

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

January 2019
J156455

Tweed Valley Hospital
Health Infrastructure

C107778: DL

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Document and Project Control

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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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EXECUTIVE SUMMARY

On 13 June 2017, the NSW Government announced \$534 million for a new state-of-the-art hospital (Tweed Valley Hospital) on a greenfield site, including an expanded emergency department, inpatient care and enhanced surgical and outpatient services. New services including interventional cardiology and radiotherapy, will also be provided in response to clinical service planning priorities.

The proposed development of the new Tweed Valley Hospital (the Project) will provide for the essential healthcare services required by the rapidly growing population of the Tweed and Byron Local Government Areas (LGAs). Furthermore, the proposed development will provide a net economic and employment benefit to the community.

Following the site selection process, due diligence assessments, public consultation, and input from the Health Infrastructure Site Selection Committee, the proposed site was confirmed and publicly announced in June 2018.

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 NSW to prepare the BDAR. The BDAR has been prepared in accordance with the *Biodiversity Assessment Method* (Office of Environment and Heritage, 2017) (BAM).

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 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.

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.

Water impacts will be managed during both the construction and operation stages. For example, construction activities will be conducted in accordance with an approved Construction Environmental Management Plan (CEMP). During operations, an integrated stormwater management system will be designed and constructed to convey stormwater runoff from buildings and associated infrastructure, roads, carparks and landscape areas. Additionally, the existing farm dam located at the north of the Site will be filled to return that part of the catchment to a more natural flow regime. On this basis, 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 and that the adverse impact of the development on water quality, water bodies and hydrological process that sustain threatened species and threatened ecological communities is, on balance, a positive impact. On this basis, the potential residual prescribed impact of the Project is considered to be negligible. 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. $VI \geq 15$), 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. $VI \geq 15$) 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*).

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).

1.2 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 some 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.

1.3 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 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 (see **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 1.2**.

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.

1.3.1 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 subject 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.

1.4 The Project

1.4.1 Overview

The Project has been established based on the following supporting documentation provided by HI prior to submission:

- Tweed Valley Hospital Business Case (TSA Management, 2018);
- Tweed Valley Hospital Masterplan (Bates Smart, 2018) (**Appendix A**); and
- Tweed Valley Hospital Concept Proposal and Design (TSA Management, 2018).

An Environmental Impact Statement (EIS) has been prepared to accompany a State Significant Development application for the Project which will be assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act). All projects which are classified as State Significant Development also require the preparation of a BDAR in accordance with the requirements of the BC Act.

The Project consists of:

Delivery of a new Level 5 major 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 centres across the region;

Master planning for additional health, education, training and research facilities to support these health services, which will be developed with service partners over time. These areas will be used initially for the construction site/ compound and an at-grade car parking facility; and

Delivery of the supporting infrastructure required for the new hospital, including green space and other amenities, campus roads and car parking, external road upgrades and connections, utilities connections, and other supporting infrastructure.

The development application pathway for the Project consists of a State Significant Development application under section 4.22 of the EP&A Act which will consist of:

- A concept development application and detailed proposal for Stage 1 (early and enabling works); and
- A second development application for Stage 2 works which will include detailed design, construction and operation of the Tweed Valley Hospital (Project Application).

The construction and operational footprint for the development is identified in **Appendix A**. A detailed description of the proposed staging of the development is provided in the following sections.

This BDAR has been prepared based on the Project information made available for Stage 1.

1.4.2 Concept Proposal and Stage 1 Early and Enabling Works

This component (and EIS) seeks approval for a Concept Proposal of the Project and Stage 1 early and enabling works. The Concept Proposal is informed by service planning to 2031/32 and has an expected gross floor area in the range 55,000 m² to 65,000 m².

The hospital is expected to include (with more detail to be confirmed/provided at Stage 2) the components/services outlined below.

- A main entry and retail area
- Administration services
- Ambulatory services
- Acute and sub-acute in-patient units
- Paediatrics
- Intensive care unit
- Close observation unit
- Mental health services
- Maternity unit
- Renal dialysis
- Pathology
- Pharmacy
- Cancer services including day oncology and radiation oncology
- Emergency department
- Integrated interventional services
- Interventional cardiology
- Medical imaging
- Mortuary
- Back of house services
- Car parking
- Future expansion areas

Stage 1 includes early and enabling works (for Site clearance and preparation), generally comprising:

- Construction compound for Stage 1 Works;
- Augmentation and connection of permanent services for the new facility (water, sewer, electricity, telecommunications);
- General clearance of Site vegetation within the footprint of construction works, including tree stumps;
- Chipping of cleared vegetation (excluding weed species) to use on Site for ground stabilisation/ erosion control, or off-site disposal as required;
- Bulk earthworks to establish the required site levels and create a stable landform in preparation for hospital construction;

- Piling and associated works;
- Stormwater and drainage infrastructure for the new facility;
- Rehabilitation and revegetation of part of the wetland area;
- Construction of internal road ways for use during construction and in preparation for final road formations in Stage 2; and
- Retaining walls.

1.4.3 Stage 2: Hospital Delivery - Main Works and Operation

Stage 2 will include the detailed design, construction and operation of the Project. Stage 2 will be subject to a separate application following Stage 1.

1.4.4 Subsequent Stages: Potential Future Expansion

Any subsequent stages would be subject to separate applications as required and would be related to works for potential future expansion of the facility. Details of this are not confirmed at this stage and would be developed as required.

1.5 Sources of Information

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).

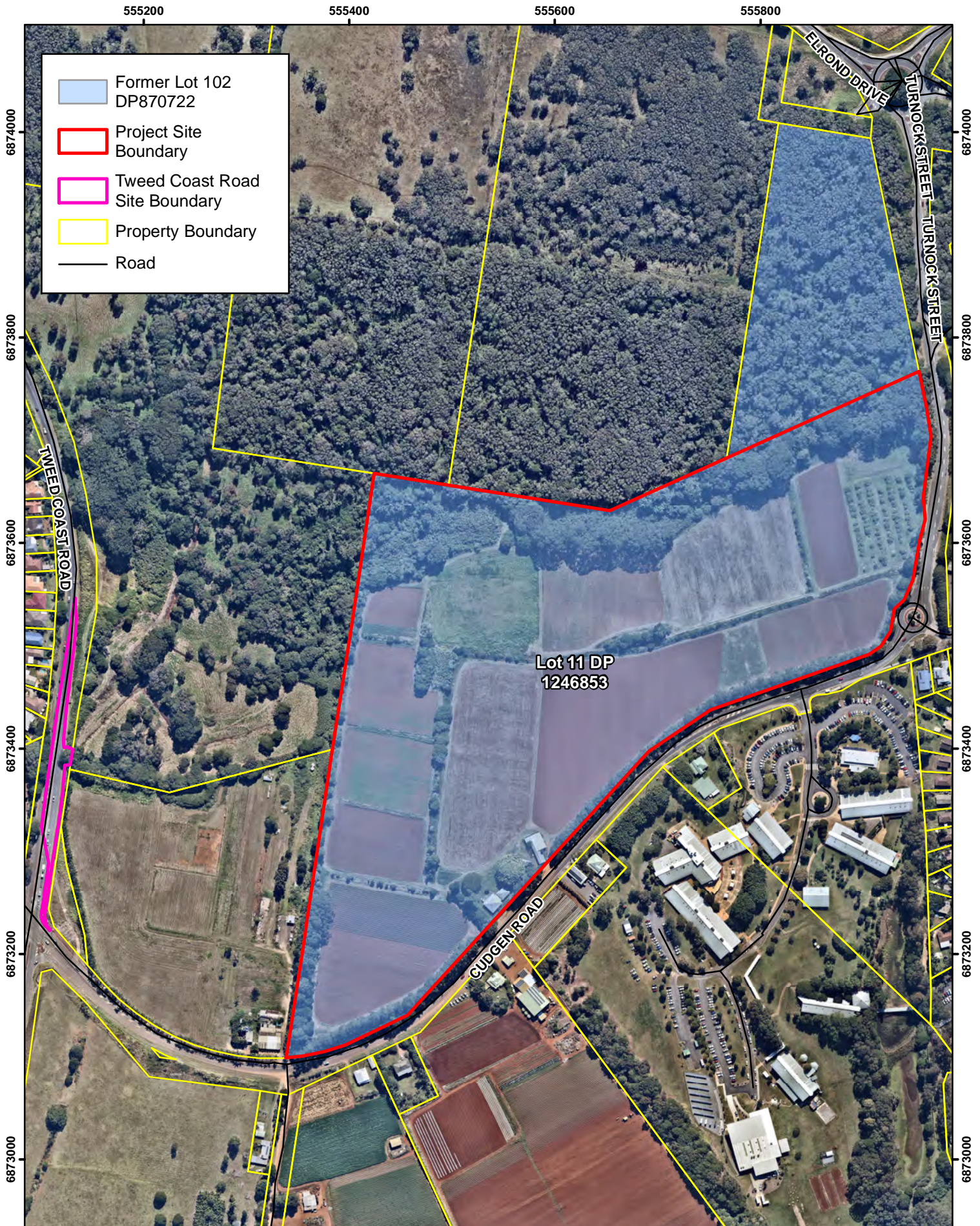
Spatial data used or consulted in the assessment include:

- 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 Aerial imagery (Nearmap 2018).

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

- Tweed Valley Hospital MASTERPLAN CONCEPT PLAN AR-SKE-10-006[06] (STH Batesmart)
- Tweed Valley Hospital Noise and Vibration Impact Assessment for State Significant Development (SSD) (Acoustic Studio);
- Aviation SEARS response: Tweed Valley Hospital (AviPro);
- Tweed Valley Hospital – Flooding Component DRAFT (BMT);
- Tweed Valley Hospital Development Design Report (Bonacci Group NSW);
- Tweed Valley Hospital Development Stormwater Management Proposal (Bonacci Group NSW);
- Preliminary and Detailed Site Investigation (Octief);
- Preliminary Geotechnical Investigation (Morrison Geotechnic);
- Tweed Valley Hospital Landscape Masterplan Report draft (Turf Design Studio);
- Tweed Valley Hospital Draft Landscape Concept Design Report, 18 January 2019 (Turf Design Studio); and
- Tweed Valley Hospital Project Traffic Impact Assessment (Bitzios Consulting).



Client: C107778

Job #: J156455

Author: M. Nunn

Checked: D. Licari

Date: 22/01/2019

GREENCAP



0 50 100
m

Scale (@A4): 1:4,750

Coordinate System: GDA 1994 MGA Zone 56

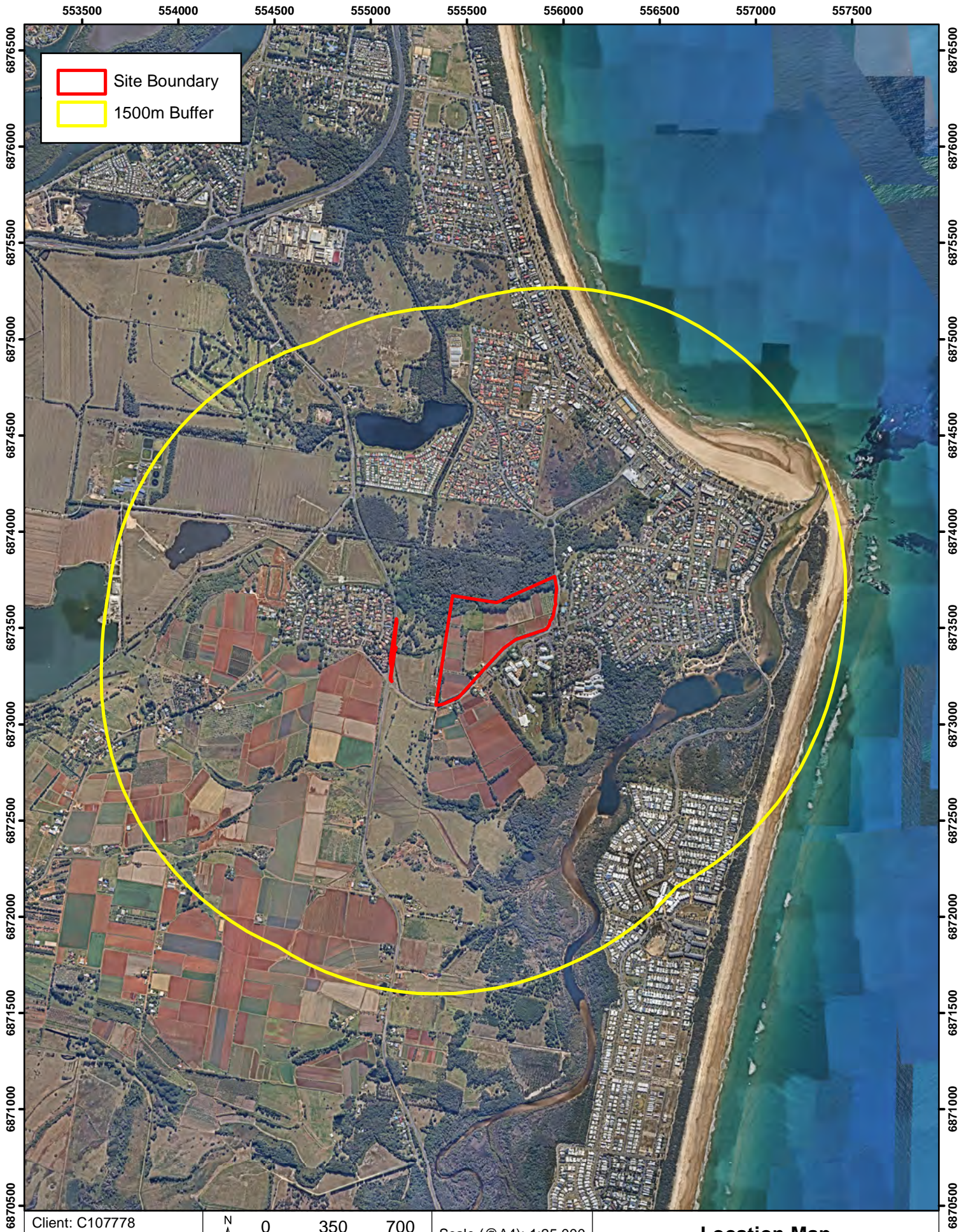
*Note: All data is approx only & subject to survey.
Imagery 8th August 2018 (7.5 cm) © Nearmap 2018
Cadastre © NSW Department of Finance, Services and
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Site Map (ref: s4.2.1.1 of BAM)

Tweed Valley Hospital BDAR
771 Cudgen Road
Cudgen NSW

**Figure
1**



Client: C107778

Job #: J156455

Author: M. Nunn

Checked: D. Licari

Date: 22/01/2019

GREENCAP



0 350 700 m

Scale (@A4): 1:25,000

Coordinate System: GDA 1994 MGA Zone 56

*Note: All data is approx only & subject to survey.
Imagery 8th August 2018 (59.7 cm) © Nearmap 2018*

Location Map (ref: s4.2.1.2 of BAM)

Tweed Valley Hospital BDAR
771 Cudgen Road
Cudgen NSW

**Figure
2**

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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 some 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 field work 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.

Acid Sulfate Soils

The potential presence of acid sulfate soils (ASS) 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.

