

## Karuah East Quarry Biodiversity Offset Strategy

Prepared for Karuah East Quarry Pty Ltd

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# Abbreviations

ABBREVIATION	DESCRIPTION
APZ	Asset Protection Zone
BAMCCOM	BioBanking Assessment Methodology and Credit Calculator Operational Manual
BBAM	BioBanking Assessment Methodology
BOS	Biodiversity Offset Strategy
CMA	Catchment Management Authority
DECC	Department of Environment & Climate Change (now OEH)
DP	Development Plan
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
GIS	Geographic Information System
GLC	Great Lakes Council
GPS	Global Positioning System
KEQ	Karuah East Quarry
LGA	Local Government Area
LEP	Local Environmental Plan
MZ	Management Zone
OEH	NSW Office of Environment and Heritage
SSD	State Significant Development
VZ	Vegetation Zone

## 1 Introduction

## 1.1 BACKGROUND AND PURPOSE OF THE OFFSET STRATEGY

Karuah East Quarry Pty Ltd (KEQ) propose to construct a quarry at Karuah in Great Lakes Local Government Area. The proposal is being assessed as a transitional Part 3A project under the provisions of the Environmental Planning and Assessment Act 1979.

To offset the biodiversity impacts of the quarry the proponent has committed to improve the condition and protect in perpetuity an area of 129 hectares of vegetation and habitat for threatened species on land adjoining the impact site. This Offset Strategy describes the land, its ecological values and the management strategies for its improvement.

The NSW Biobanking Assessment Methodology (BBAM) has been used to describe the site and quantify the ecological benefits of its conservation. The mechanism proposed to ensure protection and management of the site is a Conservation Agreement under the National Parks and Wildlife Act 1974.

## 1.2 **OFFSET SITE LOCATION**

The proposed KEQ offset site consists of three land parcels: Part Lot 13 DP 1024564 and Lot 14 DP 1024564 – Pacific Highway, Karuah in addition to Lot 5 DP 838128 The Branch Lane, Karuah. All three Lots are located in the Great Lakes Local Government Area (LGA). Lots 13 and 14 are in the ownership of KEQ. An option over Lot 5 is currently being negotiated by the proponent and the owner of Lot 5, and this is expected to be finalised in the very near future. At this time, the NSW DoPI will be notified in writing.

Access to Lot 5 is primarily from the north via The Branch Lane, while both Lots 13 and 14 are accessed by gated vehicular tracks from the Pacific Highway in the south. The combined site covers an area of 135.57 ha comprising both the 129 ha of remnant native vegetation and approximately 6.5 ha of cleared and modified lands that contain two existing dwellings, access roads and infrastructure.

## 1.3 **BIOPHYSICAL CHARACTERISTICS OF THE OFFSET SITE**

The site is located on the Lower North Coast of NSW. The site is overall undulating, but varies in slope and aspect considerably. Numerous steep, sometimes rocky, slopes and creek gullies are evident, particularly in the southern and central portions of Lot 5. The site has generally much lower relief in the southern section (Lots 13 and 14) which is generally sloping toward the Pacific Highway in the south with a more meandering watercourse and drainage line system. One main geology type occurs within and surrounding the site. The site is situated on the Nerong Volcanics which is dominated by rhyodacitic ignimbrite and comprises ignimbrite interbedded with tuffaceous sandstone and conglomerate. This soil landscape is characterised by colluvial (steeper slopes and ridgelines) and alluvial (lower elevations and watercourses) areas. The distribution of the dominant vegetation types supported in the site is closely related to the distribution of these two soil landscapes.

The site provides part of a contiguous patch of vegetation that provides as an important habitat corridor and habitat area to the north of and adjacent to Karuah Nature Reserve. The linkages are disturbed in the south by the upgraded Pacific Highway and to a lesser extent in the north and west by The Branch Lane. Vegetation links to the east are present although the remnant vegetation is fragmented through the presence of pastures for grazing, although remnant vegetation is present along major watercourses. Several drainage lines intersect the site, generally flowing either from north to south-east in the southern portion of site and from south to north in the northern section of site (Lot 5). Hollow-bearing trees are scattered across the site, particularly along the larger watercourses where large hollows are evident. Larger hollows in living trees and stags were more commonly encountered in Lot 5 than in the other two lots. Fallen trees and timber are relatively common across all parts of the combined site, providing high quality habitat for ground-dwelling fauna.

A higher abundance and diversity of weed species occurs in the eastern portion of the site (mainly pasture grasses) adjacent to the grazing lands. Weed species also occur in high densities along the north-south power easement alignment and along some vehicle tracks. Other woody weeds (e.g. *Lantana camara*) are generally widely, but sporadically disbursed across the site, although at times becoming more dense in gullies and within and adjacent to watercourses. No obvious evidence of use of the site by feral animals was observed, although it is anticipated that species such as rabbits and foxes may be present in the vicinity.



#### Figure 1: Study Area



Figure 2: Offset Site Boundary

## 1.4 LAND USE ZONING

The land use zoning of the proposed Offset site is currently 1(a) Rural Zone. Under the Draft Great Lakes Local Environmental Plan (LEP), 2013 the site is proposed to be zoned RU2 Rural Landscape. Within the RU2 zone, the following uses are proposed to be permitted with consent:

Agriculture; Airports; Airstrips; Animal boarding or training establishments; Backpackers' accommodation; Bed and breakfast accommodation; Boat launching ramps; Boat sheds; Camping grounds; Caravan parks; Cellar door premises; Cemeteries; Charter and tourism boating facilities; Child care centres; Community facilities; Correctional centres; Crematoria; Depots: Dual occupancies (attached): Dwelling houses: Eco-tourist facilities: Educational establishments; Environmental facilities; Environmental protection works; Exhibition homes; Extractive industries, Farm buildings; Farm stay accommodation; Flood mitigation works; Forestry; Hazardous storage establishments; Helipads; Heliports; Home-based child care; Home businesses; Hotel or motel accommodation; Industrial training facilities; Industries; Information and education facilities; Jetties; Kiosks; Landscaping material supplies; Marinas; Mooring pens; Moorings; Offensive storage establishments; Places of public worship; Plant nurseries; Public administration buildings; Recreation areas; Recreation facilities (indoor); Recreation facilities (major); Recreation facilities (outdoor); Registered clubs; Research stations; Roads; Roadside stalls; Rural industries; Rural supplies; Secondary dwellings; Sewerage systems; Signage; Transport depots: Truck depots: Veterinary hospitals: Water recreation structures: Water supply systems; Wharf or boating facilities

## 1.5 SITE HISTORY AND CURRENT USES OF PROPERTY

The site was previously subject to logging / timber getting and cattle grazing regimes, although both practices have ceased on all three lots. Lots 13 and 14 are currently owned and managed by Karuah East Quarry, with Lot 5 currently in separate private ownership. Lots 14 and 5 both have residences with vehicle access to adjacent roads. Lot 5 also contains a power easement servicing the residence near The Branch Lane, running north-south and bisecting the lot. A network of old logging and fire trails are evident across all lots.

## 1.6 SURROUNDING LAND USES

The site is bounded by rural grazing properties to the north and east, where much of the remnant native vegetation has been removed, leaving primarily vegetation dominated by pasture grasses. To the south the upgraded Pacific Highway borders the site with Karuah Nature Reserve and other vegetated properties located beyond. Adjacent to the west is the existing Karuah hard rock quarry on Lots 11 and 21 (DP 1024341). Lot 21 is owned by KEQ and Lot 11 is privately owned rural property, including a single dwelling. To the northwest privately owned and naturally vegetated land is present on both sides of The Branch Lane (**Figure 2**). The vegetation in the site provides habitat connectivity to other patches of native vegetation.

## 1.7 IMPACTS OF QUARRY

The construction and development of the proposed new quarry and associated infrastructure is likely to directly disturb and permanently modify 28.09 ha of native vegetation occurring in Lots 12 and 13. The vegetation communities present in the development area and their equivalent biometric communities represented in the adjacent offset area are presented in **Table 1** and is based on information in RPS (2013). Note that ecological survey of the impact site did not include biometric data collection as this was not a requirement in the DGRs.

