

Appendices

(Total No. of pages including blank pages = 132)

Appendix A	Submissions Summary (6 pages)
Appendix B	Register of Submitters (4 pages)
Appendix C	Community Information Session – Public Notice, Flyer and Presentation Slides (26 pages)
Appendix D	Correspondence with NSW Farmers Association: Oyster Committee and Port Stephens Shellfish Program (10 pages)
Appendix E	Extracts from the Updated Biodiversity Development Assessment Report (34 pages)
Appendix F	Blasting Fly-Rock Control Assessment (20 pages)
Appendix G	Extracts from the Updated Aboriginal Cultural Heritage Assessment & Updated Archaeological Report (30 pages)

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Appendix A

Submissions Summary

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						Air		Water			Ecology		Heritage	Traffic	Noise			Economic		Rehabilitation	Visual	Consultation	Miscellaneous		
Submitter	Reference	Location	Group	View	Form letter / petition	Dust Emissions	Silica Dust	Water Supply	Groundwater	Surface Water	Flora	Fauna	Aboriginal/Historic Heritage	Road User Impacts	Traffic Noise	Operational Noise	Blasting Vibration	Property Values	Economy	Rehabilitation	Visual Amenity	Community Consultation	Information/Data	Climate Change	
Port Stephens Council	390016		Council	Comment	-																				
Mid Coast Council	390126		Council	Comment	-	1				1	1	1				1							1		
Division of Resources and Geoscience	389901		Government	Comment	-																		1		
Resource Regulator	390131		Government	Comment	-																				
OEH - Heritage	390136		Government	Comment	-																				
EPA	391116		Government	Comment	-	1				1						1							1		
OEH	395426		Government	Comment	-					1	1	1	1										1		
DoI - Crown Lands and Water	400216		Government	Comment	-				1																
RMS	402516		Government	Comment	-																				
A Albury	390081 & 390146	Limeburners Creek	Individual	Object	-	1	1			1	1	1		1	1	1	1	1	1		1	1	1	1	
S Emanuel	389891	Karuah	Individual	Object	-																	1			
T Jarvis	389906	Oatley	Individual	Object	-					1	1	1						1							
S Emanuel	389911	Karuah	Individual	Object	-					1															
E Armstrong	389916	Soldiers Point	Individual	Object	-					1		1													
S Emanuel	389921	Karuah	Individual	Object	-	1				1	1	1					1								
R Filson	389931	Booral	Individual	Object	-						1	1											1		
Name Witheld	389936	Karuah	Individual	Object	-					1	1	1									1				
C Berry	389941	Raymond Terrace	Individual	Object	-	1				1		1				1									
R Zemanek	389946	The Branch	Individual	Object	FL	1				1		1				1					1		1		
S Filson	389951	Booral	Individual	Object	FL	1		1		1		1	1	1	1	1						1			
Name Witheld	389961	Soldiers Point	Individual	Object	FL									1											
T Hendriks	389966	Raymond Terrace	Individual	Object	-	1				1	1	1				1									
Name Witheld	389971	Soldiers Point	Individual	Object	-					1															
Name Witheld	389976	Soldiers Point	Individual	Object	-					1															
Name Witheld	389981	Soldiers Point	Individual	Object	-					1															
Name Witheld	389986	Karuah	Individual	Object	-					1	1	1									1		1		
Name Witheld	389991	St Ives	Individual	Object	-			1		1	1	1													
B Tehan	389996	Corlette	Individual	Object	-					1		1				1									
S Munro	390006	Wingham	Individual	Object	-	1	1			1	1	1				1									
G Tlaskal	390021	Bulga	Individual	Object	-					1															
G Stone	390031	Old Bar	Individual	Object	-	1	1			1	1	1				1								1	
A Percy	390036	Possum Brush	Individual	Object	-	1																			
P Wood	390041	Karuah	Individual	Object	-	1																			
A Johnson	390046	Elizabeth Beach	Individual	Object	-	1	1			1	1	1			1	1								1	
R Bowen	390051	Charlotte Bay	Individual	Object	-					1															
M Jut	390056	Raymond Terrace	Individual	Object	-	1				1	1	1			1	1					1				
G Schraer	390066	North Arm Cove	Individual	Object	-						1														
K Schraer	390071	North Arm Cove	Individual	Object	-						1														
H Fitzpatrick	390076	Karuah	Individual	Object	-	1				1		1				1					1		1		
D Clarke	390086	Karuah	Individual	Object	-	1					1	2				1									
Name Witheld	390091	Wahroonga	Individual	Object	-					1															
Name Witheld	390096	Wahroonga	Individual	Object	-					1															
G Woodhouse	390101	Karuah	Individual	Object	-					1															
L Woodhouse	390106	Karuah	Individual	Object	-					1															
S Albury	390121	Limeburners Creek	Individual	Object	-					1		1													

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						Air		Water			Ecology		Heritage	Traffic	Noise			Economic		Rehabilitation	Visual	Consultation	Miscellaneous			
Submitter	Reference	Location	Group	View	Form letter / petition	Dust Emissions	Silica Dust	Water Supply	Groundwater	Surface Water	Flora	Fauna	Aboriginal/Historic Heritage	Road User Impacts	Traffic Noise	Operational Noise	Blasting Vibration	Property Values	Economy	Rehabilitation	Visual Amenity	Community Consultation	Information/Data	Climate Change		
R Trotter	390141	Karuah	Individual	Object	-	1				1		1				1	1	1								
Si Emanuel	390156	Karuah	Individual	Object	FL	1				1	1			1		1										
St Emanuel	390161	Karuah	Individual	Object	FL	1				1	1			1		1										
M McConnochie	395431	Karuah	Individual	Object	-					1							1									
The Branch Lane Farm Pty Ltd	390011		Group	Object	-	1				1		1				1					1		1			
Salamander Bay Community Group Inc	389896		Group	Object	-									1												
EcoNetwork-Port Stephens Inc	389926		Group	Object	-	1				1		1				1										
Port Stephens Shellfish Program	389956		Group	Object	-					1								1				1				
NSW Farmers - Port Stephens Branch	390001		Group	Object	-					1								1				1				
Soldiers Point Community Group	390026		Group	Object	-					1	1	1														
Port Stephens Koala & Wildlife Preservation Society Ltd	390061		Group	Object	-	1				1	1	1		1		1			1							
Ironstone Community Action Group Inc	390111		Group	Object	-	1	1	1		1	1	1		1	1	1					1	1				
Rivers SOS - Regional Representatives	390116		Group	Object	-					1																
Ironstone Community Action Group Inc	390151		Group	Object	-	1	1			1	1	1	1			1							1			
Ironstone Community Action Group Inc	390466		Group	Object	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Total						25	7	4	2	45	24	31	4	9	6	23	5	3	6	1	9	7	12	4		
Local Council						1	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	
Government Agency						1	0	0	1	2	1	1	1	0	0	1	0	0	0	0	0	0	0	3	0	
Special Interest Group						6	3	2	1	10	5	7	2	4	2	6	1	1	4	1	3	4	3	1		
Individual						10	3	2	0	22	12	17	1	3	4	10	2	1	2	0	5	3	4	3		

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Appendix B

Register of Submitters

(Total No. of pages including blank pages = 4)

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Group	Reference Number	Name	Where issues are addressed (section)
NSW Government Agencies	389901	Division of Resources and Geoscience	4.1
	390131	Resource Regulator	NA
	390136	OEHL - Heritage	4.3.1.3, 4.3.2.1, 4.3.2.3, 4.3.2.7, and 4.3.9
	391116	EPA	4.1, 4.3.1.1, 4.3.3 and 4.3.4.1
	395426	OEHL	4.3.1.3, 4.3.2, and 4.3.9
	400216	Dol - Crown Lands and Water	4.3.7
	402516	RMS	NA
Councils	390016	Port Stephens Council	4.3.5
	390126	Mid Coast Council	4.3.1.1 - 4.3.1.2, , 4.3.2.1 -4.3.2.3, 4.3.2.6 – 4.3.2.8, 4.3.3 and 4.3.4.1
Community Groups	390011	The Branch Lane Farm Pty Ltd	4.3.1, 4.3.2, 4.3.3, 4.3.4 and 4.3.7
	389896	Salamander Bay Community Group Inc	4.3.5
	389926	EcoNetwork-Port Stephens Inc	4.3.1, 4.3.2, 4.3.3 and 4.3.4
	389956	Port Stephens Shellfish Program	4.3.1.1
	390001	NSW Farmers - Port Stephens Branch	4.3.1.1 and 4.3.11
	390026	Soldiers Point Community Group	4.3.1, 4.3.2.5 and 4.3.2.8
	390061	Port Stephens Koala & Wildlife Preservation Society Ltd	4.3.1, 4.3.2.4, 4.3.2.8, 4.3.3 and 4.3.4
	390111	Ironstone Community Action Group Inc	4.3.2.3-4 and 4.3.2.8-9
	390116	Rivers SOS - Regional Representatives	4.3.1
	390151	Ironstone Community Action Group Inc	4.3.1, 4.3.2, 4.3.3, 4.3.4 and 4.3.9
	390466	Ironstone Community Action Group Inc	4.1, 4.2.2, 4.3.1.1, 4.3.1.4, 4.3.2.3-4, 4.3.3, 4.3.4.1, 4.3.5, 4, 4.3.7.1, 4.3.8, 4.3.9 and 4.3.10 – 4.3.12

Group	Reference Number	Name	Where issues are addressed (section)
Individuals	390081	A. Albury	4.1, 4.2.1 - 4.2.2, 4.3.1.1 - 4.3.1.2, 4.3.2.4, 4.3.2.8, 4.3.3, 4.3.4.1 - 4.3.4.2, , and 4.3.11
	390146	A. Albury	4.3.5
	390086	D. Clarke	4.3.2.4 and 4.3.2.8
	389906	T. Jarvis	4.3.1, 4.3.2
	389916	E. Armstrong	4.3.2.5
	389931	R. Filson	4.3.2
	390076	H. Fitzpatrick	4.3.1.3, 4.3.3, 4.3.4.2 and 4.3.7
	389941	C. Berry	4.3.1, 4.3.2.3-4, 4.3.2.8, 4.3.3 and 4.3.4
	389946	R. Zemanek	4.3.1, 4.3.2.4, 4.3.3, 4.3.4 and 4.3.7
	389951	S. Filson	4.3.8 - 4.3.9
	389961	Name Withheld	4.3.5
	389966	T. Hendriks	4.3.1, 4.3.2.3-4, 4.3.2.8, 4.3.3 and 4.3.4
	389971/389976/ 389981	Name Withheld	4.3.1
	389936/389986	Name Withheld	4.3.2.9 and 4.3.7
	389991	Name Withheld	4.3.1 and 4.3.2
	389996	B. Tehan	4.3.1.1
	390006	S. Munro	4.3.3
	390021	G. Tlaskal	4.3.1.1
	390141	R. Trotter	4.3.4.3
	390031	G. Stone	4.1, 4.3.1, 4.3.2 and 4.3.4
	390036	A. Percy	4.3.3
	390046	A. Johnson	4.3.2.8
	390051	R. Bowen	4.3.1
	390056	M. Jut	4.3.1.1
	390091	Name Withheld	4.3.1 and 4.3.2.5
	390096	Name Withheld	4.3.1
	390121	S. Albury	4.3.1 and 4.3.2

Appendix C

Community Information Session – Public Notice, Flyer and Presentation Slides

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**KARUAH SOUTH QUARRY
COMMUNITY INFORMATION SESSION
Wednesday, 11 September 2019, 6:00pm to 7:30pm
Karuah Community Hall – 2 Engel Ave, Karuah**

Wedgerock Pty Ltd is seeking approval for the development and operation of a hard rock Quarry on the southern section of Lot 11 DP 1024564, approximately 4km northeast of Karuah.

The Environmental Impact Statement (EIS) for the Project was placed on public exhibition between 24 April 2019 and 21 May 2019. R.W. Corkery & Co Pty Ltd (RWC) is currently preparing the Response to Submissions for the Project to address matters raised in submissions received during the exhibition period.

RWC is inviting members of the local community to attend a community information session on 11 September 2019 at the Karuah Community Hall between 6:00pm and 7:30pm. The information session will include a brief presentation outlining amendments that have been made to the Project and the results of supplementary assessments that have been undertaken. We will also be answering any questions from community members.

For more information please contact:

Caiden O'Connor
Environmental Consultant
Tel: (02) 9985 8511
Email: caiden@rwcorkery.com

Public Notice – published in the Port Stephens Examiner and Myall Coast News of the Area in August 2019



KARUAH SOUTH QUARRY

Community Information Session

Wednesday, 11 September 2019

6:00pm to 7:30pm

Karuah Community Hall - 2 Engel Ave, Karuah

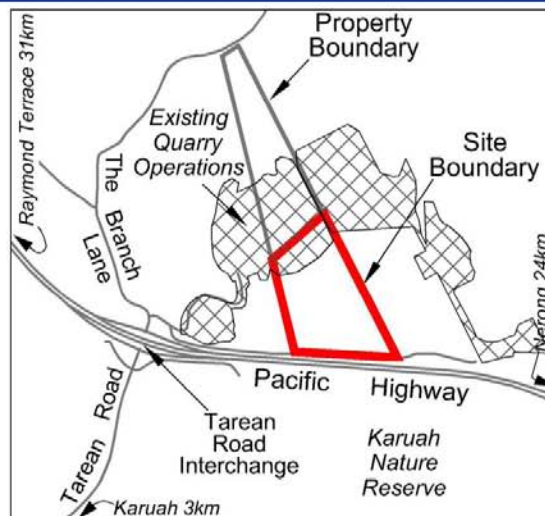
Wedgerock Pty Ltd is seeking approval for the development and operation of a hard rock Quarry on the southern section of Lot 11, DP 1024564 (see map). The proposal includes production of up to 600 000 tonnes of construction material per year and an operational life of approximately 25 years.

R.W. Corkery & Co Pty Ltd (RWC) was commissioned to prepare the Environmental Impact Statement (EIS) for the

Project which was placed on public exhibition between 24 April 2019 and 21 May 2019. A total of 61 submissions were made in relation to the Project during the exhibition period. RWC is currently preparing the Response to Submissions to address the principal matters raised by individuals, organisations and public authorities in these submissions.

RWC is inviting members of the local community to attend a community information session on Wednesday, 11 September 2019 at the Karuah Community Hall between 6:00pm and 7:30pm. The information session will include a brief presentation outlining amendments that have been made to the Project and the results of supplementary assessments that have been undertaken to address matters raised in submissions. We will also be answering any questions from community members.

If you have any questions in the interim, please contact RWC on the following details. Otherwise, we look forward to seeing you on 11 September 2019.



Caiden O'Connor

Email: caiden@rwcorkery.com

Environmental Consultant

Phone: 02 9985 8511

R. W. Corkery & Co Pty Limited

Mobile: 0417 468 381

Consultation Flyer – August 2019

Karuah South Quarry Project

COMMUNITY INFORMATION SESSION
11 SEPTEMBER 2019

2

An important resource as hard rock resources diminish close to Sydney.

The Project is State significant.

The Site is located adjacent to the Pacific Highway - minimises traffic on local roads.

The Site is strategically located within a "Quarry Precinct".

The rhyodacite on site yields high quality products.

Why Karuah?



Karuah South Quarry Project

Key Components

- ▶ Project Life - 25 years
 - Stage 1: Years 1 to 5
 - Stage 2: Years 6 to 25
- ▶ Total Available Resource
 - 11.25 million tonnes
- ▶ Maximum Annual Production
 - Stage 1: 300,000 tonnes
 - Stage 2: 600,000 tonnes

Table 1: Hours of Operation

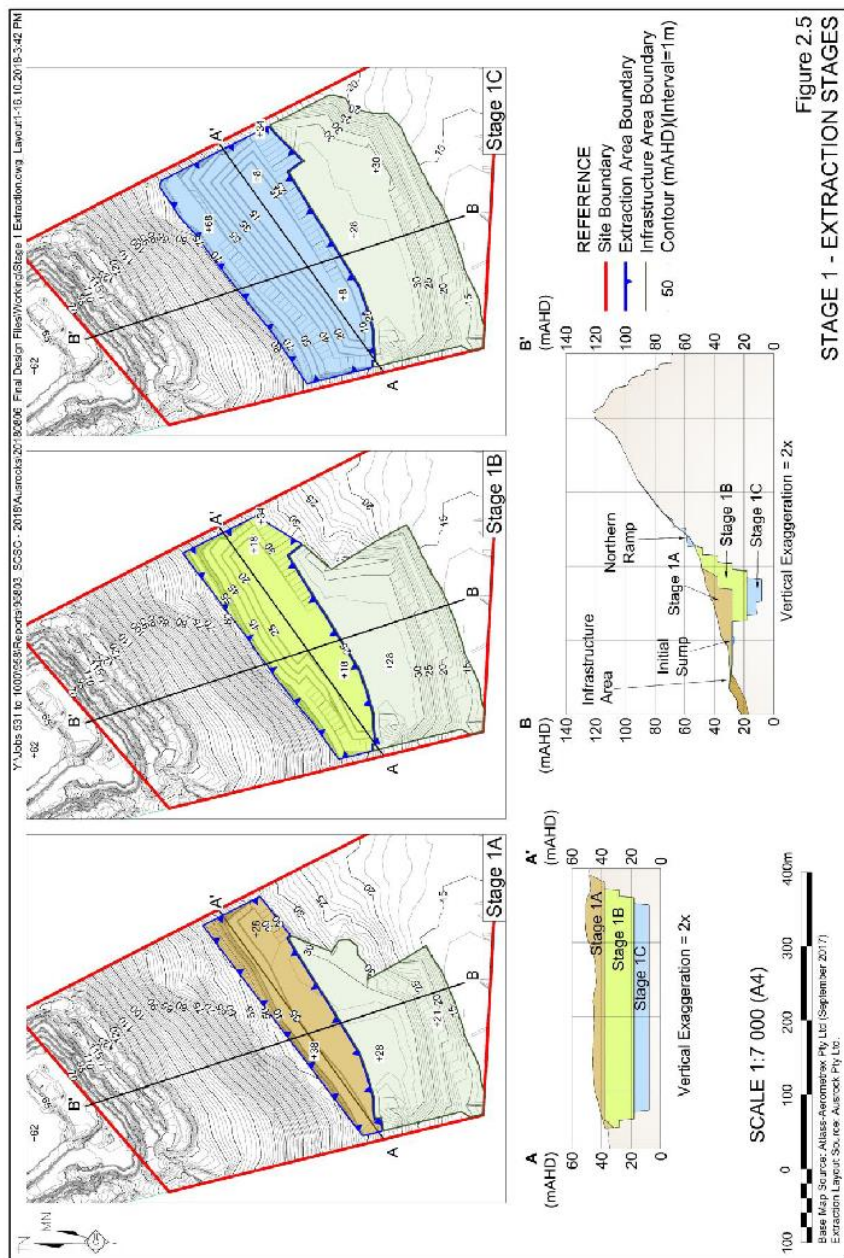
Activity	Monday to Friday	Saturdays	Sundays or Public Holidays
Site establishment and construction	7:00am to 6:00pm	7:00am to 1:00pm	Nil
Extraction operations	7:00am to 6:00pm	7:00am to 1:00pm	Nil
Blasting operations	10:00am to 4:00pm	Nil	Nil
Processing operations	7:00am to 6:00pm	7:00am to 1:00pm	Nil
Product despatch	5:00am to 6:00pm	5:00am to 1:00pm	Nil
Maintenance	24 hours / day	24 hours / day	Nil

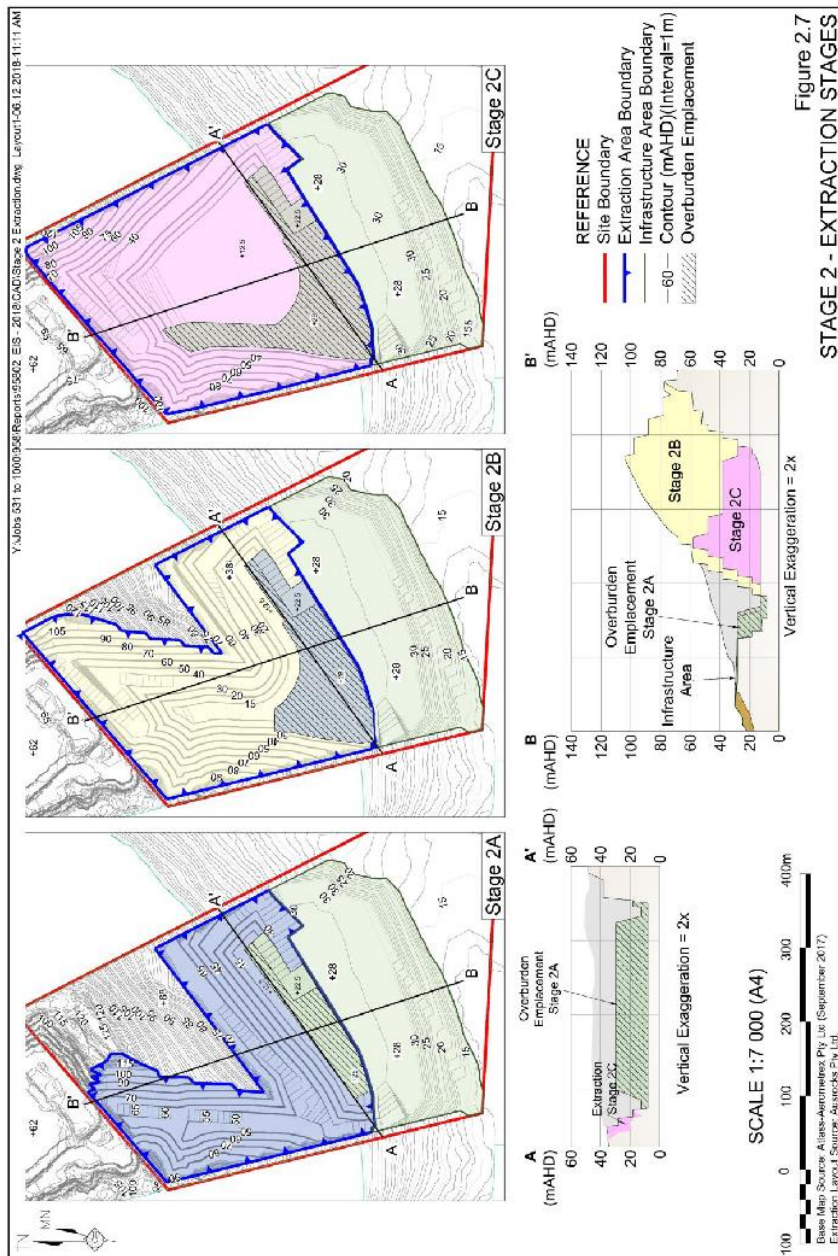


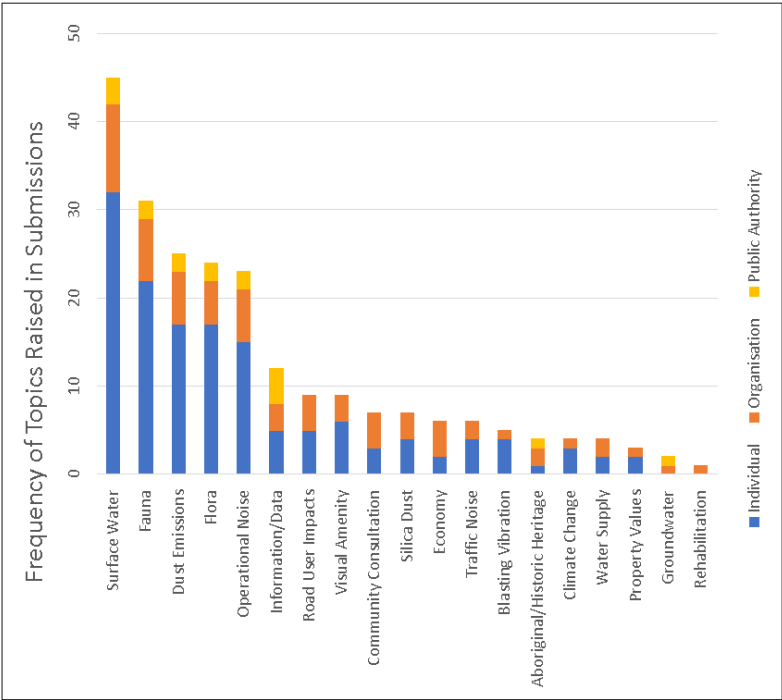
Key Site Components

- ▶ Quarry entrance
- ▶ Quarry access road
- ▶ Infrastructure Area
- ▶ Processing plant and product stockpiles
- ▶ Stage 1 Extraction Area
- ▶ Stage 2 Extraction Area
- ▶ Water Management Structures

5







Analysis of Submissions

- ▶ 41 submissions from individuals
 - ▶ 16 from within the local area
 - ▶ 16 from the region
 - ▶ 9 from broader community
- ▶ 11 submissions from organisations
- ▶ 9 submissions from public authorities

Actions Taken Since Exhibition: Consultation

8

- ▲ Community Information Session
 - ▲ Feedback from community sought to identify any additional matters for consideration in the Submissions Report
- ▲ Oyster Committee and Port Stephens Shellfish Program
 - ▲ Telephone and email correspondence
- ▲ Hunter Quarries
 - ▲ Confirmation received that extraction and rehabilitation activities within the Karuah Quarry will be completed by no later than 6 May 2021
 - ▲ Extractive operations at Karuah Quarry and Karuah South Quarry would not occur concurrently

Actions Taken Since Exhibition: Amendments to the Project & Supplementary Assessments