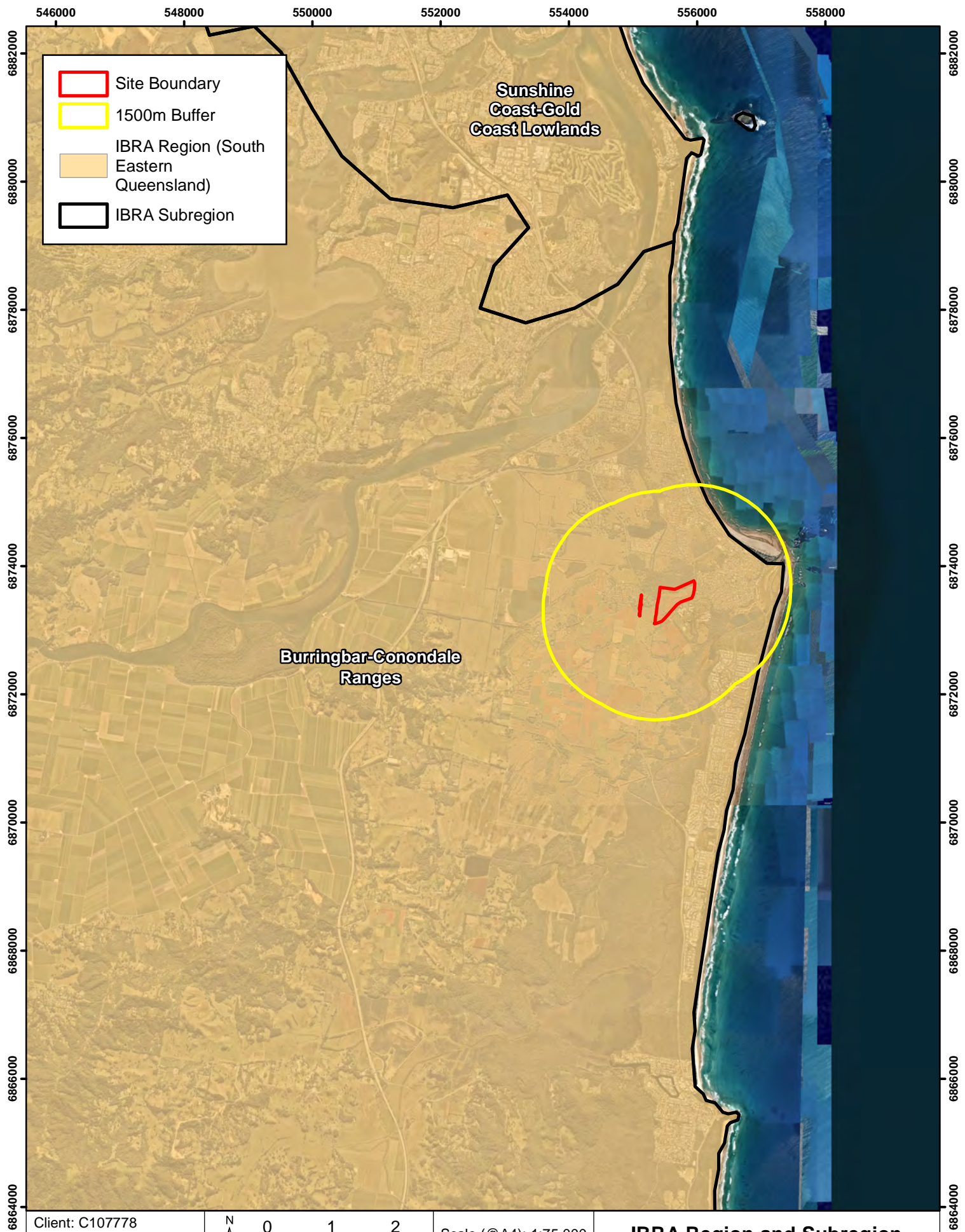
The assessment concluded that the Landslide Risk Ratings for all of the proposed development at the site is assessed to be “Very Low or Low” in its existing condition.




Soil Salinity

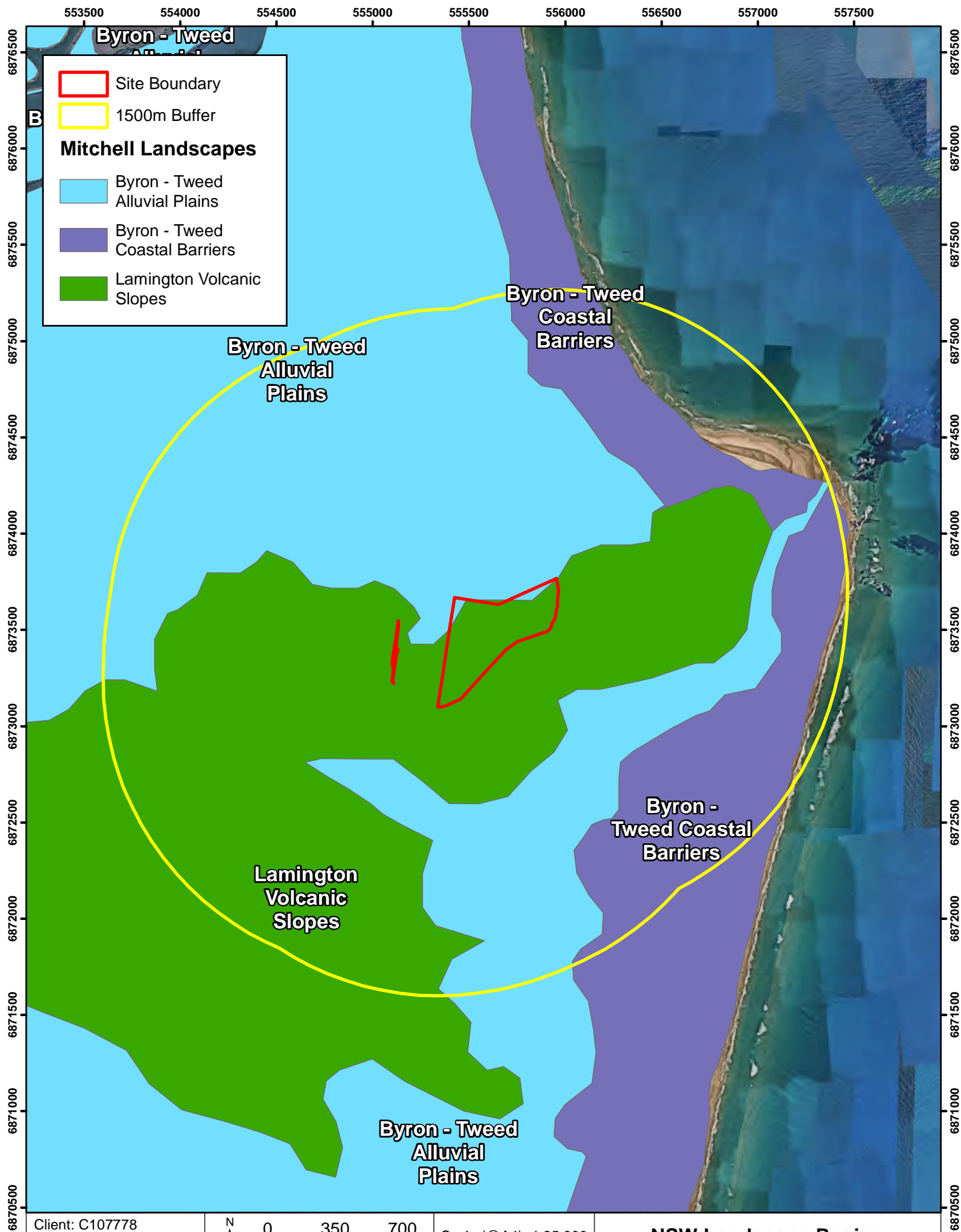
Based on laboratory analysis of five soil samples obtained from depths of between 0.15 m and 1.0m below the ground surfaces as part of contaminated land investigation undertaken on the site by Octief, soil conductivity ranged between 14 and 61 $\mu\text{S}/\text{cm}$ (0.014 and 0.061 dS/m). Based on 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 salinities 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.



Client: C107778	 <div>012</div>  km	Scale (@A4): 1:75,000	IBRA Region and Subregion (ref: s4.2.1.3a & s4.2.1.4 of BAM)	
Job #: J156455				
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56		<div>Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW</div> <div>Figure 3</div>	
Checked: D. Licari	<i>Imagery 8th August 2018 © Nearmap 2018</i> <i>IBRA Regions & Subregions © Australian Government</i> <i>Department of the Environment and Energy (2012)</i>			
Date: 22/01/2019				
	<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>			




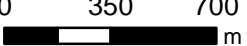

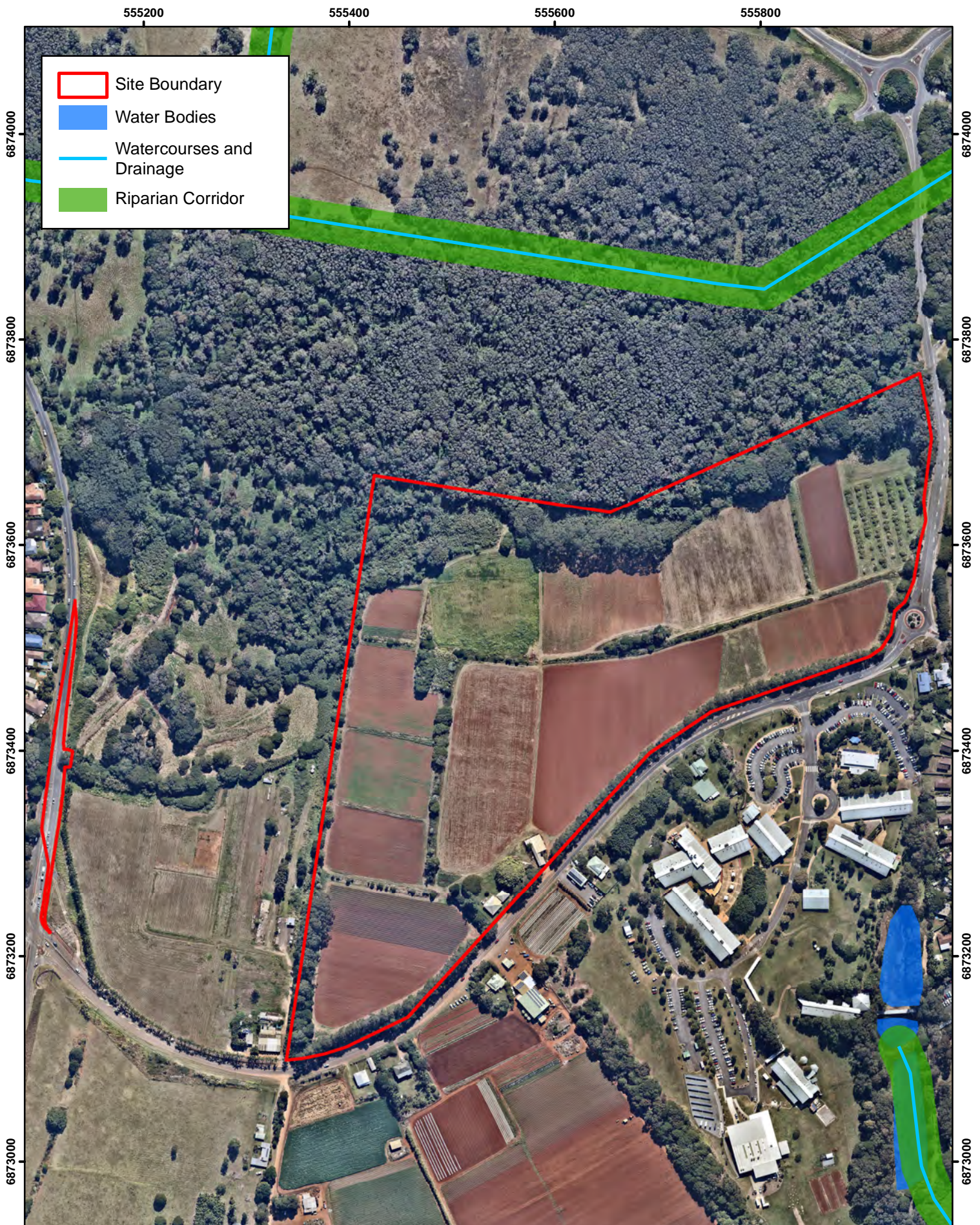
Client: C107778		0	350	700	Scale (@A4): 1:25,000	NSW Landscape Region (ref: s4.2.1.3h & s4.2.1.5 of BAM)	
Job #: J156455		 m					
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56					<div>Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW</div> <div>Figure 4</div>	
Checked: D. Licari	<i>Imagery 8th August 2018 (59.7 cm) © Nearmap 2018</i>						
Date: 22/01/2019	<i>NSW (Mitchell) Landscapes - version 3.1 © Office of Environment and Heritage (OEH) 2016.</i>						
		<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>					

Figure 4



Client: C107778

Job #: J156455

Author: M. Nunn

Checked: D. Licari

Date: 22/01/2019

GREENCAP



0 50 100 m

Scale (@A4): 1:4,750

Coordinate System: GDA 1994 MGA Zone 56

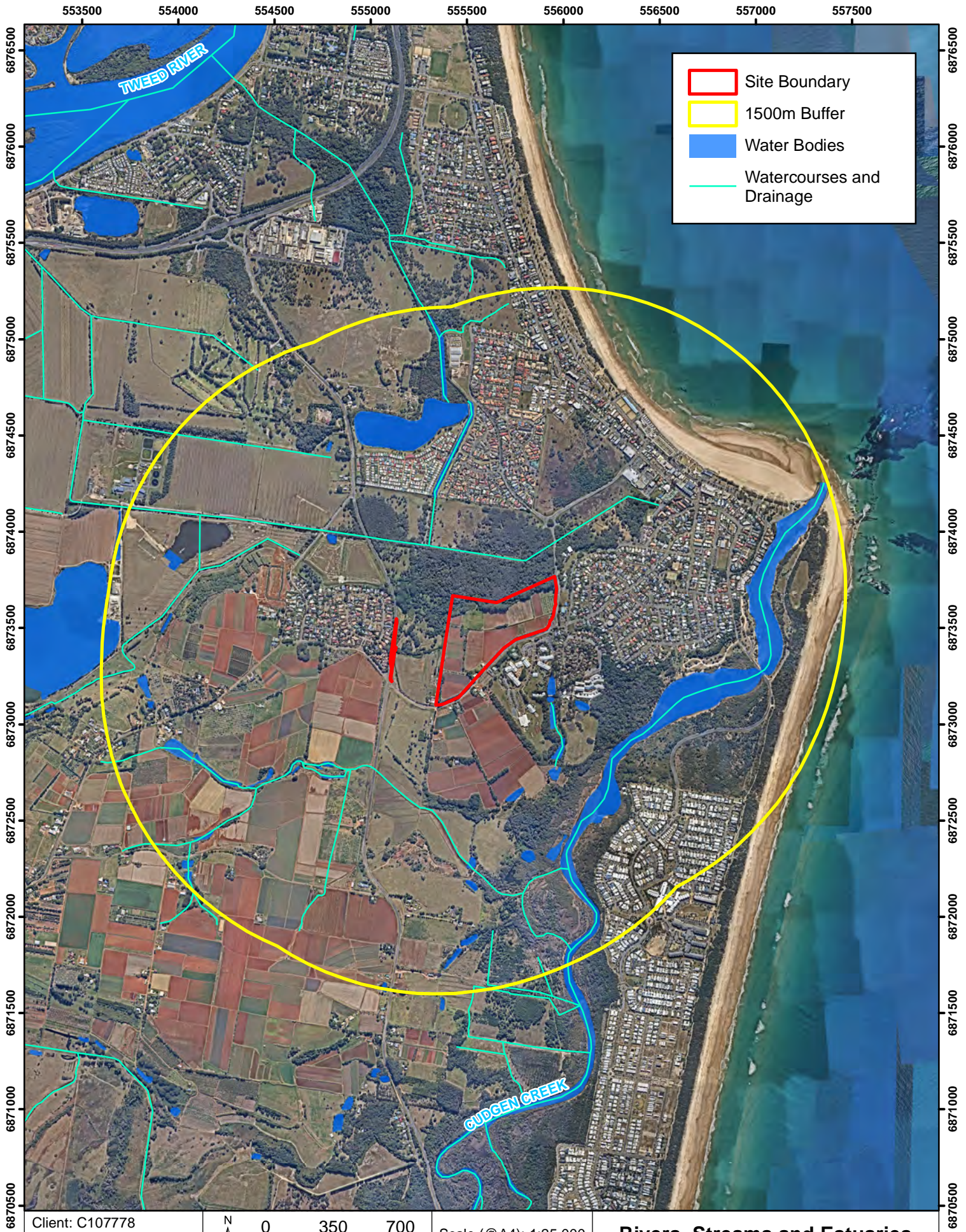
*Note: All data is approx only & subject to survey.
Imagery 8th August 2018 (7.5 cm) © Nearmap 2018
Hydrolines and Hydroarea (NSW Hydrography) ©
Department of Finance, Services and Innovation (2018)*

