Biodiversity Development Assessment Report

Lake Cathie Public School

Report prepared by Narla Environmental

for School Infrastructure NSW

January 2020

NARLA

environmental

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Prepared for:	School Infrastructure NSW
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Narla Environmental Pty Ltd

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Report Certification

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As Manager of Narla Environmental Pty Ltd, I Alexander Graham, certify that:

- This assessment has been prepared in accordance with the brief provided by the client.
- All field workers involved in the preparation of this project were appropriately licensed under the *Biodiversity Conservation Act 2016* and the Department of Primary Industries Animal Research Authority.
- The information presented in this report is a true and accurate record of the study findings in the opinion of the authors.

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Executive Summary

School Infrastructure NSW proposes to upgrade the existing Lake Cathie Public School at 1240 Ocean Drive, Bonny Hills, 245, NSW (Lot 2, DP1193553). This Biodiversity Development Assessment Report (BDAR) has been prepared by Narla Environmental Pty Ltd to identify the potential impacts of the proposal on biodiversity values within the Subject Land. This assessment has been completed in accordance with the Biodiversity Assessment Method (BAM) and includes:

- Comprehensive literature review and desktop assessment to describe the historically recorded environment and landscape features of the Subject Land and to identify the suite of threatened biota potentially affected by the proposal;
- Site assessment to describe the biodiversity values of the Subject Land and to determine the likelihood of threatened biota and their habitats occurring within the proposed activity footprint;
- Targeted field surveys for a suite of candidate species credit species identified by the Biodiversity Assessment Method Calculator (BAMC) as likely to occur within the native vegetation of the Subject Land in accordance with the relevant NSW threatened species survey guidelines;
- Discussion and recommendation of measures to avoid and minimise impacts to biodiversity values;
- BAM calculations using the offset credit calculator (version 1.2.7.2) to quantify the level of biodiversity impacts of the proposal following implementation of measures to avoid and minimise impacts and to determine the biodiversity credits that will need to be purchased and retired to offset the residual impacts of the proposal.

The proposed upgrade is located within the grounds of the existing Lake Cathie Public School, which contains small areas of remnant native vegetation, historically revegetated native vegetation and regularly maintained exotic lawns. The proposal has been purposefully designed to minimise impacts on biodiversity values as far as is practicable.

The proposed activity is expected to result in impacts to one plant community type (PCT) comprising removal of 1.17 hectares (ha) of PCT 1230 - Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion. The area of this PCT within the Subject Land comprises an occurrence of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, which is listed as an Endangered Ecological Community (EEC) under the NSW Biodiversity Conservation Act 2016 (BC Act). The total of 1.17 ha was calculated by combining the existing native vegetation observed within the site with two offset planting areas proposed to have been installed by the school, as per a Vegetation Management Plan by Darkheart (2014) and removing all areas of overlap.

The proposed activity is expected to remove habitat for the Southern Swamp Orchid (*Phaius australis*), which is listed as a species credit entity according to the BAMC.

The proposed activity is not expected to impact any threatened biota listed under the Fisheries Management Act 1994 (FM Act).

A biodiversity assessment and offset credit calculation has been performed in accordance with the BAM (OEH 2017a). As per offset credit calculator version 1.2.7.2, the following credits are required to be purchased and retired to offset the expected biodiversity impacts of the proposal:

- 17 ecosystem credits to offset impacts to 1.17 ha of PCT 1230 - Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion; and
- 15 *Phaius australis* (Southern Swamp Orchid) species credits to offset the removal of habitat within a 1.17 ha species polygon.

Other threatened species identified as potentially being impacted by the proposal are classed as ecosystem credit species which are to be offset through the retirement of the above listed ecosystem credits.

In order to avoid and minimise potential impacts of the proposal on local biodiversity values, a series of mitigation and management measures have been identified, which are to be implemented as part of any construction environmental management plan (CEMP) formulated for the site. These include measures to:

- Ensure all contractors employed to work within and around identified biodiversity values within the Subject Land are suitably qualified and experienced;
- Assign a Project Ecologist to conduct and oversee all ecological compliance requirements associated with conducting a proposed development in line with all relevant state and commonwealth legislation and guidelines;
- Have an ecologist present during the clearing of all vegetation both native and exotic related to the proposed activity;
- Prepare and adhere to a site-specific Vegetation Management Plan (VMP) that will guide the implementation of all required revegetation efforts in order to minimise and mitigate the potential biodiversity impacts of the proposed activity;
- Prepare and adhere to a site-specific Independent Koala Plan of Management (IKPoM) that will guide the implementation of all required revegetation efforts designed to minimise and mitigate the potential impacts of the proposed activity on identified Koala habitat and improve the habitat availability for Koalas within the surrounding native vegetation;
- Protect trees indicated to remain through successful implementation of the Australian Standard 4970 (2009) Protection of Trees on Development Sites (AS-4970);
- Relocate and reinstate threatened fauna habitat features identified within the proposed impact area; and
- Implement all relevant biological hygiene protocols and requirements as per NSW Government guidelines.

During operation there is potential for the proposal to indirectly impact surrounding vegetation and habitat values through:

- Generation of additional light and noise.
- Erosion and sedimentation as a result of runoff from hard stand areas.
- Introduction of weed propagules by vehicle and/or residents/businesses.
- Fauna mortality as a result of collision with vehicles.
- Increased risk of fire.
- Rubbish dumping.

Mitigation measures are to be implemented to minimise potential operational impacts. These would include:

- Ongoing management of priority weeds according to statutory requirements.
- Measures to reduce the increased risk of fire.
- Prescribed fencing and vegetation exclusion requirements.
- Ecologically sensitive construction lighting design.

Considering the nature of the proposal, the existing character of the Subject Land and the proposed impact mitigation measures proposed, there are unlikely to be any notable indirect impacts on biodiversity values arising from the proposed activity. Only the direct impacts associated with vegetation clearing and construction of the proposal will require biodiversity offsets as per the BAM.

Prescribed impacts on the Koala that were considered include the potential loss of habitat connectivity, the potential loss of freedom of movement throughout the landscape as well as the increased risk of vehicle strike caused by a projected increase in traffic flow. It was determined that there would be no significant impact to the Koala as a result of the listed prescribed impacts as a result of mitigation measures proposed within both this document as well as the corresponding Vegetation Management Plan & Koala Plan of Management.

Offsets for the residual impacts of the proposal can be made by making a payment to the Biodiversity Conservation Trust or by purchasing and retiring the appropriate credits from stewardship sites that comply with the trading rules of the NSW Biodiversity Offsets Scheme (BOS) in accordance with the 'like for like' report generated by the BAM calculator (**Appendix C**). If such credits are unavailable, credits would be sourced in accordance with the 'variation report' generated by the BAMC.

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Glossary

Acronym/ Term	Definition
BAM	The NSW Biodiversity Assessment Method
BAMC	The NSW Biodiversity Assessment Method Calculator
BC Act	New South Wales Biodiversity Conservation Act 2016
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
Biodiversity credit report	The report produced by the Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
Biodiversity Offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity from the impacts of development.
Biodiversity values	The composition, structure and function of ecosystems, including threatened species, populations and ecological communities, and their habitats.
BOS	NSW Biodiversity Offset Scheme
DA	Development Application
DBH	'Diameter at breast height ' the cylindrical diameter of a tree trunk in centimetres sampled at 1.37 metres above the ground
DPIE	NSW Department of Planning, Industry & Environment
Ecosystem credit	A credit that relates to a vegetation type and the threatened species that are reliably predicted by that vegetation type (as a habitat surrogate).
EEC	Endangered Ecological Community
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ha	Hectare
IKPoM	Independent Koala Plan of Management
km	Kilometre
KPoM	Koala Plan of Management
KTP	Key Threatening Process (as listed in the BC Act)
LGA	Local Government Area
Locality	The area within a 10km radius of the Subject Land. The same meaning when describing a local population of a species or local occurrence of an ecological community.
m	metres
MNES	Matters of National Environmental Significance

Acronym/ Term	Definition
Native Vegetation	means any of the following types of plants native to New South Wales:(a) trees (including any sapling or shrub or any scrub), (b) understorey plants, (c) groundcover (being any type of herbaceous vegetation), (d) plants occurring in a wetland.
NPWS	NSW National Parks and Wildlife Services
NSW	The State of New South Wales
OEH	Office of Environment and Heritage
PCT	NSW Plant Community Type
Proposal	The development, activity or action proposed.
SAII	Serious and Irreversible Impacts
SAII entity	Species and ecological communities that are likely to be the subject of serious and irreversible impacts (SAIIs)
SEPP	State Environmental Planning Policy
Species Credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Study Area	The area that was subject to a site survey and assessed for direct or indirect impacts arising from construction and operation of the proposal.
Subject Land	The land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement.
Subject Land	The location of the proposed activity, the subject of this report.
Subject Property	1240 Ocean Drive, Bonny Hills NSW 2445 (Lot 2//DP1193553)
Threatened biota	Threatened species, populations or ecological communities listed under the BC Act and/or the EPBC Act.
Threatened species, populations and ecological communities	Species, populations and ecological communities specified in Schedules 1, 1A and 2 and '*threatened species, population or ecological community*' means a species, population or ecological community specified in any of those Schedules.
VIS Plot	Vegetation Integrity Survey Plot
VMP	Vegetation Management Plan

1.Introduction

1.1 Overview

Narla Environmental Pty Ltd (Narla) was engaged by SHAC Architects on behalf of School Infrastructure NSW ('the proponent') to deliver this Biodiversity Development Assessment Report (BDAR) to accompany an Environmental Impact Statement (EIS) for the construction of primary and secondary structures and associated landscaping ('the activity') at Lake Cathie Public School ('The Subject Land').

Narla understands that the proposal will be assessed as a State Significant Development (SSD) under Part 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and that Secretary's Environmental Assessment Requirements (SEARS) have been issued for the proposal (SSD 9491).

An SSD of this nature requires assessment in accordance with the New South Wales Biodiversity Offset Scheme (BOS). The SEARS issued for the proposal require that an assessment of biodiversity impacts be completed in accordance with the Biodiversity Assessment Method (BAM) and documented in a BDAR, in the form required by section 6.12 of the Biodiversity Conservation Act 2016 (BC Act) and section 6.8 of the Biodiversity Conservation Regulation 2017 and the BAM.

This report describes the biodiversity values at the site, with particular emphasis on identification of native Plant Community Types (PCTs) and threatened ecological communities, populations, species and their habitats. It assesses the impact of the proposal, contains measures to avoid and minimise impacts and describes and quantifies the biodiversity credits required to offset the residual impacts of the proposal on biodiversity values.

1.2 Site Location and Description

Lake Cathie Public School is situated at 1240 Ocean Drive, Bonny Hills, NSW, 2445 (Lot 2, DP1193553; **Figure 1**).

The Subject Land is currently operating as an education facility (Lake Cathie Public School) within the Port Macquarie-Hastings Local Government Area (LGA). The Subject Land occupies approximately 3.73 ha of land zoned as '*R1 – General Residential*' as per the Port Macquarie-Hastings Local Environmental Plan (LEP) 2011. The Subject Land is bounded by Ocean Drive to the west, an unnamed road currently under construction to the north-east and soon to be established sporting fields to the south (**Figure 1**).

1.3 Proposed Activity

The proponent intends on replacing the 14 existing demountable buildings on the Subject Land and expanding the school to accommodate 17 new learning spaces, to reorientate the school to face the new (currently under construction) Collector Road to the east of the Subject Land and to connect into the new road network, therefore making the Ocean Drive access redundant. The project will include a mix of single and two storey buildings that vary in method of construction. In addition, appropriate site drainage and outdoor learning areas will be included as well as a bus bay (**Figure 1**). A total of 53 extant trees are expected to be removed by the proposed activity within an area of 1.17 hectares (ha) of native vegetation proposed to be either removed or modified. This BDAR has employed the 'site-based' assessment method and does not constitute a linear development.

1.4 Aim and Approach

This report has been prepared in accordance with the Biodiversity Assessment Method (OEH 2017a) and aims to:

- Describe the biodiversity values present within the Subject Land, including the extent of native vegetation, vegetation integrity and the presence of threatened ecological communities (TECs);
- Determine the habitat suitability within the Subject Land for candidate threatened species;
- Prepare an impact assessment in regard to potential impacts of the proposed development on biodiversity values, including potential prescribed impacts and serious and irreversible impacts (SAIIs) within the Subject Land;
- Discuss and recommend efforts to avoid and minimise impacts on biodiversity values; and
- Calculate the biodiversity credits (i.e. ecosystem credits and species credits) that measure potential impacts of the development on biodiversity values. This calculation will inform the decision maker (Department of Planning, Industry and Environment [DPIE]) as to the number and class of offset credits required to be purchased and retired as a result of the proposed development.

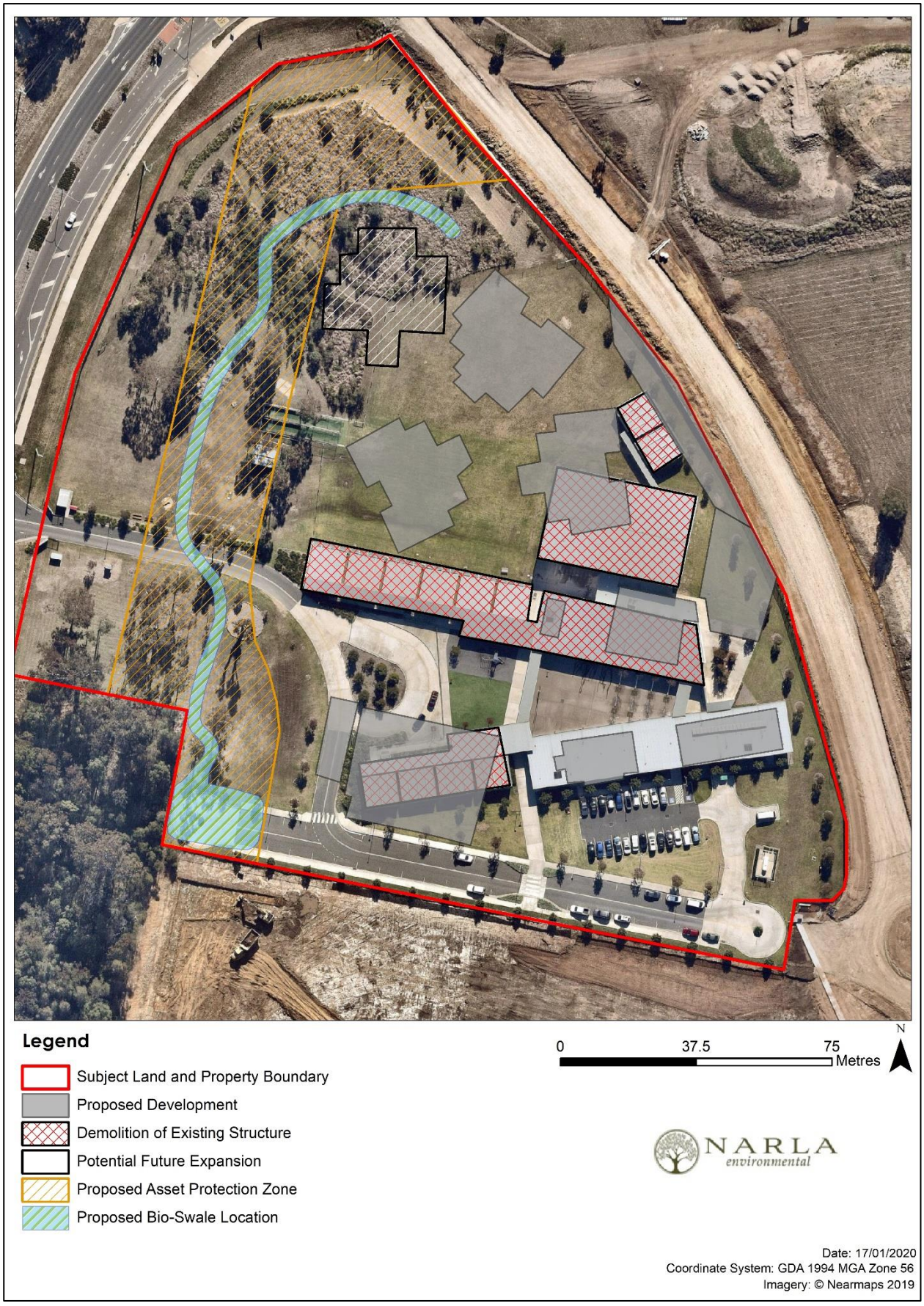

Figure 1. Site overview showing existing built structures, proposed development footprint, Bio-Swale and proposed bushfire APZ.

1.5 Sources of Information Used

A thorough literature review was undertaken into the ecology in the locality and Port Macquarie – Hastings LGA. Relevant data and literature reviewed in preparation of this report included:

- Relevant State and Commonwealth Databases:
  - Protected Matters Search Tool (Commonwealth of Australia 2018)
  - NSW BioNet. The website of the Atlas of NSW Wildlife (OEH 2018a)
  - Atlas of Living Australia Spatial Portal (ALA 2018)

- Relevant State and Commonwealth Datasets:
  - State Environmental Planning Policy No. 14 – Coastal Wetlands
  - NSW Clip & Ship: Port Macquarie – Hastings LGA

- NSW Scientific Committee Final Determinations for:
  - Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions – endangered ecological community listing NSW Scientific Committee – final determination (OEH 2011a)
  - Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing, NSW Scientific Committee – final determination (OEH 2011b)

- Commonwealth Conservation Advice for: Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community (DoEE 2018)

- Vegetation Mapping
  - The Native Vegetation of the Sydney Metropolitan Area. (OEH 2016a;2016b)
  - New South Wales Vegetation Information System (VIS) 2.1 (OEH 2017)

- NSW State Guidelines
  - Threatened Species Survey and Assessment: Guidelines for activities and activities. Working Draft. (DEC 2004)
  - Threatened species survey and assessment guidelines: field survey methods for fauna: Amphibians (DEC 2009)
  - NSW Guideline to Surveying Threatened Plants (OEH 2016b)
  - 'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method (OEH 2018c)
  - Guidance to assist a decision-maker to determine a serious and irreversible impact (OEH 2017c)

- Commonwealth Guidelines
  - Survey guidelines for Australia's threatened birds. Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia 2010a)
  - Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999(Commonwealth of Australia 2010b)
  - Survey guidelines for Australia's threatened frogs. Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia 2010c)
  - Survey guidelines for Australia's threatened mammals. Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia 2011)

    - Survey guidelines for Australia's threatened orchids. Guidelines for detecting bats listed as 'threatened' under the Environment Protection and Biodiversity Conservation Act 1999(Commonwealth of Australia 2013)

- Council Documents
    - Port Macquarie-Hastings Local Environmental Plan (LEP) 2011
    - Port Macquarie-Hastings Development Control Plan (DCP) 2013
    - Port Macquarie-Hastings Biodiversity Strategy 2017–2030
    - Draft Coastal Koala Plan of Management (Port Macquarie-Hastings Council 2018)
    - Weeds declared in the North Coast (Port Macquarie-Hastings Council) (DPI 2018)

Preparation of this BDAR also involved the review of the following accompanying project documents:

- Proposed Development Site Plan (Shac Architects 2020)
- Proposed VMP, KPoM and APZ Diagram (Shac Architects 2018b)
- Vegetation Management Plan – Lake Cathie Public School (Darkheart Eco-Consultancy 2014a)
- SEPP 44 – Koala Habitat Management Plan - Lake Cathie Public School (Darkheart Eco-Consultancy 2014b)

Online databases and literature review were utilised to gain an understanding of the natural environment and ecology of the Subject Land and its surrounds to an area of approximately 10 km². Searches using NSW Wildlife Atlas (BioNet) and the Commonwealth Protected Matters Search Tool were conducted to identify current threatened flora and fauna, and migratory fauna records within a 10km² search area centred on the Subject Land. These data were used to assist in establishing the presence or likelihood of any such ecological values as occurring on or adjacent the Subject Land and helped inform our Ecologist on what to look for during the site assessment.

Soil landscape and geological mapping was examined to gain an understanding of the environment on the Subject Land and assist in determining whether any threatened flora or ecological communities may occur (Troedson & Hashimoto 2007).

2.Landscape Features

2.1 IBRA Bioregions and Mitchell Landscapes

The Subject Land occurs within the Macleay Hastings Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion (version 7) subregion of the NSW North Coast IBRA Bioregion version 7. The Subject Land occurs entirely within the 'Manning - Macleay Coastal Alluvial Plains' NSW Mitchell Landscape (**Table 1; Figure 3; Figure 4**).

Table 1. IBRA Bioregions, Subregions and NSW Mitchell Landscapes

IBRA Bioregion	IBRA Subregion	NSW Mitchell Landscape	Subject Land Area (ha)
NSW North Coast	Macleay Hastings	Manning - Macleay Coastal Alluvial Plains	3.73

2.2 Site Description and Landscape Features

The Subject Land covers an area of approximately 3.73 ha. It is primarily surrounded by historically cleared agricultural land that has been primarily used for livestock grazing. A majority of the land within the Subject Land appeared to have been historically cleared prior to the development of the Lake Cathie Public School. Following the school development site was later revegetated with locally indigenous, native vegetation including a high proportion of 'Preferred Koala Feed Trees' (PKFTs).

2.2.1 Topography

The Subject Land contains a gentle gradient as the site slopes to the south-east towards the adjacent agricultural land, with the elevation ranging between 13m Above Sea Level (ASL) in the north-west to 5m ASL in the south-east.

2.2.2 Geology and Soils

The Subject Land is situated predominantly on a 'Quaternary Coastal Barrier System' identified by Troedson & Hashimoto (2007) as '*Qpbr: Pleistocene beach ridge and associated strandplain: marine sand, integrated sand, gravel*'. The lower areas in the south-eastern extent of the Subject Land containing fluvial sands, silts and gravels have been historically filled as part of the original school development (Darkheart 2014).