VEGETATION COMMUNITY	EQUIVALENT BIOMETRIC VEGETATION TYPE	IMPACT AREA (HA)
Eucalyptus propinqua – Eucalyptus acmenoides – Corymbia maculata – Eucalyptus paniculata subsp paniculata Moist Sclerophyll Open Forest	Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	20.38
Angophora costata – Corymbia gummifera - Eucalyptus capitellata Dry Sclerophyll Open Forest	Sydney Peppermint – Smooth barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin.	7.31
Backhousia myrtifolia Rainforest	Shatterwood-Giant Stinging Tree – Yellow Tulipwood dry rainforest of the North Coast and northern Sydney Basin	0.4
Total		28.09

Table 1: Vegetation type within the development area (based on RPS, 2013)

Two threatened flora species have been recorded as occurring within or adjacent to the proposed development area, namely *Grevillea parviflora* subsp. *parviflora* and *Tetratheca juncea*. RPS (2013) states that there will be direct impact to 243 clumps of *Tetratheca juncea* but no direct impact to the *Grevillea parviflora*. RPS also state that there may be indirect impact to threatened flora within a 50m 'edge effects zone' due to weed invasion and changes in micro-climates such as dust associated with the operation of the quarry (**Table 2**).

Whilst this Biodiversity Offset Strategy assesses the direct and indirect impacts as described in RPS (2013), ELA believes that the impacts are likely to be less than assumed by RPS. ELA understands that the haul road running past the main areas of *Tetratheca juncea* will be sealed and the crushing plant will be housed within an enclosed building thus significantly limiting the dispersion of dust. In terms of weed invasion a VMP is proposed to be prepared as part of this BOS and will include annual monitoring and weed management in the areas near the operational footprint. Hydrological changes are also not expected to be significant as stormwater will not be discharged into the *Tetratheca juncea* and nor will surface hydrology of the *Tetratheca juncea* habitat be significantly altered.

THREATENED FLORA SPECIES	DIRECT IMPACT	POTENTIAL INDIRECT IMPACT	TOTAL POTENTIAL IMPACT
Tetratheca juncea (clumps)	243	1332	1575
Grevillea parviflora subsp. Parviflora (stems)	0	32	32

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#### 1.8 OVERVIEW OF APPROACH TO MANAGEMENT

The site will be managed using standard management actions, although several additional management actions will be required for the site, i.e. Cat and/or Fox control, exclude miscellaneous species, feral and/or native herbivore control, maintain flow regimes and control feral pigs (if present).

Management of the site includes actions required to initially bring the site to a maintenance level, as well as those actions that will be required in future years, including ongoing monitoring and maintenance.

The site will be fenced to exclude inappropriate activities such as rubbish dumping, grazing and vehicle access. Information signs at all entry points to the site will provide information on the use of the site as a Offset site. Other initial management tasks may include minor drainage line restoration, native vegetation planting, fire trail upgrades and Asset Protection Zone (APZ) slashing near existing residences.

Ongoing management costs address site maintenance (weed control, feral animal control, trail maintenance, APZ maintenance, rubbish removal and ecological burns) as well as monitoring (vegetation condition, ecological burn results and feral animal abundance).

## <sup>2</sup> Assessment of Proposed Offset Site

## 2.1 INTRODUCTION

This chapter provides an overview of the methods used to assess the offset site and the results of the Biobanking Assessment Methodology which were used to quantify the conservation outcomes of managing the offset site for conservation in-perpetuity. Whilst this BOS occasionally describes the Offset site as a 'Biobank site' this is done to enable ease of understanding how the Biobanking Assessment Methodology has been applied, however as described in section 3 it is proposed to use a Conservation Agreement under the NP&W Act to secure the conservation outcomes rather than actually Biobanking the site.

## 2.2 LANDSCAPE VALUES ASSESSMENT

## 2.2.1 Assessment Circles

The amount of vegetation currently within the 100 ha and 1000 ha assessment circles was calculated using ArcGIS at a scale of 1:10,000 (Figure 3). The amount of vegetation in the circles once the Offset site is established, and managed into the future, was also estimated in ArcGIS. The area of vegetation cover in hectares was calculated then converted to a percentage for each circle.

**Table 3** summarises the results of the assessment for each circle. Both the 1000 ha and 100 ha assessment circles remain within the same native vegetation cover class before and after conservation of the offset site, at 71-80% and 91-100% respectively.

CIRCLE No.	CIRCLE TYPE	BEFORE BIOBANK	AFTER BIOBANK
1	1000 ha	720ha (71-80%)	725ha (71-80%)
	100 ha	91ha (91-100%)	92ha (91-100%)

Table 3: Area of	Vegetation in	n Each Assessment	<b>Circle Before and</b>	After the Offset Site
	rogotation in			

#### 2.2.2 Connectivity Assessment

A connectivity assessment was conducted for the site using the technique outlined in the Biobanking Assessment Methodology. The following aspects were considered:

- The width of the current and future connecting link
- The condition of the current and future connecting link (over-storey and mid-storey/ground cover)

The site lies within a large patch of vegetation that connects between the north-west (off site) and the south (on site) (**Figure 4**). The connecting vegetation is considered to be much the same as that found on site (i.e. moderate to good). The vegetation within the vegetation corridor is primarily in private land although a small portion (adjacent to The Branch Lane) is council owned land.

To the south the upgraded Pacific Highway borders the site with Karuah Nature Reserve and other vegetated properties located beyond. Adjacent to the west is the existing hard rock quarry and a privately owned rural property, including a single dwelling. The vegetation in the site is part of a large island patch of remnant vegetation directly connected to the adjacent bushland to the north-west and west, supporting habitat connectivity.

The area immediately surrounding the Offset site comprises both vegetated and cleared / modified lands, all within privately owned lands (with the exception of the GLC managed The Branch Lane. patches is for the most part vegetated, although cleared patches in private land exist north and west of the site. Between 61-70% of the 1000 ha surrounding the site retains over-storey vegetation. Whilst it is not possible to accurately extrapolate vegetation condition across land management boundaries (in this case different landholders), the vegetation observed in areas surrounding the Offset site appeared to be in moderate to good condition. The cleared areas observed in adjacent properties were observed to be highly modified and primarily used for grazing purposes.

### Connectivity Width Assessment

The narrowest point of the current vegetated connection is identified in **Figure 4**, and occurs to the south-east of the proposed Biobank site along a watercourse. GIS analysis has identified the minimum width of the current connection at approximately 30 to 40 m, placing it into the **>30-100m** connectivity width category. As the most limiting connection occurs outside the Offset site, the score for connectivity width will remain >30-100m (**Table 4**: Width Classes Before and After Biobank).

#### Table 4: Width Classes Before and After Biobank

	WIDTH CLASS (BEFORE BIOBANK)	WIDTH CLASS (AFTER BIOBANK)	
Connectivity Value (Width)	>30-100m	>30-100m	

#### Connectivity Condition Assessment

The vegetation within the 'connection' (including the offset site) is at benchmark for over-storey cover, mid-storey and groundcover (**Table 5**).

The average condition of the vegetation will not change after the offset site is established. Therefore, the condition classes allocated after offset do not change from those allocated before offset.

#### Table 5: Condition Classes Before and After Offset

STRATA	CONDITION CLASS (BEFORE BIOBANK)	CONDITION CLASS (AFTER BIOBANK)
Connectivity Value (Over-storey Condition)	PFC at benchmark	PFC at benchmark
Connectivity Value (Mid-storey/Ground Cover Condition)	PFC at benchmark	PFC at benchmark

#### 2.2.3 Adjacent Remnant Area and Mitchell Landscape

The entire site is situated within the Newcastle Coastal Ramp Mitchell Landscape (**Figure 5**). The Mitchell Landscapes Version 3 layer was used for this assessment.

The area surrounding the offset site consists primarily of a dense native canopy cover with a predominately native understorey. These areas are therefore considered to be in moderate to good

condition, and link with surrounding areas. These linkages of moderate to good condition vegetation result in a **Patch Size of 501 ha** for all patches, and an **Adjacent Remnant Area of 501 ha** for the moderate to good condition vegetation on-site.

### 2.2.4 CMA Region and CMA Subregion

The Offset site occurs entirely within the Hunter-Central Rivers CMA region and within the Karuah Manning subregion.



Figure 3: Assessment Circles



Figure 4: Connectivity



Figure 5: Mitchell Landscapes

## 2.3 GEOGRAPHIC AND HABITAT FEATURES

The following questions were asked in Step 2 of the calculator **(Table 6**). The default answer for these questions is "Yes", however an answer of "No" was given where evidence suggested that this was the correct answer.

