Boral Cement Limited
ABN: 62 008 528 523

Boral Cement – Berrima Works Blue Shale Quarry Rehabilitation Management Plan ML 1723

July 2022

Summary Table

Name of Mine	Boral Cement – Berrima Works Blue Shale Quarry
Rehabilitation Management Plan commencement date	2 July 2022
Rehabilitation Management plan revision dates and version numbers	2 July 2022, Version 1
Leases and expiry dates	ML 1723, expiry 18th December 2036
Lease Holder	Boral Cement Limited
Date of submission	1 July 2022

Table of Contents

Appendices

List of Plans

1. Introduction

1.1 Purpose

This Rehabilitation Management Plan (RMP) covers the ongoing operation of a shale quarry associated with the Boral Berrima Cement plant which is known as the Boral Cement – Berrima Works Blue Shale Quarry (hereafter "Shale Quarry").

This Rehabilitation Management Plan (RMP) has been prepared in accordance with Clause 9 of Schedule 8A to the Mining Regulation 2016, and recognises that ongoing environmental obligations are required to be met including continued environmental monitoring, management and rehabilitation at the site.

Shale is an essential component of clinker manufacture which involves kiln firing of a premixed blend of limestone, shale, iron ore and solid fuel such as coal. Once fired the resulting material is known as clinker which is then finely ground with other additives such as gypsum to regulate setting time in order to produce cement. Two types of shale are used at Shale Quarry which is sourced from the on-site quarry and yellow shale which is brought in by road and rail with the limestone from the Marulan South Limestone Mine, although other sources are used from time to time.

This RMP covers the operation of the on-site Shale Quarry and supports the current Mining Lease ML1723. The new mining lease covers the same extent as the previous Private Mining Agreement No 4 Wollongong (Mining Act 1973) which was granted in 1977.

1.2 History of Operations

The site of the Berrima Cement Plant was chosen in the late 1920's due to easy access to deposits of Ashfield Shale coupled with rail access from a limestone deposit in Marulan and coal mining operations at Medway. The Berrima Cement works was commissioned in 1929 and was initially supplied with shale from local quarries up until 1934 when the on site extraction of clay shale commenced. As a large proportion of the Berrima Cement works is located on an outcrop of Ashfield Shale, extraction initially occurred adjacent to each kiln which were subsequently infilled as the cement works expanded.

The current extraction area commenced in 1977 as part of the commissioning of Kiln 6 but also supplied kilns 4 and 5 until gradually phased out. Since the mid 1970s, clinker production increased from 750,000 tpa to the current 1.56 Mtpa. Year on year production has however varied considerably in response to the wider building and construction industry as well as specific large scale construction projects in NSW.

Approximately 20% of clinker is clay shale however not all the clay shale used in Kiln 6 is derived from the on site quarry. Specific coloured cement runs are produced using a white clay shale from Marulan from time to time as there is no white clay shale available on site.

1.3 Current Consents, Authorisations and Licences

The Shale Quarry operates under the Kiln 6 Consent (DA 401-11-2002) and subsequent modifications. Prior to this consent, the extraction of clay shale on site occurred under existing use rights provisions of the Environmental Planning and Assessment Act 1979. The Kiln 6 consent (as modified) allows for all ancillary on site activities necessary for the production of up to 1.56 Mtpa of clinker. At this rate, the anticipated peak production from the Shale Quarry would be approximately 320,000 tpa.

The operation of the Shale Quarry is also covered by Environment Protection Licence 1698 which includes the scheduled activity "land-based extractive industry". The scale of the extractive activities is specified at less than 500,000 tpa extracted, processed or stored. The EPL provides for a range of environmental monitoring activities which include dust gauges which would collect dust emissions from the extraction, transport and storage of shale on site.

1.4 Land Ownership and Land Use

The Shale Quarry is located on Lot 1 DP582277 (125 Taylor Ave, New Berrima) in the Parish of Bong Bong, County Camden. The land is owned by Boral along with the adjoining cement works and associated properties. The predominant land use has been cement manufacture, extractive industry and associated raw material stockpiling for over 90 years. There is also a significant buffer area of land not directly used by the cement plant and includes areas of tree screens, landscaping and improved pasture. Cattle grazing and horse agistment occurs under lease arrangements with neighbouring agricultural properties which include paddocks immediately to the south and west of the shale quarry.

1.5 Consultation

The Berrima Cement Plant undertakes quarterly public meetings which are widely advertised and where all aspects of the operation are covered. This is an open forum which has enabled the wider community to engage with local Boral management. Although no specific issues have been raised regarding the operation of the quarry on site, key issues of concern to the local residents include:

- ❒ Dust generated from the entire site but with specific reference to fine dust from the cement plant operation;
- ❒ Traffic generation and the conduct of drivers; and
- ❒ Noise from specific activities on site.

Boral also engages with regulatory authorities on a semi regular basis, usually involving new or amended approvals associated with the cement plant. The key agencies that are consulted include:

- ❒ Resources Regulator
- ❒ Environment Protection Authority.
- ❒ Water NSW.
- ❒ NSW Department of Planning, Industry and Environment.

❒ Wingecarribee Shire Council.

Ongoing liaison has occurred with the Inspector of Mines in relation to ongoing day to day activities at the Shale Quarry. Inspections have occurred from time to time and the content of the current Safety Management Plan has been inspected and discussed with the Mines Inspectorate.

In late 2020, the Resources Regulator undertook a series of Targeted Assessment Programs (TAPs) at mines across NSW. The TAPs were developed by the Resources Regulator to focus on critical controls across mine sites to ensure measures have been identified and implemented to facilitate sustainable rehabilitation outcomes. As a result of this program, the Berrima Blue Shale Quarry was inspected by the Resources Regulator who made a number of recommendations identified below in Table 1.1.

Table 1.1 Resources Regulator Targeted Assessment Program – Soils Management

Recommendation	Comments / Location in RMP
1. The mine does not have clearly defined processes/ procedures for recovery and storage of soil resources. The mine should define an inventory of soil resources and other rehabilitation materials to ensure the needs for rehabilitation to the final land use can be met.	Section 7.2.4 of the RMP provides additional information on topsoil resources, quality and volumes. Stockpile locations have been revised and shown on Plan 2. A topsoil balance is provided indicated an estimate of topsoil remaining within the approved quarry final footprint plus stockpiled topsoil and an estimated of topsoil demand.
2. The mine does not have clearly defined processes for vegetation clearing, including maximising recovery and re-use of beneficial materials. The mine should document and implement pre-clearance procedures to maximise the salvage of topsoil and biological resources (e.g. habitat trees, mulch).	A tree clearing protocol has been included in Section 3.2.10.
3. There is limited characterisation of soil resources within existing topsoil stockpiles. The mine should develop and implement measures to protect and maintain biological resources (topsoil, subsoil seed bank, plant material, logs, hollows etc.) for use in rehabilitation.	Section 5.1.5 of the RMP covers ongoing soil management including testing addition of ameliorants to ensure soil quality is suitable to achieve sustainable vegetation communities. There are very limited vegetation clearing required for the remainder of the quarry life.
4. The mine should identify and implement selective handling and management of mine materials (e.g. overburden, tailings, reject materials etc.) to address potential geochemical and geotechnical constraints for rehabilitation.	The RMP plans have been updated to include current and future topsoil stockpile locations.
5. Weed management at the site appears to be ad hoc and some areas with excessive weed growth were identified, notably some blackberry near the newest topsoil stockpile. The mine should ensure that control measures are validated via monitoring or inspections, and results are recorded, to ensure that risks are appropriately addressed.	Section 3.2.13 discusses weed controls and a monthly environmental inspection.

6. The rehabilitation area referred to as 'Domain 5 - Transitional Rehabilitation' (Plan 2 of the Mining Operations Plan), on the western side of the access road located north-west of the quarry had some areas of exposed coal material and evidence of erosion caused by surface water runoff. The mine should consider ecological enhancement works in the area referred to as 'Domain 5 - Transitional Rehabilitation' (Plan 2 of the Mining Operations Plan), on the western side of the access road located north-west of the quarry, to improve topsoil cover in-between trees that have been directly planted into shale. Water management in this area should also be reviewed and updated to reduce erosion which has affected some parts of this area.	Ecological enhancement works for Domain 5 are discussed in Section 5.1.5. Some raw materials have been stored adjacent to the access road from time to time. This area has been cleaned up but will also be subject to additional rehabilitation work to correct some minor erosion and topsoil improvements. Existing drainage provisions are considered adequate however areas of erosion will be corrected and the resulting disturbed area revegetated with improved pasture.
7. The mine has not adequately identified the range of risks associated with materials and soils management and appropriate controls are not in place to facilitate sustainable rehabilitation outcomes.	Additional risk management initiatives have been included in Chapter 3.
8. A formalised weed assessment and management program should be developed and implemented.	Section 3.2.13 provides additional management of weeds, a program for weed controls and a monthly environmental inspection program.

