystem to recover after fire. These areas are likely to require complex and resource-intensive restoration interventions in addition to fire. The methods for deriving restoration-potential classes are given in Appendix B.





OPEN-ECOSYSTEM RESTORATION PRIORITIES: BYRON SHIRE LGA

Map 1B

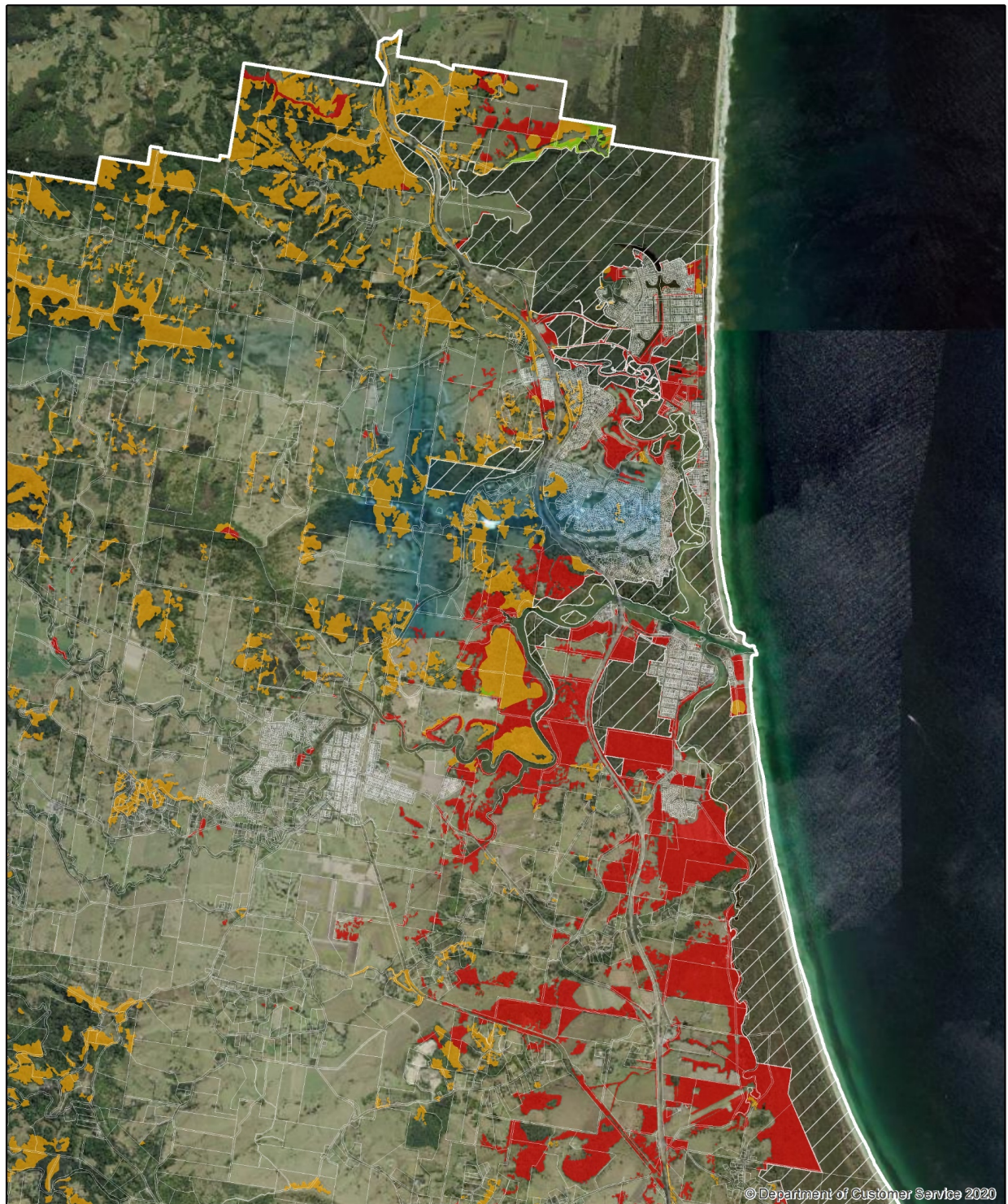
Fire-Interval Status (2023) (Main Arm - Federal)



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OPEN-ECOSYSTEM RESTORATION PRIORITIES: BYRON SHIRE LGA

Map 1C

Fire-Interval Status (2023) (Billinudgel-Tyagarah)



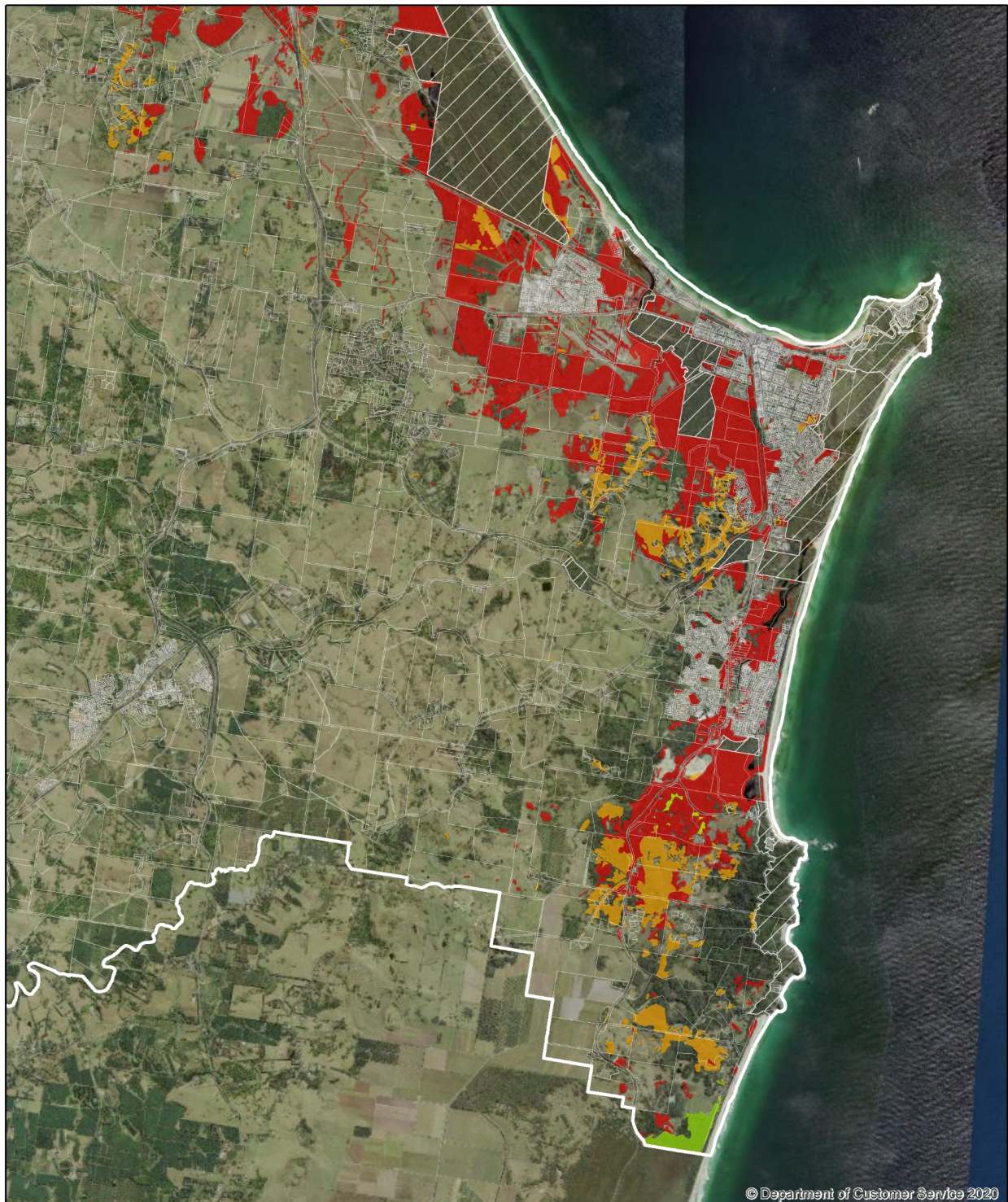
0 2.5 5 Kilometers



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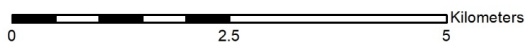
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OPEN-ECOSYSTEM RESTORATION PRIORITIES: BYRON SHIRE LGA

Map 1D

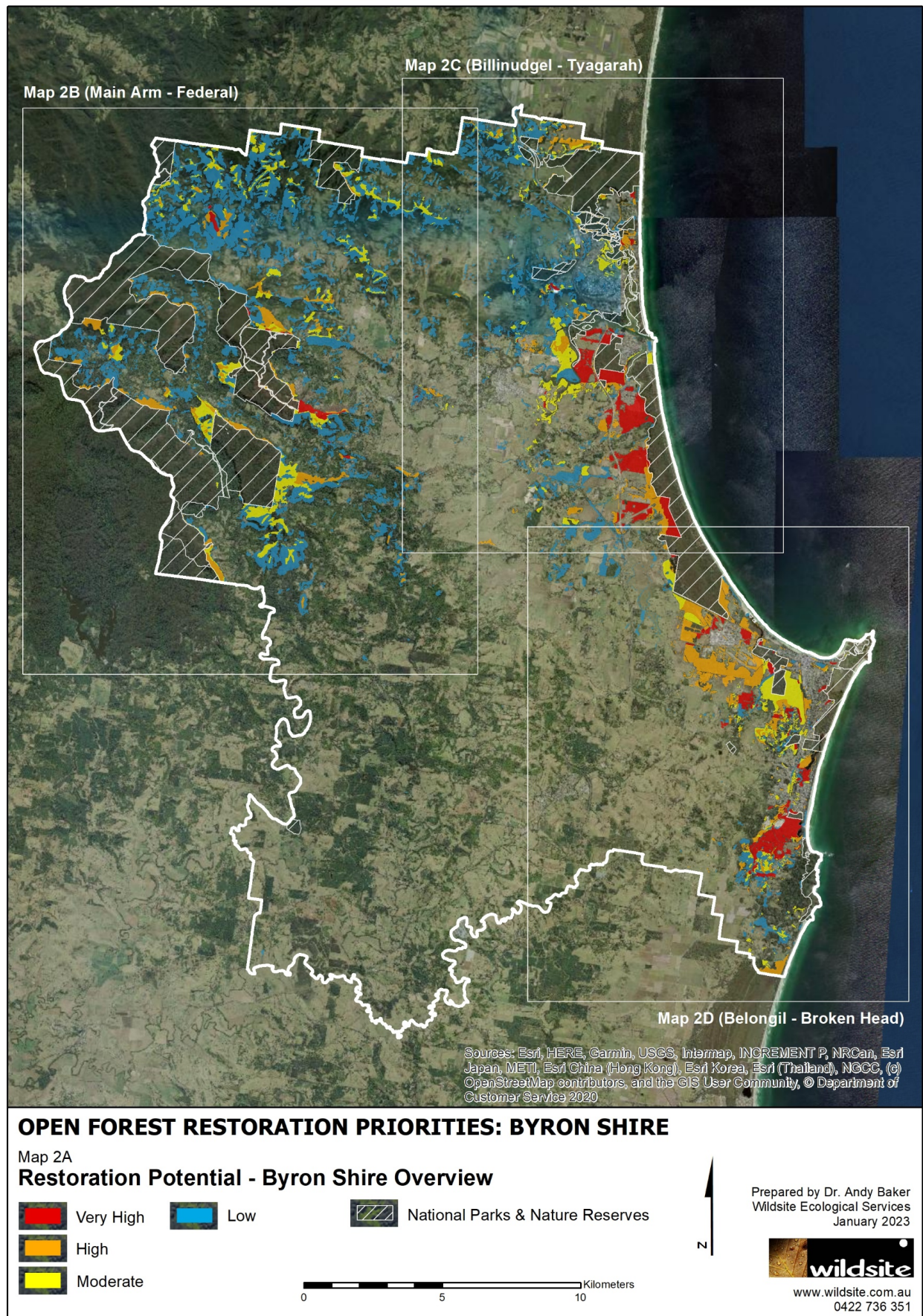
Fire-Interval Status (2023) (Belongil - Broken Head)

