JWA PTY LTD
Ecological Consultants
ABN 56 066 448 879

REVISED
BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT (BDAR)

Proposed Tweed Sand Plant Expansion

Lot 22 DP1082435, Lot 23 DP1077509, Lot 494 DP720450, Lot 1 DP1250570, Lot 2 DP1192506, Lot 3 DP1243752, Lot 51 DP1166990 and Lot 50 DP1056966, Cudgen

A Report Prepared for
Hanson Construction Materials Pty Ltd

OCTOBER 2021

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BDAR CERTIFICATION

This Biodiversity Development Assessment Report is certified by **Adam McArthur** – a suitably qualified person and accredited assessor under the accreditation scheme prepared under Section 6.10 of the *Biodiversity Conservation Act 2016* (BC Act), **accreditation number BAAS18069**.

The report has been prepared based on the requirements of, and information provided under the Biodiversity Assessment Method (DPIE 2020) and submitted via the Biodiversity Offsets and Agreement Management System (BOAMS) on 25th October 2021, **case number (00022641/BAAS18069/20/00022642 /Revision:0)**.

Signed _____ Date: 25th October 2021

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Client Issue

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EXECUTIVE SUMMARY

Hanson Construction Materials Pty Ltd (Hanson) commissioned JWA Pty Ltd (JWA) to prepare a Biodiversity Development Assessment Report (BDAR) for the proposed expansion of their Tweed Sand Plant (TSP) operation located in Cudgen, New South Wales. This report was prepared to satisfy the relevant aspects of the Secretary's Environmental Assessment Requirements (SEARs) issued for the Project in December 2019.

Hanson's existing TSP operation has a total extraction footprint of approximately 46 hectares (ha). Sand extraction has been undertaken at this location since 1983 with Hanson assuming operation of the site in 2007. TSP operates under Development Application (DA) DA 152-6-2006 issued on 31st July 2006, as modified on 20th August 2018 (Notice of Modification MOD 1). The current MOD 1 approval remains valid until 1st July 2036 and authorises TSP to produce and transport from the site up to 500,000 tonnes of quarry products per financial year.

To meet ongoing demand for sand, Hanson is proposing to expand its existing operations into lands to the north and west of the TSP site over a thirty (30) year period. This expansion will be carried out progressively over eleven (11) phases, however it is noted that Phases 1 - 4 are to have been completed prior to the proposed expansion. Therefore, this BDAR applies to Phases 5 – 11 only. The footprint of the expansion area is approximately 190 ha, giving a total combined footprint of 236 ha for the existing and future extraction areas.

The findings of this BDAR are based on detailed vegetation assessments and targeted threatened flora and fauna surveys completed in August and October 2020, and in January 2021.

The BDAR was originally submitted as part of an Environmental Impact Statement (EIS) prepared by Zone Planning Group Pty Ltd dated 30th March 2021. Revisions to the BDAR were made in October 2021 based on submissions received from Tweed Shire Council (dated 4th June 2021) and the Biodiversity Conservation Division (BCD) of the Department of Planning, Industry and Environment (dated 27th May 2021).

The ecological assessment involved a two-stage approach to ensure an appropriate level of assessment was undertaken. Firstly, a desktop review was undertaken to highlight any potential conservation significant vegetation communities, any potential habitat for threatened flora or fauna, and any ecologically sensitive areas on site. Secondly, using the results from the desktop review field surveys of flora, fauna and habitat were completed.

Detailed assessments of the composition, structure and function of site vegetation were completed on the 27th August and the 27th October 2020 utilising the Biodiversity Assessment Method (DPIE 2020). The assessments were completed respectively by one (1) suitably qualified person and accredited assessor under the accreditation scheme prepared under Section 6.10 of the *Biodiversity Conservation Act 2016* (BC Act).

The assessments determined that three (3) Plant Community Type (PCT) comprising four (4) separate vegetation zones occurs within the development area:

- **Vegetation Zone 1**: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m. This zone occurs along drainage lines throughout the subject site and is considered to be best represented by **Plant Community Type (PCT) 1235** (Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion) as described within the BioNet Vegetation Classification (OEH 2021). This vegetation is considered to be a modified/degraded of the **Threatened Ecological Community (TEC)** *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* as listed within schedules of the BC Act (2016).

- **Vegetation Zone 2**: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m. This zone occurs along drainage lines throughout the subject site and is considered to be best represented by **PCT 1235** and represents a modified/degraded version of the **TEC** *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions*.

- **Vegetation Zone 3**: Tall swamp sclerophyll forest (*Melaleuca quinquenervia, Cinnamomum camphora*) to 22m. This zone occurs in the northern portion of the site and is considered to be best represented by **PCT 1064** (Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion) and represents a modified/degraded version of the **TEC** *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* as listed within schedules of the BC Act (2016).

- **Vegetation Zone 4**: Tall rushland/reedland (*Typha orientalis*) to 2m. This zone occurs along drainage lines in the southern portion of the subject site, is highly disturbed and is considered to have been derived from **PCT 780** (Coastal floodplain sedgelands, rushlands, and forblands of the North Coast). Although this vegetation zone is highly degraded and occurs in association with a manmade drain, to satisfy Tweed Shire Council, it is considered to be representative of a modified/degraded version of the **TEC** *Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* as listed within schedules of the BC Act (2016).

- **Vegetation Zone 5:** Riparian rehabilitation areas. This zone occurs along the margins of the existing Tweed Sand Plant (TSP) operation and is comprised of areas that are currently proposed to be rehabilitated to be representative of **PCT 1235** (Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion) after completion of the current sand extraction operations, in accordance with the approved Rehabilitation and Landscape Management Plan (JWA 2021).

- **Vegetation Zone 6:** Wetland rehabilitation areas. This zone occurs within the margins of the existing Tweed Sand Plant (TSP) operation and is comprised of areas that are currently proposed to be rehabilitated to wetland vegetation, in accordance with the approved Rehabilitation and Landscape Management Plan (JWA 2021). Vegetation Zone 6 has been allocated to **PCT 1808** (Estuarine reedland).

This determination has been made with consideration of soil type, vegetation types occurring in similar locations in the locality, regenerating native species (where present) and community structure and descriptive attributes provided in the BioNet Vegetation Classification. Two (2) additional vegetation zones (**Vegetation Zone 7** and **Vegetation Zone 8**) were identified on the subject site but was comprised entirely of the exotic or planted species and were not further assessed.

Targeted surveys for threatened flora and fauna species were also completed onsite on the 27th August and 27th October 2020, and between the 26th – 28th January 2021. No threatened flora species listed within schedules of the BC Act or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were recorded from the impact area. One (1) threatened fauna species - the Southern Myotis (*Myotis macropus*) - which is provided with suitable habitat, has been assumed to be present.

A number of measures to avoid and mitigate impacts on existing flora, fauna and habitat values of the site have been discussed. The proposed development will however result in unavoidable impacts on 3.82 ha of native vegetation and 2.06 ha of land required to be rehabilitated under existing sand extraction approvals. These impacts are not considered to be serious or irreversible.

Due to the long-term nature of the proposed expansion, this BDAR has been prepared to provide overarching offsetting requirements associated with the proposed sand extraction works on a phase-by-phase basis. Prior to the commencement of sand extraction works within each phase, a phase specific BDAR (or assessment in line with the relevant legislation at that time) will be prepared to accurately assess impacts and offset obligations.

Impacts to the degraded area of PCT 780 (Vegetation Zone 4) are not required to be offset with regards to ecosystem credits or species credits as the vegetation integrity score of this vegetation is below those set out in Paragraphs 10.3.1.1 and 10.3.2.1 of the BAM respectively.

A total of 153 ecosystem credits and 157 species credits have been calculated as applicable for the unavoidable loss of site vegetation as follows:

<u>Ecosystem credits</u>

- PCT 1235 - Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion = 72 credits
- PCT 1064 - Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion = 21 credits
- PCT 1808 – Estuarine reedland = 60 credits

<u>Species credits</u>

- Southern Myotis (*Myotis macropus*) = 157 credits

In accordance with the requirements of the NSW Biodiversity Offsets Scheme, proponents have two primary ways that they can satisfy their offset credit obligation:

1. They can identify and purchase the required 'like for like' credits in the market and then retire those credits via the OEH Biodiversity Offsets and Agreement Management System (BOAMS).

OR

2. They can use the Offsets Payment Calculator to determine the cost of their credit obligation and transfer this amount to the Biodiversity Conservation Fund via OEH BOAMS. The responsibility for identifying and securing the offset obligation would then be transferred to the Biodiversity Conservation Trust.

These credits will need to be purchased or retired as an offset for the removal of site vegetation prior to each phase of the development.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

Hanson Construction Materials Pty Ltd (Hanson) commissioned JWA Pty Ltd (JWA) to prepare a Biodiversity Development Assessment Report (BDAR) for the proposed expansion of their Tweed Sand Plant (TSP) operation located in Cudgen, New South Wales. This report was prepared to satisfy the relevant aspects of the Secretary's Environmental Assessment Requirements (SEARs) issued for the Project in December 2019.

The BDAR was originally submitted as part of an Environmental Impact Statement (EIS) prepared by Zone Planning Group Pty Ltd dated 30th March 2021. Revisions to the BDAR were made in October 2021 based on submissions received from Tweed Shire Council (dated 4th June 2021) and the Biodiversity Conservation Division (BCD) of the Department of Planning, Industry and Environment (dated 27th May 2021).

Hanson's existing TSP operation has a total extraction footprint of approximately 46 hectares (ha). To meet ongoing demand for sand, Hanson is proposing to expand its existing operations into lands to the north and west of the TSP site over a thirty (30) year period. This expansion will be carried out progressively over eleven (11) phases, however it is noted that Phases 1 - 4 are to have been completed prior to the proposed expansion. Therefore, this BDAR applies to Phases 5 – 11 only. The footprint of the expansion area is approximately 190 ha, giving a total combined footprint of 236 ha for the existing and future extraction areas.

Due to the long-term nature of the proposed expansion, this BDAR has been prepared to provide overarching offsetting requirements associated with the proposed sand extraction works on a phase-by-phase basis. Prior to the commencement of sand extraction works within each phase, a phase specific BDAR (or assessment in line with the relevant legislation at that time) will be prepared to accurately assess impacts and offset obligations.

In accordance with the requirements of the *Biodiversity Conservation Regulations 2017* (BCR), this report has been prepared by Adam McArthur, a suitably qualified person and accredited assessor under the accreditation scheme prepared under Section 6.10 of the *Biodiversity Conservation Act 20016* (BC Act) (Certification No. BAAS18069). A copy of Adam's CV is provided in **APPENDIX 1.**

The preparation of the BDAR has involved the following:

- An assessment of the biodiversity values of the subject site utilising the Biodiversity Assessment Method (BAM) (DPIE 2020) including:
    - An assessment of the landscape features and site context;
    - Determining the presence of Threatened Ecological Communities (TECs), Plant Community Types (PCTs), and the condition (vegetation integrity) of native vegetation on the subject site;

  - Determining the habitat suitability for Threatened species on the subject site; and
- An impact assessment of the proposed development on biodiversity values in accordance with the requirements of the BAM including:
  - Documenting measures to avoid and/or minimise impacts of the proposed development;
  - Assessing direct and indirect impacts on native vegetation and habitat;
  - Discussing measures to mitigate and manage unavoidable impacts;
  - Identification of any serious and irreversible impacts; and
  - Calculating the offset requirement of the proposed development.

1.2 Locality

The Locality is defined as the area within a 10km radius of the Subject site for the purposes of this assessment. The locality therefore extends from Coolangatta to Round Mountain and from Upper Durobby to the Pacific Ocean (**FIGURE 1**).

Prominent features in the locality include the towns of Kingscliff, Cudgen, Chinderah, Tweed River, Stotts Island, Ukerebagh Nature Reserve, Cudgera Creek Nature Reserve, and Cudgen Nature Reserve.

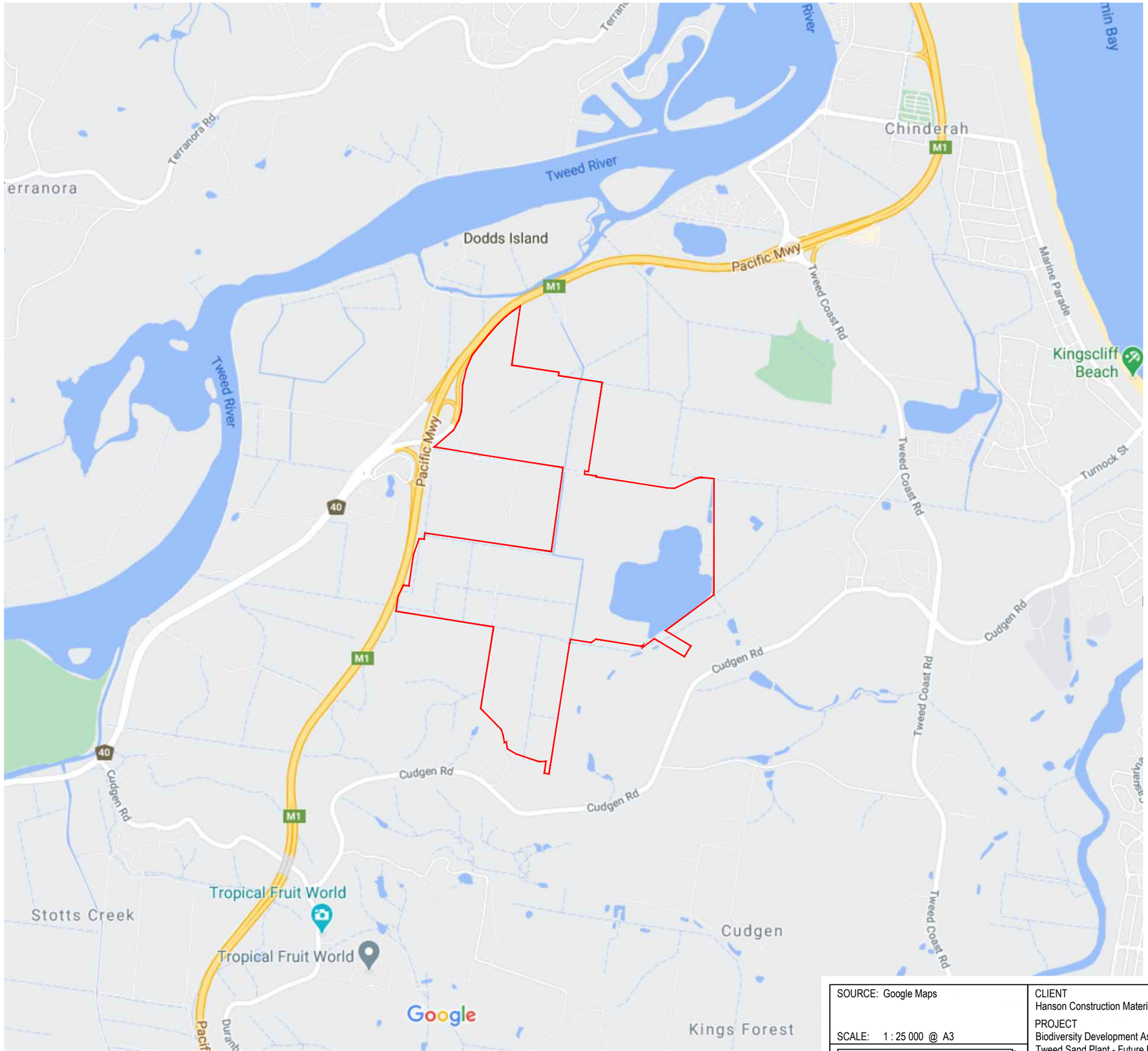
State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) wetlands occur approximately 1 – 1.5 km to the north, east south and west of the Subject site.

1.3 The Subject Site

TSP is located off Altona Road in Cudgen, Northern NSW (**FIGURE 1**). The site is formally described as Lot 22 DP1082435, Lot 23 DP1077509, Lot 494 DP720450, Lot 1 DP1250570, Lot 2 DP1192506, Lot 3 DP1243752, Lot 51 DP1166990 and Lot 50 DP1056966. Vegetation on the site ranges from moderate to poor condition due to a history of vegetation clearing, cropping and cattle grazing activities. An aerial photograph of the Subject site and surrounds is shown in **FIGURE 2**.

1.4 Planning Context

The subject site is located within the Tweed LGA. The subject site is therefore subject to the Tweed Local Environmental Plan 2014 (LEP) and associated plans, policies and controls. Under the Tweed LEP the majority of the subject site is zoned as RU1 – Primary Production with a small area in the southern portion zoned as RU2 – Rural Landscape **(FIGURE 3**).



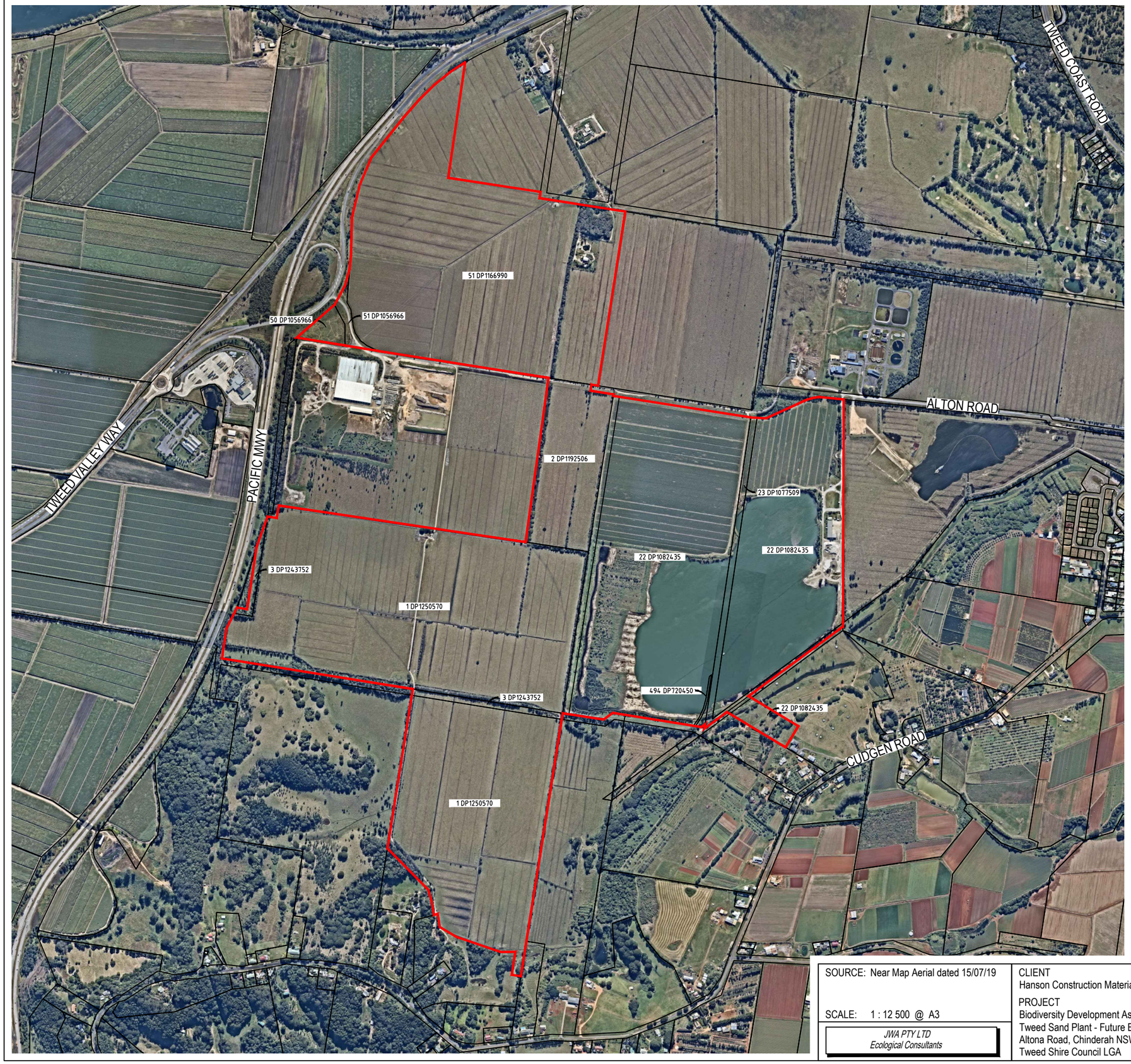
LEGEND

Subject Site

Scale 1:25 000 - Lengths in metres

200 0 200 400 600 800 1000

SOURCE: Google Maps SCALE: 1 : 25 000 @ A3 *JWA PTY LTD* *Ecological Consultants*	CLIENT Hanson Construction Materials Pty Ltd PROJECT Biodiversity Development Assessment Report Tweed Sand Plant - Future Expansion Altona Road, Chinderah NSW Tweed Shire Council LGA	FIGURE 1 PREPARED: BW DATE: 02 February 2021 FILE: N09007_BDAR_20210202.dwg	TITLE LOCALITY PLAN



LEGEND

Subject Site

N

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Near Map Aerial dated 15/07/19

SCALE: 1 : 12 500 @ A3

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FIGURE 2

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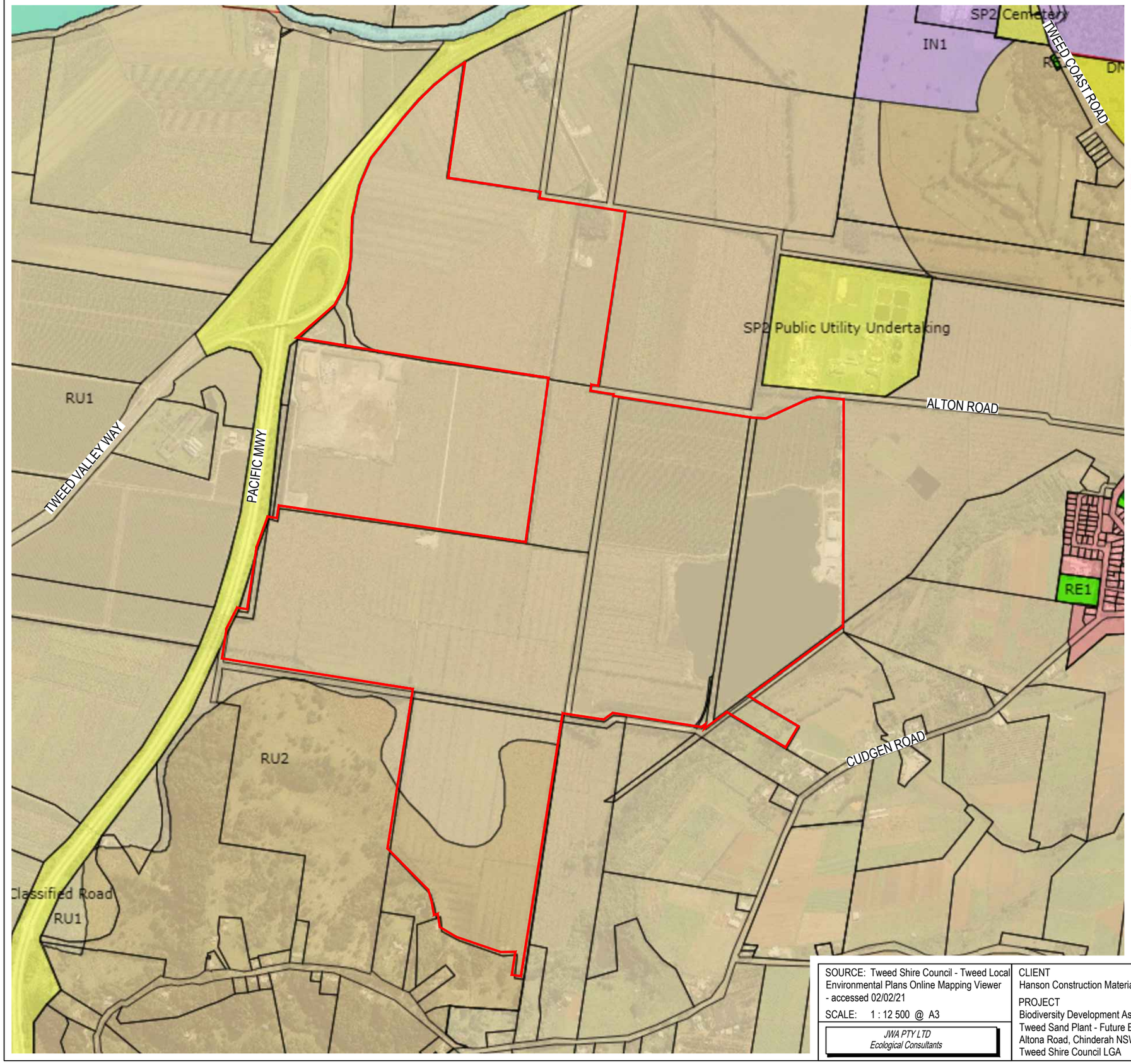
TITLE