Rivers, Streams and Estuaries (ref: s4.2.1.3 & s4.2.1.6 of BAM)

Tweed Valley Hospital BDAR
771 Cudgen Road
Cudgen NSW

**Figure
5**

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Client: C107778

Job #: J156455

Author: M. Nunn

Checked: D. Licari

Date: 22/01/2019

GREENCAP



0 350 700 m

Scale (@A4): 1:25,000

Coordinate System: GDA 1994 MGA Zone 56

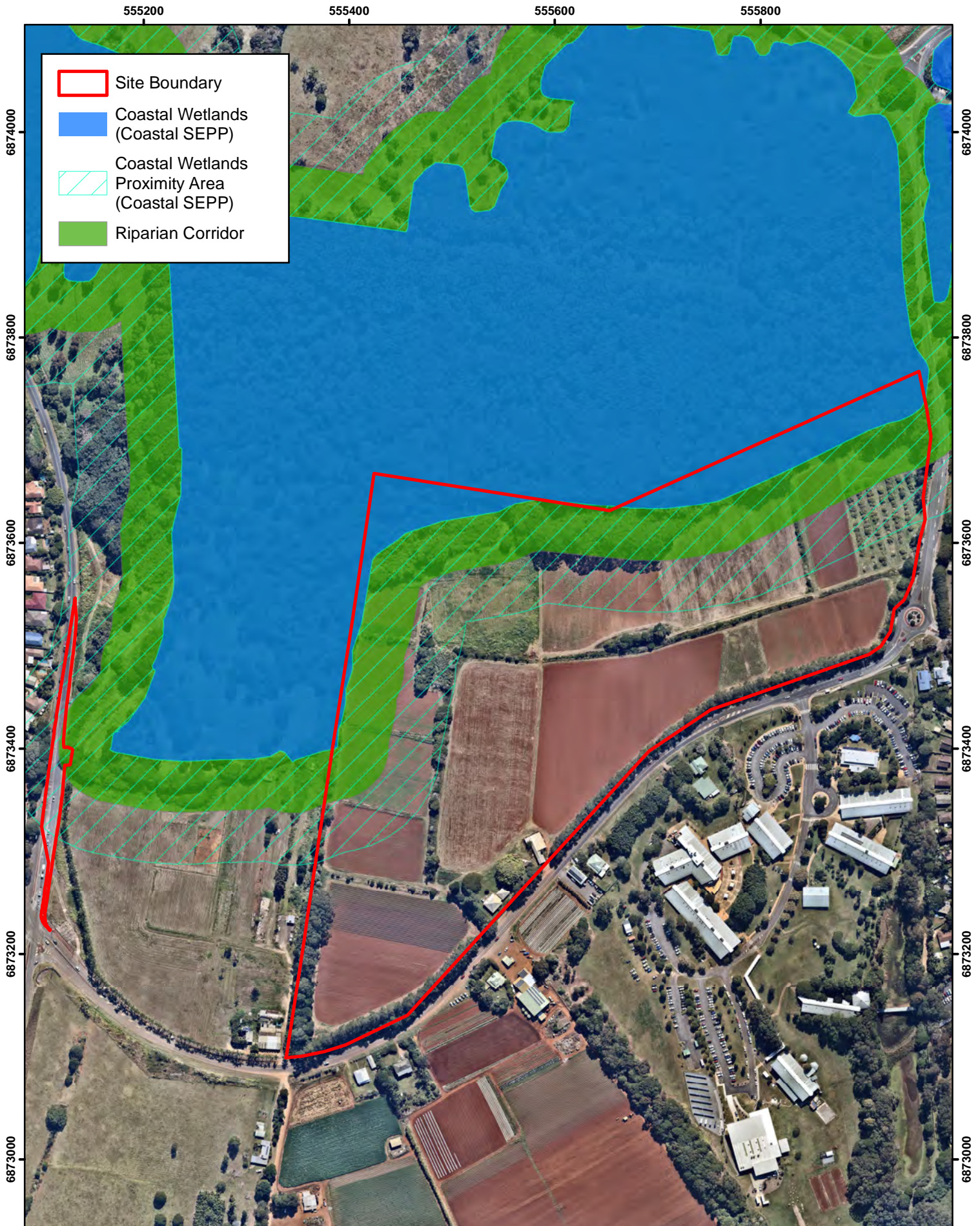
*Note: All data is approx only & subject to survey.
Imagery 8th August 2018 (59.7 cm) © Nearmap 2018
Hydrolines and Hydroarea (NSW Hydrography) ©
Department of Finance, Services and Innovation (2018)*



Rivers, Streams and Estuaries (ref: s4.2.1.3 & s4.2.1.6 of BAM)

Tweed Valley Hospital BDAR
771 Cudgen Road
Cudgen NSW

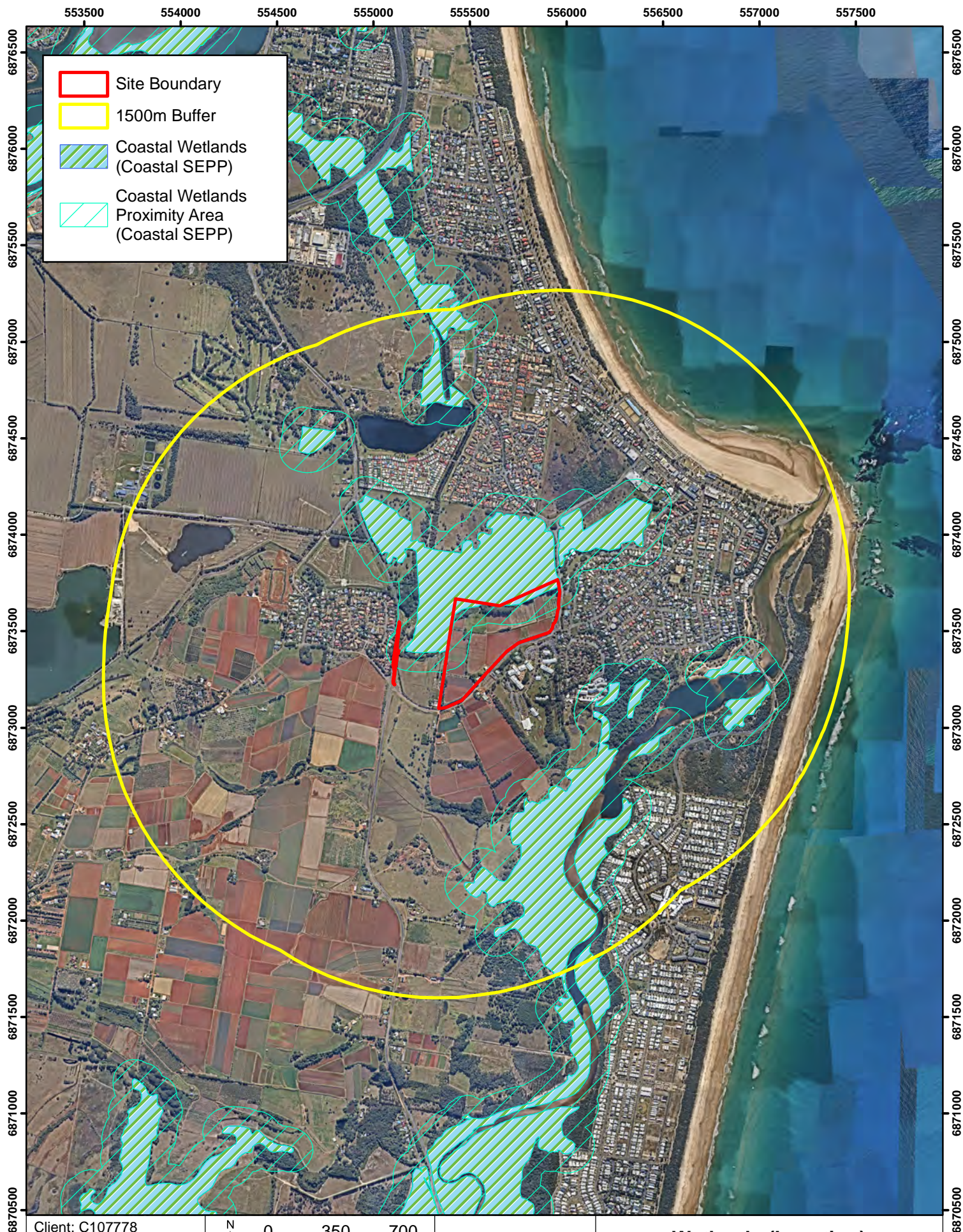
**Figure
6**



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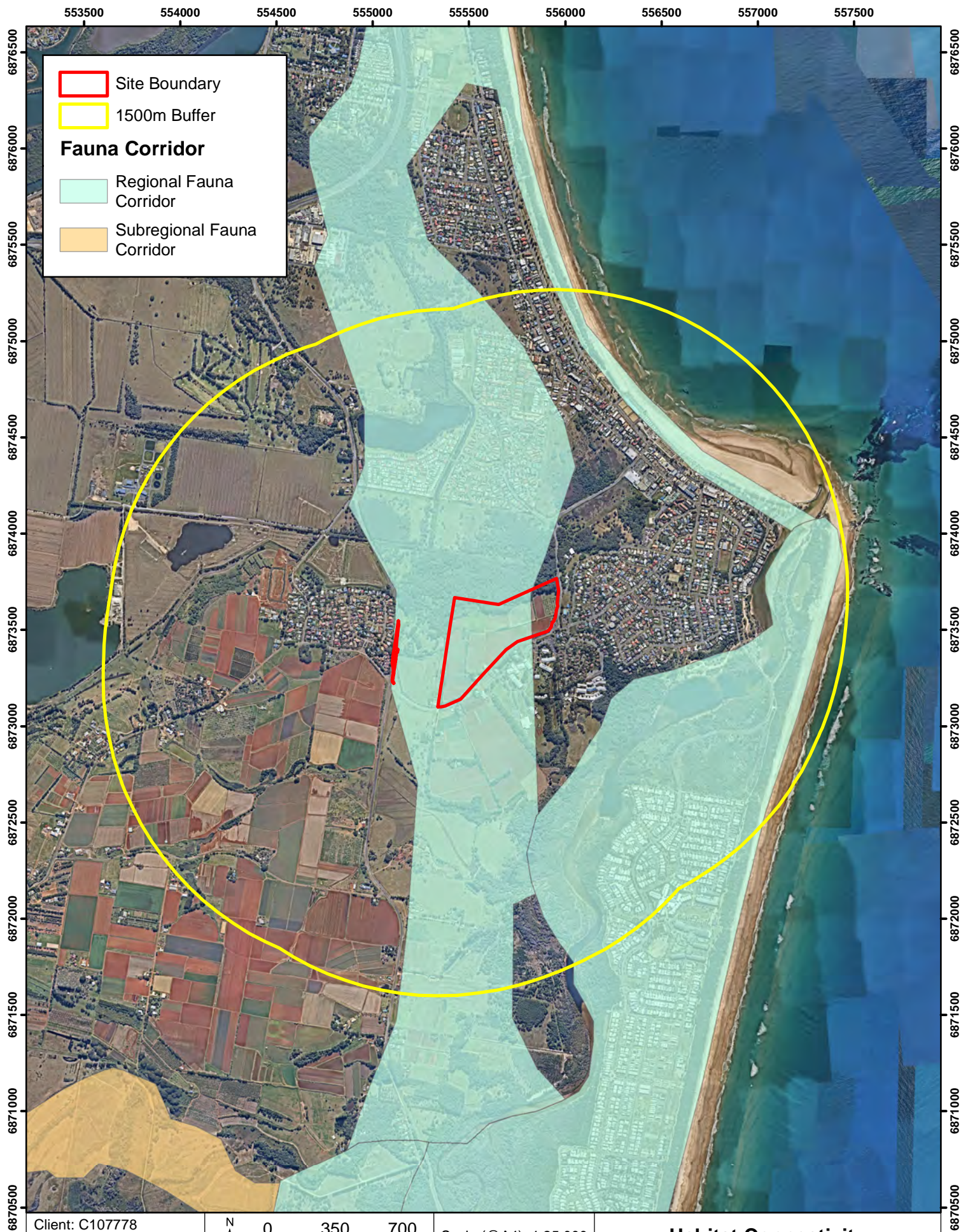
Client: C107778	 <div>050100</div> m	Scale (@A4): 1:4,750	Wetlands (Site) (ref: s4.2.1.3c & s4.2.1.7 of BAM)	
Job #: J156455				
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56		<div>Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW</div> <div>Figure 7</div>	
Checked: D. Licari	<i>Imagery 8th August 2018 (7.5 cm) © Nearmap 2018</i>			
Date: 22/01/2019	<i>Coastal SEPP mapping © Department of Planning and Environment (DPE) 2018</i>			
	<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>			



