Annexure 4 – Part 2

EIS Appendix 8 - 12

Appendix 8: Biodiversity Impact Assessment

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Report

Biodiversity Impact Assessment

Tikitere Quarry

SMK Consultants

9 February 2018
Rev 1 (Final)

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Report Details

Biodiversity Impact Assessment - Tikitere Quarry

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Function	Signature	Name and Title	Date
Prepared by		Luke Pickett Senior Ecologist	9 February 2018
Checked and Authorised for Release by		Dr Rod Bennison Lead Environmental Scientist	9 February 2018

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APPENDICES

Abbreviations

BBCC	BioBanking Credit Calculator
BC Act	Biodiversity Conservation Act 2016
BVT	Biometric Vegetation Type
CEMP	Construction Environmental Management Plan
DP&E	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999 (Federal).
FBA	Framework for Biodiversity Assessment
FM Act	Fisheries Management Act 1994 (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage
PCT	Plant Community Type
REF	Review of Environmental Factors
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
TECs	Threatened Ecological Communities
TSC Act	Threatened Species Conservation Act 1995 (NSW).
TSPD	Threatened Species Profile Database
VEC	Vulnerable ecological community
VIS	Vegetation information system
VMP	Vegetation Management Plan

1. INTRODUCTION

Advitech Pty Limited (trading as Advitech Environmental) was engaged by SMK Consultants to undertake a biodiversity assessment for proposed quarry operations located on the Tikitere Homestead property at 1135 Croppa Creek Road, North Star. The location of the proposed site is shown in **Figure 1**.

It should be noted that this report was prepared by Advitech Pty Limited for SMK Consultants Pty Ltd ("the customer") in accordance with the scope of work and specific requirements agreed between Advitech and the customer. This report was prepared with background information, terms of reference and assumptions agreed with the customer. The report is not intended for use by any other individual or organisation and as such, Advitech will not accept liability for use of the information contained in this report, other than that which was intended at the time of writing.

1.1 Proposal background

Two sites have been identified for extraction of quarry materials, including a hard rock quarry and white rock/gravel quarry. The hard rock quarry consists of a previously unworked volcanic plug, located on the western part of Tikitere property. The white gravel pit is located on the northern portion of the property, and has been previously worked. The general arrangement of the project is provided in **Figure 2**.

Approval is sought for the operations of both the hard rock quarry and the white rock gravel pit. The quarries would service construction of the Inland Rail project, currently undergoing design and assessment by the Australian Rail and Track Corporation (ARTC).

While detailed plans are not yet available, the proposed operations will include excavation and processing of material, haulage to a rail loading point, and subsequent loading onto trains. This assessment has focused on areas potentially impacting remnant vegetation at the proposed hard rock quarry and white rock/gravel quarry. It has been assumed that existing tracks and previously cleared areas would be used to transport material from the quarry operations and no vegetation would be impacted outside the proposed quarry impact areas.

1.2 Site Description

The following definitions are used throughout this report to refer to locations in the proposal area:

- The 'proposal' is all areas that would be directly impacted by the works. This includes areas subject to vegetation clearing and earthworks and is shown as 'proposal area' in **Figure 2**;
- The 'study area' includes the proposal and the areas adjacent that may be indirectly impacted by the proposed works;
- The 'search area' refers to a 40 kilometre area surrounding the proposal for the purpose of database searches.

Figure 1: Site location

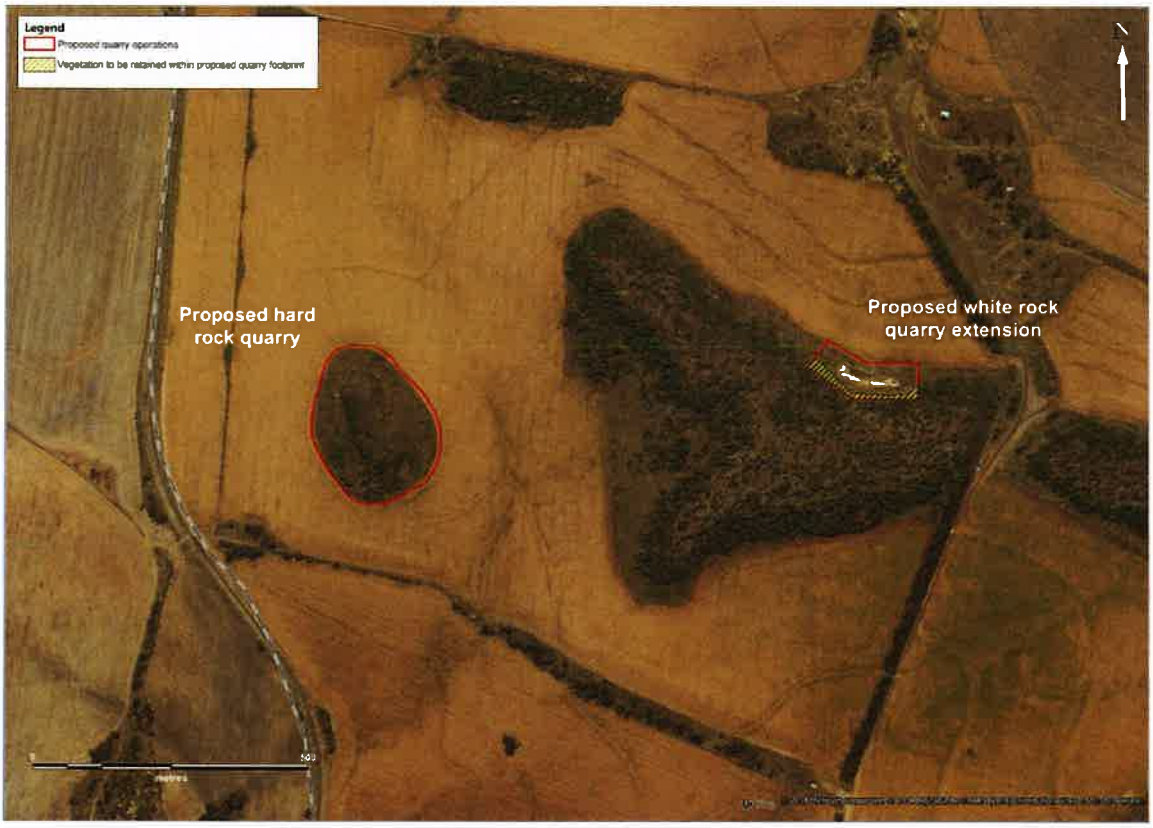

Figure 2: Proposal

1.3 Legislative context

This report presents an assessment of the potential impacts to biodiversity from the proposed quarry works. In particular, this report addresses specific legislative planning requirements relating to flora and fauna, including:

- Effects on threatened species, populations and ecological communities, as listed under the *Threatened Species Conservation Act 1995* (TSC Act), pursuant to section 5A of the *Environmental Planning & Assessment Act 1979* (EPA Act);
- Likely impacts on nationally listed threatened species, populations and ecological communities, as listed under the *Environment Protection and Biodiversity Conservation Act 1999*; and
- Effects on potential Koala habitat pursuant to *State Environmental Planning Policy 44 - Koala Habitat Protection* (SEPP 44).

1.4 Study aims

This study aims to assess the potential impacts of the proposed works on the biodiversity values of the local area. Specifically, it aims to:

- Describe the existing environment;
- Determine if the project is likely to result in any significant impacts to threatened species, populations and ecological communities, or their habitats protected under Federal and State legislation; and
- Recommend measures to minimise any potential impacts to protected biodiversity values throughout.

2. SITE CONTEXT

2.1 Landscape Features

2.1.1 IBRA bioregions and subregions

The current version of IBRA (Version 7, 2012) classifies Australia's landscapes into 89 large geographically distinct bioregions and 419 subregions based on common climate, geology, landform, native vegetation and species information. The proposal area is located within the South Brigalow bioregion and the Northern Outwash subregion.

The South Brigalow bioregion is a subhumid environment occurring on predominantly Jurassic and younger deposits of the Great Artesian Basin and Tertiary deposits with elevated basalt flows. Vegetation consists of eucalypt woodlands and open forests of ironbarks, poplar box, spotted gum, cypress pine, bloodwoods, brigalow-belah forests and semi-evergreen vine thickets.

The Northern Outwash subregion occurs on Tertiary and Quaternary alluvial fans and stream terraces. The predominant landform consists of sloping plains with alluvial fans typically with red loams and heavy brown clays. Vegetation consists of Poplar Box with White Cypress Pine, Wilga and Budda on red soils and Belah and Brigalow occurring on brown clays (OEH, 2015).

2.1.2 NSW landscape regions (Mitchell landscapes)

Two Mitchell Landscapes occur within the Proposal area; Yallaroi Basalts and Croppa Clay Plains. The proposed quarries target basalt derived rock and consequently the proposal area is predominantly located within the Yallaroi Basalts landscape. The Yallaroi Basalts landscape consists of rolling hills and flat top ridges on Tertiary basalt flows over Jurassic quartz and lithic sandstone with a local relief up to 100 metres.

2.1.3 Native vegetation and connectivity

Remnant vegetation within 1500 metres of the proposal area was mapped to assess connectivity to the site (**Figure 3**). Native vegetation in the local area is generally restricted to vegetated hills and creeks and these remnants are mostly isolated by cleared farmland. Cleared areas in the local area are primarily used for cropping and grazing and provide minimal connectivity between habitat areas.

2.1.4 Rivers, streams and wetlands

No naturally occurring rivers or streams are mapped within the vicinity of the proposal area. A number of human made irrigation channels direct water into dams that occur to the north of the proposal area. Water levels within the drainage channels and dams fluctuate widely with prevailing weather conditions and cropping requirements.

The nearest waterways to the proposal area occur about 600 metres to the north with the northern portion of Tikitere draining into first and second order streams of Mungle Creek. The southern portion of Tikitere drains in to Tackinbri Creek located along the southern boundary.

2.1.5 National Parks and Nature Reserves

No national parks or nature reserves occur in the vicinity of the proposal area. The nearest, Planchonella Nature Reserve, occurs about 25 km to the southeast and Bullala National Park occurs about 35 km to the south.

2.1.6 Areas of outstanding biodiversity value

No declared area of outstanding biodiversity value occurs within the study area.

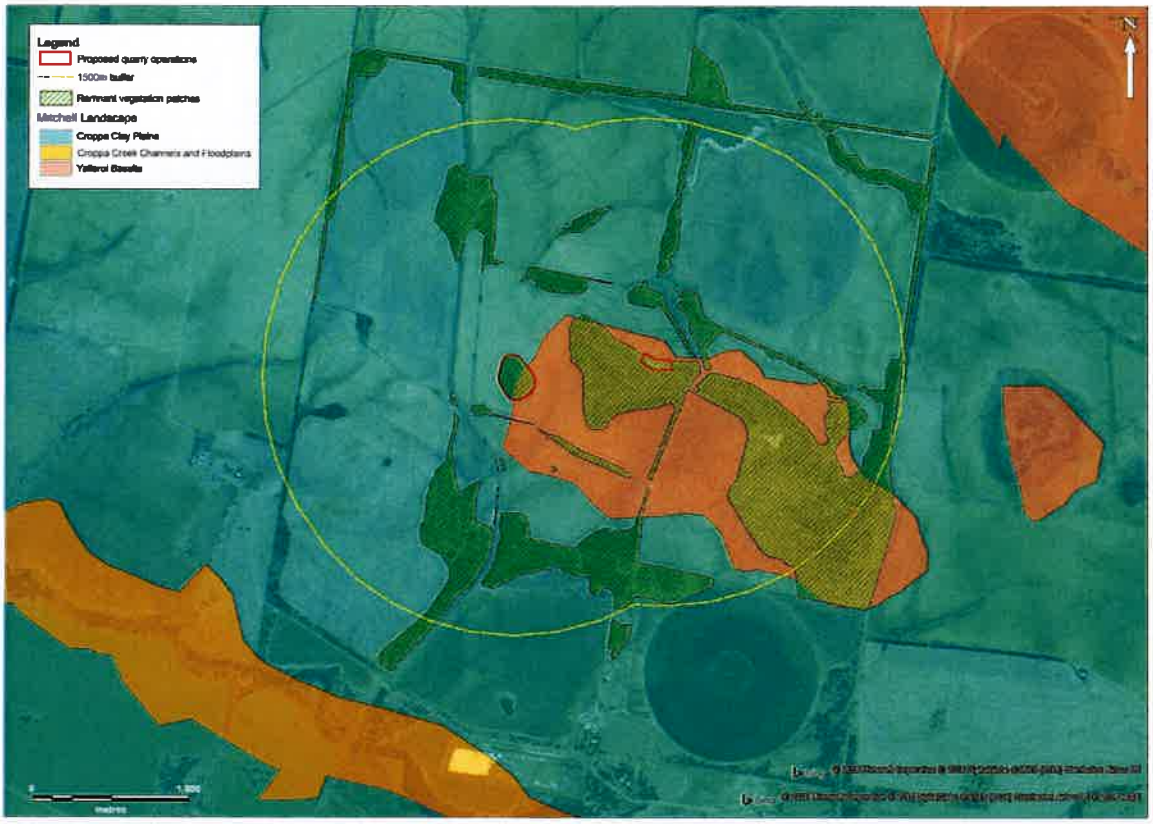

Figure 3: Landscape features

3. METHODOLOGY

3.1 Database Searches and Literature Reviews

A desktop assessment included searches of databases and a review of literature relevant to the site and local area, particularly:

- Office of Environment and Heritage (OEH) Atlas of NSW Wildlife database (licensed) for records of threatened species and endangered ecological communities which have been recorded within a 40 km radius (locality) of the subject site (accessed 18 December 2017);
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool for Matters of National Environmental Significance (MNES) listed under the EPBC Act within a 20 km radius from the site (last accessed 10 January 2018);
- NSW Vegetation Information System (VIS) classification database (OEH, 2018); and
- Proposed quarry layout provided by SMK Consultants.

3.2 Field Survey

A field survey was conducted on 19 and 20 December, 2017. The field survey targeted habitat areas likely to be impacted by the proposed subdivision and used a variety of sampling methods as described below.

3.2.1 Flora

A vegetation survey was undertaken and involved a detailed ground survey using a number of sampling techniques to ensure the site was adequately sampled. The survey methods and effort are consistent with the *Biodiversity Assessment Method* (BAM) (OEH, 2017). A list of all plant species recorded during fieldwork is listed in **Appendix I**. The location of the vegetation surveys are shown in **Figure 3**.

Vegetation communities were determined by comparing the floristic structure and composition of the vegetation on site with vegetation profiles described within the VIS database (OEH, 2018) and community descriptions of endangered ecological communities known to occur in the local area.

3.2.1.1 Vegetation Plots

Five vegetation plot surveys were undertaken on site. The vegetation plots were undertaken in accordance with the BAM being based on a 20 x 20 metre quadrat for recording floristic composition and structure attributes, combined with a 20 x 50 metre plot to assess ecological function. Data collected within each plot includes:

- Flora diversity and composition;
- Projected foliage cover of canopy and midstorey layers;
- Groundcover composition (nested 1x1m plots);
- Vegetation structure (i.e. canopy, sub-canopy, shrub and groundcovers);
- Fauna habitats (i.e. hollow trees, fallen timber);
- Regeneration of canopy species;
- Landscape features (e.g. slope, gully, and aspect);
- Soil features (e.g. soil type, rocks, organic matter); and
- Geographical coordinates and a photographic record.

3.2.1.2 *Random Meander Survey*

Flora investigations in the manner described by Cropper (1993) as the 'Random Meander Technique' were also undertaken to target threatened flora species. This involved walking in a random meander throughout the study area, visiting the full range of habitats and recording every plant species observed.

3.2.1.3 *Vegetation Condition*

A vegetation condition assessment was conducted using the *Biodiversity Assessment Method* (OEH 2017). The assessment aimed to provide a measure of habitat condition for patches of vegetation present in the study area. A condition score out of 100 is calculated by comparing attribute data collected from each vegetation plot with benchmark data for the relevant plant community type.

3.2.2 Fauna

Fauna surveys targeted species that may occur within the subject site. The sampling methods used to survey fauna habitat on site are detailed in **Table 1.**

Table 1: Fauna surveys conducted on site

Fauna Group	Surveys	Methods and Survey Effort
Diurnal Birds	Area search	A search of the subject site was undertaken to identify any birds present. Birds were identified from observations or call identification. A search for nests was also undertaken during the survey.
Herpetofauna	Habitat search	Opportunistic active searches for frogs and reptiles were undertaken during the survey within suitable habitat (i.e. leaf litter, under rocks and long grass).
Mammals	Search for scats and signs	A search for scats and other signs of animal use (e.g. scratches on trees, echidna and bandicoot diggings) was undertaken on site. Thorough searches were conducted at each vegetation plot and opportunistic sightings were also recorded.
Microchiropteran bats	Bat echo-location recording	Bat echo-location calls were recorded using a Wildlife Acoustics Echo Meter 3 (EM3) bat detector. All calls are analysed using AnalookW. Surveys were conducted from dusk till dawn.
All	Opportunistic sightings	Any opportunistic sightings of fauna on site were recorded.

3.2.3 Habitat Tree Survey

A habitat tree survey was undertaken throughout the study area. This involved traversing the entire site and recording each habitat tree. Details including the species of tree, tree characteristics and GPS location were recorded as well as specific habitat attributes including the presence of hollows, nests or indications of fauna. Hollow classification involved three classes:

- Class 1 - large sized hollow openings (i.e. >15cm) suitable for large species such as owls and cockatoos.
- Class 2 - medium sized hollow openings (i.e. 5-15cm) suitable for a range of species including gliders, possums and parrots.
- Class 3 - small sized hollow openings (i.e. <5cm) suitable for small species such as microchiropteran bats and feather-tail gliders.

3.3 Survey Timing

A summary of the time spent on site during fieldwork and the prevailing weather conditions at the time is contained below in **Table 2.**

Table 2: Survey Dates, Times, Activities and Weather Conditions

Date	Time	Activity	Weather
Tuesday 19/12/2017	0715 - 1600	General site inspection Vegetation survey Habitat tree survey Bird searches Herpetofauna searches	0/8 Cloud cover Wind - NE Temp - 24-39^{0}C
	2030 - 0600	Microbat call recording	
Wednesday 20/12/2017	0700 - 1430	General site inspection Vegetation survey Habitat tree survey Bird searches Herpetofauna searches	0/8 Cloud cover Wind - NW Temp - 26-40^{0}C

3.4 Habitat Assessment for Significant Species

The availability of habitat on site was assessed taking into account a number of factors including:

- Structural and floral diversity;
- Occurrence and extent of habitat types in the general vicinity;
- Continuity with similar habitat adjacent to the site, or connection with similar habitat off site by way of corridors;
- Key habitat features such as tree hollows, water bodies, crevices and rocky areas;
- Degree of disturbance and degradation; and
- Topographic features such as aspect and slope.

This information was used to evaluate the site as potential habitat for each of the threatened species considered and assign each species with a rating based on their likelihood to occur within the subject site. The 'likelihood of occurrence' categories are detailed in **Table 3.** The habitat assessment is provided in **Appendix III.** Species assigned with a rating of 'Moderate' or higher and are considered to be potentially impacted by the proposed works have been considered further under relevant legislation within the assessment of significance provided in **Appendix IV.**

Table 3: Likelihood of occurrence criteria

Likelihood Rating	Criteria
Known	The species was recorded within the study area during site surveys.
High	It is likely that a species would inhabit or utilise habitat within the subject site. Criteria for this category may include: ▪ Species recently and/or regularly recorded in contiguous or nearby habitat; ▪ High quality habitat types or resources present within study area; ▪ Species is known or likely to maintain a resident population surrounding the study area; and ▪ Species is known or likely to visit during migration or seasonal availability of resources.
Moderate	Potential habitat for a species occurs within the subject site. Criteria for this category may include: ▪ Species previously recorded in contiguous habitat albeit not recently (>10 years); ▪ Poor quality, depauperate or modified habitat types and/or resources present within study area; ▪ Species has potential to utilise habitat during migration or seasonal availability of resources; and ▪ Cryptic flora species with potential habitat available within the subject site that have not been seasonally targeted by surveys.
Low	It is unlikely that the species inhabits the area and would likely be considered a transient visitor if ever encountered. Criteria for this category may include: ▪ The subject site or study area lacks specific habitat types or resources required by the species; ▪ The subject site is beyond the current distribution of the species or is isolated from known populations; ▪ Non cryptic flora species that were found to be absent during targeted surveys; and ▪ The subject site only contains common habitat which would not be considered important for the local survival of a threatened species.
Unlikely	The habitat within subject site and study area is unsuitable for the species.

3.5 Limitations

The effectiveness of a survey detecting a given species is influenced by a range of factors. For this type of survey, such limitations are generally related to the short period of time in which the fieldwork was carried out during one season. Given the small period of time spent on site, the detection of certain species may be limited by:

- Seasonal migration (particularly migratory birds);
- Seasonal flowering periods (some species are cryptic and are unlikely to be detected outside of the known flowering period);
- Seasonal availability of food such as blossoms;
- Weather conditions during the survey period (some species may go through cycles of activity related to specific weather conditions, for example some microchiropteran bats, reptiles and frogs can be inactive during cold and very hot weather); and
- Species lifecycle (cycles of activity related to breeding).

These limitations have been overcome by applying the precautionary principle in all cases where the survey methodology may have given a false negative result. All species have been assessed on the basis of the presence of their habitat and the likely significance of that habitat to a viable local population.

4. SIGNIFICANT SPECIES

The threatened species listed in **Table 4** have the potential to occur within the local area and have been considered in this report.

Table 4: Threatened species likely to occur in the local area

Scientific Name	Common Name	TSC Act 1995	EPBC Act 1999	Local Records[1]
Plants				
Tylophora linearis		V	E	0
Desmodium campylocaulon	Creeping Tick-trefoil	E		9
Swainsona murrayana	Slender Darling Pea	V	V	2
Swainsona sericea	Silky Swainson-pea	V		1
Acacia jucunda	Yetman Wattle	E		1
Acacia pycnostachya	Bolivia Wattle	V	V	1
Diuris tricolor	Pine Donkey Orchid	V		1
Dichanthium setosum	Bluegrass	V	V	4
Digitaria porrecta	Finger Panic Grass	E		7
Homopholis belsonii	Belson's Panic	E	V	31
Polygala linariifolia	Native Milkwort	E		4
Thesium australe	Austral Toadflax	V	V	1
Cadellia pentastylis	Ooline	V	V	7
Reptiles				
Anomalopus mackayi	Five-clawed Worm-skink	E	V	0
Hoplocephalus bitorquatus	Pale-headed Snake	V		1
Uvidicolus sphyrurus	Border Thick-tailed Gecko	V	V	0
Birds				
Anseranas semipalmata	Magpie Goose	V		2
Calidris ferruginea	Curlew Sandpiper	E	CE	0
Ephippiorhynchus asiaticus	Black-necked Stork	E		1
Rostratula australis	Australian Painted Snipe	E	E	0
Geophaps scripta scripta	Squatter Pigeon	CE	V	0
Circus assimilis	Spotted Harrier	V		8
Haliaeetus leucogaster	White-bellied Sea-Eagle	V		1
Hieraaetus morphnoides	Little Eagle	V		5
Erythrotriorchis radiatus	Red Goshawk	CE	V	0
Falco subniger	Black Falcon	V		3
Ardeotis australis	Australian Bustard	E		2
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		11
Glossopsitta pusilla	Little Lorikeet	V		4
Lathamus discolor	Swift Parrot	E	E	0
Neophema pulchella	Turquoise Parrot	V		17
Ninox connivens	Barking Owl	V		0
Tyto longimembris	Eastern Grass Owl	V		1
Tyto novaehollandiae	Masked Owl	V		10
Anthochaera phrygia	Regent Honeyeater	CE	E	0
Climacteris picumnus victoriae	Brown Treecreeper	V		2
Chthonicola sagittata	Speckled Warbler	V		20

Scientific Name	Common Name	TSC Act 1995	EPBC Act 1999	Local Records[1]
Grantiella picta	Painted Honeyeater	V	V	28
Melithreptus gularis gularis	Black-chinned Honeyeater	V		2
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V		26
Daphoenositta chrysoptera	Varied Sittella	V		12
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V		2
Melanodryas cucullata cucullata	Hooded Robin	V		4
Mammals				
Phascolarctos cinereus	Koala	V	V	88
Petaurus norfolcensis	Squirrel Glider	V		4
Macropus dorsalis	Black-striped Wallaby	E		11
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	0
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		2
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	1
Chalinolobus picatus	Little Pied Bat	V		4
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	0
Vespadelus troughtoni	Eastern Cave Bat	V		1
Invertebrates				
Jalmenus eubulus	Pale Imperial Hairstreak	CE		4

[1] Number of OEH wildlife atlas records in selected area [North: -28.67 West: 149.86 East: 150.71 South: -29.52].