2.2.3 Hydrology

Overland stormwater flows across the site in a predominantly south-easterly direction, away from a high point in the north-western extent of the Subject Land. No natural watercourses or water bodies have been historically mapped, nor were identified to occur within the Subject Land (**Figure 7**). Owing to the low elevation, soil type and topographic gradient of the site, stormwater has accumulated in low-lying parts of the site creating a seasonal waterlogged effect. Historically these areas would have been vegetated as a palustrine wetland, dominated by *Casuarina glauca* (Swamp Oak), *Eucalyptus robusta* (Swamp Mahogany), sedges and rushes. Today these areas are dominated by exotic grasses, however, the northern extent has been recently revegetated and is now reflective of a Swamp Sclerophyll Forest.

Table 2. Landscape features identified within the Subject Land and surrounding 1500m buffer.

Landscape Feature	Identification of Landscape Feature on Site
Native vegetation extent in 1500m buffer area	The 1500m buffer zone covers an area of 826ha (**Figure 2**). Within this, native vegetation covers approximately 473ha. This area of native vegetation represents 57% of the 1500m buffer zone. The native vegetation cover observed results in the assessment area being assigned to the >30-70% cover class.
Cleared area within 1500m buffer	The total of cleared land within the assessment area surrounding the Subject Land covers approximately 142ha (**Figure 2**). This area of cleared land accounts for approximately 17.2% of the land within the 1500m buffer zone.
Rivers and Streams (classified according to stream order)	No mapped watercourses occur within the Subject Land (**Figure 7**). A number of mapped watercourses occur within the 1500m buffer of the Subject Land. The watercourses range from 1st order streams to 3rd order streams and are primarily tributaries that form part of the catchments of both Duchess Gully and Lake Cathie
Wetlands (within, adjacent to and downstream of site)	The Subject Land contains an area of native vegetation identified as 'Coastal Wetlands' as per the State Environmental Planning Policy (Coastal Management) 2018. This area of native vegetation has been identified as the Endangered Ecological Community '*Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*'. This patch of vegetation extends outside of the Subject Land in a southerly direction (**Figure 5; Figure 6**). A large area of wetland vegetation occurs to the north of the Subject Land, surrounding Lake Cathie (**Figure 6**). This area of wetland vegetation is not expected be impacted by the proposed activity.
Connectivity features	The primary connectivity feature identified within the Subject Land is the native vegetation identified within the south-western extent of the site that connects directly to a strip of remnant, native vegetation that extends in a southerly direction away from the Subject Land along the eastern boundary of Ocean Drive. The identified area of habitat connectivity between the Subject Land and native vegetation within the 1500m buffer zone has the potential to provide habitat for a number of threatened species, endangered populations and migratory species. The potential impacts of the proposed activity on such species is detailed further within **Section 4** of this report. It is likely that 'flyways' used by a suite of both terrestrial and migratory shorebird species encompass the entirety of the Subject Land as well as a majority of the 1500m buffer zone (**Figure 9**). The proposed activity consists of a series of single storey buildings that are not expected to significantly impact on the flyways for migratory species identified in **Figure 8**.
Areas of geological significance and soil hazard features	No areas of geological significance (karsts, caves, crevices or cliffs) were identified within the Subject Land. This was determined as a result of a comprehensive site-based assessment. The majority of the south-eastern extent of the Subject Land is identified as having a low probability of occurrence of Acid Sulfate Soil risk (**Figure 10**). A large area of land surrounding Lake Cathie, north of the Subject Land within the 1500m buffer zone has been identified as having a high probability of occurrence of Acid Sulfate Soils. This are will not be impacted by the proposed activity (**Figure 11**).

Figure 2. Location map identifying the extent of native vegetation occurring within the 1500m buffer surrounding the Subject Land.

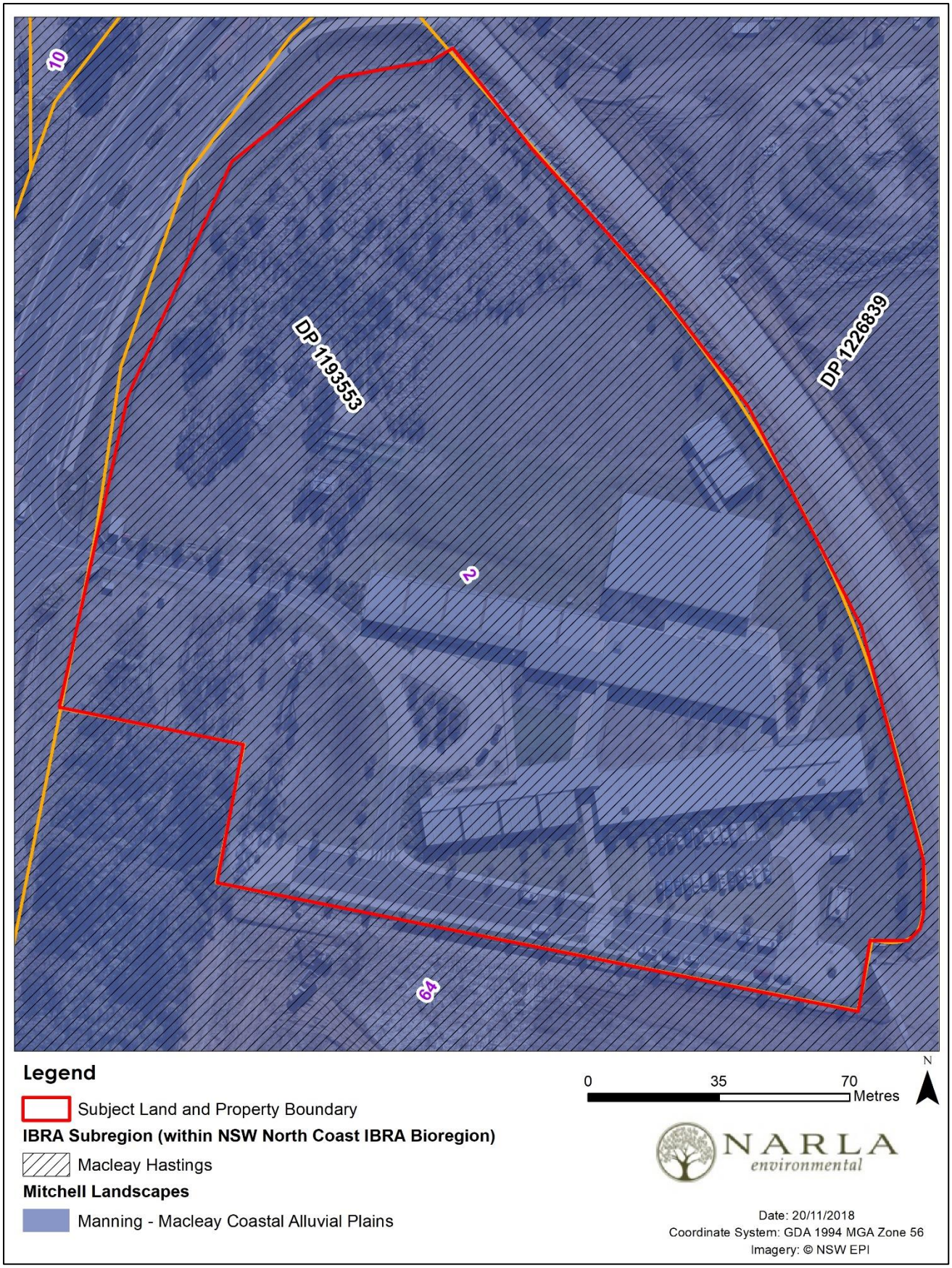

Figure 3. Site map identifying NSW Mitchell Landscapes and IBRA Bioregion and Subregion.

Figure 4. Location Map identifying NSW Mitchell Landscapes and IBRA Bioregion and Subregion

Figure 5. Site map identifying wetlands/ wetland vegetation occurring within the Subject Land.

Figure 6. Location map identifying wetlands/ wetland vegetation occurring within the 1500m buffer.

Figure 7. Location map identifying rivers, streams, estuaries and riparian buffer zones occurring within the 1500m buffer.

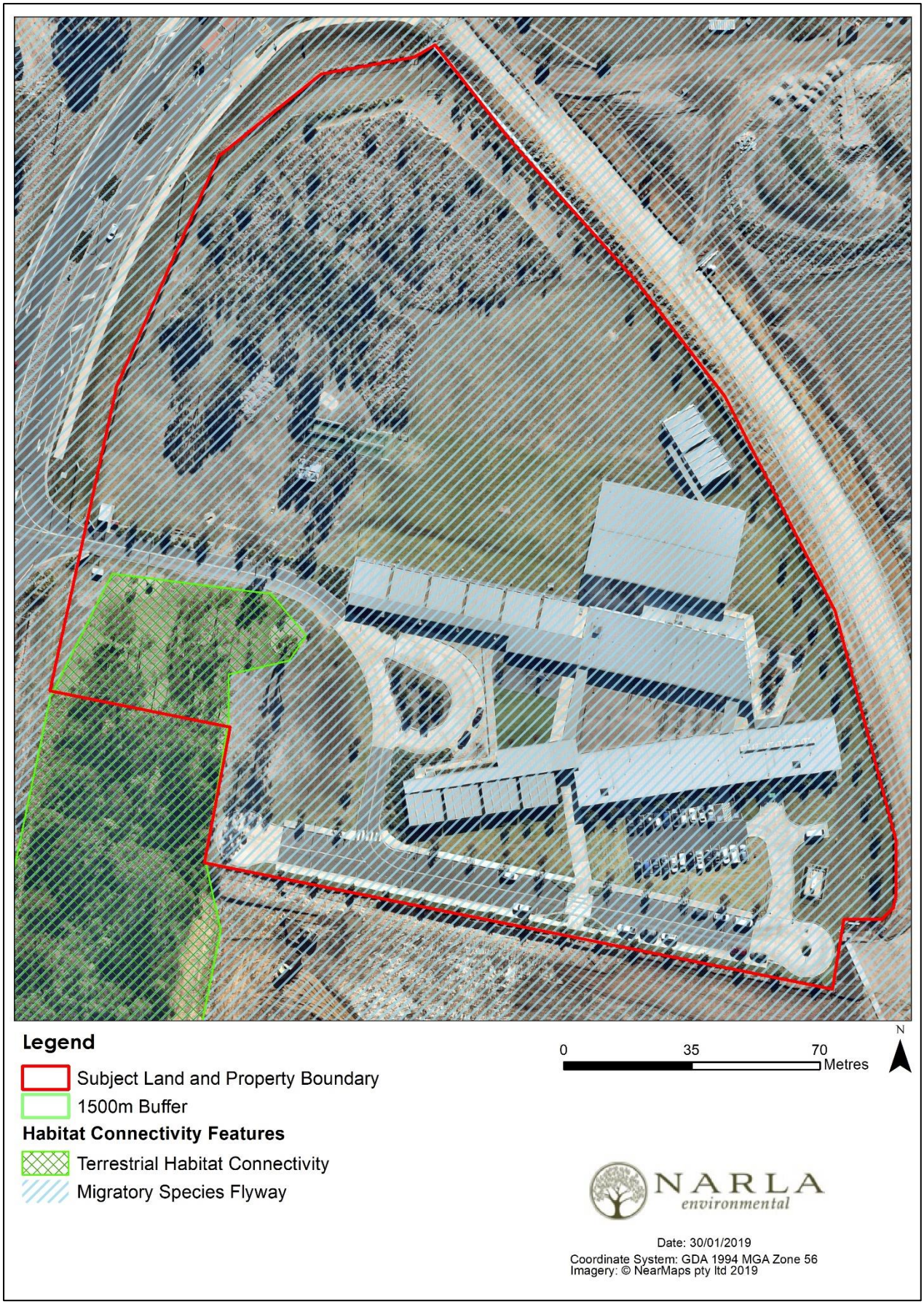

Figure 8. Site map identifying terrestrial habitat connectivity and migratory flyways within the Subject Land

Figure 9. Location map identifying terrestrial habitat connectivity and migratory flyways within the 1500m buffer

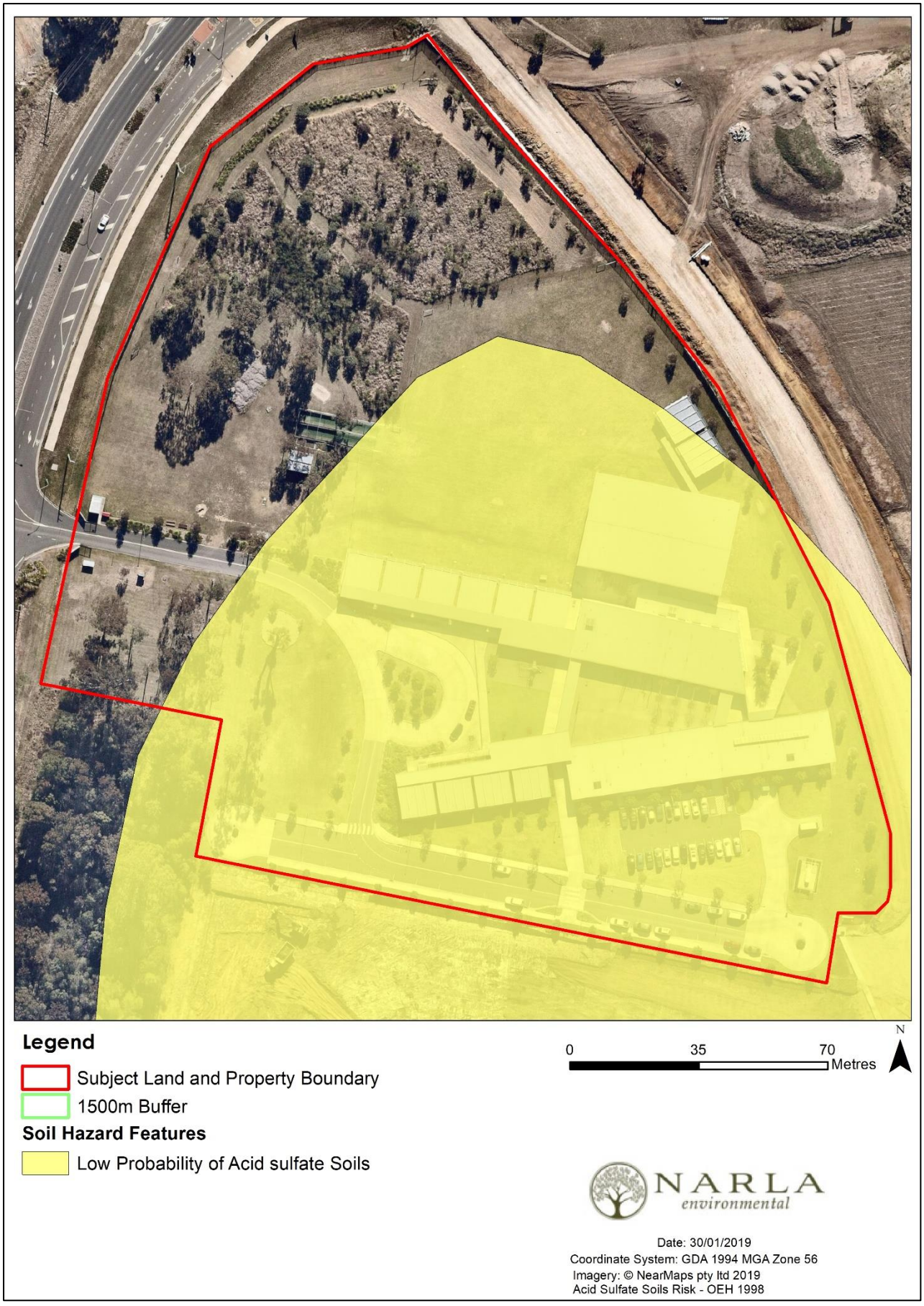

Figure 10. Site map identifying soil hazards occurring within the Subject Land

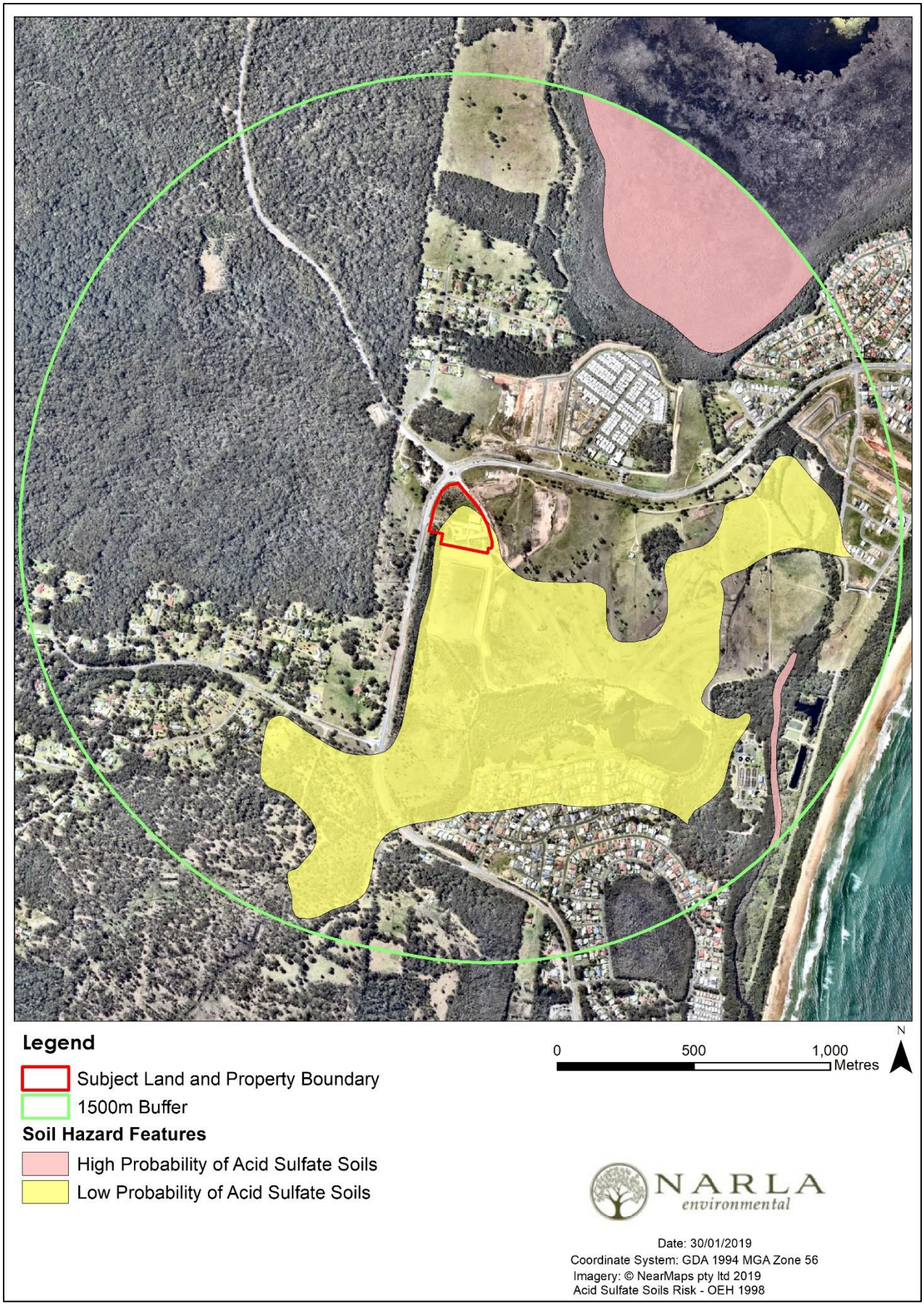

Figure 11. Location map identifying soil hazards occurring within the 1500m buffer

3.Native Vegetation

3.1 Vegetation Communities Within Subject Land

Vegetation Mapping (Port Macquarie-Hastings Council 2016) had previously mapped the Subject Land as containing a single vegetation community (**Figure 12**). The native vegetation occurring within the Subject Land had been historically mapped under the 'Port Macquarie-Hastings Council Vegetation Community Mapping' scheme (Port Macquarie Council 2016) as:

- Swamp Oak - Mixed Eucalypt Coastal Floodplain Wetland Forest Complex.

Ground truthing conducted by Narla Environmental' Principal Ecologist (Accredited Assessor BAAS18059) on 21st and 22nd July 2018 revealed the Subject Land was mostly dominated by historically cleared, exotic grassland and historically planted, native vegetation with scattered ornamental exotic shrubs and trees planted around the school buildings and driveways. Exotic species included, planted *Magnolia grandiflora* trees, ornamental shrubs, and localised occurrences of environmental and priority weeds such as *Senecio madagascariensis* (Fireweed). Native vegetation was concentrated to the western extent of the Subject Land and was largely comprised of native canopy species representative of the historically occurring Swamp Sclerophyll Forest.

The total remnant extent of the native forest vegetation on the Subject Land had been historically thinned and continuously managed for bushfire Inner Protection Zone (IPA) Asset Protection Zone (APZ) purposes (Darkheart 2014a).

The patch of vegetation located in the north-west of the Subject Land was historically planted in order to offset the ecological impact of the initial Lake Cathie Public School development and to provide supplementary Koala feed trees (Darkheart 2014a).

The completion of structural and species composition vegetation surveys over transects and 20m x 20m quadrats informed the identification of one Plant Community Type (PCT):

- PCT 1230 'Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion'.

This PCT conforms to the Endangered Ecological Community (EEC) '*Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*' (OEH 2011a) (**Table 3**).

As per the BAM, two 20m x 50m Vegetation Integrity Survey (VIS) plots were undertaken within native vegetation within the Subject Land (**Figure 14**). Each VIS plot represented a different condition class of native vegetation. A descriptive summary of the PCT within the Subject Land is presented (**Table 3**).

Two areas of proposed offset planting have been included in the native vegetation within the Subject Land. The two areas consist of offset planting locations for works related to the original construction of the existing school facilities (**Figure 13**) identified and proposed by Darkheart Eco-Consultancy (2014). As a result of the two offset phases only having been partially implemented at the time of survey, Narla have adopted the precautionary principal and assumed that the two offset planting areas had been fully implemented. Native vegetation outside of the two offset planting areas proposed by Darkheart (2014) were also identified as native vegetation to be considered throughout the assessment and development process (**Figure 13**).