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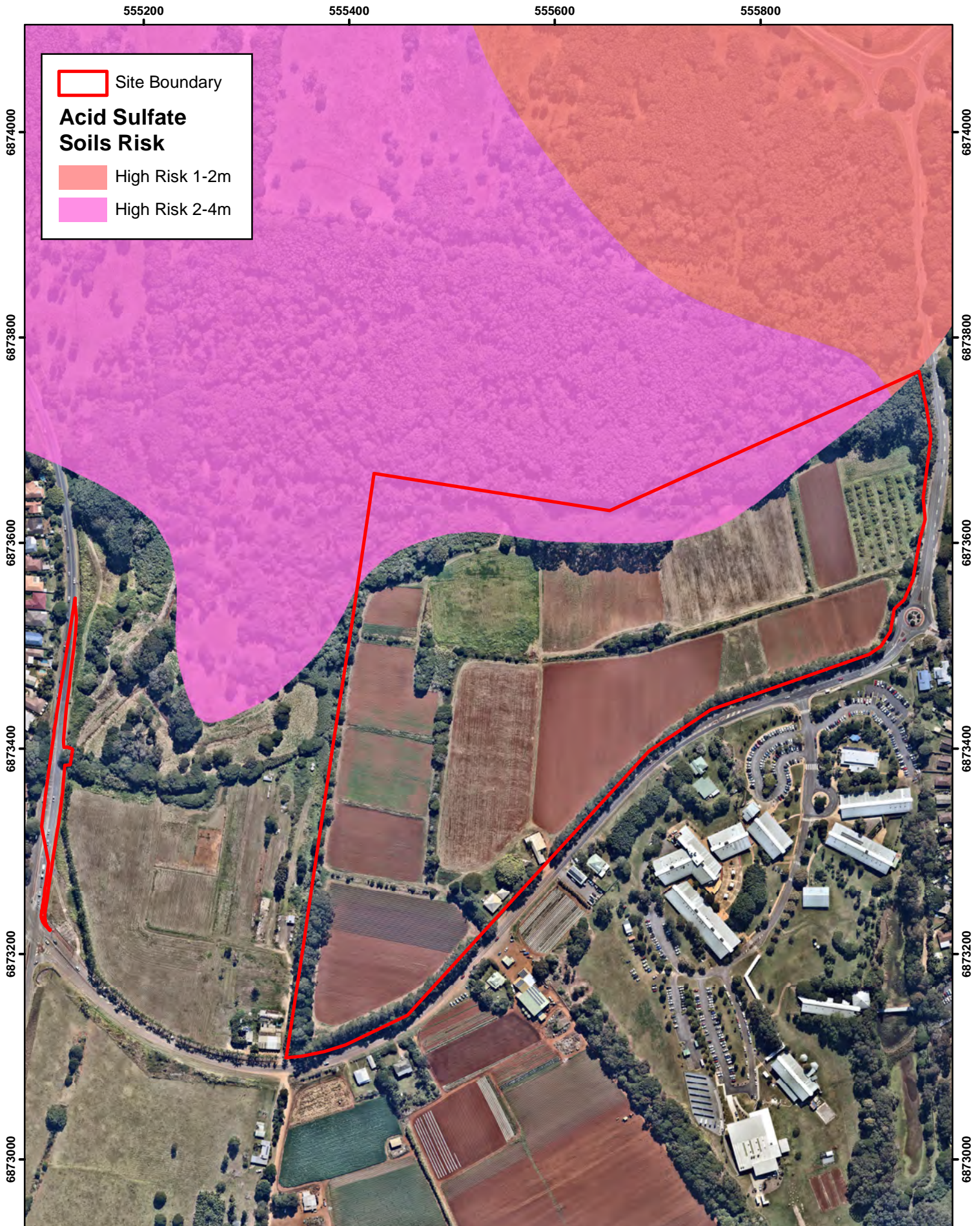




Client: C107778	 <div>0350700</div> <div><div></div></div> m	Scale (@A4): 1:25,000	Wetlands (Location) (ref: s4.2.1.3c & s4.2.1.7 of BAM)	
Job #: J156455				
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56		<div>Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW</div> <div>Figure 8</div>	
Checked: D. Licari	Imagery 8th August 2018 (59.7 cm) © Nearmap 2018			
Date: 22/01/2019	Coastal SEPP mapping © Department of Planning and Environment (DPE) 2018			
		<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>		

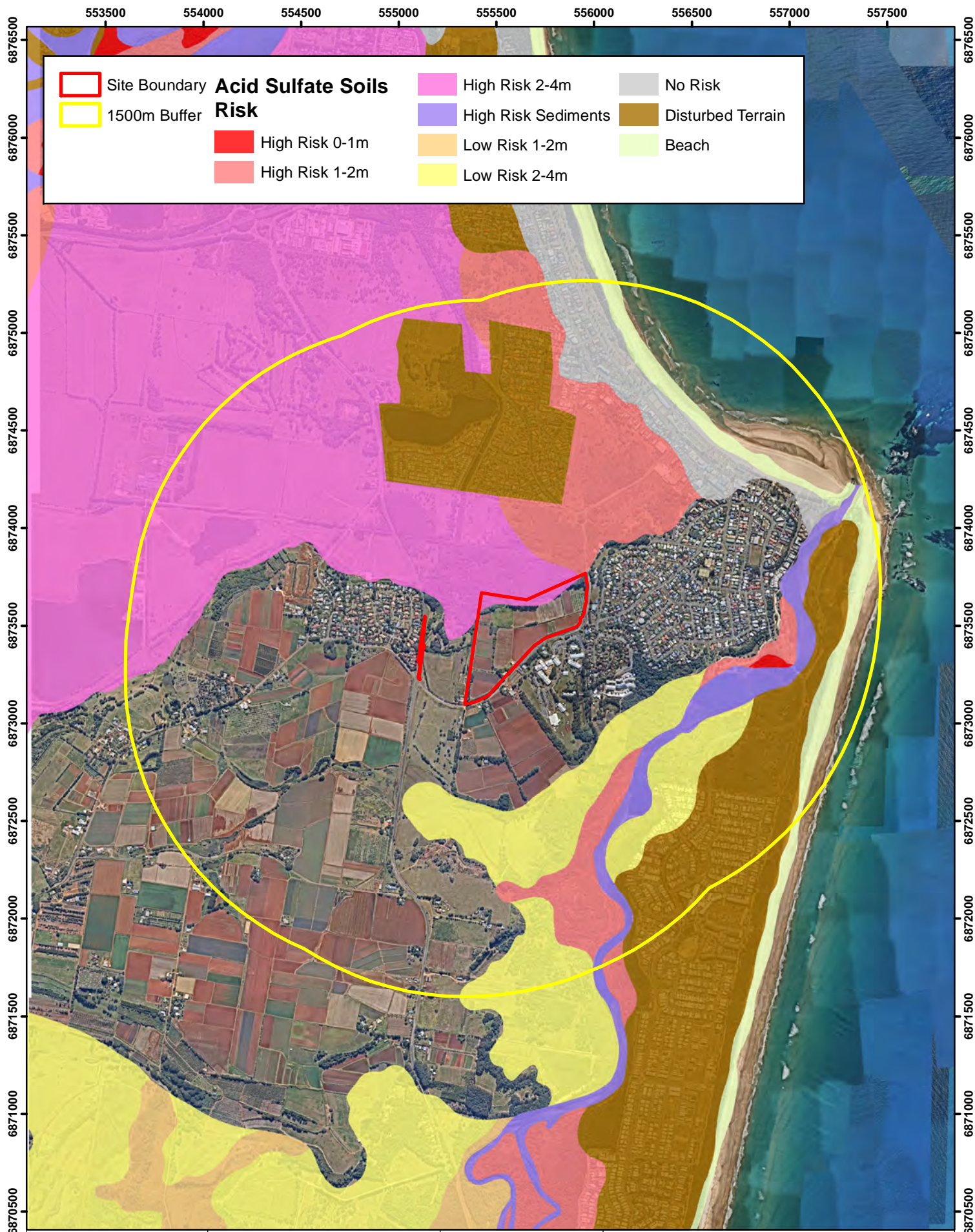
**Figure
8**



Client: C107778	 <div>0350700</div> <div>m</div>	Scale (@A4): 1:25,000	<div>Habitat Connectivity</div> <div>(ref: s4.2.1.3d & s4.2.1.9 of BAM)</div>	
Job #: J156455				
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56		<div>Tweed Valley Hospital BDAR</div> <div>771 Cudgen Road</div> <div>Cudgen NSW</div> <div>Figure 9</div>	
Checked: D. Licari	<i>Imagery 8th August 2018 (59.7 cm) © Nearmap 2018</i>			
Date: 22/01/2019	<i>Fauna corridors for NE NSW © Office of Environment and Heritage (OEH) 2010.</i>			
	<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>			



Client: C107778	 <div>050100</div> m	Scale (@A4): 1:4,750	Soil Hazard Features (Site) (ref: s4.2.1.3i & s4.2.1.13 of BAM)	
Job #: J156455				
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56			
Checked: D. Licari	<i>Imagery 8th August 2018 (7.5 cm) © Nearmap 2018</i> <i>Acid Sulfate Soils Risk mapping © Office of Environment and Heritage (OEH) 1998</i>		Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW	Figure 10
Date: 22/01/2019				
	<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>			




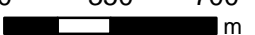

Client: C107778	 <div>0350700</div>  m	Scale (@A4): 1:25,000	Soil Hazard Features (Location) (ref: s4.2.1.3i & s4.2.1.14 of BAM)		
Job #: J156455					
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56		<div>Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW</div> <div>Figure 11</div>		
Checked: D. Licari	<i>Imagery 8th August 2018 (59.7 cm) © Nearmap 2018</i> <i>Acid Sulfate Soils Risk mapping © Office of Environment and Heritage (OEH) 1998</i>				
Date: 22/01/2019					
		<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>			

Figure 11

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: Coastal Swamp Forest, Coastal Floodplain Wetlands, Subtropical Rainforest and North Coast Wet Sclerophyll Forest (**Table 1**).

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 1 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	<i>Melaleuca quinquinervia</i> is dominant in the canopy and is the only upper stratum species	
					Selection	Chose 1064 because <i>Melaleuca quinquinervia</i> is dominant and there are no other species present in the upper stratum (i.e. <i>Eucalyptus spp.</i> or <i>Casuarina glauca</i>)	
	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	

Vegetation formation	Vegetation class	PCT	PCT Common Name	Threatened Ecological Community	PCT Identification steps		PCT % cleared
					Search Term	Selection	
					4. Upper stratum species	<i>Casuarina glauca</i> 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 <i>Casuarina glauca</i> is dominant and there are no other species present in the upper stratum (i.e. <i>Eucalyptus spp.</i> or <i>Melaleuca spp.</i>)	
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	<i>Ficus spp.</i> are dominant in the upper stratum and <i>Archontophoenix cunninghamiana</i> is abundant in the upper stratum	
					Shortlist	Returned a shortlist of 2 PCTs – 1068, 1302	

Vegetation formation	Vegetation class	PCT	PCT Common Name	Threatened Ecological Community	PCT Identification steps		PCT % cleared
					Search Term	Selection	
					Selection	Selected 1302 because both <i>Ficus spp.</i> and <i>A. cunninghamiana</i> are listed for the upper stratum. Rejected <i>A. cunninghamiana</i> 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	<i>Eucalyptus grandis</i> is dominant in the upper stratum and <i>E. microcorys</i> 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	
					4. Upper stratum species	<i>E. grandis</i> is dominant in the upper stratum.	
					Shortlist	Returned a longlist of 3 PCTs – 812, 1285, 1569	

Vegetation formation	Vegetation class	PCT	PCT Common Name	Threatened Ecological Community	PCT Identification steps		PCT % cleared
					Search Term	Selection	
					Selection	All PCTs in the shortlist include <i>E. grandis</i> and <i>E. microcorys</i> in the upper stratum. Selected 1569 because <i>E. grandis</i> is dominant in the upper stratum in this windrow and <i>E. mircocorys</i> 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 1**.

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 1**). 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 1**).

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 Section 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 are 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 2**), 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 Section 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 2**.

Floristic composition data was collected for each vascular plant species recorded in a 400 m² 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 m² 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 $\leq 5\%$ 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 1000 m² 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 m² 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.

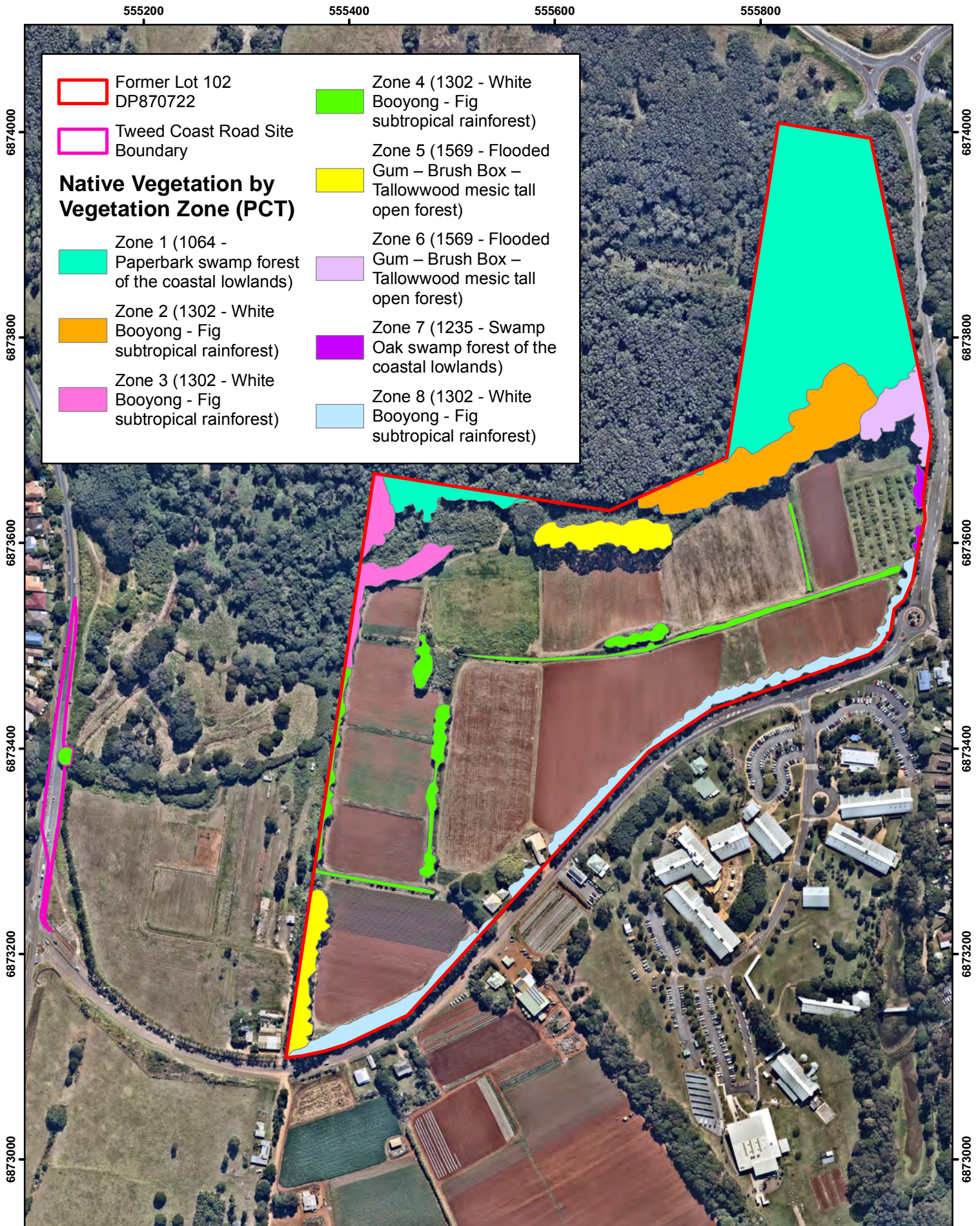
The slash pine *Pinus ellioti* windrow is considered to be exotic vegetation and not assessable under the BAM. However, given that self-sown native vegetation composed of early regrowth rainforest species grows in the understory and the BAM requirement to assess occurrence of threatened species across the Site, a plot based survey was conducted in this area as a precaution (**Table 2**; 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 2**).

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	 <div>050100m</div>	Scale (@A4): 1:4,750	Native Vegetation Extent on the Original Lot 102 DP 870722 (ref s5.1 of BAM)	
Job #: J156455				
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56		<div>Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW</div> <div>Figure 12</div>	
Checked: D. Licari	Imagery 8th August 2018 (7.5 cm) © Nearmap 2018			
Date: 22/01/2019	Vegetation mapping: Greencap (2018)			
		<div>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</div>		

No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.