9

- ▶ Amendments to the Project
 - ▶ Processing plant to be enclosed above and on three sides
- ▶ Supplementary Assessments
 - ▶ Surface Water
 - ▶ Ecology
 - ▶ Air Quality
 - ▶ Fly-Rock and Noise Management
 - ▶ Aboriginal Heritage



Surface Water – Key Issues

- ▶ Potential sediment-laden discharges from the Site and subsequent impacts on the surrounding environment and industries (e.g. the oyster industry)
 - ▶ Extraction area and upper surface of the infrastructure area would drain internally to a sump within the extraction area
 - ▶ Runoff from the outer surface of the infrastructure pad and a section of the quarry access road would report to the western and southern sediment basins
 - ▶ Quarry access road would be sealed
 - ▶ Batter slopes would be vegetated to achieve a minimum 60% cover of perennial grass
- ▶ Sediment basin design volumes exceed minimum volumes required (Table 2)
- ▶ Sediment basins not required for the management of sediment-laden runoff after 60% cover achieved with water captured to be used for Quarry-related activities

10

Table 2: Constructed Versus Required Stage Volumes for Western and Southern Sediment Basins

Stage	Western Sediment Basin/Dam			Southern Sediment Basin/Dam		
	Constructed volume (m³)	Minimum Sediment Storage (m³) ¹	Minimum Required volume (m³) ¹	Constructed volume (m³)	Minimum Sediment Storage (m³) ¹	Minimum Required volume (m³) ¹
Site establishment and construction		105	568		211	1 078
1A		10	473		21	888
1B		18	163		135	1 147
1C					160	1 533
2A						
2B						
2C						
	7 700	11	517	17 100	33	1 406

(Note¹: As per calculations for Type D and Type F soils, refer Landcom (2004), Section 6.3.4

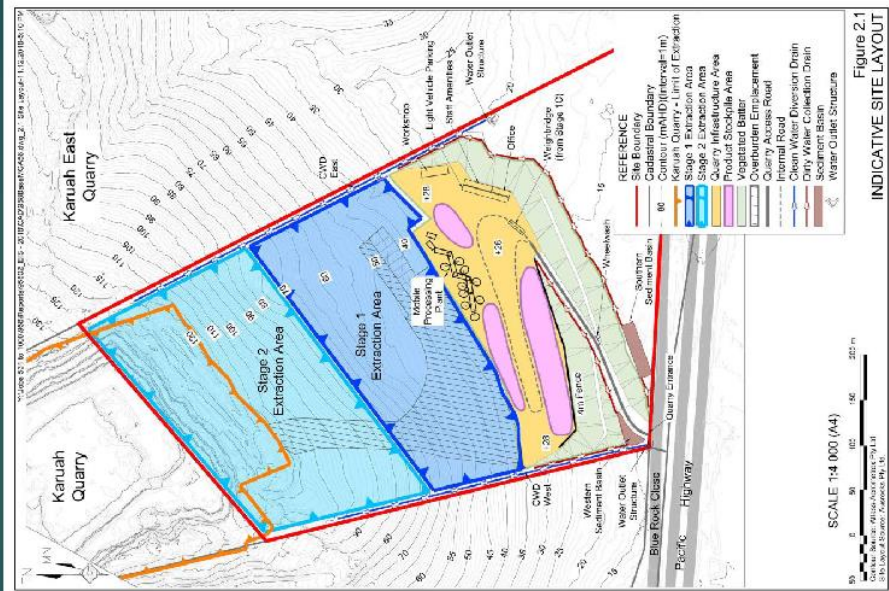
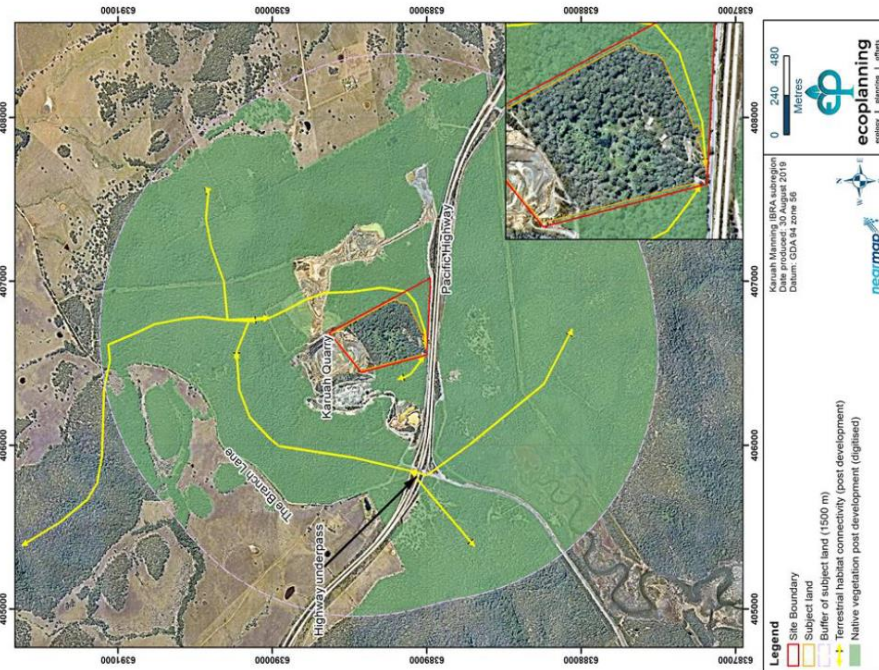


Figure 2.1
INDICATIVE SITE LAYOUT

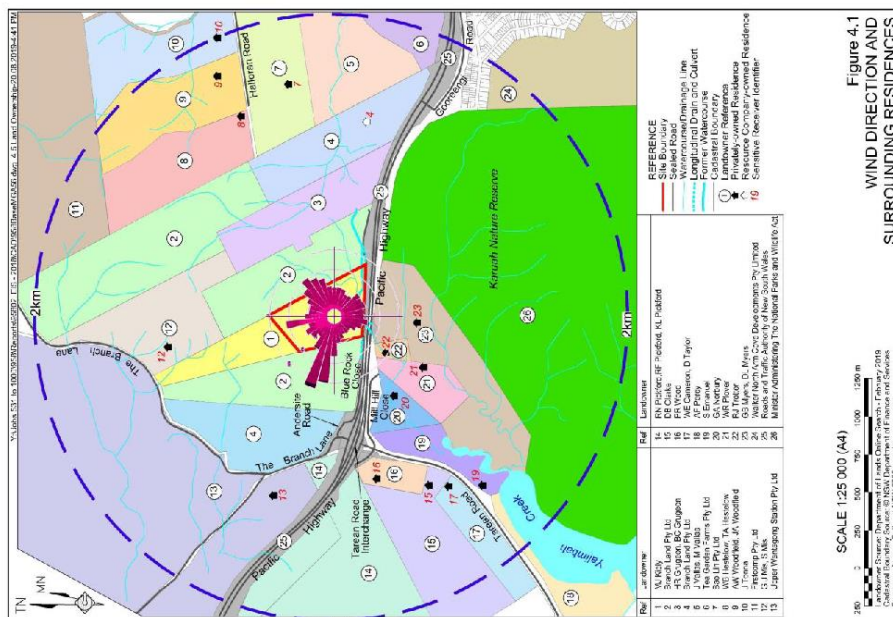


Ecology – Key Issues

- ▶ Impacts of vegetation clearing on habitat connectivity
 - ▶ Vegetation would be retained along the southern boundary of the Site to allow fauna to move to the north and south
 - ▶ A canopy gap of approximately 37m would be created by the Quarry access road
 - ▶ Less than the volplaning (gliding) distance for the Squirrel Glider and Yellow-bellied Glider
 - ▶ Koalas preferentially move across the ground between canopy gaps
- ▶ Other issues relating to edge effects, age of trees, BAM methodology and EPBC Act referral addressed in RTS

Air Quality – Key Issues

- ▲ Deposited dust and potential impacts on tank water
- ▲ Prevailing wind direction
- ▲ Mitigation measures
- ▲ Karuah South Quarry predicted to contribute a maximum of 0.3g/m^2 /month compared to a maximum of 0.7g/m^2 /month from Karuah East Quarry at surrounding receptors



Air Quality – Key Issues

- ▶ Feasibility and benefits of enclosing the processing plant
- ▶ Modelling undertaken by Northstar Air Quality Pty Ltd
 - ▶ Installation of the mobile processing plant enclosure
 - ▶ Mitigation measures identified in EIS (e.g. dust suppression, wheel wash, maximum daily production limit)
- ▶ Total site annual PM₁₀ emissions reduced by between 2.2% to 3.8% and max 24-hour PM₁₀ emissions reduced by between 3.6% to 4.4%
- ▶ Significant reductions of PM₁₀ at specific receptors - up to 33.9% (Table 3)

Table 3: Maximum predicted 24 hour PM₁₀ concentrations – Stage 2B

Receptor	PM ₁₀ concentrations without enclosure of processing plant	PM ₁₀ concentrations with enclosure of processing plant	% change
20	15.9	13.9	-12.6
21	12.7	8.4	-33.9
22	21.6	16.1	-25.5
23	16.2	15.5	-4.3

Table 4: Previously Predicted Maximum 24-hour Average Cumulative PM₁₀ Concentrations – Stage 1C

Receptor	Maximum 24-hour PM ₁₀ Concentration (µg·m ⁻³)			
	Cumulative Impact	KSQ	KEQ	BG
16	50.8	4.7	5.6	24.9

Table 5: Updated Predicted Maximum 24-hour Average Cumulative PM₁₀ Concentrations – Stage 1C

Receptor	Maximum 24-hour PM ₁₀ Concentration (µg·m ⁻³)			
	Cumulative Impact	KSQ	KEQ	BG
23	44.6	16.6	8.6	19.4
22	40.5	17.3	11.4	11.8
16	33.1	4.6	9.1	19.4

Air Quality – Key Issues

- ▶ Revised modelling to reflect maximum production at Karuah Quarry and Karuah East Quarry in the cumulative impact assessment
 - ▶ Karuah Quarry – not operational
 - ▶ Karuah East Quarry – 1.5Mtpa
 - ▶ Installation of processing plant enclosure
 - ▶ The minor exceedance of the maximum 24-hour PM₁₀ criterion which was previously predicted to occur at R16 is no longer predicted (Tables 4 & 5).
 - ▶ Primarily due to cessation of Karuah Quarry

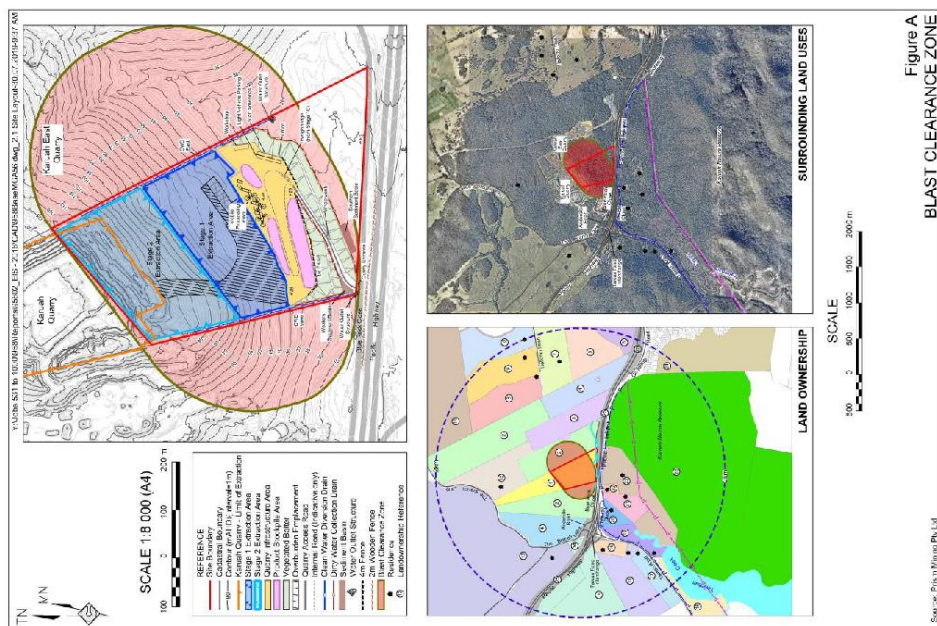
Noise – Key Issues

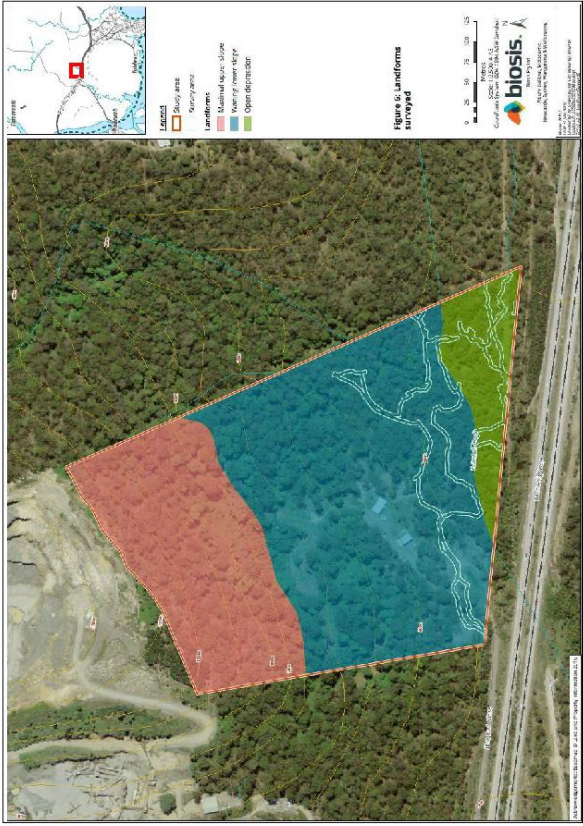
16

- ▶ Impacts on amenity due to the commencement of trucking operations at 5:00am
 - ▶ Noise from on-site truck movements would be <30 dB(A) at the most impacted receivers to the south
 - ▶ Background traffic noise is in the range of 47-53 dB(A), L90 during this period and LAeq levels are approximately 5dB higher
 - ▶ Impacts would be minimal

Blasting – Key Issues

- ▶ Ground vibration and potential damage to property
 - ▶ All blasts to be designed to satisfy all criteria with respect to ground vibration and airblast overpressure
- ▶ Stopping of traffic on the Pacific Highway during blasting
 - ▶ Prism Mining Pty Ltd commissioned to undertake a blasting assessment for fly-rock control
 - ▶ Report demonstrates that fly-rock can be controlled through blast design and operational control (e.g. restriction of free faces to south)
 - ▶ Closure of the Pacific Highway would not be required

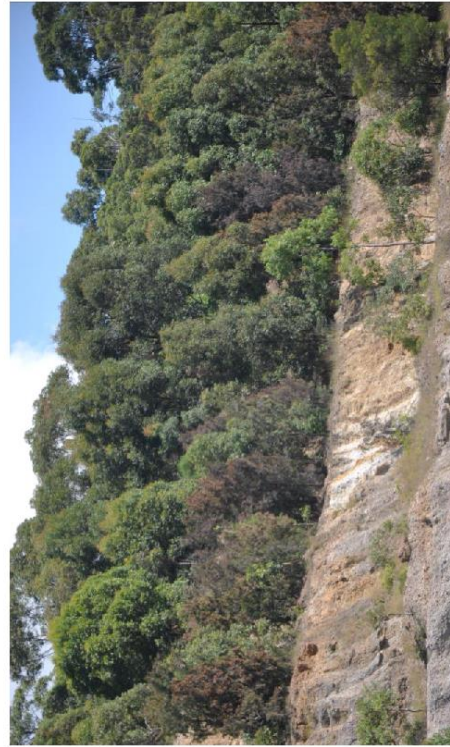
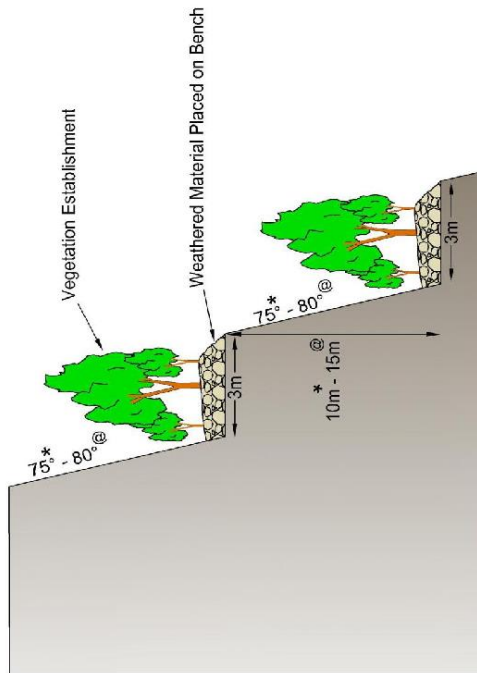




Aboriginal and Cultural Heritage – Key Issues

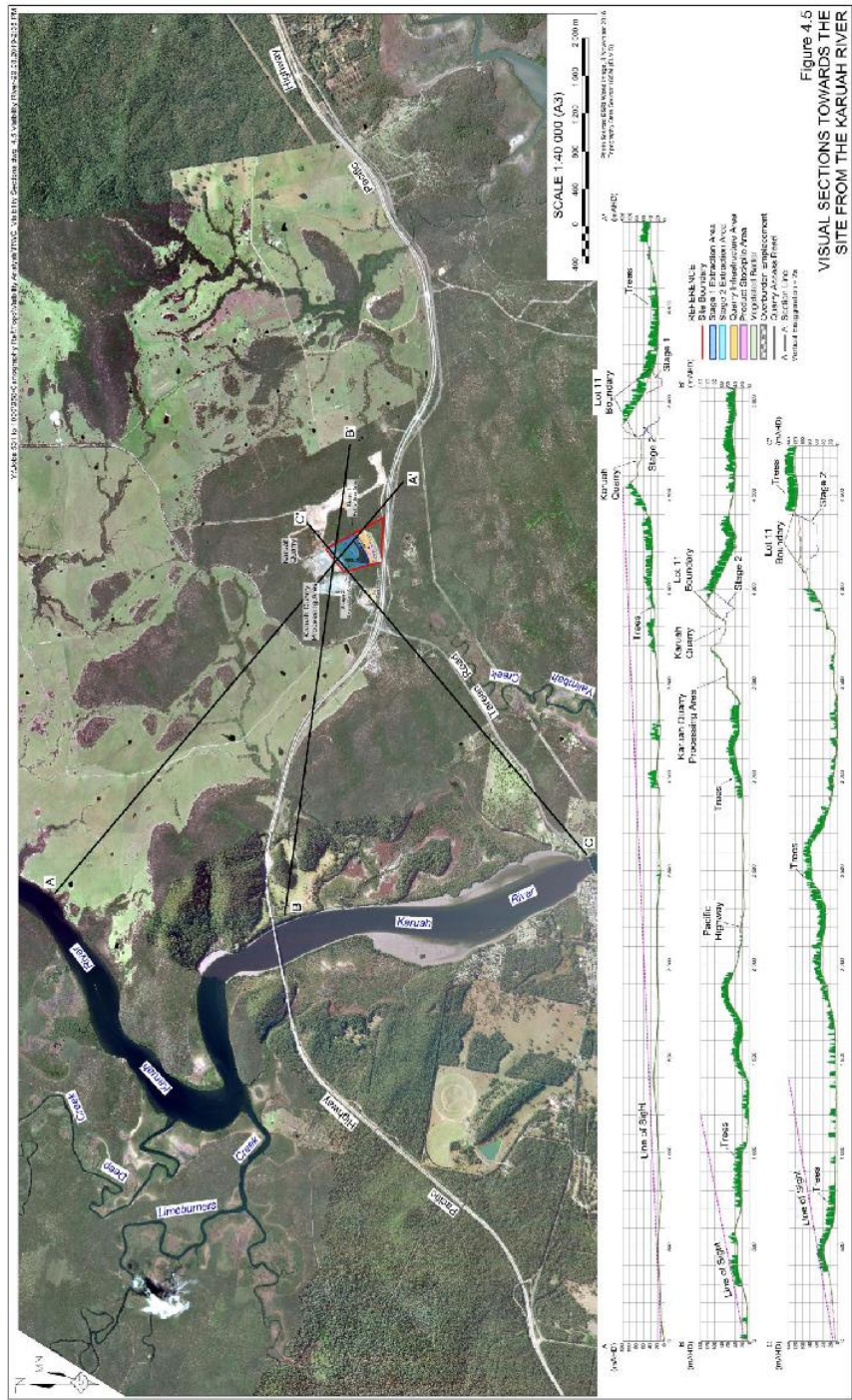
- ▶ Adequacy of the survey coverage over the southern section of the Site
- ▶ Additional survey undertaken within the southern section the Site on 24 July 2019
- ▶ Focused on drainage lines and flat landforms
- ▶ No Aboriginal objects identified during the survey

19



Visibility – Key Issues

- ▶ Impacts on visual amenity
 - ▶ Lower areas (including the infrastructure area) would be largely shielded by retained trees
 - ▶ Upper benches in extraction area would require progressive rehabilitation to minimise visual impact from Pacific Highway
 - ▶ Restricted or no visibility from surrounding residences
 - ▶ Restricted or no visibility from the Karuah River





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Appendix D

Correspondence with NSW Farmers Association: Oyster Committee and Port Stephens Shellfish Program

(Total No. of pages including blank pages = 10)

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R.W. CORKERY & CO. PTY. LIMITED

Geological and Environmental Consultants

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EMAIL TRANSMISSION

TO: Dean Cole EMAIL: colebrosoysters@live.com.au

ORGANISATION: NSW Farmers Association: DATE: 16 August 2019
Oyster Committee

COPY: A. Barnes; M. Kiely; REFERENCE: 958
R. Corkery

NO. OF PAGES (including attachments): 3

SUBJECT: Karuah South Quarry (SSD 8795)

☐ Confidential ☐ Please Reply ☐ For Follow-up ☐ Urgent ☒ For your information

MESSAGE:

Greetings Dean and Steve,

Thank you for your time recently to discuss the proposed development of the Karuah South Quarry (the "Quarry") and the concerns that the NSW Farmers Association: Oyster Committee (the "Committee") had with regard to the potential impacts that the Quarry may have on the Port Stephens oyster farming community, whose interests that the Committee helps to protect.

Based on our discussions, the Committee identified two key areas which were of particular concern and which were as follows.

Consultation

Historic, current and future development in the catchments that contribute runoff which ultimately discharges into Port Stephens is of key concern to the oyster industry due to the commercial risks that certain developments may pose. These risks include disrupted or suspended harvests through mandatory shutdown periods, retarded oyster growth and potential health impacts (perceived or otherwise) to end consumers.

It is acknowledged that the Committee was disappointed that no approach was made by either the Applicant or NSW Government Agencies with regard to the proposed development, despite the potential implications to the oyster industry as the result of upstream land use changes.

Whilst it was noted that the Applicant considers its proposed development as being of low risk to the oyster industry, it welcomes the opportunity to engage in ongoing consultation with the Committee and would commit to notifying the Program should discharge of captured runoff be required from water management infrastructure on the Quarry.

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16 August 2019

Page 2

Water Discharge from the Quarry

As runoff entering Port Stephens has clear implications on the oyster industry, the Port Stephens Shellfish Program is concerned about the water quality of discharge that may occur from the Quarry. The NSW Oyster Industry Sustainable Aquaculture Strategy (DPI, 2016) identifies that, with respect to water quality, sewerage discharge, septic tank overflows, contaminated sediments and stormwater runoff may impact food safety and that increased turbidity may impact healthy oyster growth.

The Applicant considers that, the Quarry does not pose a risk to water quality from the Site as the result of sediment in stormwater runoff being generated on a contaminated catchment. The processing of raw material (rock) to create quarry product is of a physical nature (i.e. crushing) and does not involve the introduction of process chemicals that would result in chemically altered process residues and potential contamination. In addition, the Applicant would install a pump-out system for the management of human waste and would ensure that this system was properly maintained and operated.

Rather due to the nature of the quarrying operation and existing land uses, the Applicant considers that the key risk to healthy oyster growth would be the potential discharge of sediment-laden runoff from the Quarry.

The key areas of the Quarry from which sediment-laden runoff may occur are the extraction area and the Quarry infrastructure area which would both drain internally to a sump located within the floor of extraction area. The extraction area floor would be up to 11 metres below the level of the Quarry infrastructure pad by the end of the first year of Quarry operations, thus precluding the possibility of discharge potentially sediment-laden water from the extraction area sump.

The two other areas of the Quarry containing quarry-related infrastructure with the potential to discharge to downstream watercourses would be the external slopes of the Quarry infrastructure pad and a section of the quarry access road. The runoff from these two areas would report to the western and southern sediment basins. As the contributing catchments to the basins are comprised of the constructed landform that would be the external slopes of the Quarry infrastructure pad, once constructed these areas would be covered with placed topsoil and vegetated to achieve a minimum 60% cover of perennial grass, to stabilise the surface and landform.

The intent of the 60% vegetated cover would be to achieve a C (cover)-factor of 0.1 or less, which would substantially reduce sediment loads in any runoff generated. As noted in Appendix A of the NSW erosion and sediment control guidelines, "*Managing Urban Stormwater: Soils and Construction*" (Landcom, 2004), (refer Section A6 and Table A3), vegetated cover reduces the area of bare soil exposed to raindrop impact, which has the potential to dislodge individual sediment grains but also retards the velocity of runoff and hence its erosive potential.