Status Abbreviations

V - Vulnerable
P - Protected
E - Endangered
CE - Critically Endangered
X - Presumed extinct

5. NATIVE VEGETATION

5.1 Plant community types

Two native vegetation communities in varying condition were identified within the study area. A description of these vegetation types and their distribution on site is provided below and shown in **Figure 4.** A full list of species recorded during the field survey is provided in **Appendix I.**

5.1.1 Mixed vine thicket low eucalypt woodland of the northern-western Brigalow Belt South Bioregion (PCT 452)

OEH PCTID	Mixed vine thicket low eucalypt woodland of the northern-western Brigalow Belt South Bioregion (PCT 452)
BC Act Status	Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered)
EPBC Act Status	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered)
Vegetation Formation	Rainforests
Vegetation Class	Western Vine Thickets
Identifying features and occurrence on site	Low woodland typified by emergent *Eucalyptus melanophloia* and a small tree layer composed of *Alstonia constricta*. The shrub layer has a number of species typical of dry rainforest and ranges from sparse to dense depending on previous disturbance. This community occurs along the slopes and crests of the basalt plugs that rise above the surrounding crop land on site.
Upper stratum (to 12m)	*Eucalyptus melanophloia* (Silver-leaved Ironbark) - Emergent *Alstonia constricta* (Quinine Tree)
Mid Stratum	*Alstonia constricta* (Quinine Tree), *Croton phebalioides, Hovea longipes, Carissa spinarum, Geijera parviflora* (Wilga), *Jasminum lineare* (Desert Jasmine), *Notelaea microcarpa* var. *microcarpa* (Velvet Mock Olive), *Eremophila mitchellii* (False Sandalwood), *Capparis mitchellii* (Wild Orange), *Apophyllum anomalum* (Warrior Bush)
Goundcover	*Austrostipa scabra* (Speargrass), *Paspalidium gracile* (Slender Panic), *Einadia nutans* (Climbing Saltbush), *Austrostipa verticillata* (Slender Bamboo-grass), *Cheilanthes distans* (Bristly Cloak Fern)
Vines	*Parsonsia eucalyptophylla* (Gargaloo)
Weeds	*Cenchrus ciliaris* (Buffel Grass), *Lycium ferocissimum* (Box Firethorn), *Citrullus lanatus* (Bitter Melon), *Physalis ixocarpa* (Ground Cherry), *Bidens subalternans* (Greater Beggar's Ticks), *Opuntia* sp. (Prickly Pear)

Figure 4: Landscape features

Photo 1: View of the proposed hard rock quarry hill from southeast showing presence of PCT 452.

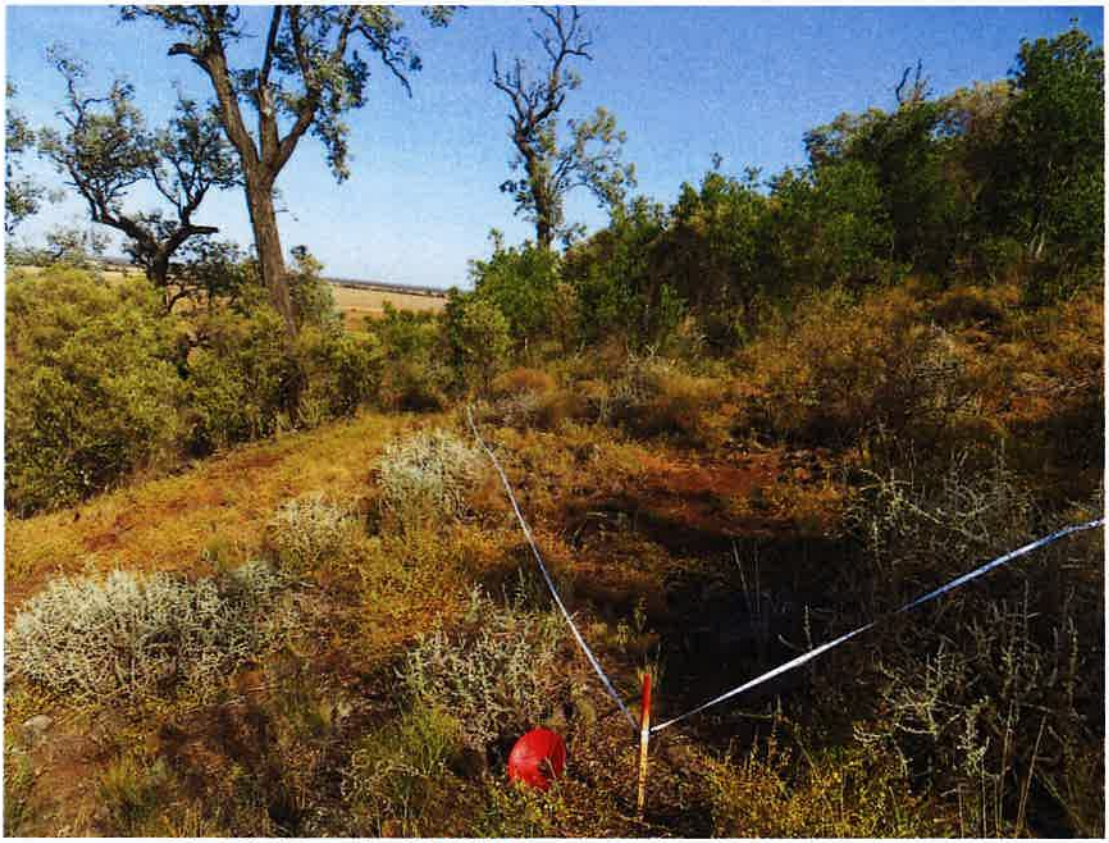

Photo 2: Example of PCT 452 on proposed rock quarry (Plot 1).

Photo 3: PCT 452 to the south of existing farm quarry.

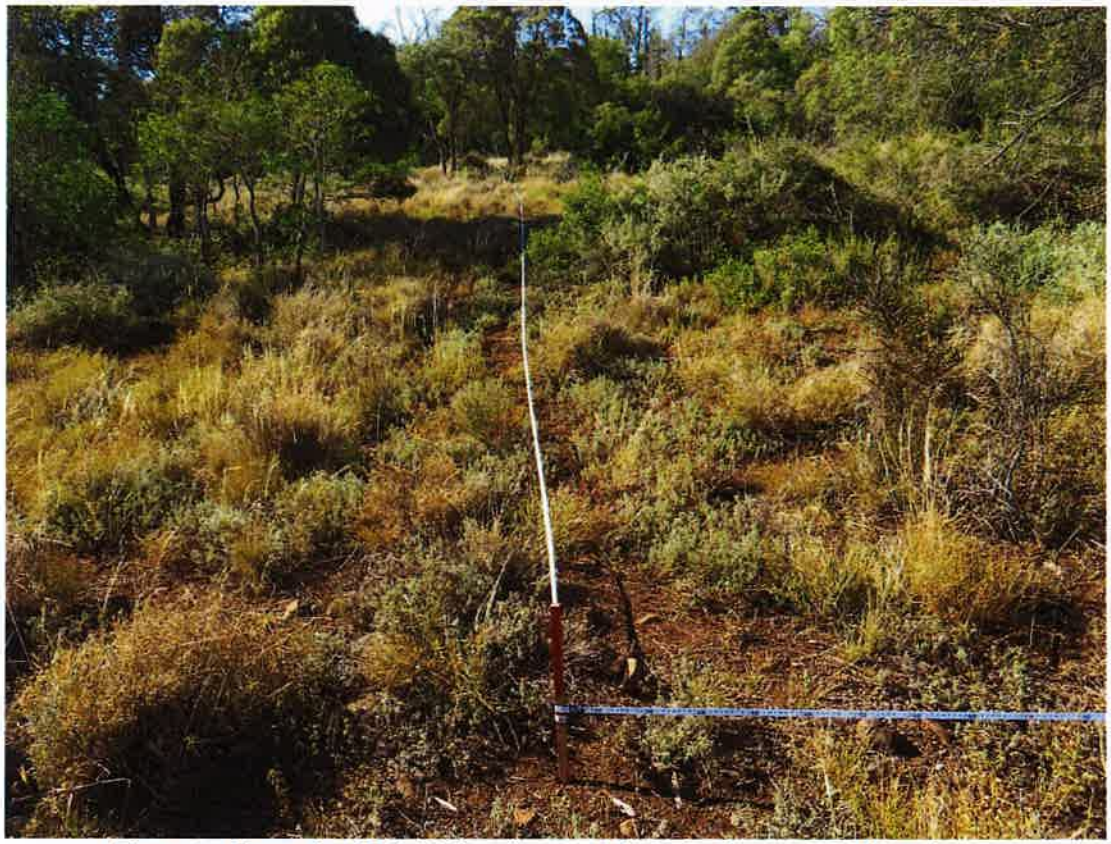

Photo 4: Example of PCT 452 to the west of existing farm quarry (Plot 4).

5.1.2 Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (PCT 445)

OEH PCTID	Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (PCT 445)
BC Act Status	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered)
EPBC Act Status	Brigalow (*Acacia harpophylla* dominant and co-dominant) (Endangered)
Vegetation Formation	Rainforests
Vegetation Class	Western Vine Thickets
Identifying features and occurrence on site	Tall open forest dominated by *Casuarina cristata* (Belah) and *Acacia harpophylla* (Brigalow). This community generally occurs on deep soils as small, thin remnants located along the edges of crop land and access tracks within the Tikitere property
Upper stratum (to 20m)	*Casuarina cristata* (Belah) *Acacia harpophylla* (Brigalow)
Mid Stratum	*Alstonia constricta* (Quinine Tree), *Carissa spinarum, Geijera parviflora* (Wilga), *Croton phebalioides, Jasminum lineare* (Desert Jasmine), *Notelaea microcarpa* var. *microcarpa* (Velvet Mock Olive)
Goundcover	*Austrostipa scabra* (Speargrass), *Goodenia hederacea, Einadia nutans* (Climbing Saltbush), *Austrostipa verticillata* (Slender Bamboo-grass), *Cheilanthes distans* (Bristly Cloak Fern)
Vines	*Parsonsia eucalyptophylla* (Gargaloo)
Weeds	*Lycium ferocissimum* (Box Firethorn), *Opuntia* sp. (Prickly Pear)

Photo 5: Example of remnant PCT 445 located adjacent to access track southeast of proposed quarry.

5.2 Vegetation Condition

Two condition classes have been mapped for the Mixed vine thicket low eucalypt woodland (PCT 452) on site (see **Figure 4**). Plot data analysis indicates the condition of PCT 452 within the proposal area is generally not within benchmark condition (see Table 5). Site attribute values are above and below benchmark condition resulting in an estimated vegetation integrity score of around 50 for vegetation occurring on the proposed rock quarry (mapped as moderate quality) with this increasing to 73 within the larger remnant located to the south of the existing house quarry (mapped as high quality).

Areas mapped as high quality had been subject to minimal clearing and had a relatively intact shrub layer. These areas were subject to grazing by macropods and feral pigs and ground cover was variable throughout the community, particularly given the dry conditions at the time of the survey.

The reduced condition of vegetation occurring on the proposed rock quarry is likely related to the small patch size and fragmentation which amplifies the impact of existing threats including weeds, feral pigs and fire. Previous fire activity was evident within the remnant, and frequent fire has resulted in reduced native species richness with species that are more tolerant of fire such as *Alstonia constricta* (Quinine Tree) dominant throughout.

Previously cleared areas were present, generally occurring between cropping land and remnant vegetation. These areas had a highly modified understorey with a high occurrence of weeds. These areas lacked larger trees and shrubs; however, some native regrowth (mostly Quinine Tree) was present (Photo 6).

Photo 6: Example of mostly cleared area adjacent between cropland and remnant vegetation

5.3 Endangered ecological communities

The Mixed vine thicket low eucalypt woodland (PCT 452) identified on site is consistent with Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions listed under both TSC Act (NSW Scientific Committee, 2011) and the EPBC Act. This PCT will be impacted by the proposal and assessments of significance for the corresponding EECs are provided in **Appendix IV**.

The remnant Brigalow viney scrub open forest (PCT 445) that occurs on deep soils along the edges of crop land and access tracks within the Tikitere property is consistent with the following EECs:

- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered - TSC Act) (NSW Scientific Committee, 2002); and
- Brigalow (*Acacia harpophylla* dominant and co-dominant) (Endangered - EPBC Act).

No areas of PCT 445 would be impacted by the proposal and no further assessment is warranted for this EEC.

No other EECs were identified within the study area.

5.3.1 Threatened Flora and Endangered Populations

Database searches identified 13 threatened flora species with the potential to occur within the search area. A habitat assessment determining the likelihood of these species to be impacted by the proposed works is provided in **Appendix III.**

No threatened flora species were observed within the proximity of the proposal area during the field survey and none are considered likely to be impacted by the proposed quarry works.

Table 5: Site values (Plot data)

Plot	Tree richness	Tree cover	Shrub richness	Shrub cover	Grass / like richness	Grass / like cover	Forb richness	Forb cover	Fern richness	Fern cover	Other richness	Other Cover	High threat weed cover	Length of Fallen Logs	Litter Cover	No. of Large Trees[1]	Estimated Vegetation Integrity Score[2]
1	2	25	8	12	4	0.6	4	40.4	0	0	2	0.4	0.3	18.8	52	3	47.6
2	2	20.1	7	55.7	3	0.3	5	16.3	0	0	2	0.4	1.4	12.2	40	0	
3	2	16	8	39.4	3	5.2	7	15.9	1	0.1	2	0.2	30.3	36.5	46	0	50.6
4	3	0.8	9	31.6	6	16.3	7	6.6	0	0	4	8.4	0.3	0.5	51	0	53.6
5	4	45.1	11	46.5	5	1.7	3	0.3	0	0	3	10.2	0.1	16	58	4	72.8
Bench mark	5	64	12	41	7	29	8	4	1	0	5	5		48	70	6	100

Note 1: Large tree threshold is 30cm DBH for PCT 452.

Note 2: These scores are indicative only and are based on plot values entered in to BAM Calculator.

5.4 Fauna

5.4.1 Fauna Habitat

Fauna habitat within the proposal area is generally restricted to the remnant vegetation located on the basalt hills. Much of this habitat is isolated by intensive cropland with the patch of vegetation located on the proposed hard rock quarry area entirely isolated by cropland. The remnant vegetation located to the south of the existing white rock quarry is contiguous with native woodland that extends along Death Adder Hill to the east. Whilst this forms a relatively large patch of vegetation about 100 hectares in size, this too is isolated by agricultural land with highly limited connectivity to other habitat areas.

Key habitat features recorded within the vicinity of the proposal area include:

- Hollow bearing trees are sparsely distributed throughout the remnant vegetation within the proposal area. These would likely provide roosting and/or foraging and/or breeding habitat for a range of birds, mammals and reptiles that may occur within the study area. Details of the hollow-bearing trees recorded within the study area are provided in **Section 5.4.2**;
- Emergent trees and shrubs may provide foraging habitat for a range of birds, reptiles and frogs. Trees and shrubs may also provide potential nesting sites for nest building birds;
- Fruit-bearing trees and shrubs are a common component of the SEVT found on site - these may provide seasonal foraging opportunities for a range of frugivorous birds and arboreal mammals;
- Ground cover including rocks, leaf litter, grassy tufts and dead wood may provide habitat and cover for a range of small terrestrial species;
- Cleared areas with grasses and herbaceous plants may provide foraging resources for a range ground foraging birds and terrestrial mammals.

A full list of fauna species observed during the survey is contained in **Appendix II.**

5.4.2 Habitat Trees

Twelve habitat trees were recorded within the vicinity of the proposal area. Habitat trees 10 to 12 were located to the south of the proposed house quarry extension and would not be impacted by the proposed works. Details of the habitat trees are provided in **Table 6** and their locations are shown in **Figure 4**.

Table 6: Results of habitat tree survey

ID	Easting[1]	Northing[1]	Species	DBH (cm)	Habitat Notes
H1	240559	6787659	*E. melanophloia*	50	Hollow dead trunk with Class 3 openings suitable for microbats
H2	240547	6787633	*E. melanophloia*	45	2 hollow dead branches with Class 3 openings suitable for microbats and small birds
H3	240544	6787628	*E. melanophloia*	50	1 dead branch with Class 3 opening suitable for microbats
H4	240538	6787628	*E. melanophloia*	30	Hollow trunk with spout Suitable for microbats
H5	240537	6787632	*E. melanophloia*	60	Hollow trunk with opening at base. 3x Class 2 hollows

ID	Easting[1]	Northing[1]	Species	DBH (cm)	Habitat Notes
H6	240537	6787645	*E. melanophloia*	40	2x Class 3 hollows
H7	240524	6787663	*E. melanophloia*	45	1x Class 2, 1x Class 3
H8	240511	6787713	*E. melanophloia*	60	Hollow trunk with many openings 1x Class 2
H9	240510	6787713	*E. melanophloia*	17	Small hollow trunk with small Class 3 suitable for Microbats. Some wear on entrance suggest previous use. Tree was inspected with a bore scope and no bats were present at time of survey.
H10	241473	6787735	*E. melanophloia*	70	2x Class 2, 1x Class 3, Tree to be retained
H11	241475	6787737	*E. melanophloia*	35	2x Class 3, Tree to be retained
H12	241479	6787726	*E. melanophloia*	40	Hollow trunk with 2 spouts and opening at base. Hollow about 6m long. Suitable for microbats. Tree to be retained

Note 1: Coordinate reference system - UTM GDA94

5.4.3 Threatened Fauna

The database searches for the survey area identified 40 threatened fauna species with the potential to occur within the locality of the subject site. A habitat assessment determining the likelihood of these species to be impacted by the proposed works is provided in **Appendix III.**

The habitat assessment identified 13 threatened fauna species with a 'moderate' or greater likelihood to utilise habitat available within the site (see **Table 7**). For the purposes of the assessment of significance, these species have been assorted into groups where species share a similar life history and habitat requirements. The assessment of significance for these species is provided in **Appendix IV**.

Table 7: Threatened fauna with a 'moderate' or greater likelihood to use habitat available within the site.

Fauna Group	Species	Common Name
Hollow dependent birds	*Glossopsitta pusilla*	Little Lorikeet
	Neophema pulchella	Turquoise Parrot
	Climacteris picumnus	Brown Treecreeper
Woodland birds	*Chthonicola sagittata*	Speckled Warbler
	Melithreptus gularis	Black-chinned Honeyeater
	Pomatostomus temporalis	Grey-crowned Babbler
	Daphoenositta chrysoptera	Varied Sittella
	Artamus cyanopterus	Dusky Woodswallow
	Melanodryas cucullata	Hooded Robin
Macropods	*Macropus dorsalis*	Black-striped Wallaby
Microchiropteran bats	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat
	Chalinolobus picatus	Little Pied Bat
	Nyctophilus corbeni	Corben's Long-eared Bat

No further assessment is required for the remaining 27 threatened fauna species assessed as they were either, unlikely to occur within the subject site, or the habitat to be impacted was not considered important for their survival in the local area.

5.4.4 SEPP 44 - Koala Habitat

An assessment of koala habitat under SEPP 44 is provided below. In addressing SEPP44 there are two questions to be considered.

a) Is the land 'Potential Koala Habitat'?
   'Potential Koala Habitat' is defined in SEPP 44 as, "...an area of native vegetation where trees of the type listed in Schedule 2 (Koala feed tree species) constitute at least 15% of the total number of trees in the upper or lower strata of the tree component"; and
b) Is the land "Core Koala Habitat'?
   'Core Koala habitat' is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (females with young), recent sightings and historical records of a Koala population.

No primary or secondary feed trees (western slopes and plains region) were identified within or adjacent to the proposal area and no indications of Koalas were observed during the survey. Preferred habitat in the local area occurs along creeks and box woodland with the nearest record located about 8.5 km northeast of the proposal area. As such, the site is not considered to constitute potential Koala habitat as defined under SEPP 44.

5.4.5 Wildlife Connectivity Corridors

The vegetation contiguous with the proposal area is largely isolated by surrounding farmland. Given the isolated nature of habitat in the local area, the vegetation on site is unlikely to form an important movement corridor for any species; however, may provide cover for highly mobile species (such as birds, microbats and kangaroos) as they move across the landscape. The proposed works are generally confined to the existing road corridor and the minor nature of the works is unlikely to further impact wildlife movement throughout the local area.

5.4.6 Migratory Species Protected Under International Agreements

Nine nationally listed migratory terrestrial and wetland species were recorded on the DoEE protected matters database or are considered to have potential habitat available within 20km of the site as listed in **Table 8**.

Table 8: Listed migratory species with the potential to occur in the local area.

Apus pacificus	Fork-tailed Swift
Hirundapus caudacutus	White-throated Needletail
Motacilla flava	Yellow Wagtail
Myiagra cyanoleuca	Satin Flycatcher
Actitis hypoleucos	Common Sandpiper
Calidris acuminata	Sharp-tailed Sandpiper
Calidris ferruginea	Curlew Sandpiper
Calidris melanotos	Pectoral Sandpiper
Gallinago hardwickii	Latham's Snipe

None of the above migratory species were recorded on site during the field survey. The proposed works are unlikely to impact on any area considered to be 'important habitat' for the above migratory species, or likely to impact a significant proportion of a migratory population.

6. POTENTIAL IMPACTS

The potential impacts discussed in this section are based on a desktop assessment of the study area and field investigations. Potential impacts to ecological values (including flora, fauna and vegetation communities) as a result of the proposed works are addressed below.

6.1 Avoid and Minimise Impacts

The proposed hard rock quarry would provide limited scope to retain vegetation as the entire plug would be removed to accommodate the quarry. The initial plan to extend the existing white rock quarry would have impacted about 0.3 hectares of moderate/high condition mixed vine thicket low eucalypt woodland (PCT 452), which is consistent with the Semi-evergreen Vine Thicket (SEVT) EEC. This has since been revised to avoid impacting the adjacent vegetation. Mitigation measures including weed control and bushfire management would also be implemented to minimise potential impacts to this EEC.

6.2 Loss of Vegetation and Habitat

The potential loss of vegetation and habitat associated with the proposal is summarised in **Table 10**.

Table 9: Summary of vegetation to be impacted by the proposed works.

Plant Community Type	EEC		Potential Direct Impact (ha)[1]	PCT % cleared[2]
	TSC Act	EPBC Act		
Mixed vine thicket low eucalypt woodland of the northern-western Brigalow Belt South Bioregion (PCT 452)	EEC	EEC	2.8	80%
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (PCT 445)	EEC	EEC	0	20%

1- Area to be cleared based on ground truthed vegetation mapping within the study area.

2- Based on the VIS classification database.

The proposed hard rock quarry would remove all vegetation present within the bounds of the proposed hard rock quarry comprising about 2.8 hectares of degraded mixed vine thicket low eucalypt woodland (PCT 452). This PCT is consistent with the Semi-evergreen Vine Thicket (SEVT) EEC and represents a loss of about 3.7 percent of this community mapped within the Tikitere property (74.9 hectares) and about 0.1 percent of the 3070 hectares mapped in the Border Rivers - Gwydir Rivers region (Ecological, 2009).

The removal of vegetation from the site would also result in the removal of nine habitat trees. The removal of such habitat has the potential to directly impact hollow dependent fauna that may inhabit the trees and reduce this habitat resource in the local area.

The clearing of native vegetation and the removal of hollow bearing trees are both listed as Key Threatening Processes under the TSC Act (1995).

6.3 Wildlife Connectivity and Habitat Fragmentation

The removal of vegetation for the proposed works will add to the incremental fragmentation of vegetation within the local area. The vegetation to be impacted on site is isolated from other habitat areas by cleared cropping land and the removal of this vegetation from the site is unlikely to significantly impact any local habitat links.

6.4 Weeds

Various forms of disturbance of semi-evergreen vine thickets are thought to promote incursion by weeds including clearing, fire, and the presence of livestock and vertebrate pests. The proposed quarrying activities would involve earthworks in areas subject to moderate levels of weed infestation, particularly *Cenchrus ciliaris* (Buffel Grass) and *Lycium ferocissimum* (Box Firethorn), which are known to impact SEVT (McDonald, 2010). The movement and the disturbance of soil by machinery can lead to further weed growth surrounding the quarry and has the potential to out-compete native species and further degrade habitat within the adjacent SEVT if not adequately managed.