AERIAL PHOTOGRAPH



LEGEND

- Subject Site

Land Zoning

- RU1 - Primary Production
- RU2 - Rural Landscape
- IN1 - General Industrial
- R2 - Low Density Residential
- SP2 - Infrastructure
- RE1 - Public Recreation
- W1 - Natural Waterway
- W2 - Recreational Waterway

N

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Tweed Shire Council - Tweed Local Environmental Plans Online Mapping Viewer - accessed 02/02/21

SCALE: 1 : 12 500 @ A3

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FIGURE 3

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TITLE

ZONING PLAN

1.5 The Proposed Development

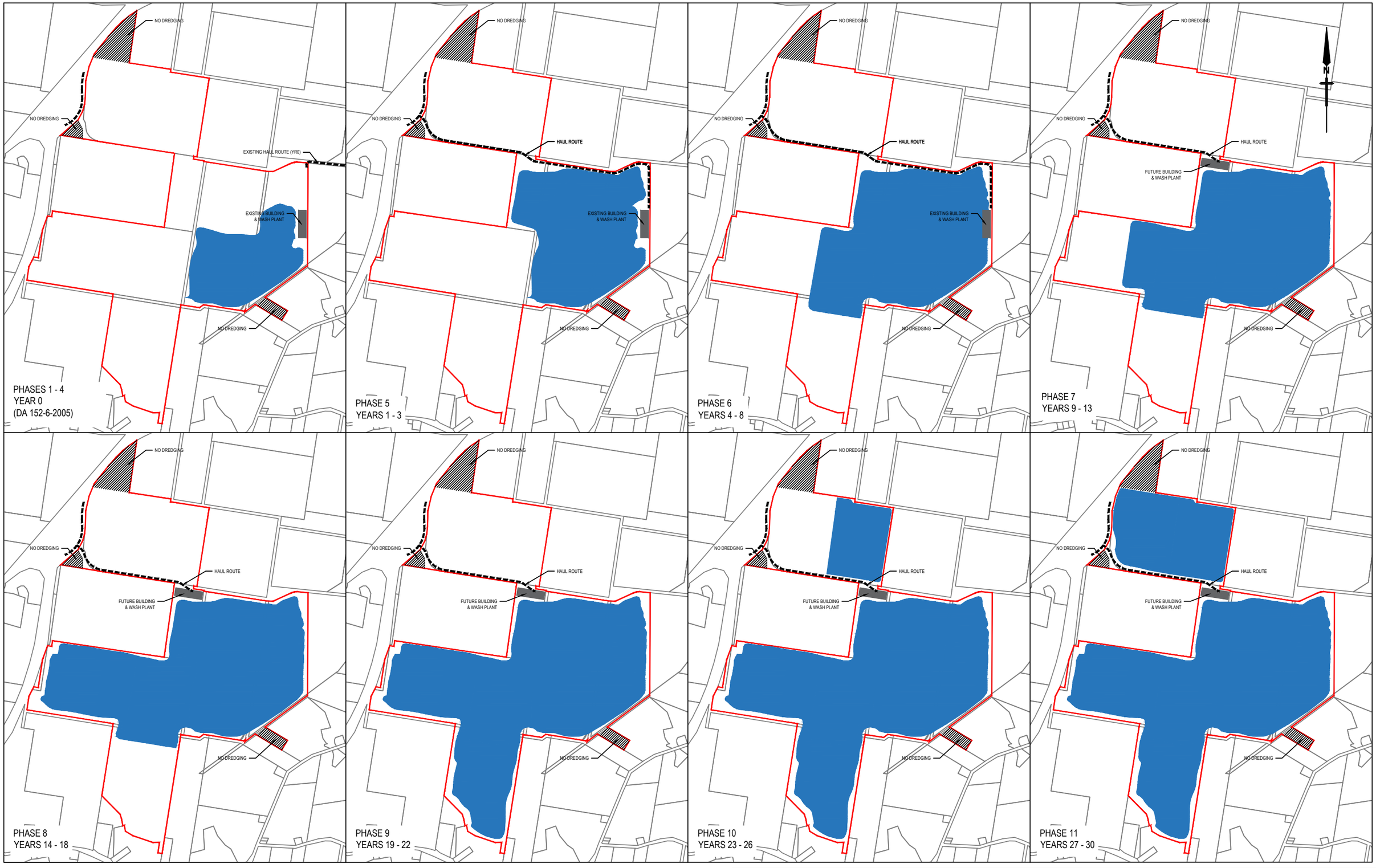
Sand extraction has been undertaken on this site since 1983 with Hanson taking over operation of the existing site in 2007. TSP operates under Development Application (DA) DA 152-6-2006 issued on 31 July 2006, as modified on 20 August 2018 (Notice of Modification MOD 1). The current MOD 1 approval remains valid until 1 July 2036 and authorises TSP to produce and transport from the site up to 500,000 tonnes of quarry products per financial year. TSP currently operates a single dredge unit which is linked to an onshore wash plant via a floating flow line. Sand product is processed through the wash plant, stockpiled and loaded via a front-end loader into standard highway trucks.

To meet ongoing demand for sand, Hanson is proposing to expand its existing operations into lands to the north and west of the TSP site over a thirty (30) year period. The footprint of the expansion area is approximately 190 ha, giving a total combined footprint of 236 ha for the existing and future extraction areas. Expansion works will also include construction of a haul road connected to the Pacific Highway and at a later time, new wash plant buildings. A layout and staging plan for the extraction works expansion is shown in **FIGURE 4**.

1.6 Sources of Information

Sources of information used in the assessment, including reports and spatial data are as follows:

- Proposed development layouts provided by the proponent;
- Australian Government's Species Profiles and Threats database (SPRAT) http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl
- Department of Environment and Climate Change NSW (DECC) (2002). Descriptions for NSW (Mitchell) Landscapes, Version 2.
- Department of Planning, Industry and Environment (DPIE) (2020). Biodiversity Assessment Method.
- Environment Australia (2001) A Directory of Important Wetlands in Australia. 3rd Edition. Environment Australia, Canberra.
- NSW OEH's BAM Calculator https://www.lmbc.nsw.gov.au/bamcalc
- NSW OEH's threatened species database http://www.threatenedspecies.environment.nsw.gov.au/index.aspx
- OEH Threatened Species Profiles
- Office of Environment and Heritage (OEH) (2007). Mitchell Landscapes with per cent cleared estimates.



LEGEND

- Subject Site
- Extent of Dredging
- Haul Route
- Building & Wash Plant

Scale 1:25 000 - Lengths in metres

200 0 200 400 600 800 1000

SOURCE: Zone Planning Group - Figure 19: Extraction Phases dwg No. Z19163-F119 Rev C dated 20/10/21 (Ref: FIG18.dwg)

SCALE: 1 : 25 000 @ A3

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FIGURE 4

PREPARED: BW
DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE

CONCEPT DEVELOPMENT PHASING

2 LANDSCAPE FEATURES

2.1 Introduction

This section of the BDAR provides details of landscape features at the development site (in accordance with Section 3.1 of the BAM) including:

- IBRA bioregions and subregions, NSW landscape region and area (ha);
- native vegetation extent and cleared areas within the buffer area;
- rivers and streams (classified according to stream order);
- wetlands within, adjacent to and downstream of the site;
- connectivity features;
- areas of geological significance and soil hazard features; and
- site context components, including:
    - identification of method applied (i.e. linear or site-based); and
    - percent native vegetation cover in the landscape (development site and biodiversity stewardship site).

2.2 IBRA Bioregions and Subregions, NSW Landscape Region and Area

The subject site is located within the Burringbar-Conondale Ranges (SEQ03) subregion of the South Eastern Queensland IBRA bioregion. Mitchell (2002) mapping places the subject site within the Byron – Tweed Alluvial Plains (Btp) NSW landscape region.

A site map showing the above features at a scale of 1:12,500 is provided as **FIGURE 5**.

2.3 Native Vegetation Extent and Cleared Areas in the Buffer Area

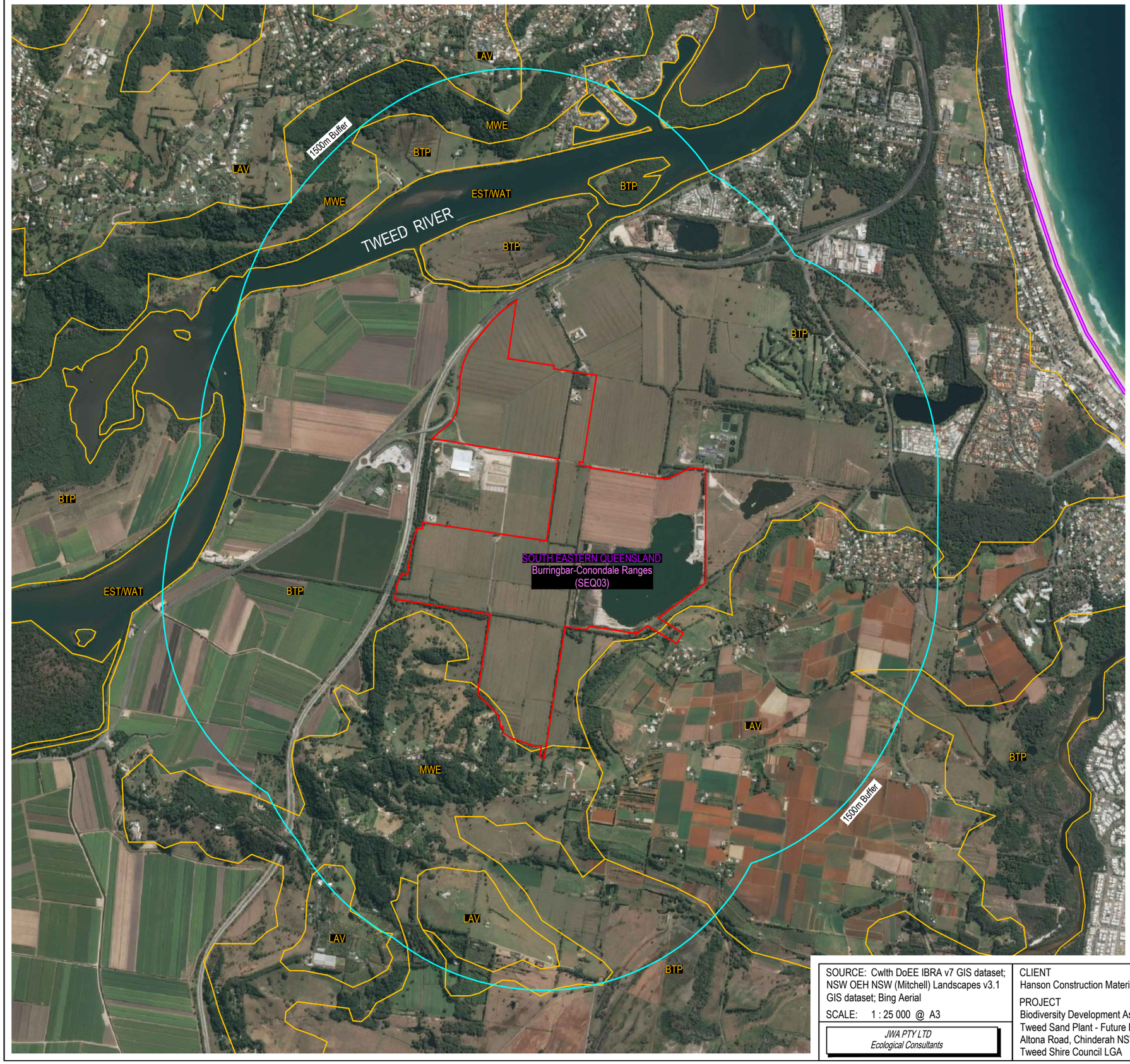
Native vegetation and cleared areas occurring within a 1,500 m buffer area to the subject site are shown in **FIGURE 6**. It is estimated that the extent of native vegetation within the buffer area is approximately 303 ha (i.e. 14%).

2.4 Rivers and Streams

The Tweed River occurs approximately 600 m to the north-north-west of the development site (**FIGURE 2**). The subject site is tenuously hydrologically linked to the river via numerous constructed drainage channels that occur throughout the site.

2.5 Wetlands Within, Adjacent to and Downstream of the Site

A number of coastal wetland areas as mapped by the Coastal Management SEPP (2018) occur to the north, east, south and west of the Subject site of the site (**FIGURE 7**).



LEGEND

- Subject Site
- 1500m Buffer to Subject Site
- IBRA Region - South Eastern Queensland
- IBRA Subregion
  - SEQ03 Burringbar-Conondale Ranges
- NSW (Mitchell) Landscape
  - BTP Byron - Tweed Alluvial Plains
  - LAV Lamington Volcanic Slopes
  - MWE Mount Warning Exhumed Slopes
  - EST/WAT Estuary/Water Added

N

Scale 1:25 000 - Lengths in metres

200 0 200 400 600 800 1000

SOURCE: Cwlth DoEE IBRA v7 GIS dataset; NSW OEH NSW (Mitchell) Landscapes v3.1 GIS dataset; Bing Aerial

SCALE: 1 : 25 000 @ A3

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FIGURE 5

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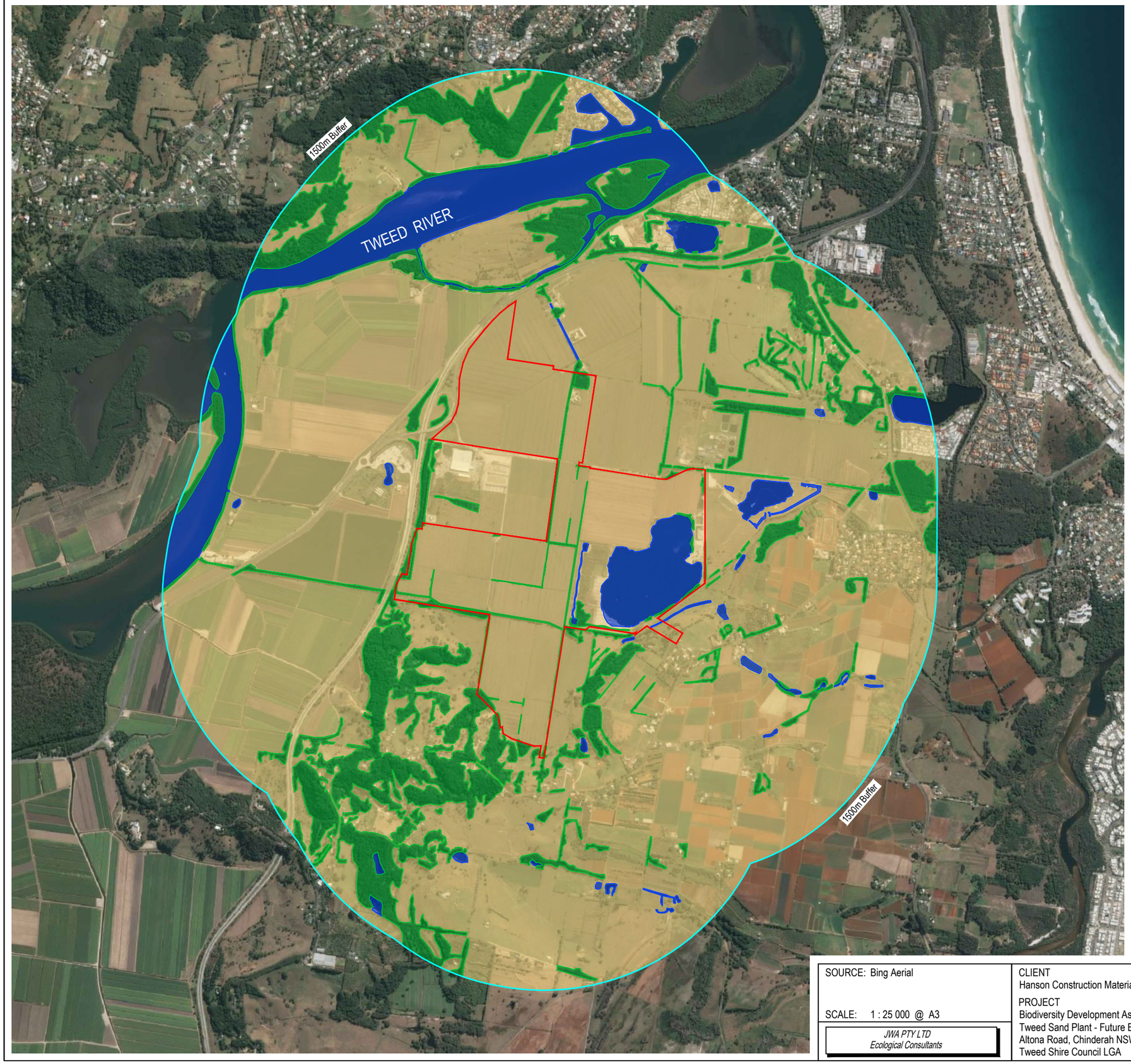
TITLE

IBRA & NSW LANDSCAPE REGIONS



LEGEND

- Subject Site
- 1500m Buffer to Subject Site

Vegetation within 1500m Buffer

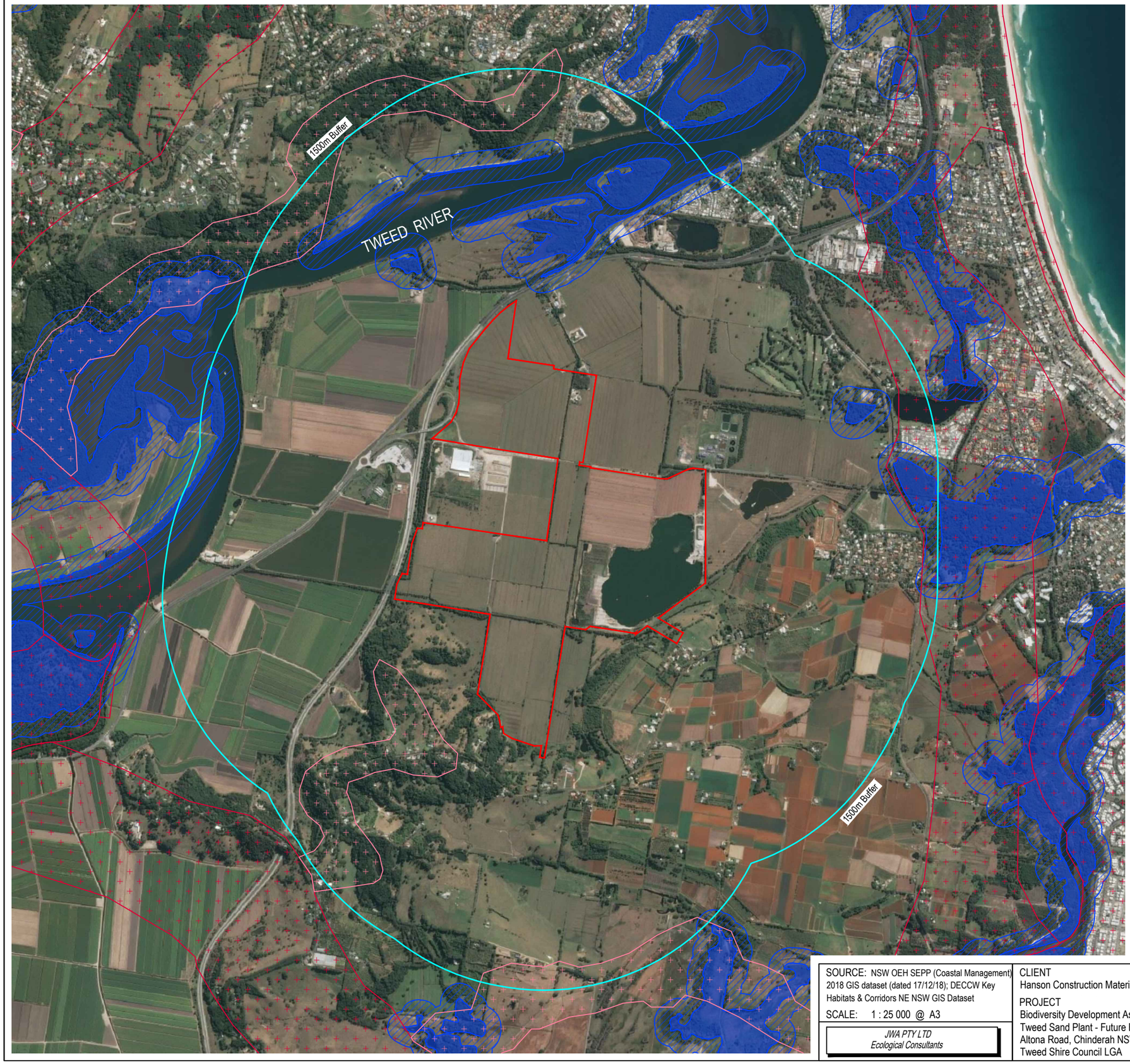
- Native Vegetation
- Cleared Areas
- Waterbodies

N

Scale 1:25 000 - Lengths in metres

200 0 200 400 600 800 1000

SOURCE: Bing Aerial SCALE: 1 : 25 000 @ A3 *JWA PTY LTD* *Ecological Consultants*	CLIENT Hanson Construction Materials Pty Ltd PROJECT Biodiversity Development Assessment Report Tweed Sand Plant - Future Expansion Altona Road, Chinderah NSW Tweed Shire Council LGA	FIGURE 6 PREPARED: BW DATE: 02 February 2021 FILE: N09007_BDAR_20210202.dwg	TITLE NATIVE VEGETATION, CLEARED AREAS WITHIN 1500M BUFFER



LEGEND

- Subject Site
- 1500m Buffer to Subject Site

State Environmental Planning Policy (Coastal Management) 2018

- Coastal Wetlands
- Proximity Area for Coastal Wetlands

Fauna Corridors of North East NSW

- Regional Corridor
- Sub-regional Corridor

N

Scale 1:25 000 - Lengths in metres

200 0 200 400 600 800 1000

SOURCE: NSW OEH SEPP (Coastal Management) 2018 GIS dataset (dated 17/12/18); DECCW Key Habitats & Corridors NE NSW GIS Dataset

SCALE: 1 : 25 000 @ A3

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FIGURE 7

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TITLE
CORRIDORS & COASTAL MANAGEMENT SEPP 2018 - COASTAL WETLANDS

2.6 Site Context Components

2.6.1 Introduction

The assessment of site context involved the application of the site-based method. The following landscape attributes were assessed:

- Percent native vegetation cover in the landscape; and
- Patch size.

