

Appendix 4

Environmental Risk Assessment

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ENVIRONMENTAL RISK ASSESSMENT

Risk is the chance of something happening that would have an impact upon the objectives or the task, which in this case is the construction and operation of the Karuah South Quarry without unacceptable environmental impact. Risk is measured in terms of consequence (severity) and likelihood (probability) of an event happening.

A preliminary environmental risk assessment, prepared in accordance with Australian and International Standards HB 203:2012, HB 89:2012 and IEC/ISO 31010:2009 was undertaken to identify environmental issues that may be affected by the Project. Risk sources, potentially affected residences or environments, potential consequences and specific potential impacts were then identified. A review of the proposed operations, the local environment and other factors was undertaken to identify the likely consequence and likelihood of each potential environmental impact.

The level of risk was initially established assuming the implementation of standard mitigation measures within the quarrying industry. In some cases, it was accepted that the standard mitigation measures would be adequate to achieve an acceptable level of impact without the need for any additional controls or mitigation measures.

The determination of consequence was based on the definitions contained in **Table A4.1**. The likelihood or probability of each impact occurring was then rated according to the definitions contained in **Table A4.2**.

The risk associated with each environmental impact was initially assessed without the inclusion of any specific operational controls or systems or mitigation measures in place (other than standard mitigation measures). Based on the assessment of consequence and likelihood, an overall risk ranking of Negligible, Minor, Moderate, Major or Severe was assigned to each potential impact based on the matrix of **Table A4.3**.

Following the review of all relevant, environmental issues, the Project Design and the outcomes from the community consultation, the preliminary risk ratings were reviewed and adjusted to reflect the specific mitigation measures proposed to achieve the required levels of impact of the Project.

The results of the risk analysis are presented in **Table A4.4**.

Table A4.1
Qualitative Consequence Rating

Level	Severity Level	Consequence Types						
		Financial	Health and Safety	Natural Environment	Social/ Cultural Heritage	Government Regulation	Public / Community Relations	Legal
1	Negligible	<\$10,000	No injury or review required	Minor impact on biological or physical environment	Minor social issues, repairable damage	Minor incident (Non-reportable) (passes the 'no material harm' assessment)	Minor adverse local public or media attention or complaints	
2	Minor	\$20,000 - \$100,000	First aid treatment required but no lost time or restricted duties	Short-term impact not affecting ecosystem functions	Minor medium-term social impacts on local population. Mostly repairable	Reportable incident (administrative or with minimal material harm) (minimal threat of action by regulator)	Attention from media and/or heightened concern by local community	Isolated complaint / incident with a threat of legal action
3	Moderate	\$100,000 - \$1M	Medical treatment leading to lost time or restricted duties	Short term impairment of ecosystem affecting function	On-going social issues, damage to items of cultural significance	Reportable incident (notable material harm or repeat of previous incident) (real threat of action by regulator)	Adverse media / public / NGO attention	Significant level of complaints / incidents with a high threat of legal action
4	Major	\$1M-\$5M	Hospitalisation required leading to permanent injury	Medium term impairment of an ecosystem	Significant social issues, significant damage to structures / items of cultural significance	Reportable incident (major material harm) (action by regulator almost certain)	Major public embarrassment / adverse media coverage	Serious breach of regulation leading to litigation
5	Severe	>\$5.0M	Fatality	Long-term impairment of ecosystem	On-going serious social issues, major permanent impact to cultural and heritage sites	Reportable incident (extensive material harm) (severe action by regulator almost certain)	Serious public or media outcry (national coverage) /major reputation impact	Significant prosecution and fines, litigation including class action
Source: Rating modified after HB 89:2012 and HB 203:2012								

Table A4.2
Qualitative Likelihood Rating

Level	Descriptor	Description
A	Certain	Is an ongoing occurrence or will occur under all conditions
B	Almost Certain	Is expected to occur in most circumstances
C	Likely	Will probably occur in most circumstances
D	Possible	Will probably occur under favourable circumstances
E	Unlikely	May occur, but only under favourable circumstances
F	Rare	Not expected to occur, unless subject to exceptional circumstances
G	Very Rare	Theoretically possible but not expected to occur

Source: Rating modified after HB 89:2012 – Figure B7

The four levels of risk that have been identified for this Project (see **Table A4.3**) are defined as follows.