6.5 Threatened Ecological Communities

The EEC Semi-evergreen Vine Thicket (SEVT) listed under the TSC and EPBC Act occurs within the proposal and up to 2.8 hectares of this EEC may be directly impacted. The assessment of significance for this EEC is provided in **Appendix IV.** This concluded that the proposed loss of SEVT is not considered significant at a local or regional level, particularly given the small area of the patch and its degraded and isolated nature. Furthermore, the proposed quarry works are unlikely to further exacerbate existing and ongoing threats (i.e. weed incursion, feral pig grazing and fire) and it is likely that these threats would be minimised through the implementation of a site VMP such that the condition of retained areas would improve over time.

6.6 Threatened Fauna

The habitat assessment identified the following 21 threatened fauna species with the potential to be impacted by the proposed works.

- *Glossopsitta pusilla* Little Lorikeet
- *Neophema pulchella* Turquoise Parrot
- *Climacteris picumnus* ssp. *victoriae* Brown Treecreeper
- *Chthonicola sagittata* Speckled Warbler
- *Melithreptus gularis* Black-chinned Honeyeater
- *Pomatostomus temporalis temporalis* Grey-crowned Babbler
- *Daphoenositta chrysoptera* Varied Sittella
- *Artamus cyanopterus* Dusky Woodswallow
- *Melanodryas cucullata cucullata* Hooded Robin
- *Macropus dorsalis* Black-striped Wallaby
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat
- *Chalinolobus picatus* Little Pied Bat
- *Nyctophilus corbeni* Corben's Long-eared Bat

The assessments of significance pursuant to the TSC Act for these species are provided in **Appendix IV.** In general, these concluded that potential direct and indirect impacts to these species are unlikely to be significant given the proposed mitigation measures and the relatively small area of habitat to be impacted by the works.

7. MITIGATION MEASURES

The following mitigation measures, provided in **Table 10,** are recommended to minimise the ecological impact of the proposed works. The following measures are recommended for inclusion in the Quarry Operations Plan to be developed for the works.

Table 10: Summary of mitigation measures for the proposed quarry works.

Impact	Environmental safeguards	Responsibility	Timing
Vegetation Management	A Vegetation Management Plan will be prepared detailing the proposed mitigation measures and implemented as part of the site operations plan. It would include, but not be limited to: • Plans showing areas to be cleared and areas to be protected, including exclusion zones; protected habitat features and revegetation areas; • Pre-clearing survey requirements; • Habitat management; • Protocols to manage weeds and pathogens; • Fire management requirements; and • Revegetation and rehabilitation works.	Quarry Operator / Landowner	Detailed design / pre-operation
Vegetation Clearing	Vegetation clearing will be limited to that identified in the plan of proposal and will avoid or minimise direct and indirect impacts to native vegetation where possible.	Quarry Operator / Landowner	Detailed design / pre-operation/ operation
Vegetation Clearing	Measures to further avoid and minimise the impact on native vegetation will be investigated during detailed design of the white rock quarry and implemented where practicable and feasible. The clearing of native vegetation must be minimised with the objective of reducing impacts to the adjacent EEC to the greatest extent practicable.	Quarry Operator / Landowner	Detailed design
Exclusion Zones	The limit of quarry works and vegetation to be retained will be delineated using appropriate signage and barriers, identified on site construction drawings and during staff inductions. The extent of SEVT ECC located to the south of the proposed white rock quarry will be clearly marked and/or fenced to exclude access during construction. The following provisions should apply as a minimum:	Quarry Operator / Landowner	Pre-operation/ operation

Impact	Environmental safeguards	Responsibility	Timing
	• Mark exclusion zones on a suitable plan; • Allow enough lead time to establish exclusion zones before quarrying works commence; • Mark out exclusion zones with temporary markings such as pegs or paint and where possible use a qualified surveyor to identify exclusion zone; • Select a suitable exclusion fence type; • Place exclusion zone fencing outside tree protection zones; • Erect signs to inform personnel of the purpose of exclusion zone fencing; and • Communicate the importance of exclusion zones, and any changes to the zones, to all site staff and visitors (e.g. in toolbox talks and inductions).		
Fauna Protection	Pre-clearing surveys should be undertaken by an ecologist prior to the commencement of any vegetation or tree removal to confirm presence of stick nests and nesting hollow-dependent species. If threatened species are found to be utilising hollows, those hollow-bearing trees are not to be cleared until the species has ceased using the hollows.	Quarry Operator / Landowner	Pre-operation/ operation
Vegetation Management	A tree protection zone should be established around any trees and shrubs to be retained close to quarrying activities. The zone should be placed outside the drip line of the trees' crown to ensure protection of the root zone.	Quarry Operator / Landowner	Pre-operation/ operation
Fauna Protection	Suitable fauna protection protocols are to be utilised for any clearing works. This includes requirements for ecologist supervision, the undertaking of pre-clearance surveys, provision of compensatory nest boxes, procedures to safely fell habitat trees and release areas for any rescued fauna.	Quarry Operator / Landowner	Pre-operation/ operation
Fauna Habitat	Fallen logs are a limited resource throughout the remnant vegetation on site with site values generally well below benchmark for the vegetation community identified on site. Large hollow logs and dead wood present within the proposed hard rock quarry should be retained and placed into the retained vegetation south of the white rock quarry to maintain and enhance this habitat resource within retained vegetation.	Quarry Operator / Landowner	Pre-operation/ operation

Impact	Environmental safeguards	Responsibility	Timing
Fire management	The SEVT community located on site is sensitive to fire and should be proactively managed to minimise the risk of fire. Fuel loads adjacent to retained vegetation should be kept to a minimum.	Quarry Operator / Landowner	Pre-operation/ operation
Weed and Pathogen Management	Protocols to manage weeds and pathogens would be detailed within the site vegetation management plan. Weed and Pathogen management should include the following: • Plans and methods to manage of weeds throughout the retained SEVT on site; • All weed plant material and topsoil containing weed plant material should be disposed of at an appropriate waste management facility or separate from remnant vegetation areas; and • Methods outlined within the *Arrive Clean, Leave Clean Guidelines* (DoE, 2015) should be used to help prevent the spread of invasive plant diseases and weeds.	Quarry Operator / Landowner	Pre-operation/ operation
Revegetation / rehabilitation works	Revegetation of previously cleared areas and rehabilitation of areas disturbed by the proposed quarrying works should utilise local species consistent SEVT. Any revegetation works should target previously cleared areas between cropping land and remnant vegetation to help minimise edge effects on SEVT.	Quarry Operator / Landowner	Pre-operation/ operation

8. CONCLUSION

Flora, fauna and habitat studies have been undertaken to identify and assess the potential impacts resulting from quarry operations proposed at 1135 Croppa Creek Road, North Star (Tikitere). This biodiversity assessment identifies the following key factors associated with the project:

The assessment identified the following key EECs and threatened species that may be impacted by the proposal:

- Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered Ecological Community, TSC Act and EPBC Act)
- *Glossopsitta pusilla* Little Lorikeet
- *Neophema pulchella* Turquoise Parrot
- *Climacteris picumnus* ssp. *victoriae* Brown Treecreeper
- *Chthonicola sagittata* Speckled Warbler
- *Melithreptus gularis* Black-chinned Honeyeater
- *Pomatostomus temporalis temporalis* Grey-crowned Babbler
- *Daphoenositta chrysoptera* Varied Sittella
- *Artamus cyanopterus* Dusky Woodswallow
- *Melanodryas cucullata cucullata* Hooded Robin
- *Macropus dorsalis* Black-striped Wallaby
- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat
- *Chalinolobus picatus* Little Pied Bat
- *Nyctophilus corbeni* Corben's Long-eared Bat

The proposed extraction activities would result in the removal all vegetation present within the bounds of the proposed hard rock quarry, comprising about 2.8 hectares of degraded Semi-evergreen Vine Thicket EEC (SEVT). This represents a loss of about 3.7 percent of this community mapped within the Tikitere property (74.9 hectares) and about 0.1 percent of the 3070 hectares mapped in the Border Rivers - Gwydir Rivers region (Ecological, 2009).

The removal of vegetation from the site would also result in the removal of nine habitat trees. The removal of such habitat has the potential to directly impact hollow dependent fauna that may inhabit the trees and reduce this habitat resource in the local area.

Key mitigation measures identified to minimise and avoid biodiversity impacts include but are not limited to:

- A Vegetation Management Plan to be prepared detailing the proposed mitigation measures and implemented as part of the site operations plan.
- Measures to further avoid and minimise the impact on native vegetation to be investigated during detailed design of the white rock quarry and implemented where practicable and feasible. The clearing of native vegetation must be minimised with the objective of reducing impacts to the adjacent EEC and threatened species habitat to the greatest extent practicable.
- The limit of quarry works and vegetation to be retained to be delineated using appropriate signage and barriers, identified on site construction drawings and during staff inductions. The extent of SEVT ECC located to the south of the proposed white rock quarry will be clearly marked and/or fenced to exclude access during construction.

- The SEVT community located on site is sensitive to fire and should be proactively managed to minimise the risk of fire. Fuel loads adjacent to retained vegetation should be kept to a minimum.
- Protocols to manage weeds and pathogens would be detailed within the site vegetation management plan. This would detail plans and methods to manage of weeds throughout the retained SEVT on site.
- Revegetation of previously cleared areas and rehabilitation of areas disturbed by the proposed quarrying works should utilise local species consistent SEVT. Any revegetation works should target previously cleared areas between cropping land and remnant vegetation to help minimise edge effects on SEVT.
- Pre-clearing surveys should be undertaken by an ecologist prior to the commencement of any vegetation or tree removal to confirm presence of stick nests and nesting hollow-dependent species. If threatened species are found to be utilising hollows, those hollow-bearing trees are not to be cleared until the species has ceased using the hollows.
- Suitable fauna protection protocols are to be utilised for any clearing works. This includes requirements for ecologist supervision, the undertaking of pre-clearance surveys, provision of compensatory nest boxes, procedures to safely fell habitat trees and release areas for any rescued fauna.

Given the limited extent of vegetation removal from the site, this assessment has determined that the proposed quarry works are unlikely to have a significant impact on SEVT or any of the above threatened species under State (TSC Act) or Federal (EPBC Act) legislation. Furthermore, it is likely, through the implementation of the site VMP, that an improvement in condition could be achieved throughout the retained areas of SEVT on the Tikitere property.

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Appendix I

Flora Species List

Flora Species List

The following is a list of all flora species recorded within the site. It should be noted that such a list cannot be considered comprehensive, but rather indicative of the flora. A period of some years is often required to identify all species present in an area, particularly for cryptic or seasonally detectable species (such as orchids, some grasses and grass-like herbs).

Family	Scientific Name	Exotic	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Adiantaceae	*Cheilanthes distans*				*		
Apocynaceae	*Alstonia constricta*		*	*	*	*	*
Apocynaceae	*Carissa ovata*			*	*	*	*
Apocynaceae	*Parsonsia eucalyptophylla*		*			*	*
Asteraceae	*Calotis lappulacea*		*	*	*	*	
Asteraceae	*Brachyscome nova-anglica*		*			*	
Asteraceae	*Bidens subalternans*	*	*		*		
Asteraceae	*Carthamus lanatus*	*		*	*	*	
Asteraceae	*Conyza sp.*	*					
Asteraceae	*Cirsium vulgare*	*					
Asteraceae	*Podolepis jaceoides*			*	*		
Asteraceae	*Sigesbeckia spp.*				*		
Boraginaceae	*Ehretia membranifolia*				*		
Brassicaceae	*Brassica sp.*	*	*	*	*	*	
Cactaceae	*Opuntia sp.*	*		*	*	*	*
Capparaceae	*Capparis mitchellii*					*	
Capparaceae	*Apophyllum anomalum*						

Family	Scientific Name	Exotic	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Capparaceae	*Capparis lasiantha*				*	*	
Casuarinaceae	*Casuarina cristata*						
Chenopodiaceae	*Einadia nutans*					*	
Chenopodiaceae	*Einadia hastata*		*	*	*	*	*
Chenopodiaceae	*Emex australis*	*	*	*	*	*	
Chenopodiaceae	*Maireana microphylla*		*	*			
Chenopodiaceae	*Sclerolaena diacantha*		*		*	*	*
Chenopodiaceae	*Rhagodia spinescens*				*	*	*
Chenopodiaceae	*Sclerolaena muricata*					*	*
Chenopodiaceae	*Enchylaena tomentosa*						*
Cucurbitaceae	*Cucumis myriocarpus subsp. leptodermis*	*					
Cucurbitaceae	*Citrullus lanatus*	*			*		
Euphorbiaceae	*Euphorbia lathyris*						
Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*		*	*	*		
Euphorbiaceae	*Croton phebalioides*		*	*	*	*	*
Fabaceae (Caesalpinioideae)	*Senna coronilloides*					*	
Fabaceae (Faboideae)	*Indigofera brevidens*		*	*	*		*
Fabaceae (Faboideae)	*Hovea longipes*		*	*	*	*	*
Fabaceae (Faboideae)	*Glycine clandestina*					*	
Fabaceae (Mimosoideae)	*Acacia harpophylla*						

Family	Scientific Name	Exotic	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Goodeniaceae	*Goodenia hederacea*						
Lamiaceae	*Spartothamnella juncea*						*
Lamiaceae	*Marrubium vulgare*	*					
Lamiaceae	*Salvia reflexa*	*	*	*	*		
Malvaceae	*Abutilon oxycarpum*		*	*	*		*
Malvaceae	*Sida cunninghamii*				*		
Malvaceae	*Malvastrum americanum*	*	*	*	*	*	*
Myoporaceae	*Eremophila mitchellii*					*	*
Myrtaceae	*Eucalyptus melanophloia*		*				*
Oleaceae	*Notelaea microcarpa var. microcarpa*					*	*
Oleaceae	*Jasminum lineare*		*	*			*
Plantaginaceae	*Plantago debilis*					*	
Poaceae	*Austrostipa verticillata*		*		*	*	*
Poaceae	*Austrostipa scabra*					*	*
Poaceae	*Chloris ventricosa*					*	*
Poaceae	*Elymus scaber*						
Poaceae	*Paspalidium gracile*				*	*	*
Poaceae	*Dactyloctenium radulans*						
Poaceae	*Aristida ramosa*		*	*	*	*	
Poaceae	*Enneapogon gracilis*			*	*		
Poaceae	*Eragrostis leptostachya*						*

Family	Scientific Name	Exotic	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5
Poaceae	*Cenchrus ciliaris*	*					
Portulacaceae	*Portulaca oleracea*		*	*	*		
Rubiaceae	*Psydrax odorata*					*	*
Rutaceae	*Geijera parviflora*						
Rutaceae	*Correa glabra*		*	*			
Sapindaceae	*Atalaya hemiglauca*			*	*	*	*
Solanaceae	*Solanum esuriale*			*	*		
Solanaceae	*Solanum prinophyllum*			*	*		*
Solanaceae	*Solanum parvifolium subsp. parvifolium*					*	
Solonaceae	*Physalis ixocarpa*	*		*	*		
Solonaceae	*Lycium ferocissimum*	*	*	*		*	
Thymelaeaceae	*Pimelea neo-anglica*						
Verbenaceae	*Verbena gaudichaudii*					*	*
Zygophyllaceae	*Zygophyllum apiculatum*			*		*	

Appendix II

Fauna Species List

Fauna Species List

The following is a list of all fauna species recorded within the site during the survey period.

Observation Type:

O - Observed	**B** - Burnt	**F** - Tracks/scratchings
T - Trapped or netted	**H** - Hair, feathers, or skin	**Y** - Bone or teeth
R - Road kill	**P** - Scat	**D** - Dog kill
W - Heard call	**C** - Cat kill	**Z** - In raptor/owl pellet
V - Fox kill	**E** - Nest/roost	**K** - Dead
M - Miscellaneous	**X** - In scat	**U** - Bat Recording

Notes

Any threatened species appear in **bold** font.

? - Indicates a species identified without certainty or to a Genus level only.

* - Indicates an introduced species.

BIRDS

Family Columbidae - Pigeons, Doves		
Ocyphaps lophotes	Crested Pigeon	O
Family Cacatuidae - Cockatoos and Corellas		
Cacatua galerita	Sulphur-crested Cockatoo	O
Cacatua roseicapilla	Galah	O
Family Maluridae - Fairy-Wrens and Emu-Wrens		
Malurus cyaneus	Superb Fairy-Wren	O
Family Meliphagidae - Honeyeaters		
Manorina melanocephala	Noisy Miner	O
Family Pardalotidae - Pardalotes, Gerygones, Scrubwrens, Heathwrens and Thornbills		
Pardalotus striatus	Striated Pardalote	W
Family Psittaculidae - Parrots		
Platycercus eximius	Eastern Rosella	O
Family Artamidae - Wood-swallows, Butcherbirds, Magpie and Currawongs		
Cracticus torquatus	Grey Butcherbird	O
Gymnorhina tibicen	Australian Magpie	O
Family Corvidae - Crows, Raven		
Corvus coronoides	Australian Raven	O

REPTILES

Family Agamidae - Dragons		
Amphibolurus muricatus	Jacky Lizard	O
Family Scinidae - Skinks		
Morethia boulengeri	South-eastern Morethia Skink	O

MAMMALS

Family Emballonuridae - Sheathtail-bats			
?	***Saccolaimus flaviventris***	**Yellow-bellied Sheathtail-bat**	
Family Molossidae - Freetail-bats			
	Mormopterus sp. 3	Inland Freetail Bat	U
Family Vespertilionidae - Plain-nosed Bats			
	Nyctophilus sp.	Long-eared Bat	U
	Chalinolobus gouldi	Gould's Wattled bat	U
Family Canidae			
	Vulpes vulpes	Red Fox	P
Family Macropodidae - Kangaroos, Wallabies			
	Macropus giganteus	Eastern Grey Kangaroo	O
Family Suidae			
	**Sus scrofa*	Feral Pig	O

Appendix III

Threatened Species Habitat Assessment

The habitat assessment evaluating the site as potential habitat for each of the threatened species that may occur in the local area is provided below in **Table A1.** Habitat descriptions and information regarding local populations are based on OEH and DoEE threatened species profiles and databases and relevant species specific literature.