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QUESTION	ANSWER
Dry sclerophyll woodland and forest with a predominantly grassy understorey.	Yes
heath on sandy soils, or moist areas in open forest	Yes
heath or eucalypt forest on sandstone with a build-up of litter or other debris and containing, or within 40 m of, ephemeral or intermittent drainage lines	Yes
Hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian zone	Yes
land below 1000 m in altitude and within 40 m of rainforest or eucalypt forest with deep leaf litter	Yes
land containing caves or similar structures	No
and containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels	Yes
land within 1 km of rock outcrops or cliff-lines	Yes
land within 100 m of emergent aquatic or riparian vegetation	Yes
land within 100 m of permanent rocky streams with thick fringing vegetation	No
land within 100 m of semi-permanent or ephemeral ponds or depressions containing leaf litter	Yes
land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters	No
land within 40 m of rainforest, coastal scrub, riparian or estuarine communities	Yes
land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber	Yes
Occurs from 10-40 m a.s.l. in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur (including the largest colony) is a Spotted Gum - Ironbark For	Yes
rainforest or tall open wet forest with understorey and/or leaf litter and within 100 m of streams	Yes
rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas	Yes
Sheltered areas such as gullies and southerly slopes in tall open forest on well-drained gravelly soil at elevations of 10-200 m	Yes
swamps, swamp margins or creek edges	Yes

## 2.4 VEGETATION TYPES

Two previous vegetation maps were reviewed in the initial desktop survey to indicate the vegetation types potentially present at the site:-

• Hunter Native Vegetation Mapping OEH (Roff et al. 2011);

 House, S (2003). Lower Hunter & Central Coast Regional Biodiversity Conservation Strategy, Technical Report, Digital Aerial Photo Interpretation & Updated Extant Vegetation Community Map. Report to Lower Hunter & Central Coast Regional Environmental Management Strategy, NSW, May 2003.

The site assessment confirmed that both these vegetation maps had inaccuracies at a site level, and identified five natural vegetation types within the site. The boundaries for these vegetation types were assessed during the site assessment and any previous mapping boundaries were disregarded.

The five biometric vegetation types within the site are:

- 'Spotted Gum Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin' occurring on the upper slopes, particularly in Lot 5
- 'Smooth-barked Apple Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin' present on the southern gently undulating areas, particularly near the Pacific Highway
- 'Blackbutt Turpentine Tallowwood shrubby open forest of the coastal foothills of the central North Coast' occurring generally along the more sheltered mid to lower slopes of the southern half of the site
- 'Sydney Peppermint Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and Northern Sydney Basin' located in the sheltered southern portion of site in the vicinity of the Pacific Highway
- 'Brush Box Turpentine shrubby open forest of the coastal ranges of the North Coast' located as part of the riparian vegetation along two south facing slopes and associated watercourses in the southern half of the site

An additional category of 'cleared / modified lands' is also present and comprises of access tracks and roads, power easements and areas immediately surrounding dwellings. Little or no native vegetation is present in these areas.

The five vegetation types have been mapped into seven distinct vegetation zones for the assessment. The 'Spotted Gum – Grey Ironbark open forest' on the site is all moderate/good condition but is represented by a modified / regrowth variation in one location in the southern portion of the site near the residence on Lot 14. The 'Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin' is also present in a moderate/good condition for the majority of its distribution but is represented by a modified / regrowth variation in two locations in the southern portion of the site near the residence on Lot 14 and one section centrally in Lot 13. The distribution of these vegetation types is shown in **Figure 6**.

The proposed Offset site generates **912** ecosystem credits at an average of 7 credits/ha, reflecting the biometric moderate-good condition of the site. **Table 7** provides a summary, with details provided in **Section 3**. 38,544 species credits were also generated for *Tetratheca juncea* and *Grevillea parviflora* subsp. *parviflora* on the site. There is potential for some indirect impacts on the offset site. If indirect impacts described in RPS (2013) occurred, the credits generated by the offset site would be 30,360. Note however that ELA does not believe the indirect impacts would be as great as assumed by RPS (see section 1.7 of this report).

VEGETATION TYPE	AREA (HA)	CREDITS GENERATED	CREDITS/HA
Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin (good)	67.03	526	0
Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin (modified regrowth)	0.83	520	o
Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin (good)	23.71		_
Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin (modified regrowth)	3.02	180	7
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast (good)	28.17	163	6
Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and Northern Sydney Basin (good)	3.96	22	6
Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast (good)	2.60	21	8
Total	129.32	912	7

### Table 7: Summary of ecosystem credits generated

## 2.4.1 Justification for selection of Biometric vegetation types

The dominant species in each stratum is listed in **Table 8** to indicate the justification for the vegetation type selection and mapping. It was difficult to uniquely ascertain each vegetation type as the site effectively consists of numerous divergent ecotones between two and often three vegetation types. The boundaries were distinguished where there was a change in dominance of primary canopy species. The condition categories were distinguished based on structure of midstorey and groundcover including abundance of weed species.

Table 8:	Dominant	species in	each	vegetation	type

VEGETATION TYPE	DOMINANT SPECIES				
Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin (good)	Canopy: Corymbia maculata (Spotted Gum), Eucalyptus paniculata subsp. paniculata (Grey Ironbark), Eucalyptus fibrosa (Broad-leaved Ironbark), Eucalyptus canaliculata (Large-fruited Grey Gum), Eucalyptus acmenoides (White Mahogany) Midstorey: Allocasuarina torulosa (Forest Oak) Groundcover: Imperata cylindrica var. major (Blady Grass), Themeda australis (Kangaroo Grass)				
Spotted Gum - Grey Ironbark open forest on the	Canopy: C. maculata, E. fibrosa, E. paniculata subsp.				

foothills of the Central Coast, Sydney Basin (modified regrowth) Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin (good)	<ul> <li>paniculata</li> <li>Midstorey: Allocasuarina torulosa</li> <li>Groundcover: Imperata cylindrica (Blady Grass), Setaria sphacelata* (South African Pigeon Grass), Andropogon virginicus* (Whisky Grass)</li> <li>Canopy: Angophora costata (Smooth-barked Apple), Corymbia gummifera (Red Bloodwood), Eucalyptus microcorys (Tallowwood) Eucalyptus pilularis,(Blackbutt)</li> <li>Midstorey: Allocasuarina littoralis (Black She-oak),</li> </ul>
	Groundcover: <i>Imperata cylindrica, Entolasia stricta</i> (Wiry Panic), <i>Doryanthes excelsa</i> (Gymea Lily)
Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin (modified regrowth)	Canopy: Angophora costata, Corymbia gummifera Eucalyptus pilularis Midstorey: Allocasuarina littoralis (Black She-oak), Groundcover: Imperata cylindrica, Entolasia stricta (Wiry Panic), Themeda australis
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast (good)	Canopy: Eucalyptus pilularis, Eucalyptus microcorys, Syncarpia glomulifera (Turpentine), Angophora costata Midstorey: Allocasuarina torulosa Groundcover: Themeda australis, Poa affinis, Imperata cylindrica var. major, Doryanthes excels
Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and Northern Sydney Basin (good)	Canopy: <i>Eucalyptus piperita</i> (Sydney Peppermint), <i>Angophora costata, Corymbia gummifera</i> Midstorey: <i>Allocasuarina littoralis</i> Groundcover: <i>Imperata cylindrica, Entolasia stricta,</i> <i>Themeda australis</i>
Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast (good)	Canopy: Lophostemon confertus (Brush Box), Syncarpia glomulifera Midstorey: Melaleuca styphelioides (Prickly Paperbark) Glochidion ferdinandi (Cheese Tree), Livistona australis (Cabbage Tree Palm) Groundcover: Lomandra longifolia (Spiny-headed Mat- rush), Doodia aspera (Rasp Fern), Lantana camara* (Lantana)

\* Denotes an introduced species

### 2.4.2 Targeted Threatened Species Survey and Predicted Threatened Species

Previous targeted flora surveys and subsequent opportunistic surveys and incidental observations have identified that there are currently known to be approximately 55 individuals of *Asperula asthenes*, 185 individual stems of *Grevillea parviflora* subsp. *parviflora* and 6,085 clumps of *Tetratheca juncea* within the site. It must be noted that targeted flora surveys will be carried out for the species during the prime flowering period. Species credits have been generated for these species based on current observations (**Figure 8**).

## 2.5 VEGETATION ZONES

Vegetation zones are defined as areas of the same vegetation type and condition and have been mapped for the Offset site. ELA have assigned condition categories to all vegetation, all of which meet the definition of moderate/good condition as defined by the Biobanking Assessment Methodology.

In total there are seven vegetation zones within the site, consisting of five vegetation types. The area of each vegetation zone is provided in Figure 6.

