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Flora and Fauna Assessment



Lot 442 // DP 1201831, Henry Parkes Drive, Kiama Downs, NSW

Flora and Fauna Assessment

Prepared for: Indesco

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Glossary and abbreviations

Acronym	Description
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
CEMP	Construction Environmental Management Plan
DA	Development Application
DCP	Development Control Plan
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESCP	Erosion and Sedimentation Control Plan
FM Act	NSW <i>Fisheries Management Act 1995</i>
FFA	Flora and Fauna Assessment
ha	hectare
HBT	Hollow bearing tree
KLEP	Kiama Local Environmental Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
OEH	NSW Office of Environment and Heritage
SEPP	State Environmental Planning Policy
study area	is the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly
subject site	is the area directly affected by a proposal
WM Act	<i>Water Management Act 2000</i>
*	denotes an exotic species
†	denotes an Australian native species, but one that is not indigenous to the botanical subregion that the study area is part of



Executive Summary

The study area, Lot 442 // DP 1201831, in Henry Parkes Drive, Kiama Downs, NSW, is currently zoned '*E2 Environmental Conservation*' under the Kiama Local Environmental Plan (KLEP 2011). The proponents are applying for re-zoning to '*R2 Low Density*' in order to facilitate a future Development Application (DA) for a residential subdivision. Part of the lot will be retained as '*E2*'. This Flora and Fauna Assessment (FFA) has been undertaken to inform the re-zoning proposal. Specifically, this FFA aims to identify and assess the flora, fauna and biodiversity values within the study area and identify ecological constraints.

An initial desktop analysis identified the study area as being cleared of native vegetation. A search of relevant databases and literature identified seven threatened flora and 20 threatened fauna species within the locality (5 km radius). No watercourses are mapped within the study area. However, the banks of an unnamed lagoon, which is part of Terragong swamp, are located around 20 m to the north of the study area boundary. The water course in this part of the swamp is mapped as 'Category 1' riparian land under the Kiama Local Environmental Plan (2011) and as key fish habitat under the *Fisheries Management Act* (1994). There is also a mapped coastal wetland to the northeast and within 100 m, therefore part of the study area is identified as 'proximity area for coastal wetlands' under the State Environmental Planning Policy (Coastal Management) (2018).

A site inspection supported results of the desktop mapping in that the lot has been cleared of native vegetation and is dominated by exotic pasture grasses and weeds. However, there are four tall trees present that are located near the centre of the lot. One of these trees is an exotic fruit tree, while another is a species of Eucalypt that is not indigenous to the area. The remaining two are indigenous to the area, but given the linear arrangement of all four trees, they are likely to be plantings and not remnants of a vegetation community that was once present. Further site assessment revealed that there was very limited foraging, nesting and roosting habitat, although one of the trees contained hollows. Tree hollows can be important habitat for threatened owls and microbats. If removal of this tree is unavoidable, then appropriate pre-clearing protocols should be in place in order to minimise harm to fauna that might be utilising these hollows.

None of the threatened flora or fauna identified in the desktop analysis were detected during the site survey. All fauna species except for Grey-headed Flying-fox, were assessed as having a 'low' likelihood of occurring on the site. Since the availability of foraging habitat for the Grey-headed Flying-fox was extremely small and due to the fact that the site does not support a camp, it was considered that the removal of the four trees to accommodate a future subdivision would be unlikely to affect this species. Impact tests were considered unnecessary for all species.

A potential constraint to development in the study area includes the presence of waterfront land in a portion of the study area. A controlled activity approval must be obtained if there is a direct impact to this portion. The land identified as proximity area for coastal wetlands is also a constraint. The consent authority must be satisfied that the proposal will not significantly impact on the biophysical, hydrological or ecological integrity of the adjacent coastal wetland, and the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland. To avoid any potential indirect offsite impacts during construction works, namely to water quality in the nearby swamp and coastal wetland, an appropriate Erosion and

Sedimentation Control Plan (ESCP) should be in place. The ESCP should be a component of a Construction Environmental Management Plan (CEMP).

Provided that mitigation measures are in-place, a future residential subdivision would be unlikely to significantly impact threatened species or communities. Given the findings of this FFA and with respect to the ecological values within the study area, it is concluded that rezoning of the study area is unlikely to have a significant impact on threatened species, communities and their habitat.

1 Introduction

1.1 Purpose of report and legislative context

Lot 442 // DP 1201831, Henry Parkes Drive, Kiama Downs, NSW, hereafter the ‘**study area**’, is currently zoned ‘*E2 Environmental Conservation*’ under the Kiama Local Environmental Plan (KLEP 2011). At the time of writing this Flora and Fauna Report (FFA), the title owners were seeking the support of Kiama Council to rezone the study area to ‘*R2 Low Density*’ in order to facilitate a future Development Application (DA) for a residential subdivision. A portion of the lot is to be retained as ‘*E2*’. This FFA has been undertaken to inform the re-zoning proposal. Specifically, it aims to identify and assess the flora, fauna and biodiversity values within the study area, identify ecological constraints, and assess whether re-zoning is appropriate in relation to biodiversity values. This FFA addresses the legislative context provided in **Table 1.1**.

Table 1.1: Legislative framework addressed in this report.

