Travers

bushfire & ecology

flora & fauna assessment

175 Racecourse Road
Clarendon

September 2014
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Flora & Fauna Assessment

175 Racecourse Road, Clarendon

October 2014

Report Authors:	Michael Sheather-Reid B. Nat. Res. (Hons.) - Senior Ecologist
	Lindsay Holmes B. Sc. - Botanist
	Corey Mead B. App. Sc. - Fauna Ecologist
Plans prepared:	Peter Tolley, Trent Matheson
Checked by:	Michael Sheather-Reid
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The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

ABN 64 083 086 677
PO Box 7138
Kariong NSW 2250

38A The Avenue
Mt Penang Parklands
Central Coast Highway
Kariong NSW 2250

t: 02 4340 5331
e: info@traversecology.com.au
www.traversecology.com.au

Executive Summary

Travers bushfire & ecology has been engaged to undertake a flora and fauna assessment for the proposed relocation of *Heartbreak Ridge Paintball* facility within the southern portion of part Lot 3 DP 1105163, located to the east of Racecourse Road, Clarendon.

The study area is contained within Lot 3 DP 1105163 but only includes lands that may be used for any future paint ball activities. However, the current proposal to limit the paint ball activity to the main cleared areas and is referred to as the subject site.

Recorded threatened flora, fauna & EECs

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979*, the *Threatened Species Conservation Act 1995*, the *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1994.*

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979* and relating to the species / provisions of the *Threatened Species Conservation Act 1995*, five (5) threatened fauna species including Large-footed Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus orianae oceansis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), East-coast Freetail Bat (*Micronomus norfolkensis*) and Cumberland Plain Land Snail (*Meridolum corneovirens*), no threatened flora species, and four (4) EECs, Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains, Freshwater Wetlands on Coastal Floodplains and Swamp Oak Floodplain Forest were recorded within the study area. The Greater Broad-nosed Bat and East-coast Freetail Bat were recorded only to a 'possible' level of certainty. No endangered populations were observed.

A finalised layout design of the proposed facility has not been provided and as such this assessment is based on an assumed impact zone as a result of the proposed facility. The proposed facility is not expected to have an adverse impact on the existing vegetation except through possible on ground trampling and damage caused by the users of the facility.

The proposed location of car parking, building and outdoor zone and seating (developable portion of the site, see figure 1) is restricted to fully cleared areas and young regrowth woodland only. The young regrowth woodland is up to 6m tall but often less, is subjected to past clearing and grazing.

Areas of older regrowth along Racecourse Road will mostly not be affected, with access generally restricted to and from Racecourse Road. The area in the central portion of the site proposed as paintball playing fields do not require vegetation clearance with the exception of potential fencing to delineate each field. The regrowth vegetation would be subjected to trampling in the playing fields which may lead to a slow long term decline in native species diversity, although the main canopy species and taller mid-storey ones are likely to remain intact.

A proposal of this nature is not likely to remove or disturb known threatened flora specimens or known Cumberland Plain Land Snail locations. There is also not likely to be any adverse impact upon the EECs Freshwater Wetlands or River-flat Eucalypt Forest. The locations of the playing fields are setback from the creek however no restriction on the paintball fields has been provided to avoid direct access and associated impacts upon riparian habitats and SREP 20 wetlands.

In accordance with Section 5A of the *Environmental Planning and Assessment Act 1979*, the 7 part test of significance concluded that the proposed paintball operations and associated facilities will not have a significant impact on any threatened species, populations or EECs. Therefore, a Species Impact Statement should not be required for the proposal.

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, no threatened fauna species, two protected migratory bird species including Great Egret (*Ardea alba*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*), no threatened flora species, and one (1) EEC, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest listed under this Act were recorded within the study area.

The proposal was not considered to have a significant impact on matters of national environmental significance. As such a referral to Department of Environment should not be required.

In respect of matters relative to the *Fisheries Management Act 1994*, the proposed activity is not located in an area identified as critical habitat. The adjacent Rickabys Creek supports sub-optimal habitat for the threatened Macquarie Perch which has not before been recorded along this tributary. There will be no detrimental effect on water quality, water quantity or any direct / indirect impacts upon threatened fish species habitat as a result of the proposed action. Therefore a species impact statement should not be required for the proposed development in regard to fish species.

Mitigation Measures

Mitigation measures have been recommended to reduce the identified potential impacts of the proposal on threatened biodiversity. Of primary importance however is the protection of any riparian, wetland and EEC habitat areas.

As a general recommendation a 40m buffer should be applied to Rickaby's Creek and any wetlands within the site. Wetlands include the mapped wetlands in the southern portion of the site and any portion of Rickaby's Creek which is mapped as A SREP 20 Wetland.

Moderate and high quality areas of EEC within the proposed playing fields should also be protected and allowed to regenerate. Should these areas be impacted to any significant degree then it may cause the imposition of biodiversity offsets in the form of protection or restoration areas which can be mostly provided within the site.

Conclusion

It is concluded that the proposed Recreational facility within the subject site (within the southern portion of part Lot 3 DP 1105163) off Racecourse Road, Clarendon, is unlikely to result in a significant impact on any threatened species, populations or EECs or their habitats.

As such no further assessments are considered to be required under the *Environmental Planning and Assessment Act 1979*, the *Environment Protection and Biodiversity Conservation Act 1999* or the *Fisheries Management Act 1994*.

Recommendations have been outlined within Section 5.3 to minimise the identified potential ecological impacts, address threatening processes which will create a more positive ecological outcome for threatened species and their associated habitats.

List of abbreviations

APZ	asset protection zone
BPA	bushfire protection assessment
CLUMP	conservation land use management plan
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from 4/07)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from 10/09)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from 4/11)
DEWHA	Commonwealth Department of the Environment, Water, Heritage & the Arts (superseded by SEWPAC)
DOE	Commonwealth Department of Environment
EEC	endangered ecological community
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESMP	ecological site management plan
FF	flora and fauna assessment
FM Act	*Fisheries Management Act 1994*
FMP	fuel management plan
HTA	habitat tree assessment
IPA	inner protection area
LEP	Local Environment Plan
LGA	local government area
NES	national environmental significance
NPWS	NSW National Parks and Wildlife Service
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (Part of the NSW Department of Premier and Cabinet)
OPA	outer protection area
PBP	*Planning for bush fire protection 2006*
POM	plan of management
RF Act	*Rural Fires Act*
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SEPP 44	*State Environmental Protection Policy No 44 – Koala Habitat Protection*
SEWPAC	Com. Department of Sustainability, Environment, Water, Population & Communities (now DOE)
SIS	species impact statement
SULE	safe useful life expectancy
TPO	tree preservation order
TPZ	tree preservation zone
TRRP	tree retention and removal plan
TSC Act	*Threatened Species Conservation Act 1995*
VMP	vegetation management plan

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Introduction 1

Travers bushfire & ecology has been engaged by *Heartbreak Ridge Paint Ball* to undertake a flora and fauna assessment for the proposed relocation of *Heartbreak Ridge Paintball* from its original location at Richmond Road, Marden Park, to a site managed by University of Western Sydney (UWS) – Richmond, on Racecourse Road, Clarendon between Richmond Road and Rickaby Street.

The proposed works area which includes a reception building and associated outdoor congregation area and the playing fields will hereafter be referred to as the 'subject site' (Figure 1).

1.1 Aims of the assessment

The aims of the flora and fauna assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their conditions
- Carry out a fauna survey for the detection and assessment of fauna and their habitats
- Complete target surveys for threatened species, populations and ecological communities
- Prepare a flora and fauna impact assessment in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act* (EPBC Act), the *Threatened Species Conservation Act* (TSC Act), the *Fisheries Management Act* (FM Act) and Threatened species assessment guidelines, the assessment of significance (DECC 2007)

1.2 Statutory requirements

1.2.1 Threatened Species Conservation Act (TSC Act)

The specific requirements of the *TSC Act* must be addressed in the assessment of impacts on threatened flora and fauna, populations and ecological communities. The factors to be taken into account in deciding whether there is a significant effect are set out in Section 5A of the *Environmental Planning and Assessment Act* (EP&A Act) and are based on a 7 part test of significance. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

1.2.2 Fisheries Management Act 194 (FM Act)

The *FM Act* provides a list of threatened aquatic species that require consideration when addressing the potential impacts of a proposed development. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, an SIS is required to be prepared.

1.2.3 *Environment Protection and Biodiversity Conservation Act (EPBC Act)*

The *EPBC Act* requires that Commonwealth approval be obtained for certain actions. It provides an assessment and approvals system for actions that have a significant impact on matters of *national environmental significance* (NES). These may include:

- World Heritage Properties and National Heritage Places
- Wetlands of International Importance protected by international treaty
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species
- Commonwealth marine environment

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on an NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, then the matter needs to be referred to the Commonwealth Department of Environment (DOE) for assessment. In the case where no listed federal species are located on site then no referral is required. The onus is on the proponent to make the application and not the Council to make any referral.

A threshold criterion apply to specific NES matters which may determine whether a referral is or is not required, such as for the EPBC listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with DOE may be required to determine whether a referral is or is not required. If there is any doubt as to the significance of impact or whether a referral is required, a referral is generally recommended to provide a definite decision under the EPBC Act 1999 thereby removing any further obligations in the case of 'not controlled' actions.

A significant impact is regarded as being:

> *important, notable, or of consequence, having regard to its context or intensity and depends upon the sensitivity, value, and quality of the environment which is impacted and upon the duration, magnitude, and geographical extent of the impacts. A significant impact is likely when it is a real or not a remote chance or possibility.*
>
> *Source: EPBC Policy Statement*

Guidelines on the correct interpretation of the actions and assessment of significance are located on the department's web site http://www.environment.gov.au/epbc/publications.