Table 3. New South Wales Plant Community Types Recorded within the Subject Land

Plant Community Type (PCT) ID	Vegetation Class	Vegetation Type	PCT Coverage within Subject Land (ha)	Description of PCT (OEH 2018)	Description of the Vegetation on the Subject Land	Equivalent Threatened Ecological communities (TEC)	Estimate of % of PCT Cleared	SAII Candidate Entity
PCT 1230: *Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion*	Coastal Swamp forests	KF_CH9 Forested Wetlands	1.17	This swamp community has an open to dense tree layer of eucalypts and paperbarks although some remnants now only have scattered trees as a result of partial clearing. The trees may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality where the tree stratum is low and dense. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. The most widespread and abundant dominant trees include Eucalyptus robusta (swamp mahogany), Melaleuca quinquenervia (paperbark) and, south from Sydney, Eucalyptus botryoides (bangalay) and Eucalyptus longifolia (woollybutt). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including Callistemon salignus (sweet willow bottlebrush), Casuarina glauca (swamp oak) and Eucalyptus resinifera subsp. hemilampra (red mahogany), Livistona australis (cabbage palm) and Lophostemon suaveolens (swamp turpentine).	A low-quality remnant stand that contains no mid-storey vegetation and is mowed on a regular basis as part of routine school grounds maintenance for on-going APZ management purposes. Dominated by Eucalyptus tereticornis, Eucalyptus robusta and hybrids of both species known as 'Eucalyptus patentinervis x'. Trees reached approximately 25m in height. A number of Melaleuca spp. were identified, scattered The ground cover was dominated by low mixed exotic-native mown grasses, including Pennisetum clandestinum, Cynodon dactylon and Stenotaphrum secundatum.	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – Endangered Ecological Community (BC Act 2016)	75%	No

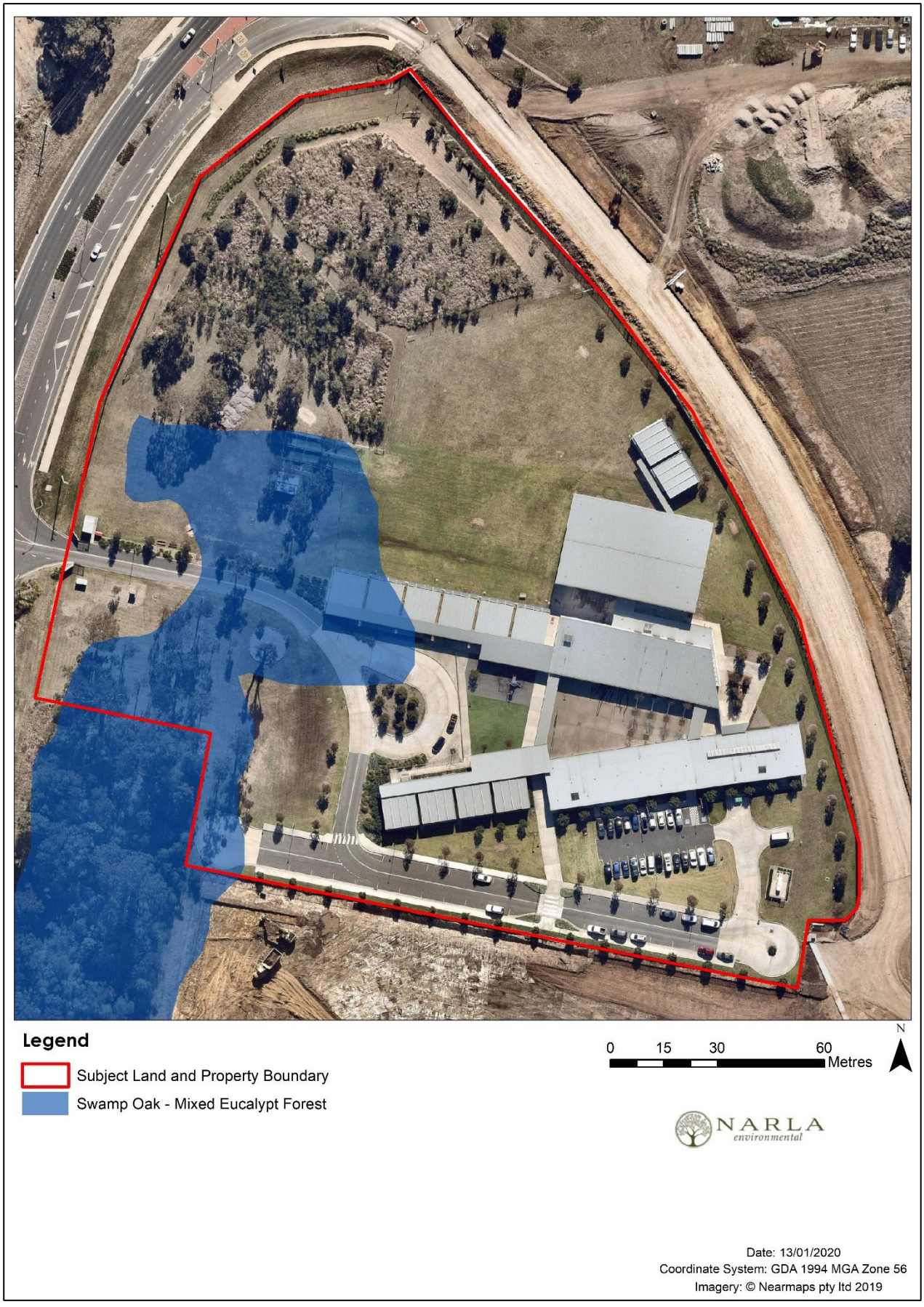

Figure 12.Historically Mapped vegetation within the Subject Land (Port Macquarie-Hastings Council 2016)

Figure 13. Site map identifying the extent of native vegetation occurring within the Subject Land as well as the proposed offset revegetation areas outlined in the VMP associated with the original school development (Darkheart 2014)

Figure 14. Subject map identifying the occurrence condition class of PCT: 1230 as well as VIS plot locations within the Subject Land - this map indicates all native vegetation to be removed

Table 4. Vegetation Zones and Vegetation Integrity Scores within the Subject Land

Vegetation Zone	Plant Community Type	Condition Class	Patch Size (Patch Size Class)	Area	Survey Effort	Vegetation integrity Score (VIS)		Future VIS	Change in VIS
Vegetation Zone 1 (includes Vegetation Zone 1 and Offset Planting Area – Phase 2 [**Figure 14]**)	PCT 1230: *Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion*	**Condition 1 -** Remnant native canopy trees occurring within routinely mown and managed understorey. Complete absence of shrub layer.	22.4ha (5-25ha size class)	0.45 ha	One 1000m^2 (20m x 50m) Vegetation Integrity Survey Plot, undertaken as per Subsection 5.3.4 of the BAM (**Figure 14**).	Composition Score: 53 Structure Score: 73.7 Function Score: 9.1	VIS = 33	33	0
Vegetation Zone 2 (includes Vegetation Zone 2 and Offset Planting Area – Phase 1 [**Figure 14]**)	PCT 1230: *Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion*	**Condition 2 -** Historically revegetated area of native vegetation conforming to PCT 1230. Canopy trees to >5m, native shrub and groundcover species present. High concentration of exotic grass species.	22.4ha (5-25ha size class)	0.60 ha	One 1000m^2 (20m x 50m) Vegetation Integrity Survey Plot, undertaken as per Subsection 5.3.4 of the BAM (**Figure 14**).	Composition Score: 80.7 Structure Score: 70 Function Score: 43.5	VIS = 62.7	22.2	-40.5
Vegetation Zone 3 (Includes all areas of Vegetation Zone 3 not overlapped by a proposed Offset Planting Area [**Figure 14])**	PCT 1230: *Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion*	**Condition 2 -** Historically revegetated area of native vegetation conforming to PCT 1230. Canopy trees to <5m, native shrub and groundcover species present. High concentration of exotic grass species.	22.4ha (5-25ha size class)	0.12 ha		Composition Score: 80.7 Structure Score: 70 Function Score: 43.5	VIS = 62.7	0	-62.7

4.Threatened Species

4.1 Candidate Ecosystem Credit Species

Ecosystem credit species associated with PCT 1230 are listed below in **Table 5**. A total of seven (7) species predicted by the BAMC as potential Ecosystem credits were excluded from the results displayed. These species were excluded due to the absence of key habitat constraints that restrict the distribution and occurrence of these species.

Table 5. Candidate Ecosystem Credits predicted to occur within the Subject Land

Ecosystem Species	BC Act Status	Excluded from Assessment?
Amaurornis moluccana Pale-vented Bush-hen	Vulnerable	Yes, the Subject Land does not contain any waterbodies or Dense vegetation, within 300m of, or in shallows of streams or other natural or artificial wetlands. The site does not occur north of south west Rocks
Anthochaera phrygia Regent Honeyeater (Foraging)	Critically Endangered	No
Artamus cyanopterus cyanopterus Dusky Woodswallow	Vulnerable	No
Botaurus poiciloptilus Australasian Bittern	Endangered	Yes, the Subject Land does not contain any waterbodies or brackish or freshwater wetlands.
Calyptorhynchus lathami Glossy Black-Cockatoo (Foraging)	Vulnerable	No
Chalinolobus nigrogriseus Hoary Wattled Bat	Vulnerable	No
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	Vulnerable	No
Coracina lineata Barred Cuckoo-shrike	Vulnerable	No
Daphoenositta chrysoptera Varied Sittella	Vulnerable	No
Dasyurus maculatus Spotted-tailed Quoll	Vulnerable	No
Ephippiorhynchus asiaticus Black-necked Stork	Endangered	Yes, the Subject Land does not contain any swamps, shallow, open freshwater, saline wetlands or shallow edges of deeper wetlands within 300m of these swamps or shallow lakes, lake margins and estuaries within 300m of these waterbodies.
Falsistrellus tasmaniensis Eastern False Pipistrelle	Vulnerable	No
Glossopsitta pusilla Little Lorikeet	Vulnerable	No

Ecosystem Species	BC Act Status	Excluded from Assessment?
Haliaeetus leucogaster White-bellied Sea-Eagle (Foraging)	Vulnerable	No
Hieraaetus morphnoides Little Eagle (Foraging)	Vulnerable	No
Ixobrychus flavicollis Black Bittern	Vulnerable	Yes, the Subject Land does not contain any waterbodies or land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation.
Lathamus discolor Swift Parrot (Foraging)	Endangered	No
Lophoictinia isura Square-tailed Kite (Foraging)	Vulnerable	No
Micronomus norfolkensis Eastern Coastal Free-tailed Bat	Vulnerable	No
Miniopterus australis Little Bentwing-bat (Foraging)	Vulnerable	No
Miniopterus orianae oceanensis Large Bentwing-bat (Foraging)	Vulnerable	No
Ninox connivens Barking Owl (Forgaing)	Vulnerable	No
Ninox strenua Powerful Owl (Foraging)	Vulnerable	No
Pandion cristatus Eastern Osprey (Foraging)	Vulnerable	No
Petaurus australis Yellow-bellied Glider	Vulnerable	Yes, the Subject Land does not contain significantly sized hollows (greater than 25cm diameter).
Phascolarctos cinereus Koala (Foraging)	Vulnerable	No
Phoniscus papuensis Golden-tipped Bat	Vulnerable	No
Potorous tridactylus Long-nosed Potoroo	Vulnerable	Yes, the Subject Land does not contain a dense shrub layer or alternatively high canopy cover exceeding 70% (i.e. to capture populations inhabiting wet sclerophyll and rainforest).
Pseudomys gracilicaudatus Eastern Chestnut Mouse	Vulnerable	No
Pteropus poliocephalus Grey-headed Flying-fox (Foraging)	Vulnerable	No
Ptilinopus superbus Superb Fruit-Dove	Vulnerable	Yes, the Subject Land does not contain any suitable fruiting tree and shrub species.

Ecosystem Species	BC Act Status	Excluded from Assessment?
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	Vulnerable	No
Scoteanax rueppellii (Greater Broad-nosed Bat	Vulnerable	No
Syconycteris australis Common Blossom-bat	Vulnerable	No
Tyto novaehollandiae Masked Owl (Foraging)	Vulnerable	No

4.2 Candidate Species Credit Species

Species credit species are predicted by the BAMC following an assessment of geographic and habitat features in the credit calculator, such as site location (e.g. IBRA subregion), PCTs and condition, patch size and the area of surrounding vegetation within the 1,500 m buffer of the study area. Some species require further assessment of habitat constraints and/or geographic limitations before being confirmed as candidate species for assessment. The list of credit species predicted to occur within the Subject Land at any stage during their life-cycle is presented (**Table 6**).

Table 6. Candidate Species Credits predicted to occur within the Subject Land

Species	BC Act Listing	Included in Assessment?	Targeted Survey/ Export Report Required/ Conducted?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
Flora					
Acronychia littoralis Scented Acronychia	Endangered	Yes	Yes, targeted survey undertaken in July 2018, species not detected.	High - 2	No
Alexfloydia repens Floyd's Grass	Endangered	No, the Subject Land occurs outside of the known range of this plant species and does not occur within proximity of the Lower Warrell Creek	N/A	N/A	No
Allocasuarina defungens Dwarf Heath Casuarina	Endangered	Yes	Yes, targeted survey undertaken in July 2018 and January 2019, species not detected.	High - 2	No
Asperula asthenes Trailing Woodruff	Vulnerable	Yes, as a precaution, although unlikely to occur as the Subject Land does not contain any damp sites or river banks (OEH 2019).	Yes, targeted survey undertaken in July 2018 and January 2019, species not detected.	High - 2	No
Dendrobium melaleucaphilum Spider orchid	Endangered	Yes	Yes, targeted survey undertaken in July 2018 and January 2019, species not detected.	High - 2	No
Eucalyptus seeana - endangered population *Eucalyptus seeana* population in the Greater Taree local government area	Endangered Population	Yes	Yes, targeted survey undertaken in July 2018 and January 2019, species not detected.	High - 2	No
Lindernia alsinoides Noah's False Chickweed	Endangered	No, the Subject Land does not contain suitable swamp forests and wetlands along coastal and hinterland creeks.	N/A	N/A	No
Maundia triglochinoides	Vulnerable	No, the Subject Land does not contain any swamps or areas of shallow freshwater on clay.	N/A	N/A	No
Melaleuca biconvexa Biconvex Paperbark	Vulnerable	No, the Subject Land does not contain any swamps, swamp	N/A	N/A	No

Species	BC Act Listing	Included in Assessment?	Targeted Survey/ Export Report Required/ Conducted?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
		margins or creek edges.			
Oberonia titania Red-flowered King of the Fairies	Vulnerable	Yes	Yes, targeted survey undertaken in May 2019, species not detected.	Moderate – 1.5	No
Phaius australis Southern Swamp Orchid	Endangered	Yes	No, species assumed present.	High - 2	Yes
Fauna					
Anthochaera phrygia Regent Honeyeater (Breeding)	Critically Endangered	No, the Subject Land occurs outside of the two known key breeding areas for this species in NSW.	N/A	N/A	No
Argynnis hyperbius Laced Fritillary	Endangered	Yes	Yes, targeted survey undertaken in May 2019, species not detected.	Very High - 3	No
Burhinus grallarius Bush Stone-curlew	Endangered	Yes	Yes, targeted survey undertaken by Ecologists using targeted spotlighting surveys, call playback and suitable microhabitat surveys during summer (January) and the species was not detected.	High - 2	No
Calyptorhynchus lathami Glossy Black-Cockatoo (Breeding)	Vulnerable	No, the Subject Land does not contain living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.	N/A	N/A	No
Cercartetus nanus Eastern Pygmy-possum	Vulnerable	No, no suitable hollows available for this species to breed in. The only suitable foraging habitat are planted banksias located in an island patch surrounded by disturbance.	N/A	N/A	No
Crinia tinnula Wallum Froglet	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted spotlighting, call playback and suitable microhabitat surveys during summer (January) and the species was not detected.	Moderate – 1.5	No

Species	BC Act Listing	Included in Assessment?	Targeted Survey/ Export Report Required/ Conducted?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
Haliaeetus leucogaster White-bellied Sea-Eagle (Breeding)	Vulnerable	No, the Subject Land does not contain suitable living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines. Tree is located in a highly disturbed environment with a high level of human traffic.	N/A	N/A	No
Hieraaetus morphnoides Little Eagle (Breeding)	Vulnerable	No, the Subject Land does not contain suitable nest trees – large, live (occasionally dead) old trees within remnant vegetation. All trees in the Subject Land are located in a highly disturbed environment with a high level of human traffic.	N/A	N/A	No
Hoplocephalus bitorquatus Pale-headed Snake	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted spotlighting surveys and suitable microhabitat surveys during summer (January) and the species was not detected.	High - 2	No
Hoplocephalus stephensii Stephens' Banded Snake	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted spotlighting surveys and suitable microhabitat surveys during summer (January) and the species was not detected.	High - 2	No
Lathamus discolor Swift Parrot (Breeding)	Endangered	No, this species breeds in Tasmania	N/A	N/A	No
Lichenostomus fasciogularis Mangrove Honeyeater	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted diurnal surveys and suitable microhabitat surveys during summer (January) and the species was not detected.	High - 2	No
Litoria aurea Green and Golden Bell Frog	Endangered	Yes	Yes, targeted survey undertaken by Ecologists using targeted spotlighting	High - 2	No

Species	BC Act Listing	Included in Assessment?	Targeted Survey/ Export Report Required/ Conducted?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
			surveys, call playback and suitable microhabitat surveys during summer (January) and the species was not detected.		
Litoria brevipalmata Green-thighed Frog	Vulnerable	No, the Subject Land does not contain suitable areas of rainforest, moist eucalypt forest or dry eucalypt forest and heath. The Subject Land does not contain suitable areas where surface water gathers after rain.	N/A	N/A	No
Lophoictinia isura Square-tailed Kite (Breeding)	Vulnerable	No, the Subject Land does not contain suitable nest trees – large, live (occasionally dead) old trees within remnant vegetation. All trees in the Subject Land are located in a highly disturbed environment with a high level of human traffic.	N/A	N/A	No
Miniopterus australis Little Bentwing-bat (Breeding)	Vulnerable	No, the Subject Land does not contain any caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding. This confirmation was informed by assessment of species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	N/A	N/A	No
Miniopterus orianae oceanensis Large Bentwing-bat (Breeding)	Vulnerable	No, the Subject Land does not contain any caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding. This confirmation was informed by assessment of species records in BioNet with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature.	N/A	N/A	No

Species	BC Act Listing	Included in Assessment?	Targeted Survey/ Export Report Required/ Conducted?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
Mixophyes iteratus Giant Barred Frog	Endangered	No, the Subject Land does not contain land within 50m of semi-permanent and permeant drainages.	N/A	N/A	No
Myotis macropus Southern Myotis	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using Harp Traps and SM4 ultrasonic acoustic devices during summer (January) and the species was not detected.	High - 2	No
Ninox strenua Powerful Owl (Breeding)	Vulnerable	No, the Subject Land does not contain any living or dead trees with hollow greater than 20cm diameter.	N/A	N/A	No
Ocybadistes knightorum Black Grass-dart Butterfly	Endangered	No, the Subject Land does not occur within the lower parts of Warrell Creek.	N/A	N/A	No
Pandion cristatus Eastern Osprey (Breeding)	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted diurnal surveys and suitable microhabitat surveys during summer (January) and the species was not detected.	N/A	No
Petalura gigantea Giant Dragonfly	Endangered	Yes	Yes, targeted survey undertaken by Ecologists using targeted diurnal surveys and suitable microhabitat surveys during summer (January) and the species was not detected.	Very High - 3	No
Petaurus norfolcensis Squirrel Glider	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted spotlighting surveys, call playback and remote camera surveys during summer (January) and the species was not detected.	High - 2	No
Phascogale tapoatafa Brush-tailed Phascogale	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted spotlighting surveys, call playback and remote camera surveys during summer (January)	High - 2	No

Species	BC Act Listing	Included in Assessment?	Targeted Survey/ Export Report Required/ Conducted?	Biodiversity Risk Weighting	Biodiversity Offset Credits Required?
			and the species was not detected.		
Phascolarctos cinereus Koala (Breeding)	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted diurnal surveys, spotlighting surveys and call playback surveys during summer (January) and the species was not detected.	High - 2	No
Planigale maculata Common Planigale	Vulnerable	Yes	Yes, targeted survey undertaken by Ecologists using targeted spotlighting surveys, call playback and remote camera surveys during summer (January) and the species was not detected.	High - 2	No
Pteropus poliocephalus Grey-headed Flying-fox (Breeding)	Vulnerable	No, the Subject Land does not contain any known former or active roost camps for this species. No active camps occur within the immediate vicinity of the Subject Land.	N/A	N/A	No
Tyto novaehollandiae Masked Owl (Breeding)	Vulnerable	No, the Subject Land does not contain any living or dead trees with hollow greater than 20cm diameter.	N/A	N/A	No

4.3 Targeted Surveys

Targeted threatened species surveys were undertaken for all candidate threatened species determined likely to occur within the Subject Land, as predicted by the BAMC.

Targeted surveys were carried out within the approved survey period for the species targeted as identified within the BAMC (**Table 8; Table 9**) and were implemented in accordance with within section 6.5 of the BAM and all relevant OEH threatened species survey guidelines.

Targeted surveys for candidate 'Species Credit Species' were undertaken at three separate time points over the course of 2018 and 2019, the weather condition observed during these survey periods are outlined in **Table 7** below.