Instrument	Considerations	Context
Commonwealth		
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Matters of National Environmental Significance	An action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance.
State (New South Wales)		
<i>Biosecurity Act 2015</i>	Priority weeds	Describes the state and regional priorities for weeds in New South Wales.
<i>Biodiversity Conservation Act 2016</i> (BC Act)	Part 7	Part 7 of the BC Act provides the environmental assessment requirements for activities being assessed under Parts 4 and 5 of the <i>Environmental Planning and Assessment Act 1979</i> (EP&A Act) and defines whether a development or an activity is ‘likely to have a significant effect on threatened species.’
<i>Water Management Act 2000</i> (WM Act)	Part 3, Section 91	Identifies the requirement for when a controlled activity approval is required for development proposed on ‘waterfront land’.
<i>State Environmental Planning Policy (Coastal Management) 2018</i>	Part 2, Division 1	The aim of this policy is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the Coastal Management Act 2016.
Local (Kiama Local Government Area)		
<i>Kiama Local Environmental Plan 2011</i> (KLEP)	Clause 6.4 Terrestrial biodiversity	The objective of this clause is to maintain terrestrial biodiversity. This clause applies to land identified as “Biodiversity land” on the Terrestrial Biodiversity Map.



Instrument	Considerations	Context
	Clause 6.5 Riparian Land and watercourses	The objective of this clause is to protect aquatic riparian habitats and ecological processes within watercourses and riparian areas. This clause applies to certain land identified on the Riparian Land and Watercourses Map.
<i>Kiama Council Development Control Plan 2012</i>	Chapter 3 – Preservation and Management of Trees & Vegetation	This chapter outlines Kiama Municipal Council's requirements for the removal or pruning of trees and other vegetation.

1.2 Site description

Following the definition of OEH (2018), the '**subject site**' is the area directly affected by a proposal, in this case, the proposed area for rezoning and subsequent subdivision. The '**study area**' is the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly (OEH 2018). Given that a lot layout and building envelopes have not yet been defined, the subject site and the study area are synonymous and defined as area within the cadastral lot boundary (Lot 442 DP // 1201831) (**Figure 1.1**). Only the study area will be referred to hereafter.

The study area is situated within the Kiama Local Government Area (KLGA) and its total area is approximately 3.1 hectares (ha). It is currently zoned '*E2 Environmental Conservation*' under the Kiama Local Environmental Plan (KLEP) 2011.

The study area is situated at the end of a cul-de-sac and consists of a vacant, grassy paddock, with four trees located near the centre of the lot (**Figure 1.2**). The northern boundary and parts of the western boundary abut the banks of a large, unnamed lagoon, which is part of Terragong Swamp. To the northeast is the western fringe of a coastal wetland. This wetland is identified in the State Environmental Planning Policy (Coastal Management) (2018). Most of the eastern and all of the southern boundaries are residential lots within the suburb of Kiama Downs. To the west of the study area is the Terragong Swamp Bridge that carries the Princes Highway.

1.2.1 Locality

The locality is described as the area within 5 km of the study area and consists largely of land cleared for agriculture. To the east is Kiama Downs, a suburb of the town of Kiama. Adjacent to the northern boundary of the study area is a large, but unnamed lagoon. The lagoon forms part of Terragong Swamp, which was once a vast marshland covering the floor of the Jamberoo Valley to the west. A drainage scheme initiated in the late 1800s changed the hydrology of the area in order to reclaim much of the area as fertile grazing land (M'Lennan 1897). Today, the swamp is still used for grazing and the many tributaries that pass across the swamp eventually drain into the Minnamurra River. The mouth of the Minnamurra River is around 3km to the northeast of the study area (**Figure 1.3**).



1.3 Description of the proposed development

As noted in **Section 1.1**, it is proposed to re-zone the study area to '*R2 Low Density Residential*' in order to support a future DA for a residential subdivision. A portion of the lot is to be retained as '*E2 Environmental Conservation*' (**Figure 1.4**).



Figure 1.1: Study area.



Figure 1.2: The study area is a vacant, grassy paddock with four isolated trees.



Figure 1.3: Locality



Figure 1.4: Proposed rezoning.

2 Methods

2.1 Literature and database review

A site-specific literature and database review were undertaken prior to field survey and report preparation. This included desktop analysis of aerial photography and regional scale information from the following sources:

- NSW Planning Viewer (DPE 2020)
- BioNet Atlas of NSW Wildlife (OEH 2020)
- Protected Matters Search Tool (DOtEE 2020)
- SIX Maps (LPI 2020)
- Southeast NSW Native Vegetation Classification and Mapping (SCIVI 2010)
- Biodiversity Values Map and threshold tool (OEH 2020a)

Polices and Guidelines relating to the proposal include:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (DotE 2013)
- Environmental Planning and Assessment Act 1979 (EP&A Act)
- State Environmental Planning Policy (Coastal Management) 2018
- Biodiversity Conservation Act 2016 (BC Act)
- Threatened Species Test of Significance Guidelines (OEH 2018)
- Kiama Local Environmental Plan (KLEP 2011)

Threatened species, populations and migratory species recorded within 5 kilometres of the study area in a search of the BioNet Atlas of NSW Wildlife (OEH 2020) were consolidated and their likelihood of occurrence was assessed by:

- review of location and date of recent (less than five years) and historical (5-20 years) records
- review of available habitat within the study area and surrounding areas
- review of the scientific literature pertaining to each species and population
- applying expert knowledge of each species

The potential for threatened species, populations and/or migratory species to occur was then considered and the necessity for targeted field surveys was determined. Following field survey and review of available habitat within the study area, the potential for species to utilise the site and to be affected directly or indirectly by the proposal were considered as either:

- “Recent record” = Species has been recorded in the study area within the past 5 years
- “High” = Species has previously been recorded in the study area (>5 years ago) or in proximity to (for mobile species), and/or habitat is present that is likely to be used by a local population.
- “Moderate” = Suitable habitat for a species is present onsite but no evidence of a species detected and relatively high numbers of recent records (5-20 years) in the locality or species highly mobile.

- “Low” = Suitable habitat species for a species is present onsite but limited or highly degraded, no evidence of a species detected and relatively low number of recent records in the locality.
- “Not present” = suitable habitat for the species is not present onsite or adequate survey has determined species does not occur in the study area.