2. Final Land Use

2.1 Regulatory Requirements for Rehabilitation

Kiln 6 Consent (DA 401-11-2002) does not contain any specific conditions in relation to rehabilitation of the quarry, nor does Environment Protection Licence 1698 which includes the scheduled activity "land-based extractive industry". The regulatory framework for the rehabilitation therefore rests solely with the Mining Act and Mining Regulation. Under the current mining lease conditions, the Shale Quarry must:

- ensure mining operations are carried out in accordance with an approved mining operations plan (MOP) that has been prepared in accordance with the departmental guidelines; and

- submitting an annual rehabilitation report in accordance with the departmental guidelines that provides a review of the progress of rehabilitation against the performance measures and criteria established in the approved MOP.

The rehabilitation requirements are therefore covered solely by the MOP, and now the RMP as contained in this document. This RMP does not seek to alter any of the rehabilitation objectives or completion criteria as previously approved by the Resources Regulator. These are listed in

2.2 Project Description

The current Shale Quarry site for at least the last past 50 years. The original mine plan was provided to the then Department of Mines on 30th March 1977 has been reproduced as the final pit limit on Plan 3c. Although this is the final mine stage and is referred to as Year 20, given the variable production rate, it is likely that the quarry life will extend well beyond the current 20 year extraction plan.

The current quarry footprint is shown on Plan 3a. This extraction area represents Year 1 under this RMP but represents over 40 years of extraction. The existing quarry covers an area of approximately 15 ha and has been developed by a series of benches of between 6 and 7 m in depth with an intervening 5 m wide berm with batter slopes at 1:1.

The initial bench through the overlying overburden above the shale is generally less than 4.5 m deep with shallower batter slopes of 1:2.5 (V:H) which takes into account the softer overlying material. The target Ashfield Shale extends to a depth of at least RL 632m which will give an extraction depth of approximately 30m.

Extraction is currently occurring at RL 645m and the pit will need to extend to the west in order to develop the lower benches. The next extension area is shown on Plan 3b. Further extensions will occur to the north and west in order to develop the final lower benches as shown on Plan 3c. The extraction orientation is along the strike of the shallow dipping shale resource in order to reduce the volume of overburden produced.

2.3 Asset Register

The primary asset is the resource. The extraction operation occurs by a separate contractor using the following equipment:

- ❒ One D9 Dozer for ripping and pushing the material;
- ❒ One D8 Dozer used primarily for pushing as well as managing the material stockpiles;
- ❒ One 980 front end loader for loading trucks;
- ❒ Two to three road registered semi trailers to transport the material to the shale storage shed.

Other than the front end loader, all equipment is owned by contractors. The front end loader is owned by Boral but is also tasked with other material handling operations around the cement plant.

There are no processing facilities associated with the Shale Quarry. The material extracted is stored in a separate shed and is fed into a raw material crusher with other materials used to manufacture clinker.

All buildings and associated facilities fall within the cement plant operation and are not part of the Shale Quarry. The relevant domains for the quarry are discussed in the following section.

2.3.1 Final Land Use and Mining Domains

The quarry has been divided up into six Primary Domains which cover operating domains and three Secondary Domains which are rehabilitation domains. These are listed below and discussed in further detail in Chapter 5. As the quarry is associated with the Berrima Cement Works, there are no infrastructure, offices, workshop and processing areas.

Primary Domains

- ❒ Domain 1 - Active extraction area
- ❒ Domain 2 – Unshaped material, storage areas and haul roads
- ❒ Domain 3 – Pre-strip and overburden removal
- ❒ Domain 4 - Water management and drainage
- ❒ Domain 5 – Water storage
- ❒ Domain 6 – Topsoil stockpiles

Secondary Domains

- ❒ Domain A – Landform establishment, completed batters
- ❒ Domain D1 – Ecosystem Sustainability – Southern Highlands Shale Woodland
- ❒ Domain D2 – Undisturbed land – pasture

As the site has no defined infrastructure areas, tailings or overburden emplacements, these Domains have been excluded. The domains are shown on Plan 2.

2.4 Mining Activities over the RMP Term

The proposed operation of the quarry will not alter from previous years as described in the following sections.

2.4.1 Exploration

As the Shale Quarry has been in operation for many years, the resource is well known and understood. However, some ongoing exploration will be undertaken as necessary to identify the extent and depth of the Ashfield Shale resource and the location of the Minchinbury Sandstone above and Hawkesbury Sandstone below the shale.

Exploration activities will include a combination of drilling and test pitting both within the existing extraction area and in advance of pre-stripping for new extraction benches. Although previous exploration work has identified the floor of the shale at RL 632m it has yet to be reached within the current pit. As the shale is known to have a slight dip to the south-west and sits unconformably above the Hawkesbury Sandstone, more intense exploration activities will be needed once the extraction reaches its final bench in order to remove the entire resource without dilution.

2.4.2 Construction

No construction activities are proposed during the term of this RMP. There are current no infrastructure facilities associated with the Shale Quarry and none are proposed in the future. All infrastructure required forms part of the cement plant operation.

2.4.3 Mining Methods

The shale is extracted by a series of shallow benches by dozer ripping then pushing up into piles which are then loaded onto trucks for transport to the storage shed. Generally bench height is approximately 7 m with an intervening 5 m berm. Batter slopes are 1:1 or 45 degrees.

Pre-stripping new areas utilises the same mining equipment however topsoil is either transported and spread over prepared final surfaces or stockpiled for later use in rehabilitation. Overburden material not suitable for clinker production is separated and used for backfilling and final shaping as well as other rehabilitation areas around the cement plant. The land will be cleared a maximum of one campaign ahead, according to the following steps, where possible:

- ❒ Pre-mining audit checklist where all environmental responsibilities are identified and these works are scheduled for capital expenditure.
- ❒ All vegetation from the stripped area should be placed into haul trucks and relocated onto prepared rehabilitation areas on site.
- ❒ The uppermost 10 centimetres of soil, known as the seed bank soil, will stockpiled separately or spread onto prepared surfaces immediately.
- ❒ The second layer of sub-soil will be stripped and stockpiled or used for rehabilitation purposes.

- ❒ Overburden clays not suitable for clinker production and with vegetation matter throughout will be used for bund construction.
- ❒ When rehabilitating areas, where possible, the overburden is laid down first, then the sub-soil, then the seed bank soil and finally the trees and vegetation laid perpendicular to the slope face so that erosion is minimised and trespassers are discouraged to disturb these areas.

The current extraction area is shown in Plate1.

Plate 1 - Current extraction area showing ripped shale pushed up ready for loading

2.4.4 Overburden, Waste and Residues

There are no process residues produced by the operation. All materials useable for clinker production will be extracted and transported to the clay shale storage sheds. From here the material is crushed and blended with other raw materials used in clinker production. These downstream processing activities form part of the cement plant operation and not subject to this RMP.

Overburden, consisting largely of the surface expression of Minchinbury Sandstone has been used for the initial bund construction around the eastern side of the quarry void. This area has been rehabilitated. The depth of overburden is generally less than 5 m above the subcrop of the Ashfield Shale resource. The extraction plan has been designed to follow this subcrop line in order to minimise overburden production.

2.4.5 Decommissioning and Demolition Activities

No decommissioning or demolition activities will occur during the term of this RMP.

2.4.6 Temporary Stabilisation

There is one external emplacement of materials, consisting largely of topsoil and subsoil material which has been temporarily revegetated. This emplacement will eventually be excavated and spread over final completed berms within the extraction area. As the extraction area moves very slowly, there is little need for ongoing temporary revegetation activities.

2.4.7 Progressive Rehabilitation and Completion

Areas currently available for rehabilitation are the external bunding and disturbed areas not associated with ongoing extraction. These areas have been previously rehabilitated. Over the term of this RMP, the two far western benches will become available for final rehabilitation activities. As the quarry extends to the east, the upper eastern benches will progressively available for final rehabilitation as well. This will likely occur during the later stages of this RMP period however the lower benches will not be fully extracted and so only the upper benches will be available for rehabilitation.

As the resource has in excess of 20 years life, final rehabilitation activities will be discussed in subsequent RMPs. There is a known future demand for clean waste disposal facilities and it is possible that the final void will be subject to future approvals associated with waste disposal activities.

2.4.8 Material Production Schedule during RMP Term

The table below shows an anticipated material production schedule over the RMP period.

Table 2.1 Material Production Schedule

Material	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Stripped Topsoil	m^3	0	2,800	0	0	0	0	0
Overburden	m^3	0	60,000	0	0	0	0	0
Clay Shale	t	320,000	320,000	320,000	320,000	320,000	320,000	320,000
Reject Material	t	0	0	0	0	0	0	0
Product	t	320,000	320,000	320,000	320,000	320,000	320,000	320,000

Actual production of blue shale is entirely dependent on the demand from the cement plant and is likely to be less than the maximum demand of 320,000 tpa. The schedule also shows the increase in the quarry footprint in Year 2 where an extra 1.4 ha of area is added to the extraction area as shown on Plan 3b. Each 7 m bench over the current extraction area will yield approximately 800,000 tonnes of shale however with the additional exposed resource after Year 2, each bench will yield approximately 900,000 tonnes.