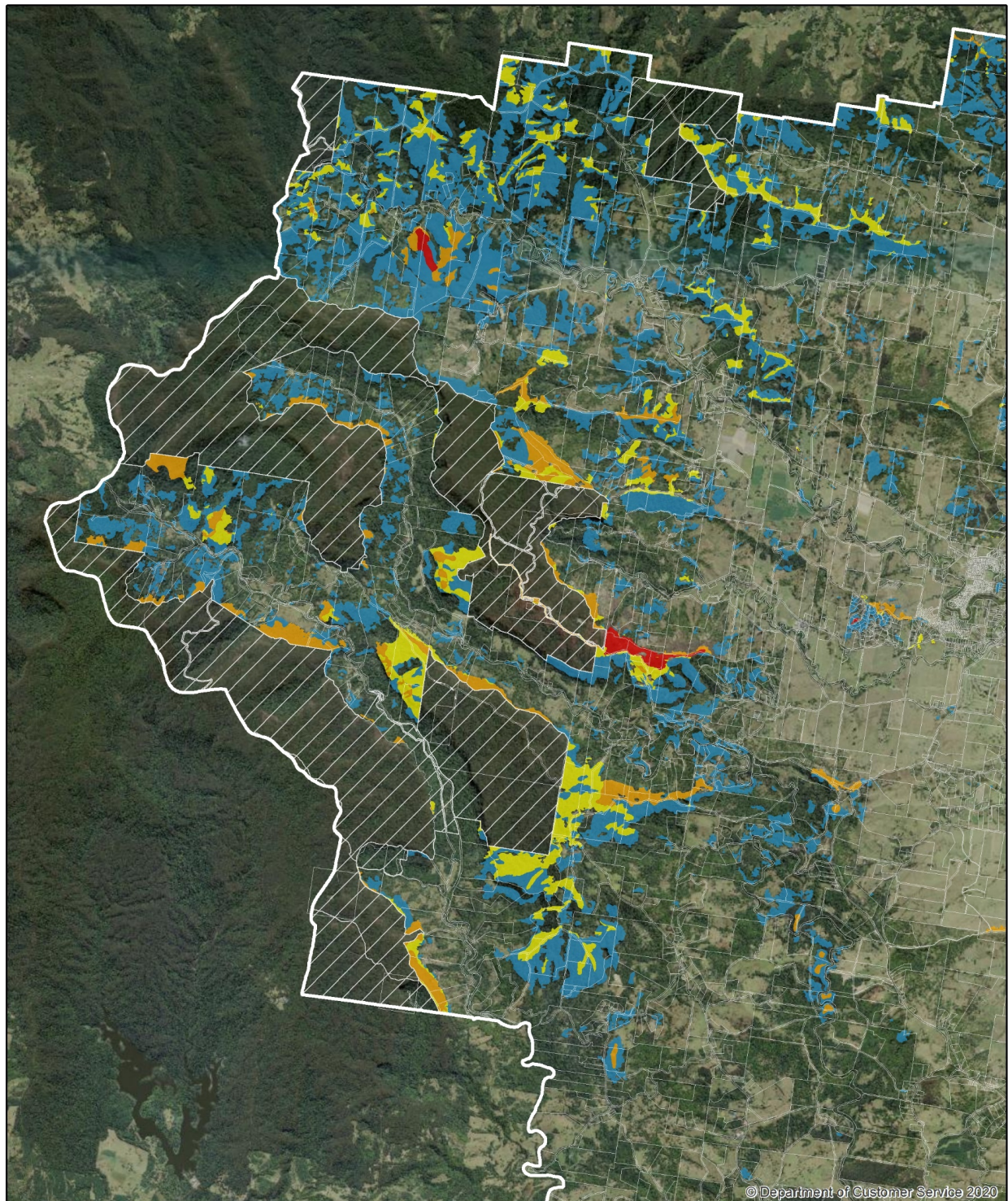


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OPEN-ECOSYSTEM RESTORATION PRIORITIES: BYRON SHIRE LGA

Map 2B

Restoration Potential (Main Arm - Federal)



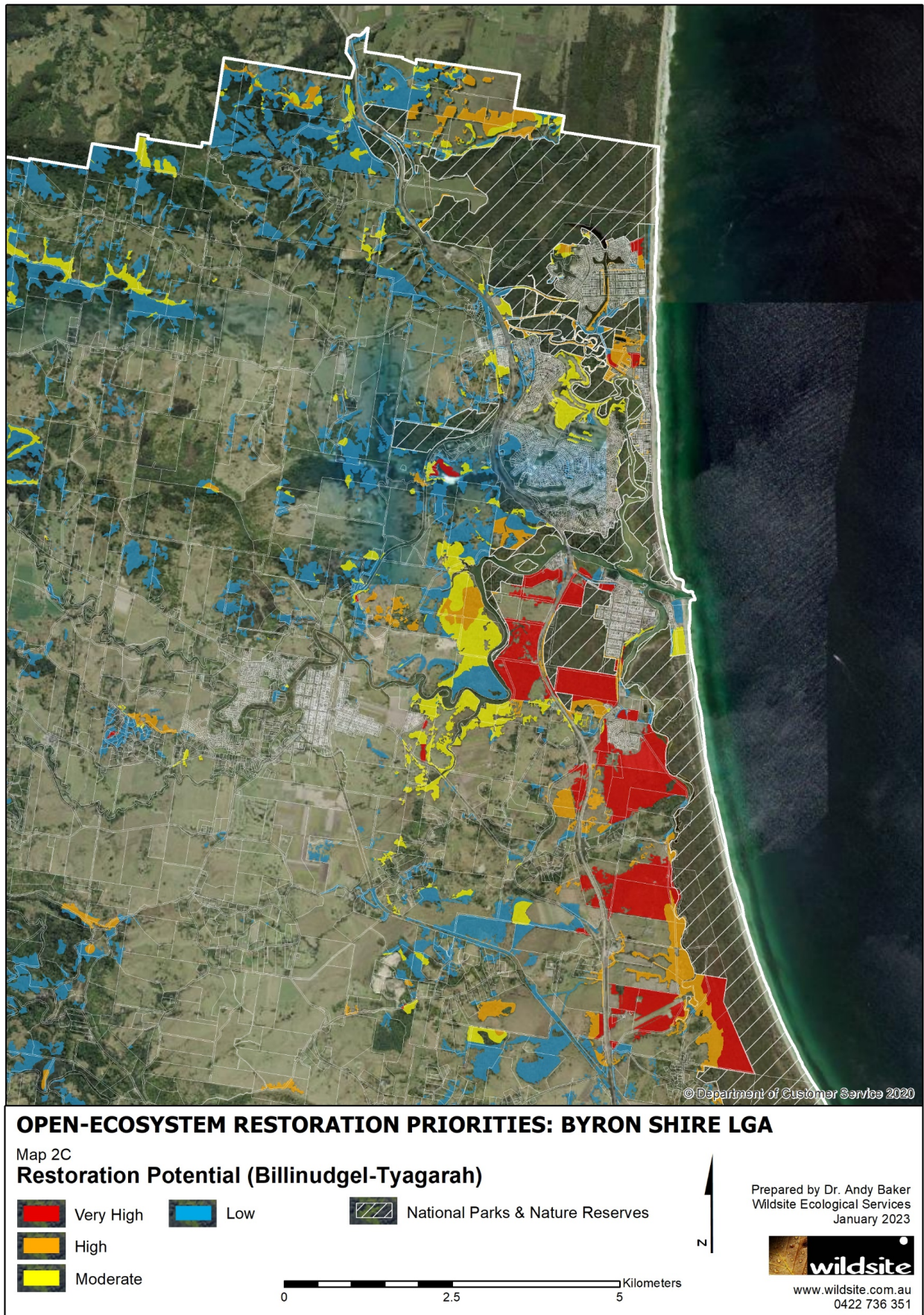
0 2.5 5 Kilometers

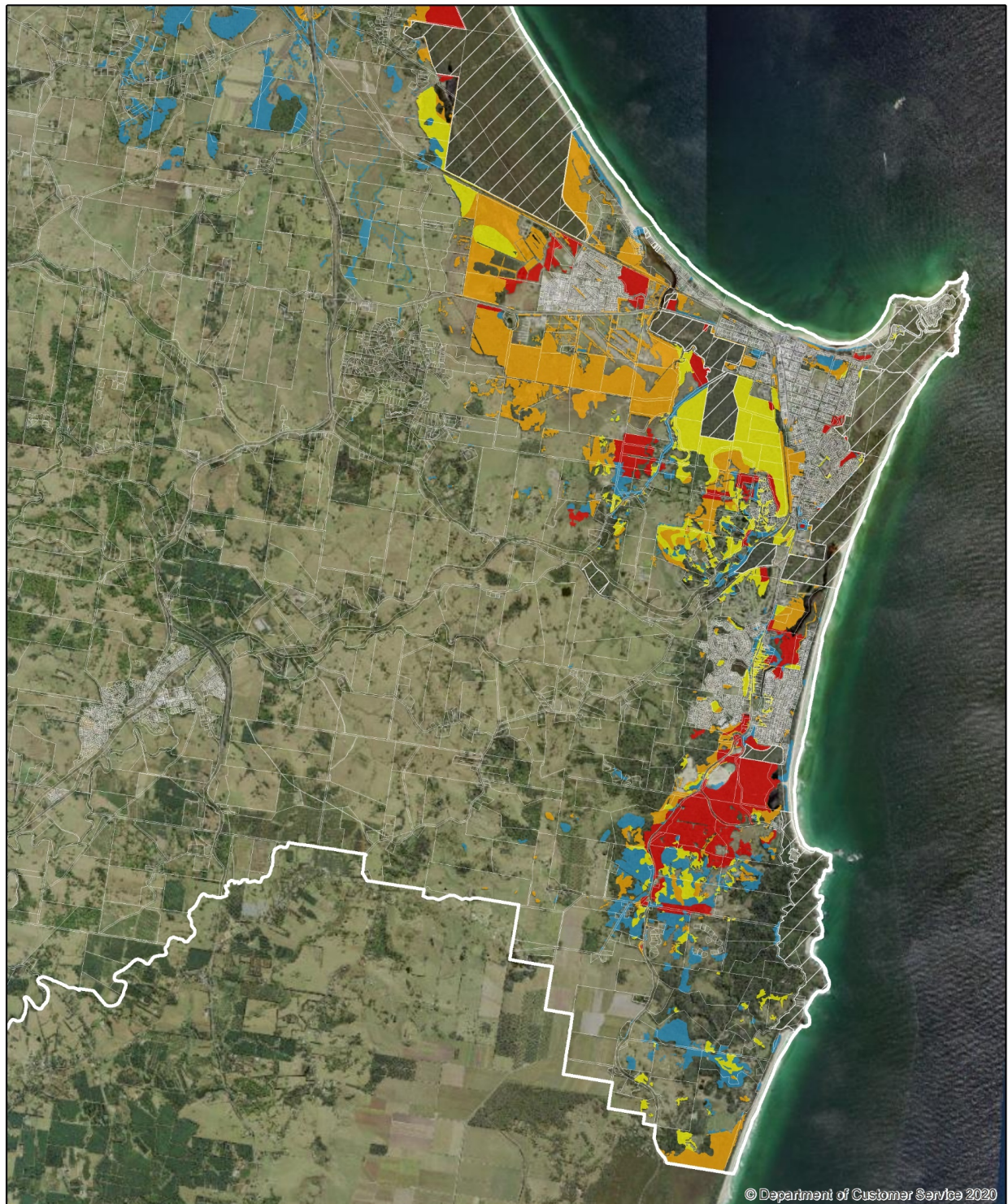


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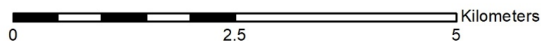




OPEN-ECOSYSTEM RESTORATION PRIORITIES: BYRON SHIRE LGA

Map 2D

Restoration Potential (Belongil - Broken Head)



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4 GUIDELINES FOR USING THE MAPS & REPORT

The restoration of historical fire regimes is a key strategy for the conservation of open-ecosystem biodiversity in Byron Shire⁵². The *Restoration Potential Maps* presented here will help plan and prioritise individual and multi-property fire-restoration projects across private and Council-managed land throughout Byron Shire. The mapping and background information can also be used to support grant applications for multi-property fire restoration projects in the Shire.

