

Biodiversity and Rehabilitation Management Plan

Menangle Sand and Soil Quarry

Prepared for Menangle Sand and Soil Pty Ltd
February 2022





Servicing projects throughout Australia and internationally

SYDNEY

Ground Floor, 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE

Level 3, 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE

Level 1, 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

ADELAIDE

Level 4, 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE

Ground Floor, 188 Normanby Road
Southbank VIC 3006
T 03 9993 1905

PERTH

Suite 9.02, Level 9, 109 St Georges Terrace
Perth WA 6000
T 02 9339 3184

CANBERRA

PO Box 9148
Deakin ACT 2600

Biodiversity and Rehabilitation Management Plan

Menangle Sand and Soil Quarry

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v4	28 February 2022	P. Towler S. Ward	P. Towler	Update to address Department of Planning and Environment (DPE) comments.

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Abbreviations

BAM	Biodiversity Assessment Methodology
BCD	Biodiversity Conservation Division (within DPE)
BRMP	Biodiversity and rehabilitation management plan
Council	Wollondilly Shire Council
DBH	Diameter at breast height
DPE	NSW Department of Planning, Industry and Environment (previously Department of Planning, Industry and Environment, DPIE)
EEC	Endangered Ecological Community
EMM	EMM Consulting Pty Limited
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPA	NSW Environment Protection Agency
LLS Act	<i>Local Land Services Act 2013</i>
LSC	land and soil capability
Menangle Sand and Soil	Menangle Sand and Soil Pty Limited
MNES	Matters of National Environmental Significance
No.	Number
NSW	New South Wales
SEPPs	State Environmental Planning Policies
SWMP	Surface Water Management Plan
TEC	Threatened Ecological Community
TSC	NSW <i>Threatened Species Conservation Act 1995</i>
VMP	Vegetation Management Plan

Definitions

Consent Condition	A condition under Schedule 2 of the Consent, unless otherwise specified.
Restoration	Conservation actions proposed for the Stage 8 conservation areas (management zones 8 on Figure 2.3).
Rehabilitation	The actions required to return all disturbed lands to an agreed post-quarrying land use.
The Consent	The <i>Notice of Orders Made, Menangle Sand and Soil Pty Limited v Minister for Planning</i> , issued by the NSW Land and Environment Court on 10 September 2020 (case number LEC 2018/342158), as modified.

1 Introduction

1.1 Background

Menangle Sand and Soil Pty Ltd (Menangle Sand and Soil) operates the Menangle Sand and Soil Quarry ('the quarry') at 15 Menangle Road, Menangle (Figure 1.1). Quarrying has been undertaken in the location for over 40 years by a number of operators and at varying rates of production. Extraction, processing and rehabilitation activities have been undertaken by Menangle Sand and Soil since 1978.

The quarry, located in the Wollondilly and Campbelltown local government areas, extracts sand and soil along the Nepean River as approved by Development Consent 85/2865, granted by the Minister for Planning on 15 November 1989.

To date, sand and soil has been extracted from Stages 1 to 2 and 4 to 7 (Figure 1.2). While previously approved, sand and soil will not be extracted from Stage 3 in exchange for the Stage 8 Area's reserves.

On 10 September 2020, the NSW Land and Environment Court (LEC) approved the Menangle Quarry Extension – Modification 1 (MOD1) to Development Consent 85/2865. Consent conditions are provided in the Notice of Orders for LEC 2018/342158). The consent to extract sand and soil from the Stage 8 area is subject to not extracting material from the Stage 3 area (as previously approved).

On 5 November 2021, the Minister for Planning and Public Spaces approved the Menangle Quarry Extension – Modification 2 (MOD2) to Development Consent 85/2865. Changes to the Consent conditions are provided in the Notice of Modification for development consent DA 85/2865.

The Consolidated Consent ('the Consent') allows the extraction of sand and soil in a new area, the Stage 8 area, that is about 13 ha, and extends about 2 kilometres (km) along the Nepean River south of the Stage 7 area. The quarry is approved to extract sand and soil from the Stage 8 area at a rate of up to 150,000 tpa. Extracted material will be transported to the processing area where it will be stockpiled, processed and blended with materials imported to the site, prior to being dispatched from the quarry. Operations (but not extraction) will continue in the Stage 6 and Stage 7 areas.

Modification 2 removed the requirement for an overland conveyor and replaced it with the operation of an off-road haul truck for the transfer of extracted materials from the Stage 8 area to the processing area using existing roads.

This Biodiversity and Rehabilitation Management Plan (BRMP) has been prepared to address the requirements of the Consent.

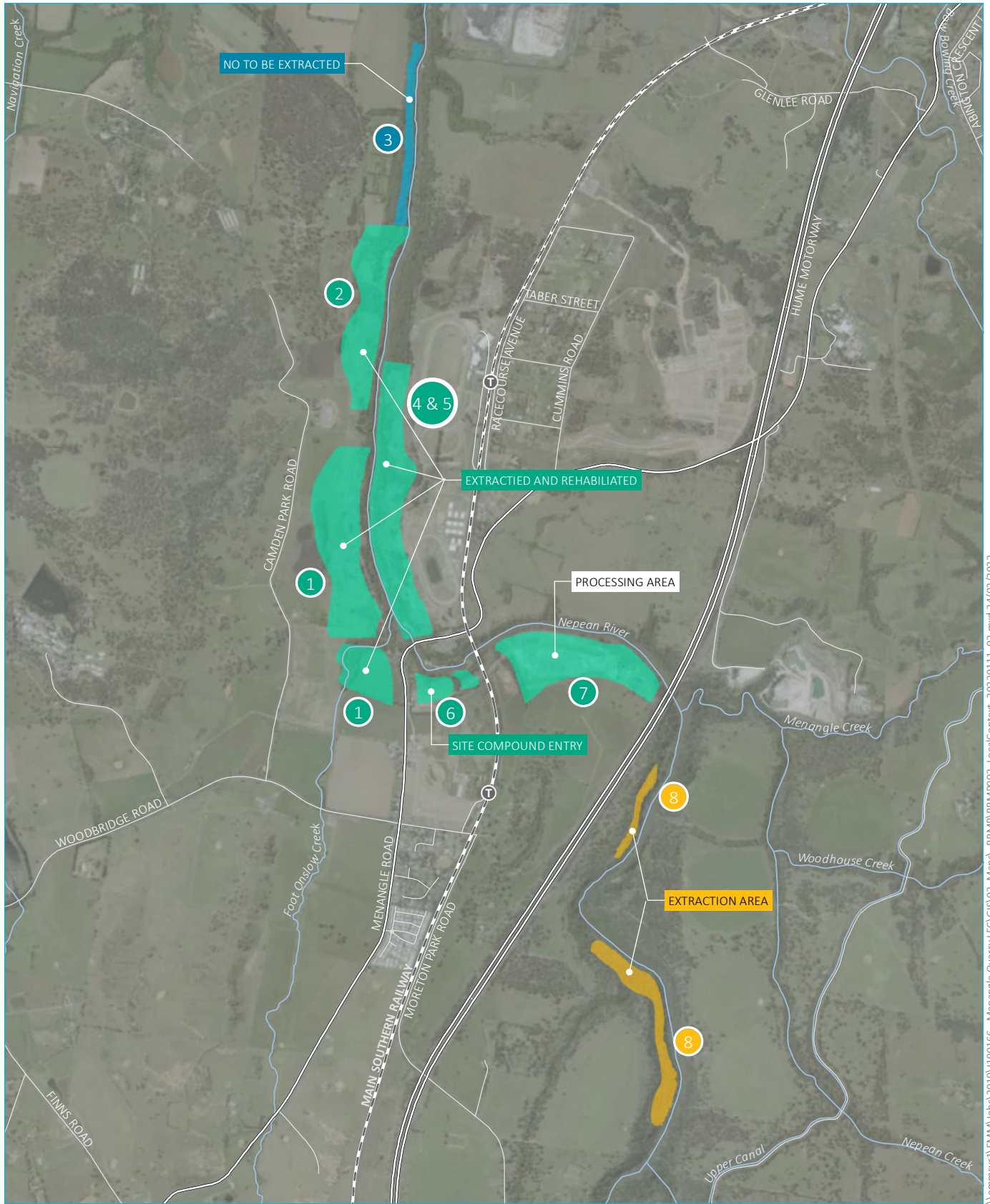


- | | |
|---|--|
| <ul style="list-style-type: none"> --- Rail line == Major road — Named watercourse ▒ Named waterbody ■ NPWS reserve ▭ Local government area | <p>INSET KEY</p> <ul style="list-style-type: none"> — Main road ■ State forest |
|---|--|

Regional context

Menangle Sand and Soil Quarry
Figure 1.1

\\emmsvr1\EMM\Jobs\2019\1190166 - Menangle Quarry\LEC\GIS\02_Maps\G035_Regional\Context_20220112_01.mxd 24/02/2022



Source: EMM (2022); Metromap (2022); DFSI (2017)

KEY

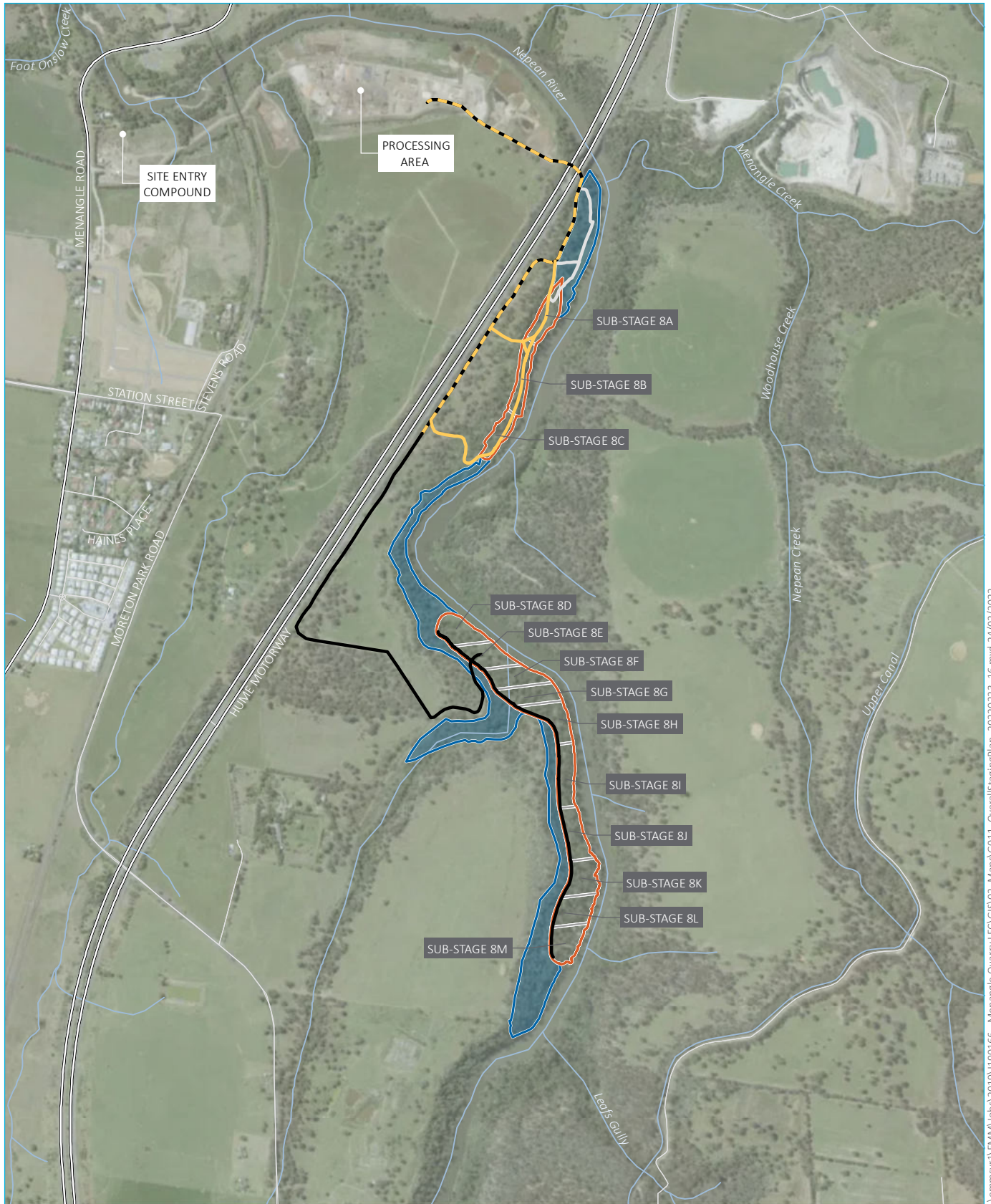
- Train station
- Rail line
- Main road
- Local road
- Named watercourse
- Extractive operations (approved)
- Extractive operations (approved but not extracted)
- Stage 8 - extraction/rehabilitation area

Menangle Quarry stages 1 to 8

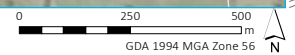
Menangle Sand and Soil Quarry
Figure 1.2



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Source: EMM (2022); Metromap (2022); DFSI (2017)



KEY

- | | | |
|--|----------------|----------------------------|
| Stage 8 - extraction/rehabilitation area | Access track | Substage boundary |
| Stage 8 - restoration area (no extraction) | Haul roads | Phase 1 Sub-stages 8A - 8B |
| Main road | Substage 8A-8M | Phase 2 Sub-stage 8C |
| Local road | Substage 8A-8C | Phase 3 Sub-stages 8D - 8E |
| Watercourse/drainage line | Substage 8D-8M | Phase 4 Sub-stages 8F - 8G |
| | | Phase 5 Sub-stages 8H - 8I |
| | | Phase 6 Sub-stages 8J - 8K |
| | | Phase 7 Sub-stages 8L - 8M |

Stage 8 area

Menangle Sand and Soil Quarry
Figure 1.3

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1.2 Project overview

The quarry has consent to extract the sand and soil resource in the Stage 8 area to 2035. Stage 8 has been split up into 15 sub-stages (Figure 1.3) which have been further categorised into seven extraction phases (Table 1.1).

Table 1.1 Stage 8 phases

Phase	Substage
1	8A–8B
2	8C
3	8D–8E
4	8F–8G
5	8H–8I
6	8J–8K
7	8L–8M

As well as the extraction areas, key components of the quarry include:

- a wheel wash and weighbridge;
- a site office and amenity building;
- a workshop west of the site office;
- fuel supply tanks north of the storage shed;
- processing equipment;
- processing area, including stockpiles; and
- other minor infrastructure.

These components will be used to support activities in the Stage 8 area which include:

- extraction in the Stage 8 extraction area followed by rehabilitation;
- restoration of areas adjacent to the extraction areas; and
- internal haul roads.

1.3 Operations

1.3.1 Activities

Operations at the quarry comprises the following activities:

- vegetation management and clearance;
- sand and soil excavation;

- material transport by off-road haul truck;
- sorting and screening of excavated material;
- processing of excavated material;
- blending of excavated material with imported materials (permitted by the Consent and EPL 3991);
- stockpiling;
- loading of product into trucks; and
- product dispatch via trucks.

1.3.2 Plant and equipment

Consent Condition A33 states:

All plant and equipment used on site, or to monitor the performance of the development must be:

- (a) maintained in a proper and efficient condition; and
- (b) operated in a proper and efficient manner.

Regular maintenance of all plant and equipment will be logged and stored on site available for review at any time.

1.4 Quarry life

The Stage 8 Operations may be carried out on the site until 31 December 2035.

1.5 Operating hours

The quarry will operate during the approved hours in accordance with Consent Condition A26 Table 1 (see Table 1.2).

Table 1.2 Operating hours

Activity	Permissible hours
Construction work	<ul style="list-style-type: none"> • 7 am to 5 pm Monday to Friday • 7 am to 1 pm Saturday • At no time on Sundays or public holidays
Quarrying operations including loading and dispatch of laden trucks	<ul style="list-style-type: none"> • 6 am to 5 pm Monday to Friday • 6 am to 12 noon Saturday • At no time on Sundays or public holidays
Maintenance, security, office work, cleaning, etc	<ul style="list-style-type: none"> • May be conducted at any time, provided that these activities are not audible at any residence on privately-owned land

Consent Condition A27 states that where police or other public authorities request that deliveries or dispatching of materials are to be carried out outside operating hours and emergency work to avoid the loss of lives, property or to prevent environmental harm is required, then these activities are permitted outside the normal operating hours.

In such circumstances, the Applicant must notify the Department and affected residents prior to undertaking the activities, or as soon as is practical thereafter.

1.6 Stage 8 area quarry design

The Stage 8 quarry design is presented in the *Applicant's Description of Amended Project* (EMM 2020) and is summarised below, describing the design from the edge of the Nepean River to the landward side of the extraction area. A schematic showing the quarry design and progression is provided in Figure 1.4.

1.6.1 Lower riverbank

The lower riverbank will be retained below the 64 mAHD contour. No extraction will occur within this zone.

1.6.2 Nepean River Buffer Zone

The Nepean River Buffer Zone (NRBZ) will provide a minimum horizontal setback of 10 m extending landward from the 64 m AHD contour on the western side of the Nepean River. Where there are native trees within the 10-m wide horizontal setback area ('Protected Trees'), the width of the setback will be increased so that edge of the setback area/start of extraction area is at least 7.5 m (measured horizontally) from the trunk of these trees. Therefore, the NRBZ will be between 10-m and 17.5-m wide. As there will be no resource extraction within this zone, there will be no resource extraction within 7.5 m of Protected Trees.

The NRBZ for Substages 8A–8C is presented in Figure A.1 in Appendix A.

1.6.3 Riverside batter

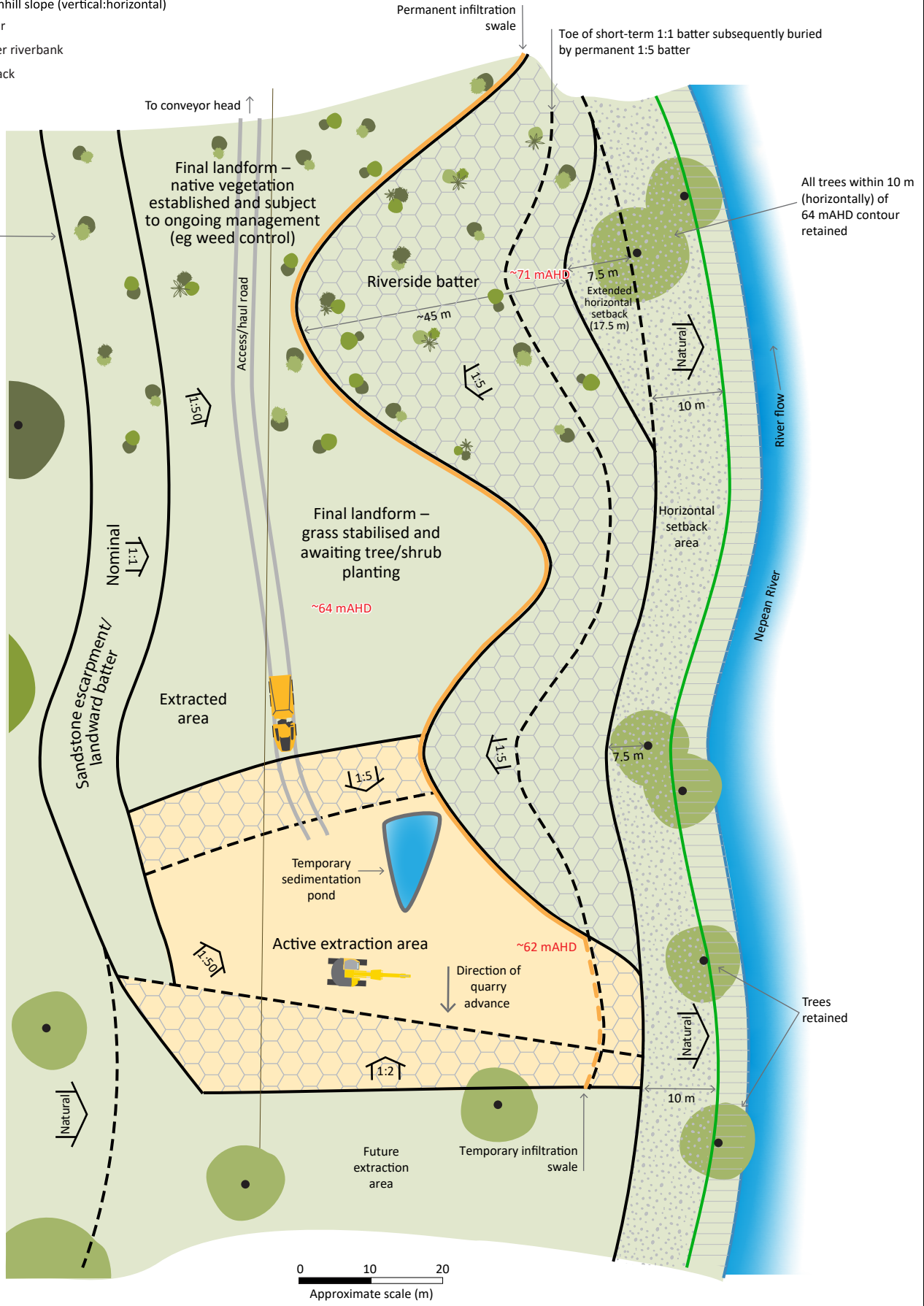
The riverside batter will be inland of the NRBZ and will be managed as follows:

- a temporary riverside batter with a maximum slope of 1:1 m (vertical: horizontal)¹, will be used during sand and soil extraction – this will allow the efficient extraction of the resource;
- following extraction of the resource above this batter, the batter will be then built up with suitable site material to give a permanent slope of 1:5 – this will provide additional assurance that the bank will be stable if the active extraction area is flooded during extraction;
- the maximum length of the riverside batter that has a slope between 1:1 and 1:5 will be restricted to 30-m long;
- regardless of the amount of material required, the maximum length of the riverside batter that has a slope between 1:1 and 1:5 will be restricted to 30 m, measured parallel along the river;
- in the final landform, the riverside batter will have a permanent slope of 1:5 – this will provide additional assurance that the bank will be stable in the long term; and
- if over the life of the quarry, activities temporarily cease in the extraction area such that the excavator is relocated from the Stage 8 area, the riverside batter will be always left as a 1:5 batter.