#### **Table 9: Vegetation Zones**

VEG ZONE ID	BIOMETRIC VEGETATION TYPE	CONDITION	ANCILLARY CODE	CHARACTERISTICS OF VEGETATION ZONE		
1	Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	Moderate/good condition	Good	Remnant open forest, with a distinct sub-canopy and an understorey, scattered shrubs and predominantly native perennial grasses and forbs.	67.03	
1a	Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	Moderate/good condition	modified regrowth	Previously cleared regrowth open forest with young saplings and taller shrubs to 3 - 5 m and sparsely scattered larger remnant trees. More dense shrub layer and primarily native grasses as a ground cover, although introduced grasses are well represented and established.	0.83	
2	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin	Moderate/good condition	Good	Remnant open forest with some large mature trees. Generally comprising a sparse sub-canopy and a variable shrub layer (often quite dense) and a grass dominated understorey predominantly native perennial grasses and forbs.	23.71	
2a	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin	Dod       Moderate/good       modified       Previously cleared regrowth open forest with young saplings to 5 m         condition       regrowth       sparsely scattered larger trees. More dense shrub layer and print         native grasses as a ground cover, although introduced grasses cover       well represented and established.		Previously cleared regrowth open forest with young saplings to 5 m and sparsely scattered larger trees. More dense shrub layer and primarily native grasses as a ground cover, although introduced grasses can be well represented and established.	3.02	
3	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast	Moderate/good condition	Good	Remnant moderately tall moist open forest to forest vegetation including some areas of younger growth. A distinct but generally sparse sub-tree layer, as well as an often sparse shrub layer. Groundcover comprised of a combination of grasses and various herbaceous species.	28.17	

4	Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and Northern Sydney Basin	Moderate/good condition	Good	Remnant open forest vegetation with a sparse sub-canopy. A distinct but variable shrub layer was present, sometimes moderately dense. The groundcover layer was generally dominated by native grass species.	3.96
7	Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast	Moderate/good condition	Good	Remnant and regrowth of moderately tall open forest to forest, comprising a distinct sub-canopy of small trees (mesic). Numerous climbers and twiners throughout. A dense understorey of ferns, rushes, grasses and various herbs.	2.6
	Total				129.32



Figure 6: Vegetation Communities



## Figure 7: Management Zones



Figure 8: Threatened flora records for the offset site

## 2.6 **VEGETATION TYPES PLOTS**

The number of transect/plots undertaken for each vegetation zone is outlined in **Table 10**. Information was collected from the required number of transect/plots for all vegetation zones. All plots were permanently marked with one star-picket to allow for the monitoring of vegetation condition in the future. A star-picket was placed at the beginning of the 50 m line transect and the 0.4 ha plot. The locations of the star-pickets were recorded using GPS co-ordinates in GDA94 datum. Two photographs were taken at the end of each transect, one in portrait and one in landscape. **Figure 9** shows the location of each of the plot/transects and photo points for each vegetation zone (in MGAs), while **Appendix 3** outlines the transect/plot data entered into the tool and **Appendix 1** lists the plant species recorded in each plot. Whilst the total number of plots was less than that required for a formal biobanking assessment, the number of plots undertaken was adequate for the purpose, including having multiple plots in the larger vegetation zones.

VEG ZONE ID	BIOMETRIC VEGETATION TYPE	CONDITION	ANCILLARY CODE	AREA (HA)	PLOTS REQ.	PLOTS COMPLETED
1	Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	Moderate/good condition	Good	67.85	5	4
2	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin	Moderate/good condition	Good	26.73	4	3
3	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast	Moderate/good condition	Good	28.17	4	3
4	Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and Northern Sydney Basin	Moderate/good condition	Good	3.96	2	1
5	Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast	Moderate/good condition	Good	2.60	2	1
	Tota	al		129.32	17	12

#### Table 10: Transects/Plots Required for Offset Site



Figure 9: Plots

## 2.7 **BIOBANKING ASSESSMENT - RESULTS**

#### 2.7.1 Ecosystem Credits

Table 11 shows the results of the credit calculations, including the number of credits generated and the credit profile information. In total, 912 ecosystem are generated by the offset site.

#### Table 11: Ecosystem Credits Generated and Credit Profile

VEG ZONE ID	VEGETATION TYPE NAME	AREA (HA)	TOTAL CREDIT GENERATED FOR VEG ZONE	CREDITS GENERATED/ HA	MIN.% SURROUNDING VEGETATION	MINIMUM PATCH SIZE (HA)	CMA SUBREGION
1	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast	28.17	163	6	>70%	>100 ha	Karuah Manning
2	Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast	2.60	21	8	>70%	>100 ha	Karuah Manning
3	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin	26.73	180	7	>70%	>100 ha	Karuah Manning
4	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	67.86	526	8	>70%	>100 ha	Karuah Manning

VEG ZONE ID	VEGETATION TYPE NAME	AREA (HA)	TOTAL CREDIT GENERATED FOR VEG ZONE	CREDITS GENERATED/ HA	MIN.% SURROUNDING VEGETATION	MINIMUM PATCH SIZE (HA)	CMA SUBREGION
5	Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin	3.96	22	6			Karuah Manning
	Total	129.32	912	7	N/A	N/A	N/A

## 2.8 SPECIES CREDITS

Species credits were generated for two species – *Tetratheca juncea* and *Grevillea parviflora* subsp. *parviflora* - at the Offset site. **Table** 12 shows the results of the species credits generated. Two sets of figure are provided, with the first set assuming no indirect impacts (best case scenario) on the Offset site and the second set assuming mortality of all individuals within 50m of the construction footprint (worst case scenario). As discussed in section 1.7 of this Biodiversity Offset Strategy the worst case scenario is unlikely to eventuate given the mitigation measures proposed.

#### Table 12: Summary of Species Credits generated

	ASSUMING NO INDIRECT IMF	PACTS ON THE OFFSET SITE	ASSUMING INDIRECT IMPACTS ON THE OFFSET SITE		
SPECIES NAME	NUMBER OF INDIVIDUALS PROTECTED	CREDITS GENERATED	NUMBER OF INDIVIDUALS PROTECTED	CREDITS GENERATED	
Grevillea parviflora subsp. Parviflora(stems)	100	600	68	408	
Tetratheca juncea (clumps)	6,324	37,944	4992	29,952	
Total	6,424	38,544	5060	30,360	

## <sup>3</sup> Offset Security and Management

## 3.1 LEGAL ARRANGEMENT

The conservation of the offset area will be secured via a Conservation Agreement (CA) under Part 4, Division 12 of the National Parks and Wildlife Act 1974. The CA will be negotiated with the NSW Office of Environment and Heritage following approval of the Part 3A Application. The CA will 'run with the land' meaning that it will apply to the owner of the properties and all successors in title and will be registered under the Real Property Act 1990.

Besides the conservation outcomes identified in this strategy, the CA will allow for the continued occupation of the two dwellings currently location on lot 5 and lot 14 and the maintenance of the small area of cleared land surrounding the dwellings and the access tracks (approx. 6.5 ha). If other tracks are required in order to undertake the conservation management, these are to be identified in the CA.

### 3.2 ON-GROUND WORKS

There are no existing easements covenants or conservation funding arrangements for the property, and the entire offset site.

The site has been categorised into 7 distinct management zones based on the vegetation communities present on site (Figure 7). The major ongoing management issue at the offset site will include the management and control of invasive weed species, in particular woody weeds (almost exclusively *Lantana camara*) and pasture grasses. Pasture grasses are particularly evident in the power easement running north to south and in the east where the site abuts grazing properties. Indicative estimates of time to carry out the weed control activities and fencing maintenance is presented in **Table 13**.

Fencing (including access gates) will need to be maintained to reduce the potential impacts from grazing stock entering the site as this can be quite destructive the environment and additional cost may arise to address the issue and damage. Fencing and associated signage will also be necessary for the control of human access for dumping and destructive recreation purposes (e.g. trail bike riding).

Feral animals are at the present time restricted to minor use of the site by Rabbits and likely transient Foxes and Cats. Although a minor issue currently, there is potential for stringent feral pest control in the future if conditions change.

Monitoring the maintenance process will be required on at least an annual basis. The results of the monitoring will help provide input into the priority areas for the following year or several years.

A Conservation Management Plan will be prepared for the site to guide the implementation of the management practices. The plan will include the restrictions and limitations to the existing two residences on Lot 5 and Lot 14 and will likely need to have specific information and work priorities updated on a three to five year interval as a minimum.