Table A1: Habitat Assessment for Threatened Species

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Plants					
Tylophora linearis	TSC Act - V EPBC Act - E	Majority of records occur in the central western region. Records from Goonoo, Pillaga West, Pillaga East, Bibblewindi, Cumbil and Eura State Forests, Coolbaggie NR, Goobang NP and Beni SCA. Also has been recorded Hiawatha State Forest near West Wyalong in the south and there are old records as far north as Crow Mountain near Barraba and near Glenmorgan in the western Darling Downs. Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum* species and *Casuarina* species.	0	Low This species was not recorded during site surveys and has not previously been recorded within the search area. Marginal habitat is present within the remnant vegetation throughout the site.	No
Desmodium campylocaulon Creeping Tick-trefoil	TSC Act - E	Occurs chiefly in the Collarenebri and Moree districts in the north-western plains of NSW. Also occurs in the NT and Darling Downs district of south-eastern Queensland. Confined to clay soils, usually with *Astrebla* and *Iseilema* species. In NSW this species grows on cracking black soils in the Narrabri, Moree and Walgett local government areas. Associated species include *Acacia harpophylla, Astrebla pectinate* and *Sorghum, Dichanthium* and *Panicum* species.	9	Low This species was not recorded during site surveys. Habitat is generally restricted to the remnant Brigalow - Belah woodland vegetation occurring on site. This vegetation would not be impacted by the proposed quarry works.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Swainsona murrayana Slender Darling Pea	TSC Act - V EPBC Act - V	Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.	2	Unlikely This species is unlikely to occur given the lack of preferred soil and vegetation types present on site.	No
Swainsona sericea Silky Swainson-pea	TSC Act - V	Recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro. Also found in South Australia, Victoria and Queensland. Found in Natural Temperate Grassland and Snow Gum *Eucalyptus pauciflora* woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. Sometimes found in association with cypress-pines *Callitris* spp.	1	Unlikely This species is unlikely to occur given the lack of preferred soil and vegetation types present on site.	No
Acacia jucunda Yetman Wattle	TSC Act - E	Found in the Yetman district near the Queensland border on the North West Slopes of NSW. It also occurs in Queensland where it is reasonably common. Mainly restricted to dry eucalypt woodland communities on sandy to sandy-loam soils. In Queensland, the species is found in dry ranges on loams or clay-loams in eucalypt communities. Associated species at the NSW sites include *Acacia polybotrya* and *Callitris endlicheri*.	1	Unlikely This species is unlikely to occur given the lack of preferred soil and vegetation types present on site.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Acacia pycnostachya Bolivia Wattle	TSC Act - V EPBC Act - V	Restricted to NSW. Two extensive populations exist in the vicinity of Bolivia Hills and Bluff River Nature Reserves south of Tenterfield, and on nearby private land. Smaller populations have been found west of Tenterfield on private land and the species may be more widespread than is currently documented. Grows in dry sclerophyll forest amongst granite outcrops, on hillsides at altitudes of 700 to 900 m. Soil types range from acid volanics to sandy and skeletal on exposed outcrops, to shallow sandy loams in less exposed sites. It often grows in stands in areas sheltered from fire. Associated species include *Eucalyptus prava, Eucalyptus andrewsii, Callitris endlicheri, Acacia adunca, Eucalyptus campanulata, Leptospermum brevipes, Acacia neriifolia, Stypandra glauca, Notelaea microcarpa* and *Callitris* species.	1	Low This species was not recorded during site surveys. Habitat is available on site although this is considered marginal given the sites' proximity to known populations and lack of preferred associated vegetation types.	No
Diuris tricolor Pine Donkey Orchid	TSC Act - V	Sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the north of NSW. Localities in the south include Red Hill north of Narrandera, Coolamon, and several sites west of Wagga Wagga. Condobolin - Nymagee road, Wattamondara towards Cowra, Eugowra, Girilambone, Dubbo and Cooyal, in the Central West. Pilliga SCA, Pilliga National Park and Bibblewindi State Forest in the north and Muswellbrook in the east. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include *Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta*, Ironbark and *Acacia* shrubland. The understorey is often grassy with herbaceous plants such as *Bulbine* species.	1	Unlikely This species is unlikely to occur given the sites' proximity to known populations and lack of preferred associated vegetation types.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Dichanthium setosum Bluegrass	TSC Act - V EPBC Act - V	Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas. Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. Associated species include *Eucalyptus albens, Eucalyptus melanophloia, Eucalyptus melliodora, Eucalyptus viminalis, Myoporum debile, Aristida ramosa, Themeda triandra, Poa sieberiana, Bothriochloa ambigua, Medicago minima, Leptorhynchos squamatus, Lomandra longifolia, Ajuga australis, Calotis hispidula* and *Austrodanthonia, Dichopogon, Brachyscome, Vittadinia, Wahlenbergia* and *Psoralea* species.	4	Low This species was not recorded during site surveys. Habitat is generally restricted to the remnant Brigalow - Belah woodland vegetation occurring on site. This vegetation would not be impacted by the proposed quarry works.	No
Digitaria porrecta Finger Panic Grass	TSC Act - E	Finger Panic Grass occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It largely occurs on private land. Most frequently recorded associated tree species are *Eucalyptus albens* and *Acacia pendula*. Common associated grasses and forbs in NSW sites include *Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum* and *Neptunia gracilis*. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire.	7	Low This species was not recorded during site surveys. Habitat is available on site although this is considered marginal given the sites' proximity to known populations and lack of preferred associated vegetation types.	No
Homopholis belsonii	TSC Act - E EPBC Act - V	Occurs on the northwest slopes and plains of NSW, mostly between Wee Waa, Goondiwindi and Glen Innes. It also occurs in Queensland, mainly in the Brigalow Belt South bioregion. Grows in dry woodland (e.g. Belah) often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils.	31	Low This species was not recorded during site surveys. Habitat is generally restricted to the remnant Brigalow - Belah woodland vegetation occurring on site. This vegetation would not be impacted by the proposed quarry works.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Polygala linariifolia Native Milkwort	TSC Act - E	Distributed north from Copeton Dam and the Warialda area to southern Queensland; also found on the NSW north coast near Casino and Kyogle, and there is an isolated population in far western NSW near Weebah Gate, west of Hungerford. This species also occurs in Western Australia. Occurs in sandy soils in dry eucalypt forest and woodland with a sparse understorey. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of *Eucalyptus caleyi*, *Eucalyptus dealbata* and *Callitris*, and in yellow podsolic soil on granite in layered open forest. Other associated species include *Eucalyptus trachyphloia, Eucalyptus sphaerocarpa, Angophora floribunda, Angophora leiocarpa, Tristania suaveolens, Allocasuarina torulosa* and *Wahlenbergia* species in the understorey.	4	Low This species was not recorded during site surveys. Habitat is available on site although this is considered marginal given the sites' proximity to known populations and lack of preferred associated vegetation types.	No
Thesium australe Austral Toadflax	TSC Act - V EPBC Act - V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*). It is parasitic, taking nutrients and water from other plants.	1	Low This species was not recorded during site surveys. Habitat is available on site although this is considered marginal given the sites' proximity to known populations and lack of preferred associated vegetation types.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Cadellia pentastylis Ooline	TSC Act - V EPBC Act - V	Occurs along the western edge of the North West Slopes from north of Gunnedah to west of Tenterfield. Also occurs in Queensland. The natural range of Ooline is from 24ºS to 30ºS in the 500 to 750 mm per annum rainfall belt. Forms a closed or open canopy mixing with eucalypt and cypress pine species. There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth.	7	Low This species was not recorded during site surveys. Habitat is available throughout the SEVT occurring on site.	No
Reptiles					
Anomalopus mackayi Five-clawed Worm-skink	TSC Act - E EPBC Act - V	Patchy distribution on the North West Slopes and Plains of north-east NSW and south-east Queensland, from the Ashford area west to Mungindi and Walgett in NSW and north to Dalby in Queensland. Found close to or on the lower slopes of slight rises in grassy White Box woodland on moist black soils, and River Red Gum-Coolibah-Bimble Box woodland on deep cracking loose clay soils. May also occur in grassland areas and open paddocks with scattered trees.	0	Low Habitat is available on site although this is considered marginal given the sites' isolated nature, proximity to known populations and lack of associated vegetation types.	No
Hoplocephalus bitorquatus Pale-headed Snake	TSC Act - V	Patchy distribution from north-east Queensland to the north-eastern quarter of NSW. In NSW it has historically been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes, and from the north coast from Queensland to Sydney. A highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest.	1	Low Habitat is available throughout the remnant vegetation on site although this is considered marginal given the sites' isolated nature.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Uvidicolus sphyrurus Border Thick-tailed Gecko	TSC Act - V EPBC Act - V	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. Occurs at sites ranging from 500 to 1100 m elevation. Populations are mostly fragmented, with over 50 discrete sites currently known that are separated by at least 2 km. Often occurs on steep rocky or scree slopes, especially granite; however, recent records from basalt and metasediment slopes and flats indicate it may have extended into areas that were cleared for agriculture. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey.	0	Low Habitat is available on site although this is considered marginal given the sites' isolated nature, proximity to known populations and lack of preferred rock types.	No
Birds					
Anseranas semipalmata Magpie Goose	TSC Act - V	Inhabits shallow wetlands (especially those with a dense growth of rushes or sedges), drying ephemeral swamps, wet grasslands and floodplains, often roosting in fringing Paperbarks (*Melaleuca* sp.).	2	Unlikely No suitable habitat is present given the lack of suitable wetland areas within and adjacent to the subject site.	No
Calidris ferruginea Curlew Sandpiper	TSC Act - E	Migratory species arriving in Australia between August and November, and departing between March and mid-April. It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration.	0	Unlikely No suitable habitat is present given the lack of suitable wetland areas within and adjacent to the subject site.	No
Ephippiorhynchus asiaticus Black-necked Stork	TSC Act - V	Inhabits swamps associated with river systems and large permanent pools but sometimes appears on the coast or in estuaries. It has also been recorded on farm dams and sewage treatment ponds.	1	Unlikely No suitable habitat is present given the lack of suitable wetland areas within and adjacent to the subject site.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Rostratula australis Australian Painted Snipe	TSC Act - E EPBC Act - V	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	0	Unlikely No suitable habitat is present given the lack of suitable wetland areas within and adjacent to the subject site.	No
Geophaps scripta scripta Squatter Pigeon	TSC Act - CE EPBC Act - V	Found from north Queensland to the North West Slopes of NSW and extending down to the Liverpool Plains and Dubbo. Today they are very rare in the southern parts of their range. Inhabits grassy woodlands and plains, preferring sandy areas and usually close to water.	0	Low May rarely forage within the site during nomadic movements but not considered important habitat for this species given the lack of local records and abundance of similar habitat in the local area	No
Circus assimilis Spotted Harrier	TSC Act - V	Occurs in grassy open woodland including *Acacia* and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	8	Low May hunt or rest within the subject site but not considered important habitat given the abundance of similar habitat in the local area. No raptor nests were observed during the site survey.	No
Haliaeetus leucogaster White-bellied Sea-Eagle	TSC Act - V	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest).	1	Unlikely No suitable habitat is present given the lack of suitable wetland areas within and adjacent to the subject site.	No
Hieraaetus morphnoides Little Eagle	TSC Act - V	Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used.	5	Low May hunt or rest within the subject site but not considered important habitat given the abundance of similar habitat in the local area. No raptor nests were observed during the site survey.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Erythrotriorchis radiatus Red Goshawk	TSC Act - CE EPBC Act - V	Inhabits open woodland and forest, preferring a mosaic of vegetation types, permanent water, a large population of birds as a source of food, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers.	0	Low May hunt or rest within the subject site but not considered important habitat given the abundance of similar habitat in the local area. No raptor nests were observed during the site survey.	No
Falco subniger Black Falcon	TSC Act - V	Widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Occur as solitary individuals, in pairs, or in family groups of parents and offspring. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres	3	Low May hunt or rest within the subject site but not considered important habitat given the abundance of similar habitat in the local area. No raptor nests were observed during the site survey.	No
Ardeotis australis Australian Bustard	TSC Act - E	In NSW, they are mainly found in the north-west corner and less often recorded in the lower western and central west plains regions. Mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams. Breeds on bare ground on low sandy ridges or stony rises in ecotones between grassland and protective shrubland cover; roosts on ground among shrubs and long grasses or under trees.	2	Low May rarely forage within the site during nomadic movements but not considered important habitat for this species.	No
Calyptorhynchus lathami Glossy Black-Cockatoo	TSC Act - V	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of She-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur.	11	Low May occasionally seek shelter within the trees on site. Not considered important habitat as preferred feed trees are absent, however may occasionally forage within the Brigalow/Belah woodland found on site. Unlikely to nest on site given the sites' proximity to preferred feeding habitat.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Glossopsitta pusilla Little Lorikeet	TSC Act - V	Forages primarily in the canopy of open Eucalypt forest and woodland, yet also forages on Angophoras, Melaleucas and other tree species. Riparian habitats are often utilised. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	4	Moderate May forage within the vegetation on site. Potential nesting habitat is also available within the hollow-bearing trees on site.	Yes
Lathamus discolor Swift Parrot	TSC Act - E EPBC Act - E	Migrates to the Australian south-east mainland between March and October. Generally occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark and White Box.	0	Low Habitat is available on site although this is considered marginal given the sites' isolated nature, proximity to known foraging areas and lack of preferred feed trees populations and lack of preferred feed trees.	No
Neophema pulchella Turquoise Parrot	TSC Act - V	Lives on the edges of Eucalypt woodland adjoining clearings and on timbered ridges and creeks in farmland. It has also been recorded utilising roadside verges and orchards. Nests in small hollow branches of Eucalypts.	17	Moderate May forage within the vegetation on site. Potential nesting habitat is also available within the hollow-bearing trees on site.	Yes
Ninox connivens Barking Owl	TSC Act - V	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils.	0	Low May hunt within the site as part of a large home range. No habitat trees with hollows suitable for this species would be impacted by the proposed quarry works..	No
Tyto longimembris Eastern Grass Owl	TSC Act - V	This species roost and nest on the ground, in crops or in thick grass tussock often associated with swamps.	1	Unlikely This species is unlikely to occur given the lack of preferred grassy habitats.	No
Tyto novaehollandiae Masked Owl	TSC Act - V	Lives in dry eucalypt forests and woodlands from sea level to 1100 m and often hunts along the edges of forests, including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	10	Low May hunt within the site as part of a large home range. No habitat trees with hollows suitable for this species would be impacted by the proposed quarry works.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Anthochaera phrygia Regent Honeyeater	TSC Act - CE EPBC Act - E	Inhabits eucalypt open forests and woodlands, predominantly box-ironbark types, but also Spotted Gum and Swamp Mahogany on the coast. The species also inhabits River She-oak gallery forest with *Amyema cambagei* (Needle-leaf Mistletoe). There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region.	0	Low May rarely forage within the vegetation on site but not considered important habitat for this species given the paucity of preferred feed trees. This species has not been recorded in the search area and is unlikely to nest in the local area.	No
Climacteris picumnus ssp. *victoriae* Brown Treecreeper	TSC Act - V	Found in eucalypt woodlands and dry open forest of the inland slopes and plains generally inland of the Great Dividing Range although has been recorded less commonly, in similar woodland habitats on the coastal ranges and plains. Mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey. Requires hollows for nesting and fallen timber is an important habitat component for foraging.	2	Moderate May forage within the vegetation on site. Potential nesting habitat is also available within the hollow-bearing trees on site.	Yes
Chthonicola sagittata Speckled Warbler	TSC Act - V	Lives in a wide range of eucalypt-dominated vegetation that typically includes scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. This species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast.	20	Moderate This species has been regularly recorded within the search area (20 records) and may nest and forage within the trees and shrubs on site.	Yes
Grantiella picta Painted Honeyeater	TSC Act - V	Lives almost entirely on the berries of mistletoes thus its movements are regulated by the fruiting of mistletoe plants	28	Low May seasonally forage within the site during seasonal or dispersive movements but not considered important habitat given the paucity of mistletoe plants recorded on site.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Melithreptus gularis ssp. *gularis* Black-chinned Honeyeater	TSC Act - V	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark, White Box, Inland Grey Box, Yellow Box and Forest Red Gum. Has also been recorded within open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. It is rarely recorded east of the Great Dividing Range but has been recorded very rarely at a few scattered sites in the Hunter, Central Coast and Illawarra regions.	2	Moderate This species has been previously recorded within the search area (2 records) and may forage and/or nest within the trees and shrubs on site.	Yes
Pomatostomus temporalis ssp. *temporalis* Grey-crowned Babbler	TSC Act - V	Open forest, woodland, scrubland, farmland and outer suburbs. Prefers woodlands with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs.	26	Moderate This species has been regularly recorded within the search area (26 records) and may forage within the trees and shrubs on site. No nests consistent with this species were observed on site.	Yes
Daphoenositta chrysoptera Varied Sittella	TSC Act - V	Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy.	12	Moderate This species has been previously recorded within the search area (12 records) and may forage and/or nest within the trees and shrubs on site.	Yes
Artamus cyanopterus cyanopterus Dusky Woodswallow	TSC Act - V	In New South Wales, this species is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region. Inhabits woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. Generally, the understorey is open with sparse eucalypt saplings, acacias and other shrubs, including heath.	2	Moderate This species has been previously recorded within the search area (2 records) and may forage and/or nest within the trees and shrubs on site.	Yes

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Melanodryas cucullata ssp. cucullata Hooded Robin	TSC Act - V	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. This species generally requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.	4	Moderate This species has been previously recorded within the search area (4 records) and may forage and/or nest within the trees and shrubs on site.	Yes
Mammals					
Phascolarctos cinereus Koala	TSC Act - V	Inhabits eucalypt woodland and forest containing suitable food trees. Key food trees in the local area include *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus microcorys* (Tallowwood) and *Eucalyptus punctata* (Grey Gum).	88	Low No primary or secondary feed trees (western slopes and plains region) were identified within or adjacent to the proposal area. Preferred habitat in the local area occurs along creeks and box woodland with the nearest record located about 8.5 km northeast of the proposal area. Koalas may occasionally occur during dispersal from other habitat areas.	No
Petaurus norfolcensis Squirrel Glider	TSC Act - V	Inhabits dry sclerophyll forests and woodlands preferably with a canopy composed of multiple species, a shrub or Acacia midstorey and a heath understorey. Requires abundant tree hollows for refuge and nest sites.	4	Low This species is unlikely to occur along within the SEVT vegetation due to the paucity of canopy trees and hollows. Suitable habitat is generally restricted to the remnant Brigalow - Belah woodland vegetation occurring on site. This vegetation would not be impacted by the proposed quarry works.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Macropus dorsalis Black-striped Wallaby	TSC Act - E	Distributed from the Townsville area in Queensland to northern NSW where it occurs on both sides of the Great Divide. On the north west slopes of NSW it occurs in Brigalow remnants to south of Narrabri. On the north coast it is confined to the upper catchments of the Clarence and Richmond Rivers. Preferred habitat is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. On the north west slopes, associated with dense vegetation, including brigalow, ooline and semi-evergreen vine thicket	11	Moderate This species has been previously recorded within the search area (11 records) and is known to inhabit SEVT vegetation. Habitat on site would be restricted to the larger remnant that occurs to the south of the existing white rock quarry that extends along Death Adder Hill to the east. This species is unlikely to occur within the proposed hard rock quarry area due to the isolated nature and small size of the remnant vegetation present.	Yes
Pteropus poliocephalus Grey-headed Flying-Fox	TSC Act - V EPBC Act - V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water and in vegetation with a dense canopy.	0	Low The trees are likely to provide a seasonal foraging resource. No roosting areas were observed on site. The foraging habitat available is common in the local area which would not be considered important for the survival of a local population.	No
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	TSC Act - V	Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	2	Moderate May hunt throughout the site. Roosting habitat is also available within the hollow-bearing trees on site.	Yes
Chalinolobus dwyeri Large-eared Pied Bat	TSC Act - V EPBC Act - V	Occupies dry sclerophyll forest and woodland. Roosts in caves, abandoned mud-nests of Fairy Martins and mine tunnels.	1	Low May hunt throughout the site although not considered important habitat for this species. Roosting habitat for this species is absent.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Chalinolobus picatus Little Pied Bat	TSC Act - V	Found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria. Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimble box woodlands. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Favoured hollows are in large mature trees with dead limbs and dead hollowed out trunks. The hollow entrances vary in size but generally open into large cavities, midway up the trunk.	4	Moderate May hunt throughout the site. Roosting habitat is also available within the hollow-bearing trees on site.	Yes
Nyctophilus corbeni Corben's Long-eared Bat	TSC Act - V EPBC Act - V	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Inhabits a variety of vegetation types, including river red gum, black box, Allocasuarina, belah, mallee, open woodlands and savannahs, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark. Tree hollows are used as maternity sites.	0	Moderate May hunt throughout the site. Roosting habitat is also available within the hollow-bearing trees on site.	Yes
Vespadelus troughtoni Eastern Cave Bat	TSC Act - V	Cave dweller, known from wet sclerophyll forest and tropical woodlands. It has been also been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings.	1	Low May hunt throughout the site although not considered important habitat for this species. Roosting habitat for this species is absent.	No

Species	Status	Habitat Description and Locally Known Populations	Local Records	Potential to Occur and Importance of Habitat Present	Assessment of Significance
Invertebrates					
Jalmenus eubulus Pale Imperial Hairstreak	TSC Act - CE	Found in Queensland and NSW. In NSW it is found only in brigalow-dominated open forests and woodlands in northern areas of the state. Only known to breed in old-growth forest or woodland and does not appear to colonise regrowth habitats following clearing or other major disturbance. Suitable habitat is dominated by brigalow, *Acacia harpophylla* and Buloke, *Casuarina cristata* on clay soils on flat to gently undulating plains, usually with scattered emergent eucalypts such as Poplar Box, *Eucalyptus populnea* and low trees of *Geijera parviflora* (Wilga).	4	Low Suitable habitat is generally restricted to the remnant Brigalow - Belah woodland vegetation occurring on site. This habitat is marginalised by past disturbance and would not be impacted by the proposed quarry works.	No

Appendix IV

Assessments of Significance

Considerations under Section 5A of the EP&A Act 1979

Endangered Ecological Communities and threatened species that have the potential to be impacted by the proposed works have been assessed under the guidelines of Section 5A of the *Environmental Planning & Assessment Act* (1979) and this is provided below in the form of a seven-part test.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Threatened Fauna

Hollow dependent birds

There is potential for the following hollow dependent birds to regularly use habitat available within the subject site:

- *Glossopsitta pusilla* Little Lorikeet
- *Neophema pulchella* Turquoise Parrot
- *Climacteris picumnus victoriae* Brown Treecreeper

None of these species were recorded during the current field survey, although each of these species has been previously recorded within the search area. Foraging habitat for these species is available within remnant vegetation present throughout the local area. Potential nesting and roosting habitat is available within the local area in the form of trees with hollows.

Four hollow-bearing trees with hollows suitable for these species (Class 2 or higher) would be removed to accommodate the proposed hard rock quarry. At most, the removal of these trees may impact a very small number of individuals that may nest or roost within the trees.

The proposed works also have the potential to adversely impact these hollow-dependent birds by the removal of 2.8 hectares of potential foraging habitat within the subject site, although this is considered a minor impact given the relative abundance of foraging habitat available in the local area. Mitigation measures to protect habitat and minimise the ecological impact of the proposed works are outlined within Section 7 of the biodiversity assessment. Mitigation measures relevant to these species include:

- Vegetation clearing will be limited to that identified in the plan of proposal and will avoid or minimise direct and indirect impacts to native vegetation where possible.
- Measures to further avoid and minimise the impact on native vegetation will be investigated during detailed design of the white rock quarry and implemented where practicable and feasible. The clearing of native vegetation must be minimised with the objective of reducing impacts to the adjacent EEC and threatened species habitat to the greatest extent practicable.
- The limit of quarry works and vegetation to be retained will be delineated using appropriate signage and barriers, identified on site construction drawings and during staff inductions.
- Pre-clearing surveys should be undertaken by an ecologist prior to the commencement of any vegetation or tree removal to confirm presence of stick nests and nesting hollow-dependent species. If threatened species are found to be utilising hollows, those hollow-bearing trees are not to be cleared until the species has ceased using the hollows.
- Suitable fauna protection protocols are to be utilised for any clearing works. This includes requirements for ecologist supervision, the undertaking of pre-clearance surveys, provision of compensatory nest boxes, procedures to safely fell habitat trees and release areas for any rescued fauna.

Hollow dependent birds

These measures should be incorporated into the operational plan for the quarry works. Taking into account the small number of habitat trees to be impacted and given the availability of habitat available in the local area, it is considered that the proposed works are unlikely to have an adverse impact on the life cycle of any of these hollow dependent bird species such that a viable local population is placed at risk of extinction.

Woodland birds

There is potential for the following threatened woodland birds to regularly use habitat available within the subject site:

- *Chthonicola sagittata* Speckled Warbler
- *Melithreptus gularis gularis* Black-chinned Honeyeater
- *Pomatostomus temporalis temporalis* Grey-crowned Babbler
- *Daphoenositta chrysoptera* Varied Sittella
- *Artamus cyanopterus* Dusky Woodswallow
- *Melanodryas cucullata* Hooded Robin

None of these species were recorded during the current field survey, although each of these species has been previously recorded within the search area. There is potential for each of these species to regularly use habitat available within the site. These species could potentially nest within the trees and shrubs that occur throughout the project site and this vegetation would also constitute potential foraging habitat for this species. The proposed works have the potential to adversely impact these species by the removal of 2.8 hectares of potential foraging and nesting habitat within the subject site, although this is considered a minor impact given the relative abundance of foraging habitat available in the local area. Mitigation measures to protect habitat and minimise the ecological impact of the proposed works are outlined within Section 7 of the biodiversity assessment. Mitigation measures relevant to these species include:

- Vegetation clearing will be limited to that identified in the plan of proposal and will avoid or minimise direct and indirect impacts to native vegetation where possible.
- Measures to further avoid and minimise the impact on native vegetation will be investigated during detailed design of the white rock quarry and implemented where practicable and feasible. The clearing of native vegetation must be minimised with the objective of reducing impacts to the adjacent EEC and threatened species habitat to the greatest extent practicable.
- The limit of quarry works and vegetation to be retained will be delineated using appropriate signage and barriers, identified on site construction drawings and during staff inductions.
- Pre-clearing surveys should be undertaken by an ecologist prior to the commencement of any vegetation or tree removal to confirm presence of stick nests and nesting hollow-dependent species. If threatened species are found to be utilising hollows, those hollow-bearing trees are not to be cleared until the species has ceased using the hollows.
- Suitable fauna protection protocols are to be utilised for any clearing works. This includes requirements for ecologist supervision, the undertaking of pre-clearance surveys, provision of compensatory nest boxes, procedures to safely fell habitat trees and release areas for any rescued fauna.
- Large hollow logs and dead wood present within the proposed hard rock quarry should be retained and placed into the retained vegetation south of the white rock quarry to maintain and enhance this habitat resource within retained vegetation.

Woodland birds

These measures should be incorporated into the operational plan for the quarry works. Given the proposed works would have a minor impact of local foraging habitat, it is considered that the proposed works are unlikely to have an adverse impact on the life cycle of these highly mobile species such that a viable local population is placed at risk of extinction.

Macropus dorsalis (Black-striped Wallaby)

The Black-striped Wallaby has been previously recorded within the search area (11 records) and is known to inhabit SEVT vegetation. Recent records of the species in the local area (<20 years) are restricted to Planchonella Nature Reserve located about 25km to the southeast, and Bullala National Park located about 35 km to the south (OEH, 2018).

Preferred habitat for this species is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must also occur near a more open, grassy area to provide suitable feeding habitat. Suitable habitat on site would be restricted to the larger remnant that occurs to the south of the existing white rock quarry that extends along Death Adder Hill to the east, although this is marginalised by the isolated nature of the remnant which is surrounded by cropland. This species is unlikely to occur within the proposed hard rock quarry area due to the isolated nature and small patch size of the remnant vegetation present.

Habitat occurring south of the proposed white rock quarry extension would be retained and the impact on potential habitat for this species would be minimal. Mitigation measures to protect habitat and minimise the ecological impact of the proposed works are outlined within Section 7 of the biodiversity assessment. Mitigation measures relevant to these species include:

- Vegetation clearing will be limited to that identified in the plan of proposal and will avoid or minimise direct and indirect impacts to native vegetation where possible.
- Measures to further avoid and minimise the impact on native vegetation will be investigated during detailed design of the white rock quarry and implemented where practicable and feasible. The clearing of native vegetation must be minimised with the objective of reducing impacts to the adjacent SEVT EEC and threatened species habitat to the greatest extent practicable.
- The limit of quarry works and vegetation to be retained will be delineated using appropriate signage and barriers, identified on site construction drawings and during staff inductions.
- Revegetation of previously cleared areas and rehabilitation of areas disturbed by the proposed quarrying works should utilise local species consistent SEVT. Any revegetation works should target previously cleared areas between cropping land and remnant vegetation to help minimise edge effects on SEVT.

In respect to the above, provided the mitigation measures are implemented, it is considered that the proposed subdivision is unlikely to impact on the lifecycle of this species such that the local population is placed at risk of extinction.

Microchiropteran Bats

There is potential for the following threatened microchiropteran bats to regularly use habitat available within the subject site:

- *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat
- *Chalinolobus picatus* Little Pied Bat
- *Nyctophilus corbeni* Corben's Long-eared Bat

The hollow bearing trees and existing buildings within the local area have the potential to be utilised by the above species to roost and or seek refuge. Foraging habitat suitable for these species is widespread in the local area. Nine hollow-bearing trees with hollows suitable for these species (Class 3 or larger) would be removed to accommodate the proposed hard rock quarry. At most, the removal of these trees may impact a small number of individuals that may roost within the trees. The proposed removal of vegetation would also modify foraging habitat for these species although this impact is considered negligible given the range of foraging habitat available in the local area.

The proposed works also have the potential to adversely impact these hollow-dependent birds by the removal of 2.8 hectares of potential foraging habitat within the subject site, although this is considered a minor impact given the relative abundance of foraging habitat available in the local area. Measures including the provision of pre-clearance surveys and adherence to tree felling protocols (detailed within **Section 7**) would also minimise the ecological impact of the proposal on these species.

Taking the proposed mitigation measures into account and given the relative abundance of habitat available in the local area for these highly mobile species, it is considered that the proposed subdivision is unlikely to have an adverse impact on the life cycle of any of these threatened microchiropteran bats such that a viable local population is placed at risk of extinction.

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b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No endangered populations would be impacted by the proposal.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions EEC

The Mixed vine thicket low eucalypt woodland (PCT 452) identified on site is consistent with Semi-evergreen Vine Thicket (SEVT) in the Brigalow Belt South and Nandewar Bioregions EEC (NSW Scientific Committee, 2011). The proposed hard rock quarry would remove all remnant vegetation present on the basalt plug comprising about 2.8 hectares of degraded SEVT. The degraded nature of vegetation occurring on the proposed hard rock quarry is likely related to the small patch size and fragmentation which amplifies the impact of existing threats including weeds, feral pigs and fire. Previous fire activity was also evident within the remnant and frequent fire has resulted in reduced native species richness with species that are more tolerant of fire such as *Alstonia constricta* (Quinine Tree) dominant throughout.

Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions EEC

This proposed removal of 2.8 hectares of vegetation represents a loss of about 3.7 percent of this community mapped within the Tikitere property (74.9 hectares) and about 0.1 percent of the 3070 hectares mapped in the Border Rivers - Gwydir Rivers region (Ecological, 2009). It is unlikely that the proposed works would substantially modify the composition of the vegetation to be retained although there is potential for edge effects to further impact retained vegetation boundaries. Mitigation measures to protect habitat and minimise the ecological impact of the proposed works are outlined within **Section 7** of the biodiversity assessment. Mitigation measures relevant to this EEC include:

- A Vegetation Management Plan will be prepared detailing the proposed mitigation measures and implemented as part of the site operations plan.
- Vegetation clearing will be limited to that identified in the plan of proposal and will avoid or minimise direct and indirect impacts to native vegetation where possible.
- Measures to further avoid and minimise the impact on native vegetation will be investigated during detailed design of the white rock quarry and implemented where practicable and feasible. The clearing of native vegetation must be minimised with the objective of reducing impacts to the adjacent EEC and threatened species habitat to the greatest extent practicable.
- The limit of quarry works and vegetation to be retained will be delineated using appropriate signage and barriers, identified on site construction drawings and during staff inductions. The extent of SEVT ECC located to the south of the proposed white rock quarry will be clearly marked and/or fenced to exclude access during construction.
- A tree protection zone should be established around any trees and shrubs to be retained close to quarrying activities. The zone should be placed outside the drip line of the trees' crown to ensure protection of the root zone.
- The SEVT community located on site is sensitive to fire and should be proactively managed to minimise the risk of fire. Fuel loads adjacent to retained vegetation should be kept to a minimum.
- Fallen logs are a limited resource throughout the SEVT on site with site values generally well below benchmark. Large hollow logs and dead wood present within the proposed hard rock quarry should be retained and placed into the retained vegetation south of the white rock quarry to maintain and enhance this habitat resource within retained vegetation
- Protocols to manage weeds and pathogens would be detailed within the site vegetation management plan. This would detail plans and methods to manage of weeds throughout the retained SEVT on site
- Revegetation of previously cleared areas and rehabilitation of areas disturbed by the proposed quarrying works should utilise local species consistent SEVT. Any revegetation works should target previously cleared areas between cropping land and remnant vegetation to help minimise edge effects on SEVT.

Given the limited extent of vegetation removal from the site the proposed works are unlikely to place the local occurrence of this EEC at risk of extinction. Furthermore, it is likely, through the implementation of the site VMP, that an improvement in condition could be achieved throughout the retained areas of SEVT on the Tikitere property.

d) In relation to the habitat of a threatened species, population or ecological community:

i. **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

ii. **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

iii. **the importance of the habitat to be removed , modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The removal of habitat for each threatened species and EEC is discussed below.

Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions EEC	
i)	The proposed hard rock quarry would remove all vegetation present on the basalt plug comprising about 2.8 hectares of degraded SEVT. The initial plan to extend the existing white rock quarry would have impacted about 0.3 hectares of moderate/high condition SEVT; however, this has since been revised to avoid impacting the adjacent vegetation.
ii)	The removal of SEVT vegetation for the proposed hard rock quarry will add to the incremental fragmentation of remnant vegetation within the local area. The vegetation to be impacted by the proposed hard rock quarry is already isolated from other habitat areas by cropland and the removal of this vegetation is unlikely to significantly impact any retained areas of SEVT on site.
iii)	The 2.8 hectares of degraded SEVT to be impacted by the proposed hard rock quarry is already isolated from other habitat areas. The degraded nature of vegetation to be impacted is likely related to the small patch size and fragmentation which amplifies the impact of existing threats including weeds, feral pigs and fire. These impacts are ongoing and will likely result in further degradation over time and the removal of this area of this degraded patch is unlikely to be important for the long term survival of this EEC in the local area.

Hollow-dependent birds - *G. pusilla, N. pulchella, Climacteris picumnus ssp. victoriae*	
i)	Potential foraging habitat is available for the bird species throughout the remnant vegetation areas on throughout the Tikitere property and nesting habitat is present in the form of hollow-bearing trees. The proposal has the potential to remove up to 2.8 hectares of potential foraging habitat and result in the removal of four habitat trees (Class 2 hollows or greater) that may be suitable for nesting or roosting.
ii)	The removal of vegetation for the proposed works will add to the incremental fragmentation of vegetation within the local area. The vegetation to be impacted by the proposed hard rock quarry is already isolated from other habitat areas by cropland and the proposed removal of vegetation is unlikely to significantly impact any local habitat links for these highly mobile species.
iii)	Four of the recorded hollow bearing trees to be impacted by the proposed hard rock quarry have the potential to be utilised by the above species to roost and / or seek refuge. At most, the removal of these trees may impact a very small number of individuals that may occasionally roost within the trees. Mitigation measures (detailed in **Section 7**) would be implemented to minimise the potential ecological impact of the proposal. The small area of habitat to be impacted by the proposed works is not considered important for the long-term survival of these species in the locality

Woodland Birds - *C. sagittata, M. gularis, P. temporalis, D. chrysoptera, A. cyanopterus, M. cucullata*	
i)	Potential foraging and nesting habitat is available for these woodland bird species throughout the remnant vegetation areas on the Tikitere property. The proposed hard rock quarry would remove up to 2.8 hectares of potential foraging and nesting habitat for species.
ii)	The removal of vegetation for the proposed works will add to the incremental fragmentation of vegetation within the local area. The vegetation to be impacted by the proposed hard rock quarry is already isolated from other habitat areas by cropland and the proposed removal of vegetation is unlikely to significantly impact any local habitat links for these highly mobile species.
iii)	The small area of habitat to be impacted by the proposed works is not considered important for the long-term survival of these species in the locality. Mitigation measures (detailed in **Section 7**) would be implemented to minimise the potential ecological impact of the proposal.

Macropus dorsalis (Black-striped Wallaby)	
i)	The proposed hard rock quarry would remove 2.8 hectares of SEVT although this species is unlikely to occur within the proposed hard rock quarry area due to the isolated nature and small patch size of the remnant vegetation present.
ii)	The removal of vegetation for the proposed works will add to the incremental fragmentation of vegetation within the local area. The vegetation to be impacted by the proposed hard rock quarry is already isolated from other habitat areas by cropland and the proposed removal of this vegetation is unlikely to impact any local habitat links for this species.
iii)	Suitable habitat on site for this species would be restricted to the larger remnant of SEVT that occurs to the south of the existing white rock quarry and extends along Death Adder Hill to the east, although this is marginalised by the isolated nature of the remnant which is also surrounded by cropland. The initial plan to extend the existing white rock quarry would have impacted about 0.3 hectares this habitat; however, this has since been revised to avoid impacting the adjacent vegetation. The proposed removal of 2.8 hectares for the proposed hard rock quarry is unlikely to be important for the long-term survival of this species in the local area.

Microchiropteran Bats - *Saccolaimus flaviventris, Chalinolobus picatus, Nyctophilus corbeni*	
i)	Potential foraging habitat is available for microchiropteran bats throughout the survey area and roosting habitat is present in the form of hollow-bearing trees. The proposal is likely to modify up to 2.8 hectares of potential foraging habitat due to the removal of vegetation and result in the removal of up to nine habitat trees that may be suitable for roosting.
ii)	The removal of vegetation for the proposed works will add to the incremental fragmentation of vegetation within the local area. The vegetation to be impacted by the proposed hard rock quarry is already isolated from other habitat areas by cropland and the proposed removal of vegetation is unlikely to significantly impact any local habitat links for these highly mobile species.
iii)	The hollow bearing trees recorded within the survey area have the potential to be utilised by the above species to roost and / or seek refuge. At most, the removal of the nine habitat trees may impact a very small number of individuals that may occasionally roost within the trees. Mitigation measures (detailed in **Section 7**) would be implemented to minimise the potential ecological impact of the proposal. The small area of habitat to be impacted by the proposed works is not considered important for the long-term survival of these species in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat.

No area identified as critical habitat is present within the survey area.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Recovery actions detailed under the Saving our Species program which are relevant to the proposed works include:

- Liaise with landholders to encourage conservation of remnant patches of EECs on their land (SEVT EEC);
- Encourage landholders to cease grazing and/or thinning in areas of habitat (SEVT EEC);
- Control feral grazers (e.g. pigs, goats, stock, rabbits) in this EEC (SEVT EEC);
- Protection of existing and future hollow-bearing trees for nest sites (Hollow dependent species);
- Protect woodland and open forest remnants, especially those containing hollow bearing trees (Hollow dependent species);
- Retain standing dead trees and large fallen logs (Hollow dependent species);
- Retain den trees and recruitment trees (future hollow bearing trees) (Hollow dependent species);
- Undertake control of predatory foxes, dogs and feral cats. Control competing feral grazing animals such as goats and rabbits (Black-striped Wallaby);
- Manage known and potential habitat to maintain mosaic of dense understorey vegetation and open areas (Black-striped Wallaby);
- Control weeds in areas of known and potential habitat (Black-striped Wallaby);
- Where appropriate, undertake strategic stock grazing or exclusion to maintain habitat (Black-striped Wallaby);
- Protect known and potential habitat from clearing, fragmentation and isolation (Black-striped Wallaby); and
- Assist landholders who wish to enter into voluntary conservation agreements at key sites (All species).

The above recovery actions have been considered and where possible, have been included within the mitigation measures to be implemented as part of the proposed works (detailed in **Section 7**).

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The 'Key Threatening Processes' currently listed under Schedule 3 of the TSC Act which are relevant to the project are listed below:

- Clearing of Native Vegetation
- Loss of hollow bearing trees
- Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)
- Competition and grazing by the feral European rabbit (Oryctolagus cuniculus)
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition

- Infection of native plants by Phytophthora cinnamomi
- Invasion of native plant communities by exotic perennial grasses

Where relevant, mitigation measures for the proposed works, detailed in Section 7, will be implemented to minimise the impact of these key threatening processes. The project is unlikely to significantly exacerbate the impact of these KTPs in the local area.

Conclusion

Based on the considerations above, the proposed works are unlikely to have a significant impact on any threatened species, population or EEC such that a local population is placed at risk of extinction.

Considerations under the EPBC Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires approval of the Commonwealth Minister representing the Department of the Environment and Energy (DoEE), for actions that may have a significant impact on Matters of National Environmental Significance (MNES). The EPBC Act also requires Commonwealth approval for certain actions on Commonwealth land.

MNES protected under the EPBC Act include:

- World Heritage properties;
- National Heritage places;
- RAMSAR wetlands of international importance;
- Threatened species or ecological communities listed in the EPBC Act;
- Migratory species listed in the EPBC Act;
- The Great Barrier Reef Marine Park;
- Commonwealth marine environment; and
- Nuclear actions.

With regard to flora and fauna, the only MNES relevant to the study area are nationally listed EECs, threatened species and migratory species. The DoEE protected matters search for the site is provided in **Appendix 5**. An assessment has been made to determine whether or not the proposal will have, or is likely to have a significant impact on these MNES and is provided below.

Five threatened ecological communities and nineteen threatened species were recorded on the DoEE online database and may have potential habitat available within 20km of the site as listed in **Table A2**.

Table A2: Nationally listed EECs and threatened species with potential habitat in the search area.

Ecological Community		Status
Brigalow (Acacia harpophylla dominant and codominant)		Endangered
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions		Endangered
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland		Critically Endangered
Weeping Myall Woodlands		Endangered
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		Critically Endangered
Scientific Name	**Common Name**	**Status**
Anthochaera phrygia	Regent Honeyeater	Critically Endangered
Calidris ferruginea	Curlew Sandpiper	Critically Endangered
Erythrotriorchis radiatus	Red Goshawk	Vulnerable
Geophaps scripta scripta	Squatter Pigeon	Vulnerable
Grantiella picta	Painted Honeyeater	Vulnerable
Lathamus discolor	Swift Parrot	Critically Endangered
Rostratula australis	Australian Painted Snipe	Endangered
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable
Nyctophilus corbeni	Corben's Long-eared Bat	Vulnerable
Phascolarctos cinereus	Koala	Vulnerable
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable
Cadellia pentastylis	Ooline	Vulnerable
Dichanthium setosum	Bluegrass	Vulnerable
Homopholis belsonii	Belson's Panic	Vulnerable

Thesium australe	Austral Toadflax	Vulnerable
Tylophora linearis		Endangered
Anomalopus mackayi	Five-clawed Worm-skink	Vulnerable
Uvidicolus sphyrurus	Border Thick-tailed Gecko	Vulnerable

The Mixed vine thicket low eucalypt woodland (PCT 452) identified on site is consistent with Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions listed under the EPBC Act. This PCT will be impacted by the proposal and an assessment of significance under the provisions of the EPBC significant impact guidelines is provided below.

The remnant Brigalow viney scrub open forest (PCT 445) that occurs on deep soils along the edges of crop land and access tracks within the Tikitere property is consistent with the Brigalow (*Acacia harpophylla* dominant and co-dominant) EEC listed under the EPBC Act. No areas of PCT 445 would be impacted by the proposal and no further assessment is warranted for this EEC.

No nationally listed threatened species were considered likely to be impacted by the proposed works.

EPBC Act Assessment of Significance - *Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions*

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- **reduce the extent of an ecological community**

The proposal would remove approximately 2.8 hectares of degraded SEVT. This represents a loss of about 3.7 percent of this community mapped within the Tikitere property (74.9 hectares) and about 0.1 percent of the 3070 hectares mapped in the Border Rivers - Gwydir Rivers region (Ecological, 2009). (Ecological, 2009). The proposal would not substantially reduce the extent of the EEC.

- **fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines**

The 2.8 hectares of degraded SEVT to be impacted by the proposed hard rock quarry is already isolated from other habitat areas. The degraded nature of vegetation to be impacted is likely related to the small patch size and fragmentation which amplifies the impact of existing threats including weeds, feral pigs and fire. These impacts are ongoing and will likely result in further degradation over time and the removal of this degraded patch is unlikely to significantly impact any retained areas of SEVT on site.

- **adversely affect habitat critical to the survival of an ecological community**

The habitat of SEVT to be impacted by the proposed hard rock quarry is a small isolated patch and is moderately degraded. No critical habitat has been declared under the Act within the vicinity of the study area. Retained occurrences within the Tikitere property would be managed onsite through the implementation of a site VMP.

- **modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns**

The proposal would not modify or destroy abiotic factors or modify hydrological regimes to an extent that would adversely impact any retained areas of SEVT within the Tikitere property.

- **cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting**

The proposed quarry works would impact a relatively small patch of vegetation entirely isolated by cropland. The degraded nature of vegetation occurring on the proposed hard rock quarry is likely related to the small patch size and fragmentation which amplifies the impact of existing threats including weeds, feral pigs and fire. Previous fire activity was also evident within the remnant and frequent fire has resulted in reduced endemic species richness with species that are more tolerant of fire such as *Alstonia constricta* (Quinine Tree) dominant throughout. Retained occurrences of SEVT would be managed onsite through the implementation of a site VMP with the aim of managing ongoing threats such as weeds, fire and feral pigs and would likely result in an improvement in condition overall.

- **Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**
  - **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
  - **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**
  - **interfere with the recovery of an ecological community**

The proposed loss of SEVT is not considered substantive at a local or regional level, particularly given the small area of the patch and its degraded and isolated nature. The proposed quarry works are unlikely to further exacerbate existing and ongoing threats (i.e. weed incursion, feral pig grazing and fire) and it is likely that these threats would be minimised through the implementation of a site VMP such that the condition of retained areas would improve over time.

- **interfere with the recovery of an ecological community**

As stated above, given the relatively small, degraded area to be impacted (2.8 hectares) and the potential to improve retained areas, which represents about 72.1 hectares of SEVT through the implementation of a site VMP, the recovery of the EEC is unlikely to be threatened by the project.

Appendix V

EPBC Protected Matters Search

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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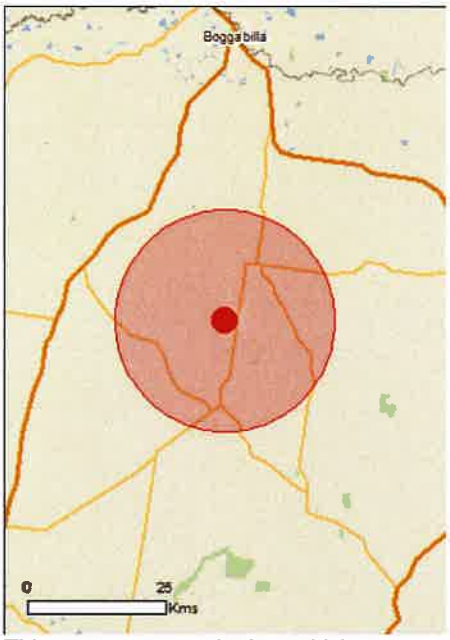

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
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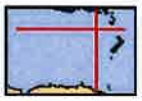

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	19
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	27
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Banrock station wetland complex	1000 - 1100km
Riverland	1000 - 1100km
The coorong, and lakes alexandrina and albert wetland	1200 - 1300km

Listed Threatened Ecological Communities		[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community likely to occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		

Name	Status	Type of Presence
Maccullochella peelii		
Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Cadellia pentastylis		
Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium setosum		
bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Homopholis belsonii		
Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area
Thesium australe		
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Tylophora linearis		
[55231]	Endangered	Species or species habitat may occur within area
Reptiles		
Anomalopus mackayi		
Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat may occur within area
Uvidicolus sphyrurus		
Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding		Species or species

Name	Status	Type of Presence
Pine [20780]		habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-29.01073 150.34104

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 9: Rehabilitation Plan

SMK

CONSULTANTS

surveying – irrigation – environmental – planning

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Tikitere Quarry

Rehabilitation Plan

Lot 5 in Deposited Plan 755984

1135 Croppa Creek Road, North Star NSW 2408

February 2018

SMK

CONSULTANTS

surveying – irrigation – environmental – planning

ABN 63 061 919 003

DOCUMENT CONTROL

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Project Reference	17/146
Report Number	17/146 – Rehabilitation Plan
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Revision History			
Version Number	**Date**	**Authority**	**Details**
0	February 2018	Hayley Greenham (SMK Consultants)	Initial Issue

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1 Introduction

SMK Consultants have been engaged by Alan and Kerry Pearlman to prepare a development application to the Gwydir Shire Council to construct and operate a 500,000 tonne/year Quarry on the property of 'Tikitere'. This Rehabilitation Plan has been prepared to accompany the Environmental Impact Statement (EIS) in support of the development application. The Plan outlines the rehabilitation strategy to be adopted on site, both during site operations and following the closure of the quarry.

The development is 'Designated Development' as described in Part 1 of Schedule 3 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) for 'Extractive Industries'. In accordance with environmental assessment procedures for Designated Developments under the Act, the Secretary of the Department of Planning issued environmental assessment requirements (SEAR's) on 26 September 2017 for the proposed development. The SEAR's include a requirement that the Proponent prepare a Rehabilitation Plan.

In particular, the SEAR's specify that the Rehabilitation Plan must include:

- A detailed description of the proposed rehabilitation measures that would be undertaken throughout the development and during quarry closure;
- A detailed rehabilitation strategy, including:
    - Justification for the proposed final landform; and
    - Consideration of the objectives of any relevant strategic land use plans or policies; and
- The measures that would be undertaken to ensure sufficient financial resources are available to implement the proposed rehabilitation strategy, recognising that a rehabilitation bond will likely be required as a condition of any future development consent.

This Plan is considered to satisfy these requirements.

1.1 Rehabilitation Plan Objectives

The following objectives have been adopted to guide rehabilitation procedures for the site:

- To produce a stable final landform able to support the rehabilitation of the land for grazing purposes;
- To minimise the environmental impact of all site earthworks associated with the rehabilitation works;
- To optimise the use of available overburden and top soil as a substrate for vegetation; and
- To achieve a stable and functional drainage system at the site under extreme rainfall events.

1.2 Relevant Plans and Policies

The following reference documents have been used in the preparation of the design and supporting documents for the proposed rehabilitation of Tikitere Quarry. The documents provide best practice methods for operation and management:

- Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry 2016 (Commonwealth)
- Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry 2016 (Commonwealth)
- Extractive Industries – Quarries – EIS Guideline 1996 (NSW Department of Urban Affairs and Planning)
- Exploration Code of Practice: Rehabilitation 2015 (NSW Department of Planning and Environment, Division of Resources and Geoscience)
- Improving Mine Rehabilitation in NSW: Discussion Paper 2017 (NSW Government Department of Planning and Environment)

2 Development Background

2.1 Locality

The proposed development site is encompassed within the property of "Tikitere" 1135 Croppa Creek Road, North Star. The property is located approximately 10 kilometres south-west of North Star and 12 kilometres north of Croppa Creek, in north-west New South Wales. The site is accessed off Croppa Creek Road via the farm access driveway and then through open cotton field paddocks. The site will be completely contained within Lot 5 in Deposited Plan 755984. An aerial image of the property boundary and proposed quarry locations is included as Figure 1.

Figure 1: Locality Plan

2.2 Activities

The proposed activities associated with the quarries will include:

- Removal of overburden (stripping involving bulldozers, scrapers or excavators) and storage of overburden and topsoil for rehabilitation;
- Extraction of material (via methods such as drilling or mechanical methods such as hammers, rippers, bulldozers, excavators, front end loaders or hydraulic methods) and temporary storage of extracted material at the quarry;

- Processing on-site using portable equipment (which may involve: crushing to reduce particle size, screening/sieving to separate materials into size fractions, blending of materials with other extractive materials to achieve required characteristics); and
- Loading and transport (involving front end loaders, excavators and trucks).

2.3 Infrastructure

The proposed infrastructure at the quarry includes:

- Office buildings
- Amenities
- Parking areas
- Mobile crushing plant
- Water tanks
- Fuel tanks
- Topsoil stockpile
- Overburden stockpile
- Sediment pond

2.4 Development Timeline

Preliminary estimates indicate that quarrying activities are intended to commence in April 2018. The quarrying activities will occur over a period of approximately 3 years to support the construction of the railway infrastructure undertaken by ARTC as part of the Inland Rail Project. Once the project is completed the quarrying activities will conclude, and the site will be rehabilitated in accordance with this guideline.

3 Site Context

3.1 Original Site Condition

3.1.1 Primary Quarry Site

The hard rock quarry consists of a volcanic plug which is located on the western part of Tikitere. The plug rises to a height of approximately 20m or more above the surrounding paddock and covers an area of approximately 5.2 hectares. The plug is steeply sloped, with slopes ranging from 3:1 to 5:1. The basalt resource to be extracted from site extends to approximately 30-35m below the peak of the plug (10-15m below surrounding ground level).

The current topography of the site is such that rainfall intercepted by the quarry site would run off radially into the surrounding region. The southern side of the plug drains towards Tackinbri Creek in the south, whilst the northern side of the development drains towards Mungle Creek in the north.

A site survey was undertaken by Advitech Pty Ltd in December, 2017. The survey identified the following vegetation community, located at the primary quarry site:

- Mixed vine thicket low eucalypt woodland (PCT 452) – Moderate Condition

The Mixed vine thicket low eucalypt woodland (PCT 452) identified on site is consistent with Semi Evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (SEVT), an endangered ecological community (EEC) listed under both TSC Act (NSW Scientific Committee, 2011) and the EPBC Act.

The EEC located at the primary quarry site is of moderate conservation significance, given that it constitutes an endangered community yet is in a moderate state of degradation. This community will be impacted by the proposed quarry development. Mitigation measures to be adopted to minimise the overall impact of the development upon native vegetation and fauna habitat within the region is available in the associated Vegetation Management Plan.

3.1.2 Secondary Quarry Site

The existing gravel quarry forms a landscape depression. The depression covers a total area of approximately 0.25ha. The lowest point of the depression is 5.5m below the ground surface, with batters of 2:1.

The site is located on the northern side of a steep hill, approximately 180m from the crest. The hill rises approximately 15m above the surrounding landscape; the slope up the hill to the south of the quarry site has a gradient of 5:1. The existing quarry site would therefore capture a small amount of rainfall runoff from the adjacent hill, in addition to rainfall directly intercepted by the depression site.

The site survey conducted by Advitech Pty Ltd in December 2017 identified the following vegetation community, located on the hill to the south of the existing quarry site:

- Mixed vine thicket low eucalypt woodland (PCT 452) – High Condition

As an EEC, the remnant vegetation bordering the secondary quarry site is of conservation significance and will be subject to a suite of management measures to protect the EEC from impacts associated with the proposed development. Further information on vegetation protection measures is available in the associated Vegetation Management Plan.

3.2 Land Capability

The NSW Soil and Land Information Database eSPADE, managed by OEH, identifies the primary quarry site within the Land and Soil Capability (LSC) Class 5 (as defined by OEH, 2012). The existing (secondary) quarry site is classified as Class 3. The definitions of each land capability class are presented in Table 1.

