North Byron Parklands Cultural Events Site

Biodiversity Assessment Report

Prepared for
Billinudgel Property Pty Ltd

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Abbreviations

Abbreviation	Description
BAR	Biodiversity Assessment Report
BBCC	BioBanking Credit Calculator
BC Act	Biodiversity Conservation Act 2016
BNR	Billinudgel Nature Reserve
CEEC	Critically Endangered Ecological Communities
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
DWLC	NSW State Groundwater Dependent Ecosystem Policy
EEC	Endangered Ecological Community
EIM	Event Impact Monitoring
EIS	Environmental Impact Statement
EPBC Act	Commonwealth Environment Protection and Biodiversity Act (1999)
FBA	Framework for Biodiversity Assessment
FM Act	NSW Fisheries Management Act (1994)
GDE	Groundwater Dependent Ecosystem
MNES	Matters of National Environmental Significance
NBP	North Byron Parklands
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SEARs	Secretaries Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
TEC	Threatened Ecological Community
TSC Act	NSW Threatened Species Conservation Act (now repealed)
WM Act	NSW Water Management Act (2000)

Executive Summary

North Byron Parklands (Parklands) is currently operating as a cultural events site under short-term State approval. The existing approvals include a trial period to allow use of the site as a cultural, education and outdoor events venue. Billinudgel Property Pty Ltd, as the owners and operators of the site, seek to obtain permanent approval to utilise the site as a cultural events centre with a maximum capacity of 50,000 patrons for one large event and a number of smaller events.

The NSW approvals process requires an Environmental Impact Statement (EIS) for permanent approval as a State Significant Development (SSD) Project. A component of this is to assess impacts to biodiversity under a SSD using the Framework for Biodiversity Assessment (FBA). This Biodiversity Assessment Report (BAR) has been prepared to address this requirement and in line with the Secretary's Environmental Assessment Requirements (SEARs), which were issued for the project on 18 January 2017. This BAR was prepared by Steve Jarman, an Accreditied Assessor (no. 239) under section 142B(1)(c) of the *Threatened Species Conservation Act 1995* (TSC Act).

The Parklands site is located on Tweed Valley Way and Jones Road in the Yelgun Valley within the Byron Shire local government area. The site forms a natural amphitheatre comprising a low lying and level central plain surrounded by steep rising hillsides on the northern, western and southern sides of the site. The Billinudgel Nature Reserve is immediately south and east of the site. Historically, the site was used as a cattle grazing property and experienced significant vegetation clearance. Acquired in 2007, the site has been used since July 2013 for cultural events and large areas have been successfully rehabilitated.

The total Parklands (Development Site) comprises an area of 240.9 ha. Within this, an area of approximately 134 ha will be directly utilised for the development, with approximately 105.3 ha preserved or rehabilitated as natural bushland habitat. This proposal is to obtain permanent approval to utilise the site as a cultural events venue with a maximum capacity of 50,000 patrons for one large event and a number of smaller events (up to 20 event days per annum). The increased utilisation of the site will be implemented in multiple phases, with staged increases in maximum patron size over several years. The gradual increase in site utilisation will allow any potential impacts to be monitored and appropriate modifications to events to be implemented.

The proposal also incorporates the construction of several new buildings and infrastructure. The proposed buildings include a new conference and health retreat centre, bus shelters and amenities blocks. The proposed infrastructure includes a new security fence, water tank, internal roads and site enhancements, potable water supply works, toilet and water treatment facility works and environmental works.

Parklands plans to undertake events and functions in the proposed conference centre, in a manner that is generally consistent with the approved concept plan. Functions in the conference centre may include a range of events such as corporate functions, conferences, celebrations, or health and wellbeing retreats.

The conference centre would operate year-round, and cater for up to 180 patrons per day. Accommodation would be provided for up to 120 guests a day in 30 on-site cabins. Accommodation would be limited to guests associated with functions and events only, and would be permitted on event days and for up to one day prior to and one day after event days.

The proposed development will not result in broadscale clearing of native vegetation within the Parklands. However, a small area of vegetation clearing/pruning would be required to facilitate the construction of a new access track. This access track has been positioned to minimise vegetation clearing and follows an

existing farm track. Nonetheless, some minor vegetation clearing will be required on either side of the track in a small patch of vegetation.

There will also be 0.4 ha of clearing within a vegetation community dominated by exotic pasture and stands of Camphor Laurel and Mango. This is associated with the proposed wastewater treatment infrastructure in the north west of the development site. Clearing and slashing of exotic pasture in the southern areas of the site would also be required to increase car parking capacity. Furthermore, there would be a requirement to remove Camphor Laurels near the proposed conference centre. Areas of existing native vegetation are to be designated no-go zones and where required, would be fenced off during all events.

Extensive survey and monitoring has been undertaken at the site and these results have been used to support the development of this BAR, along with recent surveys undertaken as per the requirements of the FBA. The overall survey and monitoring results to date indicate that the cultural events at the Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities. Increased light and noise levels are an inevitable occurrence associated with events, and these factors will impact on local fauna movements and site usage during the period of each event. However comprehensive event impact monitoring has shown that once these factors cease to operate and the site returns to pre-event conditions, fauna presence and habitat values return to baseline conditions. Moreover, there are no evidence of declines in any environmental values at the Parklands, indicating no cumulative effects of holding multiple events.

As per the requirements of the FBA, a number of analyses have been undertaken to document the ecological values of the site, including vegetation mapping and assessments of the presence of threatened and migratory species. The assessments concluded the following:

- There are five Plant Community Types (PCTs) present within the Parkland site, along with large areas of pasture (cleared land / exotic pasture grassland)
- Three plant communities listed as Endangered Ecological Communities (EECs) under the TSC Act or Threatened Ecological Communities (TEC) under the EPBC Act are present within and/or immediately surrounding the Parklands
- Habitats present within the development site are generally in moderate to good condition. There are large tracts of vegetation, which are connected to patches of vegetation in the region. Within 1 km of the site there are areas of high ecological value
- Thirty-two (32) 'ecosystem credit species' relevant to the site were identified and 23 'species credit species' were found to be known, likely or as having the potential to occur on site
- Threatened and migratory species are known to occur on site including both Commonwealth and NSW-listed species. Most commonly, these include flora, birds and microbats

Only very minor clearing / pruning of vegetation would be required as part of the project; and there would be no direct impacts to EECs, CEECs or threatened flora. Accordingly, nor would there be any direct impact to threatened fauna or flora habitat, with exception of minor areas of habitat for the Eastern Grass Owl (an ecosystem credit species, see **Section 8.3.2** for more information). Furthermore, no species credit species are likely to be directly impacted by the project. Offsets are therefore not considered to be required.

Indirect impacts were also assessed using both the results of previous event impact monitoring and an assessment of the likely impacts from future events. Previous monitoring has provided good evidence that indirect impacts from events held to date have been very minor, temporary and reversible. The future program of events would include both more event days per year and an increased number of patrons at

the largest event. Potential impacts of the new program of events are associated with more traffic (both vehicles and people), increased noise and light as well as increased trampling and bushfire risk. There are a number of impact management mitigation measures that have been successfully implemented and these would continue to be used to address further impacts. Consequently, all future indirect impacts have been assessed as low risk and are likely to result in a similar pattern of minor, temporary and reversible effects to current operations. Monitoring and adaptive management arrangements would be in place to ensure this is the case, and if not, an appropriate response implemented.

Overall, this report has provided the results of a biodiversity impact assessment for the proposed operation of Parklands as a permanent event venue. As per requirements of the SEARS, it has included an assessment in accordance with the FBA, whilst also addressing additional biodiversity assessment requirements associated with indirect impacts. A key aspect of the project is that only a very minor area of native vegetation will be cleared (<0.001% of native vegetation on site). For this reason, no offsets are considered to be required. Nonetheless, a significant and voluntary program of bush regeneration and plantings has occurred on site since 2007. Impacts from construction or operations will also be managed through the implementation of effective measures, along with ongoing monitoring and adaptive management processes. The permanent use of the site is expected to result in negligible to minor impacts to biodiversity, which are considered temporary and reversible.

1 Introduction

Billinudgel Property Pty Ltd engaged Eco Logical Australian Pty Ltd (ELA) to undertake a biodiversity assessment of North Byron Parklands (Parklands).

Parklands is currently operating as a cultural events site under short-term State approval. The existing approvals include a trial period to allow use of the site as a cultural, education and outdoor events venue.

Billinudgel Property Pty Ltd seek to obtain permanent approval to utilise the site as a cultural events centre with a maximum capacity of 50,000 patrons for one large event and a number of smaller events.

This Biodiversity Assessment Report (BAR) has been prepared as part of an Environmental Impact Statement (EIS) for the State Significant Development (SSD) Project. The Secretary's Environmental Assessment Requirements (SEARs) were issued for the project on 18 January 2017. Accordingly, impacts to biodiversity under a SSD must be assessed using the Framework for Biodiversity Assessment (FBA).

This report responds specifically to the SEARs requirements that relate to biodiversity assessment, as outlined in **Table 1**. Comments from various agencies that were included in the SEARs (see **Appendix A**) are also addressed within this report.

Table 1: Relevant draft SEARs addressed in this BAR

SEARs	Response
Biodiversity – including: an assessment of the development and all biodiversity values on the site under the *Framework for Biodiversity Assessment 2014* that is to include: • Identification of species on site; • Detail of the potential direct and indirect impacts on any threatened species, populations, endangered ecological communities or their habitats, groundwater dependant ecosystems; and • A detailed description of the measures to avoid, minimise, mitigate and/or offset biodiversity impacts	This BAR has been prepared under the FBA (OEH 2014) for major projects. Under this framework, a detailed assessment must be undertaken on the vegetation to be impacted within the development site, as well as any impacts to threatened species, populations, or endangered ecological communities. This BAR also outlines the offsetting requirement due to unavoidable impacts of the project. This BAR details all measures to avoid and minimise direct and indirect impacts to biodiversity as specified within Section 8 of the FBA. An Assessment of Significance (7-Part Test) has also been undertaken for threatened species and EECs (**Appendix M**).

1.1 Project Description

1.1.1 Location

The Parklands site is located on Tweed Valley Way and Jones Road in the Yelgun Valley within the Byron Shire local government area (**Figure 1**). The emergency access road leading from the site northwards to Wooyung Road is located within Tweed Shire. The site forms a natural amphitheatre comprising a low lying and level central plain surrounded by steep rising hillsides on the northern, western and southern sides of the site. The Billinudgel Nature Reserve is immediately south and west of the site. Lot / DP of the properties comprising the site are presented in Figure 1. An emergency bushfire assembly area is also located on a neighbouring property to the north.

The total Parklands site (Development Site) comprises an area of 240.9 ha. Within this, an area of approximately 134 ha will be directly utilised for the development, with approximately 105 ha preserved or rehabilitated as natural bushland habitat.

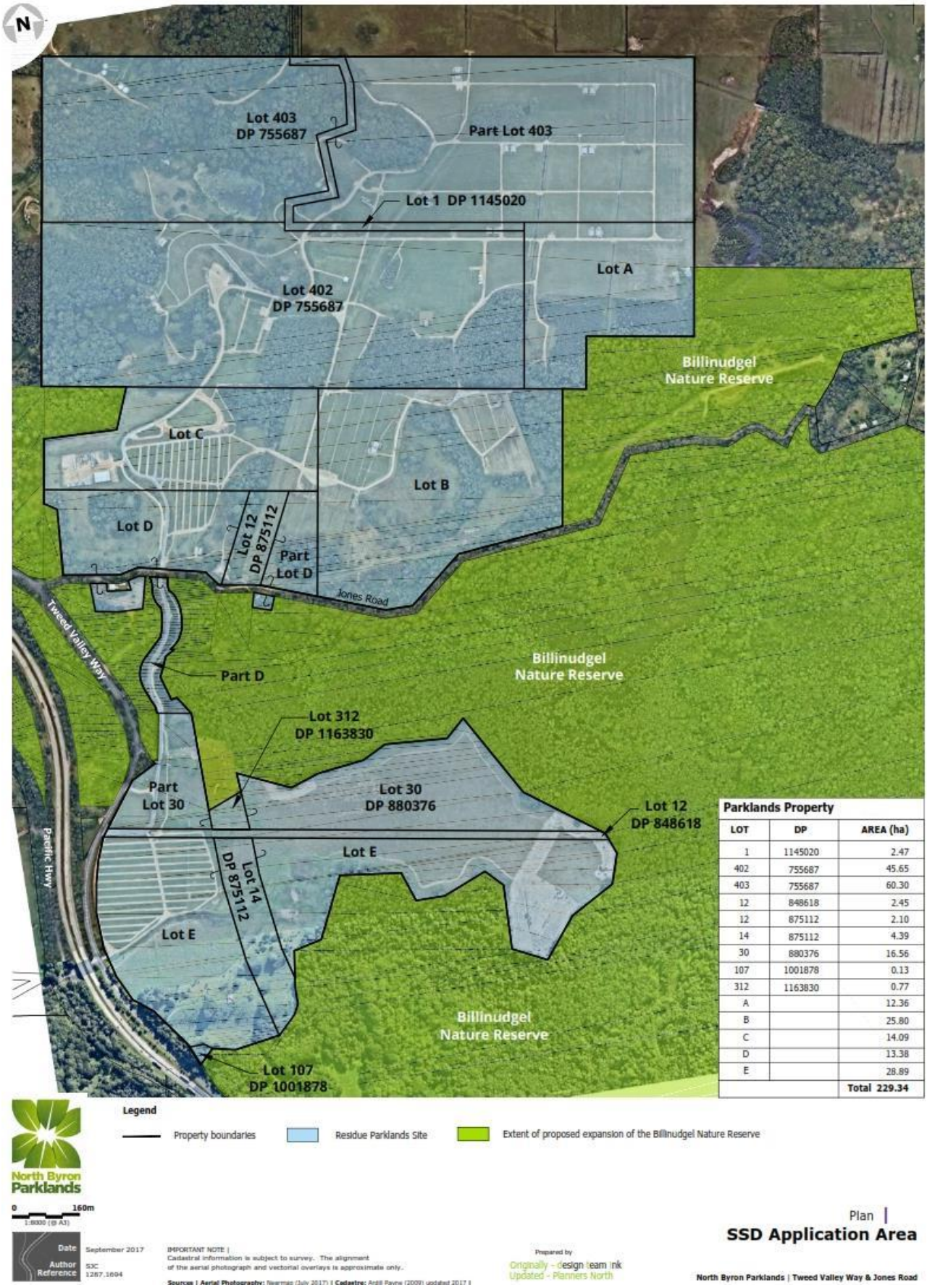


Figure 1: State Significant Development Application Area

1.1.2 Overview of Project

The Proposal

The Parklands is currently operating as a cultural events site under short-term State approval. The current approvals are for a trial period and allow the use of the site for cultural, education and outdoor events, including ancillary camping and car parking, the construction of temporary event infrastructure (completed), a permanent spine road (completed) and vegetation rehabilitation works within the site (underway). Current approval is for a maximum of three events per year, over a combined maximum of 10 event days (or 20 days including minor community events).

This proposal is to obtain permanent approval to utilise the site as a cultural events venue with a maximum capacity of 50,000 patrons for one large event and a number of smaller events (see below). The increased utilisation of the site would be implemented in multiple phases, with staged increases in maximum event size over several years. The gradual increase in site utilisation would allow any potential impacts to be monitored and appropriate modifications to events to be implemented. The proposed events and staging are:

- Splendour in the Grass event (up to an ultimate 50,000 patrons over a maximum of 5 days), subject to meeting KPIs for the following patron capacity scenarios:
    - Increase from current 35,000 to 42,500 subject to meeting KPIs
    - Increase from 42,500 to 50,000 subject to meeting KPIs
- Falls Festival Byron (up to 35,000 patrons & maximum of 5 days)
- Three event days with up to 25,000 patrons (cumulative or separate)
- Five community events with up to 5,000 patrons (cumulative or separate)
- Corresponding bump in and bump out time (up to 21 days in; 14 days out).
- 2 one-day community events up to 1,500 patrons (not-for-profit/educational)

In total, there would be a maximum of 20 event days per annum.

The layout of events is subject to event size.

The proposal also incorporates the construction of several new buildings and infrastructure. The proposed buildings include a new conference centre and associated accommodation, bus shelters and amenities blocks. The proposed infrastructure includes a 1.8m high security fence, water reservoir, internal roads and site enhancements, potable water supply works, toilet and water treatment facility works and environmental works. These are further described below.

The Proposed Conference Centre

Parklands plans to undertake events and functions in the proposed conference centre, in a manner that is generally consistent with the approved concept plan. Functions in the conference centre may include a range of events such as corporate functions, conferences, celebrations, or health and wellbeing retreats.

The conference centre would operate year-round, and cater for up to 180 patrons per day. Accommodation would be provided for up to 120 guests a day in 30 on-site cabins. Accommodation would be limited to guests associated with functions and events only, and would be permitted on event days and for up to one day prior to and one day after event days.

The drawings provided as part of the Development Application (prepared by Dominic Finlay Jones Architects Pty Ltd) show the location and design of the proposed buildings and infrastructure, whilst the masterplan is also presented in **Figure 3**.

Potable Water Facilities

A 4.3 ML reservoir and associated new pipework is proposed to address future potable water demand. This is further detailed in Section 6.10.4 of the EIS, with **Figure 7** showing the proposed location of the facility (in the north west of the site). The reservoir would be constructed in a cleared area (see **Figure 2**). No vegetation clearing is required in order to construct the proposed reservoir, or for construction access. Minor branch trimming of one *Lophostemon confertus* may be required at the reservoir site; however this would be avoided where possible.

The water reservoir would be connected to potable water points via a polypipe. The polypipe would traverse an area of forest, however as the pipe can be easily placed and is bendable, clearing of native vegetation is not required. Some vegetation (ground covers only) would be smothered by the placement of the pipe, however this is considered to represent a negligible impact and is not assessed further.

Figure 2: Location of the proposed 4.3 ML water reservoir

Proposed Wastewater Treatment Facilities

Parklands is proposing to continue, expand and upgrade the existing on-site sewage management system for the proposed development. The system involves collection of sewage waste generated within the site, composting of solid waste, secondary treatment of wastewater, and on-site disposal of composted/treated waste. Some waste that is not able or suitable to be treated on-site (e.g. kitchen

sullage) is collected separately and transported to municipal sewage treatment plants (via tanker) for disposal.

Additional sewerage infrastructure proposed to be constructed for the development includes:

- 11 additional amenities blocks across the event and camping areas (in addition to the 10 existing amenities blocks):
- Composting toilets within the conference centre and associated accommodation, administration building, and golden view bar;
- a reticulation system connecting the amenities blocks, conference centre and associated buildings to the treatment and disposal infrastructure;
- additional wastewater holding tanks (nominally eight 275 kL tanks) in the north-western area of the site (in addition to the existing four 230kL tanks in this location);
- a secondary wastewater treatment system using a reed-bed system, with disinfection using chlorine dosing, located in the north-western area of the site;
- on-site composting of solid waste, and beneficial reuse of composted waste on-site; and
- treated effluent disposal via two Effluent Management Areas, including:
  - o EMA 1 – involving disposal via 24 sand filter beds over an area of approximately 600m2 in the north-western area of the site; and
  - o EMA 2 – involving disposal via irrigation over a (up to) 36,000m2 area in the northeastern corner of the site.

A detailed wastewater assessment for the proposed system is attached as Appendix R of the EIS, and the system is discussed in more detail in Section 6.10 of the EIS.

Figure 8 shows the location of the proposed wastewater system. Vegetation clearing would be required to construct the facilities. A flora survey and single bioplot was established in the clearing area (see **Figure 23** as part of **Section 6.2.1**) to ascertain if native vegetation requiring further assessment would be cleared. The subsequent 'site value score' for the bioplot was less than 17 as the canopy trees within the bioplot are solely exotic species (Camphor Laurel and Mango). Therefore assessment of native vegetation is not required beyond Subsection 5.3.3 of the FBA methodology.

Despite the results of the bioplot, a small number of native species may require removal. This is further discussed in **Section 9.1**.

Effluent Management Areas and Burial of Solid Wastes

Effluent Management Areas and the burial of solid wastes have been assessed within Section 6.10 of the EIS and Appendix R of the EIS. As no impacts to biodiversity are anticipated and the burial of solid wastes will be undertaken in accordance with current approvals, this matter is not addressed further in this BAR.

Telecommunications and Electricity

Some minor additional infrastructure is required to service telecommunication and electricity needs (i.e. for the conference centre and associated accommodation and buildings), however no vegetation clearing is required for these works. As such, there will be no impacts to biodiversity associated with the proposal and these aspects do not require further assessment.

Proposed Vehicular Track

A vehicular access track is the only aspect of the current proposal that would result in clearing of native vegetation (see **Section 9.1**). The proposed alignment of the new vehicular access track in the north-

west of the site (west of the proposed cabins) is shown in **Figure 3**. Although the proposed access track has minimised vegetation clearing by utilising cleared areas, existing farm tracks and avoiding trees (**Figure 5**), some minor clearing would be required to widen the track and to remove overhanging branches. The proposed access track would allow the construction of cabins to the east of the track. The existing vehicular track directly east of the proposed vehicular track would be closed and rehabilitated into managed lawn.

Security Fencing

The location of the proposed 1.8m high palisade security fence is shown on **Figure 6**. A large portion of the alignment of the security fence would be erected along existing roads and fence lines. There is one area behind the existing amphitheatre where the fence would be erected within native vegetation, however this area is subject to lantana infestation and no native vegetation would be removed as part of installation. Furthermore, for the fence's entire length, every 5th or 6th panel would be on hinges (acting as a gate) and will be permanently open except during events to allow wildlife movement. (i.e. the gates will be closed the day before the first event day and opened the day after the last event day. Gates would only be closed for large and medium events). Each fencing panel is approximately 2.5m long. The fence will also be set 100mm off the ground to allow wildlife movement, however the gap cannot be larger for security reasons.

Temporary human exclusion fencing closely bordering (within 10 m of) forest blocks within event areas would be provided during events. All temporary human exclusion fencing used in these locations would be 'fauna-friendly', incorporating a minimum 100 mm continuous gap at the base of the fence or 100 mm square gaps at 10 m intervals along the base of the fence. This fencing is used to protect native vegetation from impacts associated with trampling and rubbish during events.

Proposed Southern Carkpark and Stormwater Infrastructure

The proposed southern carpark is shown on **Figure 3** and **Figure 9**. The development involves the construction of new parking area in the southeast corner of the site. The parking area consists of turfed parking bays and a sealed loop road and parking aisles with a combined length of approximately 7km.

The stormwater catchments draining to the north and south are proposed to replicate the existing stormwater catchments which are controlled by a natural ridge line that runs east-west across the middle of the proposed carpark site.

Stormwater runoff from the parking areas and loop road would be collected on site and discharged to outlet locations via vegetated swales located in alternating parking aisles and adjacent to the loop road. The final size and configuration of the swales are subject to detailed design.

Stormwater quality improvement devices (SQIDs) would be incorporated at each outlet under the loop road. It is proposed to incorporate Rocla "First Defense High Capacity" hydrocarbon & TSS separators (or similar proprietary device) at each drainage outlet in order to remove any fuels & oils from stormwater runoff prior to site discharge. The devices would be located under the proposed loop road upstream of the outlet headwall. The entirety of stormwater runoff in the minor event would be treated by a separator prior to discharging to the wetlands as per existing conditions.

The preliminary design (**Figure 9**) indicates potentially three concentrated outfall points along the northern loop road and three along the southern loop road. These outfall points are only proposed for the minor storm events. Flows in excess of the SQID treatment flow may discharge over the loop road at various low points along the loop road and at the culvert locations subject to detailed design. Irrespective of the outfall locations (minor or major storm), the flow paths would be linked and return to sheet flow before

discharging off site. This would be achieved through incorporating level spreader swales and bunds on the downslope side of the loop road.

Northern Access Road Re-alignment

Part of the existing Northern Access Road is proposed to be re-aligned to allow for a perpendicular intersection onto Wooyung Road. The intersection would be provided approximately 100 metres east of the existing intersection, to provide adequate sight distances and improved geometry (**Figure 10**). The minor departure to the existing alignment is located on cleared and disturbed land associated with the existing agricultural land use on this property, and is not expected to result in any ecological impacts. For this reason, the alignment is not further assessed within this BAR.

Off-site Bushfire Emergency Evacuation Area

An off-site bushfire emergency evacuation area would be established for future events. The proposed area is approximately 5ha and exists on an adjoining property to the north of the site. Details are within Appendix U of the EIS. The area is established to existing pasture land and will not results in impacts to biodiversity. For this reason, the area is not further assessed within this BAR.

Continuation of the Existing Rehabilitation Program

The proposed development includes the continued implementation of a flora and fauna rehabilitation program across the site, which would build on extensive habitat restoration works that have occurred on the site to date. Habitat restoration works completed at the site include planting of over 22,000 trees and shrubs, weed management and maintenance of existing native habitat and landscaped areas of the Parklands.

Summary of Impacts

Impacts associated with the proposed development would primarily be limited to the proposed 20 event days per year (and associated bump-in; bump-out time), with activity at the site throughout the remainder of the year primarily limited to ongoing management of the site. The conference centre would be available for use year-round. With the exception of the proposed minor clearing/pruning described above, direct impacts associated with the proposed development would be limited to existing cleared grassland areas within the Parklands. Construction of temporary infrastructure, and high human and vehicle activity would be limited to these areas. The only operational activities proposed to occur outside of existing cleared areas of the site are management (opening and closing) of the proposed security fence, flora and fauna monitoring and habitat restoration, including revegetation and weed management. Indirect impacts during event days such as light and noise may impact bushland areas within the Parklands and adjacent habitat areas.

The proposed development would not result in broadscale clearing of native vegetation within the Parklands. However, a small area of vegetation clearing/pruning is required to facilitate the construction of a new access track (as mentioned above and further discussed below and in **Section 9.1**). There would also be some clearing / slashing of exotic pasture in the southern areas of the site to increase car parking capacity, as well as removal of Camphor Laurels (a weed species) near the proposed conference centre. A small area of clearing (of a non-native vegetation community) is also required to construct the proposed sewerage treatment facility. Areas of existing native vegetation will be designated as 'no-go zones' and where required, will be fenced off during all events.

No Go Zones

The location of the development site including event areas and no-go zones is presented in **Figure 11**. The extent of the development site is as per the *Request for Secretary Environmental Assessment*

Requirements (Planners North, 2016). The event areas (i.e. development footprint) include all areas within the development site excluding no-go zones, as well as a small area (approx. 300m^2) of proposed vegetation clearing associated with a proposed vehicular track (see **Section 9.1**). No clearing of the extant scattered native trees will occur within the event areas.

Figure 3: Proposed Masterplan (Figure 3.2 from the EIS)

Figure 4: Proposed Vehicular Track

Figure 5: An existing track to be utilised for the proposed new vehicular access track

Figure 6: Proposed security fence location (shown in red)

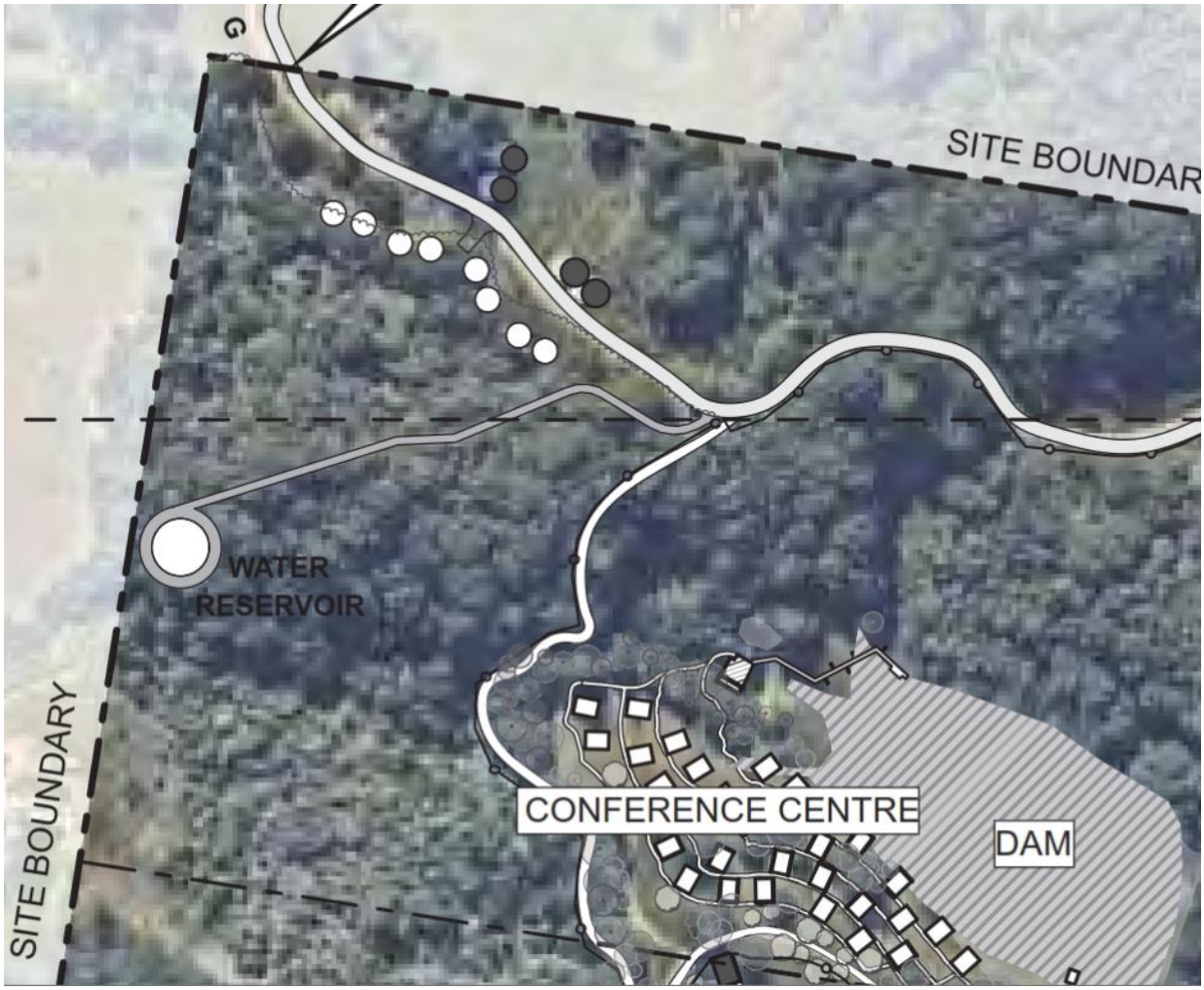


Figure 7: Proposed location of the water reservoir in the north-west of the site

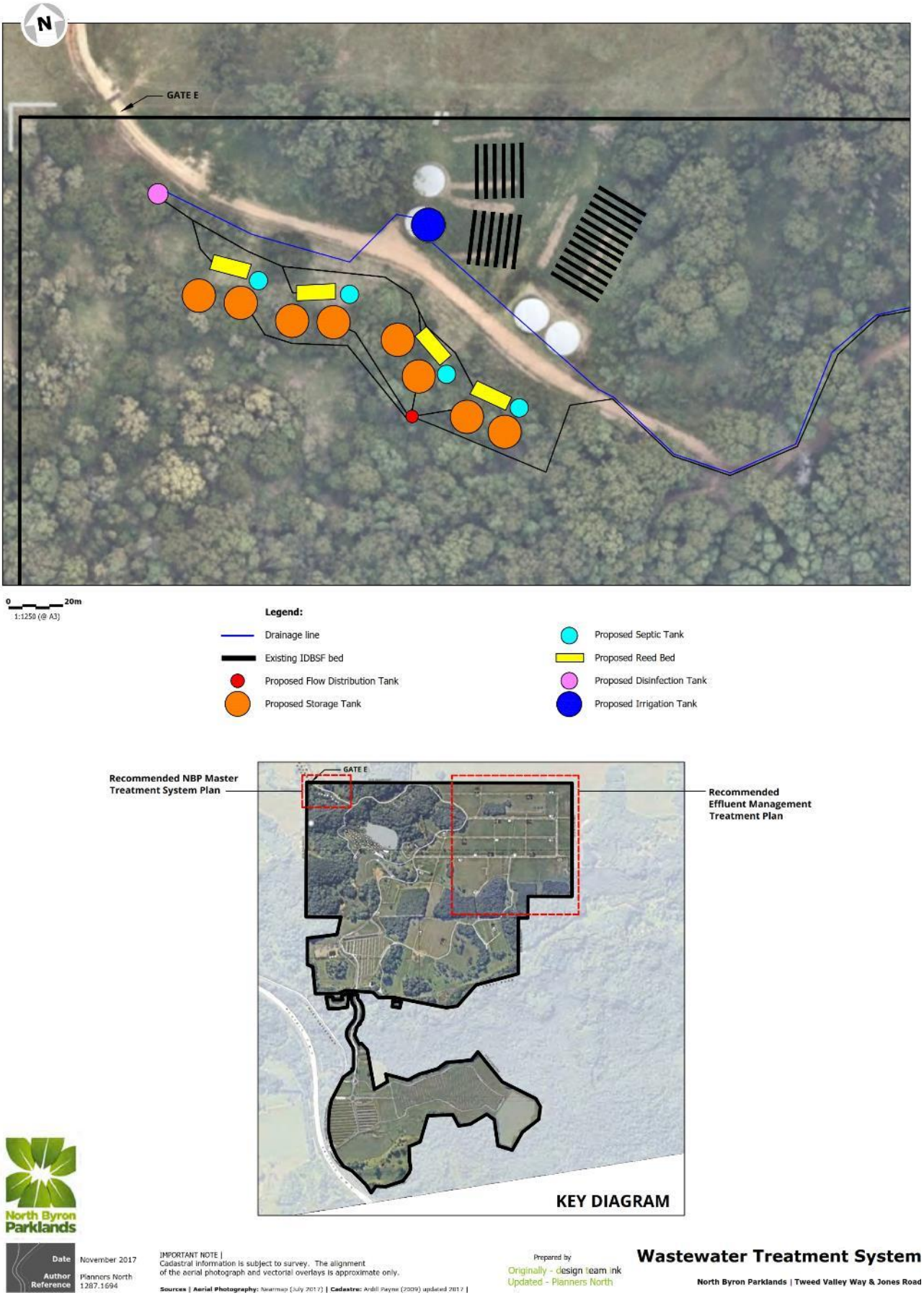


Figure 8: Proposed wastewater treatment system

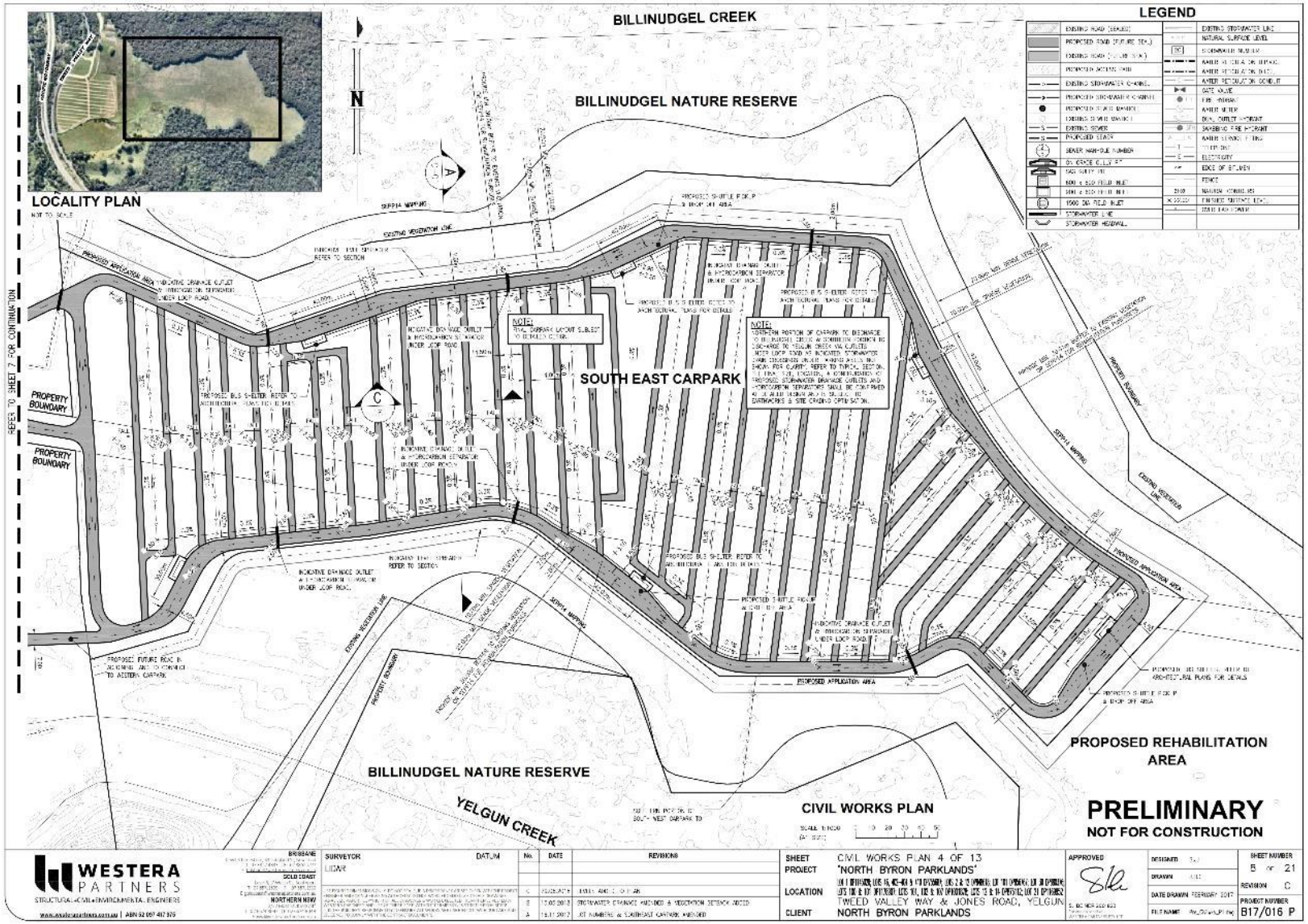


Figure 9: Southern Carpark Civil Works Plan (Preliminary Design)

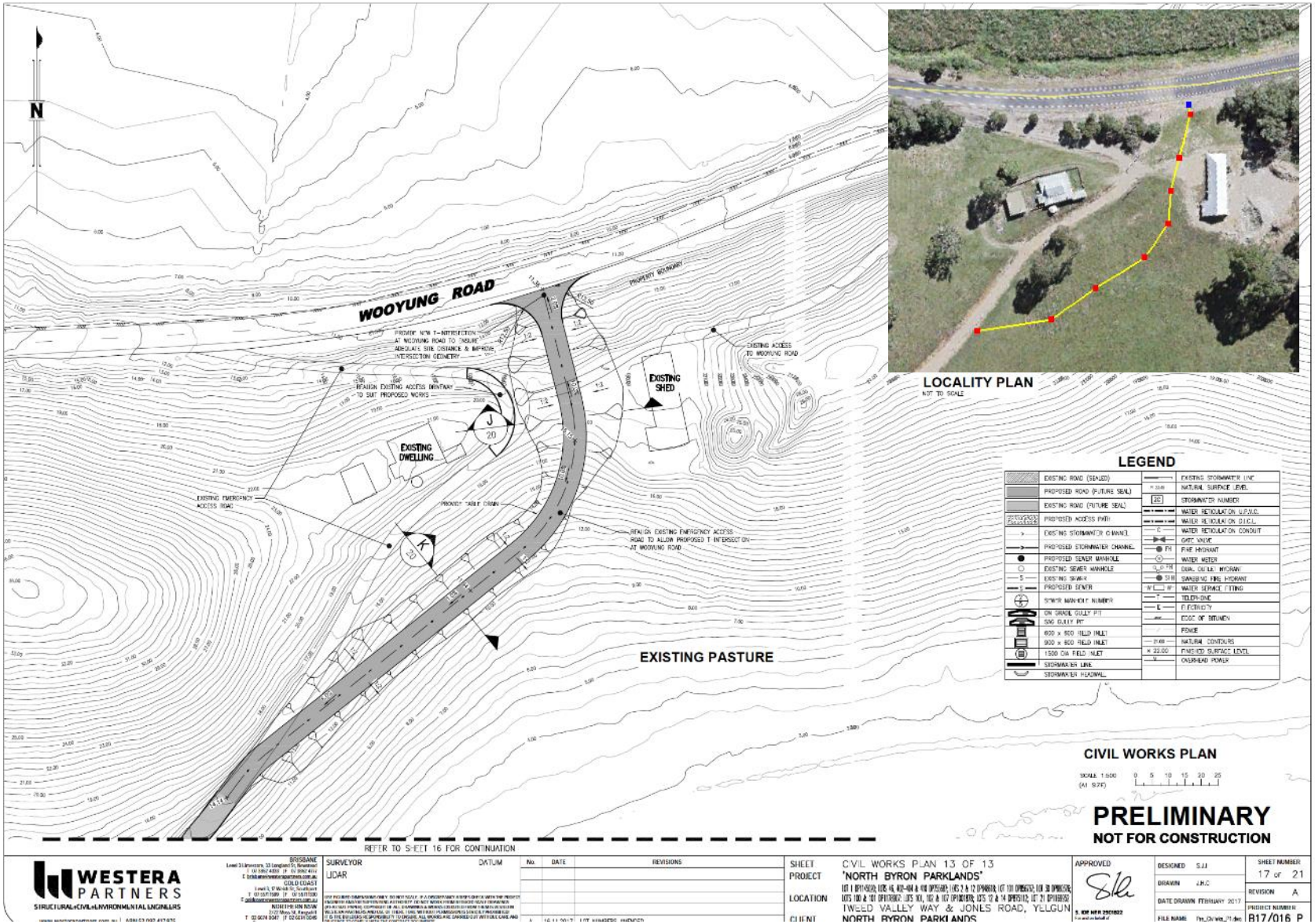


Figure 10: Proposed Northern Access Road Intersection Re-Alignment

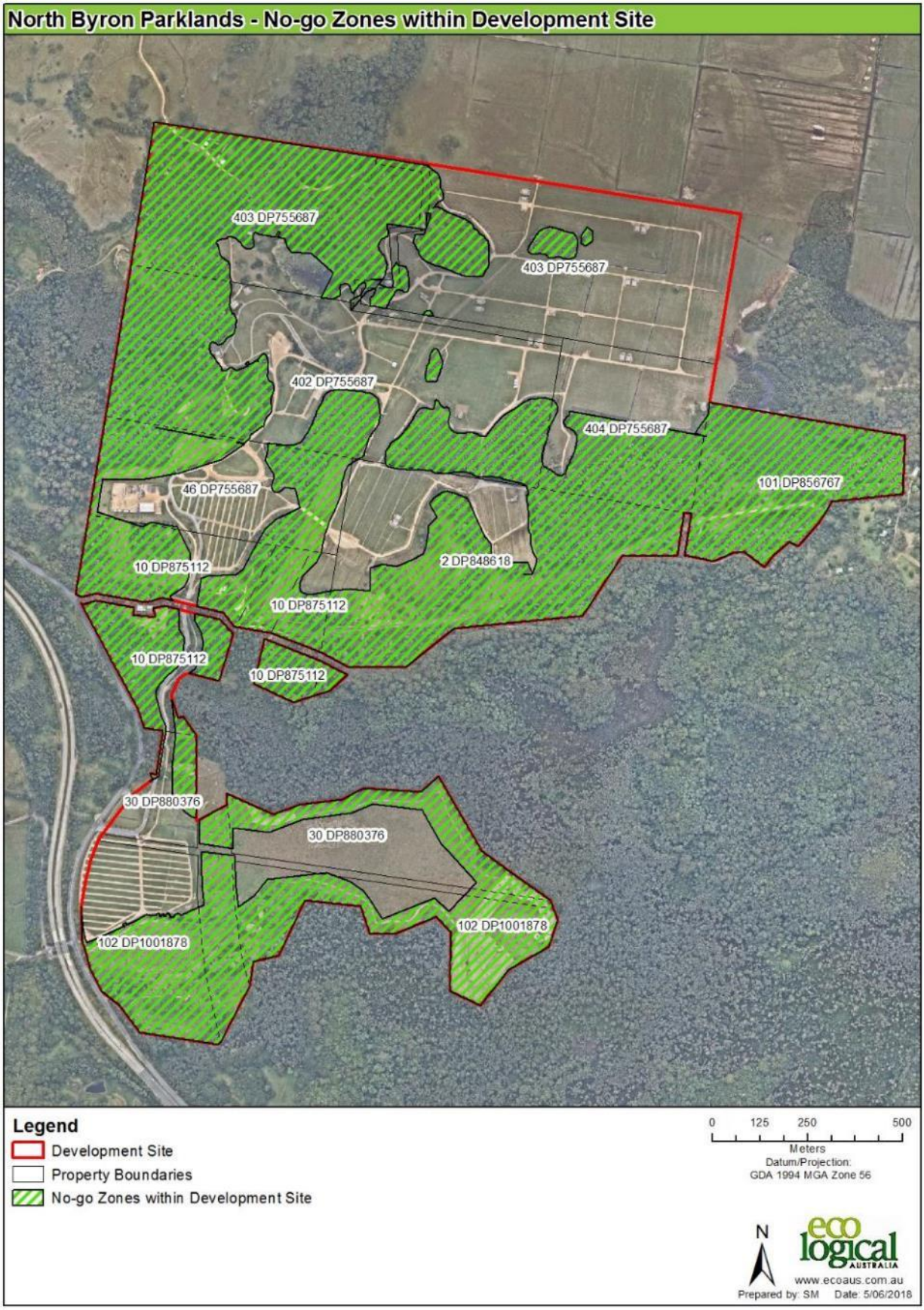


Figure 11: Development site and no-go zones

1.1.3 Existing Approvals

In 2008, Byron Shire Council granted consent for a temporary place of assembly with camping and associated infrastructure at the site. The consent allowed for the 2009 Splendour in the Grass event to be held with a patron capacity of 22,500. However, following an appeal against the legal validity of Council's consent, the Land & Environment Court ruled the approval invalid on the basis that a relatively small but integral part of the proposal was prohibited.

In 2009 Parklands sought permanent and concurrent Concept and Project Approval under the former State Environment Planning Policy (Major Development) 2005 given the project constituted development for the purpose of tourist facilities, major convention and exhibition facilities or multi-use entertainment facilities that would employ 100 people or more.

In April 2012, following a 3 year development assessment process (Ref. DP&I, 2011), the NSW Planning Assessment Commission (PAC), under delegation from the then Minister for Planning approved both the Concept Plan and Project applications (Ref. PAC, 2012).

Since then, the following modifications have been submitted to and approved in relation to the Concept Approval and Project Approval.

- On 3 December 2012, Modification 1 was approved for minor typographical amendments to Conditions B4 and E18 of the Project Approval;
- On 29 January 2013, Modification 2 was approved to modify a typographical error in Condition C32 of the Project Approval relating to a miss-description of Yelgun Creek;
- On 22 April 2016, Modification 3 was approved to the Project Approval relating to noise management measures, a request for small community events and various administrative amendments;
- On 12 September 2017, modification 4 was approved to modify the Concept Plan and Project Approval to allow trial events to operate per the parameters of the existing approval up to 31 August 2019.

As part of the Concept Approval and Project Approval (including modifications) commitments, several relevant plans and programs were required to be prepared and implemented. This included a:

- C19 - Flora and Fauna Management Plan
- C20 - Flora and Fauna Monitoring Program and Rehabilitation Program
- C21 - Koala Plan of Management
- E17 - Vegetation Management and Biodiversity Plan

Each of these are discussed below.

<u>C19 - Flora and Fauna Management Plan</u>

A Flora and Fauna Management Plan was prepared by a suitably qualified ecologist, in order to manage the impacts to flora and fauna arising from the carrying out of events at the site. The Plan was prepared in consultation with the New South Wales Office of the Environment and Heritage (NSW OEH), Byron Shire Council (BSC) and the Regulatory Working Group (RWG) having regard to 1) the Ecological Assessment and Response to NSW Department of Planning and Infrastructure Director-General's Environmental Assessment Requirements – prepared by Mark Fitzgerald, Ecological Consultant, June 2010; and 2) Parklands Environmental Health and Safety Management Manual.

The Flora and Fauna Management Plan included all requirements specified in the Project Approval and was submitted for the approval of the Director-General within 60 days prior to commencement of the first

event. The Flora and Fauna Management Plan was approved by NSW Department of Planning and Infrastructure (DPI) on July 18th 2013.

Implementation of the plan is reported within the Annual Environmental Performance Report, which is prepared and supplied to the OEH under consent condition B7 of the Planning and Assessment Commission Project Approval.

C20 - A Flora and Fauna Monitoring Program

A Flora and Fauna Monitoring Program was prepared prior to the commencement of the first event by a suitably qualified ecologist. The Flora and Fauna Monitoring Program was implemented with monitoring of the impact of the project on flora and fauna within and adjacent to the site from before March to September 2013. The Program was prepared in consultation with the Regulatory Working Group (RWG) and was approved by NSW DPI on July 18th 2013.

The Program addressed requirements provided in the Project Approval. Results of monitoring undertaken under the Flora and Fauna Monitoring Program are summarised in **Section 6.1**.

C20 - Flora and Fauna Rehabilitation Program (Modification 3)

As part of the DP&E and Planning Assessment Commission (PAC) assessment processes relating to Modification 3, government agencies and members of the community were invited to make submissions during the public exhibition period. On the 22nd of April 2016 the PAC approved the modification covering noise limits and small non-music focussed community events (up to five community events in the first year). As part of this approval the PAC deleted the existing C20 – Flora and Fauna Monitoring Program consent condition (discussed above) and replaced it with the requirement to prepare the Flora and Fauna Rehabilitation Program (FFRP) to monitor and assess the impact of the project on flora and fauna within and adjacent to the site. Results of monitoring undertaken under the Flora and Fauna Rehabilitation Program are summarised in **Section 6.1**.

C20 - Flora and Fauna Monitoring and Rehabilitation Program (Modification 4)

Modification 4 required a Flora and Fauna Monitoring and Rehabilitation Plan (FFMRP) to be provided within three months of the determination of Modification 4. This plan has been prepared and submitted as part of the development application.

C21 – Updated Koala Plan of Management

C21 required a Koala Plan of Management (KPom) to be prepared if a resident population (within the meaning of SEPP 44) of koalas became established at the site.

A SEPP 44 Koala Survey and habitat reassessment carried out by Biolink Consultants in April 2013 followed earlier assessments undertaken in 2007 and 2008. An interim Koala Plan of Management was prepared in 2007 after the location of a small area of 'core' Koala habitat 'on the Parklands site in 2007. However the 2008 reassessment "…documented a decline in the extent of Koala activity within the aforementioned Core Koala Habitat area over the intervening 12 month period to the extent that the level of use was considered to be relic and/or transient, while no other evidence of Koala activity was recorded elsewhere on the site (Biolink 2013).

To provide a contemporary assessment of Koala presence in the area, Biolink conducted an investigation of the NBP site and surrounding areas in September 2016, as well as reviewing recent OEH Bionet Atlas records for the locality. Evidence of Koala activity in the form of variably aged scats was found at several

sites in the north and west of the NBP site, as well as in the adjoining BNR. No Koalas were observed and the significance of these findings was discussed in the 2016 report.

The Biolink report (2016) notes that the discovery of scats in these areas within the NBP site has occurred during operation of the site, including two festival events annually. The Biolink report (2016) concludes with recommendations that monitoring studies be ongoing on a biennial basis, and this recommendation has been adopted as part of future monitoring (refer to the Flora and Fauna Monitoring Program and Adaptive Management Plan 2017 – 2027, prepared by Eco Logical Australia [2017]).

A KPoM specific to the development site is included in **Appendix B**.

E17 – Vegetation Management and Biodiversity Management Plan

A Vegetation Management and Biodiversity Management Plan was prepared in 2012, with the objectives to maintain and where possible improve conditions in existing native forest of the site; restore native vegetation in new habitat areas; provide low density tree cover in managed parklands zones; control and remove weeds from native forest and habitat areas; and deliver control programs for feral animals.

Vegetation and biodiversity management outcomes are reported within the Annual Environmental Performance Report, which is prepared and supplied to the OEH under consent condition B7 of the Planning and Assessment Commission Project Approval. Revegetation efforts are also described below in **Section 3.3.**

1.1.4 Results of the Trial period 2012 – 2017

The Parklands site has been operating under a trial arrangement since 2012 (see EPBC2012/6475) with the first event commencing in July 2013. At the time of the EIS for the project, a total of ten major and medium events had been held.

Event impact monitoring data and reports are available for the first nine events (refer to **Appendix F**). Extensive monitoring effort and data collection has been undertaken proceeding, during and following events using the Before-After Control-Impact (BACI) design, to enable evaluation of potential ecological impacts attributable to holding events at the Parklands site. Extensive data analysis shows that no ongoing adverse ecological impacts have been attributed to the trial events at the site, with only minor and temporary impacts during events.

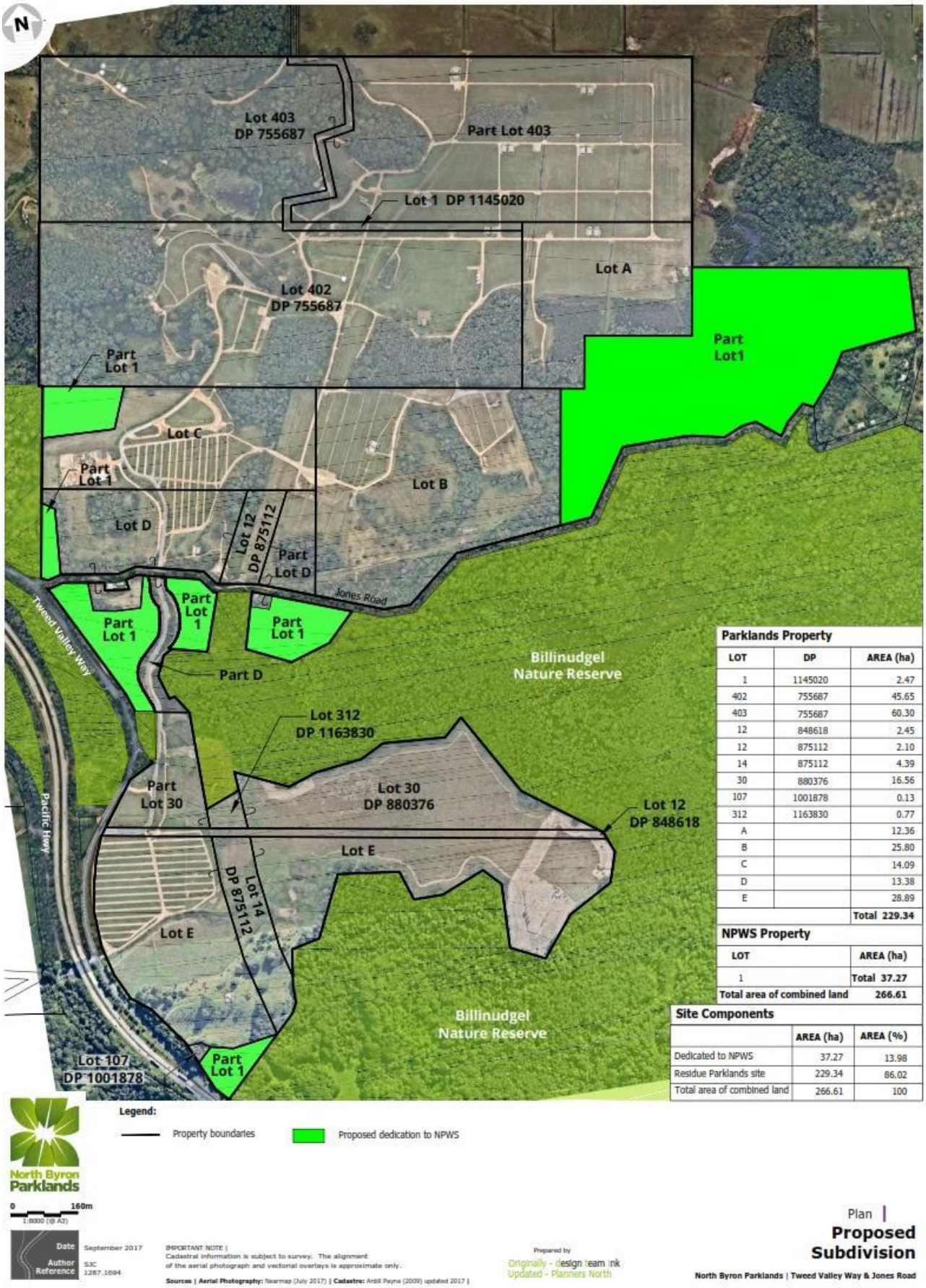
The results demonstrate that the effects of events have been relatively less than natural ecological influences in the project area. Changes that have occurred on site can be attributed to weather conditions, or changes in resources such as food sources. Minor changes have been observed, such as avoidance of the areas by wallabies and flying foxes during illumination (associated with events). However, these have been short-term and reversible. No long-term adverse impacts have been detected during monitoring.

Overall, the biodiversity characteristics of the site are being permanently improved by the current site managers and utilisation patterns. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.

1.1.5 The Proposed land swap

Parklands is also progressing a land swap with NSW NPWS. This includes 37.27 ha being transferred to NPWS, with Parklands gaining ownership of 7.56 ha (i.e. ~30 ha gain for conservation estate). The

land going to NPWS is adjacent to and will enhance Billinudgel Nature Reserve. The land going to the Parklands is highly disturbed with no remnant vegetation and will be included in the event footprint. The location and lot numbers of the proposed site reconfiguration is presented in **Figure 12**. Lands being transferred to the NPWS are excluded from the development site.



Parklands Property

LOT	DP	AREA (ha)
1	1145020	2.47
402	755687	45.65
403	755687	60.30
12	848618	2.45
12	875112	2.10
14	875112	4.39
30	880376	16.56
107	1001878	0.13
312	1163830	0.77
A		12.36
B		25.80
C		14.09
D		13.38
E		28.89
		Total 229.34

NPWS Property

LOT	AREA (ha)
1	Total 37.27
Total area of combined land	266.61

Site Components

	AREA (ha)	AREA (%)
Dedicated to NPWS	37.27	13.98
Residue Parklands site	229.34	86.02
Total area of combined land	266.61	100

Figure 12: Proposed land swap

2 Data Sources

A desktop assessment and review of previous ecological studies, environmental databases, maps and relevant literature was undertaken to evaluate existing data relating to environmental values within the Parklands.

The following was reviewed:

- EPBC Act Protected Matters Search Tool
- Bionet Atlas Database
- OEH Vegetation Information System (VIS) maps
- Coastal Wetlands (State Environmental Planning Policy No. 14) - SEPP 14
- Atlas of Living Australia
- Aerial photography
- Applicable Threatened Species Profiles, Approved Conservation Advice, Recovery Plans and Survey Guidelines for threatened species occurring within the Parklands (as referenced)

Numerous ecological studies have previously been carried out at Parklands since 2007. These reports collectively provide a comprehensive picture of the listed threatened species, their habitats and ecological communities that occur within and directly adjacent to Parklands. These include:

- Performance Report #1 – #5 Appendices B1 Environmental Performance Report and B2 Results and Analyses of Event Impact Monitoring Data (North Byron Parklands 2014a, 2014b, 2015, 2016, 2017)
- August 2007 Fauna Survey of the Parklands (Fitzgerald 2007)
- February 2009 Fauna Survey of North Byron Parklands (Fitzgerald 2009)
- North Byron Parklands Biennial Fauna Survey (Fitzgerald 2014)
- North Byron Parklands Flora and Fauna Rehabilitation Program (Fitzgerald 2016)
- Yelgun Koala Survey and Koala Plan of Management (Biolink 2007)
- Yelgun Koala Survey Koala Habitat Reassessment (Biolink 2008)
- North Byron Parklands SEPP No. 44 Koala Survey and Habitat Reassessment (Biolink 2013)
- North Byron Parklands SEPP No. 44 Koala Monitoring Report (Biolink 2016)

Furthermore, targeted surveys were undertaken to provide specific information for this assessment. These are detailed in section 6.2 below.

2.1 Terminology

The terms “Study Area”, “Development Site” and “Development Footprint” are used within this document. The meanings of these terms are consistent with the definition provided in the FBA.

Throughout this report, first mention of species names are given as scientific names with common names following in parentheses. After first mention, common names are then used except where common names do not exist for the species.

3 General Description of the Development Site

3.1 Landform, Geology & Soils

The site forms a natural amphitheatre comprising a low lying and level central plain surrounded by steep rising hillsides on the northern, western and southern sides of the site. A topographic map is provided in **Figure 13**.

Soils vary from dark organic loams to grey metasediment derived stoney clays. Approximately 60% of the Parklands property is managed exotic grassland.

3.2 Vegetation

Approximately 60% of the Parklands property is cattle pasture comprising exotic grasses, dominated by *Setaria sphacelata* (South African Pigeon Grass) and *Paspalum mandiocanum* (Broad-leaved Paspalum). Native vegetation of the site comprises mainly fragmented floodplain forests and hill slope eucalypt forests.

In summary, lowland forest patches are floodplain swamp sclerophyll forest dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark); with *Lophostemon suaveolens* (Swamp Turpentine), *Casuarina glauca* (Swamp Oak) and *Cinnamomum camphora* (Camphor Laurel) occurring variously as canopy sub-dominants. *Eucalyptus tereticornis* (Forest Red Gum) stands occur in adjacent more elevated areas with Swamp Turpentine, occasional *Corymbia intermedia* (Pink Bloodwood) and *Eucalyptus siderophloia* (Northern Grey Ironbark).

Better drained hill slope forests include *Eucalyptus pilularis* (Blackbutt) and *E. propinqua* (Grey Gum) with Forest Red Gum and *Lophostemon confertus* (Brush Box) dominated stands and a smaller area of rainforest with emergent *Araucaria cunninghamiana* (Hoop Pines).

Approximately three hundred plant species are recorded from the site. This includes 51 exotic or non-native species have been recorded on site; including noxious and environmental weeds e.g. *Chrysanthemoides monilifera* ssp. Rotundata (Bitou Bush), *Lantana camara* (Lantana), *Ligustrum sinense* (Small-leaved Privet).

Most forest communities within the development site are regenerating communities <70 years old. Few old growth trees are present, large logs and hollows are uncommon and very large trees are also rare. Cattle have previously used most of the forest and this has clearly affected the condition and species composition of ground layer plant communities. Most of the Parklands site appears to be pasture in a 1947 aerial photo of the site (**Figure 14**), and the site has more recently been grazed by cattle. Sugar cane and bananas were formerly cultivated in the central and southern portions of the property. Bee-keeping is a continuing activity on the property.

3.3 Habitat Restoration

A significant program of bush regeneration and plantings has occurred on site since 2007, with establishment works in most areas complete (see **Appendix C**). To date over 22,000 trees and shrubs have been planted, with other areas also earmarked for regeneration in the future (**Figure 15** and **Appendix C**).

All planting areas are regularly inspected and weed control undertaken. The majority of these plantings are well established with a greater than 90% establishment rate, and in many areas trees are now in excess of 5 m in height.

The earlier plantings are now developing good quality habitat structure and facilitating native regeneration and an understory. Parklands' ecologists have recorded a wide range of birds and small vertebrate fauna occupying these forest blocks. Most plantings only need once yearly follow up to prevent the establishment of woody weeds such as *Senna pendula* (Easter Cassia) and *Cinnamomum camphora* (Camphor laurel).

As part of future restoration, a minimum 30m buffer area is proposed to be established between the southern car park area and the SEPP14 wetland. The buffer would consist of:

- 350 trees planted sparsely within the buffer area shown as Polygon 39 and 41 in **Figure 15**. This is sparsely planted due to fire hazard reduction requirements. The sparse plantings also ensure potential breeding and foraging habitat for the Eastern Grass Owl is maintained.
- Full revegetation (via planted or natural regeneration) of Polygon 40, subject to bushfire hazard reduction setbacks.

The type and condition of native vegetation within the development site is further discussed within **Section 6**.

3.4 Hydrology

A long established 1.8 ha dam is located in the northwest of the property, a new smaller dam has been recently constructed in the central west of the site, and an established network of constructed drains is present in all lowland or floodplain areas (**Figure 18**). These vary from <1 m to ~2 m width and are up to 3 m depth. Yelgun Creek is present in the south of the property and Billinudgel Creek crosses the property in the south. Both are streams in a highly-modified condition.

3.5 Land Uses

Billinudgel Nature Reserve is located adjacent to the Parklands site (**Figure 12**). The reserve is 713 ha in area and forms one of several coastal nature reserves which protect important remnants of coastal habitat in an otherwise highly modified environment.

Billinudgel Nature Reserve has the following key features:

- A large tract of natural lowland coastal vegetation and a significant remnant in an otherwise highly modified environment.
- An extensive SEPP 14 listed wetland containing Melaleuca swamp forest.
- A diversity of habitat which supports a wide range of fauna and flora including rare, threatened, significant and migratory species.
- Aboriginal sites and landscapes of significance.
- Features of scientific interest.

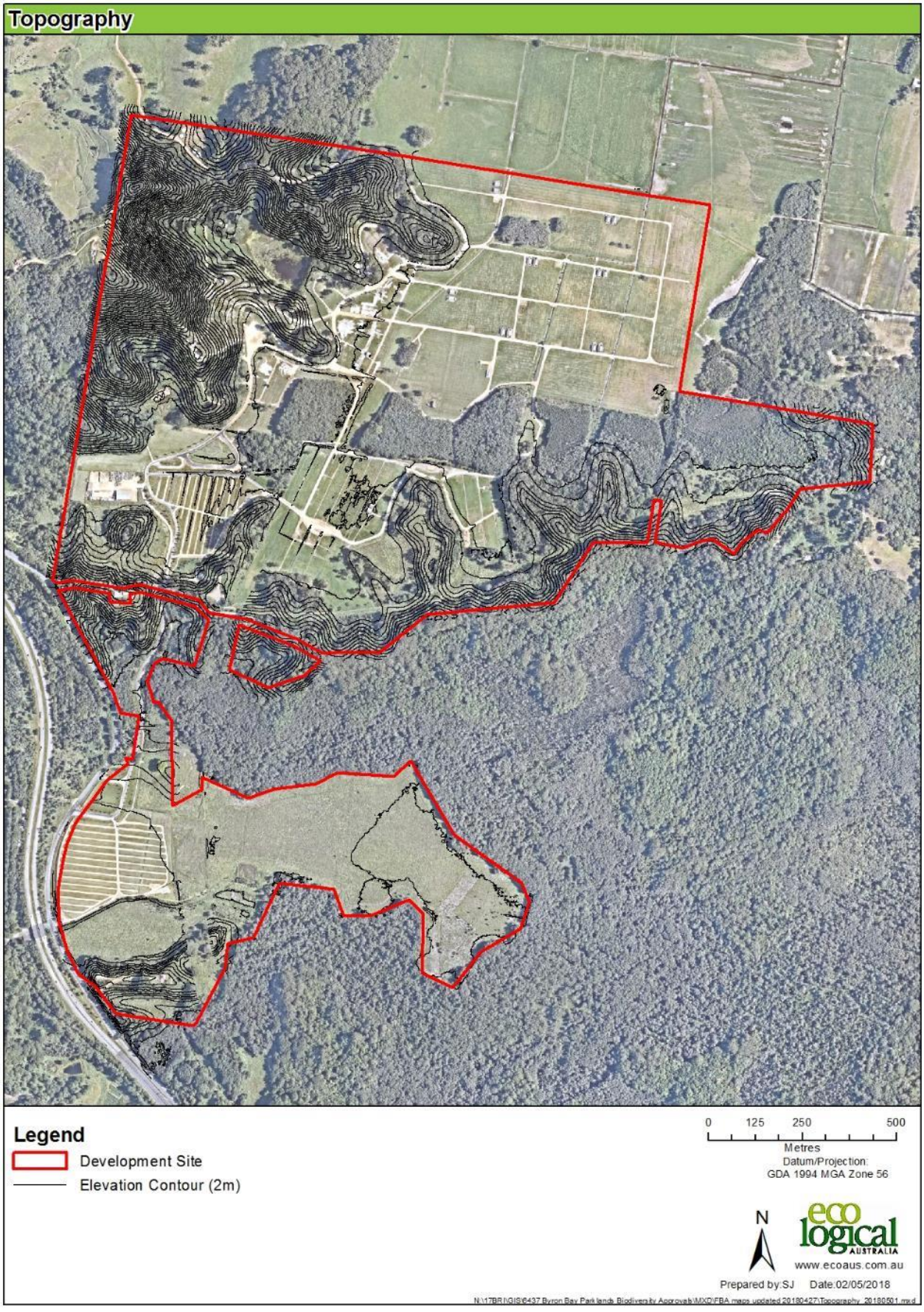


Figure 13: Topography

a

Figure 14: Aerial photo from 1947

Figure 15: Ecological Restoration Plan – green areas are to be the focus of ecological restoration

4 Policies and Legislation

4.1 New South Wales Legislation

4.1.1 Environmental Planning and Assessment Act 1979

The proposal involves two applications under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Firstly, a modification to the existing concept approval (MP 09_0028) is proposed to allow for changes to patron numbers and to update the approval to reflect a permanent cultural events site.

Secondly, development consent is sought to allow the permanent use of the cultural events site, including the continuing use of existing site infrastructure and the development of additional infrastructure to support the cultural events site.

The NSW Minister for Planning is the consent authority for both applications, and the applications will be assessed concurrently.

The NSW Department of Planning & Environment (DP&E) has issued Secretary's Environmental Assessment Requirements (SEARs) for the development application (SSD 8169), which is classified as State Significant Development and will be assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The modification application will be assessed under the former Part 3A of the EP&A Act.

This BAR directly responds to the SEARs that have been issued for the project (see **Appendix A**).

4.1.2 NSW Biodiversity Offsets Policy for Major Projects

As the project is identified as a State Significant Development, under the NSW Biodiversity Offsets Policy for Major Projects, the SEARs require the proponent, to apply the FBA to assess impacts on biodiversity. The FBA must be applied to identify reasonable measures and strategies that can be taken to avoid and minimise impacts to biodiversity. This BAR describes the biodiversity values present on the development site and the impact of the project on these values.

4.1.3 State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44)

The development site is located within the Byron local government area, which is listed under Schedule 1 of the State Environmental Planning Policy 44 (SEPP 44). This policy applies to land to which a development application has been made, which covers an area of more than 1 hectare. The aim of this policy is to promote the conservation and management of natural vegetation that may contain koala habitat. Plans of management are required for areas of core koala habitat.

Biolink Ecological Consultants have undertaken a number of koala surveys and these are summarised in the review of monitoring data (**Appendix F**). A survey conducted in 2007 by Biolink identified approximately 3 ha of Core Koala Habitat (as defined by SEPP 44). A 12-month Individual Koala Plan of Management (IKPoM) was prepared, which required a reassessment of the habitat to identify any changes, prior to the commencement of development. The reassessment undertaken in 2008 indicated a decline in koala activity with the Core Koala Habitat, to the extent that usage at that time was considered to be "relic and/or transient". No Koala activity was recorded during an additional survey in 2013.

Biolink was again engaged in 2016 to further investigate for evidence of koala activity with the Parklands site. This included 25 km radial searches for koalas at over 26 sites. Opportunistic inspections were also undertaken at the base of preferred koala food trees.

The results from the 2016 survey indicate that the cell of Core Koala Habitat in the south-eastern section of the site was likely to exist at the periphery of a larger cell to the south in Billinudgel Nature Reserve. Koala faecal pellets were recorded at 7 sites in the north-western corner of the Parklands, which is an increase in sightings from previous years.

As per the 2016 results, continued monitoring is recommended however (see **Appendix G**).

Furthermore, a KPoM specific to the development site is provided in Appendix B.

4.1.4 NSW Policy and guidelines for fish habitat conservation and management

This document focuses on promoting compliance with legislation relating to fish habitat conservation and management. Under Part 4 of the EP&A Act, NSW DPI is a 'determining authority' for local development that requires a permit under the Fisheries Management Act 1994 (NSW) (FM Act):

- Section 144 - aquaculture permit
- Section 201 - permit to carry out works of dredging or reclamation
- Section 205 - permit to harm (cut, remove, injure, destroy, shade etc.) marine vegetation (saltmarshes, mangroves, seagrass and seaweeds),
- Section 219 – permit to obstruct the free passage of fish.

A development that requires consent on the above approvals is deemed an integrated development under s91, Part 4 of the EP&A Act.

No activities requiring a permit will be undertaken as part of the development and no works will be occurring within the two waterways.

4.1.5 NSW State Groundwater Dependent Ecosystem Policy (DWLC)

The NSW State Groundwater Dependent Ecosystem Policy (DWLC) is a component of the State Groundwater Framework Policy (1997). This policy was developed in order to enhance the protection of groundwater-dependent ecosystems.

A GDE is defined as an ecosystem which has a species composition and a number of ecological processes that are determined by the groundwater. Such ecosystems include, as per the DWLC Policy, terrestrial vegetation, base flows in streams, aquifer and cave ecosystems and wetlands.

Development and use of land is listed as a potential threat to groundwater. The EP&A act requires the potential impacts to groundwater of proposed developments be assessed through the environmental impact assessment process. The *Protection of the Environment Operations Act 1997* is administered by the EPA and is one of the tools for the control of water pollution, including groundwater.

There will be no significant changes in relation to the management or use of groundwater and surface water flows as a result of the proposed development, and therefore, there will be no impacts to GDEs within the development site and within the broader area. This includes the SEPP14 wetland to the south-east of the development site (**Figure 18**), as well as the Paperbark swamp forest of the coastal lowlands within the development site, and any GDEs that may occur within Billinudgel Nature Reserve.

4.2 Commonwealth Legislation

4.2.1 Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Matters of National Environmental Significance (MNES) are protected. The FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be on the development site. Other MNES are not considered under the FBA.

A referral covering all events at the Parklands from 2017 onwards was determined by the Department of the Environment and Energy to be a not controlled action (NCA) on the 27th July 2017 (provided in **Appendix N**). No future assessment or approval under the EPBC Act is required.

5 Landscape Features

Landscape features have been identified consistent with the FBA methodology.

5.1 Landscape features

For all analysis of landscape features within this BAR, a 1,000-ha inner and 10,000-ha outer assessment circle has been utilised in accordance with Appendix 4, Table 8 of the FBA methodology.

5.1.1 Interim Biogeographic Regionalisation of Australia

Bioregions

The development site and outer assessment circle occur wholly within the South-east Queensland Bioregion. The development area is also within the SEQ3 Burringbar-Conondale Ranges (Southeast Hills and Ranges, Murwillumbah) IBRA sub-region. This subregion is characterised by finely dissected steep ranges, with narrow alluvial plains. Relief is generally to 250 m. Vegetation typically includes wet and dry sclerophyll forests, including *Melaleuca quinquenervia* forests, Blackbutt (*Eucalyptus pilularis*), Sydney Blue Gum (*Eucalyptus saligna*), and Forest Red Gum *Eucalyptus tereticornis* on lower slopes and plains.

5.1.2 Mitchell Landscapes

As per **Table 2**, the outer circle predominantly overlays the *Byron – Tweed Alluvial Plains* and the *Mount Warning Exhumed Slopes* Mitchell Landscapes (**Figure 17**). Other Mitchell Landscapes that are overlain by the outer circle include the Byron - Tweed Coastal Barriers and the Lamington Volcanic Slopes, however these do not occur in the development site and are therefore not discussed further.

The *Byron – Tweed Alluvial Plains* is described as including channels, floodplain, terraces and estuary of the Tweed River and other coastal streams on Quaternary alluvium. Elevation is generally between 0 to 50m and soils are generally comprised of uniform brown earths and structured brown clays on floodplains.

The *Mount Warning Exhumed Slopes* Mitchell Landscapes occur in the east of the project area (**Figure 17**). This is characterised by moderately steep hills and ridges with central drainage to the Tweed River, which are formed on the slopes of a pre-Tertiary landscape exposed by erosion of the Lamington volcanics. Geology generally includes Silurian Devonian greywacke, slate, phyllite and quartzite, Triassic rhyolite, tuff and claystone and Jurassic shale sandstone and coal. Soils generally include shallow structured and friable red and brown loam and clay loam gradational profiles. General elevation is 25 to 300m.

Table 2: Mitchell Landscapes Occurring within the Development Site and Outer Assessment Circle

Mitchell Landscape	Proportion of inner circle	Proportion of Outer Assessment Circle
Byron – Tweed Alluvial Plans	73.3%	48.5%
Mount Warning Exhumed Slopes	26.7%	48.3%
Byron - Tweed Coastal Barriers	0%	2.3%
Lamington Volcanic Slopes	0%	0.7%

5.1.3 Streams and rivers

Drainage lines across the site and their associated stream orders are show on **Figure 18**. The development site is traversed by several constructed drainage and natural lines, as well as Billinudgel Creek (Stream Order 2) and Yelgun Creek (Stream Order 4).

Most of the higher catchment streams (that are stream order 1) identified on **Figure 18** do not have defined banks or channels. For instance, the mapped stream directly traversed by the proposed clearing area (**Figure 4**) does not contain a defined bank or channel. In this location, overland flow would actually flow north along the existing track (along V-drains that exist along the western side of the track, as per **Figure 16**).

The mapping of Yelgun Creek is also slightly inaccurate within the development site as this creek actually flows along the southern boundary of the carpark (and not through the current carpark). This is visible on **Figure 18**.

Figure 16: The existing track, including the v drain (left), showing the mapped stream does not exist in this area.

5.1.4 Coastal Management Wetlands

A coastal management wetland (Coastal Management SEPP; formerly SEPP14) exists to the south-east of the project area, with small portions of the wetland occurring within the development site. This wetland is associated with Billinudgel Nature Reserve and is not directly impacted by the project (**Figure 18**).

Further afield, there are also coastal wetlands at Wooyung (north) and Brunswick Heads (south) that exist within the outer circle.

5.1.5 Native vegetation extent

Native vegetation within the outer assessment circle is disjunct as a result of land clearing for agriculture and urban development. Within the 10,000 ha outer assessment circle native vegetation was mapped using the VIS data for the Tweed and Byron LGAs.

Native vegetation extends over approximately 3,875 ha within the outer assessment circle (38.75 %), and is shown on **Figure 19**.

5.1.6 State or Regionally Significant Biodiversity Links

No state significant or regionally significant biodiversity links have been identified within a plan by the Chief Executive of the OEH. As mentioned above, there is a SEPP wetland adjacent to the project area. This is within 50m of the development site and therefore is considered to be a State Significant Biodiversity Link. Nonetheless, the Biobanking Credit Calculator (BBCC) accounts for direct impacts to biodiveristy links only. As the project is not impacting vegetation, inclusion of the SEPP wetland as a State Significant Biodiversity Link is not required.

This is also applicable to the fourth order stream (Yelgun Creek) and the associated 30m buffer that exists in the south of the development site.

In the wider area, the OEH has mapped a regional wildlife corridor across the site (**Figure 20**); however this is not directly relevant to Biobanking Credit Calculator. There are also other biodiversity links that exist across the site (**Figure 20**). This includes connectivity associated with remnant vegetation, as well as connectivity that has been restored via the restoration plan (see **Section 3.3**)

5.2 Landscape Value Score

The development was assessed as a site based assessment.

5.2.1 Attributes

Percent Native Vegetation Cover

In accordance with Appendix 4 of the FBA, the current and future native vegetation cover was assessed in Geographic Information Systems (GIS) using VIS data for Byron and Tweed Heads LGA. The project will result in the loss of a very small area of native vegetation (approx. 300m^2) therefore the current and future extent of vegetation is essentially the same (**Table 3**).

Table 3: Current and Future Extent of Native Vegetation with the Inner and Outer Assessment Circles

Assessment Circle	Current Native Vegetation Extent			Future Native Vegetation Extent		
	Area (ha)	**% Cover**	**Category**	**Area (ha)**	**% Cover**	**Category**
Inner Assessment Circle	3,875	38.75	36-40	3,875	38.75	36-40
Outer Assessment Circle	486	48.60	46-50	486	48.6	46-50

Connectivity Value

Connectivity of the development site was assessed using Tables 11 – 14 in Appendix 4 of the FBA. There are no connectivity value classes that will be impacted by the project. The connectivity value class score is therefore 0.

The current linkage width across site is 0-5m (very narrow). There are no linkage width classes that are lost due to the project.

The vegetation within the development site is classed as a woody vegetation type with both the over story condition and mid story / ground cover conditions being at benchmark.

Patch Size

Patch size was calculated using available VIS vegetation mapping. The patch size included all vegetation patches linked to the development footprint within the outer assessment circle. Patches within the development site were considered linked when the adjacent vegetation was:

- In moderate to good condition
- Has a patch size of > 1 ha
- Is separated by a distance of < 100 m; and
- Is not separated by a large water body, dual carriageway, wider highway, or similar hostile link.

Vegetation within the development site is connected to a wider patch of vegetation associated with Billinudgel Nature Reserve and surrounds. This patch is shown in Figure 19 and is approximately 1,500 ha. This corresponds to >1,000 in Table 15 of the FBA Methodology (regardless of the Mitchell Landscape), and therefore is considered extra-large, with a patch size score of 12.

5.2.2 Score

Based on the assessment of landscape attributes above, the Landscape Value Score has been calculated to be 12.

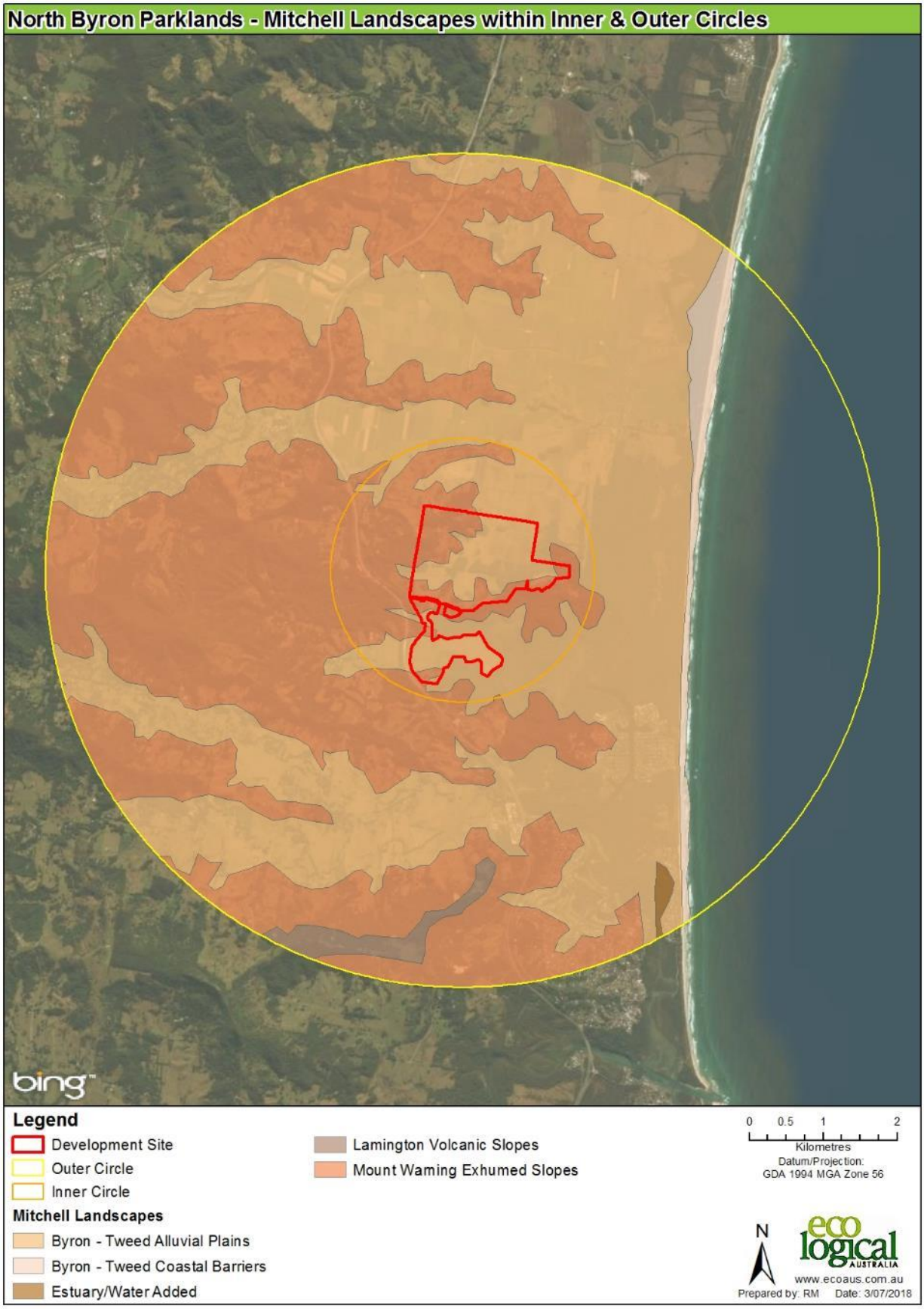


Figure 17: Mitchell Landscapes within the inner and outer circles

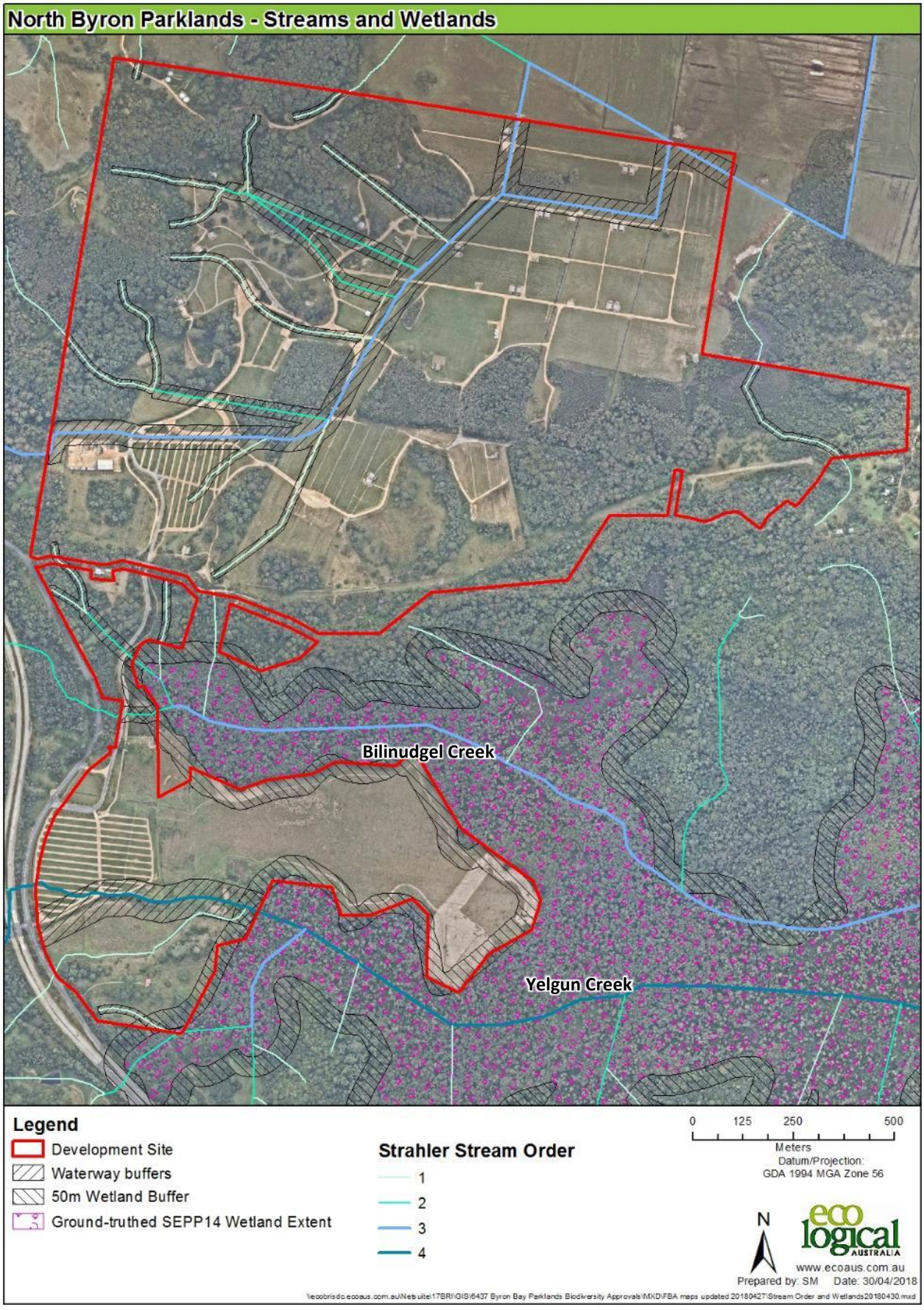


Figure 18: Wetlands and Streams, including buffers

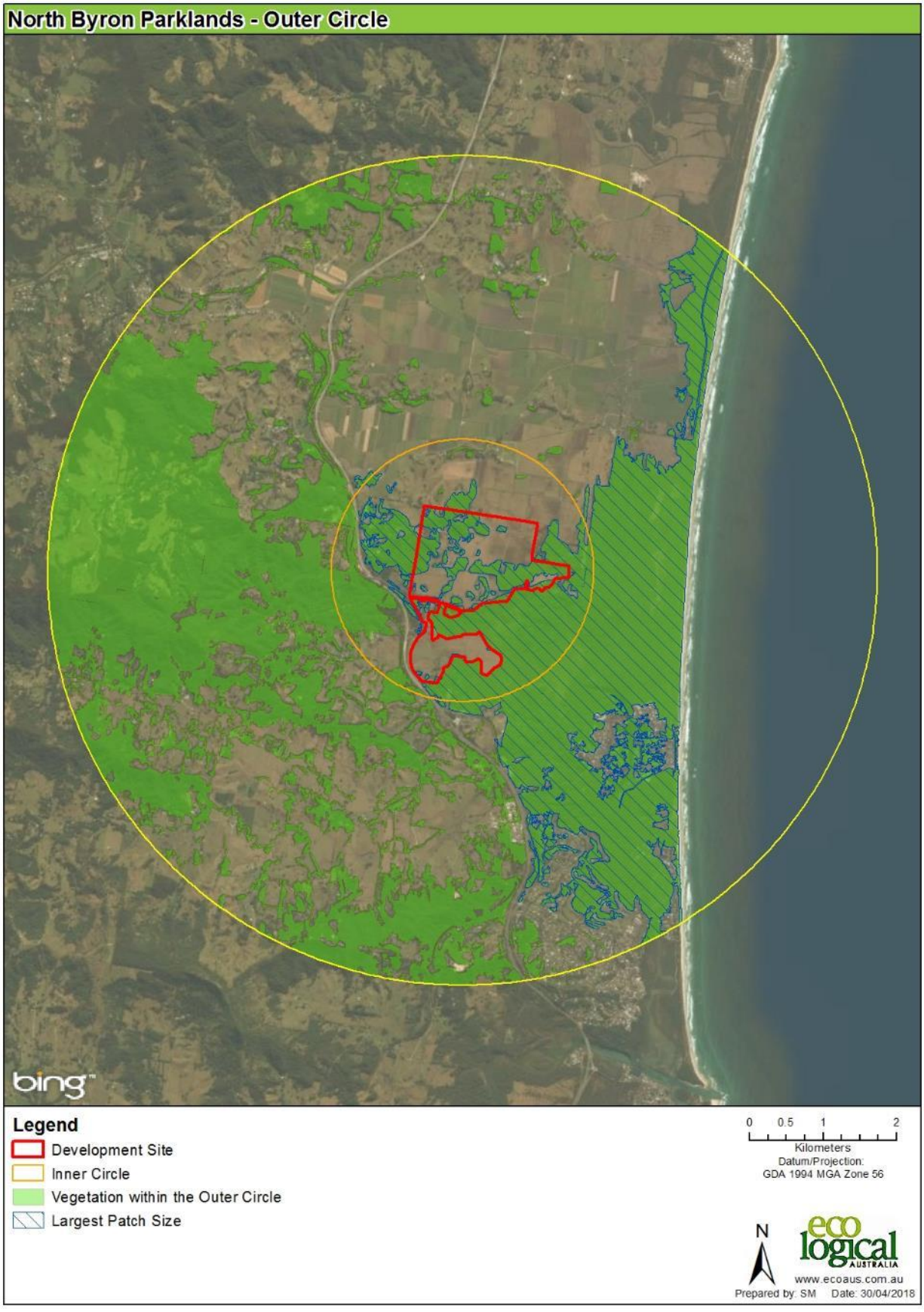


Figure 19: Largest patch size

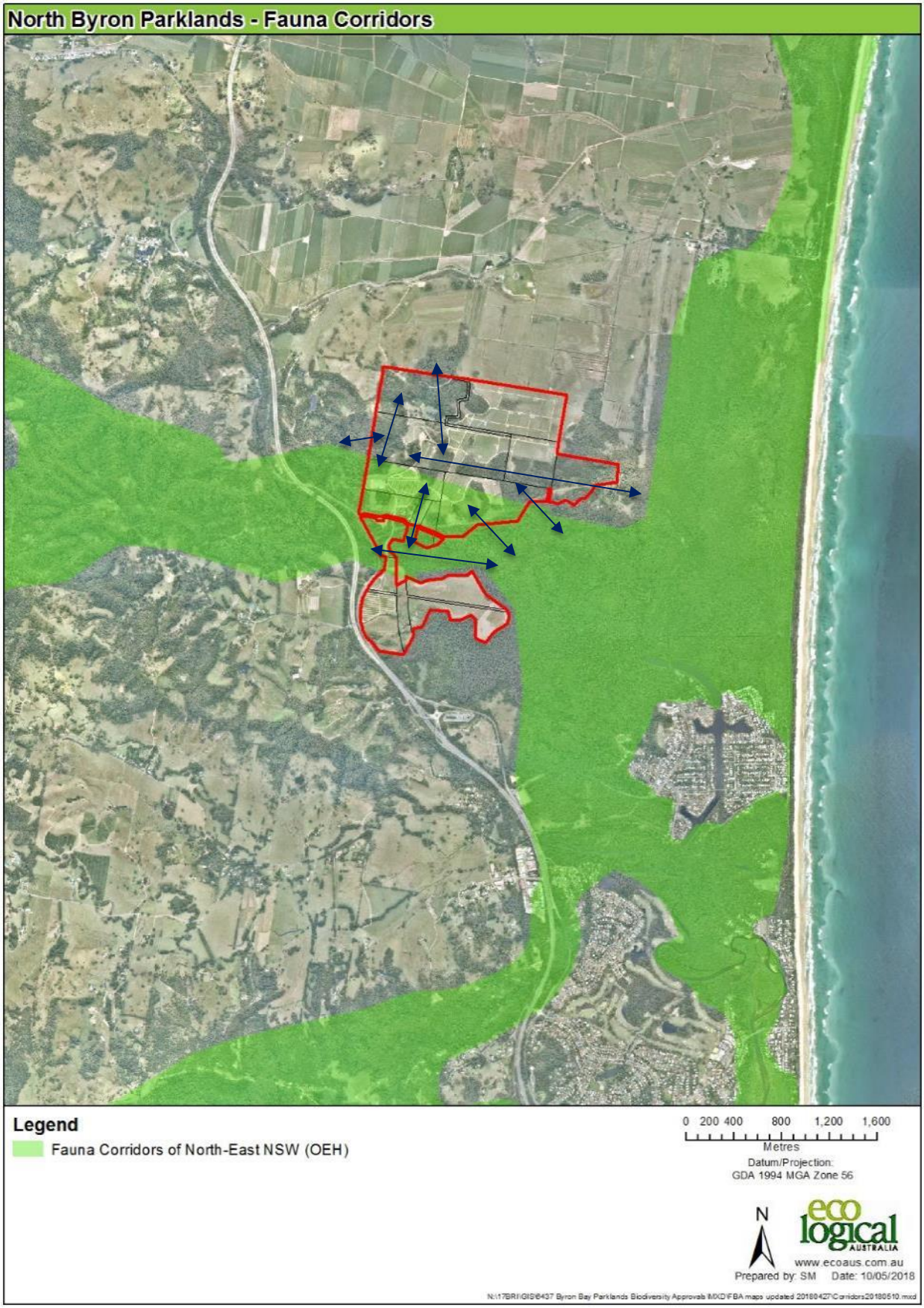


Figure 20: Fauna Corridors of North-East NSW (OEH) (arrows represent generalised terrestrial movement corridors across the development site)

6 Ecological Surveys Undertaken

The surveys have been designed to provide an overview of the biodiversity values of the development site, as well as the extent of vegetation communities and flora species. This includes historical surveys as well as recent surveys undertaken in accordance with the FBA methodology. Each of these are discussed in the below sections.

