Tetratheca juncea Translocation Management Plan For The Karuah East Quarry (Project Approval 09-0175)

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Site Details:	*Tetratheca juncea* Translocation Management Plan
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ABBREVIATIONS

DA	*Development Application*
EPA Act	*NSW Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GPS	*Global Positioning System*
MOD 1	*Modification 1 Approval*
OEH	*NSW Office of Environment and Heritage*
PA	*Project Approval*
PPR	*Preferred Project Plan*
RMS	*NSW Roads and Maritime Service*
TJMP	*Tetratheca juncea Management Plan*

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1 INTRODUCTION

Firebird ecoSultants has been engaged by Karuah East Quarry Pty Ltd to prepare a *Tetratheca juncea* Translocation Management Program (TJMP) to satisfy the requirements of the Project Approval (PA 09_0175) granted on 17 June 2014 for the Karuah East Quarry Project (Karuah East). The TJMP was endorsed by the Secretary of the NSW Department of Planning and Environment (DPE) on 14 December 2015. The 243 clumps of *Tetrathecea juncea* identified in the TJMP have been translocated and monitoring continues in accordance with recommendations of the TJMP. TJMP has been updated to include an additional thirteen (13) individuals of *Tetrathecea juncea* to be translocated as part of an approval under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the modification of the Karuah East Quarry Project Approval (09_0175), identified as MOD 1 by the NSW DPE. Mod 1 grants approval for the nominal expansion of the disturbance area of the quarry by 2,500 m^2 to allow for improved operational efficiencies. For the purposes of this TJMP the translocation of the thirteen individuals impacted by MOD 1 is referred to as Site 2 in this report.

The TJMP has been prepared with reference to the following documents:

- Biodiversity Offfset Area Management Plan, Karuah East Project, prepared by Klenfelder (April 2018)
- Flora and Fauna Impact Assessment Karuah East Quarry Project – Modification Application Pacific Highway, Karuah prepared by Kleinfelder (October 2017)
- Environmental Assessment – Section 75W Application (MOD 1) to amend Part 3A Project Approval 09_0175. Minor Increase to Approved Disturbance Area prepared by ADW Johnson (January 2018) (hereafter referred to as the MOD 1 EA);
- Environmental Assessment Report – Proposed Karuah East Hard Rock Quarry prepared by ADW Johnson Pty Ltd dated 31 January 2013 (hereafter referred to as the EA);
- Preferred Project Report – Proposed Karuah East Quarry prepared by ADW Johnson Pty Ltd dated 30 July 2013 (hereafter referred to as the PPR);
- EPBC Act Assessment Report prepared for Karuah East Quarry by Eco Logical dated October 2014;
- Notice of Project Approval **Application Number:** 09_0175 (June 2014);
- Notice of Project Approval 09_0175, MOD 1 (April 2018);
- Approval under Section 130 (1) & 133 of the Environmental Protection and Biodiversity Act 1999 (EPBC 2014/7282); and
- RPS (June 2013) Terrestrial Ecology Survey and Assessment Report Karuah East Quarry, Karuah, NSW.

2 STATUTORY REQUIREMENTS

2.1 Project Approval Requirements

Requirements of the TJMP are provided in Schedule 3, Condition 27 of the Project Approval. These are reproduced in **2-1** together with the relevant section(s) of the TJMP where the requirements have been addressed.

Table 2-1 Project Approval (PA 09_0175) Requirements

Condition 27	Requirement The Proponent must develop and implement a translocation program for *Tetratheca juncea* to the satisfaction of the Secretary.	Relevant Section
Schedule 3 – Environmental Performance Conditions		
(a)	be prepared in consultation with OEH, by a suitably qualified and experienced ecologist whose appointment has been approved by the Secretary;	Sarah Jones of Firebird ecosultants has consulted OEH and a discussion has occurred with Steve Lewer (Regional Biodiversity Conservation Officer at OEH). Steve Lewer informed that OEH does not normally recommend translocation, but will review the TJMP. OEH has reviewed the TJMP and advises it is adequate. Refer to Appendix B for OEH Letter. Sarah Jones has been approved by the Secretary of NSW Planning and Environment to prepare the translocation program. Refer to Appendix A for letter from DPE.
(b)	be submitted to the Secretary for approval prior to the commencement of construction activities that involve clearing of or potential harm to *Tetratheca juncea;*	TJMP to be summited to the Secretary for approval prior to clearing works
(c)	include measures for the translocation of all *Tetratheca juncea* stems in the area of disturbance to nearby areas with similar physical and biological habitat features;	Section 6 and 7.
(d)	include a monitoring program to study the *Tetratheca juncea* stems before and after translocation;	Section 9 of TJMP
(e)	include short and long-term goals and performance criteria to measure the effectiveness of the program	Section 8 of the TJMP
(f)	provide for the transfer of information obtained as a result of implementing the program to OEH and P&I	Section 9 of the TJMP
Schedule 5 – Environmental Management, Reporting and Auditing		
Management Plan Requirements		
3	The Proponent must ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include:	Whole of document
3(a)	Detailed baseline data	Section 3.2.1

3(b)	A description of: • The relevant statutory requirements (including any relevant approval, licence or lease conditions); • Any relevant limits or performance measures/criteria; and • The specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;	Section 2
3(c)	A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	N/A
3(d)	A program to monitor and report on the: • Impacts and environmental performance of the project; and • Effectiveness of any management measures (see (c) above);	Section 9
3(e)	A contingency plan to manage any unpredicted impacts and their consequences;	Section 8.3
3(f)	A program to investigate and implement ways to improve the environmental performance of the project over time;	General Management under the EMS
3(g)	A protocol for managing and reporting any: • Incidents; • Complaints; • Non-compliances with statutory requirements; and • Exceedances of the impact assessment criteria and/or performance criteria; and	General Management under the EMS
3(h)	A protocol for periodic review of the plan.	Section 9

2.2 Statement of Commitments

Statement of commitments Section 4.1 (Appendix 6 of the Project Approval) includes the following:

1. A salvage program for *tetratheca juncea* will be implemented. The salvage program will comprise the excavation of clumps (along with rhizomes and surrounding root balls) proposed for removal and their reintroduction into prepared 'beds' within suitable habitats nearby.

2. Application for a Section 91 licence from OEH for the salvage program will be made and will be subject to a detailed Salvage plan to be prepared by the proponent (and endorsed by OEH and the Department of Planning) prior to the commencement of works.

Item 1 is addressed within Sections 6 and 7 of this document and Item 2 is addressed in Section 2.3 of this document.

2.3 Section 91 Licence

A section 91 licence is not applicable as Projects approved under Part 3A of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) do not require subsequent approvals or separate licensing to extract a threatened plant species for the purpose of propagation or translocation in relation to that project. This is covered by the Consent Conditions issued for Project Approval.

The translocation program does not require a Section 91 license from the NSW Office of Environment and Heritage (OEH), as the translocation will be undertaken as part of a current approval for the Karuah East Quarry and involves a biodiversity offset adjacent to the site, the translocation to the offset site is considered to form part of the approval and as such no translocation license is specifically required for this program.

2.4 Federal Approval (2014/7282)

There are no conditions that specifically relate to the *Tetrathecea juncea* translocation program within the EPBC Act Approval. The Eco Logical Report dated October 2014 and titled EPBC Act Assessment Report reference the *Tetrathecea juncea* translocation program which has been addressed in Section 7 of this report.

The Kleinfelder Biodiversity Offset Area Management Plan (BOAMP), prepared in accordance with Condition 9 of the EPBC Approval (and endorsed by the Australian Government Department of the Environment on 16/3/2016) refers to the TJTP addressed in Section 7 of this report.