Table 1: Land and Soil Capability Classes

Class	Most Intensive Use	Land Definition
Class 1	Regular cultivation including intensive crops	Suitable for a wide range of agriculture. It may be regularly cultivated. Very slight to negligible limitations.
Class 2	Regular cultivation	Suited to a wide range of horticulture in rotation with pastures. Several minor constraints may limit suitability for continuous cultivation. These include stony and shallow phases of soil and moderate erosion hazard.
Class 3	Regular cultivation, but must be consciously managed to prevent degradation	Suited to grazing, including the use of improved pastures. Cultivation is limited to cash or forage crops in rotation with pastures.
Class 4	Grazing, intermittent cultivation with specialised practices	Suitable for grazing, but not for cultivation. Pasture improvement relies on minimum tillage techniques. Productivity may be seasonally high but overall is low as a result of major environmental constraints.
Class 5	Grazing, very occasional cultivation for pasture establishment	Non-arable land suitable for grazing but not cultivation. Maintain or improve perennial pastures and preserve ground cover.
Class 6	Grazing only	Non-arable and often non-trafficable. Land suitable for grazing but not cultivation. Maintain or improve perennial pastures and preserve ground cover.
Class 7	Unsuitable for rural production	Includes steep (slope 33 to 50%) or extremely erodible, or saline or shallow soils. Generally unsuited to agriculture or at best suited only to light grazing.
Class 8	Unusable for any agricultural purpose	Extremely severe limitation, includes precipitous slopes (>50%), areas with large proportion of rock outcrop and frequently inundated. Agricultural production is very low or zero as a result of severe constraints and as a results retirement form agriculture for conservation purposes may be the best option.

The land capability classes for the subject site and surrounding land are shown in Figure 2.

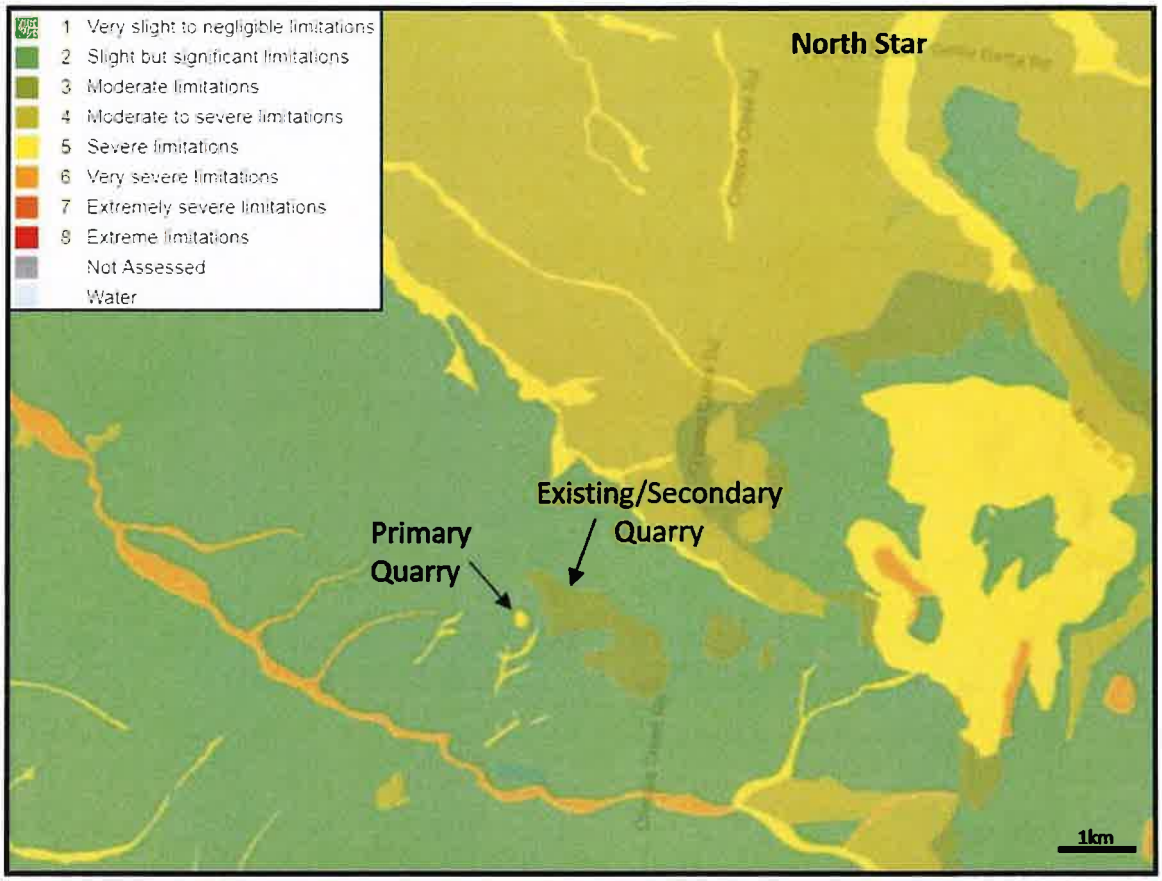


Figure 2: Land and Soil Capability Classes. Source: eSPADE (OEH).

Field inspection, and discussion with the land owner with respect to historic agricultural activities suggested the subject land for the primary quarry would be more accurately described as Class 8 land. This would reflect the limitations to agriculture presented by the steeper topography and shallow soils of the precipitous hills, abundant boulders and severe mass movement (rock falls) hazard associated with the site. The secondary quarry site is more reflective of Class 5 land given the previous extractive activities.

3.3 Current Land Use

The property of Tikitere is currently used as a mixed grazing and cropping enterprise. The adjoining properties are all similarly zoned and are also utilised for agricultural production, including dryland and irrigated crop production and cattle grazing. Intensive agricultural industries, such as feedlots, occur within the wider region. The area produces some of the country's highest crop yields and is known as the 'Golden Triangle'.

The proposed primary quarry site is a volcanic plug, which rises 15-20m above the surrounding agricultural land. The site is not utilised for agricultural production as it is not

suitable for this purpose. The site is primarily utilised to support remnant vegetation communities.

The existing gravel pit is utilised as a source of raw materials for localised farm road maintenance.

4 Rehabilitation Goals

4.1 Intended Final Land Capability

The objective of the proposal with respect to land capability is to return those areas of the final landform designated for future agricultural use to soil and land capability Class 6 or greater:

- The area designated as the primary quarry with existing slopes >15° would be rehabilitated to achieve LSC Class 5-6
- The area designated as the secondary quarry with slope 5° to 10° would be rehabilitated to achieve LSC Class 5.

The proposed management controls to be implemented would ensure that the final landform and potential for future agricultural activities is not compromised by excessive erosion, pollution or restricted availability of water.

4.2 Final Landform and Land Use

4.2.1 Primary Quarry Site

The final landform to be taken by the primary quarry is strongly dependent upon the quantity of material to be extracted. At the time of writing, the final quantity of material to be extracted from the primary quarry has not yet been finalised. It is considered that there are two likely possible final quarry landforms. These include:

- Flat Landscape; or
- Localised Depression.

Further consideration of each potential landform is presented below.

4.2.1.1 Scenario A: Flat Landscape

In the event that the primary quarry site is mostly flat/only slightly depressed following cessation of quarry operations, the site will be rehabilitated by replacing soil on site in a manner such that the final landform is largely flat. The site may subsequently be utilised for crop production as part of existing agricultural operations at Tikitere.

4.2.1.2 Scenario B: Localised Depression

If the landform of the quarry is significantly depressed below surrounding ground level, the site will be rehabilitated to ensure that the faces of the quarry should be no steeper than a horizontal to vertical ratio of 3:1. This is because steep slopes have an increased risk of erosion and are difficult to revegetate.

Rehabilitating steep slopes to gentler slopes may be achieved by:

- Replacing soil on site to fill quarry voids; and/or
- Planned excavation of steep slopes to achieve gentler gradients.

If the site is a localised depression, the site will capture and hold surface water in situ. There is potential that the site be utilised as an on-farm water storage.

4.2.2 Secondary Quarry Site

The landform of the secondary quarry site is anticipated to be that of a localised depression. Similarly, to the primary quarry site, the faces of the quarry should be no steeper than a horizontal to vertical ratio of 3:1. Rehabilitation of steep slopes to gentler slopes may be achieved through means outlined above.

The landscape surrounding the of the gravel quarry supports an endangered ecological community, is characterised by steep hills and overall is unsuitable for agricultural production. The secondary quarry site will therefore be revegetated upon conclusion of quarry activities.

4.3 Financing and Provisions

It is recognised that provision of adequate financial resources is critical to the success of this Rehabilitation Plan. To this end, the Proponent has committed to a minimum of $20,000 to be set aside over the course of the development process, to be contributed to supporting rehabilitation efforts. It is considered that this fund will be adequate to ensure that the quarry sites will be successfully rehabilitated at the conclusion of quarry activities.

5 Pre-Closure Rehabilitation Procedures

5.1 Soil Stripping

Topsoil refers to the top surface layer of soil which is biologically active and of value in revegetation. Investigations carried out by the applicant to date indicate there is minimal topsoil likely to be located within the site.

Subsoil is less biologically active than topsoil yet is still of use in rehabilitation. Together, the topsoil and subsoil form the soil profile. Although the thickness and quantity of soil across the site is likely to be variable in places, there is approximately 24,000 m^3 (average depth 1.5m) of soil overlaying the useable hard rock material.

Prior to the commencement of the quarry, a Topsoil Management Plan and register will be prepared to inform and guide the removal of upper soil layers in the early development and operational phase of the quarry. All areas to be stripped of soil would be clearly identified in advance and the depth of topsoils and subsoils available determined.

Topsoil and subsoil is to be stripped and stockpiled separately. Saline soils (if present) are to be stripped and stockpiled separately to non-saline soil.

Vehicular traffic will be kept to a minimum on the soils to be stripped to prevent compaction and degradation.

The soil will be progressively stripped across the site to enable access to quarry resources below. The area of soil to be stripped at any one time to will be minimised as far as is practicable, to minimise the risk of erosion.

During soil stripping, vegetation clearance is to be minimised as far as practicable at all times.

Movement of topsoil that is too wet or too dry will significantly degrade the soil quality. Stripping of topsoil will therefore be planned and managed to avoid working in wet conditions to prevent higher levels of soil loss due to erosion. Where stripping topsoil is unavoidable in the above situations additional erosion and sediment control procedures will be implemented.

5.2 Soil Stockpiling

Soil which contains high quantities of weeds and/or weed seed banks should be separated from soil stockpiles to be utilised for rehabilitation. This soil should not be utilised for rehabilitation, but instead should be disposed of either at an appropriate waste management facility, or in an area separated from remnant vegetation communities.

Soil stockpiling is only to occur when necessary. Where available, it is preferable that soil materials stripped from a site are directly replaced onto another site awaiting either temporary or final rehabilitation.

Topsoils are to be stockpiled separately to subsoils. Saline soils (if present) are to be stockpiled separately to non-saline soils, over an aggregate substance to allow leaching of salt concentrations over time.

Where possible, the length of time that soils are stockpiled for should be minimised as far as practicable. Where stockpiles are retained for periods in excess 6 months, stockpiles will be fertilised and seeded with a cover crop of non-persistent pasture species to maintain soil structure, organic matter and microbial activity and to prevent erosion.

The primary risk to soil as a result of the proposed quarry operation is that of soil erosion. All reasonable and practicable measures will be undertaken to minimise erosion, and the environmental impacts of erosion, of soil stockpiles. These are as follows:

- Stockpiles would be constructed in accordance with Standard Drawing (SD) 4-1 of *Managing Urban Stormwater – Soils and Construction" V1* (Landcom, 2004) (the "Blue Book") and restricted to the nominated disturbance footprint;
- A coverage of 70% grass (or equivalent stabilisation) would be established over the stockpiles within 60 days (C-Factor of 0.05);
- Topsoil and subsoil stockpiles would be aligned generally parallel with the contour in low mounds not exceeding 2m and 3m in height, respectively;
- Stockpiles will be constructed with an angle of repose that is safe and that prevents scouring;
- Where appropriate, the stockpiles would be isolated from upslope runoff by the construction of diversion embankments; and
- Sediment fencing would be positioned downslope of stockpiles until an adequate level of stabilisation is achieved. The installation and maintenance of these features would comply with the recommendations provided by SD 6-8 of the Blue Book.

5.3 Progressive Rehabilitation

During the course of quarry operations, the site will be progressively rehabilitated as far as is practicable to minimise the extent of the disturbed quarry footprint at any given time. Progressive rehabilitation may either include immediate, temporary stabilisation of worked sections, or initiation of permanent rehabilitation procedures of completed quarry sections.

All noxious weed species, environmental weeds and Weeds of National Significance are to be managed across the site during the course of quarry operations. Proactive weed management

strategies during the course of quarry operations will minimise the need for a reactive weed management strategy following the closure and final rehabilitation of the quarry.

6 Post-Closure Rehabilitation Procedures

6.1 Post-Closure Site Assessment

A site inspection by suitable qualified persons is to be undertaken as soon as practicable following the closure of quarry operations on site, to identify any potentially contaminated sites.

If the site assessment identifies potentially contaminated sites, the following steps will be undertaken:

- Detailed site assessment and testing to characterise the nature and extent of contamination; and
- Implementation of contamination remediation measures to isolate the impacts of and treat the contaminated site, such that the site is stable and does not pose a risk to human health or welfare, or to surrounding environmental values.

6.2 Fencing/Access Control

Existing fencing surrounding the quarry site is to remain in place during the rehabilitation process, to exclude domestic stock and minimise potential site disturbance during the revegetation process.

It should be noted that both quarry sites are located wholly within the private property 'Tikitere'. No public accesses (such as roads, tracks or stock routes) are present to enable visitation to the site by members of the public. All visitors, contractors and employees of Tikitere will be informed as to the location and significance of the rehabilitation sites on the property, and will be advised not to disturb sites undergoing rehabilitation.

Overall, the risk of the occurrence of unauthorised access to rehabilitation sites is low.

6.3 Soil Replacement and Preparation

Only endemic soil is to be utilised for site rehabilitation. Endemic soil is taken to mean soil that was stripped from the site at the commencement of quarry operations, or soil sourced adjacent to the quarry site as required following the closure of quarry operations (which may be required to smooth the final landform). The use of endemic soil improves the likelihood of rehabilitation success, as it consistent with natural soil characteristics on site, and enables utilisation and propagation of endemic seed banks within the soil.

Soil replacement should occur in reverse order to stripping, i.e. subsoil should be replaced prior to topsoil.

To minimise waste generation on site and to enhance drainage, remaining stockpiles of sands and raw or crushed gravel should be mixed with subsoil (where appropriate) and spread evenly over the site.

An alkaline (non-acidifying) fertiliser should be added to respread soil to assist in any nutrient deficiencies as required.

Soil is to be applied across the quarry site in such a way that it provides:

- Suitable soil depth to enable vegetative growth (where appropriate); and
- Suitable topography such that the site is stable, with an absence of steep/unstable areas which are susceptible to erosion.

Erosion during the soil replacement and preparation phase will be minimised by the following measures:

- Undertaking revegetation as soon as is practicable following soil replacement;
- Where appropriate, undertaking progressive soil replacement and revegetation across the site, to minimise the creation of large areas of bare earth; and
- Ensuring that erosion control measures installed during the course of quarry operations (such as sediment fences) remain in place until the site is revegetated with a low risk of erosion.

6.4 Revegetation

6.4.1 Primary Quarry Site

6.4.1.1 Scenario A: Flat Landscape

The site will be utilised for crop production following the conclusion of quarry operations. Replaced soil is to be seeded with a cover species during the course of revegetation works, to ensure stabilisation of the soil surface and protect the landscape from erosion, and to maintain the biota of the topsoil to preserve soil fertility. Replacement subsoil may be mixed (as appropriate) with sands and gravels left over from quarry operations.

Watering and fertilisation of rehabilitation sites will be undertaken as required to ensure the success of revegetation activities on site.

Upon the completion of the landform sculpting, stabilising and revegetating process, the landscape will be incorporated into the ongoing cropping operations of Tikitere. These operations involve periods of crop production and periods of fallow.

6.4.1.2 Scenario B: Localised Depression

The site will be utilised as an on-site storage. The depression is to be rehabilitated such that its surface is of low permeability, to minimise water loss via deep drainage. This may require lining the base of the depression with clay soils sourced from soil stockpiles.

To ensure the base of the storage is of low permeability, remaining sand/gravel stockpiles are not to be incorporated into soils to be used in lining the walls of the depression.

The edges of the depression will be revegetated as appropriate with a mixture of native and introduced pasture species, with the potential to include local native trees and shrubs where appropriate. Placement of trees and shrubs is to be managed such that the storage site is easily accessible.

Remaining gravel/sand stockpiles may be crushed as appropriate and incorporated into soils utilised to revegetate the area surrounding the storage site.

Watering and fertilisation of rehabilitation sites will be undertaken as required to ensure the success of revegetation activities on site.

6.4.2 Secondary Quarry Site

The secondary quarry site will be revegetated to support native vegetation upon conclusion of quarry activities. To this end, soil will be replaced on site and will be fertilised and watered as required to encourage propagation of the natural seed bank stored within the topsoil that is replaced on site.

Additional planting of seeds/saplings (as appropriate) will be undertaken to complement natural germination of seeds within the soil. Species to be planted as part of the revegetation process are to be consistent with local species present in the adjacent SVET EEC. A list of appropriate species is presented in Appendix A. Revegetation works are to target previously cleared areas between cropland and remnant vegetation on site, to assist in minimising edge effect disturbances on the SVET EEC.

Further information regarding revegetation procedures can be found in the associated Vegetation Management Plan.

6.5 Rehabilitation Monitoring and Maintenance

Once rehabilitation activities (landscaping, soil replacement and revegetation) have completed, rehabilitation sites will be regularly monitored to measure the success of rehabilitation strategies.

Monitoring will primarily rely upon visual inspections of the sites to examine:

- Whether revegetation activities have been successful in re-establishing vegetation cover;
- Whether there are any actively eroding locations, or whether the landform is stable.

In the event that initial revegetation practices have been unsuccessful (i.e. the plants die), the site will be re-seeded and regularly monitored, and managed as required (through measures such as regular watering and application of fertiliser) to encourage the success of rehabilitation strategies.

If actively eroding locations are identified during site inspections, control measures may be implemented on site to stabilise the landscape. Examples of such measures include additional earthworks (such as contouring or flattening of slopes) and increased emphasis on fast revegetation of the eroding surface (e.g. by planting fast-growing groundcover species such as grasses over problem areas, to complement existing revegetation efforts).

The rehabilitation process will be considered to have succeeded when:

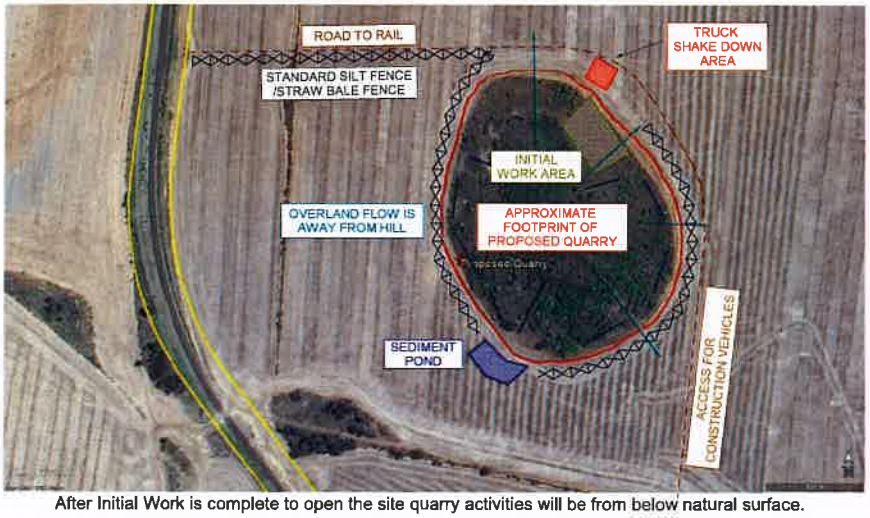
- A self-sustaining vegetation community has been established;
- The landform of the site is stable; and
- The site may be utilised safely for its intended post-rehabilitation purpose.

Appendix A – Revegetation Species List

Family	Scientific Name	Common Name
Adiantaceae	*Cheilanthes distans*	Bristly Cloak Fern
Apocynaceae	*Alstonia constricta*	Quinine Tree
Apocynaceae	*Carissa ovata*	
Apocynaceae	*Parsonsia eucalyptophylla*	Gargaloo
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy
Bignoniaceae	*Pandorea pandorana*	Wonga Vine
Boraginaceae	*Ehretia membranifolia*	Peach Bush
Capparaceae	*Apophyllum anomalum*	Warrior Bush
Capparaceae	*Capparis lasiantha*	Nepine
Capparaceae	*Capparis mitchellii*	Wild Orange
Casuarinaceae	*Casuarina cristata*	Belah
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush
Chenopodiaceae	*Maireana microphylla*	Small-leaf Bluebush
Chenopodiaceae	*Rhagodia spinescens*	Spiny Saltbush
Chenopodiaceae	*Sclerolaena diacantha*	Grey Copperburr
Chenopodiaceae	*Sclerolaena muricata*	Black Rolypoly
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine
Euphorbiaceae	*Beyeria viscosa*	Pinkwood
Euphorbiaceae	*Croton phebalioides*	
Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*	Desert Spurge
Fabaceae (Caesalpinioideae)	*Senna coronilloides*	
Fabaceae (Faboideae)	*Glycine clandestina*	Love Creeper
Fabaceae (Faboideae)	*Hovea longipes*	
Fabaceae (Faboideae)	*Indigofera brevidens*	
Fabaceae (Mimosoideae)	*Acacia harpophylla*	Brigalow
Lamiaceae	*Spartothamnella juncea*	Bead Bush
Malvaceae	*Abutilon oxycarpum*	Lantern Bush
Myoporaceae	*Eremophila mitchellii*	Budda
Myrtaceae	*Eucalyptus melanophloia*	Silver-leaved Ironbark
Oleaceae	*Jasminum lineare*	Desert Jasmine
Oleaceae	*Notelaea microcarpa var. microcarpa*	Velvet Mock Olive
Plantaginaceae	*Plantago debilis*	
Poaceae	*Aristida ramosa*	Purple Wiregrass
Poaceae	*Austrostipa scabra*	Speargrass
Poaceae	*Austrostipa verticillata*	Slender Bamboo Grass
Poaceae	*Chloris ventricosa*	Plump Windmill Grass
Poaceae	*Enneapogon gracilis*	Slender Bottle-washers
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass
Poaceae	*Paspalidium gracile*	Slender Panic
Rubiaceae	*Psydrax odorata*	Shiny-leaved Canthium

Family	Scientific Name	Common Name
Rutaceae	*Geijera parviflora*	Wilga
Sapindaceae	*Atalaya hemiglauca*	Whitewood
Solanaceae	*Solanum esuriale*	
Solanaceae	*Solanum parvifolium subsp. parvifolium*	
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Thymelaeaceae	*Pimelea neo-anglica*	Poison Pimelea
Zygophyllaceae	*Zygophyllum apiculatum*	Pointed Twinleaf

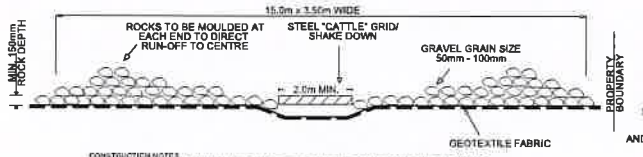
Appendix 10: Erosion and Sediment Control Plan



After Initial Work is complete to open the site quarry activities will be from below natural surface.
Sediment will be controlled within the work area with no run-off produced

NOTES:

- The contractor is responsible for all erosion protection and sediment control during the contract
- The contractor is to ensure all construction areas are to remain in a bare state for the minimum amount of time possible
- During the time that these areas are left exposed, all efforts must be taken to ensure the subject area is not eroded
- Any topsoil that is to be stripped is to be placed in a designated top soil stockpile
- Any top soil stockpiles are to be placed on suitably higher ground and a silt fence is to be built surrounding the stockpile
- Stockpiles are to have one access only and are to be rehabilitated on construction completion
- Location of silt fences and truck shake down areas were designed using the survey data and proposed access at the time of report. Should lot conditions change or access routes change, the above plan should be amended to suit
- Silt traps/fences/shakedowns are to be checked weekly and after rain events
- Dust is to be minimised during construction with watering of the site when required
- No clear drainage line was evident from the provided survey, therefore silt fences have been used to control sediment from overland flow
- Sediment fences are to be monitored and sediment is to be removed once it builds up to a height of 300mm from top of upslope side.
- All sediment and erosion devices are to remain until all construction works are completed
- It is up to the contractor to manage sediment and erosion control to suit the varying stages of construction and make sure all placement of devices and management of devices is up to best practice guidelines.