3. Rehabilitation Risk Management

3.1 Environmental Risk Assessment

In order to the identify areas where mining and mining related activities have the potential to place the natural environment at risk, the following matrix has been developed for the Shale Quarry. The risk of environmental harm resulting from each of the mining activities is classified as either high (H), medium (M), low (L), or not applicable (N/A) if such activity does not occur at the quarry.

Table 3.1 – Environmental Risk Identification Matrix

	Mining Activity, Process or Facility														
	Exploration	Land preparation, vegetation and topsoil stripping	All construction activities including earth moving	Mine development and mining	use/maintenance of roads, tracks and equipment	waste rock emplacement management	Mineral processing facilities and infrastructure	Ore/product stockpiling and handling	Tailings impoundment management	Water management including storm event contingencies	Hazardous materials and fuel, handling/spills management	Sewerage	Rubbish disposal	Rehabilitation activities	Rehabilitated land and remaining features
Air pollution, dust/other	L	L	L	L	L	L	n/a	H	n/a	L	L	n/a	L	L	L
Erosion/sediment minimisation	L	L	L	L	L	L	n/a	L	n/a	M	L	n/a	L	L	L
Surface water pollution	L	M	M	L	L	M	n/a	M	n/a	M	M	n/a	L	L	L
Groundwater pollution	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Contaminate or polluted land	L	L	L	L	L	L	n/a	L	n/a	L	M	n/a	L	L	L
Threatened flora protection	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Threatened fauna protection	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Weed control and management	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Operational noise	L	L	L	L	L	L	n/a	M	n/a	L	L	n/a	L	L	L
Vibration and air blast	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Visual amenity, stray light	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Aboriginal heritage	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Natural heritage conservation	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Spontaneous combustion	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bushfire	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Mine subsidence	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hydrocarbon contamination	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L
Methane drainage/venting	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Public safety	L	L	L	L	L	L	n/a	L	n/a	L	L	n/a	L	L	L

As the site is fully contained within the Berrima Cement Works and integrated with existing environmental management controls, the Shale Quarry is an inherently low risk activity. There are existing environmental management plans in place covering noise and dust management which extend to the shale extraction operation. The identification and assessment of environmental risks at the quarry has allowed the overall cement plant management plans and procedures to be developed to minimise the potential risk on the environment.

3.2 Environmental Risk Management

The main areas of environmental risk management of relevance to the Shale Quarry are:

- ❒ Water management - the quarry is incorporated into the overall site Water Management Plan with a separate section of the void being used to store water for later use in the cement plant;
- ❒ Noise management - the quarry activities form part of the overall site Noise Management Plan;
- ❒ Air quality - the quarry activities form part of the overall site Air Quality Management Plan;
- ❒ Rehabilitation - this RMP provides for ongoing progressive rehabilitation and a reporting framework. It includes a management framework to identify and mitigate risks associated with achieving a sustainable rehabilitation outcome; and
- ❒ Pollution Incident Response Plan for the entire Berrima Cement Works but which incorporates the Shale Quarry operation.

The quarry operates under an approved Mine Safety Management Plan which forms part of the Cement Works Occupational Health and Safety System and Procedures. The site however represents as separate mining lease within the cement works site and therefore procedures and reporting systems align with the Mines Health and Safety Act and Regulations.

3.2.1 Water Drainage

The Shale Quarry falls within the Berrima Cement Works Water Management Plan and forms an integral component in the water supply system. In the past, the Berrima Works has relied on the Wingecarribee River to supply process water. To improve the sustainability and conserve natural resources, two large dams (Lake Breed and Lake Quality) were constructed on land adjacent to the site to collect stormwater run off, preventing uncontrolled discharges to the environment and providing a supply of process water for use on site.

During sustained rainfall, excess water is pumped into the eastern void of the shale quarry. This void has been developed as a large water storage as shown on Plate 2. This system has allowed the Works to significantly reduce its dependence on the Wingecarribee River and only use the river as a backup during periods of extended dry weather when the dams are low. Water is pumped back to the Cement Works via an overland pipeline as shown on Plate 3.

Some external surface water also drains into the void as well as direct rainfall. This water is captured and pumped into the eastern water storage where it is kept until required by the Cement Works.

Plate 2 - Water Storage in Eastern Void

Plate 3 - Pump to deliver water back to the Cement Works

There are two dams which are located on drainage lines that enter the quarry area that were established as construction sediment control dams when the quarry commenced.

These dams will eventually be mined through and will be replaced by additional clean water diversion channels. The two dams are shown on Plate 4.

Plate 4 - Clean Water Catch Dams to west of current extraction area

Water for dust suppression is obtained from the main water hydrants in the Works area. Water is delivered by a dedicated water cart which operates throughout the site on all unsealed hardstand, unsealed roads and stockpile areas.

3.2.2 Contamination Issues

There are no dedicated on site refuelling area for the shale operation. A separate refuelling truck is used for all contractor equipment on site during extraction activities. There are also no workshops or other activities which could lead to contamination of the area within the proposed mining lease.

3.2.3 Noise Management

The operation of the Shale Quarry comes under the Noise Management Plan for the cement works. The development consent for the Kiln 6 Upgrade (DA 401-11-2002- i) provides specific noise assessment criteria which also apply to the operation of the Shale Quarry and other ancillary components of the cement plant. The same criteria are duplicated in the site's Environmental Protection Licence which also covers the Shale Quarry.

Annual noise monitoring is undertaken at key residential receptors which include the western boundary of the works which takes into account the Shale Quarry and Candowie Farm which is the closest residential receptor to quarry operations. The western boundary noise monitoring location includes shale extraction activities and transport of shale to the storage area. The monitoring has occurred since 2002 and has found that the noise contribution from the cement works meets both the development consent and EPL conditions.

3.2.4 Dust Management

The Cement Works operates under both an Air Quality Management Plan and a specific Dust Management Plan. The Dust Management Plan provides for specific priority areas which will be implemented progressively to reduce dust emissions from the entire site. The Shale Quarry has been identified in both plans but no additional controls have been identified. More specific controls have been nominated for other aspects of the site including unsealed site access roads, management of raw material storage areas and kiln emissions.

Dust management procedures for the Shale Quarry include:

- ❒ Continued use of the covered shale storage facility.
- ❒ Water cart to keep haul roads damp during truck transport on the unsealed road section leading to the storage shed.
- ❒ Truck speed reduced during high winds.
- ❒ Use of the water cart to reduce dust from the extraction process including ripping, stockpiling and loading of trucks when considered necessary.
- ❒ Ongoing road maintenance and prompt removal of spillages.
- ❒ Truck loads to be covered when transporting shale from the quarry to the storage area.

There are other dust suppression systems associated with the cement works including water sprays in the crusher and blending operations and large tree screen plantings around the site to create future wind breaks. The Quarry void is also used to store some other raw materials used in clinker production which helps shield them from wind erosion.

3.2.5 Traffic Management

All shale is transported from the quarry to the storage shed. There is no off site sales of shale. The only transport generated by the operation include the contract workforce of approximately 5 people (2 dozer operators, 1 loader operator and 2 truck drivers) and a refuelling truck delivery every second day whilst operating.

The only management systems covering transport operations are those which cover the entire cement works. These relate to speed for dust control and safety, minimising speed on unsealed roads and appropriate operator training.

3.2.6 Geology and Geochemistry

Outcrops of the Ashfield Shale is relatively common in the Sydney Basin and generally produces fertile well structured soils with no physical or chemical limitations on vegetation growth. The proposed future soil testing and benchmarking program will identify and mitigate against any potential soil limitations to successful rehabilitation.

The Sydney Blue Gum Forest and Sydney Turpentine-Ironbark Forest in the Sydney basin are largely associated with Ashfield Shale while locally the Southern Highlands Shale Woodland occurs exclusively on weathered shale outcrops. The shale material has also been used on site for direct planting of tubestock as part of the revegetation program at the cement works which is progressing well.

The overlying sandstones are also common in the district but produces soils with lower fertility. These soils tend to support open woodland such as the Mittagong Sandstone Woodland. Although lower in fertility than shale derived soils, they do not posses physical or chemical properties which would be considered restrictive to vegetation development.

3.2.7 Spontaneous Combustion

The shale resource does not possess sufficient volatiles or carbon content to result in an ignition risk.

3.2.8 Materials Prone to Acid Mine Drainage

The Shale Quarry has been used as a water storage for the overall cement works water management system for many years. Water quality is measured around the cement works have not indicated that water stored or reused from the quarry has low pH. Water discharged from Lake Quality tends to be alkaline.

3.2.9 Erosion and Sedimentation Control

The quarry highwall has been stable for many years without evidence of slumping and only minor rilling in places. To improve erosion control, a rock lined drain has been installed in two places on the eastern end of the quarry void. Some berms have been lined with sandstone to protect against erosion prior to rehabilitation activities. There are no other specific erosion controls in operation.