As the result of the staged development of the Quarry infrastructure pad and the vegetation of the batter slopes as they are constructed, the sediment basin design volumes significantly exceed the minimum volumes as required under "*Managing Urban Stormwater: Soils and Construction*" (Landcom, 2004) for all stages of the Quarry, as shown in **Table A**.

With the exception of the southern sediment basin during the site establishment and construction stage and stage 1C, the minimum sediment storage zones required for either sediment basin would be less than 150m³ in any Quarry stage.

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16 August 2019

Page 3

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Constructed Versus Required Stage Volumes for Western and Southern Sediment Basins

Stage	Western Sediment Basin/Dam			Southern Sediment Basin/Dam		
	Constructed volume (m³)	Minimum Sediment Storage (m³) ¹	Minimum Required volume (m³) ¹	Constructed volume (m³)	Minimum Sediment Storage (m³) ¹	Minimum Required volume (m³) ¹
Site establishment and construction	7 700	105	568	17 100	211	1 078
1A		10	473		21	888
1B		18	163		135	1 147
1C		11	517		160	1 533
2A					33	1 406
2B						
2C						
Note ¹ : As per calculations for Type D and Type F soils, refer Landcom (2004), Section 6.3.4						

Subsequently, as per Section 6.3.2 (Landcom, 2004), once 60% grass cover is established, sediment basins are not required for the management of runoff. This means that the primary purpose of the sediment basins will be the capture and storage of runoff for use in quarry-related activities and this capture and storage is permissible under the maximum harvestable rights provisions of the *Water Management Act 2000* and that any discharge that may be required from either the western or southern sediment basin would be considered as “clean” (i.e. of similar or better quality than runoff presently being generated on the catchments and sub-catchments of the Karuah River).

Notwithstanding this, when sediment basin/dam levels reach a certain height, the Applicant would measure turbidity of stored water and in the unlikely event that testing identifies the need for treatment, would apply a biodegradable, biopolymer flocculant such as chitosan to reduce turbidity. Chitosan (chemical formula $[C_6H_{11}NO_4]_n$) is a type of polysaccharide (carbohydrate) produced from chitin (chemical formula $[C_8H_{13}O_5N]_n$). Chitin is found in the shells of prawns and oysters and is estimated to have a natural production rate of 10^{12} - 10^{14} kilograms per year resulting in chitin being the most abundant polysaccharide in marine ecosystems. In addition to its use as a flocculant, chitosan has multiple applications in the production of food, drink and medicines for human consumption. Whilst chitosan for flocculants is commercially produced from prawn shells containing chitin, it too is naturally occurring.

Therefore, this naturally occurring compound that would be used for the removal of sediment in discharge would be broken down in the receiving environment by natural processes and taken up again by aquatic biota for essential development and as such are not considered harmful to aquatic organisms.

I trust that the information presented above is sufficient in addressing the concerns of the Committee and it would be greatly appreciated if you could advise in writing if this is the case. Alternatively, should you have any further queries or require additional information, please do not hesitate to contact myself so that we may discuss further.

I would like to take this opportunity to once again thank you for your time and consideration in the above matters.

Regards

Paul Ryall
Senior Environmental Consultant





R.W. CORKERY & CO. PTY. LIMITED

Geological and Environmental Consultants

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Pine Rivers Office Park
205 Leitchs Road

BRENDALE QLD 4500

Phone: (07) 3205 5400

Email: brisbane@rwcorkery.com

EMAIL TRANSMISSION

TO: Mark Hunter EMAIL: mark.hunter1962@gmail.com

ORGANISATION: Port Stephens Shellfish Program DATE: 16 August 2019

COPY: A. Barnes; M. Kiely; R. Corkery REFERENCE: 958

NO. OF PAGES (including attachments): 3

SUBJECT: Karuah South Quarry (SSD 8795)



Confidential



Please Reply



For Follow-up



Urgent



For your information

MESSAGE:

Greetings Mark,

Thank you for your time recently to discuss the proposed development of the Karuah South Quarry (the "Quarry") and the concerns that the Port Stephens Shellfish Program had with regard to the potential impacts that the Quarry may have on the Port Stephens oyster farming community, whose interests that you help to protect in your role as the coordinator of the Port Stephens Shellfish Program.

Based on our discussions, the Port Stephens Shellfish Program identified two key areas which were of particular concern and which were as follows.

Consultation

Historic, current and future development in the catchments that contribute runoff which ultimately discharges into Port Stephens is of key concern to the oyster industry due to the commercial risks that certain developments may pose. These risks include disrupted or suspended harvests through mandatory shutdown periods, retarded oyster growth and potential health impacts (perceived or otherwise) to end consumers.

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16 August 2019

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Site establishment and construction	7 700	105	568	17 100	211	1 078
1A		10	473		21	888
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Note¹: As per calculations for Type D and Type F soils, refer Landcom (2004), Section 6.3.4

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I would like to take this opportunity to once again thank you for your time and consideration in the above matters.

Regards

Paul Ryall
Senior Environmental Consultant

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24 September 2019

**NSW Farmers
Port Stephens Branch
Oyster Growers**

To R.W. Corkery & Co.

In response to your consultation with us on 16 August 2019 re; Karuah South Quarry.

We NSW Farmers Branch Port Stephens Oyster Growers recently discussed the consultation provided by yourselves at our AGM, all members were happy with the outcome and acknowledgements from your consultation.

Moving forward we would like to note that the applicant considers and acknowledges our raised concerns by continuing to engage with our committee, as agreed in the consultation.

Regards



Dean Cole

Chair

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Appendix E

Relevant Extracts from the Updated Biodiversity Development Assessment Report*

Prepared by EcoPlanning Pty Ltd

(Total No. of pages including blank pages = 34)

* A full copy of this report has been provided to the BCD of the DPIE
and the Planning team of the DPIE.

This document presents tracked extracts of text and figures that have been compiled since the BDAR dated February 2019 was prepared. The updated text addresses the relevant comments presented in submissions received by DPIE during the exhibition of the EIS.

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Wedgerock Pty Ltd

ABN: 15 099 038 123

Karuah South Quarry

Extract of additional text for the **Biodiversity Development Assessment Report**

Prepared by

Ecoplanning Pty Ltd

September 2019

**Specialist Consultant Studies Compendium
Part 4**

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EXECUTIVE SUMMARY

Wedgerock Pty Ltd is proposing to develop and operate the Karuah South Quarry (the Project) that would extract and process hard rock for use in construction and infrastructure projects within the Hunter and Greater Sydney Metropolitan Regions. The Project would be constructed and operated on the southern section of Lot 11, DP1024564, (the Site). The Site is approximately 21 hectares (ha) and is located approximately 40 kilometres (km) north of Newcastle and 4 km northeast of Karuah.

The Project would utilise conventional drill and blast, load and haul and processing methods to produce up to 600 000tpa of quarry products. Extraction would be undertaken in a staged manner, i.e. over two stages with each stage comprising three sub-stages. Production during the initial sub-stages of extraction would be lower with production during subsequent sub-stages gradually increasing. An estimated 10 million tonnes of fresh rock and 1.25 million tonnes of weathered rock have been identified within the proposed extraction area.

Secretary's Environmental Assessment Requirements ('SEARs'; SSD 17_8795 dated 2 August 2018) have been issued for the Project, which require a detailed assessment of likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, and having regard to the NSW Biodiversity Offsets Scheme (BOS) and the Biodiversity Assessment Method (BAM; OEH2017a).

This Biodiversity Development Assessment Report (BDAR) has been prepared in accordance with the BAM to document impacts to biodiversity and has been prepared by an Accredited Assessor in accordance with the NSW *Biodiversity Conservation Act 2016* (BC Act) and NSW *Biodiversity Conservation Regulation 2017*. This format for this BDAR follows that of the different 'stages' outlined within the BAM including:

- Stage 1 – Biodiversity assessment. Includes sections 1 to 4 of this BDAR including the introduction, site context including landscape features, native vegetation and threatened species.
- Stage 2 – Impact assessment. Includes sections 5 to 7 of this BDAR which identify measures to avoid and minimise impacts, assessment of residual impacts to biodiversity, mitigation measures, offset requirements and credit calculations.

In accordance with the BAM, a number of features are assessed within the subject land and a 1,500 m buffer around the subject land. These landscape features are used to identify biodiversity values that are important for the subject land and inform the habitat suitability of the subject land for threatened species.

Native vegetation was identified and mapped across 11.59 ha of the approximately 16.36 ha of the subject land. Areas which did not support native vegetation included areas identified as being 'cleared' or areas supporting 'exotic vegetation'. Generally, the 'cleared' areas were associated with existing buildings/infrastructure, tracks and disturbed areas in the north of the property associated with the adjoining Karuah Quarry. Four Plant Community Types (PCTs) were identified within the subject land, namely:

- PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest;
- PCT 1567: Tallowwood - Brush Box - Sydney Blue Gum moist shrubby tall open forest on foothills of the lower North Coast;

- PCT 1527: Bangalow Palm - Coachwood - Sassafras gully warm temperate rainforest of the Central Coast;
- PCT: 1550: Small-fruited Grey Gum - Turpentine - Tallowwood moist open forest on foothills of the lower North Coast; and

Of the PCTs identified within the subject land, two PCTs (PCT 1590 and PCT 1527), comprise Endangered Ecological Communities listed under the BC Act, namely 'Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions' and 'Lowland Rainforest in the NSW North-Coast and Sydney Basin Bioregions', respectively. Vegetation identified as PCT 1527 also meets the definition of the 'Lowland Rainforest of Subtropical Australia', Critically Endangered Ecological Community (CEEC) as listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Habitat for threatened species has been assessed in accordance with section 6 of the BAM. One threatened species listed as Vulnerable under the BC Act and EPBC Act, Koala (*Phascolarctos cinereus*), was recorded within the subject land and a species polygon has been determined for this species which includes all areas of native vegetation within the subject land.

Neither of the two Endangered Ecological Communities listed under the BC Act ('Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions' and 'Lowland Rainforest in the NSW North-Coast and Sydney Basin Bioregions') or the Koala are identified as threatened entities which are candidates for Serious and Irreversible Impacts (SAII).

Impacts to species and ecological communities listed under the EPBC Act, including the Koala, Grey-headed Flying-fox (*Pteropus poliocephalus*), Rufous Fantail (*Rhipidura rufifrons*) and Lowland Rainforest of Subtropical Australia, have been assessed in accordance with the relevant significant impact guidelines (DotE 2013; DotE 2014). These assessments, which have been informed by a previous referral to the Commonwealth Department of the Environment and Energy (DoEE; EPBC Ref: 2012/6600), concluded that these entities would not be significantly impacted by the Project and another referral to the DoEE is not required.

In accordance with section 8 of the BAM, this BDAR outlines actions taken to avoid and minimise impacts through minimising the disturbance footprint and locating the Project to avoid mapped drainage lines. Mitigation measures to avoid impacts to biodiversity are recommended within this BDAR and include the preparation of a best practice Biodiversity Management Plan in consultation with OEH to describe the short, medium, and long term measures to be undertaken to manage the remnant vegetation and fauna habitat on the site.

All residual impacts to biodiversity, after measures to avoid, minimise and mitigate impacts have been assessed using the BAM calculator and offset requirements, in terms of biodiversity credits, have been calculated in accordance with section 11.2 and Section 11.3 of the BAM to achieve the 'no net loss standard' as established by the BAM. A total of 274 ecosystem credits and 355 species credits are required to offset the impacts of the Project. The measures proposed to address the offset obligation outlined above will be determined as the Project approvals progress. Initial investigations have commenced to identify credits available for purchase, land available to purchase and enter into a Biodiversity Stewardship Agreement (BSA) and the costs of credits through payment into the Biodiversity conservation Fund (BCF). It is likely that a combination of measures will be used to retire the required credits including entering into a BSA, payment into the BCF and purchase of credits on the open market.

3.3.2 Plant Community types

Five PCTs were identified across the Site, with the distribution of these communities related to the topographical position, slope and aspect within the Site (**Figure 6**). Boundaries between the PCTs were often difficult to identify, with broad ecotones between vegetation communities present and many flora species from all structural layers shared by adjacent vegetation communities. The boundaries were distinguished based upon changes in topography, vegetation structure and the dominance of primary canopy species. The five PCTs identified within the Site are:

- PCT 1590: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest;
- PCT 1567: Tallowwood - Brush Box - Sydney Blue Gum moist shrubby tall open forest on foothills of the lower North Coast;
- PCT 1527: Bangalow Palm - Coachwood - Sassafras gully warm temperate rainforest of the Central Coast;
- PCT: 1550: Small-fruited Grey Gum - Turpentine - Tallowwood moist open forest on foothills of the lower North Coast; and
- PCT 1618: Smooth-barked Apple - White Stringybark - Red Mahogany - *Melaleuca sieberi* shrubby open forest on lowlands of the lower North Coast.

One of the PCTs identified within the Site, PCT 1618, was not identified as occurring within the subject land. No further assessment of this PCT is required. Details of each of these PCTs within the subject land are summarised in **Table 2**, with the distribution of the PCTs within the Site shown in **Figure 6**. Descriptions of each of the PCTs identified within the subject land are outlined below.

Table 2
Plant Community Types (PCTs) Identified within the Subject Land

PCT	Vegetation Class	Vegetation zones	Area (ha)	PCT percent cleared	TEC
1590 - Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Hunter-Macleay Dry Sclerophyll Forests	Dense Lantana	0.58	48%	Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions¹
		Low Lantana	0.56		
1567 - Tallowwood - Brush Box - Sydney Blue Gum moist shrubby tall open forest on foothills of the lower North Coast	North Coast Wet Sclerophyll Forest	Lantana	7.45	2%	None
1527 - Bangalow Palm - Coachwood - Sassafras gully warm temperate rainforest of the Central Coast	Northern Warm Temperate Rainforests	Intact	0.47	70%	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (BC Act) 'Lowland Rainforest of Subtropical Australia' (EPBC Act ²)
1550 - Small-fruited Grey Gum - Turpentine - Tallowwood moist open forest on foothills of the lower North Coast	Northern Hinterland Wet Sclerophyll Forests	Intact	2.53	25%	None
Exotic vegetation	N/A	-	0.53	-	-
Cleared land	N/A	-	4.24	-	-
Total			16.36*		

* Rounding errors may apply

¹ [This TEC was recently listed \(31 May 2019\) and has not yet been associated with PCT1590 within the BAM Calculator](#)

² See Section 3.3.5 for details regarding the listing of this community under the EPBC Act



Figure 6 Plant Community Types (PCTs) and Vegetation Integrity Plot Locations

3.3.3 Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (PCT 1590)

This vegetation community is located in the northern part of the subject land (**Figure 6**) on the gentle upper slopes of the hill and is an open-forest dominated by *C. maculata*, *E. acmenoides* and *E. paniculata* (**Plate 1**). *Eucalyptus fibrosa* was also identified as being present within this PCT. This PCT supported an open midstorey which included a number of mesic shrub species including *Cryptocarya rigida* (Forest Maple) and *Clerodendrum tomentosum* (Hairy Clerodendrum) over a diverse grassy understorey. The condition of this vegetation community was variable with some areas being in a relatively undisturbed condition with low levels of *Lantana camara** (Lantana) infestation, while other areas have been disturbed as part of the approved activities within the adjacent Karuah Quarry and supported a sparse canopy layer and very dense infestations of *L. camara**. Two vegetation zones (based upon areas in a broadly similar condition state, consistent with section 5.3.1.1 of the BAM) were identified for this PCT, which separated areas with low *L. camara** cover and a higher density of native shrub and understorey species (termed 'Low lantana') from those areas with a dense cover of *L. camara** and lower cover of native shrub and understorey species (termed 'Dense lantana').

The identification of the most suitable PCT was based upon consideration of PCTs with *C. maculata* as a co-dominant with the NSW North Coast Bioregion. A number of PCTs were excluded based upon a more northerly distribution, including vegetation types associated with the Clarence and Macleay River Valleys, or drier grassy vegetation types with a more westerly distribution, including grassy woodland of the Hunter Valley with co-dominant species, *E. crebra* (Narrow-leaved Ironbark) and *E. moluccana* (Grey box). Three potential PCTs were considered as being most representative of the vegetation within the subject land, including PCTs 1549, 1584 and 1590. Ultimately, PCT 1549 was excluded based upon the described dominance of *E. microcorys* within this PCT, as this species was absent within the defined area of this PCT within the subject land. Similarly, PCT 1584 was excluded based upon the absence of any Ironbark species in the description of this community and the topographic position, which is described as including gullies and lower slopes mainly on sandstone substrates and at mid to lower elevations. Consequently, PCT 1590 was considered the 'best fit' for the dry sclerophyll forest vegetation on the gentle upper slopes of the subject land.

This vegetation community forms part of the 'Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions' Endangered Ecological Community (EEC) as listed under the BC Act.

7. CREDIT CALCULATIONS

7.1 CREDIT CALCULATIONS AND CLASSES

A biodiversity offset requirement for residual impacts of a proposed development, must be calculated in accordance with section 11.2 and section 11.3 of the BAM. The following section outlines the credit requirements for the Project in order to achieve the 'no net loss standard' as established by the BAM.

7.1.1 Ecosystem Credits

The ecosystem credits required to offset the residual impacts of the Project are provided in **Table 20**. A total of 274 credits are required to offset the development.

Table 20
Ecosystem Credit Offset Requirements

Vegetation zone	Vegetation integrity loss	Area*	Credits required
1590 - Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest – Dense Lantana	52.6	0.6	11 [#]
1590 - Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest – Low Lantana	61.5	0.6	13
1567 - Tallowwood - Brush Box - Sydney Blue Gum moist shrubby tall open forest on foothills of the lower North Coast Lantana	63.2	7.5	176
1527 - Bangalow Palm - Coachwood - Sassafras gully warm temperate rainforest of the Central Coast Intact	64.9	0.5	15
1550 - Small-fruited Grey Gum - Turpentine - Tallowwood moist open forest on foothills of the lower North Coast Intact	62.1	2.5	59
Exotic vegetation	6.3	0.5	0
Cleared land	0	4.2	0
Total		16.36*	274

[#] These calculations did not identify PCT1590 as part of the recently (31 May 2019) listed the 'Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions' as this TEC is not yet associated with PCT 1590 within the BAM Calculator.

* Rounding errors may apply as the BAM calculator rounds the area of each PCT to one decimal place.

The following offset rules apply:

For credit class 1590

- Any PCT within the vegetation class '*Hunter-Macleay Dry Sclerophyll Forests*' (including PCTs 487, 613, 661, 684, 686, 692, 693, 694, 695, 699, 747, 748, 752, 812, 1073, 1208, 1217, 1222, 1237, 1244, 1245, 1257, 1259, 1260, 1261, 1265, 1266, 1282, 1284, 1285, 1504, 1561, 1562, 1563, 1566, 1567, 1568, 1569, 1572, 1573, 1575, 1579, 1590, 1841, 1843, 1915) AND < 50% cleared group (including Tier 7 or higher).
- In the following IBRA subregions: Karuah Manning, Hunter, Macleay Hastings, Mummel Escarpment and Upper Hunter, or any subregion within 100 km of the subject land.
- Containing hollow-bearing trees

For credit class 1527

- Any PCT equivalent to the '*Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions*' TEC (including PCT's 669, 670, 770, 845, 886, 887, 1068, 1201, 1275, 1302, 1525, 1527, 1528, 1529, 1533, 1534, 1535, 1541, 1545)
- In the following IBRA subregions: Karuah Manning, Hunter, Macleay Hastings, Mummel Escarpment and Upper Hunter, or any subregion within 100 km of the subject land.

For credit class 1550

- Any PCT within the vegetation class '*Northern Hinterland Wet Sclerophyll Forests*' (including PCT's 690, 697, 698, 755, 1092, 1262, 1267, 1268, 1281, 1385, 1548, 1549, 1550, 1556, 1557, 1558, 1564, 1565, 1580, 1582, 1584, 1585, 1845, 1846, 1847, 1914) AND < 50% cleared group (including Tier 7 or higher).
- In the following IBRA subregions: Karuah Manning, Hunter, Macleay Hastings, Mummel Escarpment and Upper Hunter, or any subregion within 100 km of the subject land.
- Containing hollow bearing trees.

For credit class 1567

- Any PCT within the vegetation class '*North Coast Wet Sclerophyll Forests*' (including PCT's 487, 613, 661, 684, 686, 692, 693, 694, 695, 699, 747, 748, 752, 812, 1073, 1208, 1217, 1222, 1237, 1244, 1245, 1257, 1259, 1260, 1261, 1265, 1266, 1282, 1284, 1285, 1504, 1561, 1562, 1563, 1566, 1567, 1568, 1569, 1572, 1573, 1575, 1579, 1841, 1843, 1915) AND < 50% cleared group (including Tier 7 or higher).
- In the following IBRA subregions: Karuah Manning, Hunter, Macleay Hastings, Mummel Escarpment and Upper Hunter, or any subregion within 100 km of the subject land.
- Containing hollow bearing trees.

7.1.1.1 Species Credits

A total of 345 Koala (*Phascolarctos cinereus*) species credits are required to offset the Project. These credits can be traded only with credits for this species but they can generated anywhere within NSW.

7.2 SECURING BIODIVERSITY CREDITS

The measures proposed to address the offset obligation outlined above will be determined as the Project approvals progress. Initial investigations have commenced to identify credits available for purchase, land available to purchase and enter into a Biodiversity Stewardship Agreement (BSA) and the costs of credits through payment into the Biodiversity conservation Fund (BCF). It is likely that a combination of measures will be used to retire the required credits including entering into a BSA, payment into the BCF and purchase of credits on the open market. **Table 21** outlines the costs associated with meeting offset obligations through payment into BCF, as calculated on the 18 November 2018.

Table 21
Credit Requirements and Estimated Credit Costs, as Calculated on: 26-09-2019

Ecosystem Credits				
Plant Community Type	Baseline price per credit	Price per credit*	No. of Ecosystem Credits	Final Credit Price (ex GST)
1527	\$1,998.31	\$2,679.75	15	\$24,779.76
1550	\$1,998.31	\$2,679.75	59	\$97,467.06
1567	\$1,998.31	\$2,679.75	176	\$286,244.73
1590	\$1,998.31	\$2,679.75	24	\$39,647.62
Subtotal (ex GST)				\$448,139.17
Species Credits				
Species	Price per credit	Risk Premium	No. of Species Credits	Final Credit Price (ex GST)
<i>Phascolarctos cinereus</i> (Koala)	\$434.47	24.8700%	345	\$186,755.59
Subtotal (ex GST)				\$634,894.76
Total (incl. GST)				\$698,384.24

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Annexure 1

EPBC Act Considerations

(Total No. of pages including blank pages = 10)

This annexure has been updated to accurately portray the previously proposed disturbance area for the version of the Project that was referred to the Commonwealth Department of Environment and Energy in 2012.

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The following section includes assessments of potential impacts to Matters of National Environmental Significance (MNES) listed under the EPBC Act. It is noted that a previous referral to the Commonwealth Department of Environment and Energy (DoEE) was made for a proposed quarry within the subject land in 2012 (EPBC Ref: 2012/6600). This referral specifically considered impacts of the current Project on the Koala (*Phascolarctos cinereus*) and Grey-headed Flying-fox (*Pteropus poliocephalus*). While the previously proposed quarry had a smaller disturbance footprint (approximately 8 ha) than the current Project, the previous referral was determined to be a non-controlled action and no further assessment and approval under the EPBC Act was required. The following assessments against the significant impact guidelines (DotE 2013) have been informed by this previous determination.

Koala (*Phascolarctos cinereus*)

A single individual Koala was recorded within the site in February 2018 and this species has previously been observed within the site (CEG 2012). Specific referral guidelines for the Koala under the EPBC Act have been prepared (DotE 2014). The following factors are defined by these guidelines and form the basis as to whether a referral is required:

- **Koala habitat:** The Site is coastal habitat for the Koala, being within the modelled distribution of the species, contains known feed trees and the species has been recorded within the site.
- **Habitat critical to the survival of the Koala:** The Site represents habitat critical to the survival of the Koala, as defined under the referral guidelines (DotE 2014) as is has a habitat score greater than 5 (habitat score of the Site is 8) which is comprised of the following:
 - Koala occurrence - high (+2): Koala was recorded on the site in February 2018.
 - Vegetation composition - high (+2): Has forest or woodland with 2 known Koala food tree species (*Eucalyptus microcorys* and *E. propinqua*).
 - Habitat connectivity - high (+2) areas is part of a contiguous landscape extending north of the Project area including an area of approximately 530 ha.
 - Key existing threats - medium (+1): Koala mortality due to vehicle strike have been recorded along the Pacific Highway.
 - Recovery value - medium (+1): The Project area is part of a large, connected area of koala habitat. However, there is uncertainty surrounding the use of the Project area to support breeding Koalas. No evidence is available on the genetic diversity or disease risk of koalas associated with the subject land.
- **Adversely affect habitat critical to the survival of the Koala:** The extent of habitat loss associated with the Project falls within the 'impacts uncertain' category in accordance with the referral guidelines (DotE 2014). Further consideration of the nature of the habitat loss, including the habitat score (8/12), extent of habitat loss (11.12 ha), Koala density (low as only single individual recorded across all surveys) and fragmentation (low, as connectivity with adjacent areas of native vegetation will be retained), reduce the chance that impacts will adversely impact habitat critical to the survival of the species.

- **Interfere substantially with the recovery of the Koala:** In accordance with the referral guidelines, actions which may interfere with the recovery of the Koala include actions which may increase koala fatalities due to dog attacks or vehicle-strikes, facilitate the introduction or spread of disease or pathogens (including Chlamydia or *Phytophthora cinnamomi*), create a barrier to movement between or within habitat or change hydrology which degrades habitat to the extent that the carrying capacity of the habitat is reduced in the long-term.