Table 7. Weather conditions taken from the nearest weather station (Port Macquarie Airport) in the lead up and during the field survey (BOM 2019a) (Survey dates in bold)

Survey date	Minimum Temp. °C	Maximum Temp. °C	Rainfall (mm)
August 2018			
8/08/2018	-0.1	20.9	0
9/08/2018	3.2	19.9	0
10/08/2018	6.2	21.2	0
11/08/2018	**4.0**	**23.0**	**0**
12/08/2018	**6.6**	**19.2**	**0**
January 2019			
11/01/2019	18.3	30.2	0
12/01/2019	20.6	30.5	0
13/01/2019	14.9	30.2	0
14/01/2019	**16.0**	**29.3**	**0**
15/01/2019	**17.8**	**30.9**	**0**
16/01/2019	**20.8**	**31.6**	**0**
17/01/2019	**22.1**	**31.5**	**0**
May 2019			
25/05/2019	8.4	24.2	0
26/05/2019	9.1	26.1	0
27/05/2019	4.5	24.9	0
28/05/2019	**-0.7**	**19.7**	**0**
29/05/2019	**-0.8**	**22.6**	**0**
30/05/2019	**7.5**	**19.0**	**0**
31/05/2019	**-3.5**	**20.0**	**0**

4.3.1 Targeted Flora Survey

A total of seven (7) threatened flora species were identified as likely to occur within the Subject Land (**Table 8**). Narla Principal Ecologist Kurtis Lindsay conducted an initial targeted flora survey during July of 2018 this was followed by an additional, summer flora survey undertaken by Narla Ecologists, David Hancock and Stefan Giessler who completed targeted flora surveys between Tuesday 15th of January and Thursday 17th of January (2019) within the Subject Land. Narla Ecologist Jonathan Coy conducted a final targeted survey for *Oberonia titania* between Tuesday the 28th of May and Friday the 31st of May 2019.

Targeted survey for candidate threatened flora species consisted of an initial random meander survey (Cropper 1993) of the proposed activity site followed by investigative searches of any identified microhabitats determined likely to contain one of the species identified in **Table 8,** in accordance with the NSW Guide to Surveying Threatened Plants (OEH 2016).

Ecologists also targeted *Viola betonicifolia*, an important larval feed plant for the threatened Laced Fritillary (*Argynnis hyperbius*). The entire Survey Area was assessed (**Figure 15**;**Figure 16**). *Viola betonicifolia* was discovered in a number of locations on the fringes of the revegetation zone, and in the North-Western edges of the revegetation zone. On Tuesday the 15th and Thursday the 17th of January 2019, Ecologists assessed the identified plants looking for any sign of larval feeding. No indications of larval feeding were identified as a result of the surveys undertaken. Further detail of this survey is detailed within **Section 4.3.2.6**.

Table 8. Threatened flora species identified as likely to occur within the Subject Land

Candidate Flora Species	Survey Period (BAMC as of 2018)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Acronychia littoralis							✓					
Allocasuarina defungens	✓						✓					
Asperula asthenes	✓						✓					
Dendrobium melaleucaphilum	✓						✓					
Eucalyptus seeana - endangered population	✓						✓					
Oberonia titania			✓									
Phaius australis												
											✓ = Surveyed	= Optimum Survey Period

The BAMC identifies the optimum survey period for *Phaius australis* as occurring between September and October (*Phaius australis*) (**Table 8**). Owing to time constraints, targeted surveys for this species could not be undertaken within the recommended timeframe. For the purpose of this BDAR and the BOS this species will be assumed to be present within the Subject Land. The offset credit obligations for these species are detailed in **Section 6.4** below.

4.3.2 Targeted Fauna Survey

A total of fourteen (14) threatened fauna species were identified as likely to occur within the Subject Land (**Table 9**). Details of each targeted fauna survey technique are outlined below.

Table 9. Threatened fauna species identified as likely to occur within the Subject Land

Candidate Flora Species	Survey Period (BAMC 2018)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Argynnis hyperbius Laced Fritillary					✓							
Burhinus grallarius Bush Stone-curlew	✓						✓					
Crinia tinnula Wallum Froglet	✓						✓					
Gavicalis fasciogularis Mangrove Honeyeater	✓						✓					
Hoplocephalus bitorquatus Pale-headed Snake	✓											
Hoplocephalus stephensii Stephens' Banded Snake	✓											
Litoria aurea Green and Golden Bell Frog	✓											
Myotis macropus Southern Myotis	✓											
Pandion cristatus Eastern Osprey							✓					
Petalura gigantea Giant Dragonfly	✓											
Petaurus norfolcensis Squirrel Glider	✓											
Phascogale tapoatafa Brush-tailed Phascogale	✓											
Phascolarctos cinereus Koala (Breeding)	✓						✓					
Planigale maculata Common Planigale	✓											
											✓ = Surveyed	= Optimum Survey Period

4.3.2.1 Targeted Microbat Survey

A single threatened microbat species, *Myotis macropus* (Southern Myotis), was identified by the BAMC as being likely to occur within the Subject Land and therefore required targeted survey to determine its presence. In order to determine the presence of Southern Myotis within the Subject Land, targeted surveys in accordance with the NSW survey guide for threatened bats and their habitats were undertaken (OEH 2018c). Due to the degraded and open nature of the Subject Land, only a single location was considered suitable for the establishment of a harp trap (**Figure 15**;**Figure 16**). Two acoustic detection units (Wildlife Acoustics SongMeter SM4BAT) were deployed within suitable areas identified within the Subject Land within close proximity to both hollow bearing trees and likely flyways (**Figure 15**:**Figure 16**). The targeted survey effort undertaken for this species is detailed in **Table 10** below.

Table 10. Microbat targeted survey effort undertaken within the Subject Land

Target Species	Survey Technique	Survey Effort & Timing	Target Species Identified?
Myotis macropus (Southern Myotis)	Harp Trap	1 trap over 4 nights between approximately 8:00pm and 5:00am	No, no microbat species or bycatch were caught.
	Acoustic Detection Device	2 devices over 4 nights between approximately 4:30pm and 7:30am	No, refer to **Appendix B** for the full list of species identified within the site.

As no evidence of Southern Myotis was identified as occurring within the Subject Land within the optimal survey period (Pearson 2019; **Appendix D**), the proponent is not required to purchase and retire Biodiversity Offset Credits for this species.

4.3.2.2 Targeted Small Mammal Survey

Two threatened small mammal species, *Phascogale tapoatafa* (Brush-tailed Phascogale) and *Planigale maculata* (Common Planigale), were identified by the BAMC as being likely to occur within the Subject Land and therefore required targeted survey to determine their presence. In order to determine the presence of these species within the Subject Land, targeted surveys in accordance with the NSW *'Threatened Species Survey and Assessment: Guidelines for developments and activities'* were undertaken (DEC 2004). The targeted survey effort undertaken for these species is detailed in **Table 11** below.

Table 11. Small mammal targeted survey effort undertaken within the Subject Land

Target Species	Survey Technique	Survey Effort & Timing	Target Species Identified?
Phascogale tapoatafa (Brush-tailed Phascogale) *Planigale maculata* (Common Planigale)	Elliott Trapping	50 traps set over 4 nights between approximately 4:00pm and 6:00am	No, refer to **Appendix B** for the full list of species identified within the site.
	Motion Sensing Camera Trapping	5 devices over 4 days + nights running continuously	No, refer to **Appendix B** for the full list of species identified within the site.
	Nocturnal Spotlighting Transects	1 session per night for 4 consecutive nights between 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.

As no evidence of either threatened small mammal species was identified as occurring within the Subject Land within the optimal survey period, the proponent is not required to purchase and retire any Biodiversity Offset Credits for these species.

4.3.2.3 Targeted Arboreal Mammal survey

Two threatened arboreal mammal species, *Phascolarctos cinereus* (Koala) and *Petaurus norfolcensis* (Squirrel Glider), were identified by the BAMC as being likely to occur within the Subject Land and therefore required targeted survey to determine their presence. In order to determine the presence of these species within the Subject Land, targeted surveys in accordance with the NSW '*Threatened Species Survey and Assessment: Guidelines for developments and activities*' were undertaken (DEC 2004). The targeted survey effort undertaken for these species is detailed in **Table 12** below.

Table 12. Arboreal mammal targeted survey effort undertaken within the Subject Land

Target Species	Survey Technique	Survey Effort & Timing	Target Species Identified?
Phascolarctos cinereus (Koala) *Petaurus norfolcensis* (Squirrel Glider)	Nocturnal Call Playback	2 call playback points were established undertaken twice per night for 4 nights between approximately 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.
	Motion Sensing Camera Trapping	5 devices over 4 days + nights running continuously	No, refer to **Appendix B** for the full list of species identified within the site.
	Nocturnal Spotlighting Transects	1 session per night for 4 consecutive nights between 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.

As no evidence of either threatened arboreal mammal species was identified as occurring within the Subject Land within the optimal survey period, the proponent is not required to purchase and retire any Biodiversity Offset Credits for these species.

4.3.2.4 Targeted Amphibian Survey

Two threatened amphibian species, *Litoria aurea* (Green and Golden Bell Frog) and *Crinia tinnula* (Wallum Froglet), were identified by the BAMC as being likely to occur within the Subject Land and therefore required targeted survey to determine their presence. In order to determine the presence of these species within the Subject Land, targeted surveys in accordance with the NSW '*Threatened Species Survey and Assessment: Guidelines for developments and activities*' were undertaken (DEC 2004). The targeted survey effort undertaken for these species is detailed in **Table 13** below.

Table 13. Amphibian targeted survey effort undertaken within the Subject Land

Target Species	Survey Technique	Survey Effort & Timing	Target Species Identified?
Litoria aurea (Green and Golden Bell Frog) *Crinia tinnula* (Wallum Froglet)	Nocturnal Call Playback	2 call playback points were established undertaken twice per night for 4 nights between approximately 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.
	Nocturnal Spotlighting and Targeted Micro-habitat Searches	1 session per night for 4 consecutive nights between 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.

As no evidence of either threatened amphibian species was identified as occurring within the Subject Land within the optimal survey period, the proponent is not required to purchase and retire any Biodiversity Offset Credits for these species.

4.3.2.5 Targeted Reptile Survey

Two (2) threatened reptile species, *Hoplocephalus bitorquatus* (Pale-headed Snake) and *Hoplocephalus stephensii* (Stephens' Banded Snake), were identified by the BAMC as being likely to occur within the Subject Land and therefore required targeted survey to determine its presence In order to determine the presence of these species within the Subject Land, targeted surveys in accordance with the NSW '*Threatened Species Survey and Assessment: Guidelines for developments and activities*' were undertaken (DEC 2004). The targeted survey effort undertaken for this species is detailed in **Table 14** below.

Table 14. Reptile targeted survey effort undertaken within the Subject Land

Target Species	Survey Technique	Survey Effort & Timing	Target Species Identified?
Hoplocephalus bitorquatus (Pale-headed Snake) *Hoplocephalus stephensii* (Stephens' Banded Snake	Nocturnal Spotlighting and Targeted Micro-habitat Searches	1 session per night for 4 consecutive nights between 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.

As no evidence of the threatened reptile species was identified as occurring within the Subject Land within the optimal survey period, the proponent is not required to purchase and retire any Biodiversity Offset Credits for these species.

4.3.2.6 Targeted Insect Survey

Two threatened insect species, *Petalura gigantea* (Giant Dragonfly) and *Argynnis hyperbius* (Laced Fritillary), were identified by the BAMC as being likely to occur within the Subject Land and therefore required targeted survey to determine their absence. In order to determine the presence of these species within the Subject Land, targeted surveys were undertaken in accordance with the NSW '*Threatened Species Survey and Assessment: Guidelines for developments and activities*' (DEC 2004) (**Table 15**) below (**Figure 15**; **Figure 16**).

Table 15. Insect targeted survey effort undertaken within the Subject Land

Target Species	Survey Technique	Survey Effort & Timing	Target Species Identified?
Petalura gigantea (Giant Dragonfly) *Argynnis hyperbius* (Laced Fritillary)	Random Meander Survey (Cropper 1993)	1 session per day for 4 consecutive days between 10:00am and 11:30am	No, refer to **Appendix B** for the full list of species identified within the site.
	Targeted Micro-habitat Transects (OEH 2016)	2 sessions per day for 4 consecutive days between 11:30am and 1:30pm	No, refer to **Appendix B** for the full list of species identified within the site.
	Targeted Laced Fritillary Larval Surveys on *Viola betonicifolia*	2 sessions per day for 4 consecutive days between 11:30am and 1:30pm	No, refer to **Appendix B** for the full list of species identified within the site.

As no evidence of the Giant Dragonfly or Laced Fritillary was identified as occurring within the Subject Land within the optimal survey period, the proponent is not required to purchase and retire any Biodiversity Offset Credits for these species.

The Laced Fritillary is identified as a 'Serious and Irreversible Impact (SAII) Entity' as per the NSW 'Guidance to assist a decision-maker to determine a serious and irreversible impact' document (OEH 2017c). As this species has been identified as not occurring within the Subject Land, it will not trigger a SAII. This is discussed in detail within **Section 6.1.1** below.

4.3.2.7 Targeted Avian Survey

Three threatened avian species, *Burhinus grallarius* (Bush Stone-curlew), *Pandion cristatus* (Eastern Osprey) and *Gavicalis fasciogularis* (Mangrove Honeyeater), were identified by the BAMC as being likely to occur within the Subject Land and therefore required targeted survey to determine their absence. Targeted surveys were carried-out in accordance with the NSW '*Threatened Species Survey and Assessment: Guidelines for developments and activities*' were undertaken (DEC 2004). The targeted survey effort undertaken for these species is detailed in **Table 16** below.

Table 16. Avian targeted survey undertaken within the Subject Land

Target Species	Survey Technique	Survey Effort & Timing	Target Species Identified?
Burhinus grallarius (Bush Stone-curlew) *Gavicalis fasciogularis (Mangrove Honeyeater)* *Pandion cristatus* (Eastern Osprey)	Nocturnal Call Playback (Bush Stone-curlew only)	2 call playback points were established undertaken twice per night for 4 nights between approximately 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.
	Nocturnal Spotlighting (Bush Stone-curlew only)	1 session per night for 4 consecutive nights between 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.
	Diurnal Habitat Surveys (Area Search)	1 session per night for 4 consecutive nights between 8:00pm and 9:30pm	No, refer to **Appendix B** for the full list of species identified within the site.
	Dawn Chorus Bird Call Recording (Mangrove Honeyeater Only)	1 session per day for 4 consecutive days between 5:30am and 6:30am	No, refer to **Appendix B** for the full list of species identified within the site.

As no evidence of either threatened avian species was identified as occurring within the Subject Land within the optimal survey period, the proponent is not required to purchase and retire any Biodiversity Offset Credits for these species.

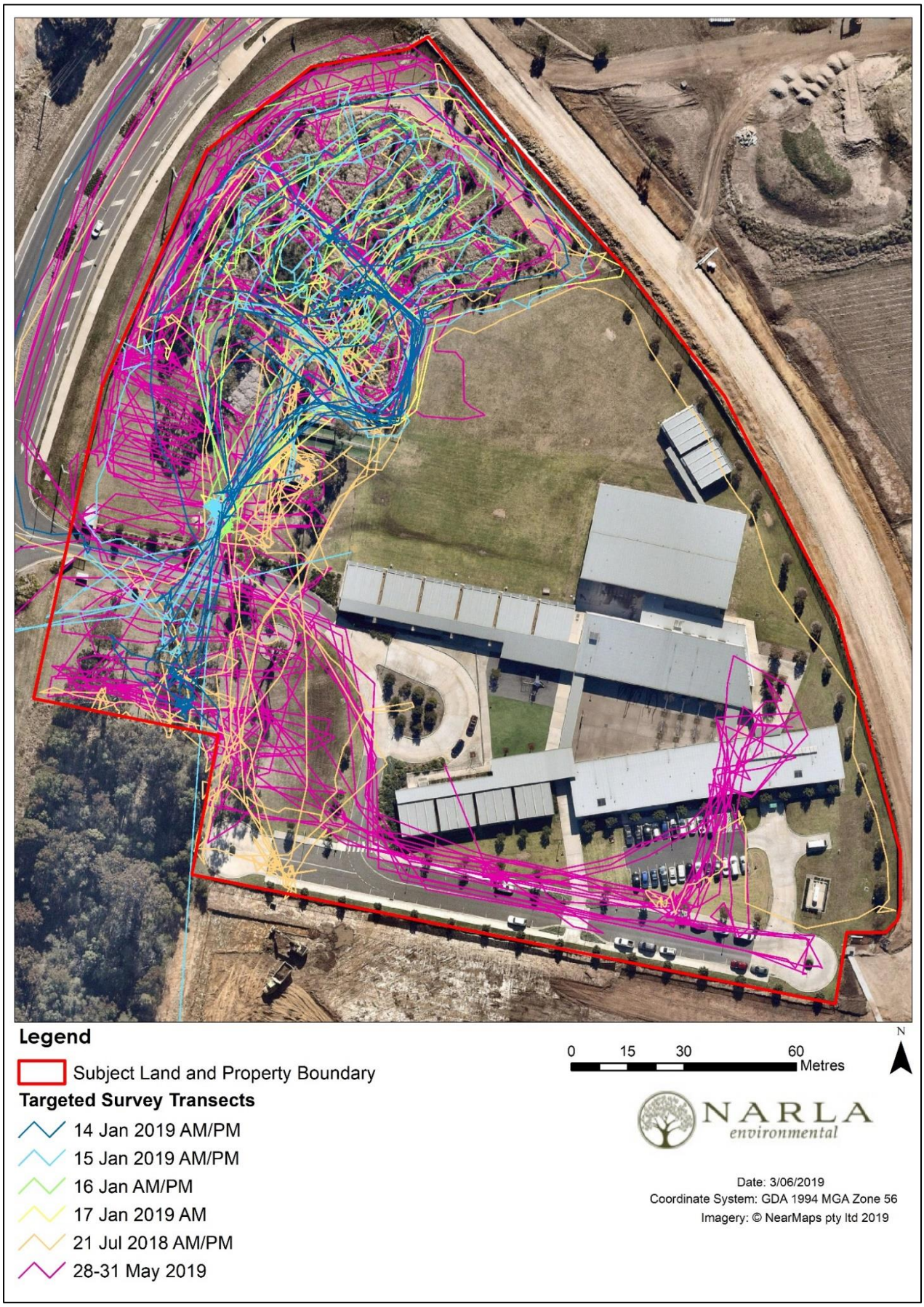

Figure 15. Fauna Species Credit Targeted survey transects undertaken by Narla Environmental within the Subject Land

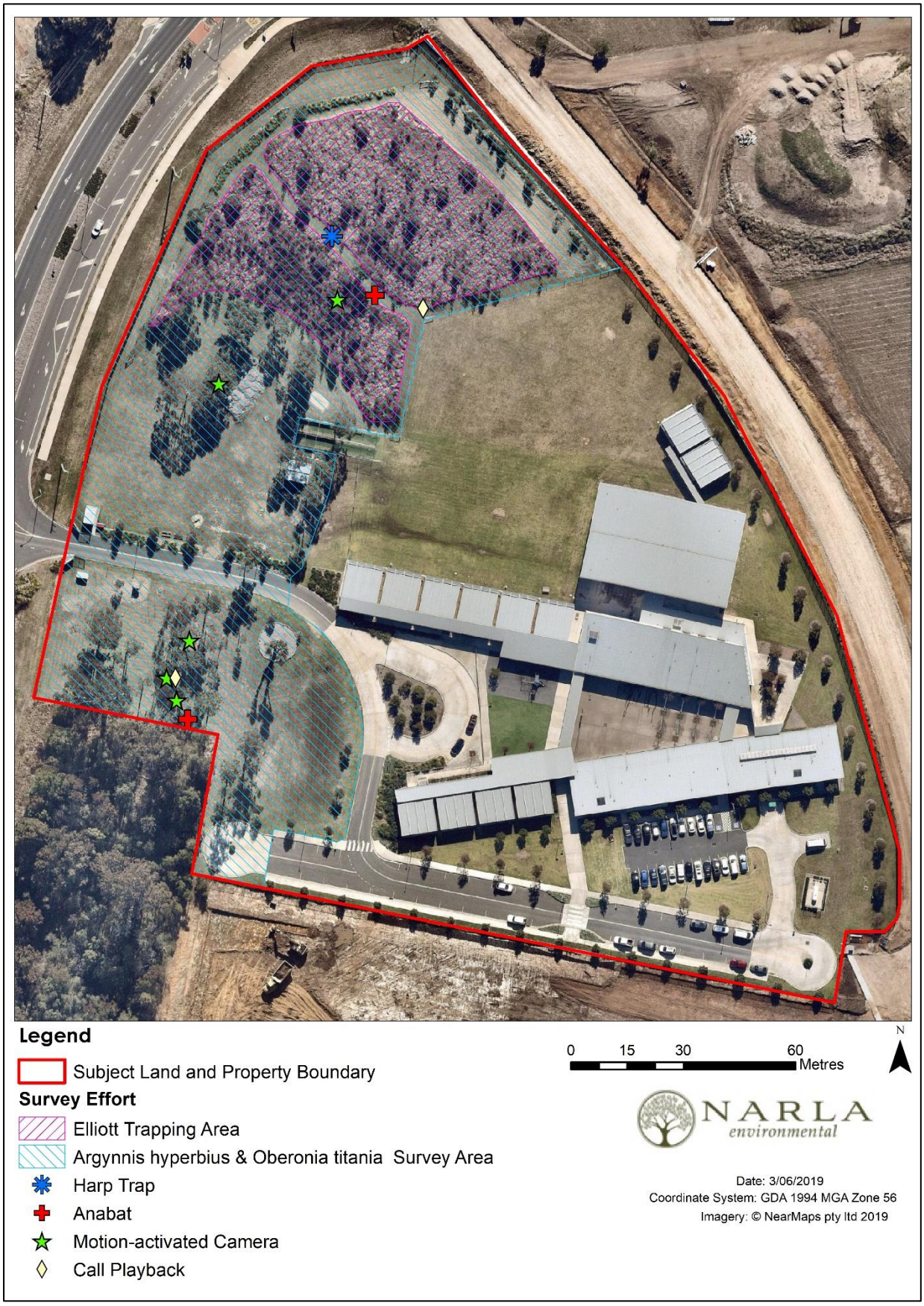

Figure 16. Fauna Species Credit Targeted survey effort undertaken by Narla Environmental within the Subject Land

4.3.3 Species Polygons

Phaius australis (Southern Swamp Orchid) could not be surveyed due to the optimal survey period (September-October) occurring outside of the component project delivery timeframe assigned to the approvals process.