4.1 Guidelines for refining restoration priorities during project planning

The Shire-wide *Restoration Potential Maps* presented here only show the likelihood of sites having open-ecosystem areas in *good-moderate condition*. However, restoration priorities should be further refined during project planning by identifying additional complimentary factors relevant to the objectives, scale and location of individual projects (**Table 4**).

Table 4. Additional factors for refining restoration priorities at project planning stage.

Additional Priorities	Rationale	Potential Information Sources
Potential Collaboration with Fire Agencies		
<i>Peri-urban areas within Fire & Rescue NSW precincts</i>	Restoring fire on peri-urban lands may compliment Fire & Rescue NSW (FRNSW) hazard reduction objectives and attract FRNSW support	<ul style="list-style-type: none"> Existing mapping (FRNSW administrative boundaries) Liaising with FRNSW to identify mutual planned burn priorities
<i>NPWS reserves (neighbouring properties)</i>	Restoring fire on lands adjoining NPWS reserves may compliment reserve fire management objectives and attract NPWS support	<ul style="list-style-type: none"> Existing mapping (NPWS estate) Liaising with NPWS to identify mutual planned burn priorities
<i>Rural areas with assets requiring hazard reduction works</i>	Restoring fire on rural lands may compliment Rural Fire Service (RFS) hazard reduction objectives and attract RFS support	<ul style="list-style-type: none"> Identify mutual planned burn priorities through liaison with RFS and review of assets listed/mapped in the <i>Far North Coast Bush Fire Risk Management Plan</i>.
Maximising Ecological Benefit		
<i>Endangered Ecological Communities (Fire-dependent)</i>	Restoring fire to lands supporting EECs can help restore, maintain and protect EEC values. Fire dependent EECs in Byron Shire include: <i>Subtropical Coastal Floodplain Forest, Coastal Cypress Pine Forest, Byron Graminoid Clay Heath, Swamp Oak Floodplain Forest, Swamp Sclerophyll Forest on Coastal Floodplains</i>	<ul style="list-style-type: none"> EEC mapping Site assessment
<i>Key threatened species habitat</i>	Restoring fire to lands supporting key threatened species habitat can help restore, maintain and protect habitat values. For example, it can help prevent wildfire damage and assist recruitment of feed trees (e.g. for Koalas and Glossy Black Cockatoos) and hollow-bearing trees (e.g. for gliders, and owls) ,	<ul style="list-style-type: none"> Habitat mapping Site assessment
<i>Wildlife corridors</i>	Restoring fire to lands within or adjoining wildlife corridors can help to restore, maintain and protect corridor values.	<ul style="list-style-type: none"> Council's corridor mapping
<i>Clustered properties</i>	Restoring fire to multiple properties clustered within the landscape can help	<ul style="list-style-type: none"> Desktop assessment

Additional Priorities	Rationale	Potential Information Sources
	maximise the area and connectivity of restored habitat locally	
<i>Wetlands on peat soils</i>	Restoring fire to wetland areas on peat soils can help: <ul style="list-style-type: none"> • restore, maintain and protect wetland values • prevent peat fires 	<ul style="list-style-type: none"> • Soil and landform mapping
<i>Existing conservation works or agreements</i>	Restoring fire to areas with existing/pledged landowner support for conservation projects, or existing conservation agreements will increase long-term restoration success	<ul style="list-style-type: none"> • Collating landowner/property information from Council, Land Care groups, Biodiversity Conservation Trust etc.
<i>Previous Restoration Assessments</i>	Restoring fire to areas prioritised under previous assessments will increase long-term restoration success	<ul style="list-style-type: none"> • Tweed Byron Bushland Audit database (Bush Futures Audit_v3.mdb) and GIS mapping (mu_byron_22092010)

4.2 Ground-truthing properties for restoration potential

The *Restoration Potential Maps* are based on GIS mapping and limited ground truthing and often only represent the *likelihood* of areas being in good-moderate condition. Final selection of properties for restoration investment should be guided by rapid site assessments of individual properties to confirm actual restoration potential.

Site inspection is needed to confirm:

- if the mapped vegetation formation matches that on the ground
- the extent of vegetation in good-moderate condition
- the degree of weed infestation which will influence the complexity of restoration works

4.3 Seeking funding for restoration projects

In addition to prioritising restoration works, the mapping and background information also provides a valuable resource for Council or other conservation organisations to support project proposals and funding applications for multiple-property projects.

4.4 Implementation

Although beyond the scope of this project, it is recommended that implementation of fire restoration projects generally consider the following:

- Environmental impact assessment (e.g. Review of Environmental Factors) of the whole-project may be more efficient than by individual properties
- Individual property plans should be prepared consistent with the *Good Fire Restoration Plan Template* and *Good Fire Healthy Country*^{116,117}
- On ground burn implementation should use qualified fire practitioners where (e.g. fire agencies, Jagun Alliance, Fireland Consultancy)

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6 APPENDICES

Appendix A. Methods for determining fire-interval status.

Overview of approach

To determine the fire interval status across the study area, GIS analysis compared *modern fire history* and *recommended (historic) fire intervals* for mapped native vegetation.

Preparation of existing fire history and vegetation spatial datasets

FIRE HISTORY DATA

The fire history datasets of the NSW Rural Fire Service (RFS) and the NSW National Parks and Wildlife Service (NPWS) were used as the basis for modern fire history mapping to determine time since last fire across the study area (**Table 1**). The publicly available datasets span all land tenures and were acquired under data usage agreements with the relevant data custodians (i.e. RFS and NPWS). Additional private mapping of recent eco-cultural burns in Broken Head were also used. These datasets were checked for duplicates before being aggregated to form a single layer.

Table A1. Fire history datasets used to determine time since last fire across the study area.

Dataset Name	Custodian	Description
<i>Fire_NPWS_FireHistory_04052022</i>	NPWS	Defines the area of all fires across all tenures as mapped by the NSW NPWS to May 2022.
<i>WildfireHistory</i>	RFS	Defines the final area of fires mapped in the NSW RFS Incident Coordination ONline (ICON) to June 2022. Fire History is derived from incidents mapped by NSW Bush Fire agencies (NPWS, NSW RFS, Fire & Rescue NSW).
<i>HRWorksActualArea</i>	RFS	Mapped area for hazard reduction burns to June 2022.

It is noted that limitations exist within fire history datasets that may cause both over- and underestimation of fire extent, and thus frequency^{118,119}. The datasets used for this study may not include some smaller fires, particularly on private lands, potentially underestimating fire frequency on some sites. Conversely, fire frequency is overestimated where mapped burn areas erroneously include unburnt patches within a larger burn area¹¹⁹, as was confirmed for several large fire events in the study area by analysis of post fire aerial photography.

VEGETATION DATA

Vegetation distribution across the study areas were derived from the Byron Shire Council vegetation mapping dataset (ByronVeg2021_VIS5109), last updated in 2021. Only fire-dependent vegetation formations were used in the analysis, namely *heathlands*, *dry sclerophyll forest*, *forested wetlands* and *wet sclerophyll forest*.

Vegetation types were assigned to one of five *fire vegetation groups* (e.g. Dry Open Forest - Shrubby) adapted from the *Planned Burn Guidelines: Southeast Queensland Bioregion of Queensland* (SEQ Guidelines)¹²⁰ and coded with the corresponding minimum and maximum recommended fire frequency (**Table 2**).

The SEQ Guidelines are regionally-specific guidelines developed for the SEQ bioregion, which includes Byron Shire. The SEQ Guidelines are more appropriate to Byron Shire than the state-wide NSW Guidelines¹²¹, as they account for a) competitive exclusion of understorey plants, b) faunal habitat change during post-fire vegetation succession, and c) regional and local variations in plant growth resources (e.g. rainfall, soil nutrients) which govern the rates of change in a & b above. Policy support for the use of the SEQ Guidelines includes the recommendations by the *NPWS Fire Management*

Manual 2021-22 and the Northern Rivers Biodiversity Management Plan to use regional fire interval guidelines in preference to state-wide guidelines. Similarly, planning guidelines for Bush Fire Management Committees also allow the use of regional guidelines where available.

Table A2. Recommended fire intervals for vegetation formations ¹²⁰.

Vegetation Classes	Recommended Fire Interval (years)
Heathlands (Coastal)*	6 – 12
Dry Sclerophyll Forests	
<i>grassy</i>	1 – 6
<i>shrubby</i>	4 – 10
Swamp Sclerophyll Forest	
<i>grass / shrub</i>	6 – 20
<i>heathy shrub</i>	8 – 12
<i>sedge / fern</i>	12 – 20
Wet Sclerophyll Forest	
<i>grassy</i>	3 – 5
<i>fern / shrub</i>	8 – 20
<i>rainforest</i>	20 – 100
Rainforest	No Fire

*The heathland group includes freshwater wetlands due to similar structure (dense ground layer with abundant graminoids) and landscape position (typically open plains with limited topographical fire protection) and to capture Coastal Heath Swamps *sensu* Keith (2004). Wetlands dominated by *Cumbungi* and *Eleocharis* were removed from the analysis as they are unlikely maintained by fire.

FIRE INTERVAL ANALYSIS

The prepared vegetation and fire history datasets were unioned and clipped to the study area. Fire interval status was calculated as follows:

1. **'Overdue For Fire'** equals all polygons where "*time since fire*" ≥ '*maximum fire interval*'
2. **'Ready For Fire'** equals all polygons where "*time since fire*" < '*maximum fire interval*' AND "*time since fire*" ≥ '*minimum fire interval*'
3. **'Not Ready For Fire'** equals all polygons where "*time since fire*" < '*minimum fire interval*'

However, given that the maximum fire interval for Wet Open Forests (100 yrs) exceeds the period for which fire history is considered reliable (c. 1990; 30 yrs), all polygons were assigned **'Ready For Fire'** where "*time since fire*" < '*minimum fire interval*'.