2.6.2 Percent Native Vegetation Cover

Native vegetation and cleared areas occurring within a 1,500 m buffer area to the subject site are shown in **FIGURE 6**. It is estimated that the native vegetation cover within the buffer area is 14%. The >10–30% native vegetation cover class has therefore been used to assess the habitat suitability of the subject site for Threatened species in **SECTION 4**.

2.6.3 Patch Size

Native vegetation and cleared areas occurring within a 1,500 m buffer area to the subject site are shown in **FIGURE 6.** The patch size in which the subject vegetation occurs has been estimated to be 7.92 ha. The 5–24 ha patch size class has therefore been used to assess the habitat suitability of the subject site for Threatened species in **SECTION 4.**

3 NATIVE VEGETATION ASSESSMENT

3.1 Introduction

This section of the BDAR identifies native vegetation extent within the development site, including any cleared areas (in accordance with the requirements of Section 4 of the BAM). This section describes Plant Community Types (PCTs) within the development site including:

- vegetation class;
- vegetation type;
- area (ha) for each vegetation type;
- species relied upon for identification of vegetation type and relative abundance;
- justification of evidence used to identify a PCT (as outlined in Paragraph 4.2 of the BAM);
- Threatened Ecological Community (TEC) status (as outlined in Paragraph 4.2 of the BAM); and
- estimate of percent cleared value of PCT (as outlined in Paragraph 4.2.1.5 of the BAM).

This Section also includes the results of a vegetation integrity assessment of the development site, including:

- mapping vegetation zones (in accordance with Subsection 4.3.1 of the BAM);
- patch size;
- assessing vegetation integrity using benchmark data (in accordance with Subsection 4.3.3.5 of the BAM);
- survey effort (as described in Subsection 4.3.4 of the BAM); and
- determining the vegetation integrity score (in accordance with Appendix H of the BAM) including:
    - composition condition score;
    - structure condition score;
    - function condition score; and
    - vegetation integrity score.

3.2 Methodology

3.2.1 Site Assessments

Site vegetation was assessed initially on the 27th August and then again on the 27th October 2020 by one (1) suitably qualified person and accredited assessor under the accreditation scheme prepared under Section 6.10 of the *Biodiversity Conservation Act 2016* (BC Act)

using a plot-based vegetation survey based on a 20 m x 20 m plot. Vegetation along drainage lines was assessed using a modified 10 m x 40 m plot due to the thin and linear nature of this vegetation.

The information contained in **TABLE 1** below was collected during the assessments.

TABLE 1
VEGETATION SURVEY DATA COLLECTED AT THE SUBJECT LAND

Attribute	Survey requirement
Stratum (and layer)	Stratum and layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name
Cover	Estimate the % foliage cover across the plot of each species rooted in or overhanging the plot. Cover should be recorded in decimals if less than 1% (0.1, 0.2…), or whole numbers up to 5% (1,2,3…), or to the nearest 5% where greater than 5% cover (5,10,15,20,25…)
Abundance rating	For species with cover less than or equal to 5%, count or estimate the number of individuals or shoots of each species within the plot, using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000, 1500, 2000, etc. Numbers above 20 are estimates only, and the recorded abundance is the upper end of each class (e.g. 50 represents an estimated abundance of between 20 and 50). For species with cover greater than 5%, abundance estimates are not required (but may be recorded if desired)

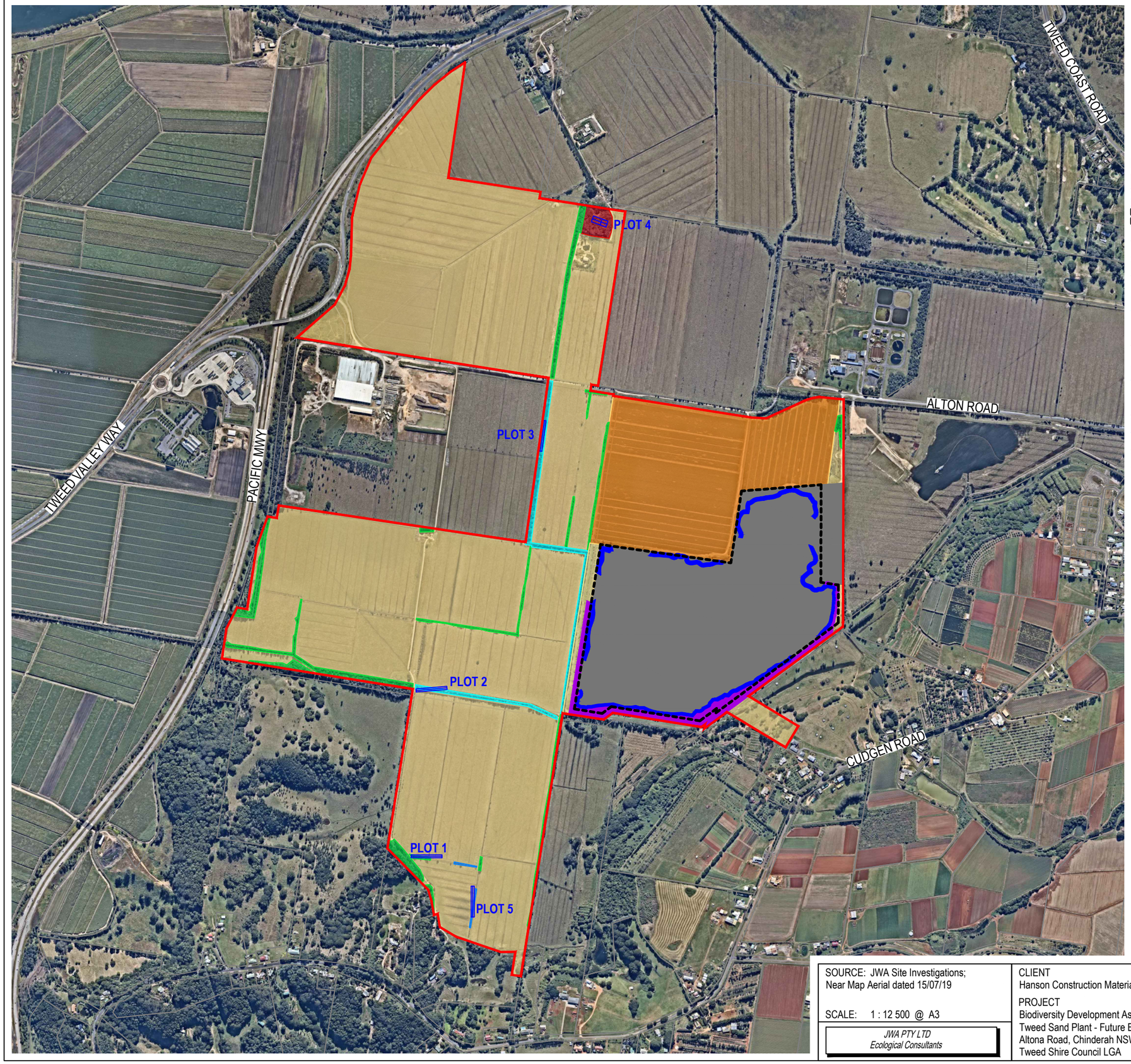
As site vegetation included multiple PCTs, with some displaying varying degrees of disturbance/modification, the Subject Land was stratified into multiple vegetation zones.

In addition, and at the request of TSC and BCD, 0.47 ha of riparian land required to be rehabilitated as PCT 1235 and 1.59 ha of land required to be rehabilitated as wetland vegetation (allocated to PCT 1808) under existing sand extraction approvals have been included as vegetation zones and assessed as if at benchmark levels for the relevant PCTs.

The vegetation zones assessed and the relevant number of plots/transects assessed are detailed in **TABLE 2** below. The location of each is shown in **FIGURE 8.**

TABLE 2
VEGETATION SURVEY DETAILS

PCT	Vegetation zones	Impact Area	Number of plots/transects	Plot details
PCT 1235 – Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	**Vegetation Zone 1**	**1.89 ha**	**1**	Plot 1
	Vegetation Zone 2 (with Mangroves)	**1.10 ha**	**2**	Plot 2; Plot 3
PCT 1064 - Paperbark swamp forest of the coastal lowlands of the NSW North	**Vegetation Zone 3**	**0.57 ha**	**1**	Plot 4



N

LEGEND

- Subject Site
- Survey Plot
- Approved Extraction Area
- Existing Works Area & Processing Plant

Vegetation Communities

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)
- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)
- Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia*, *Cinnamomum camphora*) to 22m (**PCT 1064**)
- Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m (**PCT 780, derived**)
- Vegetation Zone 5: Approved Riparian Rehabilitation Area (**PCT 1235**)
- Vegetation Zone 6: Approved Wetland Rehabilitation Area (**PCT 1290**)
- Vegetation Zone 7: Tea tree plantation (not assessed)
- Vegetation Zone 8: Pasture grasses (not assessed)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: JWA Site Investigations; Near Map Aerial dated 15/07/19

SCALE: 1 : 12 500 @ A3

JWA PTY LTD
Ecological Consultants

CLIENT
Hanson Construction Materials Pty Ltd

PROJECT
Biodiversity Development Assessment Report
Tweed Sand Plant - Future Expansion
Altona Road, Chinderah NSW
Tweed Shire Council LGA

FIGURE 8

PREPARED: BW
DATE: 05 October 2021
FILE: N09007_BDAR_20211005.dwg

TITLE
VEGETATION COMMUNITIES & SURVEY PLOT LOCATIONS

PCT	Vegetation zones	Impact Area	Number of plots/transects	Plot details
Coast Bioregion and Sydney Basin Bioregion				
PCT 780 - Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	**Vegetation Zone 4**	**0.09 ha**	**1**	Plot 5
PCT 1235 – Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Vegetation Zone 5*	0.47ha	n/a	n/a
PCT 1808 – Estuarine reedland^	Vegetation Zone 6*	1.59ha	n/a	n/a
Tea tree plantation[#]	Vegetation Zone 7	n/a	n/a	n/a
Exotic grassland[#]	Vegetation Zone 8	n/a	n/a	n/a

Notes:

* Future rehabilitation areas assessed as if at benchmark levels.

[#] Not further assessed in this BDAR.

^ It is noted that the approved rehabilitation plan allocates these areas to be representative of PCT 1209 (Soft Twig-rush Sedgeland of North Coast Wallum Swamps) however, this PCT is not listed within the BAM-C as occurring within the Burringbar-Conondale Ranges (SEQ03) subregion of the South Eastern Queensland IBRA bioregion. For the purposes of this BDAR, Vegetation Zone 6 has been allocated to **PCT 1808** (Estuarine reedland) which is considered to more closely describe the vegetation zone.

3.2.2 Identifying PCTs and TECs

Identification of PCTs and potential TECs on the subject site was completed by comparing data collected from site to:

1. detailed descriptions of PCTs and relevant geographic distributions within the BioNet Vegetation Classification;
2. detailed descriptions of TECs on the OEH website;
3. survey data and/or individual species records held in BioNet; and
4. existing maps of native vegetation in the area i.e. Tweed Vegetation Management Strategy.

3.2.3 Vegetation Integrity Assessment (Site Condition)

The survey plots were established around a central 50 m transect as follows:

a) One (1) 400 m^2 plot (standard 20 m x 20 m) was used to assess all of the composition and structure attributes. The plot used for the floristic vegetation survey (**FIGURE 8**) was also used as a vegetation integrity plot.

   Note: modified 10 m x 40 m plots were required to assess vegetation along drainage lines due to the thin and linear nature of this vegetation.

b) One (1) 1,000 m^2 plot (standard 20 m x 50 m) was used to assess the function attributes: number of large trees, stem size class, tree regeneration, length of logs, high threat exotic weed cover and number of trees with hollows.

c) Five (5) 1 m^2 sub-plots are used to assess average litter cover (and other optional groundcover components) for the plot.

The composition, structure and relevant function attributes listed in **TABLE 3** below were assessed.

TABLE 3
GROWTH FORM GROUPS AND ATTRIBUTES USED TO ASSESS THE COMPOSITION, STRUCTURE AND FUNCTION COMPONENTS OF VEGETATION INTEGRITY

Growth form groups used to assess composition and structure	Attributes used to assess function
a) Tree	a) Number of large trees
b) Shrub	b) Tree regeneration
c) Grass and grass like	c) Tree stem size class
d) Forb	d) Total length of fallen logs
e) Fern	e) Litter cover
f) Other	f) High threat exotic weed cover
	g) Hollow bearing trees

3.3 Results

3.3.1 Vegetation Zones

Surveys of the subject site recorded four (4) distinct native vegetation zones as described below (**FIGURE 8**):

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m. This zone occurs along drainage lines throughout the subject site and comprised almost entirely of a sub-mature Swamp oak (*Casuarina glauca*) to a height of 18m. The mapped extent of this vegetation zone on the subject site covers a total area of approximately 4.9 ha of which 1.89 ha occurs within the proposed expansion footprint.

- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m. This zone occurs along drainage lines throughout the subject site and comprised of a mixture of a sub-mature Swamp oak and Grey mangrove (*Avicennia marina*) to a height of 5-10m.The mapped extent of this vegetation zone on the subject site covers a total area of approximately 2.07 ha of which 1.10 ha occurs within the proposed expansion footprint.

- Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia, Cinnamomum camphora*) to 22m. This zone occurs in the northern portion of the site and is comprised of a mixture of Broad-leaved paperbark (*Melaleuca quinquenervia*) and the introduced Camphor laurel (*Cinnamomum camphora*). The mapped extent of this vegetation zone on the subject site covers a total area of

approximately 0.86 ha of which 0.57 ha occurs within the proposed expansion footprint.

- Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m. This zone occurs along drainage lines in the southern portion of the subject site and is comprised almost entirely of Broadleaf cumbungi (*Typha orientalis*) to a height of up to 2m. The mapped extent of this vegetation zone on the subject site covers a total area of approximately 0.09 ha, all of which occurs within the proposed expansion footprint.
- Vegetation Zone 5: Riparian rehabilitation areas. This zone occurs along the margins of the existing Tweed Sand Plant (TSP) operation and is comprised of areas that are currently proposed to be rehabilitated to be representative of Swamp oak forest. The mapped extent of this vegetation zone on the subject site covers a total area of approximately 2.85 ha of which 0.47 ha occurs within the proposed expansion footprint.
- Vegetation Zone 6: Wetland rehabilitation areas. This zone occurs within the margins of the existing Tweed Sand Plant (TSP) operation and is comprised of areas that are currently proposed to be rehabilitated to wetland vegetation. The mapped extent of this vegetation zone on the subject site covers a total area of approximately 2.85 ha of which 1.59 ha occurs within the proposed expansion footprint.

This determination has been made with consideration of soil type, vegetation types occurring in similar locations in the locality, regenerating native species (where present) and community structure and descriptive attributes provided in the BioNet Vegetation Classification. Two (2) additional vegetation zones (**Vegetation Zone 7** and **Vegetation Zone 8**) were identified on the subject site but was comprised entirely of the exotic or planted species and were not further assessed.

3.3.2 Applicable PCT and TEC

In accordance with Paragraph 4.2.2(a) the most likely PCT that would have occurred prior to disturbance has been determined, as the subject vegetation has been highly modified to the extent that it has reduced species richness and is missing structural layers.

Also as discussed, vegetation zones 5 and 6 are comprised of land required to be rehabilitated under existing sand extraction approvals and have been allocated to relevant PCTs.

PCTs are classified based on vegetation types occurring within the Interim Biogeographic Regionalisation for Australia (IBRA) subregions, as developed by the Commonwealth government. The IBRA framework divides Australia landscapes into bioregions and subsequently subregions based on common features such as climate, geology, landform, and vegetation. It is noted that PCT descriptions are still undergoing revision and many remain undescribed for the SEQ – Clarence Lowlands IBRA subregion.

The plant community identification function within the BioNet Vegetation Classification database was utilised to assist with PCT identification. Details of the vegetation formation (Keith 2004) and dominant species observed within the upper stratum, mid stratum and ground stratum were entered into the system. Data collected from the site was then compared to the resulting PCT descriptions.

Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m.

Vegetation Zone 1 is considered to be best represented by Plant Community Type (PCT) 1235 (Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion) as described within the BioNet Vegetation Classification (OEH 2021).

PCT 1235 is considered to be representative of the TEC *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* as listed within schedules of the BC Act (2016) and by definition has a high conservation status.

Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m

Vegetation Zone 2 is also considered to be best represented by Plant Community Type (PCT) 1235 (Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion) as described within the BioNet Vegetation Classification (OEH 2021).

PCT 1235 is considered to be representative of the TEC *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* as listed within schedules of the BC Act (2016) and by definition has a high conservation status.

Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia, Cinnamomum camphora*) to 22m

Vegetation Zone 3 is considered to be best represented by Plant Community Type (PCT) PCT 1064 (Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion) as described within the BioNet Vegetation Classification (OEH 2021).

PCT 1064 is considered to be representative of the TEC *Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* as listed within schedules of the BC Act (2016) and by definition has a high conservation status.

Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m

In accordance with Paragraph 5.2.1.4(a) the most likely PCT that would have occurred prior to disturbance has been determined, as the subject vegetation has been highly modified to the extent that it has reduced species richness and is missing structural layers. Vegetation Zone 4 is highly disturbed but is considered to have been derived from Plant Community Type (PCT) 780 (Coastal floodplain sedgelands, rushlands, and forblands of the North Coast) as described within the BioNet Vegetation Classification (OEH 2021).

PCT 780 is considered to be representative of the TEC *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner Bioregions* as listed within schedules of the BC Act (2016). The conservation status of this highly disturbed vegetation on the subject site is considered to be significantly lowered however to satisfy Tweed Shire Council Vegetation Zone 4 has been considered to be representative of this TEC.

Vegetation Zone 5: Riparian rehabilitation areas. This zone is currently proposed to be rehabilitated to be representative of PCT 1235 (Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion) after completion of the current sand extraction operations, in accordance with the approved Rehabilitation and Landscape Management Plan (JWA 2021).

PCT 1235 is considered to be representative of the TEC *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions* as listed within schedules of the BC Act (2016) and by definition has a high conservation status.

Vegetation Zone 6: Wetland rehabilitation areas. This zone is currently proposed to be rehabilitated to wetland vegetation, in accordance with the approved Rehabilitation and Landscape Management Plan (JWA 2021). Vegetation Zone 6 has been allocated to PCT 1808 (Estuarine reedland).

PCT 1808 is not considered to be representative of any TECs listed within schedules of the BC Act (2016).

3.3.3 Vegetation Integrity (Site Condition) Score

3.3.3.1 Background

To determine the vegetation integrity score, the composition score, structure score and function score were calculated by entering the collected plot survey data into the online BAM Calculator (**00022641/BAAS18069/20/00022642/Revision:0**). The relevant completed BAM Calculator workings are summarised below and completed data sheets are provided as **APPENDIX 2**.

As previously discussed, and at the request of TSC and BCD, 0.47 ha of riparian land required to be rehabilitated as PCT 1235 and 1.59 ha of land required to be rehabilitated as wetland vegetation (allocated to PCT 1808) under existing sand extraction approvals have been included as vegetation zones and assessed as if at benchmark levels for the relevant PCTs.