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 Site Boundary

Native Vegetation by Vegetation Zone (PCT) (TVH/TCR Site only)

Zone 1 (1064 - Paperbark swamp forest of the coastal lowlands)

Zone 2 (1302 - White Booyong - Fig subtropical rainforest)

Zone 3 (1302 - White Booyong - Fig subtropical rainforest)

Zone 4 (1302 - White Booyong - Fig subtropical rainforest)

Zone 5 (1569 - Flooded Gum – Brush Box – Tallowwood mesic tall open forest)

Zone 6 (1569 - Flooded Gum – Brush Box – Tallowwood mesic tall open forest)

Zone 7 (1235 - Swamp Oak swamp forest of the coastal lowlands)

Zone 8 (1302 - White Booyong - Fig subtropical rainforest)

Client: C107778

Job #: J156455

Author: M. Nunn

Checked: D. Licari

Date: 22/01/2019



0 50 100 m

Scale (@A4): 1:4,750

Coordinate System: GDA 1994 MGA Zone 56

Imagery 8th August 2018 (7.5 cm) © Nearmap 2018
Vegetation mapping: Greencap (2018)

Native Vegetation Extent on the Site (ref s5.1 of BAM)

Tweed Valley Hospital BDAR
771 Cudgen Road
Cudgen NSW
**Figure
13**
GREENCAP

No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.

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Table 2 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

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)
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	<i>Pinus sp.</i> windrow with understorey of self-sown regenerating Subtropical Rainforest in low condition, most likely original PCT	Self-sown windrow	0.75	1	98 – 15 August 2018	0.75 (0.40 to be cleared)
N/A	Barner Grass – Camphor Laurel – Small-leaf Privet exotic vegetation	9	<i>Cenchrus purpureus</i> monoculture with <i>Cinnamomum camphora</i> and <i>Ligustrum sinense</i>	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 1**. 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 1**).

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 1500 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 Greencap 2018.

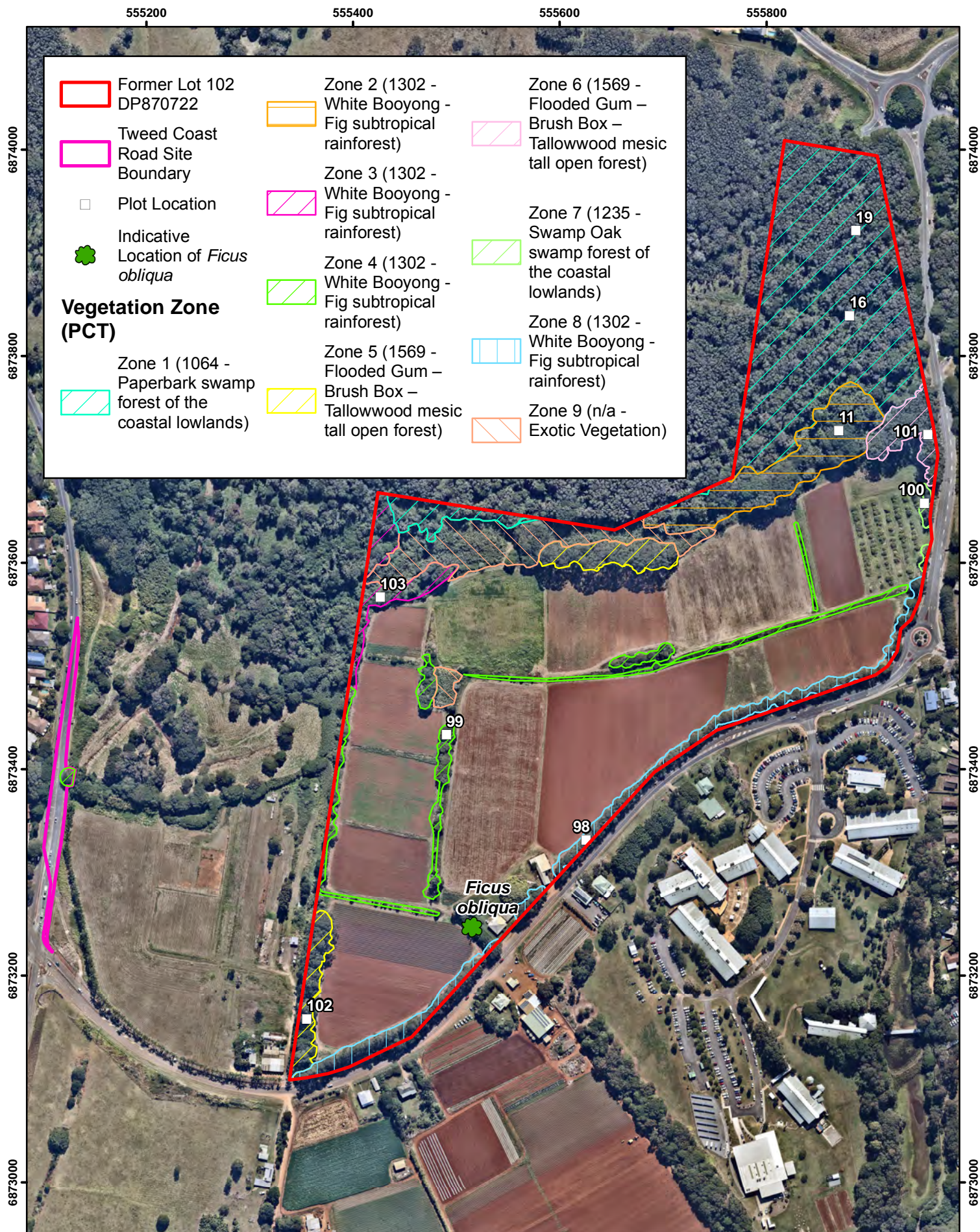
A single continuous patch of native vegetation that extends beyond the Site boundary and within and beyond the 1500 m assessment area was calculated to be 167.95ha, with a total native vegetation cover of 16.71% in the 1500 m assessment area (**Figure 17**).

2.3.7 Changes to the Mapped Native Vegetation Extent

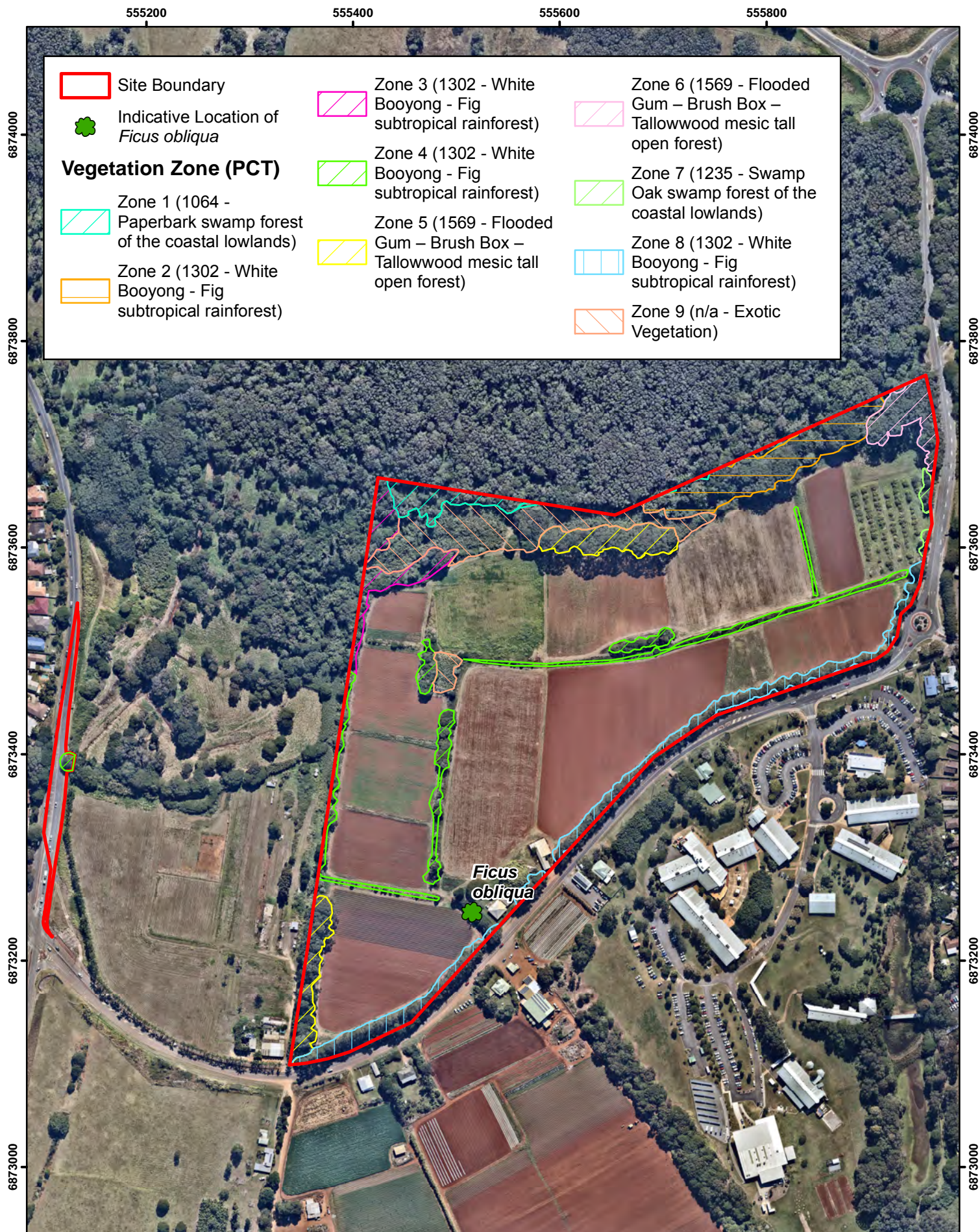
This section addresses changes to native vegetation extent in accordance with Section 5.1.1.6 and 5.1.1.7 of the BAM. Native vegetation on the Site was mapped by Greencap using aerial imagery from 2018 as the base map and matches the outline of vegetation on the base map using the method detailed in **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 1500 m buffer area.



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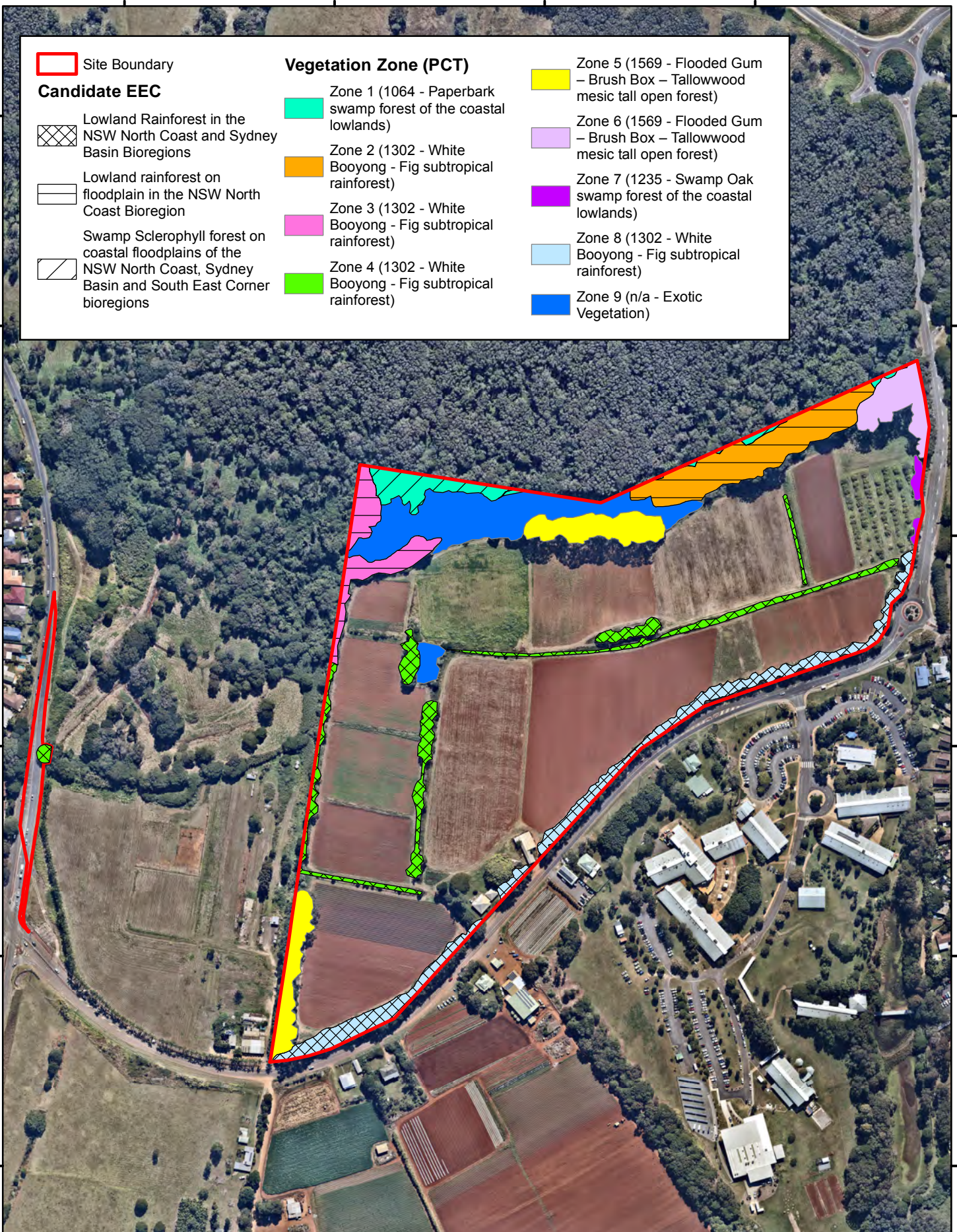
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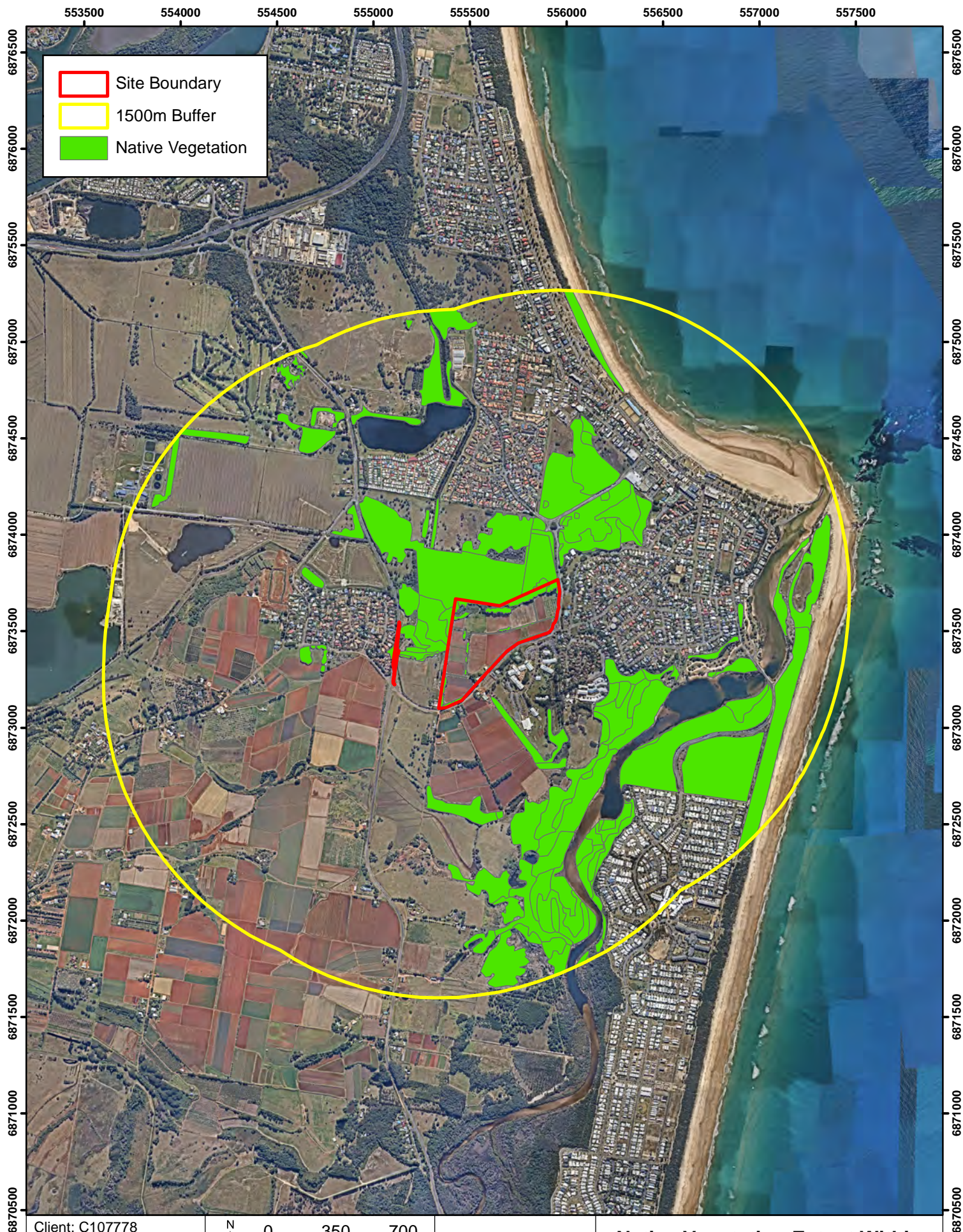
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Site Boundary