Appendix B. Methods for restoration-potential modelling

This appendix shows the detailed attribute classification used to develop the restoration-potential model. The overall process and rationale for the modelling is explained in **Section 2.2** in the main report. This appendix contains the following tables:

- **Table B1.** Classification of Plant Community Type (PCT) communities to preliminary restoration potential class (NowForm) in Council's current vegetation mapping dataset (ByronVeg2021_VIS 5109).
- **Table B2.** Classification of Vegetation Communities to preliminary restoration potential class (HISTForm) in Council's historical vegetation dataset (2007_BSC_Veg).
- **Table B3.** Classification of soil landscapes to preliminary restoration potential class (GeoMorand) within in the Soil Landscape datasets of Morand 1994 & 1996.
- **Table B4.** Attribute table calculations from preliminary to final restoration potential classes.

Table B 1. Classification of Plant Community Type (PCT) communities to preliminary restoration potential class (NowForm) in Council's current vegetation mapping dataset (ByronVeg2021_VIS 5109). DSF – dry sclerophyll forest, SSF – Swamp Sclerophyll Forest, WSF – wet sclerophyll forest, NA – Not applicable (relating to freshwater wetland types that are not maintained by fire).

PCT_form	PCT_class	PCT_comm	NowForm
DRY SCLEROPHYLL FORESTS	North Coast Dry Sclerophyll Forests	<i>Dry Blackbutt</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	North Coast Dry Sclerophyll Forests	<i>Tallowood-Small-fruited Grey Gum-Forest Oak dry open forest</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	<i>Tallowood-Blackbutt moist shrubby tall open forest</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	North Coast Dry Sclerophyll Forests	<i>Blackbutt - Turpentine tall moist open forest on sandstone ranges</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>Blackbutt-Scribbly Gum-Satinwood-Tassell Rush open forest of sandy waterlogged soils</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	North Coast Dry Sclerophyll Forests	<i>Swamp Box-Pink Bloodwood+/-Black Sheoak</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>Scribbly Gum-bloodwood heathy open forest on poorly drained sandy soils</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>Pink Bloodwood-Brush Box open forest on coastal dunes and sandplains</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>Coast Banksia woodland and open forest of coastal dunes</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>unassigned</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>Wallum Banksia-Scribbly Gum +/- Coast Cypress Pine</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	North Coast Dry Sclerophyll Forests	<i>Scribbly Gum Shrubby Woodland on Acid Volcanics</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	North Coast Dry Sclerophyll Forests	<i>unassigned</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	<i>Brush Box-Pink Bloodwood-Grey Ironbark-Blackbutt open forest on sandstone and alluvial sediments</i>	DSF HIGH
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>Coast Banksia woodland and open forest of coastal dunes</i>	DSF LOW
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>Coast Cypress Pine with littoral rainforest elements</i>	DSF MOD

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.1 - ATTACHMENT 1

PCT_form	PCT_class	PCT_comm	NowForm
DRY SCLEROPHYLL FORESTS	North Coast Dry Sclerophyll Forests	<i>Coast Cypress shrubby open forest</i>	DSF MOD
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>Coast Banksia woodland and open forest of coastal dunes</i>	DSF MOD
DRY SCLEROPHYLL FORESTS	Coastal Dune Dry Sclerophyll Forests	<i>unassigned</i>	DSF MOD
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>unassigned</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Heath Swamps	<i>unassigned</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Heath Swamps	<i>Red-fruit Saw-sedge-Coral Fern Sedgeland of North Coast Wallum Duneslopes and Open Depressions</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>Tall Saw Sedge sedgeland</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Heath Swamps	<i>Swamp Mahogany-Scribbly Gum-Plume Rush Swamp Sclerophyll Mallee</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Heath Swamps	<i>Tea-tree tall shrubland of coastal freshwater sand swamps</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>Lagoon forbland of permanent wetlands on the coastal floodplains</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>Slender Twine-rush - Pale Cord-rush Sedgeland</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Heath Swamps	<i>Red-fruited Saw-sedge - Olive Tea-tree fernland / sedgeland</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>Giant Sedge sedgeland of frequently inundated areas of sandy alluvium</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>Broad-leaf Cumbungi Rushland</i>	NA
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>Derived sedgelands or saline grasslands of disturbed sites on estuarine plains</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>Eleocharis equisetina freshwater wetland of coastal floodplains, NSW North Coast Bioregion</i>	NA
FRESHWATER WETLANDS	Coastal Freshwater Lagoons	<i>Leafy Twig-rush Sedgeland of North Coast Wallum Swamps and Lakes</i>	FW WETLANDS
FRESHWATER WETLANDS	Coastal Heath Swamps	<i>Fern-leaved Banksia - Spear Grasstree Wet Heathland of North Coast Wallum Swales</i>	FW WETLANDS
HEATHLANDS	Northern Montane Heaths	<i>Teatree</i>	HEATHLANDS HIGH
HEATHLANDS	North Coast Clay Heathlands	<i>Fern-leaved Banksia - Dwarf Heath Casuarina - Midgen Berry - Black Bog-rush graminoid heathland</i>	HEATHLANDS HIGH
HEATHLANDS	Wallum Sand Heaths	<i>Wallum Banksia - Prickly Moses - Caustis recurvata dry heathland on coastal sands</i>	HEATHLANDS HIGH
HEATHLANDS	Wallum Sand Heaths	<i>unassigned</i>	HEATHLANDS HIGH

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.1 - ATTACHMENT 1

PCT_form	PCT_class	PCT_comm	NowForm
HEATHLANDS	North Coast Clay Heathlands	<i>unassigned</i>	HEATHLANDS HIGH
HEATHLANDS	Wallum Sand Heaths	<i>Olive Tea-tree-Knotted Scale-rush-Spreading Rope-rush Wet Heathland</i>	HEATHLANDS HIGH
HEATHLANDS	Wallum Sand Heaths	<i>Coast Wattle shrubland on coastal foredunes</i>	HEATHLANDS LOW
FORESTED WETLANDS	Coastal Swamp Forests	<i>Broad-leaved Paperbark swamp sclerophyll forest with rainforest elements on coastal floodplains</i>	SSF
FORESTED WETLANDS	Coastal Swamp Forests	<i>Broad-leaved Paperbark-Swamp Mahogany-Swamp Box swamp sclerophyll forest on coastal sandsheets</i>	SSF
FORESTED WETLANDS	Coastal Swamp Forests	<i>unassigned</i>	SSF
FORESTED WETLANDS	Coastal Swamp Forests	<i>Swamp Oak - Broad-leaved Paperbark - Willow Bottlebrush floodplain forested wetland</i>	SSF
FORESTED WETLANDS	Coastal Swamp Forests	<i>Swamp Oak forested wetland of saline areas of coastal estuaries</i>	SSF
FORESTED WETLANDS	Coastal Floodplain Wetlands	<i>Broad-leaved Paperbark-Willow Bottlebrush on alluvial floodplains</i>	SSF
FORESTED WETLANDS	Coastal Swamp Forests	<i>Swamp Oak with rainforest elements on coastal floodplains and metasediments</i>	SSF
FORESTED WETLANDS	Coastal Swamp Forests	<i>Broad-leaved Paperbark-Brush Box-Swamp Box swamp sclerophyll forest on clays of coastal plains</i>	SSF
FORESTED WETLANDS	Coastal Swamp Forests	<i>Swamp Box-Red Mahogany-Paperbark transitional swamp forest on floodplain edges</i>	SSF
FORESTED WETLANDS	Coastal Floodplain Wetlands	<i>unassigned</i>	SSF
FORESTED WETLANDS	Coastal Swamp Forests	<i>Swamp Mahogany-tea-tree-Tassell Rush forested wetland of waterlogged wallum soils</i>	SSF
FORESTED WETLANDS	Coastal Floodplain Wetlands	<i>Forest Red Gum tall to very tall moist open forest/rainforest transition on the coastal plain</i>	SSF
FORESTED WETLANDS	Coastal Floodplain Wetlands	<i>Forest Red Gum-Willow Bottlebrush-Broad-leaved Paperbark tall open forest on alluvial floodplains</i>	SSF
FORESTED WETLANDS	Coastal Floodplain Wetlands	<i>Forest Red Gum-Tallowwood-Flooded Gum-Swamp Mahogany-Pink Bloodwood+/- Brush Box on floodplain</i>	SSF
FORESTED WETLANDS	Eastern Riverine Forests	<i>unassigned</i>	SSF
FORESTED WETLANDS	Eastern Riverine Forests	<i>River Oak - Weeping Bottlebrush layered woodland along drainage lines</i>	SSF

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.1 - ATTACHMENT 1

PCT_form	PCT_class	PCT_comm	NowForm
FORESTED WETLANDS	Coastal Swamp Forests	Swamp Oak - Milky Mangrove - Broad-leaved Paperbark king tide forest and woodland	SSF
FORESTED WETLANDS	Coastal Swamp Forests	Broad-leaved Paperbark-Swamp Oak-Tall Sedge swamp forest on alluvial soils	SSF
FORESTED WETLANDS	Coastal Swamp Forests	Swamp Mahogany-Tantoon-Tassell Rush forested wetland of waterlogged sandy soils	SSF
FORESTED WETLANDS	Coastal Swamp Forests	Swamp Oak - Sea Rush swamp forest on saline coastal swamps and flats	SSF
FORESTED WETLANDS	Coastal Swamp Forests	Swamp Box-Forest Red Gum-Pink Bloodwood seasonal swamp forest	SSF
FORESTED WETLANDS	Coastal Swamp Forests	Broad-leaved Paperbark - Bare Twig Rush swamp sclerophyll open forest of coastal swamps	SSF
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	unassigned	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Brush Box-Tallowwood-Pink Bloodwood+/-Flooded Gum shrubby wet open forest	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Tallowwood-Blackbutt moist shrubby tall open forest	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Tallowwood-Brush Box-Flooded Gum on sheltered lower slopes and gullies	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Wattle	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Brush Box moist tall open forest with eucalypt emergents	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Forest Red Gum-Flooded Gum-Pink Bloodwood-Tallowwood+/-Blackbutt, Grey Ironbark, Brush Box	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Blackbutt-Mixed Eucalypt-Brush Box (Moist Blackbutt)	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Flooded Gum moist open forest of lowland coastal floodplains	WSF LOW
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Old growth Blackbutt	WSF LOW
WET SCLEROPHYLL FORESTS			WSF LOW
WET SCLEROPHYLL FORESTS	Subtropical Rainforests	Maidens Blush-Yellow Carabeen-Native Tamarind-Bangalow Palm subtropical rainforest on poor soils	WSF LOW
WET SCLEROPHYLL FORESTS	Northern Hinterland Wet Sclerophyll Forests	(Blackbutt) Pink Bloodwood - Blackbutt - Grey Ironbark shrubby open forest	WSF MOD
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	Brush Box-Pink Bloodwood-Grey Ironbark-Blackbutt open forest on sandstone and alluvial sediments	WSF MOD
WET SCLEROPHYLL FORESTS	North Coast Wet Sclerophyll Forests	(Blackbutt) Turpentine - Brush Box tall open forest on rhyolite	WSF MOD

Table B 2. Classification of Vegetation Communities to preliminary restoration potential class (HISTform) in Council's historical vegetation dataset (2007_BSC_Veg).