1.3 Proposed works

The proposed development is to relocate the *Heartbreak Ridge Paintball* operation to University land located on the eastern side of Racecourse Road, bounded partly by Rickaby Street and Rickabys Creek.

The proposed facility layout is conceptually shown in Figure 1 and incorporates up to ten playing fields, access and parking off Racecourse Road, a main building and a seating area. The proposal currently provides some buffers to intact woodland, neighbouring lots and the creek line.

The area to be impacted by the proposed facility is subject to a more detailed design of the facility. However, this report has been prepared as an assessment of impacts of a potential operations area (Figure 1).

Figure 1 – Approximate layout of proposed fields and buildings

1.4 Site description

Table 1.1 provides a summary of the planning, cadastral, topographical, and disturbance details of the subject site.

Table 1.1 – Site features

Location	Clarendon, Racecourse Road
Local government area	Hawkesbury
Grid reference	294600E 6276900N
Elevation	Approximately 5-25m AMSL
Topography	Situated on a mostly flat floodplain landscape with slight rises out of the floodplain towards the north and west.
Geology and soils	Geology; Londonderry Clay – clay, patches of ferruginised, consolidated sand Soils; Upper Castlereagh Soil Landscape – deep yellow podzolic soils and yellow-brown earths.
Catchment and drainage	Catchment - Hawkesbury River Site flows run into the adjacent Rickabys Creek which flows approximately 6km north into the Hawkesbury River at Windsor.

Vegetation	The site exhibits regrowth vegetation which is comprised of small-trunked canopy trees with some tree-less patches. Cumberland Plain Woodland exists in the western and northern portion whilst River-flat Eucalypt Forest dominates the eastern and southern portion. There is some Freshwater Wetlands associated with offshoots of Rickabys Creek along the eastern boundary.
Existing land use	Rural (previous grazing)
Clearing	The majority of the study area has been previously cleared for indicated land uses.

Survey Methodology 2

2.1 Information collation, technical resources, desktop assessments, specialist identification and licences

A review of the relevant information pertinent to the subject site was undertaken.

Client documents reviewed include:

- Concept layout plan provided by *Heartbreak Ridge Paintball Pty Ltd*

Standard Technical Resources utilised:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- Aerial photographs (Google Earth Pro / Spatial Information Exchange)
- Topographical maps (scale 1:25,000)
- *Threatened Species Conservation Act 1995* (TSC Act)
- *Fisheries Management Act 1994* (FM Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Rare or Threatened Australian Plants (ROTAP)
- Vegetation Mapping of the Cumberland Plain (NPWS 2002)
- Vegetation mapping – NPWS (2002) and Hawkesbury Council (2007)

Desktop Assessment:

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site, desktop assessments were undertaken including:

- ***A literature review*** – A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey.

- ***A data search*** – A search of the *Atlas of NSW Wildlife* (OEH 2014) was undertaken to identify records of threatened flora and fauna species located within a 10km radius of the site. Searches were also undertaken on the DOE – 'protected matters search tool' website to generate a report that will help determine whether matters of national environmental significance or other matters protected by the EPBC Act are likely to occur in the area of interest. The search was broadened to a 10km radius like the Atlas search. These two searches combined, enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables A2.1, A2.2 and A2.3).

Accuracy of identification:

Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation were made according to Specht *et al* (1995).

***Licences*:**

Individual staff members of *Travers bushfire & ecology* are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Sections 120 & 131 of the *National Parks and Wildlife Act 1974* to conduct flora and fauna surveys within service and non service areas. NPWS Scientific Licence Numbers: SL100848.

Travers bushfire & ecology staff are licensed under an Animal Research Authority issued by the Department of Agriculture. This authority allows *Travers bushfire & ecology* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

2.2 Flora survey methodology

Flora survey was undertaken on July 24th and 25th, 2014. A random meander search was undertaken in accordance with Cropper (1993) to create a broad species list (see Table 3.1)

Eighteen (18) 20x20m floristic biometric style quadrats were assessed within vegetated portions of the study area. One (1) vegetation transect was also undertaken. Target searches for threatened species were undertaken for particular species where applicable during the random meander and stratified surveys.

A review of the Atlas of NSW Wildlife (OEH 2014) and searches via the EPBC coordinate tool were undertaken prior to the botanical survey to identify threatened species previously recorded within 10km of the site (or habitat and determine whether target searches were needed to be undertaken.

Target threatened flora species searches focussed more so within the Cumberland Plain Woodland remnants on species such as *Dillwynia tenuifolia, Grevillea juniperina* subsp. *juniperina* and *Acacia pubescens.*

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.1 and are depicted on Figure 2.

Current standard fauna survey techniques employed by *Travers bushfire & ecology* in line with relevant survey guidelines as well as current survey knowledge are provided in Appendix 1. Fauna survey techniques that have been tailored to the site are provided in Section 2.6.

2.4 Field survey effort

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the subject site.

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Diurnal birds	22/7/14 23/7/14	0/8 cloud, no wind, no rain, temp 16-18°C 1-4/8 cloud, no wind, no rain, temp 15-18°C	Census points / diurnal opportunistic Census points / diurnal opportunistic	5hrs 1230 - 1730 4hrs 40min 1020 - 1500
Nocturnal birds	22/7/14	0/8 cloud, no wind, no rain, temp 15-11°C	Spotlighting Call playback (Section 2.5 species)	1hr 50min 1730 - 1920 Commenced @ 1800
Arboreal mammals	22/7/14	0/8 cloud, no wind, no rain, temp 15-11°C	Spotlighting Call playback (Section 2.5 species)	1hr 50min 1730 - 1920 Commenced @ 1810
Terrestrial mammals	22/7/14	0/8 cloud, no wind, no rain, temp 15-11°C	Spotlighting	1hr 50min 1730 - 1920
Bats	22/7/14	0/8 cloud, no wind, no rain, temp 15-11°C	Spotlighting Anabat SD-2 (Passive monitoring) x3	1hr 50min 1730 - 1920 Overnight from 1720
Reptiles	22/7/14 23/7/14	0/8 cloud, no wind, no rain, temp 16-18°C 1-4/8 cloud, no wind, no rain, temp 15-18°C	Habitat search, opportunistic Habitat search, opportunistic	5hrs 1230 - 1730 4hrs 40min 1020 - 1500
Amphibians	22/7/14	0/8 cloud, no wind, no rain, temp 15-11°C	Spotlighting & call identification	1hr 50min 1730 - 1920
Molluscs	22/7/14 23/7/14	0/8 cloud, no wind, no rain, temp 16-18°C 1-4/8 cloud, no wind, no rain, temp 15-18°C	Opportunistic habitat searches Opportunistic habitat searches	5hrs 1230 - 1730 4hrs 40min 1020 - 1500

Table 2.2 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	Survey of the boundaries of all communities – field verification and aerial photographic interpretation	24/7/14, 25/7/14
Stratified sampling	20x20m quadrats in all existing bushland or remnant areas 1x linear transect	24/7/14, 25/7/14
Target searches	Target searches in known habitats	24/7/14, 25/7/14

2.5 Site specific survey techniques

Diurnal birds

Nine (9) diurnal bird census points were undertaken within the study area. A minimum of 20 minutes of survey was undertaken at each census point in an area radiating out to between 30-50m. Bird census points were selected to give an even spread and representation across the site and its communities (see Figure 2). As different small bird species are often found foraging together, census points were also located where bird activity was apparent. Opportunistic diurnal bird survey was conducted between census points and whilst undertaking other diurnal surveys.

Nocturnal birds

Given the variable suitability of habitat present, Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*) were targeted by call-playback techniques. Call-playback locations for the bitterns were undertaken only adjacent to Rickabys Creek as located on Figure 2.

Arboreal and terrestrial mammals

Given the suitability of habitat present Squirrel Glider (*Petaurus norfolcensis*) was targeted by call-playback techniques.

Invertebrates

Given the proximity to previous Atlas of NSW Wildlife records of Cumberland Plain Land Snail (*Meridolum corneovirens*) and the recorded presence of its typical host community, target surveys were undertaken. Habitat searches were undertaken both within Cumberland Plain Woodland mapped areas as well as other locations within the study area where suitable shelter habitat was found. The most appropriate areas of observed habitat were searched opportunistically when encountered. Snail refuges such as loose logs and dense areas of leaf litter with higher residual moisture were investigated. Leaf litter was carefully scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks were also turned over where possible and repositioned.

Significant habitat trees

Significant habitat trees are defined as trees containing large hollows suitable for use by owls and/or containing a number of good quality hollows typically consisting of more than one medium (10-30cm) sized hollow. A tree may also be considered significant where evidence of use by select fauna is found such as Yellow-bellied Glider sap feed tree, raptor nest, or owl roost.

No significant habitat trees were recorded present within the study area during survey (Figure 2).

2.6 Survey limitations

It is important to note that field survey data collected during the survey period is representative of species occurring within the subject site for that occasion. Due to effects of fire, breeding cycles, migratory patterns, camouflage, weather conditions, time of day, visibility, predatory and / or feeding patterns, increased species frequency or richness may

be observed within the subject site outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to minimise the implications of this survey limitation.

Given the limited potential for threatened species to occur on site because of the heavily disturbed (and removed understorey), it is unlikely that there are any significant limitations of this study.

Flora survey limitations

Whilst some flora species are difficult to identify unless flowering, the presence of some species on site may have been overlooked. Care has been taken to target any area where native vegetation was present traversing in a zig zag pattern or in linear lines approximately 8-10m apart.

