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Level 8 / 133 Mary Street
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Australia

STAGE 2 SSD: BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

August 2019

J156455-13

Tweed Valley Hospital
Health Infrastructure

C107778: DL

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Document and Project Control

Project Name:	Stage 2 SSD: Biodiversity Development Assessment Report		
Site Details:	Tweed Valley Hospital		
Project Number:	J156455-13		
Client Name:	NSW Health Infrastructure		
Client Number:	C107778		
Accredited Assessor	Dr Damian Licari (BAM Assessor Accreditation No. BASS18006)		
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Conflict of Interest Statement	Greencap warrants that as at the date of lodgement of the Biodiversity Development Assessment Report, no actual, perceived or potential conflict of interest exists between it or between any one or more of Greencap's officers, employees, consultants or agents and Health Infrastructure, or is likely to arise in relation to the Report that is submitted for this project, and if any conflict of interest arises or is likely to arise Greencap will immediately notify Health Infrastructure in writing of that actual, perceived or potential conflict of interest.		

Issue Status

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1	Electronic	Sue Folliott	TSA Management on behalf of Health Infrastructure, Senior Project Manager

EXECUTIVE SUMMARY

On the 11 June 2019 the Minister for Planning and Public Spaces granted approval for the Concept Proposal and Stage 1 Early and Enabling Works for the new Tweed Valley Hospital (SSD 9575) located at 771 Cudgen Road, Cudgen (Lot 11 DP1246853). All documents relating to this consent can be found on the major project website of DPIE at https://www.planningportal.nsw.gov.au/major-projects/project/10756.

The Environmental Impact Statement (EIS) has been prepared to assist in the State Significant Development (SSD) Stage 2 Application for the Tweed Valley Hospital which will be assessed under Part 4 Division 4.7 of the Environmental Planning and Assessment Act 1979 (EP&A Act). This, along with supporting documentation, provides a clear outline of the Stage 2 Application.

The Tweed Valley Hospital Project broadly consists of:

- *Construction of a new Level 5 major regional referral hospital to provide the health services required to meet the needs of the growing population of the Tweed-Byron region (in conjunction with the other hospitals and community health facilities across the region);*
- *Delivery of the supporting infrastructure required for the Tweed Valley Hospital, including green space and other amenities, roads and car parking, external road upgrades and connections, utilities connections, and other supporting infrastructure.*

The State Significant Development (SSD) application and supporting Environmental Impact Statement (EIS) refer to the Project Site (a 19.38 ha area of land) as part of the former single Lot 102 DP 870722, located at 771 Cudgen Road, Cudgen within the Tweed Local Government Area (LGA). The Project Site has now been formally acquired and is owned by Health Administration Corporation (HAC). The Project Site is now legally described as Lot 11 DP 1246853.

This SSD is subject to an approval under Part 4 of the Environmental Planning and Assessment Act 1979 (NSW) that requires the development of an Environmental Impact Statement. Under the Biodiversity Conservation Act 2016 (NSW), a Biodiversity Development Assessment Report (this report) is required to support the development application.

Greencap Pty Ltd (Greencap) was commissioned by TSA Management (TSA) on behalf of Health Infrastructure (HI) to prepare the Biodiversity Development Assessment Report (BDAR) in accordance with the Biodiversity Assessment Method Order 2017 (Office of Environment and Heritage [OEHa], 2017) (BAM), and to address more broadly the requirements in the Biodiversity Conservation Act 2016 (NSW) (BC Act).

This BDAR addresses the impacts of the Stage 2 Stage Significant Development (SSD) application. It is a revision of the endorsed Stage 1 SSD BDAR (Greencap 2019). It has been updated to include the detailed design plans and an assessment of any potential additional biodiversity impacts for the Project. This revision for Stage 2 has not removed information pertaining specifically to Stage 1 works in order to demonstrate consistency with the endorsed Stage 1 SSD BDAR and the Matters of National Environmental Significance (MNES) report (Greencap 2019b) as per SSD 9575 Conditions Schedule 2 B20.

*All fieldwork and assessment in **Section 2** (Biodiversity Assessment) of this BDAR was undertaken as part of the Stage 1 SSD BDAR except where otherwise noted. The assessment case 00011608/BAAS17014/19/00011609 still pertains to this revised BDAR, as based on the information provided to Greencap there has been no material change relating to direct impacts and BAM Calculator inputs. This Stage 2 BDAR should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for indirect and prescribed impacts for the Project.*

In accordance with the BAM, the Project has been located in order to avoid and minimise impacts upon biodiversity. The first phase in avoiding impacts on biodiversity started with the aforementioned site selection and due diligence process. One of the four key criteria for this process was avoiding and minimising impacts on biodiversity.

The original BAM assessment was conducted prior to the acquisition of the Project Site. This assessment identified PCTs, vegetation zones and Threatened Ecological Communities for the former Lot 102 DP 870722. The current vegetation integrity scores for all vegetation zones has been retained for this final version of the BDAR, and in some sections for clarity, figures showing mapping for both the former Lot 102 DP 870722 and for the Project Site are presented.

For the purposes of this BDAR, the subject land (the Site) is defined as the Project Site (i.e. Lot 11 DP 1246853) plus the Tweed Coast Road Crown Road Reserve (TCR Site) where additional development is proposed to be undertaken. These two development areas (the subject land) are collectively referred to as the Site throughout this BDAR.

The total area of the TCR Site is 0.29 ha and captures proposed roadworks and pavement widening to the west of the Project Site, part of which includes the removal of a tree on the road reserve.

The northern section of the Site is is part of an important wetland mapped under the State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP). At the time that the assessment was conducted the southern section of the Project Site was a working farm under cultivation (approximately 16.3 ha). Apart from the windrows planted along the Site boundary, most of the southern section of the Site has been cleared of native vegetation. No Areas of Outstanding Biodiversity Value (AOBV), as defined in the BC Act, or areas of geological significance are located on the Site.

There are four Plant Community Types (PCTs) in eight vegetation zones located on the Site. Two of these vegetation types (PCT 1064 Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion and PCT 1302 White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion) are composed of vegetation zones that can be classified as Endangered Ecological Communities (EEC).

The Project has been located on the Site to minimise direct impacts upon EECs. The development will directly impact 0.95 ha of components of PCT 1302 in Zone 4 and 8 that has been identified as an EEC in two vegetation zones located in windrows. The Vegetation Integrity (VI) score for Zone 4 is below the assessment threshold for a TEC. Direct impacts on the other six vegetation zones have been avoided and minimised.

The detailed description and implementation of the measures identified in this BDAR are given in the Stage 1 and Stage 2 Biodiversity Management Plans, which comprise of three sub-plans: Vegetation Management Plan (VMP), Fauna Management Plan (FMP), and Water Quality Management Plan (WQMP).

An assessment of indirect impacts was undertaken, including potential impacts from:

- *Noise and vibration;*
- *Light spill and visual amenity;*
- *Dust;*
- *Damage or removal of retained native vegetation;*
- *Bushfire and changing fire regimes; and*
- *Non-native vegetation and weeds.*

After an assessment of the impacts and proposed measures, it was assessed that there was a very low risk of indirect impacts from construction and operations. Detailed measures are provided in the Stage 2 Biodiversity Management Plan (BMP) and associated sub-plans.

An assessment of prescribed impacts was undertaken, with a particular focus on any prescribed impact on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities. Detailed mitigation measures are provided in the Stage 2 Biodiversity Management Plan (BMP) and associated sub-plans.

Water impacts will be managed during both the construction and operational stages in accordance with the approved Erosion and Sediment Control Plan (ESCP), Construction Environmental Management Plan (CEMP), sub-plans, and the Stage 1 and 2 BMPs. An assessment of the potential ecological impact on the coastal wetlands to the north of the site as a result of any changes to hydrology (flow regimes) caused by the Project was undertaken by SMEC (2019). The assessment considered EECs, TECs, threatened species and the overall biophysical, hydrological and ecological integrity. As a result of the prescribed impact risk assessment, it was identified that the residual risk following the application of mitigation measures as part of for surface water and groundwater management practices was very low. For pH dependent species in the wetland, the expected improvement in water quality as a result of the Project's stormwater management system could potentially be of benefit. However, additional data from long term monitoring of these species and water quality would be required to assess any potential impacts as a result of the Project in greater detail. Consequently, it is considered that there is no requirement to offset the residual impact of the development on water quality, water bodies and hydrological processes. Recommendations for adaptive management were also identified.

A total of three ecosystem credits and 14 species credits were generated by the BAM calculator.

A decrease in vegetation integrity score for the 0.55 ha portion of Zone 4 and 0.40 ha portion of Zone 8 is due to the proposed clearing of native vegetation within these vegetation zones. However, the current VI score for Zone 4 falls below the assessment threshold for Endangered Ecological Communities (i.e. VI ≥ 15), therefore in accordance with the BAM, no further assessment was required for these vegetation zones and it does not require offsetting. The current VI score for Zone 8 exceeds the assessment threshold for Endangered Ecological Communities (i.e. VI ≥ 15) and requires offsetting.

The areas of direct impacts on native vegetation noted in this report are consistent with those at the time of the Stage 1 BDAR and in line with the credit offset requirement retired as a result. It is noted that at the time of preparing this revision that the actual proposed clearing for Stage 1 is expected to differ from this, however it is noted to be below this maximum threshold. For currency however, the latest plans received by Greencap have been incorporated into the figure visually displaying direct impacts on native vegetation.

Fourteen threatened species credits were generated by the calculator based on assumed presence (i.e. powerful owl Ninox strenua and three-toed Snake-tooth Skink Coeranoscincus reticulatus). Two threatened species credits were generated from confirming presence through a survey (i.e. stinking cryptocarya Cryptocarya foetida).

One three-veined laurel Cryptocarya foetida plant (sapling) along the Cudgen Rd boundary windrow is directly impacted by the Project. However, as well as meeting the offset requirement for this threatened species, translocation of this plant for conservation will occur during Stage 1 prior to vegetation clearing, including ongoing care and maintenance, as per the Stage 1 BMP.

The above-mentioned credit offset requirement was determined and endorsed as part of the Stage 1 approval (SSD 18 9575). To meet this residual offset obligation, HI made a payment into the Biodiversity Conservation Fund on 5th July 2019 in accordance with Part 6 Division 6 of the BC Act. However, as mentioned above this revision of the BDAR for Stage 2 has not removed information pertaining specifically to Stage 1 works in order to demonstrate consistency with the endorsed Stage 1 SSD BDAR, as per SSD 9575 Conditions Schedule 2 B20.

Stage 2 SSD: Biodiversity Development Assessment Report

Tweed Valley Hospital

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1 INTRODUCTION

1.1 Overview

Greencap Pty Ltd (Greencap) was commissioned by TSA Management (TSA) on behalf of Health Infrastructure to prepare a Biodiversity Development Assessment Report (BDAR) in accordance with the *Biodiversity Assessment Method Order 2017* (Office of Environment and Heritage [OEHa], 2017) (BAM), and to address more broadly the requirements in the *Biodiversity Conservation Act 2016* (NSW) (BC Act).

1.1.1 Description of the Proposal

On the 11th of June 2019 the Minister for Planning and Public Spaces granted approval for the Concept Proposal and Stage 1 Early and Enabling Works for the new Tweed Valley Hospital (SSD 9575) located at 771 Cudgen Road, Cudgen (Lot 11 DP1246853). All documents relating to this consent can be found on the major project website of DPIE at https://www.planningportal.nsw.gov.au/major-projects/project/10756.

The Environmental Impact Statement (EIS) has been prepared to assist in the State Significant Development (SSD) Stage 2 Application for the Tweed Valley Hospital which will be assessed under Part 4 Division 4.7 of the Environmental Planning and Assessment Act 1979 (EP&A Act). This, along with supporting documentation, provides a clear outline of the Stage 2 Application.

The Tweed Valley Hospital Project broadly consists of:

- Construction of a new Level 5 major regional referral hospital to provide the health services required to meet the needs of the growing population of the Tweed-Byron region (in conjunction with the other hospitals and community health facilities across the region);
- Delivery of the supporting infrastructure required for the Tweed Valley Hospital, including green space and other amenities, roads and car parking, external road upgrades and connections, utilities connections, and other supporting infrastructure.

1.1.2 Stage 2 Hospital Main Works and Operation

The Stage 2 SSD component seeks consent for the Main Works and Operation of the Tweed Valley Hospital, including:

• Construction of Main Hospital Building

– Main entry and retail area

– Administration

– Community health

– In-Patient units

– Outpatient clinics and day only units

– Child and Adolescent Services

– Intensive Care Unit

– Mental Health Unit

– Maternity Unit and Birthing Suites

– Renal Dialysis

– Pathology

– Pharmacy

– Radiation Oncology as part of integrated Cancer Care

– Emergency Department

– Perioperative Services

– Interventional Cardiology

– Medical Imaging

– Mortuary

– Education, Training, Research

– Back of House services

– Rooftop Helipad

• Construction of Support Buildings, referred to as the 'Health Hub', containing:

– Oral Health

– Community Health

– Aboriginal Health

– Administration

– Education, Training and Research

• Internal Roads and carparking, including multi-deck parking for staff, patients and visitors;

• Construction of a temporary building for the 'Tweed Valley Skills Centre'

• External road infrastructure upgrades and main site access

• Environmental and wetland rehabilitation, including rehabilitation of existing farm dam as outlined in the Biodiversity Development Assessment

Report (BDAR) prepared for the Concept Proposal and Stage 1 works

• Site landscaping

• Signage

• Utility and service works

The works outlined above comprise five key components, which are subject to various funding allocations and may be delivered independently to each other. Stage 2 has therefore been defined in the following sub-stages (stages are not listed in chronological order and may be delivered independently to each other):

- Stage 2A – Main Hospital Building complete with supporting roads, services infrastructure and landscaping
- Stage 2B – Main Hospital Building incremental expansion areas

- Stage 2C – Health Hub
- Stage 2D – Tweed Valley Skills Centre
- Stage 2E – Multi-deck car park.

Development consent is sought for the all 5 components of Stage 2 under this SSDA.

Plans for Stage 2 Main Works and Operation are attached in Appendix B of the EIS. Approval of Stage 2 will enable the new Tweed Valley Hospital to be built which will provide a much-needed contemporary health service facilities for the surrounding region.

1.1.3 Potential Future Expansions

Any subsequent stages or modifications to the proposal would be subject to separate applications as required including the potential future expansion of the facility.

1.2 BDAR Version History

This BDAR addresses the impacts of the Stage 2 Stage Significant Development (SSD) application. It is a revision of and extension to the endorsed Stage 1 SSD BDAR (Greencap 2019a). It has been updated to include the detailed design plans and an assessment of any potential additional biodiversity impacts for the Project. This revision for Stage 2 includes information pertaining specifically to Stage 1 works in order to demonstrate consistency with the endorsed Stage 1 SSD BDAR and the Matters of National Environmental Significance (MNES) report (Greencap 2019b) as per SSD 9575 Conditions Schedule 2 B20.

All fieldwork and assessment in **Section 2** (Biodiversity Assessment) of this BDAR was undertaken as part of the Stage 1 SSD BDAR except where otherwise noted. The assessment case 00011608/BAAS17014/19/00011609 still pertains to this revised BDAR, as based on the information provided to Greencap there has been no material change relating to direct impacts and BAM Calculator inputs.

1.3 Background

The Northern Rivers is experiencing one of the fastest rates of population growth in New South Wales (NSW). The existing Tweed Hospital is at capacity and a range of clinical service and master planning studies have determined that the existing site is not able to meet the healthcare needs of a rapidly growing population and in particular the increase in the ageing population. The population of the Tweed and Byron Local Government Areas (LGAs) is expected to grow from approximately 119,100 people in 2011 to more than 147,000 in 2031, a growth rate of 24%.

Aside from the significant forecast population growth in the Tweed-Byron region, the need for the new hospital is being driven by the need for: local access to health care without having to travel beyond the region; delivery of high quality, modern health care services; capacity constraints at the existing hospital; inadequate land area to develop new facilities at the existing hospital; and access issues at the existing hospital during floods. Consequently, on 13 June 2017, the NSW Government announced $534 million for a new state-of-the-art Tweed Valley Hospital (the Project). A purpose-built referral hospital on a new site will ensure that the growing and changing healthcare needs of the Tweed-Byron community are provided for in the years to come.

A two-phase site selection process was undertaken by Health Infrastructure to assess the suitability of a range of greenfield and brownfield sites for the development of the new hospital where more than 50 sites were assessed. In the first phase (August 2017 to March 2018), 35 sites were considered, including around 20 submitted by landowners through an Expression of Interest (EOI) process.

In recognition of community concerns raised as a result of the first phase, a second phase (April to June 2018) of the selection process sought feedback from the community. The selected site was announced at the end of June 2018.

1.4 The Site

The State Significant Development (SSD) application and supporting Environmental Impact Statement (EIS) refer to the Project Site (a 19.38 ha area of land) as part of the former single Lot 102 DP 870722, located at 771 Cudgen Road, Cudgen within the Tweed LGA (**Figure 1** and **Figure 2**). The Project Site has now been formally acquired and is owned by Health Administration Corporation (HAC). The Project Site is now legally described as Lot 11 DP 1246853.

The original BAM assessment was conducted prior to the acquisition of the Project Site. This assessment identified Plant Community Types (PCTs), vegetation zones and Threatened Ecological Communities (TECs) for the former Lot 102 DP 870722. The current vegetation integrity scores for all vegetation zones has been retained for this final version of the BDAR (**Section 2.3**), and in some sections for clarity, figures showing mapping for both the former Lot 102 DP 870722 and for the Project Site are presented.

For the purposes of this BDAR, the subject land (the Site) is defined as the Project Site (i.e. Lot 11 DP 1246853) plus the Tweed Coast Road Crown Road Reserve (TCR Site) where additional development is proposed to be undertaken (**Figure 1**). These two development areas (the subject land) are collectively referred to as the Site throughout this BDAR.

The total area of the Project Site is 19.38, and it is located between the existing residential areas of Kingscliff and Cudgen, situated opposite Kingscliff TAFE. Critically, 16.4 ha of the Site is above the Probable Maximum Flood (PMF), a legislated requirement for hospital developments. This land area will support the development of the initial stage of the Project and for expansion over multiple stages as outlined in **Section 1.3**.

The total area of the TCR Site is 0.29 ha and captures proposed roadworks and pavement widening to the west of the Project Site, part of which includes the removal of a tree on the road reserve.

1.4.1 Historical Land Use

Prior to European settlement, coastal swamp forests formed part of a mosaic of vegetation communities on coastal plains and flood plains such as the Byron-Tweed Alluvial Plain NSW Landscape of which the north of the Site is a part (Keith, 2004). Rainforest also formed part of this vegetation mosaic on the floodplains of coastal rivers on the north coast of NSW (NSW Scientific Committee, 1999). Given their location many of these vegetation communities were subjected and adapted to periodic inundation.

Since European settlement the remnant forested wetland and associated rainforest vegetation located on the floodplain both on and to the north of the Site has experienced a range of significant changes as a result of historic and current land use practices acting singly and in concert. These changes include habitat fragmentation resulting from historic land clearing, draining of the floodplain through construction of agricultural drains and consequent changes in fire regime.

Settlers first arrived in the Tweed in the late 1820s to harvest red cedar *Toona ciliata*. With the aim of encouraging settlement of small freehold farms, historic land clearing across NSW was the direct result of the *Crown Land Acts 1861* (NSW) (Robinson, 1972). Selector farmers were encouraged to 'improve' the land for agriculture in exchange for land tenure. The Tweed region was progressively opened up to selector farmers from 1866 to 1914 and by the 1870s sugar cane became the major crop (Destination Tweed, 2018).

Extensive flooding in the 1850-60s resulted in large agricultural losses across the north coast and community expectation forced the colonial government to enact the *Drainage Promotion Act 1865* (NSW) and later the *Drainage Promotion Act 1901* (NSW) (Tulau, 2002). These Acts provided for the draining of land on coastal floodplains and the establishment of drainage unions. By the early 1900s, activity was undertaken to drain a range of areas including the Cudgen area of which the Site is a part (Tulau, 2002).

Fire history records on land that is not part of the NSW National Parks or NSW State Forests estate are largely unavailable for the Tweed region. However, it can be inferred that changes in fire regime resulting from habitat fragmentation and active fire suppression have resulted in reduced fire intensity and frequency in remnant vegetation.

The above land use changes have impacted upon the water-dependent forested wetland and associated rainforest vegetation that is located on and to the north of the Site. However, given the lack of baseline historical data, the result of the above impacts on composition, structure and function of the remnant vegetation on the Site is uncertain.

1.5 Sources of Information

1.5.1 Data and/or Resources Used in Assessment

Data and/or resources used or consulted in the assessment include:

- Biodiversity Assessment Method Calculator;
- BioNet Vegetation Classification;
- BioNet Threatened Biodiversity Data Collection (TBDC);
- BioNet Atlas;
- BioNet Web Services;
- OEH Data Portal;
- PlantNET NSW; and
- Biodiversity Offsets and Agreement Management System (BOAMS).

Spatial data used or consulted in the assessment include:

- Cadastre (NSW Department of Finance, Services and Innovation 2018);
- IBRA Regions and Subregions (OEH 2016);
- NSW (Mitchell) Landscapes - version 3.1 (OEH 2016);
- Tweed Shire Council Vegetation Mapping - Tweed LGA Vegetation 2012. VIS_ID 3912 (Tweed Shire Council 2012);
- SEPP Coastal Management (DPE 2018);
- Directory of Important Wetlands in Australia (Australian Government Department of the Environment, Water, Heritage and the Arts
- Fauna Corridors for North East NSW (OEH 2018);
- Acid Sulfate Soils Risk map (OEH 1998);
- NSW Hydrography (Department of Finance, Services and Innovation 2018); and
- 2018 & 2019 Aerial imagery (Nearmap 2019).

1.5.2 Related Plans and Consultant Reports

The latest consultant reports or advice informing or referenced in the assessment (including those in draft form) include:

Table 1 Plans and Consultant Reports

Report	Author	Version
Tweed Valley Hospital Proposed Site Plan – STB-AR-SKE-PRW-1000015_4	STH Batessmart	Rev 4, 7th January 2019
Auxiliary Lane and Roundabout Tree Clearance Plans Drawing numbers: RBG-CV-DWG-RIE-83-151 and RBG-CV-DWG-RIE-81-101	Robert Bird Group	Rev 2, 14th August 2019
Tweed Valley Hospital Development Landscape Zonal Plan – LS_DWG-10-003 (draft)	Turf Design Studios	Rev 6, 16th August 2019
Aviation State Significant Development Report; Tweed Valley Hospital SSD-9575	AviPro	2nd July 2019
Bushfire Hazard Assessment Tweed Valley Hospital	GeoLINK	Version 1, 20th June 2019
External Lighting Strategy Report Tweed Valley Hospital	LCI	Preliminary, 13th May 2019
Groundwater and soil investigation report 771 Cudgen Rd, Cudgen, NSW	Cavvanba	19038 R02, August 2019
Management Plan for the Mitchell's Rainforest Snail *Thersites mitchellae* (Cox, 1864) at 771 Cudgen Rd, Cudgen, New South Wales	Invertebrate Identification Australasia	Draft, June 2019
Noise & Vibration Impact Assessment for SSDA – Tweed Valley Hospital Stage 2	JHA	Rev A, 11th June 2019
Pre-construction baseline survey of *Thersites mitchellae* (Cox, 1864) (Mitchell's Rainforest Snail) at 771 Cudgen Rd, Cudgen, New South Wales	Invertebrate Identification Australasia	Draft, 3rd June 2019
Preliminary and Detailed Site Investigation	Octief	6th September 2018
Stormwater Management Plan – Tweed Valley Hospital, Prepared for Stage 2 SSD Application	Robert Bird Group	Issue A, 1st July 2019
Tweed Valley Hospital – Stage 2 Conservation and Habitat Management Sub Plan	Lendlease Building	Revision 2.2, 12th July 2019

Tweed Valley Hospital Construction & Environmental Management Plan – Main Works	Lendlease Building	Rev 3, 11th July 2019
Tweed Valley Hospital Construction Soil & Water Management Sub Plan	Lendlease Building	Rev 3.1 12th July 2019
Tweed Valley Hospital – Stage 2 Construction Noise & Vibration Management Sub Plan	Lendlease Building	Rev 2.2, 12th July 2019
Tweed Valley Hospital – Stage 2 Construction Traffic and Pedestrian Management Sub Plan	Lendlease Building	Rev 2.2, 12th July 2019
Tweed Valley Hospital Hydrology Assessment (Draft Final)	SMEC	Rev.2, 15th August 2019
Tweed Valley Hospital – Flooding Component DRAFT	BMT	Draft
Tweed Valley Hospital Project Traffic Impact Assessment	Bitzios Consulting	Version 001, 18th June 2019

The site plans for the development are attached in **Appendix A**. The full architectural drawings package is presented in Appendix B of the EIS.

1.6 Legal Requirements

1.6.1 Stage 1 - Conditions of Approval

The SSD 9575 Final Conditions of Development Consent Conditions set out the *Conditions to be satisfied in future development application(s)* in Schedule 2 Part B. Schedule 2 B20 sets out the following condition:

> **B20.** The Stage 2 application must demonstrate that the proposal is consistent with the endorsed *Biodiversity Development Assessment Report* prepared by Greencap dated January 2019 (BDAR) and the *Matters of National Environmental Significance Report* (MNES) prepared by Greencap dated February 2019 and all recommendations to mitigate the direct, indirect and prescribed impacts in the BDAR and the MNES.

1.6.2 SEARS Requirements

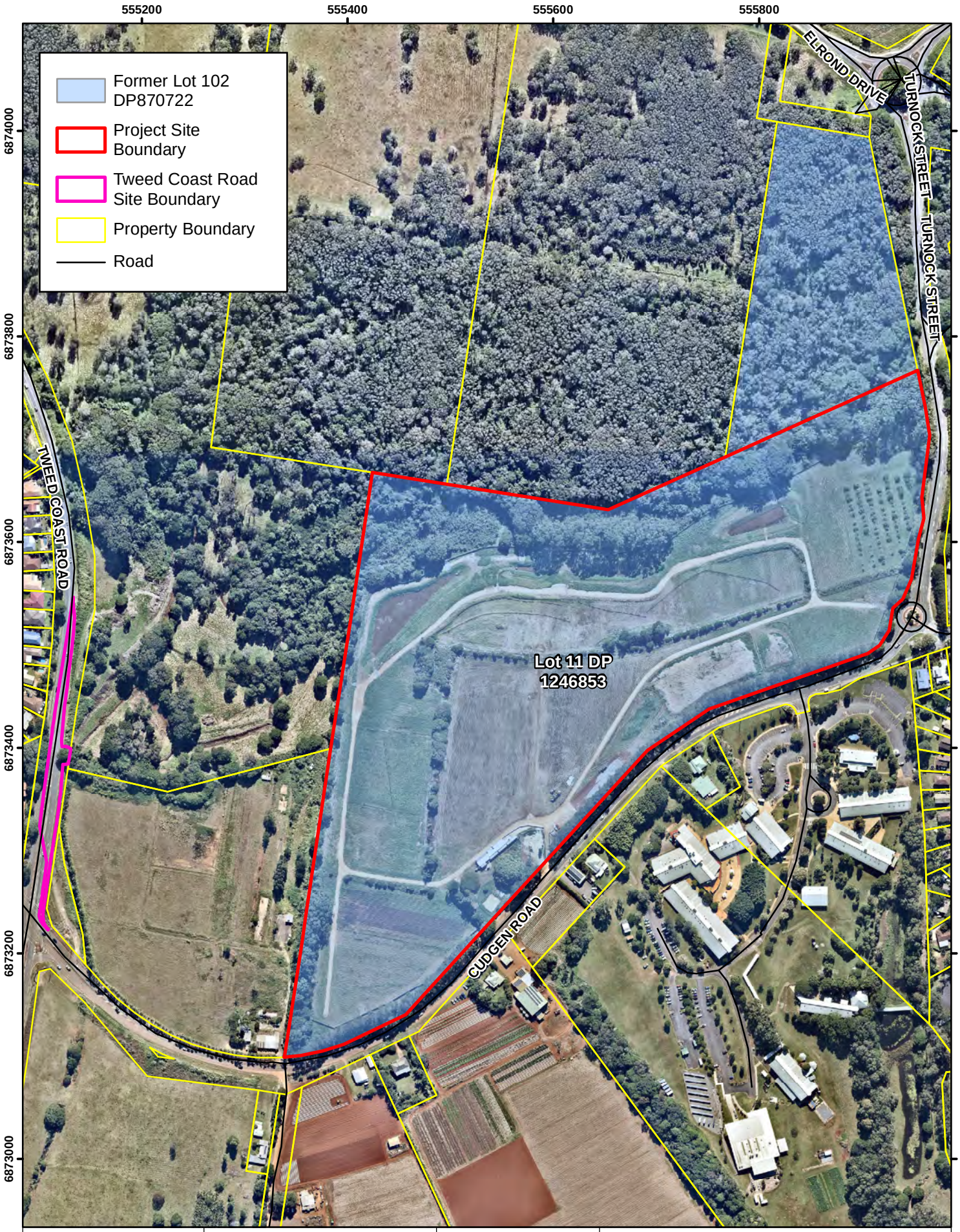
The Planning Secretary's Environmental Assessment Requirements (SEARS) issued for the Stage 2 Application (SSD-10353) contain the following biodiversity related requirements.

Key Issue 19

- Biodiversity impacts related to the proposed development (SSD-10353) are to be assessed in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the *Biodiversity Conservation Act 2016* (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method.

- The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.
- The BDAR must include details of the measures proposed to address the offset obligation as follows:
    - the total number and classes of biodiversity credits required to be retired for the development/project
    - the number and classes of like-for-like biodiversity credits proposed to be retired
    - the number and classes of biodiversity credits proposed to be retired in accordance with the variation rules
    - any proposal to fund a biodiversity conservation action
    - any proposal to make a payment to the Biodiversity Conservation Fund.
- If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.
- The BDAR must be submitted with all spatial data associated with the survey and assessment as per the BAM.
- The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the Biodiversity Conservation Act 2016.
- Where a Biodiversity Assessment Report is not required, engage a suitably qualified person to assess and document the flora and fauna impacts related to the proposal.

Note: Notwithstanding these requirements, the Biodiversity Conservation Act 2016 requires that State Significant Development Applications be accompanied by a Biodiversity Development Assessment Report unless otherwise specified under the Act.



Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Site Map (ref: s4.2.1.1 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Note: All data is approx only & subject to survey.*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 1**
Date: 8/08/2019	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019* *Cadastre © NSW Department of Finance, Services and Innovation 2018*		
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Client: C107778	N 0 350 700 m	Scale (@A4): 1:25,000	**Location Map (ref: s4.2.1.2 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Note: All data is approx only & subject to survey.*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 2**
Date: 8/08/2019	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019*		
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2 STAGE 1 – BIODIVERSITY ASSESSMENT

2.1 Biodiversity Values Not Present on the Site

The BAM (**Section 2.3**) identifies that the following biodiversity values are not assessed under the BAM:

- Marine mammals;
- Wandering sea birds;
- Biodiversity that is endemic to Lord Howe Island;
- Biodiversity values associated with the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A) of the LLS Act, other than the additional biodiversity impacts in accordance with clause 6.1 of the Biodiversity Conservation Regulation 2017 (NSW) (BC Reg).

These values are not present on the Site and therefore do not require additional assessment outside of the scope of the BDAR.

2.2 Landscape Context

2.2.1 Landscape Features

This section addresses the requirements set out in *Section 4.2.1.1 to Section 4.2.1.18* of the BAM.

The defining geophysical feature of this region is the Mount Warning shield volcano, associated caldera and the Tweed River floodplain. The Site is in the South-East Queensland IBRA Bioregion and the Burringbar-Conondale Ranges IBRA Subregion (**Figure 3**).

The southern section of the Project Site and the TCR Site are located on the Lamington Volcanic Slopes NSW Landscapes which features extensive hills and ridges forming a generally circular pattern of radial drainage centred on Mount Warning. The northern section of the Site is located on the Byron-Tweed Alluvial Plains NSW Landscapes characterised by the watercourses, floodplain, terraces and estuary of the Tweed River (Department of Environment and Climate Change [DECC], 2002; **Figure 4** to **Figure 6**).

The northern section of the Site is part of an important wetland mapped under the *State Environmental Planning Policy (Coastal Management) 2018* (Coastal Management SEPP) (**Figure 7** and **Figure 8**). The wetland is not included in the Directory of Important wetlands and has been mapped with a 50 m riparian corridor as per *Table 14* of the BAM. The wetland is part of a mapped regional fauna corridor which may facilitate the movement of threatened species across their range (Department of Environment, Climate Change and Water [DECCW], 2010; **Figure 9**).

At a local scale this forested wetland with associated rainforest components blends eastward into a coastal floodplain wetland (Keith, 2004) that extends to within 200 m of the coast (**Figure 7**). This area is a significant stepping-stone habitat to the Cudgen Creek estuary located approximately 800 m to the south-east of the Site. A constructed, east-flowing floodplain drain drains the catchment and strikes roughly north-east through the northernmost portion of the former Lot 102 DP 870722, which is situated north of the Project Site (**Figure 5**). Based on mapping provided in the NSW Hydrography dataset, Strahler stream ordering could not be determined. However, with reference to stream order data for the Nambucca Catchment (Department of Infrastructure, Planning and Natural Resources

2005), it was assumed that the drain would constitute a 1st or 2nd order stream at most and has been mapped with a conservative 20 m riparian corridor as per *Table 14* of the BAM.

At the time that the assessment was conducted the southern section of the Project Site was a working farm under cultivation (approximately 16.3 ha). Apart from the windrows planted along the Site boundary, most of the southern section of the Site has been cleared of native vegetation. No Areas of Outstanding Biodiversity Value (AOBV), as defined in the BC Act, or areas of geological significance are located on the Site.

2.2.2 Soil Hazard Features

Contaminated Land

Contaminated land investigations in the form of a Preliminary Site Investigation (PSI) and Detailed Site investigation (DSI) were undertaken at the site by Octief with fieldwork undertaken on 14 June 2018 and between 1 and 3 August 2018 respectively.

The PSI included a desktop assessment to identify potential sources of contamination associated with the Site's current and former land uses, and those of the surrounding land, a site inspection, and the collection of seven surface soil samples, one from next to the shed on Site and one composite sample from each of the paddocks on site, totalling six.

The DSI included the collection of 55 primary soil samples from 50 locations using a hand auger, two sediment samples, one from each of the storage dams on-site, as well as a surface water sample from each dam, and the installation and subsequent sampling for a groundwater monitoring bore.

A summary of sample results is as follows:

- No heavy metals (arsenic, chromium, cadmium, copper, nickel, zinc, lead or mercury) were detected in any of the soil samples at concentrations exceeding the nominated health-based investigation levels.
- Two samples reported zinc concentrations exceeding the ecological investigation levels for residential land use and ecologically sensitive areas.
- None of the soil samples analysed reported OC or OP pesticide concentrations in excess of the nominated human health or ecological guideline levels.
- The copper concentration in the groundwater sample collected from the groundwater well exceeded the Groundwater Investigation Level (GIL) for freshwater.
- Zinc concentrations in both the groundwater sample and two surface water samples from the storage dam onsite exceeded the freshwater GIL.
- One sediment sample reported copper and nickel concentrations exceeding the low sediment quality guidelines (SQG) but below the high-SQG. The copper and nickel concentrations detected were comparable to the surface soil concentrations across the cultivated area of the site and are not considered indicative of any significant contamination in the dam sediments.

The investigations concluded that:

- The site was not listed on the Contaminated Land Record.
- No exceedances of relevant human health investigation levels for chemical contaminants were identified in the soil samples analysed. Exceedances of ecological assessment criteria

were relatively minor and isolated, and the Site was considered acceptable for use in the proposed development, from a chemical contamination perspective.

- Anthropogenic wastes were noted in a small farm dump in the north western corner of the Site. Visual assessment and soil analytical testing indicated the material in this area is inert waste, however some portions of the dump could not be assessed during the PSI/DSI due to vegetation overgrowth.

Based on the conceptual site model contained in the report, exposure pathways of identified soil and groundwater contamination to ecological receptors were unlikely to be complete.

A groundwater and intrusive soil investigation was undertaken by Cavvanba Consulting Pty Ltd (Cavvanba) in November and December 2018, and July (Cavvanba 2019) focusing on specific areas of the site including the Farm Dump, Farm Pit (dip), Residential Home and Farm Shed, Farm Dam (all of which are anecdotal descriptions only) and groundwater at the site. These investigations determined that:

- Exceedances of ecological criteria in soil samples were reported, however, these were noted as likely to be localised and not considered to be significant. This is consistent with the previous assessment (Octief 2018) which found no widespread contamination-related ecological issues on the Site.
- The Cudgen Creek off-site environmental receptor and associated creeks are unlikely to be exposed to contamination as the contamination pathways are unlikely to act as a conduit, i.e. extensive distance between the source area and receptor; and depth of the groundwater. These conclusions are consistent with the previous report.

Remediation works are currently underway and will be completed during Stage 1. An auditor will complete a site clearance report for approval before Stage 2 commences.

Acid Sulfate Soils

The potential presence of acid sulfate soils (PASS) was assessed as part of the contaminated land assessment undertaken by Octief.

Mapping indicates that the Site is located within an acid sulfate soil area (Tweed Heads Maps, 2018), with the majority of the site is listed as Class 5 which is defined as “Works within 500 metres of Class 1, 2, 3 or 4 land which are likely to lower the water table below 1 metre AHD in adjacent Class 1, 2, 3 or 4 land”. The northernmost point is listed as Class 2 - Works below the ground surface or Works by which the water table is likely to be lowered. The middle length of the site is listed as Class 3 - Works beyond 1 metre below the natural ground surface or Works by which the water table is likely to be lowered beyond 1 metre below the natural ground surface.

The assessment concluded that “based on the subsurface geology of the site and depth to groundwater in the area of the proposed development, A preliminary review of the site indicates the development would not trigger the class 5 provisions and therefore an acid sulphate soil management plan or investigation is not considered to be required”.

Acid sulfate soils risk mapping (OEH 1998) confirms this assessment, with the area to the north of the eastern portion of the Project Site classified as high risk (1-2 m), and the remainder of the forested area on Site as high risk (2-4 m) (**Figure 10** and **Figure 11**). Additionally, the NSW Environmental Planning Instrument Acid Sulphate Soils (ASS) mapping (Department of Planning and Environment

[DPE], 1995) confirms that there is no ASS risk in the cleared southern section of the Project Site or in the TCR Site where development is proposed.

Slope Stability and Landslide Risk

A slope stability assessment that included land slide risk was conducted for areas of the site proposed for development as part of preliminary geotechnical investigations undertaken by Wood and Grieve Engineers PTY LTD. No evidence of recent past slope instability involving small-scale or large-scale movements of significant quantities of soil or rock in a short duration event such as slips, slumps, debris slides or a landslide was identified. However, localised areas within the mild sloping terrain which display minor evidence of slope instability in the form of creep movement of the surficial soil. Minor creep movement that was evident is not expected to impact on the proposed development providing management recommendations are followed.

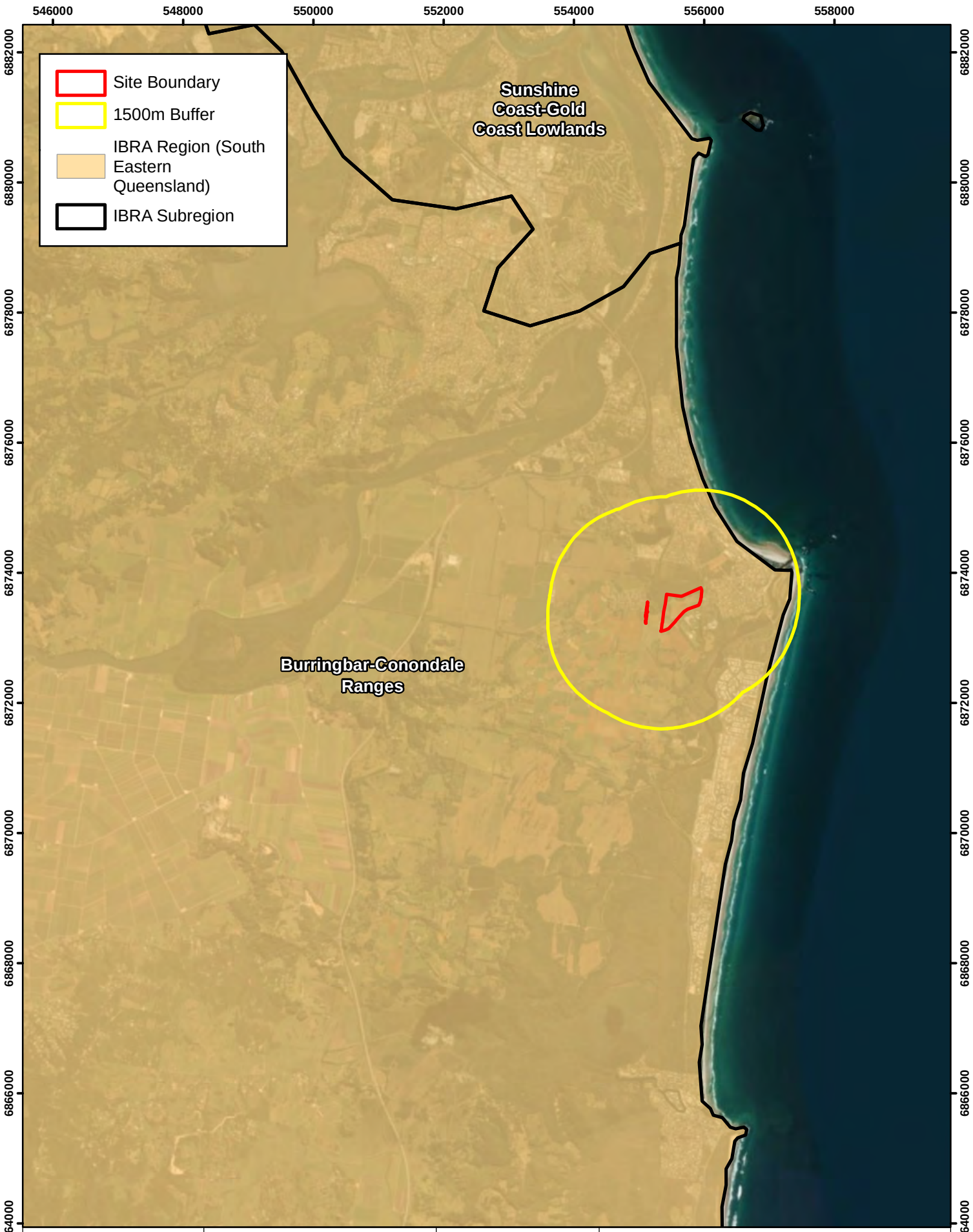
The assessment concluded that the Landslide Risk Ratings for all of the proposed development at the site is assessed to be “Very Low or Low” in its existing condition.

Soil Salinity

Based on laboratory analysis of five soil samples obtained from depths of between 0.15 m and 1.0m below the ground surfaces as part of contaminated land investigation undertaken on the site by Octief, soil conductivity ranged between 14 and 61 µS/cm (0.014 and 0.061 dS/m). Based on soil salinity criteria in the Soil Salinity Handbook, Second Edition.

Department of Environment and Resources Management Queensland (2011); the soil salinity rating for soil on the Site taking into account the range of clay contents determined from geotechnical investigations (50-87%) would fall into the “very low” category.

The soil salinity results from the contaminated land investigations infer that soil salinity risks to ecological receptors associated with the proposed development are likely to be low. With respect to potential impacts due to soil-derived saline run-off to the wetlands, the risks are expected to be further reduced through the use of appropriate erosion and sediment control measures during construction. Additionally, a proportion of run-off from the Site currently enters the wetlands, further reducing the likelihood of increases in salinity in run-off from the site during construction and operational phases of the development.



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Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery © Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community* *IBRA Regions & Subregions © Australian Government Department of the Environment and Energy (2012)*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 3**
Date: 8/08/2019			
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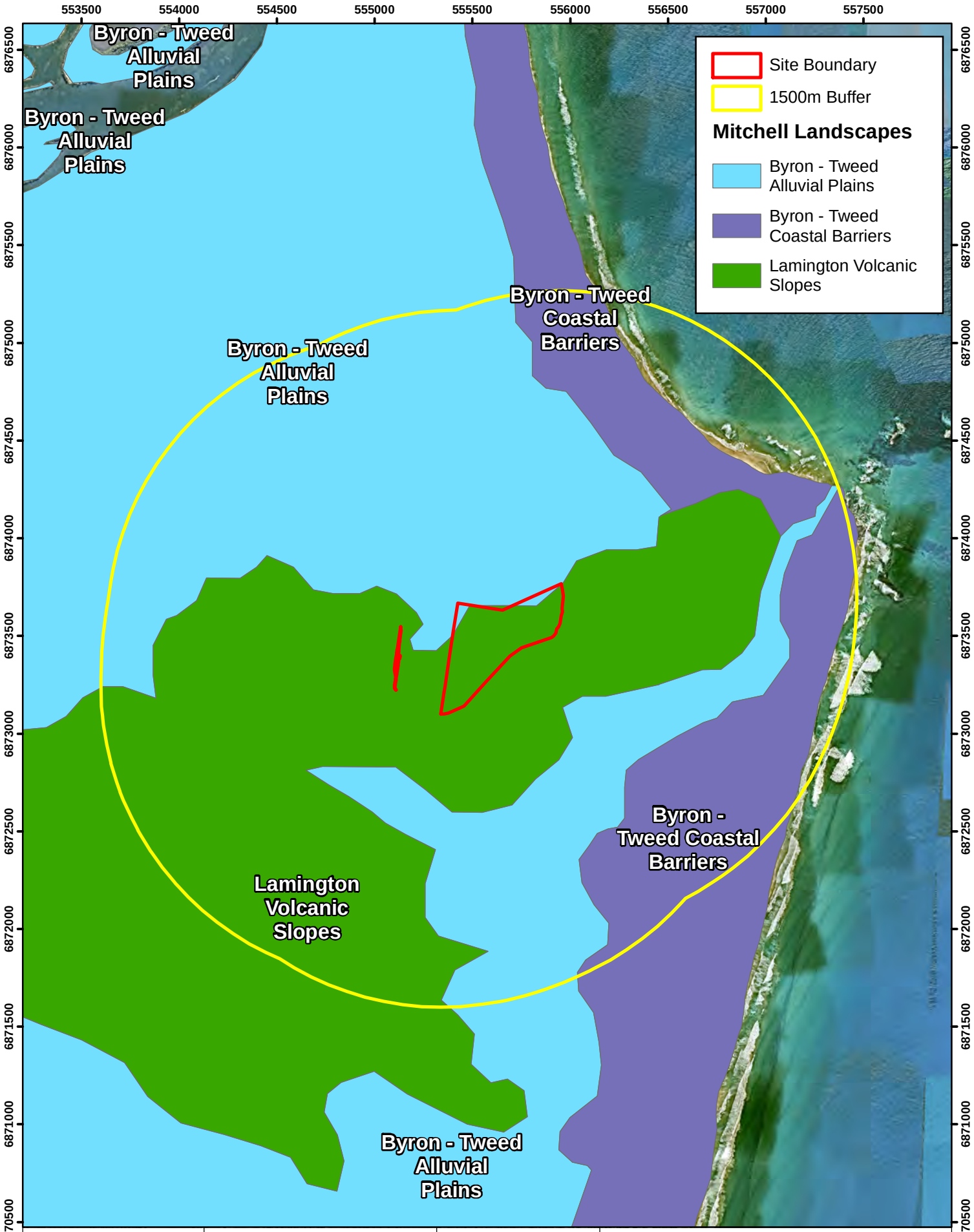

Client: C107778	N 0 350 700 m	Scale (@A4): 1:25,000	**NSW Landscape Region (ref: s4.2.1.3h & s4.2.1.5 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 4**
Date: 8/08/2019	*NSW (Mitchell) Landscapes - version 3.1 © Office of Environment and Heritage (OEH) 2016.*		
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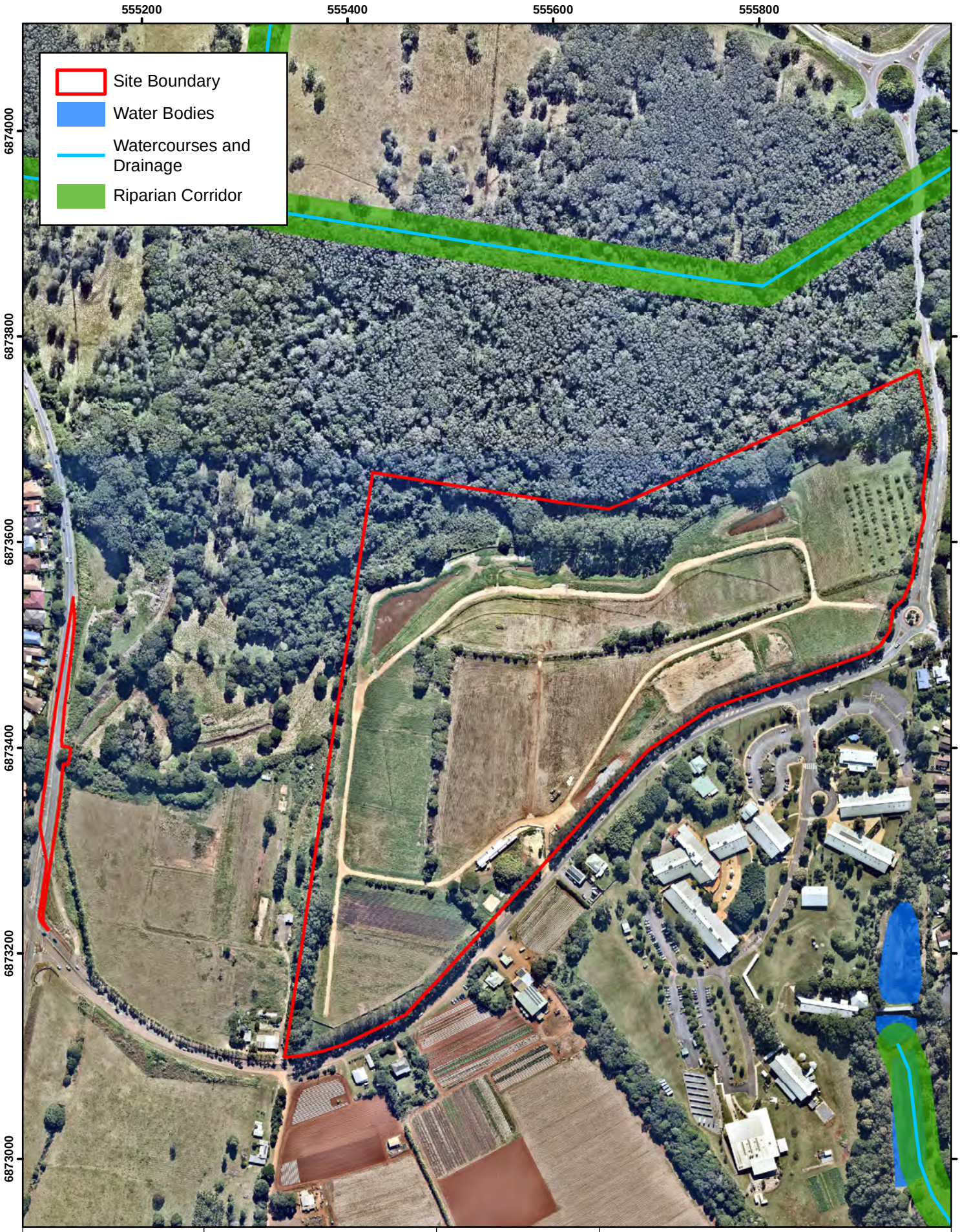