3.2.10 Pre-clearance Procedures

There are only a few trees on the far western end of the mine plan, plus landscaping trees which will not be impacted by the ultimate quarry footprint. A standard tree clearing protocol involves:

- A preclearance vegetation inspection is to be undertaken to identify native/non-native trees and presence of nesting animals (birds or mammals) and presence or absence of tree hollows.
- Trees containing hollows can only be cleared when roosting fauna are unlikely to be nesting or preparing to nest (generally from September to March).
- Trees with evidence of past nesting activity are to be tagged and inspected prior to disturbance. Prior to felling, each tagged tree is to be tapped several times and left so as to observe any movement in the hollows. Each tree is then felled by a slow push with an excavator in the presence of a qualified ecologist.
- Once felled, all hollows are to be inspected for active nests or trapped fauna. If uninjured, all trapped fauna are to be released. If any injured fauna are found they are to be transported in an appropriate manner to a Wires registered Veterinary Clinic. The location, condition and species are to be recorded by the Ecologist prior to delivery to the Veterinary Clinic.
- All cleared native vegetation is to be reused on prepared rehabilitation areas. This includes the use of crown material for brush matting and logs and larger branches to be used for habitat creation. Material is to be laid along the contour of completed rehabilitation surfaces.
- Non-native timber should be chipped and used within soil blends to improve carbon content however any non-native seed and flower material should be removed.

As a general rule, tree clearing will be avoided from late Winter to mid Summer to avoid impact on nesting bird species.

3.2.11 Soil Types and Suitability

Soils on and surrounding the quarry fall under the Moss Vale Soil Landscape which is dominated by Wianamatta Shales. Soils developed from Wianamatta Shales tend to range from moderately deep to deep, they are fairly permeable, well structured, slightly acidic (pH 5.5 to 6) and of moderate fertility. These soils respond well to fertiliser applications and given the high rainfall in the district, tend to be productive when managed correctly. These soils are moderately erodible and erosion issues can occur on steep slopes that have been cleared.

Although not as productive as soils developed on basaltic intrusions they are significantly better than sandstone derived soils. On Ashfield Shales, soils tend to be classed as either Yellow or Red Podzolic Soils (Kurosols) and given the gentle slopes around the cement works, would have a Land Capability of Class III. These soils are therefore suitable for rehabilitation purposes and would support a native forest or productive grazing enterprise.

This is evident by the healthy growth of both pasture and tube stock plantings in Domain D1 on the eastern and northern part of the quarry. Under this RMP, soil testing will be undertaken on undisturbed soils that have developed on the Ashfield Shale deposit. These results will be compared with soil quality within completed rehabilitation areas as well as the existing topsoil stockpile areas. Benchmarking natural soils will provide data on any required soil ameliorants needed on both existing rehabilitation sites as well as on the existing stockpiled soils prior to reuse.

3.2.12 Flora

Vegetation surrounding the quarry to the south is largely cleared and supports cattle grazing. The site would have supported a Southern Highlands Shale Woodland prior to being cleared over 100 years ago. Remnants exist but are of variable structure due to past clearing and disturbance. Typical trees include *Eucalyptus radiata, Eucalyptus macarthurii, Eucalyptus pauciflora, Eucalyptus globoidea, Eucalyptus cypellocarpa, Eucalyptus quadrangulata, Eucalyptus amplifolia,* and *Eucalyptus ovata*.

The understorey is variable with small trees including *Acacia melanoxylon, Acacia binervata* and *Pittosporum undulatum*, and shrubs such as *Indigofera australis, Leucopogon juniperinus*, *Olearia microphylla* and *Bursaria spinosa*. Groundcover species may include *Hardenbergia violacea, Lomandra longifolia, Pteridium esculentum, Themeda australis, Dichelachne crinita* and *Microlaena stipoides*.

Approximately 12,000 tree and shrub tubestock were planting over the past 2 years which have demonstrated a high success rate and vigorous growth. Wariapendi Nursery at Hill Top was contracted to select and plant locally province tubestock with a view to develop appropriate wind breaks for the purposes of dust control and visual amenity. The tubestock planting however included previously shaped and prepared areas around the quarry.

3.2.13 Weed Invasion and Control

Management of weeds forms part of the overall property management at the cement works. Grazing land not required by the quarry is leased to a neighbour who runs cattle in return for maintaining fencing and weeds.

A monthly environmental site inspection is conducted which involves the assessment of weed presence, erosion, drainage stability, vegetation health and vigour, status of soil stripping and reuse, and the progress of rehabilitation. Additional inspections are conducted following heavy rain events. Corrective actions are listed and the progress of implementation is recorded.

Weed spraying treatments are undertaken as required. During average or above average rainfall years twice per year, during Autumn and Spring when weed species are most vigorous. Chemicals utilised on site are alternated each season to improve the effects on surviving weed species. Common broadleaf sprays include Amicide 700, MCPA 500 and Grazon Extra (to treat woody weeds including blackberry). The majority of weed growth occurs along road verges, and minimal work is required in the surrounding open land as this is largely improved pasture.

3.2.14 Fauna

Given the quarry location within the cement works, it is unlikely that that native fauna other than wombats, kangaroos and passing avifauna frequent the site. Although Koala *Phascolarctos cinereus* is 'frequently' recorded in the region, there have been no sightings near the cement plant.

It is probable that threatened fauna species could also occur within the area surrounding the cement plant. Some species are nomadic, undertake seasonal migrations, and/or enter periods of inactivity during winter.

A key risk to rehabilitation is rabbit infestations which occur in areas surrounding the cement works. The control of rabbits over rehabilitations areas will be important to ensure successful ecosystem establishment.

3.2.15 Slopes and Slopes Management

The quarry was originally designed in the mid 1970s with typical 1:1 sloped batters. The height of the batters however has been reduced from the usual 10 high to an average of 7 m high with a corresponding 5 m wide intervening berm. The first benches have remained stable for nearly 40 years although there is some evidence of minor rilling. The rehabilitation program will include planting trees along each berm however the batter slopes will remain as is.

As the final land use may include complete or partial void filling, revegetation activities are seen as transitional at this stage.

3.2.16 Public Safety

The quarry lies within the Berrima Cement Works which has a high level of security including locked gates and man proof fencing. The site is also manned 24 hours per day 7 days per week so unauthorised access to the quarry would be very difficult.

4. Rehabilitation Objectives

4.1 Regulatory Requirements

The planning platform for the quarry does not specify a final land use. The original plans provided to the then Department of Mines in 1977 showed the final pit extent and batter design and it can be assumed that the final land use involved rehabilitation of the final profile as designed. The void would naturally fill or partially fill with water and would become a lake and could further reduce reliance on make-up water from the Wingecarribee River.

Alternative land uses would exist at the time of final closure however these may require additional approvals at the time of closure.

4.2 Rehabilitation Objectives

The overall objective of the rehabilitation program is to provide a safe, stable, non-polluting and sustainable land use covering all areas disturbed by the quarry. Specific objectives for the current approved final land use are as follows:

- Development of stable highwall accordance with the original design, that is 7 m high benches with 5 m wide berms and batter side slopes of 45 degrees.
- Revegetate the berms using tree and shrub species compatible with a Southern Highlands Shale Woodland community.
- Rehabilitate the external bunding to a sustainable vegetation community compatible with a Southern Highlands Shale Woodland community.
- Ensure external drainage systems are stable and direct water to protected channels within the quarry void to enable the void to fill with water.
- Ensure the access road into the quarry is left to enable access to the developing lake within the void. The access road is to be suitable for stock.
- Access to the highwall area is to be prevented by a man proof fence and warning signs erected.

Since there are no surface infrastructure, waste rock dumps or tailings dams, the above objectives relate to the entire quarry. As the quarry life is in excess of 20 years, it is likely that the rehabilitation objectives for the final land use may change. These issues are discussed in the following sections while performance indicators and completion criteria are provided in Chapter 6.

4.3 Alternative Final Land Uses

The quarry is currently being used for water storage as part of the cement works Water Management Plan. For this reason, a final land use which includes water containment is the most logical. However, an obvious alternative exists given the proximity to the Wingecarribee Council Resource Recovery Centre which provides, amongst other things,

recycling of VENM. At present, these materials are accepted but then transported off site for final disposal.

For the quarry to accept other materials for the purpose of void filling and final rehabilitation, additional approvals would be required. No additional approvals will be sought during the term of this RMP.

4.4 Proposed Post Mining Land Use

At this stage, the final land use of the quarry footprint will consist of a vegetated and stable quarry excavation that would continue to be used for water storage, either as part of the cement works water management system or for agricultural purposes. As shown on Plan 4, the area surrounding the quarry disturbed area will remain as agricultural land. The target native community for the batters and external bunding would be a Southern Highlands Shale Woodland community which would have been the original vegetation community prior to clearing for agriculture. However, given the steep slopes involved in the quarry excavation, it will not be possible to recreate the ecological function of a woodland community.

5. Final Landform and Rehabilitation Plan

This section describes the anticipated rehabilitation activities for each nominated domain.

5.1 Domain Selection

The quarry area has been divided into six primary operating domains and three secondary rehabilitation domains as shown on Plan 2 and described below.

5.1.1 Domain 1 – Active Extraction Area

This is the current area of extracting blue shale. It consists of the main working bench which is ripped by dozer and a separate area where the material is pushed up into a loadable pile. The area changes continually as the extraction area moves to the west and north along the strike of the shale.