The Project is unlikely to cause increased Koala fatalities due to vehicle strike as Koala-proof fencing is to be installed along the southern boundary of the site where it adjoins Blue Rock Close and the Pacific Highway. The Project is also unlikely to create a barrier to movement between habitat as connectivity will be maintained through the site through retention of vegetation outside the subject land including along the southern boundary of the site. Other impacts which interfere with the recovery of the Koala, including fatalities associated with dog attack, disease introduction or habitat degradation are unlikely to result from the Project.

Conclusion for Koala

The Project is unlikely to significantly impact the Koala and a referral is not required as the Site only supports a low density of Koalas and connectivity will be maintained between areas of retained vegetation within the site and surrounding areas of native vegetation. Additionally, the habitat loss associated with the Project only represents a small increase in habitat loss compared to that which was previously referred to the DoEE and which was determined to be a non-controlled action.

Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox has been recorded foraging within the subject land (HWR Ecological 2004). In accordance with DotE (2013), an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

lead to a long-term decrease in the size of an important population of a species

An important population is considered a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are key source populations either for breeding or dispersal; populations that are necessary for maintaining genetic diversity; and/or populations that are near the limit of the species range.

The Grey-headed Flying-fox is considered to consist of one national population due to the constant genetic exchange and movement between camps throughout the geographic distribution. Hence the individuals in the locality are part of an important population.

The proposed action is unlikely to lead to a long-term decrease in the size of an important population. There are no camps in the subject land and no camps would be indirectly impacted by the proposed action. The proposed action would not directly or indirectly cause mortality of individuals.

reduce the area of occupancy of an important population

The Grey-headed Flying-fox occupies most areas in their distribution in an irregular pattern due to seasonal and geographic variation in foraging resources. The proposed action would reduce the area available to forage for this species but would not reduce the area the species could occupy at a given time. The species would be able to continue foraging in the site in retained habitat.

fragment an existing important population into two or more populations

As the Grey-headed Flying-fox is highly dispersive and mobile, the proposed action would not fragment the existing population into two or more populations.

adversely affect habitat critical to the survival of a species

Habitat critical to the survival of the Grey-headed Flying-fox is outlined in the Draft National Recovery Plan (DECCW 2009). Foraging habitat must meet at least one of the following criteria:

- Productive during winter and spring, when food bottlenecks have been identified
- Known to support populations of >30,000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)
- Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)
- Known to support a continuously occupied camp

The subject land does not meet the definition as critical habitat for this species.

disrupt the breeding cycle of an important population

There are no camps in the subject land and hence the proposed action would not disrupt the breeding cycle of an important population. The removal of habitat critical to the survival of an important population would include clearing which reduces the availability of foraging resources that would be used during the breeding cycle. However, the small extent of habitat that would be removed by the proposed development is unlikely to disrupt a breeding cycle.

modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The removal and modification of foraging habitat is not likely to cause a species decline due to the small scale of the clearing. The additional fragmentation of habitat is not considered to isolate habitat patches as the Grey-headed Flying-fox is highly mobile.

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The proposed action would not result in an invasive species becoming established in the habitat. There are invasive species that already occur in the subject land but the proposed action would not cause new species to become established.

introduce disease that may cause the species to decline, or

It is unlikely that the proposed action would introduce disease that may cause the species to decline. Due to the highly mobile nature of the species, the transportation of disease may occur through a population by individuals moving through a large geographic range. However, the proposed works would not cause a new disease to be introduced into the population.

interfere substantially with the recovery of the species.

The proposed action is unlikely to interfere substantially with the recovery of the species.

Conclusion for the Grey-headed Flying-fox

A referral is not recommended for the Grey-headed Flying-fox. The small scale of clearing of vegetation in which no camps have been found, leads to a conclusion that the species is not adversely affected.

Lowland Rainforest of Subtropical Australia

In accordance with DotE (2013), 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 Project will clear a small area (0.47 ha) of Lowland Rainforest of subtropical Australia ('Lowland Rainforest').

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

The Project will result in the complete removal of a small area (0.47 ha) of Lowland Rainforest, although would not result in fragmentation of any large or interconnected patches of the ecological community.

adversely affect habitat critical to the survival of an ecological community

The occurrence of the ecological community within the site is outside the primary range of the ecological community which extends from the Clarence River north to Maryborough in Queensland. The geographic location of the Site to the south of the primary range of the ecological community, combined with the topographic and climatic conditions, have resulted in only a very small occurrence of the ecological community (0.47 ha). The habitat within the Site is considered marginal for the community and is not critical to the survival of the ecological community.

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 Project would result in the clearing and loss of a small area (0.47 ha) of the ecological community within the Site. The Project would not modify or destroy abiotic factors necessary for the survival of the ecological community outside the Site.

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 Project would result in the clearing and loss of a small area (0.47 ha) of the ecological community within the Site. No change in species composition, or decline in functionality important species, would occur in occurrences of the ecological community outside of the Site.

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**

The Project would result in the clearing and loss of a small area (0.47 ha) of the ecological community within the Site. No reduction in the quality or integrity of the ecological community would occur outside of the site.

interfere with the recovery of an ecological community.

The Project would result in the clearing and loss of a small area (0.47 ha) of the ecological community within the Site. The occurrence of the ecological community within the Site is not currently interconnected with any larger patches of the ecological community. The loss of the small area of the ecological community within the Site would not substantially interfere with the recovery of the ecological community.

Conclusion for Lowland Rainforest

While the Project would result in the loss of the small area (0.47 ha) of the ecological community within the Site, given the small area of the ecological community which would be impacted by the Project and the requirements to offset these impacts in accordance with the BAM, it is unlikely that the ecological community will be significantly impacted.

Rufous Fantail

In accordance with DotE (2013), an action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species

The project would involve the removal of 11.59 ha of native vegetation representing habitat for this species. Based upon the 'Referral guideline for 14 birds listed as migratory species under the EPBC Act' (DotE 2015) important habitat for the Rufous Fantail includes moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. The habitat within the subject land includes rainforest and wet sclerophyll forest vegetation types which are important habitat for this species, however only a small area (11.59ha) of this habitat would be impacted by the Project.

result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

Invasive species which may be harmful to the Rufous Fantail include the Black Rat (*Rattus rattus*) and invasive vines of riparian habitats (DotE 2015). The Project is unlikely to increase the chance of these species becoming established within the subject land.

seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species

Based upon the referral guidelines (DotE 2015), the small area of habitat which would be impacted by the Project (11.59 ha) is unlikely to support an ecologically significant portion of the species (defined as 4,800 individuals). The referral guidelines (DotE 2015) indicates that the area of important habitat for the Rufous Fantail likely to result in a significant impact if affected or the area likely to support an ecologically significant portion of the population is 750ha.

Conclusion for Rufous Fantail

The Project would result in the loss of a small area (11.59 ha) of habitat for this migratory species within the Site, however this small area is would not support an ecologically significant proportion of the species. This species would not be significantly impacted by the Project.

References

Commonwealth Department of Environment (DotE; 2013). Matters of National Environmental Significance Significant impact guidelines 1.1. Commonwealth of Australia. Available online: http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

Commonwealth Department of Environment (DotE; 2014). EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory). Commonwealth of Australia, 2014. Available online: <http://www.environment.gov.au/system/files/resources/dc2ae592-ff25-4e2c-ada3-843e4dea1dae/files/koala-referral-guidelines.pdf>

Commonwealth Department of Environment (DotE; 2015). Draft referral guideline for 14 birds listed as migratory species under the EPBC Act, Commonwealth of Australia. Available online: <http://www.environment.gov.au/system/files/resources/c05f5b87-0a99-4998-897e-7072c236cf83/files/migratory-birds-draft-referral-guideline.pdf>

Annexure 3

Species Lists

(Total No. of pages including blank pages = 12)

This annexure has been updated to include correspondence received from the Royal Botanic Gardens which identifies two plant samples (*Grevillea humilis* subsp. *humilis* and *Galium leiocarpa*) which were supplied by Ecoplaning following the field surveys undertaken within the Site in 2018. **Table 22** has also been updated to include *Galium leiocarpa* as an incidental species.

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Table 22
Flora Species Observed within the Site

Family	Species	KRH01	KRH02	KRH03	KRH04	KRH05	KRH06	KRH07	KRH08	KRH09	KRH10	KRH11	KRH12	Incidentals
Acanthaceae	<i>Brunoniella australis</i>		0.1	0.2						0.2	0.1			
	<i>Pseuderanthemum variabile</i>	0.2	0.1	0.2	0.1	0.1	0.1	0.2		0.1	0.1	0.1		
Adiantaceae	<i>Adiantum aethiopicum</i>										1			
	<i>Adiantum formosum</i>						0.5	3	2			0.1	0.1	
	<i>Adiantum hispidulum</i>			0.1	0.1							0.1		
	<i>Pellaea falcata</i>	0.1		0.5										
	<i>Pellaea paradoxa</i>			0.1	0.2	0.1						0.1		
Anthericaceae	<i>Arthropodium milleflorum</i>			0.1	0.1					0.1				
	<i>Caesia parviflora</i> var. <i>parviflora</i>										0.1			
Aphanopetalaceae	<i>Aphanopetalum resinosum</i>													X
Apiaceae	<i>Centella asiatica</i>									0.1				
	<i>Cyclospermum leptophyllum</i> *												0.1	
	<i>Hydrocotyle geraniifolia</i>			0.1										
Apocynaceae	<i>Gomphocarpus fruticosus</i> *													X
	<i>Marsdenia rostrata</i>						0.5	2						
	<i>Parsonsia straminea</i>		0.1			0.1				1	0.1			
	<i>Parsonsia velutina</i>													X
	<i>Tylophora barbata</i>			0.1		0.2						0.1		
Araceae	<i>Gymnostachys anceps</i>	5		0.1	0.2	1		0.5	0.1		0.1	2		
Araliaceae	<i>Polyscias sambucifolia</i>	0.3												
Arecaceae	<i>Archontophoenix cunninghamiana</i>								25					
	<i>Livistona australis</i>					0.2	5	0.1	2					
Asparagaceae	<i>Asparagus aethiopicus</i> *													X
Aspleniaceae	<i>Asplenium australasicum</i>													X
Asteraceae	<i>Ageratina adenophora</i> *												0.5	
	<i>Bidens pilosa</i> *												25	
	<i>Cirsium vulgare</i> *												10	
	<i>Conyza</i> spp.*			0.1										
	<i>Olearia nernstii</i>													X
	<i>Senecio hispidulus</i>			0.1										
	<i>Senecio madagascariensis</i> *			0.1										
	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>			0.1									1	
	<i>Sonchus oleraceus</i> *												0.1	
	<i>Tagetes minuta</i> *												0.5	
	<i>Vernonia cinerea</i>	0.1												
Bignoniaceae	<i>Pandorea pandorana</i>			0.1	0.1			0.1		0.1		0.1		
Blechnaceae	<i>Blechnum cartilagineum</i>	2					5	20						
Blechnaceae	<i>Blechnum neohollandicum</i>	10		0.2	0.5	8	0.1	8			1	15		
Caryophyllaceae	<i>Cerastium glomeratum</i> *													X
	<i>Stellaria flaccida</i>	0.1		0.2		0.1					0.1	0.1		
Casuarinaceae	<i>Allocasuarina torulosa</i>	0.1	1	0.5	0.5	0.1				2	1			
	<i>Casuarina glauca</i>													X
Celastraceae	<i>Denhamia cunninghamii</i>													X

Family	Species	KRH01	KRH02	KRH03	KRH04	KRH05	KRH06	KRH07	KRH08	KRH09	KRH10	KRH11	KRH12	Incidentals
	<i>Denhamia silvestris</i>	0.1		0.2						0.5	0.1			
	<i>Elaeodendron australe</i> var. <i>australe</i>							1						
Colchicaceae	<i>Wurmbea biglandulosa</i> subsp. <i>biglandulosa</i>													X
Commelinaceae	<i>Aneilema acuminatum</i>						0.1	0.5	1			0.1		
Commelinaceae	<i>Commelina cyanea</i>	0.1				0.1	0.1							
Convolvulaceae	<i>Dichondra repens</i>			0.1						0.1				
Convolvulaceae	<i>Polymeria calycina</i>		0.1							0.1				
Cunoniaceae	<i>Ceratopetalum apetalum</i>					0.1								
	<i>Schizomeria ovata</i>													X
Cyatheaceae	<i>Cyathea australis</i>								1					
Cyperaceae	<i>Carex appressa</i>									5				
	<i>Carex inversa</i>	0.1												
	<i>Carex longibrachiata</i>				0.1	0.1		0.1	0.2	2				
	<i>Cyperus</i> spp.	0.1							0.1					
	<i>Gahnia aspera</i>				0.1									
	<i>Gahnia clarkei</i>		25											
	<i>Gahnia melanocarpa</i>	0.1		0.2							0.1			
	<i>Gahnia</i> spp.				0.2	0.1				0.5		1		
	<i>Lepidosperma laterale</i>				0.1						0.1			
	<i>Lepidosperma</i> spp.			0.5										
Dennstaedtiaceae	<i>Pteridium esculentum</i>										0.1			
Dicksoniaceae	<i>Calochlaena dubia</i>	0.5				2	1	10						
Dilleniaceae	<i>Hibbertia aspera</i>		0.2											
	<i>Hibbertia dentata</i>	0.1		0.1		0.1					0.1			
	<i>Hibbertia scandens</i>	0.1	0.2											
Dioscoreaceae	<i>Dioscorea transversa</i>	1	0.1	0.1	0.1	1	0.1	0.1	0.2	0.1		1	0.1	
Droseraceae	<i>Drosera hookeri</i>													X
Dryopteridaceae	<i>Lastreopsis decomposita</i>	0.2						1				1		
	<i>Lastreopsis microsora</i> subsp. <i>microsora</i>								25					
Ebenaceae	<i>Diospyros australis</i>													X
Elaeocarpaceae	<i>Elaeocarpus obovatus</i>	0.1								0.1				
	<i>Sloanea australis</i>								2					
Ericaceae	<i>Leucopogon juniperinus</i>	0.1	0.2	0.3						1	0.2			
Euphorbiaceae	<i>Alchornea ilicifolia</i>			0.1										
	<i>Claoxylon australe</i>					0.2		2	0.3			1		
Eupomatiaceae	<i>Eupomatia laurina</i>					0.1	3	3						
Fabaceae - Faboideae	<i>Trifolium repens</i> *													X
	<i>Vicia tetrasperma</i> *													X
	<i>Desmodium gunnii</i>	0.1				0.1				0.1	0.1			
	<i>Desmodium varians</i>			0.1										
	<i>Glycine clandestina</i>	0.1	0.1			0.1				0.1	0.1	0.1	0.1	
	<i>Hardenbergia violacea</i>	0.1	0.1	0.1						0.1	0.1			
	<i>Indigofera australis</i>													X
	<i>Kennedia rubicunda</i>	0.1	0.1								0.1	0.1		
	<i>Pultenaea paleacea</i>		0.1											
	<i>Pultenaea villosa</i>		0.1											

SUBMISSIONS REPORT

Report No. 958/05

WEDGEROCK PTY LTD

Karuah South Quarry

Family	Species	KRH01	KRH02	KRH03	KRH04	KRH05	KRH06	KRH07	KRH08	KRH09	KRH10	KRH11	KRH12	Incidentals
Fabaceae (Mimosoideae)	<i>Acacia floribunda</i>									0.1				
	<i>Acacia irrorata</i>		5							1	0.2			
	<i>Acacia longifolia</i> subsp. <i>longifolia</i>		2								0.1			
	<i>Acacia maidenii</i>	2		0.4	0.5	0.1		0.1		0.1		0.1		
	<i>Pararchidendron pruinosum</i> var. <i>pruinosum</i>								5					
Flagellariaceae	<i>Flagellaria indica</i>													X
Gentianaceae	<i>Centaurium tenuiflorum</i> *													X
Geraniaceae	<i>Geranium homeanum</i>			0.1										
Goodeniaceae	<i>Goodenia heterophylla</i>		0.1								0.1			
Haloragaceae	<i>Gonocarpus teucrioides</i>		0.1											
Iridaceae	<i>Libertia paniculata</i>													X
	<i>Sisyrinchium rosulatum</i> *													X
Lamiaceae	<i>Clerodendrum tomentosum</i>	0.1			0.2	0.1	0.2	0.5	0.1	0.1	0.1	0.5		
	<i>Plectranthus parviflorus</i>			1	0.1	0.1					0.1	0.1		
	<i>Scutellaria mollis</i>			0.5		0.1					0.1	0.1		
Lauraceae	<i>Cryptocarya rigida</i>	2			0.7	2	0.2	5	0.2	1	0.4	10		
	<i>Neolitsea dealbata</i>						0.5	0.2	30			2		
Lobeliaceae	<i>Lobelia purpurascens</i>			0.1						0.1				
Lomandraceae	<i>Lomandra cylindrica</i>		0.1											
	<i>Lomandra filiformis</i>			0.2							0.1			
	<i>Lomandra longifolia</i>	0.3	8	0.2	2			0.4		5	10	1		
	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>		0.1											
	<i>Lomandra</i> spp.									0.5				
Luzuriagaceae	<i>Eustrephus latifolius</i>	0.5	0.1	0.2	0.8	0.1	0.3	0.1			0.1	0.1		
	<i>Geitonoplesium cymosum</i>				0.5	0.1		0.2		0.1	0.1	0.1		
Malvaceae	<i>Commersonia fraseri</i>													X
Meliaceae	<i>Melia azerdach</i>													X
	<i>Synoum glandulosum</i> subsp. <i>glandulosum</i>					0.4	5	2	20		0.1			
Menispermaceae	<i>Sarcopetalum harveyanum</i>	0.1			0.5		0.1	0.1				2		
	<i>Stephania japonica</i> var. <i>discolor</i>				0.5	0.2	0.1	0.1	0.5		0.1		0.1	
Monimiaceae	<i>Daphnandra micrantha</i>								3					
	<i>Wilkiea huegeliana</i>					2		0.1						
Moraceae	<i>Ficus coronata</i>						0.2		2					
	<i>Ficus rubiginosa</i>													X
	<i>Maclura cochinchinensis</i>													X
	<i>Streblus brunonianus</i>								0.1					
Myrsinaceae	<i>Embelia australiana</i>								1					
	<i>Myrsine howittiana</i>	0.2												
	<i>Myrsine variabilis</i>			0.1										
Myrtaceae	<i>Acmena smithii</i>	0.5						1.5	0.2					
	<i>Angophora costata</i>		10											
	<i>Angophora floribunda</i>	8								0.5				
	<i>Backhousia myrtifolia</i>													X

Family	Species	KRH01	KRH02	KRH03	KRH04	KRH05	KRH06	KRH07	KRH08	KRH09	KRH10	KRH11	KRH12	Incidentals
	<i>Callistemon salignus</i>	0.3								4				
	<i>Corymbia maculata</i>		3	5	1	2								
	<i>Eucalyptus acmenoides</i>	1		1	15	2					1	20		
	<i>Eucalyptus globoidea</i>		15											
	<i>Eucalyptus microcorys</i>	10	1				15	25		4	10	4		
	<i>Eucalyptus paniculata</i> subsp. <i>paniculata</i>	2	1	25	10					0.5				
	<i>Eucalyptus propinqua</i>	4				5				23	10			
	<i>Eucalyptus punctata</i>			4	4									
	<i>Eucalyptus saligna</i>	1				10		6			1	6		
	<i>Leptospermum polygalifolium</i>		0.1											
	<i>Lophostemon confertus</i>	2			0.5	3	10	25						
	<i>Melaleuca decora</i>													X
	<i>Melaleuca linariifolia</i>									1				
	<i>Melaleuca styphelioides</i>	0.5								5	2			
	<i>Syncarpia glomulifera</i>	10				3				2				
	<i>Syzygium australe</i>								0.2					
Oleaceae	<i>Notelaea venosa</i>	0.2		0.4		0.2					0.1			
Orchidaceae	<i>Caladenia carnea</i>													X
	<i>Caladenia catenata</i>													X
	<i>Calochilus paludosus</i>													X
	<i>Calochilus robertsonii</i>													X
	<i>Chiloglottis formicifera</i>													X
	<i>Chiloglottis trapeziformis</i>													X
	<i>Cymbidium suave</i>				0.1	0.1						0.1		
	<i>Microtis unifolia</i>													X
	<i>Pterostylis baptistii</i>													X
	<i>Pterostylis curta</i>													X
	<i>Pterostylis longifolia</i>													X
	<i>Pterostylis nutans</i>													X
	<i>Pterostylis pedunculata</i>													X
	<i>Thelymitra pauciflora</i>													X
Passifloraceae	<i>Passiflora subpeltata</i> *			0.1	0.1							0.1	0.1	
Phormiaceae	<i>Dianella caerulea</i>	0.1	0.3	0.1	0.1	0.1		0.1		0.1	0.2	0.1		
Phyllanthaceae	<i>Breynia oblongifolia</i>		1	0.1						0.1		0.1		
	<i>Glochidion ferdinandi</i>		0.2	0.1				2		0.1	0.1			
	<i>Phyllanthus gunnii</i>			0.1							0.5			
	<i>Phyllanthus hirtellus</i>		0.1											
	<i>Phyllanthus</i> spp.									0.1		0.1		
Piperaceae	<i>Peperomia blanda</i> var. <i>floribunda</i>													X
Pittosporaceae	<i>Billardiera scandens</i>		0.1									0.1		
	<i>Hymenosporum flavum</i>													X
	<i>Pittosporum multiflorum</i>	1				0.1						1		
	<i>Pittosporum revolutum</i>					0.1		0.1		0.1	0.1			
	<i>Pittosporum undulatum</i>			0.5										
Plantaginaceae	<i>Plantago lanceolata</i> *													X
	<i>Veronica plebeia</i>									0.1				

Family	Species	KRH01	KRH02	KRH03	KRH04	KRH05	KRH06	KRH07	KRH08	KRH09	KRH10	KRH11	KRH12	Incidentals
Poaceae	<i>Andropogon virginicus</i> *													X
	<i>Briza maxima</i> *													X
	<i>Briza minor</i> *													X
	<i>Bromus catharticus</i> *													X
	<i>Cynodon dactylon</i>												0.5	
	<i>Dichelachne micrantha</i>									0.1				
	<i>Digitaria</i> spp.		0.1											
	<i>Echinopogon caespitosus</i>			0.1							0.1			
	<i>Echinopogon ovatus</i>	0.1								0.1				
	<i>Entolasia marginata</i>	0.2		0.2	0.1	0.1		0.1		0.5	0.3			
	<i>Entolasia stricta</i>		2											
	<i>Eragrostis curvula</i> *													X
	<i>Eragrostis</i> spp.		0.1											
	<i>Imperata cylindrica</i>	0.1	15	0.1	0.2					5	2	0.1		
	<i>Microlaena stipoides</i> var. <i>stipoides</i>			0.5						1				
	<i>Oplismenus aemulus</i>				0.1		0.1		0.5	0.1	0.1		0.5	
	<i>Oplismenus imbecillis</i>	2	0.1	0.2	0.1	0.2		0.2		0.2		0.1	1	
	<i>Panicum simile</i>		0.1											
	<i>Paspalum ciliatifolium</i> *												15	
	<i>Poa labillardierei</i> var. <i>labillardierei</i>	0.2		3	0.2	0.1				1	5			
	<i>Setaria sphacelata</i> *												8	
	<i>Sorghum leiocladum</i>										1			
	<i>Themeda triandra</i>		3	2	2						15			
Polypodiaceae	<i>Platyserium bifurcatum</i>													X
Primulaceae	<i>Lysimachia arvensis</i> *													X
Proteaceae	<i>Persoonia linearis</i>		0.5							0.1				
	<i>Grevillea humilis</i> subsp. <i>humilis</i>													X
Pteridaceae	<i>Pteris tremula</i>								0.3					
	<i>Pteris umbrosa</i>								5					
Ranunculaceae	<i>Clematis aristata</i>			0.1		0.1				0.1				
	<i>Clematis glycinoides</i>										0.1			
	<i>Ranunculus lappaceus</i>													X
Rhamnaceae	<i>Pomaderris ferruginea</i>										0.1			
Ripogonaceae	<i>Ripogonum fawcettianum</i>				0.1	1	0.5	0.1	0.2			4		
Rosaceae	<i>Rubus moluccanus</i> var. <i>trilobus</i>			0.1	0.1					0.1	0.3	0.1	1	
	<i>Rubus nebulosus</i>							0.1						
	<i>Rubus parvifolius</i>	0.1		0.1	0.1						0.1	0.1		
	<i>Rubus rosifolius</i>								0.3				1	
Rubiaceae	<i>Morinda jasminoides</i>					0.1	0.2		1					
	<i>Galium leiocarpa</i>													X
Rutaceae	<i>Boronia polygalifolia</i>													X
Salicaceae	<i>Scolopia braunii</i>													X
Santalaceae	<i>Exocarpos cupressiformis</i>		0.1								0.1			
Sapindaceae	<i>Alectryon subcinereus</i>								0.1					
	<i>Diploglottis australis</i>								0.2					

Family	Species	KRH01	KRH02	KRH03	KRH04	KRH05	KRH06	KRH07	KRH08	KRH09	KRH10	KRH11	KRH12	Incidentals
	<i>Guioa semiglauc</i>					2		2						
Smilacaceae	<i>Smilax australis</i>	0.5	0.2	1	3	6	0.5	3	0.2		0.5			
	<i>Smilax glycyphylla</i>									0.1	0.1			
Solanaceae	<i>Duboisia myoporoides</i>													X
	<i>Physalis peruviana*</i>												0.1	
	<i>Solanum brownii</i>													X
	<i>Solanum mauritianum*</i>												1	
	<i>Solanum nigrum*</i>			0.1									0.5	
Stylidiaceae	<i>Stylidium graminifolium</i>													X
Unknown	<i>Shrub indeterminate</i>											0.3		
Urticaceae	<i>Dendrocnide excelsa</i>								1					
Uvulariaceae	<i>Tripladenia cunninghamii</i>				0.1									
Verbenaceae	<i>Lantana camara*</i>	3	0.3	2	35	15	45	1	2	0.1	1	15	8	
	<i>Verbena spp.*</i>												5	
Violaceae	<i>Viola hederacea</i>													X
Vitaceae	<i>Cayratia clematidea</i>			0.1	0.1	0.4	0.5	0.1	1		0.1	0.1		
	<i>Cissus antarctica</i>	0.1		1	0.5	10	0.1	2	0.1			5		
	<i>Cissus hypoglauca</i>	0.2		0.2	1	1	0.2	1	10	0.1	0.1	10		
Xanthorrhoeaceae	<i>Xanthorrhoea macronema</i>		0.6											
Zingiberaceae	<i>Alpinia caerulea</i>					0.5		0.4	0.1					



The Royal
BOTANIC GARDENS
& Domain Trust

National Herbarium of New South Wales

Mr Brian TOWLE
Ecoplanning
[REDACTED]

Enquiry No: 20773
Botanical.Is@rbgsyd.nsw.gov.au
Fax No: (02) 9251 1952
Ph. No: (02) 9231 8111
Date: 10 October 2018

Dear Mr TOWLE,

Thank you for your enquiry of 10-Oct-18. We are happy to provide the following information:

Grevillea humilis subsp. *humilis* Det R.O. Makinson 10 Oct 2018

An invoice for \$45.50 will be forwarded to you separately by our finance section to cover cost of identification.