Fauna survey limitations

Nocturnal survey was undertaken during winter. Microbat surveys should ideally instead be undertaken during warmer months when activity is greater. This is not considered to be a concern in respect to the proposal given that no hollow-bearing trees or other potential roosting habitat will be impacted.

Detection of Cumberland Plain Land Snail (CPLS) is best after rainfall when a greater number of specimens come to the surface for activity. Survey was instead undertaken after an extended dry winter period. This is not a limitation of concern given that the dominance of *Cornu aspersum* was very evident within disturbed areas and CPLS was recorded within areas most expected based on floristics mapping.

Survey Results 3

3.1 Flora results

3.1.1 Flora species

The plants observed within the vegetation communities of the subject site are listed in the Table 3.1 below.

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name
Trees		
Mimosaceae	*Acacia parramattensis*	Parramatta Wattle
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark
Myrtaceae	*Eucalyptus moluccana*	Grey Box
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Fabaceae	*Gleditsia triacanthos**	Honey Locust
Proteaceae	*Grevillea robusta**	Silky Oak
Myrtaceae	*Melaleuca decora*	-
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree
Arecaceae	*Phoenix canariensis**	Canary Island Date Palm
Shrubs		
Mimosaceae	*Acacia falcata*	Sickle Wattle
Mimosaceae	*Acacia floribunda*	Sally Wattle
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Native Blackthorn
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush
Solanaceae	*Cestrum parqui**	Chilean Cestrum
Faboideae	*Chorizema parviflorum*	Eastern Flame Pea
Asteraceae	*Chrysanthemoides monilifera* subsp. *monilifera**	Boneseed
Fabaceae	*Daviesia genistifolia*	-
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea
Fabaceae	*Dillwynia sieberi*	Prickly Parrot-pea
Sapindaceae	*Dodonaea viscosa* subsp. *angustifolia*	-
Proteaceae	*Hakea sericea*	Needlebush
Myrtaceae	*Kunzea ambigua*	Tick Bush
Verbenaceae	*Lantana camara**	Lantana
Myrtaceae	*Leptospermum polygalifolium* subsp. *polygalifolium*	Tantoon
Oleaceae	*Ligustrum sinense**	Small-leaved Privet
Solanaceae	*Lycium ferocissimum**	African Boxthorn

Family	Scientific Name	Common Name
Myrtaceae	*Melaleuca nodosa*	Ball Honey Myrtle
Oleaceae	*Olea europaea* subsp. *cuspidata**	African Olive
Rubiaceae	*Opercularia diphylla*	-
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood
Malvaceae	*Pavonia hastata**	Pavonia
Euphorbiaceae	*Poranthera ericifolia*	-
Rosaceae	*Rubus fruticosus* sp. agg.*	Blackberry Complex
Solanaceae	*Solanum linnaeanum**	Apple-of-Sodom
Solanaceae	*Solanum mauritianum**	Wild Tobacco
Groundcovers		
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed
Amaranthaceae	*Alternanthera pungens**	Khaki Weed
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel
Poaceae	*Aristida ramosa*	Wire Grass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Poaceae	*Aristida warburgii*	Wire Grass
Poaceae	*Austrodanthonia racemosa*	Wallaby Grass
Poaceae	*Axonopus fissifolius**	Narrow-leafed Carpet Grass
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Cyperaceae	*Bolboschoenus* sp.	-
Crassulaceae	*Bryophyllum delagoense**	Mother-of-Millions
Asteraceae	*Calotis cuneifolia*	Purple Burr Daisy
Cyperaceae	*Carex appressa*	Tall Sedge
Gentianaceae	*Centaurium tenuiflorum**	Branched Century
Apiaceae	*Centella asiatica*	Indian Pennywort
Sinopteridaceae	*Cheilanthes sieberi*	Rock Fern
Poaceae	*Chloris gayana**	Rhodes Grass
Poaceae	*Chloris ventricosa*	Tall Chloris
Asteraceae	*Cirsium vulgare**	Spear Thistle
Commelinaceae	*Commelina cyanea*	Native Wandering Jew
Asteraceae	*Conyza sumatrensis**	Fleabane
Poaceae	*Cortaderia selloana**	Pampas Grass
Poaceae	*Cymbopogon refractus*	Barbwire Grass
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus difformis*	Variable Flat-sedge
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Phormiaceae	*Dianella longifolia*	-
Convolvulaceae	*Dichondra repens*	Kidney Weed
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass
Poaceae	*Digitaria sanguinalis**	Crab Grass
Poaceae	*Ehrharta erecta**	Panic Veldtgrass
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia nutans* subsp. *linifolia*	Climbing Saltbush
Chenopodiaceae	*Einadia polygonoides*	-
Cyperaceae	*Eleocharis sphacelata*	Tall Spike-rush
Asteraceae	*Epaltes australis*	-
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Poaceae	*Eragrostis curvula**	African Lovegrass
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass
Euphorbiaceae	*Euphorbia peplus**	Spurge
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-rush

Family	Scientific Name	Common Name
Asteraceae	*Gamochaeta spicata**	Cudweed
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Ivy-leaved Goodenia
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort
Clusiaceae	*Hypericum perforatum**	St Johns Wort
Asteraceae	*Hypochaeris radicata**	Flatweed
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Juncaceae	*Juncus acutus**	-
Juncaceae	*Juncus cognatus**	-
Juncaceae	*Juncus usitatus*	Common Rush
Asteraceae	*Lagenophora stipitata*	Blue Bottle-daisy
Brassicaceae	*Lepidium africanum**	Common Peppercress
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Lomandraceae	*Lomandra multiflora* var. *multiflora*	Many-flowered Mat-rush
Fabaceae	*Lotus suaveolans**	Hairy Bird's Foot Trefoil
Onagraceae	*Ludwigia peploides* subsp. *montevidensis*	Water Primrose
Malvaceae	*Malva sylvestris**	Tall Mallow
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Cactaceae	*Opuntia stricta**	Prickly Pear
Oxalidaceae	*Oxalis corniculata**	Yellow Wood Sorrel
Poaceae	*Paspalum dilatatum**	Paspalum
Geraniaceae	*Pelargonium* sp. (cultivar)*	-
Poaceae	*Pennisetum clandestinum**	Kikuyu
Polygonaceae	*Persicaria decipiens*	Slender Knotweed
Philydraceae	*Philydrum lanuginosum*	Woolly Waterlily
Poaceae	*Phragmites australis*	Common Reed
Plantaginaceae	*Plantago debilis*	Slender Plantain
Plantaginaceae	*Plantago lanceolata**	Ribwort
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Rubiaceae	*Richardia brasiliensis**	White Eye
Polygonaceae	*Rumex brownii*	Swamp Dock
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	-
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Solanaceae	*Solanum nigrum**	Black Nightshade
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Solanaceae	*Solanum pseudocapsicum**	-
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Asteraceae	*Taraxacum officinale**	Dandelion
Poaceae	*Themeda australis*	Kangaroo Grass
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew
Typhaceae	*Typha orientalis*	Cumbungi
Verbenaceae	*Verbena bonariensis**	Purpletop
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell
Asteraceae	*Vittadinia cuneata var. cuneata*	Fuzzweed
Iridaceae	*Watsonia meriana**	Wild Watsonia
Fabaceae	*Zornia dyctiocarpa*	Zornia

Family	Scientific Name	Common Name
Vines		
Apocnyaceae	*Araujia sericifera**	Mothvine
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper
Sapindaceae	*Cardiospermum grandiflorum**	Balloon Vine, Love in a Puff
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Hardenbergia violacea*	False Sarsparilla
Apocynaceae	*Parsonsia straminea*	Common Silkpod
*** denotes exotic species**		

3.1.2 Vegetation communities

Eight (8) vegetation communities were identified within the study area through ground truthing.

- Vegetation Community 1 – Cleared or Disturbed
- Vegetation Community 2 – Grey Box – Forest Red Gum Woodland
- Vegetation Community 3 – Regrowth Woodland
- Vegetation Community 4 – Forest Red Gum – Paperbark Woodland
- Vegetation Community 5 – Riparian Regrowth
- Vegetation Community 6 – Swamp Oak Woodland
- Vegetation Community 7 – Freshwater Wetlands
- Vegetation Community 8 – Dams

Cleared or Disturbed

It is highly likely that the entire study area has been cleared in the past, evident by very few canopy trees with a trunk diameter at breast height of over 500mm. The majority of trees along the fringing vegetation to Racecourse Road are less than 17m tall and rarely have a diameter at breast height of over 250mm, indicating regrowth over 10-25 years. The lack of Eucalypt trees in some patches indicates that they've been removed in the past also.

Cleared or disturbed vegetation in the western and northern portions of the study area would have been Cumberland Plain Woodland previously.

Common species of this vegetation community include *Cynodon dactylon, Setaria parviflora, Cymbopogon refractus, Verbena bonariensis, Eragrostis curvula, Paspalum dilatatum, Axonopus fissifolius* and *Sida rhombifolia.*

Photo 1 – Cleared vegetation with a large infestation of Eragrostis curvula. Photo taken just north-east of quadrat 2

Grey Box – Forest Red Gum Woodland

This vegetation community occurs in the western and northern portions of the study area. The dominant canopy species is *Eucalyptus moluccana* (Grey Box), grading to *Eucalyptus tereticornis* (Forest Red Gum) in the central portion of the site as it begins to grade more towards River-flat Eucalypt Forest. The height of the canopy vegetation is mostly 13-18m with a variable projected foliage cover of 10-25%. There is an occasional sub-canopy of *Melaleuca decora* to 12m tall.