2.2 Field survey

Field survey was undertaken after midday on 8 January 2020 by Lucas Mckinnon (Principal Ecologist) and John Gollan (Ecologist). Weather conditions during the site assessment were mild with 0.2 mm of rain falling on the day of the survey and 0.2 mm in the 24 hours prior. The maximum wind gusts occurred in the morning but had abated somewhat by the time of the survey (**Table 2.1**).

Table 2.1: Daily Weather Observations at Kiama (Bombo Headland), Bureau of Meteorology Station # 068242 (~2 km to the southeast of the study area).

Date	Temp (°C)		Rainfall (mm)	Max wind gust	
	Min	Max		Direction	Speed (km/h)
8/1/2019	20.5	23.4	0.2	South	43

2.2.1 Vegetation communities and flora

Field survey involved traversing the study area, whilst recording all visible flora species and identifying potential habitat for threatened flora species. Nomenclature follows the Flora of NSW (Harden 1990-2002) and updates provided in PlantNET (RBGDT 2019).

Field survey was undertaken to validate the regional vegetation mapping of OEH (2016) and to prescribe Plant Community Types (PCT). Vegetation communities were checked against described Threatened Ecological Communities (TEC) listed under either the EPBC Act or the BC Act.

2.2.2 Fauna and fauna habitat

Opportunistic fauna survey was undertaken for birds, amphibians, reptiles and mammals, which included opportunistic observations along with searches for signs of direct and indirect occupancy (i.e. scats, owl pellets, fur, bones, tracks, bark scratches, foliage chew marks and chewed cones of *Allocasuarina* spp. or *Pinus* spp as well as some of the other cultivars known to be used by native fauna).

Fauna habitat searches were conducted for potential foraging, roosting, breeding or nesting habitat of nocturnal and diurnal species. This includes inspection for the presence of tree hollows, stags, bird nests, possum dreys, decorticated bark, rock shelters, rock outcrops/crevices, mature / old growth trees, food trees (*Banksia* spp., *Allocasuarina* spp., and winter-flowering eucalypts), culverts, dens, dams, riparian areas and refuge habitats of man-made structures.

Primary sources of literature accessed for species nomenclature were:

- Birds - Christidis and Boles (2008)



- Mammals - Van Dyck and Strahan (2008)
- Reptiles and amphibians – Cogger (2014)
- Flora - PlantNET RBGDT (2020)

2.2.3 Survey limitations

The flora survey aimed to record as many species as possible. However, a definitive list of the flora within the study area cannot be gathered without systematic traverses and survey across a number of seasons. However, the techniques used in this investigation are considered adequate to gather the data necessary to validate the vegetation communities and vegetation condition in the study area and assess the likelihood of occurrence of any threatened flora species.

A full fauna survey following *Threatened Species Survey and Assessment Guidelines* (OEH 2018) was not undertaken as sufficient detail to determine the likelihood of occurrence of threatened and migratory species for the purpose of this report was achieved through targeted survey and a habitat assessment during the field survey.

3 Results

3.1 Literature and database review

3.1.1 Topography, drainage and soils

The study area has a gentle, north-facing slope with an angle of around 4°. The site's lowest elevation (~2 m above mean sea level) is at the northern end of the study area, while the highest point, at around 26 m above mean sea level, is at the southern end.

There are no mapped watercourses in the study area. All overland water from the study area would drain towards the unnamed lagoon to the north of the study area. At the closest point, the banks of this lagoon are approximately 20 m from the study area boundary, and at this point in the landscape, the lagoon is classified as a 5th order Strahler stream (DWE 2018) and identified as a 'Category 1 watercourse' on the *Riparian Land and Watercourse Map* under the Kiama LEP (2011). There is also a coastal wetland to the northeast (and within 100 m) mapped on the *Coastal Wetlands and Littoral Rainforests Area Map* (State Environmental Planning Policy Coastal Management 2018).

The topography of the study area means that overland flow from the study area would potentially reach the unnamed lagoon and the Minnamurra River. At this point, both the lagoon and the Minnamurra River are mapped as Key Fish Habitat (DPI Fisheries 2007) and a review of Freshwater Threatened Species Distribution Maps (DPI Fisheries 2019b) showed this river as habitat for Australian Grayling (*Prototroctes maraena*). Australian Grayling is listed as Endangered under both the EPBC Act and the NSW *Fisheries Management Act 1995* (FM Act).

The study area includes two soil landscapes; 'Bombo' in the southern portion and 'Mangrove Creek' in the north (**Figure 3.1**). A brief description of each of these landscapes by Hazelton (1992) is provided below.

Bombo

Soils as part of this landscape group have a fertility that is moderate to low. The soils are deep, well-structured and freely drained on crests and upper slopes. They are strongly acid with low to moderate Cation Exchange Capacity. These soils are generally stable; however, there are localised occurrences of moderately reactive soils.

Vegetation on soils of the Bombo landscape are extensively cleared with remnant stands of closed-forest and tall open-forest. Common closed-forest species include Cabbage Tree Palm (*Livistona australis*), Bastard Rosewood (*Synoum glandulosum*), Red Cedar (*Toona australis*), Brush Cherry (*Syzygium australe*), Bolly Gum (*Litsea reticulata*), White Cedar (*Melia azedarach* var. *australasica*), Northern Boobialla (*Myoporum acuminatum*), Smooth Mock Olive (*Notelaea venosa*), Snow-wood (*Parachidendron pruinosum*), Celery Wood (*Polyscias elegans*), Black Apple (*Planchonella australis*), Plum Pine (*Polocarpus elatus*), Yellowwood, Moreton Bay Fig (*Ficus macrophylla*), Port Jackson Fig (*Ficus rubiginosa*) and Flintwood (*Scolopia braunii*).