Candidate EECLowland Rainforest in the
NSW North Coast and Sydney
Basin BioregionsLowland rainforest on
floodplain in the NSW North
Coast BioregionSwamp Sclerophyll forest on
coastal floodplains of the
NSW North Coast, Sydney
Basin and South East Corner
bioregions**Vegetation Zone (PCT)**Zone 1 (1064 - Paperbark
swamp forest of the coastal
lowlands)Zone 2 (1302 - White
Booyong - Fig subtropical
rainforest)Zone 3 (1302 - White
Booyong - Fig subtropical
rainforest)Zone 4 (1302 - White
Booyong - Fig subtropical
rainforest)Zone 5 (1569 - Flooded Gum
- Brush Box - Tallowwood
mesic tall open forest)Zone 6 (1569 - Flooded Gum
- Brush Box - Tallowwood
mesic tall open forest)Zone 7 (1235 - Swamp Oak
swamp forest of the coastal
lowlands)Zone 8 (1302 - White
Booyong - Fig subtropical
rainforest)Zone 9 (n/a - Exotic
Vegetation)

Client: C107778	<div><div><div>N</div><div>050100</div><div><div></div><div></div><div></div></div><div>m</div></div><div>Scale (@A4): 1:4,750</div></div> <td colspan="2" rowspan="2">Threatend Ecological Communities</td>	Threatend Ecological Communities	
Job #: J156455			
Author: M. Nunn		Coordinate System: GDA 1994 MGA Zone 56	
Checked: D. Licari		Imagery 8th August 2018 (7.5 cm) © Nearmap 2018 Vegetation mapping: Greencap (2018)	
Date: 22/01/2019			
<div>GREENCAP</div>	Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW		Figure 16
No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.			



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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 3**.

The current VI for Zones 1-3 exceeds the assessment threshold for EECs (i.e. $VI \geq 15$). The current VI for Zone 4 falls below the assessment threshold for PCTs that are representative of an endangered TEC (i.e. $VI \geq 15$) 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. $VI \geq 17$ and $VI \geq 20$ respectively). The current VI for Zone 8 exceeds the assessment threshold for PCTs that are representative of an endangered TEC (i.e. $VI \geq 15$; **Table 3**).

Table 3 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 the zones impacted by the Project, Zones 4 and 8. These species are summarised in

Table 4. 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 5**).

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 6**).

Moreover, three candidate species credit species were excluded on the basis that the field assessment of microhabitats on the Site is substantially degraded such that the species is 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 6**).

Table 4 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 5 Species Credit Species with Habitat Constraints

Threatened species	Common name	Type	PCT	Zone	Habitat constraint	Justification for exclusion
<i>Doryanthes palmeri</i>	Giant spear lily	Candidate	1302	4, 8	<ul style="list-style-type: none"> Cliffs Cliff tops, steep cliff faces or rocky outcrops 	There are no cliffs, cliff tops, steep cliff faces or rocky outcrops on the Site.
<i>Harnieria hygrophiloides</i>	N/A	Candidate	1302	4, 8	<ul style="list-style-type: none"> Within 5 km of Brunswick Heads township 	The Site is >5 km distance from Brunswick Heads.
<i>Mixophyes iteratus</i>	Giant barred frog	Candidate	1302	4, 8	<ul style="list-style-type: none"> 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 6 Species Credit Species with substantially degraded microhabitats

Threatened species	Common name	Type	PCT	Zone	Habitat requirement	Justification for exclusion
<i>Litoria brevipalmata</i>	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.
<i>Miniopterus australis</i>	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 located any caves, tunnels, mines or other structures known or suspected to be used by the species for breeding are located on the Site.
<i>Miniopterus schreibersii oceanensis</i>	Eastern bentwing-bat	Candidate (Breeding)	1302	4, 8		
<i>Myotis macropus</i>	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 <i>Salvinia molesta</i> (Photo 2). The presence of salvinia <i>Salvinia molesta</i> has substantially degraded this microhabitat such that the species is unlikely to utilise Zones 4 and 8.
<i>Phyllodes imperialis southern subspecies</i>	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 <i>Carronia multisepalea</i> (a	In the targeted flora survey for Zones 4 and 8 <i>Carronia multisepalea</i> 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

Threatened species	Common name	Type	PCT	Zone	Habitat requirement	Justification for exclusion
					native rainforest vine) is found to occur (OEH 2018d).	not suitable microhabitats for breeding in Zones 4 and 8.
<i>Pteropus poliocephalus</i>	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 Sections 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 Survey

Targeted fauna surveys for candidate threatened species in Zones 4 and 8 were conducted on 15-18 December 2018 in accordance with **Table 7**. Note that the survey for the grey-headed flying fox *Pteropus poliocephalus* was not required (**Section 2.4.3**, OEH 2018c). Also a nocturnal spotlight survey for koala *Phascolarctos cinereus* (not a candidate species for Zones 4 and 8) was 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 7**).

The scat survey was conducted in broad 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 location of the 30 trees that were searched during the scat survey is 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 7; 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* was conducted on 17-18 December 2018 by Dr Licari and Kyle Spiteri in both 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, within paperbark forest. One living individual and three dead shells were found (**Figure 19, Table 7; 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 Mitchell's rainforest snail *Thersites mitchellae*) 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.

Figure 19 presents the threatened species polygons for fauna along with the locations of the Mitchell's rainforest snail *Thersites mitchellae*. 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 Zone 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 Sections 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 again 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 32 hours of 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 were 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.

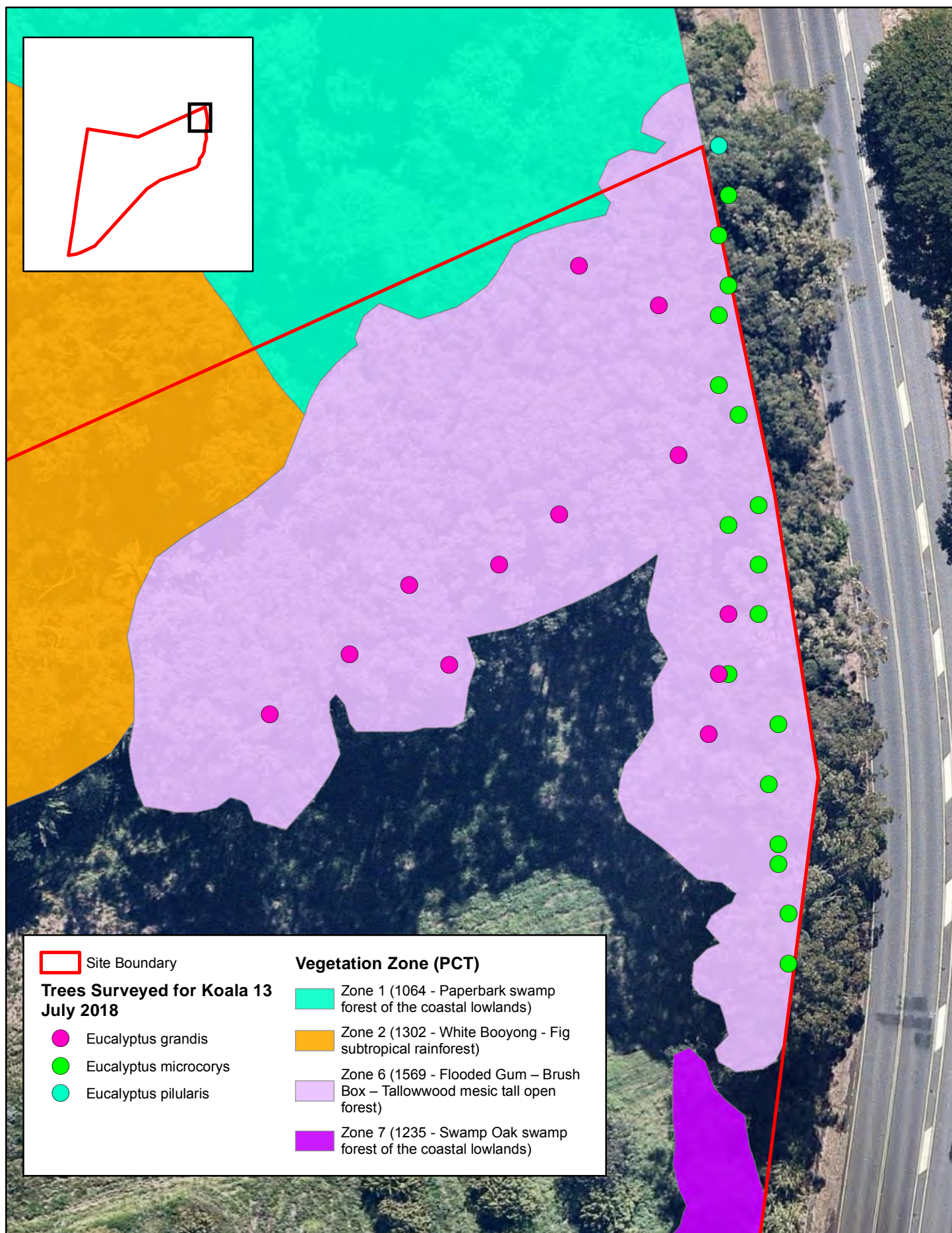
Targeted flora surveys for hairy jointgrass *Arthraxon hispidus*, slender marsdenia *Marsdenia longiloba* and *Carronia multisepalea* (host plant for the southern pink underwing moth *Phyllodes imperialis southern subspecies*) were undertaken on 17 December 2018 by Dr Barbara Stewart in Zones 4 and 8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

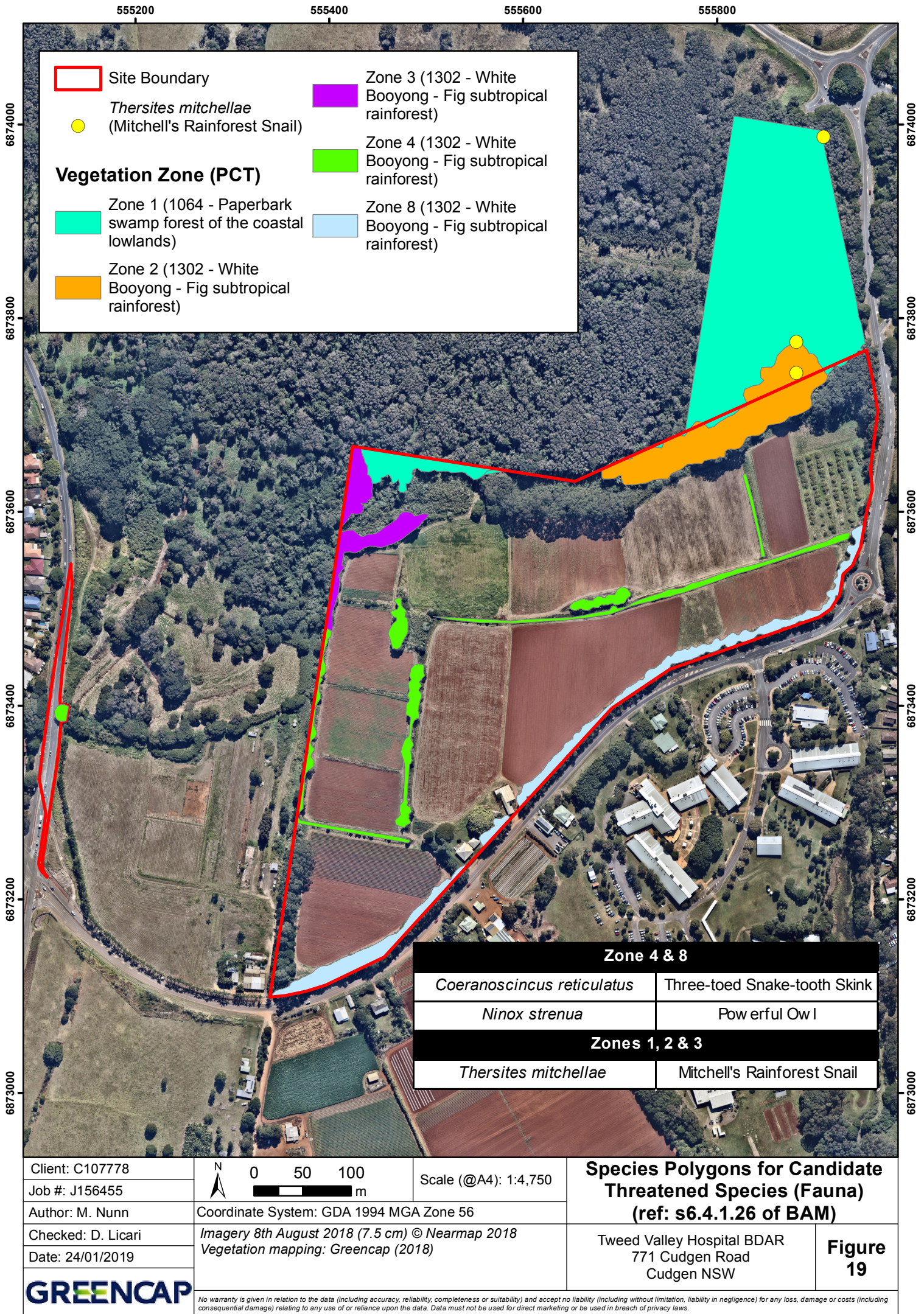
Table 7 Summary of survey method, effort and results for fauna Species Credit Species