Where a Species Credit species is assumed to be present within the Subject Land, the assessor must assign a species polygon (**Figure 17**) that encompasses the entire vegetation zone(s) within which the candidate species is predicted to occur based on the correct application of the BAMC (OEH 2017a; OEH 2018d).

The calculation of the total area of the species polygon for each species will determine the number of Biodiversity Offset Credits required to be purchased and retired. The Biodiversity Offset Credit obligations for the *Phaius australis* Species Polygon identified in **Figure 17** are detailed in **Section 6.4** below.

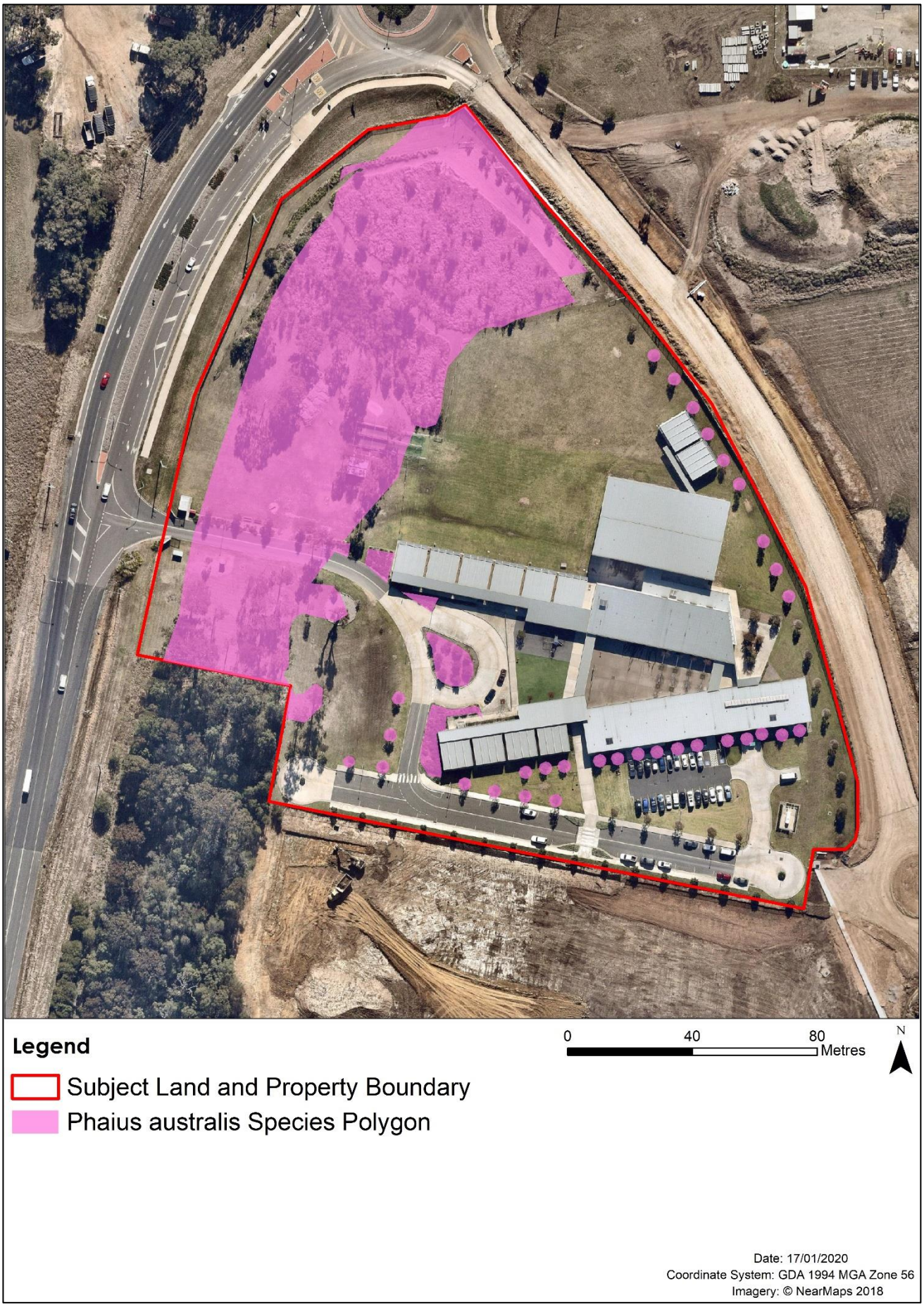

Figure 17. Species polygon for *Phaius australis*, assumed to be present within the Subject Land

5. Avoid and Minimise Impacts

5.1 Impact Mitigation and Minimisation Measures

This section of the report details recommended efforts to avoid and minimise impact on biodiversity values associated with the proposed activity. Measures to be implemented before, during and post construction to avoid and minimise the impacts of the project are detailed in **Table 17**. The final project footprint including construction and operation is presented in **Figure 1**.

Considering the nature and scale of the proposed activity, the character of the study area, the historic disturbance and ongoing vegetation maintenance within the site as well as the proposed impact mitigation measures, there are unlikely to be any appreciable indirect impacts on biodiversity values arising from the proposal that have not been addressed in **Table 17** below. Only the direct impacts associated with vegetation clearing and construction of the proposal will require biodiversity offsets according to the BAM. The Biodiversity Offset Credit obligations required for the proposed activity are detailed in **Section 6.4** below.

Table 17. Table of measures to be implemented before, during and after construction to avoid and minimise the impacts of the project

Action	Outcome/Measure	Timing	Responsibility
Project Location	The majority of the proposed activity has been positioned in order to avoid and minimise the potential resulting impacts on biodiversity values within the Subject Land, where possible. A large portion of the proposed activity is situated within historically cleared and/or built areas, including an existing bushfire Asset Protection Zone (APZ). Additional vegetation clearing will be required for a revised APZ and provision for 'future growth' areas of the school.	Pre-construction phase	▪ Proponent
Project Design	The proposed activity has been designed to avoid and minimise impacts on native vegetation and habitat where possible within the Subject Land. The activity has been positioned to avoid permanent loss of vegetation which links to an important vegetated corridor on lands to the south-west of the Subject Land. Where vegetation/habitat avoidance is not possible, mitigation measures have been designed and recommended to reduce impacts. The most significant mitigation measure is the design and planting of a structurally complex, vegetated corridor that will connect and enhance Swamp Sclerophyll Forest EEC between the Subject Land and adjoining lands to the south-west (Narla Environmental 2020). A large portion of the proposed activity is situated within historically cleared and/or built areas, however there will be some impact, as a result of the prescribed Asset Protection Zone (APZ) and provision for future growth areas. Active stormwater management has been included as a major part of the design in order to reduce environmental impact.	Pre-construction phase	▪ Proponent

Action	Outcome/Measure	Timing	Responsibility
Assigning a Project Ecologist	Prior to construction, the proponent should commission the services of a qualified and experienced Ecologist Consultant (minimum 3 years' experience) with a minimum tertiary degree in Science, Conservation, Biology, Ecology, Natural Resource Management, Environmental Science or Environmental Management. The Ecologist must be licensed with a current Department of Primary Industries Animal Research Authority permit and New South Wales Scientific License issued under the BC Act. The Ecologist will be commissioned to: ▪ Assist the proponent in identifying and assigning an appropriate skilled Bushland Restoration Professional to implement vegetation restoration; ▪ Help the proponent undertake any threatened species habitat augmentation or translocation; ▪ Undertake any required targeted searches for threatened flora prior to vegetation clearing; ▪ Undertake an extensive pre-clearing survey; delineating habitat-bearing trees and shrubs to be retained/removed; and ▪ Supervise the clearance of trees and shrubs (native and exotic) in order to capture, treat and/or relocate any displaced fauna.	Prior to vegetation clearance works	▪ Proponent
Appointment of Qualified Bushland Restoration Professionals	Qualified bush regenerators should be contracted to undertake removal of priority weeds and replacement planting of locally indigenous native species within Native Vegetation areas within the site as detailed in the corresponding VMP (Narla Environmental 2020). The Bushland Restoration Practitioner company selected to complete the project works must: ▪ provide a statutory declaration stating their compliance with provisions of the national Gardening & Landscape Services Award 2010; ▪ provide completed and signed Subcontractor Statement regarding payment of worker's compensation, payroll tax and remuneration; ▪ provide established Workplace Health & Safety and Environmental Management Systems. Preferably the company has third-party accredited systems in place; ▪ demonstrate implementation of safe workplace and appropriate environmental management practices and procedures (e.g. appropriate transport and management of herbicides); ▪ provide Public Liability (min. $10M) and Workers Compensation Insurance; ▪ have previous experience undertaking bushland restoration works within the Port Macquarie-Hastings LGA. Contractor references are to be contacted; ▪ provide supervisor with minimum qualifications and experience including Certificate III Conservation & Land Management and two years full-time equivalent experience as a trained bush regenerator; ▪ provide a minimum of one trained bush regenerator per team of four (minimum qualifications and experience including Certificate III Conservation & Land Management and one-year full-time equivalent experience as a bush regenerator); ▪ provide a minimum of two trained bush regenerators per team of five/six (minimum qualifications and experience including Certificate III Conservation & Land Management and one-year full-time equivalent experience as a trained bush regenerator); ▪ schedule appropriately resourced regular site visits for the duration of contract period; ▪ have experience 'soft-felling' vegetation as a part of APZ management works; and	Prior to vegetation clearance works On-going post construction	▪ Proponent ▪ Project Ecologist

Action	Outcome/Measure	Timing	Responsibility
	▪ all herbicide usage, including storage and transport, to be in accordance with WorkCover NSW (2006) and all relevant legislation.		
Preparation of a Construction Environmental Management Plan (CEMP)	A Construction Environmental Management Plan (CEMP) would be required for the construction phase of the project, and would be prepared prior to issue of the Construction Certificate. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures, including the procedures outlined below. The proposed mitigation measures would include environmental safeguards for protection of neighbouring properties and nearby waterways in accordance with relevant policy documentation and Government guidelines. In order to address the potential impacts of the proposal on biodiversity as discussed in **Section 6**, the mitigation and management measures outlined within this table (**Table 17**) would be implemented as part of the CEMP for the site.	Pre-construction phase	▪ Proponent ▪ Project Ecologist ▪ Construction Contractor
Preparation of a Vegetation Management Plan (VMP)	Owing to the presence of an EEC and SEPP44 Koala Feed trees within the Subject Land, a site specific Vegetation Management Plan (VMP) for the proposed activity that details the future management of the site's biodiversity (particularly EEC and potential threatened species) prior, during and post demolition and construction into the future has been produced (Narla Environmental 2020) and is to be implemented and adhered to for a period of at least five (5) years post construction. The implementation of the corresponding VMP will ensure responsible stewardship and a minimised biodiversity impact of all future works that occur on the Subject Land. The VMP should be reviewed by a suitably qualified Ecologist, every five years from the data of inception. Most importantly, the VMP will detail: 1. the on-going management of Swamp Sclerophyll Forest EEC within the south-western extent of the Subject Land 2. the protection and enhancement of fauna habitat within the Subject Land All landscape garden beds proposed should include locally-indigenous flora, to promote local biodiversity and maintain fauna habitat values on site. All native plants used in plantings should be sourced from a local provenance nursery. The proponent should plant flora species representative of the surrounding indigenous vegetation community (Swamp Sclerophyll Forest EEC) (**Appendix A**) with a focus on plants that will provide the same or increased optimal habitat functions as the trees and proposed for removal (Narla Environmental 2020).	Pre-construction phase	▪ Project Ecologist on behalf of Proponent

<table>
<tr><th>Action</th><th>Outcome/Measure</th><th>Timing</th><th>Responsibility</th></tr>
<tr><td>Preparation of a SEPP44 Independent Koala Plan of Management (IKPoM)</td><td>Owing to the presence of numerous proximal, historical records of Koala sightings within the general vicinity of the Subject Land, the presence of Preferred Koala Feed Trees (PKPFs) in accordance with State Environmental Planning Policy (No. 44) and potential Koala habitat occurring within the Subject Land, the preparation of an Independent Koala Plan of Management (IKPoM) has been undertaken by Narla Environmental (2018) and will be implemented in concurrence with the site specific VMP.

The IKPoM will ensure the responsible stewardship and minimised impact on potential Koala habitat occurring within the Subject Land.

The corresponding IKPoM details the replacement and rehabilitation of Koala habitat lost as a result of the proposed activity.</td><td>Pre-construction Phase</td><td>▪ Project Ecologist on behalf of Proponent</td></tr>
<tr><td>Tree Replacement</td><td>In order to mitigate the expected direct impacts upon koala feed trees and native vegetation in general, all native tree species to be removed are to be replaced at a complementary ratio of 1:4 in order to ensure no net loss, as detailed in the corresponding VMP (Narla Environmental 2020). All existing native trees required to be removed are to be replaced in accordance with the 'Single Tree Replacement' ratio outlined within the Coastal Koala Plan of Management (Port Macquarie-Hastings 2018) (Table 18). All trees removed are to be replaced with advanced nursery stock (advanced trees 600mm – 25L pot size minimum) within a suitable area outside of the Subject Land, as determined through collaboration between both Narla Environmental and Port Macquarie Hastings Council. Adherence to the maximum suggested tree replacement ratios contained within this report will ensure that the Koala habitat replacement requirements identified within the Draft Coastal Koala Plan of Management (Port Macquarie-Hastings Council 2018) will be satisfied.
Table 18. Single tree replacement ratio based on DBH of tree to be removed (Port Macquarie-Hastings Council 2018)
<table><tr><th>Food tree size class (dbhob)</th><th>Replacement ratio (loss:gain)</th></tr><tr><td><100 mm</td><td>1:2</td></tr><tr><td>100–300 mm</td><td>1:3</td></tr><tr><td>>300 mm</td><td>1:4</td></tr></table>Only 53 Preferred Koala Feed Trees (PKFTs) were identified for removal through on ground survey by Narla Environmental, the precautionary principal is to be applied, and it should be assumed that at least 70 PKFT are to be removed. This assumption is based on the number of PKFT that should have been planted in the Subject Land as required under a previous consent (Darkheart 2014).

In the case of the proposed development, the precautionary principal assumes that a total of 70 PKFTs are to be removed from the site. This is an increase of 17 trees when compared to on ground observations. The increased number of PKFTs (70) has been derived from the previous VMP (Darkheart 2014) produced for the development of the original school structure. Although the total number of replacements PKFTs outlined within the Darkheart VMP (2014) was never completely implemented, the</td><td>Pre-construction phase</td><td>▪ Proponent
▪ Project Ecologist
▪ School Maintenance Coordinator
▪ Bush Regeneration Contractor</td></tr>
</table>

Action	Outcome/Measure	Timing	Responsibility
	proponent has opted to offset the number originally required to be planted to ensure the most optimal outcome for the conservation of this species within the region. **Table 19. Proposed native canopy tree replacement (Narla Environmental 2020)** **Proposed Number to be Removed** | **Proposed Number to be Replanted** **70** (Original number proposed within Darkheart VMP 2014) | **280** (70 trees replaced at 1:4 replacement ratio) Due to the small area available for replacement planting available within the Subject Land and the large number of replacement trees required, an offsite replacement planting location is proposed. The process of identifying this location is detailed in the corresponding VMP & KPoM (Narla Environmental 2020).		
Revegetation of Swamp Sclerophyll Forest EEC + Installation of Bio-Swale	As a result of the proposed activity, an approximate 1.17ha of native vegetation identified as PCT ID: 1230 (Swamp Sclerophyll Forest EEC) is expected to be impacted as a result of the proposed development. In order to partially mitigate the ecological impact of the proposed activity, the western extent of the Subject Land has been identified as a suitable location to revegetate in accordance with both the corresponding VMP (Narla Environmental 2020). This area, identified as Management Zone 1, comprises an area of 0.4ha and encompasses a portion of the 'Phase 2' planting area proposed in the VMP by Darkheart (2014) that aimed to rehabilitate the western extent of the Subject Land site in relation to the original development of the Lake Cathie Public School. The proposed area identified for revegetation spans a total area of 0.76ha (**Figure 18**) and is comprised of two main areas: ▪ 0.4ha to be completely revegetated to a high density with native flora species conforming to the EEC Swamp Sclerophyll Forest, including tree species and numbers identified in **Table 19.** ▪ 0.36ha to be revegetated with native flora species conforming to the EEC Swamp Sclerophyll Forest, including tree species identified in **Table 19.** Revegetation efforts undertaken within this zone are to ensure compliance with the fuel reduction requirements of the IPA APZ detailed within the corresponding Bushfire Hazard Assessment as guided by the VMP & KPOM (Narla Environmental 2020). Adherence to the recommended revegetation species list (**Appendix A**) as well as the prescribed areas detailed above will ensure the Swamp Sclerophyll Forest EEC located within the Subject Land will experience an overall net gain of 0.21ha of on ground, native vegetation. In addition to the prescribed native revegetation efforts proposed within the Subject Land (Narla Environmental 2020), Biodiversity Offset Credits for the native vegetation to be impacted are to be purchased and retired in accordance with the requirements of the BOS. The Biodiversity Offset Credit obligations for the proposed activity are detailed in **Section 6.4** below. A Bio-Swale water retention basin is scheduled to be installed within the Asset Protection Zone area, west of the proposed construction area (Terras 2018). The Bio-Swale will be comprised of a water diversion channel that will guide on site stormwater to an approximately 330m^2 basin in the south of the site (**Figure**	Pre-construction phase	▪ Proponent ▪ Project Ecologist ▪ School Maintenance Coordinator ▪ Bush Regeneration Contractor

Action	Outcome/Measure	Timing	Responsibility
	1). The entirety of the Bio-Swale channel and basin is to be vegetated with water tolerant native species primarily representative of the Swamp Sclerophyll Forest EEC.		
Revegetation of Laced Fritillary Larval Food Plant	An estimated two (2) *Viola betonicifolia)* that comprises food for the Endangered Laced Fritillary butterfly may be removed during the proposed construction activity. Targeted surveys undertaken by Narla in May 2019 revealed that no Laced Fritillary occur on the Subject Land. However, in good environmental restoration practice it is recommended that these two individual plants are replaced at the minimum compensatory ratio of 1:10 (10 replacement plants installed to replace individual plant removed) within the proposed revegetation area in the western extent of the Subject Land (Narla Environmental 2020). The projected increase of larval food plant availability from two individual plants to at least twenty will provide a net gain in larval food habitat available for this species within the Subject Land. The plants should be planted outside of proposed APZ areas in, locations where the vegetation is likely to remain unmodified in the long term (**Figure 18**). In addition to the prescribed native revegetation efforts proposed within the Subject Land (Narla Environmental 2020), Biodiversity Offset Credits for the threatened Laced Fritillary are to be purchased and retired in accordance with the requirements of the BOS. The Biodiversity Offset Credit obligations for the proposed activity are detailed in **Section 6.4** below.	Pre-construction phase	▪ Proponent ▪ Project Ecologist ▪ Bush Regeneration Contractor
Tree Protections	Australian Standard 4970 (2009) Protection of Trees on Development Sites (AS-4970) outlines that a Tree Protection Zone (TPZ) is the principal means of protecting trees on construction sites. It is an area isolated from construction disturbance so that the tree remains viable. Ideally, works should be avoided within the TPZ. A Minor Encroachment is less than 10% of the TPZ and is outside the SRZ. A Minor Encroachment is considered acceptable by AS-4970 when it is compensated for elsewhere and contiguous within the TPZ. A Major Encroachment is greater than 10% of the TPZ or inside the SRZ. Major Encroachments generally require root investigations undertaken by non-destructive methods or the use of tree sensitive construction methods.	Pre-construction phase	▪ Proponent ▪ Arborist and fence contractor under guidance of Arboriculturalist.
Clearing of vegetation/ fauna habitat	In preparation for the authorised clearing of native vegetation, the following conditions should be adhered to in order to minimise all potential impacts to native biodiversity values within the Subject Land: ▪ before any vegetation is damaged or removed, a qualified Ecologist with flora identification experience should be assigned to undertake a pre-clearing survey to delineate areas permitted to be cleared, from areas that must be retained. Brightly coloured bunting or strong flagging tape should be used. ▪ prior to vegetation being damaged or removed, a qualified Ecologist with fauna identification experience should determine the presence of any suitable habitat for roosting microbats, nesting birds or other fauna in the area of the Subject Land due to be cleared. ▪ all trees (including dead trees) should be felled by qualified Arborists using chainsaw and pulleys only. No heavy machinery is permitted for removal of any tree that is located within 10 metres of any EEC unless otherwise agreed to by the Project Ecologist.	Construction phase	▪ Bush regeneration contractor ▪ Project Ecologist ▪ Proponent ▪ Arboricultural Professional