3.3.3.2 Composition Condition

Vegetation Zone 1 (Plot 1)

Item	Tree	Shrub	Grass & Grass Like	Forb	Fern	Other
Benchmark	7	8	8	6	2	4
Observed mean ($\bar{x}$)	3	0	7	1	1	0
Unweighted composition score (UCS_i)	45.5	0	97.9	5.5	59.1	0
Weighted composition score (WCS_i)	9.1	0	22.4	1	3.4	0
Dynamic weighting (w_i)	0.2	0.23	0.23	0.17	0.06	0.11

Composition condition score = 35.8

Vegetation Zone 2 (Plot 2 & Plot 3)

Item	Tree	Shrub	Grass & Grass Like	Forb	Fern	Other
Benchmark	7	8	8	6	2	4
Observed mean ($\bar{x}$)	3.5	0	1.5	1	0	1
Unweighted composition score (UCS_i)	59.1	0	7.4	5.5	0	14.6
Weighted composition score (WCS_i)	11.8	0	1.7	1	0	1.7
Dynamic weighting (w_i)	0.2	0.23	0.23	0.17	0.06	0.11

Composition condition score = 16.1

Vegetation Zone 3 (Plot 4)

Item	Tree	Shrub	Grass & Grass Like	Forb	Fern	Other
Benchmark	8	6	7	5	2	6
Observed mean ($\bar{x}$)	7	3	2	1	2	6
Unweighted composition score (UCS_i)	97.9	59.1	19.7	8.6	100	100
Weighted composition score (WCS_i)	23	10.4	4.1	1.3	5.9	17.6
Dynamic weighting (w_i)	0.24	0.18	0.21	0.15	0.06	0.18

Composition condition score = 62.3

Vegetation Zone 4 (Plot 5)

Item	Tree	Shrub	Grass & Grass Like	Forb	Fern	Other
Benchmark	7	8	8	6	2	4
Observed mean ($\bar{x}$)	0	0	6	0	0	0
Unweighted composition score (UCS_i)	0	0	91.9	0	0	0
Weighted composition score (WCS_i)	0	0	21	0	0	0
Dynamic weighting (w_i)	0.2	0.23	0.23	0.17	0.06	0.11

Composition condition score = 21

3.3.3.3 Structure Condition

Vegetation Zone 1 (Plot 1)

Item	Tree	Shrub	Grass & Grass Like	Forb	Fern	Other
Benchmark	31	12	107	2	0	2
Observed mean ($\bar{x}$)	21.2	0	38	0.2	1	0
Unweighted structure score (USS_i)	86.1	0	31.5	1.6	0	0
Weighted structure score (WSS_i)	17.3	0	21.9	0	0	0
Dynamic weighting (w_i)	0.2	0.08	0.69	0.01	0	0.01

Structure condition score = 39.3

Vegetation Zone 2 (Plot 2 & Plot 3)

Item	Tree	Shrub	Grass & Grass Like	Forb	Fern	Other
Benchmark	31	12	107	2	0	2
Observed mean ($\bar{x}$)	38.1	0	8	0.6	0	0.6
Unweighted structure score (USSi)	100	0	0.8	18.1	0	22
Weighted structure score (WSSi)	20.1	0	0.5	0.2	0	0.3
Dynamic weighting (wi)	0.2	0.08	0.69	0.01	0	0.01

Structure condition score = 21.2

Vegetation Zone 3 (Plot 4)

Item	Tree	Shrub	Grass & Grass Like	Forb	Fern	Other
Benchmark	37	12	82	2	1	4
Observed mean ($\bar{x}$)	69.7	1.4	5.5	30	5.5	14.6
Unweighted structure score (USSi)	100	2.3	0.6	100	100	100
Weighted structure score (WSSi)	26.8	0.2	0.3	1.4	0.7	2.9
Dynamic weighting (wi)	0.27	0.09	0.59	0.01	0.01	0.03

Structure condition score = 32.4

Vegetation Zone 4 (Plot 5)

Item	Tree	Shrub	Grass & Grass Like	Forb	Fern	Other
Benchmark	31	12	107	2	0	2
Observed mean ($\bar{x}$)	0	0	80.4	0	0	0
Unweighted structure score (USSi)	0	0	92	0	0	0
Weighted structure score (WSSi)	0	0	63.9	0	0	0
Dynamic weighting (wi)	0.2	0.08	0.69	0.01	0	0.01

Structure condition score = 63.9

3.3.3.4 Function Condition

Vegetation Zone 1 (Plot 1)

Item	Number of Large Trees	Litter Cover	Coarse Woody Debris	Stem Size Class	Regeneration Stems <5cm DBH	High Threat Weed Cover
Benchmark	1	40	12	4	Present	
Observed mean ($\bar{x}$)	0	0	0	3	1	0.07
Weighted function score (WFSi)	0	0	0	13.8	15	
Weighting (wi)	0.35	0.15	0.2	0.15	0.15	

Function condition score = 28.8

Vegetation Zone 2 (Plot 2 & Plot 3)

Item	Number of Large Trees	Litter Cover	Coarse Woody Debris	Stem Size Class	Regeneration Stems <5cm DBH	High Threat Weed Cover
Benchmark	1	40	12	4	Present	
Observed mean ($\bar{x}$)	0	39	0	2.5	1	7.0
Weighted function score (WFSi)	0	15	0	11.9	15	
Weighting (wi)	0.35	0.15	0.2	0.15	0.15	

Function condition score = 41.8

Vegetation Zone 3 (Plot 4)

Item	Number of Large Trees	Litter Cover	Coarse Woody Debris	Stem Size Class	Regeneration Stems <5cm DBH	High Threat Weed Cover
Benchmark	5	42	44	4	Present	
Observed mean ($\bar{x}$)	2	76	36	2	1	73.5
Weighted function score (WFSi)	14	15	19.2	8.9	15	
Weighting (wi)	0.35	0.15	0.2	0.15	0.15	

Function condition score = 72

Vegetation Zone 4 (Plot 5)

Item	Number of Large Trees	Litter Cover	Coarse Woody Debris	Stem Size Class	Regeneration Stems <5cm DBH	High Threat Weed Cover
Benchmark	1	40	12	4	Present	
Observed mean ($\bar{x}$)	0	0	0	0	0	0
Weighted function score (WFSi)	0	0	0	0	0	
Weighting (wi)	0.35	0.15	0.2	0.15	0.15	

Function condition score = 0

3.3.3.5 Final Vegetation Integrity Score

Vegetation Zone	PCT	TEC	Vegetation Integrity Score (out of 100)
1	1235	✓	34.3
2	1235	✓	24.3
3	1064	✓	52.6
4	780	✓	11
5*	1235	✓	100
6*	1808	✓	100

Notes:
* Future rehabilitation areas assessed as if at benchmark levels.

4 THREATENED SPECIES ASSESSMENT

4.1 Introduction

This section of the BDAR assesses habitat suitability for Threatened species (in accordance with Section 5 of the BAM). In particular, this section of the BDAR identifies:

- ecosystem credit species associated with PCTs on the development site including:
    - list of species derived (in accordance with Sections 5.1.1 and 5.2.1 of the BAM); and
    - justification for exclusion of any ecosystem credit species predicted (in accordance with Sections 5.2.1 and 5.2.2 of the BAM).
- species credit species on the development site (in accordance with Sections 5.1 to 5.3 of the BAM) including:
    - list of candidate species;
    - justification for inclusions and exclusions based on habitat features;
    - indication of presence based on targeted survey or expert report;
    - details of targeted survey technique, effort, timing and weather;
    - species polygons; and
    - biodiversity risk weighting for the species.

4.2 Threatened Plant Surveys

4.2.1 Methods

Targeted threatened plant surveys were completed on the subject site by one (1) accredited assessor/suitably qualified ecologist for approximately 6 hours on the 27th August 2020, approximately 6 hours on the 27th October 2020, and for a total of approximately 12 hours between the 26th – 28th January 2021.

Target species included: Marblewood, Scented Acronychia, Dwarf Heath Casuarina, White lace flower, Hairy joint grass, Mark's Cassia, Swamp Foxglove, Water nutgrass, Davidson's Plum, Spider orchid, Thorny pea, Red-fruited ebony, Shiny-leaved ebony, Small-leaved tamarind, Basket fern, Square-stemmed spike-rush, Green-leaved rose walnut, Ball nut, Pink nodding orchid, Sweet myrtle, White yiel yiel, Isoglossa, Fraser's screw fern, Rough-shelled bush nut, Ripple-leaf muttonwood, Red-flowered king of the fairies, Yellow-flowered king of the fairies, Southern ochrosia, *Oldenlandia galioides,* Brown fairy-chain orchid, Southern swamp orchid, Brush sauropus, Red lilly pilly and Durobby.

The surveys were completed in accordance with the NSW Guide to Surveying Threatened Plants (OEH 2016) and utilised the parallel field-traverse method. The parallel field-traverse survey technique involved searching along a grid of parallel traverses a set 10 m apart. The surveyor walked at a reasonable walking pace while making a visual sweep either side of the traverse.

4.2.2 Results

No threatened plant species were recorded from the subject site.

4.3 Threatened Fauna Surveys

4.3.1 Methods

4.3.1.1 Background

Targeted fauna surveys were completed in conjunction with the flora surveys by accredited assessor/suitably qualified ecologist on 27th August and 27th October 2020. Additional targeted surveys were completed over the three (3) nights of the 26th – 28th January 2021. Techniques utilised during the fauna survey are described below.

Weather details prior to and during the targeted surveys (where available) is summarised in **TABLE 4** below.

TABLE 4
WEATHER CONDITIONS PRIOR TO AND DURING SITE SURVEYS
(SOURCE: BOM CLIMATE DATA ONLINE)

Date	Temp (°C)		Rain (mm)	Max wind gust		
	Min	Max		Direction	Speed (km/hr)	Time
23rd January 2021	18.3	28.2	0	NE	28	13:25
24th January 2021	18.6	28.5	0	NE	31	16:33
25th January 2021	20.8	27.7	2.8	NNE	26	15:39
26th January 2021	**18.5**	**28.5**	**0**	**N**	**30**	**21:31**
27th January 2021	**20.8**	**29.7**	**0**	**NNE**	**30**	**11:08**
28th January 2021	**22.8**	**29.6**	**1.2**	**SE**	**44**	**10:21**

Notes:
Source: Station 040717 – Coolangatta (approx. 10km from the site)
Survey dates are shown in **Bold**

4.3.1.2 Targeted Bird Surveys

Targeted bird surveys were completed using a combination of the area search method and the species-time curve approach, where the observer walked through the site and the survey session ceased when no additional species were identified within a 5 minute period. Species targeted included: Terek Sandpiper and White-bellied sea-eagle.

4.3.1.3 Spotlighting

Spotlighting was undertaken by one (1) accredited assessor/principal ecologist and two (2) field assistants for approximately 3.5 hours over the three (3) nights of the 26th – 28th January 2021 – equating to a total of 31.5 hours spotlighting. Target species included: Eastern pygmy-possum, Wallum froglet, Green-thighed Frog, Olongburra frog and Mitchell's rainforest snail.

During the above spotlighting surveys the site was traversed on foot with a large spotlight used to detect 'eye-shine' from nocturnal fauna. The observer walked at approximately 1 km/h, allowing intensive listening as an adjunct to visual detection.

4.3.1.4 Call playback

Call playback was completed on the site in conjunction with the spotlighting surveys over the three (3) nights of the 26th – 28th January 2021. Target species included: Wallum froglet, Green-thighed Frog and Olongburra frog. During the call playback surveys calls of the target species were broadcast, and then followed by a five (5) minute listening period.

4.3.1.5 Microchiropteran Bat Detection

Anabat Express ultrasonic bat detector units were set at two (2) locations on the subject site. The two (2) units were deployed for the three (3) nights of the 26th – 28th January 2021 – equating to 6 trap nights.

The bat detector units were used to record calls from the Subject Land between the hours of dusk (approx. 1800h) and dawn (approx. 0600h). The data from these recordings was sent for analysed by an expert in echolocation call identification. However, unfortunately, the data from these recordings was found to be corrupted and could not be analysed.

4.3.1.6 Active Searching

Any logs, sheets of tin, cardboard, bark and leaves were overturned in search of reptiles and amphibians while traversing the site. Searches were undertaken for diggings, scats, and bones. Eucalypt trees were inspected for signs of koala activity such as scratch marks and scats. Active observation of bird and amphibian activity, both aurally and visually, was undertaken during the site visits. Target species included: Koala and Mitchell's rainforest snail.

4.3.1.7 Incidental observations

All incidental records of fauna utilising the study area were recorded. Discoveries of scratch marks on trees, scats, footprints, diggings, bones and other animal traces were noted.

4.3.2 Results

4.3.2.1 Amphibians

Amphibians occurring in the region are poikilothermic, predominantly insectivorous and generally require free water for reproduction, with the exception of two highland genera (*Assa darlingtoni* and *Philoria* spp.) The habitat requirements of most species are unlikely to be determined by forest cover or floristics but are more strongly influenced by factors such as climate, distance to water bodies, riparian vegetation, hydrological and morphological characteristics of water bodies and the availability of suitable micro-habitat for aestivation and shelter.

The majority of species that occur within the region lay eggs in or near temporary or permanent water bodies and rely on free water for larval development and metamorphosis. Of these species, a few are dependent on forested habitats beyond the riparian zone or beyond areas of temporary inundation. These species include the Red-eyed tree frog (*Litoria chloris*), Leseuer's frog (*Litoria leseueri*), Fletchers frog (*Lechriodus fletcheri*) and the Barred frogs of the *Mixophyes* genus.

Grasslands provide suitable habitat for a range of Amphibian species, particularly along drainage depressions and soaks. Species commonly encountered in grassland communities include the Common eastern froglet, Eastern sign bearing froglet (*Crinia parinsignifera*), Striped marsh frog (*Limnodynastes peronii*), Spotted grass frog (*Limnodynastes tasmaniensis*), Eastern dwarf tree frog, Rocket frog (*Litoria nasuta*), Whistling tree frog (*Litoria verreauxii*) and the introduced Cane toad* (*Rhinella marina*). These species may be observable on the site following periods of significant rainfall.

Species which typically occur in low elevation rainforest and permanent streams such as the Giant barred frog (*Mixophyes iteratus*) are unlikely to occur at the subject site.

No threatened amphibian species were recorded from the subject site.

4.3.2.2 Reptiles

As reptiles are poikilothermic, and predominantly insectivorous or carnivorous, their habitat requirements are less directly determined by vegetation species composition than other taxa which feed directly on plants. Reptile distributions are strongly influenced by structural characteristics of the vegetation, climate and factors affecting thermoregulation such as shade and availability of shelter and basking sites (Smith *et al* 1994).
In a survey of the moist forest herpetofauna of North-eastern NSW, Smith *et al* (1989) found that few species discriminated between rainforest and wet sclerophyll forest, however, most species exhibited a response to differences in elevation and the availability of microhabitat components and other substrates.

The availability of microhabitats, of varying thermal properties is particularly important for most reptile species, as behavioural thermoregulation (regulation of body heat) is important in controlling critical body functions such as digestion, foraging activity and reproduction.

Reptile diversity and abundance is often (but not always) significantly higher in drier habitat types, particularly those with a wide variety of ground substrate microhabitats. This contrasts markedly with the distribution patterns of birds, and most mammals.

The single limiting factor in terms of species diversity in coastal vegetation is the lack of shelter sites (e.g. logs, tree hollows and decorticating bark). Such habitat components characterise eucalypt forests and woodlands, where species diversity may be much higher, depending on disturbance factors.

The subject site is generally considered to provide poor to moderate quality habitat for the majority of native reptile species due to the general lack of shelter and basking sites; fallen logs for shelter; forested areas with good canopy and leaf litter development; and reliable sources of prey.

No threatened reptile species were recorded from the subject site.

4.3.2.3 Birds

The significance of near coastal environments of the N.S.W. Far North Coast and South-East Queensland as over-wintering habitat for migratory birds has been established by many observers and bird banders including Keast (1968), Robertson (1973), Gravatt (1974), Porter (1982) and Robertson and Woodall (1983). These patterns may be attributable to the relatively high winter temperatures and long growing season of this region compared with the rest of south-eastern Australia (Fitzpatrick and Nix 1973; Edwards 1979; Nix 1982; Specht *et al* 1981).

Many insectivorous birds from higher latitudes and elevation over-winter in the locality. These include species such as the Fantail cuckoo (*Cacomantis flabelliformis*), Sacred kingfisher (*Todiramphus sanctus*), Rainbow bee-eater (*Merops ornatus*), Noisy pitta (*Pitta versicolor*), Tree martin (*Petrochelidon nigricans*), Black-faced cuckoo-shrike (*Coracina novaehollandiae*), Cicada bird (*Coracina tenuirostris*), Golden whistler (*Pachycephala pectoralis*), Rufous whistler (*Pachycephala rufiventris*), Rose robin (*Petroica rosea*), Grey fantail (*Rhipidura albiscapa*), White-throated gerygone (*Gerygone olivacea*), Silvereye (*Zosterops lateralis*), Olive-backed oriole (*Oriolus sagittatus*) and Spangled drongo (*Dicrurus bracteatus*).

Birds such as honeyeaters and lorikeets are Blossom nomads (*ibid.*). These birds move locally in response to variation in the availability of nectar and or pollen, important components in their diet. Porter (1982) highlights the importance of Forest red gum, Broad-leaved paperbark and Coast banksia for Scaly-breasted (*Trichoglossus chlorolepidotus*) and Rainbow (*Trichoglossus moluccanus*) lorikeets as these species flower during the lorikeet's winter breeding period. A sequence of important nectar bearing plants in the genera Eucalyptus, Banksia, Melaleuca and Callistemon provide a continuity of food for nectarivorous birds.

Studies of bird usage in rainforest remnants by Holmes (1987), Connelly and Specht (1988) and Lott & Duigan (1993) indicate that the diversity and abundance of birds is related to the size of the rainforest patches and their degree of isolation from major areas of native forest. Lott & Duigan (1993) and Howe *et al* (1981) also note that sites with a higher diversity of vegetation and those which are closer to water generally support a greater diversity of birds. Locally nomadic and migratory rainforest species such as the Wompoo (*Ptilinopus magnificus*), Rose-crowned (*Ptilinopus regina*) and Superb fruit-doves (*Ptilinopus superbus*), Common koel (*Eudynamys orientalis*) and Black-faced cuckoo-shrike are known to use scattered areas of habitat as "stepping-stones" between more intact areas of forest (Date *et al* 1992; Lott & Duigan 1993).

The lack of intact vegetation on and adjacent to the subject site is likely to result in a low diversity of resident and nomadic birds occurring on the site over the year. Habitat occurring adjacent to the subject may provide foraging resources for nectarivorous birds due to the occurrence of Eucalypt and Melaleuca species. The site does not provide forage resources for frugivorous birds.

No threatened bird species were recorded from the subject site.

4.3.2.4 Mammals

Small terrestrial mammals generally occur in highest densities in association with a complex vegetation structure. A dense understorey layer, which provides shelter from predators and provides nesting opportunities, is particularly important.

In general, medium-large terrestrial mammals such as macropods select habitats which provide a dense cover for shelter and refuge and open areas for feeding. The larger species tend to occupy drier more open habitats: the smaller species, moister and more densely vegetated habitats.

All Arboreal mammals that occur in the region (with the exception of the Koala) utilise tree hollows for nesting and shelter (although the Common ringtail possum is not dependent on hollows). Smith & Lindenmeyer (1988) consider that shortage of nest hollows is likely to limit arboreal mammal populations where density of hollow bearing trees is less than 2 to 8 trees per hectare.

Arboreal folivores (*e.g.* Common ringtail possum, Greater glider) are widespread and abundant but exhibit local variation in response to such factors as tree species composition, foliage protein and fibre levels, leaf toughness, toxins, forest structure and the availability of shelter sites. Arboreal folivores are expected to be most abundant in areas of high productivity, high soil fertility and moderate climate, in conjunction with adequate shelter and suitable foraging substrate.

Arboreal nectarivore/insectivores feed on a wide variety of plant and insect exudates including the nectar of flowering eucalypts, and shrubs such as Banksia and Acacia sp. These species also feed extensively on insects, particularly under the shedding bark of eucalypts. The distribution of nectarivore/insectivores is considered to be related to the abundance of nectar and pollen producing plants, the abundance of bark shedding eucalypts which harbour insect prey, and the occurrence of sap and gum exudate producing trees (Sap feed trees) and shrubs (*e.g.* Acacia sp.). Arboreal nectarivores and insectivores are generally hollow dependent species.

Trees with hollows necessary for hollow-dependent mammals were not recorded on or adjacent to the subject site. The vegetation on the subject site has historically been cleared and is an early regrowth phase and does not currently represent forage habitat for koalas or any other native arboreal mammal species.

The lack of structural complexity and habitat diversity of the subject site is likely to result in a low diversity and abundance of ground dwelling mammals. Highly mobile and/or disturbance adapted species such as the Eastern grey kangaroo (*Macropus giganteus*) may occasionally utilise the site.

Insectivorous bats, like insectivorous birds, overlap considerably in diet and broad vegetation preferences (Hall 1981), but specialise in foraging in specific layers or substrates within the forest (Crome and Richards 1988). Vegetation on and adjacent to the Subject site is likely to provide forage habitat for a low diversity and abundance of insectivorous bats. Hollow-bearing trees potentially suitable for hollow-dependant bats do not occur on the site.

Suitable roost habitats for the Black flying-fox and Grey-headed flying fox are unlikely to occur on the subject site, however potential forage habitat is provided for these species while Eucalypt species and Paperbarks within the adjacent road reserve are flowering.

4.4 Ecosystem Credit Species

APPENDIX 3 lists the ecosystem credit species that have been derived from the BAM Calculator. Details of required habitat components, geographic limitations, and applicable sensitivity classes for each species is also provided.

Ten (10) derived ecosystem credit species were removed from the assessment due to habitat constraints, geographic limitations, or as PCT (780 – i.e. Vegetation Zone 4) is not required to be offset with regards to ecosystem credits as the vegetation integrity score of this vegetation is below those set out in Paragraph 10.3.1.1 of the BAM. Species that were removed from the candidate species list, along with the rationale behind the decision to remove them, are provided in **TABLE 5.**

The remaining ecosystem credit species were retained as some habitat components (i.e. breeding, foraging or roosting habitat) were present in the assessment area. However, these habitat components were marginal for most species, due to the highly disturbed nature of vegetation communities occurring on the subject site.

TABLE 5
SPECIES CREDIT SPECIES REMOVED FROM CANDIDATE SPECIES LIST

Species	Reason for determining that species is unlikely to occur on the subject land	Justification
Bar-tailed Godwit (Foraging) (*Limosa lapponica baueri*)	BAM requirements	The relevant PCT (780 – i.e. Vegetation Zone 4) is not required to be offset with regards to ecosystem credits as the vegetation integrity score of this vegetation is below those set out in Paragraph 10.3.1.1 of the BAM.
Black-tailed Godwit (Foraging) (*Limosa limosa*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Broad-billed Sandpiper (Foraging) (*Limicola falcinellus*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Brolga (*Grus rubicunda*)	BAM requirements	The relevant PCT (780 – i.e. Vegetation Zone 4) is not required to be offset with regards to ecosystem credits as the vegetation integrity score of this vegetation is below those set out in Paragraph 10.3.1.1 of the BAM.
Comb-crested jacana (*Irediparra gallinacea*)	BAM requirements	The relevant PCT (780 – i.e. Vegetation Zone 4) is not required to be offset with regards to ecosystem credits as the vegetation integrity score of this vegetation is below those set out in Paragraph 10.3.1.1 of the BAM.
Curlew Sandpiper (Foraging) (*Calidris ferruginea*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Eastern Curlew (Foraging) (*Numenius madagascariensis*)	BAM requirements	The relevant PCT (780 – i.e. Vegetation Zone 4) is not required to be offset with regards to ecosystem credits as the vegetation integrity score of this vegetation is below those set out in Paragraph 10.3.1.1 of the BAM.
Magpie Goose (*Anseranas semipalmata*)	BAM requirements	The relevant PCT (780 – i.e. Vegetation Zone 4) is not required to be offset with regards to ecosystem credits as the vegetation integrity score of this vegetation is below those set out in Paragraph 10.3.1.1 of the BAM.
Red Knot (Foraging) (*Calidris canutus*)	BAM requirements	The relevant PCT (780 – i.e. Vegetation Zone 4) is not required to be offset with regards to ecosystem credits as the vegetation integrity score of this vegetation is below those set out in Paragraph 10.3.1.1 of the BAM.
Sanderling (Foraging) (*Calidris alba*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.

4.5 Species Credit Species

APPENDIX 4 lists the species credit species that have been derived from the BAM Calculator. Details of required habitat components, geographic limitations and applicable sensitivity classes for each species is also provided. It is noted that impacts to the degraded area of PCT 780 (Vegetation Zone 4) are not required to be offset with regards to species credits as the vegetation integrity score of this vegetation is below those set out in Paragraph 10.3.2.2 of the BAM.

Targeted surveys were completed for threatened species on the subject site on the 27th August and 27th October 2020, and over the three (3) nights of the 26th – 28th January 2021. The methodology and results of these surveys are discussed in **SECTIONS 4.2 and 4.3**.

Targeted surveys were completed at the appropriate time of year for all species credit species automatically generated by the BAM calculator. One (1) species credit species - Southern Myotis (*Myotis macropus*) - has been assumed to be present however as this species is provided with suitable habitat, and data collected utilising bat detector units was found to be corrupted and could not be analysed.

A number of species credit species were removed from the calculator as either the necessary habitat components (i.e. breeding, foraging or roosting habitat) were absent in the assessment area, or due to geographic limitations, or in accordance with Paragraph 5.2.3.2(a)ii of the BAM as it was determined that the available habitat is substantially degraded such that the species is unlikely to utilise the subject land (or specific vegetation zones). Species that were removed from the candidate species list, along with the rationale behind the decision to remove them, are provided in **TABLE 6.**

All remaining species credit species derived from the BAM Calculator were addressed in detail including consideration of habitat requirements, occurrence of suitable habitat in the assessment area and survey effort required for each species.