¹ All slopes in this report are expressed as vertical:horizontal.

KEY

- ~64 mAHD Typical spot height
- 64 mAHD contour
- 1:2 Downhill slope (vertical:horizontal)
- Batter
- Lower riverbank
- Setback



Quarry progression schematic
 Menangle Quarry Extension
 Figure 1.4

1.6.4 Landward batter

The landward, or inland, batter is on the side of the extraction area furthest from the river. A maximum landward batter angle of 1:1 will be maintained, except where the batter is formed by the natural sandstone rock escarpment, which may be vertical in places.

1.6.5 Advancing quarry face

The quarry will progressively advance upstream at an average rate of about 150 m/year. The advancing quarry face will face downstream.

During large floods, river water may overtop the lower riverbank and horizontal setback area and flow into the active extraction area or may overtop the riverbank upstream of the active extraction area and flow along the bank to enter the active extraction area over the advancing face. A maximum batter angle of 1:2 will be applied to the advancing face so as to minimise any scour occurring as the water initially flows down the batter, until the water level in the extraction area is at the same level as the river.

1.6.6 Trailing quarry face

The trailing quarry face, between the active extraction area and backfilled extracted area, will face upstream.

A maximum landward batter angle of 1:5 will be maintained for this face as it will face upstream in a flood. As for the riverside batter, this will mitigate the scour risk.

1.6.7 Base of the extraction area

Bores will be installed in the base of the active extraction area prior to the commencement of extraction in each successive substage and the water level will be recorded daily during active operations. The resource will be extracted in a manner that ensures that the base of the extraction area is always at least 1 m above alluvial water table resulting from the normal low flow water level in the Nepean River.

1.7 Access

1.7.1 Site access

The main access to the site is from Menangle Road. Menangle Road is an arterial road which provides sub-regional access.

1.7.2 Access to the Stage 8 area

The existing access under the Hume Motorway was retained when the Road Transport Authority (now Transport for NSW, TfNSW) bisected the lands when acquiring the corridor for the original Hume Highway in 1969. The existing access road under the bridge will be sealed and will comply with TfNSW drainage and pavements standards.

Material will be transported beneath the Hume Motorway Menangle Bridge by off-road haul truck.

The earthmoving equipment, off-road haul truck and other plant to service the Stage 8 area may also access the area via Moreton Park Road. Major plant is expected to remain onsite through-out the duration of the quarrying operations except for major servicing or replacement.

1.7.3 Product dispatch

Truck movements at the site (ie combined inbound and outbound movements) will not exceed an average of:

- 147 per day on Monday to Friday; and
- 80 per day on Saturday.

1.8 Stage 8 area biodiversity

The Stage 8 area is located within a narrow area of remnant vegetation in a fractured landscape in the Wollondilly Shire Council local government area. The vegetation is bounded by the banks of the Nepean River to the east and a small escarpment to the west. Most of the land uphill of the escarpment has been extensively cleared and subject to agricultural uses for at least 70 years, and most likely for much longer.

The native vegetation present within the Stage 8 area comprises *River-flat Eucalypt Forest on Coastal Floodplain on the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community* (River-flat Eucalypt Forest Endangered Ecological Community (EEC)). The plant community type (PCT) is 835, and under previous vegetation mapping it corresponds to the Riparian Forest subcommunity (NPWS 2002).

The large trees present are predominantly Southern Blue Gum (*Eucalyptus botryoides* x *saligna*). These large trees form a largely contiguous canopy from almost the northern end of the Stage 8 area extending south through the remainder of Stage 8 and connecting with a further extension of the ecological community to the south along the Nepean River almost to Douglas Park.

1.9 Purpose and scope

This BMRP presents the framework for restoration and rehabilitation practices at the quarry and has been prepared to address the requirements of the Consent.

The purpose of this BMRP is to:

- minimise the quarry disturbance area;
- provide a structured approach to the restoration of vegetation in the Stage 8 area, progressive rehabilitation of the Stage 8 extraction area, additional rehabilitation in the Stage 6 and 7 areas, and final rehabilitation across the quarry; and
- identify the specific biodiversity management and rehabilitation actions in the Stage 8A–8C extraction area, in the adjacent Stage 8 restoration areas, and in the Stage 6 and 7 rehabilitation areas.

The structured approach to this BMRP includes:

- describing the quarry and activities to be undertaken;
- describing the strategic framework for activities, monitoring, reporting and auditing;
- identifying the approvals, licences and permits that relate to the quarry; and
- describing the roles and responsibilities of personnel in relation to on-ground works.
- This BMRP provides the specific management measures for:

- biodiversity management and rehabilitation in the Substage 8A–8C area, and restoration areas, during operations;
- vegetation management in the Stage 6 and 7 areas; and
- progressive quarry rehabilitation and closure following the completion of quarry operations.

This BRMP incorporates the following reports required by the Consent:

- Consent conditions B80; B81; B82: Vegetation Management Plan (stages 6 and 7) – Chapter 6;
- Consent Condition A11: Native Vegetation Identification Report – Appendix A; and
- Consent conditions B67–B69: *Biodiversity Offset Strategy* – Appendix B.

This BRMP uses the terms ‘rehabilitation’ and ‘restoration’. ‘Restoration’ refers to retaining and managing native vegetation to improve environmental outcomes, while ‘rehabilitation’ refers to vegetation works within the Stage 8 extraction area, as well as decommissioning, land shaping, stabilisation, revegetation and maintenance works for disturbances across the unrehabilitated sections of the entire quarry.

Menangle Sand and Soil will not commence quarrying operations in the Stage 8 area until this BRMP is approved by the Planning Secretary.

Menangle Sand and Soil will implement this BRMP as approved by the Planning Secretary.

1.9.1 Staged biodiversity management and rehabilitation in the Stage 8 area

Extraction in the Stage 8 area will be undertaken in a series of phases/substages (see Section 1.2). Accordingly, biodiversity management and rehabilitation will also be undertaken in a series of phases/substages. This BRMP is a staged management plan, in accordance with Consent Condition A29, addressing biodiversity management and rehabilitation for Substages 8A to 8C. While this BRMP specifically covers Substages 8A, 8B, and 8C, it also sets out the broader approach to works, and particularly biodiversity offset activities, for the other substages of Stage 8. This BRMP will be updated for Substage 8D and beyond.

Restoration works will occur concurrently with the extraction works. Once each area is restored it will require ongoing management. Therefore, to maximise the feasibility of the quarry, restoration will also be staged as described in the *Biodiversity Offset Strategy* (Appendix B) works.

Within 12 months of the start of Stage 8 operations, 106 nest boxes will be installed throughout the restoration areas adjacent to Stages 8A to 8M as part of the biodiversity management and rehabilitation for Substages 8A to 8C. Management actions, monitoring, and reporting of the nest boxes in all substages will be included in the biodiversity monitoring program.

Quarrying operations will not progress from one Phase of the development (see Table 1.1) to another unless the progressive rehabilitation performance indicator in this BRMP have been met (for the previous phase with the exception of in the active extraction area where rehabilitation has not commenced – a maximum of 0.33 ha) (see Section).

1.9.2 Vegetation management in the Stage 6 and 7 areas

This BRMP includes a Vegetation Management Plan (VMP) for rehabilitation in the Stage 6 area and Stage 7 area in accordance with Consent Condition B82 (see Section 5.5).

1.9.3 Quarry rehabilitation and closure

This BMRP outlines the proposed post quarry land uses (see Section 3) to ensure that biodiversity and rehabilitation management measures work towards the identified final land uses.

i Progressive rehabilitation

The completed extraction areas within the Stage 8 area will be progressively rehabilitated as follows:

1. landform establishment;
2. growth medium development (soil physical and chemical properties);
3. ecosystem and land use establishment (vegetation establishment); and
4. ecosystem and land use sustainability (established vegetation is supporting post-quarrying land use).

Similarly, the vegetation in the restoration areas will be progressively managed to restore River-flat Eucalypt Forest EEC.

ii Final rehabilitation

As part of quarry closure, the Stage 6 and 7 area will be rehabilitated as follows:

1. decommissioning (removal of any equipment and infrastructure);
2. landform establishment;
3. growth medium development (soil physical and chemical properties);
4. ecosystem and land use establishment (vegetation establishment);
5. ecosystem and land use sustainability (established vegetation is supporting post-quarrying land use); and
6. land relinquishment.

The Stage 8 area will be progressively rehabilitated to River-flat Eucalypt Forest EEC and final rehabilitation in the Stage 8 area will be a continuation of the progressive rehabilitation program and associated monitoring.

1.10 Report preparation

This BRMP has been prepared by Michael Frankcombe and Dr Steven Ward.

Michael holds a Bachelor of Environmental Science and is a Certified Professional in Erosion and Sediment Control. Michael has over 32 years' practical experience in the civil construction, mining, and pipeline industries, specialising in erosion and sediment control, mining landform design, rehabilitation, revegetation, natural channel design and water treatment.

Steven holds a Bachelor of Science (Botany and Zoology majors) with honours, and a Doctor of Philosophy. He is a Biodiversity Assessment Method (BAM) Accredited Assessor. Steven has led assessments for multiple large-scale projects and has wide-ranging experience across sectors including infrastructure, urban development, water, and power. He has managed and delivered environmental impact assessments, delivered ecological offsets for projects.

Updates to the report have been made by Michael and Dr Philip Towler. Philip holds a Bachelor of Science (Chemistry major) with honours, and a Doctor of Philosophy in environmental chemistry. Philip has extensive experience preparing environmental and social impact assessments and environmental management plans around Australia and internationally, and has led a wide range of geochemistry, water and sediment assessment projects.

1.11 Legislative requirements

1.11.1 Environmental Planning and Assessment Act 1979 and Regulation 2000

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the NSW Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) provide the assessment and approvals framework for development in NSW.

The Menangle Quarry Extension was approved as a modification to the quarry's development consent as a transitional project section 75W of Part 3A of the EP&A Act.

1.11.2 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) was enacted to protect threatened species, populations and ecological communities in NSW. In 2016, it was replaced by the *Biodiversity Conservation Act 2016* (BC Act). The Menangle Quarry Extension was originally assessed under the TSC Act, so the repealed TSC Act has been used in developing the biodiversity offset package to compensate for vegetation clearing in the Stage 8 area.

1.11.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) is NSW's key legislation for biodiversity conservation in NSW. The Act combines and simplifies numerous acts including the *Local Land Services Act 2013* and the TSC Act.

Parts of the BC Act applies to some measures described in this BRMP, such as to sourcing native seed for rehabilitation.

1.11.4 State Environmental Planning Policy (Koala Habitat Protection) 2021

State Environmental Planning Policies (SEPPs) are environmental planning instruments that address planning issues significant to NSW. The Menangle Quarry Extension was originally assessed under SEPP 44 – Koala Habitat Protection (SEPP 44). The policy applies to the project as it is located in the Wollondilly local government area, which is listed in Schedule 1 of SEPP 44. SEPP 44 was repealed by the SEPP (Koala Habitat Protection) 2021 (Koala SEPP 2011).

Both SEPP 44 and Koala SEPP 2021 aim to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline. However, the project is not a development application and does not require approval from Council, and thus consideration of the Koala SEPP 2021 is not triggered under Part 2 of the SEPP.

1.11.5 Pesticides Act 1999

The *Pesticides Act 1999* manages pesticide use in NSW. Pesticides are regulated by the NSW Environment Protection Agency (EPA). The Act aims to reduce risks to human health, the environment, property, industry and trade, as well as to promote collaborative and integrated policies for pesticide use.

1.11.6 Seed collecting permits

Off-site seed collection in NSW requires a Scientific Licence under Part 2 of the BC Act. Separate approvals will be required for these permits, and external suppliers of seed from outside the site will be required to hold a licence.

1.12 Relevant Consent conditions

Conditions of the Consent that are related to this BMRP, and where each condition is addressed, are presented in Table 1.3.

Table 1.3 Consent conditions relevant to the BMRP

Item	Condition no.	Contents	Section addressed
Nepean River Buffer Zone	A10	The Applicant must establish and maintain a Nepean River Buffer Zone during Quarrying Operations in the Stage 8 Area. This buffer zone must:	Section 3.5.3
		(a) include a minimum horizontal setback of 10 m extending landward from the 64 m AHD contour on the western side of the Nepean River;	
		(b) be informed by a native vegetation identification report, which must:	The Nepean River Buffer Zone for Substages 8A–8C has been determined based on a survey of the 64 m AHD contour by a qualified surveyor and the measurement of the DBH and species identification of trees by a qualified ecologist See <i>Native Vegetation Identification Report</i> (Appendix A)
		(i) be prepared by a suitably qualified and experienced botanist or ecologist, whose appointment has been endorsed by the Planning Secretary;	
		(ii) include detailed site surveys to identify the DBH of all native trees that occur within the 10 m horizontal setback from the 64 m AHD contour referred to in sub-paragraph (a);	
		(iii) classify all native trees identified in subparagraph (b)(ii) with a DBH of greater than or equal to 0.1 m as Protected Trees and provide their GPS coordinates; and	
		(iv) include a map illustrating a 7.5 m setback (measured at the outside of the native tree trunk) around each of the identified Protected Trees;	
		(v) the map required under subparagraph (iv) must overlay high-resolution ortho-photographs, with supporting digital terrain data files provided in spatial format for GIS and as high-resolution JPEG files; and	
		(c) be amended to include the findings of the native vegetation identification report, such that it is widened to include areas where the Protected Tree setbacks extend beyond the minimum 10 m horizontal setback referred to in subparagraph (a).	See Section A.3 of Appendix A and Figure A.1
	A11	The Applicant must submit a copy of the native vegetation identification report and associated survey plans, GPS coordinates and data files required under condition A10(b) of Schedule 2 and associated final landform plans to the Planning Secretary for each of Phases 1 to 7 of the development prior to commencing any vegetation clearing or Quarrying Operations in the relevant phase.	See Section A.2 of Appendix A The final landform in the Stage 8A–8C area is provided in Appendix C.
	A12	With the written agreement of the Planning Secretary, the Applicant may seek to reduce the minimum 7.5 m horizontal setback distance for Protected Trees to an appropriate distance recommended by a consulting arborist assessment. Any variation request must be supported by an expert report prepared by the consulting arborist and will be determined by the Planning Secretary on a case by case basis.	Not proposed for Substages 8A–8C (Phases 1–2) – see Section A.2 of <i>Native Vegetation Identification Report</i> (Appendix A)
	A13	The Applicant must retain and manage the minimum Nepean River Buffer Zone in accordance with the commitments in the documents listed in condition A7(c) of Schedule 2 (as may be amended by the conditions of this consent).	Section 3.5.3 See Section A.1 of <i>Native Vegetation Identification Report</i> (Appendix A)
Nepean River Buffer Zone controls	A17	The Applicant must not: (a) carry out Quarrying Operations or regrading; and/or	Nepean River Buffer Zone identified as a separate primary domain (Zone 3; see Table 2.1 in Section 2.2)

Table 1.3 Consent conditions relevant to the BMRP

Item	Condition no.	Contents	Section addressed
			See Section 3.5.3 regarding management of this zone
		(b) remove vegetation, except where necessary for Weed control, within the Nepean River Buffer Zone, without the prior written agreement of the Planning Secretary. The written agreement of the Planning Secretary may be provided in circumstances where those activities are necessary for environmental management purposes.	Section 3.5.3
	A18	The Applicant must ensure that any Weed control activities undertaken within the Nepean River Buffer Zone: (a) are limited to Weed removal techniques that use hand-held tools; and (b) minimise ground disturbance to the greatest extent practicable.	Section 3.5.3 Section 3.5.3
Set backs	A19	The Applicant must not undertake extraction within 7.5 m of any Protected Trees without the written agreement of the Planning Secretary under condition A12 of Schedule 2.	Section 3.5.3 <i>Native Vegetation Identification Report</i> (Appendix A)
	A20	The Applicant must maintain a minimum 7.5 m setback between Quarrying Operations and any native trees ^a located in the Restoration Area, except where a reduced setback is supported by an assessment by a suitably qualified and experienced arborist, and evidence of this assessment has been provided to the Planning Secretary. ^a In this condition, the setback is to be measured from the outside of the tree trunk.	Section 3.5.4
Staged plans	A29	The Applicant may prepare and submit the Soil and Water Management Plan and/or Biodiversity and Rehabilitation Management Plan required under conditions B36 and B73 of Schedule 2 on a staged basis, prior to the commencement of Quarrying Operations in each of Phases 1 to 7. Quarrying Operations must not commence in any phase until a management plan has been approved by the Planning Secretary for that phase.	This BRMP is a staged plan (see Section 1.9.1)
Early Works Construction Environmental Management Plan	B1	Early Works The Applicant may prepare an Early Works Construction Environmental Management Plan for the Early Works, to the satisfaction of the Planning Secretary. This plan must: (a) describe measures to be implemented to minimise construction-related impacts on biodiversity, including: (i) specific measures to minimise impacts on tree hollows, termite mounds and fauna; and (ii) detailed procedures for pre-clearance surveys and supervision (by an appropriately qualified person) of the felling of habitat trees within disturbance areas associated with the Early Works;	It is not proposed to undertake early works or prepare an Early Works Construction Environmental Management Plan

Table 1.3 Consent conditions relevant to the BMRP

Item	Condition no.	Contents	Section addressed
Rehabilitation levy	B51	Continuation of Rehabilitation Levy For the duration of the Stage 8 Operations, the Applicant must continue to pay Council a rehabilitation levy on all sand and soil removed from the Stage 8 Area in accordance with the existing rates, calculation methods and indexation required under condition 26 of Schedule 1. The first instalment of these payments is to be made based on the most recent Index Review Date under Schedule 1.	This ‘rehabilitation levy’ levy is a road maintenance level paid to the Council. It is not related to rehabilitation of biodiversity
Linear Infrastructure Assessment Report	B65	Construction of Linear Infrastructure Prior to commencing construction of any linear infrastructure required for the carrying out of the development (including access roads and haul roads), the Applicant must: (a) determine the final alignment of the linear infrastructure by survey; (b) minimise the environmental impacts of the alignment of this infrastructure, where practicable; (c) map the final vegetation clearance, excluding any vegetation within the approved disturbance area as identified under condition A22 of Schedule 2; (d) submit a survey plan of the disturbance boundaries for linear infrastructure and their respective GPS coordinates to the Planning Secretary; and (e) identify relevant ecosystem and species credits required to compensate for the clearance identified in subparagraph (c), to the satisfaction of BCD.	It is not proposed to construct new linear infrastructure. The location of haul roads (which are currently present) has been identified and excluded from restoration area calculations (where roads pass through these areas). No vegetation clearing will be associated with the use of existing tracks for hauling material between the extraction area and the processing area (EMM 2021).
	B66	The Applicant must retire the ecosystem and species credits identified under condition B65(e) in accordance with the Biodiversity Offsets Scheme of the BC Act, to the satisfaction of the BCT.	As above – no credits are needed as no new linear works are proposed
Biodiversity Offset Strategy	B67	Prior to commencing Quarrying Operations in the Stage 8 Area, or other timeframe agreed by the Planning Secretary, the Applicant must make suitable arrangements for the long-term protection of the Restoration Area as described in the documents listed in condition A7(c) of Schedule 2, to the satisfaction of the Planning Secretary.	Section 8.1 <i>Biodiversity Offset Strategy</i> (Appendix B) Section B.1
	B68	If the Restoration Area does not meet the listing criteria of the targeted communities or the completion criteria in Table 6 in Appendix 7, within the timeframes established in the Biodiversity and Rehabilitation Management Plan, then the Applicant must retire the relevant deficient biodiversity credits in accordance with the Biodiversity Offsets Scheme of the BC Act, to the satisfaction of the BCT.	<i>Biodiversity Offset Strategy</i> (Appendix B) Section B.1
	B69	The Applicant may satisfy condition B67 of Schedule 2 by establishing a positive covenant on title under section 88E of the NSW Conveyancing Act 1919. If the Applicant seeks to establish a positive covenant on title: (a) the positive covenant must stipulate that the Applicant will manage the Restoration Area and all rehabilitated Substages in accordance with the Biodiversity and Rehabilitation Management Plan required under condition B73 of Schedule 2; and (b) the Applicant must establish a trust with sufficient funds (calculated in accordance with the total fund deposit requirements for a biodiversity stewardship site in accordance with BC Act) to provide for the ongoing management of the Restoration Area and all rehabilitated Substages in accordance with the Biodiversity and Rehabilitation Management Plan to the satisfaction of the Planning Secretary.	Section 8.1 <i>Biodiversity Offset Strategy</i> (Appendix B) Section B.1