This community is commensurate with the critically endangered ecological community (TSC Act), Cumberland Plain Woodland, and federally listed critically endangered ecological community Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest under the EPBC Act.

All vegetation is in a state of regrowth with few trees exceeding 50cm girth or 20m tall with limited small shrubs, except for along Racecourse Road.

The mid-storey is sparse to moderate with a sub-canopy occasionally comprising *Melaleuca decora* as described above. The mid-storey vegetation typically has a height of 1-4m and a projected foliage cover to 30% but usually much less. Some common species include *Bursaria spinosa, Acacia falcata, Acacia parramattensis, Dodonaea viscosa, Hakea sericea* and *Acacia floribunda.*

The ground layer is generally up to 1m tall comprising native grasses, limited small native shrubs, and a few herbaceous and twining species. The ground layer has been impacted quite heavily throughout remnant patches of vegetation, often dominated more heavily by exotics as opposed to native species. Common native groundcovers include *Microlaena stipoides, Cymbopogon refractus, Aristida vagans, Eragrostis leptostachya* and *brownii, Themeda australis, Zornia dyctiocarpa, Daviesia ulicifolia, Calotis cunefolia, Cheilanthes sieberi, Arthropodium milleflorum, Centella asiatica, Dichondra repens, Solanum prinophyllum, Pratia purpurascens* and *Glycine clandestina.*

Photo 2 – Cumberland Plain Woodland along Racecourse Road

Regrowth Woodland

This is young regrowth Cumberland Plain Woodland in the western and northern portions of the study area characterised as generally treeless, with shrubs to 6m tall. Common shrub species include *Bursaria spinosa, Acacia parramattensis, Acacia floribunda* and *Acacia falcata.*

Photo 3 – Regrowth Woodland within Quadrat 4

The understorey contains a mixture of small shrubs, native grasses, herbs and twiners as listed for the Grey Box – Forest Red Gum Woodland community.

Forest Red Gum – Paperbark Woodland

This vegetation community is commensurate with the endangered ecological community River-flat Eucalypt Forest on Coastal Floodplains. The canopy is almost exclusively made up of *Eucalyptus tereticornis,* however there are occasional specimens of *Angophora floribunda.* Given the vegetation is regrowth, most of the canopy vegetation is between 13-18m tall with a projected foliage cover of 5-25%. *Melaleuca decora* is a sub-canopy species very common throughout the community up to 12m tall.

The mid-storey is sparse to moderate. Inclusive of the sub-canopy layer, the projected foliage cover is variable from 20-35%. Common species include *Bursaria spinosa, Acacia floribunda* and *Acacia parramattensis.*

The ground layer is generally up to 1m tall comprising native grasses, limited small native shrubs, and a few herbaceous and twining species. The ground layer has been impacted quite heavily throughout remnant patches of vegetation, occasionally dominated more heavily by exotics as opposed to native species. Common native groundcovers include *Microlaena stipoides, Aristida vagans, Eragrostis leptostachya* and *brownii, Themeda australis, Cheilanthes sieberi, Centella asiatica, Dichondra repens, Solanum prinophyllum, Pratia purpurascens, Lomandra longifolia* and *Glycine clandestina.*

Photo 4 – River-flat Eucalyptus Forest on Coastal Floodplains with some young regrowth of Acacias near Quadrat 9

Riparian Regrowth

This is young regrowth River-flat Eucalypt Forest on Coastal Floodplains in the eastern and southern portions of the study area characterised as generally treeless, with shrubs to 4m tall. Common shrub species include *Bursaria spinosa, Acacia parramattensis, Acacia floribunda* and *Leptospermum polygalifolium.*

The understorey contains a mixture of small shrubs, native grasses, herbs and twiners as listed for the Forest Red Gum – Paperbark Woodland.

Photo 5 – Riparian Regrowth between Quadrat 8 and 9 with sparse shrub layer and a largely grassed understorey

Swamp Oak Woodland

This community occurs in two small areas in the eastern portion of the study area which comprise almost completely of *Casuarina glauca* as the canopy species, with a height of 10-16m and projected canopy cover of 45-65%.

The mid-storey is heavily reduced due to the lessened light and allelopathic conditions caused by the Casuarinas. Species observed may include sparse specimens of *Melaleuca linariifolia, Melaleuca decora, Bursaria spinosa* and juvenile *Eucalyptus tereticornis.* Within Quadrat 15, these mid-storey species were between 1-5m tall and had a projected foliage cover of approximately 5%.

The ground layer is largely made up of *Microlaena stipoides* (70%) with small patches of herbs such as *Commelina cyanea, Centella asiatica* and *Dichondra repens.*

This vegetation community has been disturbed through previous clearance and grazing activities, as well as weed invasion.

Photo 6 – Swamp Oak Forest in the eastern portion of the study area

Freshwater Wetlands

This vegetation community occurs in the far eastern portion of the study area against Rickabys Creek. Some areas are dominated by *Phragmites australis,* some by *Typha orientalis* and some by *Bolboschoenus* sp. This vegetation is commensurate with the EEC Freshwater Wetlands on Coastal Floodplains.

Photo 7 – Freshwater Wetlands looking south-east from Quadrat 16

Dams

This describes the vegetation associated with the dam in the western portion of the study area. The main species observed include *Typha orientalis, Juncus usitatus, Phylidrum lanuginosum, Cyperus eragrostis, Eleocharis sphacelata* and *Persicaria decipiens.*

Photo 8 – Dam vegetation, dominated by Typha

3.2 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed in Table 3.2 below.

Table 3.2 – Fauna observations for the study area

Common name	Scientific name	Method Observed
Birds		**July 2014**
Australasian Grebe	*Tachybaptus novaehollandiae*	O
Australian Magpie	*Gymnorhina tibicen*	O W
Australian Raven	*Corvus coronoides*	O W
Australian Wood Duck	*Chenonetta jubata*	O W
Bell Miner	*Manorina melanophrys*	W
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O W
Black-fronted Dotterel	*Elseyornis melanops*	O W
Brown Thornbill	*Acanthiza pulsilla*	O W
Brown Quail	*Coturnix ypsilophora*	O
Chestnut Teal	*Anas castanea*	O
Clamorous Reed-Warbler	*Acrocephalus stentoreus*	O W
Common Myna *	*Acridotheres tristis*	W
Dusky Moorhen	*Gallinula tenebrosa*	O
Eastern Rosella	*Platycercus eximius*	O W
Eurasian Coot	*Fulica atra*	O
Golden Whistler	*Pachycephala pectoralis*	O
Great Egret	*Ardea alba*	O
Grey Butcherbird	*Cracticus torquatus*	O W
Grey Fantail	*Rhipidura fuliginosa*	O W
Grey Shrike-thrush	*Colluricincla harmonica*	O W
Laughing Kookaburra	*Dacelo novaeguineae*	O W
Long-billed Corella	*Cacatua tenuirostris*	W

Common name	Scientific name	Method Observed
Magpie-lark	*Grallina cyanoleuca*	O W
Masked Lapwing	*Vanellus miles*	O W
Nankeen Kestrel	*Falco cenchroides*	O
Noisy Miner	*Manorina melanocephala*	O W
Pacific Black Duck	*Anas superciliosa*	O W
Pied Currawong	*Strepera graculina*	O W
Rainbow Lorikeet	*Trichoglossus haematodus*	W
Red-browed Finch	*Neochmia temporalis*	O
Red Wattlebird	*Anthochaera carunculata*	W
Rock Dove *	*Columba livia*	O W
Rose Robin	*Petroica rosea*	O W
Royal Spoonbill	*Platalea regia*	O
Silvereye	*Zosterops lateralis*	O W
Spotted Pardalote	*Pardalotus punctatus*	W
Spotted Turtle-Dove *	*Streptopelia chinensis*	O W
Superb Fairy-wren	*Malurus cyaneus*	O W
Welcome Swallow	*Hirundo neoxena*	O
Whistling Kite	*Haliastur sphenurus*	W^{PR}
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	O W
White-winged Chough	*Corcorax melanorhhamphos*	E^{PO}
Yellow-billed Spoonbill	*Platalea flavipes*	O
Yellow Thornbill	*Acanthiza nana*	O W
Yellow-faced Honeyeater	*Lichenostomus chrysops*	W
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	O W
Mammals		
Black Rat *	*Rattus rattus*	E
East-coast Freetail Bat [TS]	*Micronomus norfolkensis*	U^{PO}
Eastern Bentwing-bat [TS]	*Miniopterus orianae oceansis*	U
Eastern Freetail-bat	*Mormopterus ridei*	U
Eastern Grey Kangaroo	*Macropus giganteus*	O
European Red Fox *	*Vulpes vulpes*	O
Gould's Wattled Bat	*Chalinolobus gouldii*	U
Greater Broad-nosed Bat [TS]	*Scoteanax rueppelli*	U^{PO}
Large-footed Myotis [TS]	*Myotis macropus*	U
Rabbit *	*Oryctolagus cuniculus*	O
Reptiles		
Cream-striped Shining Skink	*Cryptoblepharus virgatus*	O
Delicate Skink	*Lampropholis delicata*	O
Grass Skink	*Lampropholis guichenoti*	O
Amphibians		
Common Eastern Froglet	*Crinia signifera*	W
Mollusc		
Cumberland Plain Land Snail [TS]	*Meridolum corneovirens*	O
Common Garden Snail *	*Cornu aspersum*	O
A carnivorous snail *	*Austrorhytida capillacea*	O
An exotic garden snail *	*Bradybaena similaris*	O

Common name	Scientific name	Method Observed

Note: * indicates introduced species
TS indicates threatened species

All species listed are identified to a high level of certainty unless otherwise noted as:

PR indicates species identified to a 'probable' level of certainty – more likely than not
PO indicates species identified to a 'possible' level of certainty – recorded to a moderate to high level of uncertainty usually applied to a threatened species of note.