3 PROJECT DESCRIPTION

3.1 Overview

Following exploratory works adjacent to the existing Karuah quarry, additional resource was identified to the east on land owned by the Proponent (Project site). Following a detailed Part 3A application process,

On 17 June 2014 project approval for the Karuah East Quarry was granted by the Planning Assessment Commission (PA 09_0175) for the extraction of this additional resource. The Karuah East, is a stand-alone operation to the existing quarry.

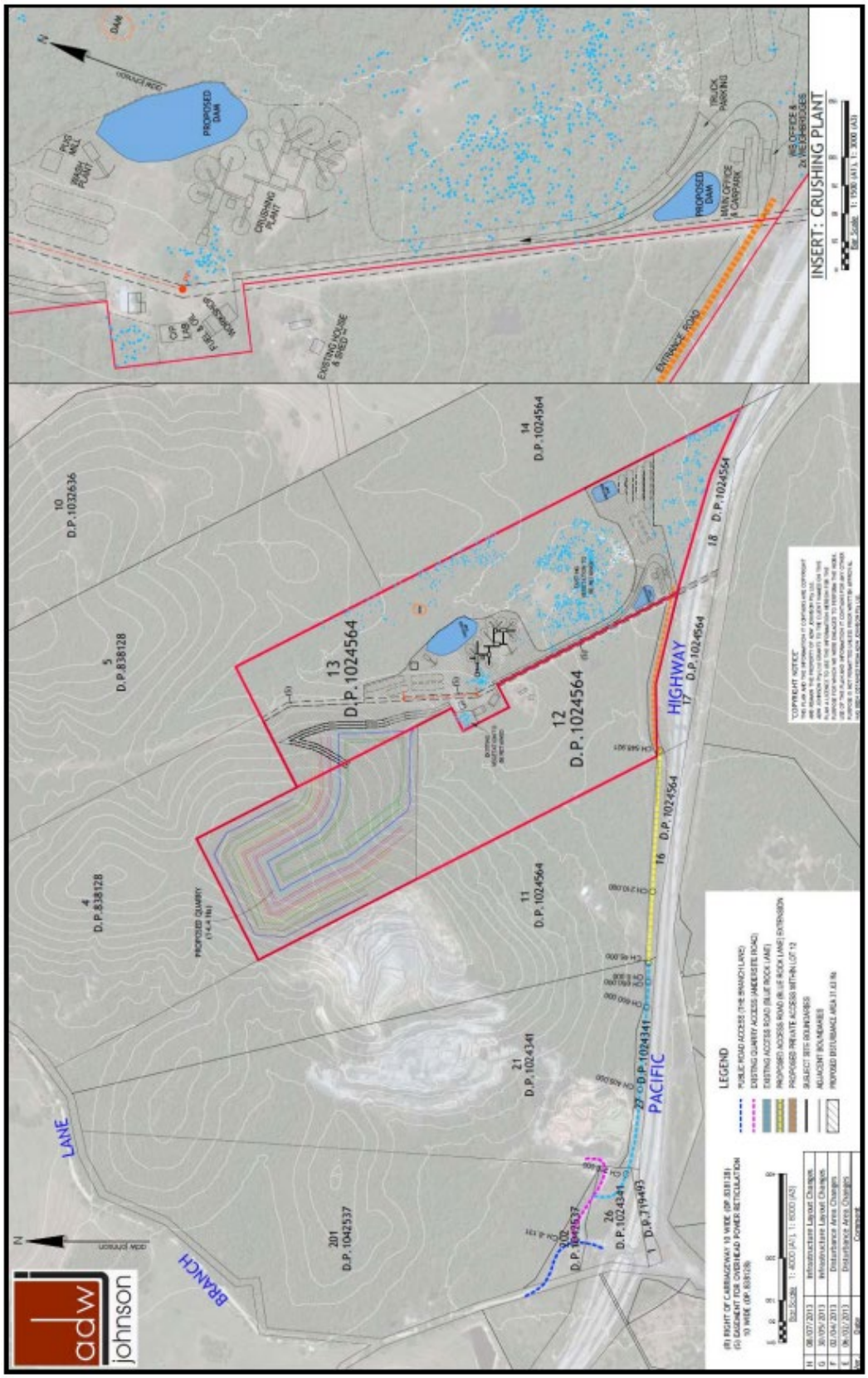
3.2 Project Site

The Karuah East Quarry is located on Lots 12 and 13 DP 1024564, off the Pacific Highway approximately 3 km north of Karuah NSW within the Mid Coast Council (MCC) (formally Great Lakes Council) Local Government Area (LGA). Vegetation clearing and construction of the quarry commenced in April 2016, with quarry operations commencing in November 2017. This included the implementation of this TJMP and translocation of 243 *Tetrathecea juncea* individuals from the project disturbance area into the translocation area (shown on Figure3-4 of this document)

The approved development includes the following key elements:

- Staged extraction of approximately 29 million tonnes of “andesite” over a 20 year timeframe;
- Extraction of up to 1.5 million tonnes of andesite material per year;
- Removal and stockpiling of an estimated 380,000 m^3 of overburden (approximately 750,000 tonnes) from the quarry extraction area in accordance with the Rehabilitation Plan prepared for the project. Removal of overburden is not included in the proposed extraction rate of 1.5 million tonnes of andesite annually;
- Haulage of up to 1.5 million tonnes of andesite per year from the site to market by 25 to 30 tonne haul trucks via the Pacific Highway;
- Up to 216 truck loads per day (at maximum production);
- Implementation of water management and erosion and sediment control works to ensure no loss of sediment, dust minimisation and to control discharges from the site to ensure that all discharges are within acceptable volumetric and water quality criteria;
- Roadworks to secure access to the site including upgrade & extension of Blue Rock Lane, realignment of Andesite Road & Blue Rock Lane intersection and adjust road markings at Branch Lane & Andesite Road intersection;
- Employment of 28 on-site staff;
- Construction of new haul road and access through adjoining RMS land;
- Staged clearing;
- Drilling and blasting activities;
- Loading and hauling of extracted material;
- Crushing and screening of extracted material;
- Stockpiling of material on-site; and
- Location of plant on Lot 13 comprised of office buildings, workshops, parking areas, crushing plant, wash plant, weigh bridge and product storage areas.

Figure 3-1 Presents the originally approved (June 2014) Karuah East site plan and layout.



The Karuah East quarry development required a translocation program to be implemented for the threatened species *Tetratheca juncea*. The approved Karuah East quarry includes a biodiversity offset conservation area adjacent to the existing quarry as shown in Figure 3-3. This area was investigated during the approval process and also in baseline studies during establishment of the biodiversity offset area and also in subsequent monitoring and it has been established that 6907 clumps of *Tetratheca juncea* are located in the offset site. The approved impact area was found to have 243 clumps of *Tetratheca juncea.* Refer to Figure 3-3 for Locations of *Tetrathecea juncea.* It is acknowledged that translocation is not a mitigation measure and is considered as a supplementary action due to low certainty of success. However, in this instance, translocation was undertaken as an additional measure to gain a better biodiversity outcome. Translocation of the individuals that would have been impacted from within the impact area to the offset site has assisted in protecting the genetic diversity of the population. Translocation has been successfully undertaken for *Tetratheca juncea* previously at other sites with a moderate survival rate of 27% after 5 years (Lake Macquarie City Council, 2013).

The translocation program comprised the careful excavation of the *Tetratheca juncea* individuals from the impact site and translocation into pre-prepared areas within the offset site now referred to as the Translocation Site within this report. An area of 2,500m^2 to 3,000m^2 has been established in Lot 14 as the Translocation Site. Refer to Figure 3-4 showing location of Translocation Site. The Translocation Site was selected to ensure that an appropriate vegetation community and aspect would be provided. The *Tetratheca juncea* removed from the impact area 243 clumps which will this identified Translocation Site to ensure that translocation success is as high as possible, and replicates the source environment as much as practicable. Translocated plants were carefully moved to ensure minimal disturbance as detailed in this report.