VC_DESC	VA_DESC	HISTform
HEATHLAND/SHRUBLAND	Teatree	DSF/HEATH/SEDGE
HEATHLAND/SHRUBLAND	Wallum Banksia-Scribbly Gum	DSF/HEATH/SEDGE
HEATHLAND/SHRUBLAND	Wallum Banksia/Dwarf Banksia/Coast Banksia	DSF/HEATH/SEDGE
HEATHLAND/SHRUBLAND	Bitou Bush-Coastal Wattle-Coast Banksia	null
HEATHLAND/SHRUBLAND	Horsetail Sheoak-Coast Banksia-Bitou Bush	null
HEATHLAND/SHRUBLAND	Coast Banksia	*DSF/HEATH/SEDGE (partial by expert classification)
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Black Sheoak	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Blackbutt	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Cypress Pine	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Eucalyptus spp not specified	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Forest Red Gum	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Grey Ironbark-Pink Bloodwood	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Mixed Eucalyptus spp.	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Pink Bloodwood	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Scribbly Gum	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Scribbly Gum-Red Bloodwood	DSF/HEATH/SEDGE
MOIST TO DRY SCLEROPHYLL FOREST AND WOODLAND	Coast Banksia	*DSF/HEATH/SEDGE (partial by expert classification)
SEDGELAND/FERNLAND/GRASSLAND	Sedgeland/Fernland/Grassland	*DSF/HEATH/SEDGE (partial by expert classification)

* Expert classification split some communities into multiple restoration potential classes. For example 'Coast Banksia' that was highly disturbed or constituted regrowth rainforest was not assigned 'DSF/HEATH/SEDGE'.

Table B 3. Classification of soil landscapes to preliminary restoration potential class (GeoMorand) within in the Soil Landscape datasets of Morand 1994 & 1996.

Soil landscape group	Soil Landscape	GeoMorand
Beach/aeolian	All classes	<i>VERY HIGH</i>
Beach/aeolian	DISTURBED TERRAIN	<i>VERY HIGH</i>
Metasediments (coarse)	BAGOTVILLE variant a	<i>VERY HIGH</i>
Metasediments (coarse)	DISTURBED TERRAIN	<i>VERY HIGH</i>
Metasediments (coarse)	BAGOTVILLE	<i>VERY HIGH</i>
Metasediments (coarse)	KUNGHUR	<i>VERY HIGH</i>
Metasediments (coarse)	BAGOTVILLE variant b	<i>VERY HIGH</i>
Metasediments (fine)	BILLINUDGEL	<i>HIGH</i>
Metasediments (fine)	BURRINGBAR	<i>HIGH</i>
Metasediments (fine)	BURRINGBAR variant a	<i>HIGH</i>
Metasediments (fine)	BILLINUDGEL variant a	<i>HIGH</i>
Metasediments (fine)	OPHIR GLEN	<i>HIGH</i>
Volcanic (rhyolitic)	NIMBIN ROCKS	<i>HIGH</i>
Volcanic (rhyolitic)	NIMBIN ROCKS variant a	<i>HIGH</i>
Volcanic (rhyolitic)	NIMBIN ROCKS variant c	<i>HIGH</i>
Volcanic (rhyolitic)	NIGHTCAP	<i>HIGH</i>
Volcanic (rhyolitic)	MINYON variant d	<i>HIGH</i>
Volcanic (rhyolitic)	MINYON	<i>HIGH</i>
Volcanic (rhyolitic)	FROGS HOLLOW	<i>HIGH</i>
Volcanic (rhyolitic)	MINYON variant c	<i>HIGH</i>
Estuarine	All classes	<i>MODERATE</i>
Swamp	All classes	<i>MODERATE</i>
Alluvial	All classes	<i>LOW</i>
Volcanic (basaltic)	COOLAMON	<i>LOW</i>
Volcanic (basaltic)	MOUNT BURRELL	<i>LOW</i>
Volcanic (basaltic)	CAROL variant b	<i>LOW</i>
Volcanic (basaltic)	BANGALOW	<i>LOW</i>
Volcanic (basaltic)	ROSEBANK	<i>LOW</i>
Volcanic (basaltic)	ROSEBANK variant a	<i>LOW</i>
Volcanic (basaltic)	WOLLONGBAR variant a	<i>LOW</i>
Volcanic (basaltic)	EWINGSDALE	<i>LOW</i>
Volcanic (basaltic)	WOLLONGBAR	<i>LOW</i>
Volcanic (basaltic)	WOLLONGBAR variant b	<i>LOW</i>
Volcanic (basaltic)	DISPUTED PLAIN	<i>LOW</i>
Volcanic (basaltic)	MYOCUM	<i>LOW</i>
Volcanic (basaltic)	DISPUTED PLAIN variant a	<i>LOW</i>

Table B 4. Attribute table calculations from preliminary to final restoration potential classes. NowForm – current mapped vegetation, HISTForm – historical mapped vegetation, GeoMorand – mapped soil landscapes, Expose – exposure, DSF – dry sclerophyll forest, SSF – Swamp Sclerophyll Forest, WSF – wet sclerophyll forest.

No.	Formula	RestoProb
1	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'high' AND "Expose" = 'high'	HIGH
2	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'high' AND "Expose" = 'low' AND "Fire_10yrs" = 'yes'	HIGH
3	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'low' AND "Expose" = 'high' AND "Fire_10yrs" = 'yes'	HIGH
4	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'moderate'	HIGH
5	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'very high'	HIGH
6	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'very high' AND "Expose" = 'high'	HIGH
7	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'very high' AND "Expose" = 'low' AND "Fire_10yrs" = 'yes'	HIGH
8	"NowForm" = 'DSF MOD' AND "GeoMorand" = 'very high' AND "Fire_10yrs" = 'yes'	HIGH
9	"NowForm" = 'FW WETLANDS' AND "GeoMorand" = 'high' AND "Fire_10yrs" = 'yes'	HIGH
10	"NowForm" = 'FW WETLANDS' AND "GeoMorand" = 'moderate' AND "Fire_10yrs" = 'yes'	HIGH
11	"NowForm" = 'FW WETLANDS' AND "GeoMorand" = 'very high'	HIGH
12	"NowForm" = 'HEATHLANDS HIGH'	HIGH
13	"NowForm" = 'SSF' AND "GeoMorand" = 'high' AND "Fire_10yrs" = 'yes'	HIGH
14	"NowForm" = 'SSF' AND "GeoMorand" = 'moderate' AND "Fire_10yrs" = 'yes'	HIGH
15	"NowForm" = 'SSF' AND "GeoMorand" = 'very high'	HIGH
16	"NowForm" = 'SSF' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'high'	HIGH
17	"NowForm" = 'SSF' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'low' AND "Fire_10yrs" = 'yes'	HIGH
18	"NowForm" = 'SSF' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'moderate' AND "Fire_10yrs" = 'yes'	HIGH
19	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'very high' AND "Fire_10yrs" = 'yes'	HIGH
20	"NowForm" = 'WSF MOD' AND "HistForm" = ' ' AND "GeoMorand" = 'very high' AND "Expose" = 'high' AND "Fire_10yrs" = 'yes'	HIGH
21	"NowForm" = 'WSF MOD' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'high' AND "Expose" = 'high' AND "Fire_10yrs" = 'yes'	HIGH
22	"NowForm" = 'WSF MOD' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'moderate' AND "Expose" = 'low' AND "Fire_10yrs" = 'yes'	HIGH
23	"NowForm" = 'WSF MOD' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'very high'	HIGH

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.1 - ATTACHMENT 1

No.	Formula	RestoProb
24	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'high' AND "Expose" = 'high' AND "Fire_10yrs" = 'yes'	HIGH
25	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'very high' AND "Expose" = 'high' AND "Fire_10yrs" = 'yes'	HIGH
26	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'low' AND "Expose" = 'low' AND "Fire_10yrs" = 'no'	LOW
27	"NowForm" = 'DSF LOW'	LOW
28	"NowForm" = 'DSF MOD' AND "GeoMorand" = 'high'	LOW
29	"NowForm" = 'DSF MOD' AND "GeoMorand" = 'low'	LOW
30	"NowForm" = 'DSF MOD' AND "GeoMorand" = 'moderate'	LOW
31	"NowForm" = 'FW WETLANDS' AND "GeoMorand" = 'low'	LOW
32	"NowForm" = 'HEATHLANDS LOW'	LOW
33	"NowForm" = 'SSF' AND "GeoMorand" = 'low'	LOW
34	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'low'	LOW
35	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'moderate'	LOW
36	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'very high'	LOW
37	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'low'	LOW
38	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'moderate'	LOW
39	"NowForm" = 'WSF MOD' AND "HistForm" = ' ' AND "GeoMorand" = 'high' AND "Expose" = 'high'	LOW
40	"NowForm" = 'WSF MOD' AND "HistForm" = ' ' AND "GeoMorand" = 'high' AND "Expose" = 'low'	LOW
41	"NowForm" = 'WSF MOD' AND "HistForm" = ' ' AND "GeoMorand" = 'low'	LOW
42	"NowForm" = 'WSF MOD' AND "HistForm" = ' ' AND "GeoMorand" = 'moderate'	LOW
43	"NowForm" = 'WSF MOD' AND "HistForm" = ' ' AND "GeoMorand" = 'very high' AND "Expose" = 'low'	LOW
44	"NowForm" = 'WSF MOD' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'high' AND "Expose" = 'low'	LOW
45	"NowForm" = 'WSF MOD' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'low'	LOW
46	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'high' AND "Expose" = 'high'	LOW
47	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'high' AND "Expose" = 'low'	LOW
48	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'low' AND "Expose" = 'high'	LOW
49	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'low' AND "Expose" = 'low'	LOW

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.1 - ATTACHMENT 1

No.	Formula	RestoProb
50	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'very high' AND "Expose" = 'high'	LOW
51	"NowForm" = 'WSF LOW' AND "HistForm" = ' ' AND "GeoMorand" = 'very high' AND "Expose" = 'low'	LOW
52	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'high' AND "Expose" = 'low'	LOW
53	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'low' AND "Expose" = 'high'	LOW
54	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'low' AND "Expose" = 'low'	LOW
55	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'very high' AND "Expose" = 'low'	LOW
56	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'high' AND "Expose" = 'low' AND 'Fire_10yrs' = 'no'	MOD
57	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'low' AND "Expose" = 'high' AND 'Fire_10yrs' = 'no'	MOD
58	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'low' AND "Expose" = 'low' AND 'Fire_10yrs' = 'yes'	MOD
59	"NowForm" = 'DSF HIGH' AND "GeoMorand" = 'very high' AND "Expose" = 'low' AND 'Fire_10yrs' = 'no'	MOD
60	"NowForm" = 'DSF MOD' AND "GeoMorand" = 'very high' AND 'Fire_10yrs' = 'no'	MOD
61	"NowForm" = 'FW WETLANDS' AND "GeoMorand" = 'high' AND 'Fire_10yrs' = 'no'	MOD
62	"NowForm" = 'FW WETLANDS' AND "GeoMorand" = 'moderate' AND 'Fire_10yrs' = 'no'	MOD
63	"NowForm" = 'SSF' AND "GeoMorand" = 'high' AND 'Fire_10yrs' = 'no'	MOD
64	"NowForm" = 'SSF' AND "GeoMorand" = 'moderate' AND 'Fire_10yrs' = 'no'	MOD
65	"NowForm" = 'SSF' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'low' AND 'Fire_10yrs' = 'no'	MOD
66	"NowForm" = 'SSF' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'moderate' AND 'Fire_10yrs' = 'no'	MOD
67	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'very high' AND 'Fire_10yrs' = 'no'	MOD
68	"NowForm" = 'WSF MOD' AND "HistForm" = ' ' AND "GeoMorand" = 'very high' AND "Expose" = 'high' AND 'Fire_10yrs' = 'no'	MOD
69	"NowForm" = 'WSF MOD' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'high' AND "Expose" = 'high' AND 'Fire_10yrs' = 'no'	MOD
70	"NowForm" = 'WSF MOD' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'moderate' AND "Expose" = 'high'	MOD
71	"NowForm" = 'WSF MOD' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'moderate' AND "Expose" = 'low' AND 'Fire_10yrs' = 'no'	MOD
72	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'high' AND "Expose" = 'high' AND 'Fire_10yrs' = 'no'	MOD
73	"NowForm" = 'WSF LOW' AND "HistForm" = 'DSF/HEATH/SEDGE' AND "GeoMorand" = 'very high' AND "Expose" = 'high' AND 'Fire_10yrs' = 'no'	MOD

Report No. 4.2 **Update on Work Carried Out by Byron Council's Bush Regeneration Team**

Directorate: Sustainable Environment and Economy

Report Author: Lizabeth Caddick, Biodiversity Officer

5 **File No:** I2023/1335

Summary:

Biodiversity Advisory Committee members recently requested further information from staff regarding management and monitoring occurring at various Council sites that contain threatened species habitat.