- Low (L): can be managed by routine procedures and unlikely to require specific application of resources.
- Medium (M): can be managed to minimise the potential for environmental harm by the implementation of specific monitoring programs and response procedures. Responsibility for the implementation of monitoring and management activities must be specified.
- High (H): requires the development of specific management or action plans identifying specific monitoring, trigger levels for contingency management and specification as to the roles and responsibilities of personnel to implement contingency management. Senior executive management attention is required to ensure appropriate resources are available to manage this risk.
- Very High (VH): presents a risk which may not be able to be satisfactorily managed by the development and implementation of management plans. Board attention needed to identify alternative methods of operation to reduce the risk to a level where it can be satisfactorily managed.

Table A4.3
Risk Ranking

Likelihood	Consequences				
	1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe
A Certain	M	H	H	VH	VH
B Almost Certain	M	M	H	VH	VH
C Likely	M	M	H	H	VH
D Possible	L	M	M	H	H
E Unlikely	L	L	M	M	H
F Rare	L	L	L	M	M
G Very Rare	L	L	L	L	M

Source: Modified after HB 89:2012 - Figure B8

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Table A4.4
Risk Analysis

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Risk Source(s)	Receiver / Surrounding Environment	Potential Consequence	Potential Impact (Assuming Mitigation Measures Adopted)	Consequence	Likelihood	Risk	Proposed Mitigation Measures EIS Section Ref.
AIR QUALITY AND GREENHOUSE GAS							
- Dust from extraction and processing operations, stockpiles and exposed surfaces. - Dust from vehicle movements within the Quarry infrastructure area or the Quarry Access Road.	Residences / water tanks.	Increased deposited dust and associated nuisance for local residents / sediment water tanks.	Nuisance/amenity impacts from dust deposited on water tanks, window sills, cars, etc.	Minor (2)	Possible (D)	M	5.1.7
	Local residents and landowners.	Increased particulate matter (in particular PM ₁₀ and PM _{2.5}) in the atmosphere.	Adverse health impacts (if levels are excessive).	Major (4)	Unlikely (E)	M	
		Complaints to the Operator by community.	Community and regulatory scrutiny.	Minor (2)	Possible (D)	M	
	Surface water bodies.	Reduction in local water quality.	Exceedance surface water quality.	Minor (2)	Unlikely (E)	L	
	Surrounding native vegetation.	Reduction in vegetation or mortality.	Reduced condition of local vegetation or value as fauna habitat.	Moderate (3)	Rare (F)	L	
Particulate and greenhouse emissions from vehicles and fixed and mobile plant.	Local and regional air shed.	Increase in greenhouse gas emissions to atmosphere.	Contribution to greenhouse effect.	Negligible (1)	Certain (A)	M	
Respirable silica within dust from extraction and processing operations, stockpiles and exposed surfaces.	Residents living on surrounding landholdings	Increase in concentrations of respirable silica in the atmosphere.	Adverse health impacts such as a respirable disease.	Major (4)	Very Rare (G)	L	
NOISE AND VIBRATION							
Noise from extraction and processing plant.	Local residents and landowners.	Increased noise levels.	Noise levels cause annoyance and/or distractions.	Moderate (3)	Unlikely (E)	M	5.2.5
		Impacts on the health and well-being of local residents.	Noise levels can cause adverse effects on physical or mental health.	Major (4)	Unlikely (E)	M	
		Complaints to Operator by community.	Community and regulatory scrutiny.	Moderate (3)	Possible (D)	M	
	Native fauna.	Detrimental effects on local fauna.	Relocation of and/or reduction of local native fauna species due to noise disturbance.	Moderate (3)	Possible (D)	M	
			Possible loss of species in the local area.	Moderate (3)	Rare (F)	L	
Noise from trucks transporting quarry products off site.	Local residents and landowners.	Increased noise levels.	Noise levels can cause annoyance and/or distractions.	Moderate (3)	Unlikely (E)	M	
		Impacts on the health and well-being of local residents.	Noise levels can cause adverse effects on physical or mental health.	Moderate (3)	Rare (F)	L	
		Complaints to Operator by community.	Community and regulatory scrutiny.	Moderate (3)	Unlikely (E)	M	
Vibration from extraction and blasting operations on site.	Local residents, business and landowners.	Nuisance/amenity impacts on surrounding landowners / residents.	Reduced local amenity.	Minor (2)	Unlikely (E)	L	
		Structural damage to buildings and structures.	Structural damage to buildings and structures.	Moderate (3)	Rare (F)	L	
		Complaints to Operator by community.	Community and regulatory scrutiny.	Minor (2)	Unlikely (E)	L	
VISIBILITY							
Changes in the visual character of the locality.	Surrounding residents.	Visibility of the quarry from local residences.	Decreased visual amenity of local setting.	Minor (2)	Unlikely (E)	L	5.3.4
	Motorists (Pacific Highway).	Visibility of the quarry.	Decreased visual amenity.	Minor (2)	Certain (A)	H	