MANAGEMEN T ZONE	BIOMETRIC TYPE	ANCILLAR Y CODE	SUM OF HA	MANAGE'T ISSUE	WEED SPECIES	WEEDING APPROACH / TECHNIQUE	PLANTIN G	ESTIMATE OF PRIMARY WORK (DAYS FOR YEAR 1- 5)	FOLLO W UP (YEAR 5-10)	ESTIMATE OF MAINTENANC E (YEAR 10 ONWARDS)
1	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast	Moderate to good	28.17	Weeds and Maintained fencing	Scattered patches of Lantana, pasture grass invasion from east	Manual removal/ cut and paint with Glyphosate	Not necessar y	5	3	2
1a	Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast	Moderate to good	2.60	Weeds	Scattered patches of Lantana	Manual removal/ cut and paint with Glyphosate	Not necessar y	4	2	2
2	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin	Moderate to good	23.71	Weeds and Maintained fencing	Scattered patches of Lantana, pasture grass invasion from east	Manual removal/ cut and paint with Glyphosate	Not necessar y	4	2	2

### Table 13: Summary of Vegetation Management Zone Issues (Indicative)

#### Karuah East Quarry Biodiversity Offset Strategy

2a	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin	Moderate to good	3.02	Weeds	Invasion by pasture grasses - Setaria and Whiskey Grass. Minor patches of Lantana	Cut and paint with Glyphosate	Not necessar y	2	1	1
3	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	Moderate to good	67.03	Weeds and Maintained fencing	Scattered patches of Lantana, pasture grass invasion from east and also along power easement	Cut and paint with Glyphosate. Spray grasses in dense areas	Not necessar y	10	8	6
4	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	Moderate to good	0.83	Weeds	Invasion by pasture grasses - Setaria and Whiskey Grass. Minor patches of Lantana	Cut and paint with Glyphosate. Spray grasses in dense areas	Not necessar y	2	2	2
5	Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and	Moderate to good	3.96	Weeds and Maintained fencing	Scattered patches of Lantana	Manual removal/ cut and paint	Not necessar y	3	2	2

#### Karuah East Quarry Biodiversity Offset Strategy

	plains of the southern North Coast and northern Sydney Basin					
Total				30	20	17
Indicative annual labour cost (team of 4 (@\$2000 / day)				\$60,000 PA	\$40,000 PA	\$34,000 PA
Material costs			Fence maintenance, bait for ferals, herbicides			

# A Adequacy of Offset

## 4.1 SUMMARY OF OFFSET

## 4.1.1 Ecosystems

The Karuah East Quarry will impact on three vegetation communities as described in the RPS (2013) report. The impact of 28.09 hectares of native vegetation will be offset by the conservation management of 129.32 hectares of vegetation similar to that found on the impact site. This provides an offset ratio of around 4.6:1 None of the vegetation communities being impacted by the quarry are EECs and all are in moderate to good condition.

BIOMETRIC (ELA)	HA IMPACTED	HA CONSERVED
Spotted Gum – Grey Ironbark open forest on the foothills of the Central Coast, Sydney Basin	20.38	67.86
Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the Central Coast, Sydney Basin		26.73
Shatterwood-Giant Stinging Tree – Yellow Tulipwood dry rainforest of the North Coast and northern Sydney Basin	0.4	0
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast		28.17
Brush Box - Turpentine shrubby open forest of the coastal ranges of the North Coast		2.60
Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and northern Sydney Basin	7.31	3.96
Total	28.09	129.32

### Table 14 Comparison of vegetation impacts and conservation

## 4.1.2 Species

As the number of threatened species to be impacted has been counted by RPS (2013) it is possible to make a comparison using the BBAM for flora species credits. Calculations have been made for direct impacts (ie, clearing for construction) as well as potential indirect impacts assumed by RPS (2013).

Table 15 shows that a positive credit balance is achieved for *Tetratheca juncea* and *Grevillea parviflora subsp parviflora* when direct impacts are taken into account but no indirect impacts are assumed.

Table 16 shows that in a worst case scenario – ie, total mortality within a 50m edge effect zone, there would still be a positive balance for *Tetratheca juncea*, however *Grevillea parviflora subsp parviflora* would have a credit deficit of 63 credits.

When interpreting these results it is important to note two points:

- Spring survey is likely to identify additional *Tetratheca juncea* and possibly *Grevillea parviflora* on lot 5 as the RPS report shows many clumps on land adjoining Lot 5; and
- ELA believes the indirect impacts are likely to be significantly less than the worst case scenario assumed in RPS (2013) as discussed in section 1.7 of this report. If for example, indirect impacts occurred to no more than a 20m edge effect, the credit balance for *Grevillea parviflora* would likely be positive and the balance for *Tetratheca juncea* would be even more so.

## Table 15: Threatened Species Credit outcome for direct impacts only

SCIENTIFIC NAME	PLANTS IMPACTED	CREDITS REQUIRED	PLANTS CONSERVED	CREDITS GENERATED	BALANCE
Tetratheca juncea(clumps)	243	3,574	6324	37,994	+34,240
Grevillea parviflora subsp. Parviflora (stems)	0	0	100	600	+600

### Table 16 Threatened species credit outcome for direct and potential indirect impacts

SCIENTIFIC NAME	PLANTS IMPACTED	CREDITS REQUIRED	PLANTS CONSERVED	CREDITS GENERATED	BALANCE
Tetratheca juncea (clumps)	1575	23,162	4992	29,952	+6790
Grevillea parviflora subsp. Parviflora (stems)	32	471	68	408	-63

## 4.2 COMPARISON TO OFFSET PRINCIPLES

The NSW OEH website contains a set of thirteen principles that provide a framework for considering environmental impacts and developing offset proposals. The following table describes how the Karuah offset compares to the thirteen principles for offsetting in NSW.

#### Table 17: Comparison of the proposed offset to the OEH Principles for biodiversity offsets in NSW

Principle	Karuah East Offset Strategy
<ol> <li>Impacts must avoided first by using prevention and mitigation measures</li> </ol>	The development footprint has undergone significant change in order to avoid impacts on the threatened species <i>Tetratheca juncea</i> . This has reduced impact from 2742 individuals down to a direct impact on 243 individuals which is more than a 90% reduction. If worst-case potential indirect impacts are considered the reduction is from 2742 to 1575 which is a

	reduction of 42%.
All regulatory requirements must be met	The project is to be assessed as a transitional Part 3A Project under the provisions of the EP&A Act and will therefore meet regulatory requirements. Whilst the offset will have benefits beyond those for biodiversity (eg: a permanent noise buffer from quarry operations) the offset is not proposed as a means of satisfying other regulatory requirements.
Offsets must never reward ongoing poor performance	Karuah East Quarry Pty Ltd does not have a record of poor performance. No illegal clearing has occurred on the subject site or offset sites.
Offsets should complement other government programs	The proposal to secure the offsets is consistent with the Hunter Central Rivers Catchment Action Plan target to increase the hectares of native vegetation being managed under a Conservation Agreement. The offset will complement the reserve system as it is less than 500m to an existing Nature Reserve.
Offsets must be underpinned by sound ecological principles	The offsets will provide for conservation of like-for-like vegetation communities. The size of the offset (129 ha) avoids edge-effects that are a risk with smaller sites and also conserves vegetation in moderate to good condition which reduces the risk often associated with rehabilitation of degraded sites.
Offsets should aim to result in a net improvement in biodiversity over time	A Conservation Plan will be prepared and implemented, addressing known issues such as weeds. The offset is low-risk in the sense that it is improving the condition of existing vegetation rather than relying on re-vegetation. Over time, the management of the site will improve its ecological value.
Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs	Offsets will be secured via a Conservation Agreement under the NP&W Act or similar. This will be an in-perpetuity agreement that will remain on the title of the property regardless of transfers of ownership.
Offsets should be agreed prior to the impact occurring	Offsets are proposed as part of the Environmental Assessment. It is proposed to enter into a Conservation Agreement prior to the commencement of clearing for the quarry.
Offsets must be quantifiable and the benefits reliably estimated	The ecological values and condition of the offset site has been assessed and the credit-generating potential of the offset has been calculated using the Biobanking Assessment Methodology. 129 hectares offset will be provided compared to an impact of 29.05 hectares, giving an offset ratio of more than 4:1.
	All regulatory requirements must be met Offsets must never reward ongoing poor performance Offsets should complement other government programs Offsets must be underpinned by sound ecological principles Offsets should aim to result in a net improvement in biodiversity over time Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs Offsets should be agreed prior to the impact occurring

10. Offsets must be targeted	Offsets have targeted the biometric vegetation types that are to be impacted by the quarry. The offset vegetation is therefore 'like for like' with the impacted vegetation.
11. Offsets must be appropriately located	Offsets are located on the same site as the development and the adjoining land.
12. Offsets must be supplementary	No management obligations for these communities currently exist on the site.
13. Offsets and their actions must be enforceable through development consent conditions, license conditions, conservation agreements or a contract.	A Conservation Agreement under the NP&W Act is proposed as a Statement of Commitment in the Environmental Assessment.