5.1.2 Domain 2 – Unshaped Material, Storage Areas and Haul Roads

This domain includes areas that will be subject to future active extraction. The area consists of unshaped overburden but also a bench where other raw materials have been temporarily stockpiled. These will be moved as the extraction area progresses. In the event of premature closure and rehabilitation, this domain would be best described as unshaped overburden for the purposes of rehabilitation cost estimation.

5.1.3 Domain 3 – Pre-strip and Overburden Removal

This area consists of soil and overburden removal in advance of resource extraction. The domain will progressively move as the extraction progresses in accordance with the original design. Generally, this domain will represent a disturbed area to the west of active extraction area as shown on Plans 3a, 3b and 3c but will also extend temporarily around the active pit area as new benches are developed.

5.1.4 Domain 4 – Water Management and Drainage

This domain consists of various water diversions and small dams to the south of the extraction area that ensure that runoff water does not enter the extraction area. This will include some permanent bunding which will be rehabilitated. As the extraction area develops, a portion of this domain will form part of the final extraction area and will assist in creating the permanent lake within the quarry void as shown on Plan 3c.

5.1.5 Domain 5 – Water Storage

As shown on Plan 3c, the final rehabilitation plan includes a permanent pond within the final void. The surrounding benches will be fully rehabilitated and drainage will be directed to the floor of the extraction area. The final water storage area is also shown in its development stage on Plan 3b.

This domain also represents the in-pit water storage dam which forms part of the Cement Works Water Management Plan. Water is transferred and stored in this facility until needed by the cement plant. The floor of the dam is not at final depth but is separated

from the active extraction area by an internal wall. As the quarry deepens to the floor of the Ashfield Shale, the location of the internal water storage facilities will likely move, and in the process, increase in size.

Ultimately this storage dam will become an integral component in the final land use, that is, an internal dam surrounded by stable and rehabilitated batters.

5.1.6 Domain 6 – Topsoil Stockpiles

There are two separate areas of temporary rehabilitation which will be removed as part of the ongoing quarry development. The first is located due west of the quarry and represents an original topsoil/subsoil stockpile. This material has been grassed but has been insitu for over 20 years and is unlikely now to produce usable topsoil for ongoing rehabilitation work.

Soil tests of the original topsoil stockpile and test results of undisturbed soils will be compared to confirm the viability of the material. This will enable the recreation of a suitable topsoil through the addition of required ameliorants, mulch, compost or fertilisers to improve the organic component of the soil which is likely to be lost over many years. The use of facsimile soils will allow the progressive rehabilitation of completed quarry areas to ensure the development of a sustainable ecosystem community. As an alternative, if the soil is not going to be used in the next 5 years, the whole stockpile will be regraded and grass cover will be established.

The second area is in the northern part of the quarry which was previously disturbed and then recently rehabilitated. This area lies within the ultimate quarry footprint and so has been labelled as temporary rehabilitation as it may be disturbed again in the later stages of the quarry development.

This Domain also includes a section on the western side of the main access road that has been used over time to temporarily store some raw materials for use in the cement plant. This area has been cleaned up however further work is planned to improve topsoil cover between trees that have been planted and to correct minor erosion.

5.1.7 Secondary Domain A – Landform Establishment, Completed Batters

This domain covers the main pit batters which will provide the final landform for the quarry. The design criteria and completion criteria for this domain are:

- Shale batters no steeper than 45 degrees.
- Bench height no greater than 7 m.
- Berm width no less than 5 m.
- Berm slopes of less than 1 in 4 if unprotected.

Completed batters will be rehabilitated to a woodland community comparable to the Southern Highlands Shale Woodland community as described in Doman D1 below.

5.1.8 Secondary Domain D1 – Southern Highlands Shale Woodland

This rehabilitation domain represents the final land use sustainability domain for the majority of the disturbed area of the quarry. The completion criteria for this domain

includes the establishment of tree and shrub species of equivalent species and density as found in the Southern Highlands Shale Woodland community. This community is often referred to as the Ashfield Shale Woodland. The target species are described in Section 7.2.5.

5.1.9 Secondary Domain D2 – Undisturbed land, Pasture

This domain includes the external pasture areas that were not disturbed by quarry activities as well as some small areas that have been disturbed in the past or incidental disturbance due to the construction of drainage facilities. The purpose of this domain is to ensure that the original agricultural capability of the land surrounding the quarry is maintained.

5.2 Domain Rehabilitation Objectives

The overall rehabilitation objectives are provided in Section 5.1. Specific objectives for each domain are provided in the following table.

Table 5.1 – Domain Objectives

Domain	During this RMP	Post Mining - Final Closure
Domain 1 – Active Extraction Area	- Keep clean and free from debris - Ensure drainage system remains stable - Develop successive benches in accordance with approved design	- Prepare for long term water storage. - Final rehabilitation of completed batters - Revegetate to native forest.
Domain 2 – Unshaped Material, Storage and Haul Roads	- Progressively remove materials to enable expansion of the active extraction area - Maintain clean and free of debris - Ensure drainage system remains stable	- Prepare for long term water storage. - Final rehabilitation of completed berms - Revegetate to native forest.
Domain 3 – Pre-strip and overburden removal	- Minimise soil disturbance at any one time - Ensure all dirty water drainage enters the quarry void.	- Prepare for long term water storage. - Rehabilitate to native forest.
Domain 4 – Water Management and Drainage	- Maintain drainage systems - Undertake maintenance of vegetation as required until considered self sustaining.	- Work completed under this RMP.
Domain 5 – Water Storage	- Maintain clean and serviceable as part of the Cement Works Water Management System	- Forms part of the final void and allowed to fill with water - Rehabilitate remaining benches above final water level - Manage revegetation work until self sustaining.
Domain 6 – Topsoil Stockpiles	- Maintain in serviceable condition until no longer required.	- Forms part of the final quarry landform and rehabilitation

Domain	During this RMP	Post Mining - Final Closure
Secondary Domain A – Landform Establishment, Completed Batters	Construction of final batters in accordance with completion criteria: - Shale batters no steeper than 45 degrees - Bench height no greater than 7 m - Berm width no less than 5 m - Berm slopes of less than 1 in 4 if unprotected	- Forms part of the final quarry landform and rehabilitation - Final land form to be stable and minimise erosion risk
Secondary Domain D1 – Southern Highlands Shale Woodland	Continue revegetation of completed batters	Establish a self sustaining woodland community comparable to the Southern Highlands Shale Woodland community
Secondary Domain D2 - Pasture	Undertake maintenance of surrounding agricultural land as required. Correct any erosion that may occur Maintain clean and free of debris Ensure natural drainage systems remains stable	- Areas within the final quarry footprint to be rehabilitated in accordance with this RMP - Remaining agricultural land to be maintained. - Any remaining farm dams to remain on completion of rehabilitation works.

5.3 Rehabilitation Phases

An outline of the rehabilitation phases for each domain is provided in Table 5.2.

Table 5.2 – Rehabilitation Phases during this RMP

Rehabilitation Phases	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5	Domain 6	Domain 7
Active Mining	✓	✓	×	×	×	×	×
Decommissioning	×	×	×	×	×	×	×
Landform Establishment	×	×	✓	✓	✓	×	×
Growing Media Development	×	×	✓	✓	✓	×	×
Revegetation Establishment	×	×	✓	✓	✓	×	×
Ecosystem and Land Use Sustainability	×	×	✓	✓	✓	×	×
Relinquished Lands	×	×	×	×	×	×	×

During the course of this RMP, active shale extraction will continue in Domains 1 and 2. The quarry will extend its footprint within this RMP and this will change the size of these domains.

6. Performance Indicators and Completion Criteria

6.1 Performance Indicators

The rehabilitation of the Shale Quarry requires standard techniques. There is no potential for acid generation and no contamination. There are some areas such as the highwalls which remain as completed but with revegetation of the intervening berms only. As with most extractive industries, the final landform is challenged by the creation of a large void. As there is little overburden produced, there are limited opportunities to fill the void as part of the ongoing operation. The final treatment of the void at this stage is to create a stable slope with adequate safety fencing above the highwall and then allow the void to fill with water.

As the quarry forms part of the Cement Works Water Management system, there are no available alternatives to fill the void at this time. Areas that will be subject to rehabilitation will have the aim of achieving a self sustaining vegetation community comparable to the Southern Highlands Shale Woodland which would have been the original vegetation community prior to clearing for agriculture some 120 years ago. Subsequent to this original disturbance, the cement works has been established and the quarry forms an integral component to this operation.

The current operation has inherently low environmental risks, no hostile materials that would be limiting to rehabilitation and a mine life in excess of 20 years. The key performance indicators relevant to the ongoing management of the quarry and progressive rehabilitation are as follows:

- Containment of all stormwater runoff from the disturbed areas of the quarry in addition to excess water pumped to the void from other water storages at the cement works;
- Progressive rehabilitation of completed berms once formed.
- Maintaining stable drainage systems within the quarry including the highwall benches.
- Meeting the overall cement plant environmental objectives and noise and dust emission targets.