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Table A4.4 (Cont'd)
Risk Analysis

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Risk Source(s)	Receiver / Surrounding Environment	Potential Consequence	Potential Impact (Assuming Mitigation Measures Adopted)	Consequence	Likelihood	Risk	Proposed Mitigation Measures EIS Section Ref.
TRAFFIC							
• Ongoing traffic levels on the public road network.	• Motorists on the Pacific Highway.	• Truck traffic and possible congestion.	• Inconvenience to commuters.	Minor (2)	Unlikely (E)	L	5.4.4
			• Increased risk of accidents occurring.	Major (4)	Unlikely (E)	M	
		• Deterioration of road surface.	• Accelerated road pavement deterioration.	Minor (2)	Rare (F)	L	
	• Residences in the vicinity of the Quarry.	• Truck traffic and vehicle noise/emissions.	• Reduced amenity of local area (noting presence of nearby traffic on the Pacific Highway).	Minor (2)	Unlikely (E)	L	
	• Native fauna.	• Death or injury to native animals on the road network.	• Loss of species in local area.	Negligible (1)	Possible (D)	L	
TERRESTRIAL ECOLOGY							
• Clearing of vegetation.	• Regional biota.	• Reduction in remnant native vegetation.	• Reduction in local biodiversity.	Moderate (3)	Possible (D)	M	5.5.4
		• Loss of local and regionally important threatened species (flora and fauna).	• Local or regional reduction in distribution of threatened species, populations and EECs.	Minor (2)	Almost Certain (B)	M	
		• Reduced local and regional biodiversity.	• Loss of biodiversity and alteration to existing habitat.	Minor (2)	Almost Certain (B)	M	
• Detrimental indirect effects of Project impacts, e.g. noise, dust, lighting.	• Locally occurring species, populations and communities.	• Dispersal of locally occurring species and populations away from the Site.	• Reduced biodiversity value of the Site and local setting.	Moderate (3)	Possible (D)	M	
		• Reduced potential for use of the Site by threatened species, populations and EECs.	• Reduced local distribution of threatened species, populations and EECs.	Moderate (3)	Possible (D)	M	
AQUATIC ECOLOGY							
• Discharge of dirty or contaminated water.	• Local creeks and tributaries.	• Decreased water quality.	• Detrimental effects to flora and fauna.	Moderate (3)	Rare (F)	L	5.5.4 5.6.3 5.7.4
			• Sedimentation or major hydrocarbon pollution event impacting on aquatic ecosystem for medium to long term.	Major (4)	Very Rare (G)	L	
• Detrimental indirect effects of Project impacts, e.g. reduced flow, changes to geomorphic function.	• Locally occurring species, populations and communities. • Downstream wetland.	• Reduced potential habitat for threatened species and populations. • Impacts on oyster farming.	• Reduced local distribution of threatened species and populations.	Moderate (3)	Unlikely (E)	L	
			• Degradation of riparian or aquatic vegetation / ecosystems	Moderate (3)	Unlikely (E)	L	
SURFACE WATER							
• Reduction in environmental flows through on-site capture of water.	• Yalimbah Creek Catchment	• Reduced natural surface water flows.	• Reduced flows to Yalimbah Creek.	Minor (2)	Unlikely (E)	L	5.6.3
	• Downstream water users.	• Reduced natural surface water flows.	• Reduced availability of water to downstream users.	Minor (2)	Unlikely (E)	L	
	• Local flora, terrestrial and aquatic fauna.	• Reduced volume of water available to local flora and fauna.	• Stress and possible reduction in viability of native vegetation.	Moderate (3)	Rare (F)	L	
			• Degradation of riparian or aquatic vegetation/ecosystems.	Moderate (3)	Rare (F)	L	
• Discharge of dirty or contaminated water.	• Local creeks and tributaries.	• Decreased water quality.	• Temporary sedimentation or hydrocarbon pollution of downstream waters.	Moderate (3)	Rare (F)	L	
			• Ongoing sedimentation or major hydrocarbon pollution of downstream waters.	Major (4)	Very Rare (G)	L	
	• Site soils and vegetation.	• Contamination of soil resources.	• Reduced potential for future land uses.	Minor (2)	Unlikely (E)	L	
	• Local and regional catchment ecosystem.	• Introduction of a toxic compound to the environment.	• Pollution of local waterways resulting in detrimental effects to flora and fauna.	Moderate (3)	Rare (F)	L	