TABLE 6
SPECIES CREDIT SPECIES REMOVED FROM CANDIDATE SPECIES LIST

Species	Reason for determining that species is unlikely to occur on the subject land	Justification
Bar-tailed Godwit (Breeding) (*Limosa lapponica baueri*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Barking owl (Breeding) (*Ninox connivens*)	Habitat constraints	The site does not contain suitable breeding habitat i.e. Hollow bearing trees/living or dead trees with hollows greater than 20 cm diameter.
Black-tailed Godwit (Breeding) (*Limosa limosa*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Broad-billed Sandpiper (Breeding) (*Limicola falcinellus*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Brush-tailed phascogale (*Phascogale tapoatafa*)	Habitat degraded	Habitat on the subject site for this species is considered to be highly degraded due to a history of disturbance (i.e. vegetation clearing and grazing activities). There are only three (3) validated records of this species within the Tweed LGA with the nearest record approx. 17.5km to the south.
Common planigale (*Planigale maculata*)	Habitat degraded	Habitat on the subject site for this species is considered to be highly degraded due to a history of disturbance (i.e. vegetation clearing and grazing activities). There nearest record occurs approx. 3km to the east.
Curlew Sandpiper (Foraging) (*Calidris ferruginea*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Eastern Curlew (Breeding) (*Numenius madagascariensis*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Eastern osprey (Breeding) (*Pandion cristatus*)	Habitat constraints	The site does not contain suitable breeding habitat i.e. presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting.
Eastern pygmy possum (*Cercartetus nanus*)	Habitat degraded	Habitat on the subject site for this species is considered to be highly degraded due to a history of disturbance (i.e. vegetation clearing and grazing activities). There is only one (1) validated records of this species within the Tweed LGA which occurs approx. 3km to the south-east.

Species	Reason for determining that species is unlikely to occur on the subject land	Justification
Glossy black cockatoo (Breeding) (*Calyptorhynchus lathami*)	Habitat constraints	The site does not contain suitable breeding habitat i.e. hollow bearing trees/living or dead tree with hollows greater than 15 cm diameter and greater than 5m above ground.
Grey-headed flying-fox (Breeding) (*Pteropus poliocephalus*)	Habitat constraints	No roosting sites (camps) representing breeding habitat occur on the subject land.
Koala (Breeding) (*Phascolarctos cinereus*)	Habitat constraints	Suitable habitat does not occur on the subject site.
Laced Fritillary (*Argynnis hyperbius*)	Habitat constraints	The site does not contain suitable habitat i.e. Arrowhead violet (*Viola betonicifolia*).
Large Bent-winged Bat (Breeding) (*Miniopterus orianae oceanensis*)	Habitat constraints	Maternity caves are not present on the subject land.
Large-eared pied bat (*Chalinolobus dwyeri*)	Habitat constraints	The subject site does not contain cliffs or occur within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.
Little Bent-winged Bat (Breeding) (*Miniopterus australis*)	Habitat constraints	Maternity caves are not present on the subject land.
Little eagle (Breeding) (*Hieraaetus morphnoides*)	Habitat constraints	No nest trees were observed on the subject site.
Pale-headed snake (*Hoplocephalus bitorquatus*)	Habitat degraded	Habitat on the subject site for this species is considered to be highly degraded due to a history of disturbance (i.e. vegetation clearing and grazing activities). There are no validated records of this species within the Tweed LGA.
Powerful owl (Breeding) (*Ninox strenua*)	Habitat constraints	The site does not contain suitable breeding habitat i.e. Hollow bearing trees/living or dead trees with hollows greater than 20 cm diameter.
Regent honeyeater (Breeding) (*Anthochaera phrygia*)	Habitat constraints	The site does not occur within the mapped breeding areas.
Red Knot (Breeding) (*Calidris canutus*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.

Species	Reason for determining that species is unlikely to occur on the subject land	Justification
Sanderling (Breeding) (*Calidris alba*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
Square-tailed kite (Breeding) (*Lophoictinia isura*)	Habitat constraints	No nest trees were observed on the subject site.
Squirrel glider (*Petaurus norfolcensis*)	Habitat degraded	Habitat on the subject site for this species is considered to be highly degraded due to a history of disturbance (i.e. vegetation clearing and grazing activities). There are only thirteen (31) validated records of this species within the Tweed LGA with the nearest record approx. 3km to the south-east.
Swift parrot (Breeding) (*Lathamus discolor*)	Habitat constraints	The site does not occur within the mapped breeding areas.
Terek sandpiper (Breeding) (*Xenus cinereus*)	Habitat constraints	The subject site is not included on the Threatened migratory shorebird habitat mapping.
White-bellied sea-eagle (Breeding) (*Haliaeetus leucogaster*)	Habitat constraints	No nest trees were observed on the subject site.
White-crowned snake (*Cacophis harriettae*)	Habitat constraints	The site does not contain suitable habitat i.e. litter/rocky areas, surface rocks/fallen/standing dead timber including logs, or within 50 m of fallen timber including logs.

5 IMPACT SUMMARY

5.1 Introduction

This section of the BDAR identifies, assesses and summarises the likely direct and indirect impacts of the proposed development. Furthermore, impacts of the proposed development are identified that:

- are considered to be potentially serious and irreversible impacts (in accordance with Section 9.1); and
- require offsets (in accordance with Section 9.2 of the BAM).

Due to the long-term nature of the proposed expansion, this BDAR has been prepared to provide overarching offsetting requirements associated with the proposed sand extraction works on a phase-by-phase basis. Prior to the commencement of sand extraction works within each phase, a phase specific BDAR (or assessment in line with the relevant legislation at that time) will be prepared to accurately assess impacts and offset obligations.

5.2 Direct Impacts on Native Vegetation/Habitat

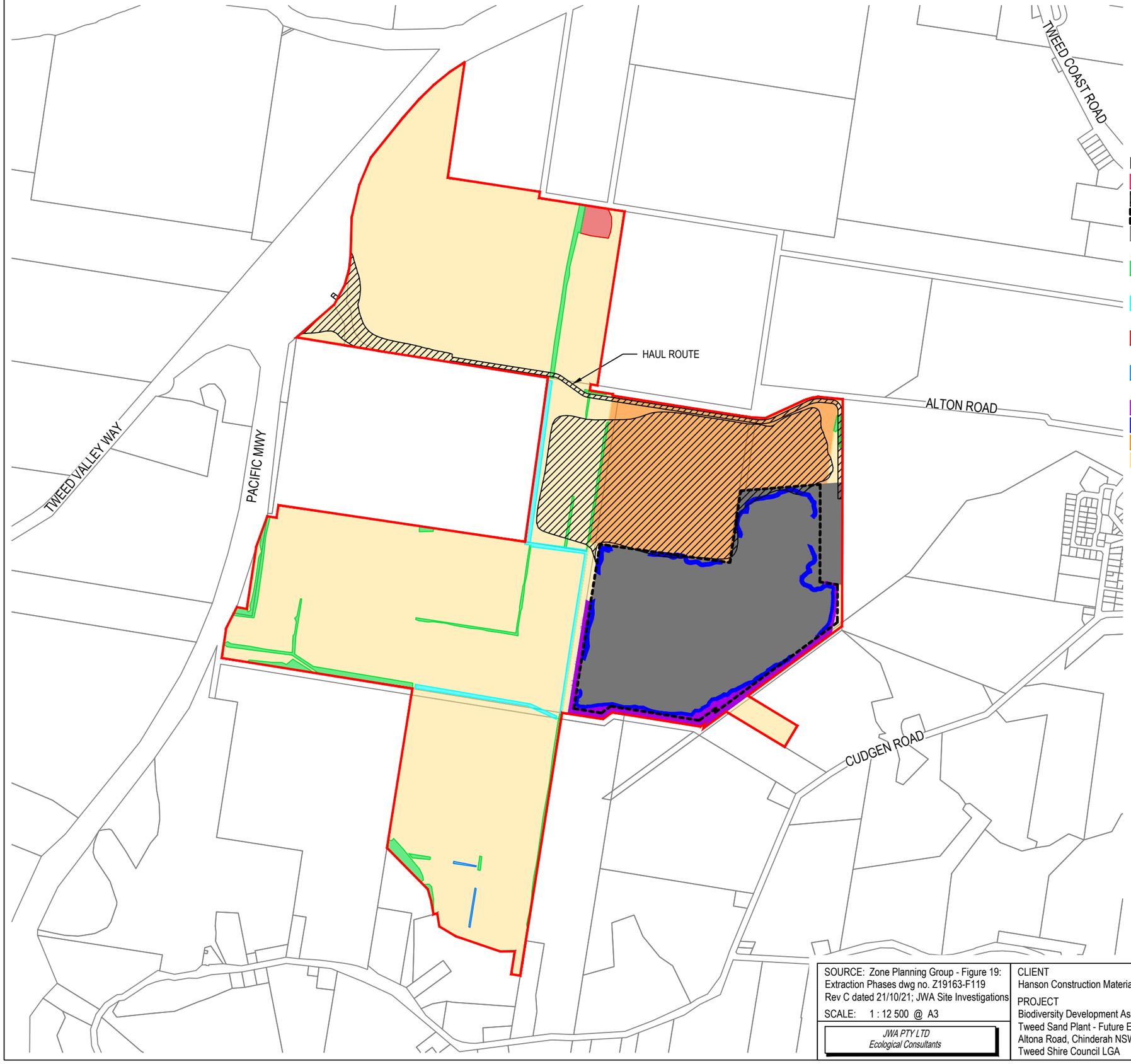
The proposed development will result in the removal of approximately 2.95 ha of PCT 1235, 0.78 ha of PCT 1064 and 0.09 ha of PCT 780. It is noted that the majority of this vegetation has been historically impacted by clearing and/or grazing activities and is currently in a disturbed/degraded state.

The proposed development will result in the removal of a total of 0.47 ha of riparian land required to be rehabilitated as PCT 1235 and 1.59 ha of land required to be rehabilitated as wetland vegetation (allocated to PCT 1808) under existing sand extraction approvals.

The proposed impacts of the development will occur over a thirty (30) year period. Prior to the commencement of sand extraction works within each future phase, a phase specific BDAR (or assessment in line with the relevant legislation at that time) will be prepared to accurately assess impacts and offset obligations.

Direct impacts on vegetation communities as a result of the proposed development on a phase-by-phase basis are detailed in **TABLE 7** and shown in **FIGURES 9 - 15.** The direct impacts on these PCTs will reduce the vegetation integrity score over these areas of the site to 0.

A species polygon has been identified on the subject site for one (1) species credit species assumed to be present on site - Southern Myotis (*Myotis macropus*) - and includes all areas within 200 m of rivers, creeks, billabongs, lagoons, dams and other waterbodies (**FIGURE 16**). Direct impacts on species polygons as a result of the proposed development on a phase-by-phase basis are detailed in **TABLE 8**.



LEGEND

- Subject Site
- Impact Area
- Approved Extraction Area
- Existing Works Area & Processing Plant

Vegetation Communities

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)
- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)
- Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia*, *Cinnamomum camphora*) to 22m (**PCT 1064**)
- Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m (**PCT 780, derived**)
- Vegetation Zone 5: Approved Riparian Rehabilitation Area (**PCT 1235**)
- Vegetation Zone 6: Approved Wetland Rehabilitation Area (**PCT 1290**)
- Vegetation Zone 7: Tea tree plantation (not assessed)
- Vegetation Zone 8: Pasture grasses (not assessed)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Zone Planning Group - Figure 19: Extraction Phases dwg no. Z19163-F119 Rev C dated 21/10/21; JWA Site Investigations

SCALE: 1 : 12 500 @ A3

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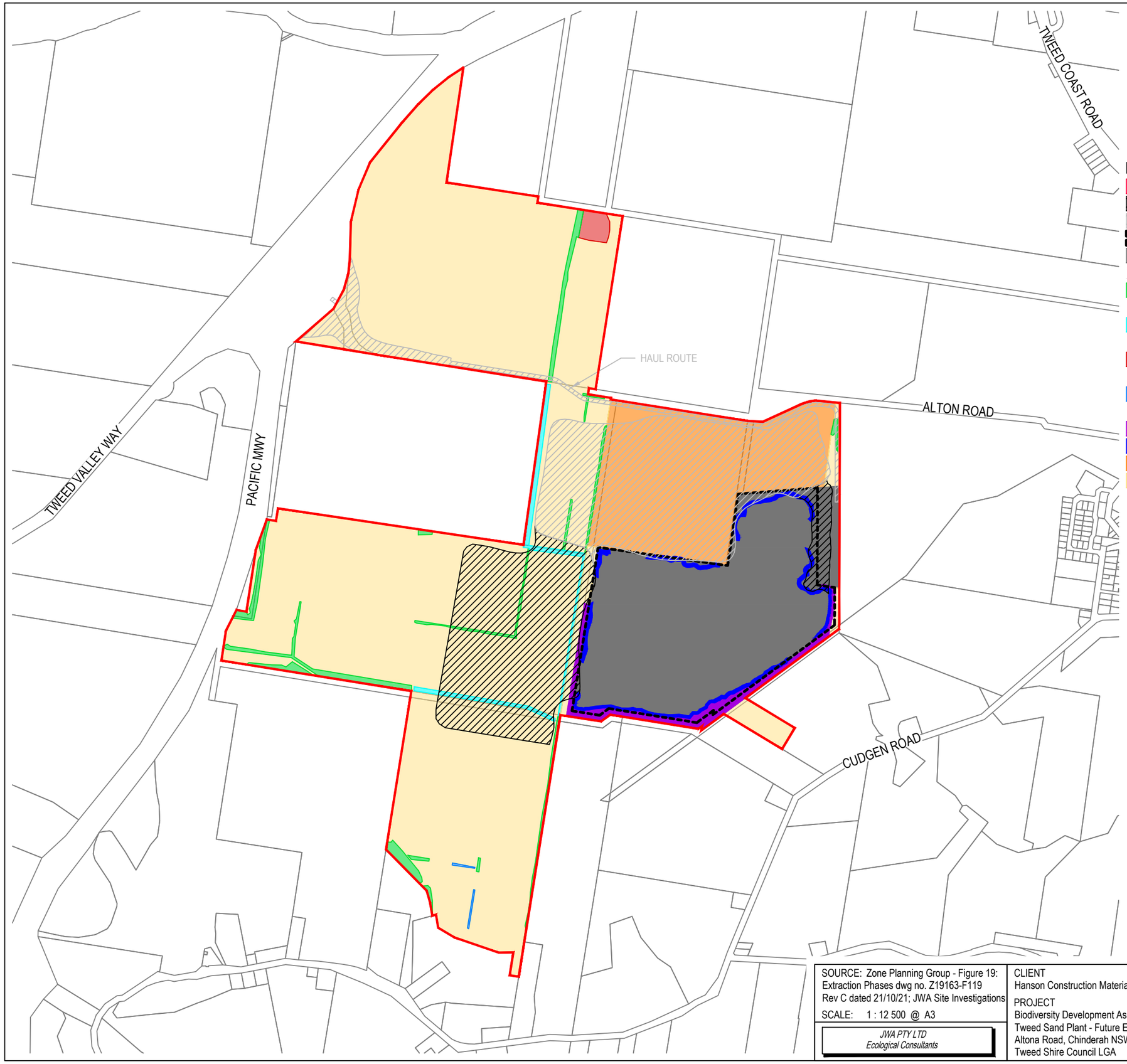
FIGURE 9

PREPARED: BW
DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE
IMPACTS ON VEGETATION COMMUNITIES - PHASE 5 (YRS 1-3)



LEGEND

- Subject Site
- Impact Area
- Previous Phases Impact Area
- Approved Extraction Area
- Existing Works Area & Processing Plant

Vegetation Communities

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)
- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)
- Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia*, *Cinnamomum camphora*) to 22m (**PCT 1064**)
- Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m (**PCT 780, derived**)
- Vegetation Zone 5: Approved Riparian Rehabilitation Area (**PCT 1235**)
- Vegetation Zone 6: Approved Wetland Rehabilitation Area (**PCT 1290**)
- Vegetation Zone 7: Tea tree plantation (not assessed)
- Vegetation Zone 8: Pasture grasses (not assessed)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Zone Planning Group - Figure 19: Extraction Phases dwg no. Z19163-F119 Rev C dated 21/10/21; JWA Site Investigations

SCALE: 1 : 12 500 @ A3

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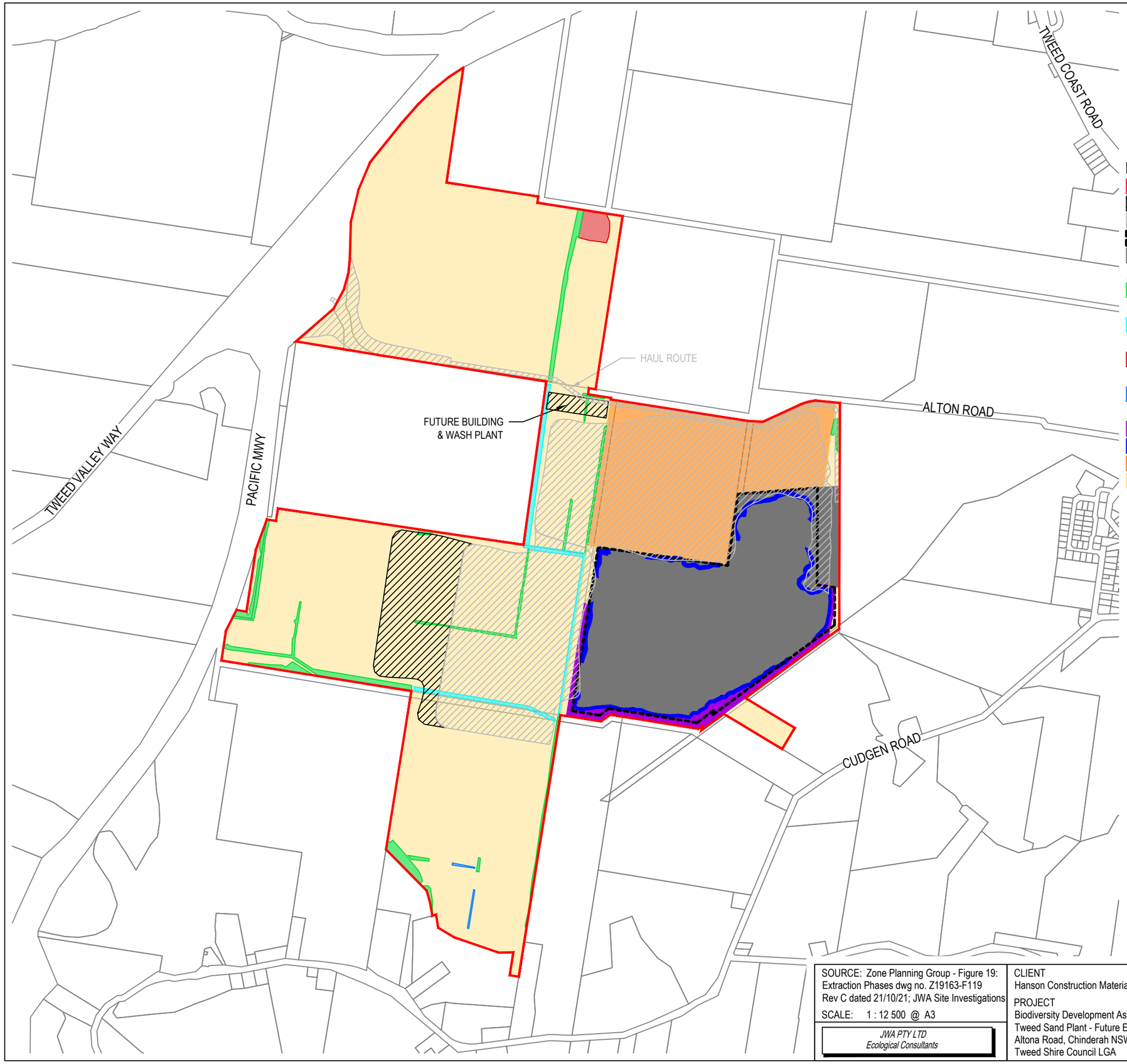
FIGURE 10

PREPARED: BW
DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE
IMPACTS ON VEGETATION COMMUNITIES - PHASE 6 (YRS 4-8)



LEGEND

- Subject Site
- Impact Area
- Previous Phases Impact Area
- Approved Extraction Area
- Existing Works Area & Processing Plant

Vegetation Communities

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)
- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)
- Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia*, *Cinnamomum camphora*) to 22m (**PCT 1064**)
- Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m (**PCT 780, derived**)
- Vegetation Zone 5: Approved Riparian Rehabilitation Area (**PCT 1235**)
- Vegetation Zone 6: Approved Wetland Rehabilitation Area (**PCT 1290**)
- Vegetation Zone 7: Tea tree plantation (not assessed)
- Vegetation Zone 8: Pasture grasses (not assessed)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Zone Planning Group - Figure 19: Extraction Phases dwg no. Z19163-F119 Rev C dated 21/10/21; JWA Site Investigations

SCALE: 1 : 12 500 @ A3

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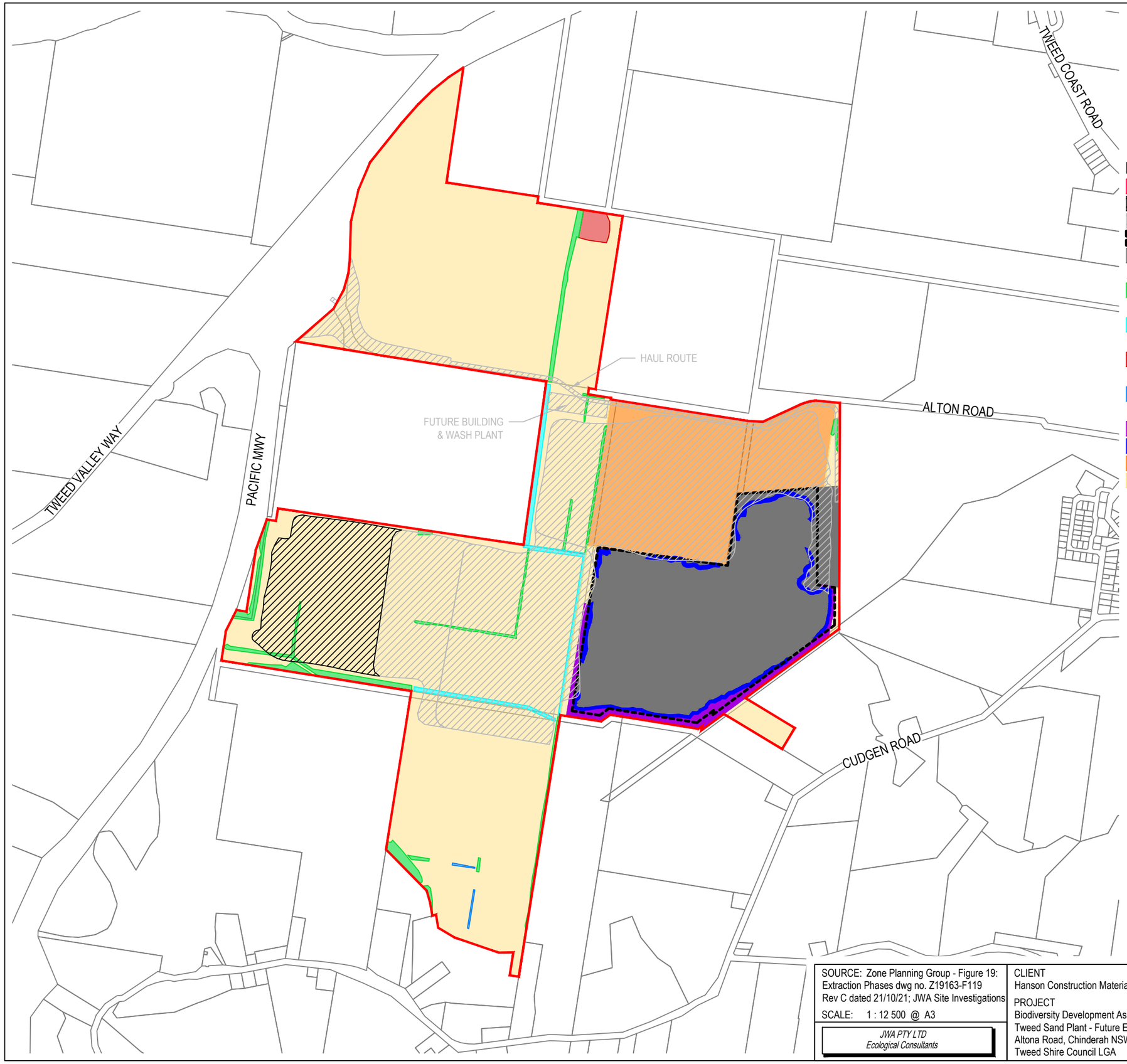
FIGURE 11