Table 1.3 Consent conditions relevant to the BMRP

Item	Condition no.	Contents	Section addressed														
Rehabilitation Objectives	B70	<p>The Applicant must rehabilitate all areas impacted by the Stage 8 Operations to the satisfaction of the Planning Secretary. This rehabilitation must be consistent with the final rehabilitation plans submitted to the Planning Secretary under condition A11 of Schedule 2 and must comply with the objectives in Table 4, to the satisfaction of the Planning Secretary.</p> <p>Table 4: Rehabilitation objectives</p> <table border="1"> <thead> <tr> <th>Feature</th> <th>Objective</th> </tr> </thead> <tbody> <tr> <td>Stage 8 Area</td> <td> <ul style="list-style-type: none"> Safe (both within the site and in relation to downstream environs, including under flood conditions) Hydraulically, geotechnically and geomorphologically stable Non-polluting Fit for the intended post-Quarrying Operations land use(s) Final landform integrated with surrounding natural landforms as far as is reasonable and feasible, and minimising visual impacts when viewed from surrounding land or the Hume Highway </td> </tr> <tr> <td>Surface infrastructure</td> <td> <ul style="list-style-type: none"> Infrastructure within the Hume Motorway road reserve (including the area under the Menangle Bridges) decommissioned and rehabilitated in accordance with TfNSW requirements All other surface infrastructure decommissioned and removed, unless otherwise agreed by the Planning Secretary </td> </tr> <tr> <td>Quarry Substages</td> <td> <ul style="list-style-type: none"> Pit floor partially backfilled with sufficient and appropriate material to promote establishment of River-flat Eucalypt Forest EEC Substages progressively landscaped and vegetated to meet the objectives, performance and completion criteria in Table 6 in Appendix 7 Batters to be established to a maximum slope of 1:1 (V:H) along the landward edge of each Substage and 1:5 (V:H) adjacent to the Nepean River Buffer Zone </td> </tr> <tr> <td>Final Landform</td> <td> <ul style="list-style-type: none"> No reduction in flood storage capacity, compared with pre-development conditions, unless otherwise agreed by the Planning Secretary Designed to incorporate geomorphological features to allow for the free draining discharge of clean water from the site Minimise sediment laden run-off into the Nepean River </td> </tr> <tr> <td>Water Quality</td> <td> <ul style="list-style-type: none"> Water discharged from the site is suitable for receiving waters and capable of supporting existing aquatic ecology and riparian vegetation </td> </tr> <tr> <td>Community</td> <td> <ul style="list-style-type: none"> Ensure public safety </td> </tr> </tbody> </table>	Feature	Objective	Stage 8 Area	<ul style="list-style-type: none"> Safe (both within the site and in relation to downstream environs, including under flood conditions) Hydraulically, geotechnically and geomorphologically stable Non-polluting Fit for the intended post-Quarrying Operations land use(s) Final landform integrated with surrounding natural landforms as far as is reasonable and feasible, and minimising visual impacts when viewed from surrounding land or the Hume Highway 	Surface infrastructure	<ul style="list-style-type: none"> Infrastructure within the Hume Motorway road reserve (including the area under the Menangle Bridges) decommissioned and rehabilitated in accordance with TfNSW requirements All other surface infrastructure decommissioned and removed, unless otherwise agreed by the Planning Secretary 	Quarry Substages	<ul style="list-style-type: none"> Pit floor partially backfilled with sufficient and appropriate material to promote establishment of River-flat Eucalypt Forest EEC Substages progressively landscaped and vegetated to meet the objectives, performance and completion criteria in Table 6 in Appendix 7 Batters to be established to a maximum slope of 1:1 (V:H) along the landward edge of each Substage and 1:5 (V:H) adjacent to the Nepean River Buffer Zone 	Final Landform	<ul style="list-style-type: none"> No reduction in flood storage capacity, compared with pre-development conditions, unless otherwise agreed by the Planning Secretary Designed to incorporate geomorphological features to allow for the free draining discharge of clean water from the site Minimise sediment laden run-off into the Nepean River 	Water Quality	<ul style="list-style-type: none"> Water discharged from the site is suitable for receiving waters and capable of supporting existing aquatic ecology and riparian vegetation 	Community	<ul style="list-style-type: none"> Ensure public safety 	<p>Section 3.1 Section 6.4.3 Section 7.6</p>
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Community	<ul style="list-style-type: none"> Ensure public safety 																
Progressive Rehabilitation	B71	The Applicant must rehabilitate the Substages progressively, to the satisfaction of the Planning Secretary.	This document identifies the progressive rehabilitation of Substages 8A–8C														

Table 1.3 Consent conditions relevant to the BMRP

Item	Condition no.	Contents	Section addressed
	B72	Unless otherwise agreed by the Planning Secretary, the Applicant must ensure that:	
		(a) no more than two Substages are opened, excavated or worked at any one time without the written approval of the Planning Secretary;	Section 7.2.3 of the <i>Menangle Sand and Soil Quarry Soil and Water Management Plan</i> (SWMP)
		(b) the active extraction area in all combined Substages does not exceed 0.33 hectares at any one time;	
		(c) the area of exposed ground at any one time is minimised as far as reasonable and feasible, for the life of the development;	
		(d) Quarrying Operations do not progress from one phase of the development to another unless the progressive rehabilitation performance criteria in the Biodiversity and Rehabilitation Management Plan have been met (with the exception of in the active extraction area) for the previous phase (see condition B73(d) of Schedule 2); and	Section 1.9.1
		(e) the post-extraction batter along the landward edge of each Substage does not exceed a maximum slope of 1:1 (V:H) or the natural underlying sandstone profile.	Section 1.6.4
Biodiversity and Rehabilitation Management Plan	B73	The Applicant must prepare a Biodiversity and Rehabilitation Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:	Section 1.10
		(a) be prepared by suitably qualified and experienced person/s;	
		(b) be prepared in consultation with BCD and Council;	Section 1.15 Appendix D
		(c) describe the short, medium, and long-term measures to be undertaken to:	Chapter 5
		(i) ensure compliance with the biodiversity objectives outlined in Table 6 in Appendix 7;	Chapter 7
		(ii) ensure compliance with the rehabilitation objectives outlined in Table 4 of Schedule 2; and	Section 4.3.4
		(iii) prevent impacts on aquatic biodiversity, including through the stabilisation of riverbanks and the prevention of sediment-laden runoff;	SWMP
		(d) include detailed progressive rehabilitation performance criteria that must be met for each phase of the development before extraction can progress into subsequent phases;	Section 8.2
		(e) include detailed performance and completion criteria for the Restoration Area and the final rehabilitation of the Stage 8 Area (including timeframes for the achievement of the listing criteria of the targeted communities) based on the performance and completion criteria in Table 6 in Appendix 7;	Section 8.2
		(f) include a program to monitor, independently audit and report on progress against the criteria in subparagraphs (d) and (e), including reporting in the Annual Review;	Section 8.6

Table 1.3 Consent conditions relevant to the BMRP

Item	Condition no.	Contents	Section addressed
	(g)	include an evaluation of the performance of the Restoration Area and the progressive rehabilitation of the Stage 8 Area against the performance and completion criteria required under paragraph (d) above;	Section 8.2 Section 8.4
	(h)	include triggers for remedial action (including additional planting or seeding), where the performance or completion criteria required under (d) and (e) above are not met;	Section 5.4.3 Section 8.6
	(i)	describe management measures to ensure that Quarrying Operations do not encroach on the Nepean River Buffer Zone and Exclusion Areas;	Section 7.1
	(j)	include a detailed description of the measures to be implemented to:	
	(i)	demonstrate compliance with conditions B76 and B78;	Section 7.5
	(ii)	manage the collection and propagation of seed;	Section 5.4.3
	(iii)	trial methods of extraction of seed resources on site and implement the most effective method of seed recovery;	Section 5.3.7
	(iv)	minimise impacts on tree hollows and termite mounds where reasonable and feasible;	Section 5.2 Section 7.2
	(v)	minimise impacts on fauna, including undertaking pre-clearance surveys and supervision (by an appropriately qualified person) of the felling of habitat trees;	Section 5.2.1
	(vi)	protect native vegetation and fauna habitat outside the approved disturbance area, including in the Restoration Area;	Section 5.2
	(vii)	implement the Stage 8 Area Weed Control Strategy in the Amended Project Summary, except where varied by condition A18 of Schedule 2;	Section 4.5 Section 5.5 Appendix E
	(viii)	control feral pests;	Section 4.6 Section 5.6
	(ix)	control erosion;	Section 4.3 Section 5.4 SWMP
	(x)	control unrestricted access;	Section 6.2.3i Section 7.2
	(xi)	manage bushfire hazards;	Section 4.7

Table 1.3 **Consent conditions relevant to the BMRP**

Item	Condition no.	Contents	Section addressed
		(xii) rehabilitate any areas of the Nepean River that are materially harmed by the development (including indirect or incidental impacts); and	Section 4.4 Section 5.4.3
		(xiii) progressively rehabilitate the site and reasonably and feasibly minimise disturbance areas; and	Section 1.9
		(xiv) ensure the successful rehabilitation and protection of Stages 6 and 7 until the completion of Quarrying Operations in the Stage 8 Area;	Section 6.2 Section 6.4
	(k)	include an annual program to monitor and report on: <ul style="list-style-type: none"> (i) the effectiveness of the measures required under (j) above; (ii) progress against the detailed performance and completion criteria required under (d) and (d) [sic] above; (iii) any progressive improvements that could be implemented to improve biodiversity outcomes; and (iv) any additional or remedial actions required over the next 12 months; 	Section 8.4
	(l)	identify the potential risks to the successful rehabilitation of the Stage 8 Area, particularly where rehabilitation is damaged or delayed by flooding, and include a detailed description of the contingency measures to be implemented to mitigate against these risks; and	Section 4.3.3 Section 4.3.4 Section 5.4.3
	(m)	include details of who would be responsible for monitoring, reviewing, and implementing the plan.	Section 5.1
B74		Subject to condition A29, the Applicant must not commence Quarrying Operations in the Stage 8 Area until the Biodiversity and Rehabilitation Management Plan is approved by the Planning Secretary.	Section 1.9
B75		The Applicant must implement the Biodiversity and Rehabilitation Management Plan as approved by the Planning Secretary.	Section 1.9
B76		The Applicant must place or create a minimum of 106 nest boxes or tree hollows within the Restoration Area within 12 months of commencing Quarrying Operations in the Stage 8 Area.	Section 7.5.1
B77		The Applicant must, to the greatest extent practicable, maximise the salvage of resources within the Stage 8 Area, including retention of: <ul style="list-style-type: none"> (a) nut and seed resources from native trees; and (b) leaf and small branch material for mulching, for beneficial reuse on the site, including in rehabilitated Substages and in the Restoration Area.	Section 5.2.1
B78		Following the conclusion of extraction in each Substage, the Applicant must actively place logs and woody debris salvaged from the approved disturbance area within the completed Substage at the following ratios: <ul style="list-style-type: none"> (a) logs and woody debris at least 10 cm in diameter and greater than 0.5 m in length are to be placed in a configuration that reflects natural systems, such that there is overall at least 400 m of this woody debris per hectare for all completed Substages; and 	Section 7.5.1

Table 1.3 Consent conditions relevant to the BMRP

Item	Condition no.	Contents	Section addressed
		(b) large woody debris at least 50 cm in diameter and greater than 0.5 m in length, such that there is overall at least 100 m of this large woody debris per hectare for all completed Substages.	
Disposal of Vegetation (Stage 8)	B79	The Applicant may undertake timber milling in Stage 8, provided this timber milling occurs outside of the Nepean River Buffer Zone and the Exclusion Areas, and that the Applicant can demonstrate ongoing compliance with condition B78 of this Schedule.	Section 5.2
Additional Rehabilitation Requirements for Stages 6 and 7	B80	The Applicant must rehabilitate 1.22 ha within Stage 6 and 3.44 ha within Stage 7 of the development in accordance with the objectives and the performance and completion criteria in Table 6 in Appendix 6.	Section 6.2.1 Appendix B
	B81	By the end of December 2020, or other timing as agreed by the Planning Secretary, the Applicant must submit a Vegetation Management Plan for Stages 6 and 7 to the Planning Secretary for approval. This plan must:	Section 1.15 Chapter 5.6
		(a) satisfy the relevant requirements of condition 13 of Schedule 1; <u>[13. Rehabilitation Plans</u>	
		The applicant shall submit detailed plans of proposed rehabilitation for the site, including details of soil stock piles, and types of vegetation to be planted for each stage of the development, to the Wollondilly Shire Council, Campbelltown City Council, the Department of Water Resources and the Director, for approval, prior to the commencement of operations. Progressively upon completion of restoration and rehabilitation works, trees, shrubs and ground cover vegetation shall be planted and maintained in accordance with these plans.]	
		(b) clearly define the extent and scope of Stage 6 vegetated lands;	Figure 2.3 Figure 6.1
		(c) clearly define the extent and scope of Stage 7 vegetated lands and identifies that the diversity of species established via retention of current species, tubestock planting or direct seeding is to be raised to deliver the native plant species diversity identified in Table 5 in Appendix 6;	Chapter 6 Figure 2.3 Figure 6.2
		(d) establish baseline data for the existing habitat in the Stage 6 and 7 areas;	Section 6.2.2
(e) describe how the Stage 6 and 7 vegetated lands would be managed and how habitat would be established and retained; and	Section 6.2.3		
(f) include detailed biodiversity objectives and performance and completion criteria for Stages 6 and 7 of the development, based on the general objectives and performance and completion criteria in Table 5 in Appendix 6, to the satisfaction of the Planning Secretary.	Section 8.2		
	B82	The Applicant must implement the Vegetation Management Plan for Stages 6 and 7 to the satisfaction of the Planning Secretary.	Section 6.2
Rehabilitation Bond	B83	Within 6 months of the approval of the Biodiversity and Rehabilitation Management Plan, the Applicant must lodge a Rehabilitation Bond with the Department to ensure that rehabilitation of the Stage 8 Area is implemented in accordance with the performance and completion	Section 8.2

Table 1.3 Consent conditions relevant to the BMRP

Item	Condition no.	Contents	Section addressed
		criteria set out in the plan and the relevant conditions in Schedule 2 of this consent. The sum of the bond must be an amount agreed by the Planning Secretary and determined by: (a) calculating the cost of rehabilitating all disturbed areas of the site at third party rates (other than land acquisition costs), taking into account the likely surface disturbance over the next 3 years of Quarrying Operations; and (b) employing a suitably qualified, independent and experienced person to verify the calculated costs.	
	B84	The calculation of the Rehabilitation Bond must be submitted to the Department for approval at least 2 months prior to the lodgement of the bond.	Section 8.2
	B85	The Rehabilitation Bond must be reviewed and if required, an updated bond must be lodged with the Department within 3 months following: (a) any update or revision to the Biodiversity and Rehabilitation Management Plan; (a) the completion of an Independent Environmental Audit in which recommendations relating to the implementation of the Biodiversity and Rehabilitation Management Plan have been made; or (b) in response to a request by the Planning Secretary.	Section 8.2
	B86	If rehabilitation is completed generally in accordance with the relevant performance and completion criteria, to the satisfaction of the Planning Secretary, the Planning Secretary will release the bond.	Section 8.2
	B87	If rehabilitation is not completed generally in accordance with the relevant performance and completion criteria, if in the opinion of the Planning Secretary the works are unlikely to be carried out by the Company then the Planning Secretary may call in all, or part of, the bond, and arrange for the completion of the relevant works.	Section 8.2
	B88	If the Applicant establishes a positive covenant on title under section 88E of the NSW Conveyancing Act 1919 under condition B69, then the Planning Secretary may waive the requirement for all or part of the Rehabilitation Bond required under conditions B83 to B87.	Section 8.1
Weed Management	B89	The Applicant must manage noxious weeds on the site in accordance with the Biodiversity and Rehabilitation Management Plan, and subject to the restrictions in condition A18 of this Schedule, to the satisfaction of the Planning Secretary.	Section 5.5
Additional Stage 6 and 7 Biodiversity and Rehabilitation requirements	Appendix 6	Additional Stage 6 and 7 Biodiversity and Rehabilitation Requirements. Table 5: Additional Biodiversity Objectives and Performance and Completion Criteria for Stage 6 and 7 Vegetated Areas	Sections 8.2–8.4 Consent Appendix 6 replicated in BRMP Appendix G
	Appendix 7	Stage 8 Operations Biodiversity and Rehabilitation Table 6: Biodiversity Objectives and Performance and Completion Criteria	Sections 8.2–8.4 Consent Appendix 7 replicated in BRMP Appendix H

1.13 Guidelines and leading practice

There are currently no mandated rehabilitation guidelines for extractive industries. The planning, design, operation, rehabilitation and closure phases of soil and sand quarries are similar to alluvial mining, in that extraction typically follows an alluvial terrace and the mining and rehabilitation is undertaken progressively. Therefore, the following mine rehabilitation and closure planning guidelines have been considered in the preparation of the rehabilitation strategy.

i Managing Urban Stormwater – Soils and Construction Volume 1

The purpose of *Managing Urban Stormwater – Soils and Construction Volume 1, 4th edition* (Landcom 2004) is to help mitigate the impacts of land disturbance on soils, landforms and receiving waters through erosion and sediment control to:

- reduce pollution to downstream areas and receiving water; and
- reduce land degradation.

It is based on the premise that land degradation can be avoided or minimised largely through appropriate planning before commencement of land disturbing activities and the application of best management practices using a ‘treatment train’ approach.

ii Managing Urban Stormwater – Soils and Construction Volume 2E Mines and Quarries

The purpose of *Managing Urban Stormwater – Soils and Construction Volume 2E – Mines and Quarries* (DECC 2008) is to provide guidelines, principles and recommended design standards for erosion and sediment control at mines and quarries. Specifically, it guides the user in the application of the principles and practices of erosion and sediment control described in Landcom (2004) to mines and quarries.

iii Strategic Framework for Mine Closure

The Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia *Strategic Framework for Mine Closure* (SFMC) (ANZMEC 2000) was developed to promote nationally consistent mine closure management. The SFMC provides guidelines for the development of a mine closure plan to make sure that all stages of mine closure are conducted appropriately, including stakeholder engagement, development of mine closure methodology, financial planning, and implementation of mine closure. The SFMC also describes the expected standards for mine closure and relinquishment of the mine to a responsible authority. Whilst the objectives generally relate to mine closure, there are key elements that are relevant to rehabilitation of the quarry, in particular the allocation of appropriate resources and the establishment of rehabilitation indicators/criteria, which have been included in this strategy.

The main objectives of the SFMC that apply to the quarry are:

- to enable all stakeholders to have their interests considered during the closure process;
- to ensure the process of closure occurs in an orderly, cost-effective and timely manner;
- to ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;
- to ensure there is clear accountability, and adequate resources, for the implementation of the closure plan;
- to establish a set of indicators which will demonstrate the successful completion of the closure process; and

- to reach a point where the company has met agreed completion criteria to the satisfaction of the responsible authority.

iv Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry

The aim of the *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (MR Handbook) (DITR 2006) is to provide guidelines to promote ‘leading practice’ sustainable mine planning and rehabilitation design, considering environmental, economic, and social aspects to support on-going sustainability of a mining development. The MR Handbook recommends procedures and mitigation measures that should be considered during mine plan and rehabilitation design, including stakeholder consultation, material and handling, water balance, final landform design, soil (topsoil and subsoil) management, vegetation and fauna habitat re-establishment and rehabilitation, and agriculture/commercial forestry suitability. The MR Handbook also provides relevant mine development case studies supporting the recommended procedures and mitigation measures. Where relevant to the quarry, the above principals have been addressed in this BRMP.

v Other relevant guidelines

The following reports provide guidance on the implementation of this BMRP:

- *National Restoration Standards*, 2nd Edition (Sera Australia 2018);
- *Recovering Cumberland Plain* (DEC 2005); and
- *Herbicides: Guidelines for Use in and Around Water* (CRAWM 2020).

1.14 Overview of relationship to other key biodiversity documents

This BRMP is the overarching biodiversity management document for the quarry which sets out how biodiversity values will be managed across the quarry. It describes the actions required for the restoration areas (which will not be impacted) and the rehabilitation areas (which have been, or will be, extracted and then rehabilitated).

The BRMP includes the following biodiversity-related documents or plans required as part of the Consent:

- *Vegetation Management Plan (VMP) for the Stage 6 area* – provided in Chapter 6. This identifies measures to achieve additional conservation gains in the Stage 6 area as required by Consent conditions B80–B82. This document supersedes the previous Stage 6 VMP (Menangle Sand and Soil 2003). The extraction of the Stage 6 lands involved vegetation establishment works and 2 years of maintenance. These works occurred, with all bonds returned on 23 October 2009. Part of the Stage 6 area will continue to be used for quarry infrastructure.
- *Vegetation Management Plan for the Stage 7 area* – provided in Chapter 6. This identifies measures to achieve additional conservation gains in the Stage 7 lands as required by Consent conditions B80–B82. This document supersedes the previous Stage 7 VMPs (Ecohort 2009 and 2013). Sand and soil extraction has been completed in the Stage 7 area. Part of the Stage 7 area will continue to be used for quarry infrastructure; the processing and stockpiling processing of materials; and for water management. Rehabilitation of the remaining area will commence in 2021.
- *Nestboxes/tree hollows* – Consent Condition B76 requires the placement or creation of a minimum of 106 nest boxes or tree hollows within the Restoration Area within 12 months of commencing Quarrying Operations in the Stage 8 Area. As described in Section 7.5.1, this management action therefore will be undertaken across the restoration area as a whole.