E	- Nest/roost	H	- Hair/feathers/skin	P	- Scat	W	- Heard call
F	- Tracks/scratchings	K	- Dead	Q	- Camera	X	- In scat
FB	- Burrow	O	- Observed	T	- Trapped/netted	Y	- Bone/teeth/shell
G	- Crushed cones	OW	- Obs & heard call	U	- Anabat/ultrasound	Z	- In raptor/owl pellet

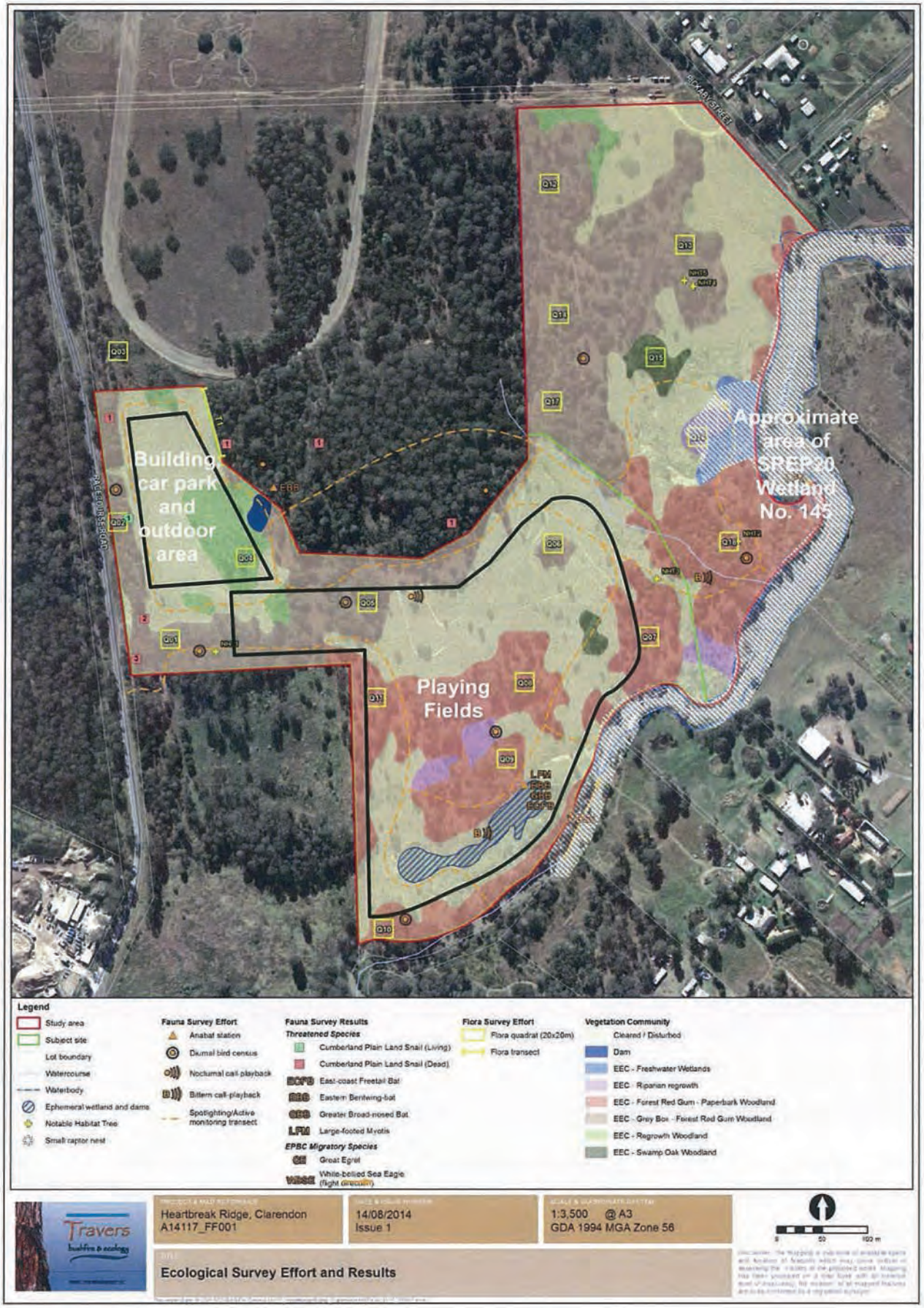

Figure 2 – Flora and fauna survey effort and results

Ecological Assessment 4

4.1 Previous surveys reviewed

The following regional vegetation mapping was examined to identify the potential vegetation communities' onsite.

Vegetation Mapping of the Cumberland Plain (NPWS 2002)

This series of vegetation mapping showed that the communities on site were a combination of Cumberland Plain Woodland and River-flat Eucalypt Forest on Coastal Floodplains

Hawkesbury LGA Vegetation Mapping (2007)

This series of vegetation mapping showed that the communities on site were a combination of Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains and Freshwater Wetlands.

4.2 Flora

No threatened flora species were observed.

All species are listed in Table 3.1.

4.2.1 Local / Regional flora matters

A few species listed in the Urban Bushland Biodiversity Study of 1997 as V2 or V3 – vulnerable taxa with limited records in the LGA (not listed under the TSC Act as vulnerable), although no regionally significant species were detected during this survey.

Rickabys Creek on the eastern boundary of the study area is part of SREP 20, wetland no. 145 which requires protection. The southern 250m section of Rickabys Creek however is excluded from nomination as a wetland.

Specific planning policies and recommendation strategies can be read on the following website:
http://www.austlii.edu.au/au/legis/nsw/consol_reg/srepn20r21997640/s6.html

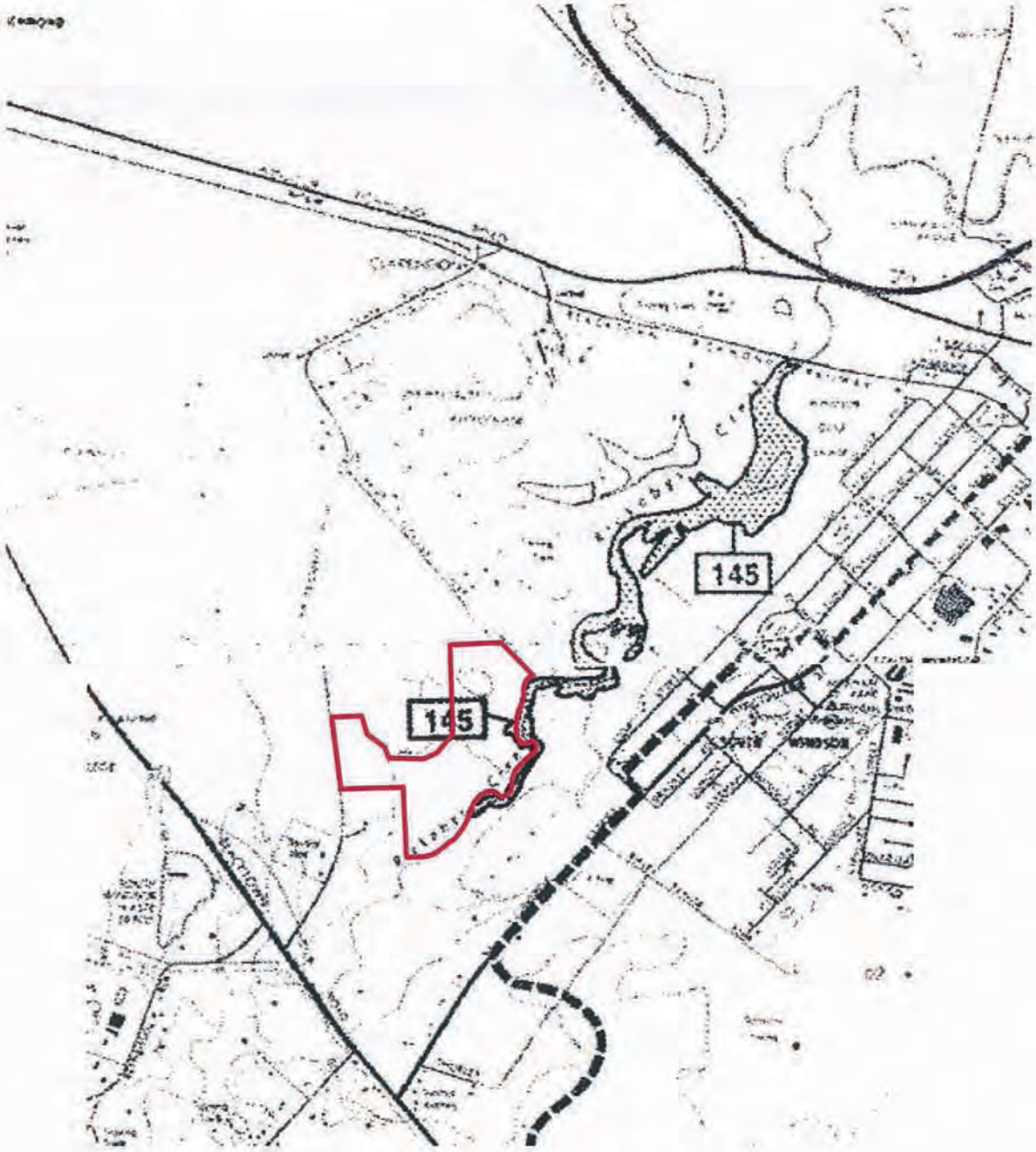

Figure 3 – SREP 20 Wetland mapping

4.2.2 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH 2014) indicated a list of species that have been recorded within a 10 km radius of the study area. Those species are considered for suitable habitat and potential to occur in Table A2.1 (Appendix 2).