PREPARED: BW
DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE
IMPACTS ON VEGETATION COMMUNITIES - PHASE 7 (YRS 9-13)



LEGEND

- Subject Site
- Impact Area
- Previous Phases Impact Area
- Approved Extraction Area
- Existing Works Area & Processing Plant

Vegetation Communities

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)
- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)
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- Vegetation Zone 6: Approved Wetland Rehabilitation Area (**PCT 1290**)
- Vegetation Zone 7: Tea tree plantation (not assessed)
- Vegetation Zone 8: Pasture grasses (not assessed)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Zone Planning Group - Figure 19: Extraction Phases dwg no. Z19163-F119 Rev C dated 21/10/21; JWA Site Investigations

SCALE: 1 : 12 500 @ A3

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Tweed Sand Plant - Future Expansion
Altona Road, Chinderah NSW
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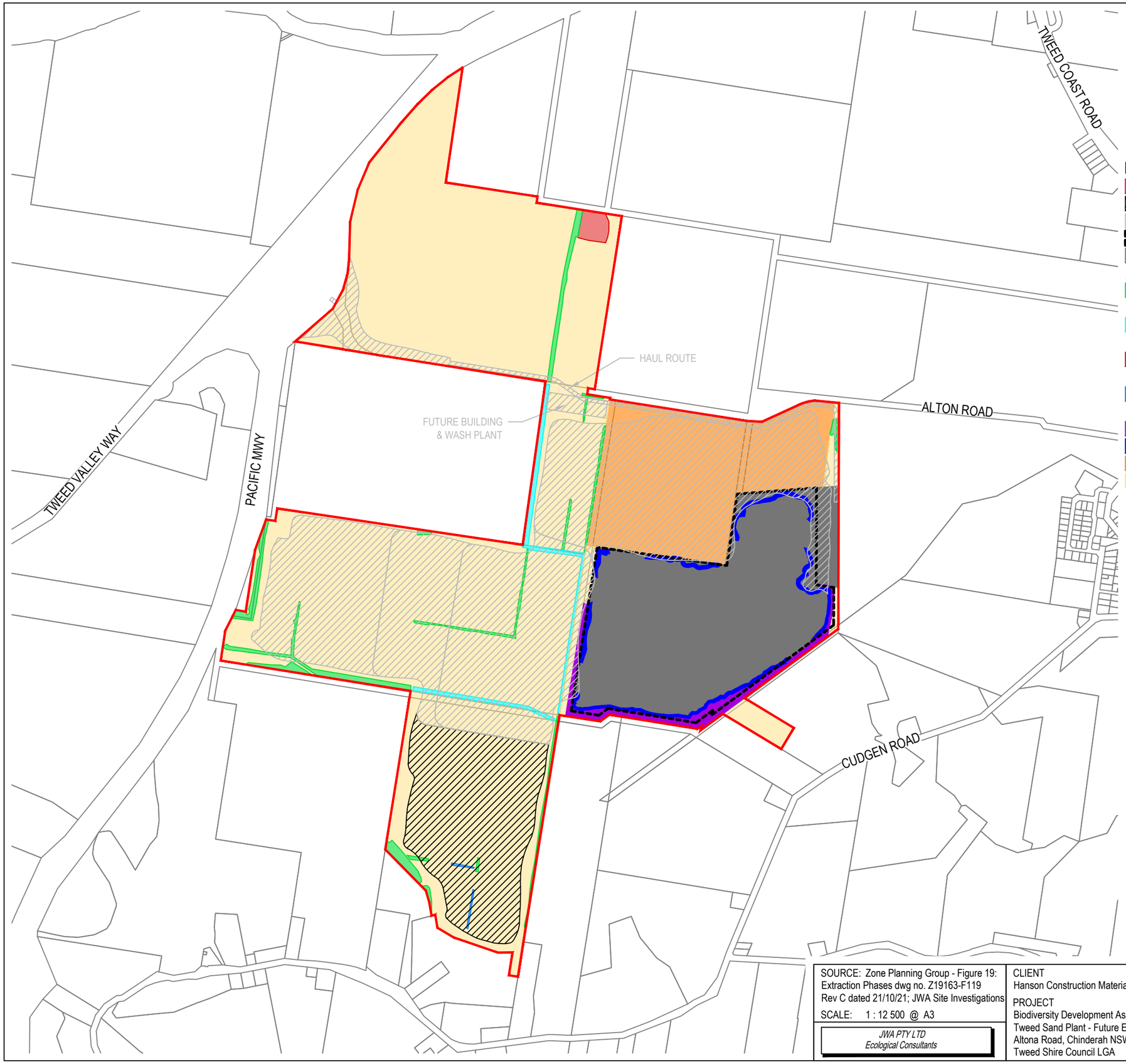
FIGURE 12

PREPARED: BW
DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE
IMPACTS ON VEGETATION COMMUNITIES
- PHASE 8 (YRS 14-18)



LEGEND

- Subject Site
- Impact Area
- Previous Phases Impact Area
- Approved Extraction Area
- Existing Works Area & Processing Plant

Vegetation Communities

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)
- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)
- Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia*, *Cinnamomum camphora*) to 22m (**PCT 1064**)
- Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m (**PCT 780, derived**)
- Vegetation Zone 5: Approved Riparian Rehabilitation Area (**PCT 1235**)
- Vegetation Zone 6: Approved Wetland Rehabilitation Area (**PCT 1290**)
- Vegetation Zone 7: Tea tree plantation (not assessed)
- Vegetation Zone 8: Pasture grasses (not assessed)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Zone Planning Group - Figure 19: Extraction Phases dwg no. Z19163-F119 Rev C dated 21/10/21; JWA Site Investigations

SCALE: 1 : 12 500 @ A3

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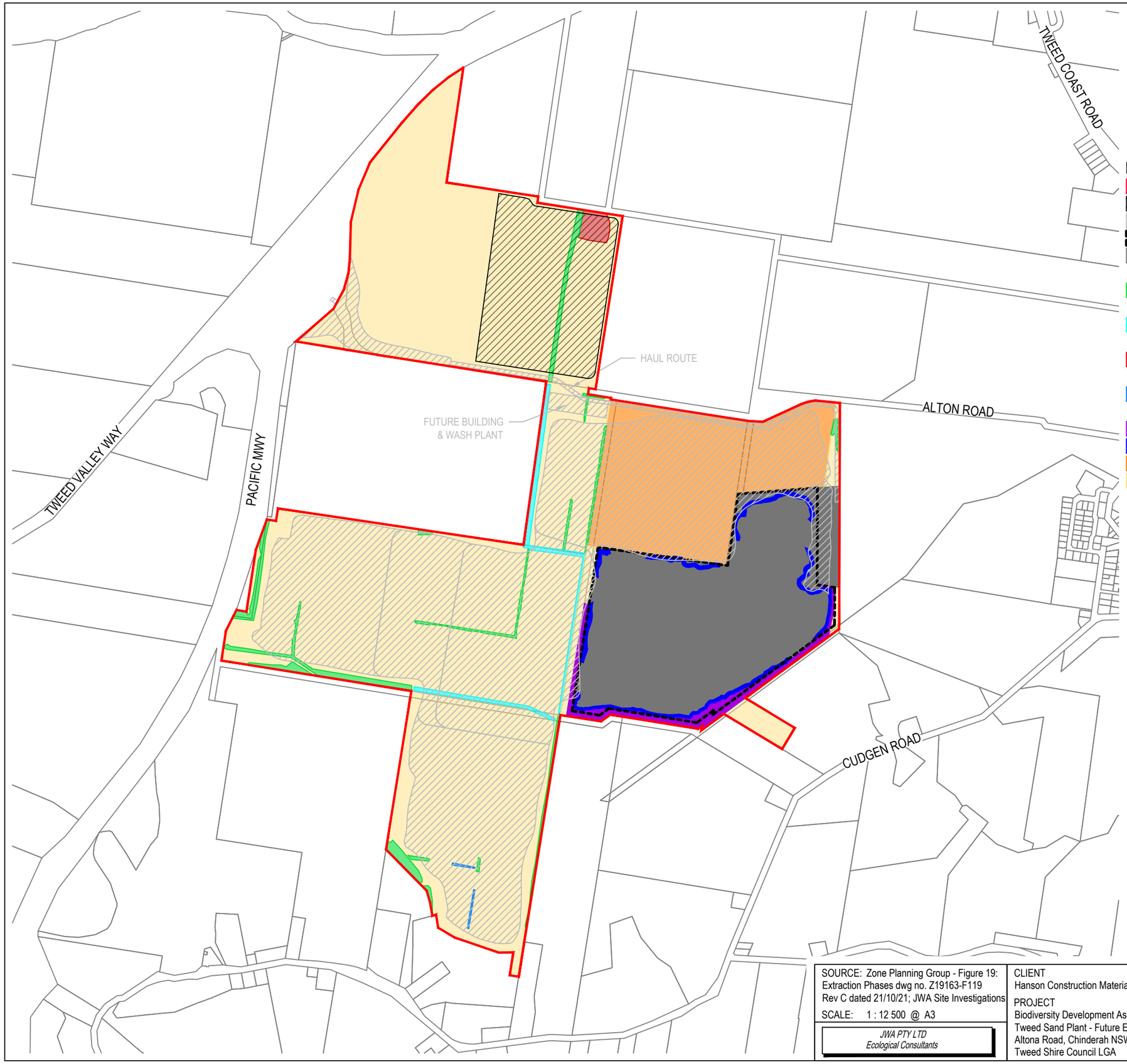
FIGURE 13

PREPARED: BW
DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE
IMPACTS ON VEGETATION COMMUNITIES
- PHASE 9 (YRS 19-22)



LEGEND

- Subject Site
- Impact Area
- Previous Phases Impact Area
- Approved Extraction Area
- Existing Works Area & Processing Plant

Vegetation Communities

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)
- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)
- Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia*, *Cinnamomum camphora*) to 22m (**PCT 1064**)
- Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m (**PCT 780, derived**)
- Vegetation Zone 5: Approved Riparian Rehabilitation Area (**PCT 1235**)
- Vegetation Zone 6: Approved Wetland Rehabilitation Area (**PCT 1290**)
- Vegetation Zone 7: Tea tree plantation (not assessed)
- Vegetation Zone 8: Pasture grasses (not assessed)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Zone Planning Group - Figure 19: Extraction Phases dwg no. Z19163-F119 Rev C dated 21/10/21; JWA Site Investigations

SCALE: 1 : 12 500 @ A3

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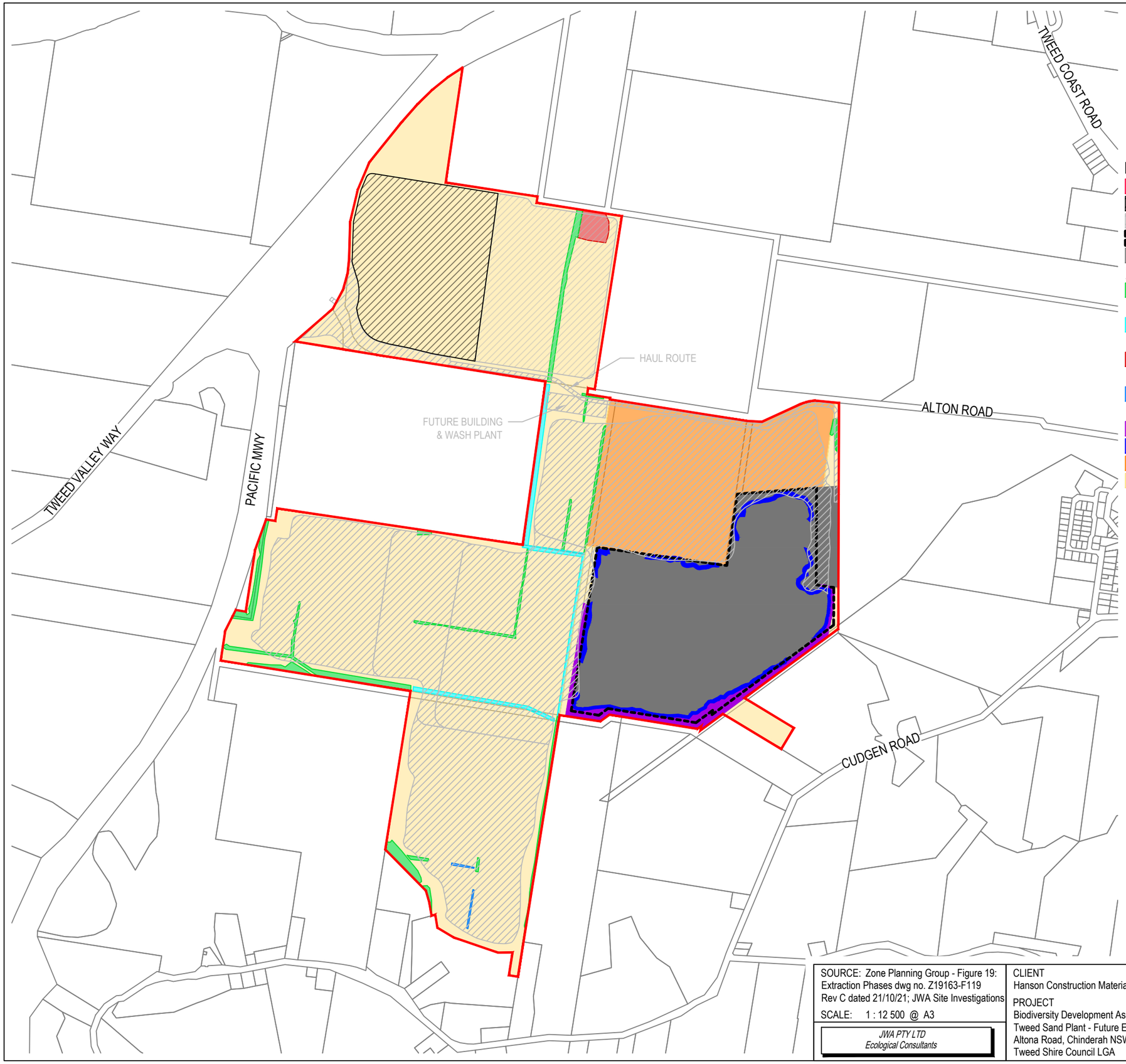
FIGURE 14

PREPARED: BW
DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE
IMPACTS ON VEGETATION COMMUNITIES - PHASE 10 (YRS 23-26)



LEGEND

- Subject Site
- Impact Area
- Previous Phases Impact Area
- Approved Extraction Area
- Existing Works Area & Processing Plant

Vegetation Communities

- Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)
- Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)
- Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia*, *Cinnamomum camphora*) to 22m (**PCT 1064**)
- Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m (**PCT 780, derived**)
- Vegetation Zone 5: Approved Riparian Rehabilitation Area (**PCT 1235**)
- Vegetation Zone 6: Approved Wetland Rehabilitation Area (**PCT 1290**)
- Vegetation Zone 7: Tea tree plantation (not assessed)
- Vegetation Zone 8: Pasture grasses (not assessed)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: Zone Planning Group - Figure 19: Extraction Phases dwg no. Z19163-F119 Rev C dated 21/10/21; JWA Site Investigations

SCALE: 1 : 12 500 @ A3

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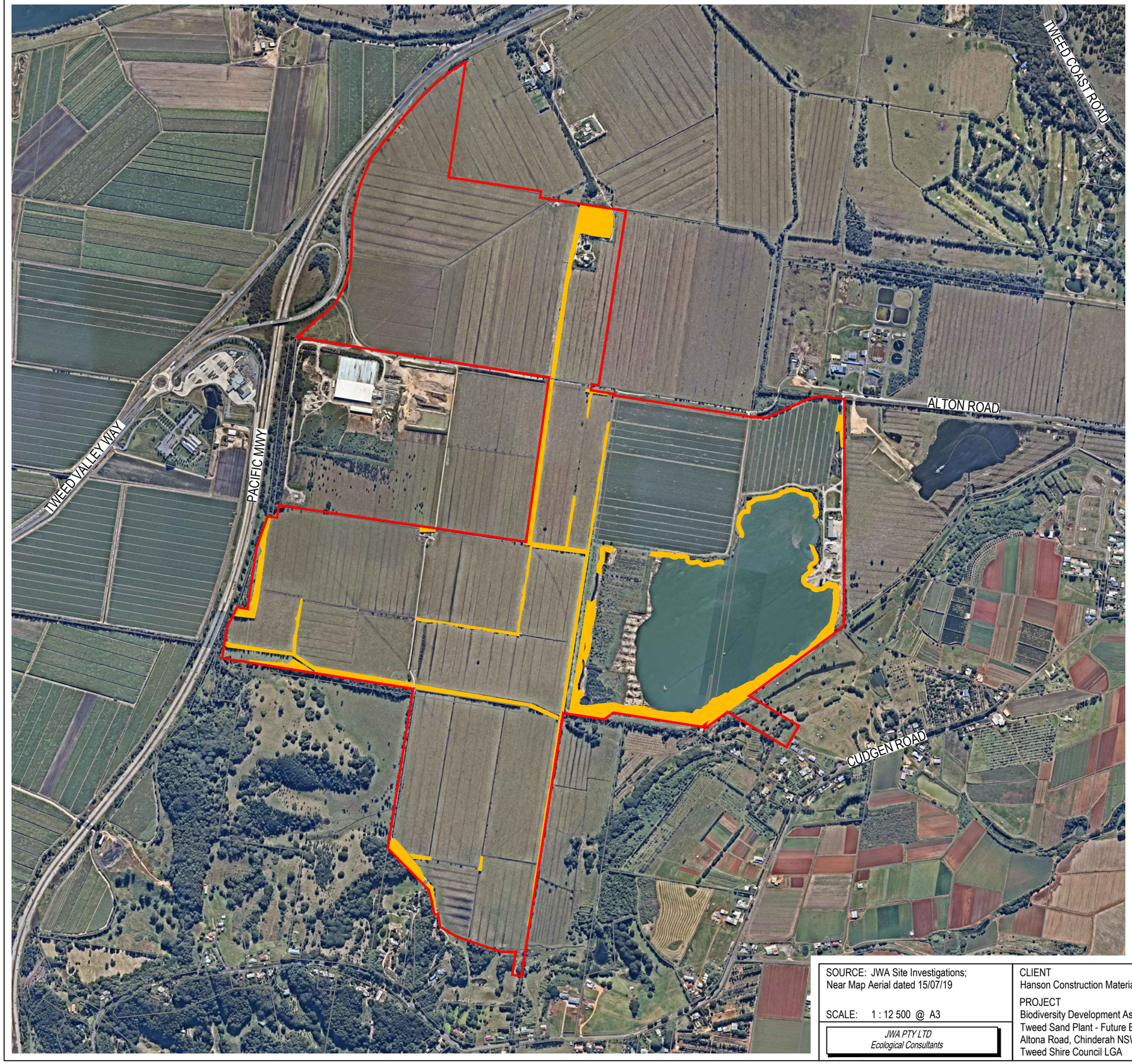
FIGURE 15

PREPARED: BW
DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE
IMPACTS ON VEGETATION COMMUNITIES
- PHASE 11 (YRS 27-30)



N

LEGEND

- Subject Site
- Species Polygon for Southern Myotis (*Myotis macropus*)

Scale 1:12 500 - Lengths in metres

100 0 100 200 300 400 500

SOURCE: JWA Site Investigations; Near Map Aerial dated 15/07/19

SCALE: 1 : 12 500 @ A3

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FIGURE 16

PREPARED: BW
DATE: 05 October 2021
FILE: N09007_BDAR_20211005.dwg

TITLE

SPECIES POLYGON FOR SOUTHERN MYOTIS

TABLE 7
DIRECT IMPACTS ON VEGETATION COMMUNITIES

Vegetation Community	Area to be Removed							
	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11	TOTAL
Vegetation Zone 1: Mid-high swamp sclerophyll forest (*Casuarina glauca*) to 18m (**PCT 1235**)	0.45 ha	0.33 ha	0.11 ha	0.21 ha	0.06 ha	0.69 ha	0.00 ha	**1.85 ha**
Vegetation Zone 2: Mid-high regenerating swamp sclerophyll forest (*Casuarina glauca*) +/- Mangroves (*Avicennia marina*) to 5-10m (**PCT 1235**)	0.00 ha	1.02 ha	0.08 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	**1.10 ha**
Vegetation Zone 3: Tall swamp sclerophyll forest (*Melaleuca quinquenervia, Cinnamomum camphora*) to 22m (**PCT 1064**)	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.78 ha	0.00 ha	**0.78 ha**
Vegetation Zone 4: Tall rushland/reedland (*Typha orientalis*) to 2m (**PCT 780**)	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.09 ha	0.00 ha	0.00 ha	**0.09 ha**
Vegetation Zone 5: Riparian rehabilitation areas (**PCT 1235**)	0.00 ha	0.47 ha	0.00 ha	0.00 ha	0.09 ha	0.00 ha	0.00 ha	**0.47 ha**
Vegetation Zone 6: Wetland rehabilitation areas (**PCT 1808**)	0.88 ha	0.71 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	**1.59 ha**
TOTAL	**1.32 ha**	**2.53 ha**	**0.19 ha**	**0.21 ha**	**0.15 ha**	**1.47 ha**	**0.00 ha**	**5.88 ha**

TABLE 8
DIRECT IMPACTS ON SPECIES POLYGONS

Vegetation Community	Area to be Removed							
	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11	TOTAL
Southern Myotis (*Myotis macropus*)	1.32 ha	2.53 ha	0.19 ha	0.21 ha	0.15 ha	1.47 ha	0.00 ha	**5.88 ha**

5.3 Potential Indirect Impacts

The proposed impacts of the development will occur over a thirty (30) year period. Prior to the commencement of sand extraction works within each future phase, a phase specific BDAR (or assessment in line with the relevant legislation at that time) will be prepared to accurately assess impacts and offset obligations. The proposed development of the subject site may contribute to the following potential indirect impacts:

- Alteration to drainage and hydrological regimes in the study area and adjacent areas;
- Decline in water quality entering adjacent waterway areas (e.g. sediment load, pH, influx of pollutants, nutrient loading);
- Potential impacts on groundwater. Given the nature of the site soils and groundwater characteristics observed to date, the most likely potential impacts on groundwater as a result of the development are (G&S 2021a):
    - Localised and minor changes to pre-development groundwater flow regimes in the vicinity of the lake that will be largely contained within the development footprint; and
    - Changes to groundwater elevation as a result of the proposed expansion. These are predominantly contained within the development footprint, occurring within the northern and southern sections of the extraction footprint;
- Increased opportunity for weeds to become established. Invasive landscape species may escape to adjacent areas of native vegetation;
- Increased light, noise and activity may cause reclusive species to move away from habitat edges;
- Increased risk of rubbish dumping, creation of walking tracks and associated impacts within adjacent native vegetation communities.