- *Native Vegetation Identification Report* – Appendix A identifies trees within the Nepean River Buffer Zone, in accordance with Consent conditions A10 and A11, and the setback to be applied. It also documents management actions in the buffer zone.
- *Biodiversity Offset Strategy* – Appendix B provides arrangements for long-term protection of conservation areas to offset biodiversity losses, in accordance with Consent conditions B67–B69.
- *Linear Infrastructure Impact Assessment Report* – Consent Condition B65 requires the assessment of biodiversity impacts from any vegetation clearance required for the construction of linear (including access roads and haul roads). The off-road haul truck and light vehicles will only use existing tracks in the Stage 8 area and no vegetation clearing will be required as part of the approved Extension Project (ie Modification 2). As no vegetation clearing is required beyond that currently approved, a Linear Infrastructure Impact Assessment Report has not been prepared. This was confirmed by the Biodiversity Development Assessment Report (EMM 2021) prepared as part of the Modification 2 application.
- *Ephemeral Creek Management Plan* – this plan has not been prepared but will be incorporated into the BRMP prior to extraction within Substage 8E as required by Consent conditions B40 and B41. The plan will identify measures to manage and control soil erosion and bank stabilisation for the ephemeral creek within Substages 8E–8G.
- *Soil and Water Management Plan (SWMP)* – this is a separate plan required by Consent Condition B36. The BRMP considers the relevant measures described in the SWMP.

A rehabilitation bond will be provided to DPE within 6 months of the approval of this BRMP as required by Consent conditions B83–B88. Menangle Sand and Soil will liaise with DPE regarding meeting these conditions following approval of the BRMP.

1.15 Consultation

The Biodiversity Conservation Division (BCD) and Wollondilly Shire Council were invited to comment on the preparation of this BRMP and the draft BRMP (v1). The BRMP was updated accordingly based on the comments received and an updated draft BRMP (v2) was provided to DPIE for review.

Details of consultation undertaken as part of preparing this BRMP are provided in Table 1.4. Key correspondence is provided in Appendix D.

Table 1.4 Consultation

Date	Organisation	Item
13 October 2020	WSC	EMM requested WSC's input on the preparation of the BRMP.
14 October 2020	BCD	EMM requested BCD's input on the preparation of the BRMP.
22 October 2020	BCD	BCD responded that they had no requirements beyond those specified in the Consent.
13 November 2020	WSC	WSC indicated that they were satisfied with the offsetting strategy for impacts to EEC vegetation and threatened species and sought clarify that impacts to aquatic ecology have been adequately assessed and minimised. The <i>Aquatic Ecology Assessment</i> (Marine Pollution Research 2019) was subsequently provided to Council.
26 February 2021	DPIE	Letter and email to DPIE providing the status of all Menangle Quarry Management Plans, described that the VMP would be included in the BRMP.
6 May 2021	WSC	Draft BRMP (v1) supplied to WSC for review.

Table 1.4 **Consultation**

Date	Organisation	Item
7 May 2021	BCD	Draft BRMP (v1) supplied to BCD for review.
7 May 2021	DPIE	Draft BRMP (v1) (including the VMP) provided to DPIE noting that agency consultation was not required regarding the VMP.
21 May 2021	DPIE	EMM requested extension to submit the VMP.
25 May 2021	WSC	WSC responded that they had no comments on the BRMP (v1).
25 May 2021	DPIE	DPIE granted extension to submit VMP to 28 May 2021.
10 June 2021	DPIE	EMM formally requested to combine VMP in the BRMP.
17 June 2021	BCD	BCD responded that they had no comments on the BRMP (v1) other than noting some cross-referencing errors. These have been corrected.
21 June 2021	DPIE	Draft BRMP (v2) supplied to DPIE for review.
20 July 2021	DPIE	DPIE approved combining VMP and BRMP.
26 November 2021	DPIE	DPIE provided comments on draft BRMP (v2).

The draft BRMP (v2), including the Vegetation Management Plan (VMP) was submitted to DPIE in May 2021. As combining of the VMP and BRMP was not formally approved until June 2021, DPIE reviewed the VMP following submission of the BRMP 21 June 2021.

2 Rehabilitation domains and biodiversity management zones

2.1 Overview

Menangle Sand and Soil have adopted a domain-based rehabilitation and restoration approach. The quarry areas have been divided into discrete rehabilitation domains that have similar rehabilitation requirements:

- Primary domains – based on the current land use; and
- Secondary domains – based on the proposed final land use.

These are described below.

2.2 Primary domains

Primary domains have been identified based on the current land use. These primary domains are identified in Table 2.1 and Figure 2.1.

The relationships between domains and biodiversity offset areas is provided in Table 2.1. The biodiversity offsets (including the removal of Stage 3 from the Consent) consent are described in the *Biodiversity Offset Strategy* (Appendix B).

Table 2.1 Primary domains

No.	Name	Description	Relationship to biodiversity offsets
1	Infrastructure	This domain includes site infrastructure including the site office, parking area, weighbridge, wheel-wash, processing area, bunds, water off-take from the Nepean River, water treatment ponds, access roads and tracks.	Not part of the biodiversity offsets. Tracks through restoration areas have been treated as a separate land use and excluded from restoration area calculations.
2	Previously extracted areas	Extraction Stages 2 to 7 (not including Stage 3 which was not quarried).	Vegetation management included in the package of positive biodiversity works but not part of the biodiversity offsets.
3	Nepean River Buffer Zone	The buffer zone between the Nepean River and extraction in the Stage 8 area. This includes land and vegetation from the edge of the Nepean River to the 64 m AHD contour, and the 10-m to 17.5-m wide horizontal setback. No extraction will occur within this zone.	Part of the package of positive biodiversity works but not part of the biodiversity offsets.
4	Extraction area	Stage 8 extraction area which will be progressively rehabilitated.	Area in which vegetation will be cleared. Rehabilitation is part of the package of positive biodiversity works but not part of the biodiversity offsets.

Table 2.1 Primary domains

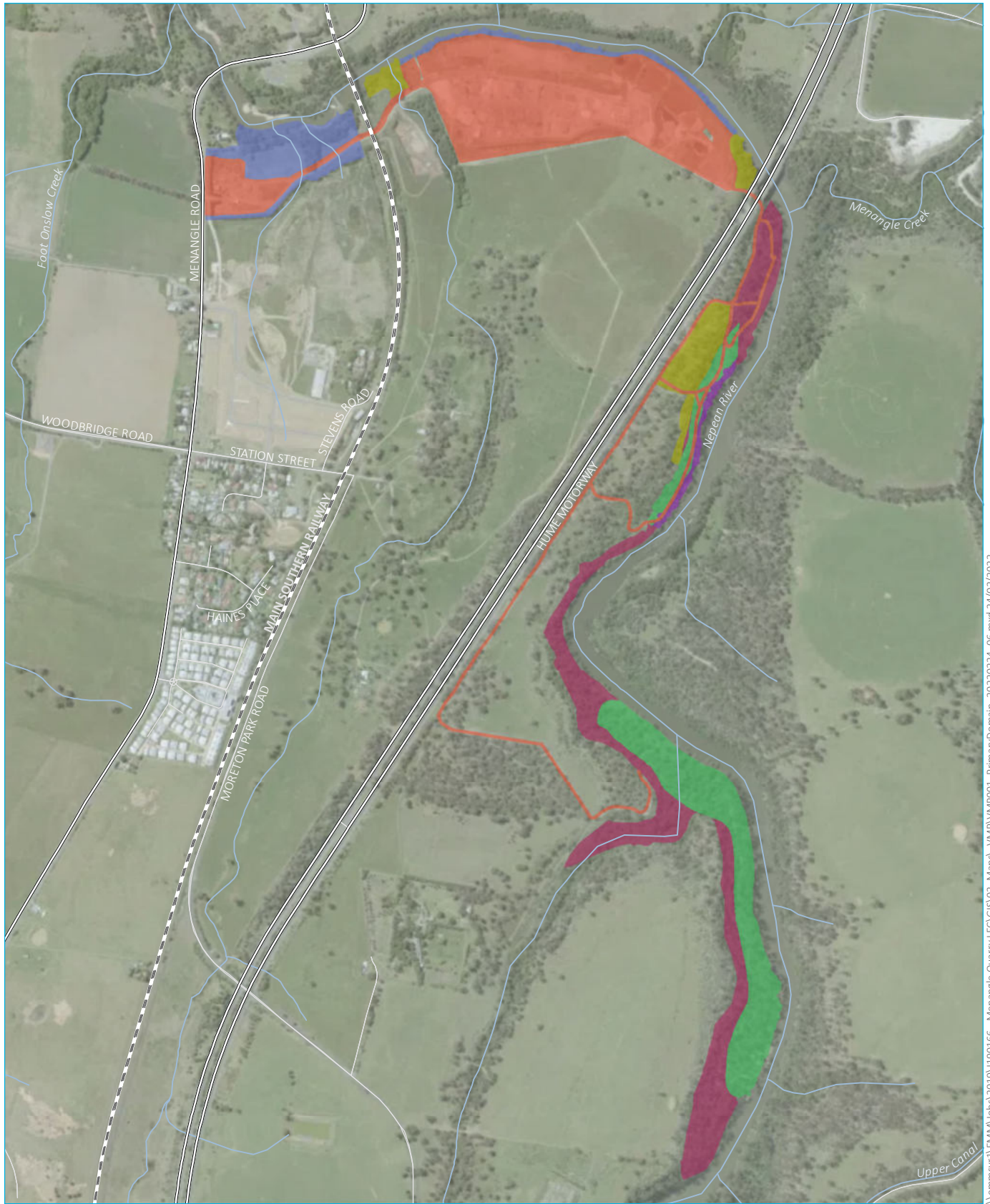
No.	Name	Description	Relationship to biodiversity offsets
5	Restoration area	Areas identified for ecological restoration to allow a high-quality vegetation community to be re-established and to compensate for the loss of ecological values within the extraction/rehabilitation area.	Following the removal of the previous approval to quarry the Stage 3 area but approval to quarry the Stage 8 area, the restoration areas will provide biodiversity offsets for the additional Stage 8 area to be cleared.
6	Weed Control	Areas upslope of restoration or extraction areas that will be targeted for weed control. These areas are additional to the restoration area are not required to be managed by the Consent. Weed control works in these areas will limit the spread of weed propagules into the rehabilitation or restoration areas.	Not part of the biodiversity offsets.

2.3 Secondary domains

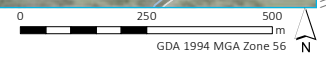
Secondary domains have been identified (Table 2.2 and Figure 2.2) based on the proposed future land use. Future land use is discussed in Chapter 3.

Table 2.2 Menangle secondary domains

Code	Secondary domain	Description
A	Grazing	Areas to be managed as pasture for agricultural grazing.
B	Tracks	Access tracks that will be retained for ongoing access and management activities.
C	Biodiversity	Areas to be management for biodiversity values. This includes lands in a range of condition states, including land that will be rehabilitated following extraction and the restoration areas where large mature trees will remain.



Source: EMM (2022); Metromap (2022); DFSI (2017)



KEY

- Rail line
 - == Main road
 - Local road
 - Watercourse/drainage line
- Primary domain**
- 1 - Infrastructure
 - 2 - Previously extracted area
 - 3 - Nepean River buffer zone
 - 4 - Extraction area
 - 5 - Restoration area
 - 6 - Weed control

Location of primary domains

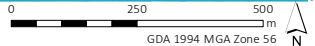
Menangle Sand and Soil Quarry
 Biodiversity and Rehabilitation Management Plan
 Figure 2.1



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Source: EMM (2022); Metromap (2022); DFSI (2017)



KEY

- Rail line
- == Main road
- Local road
- Watercourse/drainage line
- Secondary domain
 - A - Grazing
 - B - Tracks
 - C - Biodiversity

Location of secondary domains

Menangle Sand and Soil Quarry
Biodiversity and Rehabilitation Management Plan
Figure 2.2



\\emmsvr1\EMM\Jobs\2019\1901.66 - Menangle Quarry\GIS\02_Maps_VMP\VMP002_SecondaryDomain_20220224_07.mxd 24/02/2022

2.4 Biodiversity management zones

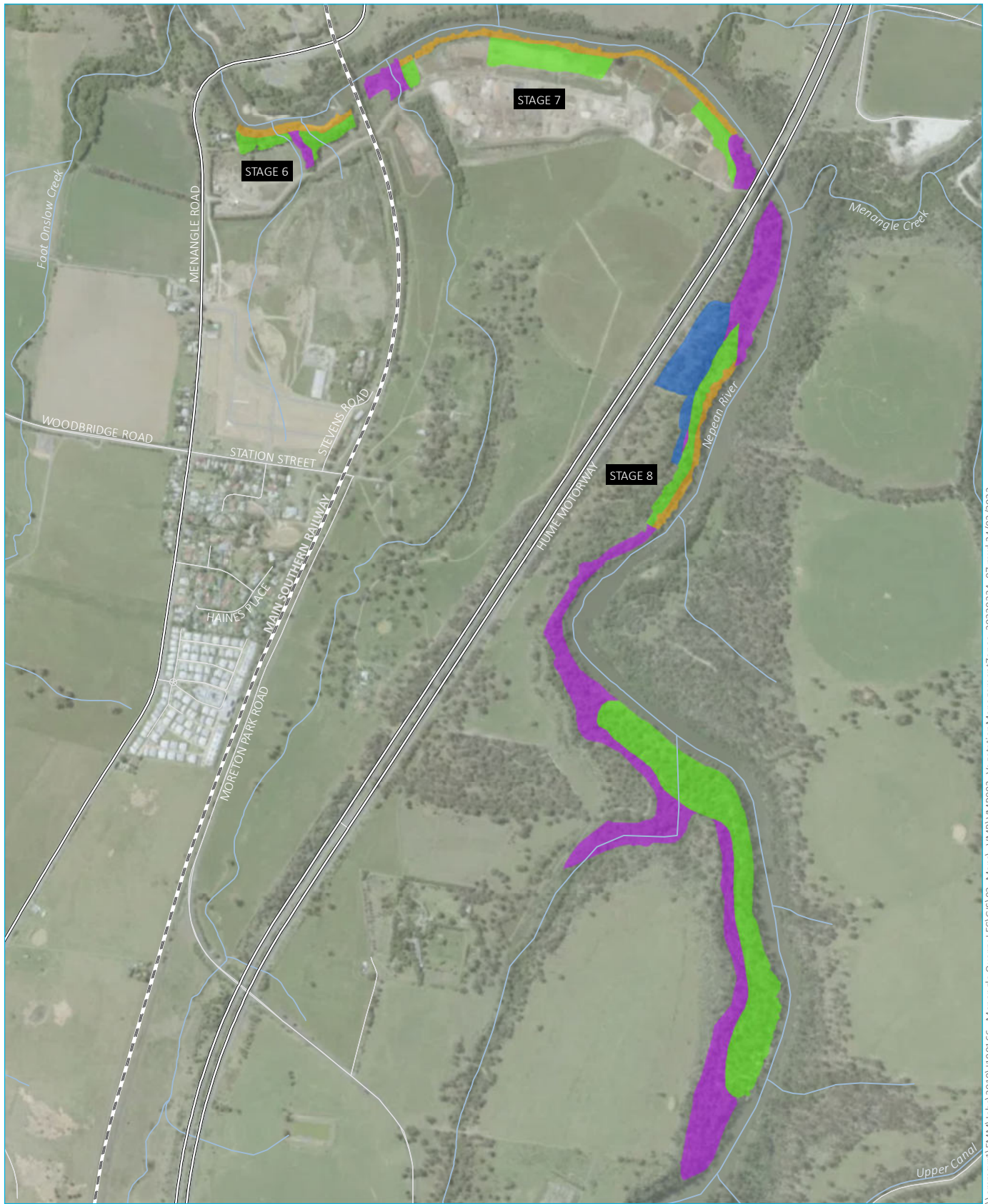
Biodiversity management zones have been identified (Table 2.3 and Figure 2.3) within the secondary domains to guide the biodiversity management performed within these areas. The rehabilitation and biodiversity restoration works in the biodiversity management zones are described chapters 5–7.

Table 2.3 Biodiversity management zones

Stage	Biodiversity management zones ID	Brief description
Stage 6	6.1	<p>This zone is well covered by a native canopy. The vegetation is approximately 15 years old, with vegetation works undertaken under the Stage 6 VMP (Menangle Sand and Soil 2003). All rehabilitation bonds were returned on 23 October 2009.</p> <p>The current native mid- and ground-cover species diversity is low, with weed species more prevalent in these vegetation layers.</p>
Stage 6	6.2	<p>This zone is located on the riverbank. It has low native species diversity. It has some native canopy cover but cover is low overall.</p> <p>The riverbank is north-facing and exposed to direct sun.</p> <p>Some of this zone has been subject to vegetation management activities as per Biodiversity Management Zone 6.1.</p> <p>Increased herbicide application controls will be implemented in this zone due to the higher potential for herbicides to wash into the Nepean River.</p>
Stage 6	6.3	<p>This zone includes a small drainage line that is eroded in a number of places.</p> <p>It is well covered by a native canopy, with low cover of native mid- and ground- species.</p> <p>This zone has been subject to vegetation management activities as per management Biodiversity Management Zone 6.1.</p>
Stage 7	7.1	<p>This zone currently has a number of uses, including water management ponds. As such, portions of this management zone will require earthworks prior to vegetation establishment.</p> <p>The vegetation is currently predominately made up of a dense weedy ground layer. Isolated native shrubs and trees, and thickets of mid-story weeds such as Giant Reed (<i>Arundo donax</i>) are also present.</p>
Stage 7	7.2	<p>This zone is located on the riverbank and has sparse native canopy cover, with low native species diversity and cover.</p> <p>The riverbank is northerly facing and exposed to direct sun.</p> <p>Increased herbicide application controls will be implemented in this zone due to the higher potential for herbicides to wash into the Nepean River.</p>
Stage 7	7.3	<p>The zone includes a steep gully in the western portion of Stage 7 which is eroded. Mature trees are present, with multiple weeds present, with overall high weed cover, including some mature trees are covered by Balloon Vine (<i>Cardiospermum grandiflorum</i>). Balloon Vine has the capacity to collapse canopy through the thick curtains of heavy stems it forms.</p> <p>This zone is outside the area that need to be rehabilitated to meet the performance measures specified in Consent conditions B80–B8 for the Stage 6 and Stage 7 rehabilitation areas. Work will consist of weed management activities to limit the spread of weed propagules.</p>
Stage 8	8.1	<p>This zone consists of large mature trees with an understorey dominated by weed species including Lantana (<i>Lantana camara</i>), Small-leaved Privet (<i>Ligustrum sinense</i>) Privet, and Broad-leaf Privet (<i>Ligustrum lucidum</i>), and a ground cover which is also dominated by exotic species.</p> <p>This zone will be subject to extraction activities.</p>

Table 2.3 Biodiversity management zones

Stage	Biodiversity management zones ID	Brief description
Stage 8	8.2	<p>This zone is located on the bank of the Nepean River. It is in a similar condition to Biodiversity Management Zone 8.1.</p> <p>It forms the Nepean River Buffer Zone required by Consent Condition A10.</p> <p>The Nepean River Buffer Zone is a minimum 10-m wide horizontal setback from the 64 m AHD contour.</p> <p>Increased herbicide application controls will be implemented in this zone due to the higher potential for herbicides to wash into the Nepean River.</p>
Stage 8	8.3	<p>This zone is in a similar condition to management Biodiversity Management Zone 8.1 and will be subject of restoration activities.</p>
Stage 8	8.4	<p>This zone is outside the required area to remediate or for restoration activities, and therefore does need to meet the performance measures for the Stage 8 area. Work will consist of weed management activities to limit the spread of weed propagules.</p>



Source: EMM (2022); Metromap (2022); DFSI (2017)
 Note: Nepean River Buffer Zone (Biodiversity Management Zone 8.2) for substages 8D-8M will be defined in an updated BRMP to be prepared prior to the extraction of these substages

<p>--- Rail line</p> <p>== Main road</p> <p>— Local road</p> <p>— Watercourse/drainage line</p>	<p>Stage 6 zone</p> <p>MZ6.1</p> <p>MZ6.2</p> <p>MZ6.3</p>	<p>Stage 7 zone</p> <p>MZ7.1</p> <p>MZ7.2</p> <p>MZ7.3</p>	<p>Stage 8 zone</p> <p>MZ8.1</p> <p>MZ8.2</p> <p>MZ8.3</p> <p>MZ8.4</p>
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Biodiversity management zones

Menangle Sand and Soil Quarry
 Biodiversity and Rehabilitation Management Plan
 Figure 2.3



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3 Post quarrying land use

3.1 Rehabilitation and restoration objectives

The rehabilitation objectives for the Stage 8 area are defined in Table 4 of Consent Condition B70 (replicated in Table 3.1 below). These rehabilitation objectives have been adopted across the quarry.

Table 3.1 Rehabilitation objectives

Feature	Objective
Stage 8 area ¹	<ul style="list-style-type: none"> • Safe (both within the site and in relation to downstream environs, including under flood conditions). • Hydraulically, geotechnically and geomorphologically stable. • Non-polluting. • Fit for the intended post-quarrying land uses. • Final landform integrated with surrounding natural landforms as far as reasonable and feasible, and minimising visual impacts when viewed from surrounding land of the Hume Highway.
Surface infrastructure	<ul style="list-style-type: none"> • Infrastructure within the Hume Motorway road reserve (including the area under the Menangle Bridges) decommissioned and rehabilitated in accordance with TfNSW requirements. • All other surface infrastructure decommissioned and removed, unless other agreed by the Planning Secretary.
Quarry substages	<ul style="list-style-type: none"> • Pit floor partially backfilled with sufficient and appropriate material to promote establishment of River-flat Eucalypt Forest EEC. • Substages progressively landscaped and vegetated to meet the objectives, performance indicators and completion criteria in Table 6, Appendix 7 [of the Consent].
Final landform	<ul style="list-style-type: none"> • No reduction in flood storage capacity, compared with pre-development conditions, unless otherwise agreed by the Planning Secretary. • Designed to incorporate geomorphological features to allow for the free draining discharge of clean water from the site. • Minimise sediment laden run-off into the Nepean River.
Water quality	<ul style="list-style-type: none"> • Water discharged from the site is suitable for receiving waters and capable of supporting existing aquatic ecology and riparian vegetation.
Community	<ul style="list-style-type: none"> • Ensure public safety.