6.1 Historical surveys

Numerous surveys have been undertaken within the development site from 2007 to 2017, including nine Event Impact Monitoring (EIM) events and seven other surveys. This includes:

- Performance Report #1 – #4 Appendices B1 Environmental Performance Report and B2 Results and Analyses of Event Impact Monitoring Data (North Byron Parklands 2014a, 2014b, 2015, 2016, 2017)
- August 2007 Fauna Survey of the Parklands (Fitzgerald 2007)
- January 2009 Vegetation Assessment and Monitoring (Kooyman 2009)
- February 2009 Fauna Survey of North Byron Parklands (Fitzgerald 2009)
- North Byron Parklands Biennial Fauna Survey (Fitzgerald 2014)
- North Byron Parklands Flora and Fauna Rehabilitation Program (Fitzgerald 2016)
- Yelgun Koala Survey and Koala Plan of Management (Biolink 2007)
- Yelgun Koala Survey Koala Habitat Reassessment (Biolink 2008)
- North Byron Parklands SEPP No. 44 Koala Survey and Habitat Reassessment (Biolink 2013)
- North Byron Parklands SEPP No. 44 Koala Monitoring Report (Biolink 2016)

Sampling methods for EIM and other surveys are summarised below, with full details available in the documents listed above. Monitoring locations are presented in **Figure 21** and **Figure 22**.

Event Impact Monitoring (EIM)

The monitoring methods for EIM were developed and approved as part of the Flora and Fauna Monitoring Program (2013) and are summarised in **Table 4** below. This program has been implemented during the nine events listed in **Table 5**.

Table 4: Summary of EIM survey and monitoring methodology across the development site (2007 – 2017)

Target Group	Sampling Methodology
Vegetation and Flora	Establishment of 22 permanent vegetation plots (as 20 x 20m quadrats with 10 x10m subplots) to sample the range of native vegetation community types on the site, inclusive of floristic and structural components.
Targeted Flora Sampling	Targeted sampling for threatened flora across the site incidentally whilst undertaking vegetation and fauna surveys. This has included a targeted assessment for *Arthraxon hispidus* (Hairy Joint Grass) in 2009 in potential habitat areas (pers. comm M. Fitzgerald, March 2017)
Vegetation	Vegetation condition and changes before and after each event recorded at 27 permanent photo-points across the Parklands.
Forest Birds	Monthly samples (ten X 20 minute / 200m transects) taken before, during and after each event over three consecutive days between November to January, and from June to September. Sampling events are undertaken by three experienced observers. Impact sites within the Parklands; control sites within Billinudgel Nature Reserve
Forest Birds – plantings	Birds monitored at two sites in established (~10 year old) native plantings in the Marshall's Ridges area – commenced 2015
Waterbirds	20-minute point counts of waterbirds around the 2 ha constructed dam on-site recording species and abundance since 2007
Eastern Grass Owl	Targeted survey and call playback each July during event years – 2013, 2014, 2015, 2016, 2017
Terrestrial Mammals	Ten hair funnels deployed at each of 5 locations at 20 m intervals along a bird transect. The sampling for four nights before, during and after each event.
Terrestrial Fauna	Two sand traps deployed (within an area of 20 m²) on three nights before, during and after each event at eight locations along tracks. Traps raked the night before sampling and checked each morning. Two motion sensor wildlife cameras deployed in the Marshall's Ridges area to monitor fauna presence – commenced 2015.
Microchiropteran Bats	Three locations sampled by Anabat call detectors. Anabats deployed for three nights before, during and after each event. Two locations are within the event area (dam and flyway) and the third nearby within Billinudgel Nature Reserve.
Flying-foxes	Incidental survey whilst ecologist on site during events
General Fauna	Incidental road kill observations
Koala	Targeted searches (KSAT) and habitat assessments.

Note: Minor methodology changes have been made during the life of the project.

Table 5: List of events monitored, including number of patrons

Event	Monitoring dates	Number of patrons per day
Splendour in the Grass 2013	Before: June; During: July; After: August, September	25,000
Splendour in the Grass 2014		27,500
Splendour in the Grass 2015		30,000
Splendour in the Grass 2016		32,500
Splendour in the Grass 2017[+]		32,500
Falls Festival 2013-14	Before: December; During: January; After: February	15,000
Falls Festival 2014-15		17,500
Falls Festival 2015-16		20,000
Falls Festival 2016-17		22,500

[+] Results not yet available

Other Historical Surveys

A number of other surveys have been undertaken at the Parklands. Prior to 2013, these were to support the environmental approvals process. Subsequent surveys have been undertaken as part of the approvals requirements. This is primarily the 2014 biennial fauna survey. A summary of these surveys and the method employed is provided in **Table 6**.

Table 6: Summary of other surveys undertaken at the Parklands

Survey type	Year	Methods employed	Reference
Fauna survey	2007	Anabat detection Bird survey (incl. call playback) Drift fence and pitfall traps Elliot traps Flying-fox census Frog survey Harp trapping Incidental observations incl. of tracks, scats, diggings and remains Reptile survey Spotlighting	Fitzgerald 2007
Fauna survey	2009	As per 2007 fauna survey above	Fitzgerald 2009
Fauna survey	2014	Anabat detection Bird survey incl. call playback Elliot traps Frog survey Harp traps Sand traps	Fitzgerald 2014

Survey type	Year	Methods employed	Reference
		Spotlighting Waterbird surveys Incidental observations incl. of tracks, scats, diggings and remains	
Koala survey	2007	Analysis of historical records Site assessment – habitat quality and koala searches (KSAT)	Biolink 2007
Koala survey	2008	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2008
Koala survey	2013	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2013
Koala survey	2016	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2016

6.1.1 Historical Survey effort

The surveys described above have resulted in extensive survey effort for target species and species groups at the Parkland since 2007. The tables below provide details of total survey effort (**Table 7**), effort during targeted fauna surveys (**Table 8**) and effort during EIM (**Table 9**).

Table 7: Total fauna survey effort 2007 – 2017, including general fauna survey, targeted Koala survey and all Event Impact Monitoring (9 events)

Target fauna group	Method	Total survey effort
Mammals	Elliot trapping	1,125 trap nights
	Hair tube sampling	5,400 tubes
Koala	Koala Spot Assessment Technique (KSAT)	97 assessments
	Habitat assessment and incidental observations	27 days
Reptiles	Pitfall traps	75 traps days
Reptiles and amphibians	Targeted habitat searches	13 days
Mammals and reptiles	Sand traps and motion cameras	420 nights
Nocturnal species	Spotlighting	65 nights
Microbats	Harp netting	26 trap nights
	Anabat deployment	264 nights
Forest birds	Timed bird census	270 hours
Water birds	Timed bird census at dam	11.6 hours
Owls and cryptic birds	Call playback	34 sessions

Table 8: Total fauna survey effort during general fauna surveys 2007, 2009, 2014

Target fauna group	Method	Total survey effort
Mammals	Elliot trapping	1,125 trap nights
Reptiles	Pitfall traps	75 traps days
Reptiles and amphibians	Targeted habitat searches	13 days
Nocturnal species	Spotlighting	11 nights
Microbats	Harp netting	26 trap nights
	Anabat deployment	21 nights
Owls and cryptic birds	Call playback	25 sessions

Table 9: Total fauna survey during Event Impact Monitoring (9 events)

Target fauna group	Method	Total survey effort
Mammals	Hair tube sampling	5,400 tubes
Mammals and reptiles	Sand traps and motion cameras	420 nights
Nocturnal species	Spotlighting	54 nights
Microbats	Anabat deployment	243 nights
Forest birds	Timed bird census	270 hours
Water birds	Timed bird census at dam	11.6 hours
Eastern Grass Owl	Call playback	9 sessions

6.1.2 Historical Survey conclusions

A detailed analysis of the survey results was undertaken to support this assessment (**Appendix F**). The overall survey and monitoring results to date indicate that the cultural events at the Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities. Increased light and noise levels are an inevitable occurrence associated with event, and these factors will impact on local fauna movements and site usage during the period of each event. However comprehensive EIM has shown that once these factors cease to operate and the site returns to pre-event conditions, fauna presence and habitat values return to baseline conditions. Moreover, there are no evidence of declines in any environmental values at the Parklands, indicating no cumulative effects of holding multiple events.

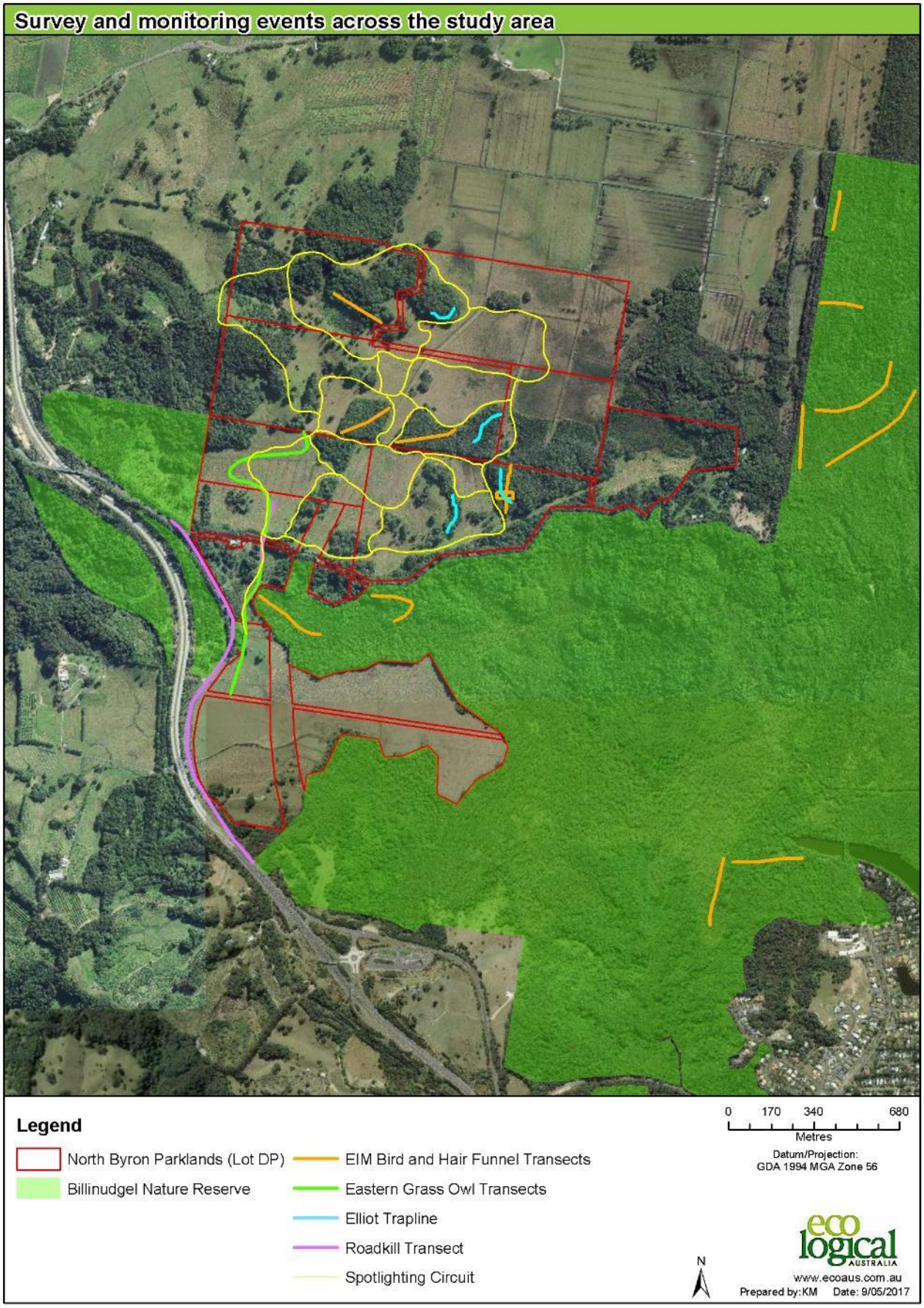


Figure 21: Transect survey and monitoring locations within the Parkland and surrounds

Figure 22: Survey and monitoring locations within the Parklands and surrounds

6.2 Recent Surveys for FBA

Additional surveys were undertaken within the development site to support the FBA, as described below.

The extent of recent survey effort is shown in **Figure 23**.

Areas of native vegetation were delineated using site observation and aerial photography. The assessment met the full requirements of the FBA including full floristic survey, as well as plot and transect survey within any PCTs identified within the development site.

To identify PCTs within the development site, plot-based full floristic surveys and plot and transect surveys were undertaken within vegetation zones as identified in Table 1 of the FBA. Plot and transect surveys were undertaken at all survey points. Previous flora data was utilised (and checked on site) for the full floristic plots, and where this data was not available, full floristic plots were undertaken. The surveys were primarily undertaken in existing woodland vegetation, with a single plot also undertaken in the grassland vegetation present in the south-east of the development site. The grassland vegetation in this area has previously been unmanaged. Photographs and site notes were also recorded within the development site and adjacent vegetation.

The location of the surveys was chosen based on the location of pre-existing vegetation survey points. Where pre-existing survey points were not available, new points were established within areas considered representative of the vegetation type.

The minimum number of plot and transect sites required, based on the condition and extent of each vegetation zone, is shown in **Table 10**. Additional plots, surplus to the requirement of the FBA, were gathered within the development site. All data collected within each of the PCTs on the development site and adjacent areas have been used for this assessment.

At each survey site, the following information was collected:

- Site ID
- Name of recorder(s)
- Date
- Plot orientation, slope, and aspect
- Easting and northing at either end of the 50 m transect
- Site photographs
- A plot-based 400 m^2 full floristic survey (except where existing flora data existed. In this case, data was ground-truthed and utilised).
- A plot and transect survey.

Table 10: Vegetation zone size and number of plots required

Vegetation zone	PCT	Condition	Area (ha)	Plots required	Plots completed
1	PCT 693 (NR121): Blackbutt - Tallowwood tall moist forest of the far north east of the NSW North Coast Bioregion	Moderate to good	31.63	4	4
2	PCT 749 (NR140): Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion	Moderate to good	23.31	4	4
3	PCT 749 (NR140): Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion	Moderate to good (Poor)	1.67	1	1
4	PCT 826 (NR159): Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast	Moderate to good	1.37	1	1
5	NR1064 (NR217): Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Moderate to good	23.07	4	4
6	PCT 837 (NR164): Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Moderate to good	22.68	4	4
7	PCT 837 (NR164): Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Moderate to good (Poor)	1.84	1	1
		Total native vegetation	**105.60**	**19**	**19**
Cleared land	No PCT assigned	N/A	135.62	0	2
Other non-native Vegetation	No PCT assigned	N/A			
		Total	**241.922**	**18**	**21**

6.2.1 Plot-based Full Floristic Survey

The plot-based full floristic surveys included two vegetation surveys, conducted by two ecologists, one of which was a qualified, accredited assessor and the author of this BAR. The vegetation surveys occurred on 22 – 24 March 2017; 19-20 April 2018; and 22 May 2018.

Within the 20 m x 20 m quadrats, the following data was collected:

- **Species name**; Scientific name and common name
- **Cover**: an estimate of the appropriate cover measure for each recorded species: from 1-5 and then to the nearest 5%

- **Abundance**: A relative measure of the number of individuals or shoots of a species within the plot using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000, or specify a number greater than 1000 if required
- **Form**: (T) Tree; (M) Mallee tree; (S) Shrub; (G) Tussock Grass (Poa/Themeda); (D) Sod grass (Couch/Kikuyu); (L) Vine/climber/scrambler; (V) Sedge (Cyperoid); (R) Rush (Restioid, Juncaceae); (F) Forb; (E) Fern; (P) Palm; (A) Cycad.

6.2.2 Plot and Transect Surveys

Within each plot and transect survey, the following information was collected:

- Within a 20 m x 20 m quadrat:
  - The number of native species present
- Along a 50 m transect every 5 m:
  - Native over-storey cover (%)
  - Native mid-storey cover (%)
  - Exotic over-storey cover (%) and
  - Exotic mid-storey cover (%)
- Along a 50 m transect every 1 m:
  - Native ground cover (grasses)
  - Native ground cover (shrubs)
  - Native ground cover (other) and
  - Exotic ground cover.
- Within a 50 m x 20 m quadrat:
  - Number of trees with hollows and
  - Total length of fallen logs > 10 cm width (m);
- Within whole vegetation zone:
  - All canopy species and
  - Proportion of regenerating canopy species.

6.2.3 Hollow Bearing Tree Surveys

Hollowing bearing tree surveys were also undertaken in response to OEH requirements within the SEARs. The surveys were undertaken in February 2017 and April 2018 to identify hollow-bearing trees within the 200m buffer zone (see **Figure 41**). As access to neighbouring freehold lots was not granted by the respective landowners, the survey was constrained to public lands, and lands owned by North Byron Parklands. Where access was not granted, knowledge of the vegetation communities on site and land disturbance history was considered to assess the likelihood of hollow bearing trees.

Two experienced ecologists conducted walking transects through all habitats within the available search area, occasionally extending beyond the 200 m boundary, as determined by GPS and mapping, but excluding freehold lands. The location of all hollow-bearing trees (as per FBA definition) was recorded, and notes made on the condition and location of habitat features.

Binoculars were used to assess size and suitability of hollows, and a GPS (Garmin, Etrex) was used to identify the location of hollow-bearing trees. Location accuracy varied from +/- 5-20metres. Trees were identified to species where possible, and the height, diameter at breast height, number of trunk hollows (truhol) and number of branch hollows (brahol) were counted. The condition of the tree was recorded: Live, Senescent or Dead.

6.2.4 Threatened Flora Species Surveys

Three threatened species surveys were undertaken, including:

- Two targeted surveys for *Arthraxon hispidus* (Hairy Joint Grass), which were undertaken on 6 June 2017, and on 17 and 21 March 2018. These were undertaken in line with the FBA methodology in pasture in the south-east of the project area. This area was targeted by the surveys as it has been left unmanaged (i.e. no mowing or grazing). This is in contrast to the rest of the pasture areas in the project area, which are regularly mown.
- Survey for threatened flora species within the proposed clearing area on 19 April 2018. The proposed clearing area is associated with the proposed vehicular track described in **Section 1.1.2** and **Figure 4**.

No threatened species were recorded during these surveys.

6.2.5 Surveys to assess the presence of lowland rainforest

Three floristic plots were undertaken in April 2017 in an area of *Lowland rainforest of the NSW north coast bioregion* EEC (see **Figure 23**). This survey was undertaken to support the associated EPBC Act referral.

The method included noting all plant species in a 20 x 20m plot, with abundance estimates for each flora species collected using the Braun-Blanquet method.

6.2.6 Surveys to assess habitats within 1km of the Development Site

An assessment of the importance of habitats within 1 km of the Development Site was also undertaken to satisfy OEH requirements within the SEARS. This was mainly based on >5 years of field data from within the Parklands site and Billinudgel Nature Reserve. Access to lands within the 1 km buffer was limited to the areas of National Parks estate, NBP holdings and road reserves, as neighbours did not provide permission for access to freehold lands in the buffer areas.

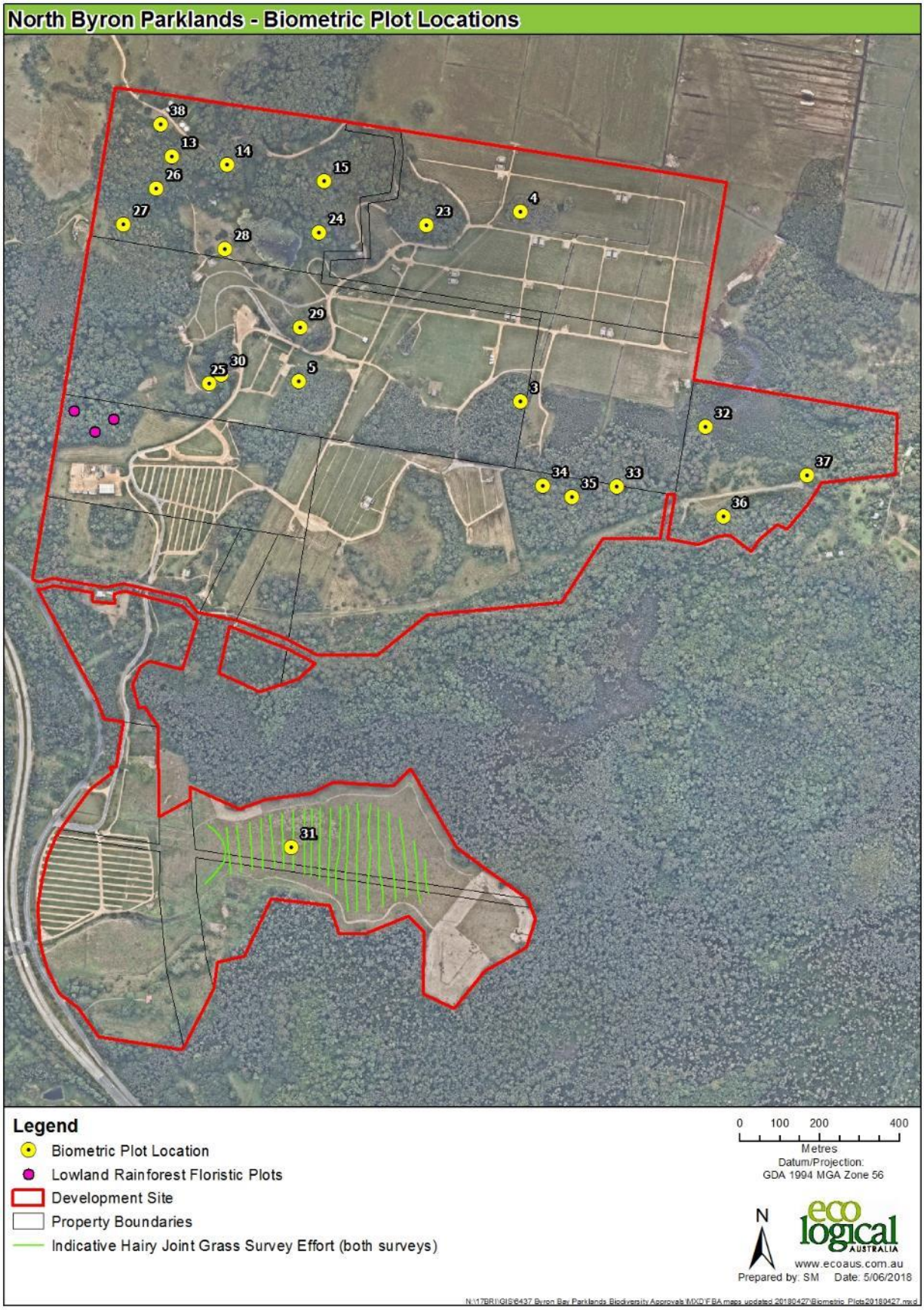


Figure 23: Survey Locations and Hairy Joint Grass survey effort

7 Native Vegetation

7.1 Review of Existing Data

The following documents and databases were reviewed during assessment of native vegetation within the development site:

- VIS Classification Database and mapping;
- Aerial photography from NearMaps from April and May 2017; and
- Previous vegetation surveys of the site (see **Section 6.1**).

7.2 Identification of Plant Community Types and Vegetation Zones

The FBA requires that PCTs are mapped within the Development Site.

A map of vegetation within the development site is provided in **Figure 24**. This figure shows both the distribution of PCTs within the Development Site, as well as the areas of unmown exotic grassland. A general description of vegetation across the site is also provided in **Section 3.2** whilst the five associated PCTs are described in **Table 11**. Although these PCTs have been mapped and described, none of them will be directly impacted by the proposed development, except for a small patch of vegetation associated with the proposed new road in the north-west, west of the proposed cabins.

Table 10 above provided details of patch size.

Identification of PCTs was undertaken by:

- Obtaining expert input from Mark Fitzgerald, the ecologist who has undertaken a majority of the surveys over the last 10 years on the site;
- Review of 2009 floristic data, which included 21 floristic plots across remnant vegetation patches within the development site (Earth Process Ecological Services and Mark Fitzgerald, 2009);
- Use of biometric plot data collected the site and use of data from three floristic plots in an area of lowland rainforest (shown in **Appendix H**, **Figure 24** and described in **Section 6.2**);
- Review of publically available databases (e.g. the NSW VIS) and mapping;
- Review of aerial photography; and
- Incorporating field data with available databases and mapping.

PCTs and vegetation zones within the development site were identified by incorporating the following hierarchy of factors in conjunction with site data:

- Occurrence of the PCT within the IBRA subregion;
- Vegetation formation;
- Landscape position;
- Dominant native canopy, mid-storey, and groundcover species; and
- Availability of the PCT within the BBCC.

Following assessment of landscape position and vegetation survey results, and with the review of 2009 floristic data and integration of site knowledge from M selection criteria were used to determine PCTs and vegetation zones within the development site as shown in **Table 11**.

Table 11: Selection criteria for PCTs and Vegetation Zones

Veg Zone	PCT code / Condition	PCT name	Selection criteria	Species relied upon for assigning PCT	Site Value Score
1	PCT 693 in VIS; PCT1294 in Biobanking Calculator (NR121): Moderate to Good	Blackbutt - Tallowwood tall moist forest of the far north east of the NSW North Coast Bioregion	**IBRA Subregion:** SEQ03 Burringbar-Conondale Ranges **Vegetation Formation:** Wet Sclerophyll Forests (Shrubby sub-formation) **Vegetation Class (Keith):** North Coast Wet Sclerophyll Forests **Landscape Position:** Foothills	**Upper Stratum Species:** *Eucalyptus pilularis* (Blackbutt), *Eucalyptus microcorys* (Tallowwood), *Eucalyptus acmenoides* (White Mahogany) **Mid Stratum Species:** None matching **Ground Stratum Species**: *Lomandra longifolia* (Spiny-headed Mat-rush), Imperata cylindrica (Blady Grass), *Pteridium esculentum* (Bracken Fern)	66.67
2	PCT 749 in VIS; PCT 1313 in Biobanking Calculator (NR140) – Moderate to Good	Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion	**IBRA Subregion:** SEQ03 Burringbar-Conondale Ranges **Vegetation Formation:** Wet Sclerophyll Forests (Shrubby sub-formation) **Vegetation Class (Keith):** Northern Escarpment Wet Sclerophyll Forests **Landscape Position:** Ranges	**Upper Stratum Species:** *Lophostemon confertus* (Brush Box) **Mid Stratum Species:** *Synoum glandulosum* (Scentless Rosewood); *Psychotria loniceroides* (Hairy psychotria) **Ground Stratum Species**: *Doodia aspera* (Prickly Rasp Fern)	63.33

Veg Zone	PCT code / Condition	PCT name	Selection criteria	Species relied upon for assigning PCT	Site Value Score
3	PCT 749 in VIS; PCT 1313 in Biobanking Calculator (NR140) – Moderate to Good (Poor)	Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion	**IBRA Subregion:** SEQ03 Burringbar-Conondale Ranges **Vegetation Formation:** Wet Sclerophyll Forests (Shrubby sub-formation) **Vegetation Class (Keith):** Northern Escarpment Wet Sclerophyll Forests **Landscape Position:** Ranges	**Upper Stratum Species:** *Lophostemon confertus* (Brush Box) **Mid Stratum Species:** None matching **Ground Stratum Species**: None matching	24.00
4	PCT 826 in VIS; PCT 1332 in Biobanking Calculator (NR159) – Moderate to Good	Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast	**IBRA Subregion:** Not listed on BioNet Vegetation Classification System. **Vegetation Formation:** Wet Sclerophyll Forests (Shrubby sub-formation) **Vegetation Class (Keith):** North Coast Wet Sclerophyll Forests **Landscape Position:** Ranges	**Upper Stratum Species:** *Eucalyptus grandis* (Flooded Gum) **Mid Stratum Species:** *Guioa semiglauca* (Guioa) **Ground Stratum Species**: *Smilax australis* (Lawyer Vine)	44.67

Veg Zone	PCT code / Condition	PCT name	Selection criteria	Species relied upon for assigning PCT	Site Value Score
5	PCT 1064 in VIS; PCT 1390 in Biobanking Calculator (NR217): Moderate to Good	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	**IBRA Subregion:** SEQ03 Burringbar-Conondale Ranges **Vegetation Formation:** Forested Wetlands **Vegetation Class (Keith):** North Coast Wet Sclerophyll Forests **Landscape Position:** Lowlands / alluvial flats	**Upper Stratum Species:** *Melaleuca quinquinervia* (Broad-leaved Paperbark); *Lophostemon suaveolens* (Swamp Box); *Casuarina glauca* (Swamp Oak) **Mid Stratum Species:** *Parsonsia straminea* (Common Silkpod) **Ground Stratum Species**: *Blechnum indicum* (Swamp Water Fern); *Gahnia* sp.	63.33
6	PCT 837; PCT 1334 in Biobanking calculator (NR161): Moderate to Good	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	**IBRA Subregion:** SEQ03 Burringbar-Conondale Ranges **Vegetation Formation:** Grassy Woodlands **Vegetation Class (Keith):** Coastal Valley Grassy Woodlands **Landscape Position:** Lowlands	**Upper Stratum Species:** *Eucalyptus tereticornis* (Forest Redgum) *Corymbia intermedia* (Pink Bloodwood); *Eucalyptus siderophloia* (Grey Ironbark) Lophostemon suaveolens (Swamp Box) **Mid Stratum Species:** None matching **Ground Stratum Species**: *Lomandra longifolia* (Spiny-headed Mat Rush)	47.40

Veg Zone	PCT code / Condition	PCT name	Selection criteria	Species relied upon for assigning PCT	Site Value Score
6	PCT 837; PCT 1334 in Biobanking calculator (NR161): Moderate to Good (Poor)	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	**IBRA Subregion:** SEQ03 Burringbar-Conondale Ranges **Vegetation Formation:** Grassy Woodlands **Vegetation Class (Keith):** Coastal Valley Grassy Woodlands **Landscape Position:** Lowlands	**Upper Stratum Species:** Non matching **Mid Stratum Species:** None matching **Ground Stratum Species**: None matching	22.40

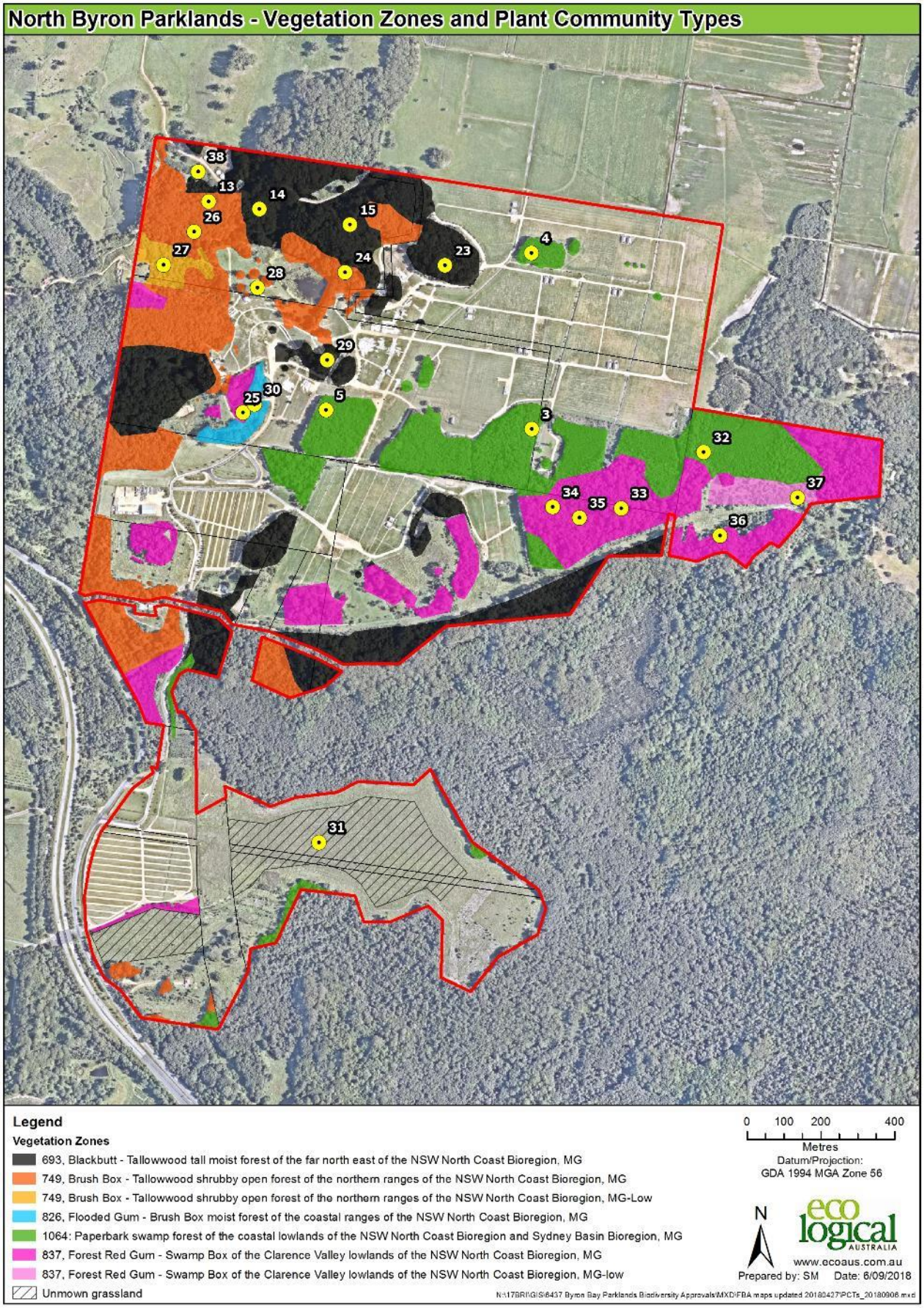


Figure 24: PCTs within the development site

7.3 Description of Plant Community Types

7.3.1 Vegetation Zone 1: Blackbutt - Tallowwood tall moist forest of the far north east of the NSW North Coast Bioregion

This community consists of regrowth forest (>70 years old) in good condition on the foothills within the development area. The canopy (approx. 20-30 m high) is dominated by Blackbutt, with Pink Bloodwood, *Eucalyptus acmenoides* (White Mahogany), *Eucalyptus microcorys* (Tallowwood), *Eucalyptus propinqua* (Small-fruited Grey Gum), *Eucalyptus siderophloia* (Grey Ironbark), Brush Box and *Syncarpia glomulifera* (Turpentine) also common.

The mid story generally consists of *Pittosporum undulatum* (Native Daphne), *Notelaea longifolia* (Large-leaved Olive), *Hovea acutifolia* (Purple Pea Bush), *Acmena smithii* (Common Lilly Pilly), *Acacia obtusifolia* (Blunt Leaf Wattle) and Guioa, amongst others that are noted in **Appendix H**. The weeds Camphor Laurel and *Lantana camara* (Lantana) were also common, though not abundant.

The ground layer generally consisted of *Doodia aspera* (Prickly Rasp Fern), *Blechnum cartilagineum* (Gristle Fern), *Pteridium esculentum* (Common Bracken), and *Lomandra multiflora* (Many-flowered Mat-rush). The climbers *Smilax* spp., *Geitonoplesium cymosum* (Scrambling Lily) and *Marsdenia rostrata* (Milk Vine) were also common.

This community would provide good fauna habitat due to the community's age and contiguousness with other large patches of vegetation. Large standing trees, fallen logs, trees with hollows, native ground covers, and course and fine litter were present.

An indicative photograph of this community is shown in **Figure 25**.

Figure 25: Vegetation Zone 1

7.3.2 Vegetation Zone 2: Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion

This vegetation zone consisted of remnant vegetation in good condition and was more often on southerly facing aspects. The canopy (20-30m high) was dominated by Brush Box, with Pink Bloodwood and Blackbutt also occasionally present in the canopy. Broad-leaved paperbark was also sometimes present on lower slopes.

The mid-story of this PCT generally consisted of *Synoum glandulosum* (Scentless Rosewood), *Wilkiea huegeliana* (Veiny Wilkiea), *Cryptocarya microneura* (Murrogun), *Eupomatia laurina* (Copper Laurel), *Pilidiostigma glabrum* (Plum Myrtle), Native Daphne, and *Ripogonum elseyanum* (Hairy Supplejack). The exotics Lantana and Camphor laurel was also occasionally present.

In the ground layer, *Blechnum cartilagineum* (Gristle Fern), *Davallia pyxidata* (Hare's-foot Fern), Ottochloa gracillima (Pademelon Grass) were occasionally present, though the ground layer was often sparse.

Similarly to Vegetation Zone 1, this community would provide good fauna habitat due to the community's age and contiguousness with other large patches of vegetation. Large standing trees, fallen logs, trees with hollows, native ground covers, and course and fine litter were present.

An indicative photograph of this community is shown in **Figure 26**.

This vegetation zone also includes an area of scattered *Araucaria cunninghamii* (Hoop Pine) among pasture grasses (Plot 28), as this was the most appropriate PCT given the plot's location and likely pre-existing vegetation community.

7.3.3 Vegetation Zone 3: Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion (rehabilitation area)

The area within Zone 3 has recently been subject to rehabilitation works and was previously used for cultivation of bananas. It was likely to be Brushbox tall moist forest prior to clearing and will develop into this community over time. It is in a poor condition due to weed infestation, though the community did not meet thresholds for low condition under the FBA methodology, as the canopy cover exceeded the minimum threshold for moderate to good condition.

As the site is in poor condition (relative to the target PCT), it has been mapped as a separate vegetation zone.

The canopy was low (approx. 5 to 10m high) and dominated by Acacia sp.; however other native species were also observed to be common, including Brush Box, *Macaranga tanarius* (Macaranga), *Melicope elleryana* (Evodia), *Mallotus philippensis* (Red Kamala) and *Jagera pseudorhus* (Foam Bark).

The mid-story and ground layer was dominated by exotic species, namely Lantana and Easter Cassia, as well as *Ageratina riparia* (Mist Flower), *Ageratina adenophora* (Crofton Weed), *Melinis minutiflora* (Molasses Grass) and *Setaria sphacelata* (Setaria). *Passiflora suberosa* (Corky Passionflower) and Pademelon Grass (a native) was also common.

Despite its current condition, the community provides some habitat resources for native fauna such as small birds and reptiles due to the thick mid-story and ground cover.

An indicative photograph of this community is shown in **Figure 27**.

Figure 26: Vegetation Zone 2

Figure 27: Vegetation Zone 3

7.3.4 Vegetation Zone 4: Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast

This community exists on the lower slopes within the development site.

The canopy of this community is dominated exclusively by Flooded Gum (20-30m tall). In the mid-storey, the natives *Cupaniopsis anacardioides* (Tuckeroo), *Acacia disparrima* (Hickory Wattle), Murrogun, *Maclura cochinchinensis* (Cockspur thorn) and Guioa were common, with Camphor laurel* also common.

Paspalum mandiocanum (Broad-leaved paspalum*), Pademelon Grass and Smilax australis were common in the ground layer.

This community would provide moderate fauna habitat as it is fragmented and subject to weed incursion on the edges. Nonetheless large standing trees, fallen logs, trees with hollows, native ground covers, and course and fine litter were present.

An indicative photograph of this community is shown in **Figure 28**.

Figure 28: Vegetation Zone 4

7.3.5 Vegetation Zone 5: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

This community exists on the lowland alluvial flats within the eastern portion of the development area.

It is dominated by Broad-leaved paperbark, with Swamp Oak also occasionally present in patches. Common Lilly Pilly and Camphor Laurel* was observed to be common in the *midstorey*, with Tuckeroo, *Cryptocarya triplinervis* var *pubens*, Evodia, *Croton verreauxii* (Green Native Cascarilla), Guioa, Native Daphne, *Rhodamnia rubescens* (Scrub Turpentine), Scentless Rosewood, *Glochidion sumatranum*

(Umbrella Cheese Tree), *Ficus coronata* (Sandpaper Fig) and *Litsea australis* (Brown Bolly Gum) occasionally occurring. Lantana* and Easter Cassia* was also occasionally present.

A diversity of ground covers exist in this community depending on location, topography and levels of disturbance. Common species observed include Swamp Water Fern, *Morinda jasminoides* (Sweet Morinda) *Geitonoplesium cymosum* (Scrambling Lily), Common Silkpod, *Smilax australis, Stephania japonica* var. *discolor* (Snake Vine), *Calochlaena dubia* (Rainbow Fern), *Cyclosorus interruptus*, *Viola hederacea* (Ivy-leaved Violet), *Oplismenus hirtellus* var. *imbecillis* (Creeping Beard Grass), *Carex* sp., and *Gahnia clarkei* (Tall Saw-sedge).

This community would provide good fauna habitat due to low level of weed infestation, and the presence of fallen logs, native ground covers, and course and fine litter. No trees with hollows were observed however.

An indicative photograph of this community is shown in **Figure 29**.

Figure 29: Vegetation Zone 5

7.3.6 Vegetation Zone 6: Forest Redgum - Pink Bloodwood open forest of the foothills and ranges of the NSW North Coast Bioregion

The zone is comprised of several areas (see **Figure 24**), including remnant vegetation in the east of the development and two areas of rehabilitation. The two areas of rehabilitation are adjacent to the Flooded Gum forest and also along Yelgun Creek.

The remnant vegetation patches in the east are dominated by Forest Red Gum, with a 20 to 30m canopy. Other common canopy species observed include Pink Bloodwood, Swamp Box, Grey Ironbark

(*Eucalyptus siderophloia*) and White Mahogany. The mid-layer was often dominated by Swamp Box, *Elaeocarpus obovatus* (Hard Quandong), Guioa and *Acacia melanoxylon* (Sally Wattle). The ground layer was often dmonated by Broad-leaved paspalum*, *Marinda jasminoides* (Sweet Marinda), *Cissus antarctica* (Kangaroo Vine), *Ottochloa gracillima*, *Panicum lachnophyllum*, *Smilax australis* (Lawyer Vine) and *Marsdenia rostrata* (Milk Vine).

The area of rehabilitation has a canopy height of approximately 5 metres. It is considered of good enough quality (in terms of site attributes relevant to the FBA method) to be included within this vegetation zone. At the rehabilitation areas Forest Red Gum, Bloodwood, Blackbutt, White Mahogany, Brush Box and *Acacia melanoxylon* (Black Wattle) were present. A similar mix of species was also present along Yelgun Creek. Along the creek the eucalypts were much older, numbered less than 10 altogether and formed a canopy approximately 20m high.

Other tree and shrub species observed in the area of rehabilitation included Lantana*, Turpentine, Evodia, *Acacia longifolia* (Sydney Golden Wattle) and Cockspur Thorn. Ground species observed include Common Bracken Fern, *Hibbertia scandens* (Golden guinea vine), Broadleaf Paspalum, *Imperata cylindrica* (Blady Grass), Gristle Fern, Purple Pea Bush, *Echinostephia aculeata*, *Pratia purpurascens* (White Root) and *Ageratum houstonianum* (Blue Billy-goat Weed).

The rehabilitaotin areas currenlty provide limited habitat value due to the lack of overstorey. Nonetheless the ground covers and shrub layer (along Yelgun Creek) provide habitat resources for native fauna such as small birds and reptiles.

An indicative photograph of this community is shown in **Figure 30**, with the area of rehabilitation where a plot was located shown in **Figure 31**.

Some of this community is considered to meet *the Subtropical coastal floodplain forest of the NSW North Coast bioregion* endangered ecological community listing (see **Section 7.5**).

7.3.7 Vegetation Zone 7: Forest Redgum - Pink Bloodwood open forest of the foothills and ranges of the NSW North Coast Bioregion

This vegetation zone comprises a small patch of Acacia regrowth, with an understory of exotic pasture grass. Prior to clearing, the area was likely to be Forest Redgum - Pink Bloodwood open forest due to its location in the landscape and proximity to remant areas of this PCT. Over time, it is assumed that this community will regenerate into Forest Redgum - Pink Bloodwood open forest.

The Forest Redgum - Pink Bloodwood open forest PCT was the most appropriate choice for PCT description due to the area's likely preclearing PCT and that there are no regrowth Acacia forest PCTs.

An indicative photograph of this community is shown in **Figure 32.**

Figure 30: Vegetation Zone 6

Figure 31: Vegetation Zone 6 (rehabilitation area)

Figure 32: Vegetation Zone 7

7.3.8 Pasture (cleared land)

One plot (Plot 31) was located in an area of unmanaged pasture. This area was dominated by Setaria*, with *Paspalum urvillei* (Vasey's grass*) and *Verbena bonariensis* (Common Verbena*) also common. A photo of this area is provided in **Figure 33**.

Other areas of the grounds are regularly mown and managed to facilitate events.

All areas of pasture have been excluded from the BBCC as they are cleared of native vegetation.

7.3.9 Other non-native vegetation areas

A single plot (Plot 38) was located in an area of exotic pasture that had scattered patches of vegetation consisting of Camphor Laurel and Mango trees as the overstory (**Figure 34**). A few native shrub and forb species were also present; however the site value score was less than 17. Therefore, assessment of native vegetation is not required beyond Subsection 5.3.3 of the FBA Methodology. This community is not considered to be a native vegetation community.

Figure 33: Unmanaged grassland

Figure 34: Non-native vegetation community surrounding Plot 38.

7.4 Comparison with Previous Vegetation Mapping

Prior to the vegetation community mapping undertaken as part of this assessment, vegetation mapping was last conducted by Kooyman (2009).

In a letter dated 24 August 2018, OEH has requested further clarification of apparent discrepancies in mapping, particularly in relation to the extent of the Forest Red Gum (*Eucalyptus tereticornis*) community mapped by Kooyman (2009).

For this BAR, plots 33 to 35 (**Figure 24**) were undertaken in a single patch of Forest Red Gum forest. Mapping in this BAR is consistent with Kooyman (2009) – see Block 9 and 10 of Kooyman (2009) in **Figure 35** and

Table 12.

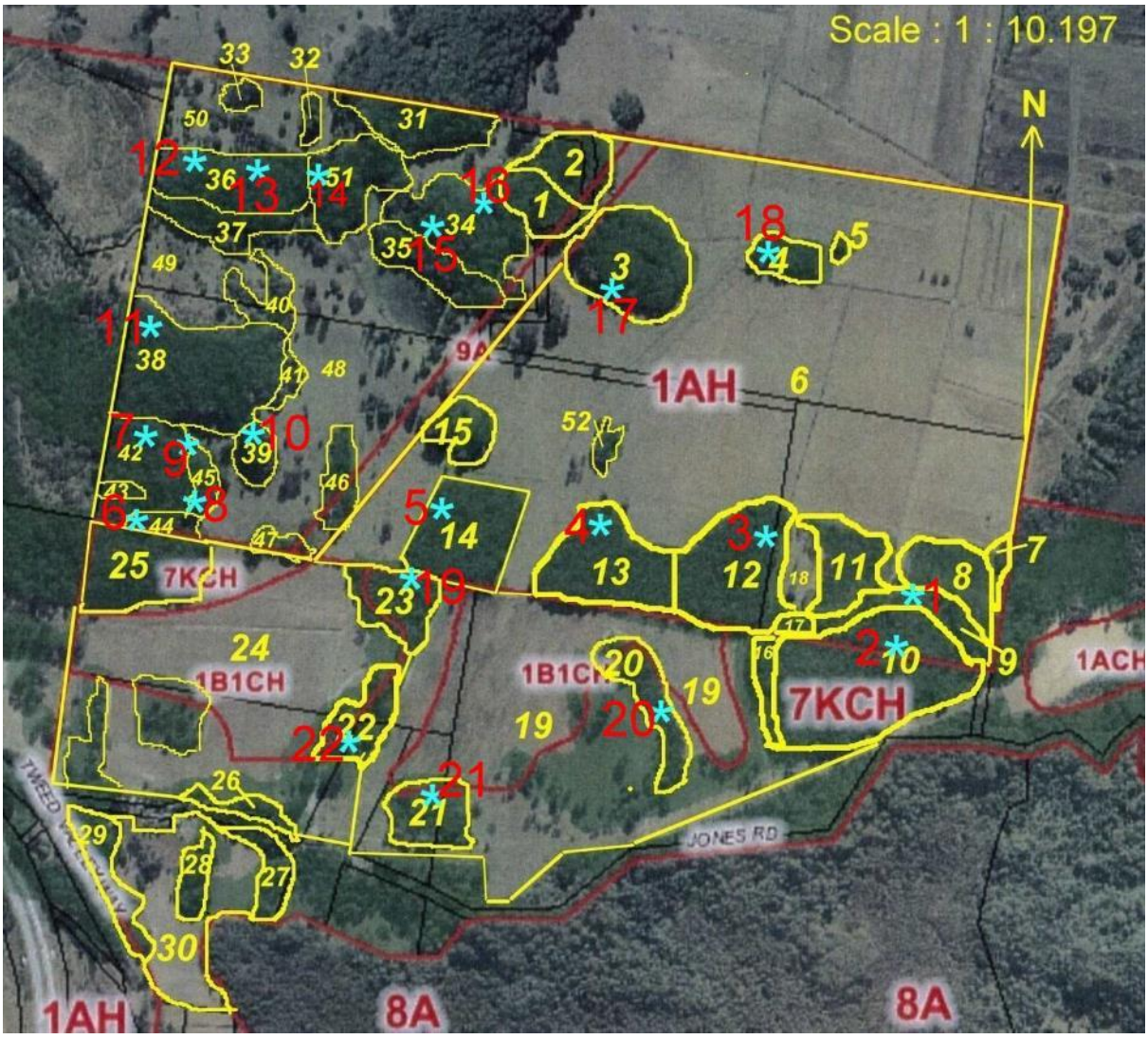


Figure 35: Vegetation Mapping from Kooyman 2009*

*Red numbers identify plot numbers, asterisks indicate location of plots; yellow numbers are vegetation patch numbers.

Table 12: Kooyman (2009) Vegetation Mapping Results for Block 9 and 10

Block	Plot Nos.	Vegetation Type
9	1	*Eucalyptus tereticornis* - edge swamp forest transition
10	2	*Eucalyptus tereticornis* - Corymbia intermedia ridge top

Block 21 in **Figure 35** is also described by Kooyman (2009) as a Forest Red Gum Community, and this is consistent with mapping within this BAR.

Plot 11 within Block 38 in **Figure 35** is described as "*Eucalyptus tereticornis - E. siderophloia - E. carnea* ridge-top" by Kooyman (2009). This type of vegetation does exist as a small patch within the ridge top area within this Block; however the areas is overwhelmingly Brushbox Forest, as per **Figure 24**.

Block 20 in **Figure 35** is described as *Lophostemon suaveolens* (Swamp Box) forest by Kooyman (2009); though it is actually a mixed community of Swamp Box, Forest Red Gum and the occasional Blackbutt. For this reason, it was described as PCT 837 - *Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion*.

Block 22 in **Figure 35** is described as '*Ficus obliqua notophyll vine forest* transitioning to Brushbox forest' by Kooyman (2009). However, due to the block's dominant layer being Blackbutt (see **Figure 36**), this block was considered to be more accurately described as Blackbutt forest.

Block 30 in **Figure 35** is described as exotic grassland / managed grassland By Kooyman; however the area has since been subject to rehabilitation works, which has in stablished both Brushbox forest and Forest Red Gum forest, as per **Figure 24**.

Figure 36: Kooyman's (2009) Block 22, which is dominated by Blackbutt, as pictured

7.5 Threatened Ecological Communities

Three plant communities listed as Endangered Ecological Communities (EECs) under the TSC Act or Threatened Ecological Communities (TEC) under the EPBC Act are present within the development site. These are further outlined in **Table 13**, with general descriptions of the communities provided in **Appendix I**. **Figure 37** shows EECs that exist within the development site.

A small patch (2 ha) of *Lowland rainforest of the NSW north coast bioregion* exists occurs in the west of the development site. This area was surveyed in April 2017 to confirm its EEC status. The survey also revealed that the area met the criteria for Lowland Rainforest of Subtropical Australia Ecological Community, listed as Critically Endangered under the EPBC Act, (**Table 13**).

The patch of Lowland Rainforest is surrounded by other native vegetation and grassy areas that provide a buffer between the event area and the TEC of ~30 m at its minimum. Lowland Rainforest and associated bushland areas are outside of proposed event areas and will be preserved.

This area of lowland rainforest is also mapped as Vegetation Zone 2. This is due to the dominance of Brush Box in the canopy and the fact that PCT 749 is the most suitable PCT description for the area. That is, no rainforest PCTs in the IBRA sub-region adequately describes this patch of vegetation.

Other areas of Brush Box open hillslope forest in Vegetation Zone 2 do not meet the definition of the *Lowland rainforest of the NSW north coast bioregion* EEC. The key parameters which distinguish the lowland rainforest area from other areas in Vegetation Zone 2 are:

- the high number and diversity of rainforest flora species present in the lowland rainforest area;
- the number of flora species present that are listed as characteristic lowland rainforest species in the BC Act Lowland Rainforest EEC determination;
- Additional flora species present are also indicative of rainforest, but not listed in the EEC determination e.g. *Calamus*, *Pseudoweinmannia*, *Sarcopteryx*, *Trophis* and *Tabernaemontana inter alia*;
- the presence of strata within the lowland rainforest area.

Other Brush Box hillslope forests in Vegetation Zone 2 are generally dominated by *Lophostemon confertus*, with few other canopy species present and these are mainly Eucalypt or Corymbia emergents; have an open groundlayer dominated by leaflitter with sparse patches of ferns, and with little or no development of strata.

Vegetation classification outcomes can be influenced by the precise location of plots; however the April 2017 survey included three floristic plots in the lowland rainforest area. As such it is considered that the results are a reliable indication of the patch's status as lowland rainforest. Significant botanical work has also been done in the other areas of Brushbox hillslope forest, and their non-inclusion as the lowland rainforest EEC area accurately reflects their predominantly different sclerophyllous composition.

Table 13: EECs and TECs within and/or immediately adjacent to the development area

EEC Name	Area within development site (ha)	Notes
Swamp sclerophyll forest on coastal floodplains of the NSW north coast bioregion	23.95	Represented in Vegetation Zone 5, although a large patch of this EEC exists within the adjacent SEPP Wetland / Billinudgel Nature Reserve.
Sub-tropical coastal floodplain forest of the NSW north coast bioregion	1.87	Further discussion is provided below this table.
Lowland rainforest of the NSW north coast bioregion	2	This area also meets the definition of Lowland Rainforest of Subtropical Australia Ecological Community, which is listed as critically endangered under the EPBC Act.
Coastal Cypress Pine of the NSW north coast bioregion	0	This EEC was previously thought to exist in within the development site; however site survey revealed that the patch of vegetation in question did not meet the description for the EEC listing.

As demonstrated within **Figure 13**, much of PCT 837 is on surrounding hill slopes. There are aspects of the listing criteria for the *Sub-tropical coastal floodplain forest of the NSW north coast bioregion* (STCFF) EEC that relate to topography and soils. The definition of the SSTCFF EEC on the OEH website[1] states the following:

> "*Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion is the name given to the ecological community associated with clay-loams and sandy loams,* ***on*** *periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less*." (emphasis added)

With this in mind, the following must apply for vegetation to meet the listing criteria for the STCFF EEC:

- vegetation must be **associated with** clay-loams and sandy loams; and
- Vegetation must be ***'on*** *periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains'*. I.e. the vegetation has to be **associated with** coastal flood plains, however it also has to be **on** *alluvial flats, drainage lines and river terraces.* Vegetation is <u>not</u> considered to meet the listing criteria if it is simply '**associated with**' alluvial flats, drainage lines and river terraces; and
- Vegetation can be considered to exist on the coastal floodplain if it is on '***level landform patterns*** *on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less'*.

[1] This is the NSW Scientific Committee's final determination. Available at: https://www.environment.nsw.gov.au/determinations/SubtropicalCoastalFloodplainEndSpListing.htm

With this in mind, most of PCT 837 mapped in **Figure 24** would not meet the definition of this EEC. Nonetheless, the 100 year flood recurrence interval and topographic mapping has been used to determine the extent of PCT 837 that exists on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains (see **Figure 38**).

7.6 Vegetation Zones within the BBCC

Vegetation zones have been input into the BBCC to enable a list of threatened species to be generated. Despite this, no clearing within the vegetation zones (PCTs) will occur, except for a small area of vegetation associated with the proposed vehicular access track in the north-west (west of the proposed cabins).

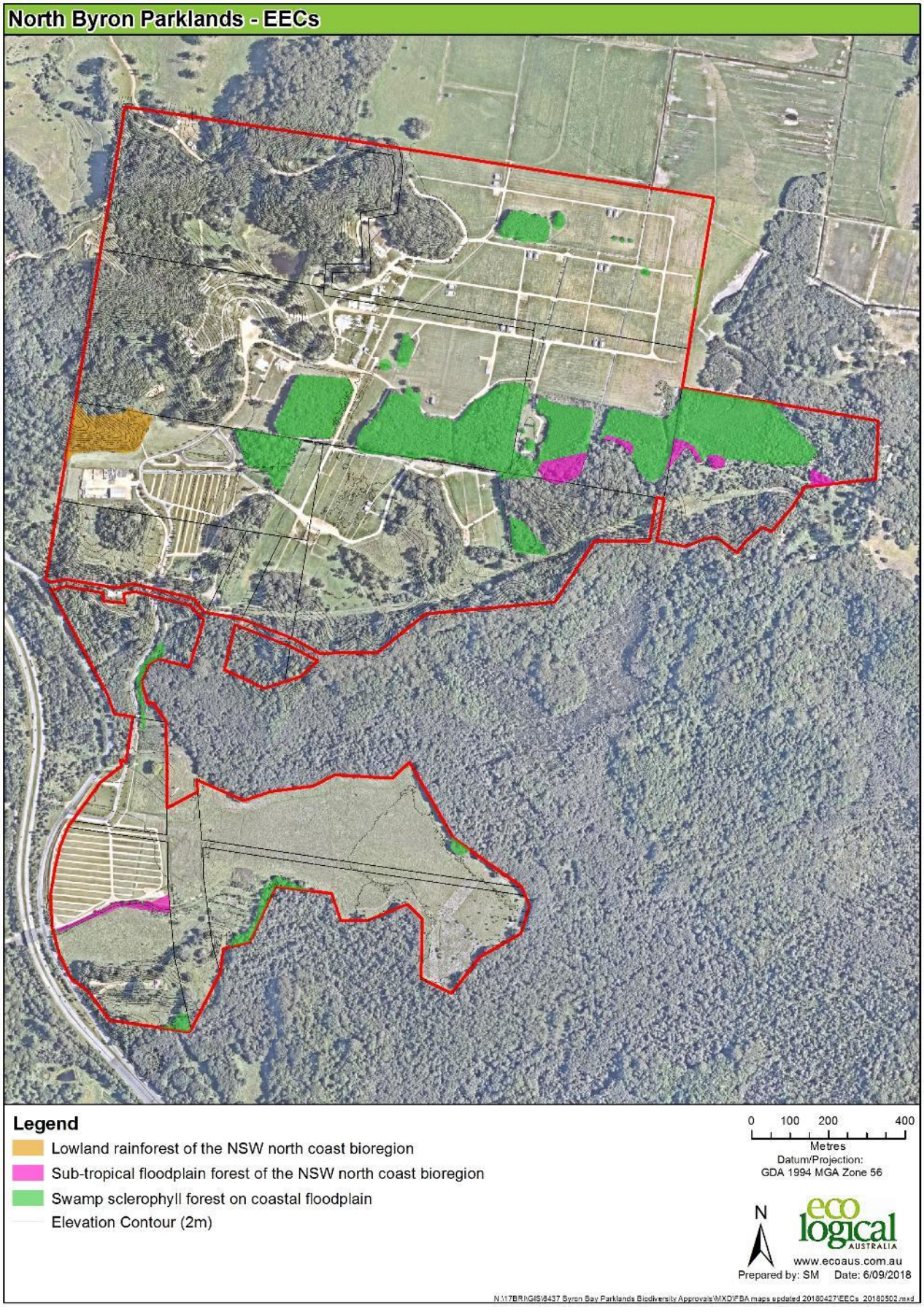


Figure 37: TSC Act Endangered Ecological Communities within the development site

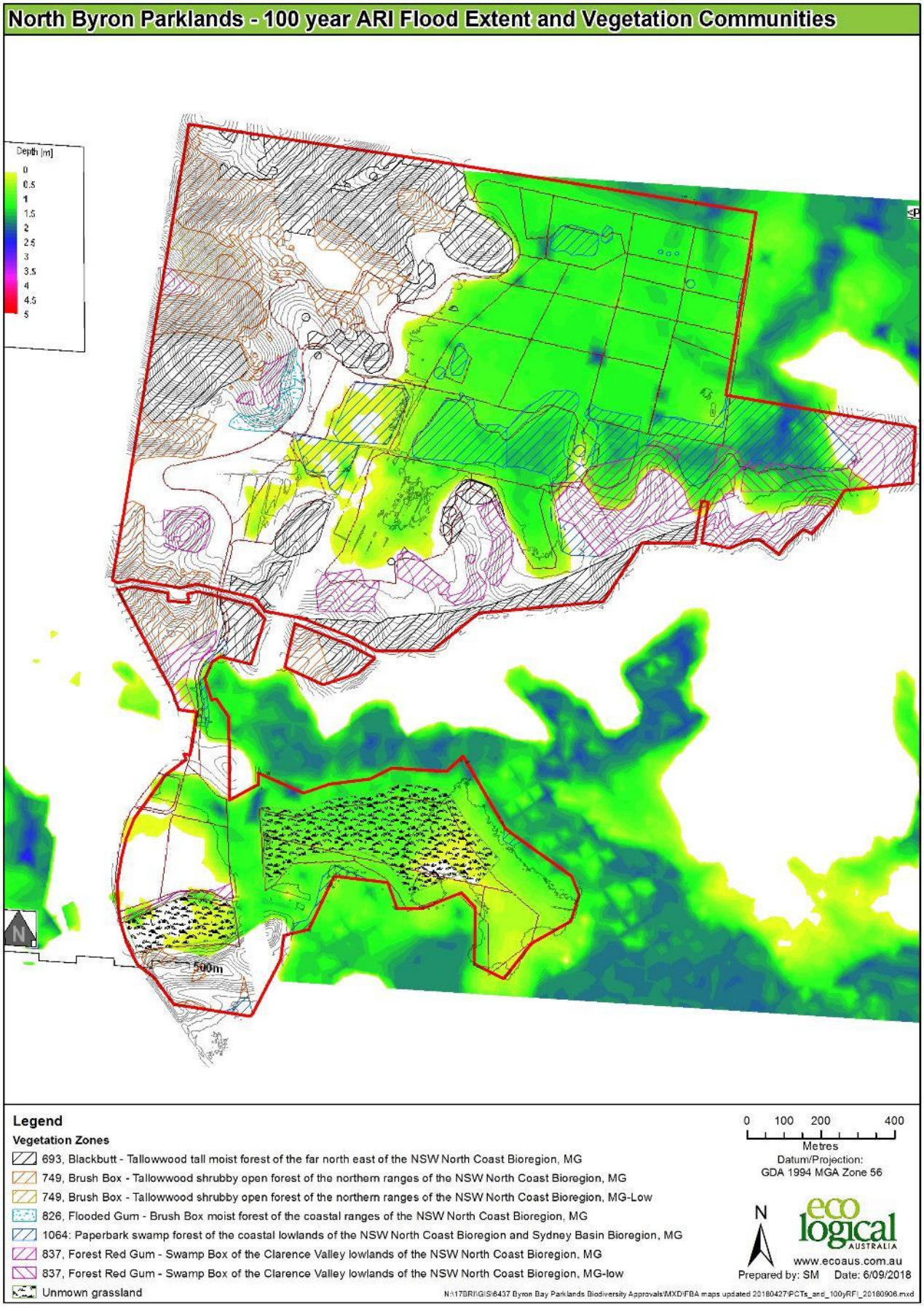


Figure 38: PCTs and the 100 year Annual Recurrence Interval Flooding Extent

8 Threatened and Migratory Species and Populations

This section provides an assessment of the presence of threatened and migratory species and populations. It is supported by the likelihood assessments in **Appendix J**, **Appendix K** and **Appendix L**. It is also supported by **Appendix F**, which provides detailed results of past surveys.

8.1 Review of Existing Data

The following resources were reviewed as part of the assessment of threatened species and populations:

- Atlas of NSW Wildlife (Bionet)
- Threatened Species Profile Database (OEH, 2016)
- Previous survey results and associated reporting (**Section 6**)
- The BBCC (OEH 2016a).

Information reviewed was incorporated into the assessment of candidate species.

8.2 Habitat present within the development site

Habitats present within the development site are generally in moderate to good condition. There are large tracts of vegetation, which are connected to patches of vegetation in the region. **Figure 19** shows the largest patch size within the outer circle, and this is in exceedance of 1000 ha.

Vegetation of the site varies from: aquatic and fringing vegetation of drains, closely grazed pasture and various coastal and hillslope forest communities. More elevated parts of the NBSP property support eucalypt and rainforest communities. The composition and condition of grassland communities reflect current management, and comprises predominantly mowed grassland. As previously mentioned, there is also a patch of unmanaged (unslashed) grass in the south-east of the development site.

A mosaic of remnant forest patches is present within the pasture matrix and includes EECs (see **Section 7.4**).

Swamp Oak elements are present within some patches of the Swamp Sclerophyll Forest, but are localised minor or sub-dominant components of the upper stratum. Forest communities within the event footprint vary considerably in their canopy species dominance, species composition and ground layer characteristics according to diverse environmental influences. However, they share several characteristics: all are regenerating communities, few or no old growth trees are present, large hollows are rare and very large trees are also rare or absent from all patches within the event site footprint.

Cattle have historically used all unfenced forest patches within the event footprint and this has clearly affected the stature and species composition of ground layer plant communities, the substrate, and terrestrial habitat values. Cattle had access to and occupied most forest patches in the site, and had trampled and browsed ground layer vegetation, causing pugging or compaction of soils in the floodplain, and influencing ground layer vegetation in these areas. Cattle were removed from areas north of Jones Road in 2011 with the remaining cattle removed from pasture areas south of Jones Road in April 2014. This has allowed some natural restoration of ground layers to occur, particularly north of Jones Road.

The Marshall's Ridge corridor is an east-west oriented ridgeline that runs through the middle of the Parklands site. This area provides good connectivity between remnant vegetation in the west and the

Billinudgel Nature Reserve. Over time, rehabilitation has enhanced the extent of the corridor, such that there eastern and western edges of the Parklands site are fully connected (albeit narrowly at some points). The ongoing revegetation works will further enhance connectivity both along Marshall's Ridge and elsewhere in the Parklands, where habitat improvement works are underway adjacent to areas of existing vegetation. Monitoring data has provided evidence that areas where extensive planting has been undertaken provide good habitat values within 10 years (e.g. diverse bird communities including threatened species have established in planting across the site).

The following habitat features are not present within the development site:

- Coastal headlands, grassland, grassy open forest or woodland on fertile or moderately fertile soils
- Shallow soil or rocks near cliff edges or gorge rims
- Cliff tops, steep cliff faces or rocky outcrops
- Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters
- Mangrove vegetation associations of coasts, estuaries and offshore islands

8.3 Ecosystem Credit Species

8.3.1 Habitat Constraints

The BBCC generates a list of predicted species known as 'ecosystem species'. These are threatened species that can be predicted at the site based on the habitat constraint criteria shown in **Table 14**.

Table 14: Ecosystem species constraints within development site

Habitat Constraint	Development site
IBRA Subregion	Murwillumbah (Qld - Southeast Hills and Ranges)
Associated PCTs	NR124, NR144, NR159, NR217, NR117
Percent Native Vegetation within Outer Assessment Circle	36 – 40 %
Condition of Vegetation	Moderate - Good
Patch Size	Very Large (>1000 ha)

8.3.2 Predicted Species

A complete list of all predicted ecosystem species is shown in **Table 15** below. This table has been generated by the BBCC. No further assessment of ecosystem species was undertaken as only a very minor area of habitat will be cleared due to the project (see **Section 11.2** for further discussion).

Table 15: Ecosystem Credit Species

Common Name	Species Name	T_G Value
Barking Owl	*Ninox connivens*	3
Barred Cuckoo-Shrike	*Coracina lineata*	1.5
Bush Stone-Curlew	*Burhinus grallarius*	2.6
Common Blossom-Bat	*Syconycteris australis*	1.2
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	2.2

Common Name	Species Name	T_G Value
Eastern Freetail-Bat	*Mormopterus norfolkensis*	2.2
Freckled Duck	*Stictonetta naevosa*	1.3
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	1.8
Greater Broad-nosed Bat	*Scoteanax rueppellii*	2.2
Hoary Wattled Bat	*Chalinolobus nigrogriseus*	2.1
Little Eagle	*Hieraaetus morphnoides*	1.4
Little Lorikeet	*Glossopsitta pusilla*	1.8
Long-nosed Potoroo	*Potorous tridactylus*	1.3
Masked Owl	*Tyto novaehollandiae*	3
New Holland Mouse	*Pseudomys novaehollandiae*	2.6
Northern Free-tailed Bat	*Mormopterus lumsdenae*	2.2
Powerful Owl	*Ninox strenua*	3
Red-legged Pademelon	*Thylogale stigmatica*	2.6
Rose-crowned Fruit-dove	*Ptilinopus regina*	1.3
Scarlet Robin	*Petroica boodang*	1.3
Sooty Owl	*Tyto tenebricosa*	3
Spotted-tailed Quoll	*Dasyurus maculatus*	2.6
Square-tailed Kite	*Lophoictinia isura*	1.4
Superb Fruit-dove	*Ptilinopus superbus*	1.3
Swift Parrot	*Lathamus discolor*	1.3
Varied Sittella	*Daphoenositta chrysoptera*	1.3
Wompoo Fruit-dove	*Ptilinopus magnificus*	1.3
Yellow-bellied Glider	*Petaurus australis*	2.3
Yellow-bellied Sheathtail-Bat	*Saccolaimus flaviventris*	2.2

In addition to the table above, the following ecosystem species were also considered as they have been observed either on or near the parklands:

- Eastern Grass Owl (*Tyto longimembris*)
- Eastern subspecies of the Brown Treecreeper (*Climacteris picumnus victoriae*)
- Golden-tipped Bat (*Kerivoula papuensis*)

The Eastern Grass Owl was recorded in the main event area (north of Jones Rd) in 2007. A pair also responded to call playback in July 2016 in the exotic grassland in the south of the parklands (south of Jones Rd). This was the first observation of this species within the site since 2007. A single owl also responded to call play-back in July 2017, again in the exotic grassland to the south of the parklands.

Brown Treecreeper was recorded in transects within the 1 km buffer area, while the Golden-tipped Bat was recorded from Anabat call detection in the development site, and are considered likely to also occur within the 1 km buffer area As above, no native vegetation associated with these species will be directly

impact by the proposed development. The exotic pasture in the south of the site would not represent potential foraging habitat for these species.

Regarding these three species, Section 5.1.1.3 of the FBA states, ''*Areas that are not native vegetation (i.e. land not included in native vegetation extent) do not require further assessment in the FBA except where it is assessed as habitat for threatened species according to Section 6.4.*' (Section 6.4 pertains to species credit species only and all three of the species mentioned above are ecosystem credit species.

See **Appendix F** for more information about fauna survey and impact monitoring results for these species.

8.4 Species Credit Species

Species credit species are threatened flora and fauna species that cannot be predicted by habitat characteristics and vegetation types within the development site. Species credit species that are likely to occur within the development site based on habitat assessment, must be surveyed to determine presence/absence, or an expert report provided.

The accredited assessor may determine that the habitat is unsuitable or too degraded for species credit species. These species do not require further assessment.

8.4.1 Candidate Species within the development site

Both historical and recent surveys (see **Section 6** and **Appendix F**) have provided thorough insight into habitats that are available and species that exist within the development site. Generally speaking, faunal assemblages of the Parklands site exhibit substantial variations both seasonally and according to habitat preferences as evidenced from monitoring. External and large-scale regional influences also contribute to changes in faunal abundance. The number of fauna species recorded on the Parklands site has gradually increased over time from 130 species in 2007 to approximately 200 species in 2017. This is largely due to ongoing survey effort but is also likely to include a number of species that have recently occurred or returned to the site as a result of habitat improvements over time. Notably, both bird and mammal diversity is high, with more than 120 bird species and 26 mammal species (including bats and flying foxes) recorded on site. Common pest fauna species observed on the site, includes cane toads, common mynah, common starling, house mouse, black rat and dogs.

Survey results, combined with the habitat preferences and distributions of species, has been used to assess the likelihood of candidate species (species credit species) existing within the development site. The likelihood of occurrence listing these species is provided in **Appendix J** and **Appendix L**.

The species within **Appendix J** and **Appendix L** include those generated as part of the BBCC, with additional species credit species also considered where relevant. **Table 16** shows those species credit species that are considered to have some likelihood of existing within the development site, or are known to exist in the development site.

Despite their likelihood of occurrence in the development site, only a very minor area of native vegetation clearing is proposed as part of the project. This is related to the widening of an existing track in the north-west of the development site. Therefore, direct impacts to species credit species are not included within the BBCC.

Figure 39 shows the location of the observed threatened flora, as well as other BioNet records in the wider area. Similarly, **Figure 40** shows the location of observed fauna.

Hairy Joint Grass (*Arthraxon hispidus*) was recognised as having a greater potential to occur within the development footprint, specifically within the area of unmanaged pasture grass in the south of the development site.

Targeted surveys were undertaken in 2009 and again in June 2017 and March 2018 in association with this FBA. The recent surveys were undertaken in the pasture to the southeast of the project area, where the area had been left unmanaged. No individuals were found, and habitat suitability was poor. The potential occurrence of this species onsite was deemed unlikely, and the proposed developments are not considered a threat to this species, or its habitat. Hence this species has been excluded from the table above and from further assessment. This is consistent with Section 6.5.1.3 of the FBA method.

8.4.2 Species that cannot withstand further loss

The following species within are classified as species that cannot withstand further loss in the Northern Rivers Catchment Management Authority Area:

Flora:

- *Corokia whiteana* (Corokia)
- *Cryptocarya foetida* (Stinking Cryptocarya)
- *Davidsonia jerseyana* (Davidson's Plum)
- *Endiandra hayesii* (Rusty Rose Walnut)
- *Endiandra muelleri* subsp. *bracteata* (Green-leaved Rose Walnut)
- *Fontainea australis* (Southern Fontainea)
- *Geodorum densiflorum* (Pink Nodding Orchid)
- *Macadamia tetraphylla* (Rough-shelled Bush Nut)

Fauna:

- *Carterornis leucotis* (White-eared Monarch)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Cyclopsitta diophthalma* coxeni (Coxen's Fig-Parrot)
- *Myotis macropus* (Southern Myotis)
- *Nyctophilus bifax* (Eastern Long-eared Bat)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Thersites mitchellae* (Mitchell's Rainforest Snail)

8.4.3 Species Polygons

Species polygons have been prepared for the species credit species within (as per Step 5 in Section 6.5 of the FBA). Associated maps are provided in **Appendix O**. Despite the extent of habitat that is mapped, only a very small area of vegetation clearing / pruning will occur as part of the project (see **Section 9.1**) and impacts associated with the development footprint can be confidently predicted and assessed for relevant matters (see **Section 9**). Species points associated with observation of species credit species are presented in **Figure 39** and **Figure 40**.

Table 16: Species credit species likely or known to exist within the development site

Species	UOM*	Likelihood	Notes on occurrence within development site	Species Polygon notes**
Flora				
Corokia whiteana (Corokia)	Count	Potential to occur within the development site, however will not be directly impacted	Marginal habitat on site, records within BNR 1.5 km from site. Species not observed during targeted flora survey 2009 or subsequent site inspections.	Bionet-listed Vegetation Types include PCT 693 and 749. Polygon of potential habitat provided. A point GIS file is not provided as there are no records of this species within the development site.
Cryptocarya foetida (Stinking Cryptocarya)	Count	**Known** to occur within the development site, however will not be directly impacted	Recorded during targeted threatened flora surveys 2009. A single tree specimen is present in an area of swamp sclerophyll forest habitat on Lot 402 DP755687 near the centre of the development site.	Bionet-listed Vegetation Types include PCT 693 and 749. PCT 1064 included due to known record.
Davidsonia jerseyana (Davidson's Plum)	Area	Potential to occur within the development site, however will not be directly impacted	A small stand of mature Davidson's Plum trees occurs to the west of the development site, in association with an area of Lowland Rainforest Threatened Ecological Community	Bionet-listed Vegetation Types include PCT 693 and 1064. Polygon of potential habitat provided. A point GIS file is not provided as there are no records of this species within the development site.
Endiandra hayesii (Rusty Rose Walnut)	Count	Potential to occur within the development site, however will not be directly impacted	Suitable habitat, several records adjacent to site (<500 m), one within BNR. Species not observed during targeted flora surveys 2009 or subsequent site inspections.	Bionet-listed Vegetation Types include PCT 693 and 749. Polygon of potential habitat provided. A point GIS file is not provided as there are no records of this species within the development site.

Species	UOM*	Likelihood	Notes on occurrence within development site	Species Polygon notes**
Endiandra muelleri subsp. *bracteata* (Green-leaved Rose Walnut)	Count	**Known** to occur within the development site, however will not be directly impacted	One individual exists within the development site, with two others to the west of the site. Observed during targeted threatened flora surveys 2009.	Bionet-listed Vegetation Types include PCT 693 and 749.
Fontainea australis (Southern Fontainea)	Count	Potential to occur within the development site, however will not be directly impacted.	Southern Fontainea is found in lowland subtropical rainforest, usually on basaltic alluvial flats, and also in cooler subtropical rainforest in the Nightcap Range. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site.	Bionet-listed Vegetation Types include PCT 749. Polygon of potential habitat provided. A point GIS file is not provided as there are no records of this species within the development site.
Geodorum densiflorum (Pink Nodding Orchid)	Area	Potential to occur within the development site, however will not be directly impacted	Four of these orchids were located at a single point to the west of the development footprint and within Forest Red Gum community.	Bionet-listed Vegetation Types include PCT 837 and 1064. PCT 693 included in polygon as precaution. Polygon of potential habitat provided. A point GIS file is not provided as there are no records of this species within the development site.
Macadamia tetraphylla (Rough-shelled Bush Nut)	Count	**Known** to occur within the development site, however will not be directly impacted	Three Rough-shelled Bush Nut trees are located in the northwest corner of the development site where the wastewater treatment infrastructure is proposed. They three trees are associated with an old agricultural structure. It is possible that they represent planted specimens. These individuals are currently being impacted by historical competition from Camphor Laurel and Mango Trees (Fitzgerald 2016a).	Bionet-listed Vegetation Types include PCT 693, 749 and 1064.

Species	UOM*	Likelihood	Notes on occurrence within development site	Species Polygon notes**
			First observed during targeted threatened flora surveys 2009.	
Marsdenia longiloba (Slender Marsdenia)	Area	Potential to occur within the development site, however will not be directly impacted	In NSW, occurs at scattered locations on the north coast north from Barrington Tops. Subtropical and warm temperate rainforest, lowland moist eucalypt forest adjoining rainforest, areas with rock outcrops. Records exist to the east of the development site. Not observed within development site.	Bionet-listed Vegetation Types include PCT 693 and 749. Polygon of potential habitat provided. A point GIS file is not provided as there are no records of this species within the development site.
Syzygium moorei (Durobby / Coolamon Rose Apple)	Count	**Known** to occur within the development site, however will not be directly impacted	One plant is located in the north of the development site, whilst another is outside of the development site to the west.	Bionet-listed Vegetation Types include PCT 693, 749 and 1064.
Fauna				
Carterornis leucotis (White-eared Monarch)	area	**Known** to occur within the development site, however will not be directly impacted	Low probability of foraging within the event area.	Bionet-listed Vegetation Types include PCT 693 and 1064.
Chalinolobus dwyeri (Large-eared Pied Bat)	Area	**Known** to occur within the development site, however will not be directly impacted	Known from Anabat call results, Annual Performance reports.	The species is a full species credit because it cannot be reliably predicted to occur on a site based on vegetation and other landscape features (either foraging or breeding). Breeding habitat identified by the presence of rocky areas containing caves, or overhangs or crevices or escarpments, old, tunnels or culverts.

Species	UOM*	Likelihood	Notes on occurrence within development site	Species Polygon notes**
Cyclopsitta diophthalma coxeni (Coxen's Fig-Parrot)	Area	Potential to occur within the development site, however will not be directly impacted	Systematic fauna surveys in 2007, 2009, and 2014 did not detect this species. However, potential habitat present adjacent to and within development site.	Bionet-listed Vegetation Types include PCT 693 and 749.
Miniopterus australis (Little Bentwing-bat)	Area	**Known** to occur within the development site, however will not be directly impacted	Known from Anabat call results, Annual Performance reports.	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding. Wide variety of PCTs apply on Bionet.
Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)	Area	**Known** to occur within the development site, however will not be directly impacted	Known from Anabat call results, Annual Performance reports.	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding. Wide variety of PCTs apply on Bionet.
Myotis macropus (Southern Myotis)	Area	**Known** to occur within the development site, however will not be directly impacted	Known from Anabat call results, Annual Performance reports.	Bridges, caves or artificial structures within 200 m of riparian zone. The species was allocated to species credit by OEH because it is dependent on waterways with pools of 3m wide or greater for foraging. Wide variety of PCTs apply.
Nyctophilus bifax (Eastern Long-eared Bat)	Area	**Known** to occur within the development site, however will not be directly impacted	Detected only during harp trapping (2007 and 2014).	Bionet-listed Vegetation Types include PCT 693, 749 and 1064.
Pandion cristatus (Eastern Osprey)	Area	**Known** to occur within the development site, however will not be directly impacted	Recorded in Parklands during targeted bird surveys (2015).	Living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting. Bionet-listed Vegetation Types include PCT 1064.

Species	UOM*	Likelihood	Notes on occurrence within development site	Species Polygon notes**
Phascolarctos cinereus (Koala)	Area	**Known** to occur within the development site, however will not be directly impacted	Species not recorded in systematic fauna surveys on the site in 2007, 2009 and 2014. Biolink surveys found scats outside the development area in 2007, 2008, & 2016. Considered an endangered population between the Tweed and Brunswick Rivers east of the Pacific Highway (BioNet Profile ID 20300).	Wide variety of PCTs apply on Bionet. Species polygon based on SEPP44 methodology and Byron Coast Comprehensive KPoM (Phillips and Jardine 2013).
Planigale maculata (Common Planigale)	Area	Potential (low) to occur within the development site.	Not detected in systematic fauna surveys that targeted this species. Note that survey effort to date includes 75 pitfall trap days, 1,125 elliott trap nights and 5,000 hair tube days. Potential, though not likely to occur in development site. This species has potential to inhabit forests within the development site. It is less likely to inhabit pasture areas (particularly the unmanaged pasture areas in the south of the site) as this area lacks the microhabitat features such as hollow logs, bark and rocks.	Not likely to occur, therefore no polygon supplied.
Pteropus poliocephalus (Grey-headed Flying-fox)	Area	**Known** to occur within the development site, however will not be directly impacted	Numerous Grey-headed Flying-fox and Black Flying Foxes observed in 2007, with only single number of individuals observed subsequently. This decline is attributed to the abandonment of the maternity camp in Brunswick Heads Nature Reserve, as well as a lack of foraging resources (blossom) on site during survey periods.	Foraging habitat is broad ranging but breeding camps are localised. Wide variety of PCTs apply
Thersites mitchellae (Mitchell's Rainforest Snail)	Area	Potential to occur within the development site, however will not be directly impacted	Annual Performance Reports 2015, 2016. Evidence of the species observed in the Billinudgel Nature Reserve.	The species is almost entirely known from the coastal plains and hills in swamp forests, which is a peripheral vegetation to its true core habitat, the lowland subtropical rainforest, which has been removed/cleared.

Species	UOM*	Likelihood	Notes on occurrence within development site	Species Polygon notes**
				Bionet-listed Vegetation Types include PCT 1064.

*UOM = Unit of Measurement for that species in the Threatened Species Profile Database;

** Species polygon notes utilise data from Bionet Atlas (https://www.environment.nsw.gov.au/AtlasApp/Default.aspx?a=1). Habitat requirements noted in **Appendix J** to **L** were also considered during creation of species polygons.

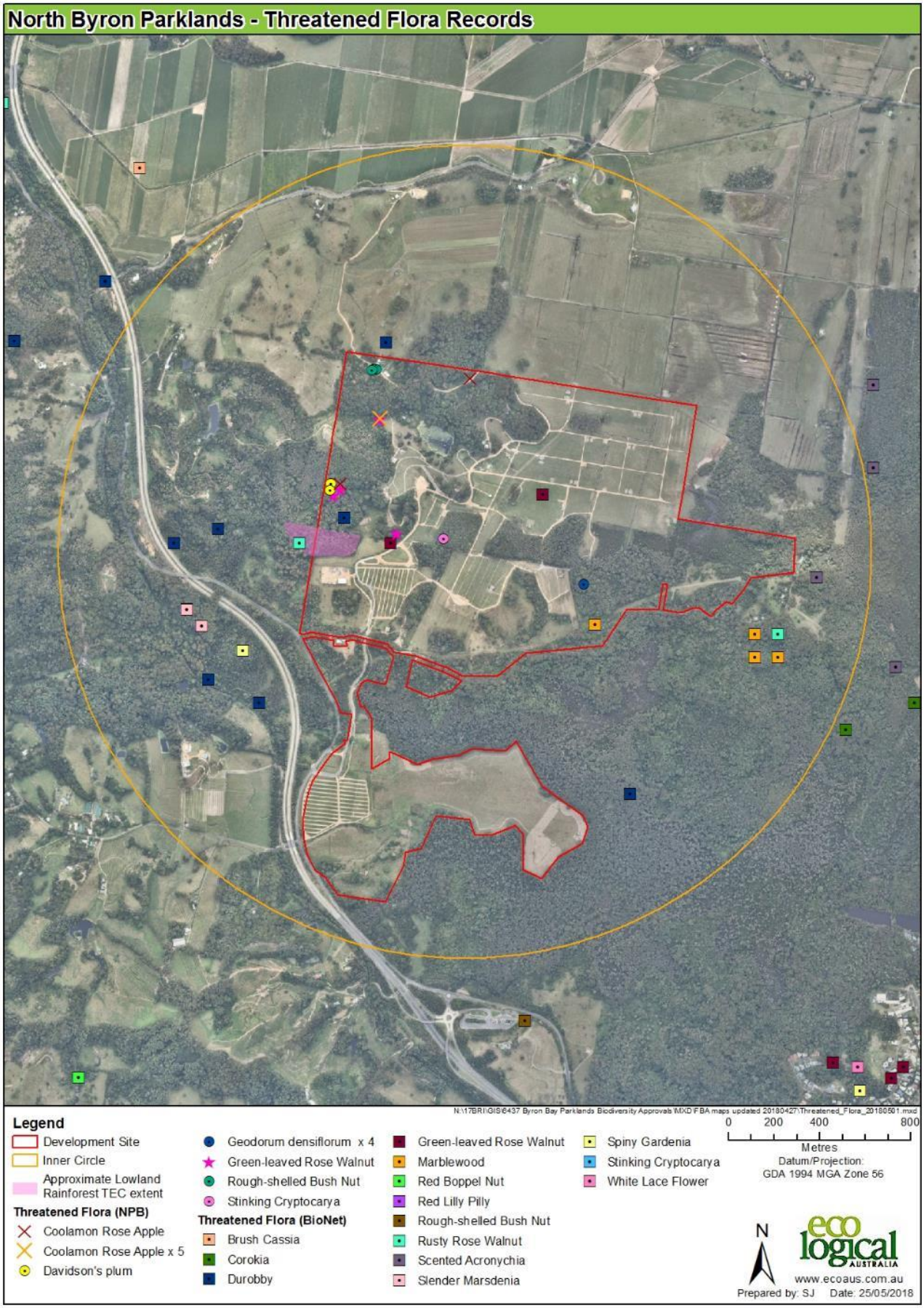


Figure 39: Location of previous threatened flora records

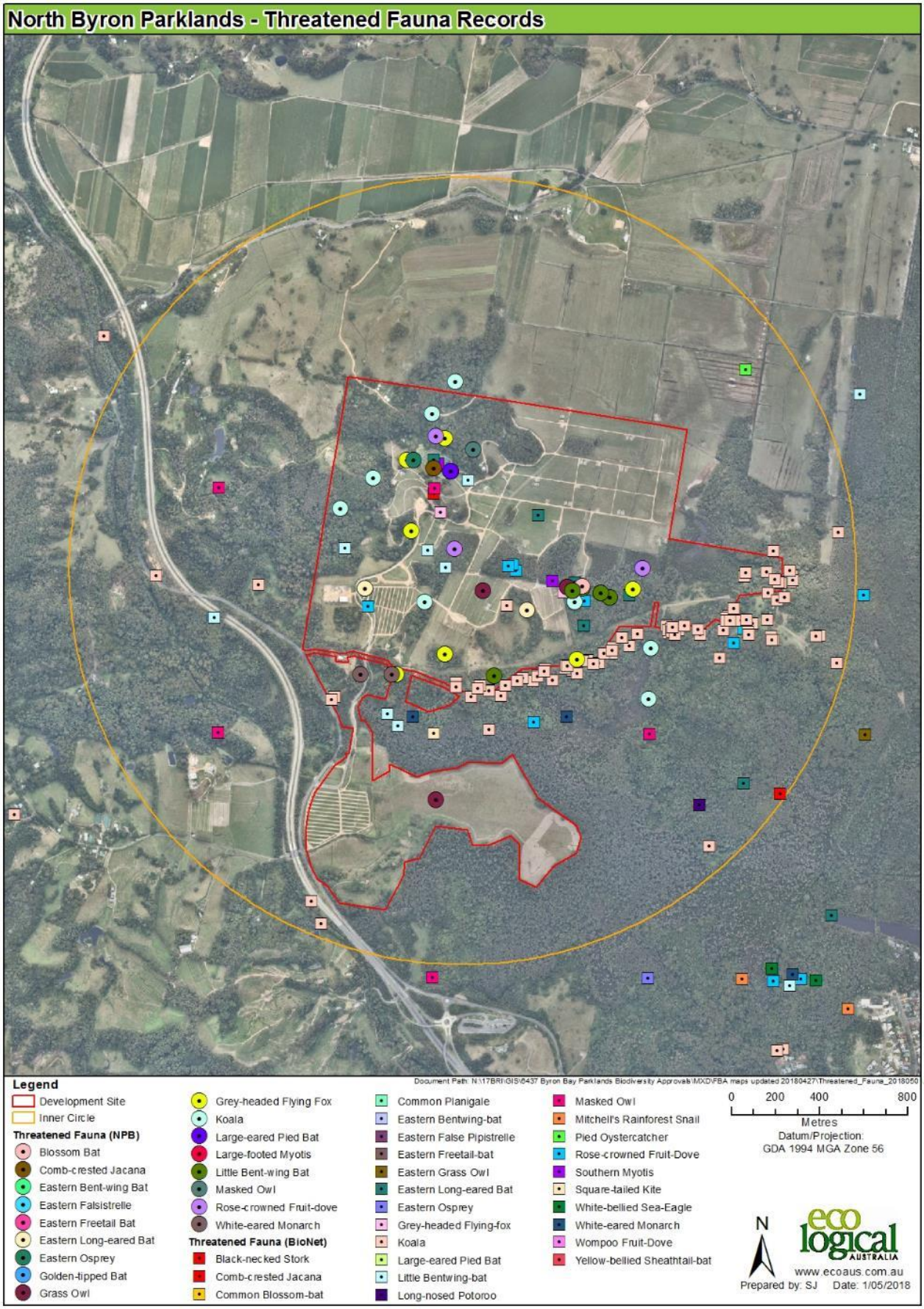


Figure 40: Location of previous threatened fauna records

8.5 Additional biodiversity assessment, as per the SEARs

The FBA requires an assessment of impact on all nationally listed threatened species and TECs that may occur within the development site. However, migratory species have also been assessed in this report, as per the requirements of the SEARs (see **Appendix A**). Additionally, the SEARs also requires that an additional set of biodiversity impacts, largely relating to fauna habitat within 1 km of the development site, be assessed for potential impacts (see **Appendix A**).

8.5.1 Habitat present within 1km of the development site

Data on local fauna are also available from Event Impact Monitoring of forest birds and small mammals (**Appendix F**). Six of ten transects regularly monitored before-during-after events at NBP are located within 1km of the development site; two are located just outside a 1km buffer, and two are located within the development site. Timed bird counts and hair funnel sampling have been undertaken at these sites since before 2012. Considering the eight transects (six within and two outside of a 1km buffer), at least 810 twenty minute bird counts, and 5000 hair funnel samples have been undertaken.

Large areas of Billinudgel Nature Reserve (BNR) are located to the south and southeast. Areas of North Byron Parklands (NBP) are located outside of and within 1km of the development site. To the west, north and northeast the area includes freehold lands.

Approximately half of the area enclosed within a 1km buffer around the development site is agricultural land supporting sugar cane and grazing (in the north) and grazing and horticulture in the south and southwest. The Pacific Highway, a fenced dual carriageway freeway and the parallel Tweed Valley Way and Brunswick Valley Way are included in the southwestern quarter of the 1km buffer as is the Yelgun interchange rest area. These areas are of relatively low ecological value and the two parallel main roads are significant physical and ecological barriers for terrestrial fauna.

High ecological value forested habitats are present in NBP and in freehold lands to the west of NBP, but mainly in small forest blocks surrounded by grazing lands. The highest quality habitats within the 1km buffer include forested lands in the eastern part of NBP and the extensive swamp sclerophyll and floodplain forests in BNR in the south-eastern quarter of the 1km buffer area. However, while these forests are highly ecologically significant, they are predominantly regrowth from an historical clearing event and, based on surveys undertaken to support this assessment, contain few old-growth trees and relatively few tree hollows. See **Figure 14**, which provides a 1947 aerial photo showing the general absence of forest within NBP, along the Jones Road ridge and in parts of the Nature Reserve.

Recent (~10 year old) plantings of native vegetation are present within the buffer, both within National Parks Estate as compensation for tree removal on the Pacific Highway, and within NBP to improve connectivity for fauna, especially south of Jones Road. While this vegetation provides resources for fauna, tree hollows are not present, and hollow-dependent fauna are unable to fully exploit this habitat.

A survey for tree hollows within 200m of the development site has been undertaken and results are provided in **Appendix E**. Forty-four hollow-bearing trees were located during surveys, including some trees that were just outside of the 200m buffer. These are presented in **Table 17** and **Figure 41**.

Table 17: Hollow-bearing trees within the 200m buffer area.