Thank you for your enquiry.

Yours sincerely

Barbara Wiecek
Identification Botanist
Botanical Information Service



Go to our online Botanical Information Services at
plantnet.rbgsyd.nsw.gov.au to find out more about
plants of New South Wales



The Botanical Information Email address is Botanical.Is@rbgsyd.nsw.gov.au
Mrs Macquaries Road Sydney NSW 2000 Australia • Telephone (02) 9231 8111 • Fax (02) 9251 1952

An estate of the Royal Botanic Gardens and Domain Trust, a statutory body within the Office of Environment and Heritage, Department of Premier and Cabinet.



National Herbarium of New South Wales

Mr Brian TOWLE
Ecoplaning



Enquiry No: 20517
Botanical.Is@rbgsyd.nsw.gov.au
Fax No: (02) 9251 1952
Ph. No: (02) 9231 8111
Date: 26 March 2018

Dear Mr TOWLE,

Thank you for your enquiry of 20-Mar-18. We are happy to provide the following information:

Galium, near *G. leiocarpum* with unusual dark +/- stellate hairs on peduncles and ovaries det S.F. McCune 20 Mar 2018, specimen retained

Pimelea curviflora var. *curviflora* det. B. M. Wiecek 26 Mar 2018, specimen retained, thank you

There is no charge for this enquiry.

Thank you for your enquiry.

Yours sincerely

Barbara Wiecek
Identification Botanist
Botanical Information Service



Go to our online Botanical Information Services at plantnet.rbgsyd.nsw.gov.au to find out more about plants of New South Wales



The Botanical Information Email address is Botanical.Is@rbgsyd.nsw.gov.au
Mrs Macquaries Road Sydney NSW 2000 Australia • Telephone (02) 9231 8111 • Fax (02) 9251 1952

An estate of the Royal Botanic Gardens and Domain Trust, a statutory body within the Office of Environment and Heritage, Department of Premier and Cabinet.

Table 23
Fauna Species Observed within the Site

Species	Common name	Status (BC Act)	Status (EPBC Act)	Record type
Amphibians				
<i>Litoria latopalmata</i>	Broad-palmed Frog			O
<i>Pseudophryne coriacea</i>	Red-Backed Toadlet			O - pifall
<i>Litoria peronii</i>	Peron's Tree Frog			Calling
<i>Uperoleia laevigata</i>	Smooth Toadlet			W
<i>Crinia signifera</i>	Common Eastern Froglet			W
Reptiles				
<i>Amphibolurus muricatus</i>	Jacky Lizard			
<i>Varanus varius</i>	Lace monitor			
Aves				
<i>Acanthiza pusilla</i>	Brown Thornbill			W
<i>Ailuroedus crassirostris</i>	Green Catbird			W
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo			W
<i>Cormobates leucophaea</i>	White-throated Treecreeper			W
<i>Columba leucomela</i>	White-headed Pigeon			W
<i>Corvus coronoides</i>	Australian Raven			Ow
<i>Corvus mellori</i>	Little Raven			W
<i>Cracticus torquatus</i>	Grey Butcherbird			W
<i>Dacelo novaeguineae</i>	Laughing Kookaburra			O
<i>Dicaeum hirundinaceum</i>	Mistletoebird			Ow
<i>Eopsaltria australis</i>	Eastern Yellow Robin			Ow
<i>Gerygone olivacea</i>	White-throated Gerygone			W
Hieraaetus morphnoides	Little Eagle	V		O
<i>Malurus cyaneus</i>	Superb Fairy-wren			W
<i>Meliphaga lewinii</i>	Lewin's Honeyeater			O
<i>Neochmia temporalis</i>	Red-browed Finch			O
<i>Nesoptilotis leucotis</i>	White-eared Honeyeater			O
<i>Pachycephala rufiventris</i>	Rufous Whistler			W
<i>Phylidonyris niger</i>	White-cheeked Honeyeater			Ow
<i>Psophodes olivaceus</i>	Eastern Whipbird			W
<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird			Remote Camera
<i>Ptilotula penicillatus</i>	White-plumed Honeyeater			W
<i>Rhipidura albiscapa</i>	Grey Fantail			Ow
Rhipidura rufifrons	Rufous Fantail		Migratory	O

Species	Common name	Status (BC Act)	Status (EPBC Act)	Record type
<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted lorikeet			Ow
Mammals				
<i>Antechinus stuartii</i>	Brown Antechinus			O - Spotlight
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			Anabat - definite
<i>Chalinolobus morio</i>	Chocolate Wattled bat			Anabat - probable
<i>Falsistrellus tasmaniensis</i> / <i>Scotorepens orion</i> / <i>Scoteanax rueppellii</i>	35 - 38 khz Mixed group			Anabat – possible Calls of these species are similar and in the absence of a clear call there is uncertainty
<i>Macropus rufogriseus</i>	Red-necked Wallaby			O
<i>Micronomus norfolkensis</i>	Eastcoast Freetail Bat			Anabat – possible
<i>Miniopterus australis</i>	Little Bentwing Bat	V		Anabat – definite
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat	V		Anabat – definite
<i>Nyctophilus</i> sp.	Long-eared Bat			Anabat – definite
<i>Ozimops ridei</i>	Eastern Freetail Bat			Anabat - probable
<i>Perameles nasuta</i>	Long-nosed Bandicoot			Remote Camera
<i>Phascolarctos cinereus</i>	Koala+	V	V	Remote Camera
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum			O - Spotlight
<i>Rattus</i> sp.	Rat			Hair analysis
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat			Anabat – definite
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna			Remote Camera
<i>Trichosurus vulpecula</i>	Common Brushtail Possum			Remote Camera
<i>Vespadelus pumilus</i>	Eastern Forest Bat			Anabat - probable
<i>Vespadelus regulus</i>	Southern Forest Bat			Anabat – possible
<i>Vespadelus vulturnus</i>	Little Forest Bat			Anabat – probable
<i>Vespadelus</i> grouped (<i>V. vulturnus</i> / <i>V. troughtoni</i>)				Anabat – definite
<i>Vulpes</i>	Fox			Remote Camera
<i>Wallabia bicolor</i>	Swamp Wallaby			Remote Camera

Appendix F

Blasting Fly-Rock Control Assessment

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Prepared by Prism Mining Pty Ltd

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BLASTING ASSESSMENT FOR FLY-ROCK CONTROL AT THE PROPOSED KARUAH SOUTH QUARRY

FINAL REPORT – 31st July 2019

EXECUTIVE SUMMARY

This report presents methods to estimate potential fly-rock range and determine suitable blast clearance distances for the proposed Karuah South Quarry, in order to manage the risks associated with fly-rock from blasting. Preliminary blast parameters, clearance distances and associated factors of safety have been determined using published guidelines, with further operational adjustments to be made once blasting commences, based on site experience.

While fly-rock risk can be largely controlled within the Quarry Site, using blast designs nominated in the EIS, modified designs will be required for some blasts, to contain fly-rock within reduced available clearance distances. Minor access restrictions may need to be applied to publicly accessible areas adjacent to the Quarry Site for blast clearance when firing some blasts, including Blue Rock Close to the south and on defined areas within the adjacent land holdings to the east and west.

In addition to appropriate blast designs, to suit local topography and ground conditions, a high level of operational control will be required for blasting, and south-facing 'end-walls' will need to be appropriately buffered for both fly-rock and airblast overpressure control.

The adoption of a suitable Blast Management Plan and associated operating procedures is required in order to mitigate fly-rock risk, and specific blast management controls have been listed for operational risk assessment prior to the commencement of blasting.

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CONTENTS

	Executive Summary	1
1	Introduction	3
2	Assessment Methodology & Criteria	8
	2.1 Initial Blast Parameters	8
	2.4 Fly-rock Assessment	9
	2.3 Fly-rock Risk	10
3	Assessment of Fly-Rock Range	13
4	Management & Operational Measures	16
5	Conclusions and Recommendations	17
6	References	18

Disclaimer

This document provides general guidance based on information provided by the client, using generic methodologies for calculating blast parameters and blasting impacts. Appropriate monitoring will be required to validate modelled impacts, and site-specific adjustments may be required to achieve desired results and minimise impacts as the project is implemented. For further assistance during implementation contact the author, or other suitable qualified person.

1 INTRODUCTION

This report presents methods to estimate potential fly-rock range and suitable blast clearance distances for the proposed Karuah South Quarry, in order to manage the risks associated with fly-rock from blasting.

The proposed Karuah South Quarry is located approximately 40km north of Newcastle, and 4km north-east of Karuah in NSW, as illustrated in the locality plan in the Environmental Impact Statement (State Significant Development 17_8795) for the Karuah South Quarry (Figure 1).

The 21ha site is planned to produce up to 600,000tpa of hard rock quarry products over a 25-year period, using conventional drill and blast methods to extract material in a staged manner (Figure 2).

Surrounding land, infrastructure, and sensitive residential locations are illustrated in Figures 3 and 4 and these locations have been used to determine suitable blast parameters and blast clearance distances for Stage 1 of the operation. Stage 1 represents initial operations, in addition to being closest to the nearest sensitive locations, including Blue Rock Close and the Pacific Highway to the south.

The initial removal of soil and overburden (density 2.2g/cc) will not require blasting, and will be removed by mechanical excavation only. Weathered rock (density 2.4g/cc) and fresh rock (density 2.6g/cc) will be excavated after blasting, and is described as Nerong Volcanics and more specifically 'rhyodacite'.

Further details regarding the proposed project can be found in the EIS on the NSW State Government planning portal at:

www.planningportal.nsw.gov.au/major-projects/project/9901 (Reference #1).

Figure 1 – Locality Plan for the Karuah South Quarry

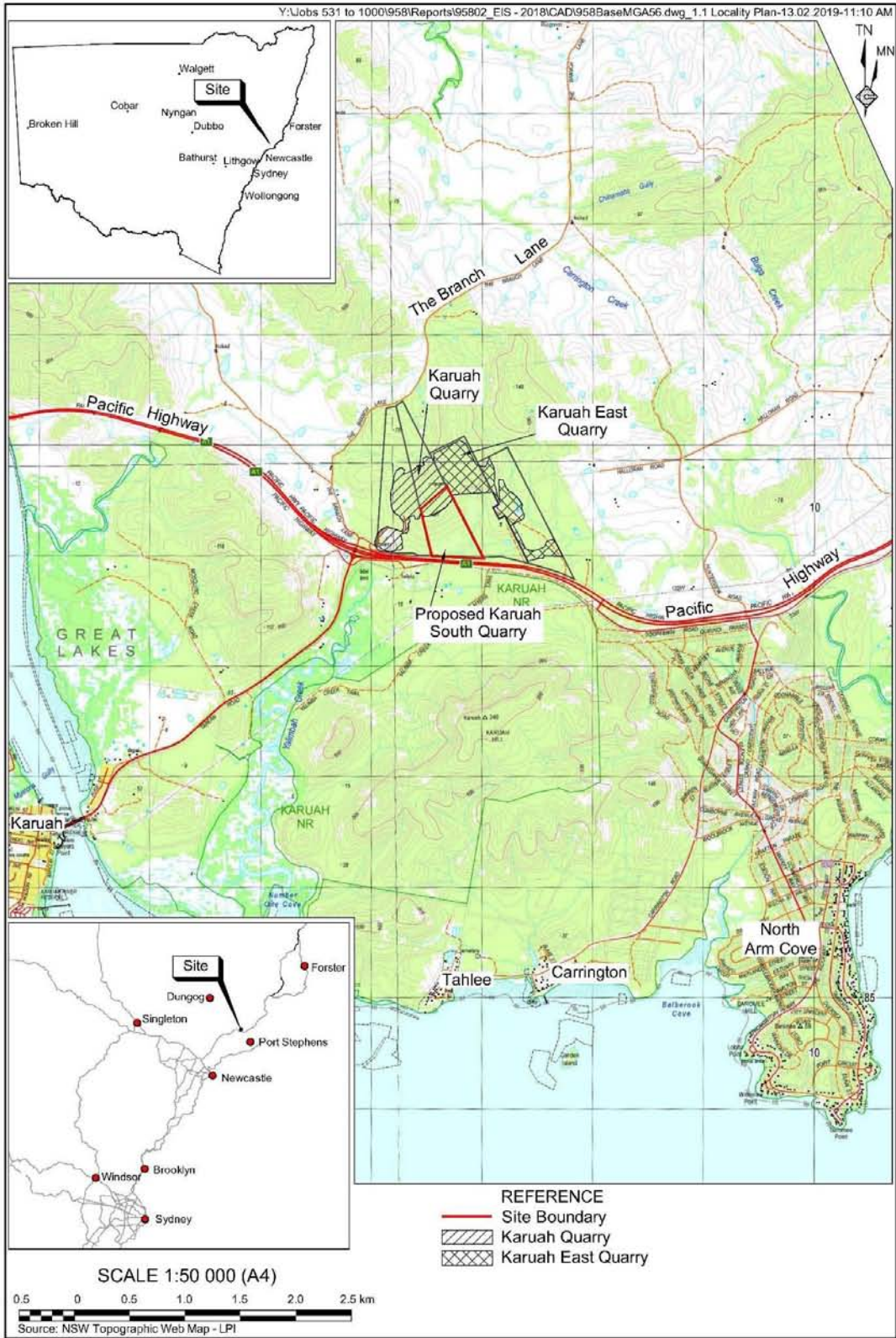


Figure 2 – Karuah South Quarry, Stage 1 and Stage 2 Extraction Areas

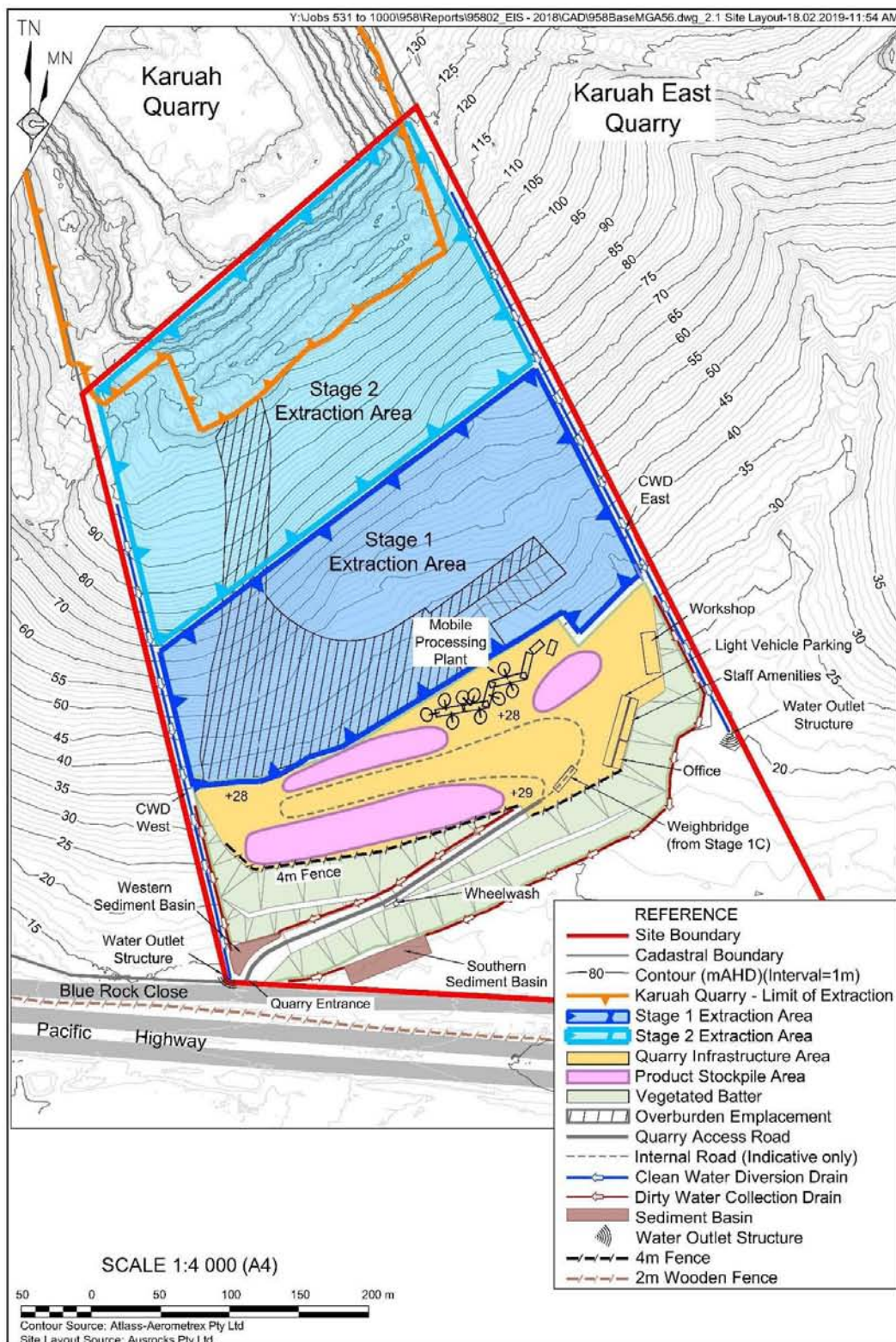


Figure 3 – Karuah South Quarry, Adjacent Land, Infrastructure and Residences

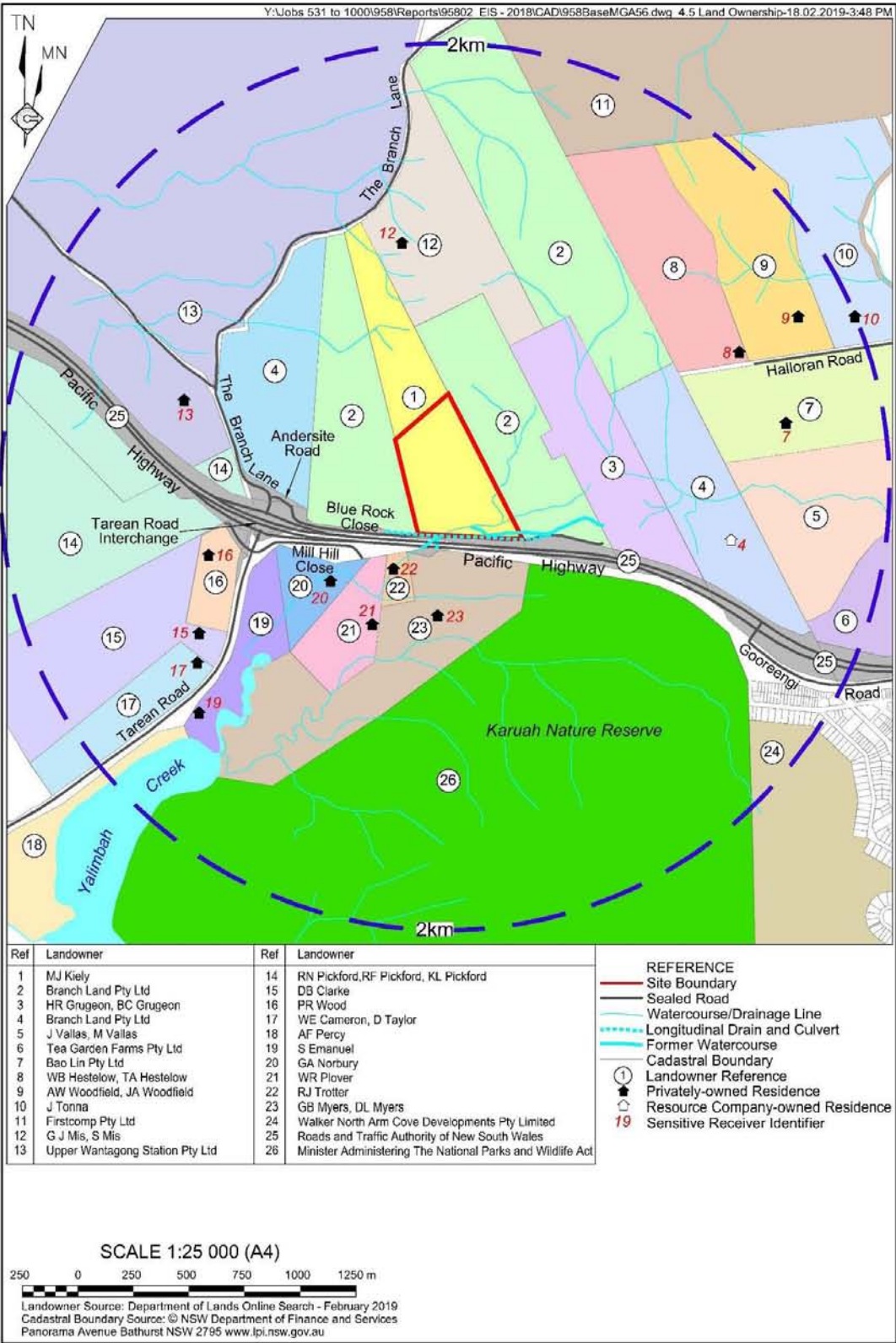
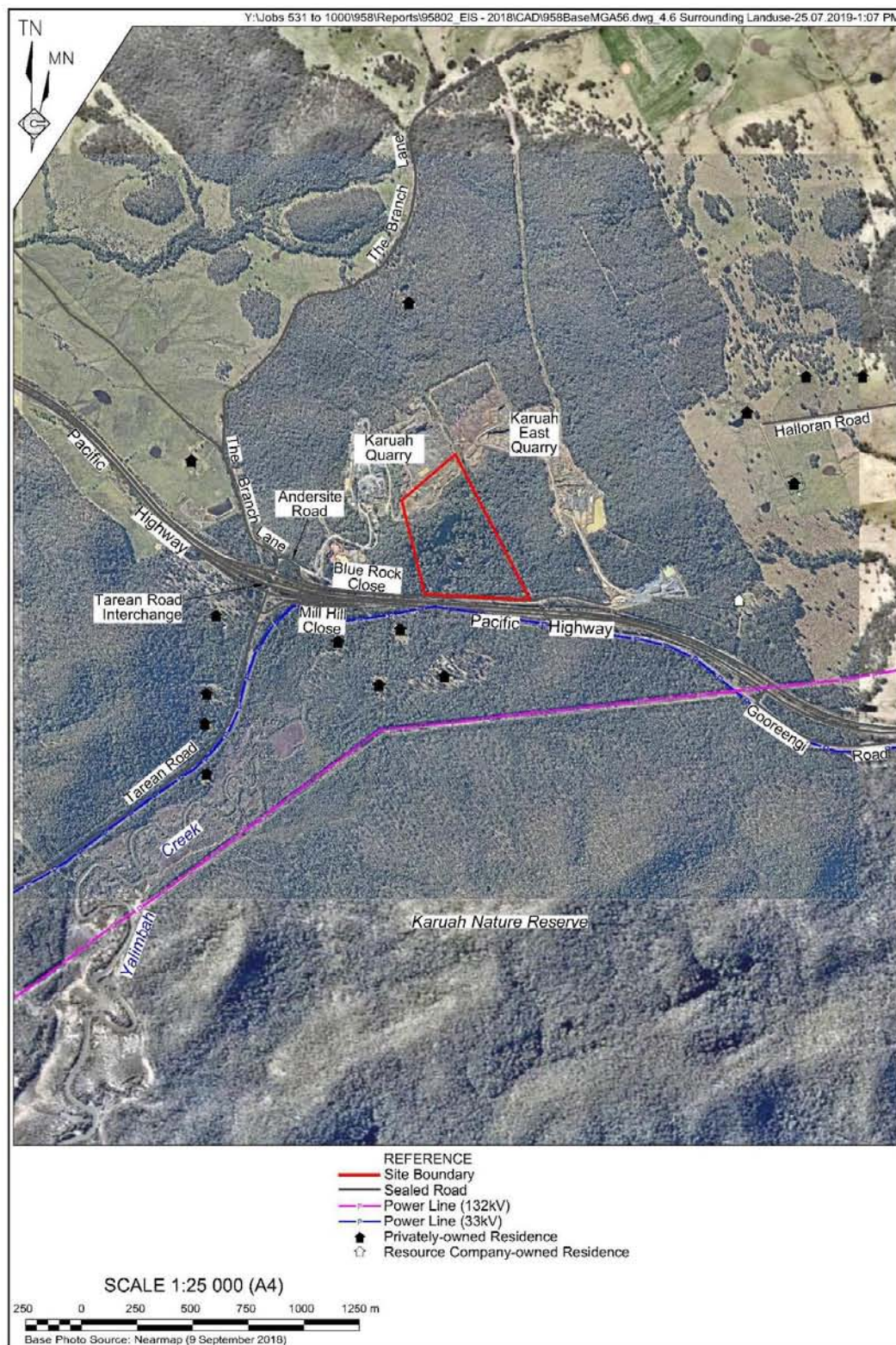


Figure 4 – Karuah South Quarry, Surrounding Land Uses



2 ASSESSMENT METHODOLOGY & CRITERIA

2.1 Initial Blast Parameters

This assessment has used blast design parameters nominated in Section 2.5 of the EIS, in addition to parameters derived using published empirical guidelines to estimate fly-rock range. Blast design parameters have been adjusted as necessary, in order to demonstrate that safe blasting can be achieved for a range of likely blasting requirements and ground conditions.