3.3 Site 2 – MOD 1- Approved Nominal Increase to Disturbance Area

A modification to the original Part 3A approval, under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) was approved by the NSW Department of Planning and Environment (DPE) in April 2018. This modification is identified as MOD 1 by the DPE (refer to Figure 3-1 for MOD 1 Impact Site). Under MOD 1, the disturbance area of the quarry will be nominally increased by 2,500 m^2 to allow for improved operational efficiencies and will remove thirteen (13) *Tetrathecea juncea* plants. Refer to Figure 3-3 for Locations of *Tetrathecea juncea.*

The translocation program for the 13 *Tetrathecea juncea* plants will comprise the careful excavation of the *Tetratheca juncea* individuals from the MOD 1 impact site and translocation into pre-prepared areas within the offset site. As noted above, an area of 2,500m^2 to 3,000m^2 has been established in Lot 14 as the Translocation Site. Refer to Figure 3-4 showing location of Translocation Site. The Translocation Site was selected to ensure that an appropriate vegetation community and aspect would be provided.

The *Tetratheca juncea* removed from the original impact area (being 243 clumps) have already been successfully translocated into the Translocation Site. The further thirteen (13) plants within the MOD 1 will be carefully moved to ensure minimal disturbance as detailed in this report. Refer to Figure 3-2 Approved Mod 1 Site Plan (April 2018)