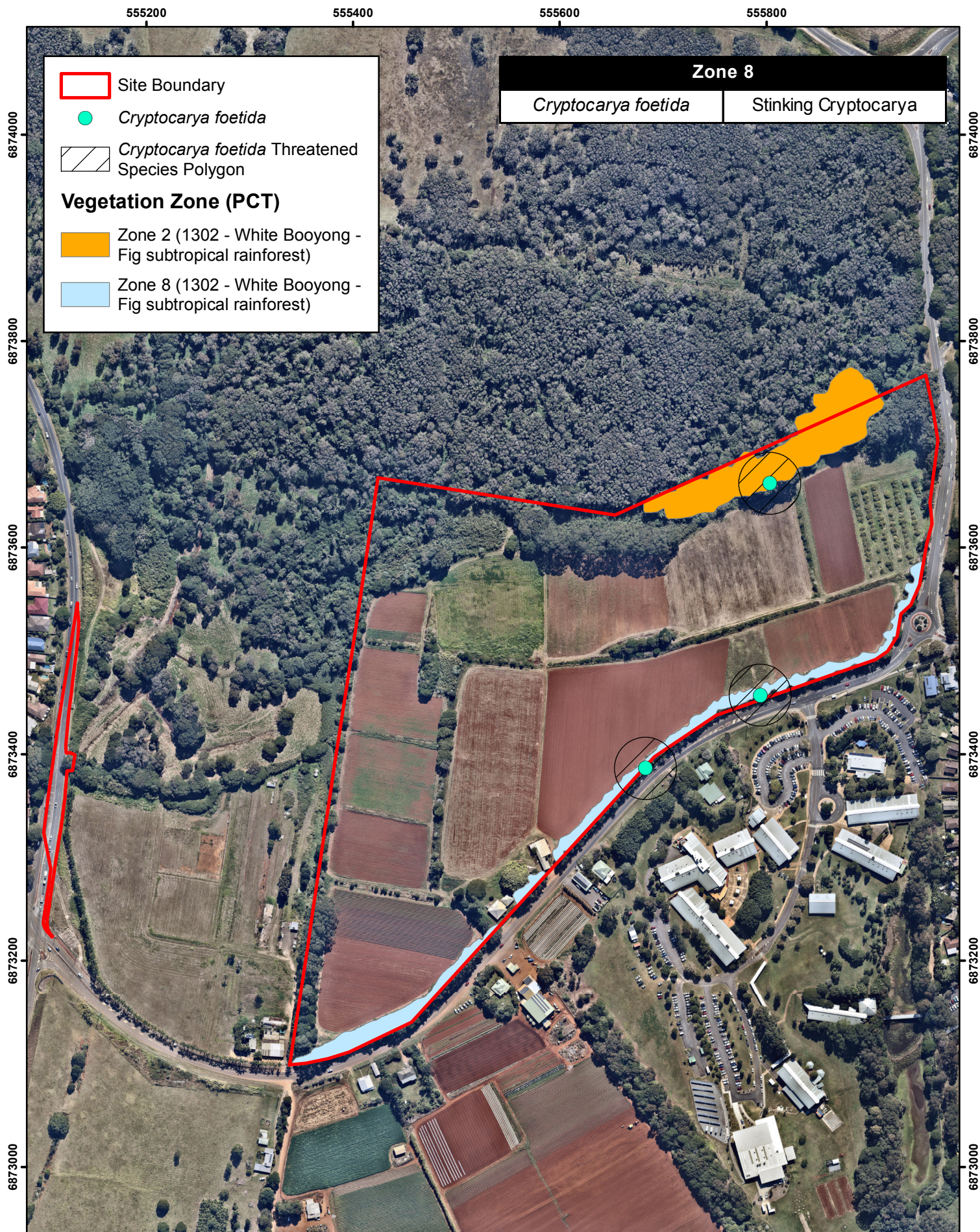
Candidate Threatened Species	Method	Survey Effort	Survey conducted	Result
Marsupials				
Eastern pygmy –possum <i>Cercartetus nanus</i>	Nocturnal spotlight survey on foot	2.25 hours – Minimum 1 hour search by 2 observers on 2 separate nights along each windrow in Zones 4 and 8	15, 17 Dec 2018	Not detected
Common planigale <i>Planigale maculata</i>	Small Elliot traps	100 trap nights over 4 consecutive nights	15-18 Dec 2018	Not detected
Koala <i>Phascolarctos cinereus</i>	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 <i>Pteropus poliocephalus</i>	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 <i>Cyclopsitta diophthalma coxeni</i>	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 <i>Hoplocephalus bitorquatus</i>	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 <i>Thersites mitchellae</i>	Opportunistic	Opportunistic recording of one live specimen in Zone 2 and one dead shell in Zone 3	19 Nov 2018	Detected
	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

Candidate Threatened Species	Method	Survey Effort	Survey conducted	Result
	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



Client: C107778	 <div>0510</div>  m	Scale (@A4): 1:500	Koala Survey Map		
Job #: J156455					
Author: M. Nunn		Coordinate System: GDA 1994 MGA Zone 56		Tweed Valley Hospital BDAR 771 Cudgen Road Cudgen NSW	Figure 18
Checked: D. Licari		<i>Imagery 8th August 2018 (7.5 cm) © Nearmap 2018</i> <i>Vegetation mapping: Greencap (2018)</i>			
Date: 22/01/2019					
		<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>			





Client: 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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 6**).

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 1500m 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), namely: pale-vented bush-hen *Amaurornis moluccana*, bush stone-curlew *Burhinus grallarius*; common blossom-bat *Syconycteris australis*; and yellow-bellied sheath-tail-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 species 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.

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 both the Concept Proposal and Stage 1 works.

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 8** 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 selected because it is currently operated as an agricultural enterprise, and therefore the majority of remnant vegetation has 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**.

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

Table 8 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.	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> The northern section of the Site is located on the Tweed River floodplain and is part of an important local wetland (mapped under <i>State Environmental Planning Policy (Coastal Management) 2018</i>; 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 is currently 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 performance criteria to be set out in an approved Biodiversity Management Plan in order to preserve and enhance current biodiversity values.

Point	Approach	Mitigation	Description
			<ul style="list-style-type: none"> 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 a Landscape Masterplan. Relevant components of this Landscape Masterplan will be incorporated into the approved Biodiversity Management Plan. 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).	<ul style="list-style-type: none"> The Site contains candidate SAIL entities, however, there are no direct impacts on associated areas of potential habitat. Therefore are no SAILS 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 Stage 1 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	<ul style="list-style-type: none"> 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 2018) will enhance connectivity within the site when compared to the existing land use.
Designing a project to avoid and minimise impacts on native vegetation and habitat			

Point	Approach	Mitigation	Description
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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Ancillary facilities will be located occur in the southern section of the Site which is currently 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	<ul style="list-style-type: none"> 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 will be detailed in the Biodiversity Management Plan.
10	Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site	All remnant native vegetation outside of the development footprint will be protected and maintained	<ul style="list-style-type: none"> 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 the vegetation management performance criteria to be set out in the Biodiversity Management Plan in order to preserve and enhance current biodiversity values.
Avoiding and minimising prescribed biodiversity impacts during project planning			
1	Impacts of development on the habitat of threatened species or ecological communities associated with karst, caves,	These habitat features have not been identified as present on the Site, impacts are avoided.	<ul style="list-style-type: none"> 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

Point	Approach	Mitigation	Description
	crevices, cliffs and other geological features of significance;		ecological communities could be avoided, and where impacts could not be avoided, where they could be minimised.
2	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	<ul style="list-style-type: none"> 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.
3	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	<ul style="list-style-type: none"> NA
4	Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.	Impacts will be minimised by retaining some windrow vegetation	<ul style="list-style-type: none"> 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.
5	Impacts of development on connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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.
6	Impacts of development on movement of threatened species that maintains their life cycle.	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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 will be 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
		<ul style="list-style-type: none"> Permanent boundary fencing will not be installed. 	
7	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)	<ul style="list-style-type: none"> 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. Water quality impacts will be avoided during construction through the use of erosion and sediment control measures. Impacts to water quality and hydrological processes during operation will be minimised through the use of WSUD measures that maintain flows to the wetlands and maintain or improve water quality. 	<ul style="list-style-type: none"> 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. The water quality strategy for the site will incorporate swales, enviropods, bioretention basins and extended 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, 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

Point	Approach	Mitigation	Description
			impediment to regular maintenance of the APZ. This advice will be factored into the water quality strategy for the site.
8	Impacts of wind turbine strikes on protected animals	<ul style="list-style-type: none"> No wind turbines are planned as part of this project 	<ul style="list-style-type: none"> N/A
9	Impacts of vehicle strikes on threatened species or animals that are part of a TEC	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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 will be detailed in the Biodiversity Management Plan.

* 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 prescribed impacts are outlined in **Appendix I** and indirect impacts are outlined in **Appendix J**.

Risk of any residual impacts likely to remain after the mitigation measures have been applied is 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 9**) and shown in **Figure 21**.

Table 9 Direct Impacts to Native Vegetation

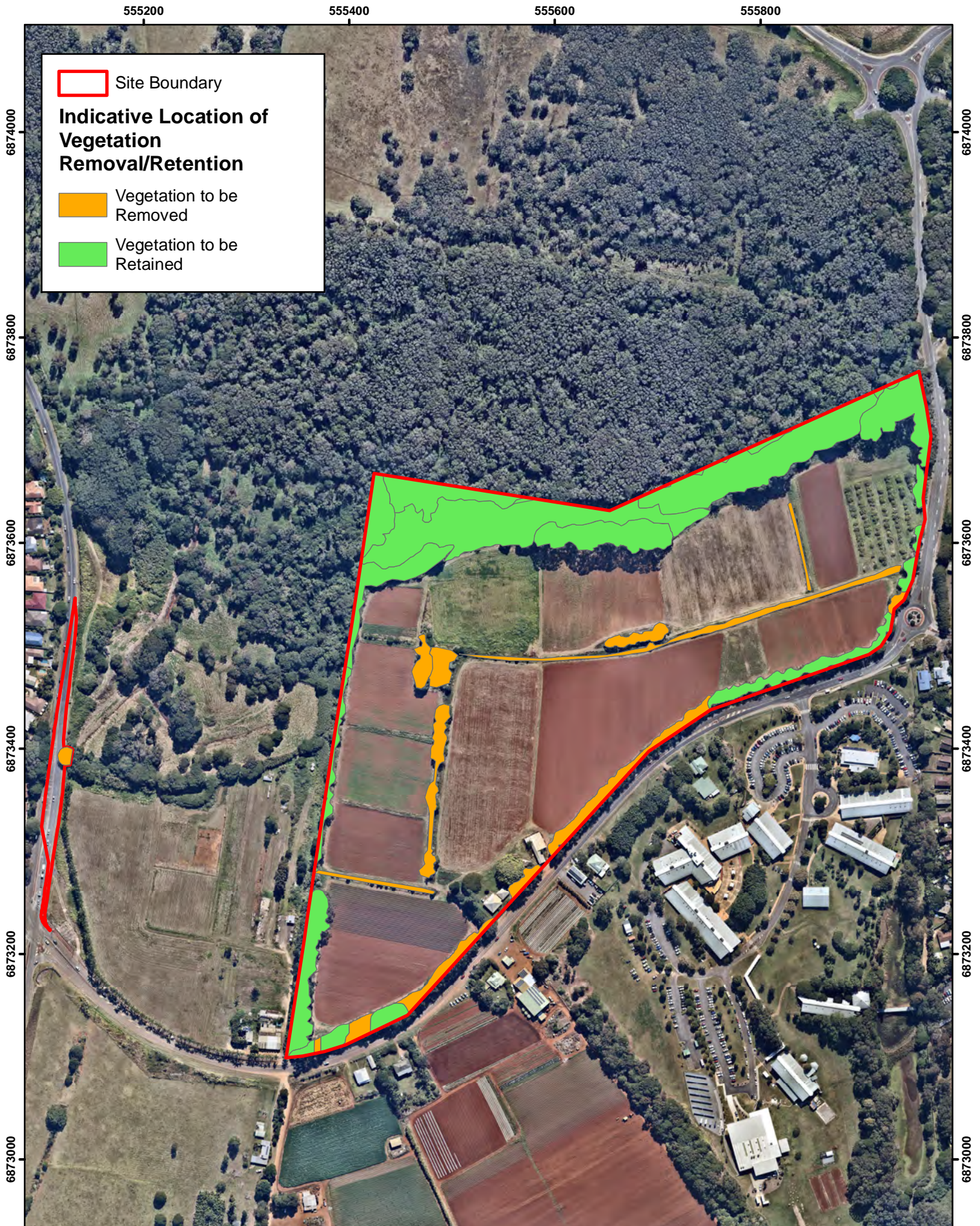
Zone	PCT ID	PCT Name	Condition Class	Area (ha)
4	1302	White Booyong- Fig subtropical rainforest	Self-sown windrow	0.55
8	1302	White Booyong- Fig subtropical rainforest	Self-sown windrow	0.40

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. Indirect impacts are addressed in **Appendix I** and generally relate to:

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

As a result of the indirect risk assessment, it was identified that the residual risk following the application of mitigation measures was very low.



3.2.3 Serious and Irreversible Impacts

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

3.2.4 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 3.2.5 to 3.2.9. Mitigation of potential prescribed impacts are detailed in **Appendix I**.

3.2.5 Prescribed Impacts on Water

Stormwater Management under the Existing Land Use

The existing land use is a working farm and site observations indicate that the cultivated fields are ploughed across the topographic contours. Under this ploughing regime, sediment-laden stormwater is encouraged to run downhill through ploughed furrows. Observation of the landholder at work during site inspections also indicate the 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.

The *Civil and Structural Design Report* (Bonacci, 2018) for the project summarises the results of the MUSIC model that was developed for the site. It 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.

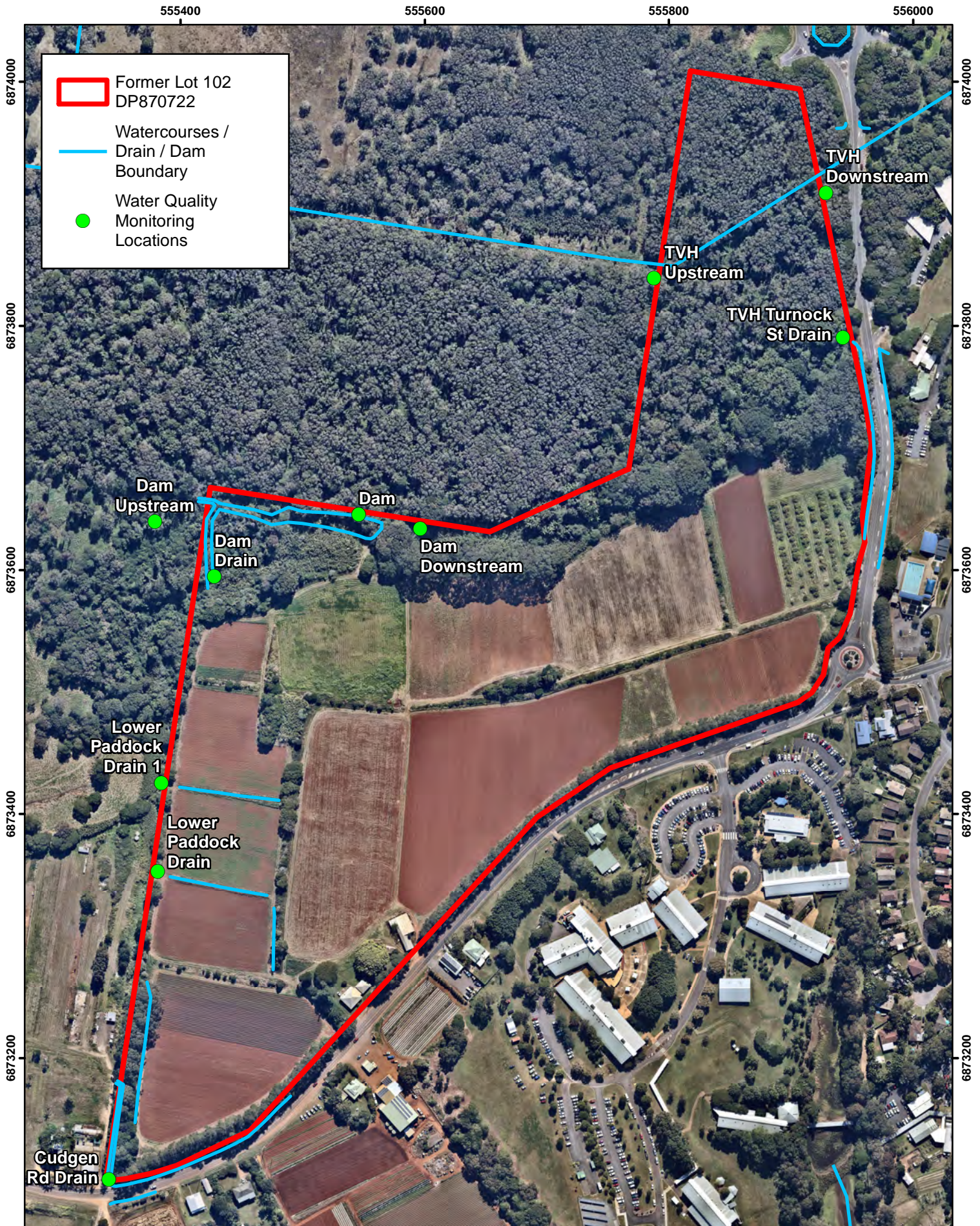
Water quality monitoring

In addition to the modelling undertaken by Bonacci (2018) as described above, Greencap conducted surface water sampling to assess water quality under the existing land use 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. To effectively assess the surface water quality across the Site, a maximum of nine sampling locations were selected (**Figure 22**). It was assumed that five of these will hold water permanently and can be sampled at any time, regardless of rainfall. The nine 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). Four of these locations are not permanent water bodies and require run off at the time of sampling, therefore these locations are triggered by rainfall events.