Common Name	Scientific Name	Count
Camphor Laurel**	*Cinnamomum camphora*	1
White Mahogany	*Eucalyptus acmenoides*	12
Flooded Gum	*Eucalyptus grandis*	3

Common Name	Scientific Name	Count
Hard Quandong	*Elaeocarpus obovatus*	1
Pink Doughwood	*Melicope elleryana*	1
Blackbutt	*Eucalyptus pilularis*	9
Grey Gum	*Eucalyptus propinqua*	2
Swamp Mahogany	*Eucalyptus robusta*	2
Forest Red Gum	*Eucalyptus tereticornis*	3
Eucalypt sp. unk.	*Eucalyptus* species unknown	1
Brush Box	*Lophostemon confertus*	4
Swamp Box	*Lophostemon suaveolens*	2
Broad-leaved Paperbark	*Melaleuca quinquenervia*	3
TOTAL		**44**

** Camphor Laurel is an exotic species, & considered an environmental weed.

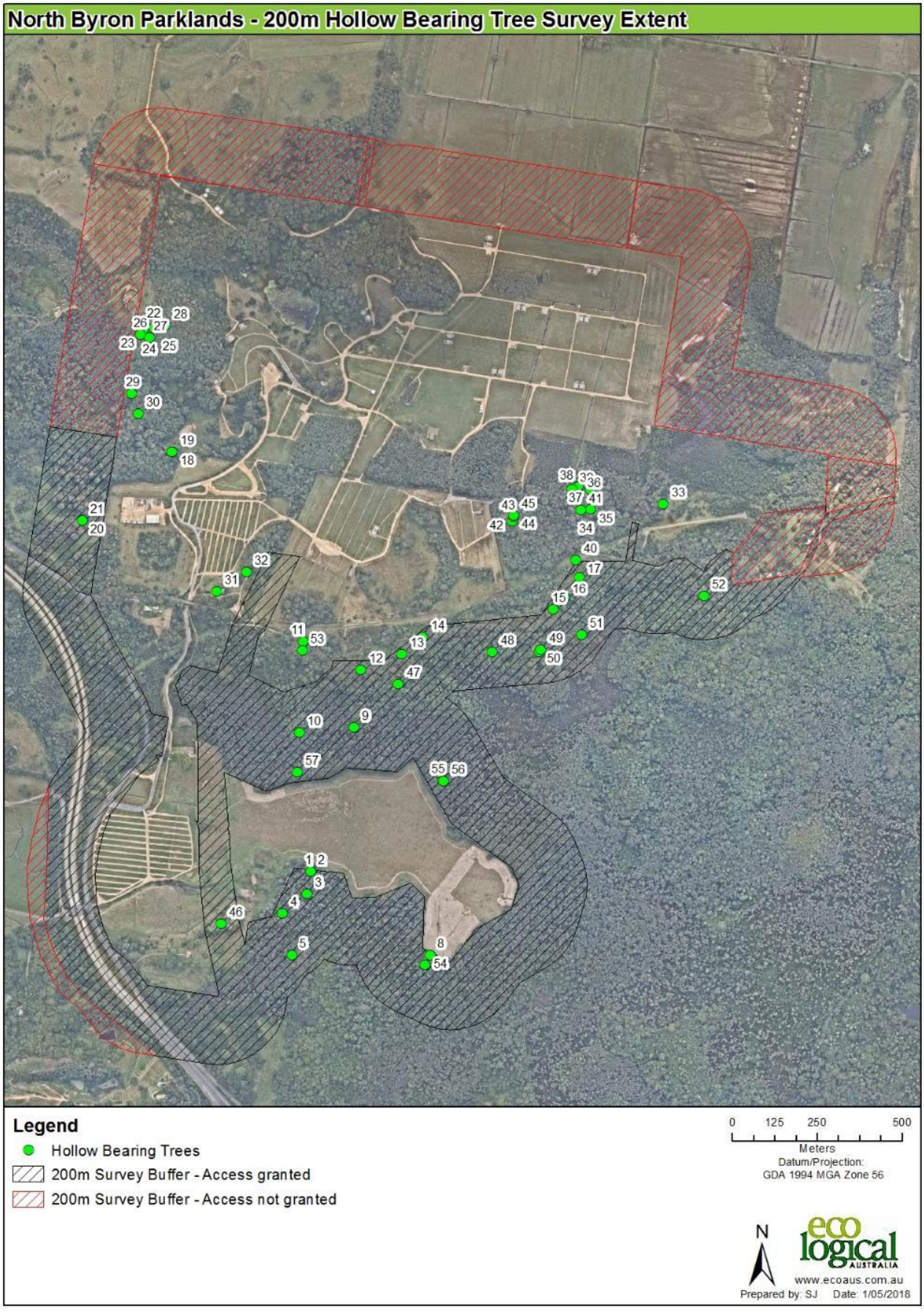


Figure 41: Hollow-bearing trees within 200m of the development site

8.5.2 Migratory Species within the development site

Table 18 lists those migratory species that are either known to occur within the development site or have potential to occur. Refer to the likelihood assessment in **Appendix K** for more detail.

Table 18: Migratory Species within the development site

Known to occur	Potential to occur
Black-faced Monarch (*Monarcha melanopsis*)	Fork-tailed Swift (*Apus pacificus*)
Oriental Cuckoo (*Cuculus optatus*)	Latham's Snipe (*Gallinago hardwickii*)
Osprey (*Pandion haliaetus*)	
Rufous Fantail (*Rhipidura rufifrons*)	
Satin Flycatcher (*Myiagra cyanoleuca*)	
Spectacled Monarch (*Symposiachrus trivirgatus*)	
White-throated Needletail (*Hirundapus caudacutus*)	

8.5.3 Threatened and migratory fauna species within 1km of the development site

To assist in the assessment of fauna that may inhabit an area within 1km of the development site, a wider OEH Bionet Atlas database search area has been utilised. **Table 19** lists threatened fauna species records from the NSW OEH Bionet Atlas database for a 10km by 10km area based on a point at the centre of the development site. Records from the Bionet 10km by 10km area search, numbers of OEH Bionet Atlas records are provided in **Table 19** for the Byron LGA for comparison.

In consideration of **Table 19**, threatened species recorded from the Bionet Atlas search area, but which are occasional visitors (*Anthochaera phrygia* [Regent Honeyeater], *Lathamas discolor* [Swift Parrot]) or only likely to occur during extensive flood events (*Anseranas semipalmata* [Magpie Goose], *Ephippiorhynchus asiaticus* [Black-necked Stork], *Grus rubicunda* [Brolga]) are excluded from further consideration, given the extremely low probability of their presence within the 1km buffer area and of any impact from the project. *Ixobrychus flavicollis* (Australasian Bittern), Black-necked Stork, Glossy Black-cockatoo, Coxen's Fig Parrot and *Turnix melanogaster* (Black-breasted Button-quail) are also considered unlikely to occur, considering the habitats within the 1km buffer area.

Table 20 lists threatened species either known from or considered likely or possible occurrences within 1km of the development site boundary. The list of species is based on those species records returned in the 10km by 10km search area mentioned above.

Threatened Species which have not been recorded from the Byron LGA and are considered unlikely to be present, or to use habitats within 1km of the project boundaries, include *Poephila cincta* (Southern Black-throated finch), *Rostratula australis* (Australian Painted Snipe) and *Coeranoscincus reticulatus* (Three-toed Snake-toothed Skink).

Habitats within the 1km buffer area are considered unsuitable for the *Dasyurus maculatus* (Spotted-tailed Quoll), *Phascogale tapoatafa* (Brush-tailed Phascogale), *Petauroides volans* (Greater Glider) and *Pseudomys novaehollandiae* (New Holland Mouse).

Table 21 lists migratory species likely to occur within 1km of the development area. The list of species is based on those species records returned in the 10km by 10km search area mentioned above. Only *Motacilla flava* (Yellow Wagtail) is considered unlikely to be present or to use habitats within 1km of the project boundaries.

Table 19: BioNet Atlas Records for a 100km2 area around the development site

Common Name	Scientific Name	NSW status*	Comm. Status*	Bionet	Byron LGA
Amphibians					
Wallum Froglet	*Crinia tinnula*	V		5	200
Wallum Sedge Frog	*Litoria olongburensis*	V	V		
Birds					
Barred Cuckoo-shrike	*Coracina lineata*	V		1	27
Black Bittern	*Ixobrychus flavicollis*	V		1	77
Black-necked Stork	*Ephippiorhynchus asiaticus*	E1		5	50
Brolga	*Grus rubicunda*	V		1	3
Comb-crested Jacana	*Irediparra gallinacea*	V		3	20
Eastern Grass Owl	*Tyto longimembris*	V		2	27
Eastern Osprey	*Pandion cristatus*	V	Mi. Ma	11	80
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V		6	60
Little Lorikeet	*Glossopsitta pusilla*	V		1	11
Magpie Goose	*Anseranas semipalmata*	V		1	1
Marbled Frogmouth	*Podargus ocellatus*	V		2	37
Masked Owl	*Tyto novaehollandiae*	V		5	18
Pale-vented Bush-hen	*Amaurornis moluccana*	V		1	213
Regent Honeyeater	*Anthochaera phrygia*	E4A	CE	1	1
Rose-crowned Fruit-Dove	*Ptilinopus regina*	V		41	270
Sooty Owl	*Tyto tenebricosa*	V		3	90
Square-tailed Kite	*Lophoictinia isura*	V		1	16
Swift Parrot	*Lathamus discolor*	E1	CE	1	1
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	Ma	17	53
White-eared Monarch	*Carterornis leucotis*	V		10	222
Wompoo Fruit-Dove	*Ptilinopus magnificus*	V		2	99
Mammals					
Brush-tailed Phascogale	*Phascogale tapoatafa*	V		1	K
Common Blossom-bat	*Syconycteris australis*	V		3	40
Common Planigale	*Planigale maculata*	V		1	45
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V		11	34
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V		1	3

Common Name	Scientific Name	NSW status*	Comm. Status*	Bionet	Byron LGA
Eastern Freetail-bat	*Mormopterus norfolkensis*	V		7	11
Eastern Long-eared Bat	*Nyctophilus bifax*	V		7	112
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V		2	7
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	7	202
Koala	*Phascolarctos cinereus*	V	V	133	1961
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	3	4
Little Bentwing-bat	*Miniopterus australis*	V		46	205
Long-nosed Potoroo	*Potorous tridactylus*	V	V	2	193
Northern Free-tailed Bat	*Mormopterus lumsdenae*	V		1	K
Southern Myotis	*Myotis macropus*	V		11	226
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	3	24
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V		3	5
Invertebrates					
Mitchell's Rainforest Snail	*Thersites mitchellae*	E1	CE	2	157

* Under TSC Act: E1 = Endangered; E2 = Endangered Population, E4 = Presumed Extinct, E4a = Critically Endangered; P = Protected; and V = Vulnerable. Under the EPBC Act: CE = Critically Endangered; E = Endangered; V = Vulnerable; Mi = Migratory, Ma = Marine.

** Additional threatened fauna species known from the area include: the Eastern subspecies of the Brown Treecreeper (*Climacteris picumnus victoriae*) is listed as Vulnerable in NSW and has recently been recorded at transects within the 1km buffer area. Golden-tipped Bats (*Kerivoula papuensis*) have been recorded from Anabat call detection in NBP and are considered likely to also occur within the 1km buffer area. The Bush-stone Curlew (Endangered in NSW) was observed for the first time in August 2017 and is also likely to exist in the 1km buffer area.

Table 20: Threatened species either known from or considered likely or possible occurrences within 1km of the development site boundary

Common Name	Scientific Name	TSC Act status	EPBC Actstatus	Bionet Search
Amphibians				
Wallum Froglet	*Crinia tinnula*	V		X
Wallum Sedge Frog	*Litoria olongburensis*	V	V	
Birds				
Barred Cuckoo-shrike	*Coracina lineata*	V		X
Bush-stone Curlew	*Burhinus grallarius*	E		
Black Bittern	*Ixobrychus flavicollis*	V		X
Brown Treecreeper	*Climacteris picumnus victoriae*	V		
Comb-crested Jacana	*Irediparra gallinacea*	V		X
Eastern Grass Owl	*Tyto longimembris*	V		X
Eastern Osprey	*Pandion cristatus*	V	Mi, Ma	X
Little Lorikeet	*Glossopsitta pusilla*	V		X
Marbled Frogmouth	*Podargus ocellatus*	V		X
Masked Owl	*Tyto novaehollandiae*	V		X
Pale-vented Bush-hen	*Amaurornis moluccana*	V		X
Rose-crowned Fruit-Dove	*Ptilinopus regina*	V		X
Sooty Owl	*Tyto tenebricosa*	V		X
Square-tailed Kite	*Lophoictinia isura*	V		X
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	Ma	X
White-eared Monarch	*Carterornis leucotis*	V		X
Wompoo Fruit-Dove	*Ptilinopus magnificus*	V		X
Mammals				
Common Planigale	*Planigale maculata*	V		X
Koala	*Phascolarctos cinereus*	V	V	X
Bats				
Common Blossom-bat	*Syconycteris australis*	V		X
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V		X
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V		X
Eastern Freetail-bat	*Mormopterus norfolkensis*	V		X
Eastern Long-eared Bat	*Nyctophilus bifax*	V		X
Golden-tipped Bat	*Kerivoula papuensis*	V		

Common Name	Scientific Name	TSC Act status	EPBC Actstatus	Bionet Search
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V		X
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	X
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	X
Little Bentwing-bat	*Miniopterus australis*	V		X
Northern Free-tailed Bat	*Mormopterus lumsdenae*	V		X
Southern Myotis	*Myotis macropus*	V		X
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V		X
Invertebrates				
Mitchell's Rainforest Snail	*Thersites mitchellae*	E1	CE	X

Table 21: Migratory species likely to occur within 1km of the development area.

Common Name	Scientific Name	Habitats	Likely to occur < 1km	NBP
Black-faced Monarch	*Monarcha melanopsis*	Woodland, sclerophyll and rainforest	Yes	X
Cattle Egret	*Bubulcus ibis*	Pasture, associates with livestock.	Yes	X
Eastern Osprey	*Pandion cristatus*	Rivers, estuaries, coasts	Yes	X
Fork-tailed Swift	*Apus pacificus*	Aerial	Yes	--
Latham's Snipe	*Gallinago hardwickii*	Swamps, marshes wetlands	Yes	
Oriental Cuckoo	*Cuculus optatus*	Woodland, Forest	Yes	X
Rainbow Bee-eater	*Merops ornatus*	Woodland and timbered plains.	Yes	X
Rufous Fantail	*Rhipidura rufifrons*	Forest, rainforest	Yes	X
Satin Flycatcher	*Myiagra cyanoleuca*	Forest, gully forest	Yes	X
Spectacled Monarch	*Monarcha* trivirgatus*	Rainforest, gully forest	Yes	X
White-throated Needletail	*Hirundapus caudacutus*	Aerial, roost in forest	Yes	X
Yellow Wagtail	*Motacilla flava*	3 records in NSW, not recorded in Byron LGA	No	

* Named '*Symposiachrus trivirgatus'* in NSW OEH lists.

9 Predicted Impacts of the Project

This section discusses the predicted impacts of the project. The conclusions have been founded in the results of the previous 10-years of survey and monitoring data from the site. In particular, the EIM has been specifically designed and implemented to detect any impacts from running events. The overall survey and monitoring results to date indicate that the events at the Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities (**Appendix F**). It is acknowledged that the future proposal will increase both the intensity and duration of events and the impact of this is explicitly considered below.

9.1 Direct Impacts relevant to the FBA

Clearing required for the proposed access track

Only very minor vegetation clearing / pruning would occur due to the project. This is associated with the widening of an existing track in the north-east of the development site. The clearing area consists of an approx. 1.5m widening (each side) of an existing track for a length of approximately 100m. This results in a clearing area that is approximately 300m^2 in area.

No native vegetation clearing is proposed within riparian buffers. Further to this, a minimum 30m buffer is provided for the SEPP wetland, and no development is proposed within the riparian buffers for Yelgun or Billinudgel Creek.

The proposed clearing area is mapped as being within Vegetation Zone 2 (PCT 749 - Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion) for practical purposes. Nonetheless, the flora of the proposed clearing area doesn't exactly reflect this PCT. This is because the proposed clearing area is on the edge of the patch of vegetation, and it also represents a very small area amongst a larger PCT.

A survey of trees likely to be required to be removed was undertaken in April 2018. The survey revealed that 35 native trees are likely to require removal with one requiring branch pruning. None of the trees that would be removed are considered to be koala food trees. **Table 22** shows trees likely to require removal; however it should be noted that the assessment was conservative in estimating impacts. Furthermore, track design is likely to be further refined to minimise and further avoid tree clearing.

No threatened flora species would be impacted by the proposed clearing associated with the access track.

Table 22: Trees likely to be removed due to proposed track widening

Species	DBH (cm)*	Height (m)	Canopy Spread (m)
Acacia disparrima	30; 32; 18	16	10
Elaeocarpus obovatus	7	10	5
Acacia disparrima	12;6	12	3
Acacia disparrima	35; 35; 40	18	8
Glochidion ferdinandi	2	2.5	0.7

Araucaria cunninghamii	5	5	1
Glochidion ferdinandi	5	8	1.4
Araucaria cunninghamii x 24	All juvenile specimens between 3 and 15m high.		
Glochidion sumatranum	2	2.5	0.5
Syzygium oleosum	Branch pruning may be required; however this tree can be retained		
Acacia disparrima	16	7	10
Pittosporum undulatum	3; 4	4	2
Archirhodomyrtus beckleri	1	1	0.3
Acacia disparrima	8	7	2

* For trees with multiple stems at breast height, each stem was recorded separately.

The approximate extent of clearing is shown in **Figure 4** whilst the existing track is shown in **Figure 5**. The area of clearing represents less than 0.001% of the 105 ha of native vegetation on the development site. As this area is very minor in the context of a major development, it has not been included in impact calculations as part of the BBCC.

Clearing required for the proposed wastewater treatment facility

Approximately 0.4 ha of a non-native vegetation community is required to be cleared for the construction of the proposed wastewater treatment facility (**Figure 8**). The vegetation community is dominated by open exotic pasture, with stands of Camphor Laurel and Mango (both exotic species). A tree survey was undertaken to identify trees that have >10cm DBH within the proposed clearing area. The survey identified two *Cupaniopsis anacardioides* (Tuckeroo, 10m and 15m high) that would require removal, as well as potential branch trimming of approximately three Acacias (*Acacia disparrima* / *Acacia melanoxylon*).

The site value score for the vegetation community was less than 17. Therefore, assessment of native vegetation is not required beyond subsection 5.3.3 of the FBA Methodology.

Within the area, there are also three *Macadamia tetraphylla* trees. These were listed as vulnerable under the TSC Act (now repealed) and are currently listed as vulnerable under the *Biodiversity Conservation Act 2016*. These trees would not be directly impacted by the proposed wastewater treatment facility. Measures to reduce potential impacts to these trees are provided in **Section 10.1**.

Other potential direct impacts

There would be no direct impacts to EECs, CEECs or threatened flora. Nor would there be any direct impact to threatened fauna or flora, with exception to an area of exotic grassland, which represents habitat for the Eastern Grass Owl.

The Eastern Grass Owl was recorded in the main event area (north of Jones Rd) in 2007 and as mentioned in **Section 8.3**, the species responded to call playback in July 2016 and July 2017 in the exotic grassland in the south of the parklands. The 2016 observation was the first observation of this species within the site since 2007.

The unmanaged exotic pasture in the south of the site (**Figure 1**) is likely to represent potential foraging and nesting/breeding habitat for the Eastern Grass Owl. However, the inferred absence of the species in the exotic pasture area in some years suggests that the site is not used annually; it could be too wet in some years, and there are also foxes that are active in that grassland (evidenced by direct observations

& scats). Some of the southern grassland is to be retained as part of the proposed wetland buffer, and therefore the breeding habitat may or may not be lost if the development takes place. If sufficient grassland is retained via the wetland buffer, the birds may forage and/or nest there after development of a car park, but not if it is planted as melaleuca forest.

If the worst case scenario (loss of that breeding habitat) is assumed:

- the effect is likely to be non-lethal if carried out outside the breeding season;
- some foraging habitat would remain; and
- the development would affect a pair of birds that may often breed elsewhere. I.e. their inferred absence (not being detected in surveys in most years) suggests they are foraging elsewhere, and possibly breeding elsewhere.

The species is highly mobile and often not present in the southern grassland, therefore occupied territory (of this pair of birds) is likely to extend well beyond NBP. Likely breeding habitat and foraging habitat for a pair of Eastern Grass Owls is likely to be removed, but not eliminated. A population scale effect such that *a viable local population of the species is likely to be placed at risk of extinction* is unlikely.

Outside of the area of exotic grassland, all areas of remnant forest vegetation would be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no significant adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures would continue across the site with the objective of improving the ecological condition of the vegetation and therefore its potential value as Eastern Grass Owl habitat over time.

No native vegetation associated with the Eastern Grass Owl would be directly impacted by the proposed development.

Approximately 14.8 ha of potential habitat in the form of exotic grassland would be directly impacted for the construction of the southern carpark (see **Figure 3**). As the area constitutes exotic grassland, it was not deemed assessable as a part of the FBA, and therefore offset for this loss is not required. A number of mitigation measures have been assigned directly to the Eastern Grass Owl to ensure that any potential direct impact to this species is minimised (see **Table 23** and **Section 10**). It is also noted that the southern carpark is already approved under the existing project approval.

Similarly, the Bush-stone Curlew (also an ecosystem credit species, first sighted at the Parklands in July 2017) is likely to occasionally forage in exotic grassland areas (outside of the forest areas), however due to the height and density of grasses, the unmanaged exotic pasture area in the south is unlikely to represent suitable habitat for this species. No direct impacts to this species due to the project are expected.

The project would not negatively impact on connectivity across the site and/or into adjacent areas. The ongoing program of ecological restoration has and will continue to improve connectivity by increasing the extent and connection between patches of native vegetation.

9.2 Indirect Impacts relevant to the FBA

The consistent conclusion across all EIM surveys has been that there are no significant adverse effects on any flora or fauna group as a consequence of events held at the Parklands (See **Appendix F**).

Nonetheless, the proposal would result in different impacts to those monitored during the trial period. These predicted indirect impacts are specifically related to:

- The proposed increase in patron numbers
- The increased number of events
- The increased frequency of events
- The maximum number of events days per event, and in aggregate per year
- Use of the conference centre throughout the year
- Minor barrier effects due to the installation of the 1.8m high security fence

With these aspects in mind, the following impacts are identified:

- An increase in the maximum number of patrons from the current scenario (maximum of 35,000 patrons currently to a maximum of 50,000 patrons for one of the events only under the ultimate proposed scenario) is predicted to result in the following impacts:
    - The risk of vehicular strike is expected to increase to a small degree during event times due to increased traffic.
    - The risk of fauna attack by dogs is likely to have a negligible increase during event times.
    - The risk of fauna entanglement with event infrastructure and trampling is expected to have a negligible increase during event times due to increased foot traffic.
    - The increases in noise impacts due to the number of patrons is not expected to be significantly different. Additional amplified stages may be established as part of events to cater for additional patron numbers, which may represent some potential additional noise sources. However, the proposal does not involve any change to existing noise limits, and Parklands would still be required to achieve its approved noise criteria offsite. Noise impacts would influence local fauna movement in varying ways during event periods. Predicted impacts to fauna species is outlined in **Table 24**. Previous surveys indicate that these impacts are temporary and rapidly reversible at the conclusion of events (see **Appendix F**). It is not expected that increases in noise levels associated with the proposal would result in longer times before wildlife return to the area (if they display avoidance behaviours due to noise).
    - Lighting impacts are not expected to increase significantly as the number of powered lights within event areas is determined by event area and not by patron numbers. Nonetheless, if new event areas are established to support additional patrons (e.g. new parking areas), then some additional light impacts may occur. One recent change is as a result of counter terrorism risk assessments undertaken by NSW Police for SITG17, which has required an increase in lighting levels at some points throughout the event for greater safety. Light spillage is also reduced by use of appropriate technologies (see **Section 10**).
    - The risk of vegetation trampling is not expected to be significantly different with increase patron numbers due to effective mitigation measures that are put in place during events (see **Section 10**). The potential for vegetation trampling is minimised by fencing off areas of native vegetation during events. There is a very limited risk of vegetation trampling from people without tickets to events trying to access the site through vegetated areas. Over the previous events, the instances of this were very low (and have continued to decrease with the assistance of NSW

Police prosecuting trespassers). Trampling risk is greatest, but still very low, where recruitment of native tree and shrub species has occurred within the project area.

- Increased numbers of people / vehicle movements on site presents a weed and plant pathogen pathway. However, the site has a long history of disturbance, with over 50 exotic flora species known to occur across the Parklands. As part of the ongoing environmental stewardship of the site, the Parklands have implemented a program of bush regeneration. This includes weed management throughout areas of remnant vegetation, and as such, habitat for threatened flora species. Ongoing management has significantly reduced the presence of weeds across the site and has resulted in an overall improved condition of the vegetation. This program would continue moving forward, and would more than offset any introduction of weeds during events.
- The risk of bushfire is increased during events due to the large numbers of people occupying the site. However, this also poses a significant safety issue for the event patrons and therefore stringent fire management protocols are implemented. The primary aim of these measures is to prevent fire and manage it effectively, from a public safety perspective, if a fire occurs. However, these measures would also benefit the vegetation and habitat on site.
- The increases in patron numbers would be staged over several years and would only be increased subject to the meeting of KPIs (see **Section 10.2.2**).

- All else being equal, an increase in the number of events days (excluding community events) from a maximum of 10 (currently) to 13 (proposed) event days per year increases the frequency and duration of all indirect impacts as well as increasing the likelihood of risks (such as vehicle strike and bushfire). Impacts observed during and immediately after events have included limited sediment movement, littering and trampling of grasses within the event area, and avoidance of illuminated areas by mobile fauna. Surveys indicated that these impacts are temporary and reversible at the conclusion of events (**Appendix F**).
- An increased number of events per year results, on average, in a shorter duration between events and therefore reduced time for recovery from any impacts. Nonetheless, a majority of events would be minor events with much less impact compared to the major events. In addition, there would often be months between events, meaning that would be ample time between events for ecological recovery.
- The maximum number of days per event is proposed to increase from four to five. Any fauna that are dispersed due to indirect impacts are expected to return within timeframes consistent with the current scenario.
- There is a minor risk that the frequency and length of events would tip certain species to leave habitats within the project area; however this risk is considered to be minor given the evidence collected to date, and all events would be monitored against KPIs to identify this kind of potential impact (see **Section 10.2.2**). Such an impact would also be reversible.
- As mentioned in **Section 1.1.2**, it is proposed that the conference centre and associated accommodation would be used for a range of events such as corporate functions, conferences, celebrations, or health and wellbeing retreats. The conference centre would operate year-round, and cater for up to 180 patrons per day. Accommodation would be provided for up to 120 guests a day in 30 on-site cabins. Impacts are likely to include the following:
  - The dam adjacent to the proposed conference centre is not considered an important habitat for migratory species. Furthermore, there is only one significant species that has a likelihood to exist in the dam and to utilise the dam (refer to **Appendix J** and **Appendix K**): Latham's Snipe, which is a migratory species, is not listed as threatened in NSW, and despite intensive bird

survey, has not been observed on the Parklands site. During times of use, patronage is likely to disturb foraging and potential nesting behaviour of waterbirds in areas of the dam adjacent to the conference centre (due to noise and visual disturbance) where activities occur within the flight-initiation distances of each resident species. Over the long term, a level of habituation may occur, potentially bringing an increased level of tolerance to the presence of humans at the dam. This may partially reduce the impact on waterbirds, however it is acknowledged that there is a paucity of data on this issue (Weston et al. 2012). Further to this, the impact that this disturbance would have on resident waterbirds at the dam is expected to be minor, and as mentioned above, is unlikely to significantly affect threatened or migratory species.

  - The level of noise generated at the conference centre is likely to be minimal with most noise generating activities being undertaken within the proposed buildings. Therefore the associated impact to adjacent aquatic and forest habitats are likely to be negligible.
  - Use of the conference centre throughout the year would result in an increase frequency of light impact, as well an increase in light spillage due to the number of lights at the centre. Light spillage can be managed to reduce spillage into adjacent habitat areas and any light impacts are predicted to be localised and not significant.

- The installation of the 1.8m high palisade security fence (**Figure 6**) would create a potential barrier effect for some wildlife across the site. However, the impact on fauna movement is considered to be negligible as the fence would be designed so that every 5th or 6th panel (approx. 2.5m in length) can be open during non-event times. This is mainly to reduce the barrier effect for macropods and koalas. Furthermore, the fence would be set 100mm off the ground and will also have space between the palisade pales to allow wildlife movement through the fence. This would not hinder movement of small mammals, reptiles, birds or others small wildlife.

These indirect impacts would have a negligible to minor impact on threatened species, should they occur within the development site. However, the Koala, Brown Treecreeper and Mitchell's Rainforest Snail are considered to be at a higher risk due to their small population sizes, observed regional declines (Koala), dependence upon forest habitats in the broader study area, and their susceptibility to fire. Effective implementation of a Bushfire Management plan which specifically addresses and minimises fire risk for BNR is considered a reliable means of managing and reducing this risk.

A summary of potential indirect impacts to flora and fauna are provided in **Table 23** and **Table 24**.

Table 23: Summary of potential impacts to threatened flora species

Species	Impact
Davidson's Plum (*Davidsonia jerseyana*) endangered Known to occur in project area	Direct impacts: nil, as all areas would be fenced off during events Indirect impacts: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

Rough-shelled Bush Nut (*Macadamia tetraphylla)* Known to occur in project area	As above
Stinking Cryptocarya (*Cryptocarya foetida*) Known to occur in project area	As above
Durobby / Coolamon Rose Apple (*Syzygium moorei*) Known to occur in project area	As above
Slender Marsdenia; Clear Milk Vine (*Marsdenia longiloba*) Potential to occur in project area	As above
Southern Fontainea (*Fontainea australis*) Potential to occur in project area	As above
Rusty Rose Walnut (*Endiandra hayesii*) Potential to occur in project area	As above
Pink Nodding Orchid (*Geodorum densiflorum)* Known from outside the development site	As above
Green-leaved Rose Walnut (*Endiandra muelleri subsp. bracteate)* Known to occur in development site	As above

Table 24: Summary of potential impacts to threatened fauna species

Species name	Indirect impacts to species
Birds	
Carterornis leucotis (White-eared Monarch) *Known to occur in project area*	• Potential fauna strike and/or entanglement, considered low risk with no previous evidence of this occurring, low probability of bird foraging on site • Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk as monitoring has shown birds returning to areas soon after disturbance has ceased. There is also significant suitable habitat adjacent to site • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Climacteris picumnus victoriae (Brown Treecreeper) Potential to occur within the development site	As above

Species name	Indirect impacts to species
Cyclopsitta diophthalma coxeni (Coxen's Fig-Parrot) Potential to occur in project area	• Potential fauna strike and/or entanglement, considered low risk with no previous evidence of this occurring, site does not appear highly utilised by this species (seasonal migrant only potentially present during winter events) • Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk as monitoring has shown birds returning to areas soon after disturbance has ceased. There is also significant suitable habitat adjacent to site • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Glossopsitta pusilla (Little Lorikeet) Known to occur in development site	• Direct impacts: potential fauna strike and/or entanglement, considered low risk with no previous evidence of this occurring, development site does not contain potential habitat for this species • Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk as monitoring has shown birds returning to areas soon after disturbance has ceased. There is also significant suitable habitat adjacent to site • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Irediparra gallinacean (Comb-crested Jacana) Potential to occur in development site	As above
Lathamus discolour (Swift Parrot) Potential to occur in development site	As above
Ptilinopus magnificus (Wompoo Fruit-Dove) Known to occur in project area	As above
Pandion cristatus Eastern Osprey Potential to occur in development site	• Potential fauna strike and/or entanglement, considered low risk with no previous evidence of this occurring, species likely to occur intermittently at site • Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk as monitoring has shown birds returning to areas soon after disturbance has ceased. There is also significant suitable habitat adjacent to site • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Ptilinopus regina Rose-crowned Fruit-Dove Known to occur in project area	• Potential fauna strike, considered low risk due to low numbers recorded on site, few event days and traffic controls during events, development site does not contain any potential habitat for this species

Species name	Indirect impacts to species
	• Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk due to lack of previous species records in area and all habitat areas would be fenced off during events. There is also significant suitable habitat adjacent to site • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Tyto longimembris Eastern Grass Owl Known to occur in project area	• Removal of potential foraging and nesting habitat associated with the establishment of the carpark in the south of the development site. • Potential fauna strike and/or entanglement, considered low risk with no previous evidence of this occurring. • Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk as monitoring has shown birds returning to areas soon after disturbance has ceased. There is also significant suitable habitat adjacent to site • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Invertebrates	
Thersites mitchellae Mitchell's Rainforest Snail Known to occur in project area	• Potential trampling, considered low risk as all habitat areas would be fenced off during events, low previous incidence of attempted unauthorised access • Potential disturbance from vibrations caused by noise (gastropods do not have a sense for hearing but feel vibration), light and people presence leading to temporary alienation of the project area, considered low risk as habitat areas would be fenced off during events • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Mammals	
Phascolarctos cinereus Koala Potential to occur in development site	• Potential fauna strike, considered low risk due to few event days and traffic controls during events. • Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk and temporary. There is also significant suitable habitat adjacent to site • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Negligible barrier effect to connectivity due to installation of security fence.
Planigale maculata Common Planigale Potential to occur in development site	• Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk due to lack of previous species records in area and all

Species name	Indirect impacts to species
	habitat areas would be fenced off during events. There is also significant suitable habitat adjacent to site • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Bats	
Chalinolobus dwyeri Large-eared Pied Bat Known to occur in project area	• Potential fauna strike and/or entanglement, considered low risk with no previous evidence of this occurring • Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk as monitoring has shown no negative impacts to other microbat species. • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Falsistrellus tasmaniensis Eastern False Pipistrelle Known to occur in project area	As above
Kerivoula papuensis Golden-tipped Bat Known to occur in project area	As above
Miniopterus australis Little Bentwing-bat Known to occur in project area	As above
Miniopterus schreibersii oceanensis Eastern Bentwing-bat Known to occur in project area	As above
Mormopterus norfolkensis Eastern Freetail-bat Known to occur in project area	As above
Myotis macropus Southern Myotis Known to occur in project area	As above The events may also provide a minor benefit to these species. There is evidence from monitoring (**Appendix D**) that suggests that increased predation on insects that are attracted to event lighting can occur. This may also apply to the other microbat species that occur in the area.
Nyctophilus bifax Eastern Long-eared Bat Known to occur in project area	As above
Pteropus poliocephalus Grey-headed Flying-fox Known to occur in project area	As above
Saccolaimus flaviventris	As above

Species name	Indirect impacts to species
Yellow-bellied Sheathtail-bat Known to occur in project area	
Syconycteris australis Common Blossom-bat Known to occur in project area	As above

Table 25: Potential Impacts to Migratory Species

Species	Potential impacts
Black-faced Monarch (*Monarcha melanopsis*) Known to occur in project area No important habitat or ecologically significant proportions of the population	• Potential fauna strike and/or entanglement, considered low risk with no previous evidence of this occurring • Potential disturbance from noise, light and people presence leading to temporary alienation of the project area, considered low risk as monitoring has shown bird species returning to areas soon after disturbance has ceased
Eastern Osprey (*Pandion cristatus*) Known to occur in project area No important habitat or ecologically significant proportions of the population	As above
Fork-tailed Swift (*Apus pacificus*) Potential to occur in project area No important habitat or ecologically significant proportions of the population	As above
Latham's Snipe (*Gallinago hardwickii*) Potential to occur in project area No important habitat or ecologically significant proportions of the population	As above Use of the conference centre throughout the year may result in disturbance to this species if it utilises the adjacent dam. Flight-initiation distance for this species is around 20m (Weston et al 2012), and due to the size of the dam, this species is unlikely to be disturbed by activities at the conference centre. This species has potential to occur at the dam, however it has not been observed within the area despite intensive survey effort at the dam.
Oriental Cuckoo (*Cuculus optatus*) Known to occur in project area No important habitat or ecologically significant proportions of the population	As above
Rufous Fantail (*Rhipidura rufifrons*) Known to occur in project area No important habitat or ecologically significant proportions of the population	As above
Satin Flycatcher (*Myiagra cyanoleuca*) Known to occur in project area No important habitat or ecologically significant proportions of the population	As above
Spectacled Monarch (*Monarcha trivirgatus*) Known to occur in project area No important habitat or ecologically significant proportions of the population	As above
White-throated Needletail (*Hirundapus caudacutus*)	As above

Species	Potential impacts
Known to occur in project area No important habitat or ecologically significant proportions of the population	

9.2.1 Impact to important habitat within 1km of the development site

Appendix D lists the individual species and the importance of their habitat within 1km of the development site. For the majority of species assessed, habitats within the 1km buffer area are not considered important, and no impact on movement patterns or use of habitat is considered likely, given the proposed use of the NBP site.

Additionally, four years of monitoring of forest birds, small terrestrial mammals and microchiropteran bats have revealed no significant adverse impacts for these fauna groups within the development site or at 8 transects within Billinudgel Nature Reserve. No adverse effects for threatened species or for habitats outside the development site have been detected. Therefore the likelihood of adverse impacts from the project within the 200m or 1km buffer area for threatened, migratory or hollow-dependent species is considered to be low.

9.2.2 Impacts to Hollow-Bearing Trees within 1km of the development footprint

Many of the larger hollow-bearing trees may potentially provide shelter for microchiropteran bats and potentially for small maternity colonies. However the majority of these are sufficiently distant from the development site as to experience little adverse effect from the permanent operation of the NBP.

Two trees are however in locations which expose them to illumination which could be adverse for roosting or nesting bats. These large Blackbutts #31 & #32 are to varying extents illuminated by the lights in the northern car park. Tree #32 in particular has large and deep hollows and is exposed to lighting during events. The importance of this tree for fauna is not known, however its availability as a shelter or roost site is influenced by the duration and extent to which it is illuminated. Overall however, the potential indirect impacts upon hollow bearing trees is considered minor to negligible.

9.3 Indirect impacts to the Billinudgel Nature Reserve

Due to the nature of the proposed development and its proximity to the BNR, indirect impacts may affect biodiversity values present in the reserve. The NSW OEH have requested an assessment of the indirect impacts specific to the BNR be undertaken, including consideration of the species and ecological communities known or potentially occurring in the BNR identified in **Table 26**.

Indirect impacts relevant to biodiversity values of the BNR associated with operation of the development site as a cultural events facility generally relate to noise, lighting, increased human traffic and hydrology. With these aspects in mind, the following impacts are identified:

- noise disturbance
- light spill
- trampling of vegetation
- rubbish dumping
- increased risk of bushfire
- introduction/spread of weeds
- pollutant run-off (or otherwise altered water quality)
- altered hydrology – water volumes and flow patterns

Potential disturbance to fauna from noise, lighting and people presence may lead to temporary alienation of the habitat in the BNR. Significant areas of habitat extend beyond the areas immediately adjacent to the development site and any fauna exhibiting avoidance behaviour are considered likely to move to adjacent habitats or less disturbed areas of their home range temporarily during events. The impact of any such disturbance is considered likely to be minimal and previous surveys indicate that these impacts are temporary and rapidly reversible at the conclusion of events (see **Appendix F**). No increase in noise or lighting levels are proposed relative to previous events and four years of event monitoring of forest birds, small terrestrial mammals and microchiropteran bats have revealed no significant adverse impacts for these fauna groups within the development site or at eight transects within Billinudgel Nature Reserve. Additionally, there will often be months between events, meaning that will be ample time between events for ecological recovery. Therefore, significant noise and lighting related impacts to fauna species within the BNR are considered unlikely.

Illegal camping and human traffic associated with people attempting to gain unauthorised entry to the site during events may result in several impacts to the BNR. Trampling of vegetation and rubbish dumping may occur as a result of illegal camping in the BNR or human traffic associated with people attempting to gain unauthorised entry to the site during events. The impact of these activities on vegetation communities, flora and fauna species and their habitats is expected to be minimal due to the low prevalence and short-term nature of any additional human presence in the reserve. The potential for impacts is also mitigated by security presence, fencing and provision of NPWS staff to enforce Regulations. These measures reduce the likelihood of people using these avenues to attempt to enter the site and monitoring at previous events has indicated the prevalence of such activities is low.

The risk of bushfire is increased during events due to the large numbers of people occupying the site. However, this also poses a significant safety issue for the event patrons and therefore stringent fire management protocols are implemented. The primary aim of these measures is to prevent fire and manage it effectively, from a public safety perspective, if a fire occurs. However, these measures also reduce the likelihood of a bushfire spreading from the site to the BNR. Illegal camping in the BNR is also associated with an increased risk of bushfire. Security presence, fencing and provision of NPWS staff to enforce Regulations are all aimed at reducing the prevalence of illegal camping activities and therefore also reduce the risk of bushfire.

Increased human traffic in the BNR and in the Parklands site present a weed and plant pathogen pathway. Several mitigation measures are aimed to reduce the prevalence of illegal camping and human traffic in the BNR such as security presence, fencing and provision of NPWS Rangers to enforce Regulations. Monitoring of vegetation communities for weeds will allow for the detection of any new weed species at the Parklands site and for control measures to be implemented to ensure weeds are not spread into the BNR. The risk of a significant infestation of a new weed species establishing in the BNR as a result of any increased human traffic is considered to be low and significant weed impacts to the BNR are considered unlikely due to the mitigation measures and monitoring activities proposed.

Nutrient run-off and changes to hydrology resulting from the operation of the development site have the potential to impact the BNR. With regards to the proposed southern carpark, design includes vegetated swales and stormwater quality improvements devices to treat runoff from the proposed carpark (see **Section 1.1.2**). The carpark catchments draining to the north and south are also proposed to mimic the existing stormwater catchments, which are controlled by a natural ridge line. Combined with the level spreaders that create sheet flow and provide diffuse discharge, stormwater discharge would mimic the current hydrological regime.

In addition, the short duration of events (and carpark use) at the site allows for waste management to occur on-site and limited off site impacts are expected.

These indirect impacts would have a negligible to minor impact on threatened species, should they occur within the BNR. Effective implementation mitigation measures such as security presence, fencing and provision of NPWS staff during events would discourage unauthorised activities within the BNR and reduce likelihood of indirect impacts. A Bushfire Management plan which specifically addresses and minimises fire risk for BNR is also considered a reliable means of managing and reducing this risk.

The consistent conclusion across all EIM surveys, including those undertaken within the BNR, has been that there are no significant adverse effects on any flora or fauna group as a consequence of events held at the Parklands (See **Appendix F**).

Table 26. Potential indirect impacts to significant species / communities known or potentially occurring in the Billinudgel Nature Reserve and identified as a concern by NPWS

Species	Potential indirect impacts
Squirrel Glider (*Petaurus norfolcensis*) Not recorded from BNR	• Potential disturbance from noise, light and people presence leading to temporary alienation of habitat adjacent to the development site, considered low risk and temporary. Suitable habitat is available away from disturbance areas and the species regularly uses multiple den sites within its home range. • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Brush-tailed Phascogale (*Phascogale tapoatafa*) Not recorded from BNR	• Potential fauna strike, considered very low risk due to few event days and traffic controls during events and limited night-time vehicle movements. • Potential disturbance from noise, light and people presence leading to temporary alienation of habitat adjacent to the development site, considered low risk and temporary. Suitable habitat is available away from disturbance areas and the species regularly uses multiple den sites within its large home range. • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
Wallum Froglet (Crinia tinnula) Known to occur in BNR	• Potential trampling, considered low risk as all habitat areas would be fenced off during events, low previous incidence of attempted unauthorised access • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Potential changes to wetland hydrology and water quality. Impacts have been reduced via engineering design (retention of catchments area, SQUIDS, swales and level spreaders).
Wallum Sedge Frog (*Litoria olongburensis*) Known to occur in BNR	• Potential trampling, considered low risk as all habitat areas would be fenced off during events, low previous incidence of attempted unauthorised access • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety

Species	Potential indirect impacts
	• Potential changes to wetland hydrology and water quality. Impacts have been reduced via engineering design (retention of catchments area, SQUIDS, swales and level spreaders).
Swamp Sclerophyll Forest EEC Known to occur in BNR	• Potential trampling, considered low risk as all areas would be fenced off during events, low previous incidence of attempted unauthorised access • Potential introduction of weed species, considered low risk due to on site monitoring and control measures and low previous incidence of unauthorised access • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Potential changes to wetland hydrology and water quality. Impacts have been reduced via engineering design (retention of catchments area, SQUIDS, swales and level spreaders).

10 Measures to Avoid and Minimise Impacts

This section is divided into two main parts – one that discusses the avoidance of impacts (**Section 10.1**), whilst another that discusses the minimisation of residual impacts (**Section 10.2**).

10.1 Avoidance of Impacts

10.1.1 Avoidance of direct impacts

Direct and indirect impacts to threatened flora, fauna and EECs will be significantly reduced utilising mitigation measures outlined in **Table 27**. Direct impacts to be avoided listed in **Table 27** are consistent with Section 8.3.1.1 of the FBA methodology.

Table 27: Avoidance of Direct Impacts

Direct Impact to be Avoided	Method to Avoid Impact
Impacts to Endangered Ecological Communities (EECs) and Critically Endangered Ecological Communities (CEECs)	• Site rehabilitation as well as weed management within vegetation communities will continue. • Temporary human exclusion fencing closely bordering (within 10 m of) forest blocks within event areas will be provided. All temporary human exclusion fencing used in these locations will be 'fauna-friendly', incorporating a minimum 100 mm continuous gap at the base of the fence or 100 mm square gaps at 10 m intervals along the base of the fence. • Stringent bushfire management during events for public safety. • Continued police enforcement and deterrence associated with illegal access to events that may result in trampling of vegetation (bearing in mind that the low occurrence results in negligible impacts). Parklands will also provision NPWS Rangers to enforce Regulations to deter use of the Billinudgel Nature Reserve. • Event operators shall only operate within the approved event areas. • No activities (apart from bushfire management) will occur within the 30m minimum buffer around the southern car parking areas surrounding the Billinudgel Nature Reserve. • All staff and contractors to undertake Parkland's Environmental Induction prior to accessing the site. Documented records shall be maintained covering the environmental induction process. • Patrons will be made aware of the environmental values of the local area via an information package (attached to current event information package).
Impacts to PCTs that contain threatened plant species habitat	• As above
Impacts to areas that contain habitat for Vulnerable, Endangered, or Critically Endangered threatened species	There will be no direct impact to the three *Macadamia tetraphylla* trees due to the establishment of the proposed wastewater infrastructure. Furthermore:

Direct Impact to be Avoided	Method to Avoid Impact
or populations in accordance with Step 5 in Section 6.5 of the FBA	• These trees will be surveyed in the future (theodolite for accuracy) so the infrastructure can be appropriately sited during the planning phase. • During construction, a tree protection zone will be established around the trees. This will be a minimum of 5m radially around each tree (or 12 x the diameter of the tree at breast height, as per the Australian standard for protection of trees on development sites). No development is to occur in the tree protection area and these areas are to be fenced and signed as exclusion zones during works. • To ensure no impacts to root zones etc., advice from a qualified arborist will be obtained prior to working occurring. If required, the arborist will direct works around the tree protection zones to ensure to impacts to these threes occur. • Site planning will ensure drainage isn't significantly affected by surrounding infrastructure. • The health of the three trees will be monitored and managed in accordance with the FFMRP (**Appendix G**). Further to this, no species polygons have been prepared for the above species credit species (as per Step 5) because only exotic pasture will be impacted and only a very minor area of clearing / pruning of vegetation will occur due to the proposed vehicular access track in the north-west. Exotic pasture areas have been excluded from the BBCC as they are do not constitute native vegetation.
Impacts to areas of land that the Minister for Environment has declared as critical habitat	No areas of land within the Parklands property have been declared as critical habitat by the Minister for Environment.
Impacts to riparian areas of 4th order or higher streams and rivers, important wetlands and estuaries	No development or event activities will occur within 20m of the 4th order stream. A SEPP wetland exists to the south-east of the development site. This wetland is associated with Billinudgel Nature Reserve and is not directly impacted by the project.
Impacts to state significant biodiversity links	No state significant or regionally significant biodiversity links have been identified within a plan by the Chief Executive of the OEH. As mentioned above, there is a SEPP wetland adjacent to the project area. This is within 50 m of the development site and therefore is deemed to be a State Significant Biodiversity Link. Nonetheless, the Biobanking Credit Calculator (BBCC) accounts for direct impacts to connectivity value classes only. As the project is not impacting SEPP vegetation, inclusion of the SEPP wetland as a State Significant Biodiversity Link is not required.

10.1.2 Site Selection

Impacts relevant to site selection have been assessed using criteria within Section 8.3.2 of the FBA methodology. The assessment is presented in **Table 28**.

Table 28: Avoidance and Minimisation of Direct Impacts through Site Selection

Site Selection Criteria	Method to Avoid Impact
Selecting a suitable development footprint for a Major Project or a route for linear projects, should be informed by knowledge of biodiversity values. An initial desktop assessment of biodiversity values would assist in identifying areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species	The area utilised for these events contains no remnant intact vegetation and is comprised of cleared pasture grass only, with scattered trees that are protected during events. The proposed vehicular access track to the north-west has been sited along an existing track to minimise vegetation clearing. Furthermore the northern parts of the alignment have been designed to weave around vegetation/trees to avoid clearing. Planning will also result in the avoidance of impacts to the three *Macadamia tetraphylla* trees in the north west.
Stage 1 of the FBA will provide the preliminary information necessary to inform project planning. Early consideration of biodiversity values is recommended in site selection, or route selection for linear projects, and the planning phase.	The direct impact of the proposed activities will be primarily restricted to the area of cleared pasture grass. As previously mentioned, there is also a very minor area of clearing / pruning associated with the proposed vehicular access track. The clearing area of approx. 300m^2 is less than 0.001% of 105 ha of native vegetation present on the site and therefore, the current and future extent of remnant vegetation will practically remain the same. Additionally, The Parklands site has been operating under trial since 2012, during which time a total of nine major and medium events have been held. Monitoring during each of these events showed that impacts to biodiversity values were short-term and reversible and no adverse impacts to biodiversity have yet been detected. As such, no alternative sites within or outside of the property were considered for the proposed developments. The current site selection is deemed to be the most appropriate for the proposed actions as it has the least biodiversity constraints and previous monitoring has demonstrated minimal impact on biodiversity due to events.
The site/route selection process should include consideration and analysis of the biodiversity constraints of the proposed development footprint and consider the suitability of the Major Project based on the types of biodiversity values present on the development footprint	
When considering and analysing the biodiversity constraints for the purpose of selecting a development footprint, the following matters should be addressed: (a) whether there are alternative sites within the property on which the proposed development is located where siting the proposed Major Project would avoid and minimise impacts on biodiversity values (b) how the development footprint can be selected to avoid and minimise impacts on biodiversity values as far as practicable (c) whether an alternative development footprint to the proposed development footprint, which would avoid adversely impacting on biodiversity values, might be feasible.	
For linear projects, the route selection process must include consideration and an analysis of the	

Site Selection Criteria	Method to Avoid Impact
biodiversity constraints of the various route options. In selecting a preferred option, loss of biodiversity values must be weighed up and justified against social and economic costs and benefits.	

10.1.3 Planning

Impacts relevant to project planning have been assessed using criteria within Section 8.3.2 of the FBA methodology. The assessment is presented in **Table 29.**

Table 29: Avoidance and Minimisation of Direct Impacts through Planning

Planning Criteria	Method to Avoid Impact
Siting of the project – the Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value score) or which avoid an EEC or CEEC	The project has established no-go zones, which fence off intact native vegetation. Events are contained within areas that consist of managed exotic pasture with scattered native trees that are protected during events.
Minimise the amount of clearing or habitat loss – the Major Project (and associated construction infrastructure) should be located in areas that do not have native vegetation, or in areas that require the least amount of vegetation to be cleared (i.e. the development site is minimised), and/or in areas where other impacts to biodiversity will be the lowest	The proposal also incorporates the construction of buildings and infrastructure. With the exception of the proposed vehicular track in the north-west, construction activities will occur within currently cleared areas / areas dominated by exotic species only. Therefore the extent of native vegetation within the development site will practically remain the same (and will actually increase due to the voluntary efforts to rehabilitate cleared areas into native vegetation). The following methods will be adopted in order to confine works to the project area: • Temporary human exclusion fencing closely bordering (within 10 m of) forest blocks within event areas will be provided. All temporary human exclusion fencing used in these locations will be 'fauna-friendly', incorporating a minimum 100 mm continuous gap at the base of the fence or 100 mm square gaps at 10 m intervals along the base of the fence. • Stringent bushfire management during events for public safety. • Continued police enforcement and deterrence associated with illegal access to events that may result in trampling of vegetation (bearing in mind that the low occurrence results in negligible impacts). • Event operators shall only operate within the approved event areas. • No activities (including slashing) will occur within the 30m buffer around the southern car parking areas surrounding the Billinudgel Nature Reserve.

Planning Criteria	Method to Avoid Impact
	• All staff and contractors to undertake Parkland's Environmental Induction prior to accessing the site. Documented records shall be maintained covering the environmental induction process. • Site rehabilitation as well as weed management within vegetation communities will continue. • Clear delineation of the clearing area associated with proposed vehicular access track in the north-west. This will include the establishment of Tree Protection Zones and arborist advice to reduce impacts to surrounding vegetation. • Tree protection zones will be erected around the three *Macadamia tetraphylla* trees, as described in **Table 27**.
Loss of connectivity – some developments can impact on the connectivity and movement of species through areas of adjacent habitat. Minimisation measures may include providing structures that allow movement of species across barriers or hostile gaps	There are no connectivity value classes that will be impacted by the project. The connectivity value class score is therefore 0. The current linkage width across site is 0-5m (very narrow). There are no linkage width classes that are lost as the project will not result in vegetation clearing to the degree that connectivity will be affected.

Other – increase in site capacity	An increase in the maximum capacity to 50,000 patrons for one large event will be implemented in multiple phases, with staged increases in maximum event size over several years. The gradual increase in site utilisation will allow any potential impacts to be monitored and appropriate modifications to events to be implemented. The proposed events and staging are: • Splendour in the Grass event (up to an ultimate 50,000 patrons over 5 days), subject to meeting KPIs of the following patron capacity scenarios: o Increase from current 35,000 to 42,500 subject to meeting KPIs o Increase from 42,500 to 50,000 subject to meeting KPIs In total, there will be a maximum of 20 event days. The down times between larger events will be maximised. Furthermore, a rigorous monitoring and adaptive management approach will be undertaken to ensure impacts to biodiversity do not rise in relation to an increased event capacity (See **Section 10.2.2**).

10.2 Measures to Minimise Impacts

Impacts relevant to construction and operations have been assessed using criteria within Section 8.3.2 of the FBA methodology. The assessment is presented in **Table 30** to **Table 32** for construction and operations respectively.

Within this section, 'construction' relates to any actions required to establish the site as a permanent events venue. As per **Section 1.1.2**, this includes the construction of buildings and infrastructure.

'Operations' refers to the set-up, operations and pack down of events.

Table 30: Minimisation of Impacts through during the Construction Phase

Matter considered to Minimise Impacts	Method to Avoid Impact
Method of clearing – using a method of clearing during the construction phase that avoids damage to retained native vegetation and reduces soil disturbance. For example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	Clear delineation of the clearing area associated with proposed vehicular access track and wastewater infrastructure in the north-west. This will include the establishment of Tree Protection Zones and arborist advice to reduce impacts to surrounding vegetation. Arborist advice on pruning requirements will also be sought. No other native vegetation apart from the 300m^2 of clearing required for the access track will be cleared as a result of construction activities.
Clearing operations – minimising direct harm to native fauna during actual construction operations through onsite measures such as undertaking pre-clearing surveys, daily fauna surveys and the presence of a trained ecologist during clearing events	A pre-clearing survey will be undertaken prior to works associated with the proposed vehicular track and wastewater infrastructure in the north-west commencing.

Matter considered to Minimise Impacts	Method to Avoid Impact
	A qualified fauna spotter catcher will be present during clearing activities. In order to minimise any potential impacts to the Eastern Grass Owl, Bush-stone Curlew and Common Planigale, the following measures will be undertaken: • An ecologist will undertake a targeted search for these species in the lead up to construction works associated to the southern carpark and/or initial slashing in this area • Slashing in the southern grassland area should be undertaken incrementally to allow any potential animals to escape The Common Planigale was deemed to have a low likelihood of occurring within the development site, however it has been included in the above measures as a precautionary measure.
Timing of construction – identifying reasonable measures that minimise the impacts on biodiversity. For example, timing construction activities for when migratory species are absent from the site, or when particular species known to or likely to use the habitat on the site are not breeding or nesting, can minimise the impacts of construction activities on biodiversity	Slashing of grassland and/or works associated with the southern carpark should occur outside the Eastern Grass Owl breeding season, and following a targeted site search for this species, to ensure no animals are killed or disturbed during nesting.
Other measures that minimise inadvertent impacts of the Major Project on the biodiversity values – measures such as installing temporary fencing to protect significant environmental features such as riparian zones, promoting the hygiene of construction vehicles to minimise spread of weeds or pathogens, appropriately training and inducting project staff and contractors so that they can implement all measures that minimise inadvertent adverse impacts of the Major Project on biodiversity values.	Machinery and vehicles that are accessing site to install temporary and permanent infrastructure will adopt the following measures when within the project area: • All machinery onsite should be cleaned for weeds and soil deposit off site. • Minimise soil disturbance during vehicle movement. • Promote the hygiene of construction vehicles to minimise spread of weeds and pathogens, • All staff and contractors to be appropriately inducted on appropriate measures to minimise impacts to biodiversity A Construction Environmental Management Plan will be prepared and implemented for all construction works to further minimise impacts to biodiversity.

Table 31: Minimisation of Impacts during the Operational Phase

Operational Phase Impact	Method to Avoid Impact
Seasonal impacts – whether there are likely to be any impacts that occur during	Impacts associated with the proposed action will primarily be limited to the proposed 20 event days per year, with a maximum

Operational Phase Impact	Method to Avoid Impact
specific seasons. Minimisation measures may include amending operational times to minimise impacts on biodiversity during periods when seasonal events such as breeding or species migration occur.	event period of 5 consecutive days. Additionally, a program of extensive monitoring of potential impacts of events at Parklands on MNES (and other values) has been undertaken since 2012. This work has clearly demonstrated little to no impact to flora and fauna at the site (Eco Logical Australia 2017, Fitzgerald 2016). The proposed future events will be undertaken in accordance with the same event management arrangements as previously employed and as such, there is no reason to suggest future significant impacts are likely. An ongoing program of monitoring and adaptive management (**Appendix G**) will ensure this conclusion remains valid.
Artificial habitats – using 'artificial habitats' for fauna where they may be effective in minimising impacts on such fauna. These include nest boxes, glider-crossings or habitat bridges.	Impacts to fauna during the event operations has thus far indicated minimal impact to faunal movement. Additionally, impact has mostly been confined to temporary site avoidance of Flying foxes and wallabies. Therefore, artificial habitats are deemed unnecessary. Parklands has also demonstrated a range of voluntary environmental management arrangements including significant on-going rehabilitation of the site and historical establishment of nest boxes, which collective demonstrate good environmental stewardship.

10.2.1 Minimising Indirect Impacts during Operations

A range of measures to avoid and/or reduce impacts have been successfully implemented during the trial period and have been effective in minimising impacts to flora and fauna during events. These will continue to be implemented for future events and will be included in the detailed Environmental Health and Safety Management Manual that determines how events will be operated on site. This will include environmental management requirements such as erosion and sediment control, lighting, noise, dust, exclusion fencing amongst others.

Table 32 discusses how indirect impacts will be minimised.

Table 32: Minimisation of Indirect Impacts

Operational Phase Impact	Method to Avoid Impact
Feral pest, weed and/or pathogen encroachment into vegetation on land adjoining the development footprint – one example is using protocols for hygiene that minimise the likelihood of construction vehicles spreading weeds or pathogens from the development footprint into native vegetation on land adjoining the development footprint	Increased numbers of people and vehicle movement on site presents a weed and plant pathogen pathway. However, the site has a long history of disturbance, with over 50 exotic flora species known to occur across the Parklands. Ongoing management has significantly reduced the presence of weeds across the site and has resulted in an overall improved condition of the vegetation. This program will continue moving forward, and will more than offset any introduction of weeds during events. Additional measure that will be adopted, include: • Event operators shall only operate within the approved event areas.

Operational Phase Impact	Method to Avoid Impact
	• Only minimal activities will occur within the 30 m buffer around the southern car parking areas surrounding the Billinudgel Nature Reserve (e.g. slashing between plantings if required). • All staff and contractors to undertake Parkland's Environmental Induction prior to accessing the site. Documented records shall be maintained covering the environmental induction process. • Temporary human exclusion fencing closely bordering (within 10 m of) forest blocks and other native vegetation within event areas will be provided. All temporary human exclusion fencing used in these locations will be 'fauna-friendly', incorporating a minimum 100 mm continuous gap at the base of the fence or 100 mm square gaps at 10 m intervals along the base of the fence. • Continued police enforcement and deterrence associated with illegal access to events that may result in trampling of vegetation, rubbish impacts and an increased risk of bushfire. (Bearing in mind that the low occurrence to date has resulted in negligible impacts). Parklands will also provision NPWS Rangers to enforce Regulations and further deter use of the Billinudgel Nature Reserve.
Impacts that are infrequent, cumulative or difficult to measure – where there are likely to be indirect impacts on biodiversity that are infrequent, cumulative or difficult to measure over time, consideration should be given to how an operational monitoring program can be used to assess the timing and/or extent of these impacts. A proposal for an operational monitoring program should be set out in the BAR. Development of a monitoring program may involve determining the base-line information that will be necessary to measure the impact over time. It should also consider how the results of the monitoring program could be used to inform ongoing operations in order to reduce the extent of indirect impacts	Extensive monitoring has been undertaken during the trial period to quantify potential impact of events at the Parklands on flora and fauna species (Eco Logical Australia 2017). This work has demonstrated some minor and temporary impacts to some species (Fitzgerald 2016). No further investigations or action has been required under the existing adaptive management framework. It is not anticipated that the ongoing and increased event schedule will alter the severity or duration of these impacts. In order to ensure this is the case, and as a component of an adaptive management strategy, ongoing monitoring of vegetation and key fauna will be undertaken. The adaptive management strategy will include provision for additional monitoring and/or investigation if increased impacts are detected. An updated environmental monitoring and adaptive management plan has been developed (**Appendix G**).
Impacts during the operational phase – measures to avoid or minimise the indirect impacts on threatened species and threatened species habitat on land adjoining the development footprint, migratory species or flight pathways as a result of the operation of the	The following measures will be implemented to minimise indirect impacts: • Event operators shall only operate within the approved event areas. • To reduce indirect impacts of the proposed carpark such as noise and light during events, Polygon 40 (shown on **Figure 15**, to the east of the proposed carpark) will be rehabilitated

Operational Phase Impact	Method to Avoid Impact
development. Such measures may include those adopted to avoid and minimise: (i) trampling of threatened flora species (ii) rubbish dumping (iii) noise (iv) light spill (v) weed encroachment (vi) nutrient run-off (vii) increased risk of fire, and (viii) pest animals.	with Melaleuca forest, subject to bushfire hazard reduction setbacks. • Impacts associated with the proposed carpark have been reduced via stormwater engineering design (retention of catchments area, SQIDS, swales and level spreaders). • Only minimal activities will occur within the 30 m buffer around the southern car parking areas surrounding the Billinudgel Nature Reserve (e.g. slashing between plantings if required). • All staff and contractors to undertake Parkland's Environmental Induction prior to accessing the site. Documented records shall be maintained covering the environmental induction process. • Temporary human exclusion fencing closely bordering (within 10 m of) forest blocks and other native vegetation within event areas will be provided. All temporary human exclusion fencing used in these locations will be 'fauna-friendly', incorporating a minimum 100 mm continuous gap at the base of the fence or 100 mm square gaps at 10 m intervals along the base of the fence. • Duration that temporary fencing is erected will be minimised to reduce barriers to fauna • As previously mentioned, the proposed security fence will include large gate panels that allow fauna movement (i.e. for large mammals). Furthermore, design allows for smaller fauna to travel through the fence. The fence also avoids designs that typically entangle or injure bats and birds (i.e. barbed or thin wire). • Provision of NPWS Rangers to enforce Regulations within the BNR. This will reduce the potential risks associated with unauthorised camping/acitivities in the Reserve. • No dogs (with the exception of trained assistance dogs) are permitted on the site. Trained security guard dogs are allowed at all times, while under the control of an authorised person. • All temporary drain crossings shall be managed to minimise sedimentation and potential discharge of contaminants. • Lighting controls will be implemented taking public safety considerations into account. These will include: a. Lighting levels to provide adequate illumination for safety purposes b. Over-night lighting (i.e. after performances have ceased each evening) will be minimised to that necessary for public safety c. Forest blocks will not be illuminated d. Illumination of individual trees within the site may occur providing they are not currently in blossom and/or are occupied by fauna

Operational Phase Impact	Method to Avoid Impact
	• Fireworks are prohibited • All internal traffic not to exceed 25 km/h (or 15 km/hr in designated event areas) • Higher levels of passengers per vehicle combined with higher public transport mode shares to reduce traffic. • Arrangement for an experienced fauna rescue person to be available to attend the venue if required to rescue and/or relocate fauna. • An environmental monitoring and adaptive management program will be developed and implemented (**Appendix G)**.

10.2.2 Monitoring and adaptive management

The key components of the monitoring plan are included in **Table 33** and **Table 34** below. For continuity of data, monitoring will be undertaken at the existing 'impact' and control sites (**Figure 21**). Monitoring and adaptive management will be geared towards the following objectives:

- The condition of Endangered Ecological Communities and associated threatened species habitat will continue to be enhanced via the on-going program of successful vegetation management and bush regeneration.
- Threatened flora species will continue to be present at the Parklands.
- Events will not prevent the on-going use of the Parkland site by threatened fauna species.

Monitoring includes both Event Impact Monitoring (EIM) as well as an ongoing monitoring program outside of event times.

The Flora and Fauna Monitoring and Adaptive Management Plan provides further detail of methods and the adaptive management framework and is provided in **Appendix G**.

Table 33: Event Impact Monitoring schedule

Timeframe	Timing of Monitoring	Matters to be monitored
Present to end of approved trial period	As per existing approvals	• Vegetation • Forest birds • Flying foxes • Terrestrial mammals • Microchiropteran bats
Splendour in the Grass (SITG) 'capacity increase' period (from current, to 42,500 then 50,000 patrons)	Annual EIM before, during and after largest event Event increase viable only if no significant new or ongoing impacts detected	• Forest Birds • Eastern Grass Owl • Bush-stone Curlew • Threatened Microchiropteran Bats • Koala • Incidental observation of other threatened species
First two years of SITG operation at full capacity (50,000 patrons)	Annual EIM before, during and after largest event Scale back to Biennial monitoring only if no significant new or ongoing impacts detected	
Subsequent and ongoing operation of SITG operation at full capacity (50,000 patrons)	Biennial EIM before, during and after largest event	

Table 34: Ongoing monitoring program schedule

Matter	Timing of Monitoring
Ecosystem Restoration Areas	Incidental monitoring during EIM and standard operations. Formal four-yearly monitoring of vegetation community condition until vegetation is considered self-sustaining. At this point, vegetation photo point monitoring will replace the formal transect monitoring.
Threatened Flora	Incidental monitoring during EIM and standard operations. Four-yearly monitoring of condition of known specimens.
Koala	Incidental monitoring during EIM and standard operations. Biennial monitoring of vegetation community condition.
Pest fauna	Incidental monitoring during EIM and standard operations.

11 Assessment and Offsetting Requirement for Unavoidable Impacts

11.1 Direct Loss of Native Vegetation

This assessment is required to identify all impacts and classify them under the following criteria:

- Impacts that the assessor is required to identify for further consideration by the consent authority
- Impacts for which the assessor is required to determine an offset
- Impacts for which the assessor is not required to determine an offset
- Impacts that do not require further assessment by the assessor

A summary of the guidelines for these is provided in **Table 35** below.

Table 35: Impact Thresholds for Landscape Features, Native Vegetation, and Threatened Species and Populations

Indirect Impact	Present within the Development footprint
Impacts that Require further consideration by consent authority	None identified within the SEARs
Impacts for which the assessor is required to determine an offset	See **Section 11.2**.
Impacts for which the assessor is not required to determine an offset	None present within the development footprint
Impacts that do not require further assessment by the assessor	All cleared areas within the development footprint

11.2 Impacts Requiring Offsetting

11.2.1 Native Vegetation

The clearing area associated with the proposed vehicular track is estimated to be approximately 300m^2. This represents less than 0.001% of the 105 ha of native vegetation that exits on the parklands site.

As part of the Vegetation Management and Biodiversity Plan, the remaining 105 ha of native vegetation is managed to improve the capacity of the site to support biodiversity. This includes feral animal and weed control, a nest box program, and ongoing fauna monitoring and surveys. These activities would continue as part of standard operations at the parklands.

As mentioned above, a significant program of voluntary bush regeneration and plantings has also occurred on site since 2007. All planting areas are regularly inspected and weed control undertaken. To date over 22,000 trees and shrubs have been planted, with other areas also earmarked for regeneration in the future (**Figure 15**). The majority of these plantings are well established with a greater than 90% establishment rate, and in many areas trees are now in excess of 5 m in height. The earlier plantings are now developing good quality habitat structure and facilitating native regeneration and an understory. Parklands' ecologists have recorded a wide range of birds and small vertebrate fauna occupying these forest blocks. Most plantings only need once yearly follow up to prevent the establishment of woody weeds such as Cassia and Camphor laurel.

Offsets are a tool designed to provide a net gain for residual impacts to the environment. Operations of the site are expected to provide a significant net benefit to biodiversity value within the development site due to the:

- voluntary efforts of North Byron Parklands to revegetate the grounds;
- the continued management of 105 ha of existing native vegetation across the site to improve habitat quality;
- the efforts undertaken to avoid and minimise clearing requirements across the development site; and
- the very minor extent of clearing required.

Therefore it is suggested an offset is not required to account for the negligible loss of native vegetation and associated biodiversity values associated with the clearing for the vehicular track in the north-west.

11.3 Impacts Not Requiring Offsetting

Impacts to cleared land (**Figure 24**) within the development site do not require offsetting as the vegetation integrity score is <17.

12 Conclusions

This report has provided the results of a biodiversity impact assessment for the proposed operation of North Byron Parklands as a permanent event venue. As per requirements of the SEARS, it has included an assessment in accordance with the FBA, whilst also addressing additional biodiversity assessment requirements associated with indirect impacts.

A key aspect of the project is that only a very small area of native vegetation is required to be cleared, and construction and operations is overwhelmingly situated in already disturbed areas. For this reason, no offsets will be required. Nonetheless, a significant and voluntary program of bush regeneration and plantings has occurred on site since 2007, and vegetation management of the 105 ha of native vegetation on site will continue to improve biodiversity value within the development site.

Significant survey effort and monitoring has been undertaken over the last 10 years at the site. This has provided important and useful data to assist in the assessment of potential indirect impacts. Results of event impact monitoring have shown that there is very minimal and temporary impact to biodiversity during major events and that time between events has allowed for impacts to reverse. A robust adaptive management framework has been in place to guide event activities and minimise impacts. This framework for management has been revised and is proposed to be continued with the permanent use of the site. The updated monitoring and adaptive management framework has been provided as part of this report.

Impacts from construction or operations will also be managed through the implementation of relevant Construction Environmental Management Plans as well as a revised Environmental health and Safety Management Manual.

Overall, permanent use of the site is expected to result in negligible to minor impacts to biodiversity. Impacts from events are also considered temporary and reversible.

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Weston, M. A., McLeod, E. M., Blumstein, D. T. and P. J Guay, 2012, "A review of flight-initiation distances and their application to managing disturbance to Australian birds", *Emu*, No. 112, pp.269-286. CSIRO publishing.

Appendix A – Content Checklist

Table 36: Relevant draft SEARs addressed in this BAR

Organisation (page number)	SEARs	Response
SEARs, general requirements (page 8	Biodiversity – including: an assessment of the development and all biodiversity values on the site under the *Framework for Biodiversity Assessment 2014* that is to include: • Identification of species on site; • Detail of the potential direct and indirect impacts on any threatened species, populations, endangered ecological communities or their habitats, groundwater dependant ecosystems; and • A detailed description of the measures to avoid, minimise, mitigate and/or offset biodiversity impacts	This BAR has been prepared under the FBA (OEH 2014) for major projects. Under this framework, a detailed assessment must be undertaken on the vegetation to be impacted within the development footprint, as well as any impacts to threatened species, populations, or endangered ecological communities. This BAR also outlines the offsetting requirement due to unavoidable impacts of the project. This BAR details all measures to avoid and minimise direct and indirect impacts to biodiversity as specified within Section 8 of the FBA. An Assessment of Significance (7-Part Test) has also been undertaken for threatened species and EECs (**Appendix M**).
Traditional Home of the Bundjalung People, 11th January 2017 (page 22).	The existing cap for the trial development is for a maximum of 35, 000 patrons. The proposed development is for up to 50, 000 patrons and includes the physical expansion of the site. The previous trial events should not be considered as an acceptable baseline for ecological assessment and outcome. A full ecological assessment of the impacts of the proposed development is required.	Flora and fauna monitoring undertaken during the trial period indicated that the cultural events held within the development site had minor, irreversible impacts to fauna species (refer to **Appendix F**). This data was used to indicate whether cultural events held within the development site had any a negative impact on flora and fauna during the trial period only. While this data was used to consider the appropriateness of site selection for such events, it will not be used as baseline data for potential future events. To reach a maximum capacity of 50, 000 patrons, event capacity will increase gradually over two years (refer to **Section 1**). This will allow for monitoring effort to identify any potential impacts to biodiversity. Details of the monitoring and adaptive management plan is provided. The adaptive management strategy will include provision for additional monitoring and/or investigation if increased impacts are detected. An updated environmental monitoring and adaptive management plan will be developed and implemented, focusing on both MNES and

Organisation (page number)	SEARs	Response
		threatened species listed under NSW legislation. It will be developed as part of the NSW environmental approvals process and include consultation with NSW OEH. This BAR has assessed the predicted impacts of the project with an understanding that the impacts of the project will generally have greater duration and frequency when compared to the impacts monitored as part of the trial period.
NSW Department of Planning and Environment, 16 December 2016 (page 24)	In relation to key issues for the land, we would suggest that the SEARs regurgitate the requirements of DGR09_0028 or alternatively include a general requirement that a review of the information required and submitted under MP09_0028 be undertaken. The previous proposal and DGRs covered the key issues for the land and in particular land use conflict, Koala management, protection of adjoining nature reserve, construction and operational management plans.	N/A
	Critical for the project, will be demonstrating that suitable management plans will be implemented to handle 50,000 patrons and minimise impacts during works and operations/events - covering matters such as traffic, access and parking (including buses),noise, lighting, flood, fire, dust, water cycle and waste management, flora and fauna management (including buffers, weed, litter, runoff, offsets) anti-social, safety and land use conflict with surrounding agricultural and rural/residential land.	The following management plans will be prepared and implemented for works: • Construction Environmental Management Plans relevant to each scope of work • An Environmental Health and Safety Management Manual that determines how events will be operated on site, including provisions for environmental management and risk management. • A Monitoring and Adaptive Management Framework (**Appendix G**).
NSW Department of Primary Industries (NSW DPI), 16 Janruary 2016) (pages 28-29)	The EIS should include a range of effective strategies to avoid, mitigate and offset any direct or indirect impacts expected to occur to key fish habitat located on and adjacent to the site. All works should be carried out in accordance with DPI Fisheries Policy and Guidelines for Fish Habitat Conservation and Management (2013)	Works will not occur within 20m of waterways with a stream order of 4. No works will occur within the waterway. Yelgun Creek is earmarked for revegetation.

Organisation (page number)	SEARs	Response
	The EIS should be required to include the following: • Identification of all riparian areas on the site, including any creeks, rivers, drainage lines, and wetlands, and outline any impacts the development may have on these areas, outline the intended management of these areas, including monitoring and mitigation measures, or any works proposed for these areas. All watercourses and drainage lines in the area should be clearly located on a plan in the EIS • Consideration of appropriate buffers to be provided adjacent to all watercourses and drainage lines affected by the development • Design and construction of works within 40 m of watercourses are to be in accordance with the DPI Water Guidelines for Controlled Activities (2012) • Erosion and sediment control measures on site during the construction and operations. It is important any riparian areas adjacent to the site are not affected by the proposed development.	The location of riparian areas, including creeks, rivers, drainage lines and wetlands within and directly adjacent to, the development site it provided in **Figure 18**, **Section 1.1.** The application of the DPI Water Guidelines for Controlled Activities (2012) is discussed within the EIS. The Environmental Health and Safety Management Manual will discuss environmental management on site, including erosion and sediment control.
Office of Envrinmonrent and Heritage, 16 Janruary 2017 (pages 30-33)	The proponent should ensure that the EIS will be sufficiently comprehensive to enable unambiguous determination of the extent of the direct and indirect impact(s) of the proposal. The EIS should include an appropriate assessment of the potential impacts on OEH estate, Aboriginal cultural heritage and biodiversy	An assessment of the potential impacts on biodiversity is outlined in **Section 9**. Impacts to individual threatened flora and fauna is addressed in **Table 23** and **Table** 24. The likely risk of these impacts, and any appropriate mitigation measures are provided in **Section 10.** Ongoing monitoring and adaptive management strategies will ensure that these impacts are minimised.
	Bidoversity impacts related to the proposed project are to be assessmed and documented in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by OEH	This BAR has been prepared under the FBA (OEH 2014) for major projects. Under this framework, a detailed assessment must be undertaken on the vegetation to be impacted within the development footprint, as well as any impacts to threatened species, populations, or endangered ecological communities. Potential

Organisation (page number)	SEARs	Response
		impacts to biodiversity are outlined in **Section 9**.
	The EIS must: a) Identify the threatened and migratory species likely to be present or likely to use habitat within 1 km of the project area. b) Identify hollow-bearing trees within 200 m of the project area. c) Describe the importance of the habitat/habitat features within 1km of the development site (including the hollow-bearing trees from (b) above) for the life cycle of the entities identified in (a) above. d) Identify and provide an assessment of potenital indirect impacts on those species and their habitat identified in (a), (b) and (c) above, including changes to movement patterns and impacts on use of habitat. e) Describe measures proposed to avoid, minimise and manage the indirect impacts identified in (d) above including an evaluation of the effectiveness and reliability of the proposed measures. f) Identify monitoring requirements for the measures in e) above.	The response to each criterion can be found in the following sections and appendices: a) Section 8.5.2 Migratory Species within the development site b) Section 8.5.1 Habitat present within 1km of the development site c) Section 9 – predicted impacts d) Section 10 – Mitigation and monitoring e) Appendix F – Monitoring results

Appendix B – Koala Plan of Management

North Byron Parklands

Koala Plan of Management (KPoM)

Prepared for
Billinudgel Property Pty Ltd

September 2018

DOCUMENT TRACKING

Item	Detail
Project Name	North Byron Parklands, Koala Plan of Management
Project Number	17BRI-6437
Project Manager	Steve Jarman 0422 213 338 Suite 1, Level 3, 471 Adelaide St
Prepared by	Ailsa Kerswell, Doug Mohr, Steve Jarman
Reviewed by	Steve Jarman
Approved by	Ailsa Kerswell
Status	Draft
Version Number	6.2
Last saved on	7 September 2018
Cover photo	North Byron Parklands site, Steve Jarman 2017

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ACKNOWLEDGEMENTS

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Abbreviations

Abbreviation	Description
BC Act	*Biodiversity Conservation Act 2016*
BCC KPoM	(Draft) Byron Coast Comprehensive Koala Plan of Management
KPoM	Koala Plan of Management
KSAT	Koala Spot Assessment Technique
Parklands	North Byron Parklands
SEPP44	*State Environmental Planning Policy No. 44 (Koala Habitat Protection*)

1 Introduction

1.1 Background

Billinudgel Property Pty Ltd have engaged Eco Logical Australia Pty Ltd (ELA) to prepare an individual Koala Plan of Management (KPoM) for North Byron Parklands (Parklands). Parklands is currently operating as a cultural events site under short-term State approval (app. No. MP 09_0028). The existing approvals include a trial period to allow use of the site as a cultural, education and outdoor events venue.

Billinudgel Property Pty Ltd are also seeking to obtain permanent approval to utilise the site as a cultural events centre with a maximum capacity of 50,000 patrons for one large event and a number of smaller events. This KPoM has been prepared to address ongoing management of Koala for the permanent approval.

Historically Koala have been observed sporadically at the Parklands site but after the implementation of the Pacific Highway upgrade no Koala have been sighted on the land. They have been seen in adjacent habitat areas. The most recent surveys were undertaken in September 2016 and found evidence of Koala visitation of at the site (i.e. scats). Under SEPP44 “core koala habitat” means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population. Small areas of the Parklands therefore may meet the definition of Core Koala Habitat under SEPP44 (see below).

1.2 Regulatory requirements

State Environmental Planning Policy No. 44 (Koala Habitat Protection) commenced on the 13th February 1995. It aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas. This was to ensure persistence of a permanent free-living population over the species’ present range and reverse the current trend of koala population decline by:

- Requiring the preparation of plans of management before development consent can be granted in relation to areas of Core Koala Habitat
- Encouraging the identification of areas of Core Koala Habitat
- Encouraging the inclusion of areas of Core Koala Habitat in environment protection zone

Over subsequent years, reporting requirements such as regular koala monitoring in relation to the SEPP44, were issued by the NSW State Government as part of ongoing approval modifications issued by the Minister for Planning and Infrastructure. The *Planning Circular No. B35 - Director’s Guidelines*, (22 March 1995) details the methods for identifying potential and core Koala habitat and outlines the requirements for Koala Management Plans.

Since the commencement of SEPP44, a number of significant events have occurred of direct relevance to the coastal koala population in the Tweed and Byron Local Government Areas including:

- Koala habitat and population assessments were completed for the Tweed and Byron coastal areas (including the North Byron Parklands site).
- Comprehensive Koala Plans of Management (CKPoM) for Tweed and Byron were prepared by the respective Councils.
- One of the outcomes arising from the Tweed and Byron koala assessments was that the conservation status of koalas along the Tweed Coast and the section of Byron Coast north of the Brunswick River was determined as precarious with wildfire events in 2004 and 2009 identified as major contributing factors to the koala population decline.

- In April 2016, the koala population between the Tweed and Brunswick Rivers east of the Pacific Highway was listed as an Endangered Population under the now repealed NSW *Threatened Species Conservation Act 1995* (Biolink 2016). This population is also listed as endangered under the current *Biodiversity Conservation Act 2016.*
- The *Biodiversity Conservation Act 2016* also lists the koalas within the area as a vulnerable species.

In the current approval for development of the site (dated 24 April 2012), several conditions are provided relating to environmental management. Requirement C21 (Updated Koala Plan of Management), of the 2012 (current) approval notes the following requirement:

> "*The Draft Vegetation Management and Biodiversity Plan – submitted as Appendix M to the Ecological Assessment is to include an updated Koala Plan of Management (KPoM) if a resident population (within the meaning of SEPP 44) of koalas becomes established at the site, The KPoM is to include a contemporary assessment of any existing and/or potential areas of core Koala habitat within the site, and results of further koala surveying efforts. The KPoM must also address the operation of ongoing events carried out at the site and the potential impacts that this will have on areas of core Koala habitat and any existing Koala populations*." (Emphasis added).

As the most recent Koala survey undertaken in 2016 identified Koala visitation of the on the site, this KPoM has been prepare on in a precautionary basis.

1.3 Purpose and scope of this report

In the event that further surveys confirm the existence of a resident Koala population (within the meaning of SEPP 44) has become established at the site, this report comprises the updated KPoM required under condition C21, as detailed above. This report will also be applicable to the permanent program of events proposed under the SSD application. It includes:

- Conservation objectives for Koala
- Details of Koala habitat and site usage at the Parklands and in surrounding areas
- An assessment of potential threats and impacts to Koala as a result of the cultural events program held at the Parklands
- Details of management measures that will be implemented to address potential impacts
- A monitoring and adaptive management program

The KPoM specifically addresses Koala habitat on the Parklands site, which includes the following lots:

- Lot 1 DP 1145020
- Lots 46 402, 403 and 404 DP 755687
- Lot 410 DP 755687
- Lots 2 and 12 DP 848618
- Lot 101 DP 856767
- Lot 30 DP 880376
- Lots 100 and 101 DP 1178907
- Lots 101 102, and 107 DP 1001878
- Lot 107 DP 1001878
- Lots 12 and 14 DP 875112

Adjacent lots are also assessed in terms of koala population / core habitat estimates. However, management and mitigation measures are restricted to those areas that are under the property ownership of Billinudgel Property Pty Ltd.

The most current guideline for SEPP44 (Department of Planning 1995) has informed the content of this KPoM. A checklist of required content and its location in this document is provided in Appendix A.

2 Koala at the Parklands and surrounds

2.1 Regional context

The (Draft) Byron Coast Comprehensive KPoM (BCC KPoM; Phillips and Jardine 2013) has divided the region into Koala Management Areas (KMA). The Parklands site is located in the North Byron Coast KMA, which encompasses an area of approximately 2,814 ha located to the north of the Brunswick River and includes Billinudgel Nature Reserve and the localities of South Golden Beach, Ocean Shores and Billinudgel.

The importance of the Parklands site in the regional context lies in its connectivity to large areas of Koala habitat within Billinudgel Nature Reserve and adjacent areas to the south. The areas of potential Koala habitat on site provide important linkages, both across the Parklands site and more broadly in the region.

2.2 Koala presence 2007 – 2017

Targeted Koala surveys have been undertaken at the Parklands in 2007, 2008, 2013 and 2016 (Biolink 2007, 2008, 2013, 2016), along with ten Event Impact Monitoring (EIM) surveys (North Bryon Parklands 2014a, 2014b, 2015, 2016). Results of these surveys include:

- 2007 – small area of core Koala habitat (3 ha) mapped on site; Koala scats observed at four locations within the Parklands; results suggest use of the site by 1 – 2 Koalas
- 2008 – significantly reduced evidence of activity, such that activity level does not reach the threshold that indicates active, ongoing use by resident animals
- 2013 – no evidence of Koala within the Parklands
- 2016 – evidence of Koala (scats and scratches) at 7 sites (see **Figure 1** and **Table 1**). Mixed age scats suggest significant, repeat use of sites by Koala individuals with home ranges that encompass the north-west corner of the Parklands (individuals may be coming to the Parklands from the Billinudgel Nature Reserve and/or areas to the west of the Pacific Highway). It is likely that these Koalas have begun using this area of the Parklands within the previous 1 – 3 years
- Event Impact Monitoring – no evidence of Koala within the Parklands or surrounds (based on general observations, not targeted survey)

The full results of the most recent Koala survey undertaken in 2016 are provided in Appendix B.

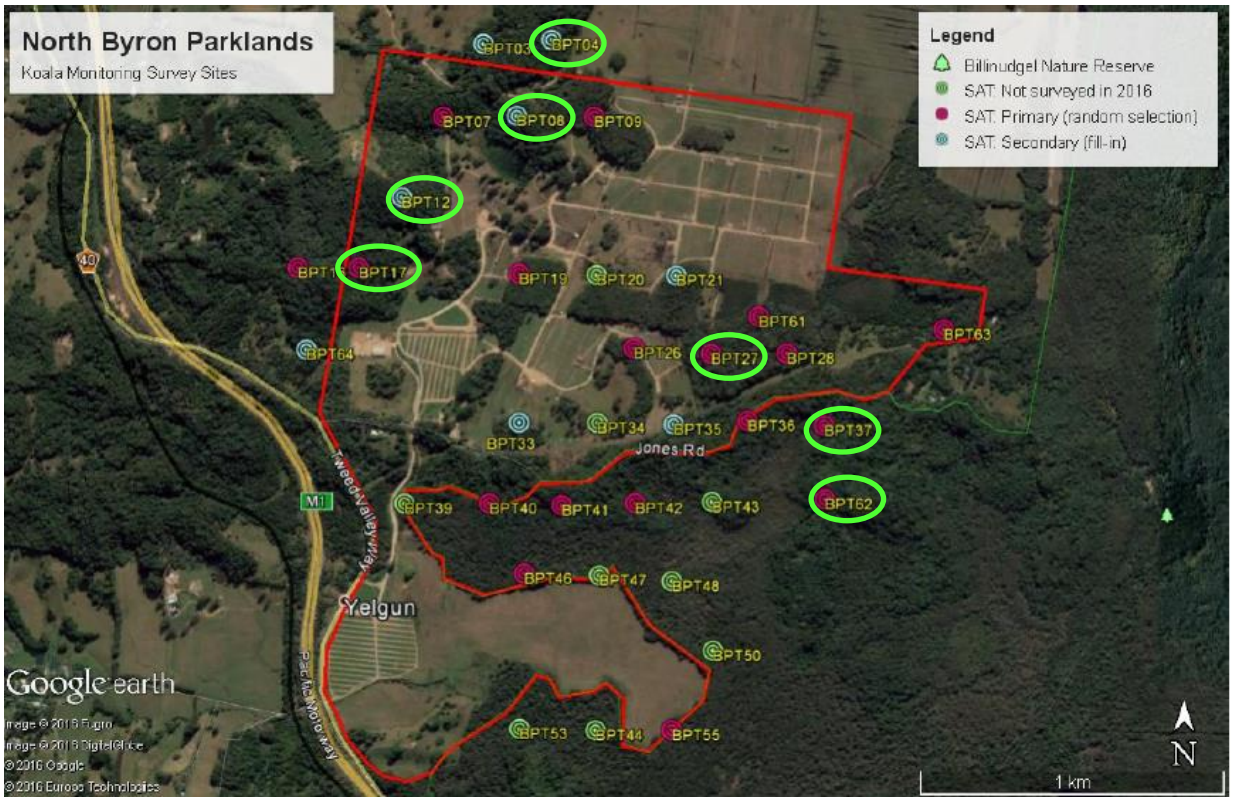

Figure 1: 2016 Survey Results. Scats were observed in 2016 at the green circled SAT sites (from Biolink 2016)

Table 1: Koala activity levels recorded for baseline SAT surveys in 2007 compared to 2016 survey results. Percentage representation of Preferred Koala Food Trees (PKFT) at each site and the age-class of pellets (old, mixed age, fresh) observed in 2016 are also shown. Note: significant koala activity levels (i.e. high or medium use) are bolded. (From Biolink 2016)

SAT sites	2007 Activity (%)	2016 Activity (%)	2016 Pellet age-class	2016 Proportion PKFT (%)	Considered Core Koala Habitat
BPT03	0	0	-	13.33	
BPT04	0	6.67	Mixed Age	3.33	
BPT07	0	0	-	0	
BPT08	0	**30**	Mixed Age	16.67	Yes
BPT09	0	0	-	13.33	
BPT12	0	**10**	Old	26.67	Yes
BPT16	0	0	-	0	
BPT17	0	**30**	Mixed Age	3.33	Yes
BPT19	0	0	-	0	
BPT20	0	NS	NS	NS	
BPT21	0	0	-	0	
BPT26	0	0	-	0	
BPT27	**13**	3.33	Old	13.33	
BPT28	0	0	-	6.67	
BPT33	0	0	-	43.33	
BPT34	0	NS	NS	NS	
BPT35	0	0	-	6.67	
BPT36	0	0	-	0	
BPT37	0	3.33	Fresh	0	
BPT39	0	NS	NS	NS	
BPT40	0	0	-	6.67	
BPT41	4	0	-	0	
BPT42	0	0	-	3.33	
BPT43	0	NS	NS	NS	
BPT44	0	NS	NS	NS	
BPT46	0	0	-	10	
BPT47	0	NS	NS	NS	
BPT48	0	NS	NS	NS	
BPT50	0	NS	NS	NS	
BPT53	0	NS	NS	NS	
BPT55	0	0	-	6.67	
BPT61	**30**	0	-	6.67	
BPT62	**43**	**16.67**	Mixed Age	23.33	Yes
BPT63	NS	0	-	0	
BPT64	NS	0	-	16.67	

2.3 Koala habitat

Approximately 60% of the Parklands property is cattle pasture comprising exotic grasses, dominated by *Setaria sphacelata* (South African Pigeon Grass) and *Paspalum mandiocanum* (Broad-leaved Paspalum). Native vegetation of the site comprises mainly fragmented floodplain forests and hill slope *Eucalyptus* and *Lophostemon* forests. The related Plant Community Types (PCTs) mapped within the Parkland site are shown on **Figure 2**, and further described in **Appendix C**. The PCTs are further broken up into vegetation zones according to their broad ecological condition. The vegetation zones provide differing vegetation types provide potential habitat areas for Koala.

2.3.1 Koala habitat and food trees

Koalas are obligate folivores feeding on species primarily in the genus *Eucalyptus*. The Parklands contains a number of distinct vegetation communities that support a diversity of *Eucalyptus* species, which are largely confined to the better drained hill slopes. Of these, the following food trees have been observed at the Parklands site:

- *E. microcorys* (Tallowwood)
- *E. tereticornis* (Forest Red Gum)
- *E. robusta* (Swamp Mahogany)
- *E. propinqua* (Grey gum)
- *E. tereticornis* x *E. robusta* hybrid

There are a range of methods that can be used to define what koala habitat is. Under SEPP 44, potential koala habitat is defined as "Areas of native vegetation where the trees of the types listed in Schedule 2 (of SEPP44) constitute at least 15% of the total number of trees in the upper or lower strata of the tree component".

At the Parklands, species listed on Schedule 2 of SEPP44 (Tallowwood, Forest Red Gum and Swamp Mahogany) were recorded in 14 of the field sites formally assessed in 2016. The species composition of Schedule 2 species at these sites ranged from 4% - 56%, with a mean of 15% (Biolink 2016), suggesting that these sites should be formally considered potential Koala habitat.

Furthermore, Core Koala Habitat is separately defined in SEPP44 as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Based on the results of the most recent Koala surveys, small areas of potential Core Koala Habitat have been identified within the Parklands. With reference to **Figure 1** and **Table 1**, Biolink (2016, **Appendix B**, pp. 6) note that:

> *"Activity levels that were considered significant (i.e. > 10% in upland areas on low-nutrient substrates and > 22.52% in lowland areas and other sites on high-nutrient substrates, falling into the 'Medium (normal) use' or 'High use' categories indicative of utilisation by resident koalas with established home ranges) and therefore indicative of Core Koala Habitat were recorded at 4 sites; BPT08 (30%-High), BPT17 (30%-High), BPT62 (16.67%-High) and BPT12 (10%-Medium); refer to Phillips & Callaghan (2011)."*

These sites are mapped in **Figure 1** and are located in the north-west corner of the Parklands site and in the adjacent Billinudgel Nature Reserve.

For this KPoM, Koala habitat has also been mapped across the site (**Figure 2** and **Figure 3**) according to Plant Community Types and floristic sampling undertaken as part of an assessment using the

Framework for Biodiversity Assessment Method (see detailed PCT descriptions in **Appendix C**). The terms 'primary' and 'secondary' habitat have been used to distinguish habitat categories, in accordance with the *Byron Coast Comprehensive KPoM*. That is:

- "Primary Koala Habitat" means any area of vegetation dominated by one or more primary koala food tree species.
- "Secondary (Class A) Koala Habitat" means any area of vegetation where one or more primary koala food tree species occur as sub-dominant components of the over-storey species.
- "Secondary (Class B) Koala Habitat" means any area of vegetation on erosional soil landscapes that contains one or more secondary koala food tree species.

Figure 3 shows that Primary and Secondary (Class A) Koala Habitat exists across most of the site and this correlates with records of Koala from both BioNet and North Byron Parkland records. The Primary Koala Habitat is represented by the community where *Eucalyptus tereticornis* is generally dominant. The other PCTs are not dominated by koala habitat trees (see **Appendix C**) however koala habitat trees do occasionally occur as a sub-dominant component.