Figure 3-2 MOD 1 Impact Site

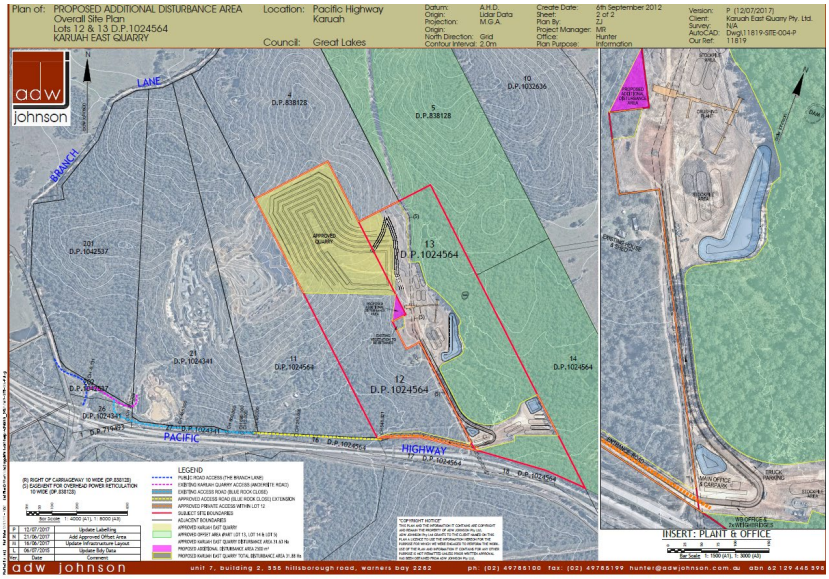


Figure 3-3 Location of *Tetratheca juncea*

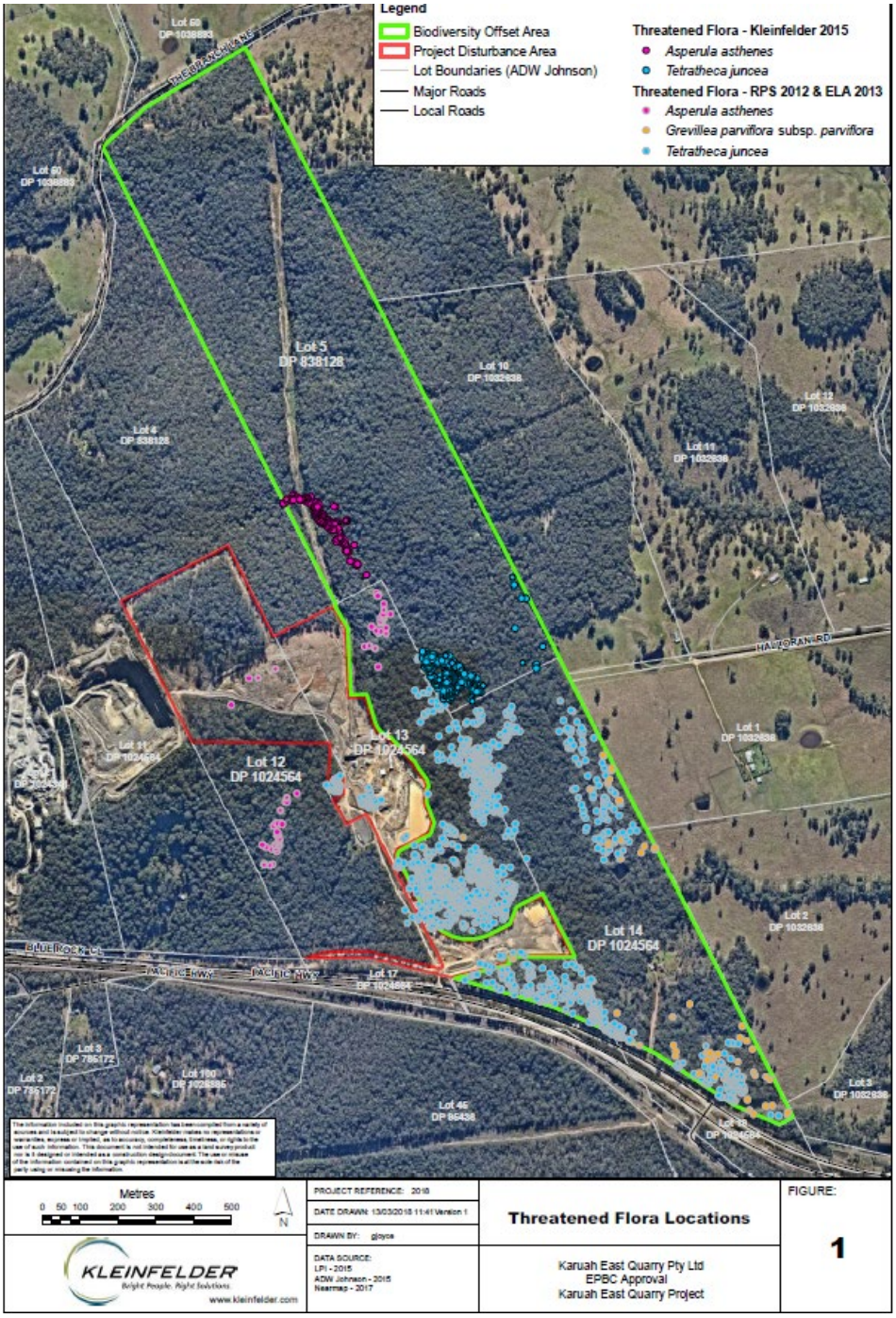


Figure 3-4 Location of Established Translocation Site

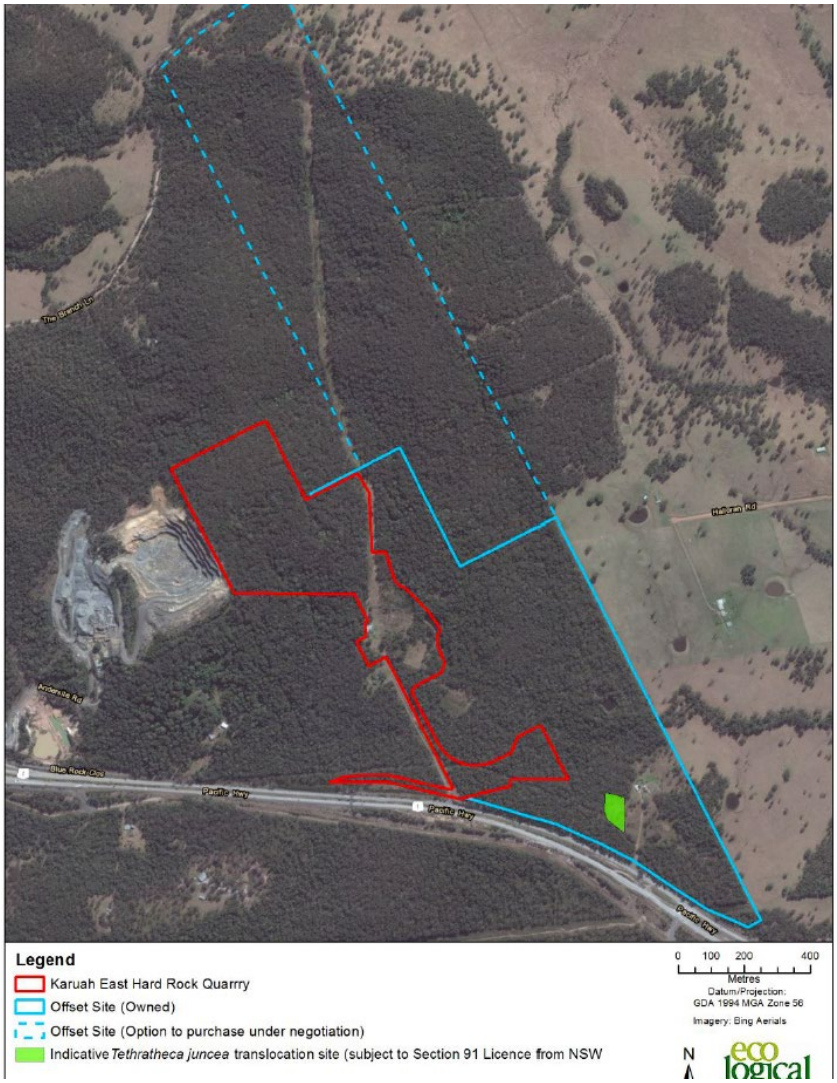
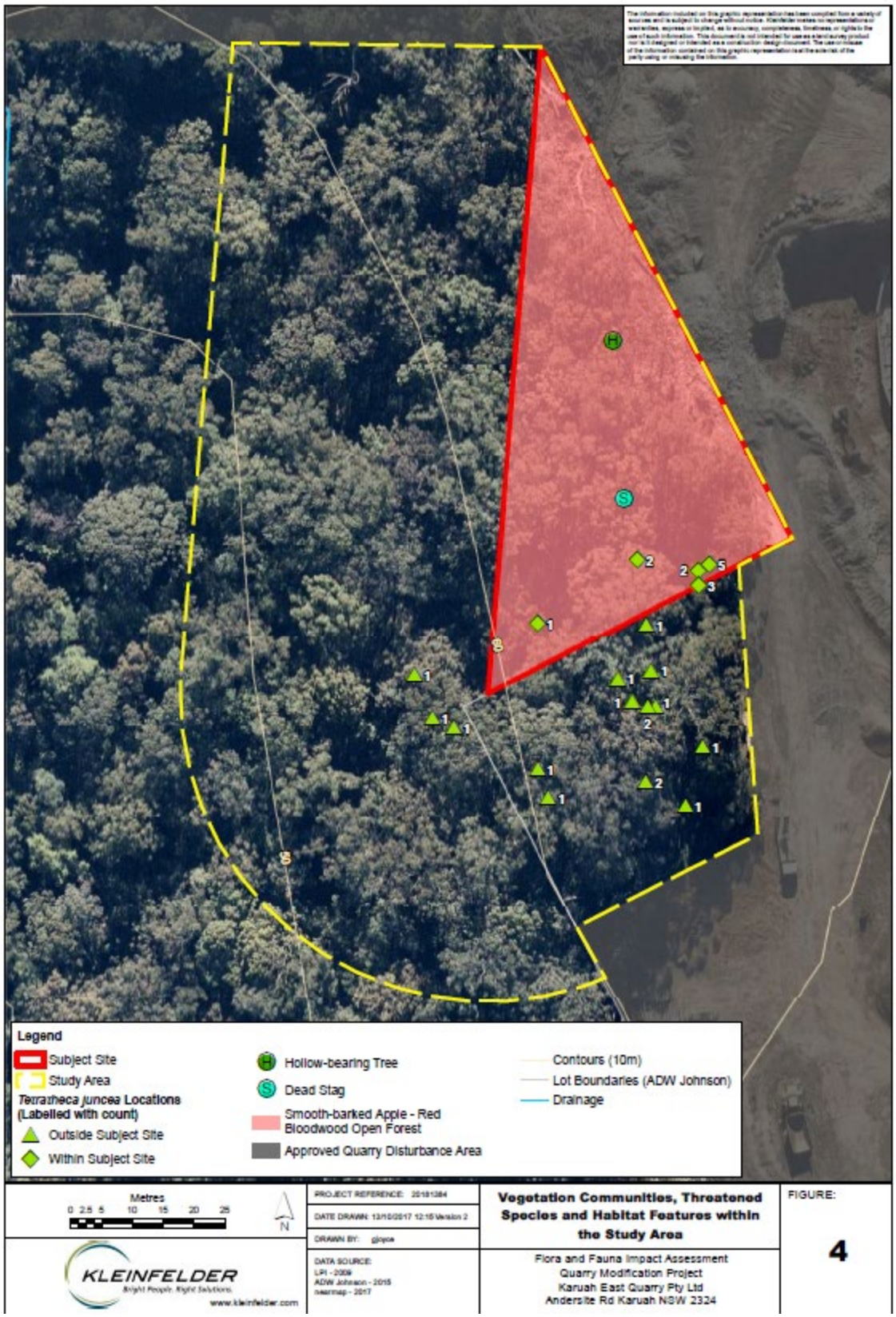


Figure 3-5 Site 2 (MOD 1) Location of *Tetrathcea juncea*



4 ECOLOGY OF TETRATHECA JUNCEA

4.1 Description

Tetratheca juncea is a low growing, usually leafless shrub with clumps of stems to one metre or more in length that bear deep lilac-pink or rarely white flowers. When present the narrow leaves are about 2cm long and lack a stalk (Thompson 1976, Harden 1992, Payne 2000). Plants are usually sprawling and are difficult to detect amongst other vegetation when not flowering. It may be readily distinguishable from other *Tetratheca* species with which it grows by its distinct winged stem and reduced leaves (NSW Department of Environment and Conservation 2005: para. 1). The below description is provided from PlantNET (Botanic Gardens Trust 2007).

Family:
Elaeocarpaceae

Common Name:
Black-eyed Susan

Description:
Prostrate shrub with stems to 1 m long; stems with 2 or 3 wings, glabrous with minute tubercles. Leaves alternate, usually reduced to narrow-triangular scales, 3 mm long, otherwise +/- narrow elliptic, to 20 mm long and c. 5 mm wide, glabrous, margins flat or recurved; sessile. Flowers solitary or paired; peduncles 5-10 mm long, glabrous. Sepals 1-1.5 mm long, pink. Petals 7-11mm long, deep lilac-pink. Ovary glabrous; ovules 4. Fruit obovate, 6-8 mm long, often beaked, +/- stalked; seeds c. 4 mm long.

A photo of the species as typically occurs across the Site is provided in **Photo 1**

Photo 1 Example of *Tetratheca juncea*

4.2 Pollination ecology and mycorrhizal associations of Tetratheca juncea

Pollination is fundamental to the existence and persistence of plant species and their associated communities with the vast majority of flowering plants relying on animal pollination (Williams & Winfree, 2013). Habitat loss and fragmentation has been shown to effect on the pollination success, visitation to flowering plants by pollinators and pollinator community composition (Williams & Winfree, 2013).