Preliminary blast design parameter ranges nominated in Section 2.5 of the EIS are listed in Table 1 below, and are suggestive of a powder factor of 0.7kg/m^3 to 0.8kg/m^3 . These are compared with parameters generated using a general approach (Reference #2) and also targeting a powder factor of 0.7kg/m^3 to 0.8kg/m^3 , which is assumed will provide adequate fragmentation.

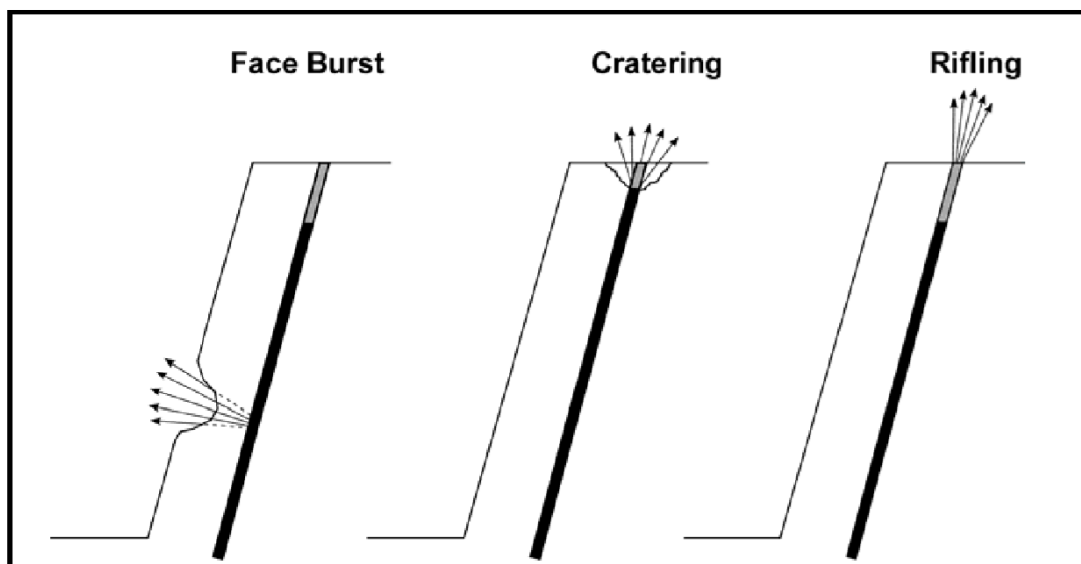
Table 1 – Blast design parameters assumed for fly-rock assessment

Parameter	Preliminary EIS values	Comparable 'general' values	Comments regarding 'general' values
Hole diameter (mm)	89mm or 102mm	89mm	Assumed 89mm diameter holes for initial, closer proximity blasting.
Bench height (m)	10m	10m	6m to 11m optimal range.
Burden (m)	2.5m to 3m	2.7m	~30 blasthole diameters.
Spacing (m)	3m to 3.5m	3.1m	~1.15 x burden.
Stem height (m)	>1.8m	2.2m	>25 blasthole diameters.
Sub-drill (m)	0.3m to 1.3m	1.0m	~0.4 x burden.
Explosive column (m)		8.8m	Bench height + sub-drill – stem height for vertical holes.
Explosive density (g/cc)		1.2g/cc	Assumed 1.2g/cc for wet conditions (worst-case).
Charge density (kg/m)		7.5kg/m	Calculated.
Charge/hole (kg)	60kg to 80kg	66kg	Calculated.
Powder factor (kg/m ³)	~0.8 kg/m ³ (implied)	0.81 kg/m ³	Based on nominated blast parameters, EIS – Table 2.3.

2.2 Fly-Rock Assessment

Fly-rock can be generated by multiple mechanisms, associated with face bursting, cratering at the blasthole collar, and stemming ejection (rifling), as illustrated in Figure 5 (Reference #4). In each case, excessive fly-rock can be generated, and travel over potentially large distances, when explosive energy is not adequately confined, due to overcharging or reduced or ineffective face burden or stemming. Reduced or ineffective face burdens may arise due to a combination of reduced burden distances, and/or weak/broken material within the face. Reduced or ineffective stemming may arise due to a combination of reduced stem heights (either inappropriately designed, or under-stemmed), weak/broken material at the collar of the blasthole, and/or from the use of unsuitable stemming material (such as drill cuttings).

Figure 5 – Three mechanisms of fly-rock



Maximum fly-rock range can be estimated using a number of published methods. A general 'cratering' model published by McKenzie (Reference #3) uses a scaled depth of burial approach and allows for air-resistance and fly-rock particle size. Empirical models for fly-rock range associated with rifling (stemming ejection) and face burst from a free-face, have been published by Moore and Richards (Reference #4).

Cratering model (Reference #3)

$$\text{Maximum Range (metres)} = 11 \cdot \text{SDB}^{-2.167} \cdot (\Phi/\text{Fs})^{0.667}$$

where SDB = scaled depth of burial (metric) = $(\text{St} + 0.0005 \cdot \text{M} \cdot \Phi) / (0.00923 \cdot (\text{M} \cdot \Phi^3 \cdot d)^{0.333})$

for: Fs (shape factor = 1.1 to 1.3), St = stem height (m), M = charge ratio (M < 8 for 89mm holes), Φ = hole diameter (mm), and d = explosive density (g/cc).

Face burst (free face) model (Reference #4)

$$\text{Max Range (m)} = (27^2/9.8) \times [(\sqrt{\text{charge per metre}/\text{burden}})]^{2.6}$$

Rifling (stemming ejection) model (Reference #4)

$$\text{Max Range (m)} = (27^2/9.8) \times [(\sqrt{\text{charge per metre}/\text{stem height}})]^{2.6} \times \sin(\theta)$$

where θ = hole angle and maximum range takes place 'behind' an angled hole. For vertical holes at 90 degrees, the value of θ is selected as 80 degrees (rather than 90 degrees) to allow for some unfavourable hole deviation (Reference #4).

2.3 Fly-Rock Risk

Higher levels of fly-rock risk are likely to apply at sensitive locations closest to blasting operations, compared to those further away. In addition, locations in front of a free face potentially represent a higher level of risk, compared to those behind, or to the side of, the face. This is due to the potential for variability of face burden in front of an explosive column, compared with the potential for variability of stem height above the top of the explosive column.

As can be seen comparing Figures 2, 3, and 4, the distances from Stage 1 blasting operations to public roads in the south (Blue Rock Close and the Pacific Highway) and nearest residences in the south-east (#20 to #23) are less than those distances to residences to the east (#4, #7, #8) or to the west (#16).

In order to evaluate fly-rock risk, maximum fly-rock range from cratering and rifling blastholes at the south-western corner of Stage 1 has been assessed with respect to the Blue Rock Close, at a minimum distance of 146m. It is assumed that temporary closure of Blue Rock Close will be permissible for the additional mitigation of fly-rock risk, but it is understood that closure of the Pacific Highway, at a minimum distance of 166m, will not be permissible due to the volume of traffic using that road.

Maximum fly-rock range from free face blasts closest to the eastern quarry boundary has been assessed with respect to privately held land to the east. The nearest residential location in that direction is over 1000m away (resource company-owned residence #4). It is assumed

that free-face blasting will only be orientated in an east or north-east direction, until free-face fly-rock models have been validated using operational data. This will also mitigate overpressure impacts at residential locations to the south-west.

Blast clearance zones around small blasting operations can typically range from 100m to 300m, while those applied at large mining operations can be around 500m (or greater). Where large clearance zones are practically achievable, it is not unreasonable to make use of that area to mitigate fly-rock risks in the event of an unexpected blast outcome associated with inadequate explosives confinement. Where large clearance zones are not practically achievable, it is necessary to better understand potential fly-rock range, and apply higher levels of operational control than might otherwise be required.

In addition to estimating potential maximum fly-rock range, it is also necessary to apply a factor of safety (FOS) in order to determine appropriate blast clearance distances. Suggested FOS values of 1.5 times the maximum fly-rock range for blast clearance, and 2 times the maximum fly-rock range from the nearest dwelling or occupied structure have been documented by McKenzie (Reference #3). More conservative FOS values of up to 2 for equipment and infrastructure, and up to 4 for personnel have been suggested by Moore and Richards (Reference #4), which allows for a higher level of variability.

For a well-controlled blasting operation, the FOS values quoted by McKenzie are likely to be appropriate for most blasting, once a high level of fly-rock control has been demonstrated. However, when blasting commences at the north-eastern-end of Stage 1, it is suggested that an initial clearance distance of 300m is applied for free-face blasting towards adjoining land to the north-east, and a FOS of 4 is applied for blast clearance towards the Pacific Highway.

It is recommended that, due to the high level of public access along the Pacific Highway, free-face blasting towards the south should not be employed, particularly at close proximity. This is for both fly-rock control and mitigation of airblast overpressure impact at the nearest sensitive receivers. This also removes the need to drill angled holes towards an exposed end-wall, to reach toe from the previous blast.

This approach should be maintained for Stage 1 operations, unless it can be demonstrated that free-face blasting can be reliably carried out, based on monitored free-face blasts fired to the north-east. Otherwise, the conservative buffering of end-walls should be implemented throughout Stage 1 operations (as illustrated in Figures 6a and 6b).

The sequencing of blasts requires the removal of overburden to a stable batter (OB1, OB2, OB3), in order to access the corresponding (underlying) drill bench (BL1, BL2, BL3) for blasting operations. When removing blasted material, a stable 'soft-wall' can be left in place to buffer the adjacent blast. For example, after blasting BL1abc, excavate BL1a, leaving BL1b and BL1c in place. When blasting BL2abc apply conservative hole spacings at the buffered end-wall to encourage movement to the north-western free face, then excavate BL2a with BL1b. Repeat the process from surface up the slope, and repeat again on the underlying benches.

Figure 6a – Plan showing blasting sequence at the commencement of operations

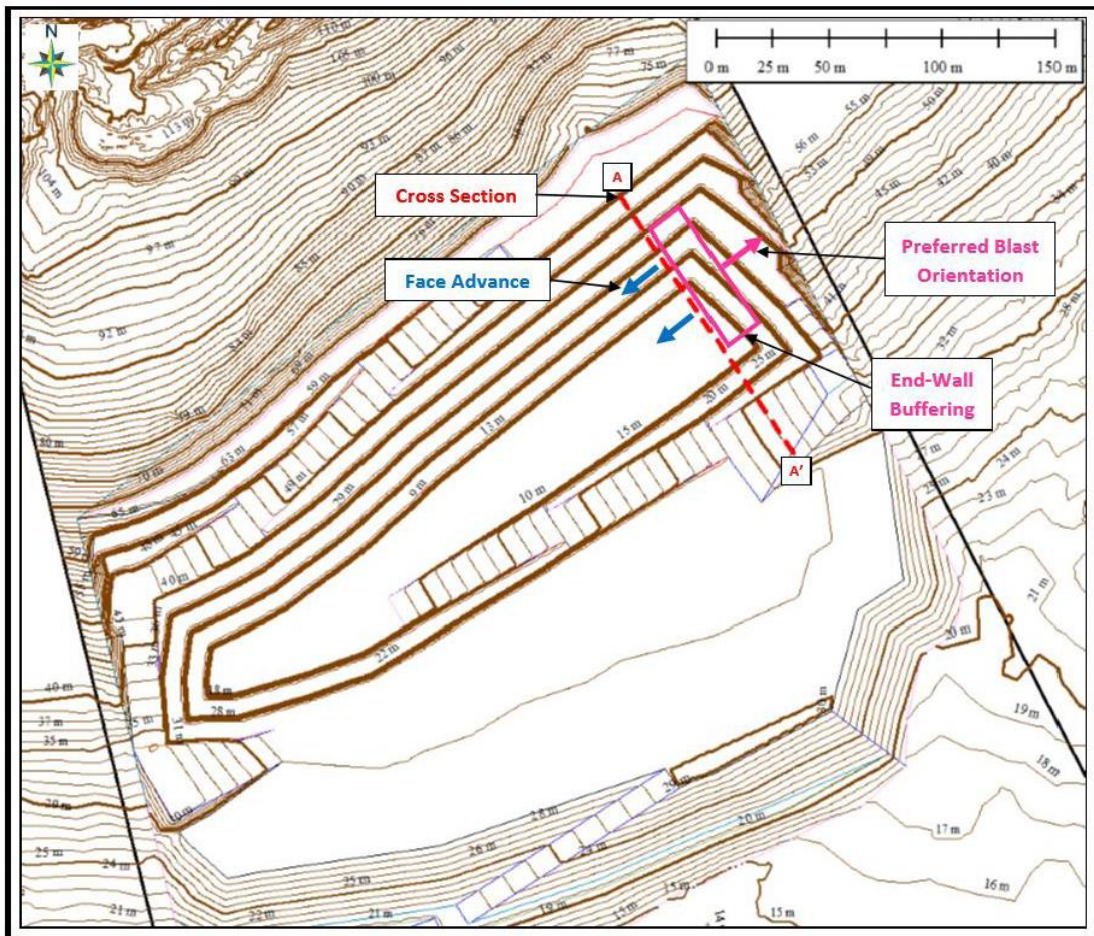
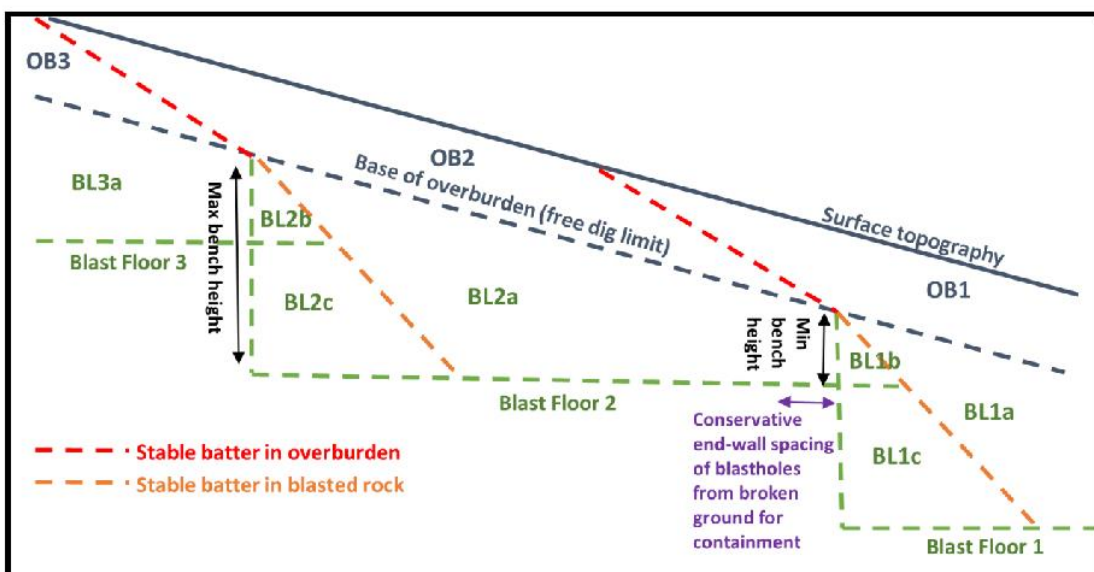


Figure 6b – Schematic cross-section along the sloping topography of A-A' above



3 ASSESSMENT OF FLY-ROCK RANGE

The potential fly-rock range towards nearby identified sensitive locations has been estimated, assuming controlled blast design, implementation and monitoring processes.

The following fly-rock range estimates (Table 2) are based on methods and criteria discussed in Section 2. Adjustments to preliminary blast designs documented in Table 1 are illustrated in order to reduce the anticipated maximum fly-rock range where necessary.

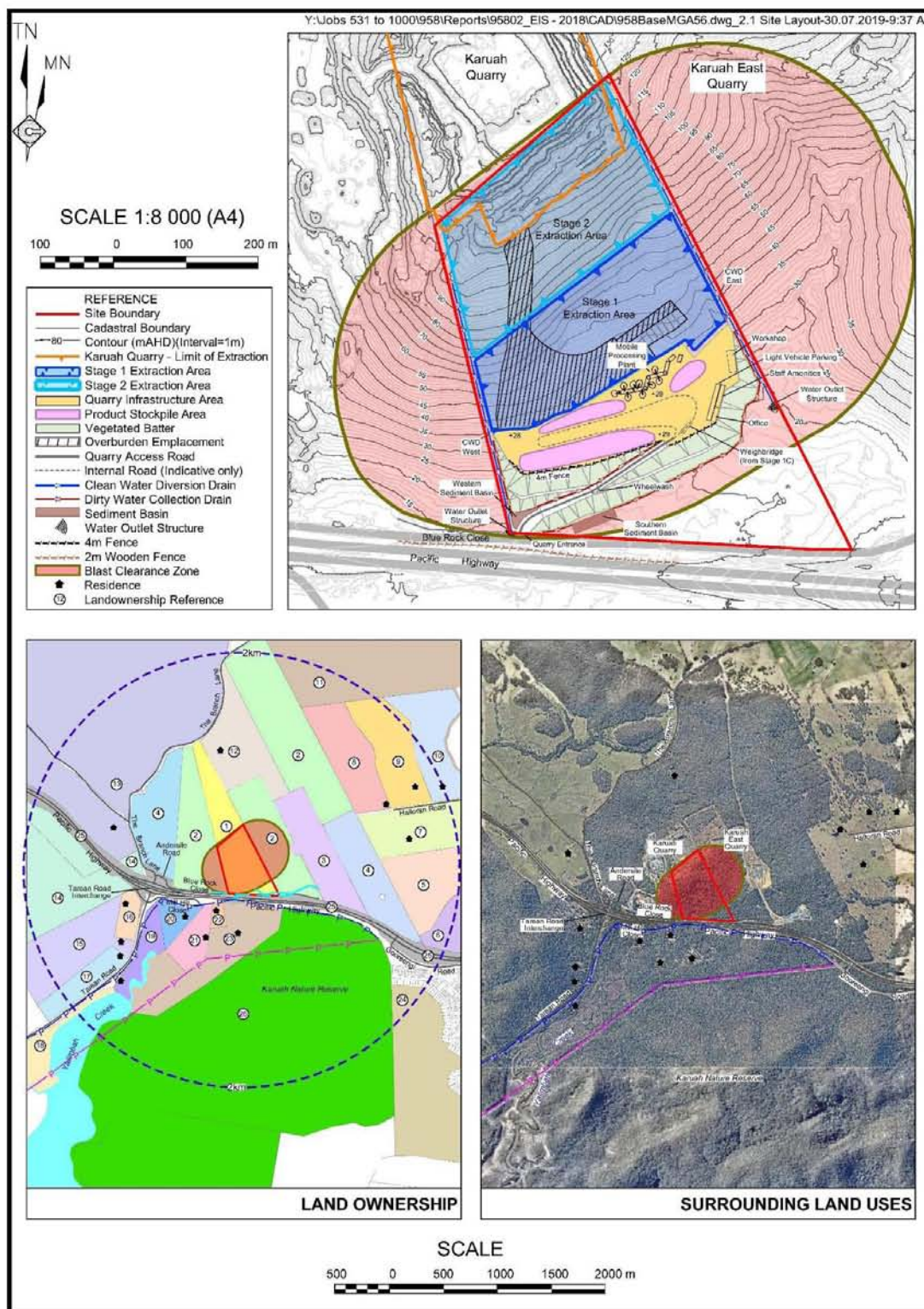
- Increases to both face burden and stem height are recommended in order to achieve appropriate factors of safety for blasting at different stages of the operation. This has an impact on both average powder factor and effective powder factor along the front row, and may require other blast design adjustments or an acceptance of reduced fragmentation for some blasts.
- Orientation of a free face has been limited to the north-east, with appropriately buffered end-wall faces towards the Pacific Highway.
- Blast clearances up to 300m have been assumed in front of any free face, for initial Stage 1 blasting operations at the north-eastern boundary, and will initially require clearance of part the adjacent land to the east, owned by the operator of the Karuah East Quarry. A FOS up to 3.9 is indicated at 300m in front of a free face with an 89mm diameter hole and 2.7m burden.
- Blast clearances up to 200m have been assumed both sides and behind the free face, while such clearance is available, until proximity to Blue Rock Close requires reduced clearances and adjustment of blast design parameters. This will require notification of blasting to the operator of Karuah Quarry¹ and may require clearance of adjacent land to the west (also owned by the operator of Karuah East Quarry). A FOS >4 is indicated at 200m from the blast, with an 89mm diameter hole and 3m stemming, assuming there is no free face in that direction. Clearance and temporary closure of Blue Rock Close to the south is recommended for blasts within 200m, or greater, subject to operational risk assessment and the need to prevent public access to the Quarry Site when blasting.
- A minimum blast clearance distance of 150m has been assumed for the control of both cratering and rifling from blasts at the south-west corner of Stage 1 operations. Again, this will require the clearance and temporary closure of Blue Rock Close at a minimum distance of 146m. A FOS >3 is indicated at 150m from the blast, with an 89mm diameter hole and 3m stemming, assuming no free face in that direction.
- The above clearance distances can be illustrated as a required clearance zone around the perimeter of Stage 1 operations, as illustrated in Figure 7.

¹ During the period of extraction and rehabilitation operations on the Karuah Quarry Site until 6 May 2021 and thereafter for 3 years during the rehabilitation monitoring and maintenance period.

Table 2 – Fly-rock range, blast clearance and factor of safety for different blast configurations

Scenario	Minimum applicable clearance distances ¹										Buffered clearance distance at 200m	Start-up (free-face) clearance distance at 300m
	EIS parameters	General parameters	Stem at 2.5m	Stem at 3m	Stem at 3.4m	Stem at 3m	Stem at 3.4m	Stem at 3m	Stem at 3.4m	Stem at 3m		
Hole diameter (mm)	89	89	89	89	89	89	89	89	89	89	89	89
Explosive density (g/cc)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Charge density (kg/m)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Nominal bench height (m)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Nominal sub-drill (m)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Charge length (m)	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Burden to free face (m)	2.5	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Burden in main blast (m)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Spacing (m)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Stemming (m)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Hole angle (degrees)	90	90	90	90	90	90	90	90	90	90	90	90
Charge mass/hole (kg)	66	66	66	66	66	66	66	66	66	66	66	66
Powder factor front row (kg/m3)	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Powder factor main blast (kg/m3)	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Fly-rock from cratering holes												
Charge length/diam (=max 8 for 89mm and max 10 for 102mm)	8	8	8	8	8	8	8	8	8	8	8	8
SDOB metric	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Fs (flyrock shape factor=1.1 to 1.2)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Rmax from cratering holes (m)	84	84	84	84	84	84	84	84	84	84	84	84
Minimum clearance distance from cratering holes (m)	150	150	150	150	150	150	150	150	150	150	150	150
FOS (distance/RangeMax)	1.8	1.8	2.3	3.2	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Fly-rock from free face												
Rmax in front of free face (m)	94	94	94	94	94	94	94	94	94	94	94	94
Minimum clearance distance from free face (m)	300	300	300	300	300	300	300	300	300	300	300	300
FOS for free face (distance/Lmax)	3.2	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Fly-rock 'behind' ejecting (angled) holes												
Effective blasthole angle (degrees) ²	75	75	75	75	75	75	75	75	75	75	75	75
Rmax 'behind' ejecting holes (m)	65	65	65	65	65	65	65	65	65	65	65	65
Minimum clearance distance behind angled holes (m)	150	150	150	150	150	150	150	150	150	150	150	150
FOS for ejection (distance/Lmax)	2.3	2.3	3.2	5.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Notes												
1 - Assuming no free faces orientated towards the Pacific Highway												
2 - Angled drilling up to 75 degrees allows for drilling errors and angled holes on the front row												

Figure 7 – Blast clearance zone around Stage 1 operations, Karuah South Quarry



4 MANAGEMENT & OPERATIONAL MEASURES

The following measures and controls are recommended to ensure effective operational blasting within appropriate constraints for fly-rock control.