5.4 Prescribed Biodiversity Impacts

5.4.1 Background

In accordance with Clause 6.1 of the BCR:

1) The impacts on biodiversity values of the following actions are prescribed (subject to subclause (2)) as biodiversity impacts to be assessed under the biodiversity offsets scheme:
    a. the impacts of development on the following habitat of threatened species or ecological communities:
        i. karst, caves, crevices, cliffs and other geological features of significance,
        ii. rocks,

iii. human made structures,

iv. non-native vegetation,

b. the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range,

c. the impacts of development on movement of threatened species that maintains their lifecycle,

d. the 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 or other development),

e. the impacts of wind turbine strikes on protected animals,

f. the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

2) The additional biodiversity impacts prescribed by this clause:

a. are prescribed for the purposes of assessment and biodiversity assessment reports under the Act, but are not additional biodiversity impacts for the purposes of calculating the number and class of biodiversity credits that are required under a biodiversity assessment report to be retired to offset the residual impact on biodiversity values of proposed development, proposed clearing of native vegetation or proposed biodiversity certification of land, and

b. may be taken into account in the determination of the biodiversity credits required to be retired (or other conservation measures required to be taken) under a planning approval or vegetation clearing approval or under a biodiversity certification of land.

5.4.2 Applicability to the Assessment Area

5.4.2.1 Habitat of Threatened Species or Ecological Communities

The assessment area does not contain any of the prescribed habitat features.

5.4.2.2 Connectivity

The proposed development will occur on an area already affected by past clearing and cattle grazing activities. The development is therefore not considered to result in any additional impacts on connectivity between habitat areas.

5.4.2.3 Movement of Threatened Species that Maintains their Lifecycle

As discussed above, the proposed development will occur on an area already currently already affected by past clearing and cattle grazing activities. The development is therefore not considered to result in any additional impacts on the movements of threatened species that maintains their lifecycles.

5.4.2.4 Water Quality, Water Bodies and Hydrological Processes that Sustain Threatened Species and Threatened Ecological Communities

Gilbert & Sutherland Pty Ltd (G&S) have prepared a Soil and Water Management Plan (SWMP) for the proposed expansion. The SWMP was prepared to satisfy relevant matters included in the Secretary's Environmental Assessment Requirements (SEAR) issued for the Project in December 2019, and establishes procedures and responsibilities for the management of soil and water related aspects of the proposed TSP expansion including:

- acid sulfate soil management;
- erosion and sediment control;
- surface water and groundwater monitoring programs;
- cyanobacteria (blue green algae) management;
- waste management; and
- contaminated lands

Although there are likely to be some minor alterations to the existing hydrology of the subject site, with the implementation of the measures detailed in the SWMP (G&S 2021) it is considered unlikely that the proposal would impact on water quality, water bodies and/or hydrological processes that sustain threatened species and threatened ecological communities.

Groundwater level changes resulting from the development are not predicted to cause impacts within proximity to any of the known registered bores. A drawdown of up to 0.5 m is predicted to occur within a small portion of the Low Potential Groundwater Dependant Ecosystem (GDE), which is mapped on the southern boundary of the expansion footprint west of Lot 1 on DP1250570. This GDE occurs in a highly modified state having regrown on a historically cleared floodplain and in associated with constructed drains. This GDE is therefore considered unlikely to be significantly impacted by groundwater drawdown of this magnitude.

5.4.2.5 Impacts of Wind Turbine Strikes

Not applicable to the proposed development.

5.4.2.6 Impacts of Vehicle Strikes

Future development and occupation of the subject site is considered unlikely to contribute to an increase in the risk of vehicle strikes.

5.5 Potential Serious and Irreversible Impacts

5.5.1 Background

Serious and irreversible impacts are those impacts that:

- will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline; or
- will further reduce the population of a species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very small population size; or
- are impacts on the habitat of a species or area of ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution; or
- are impacts on a species or ecological community is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

It is the role of the decision-maker to determine whether or not any of the residual impacts of a proposed development, activity, biodiversity certification or vegetation clearing on biodiversity values (that is, the impacts that would remain after any proposed avoid or mitigate measures have been taken) are serious and irreversible

To assist a decision-maker with this task, the BC Act (and the BCR) provides a framework to make this determination. The framework consists of a series of principles defined in the BC Regulation and supporting guidance, provided for under section 6.5 of the BC Act, to interpret these principles.

5.5.2 Applicability to the Assessment Area

No habitat for any SAII entities, as listed within *Appendix 2: List of potential species (and their habitat) that meet the SAII principles and criteria* within *Guidance to assist a decision-maker to determine a serious and irreversible impact* (the guide), is considered to be present on the subject site.

5.6 Impacts Requiring an Offset

5.6.1 Ecosystem Credits

Impacts on the following ecosystems will require offsets:

- PCT 1235 - Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion;
- PCT 1064 - Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion; and
- PCT 1808 – Estuarine reedland.

Offsets have been apportioned on a phase-by-phase basis. Refer to the BAM Biodiversity Credit Report (**APPENDIX 5**) for further details.

5.6.2 Threatened Species

Impacts on the following threatened species will require offsets:

- Southern Myotis (*Myotis macropus*).

Offsets have been apportioned on a phase-by-phase basis. Refer to the BAM Biodiversity Credit Report (**APPENDIX 5**) for further details.

6 AVOIDANCE & MINIMISATION OF IMPACTS

6.1 Introduction

This section of the BDAR discusses methods to avoid and minimise impact of the proposed development including:

- details of efforts to avoid and minimise impact on biodiversity values (in accordance with Section 7 of the BAM); and
- an assessment of direct and indirect impacts unable to be avoided at the development site (in accordance with Sections 8.1 and 8.2 of the BAM).

The assessment of impacts has considered the included the type, frequency, intensity, duration and consequence of impacts.

6.2 Avoidance and Minimisation Measures

6.2.1 Pre-Construction/Design Phase

6.2.1.1 Locating the Project

The project will generally be located in areas which have historically been cleared or otherwise disturbed by clearing impacts.

6.2.1.2 Project Design

The proposed development will be constructed in a manner sensitive to areas of retained habitat on adjoining land and designed in a manner that reduces associated indirect impacts. Prior to the commencement of sand extraction works within each phase, a phase specific BDAR (or assessment in line with the relevant legislation at that time) will be prepared to accurately assess impacts, avoidance and mitigation measures, and offset obligations.

6.2.2 Construction Phase

6.2.2.1 Education of Site Personnel

A construction personnel induction program shall be developed by the Proponent to highlight the presence of significant vegetation and habitat values adjacent to the site. The general induction of all construction personnel will cover such matters as:

- Areas adjacent to the site in which significant vegetation and habitat values occur;
- Threats to significant vegetation and habitat values associated with construction activities;
- Requirement to report any incidents within the significant vegetation and habitat areas, and actions required; and
- Requirements of any relevant Management Plans, particularly protocols for vegetation clearing and measures to protect all other native vegetation.

6.2.2.2 Vegetation Protection Measures

During construction activities, temporary high visibility fencing will be erected to assist in the protection of vegetation to be retained from all construction activities by restricting access from machinery and contractors. This fencing will be erected in accordance with Australian Standard 4970-2009 Protection of Trees and any additional requirements of a Vegetation Management Plan to be prepared by a suitably qualified ecologist. Temporary signage will be provided along all temporary fencing during the construction phase stating "Environmental Protection Zone – No Unauthorised Entry".

No machinery, rubbish or spoil will be stored within retained vegetation during the construction phase of the development. Vehicle/equipment wash-down areas or access tracks will not be located in or immediately adjacent to retained vegetation.

6.2.2.3 Fauna Protection Measures

Vegetation will be inspected for fauna by a suitably qualified ecologist immediately prior to the commencement of clearing/earthworks. Any fauna detected within proposed clearing areas will be relocated to suitable habitat outside of the subject site. Consideration will be given to appropriate release times and locations for specific fauna groups and a record kept of all species encountered/relocated.

6.2.2.4 Water Quality Protection Measures

In relation to surface water quality, the Surface Water Assessment (G&S 2021b) has determined that:

- The long-term median for pH of surface waters within the TSP Lake is 8.34. This value marginally exceeds the Tweed River Water Quality Objective of 8.0 but complies with the ANZECC 2000 criteria for primary contact recreation of 6.5 to 8.5.
- Dissolved oxygen concentrations within the TSP lake remain above the Tweed River, ANZECC and NHRMC Guideline minimums of 6.0 mg/L. As a constituent measure of waterbody health, DO at concentrations observed within the extraction lake are ideal for supporting normal aquatic ecosystem function.
- Metal-rich surface waters (Al, Fe) commonly result from the disturbance of acid sulfate soils, where the oxidation of pyrite in disturbed soils increases the solubility of these metals. Negligible concentrations of metals were detected within the surface waters of the TSP lake and within the agricultural drains throughout the expansion site. Long term median levels within the TSP lake remain compliant with the ANZECC performance criteria for aquatic ecosystem protection and primary contact recreation.
- Elevated nutrient levels have been recorded within the TSP lake although due to dilution from rainfall inflows, the levels are substantially lower than within the groundwater environment and are similar to those recorded within the nearby Tweed River.

With consideration of the above it is noted that the water quality recorded at the TSP site has remained largely stable over time. The soil and water management practices implemented at the site to date have proven successful in maintaining and in some instances improving water quality within the extraction lake. With continued implementation of existing soil and water management practices it is anticipated that existing water quality at the site will be maintained in the long-term.

It is noted that no dewatering is proposed in any of the extraction phases. In relation to groundwater quality, the Groundwater Assessment (G&S 2021a) notes that an ongoing program of groundwater quality compliance monitoring has been undertaken at the TSP site since 2001, resulting in a comprehensive data set for the site. Building on the existing water quality monitoring program, a further eight rounds of groundwater monitoring were conducted across the proposed expansion area between March and October 2020, to establish baseline conditions and determine similarities and differences between the expansion area and current TSP site.

Results obtained for shallow groundwater within the existing and proposed site area demonstrate long-term median values generally comply with the Tweed River Water Quality Objectives, ANZECC Water Quality Guidelines and NHRMC Recreation Water Quality Guidelines for primary contact recreation.

Results obtained for deep groundwater within the TSP site also demonstrate median values that generally comply with the Tweed River Water Quality Objectives, ANZECC Water Quality Guidelines and NHRMC Recreation Water Quality Guidelines for primary contact recreation.

Groundwater will be managed in accordance with the measures prescribed in the Soil and Water Management Plan (G&S 2021c). This management plan outlines monitoring regimes and mitigation measures for the management of impacts to surface and groundwaters.

6.2.3 Post-construction/Operational Phase

6.2.3.1 Rehabilitation Works and Appropriate Landscaping

Rehabilitation works on the site will be completed on a stage-by-stage basis following completion of sand extraction works within each phase. A Concept Rehabilitation and Landscape Management Plan (RLMP) has been prepared for the subject site (**FIGURE 17**). Rehabilitation works on the site will cover approx. 38.21 ha (over 16% of the site area, including landscaped road batters and beaches) and will be carried out progressively over eleven (11) phases within three (3) Rehabilitation Areas:

- Wetland rehabilitation areas – primarily assisted natural regeneration of water plants/macrophytes around the fringes of the lake;
- Riparian rehabilitation areas – providing a minimum 10m wide vegetated buffer around the perimeter of the subject site; and
- Open space areas – (in the vicinity of beach areas) consisting of landscaped and grassed areas.

LEGEND

- Subject Site
- Final Lake Extents
- Wetland Rehabilitation Area
- Beaches
- Open Space and Riparian Rehabilitation Area (minimum width 10m)
- Roadwork Batter Extents

Scale 1:25 000 - Lengths in metres

200 0 200 400 600 800 1000

SOURCE: Zone Planning Group - Figure 27: Rehabilitation Phases dwg No. Z19163-F127 Rev C dated 20/10/21 (Ref: FIG25.dwg)

SCALE: 1 : 25 000 @ A3

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FIGURE 17

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DATE: 21 October 2021
FILE: N09007_BDAR_20211021.dwg

TITLE

CONCEPT REHABILITATION PHASING

It should be noted that Phases 1 - 4 are to have been completed prior to the commencement of the proposed expansion, in accordance with an existing approved RLMP (JWA 2021). Therefore, the Concept RLMP provides details of Phases 5 – 11.

Prior to the commencement of rehabilitation works within each phase, a phase specific RLMP will be prepared to provide site specific guidance for the rehabilitation and management of the land to be restored. The phase specific RLMPs will be consistent with the strategies outlined in Concept RLMP and/or current best practice methods.

6.2.3.2 Monitoring and Reporting

Rehabilitation monitoring

Monitoring and reporting is critical in ensuring the continuing success of restoration works and will be carried out for the duration of project in accordance with the requirements of the Concept RLMP. To assess the success of rehabilitation works, vegetation assessments will be completed by a suitably qualified ecologist using plot-based vegetation surveys (transects and quadrats) and photo point monitoring. In addition, the rehabilitation team will also maintain records of works completed. The methodology to be used to monitor the rehabilitation works is outlined in the Concept RLMP.

Assessment of Biological Indicators

To assess the suitability of the extraction lakes and Rehabilitation Areas for terrestrial and aquatic fauna, assessments of biological indicators (fish, birds, and macroinvertebrates) will also be undertaken by suitably qualified persons using the methodology outlined in the Concept RLMP.

Monitoring of birds will be completed annually. Monitoring of fish and macroinvertebrates will be monitored at the end of each extraction phase.

Water quality monitoring

Water quality in the extraction lake will be monitored on a biannual basis in accordance with the Soil and Water Management Plan (G&S 2021c). Details of the water quality parameters to be tested and the water quality objectives to be met are outlined in the Soil and Water Management Plan (G&S 2021c).

Reporting

An Annual Rehabilitation Monitoring Report will be prepared which discusses the results of the monitoring of retained vegetation and rehabilitation areas against the Monitoring Performance Criteria identified in the Concept RLMP.

Each Annual Rehabilitation Monitoring Report will be included in the Annual Environmental Monitoring Report (AEMR) which is submitted to the Department of Planning, Industry and Environment (DPIE) as part of the current sand extraction licencing requirements.

7 BIODIVERSITY CREDIT REPORT

7.1 Introduction

Ecosystem credit and species credit obligations have been apportioned on a phase-by-phase basis. However, as previously discussed, due to the long-term nature of the proposed expansion, this BDAR has been prepared to provide overarching offsetting requirements associated with the proposed sand extraction works on a phase-by-phase basis. Prior to the commencement of sand extraction works within each phase, a phase specific BDAR (or assessment in line with the relevant legislation at that time) will be prepared to accurately assess impacts and offset obligations.

7.2 Ecosystem Credits

A total of 153 ecosystem credits have been calculated as applicable for the unavoidable loss of site vegetation as follows:

- **PCT 1235** - Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion = **72 credits**
- **PCT 1064** - Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion = **21 credits**
- **PCT 1808** – Estuarine reedland = **60 credits**

Offsets have been apportioned on a phase-by-phase basis (**TABLE 9**). Refer to the BAM Biodiversity Credit Report (**APPENDIX 5**) for further details. These credits will need to be purchased or retired as an offset for the removal of site vegetation.

7.3 Species Credits

A total of 157 species credit for threatened species have been calculated as applicable for the unavoidable loss of site vegetation as follows:

- Southern Myotis (*Myotis macropus*) = **157 credits.**

Offsets have been apportioned on a phase-by-phase basis (**TABLE 10**). Refer to the BAM Biodiversity Credit Report (**APPENDIX 5**) for further details. These credits will need to be purchased or retired as an offset for the removal of site vegetation.

TABLE 9
ECOSYSTEM CREDIT OFFSET OBLIGATIONS (PHASE-BY-PHASE)

Ecosystem Credits	Credit Requirement							
	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11	TOTAL
PCT 1235 - Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion (Vegetation Zones 1, 2 & 5)	8	42	3	4	3	12	0	**72**
PCT 1064 - Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion (Vegetation Zone 3)	0	0	0	0	0	21	0	**21**
PCT 1808 – Estuarine reedland (Vegetation Zone 6)	33	27	0	0	0	0	0	**60**
TOTAL								**153**

TABLE 10
SPECIES CREDIT OFFSET OBLIGATIONS (PHASE-BY-PHASE)

Vegetation Community	Area to be Removed							
	Phase 5	Phase 6	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11	TOTAL
Southern Myotis (*Myotis macropus*)	46	78	3	4	3	23	0	**157**

APPENDIX 1 – ADAM MCARTHUR CV

Curriculum Vitae

JWA PTY LTD
Ecological Consultants
ABN 56 066 448 879

ADAM MCARTHUR

DIRECTOR / PRINCIPAL ECOLOGIST

Biography

Adam has over 19 years' experience as an ecological consultant/environmental scientist throughout NSW and Qld and is an accredited assessor to apply the Biodiversity Assessment Methodology (BAM) in accordance with the requirements of the NSW *Biodiversity Conservation Regulation 2017* (Certification No.: BAAS18069).

In addition to aptitude in a broad environmental management role, he possesses expertise in wildlife biology and is also proficient in flora and fauna assessments and vegetation mapping. He has prepared baseline ecological surveys, impact assessments, rehabilitation plans, offset assessments/offset area management plans, bushfire assessments, due diligence investigations and threatened species management plans. He has completed environmental monitoring programs and compliance audits for numerous urban development, resource extraction and linear infrastructure projects.

Adam has managed teams of scientists, coordinated numerous ecological field surveys and authored/reviewed/approved countless technical reports.

Adam is proficient in the assessment of local government planning schemes, State and Commonwealth legislation, including the preparation of referrals under the EPBC Act, responses to Information Requests, and also the preparation of court evidence.

Adam's work has contributed to several major projects including:

- Altitude Aspire – prepared ecological assessment, vegetation and rehabilitation management plans including a *Macadamia tetraphylla* translocation plan and a Biodiversity Development Assessment Report (BDAR) as part of a Master Planned Residential Community at Tweed Heads, northern NSW.
- Altitude Central - prepared an ecological assessment including detailed flora and fauna surveys, and a Biodiversity Development Assessment Report (BDAR) as part of a Master Planned Development at Tweed Heads, northern NSW.
- Kings Forest – prepared ecological assessments, EPBC referrals, targeted flora and fauna surveys and various management plans for a 10,000 dwelling Master Planned Development near Kingscliff, northern NSW.
- Cobaki Estate - prepared ecological assessments, EPBC referrals, targeted flora and fauna surveys, and various management plans for a 5,500 dwelling Master Planned Development near Tweed Heads, northern NSW.

Curriculum Vitae

JWA PTY LTD
Ecological Consultants
ABN 56 066 448 879

ADAM MCARTHUR

DIRECTOR / PRINCIPAL ECOLOGIST

- Coolum Ridges – prepared ecological assessments and various management plans, and implemented a detailed monitoring program for threatened flora and fauna species for a 1,500 lot Master Planned Development on the Sunshine Coast, QLD.
- Peregian Springs - prepared and implemented a detailed monitoring program for threatened flora and fauna species for a 1,500 lot Master Planned Development on the Sunshine Coast, QLD.
- Pacific View Estate Residential Development - prepared ecological constraints assessments including targeted surveys for threatened flora and fauna species, and assisted in the identification, securing and preparation of management plans for potential vegetation offsets for a 340ha site on the Gold Coast, QLD.
- Flinders Grove – prepared ecological constraints assessments including targeted surveys for threatened flora and fauna species over a 4,000ha site within the Greater Flagstone Structure Plan Area, QLD.

Expertise

- Flora Survey, Vegetation Mapping and Conservation Assessment
- Ecological Assessment Reporting/Impact Assessment
- Licensing and Approvals (State and Federal)
- Wildlife Ecology and Management
- Threatened Species Survey and Management
- Environmental Monitoring
- Offset Management Strategies

Education

2002 Bachelor of Applied Science (Environmental Resource Management)
Southern Cross University, Lismore NSW

Short Courses and Qualifications

- Biocondition Assessment training – Determining equivalency in habitats (Queensland Herbarium)
- Regional Ecosystem training – Identification and classification of regional ecosystems in QLD and vegetation condition assessment (Queensland Herbarium)
- Advanced first aid certificate

Curriculum Vitae

JWA PTY LTD
Ecological Consultants
ABN 56 066 448 879

ADAM MCARTHUR

DIRECTOR / PRINCIPAL ECOLOGIST

- 4x4 driving and recovery course
- Blue card (Course in General Safety Induction – Construction Industry)
- GIQ Coal Safety Induction – Standard 11 (Surface)
- Venomous snake handling
- Translocation of threatened plants
- Environmental Expert training course
- Chainsaw operations (Level 1)
- Occupational Health and Safety in the workplace
- Wildlife Rescue and Rehabilitation – Basic Training

Relevant Professional Experience

July 2017 – Present	Director/Principal Ecologist JWA Pty Ltd
March 2015 – June 2017	Principal Ecologist/Qld Operations Manager JWA Pty Ltd
July 2014 – March 2015	Senior Environmental Scientist DFS Group
March 2014 – June 2014	Environmental Advisor (Contract) Northern Stevedoring Services
May 2012 – March 2014	Senior Environmental Scientist RPS Group
Sept 2007 – April 2012	Senior Environmental Scientist James Warren & Associates
July 2004 – August 2007	Environmental Scientist James Warren & Associates

Professional Memberships

Member of the Ecological Society of Australia (MESA)

CERTIFICATE OF ACCREDITATION AS A BIODIVERSITY ASSESSMENT METHOD ASSESSOR under the *Biodiversity Conservation Act 2016* (NSW)

BAM Assessor		
Adam Michael McArthur		
Accreditation number	**Accreditation date (Date of issue)**	**Expiry Date of**
BAAS18069	5 April 2018	4 April 2022

The person named above is accredited under section 6.10 of the *Biodiversity Conservation Act 2016* (NSW) (**BC Act**) as a Biodiversity Assessment Method Assessor to apply the Biodiversity Assessment Method in connection with the preparation of biodiversity stewardship site assessment reports, biodiversity development assessment reports and biodiversity certification assessment reports pursuant to Part 6 of the BC Act.