The body size of pollinators has been demonstrated to be directly correlated to their potential foraging distance, with larger bees foraging further than smaller bee species (Greenleaf et al, 2007). The data presented by Greenleaf et al (2007) indicates that the maximum foraging distance for the majority of bee species was around 1km, with some species substantially less.

The floral structure of *Tetratheca juncea* requires the flowers to be pollinated by species of native bee which are capable of "buzz-pollinating" to vibrate the pollen out of the anthers (Gross et al, 2003). Self- fertilisation within Tetratheca juncea is low for this reason accounting for only 2% of seed set under laboratory conditions. *Tetratheca juncea* is known to be buzz-pollinated by small species of native bee approx. 6mm in size (Driscoll, 2003), approximately ½ the size of the European Honeybee (Apis mellifera). Based on studies by Greenleaf et al (2007) it would be expected that given the small size of the Bee species known to pollinate *Tetratheca juncea*, that they would have a relatively small home range, as small pollinators are known to travel a maximum of several hundred metres (Williams & Winfree, 2013). It is suggested by Driscoll (2003) that pollinators for *Tetratheca juncea* would likely travel a maximum of 500m between populations of the species.

The number of Bees observed to be pollinating *Tetratheca juncea* were very low across two studies each comprising more than 100 hours of observation (Gross et al, 2003, Driscoll, 2003). Documentation of pollinators is poor across the whole Tetratheca genus and is considered poorly understood (Gross et al, 2003). Gross et al (2003) suggests that as *Tetratheca juncea* produces nectar-less flowers, that the species requires a diversity of other flowering plants within the local area to increase the chances that it is visited by suitable pollinators. Gross et al (2003), consider that *Tetratheca juncea* is for this reason susceptible to disruption of pollination services as a result of land clearance and habitat fragmentation.

Tetratheca juncea like a large number of Australian flora species is thought to be dependent on a mycorrhizal association to thrive, due to the poor viability of plants grown under laboratory conditions Bartier et al, 2001. The specific mycorrhizal association is currently unknown.

5 PRE TRANSLOCATION

5.1 Site assessment Impact Site (Original Approval)

The impact area for *Tetratheca juncea* was inspected by Firebird ecologist, Nicholas Alexander in June 2015 and found that the site has a semi-continuous canopy, mature trees and less saplings than the Translocation Site. Trees in this area included Tallowwood (*Eucalyptus microcory*s), Blackbutt (*Eucalyptus pilularis*), Blue-leaved Stringybark (*Eucalyptus agglomerate)*, Red Bloodwood (*Corymbia gummifera*), Forest Oak (*Allocasuarina torulosa*) and Hickory Wattle (*Acacia implexa*).

This site had a dense mid story, dominated by Gymea Lilies (*Doryanthes excelsa*). Other shrubs included Cheese Tree (*Glochidion ferdinandi*), Forest Oak (*Allocasuarina torulosa*), *Pultenaea* sp., and *Acacia* sp. There was dense grassy undergrowth with Bracken Fern (*Pteridium esculentum*), Spiny-headed Mat-rush (*Lomandra longifolia*), Rough Guinea Flower (*Hibbertia aspera*) and *Gahnia* sp. Vines such as Lawyer Vine (*Smilax australis*), Hairy Apple Berry (*Billardiera scandens*), Scrambling Lily (*Geitonoplesium cymosum*) and Molucca Bramble (*Rubus moluccanus*) were also present. Refer to Photos 2 and 3 showing vegetation.

This site had a steeper slope (approximately 5-7 degrees) than the Translocation Site, and this slope was also in a south eastern direction.

Photo 2 Original Impact Site

Photo 3 Impact Site (Original Approval)

5.1.1 Survey Counts

The species has been recorded extensively within Lots 13 & 14 during surveys undertaken by RPS, ELA (2014) and Klennfelder (2017). The species is also present on Lots 12 and Lot 5 (ELA, 2014). These surveys found that 6,907 clumps (clump = mass of suckering stems) occur within the project offset area, whilst 243 clumps occured within the original project impact area that required translocation and is part of this TJMP. Refer to Figure 3-3 for Location of *Tetrathecea juncea.*

5.2 Site Assessment – Site 2 (MOD 1 – Approved Additional Disturbance Area)

One vegetation community was mapped within the subject site; 0.25 ha Smooth-barked Apple – Red Bloodwood open forest (Klenfelder 2018). The vegetation community description for Smooth- barked Apple – Red Bloodwood open forest, as described in the BOAMP (Kleinfelder, 2015), is consistent with the species assemblage recorded within the subject site during field surveys. Refer to Photos 3-4 showing vegetation within the MOD 1 – Approved Additional Disturbance Area

Photo 3 MOD 1 – Approved Additional Disturbance Area

Photo 4 MOD 1 – Approved Additional Disturbance Area

5.2.1 Site 2 – Survey Counts

A total of thirteen (13) plants were recorded within the proposed modification area by Klenfelder (2017) during the targeted survey. Refer to Figure 3-5 for location of *Tetrathecea juncea.*

5.3 Mapping and Population Extent

Tetratheca juncea is well known within the local area with numerous records in the vicinity of Swan Bay, Wallaroo Nature Reserve, Karuah Nature Reserve, Tahlee and Girvan. The sub-populations in the north (Karuah to Bulahdelah), of which this population forms a component, are considered disjunct to the core population in the Lake Macquarie area. The original project site (offset and project area) were surveyed by RPS and subsequently by ELA (2014) and were found to have 6567 clumps of *Tetratheca juncea*. Additional investigations by Klenfelder as part of the BOAM identified an additional 583 *Tetrathcea juncea* individuals within the offset area. Additional investigations to the 'Site 2' area by Klenfelder (2017) identified an additional 13 *Tetrathecea juncea* individuals (refer to Figure 3-4)

5.4 Site Assessment Translocation Site

5.4.1 Assessment Prior to Establishment of Transloction Site

Nicholas Alexander Ecologist at Firebird ecosultants undertook a site survey within the Translocation Site in June 2015 for the recommended translocation area identified by Ecological (2014) to ensure that this area has the right micro-climate and conditions to give the best survival rate of the translocation program. Refer to Figure 3-4 for Translocation Site.

The site was found to accommodate a small number of sporadic mature eucalypts in the specified area, and a moderate amount of regenerating eucalypt saplings. Trees in this area included Spotted Gum (*Corymbia maculata*), Red Bloodwood (*Corymbia gummifera*), Red Mahogany (*Eucalyptus resinifera*), Broad-leaved White Mahogany (*Eucalyptus umbra*), White Stringybark (*Eucalyptus globoidea*) and Black She-oak (*Allocasuarina littoralis*). This community would best be described as a Spotted Gum Complex.

The translocation site also possesses a sporadic shrub layer consisting of individuals of *Persoonia*, *Pultanaea* and *Acacia* genus's. A relatively dense grassy understory also existed within the translocation site, with species observed including Kangaroo Grass (*Themeda australis*), Browns Lovegrass (*Eragrostis brownii*), Blady Grass (*Imperata cylindrica*), Blue flax-lily (*Dianella cerulea*), Spiny-headed Mat-rush (*Lomandra longifolia*) and Variable Sword-sedge (*Lepidosperma laterale*). The exotic South African Pigeon Grass (*Setaria sphacelata*) was also found in this location. This species will be part of the weed control within the translocation area. Refer to Photos 5-7 for Site Photos of the Translocation Site.

The slope of the translocation site is to be very gentle (approximately 2 degrees) in a south eastern direction. The site is very open and exposed due to a low incidence of canopy trees.

Whilst the recipient site is quite open and exposed, and slope is quite gentle, the site is easily accessible and plenty of space exists for the translocation sections. Therefore, the site preparation and a detailed management strategy of this area as detailed in Section 9 and 10 of this TJMP will be undertaken to ensure long term or higher success / survival rate.