## 4.3 COMPARISON TO OEH INTERIM POLICY FOR MAJOR PROJECTS

OEH have adopted a policy titled *DECCW Interim Policy on Assessing and Offsetting Biodiversity Impacts on Part 3A Developments*. Whilst Part 3A has been repealed, the proposal is being assessed as a transitional Part 3A transitional project. Whilst the interim policy is designed for use where biometric data is available on the impact and offset sites, it is still referenced here even though biometric data is not available for the impact site as it is a means of demonstrating the type of offset being proposed.

The Interim policy classifies impacts and offsets into three categories as shown in **Table 18**. The Karuah East Biodiversity Offset Strategy is likely to result in either a tier 2 No Net Loss or a Tier 3 Mitigated Loss. The uncertainty exists because biometric data was not available for the impact site. The vegetation being offset is 'like for like' with the vegetation being impacted and there are no red flag species or communities being impacted. By providing a 4:1 offset ratio the project will be providing double the offset that is the bare minimum for meeting a Tier 3 Mitigated Loss.

	Is the vegetation being impacted being offset by the same vegetation or a vegetation type that is allowable under the BBAM ?	Will Red Flag vegetation or threatened species be impacted ?	Are the credit requirements under BBAM fully met ?
Improve or maintain (tier 1)	Yes	No	Yes
No net loss (tier 2)	Yes	Yes	Yes
Mitigated loss (tier 3)	No: offset vegetation type is different to impact site	Yes	No: Impacts partially offset

#### Table 18: Interim policy categories

	Is the vegetation being impacted being offset by the same vegetation or a vegetation type that is allowable under the BBAM ?	Will Red Flag vegetation or threatened species be impacted ?	Are the credit requirements under BBAM fully met ?
Karuah East Offset Strategy	Yes	No	Unknown. Offset will deliver offset ratio of 4:1.

## Table 19: Karuah East Offset

## 5 Conclusion

The proposed biodiversity offset for the Karuah East Quarry will deliver significant conservation benefits by securing 129.32 hectares of forested lands containing significant numbers of threatened flora and good quality habitat for threatened fauna (Powerful Owl, Glossy-black Cockatoo). The suitability of the offset site for conservation purposes, in relation to the impacted area, is as indicated previously in this report. The offset site provides 100 stems of *Grevillea parviflora* subsp. *parviflora* and 6,324 clumps of *Tetratheca juncea*. Although there will be a direct loss of 243 *Tetratheca juncea* clumps within the impact area the numbers of these species to be conserved within the offset area are extremely high and located within intact high quality habitat. It is likely that the presence of additional threatened flora species will be recorded from the offset site as surveys for *Grevillea parviflora* subsp. *parviflora* and *Tetratheca juncea* are to be undertaken later this year (2013) during the appropriate flowering season for each species.

In addition to the threatened species credits and the actual numbers of threatened species to be conserved there is a significantly large area of intact good quality native vegetation to be retained as part of the offset. A total of 28.09 ha of native vegetation from three different vegetation communities will be removed or modified as part of the project, in return 129.32 ha of remnant vegetation from five different communities is to be retained within the offset. This retention to loss of native vegetation is a direct ratio of approximately 4.6:1 which is just over double the minimal offset requirements stated in the *OEH Interim Policy on Assessing and Offsetting Part 3A Major Development*. The proposed offset is consistent with the 13 offsetting principles published by OEH on their website.

The land is currently zoned 1(a) Rural under the current Great Lakes LEP (1996) and RU2 Rural Landscape under the draft LEP 2013. A significant number of landuses are permitted with consent in these zones. Establishing the site as an offset will eliminate the potential for most of these uses to be undertaken on the site unless they are consistent with the outcomes stated in the Conservation Agreement. The offset will secure the future of the site as a linkage between Karuah Nature reserve to the south and vegetated lands to the north.

## References

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Roff, A., Sivertsen, D., Somerville, M and Denholm, B. 2011. *Hunter Native Vegetation Mapping.* Office of Environment and Heritage, Department of Premier and Cabinet, Sydney, Australia

RPS (2013), Terrestrial Ecology Survey and Assessment Report, Karuah East Quarry, Karuah NSW.

## Appendix 1: Flora species Recorded in each Plot

#### Note:

1. Families are group under the headings 1. Pteridophytes, 2. Gymnosperms, 3. Dicotyledons, 4. Monocotyledons.

2. An '\*' before species indicates exotic species, # indicates non-local native.

3. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered comprehensive, but rather indicative of the actual flora assemblage. It can take many years of flora surveys to record all of the plant species occurring within any area, especially species that are only apparent in some seasons.

4. Not all species can be accurately identified to species level due to absence of flowering or fruiting material.

5. **Bold** Denotes Threatened Species

6. Incidental sightings = ^

7. ROTAP = Rare or Threatened Species (Briggs & Leigh 1996)

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
1. Pteridophytes														
Adiantaceae	Adiantum aethiopicum	Common Maidenhair Fern		*				*						
	Adiantum hispidulum	Rough Maidenhair Fern												*
Blechnaceae	Doodia aspera	Prickly Rasp Fern												*

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
Dennstaedtiaceae	Pteridium esculentum	Bracken						*	*	*				
Dicksoniaceae	Calochlaena dubia	False Bracken		*				*						*
Lindsaeaceae	Lindsaea linearis	Screw Fern					*							
	Lindsaea ^ microphylla	Lacy Wedge-fern												
Pteridaceae	Cheilanthes sieberi subsp. sieberi	Rock Fern			*						*		*	
2. Gymnosperms	-													
3. Dicotyledons														
Acanthaceae	Brunoniella pumilio	Dwarf Blue Trumpet	*	*	*	*	*	*	*				*	
	Pseuderanthemum variabile	Pastel Flower		*	*			*					*	*
Anacardiaceae	Euroschinus falcatus	Ribbonwood												*
Apiaceae	Centella asiatica	Pennywort				*				*	*	*	*	
	Hydrocotyle geraniifolia											*		
Apocynaceae	Parsonsia	Common						*						*

FAMILY	S	PECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	strami	inea	Silkpod, Monkey Rope												
	Tyloph panici	hora Jlata	Thin-leaved Tylophora		*										
Araliaceae	Polyso sambu subsp sambu	cias ucifolia ucifolia	Elderberry Panax	*	*	*			*	*			*		
Asteraceae	* Bidens	s pilosa	Cobblers Pegs									*			
	Hypoc * radica	chaeris ta	Catsear			*	*				*	*			
	Rhoda ^ anther	anthe moides	Chamomile Sunray												
	Senec madag	cio gascariensis	Fireweed									*			
	Solene belloic	ogyne les	-	*	*	*		*	*	*	*				
	Verno	nia cinerea	Vernonia							*	*				
Bignoniaceae	Pando pando	orea orana	Wonga Vine			*			*				*	*	
Caryopyllaceae	Stellar	<i>ria</i> sp.	-												*
Casuarinaceae	Alloca littoral	suarina lis	Black She-oak	*				*		*				*	
	Alloca	suarina	Forest She-oak		*	*	*		*		*	*	*		*

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	torulosa													
Celastraceae	Maytenus silvestris			*										
Clusiaceae	Hypericum gramineum	Small St John's Wort									*			
Convolvulaceae	Convolvulus erubescens	Blushing Bindweed							*			*		
	Dichondra reprens	Kidney Weed		*							*	*		
Cunoniaceae	Callicoma serratifolia	Black Wattle		*				*						
Dilleniaceae	Hibbertia aspera	Rough Guinea- flower	*	*	*	*	*	*					*	
	^ Hibbertia dentata	Golden Guinea- flower												
	Hibbertia scandens	Twining Guinea- flower		*				*				*		
	<i>Hibbertia</i> sp.		*				*	*						
Elaeocarpaceae	Elaeocarpus obovatus	Hard Quandong												*
	Tetratheca juncea	Black-eyed Susan							*					
Ericaceae - Styphelioideae	Acrotriche divaricata	-		*				*						
	Epacris pulchella									*				

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	Leucopogon juniperinus	Long-flowered Beard-heath	*	*							*	*		
Euphorbiaceae	Breynia oblongifolia	Coffee Bush		*	*			*			*	*	*	*
	Glochidion ferdinandi	Cheese Tree		*				*	*	*	*	*	*	*
	Homolanthus populifolius	Bleeding Heart												*
Fabaceae Faboideae	Daviesia ulicifolia	Gorse Bitter-pea	*		*									
	Desmodium rhytidophyllum	Tick-trefoil			*	*		*			*	*		
	Desmodium varians	Small Leaf Tick- trefoil									*	*	*	*
	Dillwynia retorta	Bush Pea											*	
	Glycine clandestina	Twining Glycine	*		*	*	*	*	*	*	*		*	
	Glycine microphylla	Love Creeper							*		*		*	*
	Gompholobium latifolium	Golden Glory Pea					*	*		*				
	Hardenbergia violacea	False Sarsaparilla	*	*				*	*	*	*	*		
	Kennedia	Dusky Coral Pea						*						