Mangrove Creek

Soils are deep (>150 cm) and made up of holocene silty to peaty quartz sands, silt and clay. Common shell layers occur in sandy mud, muddy sand siliceous and calcareous sands. Limitations to these soils are that they are regularly flooded by tidal water and so are waterlogged and saline with low fertility. Saltmarsh is found in areas less frequently inundated. Mangroves and saltmarshes are recognised as important breeding areas for commercial fish and crustaceans and for some species of water birds.

Vegetation is mainly open-scrub where the common species are grey mangrove (*Avicennia marina*), River Mangrove (*Aegiceras corniculatum*) and scattered Decorative Paperbark (*Melaleuca decora*). Shoreward of the mangroves the low open-forest is dominated by Swamp Oak (*Casuarina glauca*) and less commonly Swamp Mahogany (*Eucalyptus robusta*), Forest Red Gum (*Eucalyptus tereticornis*) and Bangalay (*Eucalyptus botryoides*). This open-forest often has an understorey of Sand Couch (*Sporobolus virginicus*). Common species of saltmarsh include Sea-blite (*Suaeda australis*), Glasswort (*Salicornia quinqueflora*), Sand Couch (*Sporobolus virginicus*), Streaked Arrowgrass (*Triglochin striata*) and Sea Rush (*Juncus kraussii*).

3.1.2 Threatened species and populations

A search of the relevant databases and literature identified seven threatened flora species and 20 threatened fauna species (including 12 birds, 7 mammals [five of which are microbats], and one amphibian) that have been recorded within a 5 km radius of the study area (**Figure 3.2**).

Fauna

The likelihood of occurrence analysis undertaken prior to field assessment identified one threatened fauna species that has a 'moderate' likelihood of utilising the study area, namely, Grey-headed Flying fox (*Pteropus poliocephalus*). Following the field inspection, its likelihood of occurrence was reduced to 'low' because the available habitat was extremely limited. Due to its high mobility, the fact that the site does not host a registered flying-fox camp (DotE 2020) and that there is a limited amount of foraging habitat on the study site, a *test of significance* (BC Act) and impact assessment (EPBC Act) were considered unnecessary. All other fauna was considered as having a 'low' likelihood of occurrence in the study area, and so impacts tests were considered unnecessary.

Flora

The likelihood of occurrence analysis undertaken prior to field assessment identified the following three threatened flora species to have a 'moderate' likelihood of utilising the study area:

- *Cynanchum elegans* (White-flowered Wax Plant)
- *Daphnandra johnsonii* (Illawarra Socketwood)
- *Zieria granulata* (Illawarra Zieria)

Due to the high level of previous disturbance and dominance of introduced plant species, the study area did not provide potential habitat for these species. Flora survey of the study area did not locate any of these three species, nor any of the other four threatened flora species known from the locality. Therefore, impact tests were considered unnecessary.

The likelihood of occurrence analysis is included in **Appendix A**.

3.1.3 Vegetation and threatened ecological communities

Vegetation maps of the region revealed that native vegetation was not present within the study area (OEH 2016). The closest mapped native vegetation is along the banks of the unnamed lagoon, which is mapped as 'Swamp Oak Forest' (**Figure 3.3**). The equivalent Plant Community Type (PCT) is 'Swamp Oak Floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion'. This PCT is listed as an Endangered Ecological Community (EEC) under the BC Act and EPBC Act.

3.2 Field survey

3.2.1 Native vegetation communities

Field survey agreed with the mapping of OEH (2016) as it identified a ground layer of mostly weeds and pasture grasses. There were only four tall trees within the study area. Given the straight-line arrangement of the trees, it is highly likely that they are plantings. One of the trees is an exotic fruit tree (*Pyrus* sp.) and another is an Australian native (*Eucalyptus globulus*[†]) but is not indigenous to the region. The two other trees, *E. tereticornis* (Forest Red Gum) and *Melaleuca styphelioides* (Prickly-leaved Tea Tree), are native and indigenous to the region and may have been part of the vegetation type that existed prior to clearing. But as noted above, they are likely to be plantings and thus are not considered to be remnants.

The ground layer consisted largely of the exotic pasture grass *Cenchrus clandestinus** (Kikuyu) and other weed species such as *Senecio madagascariensis** (Fireweed), *Sida rhombifolia** (Paddy's Lucerne) and *Cirsium vulgare** (Spear Thistle). In the northern and flatter portion of the study area, weeds associated with wetter soils such *Trifolium repens** (White Clover), *Cynodon dactylon** (Couch) and *Lotus corniculatus** (Birds-foot Trefoil) tended to dominate. The native rush, *Juncus usitatus*, also occurred in patches in this area.

Field validated vegetation within the study area is shown in **Figure 3.4**.

3.2.2 Flora species

As noted in **Section 3.2.1**, the study area is dominated by exotic pasture grasses and weeds. Two weeds listed under the NSW Biosecurity Act 2015 as priority weeds for the South East region were recorded within the study area. These species are also listed as Weeds of National Significance (WoNS) (**Table 3.1**).

Table 3.1: Priority weeds and Weeds of National Significance (WoNS).

Common name	Scientific name	WoNS	Duty
Blackberry	<i>Rubus fruticosus</i> * spp. agg.	Y	General Biosecurity Duty Prohibition on dealings <i>Must not be imported into the State or sold</i>
Fireweed	<i>Senecio madagascariensis</i> *	Y	General Biosecurity Duty Prohibition on dealings <i>Must not be imported into the State or sold</i>

No threatened flora species were identified during the site inspection. A flora species inventory is included in **Appendix B**.

3.2.3 Fauna habitat

Given that there are only three native trees in the study area and the remainder of the vegetation is exotic pasture grasses and weeds, the study area provides very limited foraging, roosting, breeding and nesting resources for native fauna. The feature with the highest potential to provide habitat for native fauna is the Tasmanian Bluegum (*Eucalyptus globulus*[†]) as it contains hollows. Trees with hollows are considered an important and limiting resource for many threatened native species such as microbats and large predatory birds like Powerful Owls (*Ninox strenua*) (NPWS1999).