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Risk Source(s)	Receiver / Surrounding Environment	Potential Consequence	Potential Impact (Assuming Mitigation Measures Adopted)	Consequence	Likelihood	Risk	Proposed Mitigation Measures EIS Section Ref.
GROUNDWATER							
• Reductions in groundwater flow.	• Local groundwater users.	• Reduction in the volume of water contained within local aquifers / availability.	• Reduced yields of groundwater bores.	Minor (2)	Unlikely (E)	L	5.7.4 5.11.2
	• Local streams, creeks and rivers.	• Reduction in base flows / spring flows.	• Reduced discharge to receiving systems.	Minor (2)	Rare (F)	L	
			• Degradation of riparian or aquatic vegetation/ecosystems.	Moderate (3)	Unlikely (E)	L	
			• Reduced availability of water to downstream users.	Minor (2)	Rare (F)	L	
• Terrestrial Groundwater dependent ecosystems.	• Reduced availability of groundwater.	• Degradation of terrestrial groundwater dependent ecosystems.	Moderate (3)	Very Rare (G)	L		
• Groundwater contaminated with hydrocarbons.	• Local users of groundwater (none within 3km).	• Reduced groundwater quality.	• Reduced availability to local users.	Minor (2)	Very Rare (G)	L	
	• Terrestrial Groundwater dependent ecosystems.	• Reduced groundwater quality.	• Degradation of terrestrial groundwater dependent ecosystems.	Moderate (3)	Very Rare (G)	L	
	• Local streams, creeks, rivers and aquatic habitat.	• Local surface water bodies become contaminated.	• Reduced availability of water to downstream users.	Minor (2)	Very Rare (G)	L	
		• Degradation of habitat quality.	• Degradation of riparian or aquatic vegetation / ecosystems.	Moderate (3)	Very Rare (G)	L	
ABORIGINAL CULTURAL HERITAGE							
• Removal or destruction of known Aboriginal sites and/or artefacts.	• Local archaeological setting.	• Damage or destruction of Aboriginal artefacts or site.	• Destruction of identified site.	Moderate (3)	Very Rare (G)	L	5.8.5
			• Cumulative reduction of the in situ archaeological record.	Moderate (3)	Very Rare (G)	L	
• Removal or destruction of currently unidentified Aboriginal sites and/or artefacts.	• Local archaeological setting.	• Damage or destruction of Aboriginal artefacts or site.	• Destruction of site not yet identified on archaeological record.	Moderate (3)	Rare (F)	L	
			• Cumulative reduction of the in situ archaeological record.	Moderate (3)	Rare (F)	L	
HISTORIC HERITAGE							
• Removal or destruction of sites of heritage significance due to proposed activities.	• Local archaeological setting.	• Loss or damage to heritage sites.	• Loss or destruction of items of heritage significance.	Moderate (3)	Very Rare (G)	L	5.8.5
SOILS							
• Loss of soil resources as a result of land preparation activities.	• Site soil resources.	• Reduced soil resource to undertake appropriate rehabilitation program.	• Rehabilitation outcomes not meeting objectives.	Minor (2)	Unlikely (E)	L	5.10.3
• Degradation of soil resources as a result of stockpiling.	• Site soil resources.	• Compromised soil quality leads to poor vegetation regrowth on site.	• Reduced standard of revegetation.	Minor (2)	Unlikely (E)	L	
• Erosion as a result of vegetation clearing, from stockpiles or following soil replacement during rehabilitation.	• Site soil resources.	• Loss of soil resources.	• Rehabilitation outcomes not meeting objectives.	Minor (2)	Unlikely (E)	L	
	• On and off-site surface water bodies.	• Sedimentation of on-site and local surface water bodies resulting in poor water quality.	• Increased erosion on the final landform.	Minor (2)	Unlikely (E)	L	