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	rubucunda													
	Pultenaea euchila	Orange Pultenaea	*			*	*	*	*	*				
	Pultenaea paleacea	Chaffy Bush-pea	*	*	*	*	*		*	*				*
	Pultenaea villosa	Hairy Bush-pea	*		*	*			*		*	*		
Fabaceae Mimosoideae	Acacia implexa	Hickory Wattle									*			
	Acacia irrorata subsp. irrorata	Green Wattle	*	*	*	*	*	*					*	
	Acacia longifolia	Sydney Golden Wattle		*				*				*		
	Acacia myrtifolia	Red-stemmed Wattle	*			*	*	*	*	*				
	Acacia terminalis subsp. longiaxialis	Sunshine Wattle								*			*	
	Acacia ulicifolia	Prickly Moses	*		*	*			*		*	*	*	
Goodeniaceae	Goodenia heterophylla	-					*	*				*		
	Goodenia paniculata	Swamp Goodenia					*							
Haloragaceae	Gonocarpus teucrioides	Raspwort	*		*	*	*				*			

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
Lamiaceae	Clerodendrum tomentosum	Hairy Clerodendrum												*
Lauraceae	Crytocarya glaucescens	Jackwood												*
Lobeliaceae	Pratia purpurascens	Whiteroot	*	*	*	*		*	*	*	*	*	*	*
Loganiaceae	Logania albiflora	Logania		*										
Meliaceae	Synoum glandulosum	Scentless Rosewood												*
Menisoermaceae	Sarcopetalum harveyanum	Pearl Vine												*
Moraceae	Ficus coronata	Sandpaper Fig												*
Myrsinaceae	Myrsine howittiana	Brush Muttonwood												*
Myrtaceae	Acmena smihii	Lilly Pilly		*							*			*
	Angophora costata	Smooth-barked Apple	*			*	*	*	*	*				*
	Backhousia ^ myrtifolia	Grey Myrtle												
	Callistemon salignus	White Bottlebrush, Pink-tips		*	*			*		*		*		*
	Callistemon sp.	Bottlebrush	*											
	Corymbia	Red Bloodwood	*	*			*		*	*				

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	gummifera													
	Corymbia maculata	Spotted Gum		*	*						*	*	*	
	Eucalyptus acmenoides	White Mahogany	*			*				*	*			
	Eucalyptus canaliculata	Large-fruited Grey Gum									*	*		*
	Eucalyptus capitellata	Brown Stringybark	*							*				
	Eucalyptus fibrosa	Broad-leaved Ironbark									*			
	Eucalyptus globoidea	White Stringybark							*					*
	Eucalyptus microcorys	Tallowwood		*	*	*		*	*			*	*	
	<i>Eucalyptus</i> paniculata subsp. paniculata	Grey Ironbark			*							*	*	
	Eucalyptus pilularis	Blackbutt		*		*	*	*						
	Eucalyptus piperita	Sydney Peppermint							*	*				
	Eucalyptus propinqua											*		*

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	<i>Eucalyptus</i> resinifera subsp. resinifera	Red Mahogany									*	*		
	Eucalyptus ^ siderophloia	A Grey Ironbark												
	Eucalyptus umbra	Bastard White Mahogany	*		*									
	Leptospermum polygalifolium subsp. cismontanum	Tantoon	*	*		*	*	*	*	*			*	
	Lophostemon confertus	Brushbox		*										*
	Melaleuca linariifolia	Snow-in-summer		*	*							*	*	
	Melaleuca styphelioides	Prickly-leaved Tea Tree		*								*		*
	Syncarpia glomulifera	Turpentine				*		*					*	*
Oleaceae	Notelea longifolia var. longifolia	Large-leaved Mock Olive	*		*				*	*				*
Oxalidaceae	Oxalis perennans	Oxalis	*								*		*	
Phyllanthaceae	Phyllanthus hirtellus	Thyme Spurge	*		*	*	*	*	*	*	*		*	

FAMILY		SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
Pittosporaceae	Billa sca	ardiera Indens	Appleberry, Dumplings, Snotberry	*	*	*	*	*	*	*	*	*	*	*	
	Bur	rsaria spinosa	Native Blackthorn										*		
	Hyr flav	menosporum ′um	Native Frangipani												*
	Pitt spir	osporum nescens	Orange Thorn												*
	Pitte	osporum olutum	Rough Fruit Pittosporum		*	*			*				*		*
Plantaginaceae	Pla. * land	ntago ceolata	Plantain									*			
	Ver	ronica plebia	Creeping Speedwell									*			
Proteaceae	Bar oble	nksia ongifolia	Fern-leaved Banksia					*							
	<i>Bar</i> sub	nksia spinulosa osp. spinulosa	Hair-pin Banksia					*	*	*					
	Gre par par	evillea viflora subsp. viflora	Small-flower Grevillea								*				
	Lan	nbertia formosa	Mountain Devils								*				
	Lon	matia silaifolia	Crinkle Bush						*	*	*				
	Per	rsoonia laurina	Laurel Geebung	*						*					

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	Persoonia levis	Broad-leaved Geebung						*	*	*				
	Persoonia linearis	Narrow-leaf Geebung	*		*	*	*	*	*	*	*		*	
Ranunculaceae	Clematis aristata	Traveller's Joy, Old Man's Beard											*	*
	Clematis glycinoides			*					*			*		
Rosaceae	Rubus moluccanus var. trilobus			*										*
Rubiaceae	Asperula asthenes	A Woodruff												*
	Morinda jasminoides	Morinda										*		*
	Opercularia sp.													
Rutaceae	Boronia pinnata	Boronia	*				*							
	Boronia polygalifolia	Dwarf Boronia	*		*		*							
	Melicope micrococca	White Euodia												*
	Zieria smithii	Sandfly Zieria		*										
Sapindaceae	Alectryon subcinereus	Native Quince												*

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	Dodonaea triquetra	Large-leaved Hop-bush							*					
	Guioa semiglau	ca Guioa												*
Thymelaeaceae	Pimelea linif subsp. linifolia	Rice Flower	*		*			*		*	*			
Ulmaceae	Trema tomentos	a Native Peach			*			*						
Verbenaceae	* Lantana camara	Lantana		*				*				*		*
	Verbena * bonariensis	Purpletop									*			
Violaceae	Hybanthus monopetalus	Slender Violet- bush									*			
	Viola betonicifol	ia Native Violet	*					*						
	Viola hederacea	Ivy-leaved Violet		*										*
Vitaceae	Clematicissus ^ opaca	Small-leaved Water Vine												
	Cissus antarctic	a Kangaroo Vine												*
	Cissus hypogla	Native Grape, uca Water Vine												*
	<ul> <li>Tetrastigma nite</li> </ul>	ns -												
4. Monocotyledons														
Anthericaceae	Arthropodium milleflorum	Vanilla Lily	*											

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	Caesia parviflora var. parviflora										*			
Araceae	Gymnostachys anceps	Settlers' Flax, Settlers' Twine												*
Arecaceae	Livistona australis	Cabbage Palm, Cabbage-tree Palm												*
	Archontophoenix cunninghamiana	Bangalow Palm												*
Cyperaceae	Carex appressa	Tall Sedge										*		
	Carex inversa					*		*						
	Carex Iongebrachiata	Sedge		*								*		*
	Fimbristylis dichotoma	Common Fringe Sedge				*					*			
	Gahnia aspera	Rough Saw- sedge									*			
	Gahnia clarkei	A Saw-sedge		*										
	Gahnia sieberiana	Red-fruit Saw- sedge												*
	<i>Gahnia</i> sp.	A Saw-sedge	*				*	*				*		
	Lepidosperma laterale	Variable Sword- sedge	*	*	*	*		*	*	*	*		*	
	Ptilothrix deusta	-				*	*							