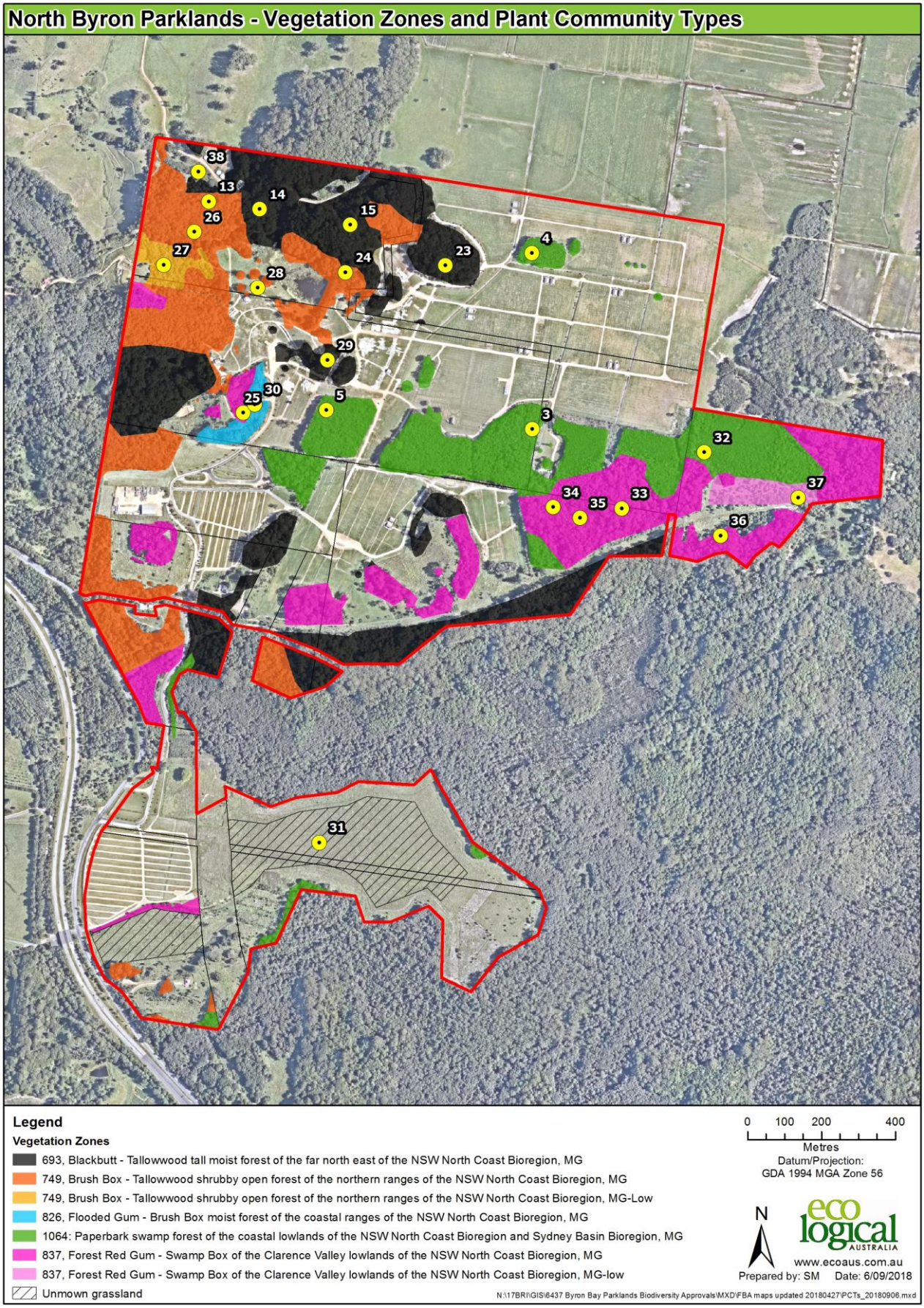

Figure 2: Plant Community Types and Vegetation Zones

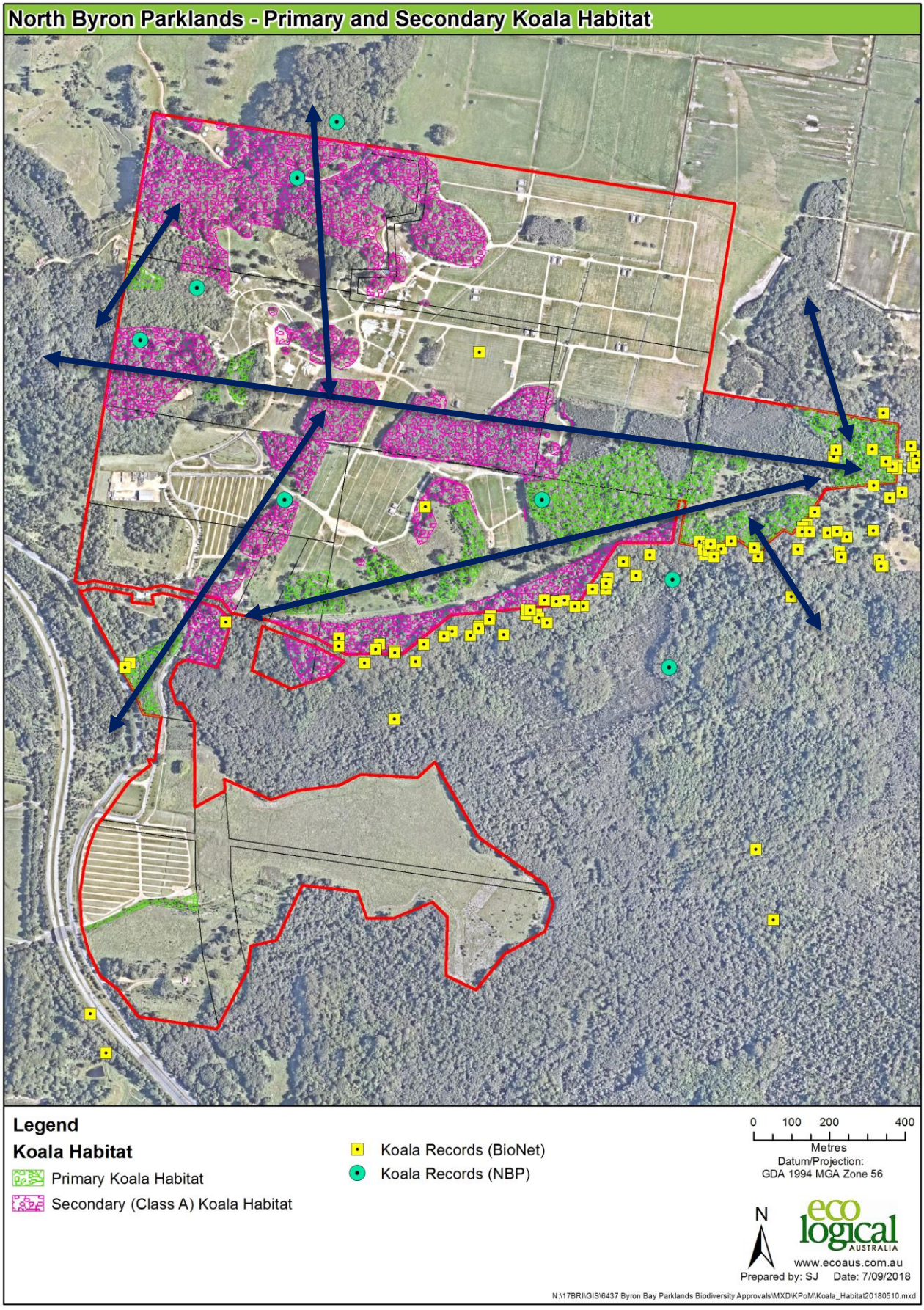

Figure 3: Primary and Secondary Koala Habitat (arrows represent generalised koala movement corridors)

3 Conservation outcomes

As highlighted above, the presence of Koala at the Parklands has been highly variable over time. There is also no evidence of a sustained or sizable population of Koalas on site. Therefore, the conservation outcomes for Koala are focused on the provision of habitat and allowing Koala to use the site freely if and when they may be in the region.

The desired conservation outcomes for Koala are:

- The condition of Koala habitat at the Parklands site will continue to be enhanced via the on-going program of successful vegetation management and bush regeneration.
- Events will not prevent the on-going use of the Parkland site by Koala.

These outcomes are also consistent with the overarching management aim for the North Byron Coast KMA, which is to recover the important sub-population of the Tweed and Brunswick Coast Population of the Koala (Phillips and Jardine 2013). Habitat enhancement is discussed further in Section 5.2 and in detail in Eco Logical 2017a.

4 Potential impacts and threats

No Koala habitat or Koala feed trees will be cleared as result of the project. All Koala habitat on site will be preserved and protected for the duration of the project. All areas of remnant vegetation within event areas will be fenced during events to prevent disturbance. These measures have also been in place during the approved trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site.

Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Koala habitat over time.

Impacts from more generalised disturbance such as noise, lighting and human disturbance will be short-lived and contained within the event areas of the Parklands site. Koalas are likely to move away from disturbance during events and good connectivity to suitable habitat is available adjacent to areas of disturbance. Koalas have moved back into the Parklands area during the approved trial period i.e. the results of the most surveys suggest Koala use of the north-western areas of the Parklands has begun within the last 1 – 3 years. This suggests the ongoing use of the site for events has not precluded the area from providing suitable habitat for Koala.

Key threats to Koala including dog attack and vehicle strike will not be exacerbated by the project. Dogs (apart from restrained assistance and security dogs) are not allowed on site and on site vehicle speed limits are restricted to 25 km/hr. There is no current wild dog management program undertaken by North Byron Parklands, though continued monitoring (via incidental sightings) is undertaken. If evidence of significant wild dog population is observed, management will be undertaken (see more information within Eco Logical 2017a).

Bushfire presents a significant threat to Koala populations. Strict fire management procedures are implemented at the site for public safety, however these measures also benefit habitat within and adjacent

to the site and the wildlife in these areas. In accordance with fire management guidelines in the BSC KPoM, Parklands has adopted a minimal use of fire policy and does not propose the use of fire for hazard reduction and aims to extinguish any bushfire at the first practical opportunity. With these measures in place the potential threat to Koala from bushfire is not significantly increased.

Koalas will be discouraged from entering event areas due to the erection of temporary fencing and the proposed permanent security fencing (see details within Biodiversity Assessment Repot [Eco Logical Australia 2017]). While this fencing may restrict Koala movement, it will be fully closed only for short periods of time at discrete intervals over the year (see Section 5.1). It is also unlikely that Koalas would be seeking to traverse the busy event area.

The site forms part of an east-west wildlife corridor between large areas of suitable habitat in the adjacent Billinudgel Nature Reserve and to the west of the Parklands. During event times, disturbance, human activity and fencing barriers will reduce the potential for Koala movement across this corridor. These restrictions will only be in place for short periods of time at discrete intervals over the year. Over time restoration works across the site will increase the area of potential habitat and improve connectivity across this corridor. Therefore the overall impact of the proposal on the potential for dispersal and movement of Koalas in the local area is considered to be minimal.

5 Impact avoidance and minimisation

5.1 Measures to avoid and minimise impact

The events areas and ancillary infrastructure have been designed to ensure that no Koala habitat will be cleared as result of the project. All Koala habitat on site will be preserved and protected for the duration of the project. This will also ensure that connectivity to large areas of adjacent potential habitat is maintained.

Additionally, the following measures will be implemented at the Parklands to avoid and/or minimise impacts to Koala and their habitat during events:

- No-go zones will be designated, which fence off intact native vegetation. Events are contained within areas that consist of managed exotic pasture with scattered native trees that are protected during events
- Temporary human exclusion fencing closely bordering (within 10 m of) forest blocks within event areas will be provided. All temporary human exclusion fencing used in these locations will be 'fauna-friendly', incorporating a minimum 100 mm continuous gap at the base of the fence.
- Stringent bushfire management during events for public safety
- Continued police enforcement and deterrence associated with illegal access to events that may result in trampling of vegetation (bearing in mind that the low occurrence results in negligible impacts)
- Event operators shall only operate within the approved event areas
- No activities (including slashing) will occur within the 30m minimum buffer around the southern car parking areas surrounding the Billinudgel Nature Reserve
- Security staff will be briefed on management requirements if koala are observed entering the event area. If displaced or disorientated individuals are observed during events, security or park management staff are to keep crowds away and observe the individual until it can return to habitat areas. A fauna spotter catcher or qualified fauna ecologist should be contacted to remove the koala if required
- Friends of the koala Inc. (located in Lismore) are to be contacted if any seriously sick or injured koalas are observed by park management staff
- All staff and contractors to undertake Parkland's Environmental Induction prior to accessing the site. Documented records shall be maintained covering the environmental induction process

Outside of event times, the proposed permanent security fencing will be opened to allow movement of koalas. That is, every 5th or 6th panel will be on hinges (acting as a gate) and will be permanently open except during events. The gates will be closed the day before the first event day and opened the day after the last event day. Gates would only be closed for large and medium events. Each fencing panel is approximately 2.5m long. The fence will also be set 100mm off the ground to allow movement of smaller fauna.

In addition to the above, event-based measures, the following will be implemented at the Parklands to minimise potential impacts to Koala and their habitat during the construction of ancillary infrastructure (associated with permanent approval):

- Clear delineation of the clearing area (approx. 300m^2) associated with proposed vehicular access track in the north-west (see ELA 2018). This will include the establishment of Tree Protection Zones and arborist advice to reduce impacts to surrounding vegetation.

- A pre-clearing survey will be undertaken prior to works associated with the proposed vehicular track in the north-west commencing. If Koalas are found, clearing will not commence until they have vacated the area. Given no koala trees exist within or immediately adjacent the clearing area, it is unlikely that these measures will need to be employed.
- A qualified fauna spotter catcher will be present during clearing activities.
- Machinery and vehicles that are accessing site to install temporary and permanent infrastructure will adopt the following measures when within the project area:
    - All machinery onsite should be cleaned for weeds and soil deposit off site.
    - Minimise soil disturbance during vehicle movement.
    - Promote the hygiene of construction vehicles to minimise spread of weeds and pathogens,
- All staff and contractors to be appropriately inducted on appropriate measures to minimise impacts to biodiversity

5.2 Habitat enhancement

A significant program of bush regeneration and plantings has occurred on site since 2007, with establishment works complete for all areas. To date over 22,000 trees and shrubs have been planted, including Koala food trees. Habitat enhancement works improve Koala habitat across the Parklands site in two important ways:

- Providing additional areas of Koala feed tree species
- Providing improved habitat connectivity and movement corridors within and across the site

All planting areas are regularly inspected and weed control undertaken. The majority of these plantings are well established with a greater than 90% establishment rate, and in many areas trees are now in excess of 5 m in height.

The earlier plantings are now developing good quality habitat structure and facilitating native regeneration and an understory. Parklands' ecologists have recorded a wide range of birds and small vertebrate fauna occupying these forest blocks. Most plantings only need once yearly follow up to prevent the establishment of woody weeds such as *Senna pendula* (Easter Cassia) and *Cinnamomum camphora* (Camphor Laurel). The extensive regeneration of eucalypts in the north-western area of Parklands increases the area of available habitat for Koalas.

The Ecological Restoration Plan (**Figure 4**) divides the Parklands into different management zones formed by the ecological restoration works. The zones include:

- Habitat, Existing – Large patches of existing mature vegetation that will undergo ongoing weed management where required. Due to their condition, limited works are required to manage these patches.
- Habitat, Improved – Areas of vegetation in various condition that undergo weed management.
- Habitat, Regeneration – Areas of existing native vegetation that may require significant weed removal and supplementary planting.
- Habitat, Planting – areas that have undergone broad scale planting and are being managed towards mature vegetation communities.
- Managed Parklands, Regeneration – Event areas that are managed to maintain the scatted native trees and to reduce weed incursion.
- Managed Parklands, Plantings – Event areas where native trees have been planted.

Note: Use of the word 'habitat' in the above dot points reflects general wildlife habitat and not specific koala habitat; although koala habitat values also be present.

The overall aim is to restore target areas to provide functioning native vegetation communities (see Eco Logical 2018a for details). The target PCT rehabilitation targets reflect adjacent native vegetation and the majority of restoration zones contain Koala food tree species including *Eucalyptus microcorys* (Tallowwood), *E. tereticornis* (Forest Red Gum) and *E. propinqua* (Small-fruited Grey Gum). The broad key performance indicators relative to Koala habitat restoration are:

- Locally occurring species present for target PCTs
- Koala food trees present in restoration areas
- Resilient vegetation communities are created, which require minimal management of exotic species
- Regeneration assists koala movement across the site

Habitat restoration and management will continue as an ongoing program of works. These works will both enhance Koala habitat within and build further connectivity across the Parklands site. The Ecological Restoration Plan will result in a broadened east-west wildlife corridor across the site, in particular, near the western end of Jones Road (Marshall's Ridge Wildlife Corridor). This coincides with the location of a large number of Koala records and a corridor identified as a Strategic Linkage Area in the BCC KPoM. Koala movements will only be restricted during event times (up to 20 days per year), and therefore the overall habitat connectivity for Koala in the locality is expected to improve as a result of the project.

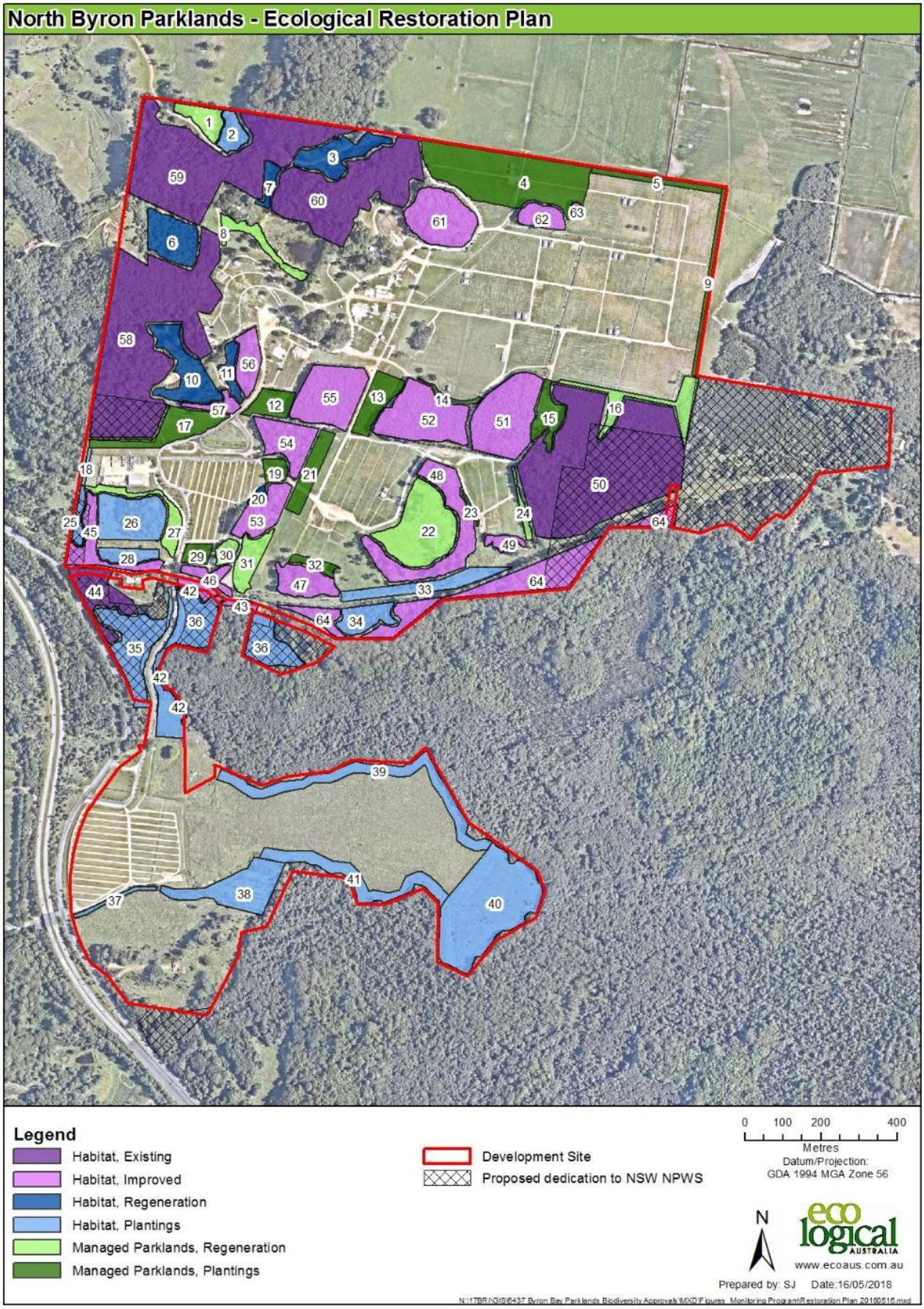

Figure 4: Ecological Restoration Plan

6 Monitoring and adaptive management

Ongoing monitoring of Koala at the Parklands will be undertaken as part of a broader program of monitoring and adaptive management. This project is detailed in Eco Logical Australia 2017a. Parts of the program relevant to Koala are provided below.

6.1 Monitoring objectives

It is predicted that the impacts from the ongoing program of cultural events at the Parklands will be minor and temporary, as evidenced by the results of extensive monitoring undertaken during the trial period. However, to ensure that no unexpected impacts occur as a result of ongoing events and/or the increased capacity and frequency of events, the following monitoring objectives have been developed:

- The condition of threatened species habitat will continue to be enhanced via the on-going program of successful vegetation management and bush regeneration.
- Events will not prevent the on-going use of the Parkland site by threatened fauna species.

6.2 Program

Long-term monitoring for Koala monitoring will occur every two years at five locations where the koala (or evidence of koala) has previously been observed (see **Figure 5**), with the next scheduled monitoring event to occur in 2018. Ideally, monitoring will be linked to surveys being undertaken in the wider region, as guided by the BCC KPoM. Parklands staff will consult with relevant stakeholders at Byron Shire Council prior to each round of monitoring commencing, to seek opportunities for alignment of efforts with wider surveys of local populations being undertaken in the region.

Event Impact Monitoring will also be undertaken for Koala during the largest event each year as per **Section 6.3**.

6.3 Method

Long-term monitoring surveys for Koala will be undertaken using the standardised KSAT method, used in previous surveys at the site (Biolink 2016; Appendix B for details). The quality of koala habitat will also be monitored over the long term as part of the Flora and Fauna Monitoring and Adaptive Management Program (see ELA 2017a).

Event Impact Monitoring for Koala using the Before-After Control-Impact (BACI) design is incorporated into the Parkland's flora and fauna monitoring and adaptive management program (see Eco Logical Australia 2017a for full details). Koala event monitoring methods are detailed below in **Table 2**.

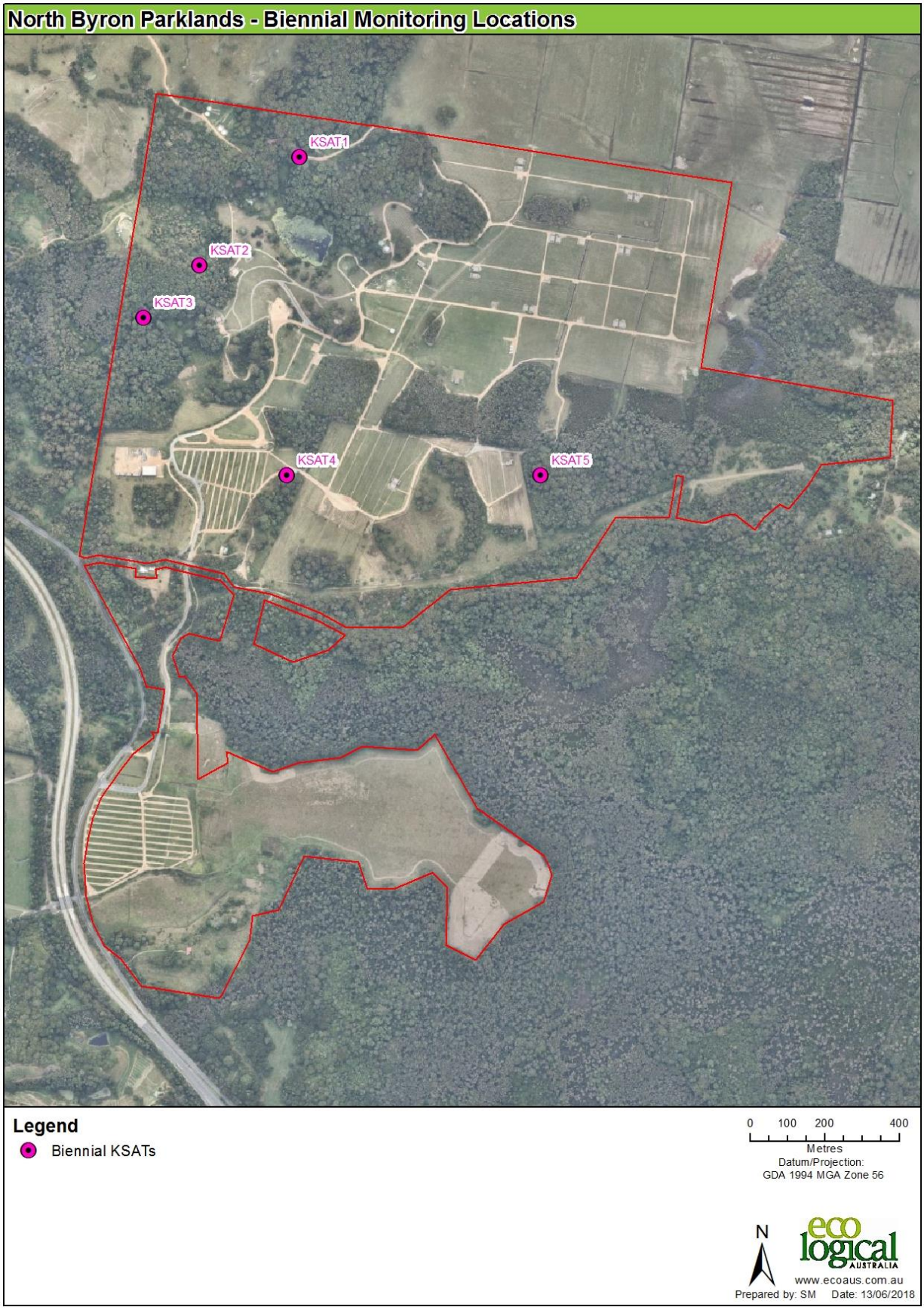

Figure 5: Biennial KSAT monitoring locations

Table 2: Koala event impact monitoring methods and timing

Timeframe	Survey timing	Methodology
Splendour in the Grass (SITG) 'capacity increase' period (from current, to 42,500 then 50,000 patrons)	Annual monitoring before, during and after largest event Event increase viable only if no significant new/ongoing impacts detected	Incidental observations of koala or evidence of koala at sites (before and after event only) in areas where Event Impact Monitoring is occurring for birds and bats (see ELA 2017a). This includes ad hoc scat and scratch mark searches along the transects as well as direct observation of koala. The surveys will include recording observations of habitat and vegetation condition (including photo points). Spotlighting transects at the five sites identified on **Figure 5**. This is to occur before events (and after events if koala is detected). Recording of other incidental sightings of Koala (or evidence of the species).
First two years of SITG operation at full capacity (50,000 patrons)	Annual monitoring before, during and after largest event Scale back to 2-yearly only if no significant new/ongoing impacts detected	
Subsequent and ongoing operation of SITG operation at full capacity (50,000 patrons)	2-yearly monitoring before, during and after largest event	

6.4 Adaptive management

The monitoring results will be used to assess any adverse impacts Koala. If data analysis indicates a trigger has been exceeded, or is likely to be exceeded, further investigation and risk assessment will be undertaken, and an appropriate response will be prescribed to remediate or prevent further adverse impact. Details of triggers, actions and responses for Koala are provided below.

6.5 Reporting structure

Koala monitoring results will be reported separately for long-term and event impact monitoring. Results of event impact monitoring for the Koala will be included in the Event Impact Monitoring report which covers all monitored flora and fauna. As per the existing monitoring program, a SEPP 44 Koala Monitoring Report will be prepared following each long-term monitoring survey. Event impact monitoring results will provide additional data for inclusion in the long-term monitoring reports.

Table 3: Koala monitoring outcomes and response

Trigger	Action	Responsibility
Koala presence has been variable over time, but there is evidence of recent activity. If individuals or evidence of presence are not recorded during the biennial koala surveys, further consideration and/or investigation should be undertaken by an experienced ecologist. Evidence of damage to koala habitats should be responded to.	Undertake investigation to determine the extent and cause of trigger exceedance. The prescribed actions will depend on the extent and nature of the impact. For further details see **Table 4**.	On-site ecologist The Parklands Manager

Trigger	Action	Responsibility
Negative incidents: displaced/dis-oriented individuals, increase of diseased animals, vehicle strike and changes in habitat use. Reduction in cover or dieback of food tress species in areas of Koala habitat Considerations: Koala presence to be assessed in comparison with concurrent surveys of the broader area, as per the Byron Coast Koala Management Plan.		

Responses to monitoring results will be required if any of the trigger values in **Table 3** are exceeded. The nature of the response will be scaled according to the extent to which triggers have been exceeded. External factors (e.g. regional population trends, climate variables) will also be considered.

Components of the adaptive management plan are outlined in **Table 4** below. Adaptive management will be geared towards determining that the objectives listed above are met.

Table 4: Adaptive management actions for koala and habitat

Monitored parameter	Extent of trigger exceedance	Action
Presence of koala	Absence of individuals and/or no evidence of activity during monitoring	Consult with local koala experts and Byron Shire Council to understand regional drivers of change Review on-site actions to determine if contributing to absence. If so, implement appropriate changes to event or site management protocols Review appropriateness of monitoring extent and frequency. Update as needed Liaise with OEH as appropriate
Presence of koala	Negative incidents: displaced/dis-oriented individuals, increase of diseased animals, vehicle strike and changes in habitat use	Respond immediately to any injured/diseased Koalas as appropriate e.g. wildlife carers Consult with local koala experts and Byron Shire Council to understand regional drivers of change Review on-site actions to determine if contributing to injury or illness. If so, implement appropriate changes to event or site management protocols Review appropriateness of monitoring extent and frequency. Update as needed Liaise with OEH as appropriate
Changes in vegetation structure,	Minor edge effects on vegetation areas e.g. litter, trampling Small-scale weed invasions	Undertake routine vegetation management activities to reduce and remediate impacts

Monitored parameter	Extent of trigger exceedance	Action
damage, weed invasion in areas of koala habitat	Vegetation damage e.g. trees damaged, small fire, reduction in eucalypt cover Moderate weed invasions	Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation plan
	Major vegetation damage e.g. large fire, dieback of vegetation, clearing Extensive weed invasions	Notify OEH Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation program

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Appendix A – KPoM content requirements

Requirement	Location in this document
Estimate of population size	Section 2.1
Identification of preferred feed tree species for the locality and the extent of resource available	Section 2.2
An assessment of the regional distribution of koalas and the extent of alternative habitat available to compensate for that to be affected by the actions	Section 2.3
Identification of linkages of Core Koala Habitat to other adjacent areas of habitat and provision of strategies to enhance and manage these corridors	Section 2.3 and section 5.2
Provision of detailed proposals for amelioration of impacts on koala populations from any anticipated development within zones of Core Koala Habitat	Section 5
Identification of any opportunities to increase size or improve condition of existing Core Koala Habitat	Section 5.2
The plan should clearly state what it aims to achieve	Section 3
The plan should state criteria against which achievement of those objectives is to be measured	Section 6.4
The plan should also have provisions for continuing monitoring, review and reporting	Section 6

Appendix B – 2016 Survey Report (Biolink)

North Byron Parklands

SEPP 44 - Koala Monitoring Report

Report to Billinudgel Property Trust

September 2016

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Document Control

Version	Prepared by	Reviewed by	Date
Draft	John Callaghan	Stephen Phillips	11/10/2016
Final			

1.0 Introduction

Billinudgel Property Trust has approval from the NSW State Government for use of the North Byron Parklands site at Yelgun (hereafter referred to as the Parklands site) for a maximum of three "cultural" events each year, subject to ongoing monitoring.

Initial surveys undertaken by Biolink in 2007 recorded localised koala use of a section of the Parklands site confined to a relatively small cell (approximately 3ha) of *Core Koala Habitat* (as defined by *State Environmental Planning Policy No 44 - Koala Habitat Protection*) focused on remnant vegetation in the east of the site. As a consequence of this finding, a short-term (12 month) Individual Koala Plan of Management (IKPoM) was prepared which *inter alia* required reassessment of the site prior to commencement of development activity to check for any changes to the area of identified *Core Koala Habitat*. The reassessment (Biolink 2008) documented a decline in the extent of koala activity within the *Core Koala Habitat* area over the intervening 12 month period to the extent that the level of use at that time was considered to be relic and/or transient. No other evidence of koala activity was recorded elsewhere on the site in 2008.

An updated assessment of koala activity at the Parklands site was undertaken by Biolink in 2013 on behalf of Billinudgel Property Trust. However, no koala activity was recorded and no koalas were observed during the 2013 surveys.

Over the time span since the initial baseline survey was undertaken in 2007 a number of significant events have occurred of direct relevance to the coastal koala population in the Tweed and Byron Local Government Areas including:

i. Koala habitat and population assessments were completed for the Tweed and Byron coastal areas (including the North Byron Parklands site) and Comprehensive Koala Plans of Management (CKPoM) for both areas were prepared and subsequently approved by the respective Councils.

ii. One of the outcomes arising from the Tweed and Byron koala assessments was that the conservation status of koalas along the Tweed Coast and the section of Byron Coast north of the Brunswick River was determined as precarious with wildfire events in 2004 and 2009 identified as major contributing factors to the koala population decline.

iii. In March 2012, the koala was listed as a Vulnerable species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* throughout Queensland, New South Wales and the Australian Capital Territory.

iv. In April 2016, the koala population between the Tweed and Brunswick Rivers east of the Pacific Highway was listed as an Endangered Population under the New South Wales *Threatened Species Conservation Act 1995*.

This report has been prepared at the request of Billinudgel Property Trust to further investigate for evidence of koala activity at the Parklands site.

2.0 Methods

The survey methodology involved the following components:

A. Investigation of koala records

An updated search of the NSW Office of Environment and Heritage BioNet - Atlas of NSW Wildlife database for koala records within a 10 km x 10 km window focused over the Parklands site.

B. Re-survey of SAT sites

This initially involved the random selection and re-surveying of 18 (i.e. 50%) of the previous 34 SAT survey sites. Additional SAT sites were included where necessary to plot the extent of any recorded koala activity. A 25m radial search for koalas was also undertaken by two ecologists at each of the SAT survey sites.

C. Opportunistic inspection of PKFTs

Opportunistic examinations were undertaken at the base of any preferred koala food trees (PKFTs) that were encountered while undertaking foot-based traverses between individual SAT survey sites..

3.0 Results

A. Investigation of koala records

Koala records were obtained from the NSW NPWS Wildlife Atlas in conjunction with the 2007 baseline survey report for a 10 km x 10 km search area centered over the Parklands site. This earlier search returned 8 records dating from 1986 to 1997 including 1 (1990) located within the Parklands site and another for 1990 from Billinudgel Nature Reserve to the south. The most recent Wildlife Atlas record at that time (1997) was located within 1 km to the west of the Parklands site. Survey work undertaken by Australian Museum Business Services (AMBS) in 1999 for the Yelgun to Chinderah Pacific Highway upgrade produced a further koala record just inside the western boundary of the Parklands site and several others along Jones Road; one of which was subsequently radio-tracked over several months.

An updated search of the BioNet - Atlas of NSW Wildlife database in September 2016 produced a total of 22 koala records for the 10 km x 10 km search area focused on the Parklands site. These included an additional 8 records within 1 km of the site dating between 2004 and 2016 with 1 record (2007) for the central section of the Parklands site and 7 records for the section of Jones Road that forms part of the border between the Parklands site and Billinudgel Nature Reserve: 1 for 2004-2006; 1 in 2012; 2 in 2013; 1 in 2015; and 2 in 2016). The remaining records are located near Mooball to the north, Wooyung to the northeast and Billinudgel, New Brighton and Ocean Shores to the south.

B. Re-survey of SAT sites

Field surveys were undertaken over 5 days in September 2016 (September 8, 9, 15, 16, 22). A total of 26 SAT survey sites were undertaken including 18 randomly selected sites, plus 8 others that were undertaken to assist in

identifying the extent of recorded koala activity at the site. Two of the initial randomly generated sites (BPT48 and BPT53) were excluded during the field surveys due to high water levels and were replaced by two additional randomly-selected sites. A new SAT site (BPT64) configured to the survey grid was established in an area of recent koala food tree plantings to the southwest of site BPT17. Figure 1 illustrates the locations and site numbers for the SAT survey sites.

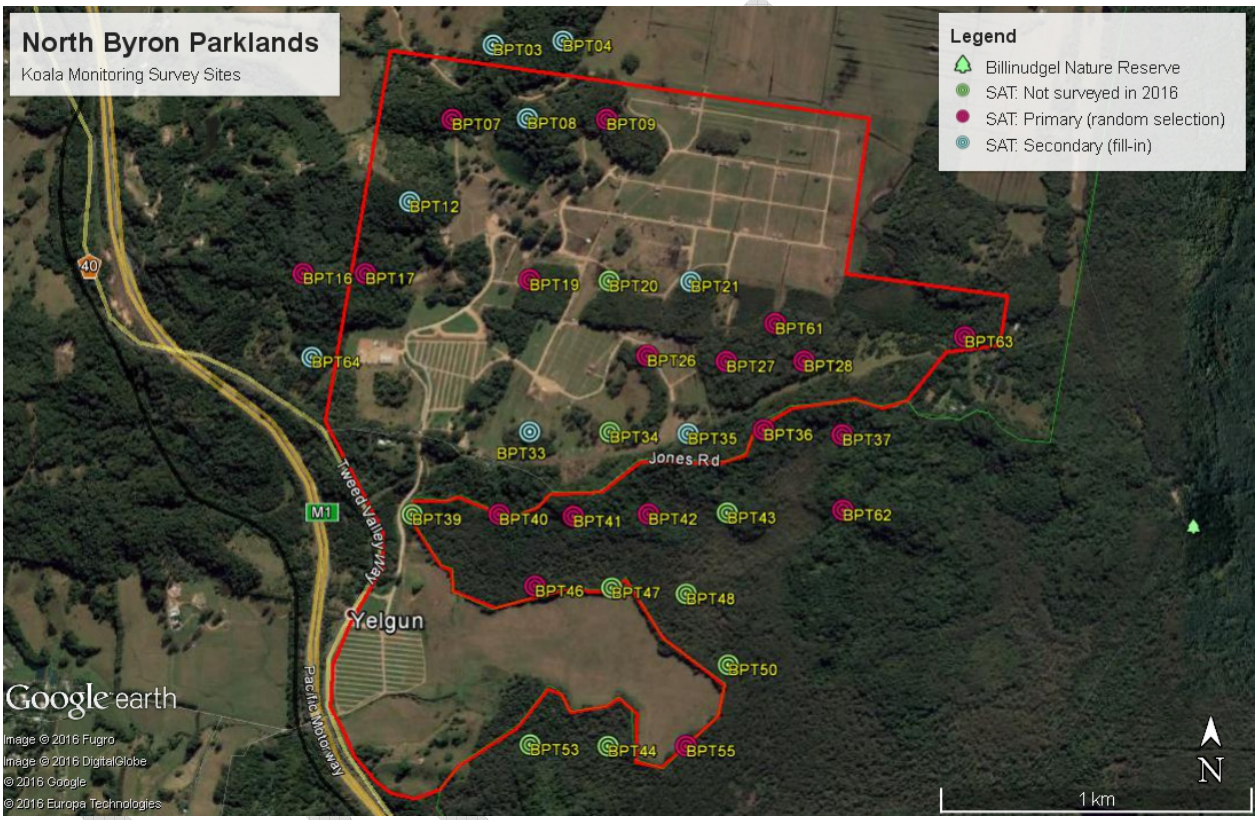

Figure 1. Grid-based koala monitoring SAT survey sites for the North Byron Parklands study area indicating sites surveyed in 2016.

Koala faecal pellets were recorded at 7 of the 26 SAT sites (see Table 1). Activity levels that were considered significant (i.e. ≥ 10% in upland areas on low-nutrient substrates and ≥ 22.52% in lowland areas and other sites on high-nutrient substrates, falling into the 'Medium (normal) use' or 'High use' categories indicative of utilisation by resident koalas with established home ranges) and therefore indicative of *Core Koala Habitat* were recorded at 4 sites; BPT08 (30%-High), BPT17 (30%-High), BPT62 (16.67%-High) and BPT12 (10%-Medium); refer to Phillips & Callaghan (2011).

Table 1. Koala activity levels recorded for baseline SAT surveys in 2007 compared to 2016 survey results. Percentage representation of Preferred Koala Food Trees (PKFT) at each site and the age-class of pellets (old, mixed age, fresh) observed in 2016 are also shown. *Note:* significant koala activity levels (i.e. high or medium use) are bolded.

SAT sites	2007 Activity (%)	2016 Activity (%)	2016 Pellet age-class	2016 Proportion PKFT (%)
BPT03	0	0	-	13.33
BPT04	0	6.67	Mixed Age	3.33
BPT07	0	0	-	0
BPT08	0	**30**	Mixed Age	16.67
BPT09	0	0	-	13.33
BPT12	0	**10**	Old	26.67
BPT16	0	0	-	0
BPT17	0	**30**	Mixed Age	3.33
BPT19	0	0	-	0
BPT20	0	NS	NS	NS
BPT21	0	0	-	0
BPT26	0	0	-	0
BPT27	**13**	3.33	Old	13.33
BPT28	0	0	-	6.67
BPT33	0	0	-	43.33
BPT34	0	NS	NS	NS
BPT35	0	0	-	6.67
BPT36	0	0	-	0
BPT37	0	3.33	Fresh	0
BPT39	0	NS	NS	NS
BPT40	0	0	-	6.67
BPT41	4	0	-	0
BPT42	0	0	-	3.33
BPT43	0	NS	NS	NS
BPT44	0	NS	NS	NS
BPT46	0	0	-	10
BPT47	0	NS	NS	NS
BPT48	0	NS	NS	NS
BPT50	0	NS	NS	NS
BPT53	0	NS	NS	NS
BPT55	0	0	-	6.67
BPT61	**30**	0	-	6.67
BPT62	**43**	**16.67**	Mixed Age	23.33
BPT63	NS	0	-	0
BPT64	NS	0	-	16.67

The distribution and significance category for the koala activity that was recorded by the 2016 SAT surveys is illustrated in Figure 2. The areas of koala activity are represented by 250 m x 250 m cells consistent with the survey grid size. The highest recorded koala activity levels were associated with sites BTP08 and BTP17 in the northwestern corner of the Parklands site. These sites recording mixed age koala pellets including fresh pellets (i.e. deposited in recent weeks) and old pellets, suggesting repeated use over the

past several months. Mixed age pellets were also recorded at BPT04 and BPT62. The single koala pellet recorded at BPT37 was assessed as being in the fresh age-class. The koala pellets recorded at sites BPT12 and BPT27 were all classed as old, suggesting that these sites have not been used by koalas in recent months.

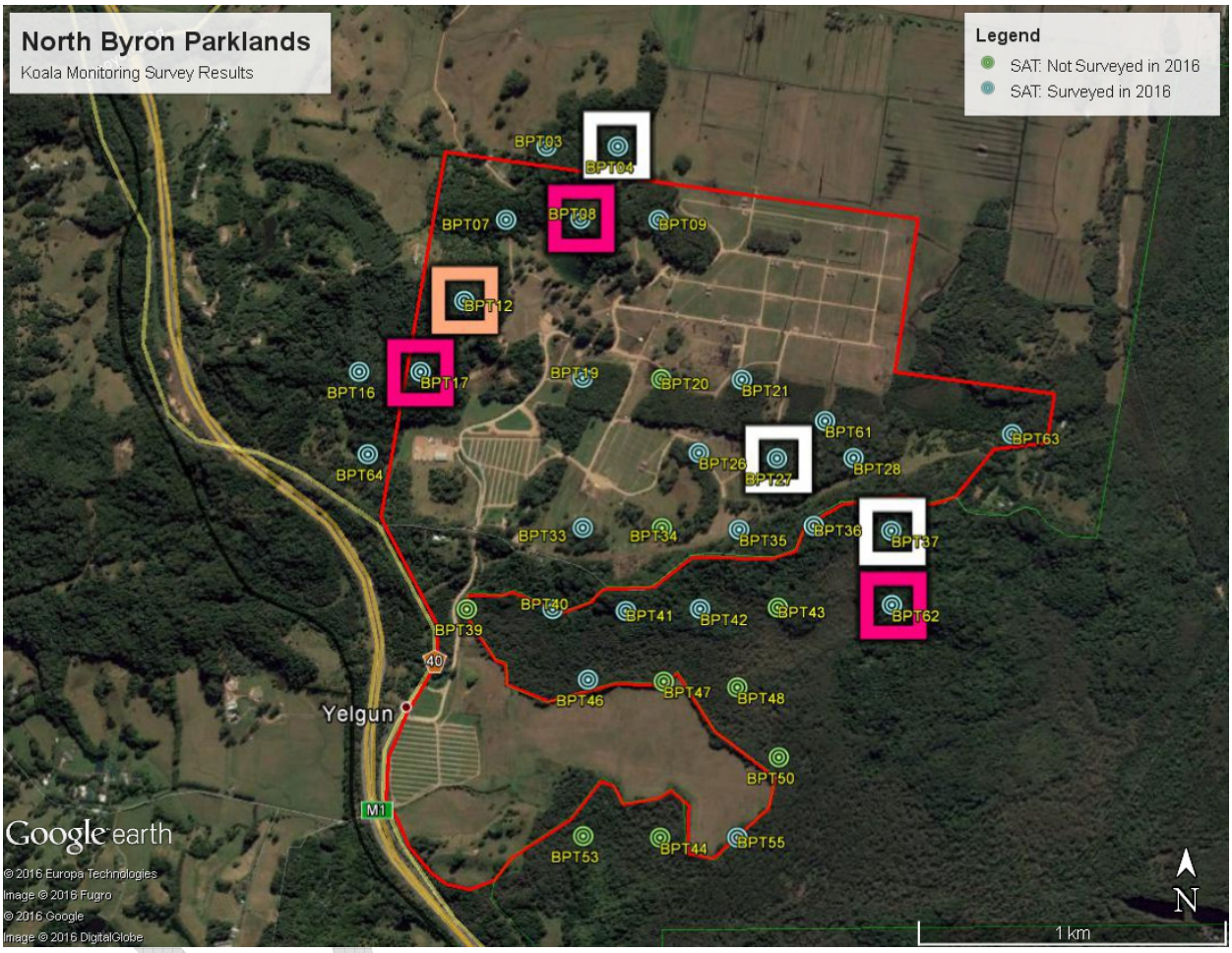

Figure 2. Grid-based koala monitoring SAT survey sites for the North Byron Parklands study area highlighting 250 m x 250 m cells where koala faecal pellet activity was recorded in 2016. Crimson squares = high use, orange = medium (normal) use, white = low use; Refer to Philips & Callaghan (2011).

Seventeen of the re-surveyed SAT sites contained one or more preferred koala food trees with combined proportional representation ranging from a low of 3.33% at sites BPT04, BPT17 and BPT42 to a high of 43.33% at BPT33 (mean representation for the 17 sites = 12.94%, SD = 10.4%), see Table 1.

***Note*: Known **preferred koala food trees** that have been recorded at the Parklands site include; tallowwood *E. microcorys*, forest red gum *E. tereticornis*, swamp mahogany *E. robusta*, grey gum *E. propinqua* and the naturally occurring *E. tereticornis* x *E. robusta* hybrid.**

No koalas were observed during the 25 m radial searches at SAT sites nor during foot and vehicle traverses of the Parklands site.

C. Opportunistic inspection of PKFTs

One additional koala pellet was observed underneath a forest red gum during opportunistic inspections of preferred koala food trees on route between BPT27 and BPT28 at 551722 E 6850049 N (±18m).

4.0 Discussion

The 2016 monitoring survey suggests that a small population cell of koalas has become established in the northwestern corner of the Parklands site and immediately adjoining areas. No evidence of koala activity was recorded for this area during the baseline surveys for the Parklands site in 2007, nor during subsequent koala monitoring surveys at the site in 2008 and 2013. Prior to the current survey, the most recent recorded observation of a koala on the northwestern fringe of the Parklands site was from 1999 during surveys for the Yelgun to Chinderah Pacific Highway upgrade.

Spatial shifts and fluctuations in koala activity may occur over time within a given area as a consequence of natural population dynamics or they may occur as a result of factors such as recent or historical habitat loss and disturbance, landscape fragmentation, and/or increased mortality due to wildfire events, dog attack, vehicle- strike and disease. The decline trend within the broader koala population in the coastal lowlands of Tweed and Byron LGAs was recognised by the recent (April 2016) listing of the koala population between the Tweed and Brunswick Rivers east of the Pacific Highway as an Endangered Population under the NSW *Threatened Species Conservation Act 1995*. The Final Determination report by the NSW Scientific

Committee indicates that historically koalas were consistently recorded in the Billinudgel Nature Reserve and notes the suggestion by Phillips and Hopkins (2012) that recent declines and paucity of koala records for this area are likely to be a consequence of recent high fire frequency. The NSW Scientific Committee report concluded that the koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is facing a very high risk of extinction in the near future.

The baseline survey report (Biolink 2007) postulated that the cell of *Core Koala Habitat* in the southeastern section of the site was likely to be at the periphery of a larger cell of significant activity to the south in Billinudgel Nature Reserve. Ongoing monitoring has indicated that the area of major activity within the Nature Reserve is likely to be quite localised and also diminishing and does not appear to extend into other areas of high-quality koala habitat further to the east. Given that the areas of suitable habitat have been retained within the Parklands site, it is possible that koalas may re-establish in the southeastern section of the site in the future, depending upon recruitment opportunities and the ongoing survival of koalas within the Nature Reserve to the south.

Despite the low numbers of koalas remaining in the Billinudgel area, it is possible that dispersal-aged sub-adults may have traversed to the northwestern corner of the Parklands site from Billinudgel Nature Reserve to the southeast. A moderate level of support for this possibility is provided by continued koala activity at BPT62 (16.67%) within the Nature Reserve, albeit lower than that recorded in 2007 (43%) and BioNet records of koala sightings on Jones Road (adjoining the Parklands site) between 2004-2006 and 2016. However, it is also plausible that koalas may have dispersed into this location and including the Jones Road from the west by using the nearby fauna overpass and/or other nearby underpass structures to cross the Pacific Highway.

Irrespective of where the koalas have come from, their presence in the far northwestern corner of the Parklands site, and presumably some of the adjoining habitat to the west of the site, provides positive news, particularly

given that the 2016 surveys affirmed a sustained overall decline of significant koala activity in the southeast. The renewed koala presence in the northwestern corner of the Parklands site is also noteworthy given that colonization has arguably occurred while the site has hosted two music festival events each year (i.e. 'The Falls' in January and 'Splendor in the Grass' in July).

Future surveys would be important to establish whether the areas of current significant koala activity in the northwestern corner of the Parklands site are sustained. It would also be of value to consider extending the monitoring survey westward towards the Pacific Highway in this location (subject to approval from adjoining property owners) in order to establish the full extent of the koala activity. Future koala monitoring surveys associated with the Byron Coast Comprehensive Koala Plan of Management which was recently approved by Byron Shire Council may help to establish the current distribution and status of koalas within Billinudgel Nature Reserve.

Given the findings from the 2016 koala assessment at the Parklands site, it is recommended that monitoring studies be ongoing. The most appropriate time frame for this work would be the same as that proposed for the Byron Coast CKPoM (i.e. biennial).

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Appendix C – Plant Community Type Descriptions

Description of Plant Community Types

Vegetation Zone 1: Blackbutt - Tallowwood tall moist forest of the far north east of the NSW North Coast Bioregion

This community consists of regrowth forest (>70 years old) in good condition on the foothills within the development area. The canopy (approx. 20-30 m high) is dominated by Blackbutt, with Pink Bloodwood, *Eucalyptus acmenoides* (White Mahogany), *Eucalyptus microcorys* (Tallowwood), *Eucalyptus propinqua* (Small-fruited Grey Gum), *Eucalyptus siderophloia* (Grey Ironbark), Brush Box and *Syncarpia glomulifera* (Turpentine) also common.

The mid story generally consists of *Pittosporum undulatum* (Native Daphne), *Notelaea longifolia* (Large-leaved Olive), *Hovea acutifolia* (Purple Pea Bush), *Acmena smithii* (Common Lilly Pilly), *Acacia obtusifolia* (Blunt Leaf Wattle) and Guioa, amongst others. The weeds Camphor Laurel and *Lantana camara* (Lantana) were also common, though not abundant.

The ground layer generally consisted of *Doodia aspera* (Prickly Rasp Fern), *Blechnum cartilagineum* (Gristle Fern), *Pteridium esculentum* (Common Bracken), and *Lomandra multiflora* (Many-flowered Mat-rush). The climbers *Smilax* spp., *Geitonoplesium cymosum* (Scrambling Lily) and *Marsdenia rostrata* (Milk Vine) were also common.

This community would provide good fauna habitat due to the community's age and contiguousness with other large patches of vegetation. Large standing trees, fallen logs, trees with hollows, native ground covers, and course and fine litter were present.

An indicative photograph of this community is shown in **Figure 6**.

Figure 6: Vegetation Zone 1

Vegetation Zone 2: Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion

This vegetation zone consisted of remnant vegetation in good condition and was more often on southerly facing aspects. The canopy (20-30m high) was dominated by Brush Box, with Pink Bloodwood and Blackbutt also occasionally present in the canopy. Broad-leaved paperbark was also sometimes present on lower slopes.

The mid-story of this PCT generally consisted of *Synoum glandulosum* (Scentless Rosewood), *Wilkiea huegeliana* (Veiny Wilkiea), *Cryptocarya microneura* (Murrogun), *Eupomatia laurina* (Copper Laurel), *Pilidiostigma glabrum* (Plum Myrtle), Native Daphne, and *Ripogonum elseyanum* (Hairy Supplejack). The exotics Lantana and Camphor laurel was also occasionally present.

In the ground layer, *Blechnum cartilagineum* (Gristle Fern), *Davallia pyxidata* (Hare's-foot Fern), Ottochloa gracillima (Pademelon Grass) were occasionally present, though the ground layer was often sparse.

Similarly to Vegetation Zone 1, this community would provide good fauna habitat due to the community's age and contiguousness with other large patches of vegetation. Large standing trees, fallen logs, trees with hollows, native ground covers, and course and fine litter were present.

An indicative photograph of this community is shown in **Figure 7**.

This vegetation zone also includes an area of scattered *Araucaria cunninghamii* (Hoop Pine) among pasture grasses (Plot 28), as this was the most appropriate PCT given the plot's location and likely pre-existing vegetation community.

Vegetation Zone 3: Brush Box - Tallowwood shrubby open forest of the northern ranges of the NSW North Coast Bioregion (rehabilitation area)

The area within Zone 3 has recently been subject to rehabilitation works and was previously used for cultivation of bananas. It was likely to be Brushbox tall moist forest prior to clearing and will develop into this community over time. It is in a poor condition due to weed infestation, though the community did not meet thresholds for low condition under the FBA methodology, as the canopy cover exceeded the minimum threshold for moderate to good condition.

As the site is in poor condition (relative to the target PCT), it has been mapped as a separate vegetation zone.

The canopy was low (approx. 5 to 10m high) and dominated by Acacia sp.; however other native species were also observed to be common, including Brush Box, *Macaranga tanarius* (Macaranga), *Melicope elleryana* (Evodia), *Mallotus philippensis* (Red Kamala) and *Jagera pseudorhus* (Foam Bark).

The mid-story and ground layer was dominated by exotic species, namely Lantana and Easter Cassia, as well as *Ageratina riparia* (Mist Flower), *Ageratina adenophora* (Crofton Weed), *Melinis minutiflora* (Molasses Grass) and *Setaria sphacelata* (Setaria). *Passiflora suberosa* (Corky Passionflower) and Pademelon Grass (a native) was also common.

Despite its current condition, the community provides some habitat resources for native fauna such as small birds and reptiles due to the thick mid-story and ground cover.

An indicative photograph of this community is shown in **Figure 8**.

Figure 7: Vegetation Zone 2

Figure 8: Vegetation Zone 3

Vegetation Zone 4: Flooded Gum - Brush Box moist forest of the coastal ranges of the North Coast

This community exists on the lower slopes within the development site.

The canopy of this community is dominated exclusively by Flooded Gum (20-30m tall). In the mid-storey, the natives *Cupaniopsis anacardioides* (Tuckeroo), *Acacia disparrima* (Hickory Wattle), Murrogun, *Maclura cochinchinensis* (Cockspur thorn) and Guioa were common, with Camphor laurel* also common.

Paspalum mandiocanum (Broad-leaved paspalum*), Pademelon Grass and Smilax australis were common in the ground layer.

This community would provide moderate fauna habitat as it is fragmented and subject to weed incursion on the edges. Nonetheless large standing trees, fallen logs, trees with hollows, native ground covers, and course and fine litter were present.

An indicative photograph of this community is shown in **Figure 9**.

Figure 9: Vegetation Zone 4

Vegetation Zone 5: Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

This community exists on the lowland alluvial flats within the eastern portion of the development area.

It is dominated by Broad-leaved paperbark, with Swamp Oak also occasionally present in patches. Common Lilly Pilly and Camphor Laurel* was observed to be common in the *midstorey*, with Tuckeroo, *Cryptocarya triplinervis* var *pubens*, Evodia, *Croton verreauxii* (Green Native Cascarilla), Guioa, Native Daphne, *Rhodamnia rubescens* (Scrub Turpentine), Scentless Rosewood, *Glochidion sumatranum* (Umbrella Cheese Tree), *Ficus coronata* (Sandpaper Fig) and *Litsea australis* (Brown Bolly Gum) occasionally occurring. Lantana* and Easter Cassia* was also occasionally present.

A diversity of ground covers exist in this community depending on location, topography and levels of disturbance. Common species observed include Swamp Water Fern, *Morinda jasminoides* (Sweet Morinda) *Geitonoplesium cymosum* (Scrambling Lily), Common Silkpod, *Smilax australis, Stephania japonica* var. *discolor* (Snake Vine), *Calochlaena dubia* (Rainbow Fern), *Cyclosorus interruptus*, *Viola hederacea* (Ivy-leaved Violet), *Oplismenus hirtellus* var. *imbecillis* (Creeping Beard Grass), *Carex* sp., and *Gahnia clarkei* (Tall Saw-sedge).

This community would provide good fauna habitat due to low level of weed infestation, and the presence of fallen logs, native ground covers, and course and fine litter. No trees with hollows were observed however.

An indicative photograph of this community is shown in **Figure 10**.

Figure 10: Vegetation Zone 5

Vegetation Zone 6: Forest Redgum - Pink Bloodwood open forest of the foothills and ranges of the NSW North Coast Bioregion

The zone is comprised of several areas, including remnant vegetation in the east of the development and two areas of rehabilitation. The two areas of rehabilitation are adjacent to the Flooded Gum forest and also along Yelgun Creek.

The remnant vegetation patches in the east are dominated by Forest Red Gum, with a 20 to 30m canopy. Other common canopy species observed include Pink Bloodwood, Swamp Box, Grey Ironbark (*Eucalyptus siderophloia*) and White Mahogany. The mid-layer was often dominated by Swamp Box, *Elaeocarpus obovatus* (Hard Quandong), Guioa and *Acacia melanoxylon* (Sally Wattle). The ground layer was often dmonated by Broad-leaved paspalum*, *Marinda jasminoides* (Sweet Marinda), *Cissus antarctica* (Kangaroo Vine), *Ottochloa gracillima*, *Panicum lachnophyllum*, *Smilax australis* (Lawyer Vine) and *Marsdenia rostrata* (Milk Vine).

The area of rehabilitation has a canopy height of approximately 5 metres. It is considered of good enough quality (in terms of site attributes relevant to the FBA method) to be included within this vegetation zone. At the rehabilitation areas Forest Red Gum, Bloodwood, Blackbutt, White Mahogany, Brush Box and *Acacia melanoxylon* (Black Wattle) were present. A similar mix of species was also present along Yelgun Creek. Along the creek the eucalypts were much older, numbered less than 10 altogether and formed a canopy approximately 20m high.

Other tree and shrub species observed in the area of rehabilitation included Lantana*, Turpentine, Evodia, *Acacia longifolia* (Sydney Golden Wattle) and Cockspur Thorn. Ground species observed include Common Bracken Fern, *Hibbertia scandens* (Golden guinea vine), Broadleaf Paspalum, *Imperata cylindrica* (Blady Grass), Gristle Fern, Purple Pea Bush, *Echinostephia aculeata*, *Pratia purpurascens* (White Root) and *Ageratum houstonianum* (Blue Billy-goat Weed).

The rehabilitaotin areas currenlty provide limited habitat value due to the lack of overstorey. Nonetheless the ground covers and shrub layer (along Yelgun Creek) provide habitat resources for native fauna such as small birds and reptiles.

An indicative photograph of this community is shown in **Figure 11**, with the the area of rehabilitation where a plot was located shown in **Figure 12**.

This community is not considered to meet *the Subtropical coastal floodplain forest of the NSW North Coast bioregion* endangered ecological community listing as it occurs on lower hillslopes in the study area and not within the floodplain.

Vegetation Zone 7: Forest Redgum - Pink Bloodwood open forest of the foothills and ranges of the NSW North Coast Bioregion

This vegetation zone comprises a small patch of Acacia regrowth, with an understory of exotic pasture grass. Prior to clearing, the area was likely to be Forest Redgum - Pink Bloodwood open forest due to its location in the landscape and proximity to remant areas of this PCT. Over time, it is assumed that this community will regenerate into Forest Redgum - Pink Bloodwood open forest.

The Forest Redgum - Pink Bloodwood open forest PCT was the most appropriate choice for PCT description due to the area's likely preclearing PCT and that there are no regrowth Acacia forest PCTs.

An indicative photograph of this community is shown in **Figure 13.**

Figure 11: Vegetation Zone 6

Figure 12: Vegetation Zone 6 (rehabilitation area)

Figure 13: Vegetation Zone 7

Pasture (cleared land)

This area was dominated by Setaria*, with *Paspalum urvillei* (Vasey's grass*) and *Verbena bonariensis* (Common Verbena*) also common. A photo of this area is provided in **Figure 14**.

Other areas of the grounds are regularly mown and managed to facilitate events.

Figure 14: Unmanaged grassland

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Appendix C – Habitat Restoration and Tree Planting Details

Table 37: Habitat Restoration and Tree Planting Details

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
1	MP	Re	100	0.809	N/A – open space area	Mature	Complete	On-maintenance
2	H	P	100	0.582	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
3	H	Re	100	1.370	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
4	MP	P	100	5.321	N/A – open space area	10 years	60 native trees to be planted along northern boundary and road D (20m apart)	On-maintenance
5	MP	P	0	0.551	N/A – open space area	10 years	20 native trees along northern boundary (every 20m and 20m off fence) Complete	On-maintenance
6	H	Re	100	1.461	749 – Brush box tall moist forest	Mature	Complete	On-maintenance
7	H	Re	100	0.320	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
8	MP	Re	100	0.721	N/A – open space area	Mature	Complete	On-maintenance
9	MP	P	0	0.975	N/A – open space area	10 years	25 native trees along northern boundary (every 20m and 20m off fence) Complete	On-maintenance
10	H	Re	100	1.726	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
11	H	Re	100	0.436	826 – Flooded Gum / Brush Box Forest	Mature	Complete	On-maintenance
12	MP	P	100	0.687	N/A – open space area	10 years	8 native trees	On-maintenance

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
13	MP	P	100	1.016	N/A – open space area	10 years	12 native trees	On-maintenance
14	MP	P	100	0.165	N/A – open space area	10 years	15 native trees	On-maintenance
15	MP	P	100	0.802	N/A – open space area	10 years	15 native trees along access road	On-maintenance
16	MP	Re	100	1.254	N/A – open space area	Mature	Complete	On-maintenance
17	MP	P	75	1.495	N/A – open space area	10 years	15 native trees along drainage line Complete	On-maintenance
18	H	P	100	0.092	749 – Brush box tall moist forest	10 years	200 native trees	On-maintenance
19	MP	P	100	0.353	N/A – open space area	10 years	8 native trees along access road	On-maintenance
20	H	Re	100	0.138	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
21	MP	P	100	0.883	N/A – open space area	10 years	15 native trees along drainage line	On-maintenance
22	MP	Re	100	2.983	N/A – open space area	Mature	Complete	On-maintenance
23	MP	P	100	0.091	N/A – open space area	10 years	8 native trees along access road	On-maintenance
24	MP	Re	100	0.259	N/A – open space area	Mature	Complete	On-maintenance
25	H	P	100	0.315	749 – Brush box tall moist forest	Mature	Complete	On-maintenance
26	H	P	100	1.929	837 - Forest Red Gum - Swamp Box forest	10 years	100 native trees west of treed hill	On-maintenance
27	MP	Re	100	0.783	N/A – open space area	Mature	Complete	On-maintenance
28	H	P	100	0.560	749 – Brush box tall moist forest	10 years	In-fill existing plantings - 100 native trees	On-maintenance
29	MP	P	100	0.355	N/A – open space area	Mature	Complete	On-maintenance
30	MP	Re	100	0.306	N/A – open space area	Mature	Complete	On-maintenance
31	MP	Re	100	0.840	N/A – open space area	Mature	Complete	On-maintenance
32	MP	P	100	0.279	N/A – open space area	10 years	30 native trees north of forest block	On-maintenance

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
33	H	P	100	1.252	837 - Forest Red Gum - Swamp Box forest	10 years	1,000 native trees – completed	On-maintenance
34	H	P	100	0.863	693 - Blackbutt - Tallowwood tail moist forest and 1064 – Paperbark Swamp Forest	Mature	Complete	On-maintenance
35	H	P	100	2.292	749 – Brush box tall moist forest and 837 - Forest Red Gum - Swamp Box forest	Mature	Complete	On-maintenance
36	H	P	100	4.459	749 – Brush box tall moist forest	Mature	Complete	On-maintenance
37	H	P	100	0.248	837 - Forest Red Gum - Swamp Box forest	10 years	100 native trees south of RMS drain	On-maintenance
38	H	P	100	2.118	837 - Forest Red Gum - Swamp Box forest	10 years	100 native trees to supplement existing plantings	On-maintenance
39	H	P	100	2.471	1064 – Paperbark Swamp Forest	10 years	3,50 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth	On-maintenance
40	H	P	100	5.524	1064 – Paperbark Swamp Forest	10 years	Initial works complete - 1,500 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth Additional works - Natural regeneration / plantings so that area is melaleuca forest, subject to bushfire hazard reduction setbacks.	Initial works are on-maintenance. Additional works underway.
41	H	P	100	1.835	1064 – Paperbark Swamp Forest	10 years	350 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth	On-maintenance
42	H	I	Ongoing	0.270	693 - Blackbutt - Tallowwood tail moist forest and 1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
43	H	I	Ongoing	0.494	749 – Brush box tall moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
44	H	E	Ongoing	1.531	749 – Brush box tall moist forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring
45	H	I	Ongoing	1.132	749 – Brush box tall moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
46	H	I	Ongoing	0.450	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
47	H	I	Ongoing	1.084	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
48	H	I	Ongoing	2.496	837 - Forest Red Gum - Swamp Box forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
49	H	I	Ongoing	0.272	837 - Forest Red Gum - Swamp Box forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
50	H	E	Ongoing	11.548	837 - Forest Red Gum - Swamp Box forest and 1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring
51	H	I	Ongoing	3.014	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
52	H	I	Ongoing	2.719	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
53	H	I	Ongoing	1.107	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
54	H	I	Ongoing	1.389	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
55	H	I	Ongoing	2.451	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
56	H	I	Ongoing	0.898	826 – Flooded Gum / Brush Box Open Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
57	H	I	Ongoing	0.351	826 – Flooded Gum / Brush Box Open Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
58	H	E	Ongoing	10.650	749 – Brush box tall moist forest and 693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring
59	H	E	Ongoing	8.436	749 – Brush box tall moist forest and 693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring
60	H	E	Ongoing	5.564	749 – Brush box tall moist forest and 693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring
61	H	I	Ongoing	2.200	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
62	H	I	Ongoing	0.663	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
63	H	I	Ongoing	0.076	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
64	H	I	Ongoing	5.459	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
			Total	**115.173**				

Zone types: H = Habitat; MP = Managed Parklands.

Treatment types: I = Improved (i.e. weed removal); P = Plantings; E = Existing / mature vegetation; Re = Regeneration.

Appendix D - Additional Biodiversity Impacts – Importance of habitat within 1km of the project

Table 38: Species predicted to occur within 1km of project area

Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
Amphibians			
Wallum Froglet *Crinia tinnula*	Known from non-reserve pastoral lands in the far northeast, but not recorded in Bionet records for BNR. BNR habitats within the 1km buffer area are potentially suitable, but the species is not recorded, and therefore these habitats are unlikely to be important for this species. The species is listed as recorded from the BNR in the Plan of Management (NPWS 2000).	5	200
Wallum Sedge Frog *Litoria olongburensis*	Not recorded in Bionet records for BNR, or for 10km by 10km search area. Habitats within the 1km buffer area are largely unsuitable, and therefore unlikely to be important for this species. The species is listed as recorded from the BNR in the Plan of Management (NPWS 2000).	0	40
Birds			
Barred Cuckoo-shrike *Coracina lineata*	This species is a mobile rainforest frugivore, exploiting fruits, especially figs, as they become ripe across the landscape. There is one unconfirmed record from within the project area. Areas within the 1km buffer are unlikely to constitute important habitat for this species.	1	27
Black Bittern *Ixobrychus flavicollis*	Reedy and sedge-dominated understory within swamp sclerophyll forest are potential shelter and foraging habitat for this species, which is more usually found along streams or close to permanent water. Habitats < 1km of the project boundary area are not likely to be important for this species.	1	77

Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
Comb-crested Jacana *Irediparra gallinacea*	Recorded within the study area from a large dam in 2007, but not since, this species is dependent upon permanent freshwater wetlands with floating surface vegetation. Areas within the 1km buffer do not constitute important habitat for this species.	3	20
Eastern Grass Owl *Tyto longimembris*	The Eastern Grass Owl is known from within the development site and from the 1km buffer area: in tall closed grasslands in the south. It may breed in this area and therefore there is important habitat for the species within the 1km buffer area.	2	27
Eastern Osprey *Pandion cristatus*	Recorded within the study area during an event in 2015, this is a highly mobile and wide-ranging species which forages over shorelines, rivers and estuaries. It may occasionally take fish from a large dam within the study area or from larger drains in agricultural areas in the buffer area. Areas within the 1km buffer do not constitute important habitat for this species.	11	80
Marbled Frogmouth *Podargus ocellatus*	Obligate rainforest species. The extensive swamp sclerophyll forest, and agricultural lands of the 1km buffer area are generally unsuitable for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	2	37
Pale-vented Bush-hen *Amaurornis moluccana*	Reedy and sedge-dominated understory within swamp sclerophyll forest are potential shelter and foraging habitat for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	1	213
Rose-crowned Fruit-Dove *Ptilinopus regina*	Rainforest frugivore likely to exploit seasonally available fruits, mobile and wide-ranging. The extensive swamp sclerophyll forest, and agricultural lands of the 1km buffer area are generally unsuitable for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	41	270
Square-tailed Kite *Lophoictinia isura*	Recorded within the study area in 2003, but not since, this is a highly mobile and wide-ranging species which may forage over the forested habitats within the buffer area. Home range is reported to be ~50km2. Areas within the 1km buffer do not constitute important habitat for this species.	1	16

Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
White-bellied Sea-Eagle *Haliaeetus leucogaster*	The White-bellied Sea-eagle breeds annually at a site in the far southeast but ~200m outside the buffer area, and is regularly recorded in surveys at one transect. Also seen over the NBP property. Areas within the 1km buffer do not constitute important habitat for this species.	17	53
White-eared Monarch *Carterornis leucotis*	This species is a rainforest canopy insectivore and has been recorded within the study area and in the 1`km buffer area transect surveys. While it is likely to occur within the large forest blocks in the buffer area, it has also been recorded from plantings adjoining large forest blocks. Areas within the 1km buffer are unlikely to constitute important habitat for this species.	10	222
Wompoo Fruit-Dove *Ptilinopus magnificus*	Rainforest frugivore likely to exploit seasonally available fruits, mobile and wide-ranging. The extensive swamp sclerophyll forest, and agricultural lands of the 1km buffer area are generally unsuitable for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	2	99
Mammals			
Brush-tailed Phascogale *Phascogale tapoatafa*	Systematic fauna surveys in 2007, 2009, 2014, not detected. NPWS consider Billinudgel Nature Reserve potential habitat.	0	0
Common Planigale *Planigale maculata*	The Planigale is not a species which can be detected from hair samples, so the presence and extent of distribution of the Common Planigale in the 1km buffer area is unknown. It was not detected in pitfall surveys and Elliot trapping effort in NBP. Tall closed grasslands and adjacent swamp sclerophyll forest in the south of the site are suitable potential habitat. In the absence of survey data, the importance of habitats in the 1km buffer for this species cannot be determined.	1	45
Koala *Phascolarctos cinereus*	Koala populations in coastal parts of the Byron LGA have declined in recent years, and specific targeted surveys in NBP have failed to find any Koalas, but have recorded scats in the western part of the property.	133	1961

Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
	Forests in the 1km buffer contain important Koala habitat and numerous Koala preferred Feed trees. Assuming that a small number of Koalas remain within BNR, habitats in the 1km buffer are likely to be important for these individuals.		
Squirrel Glider *Petaurus norfolcensis*	Species not recorded in surveys on the site in 2007, 2009 and 2014. NPWS consider Billinudgel Nature Reserve potential habitat.	0	1
Bats			
Common Blossom-bat *Syconycteris australis*	Forested habitats within the 1km buffer are forage habitat for this species with abundant winter flowering eucalypts and paperbarks. Byron coastal floodplain contains similar resources on a large scale and so the buffer area is unlikely to be important habitat for this species.	3	40
Grey-headed Flying-fox *Pteropus poliocephalus*	Forested habitats within the 1km buffer are forage habitat for this species with abundant winter flowering eucalypts and paperbarks. Food resources are also present in the agricultural lands. Byron coastal floodplain contains similar resources on a large scale and so the buffer area is unlikely to be important habitat for this species. A camp site reported in 2007 and located in or close to the 1km buffer was found to be unused when surveyed. A permanent maternity camp in Brunswick Heads Nature Reserve has been abandoned since ~2009.	7	202
Large-eared Pied Bat *Chalinolobus dwyeri*	Recorded from call detection within the project area, this is a cave dwelling species, also found roosting within fairy martin nests. Records in the study area are associated with a large permanent freshwater dam and may indicate bats coming to drink at this site. Forested areas in the 1km buffer area comprise forage habitat for this species, but, in the absence of roost habitat, e.g. cliffs, caves, mines, do not represent important habitat for this species.	3	4
Migratory birds			

Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
Fork-tailed Swift *Apus pacificus*	A wide-ranging and mobile species which does not breed in Australia, the Fork-tailed Swift was not recorded in the Bionet Atlas search of a 100km2 area centred on the project area, but may occur at times within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		21
Oriental Cuckoo *Cuculus optatus*	A wide-ranging and mobile species which does not breed in Australia, the Oriental Cuckoo was not recorded in the Bionet Atlas search. This species has been recorded once in four years of bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		9
White-throated Needletail *Hirundapus caudacutus*	A wide-ranging and mobile species which does not breed in Australia, there were 11 records of the White-throated Needletail in the Bionet Atlas search. This species has been recorded occasionally in four years of bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		172
Black-faced Monarch *Monarcha melanopsis*	The Black-faced Monarch was not recorded in the Bionet Atlas search, but has been recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		155
Spectacled Monarch *Monarcha* trivirgatus*	The Spectacled Monarch was not recorded in the Bionet Atlas search, but has been regularly recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		223
Satin Flycatcher *Myiagra cyanoleuca*	The Satin Flycatcher was not recorded in the Bionet Atlas search, but has been recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		X
Rufous Fantail *Rhipidura rufifrons*	The Rufous Fantail was not recorded in the Bionet Atlas search, but has been recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		276
Latham's Snipe	Latham's Snipe was recorded in the Bionet Atlas search, but has been not been recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.	2	25

Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
Gallinago hardwickii			
Eastern Osprey *Pandion cristatus*	The Eastern Osprey was not recorded in the Bionet Atlas search, but has been recorded in within the project area. Habitats within 1km of the study area are unlikely to be important for this species which is more likely to utilise seashore and canal habitats to the east and southeast.	11	80
Invertebrates			
Mitchell's Rainforest Snail Thersites mitchellae	Bionet search results report 2 records from BNR and 2 records from the 10km X 10km search area. During bird surveys within and just outside the buffer area in BNR an additional 5 records of Thersites shells have been discovered since 2016. Extensive swamp sclerophyll forests with tall saw-sedges, logs and an interface with Brushbox dominated rainforest constitute suitable habitat for the species within the 1km buffer area and elsewhere in BNR. Two of the five recent records were from ~200m east of the 1km buffer line. In the absence of systematic survey identifying the species current distribution within BNR, and acknowledging the Critically Endangered status of this species, it is likely that habitat within the 1km buffer is important for this species.	2	157

Table 39: Hollow Dependant Species within 1km of project area

Hollow dependent species Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10km)	Byron LGA
Birds			
Brown Tree creeper *Climacteris picumnus victoriae*	Recorded in 2017 in transect surveys in the far northeast of the 1km buffer area, this insectivorous species nests in tree hollows. It was not recorded in previous surveys, and only one record exists in the Bionet atlas for the Byron LGA. Considered a sedentary species, therefore forest within the 1km buffer area may be important habitat for this species.	0	1
Little Lorikeet *Glossopsitta pusilla*	Recorded once flying over a transect in the far northeast of the 1km buffer area, this is a mobile and widely ranging species, moving in response to the availability of blossom. Hollows in the limb or trunk of smooth-barked eucalypts are preferred. The absence of additional records from transect surveys in and close to the 1km buffer area over 4 years indicates that the species is not resident in this area. The hollow-bearing resource within the 1km buffer area is meagre and widely dispersed with ~40% of hollows in rough-barked trees, so the buffer area is unlikely to be important habitat for this species.	1	11
Masked Owl *Tyto novaehollandiae*	Recorded once in the study area prior to 2007, this species, if present, is likely to forage over the 1km buffer area. No suitable large hollow-bearing tree for nesting was located during a search of the area, therefore the buffer area is unlikely to be important habitat for this species.	5	18

Hollow dependent species Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10km)	Byron LGA
Sooty Owl *Tyto tenebricosa*	No suitable large hollow-bearing tree for breeding was located during a search of the 200m buffer area. The 1km buffer area does not contain important habitat for this rainforest species.	3	90
Bats			
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*	Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	11	34
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	Recorded regularly in low numbers from call detection at a large permanent freshwater dam in the project area, this species roosts in the hollow trunks of eucalypt trees. Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	1	3
Eastern Freetail-bat *Mormopterus norfolkensis*	Recorded regularly in low numbers from call detection at a large permanent freshwater dam in the project area, this species roosts in the hollow spouts of large mature trees, and in buildings. Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	7	11
Eastern Long-eared Bat *Nyctophilus bifax*	Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	7	112

Hollow dependent species Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10km)	Byron LGA
Golden-tipped Bat *Kerivoula papuensis*	Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.		
Greater Broad-nosed Bat *Scoteanax rueppellii*	Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The species can also roost in bird nests and epiphytes. The buffer area is considered unlikely to be important habitat for this species.	2	7
Little Bentwing-bat *Miniopterus australis*	Recorded from call detection at various sites within the project area, this is a cave dwelling species, which also occasionally roosts in hollow trees. Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	46	205
Northern Free-tailed Bat *Mormopterus lumsdenae*	This species (previously Mormopterus beccarii) was not recorded from the project area. The buffer area is considered unlikely to be important habitat for this species.	1	K
Southern Myotis *Myotis macropus*	The Southern Myotis is also known as the Fishing Bat and takes prey from the surface of permanent waterbodies. Roost habitats include caves, hollow trees, in bridge drains, mines and in vegetation. The absence of permanent freshwater forage habitat, and paucity of preferred roost habitats mean that habitat within the 1km buffer is unlikely to be important for this species.	11	226
Yellow-bellied Sheathtail-bat	Recorded regularly in low numbers from call detection at a large permanent freshwater dam in the project area, this is a large	3	5

Hollow dependent species Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10km)	Byron LGA
Saccolaimus flaviventris	insectivore which roosts in large tree hollows. Forested and open habitat within the 1 km study area constitute potential foraging habitat for the species, but roost trees with large hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.		

Appendix E – Additional Biodiversity Impacts – Location and Measurements of Hollow-bearing Trees

No	Easting	Northing	Species	dbh (cm)	stems	ht (m)	Tru hol	Bra hol	L/S/D	date
1	550956	6849082	M qui	56	1	22	1	0	L	8/2/17
2	550956	6849082	M qui	30	1	22	1	0	L	8/2/17
3	550947	6849016	M qui	70	2	20	1	1	D	8/2/17
4	550874	6848960	E rob	65	1	17	1	1	L	8/2/17
5	550901	6848837	L sua	120	1	20	1	1	L	8/2/17
8	551308	6848836	E obo	80	1	18	1	1	L	8/2/17
9	551085	6849507	E rob	96	1	22	2	1	S	14/2/17
10	550924	6849492	M ell	18	1	15	0	1	D	14/2/17
11	550936	6849760	C cam	150	4	20	0	5	L	14/2/17
12	551105	6849677	E pil	130	2	24	0	2	L	14/2/17
13	551226	6849722	E pil	95	1	15	0	1	L	14/2/17
14	551288	6849774	E pil	95	1	20	0	1	L	14/2/17
15	551672	6849855	E pil	50	1	12	0	5	D	14/2/17
16	551704	6849890	E pil	65	1	22	0	1	L	14/2/17
17	551749	6849950	E pil	75	1	25	1	2	L	14/2/17
18	550549	6850319	L con	48	1	10	1	0	D	17/2/17
19	550549	6850319	L con	100	3	18	1	0	L	17/2/17
20	550284	6850116	E gra	50	1	12	0	1	L	17/2/17
21	550284	6850116	E gra	85	1	18	1	1	L	17/2/17
22	550451	6850693	E acm	70	1	16	0	2	L	17/2/17

No	Easting	Northing	Species	dbh (cm)	stems	ht (m)	Tru hol	Bra hol	L/S/D	date
23	550462	6850678	E ter	95	1	14	1	0	S	17/2/17
24	550462	6850678	E ter	70	1	14	1	0	L	17/2/17
25	550496	6850684	L con	75	1	16	1	0	L	17/2/17
26	550456	6850664	E acm	70	1	18	1	0	L	17/2/17
27	550481	6850656	E acm	85	1	18	1	0	L	17/2/17
28	550529	6850691	L con	110	2	16	1	0	L	17/2/17
29	550430	6850490	E pro	65	1	22	0	1	L	17/2/17
30	550448	6850432	E pro	55	1	20	0	2	L	17/2/17
31	550680	6849907	E pil	115	1	22	0	1	L	20/2/17
32	550768	6849966	E pil	125	1	20	0	3	L	20/2/17
33	551996	6850165	E ter	94	1	9	1	0	D	20/2/17
34	551783	6850150	E acm	60	1	18	1	0	S	20/2/17
35	551783	6850150	E acm	65	1	18	0	1	L	20/2/17
36	551749	6850194	E acm	66	1	20	0	1	L	20/2/17
37	551782	6850208	E acm	75	1	20	1	1	L	20/2/17
38	551744	6850215	E acm	85	1	15	1	1	D	20/2/17
39	551726	6850209	E acm	75	1	22	0	1	S	20/2/17
40	551737	6850000	E acm	18	1	5	1	0	D	20/2/17
41	551753	6850147	L sua	50	1	18	0	2	L	20/2/17
42	551550	6850114	E spp.	35	1	10	1	0	D	20/2/17
43	551555	6850127	E acm	90	1	16	0	2	D	20/2/17
44	551555	6850127	E pil	95	1	24	0	2	L	20/2/17
45	551555	6850132	E acm	48	1	17	0	1	L	20/2/17
46	550692	6848928	E gra	48	1	12	0	2	L	20/2/17

No	Easting	Northing	Species	dbh (cm)	stems	ht (m)	Tru hol	Bra hol	L/S/D	date
47	551215	6849634	E micro	85	-	35	1	2	L	25/4/18
48	551492	6849729	Unknown	16	-	5	1	0	D	25/4/18
49	551635	6849737	L conf	75	-	30	1	0	L	25/4/18
50	551630	6849730	C int	65	-	35	1	1	L	25/4/18
51	551755	6849780	E pil	140	-	30	0	4	L	25/4/18
52	552116	6849894	E sid	95	-	25	2	0	L	25/4/18
53	550932	6849734	E pil	105	-	40	0	3	L	25/4/18
54	551294	6848808	E obov	56	-	25	1	1	L	25/4/18
55	551348	6949345	E rob	50	-	25	1	0	L	25/4/18
56	551348	6949345	E rob	22	-	18	1	0	L	25/4/18
57	550917	6849375	M quin	48	-	25	1	1	L	25/4/18

Appendix F – Summary of Monitoring Results

Summary of ecological surveys and monitoring at North Byron Parklands 2007 – 2017

Prepared for
Byron Venue Management Pty Ltd

July 2018

DOCUMENT TRACKING

Item	Detail
Project Name	North Byron Parklands Biodiversity Approvals
Project Number	17BRI-6437
Project Manager	Ailsa Kerswell (07) 3503 7191 Suite 1, Level 3, 471 Adelaide St, Brisbane QLD 4000
Prepared by	Liz Brown, Ailsa Kerswell, Steve Jarman
Reviewed by	Steve Jarman
Approved by	Ailsa Kerswell
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Abbreviations

Abbreviation	Description
Parklands	North Byron Parklands
OEH	NSW Office of Environment and Heritage
EIM	Event Impact Monitoring
SITG	Splendour in the Grass
FF	Falls Festival
TSC Act	NSW *Threatened Species Conservation Act 1995*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

1 Introduction

The North Byron Parklands site (Parklands) was acquired by the current owners in late 2006. Since then, ten major music festival events have been held between 2013 and 2018 (five Splendour in the Grass and five Falls Festival events).

Over the last 10 years, numerous ecological surveys and flora and fauna monitoring has been undertaken at the Parklands and in the adjacent Billinudgel Nature Reserve. This work has been primarily to support the environmental approvals for operation of the site (pre-2012) and to comply with regulatory requirements (post-2012) associated with Event Impact Monitoring (EIM). The results of these surveys are reported across numerous documents.

1.1 Purpose and scope

The purpose of this report is to provide a consolidated summary of the ecological surveys and flora and fauna monitoring that has occurred at the Parklands and adjacent sites. It provides a summary of the methods and results of each survey conducted by Dr Mark Fitzgerald (with support from Biolink Consultants, EarthProcess Ecological Services, Sandpiper Ecological Surveys and Wildlife Services). It also analyses trends over time for key datasets to assess any cumulative impacts, which is a task that has not been undertaken to date.

The report is focused on two key types of survey:

- EIM – flora and fauna monitoring undertaken before, during and after each of the nine events held up until the Splendour in the Grass event that occurred in July 2017; and
- Other ecology surveys – the collection of other ecological surveys that have been undertaken at the Parklands since 2007, including biennial fauna surveys.

This report has been prepared via review of the individual reports prepared for each survey and monitoring event, and includes an analysis of the data reported therein. Complete data for the most recent EIM undertaken for the Falls Festival 2017/2018 is not yet available and has therefore not been included in this summary. No analysis of primary data has been undertaken.

1.2 Background to event impact monitoring (EIM)

The NSW Department of Planning and Environment's approval conditions for the Parklands requires preparation and implementation of a Flora and Fauna Monitoring Program under Consent Condition C20, to monitor and assess the impact of the project on flora and fauna within and adjacent to the site. This program was developed by Billinudgel Property Trust and finalised in 2013. It has been implemented as required.

A key component of the Flora and Fauna Monitoring Program is the EIM. The EIM focuses on key groups of flora and fauna with the intention of identifying:

- Any ecological impacts as a results of events particularly on fauna within the site and Billinudgel Nature Reserve
- Requirements to ensure there are no significant impacts on the function of the Marshall's Ridge Wildlife Corridor
- Measures to ensure there are no significant impacts on threatened species and communities
- Presence of Eastern Grass Owl (*Tyto longimembris*)

Additional survey requirements for the Flora and Fauna Monitoring Program under Consent Condition C20 include biennial fauna monitoring. This has been undertaken in 2014 and was scheduled in 2016, however these surveys have been deferred until Spring 2017.

2 Methods

2.1 Development of this report

This report has been developed using results provided in the following individual survey and/or monitoring reports:

- Performance Report #1 – #5 Appendices B1 Environmental Performance Report and B2 Results and Analyses of Event Impact Monitoring Data (North Byron Parklands 2014a, 2014b, 2015, 2016, 2017)
- August 2007 Fauna Survey of (Fitzgerald 2007)
- February 2009 Fauna Survey of North Byron Parklands (Fitzgerald 2009)
- North Byron Parklands Biennial Fauna Surveys 2014 and 2017 (Fitzgerald 2014, 2017)
- North Byron Parklands Flora and Fauna Rehabilitation Program (Fitzgerald 2016)
- Yelgun Koala Survey and Koala Plan of Management (Biolink 2007)
- Yelgun Koala Survey Koala Habitat Reassessment (Biolink 2008)
- North Byron Parklands SEPP No. 44 Koala Survey and Habitat Reassessment (Biolink 2013)
- North Byron Parklands SEPP No. 44 Koala Monitoring Report (Biolink 2016)

Data review has been undertaken using reported data only, and therefore statistical analyses were not possible. No review or analysis of primary data has been undertaken.

The primary focus of this report has been on the EIM results. These surveys were specifically designed to detect any impact of events on the target flora and fauna groups. Each survey has employed a consistent methodology, therefore allowing a comparison of data over time. Results of other surveys are also reviewed, although in less detail.

2.2 Survey and monitoring method summary

Numerous surveys have been undertaken within the study area from 2007 to 2017, including ten EIM events and eight other surveys. Sampling methods for EIM and other surveys are summarised below, with full details available in the documents listed above. Monitoring locations are presented in **Figure 1** and **Figure 2**.

2.2.1 Event impact monitoring (EIM)

The monitoring methods for EIM were developed and approved as part of the Flora and Fauna Monitoring Program (2013) and are summarised in **Table 1** below. This program has been implemented during the nine events listed in **Table 2**.

Table 1: Summary of survey and monitoring methodology across the study area (2007 – 2017)

Target Group	Sampling Methodology
Vegetation	Vegetation condition and changes before and after each event recorded at 27 permanent photo-points across the Parklands
Forest Birds	Monthly samples (ten X 20 minute / 200m transects) taken before, during and after each event over three consecutive days between November to February, and from June to September. Sampling events are undertaken by three experienced observers. Impact sites within the Parklands; control sites within Billinudgel Nature Reserve
Forest Birds – plantings	Birds monitored at two sites in established (~10 year old) native plantings in the Marshall's Ridges area – commenced 2015
Waterbirds	20-minute point counts of waterbirds around the 2 ha constructed dam on-site recording species and abundance since 2007
Eastern Grass Owl	Targeted survey and call playback each July during event years – 2013, 2014, 2015, 2016, 2017
Terrestrial Mammals	Ten hair funnels deployed at each of 5 locations at 20 m intervals along a bird transect. The sampling for four nights before, during and after each event.
Terrestrial Fauna	Two sand traps deployed (within an area of 20 m²) on three nights before, during and after each event at eight locations along tracks. Traps raked the night before sampling and checked each morning. Two motion sensor wildlife cameras deployed in the Marshall's Ridges area to monitor fauna presence – commenced 2015.
Microchiropteran Bats	Three locations sampled by Anabat call detectors. Anabats deployed for three nights before, during and after each event. Two locations are within the event area (dam and flyway) and the third nearby within Billinudgel Nature Reserve.
Flying-foxes	Incidental survey whilst ecologist on site during events
General Fauna	Incidental road kill observations
Koala	Targeted searches (KSAT) and habitat assessments – 2007, 2008, 2013, 2016

Note: Minor methodology changes have been made during the life of the project.

Table 2: List of events monitored, including number of patrons

Event	Monitoring dates	Number of patrons per day
Splendour in the Grass 2013	Before: June; During: July; After: August	25,000
Splendour in the Grass 2014		27,500
Splendour in the Grass 2015		30,000
Splendour in the Grass 2016		32,500
Splendour in the Grass 2017		32,500
Falls Festival 2013-14	Before: December; During: January; After: February	15,000
Falls Festival 2014-15		17,500
Falls Festival 2015-16		20,000
Falls Festival 2016-17		22,500
Falls Festival 2017-18[+]		22,500

[+] Results not yet available

2.2.2 Other surveys

A number of other surveys have been undertaken at the Parklands. Prior to 2013, these were to support the environmental approvals process. Subsequent surveys have been undertaken as part of the approvals requirements. This is primarily the 2014 biennial fauna survey. A summary of these surveys and the method employed is provided in **Table 3**.

Table 3: Summary of other surveys undertaken at the Parklands

Survey type	Year	Methods employed	Reference
Fauna survey	2007	Anabat detection Bird survey (incl. call playback) Drift fence and pitfall traps Elliot traps Flying-fox census Frog survey Harp trapping Incidental observations incl. of tracks, scats, diggings and remains Reptile survey Spotlighting	Fitzgerald 2007
Fauna survey	2009	As per 2007 fauna survey above	Fitzgerald 2009
Fauna survey	2014 & 2017	Anabat detection Bird survey incl. call playback Elliot traps	Fitzgerald 2014, 2017

		Frog survey Harp traps Sand traps Spotlighting Waterbird surveys Incidental observations incl. of tracks, scats, diggings and remains	
Koala survey	2007	Analysis of historical records Site assessment – habitat quality and koala searches (KSAT)	Biolink 2007
Koala survey	2008	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2008
Koala survey	2013	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2013
Koala survey	2016	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2016

2.3 Survey effort

The surveys described above have resulted in extensive survey effort for target species and species groups at the Parkland since 2007. The tables below provide details of total survey effort (**Table 4**), effort during targeted fauna surveys (**Table 5**) and effort during EIM (**Table 6**).

Table 4: Total fauna survey effort 2007 – 2017, including general fauna survey, targeted Koala survey and all Event Impact Monitoring (9 events for which results are available)

Target fauna group	Method	Total survey effort
Mammals	Elliot trapping	1,125 trap nights
	Hair tube sampling	5,400 tubes
Koala	Koala Spot Assessment Technique (KSAT)	97 assessments
	Habitat assessment and incidental observations	27 days
Reptiles	Pitfall traps	75 traps days
Reptiles and amphibians	Targeted habitat searches	13 days
Mammals and reptiles	Sand traps and motion cameras	420 nights
Nocturnal species	Spotlighting	65 nights
Microbats	Harp netting	26 trap nights
	Anabat deployment	264 nights
Forest birds	Timed bird census	270 hours
Water birds	Timed bird census at dam	11.6 hours

Owls and cryptic birds	Call playback	34 sessions

Table 5: Total fauna survey effort during general fauna surveys 2007, 2009, 2014, 17

Target fauna group	Method	Total survey effort
Mammals	Elliot trapping	1,125 trap nights
Reptiles	Pitfall traps	75 traps days
Reptiles and amphibians	Targeted habitat searches	18 days
Nocturnal species	Spotlighting	16 nights
Microbats	Harp netting	66 trap nights
	Anabat deployment	30 nights
Owls and cryptic birds	Call playback	35 sessions

Table 6: Total fauna survey during Event Impact Monitoring (9 events for which results are available)

Target fauna group	Method	Total survey effort
Mammals	Hair tube sampling	5,400 tubes
Mammals and reptiles	Sand traps and motion cameras	420 nights
Nocturnal species	Spotlighting	54 nights
Microbats	Anabat deployment	243 nights
Forest birds	Timed bird census	270 hours
Water birds	Timed bird census at dam	11.6 hours
Eastern Grass Owl	Call playback	9 sessions

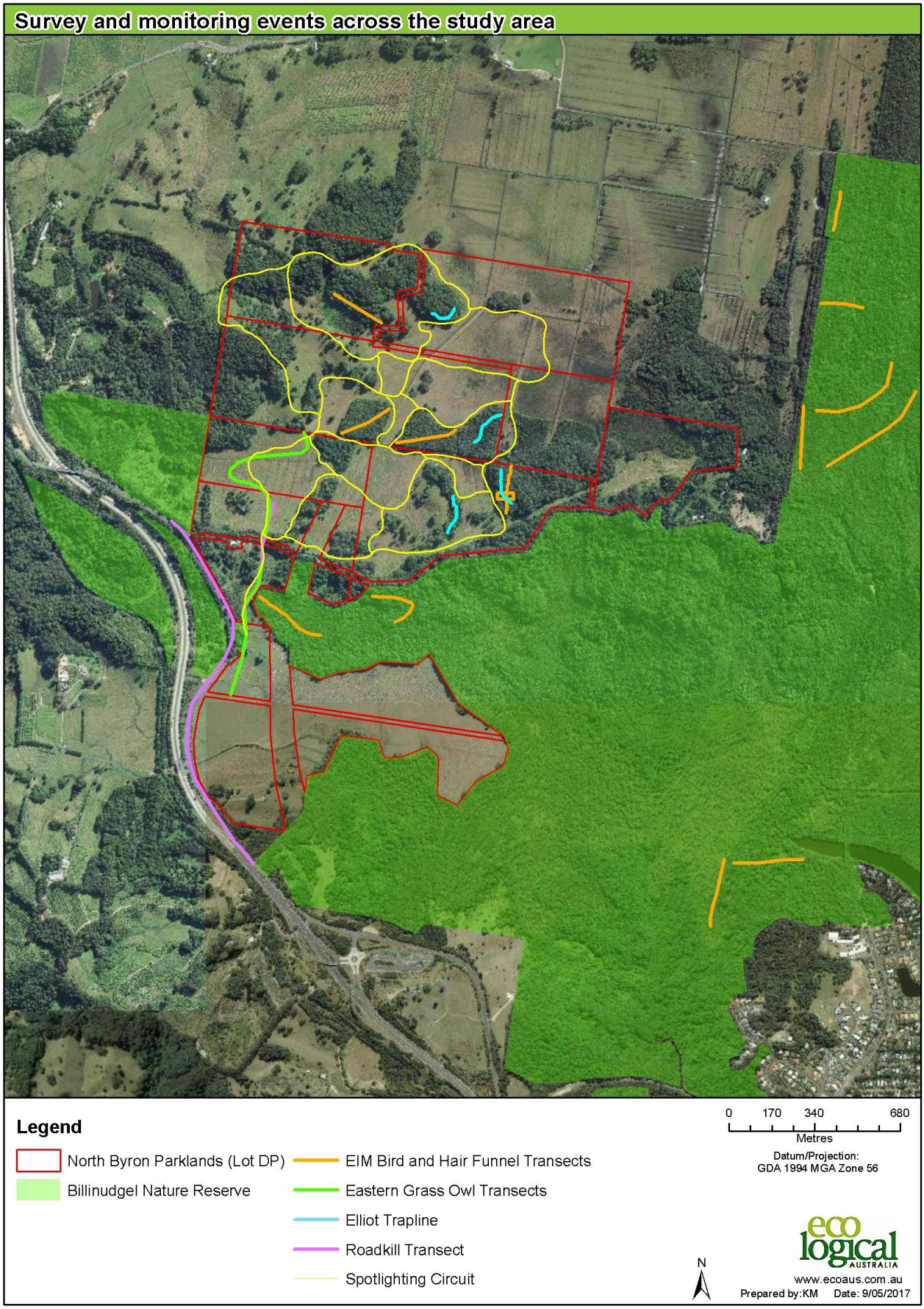

Figure 1: Transect survey and monitoring locations within the Parkland and surrounds

Figure 2: Survey and monitoring locations within the Parklands and surrounds

3 Results

The following section provides a summary of the main ecological results from the various surveys and monitoring events conducted within the study area from 2007 to 2017.