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Rivers, Streams and Estuaries (ref: s4.2.1.3 & s4.2.1.6 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Note: All data is approx only & subject to survey.*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 5**
Date: 8/08/2019	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019* *Hydrolines and Hydroarea (NSW Hydrography) © Department of Finance, Services and Innovation (2018)*		
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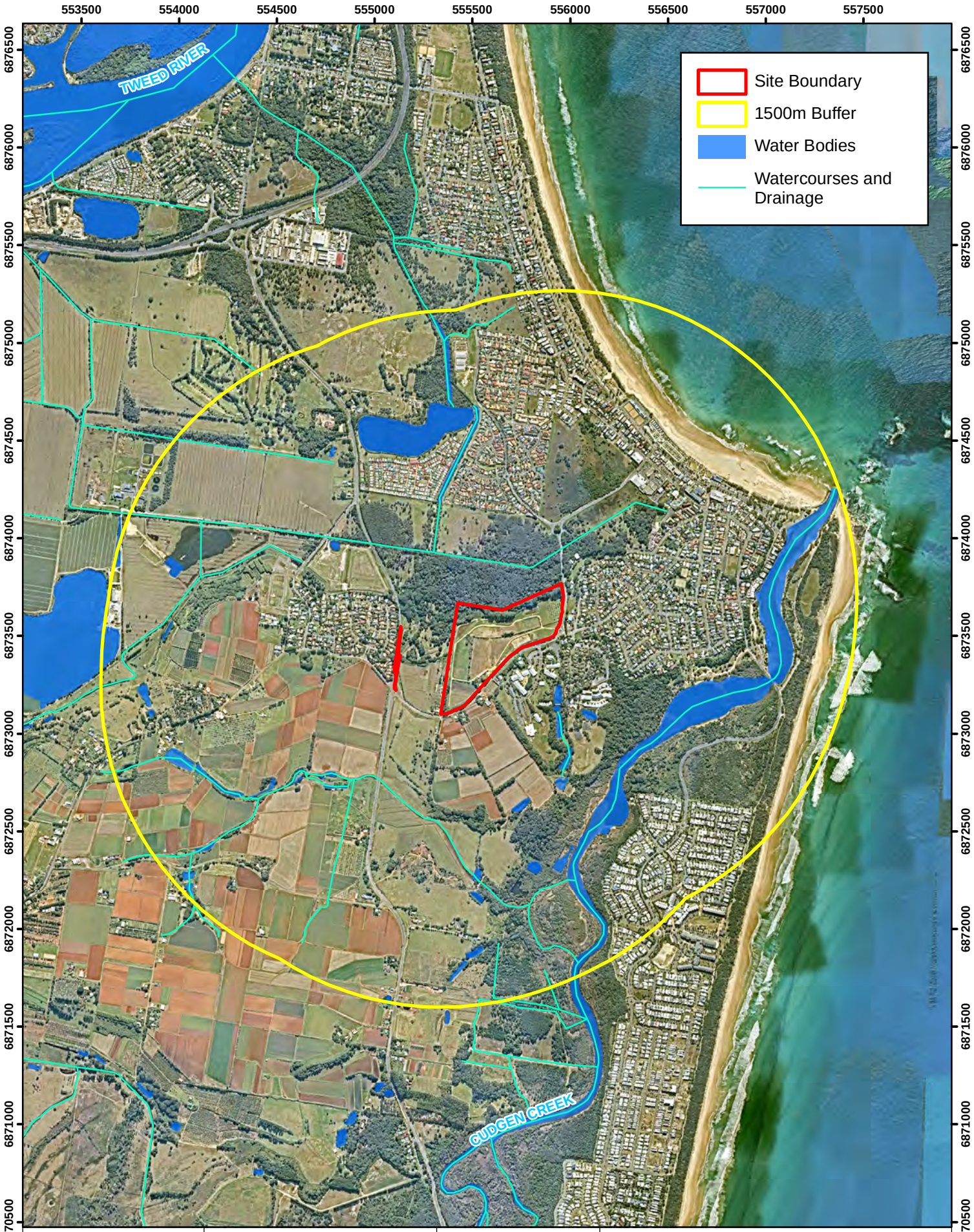

Client: C107778	N 0 350 700 m	Scale (@A4): 1:25,000	**Rivers, Streams and Estuaries (ref: s4.2.1.3 & s4.2.1.6 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Note: All data is approx only & subject to survey.*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 6**
Date: 8/08/2019	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019* *Hydrolines and Hydroarea (NSW Hydrography) © Department of Finance, Services and Innovation (2018)*		
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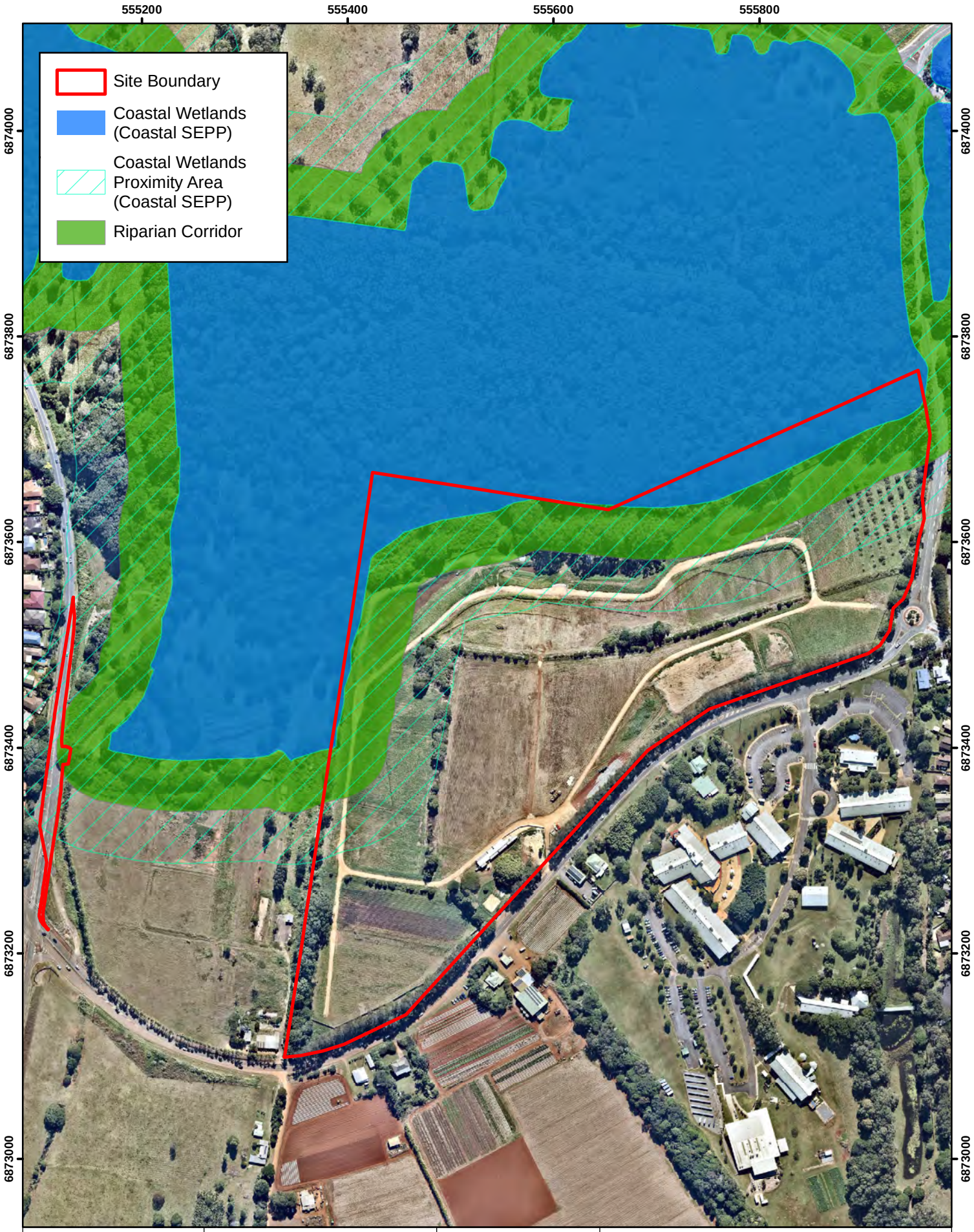

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Wetlands (Site) (ref: s4.2.1.3c & s4.2.1.7 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 7**
Date: 8/08/2019	*Coastal SEPP mapping © Department of Planning and Environment (DPE) 2018*		
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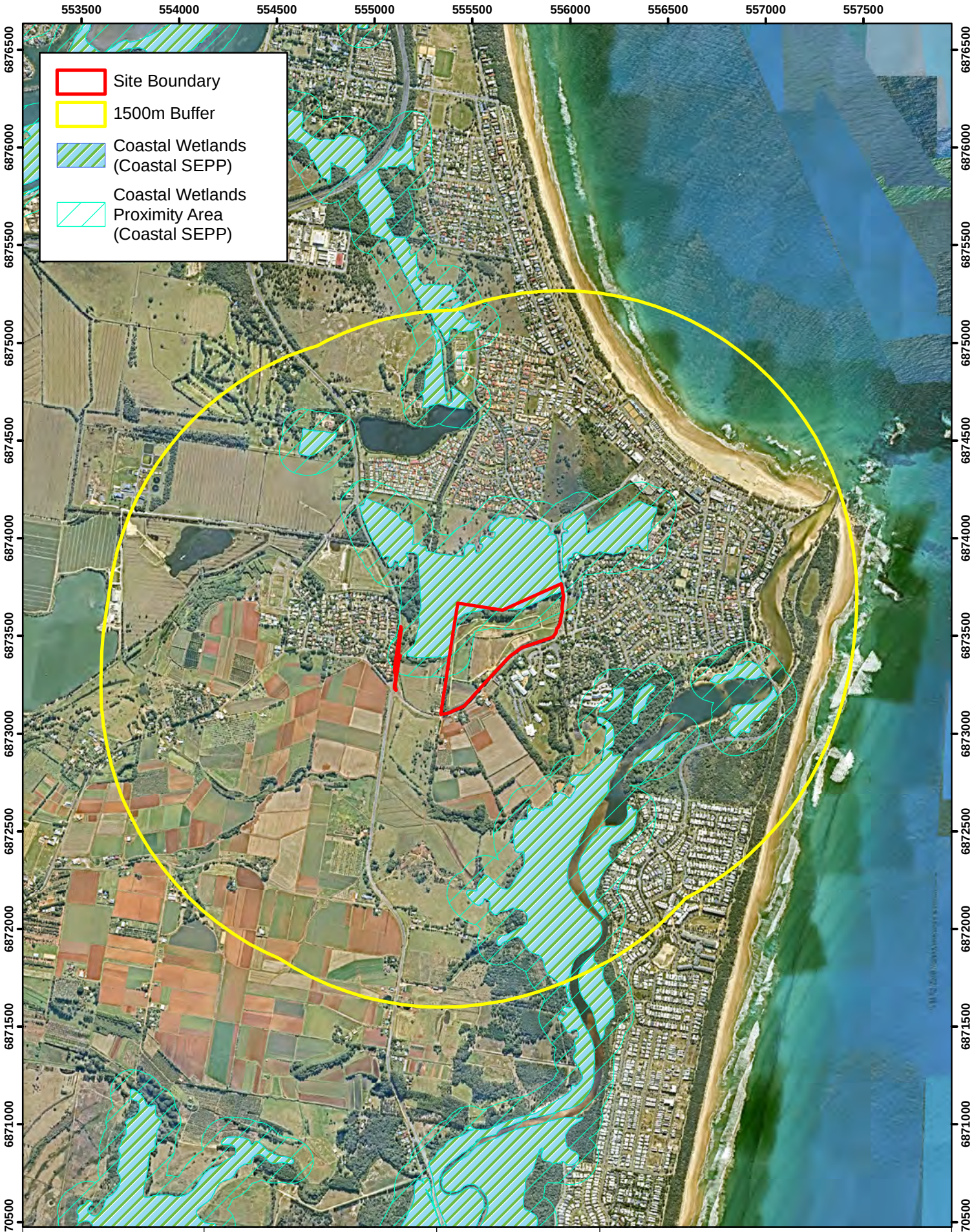

Client: C107778	N 0 350 700 m	Scale (@A4): 1:25,000	**Wetlands (Location) (ref: s4.2.1.3c & s4.2.1.7 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 8**
Date: 8/08/2019	*Coastal SEPP mapping © Department of Planning and Environment (DPE) 2018*		
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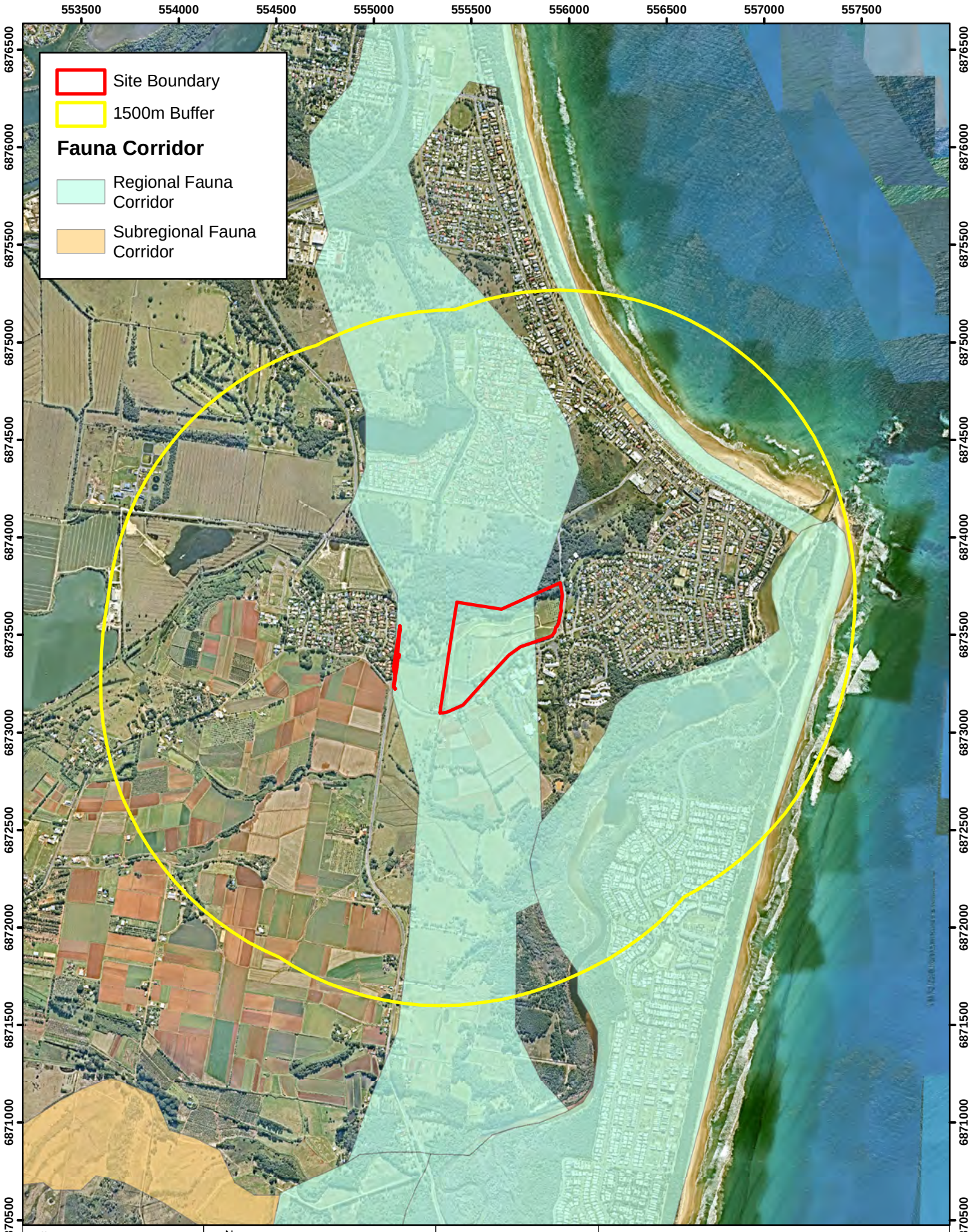

Client: C107778	N 0 350 700 m	Scale (@A4): 1:25,000	**Habitat Connectivity (ref: s4.2.1.3d & s4.2.1.9 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019* *Fauna corridors for NE NSW © Office of Environment and Heritage (OEH) 2010.*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 9**
Date: 8/08/2019			
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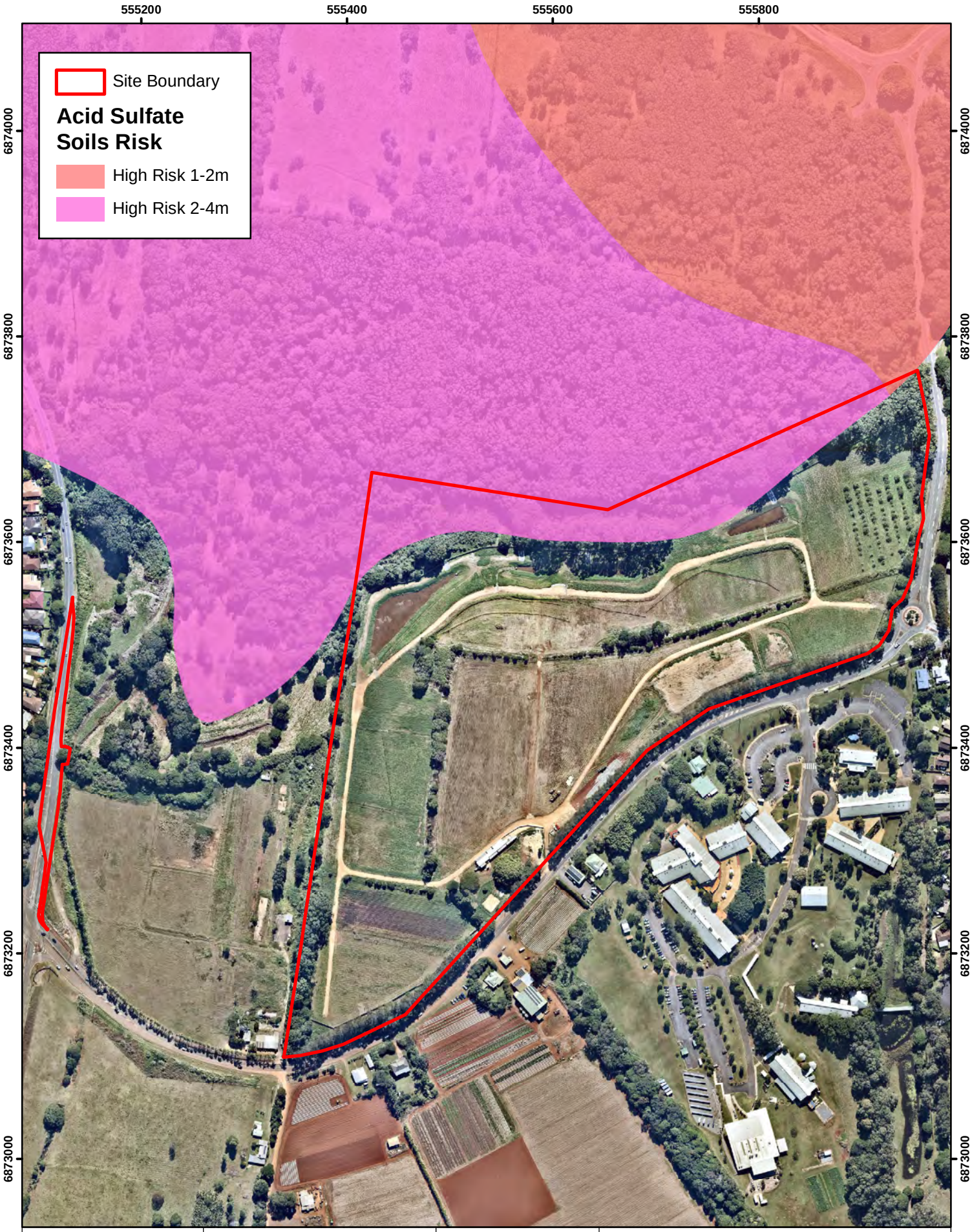

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Soil Hazard Features (Site) (ref: s4.2.1.3i & s4.2.1.13 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 10**
Date: 8/08/2019	*Acid Sulfate Soils Risk mapping © Office of Environment and Heritage (OEH) 1998*		
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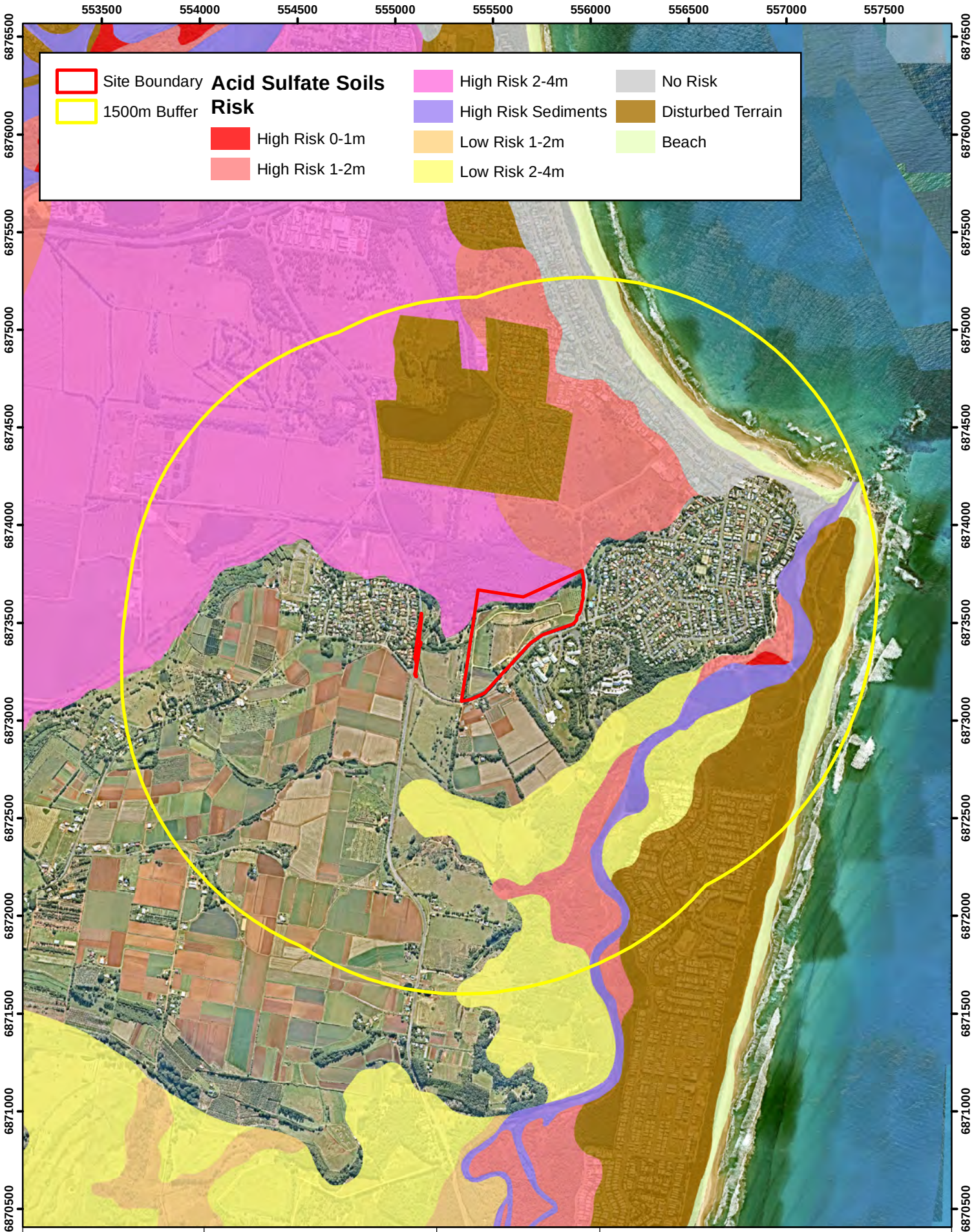

Client: C107778	N 0 350 700 m	Scale (@A4): 1:25,000	**Soil Hazard Features (Location) (ref: s4.2.1.3i & s4.2.1.14 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 11**
Date: 8/08/2019	*Acid Sulfate Soils Risk mapping © Office of Environment and Heritage (OEH) 1998*		
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2.3 Native Vegetation

In order to address the requirements set out in *Section 5.2.1.1 to 5.2.1.5* of the BAM, identifying native plant community types and ecological communities on the subject land, the assessor identified vegetation formations and vegetation class on the Site, as outlined in **Sections 2.3.1** and **Section 2.3.2**.

The native vegetation assessment was conducted for the full extent of the former Lot 102 DP 870722. The current vegetation integrity scores for all Vegetation Zones have been retained for the Site for this final version of the BDAR.

2.3.1 Vegetation Class

Observations of the vegetation formation from field surveys conducted by Greencap (**Section 2.3.5**) and correlation with the BioNet Vegetation Classification (OEHb, 2018) determined four vegetation classes present at the Site (**Table 2**):

- Coastal Swamp Forest;
- Coastal Floodplain Wetlands;
- Subtropical Rainforest; and
- North Coast Wet Sclerophyll Forest.

The remnant vegetation at the Site is Coastal Swamp Forest and Subtropical Rainforest with North Coast Wet Sclerophyll Forest and Coastal Floodplain Wetlands recorded in planted windrows. Windrow vegetation that has self-sown on the linear rock mounds throughout the Site consists of early regrowth native rainforest species and woody weeds classified as High Treat Exotics. Exotic vegetation consisting of a barner grass *Cenchrus purpureus* monoculture (3-4m tall) as well as a small patch of camphor laurel *Cinnamomum camphora* with an understorey of small-leaf privet *Ligustrum sinense* is located amongst derived and remnant native vegetation in the northern section of the Site.

Table 2 Plant Community Types and Threatened Ecological Communities

Vegetation formation	Vegetation class	PCT	PCT Common Name	Threatened Ecological Community	PCT Identification steps		PCT % cleared
					Search Term	*Selection*	
Forested Wetland	Coastal Swamp Forest	1064	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Paperbark swamp forest)	Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions ***Conservation Status – Endangered Ecological Community***	1. Vegetation formation	Forested Wetland	75%
					2. Vegetation class	Coastal Swamp Forest	
					3. IBRA Bioregion	South Eastern Queensland	
					4. IBRA Subregion	Burringbar-Conondale Range	
					Shortlist	Returned a longlist of 3 PCTs – 1064, 1227, 1230	
					5. Upper stratum species	*Melaleuca quinquinervia* is dominant in the canopy and is the only upper stratum species	
					Selection	Chose 1064 because *Melaleuca quinquinervia* is dominant and there are no other species present in the upper stratum (i.e. *Eucalyptus spp.* or *Casuarina glauca*)	
	Coastal Floodplain Wetlands	1235	Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Swamp Oak swamp forest)	This PCT does not conform to any NSW Scientific Committee Final Determination for an Endangered Ecological Community. Refer to **Section 2.3.5** for justification.	1. Vegetation formation	Forested Wetland	75%
					2. IBRA Bioregion	South Eastern Queensland	
					3. IBRA Subregion	Burringbar-Conondale Range	
					Longlist	Returned a longlist of 6 PCTs – 780, 1064, 1145, 1227, 1230, 1235	
					4. Upper stratum species	*Casuarina glauca* is dominant in the canopy and is the only upper stratum species	
					Shortlist	Returned a shortlist of 3 PCTs – 1064, 1230, 1235	
					Selection	Selected 1235 because *Casuarina glauca* is dominant and there are no other species present in the upper stratum (i.e. *Eucalyptus spp. or Melaleuca spp.)*	

Vegetation formation	Vegetation class	PCT	PCT Common Name	Threatened Ecological Community	PCT Identification steps		PCT % cleared
					Search Term	*Selection*	
Rainforest	Subtropical Rainforest	1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion (White Booyong – Fig subtropical rainforest)	Lowland rainforest on floodplain in the NSW North Coast Bioregion and Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions ***Conservation Status – Endangered Ecological Community***	1. Vegetation formation	Rainforest	75%
					2. Vegetation class	Littoral (Littoral Rainforest occur within 2 km of the coast) and Subtropical Rainforest	
					3. IBRA Bioregion	South Eastern Queensland	
					4. IBRA Subregion	Burringbar-Conondale Range	
					Longlist	Returned a longlist of 4 PCTs – 751, 1068, 1275, 1302	
					5. Upper stratum species	*Ficus spp.* are dominant in the upper stratum and *Archontophoenix cunninghamiana* is abundant in the upper stratum	
					Shortlist	Returned a shortlist of 2 PCTs – 1068, 1302	
					Selection	Selected 1302 because both *Ficus spp.* and *A. cunninghamiana* are listed for the upper stratum. Rejected *A. cunninghamiana* because this species was not listed for the upper stratum of 1068.	
Wet Sclerophyll Forests (Shrubby sub-formation)	North Coast Wet Sclerophyll Forest	1569	Flooded Gum – Brush Box – Tallowwood mesic tall open forest on ranges of the lower North Coast (henceforth, Flooded Gum – Brush Box – Tallowwood mesic tall open forest)	N/A	1. Vegetation formation	Wet Sclerophyll Forests (Shrubby sub-formation)	43%
					2. IBRA Bioregion	South Eastern Queensland	
					3. IBRA Subregion	Burringbar-Conondale Range	
					Shortlist	Returned a shortlist of 2 PCTs – 693, 749	
					4. Upper stratum species	*Eucalyptus grandis* is dominant in the upper stratum and *E. microcorys* is co-dominant and are the only upper stratum species. Rejected 693 and 749 as these PCTs do not have either of these species in the upper stratum	
					5. IBRA Bioregion	Expanded search term to include NSW North Coast	

Vegetation formation	Vegetation class	PCT	PCT Common Name	Threatened Ecological Community	PCT Identification steps		PCT % cleared
					Search Term	*Selection*	
					4. Upper stratum species	*E. grandis* is dominant in the upper stratum.	
					Shortlist	Returned a longlist of 3 PCTs – 812, 1285, 1569	
					Selection	All PCTs in the shortlist include *E. grandis* and *E. microcorys* in the upper stratum. Selected 1569 because *E. grandis* is dominant in the upper stratum in this windrow and *E. mircocorys* is co-dominant	

2.3.2 Vegetation Formations

Observations from field surveys conducted by Greencap (**Section 2.3.5**) on the Project Site indicated the presence of two distinct areas of vegetation. The northern section of the Project Site that is located on the floodplain is substantially remnant native vegetation. Above the level of the floodplain, the southern section of the Project Site that is located on a ridge is land that has been cleared of native vegetation. Vegetation formations recorded on the site and presented below are classified in accordance with Keith (2004) and are detailed in **Table 2.**

The northern section of the Project Site is remnant vegetation classified as forested wetland and rainforest formations. Adjoining the remnant vegetation is a large patch of exotic vegetation near the north-west corner and planted eucalypt windrows classified as wet sclerophyll forest shrubby sub-formation. Along the southern edge of this vegetation and extending roughly west to east across the Site rocks that have been cleared from the cultivated fields have formed a steep slope and, in some areas, have been fashioned into a dry-stone wall up to 3 m high.

Most of the southern section of the Site is cleared land under cultivation. Rocks that have been cleared from the cultivated fields have been piled into linear mounds composed of loosely consolidated rock and soil throughout the Site. Early regrowth rainforest species and woody weeds that are classified as high threat exotics have self-sown in these areas to form windrows classified as rainforest. Along the Cudgen Road/Turnock Street boundary there is a planted slash pine *Pinus elliottii* windrow with an understory also composed of self-sown early regrowth rainforest species and woody weeds. There is also a planted eucalypt windrow in the south-west corner of the Site classified as wet sclerophyll forest shrubby sub-formation. On the eastern boundary of the Site there is a planted casuarina windrow classified as a forested wetland.

Observations from the TCR Site conducted by Greencap indicated that the vegetation is an exotic grassland including *Panicum sp.*, *Paspalum sp., Chloris gayana* as well as shrubs such as lantana *Lantana camara*, tobacco bush *Solanum mauritianum*, bush daisy *Montanoa hibiscifolia*. The exception to this is a single native early regrown rainforest tree.

2.3.3 Identification of Draft Plant Community Types and Draft Vegetation Zones

This section addresses the requirements set out in *Section 5.2.1.1 to 5.2.1.8 (a)* of the BAM, identifying native plant community types and ecological communities on the subject land as well as *Section 5.3.1*, mapping vegetation zones.

Native vegetation communities within the Tweed LGA was mapped in a study commissioned by Tweed Shire Council (Ecograph, 2004) and updated in 2012 (TSC 2012). Originally based on 1996 aerial photography and updated based on 2009 aerial photography, this mapping was conducted at a nominal scale of 1:25000 with a boundary precision of +/-25 m. Consequently, remnant vegetation patches of < 1 ha or connections < 25 m wide could not be resolved (Ecograph, 2004; TSC, 2012).

In conjunction with observations from the initial Site inspection, the above vegetation mapping layers were used to conduct an initial assessment of native vegetation extent on the Site, determine draft Plant Community Types (PCT) and then stratify these draft PCTs into draft Vegetation Zones (**Table 2**). In accordance with *Section 5.2.1.4* of the BAM, for the planted and self-sown windrow vegetation, a draft PCT was assigned which was the most likely original PCT as determined by the assessor.

In accordance with *Section 5.2.1.2* of the BAM, the entire list of PCTs located on the BioNet Vegetation Classification website (OEHb 2018) were exported to facilitate PCT identification. The Data>Filter menu options in Microsoft Excel was used to filter column headings to identify PCTs. The specific steps

taken to identify each draft PCT using the above method are detailed in with reference to the relative abundance of plant species that relied upon for the identification of each PCT (**Table 2**).

The TECs identified on the Site are outlined in **Section 2.3.5.**

2.3.4 Plot-based Vegetation Surveys

This section addresses the requirements set out in *Sections 5.2.1.8 (b) to 5.2.1.11* of the BAM.

A systematic field-based floristic vegetation survey using documented and repeatable methods was employed to collect floristic data at the Site in accordance with *Tables 2 to 4, Section 5.2.1.8 (b-e) to 5.2.1.11 and Section 5.3* of the BAM. The vegetation survey was designed to survey the expected environmental variation in each draft PCT, the expected environmental variation in each stratified draft vegetation zone and to fill gaps in existing mapping and site information. Note that the vegetation survey was undertaken across the former Lot 102 DP 870722 and the results for the survey have been retained for the purpose of documenting current vegetation integrity scores for each vegetation zone on the Site (**Figure 12, Figure 14**). However, henceforth the areas presented in text and tables are for the Site.

Given the relatively small area of each draft PCT on the Site (i.e. PCT 1064 = 0.29 ha; PCT 1302 = 2.47 ha; PCT 1569 = 0.86 ha; and PCT 1235 = 0.05 ha), it was considered that the environmental variation on the Site is minimal. Also, given that much of the native vegetation within the development footprint comprises either small areas of planted or self-sown windrows, and in the case of the TCR SIte a singular tree (**Figure 12**) (Zone 4 = 0.55 ha, Zone 8 = 0.40 ha; **Table 3**), the environmental variation in each stratified draft vegetation zone is also minimal. Accordingly, it was considered that a survey effort for each vegetation zone that is in accordance with the minimum number of plots that is indicated in *Table 4* of the BAM was appropriate.

Vegetation integrity was surveyed using both standard and linear nested plots in accordance with *Sections 5.3.4.1 to 5.3.4.7* of the BAM. Vegetation surveys of Zones 1, 2, 3 and 6 were undertaken using standard nested plots as this plot configuration was considered appropriate for these vegetation zones. The vegetation surveys of the planted and self-sown windrows in Zones 4, 5, 7 and 8 on the Site were carried out using linear nested plots as this plot configuration was considered appropriate given the linear nature of these vegetation zones. For each vegetation zone the number of BAM plots that were surveyed and the date of the survey for each plot is detailed in **Table 3**.

Floristic composition data was collected for each vascular plant species recorded in a 400 m^2 plot (standard 20 m x 20 m or linear 10 m x 40 m) in accordance with *Table 2, Table 3 and Sections 5.3.4.8 to 5.3.4.12* of the BAM and included:

- Species name – Scientific (*Genus species*) and common name (*Table 2* of the BAM);
- Status – Species status: native, exotic or high threat exotic (*Section 5.3.4.11* of the BAM); and
- Growth form – Growth form classes: tree, shrub, grass and grass like, forb, fern and other (*Table 2* of the BAM).

Floristic structure data for cover, abundance and stratum in a 400 m^2 plot (standard 20 m x 20 m or linear 10 m x 40 m) was collected for the following attributes in accordance with *Table 2, Section 5.3.4.8 and Sections 5.3.4.13 to 5.3.4.17* of the BAM and included:

- Cover – Percent foliage cover across the plot for each species rooted in or overhanging the plot (*Section 5.3.4.13* of the BAM);

- Abundance – For species with ≤5% cover an estimate of the number of individuals or shoots of each species was recorded (*Table 2* of the BAM); and
- Stratum – Vegetation layers: upper, middle and ground stratum (*Table 2* of the BAM).

Floristic function data for the number of large trees, stem size class, tree regeneration and length fallen logs in a 1,000 m^2 plot (standard 20 m x 50 m or linear 10 m x 100 m) in accordance with *Table 3, Section 5.3.4.8 and Sections 5.3.4.18 to 5.3.4.30* of the BAM and included:

- Number of large trees – With reference to the appropriate large tree benchmark for each PCT;
- Tree regeneration – Presence or absence of living trees with < 5 cm diameter at breast height over bark (DBH);
- Tree stem size class – 5-9, 10-19, 20-29, 30-49, 50-79 and >80 cm DBH;
- Length of fallen logs – Total length in metres of all woody material > 10 cm in diameter and >50 cm in length;
- Litter cover – Assessed as the average percentage ground cover of litter recorded in five 1 m^2 plots evenly located along the central transect; and
- Trees with hollows – Count of the number of trees with hollows that are visible from the ground.

Plot data was collected in the Fulcrum application on a mobile device with GPS capability or on handwritten field sheets. Data that was collected on handwritten field sheets was immediately entered into Fulcrum. Data that was entered into Fulcrum was then downloaded into Microsoft Excel for ease of data manipulation.

Over the course of the vegetation surveys the boundaries of the draft vegetation zone were confirmed by annotating a paper-based map that indicated the base map and draft vegetation zones with the assistance of the Fulcrum application on a mobile device with GPS capability. This handwritten data was then digitised using a GIS application.

Samples of plant species that were not readily identifiable in the field were identified in the lab with the aid of field guides and botanical keys. Those plant species which could not be identified in the lab were identified by the Queensland Herbarium. Once identified, the plant species that were identified in the lab and by the herbarium were transferred into Microsoft Excel.

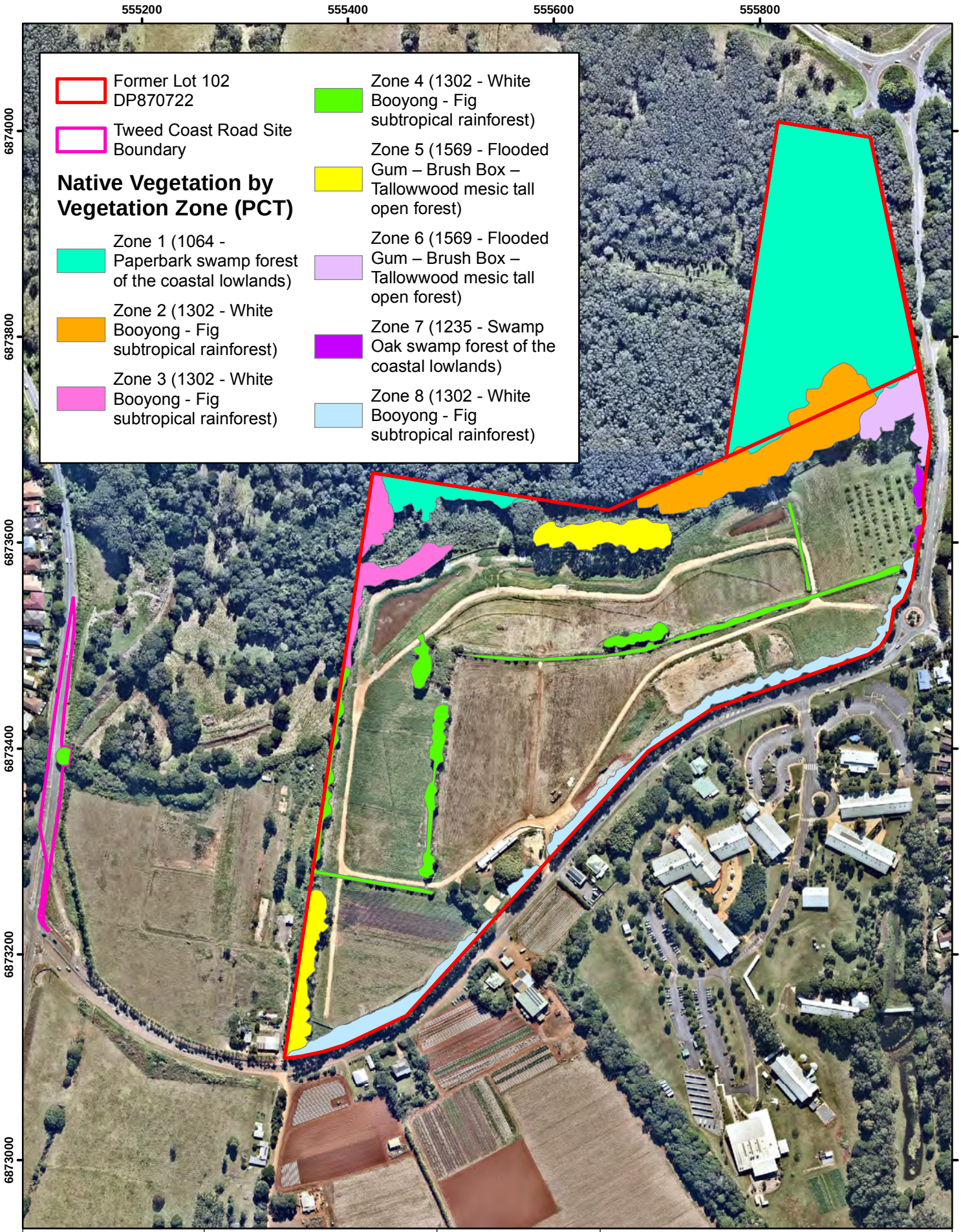
The flooded gum *E. grandis* dominated windrow that is located in Zone 5 was planted on the edge of a dry-stone wall. On this basis, it was considered as an unsafe area to work in. Consequently a plot was placed in the windrow in the south-west corner of the Site within the same Vegetation Zone.

The slash pine *Pinus ellioti* windrow is considered to be exotic vegetation and not assessable under the BAM. However, given that self-sown native vegetation composed of early regrowth rainforest species grows in the understory and the BAM requirement to assess occurrence of threatened species across the Site, a plot based survey was conducted in this area as a precaution (**Table 3;** Zone 8).

Observations from both initial and subsequent Site inspections (**Photo 1**) indicated that the vegetation in Zone 9 is exotic vegetation consisting of a barner grass *Cenchrus purpureus* monoculture (3-4m tall) as well as a small patch of camphor laurel *Cinnamomum camphora* with an understorey of small-leaf privet *Ligustrum sinense* and native vegetation was not detected. Consequently, this zone does not require assessment and no BAM plots were established within this vegetation zone (**Table 3**).

Plot based vegetation survey field records are provided in **Appendix B**. A summary of floristic results is provided in **Appendix C** and vegetation integrity assessment results are provided in **Appendix D.**

Photo 1 Zone 9 Barner Grass – Camphor Laurel – Small-leaf Privet exotic vegetation



Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Native Vegetation Extent on the Original Lot 102 DP 870722 (ref s5.1 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C, Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 12**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
GREENCAP			

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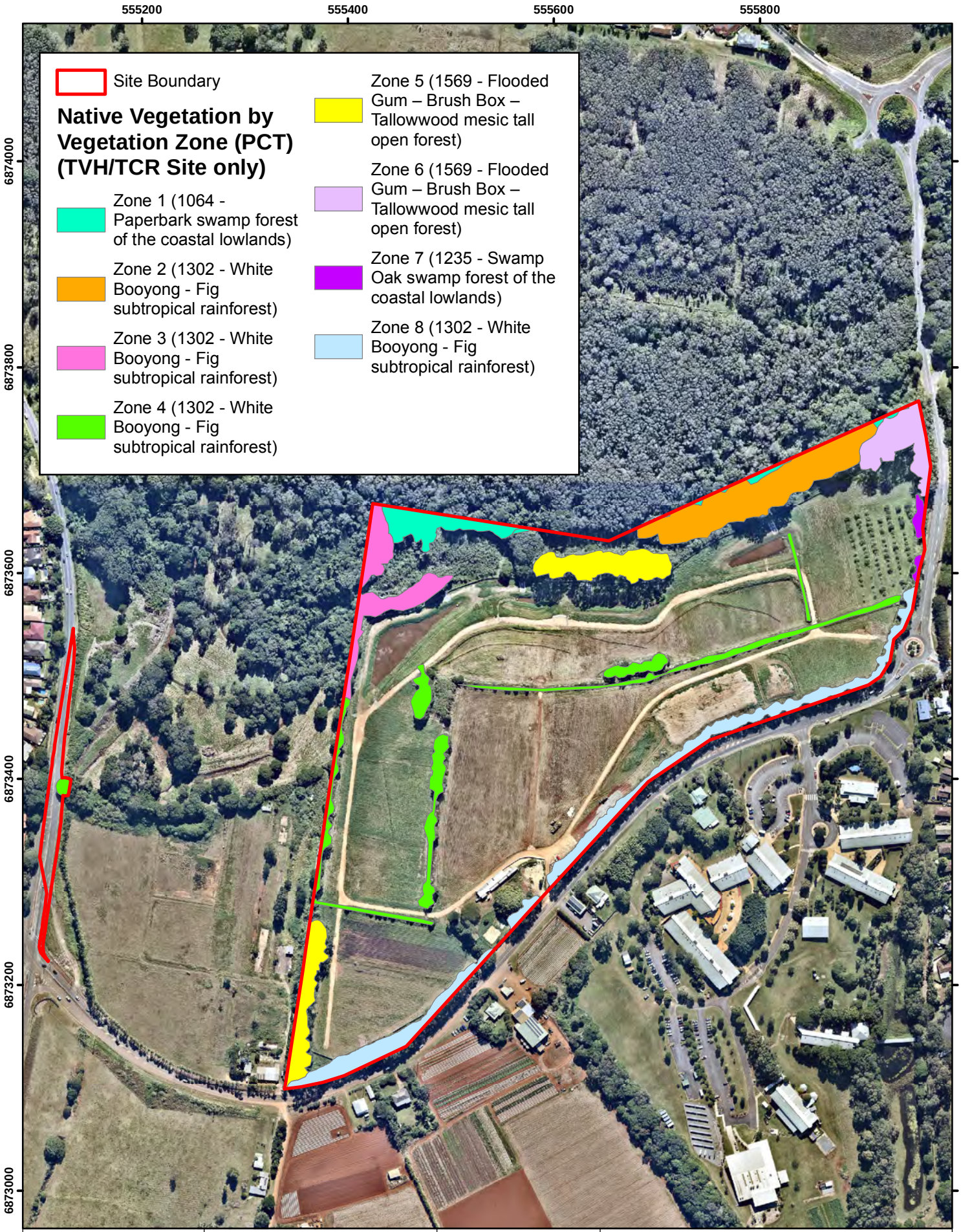

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Native Vegetation Extent on the Site (ref s5.1 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 13**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
GREENCAP			

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Table 3 Plant Community Types, Vegetation Zones and Number of BAM Plots

PCT	PCT Common Name	Vegetation Zone	Description and condition	Condition class	Area (ha) for former Lot 102 DP 870722	No. of plots	BAM plot number and survey date	Area (ha) for Site (Project Site and TCR Site)
1064	Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	1	Coastal Swamp Forest in moderate condition	Moderate	3.89	2	16 – 10 July 2018 19 – 15 June 2018	0.29
1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	2	Subtropical Rainforest in moderate condition	Moderate	0.95	1	11 – 11 July 2018	0.73
		3	Derived regenerating Subtropical Rainforest in low condition, most likely original PCT.	Low	0.37	1	103 – 3 September 2018	0.36
		4	Self-sown regenerating Subtropical Rainforest in low condition, most likely original PCT.	Self-sown windrow	0.63	1	99 – 11 July 2018	0.61 (0.55 to be cleared)
1569	Flooded Gum – Brush Box – Tallowwood mesic tall open forest on ranges of the lower North Coast	5	Planted North Coast Wet Sclerophyll Forest in low condition, best matching PCT based on local species present	Planted windrow	0.57	1	102 – 15 August 2018	0.57
		6	Planted North Coast Wet Sclerophyll Forest in low condition, best matching PCT based on local species present.	Planted windrow	0.30	1	101 – 15 August 2018	0.29
1235	Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	7	Planted Coastal Swamp Forest in low condition, best matching PCT based on local species present	Planted windrow	0.05	1	100 – 15 August 2018	0.05
1302	White Booyong – Fig subtropical rainforest of the NSW North Coast Bioregion	8	*Pinus sp.* windrow with understorey of self-sown regenerating	Self-sown windrow	0.75	1	98 – 15 August 2018	0.75 (0.40 to be cleared)

PCT	PCT Common Name	Vegetation Zone	Description and condition	Condition class	Area (ha) for former Lot 102 DP 870722	No. of plots	BAM plot number and survey date	Area (ha) for Site (Project Site and TCR Site)
			Subtropical Rainforest in low condition, most likely original PCT					
N/A	Barner Grass – Camphor Laurel – Small-leaf Privet exotic vegetation	9	*Cenchrus purpureus* monoculture with *Cinnamomum camphora* and *Ligustrum sinense*	N/A	1.02	0	N/A	1.02

2.3.5 Confirmation of PCTs, Vegetation Zones and Threatened Ecological Communities

This section addresses the requirements set out in *Sections 5.2.1.12 to 5.2.1.17* of the BAM and *Section 5.3.1* of the BAM. A combination of the quantitative data recorded in the plot-based floristic vegetation surveys outlined in **Section 2.3.4**, mapping data and Site observations was then used to confirm the identification of PCTs and Vegetation Zones detailed in **Section 2.3.3**. The evidence and steps taken to identify each confirmed PCT and a justification for the selection of each PCT is detailed in **Table 2**. Following confirmation of PCTs the extent of native vegetation on the Site and the location of vegetation zones was then mapped (**Figure 12** to Figure 15). An overlay of the vegetation zones over the Project Site Masterplan and the TCR Site Development Plan are shown in **Appendix A** in **Figures A-3** and **A-4**.

In accordance with *Sections 5.2.1.14 and 5.2.1.15* of the BAM, in addition to the data and information above, the Final Determinations of the former NSW Scientific Committee were then employed to confirm and then map Threatened Ecological Communities that are located on the Site (**Figure 16**).

Rainforest vegetation in Zones 2 and 3 (PCT1302 White Booyong – Fig subtropical rainforest) is located on the Tweed River floodplain and is dominated by an over storey of figs (e.g. *Ficus macrophylla, F. obliqua, F. coronata and F. fraseri*) with palms commonly occurring (e.g. *Archontophoenix cunninghamiana*). This vegetation conforms to the NSW Scientific Committee Final Determination for TEC Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion. However, TEC Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions is a better fit for the early regrowth rainforest vegetation in Zones 4 and 8 (PCT1302 White Booyong – Fig subtropical rainforest) given its landscape position on a ridge.

Vegetation in Zone 7 (PCT1235 Swamp Oak swamp forest) is a planted *Casuarina glauca* windrow located on a ridge, growing in red-brown silty clay soil derived from basalt. The NSW Scientific Committee Final Determination for TEC Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions indicates that this TEC is associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Consequently, PCT1235 Swamp Oak swamp forest does not conform to any NSW Scientific Committee Final Determination for an Endangered Ecological Community.

The estimated percent cleared value of the likely PCTs was recorded using data contained in the BioNet Vegetation Classification in accordance with *Section 5.2.1.16* of the BAM (**Table 2**).

2.3.6 Confirmation of Native Vegetation Extent and Patch Size

This section is designed to address the requirements set out in *Section 4.3.1* of the BAM, assessment requirements, to determine the site context of the subject land the native vegetation cover and patch size was assessed in accordance with *Sections 4.3.2 and 5.3.2* of the BAM. Percentage vegetation cover and patch size were then used to assess habitat suitability for threatened species on the Site as outlined in **Section 2.4**.

This section addresses the requirements set out in *Section 4.3.2* of the BAM, assessing native vegetation cover and *Section 5.3.2* of the BAM, assessing the patch size for a vegetation zone. Native vegetation communities within the Tweed LGA was mapped in a study commissioned by Tweed Shire Council and updated in 2012 (TSC 2012). In addition to the PCTs that were recorded on the Site (**Figure 12**), the above mapping layers were used to determine the native vegetation extent within the 1,500 m assessment area.

Vegetation woody native vegetation patches separated by ≤100 m and non-woody native vegetation patches separated by ≤30 m were considered to be part of the same patch of native vegetation.

Although several of these vegetation communities mapped in TSC 2012 were considered to be highly degraded or in early regenerative condition, these were included in the patch calculations due to the likelihood of threatened species presence which was ascertained from analysis of threatened species records detailed in *Tweed Valley Hospital Due Diligence Ecological Constraints Report (version 3)* Greencap (2018).

