LODGE
ENVIRONMENTAL

Date: 17 December 2018
Project Code: LE1054

FLORA & FAUNA ASSESSMENT
RIPARIAN ASSESSMENT
VEGETATION MANAGEMENT PLAN

14 HAMILTON ROAD
ALBION PARK

PREPARED FOR
14 Hamilton Road Pty Ltd

LODGE ENVIRONMENTAL • www.lodgeenviro.com.au • ABN 98 696 729 865

Project Name:

14 Hamilton Road, Albion Park – Flora and Fauna Assessment, Riparian Assessment and Vegetation Management Plan

Project Code:

LE1054

Document Tracking:

Prepared by:	
Jack Talbert *Environmental Planner and Ecologist* *Accredited Biodiversity Assessor BAAS18140* • Dr Amy-Marie Gilpin *Ecologist*	Lodge Environmental ABN 98 696 729 865 Scientific License SL102041 Animal Research Authority – Flora and Fauna Survey Mobile: 0423 296 045 Email: info@lodgeenviro.com.au

Record of Distribution

Copies	Report No. & File Name	Status	Date	Prepared for:
1 x PDF	LE1054 Hamilton Road FFA RA VMP_v1.docx	Rev.1	12th Dec 2018	14 Hamilton Road Pty Ltd

COMMERCIAL IN CONFIDENCE

This document has been prepared consistent with accepted scientific practice, supported by available data and resource conditions, as determined by limited data acquisition during the assessment period, evident at Site at the time. The designated recipients of this report accept all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from using the results of the interpretation, the data, and any information or conclusions drawn from it, whether or not caused by any negligent act or omission.

To the maximum permitted by law, *Lodge Environmental* excludes all liability to any person or identity, arising directly or indirectly from using the information or material contained herein.

INTELLECTUAL PROPERTY LAWS PROTECT THIS DOCUMENT

Copyright in the material provided in this document is owned by *Lodge Environmental Pty Ltd.* Lodge Environmental reserves the right to revoke this report, its content and results derived during the scope of work. Third parties may only use the information in the ways described in this legal notice:

- Temporary copies may be generated, necessary to review the data.
- A single copy may be copied for research or personal use.
- The documents may not be changed, nor any part removed including copyright notice.
- Request in writing is required for any variation to the above
- An acknowledgement to the source of any data published from this document is mandatory

TABLE OF CONTENTS

LIST OF TABLES, FIGURES & APPENDICES

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Lodge Environmental Pty Ltd were commissioned by LandTeam on behalf of 14 Hamilton Road Pty Ltd to prepare this Flora and Fauna Assessment (FFA), Riparian Assessment (RA), and Vegetation Management Plan (VMP) at 14 Hamilton Road, Albion Park (herein referred to as the Study Area). The intent of the ecological assessment is to form part of a Development Application that will be submitted to Shellharbour City Council (SCC) for a seniors housing development.

This report describes impacts to native vegetation, threatened species, populations and communities and associated habitat features as a result of proposed development within the Study Area. This report is based on information obtained through data searches and field survey. This report includes a Flora and Fauna Assessment as well as a Riparian Assessment of Macquarie Rivulet and a VMP for the revegetation and management of the riparian area within the Study Area. The legislative context, methods used, impacts to the environment and recommendations to minimise these impacts are included within this report.

This report addresses requirements of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), the *Biodiversity Conservation Act 2016* (BC Act), and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.1 PROJECT DESCRIPTION

This report will form part of the Development Application for a proposed development of seniors housing comprising of 26 self-contained dwellings and a residents community building. The proposed works would include new access roads, sewerage and drainage infrastructure, asset protection zones and retention and enhancement of Macquarie Rivulet along the northern extent of the Study Area.

1.2 SITE DESCRIPTION

The Study Area address is Lot 1 in DP 1069961, 14 Hamilton Road Albion Park and is located in the SCC Local Government Area (LGA), with the SCC being the consenting authority for development works. The Study Area is approximately 300 m north of the Albion Park main street. The Study Area is accessed off Hamilton Road and is bounded by industrial land the east, Macquarie Rivulet to the north, residential land to the west and a currently unused, partly cleared lot to the south (**Figure 1**).

It is understood that the client will be applying for approval to construct seniors housing comprising of 26 self-contained dwellings and a residents community building. It is proposed to stage the development with stage 1 being subdivision and stage 2 being the construction of the dwellings. The land is currently RU6 Transition, a rural zone under Shellharbour Local Environmental Plan 2013 (SLEP 2013). The area of investigation included the entire Study Area and has been assessed to ascertain suitability for the proposed subdivision and subsequent development.

The area proposed for development is largely cleared due to a history of agrarian usage, void of vegetation structure, with only a few trees scattered across the paddocks and garden plantings associated with the current site building. The riparian area along Macquarie Rivulet is the exception as it exists with a somewhat intact vegetative structure, however, is extremely weedy, and marks a clear divide between the paddock and creek vegetation. Macquarie Rivulet is a 5th order stream and will require a 40m buffer from the top of bank.

1.3 OBJECTIVES

This report presents an assessment of possible impacts associated with the proposed subdivision and development of the seniors housing at the Study Area and is based on a field investigation of the Study Area, a literature review of previous studies undertaken in the region, the consultation of relevant databases and a consideration of the objectives of Section 4 of the EP&A Act, the State BC Act, the Commonwealth EPBC Act and any relevant State Environmental Planning Policies (SEPP).

This report provides an assessment in accordance with Section 7.3 of the BC Act, and Matters of National Environmental Significance (MNES) under the EPBC Act, the Shellharbour City Local Environment Plan (LEP 2013) and Shellharbour Development Control Plan (DCP 2013).

A VMP is also included within this report which will provide guidance for the restoration of the riparian area within the Study Area to enhance natural values and assist in the establishment of a resilient ecosystem along Macquarie Rivulet. To inform the VMP, a Riparian Assessment has also been conducted.

Figure 1: Study Area

2.0 LEGISLATIVE CONTEXT

2.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

The NSW EP&A Act is the principal planning legislation for the state, providing a framework for the overall environmental planning, and development assessment process. Various legislative instruments, such as the BC Act, NSW *Water Management Act 2000* (WM Act) and NSW *Rural Fires Act 2007* (RF Act) are integrated with the EP&A Act and have been reviewed below where relevant.

2.2 BIODIVERSITY CONSERVATION ACT 2016

The NSW BC Act aims to slow the decline of threatened species, populations and communities listed under the Act. The BC Act is integrated with the EP&A Act and requires consideration of whether a development (Part 4 of the EP&A Act) is likely to significantly affect threatened species, populations and ecological communities or their habitat.

The schedules of the BC Act lists species, populations and communities as endangered or vulnerable. All developments, land use changes or activities need to be assessed to determine if they will have an unacceptable impact on species, populations or communities listed on these schedules.

The potential impact of the proposed development on any threatened species, populations or communities is assessed through application of an Assessment of Significance (AoS) under Section 7.3 of the BC Act at the development application stage. If the impacts on the area are found to be 'significant', a Biodiversity Development Assessment Report (BDAR) would be required as would concurrence from the Chief Executive of the NSW Office of Environment & Heritage (OEH) including application of the Biodiversity Assessment Methodology (BAM) and entering into the Biodiversity Offset Scheme (BOS). A BDAR would also be deemed necessary if the proposed development were to involve clearance of vegetation mapped on the State Biodiversity Values Map (BVM), or involve native vegetation clearance above the thresholds tables within the BC Act (**Table 1**).

Table 1: Offset scheme thresholds - area criteria

Minimum lot size associated with the property	Threshold for clearing, above which the BAM and offsets scheme applies
Less than 1 ha	0.25 ha or more
1 ha, and less than 40 ha	0.5 ha or more
40 ha, and less than 1,000 ha	1 ha or more
1,000 ha or greater	2 ha or more

2.3 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The Commonwealth EPBC Act aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. Under this Act an action will require approval from the Minister for the Environment if the action has, will have, or is likely to have, a significant impact on a MNES. MNES include listed threatened species and ecological communities, migratory species and wetlands of international importance protected under international agreements. Where applicable, the assessment criteria relevant to this Act must be drawn upon to determine whether there would be a significant impact on these species and hence whether referral to the Federal Environmental Minister is required.

2.4 LOCAL PLANNING INSTRUMENTS

2.4.1 Shellharbour City Local Environment Plan 2013

The Shellharbour City Local Environment Plan 2013 (LEP) is the principle planning instrument for the Shellharbour City Local Government Area (LGA). The LEP sets out the planning framework and establishes the requirements for the use and development of land in the LGA. The LEP provides broad direction with regard to what types of development are permitted within specific land use zones.

2.4.2 Shellharbour Development Control Plan 2013

The Shellharbour Development Control Plan 2013 (DCP) aims to make detailed local provisions for all land within the LGA. Specifically, the DCP provides detailed construction, building and environmental controls for the types permitted land use described in the LEP. Environmental controls address issues such as biodiversity, bushfire prone land, trees and vegetation.

2.5 RIPARIAN LEGISLATION OVERVIEW

The NSW Department of Primary Industries (DPI Water) administers the *Water Management Act 2000* (WM Act) and is required to assess activities carried out on waterfront land. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 meters of the highest bank of the river, lake or estuary. Certain activities within this land is defined as a 'controlled activity' and requires approval from the Office of Water.

DPI Water recommends a Vegetated Riparian Zone (VRZ) is provided adjacent to the channel to provide a protective buffer between catchment land uses and aquatic habitat. This not only helps improve water quality and aquatic habitat, but provides habitat for terrestrial and riparian flora and fauna. The VRZ plus the channel width constitute the 'riparian corridor' (**Figure 2**). The width of the VRZ within waterfront land is measured from the top of the highest bank on both sides of the watercourse. The VRZ width has been predetermined and standardised for first, second, third and fourth order and greater watercourses (**Figure 3**).

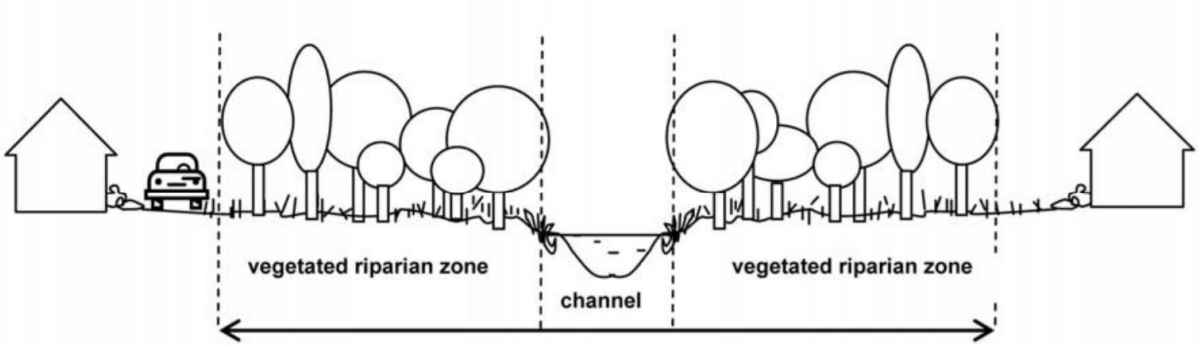
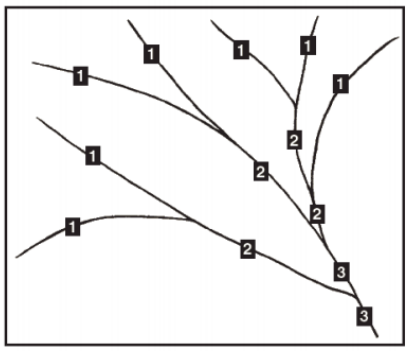


Figure 2: The riparian corridor

The watercourse type uses the Strahler stream order system of classification (**Figure 3**). The Strahler system numbers the smallest headwater streams as 1st Order, and stream order increases downstream through the catchment as streams merge and form larger streams (e.g. when two 1st Order streams join they become a 2nd Order).