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following state listed threatened flora species:

Table 4.1 – State listed threatened flora species with suitable habitat present

Scientific Name	TSC Act	Potential to occur
Acacia bynoeana	E1	✓
Acacia pubescens	V	✓
Allocasuarina glareicola	E1	low
Dillwynia tenuifolia	V	✓
Grevillea juniperina subsp. *juniperina*	V	✓
Persoonia nutans	E1	low
Pimelea spicata	E1	very low
Pultenaea parviflora	E1	low

Note: Full habitat descriptions for these species are provided in Appendix 2

No state listed threatened flora species were observed during the current survey. Species with potential occurrence are assessed in the 7 part test of significance in Appendix 3.

(b) Endangered flora populations (NSW)

Keraudrenia corrolata var. *denticulata* in the Hawkesbury Local Government Area - endangered population listing, is the only specific endangered flora populations listing for this LGA.

Keraudrenia corrolata var. *denticulata* has been recorded in tall open forest with *Eucalyptus deanei* in a gully above the floodplain, and on road verges. All occurrences in the Hawkesbury Local Government Area are associated with the endangered River-flat Eucalypt Forest on Coastal Floodplains.

There are collections from Colo River area between Lower Portland and Morans Rock and near Gees Lagoon. Known subpopulations are very small.

The attributes generally required for this species are absent from the site. Whilst River-flat Eucalypt Forest vegetation is present in the eastern and southern portion of the study area, the typical *Eucalyptus deanei* is absent, along with semi-shelteredness of adjacent sandstone areas.

(c) Endangered ecological communities (NSW)

Four (4) EECs were located onsite, namely;

- Cumberland Plain Woodland
- River-flat Eucalypt Forest on Coastal Floodplains
- Swamp Oak Floodplain Forest
- Freshwater Wetlands on Coastal Floodplains

Cumberland Plain Woodland occurs in the western and northern portions of the study area with a canopy of *Eucalyptus tereticornis and Eucalyptus moluccana*. There may be an occasional sub-canopy of *Melaleuca decora* which becomes more prevalent on the lower lying areas that grade into River-flat Eucalypt Forest. The mid-storey has been impacted by previous clearing, previous grazing and weed invasion. Several prickly shrubs such as Daviesia and Bursaria are present, along with non-prickly shrubs such as Acacia and Dodonaea.

Much of the remnant Cumberland Plain Woodland is of moderate condition with existing resilience to regenerate. Some young regrowth areas may be classed as low condition under a biometric assessment where the canopy does not meet minimum requirements and the ground layer contains greater than 50% exotic species cover.

The proposal may require removal or modification to regrowth vegetation in the western portion of the study area for proposed facilities, however the playing fields do not require vegetation removal. It is expected that the ground layer may be slashed on occasion and that no trees will be required to be removed. The frequency of use will determine the rate of impacts on site which is largely trampling, leading to soil compaction, localised erosion, and a slow decrease in regeneration capacity.

River-flat Eucalypt Forest on Coastal Floodplains is present within the eastern and southern portion of the study area, dominated by *Eucalyptus tereticornis* with very occasional *Angophora floribunda.* There is also a sub-canopy of *Melaleuca decora* throughout a large proportion of this community.

Daviesia species, *Acacia falcata* and *Zornia dyctiocarpa* occur much less frequently within this EEC.

It is highly likely that the majority of this EEC falls within the 1 in 100 year flood line.

Swamp Oak Floodplain Forest occurs in two (2) small patches amongst the River-flat Eucalypt Forest, again, most likely within the 1 in 100 year flood line. Both patches combined are less than 0.5 ha. One (1) patch is outside of the proposed playing fields therefore it is considered that the likely indirect impacts within this area would be minimum. The other smaller patch is within the playing fields. As there is no proposed clearing of vegetation, the impacts of the proposal are limited to possible trampling and a slow decline of regeneration capacity.

Freshwater Wetlands EEC occurs along the edge of Rickabys Creek on the eastern boundary of the study area and includes pockets of *Phragmites, Juncus, Ludwigia, Bolboschoenus, Persicaria, Typha* and other aquatic species just off the main creek line that are semi-permanent to permanently inundated. These areas are also likely to be a part of the SREP 20 wetland no. 145. The proposed paintball playing fields may impact on the EEC complex subject to the boundary of the southernmost playing fields.

The area of likely impact is upon approximately half of the study area. The types of impacts have been described above. The north-eastern portion of the site will not be utilised by the paintball project and will continue to regenerate, maintaining a local occurrence of the Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains and Swamp Oak Floodplain Forest EECs, such that they will not become locally extinct.

Despite the potential impacts of the proposed facility there is clear opportunity to allow existing regrowth woodland areas to regenerate and to allow a paintball facility to operate with restrictions on access.

These communities are assessed in the 7 part test of Appendix 3.

4.2.3 Matters of national environmental significance - flora

(a) Threatened flora species (national)

A review of the schedules of the *EPBC Act* indicated the potential for a list of threatened flora species to occur within a 10km radius of the site. These species have been considered for habitat presence and potential to occur within Appendix 2.1.

Based on the habitat assessment within Appendix 2.1, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened flora species:

Table 4.2 – Nationally listed threatened flora species with suitable habitat present

Scientific Name	TSC Act	Potential to occur
Acacia bynoeana	V	✓
Acacia pubescens	V	✓
Allocasuarina glareicola	E	low
Persoonia nutans	E	low
Pimelea spicata	E	very low
Pultenaea parviflora	V	low

No nationally listed threatened flora species were observed within the study area during this survey.

(b) Endangered ecological communities (national)

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest is the equivalent nationally listed EEC to Cumberland Plain Woodland.

4.3 Fauna

All fauna species recorded during survey are listed in Table 3.2.

4.3.1 Fauna habitat

The fauna habitats present within the site are identified within Table 4.3.

Table 4.3 – Observed fauna habitat

Topography				
Flat ✓	Gentle ✓	Moderate	Steep	Drop-offs
Vegetation structure				
Closed Forest	Open Forest	Woodland ✓	Heath	Grassland ✓
Disturbance History				
Fire	Under-scrubbing ✓	Cut and fill works ✓		
Tree clearing ✓	Grazing ✓			
Soil Landscape				
DEPTH:	Deep ✓	Moderate ✓	Shallow	Skeletal
TYPE:	Clay ✓	Loam ✓	Sand	Organic
VALUE:	Surface foraging ✓	Sub-surface foraging ✓	Denning/burrowing ✓	
WATER RETENTION:	Well Drained ✓	Damp / Moist ✓	Water logged ✓	Swamp / Soak ✓

Rock Habitat				
CAVES:	Large	Small	Deep	Shallow
CREVICES:	Large	Small	Deep	Shallow
ESCARPMENTS:	Winter / late sunny aspects		Shaded winter / late aspects	
OUTCROPS:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides	
SCATTERED / ISOLATED:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides	
Feed Resources				
FLOWERING TREES:	Eucalypts ✓	Corymbias	Melaleucas ✓	
	Banksias	Acacias ✓		
SEEDING TREES:	Allocasuarinas	Conifers		
WINTER FLOWERING EUCALYPTS:	C. maculata	E. crebra	E. globoidea	E. sideroxylon
	E. squamosa	E. grandis	E. multicaulis	E. scias
	E. robusta	E. tereticornis ✓	E. agglomerata	E. siderophloia
FLOWERING PERIODS:	Autumn ✓	Winter ✓	Spring	Summer ✓
OTHER:	Mistletoe - Maybe	Figs / Fruit	Sap / Manna	Termites ✓
Foliage Protection				
UPPER STRATA:	Dense	Moderate ✓	Sparse ✓	
MID STRATA:	Dense	Moderate	Sparse ✓	
PLANT / SHRUB LAYER:	Dense	Moderate	Sparse ✓	
GROUNDCOVERS:	Dense ✓	Moderate ✓	Sparse ✓	
Hollows / Logs				
TREE HOLLOWS:	Large	Medium	Small ✓	
TEE HOLLOW TYPES	Spouts / branch ✓	Trunk	Broken Trunk	Basal Cavities	Stags ✓
GROUND HOLLOWS:	Large	Medium	Small ✓	
Vegetation Debris				
FALLEN TREES:	Large	Medium ✓	Small ✓	
FALLEN BRANCHES:	Large	Medium	Small ✓	
LITTER:	Deep ✓	Moderate ✓	Shallow ✓	
HUMUS:	Deep	Moderate	Shallow ✓	
Drainage Catchment				
WATER BODIES	Wetland(s) ✓	Soak(s) ✓	Dam(s) ✓	Drainage line(s) ✓	Creek(s) ✓	River(s)
RATE OF FLOW:	Still ✓	Slow ✓	Rapid	
CONSISTENCY:	Permanent ✓	Perennial ✓	Ephemeral ✓	
RUNOFF SOURCE:	Urban / Industrial	Parkland ✓	Grazing	Natural
RIPARIAN HABITAT:	High quality	Moderate quality ✓	Low quality ✓	Poor quality
Artificial Habitat				
STRUCTURES:	Sheds	Infrastructure	Equipment	
SUB-SURFACE	Pipe / culvert(s)	Tunnel(s)	Shaft(s)	
FOREIGN MATERIALS:	Sheet	Pile / refuse		

4.3.2 Habitat trees

A complete assessment of the location of habitat trees and the size of hollows within was not conducted as part of surveys undertaken. The available size range and quality of hollows were noted during site visits.