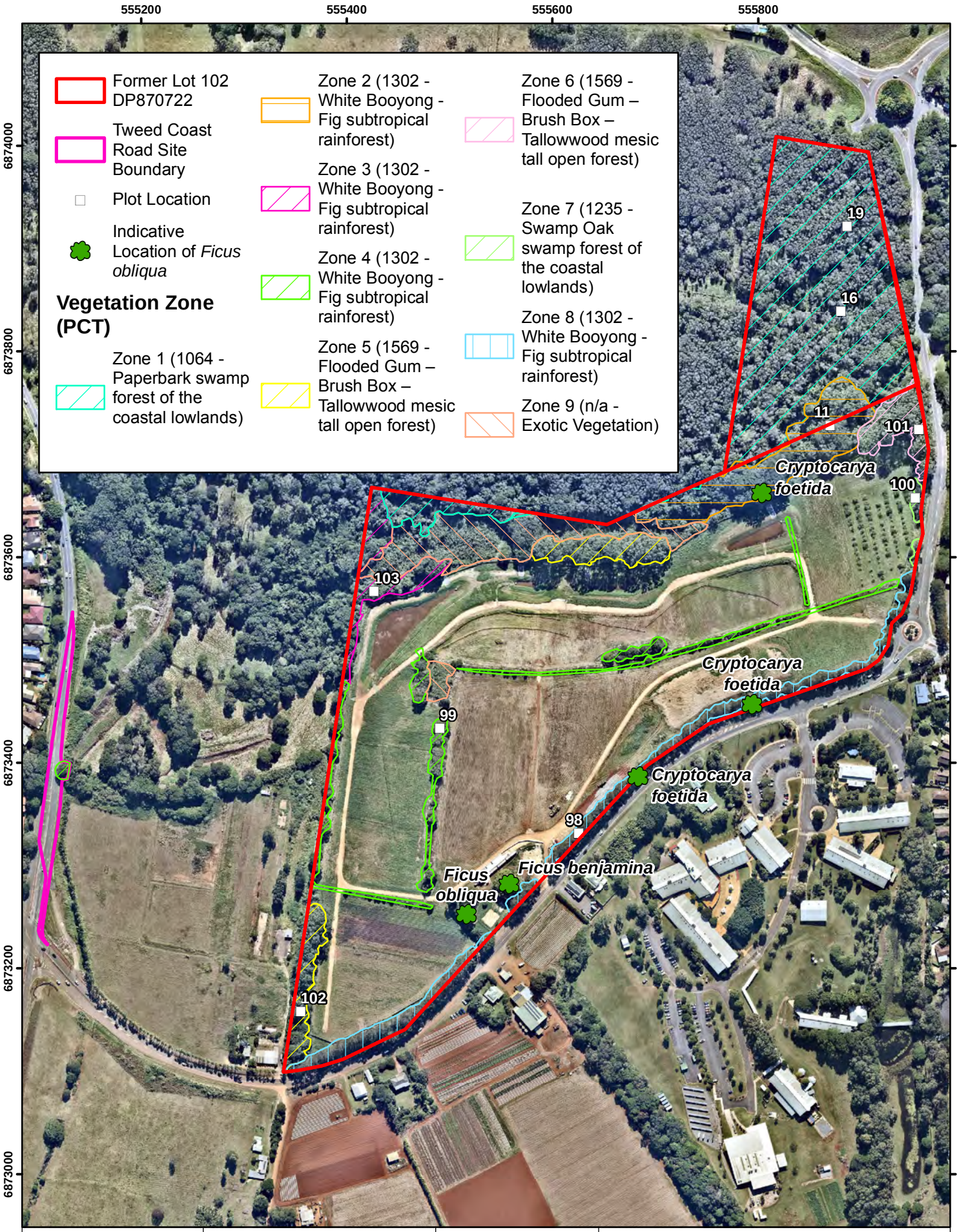
A single continuous patch of native vegetation that extends beyond the Site boundary and within and beyond the 1500 m assessment area was calculated to be 167.95ha, with a total native vegetation cover of 16. 71% in the 1,500 m assessment area (**Figure 17**).

2.3.7 Changes to the Mapped Native Vegetation Extent

This section addresses changes to native vegetation extent in accordance with *Section 5.1.1.6 and 5.1.1.7* of the BAM. Native vegetation on the Site was mapped by Greencap using aerial imagery from 2018 as the base map and matches the outline of vegetation on the base map using the method detailed in **Section 2.3.3**.

Native vegetation outside the Site but within the 1,500 m assessment area was mapped using the Tweed Shire Council mapping (TSC 2012) with reference to 2018 aerial imagery (**Figure 17**). Based on the aerial imagery, additional areas not noted as native vegetation were included as listed below, and where a determination could not be made as to whether vegetation was native or non-native, it was included. Regrowth and rehabilitation areas were also included:

- A patch of vegetation in the far south of the 1,500 m buffer not mapped in TSC 2012 was digitised and included as native vegetation;
- Additional areas of vegetation near the coastline in the eastern and north eastern part of the buffer zone were mapped as highly disturbed/early regeneration were also included;
- Several small elongated patches of vegetation to the southeast of the Site, and several patches in the eastern section of the buffer that were noted as ‘not assessed’ in TSC 2012 were included;
- Several small patches of vegetation to the west of the Site on the edges of the residential area; and
- Several patches of vegetation near the northwest edge of the 1,500 m buffer area.



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Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 14**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
GREENCAP			

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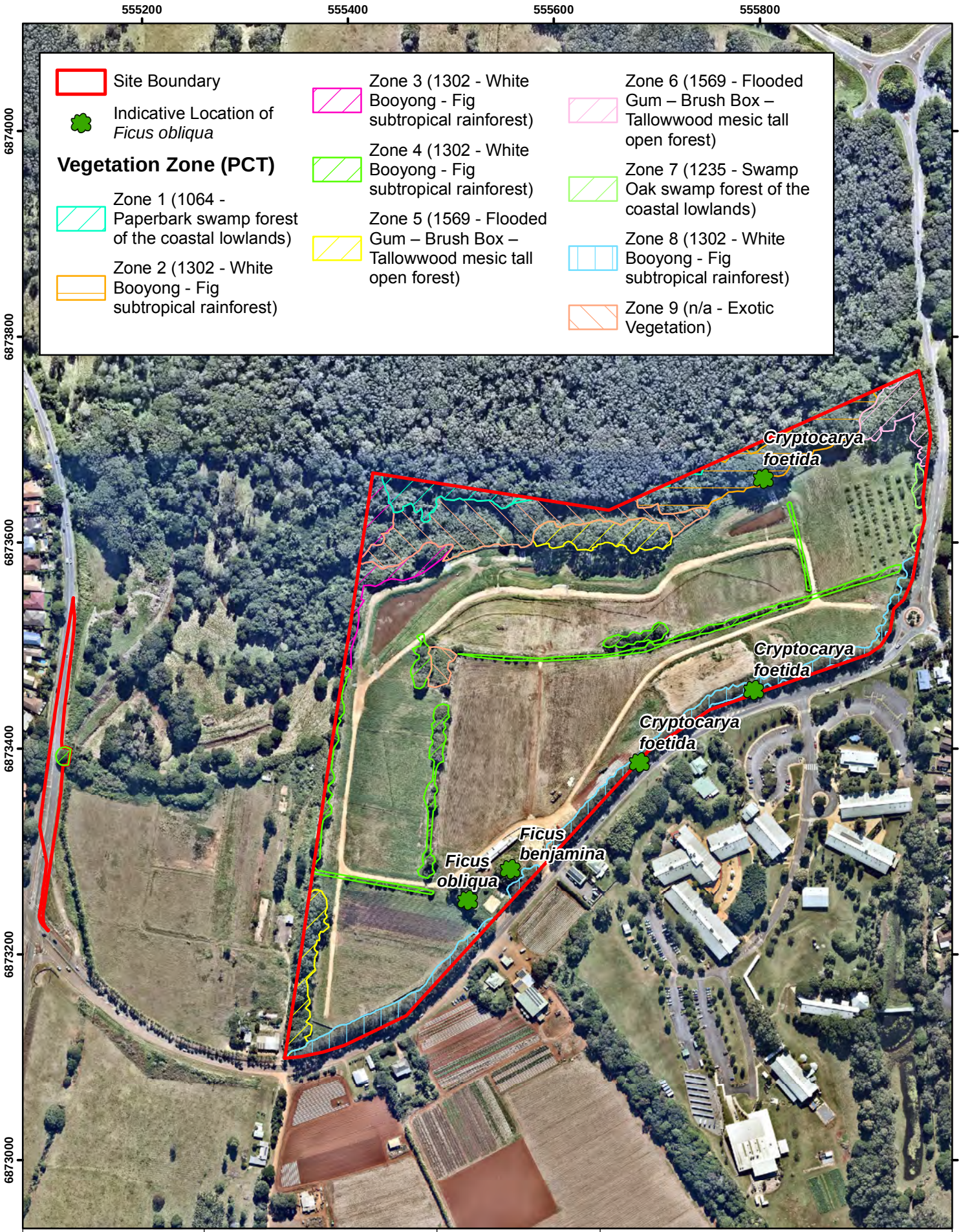

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Vegetation Zones (ref s5.2.1.12c of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 15**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
GREENCAP			

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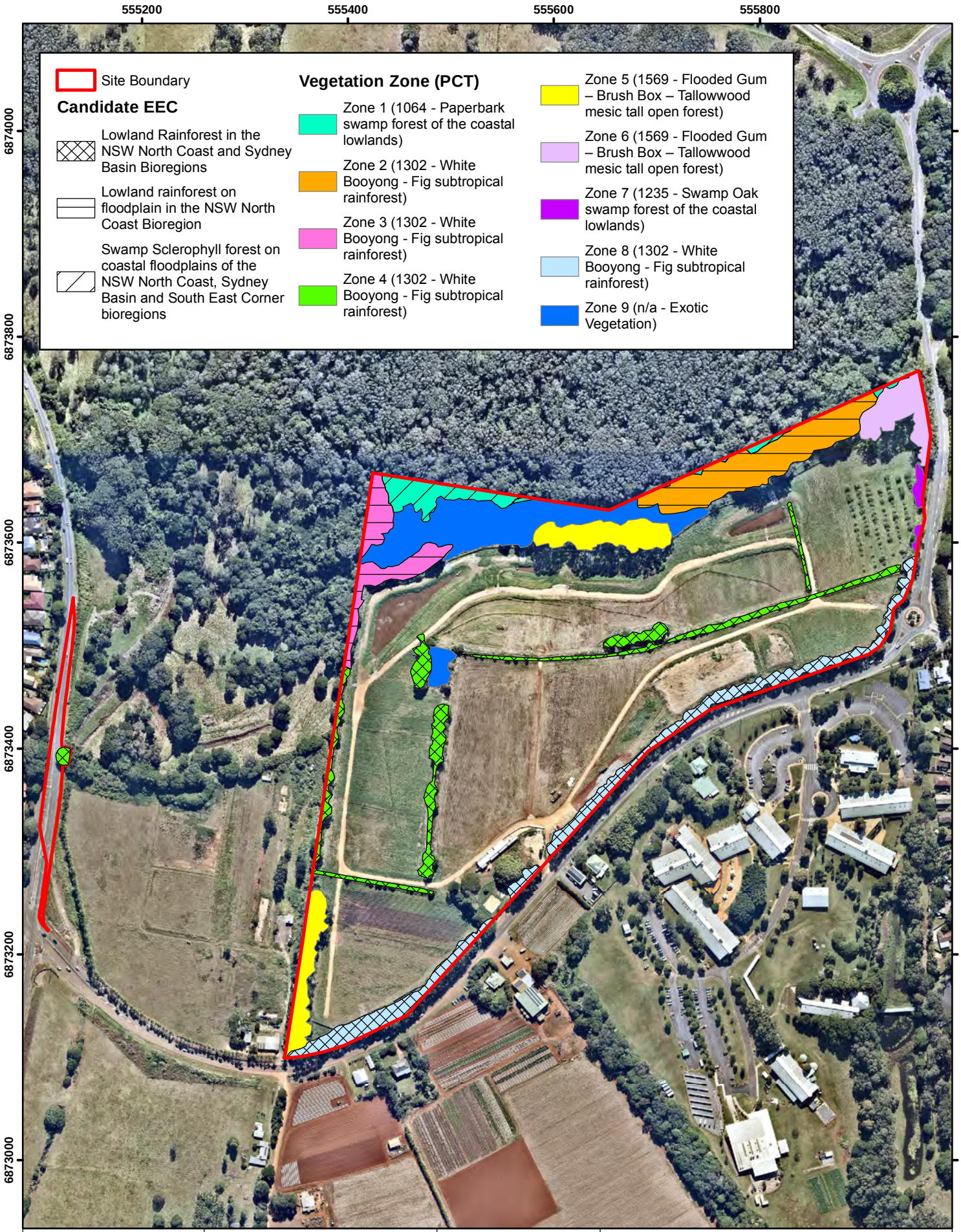

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Threatened Ecological Communities**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 16**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
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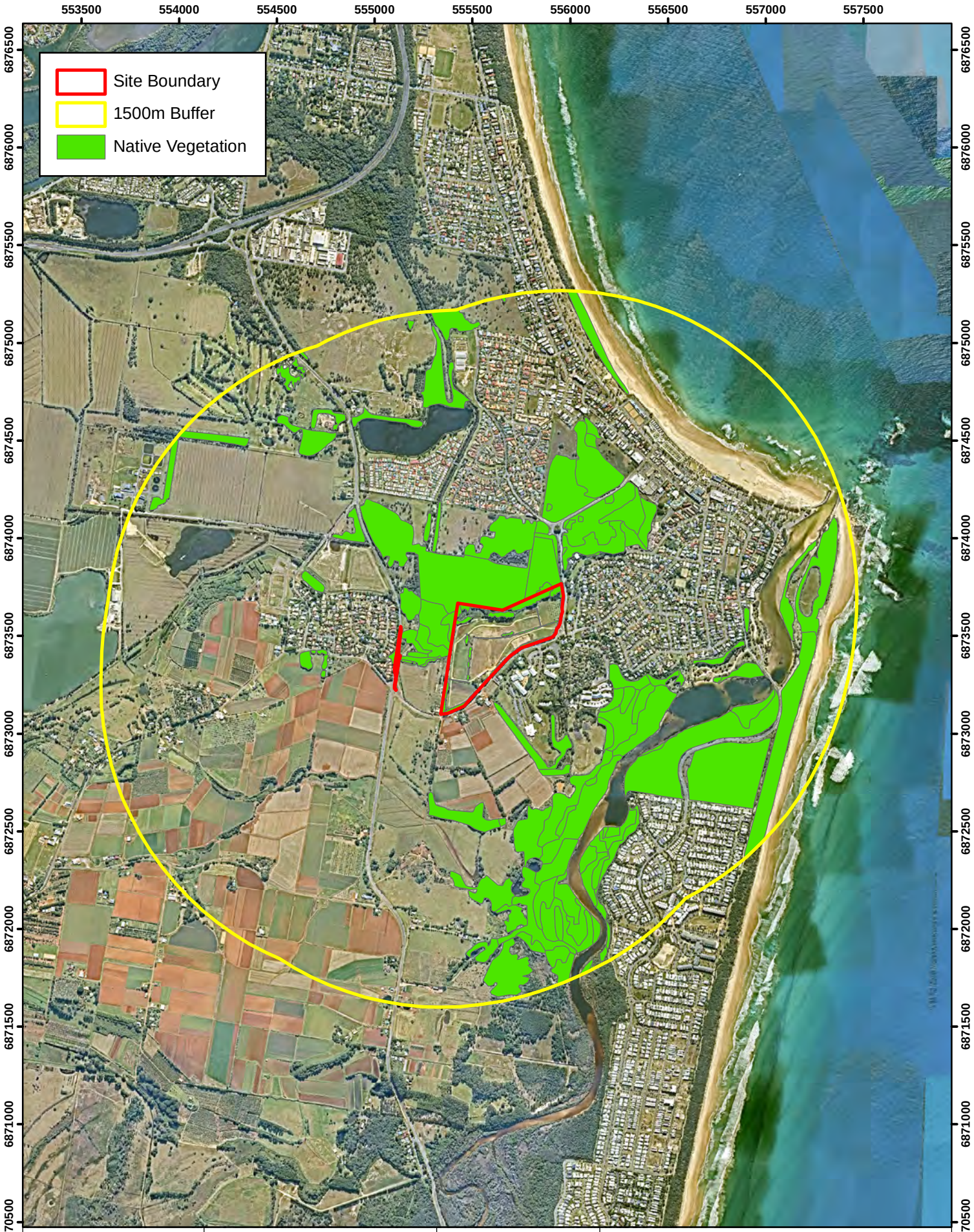

Client: C107778	N 0 350 700 m	Scale (@A4): 1:25,000	**Native Vegetation Extent Within the 1500m Buffer**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 17**
Date: 8/08/2019	*Vegetation mapping (site): Greencap (2018). Vegetation mapping (buffer area): Tweed LGA Vegetation 2012. VIS_ID 3912 (Tweed Shire Council 2012) © OEH 2013*		
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2.4 BAM Calculator Results and Habitat Suitability for Threatened Species

2.4.1 Calculation of Current Vegetation Integrity

This section addresses the requirements set out in *Section 5.4* of the BAM, determining the vegetation integrity score. For Zones 1-8, the plot-based vegetation survey data (vegetation composition, structure and function) were entered into the BAM Calculator to determine the current Vegetation Integrity (VI) for each vegetation zone. Vegetation integrity scores including composition condition, structure condition and function condition for each vegetation zone on the Site are presented in **Table 4**.

The current VI for Zones 1-3 exceeds the assessment threshold for EECs (i.e. VI ≥ 15). The current VI for Zone 4 falls below the assessment threshold for PCTs that are representative of an endangered TEC (i.e. VI ≥ 15) and does not require further assessment. The current VI for Zones 5, 6 and 7 exceeds the assessment threshold for PCTs that are associated with threatened species habitat and those PCTs that are not representative of a TEC or associated with threatened species habitat (i.e. VI ≥ 17 and VI ≥ 20 respectively). The current VI for Zone 8 exceeds the assessment threshold for PCTs that are representative of an endangered TEC (i.e. VI ≥ 15; **Table 4**).

Table 4 Vegetation Integrity Scores for each Vegetation Zone on the Site

PCT	PCT Common Name	Zone	Condition class	Area (ha)	Threatened Ecological Community	Composition condition score	Structure condition score	Function condition score	VI score	VI threshold
1064	Paperbark swamp forest	1	Moderate	0.29	Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC	50.8	43.9	64.7	52.5	≥ 15
1302	White Booyong – Fig subtropical rainforest	2	Moderate	0.73	Lowland rainforest on floodplain in the NSW North Coast Bioregion EEC	20.9	68.8	94.5	51.4	≥ 15
		3	Low	0.36	Lowland rainforest on floodplain in the NSW North Coast Bioregion EEC	18.8	4.6	64.0	17.7	≥ 15
		4	Self-sown windrow	0.64	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	0.5	40.6	59.9	10.6	≥ 15
1569	Flooded Gum – Brush Box – Tallowwood mesic tall open forest	5	Planted windrow	0.57	This PCT is not a TEC	9.1	55.8	100.0	37.1	≥ 17
		6	Planted windrow	0.29	This PCT is not a TEC	38.0	53.4	48.9	46.3	≥ 17
1235	Swamp Oak swamp forest	7	Planted windrow	0.05	This PCT is not a TEC. Did not conform to Final Determination.	16.9	21.4	63.9	28.5	≥ 20
1302	White Booyong – Fig subtropical rainforest	8	Self-sown windrow	0.72	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	11.7	9.3	43.8	16.8	≥ 15

2.4.2 Predicted and Candidate Threatened Species

Following calculation of current VI the calculations then focussed on the vegetation zones directly impacted by the Project. The BAM Calculator yielded 11 Predicted (ecosystem credit species) and 66 candidate (species credit species) threatened species impacted by the Project, Zones 4 and 8. These species are summarised in

Table 5. Predicted ecosystem credit species predicted to occur at the Site are presented in **Appendix E** and candidate species credit species are presented in **Appendix F**.

2.4.3 Assessment of Habitat Suitability for Threatened Species

This section addresses the requirements set out in *Sections 6.4.1.10 and 6.4.1.17* of the BAM, steps for identifying habitat suitability for threatened species. Assessment of habitat constraints for predicted ecosystem credit species and candidate species credit species likely to occur at the Site was undertaken to confirm presence of these species based on the occurrence of necessary habitat components or habitat constraints. For this assessment no, predicted ecosystem credit species were excluded on the basis of habitat constraints.

However, in accordance with *Section 6.4.1.17(a)* of the BAM, three candidate species credit species were excluded on the basis that none of the habitat constraints applied: giant spear lily *Doryanthes palmeri*, *Harnieria hygrophiloides* and giant barred frog *Mixophyes iteratus* (**Table 6**).

Also accordance with *Section 6.4.1.17(a)* of the BAM and relevant guidelines (OEH 2018c), three candidate species credit species were excluded on the basis that breeding habitat was not recorded on the Site (i.e. little bentwing-bat *Miniopterus australis,* eastern bentwing-bat *Miniopterus schreibersii oceanensis* and grey-headed flying-fox *Pteropus poliocephalus*; **Table 7**).

On 2 May 2019, after submission of the Stage 1 SSD BDAR, Greencap was notified of a previously unobserved constructed tunnel-like structure located at Rock Wall 4. It was uncovered during clearing of exotic vegetation for the purpose of documenting cultural heritage values of rock walls located on the site of the new Tweed Valley Hospital. On 3 May Dr Licari and Christina Maloney inspected the structure to determine the likelihood of the structure being suitable roosting and/or breeding habitat for the two cave-dwelling microbat species, the little bentwing-bat *Miniopterus australis* and the eastern bentwing-bat *Miniopterus schreibersii oceanensis*. Based on a visual inspection using a spotlight and photographs, Dr Licari determined that it was unlikely that the tunnel was used as roosting and/or breeding habitat by microbats on the basis that:

a) visual inspection found no evidence of current presence (i.e. roosting animals) nor evidence of past presence of microbats (i.e. scats/guano/staining); and

b) prior to the recent cultural heritage documentation, the tunnel was overgrown in dense exotic vegetation (primarily sicklethorn *Asparagus falcatus*) which blocked microbat flyway access the tunnel.

In addition to this, following this inspection a bat specialist (David Milledge, Landmark Ecological Services) was engaged for an expert opinion. Mr Milledge inspected the structure on Wednesday 29 May and prepared a report that concurred with the assessment of the structure (**Appendix G**). On this basis, the original habitat suitability assessment for the two cave-dwelling microbat species remained unchanged, as there was no potential breeding habitat including caves, tunnels, mines or other features such as bridges and tree hollows known or suspected to be used by the species for breeding (OEH 2018c).

Dr Licari provided this assessment to HI on 11th June 2019. A copy of the report is presented in (**Appendix G**).

Three candidate species credit species were excluded on the basis that the field assessment of microhabitats on the Site considered substantially degraded such that the species are unlikely to utilise the Site (i.e. green-thighed frog *Litoria brevipalmata*, southern myotis *macropus* and southern pink underwing moth *Phyllodes imperialis southern subspecies*, **Table 7**).

Table 5 Summary of Predicted and Candidate Threatened Species

Taxa	Predicted threatened species (Ecosystem Credits)	Candidate threatened species (Species Credits)
	Zones 4 and 8	
Plants	0	59
Marsupials	2	2
Bats	6	0
Birds	3	2
Amphibians	0	0
Reptiles	0	2
Gastropods	0	1
Insects	0	0

Table 6 Species Credit Species with Habitat Constraints

Threatened species	Common name	Type	PCT	Zone(s)	Habitat constraint	Justification for exclusion
Doryanthes palmeri	Giant spear lily	Candidate	1302	4, 8	• Cliffs • Cliff tops, steep cliff faces or rocky outcrops	There are no cliffs, cliff tops, steep cliff faces or rocky outcrops on the Site.
Harnieria hygrophiloides	N/A	Candidate	1302	4, 8	• Within 5 km of Brunswick Heads township	The Site is >5 km distance from Brunswick Heads.
Mixophyes iteratus	Giant barred frog	Candidate	1302	4, 8	• Other • Land within 50m of semi-permanent and permanent drainages	Zones 4 and 8 are not located on land within 50m of semi-permanent and permanent drainages. The habitat constraint 'other' is not defined and has therefore been excluded.

Table 7 Species Credit Species with substantially degraded microhabitats

Threatened species	Common name	Type	PCT	Zone(s)	Habitat requirement	Justification for exclusion
Litoria brevipalmata	Green-thighed frog	Candidate	1302	4, 8	Potential habitat is typically in areas where surface water pools following rainfall and ranges from rainforest and moist eucalypt forest to dry eucalypt forest and heath where the frogs are considered to forage in leaf litter. Breeding occurs from spring to autumn, eggs are laid in loose clumps around water plants in flooded areas and pooling water bodies following heavy rainfall (OEH 2019).	Field assessment of Zones 4 and 8 (which are located on a ridge) following rain did not locate any areas which could form temporary or semi-permanent ponds or flooded ditches that would provide breeding habitat (DECC 2009). The nearest suitable habitat where water could form temporary or semi-permanent ponds or flooded ditches is in the coastal wetland area that is located at least 100m from Zone 4 and at least 50m from Zone 8. Consequently, there is no suitable microhabitat located within Zones 4 and 8 and the species is unlikely to utilise these Zones.
Miniopterus australis	Little bentwing-bat	Candidate (Breeding)	1302	4, 8	Potential breeding habitat includes caves, tunnels, mines or other features such as bridges and tree hollows known or suspected to be used by the species for breeding (OEH 2018c).	Field assessment did not locate any caves, tunnels, mines or other structures known or suspected to be used by the species for breeding are located on the Site. Refer to discussion in **Section 2.4.3** and **Appendix G.**
Miniopterus schreibersii oceanensis	Eastern bentwing-bat	Candidate (Breeding)	1302	4, 8		
Myotis macropus	Southern myotis	Candidate	1302	4, 8	Potential habitat is typically within 200m of a waterbodies , such as rivers, creeks, billabongs, lagoons and dams that are greater than 3m wide (OEH 2018c).	Field assessment of the dam and floodplain drains that are located on the site recorded that these potential microhabitat features are covered in salvinia *Salvinia molesta* (**Photo 2**). The presence of salvinia *Salvinia molesta* has substantially degraded this microhabitat such that the species is unlikely to utilise Zones 4 and 8.

Threatened species	Common name	Type	PCT	Zone(s)	Habitat requirement	Justification for exclusion
Phyllodes imperialis southern subspecies	Southern pink underwing moth	Candidate	1302	4, 8	Potential breeding habitat is restricted to subtropical rainforest with low light conditions below about 600 m elevation where the caterpillar's host plant *Carronia multisepalea* (a native rainforest vine) is found to occur (OEH 2018d).	In the targeted flora survey for Zones 4 and 8 *Carronia multisepalea* was not detected. Furthermore, field assessment of Zones 4 and 8 suggested that these linear windrows are subject to high levels of light and are therefore not suitable microhabitats for breeding in Zones 4 and 8.
Pteropus poliocephalus	Grey-headed flying-fox	Candidate (Breeding)	1302	4, 8	Recorded camps and roosting habitat likely to occur on the land (OEH 2018c).	Field assessment of microhabitats recorded no flying fox camps or roosts on the Site.

Photo 2 Salvinia *molesta* infestation on the farm dam at the north of the Site

2.4.4 Habitat Survey for Candidate Threatened Species

This section addresses the requirements set out in *Section 6.5* of the BAM, undertaking a threatened species survey. Following the habitat constraints assessment an assessment of species presence for candidate threatened species was conducted.

In accordance with *Section 6.4.1.21* of the BAM, species presence was determined by:

- Assumed present – species credit species which were outside of the survey timing requirements in accordance with the BAM;
- Present – species credit species for which a survey was conducted and were not recorded; and
- Not present – species credit species for which a survey was conducted and were not recorded.

For this BAM assessment no expert reports were employed in the place of assumed presence or targeted surveys to confirm likelihood of presence of threatened species.

2.4.5 Targeted Threatened Fauna Surveys

Targeted fauna surveys for candidate threatened species in Zones 4 and 8 were conducted on 15-18 December 2018 in accordance with **Table 8**. Note that the survey for the grey-headed flying fox *Pteropus poliocephalus* was not required (**Section 2.4.3**, OEH 2018c). A nocturnal spotlight survey for koala *Phascolarctos cinereus* (not a candidate species for Zones 4 and 8) was also conducted incidental to the nocturnal spotlight survey for the eastern pygmy-possum *Cercartetus nanus* and pale-headed snake *Hoplocephalus bitorquatus*.

A targeted koala *Phascolarctos cinereus* scat survey was undertaken in a small 0.2 ha area of preferred koala habitat located in Zone 6 that is located outside of the impact area. This vegetation meets the definition of 'Secondary (Class A) Habitat' as defined in the Tweed Coast Comprehensive Koala Plan of Management (CKPoM) and 'Potential Koala Habitat' as defined in State Environmental Planning Policy 44 – Koala habitat protection 44 (**Table 8**).

The scat survey was conducted in general accordance with the SAT method (Allen & Phillips 2008) on 13 July 2018 by Dr Licari. Scat searches were undertaken in a 1 m buffer area around the base of 30 trees for two person minutes per tree and no koala *Phascolarctos cinereus* scats were recorded. Whilst undertaking the survey, it was also observed that weedy vegetation and growth of vines would be challenging for koala *Phascolarctos cinereus* to utilise the trees. The locations of the 30 trees that were searched during the scat survey are presented in **Figure 18**.

There was an opportunistic recording of Mitchell's rainforest snail *Thersites mitchellae* on 19 November 2018 by Dr Licari and David Milledge. One live individual was recorded at the ecotone between Zones 1 and 2, and one dead shell was recorded in Zone 2 (**Table 8**; **Figure 19**). Note, these two specimens were recorded outside the Project Site boundary in the northern portion of former Lot 102 DP 870722.

A targeted nocturnal spotlight survey for Mitchell's rainforest snail *Thersites mitchellae* (MRS) was conducted on 17-18 December 2018 by Dr Licari and Kyle Spiteri in Zones 4 and 8. Additional targeted diurnal and nocturnal surveys for the snail concentrating on Zones 4 and 8 were then undertaken on 19-20 December 2018 by Dr Stephanie Clark (invertebrate identification specialist), Dr David Robertson and Craig Faulkner. The targeted surveys conducted by Dr Clark included active diurnal habitat searches of logs, rocks, debris and leaf litter on the ground and a nocturnal spotlight survey for active snails. The target species was detected in the northern extremity of Zone 1 outside the Project Site boundary, within paperbark forest. One living individual and three dead shells were found (**Figure 19**, **Table 8**; **Appendix G**). The TCR section was not surveyed for the presence of the snail as the small area of habitat was substantially degraded by the presence of exotic grasses and exposed soil such that there was no accumulation of leaf litter.

Targeted fauna surveys (i.e. diurnal area search for Coxen's fig parrot *Cyclopsitta diophthalma,* and nocturnal spotlight survey for eastern pygmy–possum *Cercartetus nanus*, koala *Phascolarctos cinereus*, grey-headed flying fox *Pteropus poliocephalus*, pale-headed snake *Hoplocephalus bitorquatus* and MRS) were undertaken by assessing all of Zones 4 and 8. The targeted search of fruiting figs for Coxen's fig parrot *Cyclopsitta diophthalma* was conducted from a point located between the two fig trees indicated in **Figure G-2**. Targeted fauna survey tracks are mapped in **Figure G-2** in **Appendix G**. Note that only the GPS data for the Greencap observer has been provided. An equipment malfunction on the 17th December 2018 meant that the full survey extent was not captured, notably the survey in Zone 8.

An additional pre-construction baseline survey for MRS was undertaken by Dr Stephanie Clark (invertebrate identification specialist) on 21 and 22 May 2019. Three living MRS were found on the ground, under logs and crawling at night and three empty shells were also found, all of which were outside the Project Site boundary (Clark 2019c). Some of the empty shells showed signs of predation by birds (such as brush turkey *Alectura lathami*) and by mammals (such as black rat *Rattus rattus*) both of which were observed on the Site (Clark 2019c).

Figure 19 presents the threatened species polygons for fauna along with the locations of the Mitchell's rainforest snail *Thersites mitchellae* (excluding those found in the May 2019 MRS baseline survey). Given that Zone 3 is also located on the floodplain; and is regenerating rainforest that is potential habitat for the snail, this is also considered to be a threatened species polygon. This is consistent with the report provided by Dr Clark (**Appendix G**). Accordingly, Mitchell's rainforest snail *Thersites mitchellae* has been assigned a threatened species polygon that encompasses Zones 1, 2 and 3. The Three-toed Snake-Tooth Skink *Coeranoscincus reticulatus* and Powerful Owl *Ninox strenua* are also assigned Zones 4 and 8 as threatened species polygons on the basis of assumed presence (**Figure 19**).

2.4.6 Targeted Threatened Flora Surveys

This section addresses the requirements set out in *Section 6.5* of the BAM, undertaking a threatened species survey. Targeted flora species surveys in Zones 1 to 8 were undertaken on 16 August 2018 by Dr Damian Licari and Annette McKinley and on 3 September 2018 by Annette McKinley and Christina Maloney, under the direction of Dr Licari, with a survey effort of 32 hours. Targeted flora surveys were undertaken by assessing all areas of native vegetation on the Site. Targeted flora survey tracks are mapped in **Figure G-1** in **Appendix G**. Note that only the GPS data for the Greencap observer has been provided. An equipment malfunction on the 16th August 2018 meant that the full survey extent was not captured, notably the survey in the Zones 4 and 8.

In Zones 1 to 3, due to the thick swamp and rainforest vegetation with logs on the ground, it was difficult to walk parallel traverses in accordance with published guidelines (OEH 2016). However, with a survey effort with two observers used in tandem on two separate days with a total of 32 surveys hours, and given that Zones 1-3 will not be directly impacted by the Project, this was considered to be sufficient and in broad accordance with the guidelines. The length of each windrow in Zones 4 to 8 was inspected from an edge and in cases where a portion of a windrow was too wide for effective inspection from an edge, these areas were inspected from within the windrow.

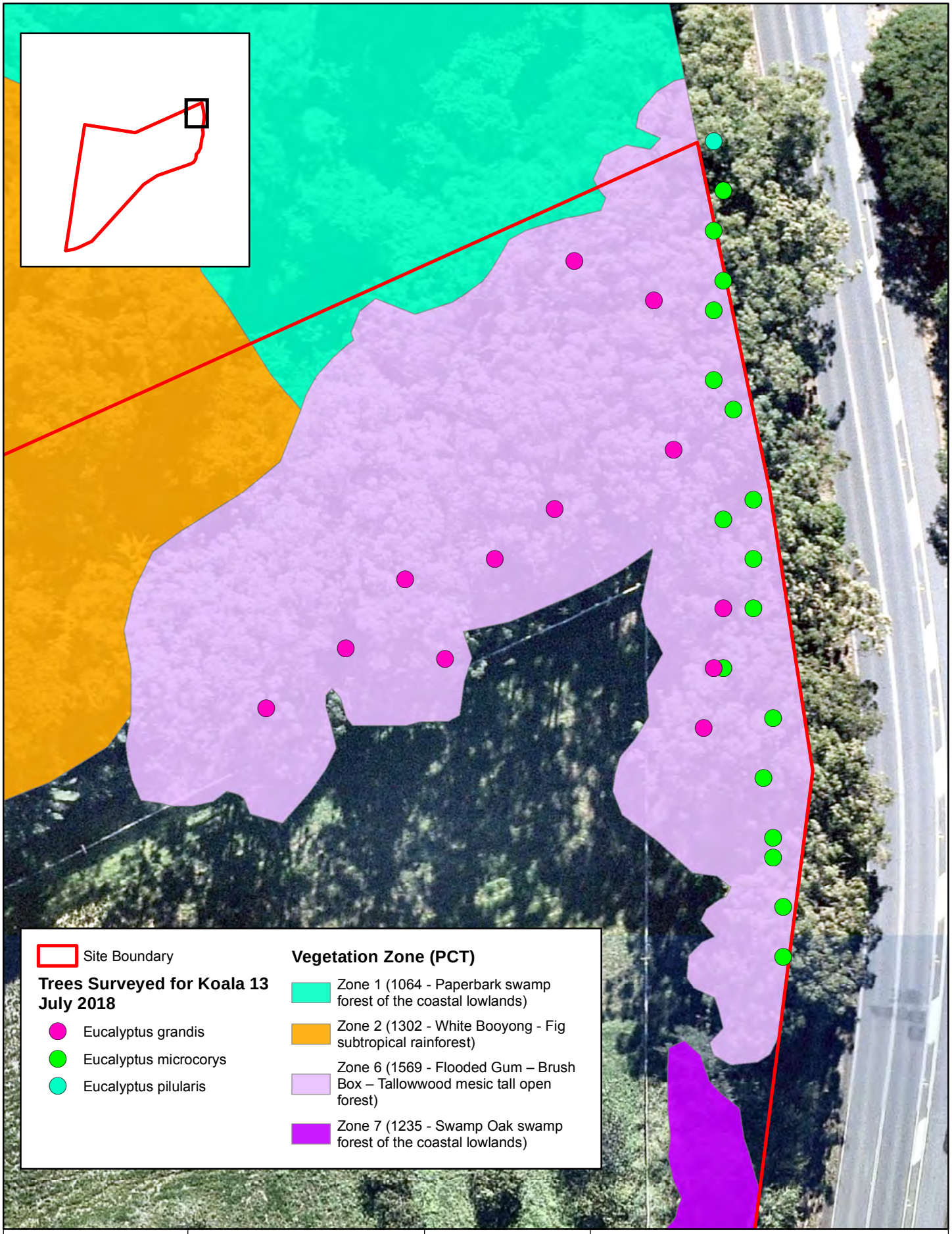
Targeted flora surveys for hairy jointgrass *Arthraxon hispidus*, slender marsdenia *Marsdenia longiloba* and *Carronia multisepalea* (host plant for the southern pink underwing moth *Phyllodes imperialis southern subspecies*) were undertaken on 17 December 2018 by Dr Barbara Stewart in Zones 4 and 8 under the direction of Dr Licari, with a survey effort of four hours.

A number of *Macadamia integrifolia x tetraphylla* plants were recorded in Zones 3 and 4, the identity of which has been confirmed by the National Herbarium of NSW (**Appendix H**). *Carronia multisepalea* was not recorded in Zones 4 and 8. With the exception of an observation of three three-veined laurel *Cryptocarya foetida* plants there were no threatened flora species recorded during the targeted surveys (**Figure 20)**.

Table 8 Summary of survey method, effort and results for fauna Species Credit Species

Candidate Threatened Species	Method	Survey Effort	Survey conducted	Result
Marsupials				
Eastern pygmy –possum *Cercartetus nanus*	Nocturnal spotlight survey on foot	2.25 hours – Minimum 1 hour search by 2 observers on 2 separate nights along each windrow in Zones 4 and 8	15, 17 Dec 2018	Not detected
Common planigale *Planigale maculata*	Small Elliot traps	100 trap nights over 4 consecutive nights	15-18 Dec 2018	Not detected
Koala *Phascolarctos cinereus*	Spot Assessment Technique	Scat searches in a 1m buffer area around the base of 30 trees for two person minutes per tree within Zone 6	13 July 2018	Not detected
	Nocturnal spotlight survey on foot	2.25 hours – Minimum 1 hour search by 2 observers on 2 separate nights along each windrow in Zones 4 and 8	15, 17 Dec 2018	Not detected
Megachiropteran bats				
Grey-headed flying fox *Pteropus poliocephalus*	Nocturnal spotlight survey on foot	2.25 hours – Minimum 1 hour search by 2 observers on 2 separate nights along each windrow in Zones 4 and 8	15, 17 Dec 2018	Not detected
Diurnal birds				
Coxen's fig parrot *Cyclopsitta diophthalma coxeni*	Targeted search of potential nesting trees and fruiting figs (DEWHA 2010)	16 hours – Survey 2 hours in morning and 2 hours late afternoon by 1 observer over 4 separate days	15-18 Dec 2018	Not detected
	Area search	3.25 hours – Survey minimum 30 minutes in morning and 30 minutes late afternoon by 1 observer over 4 separate days		
Reptiles				
Pale-headed snake *Hoplocephalus bitorquatus*	Nocturnal spotlight survey on foot	2.25 hours – Minimum 1 hour search by 2 observers on 2 separate nights along each windrow in Zones 4 and 8	15, 17 Dec 2018	Not detected
Gastropods				
Mitchell's rainforest snail *Thersites mitchellae*	Opportunistic	Opportunistic recording of one live specimen in Zone 2 and one dead shell in Zone 3	19 Nov 2018	Detected outside

Candidate Threatened Species	Method	Survey Effort	Survey conducted	Result
				Project Site boundary
	Nocturnal spotlight survey on foot	5 hours – Minimum 1 hour search by 2 observers on 2 separate nights along each windrow in Zones 4 and 8	17, 18 Dec 2018	Not detected
	Diurnal habitat searches on foot Nocturnal spotlight survey on foot	26 hours – 19 Dec 2018 2 observers for 10 hours, 20 Dec 2018 3 observers for 16 hours in Zones 2, 3, 4, 5 and 8 and briefly in Zone 1	19, 20 Dec 2018	Detected outside Project Site boundary



Client: C107778	N 0 5 10 m	Scale (@A4): 1:500	**Koala Survey Map**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 18**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
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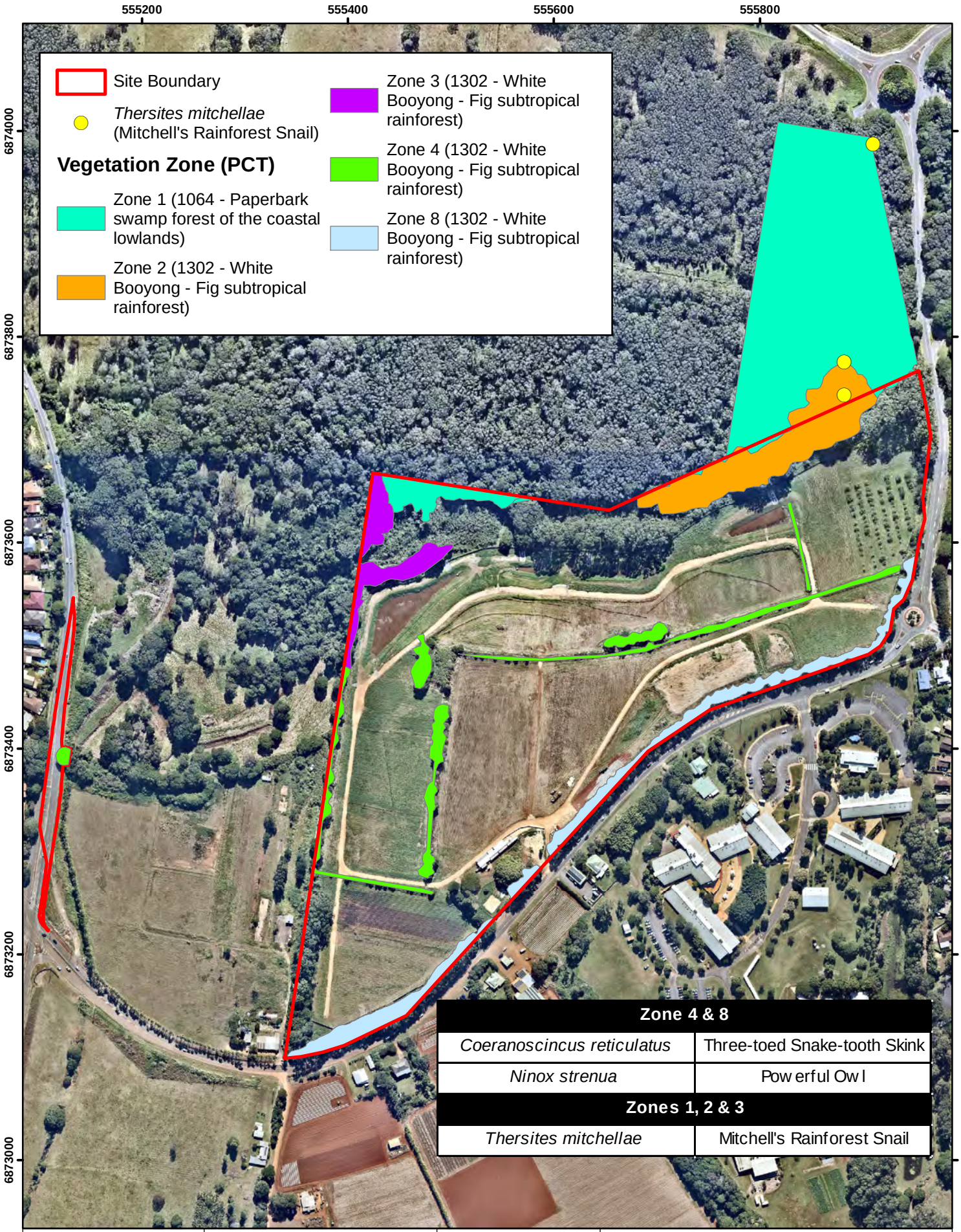

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Species Polygons for Candidate Threatened Species (Fauna) (ref: s6.4.1.26 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 19**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
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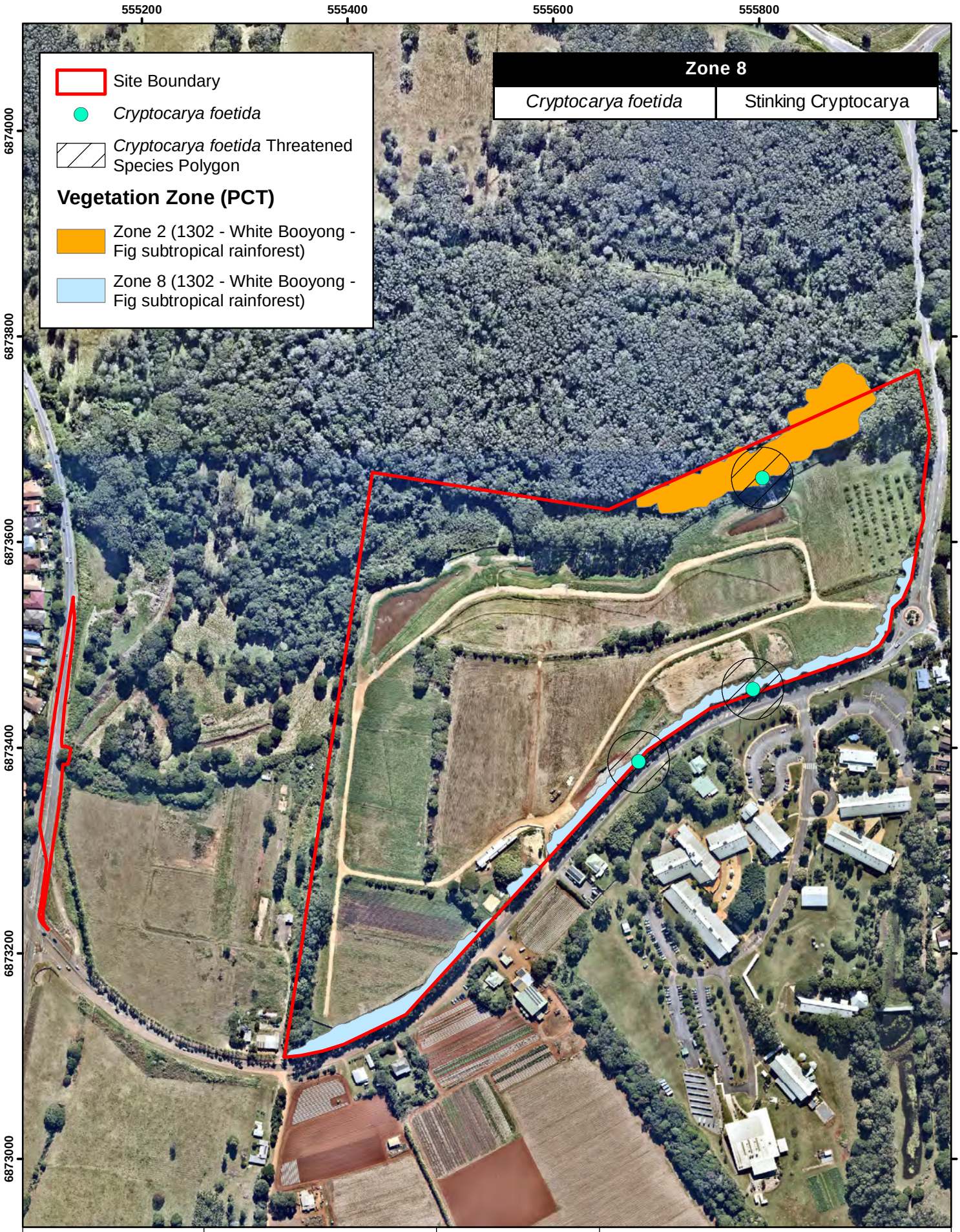

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Species Polygons for Candidate Threatened Species (Flora) (ref: s6.4.1.26 & s6.4.1.29 of BAM)**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 20**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
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2.4.7 Flying Fox-Camps

Initial desktop assessment determined that there were two flying-fox camps located within a 1 km radius of the Site (Greencap, 2018), however, there are no flying-fox camps located on the Site (**Table 7**).

The first camp is located east of the Kingscliff Library adjacent to the Cudgen Road/Herford Street intersection. Up to 100 black flying-fox *Pteropus alecto* have been recorded during quarterly monitoring events, however visibility at this camp is limited and the actual number is likely to be higher (Ecosure 2018). Furthermore, recent reports suggest that black flying-fox *Pteropus alecto* numbers at this camp may have increased to 2,000-3,000 animals in May-June 2018. However the most recent census on 16 August 2018 did not record any animals at the Kingscliff Library camp (Scott Hetherington, Tweed Shire Council, pers. com., 3 September 2018).

The second camp is located to the west of Elrond Drive, Chinderah. The camp is generally occupied by small numbers of black flying-fox *Pteropus alecto,* peaking at around 440 individuals (May 2015). Around 150 threatened grey-headed flying-fox *Pteropus poliocephalus* (listed as vulnerable under both the BC Act and the EPBC Act) were recorded during surveys in November 2017 (Ecosure 2018).

2.4.8 Coastal Raptor Nests

Coastal raptors such as the eastern osprey *Pandion cristatus* and white-bellied sea eagle *Haliaeetus leucogaster* have been recorded in the Tweed LGA. No coastal raptor nests were recorded on the Site, however, two known osprey nests have been recorded within the 1,500m assessment area (TSC, 2018).

2.4.9 Other Threatened Species

Several species that were not identified by the BAM calculator as predicted or candidate species but have been recorded within the 1,500m assessment area (Ecosure 2018) and in other areas proximal to the Site (TSC, 2018) include pale-vented bush-hen *Amaurornis moluccana,* bush stone-curlew *Burhinus grallarius*; common blossom-bat *Syconycteris australis*; and yellow-bellied sheathtail-bat *Saccolaimus flaviventris*. In order to determine presence of these species on the Site a fauna ecologist, David Milledge, was consulted and advised that it was not the ideal time to survey for these species during August and September when targeted surveys were being undertaken. Although these species are not credit species they are locally significant threatened species and therefore any potential indirect impacts which may affect these species will be addressed accordingly in Stage 2 of this BDAR.

3 STAGE 2 – IMPACT ASSESSMENT (BIODIVERSITY VALUES)

This section of the BDAR has been prepared to address the requirements of Stage 2 of the BAM. For alignment with the broader EIS for the Project, it is noted that the impacts discussed in this section relate to the previously approved Concept Proposal (Stage 1) and Stage 1 Early and Enabling Works (SSD 18_9575), as well as the Stage 2 works. Mitigation measures proposed in this BDAR are documented in the two Biodiversity Management Plans (BMPs) that have been respectively prepared for both Stage 1 and Stage 2 applications.

The following plans outline the avoid and minimise activities and mitigation measures as per the SSD 9575 Conditions Schedule:

- Stage 1 Biodiversity Management Plan (Greencap 2018b);
- Stage 2 Biodiversity Management Plan (Greencap 2018c), which is comprised of three sub-plans:
    - Vegetation Management Plan (VMP);
    - Fauna Management Plan (FMP);
    - Water Quality Management Plan (WEQMP).
- *Stormwater Management Plan* (SWMP) (Robert Bird Group 2019);
- *Erosion and Sediment Control Plan (ESCP)* (Robert Bird Group 2019);
- *Project Construction Environmental, Health & Safety Management Plan (CEMP*) Issue No 5.0 (Lendlease Building Pty Ltd 2019); and
- *Landscape Zonal Concept Plan (Turf 2019).*

3.1 Avoiding and Minimising Impacts on Biodiversity

This component of the BDAR has been prepared to address the requirements in *Section 8.1* of the BAM.

The impacts of the Project have been avoided and minimised by using the following principles to situate the development footprint in areas:

- Where there are no biodiversity values;
- Where the existing native vegetation or threatened species habitat is in poor condition;
- That avoid habitat for species with a high biodiversity risk weighting or ecological communities that are either critically endangered or endangered; and
- That maintain connectivity, enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained.

The Project's avoid and minimise strategy is set out in **Table 9** below. The key features of the Project's avoid and minimise strategy are summarised as follows:

- The Project Site was selected after an extensive due diligence that assessed the biodiversity values of a significant number of potential project locations. Other locations were disregarded in favour of the Project's proposed location due to the significant biodiversity values of those sites. This Project Site was considered preferable from a biodiversity impact perspective due to its operation as an agricultural enterprise, and therefore the majority of remnant vegetation had already been cleared.

- Those smaller parts of the Project Site which represent areas of higher biodiversity value, for example where remnant vegetation has been retained, were identified and removed from the Project's development footprint. On this basis, the Project footprint has been located in an area that avoids directly impacting threatened species and TECs.
- Those areas of the Project Site which are critical for connectivity, such as the northern section of the Site which falls within a mapped fauna corridor, will be maintained for their contribution to biodiversity values.
- Generally, the Project footprint will be situated in areas which have already been cleared. The only areas of native vegetation to be cleared are parts of the windrows in the southern section of the Project Site.

The Project design incorporating the avoid and minimise strategy is provided in **Appendix A**, including overlays of vegetation zones over the development footprints in **Figures A-3** and **A-4**. The full architectural drawings package is presented in Appendix B of the EIS.

Further to this, the successful application of the avoid and minimise strategy means that there are few residual impacts which will require offsetting.