CONSTRUCTION NOTES
1. ADDITIONAL AGGREGATE IS TO BE LAID TO TOP UP FACILITY SHOULD IT BECOME CHOKED WITH SILT
2. SHAKE DOWN BAY IS TO BE LOCATED AT THE EXIT TO THE PROPERTY, JUST OFF THE CONSTRUCTION ROAD
3. CONSTRUCTION VEHICLES ARE TO BE WASHED DOWN ON EXIT TO LIMIT TRACKING OF SEDIMENT FROM THE SITE DURING WET CONDITIONS. IT IS NOT NECESSARY TO WASH DOWN CONSTRUCTION VEHICLES IN DRY CONDITIONS
4. SHOULD ANY SEDIMENTATION OCCUR ON EXISTING PUBLIC ROADS THEY SHOULD BE CLEANED AND WASHED DOWN IMMEDIATELY

SHOULD CONTRACTORS HAVE A TRUCK LAY DOWN/UNLOAD AREA OUTSIDE THE CONSTRUCTION ZONE, A BUNDED GRAVEL AREA SHOULD BE CONSTRUCTED FOR TRUCKS TO STOP AND UNLOAD MATERIALS, THIS BUNDED AREA CAN THEN BE USED AS A SHAKE DOWN AREA IN WET WEATHER ALSO

TRUCK SHAKE DOWN FACILITY DETAIL

CONSTRUCTION NOTES:
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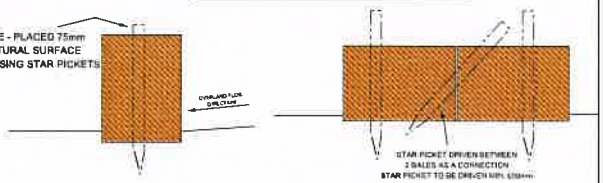
STANDARD SILT FENCE DETAIL



STRAW BALE FENCE

SCALES HORZ NOT TO SCALE VERT DATUM LOCAL	A3	SMK CONSULTANTS surveying - irrigation - environmental PO BOX 774 MOREE 2400 PHONE (02) 67 521021	CLIENT: ALAN PEARLMAN PROJECT: TIKITERE PROPOSED QUARRY	DESCRIPTION: LAYOUT PLAN FOR SEDIMENT AND STORMWATER CONTROL DURING CONSTRUCTION	PLAN REVISION: / DATE A FIRST ISSUE 18-10-2017 B SECOND ISSUE 21/2/2018 C	SHEET No. 1 of 1
SURVEYED SMK CONSULTANTS DESIGNED JASPER BUNNEY CHECKED PETER TAYLOR	CONTOUR INTERVAL -					

Appendix 11: Soil and Water Management Plan

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Tikitere Quarry

Soil and Water Management Plan

Lot 5 in Deposited Plan 755984

1135 Croppa Creek Road, North Star NSW 2408

January 2018

SMK

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DOCUMENT CONTROL

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Project Reference	17/146
Report Number	17/146 – Soil and Water Management Plan
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Revision History			
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0	January 2018	Hayley Greenham (SMK Consultants)	Initial Issue

TABLE OF CONTENTS

1 Introduction

SMK Consultants have been engaged by Alan and Kerry Pearlman to prepare a Soil and Water Management Plan (SWMP). The SWMP is to accompany an Environmental Impact Statement (EIS) in support of a development application for a quarry to be located on "Tikitere".

A SWMP is the formal plan designed to control erosion and sedimentation on a building site. It details the specific methods of erosion and sediment control that will be used to meet the specific site conditions at the various stages of construction. This assessment has been prepared in accordance with 'Managing Urban Stormwater: Soils and Construction, Vol. 1, 4th Edition' (Landcom, 2004) (the 'Blue Book').

The SWMP incorporates the management of water within the development site, which has been divided into two classes:

- "Clean" water – surface runoff from undisturbed catchments or relatively undisturbed by extraction, processing or related activities.
- "Dirty" water – surface runoff from disturbed catchments such as the active extraction, sieving, stockpiling and loading areas which could produce significant concentrations of suspended sediment.

1.1 Soil and Water Management Principles

The principal objective of surface water management at the Tikitere Quarry is to reduce the potential for transport of sediment offsite into the nearby drainage lines and Tackinbri Creek, and the flow-on impact of sedimentation on receiving waters. This is a standard objective of erosion and sedimentation designs and controls, and is achieved by implementing the following principles:

- Directing sediment-laden runoff into designated sediment retention basins;
- Diverting 'clean water' runoff unaffected by the operations away from disturbed areas and offsite; and
- Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments.

1.2 Catchment Area

The proposed development is located 2.1 kilometres from the Tackinbri Creek, which is a tributary of the Whalan Creek, and flows to the Barwon-Darling River system. Tackinbri Creek is contained within the wider Border Rivers catchment area. The subject area drains to the south-west.

The proposed development includes a sediment pond to capture direct runoff from the site. If runoff from the site were to exceed the sediment pond capacity, the flow would have to travel approximately 2.1km along a slope of less than 0.5 % fall before it could enter the creek.

Predicted water velocity across the 2.1 km of landscape between the sediment pond and the creek would be less than 0.1 m/s. Under these velocity conditions, silt deposition would occur. The area between the sediment pond and the creek is generally cropped and also contains areas of grass and other forbes. The grass and forbes would provide appropriate filtration of the sediment laden water to minimise potential silt impacts that may degrade water quality in the river.

Cultivation of this area after the overflow event would incorporate the silt into the topsoil. The quarry will involve below ground excavation. Once quarry operations commence, the sediment pond will be required to capture and settle runoff from the Quarry. The quarrying activity will result in the quarry face and immediate surround being below ground. If active onsite processing continues, the catchment area would be limited to these above ground working and stockpile areas. Once quarrying ceases, the surface areas would be remediated and cropped. As time progresses the catchment for the sediment pond will reduce.

The following figure presents an aerial image of Tikitere and the proposed quarry footprint containing a significant basalt resource. The plan shows the contour lines within the area. All silt generated as a result of rainfall runoff within the quarry area will be captured and settled within active areas of the quarry or sediment ponds. It is therefore considered that there is minimal risk of sediment and silt entering the Tackinbri Creek.

Figure 1: Tikitere Catchment Areas

2 Assessment of Constraints

Constraints are classified as either:

- on-site, i.e. relating to soils, landforms, ecology, pollutants and hydrology occurring on the site of the proposed or approved activities; or
- downstream, i.e. relating to aquatic ecosystem sensitivity and the social and aesthetic values of the community.

Based on the identified constraints and opportunities, best management practices (BMPs) have been developed for the site to minimise the potential degradation of soil and water resources and/or other aesthetic/environmental assets while maximising the achievement of outcomes in accordance with principles of Ecologically Sustainable Development (ESD). The recommended constraints to be addressed by the Blue Book are discussed in the sections below. These are in addition to the project-specific constraints discussed elsewhere in the EIS.

2.1 Riparian Lands

Waterfront Lands (formally known as Riparian Lands under the Rivers and Foreshores Improvement Act 1948) are those vegetated lands within 40 metres of waterbodies such as rivers, creeks, estuaries, lakes and wetlands. Development on riparian lands is constrained:

- to protect and enhance the social, economic, cultural, spiritual and heritage values of waterfront land for Aboriginal groups and the wider community; and
- to avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, salinity hazards and decline of native vegetation.

The proposed Quarry footprint is not within 40m of a river, creek, estuary, lake or wetland as defined by the Act.

2.2 Erosion (Rainfall Erosivity & Soil Erodibility)

Rainfall Erosivity

The rainfall erosivity factor, R, is a measure of the ability of rainfall to cause erosion. It is the product of two components, namely:

- total energy; and
- maximum 30-minute intensity for each storm.

Soil Erodibility

Soil erodibility is a measure of the susceptibility of individual soil particles to detachment and transport by rainfall and runoff. Soil texture is the principal component affecting soil erodibility, but structure, organic matter and permeability also contribute.

Topsoil material within the site is removed as overburden and stockpiled as a buffer around the perimeter of the site. The soil contains a seed bed for many of the local native grasses and forbs which recolonise the topsoil in the absence of tree shading. The revegetation of this topsoil stabilises the stockpiles and minimises the potential erosion of this soil material. No raw soil remains within the quarry site.

Soil Characteristics

Blue Book classifications for the soil show that the soils are type F soils, which are generally fine grained soils with less than 10 percent of the soil materials dispersible. Type F soils are slow settling in wet basins.

Surface Water Runoff

The surface water runoff expected during average, wet and dry rainfall years has been calculated in the water balance for the site. The following presents statistical annual rainfall quantities for the quarry site:

- Annual 10th percentile (dry year): 480.9 mm
- Annual 50th percentile (average year): 534.2 mm
- Annual 90th percentile (wet year): 805.0 mm

The proposed Quarry will have a total footprint of 6.35 Ha. However, the proposed sediment pond is only required to capture the runoff from the initial quarry area which covers approximately 1.2 Ha. Once established the quarry will involve below ground extraction pits and therefore all internal runoff will settle within the below ground quarry area. This runoff will settle into the aggregate to be extracted and therefore would not need consideration in overall runoff management.

The average annual runoff for this initial quarry area is in the order of 2.83 ML/Ha. This calculation is based on surface absorption of small falls of rain and wetting of the available surface soil profile. Based on this figure of runoff, the initial site would generate an average of 3.4 ML per annum.

2.3 Summary

Based on the information provided above in relation to the development proposal, and with the implementation of the recommended mitigation and control measures relating to soil and water management at the site, it is anticipated that there would be minimal impact on surface water within the Tackinbri Creek and downstream of the development site as a result of the proposed operations. The key features of the proposed water management system are as follows:

- All clean water would be held within the quarry site;

- Any build-up of water within the site would be utilised for dust mitigation measures;
- The water would also provide some benefit to local fauna in the form of an alternative source of water in an area where limited surface water is available

3 Site Water Balance

3.1 Introduction

This section reviews site water requirements and available water storage against water availability to present a water balance for the Tikitere Quarry. The water balance is provided for the average rainfall year.

3.2 Inputs

Rainfall/Runoff

The water balance considers rainfall and runoff generated during low (annual 10th percentile), average (annual 50th percentile) and high (annual 90th percentile) rainfall years. The rainfall data has been obtained from the Bureau of Meteorology monitoring station at Moree Aero station (No. 053115), which is considered most representative of the development site where long-term data is available. Rainfall is as follows.

- Annual 10th percentile (dry year): 480.9 mm
- Annual 50th percentile (average year): 534.2 mm
- Annual 90th percentile (wet year): 805.0 mm

Rainfall is summer dominant although rainfall is generally present in all months.

Water Access Licence

The site has a water access licence (WAL15704) with an entitlement of 486 ML per calendar year. This water allocation is obtained through a bore from the Eastern Recharge Groundwater Source.

3.3 Outputs

Evaporation losses

It is assumed that the only loss from the sediment pond would be evaporation, apart from some water for dust suppression which is discussed below. Evaporation losses have been calculated as the direct evaporation from the surface of the sediment pond.

Mean evaporation data was obtained from the Moree BOM station (No. 053115), with the average yearly evaporation being 2,348.5 mm. A factor of 0.2 has been used to account for variations in the water level in the pond, and to account for the pond not always being full. Consideration is also given to the shallowness of the sedimentation pond.

The combined annual average evaporation from the on-site sediment pond is therefore estimated at 4.4 ML.

Dust Suppression

Dust suppression would be a significant on-site water use. This includes dust suppression on the access roads, hardstands and stockpile areas. All water used for dust suppression would be non-potable water sourced from the sediment dams, when available, or from the water allocation available from groundwater.

Water used for dust suppression is not considered in the runoff calculations as it reduces the problems of dry conditions and does not promote extra runoff.

Water Balance

The sediment pond will be required to capture runoff from the extraction, processing and stockpiling areas associated within the proposed Quarry. The following tables provides a preliminary annual water balance for the site based on average, low and high rainfall years. Some notes on the production of these tables:

- Rainfall and evaporation data has been extracted from bureau of meteorology records.
- The different areas within the worksite are broken up based on their ability to produce runoff.
    - The hard area coefficient is used for less permeable areas where precipitation runs off easily such as the Site office, Working area and Road within the catchment area.
    - The soft area coefficient is used for more permeable areas where precipitation is held up such as natural surface.
    - The Pond area coefficient is used for wetted areas where all precipitation is captured.

Table 1: Annual **Water Balance 10th Percentile Year**

Annual Water Balance (10th Percentile Rainfall) - Sediment Pond Storage (ML)								
Month	90th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	68.7	0.1	0.2	0.1	0.6	0.0	-0.2	0.0
Feb	55.4	0.1	0.1	0.1	0.5	0.0	-0.2	0.0
Mar	43.9	0.1	0.1	0.1	0.5	0.0	-0.2	0.0
Apr	19.4	0.0	0.0	0.0	0.3	0.0	-0.2	0.0
May	23.9	0.0	0.1	0.0	0.3	0.0	-0.2	0.0
Jun	33.9	0.1	0.1	0.1	0.2	0.0	0.0	0.0
Jul	29.8	0.1	0.1	0.1	0.2	0.0	0.0	0.0
Aug	20.8	0.0	0.0	0.0	0.2	0.0	-0.1	0.0
Sep	30.1	0.1	0.1	0.1	0.3	0.0	-0.1	0.0
Oct	36.4	0.1	0.1	0.1	0.3	0.0	-0.1	0.0
Nov	61.7	0.1	0.1	0.1	0.5	0.0	-0.1	0.0
Dec	56.8	0.1	0.1	0.1	0.5	0.0	-0.2	0.0
Total	**480.7**	**1.0**	**1.1**	**1.0**	**4.4**	**0.0**		**0.0**

Table 2: Annual Water Balance – 50th Percentile Year

Annual Water Balance (Median Rainfall) - Sediment Pond Storage (ML)								
Month	90th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	76.3	0.2	0.2	0.2	0.6	0.0	-0.1	0.0
Feb	61.6	0.1	0.1	0.1	0.5	0.0	-0.1	0.0
Mar	48.7	0.1	0.1	0.1	0.5	0.0	-0.2	0.0
Apr	21.5	0.0	0.0	0.0	0.3	0.0	-0.2	0.0
May	26.5	0.1	0.1	0.1	0.3	0.0	-0.2	0.0
Jun	37.6	0.1	0.1	0.1	0.2	0.0	0.0	0.0
Jul	33.1	0.1	0.1	0.1	0.2	0.0	0.0	0.0
Aug	23.1	0.0	0.1	0.0	0.2	0.0	0.0	0.0
Sep	33.4	0.1	0.1	0.1	0.3	0.0	0.0	0.0
Oct	40.4	0.1	0.1	0.1	0.3	0.0	-0.1	0.0
Nov	68.5	0.1	0.2	0.1	0.5	0.0	0.0	0.0
Dec	63.1	0.1	0.1	0.1	0.5	0.0	-0.1	0.0
Total	**534.0**	**1.1**	**1.2**	**1.1**	**4.4**	**0.0**		**0.0**

Table 3: Annual Water Balance – 90th Percentile Wet Year

Annual Water Balance (90th Percentile Wet Year) - Sediment Pond Storage (ML)								
Month	90th Percentile Wet Year Rainfall (mm)	Hard Area Runoff	Soft Area Runoff	Pond Area Runoff	Pond Evaporation	Dust Suppression	Monthly Balance	Cumulative Storage Requirement
Jan	115.0	0.2	0.3	0.2	0.6	0.0	0.1	0.1
Feb	92.8	0.2	0.2	0.2	0.5	0.0	0.1	0.2
Mar	73.4	0.1	0.2	0.1	0.5	0.0	0.0	0.2
Apr	32.4	0.1	0.1	0.1	0.3	0.0	-0.1	0.1
May	39.9	0.1	0.1	0.1	0.3	0.0	-0.1	0.0
Jun	56.7	0.1	0.1	0.1	0.2	0.0	0.1	0.1
Jul	49.8	0.1	0.1	0.1	0.2	0.0	0.1	0.3
Aug	34.9	0.1	0.1	0.1	0.2	0.0	0.0	0.3
Sep	50.4	0.1	0.1	0.1	0.3	0.0	0.1	0.4
Oct	61.0	0.1	0.1	0.1	0.3	0.0	0.0	0.4
Nov	103.2	0.2	0.2	0.2	0.5	0.0	0.2	0.6
Dec	95.1	0.2	0.2	0.2	0.5	0.0	0.1	0.6
Total	**804.7**	**1.6**	**1.8**	**1.6**	**4.4**	**0.0**		**0.6**

4 Surface Water Monitoring

The following parameters consider all facets of water control and monitoring associated with the proposed construction and operation of the Tikitere Quarry.

4.1 Water quality

The proposed sediment pond will collect runoff from within the above ground working area of the quarry. No chemicals associated with vehicles or crushing and sieving machinery material will be disposed of within the sediment pond. Fuel used on the site would be stored in sealed tanks. The pond will primarily capture silty water.

4.2 Surface and groundwater impacts

Potential impacts on surface water as a result of the construction and operational phases of the project include:

- Pollution of surface water through:
    - Increased turbidity of surface waters due to sediment loss and erosion from stockpiles, haul roads or other disturbed areas.
    - Impurities, incidental minerals or other leachates from the disturbed rocks and soil.
    - Stormwater runoff from plant and equipment areas, fuel storage areas, chemical spills and uncontrolled surface runoff.
- Increased risk of erosion on slopes through increased flow rates.

The site will need to operate as a bare earth area to avoid vegetative contamination of the gravel material. No ground cover will be present and therefore artificial erosion control or silt capture devices will need to be deployed on an as required basis. Such systems will include the sediment pond and a system of diversion drains to capture and manage the flow of runoff into the pond system at suitable velocities that avoid additional erosion within the quarrying sites.

The following mitigation measures should be adopted onsite to ensure protection of surface water quality:

- Maintenance of vegetated buffer zones between the quarry site and watercourses within the region, to enable natural filtration of surface water in the event of a sediment pond overflow
- Siting of the quarry site above the 1 in 100 average recurrence interval flood level, to minimise the risk of the quarry site being inundated in the event of a major flood;
- Minimising the disturbed area by working in sections to reduce the exposure area and stabilising disturbed land as soon as possible to minimise erosion.
- Use drains, diversion banks or bund walls to direct clean stormwater away from disturbed areas, working areas and stockpiles.

- Use diversion drains, and contour drains to capture and slow down water in sloped areas, and use stones or vegetation to stabilise drains in these high velocity areas.
- Ensure that the storage and use of hazardous and dangerous materials occurs in accordance with relevant legislation, and ensuring spillages are contained.
- Minimise gradients of access tracks, and maintain table drains.
- Collect all runoff from working areas in sediment ponds, designed to contain and control water in a 1 in 10 year storm event.
- Placing hay bales, silt fences or other suitable control devices in drainage lines within the site to reduce onsite erosion where possible.

The implementation of the appropriate mitigation measures in accordance with the above recommendations and best practice management techniques are considered sufficient to avoid potential contamination of offsite surface waters.

Potential impacts on groundwater which may occur as a result of the construction and operational phases of the project include:

- Drawdown of groundwater from sourced aquifer(s) during operations for dust suppression.
- Reduction in piezometric head, within aquifers sourced for operational purposes, which could result in the reduction of landholder bore yields.

Based on the available information it is considered that using groundwater under an existing groundwater licence would be the most appropriate backup option for the dust mitigation measures throughout the operation of the quarry. There would be no increase to the existing licensed entitlements. No additional extraction will ensure that the Quarry does not adversely impact on the drawdown of sourced and/or adjacent aquifer(s).

The available setback from surface water and potential GDE's is substantial providing a sufficient barrier between the Quarry. The provision of suitable drainage and sediment controls will prevent erosion and ensure runoff does not contaminate offsite areas, including waterways and GDE's.

The storage and/or use of hazardous materials which may be used on site will occur in accordance with *National Code of Practice for the Storage and Handling of Workplace Dangerous Goods (2001).* The appropriate storage and handling will ensure such materials do not pose an unacceptable risk in respect to the pollution of groundwater.

5 Conclusions and Recommendations

All dirty water collected on site will be directed to the sediment pond or quarry pits. The water collected will be utilised for dust suppression throughout operations. As seen in the water balance, there will be limited water collected in the sediment pond and as such it is expected additional water will be required to maintain dust mitigation measures.

The proposed mitigation measures, if implemented, are considered sufficient to avoid the potential for impacts to offsite surface and groundwater from the proposed development.

Appendix 12: Vegetation Management Plan

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Tikitere Quarry

Vegetation Management Plan

Lot 5 in Deposited Plan 755984

1135 Croppa Creek Road, North Star NSW 2408

February 2018

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Project Reference	17/146
Report Number	17/146 – Vegetation Management Plan
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0	February 2018	Peter Taylor (SMK Consultants)	Initial Issue

TABLE OF CONTENTS

1 Introduction

SMK Consultants have been engaged by Alan and Kerry Pearlman to prepare a development application to the Gwydir Shire Council to construct and operate a 500,000 tonne/year Quarry on the property of 'Tikitere'. This preliminary Vegetation Management Plan (VMP) has been prepared to accompany the Environmental Impact Statement (EIS) in support of the development application. The Plan outlines the vegetation management strategy to be adopted on site, both during site operations and following the closure of the quarry. A more detailed VMP will be developed once approval is granted.

1.1 Vegetation Management Plan Objectives

The objectives of this VMP are to:

- Detail measures to minimise loss or disturbance to native vegetation;
- Detail measures to enable and support effective revegetation of disturbed sites post quarry closure;
- Detail ongoing vegetation monitoring and management measures throughout and following the conclusion of quarry activities on site, including biosecurity and fire control measures; and
- Facilitate compliance with relevant legislation, regulations and/or approvals.

1.2 Requirement for Vegetation Management Plan

In accordance with environmental assessment requirements associated with the proposed development, a detailed ecological assessment of the subject site and Biodiversity Impact Assessment (BIA) was completed by Advitech Pty Ltd. Findings of the BIA include a recommendation to prepare a VMP, as follows:

"A Vegetation Management Plan will be prepared detailing the proposed mitigation measures and implemented as part of the site operations plan. It would include, but not be limited to:

- *Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas;*
- *Pre-clearing survey requirements;*
- *Habitat management;*
- *Protocols to manage weeds and pathogens;*
- *Fire management requirements; and*
- *Revegetation and rehabilitation works."*

This Plan is considered to satisfy these requirements.

1.3 Relevant Plans and Policies

The following guidelines have been considered with regards to the development of rehabilitation and revegetation management strategies to be adopted at Tikitere Quarry:

- Commonwealth (2016) *Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry*
- Commonwealth (2016) *Mine Rehabilitation - Leading Practice Sustainable Development Program for the Mining Industry*
- Commonwealth (2016) *Biodiversity - Leading Practice Sustainable Development Program for the Mining Industry*
- ANZMEC-MCA (2000) *Strategic Framework for Mine Closure*

There is no national or State guideline for the preparation of VMPs for developments such as the proposed quarry development. The Department of Primary Industries (Office of Water) prepared the following guideline in 2012:

- *Controlled activities on waterfront land: Guidelines for vegetation management plans on waterfront land*

Further, a number of local governments within NSW have prepared guidelines for the preparation of VMPs. Examples of such guidelines include:

- Blue Mountains City Council (2016) *Vegetation Management Plan Guide*
- Lake Macquarie City Council (2013) *Vegetation Management Plan Guideline*
- Lismore City Council (2010) *Guidelines for the preparation of Vegetation Management Plans*

It should be noted that Gwydir Shire Council has not adopted a guideline for the preparation of VMPs.

This report has been prepared with consideration of relevant sections of the guidelines identified above, as such guidelines are taken to be broadly indicative of best practice measures for the development and implementation of VMPs in NSW.

2 Site Description

2.1 Locality

The proposed development site is encompassed within the property of "Tikitere" 1135 Croppa Creek Road, North Star. The property is located approximately 10 kilometres south-west of North Star and 12 kilometres north of Croppa Creek, in north-west New South Wales. The site is accessed off Croppa Creek Road via the farm access driveway and then through open cotton field paddocks. The site will be completely contained within Lot 5 in Deposited Plan 755984. An aerial image of the property boundary and proposed quarry locations is included as Figure 1.