3.2.4 Fauna species

Field survey identified a total of five fauna species, all of which were birds that are common to urban and modified landscapes. There was no indirect evidence of fauna presence (through scats or tree scratching). A fauna species inventory is included in **Appendix B**.



Figure 3.1: Soil Landscapes (Hazelton 1992).

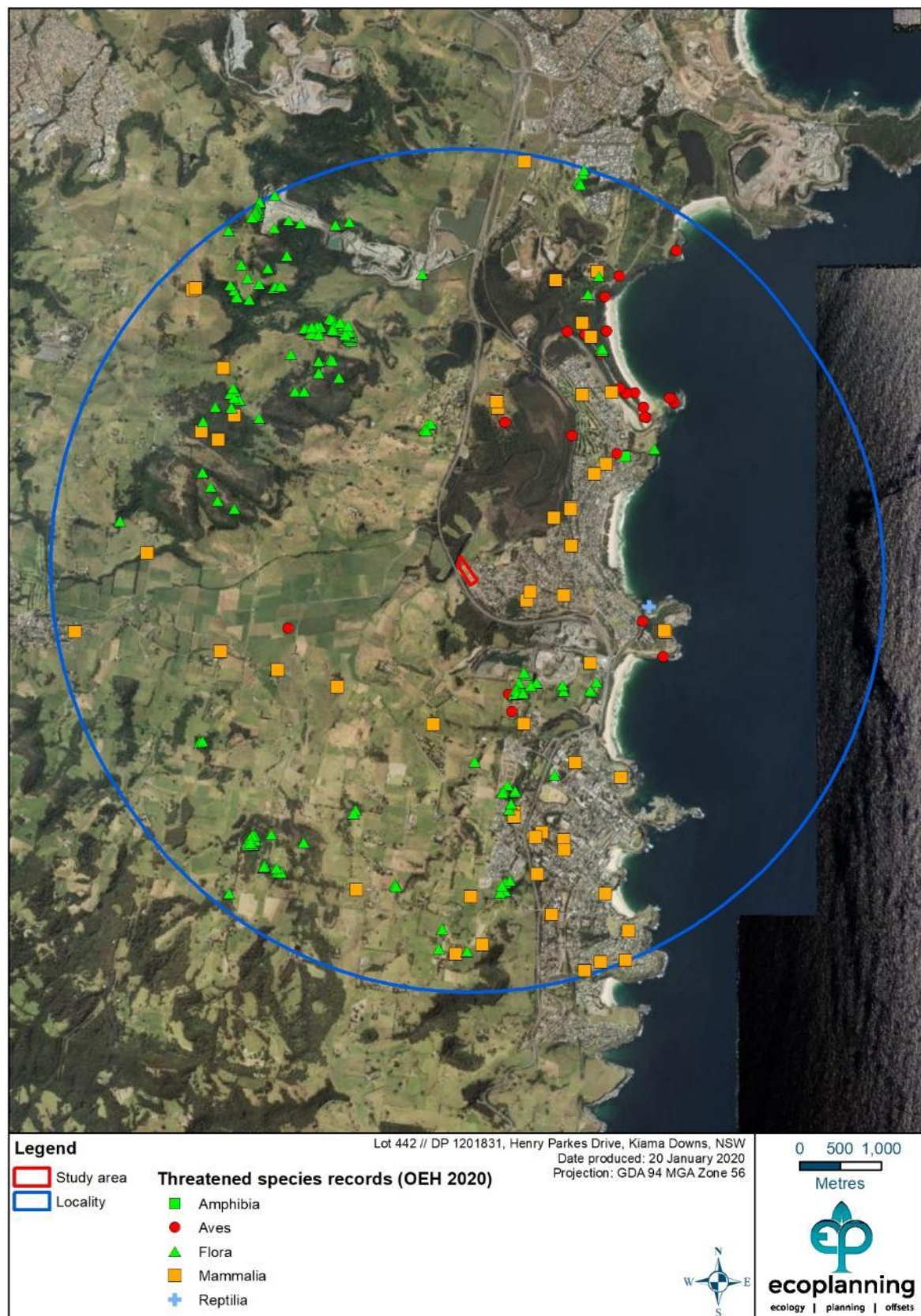


Figure 3.2: Threatened species in the locality.



Figure 3.3: Native vegetation mapping.



Figure 3.4: Field validated vegetation within the study area.

4 Impact Assessment

This section outlines the anticipated direct and indirect impacts of a subdivision on the ecological values of the study area. Avoidance and mitigation measures are also proposed.

4.1 Direct impacts

4.1.1 Vegetation clearing

If rezoning and subdivision is undertaken, approximately 0.03 hectares of planted native vegetation will be presumably cleared. The remainder of the site is previously cleared land and has been used as pasture for grazing of domestic livestock. This vegetation was dominated by exotic grasses such as *Cenchrus clandestinus** (Kikuyu grass) and weed species such as *Senecio madagascariensis** (Fireweed), *Trifolium repens** (White clover) and *Sida rhombifolium** (Paddy's lucerne).

4.1.2 Loss of fauna habitat

The proposal will result in the loss of three, mature native trees, one of which contains hollows. The other trees represent some foraging and nesting potential, however given their isolation, the value of these trees as habitat for native fauna is considered minimal. Apart from these trees, the proposal is located entirely within cleared land which has had a history of grazing by domestic livestock and is dominated by exotic species. This highly degraded habitat is of little to no value for threatened species.