Specific criteria for the revegetation works will be the establishment of a self sustaining vegetation community of equivalent dominant species as the pre-existing Southern Highlands Shale Woodland.

6.2 Completion Criteria

Individual completion criteria for the identified domains are provided in Table 6.1.

Objective/Area	Performance Indicator	Completion Criteria	Justification / Source	Progress at Start of RMP	Progress at Completion of RMP
Phase 1: Decommissioning					
All hazards and contaminated materials removed, remediation of land	Removal of stockpiles and emplaced materials	No stockpiled or emplaced materials are to present within the quarry area	RMP	Nil	Nil
Active Extraction Area to be made safe	- Final void to be converted into water storage facility - Nil discharge - Stable drainage system	- All remaining debris removed and ensure runoff is clean. - Confirm high water mark and seal to minimise seepage loss to groundwater	RMP	Nil	Nil
Unshaped Overburden to be shaped and rehabilitated	- Final void to be converted into water storage facility - Nil discharge - Stable drainage system	- All remaining debris removed and ensure runoff is clean. - Confirm high water mark and seal to minimise seepage loss to groundwater	RMP	Nil	Nil
Water Storage to remain as part of final landform	- Final void to be converted into water storage facility - Nil discharge Stable drainage system	- All remaining debris removed and ensure runoff is clean. - Confirm high water mark and seal to minimise seepage loss to groundwater	RMP	Nil	Nil
Any future infrastructure not required by the cement plant to be removed	Removal of infrastructure	All infrastructure that is not required for any other purpose to be removed. This currently only consists of mobile pumps and pipelines	RMP	Nil	Nil
External areas not required by the cement plant operation to be made safe and available for agriculture	- All areas not subject to future quarrying to be maintained with equal or better land capability as at present	- Maintain farm dams not subject to future quarry disturbance. - Adequate stock proof fencing. - Pasture to contain less than 10% weeds.	RMP	Complete	Complete

Objective/Area	Performance Indicator	Completion Criteria	Justification / Source	Progress at Start of RMP	Progress at Completion of RMP
Phase 2: Landform Establishment					
Establish landform - stable highwalls	Areas external to the quarry void to have a comparable topography to the existing surrounding landform Quarry void to have vegetated berms and be able to contain water	- Shale batters no steeper than 45 degrees - Bench height no greater than 7 m - Berm width no less than 5 m - Berm slopes of less than 1 in 4 if unprotected	RMP	2.6 ha of highwall 3.5 ha of completed rehabilitation	3.2 ha of completed quarry highwall 7.2 ha of completed external areas
Create final land form that is stable and non polluting	Surfaces to be free draining but without elevated erosion risk	Final landforms not including the extraction void or bunding to be less than 18 degrees	RMP	7.2 ha	7.2 ha
	Highwall to be permanently stable	Geotechnical consultant verification	RMP	Nil	Complete
Maintain drainage line stability	Areas of active erosion are limited	- Drainage lines carrying greater than 2.5 m/s peak flow to be protected - No gullies or rills >0.3 m in width and depth occurring along prepared benches	RMP	Ongoing	Ongoing
Effective drainage controls	Contain surface drainage	Maintain free board no less than 600 mm on any internal water storage facility	RMP	Ongoing	Ongoing
Phase 3: Growth Media Development					
Soils capable of supporting sustainable vegetation growth	Root depth	Achieve 1 m of root penetration depth or greater by ripping prepared surfaces including along each berm	RMP	7.2 ha	10.4 ha to be completed, subject to ongoing maintenance

Objective/Area	Performance Indicator	Completion Criteria	Justification / Source	Progress at Start of RMP	Progress at Completion of RMP
Soils capable of supporting sustainable vegetation growth	Soil physical and chemical properties and amelioration	- Soil testing to confirm quality, nutrient availability and structure to support mature trees - pH between 5 and 7.5 - Electrical conductivity within the range of target Ashfield Shale derived soils - Organic Carbon levels no less than found in target Ashfield Shale derived soils - Phosphorus levels no less than found in target Ashfield Shale derived soils - Nitrogen levels no less than found in target Ashfield Shale derived soils - Soil depth greater than 100 mm - Soils not sodic or saline	RMP	7.2 ha	10.4 ha to be completed, subject to ongoing maintenance
Phase 4: Ecosystem Establishment					
Establish vegetation compatible with Southern Highlands Shale Woodland	Trees	Dominant species planted: *Eucalyptus radiata, Eucalyptus macarthurii, Eucalyptus pauciflora, Eucalyptus globoidea, Eucalyptus cypellocarpa, Eucalyptus quadrangulata, Eucalyptus amplifolia, and Eucalyptus ovata.*	RMP	7.2 ha	10.4 ha to be completed, subject to ongoing maintenance
Establish vegetation compatible with Southern Highlands Shale Woodland	Shrubs and Understory	Dominant species planted: *Acacia melanoxylon, Acacia binervata and Pittosporum undulatum, and shrubs such as Indigofera australis, Leucopogon juniperinus, Olearia microphylla and Bursaria spinosa.*	RMP	7.2 ha	10.4 ha to be completed, subject to ongoing maintenance

Objective/Area	Performance Indicator	Completion Criteria	Justification / Source	Progress at Start of RMP	Progress at Completion of RMP
Establish vegetation compatible with Southern Highlands Shale Woodland	Groundcover and herbs	Dominant species planted: *Hardenbergia violacea, Lomandra longifolia, Pteridium esculentum, Themeda australis, Dichelachne crinita and Microlaena stipoides.*	RMP	7.2 ha	10.4 ha to be completed, subject to ongoing maintenance
Establish vegetation compatible with Southern Highlands Shale Woodland	Sowing	- Tubestock 1,000 stems per ha of which: - 40% upper canopy - 40% middle canopy - 20% lower canopy Direct seeding of target species mix at a rate of 1.6 kg/ha	RMP	7.2	10.4
Establish vegetation compatible with Southern Highlands Shale Woodland	Habitat features	- Brush matting (cut from surrounding vegetation) spread over patches between tubestock - rock piles (ripped) comparable with surrounding area (number/ha average)	RMP	Nil	10.4 ha
Establish vegetation compatible with Southern Highlands Shale Woodland	Determine appropriate soil conditions, structure and fertility	Soil conditions in revegetation areas comparable with reference sites	RMP	7.2 ha	10.4 ha to be completed, subject to ongoing maintenance
Establish vegetation compatible with Southern Highlands Shale Woodland	Establish a representative number of species and at similar density to a reference ecological community	Rehabilitation Monitoring demonstrates that vegetation community is self sustaining and long term viable	RMP	7.2 ha	10.4 ha to be completed, subject to ongoing maintenance

Objective/Area	Performance Indicator	Completion Criteria	Justification / Source	Progress at Start of RMP	Progress at Completion of RMP
Maintain drainage line stability	Areas of active erosion are limited	- Drainage lines carrying greater than 2.5 m/s peak flow to be protected - No gullies or rills >0.3 m in width and depth occurring along prepared benches	RMP	120 m	200 m
Phase 5: Ecosystem Development					
Revegetation is sustainable for the long term	- Stable batters - vegetated berms	- Self sustaining vegetation on berms between batter slopes - Dominant species to include *Eucalyptus radiata, Eucalyptus macarthurii, Eucalyptus pauciflora, Eucalyptus globoidea, Eucalyptus cypellocarpa, Eucalyptus quadrangulata, Eucalyptus amplifolia,* and *Eucalyptus ovata*.	RMP	2.6 ha	3.2 ha
Revegetation is sustainable for the long term	- Self sustaining vegetation community - stable landform	- Dominant tree species have seeded at least twice - Self sown saplings evident within rehabilitation area - Nil gully erosion evident - Soils are comparable to control soils developed on Ashfield Shale as confirmed by external soil scientist	RMP	7.2 ha complete but subject to ongoing maintenance	10.4 ha to be completed, subject to ongoing maintenance
Revegetation is sustainable for the long term	Weed infestation	- less than 10% exotic species in ground cover - Nil notifiable weeds present	RMP	Ongoing	Ongoing
Revegetation is sustainable for the long term	Habitat Features	The ecosystem provides linkages between other vegetation around the cement plant for native fauna species measured by observation or scats	RMP	Ongoing	Ongoing

Objective/Area	Performance Indicator	Completion Criteria	Justification / Source	Progress at Start of RMP	Progress at Completion of RMP
Phase 6: Final Land Use Sustainability					
Vegetation density	Vegetation contains a density of species comparable to that of the target Southern Highlands Shale Woodland	The density of shrubs or juvenile trees with a stem diameter < 5cm is comparable to target Southern Highlands Shale Woodland	RMP	Ongoing	Ongoing
Ecosystem Composition	The vegetation is comprised by a range of growth forms comparable to that of the target woodland	- The number of tree and shrub species regardless of age comprising the vegetation community is comparable to the Southern Highlands Shale Woodland - The number of herbs species comprising the vegetation community is within 70% of the target woodland	RMP	Ongoing	Ongoing
Soil structure and fertility capable of sustaining vegetation	Determine appropriate soil conditions, structure and fertility	Soil condition in revegetation areas comparable with reference sites and complies with the following criteria: pH >5 Not Sodic Nitrogen > 0.11% Phosphorus > 40 mg/kg Potassium > 50 mg/kg Calcium > 150 mg/kg Manganese > 20 mg/kg Zinc > 1 mg/kg	RMP	Ongoing	Ongoing
Revegetation is sustainable for the long term	Vegetation self sustaining	Dominant Species have successfully seeded twice	RMP	Ongoing	Ongoing