A reduced search for significant habitat trees was however undertaken. Significant habitat trees are defined as trees containing large hollows suitable for use by owls and/or containing a number of good quality hollows typically consisting of more than one medium (10-30cm) sized hollow. A tree may also be considered significant where evidence of use by select fauna is found such as Yellow-bellied Glider sap feed tree, raptor nest, or owl roost.

No significant habitat trees were identified within the study area. This meant that no large hollows suitable for threatened owls and no raptor nests were recorded present. The study area was notably highly deficient in hollow resources, therefore the search criteria was reduced to 'notable habitat trees'. Such trees included any large nests, any other large hollows and any tree containing a medium hollow. Five (5) such trees were identified and are shown on Figure 2, with data shown below in Table 4.4.

The lack of hollows present on site was reflected in the absence of any arboreal hollow dependent native mammals during nocturnal survey.

Table 4.4 – Notable habitat tree data

Tree No	Common Name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & Other Habitat Features Recorded
SHT1	Grey Box	45	20	10	80	white-winged chough nest tree
SHT2	stag	70	15	8	0	4x 5-10 branch hollows, 1x 10-15cm branch hollow, feral beehive
SHT3	stag	35	8	0	0	1x 20-30cm broken trunk
SHT4	Forest Red Gum	40	17	8	80	Nest (spoonbill?)
SHT5	Forest Red Gum	40	18	9	80	Nest (spoonbill?)

4.3.3 Local fauna matters

Fauna species recorded present during survey and listed as a regionally significant species within the *Native Fauna of Western Sydney - Urban Bushland Biodiversity Survey* (NPWS 1997) include the Brown Quail, Great Egret, Whistling Kite, White-bellied Sea Eagle, White-winged Chough and Eastern Grey Kangaroo.

Four Brown Quail were flushed out of the grass in the most northern proposed playing field. It is expected that a nest was located here and therefore nesting habitat for the species will likely be impacted by the proposal. The remaining tall grassland areas to the north as well as the remaining surrounds in the locality will provide suitable nesting habitat.

No raptor nests were observed within the study area and therefore no breeding habitat is expected to be disturbed for locally significant raptors (including White-bellied Sea Eagle and Whistling Kite) as a result of the proposal.

Great Egret was observed foraging along Rickabys Creek during survey. Provided that adequate buffers are provided, wading bird habitat and activity will not be impacted by the proposal. No nesting habitat is expected to occur within the subject site area.

White-winged Chough was recorded by evidence of a mud nest (location shown on figure 2) which may also have been Magpie Lark which was observed during survey. The nest location is adjacent to the proposed building and nesting activity may be altered by the proposal. There is much suitable nesting habitat in the remaining local woodland surrounds.

A small mob of no more than four (4) Eastern Grey Kangaroo were observed north of the subject site during survey, but showed evidence of activity throughout the study area. Kangaroo foraging activity will likely be altered by the proposal given a reduction in open grassland foraging area. Such areas, if fenced, will become unavailable for foraging. Foraging habitat remains in the local surrounds but the extent of remaining associated mobs is not known.

4.3.4 State legislative fauna matters

(a) Threatened species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH, 2014) provided a list of threatened fauna species previously recorded within a 10km radius of the subject site. These species are listed in Table A2.2 (Appendix 2) and are considered for potential habitat within the subject site.

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following state listed threatened fauna species:

Table 4.5 – State listed threatened fauna species with suitable habitat present

COMMON NAME	TSC Act	Potential to occur
East-coast Freetail Bat	V	recorded
Eastern Bentwing-bat	V	recorded
Large-footed Myotis	V	recorded
Greater Broad-nosed Bat	V	recorded
Cumberland Plain Land Snail	E	recorded
Spotted Harrier	V	✓
Little Eagle	V	✓
Square-tailed Kite	V	✓
Speckled Warbler	V	✓
Varied Sittella	V	✓
Grey-headed Flying-fox	V	✓
Little Lorikeet	V	low
Swift Parrot	E	low
Barking Owl	V	low
Powerful Owl	V	low
Eastern Falsistrelle	V	low
Green and Golden Bell Frog	E	unlikely
Blue-billed Duck	V	unlikely
Freckled Duck	V	unlikely
Black-necked Stork	E	unlikely
Australasian Bittern	E	unlikely
Black Bittern	V	unlikely
Black Falcon	V	unlikely
Curlew Sandpiper	E	unlikely
Black-chinned Honeyeater	V	unlikely
Regent Honeyeater	E4A	unlikely
Scarlet Robin	V	unlikely
Flame Robin	V	unlikely
Yellow-bellied Sheathtail-bat	V	unlikely
Macquarie Perch	V (FM Act)	unlikely

Note: Full habitat descriptions for these species are provided in Appendix 2

Five (5) state listed threatened fauna species including Large-footed Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus orianae oceansis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), East-coast Freetail Bat (*Micronomus norfolkensis*) and Cumberland Plain Land Snail (*Meridolum corneovirens*) were recorded within the study area during surveys. The Greater Broad-nosed Bat and East-coast Freetail Bat were recorded only to a 'possible' level of certainty. All these recorded species have been assessed in detail within Appendix 3. The impact assessment for these species has concluded a not significant impact.

FM Act – The proposed activity is not located in an area identified as critical habitat under the Fisheries Management Act. The adjacent Rickabys Creek supports sub-optimal habitat for the threatened Macquarie Perch which has not before been recorded along this tributary. There will be no detrimental effect on water quality, water quantity or any direct / indirect impacts upon threatened fish species habitat as a result of the proposed action. Therefore a species impact statement should not be required for the proposed development in regard to fish species.

(b) Endangered populations (NSW)

There are no endangered fauna populations within the Hawkesbury LGA.

(c) SEPP 44 koala habitat protection

SEPP 44 Koala Habitat Protection applies to land within Local Government Areas (LGAs) listed under Schedule 1 of the Policy. In addition, Part 2 of the Policy outlines a three (3) step process to assess the likelihood of the land in question being potential or core koala habitat. Part 2 applies to land which has an area of greater than 1 hectare or has, together with any adjoining land in the same ownership, an area of more than 1 hectare.

The subject site is required to be considered under SEPP 44 as it falls within the Hawkesbury LGA, which is listed on Schedule 1 of this Policy. In addition, the total area of the subject site is greater than 1 hectare, hence Part 2 – Development Control of Koala Habitats, of the Policy applies.

Potential Koala Habitat (PKH) is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the policy.

Core Koala Habitat (CKH) is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of and historical records of a population.

A Koala Plan of Management is required to be prepared where council is satisfied that the land is CKH.

Step 1 – Is the land PKH?

One Koala food tree species – Forest Red Gum (*Eucalyptus tereticornis),* as listed on Schedule 2 of SEPP 44 – was recorded within the study area. These trees comprised greater than 15% of the total number of trees within the eucalypt woodland communities except the strip of predominantly Grey Box along the edge of Racecourse Road. Therefore these areas of the site are classified under SEPP 44 as 'potential Koala habitat'.

Step 2 – Is the land CKH?

No Koalas were directly observed at the time of fauna survey, which included diurnal searches of trees and spotlighting. In addition, there was no secondary evidence of Koala habitation in the area including characteristic scratches on trees and scats beneath trees.

A search of the Atlas of NSW Wildlife (OEH 2014) found five (5) records of Koala habitation within a 10 km radius of the subject site. The record closest to the subject site was approximately 2.5 km to the south-west in 1949. It is therefore considered that the subject site does not comprise CKH and as such no further matters relevant to this Policy apply.

Step 3 – Koala Plan of Management

As the land is not considered to comprise CKH a Koala Plan of Management is not considered to be required.

4.3.5 National environmental significance - fauna

(a) Threatened species (National)

EPBC Act – A review of the schedules of the *EPBC Act* identified a list of threatened fauna species or species habitat likely to occur within a 10km radius of the subject site. These species have been listed in Table A2.2 (Appendix 2), and those with potential habitat within the subject site are considered in the seven-part test within Appendix 3.

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened fauna species:

Table 4.6 – Nationally listed threatened fauna species with suitable habitat present

COMMON NAME	EPBC Act	Potential to occur
Grey-headed Flying-fox	V	✓
Swift Parrot	E	low
Green and Golden Bell Frog	V	unlikely
Australasian Bittern	E	unlikely
Regent Honeyeater	E	unlikely
Macquarie Perch	E	unlikely

No nationally listed threatened fauna species were recorded within the study area during surveys undertaken.

The significant impact criteria for species listed under the EPBC Act 1999 (Appendix 4) has been reviewed in respect to nationally listed species with potential to occur. It is concluded that there will not be a significant impact on any nationally listed threatened fauna species as a result of the proposal.

(b) Protected migratory species (National)

The EPBC Act Protected Matters Report provides additionally listed terrestrial, wetland and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10km radius of the subject site. The habitat potential of migratory species is considered in Table A2.3 (Appendix 2). The habitat potential of threatened migratory species is considered in Table A2.3 Table A2.2 (Appendix 2).

Two (2) nationally protected migratory bird species including Great Egret (*Ardea alba*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*) were recorded present during the fauna survey.

The impact assessment for these species and other nationally protected migratory species with potential to occur has concluded a not significant impact based on the limited impacts caused by paintball operations and given that no breeding habitat and key local foraging habitat areas is anticipated to be removed.

4.4 Vegetation connectivity

The vegetation within the subject site contributes to fragmented local arboreal corridors. The vegetation along Rickabys Creek does not extend beyond the study area to the north but continues to the south surrounded by a managed rural residential landscape. Having said this, the vegetation along Rickabys Creek within the study area has heavily degraded sections where exotic trees are the predominant vegetation.