Action	Outcome/Measure	Timing	Responsibility
	▪ a qualified Project Ecologist with experience in handling wildlife should be present on the Project Site during all vegetation clearing in order to supervise clearing and capture and relocate any displaced, healthy animals, or care for / rehabilitate any injured or orphaned animals.		
Relocation of woody debris	Where possible; all woody debris (fallen trees and logs), within the Subject Land is to be retained. Woody debris within the activity footprint or prescribed APZ should be relocated, as directed by the Project Ecologist to an area of native vegetation planned for protection within the south-western extent of the Subject Land (Narla Environmental 2020).	Construction phase	▪ Bush regeneration contractor ▪ Project Ecologist ▪ Proponent
Installation of Koala-friendly fence crossings	The proponent should consider the installation of additional two, timber 'koala fence crossing' structures along the boundary fence in the south-western corner of the Subject Land that would enable koalas to climb over the steel fence that surrounds the entire site. These crossings should be installed in a manner that straddles the fence that borders the remnant vegetation to the south-west of the Subject Land. Such structures will enable Koalas to move between the feed trees in the Subject Land and adjoining lands to the south-west. The most optimal timber for use in construction such a crossing would consist of natural, felled logs. Permission must be sought from the adjoining landholder.	Construction phase	▪ Landscape contractor ▪ Project Ecologist ▪ Proponent
Implement a Strategy to Reduce Risk of Road-mortality and Disturbance to Koalas	▪ Install more signage along Ocean Drive surrounding Lake Cathie Public School warning motorists of the presence of Koalas. ▪ Enforce a mandatory speed limit of 5km/h within the grounds of Lake Cathie Public School. ▪ The maintenance and upkeep of Koala Proof fencing along the entire perimeter of the school in order to prevent Koalas accessing Ocean Drive from within the school grounds. ▪ Educate both patrons of the school and local residents on the presence of Koalas in the area immediately surrounding the site as well as their presence within the broader Port Macquarie-Hastings LGA. ▪ Engage the school community including school students in caring for Koala, and encouraging such community members to engage in the creation of signage and information material regarding the Koalas in the region. Including a component on local koala conservation in the school syllabus is recommended. ▪ Do not permit dogs off-leash within the school grounds ▪ Implementing a 'Koala Protection Procedure'. In the event a Koala is observed within or adjacent School grounds, a wildlife carer will be notified to come and assess the koala. Until the carer arrives, the School staff member or contractor will be assigned to watch the koala and notify any passing vehicles or persons on foot, to travel slowly and quietly to avoid disturbing or harming the koala. Temporary warning signs can be erected (e.g. on star pickets or trees) to notify people of the koala's presence. Once the wildlife carer arrives to assess the Koala, they will advise the School on the best course of action which may include capturing the koala for medical assessment/ relocation or leaving the koala in situ. The spotter will only conclude watching the koala once school day/weekend activities has finished and the school gates have been closed for the day.		▪

Action	Outcome/Measure	Timing	Responsibility
Avoidance of removing hollow-bearing Trees	All hollow-bearing trees (including dead trees) should be retained, in-situ, where possible.	Construction phase	▪ Bush regeneration contractor ▪ Project Ecologist ▪ Proponent
Relocation of Habitat Tree and/or **Installation of Artificial Hollows**	Only one hollow-bearing tree occurs on the Subject Land. This tree contains some hollows and previously installed nestboxes as recommended by Darkheart (2014): ▪ 4 nest boxes to suit microchiropteran bats; ▪ 4 nest boxes to suit lorikeets and rosellas; ▪ 2 boxes to suit Sugar/Squirrel Gliders; and ▪ 1 box to suit a possum. It is not proposed that this tree will be removed. To mitigate any potential (albeit unlikely) impacts from future loss of this tree and the nestboxes attached, it is recommended that the proponent installs artificial nestboxes on other trees present within the Subject Land. Narla recommend that the proponent installs an additional: ▪ 8 nest boxes to suit chiropteran bats; ▪ 8 nest boxes to suit lorikeets and rosellas; ▪ 4 boxes to suit Sugar/Squirrel Gliders; and ▪ 2 boxes to suit a possum. on trees that remain within the Subject Land. In the unlikely event that the large hollow-bearing *E. tereticornis* in the southern extent of the Subject Land requires removal, its relocation into the western area to be retained is recommended. Relocation and erection of this tree can be achieved through the use of excavators, cranes and a concrete footing. The process to be undertaken should involve the soft felling of the tree at the base of the trunk so that the body of the tree remains in one single piece. The hollow bearing body of the tree can then be relocated and erected into the non-APZ area of the conservation area to be retained where it should be secured in the ground with the aid of a support frame and a concrete footing (similar to the erection of a telegraph pole). The successful relocation of the identified habitat tree will ameliorate the loss of any hollow dwelling threatened fauna habitat features from within the proposed area of activity. In the event that any existing tree hollows or nest boxes are damaged in the relocation process, the damaged habitat features are to be replaced with a representative feature at the compensatory ratio of 1:2 (two new hollows for each hollow/nestbox removed). In the event of any relocation or removal of the habitat tree identified within the site, a Project Ecologist is to be supervising at all times.	Construction phase	▪ Bush regeneration contractor ▪ Suitably qualified Arboriculturalist ▪ Project Ecologist ▪ Proponent

Action	Outcome/Measure	Timing	Responsibility
	If relocation of the habitat tree cannot be achieved because of its size or structure, the proponent could explore the suitability of importing a smaller or more suitable felled hollow tree from another site and erecting that. Alternatively, the proponent could commission an experienced Arborist to chainsaw suitable hollows into other remnant trees located in the Subject Land. The total number of artificial hollows to install would equate to 1:2 (two new hollows for each hollow/nestbox removed). The proponent must commission the services of an Ecologist to monitor all nest boxes for damage or feral species nesting (e.g. Indian Mynah, feral bees). This should take place once per year. Replace/maintain nestboxes as required after formal monitoring complete in perpetuity.		
Erosion and Sedimentation	Appropriate erosion and sediment control must be erected and maintained at all times during construction in order to avoid the potential of incurring indirect impacts on biodiversity values. As minimum such measures should comply with the relevant industry guidelines such as 'the Blue Book' (Landcom 2004).	Construction phase	▪ Proponent ▪ Construction Contractor
Erection of temporary fencing	Temporary fencing should be erected around the extent of native vegetation to be retained in order to avoid the potential of incurring indirect impacts on biodiversity values resulting from the proposed construction works.	Construction phase	▪ Proponent ▪ Construction Contractor
Storage and Stockpiling (Soil and Materials)	Allocate all storage, stockpile and laydown sites away from any native vegetation that is planned to be retained. Avoid importing any soil from outside the site as this can introduce weeds and pathogens to the site in order to avoid the potential of incurring indirect impacts on biodiversity values.	Construction phase	▪ Construction Contractors
Weed eradication and continued suppression from EEC	Weeds should be eradicated across all areas of Swamp Oak Floodplain EEC within the Subject Land. Weeds should be continually supressed and prevented from re-establishing in areas of EEC as well as rehabilitated Koala habitat in order to avoid the potential of incurring indirect impacts on biodiversity values.	Construction phase and Post-construction phase	▪ Project Ecologist ▪ Bush Regeneration Contractor ▪ School Maintenance Coordinator
Stormwater	The proposed activity is unlikely to result in significant changes to storm-water runoff so it is expected there will be no exacerbated impact on native species of flora and fauna. Stormwater flow from the proposed dwellings and hard surfaces will be directed to existing paths of stormwater runoff. A new Onsite Stormwater Detention (OSD) system will be installed. Furthermore, stormwater from across the site will be channelled into an engineered 'bioswale' wetland which will be planted with locally indigenous wetland tolerant plants to enhance local biodiversity and habitat complexity (plantings will meet IPA APZ specifications)	Post-construction phase	▪ Proponent ▪ Construction Architect

Figure 18. **Locations of proposed revegetation to mitigate the impacts of the activity**

5.1.1 Adaptive Management Strategy

As the proposed activity is classified as a 'major project', an 'adaptive management strategy' may be requested in order to monitor to impacts on biodiversity values that are uncertain (OEH 2017a).

The proposed activity is not expected to result in impact or exacerbation of any of the 'uncertain biodiversity impacts' as listed in the BAM:

- Impacts related to damage to karsts, caves, crevices, cliffs and other geological features of significance;
- Impacts related to subsidence and upsidence resulting from underground mining;
- Impacts related to wind turbine strikes; and
- Impacts related to vehicle strikes

Given the nature of the proposed activity and the limited major invasive works required, no Adaptive Management Strategy is required as all infrequent or difficult to measure impacts to biodiversity values within the site are expected to be compensated for by the avoidance and mitigation actions outlined in **Table 17** such as the implementation of the IKPOM.

6.Impact Summary

6.1 Impacts on Biodiversity Values

6.1.1 Serious and Irreversible Impacts

As a result of the species' 'very high rates of decline', the threatened Laced Fritillary has been identified as an 'SAII entity' in accordance with the '*Guidance to assist a decision-maker to determine a serious and irreversible impact*' (**Table 20**) (OEH 2017c). Targeted survey for the Laced Fritillary was undertaken within the identified survey period for this species (March-June) in accordance with the relevant NSW Threatened Species Survey Guidelines, no individuals of this species were observed.

Table 20. Identification and justification for species considered to be at risk of Serious and irreversible Impacts (OEH 2017c)

Species	Criteria for identifying potential entities	Justification for listing	Threshold for consideration of SAII
Argynnis hyperbius (Laced Fritillary)	Principle 1 – species or ecological community currently in a rapid rate of decline	Very high rates of decline.	0ha of suitable habitat

As it is an SAII entity, the impact threshold for the potential Laced Fritillary is 0ha. This means that any impact on the potential habitat for this species could be serious and irreversible. Due to the potential sensitivity of this species to any impact on its potential habitat, a determination of whether or not the proposed impacts are serious and irreversible are to be undertaken in accordance with section 3.2 of the '*Guidance to assist a decision-maker to determine a serious and irreversible impact*' (**Table 21**) (OEH 2017c).

Table 21. Process of determining Serious and Irreversible Impacts

Determining Whether Impacts are Serious and Irreversible	
Step 1: Identify relevant potential entities	Thorough targeted surveys were undertaken for Laced Fritillary by an Ecologist with experience in Lepidopteran survey techniques over four separate days during the month of May 2019. This survey effort failed to identify any individuals of the species. The survey did however confirm the presence of common native butterfly species including *Zizina labradus* (Common Grass Blue), *Junonia villida calybe* (Meadow Argus) and *Delias nigrina* (Common Jezabel). The Subject Land contains scattered individuals of the preferred foraging plant (*Viola betonicifolia*) for larvae of the Laced Fritillary (**Figure 17**). A total of 1.17ha of potential habitat containing two (2) individual *Viola betonicifolia* was identified within the proposed activity footprint.
Step 2: Evaluate nature of impact on a potential entity	The proposed location of the activity footprint has been designed in such a way as to minimise the potential impact to biodiversity values relevant to the Laced Fritillary and its food plant. Within the potential habitat to be impacted, a total of two (2) individual *Viola betonicifolia* were identified. As per the corresponding VMP (Narla Environmental 2020), a minimum of 10 replacement larval foraging (*Viola betonicifolia*) plants are to be installed within the proposed revegetation zone for each individual confirmed to be impacted upon by the proposed activity. The implementation of the prescribed compensatory planting, as per the corresponding VMP (Narla Environmental 2020), will result in a significant increase in the availability of the preferred larval feed plant of the Laced Fritillary within the Subject Land. Targeted surveys were undertaken by Ecologists during a comprehensive site assessment in May of 2019. No evidence of the Laced Fritillary was observed within the Subject Land.

Determining Whether Impacts are Serious and Irreversible	
Step 3: Determine if the impacts exceed the threshold	The proposed activity is estimated to impact on approximately 1.17ha of potential habitat for the Laced Fritillary and this exceeds the species SAII threshold of 0ha. It is important to note that only two (2) individuals of the specific larval food plant are proposed to be impacted. Ensuring the compensatory revegetation measures outlined within the corresponding VMP (Narla Environmental 2020) are implemented, the potential habitat for this species within the Subject Land will see a significant increase as a result of the proposed activity. Given the significant increase in larval feed plants proposed to be provided for this species within the Subject Land, it is considered unlikely that the proposed activity will result in a SAII for the Laced Fritillary. Targeted surveys were undertaken by Ecologists during a comprehensive site assessment in May of 2019. No evidence of the Laced Fritillary was observed within the Subject Land.
Step 4: Evaluate a serious and irreversible impact	As is demonstrated by the information provided in steps 1-3 of this table, the proposed impact to the Laced Fritillary is unlikely to constitute an SAII to the Laced Fritillary. In contrast it is believed that the successful implementation of the corresponding VMP (Narla Environmental 2020) will see a significant increase in potential habitat available for this species within the Subject Land. No loss of the species population and habitat is expected to occur as a result of the proposed activity. Due to the implementation of additional compensatory habitat as outlined by the corresponding VMP (Narla Environmental 2020), no fragmentation or isolation of a local population of the Laced Fritillary is expected to occur. Targeted surveys were undertaken by Ecologists during a comprehensive site assessment in May of 2019.

6.1.2 Native Vegetation Clearance Requiring Offsetting

The following native vegetation within the Subject Land is proposed to be impacted as a result of the proposed activity and will require the purchase and retirement of Biodiversity Offset Credits:

- 1.17ha of native vegetation representative of PCT 1230 (Swamp Sclerophyll Forest EEC)

6.1.3 Vegetation Clearance not Requiring Offsetting

All remaining vegetation required to be cleared as a result of the proposed activity is comprised of historically modified and routinely mown exotic pasture grasses. The removal of this vegetation does not require the purchase of Biodiversity Offset Credits.

6.1.4 Hollow Bearing Tree Removal

A single hollow-bearing tree occurs within the new APZ proposed for the activity. This tree is not expected to be removed however in the unlikely event that its removal is required, the installation of augmented tree hollows (nest boxes) is to be implemented within suitable remaining vegetation at the compensatory ratio of 1:2 (two nest boxes installed for each tree hollow removed).

6.2 Other Impacts

6.2.1 Indirect Impacts

Indirect impacts occur when the proposal or activities relating to the construction or operation of the proposal affect native vegetation, threatened ecological communities and threatened species habitat beyond the Subject Land. Impacts may also result from changes to land-use patterns, such as an increase in vehicular access and human activity on native vegetation, threatened ecological communities and threatened species habitat.

Indirect Impact	**Extent and duration**	**Threatened species, threatened ecological communities and their habitats likely to be affected.**	**Consequences of the impacts for the bioregional persistence of the threatened species, threatened ecological communities and their habitats.**
(a) inadvertent impacts on adjacent habitat or vegetation	The proposed construction may lead to enhanced weed infiltration into adjacent habitat by enhanced edge effects. This impact is likely to be restricted the immediate area surrounding the construction footprint to a couple of metres.	Swamp Sclerophyll Forest EEC	Edge effects may increase weed intensity and reduce vegetation integrity.
(b) reduced viability of adjacent habitat due to edge effects	The proposed construction may lead to enhanced weed infiltration into adjacent habitat by enhanced edge effects. This impact is likely to be restricted the immediate area surrounding the road to a couple of metres.	Swamp Sclerophyll Forest EEC	Edge effects may increase weed intensity and reduce vegetation integrity.
(c) reduced viability of adjacent habitat due to noise, dust or light spill	The proposed works are unlikely to significantly exacerbate any of these issues which are all currently in effect, or otherwise unlikely to occur within the Subject Land.	NA	NA
(d) transport of weeds and pathogens from the site to adjacent vegetation	The proposed construction may lead to enhanced weed infiltration into adjacent habitat by enhanced edge effects. This impact is likely to be restricted the immediate area surrounding the road to a couple of metres. Active weed control efforts will be undertaken through implementation of the corresponding VMP (Narla Environmental 2020).	Swamp Sclerophyll Forest EEC	Edge effects may increase weed intensity and reduce vegetation integrity.
(e) increased risk of starvation, exposure and loss of shade or shelter	It is unlikely that any threatened fauna relies on habitat within the Subject Land, such that the proposed impacts will lead to	*Argynnis hyperbius* (Laced Fritillary)	The implementation of the prescribed VMP will result in an increase in the amount of habitat (*Viola*

Indirect Impact	Extent and duration	Threatened species, threatened ecological communities and their habitats likely to be affected.	Consequences of the impacts for the bioregional persistence of the threatened species, threatened ecological communities and their habitats.
	increased risks from starvation, exposure, shade and shelter. All habitat resources removed will be replaced at a higher ratio through implementation of the corresponding VMP (Narla Environmental 2020).		*betonicifolia*) available for this species within the Subject Land.
(f) loss of breeding habitats	The propose activity is expected to remove a total of two individual larval feed plants for *Argynnis hyperbius* (Laced Fritillary).	*Argynnis hyperbius* (Laced Fritillary)	The implementation of the corresponding VMP (Narla Environmental 2020) will result in an increase in the amount of habitat (*Viola betonicifolia*) available for this species within the Subject Land. The majority of existing plants present within the Subject Land will remain un impacted.
(g) trampling of threatened flora species	No threatened flora species were identified within the Subject Land. It is not expected that any would occur that would be impacted by trampling.	NA	NA
(h) inhibition of nitrogen fixation and increased soil salinity	The Subject Land is located close to the coastal interface and is regularly exposed to salt-spray. It is unlikely that these issues affect the Subject Land.	NA	NA
(i) fertiliser drift	This issue currently exists on the Subject Land. It is unlikely that the proposal would significantly increase this impact.	Swamp Sclerophyll Forest EEC	It is not expected that fertiliser application will cause significant impacts such that the bioregional persistence of threatened species, ecological communities or their habitats could be impacted.
(j) rubbish dumping	This issue was not observed within the Subject Land and is not expected to be exacerbated as a result of the proposed activity.	NA	NA
(k) wood collection	This issue is not likely to affect the Subject Land.	NA	NA
(l) bush rock removal and disturbance	This issue is not relevant to the Subject Land as there is no bush rock.	NA	NA

Indirect Impact	Extent and duration	Threatened species, threatened ecological communities and their habitats likely to be affected.	Consequences of the impacts for the bioregional persistence of the threatened species, threatened ecological communities and their habitats.
(m) increase in predatory species populations	It is unlikely that the proposed works will influence or alter predatory species populations.	NA	NA
(n) increase in pest animal populations	It is unlikely that the proposed works will influence or alter pest species populations. Pest animals are already present within the Subject Land.	NA	NA
(o) increased risk of fire	This issue is not relevant to the Subject Land as there is little identified bushfire hazard.	NA	NA
(p) disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds.	The proposed activity is expected to remove a total of two individual larval feed plants for *Argynnis hyperbius* (Laced Fritillary).	*Argynnis hyperbius* (Laced Fritillary)	The implementation of the corresponding VMP (Narla Environmental 2020) will result in an increase in the amount of habitat (*Viola betonicifolia*) available for this species within the Subject Land. The majority of existing plants present within the Subject Land will remain un impacted.

6.2.2 Prescribed and Uncertain Impacts

This list of impacts includes all of those impacts on biodiversity values not caused by direct vegetation clearing or development that have been prescribed by the *Biodiversity Conservation Regulation 2017*.

Will there be impacts on any of the following	Yes/No	If Yes, Address all of the assessment questions from section 9.2.1 of the BAM
Species or ecological communities associated with karst, caves, crevices, cliffs and other features of geological significance	No	NA
Habitat of threatened species or ecological communities associated with rocks	No	NA
Habitat of threatened species or ecological communities associated with human made structures	No	NA
Habitat of threatened species or ecological communities associated with non-native vegetation	No	NA

Connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	Yes	**Koala (*Phascolarctos cinereus*)** **(a) Identify the area/s of connectivity joining different areas of habitat that intersect with the Subject Land and the areas of habitat that are connected (according to Paragraph 4.2.1.3 of the BAM):** A small area of vegetation within the south-western corner of the Subject Land was identified as being connected with vegetation south of the site (**Figure 8**). Koalas may move between the vegetation south of the Subject Land and the Subject Land itself by using a designated koala fence crossing that has been previously installed. The connected vegetation consists of a thin strip of wet sclerophyll forest that connects to a wider area of wetland vegetation to the east that is largely isolated from further vegetative links by both cleared and residential land as well as Ocean Drive to the west (**Figure 9**). The area of native vegetation within the Subject Land fails to connect with the wider expanse of suitable habitat for this species, identified to the west of the site, separated by Ocean Drive. **(b) Identify the species and ecological communities likely to benefit from the connectivity:** Due to the boundary fence of the Lake Cathie Public School intersecting the area of 'connected' vegetation within the south-western corner of the Subject Land, it is expected that the connectivity of this vegetation is likely to benefit smaller, more mobile fauna species that rely on canopy connectivity for movement rather than manoeuvring on the ground between select feed trees as Koalas do. In order to provide assistance to any Koalas potentially seeking access to or egress from the vegetation within the south-western corner of the site, one timber structures has been erected over the boundary fence allowing Koalas safe passage both in and out of the Subject Land. Additional crossing structures are recommended, preferable structures that are comprised of previously felled trees. Connectivity of the Subject Land will be maintained as a result of the comprehensive revegetation of approximately 0.4ha of land within the south-western extent of the site. The Endangered Ecological Community (EEC), *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*, is represented by the vegetation present in the south-western extent of the Subject Land. This will benefit from the maintained connectivity as it will allow for the transfer of genetic material within the area increasing the long-term viability of the stand of EEC. **(c) Describe the nature, extent and duration of short and long term impacts:** Short Term Impacts: - As the vegetation within the Subject Land is currently of a low quality and condition due to historic clearing and Asset Protection Zone management works, the removal of a small area of sub-optimal habitat will not have a significant short-term impact on Koalas. The site will continue to provide access and egress to the vegetation remaining within the Subject Land. All relevant mitigation measures including pre-clearance surveys and vegetation clearance supervision will be undertaken by a suitably qualified Ecologist in order to minimise and mitigate as much risk as possible to Koalas within the proximity of the site. Long Term Impacts: - Long term, the landscape connectivity for Koalas within both the Subject Land as well as the wider locality of the PMHC LGA will increase. Within the Subject Land, an area of approximately 0.4ha will undergo comprehensive revegetation works within the south-western corner of the site, linking the area to the intact vegetation adjoining the south-western boundary of the site. Within the wider locality, a total of 280 Preferred Koala Feed Trees (PKFTs) are to be planted within, adjoining or linking an area of 'Core Koala Habitat' as identified within the Draft Coastal Koala Plan of Management (2018). **(d) Describe, with reference to relevant literature and other reliable published sources of information, the importance of the area of connectivity within the bioregion:**

The connectivity of Koala habitat within the Subject Land within the wider bioregion is of low importance to the species. The Subject Land is situated on an isolated peninsular of vegetation bounded by cleared land and public infrastructure. The area of Koala habitat connectivity between the Subject Land and adjoining vegetation is not identified as 'Core Koala Habitat' within the Draft Coastal Koala Plan of Management (2018) and would not result in increased fragmentation within the immediate area. No Koalas have been observed in the Subject Land at any time by the Principal of the School (Jock Garven pers comm. 2018). A vegetative link between the Subject Land and adjoining vegetation will be retained and comprehensively rehabilitated, reducing the potential impact of the proposed activity. In order to provide assistance to any Koalas potentially seeking access to or egress from the vegetation within the south-western corner of the site, one timber structures has been erected over the boundary fence allowing Koalas safe passage both in and out of the Subject Land. Additional crossing structures are recommended, preferable structures that are comprised of previously felled trees.