4.2 Indirect impacts

It is difficult to quantify indirect impacts of the proposed development, but these may include impacts such as erosion and water quality impacts that may be associated with the construction phase of the project. It is also possible that the works could have an indirect impact on surrounding vegetation, namely through the spread of weeds. Indirect impacts to habitat surrounding the impact area can be avoided and minimised through avoidance and mitigation measures.

4.3 Avoidance and mitigation

4.3.1 Vegetation clearing

The proposal is likely to require the removal of 0.03 ha of planted native vegetation, which includes one hollow bearing tree (see **Figure 4.1** for location). Trees with hollows are considered an important and limiting resource for many threatened native species such as microbats and large predatory birds like Powerful Owls (*Ninox strenua*) (NPWS 1999). If clearing this hollow-bearing tree is necessary, then a suitably qualified ecologist/fauna handler should be present to supervise the felling operations. Soft-felling techniques should be used, and hollows should be thoroughly inspected before and after felling. If fauna is occupying the cavity, they should be relocated to nearby bushland, or ideally, left to vacate on their own account.

4.3.2 Erosion Sedimentation Control Plan (ESCP)

To avoid potential indirect offsite impacts during construction, in particular to the nearby unnamed lagoon, Minnamurra River and the adjacent coastal wetland, an appropriate erosion and sedimentation control plan (ESCP) should be in place following best practice protocols, such as those detailed in Landcom (2004). These control measures should be established before work begins, maintained throughout the works and kept in place until the impact area has been stabilised. Any areas of bare soil created as part of the proposed works should be stabilised as soon as practicable to avoid off-site transport of eroded sediments into nearby watercourses. It is recommended that the ESCP is included in a site-specific CEMP prior to any construction works taking place.

4.3.3 Weed management

To avoid the spread of weed and pathogens during construction, the following mitigation measures are recommended:

- Exposed areas are to be kept to a minimum to reduce the establishment and spread of weeds, including from entering the drainage lines.
- All exotic biomass cleared within the impact area should be removed from the study area and disposed of at an approved facility.
- All equipment and plant brought into the impact area is to be washed/cleaned so that it is free of soil, mud debris or vegetation which may inadvertently introduce weeds and/or other pathogens into the impact area and study area.
- Measures should be taken to prevent tracking of soils/sediments from work sites to roadways as a result of work vehicle/machinery movement.

It is recommended that the ESCP is included in a site-specific CEMP prior to any construction works taking place.

4.4 Legislative context

4.4.1 Commonwealth listings

There were no Matters of National Environmental Significance (MNES) assessed as having a 'moderate' or 'high' likelihood of occurring within the study area. As such, a referral is not required.

4.4.2 State listings

Biodiversity Conservation Act 2016

The Biodiversity Offset Scheme is not triggered because:

- the vegetation clearing that is likely for a proposed subdivision does not exceed the clearing threshold (> 0.25 ha) for the minimum lot size associated with the study area (450 m^2 ; KLEP 2011) and,
- none of the study area is identified on the Biodiversity Values Map (OEH 2020a).

There were no threatened flora/fauna species assessed as having a 'moderate' or 'high' likelihood of occurring within the study area, and so further assessment is not required.



State Environmental Planning Policy (Coastal Management) 2018

Approximately 0.58 ha of the study area is identified as “proximity area for coastal wetlands” on the Coastal Wetlands and Littoral Rainforests Area Map. As noted in this policy, development consent must not be granted to development on such land unless the consent authority is satisfied that the proposed development will not significantly impact on:

- the biophysical, hydrological or ecological integrity of the adjacent coastal wetland, or
- the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland.

NSW Water Management Act 2000

The Natural Resources Access Regulator (NRAR) administers the *Water Management Act 2000* (WM Act) and is required to assess the impact of any activity proposed for waterfront land (called a controlled activity) to minimise the harm done to waterfront land as a result of the work. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. Using a mapped ‘top of bank’ that was estimated using the centre of the tree line along the unnamed lagoon, part of the study area meets the definition of ‘waterfront land’. Therefore, a controlled activity approval from the NRAR must be obtained before commencing the controlled activity within this portion of the study area (**Figure 4.1**).

NRAR also recommends a VRZ width based on watercourse order as classified under the Strahler System of ordering watercourses (**Table 4.1**). Thus, and for this proposal, a 40 m VRZ is recommended.

Table 4.1: Recommended riparian corridor widths (NRAR 2018).

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1 st order	10 metres	20 metres + channel width
2 nd order	20 metres	40 metres + channel width
3 rd order	30 metres	60 metres + channel width
4 th order and greater (includes estuaries, wetlands and parts of rivers influence by tidal waters)	40 metres	80 metres + channel width

Kiama Local Environmental Plan 2011

None of the study area is identified as ‘Biodiversity land’ on the Terrestrial Biodiversity Map as part of the KLEP 2011 (DPE 2020) and so no further consideration is required.

The unnamed lagoon to the north of the study area is identified as a ‘Category 1 watercourse’ on the Riparian Land and Watercourses Map (KLEP 2011). Part 6.5 of the KLEP 2011 applies to part of the study area because it is within 40 m from the top of bank (shown as ‘waterfront land’ in **Figure 4.1**). While a development footprint has not been finalised at the time of writing this FFA, it is recommended that the development footprint be designed to avoid this area



entirely, thereby avoiding any direct impact to this section. If this is unavoidable, and before determining a development application for development on land to which this clause applies, the consent authority must consider:

- (a) *whether or not the development is likely to have any adverse impact on the following—*
 - (i) the water quality and flows within the watercourse,
 - (ii) aquatic and riparian species, habitats and ecosystems of the watercourse,
 - (iii) the stability of the bed and banks of the watercourse,
 - (iv) the free passage of fish and other aquatic organisms within or along the watercourse,
 - (v) any future rehabilitation of the watercourse and its riparian areas, and
- (b) *whether or not the development is likely to increase water extraction from the watercourse, and*
- (c) *any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.*

Kiama Council Development Control Plan 2012 – Chapter 3 Preservation & Management of Trees & Vegetation

Four trees are likely to be removed to accommodate a subdivision within the study area. A Tree Management Application is required to remove three of these trees (*Pyrus* sp. is listed as exempt). However, where a Complying Development Certificate is issued under State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 and such tree removal is in accordance with the associated provisions, then the remaining trees are also exempt.