- The development of a Blast Management Plan, and associated operating and monitoring procedures, record keeping systems and risk assessment processes, with specific consideration of fly-rock risks. The proximity to the Pacific Highway warrants tight control and additional monitoring to prevent undesired impacts. The blast clearance area around Stage 1 operations, shown in Figure 7, identifies where fly-rock risks are likely to be greatest and should be reviewed as part of an operational risk assessment.
- Appropriate supervision of all associated drilling and blasting processes, including:
 - excavation of overlying fill, to ensure appropriate bench preparation for drill & blast;
 - blast planning and design;
 - supervision of a tightly controlled blasting process (drilling, charging, stemming, tie-up, blast clearance and firing); and (iv) review of monitored blast outcomes, and
 - adjustment of blast designs and operational processes, to ensure OH&S and environmental compliance.
- Detailed recording and assessment of design depths, drilled depths, dipped depths, explosive column rise and charge mass, and stem height should be carried out for all blastholes in high-risk blasts. Designed and actual firing sequence should be recorded for each blast showing the blast orientation, initiation point, timing, and the location of the free face and any buffered face.
- Depending on the depth of overlying overburden, consideration should be given to whether to remove that material (down to a 'hard' floor), or leave some of it in place to create a uniform bench surface for drilling. Where hard rock is not present at the collar, stem height adjustments should be made, and the depth of weak or broken material should not be included in the stem height.
- Front-row holes should be surveyed and profiled to determine blasthole alignment with respect to a free face. Charging adjustments should be made for front-row holes with variable front-row burdens, partially blocked holes, or in the event of a lack of column rise. Overloaded holes should be rectified using an approved 'scoop' or purged to the correct stem height using water.
- Likely access points to the blast clearance area need to be risk assessed, in terms of being able to control the blast area before, during and after firing. Proper control of access to the blast clearance area may justify increasing blast clearance distances further than those specified in order to achieve effective control. The proximity of members of the public, during blast clearance and firing, needs to be controlled and the presence of spectators should be avoided.

- Evacuation and operational constraints for the quarry crushing and processing facilities (and adjacent land within the blast clearance zone) should be reviewed. Utilisation of safe 'refuge' facilities when blasting should be reviewed as part of a specific operational risk assessment.
- All blasts should be videoed for blast behaviour and fly-rock assessment, to ensure that control of the blasting process is being maintained. Maximum fly-rock range from the blast boundary should be estimated for each blast where possible, based on video records and observation, to validate typical blast behaviour and the reliability of fly-rock models and the factors of safety used in this assessment. Where fly-rock is identified at distances greater than the expected maximum range an investigation should be carried out and operational adjustments or additional controls may be required.
- Drill patterns beneath a previous blast should be laid out with an off-set, in order to avoid collaring in highly fragmented material around previous toe locations and potentially misfired explosives.
- If very shallow holes create unacceptable fly-rock risk, it may be necessary to make use of mechanical rock breaking equipment rather than blasting.
- The secondary blasting of oversize should be approached very cautiously, with small charges designed to split oversize into manageable pieces. Blasting oversize for a significant fragmentation result has high fly-rock and overpressure risks attached.

5 CONCLUSIONS AND RECOMMENDATIONS

The following main conclusions and recommendations are made, based on the assessment of available data using generic methods and the assumption of good blasting practice:

- Blasting at the Karuah South Quarry, should be achievable using standard blasting methods, modified for fly-rock control. In particular, effective face burdens and stem heights must be implemented in a controlled manner.
- Blasting should commence at the north-eastern end of the Stage 1 operations area, using conservative parameters, and free faces best orientated towards the north east, with suitably contained and buffered end-walls.
- Blasting should be well controlled, and monitored in order to demonstrate that reduced blast clearances are safely achievable as the quarry advances to the south-west where proximity to Blue Rock Close and the Pacific Highway is closest.
- The development of a Blast Management Plan and operating procedures should be carried out as part of risk assessed process, prior to implementation. Fly-rock must be considered as part of that process. Consider guidelines in the referenced material, with additional background information in Appendix E of the Australian Standard AS2187 (Reference #5), and within the AEISG Code of Practice for Blast Guarding (Reference #6).

6 REFERENCES

The following references have been used in preparing this report.

1. Karuah South Quarry EIS, RW Corkery & Co, March 2019.
2. Efficient Blasting Techniques Course, Blast Dynamics and Dyno Nobel, 1995 onwards.
3. Flyrock Range & Fragment Size Prediction, C.McKenzie, ISEE, 2009.
4. Golden Pike Cut-back Fly-rock Control and Calibration of a Predictive Model, A.Moore & A.Richards, November 2005.
5. Appendix E, Flyrock and Fly,Australian Standard for Explosives Storage and Use, AS2187.2-2006.
6. Blast Guarding in an Open Cut Mining Environment, AEISG Code of Practice, 2011.

END OF DOCUMENT

Appendix G

Relevant Extracts from the Updated Aboriginal Cultural Heritage Assessment & Updated Archaeological Report*

(Total No. of pages including blank pages = 30)

Prepared by Biosis Pty Ltd

* A full copy of this report has been provided to the B&CD of the DPIE and the Planning team of the DPIE.

This document presents tracked extracts of text and figures from the updated Aboriginal Cultural Heritage Assessment and Archaeological Reports that have been compiled since the original reports dated October 2018 were prepared. The updated text addresses the relevant comments presented in submissions received by DPIE during the exhibition of the EIS.

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Wedgerock Pty Ltd

ABN: 15 099 038 123

Karuah South Quarry

**Extract of additional text
inserted following a
supplementary survey
on 24 July 2019**

Aboriginal Cultural Heritage Assessment Report

Prepared by

Biosis Pty Ltd

September 2019

**Specialist Consultant Studies Compendium
Part 7a**

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EXECUTIVE SUMMARY

Biosis Pty Ltd was commissioned by RW Corkery & Co. Pty Ltd on behalf of Wedgerock Pty Ltd to undertake an Aboriginal cultural heritage assessment (ACHA) for a proposed hard rock Quarry, on the southern part of Lot 11 DP 1024564, Karuah, New South Wales (NSW). The Study Area for the proposed Project comprised the largely undisturbed area south of the adjoining Karuah Quarry. The Study Area is located in bushland approximately 4 kilometres northeast of Karuah and approximately 40 kilometres north of the Newcastle central business district (CBD).

There are 12 Aboriginal cultural heritage sites registered with the Aboriginal Heritage Information Management System (AHIMS) register in the vicinity of the Study Area, however, none of these are located within the Study Area. Biosis conducted an archaeological survey of the Study Area in May 2018 in the company of three Aboriginal RAPs. The overall effectiveness of the survey for examining the ground for Aboriginal sites was deemed low. This was attributed to vegetation cover restricting ground surface visibility combined with a low amount of rock exposures.

An additional survey of the southern portion of the Study Area was conducted on 24 July 2019. This survey focused on areas with higher potential to contain Aboriginal sites or objects such as drainage lines and flat landforms. The overall effectiveness of the survey for examining the ground for Aboriginal sites was deemed low. The southern portion of the Study Area was noted to consist of steep slopes leading into an incised creek line, and low lying flats which exhibited evidence of frequent water inundation. Sheet wash associated with high velocity water runoff was also noted throughout this portion of the Study Area. No Aboriginal objects were identified during the additional survey. Due to the unfavourable nature of the landforms present, along with the high levels of sheet wash observed within the southern portion of the Study Area, the entire Study Area has been assessed as having low archaeological potential. Discussions with the RAPs who attended both surveys also confirmed that the Study Area has no known stories or specific cultural value. RAPs who attended the survey indicated that Aboriginal sites are more likely to be identified within the flats closer to Karuah River.

No previously unrecorded Aboriginal cultural heritage sites were identified during the field survey. No areas of (archaeological) sensitivity were identified.

Consultation

The Aboriginal community was consulted regarding the heritage management of the proposed Project throughout its lifespan. Consultation has been undertaken as per the process outlined in the DECCW document, *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010a) (consultation requirements). The appropriate government bodies were notified and advertisements were placed in the Myall Coast News of the Area newspaper (25 January 2018), which resulted in the following Aboriginal organisations registering their interest (**Table 1**):

Table 1
List of registered Aboriginal parties (RAPs) and group contacts

Organisation	Contact person
Karuah Local Aboriginal Land Council (LALC)	Kelly Drinkwater
Didge Ngunawal	Lilly Carrol
Divine Diggers	Deidre Perkins

A search conducted by the Office of the Registrar, *Aboriginal Land Rights Act 1983* listed no Aboriginal Owners with land within the Study Area. A search conducted by the National Native Title Tribunal (NNTT) listed no Registered Native Title Claims, Unregistered Claimant Applications or Registered Indigenous Land Use Agreements within the Study Area. Upon registration, the Aboriginal parties were invited to provide their knowledge on the Study Area and on the proposal provided in the methodology for the survey and assessment. The responses identify the Study Area as an area of low significance. Responses from the RAPs are included in **Annexure 5**.

Several RAPs participated in the field survey and provided comment on the Study Area with regard to the proposed Project. The outcome of the consultation process was that the RAPs considered the Study Area to have a low level of cultural significance. RAPs who attended the additional survey indicated that Aboriginal sites are more likely to be identified within the flats closer to Karuah River. The results of the consultation process are included in this document.

The recommendations that resulted from the consultation process are provided below.

Management recommendations

Prior to any development impacts occurring within the Study Area, the following is recommended:

Recommendation 1: Discovery of unanticipated Aboriginal objects

All Aboriginal objects and places are protected under the *National Parks and Wildlife Act 1974* (NPW Act). It is an offence to knowingly disturb an Aboriginal site without a consent permit issued by the Office of Environment and Heritage (OEH). Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations. These may include notifying the OEH and Aboriginal stakeholders.

Recommendation 2: Discovery of Aboriginal ancestral remains

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity you must:

1. immediately cease all work at that location and not further move or disturb the remains;
2. notify the NSW Police and OEH's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location; and
3. not recommence work at that location unless authorised in writing by OEH.

Recommendation 3: Continued consultation with the registered Aboriginal stakeholders

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010), it is recommended that the Applicant provides a copy of this draft report to the RAPs and considers all comments received. The Applicant should continue to inform these groups about the management of Aboriginal cultural heritage sites within the Study Area throughout the life of the Project.

Recommendation 4: Lodgement of final report

Additional consultation will be undertaken to provide RAPs with the updated ACHA and AR following on from the additional survey. Once consultation has been completed, the ACHA and AR will be finalised and a copy of the final report will be sent to:

- The three RAPs; and
- the AHIMS database.

4.3 STAGE 3: GATHERING INFORMATION ABOUT CULTURAL SIGNIFICANCE

4.3.1 Archaeological assessment methodology information pack

On 4 March 2018, Biosis also provided the three RAPs with a copy of the Project methodology pack outlining the proposed ACHA process and methodology for this Project. RAPs were given 28 days to review and prepare feedback on the proposed methodology. A copy of the Project methodology pack is provided in **Annexure 4**.

No comments from RAPs were received at this stage of consultation.

4.3.2 Information gathered during fieldwork

RAPs who attended the survey conducted on 24 July 2019 indicated that Aboriginal sites are more likely to be identified within the flats closer to Karuah River. No information regarding any Aboriginal cultural heritage sites or places was gathered during fieldwork.

4.4 STAGE 4: REVIEW OF DRAFT ACHA REPORT

A copy of both the draft ACHA and AR reports was emailed to all RAPs on 11 December 2018. No further comments regarding the reports were received. Following on from the additional survey, the updated ACHA and AR was sent to all RAPs, and the consultation log in the ACHA updated to reflect this. The updated reports were emailed to all RAPs on 13 August 2019 but since this time no further comments regarding the changes was provided.

5. ABORIGINAL CULTURAL SIGNIFICANCE ASSESSMENT

The two main values addressed when assessing the significance of Aboriginal sites are cultural values to the Aboriginal community and archaeological (scientific) values. This report will assess the cultural values of Aboriginal sites in the Study Area. Details of the scientific significance assessment of Aboriginal sites in the Study Area are provided in **Annexure 6**.

5.1 INTRODUCTION TO THE ASSESSMENT PROCESS

Heritage assessment criteria in NSW fall broadly within the significance values outlined in the Australia International Council on Monuments and Sites (ICOMOS) Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance (Australia ICOMOS 2013) (the Burra Charter). This approach to heritage has been adopted by cultural heritage managers and government agencies as the set of guidelines for best practice heritage management in Australia. These values are provided as background and include the following.

- **Historical significance** (evolution and association) refers to historic values and encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section. A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place the significance will be greater where evidence of the association or event survives *in situ*, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.
- **Aesthetic significance** (Scenic/architectural qualities, creative accomplishment) refers to the sensory, scenic, architectural and creative aspects of the place. It is often closely linked with social values and may include consideration of form, scale, colour, texture, and material of the fabric or landscape, and the smell and sounds associated with the place and its use.
- **Social significance** (contemporary community esteem) refers to the spiritual, traditional, historical or contemporary associations and attachment that the place or area has for the present-day community. Places of social significance have associations with contemporary community identity. These places can have associations with tragic or warmly remembered experiences, periods or events. Communities can experience a sense of loss should a place of social significance be damaged or destroyed. These aspects of heritage significance can only be determined through consultative processes with local communities.
- **Scientific significance** (Archaeological, industrial, educational, research potential and scientific significance values) refers to the importance of a landscape, area, place or object because of its archaeological and/or other technical aspects. Assessment of scientific value is often based on the likely research potential of the area, place or object and will consider the importance of the data involved, its rarity, quality or representativeness, and the degree to which it may contribute further substantial information.

The cultural and archaeological significance of Aboriginal and historic sites and places is assessed on the basis of the significance values outlined above. As well as the Burra Charter significance values guidelines, various government agencies have developed formal criteria and guidelines that have application when assessing the significance of heritage places within NSW. Of primary interest are guidelines prepared by the Australian Government, the NSW OEH and the Heritage Branch, and the NSW Department of Planning and Environment (DPE). The relevant sections of these guidelines are presented below.

These guidelines state that an area may contain evidence and associations which demonstrate one or any combination of the Burra Charter significance values outlined above in reference to Aboriginal heritage. Reference to each of the values should be made when evaluating archaeological and cultural significance for Aboriginal sites and places.

In addition to the previously outlined heritage values, the OEH *Guidelines to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) also specify the importance of considering cultural landscapes when determining and assessing Aboriginal heritage values. The principle behind a cultural landscape is that 'the significance of individual features is derived from their inter-relatedness within the cultural landscape'. This means that sites or places cannot be 'assessed in isolation' but must be considered as parts of the wider cultural landscape. Hence, the site or place will possibly have values derived from its association with other sites and places. By investigating the associations between sites, places, and (for example) natural resources in the cultural landscape the stories behind the features can be told. The context of the cultural landscape can unlock 'better understanding of the cultural meaning and importance' of sites and places.

Although other values may be considered – such as educational or tourism values – the two principal values that are likely to be addressed in consideration of Aboriginal sites and places are the cultural/social significance to Aboriginal people and their archaeological or scientific significance to archaeologists and the Aboriginal community. The determinations of archaeological and cultural significance for sites and places should then be expressed as statements of significance that preface a concise discussion of the contributing factors to Aboriginal cultural heritage significance.

5.2 CULTURAL (SOCIAL SIGNIFICANCE) VALUES

Cultural or social significance refers to the spiritual, traditional, historical and/or contemporary associations and values attached to a place or objects by Aboriginal people. Aboriginal cultural heritage is broadly valued by Aboriginal people as it is used to define their identity as both individuals and as part of a group (DECCW 2010a, p.iii). More specifically it provides a:

- 'connection and sense of belonging to Country' (DECCW 2010a, p.iii);
- link between the present and the past (DECCW 2010a, p.3);
- a learning tool to teach Aboriginal culture to younger Aboriginal generations and the general public (DECCW 2010a, p.3); and
- further evidence of Aboriginal occupation prior to European settlement for people who do not understand the magnitude to which Aboriginal people occupied the continent (DECCW 2010a, p.3).

It is acknowledged that Aboriginal people are the primary determiners of the cultural significance of Aboriginal cultural heritage. RAPs who attended the survey on 24 July 2019 indicated that Aboriginal sites are more likely to be identified within the flats closer to Karuah River. No further information regarding cultural values within the Study Area have been received from the RAPs.

5.3 HISTORIC VALUES

Historic significance refers to associations a place or object may have with a historically important person, event, phase or activity to the Aboriginal and other communities. The Study Area is not known to have any historic associations.

5.4 ARCHAEOLOGICAL (SCIENTIFIC SIGNIFICANCE) VALUES

An archaeological scientific assessment was undertaken for the Study Area and is presented in detail as part of the attached Archaeological Report (**Annexure 6**). No Aboriginal sites or Potential Archaeological Deposits (PADs) were identified within the Study Area and no previously recorded sites are located within, or in close proximity to the Study Area. There is a low likelihood of Aboriginal cultural heritage with archaeological (scientific) value occurring within the Study Area. The scientific significance of the entire Study Area is therefore assessed as low.

5.5 AESTHETIC VALUES

Whilst the Study Area is relatively undisturbed and is a typical example of the Port Stephens hinterland in its natural context, the northern part of Lot 11 DP 1024564 has been highly disturbed by quarrying, resulting in substantial modification of original landforms. The natural landscape features of the moderate-steep and lower slopes of an unnamed hill gradually descending to a minor drainage line feeding into the headwaters of Yalimbah Creek are still evident. The Study Area has been subject to historic logging, and is covered in dense regrowth vegetation. Very few old growth trees were noted during the field survey. The Study Area has been assessed as having low aesthetic significance.

5.6 STATEMENT OF SIGNIFICANCE

No Aboriginal sites or PADs were identified within the Study Area and no previously recorded sites are located within, or in close proximity to the Study Area. The archaeological significance of the Study Area has been assessed as low. This is because the landforms present (predominantly moderate to steep slopes and open depression); the lack of sandstone outcropping suited to shelter or engraving; the considerable distance of the less disturbed parts of the Study Area to permanent water sources; the widespread presence of shallow soils; and the major disturbances to the ground surface in the northern part of the Lot mean that the Study Area is unlikely to retain intact or extensive evidence of past Aboriginal use.

No specific information on the cultural significance of the Study Area has been provided by the RAPs. The historic and aesthetic significance of the Study Area have both been assessed as low. Overall, the study demonstrates low Aboriginal cultural heritage significance.

REFERENCES

Australia ICOMOS 2013. *The Burra Charter: the Australia ICOMOS Charter for Places of Cultural Significance*, Australia ICOMOS, Burwood, VIC.

DECCW 2010a. *Aboriginal Cultural Heritage Consultation Requirements for Proponents*, Department of Environment and Climate Change, Sydney NSW.

DECCW 2010b. *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*, Department of Environment and Climate Change, Sydney NSW.

OEH 2011. *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*, Office of Environment and Heritage.

Annexure 2

Consultation Log

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SUBMISSIONS REPORT

Report No. 958/05

WEDGEROCK PTY LTD

Karuah South Quarry

STAGE 1 Notifications		Contacted By		Date	Method	Notes
Organisation	Person	Organisation	Person			
Office of Environment and Heritage		Biosis	Amy Butcher	19/01/2018	Email	
NNTT		Biosis	Amy Butcher	19/01/2018	Email	
NTS		Biosis	Amy Butcher	19/01/2018	Email	
Registra		Biosis	Amy Butcher	19/01/2018	Email	
Midcoast Council		Biosis	Amy Butcher	19/01/2018	Email	
KaruahLALC		Biosis	Amy Butcher	19/01/2018	Email	
Biosis	Amy Butcher	NNTT		19/01/2018	Email	
Biosis	Amy Butcher	Registra	Jodie Rikiti	23/01/2018	Email	
Biosis	Amy Butcher	OEH	Peter Saaid	24/01/2018	Email	
AGA Services	Ashley, Gregory, Adam Sampson	Biosis	Amy Butcher	9/02/2018	Email	
Cacatua Culture	Donna and George Sampson	Biosis	Amy Butcher	9/02/2018	Email	
Crimson-Rosie	Jeffery Matthews	Biosis	Amy Butcher	9/02/2018	Email	
Divine Diggers	Deidre Perkins	Biosis	Amy Butcher	9/02/2018	Email	
Hunters and Collectors	Tania Matthews	Biosis	Amy Butcher	9/02/2018	Email	
Karuah Indigenous corporation	David Feeney	Biosis	Amy Butcher	9/02/2018	Email	
Kawul (Wonn1 sites)	Arthur Fletcher	Biosis	Amy Butcher	9/02/2018	Email	
Lakkari NTCG	Mick Leon	Biosis	Amy Butcher	9/02/2018	Email	
Lower Hunter Aboriginal Inc.	David Ahoy	Biosis	Amy Butcher	9/02/2018	Email	
Lower Hunter Wonnarua	Lea-Anne Ball	Biosis	Amy Butcher	9/02/2018	Email	
Murra Bidgee Mullangari	Ryan Johnson	Biosis	Amy Butcher	9/02/2018	Email	
Didge Ngunawal Clan	Paul Boyd	Biosis	Amy Butcher	9/02/2018	Email	
Worimi LALC		Biosis	Amy Butcher	9/02/2018	Email	
Biosis	Amy Butcher	Karuah LALC	kelly Drinkwater	1/02/2018	Email	Registering interest
Biosis	Amy Butcher	Didge Ngunawal	Lilly Caroll	9/02/2018	Email	Registering interest
Biosis	Amy Butcher	Divine Diggers	Deidre Perkins	9/02/2018	Email	Registering interest

Stage 2 Project Information Mail Out		Contacted By			
Organisation	Person	Organisation	Person	Date	Method
Karuah LALC	Kelly Drinkwater	Biosis	Amanda Markham	4/03/2018	Letter
Didge Ngunawal	Lilly Caroll	Biosis	Amanda Markham	4/03/2018	Email
Divine Diggers	Deidre Perkins	Biosis	Amanda Markham	4/03/2018	Email

Stage 3 Project Methodology Mail Out		Contacted By			
Organisation	Person	Organisation	Person	Date	Method
Karuah LALC	Kelly Drinkwater	Biosis	Amanda Markham	4/03/2018	Letter
Didge Ngunawal	Lilly Caroll	Biosis	Amanda Markham	4/03/2018	Email
Divine Diggers	Deidre Perkins	Biosis	Amanda Markham	4/03/2018	Email

Field Survey Contact Log							
Organisation	Person	Contacted By Organisation	Person	Date	Method	Notes	Additional Comments
Karuah LALC	Kelly Drinkwater	Biosis	Ashleigh Keevers-Eastman	1/05/2018	Email	Email response received after phone call on same day	Confirmed that a KLALC rep would be available in mid-May for the field survey
Karuah LALC	Kelly Drinkwater	Biosis	Amanda Markham	15/05/2018	Email	Email response received after phone call on same day	Email with KLALC, confirming costs, date of survey (16/5/2018), availability of RAPs and site logistics.
<u>Karuah LALC</u>	<u>Bill Fisher</u>	<u>Biosis</u>	<u>Ashleigh Keevers-Eastman</u>	<u>19/07/2019</u>	<u>Email and phone call</u>	<u>Phone call confirmed details of email on same day</u>	<u>Email with KLALC confirming availability for 2 representatives for field survey for 24 July 2019, and phone call discussed details of survey</u>

Field Survey Contact Log							
Organisation	Person	Contacted By Organisation	Person	Date	Method	Notes	Additional Comments
<u>Biosis</u>	<u>Taryn Gooley and Madeleine Lucas</u>	<u>Karuah LALC</u>	<u>Colleen Perry and Kyrin Simms</u>	<u>24/07/2019</u>	<u>In person</u>	<u>Email response received after phone call on same day</u>	<u>RAPs who attended the survey indicated that Aboriginal sites are more likely to be identified within the flats closer to Karuah River.</u>

Wedgerock Pty Ltd

ABN: 15 099 038 123

Karuah South Quarry

**Extract of additional text
inserted following a
supplementary survey
on 24 July 2019**

Archaeological Report

Prepared by

Biosis Pty Ltd

September 2019

**Specialist Consultant Studies Compendium
Part 7a – Annexure 6**

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EXECUTIVE SUMMARY

Biosis Pty Ltd was commissioned by RW Corkery & Co. Pty Ltd on behalf of Wedgerock Pty Ltd to undertake an Aboriginal cultural heritage assessment for a proposed hard rock Quarry, on the southern part of Lot 11 DP 1024564, Karuah, New South Wales (NSW) (the Study Area). The Study Area is located in bushland approximately 4 kilometres northeast of Karuah and approximately 40 kilometres north of the Newcastle central business district (CBD). There are 12 Aboriginal cultural heritage sites registered with the Aboriginal Heritage Information Management System (AHIMS) a 5 x 5 kilometre area surrounding the Study Area, however, none of these are located within the Study Area.

The Aboriginal community was consulted regarding the heritage management of the proposed Project throughout its lifespan. Consultation has been undertaken in accordance with the process outlined in the Department of Environment, Climate Change, and Water (DECCW) document, *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010a) (consultation requirements). The survey was conducted on 17 May 2018. The overall effectiveness of the survey for examining the ground for Aboriginal sites was deemed low. This was attributed to vegetation cover restricting ground surface visibility (GSV) combined with a low amount of exposures. No previously unrecorded Aboriginal cultural heritage sites were identified during the field survey. No areas of (archaeological) sensitivity were identified.