3.1 Event impact monitoring (EIM) 2013 – 2017

EIM has been undertaken for each of the nine events held at the Parklands to date (2013 – 2017). The consistent conclusion across all EIM surveys has been that there were no significant adverse effects on any flora or fauna group as a consequence of events held at the Parklands. Minor negative ecological effects observed during and immediately after events included limited sediment movement, littering and trampling of grasses within the event area and avoidance of illuminated areas by mobile fauna. These impacts were temporary and reversible at the conclusion of events.

Overall, EIM data highlight the natural variability of the fauna assemblages (particularly bird and microbat). The main driver of this variability appears to be seasonal movements of species and local patterns of food resource abundance, primarily blossom in swamp sclerophyll forest and fruit crops in both native and exotic species (e.g. Camphor Laurel).

Table 7 provides a summary of the results of the EIM at each event. Results and trends for birds, microbats and flying foxes are presented and discussed in more detail in the subsequent sections. These groups have been focused on because they:

- Are the most prevalent on site
- Contain threatened species
- Have the greatest potential to be impacted by events.

Table 7: Summary of EIM results for each event

Group	SITG 2013	FF 2013-14	SITG 2014	FF 2014-15	SITG 2015	FF 2015-16	SITG 2016	FF 2016-17	SITG 2017
Vegetation	No impact to remnant forest vegetation; improvements in specific areas due to bush regeneration activities; minor tramping of grass within event area (areas recovered soon after)								
Threatened flora species	Individuals retained and condition maintained; Rough-shelled Bush Nut (*Macadamia tetraphylla*) experiencing some impact from historical competition from Camphor Laurel and Mango Trees, though this is unrelated to the SITG and FF events and has been addressed by Parklands' bush regeneration team								
Forest birds	No difference in abundance or diversity across before-during-after events								
Water birds (@ dam)	No difference in abundance or diversity across before-during-after events; low abundance during SITG 2013 due to patrons swimming in the dam (this practise has ceased in subsequent events)								
Microbats	No difference in abundance or diversity across before-during-after events								
Flying foxes (within event areas)	Absent	Present (5 – 7 individuals)	Absent	Present (2 individuals)	Present (2 – 5 individuals)	Absent	Present (3 – 5 individuals)	Absent	Absent
Mammals (hairtube results)	No difference in abundance or diversity across before-during-after events; species detected include Dog, Rat, House Mouse, Northern Brown Bandicoot, Antechinus, Possum								
Mobile fauna (sand trap, motion camera)	Technique had limited effectiveness; demonstrated connectivity within and across the site maintained; species detected include Dog, Rat, Cane Toad, Fox, Water Dragon, Brushtail Possum, Northern Brown Bandicoot, Swamp Wallaby, Scrub Turkey, Lace Monitor								
Road kill (incidental observations)	Primarily cane toad								
Threatened fauna species	2 microbat spp. 2 bird spp.	7 microbat spp. 1-3 bird spp. (report unclear)	5 microbat spp. 3 bird spp.	8 microbat spp. 1 bird spp.	3 microbat spp. 2 bird spp.	5 microbat spp. 3 bird spp.	4 microbat spp. 0 bird spp.	5 microbat spp. 2 bird spp.	5 microbat spp. 1 bird spp.

3.1.1 Birds

Forest birds

The forest bird assemblage at the Parklands and adjacent monitoring areas is diverse and has been monitored consistently across all nine events. The monitoring sites are within the Parklands event areas and in the adjacent areas of Billinudgel Nature Reserve. Bird communities at the sites within the event area have the potential to be disturbed during events. Each EIM survey result demonstrated no differences in bird diversity, abundance or community structure before, during or after events (North Bryon Parklands 2014a, 2014b, 2015, 2016, 2017).

Across all EIM surveys there were between 70 and 86 species and up to 4023 individuals recorded (sum across all survey transects, **Table 8**). Surveys associated with SITG 2016 recorded the highest number of individuals to date. While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either parameter (**Figure 3**). This result suggests the combined program of events since 2013 has not impacted regional forest bird communities over time.

Table 8: Summary of forest bird diversity and abundance at each event

Index	SITG 2013	FF 2013-14	SITG 2014	FF 2014-15	SITG 2015	FF 2015-16	SITG 2016	FF 2016-17	SITG 2017
Diversity (# species)	86	84	80	73	83	82	80	85	70
Abundance (# individuals)	3246	2077	3164	1740	2979	2455	4023	2566	3465

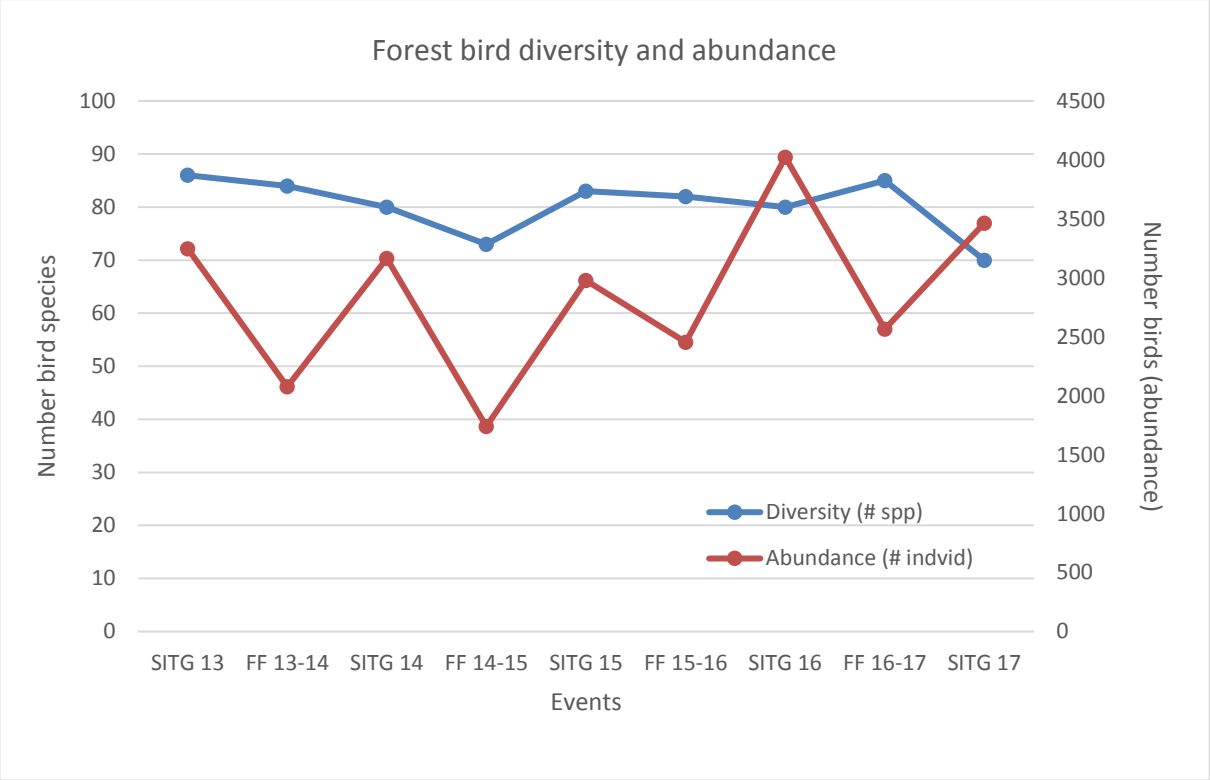

Figure 3: Forest bird diversity and abundance trends over time (2013 – 2017)

There is data available to directly compare bird monitoring data before and after events commenced at the Parklands. Species and abundance data from forest block A (native vegetation block surrounded by event area) was collected over 12 samples prior to SITG 2013 and 44 samples subsequent to this first event. Data show no differences in either the number of birds (abundance) or the number of species (diversity) over time (**Figure 4**).

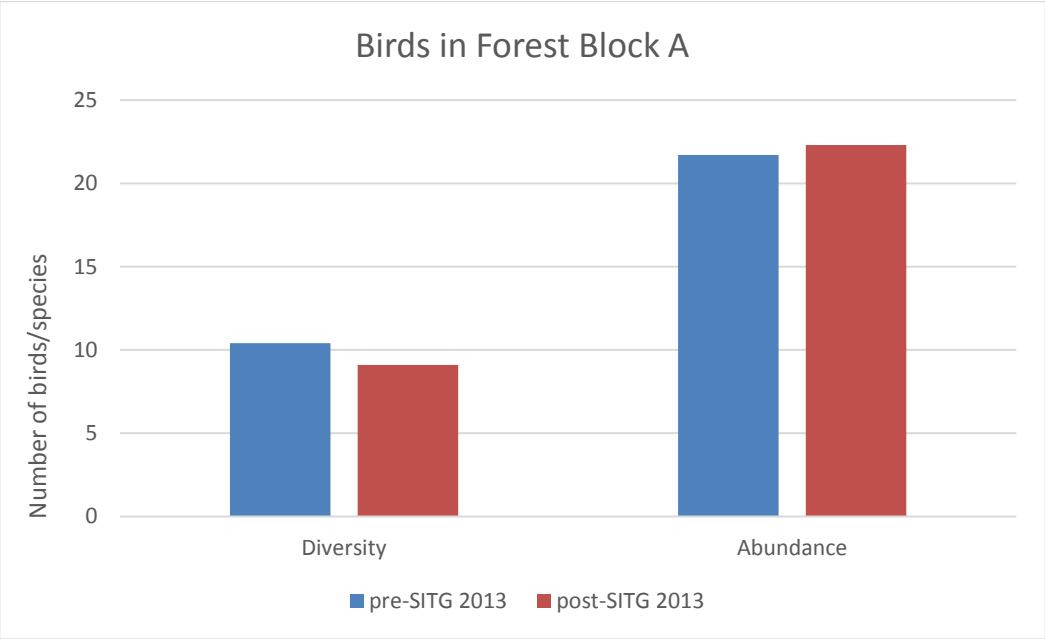

Figure 4: Forest bird species and abundance in Forest Block A before and after the commencement of events

Water birds

The water bird assemblage at the Parklands dam has been monitored over time since 2007. The dam is within the event area and the waterbird population has the potential to be disturbed during events. Monitoring over time, include during EIM surveys has demonstrated no impact on the waterbird population that is attributable to individual events (North Bryon Parklands 2014a, 2014b, 2015, 2016, 2017; Fitzgerald 2016).

Across all surveys there were between 2 and 10 species and up to 62 individuals recorded (per survey, **Figure 5**). While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either diversity or abundance (**Figure 5**). Additionally, when aggregated across surveys from before and after the commencement of events at the Parklands, the data show both higher diversity and abundance of waterbirds since commencement of events in 2013 (**Figure 6**). These results suggest the combined program of events since 2013 has not impacted water bird communities over time. It should be noted that the low abundance coincident with SITG 2013 (first grey block on **Figure 5**) was a direct result of patrons swimming in the dam, and this practise that has since ceased.

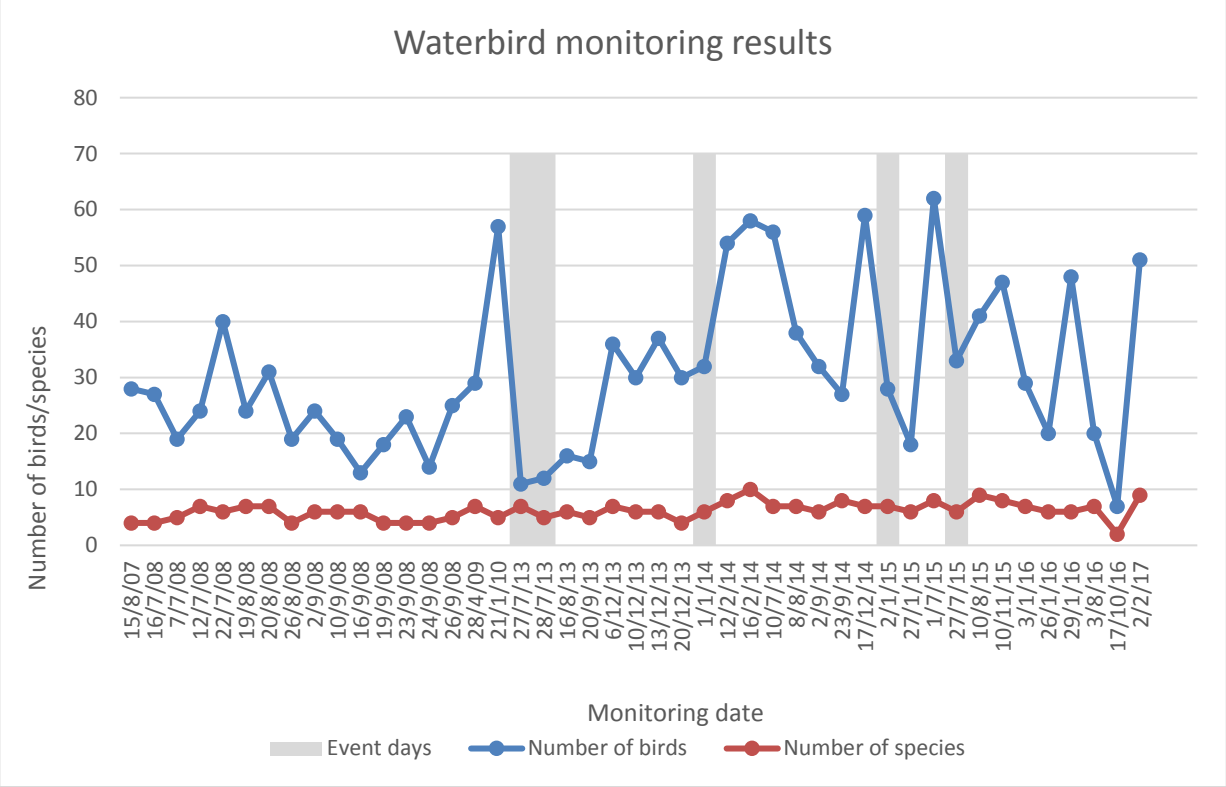

Figure 5: Water bird diversity and abundance over time (grey bars are monitoring data from during events)

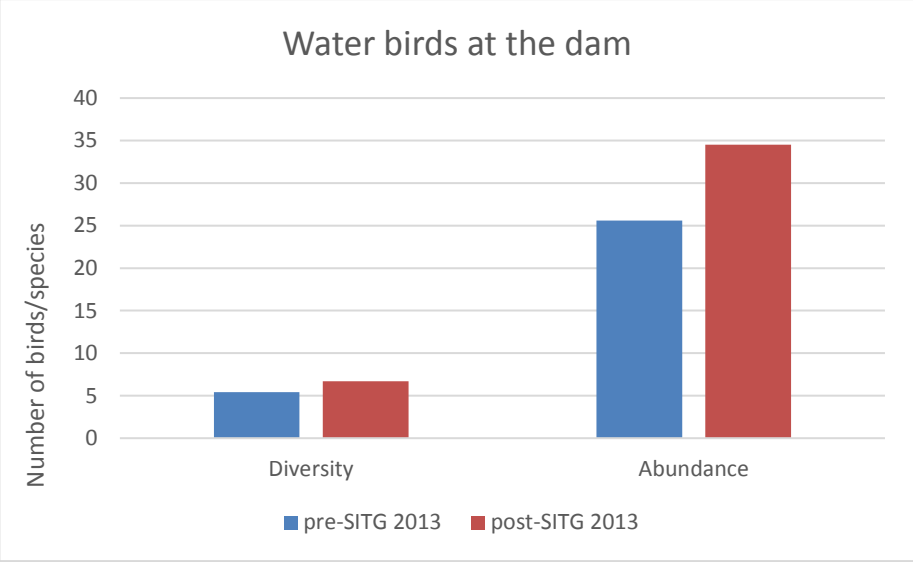

Figure 6: Water bird diversity and abundance before and after the commencement of events

Threatened bird species

Threatened bird species have not been specifically targeted during the EIM, rather their presence recorded along with that of all other species (with the exception of the Eastern Grass Owl – see below).

Eight threatened species have been recorded during EIM surveys. All are listed as vulnerable on the NSW Threatened Species Conservation Act (TSC Act), with the exception of the Bush Stone Curlew which is listed as endangered. Species include:

- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Bush Stone Curlew (*Burhinus grallarius*)
- Eastern Grass Owl (*Tyto longimembris*)
- Eastern Osprey (*Pandion cristatus*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Rose-crowned Fruit Dove (*Ptilinopus regina*)
- White-eared Monarch (*Carterornis leucotis*)
- Wompoo Fruit Dove (*Ptilinopus magnificus*)

It is noteworthy that several of these records are recent local 'first sightings', which have occurred since the commencement of events at the Parklands. The Brown Treecreeper was first sighted during EIM for Falls Festival 2016-17 and the Bush Stone Curlew was first sighted at SITG 2017. Also, the Eastern Grass Owl was absent from the Parklands from 2007 until recent responses to call playback in July 2016 and 2017 (see below).

There is insufficient data at an individual event level to undertake an analysis of whether threatened birds are impacted during single events. However, given that the majority of records are from outside the event area, and there is no evidence that events are impacting the general bird communities, it seems reasonable to conclude individual events are not impacting on these species.

A longer-term analysis of the threatened bird data supports this conclusion. Both the Rose-crowned Fruit Dove and the White-eared Monarch have been recorded during multiple EIM surveys, with the most recent being the Falls Festival 2015-16 for the White-eared Monarch and SITG 2017 for the Rose-crowned Fruit Dove (**Table 9**). Furthermore, both species have been recorded within 'the plantings' i.e.

areas of active regeneration inside the Parklands (see below). This demonstrates ongoing use of the Parklands and surrounds during 2013 – 2017, and the improvements in habitat value within the Parklands site.

Table 9: Summary of threatened bird species abundance at each event

Species	SITG 2013	FF 13-14	SITG 2014	FF 14-15	SITG 2015	FF 15-16	SITG 2016	FF 16-17	SITG 2017	Total count	# events present
Rose-crowned Fruit Dove	42	–	6	18	15	21	–	37	11	113	5
White-eared Monarch	2	–	2	–	1	1	–	–	-	6	4
Eastern Osprey	–	1	–	–	–	–	–	–	-	1	1
Wompoo Fruit Dove	–	–	1	–	–	–	–	–	-	1	1
Little Lorikeet	–	–	–	–	–	1	–	–	-	1	1
Brown Treecreeper	–	–	–	–	–	–	–	4	-	4	1
Bush Stone Curlew*									1		1

* The Bush-stone Curlew was recorded during vegetation monitoring after SITG 2017; it was not recorded during forest bird monitoring.

Eastern Grass Owl

Targeted surveys for the Eastern Grass Owl (*Tyto longimembris*, listed as vulnerable on the TSC Act) were undertaken in July each year for five years (2013 – 2017) and in September 2014 as part of the biennial fauna survey. This species was not present in the main event area (north of Jones Rd) in any year. A pair of Eastern Grass Owls responded to call play back in July 2016 in the exotic grassland in the south of the Parklands. This was the first observation of these species within the site since 2007. Further responses from a single Owl were also recorded in July 2017, at the same site.

3.1.2 Microbats

All microbat species

The microbat assemblage at the Parklands and adjacent monitoring areas is diverse and has been monitored consistently across all nine events. Microbat assemblages are monitored via bioacoustic recordings (i.e. anabats), with the number of calls recorded providing a proxy for abundance. The microbat monitoring sites are within the Parklands event areas (primarily the dam) and in the adjacent areas of Billinudgel Nature Reserve. Microbats at the dam within the event area have the potential to be disturbed during events, primarily due to lighting impacts. Each EIM survey result demonstrated no differences in microbat diversity, abundance or assemblage structure before, during or after events (North Bryon Parklands 2014a, 2014b, 2015, 2016, 2017).

Across all EIM surveys there were between 16 and 21 species[1] and up to 7061 individual calls recorded (sum across transects, Table 10). The most recent winter surveys (associated with SITG 2016) recorded fewer calls than previous surveys, however, this was attributed to equipment malfunction rather than an ecological effect. Conversely, the most recent summer surveys (associated with FF 2016-17) recorded the highest number of calls to date.

While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either the number of species recorded or the total number of calls (**Figure 7**). This result suggests the combined program of events since 2013 has not impacted microbat assemblages over time. It should also be noted that results from SITG 2017 are excluded from **Figure 7** as one of the anabat recorders was stolen, meaning that call abundance would appear significantly lower for this event.

Table 10: Summary of microbat diversity and abundance at each event

Index	SITG 2013	FF 2013-14	SITG 2014	FF 2014-15	SITG 2015	FF 2015-16	SITG 2016	FF 2016-17	SITG 2017
Diversity (# species)	16	21	18	18	19	20	20	20	20
Abundance (# calls)	762	5070	2336	2743	4805	3614	1367	7061	1852*

* theft of an anabat device during SITG 2017 meant that the abundance of calls may be lower than expected.

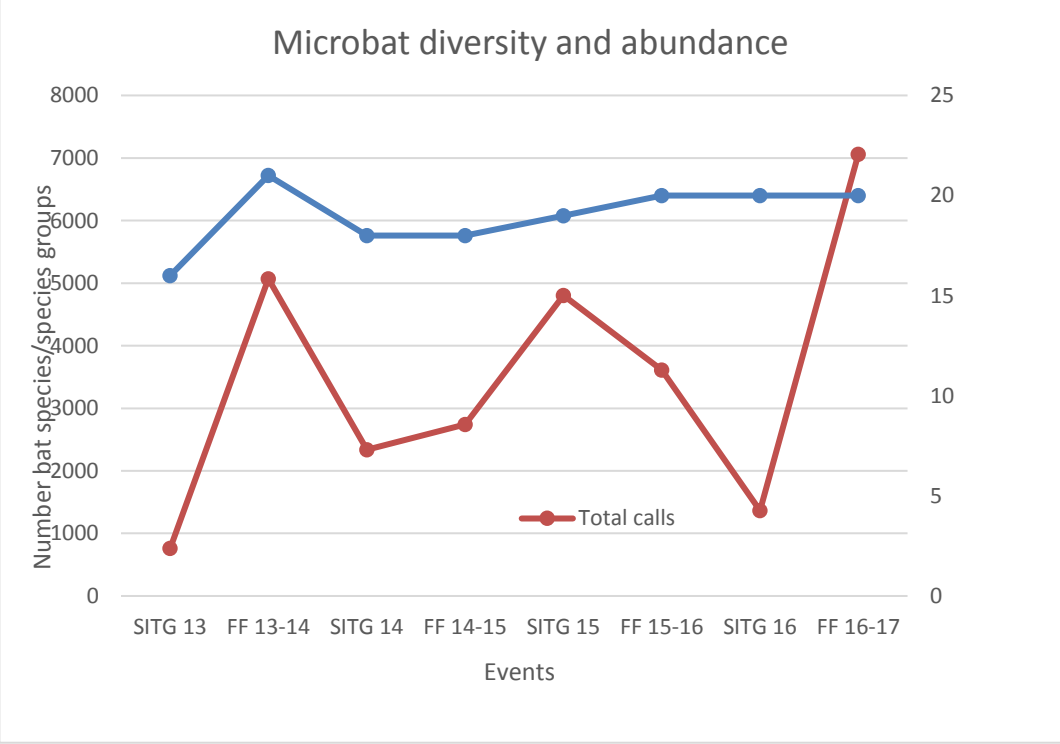

Figure 7: Microbat diversity and abundance (using calls as a proxy) trends over time (2013 – 2017)

[1] Or species groups if calls could not be attributed to only one species, as commonly occurs in microbat call analysis

Threatened microbats

Threatened microbat species have not been specifically targeted during the EIM, rather their presence recorded along with that of all other species. Eight threatened species have been recorded during EIM surveys. All are listed as vulnerable within the NSW TSC Act and one is also listed as vulnerable on the EPBC Act. The species include:

- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Golden-tipped Bat (*Kerivoula papuensis*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – EPBC Act vulnerable species
- Little Bent-wing Bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*)
- Yellow-bellied Sheathtailed Bat (*Saccolaimus flaviventris*)

There is sufficient data for the two most common species (Little Bent-wing Bat and Southern Myotis) at an individual event level to undertake analysis of whether threatened microbats are impacted during events. **Figure 8** shows the numbers of calls from each of these species recorded before, during and after six events. These data come from anabats located at the dam wall, the site most likely to be impacted by event-related disturbances. Results for the Little Bent-wing Bat show higher numbers of calls recorded in the month after most events, with similar numbers of calls before and during. Conversely, results for the Southern Myotis show higher numbers of call during most events, with similar numbers of calls before and after. This later result suggests increased predation on insects that are attracted to event lighting in and around the dam, which is key foraging habitat for this species (OEH 2017). Collectively, the results demonstrate no adverse impact associated with events and are consistent with those from the broader microbat assemblage data (as discussed above).

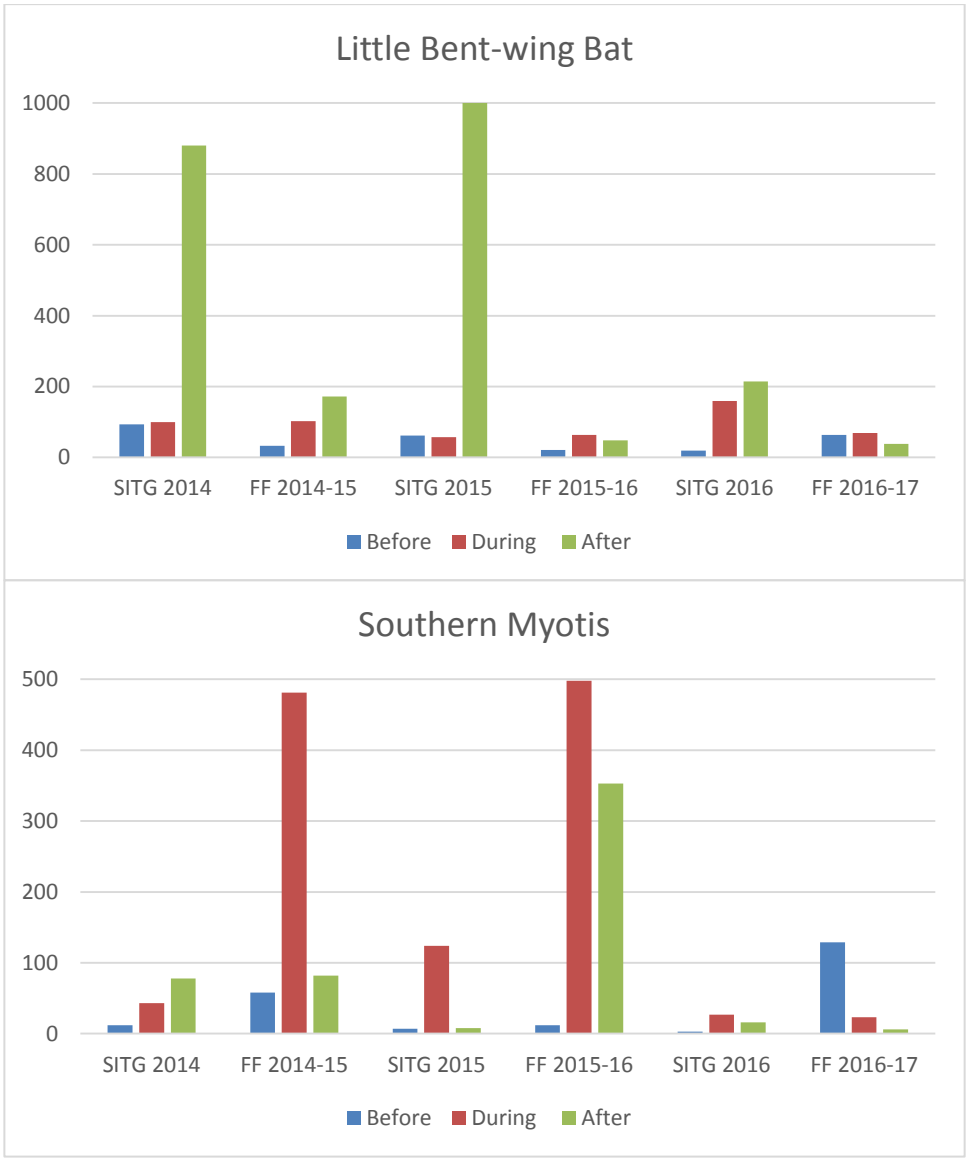

Figure 8: Before, during and after event call data for Little Bent-wing Bat and Southern Myotis at the dam (note – there were 2572 calls from Little Bent-wing Bat during SITG 2015, however this has been reduced on the figure for scaling purposes)[2]

A longer-term analysis of the collective dataset of threatened microbats further supports the conclusion that events have not negatively impacted microbat assemblages. Several microbat species have been recorded during multiple EIM surveys and while call abundance has fluctuated over time, there are no evident trends on an ongoing decline (**Table 11**, **Figure 9**, **Figure 10**)[2]. This demonstrates the ongoing use of the Parklands and surrounds during 2013 – 2017 and over the course of the events held to date.

[2] results from SITG 2017 are excluded from **Figure 8** due to theft of one anabat recorder during the event.

Table 11: Summary of threatened microbat abundance (calls) during each event

Species	SITG 2013	FF 13-14	SITG 2014	FF 14-15	SITG 2015	FF 15-16	SITG 2016	FF 16-17	SITG 2017 *	Total count	# events present
Little Bent-wing Bat	217	356	489	356	2723	140	392	171	454	5298	9
Large-eared Pied Bat	-	1	10	1	-	-	-	1	-	13	4
Eastern Freetail-bat	-	25	22	25	62	59	9	160	27	389	8
Southern Myotis	-	623	133	622	139	863	46	158	151	2735	8
Eastern False Pipistrelle	1	4	-	4	-	1	-	-	-	10	4
Yellow-bellied Sheathtailed Bat	-	4	-	4	-	-	-	-	1	9	3
Golden-tipped Bat	-	5	-	5	-	4	-	-	-	14	3
Eastern Bent-wing Bat	-	-	21	6	-	-	53	18	6	104	5
Total calls	218	1018	675	1023	2924	1067	500	508	639	8572	
Total spp	2	7	5	8	3	5	4	5	6	8	

* theft of an anabat device during SITG 2017 meant that the abundance of calls may be lower than expected.

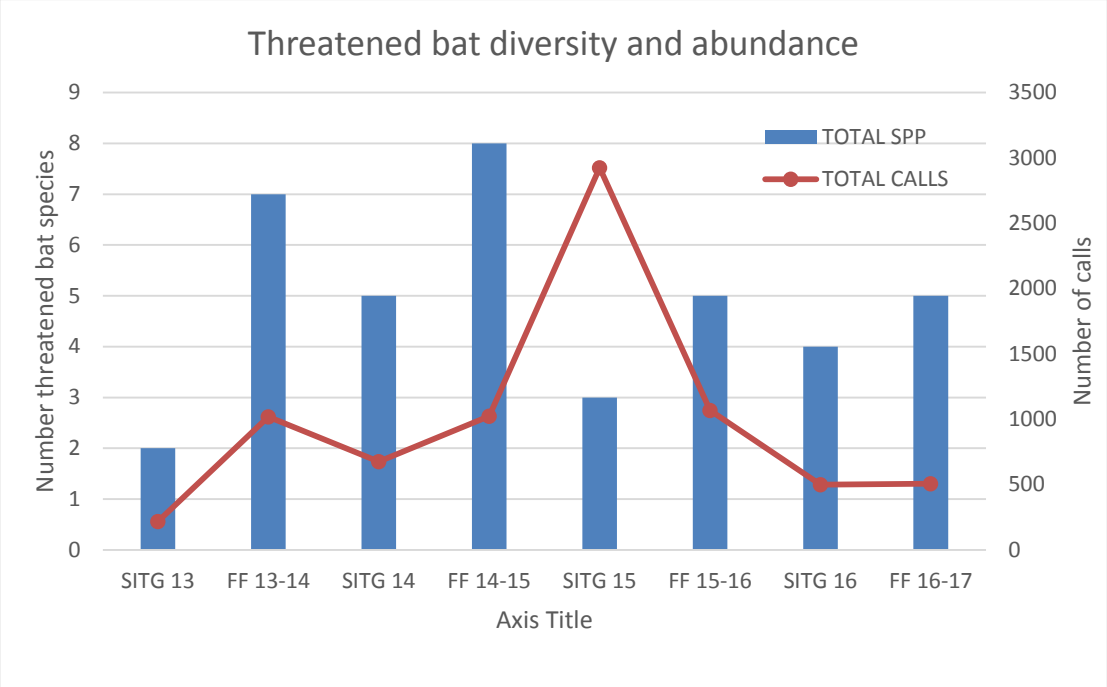

Figure 9: Diversity and abundance (number of calls) of threatened microbat species over time[3]

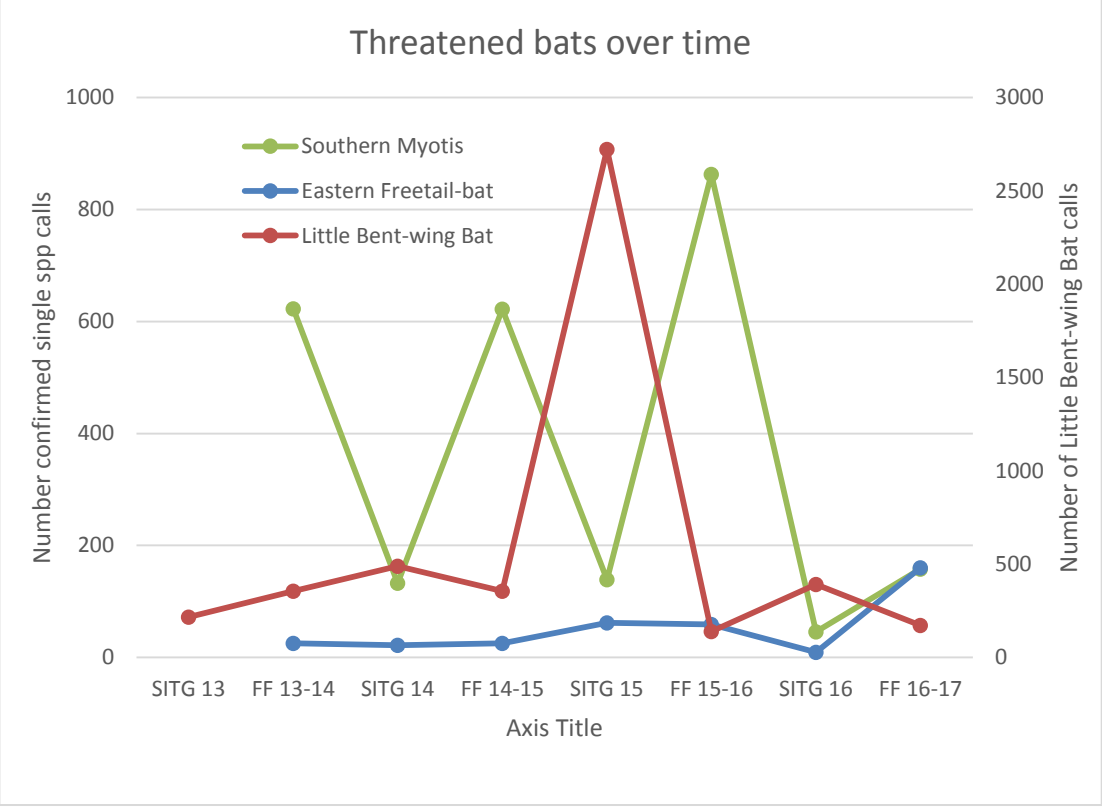

Figure 10: Abundance (number of calls) of three most comment threatened microbat species over time (note – Little Bent-wing Bat data on secondary axis) [3]

[3] results from SITG 2017 are excluded from **Figure 8**, **Figure 9**, **Figure 10** due to theft of one anabat recorder during the event.

3.1.3 Flying foxes

Flying fox observations have been largely incidental sightings from during event monitoring. Flying foxes have been observed on site during four of the nine events held to date and numbers observed at the site during each event has been low (**Table 12**). Event abundances are consistent with numbers observed during fauna surveys in 2009 and 2014 (Mark Fitzgerald, pers comm. 2017). Events at the Parklands have not coincided with any large blossom events (i.e. times of highly abundant food resources) and the closest maternity camp (at Brunswick Heads Nature Reserve) for Black and Grey-headed Flying Foxes was abandoned in 2011. Both these factors are likely to be the drivers behind low flying fox numbers of site.

Table 12: Summary of flying fox abundance at each event

Index	SITG 2013	FF 2013-14	SITG 2014	FF 2014-15	SITG 2015	FF 2015-16	SITG 2016	FF 2016-17	SITG 2017
Flying fox numbers	0	5 – 7	0	2	2 – 5	0	3 – 5	0	0

3.2 Other surveys 2007 – 2017

Numerous other surveys have been undertaken at the Parklands between 2007 and 2014. Most have been associated with fauna. The results of these surveys are discussed by fauna group below (**Table 13**), with particular focus on comparisons over time. Surveys prior to 2013 provide a pre-event baseline, while surveys after this time were undertaken to detect any impact of events on local fauna communities (specifically the 2014 biennial fauna survey).

Table 13: Summary of fauna surveys 2007 – 2014

Fauna group	Summary of results
Forest birds	Bird species diversity was similar across all fauna survey years. When summed across all transects at all sites diversity was 70 species in 2007; 63 species in 2009 and 68 species in 2014. Bird surveys were based on incidental sighting in 2017 and recorded 81 species.
Water birds	Water bird diversity (8 species) and abundance (27 individuals) was within the range of variability recorded during EIM. Water bird surveys were not undertaken in 2007 and 2009.
Threatened bird species	Three threatened bird species were recorded prior to events commencing – Comb-crested Jacana (*Irediparra gallinacea*, TSC Act vulnerable), Eastern Grass Owl and Rose-crowned Fruit Dove. None of these species were recorded in the 2014 fauna surveys, however both the Eastern Grass Owl and Rose-crowned Fruit Dove have been recorded during EIM. The Rose-crowed Fruit Dove was recorded in the 2017 survey. The Comb-crested Jacana has not been recorded on site since 2007. The reason for this is unclear, however it is unlikely to be related to events as events began in 2013. The species was absent well before the first event was held and suitable habitat remains on site at the dam that continues to be well utilised by a range of other water bird species.

Frogs	Frog species diversity has varied over time with records of 8 species in 2007; 12 species in 2009 and 6 species in both 2014 and 2017. No threatened frogs have been recorded on site.
Reptiles	Reptile species diversity has varied over time with records of 4 species in 2007 (winter); 0 species in 2009 (summer);5 species in 2014 (winter) and 1 species in 2017 (early summer). No threatened reptiles have been recorded on site.
Mammals (general)	Mammal species diversity has varied over time with records of 17 species in 2007; 15 species in 2009; 13 species in 2014 and 17 species in 2017. The lower diversity in 2014 was due to an absence of possum and bandicoot in this survey. Both species were regularly detected during EIM. One threatened mammal (Grey-headed Flying Fox) has been recorded on site. Mammals recorded on site include exotic species: Black Rat, House Mouse, Dog and Red Fox.
Microbats	Nine species of microbat were captured during all harp trapping over the surveys in 2007, 2009, 2014 and 2017. This included four threatened species (Common Blossom Bat, Eastern Long-eared Bat, Eastern Bent-wing Bat and Little Bent-wing Bat). Both Bent-wing Bats were also regularly detected in EIM surveys, whist the Common Blossom Bat (*Syconycteris australis*) and Eastern Long-eared Bat (*Nyctophilus bifax*) detected only during harp trapping (2007 and 2014). There were fewer bats capture in 2014, however this is attributed to poor trap placement rather than a true reflection of decreased abundance. Anabat survey was different in the pre-event (2007, 2009) surveys versus the 2014/2017 surveys and data cannot therefore be compared. Bat assemblages during all surveys were comprised of similar species to those detected during EIM, with Little Bent-wing Bat being the most commonly recorded species.
Flying foxes	Flying fox numbers declined over time, with numerous Grey-headed and Black Flying Foxes observed in 2007, with only single number of individuals observed subsequently. This decline is attributed to the abandonment of the maternity camp in Brunswick Heads Nature Reserve, as well as a lack of foraging resources (blossom) on site during survey periods.
Koala	Targeted Koala surveys of the site were undertaken by Biolink in 2007, 2008, 2013 and 2016. 2007 – small area of core Koala habitat (3 ha) mapped on site; koala scats observed at four locations within the Parklands; results suggest use of the site by 1 – 2 Koalas 2008 – significantly reduce evidence of activity, such that activity level does not reach the threshold that indicates active, ongoing use by resident animals 2013 – no evidence of Koala within the Parklands 2016 – evidence of Koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billindugel Nature Reserve. Mixed age scats suggest repeat use of sites by Koala individuals with home ranges that encompass the north-west corner of the Parklands 2017 fauna survey – call playback for Koala was undertaken at 8 locations. No responding calls were heard

	EIM – no evidence of Koala within the Parklands or surrounds (based on general observations, not targeted survey)

3.2.1 Birds of the plantings

Planting of local native forest flora species has been ongoing at the Parklands since 2007. Plantings have taken place within degraded farmland areas across the site and in areas adjacent to Billinudgel Nature Reserve. The total area of replanting is 10.7 ha. These areas have filling in gaps in vegetation and have joined previously fragmented areas. Plantings now support a range of native fauna.

Forest birds have been specifically surveyed in two established (approx 10 years old) in the Marshall's Ridge Area. Over nine surveys, 418 birds across 55 species have been recorded. This includes two threatened species (NSW TSC Act) – Rose-crowned Fruit Dove (1 sighting) and White-eared Monarch (1 sighting of 4 individuals).

4 Discussion and conclusion

The overall survey and monitoring results to date indicate that the cultural events at the North Byron Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities. Increased light and noise levels are an inevitable occurrence associated with event, and these factors will impact on local fauna movements and site usage during the period of each event. However comprehensive EIM has shown that once these factors cease to operate and the site returns to pre-event conditions, fauna presence and habitat values return to baseline conditions. Moreover, there are no evidence of declines in any environmental values at the Parklands, indicating no cumulative effects of holding multiple events.

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Appendix G - Flora and Fauna Monitoring and Adaptive Management Plan

North Byron Parklands: Flora and Fauna Monitoring Program and Adaptive Management Plan

To be implemented from commencement of permanent approval

Prepared for
North Byron Parklands

July 2018

DOCUMENT TRACKING

Item	Detail
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Abbreviations

Abbreviation	Description
EEC	Endangered Ecological Community
EIM	Event Impact Monitoring
FF	Falls Festival
NBP	North Byron Parklands
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SITG	Splendour in the Grass
TEC	Threatened Ecological Community
TSC Act	NSW Threatened Species Conservation Act

1 Introduction

1.1 Project description

1.1.1 Location

North Byron Parklands (Parklands) is located on Tweed Valley Way and Jones Road in the Yelgun Valley within the Byron Shire local government area. The access road leading from the site northwards to Wooyung Road is located within Tweed Shire.

The total Parklands comprises an area of 229.34 ha. Within this, an area of approximately 134 ha will be directly utilised for events, with approximately 105 ha preserved or rehabilitated as natural bushland habitat.

The site forms a natural amphitheatre comprising a low lying and level central plain surrounded by steep rising hillsides on the northern, western and southern sides of the site. The Billinudgel Nature Reserve is immediately south and east of the site.

1.1.2 Overview of the project

The Parklands is currently operating as a cultural events site under short-term state approvals. The current approvals are for a trial period and allow the use of the site for cultural, education and outdoor events, including ancillary camping and car parking, the construction of temporary event infrastructure (completed), a permanent spine road (completed) and vegetation rehabilitation works within the site (underway). Current approval is for a maximum of three events per year, over a combined maximum of 10 event days (plus up to 10 minor community event days).

Billinudgel Property Pty Ltd, as the owners and operators of the site, is seeking to obtain permanent approval to utilise the site as a cultural events centre with a maximum capacity of 50,000 patrons for one large event and a number of smaller events (see below). The increased utilisation of the site will be implemented in multiple phases, with staged increases in maximum event size over several years. The gradual increase in site utilisation will allow any potential impacts to be monitored and appropriate modifications to events to be implemented. The proposed events and staging are:

- Splendour in the Grass event (up to an ultimate 50,000 patrons over a maximum of 5 days), subject to meeting KPIs for the following patron capacity scenarios:
  - Increase from current 35,000 to 42,500 subject to meeting KPIs
  - Increase from 42,500 to 50,000 subject to meeting KPIs
- Falls Festival Byron (up to 35,000 patrons & maximum of 5 days)
- Three event days with up to 25,000 patrons (cumulative or separate)
- Five community events with up to 5,000 patrons (cumulative or separate)
- Corresponding bump in and bump out time (up to 21 days in; 14 days out).
- 2 one-day community events up to 1,500 patrons (not-for-profit/educational)

In total, there will be a maximum of 20 event days per annum.

The proposal also incorporates the construction of several new buildings and infrastructure. The proposed buildings include a new conference and associated accommodation, bus shelters and amenities blocks. The proposed infrastructure includes a security fence, water tank, internal roads and site enhancements, potable water supply works, toilet and water treatment facility works and environmental works.

1.2 Previous ecological surveys and monitoring

Numerous surveys have been undertaken within the development site from 2007 to 2017, including ten Event Impact Monitoring (EIM) events and eight other surveys. This includes:

- Performance Report #1 – #5 Appendices B1 Environmental Performance Report and B2 Results and Analyses of Event Impact Monitoring Data (North Byron Parklands 2014a, 2014b, 2015, 2016)
- August 2007 Fauna Survey of (Fitzgerald 2007)
- January 2009 Vegetation Assessment and Monitoring (Kooyman 2009)
- February 2009 Fauna Survey of North Byron Parklands (Fitzgerald 2009)
- North Byron Parklands Biennial Fauna Surveys 2014 and 2017 (Fitzgerald 2014, 2017)
- North Byron Parklands Flora and Fauna Rehabilitation Program (Fitzgerald 2016)
- Yelgun Koala Survey and Koala Plan of Management (Biolink 2007)
- Yelgun Koala Survey Koala Habitat Reassessment (Biolink 2008)
- North Byron Parklands SEPP No. 44 Koala Survey and Habitat Reassessment (Biolink 2013)
- North Byron Parklands SEPP No. 44 Koala Monitoring Report (Biolink 2016)

A summary of all surveys that have been undertaken within the Development Site is provided in the 'Summary of Ecological Surveys and Monitoring Byron Parklands: 2007 – 2017' (Eco Logical Australia 2018b).

The overall survey and monitoring results to date indicate that the cultural events at the North Byron Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities. Increased light and noise levels are an inevitable occurrence associated with events, and these factors will impact on local fauna movements and site usage during the period of each event. However comprehensive EIM has shown that once these factors cease to operate and the site returns to pre-event conditions, fauna presence and habitat values return to baseline conditions. Moreover, there are no evidence of declines in any environmental values at the Parklands, indicating no cumulative effects of holding multiple events.

1.3 Background to past monitoring and rehabilitation plans

C20 of the original approval (2012) required development and implementation of a Flora and Fauna Monitoring Program (FFMP). A FFMP was prepared by Dr Mark Fitzgerald (2013). The Flora and Fauna Monitoring Program was implemented with monitoring of the impact of the project on flora and fauna within and adjacent to the site from before March to September 2013. The Program was prepared in consultation with the Regulatory Working Group (RWG) and was approved by NSW DPI on July 18th 2013.

Subsequently, and as part of the DP&E and Planning Assessment Commission (PAC) assessment processes relating to Mod 3, government agencies and members of the community were invited to make submissions during the public exhibition period. On the 22nd of April 2016 the PAC approved the modification covering noise limits and small non-music focussed community events (up to five community events in the first year). As part of this approval the PAC deleted the existing C20 – Flora and Fauna Monitoring Program consent condition and replaced it with the requirement to prepare the Flora and Fauna Rehabilitation Program (FFRP) to monitor and assess the impact of the project on flora and fauna within and adjacent to the site. To address this requirement, a FFRP was prepared in 2016 by Dr Mark Fitzgerald (Fitzgerald 2016).

Further to this, approval for future trial events up until 31 August 2019 was granted (via modification of the existing approval) on the 12th September 2017. This represents the fourth modification (Mod 4) to the existing approval. As part of the modification, Commitment C20 requires an assessment of site condition prior to events; a monitoring program for future events; and a summary of restoration activities within the site. These details were presented within a Draft Flora and Fauna Monitoring and Rehabilitation Program (FFMRP) (ELA 2017) which will direct monitoring and rehabilitation efforts until the end 31 August 2019.

1.4 Purpose of this report

This FFMAMP builds upon and aligns with aspects of the current FFMRP (ELA 2017).

The purpose of this FFMAMP is to provide a monitoring and adaptive management program that will be implemented from the time of permanent approval for activities at the Parklands onwards (i.e. from 31 August 2019 onwards). The program includes both Event Impact Monitoring (EIM) for target species as well as ongoing monitoring activities for Koalas, pest species, threatened flora and areas of ecological restoration. It will supersede the FFRMP after 31 August 2019 (end of the Mod 4 approval period of validity).

It is not anticipated that the ongoing and slightly increased event schedule will alter the severity or duration of current impacts. Nonetheless, the FFMAMP also includes an adaptive management framework in order to monitor and detect any increased impacts, and to provide additional monitoring and/or investigation measures to ameliorate these, should they occur.

1.5 Event Impact Monitoring

The EIM is designed to detect impacts of the program of cultural events and in particular, determine if the proposed increase in patron number and event days is having an impact that is greater than that currently experienced. The EIM focuses on key groups of flora and fauna with the intention of identifying any adverse ecological impacts to threatened species and EECs as a result of events within the site and Billinudgel Nature Reserve. It is proposed that the EIM continue in the long-term with some modifications (detailed below).

The EIM method follows the BACI method (Before, After, Control, Impact), and as such monitoring occurs before events begin, during events and after events conclude. Monitoring also occurs at impact sites as well as control sites. **Section 3.5** provides further information on methods.

1.6 Ongoing Monitoring

Ongoing monitoring activities are unrelated to the EIM; however may be undertaken directly before any of the largest two events and a minimum of two weeks after any of the largest two events. The ongoing monitoring program will be undertaken to detect changes in population of Koala, threatened flora and pest species, and monitor the progress and condition of the ecological restoration areas.

1.7 Review of monitoring program

This Flora and Fauna Monitoring and Adaptive Management Plan is designed to be implemented for a period of ten years. After this period, this plan should be reviewed and updated where necessary.

2 Site biodiversity values

2.1 Overview

Numerous reports document the biodiversity values of the site, including the results of monitoring and survey as well as the outcomes of the Framework for Biodiversity Assessment (FBA; Eco Logical Australia 2018a) undertaken to support the application for permanent approval of events. Overall biodiversity values of the site include:

- There are five Plant Community Types (PCTs) present within the Parkland site, along with large areas of pasture (cleared land / exotic pasture grassland)
- Three plant communities listed as Endangered Ecological Communities (EECs) under the TSC Act or Threatened Ecological Communities (TEC) under the EPBC Act are present within and/or immediately surrounding the Parklands
- Habitats present within the development site are generally in moderate to good condition. There are large tracts of vegetation, which are connected to patches of vegetation in the region. Within 1 km of the site there are areas of high ecological value
- Threatened and migratory species are known to occur on site including both Commonwealth and NSW-listed species. Most commonly, these include flora, birds and microbats.

A summary of the threatened ecological communities and threatened/migratory species is provided in **Section 2.1.1 – 2.1.2** below. Full details of the results of survey and Event Impact Monitoring are available in Eco Logical Australia (2018b).

2.1.1 Threatened Ecological Communities

Three plant communities listed as Endangered Ecological Communities (EECs) under the TSC Act or Threatened Ecological Communities (TEC) under the EPBC Act are present within the Parklands. These are described in **Table 1** and shown in **Figure 1**.

Table 1: EECs and TECs within and/or immediately adjacent to the development area

EEC Name	Area within development site (ha)	Notes
Swamp sclerophyll forest on coastal floodplains of the NSW north coast bioregion	23.95	Represented in Vegetation Zone 5, although a large patch of this EEC exists within the adjacent SEPP14 Wetland / Billinudgel Nature Reserve.
Sub-tropical floodplain forest of the NSW north coast bioregion	0.5	One small patch of this EEC exists along Yelgun Creek. The other areas of Vegetation Zone 4, 6 and 7 do not exist on the floodplain.
Lowland rainforest of the NSW north coast bioregion	2	This area also meets the definition of Lowland Rainforest of Subtropical Australia Ecological Community, which is listed as critically endangered under the EPBC Act.

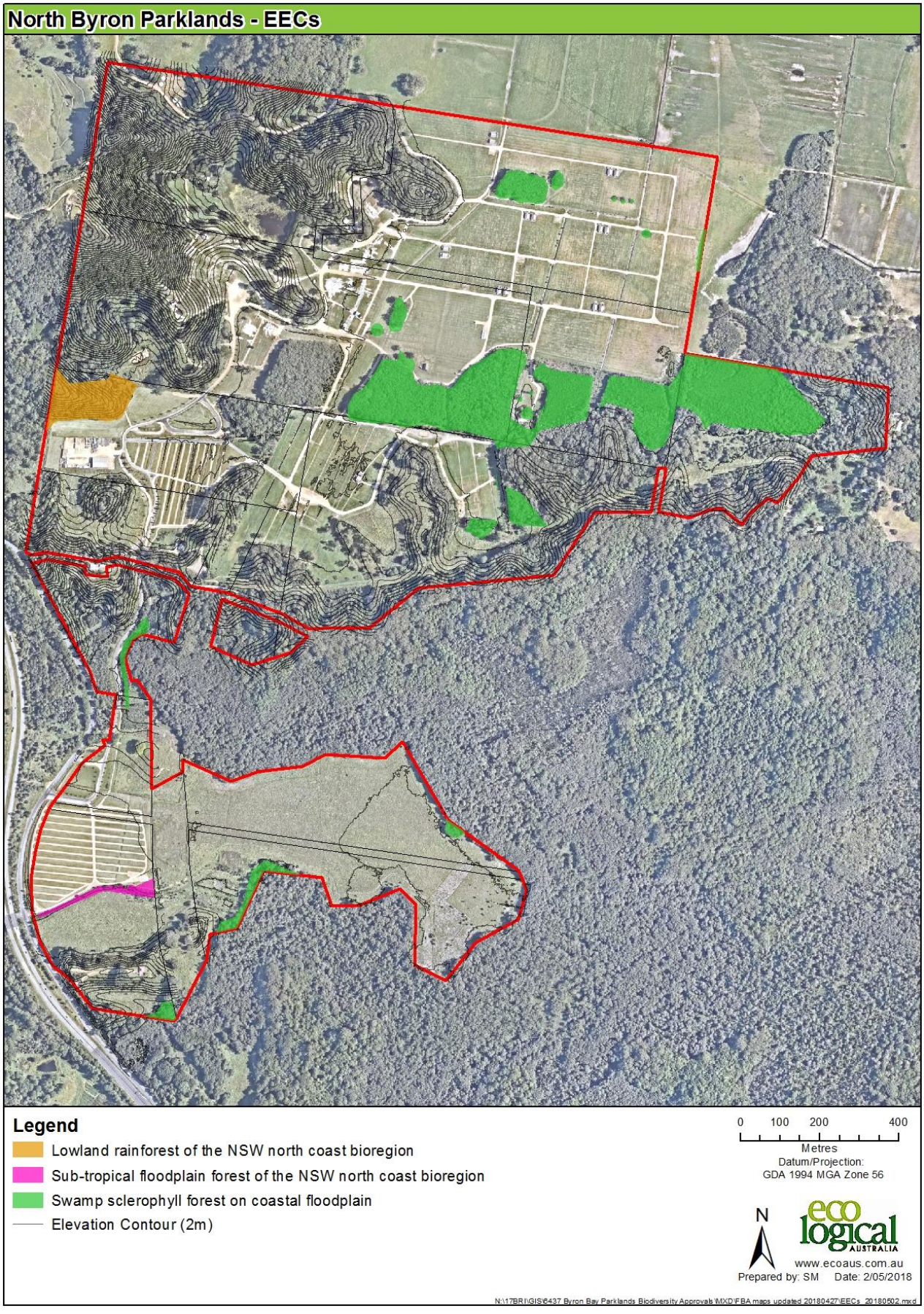

Figure 1: EECs

2.1.2 Threatened and migratory species and populations

Flora

There are eight threatened flora species that are known to occur within or adjacent to the Parklands, as shown in **Figure 2**. These include:

- Stinking Cryptocarya (*Cryptocarya foetida*)
- Davidson's Plum (*Davidsonia jerseyana*)
- Rusty Rose Walnut (*Endiandra hayesii*)
- Green-leaved Rose Walnut (*Endiandra muelleri* subsp. *bracteata*)
- Pink Nodding Orchid (*Geodorum densiflorum*)
- Rough-shelled Bush Nut (*Macadamia tetraphylla*)
- Slender Marsdenia (*Marsdenia longiloba*)
- Durobby (*Syzygium moorei*)

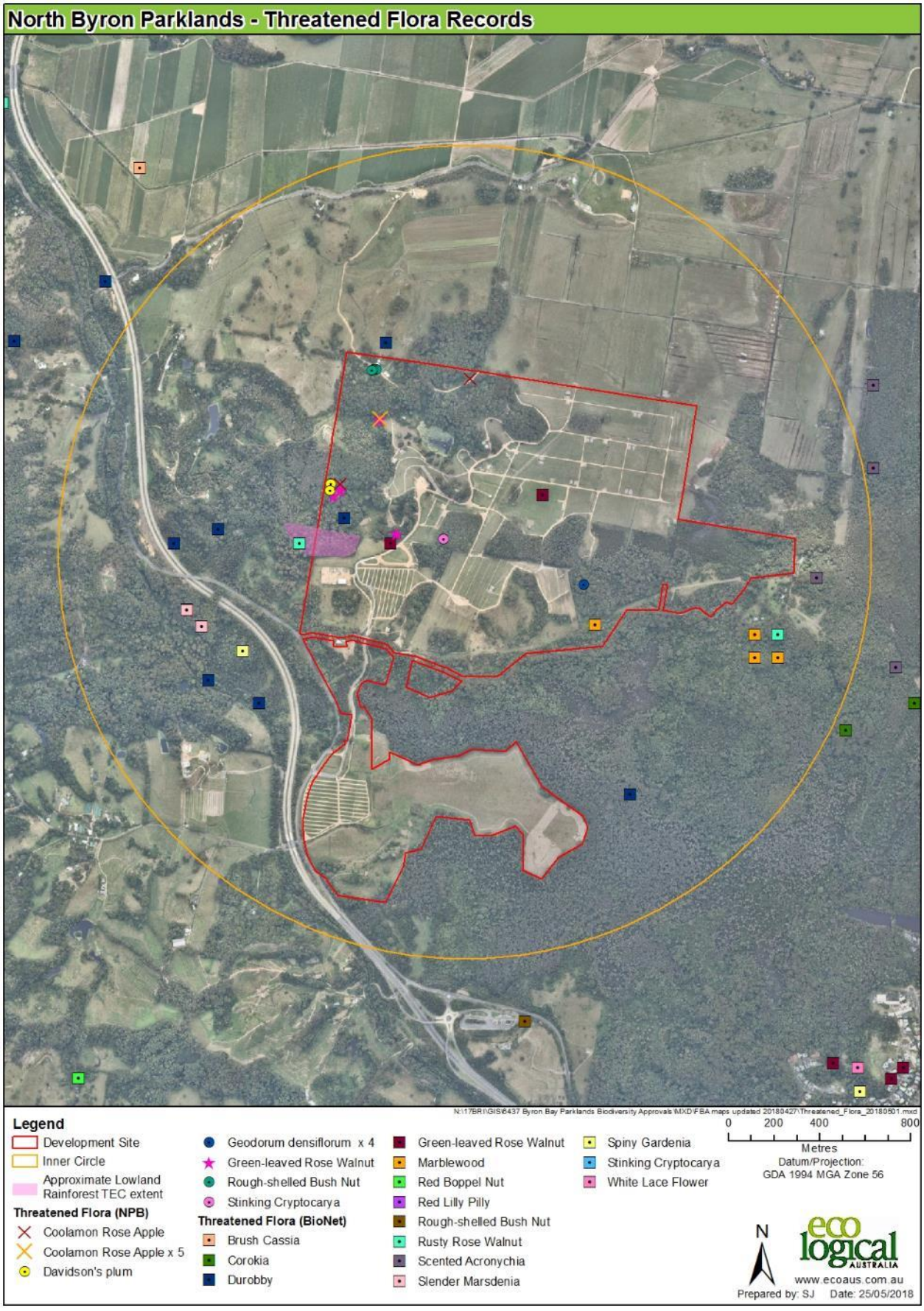

Figure 2: The location of threatened flora

Birds

Eight threatened bird species have been recorded during EIM surveys. All are listed as vulnerable on the NSW Threatened Species Conservation Act (TSC Act), with the exception of the Bush Stone Curlew which is listed as endangered. Species include:

- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Bush Stone Curlew (*Burhinus grallarius*)
- Eastern Grass Owl (*Tyto longimembris*)
- Eastern Osprey (*Pandion cristatus*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Rose-crowned Fruit Dove (*Ptilinopus regina*)
- White-eared Monarch (*Carterornis leucotis*)
- Wompoo Fruit Dove (*Ptilinopus magnificus*)

It is noteworthy that several of these records are recent local 'first sightings', which have occurred since the commencement of events at the Parklands. The Brown Treecreeper was first sighted during EIM for Falls Festival 2016-17 and the Bush Stone Curlew was first sighted at SITG 2017. Also, the Eastern Grass Owl was absent from the Parklands from 2007 until recent responses to call playback in July 2016 and 2017.

Microbats

Threatened microbat species have not been specifically targeted during the EIM, rather their presence recorded along with that of all other species. Eight threatened species have been recorded during EIM surveys. All are listed as vulnerable within the NSW TSC Act and one is also listed as vulnerable on the EPBC Act. The species include:

- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Golden-tipped Bat (*Kerivoula papuensis*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – EPBC Act vulnerable species
- Little Bent-wing Bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*)
- Yellow-bellied Sheathtailed Bat (*Saccolaimus flaviventris*)

Prior to any events, nine species of microbat were captured during harp trapping surveys 2007, 2009, 2014. This included four threatened species (Common Blossom Bat (*Syconycteris australis*), Eastern Long-eared Bat (*Nyctophilus bifax*), Eastern Bent-wing Bat and Little Bent-wing Bat). Both Bent-wing Bats were also regularly detected in EIM surveys, whist the Common Blossom Bat and Eastern Long-eared Bat were detected only during harp trapping (2007 and 2014)

Koala

Biolink Ecological Consultants have undertaken a number of koala surveys and these are summarised in the review of monitoring data (ELA 2017). A survey conducted in 2007 by Biolink identified approximately 3 ha of Core Koala Habitat (as defined by SEPP 44). A 12-month Individual Koala Plan of Management (IKPoM) was prepared, which required a reassessment of the habitat to identify any changes, prior to the commencement of development. The reassessment undertaken in 2008 indicated a decline in koala activity with the Core Koala Habitat, to the extent that usage at that time was considered to be "relic and/or transient". No Koala activity was recorded during an additional survey in 2013.

Biolink was again engaged in 2016 to further investigate for evidence of koala activity with the Parklands site. This included 25 km radial searches for koalas at over 26 sites. Opportunistic inspections were also undertaken at the base of preferred koala food trees. The results from the 2016 survey found evidence of koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billindugel Nature Reserve. Mixed age scats suggest repeated use of sites by koala individuals with home ranges that encompass the north-west corner of the Parklands.

A Koala Plan of Management specific to the Parklands has also been prepared for the project (ELA 2018b). The Ecological Structure Plan identifies several areas of active rehabilitation and restoration targeted to provide additional Koala habitat (refer to **Section 3.3.1**).

Migratory species

Migratory species listed under the EPBC Act have not been specifically targeted during the EIM, rather their presence recorded along with that of all other species.

Seven migratory species have been recorded within the project area. These include:

- Black-faced Monarch (*Monarcha melanopsis*)
- Eastern Osprey (*Pandion cristatus*)
- Oriental Cuckoo (*Cuculus optatus*)
- Rufous Fantail (Rhipidura rufifrons)
- Satin Flycatcher (*Myiagra cyanoleuca*)
- Spectacled Monarch (*Monarcha trivirgatus*)
- White-throated Needletail (*Hirundapus caudacutus*)

2.1.3 Regenerating ecosystems

Planting of local native forest flora species has been ongoing at the Parklands since 2007 (see **Section 3.3.1** for more detail). Plantings have taken place within degraded farmland areas across the site and in areas adjacent to Billinudgel Nature Reserve. The total area of replanting is approximately 11 ha and has included 22,000 trees. These areas have filling in gaps in vegetation and have joined previously fragmented areas. Plantings now support a range of native fauna.

Forest birds have been specifically surveyed in two established planting locations. Over four surveys, 161 birds across 31 species have been recorded. This includes two threatened species (NSW TSC Act) – Rose-crowned Fruit Dove (1 sighting) and White-eared Monarch (4 sightings) – which were observed in ~9 year old stands of native plantings located south of Jones Road.

2.2 Potential impacts to biodiversity values

This section summarises the predicted impacts of the project and full details are provided in Eco Logical Australia (2018a). The conclusions have been founded in the results of the previous 10-years of survey and monitoring data from the site. In particular, the EIM has been specifically designed and implemented to detect any impacts from running events. The overall survey and monitoring results to date indicate that the events at the Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities (Eco Logical Australia 2018b). It is acknowledged that the future proposal will increase both the intensity and duration of events and the impact of this is explicitly considered below.

2.2.1 Direct Impacts relevant to the FBA

Only very minor native vegetation clearing / pruning will occur due to the project. This is associated with the widening of an existing track in the north-east of the development site. The clearing area consists of an approx. 1.5m widening (each side) of an existing track for a length of approximately 100m. This results in a clearing area that is approximately 300m^2 in area and represents an estimated loss of approximately 20 native trees (+/- 10). This clearing area also includes potential pruning of overhanging branches.

There will also be 0.4 ha of clearing within a vegetation community dominated by exotic pasture and stands of Camphor Laurel and Mango. This is associated with the proposed wastewater treatment infrastructure in the north west of the development site. Clearing and slashing of exotic pasture in the southern areas of the site is also required to increase car parking capacity. Furthermore, there will be removal of Camphor Laurels near the proposed conference centre.

There will be no direct impacts to EECs, CEECs or threatened flora. Nor will there be any direct impact to threatened fauna or flora, with exception to an area of exotic grassland, which represents habitat for the Eastern Grass Owl. The Eastern Grass Owl was not recorded in the main event area (north of Jones Rd) in any year; however, the species responded to call playback in July 2016 and July 2017 in the exotic grassland in the south of the parklands. The 2016 observation was the first observation of this species within the site since 2007. Approximately 14.8 ha of potential habitat in the form of exotic grassland will be directly impacted for the construction of the south-eastern carpark.

2.2.2 Indirect Impacts relevant to the FBA

The consistent conclusion across all EIM surveys has been that there are no significant adverse effects on any flora or fauna group as a consequence of events held at the Parklands. Nonetheless, the proposal will result in different impacts to those monitored during the trial period. These predicted indirect impacts are specifically related to:

- The proposed increase in patron numbers
- The increased number of events
- The increased frequency of events
- The maximum number of events days per event, and in aggregate per year
- Use of the conference centre throughout the year
- Minor barrier effects due to the installation of the 1.8m high security fence

With these aspects in mind, the following impacts are identified:

- An increase in the maximum number of patrons from the current scenario (maximum of 35,000 patrons currently to a maximum of 50,000 patrons under the ultimate proposed scenario for SITG) is predicted to result in the following impacts:
    - The risk of vehicular strike is expected to increase to a small degree during event times due to increased traffic.
    - The risk of fauna attack by dogs is likely to have a negligible increase during event times.
    - The risk of fauna entanglement with event infrastructure and trampling is expected to have a negligible increase during event times due to increased foot traffic.
    - The increases in noise impacts due to the number of patrons is not expected to be significantly different. Additional amplified stages may be established as part of events to cater for additional numbers, which may represent some potential additional noise sources. However, the proposal

does not involve any change to existing noise limits, and Parklands will still be required to achieve its approved noise criteria offsite.

- Lighting impacts are not expected to increase significantly as the number of powered lights within event areas is determined by event area and not by patron numbers. Nonetheless, if new event areas are established to support additional patrons (e.g. new parking areas), then some additional light impacts may occur. Light spillage is also reduced by use of appropriate technologies.
- The risk of vegetation trampling is not expected to be significantly different with increase patron numbers due to effective mitigation measures that are put in place during events. The potential for vegetation trampling is minimised by fencing off areas of native vegetation during events.
- Increased numbers of people / vehicle movements on site presents a weed and plant pathogen pathway. However, the site has a long history of disturbance, with over 50 exotic flora species known to occur across the Parklands site and an ongoing program of weed management is in place.
- The risk of bushfire is increased during events due to the large numbers of people occupying the site. However, this also poses a significant safety issue for the event patrons and therefore stringent fire management protocols are implemented.
- The increases in patron numbers will be staged over several years and will only be increased subject to the meeting of KPIs.

- All else being equal, an increase in the number of events days (excluding community events) from a maximum of 10 (currently) to 13 (proposed) event days per year increases the frequency and duration of all indirect impacts as well as increasing the likelihood of risks (such as vehicle strike and bushfire). Impacts observed during and immediately after events have included limited sediment movement, littering and trampling of grasses within the event area, and avoidance of illuminated areas by mobile fauna. Surveys indicated that these impacts are temporary and reversible at the conclusion of events.
- An increased number of events per year results, on average, in a shorter duration between events and therefore reduced time for recovery from any impacts. Nonetheless, a majority of events will be minor events with much less impact compared to the major events. In addition, there will often be months between events, meaning that will be ample time between events for ecological recovery.
- The maximum number of days per event is proposed to increase from four to five. Any fauna that are dispersed due to indirect impacts are expected to return within timeframes consistent with the current scenario.
- There is a minor risk that the frequency and length of events will tip certain species to leave habitats within the project area; however this risk is considered to be minor given the evidence collected to date, and all events will be monitored against KPIs to identify this kind of potential impact. Such an impact would also be reversible.
- It is proposed that the conference centre and associated accommodation will be used for a range of events such as corporate functions, conferences, celebrations, or health and wellbeing retreats. The conference centre would operate year-round, and cater for up to 180 patrons per day. Accommodation would be provided for up to 120 guests a day in 30 on-site cabins. Impacts are likely to include the following:
    - Disturbance to species using the dam located adjacent to the conference centre. However, this is expected to be minor and over the longer term habituation may occur.

- The level of noise generated at the conference centre is likely to be minimal with most noise generating activities being undertaken within the proposed buildings. Therefore the associated impact to adjacent aquatic and forest habitats likely to be negligible.
- Use of the conference centre throughout the year will result in an increase frequency of light impacts, as well an increase in light spillage due to the number of lights at the centre. Light spillage can be managed to reduce spillage into adjacent habitat areas and any light impacts are predicted to be localised and not significant.

- The installation of the 1.8m high palisade security fence will create a potential barrier effect for some wildlife across the site. However, the impact on fauna movement is considered to be negligible as the fence will be designed so that every 5th or 6th panel (approx. 2.5m in length) can be open during non-event times. This is mainly to reduce the barrier effect for macropods and koalas. The panels will be closed only for a few days, i.e. one day before the first event day and opened one day after the last event day. Furthermore, the fence will be set 100mm off the ground and will also have space between the palisade pales to allow wildlife movement through the fence. This will not hinder movement of small mammals, reptiles, birds or others small wildlife.

3 Monitoring Objectives

3.1 Monitoring objectives

It is predicted that the impacts from the ongoing program of cultural events at the Parklands will be minor and temporary, as evidenced by the results of extensive monitoring undertaken during the trial period. However, to ensure that no unexpected impacts occur as a result of the increased capacity and frequency of events, the following monitoring objectives have been developed:

- Endangered Ecological Communities and associated threatened species habitat will continue to be enhanced via the on-going program of successful vegetation management and bush regeneration.
- Threatened flora species will continue to be present at the Parklands.
- Events will not prevent the on-going use of the Parkland site by threatened fauna species.
- Increases in maximum patron numbers are only to occur where no significant new or ongoing impacts are detected.

3.2 Matters to be monitored during EIM

3.2.1 Target Threatened Fauna Species

Based on post-event surveys and baseline monitoring data, it was deemed that the majority of threatened fauna species utilise the site infrequently, sporadically or in low numbers, with the exception of a few species. These species have been identified as having a greater and well-established presence on site, and will therefore be monitored more closely to identify any changes to their populations and their on-going presence on site.

The threatened species that will be targeted during EIM are:

- Rose-crowned Fruit Dove
- Little Bent-wing Bat
- Eastern Freetail-bat
- Southern Myotis
- Eastern Grass Owl
- Bush-stone Curlew
- Koala

The koala will also be monitored as part of the ongoing monitoring program (see below).

Despite this, the bird monitoring surveys will record all observed species. This is because declines in overall diversity (e.g. bird species richness) may also be indicative of any potential adverse impacts to threatened species, including those that use the site sporadically. For this reason, all data recorded (not just for targeted threatened species) will be used to assess for any adverse impacts to site's biodiversity values.

A more detailed rationale for species selection is provided in **Table 2**. Detailed methods are also described in **Section 3.5.1**.

Table 2: Summary of fauna surveys 2007 – 2017 and selected targeted species

Group	Summary of results (see Eco Logical Australia 2018b for details and references to full results)	Selected targeted species & other monitoring parameters
Bird species	Across all EIM surveys there were between 73 and 86 species and up to 4023 individuals recorded (sum across all survey transects). Surveys associated with SITG 2016 recorded the highest number of individuals to date. While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either parameter. This result suggests the combined program of events since 2013 has not impacted regional forest bird communities over time. Out of the eight threatened species recorded during the EIM surveys, only the Rose-crowned Fruit Dove and the White-eared Monarch have been recorded more than once during surveys; 6 and 4 events out of 8*, respectively. While there is currently insufficient data at an individual level to undertake an analysis of whether these birds are being impacted during individual events, these birds evidentially frequent and/or occupy the site more readily compared to other threatened bird species. The Eastern Grass Owl was recorded in the main event area (north of Jones Rd) in 2007. A pair also responded to call playback in July 2016 in the exotic grassland in the south of the parklands (south of Jones Rd). This was the first observation of this species within the site since 2007. A single owl also responded to call play-back in July 2017, again in the exotic grassland to the south of the parklands. Similarly, the Bush-stone Curlew was first sighted at the Parklands in July 2017. All other threatened bird species are considered to be occasional visitors to the site.	• Total bird abundance • Total bird species richness • Rose-crowned Fruit Dove • Eastern Grass Owl • Bush Stone-curlew • Noisy Miner
Frogs	No threatened frogs have been recorded on site.	No target frog species
Reptiles	No threatened reptiles have been recorded on site.	No target reptile species
Mammals (general)	A number of common mammal species have been recorded at the Parklands across all monitoring and survey events, including Northern Brown Bandicoot, Antechinus, Possum and Flying-foxes. Non-native species were also observed. Threatened mammal species observed during these other surveys include Koala and several microbat species. These are discussed below.	• Koala – see below • Microbats – see below

Group	Summary of results (see Eco Logical Australia 2018b for details and references to full results)	Selected targeted species & other monitoring parameters
Microchiropteran Bats	Across all EIM surveys there were between 16 and 21 species[1] and up to 7061 individual calls recorded. The most recent winter surveys (associated with SITG 2016) recorded fewer calls than previous surveys, however, this was attributed to equipment malfunction rather than an ecological effect. Conversely, the most recent summer surveys (associated with FF 2016-17) recorded the highest number of calls to date. While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either the number of species recorded or the total number of calls. This result suggests the combined program of events since 2013 has not impacted microbat assemblages over time. There is sufficient data for the two most common species (Little Bent-wing Bat and Southern Myotis) at an individual event level to undertake analysis of whether threatened microbats are impacted during events; these species were recorded at 8 and 7 of the 8 events, respectively. The overall results demonstrate no adverse impact associated with events and are consistent with those from the broader microbat assemblage data (as discussed above). The Eastern Free-tail Bat was also recorded at 7 of 8 events, and while there is insufficient data to assess any impacts to this species during events, this species evidentially has a significant presence on the site when compared to other species. All other threatened microbat species are considered to be occasional visitors to the site.	• Total threatened microbat species richness • Little Bent-wing Bat • Eastern Freetail-bat • Southern Myotis
Koala	Targeted Koala surveys of the site were undertaken by Biolink in 2007, 2008, 2013 and 2016. 2007 – small area of core Koala habitat (3 ha) mapped on site; koala scats observed at four locations within the Parklands; results suggest use of the site by 1 – 2 Koalas 2008 – significantly reduce evidence of activity, such that activity level does not reach the threshold that indicates active, ongoing use by resident animals 2013 – no evidence of Koala within the Parklands 2016 – evidence of Koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billindugel Nature Reserve. Mixed age scats suggest repeat use of sites by Koala individuals with home ranges that encompass the north-west corner of the Parklands	• Koala occupancy • Koala activity • Consistent with Koala Plan of Management (ELA 2017)

[1] Or species groups if calls could not be attributed to only one species, as commonly occurs in microbat call analysis

Group	Summary of results (see Eco Logical Australia 2018b for details and references to full results)	Selected targeted species & other monitoring parameters
	EIM – no evidence of Koala within the Parklands or surrounds (based on general observations, not targeted survey)	
Exotic / pest fauna	Exotic mammals recorded on the site include Black Rat, House Mouse, Dog and Red Fox. Of note, there has been an increase in population of Black Rat that has been observed during monitoring.	• Black Rat, • Wild Dog • Red Fox • Feral Cat

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3.3 Matters to be monitored during the ongoing monitoring program

3.3.1 Ecological Structure Plan Areas

In 2010, as part of the Environmental Assessment, Parklands made a commitment to prepare and implement a revised ecological structure plan across the site over a 10 year period based on receiving an approval to host cultural arts and music events. Parklands has already undertaken a significant amount of ecological restoration since purchasing the property in late 2006 and commencing approved activities in 2013. The development of the ecological restoration plan (ERP) has been based on identifying, categorising and managing vegetation across different land use types (Parklands 2016).

As part of this revision of the ecological structure plan, the following map (**Figure 3**) provides the numbered Habitat and Managed Parkland zones that form the ecological restoration works proposed to be completed by August 2019. The zones in **Figure 3** include:

- Habitat, Existing – Large patches of existing mature vegetation that will undergo ongoing weed management where required. Due to their condition, limited works are required to manage these patches.
- Habitat, Improved – Areas of vegetation in various condition that undergo weed management.
- Habitat, Regeneration – Areas of existing native vegetation that may require significant weed removal and supplementary planting.
- Habitat, Planting – areas that have undergone broad scale planting and are being managed towards mature vegetation communities.
- Managed Parklands, Regeneration – Event areas that are managed to maintain the scatted native trees and to reduce weed incursion.
- Managed Parklands, Plantings – Event areas where native trees have been planted.

Table 3 references this map, providing information on each restoration management unit. It is important to note that the overall aim is to restore the target areas to provide functioning native vegetation communities. There is no requirement or prescription to re-create specific PCTs as part of original ecological restoration commitments. Hence, much of the ecological restoration work has been undertaken using the extant native vegetation communities on site as a guide, but without formal PCT benchmarks in mind. Nonetheless, the preferred PCTs indicated in **Table 3** are indicative and based on the likely community that will establish via restoration. Establishment of alternative PCTs and their associated habitat features is considered equally acceptable.

The progress and condition of restoration areas will be monitored into the future as part of the ongoing monitoring program. As part of this, the condition of EECs present within the site will also be monitored.

The following broad Key Performance Indicators exist for management units that aim to establish PCTs as shown in **Table 3**:

- Utilise locally occurring species
- Create resilient vegetation that requires minimal management of exotic species
- Provide habitat for fauna found on-site, particularly threatened species.

Specific monitoring and adaptive management triggers are provided in **Section 4**.

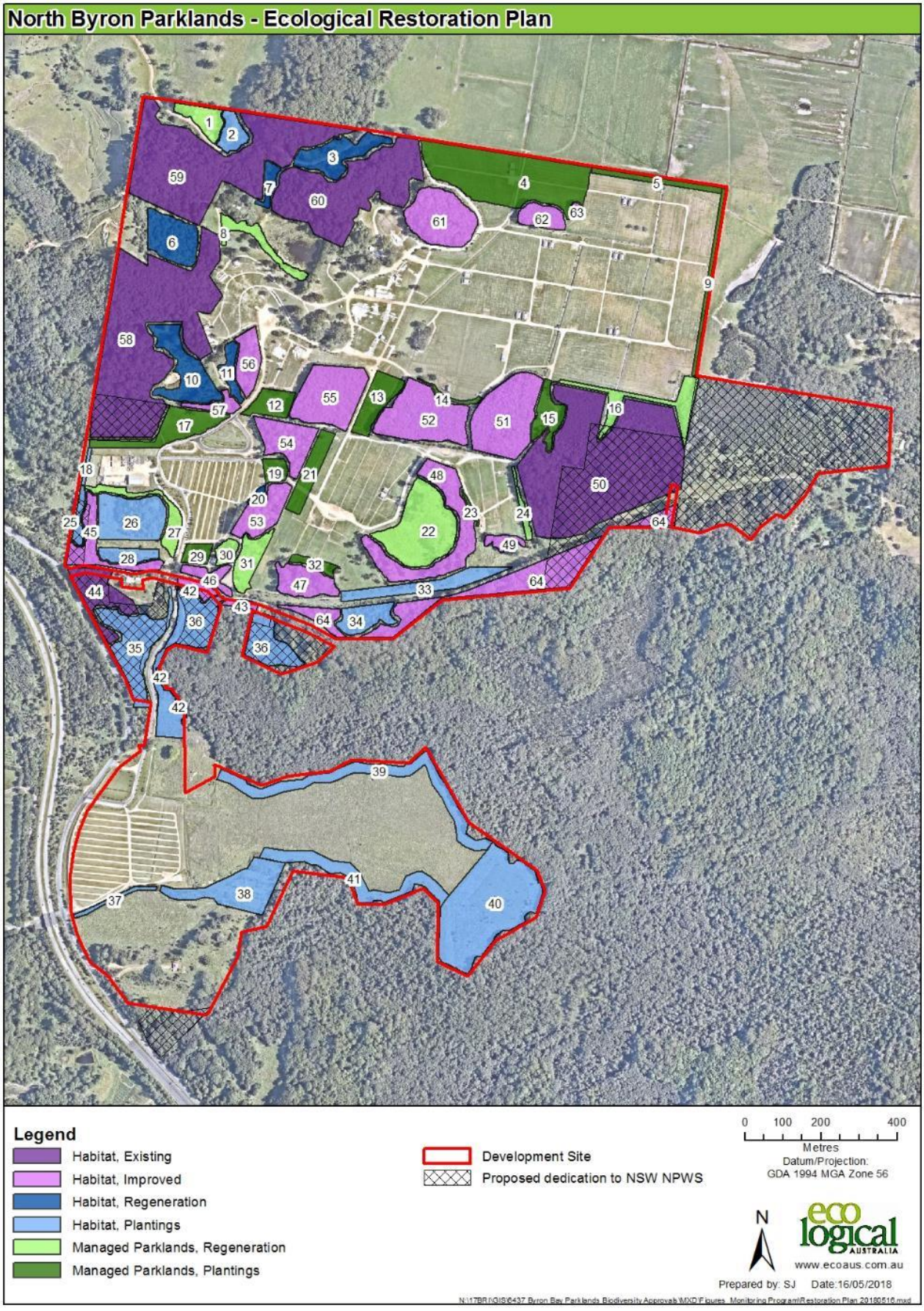

Figure 3: Ecological restoration Plan / Structure Plan

A range of restoration activities are proposed for the site. Table 3, with reference to **Figure 3,** shows areas proposed for restoration, the vegetation community type where relevant and estimated age required until canopy species reach maturity.

Table 3: Rehabilitation areas, community types, time to maturity and broad management actions.

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
1	MP	Re	100	0.809	N/A – open space area	Mature	Complete	On-maintenance
2	H	P	100	0.582	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
3	H	Re	100	1.370	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
4	MP	P	100	5.321	N/A – open space area	10 years	60 native trees to be planted along northern boundary and road D (20m apart)	On-maintenance
5	MP	P	0	0.551	N/A – open space area	10 years	20 native trees along northern boundary (every 20m and 20m off fence) Complete	On-maintenance
6	H	Re	100	1.461	749 – Brush box tall moist forest	Mature	Complete	On-maintenance
7	H	Re	100	0.320	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
8	MP	Re	100	0.721	N/A – open space area	Mature	Complete	On-maintenance
9	MP	P	0	0.975	N/A – open space area	10 years	25 native trees along northern boundary (every 20m and 20m off fence) Complete	On-maintenance
10	H	Re	100	1.726	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
11	H	Re	100	0.436	826 – Flooded Gum / Brush Box Forest	Mature	Complete	On-maintenance
12	MP	P	100	0.687	N/A – open space area	10 years	8 native trees	On-maintenance
13	MP	P	100	1.016	N/A – open space area	10 years	12 native trees	On-maintenance

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
14	MP	P	100	0.165	N/A – open space area	10 years	15 native trees	On-maintenance
15	MP	P	100	0.802	N/A – open space area	10 years	15 native trees along access road	On-maintenance
16	MP	Re	100	1.254	N/A – open space area	Mature	Complete	On-maintenance
17	MP	P	75	1.495	N/A – open space area	10 years	15 native trees along drainage line Complete	On-maintenance
18	H	P	100	0.092	749 – Brush box tall moist forest	10 years	200 native trees	On-maintenance
19	MP	P	100	0.353	N/A – open space area	10 years	8 native trees along access road	On-maintenance
20	H	Re	100	0.138	693 - Blackbutt - Tallowwood tail moist forest	Mature	Complete	On-maintenance
21	MP	P	100	0.883	N/A – open space area	10 years	15 native trees along drainage line	On-maintenance
22	MP	Re	100	2.983	N/A – open space area	Mature	Complete	On-maintenance
23	MP	P	100	0.091	N/A – open space area	10 years	8 native trees along access road	On-maintenance
24	MP	Re	100	0.259	N/A – open space area	Mature	Complete	On-maintenance
25	H	P	100	0.315	749 – Brush box tall moist forest	Mature	Complete	On-maintenance
26	H	P	100	1.929	837 - Forest Red Gum - Swamp Box forest	10 years	100 native trees west of treed hill	On-maintenance
27	MP	Re	100	0.783	N/A – open space area	Mature	Complete	On-maintenance
28	H	P	100	0.560	749 – Brush box tall moist forest	10 years	In-fill existing plantings - 100 native trees	On-maintenance
29	MP	P	100	0.355	N/A – open space area	Mature	Complete	On-maintenance
30	MP	Re	100	0.306	N/A – open space area	Mature	Complete	On-maintenance
31	MP	Re	100	0.840	N/A – open space area	Mature	Complete	On-maintenance
32	MP	P	100	0.279	N/A – open space area	10 years	30 native trees north of forest block	On-maintenance
33	H	P	100	1.252	837 - Forest Red Gum - Swamp Box forest	10 years	1,000 native trees – completed	On-maintenance

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
34	H	P	100	0.863	693 - Blackbutt - Tallowwood tail moist forest and 1064 – Paperbark Swamp Forest	Mature	Complete	On-maintenance
35	H	P	100	2.292	749 – Brush box tall moist forest and 837 - Forest Red Gum - Swamp Box forest	Mature	Complete	On-maintenance
36	H	P	100	4.459	749 – Brush box tall moist forest	Mature	Complete	On-maintenance
37	H	P	100	0.248	837 - Forest Red Gum - Swamp Box forest	10 years	100 native trees south of RMS drain	On-maintenance
38	H	P	100	2.118	837 - Forest Red Gum - Swamp Box forest	10 years	100 native trees to supplement existing plantings	On-maintenance
39	H	P	100	2.471	1064 – Paperbark Swamp Forest	10 years	3,50 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth	On-maintenance
40	H	P	100	5.524	1064 – Paperbark Swamp Forest	10 years	Initial works complete - 1,500 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth Additional works - Natural regeneration / plantings so that the area is melaleuca forest, subject to bushfire hazard reduction setbacks.	Initial works are on-maintenance. Additional works underway.
41	H	P	100	1.835	1064 – Paperbark Swamp Forest	10 years	350 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth	On-maintenance
42	H	I	Ongoing	0.270	693 - Blackbutt - Tallowwood tail moist forest and 1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
43	H	I	Ongoing	0.494	749 – Brush box tall moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
44	H	E	Ongoing	1.531	749 – Brush box tall moist forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
45	H	I	Ongoing	1.132	749 – Brush box tall moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
46	H	I	Ongoing	0.450	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
47	H	I	Ongoing	1.084	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
48	H	I	Ongoing	2.496	837 - Forest Red Gum - Swamp Box forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
49	H	I	Ongoing	0.272	837 - Forest Red Gum - Swamp Box forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
50	H	E	Ongoing	11.548	837 - Forest Red Gum - Swamp Box forest and 1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring
51	H	I	Ongoing	3.014	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
52	H	I	Ongoing	2.719	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
53	H	I	Ongoing	1.107	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
54	H	I	Ongoing	1.389	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
55	H	I	Ongoing	2.451	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
56	H	I	Ongoing	0.898	826 – Flooded Gum / Brush Box Open Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
57	H	I	Ongoing	0.351	826 – Flooded Gum / Brush Box Open Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
58	H	E	Ongoing	10.650	749 – Brush box tall moist forest and 693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring

Polygon*	Type	Treatment	% initial works completed	Area (Ha)	Preferred / target Plant Community Type	Time to canopy species maturity	Notes	Status
59	H	E	Ongoing	8.436	749 – Brush box tall moist forest and 693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring
60	H	E	Ongoing	5.564	749 – Brush box tall moist forest and 693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	Ongoing monitoring
61	H	I	Ongoing	2.200	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
62	H	I	Ongoing	0.663	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
63	H	I	Ongoing	0.076	1064 – Paperbark Swamp Forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
64	H	I	Ongoing	5.459	693 - Blackbutt - Tallowwood tail moist forest	Mature	As part of the ongoing habitat restoration program	On-maintenance
			Total	**115.173**				

Zone types: H = Habitat; MP = Managed Parklands.

Treatment types: I = Improved (i.e. weed removal); P = Plantings; E = Existing / mature vegetation; Re = Regeneration.

***- Refer to Figure 3**

3.3.2 Target Flora Species

As mentioned in **Section 2.1.2**, there are eight threatened flora species that are known to occur within or adjacent to the Parklands. The health of these specimens will be monitored over the long term as part of the ecological restoration area monitoring.

3.3.3 Koala

Long-term monitoring for Koala will occur every two years, with the next scheduled monitoring event to occur in 2018. Ideally, monitoring will be linked to surveys being undertaken in the wider region, as guided by the BCC KPoM. Parklands staff will consult with relevant stakeholders at Byron Shire Council prior to each round of monitoring commencing, to seek opportunities for alignment of efforts with wider surveys of local populations being undertaken in the region.

Event Impact Monitoring will also be undertaken for Koala (see **Section 3.2.1**).

3.3.4 Targeted Pest or Nuisance Species

Several pest species are known to occur on or adjacent to the site, including Black Rat, Red Fox (*Vulpes vulpes*), and Wild Dog (*Canis lupus*). Incidental observations collected during standard operations and during monitoring events will be used to identify increased use of the site by pest species and control and management regimes will be implemented as required. Target species will include Black Rat, Red Fox, Wild Dog and Feral Cat

Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant Noisy Miners (*Manorina melanocephala*) is a listed key threatening process under the BC Act and EPBC Act. The Noisy Miner is a native species, however monitoring of the population at the site will be undertaken in relation its potential impact on habitat availability for other native bird species. Although this monitoring is unrelated to EIM, for efficiency it may be undertaken immediately before events, as part of the standard EIM bird surveys.

3.4 Program / Timeframes

3.4.1 Event Monitoring Program

To reach a maximum capacity of 50,000 patrons (for Splendour in the Grass only), event capacity will increase gradually over two years (refer to **Section 1**). This gives an opportunity for monitoring effort to identify any potential impacts to biodiversity. The schedule for monitoring is provided in **Table 4** below[2]. Ongoing monitoring will be geared towards determining that the objectives listed in **Section 3.1** are met. A detailed monitoring methodology is provided in subsequent sections.

The proposed increase in patrons will only go ahead if no significant new or ongoing impacts are detected.

Table 4: EIM schedule

Timeframe	Timing of Monitoring
Splendour in the Grass (SITG) 'capacity increase' period (from current, to 42,500 then 50,000 patrons)	Annual EIM before, during and after largest event Event increase viable only if no significant new or ongoing impacts detected

[2] It should be noted that the monitoring program approved under the trial period and associated modifications will continue to operate in its current form until the permanent approval commences.

Timeframe	Timing of Monitoring
First two years of SITG operation at full capacity (50,000 patrons)	Annual EIM before, during and after largest event Scale back to Biennial EIM only if no significant new or ongoing impacts detected
Subsequent and ongoing operation of SITG operation at full capacity (50,000 patrons)	Biennial EIM before, during and after largest event

3.4.2 Ongoing Monitoring Program

Table 5 outlines the schedule for ongoing monitoring activities.

Table 5: Ongoing monitoring program schedule

Matter	Timing of Monitoring
Ecosystem Restoration Areas	Incidental monitoring during EIM and standard operations. Formal four-yearly monitoring of vegetation community condition until vegetation is considered self-sustaining. At this point, vegetation photo point monitoring will replace the formal transect monitoring.
Threatened Flora	Incidental monitoring during EIM and standard operations. Four-yearly monitoring of condition of known specimens.
Koala	Incidental monitoring during EIM and standard operations. Biennial monitoring of vegetation community condition.
Pest fauna	Incidental monitoring during EIM and standard operations.
Noisy Minor	Undertaken as part of EIM monitoring program and standard operations.

3.5 Method

3.5.1 Monitoring methods

Extensive monitoring to date has indicated that events at the Parklands caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities. Although the size, intensity and duration of events are expected to increase, additional or enhanced adverse impacts to ecological attributes, compared to those already witnessed, are not predicted.

The monitoring methods proposed from the commencement of permanent approval onwards are based on previous monitoring methods to ensure continuity across monitoring years; however, based on the EIM results thus far, the methods have been scaled back, with the primary aim of identifying changes to threatened species populations and EECs in order to trigger further monitoring and management actions where necessary (see **Section 4**). Accordingly, monitoring will focus on target species/groups, as listed in **Section 3.2** and has been focused to address the monitoring objectives detailed in **Section 3.1**.