1. Applied to all extraction areas.

3.2 Land use

Land uses immediately surrounding the quarry primarily comprise of grazing and transport infrastructure. In the wider area, there are agricultural activities, the Menangle Park harness racing track, and a range of land uses in the town of Menangle and Menangle Park. The final land-use options have considered the importance of re-establishing and improving the River-flat Eucalypt Forest endangered ecological community (EEC) and associated riparian corridor; the surrounding agricultural land uses; views from the Hume Motorway and other roads; and the land uses in the wider area.

Some quarry infrastructure may provide beneficial post-quarrying uses. The opportunity for beneficial post-quarrying uses will be considered as part of detailed closure planning, and in consultation with relevant stakeholders, including DPE and Wollondilly Shire Council.

3.3 Soils

The *Land and Soil Capability Assessment Scheme* (OEH 2012) ('LSC scheme') uses 'LSC classes' that distinguish between the inherent physical capacity of the land to sustain a range of land uses (and management practices) in the long term without leading to degradation of soil, land, air and water resources. A formal assessment of land and soil capability (LSC) was not required as part of the environmental assessment for the Extension Project.

The active quarry areas are mapped at the state scale (eSPADE database, DPIE 2021) as LSC Classes 3, 4 and 8, ie as land with a range of capability, from land with 'slight limitations', capable of a wide variety of land uses (LSC class 3 and 4), to 'extreme limitations' to cropping (LSC class 8) (Table 3.2 and Figure 3.1).

Table 3.2 Land and soil classifications mapped for the quarry area

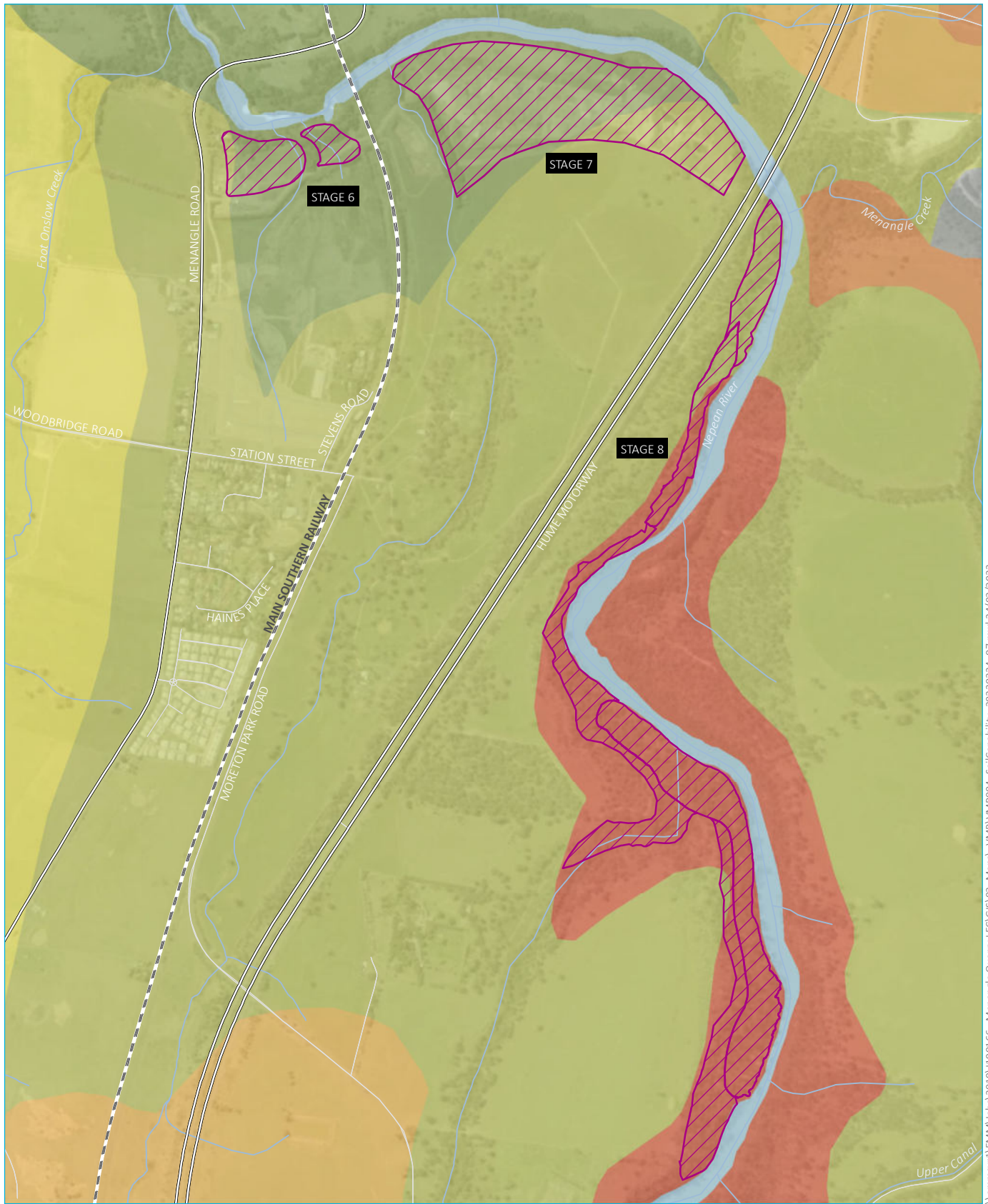
LSC Class ¹	Description
Class 3 – High capability land	<ul style="list-style-type: none"> Land has moderate limitations for high-impact land uses. Land is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. Careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Class 4 – Moderate capability land	<ul style="list-style-type: none"> Land has moderate to high limitations for high-impact land uses. Will largely restrict land use to low intensity grazing, some low intensity horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Class 8 – Extremely low capability land	<ul style="list-style-type: none"> Limitations are so severe that the land is incapable of sustaining any land-use apart from nature conservation. There should be no disturbance of native vegetation.

The main limitation for agricultural use is the wind and water erosion risk associated with the fine sandy loam soils. Land mapped as LSC class 3 or class 4 lands will be rehabilitated to LSC grazing or biodiversity post-quarrying land uses, while land mapped as LSC class 8 lands will be rehabilitated to a biodiversity post-quarrying land use.

The proposed post-quarrying land uses are:

- enhancing or re-establishing the River-flat Eucalypt Forest EEC in Stage 8 extraction and biodiversity restoration areas and parts of the Stage 6 and Stage 7 areas;
- leaving access tracks for management and maintenance purposes; and
- grazing for all other areas.

Proposed post quarrying land use for each domain is summarised in Table 3.3. The primary domains are identified numerically, and the secondary domains are identified alphabetically (see Chapter 2). The primary and secondary domains for the project area are shown on Figure 3.2.



Source: EMM (2022); Metromap (2022); DFSI (2017); DPIE (2017)

KEY

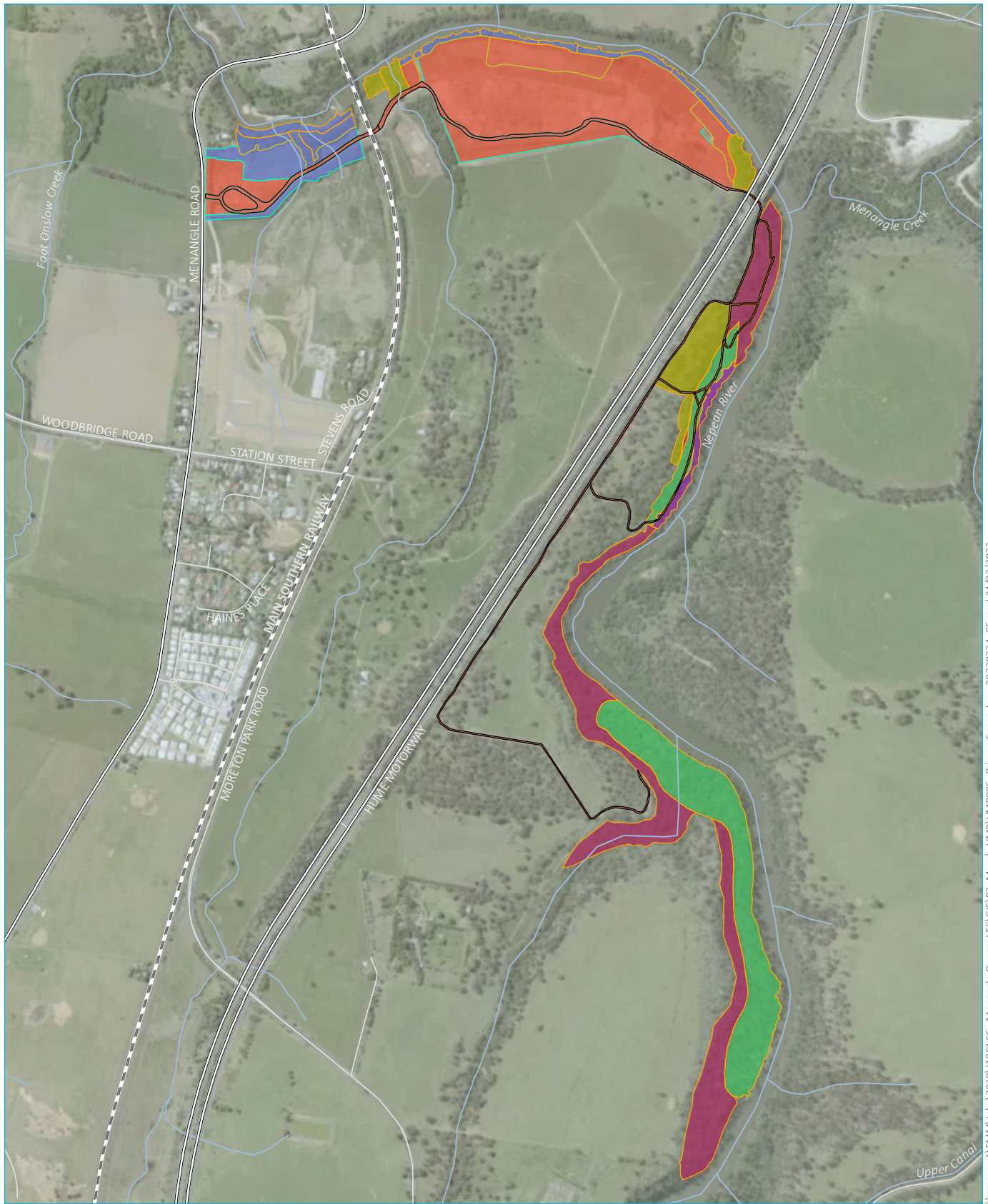
- Project area
- Rail line
- Main road
- Local road
- Watercourse/drainage line
- 3
- 4
- 5
- 6
- 7
- 8
- Disturbed Terrain
- Water

Mapped land and soil capability

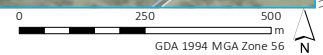
Menangle Sand and Soil Quarry
Biodiversity and Rehabilitation Management Plan
Figure 3.1



\\emmsvr1\EMM\Jobs\2019\190166 - Menangle Quarry LEC\GIS\02_Maps_VMP\WMP004_SoilCapability_2022\2024_07.mxd 24/02/2022



Source: EMM (2022); Metromap (2022); DFSI (2017); DPIE (2017)



KEY

- Rail line
- Main road
- Local road
- Watercourse/drainage line

- Primary domain**
- 1 - Infrastructure
 - 2 - Previously extracted area
 - 3 - Nepean River buffer zone
 - 4 - Extraction area
 - 5 - Restoration area
 - 6 - Weed control

- Secondary domain**
- A - Grazing
 - B - Tracks
 - C - Biodiversity

Primary and secondary domains

Menangle Sand and Soil Quarry
Biodiversity and Rehabilitation Management Plan
Figure 3.2



\\emmsvr1\EMM\Jobs\2019\1901.66 - Menangle Quarry\ECGIS\02_Maps_VMP\WMP005_PrimarySecondary_20220224_05.mxd 24/02/2022

Table 3.3 Menangle primary and secondary domains

No. ¹	Primary domain ¹ (operational)	Quarry areas	Code ²	Secondary domains (post-quarrying land use)
1	Infrastructure	Site office, parking area, weighbridge, wheel-wash, processing area, bunds, water storages, water treatment ponds, access roads and tracks and laydown areas.	A	Rehabilitation Pasture
			B	Access track
2	Previously quarried areas	Completed extraction areas: Stages 2, 4, 5, 6 and 7.	A	Rehabilitation Pasture
			C	Biodiversity - River-flat Eucalypt Forest EEC
3	Nepean River Buffer Zone	A buffer zone to the Stage 8 extraction. This includes land and vegetation from the edge of the Nepean River to the 64 m AHD contour, and the 10-m to 17.5-m wide horizontal set back. No extraction will occur within this zone.	C	Biodiversity - River-flat Eucalypt Forest EEC
4	Stage 8 extraction area	Area of Stage 8 extraction.	C	Biodiversity - River-flat Eucalypt Forest EEC
5	Restoration area	Areas identified for ecological restoration activity to provide biodiversity offsets for the loss of ecological values within the extraction area (Primary Domain 4).	C	Biodiversity - River-flat Eucalypt Forest EEC
6	Weed control	Areas upslope of restoration or extraction zones that will be targeted for weed control. These areas are additional to the restoration area are not required to be managed by the Consent. Weed control works in these areas will limit the spread of weed propagules into the rehabilitation or restoration areas.	C	Biodiversity - River-flat Eucalypt Forest EEC

1. See Table 2.1.

2. See Table 2.2.

3.4 Post-quarrying landforms

The main constructed landforms within the Stage 6 and 7 areas are the existing noise/visual bund south the processing area, safety bunds and Water Management Dams 01, 02a, 02b and 03 (Figure 3.2). When these are no longer required at the end of quarry operations, they will be re-shaped to a landform that is generally compatible with surrounding topography and is suitable for the final land use.

Areas associated with extraction in the Stage 7 area are currently being used as water management and sediment control structures (Water Management Dams 02a, 02b and 03). These will ultimately be back filled and the land reshaped, so as to be suitable for the final land uses (grazing and biodiversity) and generally compatible with surrounding topography.

The final landform for substages 8A–8C is provided in Appendix C. It is based on a variable-width horizontal setback (10 to 17.5-m wide) based on the surveyed tree locations (see Appendix A).

Sand and soil extraction in the Stage 8 area will lower the benches between the Nepean River Buffer Zone and the escarpment but will not change the landform within the Nepean River Buffer Zone. There will be a final maximum

batter grade of 1v:5h between the infilled base of the extracted area and the Nepean River Buffer Zone – in accordance with Consent Condition B32.

There will be a maximum gradient of 1v:1h (or the angle of repose of the sandstone bedrock) between the final base of the extracted area furthest from the river and the ‘landward’ bank – in accordance with Consent Condition B72.

Initially, the resultant landform will slightly increase the flood storage capacity due to the excavation of sand and soil. Over the long-term, the extraction areas will be infilled by flood deposition events because of the same mechanisms that originally deposited the extracted material.

3.5 Rehabilitation and restoration by domain

A summary of rehabilitation and restoration activities for each primary domain is provided in the following sections.

3.5.1 Domain 1 – Infrastructure areas

Domain 1 includes the existing infrastructure areas within the quarry including:

- offices;
- weighbridge;
- wheel wash down;
- workshop and laydown areas;
- roads and hardstands; and
- processing plant and associated stockpiles.

The infrastructure areas are in the previously extracted stage 6 and 7 areas. Tracks are the only infrastructure in the Stage 8 area.

It has been assumed that at the completion of operations, all infrastructure (with the exemption of roads/tracks), footings and services will be removed from quarry site. Although, as noted in Section 3.2, options for post-quarrying use of infrastructure will be considered as part of detailed closure planning.

Any remaining excavations such as sedimentation sumps and dams will be backfilled, and bunds and batters reshaped to be suitable for the final land use and to be generally compatible with surrounding topography. Some bunds that have been revegetated with native species will remain.

Water Management Dam 01, the infiltration/evaporation area immediately to the east of the dam, and Water Management Dams 02a and 02b will remain until quarry closure and the rehabilitation of the processing area within Domain 1. At this time, the remaining water management structures will be dewatered, backfilled and the area reshaped to resemble the pre-disturbance land contours.

A permanent access track will remain within Domain 1 to allow ongoing management and maintenance of rehabilitation and restoration areas.

Reshaped areas will be topsoiled and planted with pasture grass and legume species.

3.5.2 Domain 2 – Previously extracted areas

Domain 2 includes areas that have previously extracted areas where quarrying has been completed (Stage 1, Stage 2, Stage 4 and Stage 5). The rehabilitation bonds held by Wollondilly Shire Council and Campbelltown City Council for all these stages have been returned. The Stage 3 area has not been, and will not be, extracted.

Parts of the previously extracted area in the Stage 6 area have been rehabilitated with pasture and River-flat Eucalypt Forest species. The infrastructure in the Stage 6 area is in Domain 1 (see Section 3.5.1). Additional management and mitigation measures (described in Section 6.2) in accordance with Consent conditions B80–B82 in these areas will improve the biodiversity value of this domain.

Rehabilitation of the previously extracted Stage 7 areas has commenced where the area is not used for water management. However, most of Domain 2 has not been rehabilitated as extraction was only completed in December 2020 and much of the area is covered by the processing area. Completed vegetation is primarily pasture species (with some weeds currently present). Parts of the previously extracted Stage 7 areas will be rehabilitated to River-flat Eucalypt Forest. The remainder of this domain will be rehabilitated to grazing.

A detailed description of planned rehabilitation works for the previously extracted areas is provided in Section 6.2.

3.5.3 Domain 3 – Nepean River Buffer Zone and lower riverbank

Domain 3 consists of the Nepean River Buffer Zone (NRBZ) (as defined by Consent Condition 10) and the lower riverbank within the Stage 8 area, referred to as ‘NRBZ & lower riverbank’. No extraction will occur within this zone.

The NRBZ will provide a minimum horizontal setback of 10 m extending landward from the 64 m AHD contour on the western side of the Nepean River. Where there are native trees within the 10-m wide horizontal setback area (‘Protected Trees’), the width of the setback will be increased so that edge of the setback area/start of extraction area is at least 7.5 m (measured horizontally) from the trunk of these trees. Therefore, the NRBZ will be between 10-m and 17.5-m wide. As there will be no resource extraction within this zone, there will be no resource extraction within 7.5 m of Protected Trees.

The lower riverbank will be retained below the 64 m AHD contour.

The NRBZ and lower riverbank (Domain 3) will separate the active extraction area (Domain 4) from the river.

There will be minimal ground disturbance within the NRBZ and lower riverbank zone, except for hand removal of weeds, felling of non-native trees leaving the roots in place.

The restoration works described in Section 7.1 will be undertaken in Domain 3 to improve its biodiversity values.

The NRBZ and lower riverbank area has been surveyed for Substages 8A–8C (see Appendix A). The NRBZ and lower riverbank area will be surveyed for Substages 8D–8M as part of future updates to this BRMP (see Section 1.9.1).

3.5.4 Domain 4 – Stage 8 extraction areas

Domain 4 consists of the Stage 8 extraction areas that will be progressively extracted and rehabilitated from north to south. Apart from access tracks, which will be left in place to allow ongoing access, Domain 4 will be revegetated with River-flat Eucalypt Forest species and will have a biodiversity post-quarrying land use.

Habitat trees will be identified prior to vegetation clearing. Felled habitat trees and woody debris will be preserved for rehabilitation and restoration purposes. Weeds and weed infested topsoil will be buried within the extraction area to minimise the potential for weed infestations in the domain and in the adjacent biodiversity areas (Domains 3 and 5). The land will be reshaped to achieve stable gradients and topsoil will be spread where the gradients allow.

Woody debris will be placed over the ground in rehabilitation areas and pressed in or tracked-rolled to ensure intimate contact with soil to minimise the potential for erosion under the woody debris.

Stabilisation methods will be selected based on variables including the specific location, the slope gradient and length, proximity to the Nepean River, time of year, surrounding vegetation (weed-infested versus self-sustaining native vegetation) and the final rehabilitation objectives.

A minimum 7.5 m setback (measured from the outside of the tree trunk) will be maintained between quarrying operations in the extraction area (Domain 4) and any native trees located in the restoration area (Domain 5), except where a reduced setback is supported by an assessment by a suitably qualified and experienced arborist, and evidence of this assessment has been provided to the Planning Secretary.

3.5.5 Domain 5 –Restoration area

The restoration areas, Domain 5, are located immediately to the north, west and south of Domain 4. Biodiversity restoration within this area will enhance the biodiversity values of the existing vegetation community to offset the loss of biodiversity values from vegetation clearing in the Stage 8 extraction areas (Domain 4).

Restoration works will include scalping and burial of weeds and weed-infested topsoil (within the void created in Domain 4), mechanical and chemical (wick wiping) weed control, seeding and planting and establishment of habitat using nest boxes and woody debris.

3.5.6 Domain 6 – Weed control areas

Weed control areas, Domain 6, have significant weed infestations that are a risk to the successful rehabilitation of Domain 4 and the restoration of Domain 5. This domain will have a biodiversity post-quarrying land use and the primary activity in the domain will be weed control. These areas are additional to the restoration area are not required to be managed by the Consent.

Weed control methods are described in Sections 5.5.

4 Rehabilitation and restoration risks

Successful development and implementation of the quarry's rehabilitation program depends on understanding the key risks that need to be managed for the quarry site and operations. The following key risks have been identified:

- vegetation clearing;
- erosion;
- flooding;
- impacts to aquatic biodiversity;
- seed availability;
- weeds and pests;
- bushfire; and
- spills/leaks of hydrocarbons, chemicals and wastes.