Objective/Area	Performance Indicator	Completion Criteria	Justification / Source	Progress at Start of RMP	Progress at Completion of RMP
Phase 7: Lease Relinquishment					
Rehabilitation	Establish a representative number of species and at similar density to the reference ecological community Vegetation growth is self sustaining	Rehabilitation Monitoring demonstrates that vegetation community is self sustaining and long term viable Monitoring program demonstrates vegetation viability	RMP	Nil	Nil
Establish final self sustaining vegetation community	Establish a representative number of species and at similar density to a reference ecological community	Rehabilitation monitoring demonstrates that vegetation community is self sustaining and long term viable	RMP	Nil	Ongoing
Satisfy lease conditions	Audit compliance	Satisfactorily demonstrate to government stakeholders that the rehabilitation work has been completed in accordance with this RMP	RMP	Nil	Nil

7. Rehabilitation Implementation

7.1 Status at RMP Commencement

At the commencement of this RMP Period, rehabilitation activities have occurred on the external areas around the quarry void. The main area is Domain 4 which includes the original overburden emplacement which has been shaped as a bund around the eastern quarry extraction area as shown on Plate 5.

Plate 5 - View of Domain 4 in Background

Domain 4 also includes areas of tree planting to the north of the quarry extraction area. The tree planting was part of an overall program at the cement works to improve dust control, scenic quality and habitat improvement. The planting involved areas that had previously been rehabilitated to improved pasture as well as recent disturbed areas adjacent to haul roads, as shown on Plate 6.

Plate 6 was taken adjacent to the main access road on the northern side of the quarry. This shows an area of direct tree planting into Ashfield Shale. These trees are growing well, arguably better than areas that were previously rehabilitated using improved pasture.

Plate 6 - Tree Planting Directly into Ashfield Shale

Plate 7 below show examples of tree planting around the northern section of the quarry.

Plate 7 - Domain 4 Tree Planting

Plate 8 below shows an area of transitional rehabilitation consisting of excess topsoil and subsoil generated during the original quarry development. The material has been emplaced in a long but relatively shallow emplacement located just outside the next extension of the quarry footprint. This material will not be required for several years but eventually will be used in the rehabilitation of finished berms.

Plate 8 - Transitional Rehabilitation

7.2 Proposed Rehabilitation Activities during the RMP Term

During this RMP period the following activities will occur:

- The extraction area will extend deeper and to the west as shown on Plan 3b;
- Increase in pit area of approximately 1.5 ha to the west which will require topsoil stripping and overburden removal;
- Rehabilitation of approximately 2.6 ha of existing highwall and a further 0.6 ha of new highwall (Domain 3);
- Undertake soil characterisation and benchmarking to establish appropriate facsimile soil quality and structure to sustain future vegetation communities to be established;
- Progressively rehabilitate 3.7 ha of Domain 4 to achieve a total of 7.2 ha of completed rehabilitation at the end of this RMP period.

By the end of the RMP period there will be a total of 10.4 ha of completed rehabilitation. These areas will still be subject to ongoing maintenance and will remain under mining title. It is not proposed to relinquish any portion of the mining lease during the term of this RMP. The progress of rehabilitation versus disturbance is provided in Table 7.1.

Table 7.1 - Rehabilitation Summary

RMP Year	Total Disturbed Area	Total Rehabilitation Area	Cumulative Rehabilitation Area	Comments
Start of RMP	10.4	7.2	7.2	
Year 1	10.4	1.3	8.5	Rehabilitate prepared benches
Year 2	11.8	1.3	9.8	Pit extension
Year 3	9.2		9.8	Disturbance area reduced by additional highwall rehabilitation
Year 4	9.2		9.8	Maintain existing rehabilitation
Year 5	9.2		9.8	Maintain existing rehabilitation
Year 6	8.6	0.6	10.4	Rehabilitate prepared benches
Year 7	8.6		10.4	Maintain existing rehabilitation

The active mining area will range between 8 and 12 ha over the next 10 years. As the pit area increases to develop deeper benches the active extraction area will also increase. There is currently 0.12 ha of in-pit water storage which is included in the active extraction area. This area will also increase as the pit is deepened but may also move to allow extraction to occur beneath the current dam location.

On final completion of the quarry, the surrounding batters would have been rehabilitated leaving only the floor of the quarry extraction area. As the final rehabilitation program involves the creation of a large water storage, the area taken up by the in-pit water storage would convert from active pit to final rehabilitation.

7.2.1 Timing of Activities

Rehabilitation activities have been undertaken progressively and are currently up to date and in accordance with the original design. There is approximately 2.6 ha of highwall batter which has been shaped and waiting final rehabilitation works. This work will progress during the first two years of this RMP period. The timing of the works depends on the ability to obtain access along the developing berm of each batter. There are two batters which will need to be extended to the west into the new extension area and therefore access to this new area needs to be maintained. Once the berms have been rehabilitated, no further access is available so timing is critical to the ongoing extraction program. This work should be completed in Year 3, that is by the end of 2018.

Once the pit is extended, there will be limited opportunity to undertake further rehabilitation until at the first bench is completed. It has been indicated that a further 0.6 ha of batter will be completed in Year 6 however this will be dependent on a number of variables including production level.

7.2.2 Physical and Chemical Characteristics

The chemical composition of the shale is tested on a weekly basis. A summary of the results over the past 18 years is provided in Table 2.1, Section 2.3.1. Based on these results, the material does not pose a threat to future rehabilitation having low sulphate and salt content but with relatively high potassium and moderate phosphate levels. Aluminium levels are naturally high as with all clay minerals but may become limiting to plant growth if pH falls 4.5.

Based on the vegetation patterns of the local area, soils formed from Ashfield Shale was prized for agricultural land as was soils derived from Basalt. Conversely, soils derived from the Hawkesbury Sandstone or sandstone members of the Narrabeen Group have either resulted in poor agricultural soils or have largely been uncleared. For this reason, the Southern Highlands Shale Woodland has been almost completely cleared for agriculture to the point where there are few remaining examples in the region.

On this basis, it is considered that there are no physical or chemical risks to successful rehabilitation of the quarry.

7.2.3 Method of Landform Establishment and Final Slopes

The design of the quarry benches has been consistent since the original design in the mid 1970s. The shale is relatively hard and resists weathering when exposed. The long term stability of the batter slopes has been demonstrated over the past 40 years however as the quarry deepens, a geotechnical assessment will be undertaken to confirm the batter design.

The batters are formed by dozer working each bench to a depth of 7 m. The batters are surveyed prior to final trimming. The intervening 5 m wide berm is sloped slightly towards the batter face at 1% fall so that runoff does not run over the batter face. Once completed, each berm is then ripped and top-dressed with stockpiled topsoil at a depth of no less than 100mm.

7.2.4 Topsoil Balance and Usage

Prior to the development of the quarry, all topsoil resources from the initial extraction area were stripped and stockpiled. Additional soil was added to the stockpile as the quarry extended to its current 22 ha footprint. This stockpile remained for many years until the first benches were completed and available for rehabilitation. Topsoil was spread over completed batters to a depth of approximately 20cm and sown with pasture.

There is currently approximately 1,500 m^3 of topsoil stockpiled on site which was not needed in the last round of rehabilitation work. It is estimated that a further 2,200 m^3 will be generated over the term of this RMP. This will be generated from the 11 ha of new disturbance as the quarry develops to its full extent.

The demand for topsoil will be approximately 2,600 m^3 giving an excess of topsoil still requiring stockpiling on site. As the quarry develops, there will be a continuing excess of topsoil generated as only the extraction berms along the highwall will be rehabilitated while the batters will be left as is and the extraction floor of the void will be left to fill with water.

The current topsoil stockpile, shown on Plate 1, has been in place for over 20 years and shows signs of deterioration. This stockpile area lies within the footprint of the future quarry footprint and will ultimately have to be relocated.

Plate 1 – Existing Topsoil Stockpile

Excess topsoil will continue to be stored in low emplacements that have been temporarily vegetated with pasture to maintain viability. Topsoil is usually stockpiled in low mounds (<2m high with 1 in 3 side slopes) to maximise biological activity. The soil however will be tested prior to planting to ensure that the quality is suitable for healthy plant growth.

An initial sterile cover crop may also be established (either sterile rye grass or oats depending on season). This would be applied at around 40 kg/ha with a general balanced fertiliser treatment at a rate of 125 kg/ha. This application would reduce the need for the application of mulch prior to sowing native seed.

Topsoil is stripped using a small dozer with a front end loader and truck to relocate the soil to the identified stockpiling area. Plan 2 Domain 6 shows two stockpile sites. The southern stockpile will be mined through in the later stages of the quarry development however a small portion of the northern stockpile area will remain until the quarry footprint has reached its final extent.