Table 6: Proposed EIM monitoring methods

Target Group	Monitoring methodology
Forest Birds	In forest areas: Samples before-during-after SITG of nine x 20minute/200m transects undertaken by experienced observers. Observers to record abundance and species. This is consistent with the current method and includes impact sites and control sites (**Figure 4**). All observations of threatened bird species at the Parklands to be recorded during standard operations or other monitoring events.
Eastern Grass Owl and Bush Stone-curlew	Spotlighting and call-playback surveys before-during-after SITG in suitable habitat associated with previous records of the target species (**Figure 4**).
Threatened Microchiropteran Bats	As per current method, three locations are sampled by Anabat Call detectors for each event monitored (before, during and after). Two locations are within the event area and the third nearby within Billinudgel Nature Reserve (**Figure 4**).
Koala	Incidental observations of koala or evidence of koala at sites (before and after event only) in areas where Event Impact Monitoring is occurring for birds and bats. This includes ad hoc scat and scratch mark searches along the transects as well as direct observation of koala. The surveys will include recording observations of habitat and vegetation condition (including photo points). Spotlighting transects at the five koala survey sites identified on **Figure 5**. This is to occur before events (and after events if koala is detected). Recording of other incidental sightings of Koala (or evidence of the species).
Other species	Incidental observation / recording of all other threatened fauna species during EIM Incidental observation / recording of road kills during EIM Two motion sensor wildlife cameras deployed in the Marshall's Ridges area to monitor fauna presence.

Table 7: Proposed ongoing monitoring methods

Target Group	Monitoring methodology
Vegetation	Until vegetation is considered self-sustaining, monitoring of six sites (four-yearly) will be undertaken in accordance with the *Biodiversity Assessment Method* (OEH 2017). Specifically, a Vegetation Integrity Survey Plot will be established at each of the monitoring locations (**Figure 5**). This includes establishment of: a) One 400m^2 plot (standard 20m x 20m), used to assess all of the composition and structure attributes set out in Table 3 of the *Biodiversity Assessment Method*. b) One 1000m^2 (standard 20m x 50m) plot, used to assess the function attributes. c) Five 1m^2 sub-plots, used to assess average litter cover (and other optional groundcover components) for the plot. The person undertaking the ecological monitoring will be required to refer to the detailed methods associated with the (a) to (c) above within the *Biodiversity Assessment Method*. In addition to this, monitoring of 20 permanent vegetation photo points will occur. Photo points will include photos facing north, south, east and west. Once the vegetation being monitored by the Vegetation Integrity Survey Plots becomes self-sustaining, the plots will become photo points.
Target Flora Species	Incidental observation of health during EIM and standard operations. Four-yearly health assessment of each specimen, including recording DBH, height, canopy width, and general health. Photos are also to be taken. The three *Macadamia tetraphylla* that exist in close proximity to the proposed sewerage treatment infrastructure (see ELA 2018a) will be monitored monthly for a period of six months after construction, and then on an annual basis for four years. Monitoring will then occur as part of four yearly health assessments mentioned above.
Koala	Biennial KSAT surveys at five locations, where evidence of koala has previously been observed (**Figure 5**).
Pest Fauna	Incidental observation during EIM and standard operations.
Noisy Miner	Although this monitoring is unrelated to EIM, for efficiency it may be undertaken immediately before events, as part of the standard EIM bird surveys. The method is as per the forest bird survey method in **Table 6**).

Figure 4: Location of EIM surveys

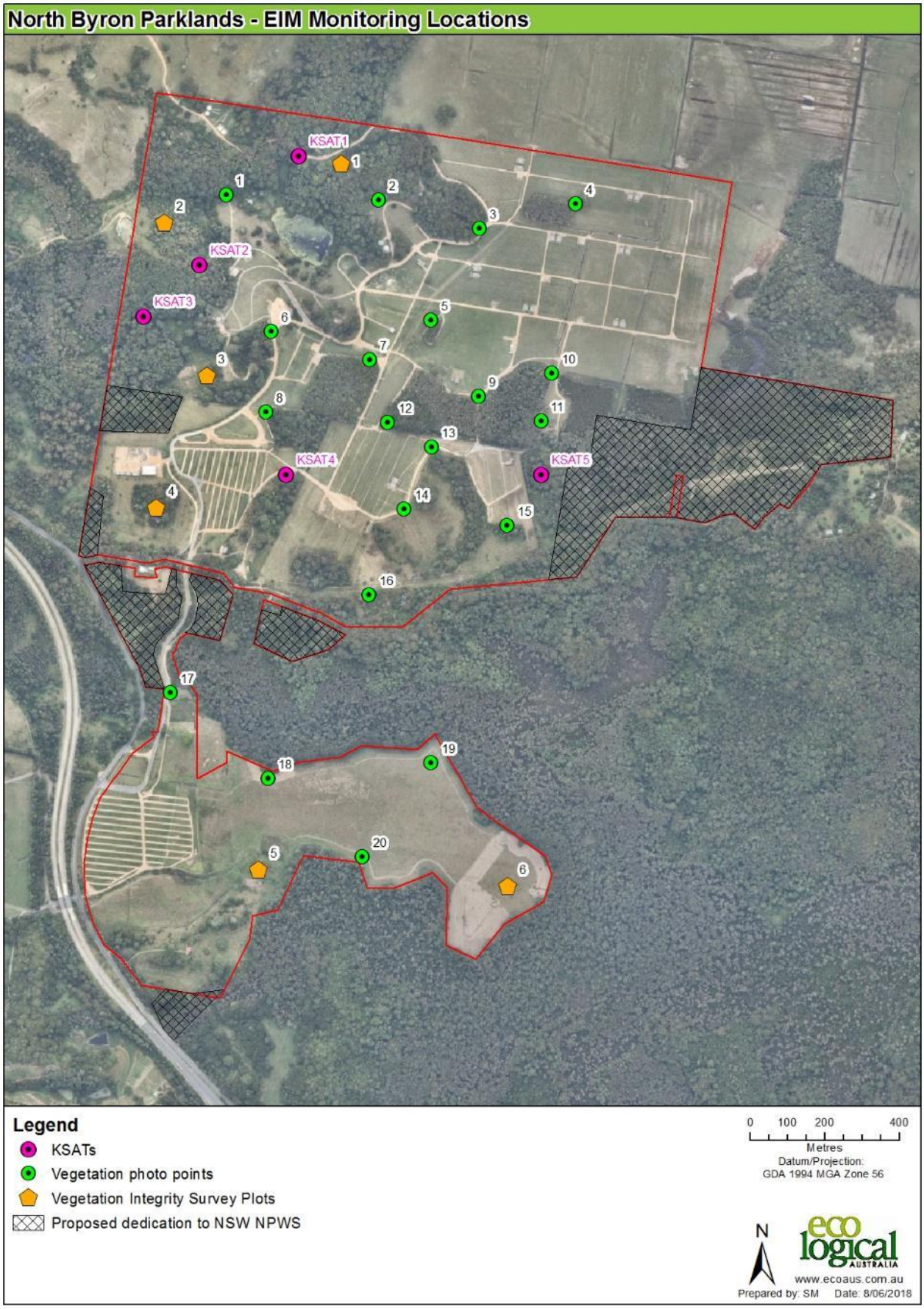

Figure 5: Location of Ongoing Monitoring surveys

3.6 Data analysis and reporting

Previous monitoring effort and data collection was undertaken proceeding, during and following events using the Before-After Control-Impact (BACI) design, to enable evaluation of potential ecological impacts attributable to holding events at the Parklands site. For continuity of data, monitoring will continue the adoption of the BACI design.

Comparison between control and impact sites and through time should be undertaken following each monitoring event. Additionally, trends over time should also be analysed to determine any cumulative declines that are not detectable at a single-event scale.

The following analyses are recommended:

Table 8: Analyses for the EIM program

Target Group	Analysis
Forest Birds	Analyses for changes in the faunal communities will be made using species richness and abundance data. Summary statistics will be calculated as required to compare to trigger actions (see below). Comparisons of threatened species before and after events will be made using appropriate statistical analysis (e.g. ANOVA), where possible.
Eastern Grass Owl and Bush Stone-curlew	
Threatened Microchiropteran Bats	
Koala	
Other species	Other incidental sightings of threatened fauna / road kill and motion sensor cameras will be reported on and qualitatively compared to past records.

Table 9: Analyses for the ongoing monitoring program

Target Group	Analysis
Vegetation	For analyses of native vegetation communities, vegetation integrity scores (as per the BAM) will be compared against PCTs benchmarks. Photo point photos will be compared against photo point photos from previous years. Qualitative analysis of condition, weed abundance and disturbance will be undertaken. The habitat value will also be assessed, with particular attention to koalas.
Target Flora Species	Comparison of presence and health assessments from previous years
Koala	Comparisons of presence absence records.
Pest Fauna	Analyses for changes in the abundance against past observations.
Noisy Miner	Analyses for changes in abundance will be made using abundance data. Summary statistics will be calculated as required to compare to trigger actions (see below).

Results will be assessed against the relative trigger actions outlined in **Table 10**. If data analysis indicates that a trigger has been exceeded (or is likely to be exceeded) an assessment will be made and appropriate responses developed or management measures recommended (see **Section 4.1**).

EIM reports will be prepared after each event that is monitored, or in the case of ongoing monitoring, after the monitoring is undertaken. Reports shall be prepared for both EIM and ongoing monitoring events. Reports shall provide:

- Background to why the monitoring was undertaken
- A description of the event that was monitored (in the case of EIM)
- Monitoring methods
- Monitoring results and data analysis (including historical analysis)
- Assessment of results against triggers for adaptive management and associated management recommendations

4 Adaptive management

The monitoring results will be used to assess any adverse impacts to the targeted species/fauna groups (**Section 3.2.1**) and the associated monitoring objectives (**Section 3.1**). If data analysis indicates a trigger has been exceeded, or is likely to be exceeded, further investigation and risk assessment will be undertaken, and an appropriate response will be prescribed to remediate or prevent further adverse impact (**Table 10**; **Table 12**).

Table 10: Targeted Group/Species Trigger, Action and Response

Targeted Group	Trigger	Action	Responsibility
Threatened birds and microbats	Fauna records display a significant decrease in bird or microbat species richness or abundance from before to during and after event. Fauna records display a significant decrease in bird or microbat species richness or abundance from between years and/or over time. Target bird or bat species are absent from the site for two consecutive monitoring events. Considerations: • Seasonal conditions • Local patterns of food resource abundance • Climatic variations (dry vs wet) • Seasonal movements • Breeding season • Observations of Eastern Grass Owl and Bush Stone-curlew are very rare.	Undertake investigation to determine the extent and cause of trigger exceedance. The prescribed actions will depend on the extent and nature of the impact. For further details see **Table 11**.	On-site ecologist The Parklands Manager
Vegetation	Full floristic monitoring (every four years) shows: • A greater than 10% reduction in floristic composition (allowing for natural variation due to weather etc.) • A greater than 10% increase in exotic species and/or weed cover in impact quadrats in comparison to control quadrats • A reduction in vegetation integrity score by more than 25% from previous score.	Undertake investigation to determine the extent and cause of trigger exceedance. This may be done by revegetation team leader and/or an ecologist. The prescribed actions will depend on the extent and nature of the impact. For further details see **Table 12** and **Table 13**.	On-site reveg team leader or ecologist The Parklands Manager
Threatened Flora	Incidental sightings or formal analysis reveals damage to or decline in health of threatened flora species.	Undertake investigation to determine the extent and cause of trigger exceedance. This may be done by revegetation team leader and/or an ecologist.	On-site reveg team leader or ecologist The Parklands Manager

Targeted Group	Trigger	Action	Responsibility
		The prescribed actions will depend on the extent and nature of the impact. For further details see **Table 12** and **Table 13**.	
Koala	Koala presence has been variable over time, but there is evidence of recent activity. If individuals or evidence of presence are not recorded during the biennial koala surveys, further consideration and/or investigation should be undertaken by an experienced ecologist. Evidence of damage to koala habitats should be responded to. Koala presence to be assessed in comparison with concurrent surveys of the broader area, as per the Byron Coast Koala Management Plan.	Undertake investigation to determine the extent and cause of trigger exceedance. The prescribed actions will depend on the extent and nature of the impact. For further details see **Table 11**.	On-site ecologist The Parklands Manager
Pest Fauna / Noisy Miner	Significant increase in abundance that is likely to lead to other undesirable issues (e.g. hygiene issues, aesthetic issues, high predation or competition with native species)	Undertake investigation to determine the extent and cause of trigger exceedance. Design management plan to reduce impact and abundance of pest fauna.	The Parklands Manager
Other species	Incidental observations of other threatened species	Assess potential impacts of events and formulate management measures if required. Consider integration of targeted methods in next survey.	On-site ecologist The Parklands Manager

4.1 Adaptive management actions

Responses to monitoring results will be required if any of the trigger values in **Table 10** are exceeded. The nature of the response will be scaled according to the extent to which triggers have been exceeded. External factors (e.g. regional population trends, climate variables) will also be considered.

Components of the adaptive management plan are outlined in **Table 11** and **Table 12** below. Adaptive management will be geared towards determining that the objectives listed in **Section 3.1** are met.

Table 11: Adaptive management actions for threatened fauna

Monitored parameter	Extent of trigger exceedance	Action
Threatened bird and microbat species richness and abundance	Significant decrease in either richness or abundance after single event compared to before event data Significant decrease in either richness or abundance after single event compared to previous round of monitoring data	Consider regional drivers of change (e.g. climate, regional population trends) Review on-site actions to determine if the project is contributing to change. If so, implement appropriate changes to event or site management protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, see next row
	Significant decrease in either richness or abundance after two consecutive events compared to before event data Significant decrease in either richness or abundance after two consecutive events compared to previous rounds of monitoring data	Consider regional drivers of change (e.g. climate, regional population trends) Review and address effectiveness of previously implemented changes to protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, see next row
	Significant decrease in either richness or abundance after multiple consecutive events compared to before event data Significant decrease in either richness or abundance after multiple consecutive events compared to previous rounds of monitoring data	Consider regional drivers of change (e.g. climate, regional population trends) Review and address effectiveness of previously implemented changes to protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, continue monitoring and commence discussions with OEH. Prepare and implement rehabilitation program Consider compensatory measures in discussion with OEH
Presence of key threatened fauna species: • Rose-crowned Fruit Dove	Any of key threatened fauna species are absent from monitoring for two consecutive events	Consider regional drivers of change (e.g. climate, regional population trends) Review on-site actions to determine if the project is contributing to absence. If so, implement appropriate changes to event or site management protocols

• Little Bent-wing Bat • Eastern Freetail-bat • Southern Myotis	Any of key threatened fauna species are absent from monitoring for three consecutive events Reasons cannot be attributed to regional driver of change	Review on-site actions to determine if contributing to absence. If so, implement appropriate changes to event or site management protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, see next row
	Any of key threatened fauna species are absent from monitoring for more than three consecutive events Reasons cannot be attributed to regional driver of change	Review and address effectiveness of previously implemented changes to protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, continue monitoring and commence discussions with OEH Prepare and implement rehabilitation program Consider compensatory measures in discussion with OEH
Presence of koala	Absence of individuals and/or no evidence of activity during monitoring	Consult with local koala experts and Byron Shire Council to understand regional drivers of change Review on-site actions to determine if contributing to absence. If so, implement appropriate changes to event or site management protocols Review appropriateness of monitoring extent and frequency. Update as needed Liaise with OEH as appropriate
Damage to koala habitat	As per **Table 12**: Changes in vegetation structure, damage, weed invasion	

Table 12: Adaptive management actions for vegetation communities

Monitored parameter	Extent of trigger exceedance	Action
Changes in vegetation structure, damage, weed invasion	Minor edge effects on vegetation areas e.g. litter, trampling Small-scale weed invasions	Undertake routine vegetation management activities to reduce and remediate impacts
	Vegetation damage e.g. trees damaged, small fire Moderate weed invasions	Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation plan
	Major vegetation damage e.g. large fire, dieback of vegetation, clearing Extensive weed invasions	Notify OEH Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols

Monitored parameter	Extent of trigger exceedance	Action
		Prepare and implement rehabilitation program
Floristics	Trigger exceeded (>10% change in composition; >10% increase in exotic species) AND community continues to meet definition of PCT / EEC	Consider regional drivers of change (e.g. climate) Review on-site actions to determine if the project is contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation program
	Trigger exceeded (>10% change in composition; >10% increase in exotic species) AND community no longer meets definition of PCT / EEC	Consider regional drivers of change (e.g. climate) Review on-site actions to determine if the project is contributing to change. If so, implement appropriate changes to event or site management protocols Notify OEH Prepare and implement rehabilitation program Consider compensatory measures in discussion with OEH

Table 13: Adaptive management actions for threatened flora species

Monitored parameter	Extent of trigger exceedance	Action
Presence and condition of threatened flora species	One individual of a threatened flora species damaged or health declining Isolated occurrence	Undertake routine vegetation management activities / arboricultural assessment to reduce and remediate impacts
	Several individuals of threatened flora species damaged or health declining Occurring at discrete location within Parklands site	Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation program. Seek arborist advice if necessary.
	Numerous individuals of threatened flora species damaged or health declining Occurring across the entire Parklands site	Consider regional drivers of change (e.g. climate) Review on-site actions to determine if the project is contributing to change. If so, implement appropriate changes to event or site management protocols Notify OEH Prepare and implement rehabilitation program Seek arborist advice if necessary Consider compensatory measures in discussion with OEH

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Appendix H - Plot and Transect Data

Table 40: Full floristic plot data

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5						Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Canopy	Tree	Acacia melanoxylon (Blackwood)																																			50	48				
		Araucaria cunninghamii (Hoop Pine)															40	4																								
		Casuarina glauca (Swamp Oak)																					21-50				30	100									2	1				
		Corymbia intermedia (Pink Bloodwood)	<5		6-20		1	1	10	1			60	16	1	1															10	1	15	2								
		Elaeocarpus obovatus (Blueberry Ash)																											10	3												
		Eucalyptus acmenoides (White Mahogany)			6-20		5	3	30	2																							20	3								
		Eucalyptus grandis (Flooded Gum)																			50	4																				
		Eucalyptus microcorys (Tallowwood)			< 5				40	3																																
		Eucalyptus pilularis (Blackbutt)	51-75				30	4			< 5																															
		Eucalyptus propinqua (Small-fruited Grey Gum)			< 5																																					
		Eucalyptus siderophloia (Grey Ironbark)			21-50																												10	3								
		Eucalyptus tereticornis (Forest Red Gum)																											25	1	40	3			30	3						
		Guioa semiglauca (Guioa)																																					2	10		
		Lophostemon confertus (Brush Box)	6-20				10	3							40	9																										
		Lophostemon suaveolens (Swamp Mahogany)																											10	10	5	1										
		Melaleuca quinquenervia (Broad-leaved Paperbark)											5	1									21-50		51-75		30	100			5	2										
		Macadamia tetraphylla																																					1	5		
		Mangifera indica (Mango)																																					30	2		
		Syncarpia glomulifera (Turpentine)			6-20		10	8													20	20																				

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5				Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Mid-storey	Tree	Acacia disparrima (Hickory Wattle)									1								40	20													10	7	5	2				
		Acacia longifolia (Sydney Golden Wattle)																																						
		Acacia melanoxylon (Blackwood)																	5	1											0	1	1	10						
		Acacia obtusifolia (Blunt Leaf Wattle)			1		1	2			1																													
		Acmena smithii (Lilly Pilly)																					1		6-20															
		Acronychia imperforata (Logan Apple)			<5																																			
		Acronychia oblongifolia (White Aspen)																									1	1												
		Allocasuarina torulosa (Forest Oak)									<5																													
		Alyxia ruscifolia (Prickly Alyxia)													1	1																								
		Araucaria cunninghamii (Hoop Pine)													1	1																								
		Archontophoenix cunninghamiana (Bangalow Palm)																													2	1								
		Austromyrtus dulcis (Midgen Berry)									<5		1	5																										
		Austrosteenisia blackii (Blood Vine)													1	1																								
		Bursaria spinosa (Blackthorn)	<5																																				
		Callicarpa pedunculata (Velvet Leaf)	1																																				
		Callistemon salignus (Willow Bottlebrush)																															10	1					
		Cayratia clematidea (Native Grape)							2	40											1	3																		
		Cinnamomum camphora (Camphor Laurel)	6-20								<5				5	3							6-20		6-20						3	50					40	17	
		Cirsium vulgare (Spear Thistle)							1	5																														
Mid-storey	Shrub	Citrus sp. (Citrus)																																						
		Commersonia bartramia (Brown Kurrajong)																															1	1						
		Cordyline rubra (Palm-lily)									1																													
		Cordyline stricta (Narrow-leaved Palm Lily)													1	5																								

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5						Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
		Croton verreauxii (Green Native Cascarilla)																																								
		Cryptocarya microneura (Thick-leaved Laurel)																															1	1								
		Cryptocarya microneura (Murrogun)			1						<5		1	1	5	20					1	1																				
		Cryptocarya rigida (Forest Maple)	<5		1		1	1			1		1	5																												
		Cryptocarya triplinervis var pubens																																								
		Cupaniopsis anacardioides (Tuckeroo)	<5						1	10			1	1	1	1					5	50							0	1	1	1	1	2								
		Cupaniopsis parvifolia (Small-leaved Tuckeroo)											1	1																												
		Cyclophyllum longipetalum (Coast Canthium)	1												1	5																										
		Decaspermum humile (Silky Myrtle)					1	1																																		
		Denhamia celastroides (Orange Boxwood)	<5		<5						<5																															
		Doodia aspera (Prickly Rasp Fern)	6-20												5	50																										
		Duboisia myoporoides (Corkwood)																																	1	2						
		Echinostephia aculeata											1	1																												
		Elaeocarpus obovatus (Blueberry Ash)																													1	1										
		Endiandra discolor (Rose Walnut)									<5																															
		Endiandra globosa (Black Walnut)											5	1	1	2																										
		Eupomatia laurina (Copper Laurel)			<5						<5		1	10	1	5													1	2	1	5										
		Euroschinus falcatus (Ribbonwood)																																	1	1						
		Eustrephus latifolius (Wombat Berry)	<5																																						
		Ficus fraseri (Sandpaper Fig)																																	1	1					1	2
		Flindersia bennettii (Bennett's Ash)													1	1																										
		Flindersia schottiana (Cudgerie)									1		1	1																												
		Geitonoplesium cymosum (ground cover) (Scrambling Lily)	1		<5				1	10					1	10					10	1			1				0	5			3	5	1	5						

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5				Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
		Glochidion ferdinandi (Cheese Tree)																			1	1			1																	
		Glochidion sumatranum (Umbrella Cheese Tree)																					<5		<5						5	5							<5	1
		Guioa semiglauca (Guioa)	<5		6-20						<5										1	1	<5					5	6	10	16	5	1	10	20						
		Hovea acutifolia (Purple Pea Bush)					1	4			<5		1	5																												
		Jagera pseudorhus (Foam Bark Tree)	<5				1	1			1				1	2			1	2													1	1								
		Lantana camara (Lantana)	<5		<5		1	3			<5				1	5			40	10	5	20					2	1			1	1	5	10	1	50					3	3
		Litsea australis (Brown Bolly Gum)																																								
		Lophostemon confertus (Brush Box)			<5						21-50								1	1																						
		Lophostemon suaveolens (Swamp Mahogany)																					6-20				1	1			5	1										
		Macaranga tanarius (Nasturtium Tree)																	1	2											5	1										
		Maclura cochinchinensis (Cockspur Thorn)	<5		<5						<5										5	20	1		<5				0	5	1	1	3	5	10	10					<5	3
		Marsdenia rostrata (Milk Vine)			<5		1	2	1	25	<5												<5						0	3												
		Mallotus discolor (White Kamala)									1																															
		Mallotus philippensis (Red Kamala)																	1	10											4	1									<5	1
		Melicope elleryana (Pink-flowered Doughwood)																	2	1			<5		<5						1	1	5	5								
		Melodinus australis (Southern Melodinus)									1																															
		Morinda jasminoides (ground cover) (Sweet Morinda)			1						1												<5		<5		1	1	0	3	1	1	3	10								
Mid-storey	Shrub	Notelaea longifolia (Large-leaved Olive)	<5		<5		2	3			1		1	5																	2	3	0	1								
		Ochna serrulata (Mickey Mouse Plant)			1																												1	10								
		Pararchidendron pruinsoum (Snow Wood)	1								1																															
		Passiflora suberosa (Cork Passionflower)							1	20	<5																								1	5					1	1
		Phyllanthus gunnii (Scrubby Spurge)	<5																1	1																						

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5				Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
		Pilidiostigma glabrum (Plum Myrtle)									<5		5	25	1	5															1	1						
		Pittosporum revolutum (Wild Yellow Jasmine)													1	1											2	2										
		Pittosporum undulatum (Native Daphne)			<5		2	9			<5		1	5										<5			1	2	1	1	5	5					<5	1
		Polyscias elegans (Celery Wood)			<5																								1	1			1	1				
		Psychotria loniceroides (Hairy Psychotria)	<5												1	1											0	1										
		Rapanea variabilis	<5												1	1																						
		Rhodamnia rubescens (Scrub Turpentine)	<5												1	1								<5														
		Ripogonum elseyanum (Hairy Supplejack)													5	50																						
		Schefflera actinophylla (Umbrella Tree)					1	1																													0	1
		Sida rhombifolia (Paddy's Lucerne)							1	50																												
		Senna pendula var. glabrata (Easter Cassia)													1	2										5	10	1	1	1	1	2	1	25	5	2	1		
		Syagrus romanzoffiana (Queen Palm)					1	2																														
		Synoum glandulosum (Scentless Rosewood)	<5		1						<5		10	50	5	20													5	10	20	10						
		Syzygium oleosum (Blue Lilly Pilly)									1																											
		Wilkiea huegeliana (Veiny Wilkiea)													1	10																						
Ground	Climber	Cissus antarctica (Kangaroo Vine)																									0	4			1	5	3	5				
		Commelina diffusa (Climbing Dayflower)															1	1																				
		Eustrephus latifolius (Wombat Berry)									<5																											
		Geitonoplesium cymosum (Scrambling Lily)					5	50															1			1	3			0	5						
		Hibbertia dentata (Trailing Guinea Flower)	1																																			
		Hibbertia scandens (Climbing Guinea Flower)			1		1	2					1	2							1	1	1		<5						0	1						
		Ipomoea cairica (Coastal Morning Glory)																							1		5	1										
		Marsdenia rostrata (Milk Vine)					2	10							1	10													1	40	2	5	1	5				

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5				Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
		Pandorea pandorana (Wonga Vine)			1																1	1					0	5			0	2								
		Parsonsia straminea (Common Silkpod)													1	5							<5		<5		1	20	0	10										
		Passiflora edulis (Common Passionfruit)																											0	3										
		Passiflora suberosa (Cork Passionflower)	1		<5												1	1	0	5									0	1										
		Smilax australis (Lawyer Vine)	<5		<5		1	1			1		1	1	1	5					1	5	<5		<5				0	3	1	3	1	5	1	1			<5	1
		Smilax glyciphylla (Sweet Sarsaparilla)					1	10					1	5													1	1												
		Stephania japonica var. discolor (Snake Vine)			<5						<5												1		1				0	1			0	3						
	Fern	Adiantum aethiopicum (Common Maidenhair)																																						
		Adiantum hispidulum (Rough Maidenhair Fern)																																					<5	20
		Asplenium australasicum (Bird's Nest Fern)											1	1									<5																<5	1
		Blechnum cartilagineum (Gristle Fern)			6-20						1		40	50	5	50																	10	50						
		Blechnum indicum (Swamp Water Fern)																							1															
		Calochlaena dubia (Rainbow Fern)													1	5									1						10	40								
		Cyclosorus interruptus																					<5		1														<5	5
		Lygodium japonicum																																					<5	3
Ground	Fern	Davallia pyxidata (Hare's-foot Fern)					1	10							5	50																								
		Doodia aspera (Prickly Rasp Fern)			6-20						6-20																													
		Platycerium bifurcatum (Elkhorn Fern)															1	1																						
		Platycerium superbum (Staghorn)															1	1					<5																	
		Pteridium esculentum (Common Bracken)					2	5																																
		Pyrrosia rupestris (Rock Felt Fern)					1	1																																
	Seedling	Acacia disparrima															1	1																						
		Alchornea ilicifolia (Dovewood)															1	1																						
		Alphitonia excelsa (Red Ash)			1																																			

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5						Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
		Cinnamomum camphora (Camphor Laurel)			1		1	2	1	1											1	10																			2	100
		Cupaniopsis anacardioides (Tuckaroo)			1		1	1									1	1						1																		
		Elaeocarpus obovatus (Blueberry Ash)			1																																					
		Ficus coronata (Sandpaper Fig)																					<5		<5						0	1										
		Ficus obliqua (Small-leaved Fig)									1																															
		Ficus rubiginosa																																							<5	1
		Flindersia australis (Crows Ash)															1	1																								
		Glochidion sumatranum (Umbrella Cheese Tree)																			1	1								5	10										
		Guioa semiglauca (Guioa)																			1	1																				
		Hovea acutifolia	1		1																																					
		Hovea longifolia (Rusty Pods)																																	1	3						
		Jagera pseudorhus (Foam Bark Tree)			1																		1																		
		Lantana camara (Lantana)															5	5					1																		
		Phyllanthus gunnii (Scrubby Spurge)			<5																																				
		Psidium guajava (Common Guava)																	1	2																					
		Psychotria loniceroides (Hairy Psychotria)			<5																									1	1										
		Rubus hillii																						1		0	3														
		Senna pendula var. glabrata (Easter Cassia)																	2	20				1									5	4						
		Solanum stelligerum (Devil's Needles)	1																																						
		Syagrus romanzoffiana (Queen Palm)																	1	1											3	2	1	2						
		Synoum glandulosum (Scentless Rosewood)																										0	3											
		Toechima dasyrrhache (Blunt-leaved Steelwood)	1																																						
		Wilkiea huegeliana (Veiny Wilkiea)									<5													1																	
	Forb	Ageratina adenophora (Crofton Weed)																	5	500																					

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5						Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
		Ageratum houstonianum (Blue Billy-goat Weed)																																	1	10				
		Ageratina riparia (Mistflower)			1														5	100											0	1							5	30
		Alpinia caerulea (Native Ginger)			1																																			
		Bidens pilosa (Cobbler's Pegs)							1	1																														
		Centella asiatica (Indian Pennywort)							1	50																					0	10								
		Commelina salicifolia (Asiatic Dayflower)							1	20							1	1																						
		Crassocephalum crepidioides (Thickhead)															1	1																						
		Cuphea carthagenensis															5	200					<5																	
		Cymbidium madidum	1																																				
		Dianella caerulea (Blue Flax-lily)			1		1	1															1		1								1	5					
		Dioscorea transversa (Native Yam)	<5		1		1	1	1	1	<5		1	2																	0	1								
Ground	Forb	Entolasia stricta (Wiry Panic)									1																													
		Gymnostachys anceps (Settlers' Twine)			1																																			
		Hibiscus diversifolius (Swamp Hibiscus)	1																																				
		Hybanthus monopetalus (Slender Violet-bush)			1																																			
		Lomandra confertifolia su bsp. pallida	1		<5																														1	5				
		Lomandra longifolia (Spiny-headed Mat-rush)	1				1	1	1	1																														
		Lomandra multiflora (Many-flowered Mat-rush)					2	20																																
		Oxalis sp.			1				1	50																														
		Pratia purpurascens (White Root)			1																																			
		Pseuderanthemum variabile (Pastel Flower)	<5		<5						<5																													
		Rumex sp.							1	20																														
		Tripladenia cunninghamaii	1		<5						<5																													
		Verbena bonariensis (Purpletop)																																			1	3		

Stratum	Form	Species name	Zone 1								Zone 2								Zone 3		Zone 4		Zone 5				Zone 6								Zone 7		Cleared / non-native			
			Plot 14		Plot 15		Plot 23		Plot 29		Plot 13		Plot 24		Plot 26		Plot 28		Plot 27		Plot 30		Plot 3		Plot 4		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36		Plot 37		Plot 31		Plot 38	
			C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
		Viola hederacea (Ivy-leaved Violet)			1																		< 5		< 5																
	Grass	Andropogon virginicus																																					0	2
		Imperata cylindrica (Blady Grass)			1		1	5	1	10																														
		Melinis minutiflora (Molasses Grass)																	1	5																				
		Oplismenus hirtellus var. imbecillis (Creeping Beard Grass)	1		< 5						< 5												< 5		< 5															
		Ottochloa gracillima					1	50					1	50	5	100	1	1	1	10	1	50					0	5	5	50			2	40					1	50
		Panicum species	1		< 5																										2	20	0	3	20	100				
		Paspalum distichum (Water Couch)	1						15	10													1																	
		Paspalum mandiocanum (Broadleaf Paspalum)															90	2000			70	2000					80		1	10			10	30	20	50			75	600
		Paspalum urvillei (Vasey Grass)																																			10	20		
		Setaria sphacelata (South African Pigeon Grass)															1	1	1	1															90		80	2000		
	Sedge	Carex spp																					< 5		< 5															
		Gahnia clarkei (Tall Saw-sedge)																			1	1																		
		Xanthorrhoea fulva					10	50					1	1																										
		Xanthorrhoea latifolia									1																													
	Shrub	Desmodium uncinatum (Silver-leaved Desmodium)																	1	1																				
		Echinostephia aculeata																																						
		Ochna serrulata																																					1	20
		Rapanea variabilis			< 5												1	1																						
		Solanum mauritianum (Wild Tobacco Bush)															1	1																						
		Trochocarpa laurina (Tree Heath)															1	1																						
		Trema tomentosa (Native Peach)															1	1																						
		Zieria smithii	1		1						< 5		1	5																										

C = % cover, A = Abundance

Table 41**: Plot and transect data**

Element	Zone 1				Zone 2				Zone 3	Zone 4	Zone 5				Zone 6					Zone 7	Exotic Grassland, No zone
	Plot 14	Plot 15	Plot 23	Plot 29	Plot 13	Plot 24	Plot 26	Plot 28	Plot 27	Plot 30	Plot 3	Plot 4	Plot 31	Plot 32	Plot 25	Plot 33	Plot 34	Plot 35	Plot 36	Plot 37	0
Number of native plant species	37	49	29	12	41	25	30	12	9	16	25	25	31	12	18	23	25	32	21	3	0
Native over-storey cover (%)	35	35	35.5	48.5	38.5	56.5	51	32	30	40	33	31.5	39.5	30	9.5	20	25.4	27.5	19.3	48	0
Native mid-storey cover (%)	58.5	34	32.5	8	28	44	63	1	0	38.5	34.5	35	32	28.5	41.5	42.5	29	31.5	20	12	0
Exotic over-storey cover (%)	0	0	0	0	0	1	0	10	5	0	29.5	2.5	13.5	0	0	0	0	0	0	0	0
Exotic mid-storey cover (%)	7	6.5	2	0	13	0	0	2	50	1	10.5	1.5	1.5	2	3.5	1	0	5	6	0	0
Native ground cover (hits/50 points) – Grasses	10	4	0	6	20	0	2	0	5	0	14	64	20	8	0	46	26	38	40	0	0
Native ground cover (hits/50 points) – shrubs	0	2	6	2	4	2	6	0	0	0	0	0	4	2	0	0	2	4	0	0	0
Native ground cover (hits/50 points) – other	18	54	30	6	24	27	40	0	0	0	24	22	14	0	34	8	8	12	0	0	0
Exotic ground cover (%)	1	4.5	4	71	6	1	0.5	96	30	34	24.5	5	4.5	27.3	49	2.3	0	4.3	12	33.3	90
Number of trees with hollows	1	2	1	2	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Over-storey regeneration	None	None	Lophostemon only (20%)	None	None	None	None	None	None	None	Camphor only with 5 percent cover	Camphor only 5 percent of ground layer	Camphor with 5 percent ground cover	0.8 (most spp.)	All overstorey spp (100%)	None	None	None	None	None	None
Total length fallen logs >10cm width (m)	13	48	15	0	51	11	33	33	0	43	83	88	82	0	0	15	9	35	0	0	0
Easting (meters, GDA1994)	550794	551039	551296	550978	550657	551026	550617	550789	550535	550780	551532	551531	550974	551998	550750	551775	551589	551662	552042	552252	550956
Northing (meters, GDA1994)	6850940	6850890	6850780	6850530	6850960	6850760	6850870	6850720	6850780	6850410	6850340	6850820	6850390	6850280	6850380	6850130	6850130	6850100	6850050	6850150	6849220
Zone	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56

Appendix I - EEC and TEC Descriptions

Information sheets from OEH and DoE

Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions - profile

Scientific name: *Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions*

Conservation status in NSW: **Endangered Ecological Community**

Commonwealth status: **Critically Endangered**

Gazetted date: 22 Dec 2006
Profile last updated: 06 Jun 2017

Description

Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions is an ecological community of subtropical rainforest and some related, structurally complex forms of dry rainforest. Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees are taxonomically diverse at the genus and family levels, and some may have buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. In disturbed stands of this community the canopy cover may be broken, or the canopy may be smothered by exotic vines.

Indicative distribution

The areas shown in pink and/purple are the sub-regions where the species or community is known or predicted to occur. They may not occur thoughout the sub-region but may be restricted to certain areas. (**click here** to see geographic restrictions). The information presented in this map is only indicative and may contain errors and omissions.

Distribution

The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions. South of the Sydney metropolitan area, Lowland Rainforest is replaced by Illawarra Subtropical Rainforest of the Sydney Basin Bioregion, which is listed as an endangered ecological community. Milton Ulladulla Subtropical Rainforest is also a related rainforest endangered ecological community that occurs still further south in the South East Corner Bioregion.

Regional distribution and habitat

Click on a region below to view detailed distribution, habitat and vegetation information.

- **Hawkesbury-Nepean**
- **Hunter-Central Rivers**
- **Northern Rivers**

Threats

- Extensive clearing of Lowland Rainforest has resulted in fragmentation and loss of ecological connectivity. The integrity and survival of small, isolated stands is impaired by the small population size of many species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations.
- Weed invasion also poses a major threat to Lowland Rainforest, with introduced vines and scramblers having particularly serious impacts. Exotic species form dense thickets capable of smothering indigenous plants, reducing both reproduction and survival.
- Inappropriate fire regimes associated with burning off and hazard reduction pose a threat to the margins of rainforest stands and the entirety of small stands in fragmented landscapes.
- Grazing by livestock, potential impacts of anthropogenic climate change and impacts associated with human interaction; including soil compaction, possible spread of pathogens, clearing of understorey and inappropriate collection of plant species.

Recovery strategies

A targeted strategy for managing this species has been developed under the Saving Our Species program; click **here** for details. For more information on the Saving Our Species program click **here**

Activities to assist this species

- Ensure remnants remain connected or linked to each other; in cases where remnants have lost connective links, re-establish them by revegetating sites to act as stepping stones for fauna, and flora (pollen and seed dispersal).
- Manage weed populations.
- Protect against inappropriate fire regimes associated with burning off and hazard reduction burns.
- Reduce grazing by livestock and minimise environmental impacts associated with human interaction.

Related information

Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion - endangered ecological community listing. Fi determination DEC (NSW), Sydney.

SPRAT Profile: Lowland Rainforest of Subtropical Australia

GET INVOLVED

REPORT A SIGHTING

Approved Conservation Advice for the Lowland Rainforest of Subtropical Australia

(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

This Conservation Advice has been developed based on the best available information at the time this Conservation Advice was approved; this includes existing plans, records or management prescriptions for this ecological community.

Description

Location

The **Lowland Rainforest of Subtropical Australia** ecological community primarily occurs from Maryborough in Queensland to the Clarence River (near Grafton) in New South Wales (NSW). The ecological community also includes isolated areas between the Clarence River and Hunter River such as the Bellinger and Hastings Valleys.

Physical environment

The ecological community occurs on basalt and alluvial soils, including sand and old/elevated alluvial soils as well as floodplain alluvia. It also occurs occasionally on historically enriched rhyolitic soils and basaltically enriched metasediments. Lowland Rainforest mostly occurs in areas <300 m above sea level. Aspect can result in the community being found at >300 m altitude on north-facing slopes, but typically 300 m defines the extent of the lowlands. In addition, Lowland Rainforest typically occurs in areas with high annual rainfall (>1300 mm).

The ecological community is differentiated from the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community (hereafter referred to as Littoral Rainforest) by the level of coastal or estuarine influence (such as windshear). Lowland Rainforest of Subtropical Australia typically occurs more than 2 km from the coast, however, it can (and does) intergrade with Littoral Rainforest in some coastal areas.

Vegetation structure

The ecological community is generally a moderately tall (≥20 m) to tall (≥30 m) closed forest (canopy cover ≥70%). Tree species with compound leaves are common and leaves are relatively large (notophyll to mesophyll). Typically there is a relatively low abundance of species from the genera *Eucalyptus*, *Melaleuca* and *Casuarina*. Buttresses are common as is an abundance and diversity of vines.

The ecological community has the most diverse tree flora of any vegetation type in NSW (Floyd, 1990) and the species composition of the canopy varies between local stands and between regions (Keith, 2004). The canopy comprises a range of tree species but in some areas a particular species may dominate e.g. palm forest, usually dominated by *Archontophoenix cunninghamiana* (bangalow palm) or *Livistona australis* (cabbage palm); and riparian areas dominated by *Syzygium floribundum* (syn. *Waterhousea floribunda*) (weeping satinash/weeping lilly pilly).

The canopy is often multilayered consisting of an upper, discontinuous layer of emergents, over the main canopy and subcanopy. Below the canopy is an understorey of sparse shrubs and seedlings.

The upper, discontinuous layer includes **canopy emergents** that may be 40–50 m tall and have large spreading crowns. This layer is composed of species such as *Araucaria cunninghamii* (hoop pine), *Ficus* spp. (figs), *Lophostemon confertus* (brushbox), and in some sites, *Eucalyptus* spp.. Typically non-rainforest species such as eucalypts and brushbox comprise <30% of canopy emergents.

The **canopy/subcanopy layer** contains a diverse range of species. Representative species include: hoop pine, figs, *Argyrodendron trifoliolatum/ Heritiera trifoliolata* (white booyong), *Castanospermum australe* (black bean), *Cryptocarya obovata* (white walnut, pepperberry tree), *Dendrocnide excelsa* (giant stinging tree), *Diploglottis australis* (native tamarind), *Dysoxylum fraserianum* (rosewood), *Dysoxylum mollissimum* (red bean), *Endiandra pubens* (hairy walnut), *Elattostachys nervosa* (green tamarind), *Flindersia schottiana* (bumpy ash, cudgerie, silver ash), *Gmelina leichhardtii* (white beech), *Neolitsea dealbata* (white bolly gum), *Neolitsea australiensis* (bolly gum), *Sloanea australis* (maiden's blush), *Sloanea woolsii* (yellow carabeen), *Toona ciliata* (red cedar), and epiphytes such as *Platycerium* spp. and *Asplenium australasicum* (bird's nest fern).

In areas where the canopy is lower (<25 m) due to coastal or estuarine influences the Littoral Rainforest ecological community typically replaces the Lowland Rainforest ecological community.

The **understorey** contains a sparse layer of species such as *Cordyline stricta* (narrow-leaved palm lily), *Linospadix monostachya* (walking stick palm), *Neolitsea dealbata* (white bolly gum), *Notelaea johnsonii* (veinless mock olive), *Pittosporum multiflorum* (orange thorn), *Triunia youngiana* (native honey-suckle bush), *Wilkiea austroqueenslandica* (smooth wilkiea) and *Wilkiea huegeliana* (veiny wilkiea) as well as seedlings of a variety of canopy species. A variety of vines may be present such as *Calamus muelleri* (Southern lawyer vine), *Cissus antarctica* (native grape vine, water vine), *Cissus hypoglauca* (giant water vine), *Dioscorea transversa* (native yam), *Flagellaria indica* (whip vine), *Morinda jasminoides* (sweet morinda), *Pandorea floribunda* (wonga wonga vine) and *Smilax australis* (sarsaparilla). Ferns such as *Adiantum hispidulum* (rough maidenhair fern), *Doodia aspera* (rasp fern), *Lastreopsis decomposita* (trim shield fern) and *Lastreopsis marginans* (bordered shield fern, glossy shield fern) may also be present.

Fauna

Lowland Rainforest is characterised by a high proportion of frugivorous birds, epiphyte and litter foraging vertebrates, micro- and mega-chiropteran bats, and a broad range of invertebrate groups associated with the decomposition cycle (such as insects and snails).

A more comprehensive description of the ecological community is contained in the Listing Advice which is available on the Internet at:
http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl

Conservation Status

The Lowland Rainforest of Subtropical Australia ecological community is listed as **critically endangered**. This ecological community is eligible for listing as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as, the Minister has considered the Threatened Species Scientific Committee's (TSSC) advice (TSSC, 2011) and amended the list under section 184 to include the Lowland Rainforest of Subtropical Australia ecological community. The TSSC determined that this ecological community met criteria 1, 2, 3 and 4 of the eligibility criteria for listing as threatened under the EPBC Act because its decline in geographic distribution is severe; its very restricted geographic distribution makes it likely that the action of a threatening process could cause it to be lost in the immediate future; it has undergone a severe decline in functionally important species; and because the reduction in integrity across most its range is severe, as indicated by degradation of the ecological community.

Distribution and Habitat

The ecological community primarily occurs from Maryborough in Queensland to the Clarence River (near Grafton) in NSW. The ecological community also includes isolated areas between the Clarence River and Hunter River such as the Bellinger Valley. Patches of Lowland Rainforest are generally small in size (<10 ha). The ecological community occurs in the following Interim Biogeographic Regionalisation for Australia Version 6.1 (IBRA) Bioregions: South Eastern Queensland Bioregion and NSW North Coast Bioregion.

The ecological community is known to occur in the following Natural Resource Management (NRM) and Catchment Management Authority (CMA) regions: SE Queensland Catchments, Burnett Mary Regional Group, Hunter-Central Rivers and Northern Rivers.

Lowland rainforest mostly occupies areas on highly fertile basaltic and alluvial soils. These areas have been heavily cleared as they are the most suitable for agricultural use.

Most of the remaining patches of this ecological community are small and scattered.

The ecological community provides habitat for a large number of animals including a high proportion of frugivorous birds and large number of threatened species.

Threats

The main ongoing threats to the ecological community include: vegetation clearance, impacts associated with fragmentation of remnants and weeds.

The **Lowland Rainforest of Subtropical Australia** ecological community has been extensively cleared for agricultural purposes because it primarily occurs on flat and relatively fertile soils. Clearing has dramatically decreased its extent and the resulting fragmentation has made the ecological community more vulnerable to threats such as weed invasion.

Weeds compete with native species for space, light, water and nutrients. They also suppress and out-compete mid-storey and canopy trees.

Ongoing incremental clearing of vegetation for agricultural activities (in particular macadamias and fruit crops), horticultural industry (and the subsequent introduction of new potential weeds), hobby farming, peri-urban and rural residential development (including vegetation removal for bush fire protection) and also private native forestry are further adding to isolation and fragmentation of Lowland Rainforest remnants.

Urbanisation results in impacts such as the invasion of bushland by domestic dogs and cats, rubbish dumping, trampling, garden escapes, firewood collection, impacts from vehicles, the creation of informal trails, and arson. Urbanisation also increases pressure to reduce bushfire fuel loads that may be detrimental to the ecological community.

More detail about these threats is contained in the Listing Advice which is available on the Internet at:
http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl

The following EPBC Act listed Key Threatening Processes are considered relevant to Lowland Rainforest of Subtropical Australia:

- Land clearance;
- Predation by European red fox;
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants and;
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Rhinella marina*).

Research Priorities

Research priorities that would inform future regional and local priority actions include:

- Undertake surveys to locate and map remnants and other occurrences of the ecological community, as well as threatened species that occur in the ecological community.
- Design and implement a monitoring program or, if appropriate, support and enhance existing programs for the ecological community and associated threatened species.
- Further develop sustainable management guidelines and technical material to assist landowners, including measures to address inappropriate fertiliser application, stock management, ecological fire management and spray drift.
- Develop effective control methods for the most damaging weed species that infest the ecological community e.g. madeira vine (*Anredera cordifolia*), cats claw creeper (*Macfadyena unguis-cati*), morning glory (*Ipomoea* spp.), wandering jew (*Tradescantia fluminensis*), climbing asparagus (*Asparagus plumosus*), ochna (*Ochna serrulata*) and small-leaved privet (*Ligustrum sinense*).
- Investigate the importance of landscape scale geneflow and its implications for management of remnants, associated fauna, plant and animal interactions and longer term ecological function. This includes research into optimal distances between remnants and remnant sizes that are crucial for a range of flora and fauna movements.
- Undertake research, monitoring and evaluation to determine the relative biodiversity, conservation benefits of remnants, areas of regeneration and supplementary planting.
- Assess the vulnerability of the ecological community to climate change.
- Investigate the likely impacts of nearby eucalypt plantations on groundwater and fire potential of the ecological community.
- Undertake analysis of cost effectiveness of landscape connectivity and the importance of small isolates.

Priority Actions

The following priority recovery and threat abatement actions should be done to support the recovery of the **Lowland Rainforest of Subtropical Australia** ecological community.

Habitat Loss, Disturbance and Modification

- Protect and conserve remaining areas of the ecological community. Further clearance and fragmentation of this critically endangered ecological community should be avoided.
- Maintain and reconnect wildlife corridors or linkages and ensure that areas of particularly high quality, connectivity or importance in a landscape context, are protected.
- Investigate formal conservation arrangements, management agreements and covenants on private land and, for crown and private land, investigate inclusion in reserve tenure. This is particularly important for areas that link patches and create wildlife corridors.
- Monitor the progress of recovery, through improved mapping, estimates of extent and condition assessments of the ecological community, and effective adaptive management actions.
- Implement appropriate management regimes to maintain the biodiversity, including the threatened species, of the ecological community.
- Manage any adverse effects on groundwater and altered fire potential due to nearby eucalypt plantations e.g. ensure appropriate fuel load and fire break management is undertaken to minimise the risk of fire in the ecological community.
- Develop and implement best practice standards for management of the ecological community on private and public lands.
- Liaise with local councils and state authorities to ensure new developments, road widening, maintenance activities, or other activities involving substrate or vegetation disturbance in areas where the ecological community occurs, do not adversely impact the ecological community.
- Liaise with planning authorities to ensure that planning takes the protection of the ecological community into account, with due regard to principles for long-term conservation.
- Include buffer zones between the ecological community and development zones and areas undergoing pasture development or cultivation.
- Involve landowners in, and promote community programs that assist with, the conservation of the ecological community.

Impacts from residential and peri-urban development

- Fence significant remnants in or adjacent to residential areas and limit access for vehicles and pets.
- Exclude fire.
- Develop education programs, information products and signage to help the public recognise the presence and importance of the ecological community, and their responsibilities under state and local regulations and the EPBC Act.
- Encourage local patch management through local conservation groups (e.g. Bushcare/Landcare).

Invasive Species

- Target control of key existing weeds which threaten the ecological community, using appropriate methods. Manage sites to prevent the introduction of new, or further spread of existing, invasive weeds.
- Implement staged removal of camphor laurel (*Cinnamomum camphora*) to provide site stability and on-going functionality to facilitate regeneration.
- Discourage the clearing of camphor laurel using heavy machinery. This style of weed control does not help the recovery of the ecological community unless it incorporates ecological restoration as an integrated component of the action.
- Ensure chemicals, or other mechanisms used to manage weeds, do not have significant adverse, non-target impacts on the ecological community.
- Control introduced pest animals to allow natural regeneration and to manage threats, especially to threatened species, at known sites through coordinated landscape-scale control programs.

Trampling, Browsing or Grazing

- Ensure that livestock are excluded from patches of the ecological community, through exclusion fencing or other barriers.

Fire

- Discourage the use of fire as a means to control lantana or other weeds in or near to rainforest remnants.
- Ensure that managed fires and, where possible, wildfires do not enter buffer zones around remnants.
- Negotiate appropriate standing procedures with local fire brigades, in relation to establishing fire control lines in native vegetation areas, to avoid unnecessary destruction of the ecological community.

Conservation Information

- Develop sustainable management guidelines and technical material to assist landowners, including measures to address inappropriate fertiliser application, stock management, weed management and spray drift.
- Raise awareness of the ecological community within State Government authorities (including Natural Resources Management/ Catchment Management Authorities) and the local community (e.g. through active Conservation Management Networks, Landcare groups and other groups), as well as local councils.
- Raise awareness about the importance of large trees, and coarse woody debris (dead trees, logs) as faunal habitat.
- Maintain liaison with private landholders and land managers of land on which the ecological community occurs.

Enable Recovery of Additional Sites

- Patches of the Lowland Rainforest ecological community should be considered a priority for conservation funding (priority repair sites are identified in the Border Ranges Rainforest Biodiversity Management Plan (DECCW, 2010)).
- Plant local indigenous rainforest species to facilitate landscape processes and regeneration.
- Investigate options to maintain and improve connectivity, including the protection of paddock trees and the replanting of key canopy tree species.
- Develop seed harvesting and propagation techniques (having acquired the necessary permits required) for Lowland Rainforest species not already available from rainforest nurseries to facilitate the species diversity in revegetation sites.
- Ensure that any revegetation is undertaken in an appropriate manner.

This list does not necessarily encompass all actions that may be of benefit to the **Lowland Rainforest of Subtropical Australia** ecological community, but highlights those that are currently considered to be a priority.

Existing Plans/Management Prescriptions that are Relevant to the Ecological Community

- Big Scrub Rainforest Landcare Group (2005). Subtropical Rainforest Restoration: A practical manual and data source for landcare groups, land managers and rainforest regenerators. Big Scrub Rainforest Landcare Group, Bangalow NSW.
- Big Scrub Rainforest Landcare Group (2008). Common weeds of subtropical rainforests of eastern Australia. Big Scrub Rainforest Landcare Group, Bangalow NSW.
- DECCW (2010). Border Ranges Rainforest Biodiversity Management Plan - NSW and Queensland. Department of Environment, Climate Change and Water NSW, Sydney.

  http://www.environment.gov.au/biodiversity/threatened/publications/recovery/border-ranges/pubs/brrb-management-plan.pdf
- DECCW (2010). Northern Rivers Regional Biodiversity Management Plan, National Recovery Plan for the Northern Rivers Region. Department of Environment, Climate Change and Water NSW, Sydney. http://www.environment.gov.au/biodiversity/threatened/publications/recovery/pubs/northern-rivers.pdf

These prescriptions were current at the time of publishing; please refer to the relevant agency's website for any updated versions.

Other Information Sources:

- Qld Department of Environment and Resource Management (2011). Regional Ecosystem details for 12.3.1, 12.5.13, 12.8.3, 12.8.4, 12.11.1, 12.11.10, 12.12.1 and 12.12.16. Available on the Internet at: http://www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/regional_ecosystems
- NSW Scientific Committee (1999). Lowland Rainforest on Floodplain in the NSW North Coast Bioregion – endangered ecological community listing. Viewed 26 January 2011. Available on the Internet at: http://www.environment.nsw.gov.au/determinations/LowlandRainforestNorthCoastEndComListing.htm
- NSW Scientific Committee (2006). Lowland Rainforest in NSW North Coast and Sydney basin Bioregion – endangered ecological community listing. Viewed 26 January 2011. Available on the Internet at: http://www.environment.nsw.gov.au/determinations/LowlandRainforestEndCom.htm
- TSSC (2011). Listing advice for the Lowland Rainforest of Subtropical Australia ecological community.

References:

DECCW (2010). Border Ranges Rainforest Biodiversity Management Plan - NSW and Queensland. Department of Environment, Climate Change and Water NSW, Sydney.

Floyd AG (1990). Australian Rainforests in New South Wales. Surrey Beatty and Sons Pty Limited, Chipping Norton, NSW.

Keith DA (2004). Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT. NSW Department of Environment and Conservation, Sydney.

TSSC (2011). Listing Advice for the Lowland Rainforest of Subtropical Australia ecological community.

Sub-tropical Coastal Floodplain Forest

Introduction

These guidelines provide background information to assist landholders to identify remnants of Sub-tropical Coastal Floodplain Forest. For more detailed information, refer to the NSW Scientific Committee's Determination Advice at http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Final+determinations

What is an Endangered Ecological Community?

An ecological community is a group of trees, shrubs and understorey plants that occur together in a particular area. An Endangered Ecological Community is an ecological community listed under the *Threatened Species Conservation Act* 1995 as being at risk of extinction unless threats affecting these areas are managed and reduced.

What is Sub-tropical Coastal Floodplain Forest?

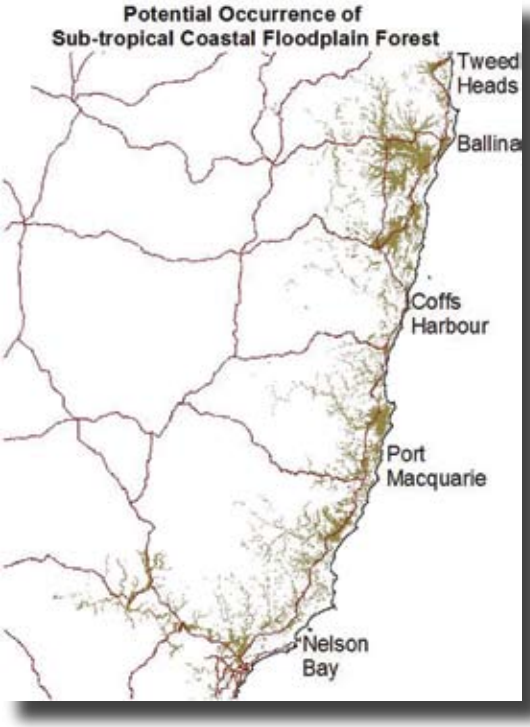
Sub-tropical Coastal Floodplain Forest is a tall mixed forest occurring on coastal floodplains on the north coast of NSW. The most widespread and abundant dominant trees include Forest Red Gum (*Eucalyptus tereticornis*), Grey Ironbark (*E. siderophloia*), Pink Bloodwood (*Corymbia intermedia*) and, north of the Macleay floodplain, Swamp Turpentine (*Lophostemon suaveolens*). A layer of small trees may be present, including Forest Oak (*Allocasuarina torulosa*) and a range of rainforest species such as Red Ash (*Alphitonia excelsa*) and Cheese Tree (*Glochidion ferdinandii*). Scattered shrubs and occasional vines may also be present. The groundcover is composed of abundant herbs, scramblers and grasses.

Where is Sub-tropical Coastal Floodplain Forest found?

Sub-tropical Coastal Floodplain Forest occurs north from Port Stephens. It has been recorded from all coastal and near-coastal local government areas.

Why is it important?

Only a small area (less than 30%) of the original distribution of Sub-tropical Coastal Floodplain Forest remains, and these areas are often highly fragmented and threatened by clearing for cropping and pasture, timber harvesting, drainage works, pollution from urban runoff and weed invasion.



What is the Coastal Floodplain?

Floodplains are level landform patterns on which there may be active erosion and deposition by flooding where the average interval is 100 years or less.

Coastal floodplains include coastal river valleys, alluvial flats and drainage lines below the escarpment of the Great Dividing Range. While most floodplains are below 20m in elevation, some may occur on localised river flats up to 250m elevation. Compared with the surrounding landscape, floodplains are generally quite flat. However, there may be local variation associated with river channels, local depressions, natural levees and river terraces. The latter are areas that rarely flood anymore due to deepening or widening of streams.

Department of Environment & Climate Change NSW

Description of the community

The tree layer

The tree layer of Sub-tropical Coastal Floodplain Forest varies considerably, however, the most widespread and abundant dominant trees include Forest Red Gum, Grey Ironbark, Pink Bloodwood and, north of the Macleay floodplain, Swamp Turpentine.

Other less common trees may also be present, particularly where soil type is influenced from rocks upslope. These include Grey Box (*Eucalyptus moluccana*), Grey Gum (*E. propinqua*), Narrow-leaved Red Gum (*E. seeana*), Broad-leaved Apple (*Angophora subvelutina*), Swamp Mahogany (*E. robusta*), Red Mahogany (*E. resinifera* subsp. *hemilampra*), White mahogany (*E. acmenoides*), *Angophora woodsiana*, *A. paludosa* and rainforest trees such as Figs (*Ficus* spp.) and Tuckeroos (*Cupaniopsis* spp). A number of other Eucalypt species may also occasionally occur.

The shrub layer

A layer of small trees may be present, including Forest Oak, Red Ash, Cheese Tree, Bottlebrushes (*Callistemon spp.*), Paperbarks (*Melaleuca spp.*) and Swamp Oak (*Casuarina glauca*).

Scattered shrubs include Coffee Bush (*Breynia oblongifolia*), Curracabah (*Acacia concurrens*), (*Commersonia* spp.), and Native Hibiscus (*Hibiscus* spp.). Vines such as Wombat Berry (*Eustrephus latifolius*), Scrambling Lily (*Geitonoplesium cymosum*) and Common Silkpod (*Parsonsia straminea*) may occur occasionally.

The ground layer

The ground layer is made up of herbs, scramblers and grasses. These include Blady Grass (*Imperata cylindrica*), Kangaroo Grass (*Themeda australis*), Blue Flax Lily (*Dianella caerulea*), Whiteroot (*Pratia purpurascens*), Forest Fern (*Cheilanthes sieberi* subsp. *sieberi*), and Kidney Weed (*Dichondra repens*). The composition and structure of the ground layer is influenced by disturbances such as grazing and fire history, and may have a substantial component of weed species.

Forest Red Gum *Pink Bloodwood* *Swamp Turpentine*

John Turbill

Characteristic species

A list of canopy trees and understorey plants that characterise a patch of Sub-tropical Coastal Floodplain Forest is provided in the Table below. Not all the species listed need to occur at any one site for it to be considered Sub-tropical Coastal Floodplain Forest. Conversely, other species not listed may also form part of this community.

Variation in the community

At heavily disturbed sites only some of the species which characterise the community may be present. In addition, above ground plants of some species may not be present, but may be represented below ground in the soil seed banks or as bulbs, corms, rhizomes or rootstocks.

How can I identify an area of Sub-tropical Coastal Floodplain Forest?

The following is a list of key characteristics to help identiufy an area of Sub-tropical Coastal Floodplain Forest:

- Is the site north of Port Stephens?
- Is the site on the coastal floodplain (see "What is the Coastal Floodplain" on previous page)?
- Is the tree layer made up of mixed eucalypts?
- Does the tree layer contain any of the following: Forest Red Gum, Grey Ironbark, Pink Bloodwood or, north of the Macleay floodplain, Swamp Turpentine?
- Are rainforest trees or shrubs scattered throughout?
- Are there relatively low numbers of *Casuarina* species, *Melaleuca* species and Swamp Mahogany?

If you answered yes to the above questions, the area is likely to be Sub-tropical Coastal Floodplain Forest.

What does this mean for my property?

As a listed Endangered Ecological Community under the *Threatened Species Conservation Act* 1995, Sub-tropical Coastal Floodplain Forest has significant conservation value and some activities may require consent or approval. Please contact the Department of Environment and Conservation for further information.

Species List

Sub-tropical Coastal Floodplain Forest is characterised by the species listed in the table below. The species present at any site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire and logging) history. Note that **NOT ALL** the species listed below need to be present at any one site for it to constitute Sub-tropical Coastal Floodplain Forest.

Scientific Name	Common Name
Trees	
Angophora paludosa	
Angophora subvelutina	Broad-leaved Apple
Angophora woodsiana	
Allocasuarina torulosa	Forest Oak
Alphitonia excelsa	Red Ash
Brachychiton populneus	Kurrajong
Callitris columellaris	A native Cypress Pine
Casuarina cunninghamiana	River Oak
Casuarina glauca	Swamp Oak
Corymbia intermedia	Pink Bloodwood
Drypetes australasica	Yellow Tulipwood
Glochidion ferdinandii	Cheese Tree
Elaeocarpus reticulatus	Blueberry Ash
Eucalyptus acmeniodes	White Mahogany
Eucalyptus amplifolia	Cabbage Gum
Eucalyptus moluccana	Grey Box
Eucalyptus propinqua	Grey Gum
Eucalyptus resinifera	Red Mahogany
Eucalyptus robusta	Swamp Mahogany
Eucalyptus seeana	Narrow-leaved Red Gum
Eucalyptus siderophloia	Small-fruited Grey Gum
Eucalyptus tereticornis	Forest Red Gum
Ficus macrophylla	Moreton Bay Fig
Ficus obliqua	Small-leaved Fig
Ficus superba var. *henneana*	Deciduous Fig
Lophostemon suaveolens	Swamp Box
Mallotus philippensis	Red Kamala
Melaleuca quinquenervia	Broad-leaved Paperbark
Small trees/shrubs	
Acacia concurrens	Curracabah
Acacia disparrima	
Breynia oblongifolia	Coffee Bush
Callistemon salignus	White Bottlebrush
Callistemon viminalis	Weeping Bottlebrush
Commersonia bartramia	Brown Kurrajong
Commersonia fraseri	Brush Kurrajong
Cordyline congesta	Tooth-leaved Palm Lily
Cupaniopsis anacardioides	Tuckeroo
Cupaniopsis parviflora	Small-leaved Tuckeroo
Hibiscus diversifolius	Swamp Hibiscus
Hibiscus tiliaceus	Cottonwood Hibiscus
Hovea acutifolia	A native pea
Melaleuca alternifolia	A tea tree
Melaleuca decora	A tea tree
Melaleuca nodosa	A tea tree
Melaleuca styphelioides	Prickly-leaved Tea Tree
Notelaea longifolia	Native Olive
Persoonia stradbrokensis	A Geebung
Pimelea linifolia	Rice Flower
Pittosporum revolutum	Hairy Pittosporum
Wikstroemia indica	

Scientific Name	Common Name
Grasses	
Aristida vagans	Threeawn Speargrass
Cymbopogon refractus	Barbed Wire Grass
Dichelachne micrantha	Shorthair Plumegrass
Digitaria parviflora	Small-flowered Finger Grass
Echinopogon caespitosus	Hedgehog Grass
Entolasia marginata	Bordered Panic
Entolasia stricta	Wiry Panic
Eragrostis leptostachya	Paddock Lovegrass
Imperata cylindrica var. *major*	Blady Grass
Microlaena stipoides	-
Panicum simile	Two Colour Panic
Themeda australis	Kangaroo Grass
Herbs and Ferns	
Brunoniella australis	Blue Trumpet
Centella asiatica	Pennywort
Cheilanthes sieberi	Forest Fern
Cymbidium suave	Snake Orchid
Commelina cyanea	Native Wandering Jew
Cyperus enervis	
Dianella caerulea	Blue Flax Lily
Dianella longifolia	A flax lily
Dichondra repens	Kidney Weed
Gahnia aspera	
Gahnia clarkei	
Lomandra filiformis	A mat rush
Lomandra longifolia	Spiny-headed Mat Rush
Lomandra multiflora	A mat rush
Oplismenus aemulus	
Oplismenus imbecillis	
Pratia purpurascens	Whiteroot
Pteridium esculentum	Bracken Fern
Vernonia cinerea	
Viola hederacea	Native Violet
Lagenifera stipitata	
Laxmannia gracilis	
Phyllanthus virgatus	
Sigesbeckia orientalis	
Tricoryne elatior	
Vines	
Cissus hypoglauca	Water Vine
Desmodium rhytidophyllum	
Desmodium varians	Slender Tick-trefoil
Eustrephus latifolius	Wombat Berry
Geitonoplesium cymosum	Scrambling Lily
Glycine clandestina	
Hardenbergia violacea	False Sarsparilla
Hibbertia scandens	Climbing Guinea Flower
Kennedia rubicunda	Red Kennedy Pea
Maclura cochinchinensis	Cockspur Thorn
Morinda jasminoides	Morinda Vine
Parsonsia straminea	Common Silkpod
Smilax australis	Native Sarsparilla
Smilax glyciphylla	Sweet Sarsparilla
Stephania japonica	Snake Vine

Determining the conservation value of remnants

The degree of disturbance (i.e. condition) of many remnants can vary, from almost pristine to highly modified. It is important to note that even small patches or areas that have been disturbed in the past by activities such as selective logging, fire or grazing may still be important remnants of Sub-tropical Coastal Floodplain Forest and be considered the EEC. Where difficulties arise when faced with decisions on whether particular sites are Sub-tropical Coastal Floodplain Forest, expert advice may be needed.

Retaining mature native vegetation or EECs for conservation purposes may attract incentive funding. Funding is allocated to landholders by the local Catchment Management Authority (CMA) according to the priorities set out in their Catchment Action Plan and strategies. For more information contact your local CMA or email: info@nativevegetation.nsw.gov.au

For further assistance

This and other EEC guidelines are available on the DECC website: at www.environment.nsw.gov.au

The references listed below also provide further information on EECs.

- NSW Scientific Committee Determinations: http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Final+determinations
- Department of Environment and Climate Change (NSW) Threatened Species profiles: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx
- Botanic Gardens Trust plant identification assistance: http://www.rbgsyd.nsw.gov.au/information_about_plants/botanical_info/plant_identification
- Brooker, M. and Kleinig, D. (1990) Field Guide to Eucalypts of South-eastern Australia, Vol 2. Inkata, Melbourne.
- Harden, G. (ed) Flora of NSW Vols 1 – 4 (1990-2002). NSW University Press.
- Harden, G., McDonald, W. and Williams, J. (2006) Rainforest Trees and Shrubs – A Field Guide to their identification. Gwen Harden Publishing, Nambucca Heads.

John Turbill

Examples of Sub-tropical Coastal Floodplain Forest Endangered Ecological Community at Urunga Lagoon

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Department of Environment & Climate Change NSW

Swamp Sclerophyll Forest on Coastal Floodplains

Introduction

These guidelines provide background information to assist land managers and approval authorities to identify remnants of Swamp Sclerophyll Forest on Coastal Floodplains (hereafter referred to as Swamp Sclerophyll Forest), an Endangered Ecological Community (EEC). For more detailed information refer to the Swamp Sclerophyll Forest Profile and the NSW Scientific Committee Final Determination at: threatenedspecies.environment.nsw.gov.au

Lucas McKinnon

Paperbark Forest on the NSW North Coast, a component of Swamp Sclerophyll Forest

What is an Endangered Ecological Community?

An ecological community is an assemblage of species which can include flora, fauna and other living organisms that occur together in a particular area. They are generally recognised by the trees, shrubs and groundcover plants that live there. An Endangered Ecological Community is an ecological community listed as facing a very high risk of extinction in NSW under the *Threatened Species Conservation Act* 1995.

What is Swamp Sclerophyll Forest?

Swamp Sclerophyll Forest is a community that generally has several layers of vegetation, including trees, shrubs, groundcovers and wetland plants such as reeds and sedges. It is a community of plants that are generally found close to standing water on soils that are either waterlogged or subject to periodic flooding or inundation. It is usually an open to closed forest with a shrubby or reedy/ferny understorey, although in some areas the tree layer is low and dense and the community takes on the structure of scrub. A particular site may only include some of these vegetation structures such as the reedland or a paperbark forest but should still be considered as the community. See 'Identifying Swamp Sclerophyll Forest' below for further assistance.

The Scientific Committee's final determination of the Swamp Sclerophyll Forest does not delineate between higher and lower quality remnants of this community. It specifically notes that partial clearing and disturbance, in some instances, may have reduced this community's canopy to scattered trees and this disturbed type is still considered part of the EEC. Relatively few examples of this community would be unaffected by weedy taxa, including noxious species, such as those listed in a variety of key threatening processes (e.g. Lantana, introduced perennial grasses and exotic vines / creepers).

Clearing on the edge of Swamp Sclerophyll Forest. This introduces the community to edge effects such as weed invasion.

Lucas McKinnon

An area of Swamp Sclerophyll Forest cleared for grazing with scattered paddock trees.

Natural Heritage Trust
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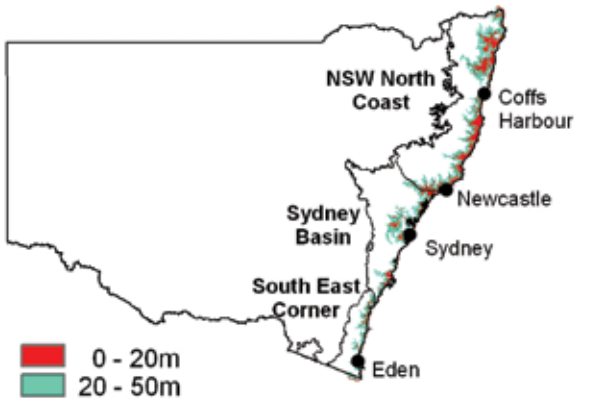
Department of Environment & Climate Change NSW

Identification Guidelines for Endangered Ecological Communities

Where is Swamp Sclerophyll Forest found?

Swamp Sclerophyll Forest is associated with humic clay and sandy loam soils on waterlogged or periodically flooded areas. These soils are generally deposited during flood events and occur on the flats, drainage lines and river terraces of the Coastal Floodplain. The community is usually found below 20m in elevation although sometimes up to 50 m elevation on small floodplains or where the larger floodplains adjoin lithic (rocky) substrates or coastal sand plains. It is found in the NSW North Coast, Sydney Basin and South East Corner bioregions (see map).



Potential occurrence of Swamp Sclerophyll Forest

Description of the community

Characteristic species

A list of trees, shrubs and ground cover species that characterise Swamp Sclerophyll Forest have been identified by the NSW Scientifc Committee (see table).

The tree layer

The most common trees in Swamp Sclerophyll Forest include Swamp Mahogany (*Eucalyptus robusta*), Broad-leaved paperbark (*Melaleuca quinquenervia*) and, south from Sydney, Bangalay (*Eucalyptus botryoides*) and Woollybutt (*Eucalyptus longifolia*). Other trees occur less frequently or may be locally common at some sites, including Sweet Willow Bottlebrush (*Callistemon salignus*), Swamp Oak (*Casuarina glauca*), Red Mahogany (*Eucalyptus resinifera* subsp. *hemilampra*), Cabbage Tree Palm (*Livistona australis*) and Swamp Turpentine (*Lophostemon suaveolens*). The density of tree species (i.e. the number of any particular species at any one site), is not a critical factor in determining the presence or absence of this community as this will vary depending on site history.

Shrubs and Groundlayer plants

The understorey of this community is characterised by a layer of shrubs including tea-trees, paperbarks and wattles, and the groundcover may consist of ferns, grass, sedges and reeds. Most commonly a site will have a combination of these plant types. See table for typical species of the understorey.

What is the Coastal Floodplain?

Floodplains are level landform patterns on which there may be active erosion and deposition of sediment by flooding where the average interval is 100 years or less.

Coastal floodplains include coastal river valleys, alluvial flats and drainage lines below the escarpment of the Great Dividing Range. While most floodplains are below 20m in elevation, some may occur on localised river flats up to 250m elevation. However, there may be local variation associated with river channels, local depressions, natural levees and river terraces. The latter are areas that rarely flood anymore due to the deepening or widening of streams.

How can I identify areas of Swamp Sclerophyll Forest?

The following are 'Key Indicators' to look for when identifying Swamp Sclerophyll Forest:

1. Is the site on the coastal floodplain of the NSW North Coast, Sydney Basin or South East Corner bioregion (see map)?
2. Is the site associated with humic clay or sandy loams soils (refer to soil maps)?
3. Is the site subject to waterlogging and/or below the highest flood level (check with Local Government or Catchment Management Authority to determine highest flood mark)?
4. Are any of the tree species present at the site listed as characteristic of Swamp Sclerophyll Forest in the table (check with local botanist, consult reference books or see plantnet.rbgsyd.nsw.gov.au)?
5. Are any of the shrub and/or groundlayer species listed as characteristic in the table present?

If you answered yes to the above questions your site is likely to be Swamp Sclerophyll Forest.

EECs that may adjoin or intergrade with Swamp Sclerophyll Forest

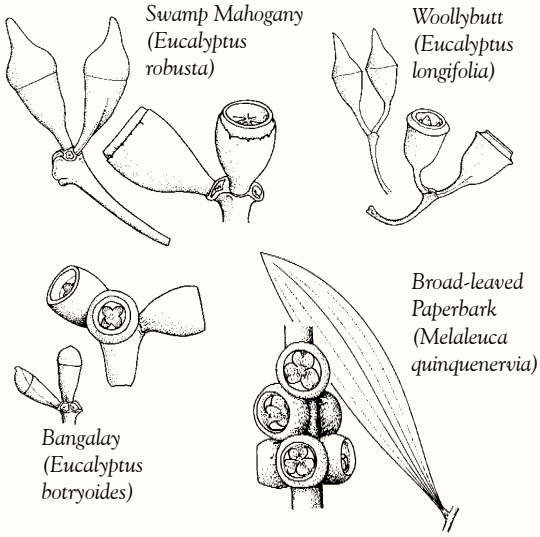
This community occurs with, would have previously occurred with or closely resembles other coastal floodplain vegetation types which are also listed as EECs. Collectively, these EECs cover all remaining native vegetation on the coastal floodplains of NSW. These EECs are:

1. *Swamp Oak Floodplain Forest* where there is increasing estuarine influence;
2. *River-Flat Eucalypt Forest* and *Sub-tropical Coastal Floodplain Forest* (north of Port Stephens) where soils become less waterlogged;
3. *Freshwater Wetlands on Coastal Floodplains* where they adjoin more permanent standing water;
4. *Coastal Saltmarsh*; and
5. *Bangalay Sand Forest* closer to coastal sand dunes.

Characteristic Species List

Swamp Sclerophyll Forest is characterised by the species listed below. The species present at any site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire and logging) history. Note that NOT ALL the species listed below need to be present at any one site for it to constitute Swamp Sclerophyll Forest.

+ = Key indicator species; N = North of; S = South of; B-Bay = Batemans Bay; Gos = Gosford; Illa = Illawarra; J-Bay = Jervis Bay; Sho = Shoalhaven; Syd = Sydney; Ulla = Ulladulla
For further help with identification see: plantnet.rbgsyd.nsw.gov.au/search/simple.htm



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Blue Flax-lily (Dianella caerulea)

Lucas McKinnon

Saw sedge (Gahnia spp.)

Lucas McKinnon

Glochidion ferdinandi; a species common to Swamp Sclerophyll Forest and Swamp Oak Floodplain Forest

Lucas McKinnon

Scientific Name	Common Name (Range)
Tree Canopy Species (>6m)	
Allocasuarina littoralis	Black She-Oak
Casuarina glauca	Swamp Oak +
Eucalyptus botryoides	Bangalay + (S-Gos)
Eucalyptus longifolia	Woollybutt (S-Syd)
Eucalyptus resinifera subsp. *hemilampra*	Red Mahogany (N-J-Bay)
Eucalyptus robusta	Swamp Mahogany + (N-Ulla)
Ficus coronata	Sandpaper Fig
Livistona australis	Cabbage Tree Palm +
Lophostemon suaveolens	Swamp Turpentine
Melaleuca ericifolia	Swamp Paperbark
Melaleuca linariifolia	Flax-leaved Paperbark +
Melaleuca quinquenervia	Broad-leaved Paperbark +
Melaleuca styphelioides	Prickly-leaved Tea Tree (N-Now)
Shrub Species (~1.5-6m)	
Acacia irrorata	Green Wattle
Acacia longifolia	Coastal Wattle +
Acmena smithii	Lilly Pilly
Banksia oblongifolia	Fern leaved Banksia (N-Ulla)
Banksia spinulosa	Hairpin Banksia
Breynia oblongifolia	Coffee Bush
Callistemon salignus	Crimson Bottlebrush
Dodonaea triquetra	Large leaf Hop-bush
Elaeocarpus reticulatus	Blueberry Ash
Glochidion ferdinandi	Cheese Tree +
Homalanthus populifolius	Bleeding Heart
Leptospermum polygalifolium subsp. *polygalifolium*	Tantoon +
Melaleuca sieberi	Sieber's Paperbark (N-Gos)
Morinda jasminoides	Sweet Morinda
Polyscias sambucifolia	Elderberry Ash
Groundcover Species (~0-1.5m) & Vines/Scramblers	
Adiantum aethiopicum	Maiden Hair Fern
Baumea articulata	Jointed Twig Rush
Baumea juncea	Bare Twig Rush
Blechnum camfieldii	Lance Water-fern (N-B-Bay)
Blechnum indicum	Swamp Water-fern (N-J-Bay)
Calochlaena dubia	False Bracken
Carex appressa	Tall Sedge
Centella asiatica	Indian Pennywort + (N-Illa)
Dianella caerulea	Blue Flax Lily +
Entolasia marginata	Bordered Panic
Entolasia stricta	Wiry Panic
Gahnia clarkei	Tall Saw-sedge +
Gahnia sieberiana	Red-fruit Saw-sedge +
Glycine clandestina	Twining Glycine
Gonocarpus tetragynus	A Raspwort
Hydrocotyle peduncularis	A Pennywort
Hypolepis muelleri	Harsh Ground Fern
Imperata cylindrica var. major	Blady Grass +
Isachne globosa	Swamp Millet
Lomandra longifolia	Ribbon Grass
Oplismenus aemulus	Basket Grass
Oplismenus imbecillis	Basket Grass
Pteridium esculentum	Bracken +
Parsonsia straminea	Common Silkpod (N-Sho)
Phragmites australis	Common Reed +
Pratia purpurascens	Whiteroot
Stephania japonica var. *discolor*	Snake Vine
Themeda australis	Kangaroo Grass
Villarsia exaltata	Yellow Marsh Flower
Viola banksii	A Violet
Viola hederacea	Ivy-leaved Violet +

Where fire has been excluded for long periods in Swamp Sclerophyll Forest, it may contain many species typical of the EEC, *Littoral Rainforest*, and on the NSW North Coast where substrates are volcanically derived it may adjoin with the EEC, *Lowland Rainforest on Floodplains*.

Determining the conservation value of remnants

The degree of disturbance (i.e. the site condition) of any remnant of Swamp Sclerophyll Forest may vary dependant on past land use, management practices and/or natural disturbance and this should be considered at the time of assessment. Whilst not exhaustive, the following are a number of variations of Swamp Sclerophyll Forest you may encounter:

1. Tree canopy intact with limited native vegetation in the understorey due to underscrubbing, stock grazing pressure or too frequent fire;
2. Tree canopy intact (+/– reduced cover) with limited native vegetation in the understorey due to lack of fire or weed infestation (e.g. dense Lantana incursion or Carpet Grass (*Axonopus* spp.) invasion in areas partially cleared for agriculture);
3. Tree canopy absent due to prior clearing or fire, occurrence of regrowth of native understorey species along with herbaceous and/or woody weeds; or
4. Some characteristic tree canopy species not present due to past selective clearing.

Even where a remnant is considered to be heavily degraded and in poor condition, it may still have conservation value for a number of reasons including:

1. As part of a wildlife corridor that has connective importance at local and/or regional scales;
2. Providing important winter feed trees for arboreal mammals and birds;
3. Providing a 'stepping stone' for fauna in an otherwise cleared / fragmented landscape;
4. Providing significant habitat components such as hollow bearing trees important to the life cycle of migratory, non-migratory and/or nomadic species;
5. It may contain threatened species of flora in its own right; and/or
6. Maintaining a healthy native seed bank, very important in highly cleared landscapes.

Lucas McKinnon

Swamp Sclerophyll Forest in Wollongong LGA, showing the transition between 3 components of the community, reedland, shrubland and sclerophyll forest.

It is important to take these factors into account when determining the conservation significance of remnants.

For further assistance

This and other EEC guidelines are available on DECC Threatened Species website: threatenedspecies.environment.nsw.gov.au

The references listed below also provide further information to aid in identifying EECs.

- Botanic Gardens Trust plant identification assistance: rbgsyd.nsw.gov.au/plant_info/botanical_info/plant_identification
- Botanic Gardens Trust PlantNET: plantNET.rbgsyd.nsw.gov.au/search/simple.htm
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- NSW Scientific Committee Determinations: nationalparks.nsw.gov.au/npws.nsf/Content/Final+determinations
- River-flat Eucalypt Forest on Coastal Floodplains species profile: threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10786
- Robinson, L (2003) *Field guide to native plants of Sydney revised 3rd edition.* Kangaroo Press.
- Thackway, R, and Cresswell, I. (1995) (eds) *'An interim biogeogeographic regionalisation of Australia: a framework for establishing the national system of reserves.'* (Australian Nature Conservation Agency: Canberra)

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Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological listing

NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act, and as a consequence to omit reference to Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion from Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low and dense, so that the community takes on the structure of scrub. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. Typically these forests, scrubs, fernlands, reedlands and sedgelands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

The composition of Swamp Sclerophyll Forest on Coastal Floodplains is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil. Composition also varies with latitude. The community is characterised by the following assemblage of species:

Acacia irrorata	*Acacia longifolia*
Acmena smithii	*Adiantum aethiopicum*
Allocasuarina littoralis	*Banksia oblongifolia*
Banksia spinulosa	*Baumea articulata*
Baumea juncea	*Blechnum camfieldii*
Blechnum indicum	*Breynia oblongifolia*
Callistemon salignus	*Calochlaena dubia*
Carex appressa	*Casuarina glauca*
Centella asiatica	*Dianella caerulea*
Dodonaea triquetra	*Elaeocarpus reticulatus*
Entolasia marginata	*Entolasia stricta*
Eucalyptus botryoides	*Eucalyptus longifolia*
Eucalyptus resinifera subsp. *hemilampra*	*Eucalyptus robusta*
Ficus coronata	*Gahnia clarkei*
Gahnia sieberiana	*Glochidion ferdinandi*

Glycine clandestina	*Gonocarpus tetragynus*
Hydrocotyle peduncularis	*Hypolepis muelleri*
Imperata cylindrica var. *major*	*Isachne globosa*
Leptospermum polygalifolium subsp. *polygalifolium*	*Livistona australis*
Lomandra longifolia	*Lophostemon suaveolens*
Melaeuca ericifolia	*Melaleuca linariifolia*
Melaleuca quinquenervia	*Melaleuca sieberi*
Melaleuca styphelioides	*Morinda jasminoides*
Omalanthus populifolius	*Oplismenus aemulus*
Oplismenus imbecillis	*Parsonsia straminea*
Phragmites australis	*Polyscias sambucifolia*
Pratia purpurascens	*Pteridium esculentum*
Stephania japonica var. *discolor*	*Themeda australis*
Villarsia exaltata	*Viola banksii*
Viola hederacea	

2. The total species list of the community is considerably larger than that given above, with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire, grazing, flooding and land clearing) history. The number and relative abundance of species will change with time since fire, flooding or significant rainfall, and may also change in response to changes in grazing regimes. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

3. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995). Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.

4. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has an open to dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. For example, stands dominated by *Melaleuca ericifolia* typically do not exceed 8 m in height. The most widespread and abundant dominant trees include *Eucalyptus robusta* (swamp mahogany), *Melaleuca quinquenervia* (paperbark) and, south from Sydney, *Eucalyptus botryoides* (bangalay) and *Eucalyptus longifolia* (woollybut). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including *Callistemon salignus* (sweet willow bottlebrush), *Casuarina glauca* (swamp oak) and *Eucalyptus resinifera* subsp. *hemilampra* (red mahogany), *Livistona australis* (cabbage palm) and *Lophostemon suaveolens* (swamp turpentine). A layer of small trees may be present, including *Acacia irrorata* (green wattle), *Acmena smithii* (lilly pilly), *Elaeocarpus reticulatus* (blueberry ash), *Glochidion ferdinandi* (cheese tree), *Melaleuca linariifolia* and *M. styphelioides* (paperbarks). Shrubs include *Acacia longifolia* (Sydney golden wattle), *Dodonaea triquetra* (a hopbush), *Ficus coronata* (sandpaper fig), *Leptospermum polygalifolium* subsp. *polygalifolium* (lemon-scented tea tree) and *Melaleuca* spp. (paperbarks). Occasional vines include *Parsonsia straminea* (common silkpod), *Morinda jasminoides* and *Stephania japonica* var. *discolor* (snake vine). The groundcover is composed of abundant sedges, ferns, forbs, and grasses including *Gahnia clarkei, Pteridium esculentum* (bracken), *Hypolepis muelleri* (batswing fern), *Calochlaena dubia* (false bracken), *Dianella caerulea* (blue flax lily), *Viola hederacea, Lomandra longifolia* (spiny-headed mat-rush) and *Entolasia marginata* (bordered panic) and *Imperata cylindrica* var. *major* (blady grass). The endangered swamp orchids *Phaius australis* and *P. tankervillei* are found in this community. On sites downslope of lithic

substrates or with soils of clay-loam texture, species such as *Allocasuarina littoralis* (black she-oak)*, Banksia oblongifolia, B. spinulosa* (var. *collina* or var. *spinulosa*) (hairpin banksia), *Ptilothrix deusta* and *Themeda australis* (kangaroo grass)*,* may also be present in the understorey. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.

5. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions provides habitat for a broad range of animals, including many that are dependent on trees for food, nesting or roosting (Law *et al*. 2000). The blossoms of *Eucalyptus robusta* and *Melaleuca quinquenervia* are also an important food source for the Grey-headed Flying Fox (*Pteropus poliocephalus*) and Common Blossom Bat (*Sycoyncteris australis*) (Law 1994), as well as the Yellow-bellied Glider (*Petaurus australis*), Sugar Glider (*Petaurus breviceps*), Regent Honeyeater (*Xanthomyza phrygia*) and Swift Parrot (*Lathamus discolor*). Other animals found in this community include the Osprey (*Pandion haliaetus*), Australasian Bittern (*Botaurus poiciloptilus*), Large-footed myotis (*Myotis adversus*), *Litoria olongburensis* and Wallum Froglet (*Crinia tinnula*).

6. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions forms part of a complex of forested and treeless wetland communities found throughout the coastal floodplains of NSW. A recent analysis of available quadrat data from these habitats identified a distinct grouping of vegetation samples attributable to this community (Keith and Scott 2005). The combination of features that distinguish Swamp Sclerophyll Forest on Coastal Floodplains from other endangered ecological communities on the coastal floodplains include: its relatively dense tree canopy dominated by *Eucalyptus robusta, Melaleuca quinquenervia* or *E. botryoides*, the relatively infrequent occurrence of other eucalypts, *Casuarina glauca* or *Lophostemon suaveolens*; the occasional presence of rainforest elements as scattered trees or understorey plants; and the prominence of large sedges and ferns in the groundcover. It generally occupies small alluvial flats and peripheral parts of floodplains where they adjoin lithic substrates or coastal sandplains. The soils are usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water.

7. Swamp Sclerophyll Forest on Coastal Floodplains includes and replaces Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion. It may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. These include Lowland Rainforest on Floodplain in the NSW North Coast bioregion, River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal River-Flat Forest in the Sydney Basin bioregion), Subtropical Floodplain Forest, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. For example, as soils become less waterlogged, Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions may adjoin or intergrade with River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. As soil salinity increases Swamp Sclerophyll Forest on Coastal Floodplains may intergrade with, and be replaced by, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. The boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices (e.g. Johnston *et al.* 2003, Stevenson 2003). The Determinations for these communities collectively encompass the full range of intermediate assemblages in transitional habitats.

8. A number of vegetation surveys and mapping studies have been conducted across the range of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. This community includes the *Eucalyptus robusta* (Swamp Mahogany) community identified on coastal alluvium by Douglas and Anderson (2002) and the Coastal Alluvium Swamp Forest complex defined by Anderson and Asquith (2002). In the Comprehensive Regional Assessment of the north-eastern NSW (NPWS 1999), those areas on floodplains mapped as 'Forest Ecosystem 112, Paperbark', and those areas on floodplains mapped as 'Forest Ecosystem 142, Swamp Mahogany' are included within this community. On the Tweed lowlands, this community includes '*Eucalyptus robusta* mid-high to very tall closed forest' (F7), '*Archontophoenix cunninghamiana-Melaleuca quinquenervia* very tall feather palm swamp forest' (F9), those parts of *Melaleuca quinquenervia* tall to very tall open to closed forest' (F8) on alluvial soils and parts of 'Floodplain Wetland Complex' (FL) dominated by *Eucalyptus robusta* or *Melaleuca quinquenervia* (Pressey and Griffith 1992). In the lower Hunter district, this community includes 'Swamp Mahogany-Paperbark Swamp Forest' (map unit 37), Riparian Melaleuca Swamp Woodland (map unit 42) and Melaleuca Scrub (map unit 42a) of NPWS (2000). In the Sydney-Gosford region, this community includes those parts of 'Freshwater Swamp complex' (map unit 27a) dominated by *Eucalyptus robusta* or *E. botryoides* (Benson 1986, Benson and Howell 1994) and parts of the 'Freshwater wetlands - on the floodplains' of Benson and Howell (1990) and Benson et al. (1996). In the Illawarra, this community includes 'Alluvial swamp mahogany forest' (map unit 35) of NPWS (2002). On the south coast, this community includes 'Northern Coastal Lowlands Swamp Forest' (forest ecosystem 175) of Thomas *et al*. (2000) and 'Coastal Sand Swamp Forest' (map unit 45) of Tindall *et al*. (2004). Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is included within the 'Coastal Floodplain Wetlands' and 'Coastal Swamp Forest' vegetation classes of Keith (2002, 2004). There may be additional or unmapped occurrences of Swamp Sclerophyll Forest on Coastal Floodplains within and beyond these surveyed areas.

9. The extent of the Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions prior to European settlement has not been mapped across its entire range. However, one estimate estimate based on a compilation of regional vegetation maps suggests that Coastal Floodplain Wetlands, which include Swamp Sclerophyll Forest on Floodplains, currently cover 800-1400 km2, representing less than 30% of the original extent of this broadly defined vegetation class (Keith 2004). Compared to this combined estimate, the remaining area of Swamp Sclerophyll Forest on Coastal Floodplains is likely to be considerably smaller and is likely to represent much less than 30% of its original range. For example, there were less than 350 ha of native vegetation attributable to this community on the Tweed lowlands in 1985 (Pressey and Griffith 1992), less than 2500 ha on the Clarence floodplain in 1982 (Pressey 1989a), less than 700 ha on the Macleay floodplain in 1983 (Pressey 1989b), up to 7000 ha in the lower Hunter - central coast district during the 1990s (NPWS 2000), and less than 1000 ha in the Sydney - South Coast region in the mid 1990s (Tindall *et al*. 2004), including less than 40 ha on the Illawarra plain in 2001 (NPWS 2002) and about 450 ha on the South Coast in the 1990s (Thomas *et al*. 2000).

10. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has been extensively cleared and modified. Large areas that formerly supported this community are occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, poplars, etc.) and, on the far north coast, canefields. On the Tweed lowlands, Pressey and Griffith (1992) estimated that less than 3% of the original Floodplain Wetlands and Floodplain Forest remained in 1985. Similar estimates are likely to apply to Swamp Sclerophyll Forest on Coastal Floodplains in other parts of the NSW North Coast bioregion (Goodrick 1970, Pressey 1989a, 1989b). In the lower Hunter - central coast district, about 30 % of the original area of Swamp mahogany - paperbark forest was estimated to remain in the 1990s (NPWS 2000).

11. Land clearing continues to threaten Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. A small minority of the remaining area occurs on public land (e.g. Pressey and Griffith 1992, NPWS 2000), with most occurring on productive agricultural land or in close proximity to rural centres. The remaining stands are severely fragmented by past clearing and further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils', removal of dead wood and rubbish dumping (e.g. Pressey 1989a, b; Pressey and Griffith 1992, Boulton and Brock 1999, Johnston *et al*. 2003). Anthropogenic climate change may also threaten Swamp Sclerophyll Forest on Coastal Floodplains if future flooding regimes are affected (IPCC 2001, Hughes 2003). Localised areas, particularly those within urbanised regions, may also be exposed to frequent burning which reduces the diversity of woody plant species. Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change; High frequency fire and Removal of dead wood and dead trees are listed as Key Threatening Processes under the Threatened Species Act (1995).

12. Large areas of habitat formerly occupied by Swamp Sclerophyll Forest on Coastal Floodplains have been directly drained by construction of artificial channels (e.g. Pressey 1989a, Boulton and Brock 1999). While much of the early drainage works were associated with agricultural development, more recently they are associated with urban expansion. Additional areas that have not been directly drained may have been altered hydrologically by changed patterns of flooding and drainage following flood mitigation works, particularly the construction of drains, levees and floodgates (Pressey and Griffith 1992). On the north coast of NSW, expansion of *Melaleuca quinquenervia* into open floodplain swamps has been attributed to artificial drainage and shortening of the hydroperiod (Johnston *et al*. 2003, Stevenson 2003). These changes appear to be closely associated with enhanced acidity, altered ionic ratios, increased dissolved organic carbon and sulfide oxidation in the soil profile (Johnston *et al*. 2003).

13. Relatively few examples of Swamp Sclerophyll Forest on Coastal Floodplains remain unaffected by weeds. The causes of weed invasion include physical disturbance to the vegetation structure of the community, dumping of landfill rubbish and garden refuse, polluted runoff from urban and agricultural areas, construction of roads and other utilities, and grazing by domestic livestock. The principal weed species affecting Swamp Sclerophyll Forest on Coastal Floodplains include *Andropogon virginicus* (whiskey grass), *Anredera cordifolia* (Madeira vine)*, Ageratina adenophora* (crofton weed), *Baccharis halimifolia* (groundsel bush)*, Cinnamomum camphora* (camphor laurel), *Lantana camara* (lantana), *Ligustrum sinense* (small-leaved privet)*, Lonicera japonica* (Japanese honeysuckle) and *Ludwigia peruviana* (Keith and Scott 2005).