10 Further to the information provided to the committee at the 17 August Biodiversity Committee Advisory Meeting, Bush Regeneration team leader, Dave Filipczyk, will present an update on the current work carried out by Council's Bush Regeneration team.

15

RECOMMENDATION:

That the Biodiversity Advisory Committee notes the report and presentation on work carried out by Council's bush regen team.

20 **Attachments:**

- 1 Report 17/08/2023 Biodiversity Advisory Committee Future Discussion Items for Biodiversity Advisory Committee, I2023/624 , page 73 [↓](#) 

25

Report

Biodiversity Advisory Committee members recently requested further information from staff regarding management and monitoring occurring at various Council sites that contain threatened species habitat.

- 5 Further to the information provided to the committee at the 17 August Biodiversity Committee Advisory Meeting (Attachment 1), Bush Regeneration team leader, Dave Filipczyk, will present an update on the current work carried out by Council's Bush Regeneration team, in particular:
- Restoration work being carried out at Council wastewater treatment facilities.
- 10 • Restoration work at the Lilli Pilli biobanking site.

Strategic Considerations

Community Strategic Plan and Operational Plan

CSP Objective	CSP Strategy	DP Action	Code	OP Activity
3: Nurtured Environment We nurture and enhance the natural environment	3.1: Partner to nurture and enhance our biodiversity, ecosystems, and ecology	3.1.3: Habitat restoration - Restore degraded areas that provide high environmental or community value	3.1.3.6	Undertake bush regeneration activities to maintain and expand restoration of HEV sites on Council owned or managed lands forming part of the Council bush regeneration program

15 Recent Resolutions

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.2

BIODIVERSITY ADVISORY COMMITTEE MEETING MINUTES

17 AUGUST 2023

Report No. 4.3 **Future Discussion Items for Biodiversity Advisory Committee**
File No: **I2023/624**

Committee Recommendation:

- 1. That the Biodiversity Advisory Committee notes the report.**
- 2. That the Biodiversity Advisory Committee invites David Milledge to provide comments on item 4.3 from the August meeting for discussion at a future meeting.**
- 3. That the Biodiversity Advisory Committee seeks a follow up response to item 4.2 from the April meeting agenda.**

(Ndiaye/Westheimer)

The recommendation was put to the vote and declared carried.

Legal/Statutory/Policy Considerations

N/A

5 Financial Considerations

N/A

Consultation and Engagement

N/A

10

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

Report No. 4.3 Future Discussion Items for Biodiversity Advisory Committee

Directorate: Sustainable Environment and Economy

Report Author: Lizabeth Caddick, Biodiversity Officer

5 **File No:** I2023/624

Summary:

10 This report summarises reports and information requested by the Biodiversity Advisory Committee. These requests, resourcing and alignment with Council's Operational Plan are tabled for discussion by the committee, to resolve whether these requests are taken to Council for consideration for inclusion in a future Council OP and budget.

RECOMMENDATION:

15 **That the Biodiversity Advisory Committee notes the report.**

Attachments:

- 1 Attachment 1 - Threatened Species Monitoring on Council Land - 17 Aug 2023, E2023/78469
- 20 2 Lilly Pilly - Biobanking Agreement - SITE action plan_ Lilly Pilly BBA_final 6 March 2020, E2023/40251
- 3 Lilly Pilly - Biobanking Agreement - BA 352 Annual report and BCT Audit Template - Yr 3 - 27 June 2021 to 27 June 2022, E2023/40252
- 4 Lilly Pilly - Biobanking Agreement - BA352 Active audit letter - Yr 3 Sep 2022 - payment released AMP4, E2023/40253
- 25 5 Lilly Pilly - Biobanking Agreement - BA 352 - site inspection & photopoint monitoring templates, E2023/40254
- 6 Lilly Pilly - Biobanking Agreement - Active agreement letter - Yr 1 Aug 2019 - BSA 352, E2023/40255
- 30 7 Lilly Pilly - Biobanking Agreement - BA 352 Annual Report and BCT Audit Template - Yr 2 - 27 June 2020 to 27 June 2021 - unsigned, E2023/40258
- 8 Lilly Pilly - Biobanking Agreement - BA 352_Lilli Pilli BioBanking Agreement final version, E2023/40259
- 9 Lilly Pilly - Biobanking Agreement - BA 352 Annual Report audit letter - Yr 2 - 27 June 2020 to 27 June 2021
- 35 - payment released, E2023/40260
- 10 Lilly Pilly - Biobanking Agreement - Supplementary Reports combined_Year 2 - July 2021, E2023/40261
- 40 11 Lilly Pilly - Biobanking Agreement - Lilli Pilli Photo Monitoring, E2023/40263

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

Report

The following requests for reports or information have been received by Biodiversity Advisory Committee members:

Information requested	Resourcing	Operational Plan & other Council Strategies
<p>Council lands being managed for Biodiversity.</p> <p>Which threatened communities and/or species are being managed in each of the Council-managed areas listed below and is management and monitoring revealing any positive outcomes?</p> <p>i) sections of West Byron STP including Cell H and areas of forest, woodland and shrubland in the NW part of the site,</p> <p>ii) Valances Road STP including (?) land linking to the Ocean Shores STP,</p> <p>iii) land to the east of Lilli Pilli Drive,</p> <p>iv) land to the east of the Byron Bypass, and</p> <p>v) an informal flora reserve adjacent to the southern boundary of Brunswick Heads Nature Reserve off</p>	<p>Note: not all of the sites requested are managed by Council:</p> <ul style="list-style-type: none"> - Council does not manage any land linking Vallances Rd STP with Ocean Shores STP. - Land to the east of the Byron Bypass (Lot 2 DP1289363) is owned by the Transport Asset Holding Entity of NSW. - The informal flora reserve adjacent to the southern boundary of Brunswick Heads Nature Reserve off Bashforth Trail (Lot 58 DP755692) is owned by Tweed Byron Local Aboriginal Land Council. <p>Attachment 1 gives a summary of current Council maintenance and monitoring actions at:</p> <ul style="list-style-type: none"> i) West Byron STP ii) Valances Road STP iii) land to the east of Lilli Pilli Drive iv) land to the east of the Byron Bypass <p>As per the information below it is recommended that:</p> <ul style="list-style-type: none"> a) For STP sites BAC members can review the Biodiversity Management Plan when the draft is available later in the year. 	<p>There is no activity in Council's OP that directly resources this action.</p> <p>The following OP action provides indirect support:</p> <p>OP 3.1.3.6 Undertake bush regeneration activities to maintain and expand restoration of HEV sites on Council owned or managed lands forming part of the Council bush regeneration program.</p> <p>Council is currently developing a Biodiversity Management Plan for West Byron STP that will guide future threatened species monitoring and reporting at this site.</p>

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

Information requested	Resourcing	Operational Plan & other Council Strategies
<p>Bashforth Trail.</p> <p>It would be valuable for Council and the community generally to know that areas of Council land are being managed for the conservation of particular threatened communities and species. Public dissemination of this information could have positive benefits for Council in promoting a favourable public image, particularly in light of Byron Shire's location at the centre of one of the most biodiverse regions in Australia and its significance for maintaining refugial populations of many species with Gondwanan lineages.</p> <p>Requested by: David Milledge & Peter Westheimer 18/4/2023</p>	<p>b) For Biobanking sites (Lilli Pilli drive), BAC members can review the attached monitoring reports if these are of interest.</p> <p>In addition, Dave Filipczyk, bush regen team leader, is happy to present his restoration data to a future BAC meeting or show members some of the results on-site.</p> <p>Note also, as per Biodiversity Conservation Strategy Action 1.11, updated threatened species lists for Byron Shire have recently been added to Council's website Threatened species of plants and animals in Byron Shire - Byron Shire Council (nsw.gov.au)</p>	

Strategic Considerations

Community Strategic Plan and Operational Plan

CSP Objective	CSP Strategy	DP Action	Code	OP Activity
3: Nurtured Environment	3.1: Partner to nurture and	3.1.3: Habitat restoration -	3.1.3.6	Undertake bush regeneration activities

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.2 - ATTACHMENT 1

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

We nurture and enhance the natural environment	enhance our biodiversity, ecosystems, and ecology	Restore degraded areas that provide high environmental or community value		to maintain and expand restoration of HEV sites on Council owned or managed lands forming part of the Council bush regeneration program
3: Nurtured Environment We nurture and enhance the natural environment	3.2: Deliver initiatives and education programs to encourage protection of our environment	3.2.3: Planning - Plan to improve the quality of the natural environment	3.2.3.1	Update flora and fauna lists for the shire, including status of threatened flora and fauna.

Recent Resolutions

N/A

Legal/Statutory/Policy Considerations

5 N/A

Financial Considerations

No detailed costings for requested items provided at this stage.

Consultation and Engagement

N/A

Report No. 4.3 Future Discussion Items for Biodiversity Advisory Committee

Directorate: Sustainable Environment and Economy

Report Author: Lizabeth Caddick, Biodiversity Officer

5 **File No:** I2023/1336


Summary:

10 This report summarises reports and information requested by the Biodiversity Advisory Committee. These requests, resourcing and alignment with Council's Operational Plan are tabled for discussion by the committee, to resolve whether these requests are taken to Council for consideration for inclusion in a future Council OP and budget.