Figure 4.1: Waterfront land, proximity area for coastal wetlands and hollow bearing tree within study area.

5 Conclusion and recommendations

The proponents are applying for re-zoning of Lot 442 // DP 1201831, in Henry Parkes Drive, Kiama Downs, NSW to '*R2 Low Density*' in order to facilitate a future Development Application (DA) for a residential subdivision. Part of the lot is to be retained as '*E2 Environmental Conservation*'. The lot is situated on the fringes of a long-established residential area. Immediately to the north of the study area is Terragong Swamp, a coastal wetland system that enters the ocean at the mouth of the Minnamurra River.

The study area is a cleared paddock that is dominated by exotic pasture grasses and weeds. There are four tall trees in the centre of the lot, one of which contains hollows. If clearing of this hollow-bearing tree is required, then appropriate pre-clearance protocols should be followed to minimise harm to native fauna that may be using the tree for roosting.

Identified constraints to a potential development includes the presence of waterfront land within a portion of the study area. A controlled activity approval must be obtained if there is a direct impact to this part. The lagoon is also identified as a 'Category 1 watercourse' under the Kiama LEP (2011) and so the consent authority must be satisfied that the development is unlikely to have any adverse impact on, among other aspects, the water quality and flows within the watercourse and the stability of the bed and banks of the watercourse. Furthermore, 0.58 ha of the study area is 'proximity area for coastal wetlands' and thus the consent authority must be satisfied that the proposed development will not significantly impact on aspects of the adjacent coastal wetland.

To avoid any potential indirect offsite impacts during construction works, namely to water quality in the nearby swamp and coastal wetland, an appropriate Erosion and Sedimentation Control Plan (ESCP) should be in place. The ESCP should be a component of a Construction Environmental Management Plan.

No threatened flora or fauna species listed under the EPBC Act or BC Act were identified within the study area during field assessment. Provided that mitigation measures are in place, a future residential subdivision is unlikely to significantly impact threatened species or communities.

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Appendix A Species likelihood of occurrence

The potential for each threatened species, population and/or migratory species to occur was then considered and the necessity for targeted field surveys was determined. Following field surveys and review of available habitat within the study area, the potential for species to utilise the site and be affected directly or indirectly by the proposal were considered as either:

- “Recent record” = species has been recorded in the study area within the past 5 years
- “High” = species has previously been recorded in the study area (<5 years ago) or in proximity (for mobile species), and/or habitat is present that is likely to be utilised by a local population
- “Moderate” = suitable habitat for a species is present onsite but no evidence of a species detected and relatively high number of recent records (5-20 years) in the locality or species is highly mobile
- “Low” = suitable habitat for a species is present onsite but limited or highly degraded, no evidence of a species detected and relatively low number of recent records in the locality
- “Not present” = suitable habitat for the species is not present onsite or adequate survey has determined species does not occur in the study area.



Scientific Name (Common Name)	Legal Status	No. of records	Closest record and date	Most recent and proximity	Likelihood of occurrence	
					Before (survey)	After (survey)
KINGDOM: Animalia; CLASS: Amphibia						
<i>Litoria aurea</i> (Green and Golden Bell Frog)	BC Act = E EPBC Act = V	1	2.4 km (1/01/2000)	2.4 km (1/01/2000)	Low	Low
KINGDOM: Animalia; CLASS: Aves						
<i>Circus assimilis</i> (Spotted Harrier)	BC Act = V	2	3.4 km (29/10/2014)	3.4 km (29/10/2014)	Low	Low
<i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)	BC Act = V	6	1.9 km (15/01/2019)	1.9 km (15/01/2019)	Low	Low
<i>Hieraaetus morphnoides</i> (Little Eagle)	BC Act = V	2	1.6 km (16/03/2019)	1.6 km (16/03/2019)	Low	Low
<i>Pandion cristatus</i> (Eastern Osprey)	BC Act = V	2	3.3 km (7/08/2014)	3.3 km (7/08/2014)	Low	Low
<i>Ixobrychus flavicollis</i> (Black Bittern)	BC Act = V	1	3.4 km (22/12/2017)	3.4 km (22/12/2017)	Low	Low
<i>Artamus cyanopterus cyanopterus</i> (Dusky Woodswallow)	BC Act = V	1	4 km (8/10/2014)	4 km (8/10/2014)	Low	Low
<i>Burhinus grallarius</i> (Bush Stone-curlew)	BC Act = E	1	2.1 km (5/12/2003)	2.1 km (5/12/2003)	Low	Low
<i>Haematopus fuliginosus</i> (Sooty Oystercatcher)	BC Act = V	6	2.6 km (14/07/2007)	2.9 km (18/11/2014)	Low	Low
<i>Haematopus longirostris</i> (Pied Oystercatcher)	BC Act = E	8	2.9 km (18/11/2014)	3.2 km (29/12/2014)	Low	Low
<i>Sternula albifrons</i> (Little Tern)	BC Act = E	1	2.9 km (8/10/2014)	2.9 km (8/10/2014)	Low	Low