Table 9 Avoiding and Minimising Impacts on Vegetation, Habitat and Biodiversity Values - Project Location and Design

Point	Approach	Mitigation	Description
Locating the project to avoid and minimise impacts on native vegetation			
1	Locating a project in areas where there are no biodiversity values.	The Project has been located on those portions of the site that are cleared land where there are no biodiversity values.	• A two-phase site selection process was undertaken by Health Infrastructure to assess the suitability of a range of greenfield and brownfield sites for the development of the new hospital where more than 50 sites were assessed. Assessment of impacts on biodiversity was an important component of this due diligence assessment. • Following the site selection process, due diligence assessments, public consultation, and input from the Health Infrastructure Site Selection Committee, the Site was confirmed and publicly announced in June 2018. An ecological constraints analysis was then undertaken for the chosen Site (Greencap 2018). • The ecological constraints analysis recommended that the areas of the Site that have been identified with high ecological constraint are considered to be areas where development should be avoided and afforded an appropriate level of protection. Moreover, consideration should be given to undertake ecological restoration and management activity that improves the quality of remnant habitat on the Site (Greencap 2018). • No Areas of Outstanding Biodiversity Value or areas of geological significance are located on the Site.
2	Locating the project in areas where the native vegetation is in the poorest condition (i.e. low VI score).	The Project has been located in an area where the project footprint will only impact areas of native vegetation that are in the poorest condition where the potential for impacting threatened species is low.	• The northern section of the Site is located on the Tweed River floodplain and is part of an important local wetland (mapped under *State Environmental Planning Policy (Coastal Management) 2018;* Coastal Management SEPP). This section of the site is also mapped regional fauna corridor. The entire northern section of the Site will be retained and maintained for its biodiversity values. • The project development will occur in the southern section of the Site which was previously a working farm under cultivation. Apart from the windrows planted along the Site boundary, most of the southern section of the Site has been cleared of native vegetation. • All areas of remnant native vegetation on Site (Zones 1, 2 and 3) and planted windrow vegetation at the Site (Zones 5, 6 and 7) will be retained and managed in accordance with the vegetation management zones detailed in the Vegetation Management Plan of the Stage 1 and Stage 2 BMPs in order to preserve and enhance current biodiversity values.

Point	Approach	Mitigation	Description
			• Some areas of native vegetation in windrows (Zones 4 and 8) will be cleared, with the remaining vegetation in these windrows regenerated to remove woody weeds and regenerated with native species and woody weeds that are classified as High Threat Exotics in accordance with the Landscape Masterplan (Turf 2019). Relevant components of this Landscape Masterplan (Turf 2019) have been incorporated into the Stage 1 and 2 BMPs. • The current VI for Zone 4 falls below the assessment threshold for PCTs that are representative of an Endangered Ecological Communities (i.e. VI ≤ 15). The current VI for Zone 8 is very low (16.8) is very low. • Based on the above results, there will be no decrease in the overall condition of the potential TECs identified on Site remaining in the IBRA sub region due to impact from the Projects construction or operation.
3	Locating the project in areas that avoid habitat for species that have a high biodiversity risk rating and vegetation that is a CEEC or an EEC, indicated by the biodiversity risk weighting for the species.	The Project has been located in an area that avoids impacting on threatened species and vegetation in high threat categories (i.e. Endangered Ecological Communities).	• The Site contains candidate SAII entities, however, there are no direct impacts on associated areas of potential habitat. Therefore are no SAIIs which are likely to contribute significantly to the risk of extinction of any threatened species or ecological community. • There are no hollow bearing trees located in areas to be cleared (Zones 4 and 8). • A detailed site selection process and due diligence assessment as outlined above was undertaken to assess any ecological constraints present at the chosen Site. It was assessed that the Project design and the location of the projects ancillary features will minimise direct impacts on threatened species and vegetation in high threat categories.
4	Locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained.	The Project does not impact on regional connectivity values.	• The project will have negligible impact on connectivity values surrounding the development Site. The Site is located within mapped regional fauna corridor; however, the development will not directly impact any areas of intact remnant vegetation or areas of habitat connectivity. • Sections of self-sown windrow vegetation (Zones 4 and 8) will be cleared for the development (1 ha). These windrows may offer marginal foraging habitat and stepping-stone connectivity for some threatened species. However, the fauna species which may potentially utilise these windrows are highly mobile. • Furthermore, regeneration and revegetation of areas detailed in the Landscape Masterplan Report (Turf 2019) will enhance connectivity within the site when compared to the existing land use.

Point	Approach	Mitigation	Description
Designing a project to avoid and minimise impacts on native vegetation and habitat			
5	Reducing the clearing footprint of the project.	The clearing footprint will be reduced to a minimum in vegetation zones with low vegetation integrity and no remnant native vegetation will be cleared.	• Incorporating a multi-level building design for the main hospital building has avoided impacts on habitat, by allowing for a smaller site area to be considered during the site selection process. • All areas of the Site that have been identified with high ecological constraint are located in areas where development will be avoided. No remnant native vegetation will be cleared.
6	Locating ancillary facilities in areas where there are no biodiversity values.	Ancillary facilities will be located on land that has been cleared for cultivation.	• Ancillary facilities will be located in the southern section of the Site which was previously a working farm under cultivation. Apart from derived vegetation located in self-sown and planted windrows, most of the southern section of the Site has been previously cleared of native vegetation.
7	Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition.	Ancillary facilities will be located on land where native vegetation has low VI.	
8	Locating ancillary facilities in areas that avoid habitat for species that have a high biodiversity risk rating and vegetation that is a CEEC or an EEC, indicated by the biodiversity risk weighting for the species.	The proposed ancillary facilities have been located in an area that avoids impacting on threatened species and vegetation in high threat categories (i.e. EECs).	• See point 5.
9	Providing structures to enable species and genetic material to move across barriers or hostile gaps.	Where possible structures will be provided to enable connectivity for species.	• It is recommended that a wildlife crossing is established to the north-east of the Site where the Turnock Street roadway passes through the remnant vegetation. Fauna management guidelines are detailed in the Stage 1 and Stage 2 Biodiversity Management Plans.
10	Making provision for the demarcation, ecological restoration, rehabilitation	All remnant native vegetation outside of the development	• All areas of intact remnant native vegetation on Site and remaining areas of planted or self-sown windrow vegetation at the Site will be retained and managed in accordance with

Point	Approach	Mitigation	Description
	and/or ongoing maintenance of retained native vegetation habitat on the development site.	footprint will be protected and maintained.	the vegetation management zones detailed in the Vegetation Management Plan of the Stage 1 BMP in order to preserve and enhance current biodiversity values. • One *Cryptocarya foetida* plant (sapling) along the Cudgen Rd boundary windrow will be translocated for conservation during Stage 1 vegetation clearing, including ongoing care and maintenance, as per the Stage 1 BMP.
Avoiding and minimising prescribed biodiversity impacts during project planning			
11	Impacts of development on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other geological features of significance.	These habitat features have not been identified as present on the Site, impacts are avoided.	• While not specific to a particular habitat feature, habitat constraints were considered as part of the site selection process* during project planning, with a preference for sites where known habitat of threatened species or ecological communities could be avoided, and where impacts could not be avoided, where they could be minimised.
12	Impacts of development on the habitat of threatened species or ecological communities associated with rocks.	As part of the current use of the Site, rocks have been moved to form walled areas in the windrows.	• While not specific to a particular habitat feature, habitat constraints were considered as part of the site selection process during project planning, with a preference for sites where known habitat of threatened species or ecological communities could be avoided, and where impacts could not be avoided, where they could be minimised.
13	Impacts of development on the habitat of threatened species or ecological communities associated with human made structures.	Human made structures present on the development site including buildings, stonewalls, and dams have not been identified as habitat for threatened species or ecological communities.	• N/A
14	Impacts of development on the habitat of threatened species or ecological communities	Impacts will be minimised by retaining some windrow vegetation.	• Sections of self-sown windrow vegetation (Zones 4 and 8) containing non-natives will be cleared for the development (1 ha). These windrows may offer marginal foraging habitat and stepping-stone connectivity for some threatened species. However, the fauna species which may potentially utilise these windrows are highly mobile.

Point	Approach	Mitigation	Description
	associated with non-native vegetation.		
15	Impacts of development on connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.	• Site selection processes sought to avoid areas of habitat connectivity of threatened species and the potential to cause habitat fragmentation. • Location of the envelope of surface works will avoid direct impacts on connectivity of different areas of habitat.	• Habitat connectivity and the potential for fragmentation were included in the site selection criteria. • The location of the development area on the site has been selected to avoid and minimise clearing of habitat areas of threatened species, including those that facilitate the movement of those species across their range.
16	Impacts of development on movement of threatened species that maintains their life cycle.	• Locating the project development area away from threatened species habitat areas and establishing a vegetated buffer will minimise impacts on the movement of threatened species that maintains their life cycle. • A 'post and bridge' system will be installed with the temporary boundary fencing during construction to facilitate movement of arboreal fauna. • Permanent boundary fencing will not be installed.	• The location of the development area on the site has been selected to avoid and minimise clearing of habitat areas of threatened species, including those that facilitate the movement that maintains their life cycle. • For construction of the development, the temporary boundary fencing has been fitted with a 'post and bridge' system to facilitate movement of koala • For operation of the development, a boundary fence will not be installed, thereby facilitating movement of threatened species.

Point	Approach	Mitigation	Description
17	Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining).	• Selection of a site that avoids the direct impacts to water bodies or water quality. • Avoiding locating the development footprint in areas of the site that directly impact water bodies, or significantly interfere with hydrological processes. • Implementation of a Water Quality Management Plan (WQMP) in the Stage 2 BMP • Water quality impacts will be avoided during construction using erosion and sediment control measures. • Impacts to water quality and hydrological processes during operation will be minimised using WSUD measures that maintain flows to the wetlands and maintain or improve water quality. • Monitoring of surface water quality with a water quality monitoring program.	• Direct impacts to water quality, water bodies and hydrological processes that sustain threatened species and ecological communities were avoided through the site selection process by including constraints on sites that would require the development footprint to impede on water bodies. • The location of the development footprint on the Site seeks to minimise interference with hydrological flows through the wetlands including contributions from groundwater. Other than what may be required for piling, subsurface excavations will be at a shallower depth than measured groundwater depths on the site. Piles will be between 800 mm and 1200 mm in diameter and will typically be spaced 8.4 m apart, except under lift and/or stairwell cores where they will be not less than 2m apart. As the piles are not continuous, it is not anticipated that they will create a barrier to any shallow or perched groundwater flow that currently occurs within the development footprint, minimising the potential for the development to impact groundwater contributions to baseflow in the wetlands. • Water quality impacts to the wetlands will be avoided by employing effective and properly designed erosion and sediment control measures at prior to the commencement of other construction activities, including adequately sized retention basins that are appropriately monitored and managed. The stormwater management system for operation of the Project will be designed in accordance with the locally appropriate standard (TSC 2016), and it is expected that operation of the Project will result in a net improvement in the quality of stormwater that is discharged from the Site. • WSUD measures as specified in the Stormwater Management Plan (RBG 2019) will incorporate swales, enviropods, sediment basins and bio-detention basins. The roof runoff will be directed into the bioretention basin by a pit and pipe system while hardstand runoff will be first treated by enviropods, and then either swales that discharge to the bioretention system or directly into the bioretention systems. Ultimately the bulk of the stormwater will end up in an extended detention basin where it will settle and discharge to the receiving waters in a controlled manner. It is noted, upon the advice of the accredited Bushfire Consultant for the Project during the Stage 1 application (Paola Rickard, Land and Fire Assessments), that permanent bioretention basins are an appropriate landuse within an APZ provided that the installation of such structures does not increase the fuel load within the APZ, for example, through inappropriate landscaping, and as long as it does not present an impediment to regular maintenance of the APZ. This advice will be factored into the water quality strategy for the site.

Point	Approach	Mitigation	Description
			• A surface water quality monitoring program will be implemented as part of the Stage 2 BMP • Further details of measures proposed are provided in the Water Quality Management Plan (WQMP) in the Stage 2 BMP.
18	Impacts of wind turbine strikes on protected animals.	• No wind turbines are planned as part of this project.	• N/A
19	Impacts of vehicle strikes on threatened species or animals that are part of a TEC.	• Impacts will be minimised by locating the main site entrances on alternative routes than those adjacent to TECs. • Where possible impacts will be minimised by providing structures to enable connectivity for species that prevent or avoid crossing roads.	• Main site entrances provided off Cudgen Road • It is recommended that a wildlife crossing is established to the north-east of the Site where the Turnock Street roadway passes through the remnant vegetation. Fauna management guidelines are detailed in the BMPs.

* As part of the site selection process, a comprehensive list of constraints from a variety of disciplines were assessed for each proposed site to ensure project needs could be met, and to short list sites for further evaluation to determine the most suitable site overall. Criteria used in this process included:

- **Location, Access and Traffic -** ease of site access for cars and pedestrians; travel time to existing health facilities; travel time from population growth areas; equitable travel accessibility, population distributions; existing road networks and planned road network upgrades; time of day, day of week traffic conditions; access to and number of public transport service within a day; ability to divert existing bus routes through the site; commercial centre proximity and availability of helicopter access.
- **Urban Context** - development issues; consideration of locality, suburban/urban context compatibility; impact on neighbouring properties/land uses; planning controls/ approvals; displacement of existing facilities; location of communal open space; and proximity to other community facilities
- **Built Forms and Landscaping -** existing buildings/structures; desired future character; built form controls; building envelope; aesthetics, orientation and access to sunlight; views and vistas; privacy and security; existing vegetation; and meeting ESD objectives.
- **Environment, Heritage and Cultural –** geotechnical considerations, contamination potential**;** site boundary configuration; topography; flood prone land; bushfire prone land; coastal protection zone/wetlands/riparian zone; views, vistas and panoramas; acoustics; air quality; heritage Items; preservation of cultural artefacts; wellness precinct opportunity; and the perceived therapeutic benefits of the site.

Not all criteria held equal weighting with some criteria such as flood risk, travel times within the catchment area, accessibility, available land area, and ecological constraints having a higher value than some of the other constraints.

3.2 Impact Assessment and Risk Mitigation

This component of the BDAR addresses the requirements in *Section 9.1* of the BAM.

Mitigation measures (including timing, frequency and responsibility) proposed to mitigate or manage indirect impacts and prescribed impacts are outlined in **Appendices I** and **J** respectively.

The risk of any residual impacts likely to remain after the mitigation measures have been applied is also evaluated in **Appendix I** and **Appendix J.** Risk assessment criteria for likelihood, consequence and risk level are provided in **Appendix K**.

3.2.1 Direct Impacts

A total of 0.95 ha of native vegetation on the Site will be directly impacted by the Project during the construction stage. Direct impacts (ha) on native vegetation are outlined in (**Table 10**) and shown in **Figure 21**[1].

The areas of direct impacts on native vegetation noted in this report are consistent with those at the time of the Stage 1 BDAR and in line with the credit offset requirement retired as a result. It is noted that at the time of preparing this revision that the actual proposed clearing for Stage 1 is expected to differ from this, however it is noted to be below this maximum threshold. For currency however, the latest plans received by Greencap have been incorporated into **Figure 21**.

One *Cryptocarya foetida* plant (sapling) along the Cudgen Rd boundary windrow is directly impacted by the Project. However, as well as meeting the offset requirement for this threatened species as discussed in **Sections 3.3.2** and **3.5.2**, this plant will be translocated prior to Stage 1 vegetation clearing along this windrow, including ongoing care and maintenance, as per the Stage 1 BMP.

The targeted survey for MRS undertaken by Dr Stephanie Clark concluded that the clearing of 0.95 ha of rainforest vegetation from the proposed development area during Stage 1 would not significantly impact Mitchell's rainforest snail habitat as this was not considered suitable habitat for MRS (Clark 2019a).

Table 10 Direct Impacts to Native Vegetation

Zone	PCT ID	PCT Name	Condition Class	Area (ha)
4	1302	White Booyong- Fig subtropical rainforest	Self-sown windrow	0.55
8	1302	White Booyong- Fig subtropical rainforest	Self-sown windrow	0.40

3.2.2 Indirect Impacts

A total of approximately 3.65 ha of native vegetation on the Site may be indirectly impacted by the Project, including approximately 2.74 ha of Endangered Ecological Communities in Zones 1, 2, 3, 4 and 8. Vegetation condition of vegetation that will not be directly impacted by the Project will not decrease.

[1] The areas of direct impacts on native vegetation noted in this report are consistent with those at the time of the Stage 1 BDAR and in line with the credit offset requirement retired as a result. It is noted that at the time of preparing this revision that the actual proposed clearing for Stage 1 is expected to differ from this, however, less than this maximum threshold. For currency however, the latest plans received by Greencap have been incorporated into the figure visually displaying direct impacts on native vegetation.

Sensitive environmental receptors relevant to dust, vibration and light spill impacts include vegetation communities and wildlife adjacent to the Project's construction activities. The impact of potential dust migration, air quality reduction, vibration and light spill on surrounding flora and fauna will be managed in accordance with management plans including guideline criteria and any prescriptions will be implemented as part of an approved CEMP and sub-plans, including the CAQMDMSP and the CNVMSP.

Grey-headed flying fox camps are noted to be >300 m (Kingscliff Library Flying Fox camp) and >1 km (Eldron Dr, Chinderah Flying Fox camp) (Ecosure 2018) from the Project Site. Three osprey nests are known to be east and south of the Site, a minimum of 600 m away (TSC Environmental Mapping Portal). The indicative locations are shown in **Figure I-1, Appendix I**. Given the distance from the Site, the indirect impacts on these threatened species are negligible. Prescribed impacts of vehicle strikes with respect to aviation traffic is discussed in **Section 3.2.7.3**.

Where avoidance of light spill, airborne noise, vibration and dust generation is not practicable, key mitigation measures to reduce and address residual impacts from light, noise, vibration or dust generated as a result of construction activities. Such measures will be implemented, as outlined below. Indirect impacts and mitigation measures are addressed in detail in **Appendix I**.

The Project has the potential to impact upon Mitchell's Rainforest Snail (MRS) population and habitat. However, mitigation and management measures to protect MRS populations including the management of vegetation and invasive species which may be harmful to threatened species, are summarised in **Appendix I** and described in detail in the Stage 2 BMP.

This Stage 2 BDAR should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for indirect and prescribed impacts for the Project.

3.2.2.1 Noise and Vibration

Noise and vibration during construction and operation including construction works and traffic has the potential to disrupt threatened species or reduce the viability of adjacent habitat. A detailed review of potential impacts and mitigation measures is provided in **Appendix I**.

After the mitigation measures are implemented, it is assessed that there is a very low risk of noise and vibration impacts.

3.2.2.2 Light Spill and Visual Amenity

Light spill during construction and operation including construction lighting, construction traffic, and operational lighting has the potential to disrupt threatened species and/or reduce the viability of adjacent habitat. The Site does not contain habitat for threatened species that are drawn to light (i.e. turtles) that could be adversely impacted by light spill. A detailed review of potential impacts and mitigation measures is provided in **Appendix I**.

After the mitigation measures are implemented, it is assessed that there is a very low risk of light spill and visual amenity impacts.

3.2.2.3 Dust

There are potential dust impacts during construction and operation including inadvertent dust deposition on native vegetation or threatened species, and the potential disruption of threatened species or reduced viability of adjacent habitat. A detailed review of potential impacts and mitigation measures is provided in **Appendix I**.

After the mitigation measures are implemented, it is assessed that there is a very low risk of dust impacts.

3.2.2.4 Damage or removal of retained native vegetation

There is the potential for impacts relating to the damage or removal of retained vegetation during construction and the unplanned loss of habitat. The Vegetation Management Plan in the Stage 2 BMP sets out measures to ensure that retained native vegetation is protected. A detailed review of potential impacts and mitigation measures is provided in **Appendix I**.

This includes the management of vegetation in core MRS habitat to protect and improve the quality of habitat by increasing the key habitat requirements of well-developed leaf litter and tree intact canopy as detailed in the Stage 2 BMP.

The vegetation management measures also include protection of koala habitat (Zone 6) as outlined in Section 3.2.1 of the Stage 2 BMP.

After the mitigation measures are implemented, it is assessed that there is a very low risk of damage or removal to retained native vegetation.

3.2.2.5 Bushfire and changing fire regimes

There are potential impacts to native vegetation and threatened species relating to construction and operations from bushfire and changing fire regimes. A detailed review of potential impacts and mitigation measures is provided in **Appendix I**.

After the mitigation measures are implemented, it is assessed that there is a very low risk of impacts from bushfire and changing fire regimes.

3.2.2.6 Non-native Vegetation and Pests

Construction and operations on the Site have the potential to introduce weeds to the Site. Detailed measures for weed control have been detailed in the Stage 2 BMP.

This includes the decommissioning of the farm dam to control and reduce the risk of *Salvinia molesta* infestations. This will remove the requirement for ongoing monitoring and treatment of *Salvinia molesta*. Further information on the method for rehabilitation of the farm dam, including mitigation measures to prevent impacts on native aquatic fauna, is provided in the Stage 2 BMP. Details of potential prescribed impacts on water associated with infilling the dam are discussed in **Section 3.2.4**.

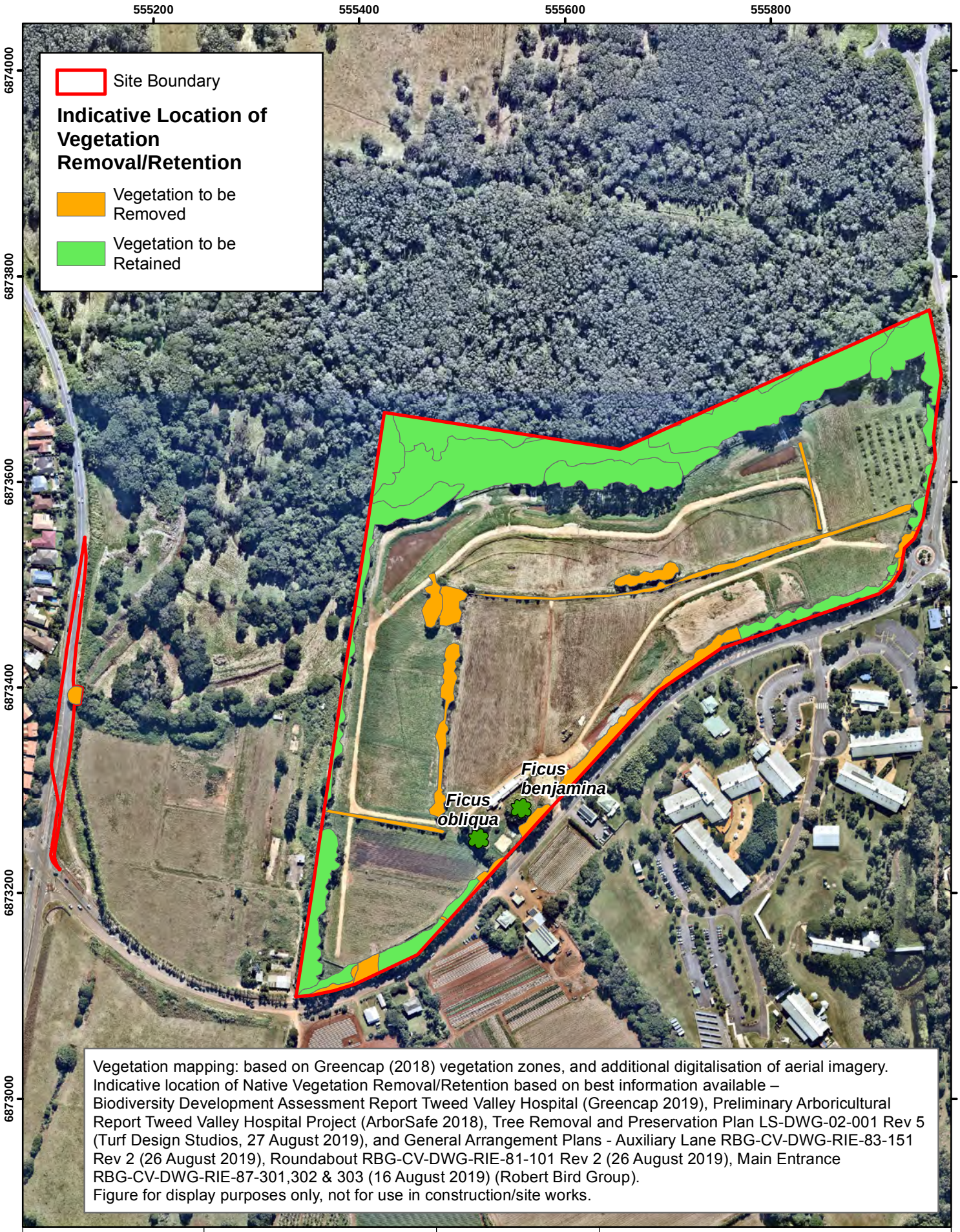
Additionally, the identification of several black rats *Rattus rattus* during surveys are noted to pose a potential threat to MRS populations on the Site, and a control program is to be implemented during construction of the Project.

A detailed review of potential impacts and mitigation measures is provided in **Appendix I**.

After the mitigation measures are implemented, it is assessed that there is a very low risk of potential impacts from weeds.

3.2.2.7 Summary of Indirect Impacts

Specific details of management of indirect impacts are details in the Stage 2 BMP (Greencap 2019d). As a result of the indirect risk assessment, it was identified that the residual risk following the application of mitigation measures was very low.



Vegetation mapping: based on Greencap (2018) vegetation zones, and additional digitalisation of aerial imagery. Indicative location of Native Vegetation Removal/Retention based on best information available – Biodiversity Development Assessment Report Tweed Valley Hospital (Greencap 2019), Preliminary Arboricultural Report Tweed Valley Hospital Project (ArborSafe 2018), Tree Removal and Preservation Plan LS-DWG-02-001 Rev 5 (Turf Design Studios, 27 August 2019), and General Arrangement Plans - Auxiliary Lane RBG-CV-DWG-RIE-83-151 Rev 2 (26 August 2019), Roundabout RBG-CV-DWG-RIE-81-101 Rev 2 (26 August 2019), Main Entrance RBG-CV-DWG-RIE-87-301,302 & 303 (16 August 2019) (Robert Bird Group).
Figure for display purposes only, not for use in construction/site works.

Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,750	**Direct Impacts on Vegetation**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney		Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure 21**
Date: 29/08/2019	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*		
GREENCAP			

Doc Path: R:_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BDARs2\mxd\J156455_13_BDARs2_F21_direct_impacts_190829.mxd

3.2.3 Prescribed Impacts

The Project has the potential to result in prescribed biodiversity impacts that are detailed in the *Biodiversity Conservation Regulation 2017* (NSW) (BC Regulation).

- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities. Note, these impacts are also identified as uncertain impacts;
- Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range;
- Impacts on movement of threatened species that maintains their lifecycle;
- Impacts of vehicle strikes (including aircraft) on threatened species of animals or on animals that are part of a threatened ecological community; and
- Impacts of development on habitat of threatened species or ecological communities through removal of rocks.

Potential prescribed impacts on biodiversity are addressed in Sections 3.2.4 to 3.2.8. Mitigation of potential prescribed impacts are detailed in **Appendix J.** This Stage 2 BDAR should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for indirect and prescribed impacts for the Project.

3.2.4 Prescribed Impacts on Water

3.2.4.1 Stormwater management

Stormwater management under the pre-construction conditions

The previous land use is agricultural, site observations indicate that the cultivated fields are ploughed across the topographic contours. Under this cultivation regime, sediment-laden stormwater was encouraged to run downhill through ploughed furrows. Observations during site inspections also indicated frequent use of pesticides on the crops. Apart from a bund that has been constructed along the western boundary of the Site which adjoins an open drain, there is currently no stormwater management system in place. In the western section of the Site the aspect of the land is roughly west to north-west and the bund currently directs untreated stormwater flows to three discharge points that have been bulldozed through the bund wall. The aspect of the rest of the Site is roughly north and the ploughing regime directs sediment-laden stormwater to discharge directly into the receiving catchment and wetland located to the north of the Site. Furthermore, a Council owned drain carrying untreated stormwater flows from Turnock Street discharges directly into the receiving catchment.

Proposed stormwater management

The Project's stormwater detention measures have been designed in accordance with the *Guidelines for Development Adjoining Land managed by the OEH* (OEH 2013) and with the *Tweed Shire Council Development Design Specifications D5 – Stormwater Drainage Design* and *D7 –Stormwater Quality* (TSC 2016). The storage volumes of the converted basins have been modelled to ensure that the combined post development discharge from the basins is no greater that the pre-development flow. The preliminary DRAINS model confirms that there is no increase in the total site discharge rate in the 5 year and 100 year ARI storm events. For details of how soil and stormwater quality will be managed refer to the SWMP (Robert Bird Group 2019).

The SWMP (Robert Bird Group 2019) for the Project summarises the results of the MUSIC model that demonstrate compliance of the system with the DRAINS and WSUD objectives developed for the site, including:

- no increase in pre-development peak flows from rainfall events with a 1 in 5-year and 1 in 100-year recurrence interval;
- Tweed Shire Council Water Quality Objectives; and
- no increase in the natural annual average load of nutrients and sediments.

The MUSIC model assesses water quantity and water quality under the existing land use, across the following parameters:

- Flow;
- Total suspended solids;
- Total phosphorus;
- Total nitrogen; and
- Gross pollutants.

The WSUD measures proposed for the final development are designed to provide a reduction in nutrient levels of stormwater discharged from the Site which would potentially be beneficial to ecological receptors in the wetlands.

Soil erosion and stormwater quality will be managed during construction of the Project in accordance with current industry standards as per the Sites approved ESCP, CEMP and associated CSWMSP and the SWMP and which sets out the key items to manage stormwater runoff, as follows:

- Installation of Sedimentation Basins (installed as part of Preliminary Works package).
- Regular inspections of basins.
- Retained capacity in detention basins
- Test, treat and discharge collected stormwater off-site if it cannot be reused on site.
- No discharge of non-compliant water or off-site pollution.

During construction, mitigation measures will be undertaken to minimise the risk of erosion and of sediment-laden stormwater being discharged into the receiving catchment and wetland located to the north of the site. These measures will include but are not limited to:

- A sediment fence/catch drain (or diversion bund) around the Site;
- Temporary access to Site with shaker pad;
- Sediment fencing around stockpile areas. Stockpiles will be located out of water flow paths and will be protected by earth banks/drains as required; and
- Four adequately sized sediment basins with a total capacity of 7,562 m^3 volume have been constructed to capture flows (Bonacci 2019). The receiving catchment will be protected by providing diversion stormwater drainage lines that bypass the construction site. Sediment basins will be appropriately monitored and managed in accordance with an erosion and sediment control plan (ESCP) as outlined below.

The Site's CEMP will incorporate all relevant safeguards and mitigation measures detailed in the EIS and any requirements detailed in the development consent conditions. All construction staff and site personnel will be made aware of their environmental responsibilities and safeguard measures within the CEMP to avoid and minimise environmental impacts. The CEMP will be submitted to the Department of Planning and Environment for review and approval prior to commencement of works.

Sediment basins

Sediment basins will minimise the impact of any change in water quality and protect the TEC in the wetland area. Sediment basins have been constructed as part of preliminary works which will capture and treat stormwater on the Site during the pre-construction and construction phases of the project.

The sediment basins function by providing a large, standing body of water such that stormwater runoff entering the basins, which is laden with sediments, has a chance to settle to the base of the basin before it overflows via the weir into the receiving watercourse. The weir and headwalls have been constructed with rock scour protection which will dissipate the water via sheet flow across the land to mitigate any direct impact on native vegetation directly within the discharge area. The size of the sediment basins has been designed in accordance with the the NSW Managing Urban Stormwater "Blue Book" (Landcom 2004). The basins have been designed for five-day rainfall, and adequate settling is required four days from the conclusion of each storm event.

Each sediment basin is lined so water should only be able to escape by overtopping the weir or through evaporation or pumping following flocking and testing pH and TSS (Total Soluble Solids). Each basin will be dosed with flocculent per rain event and the sediment will typically settle and water quality will be confirmed by site specific testing prior to being pumped out within five days from the conclusion of a rainfall event. In the event of an uncontrolled discharge, a monitoring event will be triggered to assess potential impacts resulting from surface water discharges on the receiving environment as described in more detail in the Stage 2 BMP.

The sediment basins will be converted to bio-detention basins during Stage 2 works, once the site excavation works and roads have been completed and all surfaces have been stabilised with appropriate ground cover.

Management of cane toad *Rhinella marina* around sediment basins is addressed in the FMP in Stage 2 BMP.

Monitoring the sediment basins for aquatic weeds in (particularly salvinia *Salvinia molesta*) must be undertaken and is addressed in the VMP in Stage 2 BMP.

Bio-detention basins

Bio-detention systems improve stormwater water quality via nutrient uptake and denitrification. The bioretention system will be made up of three sub-surface layers: filtration, transition and drainage layer. The stormwater pools on the surface which is densely planted with grasses, sedges and select shrub or tree species, and filters down through the soil filter media (RBG 2019).

The compactly vegetated surface of bioretention systems physically controls the flows across the filter media. Beneath this, the root zone of the plants is very biologically effective as sediments and nutrients in stormwater are caught or utilised by the plants, bacteria and fungi. As part of an integrated living system, the plant life cycle maintains the soil structure and hydraulic conductivity of the natural filter (RBG 2019).

Bio-detention systems require regular routine maintenance, including inspections every three to six months or after heavy rain, cleaning and inspections and replacement of filter media every five to seven years. The proprietary pit filter baskets (i.e. enviropods) in the stormwater pits also require routine monitoring and cleaning. An indicative maintenance plan for the bio-detention systems is provided in the SWMP (RBG 2019).

Erosion and sediment controls

The impact of erosion and sedimentation during the construction phase will be managed in accordance with an ESCP prepared for the Site to effectively manage erosion and subsequent sediment mobilisations. The ESCP will be implemented prior to the commencement of construction works, especially prior to the onset of each wet season (from late February to late April). The ESCP is discussed in more detail in the Stage 2 BMP. The erosion and sediment control management strategy aims to minimise offsite impacts by diverting overland surface flows to sediment controls, and to manage any active discharge so that it meets the

applicable water-quality criteria, such as the IECA (2008) guidelines for discharge from detention basins and the Tweed Shire Council specifications (TSC 2016)

Wetland hydrology

In respect of the TECs located within the wetland area, it is noted that these species are generally located in areas subject to periodic inundation (NSW Scientific Committee, 2004). The sediment basins will function to allow the wetland area to continue to occur in line with the pre-construction land use. The quality of the water entering the downstream wetland environment will be managed under the approved CEMP and ESPC.

The location of the development footprint on the Site seeks to minimise interference with hydrological flows through the wetlands, including contributions from groundwater. It is not anticipated that piles will create a barrier to any shallow or perched groundwater flow that currently occurs within the Project footprint, minimising the potential for the development to impact groundwater contributions to the wetlands.

The stormwater design for the site is on the basis of ensuring that the post development discharge rate does not exceed the pre-development rate in the 100-year and 5-year ARI storms (RBG 2019). However, the discharge from the bio-detention basins will be via four surface headwalls, which would therefore not produce an exact match to the existing flow regime which may result in some amount of concentration of flow rather than the existing sheet flows (RBG 2019).

As part of the Project, the farm dam in the northwest of the Site is to be infilled and rehabilitated, which has the potential to impact upon the wetland hydrology. An analysis of potential impact of any change in hydrological flows on the wetland as a result of infilling the dam was undertaken by SMEC (2019). The assessment identified that filling the dam back to natural ground level will have no impact on the 1% AEP (100 year ARI), the 20% AEP (5 year ARI) flood levels and no material impact from more frequent events post development. The report recommends that the detailed design of the dam infilling incorporate a minimal downhill grade, low flow channel or path to allow flows to travel from the upstream to the downstream side of the decommissioned dam and minimise the amount of ponding water that could become reinfested with *Salivina molesta* (SMEC 2019).

An assessment of the potential ecological impact on the coastal wetlands to the north of the site as a result of any changes to hydrology (flow regimes) caused by the Project was undertaken by SMEC (2019). The assessment considered EECs, TECs, threatened species and the overall biophysical, hydrological and ecological integrity. The modelling conducted as part of the assessments predicts an mean total annual flow from site to increase by almost 50% from 90.6 ML/yr pre-development to 140 ML/yr post development. This volume increase is due to: a predicted greater frequency of minor runoff events into the wetland, more frequent than the 20% AEP; approximately 10 to 20mm of additional inflow from the developed site during significant events for parts of the wetland; and 10 to 50mm within the dam. Modelling results indicated that the Project will have minimal impact on the coastal wetland estimated water levels. For detailed results on the hydrology (flow regimes) modelling please refer to SMEC 2019.

The potential impacts of these additional flows on the EEC's identified on the Site, Mitchell's rainforest snail *Thersites mitchellae* (MRS) and two pH dependent threatened species (i.e. Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis*) were assessed by Jon Alexander, an ecologist and suitably qualified professional (SMEC 2019). In summary, the assessment found that the predicted minor increases in flow are unlikely to result in any apparent or significant impacts to wetland hydrology due to;

- The coastal wetlands to the north of the site are dominated by Broad-leaved Paperbark *Melaleuca quinquenervia.* Although this species cannot survive permanent inundation, it has adaptations such as fibrous roots around their lower trunk that are understood to allow the plant to respire during long periods of submersion. Furthermore, the mid- and understory species such as rushes, sedges, ferns and grasses are also adapted to periodic inundation.

- Predicted change in flood level from the Projects outflows is expected to be very small (<50mm). When compared to the existing flooding from the Tweed River (BMT 2018) which indicates inundation depths for the wetland of approximately 2m for the 5% AEP event and 3m for the 1% AEP event. Suggesting that the Paperbark swamp forest present are naturally resilient to large scale flood events in excess of the inflows likely to be a result of the Project;
- White Booyong – Fig subtropical rainforest community appears to be limited to the slightly elevated fringes of the Paperbark swamp forest and therefore is unlikely to be materially impacted by the additional inflows expected; and
- The available information on MRS habitat suggests the species is dependent on high moisture levels, low fire frequency, and a well-developed leaf litter layer and are typically found on somewhat elevated ground around the edges of wetlands (DEE 2019; OEH 2019). It was assessed that the predicted change in inflow levels is unlikely to negatively impact or reduce the existing MRS habitat to the north of the site through permanent inundation.

To reduce the modelled higher frequency flows (more frequent than the 20% AEP), mitigation measures recommended by SMEC (2019) will further minimise the impact on the coastal wetland, including additional assessment to carried out to inform potential modification(s) in the basin outflow design, such as staging the basin outlets to reduce peak discharges and by removing the proposed bio-basin lining and providing additional infiltration downstream of the basins.

Aquatic fauna

During the development of the BDAR, two pH dependent amphibians were identified by the BAM Calculator as candidate threatened species, namely, Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis* (Greencap, 2019). There are records for these species within the 1,500 m assessment area and within the receiving catchment. The use of gypsum as a flocculent in the sediment basins to quickly settle sediment-laden stormwater runoff during construction may impact the abovementioned threatened amphibian species upon discharge from basins to the downstream receiving wetland environment. To avoid any potential changes in pH and impacts on these threatened species, other commercially available flocculants that work as effectively as a gypsum replacement yet do not create the large changes in pH will be used to treat stormwater before discharge on the Site.

As part of a Water Quality Monitoring Program as outlined in the WQMP in the Stage 2 BMP, physico-chemical parameters including pH will be monitored in water discharged from sediment basins and in the downstream wetland environment.

As discussed in the above section on Wetland Hydrology, the potential impacts of these additional flows on the EEC's identified on the Site, MRS and two pH dependent threatened species (i.e. Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis*) were assessed by Jon Alexander, an ecologist and suitably qualified professional (SMEC 2019). In summary, the assessment found that the predicted minor increases in flow are unlikely to result in any apparent or significant impacts to aquatic fauna due to;

- The Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis* prefer areas of generally different habitat such as inundated habitat with emergent sedge species. If present, there is no apparent likelihood that the additional inflows expected would negatively impact these species; and
- Additionally, if the above species are present, the expected improvement in water quality as a result of the Projects stormwater management system could potentially be of benefit. However, additional data from long term monitoring of these species would be required to assess any potential impacts as a result of the Project in greater detail.

Cane toad *Rhinella marina* management

Sediment basins and WSUD features have the potential to attract cane toads *Rhinella marina* and provide breeding habitat which could impact native fauna species, in particular the Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis* or other reptiles and birds that prey on cane toad *Rhinella marina*. Measures to mitigate the impacts of cane toad *Rhinella marina* on the Project Site are described in the FMP and in section **3.2.2.**

Sediment basin discharge criteria

Assessment of the relevant discharge parameters will be carried out prior to active discharge offsite from sediment detention basins, excavations or other areas of collected water. Monitoring of the parameters will be conducted using calibrated hand-held monitoring devices and/or sample collection for laboratory analysis. Active discharge of water from a sediment basin into the off Site receiving environment will require approval from a Project Environmental Representative/Manager.

At a minimum, stormwater actively discharged from a controlled sediment basin to receiving waters must comply with Tweed Shire Council stormwater discharge criteria (TSC 2016), the Sites approved ESCP and CEMP.

The Tweed Shire Council specifications (TSC 2016) require that stormwater discharge monitoring must take place at all surface water locations leaving the Site for the following parameters:

- suspended solids and non-filterable residue (NFR) – monthly or during a discharge event (defined as >25mm in any 24 hour period);
- pH – monthly or during a controlled discharge event; and
- Total phosphorus and Total nitrogen – every three months.

Furthermore, a monthly water quality monitoring program will monitor water quality at sediment basin discharge points (near the outlet) and in the wetland received environment as described in **Section 3.2.4.5.**

3.2.4.2 Contamination pathways

As per Condition 3 B25, all Stage 2 works and associated activities are to be delivered in accordance with an approved groundwater management plan including measures to prevent groundwater contamination in order to avoid any impacts on groundwater, particularly during piling and excavation activities. Contamination is also addressed under the CEMP Sub-plans (CAQMDMSP, CTPMSP and CSWMSP). Furthermore, for the additional Soil and Groundwater Investigation Report, required by condition B10 of Schedule 3, a data quality objectives (DQOs) and sampling, analysis and quality plan (SAQP) for soil and groundwater was developed (Cavvanba 2019).

Contaminated land investigations in the form of a Preliminary Site Investigation (PSI) and Detailed Site investigation (DSI) were undertaken at the Site (Octief 2018).

The DSI included the collection of:

- 55 primary soil samples from 50 locations using a hand auger;
- two sediment samples, one from each of the storage dams on-site;
- a surface water sample from each dam; and
- the installation and subsequent sampling for a groundwater monitoring bore.

The investigations concluded that based on the conceptual site model presented in the report, exposure pathways of identified soil and groundwater contamination to ecological receptors were unlikely to be complete.

A groundwater and intrusive soil investigation undertaken by Cavvanba Consulting Pty Ltd (Cavvanba) in November and December 2018, and July (Cavvanba 2019) noted that exceedances of ecological criteria in soil samples were reported, however, these were noted as likely to be localised and not considered to be

significant. This is consistent with the previous assessment (Octief 2018) which found no widespread contamination-related ecological issues on the Site.

The report also found the Cudgen Creek off-site environmental receptor and associated creeks are unlikely to be exposed to contamination as the contamination pathways are unlikely to act as a conduit, i.e. extensive distance between the source area and receptor; and depth of the groundwater. These conclusions are consistent with the previous report.

3.2.4.3 Groundwater

The location of the Project's development footprint on the Site seeks to minimise interference with hydrological flows, including contributions from groundwater.

Other than what may be required for piling, subsurface excavations will be at a shallower depth than measured depth to groundwater on the Site. The geotechnical investigations undertaken by Morrison Geotechnical (2018) identified that the water table is approximately at RL 11.0. The future building will not have finish floor levels below RL 11.0, therefore lowering the water table or dewatering will not be required. This proposed method of pile construction using a continuous flying auger (CFA) manages any incursions of the water table within the pile bore without extracting water from the aquifer. Piles will be between 600 mm and 1,200 mm in diameter and will typically be spaced 8.4 m apart, except under lift and/or stairwell cores where they will be no less than 2 m apart. As the piles are not continuous, it is not anticipated that they will create a barrier to any shallow or perched groundwater flow that currently occurs within the Project footprint, minimising the potential for the development to impact groundwater contributions to base flow in the wetlands.

While no site specific groundwater modelling data is currently available for the Site, the level that groundwater has been encountered in the bores which are situated upslope from the wetlands is at a higher elevation that the wetlands, indicating that there is potential for groundwater to influence the wetlands and provide some base flow. However, the extent to which groundwater influences flows and water quality within the wetlands is unknown based on available site information.

There is a very low risk of any reduction of groundwater recharge during Stage 2 works.

3.2.4.4 Spill management

A spill prevention and response management plan along with supporting documentation will be produced as part of the Project's CEMP and their prescriptions will be implemented to minimise the risk of soil, surface water or groundwater contamination. This is detailed further in the Stage 2 BMP.

3.2.4.5 Surface water quality monitoring program

A surface water quality monitoring plan is being implemented to enable effective management of prescribed impacts on water. The surface water monitoring objectives for the Site are to detect changes during construction in receiving water quality resulting from the Project, with stormwater discharges potentially containing increased sediment loads, nutrients, total and dissolved metals, hydrocarbons or other contaminants such as pesticides.

The details of the water quality monitoring plan, including background data, sampling locations, sampling frequency, and parameters are provided in the Stage 2 BMP.

As part of the adaptive management approach, the water quality monitoring program will be reviewed periodically once sufficient data is available to ensure alignment with any changes in Site activities and potential impact pathways and determine whether any parameters should be excluded from further monitoring rounds. Based on the seasonality of rainfall in the region, it is anticipated that 12 months of monitoring data would be required to adequately assess all parameters, as such it is proposed that this is undertaken as part of the annual reporting process with recommendations for any change in parameters included in the report.

In addition to the modelling undertaken by RBG (2019), Greencap conducted three surface water sampling events on 19 and 26 November and 19 December 2018 to record water quality conditions under the existing land use. The intention of this sampling was to create some indicative background data to enable detection of potential changes during construction and operation in receiving water quality resulting from the Project. The water quality monitoring program collected water quality data over two sampling events on existing stormwater which flows into the downstream forested wetland and the east-flowing floodplain drain receiving environment. Sample locations were selected to allow a best possible indication of stormwater runoff quality upstream and downstream of the Site and the receiving environment (wetland) (see WQMP in Stage 2 BMP for further details about the monitoring program).

Given the objective for detection of changes to water quality in receiving water bodies during construction and operation of the Project, specific contaminants of concern were selected as listed above. Organochlorine Pesticides (OCP) and Organophosphorus Pesticides (OPP) as a result of the historic and current agricultural land-use. Physico-chemical parameters were also monitored for pH dependent threatened species such as the Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis*.

3.2.4.6 Summary of Prescribed Impacts on Water

As a result of the prescribed impact risk assessment, it was identified that the residual risk following the application of mitigation measures for surface water and groundwater management was very low.

For pH dependent species in the wetland, the expected improvement in water quality as a result of the Projects stormwater management system could potentially be of benefit. However, additional data from long term monitoring of these species and water quality would be required to assess any potential impacts as a result of the Project in greater detail. Consequently, it is considered that there is no requirement to offset the residual impact of the development on water quality, water bodies and hydrological processes.

3.2.5 Prescribed Impacts on Connectivity of Different Areas of Habitat of Threatened Species

Habitat connectivity will be maintained across the Site by vegetation management measures as outlined in the VMP, primarily by the installation of TPZ's to protect retained native vegetation during the construction works.

Importantly, to facilitate the movement of fauna, vegetated buffer zones will be substantial (10 m and 30 m wide) and representative of forest types being connected by these zones. Vegetation buffer zones will connect to the retained Subtropical Rainforest vegetation in the northern portion of the site and will run north to south in line with the mapped regional fauna corridor (**Figure 9**). This will provide important stepping stone and refuge habitat for threatened species and will represent an improvement in connectivity from the existing use of the Site. Revegetation will be undertaken during Stage 2 works and are addressed in the Stage 2 BMP.

Furthermore, stormwater management will incorporate WSUD principles and the make use of landscaped areas for filtering runoff, swale drains and vegetated sediment basins. New plantings in vegetation management zones, including rain gardens, as detailed in the Stage 2 BMP as part of Stage 2 works will treat both stormwater quality and contribute to providing a range of native habitat or 'moist corridors' across the site.

Where possible, landscaping will include habitat features such as rocks that have been salvaged from other areas of the Site (cleared windrows) that will create habitat for ground dwelling species (Turf, 2019).

3.2.6 Prescribed Impacts on Movement of Threatened Species that Maintains their Lifecycle

The primary impact on movement of threatened species relates to boundary fencing of the site, noting that species would be able to move around the Project site unless impeded by a boundary fence. In respect of

the current fencing on the site, the only existing permanent fencing in proximity to the site is the wildlife fencing along the Turnock St roadside. The Project will not impact this existing fencing.

Temporary boundary fencing has been installed during the pre-construction works. Tree Protection Zones (TPZ) have been installed around native vegetation and specific trees to be retained adjacent to the construction footprint as described in the VMP. This temporary fencing will be removed at the conclusion of the construction phase of the development. Temporary boundary fencing has been fitted with a 'post and bridge' system at least every 50 m in accordance with published guidelines (KRS 2009) to facilitate movement of koala *Phascolarctos cinereus* and other arboreal marsupials. As per the Stage 1 SSD application, there is no intent for a permanent boundary fence to be installed for the operation phase of the Project, thereby allowing movement of threatened species.

As per SEARs supporting advice received from DPIE on the 12 July 2019; "*the design and implementation of wildlife-friendly fencing that avoids impeding fauna movement on and through the Site and protects species such as koalas for collisions with vehicles along Cudgen Road and Turnock Street"* is currently being assessed in consultation with the OEH and is planned to continue until final lodgement of the EIS.

3.2.7 Prescribed Impacts of Vehicle Strikes on Threatened Species

3.2.7.1 On-site

The following traffic management measures will reduce the risk of impact on wildlife during the construction and/or operations phase of the Project:

- A CTPMSP has been produced as part of an approved CEMP and its prescriptions will be implemented during the construction phase of the Project.
- Construction traffic must maintain low vehicle speeds to 20km/hr on internal roads and access ways (LLB 2019) and operators shall take care and be aware of any wildlife that may be in the area to minimise the risk of fauna injury or mortality. Should wildlife enter the construction footprint, a suitably qualified fauna handler will be notified and actions taken in accordance with the CEMP.
- Documentation of all native fauna injuries and deaths will be recorded in incident registers to monitor species mortality and any direct impacts will trigger investigation and adaptive management actions where possible.
- Any injured native fauna detected shall be rescued and transferred to a local veterinarian for treatment and/or WIRES for rehabilitation.
- Traffic will be mainly restricted to the southern portion of the Site where the project footprint is at least 67 m from the remnant native vegetation. This provides a natural buffer zone.
- During the 24-hour operation of the hospital, traffic must maintain low vehicle speeds to 20km/hr on internal roads and access ways.

3.2.7.2 Off site

The proposed Stage 2 development will widen the access road (Cudgen Road) and is estimated to generate an incremental increase in daily traffic volumes to 5,300 trips in year 2033 along Cudgen Road and Turnock Street at the peak of the operations phase (Bitzios, 2019). There is an existing wildlife fence along Turnock Street that is owned and managed by TSC. The wildlife fence is located adjacent to the koala habitat on the Site.

In general, the wildlife fence is in good condition and affords good protection for small to medium size ground dwelling mammals. However, overgrown vegetation on both sides of the fence allows arboreal mammals such as koala *Phascolarctos cinereus* to cross the fence and the road. Consequently, this provides connectivity between areas of habitat for arboreal mammals and places these species at risk of vehicle strike. Weed control measures that commenced in in Stage 1 as outlined in the BMP will improve the function of

this fence as a barrier and will provide better protection for risk of vehicle strike to fauna trying to cross Turnock Street.

During Stage 1, the Applicant design plans were submitted to the relevant road authority in order to implement measures during Stage 2 on the Turnock Street and/or Cudgen Road to reduce the risk of impact on wildlife. All roads and traffic facilities must be designed to meet the requirements standards/road specifications of Council and/or RMS.

During Stage 2, the road environment adjoining the site will be changed from rural to urban The road environment will be upgraded to enable Site access as well as install and/or upgrade features associated with urban roads such as street lighting, kerb and channel guttering, signage, lane delineation and line-marking. Along with the increased pedestrian activity and traffic associated with the Project these measures are expected to reduce the existing traffic speeds along Turnock Street and Cudgen Road.

Advisory signage to mitigate impacts (movement and collisions with vehicles) due to the increase in traffic numbers along Cudgen Road and Turnock Street on fauna, particularly on the endangered population of koalas, is currently being assessed in consultation with the OEH and is planned to continue until final lodgement of the EIS.

3.2.7.3 Aviation

The proposed development includes a Helicopter Landing Site (HLS) on the top of the main building, which will result in low level air traffic in the vicinity of the Site. There is a small risk that threatened species of birds and bats may be flying across the Site in remnant vegetation that is located at the level of the floodplain at the time of aircraft operation.

Megabatfox strike with helicopters is classified by the Australian Transport Safety Bureau as 'birdstrike' and negligible birdstrikes occur with helicopters . In 2015, a total of 32 birdstrikes with helicopters were reported in Australia (Australian Transport Safety Bureau, 2017). Reported birdstrikes were significantly lower for most helicopter weight categories when compared with most aeroplane groups which may be partly due to helicopters flying at lower speeds and being easier for birds and pilots to see and avoid (Australian Transport Safety Bureau, 2017).

The highest proportion of helicopter birdstrikes recorded is whilst on the ground (standing) and the lower proportion of birdstrikes during landing and take-off, possibly due to the louder and varying noise caused by helicopter rotor speed and pitch changes during these flight phases (Australian Transport Safety Bureau, 2017). The HLS will be situated on the top of the multiple level hospital facility that is constructed on a ridge above the level of the floodplain. As such this location is considered to be above the flight path altitude of any birds or bats and will therefore not interrupt any local migration or cause death through aircraft strike.