The accreditation is in force until and including the Expiry Date. The accreditation is subject to the conditions set out in the *Accreditation Scheme for the Application of the Biodiversity Assessment Method*, under the BC Act, and the conditions specified on the reverse of this certificate.

DEREK RUTHERFORD

Director Conservation Programs Branch
Department of Planning, Industry & Environment

NOTES

- DPIE maintains a register of Accredited Biodiversity Assessment Method (BAM) Assessors accessible from the DPIE website.
- The BAM Assessor's accreditation expires on the Expiry Date unless renewed in accordance with the *Accreditation Scheme for the Application of the Biodiversity Assessment Method*. It is the BAM Assessor's responsibility to monitor the Expiry Date of their accreditation, and apply for any renewal with sufficient time for the application to be processed prior to the Expiry Date.
- Words and expressions used in this accreditation instrument and which are also used in the Act have the same meaning.

Southern Cross University

Adam Michael McArthur

having fulfilled the conditions prescribed by

the University is this day admitted to the degree of

Bachelor of Applied Science

Given under the Common Seal of
Southern Cross University on the

11th April, 2003

Chancellor

Vice-Chancellor

Council Secretary

20008696

APPENDIX 2 – BAM DATA SHEETS

-This document has not been endorsed or approved by Office of Environment and Heritage or Muddy Boots Environmental Training-

BAM Site – Field Survey Form

Site Sheet no:

		Survey Name	Zone ID	Recorders			
Date	27 8 20	Tweed Sand Plant		NG			
Zone 56	Datum	Plot ID	1	Plot dimensions	100 x 10	Photo #	
Easting 552332	Northing 6872654	IBRA region		Midline bearing from 0 m	90°		
Vegetation Class						Confidence: H M L	
Plant Community Type	Swamp oak / wetland in drainage channel			EEC:		Confidence: H M L	

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

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	3
	Shrubs	0
	Grasses etc.	7
	Forbs	1
	Ferns	1
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	21.2
	Shrubs	0
	Grasses etc.	38
	Forbs	0.2
	Ferns	1
	Other	0
High Threat Weed cover		0.7

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

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

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

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

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

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

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

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 27 8 20	Tweed Sand	1	MT

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
T	Swamp oak		15			
T	BL Paperbark		6			
G	Eleocharis sphacelata.		7			
	Nymphaea caerulea	E	5			
G	Couch		30			
	Carpet grass.	E	20			
	Fireweed	HTE	0.2	20		
	Coastal morning glory	HTE	0.5	10		
	Columbian waterweed	E	0.1	20		
Fern	Azzolla pinnata		1	100		
G	Cyperus polystachyos.		0.1	12		
Forb	Wandering Jew		0.1	20		
T	Acacia melanoxylon.		0.2	1		
G	Phragmites australis		0.1	8		
G	Triangle club rush.		0.1	10		
G	Juncus ~~usitatus~~ mollis		0.5	30		
G	Typha.		0.2	20		
	Setaria	E	10			
	clover	E	0.1	10.		

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

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

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

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BAM Site – Field Survey Form

Site Sheet no:

		Survey Name	Zone ID	Recorders			
Date	27 8 20	Tweed Sand Plant		MT			
Zone 56	Datum	Plot ID	2	Plot dimensions	100 x 10	Photo #	
Easting 552328	Northing 6873183	IBRA region		Midline bearing from 0 m	85°		
Vegetation Class						Confidence: H M L	
Plant Community Type	Swamp oak / mangrove			EEC:		Confidence: H M L	

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

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	5
	Shrubs	0
	Grasses etc.	1
	Forbs	1
	Ferns	0
	Other	2
Sum of Cover of native vascular plants by growth form group	Trees	46.2
	Shrubs	0
	Grasses etc.	10
	Forbs	1
	Ferns	0
	Other	1.2
High Threat Weed cover		13.8

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

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

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

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	85 90 75 60 80			
Average of the 5 subplots	78			

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

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

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

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 27 8 20	Tweed Sand	2	M

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
T	Swamp oak		30			
T	Grey mangrove		5			
	Lantana	HTE	8			
	Fireweed	HTE	0.2	20		
T	Tuckeroo		10			
	Sotanum seaforthianum	HTE	0.1	10		
	Paddys lucerne	E	0.1	20		
	Annual ragweed	E	0.1	20		
	Corky passionfruit	HTE	0.2			
	Coastal morning glory	HTE	0.2	15		
O	Cockspur		1	10		
	Signal grass	E	2			
	Ground asparagus	HTE	5			
G	Common couch		10			
	Setaria	E	0.5	20		
	Sivatro	E	0.1	3		
T	Red kamala		0.2	3		
O	Scrambling lily		0.2	8		
T	Guioa		1	4		
Forb	Tetragonia tetragonoides		1	20		
	Rhodes grass	HTE	0.1	5		

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

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

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

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BAM Site – Field Survey Form

Site Sheet no:

Date	27 8 20	Survey Name	Tweed Sand Plant	Zone ID		Recorders	MT		
Zone	Datum	Plot ID	3	Plot dimensions	100 x 10	Photo #			
Easting	Northing	IBRA region		Midline bearing from 0 m	345°				
552724	6873957								
Vegetation Class								Confidence: H M L	
Plant Community Type	Mangrove / Swamp oak			EEC:				Confidence: H M L	

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

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	2
	Shrubs	0
	Grasses etc.	2
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	30
	Shrubs	0
	Grasses etc.	6
	Forbs	0.1
	Ferns	0
	Other	0
High Threat Weed cover		0.1

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

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

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

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

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

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

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

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

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400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 27 8 20	Tweed Sand	3	MT

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
T	Grey mangrove		20			
T	Swamp bak		10			
G	Setaria	E	5			
	Parramatta grass	E	1			
G	Cyperus polystachyos		1	20		
G	Common couch		5			
	Fireweed	HTE	0.1	10		
Forb	Triglochin striatum		0.1	2		

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

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

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

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BAM Site – Field Survey Form

Site Sheet no: 1 of ____

		Survey Name	Zone ID	Recorders			
Date	27/10/20	TWEED SAND	PLANT	AM			
Zone	Datum	Plot ID	4	Plot dimensions		Photo #	
56							
Easting	Northing	IBRA region	In m	Midline bearing from 0 m	290	Magnetic °	
552945	6874690						
Vegetation Class		Forested wetland				Confidence: H M L	
Plant Community Type		Paperbark forest		EEC:		Confidence: H M L	

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

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	7
	Shrubs	3
	Grasses etc.	2
	Forbs	1
	Ferns	2
	Other	6
Sum of Cover of native vascular plants by growth form group	Trees	69.7
	Shrubs	1.4
	Grasses etc.	5.5
	Forbs	30
	Ferns	5.5
	Other	14.6
High Threat Weed cover		73.5

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	1	0
50 – 79 cm	1	0
30 – 49 cm	✓	
20 – 29 cm	✓	
10 – 19 cm		
5 – 9 cm		
< 5 cm	✓	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	36m Tally space	

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

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

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	80	85	65	95	85	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	76																			

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

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

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

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

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400 m² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	27/10/20	TWEED SAND PLANT	4	AM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
T	1 Melaleuca quinquenervia	N	65%			
	2 Cinnamomum camphora	HTE	65%			
T	3 whalebone tree		2%	5		
	4 Broad-leaved paspalum	E	60%			
Forb	5 Centella asiatica		30%			
Grass	6 Tassel sedge		5%			
	7 Giant devils fig	E	1%	11		
Other	8 Scrambling lily		5%			
Other	9 Prickly smilax		5%			
T	10 Cheese tree		0.5%	2		
T	11 Foambark		1%	4		
T	12 Waterhousea floribunda		0.1%	1		
~~Other~~	13 Coastal morning glory	HTE	2%	20		
Other	14 Cockspur thorn		2%	10		
	15 Umbrella tree	HTE	1%	5		
	16 Murraya paniculata	E	0.1%	1		
	17 Ochna serrulata	HTE	5%			
Other	18 Burny vine		2%	20		
S	19 Coffee bush		0.2%	3		
S	20 Muttonwood		0.2%	10		
	21 Asparagus fern	HTE	0.5%	10		
T	22 Tuckeroo		0.1%	1		
Fern	23 Binung		5%			
Other	24 Bangalow palm		0.5%	5		
S	25 Creek sandpaper fig		1%	10		
T	26 Guioa		1%	3		
Fern	27 Bracken		0.5%	20		
Grass	28 Entolasia		0.5%	50		
Other	29 Whip vine		0.1%	2		
	30 Cocos palm	E	0.1%	1		
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

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

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

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

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BAM Site – Field Survey Form

Site Sheet no: 1 of

Survey Name	Zone ID	Recorders
TWEED SAND PLANT		AM

Date	Zone	Datum	Plot ID	Plot dimensions		Photo #	
27/10/20			5				

Easting	Northing	IBRA region		Midline bearing from 0 m		Magnetic °
552511	6872451	In m			25	

Vegetation Class	Wetland		Confidence: H M L
Plant Community Type	Rushland	EEC:	Confidence: H M L

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

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	6
	Forbs	0
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	80.4
	Forbs	0
	Ferns	0
	Other	0
High Threat Weed cover		0

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

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

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

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e	a	b	c	d	e
Average of the 5 subplots	0																			

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

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

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

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

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

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

-This document has not been endorsed or approved by Office of Environment and Heritage or Muddy Boots Environmental Training-

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 27/10/20	TWEED SAND	5	AM

GF Code	*Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable*	N, E or HTE	Cover	Abund	stratum	voucher
G	1 Typha	N	75			
	2 Setaria	E	5			
G	3 Triangle club rush	N	0.1	20		
G	4 Phragmites australis	N	0.1	10		
G	5 Cyperus polystachyos	N	0.1	5		
G	6 Couch grass	N	5			
G	7 Eleocharis sphacelata	N	0.1	5		
	8					
	9					
	10					
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
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	35					
	36					
	37					
	38					
	39					
	40					

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

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

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

APPENDIX 3 – BAM PREDICTED SPECIES REPORT

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00022641/BAAS18069/20/00022642	Tweed Sand Plant	10/06/2021
Assessor Name	Report Created	BAM Data version *
Adam Michael McArthur	25/10/2021	45
Assessor Number	Assessment Type	BAM Case Status
BAAS18069	Major Projects	Finalised
Assessment Revision		Date Finalised
0		25/10/2021

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

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

Common Name	Scientific Name	Vegetation Types(s)
Australasian Bittern	Botaurus poiciloptilus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Australian Painted Snipe	Rostratula australis	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1808-Estuarine reedland
Barking Owl	Ninox connivens	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Barred Cuckoo-shrike	Coracina lineata	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Black Bittern	Ixobrychus flavicollis	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

Black Bittern	Ixobrychus flavicollis	1808-Estuarine reedland
Black-necked Stork	Ephippiorhynchus asiaticus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Dusky Woodswallow	Artamus cyanopterus cyanopterus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Eastern Osprey	Pandion cristatus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Freckled Duck	Stictonetta naevosa	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Glossy Black-Cockatoo	Calyptorhynchus lathami	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
Grey-headed Flying-fox	Pteropus poliocephalus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Hoary Wattled Bat	Chalinolobus nigrogriseus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Koala	Phascolarctos cinereus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

Large Bent-winged Bat	Miniopterus orianae oceanensis	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Little Bent-winged Bat	Miniopterus australis	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Little Eagle	Hieraaetus morphnoides	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Little Lorikeet	Glossopsitta pusilla	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
New Holland Mouse	Pseudomys novaehollandiae	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Northern Free-tailed Bat	Ozimops lumsdenae	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Powerful Owl	Ninox strenua	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Regent Honeyeater	Anthochaera phrygia	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Spotted Harrier	Circus assimilis	1808-Estuarine reedland
Spotted-tailed Quoll	Dasyurus maculatus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Square-tailed Kite	Lophoictinia isura	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion

Square-tailed Kite	Lophoictinia isura	1808-Estuarine reedland
Superb Fruit-Dove	Ptilinopus superbus	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Swift Parrot	Lathamus discolor	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Terek Sandpiper	Xenus cinereus	1808-Estuarine reedland
Varied Sittella	Daphoenositta chrysoptera	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
White-bellied Sea-Eagle	Haliaeetus leucogaster	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
White-throated Needletail	Hirundapus caudacutus	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
		1808-Estuarine reedland
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion
		1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Common Name	Scientific Name	Plant Community Type(s)
Australasian Bittern	Botaurus poiciloptilus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Australian Painted Snipe	Rostratula australis	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Barking Owl	Ninox connivens	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Barred Cuckoo-shrike	Coracina lineata	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Bar-tailed Godwit (baueri)	Limosa lapponica baueri	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Black Bittern	Ixobrychus flavicollis	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

Black-necked Stork	Ephippiorhynchus asiaticus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Black-tailed Godwit	Limosa limosa	1808-Estuarine reedland
Broad-billed Sandpiper	Limicola falcinellus	1808-Estuarine reedland
Brolga	Grus rubicunda	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Comb-crested Jacana	Irediparra gallinacea	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Curlew Sandpiper	Calidris ferruginea	1808-Estuarine reedland
Dusky Woodswallow	Artamus cyanopterus cyanopterus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Eastern Curlew	Numenius madagascariensis	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Eastern Osprey	Pandion cristatus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Freckled Duck	Stictonetta naevosa	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Glossy Black-Cockatoo	Calyptorhynchus lathami	1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion
Large Bent-winged Bat	Miniopterus orianae oceanensis	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Little Eagle	Hieraaetus morphnoides	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Magpie Goose	Anseranas semipalmata	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
New Holland Mouse	Pseudomys novaehollandiae	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Northern Free-tailed Bat	Ozimops lumsdenae	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Red Knot	Calidris canutus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Sanderling	Calidris alba	1808-Estuarine reedland
Spotted Harrier	Circus assimilis	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

Spotted-tailed Quoll	Dasyurus maculatus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Terek Sandpiper	Xenus cinereus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
White-bellied Sea-Eagle	Haliaeetus leucogaster	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
White-throated Needletail	Hirundapus caudacutus	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	780-Coastal floodplain sedgelands, rushlands, and forblands of the North Coast

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C
Bar-tailed Godwit (baueri)	Limosa lapponica baueri	Habitat constraints
Black-tailed Godwit	Limosa limosa	Habitat constraints
Broad-billed Sandpiper	Limicola falcinellus	Habitat constraints Geographic limitations
Brolga	Grus rubicunda	Refer to BAR
Comb-crested Jacana	Irediparra gallinacea	Habitat constraints
Curlew Sandpiper	Calidris ferruginea	Habitat constraints
Eastern Curlew	Numenius madagascariensis	Habitat constraints
Magpie Goose	Anseranas semipalmata	Refer to BAR
Red Knot	Calidris canutus	Habitat constraints
Sanderling	Calidris alba	Habitat constraints

APPENDIX 4 - BAM CANDIDATE SPECIES REPORT

BAM Candidate Species Report

Proposal Details

Assessment Id 00022641/BAAS18069/20/00022642	Proposal Name Tweed Sand Plant	BAM data last updated * 10/06/2021
Assessor Name Adam Michael McArthur	Report Created 25/10/2021	BAM Data version * 45
Assessor Number BAAS18069	Assessment Type Major Projects	BAM Case Status Finalised
Assessment Revision 0	Date Finalised 25/10/2021	

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

List of Species Requiring Survey

Name	Presence	Survey Months
Acacia bakeri Marblewood	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Acronychia littoralis Scented Acronychia	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Allocasuarina defungens Dwarf Heath Casuarina	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Archidendron hendersonii White Lace Flower	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Arthraxon hispidus Hairy Jointgrass	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Cassia marksiana Cassia marksiana	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Centranthera cochinchinensis Swamp Foxglove	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Crinia tinnula Wallum Froglet	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Cyperus aquatilis Water Nutgrass	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Davidsonia jerseyana Davidson's Plum	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Dendrobium melaleucaphilum Spider orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Desmodium acanthocladum Thorny Pea	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Diospyros mabacea Red-fruited Ebony	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Diospyros yandina Shiny-leaved Ebony	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Diploglottis campbellii Small-leaved Tamarind	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Drynaria rigidula Basket Fern	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Eleocharis tetraquetra Square-stemmed Spike-rush	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Endiandra muelleri subsp. bracteata Green-leaved Rose Walnut	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Floydia praealta Ball Nut	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Geodorum densiflorum Pink Nodding Orchid	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Gossia fragrantissima Sweet Myrtle	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Grevillea hilliana White Yiel Yiel	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Isoglossa eranthemoides Isoglossa	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Lindsaea fraseri Fraser's Screw Fern	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Litoria brevipalmata Green-thighed Frog	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Litoria olongburensis Olongburra Frog	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Macadamia tetraphylla Rough-shelled Bush Nut	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Myotis macropus Southern Myotis	Yes (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Myrsine richmondensis Ripple-leaf Muttonwood	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Oberonia complanata Yellow-flowered King of the Fairies	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Oberonia titania Red-flowered King of the Fairies	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Ochrosia moorei Southern Ochrosia	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Oldenlandia galioides Oldenlandia galioides	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Peristeranthus hillii Brown Fairy-chain Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Petalura litorea Coastal Petaltail	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Phaius australis Southern Swamp Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Phascolarctos cinereus - endangered population Koala population between the Tweed River and Brunswick River east of the Pacific Highway	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Phyllanthus microcladus Brush Sauropus	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Syzygium hodgkinsoniae Red Lilly Pilly	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Syzygium moorei Durobby	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Thersites mitchellae Mitchell's Rainforest Snail	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Barking Owl	Ninox connivens	Habitat constraints
Bar-tailed Godwit (baueri)	Limosa lapponica baueri	Habitat degraded
Black-tailed Godwit	Limosa limosa	Habitat degraded
Broad-billed Sandpiper	Limicola falcinellus	Habitat degraded Geographic limitations
Brush-tailed Phascogale	Phascogale tapoatafa	Habitat degraded
Common Planigale	Planigale maculata	Habitat degraded
Curlew Sandpiper	Calidris ferruginea	Habitat degraded
Eastern Curlew	Numenius madagascariensis	Habitat degraded
Eastern Osprey	Pandion cristatus	Habitat constraints
Eastern Pygmy-possum	Cercartetus nanus	Habitat degraded
Glossy Black-Cockatoo	Calyptorhynchus lathami	Habitat constraints
Grey-headed Flying-fox	Pteropus poliocephalus	Habitat constraints
Koala	Phascolarctos cinereus	Habitat constraints
Laced Fritillary	Argynnis hyperbius	Habitat constraints Geographic limitations
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat constraints

Large-eared Pied Bat	Chalinolobus dwyeri	Habitat constraints
Little Bent-winged Bat	Miniopterus australis	Habitat constraints
Little Eagle	Hieraaetus morphnoides	Habitat constraints
Pale-headed Snake	Hoplocephalus bitorquatus	Habitat degraded
Powerful Owl	Ninox strenua	Habitat constraints
Red Knot	Calidris canutus	Habitat degraded
Regent Honeyeater	Anthochaera phrygia	Habitat constraints
Sanderling	Calidris alba	Habitat degraded
Square-tailed Kite	Lophoictinia isura	Habitat constraints
Squirrel Glider	Petaurus norfolcensis	Habitat degraded
Swift Parrot	Lathamus discolor	Habitat constraints
Terek Sandpiper	Xenus cinereus	Habitat degraded Geographic limitations
White-bellied Sea-Eagle	Haliaeetus leucogaster	Habitat constraints
White-crowned Snake	Cacophis harriettae	Habitat constraints

APPENDIX 5 – BAM BIODIVERSITY CREDIT REPORT

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00022641/BAAS18069/20/00022642

Proposal Name
Tweed Sand Plant

BAM data last updated *
10/06/2021

Assessor Name
Adam Michael McArthur

Assessor Number
BAAS18069

BAM Data version *
45

Proponent Names

Report Created
25/10/2021

BAM Case Status
Finalised

Assessment Revision
0

Assessment Type
Major Projects

Date Finalised
25/10/2021

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

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Nil

Additional Information for Approval

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Anseranas semipalmata / Magpie Goose
Grus rubicunda / Brolga
Irediparra gallinacea / Comb-crested Jacana
Calidris alba / Sanderling
Calidris ferruginea / Curlew Sandpiper
Limicola falcinellus / Broad-billed Sandpiper
Limosa limosa / Black-tailed Godwit
Numenius madagascariensis / Eastern Curlew
Calidris canutus / Red Knot
Limosa lapponica baueri / Bar-tailed Godwit (baueri)

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

BAM Biodiversity Credit Report (Like for like)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	3.5	0	72	72
1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.8	0	21	21
1808-Estuarine reedland	Not a TEC	1.6	0	60	60

1064-Paperbark swamp forest of the coastal lowlands of the NSW North Coast Bioregion and Sydney Basin Bioregion

Like-for-like credit retirement options

Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1064_Phase_10	No	21	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1235-Swamp Oak swamp forest of the coastal lowlands of the NSW North Coast Bioregion	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Phase_5	No	8	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Phase_10	No	12	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Mangroves_Phase_6	No	12	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Mangroves_Phase_7	No	1	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Phase_6	No	6	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Phase_7	No	2	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Phase_8	No	4	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Phase_9	No	3	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions This includes PCT's: 837, 839, 926, 971, 1064, 1092, 1227, 1230, 1231, 1232, 1235, 1649, 1715, 1716, 1717, 1718, 1719, 1721, 1722, 1723, 1724, 1725, 1730, 1795, 1798	-	1235_Rehab_Phase_6	No	24	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1808-Estuarine reedland	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

Coastal Freshwater Lagoons This includes PCT's: 781, 782, 783, 1071, 1735, 1736, 1737, 1738, 1740, 1741, 1742, 1808, 1911	Coastal Freshwater Lagoons <50%	1808_Rehab_Phase_5_	No	33	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Coastal Freshwater Lagoons This includes PCT's: 781, 782, 783, 1071, 1735, 1736, 1737, 1738, 1740, 1741, 1742, 1808, 1911	Coastal Freshwater Lagoons <50%	1808_Rehab_Phase_6	No	27	Burringbar-Conondale Ranges, Scenic Rim and Sunshine Coast-Gold Coast Lowlands. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Like for like)

Species	Vegetation Zone/s	Area / Count	Credits
Myotis macropus / Southern Myotis	**1235_Phase_5, 1235_Phase_10, 1235_Mangroves_Phase_6, 1235_Mangroves_Phase_7, 1064_Phase_10, 1235_Phase_6, 1235_Phase_7, 1235_Phase_8, 1235_Phase_9, 1808_Rehab_Phase_5_, 1808_Rehab_Phase_6, 1235_Rehab_Phase_6**	5.2	157.00

Credit Retirement Options

Like-for-like credit retirement options

	Spp	IBRA subregion
Myotis macropus / Southern Myotis	**Myotis macropus /** Southern Myotis	Any in NSW