Non-riparian corridor works such as asset protection zones, roads, infrastructure and recreational areas can be authorised by DPI Water in the outer riparian corridor (outer 50%), so long as an equivalent area connected to the VRZ is offset and the average width of the VRZ is achieved over the watercourse within the site (**Table 2**). The inner 50% of the VRZ must be fully maintained as a functional riparian zone.



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

Figure 3: The Strahler System and recommended riparian corridor widths (DPI Water)

Table 2: Riparian corridor matrix

Stream order	Vegetated Riparian Zone (VRZ)	RC off-setting for non RC uses	Cycleways and paths	Detention basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10m	•	•	•	•	•	•	•		
2nd	20m	•	•	•	•	•		•		
3rd	30m	•	•	•		•			•	•
4th +	40m	•	•	•		•			•	•

Watercourses are identified on 1:25,000 topographic maps published by NSW Government Spatial Services (maps.six.nsw.gov). The Guidelines for riparian corridors on waterfront land (NSW Office of Water 2012) also note that "*where a watercourse does not exhibit the features of a defined channel with beds and banks, the Office of Water may determine that the watercourse in not waterfront land for the purposes of the WM Act*". However, removal of a watercourse from the existing hydroline mapping does not alter the downstream watercourse type (i.e. Strahler stream order is fixed).

3.0 METHODS

3.1 DATA AND LITERATURE REVIEW

Data records and relevant literature pertaining to the ecology of the study area and surrounding areas were reviewed. The material reviewed included:

- NSW BioNet, Atlas of NSW Wildlife database search (10 km) (Accessed 20 November 2018)
- OEH threatened species profile database (OEH 2018)
- EPBC Act Protected Matter Search Tool (10 km) (Accessed 20 November 2018)
- Review of the State Biodiversity Values Map (Accessed 5 June 2018)
- SCIVI Vegetation Mapping (OEH 2009)
- previous site and surrounds assessments
- relevant legislative documents
- aerial photography

A review of the databases allowed for the production of a list of threatened species and communities that may occur within the study area (**Appendix A**). Likelihood of occurrences for threatened species, endangered populations and communities in the study area were then made based on location of database records, the likely presence or absence of suitable habitat on the site, and knowledge of the species' ecology. The likelihood of occurrence was stratified using a rating of "high", "moderate" or "low" likelihood, with those species considered to have a considerable likelihood of occurrence then identified as either potentially "affected" by the proposal and therefore requiring a significance assessment or not.

3.2 FIELD SURVEY

To address the Flora and Fauna Assessment the following survey methods were undertaken on the 30th November 2018 by ecologists Jack Talbert and Dr Amy-Marie Gilpin:

- Identification of plant species and vegetation communities present within the site, with a particular focus on the areas of likely disturbance – both direct and indirect
- search for signs of threatened species, observe and record significant flora and fauna – threatened and migratory species, other incidental fauna observations
- observe and record current disturbance and threats (e.g. weeds, trampling, litter)
- identifying potential habitat for threatened fauna species/populations (e.g. hollow-bearing trees (HBTs), creeks, boulders etc)
- recording presence of environmental weeds
- taking reference photographs of the entire site.

3.2.1 Riparian Survey and Top of Bank Mapping

Strahler stream order was extracted from the LPI online dataset. Top of bank mapping occurred during the field survey, utilising a Differential GPS (Trimble Geo 7X handheld (H-Star Floodlight NMEA) - WEHH 6) with horizontal accuracy on average sub 30 cm. One waterway was considered in this assessment:

- Macquarie Rivulet along the northern boundary.

Access to the waterway within the site was adequate for the purposes of the assessment. A visual assessment of the waterway aimed to describe the general hydrology, physical form, water quality, aquatic habitat and streamside vegetation; and provide an overall condition assessment.

3.3 SURVEY LIMITATIONS

Survey was conducted during Summer, and may be outside of the optimal survey period for some flora and fauna species. It is therefore possible that some species may not have been detected due to their seasonal geographic variation. Cryptic species may not have been obvious. However, habitat assessments were conducted to further predict the likelihood of species occurrence at the site. A conservative approach was applied in the assumption of the presence of species that could potentially occur within the site area. In this regard, the survey is considered adequate for the purposes of this report.

4.0 DESKTOP REVIEW

4.1 EXISTING VEGETATION MAPPING

A review of vegetation mapping that covers the study area (OEH 2009) identified two vegetation communities within a small area along the watercourse of the study area – being Cleared, and Estuarine Fringe Forest (**Figure 5**).

There is a small amount of vegetation within the study area that is mapped on the State BVM (**Figure 4**). The BVM mapping within the study area is associated with the riparian corridor along Macquarie Rivulet. The proposed development avoids clearance on any mapped areas of biodiversity value (AOBV).

Figure 4: Biodiversity Values Map showing land with high biodiversity value in purple, and the study area identified in blue

Figure 5: Vegetation communities as mapped by OEH (2009)

4.2 THREATENED FLORA SPECIES

A review of the OEH and Department of the Environment and Energy (DEE) databases identified 32 threatened plants listed under the BC Act and/or the EPBC Act that have been previously recorded, or are considered to have habitat, within 10 km of the site (**Figure 6**). This initial compilation of potentially occurring species informed the site survey, providing an indication of which species required consideration within the site. An assessment of the likelihood of occurrence of threatened flora species within the site is available in **Appendix A** and was used to guide the field survey methodology. The following threatened flora species were identified as having a high or medium degree of likelihood to occur within the Study Area prior to conducting the field survey:

- *Solanum celatum*
- *Zieria murphyi* (Velvet Zieria)

4.3 THREATENED FAUNA SPECIES

A review of the OEH and DEE databases identified 109 threatened fauna listed under the BC Act and/or the EPBC Act that have been previously recorded, or are considered to have habitat, within 10 km of the site (**Figure 6**). Many of these species are migratory due to the coastline distance of less than 10 km from the site. An assessment of the likelihood of occurrence of threatened fauna species within the site is available in **Appendix A** and was used to guide the field survey methodology.

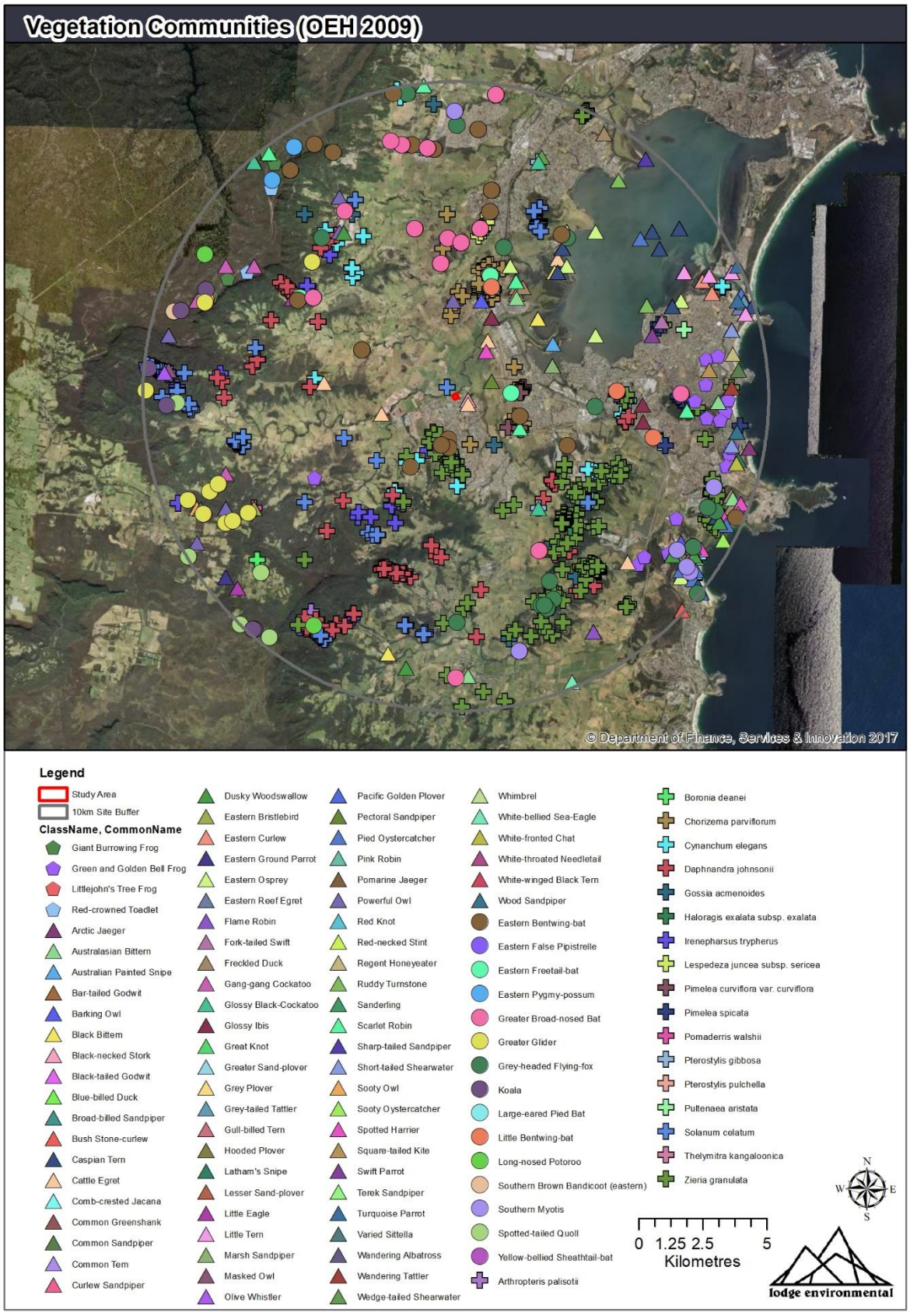


Figure 6: Threatened species records within 10km of the site (BioNet 2018)

5.0 FIELD SURVEY RESULTS

5.1 EXISTING ENVIRONMENT

The Study Area presents in a highly modified state due to the past land practices which have altered the original vegetation substantially, both in species diversity and structural composition. The Study Area has been largely cleared and weeds have been allowed to dominate the site without any notable management. Scattered trees have been retained within the cleared paddock, however these are the noxious species *Erythrina x sykesii* (Coral tree). Garden plantings exist surrounding the existing site house and includes a few native ornamentals (*Brachychiton acerfolius* and *Calistemon* sp.) however most plantings were exotic, commonly used plants such as *Jacaranda mimosifolia*, *Citrus reticulate*, *Cinnamomum camphora* and *Nerium oleander*.