Based on the available data from the northern NSW/SE QLD hospital transfers from NSW Ambulance, it is estimated that aircraft movements at peak operation of the Project would amount to approximately two movements per week, with total estimated time of six minutes for each event, a combination of three minutes inbound and three minutes outbound (Steve Graham, AviPro, 2019, pers. comm. 15 February). The nature of aircraft operation for the site is such that the majority of aviation movements are outbound (i.e. not inbound transport of trauma patients). Consequently, most outbound patient transfers would take place during the day when clinicians are available to make transport decisions. This would therefore minimise if not avoid aircraft movements in the peak periods of flying fox activity in the hours preceding dusk and dawn. As a consequence the probability of aircraft strike on flying foxes is considered very low.

Obtainable data for birdstrikes comes from helicopter operations in the vicinity of aerodromes. The Australian Transport Safety Bureau record the risks for birdstrikes and the Civil Aviation Safety Authority regulate the requirements for that recording. Because HLS are not regulated like aerodromes, the only data comes from helicopter operations in the vicinity of aerodromes. Therefore, the data does not give as clear a picture for birdstrikes in the vicinity of hospitals and threshold criteria which will trigger adaptive

management actions for aircraft strike on flying foxes/birds cannot be easily defined. However, this aerodrome birdstrike data does provide information on the characterisation of the rate of strikes and the times of day they occur and will be used to recommend peak birdstrike times to avoid helicopter operations where practical in the Aviation Operations Manual.

The following mitigation measures will be implemented to reduce the likelihood of fauna injuries and deaths from aviation operations:

- Aviation operations for the development will be conducted in accordance with an approved Aviation Operations Manual;
- The siting of the HLS and primary considerations in HLS approach and departure path selection included avoidance of ecologically and environmentally sensitive areas. The SSD general requirements of preferred flight path directions are detailed in the *Aviation State Significant Development Report: Tweed Valley Hospital SSD-9575* (AviPro 2019). The planned flight approach and departure paths to the HLS run north-northeast to southwest, minimising any impact on the environmentally sensitive areas (Flying fox camp);
- Documentation of all native fauna injuries and deaths will be recorded in incident registers to monitor species mortality, including fauna mortality resulting from aircraft movement. Should any of the following occur, it will trigger investigation and adaptive management actions may be implemented such as auditory repellents, visual deterrents and physical barriers where birds, bats and other animals are an issue:
    - when aircraft experiences an increase in frequency of wildlife strikes;
    - when an aircraft experiences substantial damage following a wildlife strike; and
    - when wildlife are observed on or close to the HLS in size or in numbers that are capable of causing the events described above.

3.2.8 Prescribed Impacts on Habitat of Threatened Species or TECs through removal of rocks

- Windrow vegetation that has self-sown on the linear rock mounds throughout the Site consists of early regrowth native rainforest species and woody weeds classified as High Threat Exotics. These rock mounds in Zones 4 will be removed as part of the development.
- The soil alongside the rock mounds is heavily compacted as a result of the existing agricultural use of the site. It is therefore unlikely to provide suitable habitat for threatened species that would be disturbed during the removal of these areas.
- To minimise impacts and ensure the safety of any native ground dwelling and arboreal fauna occupying trees, vegetation and around rocks proposed for removal, a suitably qualified and experienced fauna rescue person shall be present to supervise the clearing activities. A Fauna Management Procedure for vegetation and rock clearance activities on the Site is outlined in the FMP of the Stage 2 BMP. Adaptive Management for Uncertain Impacts

The Stage 1 and Stage 2 BMPs will set out the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain in accordance with section 9.4 of the BAM. Uncertain impacts include impacts related to vehicle and aircraft strikes.

3.2.9 Serious and Irreversible Impacts

The Credit Summary Report (**Appendix L**) for the assessment does not indicate that candidate Serious and Irreversible Impact (SAII) entities are likely to be present in Zones 4 and 8. Therefore there is no requirement to assess for potential SAII entities.

3.3 Impact Summary

3.3.1 Serious and Irreversible Impacts

There are no Serious and Irreversible Impacts (SAII) entities associated with the development.

3.3.2 Impacts Requiring Offsets

Measures to be implemented to avoid and minimise direct impacts on biodiversity are outlined in **Section 3.1** and **Table 9.**

The Project will result in the removal of a total 0.40 ha of vegetation in PCT 1302 Zone 8 as described in **Section 3.2.1**. The VI scores for Zone 8 (16.8) exceeds the threshold for PCTs in a vegetation zone that has a VI ≥15 where the PCT is representative of an endangered or critically endangered ecological community.

The impact of the Project will also generate a credit requirement based on the assumed presence of the three-toed snake-tooth skink *Coeranoscincus reticulatus* and powerful owl *Ninox strenua* as well as presence confirmed by survey for stinking cryptocarya *Cryptocarya foetida*.

Details of the Ecosystem and Species Credits required to the residual impact of the development are covered in **Section 3.5**.

3.3.3 Impacts Not Requiring Offsets

The Project will result in the removal of a total 0.55 ha of vegetation in PCT 1302 Zone 4 as described in **Section 3.2.1**. However, the VI scores for Zone 4 (10.6) fall below the threshold for PCTs in a vegetation zone that has a VI ≥15 where the PCT is representative of an endangered or critically endangered ecological community. Therefore, in accordance with *Subsection 3.1.1.3* of the BAM, no further assessment was required for this vegetation zone and Zone 4 does not require offsetting. The vegetation in Zone 9 is exotic vegetation that does not contain native vegetation (**Section 2.3.4)** and does not require offsetting.

The Project has the potential to cause indirect and prescribed impacts as detailed in **Sections 3.2.2** through **3.2.8**. However, the mitigation measures which are outlined in **Appendices I** and **J** will reduce the likelihood and consequence to acceptably low levels. Consequently, it is considered that the residual impact does not generate an offset requirement.

3.3.4 Areas Not Requiring Assessment

Areas that did not require assessment comprise of approximately 16 ha of cleared farmland under cultivation at the time of assessment, a custard apple tree orchard, unsealed roadways, the house and other areas of exotic vegetation that have no biodiversity values present. These areas only contain exotic vegetation, do not contain native vegetation and therefore do not require assessment. These areas that did not require assessment constituted approximately 70% of the entire Site (**Figure 21**).

3.4 Summary of Recommendations

The Project will monitor and manage potential impacts which have been outlined in the Stage 1 and Stage 2 BMPs and sub-plans (VMP, FMP, WQMP), with reference to other documents including the CEMP, SWMP and ESCP.

The BMPs include adaptive management for impacts on biodiversity that are uncertain in accordance with *Section 9.4.2* of the BAM and include details of measures to monitor predicted impacts, guidelines and thresholds which will trigger adaptive management actions and other measures proposed to mitigate potential impacts.

The BMPs also address proposed measures that will contribute to the recovery of the Mitchell's rainforest snail *Thersites mitchellae* that are consistent with the published recovery plan (NPWS 2011). Revegetation

of the exotic grassland in Zone 9 (0.95 ha) to rainforest will increase the area of potential habitat available to the snail and has been outlined in the VMP and FMP.

3.4.1 Summary of Mitigation Measures

Mitigation measures are captured in detail in the Stage 1 & 2 BMPs and associated sub-plans. Mitigation measures identified in this BDAR are summarised as follows:

- Minimisation of impacts on native vegetation and habitat during planning – see **Table 8**.
- Minimisation of impacts on native vegetation and habitat during construction and operation – see supporting management plans and **Appendices I and J**.

3.5 Credit Summary

The credit offset requirement discussed below was determined and endorsed as part of the Stage 1 approval (SSD 18 9575). To meet this residual offset obligation, HI made a payment into the Biodiversity Conservation Fund on 5th July 2019 in accordance with Part 6 Division 6 of the BC Act. However, as mentioned above this revision of the BDAR for Stage 2 has not removed information pertaining specifically to Stage 1 works in order to demonstrate consistency with the endorsed Stage 1 SSD BDAR, as per SSD 9575 Conditions Schedule 2 B20.

3.5.1 Change in Vegetation Integrity Score

The development of the Project will result in a direct impact on Zones 4 and 8. All other vegetation zones will not be directly impacted by the proposal. The future VI score of zero for the 0.55 ha portion of Zone 4 and the 0.40 ha portion of Zone 8 is due to the clearing of native vegetation within these vegetation zones. The change in vegetation integrity as a result of the Project is outlined in **Table 11.**

Table 11 Change in Vegetation Integrity

Zone	PCT ID	PCT Name	Condition class	Area (ha)	Current (VI)	Future (VI)	Total Change (VI)
4	1302	White Booyong- Fig subtropical rainforest	Self-sown windrow	0.55	10.6	0	-10.6
8	1302	White Booyong- Fig subtropical rainforest	Self-sown windrow	0.40	16.8	0	-16.8

3.5.2 Required Ecosystem Credits

A summary of the Biodiversity Credit Report (**Appendix L**) is outlined in **Table 12.** A total of three ecosystem credits were generated by the BAM calculator:

- The current VI for Zones 4 falls below the assessment threshold for Endangered Ecological Communities (i.e. VI ≥ 15) and no ecosystem credits are required to offset the residual impact of development (**Table 12**);
- The current VI for Zones 8 exceeds the assessment threshold for Endangered Ecological Communities (i.e. VI ≥ 15) and three ecosystem credits are required to offset the residual impact of development (**Table 12**).

Table 12 PCTs Requiring Offset and the Number of Ecosystem Credits

PCT ID	PCT Name	Vegetation Zone	Area (ha)	Sensitivity to gain	Biodiversity Risk rating	Ecosystem credits

1302	White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	Z4_Self-sown_windrow	0.55	High	2	0
		Z8_Self-sown_windrow	0.40	High	2	3
TOTAL						**3**

3.5.3 Required Species Credits

A summary of the Biodiversity Credit Report (**Appendix M**) is outlined in **Table 13**. One candidate species credit species was recorded within impacted sections of Zones 4 and 8 and two candidate species credit species were assumed present on the Site generating a total of 14 species credits (**Table 13**).

Table 13 Threatened Species Requiring Offset and the Number of Species Credits

Species name	Common name	Vegetation Zone	Direct impact (ha) or Individual	Count	Biodiversity risk rating	Species credits
Cryptocarya foetida	Stinking cryptocarya	Z8_Self-sown_windrow	N/A	1	1.5	2
Coeranoscincus reticulatus	Three-toed snake-tooth Skink	Z4_Self-sown_windrow	0.40	N/A	2.0	3
		Z8_Self-sown_windrow	0.55	N/A	2.0	3
Ninox strenua	Powerful owl	Z4_Self-sown_windrow	0.40	N/A	2.0	3
		Z8_Self-sown_windrow	0.55	N/A	2.0	3
TOTAL						**14**

The individual *Cryptocarya foetida* plant (sapling) along the Cudgen Rd boundary windrow will be translocated for conservation as discussed in **Section 3.2.1** and detailed in the Stage 1 BMP.

3.5.4 Conclusion

A total of three ecosystem credits and 14 species credits were generated by the BAM calculator.

A decrease in vegetation integrity score for the 0.55 ha portion of Zone 4 and 0.40 ha portion of Zone 8 is due to the proposed clearing of native vegetation within these vegetation zones. However, the current VI score for Zone 4 falls below the assessment threshold for Endangered Ecological Communities (i.e. VI ≥ 15), therefore in accordance with the BAM, no further assessment was required for these vegetation zones and it does not require offsetting. The current VI score for Zone 8 exceeds the assessment threshold for Endangered Ecological Communities (i.e. VI ≥ 15) and requires offsetting.

Fourteen threatened species credits were generated by the calculator based on assumed presence (i.e. powerful owl *Ninox strenua* and three-toed Snake-tooth Skink *Coeranoscincus reticulatus*). Two threatened species credits were generated from confirming presence through a survey (i.e. stinking cryptocarya *Cryptocarya foetida*).

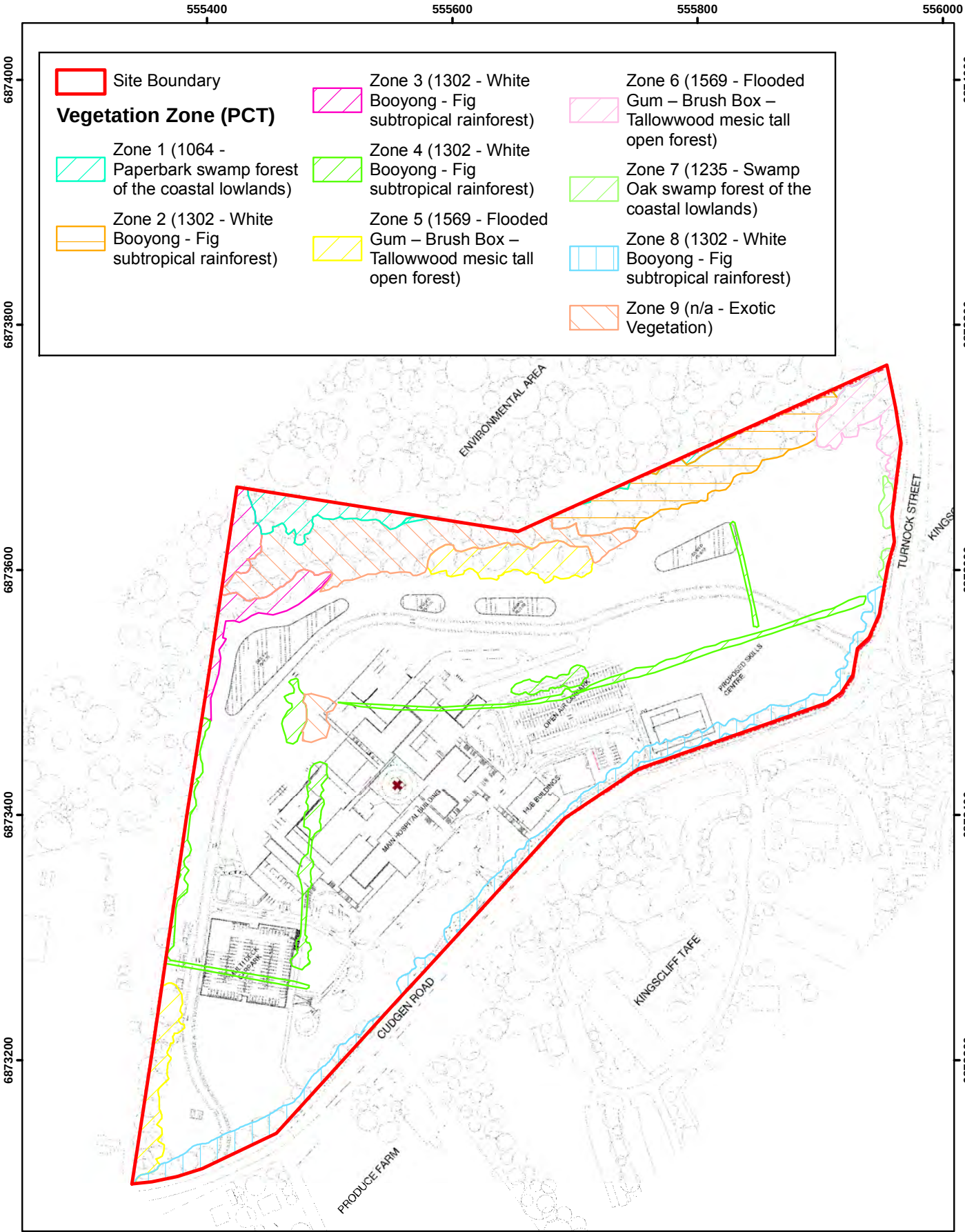
The individual *Cryptocarya foetida* plant (sapling) along the Cudgen Rd boundary windrow will be translocated for conservation as detailed in the Stage 1 BMP.

The above-mentioned credit offset requirement was determined and endorsed as part of the Stage 1 approval (SSD 18 9575). To meet this residual offset obligation, HI made a payment into the Biodiversity Conservation Fund on 5 July 2019.

The Project has the potential to cause indirect and prescribed impacts, however the mitigation measures including adaptive management strategies addressed in **Sections 3.2.2** through **3.2.8, Appendices I** and **J**, and in the BMPs will reduce the likelihood and consequence to of any residual impacts to low levels that does not generate an offset requirement.

4 GLOSSARY, ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
BC Act	*Biodiversity Conservation Act 2016*
BC Regulation	*Biodiversity Conservation Regulation 2016*
BAM	*Biodiversity Assessment Method Order 2017*
Coastal Management SEPP	State Environmental Planning Policy (Coastal Management) 2018
CKPoM	Tweed Coast Comprehensive Koala Plan of Management 2015
EEC	Ecological communities that are listed as 'endangered' under the *Biodiversity Conservation Act 2016.*
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Cth)
LGA	Local Government Area
OEH	Office of Environment and Heritage
PCT	Plant Community Type
PMF	Probable Maximum Flood
SAII	Serious and Irreversible Impact
VI	Vegetation Integrity
TEC	Ecological communities that are listed as 'threatened' under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Biodiversity Conservation Act 2016.*
TCR	Tweed Coast Road
TSC	Tweed Shire Council



Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,000	**Project Site Masterplan and Vegetation Zones**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 8th August 2018 (7.5 cm) © Nearmap 2018*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure A-3**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)* *Masterplan: Georeferenced plan STB-AR-SKE-PRW-10000154.pdf Rev. 4 (Sth Batessmart, 1 July 2019)*		
GREENCAP			

Doc Path: \\ser2bne1\Brisbane_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BDARs2\mxd\J156455_13_BDARs2_zA03_Masterplan_and_vege_zones_site_190801.mxd

5 REFERENCES

Allen, C. and Phillips, S. (2008). Grid-based SAT (RGB-SAT) sampling for the purposes of identifying areas being utilized by koalas in the South-east Forests of NSW. Project update & future directions. Unpublished report to NSW Department of Environment and Climate Change.

Bates Smart (2018). *Tweed Valley Hospital Masterplan*.

Biodiversity Conservation Act 2016 (NSW).

Bonacci (2018), *Tweed Valley Hospital Development – Design Report Civil & Structural,* Revision B. Bonacci Group (NSW) Pty Ltd, Sydney.

Cavvanba (2019) Data quality objectives and sampling, analysis and quality plan - Groundwater and soil investigation, Byron Bay, NSW.DECC (2002), *Descriptions for NSW (Mitchell) Landscapes Version 2*, Department of Environment and Climate Change, Sydney.

Clarke, S. A (2019a) *Targeted survey for Thersites mitchellae (Cox, 1864) (Mitchell's Rainforest Snail) at 771 Cudgen Rd, Cudgen, NSW, site for the proposed Tweed Valley Hospital*, Prepared for Herbert Smith Freehills LLP by Invertebrate Identification Australasia, Faulconbridge NSW.

Clark, S. A (2019b) Management Plan for the Mitchell's Rainforest Snail *Thersites mitchellae* (Cox, 1864) at 771 Cudgen Rd, Cudgen, New South Wales by Invertebrate Identification Australasia, Faulconbridge NSW.

Clark, S. A (2019c) Pre-construction baseline survey of *Thersites mitchellae* (Cox, 1864) (Mitchell's Rainforest Snail) at 771 Cudgen Rd, Cudgen, New South Wales by Invertebrate Identification Australasia, Faulconbridge NSW.

DECC (2009), *Threatened species survey and assessment guidelines: field survey methods for fauna (Amphibians)*, Department of Environment, Climate Change and Water, Sydney.

DECCW (2010), *Far North Coast Regional Conservation Plan*, Department of Environment, Climate Change and Water, Sydney.

DEWHA (2010), *Survey guidelines for Australia's threatened birds – Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*, Department of Environment, Water, Heritage and Arts, Canberra.

Destination Tweed (2018), *The Tweed, short history,* viewed 12 September 2018, https://destinationtweed.com.au/welcome/history/

Ecograph (2004). *Tweed Vegetation Management Strategy*. Vols.1 to 3. Report to Tweed Shire Council.

Ecosure (2018), *Tweed Flying-fox Camp Management Plan - Final Report to Tweed Shire Council*, Ecosure, Burleigh Heads, Queensland.

Greencap (2018) *Tweed Valley Hospital Due Diligence Ecological Constraints Report (version 3).* Greencap, Brisbane, Queensland.

Greencap (2018), *Ecological constraints analysis – Tweed Valley Hospital*. Greencap Pty Ltd, Brisbane.

Greencap (2019a), *Biodiversity Development Assessment Report – Tweed Valley Hospital*. Revision H, Greencap Pty Ltd, Brisbane.

Greencap (2019b), *Matters of National Environmental Significance Report – Tweed Valley Hospital*. Greencap Pty Ltd, Brisbane.

Greencap (2019c), *Stage 1 Biodiversity Management Plan*. Greencap Pty Ltd, Brisbane.

Greencap (2019d), *Stage 2 Biodiversity Management Plan*. Greencap Pty Ltd, Brisbane.

Interim Noise Guidelines (2009)

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

Landcom (2004), *Managing Urban Stormwater: Soils and Construction Volume 1*, Fourth Edition. Landcom, Parramatta.

NPWS (2001), *Mitchell's Rainforest Snail Thersites mitchellae recovery plan*. NSW National Parks and Wildlife Service, Hurstville, NSW.

NSW Scientific Committee (1999), *Lowland rainforest on floodplain in the NSW North Coast Bioregion – endangered ecological community listing*. NSW Scientific Committee final determination.

OEH (2016), *NSW Guide to Surveying Threatened Plants surveying guide*, Office of Environment and Heritage, Sydney.

OEH (2017), *Guidance to assist a decision-maker to determine a serious and irreversible impac*t, Office of Environment and Heritage, Sydney.

OEH (2018a), *Biodiversity Assessment Method Operational Manual – Stage 1*, Office of Environment and Heritage, Sydney.

OEH (2018b), *BioNet Vegetation Classification*, Office of Environment and Heritage, Sydney. Viewed 19 July 2018: http://www.environment.nsw.gov.au/NSWVCA20PRapp/search/compexportcustom.aspx

OEH (2018c), *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method*, Office of Environment and Heritage, Sydney.

OEH (2018d), '*BioNet Threatened Biodiversity Web Service*', NSW Office of Environment and Heritage, Sydney. Downloaded 25th July 2018.OEH (2019a), NSW BioNet, Office of Environment and Heritage, Sydney. Viewed 16 January 2019: https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/ProfileEdit.aspx?pId=20073&pType=Other&a=1

OEH (2019b) Threatened species Green-thighed Frog – profile. Viewed 21 January 2019: profile https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10485

RFS (2006), *Planning for Bushfire Protection*. NSW Rural Fire Service, Granville.

RFS (2007), *Standards for Asset Protection Zones*. NSW Rural Fire Service, Granville.

Robinson, M. (1974), The Robertson Land Acts in New South Wales, 1861-84. *Transactions of the Institute of British Geographers*, (61), 17-33. doi:10.2307/621597.

SMEC (2019) Tweed Valley Hospital Hydrological Assessment – Draft Rev 2. Fortitude Valley, QLD.

TSA Management. (2018), *Tweed Valley Hospital Concept Proposal and Design*.

TSC (2016), Tweed Shire Council – Development Design Specification D7 Stormwater quality, Tweed Shire Council, Murwillumbah.

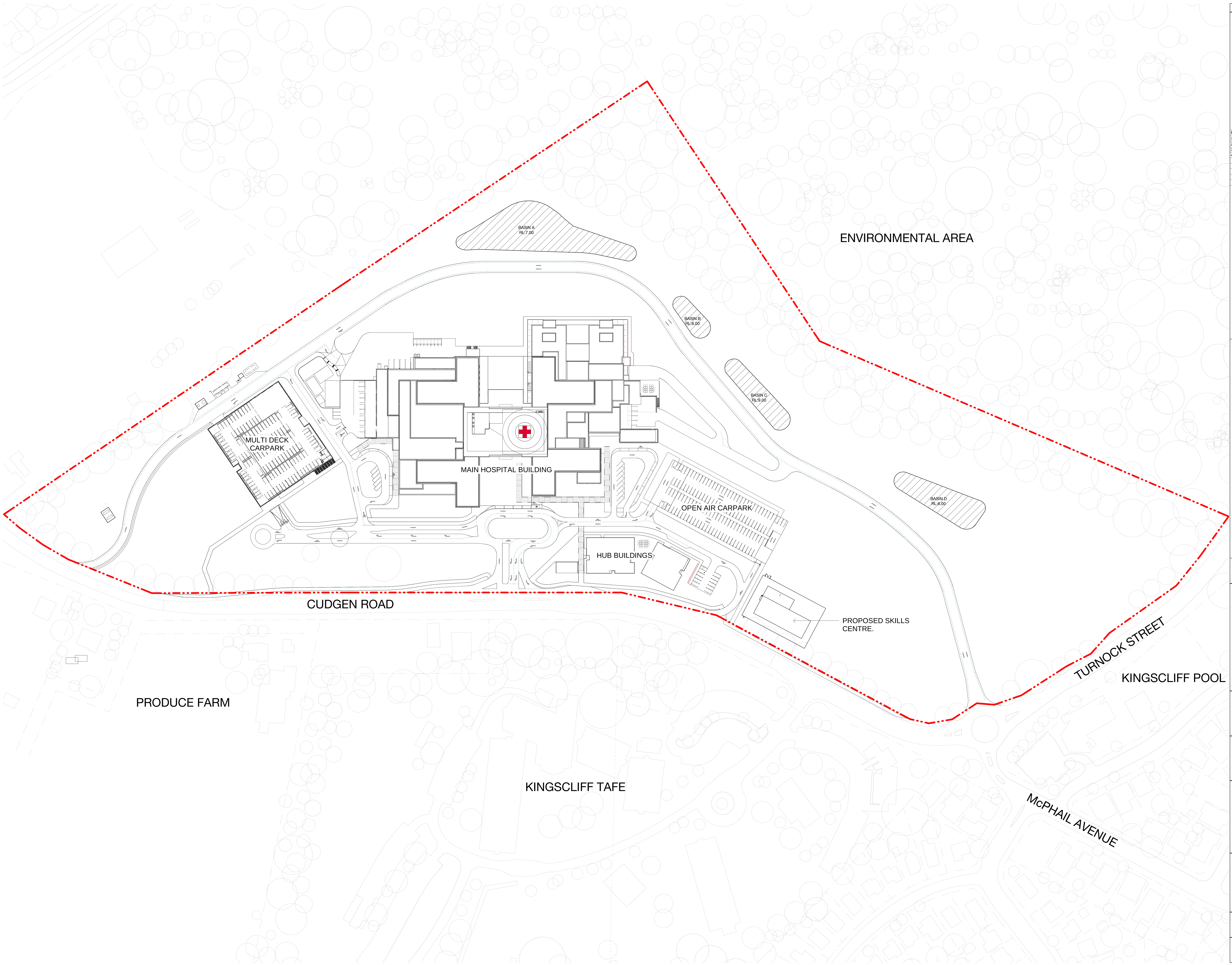
Turf (2018), *Tweed Valley Hospital Landscape Masterplan Report*. Turf Design Studio, Cronulla.

Tulau, M. J. (2002), *Agricultural Drainage in Acid Sulfate Soil Backswamps in New South Wales, Australia – Technical, Regulatory and Policy Responses.* NSW Department of Land and Water Conservation, Kempsey.

Tweed Shire Council (2018), *Kingscliff Locality Plan Volume 1 Context and locality wide strategies*, Tweed Shire Council, Murwillumbah.

White, I., Heath, L. and Melville, M. (1999), Ecological impacts of flood mitigation and drainage in coastal lowlands. *Australian Journal of Emergency Management*, Spring 1999.

APPENDIX A. TWEED VALLEY HOSPITAL MASTERPLAN (DEVELOPMENT AND CONSTRUCTION FOOTPRINT) AND TWEED COAST ROAD DEVELOPMENT FOOTPRINT



KEY PLAN

N

REV	DESCRIPTION	DRN	DATE
1	ISSUED FOR SSD2	BM	08/07/19
2	ISSUED FOR SSD2	BM	29/07/19
3	ISSUED FOR SSD2	BM	30/07/19
4	ISSUED FOR SSD2	BM	02/08/19

SITE PROPOSED LEGEND:

- SITE BOUNDARY.
- PROPOSED CONTOUR LEVELS 1 METER INTERVALS.
- SEDIMENT BASIN WORKS ALREADY COMPLETE.
- TREES.

DIMENSIONS

USE FIGURED DIMENSIONS, DO NOT SCALE. CONTRACTORS MUST VERIFY ALL DIMENSIONS ON THE SITE BEFORE COMMENCING ANY WORK OR MAKING ANY SHOP DRAWING WHICH MUST BE SUBMITTED AND REVIEWED BEFORE MANUFACTURE.

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PROJECT MANAGER
TSA MANAGEMENT

CLIENT
NSW GOVERNMENT | Health Infrastructure | Health Northern NSW Local Health District

PROJECT
TWEED VALLEY HOSPITAL

DRAWING TITLE
PROPOSED SITE PLAN

SCALE	DATE	DRAWN BY	CHECKED
1 : 1250@A1 1 : 2500@A3@A3	07/01/19	BM	BS

PROJECT No	DRAWING No	REVISION
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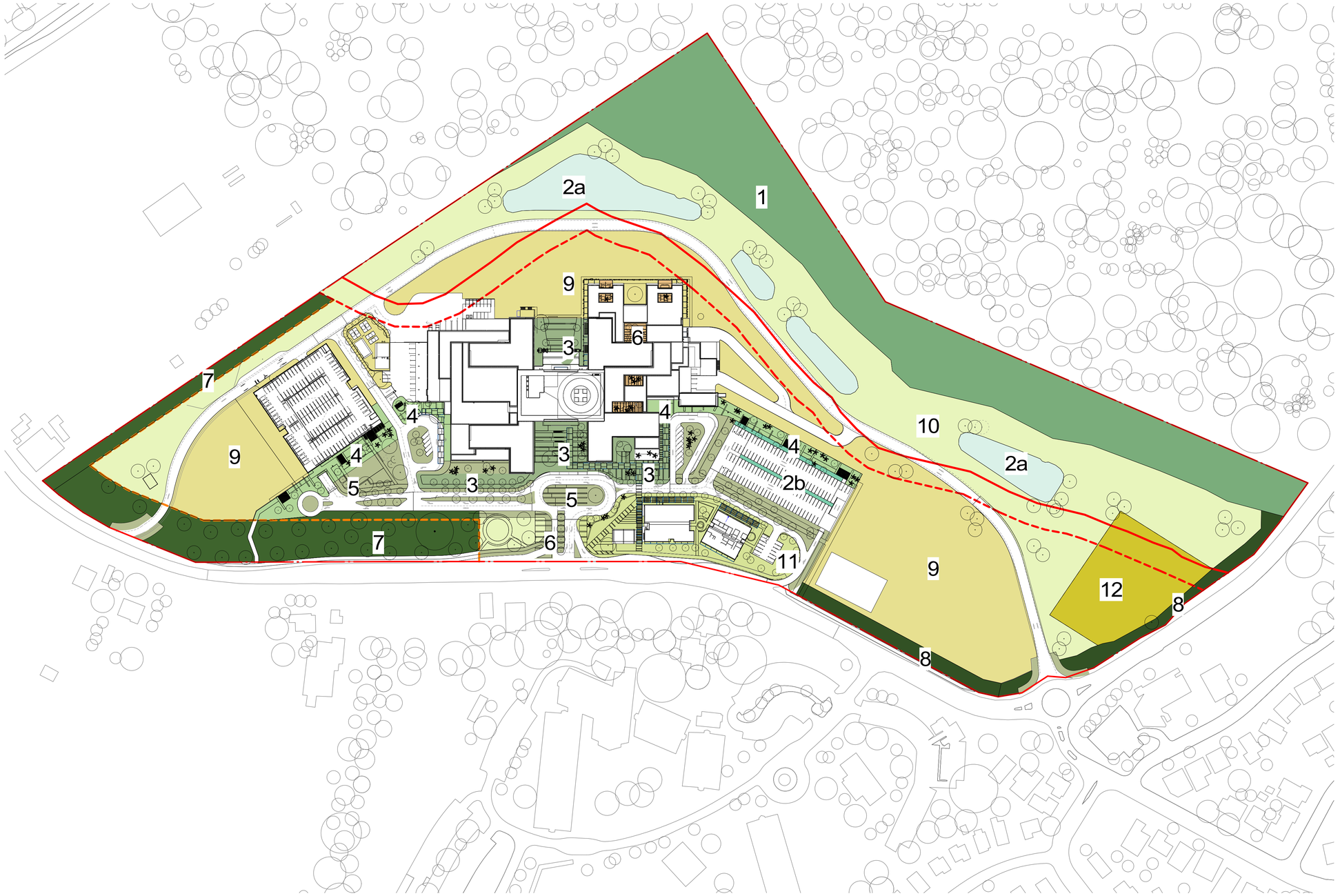

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SURVEY INFORMATION

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LEGEND

- 1. Retained forest - Restored and enhanced in accordance with Biodiversity Management Plan
- 2a. Bioretention planting
- 2b. Rain Gardens
- 3. Hospital landscape
- 4. Green Spine
- 5. Feature Entries/Hospital landscape fringe
- 6. Landscaped courtyards within hospital envelope
- 7. Vegetated buffer
- 8. Embellished Buffer - Embellished in accordance with Biodiversity Management Plan
- 9. Hydromulched/drill seeded lawn (Exotic grass-mowing maintenance eg. couch, buffalo)
- 10. Lawn with clusters of native planting
- 11. Health Hub
- 12. Existing Orchard

DRAFT NOT FOR CONSTRUCTION

Rev	Date	Description	Drawn	Checked
6	16.08.2019	ISSUED FOR SSD2	AR	MC
5	09.08.2019	ISSUED FOR SSD2	AR	MC
4	02.08.2019	ISSUED FOR SSD2	AR	MC
3	09.07.2019	ISSUED FOR SSD2	HH	MC
2	08.07.2019	ISSUED FOR SSD2	HH	MC
1	19.06.2019	70% SCHEMATIC DESIGN	AR	MC

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Client

NSW GOVERNMENT Health Infrastructure | Health Northern NSW Local Health District

Project

TWEED VALLEY HOSPITAL DEVELOPMENT

Drawing Title

Zonal Plan

Drawing Status

DRAFT ONLY

Scale. As indicated @A1 Plot Date 16/08/2019 3:01:53 PM

Project No.	Drawing No.	Revision
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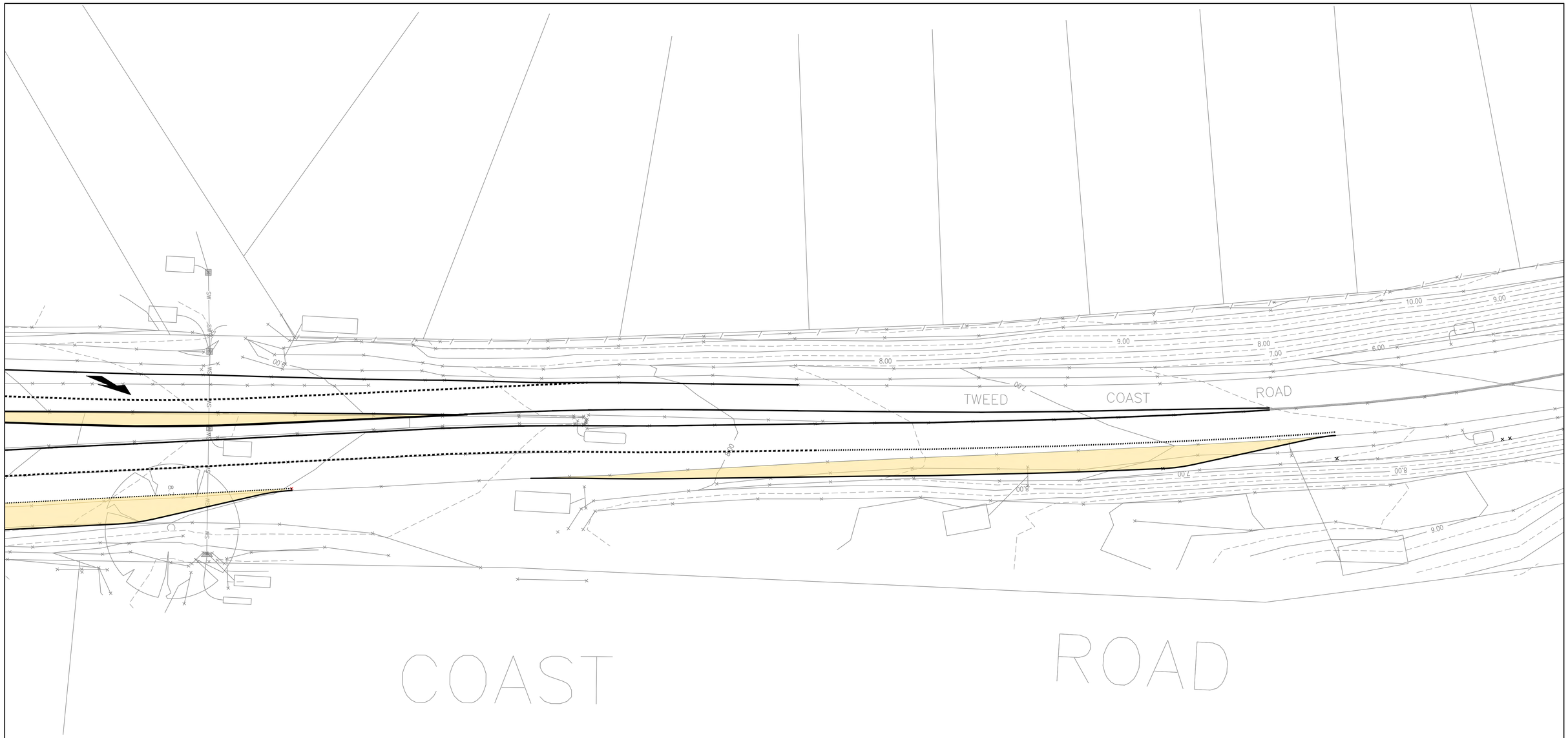

LEGEND

— · —	EXISTING SITE BOUNDARY
21.00	PROPOSED MAJOR CONTOUR
– – – –	PROPOSED MINOR CONTOUR
19.00	EXISTING MAJOR CONTOUR
– – – –	EXITING MINOR CONTOUR
⁄ ⁄ ⁄ ⁄ ⁄	PROPOSED BUILDING
— — — —	PROPOSED STOCKPILE
—— – ——	PROPOSED ROAD CENTRELINE
K&G	PROPOSED KERB & GUTTER
KO	PROPOSED KERB ONLY
MK	PROPOSED MOUNTABLE KERB

——	PROPOSED STORMWATER PIPE
→	PROPOSED STORMWATER PIPE FLOW DIRECTION
▣	PROPOSED SURFACE INLET PIT
	PROPOSED KERB INLET PIT
	PROPOSED SAG PIT
D02–2	PROPOSED STORMWATER PIT LABEL
900mm PIT	PROPOSED STORMWATER PIT SIZE
⏢	PROPOSED HEADWALL OUTLET
▨	ASPHALT PAVEMENT REFER TO RBG–CV–DWG–RIE–83–321 FOR DETAIL

SCALE 1:250
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KEY PLAN

Rev	Revision Description	By	App	Date
1	XXX	RG	CR	XX.XX.XX

REVISION IN PROGRESS

Rev	Revision Description	By	App	Date

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REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

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lendlease

Title
TWEED COAST ROAD & CUDGEN ROAD INTERSECTION – GA – SHEET 3 OF 3

Project
TWEED VALLEY HOSPITAL
TWEED SHIRE, GREENFIELD SITE,
NORTHERN RIVERS, NSW 2485

Scale at A1 AS SHOWN	Drawn Value	Design Checker D.RAVANDEH
Date 07.08.19	Designer Value	Approved C.ROPE
		Job Number 19005

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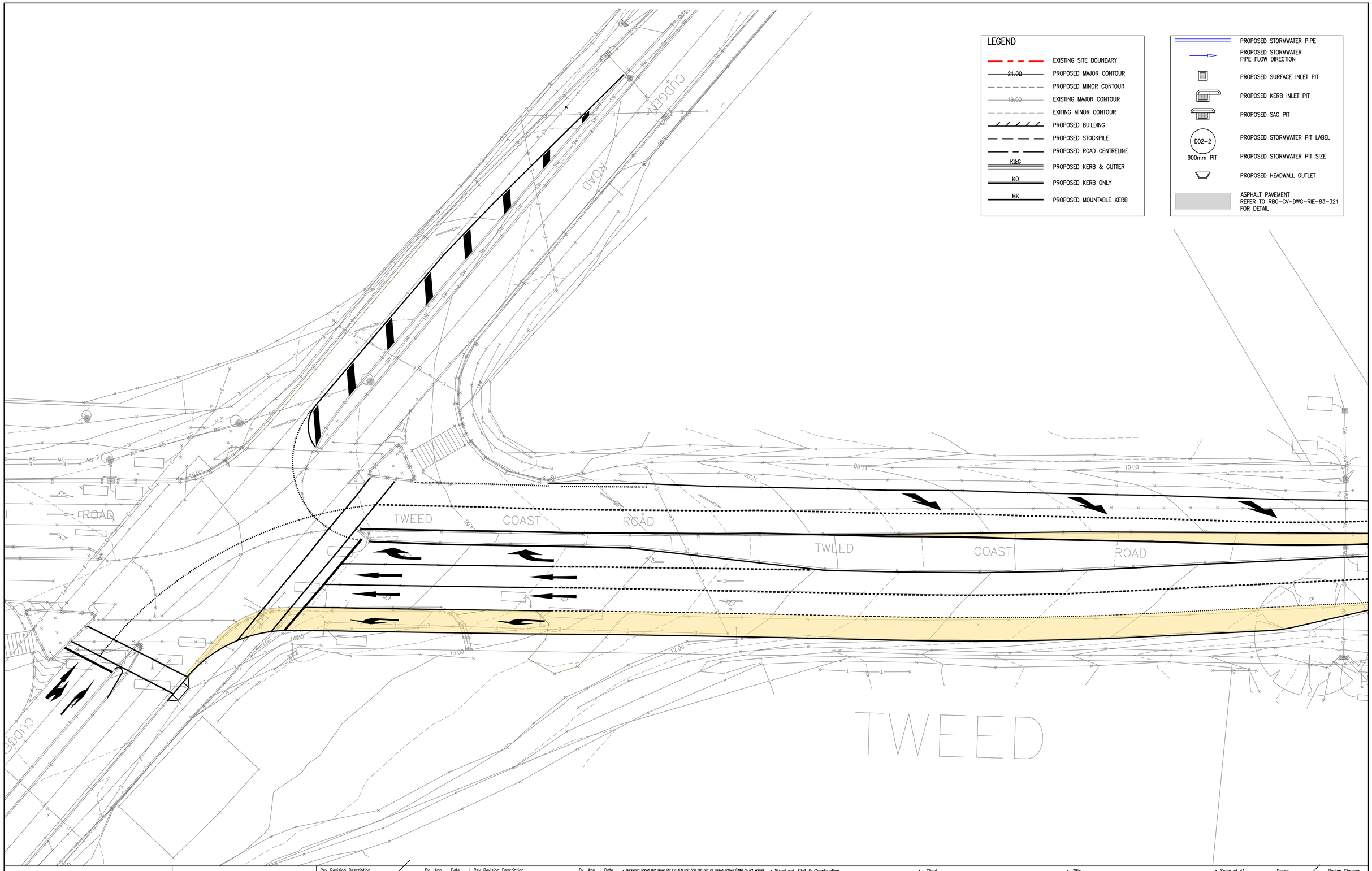
REVISION IN PROGRESS

Drawing Number
RBG–CV–DWG–RIE–88–302

Revision
1



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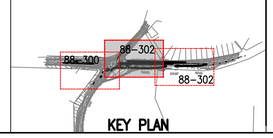

KEY PLAN

Rev	Revision Description	By	App	Date
1	XXX	RG	CR	XX.XX.XX

REVISION IN PROGRESS

Rev	Revision Description	By	App	Date

Structural, Civil & Construction Engineering Consultant

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Title

TWEED COAST ROAD & CUDGEN ROAD INTERSECTION – GA – SHEET 2 OF 3

Project

TWEED VALLEY HOSPITAL
TWEED SHIRE, GREENFIELD SITE, NORTHERN RIVERS, NSW 2485

Scale at A1	Drawn	Design Checker
AS SHOWN	Value	D.RAVANDEH
Date	Designer	Approved
07.08.19	Value	C.ROPE

Job Number **19005**

REVISION IN PROGRESS

NOT FOR CONSTRUCTION

Drawing Number **RBG-CV-DWG-RIE-88-301**

Revision **1**

PROPOSED ROAD WIDENING

DEMOLISH EXISTING KERB ISLAND AND REBUILD ROAD PAVEMENT

PROPOSED MOUNTABLE KERB

3.5m

3.2m

3.2m

1.0m

50m

TWEED COAST ROAD

CUDGEN ROAD

LEGEND

- EXISTING SITE BOUNDARY
- 21.00 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 19.00 EXISTING MAJOR CONTOUR
- EXITING MINOR CONTOUR
- PROPOSED BUILDING
- PROPOSED STOCKPILE
- PROPOSED ROAD CENTRELINE
- K&G PROPOSED KERB & GUTTER
- KO PROPOSED KERB ONLY
- MK PROPOSED MOUNTABLE KERB

- PROPOSED STORMWATER PIPE
- PROPOSED STORMWATER PIPE FLOW DIRECTION
- PROPOSED SURFACE INLET PIT
- PROPOSED KERB INLET PIT
- PROPOSED SAG PIT
- D02-2 / 900mm PIT PROPOSED STORMWATER PIT LABEL / PROPOSED STORMWATER PIT SIZE
- PROPOSED HEADWALL OUTLET
- ASPHALT PAVEMENT REFER TO RBG-CV-DWG-RIE-83-321 FOR DETAIL

SCALE 1:250

5 0 5 10m

KEY PLAN

88-300 88-302 88-302

REVISION IN PROGRESS

Rev	Revision Description	By	App	Date
1	XXX	RG	CR	XX.XX.XX

Rev	Revision Description	By	App	Date

DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS
REFER TO GENERAL NOTES UNLESS NOTED OTHERWISE

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Client: lendlease

Title: TWEED COAST ROAD & CUDGEN ROAD INTERSECTION – GA – SHEET 1 OF 3

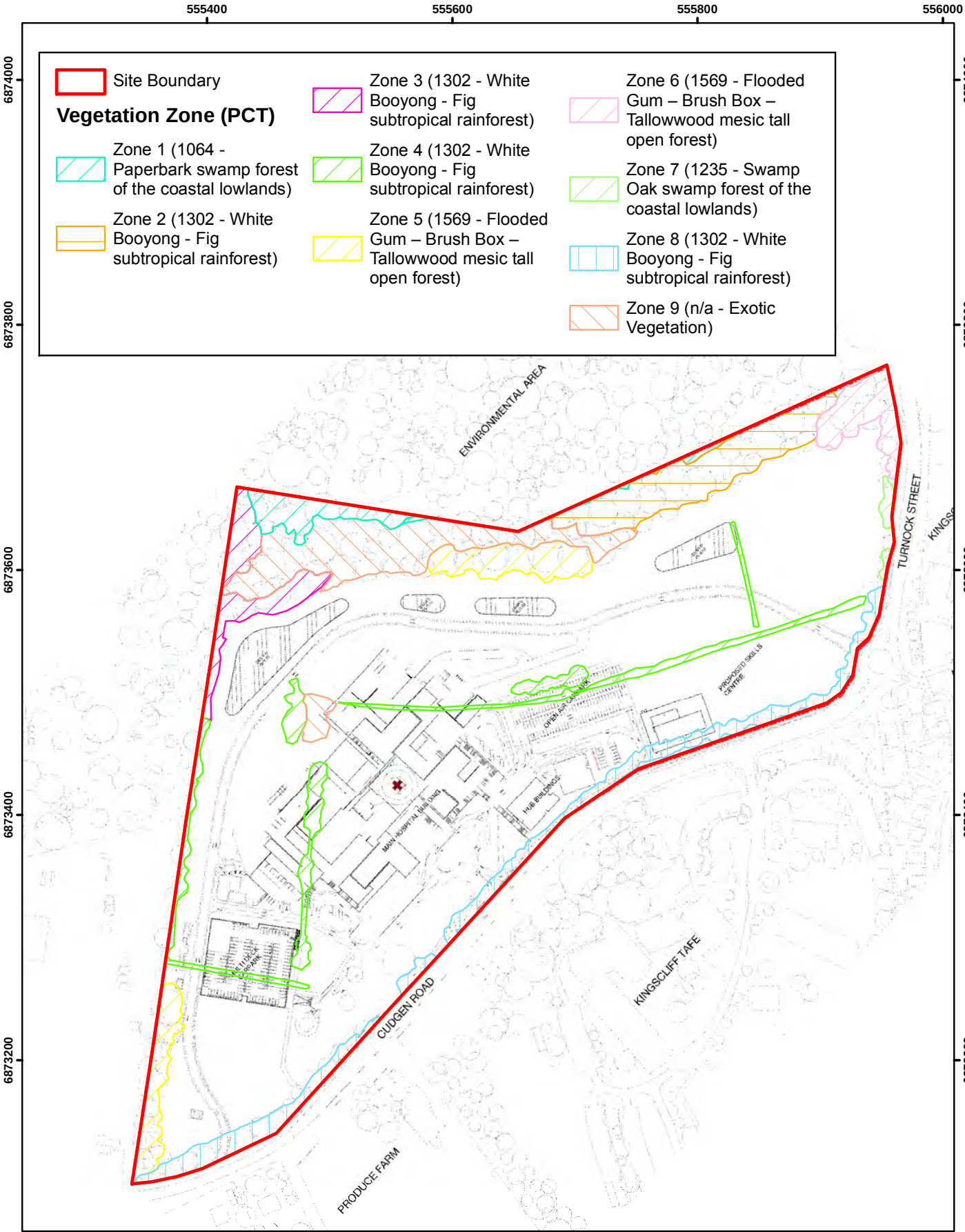
Project: TWEED VALLEY HOSPITAL
TWEED SHIRE, GREENFIELD SITE,
NORTHERN RIVERS, NSW 2485

Scale at A1	Drawn	Design Checker
AS SHOWN	Value	D.RAVANDEH
Date	Designer	Approved
07.08.19	Value	C.ROPE
		Job Number 19005

NOT FOR CONSTRUCTION

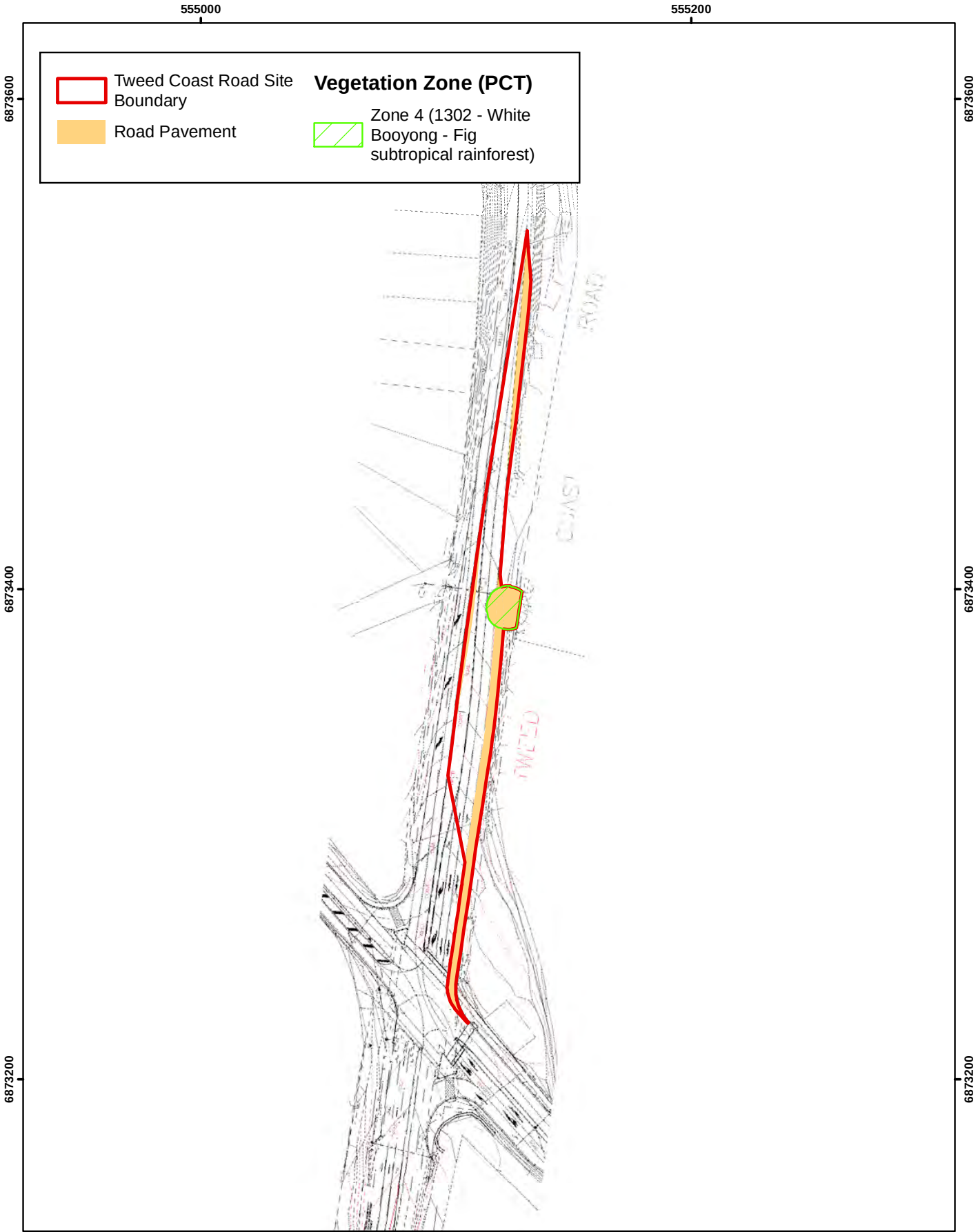
Drawing Number: RBG-CV-DWG-RIE-88-300
Revision: 1