The quality of the topsoil will be tested within 12 months of being placed on the stockpile. Soil characteristics including:

- pH and conductivity;
- Exchangeable cations;
- Plant available nutrients including nitrate, phosphorus, potassium, sulphur, calcium, iron, and magnesium;
- Trace elements including zinc, copper, boron and manganese; and
- Physical properties including clay and organic matter content.

The need for soil supplements will be determined and added prior to reuse on completed benches. Given the low soil usage required for the ongoing rehabilitation requirements, a manufactured topsoil or the addition of mulch from local sources will be considered.

7.2.5 Vegetation Species and Establishment Methods

The following species will be used in the revegetation program.

Canopy Species - *Eucalyptus radiata, Eucalyptus macarthurii, Eucalyptus pauciflora, Eucalyptus globoidea, Eucalyptus cypellocarpa, Eucalyptus quadrangulata, Eucalyptus amplifolia, and Eucalyptus ovata.*

Shrub and Understory Species - *Acacia melanoxylon, Acacia binervata and Pittosporum undulatum, and shrubs such as Indigofera australis, Leucopogon juniperinus, Olearia microphylla and Bursaria spinosa.*

Groundcover and herbaceous layer - *Hardenbergia violacea, Lomandra longifolia, Pteridium esculentum, Themeda australis, Dichelachne crinita and Microlaena stipoides.*

Two methods are currently being used for vegetation establishment. The first is direct sowing at a combined rate of approximately 7 kg/ha using commercially available target species. The mix will include all three strata species. The second method involves tube stock planting of target canopy and shrub species.

Any vegetation cleared as part of the quarry development will be reused over completed benches and other disturbed areas. This will include any plant material and logs to assist in habitat creation.

Where possible, topsoil stripped from extension areas will be spread over completed shaped landforms as soon as possible to preserve the subsoil seed bank and organic matter. Where this is not possible, soil testing will be undertaken to determine if additional ameliorants such as fertiliser and compost is required.

Tubestock are planted within the rip lines and include a weed mat, support stakes, guard and fertiliser pellets. The guards are removed once the trees are sufficiently established to withstand attack by rabbits.

7.2.6 Habitat Establishment and Maintenance

Boral have subcontracted vegetation establishment and maintenance to a local nursery. This contract covers all the tree screen and vegetation planting around the entire cement works including in and around the shale quarry. The condition of the planted trees and shrubs are inspected annually and where necessary replaced, weed treated, watered or guards replaced as required.

Given the nature of the landform being rehabilitated, that is, narrow strips perched along a highwall, the ability to recreate a particular vegetation community with any degree of scientific validity is not possible. The broad aim of the program is therefore to establish a similar dominant species composition but without the same complexity, diversity or functionality. The success criteria for the resultant habitat will simply be a stable landform

with a density of 80 stems per ha with a goal of 30 trees per ha and which have seeded three times.

7.3 Summary of Rehabilitation Areas during the RMP Term

In summary, the following rehabilitation will be done during the RMP term:

- ❒ Rehabilitate 2.6 ha of shaped highwall;
- ❒ Rehabilitate a further 0.6 ha of new highwall to be created with the extended quarry footprint;
- ❒ Progressively rehabilitate an existing 3.7 ha area of Domain 4 which will add to the existing 3.5 ha of rehabilitated external bund to create a total of 7.2 ha of completed rehabilitation.

At the end of this RMP period, the total combined rehabilitation will be 10.4 ha.

7.4 Relinquishment Phase Achieved during RMP Period

No areas will be relinquished during the term of this RMP.

8. Rehabilitation Monitoring and Research

8.1 Environmental Monitoring

The Shale Quarry falls within the overall environmental monitoring program for the cement works. This includes dust and noise monitoring at key residential receptors around the facility. This monitoring program includes activities at the quarry as they contribute to the overall emissions from the cement works.

8.2 Rehabilitation Monitoring Methodology

No rehabilitation monitoring has been done to date at the quarry. Although it is not possible to recreate the pre-existing shale woodland community given the resultant landform of the quarry, it is possible to use a similar species diversity. The functionality of the community will not be the same as a natural system given that the rehabilitation will be done on separate 5 m berms. Monitoring of these areas will also be physically difficult given that there will be no access available and each berm will be flanked on one side by a steep slope.

It is proposed to monitor the rehabilitation visually by using photographs from standardised locations, recording the type and density of the original planting and recording the health and vigour of plant growth on an annual basis. Areas that are accessible, such as the external bunds will have species density (stems per ha) recorded along with species diversity. This data will be presented in the Annual Environmental Management Report.

For areas nominated to continue as agricultural land, the land capability will be measured during the course of this RMP and used as a basis for future assessment. It is not considered necessary to calculate the carrying capacity of the land as the area nominated for continuing agricultural use has not, and will not in future, be disturbed by the quarry.

8.3 Research and Rehabilitation Trials and the Use of Analogue Sites

Vegetation mapping undertaken on behalf of Wingecarribee Shire Council found that remnants of the Southern Highlands Shale Woodland (SHSW) may now all be of variable structure and quality due to many years of clearing and disturbance. This particular woodland community occurred on relatively fertile soils and was therefore almost completely cleared. Although there are some very small scattered patches remaining on privately owned agricultural land to the south east of the quarry along Stoney Creek there is a larger community located on the upper slopes of Black Bobs Creek to the west of the Hume Highway, some 12 km to the south west of the quarry.

There is however some literature available on the structure and floristics of this community which is sufficient to develop the rehabilitation design. Although SHSW includes vegetation ranging from open-forest to woodland and even simple scrub without a dominant tree canopy, it was predominantly woodland which should be structured with around 30 trees per ha with at least 4 different species. To achieve this, the planting density will be around 80 stems per ha of which at least 5 tree species listed in Section 7.2.5 will be used.

9. Intervention and Adaptive Management

9.1 Threats to Rehabilitation

Progressive rehabilitation of the quarry is governed by the advance of the extraction area and the development of new benches. Although the rehabilitation techniques that are currently employed are proving successful, the key risks to the success of the program.

- The need to maintain in-pit water storage for the cement works. This governs access to some sections of the quarry and the ability to rehabilitate the lower benches.
- Access along each berm once the planting is completed. It will be difficult to undertake any major maintenance works in some areas as access will be unavailable.
- Ongoing agricultural activities surrounding the quarry. This activity is important in maintaining the areas nominated for ongoing agricultural use however there is a low risk of damage to rehabilitation work if fencing is not adequate and stock enter rehabilitation areas.

Given the site is located within the cement works, it will have an ongoing use for as long as the cement works exists. The key usage is for the storage of water which is critical to the long term water sustainability of the cement operation.

9.2 Trigger Action Response Plan

The following Trigger Action Response Plan (TARP) covers the activities of the Shale Quarry as part of the overall cement plant operation.

Criteria	Trigger	Action
Dust emissions	Dust emissions greater than 2 g/m^2/month	Increase use of water cart Stabilise areas causing wind erosion
Surface Erosion	Bank or bed cutting, sediment movement and build-up Erosion of berm channels Rilling on batter slopes	Widen channel to achieve less than 2.5 m/s peak flow Install channel protection such as rock rubble
Nil discharge from quarry operation	Overtopping of in-pit dam during storm events	Use water for dust suppression Pump water to other cement plant water storages Increase in-pit dam capacity
Growing Media Depth	Depth less than 100 mm	Rectify as required
Growing Media Quality	pH >5 Not Sodic Electrical Conductivity < 6.5 dS/m Nitrate content > 1.5 g/m^2 Phosphate content > 6 g/m^2 Sulfate content > 4 6 g/m^2	Apply fertiliser and soil conditioners until optimal media quality is achieved

	Calcium content > 250 g/m^2 Magnesium content > 20 g/m^2 Iron content > 25 g/m^2 but < 220 g/m^2 Manganese content > 8 g/m^{2}but < 20 g/m^2 Zinc content > 0.2 g/m^2 Copper content > 0.5 g/m^2 Boron content > 0.2 g/m^2	
Vegetation dieback	Greater than 10% death rate	Establish soil chemistry Apply soil ameliorants Retest soil to confirm suitability
Sustained growth	Lack of self seeding	Monitor growth stages to determine limitations Improve soil structure and fertility, reduce physical limitations
Community Establishment	Vegetation monitoring shows sustainability curve not being achieved after 3 years Bare patches greater than 10% of transects	Targeted plantings using tubestock or seed Test soil to determine any limiting factors Apply soil ameliorants

9.3 Reporting

Annual Rehabilitation Reports will be lodged each year with the Resources Regulator through its on line portal and then provided to relevant government departments as required. The Annual Rehabilitation Report is an important tool for measuring and documenting the success and implementation of the commitments and planning made in this RMP.

In the event that a pollution incident occurs at the site the relevant government departments will be advised as soon as possible.

The Annual Rehabilitation Report will provide a summary of all environmental monitoring data collected during the reporting period and compare these with the stated objectives and targets.

Plans

Appendix A – Rehabilitation Cost Estimate