Photo 5 Translocation Site (Prior to Establishment)

Photo 6 Translocation Site (Prior to Establishment)

Photo 7 Translocation Site (Prior to Establishment)

5.4.2 Ongoing Monitoring of Established Translocation Site

The Translocation Site is established, with monitoring and management of the site in accordance with the approved TJMP. Refer to Photos 8 -11 showing the Established Translocation Site.

Photo 8 Established Translocation Site (2016)

Photo 9 Translocated *Tetrathecea juncea* recorded during the 2016 Monitoring Period

Photo 10 Translocated *T.juncea* in flower in the established Translocation Site during the October 2017 Monitoring Period

Photo 11 Considerable regrowth of vegetation in the Established Translocation Site during the 2017 Monitoring Period

6

6 TRANSLOCATION PREPARATION

6.1 Original Project Approval – identified during the original assessment process

The 243 clumps of *Tetratheca juncea* have already been translocated to the translocation area and subject to ongoing monitoring .

6.2 Site 2 – MOD 1(Approved Additional Disturbance Area)

The approved Mod 1 will directly disturb 13 *Tetrathecea juncea* plants. Accordingly, translocation of these plants is necessary. Consistent with the methodology used to located and identify the 243 Tetrathecea juncea individuals that have been previously translocated, removal of the 13 plants within the Mod 1 extension area will be undertaken in patches. Each of these patches will be referred to as a translocation section.

A GPS will be used to locate the clumps of *Tetratheca juncea* by a Firebird Ecologist. The ecologist will then use pink marking spray to mark each translocation section. This action is important to enable excavating teams to recognise translocation sections. This area has been marked in the field.

Each translocation section will be inspected by an ecologist prior to translocation and the following noted.

- Number of clumps
- Health of stems
- Flower numbers
- A species list of all plants within the translocation section
- Each translocation section will be individually numbered to assist in monitoring.

Ecologists will be present during the removal of the translocation sections from the impact site, and will assist in the relocation to the translocation site. Refer Table 7-1 for proposed actions

6.3 Translocation Site Preparation

As the translocation will occur immediately after collection, the existing Translocation Site will be prepared prior to translocation. The collection methods entail digging within the Translocation Site before collecting a translocation section from the MOD 1 impact area and placing the section into the hole within the Translocation Site.

Site preparation includes the removal of threatening processes that may impact upon the success of plant survival. These include weed control, protection from herbivory and management of fire risks. An irrigation system is also available to ensure moisture levels remain adequate for plant survival.

It is recommended that weather conditions are monitored prior to translocation. A moist site is preferable for translation. Refer Table 7-1 for proposed actions

7 TRANSLOCATION OF SECTIONS

7.1 Timing – Original Project Approval

Translocation of 243 plants has been successfully completed and is subject to monitoring as required by this TJMP.

7.2 Timing – Site 2 (MOD 1 Approved Additional Disturbance Area)

The modification area is expected to be cleared and developed in 2018. The success rate of the translocation program for *Tetratheca juncea* is not reliant on if the species is in flower or not and therefore can be undertaken anytime. However, it is considered that spring is an ideal translocation time as the *Tetratheca juncea* will be flowering. This will ensure that *Tetratheca juncea* plants can be confidently identified before translocation occurs.

7.3 Translocation Process – Site 2 (MOD 1 Approved Additional Disturbance Area)

Consistent with the previous translocation completed on the site as part of the original approval, the translocation of each of the sections within Site 2 will be undertaken by an experienced ecologist and excavator driver. The entire root body and associated soil should be moved as a whole. Small individual plants can be removed by manual labour. Larger clumps of plants will require mechanical removal to limit disturbance and plant stress. Mechanical removal will be undertaken by the excavator.

It is recommended that translocation takes place in the morning to ensure that moisture and heat stress is minimised, and that the root balls do not dry out during translocation.

The following methods are proposed for the translocation program:

- Driver to take a large scoop, using the pink spray and the ecologist guidance as an indicator for size. The translocated sections will have large root balls which will include soil from the source area. This will assist in ensuring that any mycorrhizal fungi present within the soil and to harvest a maximum quantity of vegetative and growing media material and in doing so optimising the chances of success post transfer is also transported to the Translocation Site.
- Translocated sections will be carefully moved to ensure minimal disturbance and will be cleaned of any weed species.
- Driver to carefully place the sections on a truck and then transported to Translocation Site.
- Driver to carefully place the translocation section in the pre prepared hole under supervision of the ecologist.

- The area should be watered immediately by water tanker. The translocation sections will receive follow up watering to ensure establishment (subject to local weather conditions and requirements).

Follow the above steps until all translocation sections have been transferred. Refer Table 7-1 for proposed actions

7.4 After planting care

In order to maximise plant survival a maintenance program is required. The translocated *Tetrathecea juncea* plants from 'Site 2' will be monitored and maintained as part of the broader established translocation area. Mulch can be used to reduce moisture loss and provide a barrier for weed establishment. Mulch is a good source of organic matter and can provide protection from frosts. Mulch needs to be sterile and free from weed seeds. Watering can occur via an irrigation or dripper system if required (it is understood that an irrigation system is already available to the established *Tetrathecea juncea* translocation site). The site under the advice of the ecologist will manage the irrigation schedule. Maintaining moisture levels ensures the individuals are not experiencing unnecessary stress during the establishment period. Once established the watering regime can be adjusted to allow the plants to adapt to drier conditions. Soil wetting agents can be used to increase the moisture holding capacity of the soil, or hydro-crystals can be used to store moisture that is available for uptake by the plants.

Protection of the transplant sites through fencing or tree guards will exclude herbivores from impacting on plant survival. Ongoing weed control is undertaken to ensure competition is minimal. Monitoring of plant health for insect attack, pathogens and fungus are important to allow the effective treatment of plants to prevent avoidable attrition and is undertaken regularly in accordance with the TJMP. Other preventative measures such as spraying replanted areas with Phosphonate can improve plant vigour and prevent the infection of *Phytophora cinnamomi*. Refer Table 7-1 for proposed actions.

7.5 General Inspections

Firebird Ecologists will undertake general inspections of the translocated sections within the first two weeks after translocation occurs. General health, flower numbers, stems and soil moisture will be monitored during these inspections.

Monitoring of plant health for insect attack, pathogens and fungus are important to allow the effective treatment of plants to prevent avoidable attrition. Other preventative measures such as spraying replanted areas with Phosphonate can improve plant vigour and prevent the infection of *Phytophora cinnamomi*.

Reports should be provided annually to OEH and DPE, for five years only on the success of translocation methods and recommendations made to assist in future

translocation efforts. All works are to be recorded via a photographic record, the results of which are to be included in the ensuing project reports.