REVISION IN PROGRESS



Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,000	**Project Site Masterplan and Vegetation Zones**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 8th August 2018 (7.5 cm) © Nearmap 2018*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure A-3**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)* *Masterplan: Georeferenced plan STB-AR-SKE-PRW-10000154.pdf Rev. 4 (Sth Batessmart, 1 July 2019)*		
GREENCAP			

Doc Path: \\ser2bne1\Brisbane_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BDARs2\mxd\J156455_13_BDARs2_zA03_Masterplan_and_vege_zones_site_190801.mxd



Client: C107778	N 0 25 50 m	Scale (@A4): 1:2,000	**Tweed Coast Road Site and Vegetation Zones**
Job #: J156455			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Vegetation mapping: Greencap (2018)*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure A-4**
Date: 8/08/2019	*Plan: Georeferenced version of Drawing No. RBG-CV-DWG-RIE-88-30088-300, RBG-CV-DWG-RIE-88-30088-301, and RBG-CV-DWG-RIE-88-30088-302 (Lendlease, 7 August 2019)*		
GREENCAP			

Doc Path: \\ser2bne1\Brisbane_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BDARs2\mxd\J156455_13_BDARs2_zA04_TCR_footprint_and_vege_zones_site_190801.mxd

APPENDIX B. FLORISTIC AND VEGETATION INTEGRITY PLOT SURVEY FIELD RECORDS

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

		Survey Name	Zone ID	Recorders			
Date	15/06/18	TVH	Veg Zone 1	Damian Licari and Gina Minatel			
Zone 56	Datum GDA 1994	Plot ID	19	Plot dimensions	20m X 50m	Photo #	
Easting 555890	Northing 6873927	IBRA region	Burringbar-Conondale Ranges	Midline bearing from 0 m	350 Magnetic °		
Vegetation Class		Coastal Swamp Forest				Confidence: H M L	
Plant Community Type		1064		EEC: Yes		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	4
	Shrubs	1
	Grasses etc.	2
	Forbs	5
	Ferns	3
	Other	1
Sum of **Cover** of native vascular plants by growth form group	Trees	30.3
	Shrubs	0.2
	Grasses etc.	10.5
	Forbs	30.3
	Ferns	50.4
	Other	15
High Threat Weed cover		10

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	0
50 – 79 cm	0	
30 – 49 cm	Present	
20 – 29 cm	present	
10 – 19 cm	present	
5 – 9 cm	absent	
< 5 cm	present	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	253.50 Tally space	

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)	100	100	100	100	100	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	100																			

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		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)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 15 / 06 / 18	TVH	19	Damian Licari and Gina Minatel

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
Tree	Melaleuca quinquenervia-Broad-leaved Paperbark	N	30		U	
Tree	Macaranga tanarius-Blush Macaranga	N	0.1	1	G	
Other	Parsonsia straminea-Common Silkpod	N	15		U	
Exotic	Paspalum conjugatum-Sour Grass	E	40		G	
Shurb	Hibiscus diversifolius-Swamp Hibiscus	N	0.2	2	M	
HTE	Ipomoea cairica- Coastal Morning Glory	HTE	10		G,M	
Fern	Blechnum indicum-Swamp Water Fern	N	50		G	
Forb	Persicaria strigosa- Spotted Knotweed	N	20		G	
Grass	Phragmites australis-Common Reed	N	10		G	
Forb	Solanum americanum-Glossy Nightshade	N	0.1	2	G	
Forb	Crinum pedunculatum-Swamp Lily	N	0.1	3	G,M	
Tree	Glochidion ferdinandi-Cheese Tree	N	0.1	1	G	
Forb	Persicaria dichotoma-Blume	N	0.1	3	G	
Grass	Baumea rubiginosa- Soft twigrush	N	0.5	30	G	
Forb	Persicaria sp.-Persicaria	N	10		G	
Fern	Hypolepis muelleri-Harsh Ground Fern	N	0.1	2	G	
Fern	Lygodium microphyllum-Climbing Snake Fern	N	0.3	2	M	
Tree	Melicope elleryana-Pink-flowered Doughwood	N	0.1	1	M	
	19					
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	25					
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	38					
	39					
	40					

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, …

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

		Survey Name	Zone ID	Recorders			
Date	10 / 07 / 18	TVH	Veg Zone 1	Damian Licari and Gina Minatel			
Zone 56	Datum GDA1994	**Plot ID**	16	**Plot dimensions**	20m X 50m	**Photo #**	
Easting 555 898	Northing 68 73830	**IBRA region**	Burringbar-Conondale Ranges	**Midline bearing from 0 m**	310 Magnetic °		
Vegetation Class		Coastal Swamp Forests				Confidence: H M L	
Plant Community Type		1064		**EEC:** Yes		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**	5
	Shrubs	2
	Grasses etc.	5
	Forbs	1
	Ferns	2
	Other	2
Sum of **Cover** of native vascular plants by growth form group	**Trees**	26.8
	Shrubs	0.7
	Grasses etc.	40
	Forbs	10
	Ferns	120
	Other	25
High Threat Weed cover		13.5

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	1
50 – 79 cm	0	
30 – 49 cm	present	
20 – 29 cm	present	
10 – 19 cm	present	
5 – 9 cm	present	
< 5 cm	present	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	252 Tally space	

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)	95	70	80	95	100	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	88																			

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		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)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	10 / 07 / 18	TVH	16	Damian Licari and Gina Minatel

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
Tree	Melaleuca quinquenervia-Broad-leaved Paperbark	N	20		U	
Other	Archontophoenix cunninghamiana-Bangalow Palm	N	10		M	
Tree	Melicope elleryana-Pink-flowered Doughwood	N	5	4	M	
Fern	Blechnum indicum-Swamp Water Fern	N	90		G	
Grass	Phragmites australis-Common Reed	N	10		G	
Forb	Persicaria strigosa-Spotted Knotweed	N	10		G	
Other	Parsonsia straminea-Common Silkpod	N	15		U	
Grass	Lepironia articulata-Grey Rush	N	10		G	
Grass	Carex appressa-Tall Sedge	N	5	40	G	
HTE	Ipomoea cairica- Coastal Morning Glory	HTE	10		G,M	
HTE	Cinnamomum camphora-Camphor Laurel	HTE	3	20	G,M	
Shurb	Ficus coronata-Creek Sandpaper Fig	N	0.2	3	M	
HTE	Schefflera actinophylla-Umbrella Tree	HTE	0.5	1	M	
Tree	Ficus macrophylla-Moreton Bay Fig	N	1	3	M	
Tree	Ficus obliqua-Small-leaved Fig	N	0.5	1	M	
Grass	Leersia hexandra-Swamp Ricegrass	N	10		G	
Fern	Hypolepis muelleri-Harsh Ground Fern	N	30		G	
Shurb	Myrsine Howittiana-Brush Muttonwood	N	0.5	1	M	
Tree	Glochidion ferdinandi var.pubens-Cheese Tree	N	0.3	1	G	
Grass	Baumea rubiginosa-Soft twigrush	N	5	100	G	
	21					
	22					
	23					
	24					
	25					
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	36					
	37					
	38					
	39					
	40					

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, …

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

Survey Name	Zone ID	Recorders
TVH	Veg Zone 2	Damian Licari and Gina Minatel

Date	Zone	Datum	Plot ID	Plot dimensions	Photo #
11/07/18	56	GDA1994	11	20m X 50m	

Easting	Northing	IBRA region	Midline bearing from 0 m
555871	6873727	Burringbar-Conondale Ranges	220 Magnetic °

		Confidence
Vegetation Class	Subtropical Rainforests	H M L
Plant Community Type	1302 — **EEC:** Yes	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**	6
	Shrubs	0
	Grasses etc.	1
	Forbs	2
	Ferns	1
	Other	6
Sum of **Cover** of native vascular plants by growth form group	**Trees**	110.1
	Shrubs	0
	Grasses etc.	0.1
	Forbs	3
	Ferns	0.2
	Other	39.4
High Threat Weed cover		9.4

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	2	3
50 – 79 cm	2	
30 – 49 cm	present	
20 – 29 cm	present	
10 – 19 cm	present	
5 – 9 cm	present	
< 5 cm	present	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	119.50 Tally space	

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)	80	75	95	100	100	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	90																			

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		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)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	11/07/18	TVH	11	Damian Licari and Gina Minatel

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
Tree	Ficus macrophylla-Moreton Bay Fig	N	80		U	
Tree	Ficus obliqua-Small-leaved Fig	N	20		U	
Tree	Melaleuca quinquenervia-Broad-leaved Paperbark	N	5	1	M	
Other	Archontophoenix cunninghamiana-Bangalow Palm	N	14		G,M,U	
Other	Mucuna gigantea subsp. gigantea-Burny Bean	N	0.2	5	G,M	
Other	Maclura cochinchinensis-Cockspur Thorn	N	10		G,M,U	
HTE	Ochna serrulata-Mickey Mouse Plant	HTE	0.1	2	G	
HTE	Schefflera actinophylla-Umbrella Tree	HTE	5	10	G,M	
Other	Cordyline congesta- Narrow-leaved Palm Lily	N	0.1	2	G,M	
HTE	Ipomoea indica- Morning Glory	HTE	2	5	M,U	
Tree	Macaranga tanarius-Blush Macaranga	N	0.1	5	G	
Forb	Alpinia caerulea-Native Ginger	N	1	10	G	
HTE	Cinnamomum camphora-Camphor Laurel	HTE	0.1	2	M	
Tree	Ficus coronata-Creek Sandpaper Fig	N	2	3	M	
Exotic	Solanum chrysotrichum-Devil's Fig	E	0.1	2	G	
Other	Flagellaria indica-Whip Vine	N	15		U	
Grass	Oplismenus aemulus-Australian Basket Grass	N	0.1	5	G	
Other	Smilax australis-Lawyer Vine	N	0.1	5	M,U	
Forb	Alocasia brisbanensis-Cunjevoi	N	2	10	G	
HTE	Ligustrum sinense-Small-leaved Privet	HTE	2	5	G,M	
HTE	Lantana camara- Lantana	HTE	0.2	2	G,M	
Exotic	Solanum mauritianum-Wild Tobacco Bush	E	0.2	1	M	
Tree	Acmena smithii-Lilly Pilly	N	3	1	M	
Exotic	Murraya paniculata-Murraya	E	0.4	1	G,M	
Fern	Christella dentata- Binung	N	0.2	2	G	
Exotic	Archontophoenix alexandrae - Alexandra palm	E	56		G,M,U	
	27					
	28					
	29					
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	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

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, …

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

Date	Survey Name	Zone ID	Recorders
11/07/18	TVH	Veg Zone 4	Damian Licari and Gina Minatel

Zone	Datum	Plot ID	Plot dimensions	Photo #
56	GDA 1994	99	10m X100m	

Easting	Northing	IBRA region	Midline bearing from 0 m
555489	6873425	Burringbar-Conondale Ranges	178 Magnetic °

		Confidence: H M L
Vegetation Class	Subtropical Rainforests	
Plant Community Type	1302 — **EEC:** No	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**	2
	Shrubs	0
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	1
Sum of **Cover** of native vascular plants by growth form group	**Trees**	90
	Shrubs	0
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	1
High Threat Weed cover		42

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	0
50 – 79 cm	0	
30 – 49 cm	present	
20 – 29 cm	present	
10 – 19 cm	present	
5 – 9 cm	present	
< 5 cm	present	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	34.5 Tally space	

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)	85	40	10	70	50	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	51																			

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		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)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	11/07/18	TVH	99	Damian Licari and Gina Minatel

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
Tree	Macaranga tanarius-Blush Macaranga	N	80		M,U	
HTE	Ochna serrulata-Mickey Mouse Plant	HTE	5	10	G	
HTE	Bidens pilosa-Cobblers Pegs	HTE	2	20	G	
HTE	Chloris gayana-Rhodes Grass	HTE	10		G	
HTE	Cinnamomum camphora-Camphor Laurel	HTE	10		M,U	
HTE	Schefflera actinophylla- Umbrella Tree	HTE	5	4	M,U	
Tree	Cupaniopsis anacardioides-Tuckeroo	N	10	2	M,U	
Exotic	Strelizia Sp.-Strelizia	E	0.1	1	G	
HTE	Asparagus aethiopicus-Ground Asparagus	HTE	10		G	
Other	Parsonsia straminea-Common Silkpod	N	1	1	U	
Exotic	Sonchus asper-Prickly Sowthistle	E	0.1	5	G	
	12					
	13					
	14					
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	40					

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, …

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

		Survey Name	Zone ID	Recorders			
Date	12/07/18	TVH	Veg Zone 8	Damian Licari and Gina Minatel			
Zone 56	Datum GDA 1994	Plot ID	98	Plot dimensions	10m X100m	Photo #	
Easting 555619	Northing 6873327	IBRA region	Burringbar-Conondale Ranges	Midline bearing from 0 m	38 Magnetic °		
Vegetation Class		Subtropical Rainforests				Confidence: H M L	
Plant Community Type		1302		EEC: No		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**	6
	Shrubs	0
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	5
Sum of **Cover** of native vascular plants by growth form group	**Trees**	42
	Shrubs	0
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	4.7
High Threat Weed cover		106

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

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)	100	40	100	60	100	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	80																			

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		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)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	12/07/18	TVH	98	Damian Licari and Gina Minatel

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
HTE	Pinus elliottii-Slash Pine	HTE	75		U	
Tree	Guioa semiglauca-Guioa	N	3	5	M	
Tree	Mallotus philippensis-Red Kamala	N	2	3	M	
Tree	Cryptocarya triplinervis var.triplinervis-3 veined laurel	N	2	5	M	
Tree	Macaranga tanarius-Blush Macaranga	N	30		M	
HTE	Senna pendula- Senna	HTE	1	1	M	
HTE	Ipomoea cairica- Coastal Morning Glory	HTE	5	10	M,U	
Other	Smilax australis-Lawyer Vine	N	1	3	M,U	
HTE	Cinnamomum camphora-Camphor Laurel	HTE	5	5	M,U	
HTE	Ochna serrulata-Mickey Mouse Plant	HTE	2	5	M	
HTE	Schefflera actinophylla-Umbrella Tree	HTE	2	5	M,U	
Exotic	Murraya paniculata-Murraya	E	0.5	2	M	
HTE	Bidens pilosa-Cobblers Pegs	HTE	5	50	G	
Other	Maclura cochinchinensis-Cockspur Thorn	N	1	1	G,M	
HTE	Chloris gayana-Rhodes Grass	HTE	1	20	G	
Other	Parsonsia straminea-Common Silkpod	N	2	3	M,U	
Tree	Mallotus discolor-White Kamala	N	1	1	M	
HTE	Asparagus aethiopicus-Ground Asparagus	HTE	10		G	
Exotic	Syagrus romanzoffiana-Cocos Palm	E	2	1	M	
Other	Archontophoenix cunninghamiana-Bangalow Palm	N	0.5	1	G,M	
Tree	Cupaniopsis anacardioides-Tuckeroo	N	4	3	M	
Exotic	Rhaphiolepis indica-Indian Hawthorn	E	1	1	M	
Exotic	Eragrostis tenuifolia-Elastic Grass	E	10		G	
Other	Amylotheca dictyophleba-Brush Mistletoe	N	0.2	5	M	
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	39					
	40					

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, …

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

Date	Survey Name	Zone ID	Recorders
15 / 08 / 18	TVH	Veg Zone 7	Damian Licari and Christina Maloney

Zone	Datum	Plot ID	Plot dimensions	Photo #
56	GDA1994	100	10mx100m	

Easting	Northing	IBRA region	Midline bearing from 0 m
555953	6873675	Burringbar-Conondale Ranges	174 Magnetic °

		Confidence: H M L
Vegetation Class	Coastal Floodplain Wetlands	
Plant Community Type	1235 — **EEC:** No	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**	4
	Shrubs	0
	Grasses etc.	0
	Forbs	1
	Ferns	0
	Other	1
Sum of **Cover** of native vascular plants by growth form group	**Trees**	35.8
	Shrubs	0
	Grasses etc.	0
	Forbs	0.1
	Ferns	0
	Other	3
High Threat Weed cover		33.3

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	0
50 – 79 cm	1	
30 – 49 cm	Present	
20 – 29 cm	Present	
10 – 19 cm	Present	
5 – 9 cm	Present	
< 5 cm	Present	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	9.5 Tally space	

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)	85	95	90	95	95	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	92																			

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		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)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 15 / 08 / 18	TVH	100	Damian Licari and Christina Maloney

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
Tree	1 Casuarina glauca-Swamp Oak	N	25		U	
Exotic	Melinis repens-Red Natal Grass	E	0.1	2	G	
HTE	3 Lantana camara-Lantana	HTE	2	3	M	
HTE	Bidens pilosa-Cobblers Pegs	HTE	10		G	
Tree	Macaranga tanarius-Blush Macaranga	N	0.5	10	M	
HTE	Senna pendula-Senna	HTE	2	5	M	
Exotic	Cenchrus purpureus-Barner Grass	E	35		M	
Forb	2 Oxalis sp.- Oxalis	N	0.1	1	G	
Exotic	Sonchus asper-Prickly Sowthistle	E	0.1	5	G	
HTE	Ricinus communis-Castor Oil Plant	HTE	0.2	1	M	
HTE	Ipomoea cairica-Coastal Morning Glory	HTE	6		M,U	
Exotic	Solanum mauritianum- Wild Tobacco Bush	E	5	4	M	
HTE	Schefflera actinophylla-Umbrella Tree	HTE	0.1	1	M	
Tree	Mallotus philippensis-Red Kamala	N	0.3	1	M	
Exotic	Macroptilium atropurpureum-Siratro	E	2	3	G	
Other	Diplocyclos palmatus- Native bryony	N	3	3	M	
HTE	Chloris gayana-Rhodes Grass	HTE	10		G	
HTE	Ipomoea indica-Morning Glory	HTE	3	10	M,U	
Exotic	Triumfetta rhomboidea-Chinese Bur	E	0.2	20	G	
Exotic	Passiflora subpeltata-White Passionflower	E	3	3	G,M	
Tree	Callistemon viminalis-Weeping Bottlebrush	N	10		M	
Exotic	Megathyrsus maximus var. coloratus- guinea grass	E	15		G	
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

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, …

BAM Site – Field Survey Form

Site Sheet no: 1 of 3

		Survey Name	Zone ID	Recorders			
Date	15 / 08 / 18	TVH	Veg Zone 6	Damian Licari and Christina Maloney			
Zone 56	Datum GDA 1994	Plot ID	101	Plot dimensions	20m X 50m	Photo #	
Easting 555957	Northing 6873725	IBRA region	Burringbar-Conondale Ranges	Midline bearing from 0 m	255 Magnetic °		
Vegetation Class		North Coast Wet Sclerophyll Forests				Confidence: H M L	
Plant Community Type		1569		EEC: No		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**	8
	Shrubs	1
	Grasses etc.	0
	Forbs	3
	Ferns	0
	Other	6
Sum of **Cover** of native vascular plants by growth form group	**Trees**	78.4
	Shrubs	2
	Grasses etc.	0
	Forbs	0.7
	Ferns	0
	Other	7.8
High Threat Weed cover		61.8

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	1
50 – 79 cm	present	
30 – 49 cm	present	
20 – 29 cm	present	
10 – 19 cm	present	
5 – 9 cm	present	
< 5 cm	present	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	15 Tally space	

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)	95	90	90	98	100	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	94.6																			

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		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)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	15 / 08 / 18	TVH	101	Damian Licari and Christina Maloney

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
Tree	Eucalyptus grandis-Flooded Gum	N	40		U	
Tree	Eucalyptus microcorys-Tallowwood	N	20		U	
Tree	Macaranga tanarius-Blush Macaranga	N	10		G,M	
HTE	Schefflera actinophylla-Umbrella Tree	HTE	15		M	
Tree	Cryptocarya triplinervis-Three-veined laurel	N	6		G,M	
HTE	Senna pendula-Senna	HTE	2	10	M	
Other	Geitonoplesium cymosum-Scrambling Lily	N	0.1	5	G	
Exotic	Syagrus romanzoffiana- Cocos Palm	E	0.3	20	M	
Other	Smilax australis-Lawyer Vine	N	2	10	G,M,U	
Exotic	Ambrosia Artemisiaefolia-Common Ragweed	E	6		G	
Forb	Alpinia caerulea-Native Ginger	N	0.5	2	G	
HTE	Ipomoea cairica- Coastal Morning Glory	HTE	10		G,M	
Other	Parsonsia straminea-Common Silkpod	N	0.1	4	M	
HTE	Asparagus aethiopicus-Ground Asparagus	HTE	0.5	10	G	
Forb	Alocasia brisbanensis-Cunjevoi	N	0.1	1	G	
Tree	Ficus coronata-Creek Sandpaper Fig	N	0.2	2	M	
Other	Maclura cochinchinensis-Cockspur Thorn	N	5	5	G,M,U	
HTE	Bidens pilosa-Cobblers Pegs	HTE	10		G	
Exotic	Hypochaeris glabra-Smooth Catsear	E	0.1	1	G	
Exotic	Ageratum conyzoides subsp. Conyzoides-Goatweed	E	2	20	G	
HTE	Chloris gayana- Rhodes Grass	HTE	0.5	20	G	
Exotic	Stelitzia sp-Strelizia	E	0.1	1	G	
HTE	Ochna serrulata-Mickey Mouse Plant	HTE	1	15	G	
HTE	Lantana camara- Lantana	HTE	2	3	M	
Tree	Glochidion ferdinandi-Cheese Tree	N	0.1	1	G	
HTE	Chrysanthemoides monilifera- Bitou Bush	HTE	0.2	1	G	
Forb	Oxalis sp.-Oxalis	N	0.1	1	G	
Exotic	Murraya paniculata-Murraya	E	2	10	M	
Exotic	Setaria sphacelata- Setaria	E	1	20	G	
HTE	Ipomoea purpurea- Common Morning Glory	HTE	10		G,M	
Exotic	Passiflora subpeltata-White Passionflower	E	2	20	G,M	
Exotic	Triumfetta rhomboidea- Chinese Bur	E	20		G	
Exotic	Paspalum conjugatum- Sour Grass	E	1	30	G	
Exotic	Vicia tetrasperma-Slender Vetch	E	0.1	5	G	
Exotic	Conyza bonariensis- Flaxleaf Fleabane	E	0.1	1	G	
Other	Hibbertia scandens-Climbing Guinea Flower	N	0.5	20	G	
Exotic	Tagetes minuta- Stinking Roger	E	1	10	G	
Exotic	Desmodium intortum-Green-leaved Desmodium	E	5	10	G	
HTE	Ageratina riparia- Mistflower	HTE	0.1	4	G	
Tree	Notelaea longifolia-Large Mock-olive	N	2	2	M	

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, …

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 15 / 08 / 18	TVH	101	Damian Licari and Christina Maloney

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
Tree	Glochidion sumatranum-Umbrella Cheese Tree	N	0.1	5	G	
Other	Marsdenia rostrata- Milk Vine	N	0.1	10	G,M	
Shrub	Myrsine variabilis- Muttonwood	N	2	10	M	
HTE	Melinis minutiflora-Molasses Grass	HTE	10		G	
	5					
	6					
	7					
	8					
	9					
	10					
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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, …

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

		Survey Name	Zone ID	Recorders			
Date	15 / 08 / 18	TVH	Veg Zone 5	Damian Licari and Christina Maloney			
Zone 56	Datum GDA1994	Plot ID	102	Plot dimensions	10mX100m	Photo #	
Easting 555362	Northing 6873160	IBRA region	Burringbar-Conondale Ranges	Midline bearing from 0 m	13 Magnetic °		
Vegetation Class		North Coast Wet Sclerophyll Forests				Confidence: H M L	
Plant Community Type		1569		EEC: No		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	3
	Shrubs	0
	Grasses etc.	0
	Forbs	1
	Ferns	0
	Other	4
Sum of **Cover** of native vascular plants by growth form group	Trees	70
	Shrubs	0
	Grasses etc.	0
	Forbs	0.1
	Ferns	0
	Other	14.3
High Threat Weed cover		62.6

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	5	1
50 – 79 cm	Present	
30 – 49 cm	present	
20 – 29 cm	present	
10 – 19 cm	present	
5 – 9 cm	present	
< 5 cm	present	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	146 Tally space	

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)	80	95	95	97	100	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	93.4																			

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		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)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

400 m^2 plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 15 / 08 / 18	TVH	102	Damian Licari and Christina Maloney

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
Exotic	Syagrus romanzoffiana- Cocos Palm	E	4	3	M,U	
Tree	Macaranga tanarius-Blush Macaranga	N	20		M,U	
Tree	Eucalyptus grandis- Flooded Gum	N	40		U	
Tree	Guioa semiglauca-Guioa	N	10		M,U	
HTE	Cinnamomum camphora- Camphor Laurel	HTE	35		M,U	
Other	Maclura cochinchinensis-Cockspur Thorn	N	4	10	G,M,U	
Other	Smilax australis-Lawyer Vine	N	10		G,M,U	
HTE	Bidens pilosa- Cobblers Pegs	HTE	15		G	
HTE	Schefflera actinophylla- Umbrella Tree	HTE	0.5	3	M,U	
HTE	Ochna serrulata- Mickey Mouse Plant	HTE	0.5	10	G	
Exotic	Solanum nigrum- Black-berry Nightshade	E	0.2	15	G	
Exotic	Murraya paniculata- Murraya	E	0.3	10	M,U	
HTE	Lantana camara- Lantana	HTE	0.2	5	G,M	
HTE	Asparagus aethiopicus- Ground Asparagus	HTE	0.1	3	G	
HTE	Ligustrum sinense- Small-leaved Privet	HTE	0.5	6	G,M	
HTE	Senna pendula- Senna	HTE	0.5	10	M,U	
HTE	Tradescantia fluminensis- Trad	HTE	0.1	10	G	
Forb	Oxalis sp.- Oxalis	N	0.1	1	G	
Exotic	Triumfetta rhomboidea- Chinese Bur	E	10		G	
Other	Hibbertia scandens-Climbing Guinea Flower	N	0.1	2	G	
Exotic	Passiflora subpeltata- White Passionflower	E	1	3	G,M	
Exotic	Cestrum nocturnum- Lady of the Night	E	0.5	5	G,M	
Other	Stephania japonica-Snake vine	N	0.2	3	G,M	
Exotic	Passiflora suberosa- Cork Passionflower	E	0.5	15	G,M	
HTE	Ageratina riparia- Mistflower	HTE	0.2	5	G	
HTE	Melinis minutiflora- Molasses Grass	HTE	10		G	
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

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, …

BAM Site – Field Survey Form

Site Sheet no: 1 of 2

		Survey Name	Zone ID	Recorders			
Date	03 / 09 / 18	TVH	Veg Zone 3	Annette McKinley and Christina Maloney			
Zone 56	Datum GDA1994	Plot ID	103	Plot dimensions	20mX50m	Photo #	
Easting 555433	Northing 6873550	IBRA region	Burringbar-Conondale Ranges	Midline bearing from 0 m	68 Magnetic °		
Vegetation Class		Subtropical Rainforests				Confidence: H M L	
Plant Community Type		1302		EEC: Yes		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**	8
	Shrubs	3
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	5
Sum of **Cover** of native vascular plants by growth form group	**Trees**	31.5
	Shrubs	0.7
	Grasses etc.	0
	Forbs	0
	Ferns	0
	Other	1.7
High Threat Weed cover		19.1

BAM Attribute (1000 m² plot)		
DBH	**# Tree Stems Count**	**# Stems with Hollows**
80 + cm	0	0
50 – 79 cm	0	
30 – 49 cm	present	
20 – 29 cm	present	
10 – 19 cm	present	
5 – 9 cm	present	
< 5 cm	present	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	38.5 Tally space	

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)	85	75	75	95	95	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	85																			

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		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)	0		
Cultivation (inc. pasture)	1		Edge of plot
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness	2		Lantana camera, Madeira vine, elephant grass, Bidens pilosa
Other			

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

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

400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	03 / 09 / 18	TVH	103	Annette McKinley and Christina Maloney

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
Tree	Guioa semiglauca-Guioa	N	8		M,U	
Tree	Macaranga tanarius-Blush Macaranga	N	10		M,U	
Tree	Diospyros fasciculosa-Grey Ebony	N	0.5	1	U	
HTE	Ligustrum sinense- Small-leaved Privet	HTE	10		G,M	
Exotic	Rivina humilis- Coral Berry	E	1	50	G	
HTE	Ipomoea cairica- Coastal Morning Glory	HTE	1	10	G,M,U	
Tree	Mallotus philippensis-Red Kamala	N	2	2	M	
HTE	Lantana camara-Lantana	HTE	4	2	G,M	
Other	Mucuna gigantea subsp. gigantea-Burny Bean	N	0.5	4	G,M,U	
Exotic	Passiflora edulis- Common Passionfruit	E	0.1	1	G,M,U	
HTE	Ochna serrulata- Mickey Mouse Plant	HTE	1	10	G	
Other	Trophis scandens-Burny Vine	N	0.1	2	G,M	
HTE	Bidens pilosa- Cobblers Pegs	HTE	3	500	G	
HTE	Senna pendula- Senna	HTE	0.1	2	M	
Exotic	Persea americana-avocado	E	0.5	2	M	
Tree	Commersonia bartramia-Brown Kurrajong	N	3	2	M,U	
Exotic	Cenchrus purpureus- Barner Grass	E	10		G	
Exotic	Solanum mauritianum- Wild Tobacco Bush	E	0.5	3	M	
Exotic	Murraya paniculata-Murraya	E	0.1	1	M	
Tree	Ficus fraseri-Sandpaper Fig	N	1	1	M	
Exotic	Cestrum sp. Cestrum	E	1	1	M	
Other	Cordyline congesta- Narrow-leaved Palm Lily	N	0.5	3	G	
Shrub	Eupomatia bennettii-Small Bolwarra	N	0.1	1	M	
Exotic	Passiflora suberosa- Cork Passionflower	E	0.1	2	G,M,U	
Tree	Cryptocarya triplinervis var. triplinervis-3 veined laurel	N	1	5	G,M	
Other	Flagellaria indica-Whip Vine	N	0.5	1	M,U	
Shrub	Capparis arborea-Native Pomegranate	N	0.5	1	M	
Shrub	Tabernaemontana pandacaqui-Banana Bush	N	0.1	1	M	
Other	Maclura cochinchinensis-Cockspur Thorn	N	0.1	1	G,M,U	
Exotic	Monstera deliciosa-Fruit Salad Plant	E	0.2	1	G	
Exotic	Paspalum mandiocanum-Boradleaf Paspalum	E	0.1	1	G	
Tree	Macadamia integrifolia <-> tetraphylla hybrid	N	6	5	M,U	
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

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, …

APPENDIX C. FLORISTIC VEGETATION SURVEY SUMMARY OF RESULTS

Plot Name	Scientific Name	Common Name	Growth Form Group	Stratum	Species Type	Cover	Abundance
Plot 19							
19	*Baumea rubiginosa*	Soft twigrush	Grass or grass like	G	Native	0.5	30
19	*Blechnum indicum*	Swamp Water Fern	Fern	G	Native	50	-
19	*Crinum pedunculatum*	Swamp Lily	Forb	G, M	Native	0.1	3
19	*Glochidion ferdinandi*	Cheese Tree	Tree	G	Native	0.1	1
19	*Hibiscus diversifolius*	Swamp Hibiscus	Shrub	M	Native	0.2	2
19	*Hypolepis muelleri*	Harsh Ground Fern	Fern	G	Native	0.1	2
19	*Ipomoea cairica*	Coastal Morning Glory	N/A	G, M	Hight Threat Exotic	10	-
19	*Lygodium microphyllum*	Climbing Snake Fern	Fern	M	Native	0.3	2
19	*Macaranga tanarius*	Blush Macaranga	Tree	G	Native	0.1	1
19	*Melaleuca quinquenervia*	Broad-leaved Paperbark	Tree	U	Native	30	-
19	*Melicope elleryana*	Pink-flowered Doughwood	Tree	M	Native	0.1	1
19	*Parsonsia straminea*	Common Silkpod	Other	U	Native	15	-
19	*Paspalum conjugatum*	Sour Grass	N/A	G	Exotic	40	-
19	*Persicaria dichotoma*	Blume	Forb	G	Native	0.1	3
19	*Persicaria sp.*	Persicaria	Forb	G	Native	10	-
19	*Persicaria strigosa*	Spotted Knotweed	Forb	G	Native	20	-
19	*Phragmites australis*	Common Reed	Grass or grass like	G	Native	10	-
19	*Solanum americanum*	Glossy Nightshade	Forb	G	Native	0.1	2

Growth Form Group	Count of Native Species Richness	Sum of Cover
Tree	4	30.3
Shrub	1	0.2
Forb	5	30.3
Grass or grass like	2	10.5
Fern	3	50.4
Other	1	15
High Threat Weed Cover	10	
DBH (cm)	**Stem Count**	
>80 cm	0	
50-79	0	
30-49	Present	
20-29	Present	
10-19	Present	
5-9	Absent	
<5	Present	
Stems with hollow (No.)	0	
Length of logs (m)	253.5	
Litter plot	**Litter cover**	
1	100	
2	100	
3	100	
4	100	
5	100	
Average	100	

Plot 16							
16	*Archontophoenix cunninghamiana*	Bangalow Palm	Other	M	Native	10	-
16	*Baumea rubiginosa*	Soft twigrush	Grass or grass like	G	Native	5	100
16	*Blechnum indicum*	Swamp Water Fern	Fern	G	Native	90	-
16	*Carex appressa*	Tall Sedge	Grass or grass like	G	Native	5	40
16	*Cinnamomum camphora*	Camphor Laurel	N/A	G, M	Hight Threat Exotic	3	20
16	*Ficus coronata*	Creek Sandpaper Fig	Shrub	M	Native	0.2	3
16	*Ficus macrophylla*	Moreton Bay Fig	Tree	M	Native	1	3
16	*Ficus obliqua*	Small-leaved Fig	Tree	M	Native	0.5	1
16	*Glochidion ferdinandi var.pubens*	Cheese Tree	Tree	G	Native	0.3	1
16	*Hypolepis muelleri*	Harsh Ground Fern	Fern	G	Native	30	-
16	*Ipomoea cairica*	Coastal Morning Glory	N/A	G, M	Hight Threat Exotic	10	-
16	*Leersia hexandra*	Swamp Ricegrass	Grass or grass like	G	Native	10	-
16	*Lepironia articulata*	Grey Rush	Grass or grass like	G	Native	10	-
16	*Melaleuca quinquenervia*	Broad-leaved Paperbark	Tree	U	Native	20	-
16	*Melicope elleryana*	Pink-flowered Doughwood	Tree	M	Native	5	4
16	*Myrsine Howittiana*	Brush Muttonwood	Shrub	M	Native	0.5	1
16	*Parsonsia straminea*	Common Silkpod	Other	U	Native	15	-
16	*Persicaria strigosa*	Spotted Knotweed	Forb	G	Native	10	-
16	*Phragmites australis*	Common Reed	Grass or grass like	G	Native	10	-
16	*Schefflera actinophylla*	Umbrella Tree	N/A	M	Hight Threat Exotic	0.5	1

Growth Form Group	Count of Native Species Richness	Sum of Cover
Tree	5	26.8
Shrub	2	0.7
Forb	1	10
Grass or grass like	5	40
Fern	2	120
Other	2	25
High Threat Weed Cover	13.5	
DBH (cm)	**Stem Count**	
>80 cm	0	
50-79	0	
30-49	Present	
20-29	Present	
10-19	Present	
5-9	Present	
<5	Present	
Stems with hollow (No.)	1	
Length of logs (m)	252	
Litter plot	**Litter cover**	
1	95	
2	70	
3	80	
4	95	
5	100	
Average	88	

Plot 11							
11	*Acmena smithii*	Lilly Pilly	Tree	M	Native	3	1
11	*Alocasia brisbanensis*	Cunjevoi	Forb	G	Native	2	10
11	*Alpinia caerulea*	Native Ginger	Forb	G	Native	1	10
11	*Archontophoenix alexandrae*	Alexandra Palm	N/A	G,M, U	Exotic	56	-

Growth Form Group	Count of Native Species Richness	Sum of Cover
Tree	6	110.1
Shrub	0	0
Forb	2	3

Plot Name	Scientific Name	Common Name	Growth Form Group	Stratum	Species Type	Cover	Abundance
11	*Archontophoenix cunninghamiana*	Bangalow Palm	Other	G,M, U	Native	14	-
11	*Christella dentata*	Binung	Fern	G	Native	0.2	2
11	*Cinnamomum camphora*	Camphor Laurel	N/A	M	Hight Threat Exotic	0.1	2
11	*Cordyline congesta*	Narrow-leaved Palm Lily	Other	G, M	Native	0.1	2
11	*Ficus coronata*	Creek Sandpaper Fig	Tree	M	Native	2	3
11	*Ficus macrophylla*	Moreton Bay Fig	Tree	U	Native	80	-
11	*Ficus obliqua*	Small-leaved Fig	Tree	U	Native	20	-
11	*Flagellaria indica*	Whip Vine	Other	U	Native	15	-
11	*Ipomoea indica*	Morning Glory	N/A	M, U	Hight Threat Exotic	2	5
11	*Lantana camara*	Lantana	N/A	G, M	Hight Threat Exotic	0.2	2
11	*Ligustrum sinense*	Small-leaved Privet	N/A	G, M	Hight Threat Exotic	2	5
11	*Macaranga tanarius*	Blush Macaranga	Tree	G	Native	0.1	5
11	*Maclura cochinchinensis*	Cockspur Thorn	Other	G, M, U	Native	10	-
11	*Melaleuca quinquenervia*	Broad-leaved Paperbark	Tree	M	Native	5	1
11	*Mucuna gigantea subsp. gigantea*	Burny Bean	Other	G, M	Native	0.2	5
11	*Murraya paniculata*	Murraya	N/A	G, M	Exotic	0.4	1
11	*Ochna serrulata*	Mickey Mouse Plant	N/A	G	Hight Threat Exotic	0.1	2
11	*Oplismenus aemulus*	Australian Basket Grass	Grass or grass like	G	Native	0.1	5
11	*Schefflera actinophylla*	Umbrella Tree	N/A	G, M	Hight Threat Exotic	5	10
11	*Smilax australis*	Lawyer Vine	Other	M, U	Native	0.1	5
11	*Solanum chrysotrichum*	Devil's Fig	N/A	G	Exotic	0.1	2
11	*Solanum mauritianum*	Wild Tobacco Bush	N/A	M	Exotic	0.2	1

Grass or grass like	1
Fern	1
Other	6
High Threat Weed Cover	9.4
DBH (cm)	**Stem Count**
>80 cm	2
50-79	2
30-49	Present
20-29	Present
10-19	Present
5-9	Present
<5	Present
Stems with hollow (No.)	3
Length of logs (m)	119.5
Litter plot	**Litter cover**
1	80
2	75
3	95
4	100
5	100
Average	90

Plot 99							
99	*Asparagus aethiopicus*	Ground Asparagus	N/A	G	Hight Threat Exotic	10	-
99	*Bidens pilosa*	Cobblers Pegs	N/A	G	Hight Threat Exotic	2	20
99	*Chloris gayana*	Rhodes Grass	N/A	G	Hight Threat Exotic	10	-
99	*Cinnamomum camphora*	Camphor Laurel	N/A	M, U	Hight Threat Exotic	10	-
99	*Cupaniopsis anacardioides*	Tuckeroo	Tree	M, U	Native	10	2
99	*Macaranga tanarius*	Blush Macaranga	Tree	M, U	Native	80	-
99	*Ochna serrulata*	Mickey Mouse Plant	N/A	G	Hight Threat Exotic	5	10
99	*Parsonsia straminea*	Common Silkpod	Other	U	Native	1	1
99	*Schefflera actinophylla*	Umbrella Tree	N/A	M, U	Hight Threat Exotic	5	4
99	*Sonchus asper*	Prickly Sowthistle	N/A	G	Exotic	0.1	5
99	*Strelizia Sp.*	Strelizia	N/A	G	Exotic	0.1	1

Growth Form Group	Count of Native Species Richness	Sum of Cover
Tree	2	90
Shrub	0	0
Forb	0	0
Grass or grass like	0	0
Fern	0	0
Other	1	1
High Threat Weed Cover	42	
DBH (cm)	**Stem Count**	
>80 cm	0	
50-79	0	
30-49	Present	
20-29	Present	
10-19	Present	
5-9	Present	
<5	Present	
Stems with hollow (No.)	0	
Length of logs (m)	34.5	
Litter plot	**Litter cover**	
1	85	
2	40	
3	10	
4	70	
5	50	
Average	51	

Plot 98							
98	*Amylotheca dictyophleba*	Brush Mistletoe	Other	M	Native	0.2	5
98	*Archontophoenix cunninghamiana*	Bangalow Palm	Other	G, M	Native	0.5	1
98	*Asparagus aethiopicus*	Ground Asparagus	N/A	G	Hight Threat Exotic	10	-
98	*Bidens pilosa*	Cobblers Pegs	N/A	G	Hight Threat Exotic	5	50
98	*Chloris gayana*	Rhodes Grass	N/A	G	Hight Threat Exotic	1	20
98	*Cinnamomum camphora*	Camphor Laurel	N/A	M, U	Hight Threat Exotic	5	5
98	*Cryptocarya triplinervis var. triplinerv*	Three-veined laurel	Tree	M	Native	2	5
98	*Cupaniopsis anacardioides*	Tuckeroo	Tree	M,	Native	4	3

Growth Form Group	Count of Native Species Richness	Sum of Cover
Tree	6	42
Shrub	0	0
Forb	0	0
Grass or grass like	0	0
Fern	0	0
Other	5	4.7
High Threat Weed Cover	106	

Plot Name	Scientific Name	Common Name	Growth Form Group	Stratum	Species Type	Cover	Abundance
98	*Eragrostis tenuifolia*	Elastic Grass	N/A	G	Exotic	10	-
98	*Guioa semiglauca*	Guioa	Tree	M	Native	3	5
98	*Ipomoea cairica*	Coastal Morning Glory	N/A	M, U	Hight Threat Exotic	5	10
98	*Macaranga tanarius*	Blush Macaranga	Tree	M	Native	30	-
98	*Maclura cochinchinensis*	Cockspur Thorn	Other	G, M	Native	1	1
98	*Mallotus discolor*	White Kamala	Tree	M	Native	1	1
98	*Mallotus philippensis*	Red Kamala	Tree	M	Native	2	3
98	*Murraya paniculata*	Murraya	N/A	M	Exotic	0.5	2
98	*Ochna serrulata*	Mickey Mouse Plant	N/A	M	Hight Threat Exotic	2	5
98	*Parsonsia straminea*	Common Silkpod	Other	M, U	Native	2	3
98	*Pinus elliottii*	Slash Pine	N/A	U	Hight Threat Exotic	75	-
98	*Rhaphiolepis indica*	Indian Hawthorn	N/A	M	Exotic	1	1
98	*Schefflera actinophylla*	Umbrella Tree	N/A	M, U	Hight Threat Exotic	2	5
98	*Senna pendula*	Senna	N/A	M	Hight Threat Exotic	1	1
98	*Smilax australis*	Lawyer Vine	Other	M, U	Native	1	3
98	*Syagrus romanzoffiana*	Cocos Palm	N/A	M	Exotic	2	1

DBH (cm)	Stem Count
>80 cm	0
50-79	0
30-49	Absent
20-29	Present
10-19	Present
5-9	Present
<5	Present
Stems with hollow (No.)	0
Length of logs (m)	0
Litter plot	Litter cover
1	100
2	40
3	100
4	60
5	100
Average	80

Plot 100							
100	*Bidens pilosa*	Cobblers Pegs	N/A	G	Hight Threat Exotic	10	-
100	*Callistemon viminalis*	Weeping Bottlebrush	Tree	M	Native	10	-
100	*Casuarina glauca*	Swamp Oak	Tree	U	Native	25	-
100	*Chloris gayana*	Rhodes Grass	N/A	G	Hight Threat Exotic	10	-
100	*Diplocyclos palmatus*	Native bryony	Other	M	Native	3	3
100	*Ipomoea cairica*	Coastal Morning Glory	N/A	M, U	Hight Threat Exotic	6	-
100	*Ipomoea indica*	Morning Glory	N/A	M, U	Hight Threat Exotic	3	10
100	*Lantana camara*	Lantana	N/A	M	Hight Threat Exotic	2	3
100	*Macaranga tanarius*	Blush Macaranga	Tree	M	Native	0.5	10
100	*Macroptilium atropurpureum*	Siratro	N/A	G	Exotic	2	3
100	*Mallotus philippensis*	Red Kamala	Tree	M	Native	0.3	1
100	*Megathyrsus maximus var. coloratus*	Guinea Grass	N/A	G	Exotic	15	-
100	*Melinis repens*	Red Natal Grass	N/A	G	Exotic	0.1	2
100	*Oxalis Sp.*	Oxalis	Forb	G	Native	0.1	1
100	*Passiflora subpeltata*	White Passionflower	N/A	G, M	Exotic	3	3
100	*Cenchrus purpureus*	Barner Grass	N/A	M	Exotic	35	-
100	*Ricinus communis*	Castor Oil Plant	N/A	M	Hight Threat Exotic	0.2	1
100	*Schefflera actinophylla*	Umbrella Tree	N/A	M	Hight Threat Exotic	0.1	1
100	*Senna pendula*	Senna	N/A	M	Hight Threat Exotic	2	5
100	*Solanum mauritianum*	Wild Tobacco Bush	N/A	M	Exotic	5	4
100	*Sonchus asper*	Prickly Sowthistle	N/A	G	Exotic	0.1	5
100	*Triumfetta rhomboidea*	Chinese Bur	N/A	G	Exotic	0.2	20

Growth Form Group	Count of Native Species Richness	Sum of Cover
Tree	4	35.8
Shrub	0	0
Forb	1	0.1
Grass or grass like	0	0
Fern	0	0
Other	1	3
High Threat Weed Cover	33.3	
DBH (cm)	Stem Count	
>80 cm	0	
50-79	1	
30-49	Present	
20-29	Present	
10-19	Present	
5-9	Present	
<5	Present	
Stems with hollow (No.)	0	
Length of logs (m)	9.5	
Litter plot	Litter cover	
1	85	
2	95	
3	90	
4	95	
5	95	
Average	92	

Plot 101							
101	*Ageratina riparia*	Mistflower	N/A	G	Hight Threat Exotic	0.1	4
101	*Ageratum conyzoides subsp. Conyzoi*	Goatweed	N/A	G	Exotic	2	20
101	*Alocasia brisbanensis*	Cunjevoi	Forb	G	Native	0.1	1
101	*Alpinia caerulea*	Native Ginger	Forb	G	Native	0.5	2
101	*Ambrosia Artemisiaefolia*	Common Ragweed	N/A	G	Exotic	6	-
101	*Asparagus aethiopicus*	Ground Asparagus	N/A	G	Hight Threat Exotic	0.5	10
101	*Bidens pilosa*	Cobblers Pegs	N/A	G	Hight Threat Exotic	10	-
101	*Chloris gayana*	Rhodes Grass	N/A	G	Hight Threat Exotic	0.5	20
101	*Chrysanthemoides monilifera*	Bitou Bush	N/A	G	Hight Threat Exotic	0.2	1
101	*Conyza bonariensis*	Flaxleaf Fleabane	N/A	G	Exotic	0.1	1
101	*Cryptocarya triplinervis*	Three-veined laurel	Tree	G, M	Native	6	-
101	*Desmodium intortum*	Green-leaved Desmodium	N/A	G	Exotic	5	10
101	*Eucalyptus grandis*	Flooded Gum	Tree	U	Native	40	-

Growth Form Group	Cover of Native Richness	Sum of Cover
Tree	8	78.4
Shrub	1	2
Forb	3	0.7
Grass or grass like	0	0
Fern	0	0
Other	6	7.8
High Threat Weed Cover	61.8	
DBH (cm)	Stem Count	
>80 cm	0	
50-79	Present	
30-49	Present	
20-29	Present	

Plot Name	Scientific Name	Common Name	Growth Form Group	Stratum	Species Type	Cover	Abundance
101	*Eucalyptus microcorys*	Tallowwood	Tree	U	Native	20	-
101	*Ficus coronata*	Creek Sandpaper Fig	Tree	M	Native	0.2	2
101	*Geitonoplesium cymosum*	Scrambling Lily	Other	G	Native	0.1	5
101	*Glochidion ferdinandi*	Cheese Tree	Tree	G	Native	0.1	1
101	*Glochidion sumatranum*	Umbrella Cheese Tree	Tree	G	Native	0.1	5
101	*Hibbertia scandens*	Climbing Guinea Flower	Other	G	Native	0.5	20
101	*Hypochaeris glabra*	Smooth Catsear	N/A	G	Exotic	0.1	1
101	*Ipomoea cairica*	Coastal Morning Glory	N/A	G, M	Hight Threat Exotic	10	-
101	*Ipomoea purpurea*	Common Morning Glory	N/A	G, M	Hight Threat Exotic	10	-
101	*Lantana camara*	Lantana	N/A	M	Hight Threat Exotic	2	3
101	*Macaranga tanarius*	Blush Macaranga	Tree	G, M	Native	10	-
101	*Maclura cochinchinensis*	Cockspur Thorn	Other	G, M, U	Native	5	5
101	*Marsdenia rostrata*	Milk Vine	Other	G, M	Native	0.1	10
101	*Melinis minutiflora*	Molasses Grass	N/A	G	Hight Threat Exotic	10	-
101	*Murraya paniculata*	Murraya	N/A	M	Exotic	2	10
101	*Myrsine variabilis*	Muttonwood	Shrub	M	Native	2	10
101	*Notelaea longifolia*	Large Mock-olive	Tree	M	Native	2	2
101	*Ochna serrulata*	Mickey Mouse Plant	N/A	G	Hight Threat Exotic	1	15
101	*Oxalis Sp.*	Oxalis	Forb	G	Native	0.1	1
101	*Parsonsia straminea*	Common Silkpod	Other	M	Native	0.1	4
101	*Paspalum conjugatum*	Sour Grass	N/A	G	Exotic	1	30
101	*Passiflora subpeltata*	White Passionflower	N/A	G, M	Exotic	2	20
101	*Schefflera actinophylla*	Umbrella Tree	N/A	M	Hight Threat Exotic	15	-
101	*Senna pendula*	Senna	N/A	M	Hight Threat Exotic	2	10
101	*Setaria sphacelata*	Setaria	N/A	G	Exotic	1	20
101	*Smilax australis*	Lawyer Vine	Other	G, M, U	Native	2	10
101	*Strelizia Sp.*	Strelizia	N/A	G	Exotic	0.1	1
101	*Syagrus romanzoffiana*	Cocos Palm	N/A	M	Exotic	0.3	20
101	*Tagetes minuta*	Stinking Roger	N/A	G	Exotic	1	10
101	*Triumfetta rhomboidea*	Chinese Bur	N/A	G	Exotic	20	-
101	*Vicia tetrasperma*	Slender Vetch	N/A	G	Exotic	0.1	5

Litter plot	Litter cover
10-19	Present
5-9	Present
<5	Present
Stems with hollow (No.)	1
Length of logs (m)	15
1	95
2	90
3	90
4	98
5	100
Average	94.6

Plot 102							
102	*Ageratina riparia*	Mistflower	N/A	G	Hight Threat Exotic	0.2	5
102	*Asparagus aethiopicus*	Ground Asparagus	N/A	G	Hight Threat Exotic	0.1	3
102	*Bidens pilosa*	Cobblers Pegs	N/A	G	Hight Threat Exotic	15	-
102	*Cestrum nocturnum*	Lady of the Night	N/A	G, M	Exotic	0.5	5
102	*Cinnamomum camphora*	Camphor Laurel	N/A	M, U	Hight Threat Exotic	35	-
102	*Eucalyptus grandis*	Flooded Gum	Tree	U	Native	40	-
102	*Guioa semiglauca*	Guioa	Tree	M, U	Native	10	-
102	*Hibbertia scandens*	Climbing Guinea Flower	Other	G	Native	0.1	2
102	*Lantana camara*	Lantana	N/A	G, M	Hight Threat Exotic	0.2	5
102	*Ligustrum sinense*	Small-leaved Privet	N/A	G, M	Hight Threat Exotic	0.5	6
102	*Macaranga tanarius*	Blush Macaranga	Tree	M, U	Native	20	-
102	*Maclura cochinchinensis*	Cockspur Thorn	Other	G, M, U	Native	4	10
102	*Melinis minutiflora*	Molasses Grass	N/A	G	Hight Threat Exotic	10	-
102	*Murraya paniculata*	Murraya	N/A	M, U	Exotic	0.3	10
102	*Ochna serrulata*	Mickey Mouse Plant	N/A	G	Hight Threat Exotic	0.5	10
102	*Oxalis Sp.*	Oxalis	Forb	G	Native	0.1	1
102	*Passiflora suberosa*	Cork Passionflower	N/A	G, M	Exotic	0.5	15
102	*Passiflora subpeltata*	White Passionflower	N/A	G, M	Exotic	1	3
102	*Schefflera actinophylla*	Umbrella Tree	N/A	M, U	Hight Threat Exotic	0.5	3
102	*Senna pendula*	Senna	N/A	M, U	Hight Threat Exotic	0.5	10
102	*Smilax australis*	Lawyer Vine	Other	G, M, U	Native	10	-
102	*Solanum nigrum*	Black-berry Nightshade	N/A	G	Exotic	0.2	15
102	*Stephania japonica*	Snake Vine	Other	G, M	Native	0.2	3
102	*Syagrus romanzoffiana*	Cocos Palm	N/A	M, U	Exotic	4	3
102	*Tradescantia fluminensis*	Trad	N/A	G	Hight Threat Exotic	0.1	10
102	*Triumfetta rhomboidea*	Chinese Bur	N/A	G	Exotic	10	-