RECOMMENDATION:

15 **That the Biodiversity Advisory Committee notes the report.**

Attachments:

20 1 Biodiversity Advisory Committee - ECOHEALTH MONITORING PROGRAM Info Request - Leonard Cronin - Staff Response - 1/9/23, E2023/90997 , page 87 [↓](#) 

Report

At the 17 August Biodiversity Advisory Committee meeting, the committee sought a follow up response to the following items that were discussed at the 20 April Biodiversity Advisory Committee meeting:

Information requested	Resourcing	Operational Plan & other Council Strategies
<p>The health of our Shire's biodiversity is significantly impacted by the condition of our waterways. The 2014 Ecohealth Report Card for the Richmond River gave the catchment a D+ rating (gradings A through F).</p> <p>Do we have recent ecohealth data for our waterways?</p> <p>Requested by: Leonard Cronin</p>	<p>Attachment 1 provides a summary of current known environmental and water quality monitoring occurring in Byron Shire.</p> <p>As per this report, there is currently no funding to implement an Ecohealth program in the Brunswick Estuary, as the 2018 CZMP was not certified by the Minister. Due to the enactment of the NSW Coastal Management Framework in 2018, Council is now required to prepare Coastal Management Programs (CMPs) for its coastline. Council is now required to prepare Coastal Management Programs (CMPs) for its coastline.</p> <p>Council will continue to support and implement (as required) the other water quality monitoring programs described in the attached report.</p>	<p>There is no activity in Council's OP that directly resources this action.</p> <p>The following actions provide indirect support:</p> <p>OP 3.3.1.11 Participate in the preparation of a Coastal Management Program (CMP) for the Richmond River</p> <p>OP 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</p> <p>OP 3.3.1.3 Identify pollution sources and plan to improve water quality in Byron Shire's intermittently closed and open lakes and lagoons (ICOLLs)</p> <p>OP 3.2.2.2 Provide coastal and biodiversity information and encourage and support community activities and groups</p>
<p>What programs exist to improve the biodiversity of our waterways and</p>	<p>Council already delivers a range of riparian restoration projects through the Biodiversity and Agriculture Team and</p>	<p>There are several OP actions that already support this aim:</p> <p>OP 3.1.3.4 Investigate grant opportunities for improving</p>

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

Information requested	Resourcing	Operational Plan & other Council Strategies
<p>riparian degradation?</p> <p>Requested by: Leonard Cronin</p>	<p>Restorations Team.</p> <p>Updates to the Committee on these projects are provided at each Committee meeting.</p> <p>The Key Issues section below lists current projects.</p>	<p>the Brunswick Estuary ecosystems and river health.</p> <p>OP 3.1.3.5 Deliver Federal Fish Habitat Restoration Project.</p> <p>OP 3.1.3.6 Undertake bush regeneration activities to maintain and expand restoration of HEV sites on Council owned or managed lands forming part of the Council bush regeneration program.</p> <p>OP 3.2.2.1 Support Brunswick Valley Landcare to deliver the Land for Wildlife Program and biodiversity enquiries.</p> <p>OP 3.3.1.11 Participate in the preparation of a Coastal Management Program (CMP) for the Richmond River.</p>
<p>Can we implement ways to deal with: Unfenced cattle damaging riverbanks and waterways and High levels of nutrients derived from agricultural runoff.</p> <p>Requested by: Leonard Cronin</p>	<p>Council already provides support to farmers on this through Council's Sustainable Agriculture Program, which includes community engagement, workshops, mail outs and one on one farmer site visits.</p> <p>There are no laws that require farmers to fence off their creeks. Education and incentive funding have had the best results by teaching the landholders the benefit of riparian fencing/ rehabilitation and incentive funds assist them to fence off the waterways and water their</p>	<p>There are several OP actions that already support this aim:</p> <p>OP 4.3.5.1 Maintain and update Byron Shire Farmer database.</p> <p>OP 4.3.5.2 Provide extension services to farmers to support and promote sustainable agriculture.</p> <p>OP 4.3.5.3 Deliver farmer mentoring and farmer education activities.</p>

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

Information requested	Resourcing	Operational Plan & other Council Strategies
	<p>stock.</p> <p>The Biodiversity/ Agriculture program supports and promotes Regenerative Agriculture which supports the retention of groundcover and the reduction of fertilizer and other chemical use. This greatly reduces soil and nutrient/chemical runoff into the waterways.</p> <p>Currently, 360 members of the Byron Farmer Network are interested in commencing or already practicing Regenerative Agriculture over a number of farming types, predominantly grazing and macadamias.</p>	
<p>Can we implement ways to deal with: Sewage discharge in flood events?</p> <p>Requested by: Leonard Cronin</p>	<p>As part of the development of Coastal Management Programs for Belongil and Tallow Creeks, a recent study identifies and prioritises water quality pollutant sources for each ICOLL and provides potential management options to address water quality threats.</p> <p>As part of the study a review of Council's sewer overflow incident reporting from the last six years (2016 to 2022) was completed. Sewer overflow incidents represent a short-term but potentially high impact point source of pollutants to stormwater drains and downstream receiving environments. Interestingly, the Byron Bay STP had no major issues during the 2022 Flood event, however there was one</p>	<p>There are several OP actions that already support this aim:</p> <p>OP 5.5.2.13 Review Strategic Business Plan / Integrated Water Cycle Management Strategy</p> <p>OP 3.3.1.3 Identify pollution sources and plan to improve water quality in Byron Shire's intermittently closed and open lakes and lagoons (ICOLLs)</p>

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

Information requested	Resourcing	Operational Plan & other Council Strategies
	<p>incident noted with relevance to the Tallow Creek catchment.</p> <p>It is currently unknown whether sewer overflow incidents are contributing to poor stormwater quality. As such, a recommended management action in the study is to undertake microbial source tracking, which uses DNA analysis to identify sources of faecal contamination (i.e. human vs. dog vs. other animal sources). This would provide further information and assist in directing management action. Other actions recommended are to monitor and maintain sewage infrastructure. The study is being reported to Council on the 28 September for adoption and will be put on Council's CMP webpage: Coastal Management Program Southern Coastline including Estuaries - Byron Shire Council (nsw.gov.au).</p> <p>Council is also currently preparing an Integrated Water Cycle Management Strategy (IWCM) and the issue of sewage system performance and overflow frequency is being addressed through that process. This project is being led by Infrastructure Services with updates provided to the Water and Sewer Committee.</p>	

Key issues

Recent Council waterway health improvement projects

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

- Council and community riparian restoration projects to date have been mapped.
- The Council Bush Regeneration team have a strong focus on waterway restoration, e.g. along the Brunswick River (Figure 1).
- 5 • NSW Fisheries habitat Action Grant (max \$40k) riverbank rehabilitation project – Bringing Back the Bruns. Riparian rehabilitation by bush regeneration and some revegetation along 1.8km of Brunswick riverbank in Mullumbimby (approx. 3ha), on the left bank, downstream from the showground to Riverside drive.
- 10 • Flying-fox habitat improvement. Approx 450m of riparian rehabilitation. 250m along the Brunswick River left bank opposite Brunswick Terrace and along Mullumbimby Ck at River Terrace Mullumbimby.
- Flying-fox habitat improvement. Approx 150m of Paddys Ck in Bangalow. Riparian zone both sides regenerated and 600 plants added to riparian zone.
- Flying-fox habitat improvement. Approx 80m of Yoga Bera Ck in Mullumbimby. Riparian zone stabilised and revegetated. 400 plants.
- 15 • Flood rehabilitation – approx. 500m bed and banks of Upper Coopers Ck in Huonbrook re-modelled and rehabilitated following 2022 floods. This was carried out along with the rebuilding of the road adjacent to the creek.
- Bringing Back the Bruns project with North Coast Local Land Services (NCLLS). 160m of riverbank stabilisation and rehabilitation/revegetation on right bank of the Bruns R in Mullumbimby just upstream of the Mullumbimby Giants Rugby Club.
- 20 • Promotion and support of Regenerative Agriculture by the Biodiversity/Agriculture team teaches the benefits of riparian rehabilitation and protection. Agriculture incentive funds contribute towards fencing for rotational grazing which can be used to fence off riparian zones.
- 25 • Limited NCLLS funds are available for targeted riparian rehabilitation projects in the Richmond and the Brunswick catchments.

Figure 1. Byron Shire Council riparian restoration projects along the Brunswick River.



Strategic Considerations

Community Strategic Plan and Operational Plan

CSP Objective	CSP Strategy	DP Action	Code	OP Activity
3: Nurtured Environment We nurture and enhance the natural environment	3.1: Partner to nurture and enhance our biodiversity, ecosystems, and ecology	3.1.3: Habitat restoration - Restore degraded areas that provide high environmental or community value	3.1.3.1	Update Byron Shire habitat restoration database and DPE Koala Habitat Restoration Archive.
3: Nurtured Environment We nurture and enhance the natural environment	3.1: Partner to nurture and enhance our biodiversity, ecosystems, and ecology	3.1.3: Habitat restoration - Restore degraded areas that provide high environmental or community value	3.1.3.4	Investigate grant opportunities for improving the Brunswick Estuary ecosystems and river health.

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

3: Nurtured Environment We nurture and enhance the natural environment	3.1: Partner to nurture and enhance our biodiversity, ecosystems, and ecology	3.1.3: Habitat restoration - Restore degraded areas that provide high environmental or community value	3.1.3.5	Deliver Federal Fish Habitat Restoration Project
3: Nurtured Environment We nurture and enhance the natural environment	3.1: Partner to nurture and enhance our biodiversity, ecosystems, and ecology	3.1.3: Habitat restoration - Restore degraded areas that provide high environmental or community value	3.1.3.6	Undertake bush regeneration activities to maintain and expand restoration of HEV sites on Council owned or managed lands forming part of the Council bush regeneration program
3: Nurtured Environment We nurture and enhance the natural environment	3.2: Deliver initiatives and education programs to encourage protection of our environment	3.2.2: Environmental education and awareness - Coordinate and support environmental education to the community	3.2.2.1	Support Brunswick Valley Landcare to deliver the Land for Wildlife Program and biodiversity enquiries.
3: Nurtured Environment We nurture and enhance the natural environment	3.3: Protect the health of our coastline, estuaries, waterways, and catchments	3.3.1: Coastal Management Program planning and implementation - Undertake Coastal Management Program planning and implementation	3.3.1.3	Identify ICOLL water quality pollution sources

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

3: Nurtured Environment We nurture and enhance the natural environment	3.3: Protect the health of our coastline, estuaries, waterways, and catchments	3.3.1: Coastal Management Program planning and implementation - Undertake Coastal Management Program planning and implementation	3.3.1.11	Participate in the preparation of a Coastal Management Program (CMP) for the Richmond River.
4: Ethical Growth We manage growth and change responsibly	4.3: Promote and support our local economy	4.3.5: Regenerative agriculture - Develop and implement strategies to support regenerative agriculture, agri-business and farmers	4.3.5.1	Maintain and update Byron Shire Farmer database.
4: Ethical Growth We manage growth and change responsibly	4.3: Promote and support our local economy	4.3.5: Regenerative agriculture - Develop and implement strategies to support regenerative agriculture, agri-business and farmers	4.3.5.2	Provide extension services to farmers to support and promote sustainable agriculture.
4: Ethical Growth We manage growth and change responsibly	4.3: Promote and support our local economy	4.3.5: Regenerative agriculture - Develop and implement strategies to support regenerative agriculture, agri-business	4.3.5.3	Deliver farmer mentoring and farmer education activities.

BYRON SHIRE COUNCIL

STAFF REPORTS - SUSTAINABLE ENVIRONMENT AND ECONOMY

4.3

		and farmers		
5: Connected Infrastructure We have connected infrastructure, transport, and facilities that are safe, accessible, and reliable	5.1: Provide a safe, reliable, and accessible transport network	5.1.1: Road network maintenance - Undertake road and transport network maintenance to meet the standards identified in the Asset Management Plan	5.1.1.8	Undertake urban roadside tree maintenance for dead, dying, and dangerous trees

Recent Resolutions

N/A

Legal/Statutory/Policy Considerations

5 N/A

Financial Considerations

No detailed costings for requested items provided at this stage.

Consultation and Engagement

N/A

10



Environmental/Ecohealth Monitoring and WQ Programs, Byron Shire

Information request - Biodiversity Advisory Committee

This document provides a brief overview of environmental/ecohealth and water quality monitoring and programs undertaken in Byron Shire known to staff. This overview was prepared by Council's Coast and Estuary Team.