Table 7-1 Proposed Actions

Site	Action	Timing	Person Responsible	Equipment
Impact Site	Mark out translocation sections with pink spray	Preferable during flowering period September - January	Firebird Ecologist	Pink Spray
Impact Site	Number each translocation site	Preferable during flowering period September - January	Firebird Ecologist	Marking Tape, Permanent Marker
Impact Site	Photograph each translocation section	Preferable during flowering period September - January	Firebird Ecologist	Camera
Impact Site	Plant species list for each translocation section	Before removal of the Tetrathecea juncea	Firebird Ecologist	
Translocation Site	Digging hole for translocation section	Preferable during flowering period September - January	Firebird Ecologist and excavator driver	Excavator
Impact Site	Taking a scoop from delineated translocation section	Preferable during flowering period September - January	Firebird Ecologist and excavator driver	Excavator
Translocation site and impact site	Trucks and excavator area to continue from the impact site to the translocation site removing and re planting translocation sections until all sections are transferred.	Preferable during flowering period September - January September	Firebird Ecologist and excavator driver	Excavator
Translocation Site	Protection of transplant sites through fencing or tree guards will exclude herbivores from impacting on plant survival	Preferable during flowering period September - January September	Firebird Ecologist with the contractor	Fencing or tree guards
Translocation	Watering of translocated sections or otherwise drip	Every afternoon for	Site Supervisor	Water Tanker or

Site	Action	Timing	Person Responsible	Equipment
Site	irrigation	the first week and twice weekly for next fortnight.	with input from Firebird ecologist	irrigation or dripper system.
Translocation Site	GPS Translocation section locations. Install permanent marker (star picket) and number	After *Tetrathecea juncea* has been translocated	Firebird Ecologist	Star pickets, GPS
Translocation Site	Ongoing weed control will be necessary to ensure competition is minimal and Monitoring of plant health for insect attack, pathogens and fungus are important to allow the effective treatment of plants to prevent avoidable attrition.	Ongoing weed control and monitoring of plant health every two months for the first year and proving affective treatment measures	Firebird Ecologist	
Translocation Site	Monitoring. Recording flower numbers, fruits plant health, soil moisture levels, plant species and taking photos. A Monitoring report will be produced detailing these findings and correction actions.	During the peak flowering period which is normally October / December 2015. October & December 2016, 2017, 2018, 2019, 2020.	Firebird Ecologist	Camera

8 OBJECTIVES OF THE TRANSLOCATION PROGRAM

The objectives of the translocation program is to successfully translocate the clumps of *Tetratheca juncea* that occur within the project impact area (both the original approval area and the MOD 1 additional disturbance area 'Site 2') to the Translocation Site, and to enhance the survival of this species by weed control and monitoring of plant health for insect attack, pathogens and fungus are important to allow the effective treatment of plants to prevent avoidable attrition and to determine the best actions to help the survival and success rate of the translocated clumps. The overall objective is to ensure that the *Tetrathecea juncea* within the Translocation Site is able to survive on its own accord.

8.1 Short Term Goals

Ongoing weed control and monitoring of the health of the species to ensure high survival and success rate of the translocated clumps. The performance criteria measured by the establishment of a self-sustaining population of the focal species (Griffith *et al.*, 1989; Fischer & Lindenmayer, 2000). Successful flora translocations have also been described as the ability of the translocated population to persist and reproduce (Godefroid *et al.*, 2011). The short-term goal is the successful establishment of the translocated individuals. The short term Performance Criteria will identify threats and these will be addressed, along with new growth and the monitoring requirements in Table 9.1. This will be detailed in the monitoring report will detail the percentage of individuals that have survived detailed on a graph. It is noted that the success rate of *Tetratecea juncea* translocation has been 25% survival. The short-term performance criteria is to reach a success rate of 25%.

8.2 Long Term Goals

The Long erm Performance Criteria will be to measure the success of translocation methods and make recommendations to assist in future translocation efforts. Reports should be provided annually to OEH and DPE on the success of translocation methods and recommendations made to assist in future translocation efforts. This being if the short-term goals of > than 25% success rate is not achieved then other methods should be introduced such as fire for seed germination may be required.

8.3 Contingency Plan

The main unpredicted impacts to the success of *Tetrathecea juncea* would be by competition from weed species, and grazing by herbivores. Table 8-1 details the contingency plan to manage these unpredicted impacts and their consequences.

Table 8-1 Contingency Plan

Weed presence	Trigger	Weeds (OEH 2017d) do not comprise more than 20% cover of any stratum.	Weeds (OEH 2017d) comprise >20% but <40% cover of any stratum.	Weeds (OEH 2017d) comprise more than 40% cover of any stratum.
	Response	No response required. Continue monitoring program.	Undertake weed management to remove / spray introduced weed species. Treatment of infestations as appropriate to the species.	Undertake weed management to remove introduced weed species. Investigate management measures to reduce weeds including additional soil amelioration, establishment and retention of cover crops until weed presence is at acceptable levels. Implement recommendations as appropriate. Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on *T. juncea*.
Evidence of herbivore	Trigger	No evidence of herbivores	Evidence of impact from herbivores	
	Response	No response required. Continue monitoring program.	Protection of transplant sites through fencing that will exclude herbivores from impacting on plant survival	

9 MONITORING PROGRAM

9.1 Monitoring Program for Original Development Approval

Follow up monitoring on the success of the translocation will be undertaken for the first two weeks of the translocation and then 1 month after translocation (ELA, 2014). Further monitoring will be undertaken when the species fruits in December. Further monitoring will be undertaken annually during the peak flowering period of the species for a period of 5 years.

A qualified ecologist will conduct monitoring for each translocation section, which will include the following actions detailed in Table 9-1;

Table 9-1 Monitoring Elements

Timing	Monitoring Action
October 2015	• Count Flowers • Observe general plant health • Identify all plants within section • Photo point • Weed monitoring and management
December 2015	• Count Flowers • Count fruits • Observe general plant health • Identify all plants within section • Photo point
October 2016 October 2017 October 2018 October 2019 October 2020	• Count Flowers • Observe general plant health • Identify all plants within section • Photo point

The above information will be used to report and measure the general health and success of translocated *Tetratheca juncea* sections. Reports should be provided annually to OEH and DPE on the success of translocation methods and recommendations made to assist in future translocation efforts. All works are to be recorded via a photographic record, the results of which are to be included in the ensuing project reports

9.2 Monitoring Program for Site 2 – MOD 1 (Approved Additional Disturbance Area)

Follow up monitoring on the success of the translocation will be undertaken for the first two weeks of the translocation and then 1 month after translocation (ELA, 2014). Further monitoring will be undertaken when the species fruits in December. Further monitoring will be undertaken annually during the peak flowering period of the species for a period of 5 years.

A qualified ecologist will conduct monitoring for each translocation section, which will

include the following actions detailed in Table 9-2;

Table 9-2 Monitoring Elements – Site 2

Timing	Monitoring Action
October 2018	• Count Flowers • Observe general plant health • Identify all plants within section • Photo point • Weed monitoring and management
December 2019	• Count Flowers • Count fruits • Observe general plant health • Identify all plants within section • Photo point
October 2018 October 2019 October 2020 October 2021 October 2022	• Count Flowers • Observe general plant health • Identify all plants within section • Photo point

The above information will be used to report and measure the general health and success of translocated *Tetratheca juncea* sections. Reports should be provided annually to OEH and DPE on the success of translocation methods and recommendations made to assist in future translocation efforts. All works are to be recorded via a photographic record, the results of which are to be included in the ensuing project reports

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Karuah East Quarry, Karuah, NSW

APPENDIX A EXPERT APPROVAL FOR PROJECT

NSW GOVERNMENT Planning & Environment

Planning Services
Resource Assessments

Contact: Swati Sharma
Phone: 9228 6221
Email swati.sharma@planning.nsw.gov.au

Our Ref: MP 09_0175

Mr Blake Almond
GM Business Development
Karuah East Quarry Pty Ltd
PO Box 3081
Thornton NSW 2322

Dear Mr Almond

Karuah East Quarry Project (MP 09_0175)
Expert Approval

I refer to your letter dated 23 June 2015 requesting the Secretary's approval of suitably qualified persons to prepare specific management plans stipulated under conditions 7, 12, 16, 21, 26, 27, 32, 33 and 36 of Schedule 3 of the quarry's project approval.