The majority of the site is represented by exotic pasture, however, there is a clear distinction along the northern boundary which follows Macquarie Rivulet. This creek has retained a poor vegetation structure along its banks in the form of a, generally no more than one tree wide, linear corridor with all stratum choked by weeds with the exception of the canopy species *Casuarina cunninghamiana* subsp. *cunninghamiana*.. The creek represents the most consolidated vegetation adjacent to the Study Area and would facilitate movement of more mobile native fauna species (i.e. birds and mammals) as well as less mobile fauna (i.e. amphibians and fish) between the Study Area and wider locality. The Study Area however is not considered to provide any considerable habitat to native fauna. The Study Area is surrounded by a windrow of planted natives along its western and southern boundary.

The history of disturbance, and prevalence of weeds, has left the Study Area in a state which is not considered to provide any important habitat features to native fauna. No hollow bearing trees were recorded, there were no native, intact canopies for foraging, nor were there any other important features such as caves, sandstone cliff faces or nests.

5.2 VEGETATION COMMUNITIES

The field inspection recorded two vegetation types as mapped in **Figure 10**, which included:

- Exotic grassland and obvious garden plantings
- River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1105) – directly adjacent to the sites northern boundary with overhanging canopy only within the Study Area

The site was also bordered on two sides to the east and south by native planted trees including *Melaleuca* sp., *Acacia mernsii* and *Brachychiton acerifolius*.

The exotic grassland dominates the subject site and is primarily dominated by introduced grass and weed species such as *Hypocaheris* sp*, Plantago lanceolata*, *Paspalum urvillei*, *Briza subaristata*, and *Conyza* sp and to a lesser extent *Rubus fruicosus* (Blackberry), *Senecio madagascariensis*

(Fireweed) and *Lotus subbiflorus*. Scattered *Erythrina X sykesii* (Coral Tree) were also within the exotic grassland. No threatened species were recorded within this vegetation type.

Around the remnant dwelling are a variety of introduced and native trees. Native trees include *Brachychiton acerifolius* (Illawarra flame tree) and a hybrid *Callistemon* sp. Introduced plant species include *Jacaranda mimosifolia* (Jacaranda), *Citrus reticulata* (Mandarin) and *Cinnamomum camphora* (Camphor laurel).

The majority of the subject site was cleared of vegetation and dominated by exotic groundcover that had undergone extensive historic grazing by cattle.

Figure 7: Exotic Grassland which dominates the Study Area

Figure 8: Garden plantings associated with existing Study Area house

The River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1105) was recorded in very poor condition with extensive weed invasion. The presence of *Casuarina cunninghamiana* subsp. *cunninghamiana* and geographic locality of the vegetation were they key diagnostics to define the PCT, however, the vegetation is void of any natural resemblance to the community with the exception of the canopy species. This community was represented primarily by several large mature *Casuarina cunninghamiana* subsp. *cunninghamiana*. The understorey was dominated by exotics including *Lantana camara*, *Ligustrum lucidum*, *Verbena bonariensis* and *Cardiospermum grandiflorum* (Balloon vine).

The River Oak occurs directly adjacent to the Study Areas northern boundary. River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (PCT 1105) is considered equivalent to the state listed Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This vegetation is listed as an Endangered Ecological Community under the State BC Act.

No threatened species were identified within the Study Area.

Figure 9: The boundary between the weedy River Oak open forest and exotic grassland

Figure 10: Validated vegetation communities and habitat features mapped by Lodge Environmental (2018)

5.3 HOLLOW BEARING TREE ASSESSMENT

No Hollow Bearing Trees were recorded within the Study Area.

5.4 FLORA

A total of 30 species were recorded during the site inspection (3 Natives and 27 Exotic). A species list is provided in **Appendix B**.

Three NSW Priority weed species were recorded within the study area. All three weeds are also Weeds of National Significance.

Table 3: NSW Priority Weeds

Scientific Name	Common Name	Control Class	Weed Category	WoNS
Lantana camara	Lantana	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread	Yes
Fruticosus aggregate	Blackberry Rubus	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Yes
Senecio madagascariensis	Fireweed	4	The plant must not be sold, propagated or knowingly distributed	Yes

5.4.1 Threatened Flora Species

There were no threatened fauna species identified within the Study Area.

5.5 FAUNA

A total of 12 fauna species were identified within the site. A species list is included in **Appendix C**.

5.5.1 Threatened Fauna Species

There were no threatened fauna species identified within the Study Area. The Study Area is not considered to provide any important habitat for threatened fauna.

5.6 RIPARIAN ASSESSMENT

Macquarie Rivulet is a 5th order stream, requiring a 40m VRZ. Its riparian corridor (VRZ + channel) is mapped in **Figure 11**. In total, there is a requirement for 0.442 ha of riparian corridor falling within the property boundary. Results of the condition assessment are in **Table 4**. The proposed footprint encroaches into a very minor 0.002 ha of the outer 50% of the VRZ and. Should Natural Resources Access Regulator (NRAR) request an offset for this area is can be provided adjacent to

the unimpacted VRZ. Land available for compensation is shown in **Figure 12**. The offset shown achieves a 1:1 ratio of encroachment to offset.

Considering the existing poor condition of Macquarie Rivulet, it is unlikely that the proposed development will further contribute to the degradation of the waterway. It is, however, likely that the waterway will be enhanced through the proposed vegetation management. The embellishment of riparian vegetation will contribute to bank stability and water quality as the vegetation acts as soft engineering structures consolidating the streamside soil and filtering overland flows. It is not expected that the stream flows will be altered from the proposed development.

Figure 11: Riparian Corridor and Top of Bank (LE 2018)

Figure 12: Vegetated Riparian Zones

Table 4: Condition assessment of Macquarie Rivulet

Waterway	Macquarie Rivulet
Stream order	5th
Hydrology and Physical Form	The drainage line was recorded in a very weedy state, however, the bed and banks appeared stable. The waterway features an incised bed, faceted lower bed benches and near steeply sloping walls towards the top of bank. The channel bed is lined with small rocks. Agricultural disturbance is present in the form of weediness. The high prevalence of weeds is likely exacerbated by the nearby agricultural practices – with the effects of unmanaged weed spread and elevated levels of nutrients observed.
Water Quality and Aquatic Habitat	The water quality was observed to be clear and fast flowing. The stream contained aquatic vegetation, however minimal woody debris and rock were observed. Weeds were present and in some areas were choking the stream.
Streamside Vegetation	Streamside vegetation was thick with weeds. *Casuarina* sp dominated the canopy.
Overall Condition	Very poor
Photos	 Creek facing east, with weeds covering all banks into the flowing water

Bank choked by weeds, facing south from creek lower bank

Bank choked by weeds, facing east from creek high bank

6.0 IMPACT ASSESSMENT

6.1 SUMMARY OF IMPACTS

The proposed development layout has been sited to ensure avoidance of all native vegetation associated with the riparian area. The development is located entirely on exotic pastureland, scattered noxious Coral Trees, and the ornamentals associated with the existing house. The development will not directly impact on the native vegetation associated with Macquarie Rivulet. Furthermore, a VMP will be implemented along the areas of the riparian corridor of Macquarie Rivulet within the Study Area to protect and enhance the vegetation in this area. The proposed development has successfully implemented the avoidance principle in accordance with the BC Act by allowing for retention of all vegetation of value within the Study Area.

Direct impacts

The direct impact imposed by future development will only occur to the exotic pasture land which includes scattered paddock trees consisting of a *Erythrina x sykesii* (Coral Tree) and garden ornamentals, the majority of which are exotic species. The exotic pasture and garden ornamentals are not considered to provide habitat to threatened species and therefore there will not be any impact on listed threatened flora, fauna or ecological communities.

Indirect impacts

Construction and occupation of the future dwellings within the development may introduce potential for indirect impacts on the retained vegetation within the riparian corridor. These indirect impacts will be managed primarily through the implementation of the VMP as well as the mitigation measures summarised below.

- Development areas will be clearly marked using steel pickets and/or flagged bunting to ensure that all clearing operations occur only within the approved clearance areas.
- Increased light around future developments penetrating retained vegetation will be managed by ensuring that development complies with the Australian Standard 4282 – control of the obtrusive effects of outdoor lights, which provides recommended limits for lighting, and usage of down-facing lighting.
- Monitoring and adaptive management prescriptions within the VMP to address any increases in edge effects due to the increase in traffic and access.
- Changes in hydrology from surface and stormwater runoff from increased impervious areas will be managed with onsite stormwater management to control any excess water flows and nutrients into retained areas of vegetation.
- Dust and stockpiles will be managed in accordance with the Blue Book (Landcom 2004) and best practice management as developed by the Soil Conservation Service.

6.2 SIGNIFICANCE ASSESSMENTS

6.2.1 Assessment of Significance under the EP&A Act

Assessments using the criteria provided under Part 1 Section 5A of the EP&A Act (i.e. Assessment of Significance (AoS)) must be taken into account by consent or determining authorities when considering a development proposal or development application. This enables a decision to be made as to whether there is likely to be a significant impact on the species and hence if entry into the Biodiversity Offset Scheme (BOS) is required.

The results of the field survey have been used to inform whether significance assessments are required and for which listed species and communities. Significance assessments have not been undertaken as the proposed development successfully avoids listed species or their habitats and communities.

The proposed development is not considered to have any significant impact on threatened species, ecological communities or populations such that a viable local population will be placed at risk of extinction.

6.2.2 EPBC Act Significant Impact Guidelines

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where MNES may be affected. The process includes the application of Significant Impact Criteria for listed threatened species and ecological communities that represent a MNES that will be impacted as a result of the proposed action. Significant impact guidelines that outline a number of criteria have been developed by the Commonwealth, to provide assistance in conducting the assessment and help decide whether or not a referral to the Commonwealth is required.

The Significant Impact Criteria was not applied as the proposed development successfully avoids listed MNES species and communities.

It is determined that the proposed development is unlikely to result in a significant impact to MNES (threatened and migratory species).