Growth Form Group	Cover of Native Richness	Sum of Cover
Tree	3	70
Shrub	0	0
Forb	1	0.1
Grass or grass like	0	0
Fern	0	0
Other	4	14.3
High Threat Weed Cover	62.6	
DBH (cm)	**Stem Count**	
>80 cm	5	
50-79	Present	
30-49	Present	
20-29	Present	
10-19	Present	
5-9	Present	
<5	Present	
Stems with hollow (No.)	1	
Length of logs (m)	146	
Litter plot	**Litter cover**	
1	80	
2	95	
3	95	
4	97	
5	100	
Average	93.4	

Plot Name	Scientific Name	Common Name	Growth Form Group	Stratum	Species Type	Cover	Abundance
Plot 103							
103	*Bidens pilosa*	Cobblers Pegs	N/A	G	Hight Threat Exotic	3	500
103	*Capparis arborea*	Native Pomegranate	Shrub	M	Native	0.5	1
103	*Cestrum sp.*	Cestrum	N/A	M	Exotic	1	1
103	*Commersonia bartramia*	Brown Kurrajong	Tree	M, U	Native	3	2
103	*Cordyline congesta*	Narrow-Leaved Palm Lily	Other	G	Native	0.5	3
103	*Cryptocarya triplinervis var. triplinerv*	Three-veined laurel	Tree	G, M	Native	1	5
103	*Diospyros fasciculosa*	Grey Ebony	Tree	U	Native	0.5	1
103	*Eupomatia bennettii*	Small Bolwarra	Shrub	M	Native	0.1	1
103	*Ficus fraseri*	Sandpaper Fig	Tree	M	Native	1	1
103	*Flagellaria indica*	Whip Vine	Other	M, U	Native	0.5	1
103	*Guioa semiglauca*	Guioa	Tree	M, U	Native	8	-
103	*Ipomoea cairica*	Coastal Morning Glory	N/A	G, M, U	Hight Threat Exotic	1	10
103	*Lantana camara*	Lantana	N/A	G, M	Hight Threat Exotic	4	2
103	*Ligustrum sinense*	Small-leaved Privet	N/A	G, M	Hight Threat Exotic	10	-
103	*Macadamia integrifolia x tetraphylla*	Macadamia	Tree	M, U	Native	6	5
103	*Macaranga tanarius*	Blush Macaranga	Tree	M, U	Native	10	-
103	*Maclura cochinchinensis*	Cockspur Thorn	Other	G, M, U	Native	0.1	1
103	*Trophis scandens*	Burny Vine	Other	G, M	Native	0.1	2
103	*Mallotus philippensis*	Red Kamala	Tree	M	Native	2	2
103	*Monstera deliciosa*	Fruit Salad Plant	N/A	G	Exotic	0.2	1
103	*Mucuna gigantea subsp. Gigantea*	Burny Bean	Other	G, M, U	Native	0.5	4
103	*Murraya paniculata*	Murraya	N/A	M	Exotic	0.1	1
103	*Ochna serrulata*	Mickey Mouse Plant	N/A	G	Hight Threat Exotic	1	10
103	*Paspalum mandiocanum*	Broadleaf Paspalum	N/A	G	Exotic	0.1	1
103	*Passiflora edulis*	Common Passionfruit	N/A	G, M ,U	Exotic	0.1	1
103	*Passiflora suberosa*	Cork Passionflower	N/A	G, M, U	Exotic	0.1	2
103	*Cenchrus purpureus*	Barner Grass	N/A	G	Exotic	10	-
103	*Persea americana*	Avocado	N/A	M	Exotic	0.5	2
103	*Rivina humilis*	Coral Berry	N/A	G	Exotic	1	50
103	*Senna pendula*	Senna	N/A	M	Hight Threat Exotic	0.1	2
103	*Solanum mauritianum*	Wild Tobacco Bush	N/A	M	Exotic	0.5	3
103	*Tabernaemontana pandacaqui*	Banana Bush	Shrub	M	Native	0.1	1

Growth Form Group	Cover of Native Richness	Sum of Cover
Tree	8	31.5
Shrub	3	0.7
Forb	0	0
Grass or grass like	0	0
Fern	0	0
Other	5	1.7
High Threat Weed Cover	19.1	
DBH (cm)	**Stem Count**	
>80 cm	0	
50-79	0	
30-49	Present	
20-29	Present	
10-19	Present	
5-9	Present	
<5	Present	
Stems with hollow (No.)	0	
Length of logs (m)	38.5	
Litter plot	**Litter cover**	
1	85	
2	75	
3	75	
4	95	
5	95	
Average	85	

APPENDIX D. VEGETATION INTEGRITY SURVEY SUMMARY OF RESULTS

Plot Name	Date of Survey	Recorders	Veg Zone	PCT	EEC	Area	Patch Size	Plot Dimensions	Condition Class	Datum	Zone	Easting	Northing	Bearing	IBRA Bioregion	IBRA Subregion	Vegetation Formation	Vegetation Class	DBH <5cm	DBH 5cm to 9cm	DBH 10cm to 19cm	DBH 20cm to 29cm
19	15/06/2018	Damian Licari and Gina Minatel	1	1064	Yes	3.8	68	20m X 50m	Moderate	GDA1994	56	555890	6873927	350	South East QLD	Burringbar-Conondale Ranges	Forested Wetlands	Coastal Swamp Forests	yes	no	yes	yes
16	10/07/2018	Damian Licari and Gina Minatel	1	1064	Yes	3.8	68	20m X 50m	Moderate	GDA1994	56	555898	6873830	310	South East QLD	Burringbar-Conondale Ranges	Forested Wetlands	Coastal Swamp Forests	yes	yes	yes	yes
11	11/07/2018	Damian Licari and Gina Minatel	2	1302	Yes	1.0	68	20m X 50m	Moderate	GDA1994	56	555871	6873727	220	South East QLD	Burringbar-Conondale Ranges	Rainforests	Subtropical Rainforests	yes	yes	yes	yes
99	11/07/2018	Damian Licari and Gina Minatel	4	1302	No	0.6	68	10 x 100m	Derived	GDA1994	56	555489	6873425	178	South East QLD	Burringbar-Conondale Ranges	Rainforests	Subtropical Rainforests	yes	yes	yes	yes
98	12/07/2018	Damian Licari and Gina Minatel	8	1302	No	0.7	68	10 x 100m	Derived	GDA1994	56	555619	6873327	38	South East QLD	Burringbar-Conondale Ranges	Rainforests	Subtropical Rainforests	yes	yes	yes	yes
100	15/08/2018	Damian Licari and Christina Maloney	7	1235	No	0.1	68	10 x 100m	Derived	GDA1994	56	555953	6873675	174	South East QLD	Burringbar-Conondale Ranges	Forested Wetlands	Coastal Floodplain Wetlands	yes	yes	yes	yes
101	15/08/2018	Damian Licari and Christina Maloney	6	1569	No	0.2	68	20m X 50m	Derived	GDA1994	56	555957	6873725	255	South East QLD	Burringbar-Conondale Ranges	Wet sclerophyll	North Coast Wet Sclerophyll Forests	yes	yes	yes	yes
102	15/08/2018	Damian Licari and Christina Maloney	5	1569	No	0.5	68	10 x 100m	Derived	GDA1994	56	555362	6873160	13	South East QLD	Burringbar-Conondale Ranges	Wet sclerophyll	North Coast Wet Sclerophyll Forests	yes	yes	yes	yes
103	3/09/2018	Annette McKinley and Christina	3	1302	Yes	0.3	68	20m X 50m	Low	GDA1994	56	555433	6873550	68	South East QLD	Burringbar-Conondale Ranges	Rainforests	Subtropical Rainforests	yes	yes	yes	yes

Plot Name	DBH 30cm to 49cm	DBH 30cm to 49cm Count	DBH 50cm to 79cm	DBH 50cm to 79cm Count	DBH 80cm	DBH 80cm Count	Length of logs (m)	Hollow Trees Count	Litter Cover Plot 1	Litter Cover Plot 2	Litter Cover Plot 3	Litter Cover Plot 4	Litter Cover Plot 5
19	yes	0	no	0	no	0	253.5	0	100	100	100	100	100
16	yes	17	no	0	no	0	252	1	95	70	80	95	100
11	yes	7	yes	2	yes	2	119.5	3	80	75	95	100	100
99	yes	2	no	0	no	0	34.5	0	85	40	10	70	50
98	no	0	no	0	no	0	0	0	100	40	100	60	100
100	yes	0	yes	1	no	0	9.5	0	85	95	90	95	95
101	yes	9	yes	7	no	0	15	1	95	90	90	98	100
102	yes	0	yes	0	yes	5	146	1	80	95	95	100	97
103	yes	0	no	0	no	0	38.5	0	85	75	75	95	95

APPENDIX E. BAM PREDICTED SPECIES REPORT

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00011608/BAAS17014/19/00011609	Tweed Valley Hospital - Impact assessment calculations	04/01/2019
Assessor Name	**Report Created**	**BAM Data version ***
Damian Licari	22/01/2019	6
Assessor Number	* 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.	
BAAS18006		

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Barred Cuckoo-shrike	Coracina lineata	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Eastern Bentwing-bat	Miniopterus schreibersii oceanensis	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Eastern Freetail-bat	Mormopterus norfolkensis	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Grey-headed Flying-fox	Pteropus poliocephalus	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Little Bentwing-bat	Miniopterus australis	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Northern Free-tailed Bat	Mormopterus lumsdenae	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Powerful Owl	Ninox strenua	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Red-legged Pademelon	Thylogale stigmatica	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Spotted-tailed Quoll	Dasyurus maculatus	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Superb Fruit-Dove	Ptilinopus superbus	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion

BAM Predicted Species Report

APPENDIX F. BAM CANDIDATE SPECIES REPORT

BAM Candidate Species Report

Proposal Details

Assessment Id 00011608/BAAS17014/19/00011609	Proposal Name Tweed Valley Hospital - Impact assessment calculations	BAM data last updated * 04/01/2019
Assessor Name Damian Licari	Report Created 22/01/2019	BAM Data version * 6
Assessor Number BAAS18006	* 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.	

List of Species Requiring Survey

Name	Presence	Survey Months
Acacia bakeri Marblewood	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Acalypha eremorum Acalypha	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Acronychia littoralis Scented Acronychia	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Niemeyera whitei Rusty Plum, Plum Boxwood	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Angiopteris evecta Giant Fern	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Archidendron hendersonii White Lace Flower	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Arthraxon hispidus Hairy Jointgrass	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Gossia fragrantissima Sweet Myrtle	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Belvisia mucronata Needle-leaf Fern	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Bosistoa transversa Yellow Satinheart	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Coeranoscincus reticulatus Three-toed Snake-tooth Skink	Yes (assumed present)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Cassia marksiana Cassia marksiana	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Corokia whiteana Corokia	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Cercartetus nanus Eastern Pygmy-possum	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Cryptocarya foetida Stinking Cryptocarya	Yes (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Cupaniopsis serrata Smooth Tuckeroo	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Cyclopsitta diophthalma coxeni Coxen's Fig-Parrot	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Choricarpia subargentea Giant Ironwood	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Cynanchum elegans White-flowered Wax Plant	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Cyperus semifertilis Missionary Nutgrass	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Davidsonia jerseyana Davidson's Plum	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Davidsonia johnsonii Smooth Davidson's Plum	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Dendrocnide moroides Gympie Stinger	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Desmodium acanthocladum Thorny Pea	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Diospyros mabacea Red-fruited Ebony	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Diospyros yandina Shiny-leaved Ebony	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Diploglottis campbellii Small-leaved Tamarind	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Drynaria rigidula Basket Fern	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Sarcochilus weinthalii Blotched Sarcochilus	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Senna acclinis Rainforest Cassia	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Sophora fraseri Brush Sophora	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Tinospora tinosporoides Arrow-head Vine	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Ozothamnus vagans Wollumbin Dogwood	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Xylosma terrae-reginae Queensland Xylosma	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Peristeranthus hillii Brown Fairy-chain Orchid	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Eidothea hardeniana Nightcap Oak	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Elaeocarpus williamsianus Hairy Quandong	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Endiandra floydii Crystal Creek Walnut	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Endiandra hayesii Rusty Rose Walnut	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Endiandra muelleri subsp. bracteata Green-leaved Rose Walnut	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Floydia praealta Ball Nut	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Fontainea australis Southern Fontainea	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Coatesia paniculata Axe-Breaker	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Grevillea hilliana White Yiel Yiel	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Hicksbeachia pinnatifolia Red Boppel Nut	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Hoplocephalus bitorquatus Pale-headed Snake	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Isoglossa eranthemoides Isoglossa	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Lepiderema pulchella Fine-leaved Tuckeroo	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Lindsaea brachypoda Short-footed Screw Fern	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Macadamia tetraphylla Rough-shelled Bush Nut	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Marsdenia longiloba Slender Marsdenia	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Melicope vitiflora Coast Euodia	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Niemeyera chartacea Smooth-leaved Plum	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Ninox strenua Powerful Owl	Yes (assumed present)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Oberonia complanata Yellow-flowered King of the Fairies	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Ochrosia moorei Southern Ochrosia	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Owenia cepiodora Onion Cedar	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Phyllanthus microcladus Brush Sauropus	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Planigale maculata Common Planigale	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Pomaderris notata McPherson Range Pomaderris	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Randia moorei Spiny Gardenia	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Myrsine richmondensis Ripple-leaf Muttonwood	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Symplocos baeuerlenii Small-leaved Hazelwood	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Syzygium hodgkinsoniae Red Lilly Pilly	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Syzygium moorei Durobby	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Thersites mitchellae Mitchell's Rainforest Snail	No (surveyed)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

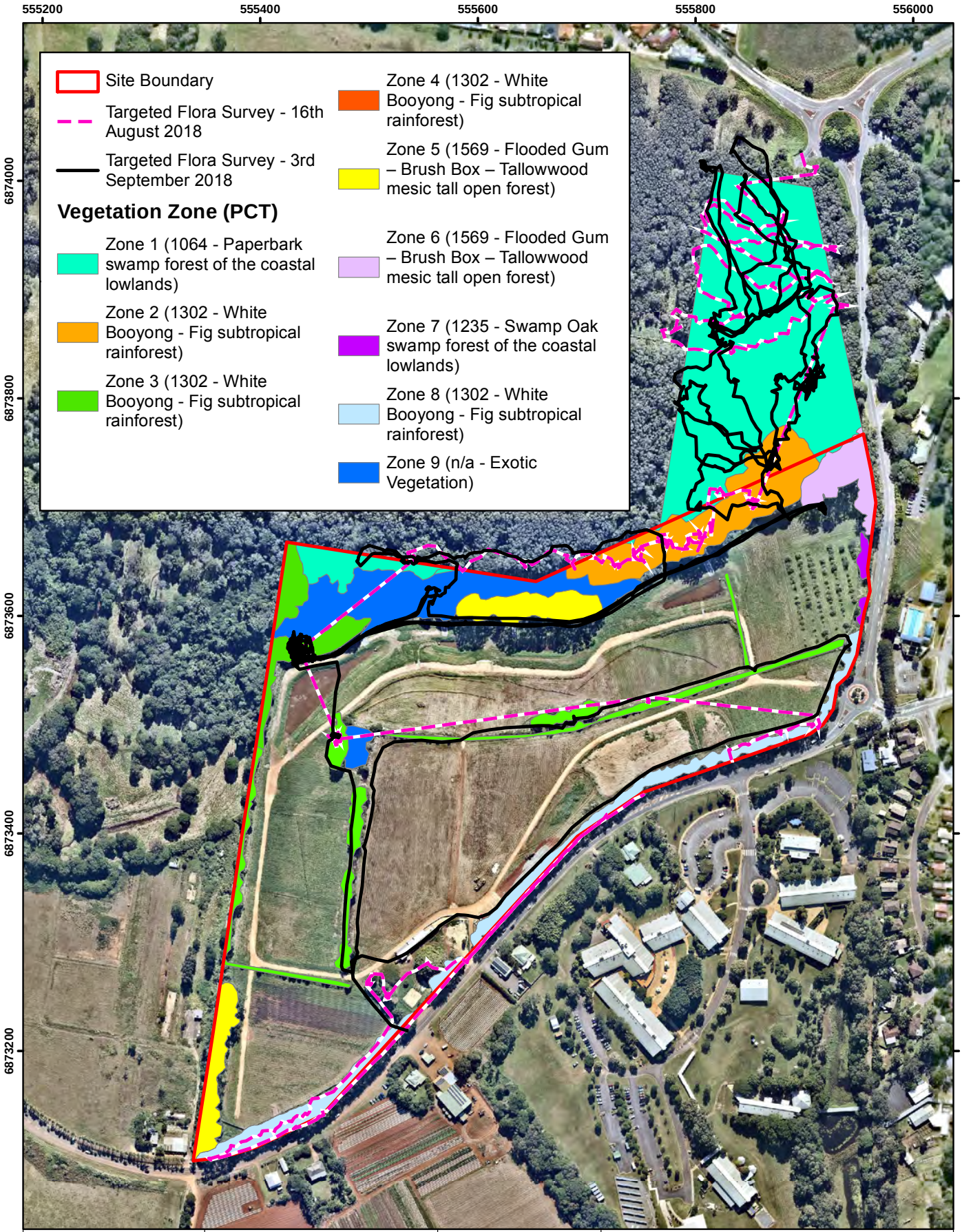
List of Species Not On Site

Name
Harnieria hygrophiloides Harnieria hygrophiloides
Doryanthes palmeri Giant Spear Lily
Litoria brevipalmata Green-thighed Frog
Miniopterus australis Little Bentwing-bat
Miniopterus schreibersii oceanensis Eastern Bentwing-bat
Mixophyes iteratus Giant Barred Frog
Myotis macropus Southern Myotis
Phyllodes imperialis southern subspecies Southern Pink Underwing Moth
Pteropus poliocephalus Grey-headed Flying-fox

Stage 2 SSD: Biodiversity Development Assessment Report

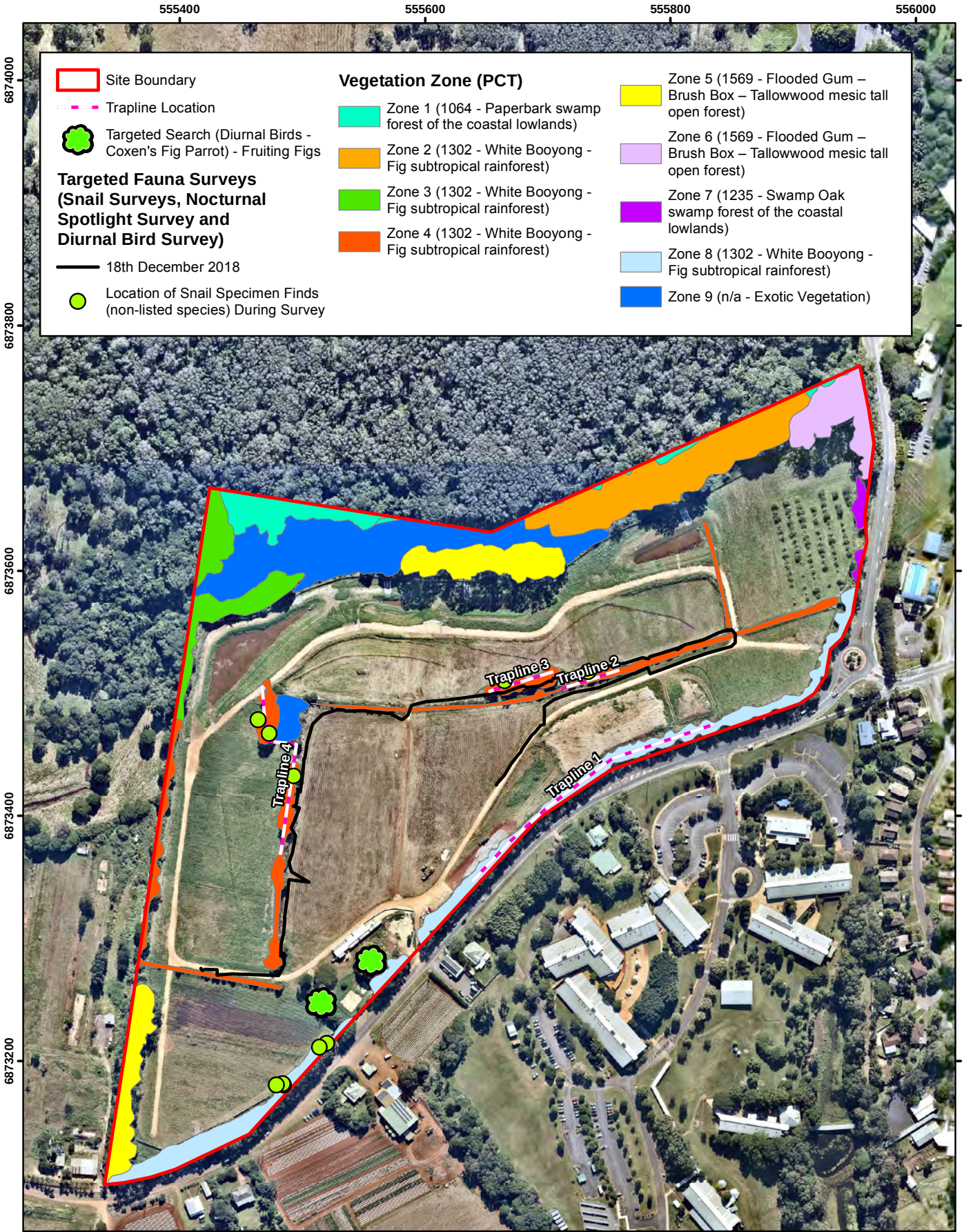
Tweed Valley Hospital

APPENDIX G. THREATENED SPECIES SURVEY RESULTS



Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,500	**Survey Efforts - Flora**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) © Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure G-1**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
GREENCAP			

Doc Path: \\ser2bne1\Brisbane_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BDARs2\mxd\J156455_13_BDARs2_zG01_survey_effort_flora_190801.mxd



Client: C107778	N 0 50 100 m	Scale (@A4): 1:4,000	**Fauna Survey Effort**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Imagery 15th July 2019 (7.5 cm) @ Nearmap 2019*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure G-2**
Date: 8/08/2019	*Vegetation mapping: Greencap (2018)*		
GREENCAP			

Doc Path: \\ser2bne1\Brisbane_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BDARs2\mxd\J156455_13_BDARs2_zG02_fauna_survey_effort_190801.mxd

Targeted survey - Candidate threatened flora					
Date	**Start time**	**Finish time**	**Survey effort (hours)**	**Observer**	**Weather**
16/08/2018	8:00 AM	4:00 PM	16.0	Dr Damian Licari Annette McKinley	
3/09/2018	8:00 AM	4:00 PM	16.0	Annette McKinley Christina Maloney	
17/12/2018	8:00 AM	12:00 PM	4.0	Dr Barbara Stewart	Overcast, drizzle

Results 16/08/18					
Waypoint	**Easting**	**Northing**	**No. of specimens**	**Species**	**Notes**
056	555803	6873662	1	*Cryptocarya foetida*	

Results 17/12/18					
Waypoint	**Easting**	**Northing**	**No. of specimens**	**Species**	**Notes**
081	555683	6873386	1	*Cryptocarya foetida*	
082	555794	6873457	1	*Cryptocarya foetida*	

Targeted survey - Common planigale					
		Start		Finish	
Trapline	No. of traps	Easting	Northing	Easting	Northing
1	25	555638	6873346	555834	6873479
2	6	555756	6873523	555709	6873508
3	6	555701	6873522	555648	6873506
4	13	555467	6873506	555482	6873368

Results				
Species	Trapline			
	1	2	3	4
15/12/2018				
Planigale maculata	Not detected	Not detected	Not detected	Not detected
Rattus rattus	1			
Mus musculus	5	1		1
16/12/2018				
Planigale maculata	Not detected	Not detected	Not detected	Not detected
Rattus rattus	1			
Mus musculus	6	5	4	1
17/12/2018				
Planigale maculata	Not detected	Not detected	Not detected	Not detected
Rattus rattus				
Mus musculus	2	2	3	1
18/12/2018				
Planigale maculata	Not detected	Not detected	Not detected	Not detected
Rattus rattus		1	1	
Mus musculus		5	1	1

Targeted survey - Coxen's Fig Parrot						

Fig tree observation

Date	Start	Finish	Survey Effort (hours)	Result - Target species	Recorder	Weather
15/12/2018	9:30 AM	11:30 AM	2.0	Not detected	Kyle Spiteri	Overcast, light wind
15/12/2018	5:00 PM	7:00 PM	2.0	Not detected	Kyle Spiteri	Overcast, medium wind
16/12/2018	8:30 AM	10:30 AM	2.0	Not detected	Kyle Spiteri	Light wind, overcast
16/12/2018	5:40 PM	7:40 PM	2.0	Not detected	Kyle Spiteri	Medium wind, drizzle
17/12/2018	8:15 AM	10:15 AM	2.0	Not detected	Kyle Spiteri	Overcast, drizzle
17/12/2018	5:45 PM	7:45 PM	2.0	Not detected	Kyle Spiteri	Warm, sunny
18/12/2018	8:30 AM	10:30 AM	2.0	Not detected	Kyle Spiteri	Overcast, light rain
18/12/2018	5:05 PM	7:00 PM	2.0	Not detected	Kyle Spiteri	

Diurnal bird survey

Date	Start	Finish	Survey Effort (hours)	Result - Target species	Recorder	Weather
15/12/2018	7:55 AM	8:25 AM	0.50	Not detected	Dr Damian Licari	Overcast, light wind
15/12/2018	6:30 PM	7:00 PM	0.50	Not detected	Dr Damian Licari	Overcast, light wind
16/12/2018	7:15 AM	8:00 AM	0.75	Not detected	Dr Damian Licari	Overcast, light wind
17/12/2018	7:20 AM	7:50 AM	0.50	Not detected	Dr Damian Licari	Overcast, drizzle
17/12/2018	6:35 PM	7:10 PM	0.50	Not detected	Dr Damian Licari	Overcast
18/12/2018	7:15 AM	7:45 AM	0.50	Not detected	Dr Damian Licari	Overcast, drizzle

Result - Non-target species

Scientific name	Common Name
Anthochaera chrysoptera	Little Wattlebird
Cacatua sanguinea	Little Corella
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo
Centropus phasianinus	Pheasant Coucal
Corvus orru	Torresian Crow
Coturnix ypsilophora	Brown Quail
Cracticus quoyi	Black Butcherbird
Cracticus tibicen	Australian Magpie
Dacelo novaeguineae	Laughing Kookaburra
Dicrurus bracteatus	Spangled Drongo
Elanus axillaris	Black-shouldered Kite
Entomyzon cyanotis	Blue-faced Honeyeater
Eolophus roseicapillus	Galah
Geopelia humeralis	Bar-shouldered Dove
Grallina cyanoleuca	Magpie-lark
Leucosarcia picata	Wonga Pigeon
Malurus cyaneus	Superb Fairy-wren
Manorina melanocephala	Noisy Miner
Meliphaga lewinii	Lewin's Honeyeater
Neochmia temporalis	Red-browed Finch
Oriolus sagittatus	Olive-backed Oriole
Philemon corniculatus	Noisy Friarbird
Psophodes olivaceus	Eastern Whipbird
Rhipidura leucophrys	Willie Wagtail
Sphecotheres vieilloti	Australasian Figbird
Strepera graculina	Pied Currawong
Sturnus tristis	Common Myna
Threskiornis molucca	Australian White Ibis
Threskiornis spinicollis	Straw-necked Ibis
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet
Trichoglossus haematodus	Rainbow Lorikeet
Vanellus miles	Masked Lapwing
Zosterops lateralis	Silvereye

Results 17/12/18					
Waypoint	**Easting**	**Northing**	**No. of specimens**	**Species**	**Notes**
067	555520	6873214	3	*Sphaerospira fraseri*	
068	555514	6873211	3	*Sphaerospira fraseri*	
069	555485	6873180	1	*Sphaerospira fraseri*	
070	555484	6873181	1	*Sphaerospira fraseri*	
071	555479	6873180	1	*Sphaerospira fraseri*	
073	555493	6873432	2	*Sphaerospira fraseri*	
074	555473	6873467	1	*Sphaerospira fraseri*	
075	555464	6873478	1	*Sphaerospira fraseri*	
077	555665	6873510	1	*Sphaerospira fraseri*	
079	555733	6873517	1	*Sphaerospira fraseri*	

Results 18/12/18					
Waypoint	**Easting**	**Northing**	**No. of specimens**	**Species**	**Notes**
086	555399	6873131	1	*Sphaerospira fraseri*	
087	555358	6873121	1	*Sphaerospira fraseri*	Dead snail shell

Opportunistic recording - Mitchell's Rainforest Snail					
Date	**Start time**	**Finish time**	**Survey effort (hours)**	**Observer**	**Weather**
19/11/2018				Damian Licari, David Milledge	Cool, dry
Snail Site	**Easting**	**Northing**	**No. of specimens**	**Species**	**Notes**
1	555884	6873796	1	*Thersites richmondiana*	Juvenile
2	555881	6873789	1	*Thersites richmondiana*	Sub-adult
3	555419	6873629	1	*Sphaerospira fraseri*	Adult
4	555882	6873775	1	*Thersites mitchellae*	Adult
5	555882	6873743	2	*Thersites mitchellae* *Sphaerospira fraseri*	Dead shells
6	555864	6873712	2	*Sphaerospira fraseri* *Rhinella marina*	Adult

Targeted Survey - Mitchell's Rainforest Snail (Dr Stephanie Clark - refer third party report in Appendix G)					
Date	**Start time**	**Finish time**	**Survey effort (hours)**	**Observer**	**Weather**
19/12/2018			10	Dr Stephanie Clark, Craig Faulkner	Warm and dry, very high relative humidity
20/12/2018			16	Dr Stephanie Clark, Dr David Robertson, Craig Faulkner	Warm and dry, very high relative humidity
Zone	**Longitude**	**Latitude**	**No. of specimens**	**Species**	**Notes**
1	153°34'12"E	28°15'32" S	4	*Thersites mitchellae*	1x adult, 3x dead shells

Targeted survey - Eastern pygmy possum, Pale-headed snake, Grey-headed flying fox, Koala					
Date	**Start**	**Finish**	**Survey Effort (hours)**	**Recorder**	**Weather**
15/12/2018	8:30 PM	9:30 PM	2.0	Dr. Damian Licari, Kyle Spiteri	Overcast, light wind
17/12/2018	8:15 PM	9:30 PM	2.5	Dr. Damian Licari, Kyle Spiteri	Overcast, drizzle

Results		
Species	**15/12/2018**	**17/12/2018**
Hoplocephalus bitorquatus	Not detected	Not detected
Cercartetus nanus	Not detected	Not detected
Pteropus poliocephalus	Not detected	Not detected
Phascolarctos cinereus	Not detected	Not detected
Vulpes vulpes	2	
Pteropus alecto		1

Targeted survey for *Thersites mitchellae* (Cox, 1864) (Mitchell's Rainforest Snail) at 771 Cudgen Rd, Cudgen, NSW, site for the proposed Tweed Valley Hospital

Prepared for Herbert Smith Freehills LLP

Stephanie A. Clark

9 January, 2019

INVERTEBRATE IDENTIFICATION AUSTRALASIA
481a Great Western Highway, Faulconbridge, NSW 2776
Phone 0426204240
Email: meridolum@ozemail.com.au
http://www.invertebrateidentification.com/

Introduction

The author was engaged by Herbert Smith Freehills LLP to conduct a targeted survey for the New South Wales endemic land snail *Thersites mitchellae* (Mitchell's Rainforest Snail) at 771 Cudgen Rd, Cudgen, N.S.W, the proposed site for the construction of Tweed Valley Hospital (Figure 1). The purpose of the survey was twofold:

- to determine the nature and extent of habitat and potential habitat for the species on the subject site, particularly within corridors of regenerating rainforest that form narrow strips across the proposed development area (Figure 1);
- to consider whether development of the subject site as a hospital would have a significant impact on the species.

Mitchell's Rainforest Snail is currently listed as critically endangered under the Commonwealth's Environment Protection and Biodiversity Conservation Act, 1999 and as endangered under the New South Wales Biodiversity Conservation Act, 2016.

Previous surveys undertaken both on the site and lands adjoining the development site had found evidence for *Thersites mitchellae* along the northern boundary of the site but in vegetation that is being retained. These are shown as vegetation zones 1, 2 and 3 on Figure 1.

I have relevant qualifications and experience to conduct the survey, as set out in my CV attached at the end of this report.

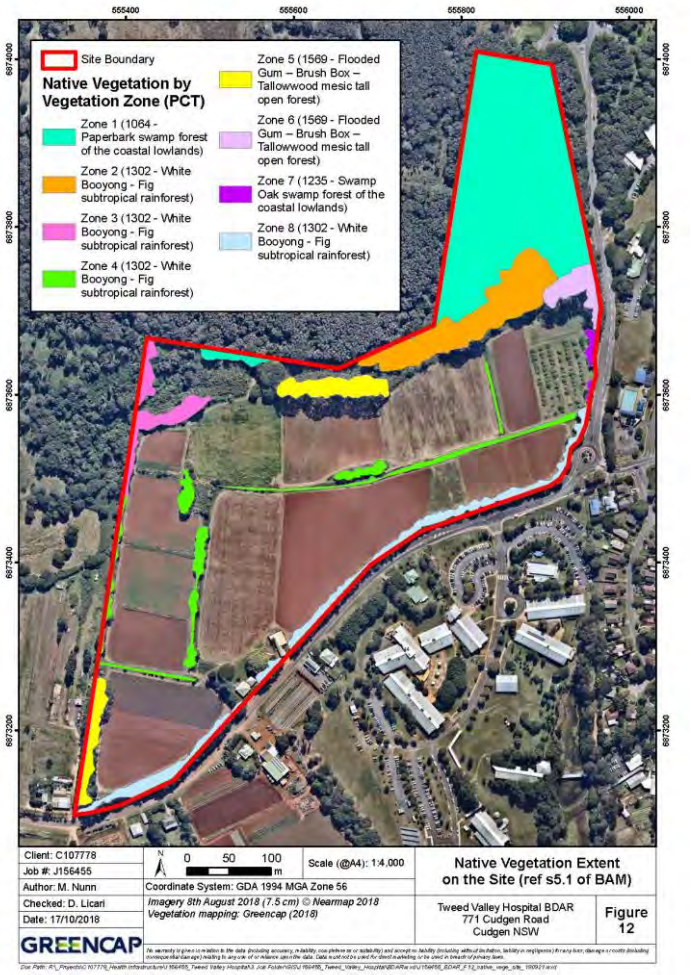


Figure 1. Site map showing the different vegetation zones.

Methods

The author examined draft reports outlining the proposed development of the subject land as the new Tweed Hospital. It was noted that development was proposed in the form of an early works program (various drainage and water management measures) (GeoLink, 2018a), followed by the construction of the hospital itself (GeoLink, 2018b).

The author and two colleagues (Dr David Robertson and Craig Faulkner) visited the site on 19-20th December, 2018, during which conditions appeared suitable to conduct surveys for terrestrial snails. The conditions were warm and dry with relative humidity very high, while only a small amount of rainfall had been recorded at the site in the previous two weeks.

Surveys for snails were conducted both during the day and at night. During the day, logs, rocks and other debris on the ground were turned and the leaf litter was raked. Snails actively crawling on the ground, on logs, rocks and the leaf litter etc, were searched for at night by spotlight (see Table 1 for search effort).

Efforts were concentrated in vegetation Zones 4 and 8 (see Figure 1) to determine if individuals of *Thersites mitchellae* might be present and or that these zones might provide suitable habitat for the species. In addition, the edges of Zones 2, 3 and 5 were searched using spotlights during the night.

The area zoned as Zone 1 in Figure 1, was briefly searched on 20th December, 2018. However, at the time of the site visit it was indicated that this area was no longer included as part of the development site. Given that there are known records for *Thersites mitchellae* (Bionet database searched, 7 December, 2018) both to the east and west of this area and that suitable habitat was present, it was thought highly likely that the species might be present.

Name	19 December	20 December
Dr Stephanie Clark	5 hours	6 hours
Craig Faulkner	5 hours	5 hours
Dr David Robertson		5 hours
Total	10 hours	16 hours

Table 1. Search effort in hours includes both day and night search effort.

Results

No evidence for *Thersites mitchellae* was found within Zones 4 and 8 nor along the edges of Zones 2, 3 and 5.

Land snails were found during the survey period. Three other species of snail were located in Zones 2-5 and 8:

- the non-listed native snails *Sphaerospira fraseri* (Griffith & Pidgeon, 1833) and *Terrycarlessia turbinata* Stanisic in Stanisic *et. al*., 2010, and
- the introduced snail *Bradybaena similaris* (Férussac, 1821).

Sphaerospira fraseri was the most abundant species recorded with more than 40 living individuals observed crawling on both nights, while *Terrycarlessia turbinata* was the least abundant with only four individuals being observed.

Thersites mitchellae was found in the northern extremity of Zone 1, within paperbark forest (Figure 1). The finds comprised one living individual and three dead shells of *Thersites mitchellae*. The habitat in which they were found is part of a large relatively unfragmented area of swamp forest with a moist understorey and a humid internal microclimate.

Discussion

The proposed development area has been extensively cleared and the remaining corridors of rainforest regeneration occur on well drained land that is relatively dry. They are not suitable habitat for *Thersites mitchellae:*

- The vegetation present in Zone 8 in not suitable habitat for *Thersites mitchellae*, as it is dominated by a line of large pines and otherwise very xeric with very few rainforest plants present along the length of the entire zone.
- The vegetation present in Zone 4 is also not considered suitable habitat for *Thersites mitchellae*, although a number of rainforest plants are present, there is still a high proportion of exotic species

present, the patches are generally relatively narrow and completely surrounded by cleared fields, resulting in the patches being susceptible to drying due to increased exposure to wind blowing across open the fields.

Swamp forest to the north of the site (Zone 1) does support a population of the snail. Similarly, Zones 2 and 3 appear to provide suitable habitat for *Thersites mitchellae*, but due to the fairly dry conditions during the site visit no evidence for the species was observed over the survey period.

It was observed that the existing cleared farmland is on hillsides that drain in unrestricted fashion into the larger blocks of forest and swamp forest on the northern portion of the subject land. The author believes that runoff from farmland may have impacted habitat values for the snail historically. Based upon the early works proposed for the site, and assuming best practice future stormwater management would be implemented for the hospital site, the author believes that it is likely that the future management of runoff may be beneficial to the existing areas of snail habitat to the north of the construction site.

Clearance of the strips of rainforest from the proposed development area (Zones 4 and 8) would not clear or otherwise significantly impact *Thersites mitchellae* habitat. No significant impact is likely upon the species from either the proposed early works program, or the main development proposal for the site.

References

GeoLink (2018a) Preliminary Works – Proposed Tweed Valley Hospital Site: Assessment of Review of Environmental Factors. Prepared by GeoLink for Health Infrastructure

GeoLink (2018b) Environmental Impact Statement: New Tweed Valley Hospital (Concept Proposal and Stage 1 Works). Prepared by GeoLink for Health Infrastructure

CURRICULUM VITAE OF STEPHANIE CLARK

PERSONAL

Business address	Faulconbridge, NSW 2776
Mobile	0426 204 240
E-mail:	meridolum@ozemail.com.au
Citizenship	Australian and American

EDUCATION

Ph.D., 2005. University of Western Sydney, New South Wales, Australia. Taxonomy and conservation.
M.Sc., 1998. Macquarie University, New South Wales, Australia. Taxonomy and genetics.
B.App.Sc., 1990. University of Technology, Sydney, New South Wales, Australia. Major biochemistry.

ACCREDITATIONS ETC

I am the first person to be listed as a Biodiversity Expert under Section 6.5.2.4 of the BAM, under the Biodiversity Conservation Act, 2017 for the snails *Meridolum corneovirens* and *Pommerhelix duralensis* as 16 May 2018.

PROFESSIONAL EXPERIENCE

Current and/or completed:

1997 - present. Consultant work (Invertebrate Identification Australasia - Owner) for various Australian and United States councils, government agencies (State, Commonwealth and Federal), environmental consultancies, mining companies and developers on short and medium term projects dealing mostly with molluscs and insects (particularly endangered species assessments).

Oct 2017 - Completed Biodiversity Assessment Method (BAM) course.

Aug 2017 – Sept 2017. Conduct one day snail identification workshops for the Department of Agriculture & Water Resources, biosecurity biomonitoring sections in Sydney, Melbourne and Perth.

Sept 2016 - Mar 2017. Identified almost 4000 lots of North American land and freshwater molluscs for the Field Museum of Natural History, Chicago, IL.

July 2016 – Dec 2016. Formally describe the US federally endangered freshwater snail, the Banbury Lanx for the Boise Office of the US Fish and Wildlife Service.

Feb 2015 – Mar 2016. Preparing a list of all the names, synonyms and combinations applied to the non-marine molluscs of North America, for the Field Museum of Natural History, Chicago, IL.

Oct 2014 – Feb 2016. Prepare a status report for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) on the Shortface Lanx (*Fisherola nuttallii*) in Canada.

Jan 2013. Conducted a one day workshop on the identification of the endangered Cumberland Land Snail (*Meridolum corneovirens*) for the Ecological Consultants Association of NSW, Mount Annan, NSW, Australia.

June 2011 – present. Contracted with Deixis Consultants to write a Field Guide to the freshwater Molluscs of the Pit-Sacramento Rivers, California by the Cantara Trustee Council Grant Program.

Jan 2010 – Aug 2011. Co-founder and Executive Director, EKOsystems Services, LLP, Chicago, IL.

GRANTS

Clark, S.A. and Harris, P. State of Alabama Department of Conservation and Natural Resources - Distribution, life history, conservation and systematics of Alabama's Pebblesnails. Oct 2004 - Sept 2006. $26,930.

Clark, S.A. Hawkesbury Postgraduate Research Award - PhD, University of Western Sydney. Jan 2000 - Oct. 2002. $47,250.

Ponder, W.F. and Clark, S.A. Australian Biological Resources Study - Interactive CD-Rom guide and key to the freshwater Mollusca of Australia. Jan 1999 - Dec 2001. $90,000.

PROFESSIONAL SOCIETIES

American Malacological Society
Conchological Society of Great Britain and Ireland
Malacological Society of Australasia
The Ecological Consultants Association of New South Wales
Malacological Society of London
Royal Zoological Society of New South Wales
Freshwater Mollusc Conservation Society

Member of the IUCN SSC Mollusc Specialist Group.

RESEARCH INTERESTS

Systematics, population and conservation genetics of invertebrates, particularly terrestrial and freshwater molluscs.

EXPERIENCE

I have over 30 years experience in the collection, identification and taxonomy of marine, estuarine, freshwater and terrestrial molluscs in 16 countries and 40 US states. I have over 12 years experience using allozyme electrophoresis to study speciation and population genetics particularly of molluscs but also some work with reptiles and spiders and at least 5 years experience analysing DNA data. I have about 6 years experience preparing material for and using a scanning electron microscope and have dissected individuals from several hundred populations of freshwater and terrestrial molluscs.

LEGAL EXPERIENCE

I have served as an expert witness for the Land and Environment Court of New South Wales on six occasions since 1997 and have provided expert testimony for several other cases.

PROFESSIONAL ACTIVITIES

Research Associate at the Field Museum of Natural History, Chicago, Illinois, June, 2010 to present.

Vice President of the Chicago Shell Club, Chicago, Illinois, May, 2010 to May, 2016.

Courtesy Postdoctoral Researcher, Division of Malacology at the Florida Museum of Natural History, Gainesville, Florida, September, 2009 to 2016.

Invited participant at the IUCN Red List workshop assessing the Red List status of the world's freshwater molluscs, organised jointly by the Zoological Society of London, the Encyclopedia of Life (EOL), International Union for Conservation of Nature (IUCN), and the IUCN SSC Mollusc Specialist Group. Held in London, United Kingdom, February, 2010.

Served on the Status Review Panel for the federally endangered Idaho Springsnail (*Pyrgulopsis robusta*), in Boise, Idaho, for the United States Fish and Wildlife Service, Western Region, October, 2005.

TELEVISION

Short interview about my PhD project on the endangered endemic Sydney land snail *Meridolum corneovirens*, aired on 'Totally Wild' (a children's educational program on wildlife and the environment), Australia wide, 7 May 2002.

Short interview regarding the endangered endemic Sydney land snail *Meridolum corneovirens* and how the Olympic Coordinating Authority (OCA) has helped in its conservation, aired on 'A Current Affairs' (a prime time news and current affairs program) Australia wide on the 15 September, 1998.

RADIO

Short interview with Brian Bury, 4BC, Brisbane, about Australian native snail diversity aired Nov. 2002.

NEWSPAPER/INTERNET

Several interviews about molluscs, endangered species and rediscovering a species previously thought to be extinct, with national, local and internet media outlets, both in Australia and the United States since 2002.

Some recent examples:
ABC News: When Birds Overshadow Snails -- And Why That's a Problem
http://abcnews.go.com/Technology/story?id=734467&page=1

http://www.cofc.edu/~fwgna/archive/9May05.html

PUBLICATIONS

Keenan, S.W., Audrey T. Paterson, A.T., Niemiller, M.L., Slay, M.E., Clark, S.A. and Engel, A.S. 2017. Observations of the first stygobiont snail (Hydrobiidae, *Fontigens* sp.) in Tennessee. *Proceedings of the 17th International Congress of Speleology* **2017**:91-94.

Campbell, D.C., Clark, S.A. and Lydeard, C. 2017. Phylogenetic analysis of the Lancinae (Gastropoda, Lymnaeidae) with a description of the U.S. federally endangered Banbury Springs lanx. *ZooKeys* **663**:107-132.

Ponder, W.F., Hallan, A., Shea, M. and Clark, S.A. 2016. Australian Freshwater Molluscs. The snails and bivalves of Australian inland waters. Interactive key http://keys.lucidcentral.org/keys/v3/freshwater_molluscs/

Johannes, E.J. and Clark, S.A. 2016. Freshwater mollusc declines, local extinctions and introductions in five northern California streams. *Tentacle* **24**:22-25.

Campbell, D., Clark, S.A., Johannes, E., Lydeard, C. and Frest, T. 2016. Molecular phylogenetics of the freshwater gastropod genus *Juga* (Cerithioidea: Semisulcospiridae). *Biochemical Systematics and Ecology* **65**:158-170.

Gerber, J. and Clark, S.A. 2015. First record of the predatory land snail *Streptostele* (*Tomostele*) *musaecola* (Pulmonata: Streptaxidae) in the continental United States. *American Conchologist* **43(4)**:26-28.

Hauk, A., Clark, S.A., McCravy, K.W., Jenkins, S.E. and Lydeard, C. 2015. A Survey of Terrestrial Gastropods of the Alice L. Kibbe Life Science Station in West-Central Illinois. *Northeastern Naturalist* **22(2)**:299-306.

Bieler, R., Mikkelsen, P.M., Timothy M. Collins, T.M., Glover, E.A., González, V.L., Daniel L. Graf, D.L., Harper, E.M., John Healy, J., Kawauchi, G.Y., Sharma, P.P., Staubach, S., Strong, E.E., Taylor, J.D., Tëmkin, I., Zardus, J.D., Clark, S., Guzmán, A., McIntyre, E., Sharp, P. and Giribet, G. 2014. Investigating the Bivalve Tree of Life – an exemplar-based approach combining molecular and novel morphological characters. *Invertebrate Systematics* **28(1)**:32-115.

Clark, S.A. 2009. Revision of the genus *Posticobia* (Mollusca: Caenogastropoda: Rissooidea: Hydrobiidae s.l.) from Australia and Norfolk Island. *Malacologia* **51(2)**:319-341.

Clark, S.A. 2009. A review of the land snail genus *Meridolum* (Gastropoda: Camaenidae) from central New South Wales, Australia. *Molluscan Research* **29(2)**:61-120.

Ó Foighil, D., Lee, T., Campbell, D.C. and Clark, S.A. 2009. All voucher specimens are not created equal: a cautionary tale involving North American pleurocerid gastropods. *Journal of Molluscan Studies* **75(3)**:305-306.

Waggoner, J., Clark, S.A., Perez, K.E. and Lydeard, C. 2006. A survey of terrestrial gastropods of the Sipsey Wilderness (Bankhead National Forest), Alabama. *Southeastern Naturalist* **5(1)**:57-68.

Ponder, W.F., Clark, S.A., Eberhard, S. and Studdert, J.B. 2005. A radiation of hydrobiid snails in the caves and streams at Precipitous Bluff, southwest Tasmania, Australia (Mollusca: Caenogastropoda: Rissooidea: Hydrobiidae s.l.). *Zootaxa* **1074**:1-66.

Perez, K.E., Ponder, W.F., Colgan, D.J., Clark, S.A. and Lydeard, C. 2005. Molecular phylogeny and biogeography of spring-associated hydrobiid snails of the Great Artesian Basin, Australia. *Molecular Phylogenetics and Evolution* **34(3)**:545-556.

Clark, S.A. 2005. Systematics, spatial analysis and conservation genetics of *Meridolum corneovirens* and related forms (Gastropoda: Camaenidae) from the Sydney Region of Australia. Ph.D. Thesis, University of Western Sydney, Richmond, Sydney, New South Wales. pp. i-xiii, 1-256.

Lydeard, C., Cowie, R.H., Ponder, W.F., Bogan, A.E., Bouchet, P., Clark, S.A., Cummings, K.S., Frest, T.J., Gargominy, O., Herbert, D.G., Hershler, R., Perez, K.E., Roth, B., Seddon, M., Strong, E.E., Thompson, F.G. 2004. The global decline of nonmarine mollusks. *Bioscience* **54(4)**:321-330.

Clark, S.A. 2004. Native snails in an urban environment – conservation from the ground up. In: *Urban wildlife: more than meets the eye*. Eds. Lunney, D. and Burgin, S., Royal Zoological Society of New South Wales, Mosman, NSW, Australia, pp. 78-81.

Clark, S.A., Miller, A.C. and Ponder, W.F. 2003. Revision of *Austropyrgus* (Gastropoda: Hydrobiidae); a morphostatic radiation of freshwater gastropods in south-eastern Australia. *Records of the Australian Museum, Supplement* **28**:1-109.

Clark, S.A. and Richardson, B.J. 2002. Spatial analysis of genetic variation as a rapid assessment tool in the conservation management of narrow range endemics. *Invertebrate Systematics* **16(4)**:583-587.

Ponder, W.F., Clark, S.A. and Dallwitz, M.J. 2000. Freshwater and Estuarine Molluscs. An interactive, illustrated key for New South Wales. CD-ROM, CSIRO Publishing, Melbourne, Australia.

Miller, A.C., Ponder, W.F. and Clark, S.A. 1999. Freshwater snails of the genera *Fluvidona* and *Austropyrgus* (Gastropoda, Hydrobiidae) from northern New South Wales and southern Queensland, Australia. *Invertebrate Taxonomy* **13(3)**:461-493.

Ponder, W.F., Clark, S.A. and Miller, A.C. 1999. A new genus and two new species of Hydrobiidae (Mollusca: Gastropoda: Caenogastropoda) from south Western Australia. *Proceedings of the Royal Society of Western Australia* **82(3)**:109-120.

Clark, S.A. 1997. Taxonomy and biology of *Posticobia* (Gastropoda: Hydrobiidae). M.Sc. Thesis, Macquarie University, North Ryde, Sydney, New South Wales. pp. 1-199.

Ponder, W.F., Colgan, D.J., Terzis, T., Clark, S.A. and Miller, A.C. 1996. Three new morphologically and genetically determined species of hydrobiid gastropods from Dalhousie Springs, northern South Australia, with the description of a new genus. *Molluscan Research* **17**:49-106.

GREENCAP
Going Further in Managing Risk

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NSW Health Infrastructure c/o TSA Management
Tweed Valley Hospital
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11 June 2019

To Jacqueline Hawkins,

Re: Rock wall tunnel and the Biodiversity Development Assessment Report (BDAR)

On 2 May 2019 Greencap was notified of a previously unobserved man-made tunnel-like structure located at Rock Wall 4. It was uncovered during clearing of exotic vegetation for the purpose of documenting cultural heritage values of rock walls located on the site of the new Tweed Valley Hospital. On 2 May I (Dr Damian Licari, Principal Consultant and Accredited Assessor) reviewed the photographs taken at the time of the clearing works and determined that this structure may provide potential habitat for cave-dwelling microbat species and that consequently this may have implications for credit offset requirements for the approved Stage 1 BDAR.