Each of these risks are discussed below.

4.1 Vegetation

Vegetation within the Stage 8 area, and to a lesser extent within Stage 6 and 7, provide some ecological connectivity along the Nepean River.

The primary, but not exclusive, ecology value is associated with the large trees that are present within extraction area. These trees:

- provide tree hollows which are utilised by fauna;
- are a potential source of woody debris which provide structural complexity;
- provide shade, shelter and food resource to various fauna species; and
- contain seed resources (depending on the time of year), and leaf resources.

Vegetation clearing within the Stage 8 extraction area (Primary Domain 4) will remove the ecological, flora and fauna values associated with the vegetation.

Vegetation clearing will only occur within the Stage 8 extraction area. Menangle Sand and Soil will implement an internal Land Disturbance Permit process to ensure unnecessary land disturbance does not occur. Clearing limits will be clearly demarcated using barrier mesh, bunting or some other appropriate high visibility material.

The rehabilitation and restoration measures described in this BRMP will be implemented to minimise impacts from vegetation clearance and to facilitate a long-term improvement in the biodiversity values of the quarry site.

Vegetation management is described in Section 5.2.

4.2 Seed availability

The availability of suitable quantities of biologically viable native seed is a key risk for the restoration and rehabilitation of native communities due to:

- target species may not be present within or adjacent to the project area and suitable seed may need to be collected from external public or private lands, or purchased commercially;
- restricted access to private land to collect suitable local provenance species – considered to be within 20 km of the quarry;
- some species only produce in response to certain environment stimulus, eg flood, fire, suitable rainfall and therefore seed may not be able to be collected for several years;
- seed viability during storage; and
- purity (ie uncontaminated with inappropriate species) and biological viability of commercially purchased seed.

Seed collection, procurement and storage management and mitigation measures that address this risk are provided in Section 5.3.

4.3 Water and sediment

4.3.1 Erosion

Land disturbance associated with quarrying has the potential to increase erosion hazard by exposing soil to rain-drop splash, overland flow and flood flows. Vegetation clearing and extraction will remove root systems, alter soil biology and modifying drainage paths and patterns.

A detailed assessment of erosion hazard has been undertaken in accordance with Landcom (2004) is provided in the SWMP. The erosion hazard assessment generally found that, without appropriate controls as described in the SWMP, there will be a high to very high risk due to:

- the erodibility of soils (non cohesive sands);
- calculated soil loss;
- slope steepness; and
- rainfall erosivity in the wettest season (December to March).

Erosion and sediment control measures are described in Section 5.3.

4.3.2 Runoff water quality

Erosion has the potential to elevate suspended solid concentrations in runoff. Surface water will be managed in as described in Section 5.2 of the SWMP. Any runoff contacting work areas (the active extraction area, tracks and the processing area) will be captured in sedimentation basins. Erosion and sediment control measures are described in Section 5.4.1.

No chemicals are used during extraction or in the processing area. The off-road haul trucks and heavy and plant in the processing area use diesel. Modification 2 removed the diesel-powered conveyor and allows the off-road haul

truck to travelling between the Stage 8 active extraction area and the Stage 7 area for refuelling. Therefore, with approval of Modification 2, only the excavator in the Stage 8 area will need to be refuelled in situ. Haul trucks will be refuelled at the site entry compound. Plant in the processing area (which is 90 m from the river at its closest point) will be refuelled in situ. A spill kit will be available during refuelling. The management of any spills or leaks is described in Section 5.4.2.

4.3.3 Flooding

The Stage 8 area will be rehabilitated/restored to River-flat Eucalypt Forest ecological community, which occurs naturally in this location and is naturally subjected to flooding of the Nepean River.

An assessment of the potential for flood erosion in the Stage 8 areas was assessed by Fluvial Systems (2019) as part of the fluvial geomorphological assessment for the Extension Project. Fluvial Systems identified that during flood conditions, scattered patches of scour could occur within Stage 8 although that these would be likely to infill, or partially infill with coarse sediment on the falling limbs of the flood hydrograph. Fluvial Systems (2019) stated that this is a natural and expected process that would occur regardless of extraction operations. Fluvial Systems (2019) also stated that the risk of scour can be reduced by retaining as much vegetation as possible, revegetating disturbed land as quickly as possible and protecting with appropriate erosion resistant materials.

The primary flooding risk to vegetation in the Stage 8 area will occur during the early vegetation establishment phases if scour and erosion occur. The *Menangle Sand and Soil Quarry Flood Management Plan* identifies potential flood risks and management measures during extraction and rehabilitation of the quarry. It describes how flood emergency response will be managed and provides controls and the procedures that will be implemented to minimise potential adverse impacts to the environment from flooding of the active extraction area and processing area.

The quarry has been designed to minimise potential erosion and scour during flooding events (see Section 1.6). The key design features, the measures to monitor for potential flooding and the actions to be taken prior to predicted flooding are described in the Flood Management Plan. The following actions will be taken when flooding of the Nepean River above 64 m AHD in the Stage 8 area is predicted:

- any riverside batter that has a batter angle of less than 1:5 will be built up so that it has a maximum 1:5 slope;
- exposed batters and the base of the pit will be flattened so that there are no isolated highpoints susceptible to scour;
- all exposed sand and soil will be smoothed such that there are no rapid changes in slopes, particularly at the intersections of different batters; and
- unattended earthmoving equipment will not be left below the 1% AEP level within the Stage 8 area while a flood warning is current.

The flood event trigger action response plan (see Section 5.4.3) provides the actions that will be taken if scouring of the extraction of rehabilitation areas occurs during flooding.

4.3.4 Bank stability

Since the approval of Menangle Sand and Soil Quarry in 1989, quarry operations along the riverbank in the Stage 1, 2, 4, 5, 6 and 7 areas have not resulted in bank failure. There was no extraction in the Stage 3 area. There will be no further extraction works on the riverbank in the Stage 6 and 7 areas other than the ongoing use of water management dams and rehabilitation works.

Scour potential was extensively considered during the NSW LEC proceedings. As a result, ‘Exclusion Areas’ as are defined in the Consent as “areas with 1% AEP [Annual Exceedance Probability] peak flow velocities greater than 4 metres/second as identified in the figures in Appendix 2 and the plan required under condition A15” would be defined as “Exclusion Areas” (see Definitions in the Consent). And therefore, that the scour risk for velocities less than 4 metres/second were considered acceptable by the Minister.

Extraction in the Stage 8 area has been designed to leave the lower riverbank, the NRBZ and covering native vegetation in situ (see Section 1.6) to ensure bank stability. The only proposed works being mechanical removal of weeds with hand tools and restoration plantings to enhance biodiversity. The mechanical removal of large weeds will not involve removal of the roots and therefore there will be not soil disturbance and need for erosion and sediment control measures.

The Substage 8A–8C figure in Appendix 2 of the Consent shows that the post-extraction 1% AEP peak flow velocity of greater than 4 metres/second will remain outside of the Substage 8A–8C extraction area.

The flood event trigger action response plan (see Section 5.4.3) considers loss of bank stability.

4.4 Potential impacts to aquatic biodiversity

If inadequate controls are in place, aquatic biodiversity in the Nepean River could be impacted by the discharge of water with elevated pollutant concentrations to the river or by erosion or slumping of the riverbank.

The quarry design and management incorporate measures to:

- prevent runoff becoming contaminated (see Sections 4.3 and 5.4.2);
- prevent runoff from active extraction areas entering the river (see Sections 4.3 and 5.4.1); and
- to preserve the stability of the riverbank (see Sections 4.3, 5.4.1 and 5.4.3).

The design of the quarry and the erosion and sediment controls will prevent the formation of chemically polluted water and captures water with elevated suspended solid concentrations prior to entering the river to prevent degraded water quality impacting aquatic biodiversity.

The quarry and management measures will maintain bank stability. If bank failure occurs during flooding, the flood event trigger action response plan (see Section 5.4.3) provides the actions that will be taken.

4.5 Weeds

The presence of weed and pest species has the potential to impact revegetation and restoration outcomes primarily due to competition for nutrients, water and light. Additionally, weed species from the surrounding agricultural land, or from more distant gardens, have the potential to impact rehabilitation success. Weed and pest management will therefore be a critical component of rehabilitation and restoration activities. Weeds recorded within the quarry area are listed in Table 4.1.

Table 4.1 Weeds recorded within the project area

Family	Common name	Scientific name
Asteraceae	Cobbler’s Pegs	<i>Bidens pilosa</i>
Asteraceae	Spear Thistle	<i>Cirsium vulgare</i>
Asteraceae	A fleabane	<i>Conyza sp.</i>

Table 4.1 Weeds recorded within the project area

Family	Common name	Scientific name
Asteraceae	Cape Ivy	<i>Delairea odorata</i>
Asteraceae	Catsear	<i>Hypochaeris radicata</i>
Asteraceae	Fireweed	<i>Senecio madagascariensis</i>
Asteraceae	Bindyi	<i>Soliva sessilis</i>
Asteraceae	Stinking Roger	<i>Tagetes minuta</i>
Brassicaceae	Hairy Bittercress	<i>Cardamine hirsuta</i>
Caryophyllaceae	Common Chickweed	<i>Stellaria media</i>
Chenopodiaceae	-	<i>Atriplex hastata</i>
Chenopodiaceae	Fat Hen	<i>Chenopodium album</i>
Commelinaceae	Wandering Jew	<i>Tradescantia fluminensis</i>
Fabaceae - Caesalpinioideae	Arsenic Bush	<i>Senna septemtrionalis</i>
Fabaceae - Caesalpinioideae	Honey Locust	<i>Gleditsia triacanthos</i>
Malvaceae	Paddy's Lucerne	<i>Sida rhombifolia</i>
Malvaceae	Prickly Sida	<i>Sida spinosa</i>
Myrsinaceae	Scarlet Pimpernel	<i>Anagallis arvensis</i>
Oleaceae	Large-leaved Privet	<i>Ligustrum lucidum</i>
Oleaceae	African Olive	<i>Olea europaea subsp. cuspidata</i>
Pennisetum	Kikuyu grass	<i>Pennisetum clandestinum</i>
Plantaginaceae	Lamb's Tongues	<i>Plantago lanceolata</i>
Poaceae	Couch	<i>Cynodon dactylon</i>
Poaceae	Panic Veldtgrass	<i>Ehrharta erecta</i>
Polygonaceae	Rambling Dock	<i>Acetosa sagittata</i>
Sapindaceae	Balloon Vine	<i>Cardiospermum grandiflorum</i>
Solanaceae	African Boxthorn	<i>Lycium ferrocissimum</i>
Solanaceae	Wild Tobacco Bush	<i>Solanum mauritianum</i>
Solanaceae	Blackberry Nightshade	<i>Solanum nigrum</i>
Ulmaceae	Japanese Hackberry	<i>Celtis sinensis</i>
Verbenaceae	Lantana	<i>Lantana camara</i>

Source: EMM (2017).

Weed and pest control programs will be implemented according to industry best management practice for the weed species present as detailed in Section 5.5.

4.6 Pests

Pest species recorded or likely to occur in the quarry area are listed in Table 4.2.

Table 4.2 Pest species recorded in the project area

Species group	Common name	Scientific name	Occurrence
Aves	Common Myna	<i>Sturnus tristis</i>	Observed
Aves	Common Starling	<i>Sturnus vulgaris</i>	Observed
Mammalia	Fox	<i>Vulpes vulpes</i>	Observed
Mammalia	Rabbit	<i>Orytolagus cuniculus</i>	Observed
Aves	Eurasian blackbird	<i>Turdus merula</i>	Likely to occur
Aves	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Likely to occur
Aves	Spotted Turtle-dove	<i>Streptopelia chinensis</i>	Likely to occur
Mammalia	Feral cat	<i>Felis castus</i>	Likely to occur
Mammalia	Feral dog	<i>Canis lupus familiaris</i>	Likely to occur

Source: EMM (2017).

A pest control program will be implemented as detailed in Section 5.6.

4.7 Bushfire

Whilst most vegetation communities in Australia are adapted to respond to fire, the overall bushfire regime within an area can favour particular species over others, and high intensity fire events can also lead to changes in flora or fauna assemblages. The Cumberland Plain Recovery Plan (DECCW 2011) recommends between 7 and 35 years between burning River-flat Forests. There is no vegetative evidence that the site has been burned in the last 35 years. The long-term landowner of the Stage 8 area, C. Halfpenny, reports that there have been no fires within the Stage 8 area since Menangle Sand and Soil started operating the quarry in 1978.

River-flat Eucalypt Forest, being located in gullies, tends to experience less frequent fire than woodland occurring outside of gullies.

Should an uncontrolled bushfire occur, it could disrupt regeneration works, for example burning seedlings, tree guards, signage or other infrastructure.

To prevent or manage bushfire risks, a hot work permit system will be used during rehabilitation and restoration works which will take into account the risk factors for bushfires. Machinery working on site will have spark arrestors fitted to their exhaust systems.

5 Rehabilitation and restoration management

5.1 Environmental roles and responsibilities

5.1.1 Quarry Manager

The Quarry Manager's overall responsibilities are described in Section 3.2.1 of the Environmental Management Strategy. The Quarry Manager is responsible for the implementation of this BRMP. Many of the measures described will be implemented by the Rehabilitation Officer (see below). The Quarry Manager is responsible for monitoring the implementation of the plan and its periodic review in accordance with Section 9.9.2 of the Environmental Management Strategy.

5.1.2 Rehabilitation Officer

A full-time Rehabilitation Officer will be employed by Menangle Sand and Soil. The Rehabilitation Officer will implement the measures and monitoring described in this BRMP.

The Rehabilitation Officer will:

- implement the erosion control, soil stabilisation and rehabilitation measures described in the SWMP;
- implement the rehabilitation and restoration measures described in the BRMP;
- ensure that disturbed areas are stabilised as soon as possible, initially applying temporary measures if required; and
- regularly inspect the success, or otherwise, of the measures implemented and will adjust the application of these measures accordingly

5.1.3 Consultant Ecologist

A suitably qualified and experienced ecologist will be engaged as and when required to:

- undertake pre-clearing and clearing habitat inspections (see Section 5.2);
- conduct the floristic monitoring program (see Section 8.4.1); and
- annually audit the monitoring described in this BRMP (see Section 8.9).

5.2 Vegetation management

5.2.1 Vegetation clearing

Clearing of native vegetation and weeds will be required in the Stage 8 extraction area (Domain 4) ahead of extraction operations. Clearing will be undertaken progressively with only enough vegetation cleared for approximately 3–6 months of extraction.

The extraction area extent is provided in Appendix 1 of the Consent. A Land Disturbance Permit system will be implemented to minimise the potential for any unauthorised vegetation clearing or ground disturbance.

Pre-clearance surveys will be completed prior to clearing to identify fauna habitat features including tree hollows, hollow logs, burrows, or nests that require management during vegetation clearing. Pre-clearance surveys will be completed by an appropriately qualified and experienced ecologist.

The following procedure will be implemented prior to and during vegetation clearing:

- The extraction limit boundary will be surveyed by a registered surveyor and clearly marked in the field with survey pegs.
- The area to be cleared will be surveyed by the Ecologist for habitat trees (those that are hollow bearing). Fauna habitat features will be marked with brightly coloured (eg pink/red) spray paint or flagging tape. The location and type (eg habitat tree) will be recorded using a global positioning system (GPS) unit. The results will be tabulated in a pre-clearing report, which will identify the number, type and location of fauna habitat features for management during vegetation clearing. The report will also document the habitat features available for salvage and future use in rehabilitation.
- All non-hollow-bearing trees will be cleared first. This will provide hollow-dependent fauna with a chance to self-relocate to areas outside of the clearing area and reduce handling stress. There will be no clearing of native vegetation outside of the extraction areas. Therefore, no tree hollows will be removed other than those within the extraction areas. Hollow-bearing trees will be cleared as follows:
 - Hollow-bearing trees will be shaken by tapping the tree with the excavator bucket the afternoon/evening prior to clearing.
 - Hollow-bearing trees will be cleared 24 hours following the tapping of the tree.
 - The excavator operator will fell the tree as slowly as possible to minimise the intensity of the impact to any fauna potentially roosting in the tree hollow.
 - The tree hollows will be viewed with an inspection camera for signs of any trapped or injured fauna once felled. If fauna are detected and they do not appear to be injured, felled hollow-bearing trees will be left in situ for at least 24 hours to allow fauna to self-relocate. The hollow will be checked the following day. If any injured fauna are detected, they will be carefully captured by the Ecologist, wherever possible, and taken to a veterinarian or wildlife carer.
- Exotic weeds and weed-infested topsoil will be placed into separate stockpiles. These materials will be placed at the bottom of the extracted void as soon as reasonably practical. Care will be taken that weed propagules do not spread from these stockpiles.
- Habitat material, eg woody debris, will be preserved and either direct-placed in restoration areas or stockpiled for future use in rehabilitation areas. Logs and woody debris at least 0.1 m in diameter and greater than 0.5 m in length will be replaced in a configuration that reflects natural systems although generally on the contour to minimise erosion such that there will be greater than or equal to 400 m³ of woody debris per hectare and there will be 100 m³/ha of large woody debris at least 0.5 m in diameter for the rehabilitated substages.
- Woody debris will be preferentially placed on steeper slopes to provide additional erosion protection.
- Large mature trees with hollows and pipes may be installed vertically as stag trees in restoration or rehabilitation areas. Other woody material will be placed on the contour on the soil surface. Woody debris

placed primarily for erosion control will be pressed in to ensure intimate soil contact and to minimise the concentration of runoff or flood flows under the tree debris.

- Felled trees from outside of the Nepean River Buffer Zone and the Exclusion Areas that are surplus to the requirement for woody debris placement may be milled for timber.
- Nut and seed resources (as native plant propagative material) and leaf and small branch (<5 cm) material will be used as mulch. Smaller branches of felled native trees will be removed as soon as possible after felling (with 1 week of felling). Where possible, this material will be distributed over rehabilitation and restoration areas where land-shaping has been completed. The intent is that native tree seeds present in the branches are broadcast, and that leaf and branch material contributes to litter cover, without smothering the establishment of other plants. Care will be taken that only native tree material will be distributed in this manner.

Within the NRBZ and lower riverbank (Domain 3) and the Stage 8 Restoration area (Domain 5), weeds will need to be removed prior to other restoration activities occurring (see Section 5.5). Clearing works within these areas will occur using the same protocols as for the extraction area (Domain 4), with the following additional controls applied to works in these domains:

- Native trees and shrubs will be retained where practical to do so. For White Cedar (*Melia azedarach*), it is only necessary to keep trees that have a diameter at breast height (DBH) greater than 15 cm, and only necessary to keep trees and shrubs below 15 cm DBH if they do not impede weed management actions.
- Weed contaminated topsoil will be excavated to 0.2–0.3 m depth where practical to do so and buried within Domain 4 (see Section 3.5.4). Where native trees area present, the stripping of topsoil will be completed sensitively within the following buffers, seeking to avoid damage to structural roots:
 - 10 m from a native tree with a DBH greater than 80 cm;
 - 5 m from a native tree with a DBH between 30 and 70 cm;
 - 2 m from a native tree with a DBH between 20 and 30 cm; and
 - 0 m from native trees with a DBH below 20 cm.

5.2.2 Soil management

Best practice management of soil resources generally involves the selective stripping and direct placement of the soil 'O' and 'A' horizons to preserve soil seeds reserves, the soil layers highest in plant available nutrients and organic carbon and mycorrhizae and beneficial soil bacteria. However, as there is substantial weed infestation in the Stage 8 area, the use of topsoil stripped from this area would be detrimental to rehabilitation and restoration as weed domination would be anticipated. Menangle Sand and Soil will strip the top 0.2–0.3 m of soil and bury it within Domain 4 to minimise the potential for weed growth in the rehabilitation areas.

The soils in the Stage 8 area are primarily alluvial soils that have deposited during flood events due to the low velocity conditions on the inside of the river bend. Drilling undertaken by the Menangle Sand and Soil found that the soils consist of deep fine to coarse sands ranging from 3 to 5.5 m deep with sandy loam topsoil.

Rehabilitation will use a non-water-soluble mineral based biologically activated fertiliser to build soil biology and increase organic carbon levels in site soils to create suitable conditions for plant growth. The biologically activated fertilisers rapidly establish beneficial soil bacteria and arbuscular mycorrhizal fungi further binding the soil with glomalin (soil carbon cement) and increasing soil aggregation (Hendrickson et al 2008) without the risk of nutrient loss to groundwater and surface associated with water soluble chemical fertilisers.

As the stripped sandy loams will not contain beneficial soil biology or viable native seeds, there are no limitations to the height that these materials can be stockpiled (other than geotechnical or erosional constraints). Soil will initially be stockpiled at the start-up of Stage 8A. Soil stockpiles that will remain for between 1 week and 3 months will be stabilised with a soil stabilising polymer to prevent erosion and to minimise weed germination.

Soil stockpiles that will remain for greater than 3 months will be direct seeded with cover crop and native plant species and/or will be hydromulched.

5.2.3 Vegetation maintenance

Vegetation immediately adjacent to tracks used by the quarry will be maintained over the life of the quarry to ensure that tracks remain trafficable and to ensure that branches and limbs are not damaged by passing vehicles. This may require minor pruning.

Existing tracks will be used as haul roads, that will be maintained to provide a 4-m wide and 4-m tall corridor until they are no longer required for off-road haul truck access. These tracks will continue to provide light vehicle access for restoration, rehabilitation and monitoring works.