7.0 RECOMMENDATIONS

The following recommendations are provided to minimise potential impacts to threatened and non-threatened vegetation communities, flora and fauna that could result from the proposed action:

- This report assesses the removal of the exotic pasture land, scattered Coral Trees and garden ornamentals, with all native riparian vegetation to be protected throughout the proposed development
- Care must be taken when moving equipment near vegetation to be retained. If works appear to encroach on retained vegetation, advice from a qualified Arborist should be gained to infer appropriate tree protection measures
- Tree protection fencing should be placed upslope from Macquarie Rivulet with a clear "No-Go-Area" signage system in place
- Drainage should be controlled in the impact areas in line with the *Protection of the Environment Operations Act 1997* to avoid impacts on downstream habitats
- Landscaping should aim to utilise local-provenance stock and species representative of the River Oak plant assemblage
- A Vegetation Management Plan should be implemented along the riparian areas of the Study Area to enhance and protect the ecological function of Macquarie Rivulet
- Adequate erosion and sediment measures should be in place at all times during construction in accordance with best practice guidelines (Landcom 2004), including:
    - sediment fencing upslope of Macquarie Rivulet
    - surface runoff to be diverted away from areas of soil disturbance and Macquarie Rivulet
    - vehicle and machinery movement will be confined to designated tracks and work areas
    - work will not take place during or after heavy rain when doing so is likely to cause soil erosion or soil structural damage
    - no washing of concrete will be undertaken on site.
- Equipment, heavy machinery and materials should be situated in designated lay-down areas in portions of cleared land where they are least likely to cause erosion or damage vegetation
- Weed removal should be undertaken using mechanical and manual means, with any use of herbicides to be given careful consideration to impacts on aquatic habitat.

8.0 CONCLUSION

Through the completion of the surveys conducted as part of this report, no threatened flora, fauna or vegetation communities were recorded within the Study Area. All impacts are to occur to the exotic pasture. The riparian habitat will be enhanced through the implementation of the VMP. It is considered unlikely that the proposed seniors living development will result in any impacts on species and communities listed under the State BC Act and Commonwealth EPBC Act.

This Flora and Fauna Assessment has adequately considered threatened species and communities in the context of the proposed seniors living development at the subject site by:

- conducting field survey
- adopting the precautionary principle in the assessment of threatened species
- designating appropriate recommendations to minimise potential impacts to threatened species that may transiently occur on the site as well as any other fauna

The assessments contained within this report have determined that the proposed seniors living development is unlikely to have a significant effect on the listed communities or species or their habitat in accordance with the EP&A Act, BC Act and EPBC Act provided the recommendations contained in this report are adhered with. There will not be an impact on any mapped areas of Biodiversity Value, nor will there be an impact on native vegetation above the impact threshold.

Therefore, the preparation and submission of a BDAR or referral to the Commonwealth is not required.

9.0 VEGETATION MANAGEMENT PLAN

9.1 OBJECTIVES

This VMP will guide the bushland restoration of the riparian areas and provide a guide to bush regeneration contractors to:

- protect and regenerate remnant vegetation within the riparian areas of the study area
- control noxious and environmental weeds
- revegetate the riparian areas where necessary with local provenance species
- protect flora and fauna habitat

The maintenance period will run for a minimum of two years and until the objectives and performance criteria outlined in this VMP are met.

The VMP area is defined by the area of Riparian Corridor within the Study Area that has taken into account any offsetting due to encroachments into the outer 50% (**Figure 13**). The VMP area is herein referred to as the Subject Site.

9.2 PRELIMINARY WORKS

The civil construction company / developer shall be responsible for the following VMP works within the Subject Site.

The Subject Site is to be fenced to prevent civil construction machinery from entering unless under supervision from a suitably qualified ecologist or bush regenerator. This will be undertaken on active development interfaces.

Additionally, prior to construction commencing, sediment fencing will be required around the construction area / VRZ interface to prevent sediment running into the VRZ area and limit the spread of weed propagules in soil sediments during the construction period.

All waste, rubbish, weedy biomass and propagules are to be removed by the civil construction company during the initial stages of the civil earthworks. Where applicable, the subject site is to be 'scraped' of its 'O' and 'A' soil horizons to a maximum depth of 200 mm with scope to remove the residing weed seed bank. Soil derived from this activity is to be removed from site and not stockpiled for future use within or adjacent to the VMP area.

9.3 VEGETATION MANAGEMENT ZONES

The two treatment zones as shown in **Figure 13** are proposed to achieve plantings in a manner which resembles a natural environment that maintains a lateral connectivity between the waterway and riparian vegetation while also allowing for management as an Asset Protection Zone (APZ).

- Zone 1: Inner Vegetated Riparian Zone
- Zone 2: Outer Vegetated Riparian Zone (including encroachment offset)

Figure 13: Vegetation Management Zones

9.3.1 Inner Vegetation Riparian Zone

Zone 1 (approximately 2100 m^2) is dominated by exotic grass, primarily dominated by introduced grass and weed species such as *Hypocaheris* sp*, Plantago lanceolata*, *Paspalum urvillei*, *Briza subaristat*a, and *Conyza* sp and to a lesser extent *Rubus fruicosus* (Blackberry), *Senecio madagascariensis* (Fireweed) and *Lotus subbiflorus*.

Works within this zone will aim to re-establish the degraded riparian forest through the removal of all waste and exotic biomass followed by the installation of 850g/m^2 jute matting (~6 mm thickness) across the majority of the management zone. The jute matting will aid the growth of native plantings by reducing any competition from weeds.

All Noxious weeds shall be treated. Following removal of the weedy biomass, all weed propagules are also to be bagged and removed from site to a registered green waste facility. All woody waste is to be either chipped and mulched onsite or left in small piles.

Any re-emerging noxious weeds, woody weeds and vine weeds are to be controlled. All emerging annual herbaceous and exotic grass species are to be controlled using a combination of brush cutting prior to seed set, spot spraying and hand weeding.

Revegetation will occur within the zone where trees will be planted at a density of 1 plant per 4 square metres (m^2) and shrubs / mid storey species at 1 plant per 2 m^2 and sedges/grasses at 4 plants per m^2 (**Table 5**) and utilising species identified in **Table 6**.

This zone also has a dual purpose of maintaining adherence to the bushfire protection measures and shall be managed to achieve the following:

- tree canopy of less than 30%
- vegetation that does not provide continuous path for the transfer of fire
- should have an understorey where fuel loadings are maintained below 8 tonnes per hectare by mowing, slashing or other approved hazard reduction methods.

9.3.2 Outer Vegetated Riparian Zone

Zone 2 (approximately 2,300 m^2) is also dominated by introduced pasture species including *Hypocaheris* sp*, Plantago lanceolata*, *Paspalum urvillei*, *Briza subaristat*a, and *Conyza* sp and to a lesser extent *Rubus fruicosus* (Blackberry), *Senecio madagascariensis* (Fireweed) and *Lotus subbiflorus.* This area has no current structure other than the scattered Coral Trees.

Works within this zone will aim to re-establish the heavily degraded pastureland within the zone through the removal of all exotic biomass followed by the installation of mulch to a maximum depth of 100 mm.

Mulch should be comprised of un-composted wood (preferably wood waste), with a particle size of 15 mm to 40 mm, with no fines, and good air filled porosity. Mulch should not contain any weed seeds nor be derived from diseased trees.

All Noxious weeds shall be treated. Following removal of the weedy biomass, all weed propagules are also to be bagged and removed from site to a registered green waste facility. All woody waste is to be either chipped and mulched onsite or left in small piles.

Any re-emerging noxious weeds, woody weeds and vine weeds are to be controlled. All emerging annual herbaceous and exotic grass species are to be controlled using a combination of brush cutting prior to seed set, spot spraying and hand weeding.

Revegetation will occur within the zone where trees will be planted at a density of 1 plant per 10 m^2 and sedges/grasses at 1 plant per 5 m^2 and sedges/grasses at 3 plants per m^2 (**Table 5**) and utilising species identified in **Table 6**.

This zone also has a dual purpose of maintaining adherence to the bushfire protection measures and shall be managed to achieve the following:

- tree canopy of less than 15%
- minimal fine fuel at ground level
- vegetation that does not provide a continuous path to the proposed buildings for the transfer of fire. Garden beds of flammable shrubs are not to be located under trees and should be no closer than 10 m from an exposed window or door
- shrubs and trees that do not form a continuous canopy
- vegetation that is maintained in clumps rather continuous rows
- species that retain dead material or deposit excessive quantities of ground fuel are to be avoided
- shrubs and trees are pruned or removed so they do not touch or over hang the buildings
- vegetation is to be located far away from buildings so that plants will not ignite the building by direct flame contact or radiant hear emission.

Planting works will commence at the start of the VMP implementation. Trees, shrubs and groundcovers will be planted utilising set densities and species as per **Table 6**.

Propagation or striking of plant stock can take up to nine months prior to revegetation works occurring on-site, and this needs to be factored into project timeframes along with seed collection requirements. Confirmation from suppliers will be required regarding seed origin.

The following actions will be undertaken when planting is to occur:

- any planting that is undertaken must use local provenance stock
- plant at specified densities using species in the revegetation list above
- all plants will be installed as tube stock or hiko cells
- herbaceous species will be planted in clumps rather than scattered individuals
- location of tree plantings will be determined based on breaks in canopy where relevant
- all plants will be watered at least twice after planting to increase survival rates of revegetation.
- Further watering will occur if deemed necessary by the Bushland Regeneration Contractor depending on rainfall after the planting has occurred and season of planting.

Table 5: Revegetation densities

Zone	Description	Area (m2)	Revegetation densities			Total
			Tree	Shrub	Grass/sedges	
Zone 1	Inner vegetated riparian zone	2,100	1/4m2 525	1/2m2 1,050	4/m2 8,400	9,975
Zone 2	Outer vegetated riparian zone	2,300	1/10m2 230	1/5m2 460	3/m2 6,900	7,590
	Grand total	4,400	755	1,510	15,300	17,565

Table 6: Revegetation species list

Type	Scientific Name	Common Name
Trees and large shrubs (1.5 to 6m)	*Acmena smithii*	Lily Pilly
	Alectryon subcinereus	Native Quince
	Backhousia myrtifolia	Carrol
	Casuarina glauca	Swamp She Oak
	Casuarina cunninghamiana	She Oak
	Cryptocarya glaucescens	Jackwood
	Cryptocarya Microneura	Murrogun
	Ficus coronata	Sandpaper Fig
	Guioa semigaluca	Wild Quince
	Pittosporum undulatum	Native Daphne
	Scalopia braunii	Flintwood
Small shrubs and accent plants	*Acacia longifolia*	Coastal Wattle
	Acacia maidenii	Maiden's Wattle
	Bursaria spinosa	Blackthorn
	Breynia oblongifolia	Coffee Bush
	Indigofera australis	Australian Indigo
	Leucopogon parvifolius	Coast Beard Heath
	Notelaea venosa	Veined mock-olive
	Streblus brunonianus	Whalebone Tree
	Tristaniopsis laurina	Kanooka

Ground covers, grasses, reeds and rushes	*Carex appressa*	Carex
	Carex longebrachiata	Australian sedge
	Cyperus difformis	Rice Sedge
	Crinum penduculatum	Swamp Lily
	Eleocharis sphacelata	Tall Spike Rush
	Grevillea juniperea	Grevillea
	Hibbertia scandens	Golden guinea vine
	Imperata cylindrical	Blady Grass
	Isolepsis inundata	Knobby Club Rush
	Juncus usitiatus	Common Rush
	Lomandra longifolia	Mat Rush
	Myoporum parvifolium	Creeping Boobialla

9.4 MAINTENANCE

The subject site will require ongoing maintenance to control weed regrowth (seed and vegetative) for a duration of two years as per NRAR/DPI Water Guidelines.