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Risk Source(s)	Receiver / Surrounding Environment	Potential Consequence	Potential Impact (Assuming Mitigation Measures Adopted)	Consequence	Likelihood	Risk	Proposed Mitigation Measures EIS Section Ref.
ECONOMIC							
• Discharge of sediment-laden or contaminated water.	• Local creeks and tributaries.	• Decreased water quality.	• Temporary sedimentation or hydrocarbon pollution of downstream waters.	Moderate (3)	Rare (F)	L	5.6.5 5.11.2 5.5.4 5.12.4
			• Ongoing sedimentation or major hydrocarbon pollution of downstream waters.	Major (4)	Very Rare (G)	L	
			• Perceived or real impacts on oyster farming operations in the Karuah River Estuary	Major (4)	Very Rare (G)	L	
	• Site soils and vegetation.	• Contamination of soil resources.	• Reduced potential for future land uses and remediation costs.	Moderate (3)	Rare (F)	L	
	• Local and regional catchment ecosystem.	• Introduction of a toxic compound to the environment.	• Pollution of local waterways resulting in detrimental effects to flora and fauna and remediation costs.	Moderate (3)	Rare (F)	L	
• Increase in local employment	• Local community and residents.	• Employment of quarry personnel and contractors.	• Improvement of economic well-being with the LGA.	Positive Impact			
• Supply of crushed hard rock aggregates and construction materials	• Hunter and Greater Sydney Regions	• Provision of cost-competitive hard rock aggregates and construction materials	• Downward pressure on regional infrastructure and construction projects.	Positive Impact			
SOCIAL							
• Increase in local employment.	• Local community and residents.	• Employment of quarry personnel and contractors.	• Improvement of economic well-being within the LGA.	Positive Impact			5.13.4
			• Change in local community structure as a result of income disparity.	Negligible (1)	Unlikely (E)	L	
			• Inability of existing services and infrastructure to meet needs of community.	Negligible (1)	Rare (F)	L	
• Impacts associated with local amenity such as noise, visual or dust impacts.	• Local community and residents.	• Loss of amenity.	• Changes to an individual's experience of a place or of their home.	Moderate (3)	Likely (C)	H	
			• Negative impacts to way of life and in extreme cases community interactions and cohesion.	Moderate (3)	Unlikely (E)	M	
			• Devaluation of personal property.	Moderate (3)	Rare (F)	L	
• Proximity of quarry to local and neighbouring properties.	• Local community and residents.	• Perceived / loss of amenity at local and neighbouring properties.	• Change of social activities in local communities and impact on feelings of well-being derived from associated location.	Moderate (3)	Rare (F)	L	
• Detrimental impacts to land values.	• Local landowners.	• Perceived / loss of land values arising from quarry's operation.	• Reduction in land values.	Moderate (3)	Rare (F)	L	
• Community fears and concerns for the future exacerbated by perceived inability to adapt or be involved in decisions that affect their lives	• Local community and residents.	• Feeling that the community has no control over matters that directly affect their lives	• Fears for the future and future generations and feelings of helplessness.	Moderate (3)	Possible (D)	M	
• Detrimental impacts to agricultural resources.	• Local business and landowners.	• Loss of agricultural resources (land and water)	• Loss of income	Moderate (3)	Very Rare (G)	L	

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Risk Source(s)	Receiver / Surrounding Environment	Potential Consequence	Potential Impact (Assuming Mitigation Measures Adopted)	Consequence	Likelihood	Risk	Proposed Mitigation Measures EIS Section Ref.
REHABILITATION							
• Rehabilitated soils and vegetation of the Site.	• Future land use.	• Soils and vegetation quality and suitability for future use is compromised or restricted.	• Rehabilitation outcomes do not meet objectives.	Moderate (3)	Possible (D)	M	2.12
	• Surrounding residents.	• Poor rehabilitation.	• Reduced amenity of the final landform.	Minor (2)	Unlikely (E)	L	
• Final land use of the Site.	• Surrounding residents.	• Altered landforms.	• Reduced amenity of the final landform resultant from altered topography.	Minor (2)	Unlikely (E)	L	
	• Future land use.	• Landform unsuitable for proposed final land use.	• Final land use incompatible with surrounding landscape.	Moderate (3)	Unlikely (E)	M	
BUSH FIRE							
• Initiation of bush fire due to on Site activities.	• Local residents, business and landowners.	• Health and safety impacts to employees and residents.	• Loss of life, assets and property on site and in surrounding area.	Major (4)	Rare (F)	M	5.11.3
		• Reduction of operating performance for the Site and surrounding businesses.	• Property damage and impacts on production.	Major (4)	Rare (F)	M	
	• Native flora and fauna.	• Destruction and damage of native flora and fauna.	• Reduced biodiversity value of the Site.	Major (4)	Rare (F)	M	

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