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	Schoenus apogon	Common Bog- rush	*						*		*			
Dioscoreaceae	Dioscorea transversa	Native Yam		*				*				*		*
Doryanthaceae	Doryanthes excelsa	Gymea Lily	*			*	*	*		*			*	
Iridaceae	Libertia paniculata	Branching Grass- flag												*
	Patersonia sericea	Silky Purple-flag					*		*					
Lomandraceae	Lomandra cylindrica	Needle Mat-rush								*				
	Lomandra filiformis subsp. filiformis	Wattle Mat-rush			*					*				
	Lomandra hystrix	-		*										*
	Lomandra Iongifolia	Spiny-headed Mat-rush, Honey Reed, Spike Mat- rush	*	*	*	*	*	*	*		*	*	*	*
	Lomandra ^ multiflora	Many-flowered Mat-rush												
	Lomandra obliqua	Fish-bones	*			*		*	*	*				
Luzuriagaceae	Eustrephus latifolius	Wombat Berry			*				*		*	*	*	

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	Geitonoplesium cymosum	Scrambling Lily							*		*	*		*
Orchidaceae	Acianthus fornicatus	Pixie Caps		*	*	*		*					*	
	<ul><li>Arthrochilus</li><li>prolixus (ROTAP)</li></ul>	Elbow Orchid												
	Corybas aconitiflorus	Spurred Helmut Orchid			*	*		*					*	
	Corybas fimbriatus	Fringed Helmet Orchid											*	
	Cryptostylis subulata	Large Tongue Orchid				*								
	Cymbidium suave	Snake Orchid						*						
	Pterostylis Iongifolia	Tall Greenhood											*	
	Pterostylis nutans	Nodding Greenhood				*							*	
Phormiaceae	Dianella caerulea var. producta	Blue Flax-lily	*	*	*	*	*	*	*	*	*	*	*	
Poaceae	Andropogon * virginicus	Whisky Grass				*					*			
	Aristida ramosa	Purple Wiregrass								*	*			
	Aristida vagans	Three-awn Speargrass			*						*		*	

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	Axonopus * fissifolius	Narrow-leaved Carpet Grass			*									
	* Briza maxima	Quaking Grass									*			
	Cymbopogon refractus	Barbed Wire Grass				*				*	*		*	
	Dichelachne micrantha	Short-hair Plumegrass								*				
	<i>Digitaria</i> sp.	-		*	*	*		*			*		*	
	Echinopogon ovatus	Forest Hedgehog Grass								*	*			
	Entolasia marginata	Bordered Panic								*	*	*	*	
	Entolasia stricta	Wiry Panic	*	*	*	*	*	*	*	*	*		*	
	Eragrostis brownii	Browns Lovegrass								*	*		*	
	Eragrostis leptostachya	Paddock Lovegrass				*					*			
	Imperata cylindrica var. major	Blady Grass		*		*		*	*	*	*	*	*	
	Microlaena stipoides	Meadow Rice- grass, Weeping Grass	*					*		*	*		*	
	Oplismenus aemulus	Broad-leaved Basket Grass									*	*	*	

FAMILY	5	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	Oplis imbe	smenus cillis	Narrow-leaved Basket Grass		*		*		*						*
	Panio	cum simile	Two-colour Panic	*			*					*			
	Pasp dista	palidium ns	Spreading Panicgrass	*			*								
	Pasp * ^ ciliati	palum ifolium	One-spiked Paspalum												
	Pasp * dilata	palum atum	Paspalum								*				
	Poa I	labillardierei	Tussock										*	*	
	* Setai	ria sphacelata	South African Pigeon Grass			*	*				*	*			
	Then	neda australis	Kangaroo Grass	*		*	*	*	*		*	*		*	
Ripogonaceae	Ripo <u>(</u> albur	gonum n?													*
Smilacaceae	Smila	ax australis	Lawyer Vine, Native Sarsaparilla		*										*
	Smila	ax glyciphylla	Sweet Sarsaparilla		*				*						
Uvulariaceae	Tripla cunn	adenia inghamii	Tripladenia												*
Xanthorrhoeaceae	Xantl	<i>horrhoea</i> sp.	Grass Tree	*	*	*		*	*	*	*				
Zingiberaceae	Alpin	nia	Native Ginger												*

FAMILY	SPECIES	COMMON NAME	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14
	arundelliana													

# **Appendix 2: Species Predicted**

Species predicted for ecosystem credits

SCIENTIFIC NAME	COMMON NAME							
Burhinus grallarius	Bush Stone-curlew							
Calyptorhynchus lathami	Glossy Black-cockatoo							
Cercartetus nanus	Eastern Pygmy-possum							
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)							
Dasyurus maculatus	Spotted-tailed Quoll							
Falsistrellus tasmaniensis	Eastern False Pipistrelle							
Glossopsitta pusilla	Little Lorikeet							
Grantiella picta	Painted Honeyeater							
Hoplocephalus stephensii	Stephens' Banded Snake							
Kerivoula papuensis	Golden-tipped Bat							
Lathamus discolor	Swift Parrot							
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)							
Miniopterus australis	Little Bentwing-bat							
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat							
Mormopterus norfolkensis	Eastern Freetail-bat							
Myotis macropus (formally Myotis adversus)	Large-footed Myotis							
Neophema pulchella	Turquoise Parrot							
Ninox connivens	Barking Owl							
Ninox strenua	Powerful Owl							
Petaurus australis	Yellow-bellied Glider							
Petaurus norfolcensis	Squirrel Glider							
Petroica boodang	Scarlet Robin							
Phascolarctos cinereus	Koala							
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)							
Potorous tridactylus	Long-nosed Potoroo							
Pteropus poliocephalus	Grey-headed Flying-fox							
Pyrrholaemus saggitatus	Speckled Warbler							

SCIENTIFIC NAME	COMMON NAME
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat
Scoteanax rueppellii	Greater Broad-nosed Bat
Stagonopleura guttata	Diamond Firetail
Tyto novaehollandiae	Masked Owl
Vespadelus troughtoni	Eastern Cave Bat
Xanthomyza phrygia	Regent Honeyeater

Species requiring survey to generate species credits

SPECIES
Acacia bynoeana
Asperula asthenes
Caladenia tessellata
Callistemon linearifolius
Callocephalon fimbriatum
Corybas dowlingii
Cryptostylis hunteriana
Cynanchum elegans
Diuris bracteata
Diuris praecox
Grevillea parviflora subsp. parviflora
Hieraaetus morphnoides
Hoplocephalus bitorquatus
Litoria aurea
Litoria brevipalmata
Lophoictinia isura
Macropus parma
Melaleuca biconvexa
Melaleuca groveana
Mixophyes balbus
Mixophyes iteratus
Myotis macropus (formally Myotis adversus)
Pandion haliaetus
Petrogale penicillata
Phascogale tapoatafa
Planigale maculata
Pseudomys gracilicaudatus
Pseudophryne australis
Rutidosis heterogama
Tetratheca juncea

## Appendix 3: Plot Data entered into tool

14	13	12	11	10	9	8	7	6	5	4	ω	Plot Name
56	56	49	61	50	46	67	36	45	46	57	62	NPS
34	51	45	42.5	34.5	38	59.5	29.5	53	44	40	34	NOS
61	12.5	45	2	8.5	30.5	30.5	30.5	18.5	7.5	46	ი	NMS
24	50	64	58	76	72	62	44	72	50	14	14	NGCG
14	0	12	2	4	28	26	36	6	10	12	20	NGCS
76	74	16	28	26	23	36	74	30	24	48	62	NGCO
10	0	4	2	0	0	2	0	0	0	0	0	EPC
2	ч	0	2	0	0	2	4	2	0	0	4	NTH
<u>ц</u>	ц	4	4	4	4	<u>н</u>	<u>ц</u>	4	1	<u>н</u>	Ч	OR
57	25	108	л	51	36	30	15.5	28.5	33.5	19	11	FL
407233	407651	406671	406627	408122	407684	407908	407800	407609	407877	407394	407469	Longitude
6389874	6389486	6390977	6391199	6388737	6388920	6389153	6389458	6389626	6389046	6389439	6389149	Latitude
- 56	56	56	9 56	56	) 56	56	56	56	56	56	56	Zone
Brush Box - Turpentine shrubby open forest of the coastal ranges of the North 5   Coast	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, 5 Sydney Basin	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, 5 Sydney Basin	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, 5 Sydney Basin	Sydney Peppermint - Smooth-barked Apple shrubby open forest on coastal hills and plains of the southern North Coast and Northern Sydney Basin	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the 5 Central Coast, Sydney Basin	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills 5 of the central North Coast	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the 5 Central Coast, Sydney Basin	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills 5 of the central North Coast	Spotted Gum - Grey Ironbark open forest on the foothills of the Central Coast, 5 Sydney Basin	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills 5 of the central North Coast	Smooth-barked Apple - Red Bloodwood open forest on coastal plains on the 5 Central Coast, Sydney Basin	ELA_Veg_Type



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