Scientific Name (Common Name)	Legal Status	No. of records	Closest record and date	Most recent and proximity	Likelihood of occurrence	
					Before (survey)	After (survey)
<i>Calidris alba</i> (Sanderling)	BC Act = V	1	3 km (11/11/2014)	3 km (11/11/2014)	Low	Low
<i>Ninox strenua</i> (Powerful Owl)	BC Act = V	1	2.4 km (1/08/2017)	2.4 km (1/08/2017)	Low	Low
<i>Dasyurus maculatus</i> (Spotted-tailed Quoll)	BC Act = V EPBC Act = E	3	1.3 km (1/07/2004)	3.5 km (1/07/2012)	Low	Low
KINGDOM: Animalia; CLASS: Mammalia						
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail-bat)	BC Act = V	1	2.1 km (14/01/2019)	2.1 km (14/01/2019)	Low	Low
<i>Miniopterus orianae oceanensis</i> (Large Bent-winged Bat)	BC Act = V	5	2.1 km (14/01/2019)	2.1 km (14/01/2019)	Low	Low
<i>Micronomus norfolkensis</i> (Eastern Coastal Free-tailed Bat)	BC Act = V	1	2.1 km (14/01/2019)	2.1 km (14/01/2019)	Low	Low
<i>Pteropus poliocephalus</i> (Grey-headed Flying-fox)	BC Act = V EPBC Act = V	78	0.8 km (23/03/2017)	4 km (24/03/2018)	Moderate	Low – very limited amount of foraging only. Study area does not host a registered camp.
<i>Myotis macropus</i> (Southern Myotis)	BC Act = V	5	3.3 km (7/10/2014)	3.8 km (10/10/2014)	Low	Low
<i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat)	BC Act = V	1	4.8 km (30/04/2009)	4.8 km (30/04/2009)	Low	Low
KINGDOM: Plantae						

Scientific Name (Common Name)	Legal Status	No. of records	Closest record and date	Most recent and proximity	Likelihood of occurrence	
					Before (survey)	After (survey)
<i>Cynanchum elegans</i> (White-flowered Wax Plant)	BC Act = E EPBC Act = E	14	1.8 km (27/10/2017)	5.1 km (2/09/2019)	Moderate	Not present
<i>Haloragis exalata</i> subsp. <i>exalata</i> (Square Raspwort)	BC Act = V EPBC Act = V	1	4.8 km (2/07/2003)	4.8 km (2/07/2003)	Low	Not present
<i>Daphnandra johnsonii</i> (Illawarra Socketwood)	BC Act = E EPBC Act = E	27	2.7 km (11/10/2016)	3 km (11/10/2019)	Moderate	Not present
<i>Gossia acmenoides</i> (<i>Gossia acmenoides</i> population in the Sydney Basin Bioregion south of the Georges River)	BC Act = E	5	3.2 km (6/05/2015)	4.6 km (11/09/2018)	Low	Not present
<i>Rhodamnia rubescens</i> (Scrub Turpentine)	BC Act = E	1	5.2 km (20/09/2004)	5.2 km (20/09/2004)	Low	Not present
<i>Zieria granulata</i> (Illawarra Zieria)	BC Act = E EPBC Act = E	179	1.4 km (12/02/2012)	4.1 km (26/09/2019)	Moderate	Not present
<i>Pimelea spicata</i> (Spiked Rice-flower)	BC Act = E EPBC Act = E	2	2.7 km (1/10/2001)	2.8 km (2/09/2013)	Low	Not present

Unless other stated, text is taken from the OEH Threatened Species (<http://www.environment.nsw.gov.au/threatenedspecies/>); Legal Status codes from the Atlas of NSW Wildlife: V = Vulnerable, E = Endangered. BC Act = NSW Biodiversity Conservation Act 2016, EPBC Act = Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Appendix B Flora and fauna species inventories

FLORA

Family	Scientific name	Common Name	Notes
Apiaceae	<i>Ammi majus</i> *	Bishop's Weed	
Asteraceae	<i>Cirsium vulgare</i> *	Spear Thistle	
Asteraceae	<i>Conyza</i> sp.*		
Asteraceae	<i>Hypochaeris radicata</i> *	Catsear	
Asteraceae	<i>Lactuca serriola</i> *	Prickly Lettuce	
Asteraceae	<i>Senecio madagascariensis</i> *	Fireweed	High Threat Exotic
Cyperaceae	<i>Cyperus eragrostis</i> *	Umbrella Sedge	
Fabaceae subf. Faboideae	<i>Lotus corniculatus</i> *	Birds-foot Trefoil	
Fabaceae subf. Faboideae	<i>Trifolium repens</i> *	White Clover	
Juncaceae	<i>Juncus usitatus</i>		
Malvaceae	<i>Modiola caroliniana</i> *	Red-flowered Mallow	
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne	
Myrtaceae	<i>Eucalyptus globulus</i> †	Tasmanian Blue Gum	Planted
Myrtaceae	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Planted
Myrtaceae	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree	Planted
Poaceae	<i>Cenchrus clandestinus</i> *	Kikuyu Grass	
Poaceae	<i>Cynodon dactylon</i> †	Couch	
Poaceae	<i>Paspalum dilatatum</i> *	Paspalum	
Poaceae	<i>Phalaris</i> sp.*		
Poaceae	<i>Stenotaphrum secundatum</i> *	Buffalo Grass	
Polygonaceae	<i>Persicaria decipiens</i>	Slender Knotweed	
Rosaceae	<i>Pyrus</i> sp.*		Planted
Rosaceae	<i>Rubus fruticosus</i> agg.*	Blackberry	High Threat Exotic
Solanaceae	<i>Solanum mauritianum</i> *	Wild Tobacco Bush	

*denotes exotic species. †denotes Australian native, but not indigenous to local area.



FAUNA

Family	Scientific name	Common Name
Maluridae	<i>Malurus cyaneus</i>	Superb Fairy-wren
Meliphagidae	<i>Anthochaera carunculata</i>	Red Wattlebird
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark
Psittacidae	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet
Sturnidae	<i>Acridotheres tristis</i> *	Common Myna

*denotes exotic species.