The maintenance will be undertaken during peak growing seasons (spring and summer) and less frequently during cooler periods (autumn and winter). Maintenance will be undertaken for a period of two years after practical completion of establishment works or until the objectives and performance criteria outlined in this VMP are met. Practical completion refers to the completion of all civil works, soil preparation, initial weed control and planting.

10.0 TECHNIQUES AND SPECIFICATIONS

10.1 WEED CONTROL

Weed control involves a combination of mechanical, physical and chemical techniques to remove the weeds and prevent regrowth. Weed control will be undertaken in all management zones. A selection of the best suited weed control methods within the site depends on a number of factors including:

- the species or combination of weeds being targeted
- the density of the weeds
- resources available (time, labour, equipment and finances)
- weather conditions of the day.

10.2 WEED CONTROL TECHNIQUES

Detail of specific weed control techniques to be used such as cut and paint, scrape and paint, herbicide spraying and hand weeding are given in Brodie (1999). The principles of bush regeneration and techniques to trigger natural regeneration are to be in accordance with the Bradley Method and other techniques described in Buchanan (2000). Management techniques for different types of weeds are provided below.

10.2.1 Annual grasses

Annual grasses should be hand removed or spot sprayed where isolated or in low concentrations. Larger patches of annual grasses may be slashed/brush cut in late spring to early summer, after flowering, but prior to seed set. For most species, slashing/brush cutting prior to late spring through to early summer will promote vigorous growth and should not occur. However, some annual grasses can grow and produce seed at any time of the year dependent on climatic conditions such as high rainfall and warm temperatures. Monitoring of annual species should be undertaken and if new growth occurs, the same treatment will be applied to the new growth to prevent seed production. Individual plants should be hand removed, bagged and disposed of appropriately offsite.

10.2.2 Perennial grasses

Perennial grasses will be hand removed where isolated or in low concentrations. Larger patches may be slashed prior to seed production in spring or summer (depending on the growth cycle of the species) and the regrowth spot-sprayed 2-3 weeks later when it is actively growing and approximately 10 cm in length. Monitoring of these species will occur and if new seed production occurs, the same treatment will be applied again as required. However, slashing will not reduce the presence of exotic grasses on its own and must always be combined with targeted removal to reduce densities and allow for native regeneration. Individual plants should be hand removed, bagged and disposed of appropriately offsite.

10.2.3 Woody weeds

Where woody weeds invade the site, these will be controlled by the cut and paint or drill and fill method using a non-selective herbicide. The most appropriate method to be used depends on the size of the individual to be removed and will be determined by the bush regeneration contractor. Primary weed control should use techniques that will not encourage flushes of secondary weed growth. All seedlings of woody weeds will be hand pulled or spot-sprayed with a non-selective herbicide.

Mechanical removal of the large Coral Trees should occur during dry periods. It is recommended that the stumps are immediately treated with herbicide (i.e. Bioactive Roundup) after cutting to prevent regrowth. If it is not possible to kill the Coral Trees during to removal, the tree should be cut limb by limb, taking care to stack the debris at a suitable location away from the watercourse, taking care to minimise the spread of small pieces. Smaller twigs should be bagged and disposed of at tip facilities so that they do not sprout and cause further problems.

10.2.4 Creepers and climbers

The control of creepers varies depending on the species. For the most part, seedlings will be hand pulled, while mature plants can be controlled by the stem-scrape method or spot spraying using a non-selective herbicide. The precise method to be used will be determined by the bush regeneration contractor depending on the species, size and reproductive status of the individual. All vegetative material removed should be bagged, removed from site and disposed of appropriately.

10.2.5 Herbaceous weeds

Where individual plants or herbaceous weeds are found, they will be hand pulled prior to flowering. Where large swaths of these species occur they will be sprayed using a non-selective herbicide. If high densities of mature stands occur, weeds may be slashed first using a brush cutter and any subsequent regrowth sprayed. Monitoring of these species will be required to prevent seed production. *Cirsium vulgare* (Spear Thistle) will not be hand-pulled due to its thorns and instead will be spot sprayed using a non-selective herbicide. All vegetative material that is pulled out and has the potential to regrow if deposited on ground will be bagged and removed from site.

10.2.6 Management of Weed Waste

All propogules, especially noxious weeds, will be bagged and disposed of as directed by legislation at a facility licensed to receive green waste. All weed waste without propogules will be composted onsite in small unobtrusive piles.

10.2.7 Herbicide use

The use of herbicide to control weeds should be carefully considered. Herbicide use should assess potential long-term impacts of the technique including whether the proposed works actually address the source of the weed infestation. However, herbicide application forms an important

and useful component of an integrated weed management approach and can be the most appropriate method to control some weed species.

Herbicide use should occur during the active growing season for plants to encourage the chemical uptake into the plant. The selection of herbicides should also consider the type of weed and the location. Where non-selective herbicides are required for use, glyphosate is the most suitable. If herbicides are required to be used near waterways, a glyphosate-based herbicide formulated for use near waterways will be used (e.g. RoundUp© Biactive™).

Broad-leaf selective herbicide may be used as per the noxious and environmental weed control handbook (DPI 2014). However, this type of herbicide is extremely toxic to aquatic life and must not be used in, or adjacent to, waterways. Registration and records must be kept in accordance with the NSW Pesticide Regulation 2009.

10.3 REVEGETATION WORKS

Revegetation has the twin aims of both re-establishing the original native vegetation community at the site and reducing erosion along the length of the riparian corridor.

Planting of Hiko for trees and shrub species and Hiko or Viro cells for grasses and other groundcover species is the preferred method. Planting should be done via a low impact method such as hand digging or hand auger. The holes dug for each plant should be at least 1.5x the width and 2x the depth of the rootball. Fertiliser should be added to each hole dug as per the label specifications. Water crystals or wetting agents should be added to each plant hole. This will increase the water holding capacity of the soil and reduce watering schedules. Initial irrigation of the plantings is essential to ensure that the soil forms around the rootball and no air pockets are left. This will be required unless sufficient rainfall (approximately 10 mm) occurs on the day of planting.

Following the revegetation works, irrigation needs to be undertaken for at least eight weeks following planting to ensure the establishment of the plants. The level of irrigation will be determined by rainfall and temperature experienced at the planting site.

Mulch should be used where identified. The use of mulch is very important because it provides organic matter to the top soil, improves soil structure and aeration, water infiltration, nutrient availability, and is also useful in the suppression of weed growth (Buchanan 2009). Mulch should be sourced from within the local area. Mulch must be free of weed propagules and invasive woody species such as *Erythrina* x *sykesii* (Coral Tree). Mulching should not be undertaken within areas of high potential erosion. It is recommended jute matting is used in these areas prior to revegetation (i.e. Zone 1).

A temporary irrigation system should be installed to assist in the establishment of vegetation. Timing of the planting of these areas will need to take into consideration surrounding civil works and erosion/sediment control requirements, these areas will not be planted until earthworks have been completed. A maximum rate of attrition of 10% is to be tolerated, with any plant loss above this rate to be replaced at the expense of the contractor.

10.4 BUSH REGENERATION CONTRACTORS

All vegetation management works in the establishment phase will be undertaken by suitably qualified and experienced bush regeneration contractors who are members of the Australian Association of Bush Regenerators (AABR) or fulfil the membership criteria. In addition to this, team leaders should have, as a minimum, a Certificate III in Conservation & Land Management or equivalent. The contractor will need to carry out best practice bush regeneration techniques as described by Buchanan (2009). A flexible approach to this site is recommended since techniques may need to be changed or modified to suit site conditions. This approach is consistent with adaptive management and allows the contractor to develop and build on site knowledge whilst implementing this VMP. Monitoring will assist in the development of the VMP actions in subsequent years.

11.0 IMPLEMENTATION SCHEDULE AND PERFORMANCE CRITERIA

All revegetation and bush regeneration works are to be implemented by suitably qualified and experienced bush regeneration contractors who are members of the Australian Association of Bush Regenerators (AABR) or fulfil the membership criteria (e.g. TAFE Certificate III in Conservation & Land Management or equivalent and/or two years' experience in bush regeneration). All staff are to be suitably qualified and have a minimum of AQF 3 Chemical users certificate with senior project management staff with a AQF 4 in Chemical Risk management. Current CVs and certificates are to be supplied to the client prior to the commencement of works.

11.1 IMPLEMENTATION SCHEDULE

An implementation schedule for these works is provided in **Table 7**. Any natural regeneration should be assessed and taken into account before revegetation works begin.

Table 7: Implementation schedule

Establishment	Year 1	Year 2
Site preparation of riparian areas including: weed and rubbish removal, erosion control, mulching and jute matting	-	-
Primary and secondary control of all weeds	Secondary and maintenance weed control	Maintenance weed control
Revegetation in all zones	-	Replacement planting
Monitoring and reporting	Monitoring and reporting	Monitoring and reporting

11.2 PERFORMANCE CRITERIA

The performance criteria required for the site to be assessed annually are listed in **Table 8**.

If monitoring indicates that the VMP tasks are not resulting in achievement of the performance criteria, the task program will be revised. The bush regeneration contractor, in consultation with the Council, can adapt these criteria as required in response to the success of rehabilitation works.

Where non-performance occurs and is not immediately rectified, a 'stop-the-clock' notice on the maintenance period will be issued by the Council until the non-performance is rectified.

Table 8: Performance criteria

Zone	Establishment Phase	Year 1: Maintenance Period	Year 2: Maintenance Period
All zones	Commencement of all tasks outlined within VMP. An increase in native cover and diversity and a decrease in exotic cover and diversity by the end of the maintenance period. At the end of each year, a minimum of 85% survival rate of all vegetation strata planted in each zone (e.g. tree, shrub and groundcover). Any localised plant failure within planting areas are addressed with no area larger than 2m x 2m without surviving plants at the end of each year. Maintenance replanting is to replace plants by the same species, or where that species is not available, with the same growth from (i.e. tree for tree) and must not decrease species diversity. Monitoring and reporting undertaken in accordance with this report.		
	All adult seeding noxious weed individuals to be controlled and no establishment of new noxious species.	No noxious plants allowed to set seed and no establishment of new noxious species.	No noxious plants allowed to set seed and no establishment of new noxious species.
Zone 1	Native groundcover vegetation no less than 20% of zone. Exotic groundcover vegetation no more than 20% of zone.	Native groundcover vegetation no less than 30% of zone. Exotic groundcover vegetation no more than 10% of zone.	Native groundcover vegetation no less than 30% of zone. Exotic groundcover vegetation no more than 5% of zone.
Zone 2	Native groundcover vegetation no less than 20% of zone. Exotic groundcover vegetation no more than 20% of zone.	Native groundcover vegetation no less than 30% of zone. Exotic groundcover vegetation no more than 10% of zone.	Native groundcover vegetation no less than 30% of zone. Exotic groundcover vegetation no more than 5% of zone.