14. Small areas of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions are contained within existing conservation reserves, including Bungawalbin, Tuckean and Moonee Beach Nature Reserves, and Hat Head, Crowdy Bay, Wallingat, Myall Lakes and Garigal National Parks. These occurrences are unevenly distributed throughout the range and unlikely to represent the full diversity of the community. In addition, wetlands within protected areas are exposed to hydrological changes that were, and continue to be initiated outside their boundaries. Some areas of Swamp Oak Floodplain Forest are protected by State Environmental Planning Policy 14, although this has not always precluded impacts on wetlands from the development of major infrastructure.

15. Given the dynamic hydrological relationship between Swamp Sclerophyll Forest on Coastal Floodplains, Coastal Saltmarsh and other endangered ecological communities on coastal floodplains, future management of water and tidal flows may result in the expansion of some communities at the expense of others. Proposals for the restoration of natural hydrological regimes and for the rehabilitation of acid sulfate soils may also result in changes to the distribution and composition of floodplain communities. Co-ordinated planning and management approaches across whole catchments will be required to address and resolve priorities between different management objectives.

16. In view of the above the Scientific Committee is of the opinion that Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Associate Professor Paul Adam

Chairperson

Scientific Committee

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About the NSW Scientific Committee

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Appendix J - Likelihood Assessment for Fauna Species

Species name	TSC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
Amphibians						
Assa darlingtoni Pouched Frog	V		North-east NSW and far south-east Qld. There are three isolated populations in NSW: Dorrigo Plateau and Gibraltar Range, Border Ranges.	Cool, moist rainforest (including Antarctic Beech), or moist eucalypt forest in mountainous areas, mostly above 800 m.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Crinia tinnula Wallum Froglet	V		Along the coastal margin from Litabella National Park in south-east Qld to Kurnell in Sydney.	Acidic swamps on coastal sand plains (typically in sedgelands and wet heathlands), drainage lines, and swamp sclerophyll forests.	Unlikely. Species not recorded in BNR or in surveys on the site in 2007, 2009 and 2014. Detected during bird counts on freehold land to northeast of the site. Species known from Billinudgel Nature Reserve.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Litoria brevipalmata Green-thighed Frog	V		Isolated localities along the coast and ranges from just north of Wollongong to south-east Qld.	Rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain.	Unlikely. Species not recorded in Byron LGA, or in BNR or in systematic fauna surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Litoria olongburensis Olongburra Frog	V	V	Distributed from Fraser Island in southern Qld to Yuraygir National Park in northern NSW.	Confined to coastal sandplain wallum swamps. Breeding habitat is characterised by the presence of emergent sedges.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014. Species known from Billinudgel Nature Reserve.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Mixophyes fleayi Fleay's Barred Frog	E1	E	Eastern side of the ranges in south-east Qld (south from Conondale ranges) and northeast NSW	Rainforest and wet eucalypt forest of the escarpment and foothills, usually close to gravely streams.	Unlikely. Escarpment and foothill riparian species. Systematic fauna surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Mixophyes iteratus Giant Barred Frog	E1	E	Coast and ranges from Eumundi in south-east Qld to Warrimoo in the Blue Mountains.	Freshwater permanent/semi-permanent streams, generally at lower elevation. Riparian rainforest or wet sclerophyll forest is favoured.	Unlikely. Riparian species not recorded in BNR or in systematic fauna surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Birds						
Amaurornis moluccana Pale-vented Bush-hen	V		In NSW, occurs from the Qld border south to the Clarence River, though the species appears to be expanding its range southwards with recent records as far south as the Nambucca River.	Tall dense vegetation on the margins of freshwater streams and natural or artificial wetlands, usually within or bordering rainforest, rainforest remnants or forests. Also rank grass or reeds, thickets of weeds and farmland.	Unlikely. Targeted in call playback surveys in 2007 & 2014, not detected.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Anthochaera Phrygia Regent Honeyeater	E4A	CE	Inland slopes of south-east Australia, and less frequently in coastal areas. In NSW, most records are from the North-West Plains, North-West and South-West Slopes, Northern Tablelands, Central Tablelands and Southern Tablelands regions; also recorded in the Central Coast and Hunter Valley regions.	Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana (*River Oak).	Unlikely. Species not recorded in BNR or in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Botaurus poiciloptilus Australasian Bittern	E1	E	Found over most of NSW except for the far north-west.	Permanent freshwater wetlands with tall, dense vegetation, particularly *Typha* spp. (bullrushes) and *Eleocharis* spp. (spikerushes).	Unlikely. Targeted in call playback surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Burhinus grallarius Bush Stone-curlew	E1		In NSW, found sporadically in coastal areas, and west of the divide throughout the sheep-wheat belt.	In NSW, it occurs in lowland grassy woodland and open forest.	Known. Recorded for the first time in 2017.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Calyptorhynchus banksii banksia Red-tailed Black-Cockatoo (coastal subspecies)	E4A		Confined to northern and eastern coastal Qld and, possibly, far north-eastern NSW. Only four records for NSW between 1980 and July 2009, all in the Tweed and Richmond Valleys: at Bungawalbin Nature Reserve, Round Mountain (Bogangar), Wilsons Creek (north of Alstonville), and at Cabarita.	In NSW, reported from dry open forest and mixed rainforest-eucalypt forest.	Unlikely. Species not recorded in Byron LGA or in surveys on the site in 2007, 2009 and 2014.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Carterornis leucotis White-eared Monarch	V		In NSW, generally found from the Qld border south to Iluka at the mouth of the Clarence River, and inland to the Richmond Range. Occasional records further south near Woolgoolga and around Port Macquarie.	In NSW, it occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest.	Known. Low probability of birds foraging within the development footprint.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Cyclopsitta diophthalma coxeni Coxen's Fig-Parrot	E4A	E	Limited to about five populations scattered between Bundaberg in Qld and the Hastings River in NSW.	Drier rainforests and adjacent wetter eucalypt forest, and wetter lowland rainforests.	Potential. Systematic fauna surveys in 2007, 2009, 2014, not detected. However, potential habitat present adjacent to development site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Ephippiorhynchus asiaticus Black-necked Stork	E1		Coastal and subcoastal northern and eastern Australia, south to central-eastern NSW and with vagrants recorded further south and inland.	In NSW, floodplain wetlands of the major coastal rivers are key habitat. Also minor floodplains, coastal sandplain wetlands and estuaries.	Unlikely. Not detected in 45 surveys from 2005-2017 of the only suitable habitat in the development area. Annual Performance Reports	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Erythrotriorchis radiates Red Goshawk	E4A	V	In NSW, extends to ~30°S. Recent records confined to the Northern Rivers region north of the Clarence River.	Open woodland and forest, often along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and coastal riparian *Eucalyptus* forest.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	This species is rare in NSW and has a very low probability of occurrence in the development footprint, but is unlikely to experience any direct adverse effect.
Gavicalis fasciogularis Mangrove Honeyeater	V		Coastal eastern Australia from north east QLD to north east NSW.	Subtropical or tropical mangrove forests, adjacent vegetation and gardens.	Unlikely. Estuarine & Mangrove species. Not detected in systematic fauna surveys.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Glossopsitta pusilla Little Lorikeet	V		In NSW, found from the coast westward as far as Dubbo and Albury.	Dry, open eucalypt forests and woodlands, including remnant woodland patches and roadside vegetation.	Known. Recorded in surveys	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Ixobrychus flavicollis Black Bittern	V		In NSW, records are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	Terrestrial and estuarine wetlands. Also flooded grassland, forest, woodland, rainforest and mangroves where permanent water is present.	Unlikely. Targeted in call playback surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Lathamus discolour Swift Parrot	E1	CE	Migrates from Tasmania to mainland in Autumn-Winter. In NSW, the species mostly occurs on the coast and south west slopes.	Box-ironbark forests and woodlands.	Potential. Not detected in previous surveys however potential to occur intermittently.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Menura alberti Albert's Lyrebird	V		Restricted to a small area of far south-eastern Qld and north-eastern NSW. In NSW, it is mainly found in the McPherson and Tweed Ranges, but occurs west to the Acacia Plateau in the Border Ranges and south to the Koonyum and Nightcap Ranges, and with an isolated population at the species' eastern and southern limit in the Blackwall Range, between Alstonville and Bagotville.	Rainforests or wet sclerophyll forests with a wet understorey, often of rainforest plants.	Unlikely. NSW OEH Bionet Atlas mapping for this species. Not detected in systematic fauna surveys in 2007, 2009, 2014,	No, physical impacts of the development are essentially confined to the development footprint. Nearest records of the species are >8kms west & separated by the Pacific Highway, and fauna fencing
Pandion cristatus Eastern Osprey	V		Common around the northern NSW coast, and uncommon to rare from coast further south. Some records from inland areas.	Rocky shorelines, islands, reefs, mouths of large rivers, lagoons and lakes.	Potential. Systematic fauna surveys in 2007, 2009, 2014, not detected. However, potential habitat present in the site and has the potential to occur intermittently.	Once found near the large dam in the development footprint. Single record was during an event, however event related disturbance may alienate a small are of forage habitat for this species, during events.
Podargus ocellatus Marbled Frogmouth	V		Southern subspecies restricted to south-eastern Qld and north-eastern NSW, between Gladstone and Lismore, and inland to Burnett Range in Qld and west of the Richmond Range.	Subtropical rainforest, or occasionally cool rainforest, higher elevation temperate rainforests or wet Eucalypt forest. In NSW, most often found in moist, lowland, mesophyll vine forest.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Ptilinopus magnificus Wompoo Fruit-Dove	V		In NSW, occurs south along coast and coastal ranges to the Hunter River.	Rainforest, low-elevation moist eucalypt forest and brush box forests.	Known – recorded in 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Ptilinopus regina Rose-crowned Fruit-Dove	V		In NSW, found on coast and ranges north from Newcastle. Vagrants are occasionally found further south to Victoria.	Sub-tropical and dry rainforest, moist eucalypt forest and swamp forest, where fruit is plentiful.	Known – recorded in surveys	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Todiramphus chloris Collared Kingfisher	V		In NSW, occurs along north coast south to the estuary of the Tweed River, with rare scattered records south to the Clarence River.	Mainly restricted to mangrove associations of estuaries, inlets, sheltered bays and islands, and the tidal flats and littoral zone bordering mangroves.	Unlikely. Estuarine & Mangrove species. Not detected in systematic fauna surveys.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Tyto longimembris Eastern Grass Owl	V		Recorded occasionally in all mainland states. In NSW they are more likely to be resident in the north-east.	Areas of tall grass, including grass tussocks, swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	Targeted surveys were undertaken in July each year for four years (2013 – 2016) and in September 2014 as part of the biennial fauna survey. This species was not present in the main event area (north of Jones Rd) in any year. A pair of Eastern Grass Owls responded to call play back in July 2016 in the exotic grassland in the south of the Parklands. This was the first observation of these species within the site since 2007.	A small area of potential habitat (exotic grassland) will be removed for the construction of the southern carpark.
Invertebrates						
Argynnis hyperbius Laced Fritillary	E1	CE	South-east QLD and far north-east NSW from Port Macquarie to Gympie.	Open swampy coastal habitat.	Unlikely. Not recorded in BNR, nearest BioNet record 2.5km to south of site. Not detected in systematic fauna surveys. Larval host plant species *Viola betonicifolia* not recorded on site.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Thersites mitchellae Mitchell's Rainforest Snail	E1	CE	Found on the coastal plain between the Richmond River and Tweed River on the NSW north coast. It has also been recorded from some adjacent mid-elevation areas including Wilsons River and Mount Jerusalem.	Remnant areas of lowland subtropical rainforest and swamp forest on alluvial soils. Particularly favours wetland edges with palms and fig trees.	Known. Annual Performance Reports 2015, 2016	The species has been found in BNR during bird surveys, but no direct impact from the development is likely. Only indirect potential threat is the possible increase in the risk of wildfire.
Petalura litorea Coastal Petaltail	E1		In NSW it is known from a very small number of locations, including Brooms Head, Tucabia, Diggers Camp and Bonville.	Permanent to semi-permanent coastal freshwater wetlands.	Unlikely. Not recorded in BNR, Bionet Atlas records for Byron LGA are from >20km to south. Not detected in systematic fauna surveys.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Mammals						

Aepyprymnus rufescens Rufous Bettong	V		Distribution extends south to Mt Royal National Park in north-eastern NSW. There are also sporadic, unconfirmed records inland from the Pilliga and Torrington districts.	From tall wet sclerophyll forests on the coast to the dry forests and open woodlands west of the Great Dividing Range.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Cercartetus nanus Eastern Pygmy-possum	V		In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes.	Rainforest, sclerophyll forest (including Box-Ironbark), woodland and heath.	Unlikely. Systematic fauna surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Petaurus norfolcensis Squirrel Glider	V		Widely though sparsely distributed on both sides of the Great Dividing Range in eastern Australia, from northern Qld to western Victoria.	Mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014. NPWS consider Billinudgel Nature Reserve potential habitat.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Phascogale tapoatafa Brush-tailed Phascogale	V		In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide.	Dry sclerophyll open forest, heath, swamps, rainforest and wet sclerophyll forest.	Unlikely. Systematic fauna surveys in 2007, 2009, 2014, not detected. NPWS consider Billinudgel Nature Reserve potential habitat.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Phascolarctos cinereus Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. There are sparse and possibly disjunct populations in the Bega District, and at several sites on the southern tablelands.	Eucalypt woodlands and forests.	Potential. Species not recorded in systematic fauna surveys on the site in 2007, 2009 and 2014. Biolink surveys found scats outside the development area in 2007, 2008, & 2016.	Scats found in the far north west of the development footprint in 2016, but the species has not been observed on the site. Numerous koala preferred feed trees included in plantings. Only indirect potential threat is the possible increase in the risk of wildfire. Species may exhibit avoidance behaviour during events.
Planigale maculata Common Planigale	V		Occurs in coastal north-eastern NSW, and reported from as far south as the central NSW coast west of Sydney.	Rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas.	Potential. However, not detected in systematic fauna surveys.	No, physical impacts of the development are essentially confined to the development footprint. Possible direct impact; loss of habitat if the species is present in southern grassland to be cleared for parking.
Potorous tridactylus Long-nosed Potoroo, Cobaki Lakes and Tweed Heads West population	E2,V	V	The Endangered Population is found in a small area between the northern shore of Cobaki Broadwater and the NSW-Qld border, within the localities of Cobaki Lakes and Tweed Heads West.	Occupies a patch of heath and heathy woodland. At Cobaki, potoroos have been recorded mainly in Scribbly Gum Heathland, but also in Scribbly Gum/Swamp Mahogany Forest, Tree Broom Heath, Scribbly Gum Forest, Black She-oak Heath and Swamp Mahogany Forest.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Potorous tridactylus Long-nosed Potoroo	V	V	In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm.	Coastal heaths and dry and wet sclerophyll forests.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Pseudomys gracilicaudatus Eastern Chestnut Mouse	V		In NSW, it mainly occurs north from the Hawkesbury River area along the coast and eastern edge of the Great Dividing Range. There are however isolated records in the Jervis bay area.	In NSW mostly found in dense, wet heathland and swamps.	Unlikely. Not recorded in BNR, sole Bionet Atlas record for Byron LGA is from >20km to south.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Bats						
Chalinolobus dwyeri Large-eared Pied Bat	V	V	Recorded from Rockhampton in Qld south to Ulladulla in NSW. Largest concentrations of populations occur in the sandstone escarpments of the Sydney basin and the NSW north-west slopes.	Wet and dry sclerophyll forests, Cyprus Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.	Known. Anabat call results, Annual Performance reports	No. Known from the site, recorded from bat calls at the large dam both during and outside events.
Falsistrellus tasmaniensis Eastern False Pipistrelle	V		South-east coast and ranges of Australia, from southern Qld to Victoria and Tasmania. In NSW, records extend to the western slopes of the Great Dividing Range.	Tall (greater than 20m) moist habitats.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Kerivoula papuensis Golden-tipped Bat	V		Scattered locations on east coast of Australia to south of Eden in southern NSW.	Rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, *Casuarina*-dominated riparian forest and coastal *Melaleuca* forests.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Miniopterus australis Little Bentwing-bat	V		East coast and ranges south to Wollongong in NSW.	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	V		In NSW it occurs on both sides of the Great Dividing Range, from the coast inland to Moree, Dubbo and Wagga Wagga.	Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Mormopterus norfolkensis Eastern Freetail-bat	V		Found along the east coast from south Qld to southern NSW.	Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Myotis macropus Southern Myotis	V		In NSW, found in the coastal band. It is rarely found more than 100 km inland, except along major rivers.	Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20m.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.

Nyctimene robinsoni Eastern Tube-nosed Bat	V		Few records from far north-east NSW, including the Nightcap, Tweed and Burringbar Ranges and in the vicinity of Mt Warning.	Streamside habitats in coastal subtropical rainforest and moist eucalypt forests with a well-developed rainforest understorey.	Unlikely. Systematic fauna surveys in 2007, 2009, 2014, not detected	Low probability of this species foraging within the development footprint. No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Nyctophilus bifax Eastern Long-eared Bat	V		In NSW, appears to be confined to the coastal plain and nearby coastal ranges, extending south to the Clarence River area, with a few records further south around Coffs Harbour.	Lowland subtropical rainforest, wet and swamp eucalypt forest, moist eucalypt forest, coastal scrub.	Known. Detected only during harp trapping (2007 and 2014).	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Pteropus poliocephalus Grey-headed Flying-fox	V	V	Along the eastern coast of Australia, from Bundaberg in Qld to Melbourne in Victoria.	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	Known. Numerous Grey-headed Flying-fox and Black Flying Foxes observed in 2007, with only single number of individuals observed subsequently. This decline is attributed to the abandonment of the maternity camp in Brunswick Heads Nature Reserve, as well as a lack of foraging resources (blossom) on site during survey periods.	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	V		There are scattered records of this species across the New England Tablelands and North West Slopes. Rare visitor in late summer and autumn to south-western NSW.	Almost all habitats, including wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Syconycteris australis Common Blossom-bat	V		Found north from Hawks Nest in NSW in coastal areas of eastern Australia.	Often roost in littoral rainforest and feed in adjacent heathland and paperbark swamps. Also recorded in subtropical rainforest, wet sclerophyll forest and other coastal forests.	Known. Detected only during harp trapping (2007 and 2014)	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Reptiles						
Cacophis harriettae White-crowned Snake	V		Coastal and near-coastal areas south to the Coffs Harbour area in north-east NSW. The western limit is the Legume area near the NSW-Qld border.	Low to mid-elevation dry eucalypt forest and woodland, moist eucalypt forest and coastal heathland.	Species not recorded in BNR or Byron LGA or in surveys on the site in 2007, 2009 and 2014.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Coeranoscincus reticulatus Three-toed Snake-tooth Skink	V	V	Coast and ranges from the Macleay valley in NSW to south-eastern Qld.	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	Unlikely. Species not recorded in Byron LGA or in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Hoplocephalus bitorquatus Pale-headed Snake	V		In NSW, it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. Historically recorded west to Mungindi and Quambone on the Darling Riverine Plains, across the North West Slopes, and the New England Tablelands.	Dry eucalypt forests and woodlands, cypress forest, rainforest and moist eucalypt forest. Dependent upon hollow-bearing trees.	Unlikely. Not recorded from the Byron LGA. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Hoplocephalus stephensii Stephens' Banded Snake	V		Coast and ranges from Southern Qld to Gosford in NSW.	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. Dependent upon hollow-bearing trees.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Appendix K – Likelihood Assessment for Migratory Fauna Species

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Distribution and Habitat	Likelihood	Justification
Birds						
Anthochaera phrygia	Regent Honeyeater	CE 2012: E, Mi	E4A,P	The Regent Honeyeater mostly inhabits the inland slopes of the Great Dividing Range and can be found in dry eucalypt woodland and open forests on wetter, more fertile areas around forest edges, wooded farmland and urban areas.	Unlikely	Outside species primary range and habitat largely unsuitable. One record approximately 2km south of site. Species not recorded in BNR or in surveys on the site in 2007, 2009 and 2014. Nor during event monitoring.
Apus pacificus	Fork-tailed Swift	Mi		The Fork-tailed Swift is predominantly aerial, more commonly inland however occasionally above foothills in coastal areas with dry and open habitat.	Possible	Marginal habitat, may be seen flying overhead
Calidris ferruginea	Curlew Sandpiper	CE, Mi 2012: Mi		Curlew Sandpiper commonly occur on the coastline, foraging and roosting in intertidal mudflats in sheltered estuaries, bays, inlets and lagoons.	Unlikely	No suitable habitat
Cuculus optatus	Oriental Cuckoo	Mi		Oriental Cuckoo inhabits forested woodlands. Large range, visiting the east coast of Australia from late Spring and Summer.	Likely	Recorded once in four years' of site surveys within 1 km of project area
Gallinago hardwickii	Latham's Snipe	Mi		Latham's Snipe occurs in permanent and ephemeral wetlands, inhabiting low dense vegetation.	Possible	Marginal habitat on site, existing records in surrounding areas Species not detected during targeted surveys on the site in 2007, 2009 and 2014. Nor during event monitoring.
Gallinago megala	Swinhoe's Snipe	Mi		Swinhoe's Snipe occurs along the coast, preferring the edges of wetlands, such as wet paddy fields, swamps and freshwater streams.	Unlikely	Marginal habitat, few definite records exist within Australia
Gallinago stenura	Pin-tailed Snipe	Mi		The distribution of the Pin-tailed Snipe in Australia is not well understood. The species can be found most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation.	Unlikely	Marginal habitat, few definite records exist within Australia
Hirundapus caudacutus	White-throated Needletail	Mi		White-throated Needletail is recorded in all regions of Australia and is almost exclusively aerial, however has been observed roosting in a variety of wooded habitats.	Known	Recorded during 2009 surveys.
Limosa lapponica	Bar-tailed Godwit	V, Mi 2012: Mi		Bar-tailed Godwit is found in all coastal areas of Australia, inhabiting large intertidal sandflats, mudflats, banks and estuaries	Unlikely	No suitable habitat
Monarcha melanopsis	Black-faced Monarch	Mi		Black-faced Monarch occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical and sub-tropical rainforests	Known	Recorded in Parklands during targeted bird surveys
Monarcha trivirgatus	Spectacled Monarch	Mi		The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Known	Recorded regularly in Parklands during targeted bird surveys
Motacilla flava	Yellow Wagtail	Mi		Summer migrant to north-east Queensland and increasing records in the Hunter region of NSW (DoE 2017). No known records in the Byron LGA. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland	Unlikely	Suitable habitat, no records in Byron LGA

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Distribution and Habitat	Likelihood	Justification
Myiagra cyanoleuca	Satin Flycatcher	Mi		The Satin Flycatcher is widespread across Australia, often found in eucalypt forests near wetlands or watercourses.	Known	Recorded in Parklands during targeted bird surveys
Numenius madagascariensis	Eastern Curlew	CE, Mi 2012: Mi		The Eastern Curlew can be found along the Australian coast, found in estuaries, bays, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats	Unlikely	No suitable habitat
Numenius minutus	Little Curlew	Mi		The Little Curlew can be found along the NSW coast, often found in short, dry grassland and sedgeland, including dry floodplains with scattered shallow freshwater pools or seasonally inundated areas.	Unlikely	Marginal habitat, no known records in area
Numenius phaeopus	Whimbrel	Mi		The Whimbrel can be found along the coast of Australia, typical habitat includes intertidal mudflats or sheltered coasts, as well as harbours, lagoons, estuaries and rivers.	Unlikely	No suitable habitat
Pandion cristatus	Eastern Osprey	Mi		Osprey habitat includes terrestrial wetlands, mostly in coastal areas, however can travel inland along major rivers. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes (DoE 2017)	Known	Recorded in Parklands during targeted bird surveys (2015)
Pluvialis fulva	Pacific Golden Plover	Mi		The Pacific Golden Plover is a widespread coastal species, usually inhabiting beaches, mudflats and sandflats, occasionally around inland wetlands.	Unlikely	Marginal habitat, no known records in area
Rhipidura rufifrons	Rufous Fantail	Mi		The Rufous Fantail occurs in coastal and near coastal areas of northern and eastern Australia. Usually inhabits wet sclerophyll forests usually with a dense shrubby understory.	Known	Recorded in Parklands during targeted bird surveys
Rostratula australis	Australian Painted Snipe	E 2012: V, Mi		Australian Painted Snipe occurs in all states of Australia, more common in eastern Australia. Wetland dependent species, found in shallow terrestrial freshwater (occasionally brackish) wetlands, temporary or permanent lakes, swamps and clay pans.	Unlikely	Marginal habitat, no records in area
Sterna albifrons	Little Tern	Mi		In NSW, the Little Tern occurs mostly north of Sydney, with small numbers in Victoria. Species is almost exclusively coastal, preferring sheltered environments, occasionally observed in inlets and rivers.	Unlikely	No suitable habitat
Tringa brevipes	Grey-tailed Tattler	Mi		Grey-tailed Tattler is found in most coastal regions in Australia, found in sheltered coasts with reefs and rock platforms or intertidal mudflats.	Unlikely	No suitable habitat
Tringa nebularia	Common Greenshank	Mi		The Common Greenshank can be found along the coast and coastal inland areas of Australia. Occurs in all types of wetland habitats and coastal habitats of varying salinity, both permanent and ephemeral.	Unlikely	No suitable habitat
Turnix melanogaster	Black-breasted Button-quail	V		Black-breasted Button-quail has a scattered distribution in New South Wales. Often found in semi-evergreen vine thickets, coastal dune scrub and dry rainforests	Unlikely	Suitable habitat onsite, no known records in area

Appendix L - Likelihood Assessment for Flora Species

Targeted threatened flora surveys were undertaken in 2009. It is acknowledged that this data is now around nine years old and considered outdated. Nonetheless, it is considered to be valuable for the purposes of the likelihood assessment and is used (in part) to assess the likelihood of a species occurring within the development site. To complete the likelihood assessment for threatened flora, a review of threatened flora distributions, ecology and habitat preferences was combined with an assessment of available habitat (by considering vegetation communities and landform within the development site). Incidental observations of threatened flora species during the other surveys (see **Section 6**) further informed the assessment of likelihood.

In addition to this, a threatened flora survey was undertaken within the 300m^2 area proposed to be cleared (**Section 9.1**).

No threatened flora species will be directly impacted by the proposed development.

Species name	Common name	TSC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site*	Habitat on site directly or indirectly impacted
Acacia bakeri	Marblewood	V		Restricted to coastal south-east Qld and north-east NSW, where it occurs north from Mullumbimby.	Lowland subtropical rainforest, adjacent eucalypt forest and in regrowth of both.	Unlikely.	No, physical impacts of the development are confined to the development footprint which does not contain any potential habitat for this species.
Acalypha eremorum	Acalypha	E1		In NSW it occurs in only a few localities, including the Chaelundi, Lismore and Burringbar areas.	Subtropical rainforest, dry rainforest and vine thickets.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are confined to the development footprint which does not contain any potential habitat for this species.
Acronychia littoralis	Scented Acronychia	E1	E	Between Fraser Island in Qld and Port Macquarie on the north coast of NSW.	Littoral rainforest on sand.	Unlikely. No suitable habitat (unsuitable soils within site)	No, physical impacts of the development are confined to the development footprint which does not contain any potential habitat for this species.
Allocasuarina defungens	Dwarf Heath Casuarina	E1	E	Only in NSW, from the Nabiac area, north-west of Forster, to Byron Bay on the NSW north coast.	Tall heath on sand, also nearby-coastal hills or headlands adjacent to sandplains.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are confined to the development footprint which does not contain any potential habitat for this species.
Angiopteris evecta	Giant Fern	E1		Only one plant known in the wild in NSW, in the Burringbar Range near Murwillumbah.	Lowland rainforest or wet eucalypt forest where water is abundant.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Archidendron hendersonii	White Lace Flower	V		Found south to the Richmond River in north-east NSW.	Riverine and lowland subtropical rainforest and littoral rainforest.	Unlikely. Targeted threatened flora surveys 2009. Basalt soils, not present on the site.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Arthraxon hispidus	Hairy Joint Grass	V	V	In NSW, found on the northern tablelands and north coast.	Edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	Unlikely. Target surveys in June 2017 and March 2018 did not detect the species and habitat suitability was considered poor.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Belvisia mucronata	Needle-leaf Fern	E1		In NSW, it is known from only five locations on the far north coast, north from Evans Head.	On trees or rocks in dry rainforest or along creeks in moist open forest.	Unlikely.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Bosistoa transversa syn. selwynii	Yellow Satinheart	V	V	In north-east NSW, it is found south to the Nightcap Range north of Lismore.	Lowland subtropical rainforest up to 300 m in altitude.	Unlikely.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Caesalpinia bonduc	Knicker Nut	E1		In NSW found on the northern part of Lord Howe Island, and on the far north coast.	Coastal scrub on sandy, coral-derived soil close to the shoreline.	Unlikely.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Cassia brewsteri var. marksiana	Brush Cassia	E1		North from Brunswick Heads, around Murwillumbah.	Littoral and riverine rainforest, regrowth vegetation on farmland and along roadsides.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Centranthera cochinchinensis	Swamp Foxglove	E1		North from Wooli.	Swampy areas and other moist sites.	Unlikely.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Choricarpia subargentea	Giant Ironwood	E1		Known in NSW only from Mount Chincogan near Mullumbimby and one recent record at Jiggi north-west of Lismore.	Has been recorded in NSW in rainforest regrowth on basalt-derived soil.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site*	Habitat on site directly or indirectly impacted
Coatesia paniculata	Axe-Breaker	E1		Moderately common in restricted habitat in Queensland between the Brisbane River and the central Queensland coast, but very rare in north-east NSW, where it is known from the Tweed, Lismore and Wardell areas.	Axe-Breaker is found in dry subtropical rainforest and vine scrub, often along rivers.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
Corokia whiteana	Corokia	V	V	Only in north-east NSW: one population in the Nightcap Range, one in the Tweed Valley, and the other near Brunswick Heads.	Boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m.	Potential. Marginal habitat on site, records within BNR 1.5 km from site. Species not observed during targeted flora survey 2009 or subsequent site inspections	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Cryptocarya foetida	Stinking Cryptocarya	V	V	Coastal south-east Qld and north-east NSW south to Iluka.	Littoral rainforest, on sandy or basaltic soils.	Known. Recorded during targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Cupaniopsis serrata	Smooth Tuckeroo	E1		In NSW, it is confined to the Tweed Valley.	Subtropical and dry rainforest.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Cyperus aquatilis	Water Nutgrass	E1		In NSW, known only from a few sites north from Grafton.	Ephemerally wet sites, such as roadside ditches and seepage areas from small cliffs, in sandstone areas.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Cyperus semifertilis	Missionary Nutgrass	E1	V	In NSW, currently known from only one site, in the Mullumbimby area on the north coast.	Open forest dominated by *Eucalyptus acmenoides* (White Mahogany).	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Davidsonia jerseyana	Davidson's Plum	E1	E	Restricted to north-east NSW to as far south as Wardell.	Lowland subtropical rainforest and wet eucalypt forest below 300m.	Potential. Suitable habitat on site, records to the west of the development footprint.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Davidsonia johnsonii	Smooth Davidson's Plum	E1	E	South-east Qld and north-east NSW south to Tintenbar.	Lowland subtropical rainforest and wet eucalypt forest below 300m.	Known. Targeted threatened flora surveys 2009. Recorded immediately adjacent to development site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Dendrobium melaleucaphilum	Spider orchid	E1		Costal districts and nearby ranges, extending from Qld to the lower Blue Mountains.	Grows on *Melaleuca styphelioides,* on rainforest trees or on rocks in coastal districts.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Dendrocnide moroides	Gympie Stinger	E1		South from Qld to the Clarence River in north-east NSW.	Lowland rainforest, especially in gaps or other disturbed sites.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site*	Habitat on site directly or indirectly impacted
Desmodium acanthocladum	Thorny Pea	V	V	Occurs only in north-east NSW, in the Lismore area, near Grafton, Coraki, Casino and the Mount Warning area.	Dry rainforest and fringes of riverine subtropical rainforest, on basalt-derived soils at low elevations.	Unlikely. Basalt soils, not present on the site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Diospyros mabacea	Red-fruited Ebony	E1	E	Only in north-east NSW. Found in a few stands on the Tweed and Oxley Rivers, upstream from Murwillumbah, on Stotts Island in the lower Tweed River and west of Mullumbimby on the Brunswick River.	Lowland subtropical rainforest, often close to rivers.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Diospyros yandina	Shiny-leaved Ebony	E1		In NSW this species is found only in Hogans Scrub at North Tumbulgum and on Mount Cougal, in the Tweed Valley. It also occurs in south-east Queensland.	It grows in the understorey of riverine or lowland subtropical rainforest.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Diploglottis campbellii	Small-leaved Tamarind	E1	E	Coastal lowlands between Richmond River on the Far North Coast of NSW and Mudgeeraba Creek on the Gold Coast hinterland, Qld.	Confined to the warm subtropical rainforests of the NSW-Qld border lowlands and adjacent low ranges, ranging from lowland subtropical rainforest to drier subtropical rainforest with a Brush Box open overstorey.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Doryanthes palmeri	Giant Spear Lily	V		In NSW, occurs on the coastal ranges that are part of the Mt Warning Caldera. Its southern distributional limit is Mount Billen.	Exposed rocky outcrops, cliff-tops and on steep cliff-faces in montane heath next to subtropical rainforest, warm temperate rainforest or wet eucalypt forest.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Drynaria rigidula	Basket Fern	E1		In NSW it is only found north of the Clarence River, in a few locations at Maclean, Bogangar, Byron Bay, Mullumbimby, in the Tweed Valley and at Woodenbong.	Rainforest, moist eucalypt or Swamp Oak forest, growing on plants, rocks or on the ground.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Eidothea hardeniana	Nightcap Oak	E1	CE	Only in the Nightcap Range north of Lismore.	Upland warm temperate rainforest, usually near creeks.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Elaeocarpus williamsianus	Hairy Quandong	E1	E	Restricted to a very few sites between Goonengerry and Burringbar in north-east NSW.	Subtropical to warm temperate rainforest, including regrowth areas, on soils derived from metasediments.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Eleocharis tetraquetra	-	E		In NSW, found on the north coast at Boambee near Coffs Harbour and near Grafton and Murwillumbah.	Damp locations on stream edges and in and on the margins of freshwater swamps.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site*	Habitat on site directly or indirectly impacted
Elionurus citreus	Lemon-scented Grass	E1		North of Grafton, NSW specifically Casino, Cudgen Lake and Yuraygir National Park. Also occurs in QLD, NT, WA and New Guinea.	Grows on sandy soils near rivers or along the coast in wallum areas or sand dunes. In NSW, the species has been found growing in infertile white sands.	Unlikely. All NSW locations the species has been found growing in Infertile white sands: OEH species profile. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Endiandra floydii	Crystal Creek Walnut	E1	E	In NSW, confined to the Tweed and Brunswick Valleys and Byron Bay area.	Warm temperate or subtropical rainforest with Brush Box overstorey, and in regrowth rainforest and Camphor Laurel forest.	Recorded immediately adjacent to development site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Endiandra hayesii	Rusty Rose Walnut	V	V	From Burleigh Heads in Qld to the Richmond River in north-east NSW.	Sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils.	Suitable habitat, several records adjacent to site (<500 m), one within BNR Species not observed during targeted flora surveys 2009 or subsequent site inspections	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	E1		From southern Qld to north-east NSW south to Maclean.	Subtropical rainforest or wet eucalypt forest, chiefly at lower altitudes.	Known. Plants are present within development site and adjacent areas. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Floydia praealta	Ball Nut	V	V	Scattered populations from Gympie in Qld to the Clarence River in north-east NSW.	Riverine and subtropical rainforest, usually on soils derived from basalt.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Fontainea australis	Southern Fontainea	V	V	Restricted to the Tweed Valley and a few locations in the upper reaches of the Richmond Valley.	Lowland subtropical rainforest, usually on basaltic alluvial flats, and cooler subtropical rainforest in the Nightcap Range.	Unlikely. No basalt derived soils on site.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Geodorum densiflorum	Pink Nodding Orchid	E1		In NSW, occurs north of Bundjalung National Park, including the Tweed Shire.	Dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand.	Known from outside the development site. No, physical impacts of the development are essentially confined to the development footprint.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Gossia fragrantissima	Sweet Myrtle	E1	E	South-east Qld and in north-east NSW south to the Richmond River.	Dry subtropical and riverine rainforest, mainly on basalt-derived soils.	Unlikely. No basalt derived soils on site.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Grevillea hilliana	White Yiel Yiel	E1		In NSW, known only near Brunswick Heads, on the slopes of Mt Chincogan near Byron Shire, and in patches of remnant habitat in the Tweed Shire, particularly around Terranora.	Subtropical rainforest, often on basalt-derived soils.	Unlikely. No basalt derived soils on site.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Harnieria hygrophiloides		E1		In NSW, recorded only at Hortons Creek and two other places south of Nymboida, and at Brunswick Heads.	Littoral rainforest, dry rainforest and wet eucalypt forest, usually in well-drained areas.	Unlikely.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site*	Habitat on site directly or indirectly impacted
Hicksbeachia pinnatifolia	Red Boppel Nut	V	V	Coastal areas of north-east NSW from the Nambucca Valley north to south-east Qld.	Subtropical rainforest, moist eucalypt forest and Brush Box forest.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Isoglossa eranthemoides	Isoglossa	E1	E	Very restricted distribution in north-east NSW from the Tweed to the Lismore area.	Lowland subtropical rainforest, in moist situations on floodplains and slopes.	Unlikely. All Byron LGA records in the Bionet Atlas are located in the far south-west of the Shire.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Lepiderema pulchella	Fine-leaved Tuckeroo	V		NSW north coast, north of Brunswick Heads, into Qld. Most records in NSW are from the Tweed Valley.	Subtropical rainforest, mainly on infertile metasediments, fertile basalts and back swamp alluvium.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Lindsaea brachypoda	Short-footed Screw Fern	E1		In NSW mainly found in a few locations north from Minyon Falls in Nightcap National Park. Records exist for Tumbulgum, Mullumbimby and Mooball.	Very moist habitats in subtropical or warm-temperate rainforest or palm forest.	No suitable habitat (unsuitable soils within site)	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Lindsaea fraseri	Fraser's Screw Fern	E1		In NSW it is known from near Hastings Point on the Tweed coast and in the Pillar Valley east of Grafton.	Poorly drained, infertile soils in swamp forest or open eucalypt forest.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Macadamia tetraphylla	Rough-shelled Bush Nut	V	V	Confined chiefly to the north of the Richmond River in north-east NSW, extending just across the border into Qld.	Subtropical rainforest, usually near the coast.	Known. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Marsdenia longiloba	Slender Marsdenia	E1	V	In NSW, occurs at scattered locations on the north coast north from Barrington Tops.	Subtropical and warm temperate rainforest, lowland moist eucalypt forest adjoining rainforest, areas with rock outcrops.	Known Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Myrsine richmondensis	Ripple-leaf Muttonwood	E1	E	Coraki, Boatharbour near Lismore, and the Cherry Tree area west of Casino.	Subtropical and dry rainforest and swamp forest on creek flats and slopes on basalt derived soil.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Niemeyera whitei	Rusty Plum, Plum Boxwood	V		Coast and adjacent ranges of northern NSW from the Macleay River into southern Qld.	Rainforest and adjacent moist eucalypt forest.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Oberonia complanata	Yellow-flowered King of the Fairies	E1		Within NSW, several historical collections from Byron Bay, Lismore, and Coffs Harbour. More recently recorded from Lismore and Wollumbin.	Littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes, stream-side areas, swampy forests and mangroves. Grows on trees and rocks.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site*	Habitat on site directly or indirectly impacted
Ochrosia moorei	Southern Ochrosia	E1	E	North-east NSW north from the Richmond River into south-east Qld.	Riverine and lowland subtropical rainforest.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Oldenlandia galioides		E1		In NSW, known from Whiporie State Forest south of Casino, one location in the Tweed district, and also occurs on the north-west plains.	Margins of seasonally inundated wetlands in paperbark swamps and *Eucalyptus tereticornis* (Forest Red Gum) woodlands.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Owenia cepiodora	Onion Cedar	V	V	North from the Richmond River in north-east NSW extending just across the Qld border.	Subtropical and dry rainforest on or near soils derived from basalt.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Ozothamnus vagans	Wollumbin Dogwood	E1	V	Restricted to Mt Warning and the Tweed and McPherson Ranges of north east NSW and south east Qld.	Subtropical rainforest and cool temperate rainforest. Prefers open areas of disturbance.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Phaius australis	Southern Swamp Orchid	E1	E	Qld and north-east NSW as far south as Coffs Harbour.	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Phaius tancarvilleae	Lady Tankerville's Swamp Orchid	E1	E	May now be extinct in former range of north-east NSW. Also Qld.	Swampy grassland or swampy forest, including rainforest, eucalypt and paperbark forest.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Phyllanthus microcladus	Brush Sauropus	E1		In NSW confined to a few locations in the Tweed, Brunswick, Richmond and Wilson River Valleys with an outlying population near Grafton.	Riparian rainforest.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Pomaderris notata	McPherson Range Pomaderris	V		In NSW it is known from five sites in the McPherson and Tweed Range areas, including Mount Warning National Park, Mebbin National Park and Limpinwood Nature Reserve.	Rocky basalt ranges in montane heaths and scrubs or in scrubby rainforest.	Unlikely. No basalt geology within development site.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Randia moorei	Spiny Gardenia	E1	E	From Lismore in north-east NSW north to the Logan River in south-east Qld.	Subtropical, riverine, littoral and dry rainforest.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Rhynchosia acuminatissima	Pointed Trefoil	V		Nine locations north of Lismore, in NSW and Qld.	In or near dry rainforest dominated by Hoop Pine.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site*	Habitat on site directly or indirectly impacted
Sarcochilus hartmannii	Hartman's Sarcochilus	V	V	From the Richmond River in northern NSW to Gympie in south-east Qld.	On volcanic rocks, in sclerophyll forest or exposed sites, from 500 to 1000 m. Rarely on bases of trees.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Senna acclinis	Rainforest Cassia	E1		Coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Qld.	Subtropical and dry rainforest.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Sophora fraseri	Brush Sophora	V	V	North from the Casino district in north-east NSW, into south-east Qld.	Moist situations, often near rainforest.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Syzygium hodgkinsoniae	Red Lilly Pilly	V	V	From the Richmond River in north-east NSW to Gympie in Qld.	Riverine and subtropical rainforest on rich alluvial or basaltic soils.	Potential.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Syzygium moorei	Durobby / Coolamon Rose Apple	V	V	Richmond, Tweed and Brunswick River valleys in north-east NSW and into south-east Qld.	Subtropical and riverine rainforest at low altitude. Often occurs as isolated remnant paddock trees.	Recorded on site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Appendix M - EP&A Act Assessment of Significance (7-Part Test)

The TSC Act (now repealed and replaced by the BC Act) aimed to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The Act was integrated with the EP&A Act and required consideration of whether a development was likely to significantly affect threatened species, populations and ecological communities or their habitat. Impacts were assessed through the application of the Assessment of Significance (7-part test). If such impacts were considered significant under the terms of the TSC Act, a Species Impact Statement may have been required.

As the TSC Act has now been repealed, the equivalent assessment process has now been integrated into the BC Act (Part 7, Division 1, Section 7.3). Nonetheless, the below assessment has been undertaking using the TSC Act 7-part test assessment, as the TSC Act remains the relevant statutory framework for this proposal.

Threatened species and communities known or potentially likely to occur have been assessed and are grouped below.

Table 13: Species and EEC groupings subject to 7-part test assessment

Grouping	Species / Community
Forest flora	KNOWN Davidson's Plum (*Davidsonia jerseyana*) Rough Shelled Bushnut (*Macadamia tetraphylla*) Durobby / Coolamon Rose Apple (*Syzygium moorei*) Stinking Cryptocarya (*Cryptocarya foetida)* Green-leafed Rose Walnut (*Endiandra muelleri* ssp*. bracteata*) POTENTIAL Rusty Rose Walnut (*Endiandra hayesii*) Clear Milkvine (Slender Marsdenia) (*Marsdenia longiloba*) Southern Fontainea (*Fontainea australis*) Pink Nodding Orchid (*Geodorum densiflorum*) *Corokia whiteana*
EECs	Swamp sclerophyll forest on coastal floodplains of the NSW north coast bioregion Subtropical coastal floodplain forest of the NSW north coast bioregion Lowland rainforest of the NSW north coast bioregion
Microbats	KNOWN Common Blossom-bat (*Syconycteris australis*) Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) Eastern Freetail-bat (*Mormopterus norfolkensis*) Eastern Long-eared Bat (*Nyctophilus bifax*) Golden-tipped Bat (*Kerivoula papuensis*)

	Large-eared Pied Bat (*Chalinolobus dwyeri*) – EPBC Act vulnerable species Little Bent-wing Bat (*Miniopterus australis*) Southern Myotis (*Myotis macropus*) Yellow-bellied Sheathtailed Bat (*Saccolaimus flaviventris*)
Nectar or fruit foraging species (birds and bats)	KNOWN Little Lorikeet (*Glossopsitta pusilla*) Rose-crowned Fruit Dove (*Ptilinopus regina*) White-eared Monarch (*Carterornis leucotis*) Wompoo Fruit Dove (*Ptilinopus magnificus*) Grey-headed Flying-fox (*Pteropus poliocephalus*) POTENTIAL Coxen's Fig Parrot (*Cyclopsitta diopthalma coxeni*) Swift Parrot (*Lathamus discolor*)

Individually assessed species:

- Eastern Grass Owl (*Tyto longimembris*) – known
- Eastern Osprey (*Pandion cristatus*) – known
- Koala (*Phascolarctos cinereus*) – vulnerable species AND endangered population (Koala *Phascolarctos cinereus* (Goldfuss, 1817) between the Tweed and Brunswick Rivers east of the Pacific Highway) – known
- Mitchell's Rainforest Snail (*Thersites mitchellae*) – potential (known from Billinudgel Nature Reserve)
- Common Planigale (*Planigale maculata*) – potential

12.1 Flora

Five listed flora species have been identified as occurring in the Development site and five have the potential to occur. A 7 part test, conducted in accordance with the EP&A Act, has been conducted for the flora species and is provided in **Table 42**.

12.1.1 Five flora species identified within the Development Site

Davidson's Plum (Davidsonia jerseyana)

This species occurs in lowland subtropical rainforest and wet eucalypt forest at low altitudes. Many trees are isolated in paddocks and on roadsides in former rainforest habitats. A small stand of mature Davidson's Plum trees occurs just outside the western boundary of the Parklands site, in association with an area of Lowland Rainforest TEC. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat
- Grazing by domestic stick
- Roadworks
- Invasion of habitat by weeds
- Fire
- Collection of fruit for bush food, and seeds for horticulture

Rough-shelled Bush Nut (Macadamia tetraphylla)

This species occurs in subtropical rainforest, usually near the coast and was found in the rainforest and Brush Box communities in the development site. Three Rough-shelled Bush Nut trees are located in the northwest corner of the Parklands site. They are located in a paddock in the north-east corner of the site and are associated with an old domestic structure. It is possible that they represent planted specimens. These individuals are have impacted by historical competition from Camphor Laurel and Mango Trees (Fitzgerald 2016a), but this is being addressed by the Parkland's bush regeneration team. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for coastal development, agriculture and roadworks
- Risk of local extinction due to low numbers
- Grazing and trampling by domestic stock
- Fire
- Invasion of habitat by weeds
- Loss of local genetic strains through hybridisation with commercial varieties
- Reduction of genetic diversity as a result of fragmentation

Durobby / Coolamon Rose Apple (Syzygium moorei)

This species prefers subtropical and riverine rainforest at low altitude. It often occurs as isolated remnant paddock trees and is readily propagated and widely planted in rural areas. The species has been recorded 75 times in the Byron Bay Local Government Area, with many records consisting of just one individual (TSSC, 2008b). This species was found in rainforest and as isolated individuals in paddocks in the development site. Two mature Coolamon Rose Apple trees are located close to the western boundary of the Parklands site. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for agriculture
- Clearing and fragmentation of habitat for rural and residential development and roadworks
- Weed infestation of rainforest habitats
- Grazing and trampling of seedlings and saplings by domestic stock, particularly around remnant paddock trees
- Illegal collection for horticulture
- Risk of local extinction due to small population sizes

Stinking Cryptocarya (Cryptocarya foetida)

This species is found in littoral, warm temperate and subtropical rainforest, wet sclerophyll forest and Camphor laural forest usually on sandy soils, but mature trees are also known on basalt soils. This species occurs as a single tree specimen located in an area of Swamp Sclerophyll Forest habitat on Lot 402 DP755687 near the centre of the Parklands site. The OEH profile for this species list the following threats:

- Risk of local extinction because populations are small
- Clearing and fragmentation of habitat for development
- Clearing and fragmentation of habitat for agriculture
- Infestation of habitat by weeds
- Clearing and disturbance as a result of roadworks and track maintenance
- Inappropriate fire regime including altering habitat and destroying individuals
- Trampling by visitors when accessing beach areas through littoral rainforest
- Trampling by domestic stock
- Risk of local extinction due to small population sizes

Green-leaved Rose Walnut (Endiandra muelleri subsp. bracteata)

This species occurs in subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats. This species was found adjacent to the project area in Lowland Rainforest. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for coastal development
- Clearing and fragmentation of habitat for agriculture
- Infestation of habitat by weeds
- Clearing and fragmentation of habitat for road works
- Frequent fire
- Disturbance from recreational users in reserve areas
- Forestry related activities within we sclerophyll forest habitat
- Damage from domestic stock
- Habitat loss and fragmentation as a result of infrastructure development including powerline construction

12.1.2 Five flora species with the potential to occur within the Development Site.

Rusty Rose Walnut (Endiandra hayesii)

This species is found on sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils. The species occurs in regrowth and highly modified forms of these habitats. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for coastal development
- Clearing and fragmentation of habitat for agriculture
- Infestation of habitat by weeds
- Clearing and fragmentation of habitat for road works
- Frequent fire
- Disturbance from recreational users in reserve areas
- Forestry related activities within we sclerophyll forest habitat
- Damage from domestic stock
- Habitat loss and fragmentation as a result of infrastructure development including powerline construction

Slender Marsdenia (Marsdenia longiloba)

This species is found in subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

The OEH profile for this species list the following threats for this species:

- Loss and fragmentation of habitat through land clearing for agriculture
- Loss and fragmentation of habitat through land clearing for urban development
- Invasion of habitat by introduced weeds
- Grazing and trampling of plants by cattle
- Disturbance of habitat and loss of individuals as a result of forestry activities
- Risk of local extirpation because populations are small
- At risk from the use of herbicides in weed control activities
- Roadside populations are at risk from road works

Southern Fontainea (Fontainea australis)

Southern Fontainea is found in lowland subtropical rainforest, usually on basaltic alluvial flats, and also in cooler subtropical rainforest in the Nightcap Range. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for agriculture
- Clearing and fragmentation of habitat for urban development
- Infestation of habitat by weeds

- Risk of local extinction because populations are small
- Low genetic diversity
- Grazing and trampling by domestic stock limiting opportunities for recruitment
- Loss of individuals as a result of fire

Pink Nodding Orchid (Geodorum densiflorum)

This species is found on dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for urban development
- Infestation of habitat by introduced weeds such as Bitou Bush
- Trampling by bushwalkers and fishers
- Illegal collection of orchids

Corokia (Corokia whiteana)

Inland populations of this species are found at the boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

- Loss of habitat clearing for urban expansion
- Risk of extinction because populations are small and distribution is highly restricted
- Timber harvesting activities
- Fire, as hot fires will kill the plants
- Invasion of habitat by weeds

Hairy Joint Grass

Hairy-joint Grass is a slender tufted creeping grass. It occurs in scattered areas in Queensland and on the northern tablelands and north coast of New South Wales. No individuals of these species have been detected within the development site.

This species was recognised as having a greater potential to occur within the development footprint, specifically within the area of unmanaged pasture grass in the south of the development site.

The OEH lists the threatening processes to Hairy-joint Grass as:

- Clearing of habitat for agriculture and development
- Inappropriate fire regimes
- Over-grazing by domestic stock
- Competition from introduced grasses such as *Paspalum dilatatum* (Paspalum) and *Pennisetum clandestinum* (Kikuyu)
- Slashing or mowing of habitat

Table 42: Flora grouping 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	No individual plants of these flora species will be removed. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems. Indirect impacts: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site Ongoing monitoring and remedial action will be undertaken if condition is impaired (e.g. Rough-shelled Bush Nut individuals were experiencing some impact from historical competition from Camphor Laurel and Mango Trees, though this is unrelated to the SITG and FF events and has been addressed by Parklands' bush regeneration team).
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A - this is not an endangered population.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. is likely to substantially and adversely modify the composition of the ecological community such that its local	N/A - this is not an EEC or CEEC

occurrence is likely to be placed at risk of extinction.	
d) in relation to the habitat of a threatened species, population or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	No individual plants of these species will be removed. Overall, the biodiversity characteristics of the site are being permanently improved by the current site managers and utilisation patterns. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	The Development site does not constitute a critical habitat for these species.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	No recovery plan or threat abatement plan have yet been developed for the Durobby / Coolamon Rose Apple (*Syzygium moorei*), Stinking Cryptocarya (*Cryptocarya foetida*), Slender Marsdenia (*Marsdenia longiloba*), Southern Fontainea (*Fontainea australis*), Pink Nodding Orchid (*Geodorum densiflorum*), Hairy-joint Grass (*Arthraxon hispidus*) or Corokia (*Corokia whiteana*). However a National recovery plan has been prepared for the Davidson's Plum by the (former) Department of Environment and Conservation (now OEH) in 2004. The recovery plan identifies the following objectives: • Objective 1: Co-ordinate the recovery of the Davidson's Plum • Objective 2: Determine whether further wild sub-populations exist in NSW, and implement measures as appropriate • Objective 3: Research into the biology, ecology and genetics of the Davidson's Plum • Objective 4: Gain an understanding of the cultural importance of the Davidson's Plum to Local Aboriginal Land Councils, Elders and other groups representing indigenous people. • Objective 5: Manage and protect the Davidson's Plum and associated habitat from threatening processes

	• Objective 6: Develop a contingency strategy to ensure the long-term survival of the Davidson's Plum The proposed works do not conflict with any of the objectives of the recovery plan. A recovery plan for Southern Macadamia Species was produced by Horticulture Australia Limited and the Australian Macadamia Society which includes *Macadamia tetraphylla*. The recovery plan identifies the following objectives: • Objective 1: Identify and evaluate the extent and quality of southern macadamia species populations and their habitat • Objective 2: Reduce and manage the major threatening processes affecting southern macadamia species habitat • Objective 3: Increase knowledge of southern macadamia species and their ecology to effect their conservation and management • Objective 4: Improve awareness and understanding of southern macadamia species, especially the management requirements of these species and their major threats. • Objective 5: Manage, monitor and evaluate the Southern Macadamia Species Recovery Plan The proposed works do not conflict with any of the objectives of the recovery plan. An approved recovery plan for the Green-leaved rose Walnut (*Endiandra muelleri* subsp. *bracteata*) and Rudy Rose Walnut (*Endiandra hayesii*) has been prepared by the (former) Department of Environment and Conservation (now OEH) in 2004. The recovery plan identifies the following objectives: • Objective 1: Co-ordinate the recovery of the Green-leaved Rose Walnut and the Rusty Rose Walnut • Objective 2: To resolve the taxonomic difficulties in the separation of the Green-leaved Rose Walnut and the Rusty Rose Walnut, and other closely related taxa and conduct field surveys where necessary to fill information gaps • Objective 3: To reassess background information for the newly resolved taxa • Objective 4: To improve the consideration of the Green-leaved Rose Walnut and the Rusty Rose Walnut in environmental impact assessments for developments and activities. • Objective 5: To manage and protect the Green-leaved Rose Walnut and Rusty Rose Walnut and associated habitat from threatening processes • Objective 6: fire planning and management • Objective 7: To improve knowledge of distribution, regeneration and genetics • Objective 8: To integrate the recovery of the Green-leaved Rose Walnut and the Rusty Rose Walnut with the recovery of other biota • Objective 9: To involve the community in the recovery of the Green-leaved Rose Walnut and Rusty Rose Walnut

	The proposed works do not conflict with any of the objectives of the recovery plan. The Border Ranges Rainforest Biodiversity Management Plan prepared by the (former) Department of Environment, Climate Change and Water (now OEH) in 2010 which covers all of the flora species mentioned in this assessment with the exception of Pink Nodding Orchid (*Geodorum densiflorum*). The management plans identify the following objectives: • Objective 1: to reduce organisational-related impediments to biodiversity conservation • Objective 2: to minimize the impacts of climate change on biodiversity • Objective 3: to protect rainforest, related vegetation and species from clearing • Objective 4: to protect rainforest and related vegetation from fragmentation, modification and degradation. • Objective 5: To protect rainforest and related vegetation from the impact of weeds • Objective 6: to protect rainforest from fire and to promote the implementation of appropriate fire regimes in related vegetation • Objective 7: to protect rainforest and related vegetation from the impact of pest animals • Objective 8: to minimize the effects of Bell miner associated dieback on rainforest and associated wet sclerophyll forest • Objective 9: to protect rainforest and related vegetation from grazing and trampling by livestock • Objective 10: To minimize the impacts of human interference • Objective 11: to control and minimize impacts of introduced pathogens and diseases • Objective 12: to maintain the viability and evolutionary potential of rainforest and related populations, species and communities • Objective 13: to recognize the cultural value of rainforest and related vegetation to the Indigenous community and engage the Indigenous community in the protection and enhancement of rainforest and associated biodiversity and cultural values • Objective 14: to engage the community and private land-holders in biodiversity conservation • Objective 15: to establish effective monitoring of biodiversity related projects The proposed works do not conflict with any of the objectives of the management plan.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Clearing is a key threatening process to all of the threatened flora species assessed as part of this 7 part test. However, no individual plants of these species will be removed. The proposed action may result in the following indirect impacts: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence

	• Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.

12.1.3 Conclusion

The proposal is unlikely to have a significant impact on the listed flora species given that:

- No individuals of these species will be removed
- Only a very small area of vegetation will be removed as part of the project (approximately 300m^2, or <0.001% of native vegetation within the development site. Pre-clearing survey will ensure that no threatened flora species will be impacted by the proposed clearing.
- Potential indirect impacts are considered low risk
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- On-going benefits will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these species. Consequently, a Species Impact Statement is not required for the proposal with respect to these listed flora species.

12.2 EEC

A 7 part test, conducted in accordance with the EP&A Act, has been conducted for the EECs within the development site, and is provided in Table 43.

Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion

Subtropical Coastal Floodplain Forest is listed as an EEC under the TSC Act. Subtropical Coastal Floodplain Forest is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, but may occur elsewhere in this bioregion. Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.

The extent of the Subtropical Coastal Floodplain Forest prior to European settlement has not been mapped across its entire range. However, the remaining area of Subtropical Coastal Floodplain Forest is likely to be considerably smaller and is likely to represent much less than 30% of its original range. There are less than 350 ha of native floodplain vegetation on the Tweed lowlands.

Small areas of Subtropical Coastal Floodplain Forest are contained within existing conservation reserves, including Stotts Island, Ukerebagh and Limeburners Creek Nature Reserves and Bundjalung and Myall Lakes National Parks. These are unevenly distributed throughout the range and unlikely to represent the full diversity of the community.

This community occurs within the Parklands.

The OEH profile for this EEC list the following threats:

- Further clearing for urban and rural development, and the subsequent impacts from fragmentation
- Flood mitigation and drainage works.
- Management of water and tidal flows
- Landfilling and earthworks associated with urban and industrial development
- Grazing and trampling by stock and feral animals (e.g. pigs)
- Changes in water quality, particularly increased nutrients and sedimentation
- Weed invasion
- Climate change
- Activation of acid sulfate soils
- Removal of dead wood
- Rubbish dumping
- Frequent burning which reduces the diversity of woody plant species

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Swamp Sclerophyll Forest is listed as an EEC under the TSC Act. This community is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.

The exact amount of its original extent is unknown but it is much less than 30%. There are less than 350 ha of native vegetation attributable to this community on the Tweed lowlands, less than 2,500 ha on the Clarence floodplain, less than 700 ha on the Macleay floodplain, up to 7,000 ha in the lower Hunter – central coast district, and less than 1,000 ha in the Sydney – South Coast region.

This community occurs within the Parklands and within the Billinudgel Nature Reserve.

The OEH profile for this EEC list the following threats:

- Further clearing for urban and rural development, and the subsequent impacts from fragmentation
- Flood mitigation and drainage works
- Management of water and tidal flows
- Landfilling and earthworks associated with urban and industrial development
- Grazing and trampling by stock and feral animals (particularly pigs)
- Changes in water quality, particularly increased nutrients and sedimentation
- Weed invasion
- Climate change
- Activation of acid sulfate soils
- Removal of dead wood
- Rubbish dumping
- Frequent burning which reduces the diversity of woody plant species

Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions

The Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (Lowland Rainforest) is listed as an EEC under the TSC Act. The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions. South of the Sydney metropolitan area, Lowland Rainforest is replaced by Illawarra Subtropical Rainforest of the Sydney Basin Bioregion, which is listed as an endangered ecological community. Milton Ulladulla Subtropical Rainforest is also a related rainforest endangered ecological community that occurs still further south in the South East Corner Bioregion. This community was not recorded within the parklands site but has been recorded immediately adjacent to the Parklands in an area of remnant vegetation.

The OEH profile for this EEC list the following threats:

- Extensive clearing of Lowland Rainforest has resulted in fragmentation and loss of ecological connectivity. The integrity and survival of small, isolated stands is impaired by the small population size of many species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations.
- Weed invasion also poses a major threat to Lowland Rainforest, with introduced vines and scramblers having particularly serious impacts. Exotic species form dense thickets capable of smothering indigenous plants, reducing both reproduction and survival.
- Inappropriate fire regimes associated with burning off and hazard reduction pose a threat to the margins of rainforest stands and the entirety of small stands in fragmented landscapes.
- Grazing by livestock, potential impacts of anthropogenic climate change and impacts associated with human interaction; including soil compaction, possible spread of pathogens, clearing of understorey and inappropriate collection of plant species.

Table 43: EEC grouping 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	N/A – this is not a threatened species.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A – this is not an endangered population.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	No EEC vegetation is proposed to be removed as part of the proposed action. Indirect impact are expected to be minimal and would consist of: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site Overall, the biodiversity characteristics of the site are being permanently improved by the current site managers and utilisation patterns. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.
d) in relation to the habitat of a threatened species, population or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	No EEC vegetation is proposed to be removed as part of the proposed action. Indirect impact are expected to be minimal and would consist of: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site Overall, the biodiversity characteristics of the site are being permanently improved by the current site managers and utilisation patterns. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No areas identified under the TSC Act as ‘critical habitat’ will be affected by the proposed activity.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	There is currently no Recovery Plan or Threat Abatement Plan for these ecological communities.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	The proposed action may result in the following indirect impacts: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these vegetation communities in and adjacent to the development site.

12.2.1 Conclusion

The proposal is unlikely to have a significant impact on the listed EECs given that:

- No EEC vegetation will be removed
- Potential indirect impacts associated with bushfire, weed invasion and trampling are considered low risk
- Potential indirect impacts from erosion and sedimentation will be managed and ameliorated and are therefore considered low risk
- On-going benefits will continue to be realised through habitat restoration and conservation activities
- No local occurrence of these communities will be placed at risk of extinction.

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these EECs. Consequently, a Species Impact Statement is not required for the proposal with respect to these EECs.

12.3 Microbats

Eight listed microbat species have been identified as occurring in the Development site. A 7 part test, conducted in accordance with the EP&A Act, has been conducted for these species and is provided in Table 44.

Common Blossum-bat (*Syconycteris australis*)

This species occurs in coastal areas of eastern Australia from Hawks Nest in NSW to Cape York Peninsula in Queensland. In some areas, the distribution extends inland to coastal foothills. Common Blossom-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of other vegetation communities, such as subtropical rainforest, wet sclerophyll forest and other coastal forests. The OEH profile for this species list the following threats:

- Clearing of coastal habitat for urban development and sandmining
- Weeds, such as Bitou Bush, that suppress the regeneration of key food trees, such as Coastal Banksia
- Predation by foxes and feral cats may occur whilst the bat is feeding on low hanging flowers and fruit
- Inappropriate fire regimes in heathland habitats leading to reduced flowering of Banksia, Callistemon and Melaleuca species

Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)

This species occurs in rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland. It forages above and below the tree canopy on small insects, especially moths. The bats congregate at the same maternity roosts each year to give birth and rear young. In the southern part of the species' range this occurs during spring. Maternity roosts may be located in caves, abandoned mines, concrete bunkers and lava tubes. Over-wintering roosts used outside the breeding period include cooler caves, old mines, and stormwater channels, under bridges and occasionally buildings. This species is capable of flying 30-50 km in a single night of foraging. The OEH profile for this species list the following threats:

- Disturbance by recreational cavers and general public accessing caves and adjacent areas particularly during winter or breeding
- Loss of high productivity foraging habitat
- Introduction of exotic pathogens, particularly white-nose fungus
- Cave entrances being blocked for human health and safety reasons, or vegetation (particularly blackberries) encroaching on and blocking cave entrances
- Hazard reduction and wildfire fires during the breeding season

Eastern False pipistrelle (*Falsistrellus tasmaniensis*)

The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. This species prefers moist habitats, with trees taller than 20 m and generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. The OEH profile for this species list the following threats:

- Disturbance to winter roosting and breeding sites

- Loss of roosting habitat, primarily hollow-bearing eucalypts
- Loss and fragmentation of foraging habitat, particularly extensive areas of continuous forest and areas of high productivity

Eastern Freetail-bat (*Mormopterus norfolkensis*)

The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW and occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Eastern Freetail-bats roost mainly in tree hollows but will also roost under bark or in man-made structures. They are usually solitary but have also been recorded roosting communally. They are thought to be insectivorous. The OEH profile for this species list the following threats:

- Loss of hollow-bearing trees
- Loss of foraging habitat
- Application of pesticides in or adjacent to foraging areas
- Artificial light sources spilling onto foraging and/or roosting habitat
- Large scale wildfire or hazard reduction burns on foraging and/or roosting habitat

Eastern Long-eared Bat (*Nyctophilus bifax*)

The Eastern Long-eared Bat is found from Cape York through eastern Queensland to the far north-east corner of NSW. In NSW they appear to be confined to the coastal plain and nearby coastal ranges, extending south to the Clarence River area, with a few records further south around Coffs Harbour. The species can be locally common within its restricted range.

Suitable habitat includes lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. Coastal rainforest and patches of coastal scrub are particularly favoured. The species roosts in tree hollows, the hanging foliage of palms, in dense clumps of foliage of rainforest trees, under bark and in shallow depressions on trunks and branches, among epiphytes, in the roots of strangler figs, among dead fronds of tree ferns and less often in buildings.

The OEH profile for this species list the following threats:

- Loss of hollow-bearing trees
- Loss of foraging habitat
- Application of pesticides in or adjacent to foraging areas
- Artificial light sources spilling onto foraging and/or roosting habitat
- Large scale wildfire or hazard reduction burns on foraging and/or roosting habitat

Golden-tipped Bat (*Kerivoula papuensis*)

The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW. It also occurs in New Guinea. It is found in rainforest and adjacent wet and dry sclerophyll forest up to 1000 m and has also been recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Bats will fly up to two kilometres from roosts to forage in rainforest and sclerophyll forest on mid and upper-slopes.

The species roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole

on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes. Bats will use multiple roost and change roosts regularly. They roost individually or in small colonies which can contain up to approximately 20 bats of both males and females or just a single sex. Maternity roots may occur away from water sources.

The OEH profile for this species list the following threats:

- Loss of riparian rainforest for roosting and foraging habitat
- Loss of understorey habitat on upper-slopes for foraging
- Forestry operations that fragment habitat or result in loss of roosting habitat
- Habitat fragmentation
- Lack of knowledge of the threats to the species
- Burning of rainforest habitat
- Loss of hollow-bearing trees

Large-eared Pied Bat (*Chalinolobus dwyeri*)

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

Large-eared Pied Bats are found in well-timbered areas containing gullies. It frequents low to mid-elevation dry open forest and woodland close to caves, crevices in cliffs, old mine workings and disused mud nests of Fairy Martin. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

This species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the *Hirundo ariel* (Fairy Martin) in south-eastern Queensland. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years.

The OEH profile for this species list the following threats:

- Clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture or development
- Loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities and too-frequent burning, usually associated with grazing
- Damage to roosting and maternity sites from mining operations, and recreational caving activities
- Use of pesticides
- Disturbance to roosting areas by goats

Little Bentwing-bat (*Miniopterus australis*)

This species occurs in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. It roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forages for small insects beneath the canopy of densely vegetated habitats. They often share

roosting sites with the Common Bentwing-bat. Maternity colonies form in spring. Males and juveniles disperse in summer. The species capable of flying up to 55 km from nursery roosts.

The OEH profile for this species list the following threats:

- Disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic
- Destruction of caves that provide seasonal or potential roosting sites
- Changes to habitat, especially surrounding maternity/nursery caves and winter roosts
- Pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals
- Predation from foxes, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges
- Predation from feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges
- Introduction of exotic pathogens such as the White-nosed fungus
- Hazard reduction and wildfire fires during the breeding season
- Large scale wildfire or hazard reduction can impact on foraging resources
- Poor knowledge of reproductive success and population dynamics

Southern Myotis (*Myotis macropus*)

The Southern Myotis (also known as the Large-footed Myotis) is found in the coastal band from north-west Australia to western Victoria. The Large-footed Myotis generally roost in groups of 10-15 in caves, mine shafts, hollow-bearing trees, storm water channels and under bridges in areas of dense foliage. They forage across the top of water sources, catching insects and small fish by raking their feet across the surface of the water (OEH 2015). Their foraging range is in the order of 10-15 km from roosts and they will roost in tree hollows as well as culverts.

The OEH profile for this species list the following threats:

- Loss or disturbance of roosting sites
- Clearing adjacent to foraging areas
- Application of pesticides in or adjacent to foraging areas
- Reduction in stream water quality affecting food resources

Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*)

The Yellow-bellied Sheath-tail Bat roosts singly or in groups of up to six, in tree hollows and buildings. In treeless areas they are known to utilise mammal burrows. They forage in most habitats throughout their very wide range, including areas with and without trees and appear to defend an aerial foraging territory. This species is a high and fast flying bat that forages above the canopy or lower in open areas and along water courses. It is not very manoeuvrable and requires room to move. It will not be found within the cluttered road area, but rather along the edges of such sites.

The OEH profile for this species list the following threats:

- Disturbance to roosting and summer breeding sites
- Foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions
- Loss of hollow-bearing trees; clearing and fragmentation of forest and woodland habitat

- Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores

Table 44: Microbat species 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	With the exception of the 300m2 required to be cleared/pruned for the proposed vehicular track, the proposed action will not result in clearing of native vegetation that represent potential foraging or roosting habitat within the Parklands. The proposed action will result in temporary disturbance to these species in the form of noise and increased lighting in the Parklands during events. The behaviour of numerous microbats (including these threatened species) has been monitored during previous events. Food resources and feeding behaviour are increased for many of these species during events, as light attracts insects, which are a key diet item. Adverse impacts such as avoiding lighting or leaving the Parklands were not observed. A range of light and noise management measures are implemented during each event, which aim to minimise disturbance impacts to these species. On-going benefits to microbat habitat will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A – these species are not part of an endangered population
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. is likely to substantially and adversely modify the	N/A – these species are not an EEC or CEEC

composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	
d) in relation to the habitat of a threatened species, population or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	With the exception of the 300m2 required to be cleared/pruned for the proposed vehicular track, the proposed action will not result in clearing of native vegetation that represent potential foraging or roosting habitat within the Parklands.. The proposed action will result in temporary disturbance to these species in the form of noise and increased lighting in the Parklands during events. The behaviour of numerous microbats (including these threatened species) has been monitored during previous events. Food resources and feeding behaviour are increased for many of these species during events, as light attracts insects, which are a key diet item. Adverse impacts such as avoiding lighting or leaving the Parklands were not observed. A range of light and noise management measures are implemented during each event, which aim to minimise disturbance impacts to these species. On-going benefits to microbat habitat will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems. Given that these species are highly mobile, only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site) and that no roosting habitat will be directly impacted, it is considered unlikely that the proposal would impact on this species such that it would place any local populations at risk of extinction.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No critical habitat has been declared for these species with the Development site.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	No recovery plan or threat abatement plan has been prepared for the Eastern Bentwing-bat, Little bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat, Yellow-bellied Sheathtail Bat, Golden-tipped Bat or Southern Myotis, however a National recovery plan has been prepared for the Large-eared Pied Bat by the State of Queensland, (former) Department of Environment and Resource Management (now DEHP) in 2011. The recovery plan identifies the following objectives: • Objective 1: Identify priority roost and maternity sites for protection • Objective 2: Implement conservation and management strategies for priority sites • Objective 3: Educate the community and industry to understand and participate in the conservation of the Large-eared Pied Bat • Objective 4: Research the Large-eared Pied Bat to augment biological and ecological data to enable conservation management

	• Objective 5: Determine the meta-population dynamics throughout the distribution of the Large-eared Pied Bat The proposed works do not conflict with any of the objectives of the recovery plan.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Only a very minor area of potential habitat will be removed (300m2 or <<0.001% of native vegetation within the development site). The extent of clearing represents an insignificant increase in a key threatening impact. Furthermore, all other habitat on site will be preserved and protected for the duration of the project whilst significant areas of bushland rehabilitation has occurred, and is planned to occur in the future. The proposed action may result in the following indirect impacts to : • Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk • Temporary disturbance from light and noise during events – has been shown to be temporary and reversible The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.

12.3.1 Conclusions

The proposal is unlikely to have a significant impact on these species given that:

- Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).
- The proposed action will result in a minor disturbance to these species during events, which has been shown via monitoring to be temporary and reversible upon the conclusion of events
- Bat monitoring data has shown ongoing use of the site with numbers (both species and individuals) maintained within the range of natural viability over time
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these species. Consequently, a Species Impact Statement is not required for the proposal with respect to the Common Blossum-bat, Eastern Bentwing-bat, Little Bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat, Eastern Long-eared Bat, Yellow-bellied Sheathtail Bat, Golden-tipped Bat, Southern Myotis or the Large-eared Pied Bat.

12.4 Nectar or fruit foraging species

Five listed nectar or fruit foraging species have been identified as occurring in the Development site and two have the potential to occur. A 7 part test, conducted in accordance with the EP&A Act, has been conducted for these species and is provided in Table 45.

Little Lorikeet (*Glossopsitta pusilla*)

The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs. This species forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. This species is known at the Parklands from one recorded during surveys completed in 2015-2016.

The OEH profile for this species list the following threats:

- Given that large old Eucalyptus trees on fertile soils produce more nectar, the extensive clearing of woodlands for agriculture has significantly decreased food for the lorikeet, thus reducing survival and reproduction. Small scale clearing, such as during roadworks and fence construction, continues to destroy habitat and it will be decades before revegetated areas supply adequate forage sites
- The loss of old hollow bearing trees has reduced nest sites, and increased competition with other native and exotic species that need large hollows with small entrances to avoid predation. Felling of hollow trees for firewood collection or other human demands increases this competition
- Competition with the introduced Honeybee for both nectar and hollows exacerbates these resource limitations
- Infestation of habitat by invasive weeds
- Inappropriate fire regimes
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners
- Climate change impacts including reduction in resources due to drought
- Degradation of woodland habitat and vegetation structure due to overgrazing

Rose Crowned Fruit Dove (*Ptilinopus regina*)

This species occurs in sub-tropical and dry rainforest, moist eucalypt forest and swamp forest, where fruit is plentiful. Birds feed entirely on fruit from vines, shrubs, large trees and palms, and are thought to be locally nomadic as they follow the ripening of fruits. Some populations are migratory in response to food availability. Numbers in north-east NSW increase during spring and summer then decline in April or May.

This species is regularly recorded in surveys at the Parklands, both on site and within the adjacent Billinudgel Nature Reserve.

The OEH profile for this species list the following threats:

- Clearing and fragmentation of low to mid-elevation rainforest
- Logging and roading in moist eucalypt forest with well-developed rainforest understorey
- Burning of remnant rainforest habitat
- Invasion of habitat by introduced weed species
- Removal of Camphor Laurel food source without appropriate mitigation measures

Wompoo Fruit Dove *(Ptilinopus magnificus)*

This species occurs in rainforest, low-elevation moist eucalypt forest and brush box forests. It feeds on a diverse range of tree and vine fruits and is locally nomadic following ripening fruit. The nest is a flimsy

platform of sticks on a thin branch or a palm frond, often over water, usually 3 – 10 m above the ground. Birds breed in spring and early summer.

This species has been recorded at the Parklands during monitoring in winter 2014.

The OEH profile for this species list the following threats:

- Clearing and fragmentation of low to mid-elevation rainforest due to coastal development and grazing
- Logging and road creation in moist eucalypt forest with well-developed rainforest understorey
- Burning, which reduces remnant rainforest habitat patches
- Infestation of rainforest habitat by invasive weeds

Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox is endemic to the east coast of Australia with a distribution from Bundaberg in the north to Melbourne in the south, from the western slopes of the Great Dividing Range to the coast.

Grey-headed Flying-foxes are a highly mobile species whose migration patterns are determined by the availability of flowering food resources (Eby 1991). The species is a canopy-feeding frugivore, blossom-eater and nectarivore, and occurs in rainforest, woodlands, paperbark swamps and Banksia woodlands (NSW Scientific Committee 2001). This species feeds in particular on the nectar and pollen of native trees, especially *Eucalyptus* spp., *Melaleuca* spp. and *Banksia* spp., and fruits of rainforest trees and vines. During times when native food resources are limited, Grey-Headed Flying-foxes forage on fruit crops and cultivated gardens.

Grey-headed Flying-foxes congregate in large colonies of up to 200,000 individuals in the summer season (Churchill 1998). Camp sites are generally located next to rivers or creeks, and occur in a range of vegetation communities including rainforest, wet sclerophyll forest, Melaleuca woodland, Casuarina forest or mangroves (Eby 2000). These sites have a dense canopy, providing them with the moist, humid microclimate they require. Campsites are critical for mating, birthing, rearing of young and as diurnal refuge from predators (Tidemann *et al.* 1999). Urban gardens, cultivated fruit crops and roadside verges may also provide temporary roosting habitat for this species.

Grey-headed flying foxes have been recorded within the development site on multiple occasions since 2007. The species is known to utilise the site when food resources are present and has been recorded feeding on flowering Forest Red Gum and Swamp Mahogany (*Eucalyptus robusta*) during spot-light surveys of the Development site (Fitzgerald, 2007). The species has also been observed feeding in Blackbutt (*Eucalyptus pilularis*) (Fitzgerald, 2014). Records are primarily from the south-eastern boundary of the project area, adjacent to Billinudgel Nature Reserve. Grey-headed Flying Foxes have been recorded within event areas.

The OEH profile for this species list the following threats:

- Loss of roosting and foraging sites
- Electrocution on powerlines, entanglement in netting and on barbed-wire
- Heat stress
- Conflict with humans
- Incomplete knowledge and abundance and distribution across the species' range

Fauna species with the potential to occur within the development site include:

Coxen's Fig-Parrot (*Cyclopsitta diopthalma coxeni*)

This species is limited to about five populations scattered between Bundaberg in Queensland and the Hastings River in NSW. The total number is thought to be less than 200 birds which makes it one of Australia's most endangered birds. It is usually recorded from drier rainforests and adjacent wetter eucalypt forest but is rarely seen due to its small size and cryptic habits. It is also found in the wetter lowland rainforests that are now largely cleared in NSW.

The Coxen's Fig Parrot has not been recorded at the Parklands during the extensive fauna survey and monitoring that has been undertaken since 2007. However, there are numerous food trees for this species within the patches of remnant vegetation on site. This includes native fig trees e.g. Sandpaper Figs, Moreton Bay Fig, Strangler Figs and Small-leaved Figs. It is therefore possible that this species would occasionally visit the Parklands for foraging. Given the small overall extent and fragmented nature of the remnant vegetation on site and historical disturbance, the Parklands is not considered to be habitat critical to the survival of these species.

The OEH profile for this species list the following threats:

- Clearing of rainforest, wet sclerophyll and ecotone habitat and clearing of fig trees on farms for agricultural purposes
- Clearing of habitat for rural and residential development
- Logging or clearing of eucalypt forest adjacent to rainforest
- Habitat fragmentation, including loss of connectivity between summer and winter feeding areas
- Illegal bird trapping and egg collection
- Dissection of habitat corridors by roads
- Small population sizes make populations susceptible stochastic events and fluctuations in food supply
- Low numbers, preventing a social breeding triggers being activated and reducing available breeding partners
- Weeds, particularly exotic vines and scramblers, impacting on habitat and food trees.
- Burning of rainforest and wet sclerophyll ecotone areas preventing establishment of additional habitat and foraging resources

Swift Parrot (*Lathamus discolor*)

This species breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW, it mostly occurs on the coast and south west slopes. On the mainland birds occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.

Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*). Commonly used lerp infested trees include Inland Grey Box (*E. macrocarpa*), Grey Box (*E. moluccana*) and Blackbutt (*E. pilularis*).

The Swift Parrot has not been recorded at the Parklands during the extensive fauna survey and monitoring that has been undertaken since 2007. However, there are numerous food trees for this species within the patches of remnant vegetation on site. This includes Eucalyptus species e.g. Forest Red Gum and Blackbutt. The Swift Parrot has also been recorded within 5 km of the Parklands. It is therefore possible

this species would occasionally visit the Parklands for foraging (during its winter northward migration). Given the small overall extent and fragmented nature of the remnant vegetation on site and historical disturbance, the Parklands is not considered to be habitat critical to the survival of this species.

The OEH profile for this species list the following threats:

- Habitat loss and fragmentation from forest harvesting, residential/industrial development, agricultural clearing, senescence and dieback
- Changes in spatial and temporal distribution of habitat due to climate change
- Reduced food availability due to drought conditions
- Competition from introduced bees and large, aggressive honeyeaters for food resources
- Collision with human made structures resulting in death or injury
- Psittacine Beak and Feather Disease vulnerability
- Weed invasion impacting on habitat regeneration and health
- High fire frequency impacting on food resource availability
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners
- Predation by cats
- Illegal capture and trade of wild birds for aviculture

Table 45: Nectar or fruit foraging species 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	With the exception of the 300m2 required to be cleared/pruned for the proposed vehicular track, the proposed action will not result in clearing of native vegetation that represent potential foraging or roosting habitat within the Parklands. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems. Both the White-eared Monarch and Rose-crowned Fruit Dove have been recorded within regeneration areas ('the plantings'). Indirect impacts to these species are also unlikely. Minor disturbance of individuals may occur if the species is present on site during events (for the Swift Parrot this is relevant only during the winter months). These species are highly mobile and as such this disturbance is likely to be insignificant. Monitoring of events has demonstrated that all bird species that leave the site during events return very soon after. This is not likely to affect the life cycle of this species such that a viable local population would be placed at risk of extinction.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A – not an endangered population

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	N/A – not an EEC or CEEC
d) in relation to the habitat of a threatened species, population or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site). All other habitat on site will be preserved and protected for the duration of the project. All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as habitat for these species over time.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	The habitat is not critical habitat and therefore the proposed action will not have an adverse effect (either directly or indirectly).

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	There is no recovery plan or threat abatement plan for Little Lorikeet, Rose-crowned Lorikeet and Wompoo Fruit-dove. However recovery plans have been prepared for the Grey-headed Flying-fox, Swift Parrot and Coxen's Fig-parrot. A Draft National Recovery Plan for the Grey-headed Flying-fox was created in 2009 (DECCW 2009). Specific recovery actions identified in the recovery plan include: • Action 1: Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range • Action 2: Enhance winter and spring foraging habitat for Grey-headed Flying-foxes • Action 3: Identify, protect and enhance roosting habitat critical to the survival of Grey- headed Flying-foxes • Action 4: Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture • Action 5: Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps • Action 6: Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions • Action 7: Monitor population trends for the Grey-headed Flying-fox • Action 8: Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts • Action 9: Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox • Action 10: Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan. The current proposal is not in conflict with any recovery actions from the recovery plan. A recovery plan for the Coxen's fig-parrot (*Cyclopsitta diophthalma coxeni*) 2001-2005 was prepared by the State of Queensland, Environmental Protection Agency, 2001. The overall objective of this recovery plan is to prevent extinction of Coxen's fig-parrot from human-induced causes and ensure the stability of wild populations. Specific objectives during the life of the current recovery plan are to: • Locate one or more remaining populations • Protect remaining populations and their habitat from human-induced threatening processes, thereby maintaining the populations and habitat • Increase understanding of the ecology of Coxen's fig-parrot • Secure and breed a captive population of Coxen's fig-parrots • Increase the extent, quality and connectivity of the habitat of Coxen's fig-parrot

	The current proposal is not in conflict with any recovery actions/objectives from the recovery plan. A recovery plans been prepared for the Swift Parrot (*Lathamus dicolor*) for NSW. A recovery plan has also been prepared under the EPBC Act. A summary of the objectives and actions outlined in this plan are included below (Swift Parrot Recovery Team 2001): **Overall objectives** • To change the conservation status of the swift parrot from endangered to vulnerable within 10 years. • To achieve a demonstrable sustained improvement in the quality of swift parrot habitat to increase carrying capacity. **Specific objectives** • To identify priority habitats and sites across the range of the swift parrot. • To implement management strategies to protect and improve priority habitats and sites resulting in a sustained improvement in carrying capacity. • To reduce the incidence of collisions with man-made structures. • To determine population trends within the breeding range. • To quantify improvements in carrying capacity by monitoring changes in extent and quality of habitat. • To increase public awareness about the recovery program and to involve the community in the recovery **Recovery Criteria** • Priority habitats and sites have been identified and protected. • Management strategies to protect breeding and foraging habitat have been implemented. • The incidence of collisions is reduced. • The population density or extent and quality of habitat is not reduced and ideally is enhanced. • Community based networks are maintained and a newsletter is produced. **Actions Needed** • Identify the extent and quality of foraging habitat. • Protect and manage the habitat of swift parrots at a landscape scale. • Reduce the incidence of collisions. • Monitor population trends and habitat use. • Keep the public, volunteers and community networks informed. • Manage the recovery process through a recovery team. The proposal does not conflict with any of the proposed objectives or actions.
g) whether the action proposed constitutes or is part of a key threatening process or	Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site). The extent of clearing represents an insignificant increase in a key threatening impact. Furthermore,

is likely to result in the operation of, or increase the impact of, a key threatening process.	all other habitat on site will be preserved and protected for the duration of the project whilst significant areas of bushland rehabilitation has occurred, and is planned to occur in the future. The proposed action may result in the following indirect impacts to : • Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk • Temporary disturbance from light and noise during events – has been shown to be temporary and reversible The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.

12.4.1 Conclusions

The proposal is unlikely to have a significant impact on these species given that:

- Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site)
- The proposed action will result in a minor disturbance to these species during events, which has been shown via monitoring to be temporary and reversible upon the conclusion of events
- Bird monitoring data has shown ongoing use of the site with numbers (both species and individuals) maintained within the range of natural viability over time
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities
- Both Rose-crowned Fruit-Dove and White-eared Monarch have begun to use the plantings (areas of regeneration) showing positive effects of works at the Parklands

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these species. Consequently, a Species Impact Statement is not required for the proposal with respect to these nectar or fruit foraging species.

12.5 Amphibians

Two listed amphibian species (Wallum Froglet and Wallum Sedge Frog) have been previously recorded from the Billinudgel Nature Reserve (NPWS 2000), adjacent to the development site, and as such indirect impacts may affect these species. These species were not recorded from the development site or adjacent habitats during targeted surveys in 2007, 2009 and 2014, although the Wallum Froglet is known to occur in pastoral lands north east of the development site and outside of the BNR. A 7 part test, conducted in accordance with the EP&A Act, has been conducted for these species and is provided in Table 44.

Wallum Froglet (*Crinia tinnula*)

Wallum Froglets are found along the coastal margin from Litabella National Park in south-east Queensland to Kurnell in Sydney and are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. The species breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches. Breeding is thought to peak in the colder months, but can occur throughout the year following rain. Wallum Froglets shelter under leaf litter, vegetation, other debris or in burrows of other species. Shelter sites are wet or very damp and often located near the water's edge. The OEH profile for this species list the following threats:

- Destruction and degradation of coastal wetlands as a result of roadworks, coastal developments and sandmining.
- Reduction of water quality and modification to acidity in coastal wetlands.
- Changes to hydrology of coastal wetlands as a result of a changing climate and/ or sea level rise.
- Nutrient enrichment and chemical run off from urban and agricultural areas and as a result of mosquito control.
- Predation of tadpoles and eggs by the Plague Minnow *Gambusia holbrooki*. While little is known of the extent of Plague Minnow predation on Wallum Froglets, it must be considered a potential threat.
- Habitat disturbance by feral pigs.

Wallum Sedge Frog (*Litoria olongburensis*)

Olongburra Frogs are found in coastal wallum swamps from Fraser Island in southern Queensland to Yuraygir National Parkin northern NSW. The Olongburra Frog is an "acid" frog confined to the coastal sandplain wallum swamps. Their life-cycle is adapted to the acidic pH (2.8-5.5) of these wetlands. Frogs are highest in abundance in relatively undisturbed wallum swamps. Breeding habitat is characterised by the presence of emergent sedges, with upright species such as *Baumea* spp. And *Schoenus* spp. preferred by adult frogs for perching. Frogs can be found in breeding habitat all year. However, little is known about habitat use when breeding is not occurring and drier areas adjacent to primary habitat may also be utilised. Breeding occurs mainly in spring, summer and autumn after rain. The OEH profile for this species list the following threats:

- Destruction and degradation of wallum habitat for coastal development.
- Reduction of water quantity and/or quality (including changes to pH) in coastal wetland habitat.
- Changes in average and extreme temperatures and the amount and timing of rainfall due to climate change.
- Severe fires in very dry periods that result in insufficient refuge remaining post-fire.

- Roadkill (it has been estimated that >10,000 Olongburra Frogs are killed annually on one 4km stretch of road near Lennox Head).
- Predation of tadpoles and eggs by the Plague Minnow *Gambusia holbrooki*. While little is known of the extent of Plague Minnow predation on Wallum Froglets, it must be considered a potential threat.

Table 46: Amphibian species 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	The proposed action will not result in clearing of native vegetation or any known habitat for the two threatened amphibian species. During events, the proposed action will result in temporary noise and lighting disturbance to areas potentially containing these species adjacent to the development site. Noise may impact the potential of amphibians to breed successfully as calling is used to locate mates. Both species have extended breeding seasons and therefore events of short duration are unlikely to result in an unsuccessful breeding period. A range of light and noise management measures are implemented during each event, which aim to minimise disturbance impacts to habitats in the BNR. Potential impacts to off-site habitat in the Billinudgel Nature Reserve will be minimised by utilising best practice with soil and water systems, implementing mitigation measure to discourage illegal access and via major site bush regeneration on the development site.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A – these species are not part of an endangered population
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: iii. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	N/A – these species are not an EEC or CEEC

iv. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	
d) in relation to the habitat of a threatened species, population or ecological community: iv. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and v. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and vi. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	No habitat for these amphibian species will be directly impacted as a result of the proposed action. Indirect impacts associated with noise and lighting are would be limited to areas adjacent to the development site and restricted to event times (20 days per year in total). Indirect impacts associated with potential increase in human traffic and will be limited to small areas (i.e.walking tracks) and restricted to event times. Potential nutrient and hydrology impacts will be minimised by utilising best practice soil and water systems and buffer zones. No fragmentation or isolation of habitat is predicted to occur as a result of the proposed action. Habitat adjacent to the development site for the is unlikely to be important for these species as targeted surveys in 2007, 2009 and 2014 failed to detect the species, therefore significant populations are considered unlikely to be present.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No critical habitat has been declared for these species with the development site or adjacent areas, including the Billinudgel Nature Reserve.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	No recovery plan or threat abatement plan has been prepared for either amphibian species.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	No habitat for these amphibian species will be directly impacted as a result of the proposed action and indirect impacts will be minimised by utilising best practice with soil and water systems, implementing mitigation measures to discourage illegal access to the BNR. The proposed action may result in the following indirect impacts: • Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk • Temporary disturbance from light and noise during events – considered low risk

	The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.

12.5.1 Conclusions

The proposal is unlikely to have a significant impact on these species given that:

- No habitat will be removed
- Indirect impacts associated with noise and lighting are would be limited to areas adjacent to the development site and restricted to event times (20 days per year in total).
- Indirect impacts associated with potential increase in human traffic and will be limited to small areas (i.e.walking tracks) and restricted to event times.
- Potential nutrient and hydrology impacts will be minimised by utilising best practice soil and water systems and buffer zones.
- Large amounts of potential habitat for these species is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these species. Consequently, a Species Impact Statement is not required for the proposal with respect to the Wallum Froglet or Wallum Sedge Frog.

12.6 Common Planigale (*Planigale maculata*)

The common Planigale occurs in rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. This species has not been recorded at the Parklands, but some areas of suitable habitat area present on site and in adjacent areas. I.e. forests within the development site. It is less likely to inhabit pasture areas (particularly the unmanaged pasture areas in the south of the site) as this area lacks the microhabitat features such as hollow logs, bark and rocks. Targeted surveys within the parklands over the last 10 years have not detected this species.

The OEH profile for this species list the following threats:

- Predation by foxes
- Predation by cats
- Predation and poisoning by cane toads
- Loss and fragmentation of habitat through clearing for agriculture and development in coastal areas
- Frequent burning that reduces ground cover such as hollow logs and bark
- Over grazing that reduces ground cover
- Disturbance of vegetation surrounding water bodies

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Common Planigale habitat over time.

Therefore, the proposed works are not likely to place any viable local population of the species at risk of extinction.

b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. The Common Planigale is not an endangered population.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Common Planigale is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site) . Slashing of the unmanaged exotic grassland in the south of the development area is planned to occur. However, this is less likely to constitute habitat for the species.

iii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species becoming fragmented or isolated from other areas of habitat.

iv. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site). This will not result in fragmentation and isolation of habitat or impacts to the long term survival of the species.

All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Common Planigale habitat over time

Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Common Planigale.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for the Common Planigale.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts to:

- Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk
- Temporary disturbance from light and noise during events – has been shown to be temporary and reversible

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.

12.6.1 Conclusion

The proposal is unlikely to have a significant impact on the Common Planigale given that:

- Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the Common Planigale. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.7 Squirrel Glider (*Petaurus norfolcensis*)

The Squirrel Glider is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. It inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas and prefers mixed species stands with a shrub or Acacia midstorey. They live in family groups of a single adult male one or more adult females and offspring, and require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of *Acacia* gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein. This species has not been recorded at the Parklands during targeted surveys over the last 10 years, nevertheless there remains potential for the species to occur particularly in adjacent habitats and the Billinudgel Nature Reserve which may be subject to indirect impacts from the proposed action.

The OEH profile for this species list the following threats:

- Habitat loss and degradation.
- Fragmentation of habitat.
- Loss of hollow-bearing trees.
- Loss of understorey food resources.
- Inappropriate fire regimes.
- Reduction in food resources due to drought.
- Mortality due to entaglement on barbed wire.
- Occupation of hollows by exotic species.
- Mortality due to collision with vehicles.
- Predation by exotic predators.
- Changes in spatial and temporal distribution of habitat due to climate change

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

No direct impacts to the life cycle of a local population the Squirrel Glider are proposed.

Indirect impacts potentially affecting the life cycle of any local population of the Squirrel Glider are limited to noise and lighting disturbance and bushfire risks. All areas of remnant vegetation within the development site will be fenced during events to reduce disturbance, and a range of light and noise management measures are implemented during each event to reduce disturbance to surrounding habitats including the BNR. Mitigation measures to discourage illegal access to the BNR and strict fire management procedures are also implemented.

Therefore, the proposed action is not likely to place any viable local population of the species (if present) at risk of extinction.

b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. The Squirrel Glider is not an endangered population.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

iii. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

iv. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Squirrel Glider is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

v. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

No Squirrel Glider habitat will be removed as a result of the proposed action. Indirect impacts associated with noise and lighting are may affect connected forest habitats within and adjacent the development site and areas however these impacts would be minimal and restricted to event times only (20 days per year in total).