As plant health is better protected by cutting branches and limbs rather than allowing them to be broken, the following measures will be employed to protect vegetation adjacent to tracks that encroaches within the 4-m wide and 4-m tall corridor:

- pruning will not exceed 10% of the overall canopy volume of the tree;
- no limbs greater than 150 mm in diameter will be removed; and
- the final pruning cut will be at the branch collar in accordance with AS4373-2007 Pruning of Amenity Trees.

If proposed pruning does not meet these specifications, an arborist will be consulted to assess the potential impacts of the trimming and the vegetation trimming will only proceed if there is minimal risk to the health of the vegetation to be trimmed.

The tracks in the Stage 8 area that will be used by the quarry are on agricultural land and may also be maintained by the landholder under Division 4, Part 5A of the *Local Land Services Act 2013*.

5.3 Seed collection and propagation

5.3.1 Sourcing seed

Rehabilitation and restoration revegetation works will be via direct seeding, supplemented by tube stock infill planting or other methods determined through experience gained during the rehabilitation program if direct seeding does not achieve the agreed performance indicators, or where it has only been possible to collect small quantities of seed for a particular species. Seeds for restoration and rehabilitation activities will be collected onsite, sourced from parties contracted to gather seed outside of the quarry or purchased commercially. Onsite seed collection is expected to increase as the quarry and restoration progresses, as the restoration and rehabilitation areas become established and more capable of supplying seed from a range of species. Where possible, the reuse of the woody portions of cleared native vegetation will assist the supply seeds for the native species that are present within the extraction area. Over the years, the more advanced restoration areas will provide a potential source of a wider range of seed species.

Where required, Menangle Sand and Soil will purchase commercially available seed or contract seed collection of species where seed is not commercially available. Seed will be collected locally where possible (local provenance).

If it necessary to obtain seed that is not local provenance, Menangle Sand and Soil to aim to source seed from locations with environmental conditions that most closely match the quarry area.

Seed collection depends on seasonal characteristics of individual species, as well as responses to climatic conditions. Purchase of tubestock will consider the lead times required to allow plants to be grown and hardened prior to on-site planting.

Pasture seeds will be purchased from commercial suppliers.

5.3.2 Species selection

Species targeted for native seed collection will focus on establishing the 40 key River-flat Eucalypt Forest EEC species listed in Table 5.1, noting that River-flat Eucalypt Forest includes a wider range of species. A rehabilitation and restoration criterion is the establishment of ≥ 24 species, across all monitoring plots, that are aligned with the River-flat Eucalypt Forest EEC species list in the Final Determination.

Table 5.1 Plant species list

Growth form	Scientific name	Common name
Tree (canopy layer)	<i>Angophora floribunda</i>	Rough-barked Apple
	<i>Angophora subvelutina</i>	Broad-leaved Apple
	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	River Oak
	<i>Casuarina glauca</i>	Swamp Oak
	<i>Eucalyptus baueriana</i>	Blue Box
	<i>Eucalyptus benthamii</i>	Camden White Gum
	<i>Eucalyptus botryoides</i>	Bangalay
	<i>Eucalyptus elata</i>	River Peppermint
	<i>Eucalyptus saligna</i> x <i>botryoides</i>	Southern Blue Gum
	<i>Eucalyptus tereticornis</i>	Forest Red Gum
	<i>Melia azedarach</i>	White Cedar
Small tree/shrub (mid-story layer)	<i>Acacia floribunda</i>	White Sally
	<i>Acacia parramattensis</i>	Parramatta Wattle
	<i>Backhousia myrtifolia</i>	Grey Myrtle
	<i>Breynia oblongifolia</i>	Coffee Bush
Grass/vine/rush/fern (ground layer)	<i>Adiantum aethiopicum</i>	Maidenhair Fern
	<i>Austrostipa ramosissima</i>	Stout Bamboo Grass
	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Rock Fern
	<i>Clematis aristata</i>	Old Man's Beard
	<i>Commelina cyanea</i>	Native Wandering Jew
	<i>Dichondra repens</i>	Kidney Weed
	<i>Echinopogon ovatus</i>	Forest Hedgehog Grass
	<i>Einadia hastata</i>	Saltbush

Table 5.1 Plant species list

Growth form	Scientific name	Common name
	<i>Entolasia marginata</i>	Bordered Panic
	<i>Entolasia stricta</i>	Wiry Panic
	<i>Eustrephus latifolius</i>	Wombat Berry
	<i>Glycine clandestina</i>	Twining glycine
	<i>Lomandra filiformis</i>	Wattle Mat-rush
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
	<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass
	<i>Oplismenus aemulus</i>	Australian Basket Grass
	<i>Plectranthus parviflorus</i>	Little Spurflower
	<i>Poranthera microphylla</i>	Small Poranthera
	<i>Pratia purpurascens</i>	Whiteroot
	<i>Pteridium esculentum</i>	Bracken
	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	Indian Weed
	<i>Solanum prinophyllum</i>	Forest Nightshade
	<i>Themeda australis</i> / <i>Themeda triandra</i>	Kangaroo Grass
	<i>Veronica plebeia</i>	Trailing Speedwell

Pastures within the quarry are dominated by Kikuyu grass. Proposed grazing areas will be seeded with appropriate pasture species including warm and dry season cover crops as required.

5.3.3 Seed collection

The following controls will be implemented to maximise seed germination viability from collected seeds:

- Seeds of each species will be collected from numerous plants spread out around the site. The plants must be healthy, viable and neither isolated (since seed from isolated plants may be inbred from self-pollination) or all clustered together.
- Only mature, dry seed will be collected.
- For seed collected from plants outside of the Stage 8 area (Domain 4), no more than 20% of the total seed produced by the plant will be collected to ensure the natural function of the community and seed collection techniques that avoid or minimise damage to the plants.

Seed collection techniques are identified in Table 5.2.

Table 5.2 Seed collection techniques

Type	Advantages	Disadvantages	Technique
Bagging whole plants	Suitable for individual plants.	Time-consuming. Plants need to be checked regularly in case tarp/bag comes off, and to prevent seed from being eating/damaged/blown away.	Tie bags around the bases of individual plants. If removing plants, it may be more efficient to pull out the entire plant and store it in a bag for processing off-site, thereby avoiding a repeat visit. Alternately, a tarp can be tied to parts of the bush and funnelled into a container.
Shaking seed off plants	Works well for some Acacia species. Can be done with a ute.	-	Line the tray of a ute with tarp, then back the ute gently into a bush. Shake the bush by hand. This works well with some Acacia species when their seed pods are mature.
Hand-picking fruit	Necessary for collecting fleshy fruits.	Time-consuming. Must be done by hand.	-
Cut and bag	Quick. Seeds can be processed off-site. Suitable for thorny plants with fleshy fruits that bruise easily.	-	Cut long stems filled with seeds by hand and place the stems in a basket for separation off-site.
Fell tree (in Domain 4 prior to sand and soil excavation works)	Quick. Large amount of seed can be collected and transported.	Need to move tree within 24 hours in warm weather, otherwise most of the seed may be dropped before the tree is moved.	During excavation works, entire trees and shrubs can be felled and placed into the restoration site or a section of the rehabilitation site that is complete. Seed will then fall naturally off the felled tree into the soil below and will germinate when conditions are right, protected by the felled tree and whatever other vegetation is present.
Collecting seed from the ground (ie from fallen branches, seed pods, etc.)	Easy to access.	Seed on the ground is quickly eaten, or falls out, or rots, or is immature.	Inspect seedpods and branches on the ground for seed. Put seed into bags.

These methods will be trialled (see Section 5.3.7).

5.3.4 Timing of seed collection

There is limited accurate published information on the timing of when the native plants have seed available for collection and it is very much dependent on the antecedent conditions at that time (fire, flood drought, etc). Seed organisations such as Greening Australia, Toolijoola and the Australian Botanic Gardens have seed collection databases, including species and dates of however these are not readily available.

Indicatively, hard seeded species such as Fabaceae may be available from November to January, native grasses – December to March depending on the species and season, and hard woody fruits such as the Myrtaceae family may be available throughout the year (River of Carbon 2021).

Menangle Sand and Soil will engage an appropriate seed collection/seed supplier to ensure sufficient seed is collected or purchased for site needs.

5.3.5 Seed management and storage

Following cleaning and the extraction of seeds (where required), seed will be stored in vacuum sealed bags in a low humidity, refrigerated environment protected from insects, vermin and fungi to maximise seed viability.

Samples of the collected seed will be tested initially for purity and viability and then annually for viability. This will provide guidance on seed storage times and will guide the need to collect or purchase additional seed.

Commercial seed suppliers will be asked to provide purity and germination testing certificates for any purchased native seed.

5.3.6 Seed preparation for seeding

Certain seed species require treatment to break dormancy and encourage germination.

i Legumes

Seeds of the leguminous genera such as *Acacia* typically have hard seed coats that are hard and impervious to water (Doran and Turnbull 1997). Either manual scarification (abrasion) of the seed coat is undertaken or the seed is placed in boiling water for 1 minute. For seeds that are immersed in boiling water, seeds that do not swell require additional treatment and seeds that float to the surface are considered to be infertile and will be discarded.

ii Myrtaceae

Seeds of the myrtaceous genera such as *Eucalyptus* have a low seed to chaff ratio (3–20%) and therefore are stored and sown as a mixture of viable seed and chaff (Doran and Turnbull 1997). The seeds germinate readily without treatment provided adequate temperature and moisture at the time of sowing.

iii Casuarinaceae

The winged seeds of casuarinas germinate readily without treatment provided adequate temperature and moisture at the time of sowing (Doran and Turnbull 1997).

iv Difficult to germinate species

Smoke derived from the combustion of plant material enhances seed germination in a wide range of native species that will not germinate under normal nursery conditions (AFF 1997). Species in the families Rutaceae, Restionaceae, Ericaceae, Thymeleaceae, Proteaceae and Dilleniaceae and many other species in other families have improved germination in response to the application of smoke, smoke water or the key germination promoting agent in smoke, Karrikinolide.

Genera known to be highly recalcitrant to conventional seed propagation which respond to smoke include *Stylidium* (Stylidiaceae), *Geleznowia* (Rutaceae), *Hibbertia* (Dilleniaceae), *Stirlingia* (Proteaceae), *Verticordia* (Myrtaceae), *Actinostrobos* (Cupressaceae) and *Pimelea* (Thymeleaceae). Germination percentages of species which normally germinate in small numbers are positively influenced by smoke treatment. Menangle Sand and Soil will use the 'Smoke water' technique for the pre-germination of difficult seeds prior to sowing. Smoke water is produced by drawing smoke produced from the combustion drum operating as for aerosol smoke, through a 20-litre container of water. Smoke bubbling is done for approximately 60 minutes and the resultant solution is frozen till required. Commercial smoke water products are available but if they are derived from wood this smoke water can be highly suppressive of germination (AFF 1997).

Seed to be treated with smoked water will be soaked for 12 hours in a 10% solution of the neat solution and then sown or dried then sown as required.

5.3.7 Trials

The most effective seed collection methods, providing a balance between high species diversity and a high quantity of seeds, will be determined based on the potential seed collection methods listed in Table 5.2. The success of these methods will be determined based on the quantity of seeds collected (known at the end of the collection processes), and/or the overall germination success in trial plots (see below) and from the annual floristic monitoring results (see Section 8.4.1). A range of seed collection methods are likely to be implemented, depending on the specific conditions of each area.

On-site trials will be conducted to determine an effective smoked water treatment for the germination of seeds, considering:

- the seed soaking period;
- species types;
- immediate sowing or sowing after storage; and
- other germination treatments if smoked water is poorly effective.

Trial seeds will be sown on numbered 10-m by 10-m trial plots marked by stakes. Overall germination success will be visually monitored by the Rehabilitation Officer as part of their ongoing inspections. The trials results will be used to improve seeding methods employed by the quarry. The rehabilitation trials will, over time, arrive at the most effective methods.

5.4 Water and sediment

Extraction in the Stage 8 area has been designed to minimise erosion and capture any sediment-laden runoff, preventing it flowing to the Nepean River. The quarry design and progression are described in Section 1.6.

Erosion and sediment control measures are described in the SWMP including:

- ensuring that the active extraction area will be no greater than 0.33 ha to minimise the extent of disturbance;
- implementation of location-specific environmental, drainage and erosion and sediment controls;
- progressive stabilisation and rehabilitation of disturbed areas to minimise the extent and duration of disturbance; and
- scheduling initial vegetation clearing and stripping works to avoid high rainfall erosivity periods, where practical – where major land disturbing works need to occur in a high rainfall erosivity period, there will be an appropriate increase in the levels of control measures to compensate for the increased erosion risk.

5.4.1 Erosion and sediment control

Erosion and sediment control measures that will be applied to each quarry areas as detailed in the SWMP are summarised in the following tables.

Table 5.3 Drainage, erosion and sediment control options – site entry compound

Control measure	Purpose
Drainage control	
Lined drains	To convey run-off in a non-erosive manner.
Guttering and down pipes	To convey clean roof-run-off
Erosion control	
Temporary	
Check dams	To reduce flow velocity in drains until permanent drain linings can be installed.
Cover crops	Rapid vegetation establishment until permanent vegetation germinates and grows.
Polymer soil stabiliser	To protect exposed soil from erosion and to control dust.
Permanent	
Slope reduction	To reduce flow velocities below the maximum permissible velocity for the soil.
Revegetation	To protect exposed embankments, stockpiles and borrow areas from raindrop splash erosion and surface flows.
Sediment control	
Temporary	
Check dams	Capture small quantities of coarse sediment in drains.
Sediment fence	To capture coarse sediment in sheet flow environments.
Permanent	
Wheel wash	To remove sediment from light vehicles and trucks to prevent mud tracking to public roads

Table 5.4 Drainage, erosion and sediment control options – processing area

Control measure	Purpose
Drainage control	
Lined drains	To convey run-off in a non-erosive manner.
Erosion control	
Temporary	
Check dams	To reduce flow velocity in drains until permanent drain linings can be installed.
Cover crops	Rapid vegetation establishment until permanent vegetation germinates and grows.
Polymer soil stabiliser	To protect exposed soil from erosion and to control dust.
Permanent	
Slope reduction	To reduce flow velocities below the maximum permissible velocity for the soil.
Revegetation	To protect exposed embankment and bunds from raindrop splash erosion and surface flows.
Rock energy (stilling pond type)	To reduce flow velocities from drains and culvert outlets to below the maximum permissible velocity for the downstream soil.

Table 5.4 Drainage, erosion and sediment control options – processing area

Control measure	Purpose
Sediment Control	
Check dams	Capture small quantities of coarse sediment in drains.
Sediment fence	To capture coarse sediment in sheet-flow environments.
Sediment sumps	To capture coarse sediments.
Type F, high efficiency sediment basin	To capture and treat sediment and turbid runoff.

Table 5.5 Drainage, erosion and sediment control options – Stage 8 extraction area

Control measure	Purpose
Drainage control	
Trafficable cross banks	To divert quarry runoff from the access track to sediment controls.
Lined drains	To convey run-off in a non-erosive manner.
Mitre drains	To divert run-off to reduce the volume and velocity of drainage.
Earth bunds	To contain sediment and turbid run-off to the active quarrying area.
Erosion control	
Temporary	
Check dams	To reduce flow velocity in drains until permanent drain linings can be installed.
Cover crops	Rapid vegetation establishment until permanent vegetation germinates and grows.
Polymer soil stabiliser	To protect exposed soil from erosion and to control dust.
Permanent	
Slope reduction	To reduce flow velocities below the maximum permissible velocity for the soil.
Timber debris	To provide soil surface cover, habitat, rill interruption and to discourage vehicle damage
Revegetation	To cover and stabilise exposed soil, including the completed extraction area and embankments from raindrop splash erosion and surface flows.
Straw based hydromulch/ Hydraulically applied growth medium (HGM)	To protect newly seeded areas from erosion and allow rapid vegetation establishment.
Rock mulching	To protect steep cut and fill batters from erosion.
Rock energy (stilling pond type)	To reduce flow velocities from drains and culvert outlets to below the maximum permissible velocity for the downstream soil.
Sediment Control	
Temporary	
Check dams	Capture small quantities of coarse sediment in drains.
Sediment Fence	To capture coarse sediment in sheet flow environments.

Table 5.5 Drainage, erosion and sediment control options – Stage 8 extraction area

Control measure	Purpose
Mulch bunds	To capture medium and coarse sediment in sheet flow environments.
Type F sediment basin	To capture and treat sediment and turbid runoff.

Table 5.6 Drainage, erosion and sediment control options – access tracks and haul road

Control measure	Purpose
Drainage control	
Lined table drains	To convey track run-off in a non-erosive manner.
Mitre drains	To divert track run-off away from the track to reduce the volume and velocity of drainage.
Trafficable cross banks	To minimise track erosion, disperse water to reduce slope lengths and velocity.
Pipe culverts	To allow vehicle access over ephemeral creeks and to allow clean up-stream water to pass through the construction zone without contamination. Maintain natural drainage paths.
Erosion control	
Temporary	
Check dams	To reduce flow velocity in the access track table drains and mitre drains until permanent drain linings can be installed.

The water management dams in the Stage 7 area collect water from the upslope catchments, including the processing area. These dams spill to the infiltration area where water infiltrates to the underlying stratum, removing any suspended solids.

A sedimentation basin will be formed in the base of the Stage 8 active extraction area. This will be progressively relocated as the quarry advances. If the basin fills, it will spill into the active extraction area. The active extraction area will be separated from the river by the bund formed by leaving the lower river bank in situ so water from the sedimentation basin will not be able to spill to the river. Any water in the base of the extraction area will be allowed to infiltrate into the base of the extraction area, removing any suspended solids. No water will be pumped from the extraction to the river.

The careful management of vegetation clearing and progressive rehabilitation described in this BRMP will complement the measures described in the SWMP.

5.4.2 Spills and leaks

i Operations

There is a low risk that hydrocarbon spills may also occur during soil spreading during extraction or rehabilitation activities (eg a burst hydraulic hose or a spill during refuelling). Spill-clean-up procedures will minimise the amount of soil contaminated. Any contaminated soil would be removed from site and not be used for rehabilitation. Spill kits will be available during refuelling.

ii Decommissioning

Despite designs that prevent or contain spills, there is a residual risk that land within the processing area has been, or will be, contaminated. This needs to be considered during de-commissioning of this area.

To manage any potential contamination sources, waste management practices in accordance with the quarry's Environmental Management System will continue to be implemented during decommissioning and rehabilitation of this area. For example:

- hydrocarbons will be stored in self bunded tanks or bunded areas designed in accordance with Australian Standard 1940;
- refuelling will be undertaken away from the Nepean River and in-pit water storages;
- waste products that are removed from the quarry will be appropriately disposed of at licensed facilities; and
- any contaminated soil would be removed from site and not be used for rehabilitation.

5.4.3 Flooding

A Flood Event TARP is provided in Table 5.7. The TARP provides the triggers and actions that will be implemented to protect bank stability during a flood event and to minimise the risk of impacts to aquatic biodiversity and provides the measures that will be implemented if rehabilitation is damaged or delayed by flooding.

Table 5.7 Flood event TARP

Trigger	Action required	Timing	Follow up actions
Prior to extraction within substage			
Sand and soil extraction in the Stage 8 area.	<p>Flood modelling to predict the peak flow velocities in potential extraction areas.</p> <p>Survey the extent of the exclusion zones – defined in the Consent as areas where predicted the peak flow velocity is >4 m/s during a 1% AEP flood.</p>	<p>Prior to extraction in each substage.</p> <p>Flood modelling for has been completed.</p> <p>Exclusion zones associated with Substages 8A–8C have been surveyed by a registered surveyor in accordance with Consent Condition A22.</p>	<p>Review/update modelling should scour occur that results in the loss of trees in the lower riverbank or Nepean River Buffer Zone.</p>
Ongoing during extraction			
Sand and soil extraction within an area that may be inundated by flooding of the Nepean River with a predicted peak flow velocity of ≤4 m/s during a 1% AEP flood.	<p>Quarry design to meet the requirements specified in:</p> <ul style="list-style-type: none"> the Consent (including Conditions A10, B32, B71 and B72); the <i>Applicant’s Description of Amended Project</i> (EMM 2020); and the environmental management plans. <p>The key requirements are summarised in Section 1.6 above.</p> <p>Inspections to review compliance against the quarry design.</p>	<p>Ongoing implementation of quarry design.</p> <p>Weekly inspections.</p>	<p>If the quarry does not meet the design requirements (eg batter angles are too steep), undertake earthmoving operations to ensure that quarry design conforms with the approved design.</p> <p>If any extraction is identified outside of the surveyed extraction area or within the exclusion zone:</p> <ul style="list-style-type: none"> cease work in this area immediately; report as an incident/non-compliance as described in Section 8 of the <i>Environmental Management Strategy</i> (EMM 2021c); and rehabilitate the area in accordance with Section 7.2.
	<p>Commence rehabilitation of completed extraction area as soon as practicable, always ensuring that the active extraction area is no more than 0.33 ha, in accordance with Consent Condition B72.</p>	<p>Ongoing implementation of quarry design.</p> <p>Weekly inspections of active quarry area.</p>	<p>If any extraction is identified outside of the surveyed extraction area or within the exclusion zone:</p> <ul style="list-style-type: none"> cordon off part of the extraction area such that the active extraction area is ≤0.33 ha; commence rehabilitation as described in the BRMP in the cordoned off area; and

		Monthly review of active quarry area using most recent NearMap (or equivalent) images.	<ul style="list-style-type: none"> report as an incident/non-compliance as described in Section 8 of the <i>Environmental Management Strategy</i> (EMM 2021c).
	Install woody debris in rehabilitation area (as required by Consent Condition B78) and in restoration area.	Ongoing.	Annual monitoring to confirm that woody debris meets the requirements of Consent Condition B78 (see Section 8.4.4).
Sand and soil extraction within an area that may be inundated by flooding of the Nepean River with a predicted peak flow velocity of >4 m/s during a 1% AEP flood.	<p>Do not extract sand and soil within the exclusion zone, where predicted the peak flow velocity is >4 m/s during a 1% AEP flood as provided in Appendix 2 of the Consent.</p> <p>As described in Section 2.3.3 of the <i>Applicant's Description of Amended Project</i>, a qualified surveyor has undertaken the following in Substages 8A–8C:</p> <ul style="list-style-type: none"> mark the boundary of the extraction area closest to the river as defined by the 64 m AHD contour; mark the extent of the 10-m wide horizontal setback area; mark all living native trees with their trunk within the 10-m wide horizontal setback area; place a peg 7.5 m horizontally landward of each tree within the 10-m wide horizontal setback area – marking the extent to which the existing bank will be retained, ie forming the 10-m to 17.5-m wide horizontal setback area; mark all other boundaries of the extraction area; and mark the boundaries of the adjacent restoration (no resource extraction) area. <p>Sand and soil is <u>not</u> to be extracted from outside of the marked extraction area.</p>	Each extraction area is to be marked prior to extraction within the substage.	<p>If any extraction is identified outside of the surveyed extraction area or within the exclusion zone:</p> <ul style="list-style-type: none"> cordon off part of the extraction area such that the active extraction area is ≤0.33 ha; commence rehabilitation as described in the BRMP in the cordoned off area; and report as an incident/non-compliance as described in Chapter 8 of the <i>Environmental Management Strategy</i> (EMM 2021c).
Prior to flooding (see SWMP for definitions of flood levels)			
Stand-by: Bureau of Meteorology (BoM) issues 'flood watch' for Nepean River catchment.	<p>Inform quarry personnel that flooding may impact the quarry in the coming days.</p> <p>Continue to monitor rainfall and flood watch advice.</p>	Immediately following the 'flood watch' notification being received by the quarry.	Inform quarry personnel if BoM updates 'flood watch' so that flooding is no longer expected.