Figure 1: Locality Plan

2.2 Original Site Topography

2.2.1 Primary Quarry Site

The hard rock quarry consists of a volcanic plug which is located on the western part of Tikitere. The plug rises to a height of approximately 20m or more above the surrounding paddock and covers an area of approximately 5.2 hectares. The plug is steeply sloped, with slopes ranging from 3:1 to 5:1. The basalt resource to be extracted from site extends to approximately 30-35m below the peak of the plug (10-15m below surrounding ground level).

2.2.2 Secondary Quarry Site

The existing gravel quarry forms a landscape depression. The depression covers a total area of approximately 0.25ha. The lowest point of the depression is 5.5m below the ground surface, with batters of 2:1. The site is located on the northern side of a steep hill, approximately 180m from the crest. The hill rises approximately 15m above the surrounding landscape; the slope up the hill to the south of the quarry site has a gradient of 5:1.

2.3 Current Land Use

The property of Tikitere is currently used as a mixed grazing and cropping enterprise. The adjoining properties are all similarly zoned and are also utilised for agricultural production, including dryland and irrigated crop production and cattle grazing. Intensive agricultural industries, such as feedlots, occur within the wider region. The area produces some of the country's highest crop yields and is known as the 'Golden Triangle'.

The proposed primary quarry site is not utilised for agricultural production as it is not suitable for this purpose. The site is primarily utilised to support remnant vegetation communities. The existing gravel pit is utilised as a source of raw materials for localised farm road maintenance.

2.4 Vegetation Community Distributions

A site survey was conducted across 19th and 20th of December, 2017 by Advitech Pty Ltd to assess vegetation communities present on site. The survey identified the following vegetation communities on site:

- Brigalow viney scrub open forest (PCT 445)
- Mixed vine thicket low eucalypt woodland (PCT 452) – High Condition
- Mixed vine thicket low eucalypt woodland (PCT 452) – Moderate Condition

The Mixed vine thicket low eucalypt woodland (PCT 452) identified on site is consistent with Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (SEVT), an endangered ecological community (EEC) listed under both TSC Act (NSW Scientific Committee, 2011) and the EPBC Act.

The remnant Brigalow viney scrub open forest (PCT 445) that occurs on deep soils along the edges of crop land and access tracks within the Tikitere property is consistent with the following EECs:

- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered – TSC Act) (NSW Scientific Committee, 2002); and
- Brigalow (Acacia harpophylla dominant and co-dominant) (Endangered – EPBC Act).

The distribution of the above vegetation communities across the development site is outlined in Figure 2.

2.5 Habitat Values

The site survey identified a suite of habitat features which are likely to be of value to a range of species of conservation significance. Key habitat features include:

- Hollow bearing trees, which are sparsely distributed throughout remnant vegetation, and are likely to provide roosting and/or foraging and/or breeding habitat for a range of birds, mammals and reptiles that may occur within the region;
- Emergent trees which may provide shade and nesting sites;
- Fruit-bearing trees and shrubs which may provide seasonal foraging opportunities;
- Ground cover including rocks, leaf litter, grassy tufts and dead wood, which may provide habitat for terrestrial species; and
- Cleared areas with grasses and herbaceous plants which may provide foraging resources for a range of ground foraging birds and terrestrial mammals.

It should be noted that the landscape surrounding the development site has been extensively cleared for the purposes of agricultural production, and subsequently that regional habitat connectivity of vegetation remnants on Tikitere is low. Given the isolated nature of habitat in the local area, the vegetation on site is unlikely to form an important movement corridor for any species; however, may provide cover for highly mobile species (such as birds, microbats and kangaroos) as they move across the landscape.

Figure 2: Landscape Features of Development Site

3 Development Overview

3.1 Activities

The proposed activities associated with the quarries will include:

- Removal of overburden (stripping involving bulldozers, scrapers or excavators) and storage of overburden and topsoil for rehabilitation;
- Extraction of material (via methods such as drilling or mechanical methods such as hammers, rippers, bulldozers, excavators, front end loaders or hydraulic methods) and temporary storage of extracted material at the quarry;
- Processing on-site using portable equipment (which may involve: crushing to reduce particle size, screening/sieving to separate materials into size fractions, blending of materials with other extractive materials to achieve required characteristics); and
- Loading and transport (involving front end loaders, excavators and trucks).

3.2 Development Footprint

The proposed basalt quarry covers an area of 5.1 hectares. The secondary gravel quarry will be extended to cover an area of approximately 1.25 hectares. The project's combined total footprint is 9.5 hectares, including areas for the crushing plant, stockpiles, sediment pond, drains and access roads. The red lines in Figure 2 indicate the footprint of disturbance associated with the proposed development.

3.3 Predicted Impacts on Vegetation Communities

Some areas of PCT452 will be impacted by the proposed development. A suite of mitigation measures will therefore be implemented on site to minimise the extent and severity of potential impacts which may occur in association with the proposed development. These measures are outlined below.

No areas of PCT445 will be impacted by the proposal, and therefore no mitigation measures are required to protect this ecological community from potential impacts associated with the development.

3.4 Predicted Impacts on Potential Habitat

Vegetation clearance has the potential to impact upon habitat features of conservation significance at the subject sites, such as through loss of hollow-bearing trees. A suite of mitigation measures will therefore be implemented in association with the development, to protect habitat values of the locality. These are further outlined below.

The development site will not take place in or adjacent to a significant wildlife corridor through the landscape. The development is subsequently not predicted to significantly impact upon the movement of fauna species throughout the landscape.

3.5 Final Landform and Intended Final Land Use

3.5.1 Primary Quarry Site

The final landform to be taken by the primary quarry is strongly dependent upon the quantity of material to be extracted. At the time of writing, the final quantity of material to be extracted from the primary quarry has not yet been finalised. It is considered that there are two likely possible final quarry landforms. These include:

- Flat Landscape; or
- Localised Depression.

3.5.1.1 Scenario A: Flat Landscape

In the event that the primary quarry site is mostly flat/only slightly depressed following cessation of quarry operations, the site will be rehabilitated by replacing soil on site in a manner such that the final landform is largely flat. The site may subsequently be utilised for crop production as part of existing agricultural operations at Tikitere.

3.5.1.2 Scenario B: Localised Depression

If the landform of the quarry is significantly depressed below surrounding ground level, the site will be rehabilitated to ensure that the faces of the quarry should be no steeper than a horizontal to vertical ratio of 3:1. There is potential that the site be utilised as an on-farm water storage.

3.5.2 Secondary Quarry Site

The landform of the secondary quarry site is anticipated to be that of a localised depression. The landscape surrounding the gravel quarry supports an endangered ecological community, is characterised by steep hills and overall is unsuitable for agricultural production. The secondary quarry site will therefore be revegetated upon conclusion of quarry activities.

3.6 Development Timeline

Preliminary estimates indicate that quarrying activities are intended to commence in April 2018. The quarrying activities will occur over a period of approximately 3 years to support the construction of the railway infrastructure undertaken by ARTC as part of the Inland Rail Project. Once quarrying activities conclude, the site will be rehabilitated in accordance with the associated Rehabilitation Management Plan, and revegetated in accordance with this VMP.

4 Management and Mitigation Measures

4.1 Vegetation Clearing

4.1.1 Minimisation of Vegetation Clearing

Detailed site plans of quarry operations will be developed to clearly delineate and minimise the impact of the development on native vegetation. Key objectives in developing detailed site plans will be to minimise impacts to:

- The adjacent SEVT EEC; and
- Hollow-bearing trees.

GPS coordinates outlining the extent of the SEVT EEC and the location of hollow-bearing trees will therefore be utilised to assist in development of detailed site plans.

Vegetation clearing will then be limited to the regions identified on the detailed site plans.

4.1.2 Management of Unavoidable Clearing Activities

In the month prior vegetation clearing taking place, pre-clearing surveys of vegetation to be cleared must be conducted by an ecologist to confirm the presence of threatened species which may be utilising habitat on site (such as through utilising stick nests or tree hollows). If threatened species are found to be utilising on-site habitat in such a manner where animal removal cannot be safely facilitated (such as utilisation of tree hollows for the rearing of young), the trees being utilised are not to be cleared until the species in question are sufficiently mobile such that they may be induced to vacate the habitat (e.g. until nesting/rearing of young has been completed).

Secondary pre-clearing surveys to identify the locations of threatened species are to be conducted as close as possible prior to tree felling activities (preferably the day beforehand), to identify the presence of threatened species which may remain within habitat features on site. Any non-mobile threatened species (as described above) identified during this site inspection are not to be disturbed until such a time as the species becomes mobile again.

On the day where habitat trees are to be felled, a visual canopy inspection is to be conducted by a qualified person to identify the potential presence of threatened species. If threatened species are identified, the tree is to be left undisturbed overnight and re-visited the following day, at which point on-site inspection is to be repeated. Trees are not to be cleared until no threatened species are visible during canopy inspection.

If no threatened species are visible, the tree is to be shaken for 30 seconds, and then the canopy is to be re-inspected for the presence of threatened species. If threatened species are present, the tree is to be left overnight and then inspected the following day. If, upon several

visitations, the animal repeatedly remains in the tree, steps may be taken to reduce the habitat quality of the tree by:

- Reducing the habitat quality of the tree by removing branches around the hollow/nest and shaking the tree daily;
- Capturing and removing the animal with a licensed wildlife handler; and/or
- Seeking additional advice from an experienced ecologist.

If no threatened species are visible, the tree is to be felled. Habitat trees are to be felled by being slowly pushed over (where safe and practical to do so) using machinery. The felled tree is to positioned such that no hollows are blocked by the ground or other trees. Felled habitat trees are to be inspected for the presence of remaining or injured fauna species, which will be rescued as required. Felled trees are then to be left overnight, to permit fauna to vacate the felled trees.

All reasonable measures are to be taken to reduce the impact of tree felling on both threatened and non-threatened species. Trees identified to contain non-threatened birds on site will be shaken prior to felling, to permit birds to vacate the tree.

Personnel undertaking clearing activities should remain alert for the potential presence of native fauna. In instances in which native fauna are disturbed during clearing activities, fauna should be rescued, administered veterinary care (where required) and (when suitable) released at a designated fauna release site. Orphaned young will be taken to wildlife carers where possible.

The site survey undertaken by Advitech Pty Ltd in December, 2017 identified nine habitat trees within the proposed clearing areas. Upon finalisation of detailed site plans, the number of hollow-bearing trees and nature of tree hollows to be impacted is to be identified. An equivalent number of nest boxes of similar dimensions to the tree hollows to be impacted are to be erected within the retained vegetation community as shown in Figure 3.

Felled habitat trees containing hollows, cracks and crevices and fallen logs are a significant habitat resource for a range of native species. Suitable felled habitat trees, large hollow logs and dead wood present within the footprint of quarry disturbance are to be retained and placed within the vegetation areas designated to be retained or revegetated as shown in Figure 3.

Figure 3: Vegetation Management Plan

4.2 Buffer and Exclusion Zones

The footprint of vegetation disturbance associated with quarry activities is to be clearly delineated on site plans and construction plans, with GPS coordinates provided. An exclusion zone is to be established for native vegetation beyond the boundary of the quarry footprint, to protect the integrity of the SEVT EEC bordering quarry operations. The location of exclusion zones is to be included in all relevant site and construction plans.

The limits of the quarry footprint, and location of exclusion zones, must be clearly demarcated on site using appropriate signage and exclusion barriers. Where possible, surveyors are to be employed to delineate the barriers of exclusion zones, utilising GPS coordinates provided in site plans.

Exclusion barriers are to be erected outside of the drip line of the tree's crown of vegetation within the habitat protection zone, such that root zones of native vegetation are protected from disturbance.

Quarry activities are not to commence until all exclusion zones are clearly identified and secured on site through the construction of appropriate signage, fencing and site plans.

Site inductions of all employees, contractors and visitors to the quarry site are to outline the location and significance of exclusion zones on the quarry site, to minimise the likelihood of site disturbance by visitation.

For all native vegetation to be retained on site that is not located within exclusion zones, buffer zones are to be maintained on site to protect vegetation from disturbance. Buffer zones will ensure that no quarrying activities occur within the drip line of the tree's crown, such that the root zone of native vegetation on site is protected from disturbance.

4.3 Revegetation Management

Prior to revegetation of sites impacted by quarry activities, sites will be rehabilitated through landscaping, soil replacement and soil treatment measures as outlined in the associated Rehabilitation Plan. Effective rehabilitation of the site landscape prior to the commencement of revegetation activities is essential to ensuring the success of revegetation efforts.

Progressive revegetation, where practicable, is encouraged such that revegetation works may commence in completed quarry sections. Overall, rehabilitation and revegetation efforts should begin as soon as is practicable following the cessation of quarry activities on site.

The nature of revegetation efforts to be undertaken on site will be strongly influenced by variations in the intended final land use of each site. Subsequently, the primary quarry site

will undergo different revegetation measures to land disturbed by the secondary quarry site. Further information is outlined below.

4.3.1 Primary Quarry Site

Depending upon the nature of the final landform of the primary quarry site (i.e. flat or depressed), the primary quarry site may be utilised for crop production or as an on-farm storage site at the conclusion of quarry activities. Subsequently, it is not anticipated that the primary quarry site will be revegetated with the intent to re-establish a native vegetation community on the site.

In the event that the site will be utilised for crop production, replaced soil is to be seeded with a cover species during the course of revegetation works, to ensure stabilisation of the soil surface and protect the landscape from erosion, and to maintain the biota of the topsoil to preserve soil fertility. Upon the completion of the landform sculpting, stabilising and revegetating process, the landscape will be incorporated into the ongoing cropping operations of Tikitere.

Where the site will be utilised as an on-farm water storage, the edges of the depression will be revegetated as appropriate with a mixture of native and introduced pasture species, with the potential to include local native trees and shrubs where appropriate. Placement of trees and shrubs is to be managed such that the storage site is easily accessible.

4.3.2 Secondary Quarry Site

The secondary quarry site is to be revegetated such that it is consistent with the remnant SVET EEC located to the south of the subject site.

To this end, soil removed and stockpiled during the course of quarry activities is to be replaced on site in accordance with the Rehabilitation Plan. Topsoil is to be watered and fertilised (as required), to encourage propagation of seeds stored within the seed bank of the soil.

Additional planting of seeds/saplings (as appropriate) will be undertaken to complement natural germination of seeds within the soil. Species to be planted as part of the revegetation process are to be consistent with local species present in the adjacent SVET EEC. A list of appropriate species is presented in Appendix A. Revegetation works are to target previously cleared areas between cropland and remnant vegetation on site, to assist in minimising edge effect disturbances on the SVET EEC.

During the course of revegetation activities, the site will be fenced with access restricted to appropriate personnel, to minimise disturbance to revegetation sites. The site will be regularly monitored to ensure the effectiveness of revegetation efforts.

The revegetation of the subject site will be taken to be successful in the event that:

- The site is stable after 12 months; and
- Adequate, self-sustaining vegetation cover (80% of the cover of analogue sites after 24 months) is established on site.

If monitoring indicates that the revegetation of the subject site will not meet success criteria outlined above, watering/fertilising/re-planting of flora on site to be undertaken as required to assist revegetation efforts.

Once a juvenile vegetation community is established and stabilised, any exclusion fencing separating the remnant vegetation community from the disturbance site will be removed to enable fauna access to the revegetated subject site.

Regular monitoring and maintenance of the revegetating site will be undertaken to control weed propagation, in accordance with biosecurity measures outlined below.

4.4 Biosecurity Management

Both quarries will be actively managed to minimise the occurrence of weed and plant pathogens on site.

Throughout the life of quarry operations, both quarry sites will maintain a 'come clean – go clean' policy, in accordance with the *Arrive Clean, Leave Clean* guidelines published by the Department of the Environment in 2015. To this end, vehicles, boots and other potential seed/disease vectors are checked for cleanliness and washed/disinfected as required prior to entering and leaving quarry sites.

As part of the soil stripping/stockpiling/replacement process detailed within the Rehabilitation Plan, soils which contain high quantities of weeds and/or weed seed banks should be separated from soil stockpiles to be utilised for rehabilitation. Such soils are to be either disposed of at an appropriate waste management facility, or in an area separated from remnant vegetation communities.

Weed presence will be actively controlled during quarry operations (including rehabilitation and revegetation operations). The quarry sites will regularly be inspected for weed outbreaks, both within the disturbance footprint and within retained vegetation fringing the boundary of the secondary quarry site. Weed outbreaks are to be addressed promptly to prevent the development of weed seed banks within the soil of the site. Control methods utilised on site may include methods such as spot spraying or physical removal.

In the event that notifiable pests or diseases under the *Biosecurity Act 2015* are detected on site, it is the responsibility of the quarry manager to report the sighting to the Exotic Plant

Pest Hotline on 1800 084 881, or by sending a clear photograph and contact details by email to biosecurity@dpi.nsw.gov.au. Pests and diseases requiring notification are outlined in Appendix B.

The national biosecurity outbreak website, www.outbreak.gov.au, should be checked regularly for the most up-to-date records of severe biosecurity risks/outbreaks in NSW.

4.5 Fire Management

The SEVT EEC community to be retained adjacent to the secondary quarry site is sensitive to fire disturbance. The site should therefore be managed to minimise the risk of fire. The fuel load adjacent to areas of retained vegetation should be kept to the minimal extent practicable.

Further, when placing dead wood/fallen logs within the remnant vegetation community for habitat purposes (as outlined in Section 4.1.2), wood is to be evenly distributed throughout the site as far as practicable, such that the fuel load of single locations is not artificially elevated within the remnant vegetation community.

Appendix A – Revegetation Species List

Family	Scientific Name	Common Name
Adiantaceae	*Cheilanthes distans*	Bristly Cloak Fern
Apocynaceae	*Alstonia constricta*	Quinine Tree
Apocynaceae	*Carissa ovata*	
Apocynaceae	*Parsonsia eucalyptophylla*	Gargaloo
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy
Bignoniaceae	*Pandorea pandorana*	Wonga Vine
Boraginaceae	*Ehretia membranifolia*	Peach Bush
Capparaceae	*Apophyllum anomalum*	Warrior Bush
Capparaceae	*Capparis lasiantha*	Nepine
Capparaceae	*Capparis mitchellii*	Wild Orange
Casuarinaceae	*Casuarina cristata*	Belah
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush
Chenopodiaceae	*Maireana microphylla*	Small-leaf Bluebush
Chenopodiaceae	*Rhagodia spinescens*	Spiny Saltbush
Chenopodiaceae	*Sclerolaena diacantha*	Grey Copperburr
Chenopodiaceae	*Sclerolaena muricata*	Black Rolypoly
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine
Euphorbiaceae	*Beyeria viscosa*	Pinkwood
Euphorbiaceae	*Croton phebalioides*	
Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*	Desert Spurge
Fabaceae (Caesalpinioideae)	*Senna coronilloides*	
Fabaceae (Faboideae)	*Glycine clandestina*	Love Creeper
Fabaceae (Faboideae)	*Hovea longipes*	
Fabaceae (Faboideae)	*Indigofera brevidens*	
Fabaceae (Mimosoideae)	*Acacia harpophylla*	Brigalow
Lamiaceae	*Spartothamnella juncea*	Bead Bush
Malvaceae	*Abutilon oxycarpum*	Lantern Bush
Myoporaceae	*Eremophila mitchellii*	Budda
Myrtaceae	*Eucalyptus melanophloia*	Silver-leaved Ironbark
Oleaceae	*Jasminum lineare*	Desert Jasmine
Oleaceae	*Notelaea microcarpa var. microcarpa*	Velvet Mock Olive
Plantaginaceae	*Plantago debilis*	
Poaceae	*Aristida ramosa*	Purple Wiregrass
Poaceae	*Austrostipa scabra*	Speargrass
Poaceae	*Austrostipa verticillata*	Slender Bamboo Grass
Poaceae	*Chloris ventricosa*	Plump Windmill Grass
Poaceae	*Enneapogon gracilis*	Slender Bottle-washers
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass
Poaceae	*Paspalidium gracile*	Slender Panic
Rubiaceae	*Psydrax odorata*	Shiny-leaved Canthium

Family	Scientific Name	Common Name
Rutaceae	*Geijera parviflora*	Wilga
Sapindaceae	*Atalaya hemiglauca*	Whitewood
Solanaceae	*Solanum esuriale*	
Solanaceae	*Solanum parvifolium subsp. parvifolium*	
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Thymelaeaceae	*Pimelea neo-anglica*	Poison Pimelea
Zygophyllaceae	*Zygophyllum apiculatum*	Pointed Twinleaf

Appendix B: Pests and Diseases Requiring Notification

Part 1 Animal pests and diseases

- *Aethina tumida* (Small hive beetle)
- *Anaplasma marginale* (Anaplasmosis)
- *Ascosphaera apis* (Chalkbrood)
- Avian influenza
- *Babesia bigemina* (Babesiosis)
- *Babesia bovis* (Babesiosis)
- *Brucella suis* (Brucellosis)
- *Cysticercus bovis* (Bovine cysticercosis)
- *Cysticercus cellulosae* (Porcine cysticercosis)
- Chlamydiosis in poultry and other birds
- Duck virus enteritis/Duck plague
- Duck virus hepatitis
- Egg drop syndrome (EDS 76)
- Enzootic bovine leucosis
- Equine herpesvirus 1 (abortigenic strain)
- Equine infectious anaemia
- Equine viral arteritis
- Footrot in sheep and goats
- Infectious laryngotracheitis
- Influenza pandemic A(H1N1)pdm09
- Leishmaniosis
- *Melissococcus plutonius* (European foulbrood)
- *Mycobacterium avium* (Avian tuberculosis)
- *Nosema apis* and *Nosema ceranae* (Nosemosis)
- *Paenibacillus larvae* (American foulbrood)
- Paratuberculosis (Johne's disease)
- Pigeon paramyxovirus
- Porcine myocarditis (Bungowannah virus infection)
- *Rhipicephalus (Boophilus) australis* (Cattle tick)
- *Rhipecephalus (Boophilus) microplus* (Cattle tick)
- *Salmonella enteritidis* (Salmonella Enteritidis infection in poultry)
- *Salmonella pullorum* (Pullorum disease)
- Trichomoniasis
- West Nile Virus infection – clinical

Part 2 Aquatic pests and diseases

- *Acanthogobius flavimanus* (Yellowfin goby)
- *Aeromonas salmonicida*—atypical strains (Goldfish ulcer disease)
- *Amniataba percoides* (Banded Grunter)
- *Batrachochytrium dendrobatidis* (Chytridiomycosis in amphibians)
- *Betanodavirus* (Viral encephalopathy and retinopathy, VER)
- *Bonamia* spp. all species except *Bonamia ostreae* & *B. exitiosa* (Bonamia)
- *Carcinus maenas* (European green crab)

- *Caulerpa taxifolia* (Caulerpa)
- Epizootic haematopoietic necrosis of fish (EHN virus)
- Epizootic ulcerative syndrome of fish (infection with *Aphanomyces invadans*)
- Gill-associated virus disease (GAV)
- *Maoricolpus roseus* (New Zealand Screw Shell)
- *Marteilia sydneyi* (QX disease)
- *Misgurnus anguillicaudatus* (Weatherloach/Oriental Weatherloach)
- *Oreochromis mossambicus* (Tilapia/Mozambique Mouthbrooder)
- Ostreid herpesvirus–μ variant—OsHV–1 μvar (OSHV1) that causes Pacific Oyster Mortality Syndrome (POMS)
- *Perca fluviatilis* (Redfin Perch)
- *Perkinsus olseni* (Perkinsosis)
- *Phalloceros caudimaculatus* (Speckled Mosquitofish/Dusky Millions Fish)
- *Sabella spallanzanii* (European Fan Worm)
- Thelohaniosis of crustaceans
- *Tridentiger trigonocephalus* (Trident Goby/Chameleon Goby/Striped Goby/Japanese Goby)
- Winter mortality (of Sydney Rock Oysters)

Part 3 Invasive species

- *Hylotrupes bajulus* (European house borer)

Part 4 Plant pests and diseases

- *Cantareus apertus* (Green snail)
- Citrus tristeza virus (but limited to orange stem pitting strains only)
- Cucumber green mottle mosaic virus (CGMMV)
- *Marchalina hellenica* (Giant pine scale)
- Melon necrotic spot carmovirus (Melon necrotic spot virus)
- *Panonychus citri* (Citrus red mite)
- Potato spindle tuber viroid (PSTVd)
- *Protopulvinaria pyriformis* (Pyriform scale)
- *Ralstonia solanacearum race 3* (causal agent of bacterial wilt) but only in a seed potato protected area within the meaning of Division 4 of Part 4 of this Regulation
- *Spongospora subterranea* (Powdery scab) but only in a seed potato protected area within the meaning of Division 4 of Part 4 of this Regulation
- *Tomato yellow leaf curl virus* (TYLCV)