No fragmentation or isolation of habitat is predicted to occur as a result of the proposed action.

i. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species becoming fragmented or isolated from other areas of habitat.

ii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Habitat within and adjacent to the development site for the is unlikely to be important for thespecies as targeted surveys in 2007, 2009 and 2014 failed to detect the species, therefore significant populations are considered unlikely to be present. The proposed action will not

remove, fragment, isolate or significantly modify habitat for the species and no impacts impacts likely to affect the long term survival of the species in the locality are expected to occur.

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Squirrel Glider.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for the Squirrel Glider.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts to:

- Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk
- Temporary disturbance from light and noise during events – has been shown to be temporary and reversible

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site, including the Billinudgel Nature Reserve.

12.7.1 Conclusion

The proposal is unlikely to have a significant impact on the Squirrel Glider given that:

- No direct impacts to potential habitat are proposed within the development site.
- Large amounts of potential habitat for this species will remain within the site, throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the Squirrel Glider. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.8 Brush-tailed Phascogale (*Phascogale tapoatafa*)

The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occassional records west ot the divide. It prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter and also inhabits heath, swamps, rainforest and wet sclerophyll forest. The species is an agile climber foraging preferentially in rough barked trees of 25 cm DBH or greater where it feeds mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates. Females have exclusive territories of approximately 20 - 40 ha, while males have overlapping territories often greater than 100 ha. They nest and shelter in tree hollows with entrances 2.5 - 4 cm wide and use many different hollows over a short time span. This species has not been recorded at the Parklands during targeted surveys over the

last 10 years, nevertheless there remains potential for the species to occur, particularly in adjacent habitats and the Billinudgel Nature Reserve which may be subject to indirect impacts from the proposed action.

The OEH profile for this species list the following threats:

- Loss and fragmentation of habitat.
- Loss of hollow-bearing trees.
- Predation by foxes and cats.
- Competition for nesting hollows with the introduced honeybee.

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

No direct impacts to the life cycle of a local population the Brush-tailed Phascogale are proposed.

Indirect impacts potentially affecting the life cycle of any local population of the Brush-tailed Phascogale are limited to noise and lighting disturbance and bushfire risks. All areas of remnant vegetation within the development site will be fenced during events to reduce disturbance, and a range of light and noise management measures are implemented during each event to reduce disturbance to surrounding habitats including the BNR. Mitigation measures to discourage illegal access to the BNR and strict fire management procedures are also implemented.

Therefore, the proposed action is not likely to place any viable local population of the species (if present) at risk of extinction.

b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. The Brush-tailed Phascogale is not an endangered population.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

v. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

vi. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Brush-tailed Phascogale is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

vi. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

No Brush-tailed Phascogale habitat will be removed as a result of the proposed action. Indirect impacts associated with noise and lighting are may affect connected forest habitats within and

adjacent the development site and areas however these impacts would be minimal and restricted to event times only (20 days per year in total).

No fragmentation or isolation of habitat is predicted to occur as a result of the proposed action.

iii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species becoming fragmented or isolated from other areas of habitat. Traffic and fencing during events are considered unlikely to create a barrier for movement for the Brush-tailed Phascogale. Fencing contains a 100mm gap underneath which is sufficient space for this species to pass under and nocturnal traffic movements will be limited

iv. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Habitat within and adjacent to the development site for the is unlikely to be important for thespecies as targeted surveys in 2007, 2009 and 2014 failed to detect the species, therefore significant populations are considered unlikely to be present. The proposed action will not remove, fragment, isolate or significantly modify habitat for the species and no impacts impacts likely to affect the long term survival of the species in the locality are expected to occur.

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Brush-tailed Phascogale.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for the Brush-tailed Phascogale.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts to:

- Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk
- Temporary disturbance from light and noise during events – has been shown to be temporary and reversible

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site, including the Billinudgel Nature Reserve.

12.8.1 Conclusion

The proposal is unlikely to have a significant impact on the Brush-tailed Phascogale given that:

- No direct impacts to potential habitat are proposed within the development site.
- Large amounts of potential habitat for this species will remain within the site, throughout the adjacent Billinudgel Nature Reserve and more broadly in the region

- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the Brush-tailed Phascogale. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.9 Eastern Grass Owl (*Tyto longimembris*)

Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues.

Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. Targeted surveys for the Eastern Grass Owl were undertaken in July each year for four years (2013 – 2016) and in September 2014 as part of the biennial fauna survey. This species was recorded in the main event area (north of Jones Rd) in 2007 (observed during spotlighting). A pair of Eastern Grass Owls responded to call play back in July 2016 in the exotic grassland in the south of the Parklands. This was the first observation of these species within the site since 2007.

The OEH profile for this species list the following threats:

- Predation by foxes
- Loss of suitable habitat due to grazing, agriculture and development
- Habitat disturbance and degradation by stock
- Use of pesticides in agriculture to control rodent populations thereby limiting seasonal food sources for owls, reducing reproductive potential, and potentially poisoning owls
- Frequent burning, which reduces ground cover needed for safe roosting and nesting, and can reduce prey abundance
- Poor understanding of the ecology of inland populations
- Interacting effects of habitat degradation and increasing prevalence of invasive species

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The unmanaged exotic pasture in the south of the site (**Figure 1**) is likely to represent potential foraging and nesting/breeding habitat for this species. This exotic grassland will be directly impacted for the construction of the southern carpark.

The inferred absence of the species in the exotic pasture area in some years suggests that the site is not used annually; it could be too wet in some years, and there are also foxes that are active in that grassland (evidenced by direct observations & scats). Some of the southern grassland is to be retained as part of the proposed wetland buffer, and therefore the breeding habitat may or may not be lost if the development takes place. If sufficient grassland is retained via the wetland buffer, the birds may forage and/or nest there after development of a car park, but not if it is planted as melaleuca forest.

If the worst case scenario (loss of that breeding habitat) is assumed:

- the effect is likely to be non-lethal if carried out outside the breeding season;
- some foraging habitat will remain; and
- the development will affect a pair of birds that may often breed elsewhere. I.e. their inferred absence (not being detected in surveys in most years) suggests they are foraging elsewhere, and possibly breeding elsewhere.

The species is highly mobile and often not present in the southern grassland, therefore occupied territory (of this pair of birds) is likely to extend well beyond NBP. Likely breeding habitat and foraging habitat for a pair of Eastern Grass Owls is likely to be removed, but not eliminated. A population scale effect such that *a viable local population of the species is likely to be placed at risk of extinction* is unlikely.

Outside of the area of exotic grassland, all areas of remnant forest vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no significant adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its potential value as Eastern Grass Owl habitat over time.

No native vegetation associated with the Eastern Grass Owl will be directly impacted by the proposed development.

b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. The Eastern Grass Owl is not an endangered population.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Eastern Grass Owl is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).

Only a small proportion of potential habitat in the form of exotic grassland will be directly impacted for the construction of the southern carpark.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No native vegetation will be removed that would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Eastern Grass Owl.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The Eastern Grass Owl has been observed on site on three occasions in a decade (2007, 2016 and 2017). The Parklands is not considered to be important to the long-term survival of the species. Furthermore, only a small area of potential habitat (mostly exotic grassland) will be removed.

Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality.

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Eastern Grass Owl.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for the Eastern Grass Owl.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.9.1 Conclusion

The proposal is unlikely to have a significant impact on the Eastern Grass Owl given that:

- The species has been recorded within the Parklands on only three occasions in the previous decade (2007, 2016 and 2017) despite intensive targeted survey.
- Only a small area of vegetation representing known or potential habitat will be removed or fragmented

- Areas of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

If the worst case scenario (loss of that breeding habitat) is assumed:

- the effect is likely to be non-lethal if carried out outside the breeding season;
- a portion of the foraging habitat will remain; and
- the development will affect a pair of birds that may often breed elsewhere. I.e. their inferred absence (not being detected in surveys in most years) suggests they are foraging elsewhere, and possibly breeding elsewhere.

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Eastern Grass Owl. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.10 Eastern Osprey (*Pandion cristatus*)

The Osprey has a global distribution with four subspecies previously recognised throughout its range. However, recent studies have identified that there are two species of Osprey - the Western Osprey (*P. halietus*) with three subspecies occurring in Europe, Asia and the Americas and the Eastern Osprey (*P. cristatus*) occurring between Sulawesi (in Indonesia), Australia and New Caledonia. Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. They favour coastal areas, especially the mouths of large rivers, lagoons and lakes and feed on fish over clear, open water.

A single Eastern Osprey was observed during the Falls Festival 2013-14 event monitoring. It was flying over the site.

The OEH profile for this species list the following threats:

- Disturbance to or removal of large trees near the coast that have been or could be used as nest sites
- Disturbances to water quality, such as from the disposal of treated effluent or stormwater runoff that increases turbidity in feeding areas
- Ingestion of fish containing discarded fishing tackle
- Potential electrocution of individuals using powerline poles for nesting
- Disturbance to active nests potentially reducing reproductive success

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species has been sighted only once in 10 ecological surveys at the site and it was flying overhead. Therefore, it is not considered that there is a local population using the site nor that the proposed works are not likely to place any viable local population of this species at risk of extinction.

b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. The Eastern Osprey is not an endangered population.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Eastern Osprey is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Eastern Osprey.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

This species has been sighted only once in 10 ecological surveys at the site and it was flying overhead. Therefore, it is not considered that the habitat on site is of any importance to Eastern Osprey. Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Eastern Osprey.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for the Eastern Osprey.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site). The extent of clearing represents an insignificant increase in a key threatening impact. Furthermore, all other habitat on site will be preserved and protected for the duration of the project whilst significant areas of bushland rehabilitation has occurred, and is planned to occur in the future.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.10.1 Conclusion

The proposal is unlikely to have a significant impact on the Eastern Osprey given that:

- The species has only been observed once in the last decade of monitoring and survey, and this was one individual flying over the site
- Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).
- Large amounts of potential habitat for this species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Eastern Osprey. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.11 Bush Stone-curlew (*Burhinus grallarius*)

The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. It inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. The species is largely nocturnal, being especially active on moonlit nights. It feeds on insects and small vertebrates, such as frogs, lizards and snakes. Nestiong takes place on the ground in a scrape or small bare patch, where two eggs are laid in spring and early summer

Bush Sone-curlew was first recorded at the site in 2017.

The OEH profile for this species list the following threats:

- Predation by foxes and cats.
- Trampling of eggs by cattle.
- Clearance of woodland habitat for agricultural and residential development.
- Modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, grazing and frequent fires.
- Disturbance in the vicinity of nest sites.

h. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

This species has been sighted only once in ten ecological surveys at the site and it was flying overhead. Therefore, it is not considered that there is a local population using the site nor that the proposed works are not likely to place any viable local population of this species at risk of extinction.

i. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. The Bush Stone-curlew is not an endangered population.

j. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

iii. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

iv. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Bush Stone-curlew is not an endangered ecological community.

k. in relation to the habitat of a threatened species, population or ecological community:

iv. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).

v. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Bush Stone-curlew.

vi. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

This species has been sighted only once in ten ecological surveys at the site. Therefore, it is not considered that the habitat on site is of high importance to Bush Stone-curlew. Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality

l. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Bush Stone-curlew.

m. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan has been prepared for the Bush Stone-curlew (DEC 2006). The objectives of the recovery plan are:

- Objective 1: Expand existing Bush Stone-curlew community conservation programs.
- Objective 2: Raise community recognition of the Bush Stone-curlew and interest in the recovery program.
- Objective 3: Increase the total area of Bush Stone-curlew habitat protected and managed for conservation on public and private lands by 25% in each CMA.

- Objective 4: Supplement declining wild populations with a robust and well-funded captive-breeding and translocation program.
- Objective 5: Ensure the conservation status of the Bush Stone-curlew is adequately recognised under NSW and Commonwealth legislation.
- Objective 6: Ensure that impacts on Bush Stone-curlews and their habitat are accurately assessed during planning and environmental assessment processes.
- Objective 7: Increase understanding of the ecology of the Bush Stone-curlew.
- Objective 8: Increase understanding of threatening processes affecting Bush Stone-curlews.
- Objective 9: Increase understanding of the significance of the Bush Stone-curlew to indigenous Australians.
- Objective 10: Integrate the recovery plan with other conservation plans and programs to maximise the efficient use of resources and benefits to biodiversity.
- Objective 11: Implement a well-funded and coordinated recovery program across NSW.

The proposed development does not conflict with any of the listed objectives of the recovery plan.

n. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site). The extent of clearing represents an insignificant increase in a key threatening impact. Furthermore, all other habitat on site will be preserved and protected for the duration of the project whilst significant areas of bushland rehabilitation has occurred, and is planned to occur in the future.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.11.1 Conclusion

The proposal is unlikely to have a significant impact on the Bush Stone-curlew given that:

- The species has only been observed once in the last decade of monitoring and survey
- Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).
- Large amounts of potential habitat for the species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Bush Stone-curlew. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.12 Koala (*Phascolarctos cinereus*)

Koalas are solitary and territorial (particularly males) yet live in established sedentary polygynous breeding aggregates arranged in a matrix of overlapping home ranges whose size varies according to sex (males tend to be larger so that they overlap the ranges of several females) and carrying capacity of the habitat (usually measured in terms of density of primary browse species) (Phillips and Callaghan 1995).

Nationally, koalas have been observed feeding or resting in about 120 eucalypt species (66 in NSW) and 30 non-eucalypt (seven in NSW) species. Usage may also be determined by site-dependent edaphic factors e.g. soil type (Sharp and Phillips 1999), which affects the nutrient quality of forage. Forest consisting of primary browse species associations located on deep, fertile soils on floodplains, in gullies and along watercourses are generally considered preferred koala habitat. This may possibly be a reflection of the nutritional value of the foliage.

An established koala home range is usually occupied for several years or throughout its life (Phillips 1997, Sharp and Phillip 1999). Size of a koala home range may vary from a hectare to hundreds of hectares (eg Jurskis and Potter 1997 report home ranges of 38 ha to 520 ha with an average size of 169 ha, near Eden); varying with habitat quality (e.g. if primary browse species dominate the tree component, home range size is expected to be small and carrying capacity high), sex (males have larger territories and may make forays into other areas), age of the animals (e.g. sub-adults versus adults), and location (Jurskis and Potter 1997, Phillips 1997, Sharp and Phillip 1999).

The site use of the Parklands by koala has been variable over time. Targeted koala surveys provided the following indication of site usage:

- 2007 – small area of core Koala habitat (3 ha) mapped on site; Koala scats observed at four locations within the Parklands; results suggest use of the site by 1 – 2 Koalas
- 2008 – significantly reduce evidence of activity, such that activity level does not reach the threshold that indicates active, ongoing use by resident animals
- 2013 – no evidence of Koala within the Parklands
- 2016 – evidence of Koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billindugel Nature Reserve. Mixed age scats suggest repeat use of sites by Koala individuals with home ranges that encompass the north-west corner of the Parklands

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

All potential habitat for the Koala on site will be preserved and protected for the duration of the project. All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Koala habitat over time.

Indirect impacts to Koala are also unlikely. Koalas have moved back into the Parklands area during the trial period (i.e. there was no evidence of Koala in 2013 compared to evidence of repeat use of north-west corner of the site in 2016). This suggest the ongoing use of the site for events has not precluded the area from providing suitable habitat for Koala.

Therefore, the proposed works are not likely to place any viable local population of this species at risk of extinction.

b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

In addition to being listed as a threatened species, the Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is also listed as an endangered population.

As discussed in (a) above, the events are not likely to have an impact on either the local habitat or koalas using the Parklands site. There is some uncertainty as to whether the koalas on site comprise a 'viable local population'. However, ongoing habitat improvements and effective management and mitigation measures will ensure any local population is not put at risk of extinction.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Koala is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed action will not result in clearing of koala habitat within the Parklands.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Koala.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The proposed action will not result in any removal of koala habitat. All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management

procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Koala habitat over time.

The importance of vegetation within the Parklands to Koala is unclear. However, Koalas have moved back into the Parklands area during the trial period (i.e. there was no evidence of Koala in 2013 compared to evidence of repeat use of north-west corner of the site in 2016). This suggest the ongoing use of the site for events has not precluded the area from providing suitable habitat for Koala.

Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality.

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Koala.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The Approved Recovery plan for the koala (DECC 2008) provides a framework for localised recovery efforts throughout NSW through a number of recovery actions. The actions include:

- Conserving Koalas in their existing habitat, rehabilitate and restore Koala habitat and populations;
- Develop a better understanding of the conservation biology of Koalas;
- Ensure that the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local level;
- Manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care;
- Manage over browsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat; and,
- Coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across New South Wales.

The proposal does not conflict with any of the objectives outlined in the recovery plan.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

- Increased risk of vehicular strike during events, if koalas disperse away from noise and light sources. This is considered low however. Furthermore, all internal roads within the development site are limited to 25km/hr and the nearby highway has fauna exclusion fencing/barriers.

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.12.1 Conclusion

The proposal is unlikely to have a significant impact on the Koala given that:

- No vegetation representing known or potential habitat will be removed
- Large amounts of potential habitat for these species will remain within the site and is present throughout the locality.
- No habitat would be isolated of known habitat from currently interconnecting areas of potential habitat for this species
- The proposed action will result in a minor disturbance during events, but monitoring data has shown koalas have moved back into the Parklands in 2016 over the time that events have been running
- On-going benefits will continue to be realised through habitat creation and preservation through bush regeneration

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Koala. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.13 Mitchell's Rainforest Snail (*Thersites mitchellae*)

This species is restricted to coastal lowlands occurring between the Tweed and Richmond Rivers in NSW. The species is currently only known from five locations between Banora Point and Lennox Head, within an 80 km long stretch of coastline. The estimated total number of mature individuals is less than 500 (DoE, 2017c).

The preferred habitat for the species is lowland subtropical rainforest and swamp sclerophyll forest with a rainforest understorey on alluvial soils with a basaltic influence (DoE, 2017c). The species is found in areas with deep leaf litter and an intact forest canopy and are known to shelter under palm fronds, leaf litter and bark during the day.

Three shells of Mitchell's Rainforest Snail have been found in Billinudgel Nature Reserve and suitable habitat exists within the patches of remnant vegetation at the Parklands. The long history of forest clearing, fragmentation and trampling by cattle suggests the species would not be present found in the event areas. The species has not been detected during targeted survey and monitoring. However, given the close proximity of the Billinudgel Nature Reserve and suitable habitat on site, there is potential for the species to be present within areas of remnant vegetation at the Parklands.

The OEH profile for this species list the following threats:

- Clearing of lowland rainforest, swamp forest and wetland margins for agriculture.
- Clearing of lowland rainforest, swamp forest and wetland margins for urban development.

- Damage to remnant areas of habitat from grazing by domestic stock.
- Damage to remnant areas of habitat by fire.
- Damage to remnant areas of habitat by weed invasion.
- Predation of snails by introduced rats.
- Habitat fragmentation increasing edge effects including increasing the severity of disturbance from fire, weeds and predation by introduced rats.
- Use of herbicides and pesticides in and near areas of habitat.
- Impacts on habitat as a result of dieback caused by root rot fungus (*Phytophthora cinnamomi*).
- Loss of coastal populations from sea level rise and climate change
- Damage to habitat from changes in hydrology
- Poor knowledge of species distribution
- Lack of awareness of the species within the community

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

All potential habitat for the Mitchell's Rainforest Snail on site will be preserved and protected for the duration of the project. All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Mitchell's Rainforest Snail habitat over time.

Therefore, the proposed works are not likely to place any viable local population of this species at risk of extinction.

b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable. Mitchell's Rainforest Snail is not an endangered population.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Mitchell's Rainforest Snail is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed that would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Mitchell's Rainforest Snail.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).

All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as the Mitchell's Rainforest Snail habitat over time.

The importance of habitat at the Parklands for Mitchell's Rainforest Snail is uncertain, however, given the very minor clearing that is planned and the habitat rehabilitation that is taking place, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality.

Regarding the impacts of noise, gastropods do not have a sense of hearing, though do feel vibrations. The potential impact of event generated vibrations is unclear and dependant on distance to the source of noise. It is predicted that vibrations would not be at levels that could cause harm to this species.

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Mitchell's Rainforest Snail.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan was prepared in 2001 by NSW National Parks and Wildlife Service for Mitchell's Rainforest Snail. The objectives outlined in the plan include:

- Objective 1: to assist identification of potential habitat for Mitchell's Rainforest Snail
- Objective 2: to assist identification of additional populations of Mitchell's Rainforest Snail
- Objective 3: to maximise the protection of the population of Mitchell's Rainforest Snail on Stotts Island
- Objective 4: to encourage community participation in the recovery of Mitchell's rainforest snail

The proposed works do not conflict with any of the objectives of the recovery plan.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.13.1 Conclusion

The proposal is unlikely to have a significant impact on the Mitchell's Rainforest Snail given that:

- Only a very minor area of potential habitat will be removed (300m2 or <0.001% of native vegetation within the development site).
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Mitchell's Rainforest Snail. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

Appendix N – EPBC Act Referral Determination

Notification of

REFERRAL DECISION – not controlled action
North Byron Parkland Cultural Events, NSW (EPBC: 2017-7973)

This decision is made under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

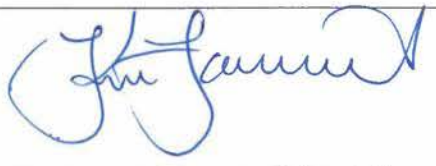
Proposed action

Person proposing to take the action	The trustee of Billinudgel Property trust ABN: 52031674697
proposed action	To use the Parklands site, located on Tweed Valley Way and Jones Road in the Yelgun Valley NSW as a cultural events centre and construct associated event infrastructure including a number of site enhancements [See EPBC Act referral 2017/7973].

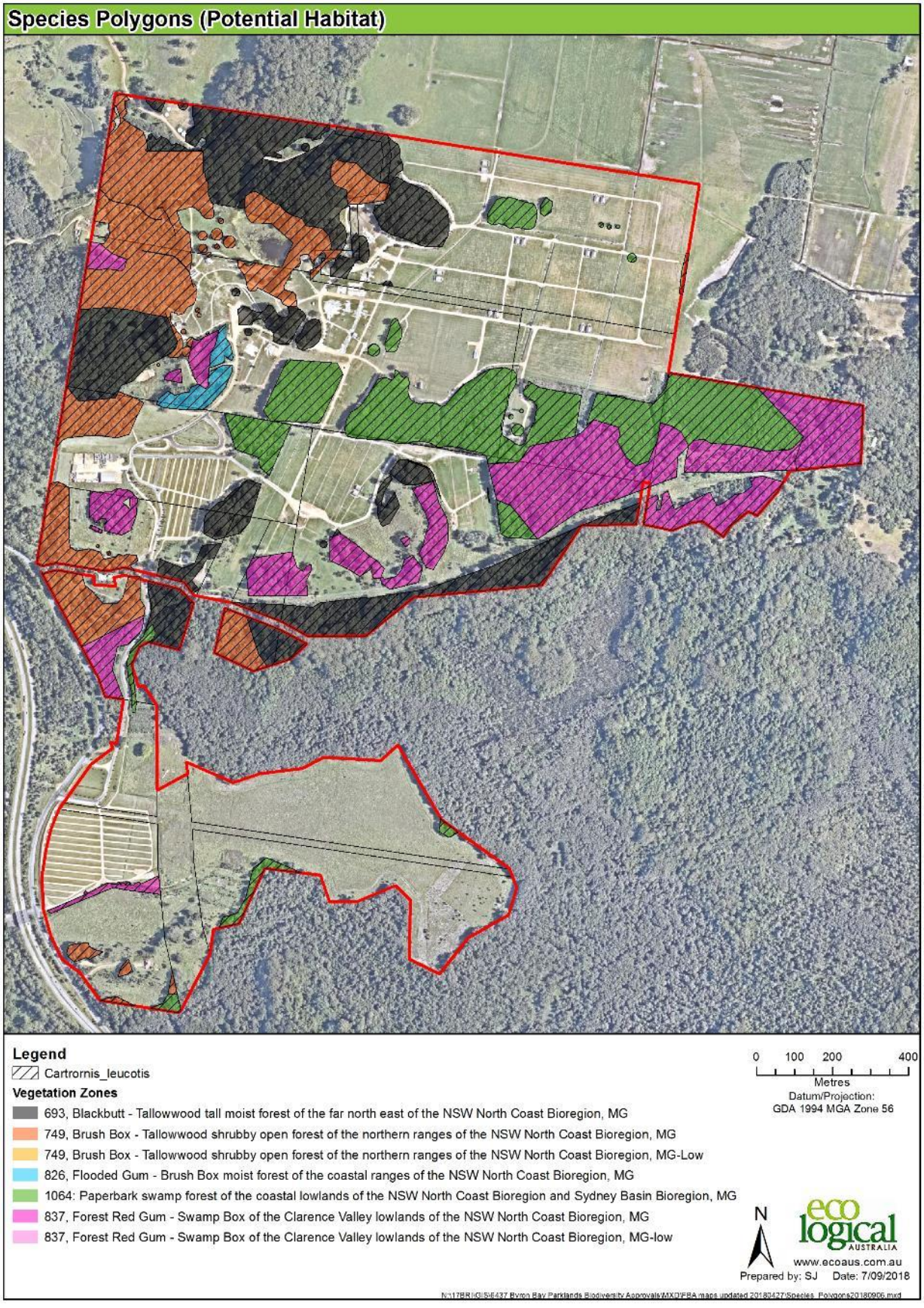
Referral decision: Not a controlled action

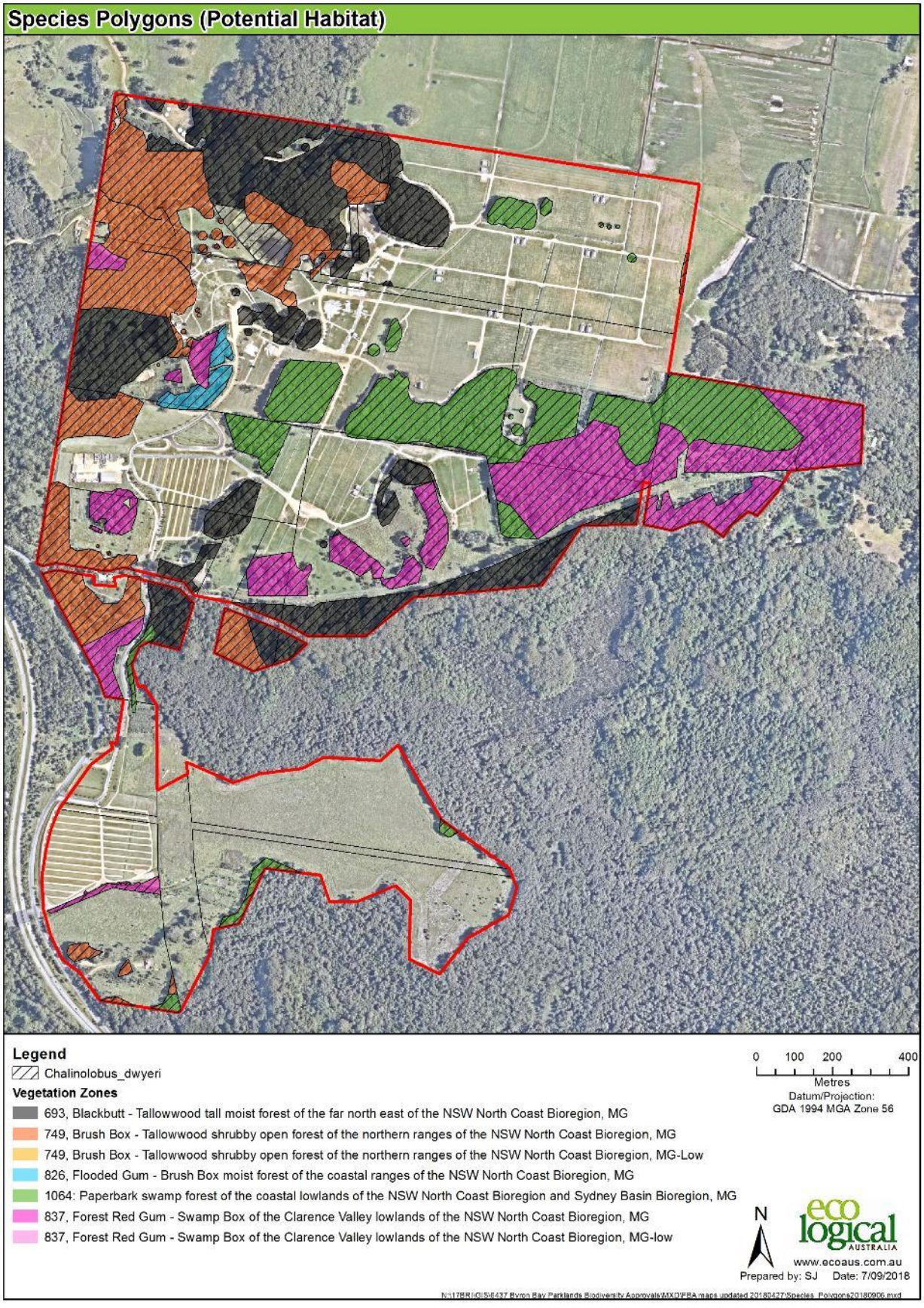
status of proposed action	The proposed action is not a controlled action.

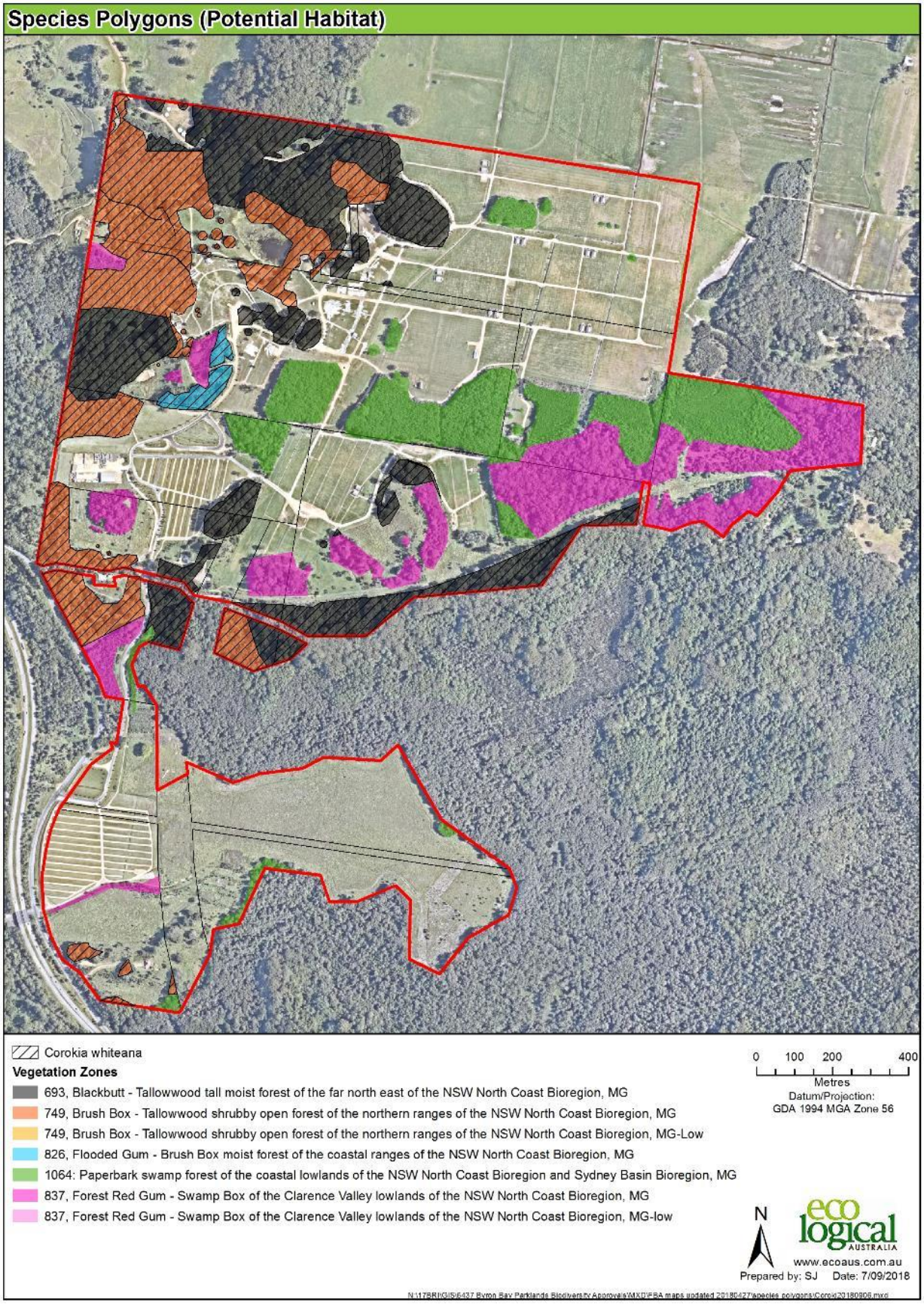
Person authorised to make decision

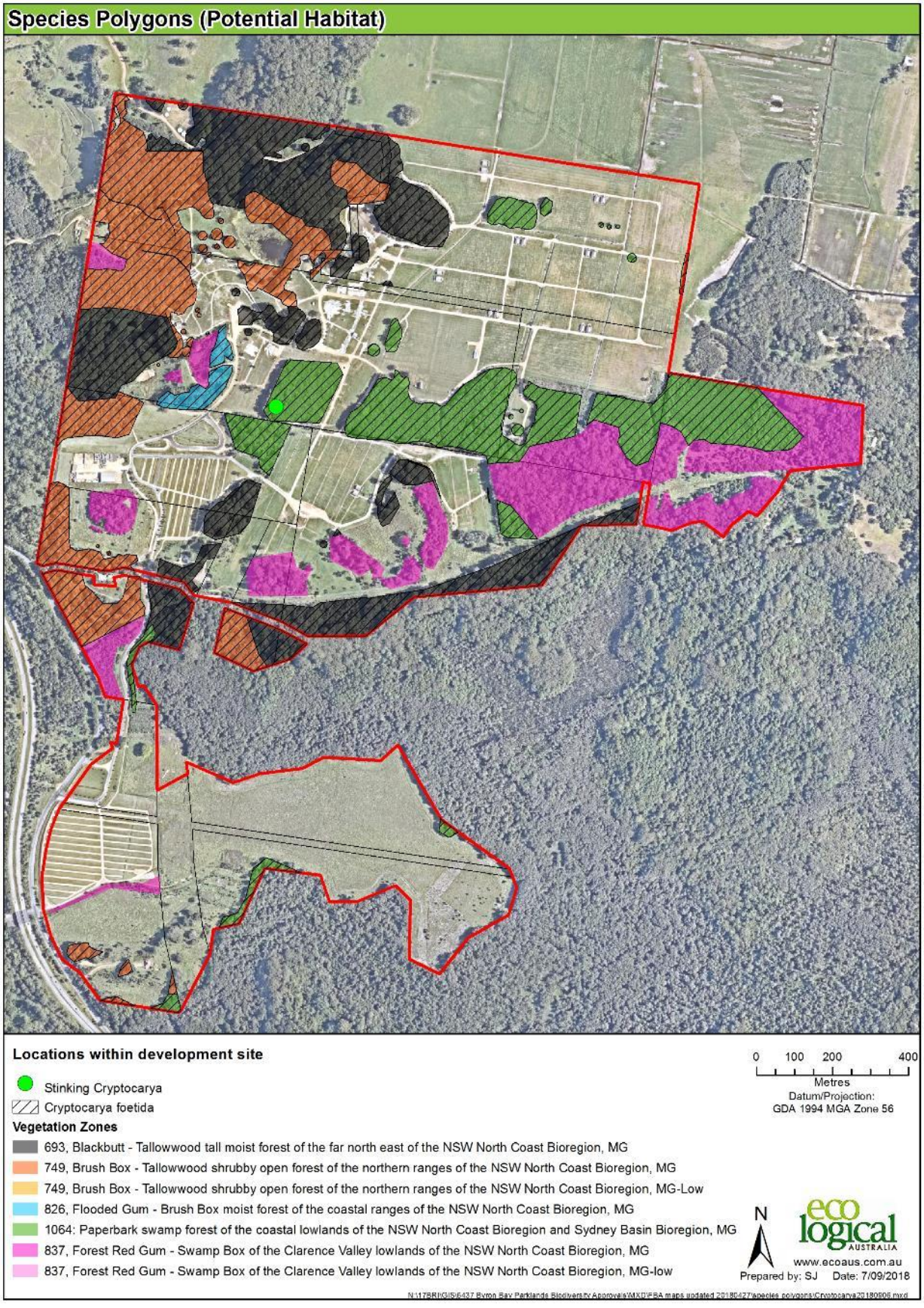
Name and position	Kim Farrant Assistant Secretary Assessments (NSW, ACT) and Fuel Branch
signature	
date of decision	27 July 2017

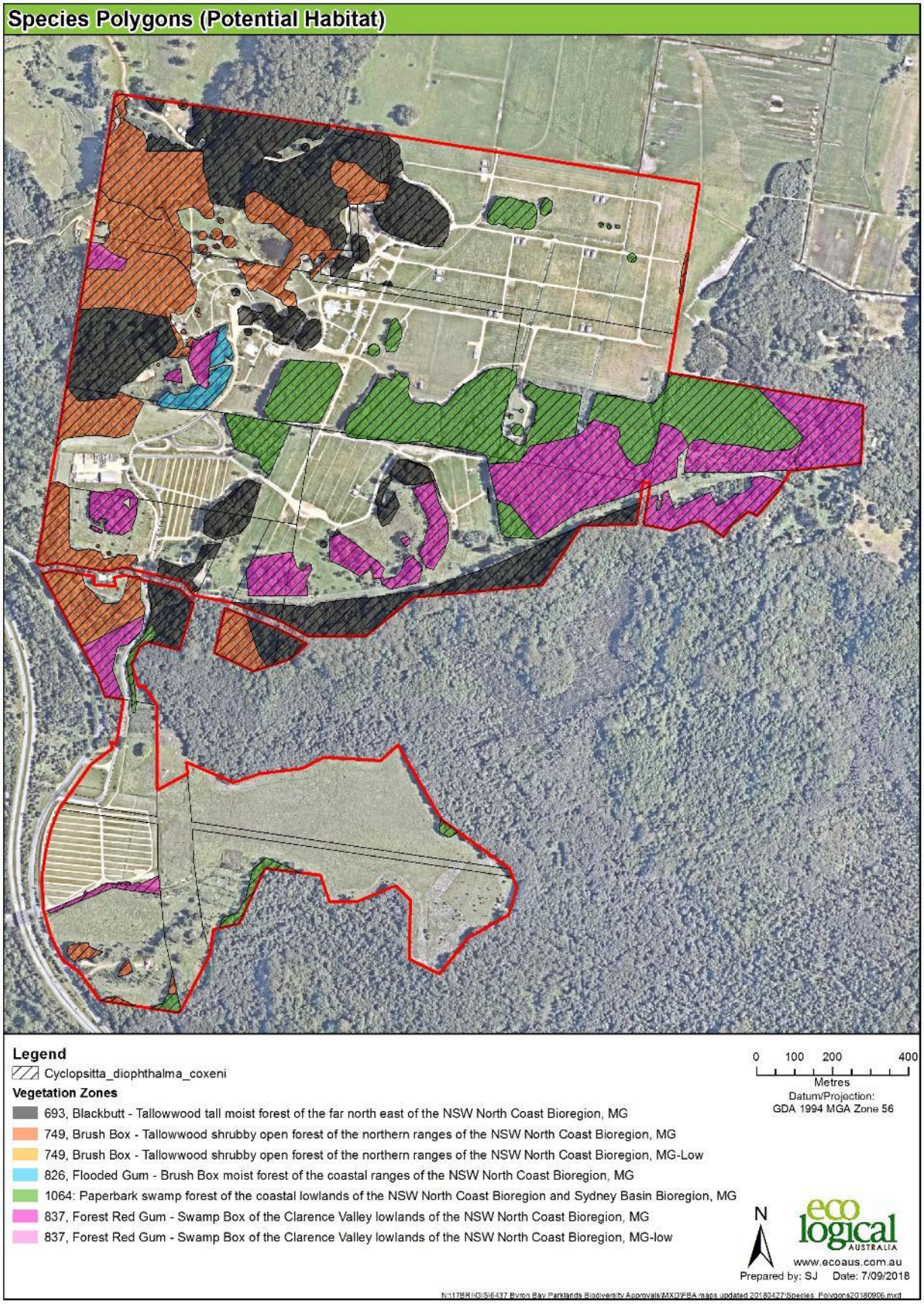
Appendix O – Species Polygon (Potential Habitat) Maps

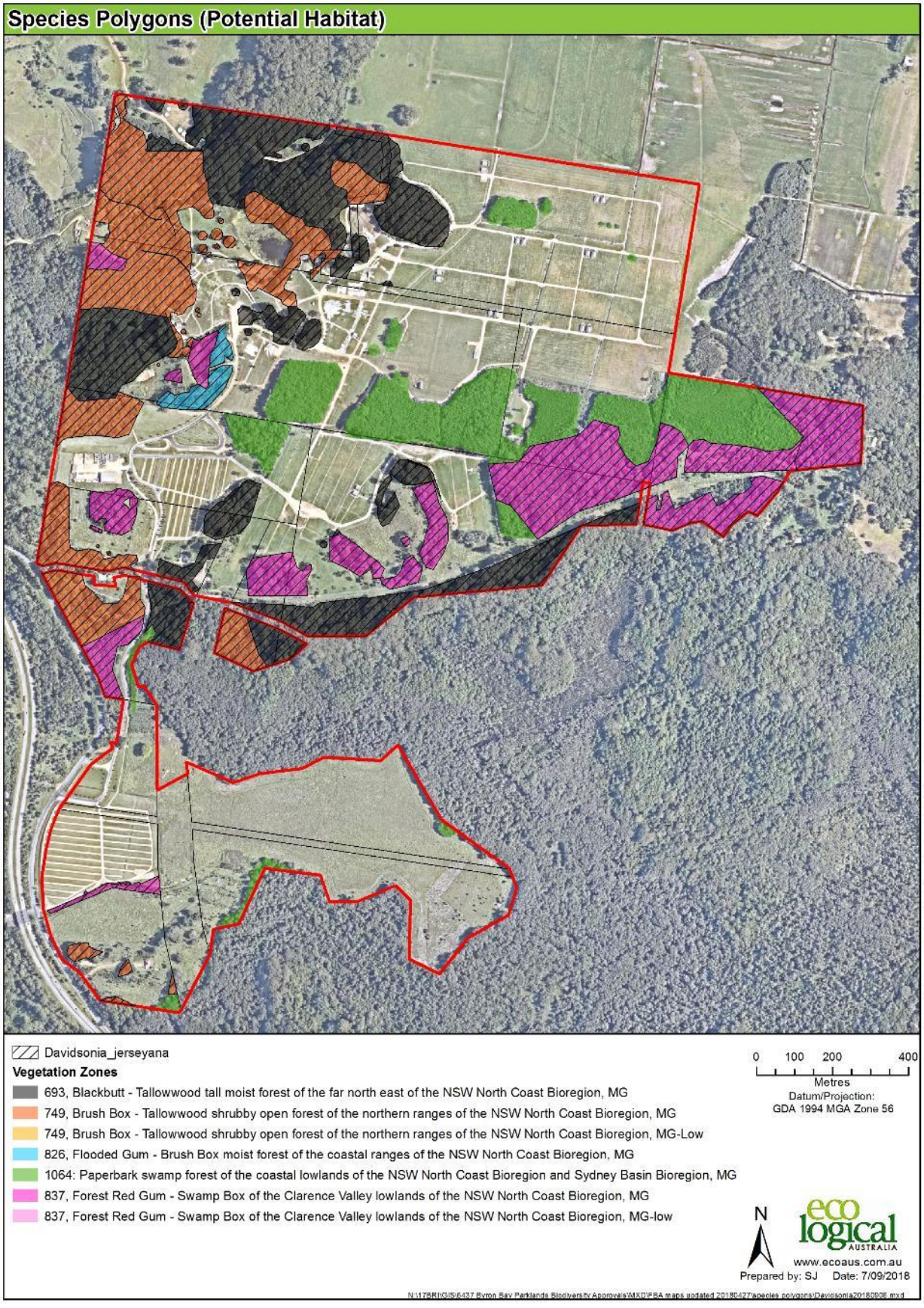


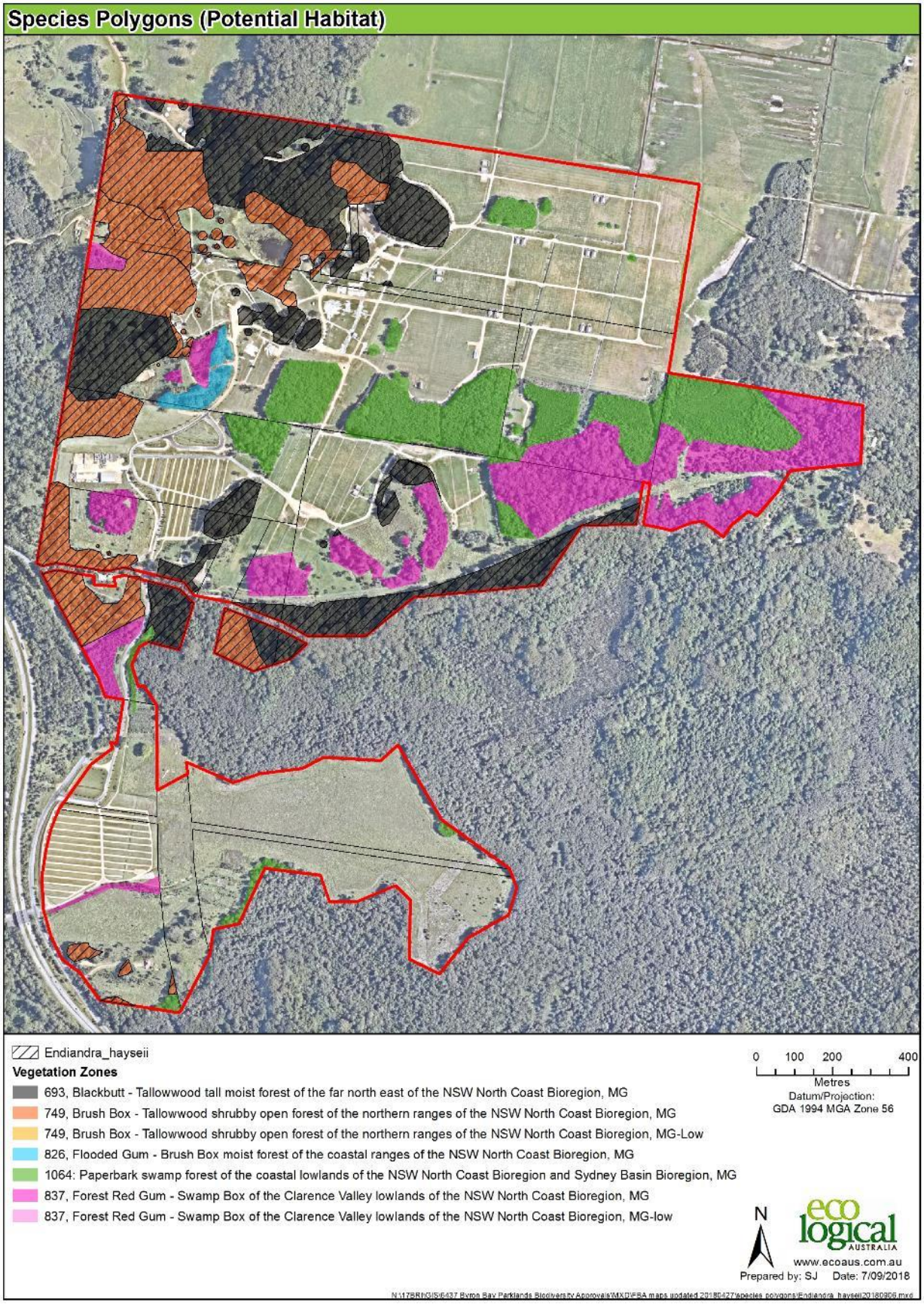


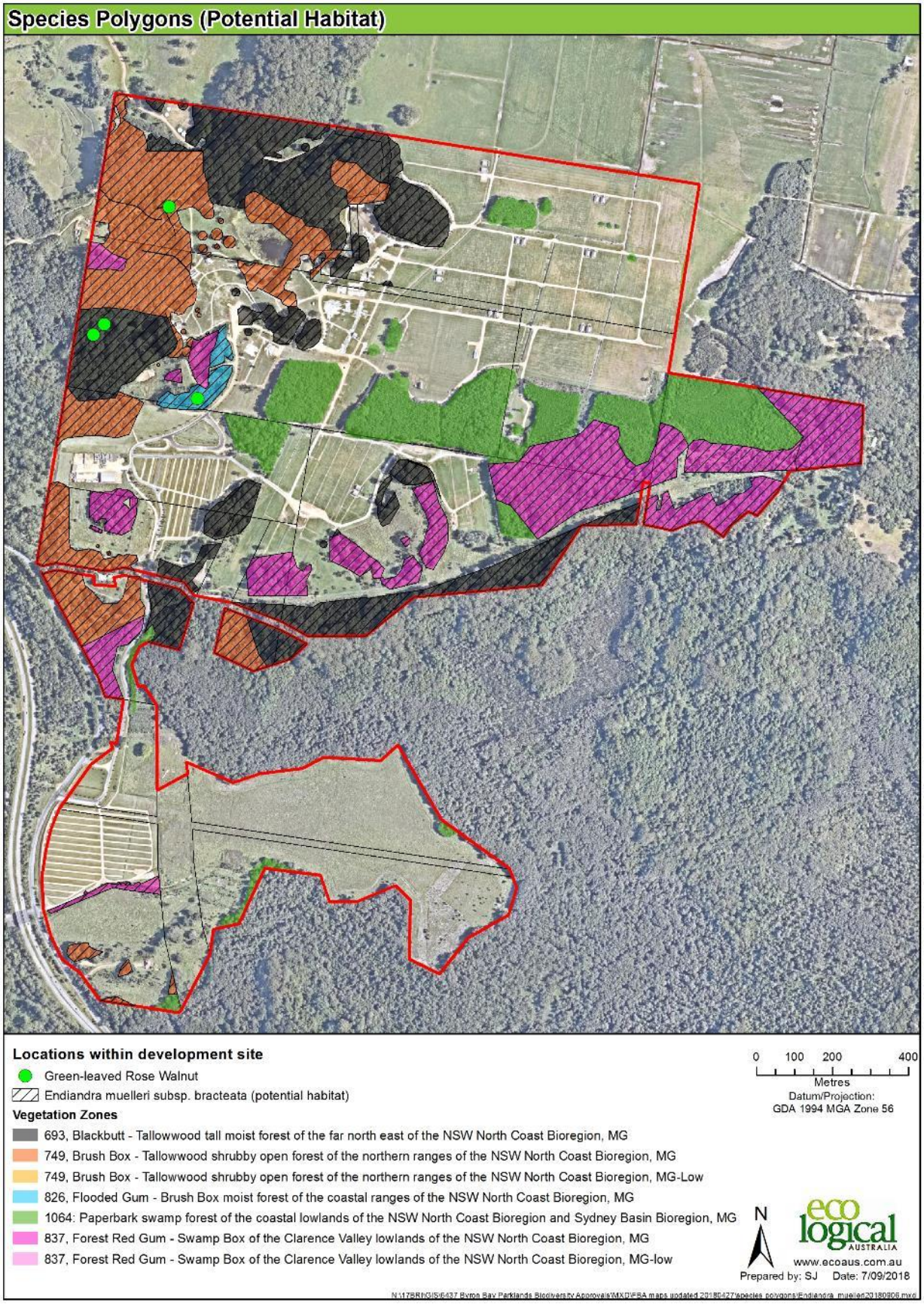


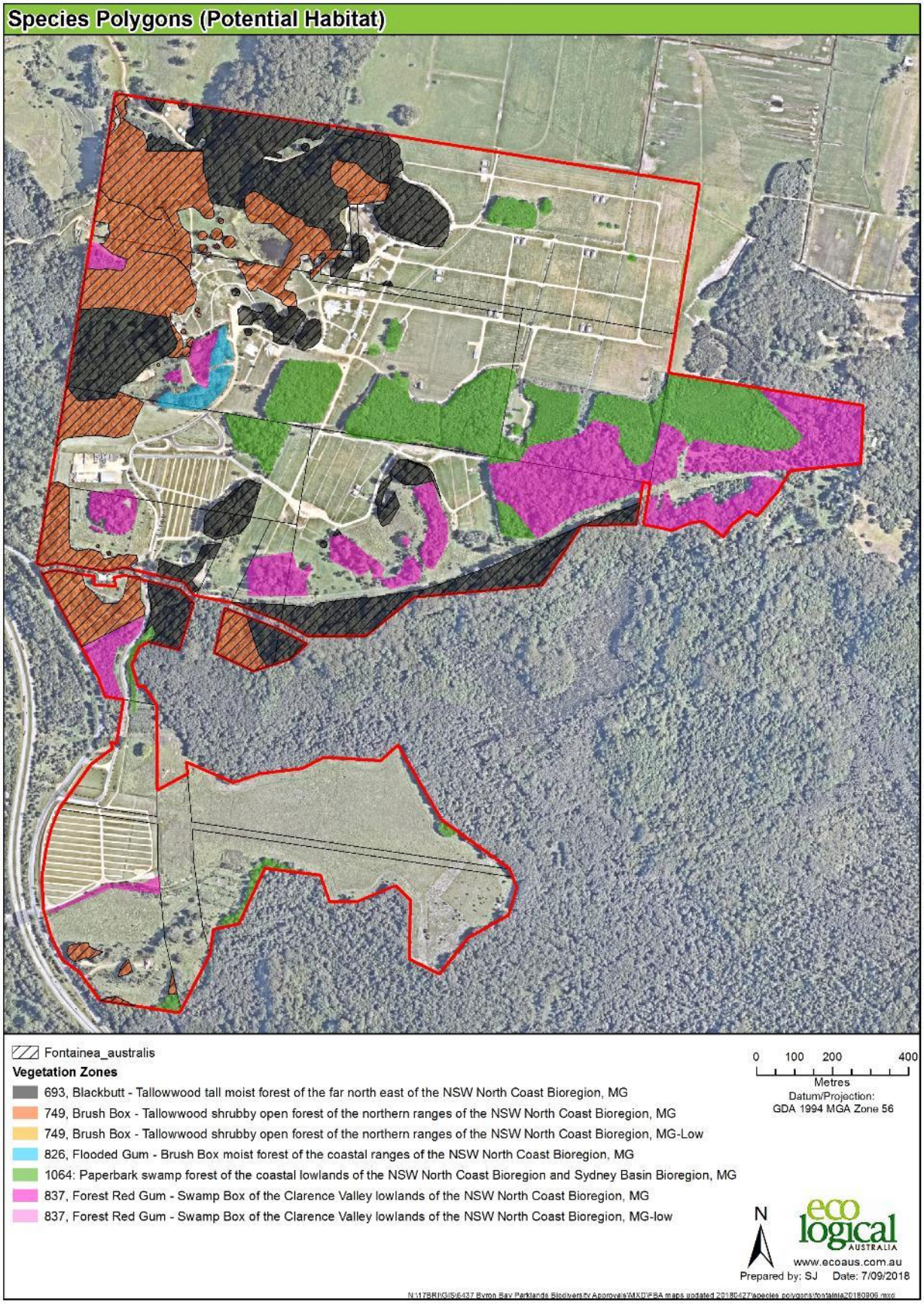


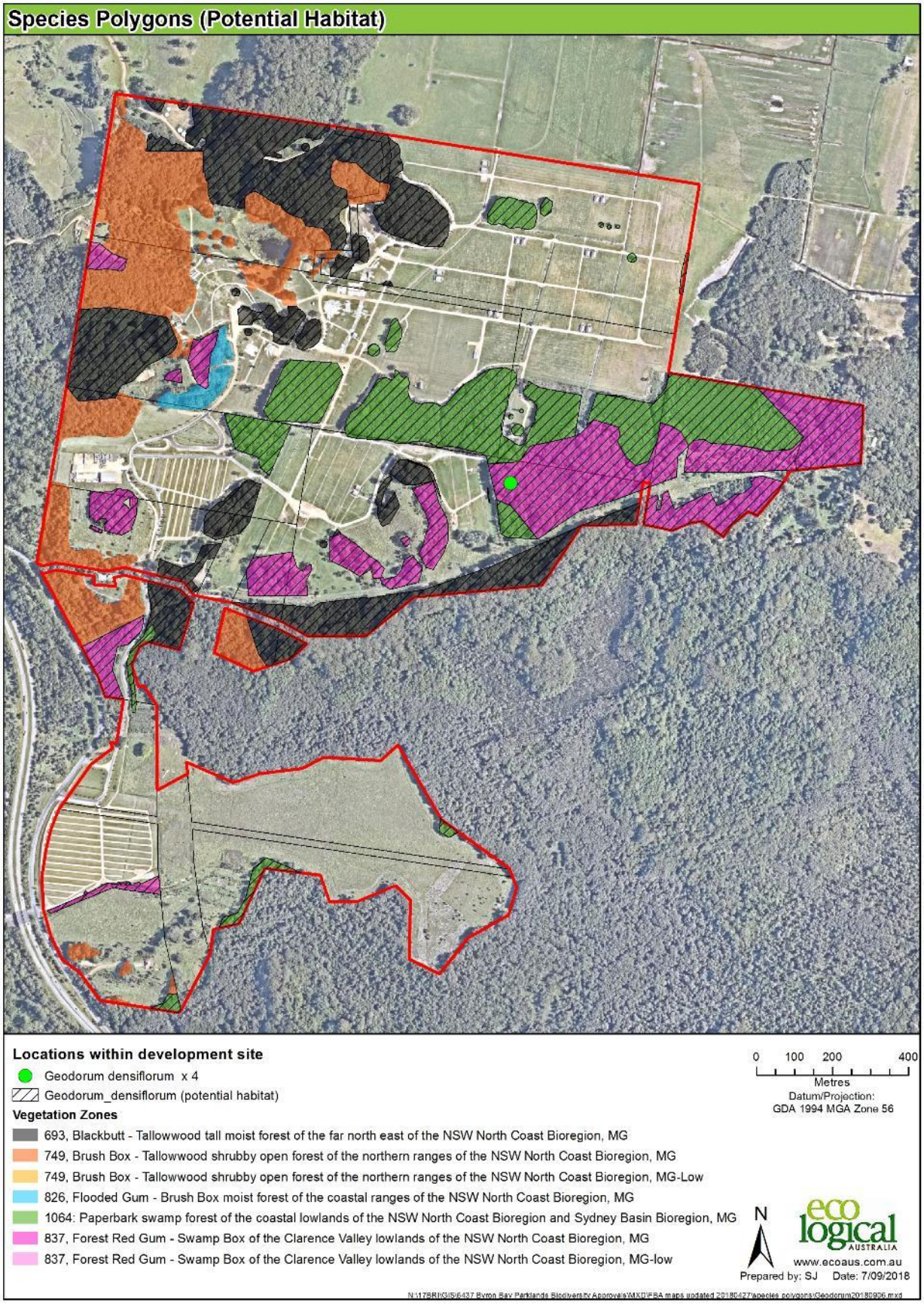


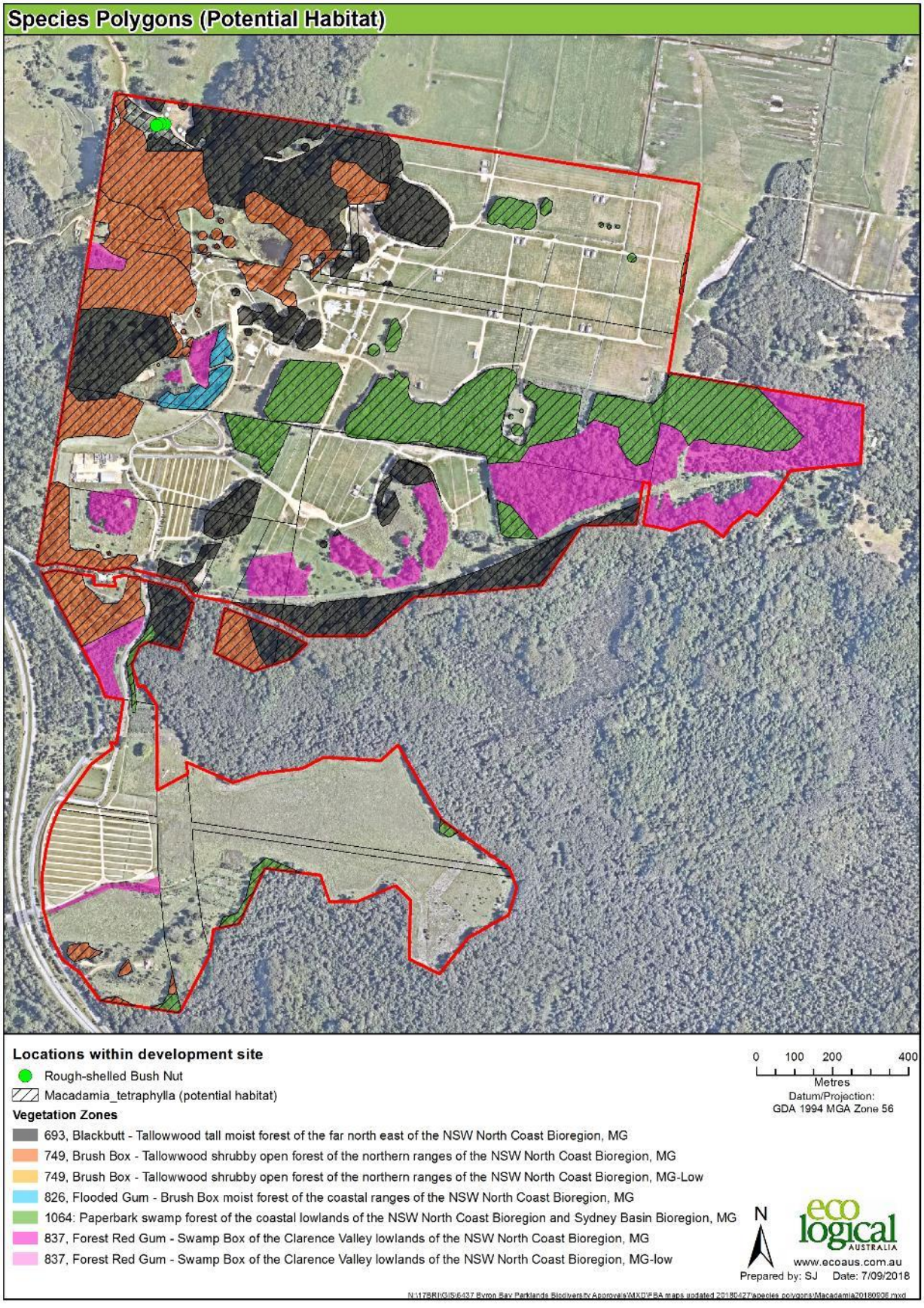


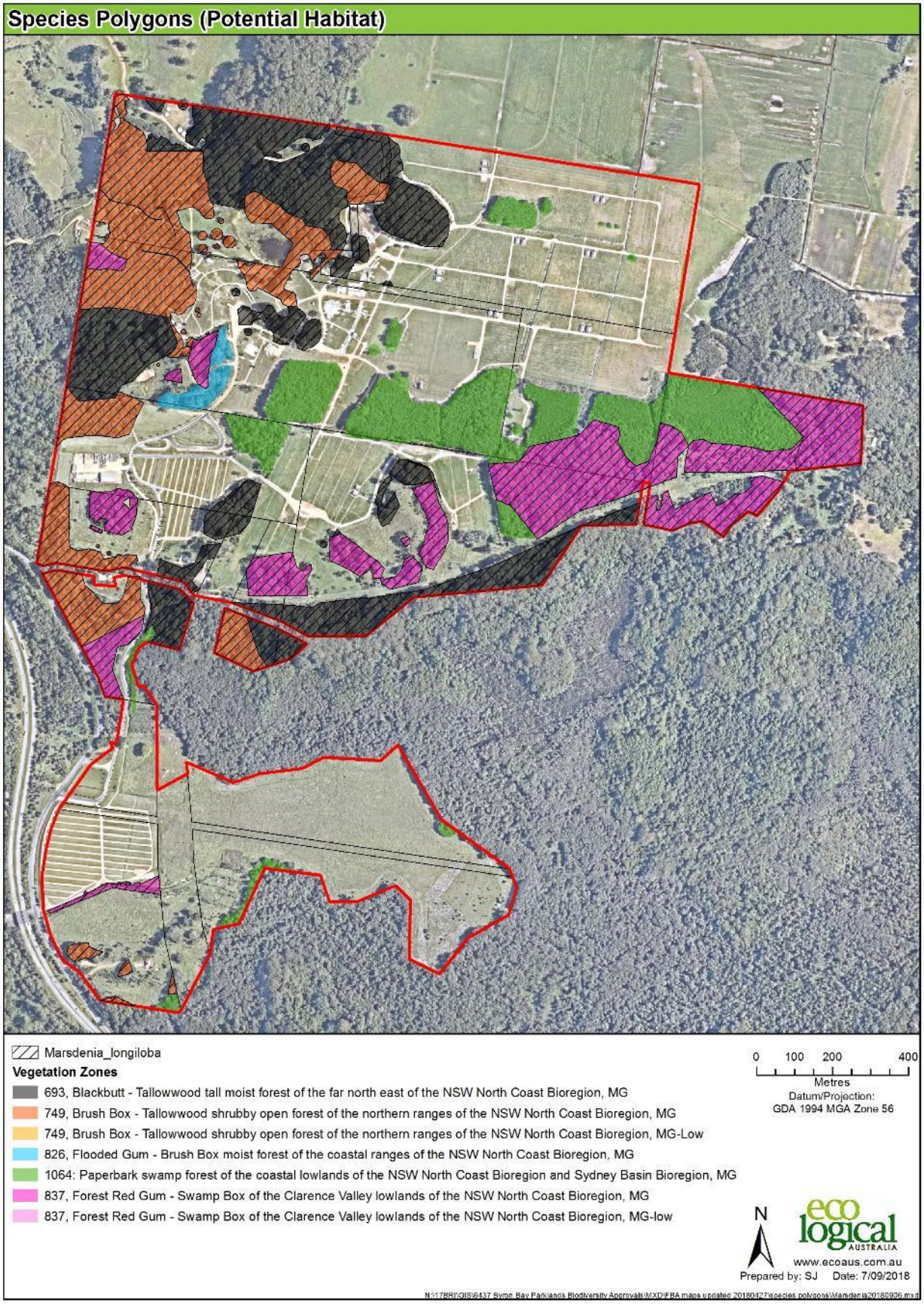


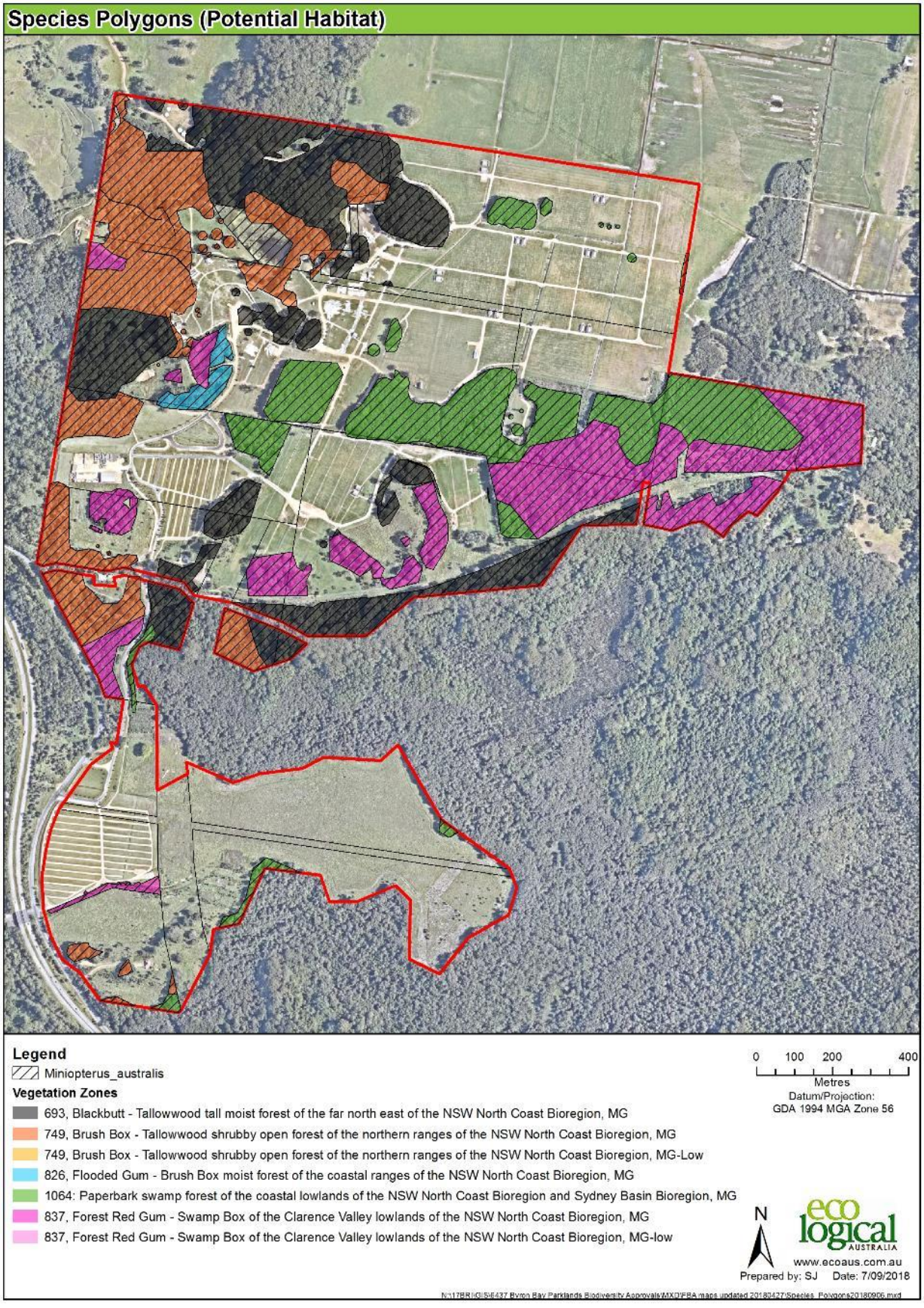


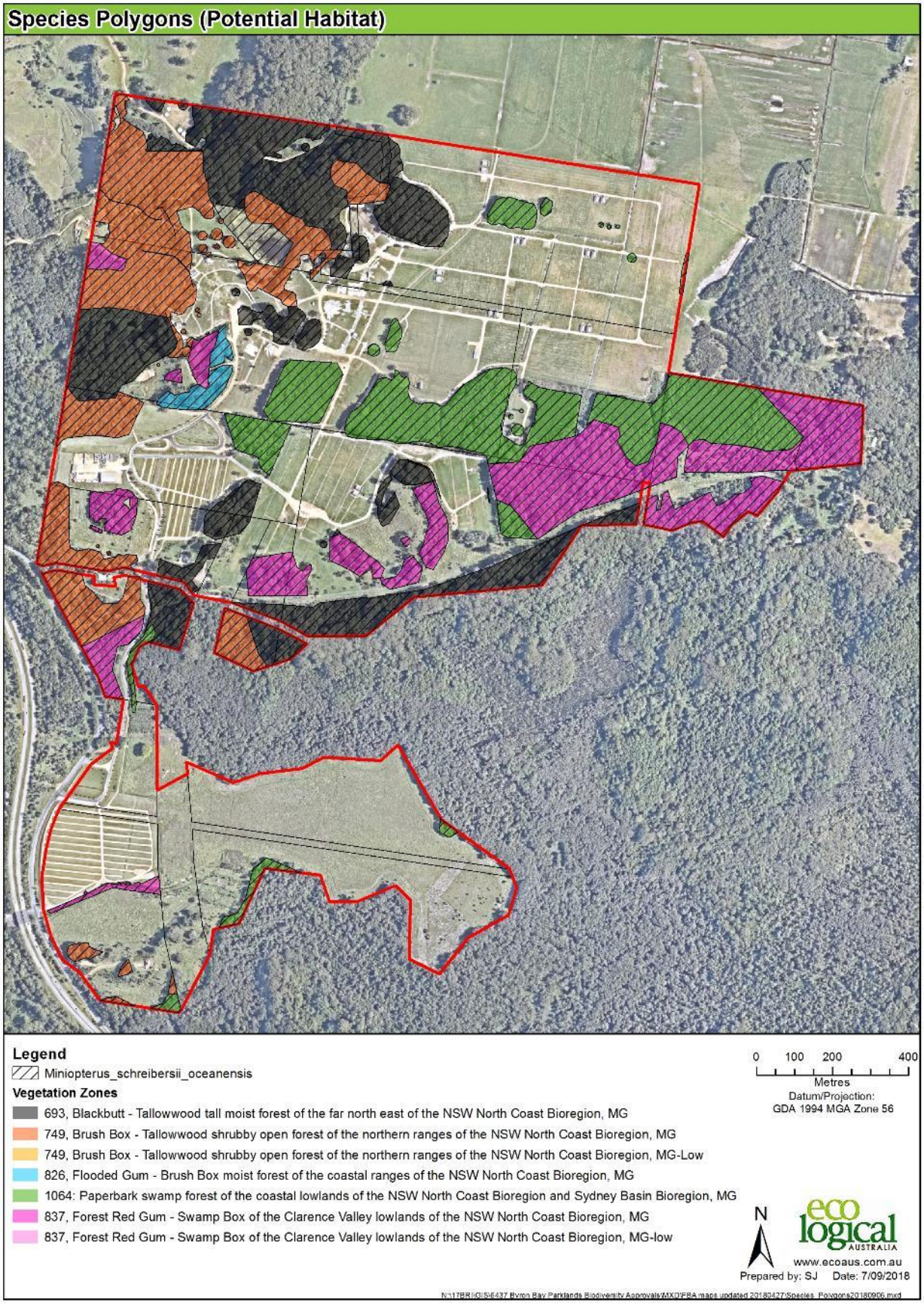


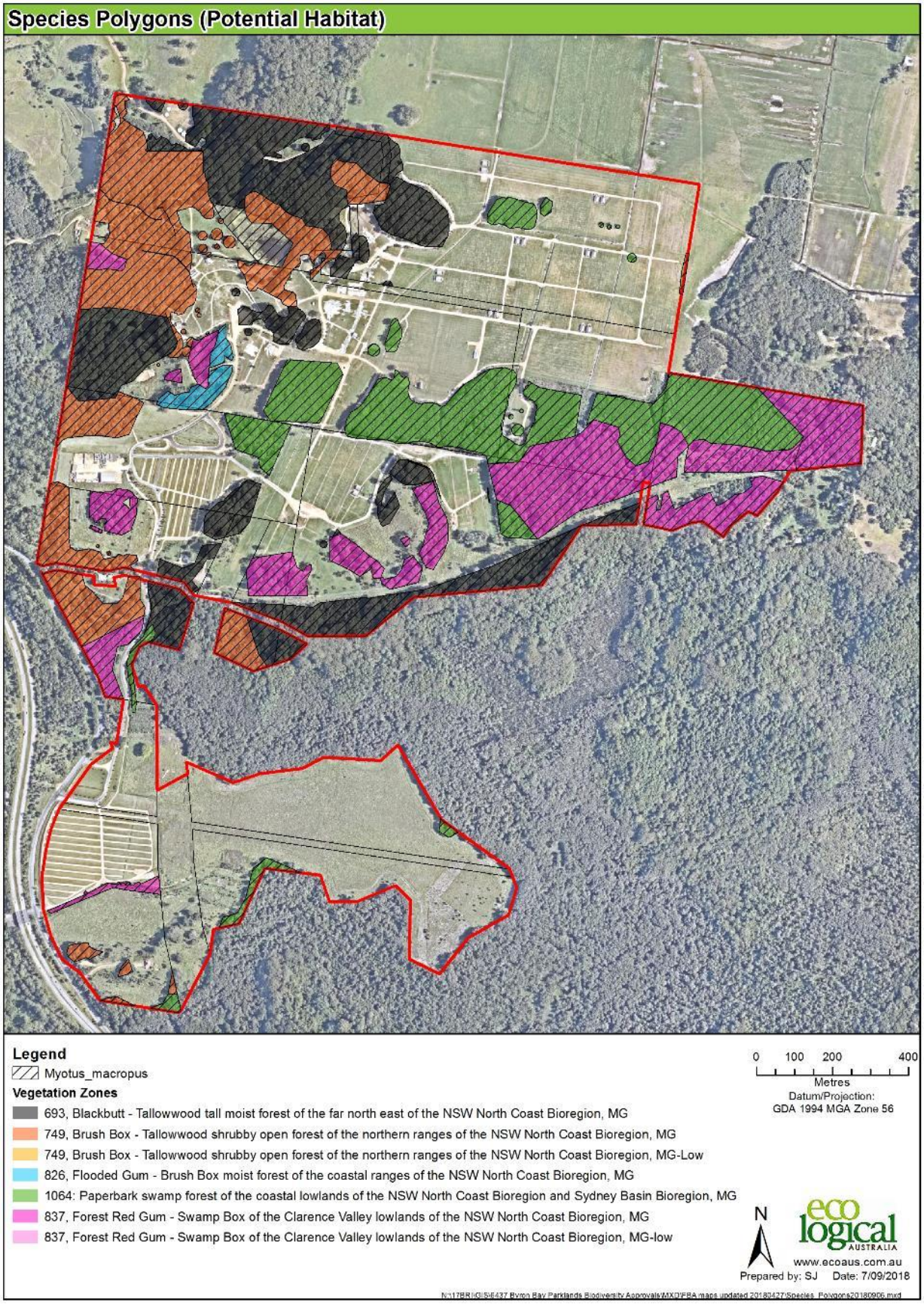


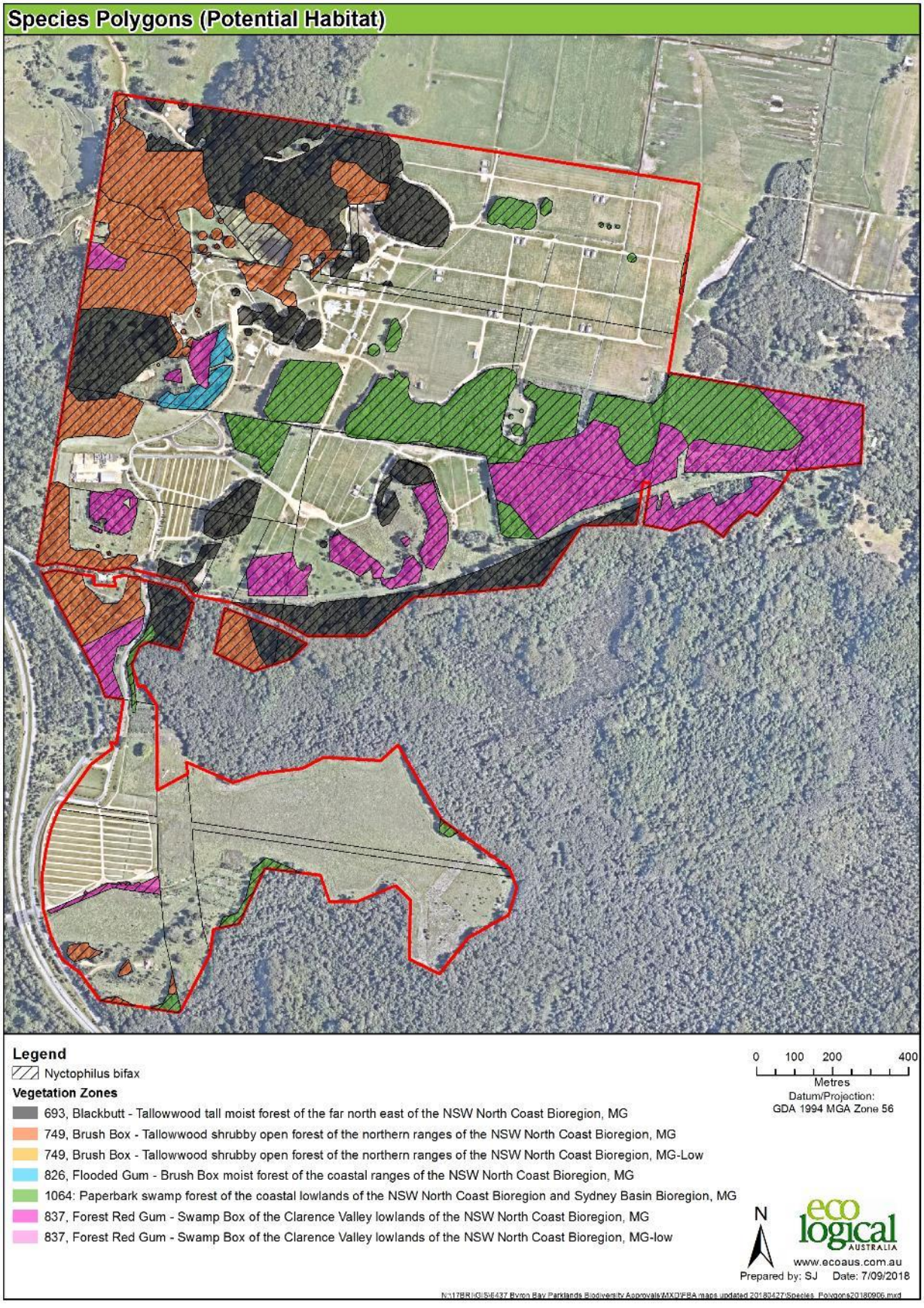


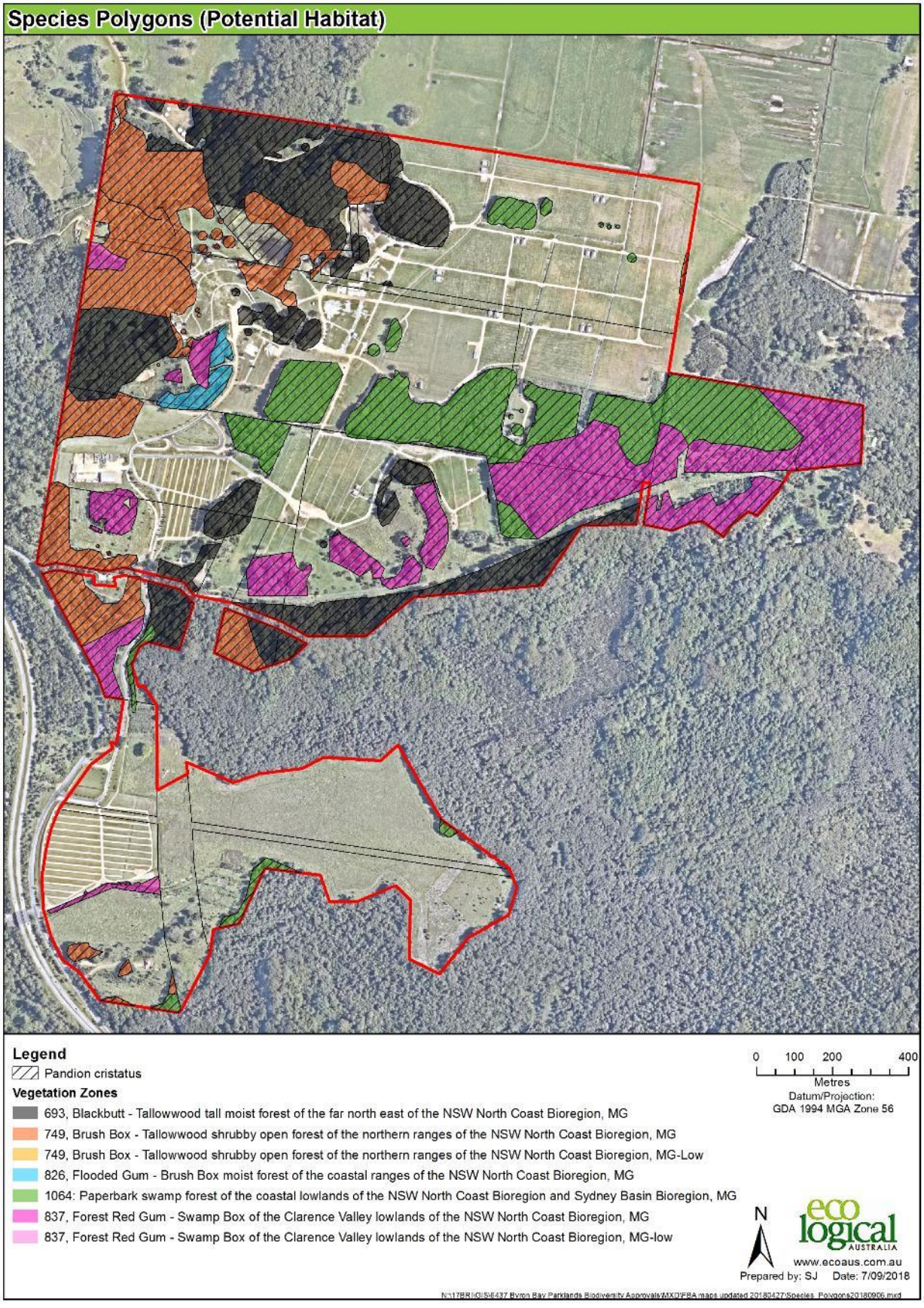


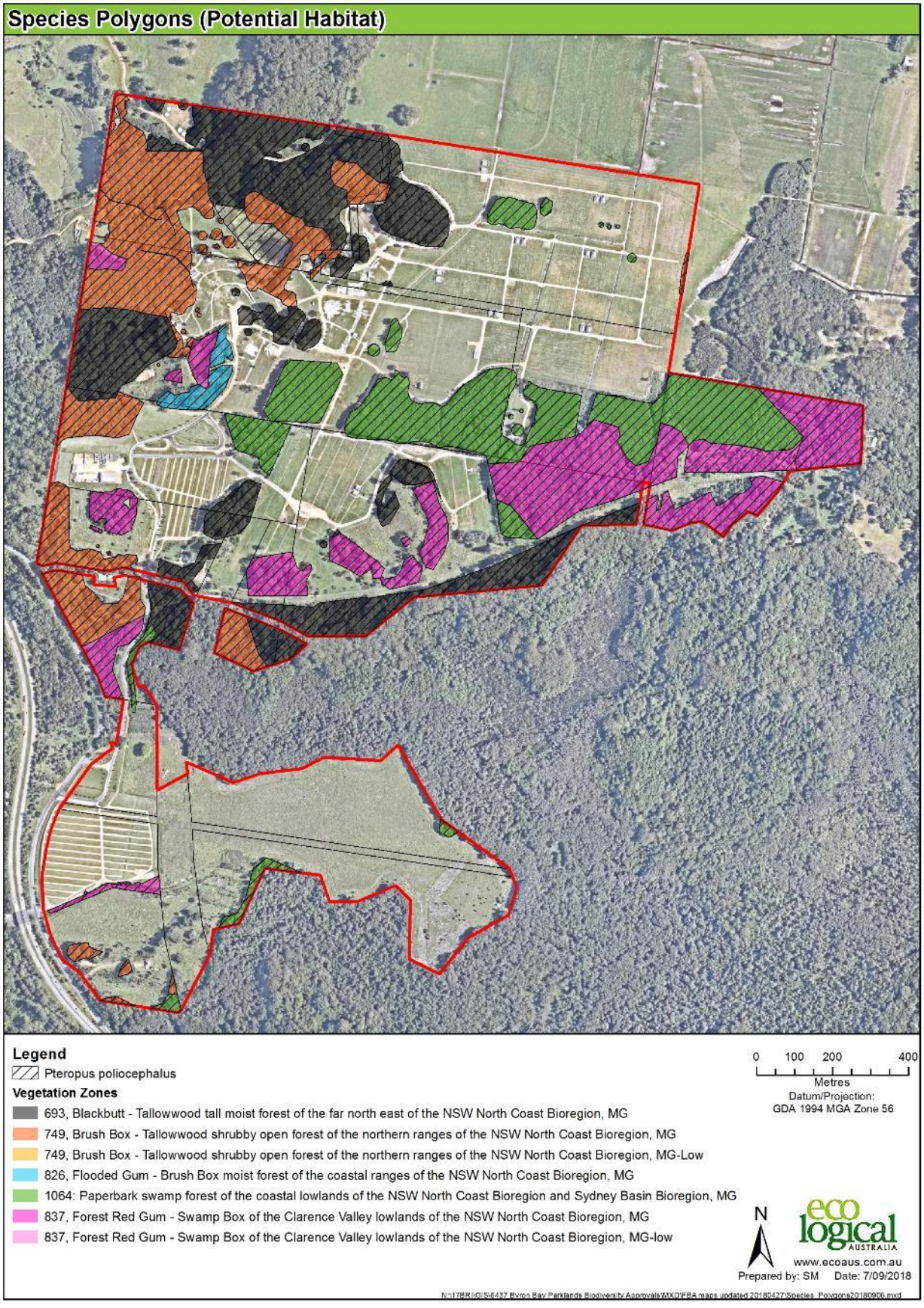


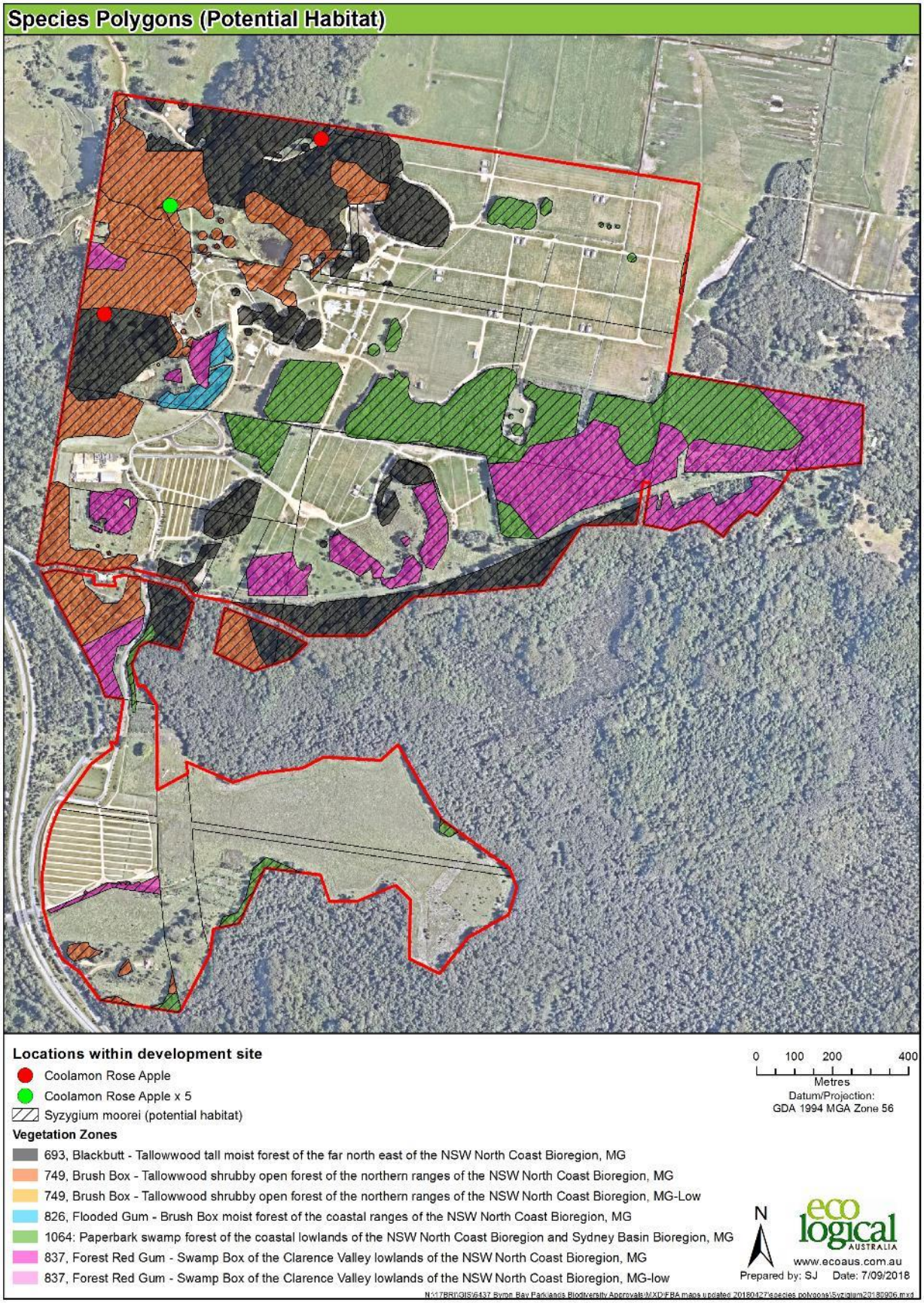


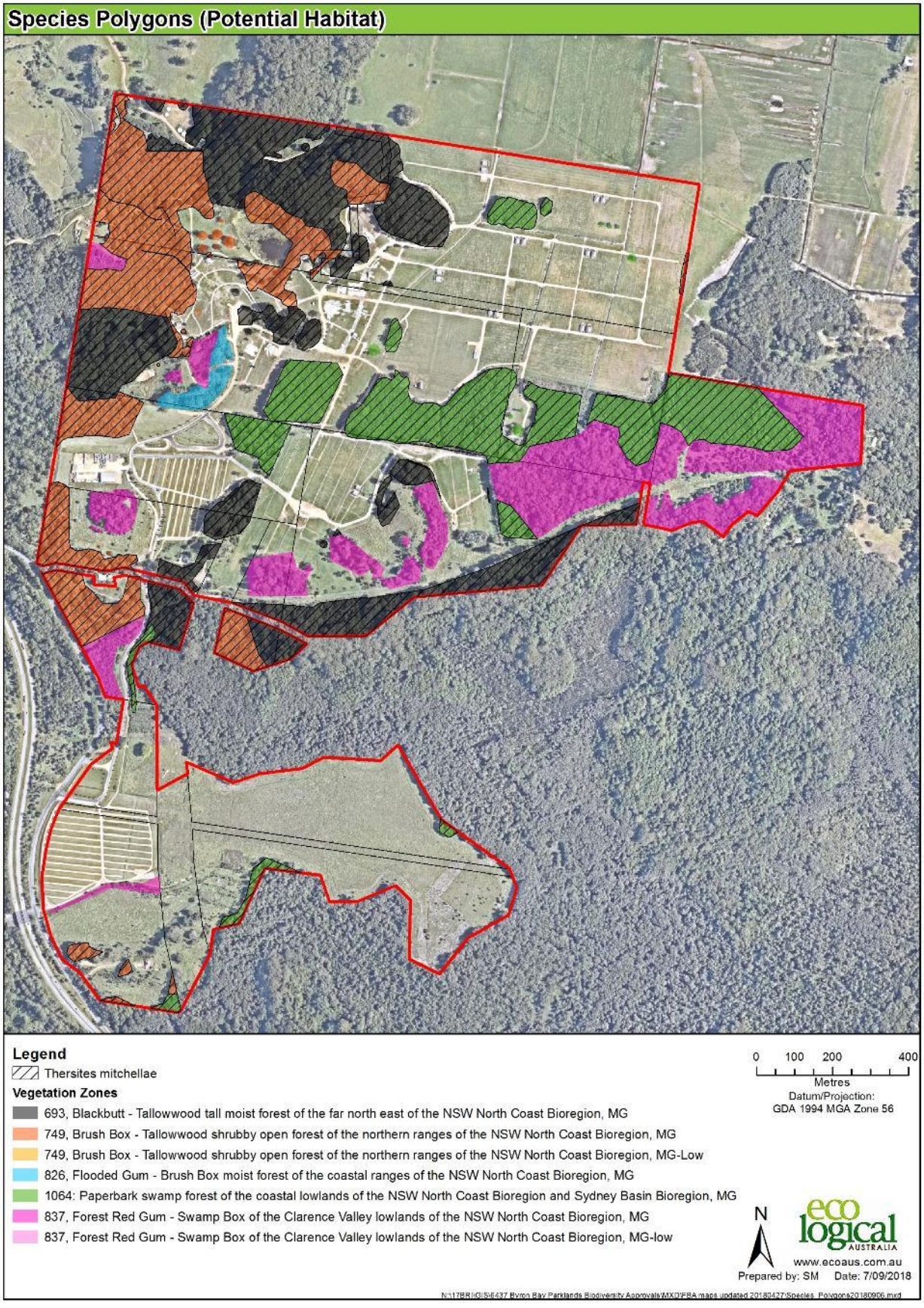












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