On 3 May Christina Maloney (Senior Environmental Consultant) and I inspected the structure to determine the likelihood of the structure being suitable roosting and/or breeding habitat for cave-dwelling microbat species. Based on a visual inspection using a spotlight and photographs, I determined that it was unlikely that the tunnel was used as roosting and/or breeding habitat by microbats on the basis that:

a) visual inspection found no evidence of current presence (i.e. roosting animals) nor evidence of past presence of microbats (i.e. scats/guano); and
b) prior to the recent cultural heritage documentation, the tunnel was overgrown in dense exotic vegetation (primarily Sicklethorn *Asparagus falcatus*) which blocked microbat flyway access the tunnel.

Following this inspection I sought an expert opinion from a bat specialist (David Milledge, Landmark Ecological Services). Mr Milledge inspected the structure on Wednesday 29 May and prepared a report that concurred with my assessment of the structure (Attachment 1).

The identification and assessment of the structure is applicable to the Stage 1 BDAR as it will be removed as part of the Stage 1 works. The presence of the structure should be documented because the Stage 1 BDAR currently states "*Field assessment did not locate any caves, tunnels, mines or other structures known or suspected to be used by the species for breeding are located on the Site*" to justify exclusion of the above species from the assessment (Stage 1 BDAR Greencap 2019; Table 6). The Stage 1 BDAR and SSD application was already lodged at the time the structure was discovered. The finding is considered unforeseeable prior to the clearance of the dense vegetation, hence the assessment has occurred post-application.

The Stage 1 BDAR should be amended with the above findings to correctly note the presence of potential microbat habitat. In accordance with published guidelines[1], two candidate microbat species identified by the BAM Calculator (i.e. Little bentwing-bat *Miniopterus australis* and Eastern bentwing-bat *Miniopterus schreibersii oceanensis*, also 'potential' serious and irreversible impact [SAII] species) would remain excluded from the Stage 1 BDAR assessment. This is based on my assessment that microhabitats on which the species depend are sufficiently degraded such that the species are unlikely to utilise the subject land (i.e. dense exotic vegetation obstructed flyway access to the structure). Consequently, there would be no change in credit offset requirement and I do not foresee a negative impact on the outcome of the Stage 1 BDAR.

As a matter of professional diligence as an Accredited Assessor and to allow NSW Health Infrastructure to manage any risks of non-compliance with the legislation, the Stage 1 BDAR needs to be updated accordingly. However, as the timing for updating the Stage 1 BDAR is undesirable given the application is currently being determined I recommend as an alternative that OEH is informed of the above findings and the agency's advice on their preferred course of action is sought given that the outcome presents no negative impact on the Stage 1 BDAR.

[1] Office of Environment and Heritage (2018),*'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method.*

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Greencap is keen to work with NSW Health Infrastructure in reaching the outcome with least risk to project cost and schedule and can raise this issue with OEH together with TSA or act on TSA's behalf.

We look forward to your response.

Regards,

Dr Damian Licari
Principal Consultant - Environment | Greencap

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Attachment 1: Assessment of Tunnel-Like Structure

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Ecological Services Pty Ltd
PO Box 100 Suffolk Park NSW 2481 Australia | ABN 29 064 548 876

DAVID MILLEDGE | DIRECTOR
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4 June 2019

Report on an inspection of a tunnel formed by an old boiler-like structure built into a stone wall at the site of the new Tweed Hospital and its potential as a roosting site for threatened hollow-dependent microbats

On 29 May 2019 I inspected a tunnel formed by an old boiler-like structure built into a dry-stone wall at the site of the new Tweed Hospital, 771 Cudgen Road, Cudgen (**Photos 1, 2** and **3**) in the company of Christina Maloney of Greencap. GPS co-ordinates for the location of the tunnel are (GDA94) Easting 555680, Northing 6873508.

The dimensions of the tunnel were approximately 1.5 m in width, 1.0 m in height and 2.5 m in length. The entrance of the tunnel was boarded up with plywood when I arrived but this was removed to allow an inspection and photographs to be taken. The end wall of the tunnel was noted to be constructed of loosely wedged stones and the floor was relatively firmly-packed soil (**Photos 1** and **2**).

I inspected the walls including the end wall and the floor of the tunnel closely but could find no indication of its past use as a roost site by species of microchiropteran bats (microbats), particularly threatened (*Biodiversity Conservation* (*BC*) *Act 2016*) microbats.

Human made structures and rocks/stones are prescribed impacts identified under the *BC Regulation* (clause 6.1) and this boiler-like structure in the stone wall was considered to have represented potential roosting habitat for threatened cave-dwelling microbat species prior to the time of its location in early May 2019.

My inspection did reveal a series of droppings (scats) scattered on the floor of the tunnel that appeared relatively fresh, but these appeared to be of the introduced Black Rat *Rattus rattus* based on their size, shape and texture.

When the tunnel was initially located it was screened across its entrance by a dense growth of Sicklethorn *Asparagus falcatus* (C. Maloney pers. comm.), an exotic scrambler that formed an impenetrable barrier to its entry (**Photo 4**). This vegetation was cleared from the tunnel entrance in early May 2019 (C. Maloney pers. comm.).

My opinion is that with the Sicklethorn barrier in place, the tunnel would not have provided a suitable temporary or breeding roost site for either of the two cave-dwelling microbat species that have been identified as Biodiversity Assessment Methodology (BAM) Candidate (breeding) credit species in the Biodiversity Development Assessment Report (BDAR) for the new Tweed Hospital site. These comprise the Vulnerable (*BC Act 2016*) Little Bent-winged Bat *Miniopterus australis* and Eastern Bent-winged Bat *M. schreibersii* and in my experience both species require a relatively clear entrance or flyway to a roost site. In addition, it is unlikely that either species would have used the tunnel for roosting due to its restricted dimensions as they typically use caves or artificial structures that extend substantially further underground than the 2.5 m length of the subject tunnel.

Two additional threatened (*BC Act 2016*) cave-dwelling microbat species that may occur in the general area of the new Tweed Hospital site, the Large-eared Pied Bat *Chalinolobus dwyeri* and Eastern Cave Bat *Vespadelus troughtoni* could potentially roost in a structure with the dimensions of the subject tunnel. However, neither of these species are likely to forage in the habitats present in the site and would also have been unlikely to use the tunnel for roosting because of the dense screening of the entrance by Sicklethorn. In addition, neither of these threatened species were identified as candidate or predicted species by the BAM Calculator in the BDAR assessment.

Photo 1 **The tunnel formed by the old boiler-like structure built into the stone wall at the site of the new Tweed Hospital showing dimensions and hardened soil forming the floor Photo D. Milledge**

Photo 2 **The end wall of the tunnel formed by loosely wedged stones and the area of the floor where scattered droppings, probably from the introduced Black Rat *Rattus rattus*, were found Photo D. Milledge**

Photo 3 **The tunnel entrance in the dry-stone wall that was previously covered by a dense growth of Sicklethorn *Asparagus falcatus* Photo D. Milledge**

Photo 4 **The dense growth of Sicklethorn *Asparagus falcatus* that covered the entrance to the tunnel in the stone wall, taken in early April 2019 before it was cleared to reveal the tunnel's existence** **Photo C. Maloney**

David Milledge

Director

APPENDIX H. HERBARIUM CORRESPONDENCE

The Royal
BOTANIC GARDENS
& Domain Trust

National Herbarium of New South Wales

Gina MINATEL
Greencap
Level 8/133 Mary Street
brisbane City, QUEENSLAND 4000
AUSTRALIA

Enquiry No: 20733
Botanical.Is@rbgsyd.nsw.gov.au
Fax No: (02) 9251 1952
Ph. No: (02) 9231 8111
Date: 11 September 2018

Dear Gina MINATEL,

Thank you for your enquiry of 28-Aug-18. We are happy to provide the following information:

Dear Gina,
Dr Peter Weston and I spent yesterday looking through our Macadamia specimens and those of yours and another enquirer. I understand you no longer require this information but thought you might be interested in the results anyway. There is of course no charge for this enquiry. We also examined aerial maps and species distribution maps to determine context for your specimens. The rural setting and nearby plantations influenced our thinking.
075 *Macadamia integrifolia* <-> *tetraphylla* det P.H. Weston & B.M. Wiecek 10 Sep 2018, leaves almost entire but too long and large for *M. tetraphylla*, leaves in 2s,3s, and 4s (mostly 4s as in *tetraphylla*)
074 *Macadamia integrifolia* <-> *tetraphylla* det P.H. Weston & B.M. Wiecek 10 Sep 2018, leaves in 3s, more teeth than 075 but far too large for *tetraphylla*
058 *Macadamia integrifolia* <-> *tetraphylla* det P.H. Weston & B.M. Wiecek 10 Sep 2018, leaves in 3s, more teeth than 075 but far too large for *tetraphylla*

Thank you for your enquiry.

Yours sincerely

Barbara Wiecek
Identification Botanist
Botanical Information Service

PlantNET

Go to our online Botanical Information Services at plantnet.rbgsyd.nsw.gov.au to find out more about plants of New South Wales

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APPENDIX I. INDIRECT IMPACT ASSESSMENT

Appendix I Indirect Impacts and Mitigation Measures

Aspect	Project phase	Potential Impact	Mitigation	Risk before Mitigation	Risk After Mitigation
Noise	Construction	Noise during construction due to construction works and construction traffic. Potential disruption of threatened species or reduced viability of adjacent habitat.	• Noise during construction will be mitigated by applying appropriate safeguards and management measures before works commence including daily timing of construction activities and such as restricting works to approved construction hours in accordance with the Noise Policy for Industry (NSW EPA 2017), Interim Construction Noise Guidelines (DECC 2009) and the approved CNVMP. Furthermore, construction will be restricted to the southern portion of the Site where the project footprint is at least 67 m from the remnant native vegetation. This provides a natural buffer zone to dissipate noise and vibration impacts. • Noise levels during construction will be delivered in accordance with the approved CEMP Construction Noise and Vibration Management Sub-Plan. • Noise and Vibration Impact Assessments for the Project should consider acoustic and vibration ecological sensitive receivers. Objectives of the Draft Noise and Vibration Impact Assessment (JHA 2019) are to identify noise and vibration sensitive receivers that will potentially be impacted by the operation of the Project, establish the appropriate noise levels and vibration criteria, carry out noise assessments, determine whether the relevant criteria can be achieved and provide recommendations for Construction Noise and Vibration Planning.	Low	Very low
	Operation	Noise during operations including traffic. Potential disruption of threatened species or reduced viability of adjacent habitat.	• Noise levels during operations would be delivered in accordance with an approved Operational Environmental Management Plan (OEMP) that details safeguards and management measures in accordance with the *POEO (Noise Control) Regulation 2017* or any other relevant Tweed Shire Council noise regulation. • Potential noise impacts on noise sensitive receivers for helicopter operations are addressed within the Airservices Australia Principles and Procedures for minimizing the impact of aircraft noise fly Neighbourly Guide (JHA 2019).	Low	Very low
Vibration	Construction	Vibration during construction due to construction works and construction traffic.	• Vibration levels during construction will be delivered in accordance with the approved CEMP Construction Noise and Vibration Management Sub-Plan. • Noise and Vibration Impact Assessments for the Project should consider acoustic and vibration ecological sensitive receivers. Objectives of the Draft Noise and Vibration Impact Assessment (JHA 2019) are to identify noise and	Low	Very low

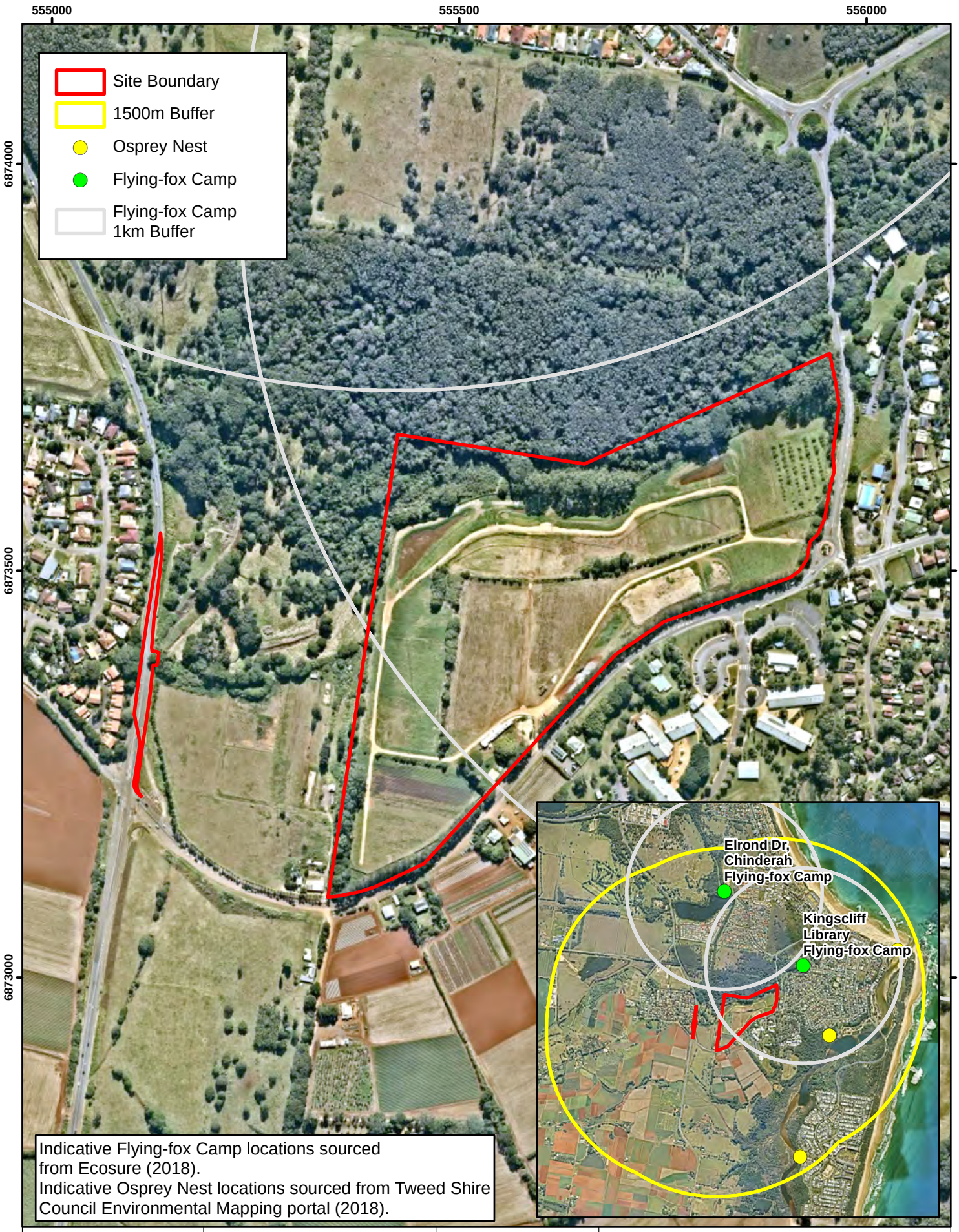
Aspect	Project phase	Potential Impact	Mitigation	Risk before Mitigation	Risk After Mitigation
		Potential disruption of threatened species or reduced viability of adjacent habitat.	vibration sensitive receivers that will potentially be impacted by the operation of the Project, establish the appropriate noise levels and vibration criteria, carry out noise assessments, determine whether the relevant criteria can be achieved and provide recommendations for Construction Noise and Vibration Planning. • Vibration during construction will be mitigated by applying appropriate safeguards and management measures before works commence including daily timing of construction activities and such as avoiding night works as much as possible • Construction will be restricted to the southern portion of the Site where the project footprint is at least 67 m (the width of the APZ for bushfire protection) from the remnant native vegetation.		
	Operation	Vibration during operations including traffic. Potential disruption of threatened species or reduced viability of adjacent habitat.	• Vibration levels (if any) during operations would be managed in accordance with an approved OEMP that details safeguards and management measures in accordance with relevant standards and guidelines.	Low	Very low
Light spill	Construction	Light spill during construction due to construction lighting and construction traffic. Potential disruption of threatened species or reduced viability of adjacent habitat.	• Light sensitive species are presumed unlikely to be present at the Site. • Construction will be restricted to the southern portion of the Site where the Project footprint is at least 67 m (the width of the APZ for bushfire protection) from the remnant native vegetation. This provides a natural buffer zone to dissipate light spill impacts. • All construction works and associated activities would be delivered in compliance with AS4282 and AS1158. As per the CEMP (LLB 2019); the lighting designer will have the appropriate competence in the fields of illuminating engineering and environmental design. • Mitigation measures to reduce the impact of potential disruption to threatened wildlife species or reduced viability of adjacent habitat from light spill during the construction of the Project include a range of measures as detailed in the	Low	Very low

Aspect	Project phase	Potential Impact	Mitigation	Risk before Mitigation	Risk After Mitigation
			CEMP and Stage 2 BMP, and include measures to avoid impacts on ecologically and environmentally sensitive areas.		
	Operation	Light spill during operations. Potential disruption of threatened species or reduced viability of adjacent habitat.	• The Site does not contain habitat for threatened species that are drawn to light (i.e. turtles) that could be adversely impacted by light spill. • The development will be located at least 67m (the width of the APZ) from vegetation (Zones 1,2,3). Provision of lighting would be delivered in accordance with the approved CEMP and any relevant standards and guidelines, in particular local hospitals. • Light spill will be minimised during the operations of the Project by incorporating a range of external lighting design approaches as per the External Lighting Strategy Report (LCI 2019) and Stage 2 BMP.	Low	Very low
Visual Amenity	Construction	Rubbish and waste retained onsite attracting native fauna.	• Activities on the Site will be managed in accordance with the approved CEMP and Construction Waste Management Sub-Plan (CWMSP); and designed to limit the amount of rubbish and waste onsite through good housekeeping practices.	Low	Very low
	Operation	Rubbish and waste retained onsite attracting native fauna.	• Activities on the Site will be managed in accordance with the approved CEMP and Construction Waste Management Sub-Plan (CWMSP); and designed to limit the amount of rubbish and waste onsite through good housekeeping practices.	Low	Very low
Dust	Construction	Inadvertent impacts of dust deposition on native vegetation or threatened species. Potential disruption of threatened species or reduced viability of adj acent habitat.	• Dust levels during operations will be managed in accordance with the approved CEMP Construction Air Quality Management and Dust Management Sub-Plan that details safeguards and management measures in accordance with relevant guidelines for construction sites, including: ○ Air quality monitoring ○ Planning of construction activities to meet dust management requirements ○ Dust suppression techniques ○ Stockpile management ○ Road management and sealing ○ Maximum speed limits ○ Designation of trafficable areas	Low	Very low

Aspect	Project phase	Potential Impact	Mitigation	Risk before Mitigation	Risk After Mitigation
			○ Minimising handling of soil/rock materials ○ Covering of loads • The details of all measures are discussed in further detail in the Stage 2 BMP.		
	Operation	Inadvertent impacts of dust deposition on native vegetation or threatened species. Potential disruption of threatened species or reduced viability of adjacent habitat.	• It is expected that dust generation during operations will be negligible once construction activities cease, and air quality/dust management will occur in accordance with *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA) and *Guidelines for development adjoining land and water managed by DECCW* (OEH, 2013).	Low	Very low
Retained native vegetation	Construction	Damage or removal of retained native vegetation. Unplanned loss of habitat.	• All works and associated activities are to be delivered in accordance with the approved CEMP and sub plans, the VMP in the Stage 1 and Stage 2 BMPs, and the Landscape Masterplan Report (Turf 2019). • All existing trees and areas of native vegetation not identified for removal on approved plans of the proposed development shall be protected from damage during works. • The measures are detailed in the VMP in Stage 1 and Stage 2 BMPs, and include: ○ Maintain tree protection zone (TPZ) around retained native vegetation inside the temporary boundary fence, including the two high and moderate retention value *Ficus* sp. Trees and one *Cryptocarya foetida*. ○ Establish a TPZ at the Tweed Coast Road/Cudgen Road Intersection. ○ Maintain protective fencing and signage. ○ Vegetation management works within areas containing native vegetation must be undertaken by a suitably qualified and experienced bush regeneration contractors. ○ Suitably qualified and experienced arborists must be engaged to undertake vegetation clearing works. ○ Clearing vegetation as per approval at the Tweed Coast Road/Cudgen Road Intersection upgrade. ○ Translocation of threatened plant *Cryptocarya foetida.* ○ Ensuring contractor awareness.	Low	Very low

Aspect	Project phase	Potential Impact	Mitigation	Risk before Mitigation	Risk After Mitigation
			• Potential impacts on MRS are to be managed by: ○ management of vegetation in core MRS habitat to protect and increase the quality of habitat by improving key habitat requirements of well-developed leaf litter and intact canopy as detailed in the Stage 2 BMP. ○ Development of a scientific survey and management plan for the MRS at the Site by a specialist invertebrate consultant, Dr Stephanie Clark, including a baseline survey (conducted in May 2019), an ongoing repeatable monitoring program, and scheduled reporting		
	Operation	Damage or removal of retained native vegetation. Unplanned loss of habitat.	• Native vegetation management will continue to occur during operations as per the BMP and VMP sub-plan. • It is recommended in the Stage 2 BMP that Site Management enforce various policies including not permitting pets in areas of conservation. • Potential impacts on MRS are to be managed by: ○ management of vegetation in core MRS habitat to protect and increase the quality of habitat by improving key habitat requirements of well-developed leaf litter and intact canopy as detailed in the Stage 2 BMP. ○ Development of a scientific survey and management plan for the MRS at the Site by a specialist invertebrate consultant, Dr Stephanie Clark, including a baseline survey (conducted in May 2019), an ongoing repeatable monitoring program, and scheduled reporting	Low	Very Low
Non-native vegetation	Construction	Introduction of weeds to the Site.	• In order to avoid the introduction or spread of weeds on the Site, weed hygiene practices will be implemented in accordance with the approved CEMP and sub plans, and the Stage 1 and Stage 2 BMPs. • Mitigation measures for weed control are detailed in the BMPs, and include: ○ Ongoing vehicle inspection and wash-down ○ Inspection and wash-down procedures ○ Topsoil management ○ Communication of biosecurity risk management to all personnel ○ Appropriate disposal of weed contaminated material ○ Weed control measures ○ Contractor awareness	Low	Very low

Aspect	Project phase	Potential Impact	Mitigation	Risk before Mitigation	Risk After Mitigation
			○ *Salvinia molesta* aquatic weed infestation control in the wetland area ○ Decommissioning and infilling of the farm dam in the northwest of the Site • Potential impacts on MRS are to be managed by: ○ A black rat *Rattus rattus* control program to be implemented during construction of the Project. ○ Development of a scientific survey and management plan for the MRS at the Site by a specialist invertebrate consultant, Dr Stephanie Clark, including a baseline survey (conducted in May 2019), an ongoing repeatable monitoring program, and scheduled reporting		
	Operation	Introduction of weeds to the Site.	• Vegetation will continue to be managed during operations in accordance with the Stage 2 BMP VMP sub-plan.	Low	Very low
Bushfire / Changing Fire Regimes	Construction	Changes to existing fire regime and / or increased prevalence of fire.	• Bushfire impacts will be identified and managed through the Bushfire Hazard Assessment Report (GeoLINK 2019) impact assessment and associated management plans. • There will be minimal impact to retained native vegetation as most of this is outside the Asset Protection Zone (APZ). • The APZ will be separated into Inner (IPA) and Outer (OPA) zones. No retained vegetation is present within the IPA.	Low	Very low
	Operation			Low	Very low



Client: C107778	N 0 80 160 m	Scale (@A4): 1:6,000	**Indicative Location of Flying Fox Camps and Osprey Nests**
Job #: J156455-13			
Author: D. Correa	Coordinate System: GDA 1994 MGA Zone 56		
Checked: C. Maloney	*Note: All data is approx only & subject to survey.*	Tweed Valley Hospital Stage 2 BDAR 771 Cudgen Road Cudgen NSW	**Figure I-1**
Date: 9/08/2019	*Imagery 15th July 2019 (1.2 m) © Nearmap 2019*		
GREENCAP			

Doc Path: R:_Projects\C107778_Health Infrastructure\J156455_Tweed Valley Hospital\3. Job Folder\GIS\J156455_13_TVHs2\BDARs2\mxd\J156455_13_BDARs2_zI01_flyingfoxes_ospreys_190809.mxd

APPENDIX J. PRESCRIBED IMPACT ASSESSMENT

Appendix J Prescribed Impacts and Mitigation Measures

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities.					
Hydrology	Construction	Sediment run-off during construction. Sediment basin discharge water quality	Management of water quality, water bodies and hydrological processes that sustain threatened species and TECs to be managed as per: • Water Quality Management Plan (WQMP) as per Section 4 of the Stage 2 BMP with detailed measures in Section 4, Table 11; • CEMP and associated CSWMSP; and • SWMP and ESCP. These measures include: • Location of development footprint to minimise interference with hydrological flows; • Stormwater management systems modelled in accordance with the locally appropriate standard the *Tweed Shire Council Development Design Specification - D7* (TSC 2016) and guidelines for development adjoining land and water managed by DECCW (OEH 2013) to minimise the risk of erosion and sediment-laden stormwater into the receiving catchment and wetland; • Erosion and sediment control (ESC) design is in accordance with the guidelines in Best Practice Erosion and Sediment Control (IECA 2008), the *NSW Managing Urban Stormwater "Blue Book"* (Landcom 2004); • Installation of four adequately sized sediment basins with a total capacity of 7,562 m^3 volume were constructed as part of Preliminary Works package to capture flows (Bonacci 2019); • Prior to a controlled discharge event, the four sediment basins will be sampled at the discharge points (near the outlet) to ensure the quality of water released is consistent with the water quality objectives;	High	Very low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
			• The sediment basins will be converted into bio-detention basins once the site excavation works and roads have been completed and all surfaces have been stabilised with appropriate ground cover (i.e. landscaping has commenced); • Protection of receiving catchment by providing diversion stormwater drainage lines that bypass the construction site; • Monitoring of the sediment basins for aquatic weeds; • Suitable plant selection for revegetation around the basins; • Selection of a flocculant for use in sediment basins that does not create a significant pH change but works effectively as gypsum to be used to mitigate risks to pH dependent threatened species within the wetland area (i.e. Wallum froglet *Crinia tinnula* and Olonburra frog *Litoria olongburensi*), as detailed in the Stage 2 BMP; and • In accordance with section 9.4.2 of the BAM, the WQMP in the Stage 2 BMP includes measures to monitor water quality in the receiving environment (uncontrolled event-based and monthly). Water quality monitoring commenced in pre-construction and will be undertaken during periodically to detect changes during construction in receiving water quality resulting from the Project. Water quality results shall be compared against the adopted water quality guidelines as per the Stage 2 WQMP as well as monitoring for change (trends in increases or decreases) over time. Exceedances and/or any continuous changes in water quality will trigger investigation and adaptive management actions.		

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
	Operation	Changes in water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	Management of water quality, water bodies and hydrological processes that sustain threatened species and TECs to be managed as per: • Water Quality Management Plan (WQMP) as per Section 4 of the Stage 2 BMP with detailed measures in Section 4, Table 11; and • SWMP and ESCP. These measures include: • A stormwater drainage system will be constructed to convey stormwater runoff from the buildings and associated, roads, carparks and landscape areas. It has been designed to mimic natural flows to minimise future impact to the endangered ecological community in the receiving wetland; • The storage volumes of the converted basins were designed to ensure that the combined post development discharge from the basins is no greater that the pre-development flow (there is no increase in the total site discharge rate in the 5-year and 100-year ARI storm events) (RBG 2019); • The stormwater management system for the Site uses Water Sensitive Urban Design Measures (WSUD) – installation of bio-retention basins to reduce nutrient levels of stormwater discharged from the site and incorporates swales, enviropods and the use of landscaped areas for filtering runoff. Ultimately the bulk of the stormwater will end up in a bio-detention basin where it will settle and discharge to the receiving waters in a controlled manner. The water quality strategy for the Site is outlined in the SWMP (RBG 2019); • Monitoring of the bio-detention basins for aquatic weeds; • Additionally, new plantings within rain gardens that both treat stormwater quality and contribute to providing a range of native habitat or 'moist corridors' across the site (Turf 2019); and	High	Very low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
			• As described above, water quality monitoring commenced in pre-construction and will be undertaken periodically during operations. Water quality results shall be compared against the adopted water quality guidelines as per the Stage 2 WQMP. The surface water monitoring objectives for the Site during operations are to detect changes in receiving water quality resulting from the Project. An assessment of the potential ecological impact on the coastal wetlands to the north of the site as a result of any changes to hydrology (flow regimes) caused by the Project was undertaken by SMEC (2019). The assessment considered EECs, TECs, threatened species and the overall biophysical, hydrological and ecological integrity. The modelling conducted as part of the assessments predicts a mean total annual flow from site to increase by almost 50% from 90.6 ML/yr pre-development to 140 ML/yr post development. The potential impacts of these additional flows on the EECs identified on the Site, Mitchell's rainforest snail *Thersites mitchellae* (MRS) and two pH dependent threatened species (i.e. Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis*) were assessed by Jon Alexander, an ecologist and suitably qualified professional. In summary, the assessment found that the predicted minor increases in flow are unlikely to result in any apparent or significant impacts (SMEC 2019). It is a design requirement to achieve a reduction of peak 1% and 20% peak flows to below existing levels, and with minor basin modification the proposed stormwater management will achieve this. The impact of increased and more frequent flows on the wetland is assessed as minimal, however, to reduce the modelled higher frequency flows (more frequent than the 20% AEP), mitigation measures recommended by SMEC (2019) include additional assessment to be carried out to inform potential modification(s) in the basin outflow design, such as staging the basin outlets to reduce peak discharges		

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
			and by removing the proposed bio-basin lining and providing additional infiltration downstream of the basins.		
Hydrogeology	Construction	Changes in water quality, water bodies and hydrological processes that sustain threatened species and threatened	To avoid any impacts on groundwater, particularly during piling and excavation activities, all works and associated activities are to be delivered in accordance with an approved; • Water Quality Management Plan (WQMP) as per Section 4 of the Stage 2 BMP with detailed measures in Section 4, Table 11; • CEMP and associated CSWMSP and CWMSP; and • SWMP and ESCP.	Medium	Very low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
		ecological communities	Mitigation measures include: • A spill prevention and response management plan, along with supporting documentation, will be produced as part of the Project's CEMP and their prescriptions will be implemented to minimise the risk of surface water or groundwater contamination; and • Other than what may be required for piling, subsurface excavations will be at a shallower depth than measured depth to groundwater on the Site. The proposed less intrusive method of pile construction using a continuous flight auger (CFA) or Bore Pile type is expected to remove the requirement to de-water from groundwater table during piling activities (Darren Chow, Lendlease Building Pty Ltd, pers. comm. 25 June 2019); • Whilst no site specific groundwater modelling data was available to the time of writing this report, the level that groundwater was encountered in test bores was upslope and therefore at a higher elevation than the wetlands. This suggests that there is potential for groundwater to influence the wetlands and provide some base flow. However, contaminated land investigations to date (Cavvanba 2019; Octief 2018) found localised, but no widespread ecological issues on the Site and that the Cudgen Creek off-site environmental receptor and associated creeks are unlikely to be exposed to the contamination pathway due to the distance from the source area and depth of the groundwater; and • The groundwater and intrusive soil investigation in July 2019 recommended a further groundwater monitoring round to investigate the exceedances of criteria for zinc and mercury; the presence of low-level detections of TRH; and to conduct analysis for OCPs with appropriate LORs in comparison to site criteria (Cavvanba 2019).		

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
	Operation	Change in ground water base flow to wetland and water bodies that sustain threatened species and threatened ecological communities.	To avoid any impacts on groundwater, all works and associated activities are to be delivered in accordance with an approved; • Water Quality Management Plan (WQMP) as per Section 4 of the Stage 2 BMP with detailed measures in Section 4, Table 11; and • SWMP and ESCP. Mitigation measures include: • Geotechnical investigations undertaken by Morrison Geotechnical (2018) identified that the water table is approximately at RL 11.0. The future building will not have finish floor levels below RL 11.0, therefore lowering the water table or dewatering will not be required. As the piles will typically be spaced 8.4 m apart and are not continuous, it is not anticipated that they will create a barrier to any shallow or perched groundwater flow that currently occurs within the Project footprint, minimising the potential for the development to impact groundwater contributions to base flow in the wetlands; • It is expected that any reduction of groundwater recharge due to the development footprint of the hospital would be mitigated through recharge that would occur through the proposed WSUD measures such as: rain gardens, swales, car park plantings to reduce impervious surfaces, managing stormwater and ground water recharge through landscaping; • It is recommended that the bioretention basins are modified to be unlined and that the outlet channels be extended along the contour with wide flow spreaders to connect to the wetland (1%AEP velocity < 1m/s) so that stormwater can infiltrate to the wetland rather than being contained in a lined basin (SMEC 2019); and • In accordance with section 9.4.2 of the BAM, a Biodiversity Management Plan has an adaptive management approach, and the water quality monitoring program will ensure alignment with any changes in Site activities and potential impact pathways and determine whether groundwater quality parameters are monitored.	Medium	Very low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
Impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community					
Traffic	Construction	Vehicle strikes	To avoid any impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community, all works and associated activities are to be delivered in accordance with an approved; • Fauna Management Plan (FMP) as per Section 3 of the Stage 2 BMP with detailed measures in Table 8; and • CEMP and associated sub plans (CHMSP and CTPMSP). Mitigation measures include: • A suitably qualified and experienced fauna rescue person shall be present to supervise the clearing activities. A Fauna Management Procedure for vegetation and rock clearing activities on the Site is outlined in Section 3.7 of the Stage 2 FMP; • Traffic will be restricted to the southern portion of the Site where the Project footprint is which is approximately 67 m from the intact remnant native vegetation; • Construction traffic must maintain low vehicle speeds, with a20km/hr speed limit on internal roads and access ways (LLB 2019) and operators shall take care and be aware of any wildlife that may be in the area. Should wildlife enter the construction footprint, a suitably qualified fauna handler should be notified, and actions taken in accordance with the FMP; • Any injured native fauna detected shall be rescued and transferred to a local veterinarian for treatment and/or WIRES for rehabilitation. • Monitoring of species mortality and injuries. Should an increase in Project related fauna mortalities/injuries occur, this will trigger investigation and adaptive management actions. • Weed control measures will improve the function of the wildlife fence located adjacent to the koala habitat on the Site. This fence is a barrier	Low	Very low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
			and will provide better protection for risk of vehicle strike to fauna trying to cross Turnock Street.		
	Operation	Vehicle strikes	To avoid any impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community, all works and associated activities are to be delivered in accordance with an approved Fauna Management Plan (FMP) as per Section 3 of the Stage 2 BMP with detailed measures in Table 8. Mitigation measures include: • During Stage 2, the road environment adjoining the site will be changed from rural to urban. The road environment will be upgraded to enable Site access as well as install and/or upgrade features associated with urban roads such as street lighting, kerb and channel guttering, signage, lane delineation and line-marking. Along with the increased pedestrian activity and traffic associated with the Project these measures are expected to reduce the existing traffic speeds along Turnock Street and Cudgen Road. • Advisory signage to mitigate impacts (movement and collisions with vehicles) due to the increase in traffic numbers along Cudgen Road and Turnock Street on fauna, particularly on the endangered population of Koalas, is currently being assessed in consultation with the OEH and is planned to continue until final lodgement of the EIS. • Any injured native fauna detected shall be rescued and transferred to a local veterinarian for treatment and/or WIRES for rehabilitation. • Monitoring of species mortality and injuries. Should an increase in Project related fauna mortalities/injuries occur, this will trigger investigation and adaptive management actions.	Low	Very low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
Aviation	Operation	Aircraft strike	To avoid any impacts of aircraft strikes on threatened species of animals or on animals that are part of a TEC, all works and associated activities are to be delivered in accordance with an approved Fauna Management Plan (FMP) as per Section 3 of the Stage 2 BMP with detailed measures in Table 8 and Section 3.8.3. Mitigation measures include: • Aviation operations for the development will be conducted in accordance with an approved Aviation Operations Manual. This manual will identify areas of wildlife hazards including bird and flying fox activity such as the Elrond Drive and Kingscliff Library flying fox camps that are located within 1km of the Site (Ecosure, 2018, Greencap, 2018). The location of known flying fox camps will be included as either an 'avoid area' or a 'fly neighbourly' area; • Given the nature of hospital operational activity, aircraft movement will be avoided during peak periods of flying fox activity (i.e. hours preceding dusk and dawn) and at peak birdstrike times as reported in the Australian aviation wildlife strike statistics report (Australian Transport Safety Bureau, 2017). These details will also be incorporated into the Enroute Supplement Australia (ERSA) published by Airservices Australia. The ERSA is a publication which contains information vital for planning a flight and for in flight operations for the aircraft pilot. • The siting of the HLS and primary considerations in HLS approach and departure path selection included avoidance of ecologically and environmentally sensitive areas. The SSD general requirements of preferred flight path directions are detailed in the Aviation State Significant Development Report: Tweed Valley Hospital SSD-9575 (AviPro 2019). The planned flight approach and departure paths to the HLS run north-northeast to southwest, minimising any impact on the environmentally sensitive areas including flying fox camps; and • In accordance with section 9.4.2 of the BAM, the FMP outlines measures to monitor fauna at the Site, including species mortality resulting from	Low	Very low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
			aircraft movement. The plan will outline objectives and thresholds for threatened species mortality, which in the event of exceedances will trigger investigation and adaptive management actions. Adaptive management actions may include auditory repellents, visual deterrents, and physical barriers where birds, bats and other animals are an issue.		

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range					
Habitat; established home range and connectivity	Construction	Removal of windrow vegetation in Zone 4 and 8.	To avoid any impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range, all works and associated activities are to be delivered in accordance with an approved; • Vegetation Management Plan (VMP) as per Section 2 of the Stage 2 BMP with detailed measures in Table 4 and 7; and • Fauna Management Plan (FMP) as per Section 3 of the Stage 2 BMP with detailed measures in Table 8 and Section 3.3. Mitigation measures include: • All native vegetation on the Site that is not approved for removal must be suitably protected during construction as per recommendations of Section 2.3.1 of the Stage 2 VMP as required by Conditions B33 and C25 of Schedule 3 for the duration of the construction works; • The vegetation maintenance program, including weed control activities, and regular monitoring and reporting including objectives and thresholds, which in the event of exceedances will trigger investigation and adaptive management actions. This will be undertaken to evaluate the progress and compliance with the VMP (See; Section 2.3.2 and 2.3.3 of the Stage 2 VMP); and • A suitably qualified and experienced fauna rescue person shall be present during vegetation clearing. A Fauna Management Procedure for vegetation and rock clearing activities on the Site is outlined in Section 3.7 of the Stage 2 FMP, including protocols to follow if koalas *Phascolarctos cinereus* are found on the Site during vegetation clearing works and/or earthworks.	Medium	Low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
	Both	Decrease in biodiversity values including connectivity and movement of threatened species that maintains their lifecycle	To avoid any impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range, all works and associated activities are to be delivered in accordance with an approved; • Vegetation Management Plan (VMP) as per Section 2 of the Stage 2 BMP with detailed measures in Table 4 and 7; and • Fauna Management Plan (FMP) as per Section 3 of the Stage 2 BMP with detailed measures in Table 8 and Section 3.3. Mitigation measures include: • The primary impact on movement of threatened species relates to boundary fencing of the Site. In respect of the current fencing on the site, the only existing permanent fencing in proximity to the site is the wildlife fencing along the Turnock St roadside. The Project will not impact this existing fencing. • Temporary boundary fencing has been installed during pre-construction works. This temporary fencing will be removed at the conclusion of the construction phase of the development. Temporary boundary fencing has been fitted with a 'post and bridge' system at least every 50 m in accordance with published guidelines (KRS 2009) to facilitate movement of koala *Phascolarctos cinereus* and other arboreal marsupials (See; Section 3.3.1 of the Stage 2 FMP). Wildlife-friendly is currently being assessed in consultation with the OEH and is planned to continue until final lodgement of the EIS; • As per the Stage 1 SSD application, there is no intent for a permanent boundary fence to be installed for the operations phase of the Project, thereby not impeding movement of threatened species; • To facilitate the movement of fauna, threatened species habitat and connections for foraging and dispersal, retained and enhanced vegetated buffer zones (MZs 6 and 7 in the VMP) will be substantial (augmented to a minimum of 10 m and 30 m wide) and representative of forest types being connected by these zones. Vegetated buffer zones will	Medium	Low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
			connect to the retained Subtropical Rainforest vegetation in the northern portion of the site and will run north to south in line with the mapped regional fauna corridor. This will provide important stepping-stone and refuge habitat for species connectivity. Revegetation and vegetation maintenance will be undertaken during Stage 2 works and is addressed in Section 2.3.3 and 2.3.4 of the VMP; • New plantings in the WSUD bio-detention basins, landscaped areas for filtering runoff and swale drains as part of Stage 2 works will treat both stormwater quality and contribute to providing a range of native habitat or 'moist corridors' across the site; • Where possible, landscaping will include habitat features such as rocks that have been salvaged from other areas of the Site (cleared windrows) that will create habitat for ground dwelling species (Turf, 2019); • The vegetation maintenance program, including weed control and restoration activities, and regular monitoring and reporting including objectives and thresholds which in the event of exceedances will trigger investigation and adaptive management actions, will be undertaken to evaluate the progress and compliance with the VMP (See; Section 2.3.2 and 2.3.3 of the Stage 2 VMP); • Weed removal will include removal of an exotic grassland monocultures of barner grass *Pennisetum purpureum* and of camphor laurel *Cinnamomum camphora* located amongst derived and remnant native vegetation in the northern section of the Site (Zone 9) and revegetation with appropriate native rainforest species. Currently there is a *Salvinia molesta* infestation in the dam located in the central northern section of the Site. Decommissioning the dam has been recommended to reduce ongoing control efforts of Salvinia as per Section 2.3.2.6 of the Stage 2 VMP; and • Where avoidance of light spill, airborne noise, vibration and dust generation is not practicable, key measures to mitigate the impact of potential disruption to threatened wildlife species or reduced viability of adjacent habitat and address residual impacts from light, noise, vibration or dust generated as a result of construction activities will be		

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
			implemented, as outlined in Section 3.9 of the FMP.		

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

Aspect	Project phase	Potential Impact	Mitigation	Risk before mitigation	Residual risk
Impacts of development on the habitat of threatened species or ecological communities associated with rocks					
Removal of wood or rocks along the windrows, particularly in Zone 4. Removal of native vegetation	Construction (Duration of vegetation clearing works and/or earthworks)	Death or injury to wildlife	To avoid any impacts of development on the on the habitat of threatened species or ecological communities associated with rocks, all works and associated activities are to be delivered in accordance with an approved Fauna Management Plan (FMP) as per Section 3 of the Stage 2 BMP with detailed measures in Table 8 and Section 3.7. Mitigation measures include: • For the duration of the construction works all native vegetation on the Site that is not approved for removal must be suitably protected during construction as per recommendations of Section 2.3.1 of the Stage 2 BMP as required by Conditions B33 and C25 of Schedule 3; and • A suitably qualified and experienced fauna rescue person shall be present during vegetation clearing. A Fauna Management Procedure for vegetation and rock clearing activities on the Site is outlined in Section 3.7 of the Stage 2 FMP.	Low	Very low

NOTE: This table should be read in conjunction with the following associated plans: Stage 1 Biodiversity Management Plan & Stage 2 Biodiversity Management Plan. These plans contain the detailed mitigation measures for the Project.

APPENDIX K. RISK MATRIX

		Probability				
		A	B	C	D	E
Maximum reasonable consequence	1	CR	CR	HR	HR	MR
	2	CR	HR	HR	MR	LR
	3	HR	HR	MR	LR	LR
	4	HR	MR	LR	LR	LR
	5	MR	LR	LR	LR	LR

CRITICAL	CR
HIGH RISK	HR
MODERATE RISK	MR
LOW RISK	LR

Consequence criteria: Impacts on threatened species and/or threatened species habitat
1. CRITICAL • Impact – Severe; Spatial scale – Widespread; Time scale – Long-term. • Requires consideration of whether impacts may result in a Serious and Irreversible Impact that may lead to local extinction.
2. MAJOR • Impact – Moderate; Spatial scale – Moderate to widespread; Time scale – Mid- to long-term. • May result in temporary or long-term damage.
3. MODERATE • Impact – Moderate; Spatial scale – Local to moderate; Time scale – Short- to mid-term. • May result in a moderate, temporary impact. However, it may be difficult to rehabilitate impact and may have negative implications on the ecosystem.
4. MINOR • Impact – Minor; Spatial scale – Local; Time scale – Short-term. • May result in minor impacts that are relatively easily rehabilitated. Not likely to have negative implications on the ecosystem.
5. NEGLIGIBLE • Impact – Minor; Time scale – Short-term with no lasting effect. • May result in negligible impacts that can be categorised as temporary, local and reversible.
Likelihood criteria
A. ALMOST CERTAIN • Very high or certain probability that impact will occur or event is of a continuous nature.
B. LIKELY • Likely probability that impact will occur or event is frequent (frequency 1-5 years).
C. MODERATE • Moderate probability that impact will occur or event is infrequent (frequency 5-20 years).
D. UNLIKELY • Low probability that impact will occur or event is very infrequent (frequency 100 years).
E. REMOTE • Very low probability that impact will occur or may occur under extenuating circumstances. Event is very rare of stochastic in nature (frequency 1000 years)

APPENDIX L. CREDIT SUMMARY REPORT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00011608/BAAS17014/19/00011609	Tweed Valley Hospital - Impact assessment calculations	04/01/2019

Assessor Name	Report Created	BAM Data version *
Damian Licari	22/01/2019	6

Assessor Number

BAAS18006

* 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.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion								
1	1302_Z4_Self-sown_windrow	10.6	0.6	0.25	High Sensitivity to Potential Gain	2.00		0

2	1302_Z8_Self-sown_windrow	16.8	0.4	0.25	High Sensitivity to Potential Gain	2.00		3
							Subtotal	**3**
							Total	**3**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits
Coeranoscincus reticulatus / Three-toed Snake-tooth Skink (Fauna)						
1302_Z4_Self-sown_windrow	10.6	0.55	0.25	2	False	3
1302_Z8_Self-sown_windrow	16.8	0.4	0.25	2	False	3
					Subtotal	**6**
Cryptocarya foetida / Stinking Cryptocarya (Flora)						
1302_Z8_Self-sown_windrow	N/A	1	0.25	1.5	False	2
					Subtotal	**2**

Ninox strenua / Powerful Owl (Fauna)						
1302_Z4_Self-sown_windrow	10.6	0.55	0.25	2	N/A	3
1302_Z8_Self-sown_windrow	16.8	0.4	0.25	2	N/A	3
					Subtotal	**6**

APPENDIX M. BIODIVERSITY CREDIT REPORT

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00011608/BAAS17014/19/00011609

Proposal Name
Tweed Valley Hospital - Impact assessment calculations

BAM data last updated *
04/01/2019

Assessor Name
Damian Licari

Assessor Number
BAAS18006

BAM Data version *
6

Proponent Names
Jacqueline Hawkins ,

Report Created
22/01/2019

* 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.

Candidate Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

BAM Biodiversity Credit Report (Like for like)

No Changes

Ecosystem Credit Summary

PCT	TEC	Area	Credits
1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	1.0	3.00

Credit classes for 1302

Like-for-like options

Any PCT with the below TEC	Containing HBT	In the below IBRA subregions
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (including PCT's 669, 670, 770, 845, 886, 887, 1068, 1201, 1275, 1302, 1525, 1527, 1528, 1529, 1533, 1534, 1535, 1541, 1545)	No	Burringbar-Conondale Ranges,Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Area	Credits
Coeranoscincus reticulatus / Three-toed Snake-tooth Skink	1.0	6.00

Cryptocarya foetida / Stinking Cryptocarya	1.0	2.00
Ninox strenua / Powerful Owl	1.0	6.00

Coeranoscincus reticulatus/ Three-toed Snake-tooth Skink	1302_Z4_Self-sown_windrow	**Like-for-like options**	
		Only the below Spp	In the below IBRA subregions
		Coeranoscincus reticulatus/Three-toed Snake-tooth Skink	Any in NSW
	1302_Z8_Self-sown_windrow	**Like-for-like options**	
		Only the below Spp	In the below IBRA subregions
		Coeranoscincus reticulatus/Three-toed Snake-tooth Skink	Any in NSW
Cryptocarya foetida/ Stinking Cryptocarya	1302_Z8_Self-sown_windrow	**Like-for-like options**	
		Only the below Spp	In the below IBRA subregions
		Cryptocarya foetida/Stinking Cryptocarya	Any in NSW

Cryptocarya foetida/ Stinking Cryptocarya	1302_Z8_Self-sown_windrow	
Ninox strenua/ Powerful Owl	1302_Z4_Self-sown_windrow	**Like-for-like options**
		Only the below Spp / In the below IBRA subregions
		Ninox strenua/Powerful Owl / Any in NSW
	1302_Z8_Self-sown_windrow	**Like-for-like options**
		Only the below Spp / In the below IBRA subregions
		Ninox strenua/Powerful Owl / Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00011608/BAAS17014/19/00011609

Proposal Name
Tweed Valley Hospital - Impact assessment calculations

BAM data last updated *
04/01/2019

Assessor Name
Damian Licari

Assessor Number
BAAS18006

BAM Data version *
6

Proponent Name(s)
Jacqueline Hawkins ,

Report Created
22/01/2019

* 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.

Candidate Serious and Irreversible Impacts

Nil

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

BAM Biodiversity Credit Report (Variations)

No Changes

Ecosystem Credit Summary

PCT	TEC	Area	Credits
1302-White Booyong - Fig subtropical rainforest of the NSW North Coast Bioregion	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	1.0	3.00

Credit classes for 1302

Like-for-like options

Any PCT with the below TEC	Containing HBT	In the below IBRA subregions
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (including PCT's 669, 670, 770, 845, 886, 887, 1068, 1201, 1275, 1302, 1525, 1527, 1528, 1529, 1533, 1534, 1535, 1541, 1545)	No	Burringbar-Conondale Ranges,Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Any PCT in the below Formation	And in any of below trading groups	Containing HBT	In the below IBRA regions/subregions
Rainforests	Tier 3 or higher	No	IBRA Region: South Eastern Queensland, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

Species Credit Summary

Species	Area	Credits
Coeranoscincus reticulatus / Three-toed Snake-tooth Skink	1.0	6.00
Cryptocarya foetida / Stinking Cryptocarya	1.0	2.00
Ninox strenua / Powerful Owl	1.0	6.00

<table>
<tr><td rowspan="6">Coeranoscincus reticulatus/
Three-toed Snake-tooth Skink</td><td rowspan="6">1302_Z4_Self-sown_windrow</td><td colspan="3">Like-for-like options</td></tr>
<tr><td>Only the below Spp</td><td colspan="2">In the below IBRA subregions</td></tr>
<tr><td>Coeranoscincus reticulatus/Three-toed Snake-tooth Skink</td><td colspan="2">Any in NSW</td></tr>
<tr><td colspan="3">Variation options</td></tr>
<tr><td>Any Spp in the below Kingdom</td><td>Any species with same or higher category of listing under Part 4 of teh BC Act showb below</td><td>In the below IBRA subregions</td></tr>
<tr><td>Fauna</td><td>Vulnerable</td><td>Burringbar-Conondale Ranges,Scenic Rim and Sunshine Coast-Gold Coast Lowlands.
or
Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.</td></tr>
</table>

Coeranoscincus reticulatus/ Three-toed Snake-tooth Skink	1302_Z8_Self-sown_windrow	**Like-for-like options**		
		Only the below Spp	In the below IBRA subregions	
		Coeranoscincus reticulatus/Three-toed Snake-tooth Skink	Any in NSW	
		Variation options		
		Any Spp in the below Kingdom	Any species with same or higher category of listing under Part 4 of teh BC Act showb below	In the below IBRA subregions
		Fauna	Vulnerable	Burringbar-Conondale Ranges,Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Cryptocarya foetida/ Stinking Cryptocarya	1302_Z8_Self-sown_windrow	**Like-for-like options**		
		Only the below Spp	In the below IBRA subregions	
		Cryptocarya foetida/Stinking Cryptocarya	Any in NSW	
		Variation options		
		Any Spp in the below Kingdom	Any species with same or higher category of listing under Part 4 of teh BC Act	In the below IBRA subregions

			showb below	
		Flora	Vulnerable	Burringbar-Conondale Ranges,Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Ninox strenua/ Powerful Owl	1302_Z4_Self-sown_windrow	**Like-for-like options**		
		Only the below Spp	In the below IBRA subregions	
		Ninox strenua/Powerful Owl	Any in NSW	
		Variation options		
		Any Spp in the below Kingdom	Any species with same or higher category of listing under Part 4 of teh BC Act showb below	In the below IBRA subregions
		Fauna	Vulnerable	Burringbar-Conondale Ranges,Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

<table>
<tr><td rowspan="6">Ninox strenua/ Powerful Owl</td><td rowspan="6">1302_Z8_Self-sown_windrow</td><td colspan="3">Like-for-like options</td></tr>
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