11.4 ADAPTIVE MANAGEMENT

An addaptive management approach will be implemented that enables the successful contractor to learn from and respond to successful and unssuccessful techniques used on the site. This may include the substitution of species identified in the planting table and for advanced direct seeding techniques in place of manual planting techniques.

The success of the works will be determined by meeting the performance criteria identified in **Table 8**. Contractors have the flexibility to implement different techniques to those specified here providing that performance criteria are met. Any major departures from this VMP of change to performance criteria must be approved in writing by Council.

12.0 MONITORING AND REPORTING

Monitoring and reporting are both extremely important. The bush regeneration contractor and the land manager will monitor the vegetation for changes over time. Information gained through the monitoring and reporting process will identify works that have and have not been successful, and the reasons for their success or failure.

The aim of monitoring is to measure the effectiveness of the control actions being undertaken to achieve the desired outcome. It will identify non-conformance and provide the land manager with the ability to implement corrective actions. Information derived from the results of monitoring will also be used in adaptive management (i.e. learning from past experience to inform future priorities and work plans). For example, as annual grass weeds are removed, herbaceous and perennial weeds may establish.

Finally, monitoring and reporting will help determine and quantify the costs related to weed management and the cost effectiveness of the VMP.

12.1 MONITORING

Monitoring will be undertaken by vegetation survey and photo monitoring. Monitoring will need to be undertaken prior to works being commenced to establish a benchmark for performance, and to occur for the first two years on a 12-month basis. Monitoring results will be included in the Monitoring Report.

Photo monitoring points should be set-up using a permanent reference point to provide a visual reference of changes in the vegetation.

Photo monitoring is to include two photo points across the site. The points are to be established using the following methods:

- mark the photo point with a wooded stake and map the location using GPS
- take a digital photo showing the length of the star picket at a recorded bearing, preferably with a visual reference point in the background
- organise the digital photos logically with each image labelled with a unique reference number indicating the location of the photo point and the date the photo is taken.

12.2 MONITORING REPORTS

Monitoring reports are to be provided for the first two years on a 12-month basis. The reporting will include the implementation of the monitoring actions specified in this VMP. In addition to a description of the works that have been undertaken, this report should be structured to address the following questions:

- what environmental threats have been reduced
- what environmental improvements have been achieved
- what tasks have been successful

- what has not been successful
- what measures, if any, have been taken to rectify problems
- what, if any, issues need to be addressed
- what are the outcomes of the management activities
- recommendations for revisiting the task program if necessary.

13.0 COSTS

The total cost to implement this VMP is estimated at $86,315 until the end of the two-year maintenance period, exclusive of GST. An indicative costing timeline is provided in **Table 9**. Costs may vary significantly over consecutive years of management according to the response to the management actions.

The costings provided are indicative and there is potential for variation across the sector along with changes due to inflation. Other assumptions have been made in regards to estimating costs and are outlined below.

13.1 FENCING AND WASTE REMOVAL

Costs for any fencing works (silt and construction) or the removal of residing domestic waste and weedy biomass will be incurred by the client or contractors and have not been included in this budget.

13.2 WEED CONTROL TREATMENTS

Bush regeneration contractors will implement the weed control treatments identified in this VMP. These works have been estimated to cost $2,000 for a team of four bush regenerators, including a supervisor, per day. The cost of bush regeneration works includes the costs of herbicide, vehicles and equipment which are required to implement the VMP.

13.3 MULCH

Costs associated with the supply and delivery of mulch will be incurred by the client or contractors and have not been included in this budget.

13.4 REGENERATION TREATMENTS

Bush regeneration contractors will implement the revegetation treatments identified in this VMP. Tubestock costs have been budgeted at an estimated $3.50 per tree and shrub including planting, water crystals, fertiliser and initial watering, and an estimated $2.25 per grass, sedge and groundcover including planting, water crystals and initial watering. Revegetation has been based upon a revegetation cost using tubestock only.

A total of 17,565 plants will be required to achieve the densities identified in the VMP. The total estimated cost of revegetation is approximately $42,380.40 including a 10% replacement rate.

13.5 MONITORING AND REPORTING

Bush regeneration contractors or ecologists will undertake the monitoring and reporting identified in this VMP. This includes:

- initial setup of the photo points and conducting the baseline surveys
- preparing an annual report for the first two years

All monitoring, mapping and reporting works have been calculated using the rate for a qualified and trained Restoration Ecologist at $160/hour.

Table 9: Lump sum costs for management actions

Treatment	Unit costs for treatment zones		Total
	Zone 1	Zone 2	
Total area	2,100 m^2	2,300 m^2	4,400 m^2
Revegetation			
Seed collection, cleaning storage	$1,496.18	$1,138.78	$2,634.96
Site preparation	$1,050.00	$1,150.00	$2,200.00
Jute matting / mulch	$13,650.00	$8,510.00	$22,160.00
Tubestock, supply and install	$22,312.64	$16,215.00	$38,527.64
Replacement tubestock, supply and install	$2,231.26	$1,621.50	$3,852.76
Irrigation	$1,575.00	$1,725.00	$3,300.00
Weed control			
Establishment	$1,050.00	$1,150.00	$2,200.00
Maintenance – years 1 and 2	$4,200.00	$4,600.00	$8,800.00
Associated costs			
Monitoring and reporting	$1,260.00	$1,380.00	$2,640.00
Grand Total	**$48,825.09**	**$37,490.28**	**$86,315.37**

Table 10: Indicative annual breakdown of works

Treatment	Unit costs for treatment zones			
	Establishment	**Year 1**	**Year2**	**Total**
Revegetation				
Seed collection, cleaning storage	$2,634.96	-	-	$2,634.96
Site preparation	$2,200.00	-	-	$2,200.00
Jute matting / mulch	$22,160.00	-	-	$22,160.00
Tubestock, supply and install	$38,527.64	-	-	$38,527.64
Replacement tubestock, supply and install	-	-	$3,852.76	$3,852.76
Irrigation	$3,300.00	-	-	$3,300.00
Weed control				
Establishment	$2,200.00	-	-	$2,200.00
Maintenance – years 1 and 2	-	$4,400.00	$4,400.00	$8,800.00
Associated costs				
Monitoring and reporting	-	$1,320.00	$1,320.00	$2,640.00
Grant Total	$71,022.60	$5,720.00	$9,572.76	**$86,315.37**

14.0 REFERENCES

Brodie L. (1999). The National Trust Bush Regenerators Handbook. National Trust of Australia (NSW).

Buchanan R.A. (2000). Bush regeneration: recovering Australian landscapes. 2nd Edition. TAFE NSW, Sydney.

Department of Primary Industries (DPI) (2014). Noxious and environmental weed control handbook – A guide to weed control in non-crop, aquatic and bushland situations. 6th Edition. Department of Trade and Investment, Regional Infrastructure and Services. Available at: http://www.dpi.nsw.gov.au/content/agriculture/pests-weeds/weeds/publications/noxious-enviro-weed-control

DEC (2004). *Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft). NSW Department of Environment and Conservation, Hurstville NSW*

DECC (2007). *Threatened Species Assessment Guidelines: The Assessment of Significance. Department of Environment and Climate Chance, Hurstville NSW*

DotEE (2018). *Protected Matters Report using coordinates -34.56811 150.770681. Report created: 8/12/18 11:20:13*

Fairley, A., & Moore, P. (2010). *Native Plants of the Sydney Region. From Newcastle to Nowra and west to the Dividing Range. Allen & Unwin*

Keith, D. (2004). *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT. NSW Department of Environment and Conservation, Hurstville.*

Landcom (2004). Soils and Construction Volume 1 Managing Urban Stormwater., 4th Edition, March 2004.

Office of Environment and Heritage (OEH) (2018a). *Atlas of NSW Wildlife. Wildlife Data Unit, OEH, Parramatta NSW. Accessed 24 June 2018. Available at http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx*

Office of Environment and Heritage (OEH) (2018b). *Threatened species profiles. Accessed 20 November 2018. Available at http://www.threatenedspecies.environment.nsw.gov.au/index.aspx*

Office of Environment and Heritage (OEH) (2018c). *NSW Scientific Committee Determinations. Accessed 20 November 2018. Available at* http://www.environment.nsw.gov.au/determinations/

Tozer, M.G., Turner, K., Keith, D.A., Tindall, D., Pennay, C., Simpson, C., MacKenzie, B., Beukers, P. & Cox, S. (2010). *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Cunninghamia 11(3), 359-406.*

15.0 LIMITATIONS

This report and the associated services performed by Lodge Environmental are in accordance with the scope of services set out in the contract between Lodge Environmental and the Client. The scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to Site.

Lodge Environmental derived the data in this report primarily from visual inspections, and, limited survey and analysis made on the dates indicated. In preparing this report, Lodge Environmental has relied upon, and presumed accurate, certain information provided by government authorities, the Client and others identified herein. The report has been prepared on the basis that while Lodge Environmental believes all the information in it is deemed reliable and accurate at the time of preparing the report, it does not warrant its accuracy or completeness and to the full extent allowed by law excludes liability in contract, tort or otherwise, for any loss or damage sustained by the Client arising from or in connection with the supply or use of the whole or any part of the information in the report through any cause whatsoever.

The data, findings, observations, conclusions and recommendations in the report are based solely upon the state of the Site at the time of the investigation. The passage of time, manifestation of latent conditions or impacts of future events (e.g. changes in legislation, scientific knowledge, land uses, etc) may render the report inaccurate. In those circumstances, Lodge Environmental shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of the report.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between Lodge Environmental and the Client. Lodge Environmental accepts no liability or responsibility whatsoever and expressly disclaims any responsibility for or in respect of any use of or reliance upon this report by any third party or parties.

It is the responsibility of the Client to accept if the Client so chooses any recommendations contained within and implement them in an appropriate, suitable and timely manner.