The large woodland patch to the immediate north retains only diminished connectivity to surrounding remnants including Rickabys Creek to the east and strips of habitat along the south-western boundary. The most extensive area of contiguous native woodland habitat exists directly across Racecourse Road to the west within remaining University of Western Sydney lands. This connectivity to the west continues beyond other roads and narrow portions but also does not link to any contiguous woodland or forest beyond.

Figure 4 - Local Connectivity

The diversity of native fauna on site is predominantly maintained only from arboreal species. The proposal is not undertaking tree removal however some of the playing field areas containing trees will become less suitable for use by native birds during operation hours. Given the lack of any tree removal, the local connectivity will remain consistent. Any restoration of riparian habitat or improvement of cross-site areas would be of benefit to local avifauna and arboreal mammals.

Conclusion 5

Travers bushfire & ecology has been engaged to undertake a flora and fauna assessment for the proposed relocation of *Heartbreak Ridge Paintball* within the southern portion of part Lot 3 DP 1105163, located to the east of Racecourse Road, Clarendon.

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act*, the *Threatened Species Conservation Act*, the commonwealth *Environment Protection and Biodiversity Conservation Act* and the *Fisheries Management Act*.

5.1 Legislative compliance

In respect of matters required to be considered under the *Environmental Planning and Assessment Act* and relating to the species / provisions of the *Threatened Species Conservation Act*, Five (5) state listed threatened fauna species including Large-footed Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus orianae oceansis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), East-coast Freetail Bat (*Micronomus norfolkensis*) and Cumberland Plain Land Snail (*Meridolum corneovirens*), no threatened flora species, and four (4) EECs, Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains, Freshwater Wetlands on Coastal Floodplains were observed. The Greater Broad-nosed Bat and East-coast Freetail Bat were recorded only to a 'possible' level of certainty.

In accordance with Section 5A of the *Environmental Planning and Assessment Act*, the 7 part test of significance concluded that the proposal will not have a significant impact on any threatened species, populations or EECs. Therefore, a Species Impact Statement should not be required for the proposal.

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act*, no threatened fauna species, two protected migratory bird species Great Egret (*Ardea alba*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*), no threatened flora species, and one (1) EEC, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest listed under this Act were recorded within the study area.

The proposed paintball facility was not considered to have a significant impact on matters of national environmental significance. As such a referral to Department of Environment should not be required.

In respect of matters relative to the *Fisheries Management Act*, the proposed activity is not located in an area identified as critical habitat. The adjacent Rickabys Creek supports sub-optimal habitat for the threatened Macquarie Perch which has not before been recorded along this tributary. There will be no detrimental effect on water quality, water quantity or any direct / indirect impacts upon threatened fish species habitat as a result of the proposed action. Therefore a species impact statement should not be required for the proposed development in regard to fish species.

5.2 Observations

Flora

Four (4) EECs, Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains, Freshwater Wetlands on Coastal Floodplains were observed. The condition of each remnant of vegetation differs from the other however overall, the vegetation quality would be moderate based on the existing native mid-storey and native species diversity. Much of the vegetation is in a regrowth state as there are few large canopy trees. The entire site has been cleared at some point and there are areas of both older and newer regrowth.

The eastern edge of the site adjacent to Rickabys Creek has been impacted through weed invasion, in particular the prickly species *Gleditsia tricanthos* (Honey Locust). There are some small freshwater wetlands along the creek line too.

Whilst the vegetation is sensitive and protected under legislation, the likely impacts to the EECs will be largely trampling from usage as opposed to clearing of vegetation. Trampling will limit the level or regeneration within proposed playing and development areas, however large areas of remnant native vegetation will be set aside for the protection of remnant EECs within the study area (mostly in the north-east), which adjoins high quality vegetation immediately adjacent to the study area. The proposal seeks to have a set back from Rickabys Creek which will assist in maintaining a fauna corridor and an ecological gradient from floodplain EECs to Cumberland Plain Woodland.

Despite potential habitat for a number of threatened flora, none were observed during the survey in 2014. It is possible that the non-surveyed area of high quality remnant vegetation immediately adjacent at the southern end of the horse racing track would also provide suitable protected habitat for these species. The likelihood of occurrence of threatened flora within the study area has been diminished through weed invasion and previous clearing and grazing.

Fauna

In respect to threatened fauna species, the proposal will have minimal anticipated impacts.

Much of the open and disturbed landscape where the facilities and playing fields are proposed are dominated by the exotic garden snail. Whilst Cumberland Plain Land Snail (CPLS) was recorded within the study area, no CPLS were found in disturbed areas likely due to this dominance of the exotic garden snail. This was also noted as occurring around the fringes of the Cumberland Plain Woodland remnant to the north where *Cornu aspersum* penetrated well into the outer fringes. The best area of habitat for CPLS was found to be the roadside CPW strip along Racecourse Road. This area was however found to be deficient in mature trees and logs.

The Rickabys Creek to the immediate east of the site provides quality habitat for wading birds and waterfowl including threatened and in particular protected migratory species. There are two locations where foraging areas extend into depressions within the site. The more northern of these two is north of the subject site area and provides high quality wetland habitat that will require protection from any paintball activity including shooting disturbance.

The second area extends into the subject site and includes a permanent small dam and other currently muddy depressions. The Royal and Yellow-billed Spoonbills were recorded foraging in this dam during survey and the adjacent muddy depressions would provide an extension to wetland foraging areas during and after flood or high rain events. An inspection

of aerial photos on *NearMap* shows that this area was last inundated after rain in February 2013 and slowly dried up since. Such habitat should ideally be protected during times of inundation.

Despite woodland habitats present the number and diversity of bird use of the woodland remnants was notably low. This was probably attributed to the dominance of Noisy Miners across these areas.

The presence of hollows across the study area and surrounds was notably very low. This was probably attributed to previous logging of larger trees. No raptor nests were located within the study area.

5.3 Potential ecological impact

This report has identified the following ecological issues, threatening processes and potential ecological impacts as a result of the proposed works:

- Disturbance of wading bird and water fowl foraging areas during inundated periods
- Disturbance of breeding habitat for locally significant fauna including Brown Quail and White-winged Chough
- Disturbance to and dissection of Cumberland Plain Land Snail habitat for provision of a site entry road
- Increased risk of weed invasion and fungal mobilisation or infections
- Trampling of vegetation which limits regenerative capacity
- Minor loss of EEC vegetation in the western portion of the site off Racecourse Road for proposed buildings and car parking facilities
- Increased noise pollution and potential short term disturbances to local fauna.

5.4 Recommendations

Mitigation measures have been recommended to reduce the identified potential impacts of the proposal on threatened biodiversity. Of primary importance however is the protection of any riparian, wetland and EEC habitat areas.

As a general recommendation a 40m buffer should be applied to Rickaby's Creek and any wetlands within the site. Wetlands include the mapped wetlands in the southern portion of the site and any portion of Rickaby's Creek which is mapped as A SREP 20 Wetland.

Moderate and high quality areas of EEC within the proposed playing fields should also be protected and allowed to regenerate. Should these areas be impacted to any significant degree then it may cause the imposition of biodiversity offsets in the form of protection or restoration areas which can be mostly provided within the site.

Mitigation Measures

The following general recommendations are made to minimise the above potential ecological impacts, address threatening processes and to create a positive ecological outcome for threatened species and their associated habitats.

- It is recommended that a VMP be prepared to identify the ongoing management of habitat resources, weeds, revegetation and site works within non-utilised parts of the study area to maintain ecological functioning and native species diversity.

- No mature or advance regrowth vegetation to be removed with the exception of an access off Racecourse Road.

- Delineate retained vegetation along Racecourse Road from proposed development areas by fencing or similar to protect native vegetation and Cumberland Plain Land Snail habitat.

- Undertake weed control of noxious and environmental weeds.

- The portion of Cumberland Plain Woodland along Racecourse Road providing the most suitable habitat areas on site for Cumberland Plain Land Snail is to be protected. An access to the site off Racecourse Road is required as part of the proposal and this will bisect this habitat strip. Therefore it is recommended that access to the site is located where the existing access road and entry gate is provided so that no additional habitat fragmentation occurs.

- The paving of this access may make passage by snails less suitable, therefore habitat on either side is to be enriched by the placement of logs for addition shelter opportunities. Due to the age of this woodland strip no mature trees or logs currently exist. The placement of logs is to be undertaken under the direction of a fauna ecologist to ensure their suitability.

- The southern corner of the subject site contains a small permanent dam that provides foraging habitat for water birds. Given its steep edge this dam is not high quality foraging habitat during most periods, however following a flood or high rainfall event this dam would overflow into the adjacent depression running further back off Rickabys Creek. It is likely that this depression is an oxbow and provided the previous creekline. During periods of inundation (such as that observed after rains of February 2013) this portion of the site would provide quality foraging habitat for wading birds and waterfowl including protected migratory species. This can be seen on the aerial used for Figure 2. It is recommended that this area is not utilised during these periods and occupying waterbirds are protected at this time from any disturbance.

- A buffer of 40m is to be provided to Rickabys Creek to the east and another buffer of 40m is provided for wetlands to ensure that there is no disturbance to water birds foraging along adjacent shallows and soaks. These buffers will define a protection zone for sensitive riparian and wetland habitat. A 40 m buffer is based on the NSW Office of Water Controlled Activity Guidelines (2012) for wetlands and 4th order creeks.

- Revegetation and regeneration should be considered to defragment vegetation areas hence increasing connectivity surrounding the site. The placement of nest boxes within the surrounding woodland patches is also encouraged to restore surrounding site usage by arboreal mammals and hollow-dependent bird species.

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