The Department has reviewed the CVs provided with your letter and is satisfied that the nominated persons are suitably qualified. Consequently, I can advise that the Secretary endorses the following persons:

Expert	Company	Management Plan	Condition in Schedule 3
Nathan Archer	SLR Consulting	Noise Management Plan	7
Nathan Archer	SLR Consulting	Blast Management Plan	12
Martin Doyle	SLR Consulting	Air Quality Management Plan	16
Duncan Barnes	SLR Consulting	Water Management Plan	21
Craig Nethery and Andy Davis	Streetwise Road Safety and Traffic Services	Transport Management Plan	26
Sarah Jones, Alex Picton and Nicholas Alexander	Firebird EcoSultants	*Tetratheca juncea* Translocation Program	27
Chris Jones and Aaron Mulcahy	SLR Consulting / Kleinfelder	Landscape and Rehabilitation Management Plan	32
Aaron Mulcahy and Luke Forster	Kleinfelder	Biodiversity Offset Area Management Plan	33
Jeremy Hill and Darrell Rigby	RPS	Heritage Management Plan	36

If you require any more information, please call Swati Sharma on 9228 6221.

Yours sincerely

Howard Reed 22.7.15
Howard Reed
Director
Resource Assessments
As nominee of the Secretary

Department of Planning & Environment
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APPENDIX B OEH LETTER

NSW GOVERNMENT | Office of Environment & Heritage

Your reference: MP09-0175
Our reference: DOC15/369200-7
Contact: Steve Lewer, 4927 3158

Mr Blake Almond
Business Development
Hunter Quarries
PO Box 3284
THORNTON NSW 2322

Dear Mr Almond

RE: HUNTER QUARRIES MANAGEMENT PLANS AND BIODIVERSITY OFFSET STRATEGY – KARUAH EAST QUARRY SITE

Thank you for forwarding the Management Plans and Biodiversity Offset Strategy for the Karuah East Quarry project (MP09-0175) for our records; specifically the following plans:

- Landscape and Rehabilitation Management Plan
- Heritage Management Plan
- Biodiversity Offset Area Management Plan
- Biodiversity Offset Strategy – Finalisation Letter
- *Tetratheca juncea* Translocation Management Plan.

The Office of Environment and Heritage (OEH) understands that it was a requirement of the project approval issued by the Department of Planning and Environment (DPE) to produce the above documents in consultation with OEH. OEH encourages the development of such plans to ensure that proponents have determined how they will meet their statutory obligations and designated environmental objectives. However, OEH typically does not extensively review environmental management plans nor approve or endorse these documents. OEH's role is to set environmental objectives for environmental/conservation management, not to be directly involved in the development of strategies to achieve those objectives. However, in this instance OEH offers the following brief comments on the following management plans:

Biodiversity Offset Strategy – Finalisation Letter

As part of the review of the Preferred Project Report for Karuah East Quarry, OEH provided comment on the proposed biodiversity offset strategy - 'Karuah East Quarry Biodiversity Offset Strategy' (EcoLogical July 2013), which used the BioBanking Assessment Methodology (BBAM) to test its adequacy. OEH noted that the proposed offset contained 129.3 hectares of remnant vegetation in moderate to good condition, that included 'Spotted Gum-Grey Ironbark foothills forest', 'Smooth-barked Apple-Red Bloodwood Forest', 'Blackbutt-Turpentine-Tallowwood sheltered forest', 'Sydney Peppermint-Smooth-barked Apple shrubby Forest' and 'Brush Box-Tallowwood wet forest'. The proposed offsets would would include three lots; Part Lot 13 DP 1024564 and Lot 14 DP 1024564, which are currently owned by Hunter Quarries, and an adjacent lot, Lot 5 DP 838128 which was under negotiation for purchase. Under BBAM, OEH acknowledged that the proposed offset generally compensated for most of the affected ecosystem and species credits, except for the 0.4 hectares of Dry Rainforest. However, in terms of the overall adequacy of the offset proposal for the three lots combined, OEH noted an overall 4:1 offset ratio and that the lack of dry rainforest in the offset is to

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a certain extent offset by the presence of 30 hectares of moist forest of other types in the offset lands. As such, OEH supported the proposed biodiversity offset strategy presented in the PPR, providing that Lot 5 was included in the proposal.

The project was approved by DPE on the 17 June 2014 subject to a number of conditions as set out in Schedules 2 to 5 of the Project Approval. Condition 28, which deals with the biodiversity offset strategy, specifically states that "*The Proponent shall, prior to the commencement of vegetation clearing activities, finalise and implement the Biodiversity Offset Strategy, as described in the EA, summarised in Table 10* [shown below] *and shown conceptually in Figure 1 of Appendix 4, in consultation with OEH and Council, and to the satisfaction of the Secretary*".

Table 10: Biodiversity Offset Strategy

Area	***Area Offset Type Minimum Size***	***Minimum Size (ha)***
Offset Area	Existing vegetation to be managed and enhanced	129.32 ha

Note: The Biodiversity Offset Strategy shall direct that the land proposed as the Biodiversity Offset shall be free of any dwelling-houses and associated sheds, bushfire asset protection zones and other related utilities or structures so as to preserve the integrity and function of that offset area. The Biodiversity Offset Strategy shall also provide details of the revegetation of any parts of the offset area that are cleared of native vegetation or are in an otherwise substantially modified state, other than required management trails and boundary fencing buffer distances.

Correspondence titled '*Finalisation of Biodiversity Offset Strategy for the Karuah East Quarry Project (09_0175)*' by Kleinfelder Australia Pty Ltd (dated 13 July 2015), indicates that Lot 5 (as per above) has now been purchased by Hunter Quarries. This correspondence states the proponent has exchanged contracts with the vendor and that settlement of the transaction will occur on 19 December 2015. As such OEH concurs with this letter that the purchase of Lot 5 DP 838128, along with Part Lot 13 DP 1024564 and Lot 14 DP 1024564 now effectively finalises the Biodiversity Offset Strategy as per Condition 28. Kleinfelder have also confirmed that the biodiversity offset is free of dwellings, asset protection zones and other infrastructure, as required under Condition 28.

OEH notes that the proponent intends to secure the biodiversity offset via a Conservation Agreement, under Part 4, Division 12 of the *National Parks and Wildlife Act 1974*, which will be done in consultation of OEH. OEH confirms that this meets the 'long term security' obligations as set out in Condition 29 of the Project Approval.

Biodiversity Offset Management Plan

OEH has briefly reviewed the 'Biodiversity Offset Plan' (prepared by Kleinfelder and dated September 2015). In general, this plan generally address the appropriate management strategies, performance criteria and reporting requirements OEH would expect from such a document. However, OEH notes that this plan will be subject to the management requirement and expectations required for a Conservation Agreement, which is the mechanism the proponent is utilising to secure the offset in the long-term. As such, OEH's Conservation Partnership staff will review this document in detail as part of the Conservation Agreement application and process. Ultimately, this plan will need to be compliant with their requirements.

***Tetratheca juncea* Translocation Management Plan**

Generally, OEH is not supportive of translocation programs given the uncertainty of their effectiveness, with respect to securing and/or maintaining the long-term conservation of the species being impacted upon. However, in this instance, OEH notes that biodiversity offset area (discussed above) adequately compensates for the impacts of the proposed quarry on *Tetratheca juncea* (i.e. the proposed offset area contains *Tetratheca juncea* 'species credits' commensurate with that required under BBAM) and the proposed translocation program is essentially targeting plants that would have been cleared under the proposal. Therefore, OEH sees some merit in the project particularly from view of testing current translocation techniques and strategies for the species. As such, OEH would like to be kept informed of the progress of the translocation project, receive updates and be sent a copy of the final report.

OEH has briefly reviewed the 'Tetratheca juncea Translocation Management Plan' (prepared by Firebird and dated August 2015) and is of the opinion it adequately details the proposal. OEH notes that Firebird state that OEH gave an undertaking we would review the plan and sign-off on the report, as stated in Table 2-1 of the plan, however, OEH does not have a sign-off role as we are not the consent authority for the project. OEH is content with providing consultative advice.

If you require any further information regarding this matter please contact Steve Lewer, Regional Biodiversity Conservation Officer, on 4927 3158.

Yours sincerely

23 SEP 2015

RICHARD BATH
Senior Team Leader Planning, Hunter Central Coast Region
Regional Operations