MONITORING PROGRAMS

Byron Shire Council Monitoring Programs

Council undertakes a lot of different water quality programs and data collection for the Brunswick Estuary and the ICOLLs (excluding Ti-Tree). The collection of data depends on the nature of the issue or, if tied to a Council activity (such as ICOLL entrance management) it is usually based on authority approval conditions.

As a brief outline, monitoring and programs include (but are not limited to):

1. Surface Water Quality Monitoring Program - physical surface water quality parameters are monitored monthly at selected sites throughout the Shire. Parameters being monitored include turbidity, pH, conductivity, Enterococci & E.coli, suspended solids and nutrients. Data is available on Council's website at - [SURFACE WATER QUALITY | Byron Data SGA \(sgautomation.com.au\)](https://www.byron.nsw.gov.au/SGA/SurfaceWaterQuality).
2. Event-based water quality monitoring before and after ICOLL opening events for Tallow and Belongil Creek – physical surface and depth water quality parameters are measured prior to, during and after estuary entrance opening to understand changes in water quality during an opening. Parameters measured include turbidity, pH, conductivity, dissolved oxygen.
3. Long-term vegetation monitoring at sites adjacent Belongil and Tallow Creek to monitor and try to understand any changes in vegetation communities that may be due to entrance management or opening of the ICOLLs.

4. Beachwatch Monitoring Program - monitoring of key swimming locations during the summer months for E.coli (bacteria). This program is focussed on swimmer safety. Information is available at [Beachwatch \(nsw.gov.au\)](https://beachwatch.nsw.gov.au).

The Ecohealth Program

Developed by the University of New England in collaboration with the Department of Planning and Environment (DPE): *"The Ecosystem Health Monitoring Program (Ecohealth) is a comprehensive estuarine and freshwater monitoring program that reports on the health of our waterways. The Ecohealth program includes a number of physical, chemical and biological indicators to determine the health of waterways. The combination of waterway health indicators that identify short-term (water chemistry), intermediate-term (zooplankton, macroinvertebrates), and long-term responses (fish, geomorphology and riparian vegetation) provides a robust program for quantifying, reporting and communicating waterway health, and prioritising management actions"*.

The objective of the program was to track estuaries throughout the state over time to focus attention on estuaries with poor health for action. The program has been implemented by DPE throughout NSW through the State-wide Estuary Health Program, however many of the systems were only being monitored every 3-years and for a small number of indicators only. As outlined at the below link, ecosystem health data is collected for 2 indicators - algae and water clarity. Sampling is only done every 3 years.

Brunswick River | NSW Environment and Heritage

While it may have been valuable when it was first developed and received a good uptake by some council's when it was first developed, continuation of the program and monitoring of several indicators over a more regular timeframe to track estuary health is generally cost prohibitive for a lot of councils.

Currently, DPE is conducting an audit of the Estuary Health Program and consulting with coastal councils to understand and consolidate known monitoring data of estuaries. If the program gets revitalized there may be an opportunity for Council to be more involved, depending on costs and resources required to administer.

Ecohealth Program and Costs

In 2018 Council prepared a Coastal Zone Management Plan (CZMP) for the Brunswick Estuary under the previous coastal legislation framework for certification by the Minister. The plan outlines a variety of actions to be implemented to improve the condition of the Brunswick River and catchment and is available on our website at:

[E2018-34867-CZMP-for-the-Brunswick-Estuary-Issue-5.1-April-2018-for-upload-to-website \(2\).pdf](#)

As recommended in the 2018 CZMP, development and implementation of an Ecohealth Program in the Brunswick Estuary to report on estuarine and freshwater health of the waterway was an

identified action (refer 'Recommended Strategy, M1' on page 78). An extract of this Recommended Strategy from the CZMP is provided below.

Recommended Strategy	
M1. DEVELOP AND IMPLEMENT THE ECOHEALTH PROGRAM IN THE BRUNSWICK ESTUARY REPORTING ON ESTUARINE AND FRESHWATER HEALTH OF THE WATERWAY	
Description of Task	
<p>Actions required:</p> <ol style="list-style-type: none"> 1. Prepare media release advising community of the plan to establish water quality and ecosystem monitoring within the Brunswick Estuary (and other areas in the Byron LGA if applicable) 2. Develop and implement the Ecohealth Program (as part of the North Coast Bioregion Ecohealth Program) using sampling protocols and data analysis developed by OEH and the University of New England. 3. Undertake field sampling of ecohealth indicators at required intervals (annually) 4. Report on water quality and ecohealth indicators in regular 4 yearly report cards in the State of the Environment Report and on the Byron Shire Council website / local media. <p>BSC does not currently have an active water quality program in the Brunswick Estuary. Sampling was ceased with the construction of the new STP at Vallances Road, Mullumbimby.</p> <p>Water quality in the estuary has no doubt improved significantly due to the reduction in STP wastewater nutrient loads, however, the current state of the quality of water is unknown as there has been no sampling undertaken in recent years (since 2009).</p> <p>The NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy 2010-2015 guides the monitoring, evaluation and reporting of natural resources in NSW. The strategy focuses on developing a link between local, regional, state and national data on natural resource management (NRM) that will inform the community about how we care for the natural resources of NSW (OEH accessed online at http://www.environment.nsw.gov.au/soc/NaturalresourcesMER.htm, 29 May 2017).</p> <p>Under the NSW MER strategy, a Northern Rivers Ecosystem Health Monitoring Program (Ecohealth) has been developed which is a comprehensive estuarine and freshwater monitoring program that reports on the health of waterways. It aims to bring together the aquatic sampling programs of local and state government and other stakeholders into one region-wide system. The program was designed by the University of New England with input from the Office of Environment and Heritage. Sampling is undertaken at certain locations and sites for an established set of criteria/parameters on a regular basis, similar to the 'South East Queensland Ecosystem Health Monitoring Project'. Waterway health is scored and presented in easily interpreted report cards.</p>	
Implementation of Task	
Lead Agency	Byron Shire Council
Support Organisation	Office of Environment and Heritage
Total Cost Estimate	\$18,000 per year
Grant/Funding Opportunities	Coastal and Estuary Grants Program
Projected Date for Commencement	Within 7 years
Status	Not started (0% completion)

However, the CZMP was unfortunately not certified by the Minister and hence state funding was not available for implementation of the program. The absence of a certified CZMP makes allocation of funding for implementation of actions very difficult.

In 2018 the annual cost for implementation of the Ecohealth Program for the Brunswick River was estimated to be \$18,000. Based on discussions with DPE staff, the costs these days have increased substantially. As an example the Ecohealth Program being undertaken for Emigrant Creek in Ballina Shire (including 12 sites, 3 loggers + mussel analysis) will cost \$120K.

Preparation of Coastal Management Programs

With the enactment of the new NSW Coastal Management Framework in 2018 by the State Government CZMP's are now redundant. Council is now required to prepare Coastal Management Programs (CMPs) for its coastline. This is a four-stage process that requires significant funding and staff time. Commenced in 2018, the CMPs proposed for the Byron Shire coastal zone are:

1. **CMP for Tallow Estuary** – includes estuary/ICOLL and catchment issues and actions including entrance opening/management activities (EOS) for flood mitigation.
2. **CMP for Belongil Estuary** - includes estuary/ICOLL and catchment issues and actions including entrance opening/management activities (EOS) for flood mitigation. Similar to
3. **CMP for the Byron Shire Open Coast** – includes the entire Byron Shire open coast split into 3 management segments such as Cape Byron to South of the LGA border; Cape Byron to the Brunswick River; Brunswick River north to the LGA border. The spatial extents are not yet confirmed and are subject to refinement.
4. **CMP for the Brunswick River Estuary** (not yet commenced) at a later date pending funding and staff capacity but not likely until 2025.

Currently Council is progressing through Stage 2 of CMP preparation. Stage 2 technical studies confirm current knowledge on key issues and 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).

Costs for preparing the CMPs (four stage process) vary depending on the location but have been estimated **between \$365,000 to \$750,000 (per CMP)**. Grant funding from the State Government is available to Council at a 2:1 ratio (State:Council). A CMP is the recommended process for developing a plan of action for our coast and estuaries to determine the risks, threats and vulnerabilities of the coastline, and hence identify and evaluate options for reducing the threats. The development of a CMP is around a 3-5 year process, noting that Council does not yet have a final or certified CMP.

Development of future water quality or environmental monitoring programs for Byron Shire estuaries/ICOLLs is hence through CMP preparation. Through CMP preparation key threats are identified as based on review of multiple lines of evidence, studies and data held by Council, stakeholders, agencies and field observations. The process comprises review of threats, assessment and prioritisation of risks and development of appropriate management action such as future monitoring programs and actions to improve estuary and catchment conditions. Through the CMP the feasibility, acceptability to the community, cost, approvals process, as well as the responsible land manager for any actions is considered.

As such, until such time as a CMP is prepared, which recommends implementing the Ecohealth Program as a management strategy, diversion of resources or budget would not be supported by staff.

However, it is noted that Coast and Estuary Staff are in regular discussions with DPE regarding any opportunities for collaboration. Also, Council still does deliver actions outlined in the draft (2018) CZMP where funding and grants are available and does implement projects in collaboration with other agencies and stakeholders to improve the health of the Brunswick Catchment. An example being, our 'Bringing Back the Bruns' project - [Bringing back the Bruns - Byron Shire Council \(nsw.gov.au\)](#). On-ground actions to improve estuary and catchment health do not cease in absence of a CMP, but are subject to funding allocation and justification of resources.

Other Environmental Monitoring Programs:

NSW East Coast Flood Recovery WQ Monitoring Program:

A comprehensive water quality monitoring programs for waterways in disaster declared LGAs. The program is funded under the joint Commonwealth-State Disaster Recovery Funding Arrangements. Led by DPE the project aims to facilitate government, local government and community understanding of flood affected water quality and recovery timeframes, identify sources of pollution, and drive evidence-based decisions on matters affecting waterways impacted by floods.

[Flood recovery water quality monitoring project \(nsw.gov.au\)](#)

The Brunswick River is being monitored by this project.

At this stage the project is in a data collection phase with reporting and results to be shared with the community ~May/June 2024 (prior to the project end date).

A component of the project is the collaboration with community organisations to develop or expand citizen science projects that are centred around improving understanding of waterway health.

In partnership with the Flood Recovery Project, **Positive Change for Marine Life** (PCFML) are expanding their ecological monitoring program to include freshwater macroinvertebrate sampling and a wetland monitoring program to assess the condition of mangrove habitat in the estuary. The results of the PCFML work will contribute to an ArcGIS StoryMap for the Brunswick River and will help interpret the results regarding water quality recovery following floods in this waterway.

Positive Change for Marine Life – Rewilding our Floodplains

As outlined on the PCFML website *"Our Rewilding our Floodplains program takes an integrated, ecosystem approach to determine waterway health based on key environmental factors. We work with the community to develop solutions that will create real change and long-lasting rejuvenation of our catchments and the ocean"*.

[Rewilding Our Floodplains - Australia — Positive Change for Marine Life \(pcfml.org.au\)](#)

The program includes a number of components including:

- Brunswick River Story Map - interactive StoryMap: <https://storymaps.arcgis.com/stories/659fe5585635418b9e9e76e54a353326>
- Blue Forest Rewilding
- Macroinvertebrate and Water Quality Surveys and Monitoring (supported by DPE led Flood Recovery Project).
- Health Rivers Citizen Science Program

Reports are available under 'Campaign Reports', 'River Warriors (Brunswick River)' at [Reports — Positive Change for Marine Life \(pcfml.org.au\)](#)

The program is supported by Byron Shire Council through staff time - provision of data and reference material, and review of deliverables (when requested).