The surface water monitoring objectives for the Site were to detect changes during construction and operation in receiving water quality resulting from the Project, with stormwater discharges potentially containing increased sediment loads, nutrients, dissolved metals, hydrocarbons or other contaminants such as pesticides. Therefore, these analytical parameters were selected for the water quality testing. Organochlorine Pesticides (OCP) and Organophosphorus Pesticides (OPP) were included as it is probable that the current agricultural land-use would result in these contaminants being present. Physico-chemical parameters were also monitored, for pH dependent threatened species such as the wallum froglet *Crinia tinnula* and longburra frog *Litoria longburensis*, monitoring of water discharged from sediment basins is particularly important.

The results of the pre-construction water quality monitoring are summarised below:

- Slightly acidic water, low dissolved oxygen and generally low turbidity;
- No detections of organochlorine pesticides (OCP) or organophosphorus pesticides (OPP);
- No hydrocarbon detections;
- Elevated concentrations of some nutrients at some locations, particularly oxides of nitrogen, ammonia, filterable reactive phosphorus, as well as total nitrogen at all locations; and
- Elevated concentrations of some metals, particularly aluminium, cobalt, copper, manganese and zinc in the dam.





Client: C107778	 <div>050100</div> <div>m</div>	Scale (@A4): 1:4,000	<div>Surface Water Sampling Locations</div>	
Job #: J156455-04				
Author: M. Nunn	Coordinate System: GDA 1994 MGA Zone 56		<div>Tweed Valley Hospital 771 Cudgen Road Cudgen NSW</div> <div>Figure 22</div>	
Checked: T. Kennedy	<i>Note: All data is approx only & subject to survey. Imagery 8th August 2018 (7.5 cm) © Nearmap 2018 Hydrolines and Hydroarea (NSW Hydrography) © Department of Finance, Services and Innovation (2018)</i>			
Date: 22/01/2019				
		<small>No warranty is given in relation to the data (including accuracy, reliability, completeness or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of or reliance upon the data. Data must not be used for direct marketing or be used in breach of privacy laws.</small>		

Figure 22

Stormwater Management during Construction

Soil erosion and stormwater quality will be managed during construction of the Project in accordance with current industry standards (Landcom, 2004). 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:

- 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
- A sediment basin of minimum 7126 m³ volume will be constructed to capture flows. The receiving catchment will be protected by providing diversion stormwater drainage lines that bypass the construction site.

For details of how soil and stormwater quality will be managed refer to Bonacci 2018 (drawings C0005 Soil and Water Management Plan, C0006 Soil and Water Management Details and C0007 Soil and Water Management Calculations).

All construction works will be delivered in accordance with a Construction Environmental Management Plan (CEMP) and will incorporate the aforementioned Soil and Water Management Plan as a sub-plan and will include relevant performance criteria. The CEMP will incorporate all relevant safeguards and mitigation measures detailed in the Environmental Impact Statement and any requirements detailed in the development consent. 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 Environment and Planning for review and approval prior to commencement of works.

Stormwater Management during Operation

During operation of the Project, an integrated stormwater management system will be designed and constructed to convey stormwater runoff from buildings and associated infrastructure, roads, carparks and landscape areas. Additionally, the existing farm dam located at the north of the site will be filled to return that part of the catchment to a more natural flow regime. At the time of lodgement, the stormwater management system is at a concept development stage.

At the concept development stage of the stormwater management system, the design will cater for water volume discharges associated with design storms up to and including 100-year ARI (1% AEP) storm events as detailed in local development design specifications (TSC, 2016). In regards to water quality, the system will also be designed to meet water quality performance criteria detailed in TSC 2016, namely:

- Reduction of Mean Annual Load of Gross Pollutants – 90% (greater than 5mm).
- Reduction of Mean Annual Load of Total Suspended Solids – 80%.
- Reduction of Mean Annual Load of Total Phosphorous – 60%.
- Reduction of Mean Annual Load of Total Nitrogen – 45%.

As part of Stage 1 of the Project, the detailed design of the stormwater management system will be designed and constructed to mimic natural flows to minimise indirect impacts on the floodplain EECs in the receiving catchment and wetland located to the north of the Site.

The detailed design of the stormwater management system will incorporate swales, enviropods, bio-retention basins and extended detention basins. The roof runoff will be directed into the bio-retention basin via a pit and pipe system. Hardstand runoff will be first treated by enviropods, and then either swales that discharge to the bio-retention system or directly into the bio-retention systems. Ultimately the bulk of the stormwater will end up in an extended detention basin where it will settle and discharge to the receiving catchment in a controlled manner. The details of the discharge characteristics will be determined at detail design stage, guided by advice from the Accredited Person.

The *Civil and Structural Design Report* (Bonacci, 2018) for the project summarises the results of the MUSIC model that was developed for the site. It assesses impacts associated with the long-term management of the site. The model (see Figure 4-4 of the report) identifies a number of key outcomes following the implementation of the stormwater management system (**Table 10**).

Table 10 Summary of MUSIC Model

Parameter	Sources	Residual Load	% Reduction
Flow (ML/yr)	198	194	2
Gross Pollutants (kg/yr)	1680	0	100
Total Suspended Solids (kg/yr)	31,100	5,890	81.1%
Total Phosphorus (kg/yr)	61.1	22.2	63.7
Total Nitrogen (kg/yr)	404	217	46.2

This demonstrates the significant improvement in water quality that will be achieved following the effective implementation of the long-term stormwater management system for the site. This improvement is in line with the water quality improvement criteria identified by Tweed Shire Council (TSC, 2016).

Assessment of Prescribed Impacts during Construction

Soil erosion and stormwater quality will be managed during construction of the development in accordance with current industry standards (Landcom, 2004) and in accordance with an approved CEMP.

To manage discharges from sediment basins employed during construction it is a standard industry practice to use gypsum as a flocculant to quickly settle sediment-laden stormwater runoff. However, the use of gypsum may raise the pH water discharged from gypsum-treated sediment basins. Two pH dependent amphibians have been identified by the BAM Calculator as candidate threatened species (i.e. Wallum froglet *Crinia tinnula* and Olongburra frog *Litoria olongburensis*).

There are records for these species within the 1,500 m assessment area (Greencap 2018; Figure 7) and within the receiving catchment. Consequently, the use of gypsum in the sediment basins may have an impact upon the above threatened amphibian species. There are other commercially available flocculants that work effectively as a gypsum replacement that do not create the large increases in pH that can be associated with the use of gypsum and this will mitigate this potential impact (see **Section 3.5**).

Assessment of Prescribed Impacts during Operation

The stormwater management system for operation of the Project will be designed in accordance with the locally appropriate standard (TSC 2016). Given application of this standard, 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.

The MUSIC model developed for the site demonstrates that water quality will be improved through the effective implementation of the stormwater management system, in line with locally appropriate standards (TSC, 2016).

In respect of water quantity, the MUSIC model demonstrates that flow will be largely consistent with the existing land use. 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 model demonstrates that inundation of the wetland area will continue to occur as part of the stormwater management system for the site, in line with the existing land use. The quality of the water entering this area will improve, in accordance with the model.

On this basis it is considered that the adverse impact of the development on water quality, water bodies and hydrological process that sustain threatened species and threatened ecological communities is, on balance, a positive impact. 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.

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

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

Current connectivity of different areas of habitat differs between the northern and southern portions of the site. The existing vegetation in the northern portion of the site contributes to the mapped regional fauna corridor identified in **Figure 9**. This area of vegetation is bordered by an existing wildlife fence within the road corridor which runs alongside Turnock St (and therefore outside the boundary of the site). This vegetation in the northern portion of the site will be retained and therefore will continue to contribute to connectivity of this part of the habitat.

The southern portion of the site, currently used for agriculture, is largely cleared with the exception of small clumps of trees and vegetation. In respect of connectivity, these areas currently contribute to connectivity by providing 'stepping stone' habitats for threatened species such as birds, mammals etc. These existing stepping stone areas will be removed as part of the proposed development.

In response to this impact, two main types of mitigation actions will be employed, as follows:

- It is proposed that a 10 m wide vegetation buffer will be provided along the western boundary of the site. This vegetation buffer will connect to the retained vegetation in the northern portion of the site, and will run north to south, in line with the mapped regional fauna corridor. It is anticipated that this will represent an improvement in connectivity from the existing use of the site.
- While the existing stepping stone habitats in the southern portion of the site will be removed, these will be replaced with new and additional stepping stone habitats in the form of rain gardens (identified in the Landscaping Plan for the project). These will provide habitat for threatened species within the cleared areas of the site, and will provide those 'stepping stone' locations which contribute to connectivity. In doing so, connectivity through the use of stepping stone habitats will be maintained across the site.

3.2.7 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 development unless impeded by a boundary fence.

In respect of the current fencing of the site, the only existing fencing in proximity to the site is the wildlife fencing along the Turnock St roadside. The development will not impact this existing fencing.

In respect of fencing that will be installed as part of the development, temporary fencing will be installed during the construction phase of the development to facilitate movement of arboreal marsupials such as koala *Phascolarctos cinereus*.

This fencing will be installed in accordance with the guidance provided in the *Tweed Coast Comprehensive Koala Plan of Management* (Tweed Shire Council, 2015), Appendix D Wildlife Infrastructure Design Guidelines. This fencing will be removed at the conclusion of the construction phase of the development.

It is not intended that permanent fencing around the site will be erected to support the long-term operation of the Hospital. On this basis, it is not anticipated that the development will impact on the movement of threatened species that maintains their lifecycle. Threatened species will continue to be able to access the vegetation running along the northern portion of the site. Threatened species will also have access to a new 10m vegetation buffer to be established along the western boundary of the site, and a series of 'stepping stone' habitats across the cleared parts of the site.

3.2.8 Prescribed Impacts of Vehicle Strikes on Threatened Species

Vehicle strike

The proposed development will widen the access road (Cudgen Road) and traffic volumes will incrementally increase to 5007 vehicles per day along Cudgen Road and Turnock Street (Bitzios 2018). There is an existing wildlife fence along Turnock Street that owned and managed by TSC that is located adjacent to Zones 1, 2 and 6 (**Figure 14**). The wildlife fence is located adjacent to the koala habitat on the Site (Zone 6).

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, it also places these species at risk of vehicle strike.

Aircraft strike

The proposed development includes a helipad on the top of the main building which will result in low level air traffic in the vicinity of the sites. There is a risk that threatened species of birds and bats (in particular local populations of the threatened grey-headed flying-fox *Pteropus poliocephalus*) may be flying across the Site in remnant vegetation that is located at the level of the floodplain at the time of aircraft operation.

The helipad 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.

At peak operation it is expected that aircraft movements would amount to six movements per week with an estimated flight time of 2 hours per annum. The nature of aircraft operation for the site are 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 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 negligible.

3.2.9 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 Treat 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.

However, fauna spotter catchers will be employed onsite during the clearing of these areas. If threatened species are identified during this process, adaptive management strategies documented in the Biodiversity Management Plan will be employed to mitigate potential impacts.

3.3 Adaptive Management for Uncertain Impacts

The approved Biodiversity Management Plan 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 (**Section 0**).

3.4 Impact Summary

3.4.1 Serious and Irreversible Impacts

There are no SAIL entities associated with the development.

3.4.2 Impacts Requiring Offsets

Measures to be implemented to avoid and minimise direct impacts on biodiversity are outlined in **Section 3.1** and **Table 8**.

The Project will result in the removal of a total 0.40ha of vegetation in PCT 1302 Zones 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 3.6**.

3.4.3 Impacts Not Requiring Offsets

The Project will result in the removal of a total 0.55 ha of vegetation in PCT 1302 Zones 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 prescribed impacts as detailed in **Section 3.2.4**. However, mitigation measures which are outlined in **Appendix I** will reduce the likelihood and consequence to acceptably low levels. Consequently, it is considered that the residual impact does not generate an offset requirement.

3.4.4 Areas Not Requiring Assessment

Areas that did not require assessment comprise of approximately 16 ha of cleared farm land 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).

3.5 Summary of Recommendations

Advice has been provided to HI regarding options for the long-term management of the retained vegetation on the Site including rezoning to E2 Environmental Conservation. However, to date HI has not confirmed its preferred approach.

Nonetheless, the Project will monitor and manage potential impacts which shall be outlined in a Biodiversity Management Plan (BMP) and its sub plans:

- Vegetation Management Plan (VMP) that incorporates revegetation of the exotic grassland in Zone 9 with rainforest species, regeneration and weed management of retained remnant vegetation in the north of the Site. This plan will be linked to the Landscape Masterplan which is focused on the regeneration of retained windrows, as well as native landscape plantings.
- Water Quality Management Plan; and
- Fauna Management Plan (FMP).

The BMP will include adaptive management for impacts on biodiversity that are uncertain in accordance with section 9.4.2 of the BAM and will 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 BMP will 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 will be outlined in the VMP and FMP.

3.6 Credit Summary

3.6.1 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

3.6.2 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. $VI \geq 15$) 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. $VI \geq 15$) 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

3.6.3 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
<i>Cryptocarya foetida</i>	Stinking cryptocarya	Z8_Self-sown_windrow	N/A	1	1.5	2
<i>Coeranoscincus reticulatus</i>	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
<i>Ninox strenua</i>	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

3.6.4 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. $VI \geq 15$), 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. $VI \geq 15$) 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 Project has the potential to cause some prescribed impacts, however, mitigation measures including adaptive management strategies will reduce the likelihood and consequence to of any residual impacts to low levels that do require an offset.

4. GLOSSARY, ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
BC Act	<i>Biodiversity Conservation Act 2016</i>
BC Regulation	<i>Biodiversity Conservation Regulation 2016</i>
BAM	<i>Biodiversity Assessment Method Order 2017</i>
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 <i>Biodiversity Conservation Act 2016</i> .
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i> (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 <i>Environment Protection and Biodiversity Conservation Act 1999</i> and the <i>Biodiversity Conservation Act 2016</i> .
TCR	Tweed Coast Road
TSC	Tweed Shire Council

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