An additional survey of the southern portion of the Study Area was conducted on 24 July 2019. This survey focused on areas with higher potential to contain Aboriginal sites or objects such as drainage lines and flat landforms. The overall effectiveness of the survey for examining the ground for Aboriginal sites was deemed low. The southern portion of the Study Area was noted to consist of steep slopes leading into an incised creekline, and low lying flats which exhibited evidence of frequent water inundation. Sheet wash associated with high velocity water runoff was also noted throughout this portion of the Study Area. No Aboriginal objects were identified during the additional survey. Due to the unfavourable nature of the landforms present, along with the high levels of sheet wash observed within the southern portion of the Study Area, the entire Study Area has been assessed as having low archaeological potential. Discussions with the RAPs who attended both surveys also confirmed that the Study Area has no known stories or specific cultural value. RAPs who attended the survey indicated that Aboriginal sites are more likely to be identified within the flats closer to Karuah River. The proposed Project will therefore not impact on Aboriginal cultural heritage values.

Strategies have been developed based on the archaeological (significance) of cultural heritage relevant to the Study Area. The strategies also take into consideration:

- predicted impacts to Aboriginal cultural heritage;
- the planning approvals framework; and
- current best conservation practice, widely considered to include:
 - ethos of the Australia International Council on Monuments and Sites (ICOMOS) Burra Charter; and
 - the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010) (the code).

The recommendations that resulted from the consultation process are provided below.

Management recommendations

Prior to any development impacts occurring within the Study Area, the following is recommended:

Recommendation 1: Discovery of Unanticipated Aboriginal Objects

All Aboriginal objects and places are protected under the *National Parks and Wildlife Act 1974* (NPW Act). It is an offence to knowingly disturb an Aboriginal site without a consent permit issued by the Office of Environment and Heritage (OEH). Should any Aboriginal objects be encountered during works associated with this proposal, works must cease in the vicinity and the find should not be moved until assessed by a qualified archaeologist. If the find is determined to be an Aboriginal object the archaeologist will provide further recommendations. These may include notifying the OEH and Aboriginal stakeholders.

Recommendation 2: Discovery of Aboriginal Ancestral Remains

Aboriginal ancestral remains may be found in a variety of landscapes in NSW, including middens and sandy or soft sedimentary soils. If any suspected human remains are discovered during any activity you must:

1. Immediately cease all work at that location and not further move or disturb the remains
2. Notify the NSW Police and OEH's Environmental Line on 131 555 as soon as practicable and provide details of the remains and their location
3. Not recommence work at that location unless authorised in writing by OEH.

Recommendation 3: Continued consultation with the registered Aboriginal stakeholders

In accordance with the consultation requirements (DECCW 2010), it is recommended that the Applicant provides a copy of this draft report to the Registered Aboriginal Parties (RAPs) and considers all comments received. The Applicant should continue to inform these groups about the management of Aboriginal cultural heritage sites within the Study Area throughout the life of the Project.

Recommendation 4: Lodgement of Final Report

A copy of the final report will be sent to:

- the three RAPs; and
- the AHIMS database.

1.5 INVESTIGATORS AND CONTRIBUTORS

The roles, previous experience and qualifications of the Biosis Project team involved in the preparation of this archaeological report are described below in **Table 1**.

Table 1
Investigators and Contributors

Page 1 of 3

Name and Qualifications	Experience Summary	Project Role
Amanda Atkinson BA (Hons) , GDip	Amanda has ten years' archaeological consulting experience across south-eastern and western Australia. She is experienced in all aspects of heritage consulting with specialisation in Aboriginal archaeology. Amanda has extensive experience in the successful completion of Aboriginal and historical assessments, archaeological surveys, excavations, permits and management plans. She is accomplished in obtaining approvals under the NPW Act. Amanda has primarily undertaken projects in south-eastern Australia and the Pilbara region of Western Australia and has a detailed understanding of heritage values within the Sydney Basin, Cumberland Plain and Hunter Valley. Amanda specialises in the archaeology of central and far western NSW, with particular research interests in riverine and lacustrine environments. Amanda specialises in water infrastructure and linear projects having undertaken heritage assessment for many of the major water infrastructure projects in NSW. She has operated as the heritage consultant within large multidisciplinary teams tasked with delivering Environmental Impact Statements (EIS) under the EP&A Act, Amanda is a diligent and highly experienced heritage consultant with extensive experience in Project management. She is easily able to develop excellent working relationships with Project stakeholders and manage and negotiate the relationship between Aboriginal stakeholders, government regulators and clients.	• Quality control

Table 1 (Cont'd)
Investigators and Contributors

Page 2 of 3

Name and Qualifications	Experience Summary	Project Role
Dr Amanda Markham BA Hons, PhD (Anthropology), Grad. Cert (Archaeology)	Amanda Markham has over 20 years' experience in Anthropology and Archaeology throughout Australia, including extensively in remote outback Australia. Her Project experience includes working for Aboriginal representative bodies, mining and exploration companies, Commonwealth, state and territory government agencies, community groups and Indigenous stakeholder groups. Over her career Amanda has developed a deep understanding of Aboriginal people and culture and has extensive experience providing advice on Aboriginal cultural heritage management. Amanda's particular areas of expertise include cultural heritage management field work in remote areas with Aboriginal Traditional Owners, conducting heritage assessments under state and territory legislation, skeletal remains assessment and conducting archaeological and anthropological surveys and assessments. Amanda has proven staff and Project management skills and ability to simultaneously oversee multiple large complex projects to deliver client outcomes within tight time frames and budget constraints. Amanda's excellent communication and negotiation skills have seen her easily managing and building relationships between Aboriginal people and senior government and corporate figures.	• <u>Lead cultural heritage advisor</u> • Project management • Report writing
Taryn Gooley BA/Sci (Hons) Archaeology	Taryn is a consultant archaeologist with seven years' experience across south eastern NSW and Western Australia. Taryn has a particular interest in Aboriginal archaeology of North Western NSW, and the Hunter Valley and Newcastle regions. Taryn has experience in the successful completion of Aboriginal Cultural Heritage assessments, archaeological surveys, test excavations, and salvage excavations, as well as Aboriginal community consultation. She is also accomplished in obtaining approvals under the NPW Act and Heritage Act 1977.	• Field investigations

Table 1 (Cont'd)
Investigators and Contributors

Page 3 of 3

Name and Qualifications	Experience Summary	Project Role
Ashleigh Keevers-Eastman BA (Hons) Ancient History and Classical Languages	Ashleigh has recently joined Biosis at the Newcastle Office as a Research Assistant. She completed her Honours in Ancient History and Classical Languages in 2016, having written a comparative study on the Imperial models for civic patronage during the Age of Augustus within Rome and Pompeii. Ashleigh possesses experience in desktop research as a Volunteer Research Assistant for the Cultural Collections at the University of Newcastle. Her research with the Cultural collections involved the location and transcription of Aboriginal sites in the NSW region. Ashleigh has also undertaken field work in Gotland, Sweden, as a volunteer. She excavated a site known as Paviken III to obtain evidence that would support or oppose the presence of Viking settlement and harbour side/trade activity within the area in relation to previous excavations carried out within the area (Paviken I, Paviken II). She is now looking forward to developing her professional career with Biosis with an interest in Aboriginal Cultural Heritage and Archaeology.	• Project management support • Background research

5. ARCHAEOLOGICAL SURVEY

A field survey of the Study Area was undertaken on 17 May 2018 by Biosis archaeologist, Taryn Gooley in the company of Aboriginal RAPs, Ron Tisdell and Colleen Perry from the Karuah LALC. A supplementary survey was conducted for the southern portion of the Study Area on 24 July 2019 by Biosis archaeologists Taryn Gooley and Madeleine Lucas, and representatives of the Karuah LALC, Colleen Perry and Kyron Simms. The field survey sampling strategy, methodology and a discussion of results are provided below.

5.1 ARCHAEOLOGICAL SURVEY OBJECTIVES

The objectives of the survey were to:

- provide RAPs an opportunity to view the Study Area and to discuss previously identified Aboriginal object(s) and/or place(s) in or within close proximity to the Study Area;
- to undertake a systematic survey of the Study Area targeting areas with the potential for Aboriginal heritage sites;
- identify and record Aboriginal archaeological sites visible on the ground surface; and
- identify and record areas of PADs.

5.2 ARCHAEOLOGICAL SURVEY METHODOLOGY

The survey methods were designed to assess and understand the landforms and to determine whether any archaeological material from Aboriginal occupation or land use exists within the Study Area.

5.2.1 Sampling Strategy

The survey effort targeted all landforms within the Study Area. Particular attention was given to stands of remnant native vegetation with the potential to contain modified trees and areas of higher visibility such as tracks and areas of disturbance around buildings. The supplementary survey focused on the southern portion of the Study Area, where a number of small drainage lines are located.

5.2.2 Survey Methods

The archaeological survey undertaken on 17 May 2018 was conducted on foot and by vehicle with a field team of three members. The supplementary survey was conducted on foot with a field team of four members. The pedestrian survey followed the random meander method, and target areas of visibility such as access tracks, vegetation clearings, and areas of erosion. The supplementary survey targeted the southern portion of the Study Area and the flats surrounding the creek lines. Recording during the survey followed the archaeological survey

requirements of the code and industry best practice methodology. Information that was recorded during the survey included:

- Aboriginal objects or sites present in the Study Area during the survey;
- survey coverage;
- any resources that may have potentially been exploited by Aboriginal people;
- landform;
- photographs of the site indicating landform;
- evidence of disturbance; and
- Aboriginal artefacts, culturally modified trees or any other Aboriginal sites.

Where possible, identification of natural soil deposits within the Study Area was undertaken. Photographs and recording techniques were incorporated into the survey including representative photographs of survey units, landform, vegetation coverage, GSV and the recording of soil information for each survey unit were possible. Any potential Aboriginal objects observed during the survey were documented and photographed. The locations of Aboriginal cultural heritage and points marking the boundary of the landform elements were recorded using a hand-held Global Positioning System and the Map Grid of Australia (94) coordinate system.

5.3 ARCHAEOLOGICAL SURVEY RESULTS

A total of four random transects were walked across the three landforms present within the Study Area as part of the survey conducted on 17 May 2018 (**Figure 6**). The three surveyors walked two metres apart (**Figure 7**). Access tracks were driven to points of exposure. This follows the methodology set out in Burke and Smith (2004, p. 65) which states that a single person can only effectively visually survey an area of two linear metres. No Aboriginal sites or PADs were identified in the Study Area during the initial survey. The results from the field survey have been summarised in **Table 7** and full transect details are provided in **Figure 7**. Generally, the survey was restricted by poor GSV and narrow survey transects in most areas due to dense vegetation.

One random meander transect was walked across the entire southern portion of the Study Area during the supplementary survey conducted on 24 July 2019. The four surveyors walked approximately 2 metres apart. The survey was hampered by poor GSV due to dense vegetation cover.

5.3.1 Survey Constraints

The Study Area comprised a very steep hillside covered largely in dense vegetation with visibility across most of the site being 0% (**Plate 4** and **Plate 5**). Opportunities to examine the ground surface primarily occurred along old logging and graded tracks and occasional cleared patches in the proximity of two sheds on the lot (**Plate 6**). Areas of exposure, within which visibility approached 60-100%, were targeted for their increased potential to contain visible Aboriginal cultural features. The majority of these exposures had been subject to, and were created by, some disturbance from clearing, grading, excavation, sheet wash erosion or building construction.

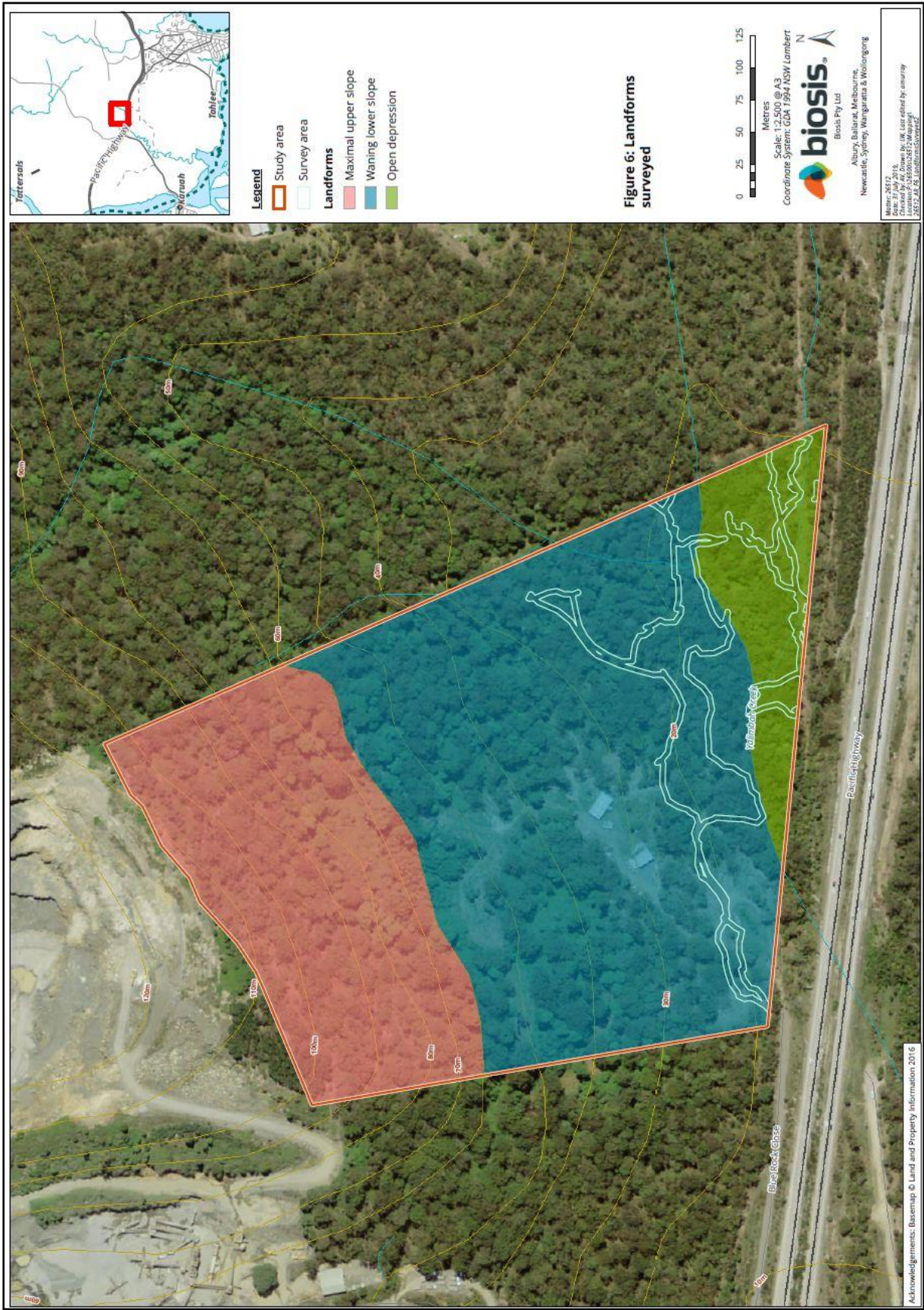


Figure 6 Landforms Surveyed

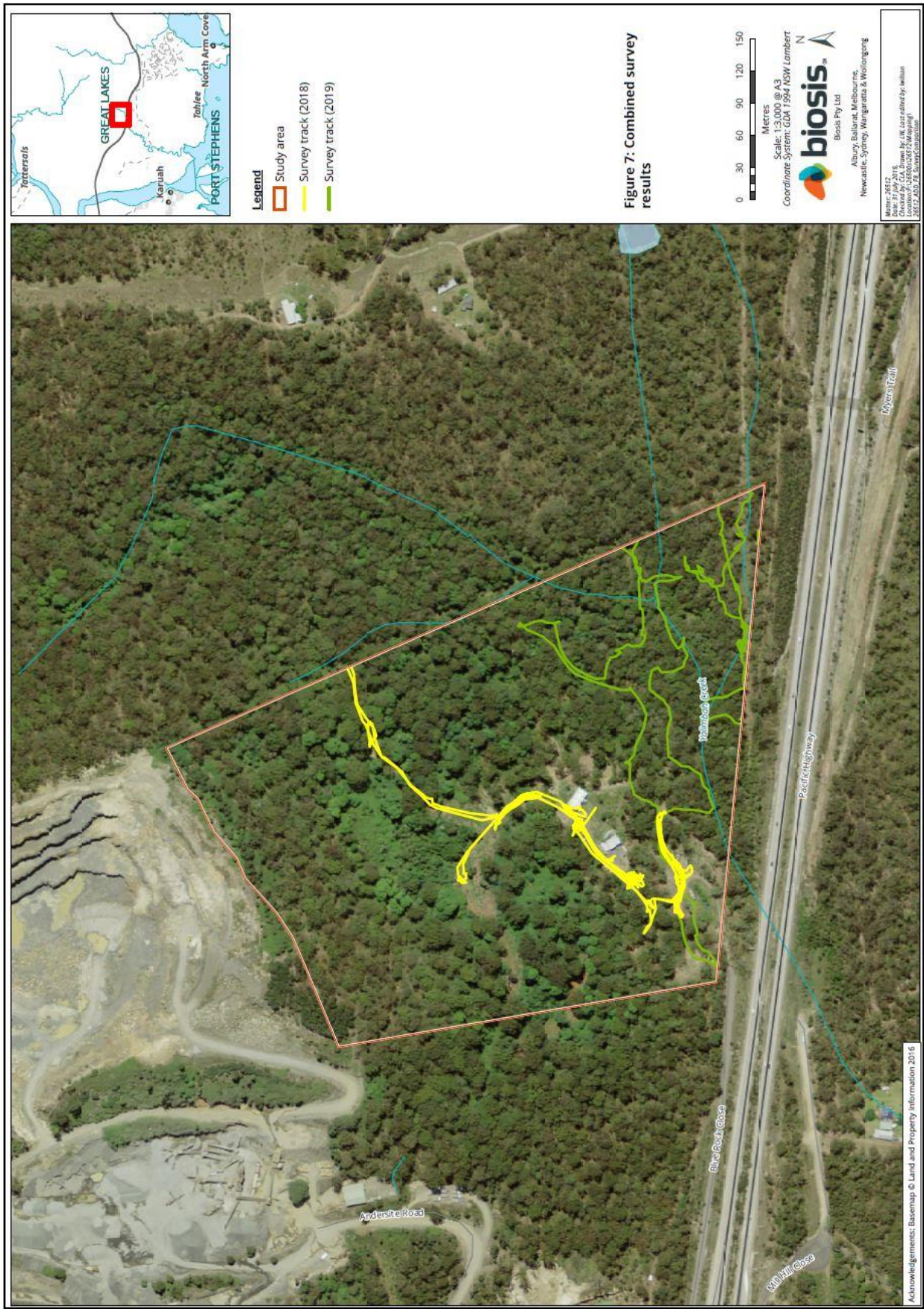


Figure 7 Combined Survey Results

Disturbance in the Study Area was associated with both natural and human agents. Natural agents generally affect small areas and include the burrowing and scratching in soil by animals, such as foxes, rabbits and kangaroos, and sometimes exposure from slumping or scouring. Human disturbances within the Study Area included previous logging, the grading of access tracks, building of sheds and other small structures, areas of gravel and fill (**Plate 7**, **Plate 8** and **Plate 9**). Evidence of extensive sheet wash associated with high velocity water runoff was observed throughout the southern portion of the Study Area. The construction of the Pacific Highway and Blue Rock Close has resulted in modification of the landscape, and the creek lines adjacent to the southern boundary of the Study Area. The installation of services has also resulted in high levels of ground disturbance at the southern boundary of the Study Area.

5.3.2 Discussion of Archaeological Survey Results

The initial archaeological survey was conducted on 17 May 2018 with a field team of three members. A total of four transects were walked across the three landforms across the Study Area (**Figure 6**). The survey was hampered by poor surface visibility across its entirety, and did not identify any Aboriginal sites, modified trees or PADs within the Study Area. The landforms surveyed and results are summarised in **Table 7** and **Table 8**.

As the landform and dense vegetation was uniform across the entire Study Area, the survey effort was targeted on areas of increased visibility such as tracks, gravel scapes, logged areas, and other exposures. The results of the survey were expected to be representative of the entire Study Area, and it was concluded that Aboriginal heritage sites are unlikely to occur within the Study Area. This conforms broadly with the predictive model, where Aboriginal sites are more likely to occur in areas adjacent to permanent fresh water sources and other resource gathering sites. Given the absence of the features in the landscape, it was determined that Aboriginal people were unlikely to have intensively use the Study Area.

The soil profiles in both the Gan Gan and Nungra soil landscapes are generally shallow, and given that activities such as logging and land clearance have historically taken place within the Study Area, there is limited opportunity for subsurface archaeological deposit to have survived.

A supplementary survey was conducted on 24 July 2019 at the request of OEH focussing on the southern portion of the Study Area. The purpose of this supplementary survey was to inspect the creek lines and associated flat landforms within this portion of the Study Area and to determine if the southern portion of the Study Area contained potential for Aboriginal sites or objects to be present. Due to the dense vegetation present throughout the Study Area, a single meander transect was walked throughout the entire southern portion of the Study Area. Topographic maps indicate that the southern portion consists of mid and lower slopes and an open depression. Yalimbah Creek and three of its tributaries are also shown as being within or immediately adjacent to the Study Area. The survey confirmed a very small drainage depression is located along the eastern portion of the Study Area within a steep midslope landform unit. This small drainage depression meets Yalimbah Creek within the lower slope/open depression landform. Yalimbah Creek consists of a small incised drainage line; it flows through the southern portion of the Study Area and has been heavily modified within the south western portion, where it has been diverted to flow under the Pacific Highway and Blue Rock Close. These modifications have resulted in water pooling in portions of the creek line, which prior to the modification of the drainage line would likely have flowed only during rainfall

events. The third tributary noted on the topographic map as running adjacent to the southernmost boundary was not present within the Study Area. It is likely this drainage line is actually the manmade drainage channel which runs alongside Blue Rock Close.

The southern portion of the Study Area slopes from the east in a south-westerly direction, and from the north in a southerly direction creating a moderately incised open depression landform surrounding Yalimbah Creek. The vegetation present within this portion of the Study Area is consistent with Swamp Mahogany *Eucalyptus robusta* – flax leaved paperbark swamp forest, with a closed mid and ground story of sedges and rushes suggesting frequent inundation within the locality. This portion of the Study Area was noted to be highly uneven and was also wet underfoot despite limited rainfall events occurring within the region in the weeks prior to conducting the survey.

Large amounts of debris such as branches, leaf litter and soil within portions of the creek line, along with the very steep slopes located through the majority of the Study Area indicate that runoff on the slopes rapidly reports to the creek line which, due to the topography, then conveys high velocity discharge for a short duration. This suggests that, on the slopes, soils are highly unstable and unlikely to preserve evidence of Aboriginal occupation in the archaeological record. The presence of unfavourable landforms such as a frequently inundated open depression, along with very steep slopes throughout the Study Area also suggest the Study Area was unlikely to have been used by Aboriginal people for anything other than resource gathering. The Study Area has therefore been assessed as having low potential to contain Aboriginal archaeological objects or sites.

Table 7
Survey Coverage

Survey Unit	Landform	Survey unit area (m ²)	Visibility (%)	Exposure (%)	Effective coverage area (m ²)	Effective coverage (%)
1	Maximal upper slope	53505	5%	5%	35	0.06
2	Waning lower slope	107967	5%	5%	4923	4.56
3	Open depression	17345	5%	5%	2638	15.21
TOTAL		178817	-	-	7596	19.83

Table 8
Landform Summary

Landform	Landform area (m ²)	Area effectively surveyed (m ²)	Landform effectively surveyed (%)	No. of Aboriginal sites	No. of artefacts or features
Maximal upper slope	53505	35	0.06	0	0
Waning lower slope	107967	4923	4.56	0	0
Open depression	17345	2638	15.21	0	0

6. ANALYSIS AND DISCUSSION

An AHIMS search encompassing 5 x 5 kilometres centred on the Study Area returned 12 previously recorded Aboriginal sites, none of which were located within the Study Area. The predominant site types in the search area comprise artefact scatters and scarred (modified) trees. The majority of these sites are located adjacent to watercourses, most notably the Karuah River, but also along minor fresh watercourses and in resource-rich areas such as the Port Stephens coast. The closest previously recorded sites are an isolated artefact and a modified (scarred) tree, approximately 1.1 kilometres and 1.5 kilometres south-east, respectively, of the Study Area, nearer to water sources. Both sites are situated in low-lying areas near either swamps or watercourses.

The results of the archaeological survey remain broadly consistent with the predictive statements made for this assessment, with artefact sites of higher density being located in closer proximity to higher stream order creek lines and scarred (modified) trees being present where land clearing and logging have not taken place, or selected mature trees bearing scars have survived such activities. Other sites such as shell middens have been located adjacent to coastal areas. Areas of steep, hilly country were predicted to have low potential for Aboriginal sites to be present.

The results of the survey of the Study Area are similar to other previous archaeological investigations undertaken in the Karuah area indicating that, whilst Aboriginal people visited and utilised the area, areas of hilly country were not intensively occupied. In particular, RPS (2011) undertook archaeological investigations on Lots 12 and 13, DP 1024564, directly adjacent to the current Study Area, within no Aboriginal cultural sites being identified. The survey carried out by RPS was on a similar landform comprising a steep, simple slope, densely vegetated and subject to disturbance from logging and land clearing. RPS also noted patterns of traditional land use by Aboriginal people, land disturbance and poor visibility as potential explanations for the lack of sites. The current Study Area has been similarly subject to disturbance from land clearing and logging, with dense regrowth of vegetation hampering visibility. Finally, as the Study Area is consists of a steep, simple slope and a moderately incised open depression almost 1 kilometre from a reliable water source, the lack of cultural material fits broadly into the patterns of occupation described both above and within Section 4 of this report.