Appendices

Appendix A: Threatened flora and fauna likelihood table

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Ecological Communities						
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community		-	E	Coastal Swamp Oak Forest typically occurs on unconsolidated sediments, including alluvium deposits, and where soils formed during the Quaternary period as a result of sea-level rise during the Holocene period. These are most typically hydrosols, which are saturated with water for long periods of time (typically grey-black clay-loam and/or sandy loam soils).	Low	No
Coastal Upland Swamps in the Sydney Basin Bioregion		E	E	The Coastal Upland Swamp in the Sydney Basin Bioregion includes open graminiod heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaux.	Low	No
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		**E**	**-**	**Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains.**	**High**	**No, only present off northern boundary, no impact to occur**
Illawarra and south coast lowland forest and woodland ecological community		E	CE	The ecological community occurs on the coastal plains and low foothills below the Great Escarpment between Wollongong and just south of Moruya. The ecological community is known from the Wollongong, Shellharbour, Kiama, Shoalhaven and Eurobodalla Local Government Areas	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Southern Highlands Shale Forest and Woodland in the Sydney Basin Bioregion		E	CE	It occurs roughly within an area bounded by the Illawarra Escarpment in the east, Burrawang and Bundanoon in the south, Canyonleigh in the west and Berrima and Colo Vale in the north. Occurs in the Wingecarribee local government area, but may occur elsewhere in the Sydney Basin Bioregion. Restricted to clay soils derived from Wianamatta Shale.	Low	No
Subtropical and Temperate Coastal Saltmarsh		E	V	Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands.	Low	No
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion		CE	E	Restricted chiefly to occurrences of Robertson Basalt on the Southern Highlands of NSW but also found on the Cambewarra Range to the south. Found on highly fertile soils derived from basalt.	Low	No
Plants						
Bynoe's Wattle	*Acacia bynoeana*	E	V	Bynoe's wattle is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches.	Low	No
	Allocasuarina glareicola	E	E	Grows in Castlereagh woodland on lateritic soil. Found in open woodland with Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla and Melaleuca decora.	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Lesser Creeping Fern	*Arthropteris palisotii*	E	-	The Lesser Creeping Fern grows on trees. Its creeping stem is branched and wiry and covered with dark scales. Occurs in rainforest.	Low	No
Deane's Boronia	*Boronia deanei*	V	V	Grows in wet heath, often at the margins of open forest adjoining swamps or along streams.	Low	No
Thick-lipped Spider-orchid	*Caladenia tessellata*	E	V	Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Also open heathland habitat. Flowers September to November.	Low	No
	Chorizema parviflorum	EP	-	This endangered population has been recorded from between Austinmer and Albion Park in the local government areas of Wollongong and Shellharbour. All known sites (excluding the site at Austinmer) occupy woodland or forest dominated by Forest Red Gum (Eucalyptus tereticornis) and/or Woollybutt (E. longifolia).	Low	No
Leafless Tongue-orchid	*Cryptostylis hunteriana*	V	V	Occurs in a range of communities, including swamp-heath and woodland. Larger populations typically occur in woodland dominated by Scribbly Gum (Eucalyptus sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black She-Oak (Allocasuarina littoralis). Flowers November to February.	Low	No
White-flowered Wax Plant	*Cynanchum elegans*	E	E	Restricted to eastern NSW, from Brunswick Heads on the north coast to Gerroa in the Illawarra region, and as far west as Merriwa in the upper Hunter River valley. Dry rainforest; littoral rainforest; Leptospermum laevigatum-Banksia integrifolia subsp. integrifolia (Coastal Tea-tree– Coastal Banksia) coastal scrub; Eucalyptus tereticornis (Forest Red Gum) or Corymbia maculata (Spotted Gum) open forest	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
				and woodland; and Melaleuca armillaris (Bracelet Honeymyrtle) scrub.		
Illawarra Socketwood	*Daphnandra johnsonii*	E	E	Rainforest tree to 20 metres tall. Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes.	Low	No
Yellow Gnat-orchid	*Genoplesium baueri*	E	E	Grows in dry sclerophyll forest and moss gardens over sandstone.	Low	No
	Gossia acmenoides	EP	-	Found in subtropical and dry rainforest on the ranges and coastal plain of eastern Australia	Low	No
Wingless Raspwort	*Haloragis exalata* subsp. *exalata*	V	V	Protected and shaded damp situations in riparian habitats.	Low	No
Illawarra Irene	*Irenepharsus trypherus*	E	E	Typically inhabits steep rocky slopes near cliff lines and ridge tops. The species is less typically found growing out of rock crevices or on narrow benches along cliff lines	Low	No
	Lespedeza juncea subsp. sericea	EP	-	Located in a small strip of open forest dominated by Eucalyptus tereticornis (Forest Red Gum), E. longifolia (Woollybutt), and Melaleuca decora (White Feather Honeymyrtle), on Budgong Sandstone.	Low	No
Biconvex Paperbark	*Melaleuca biconvexa*	V	V	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Low	No
Omeo Stork's-bill	*Pelargonium sp. Striatellum*	E	E	Known from only 4 locations in NSW, with three on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. Usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Low	No
Hairy Geebung	*Persoonia hirsuta*	-	E	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
-	*Pimelea curviflora var. curviflora*	V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowalnd Grassy Woodland habitat at Albion Park on the Illawaraa coastal plain.	Low	No
Spiked Rice-flower	*Pimelea spicata*	E	E	In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils.	Low	No
Carrington Falls Pomaderris	*Pomaderris walshii*	CE	-	Pomaderris walshii has been recorded in riparian habitat varying from shrubland to open grassy forest. Some more recent new records have found the species approximately 100 m from riparian habitat. Pomaderris walshii has a very highly restricted distribution. It is currently known only from the upper catchment of the Kangaroo River, above the escarpment near Robertson within the Sydney Basin Bioregion.	Low	No
Jervis Bay Leek Orchid	*Prasophyllum affine*	E	E	Grows on poorly drained grey clay soils that support low heathland and sedgeland communities.	Low	No
Illawarra Greenhood	*Pterostylis gibbosa*	E	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage.	Low	No
Waterfall Greenhood	*Pterostylis pulchella*	V	V	The Waterfall Greenhood is found on cliff faces close to waterfalls and creek banks and mossy rocks alongside running water.	Low	No
Sydney Plains Greenhood	*Pterostylis saxicola*	E	E	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where Pterostylis	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
				saxicola occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.		
Prickley-bush Pead	*Pultenaea aristata*	V	V	The species occurs in either dry sclerophyll woodland or wet heath on sandstone.	Low	No
	Solanum celatum	**E**	**-**	**Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Grows in rainforest clearings, or in wet sclerophyll forests.**	**Medium**	**No, none recorded**
Magenta Lilly Pilly	*Syzygium paniculatum*	V	E	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest.	Low	No
Kangaloon Sun Orchid	*Thelymitra kangaloonica*	CE	CE	Only known from the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area where it occurs in swamps in sedgelands. late October and early November.	Low	No
Austral Toadflax	*Thesium australe*	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast.	Low	No
Swamp Everlasting	*Xerochrysum palustre*	-	V	Grows in swamps and bogs which are often dominated by heaths.	Low	No
Velvet Zieria	***Zieria murphyi***	**V**	**V**	**The Velvet Zieria is found in sheltered positions in moist gullies in moist eucalypt forest with sandy soil.**	**Medium**	**No, none recorded**
Illawarra Zieria	*Zieria granulata*	E	E	The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils, usually on Bumbo Latite. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas on Quaternary sediments	Low	No
Aves						
Regent Honeyeater	*Anthochaera phrygia*	CE	CE	Mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. These woodlands have significantly	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
				large numbers of mature trees, high canopy cover and abundance of mistletoes.		
Common Sandpiper	*Actitis hypoleucos*	-	M	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	Low	No
Fork-tailed Swift	*Apus pacificus*	-	M	The Fork-tailed Swift is almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher.	Low	No
Wedge-tailed Shearwater	*Ardenna pacificus*	-	M	A pelagic, marine bird known from tropical and subtropical waters.	Low	No
Short-tailed Shearwater	*Ardenna tenuirostris*	-	M	A pelagic, marine bird known from tropical and subtropical waters.	Low	No
Ruddy Turnstone	*Arenaria interpres*	-	M	The Ruddy Turnstone is mainly found on coastal regions with exposed rock coast lines or coral reefs. It also lives near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches.	Low	No
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris.	Low	No
Australasian Bittern	*Botaurus poiciloptilus*	E	E	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.).	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Bush Stone-curlew	*Burhinus grallarius*	E	-	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.	Low	No
Sharp-tailed Sandpiper	*Calidris acuminata*	-	M	The Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Low	No
Sanderling	*Calidris alba*	V	M	Almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks	Low	No
Red Knot	*Calidris canutus*	-	E, M	The Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs.	Low	No
Curlew Sandpiper	*Calidris ferruginea*	E	CE, M	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts.	Low	No
Pectoral Sandpiper	*Calidris melanotos*	-	M	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Low	No
Great Knot	*Calidris tenuirostris*	V	CE	Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons.	Low	No
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V	-	Prefers tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests during summer, these being at higher altitudes. In winter, occurs at lower altitudes in drier, more	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
				open eucalypt forests and woodlands, or in dry forest in coastal areas.		
Glossy Black Cockatoo	***Calyptorhynchus lathami***	**V**	**-**	**In NSW, widespread along coast and inland to the southern tablelands and central western plains, with a small population in the Riverina. Open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur.**	**Medium**	**No, no impact to occur**
Greater Sand Plover	*Charadrius leschwenaultii*	-	E	Almost entirely coastal, inhabiting littoral and estuarine habitats.	Low	No
Lesser Sand Plover	*Charadrius mongolus*	-	E	Almost entirely coastal, inhabiting littoral and estuarine habitats.	Low	No
White-winged Black Tern	*Chlidonias leucopterus*	-	M	Mostly inhabits fresh, brackish or saline, and coastal or subcoastal wetlands.	Low	No
Spotted Harrier	*Circus assimilis*	V	-	Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Low	No
Oriental Cuckoo	*Cuculus optatus*	-	M	Mainly inhabits forests, occurring in coniferous, deciduous and mixed forest.	Low	No
Varied Sittella	*Daphoenositta chrysoptera*	V	-	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Low	No
Eastern Bristlebird	*Dasyornis brachypterus*	E	E	Dense, low vegetation including heath and open woodland with a heath understorey.	Low	No
Antipodean Albatross	*Diomedea antipodensis*	V	V, M	This species regularly occurs in small numbers off the NSW south coast from Green Cape to Newcastle during winter where they feed on cuttlefish.	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Gibson's Albatross	*Diomedea antipodensis gibsoni*	-	V, M	Gibson's Albatross is marine, pelagic and aerial. In the Antarctic, it occurs in open water, and rarely enters the belt of icebergs region.	Low	No
Southern Royal Albatross	*Diomedea epomophora*	-	V, M	Marine, pelagic and aerial.	Low	No
Wandering Albatross	*Diomedea exulans*	-	V	Marine, pelagic and aerial.	Low	No
Northern Royal Albatross	*Diomedea sanfordi*	-	E	Marine, pelagic and aerial.	Low	No
Black-necked Stork	*Ephippiorhynchus asiaticus*	E	-	Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	Low	No
White-fronted Chat	*Epthianura albifrons*	V	-	Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs.	Low	No
Latham's Snipe	*Gallinago hardwickii*	-	M	hey usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies).	Low	No
Gull-billed Tern	*Gellochelidon nilotica*	-	M	Found in freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grasslands.	Low	No
Sooty Oystercatcher	*Haematopus fuliginosus*	V	-	Strictly coastal, usually within 50 m of the ocean.	Low	No
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	-	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea.	Low	No
Little Eagle	*Hieraaetus morphnoides*	V	-	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
White-throated Needletail	*Hirundapus caudacutus*	-	M	Almost exclusively aerial. Takes insects on wing over a range of habitat types. Recorded most often above wooded areas, including open forest and rainforest	Low	No
Caspian Tern	*Hydroprogne caspia*	-	M	Found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred.	Low	No
Comb-crested Jacana	*Irediparra gallinacea*	V	-	Found in tropical and subtropical freshwater wetlands, including lagoons, billabongs, swamps, lakes, rivers, sewage ponds and dams, providing there is adequate floating vegetation.		
Black Bittern	*Ixobrychus flavicollis*	V	-	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation.	Low	No
Swift Parrot	*Lathamus discolor*	E	CE	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations	Low	No
Black Bittern	*Ixobrychus flavicollis*	V	-	Found in tree-lined wetlands and in mangroves.	Low	No
Broad-billed Sandpiper	*Limicola falcinellus*	V	M	Favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat.	Low	No
Bar-tailed Godwit	*Limosa lapponica baueri*	-	V	Mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays	Low	No
Northern Siberian Bar-tailed Godwit	*Limosa lapponica menzbieri*	-	M	Mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays	Low	No
Square-tailed Kite	*Lophoictinia isura*	V	-	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Southern Giant Petrel	*Macronectes giganteus*	-	E	Marine bird that occurs in Antarctic to subtropical waters.	Low	No
Northern Giant Petrel	*Macronectes halli*	-	V	Marine and oceanic	Low	No
Black-faced Monarch	*Monarcha melanopsis*	-	M	Mainly occurs in rainforest ecosystems	Low	No
Spectacled Monarch	*Monarcha trivigatus*	-	M	Prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Low	No
Yellow Wagtail	*Motacilla flava*	-	M	Inhabits open country near water, such as wet meadows.	Low	No
Satin Flycatcher	*Myiagra cyanoleuca*	-	M	Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands.	Low	No
Orange-bellied Parrot	*Neophema chrysogaster*	-	CE	Breeding occurs in south-west Tasmania in summer, and the birds overwinter on the coast of south-east mainland Australia.	Low	No
Turquoise Parrot	*Neophema pulchella*	V	-	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Low	No
Eastern Curlew	*Numenius madagascariensis*	-	CE	The eastern curlew takes an annual migratory flight to Russia and north-eastern China to breed, arriving back home to Australia in August to feed on crabs and molluscs in intertidal mudflats.	Low	No
Whimbrel	*Numenius phaeopus*	-	M	Often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats.	Low	No
Barking Owl	*Ninox connivens*	V	-	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland.	Low	No
Powerful Owl	*Ninox strenua*	V	-	Large tracts of open or closed sclerophyll forest or woodlands but can occur in fragmented	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
				landscapes as well. Gullies consisting of wet to dry sclerophyll forest with a dense understorey.		
Blue-billed Duck	*Oxyura australis*	V	-	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover.	Low	No
Olive Whistler	*Pachycephala olivacea*	V	-	Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes.	Low	No
Fairy Prion	*Pachyptila turtur subantarctica*	-	V	The fairy prion is found throughout oceans and coastal areas	Low	No
Eastern Osprey	*Pandion cristatus*	V	-	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes.	Low	No
Scarlet Robin	*Petroica boodang*	V	-	Lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. Its habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	Low	No
Flame Robin	*Petroica phoenicea*	V	-	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys.	Low	No
Pink Robin	***Petroica rodinogaster***	**V**	**-**	**Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.**	**Medium**	**No, no impact to occur**
Eastern Ground Parrot	*Pezoporus wallicus wallicus*	V	-	The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover).	Low	No
Glossy Ibis	*Plegadis falcinellus*	-	M	Fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation.	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Pacific Golden Plover	*Pluvialis fulva*	-	M	Usually inhabits coastal habitats, though it occasionally occurs around inland wetlands.	Low	No
Grey Plover	*Pluvialis squatarola*	-	M	Almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons	Low	No
Australian Painted Snipe	*Rostratula australis*	E	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Low	No
Rufous Fantail	*Rhipidura rufifrons*	-	M	Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground.	Low	No
Australian Fairy Tern	*Sternula nereis nereis*	-	V	Nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation.	Low	No
Freckled Duck	*Stictonetta naevosa*	V	-	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree.	Low	No
Buller's Albatross	*Thalassarche bulleri*	-	V	Marine and pelagic.	Low	No
Northern Buller's Albatross	*Thalassarche bulleri platei*	-	V	Marine and pelagic.	Low	No
Shy Albatross	*Thalassarche cauta cauta*	-	V	Marine and pelagic.	Low	No
White-capped Albatross	*Thalassarche cauta steadi*	-	V	Marine and pelagic.	Low	No
Chatham Albatross	*Thalassarche eremita*	-	E	Marine and pelagic.	Low	No
Campbell Albatross	*Thalassarche impavida*	-	V	Marine and pelagic.	Low	No
Black-browed Albatross	*Thalassarche melanophris*	-	V	Marine and pelagic.	Low	No
Salvin's Albatross	*Thalassarche salvini*	-	V	Marine and pelagic.	Low	No
Masked Owl	*Tyto novaehollandiae*	V	-	Lives in dry eucalypt forests and woodlands from sea level to 1100 m.	Low	No