(e) Predict the consequences of the impacts for the bioregional persistence of the suite of threatened species and communities currently benefitting from the connectivity with reference to relevant literature and other published sources of information and taking in consideration mobility, abundance, range and other relevant life history factors:

The consequences for the bioregional persistence of the Koala with regards to the modification of the vegetative connectivity between the Subject Land and the area immediately adjoining the south-west are negligible. No Koalas have been observed in the Subject Land at any time by the Principal of the School (Jock Garven pers comm. 2018). The habitat and general connectivity within the Subject Land is of sub-optimal quality and largely isolated from adjoining patches of suitable habitat for this species.

As a result of the proposed activity, a total of 280 PKFTs are to be planted within priority Koala areas identified as areas of 'Core Koala Habitat' within the Draft Coastal Koala Plan of Management (2018). Planting these 280 PKFTs in a more important Core Koala Habitat area will provide improved long-term benefits to Koalas in the region. This implementation of complementary habitat will increase the connectivity of habitat suitable for this species within the locality and, in turn, the aid the bioregional persistence of the Koala (Port Macquarie Hastings Council 2018).

Will there be impacts on any of the following	Yes/No	If Yes, Address all of the assessment questions from section 9.2.1 of the BAM
Movement of threatened species that maintains their life cycle	Yes	**Koala (*Phascolarctos cinereus*)** **(a) Identify movement patterns key to the life cycle of the relevant threatened species that intersect with the Subject Land:** Koalas can inhabit intact woodlands and forests with a wide range of home ranges varying from anywhere between two hectares and several hundred hectares (OEH 2019), they do not undertake any systematic or regular migration events that are key to their lifecycle. Given the low quality of native vegetation within the Subject Land and the limited access to and from the site due to fencing surrounding the boundary of the property, it is reasonable to conclude that the Subject Land is not significant to the movement of the Koala and does not intersect any identified migratory or established movement pathways. The Subject Land does not link any two areas of identified 'Core Koala Habitat' (Port Macquarie Hastings Council 2018). **(b) Describe the nature, extent and duration of short and long term impacts:** Short Term Impacts: - The removal of native vegetation containing Preferred Koala Feed Trees (PKFTs) for the establishment of the proposed activity and prescribes APZ. A total of approximately 1.17ha of native vegetation containing PKFTs is proposed to be removed or modified as a result of the proposed activity. The vast majority of this vegetation has been planted within the last 10 years and is not sufficiently mature to sustain a healthy population or the movement of Koalas through the site. The removal of this vegetation is expected to take roughly one to two weeks of vegetation clearance works and any impacts to the movement of Koalas will be mitigated by having suitably trained and qualified fauna spotter-catcher Ecologists on site during all vegetation clearance works undertaken in order to catch and re-locate any native fauna species (including Koalas) that are identified within the Subject Land whilst the works are undertaken. Long Term Impacts - The revegetation of an area of 0.4ha of native vegetation containing PKFTs is proposed to be implemented within the western extent of the Subject Land. In addition to this, a total of 280 PKFTs are to be planted within an area elsewhere within the Port Macquarie-Hastings LGA in order to either link or expand an area of identified 'Core Koala Habitat'. Replacing the required PKFTs in an area adjacent to or linking an area of identified 'Core Koala Habitat' elsewhere within the PMHC LGA will increase the connectivity and overall coverage of Koala habitat within the region. Koala habitat within the Subject Land is of low conservation value due to its lack of connectivity and close proximity to human disturbance and public roads (Ocean Drive) and the long-term rehabilitation of habitat within this area would not be comparable to the positive conservation gain through the implementation of preferred Koala habitat elsewhere within the PMHC LGA. **(c) Describe, with reference to relevant literature and other reliable published sources of information, the importance of movement of the threatened species to their life cycle:** Movement is important in establishing home ranges of new generations of Koalas once they have established independence and will generally disperse between 1-11km from the home range of their mothers (Ramsay 1999; Gall 1980; Mitchell and Martin 1990; DECC 2008). Movement throughout large areas of intact native vegetation is essential for the continued lifecycle of Koalas however they are not a migratory species that rely on routine or seasonal movements to ensure breeding success. The Subject Land occurs in a historically disturbed landscape at the peninsular of a thin strip of native vegetation with limited to no feasible connectivity. The removal of 70 recently planted PKFTs from within the site will not have a significant impact on the movement of

Will there be impacts on any of the following	Yes/No	If Yes, Address all of the assessment questions from section 9.2.1 of the BAM
		this species throughout the landscape. This is because the vegetation within the Subject Land had been historically fragmented and isolated by the widening and increased usage of Ocean Drive and the clearing of vegetation surrounding the School. **(d) Predict the consequences of the impacts for the bioregional persistence of the threatened species, with reference to relevant literature and other reliable published sources of information:** The removal of fragmented and historically planted koala habitat from within the Subject Land is highly unlikely to have significant, detrimental consequences on the bioregional persistence of the Koala. The compensatory installation of 280 PKFTs planted in an area elsewhere within the Port Macquarie-Hastings LGA in order to either link or expand an area of identified 'Core Koala Habitat' will increase the connectivity and overall coverage of Koala habitat within the region and ultimately, benefit the bioregional persistence of the Koala within the PMHC LGA (Port Macquarie Hastings Council 2018).
Water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)	No	NA
Wind turbine strikes on protected animals	No	NA
Vehicle strikes on threatened species of animals or on animals that are part of a TEC	Yes	**Koala (*Phascolarctos cinereus*)** **(a) Identify the range of threatened animal species or animals that are part of a TEC at risk of vehicle (or other transport mode) strike:** The primary threatened animal species at risk of vehicle strike as a result of the proposed development is the Koala. Records identify a number of nearby Koala fatalities recorded (2005, 2007, 2015) to the north of the proposed development (OEH 2010). **(b) Predict the likelihood of vehicle strike to each relevant species, taking into consideration mobility, abundance, range and other relevant life history factors:** The upgrade and development of the Lake Cathie Public School is unlikely to result in a significant increase of vehicle strike on Koalas along Ocean Drive surrounding the northern extent of the proposed development. The potential Koala habitat occurring within the Subject Land is largely isolated from connecting patches and has not been identified as 'Core Koala Habitat' within the Coastal Koala plan of Management (Port Macquarie-Hastings Council 2018). Approximately nine (9) koala deaths as a result of vehicle strike have been recorded along Ocean Drive, north of the Subject Land between 1960 and 2019 (OEH 2010). The number of future vehicle strikes is predicted to decrease as a series of mitigation measures recommended in the corresponding, site specific Koala Plan of Management (Narla Environmental 2020) are implemented. Recommendations include: - Increased signage along Ocean Drive surrounding Lake Cathie Public School warning motorists of the presence of Koalas. - A mandatory speed limit of 5km/h within the grounds of Lake Cathie Public School. - The maintenance and upkeep of Koala Proof fencing along the entire perimeter of the school in order to prevent Koalas accessing Ocean Drive from within the school grounds. - Educating both patrons of the school and local residents on the presence of Koalas in the area immediately

Will there be impacts on any of the following	Yes/No	If Yes, Address all of the assessment questions from section 9.2.1 of the BAM
		surrounding the site as well as their presence within the broader Port Macquarie-Hastings LGA. - Engaging the school community including school students in caring for Koala, and encouraging such community members to engage in the creation of signage and information material regarding the Koalas in the region. Including a component on local koala conservation in the school syllabus is recommended. - Implementing a 'Koala Protection Procedure'. In the event a Koala is observed within or adjacent School grounds, a wildlife carer will be notified to come and assess the koala. Until the carer arrives, the School staff member or contractor will be assigned to watch the koala and notify any passing vehicles or persons on foot, to travel slowly and quietly to avoid disturbing or harming the koala. Temporary warning signs can be erected (e.g. on star pickets or trees) to notify people of the koala's presence. Once the wildlife carer arrives to assess the Koala, they will advise the School on the best course of action which may include capturing the koala for medical assessment/ relocation or leaving the koala in situ. The spotter will only conclude watching the koala once school day/weekend activities has finished and the school gates have been closed for the day. **(c) Estimate vehicle strike rates where supporting data or literature is available:** According to the available data, a total of 19 vehicle related incident have occurred along the extent of Ocean Drive that traverses the western and northern boundaries of Lake Cathie Public School (OEH 2010). The records available cover the period between 1960 and 2019 and have been submitted to the BioNet Atlas of NSW Wildlife (OEH 2010). **(d) Predict the consequences of the impacts for the local and bioregional persistence of the suite of relevant species, with reference to relevant literature and other published sources of information:** It is predicted that the consequences of the impacts of the proposed development on the local and bioregional persistence of the Koala will be negligible. As indicated by the Draft Coastal Koala Plan of Management (Port Macquarie Hastings Council 2018), the proposed development is not located within an area of identified 'Core Koala Habitat', nor does it occur within close proximity to or link two areas of identified 'Core Koala Habitat'. Through the mandatory implementation of the corresponding, site specific KPoM (Narla Environmental 2020), a series of mitigation measures have been proposed and are to be implemented that are designed to reduce the likelihood of future Koala mortalities as a result of vehicle strike. Mitigation measures proposed include: - Increased signage along Ocean Drive surrounding Lake Cathie Public School warning motorists of the presence of Koalas - A mandatory speed limit of 5km/h within the grounds of Lake Cathie Public School - The maintenance and upkeep of Koala Proof fencing along the entire perimeter of the school in order to prevent Koalas accessing Ocean Drive from within the school grounds; - Educating both patrons of the school and local residents on the presence of Koalas in the area immediately surrounding the site as well as their presence within the broader Port Macquarie-Hastings LGA.

6.3 Other Relevant Legislation or Planning Policies Requiring Address

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

SEPP 44 - Koala Habitat Protection only applies to land which:

- (i) has an area of more than 1 hectare; or
- (ii) has, together with any adjoining land in the same ownership, an area of more than 1 hectare whether or not the activity application applies to the whole, or only part, of the land.

The *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44) applies to all local government areas (LGAs) listed on Schedule 2 of the policy, except land dedicated under the *National Parks and Wildlife Act 1974* or the *Forestry Act 1916*. The identification of an area of land as SEPP 44 Potential Koala Habitat is determined by the presence Koala feed tree species listed within Schedule 2 of the policy.

Narla Environmentals site assessment revealed that there were two (2) species of Schedule 2 Feed Trees within the Subject Land:

- *Eucalyptus tereticornis*; and
- *Eucalyptus robusta* (includes hybrids between the two species as they show more morphological similarities to *E. robusta* than *E. tereticornis*)

As the concentration of SEPP44 Schedule 2 feed trees within the native vegetation of the Subject Land comprise greater than 15% of the total number of trees within the Subject Land, the site conforms to the definition of 'Potential Koala Habitat' under SEPP 44. Analysis of the vegetation within the Subject Land in combination with analysis of the local historical records of Koala presence within a 10km radius of the Subject Land and consultation of relevant mapping within the Draft Coastal Koala Plan of Management (Port Macquarie-Hastings Council 2018) concluded that the Subject Land did not constitute 'Core Koala Habitat' as defined in Clause 4 of SEPP 44 (1995) and as a result did not require further assessment as per this SEPP.

Core Koala Habitat has been identified and mapped in areas north of the site (Port Macquarie Hastings Council 2018). Despite the proximity of the site to mapped areas of 'Core Koala Habitat', it is unlikely that the proposed activity will adversely affect any such habitat or linkages between them as a result of the position of the Subject Land in relation to Ocean Drive and the low level of Koala habitat within the Subject Land. The prescribed impacts on the movement of Koalas, the connectivity of their habitat and an increased risk of vehicle strike as a result of a projected increase in vehicle have been assessed within **Section 6.2.2.**

The proponent has produced an updated Koala Plan of Management (KPoM) specific to the Subject Land. This has been prepared to accompany the proposed activity (Narla Environmental 2020). The corresponding KPoM outlines the remediation efforts required in order to rehabilitate the potential Koala habitat impacted by the proposed activity. The site specific KPoM has been produced in accordance with the Port Macquarie-Hastings Council Draft Coastal Koala Plan of Management (Port Macquarie-Hastings Council (2018).

Only 53 PKFTs were identified for removal through on ground survey by Narla Environmental, the precautionary principal is to be applied, and it should be assumed that at least 70 PKFT are to be removed. This assumption is based on the number of PKFT that should have been planted in the Subject Land as required under a previous consent (Darkheart 2014).

The IKPoM (Narla Environmental 2020) concludes that a total of 280 PFKTs should be planted to replace all PFKT's removed, at a ratio of 1:4. Owing to constraints regarding the availability of space within the subject Lands for planting, the IKPOM (Narla Environmental 2020) recommends that all replacement plantings take place on public lands located outside of the Subject Land. The most optimal location for planting would be an area of historically cleared land located within an area mapped as 'Core Koala Habitat' by site (Port Macquarie Hastings Council 2018).

6.3.2 Groundwater Dependent Ecosystems

The NSW Groundwater Dependent Ecosystem (GDE) Policy defines GDEs as ecosystems, which have their species composition, and their natural ecological processes determined by groundwater (DLWC 2002). The Policy defines groundwater as the water beneath the earth's surface that has filtered down to the zone where the earth or rocks are fully saturated (DLWC 2002). Ecosystems vary dramatically in the degree of dependency of groundwater, from having no apparent dependence through to being entirely dependent on it (DLWC 2002). The Australian Government Atlas of Groundwater Dependent Ecosystems was used to identify any previously mapped GDEs that occur in or near the Subject Land. This atlas identifies GDEs reliant on surface groundwater (rivers, springs and wetlands) and subsurface groundwater (vegetation). The Atlas was reviewed and it was identified that the Subject Land may contain land with a low potential of containing a GDE. Fine scale site surveys identified that the only potential GDE identified within the Subject Land occurs outside of the proposed activity footprint and adjoins an additional corridor of native vegetation outside of the south-western boundary of the Subject Land.

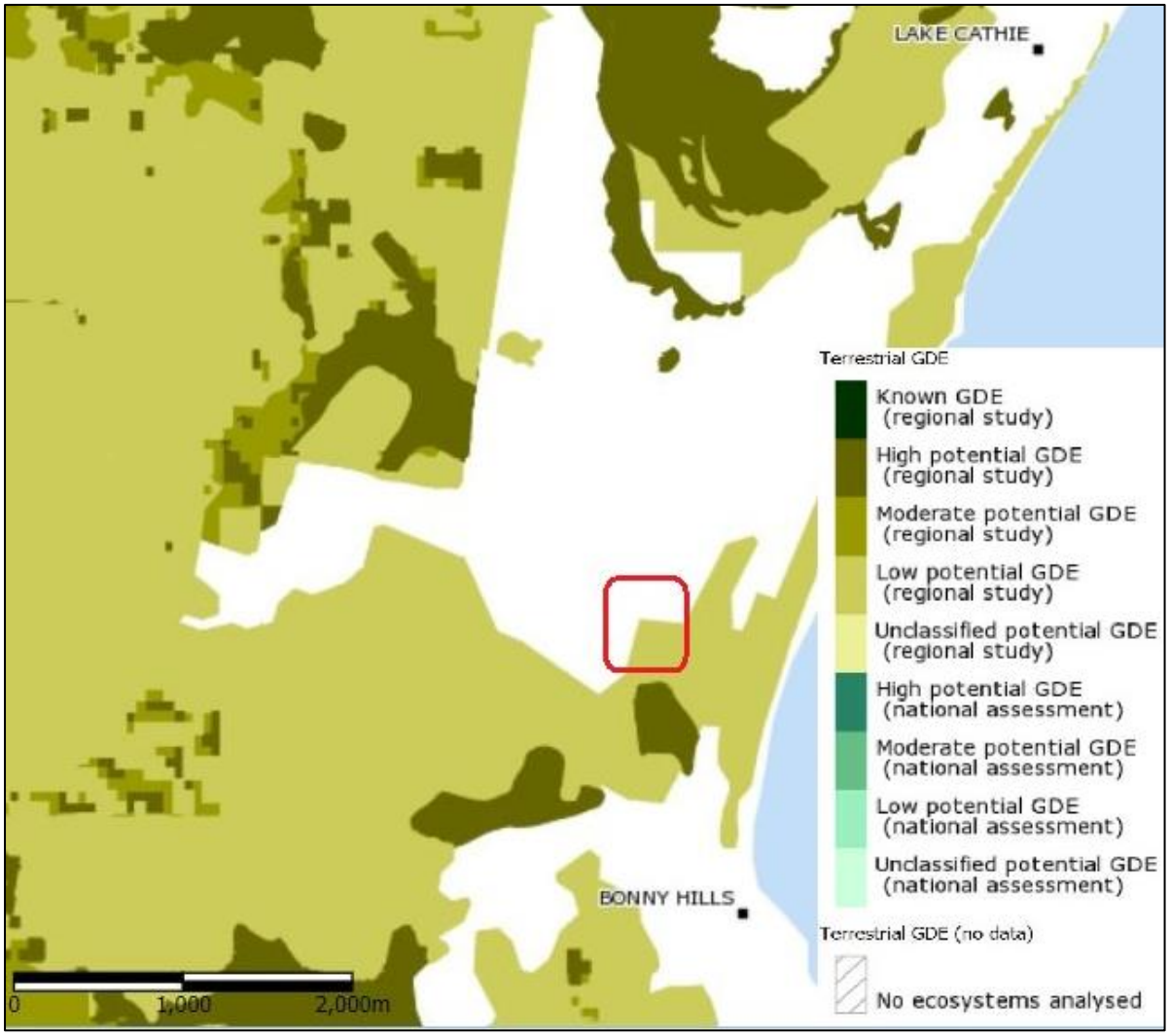

Figure 19. Ground Water Dependant Ecosystem Mapping (approximate Subject Land identified by red polygon) (BOM 2019b)

6.4 Biodiversity Offset Credit Requirements

6.4.1 Offset Requirement for Ecosystem Credits

A total of seventeen (17) ecosystem credits are required to offset the biodiversity impacts of the proposed activity. Estimated costs to purchase these credits, or alternatively, to allocate offset funds directly into the NSW Biodiversity Conservation Trust (BCT) are available in the NSW Biodiversity Offsets Payment Calculator (OEH 2018e). These values are presented here (**Table 22; Appendix C**).

Table 22. Ecosystem credits required to offset the proposed activity (as calculated 10/01/2020)

Plant Community Type (PCT)	Total Area	BC Act Status	Ecosystem Credits Required	Estimated Price Per Credit	Estimated Final Credit Price (ex-GST)
1230 - Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	1.17ha	Endangered Ecological Community	17	$8,083.83	$137,425.09
				GST	$13,742.51
				Total ecosystem credits (incl. GST)	**$151,167.60**

6.4.2 Offset Requirement for Species Credits

A single candidate species will require offsetting under the BOS as a result of the proposed activity. Due to the timing of the optimal survey period, targeted survey was unable to be undertaken *Phaius australis,* listed below in **Table 23**. Estimated costs to purchase these credits, or alternatively, to allocate offset funds directly into the NSW Biodiversity Conservation Trust (BCT) are available in the NSW Biodiversity Offsets Payment Calculator. This value is presented below (**Table 23**).

Table 23. Species credits required to offset the proposed activity (as calculated 10/01/2020)

Plant Community Type (PCT)	Total Area of Potential Habitat	BC Act Status	Species Credits Required	Estimated Price Per Credit	Estimated Final Credit Price (ex-GST)
Phaius australis (Southern Swamp Orchid)	1.17ha	Endangered	15	$865.08	$16,089.19
				GST	$1,608.92
				Total Species Credits (incl. GST)	**$17,698.11**

The total cost of retiring all required credits through the method of issuing a payment to the Biodiversity Conservation Trust is **$168,865.71 (incl. GST).** This offset payment calculation was undertaken on Friday the 10th of January 2020 and may be subject to change.

7.Conclusion

School Infrastructure NSW proposes to upgrade the existing Lake Cathie Public School at 1240 Ocean Drive, Bonny Hills, 245, NSW (Lot 2, DP1193553). This Biodiversity Development Assessment Report (BDAR) has been prepared by Narla Environmental Pty Ltd to identify the potential impacts of the proposal on biodiversity values within the Subject Land. This assessment has been completed in accordance with the Biodiversity Assessment Method (BAM) and includes:

- Comprehensive literature review and desktop assessment to describe the historically recorded environment and landscape features of the Subject Land and to identify the suite of threatened biota potentially affected by the proposal;
- Site assessment to describe the biodiversity values of the Subject Land and to determine the likelihood of threatened biota and their habitats occurring within the proposed activity footprint;
- Targeted field surveys for a suite of candidate species credit species identified by the Biodiversity Assessment Method Calculator (BAMC) as likely to occur within the native vegetation of the Subject Land in accordance with the relevant NSW threatened species survey guidelines;
- Discussion and recommendation of measures to avoid and minimise impacts to biodiversity values;
- BAM calculations using the credit calculator (version 1.2.7.2) to quantify the level of biodiversity impacts of the proposal following implementation of measures to avoid and minimise impacts and to determine the biodiversity credits that will need to be purchased and retired to offset the residual impacts of the proposal.

The proposed upgrade is located within the grounds of the existing Lake Cathie Public School which contains a small area of remnant native vegetation as well as historically revegetated native vegetation and regularly maintained exotic lawns. The proposal has been purposefully designed to minimise impacts on biodiversity values as far as is practicable.