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Sooty Owl	*Tyto tenebricosa*	V	-	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	Low	No
Terek Sandpiper	*Xenus cinereus*	V	M	Found on the coast in mangrove swamps, tidal mudflats and the seashore.	Low	No
Mammals						
Eastern Pygmy-possum	*Cercartetus nanus*	V	-	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes.	Low	No
Large-eared Pied Bat	***Chalinolobus dwyeri***	**V**	**V**	**Cave-roosting bat that forages in timbered woodland and dry sclerophyll forest**	**Medium**	**No, no impact to occur**
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Low	No
Eastern False Pipistrelle	***Falsistrellus tasmaniensis***	**V**	**-**	**Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.**	**Medium**	**No, no impact to occur**
Southern Brown Bandicoot (eastern)	*Isoodon obesulus obesulus*	E	E	Southern Brown Bandicoots are largely crepuscular (active mainly after dusk and/or before dawn). They are generally only found in heath or open forest with a heathy understorey on sandy or friable	Low	No
Little Bentwing-bat	***Miniopterus australis***	**V**	**-**	**Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.**	**Medium**	**No, no impact to occur**
Eastern Bentwing-bat	***Miniopterus schreibersii oceanensis***	**V**	**-**	**Cave-roosting bat that forages in well-timbered habitats and open grasslands.**	**Medium**	**No, no impact to occur**

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
Eastern Freetail-bat	***Mormopterus norfolkensis***	**V**	**-**	**Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost maily in tree hollows but will also roost under bark or in man-made structures.**	**Medium**	**No, no impact to occur**
Southern Myotis	***Myotis macropus***	**V**	**-**	**Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.**	**Medium**	**No, no impact to occur**
Greater Glider	*Petauroides volans*	-	V	It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species.	Low	No
Brush-tailed Rock-wallaby	*Petrogale penicillata*	E	V	Habitats containing numerous ledges, caves and crevices are favoured by this species.	Low	No
Koala	*Phascolarctos cinereus*	V	V	Open eucalypt forest and woodland, containing a variety of 'preferred'	Low	No
Long-nosed Potoroo	*Potorous tridactylus tridactylus*	V	V	Inhabits coastal heath and dry and wet sclerophyll forests with dense cover which provides diurnal sheltering sites and protection from predators, whilst foraging in adjacent, open areas.	Low	No
New Holland Mouse	*Pseudomys novaehollandiae*	-	V	Open heathland, open woodland with a heathland understorey and vegetated sand dunes.	Low	No
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests	Low	No
Yellow-bellied Sheathtail-bat	***Saccolaimus flaviventris***	**V**	**-**	**Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.**	**Medium**	**No, no impact to occur**
Greater Broad-nosed Bat	***Scoteanax rueppellii***	**V**	**-**	**Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and**	**Medium**	**No, no impact to occur**

Common Name	Scientific Name	Legislation		Habitat Associations	Likelihood of Occurrence	Further Significance Assessment Undertaken
		BC Act	EPBC Act			
				rainforest, though it is most commonly found in tall wet forest.		
Frogs						
Giant Burrowing Frog	*Heleioporus australiacus*	V	V	Heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	Low	No
Green and Golden Bell Frog	*Litoria aurea*	E	V	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.).	Low	No
Littlejohn's Tree Frog	*Litoria littlejohni*	V	V	This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation.	Low	No
Stuttering Frog	*Mixophyes balbus*	E	V	Typically found in association with permanent streams through temperate and sub-tropical rainforest and wet sclerophyll forest, and also in moist gullies in dry forest.	Low	No
Red-crowned Toadlet	*Pseudophryne australis*	V	-	Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings.	Low	No
Reptiles						
Broad-headed Snake	*Hoplocephalus bungaroides*	E	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges.	Low	No
Fish						
Macquarie Perch	*Macquaria australasica*	E	E	A riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover.	Low	No
Australian Grayling	*Prototroctes maraena*	E	V	Adults (including pre spawning and spawning adults) inhabit cool, clear, freshwater streams with gravel substrate and areas alternating between pools and riffle zones.	Low	No

Key. V=Vulnerable, E=Endangered, Ep=Endangered Population, CE=Critically Endangered, M=Migratory.
Species habitat associations have been informed predominantly from OEH (2018) and DotEE (2018) species profiles.

Appendix B: Flora Species List

Scientific name	Native	Exotic
Acetosella vulgaris		x
Briza subaristata		x
Calistemon sp	x	
Cardiospermum grandiflorum.		x
Cinnamomum camphora		x
Cirsium vulgare		x
Cirsium vulgare		x
Citrus reticulata		x
Conyza sp.		x
Cynodon dactylon	x	
Erythrina x sykessii		x
Fruticosus aggregate		x
Holcus lanatus		x
Hypochaeris sp.		x
Jacaranda mimosifolia		x
Juncus sp	x	
Lantana camara		x
Ligustrum lucidum		x
Lotus subbiflorus		x
Lysmachia arvensis		x
Nerium oleander		x
Paspalum urvillei		x
Plantago lancelata		x
Senecio madagascariensis		x
Solanum linnaeanum		x
Solanum mauritianum		x
Strelitzia reginae		x
Taraxicum sp.		x
Trifolium repens		x
Verbena bonariensis		x

Appendix C: Fauna Species List

Class Name	Scientific Name	Common Name
Bird	*Chenonetta jubata*	Australian wood duck
	Coracina novaehollandiae	Black-faced cuckooshrike
	Corvus coronoides	Australian Raven
	Dacelo novaeguineae	Laughing kookaburra
	Egretta novaehollandiae	White-faced Heron
	Falco cenchroides	Nankeen kestrel
	Gymnorhina tibicen	Australian Magpie
	Platycercus eximius	Eastern Rosella
	Rhipidura albiscapa	Grey Fantail
	Rhipidura leucophrys	Willie wagtail
	Threskiornis moluccus	Australian White Ibis
	Trichoglossus moluccanus	Rainbow lorikeet