The proposed activity is expected to result in impacts to one plant community type (PCT) comprising removal of 1.17 hectares (ha) of PCT 1230 - Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion. The area of this PCT within the Subject Land comprises an occurrence of Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, which is listed as an Endangered Ecological Community (EEC) under the NSW Biodiversity Conservation Act 2016 (BC Act). The total of 1.17 ha was calculated by combining the existing native vegetation observed within the site with two offset planting areas proposed to have been installed by the school, as per a Vegetation Management Plan by Darkheart (2014) and removing all areas of overlap.

The proposed activity is expected to remove habitat for the Southern Swamp Orchid (*Phaius australis*) which is listed as a species credit entity according to the BAMC.

The proposed activity is not expected to impact any threatened biota listed under the Fisheries Management Act 1994 (FM Act).

A biodiversity assessment and offset credit calculation has been performed in accordance with the BAM (OEH 2017a). As per offset credit calculator version 1.2.7.2, the following credits are required to be purchased and retired to offset the expected biodiversity impacts of the proposal:

- 17 ecosystem credits to offset impacts to 1.17 ha of PCT 1230 - Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion; and
- 15 *Phaius australis* (Southern Swamp Orchid) species credits to offset the removal of habitat within a 1.17 ha species polygon.

Other threatened species identified as potentially being impacted by the proposal are classed as ecosystem credit species which are to be offset through the retirement of the above listed ecosystem credits.

A suite of mitigation and management measures have been proposed in order to avoid and minimise potential impacts of the proposal on local biodiversity values.

Considering the nature of the proposal, the existing character of the Subject Land and the proposed impact mitigation measures proposed, there are unlikely to be any notable indirect impacts on biodiversity values arising from the proposed activity. Only the direct impacts associated with vegetation clearing and construction of the proposal will require biodiversity offsets as per the BAM.

Prescribed impacts on the Koala that were considered include the potential loss of habitat connectivity, the potential loss of freedom of movement throughout the landscape as well as the increased risk of vehicle strike caused by a projected increase in traffic flow. It was determined that there would be no significant impact to the Koala as a result of the listed prescribed impacts as a result of mitigation measures proposed within both this document as well as the corresponding Vegetation Management Plan & Koala Plan of Management.

Offsets for the residual impacts of the proposal can be made by making a payment to the Biodiversity Conservation Trust or by purchasing and retiring the appropriate credits from stewardship sites that comply with the trading rules of the NSW Biodiversity Offsets Scheme (BOS) in accordance with the 'like for like' report generated by the BAM calculator (**Appendix C**). If such credits are unavailable, credits would be sourced in accordance with the 'variation report' generated by the BAMC.

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9.Appendices

Appendix A. Flora species identified with the Subject Land

Appendix B. Fauna species identified within the Subject Land

Appendix C. BAMC Generated Biodiversity Credit Report

Appendix D. Echolocation Report - Tim Pearson 2019

Appendix E. BAM Site-Field Survey Form

Appendix A. Flora species identified with the Subject Land

Scientific Name	Exotic	Canopy	Midstory	Groundcover
Ageratum houstonianum	x			x
Anagallis arvensis	x			x
Andropogon virginicus	x			x
Banksia integrifolia			x	
Banksia marginata			x	
Banksia robur			x	
Breynia oblongifolia			x	
Carex spp.				x
Casuarina glauca		x		
Cenchrus clandestinus	x			x
Centella asiatica				x
Chloris gayana	x			x
Conyza bonariensis	x			x
Conyza sp.	x			x
Cynodon dactylon				x
Dianella caerulea				x
Digitaria eriantha				x
Digitaria sp.				x
Eragrostis brownii				x
Eragrostis sp.				x
Eucalyptus robusta		x		
Eucalyptus robusta x tereticornis		x		
Eucalyptus tereticornis		x		
Gahnia sp.				x
Glochidion ferdinandi			x	
Gonocarpus teucrioides				x
Goodenia bellidifolia subsp argentea				x
Hydrocotyle bonariensis	x			x
Hydrocotyle sibthorpioides	x			x
Hypericum sp.				x
Hypochaeris radicata				x
Imperata cylindrica				x
Leptospermum polygalifolium			x	
Lomandra longifolia				x
Melaleuca linariifolia			x	
Melaleuca quinquenervia			x	
Microlaena stipoides				x
Paspalum dialatatum	x			x
Paspalum urvillei	x			x
Persicaria sp.				x

Scientific Name	Exotic	Canopy	Midstory	Groundcover
Pimelea linifolia				x
Pittosporum undulatum			x	
Plantago lanceolata	x			x
Poa annua	x			x
Polygala paniculata				
Pratia purpurascens				x
Ranunculus sp.	x			x
Senecio madagascarensis	x			x
Setaria sphacelata	x			x
Sonchus oleraceus	x			x
Sporobolus elongatus	x			x
Stenotaphrum secundatum	x			x
Themeda triandra				x
Trifolium repens	x			x
Verbena bonariensis	x			x
Verbena rigida	x			x
Viola betonicifolia				x

Appendix B. Fauna species identified within the Subject Land

Class	Common Name	Scientific Name	Status
Aves	Australian Wood Duck	*Chenonetta jubata*	Protected
	Brown Falcon	*Falco berigora*	Protected
	Brown Goshawk	*Accipiter fasciatus*	Protected
	Brown Honeyeater	*Lichmera indistincta*	Protected
	Brown Thornbill	*Acanthiza pusilla*	Protected
	Brown-headed Honeyeater	*Melithreptus brevirostris*	Protected
	Cattle Egret	*Bubulcus ibis*	Protected
	Eastern Rosella	*Platycercus eximius*	Protected
	Galah	*Eolophus roseicapilla*	Protected
	Golden Whistler	*Pachycephala pectoralis*	Protected
	Grey Butcherbird	*Cracticus torquatus*	Protected
	Grey Fantail	*Rhipidura albiscapa*	Protected
	Laughing Kookaburra	*Dacelo novaeguineae*	Protected
	Lewin's Honeyeater	*Meliphaga lewinii*	Protected
	Little Friarbird	*Philemon citreogularis*	Protected
	Little Lorikeet	*Glossopsitta pusilla*	Vulnerable (BC Act 2016)
	Magpie-lark	*Grallina cyanoleuca*	Protected
	Masked Lapwing	*Vanellus miles*	Protected
	Noisy Friarbird	*Philemon corniculatus*	Protected
	Noisy Miner	*Manorina melanocephala*	Protected
	Pied Butcherbird	*Cracticus nigrogularis*	Protected
	Rainbow Lorikeet	*Trichoglossus moluccanus*	Protected
	Red Wattlebird	*Anthochaera carunculata*	Protected
	Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*	Protected
	Straw-necked Ibis	*Threskiornis spinicollis*	Protected
	Striated Pardalote	*Pardalotus striatus*	Protected
	Tawny Grassbird	*Cincloramphus timoriensis*	Protected
	Torresian Crow	*Corvus orru*	Protected
	White-bellied Sea-eagle	*Haliaeetus leucogaster*	Vulnerable (BC Act 2016)
	Olive-backed Oriole	*Oriolus sagittatus*	Protected
	Black-shouldered Kite	*Elanus axillaris*	Protected
	Pacific Baza	*Aviceda subcristata*	Protected
	Satin Bowerbird	*Ptilonorhynchus violaceus*	Protected
	Eastern Koel	*Eudynamys orientalis*	Protected
	Yellow-faced Honeyeater	*Caligavis chrysops*	Protected
	Common Myna	*Acridotheres tristis*	Exotic
Amphibia	Common Eastern Froglet	*Crinia signifera*	Protected
Mammalia	Common Brush-tailed Possum	*Trichosurus vulpecula*	Protected
	Northern Brown Bandicoot	*Isoodon macrourus*	Protected
	Black Rat	*Rattus rattus*	Exotic

Class	Common Name	Scientific Name	Status
	House Mouse	*Mus musculus*	Exotic
	Australian Swamp Rat	*Rattus lutreolus*	Protected
	Eastern Forest Bat	*Vespadalus pumilus*	Protected
	Gould's Wattled Bat	*Chalinolobus gouldii*	Protected
	Eastern Freetail Bat	*Mormopterus ridei*	Vulnerable (BC Act 2016)
	Little Forest Bat	*Vespadalus vulturnus*	Protected
	Eastern Broad-nosed Bat	*Scotorepens orion*	Protected
Insecta - Lepidoptera	Meadow Argus	*Junonia villida*	
	Common Grass Blue	*Zizina labradus*	
	Common Jezabel	*Delias nigrina*	
	Wanderer	*Danaus plexippus*	

Appendix C. BAMC Generated Biodiversity Credit Report (10/01/2020)

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00018871/BAAS19040/20/00018872	Lake Cathie	26/11/2019
Assessor Name	Assessor Number	BAM Data version *
		22
Proponent Names	Report Created	BAM Case Status
Department of Education NSW	13/01/2020	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	13/01/2020

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

BAM Biodiversity Credit Report (Like for like)

Predicted Threatened Species Not On Site

No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
1230-Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	1.2	17.00

1230-Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion

Like-for-like credit retirement options

Name of offset trading group	Trading group	HBT	IBRA region
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	No	Macleay Hastings, Carrai Plateau, Coffs Coast and Escarpment, Comboyne Plateau, Karuah Manning, Macleay Gorges, Mummel Escarpment and Upper Manning. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

1230-Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion

Species Credit Summary

Species	Area	Credits
Phaius australis / Southern Swamp Orchid	1.2	15.00

Phaius australis/ Southern Swamp Orchid	1230_Remnant_Veg	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Phaius australis/Southern Swamp Orchid	Any in NSW
	1230_Revegetated_APZ	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Phaius australis/Southern Swamp Orchid	Any in NSW

BAM Biodiversity Credit Report (Like for like)

Phaius australis/ Southern Swamp Orchid	1230_Revegetated_Cleared	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Phaius australis/Southern Swamp Orchid	Any in NSW

Appendix D. Echolocation Report - Tim Pearson 2019

Report for Narla Environmental

Results of bat echolocation survey, Lake Cathie School, New South Wales, January 14 - 18, 2019.

Tim Pearson BSc(Hons)

Wildlife Ecologist

Two ultrasonic bat detectors (Wildlife Acoustics Songmeter SM4BAT ZC, Serial # 00363 & # 606) were deployed at the Lake Cathie School, 1240 Ocean Drive, Bonny Hills, NSW, over 4 nights on the 14th - 18th January, 2019. The units were set to record from sunset to sunrise.

A total of 4,035 trace files were recorded over the period, with initial analysis showing that 2,165 of these were attributable to bat echolocation calls.

Traces were analysed using Analook for Windows Version 4.4a (Chris Corben), and Kaleidoscope Pro Version 5.0.2 (Wildlife Acoustics, Inc.), and then identified to species level where possible using the standard key to bat calls of New South Wales (Pennay *et al.* 2004) and *Australian Bats* (Churchill 2009).

The two detectors returned markedly different results. Serial # 606 (files labelled as "Bat 3 grass") recorded a total of 492 traces over the four nights, only 102 of which contained echolocation traces. The majority of the traces (84) were far too fragmented to identify to species level, suggesting bats passing at some distance. Of the remainder, 9 traces were identified as from the Eastern freetail bat *Mormopterus ridei*, a medium sized species that predominantly hunts in the open spaces between stands of trees. Feeding buzz was detected from this species.

Small numbers of traces were detected from the Eastern forest bat, *Vespadalus pumilus*, a tree dweller which uses mostly large mature trees with a number of hollows; and from Gould's wattled bat *Chalinolobus gouldii*, possibly the most common and widespread microbat species in eastern Australia. A single trace was attributable to one of the long-eared bats, either Gould's long-eared bat *Nyctophilus gouldi* or the Lesser long-eared bat *Nyctophilus geoffroyi* (these two species cannot be distinguished by echolocation calls).

The second detector, Serial # 363, had recorded far more traces, and of a larger variety. Of the 3,543 trace files, 2,063 were identifiable as at least partial echolocation calls.

Again, roughly 75% of these calls were too fragmented to confidently identify - although in most cases they did appear to be fragments of calls from the species that did have positive identification.

Two species dominated, the Eastern freetail bat *Mormopterus ridei*, and the Little forest bat *Vespadalus vulturnus*. Little forest bats are normally found either inside or on the margins of stands of trees, hunting in and around the trees themselves. Feeding buzz was detected from both these species.

Significant numbers of traces were identified from two other species also identified from the other detector; the Eastern forest bat, *Vespadalus pumilus*, and Gould's wattled bat *Chalinolobus gouldii*. Numbers of traces were also identified from the Eastern broad-nose bat *Scotorepens orion*. A small number of traces from long eared bats *Nyctophils spp.* were also detected.

A small number of social calls were recorded, suggesting animals either at or near a roost. Given the presence of a large hollow bearing tree, it is suggested that this should be investigated for the

existence of a roost. it is interesting to note, given the species detected in this survey, particularly the predominance of the Eastern freetail bat *Mormopterus ridei* that Churchill (2009) notes that this species roosts mainly in tree hollows, and have been reported to share roosts with both Gould's wattled bat *Chalinolobus gouldii* and Eastern broad-nose bats *Scotorepens orion*,

A number of other distinct traces could only be tentatively identified, however they did not suggest any species likely to raise conservation red flags.

Churchill, S. (2009) 'Australian Bats.' (Reed New Holland: Sydney)

Pennay, M., Law, B., and Reinhold, L. (2004) Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats. In '.' (Ed. NDoEa Conservation): Hurstville)

Appendix E. BAM Site - Field Survey Form (Note: these are the unaltered versions, some of the species that were not identified to species level were later identified)

Veg zone 1.

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BAM Site – Field Survey Form | Site Sheet no:

		Survey Name	Zone ID	Recorders			
Date	21 07 18	Barry Watts School	1	Kurtis Lindsay			
Zone 56	Datum GDA94	Plot ID	2	Plot dimensions	20x50	Photo #	
Easting 483613	Northing 6507389	IBRA region	NSW North Coast	Midline bearing from 0 m	20°		
Vegetation Class		Coastal Swamp Forest				Confidence: H M L	
Plant Community Type		1230 Swamp mahogany swamp forest on coastal lowlands of the NSW North coast		EEC: ✓		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot. Biregion

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	3
	Shrubs	2
	Grasses etc.	8
	Forbs	8
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	16.1
	Shrubs	0.2
	Grasses etc.	68.2
	Forbs	10.2
	Ferns	0
	Other	0
High Threat Weed cover		23

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	
50 – 79 cm	0	
30 – 49 cm	III	
20 – 29 cm	IIII	
10 – 19 cm		
5 – 9 cm		
< 5 cm		n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	4	

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30… , 100, 200, 300…). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living.

For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	2 1 2 1 1	15 2 5 1 0	0 0 0 0 0	0 0 0 0 0
Average of the 5 subplots	1.4%	4.6	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less then 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	3		
Cultivation (inc. pasture)	3		
Soil erosion	1		
Firewood / CWD removal	1		
Grazing (identify native/stock)	0		
Fire damage	0		
Storm damage	0		
Weediness	2		
Other			Has been mowed frequently

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

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400 m² plot: Sheet 2 of 2	Survey Name	Plot Identifier	Recorders
Date: 21 07 18	Bonny Hills	Plot 2	Kurtis Lindsay

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	1 Eucalyptus robusta		8%		T	
	2 Eucalyptus tereticornis		8%		T	
	3 Glochidion ferdinandi		0.1	3	S	
	4 Lomandra longifolia		0.1	3	G	
	5. Theneda triandra		1%	5	G	
	6. Pimelea linifolia		0.1	6	G	
	7 Cynodon dactylon		15%		G	
	8 Eragrostis brownii		0.1%	30	G	
	9 Paspalum dilatatum	HTE	1%		G	
	10 Erochloa procera		2%		G	
	11 Kikuyu Cenchrus clandestinum	E	20%		G	
	12 Polygala paniculata	E	1%		G	X
	15 Senecio madagascariensis	HTE	1%		G	
	14 Microlaena stipoides		10%		G	
	15 Centella asiatica		5%		G	
	16 Goodenia bellidifolia subsp. argentea.		1%	12	G	X
	17 Hypochaeris radicata.	E	2%		G	
	18 Plantago purpurascens		1%	15	G	
	19 Gonocarpus teucrioides		1%	5	G	
	20 Digitaria spp.	E	40		G	X
	21 Plantago lanceolata	E	2%		G	
	22 Conyza bonariensis	E	1%		G	
	23 Imperata cylindrica		2%		G	
	24 Sonchus oleraceus	E	1%		G	
	25 Trifolium repens	E	1%		G	
	26 Hydrocotyl sibthorpioides		1		G	
	27 Dianella caerulea		0.1	6	G	
	28 Hypericum (native)		0.1	3	G	
	29 Anagallis arvensis	E	0.1	5	G	
	30 Hydrocotyl bonariensis	E	1%	10	G	
	31 Leptospermum polygalifolium		0.1	1	G	
	32 Xenophasium secundatum	HTE	10%		G	
	33 verbena rigidus	E	01	2	G	
	34 Sporobolus elongatus		0.1	1	G	
					G	
					G	
					G	
					G	
					G	
					G	

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Total 34 species

HTE = 4
E = 11
N = 19

Veg zone 2

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BAM Site – Field Survey Form

Site Sheet no: 1 of

		Survey Name	Zone ID	Recorders			
Date	21 07 18	Bonny Hills School	2/3	Kurtis Lindsay			
Zone	Datum	Plot ID	Plot 1	Plot dimensions	20 x 50	Photo #	
56	GDA 94						
Easting	Northing	IBRA region	NSW North Coast	Midline bearing from 0 m	0° North		
483632	6507437						
Vegetation Class		Coastal Swamp Forest				Confidence: H M L	
Plant Community Type		1230 - Swamp mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion		EEC: ✓		Confidence: H M L	

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	7
	Shrubs	7
	Grasses etc.	8
	Forbs	8
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	36.85
	Shrubs	6.2
	Grasses etc.	40.3
	Forbs	0.95
	Ferns	0
	Other	0.1
High Threat Weed cover		6.25

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	0	0
50 – 79 cm	0	0
30 – 49 cm	✓	0
20 – 29 cm	✓	0
10 – 19 cm	✓	0
5 – 9 cm	✓	0
< 5 cm	✓	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	1 metre	

Counts apply when the number of tree stems within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30, . . 100, 200, 300 . .). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree stems must be living.

For hollows, count only the presence of a stem containing hollows. For a multi-stemmed tree, only the largest stem is included in the count/estimate. Stems may be dead and may be shrubs.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	20 40 50 70 35	5 0 0 1 5	0 0 0 0 0	0 0 0 0 0
Average of the 5 subplots	43	2.2	0	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern	depression	Microrelief	
Lithology		Soil Surface Texture	clay loam	Soil Colour	dark brown	Soil Depth	
Slope	Flat	Aspect		Site Drainage	damp ground throughout	Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			Tracks dissect patch and edges mowed
Cultivation (inc. pasture)			–
Soil erosion			–
Firewood / CWD removal			–
Grazing (identify native/stock)			–
Fire damage			–
Storm damage			–
Weediness			2 - 3
Other			completely planted within last 10 years

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

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E=16
HTE=4
N=30

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 21 07 18	Bonny Hills	Plot 1	Kurtis Lindsay

GF Code	Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher	
	1 Eucalyptus robusta		7%		T2		
	2 Eucalyptus tereticornis (Tallest)		3%	1	T1		
	3 Casuarina glauca		25%		T2		
	4 Glochidion ferdinandi		1%	IIII (6)	S2		
	5 Leptospermum polygalifolium		2%	IIII II (7)	S2		
	6 Melaleuca linariifolia (co-tallest)		2%	IIII II (7)	S1		
	7 Banksia integrifolia (co-tallest)		0.25%	III (3)	S1		
	8 Melaleuca quinquenervia		0.5%	IIII (6)	T2		
	9 Eucalyptus sp. (stringybark / peppermint)		0.1	1 (1)	S2		
	10 Pittosporum undulatum		0.1	II (2)	G		
	11 Banksia robur		0.5%	III (3)	G		
	12 Setaria sphacelata	E	2%		G		
	13 Paspalum urvillei	E	25%		G		
	14 Chloris gayana	HTE	5%		G		*
	15 Senecio madagascariensis	HTE	1%	24	G		
	16 Verbena rigidus	E	0.5%	32	G		*
	17 Themeda triandra / australis		2%	10	G		
	18 Lomandra longifolia		2%	16	G		
	19 Ageratum houstonianum (Billygoat weed)	E	1%	8	G		
	20 Eragrostis sp.		10%		G	X	
	21 Paspalum dilatatum	HTE	0.25%	20	G		
	22 Imperata cylindrica		25%		G		
	23 Pimelea linifolia		1%	8	G		
	24 Cynodon dactylon		1%	30	G		
	25 Banksia marginata		0.5	II (2)	S2		
	26 Andropogon virginicus	HTE	0.25	10	G		
	27 Verbena bonariensis	E	0.25	5	G		
	28 Hydrocotyl bonariensis	E	0.25	30	G		
	29 Polygala paniculata	E	0.1	8	G	X	*
	30 Hypericum sp. (native)		0.1%	3	G	X	
	31 Digitaria eriantha	E	0.25	20	G	X	
	32 Hypochoeris radicata	E	0.1	10	G		
	33 Carex spp		0.1	30	G	X	
	34 Conocarpus leucriodes		0.1	4	G		
	35 Pratia purpurascens		0.1	30	G		
	36 Ranunculus sp.		0.1	2	G	X	
	37 Conyza bonariensis	E	0.1	1	G		
	38 Cahnia sp.		0.1	1	G		
	39 Centella asiatica		0.1	5	G		
	40 Conyza sp. 2	E			G	X	*

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

	41 Bracteantha bracteata		0.1	1	S2	45. Hydrocotyle sibthorpioides	
46 species total	42 Plantago lanceolata	E	0.1	4	G	0.1 i 2	
	43 Microlaena stipoides		0.1	3	G	46. Glycine sp. (native)	
	44 Viola hederacea		0.1	1	G	0.1 i 2	

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