'Flood watch' generally issued up to four days in advance of the expected onset of flooding but maybe as short as 12 hours.

<p>Risk level to be advised: BoM issues 'flood warning' for Nepean River catchment in vicinity of the quarry.</p>	<p>Inform quarry personnel that flooding within the Nepean River may inundate quarrying areas. Monitor rainfall and flood warning advice hourly.</p>	<p>Immediately following the 'flood warning' notification being received by the quarry</p>	<p>Continue to monitor BoM flood severity for updates. Proceed to next level of TARP if flood severity classed as 'minor'.</p>
<p>Minor: Nepean River flooding adjacent to the quarry is predicted to exceed 64 mAHD (ie a predicted Menangle Weir level of 63.5 mAHD).</p>	<p>Prepare the Stage 8 extraction area for potential flood inundation as described in the Flood Management Plan, including:</p> <ul style="list-style-type: none"> • Backfill the active Stage 8 extraction area to achieve a maximum batter slope of 1:5 adjacent to the riverside batter. • Flatten exposed batters and the base of the active extraction area to remove isolated highpoints that may be susceptible to scour. • Smooth all exposed sand and soil in the extraction area so that there are no rapid changes in slopes, particularly at the intersections of different batters. • Move all plant and infrastructure from the active extraction area to higher ground (above predicted maximum flood level). 	<p>Immediately (if safe to do so) following the prediction that flood levels will exceed 64 mAHD.</p>	<p>Continue to monitor BoM flood severity for updates. Proceed to next level of TARP if flood severity classed as 'moderate'. Proceed to 'event over' when flood warning removed.</p>
<p>Moderate: Nepean River flooding adjacent to the quarry is predicted to exceed 66 mAHD – access road between site entry and operations area becomes inundated.</p>	<p>Move all plant to higher ground (above predicted maximum predicted flood level).</p>	<p>Immediately (if safe to do so) following the prediction that flood levels will exceed 66 mAHD.</p>	<p>Continue to monitor BoM flood severity for updates. Proceed to next level of TARP if flood severity classed as 'major'. Proceed to 'event over' when flood warning removed.</p>
<p>Major: Nepean River flooding adjacent to the quarry is predicted to exceed 74 mAHD – entire site inundated</p>	<p>Evacuate personnel from the site.</p>	<p>Immediately (if safe to do so) following the prediction that flood levels will exceed 74 m AHD.</p>	<p>Continue to monitor BoM flood severity for updates. Proceed to 'event over' when flood warning removed.</p>
<p>Event over: The SES issue safe to return or flood levels have receded below 64 m AHD.</p>	<p>Assess and report any damage to the active extraction area and operations area.</p>	<p>Within 5 days or as soon as practical following the 'event over' trigger is actioned.</p>	<p>Debrief all key personnel and update/modify the Flood Management Plan as necessary.</p>

Remediate areas of damage, including clearing of debris and areas undergoing rehabilitation at the time of the flood event.
 Recommence quarrying activities.

Post flood event

Following a minor, moderate or major flood event.	Inspect the following areas that have been inundated: <ul style="list-style-type: none"> • lower riverbank and NRBZ adjacent to Substages 8A–8C; • rehabilitation area; and • active extraction area. 	Within 24 hours of floodwater receding.	Implement corrective actions if required (see rows below).
Rehabilitation areas have been scoured such that they are below the final landform level (approximately 64 mAHD).	Infill the scoured area with sand and soil to restore the final landform level.	Within 1 week of the flood event.	Monitor rehabilitation in accordance with Chapter 8.
Vegetation in post-extraction rehabilitation areas has been swept away.	Rehabilitate the area in accordance with this BRMP including: <ul style="list-style-type: none"> • addition of soil ameliorants if required; • placement of woody debris if density no longer meets the requirements of Consent Condition B78; and • infill seeding or planting. 	Within 1 month of re-establishing the final landform.	Monitor rehabilitation in accordance with Chapter 8.
Woody debris placed in post-extraction rehabilitation areas has been washed away.	Felled habitat trees and woody debris will be preserved for rehabilitation and restoration purposes. Woody debris will be placed over the ground in rehabilitation areas and pressed in or tracked-rolled to ensure intimate contact with soil to minimise the potential for erosion under the woody debris.	Within 1 week of the flood event.	Monitor woody debris placement in accordance with Section 8.3.3.
Batters have been scoured such that they are too steep and no longer meet the maximum batter angle requirements.	Infill scoured batters with sand and soil to ensure that they meet the maximum batter angle requirements.	Within 1 week of the flood event.	Review batter angles as part of weekly site inspections to ensure that quarry design conforms with the approved design. Undertake further rectification earthworks if required.
The base of the active extraction area has been scoured such that it	Infill the base of the active extraction with sand and soil to ensure that it is not below the maximum depth (within 1 m of the normal water table).	Within 1 week of the flood event.	Measure the depth to groundwater using the bores in the active extraction area.

is with 1 m of the normal water table.	Reinstall bores in the base of the extraction area in accordance with the SWMP.		Undertake further rectification earthworks if required.
Trees in the lower riverbank or NRBZ adjacent to the active extraction area or rehabilitation area have been uprooted.	<p>If roots of the tree are no longer providing bank stability, install measures, eg coir matting, large rocks or rip rap, around the previous root area to prevent erosion.</p> <p>If part of the roots remain in the soil, leave in situ to allow the roots to continue to provide bank stability. Remove the upper part of the tree (chainsaw) to reduce the risk of the tree being washed away in subsequent flooding. If required, install measures to prevent erosion.</p>	Within 2 weeks of the flood event.	<p>Inspect area as part of the drainage, erosion and sediment control inspections (see SWMP Chapter 8):</p> <ul style="list-style-type: none"> • weekly during normal operations; • daily during periods of rainfall; and • within 12 hours of the cessation of a rainfall event (greater than 10 mm) causing runoff to occur on, or from, the quarry. <p>Undertake further stabilisation works if required.</p>
The lower riverbank and NRBZ adjacent to the active extraction area or rehabilitation area is scoured such that the top of the lower riverbank is reduced to less than 64 mAHD or the bank becomes unstable.	Install measures, eg coir matting, large rocks or rip rap, in and around the scour area to prevent erosion.	Within 1 week of the flood event.	<p>Inspect area as part of the drainage, erosion and sediment control inspections:</p> <ul style="list-style-type: none"> • weekly during normal operations; • daily during periods of rainfall; and • within 12 hours of the cessation of a rainfall event (greater than 10 mm) causing runoff to occur on, or from, the quarry. <p>Undertake further stabilisation works if required.</p>
Sediment from the Stage 8 area deposits in the Nepean River such that river flow is impeded.	<p>Inspection by an appropriately qualified geomorphologist to assess the potential impacts of the deposited sediment on river flow, bank stability and flooding and to determine the rate at which the deposited sediment is likely to be removed by river flow.</p> <p>Inspection by an appropriately qualified aquatic ecologist to determine if the changed flow conditions are likely to cause impacts to aquatic biodiversity.</p> <p>If significant impacts are predicted, prepare and implement a plan to remove the sediment. The sediment will be returned to the Stage 8 area.</p>	<p>Inspections within 1 month of the flood event.</p> <p>Plan preparation within 2 months of the inspection.</p> <p>Required works within 2 months of plan finalisation.</p>	To be determined as part of the sediment removal plan.

5.5 Weed control

5.5.1 Weed control strategy

The Stage 8 area currently contains extensive weeds that will need to be controlled to prevent weeds infesting the extraction area during rehabilitation and to allow rehabilitation objectives to be met. As well as extensive weeds visible above the ground, the soil in these areas contains a weed seedbank that would allow weeds to be quickly re-established if only the parts of the weeds above the surface and some of the roots are removed.

Weed control measures have been developed based on the options considered in the *Menangle Sand and Soil - Restoration Area Weed Strategy* (EMM 2019b) (provided in Appendix E) and the controls proposed in the *Applicant's Description of Amended Project* (EMM 2020).

The *Applicant's Description of Amended Project* states that:

- “[T]he entire horizontal setback area [the NRBZ] [will be] undisturbed, save for hand weeding of the extensive existing noxious weeds”;
- “The lower riverbank will be retained below the 64 mAHD contour and remain untouched (except for hand removal of weeds, felling of non-native trees leaving the roots in place, and very selective herbicide application)”;
- “Topsoil will be stripped to a depth of approximately 0.2–0.3 m. Given that the topsoil in the Stage 8 area contains the seedbank for the noxious weeds infesting the area, this weed-infested material will be placed in the bottom of the preceding extraction area, following resource extraction, and will be covered by material returned as part of creating the final landform”; and
- “Following completion of resource extraction, any weed-infested topsoil will be placed in the base of the extracted area followed by scalps and fines. These will be used to build up the base of the extracted area to about 64 mAHD. Following construction of the final landform, the area will be immediately planted with grasses to stabilise the surface. Native vegetation will then be established through planting and seeding. There will be ongoing active management of the rehabilitated extraction area, including weed control”.

The weed control strategy aims to improve the vegetation community in the restoration area and to prevent the spread of weeds to the rehabilitation area, through:

- mechanical removal of weeds in the restoration area and burying them at a depth where they cannot regenerate;
- removal of the weed-infested soil in the restoration area and burying it at a depth where the seeds they cannot regenerate;
- ongoing weed control measures in the lower riverbank, NRBZ, rehabilitation area, restoration area and weed control area; and
- rapid establishment of native vegetation.

The weed control strategy for the NRBZ and lower riverbank is designed to minimise soil disturbance while generally leaving existing roots in situ.

5.5.2 Weed control methods

The weed control methods that will be implemented are described in Table 5.8.

Table 5.8 Weed control methods

Method	Method	Frequency
Mechanical removal – slashing/cutting or pulling	<p>Initial mechanical removal of weeds where slopes are flat and away from the riverbank.</p> <p>Large weeds such as lantana may be initially removed by slashing/cutting or using mobile plant.</p> <p>Very large weeds, such as the extensive stands of large-leafed privet and African olive in the central part of the restoration area, will be knocked over and removed using an excavator.</p> <p>Controls will be implemented for the protection of the large native trees in the restoration, NRBZ and lower riverbank areas during weed removal:</p> <ul style="list-style-type: none"> • large native trees will be surveyed and marked; • an appropriate exclusion zone will be delineated around each large native tree – this will be equal to the tree protection zone (TRZ) as provided in AS4970–2009 Protection of Trees on Development Sites ; and • large weeds in the exclusion zone would be removed in sections by a chainsaw or drilled and injected with herbicide and left in-situ. <p>Mechanically removed weeds will be loaded into a haul truck by the excavator or a loader for transport to the pit.</p> <p>Everywhere else, including the areas infested with lantana, will be slashed followed by herbicide application as required (eg wick application) with intensive revegetation.</p>	<p>Progressive in the extraction area as the quarry advances.</p> <p>Via an initial campaign and then as required however there should be no large woody post the initial removal campaign</p>
Soil removal and burial	<p>In conjunction with mechanical weed removal, soil removal will remove above-ground portion of weed plants, roots in the soil and the weed seedbank in a single campaign.</p> <ul style="list-style-type: none"> • Weed infested soil will be stripped progressively from the restoration area using an excavator so that it can be accurately removed close to existing trees. The soil will be loaded into a haul truck by the excavator or a loader for transport to the pit. • Topsoil will be removed to a depth of 0.3 m. • Mechanically removed weeds and the stripped weed-infested soil from the extraction and restoration areas will be buried in the base of the pit and covered with at least 0.5 m of soil and scalps to kill the weeds and prevent germination of the weed seeds. • Soil will not be stripped from the lower riverbank or the ungraded horizontal setback area. 	<p>Progressive in the extraction area as the quarry advances.</p> <p>Via an initial campaign in each part of the restoration area.</p>

Table 5.8 Weed control methods

Method	Method	Frequency
Establish native plants	<ul style="list-style-type: none"> Establish native plants as described in chapters 5.6 and 7. A wire fence will be installed along the boundary between the extraction areas and the restoration areas (see Section 7.3). Stock will be excluded from the extraction, restoration, NRBZ and lower riverbank areas. 	<p>Starting as soon extraction is complete and the final landform is created.</p> <p>Starting as soon as soil is removed in the restoration area and ongoing as guided by formal and informal monitoring.</p>
Herbicide – selective/targeted application	<p>Targeted-spot application of herbicide by hand will be required for weeds in areas where the roots of the weed need to be initially retained for stability, where mechanical removal may damage native vegetation (eg close to large native trees) and where minor regrowth occurs. Targeted-spot application of herbicide is more effective than broad spraying, uses far less herbicide and there is no spray drift.</p> <p>Herbicide will be applied using backpack spray, paintbrush or wick.</p> <p>The cut-stump application of herbicide will be used on steep slopes, the NRBZ and lower riverbank.</p> <p>Very large privet trees (some over 40 m tall) that are on steep areas will be removed progressively and/or cut, drilled and injected with herbicide in areas where complete removal in one event may compromise soil stability.</p>	Ongoing as required as guided by formal and informal monitoring.
Burning	Controlled ecological burns may be used to assist the reestablishment of the native vegetation community.	Approximately every 10 years where vegetation is suitably mature.

The application of these weed control measures in the Stage 6 and 7 areas is described in Section 6.2.3 and the application of these measures in the Stage 8 areas is described in Sections 7.1 to 7.4.

5.6 Pest management

Pests such as rabbits, feral cats, feral dogs and foxes will be controlled if their presence is detected. Pest control measures will include rabbit warren eradication, trapping, and baiting as required.

Monitoring for pests will be undertaken informally and formally:

- Site employees will be encouraged to report any pest sighting or evidence of pest eg visual observation of dogs, cats, rabbits and foxes to the Rehabilitation Officer
- Formal monitoring will be undertaken as part of rehabilitation monitoring program eg: scats, evidence of predation, rabbit warrens, etc.

The pest control program will be developed on the basis of the species observed and location of observations from the informal and formal monitoring programs.

6 Stage 6 and 7 vegetation management plan

6.1 Overview

The following vegetation management works will be undertaken in the Stage 6 and 7 areas:

- additional vegetation management of the previously rehabilitated Stage 6 areas (Domain 2 – previously extracted areas that do not contain infrastructure) to improve the biodiversity values in these areas in accordance with Consent conditions B80 and B81;
- rehabilitation of Domain 2 in the Stage 7 area now that extraction in the Stage 7 area has been completed;
- revegetation along the riverbank in the Stage 7 area;
- final site rehabilitation in Domain 1 (infrastructure) following the completion of all quarry activities.

These rehabilitation works are described below. Management/restoration of NRBZ and lower riverbank (Domain 3), biodiversity restoration areas (Domain 5) and weed control areas (Domain 6) is described in Chapter 7.

6.2 Vegetation management plan (Domain 2)

Extraction has been completed in the Stage 6 and 7 areas. Portions of the Stage 6 area have been rehabilitated. Rehabilitation has commenced at the eastern end of the Stage 7 area, including reshaping and seeding with grass species. Additional rehabilitation will be undertaken in these areas to achieve improved biodiversity values in accordance with Consent conditions B80 to B82.

This chapter has been prepared to meet the Vegetation Management Plan (VMP) requirements of Consent conditions B80 to B82. The management actions described will be implemented to the satisfaction of the Planning Secretary.

6.2.1 Vegetation management plan requirements

Consent Condition B80 requires the rehabilitation of 1.22 ha of River-flat Eucalypt Forest EEC in the Stage 6 area and 3.44 ha in the Stage 7 area, in accordance with the objectives, performance indicators and completion criteria nominated in Appendix 6 of the Consent (provided in Appendix G of this BRMP). The areas to which this vegetation management plan apply (Management Zones 6.1–6.3 and 7.1–7.2) are shown in Figure 2.3. These areas exceed the requirements of Consent Condition B80 (Table 6.1), increasing in total Stage 6 and Stage 7 areas managed for positive ecological outcomes by 2.20 ha.

Table 6.1 **Vegetation Management Plan Stage 6 and 7 areas**

Area	Management Zones	Area required by Consent Condition B80 (ha)	As per this BRMP (ha)	Change in Area (ha)
Stage 6 vegetated area (Domain 2)	MZ6.1 – MZ6.3	1.22	2.13	Increase of 0.91
Stage 7 vegetated area (Domain 2)	MZ7.1 – MZ7.2	3.44	4.95	Increase of 1.51
Total		4.66	7.08	Increase of 2.42

Management Zone 7.3 is outside of the area required to be rehabilitated under the Consent. However, weed management in this area has been included within the VMP area, as this will improve the resilience of the River-flat Eucalypt Forest in Stages 6 and 7 by improving the vegetation corridor along the river and by minimising the areas from where weeds may spread into the rehabilitated Stage 6 and 7 areas.

6.2.2 Baseline

i Stage 6 area

The native flora and weed species identified in the Stage 6 area are listed in Table 6.2.

Table 6.2 **Stage 6 area flora baseline**

Scientific name	Common name
NATIVE SPECIES	
<i>Acacia parramattensis</i>	Paramatta Wattle
<i>Angophora subvelutina</i>	Broad-Leaved Apple
<i>Austrostipa</i> spp.	Speargrass
<i>Bursaria spinosa</i>	Blackthorn
<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	River Oak
<i>Casuarina glauca</i>	Swamp Sheoak
<i>Callistemon</i> sp.	Bottlebrush
<i>Commelina cyanea</i>	Scurvy Weed
<i>Eucalyptus amplifolia</i>	Cabbage Gum
<i>Eucalyptus botryoides</i>	Bangalay
<i>Eucalyptus saligna</i> x <i>botryoides</i>	Southern Blue Gum
<i>Lomandra longifolia</i>	Spiny-Head Mat-Rush
<i>Themeda australis</i>	Kangaroo Grass
EXOTIC SPECIES	
<i>Acetosa sagittata</i>	Rambling Dock
<i>Anagallis arvensis</i>	Scarlet Pimpernel
<i>Araujia sericiflora</i>	Moth Vine

Table 6.2 Stage 6 area flora baseline

Scientific name	Common name
<i>Bidens pilosa</i>	Cobbler's Pegs
<i>Brassica tournefortii</i>	Mediterranean Turnip
<i>Cardiospermum grandiflorum</i>	Balloon Vine
<i>Celtis</i> sp.	Hackberry
<i>Conium maculatum</i>	Hemlock
<i>Conyza</i> sp.	A fleabane
<i>Cynodon dactylon</i>	Couch
<i>Ehrharta erecta</i>	Panic Veldt Grass
<i>Fumaria capreolata</i>	Climbing Fumitory
<i>Gamochaeta coarctata</i>	
<i>Hypochaeris radicata</i>	Catsear
<i>Lantana camara</i>	Lantana
<i>Ligustrum lucidum</i>	Broad-leaf Privet
<i>Ligustrum sinense</i>	Small-leaved Privet
<i>Maclura pomifera</i>	Osage Orange
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Petrorhagia dubia</i>	
<i>Plantago lanceolatus</i>	Lamb's Tongues
<i>Prunus</i> sp.	
<i>Senecio madagascariensis</i>	Madagascan Fireweed
<i>Sisymbrium officinale</i>	Hedge Mustard
<i>Solanum mauritianum</i>	Wild Tobacco Bush
<i>Solanum nigrum</i>	Blackberry Nightshade
<i>Tradescantia fluminensis</i>	Wandering Jew

The native vegetation in the Stage 6 area has low structural diversity and coverage, with the low native groundcover species diversity and abundance (EMM 2019).

ii Stage 7 area

The native flora and weed species identified in the Stage 7 area are listed in Table 6.3.

Table 6.3 Stage 7 flora baseline

Scientific name	Common name
NATIVE SPECIES	
<i>Acacia parramattensis</i>	Paramatta Wattle
<i>Pteridium esculentum</i>	Bracken Fern
<i>Casuarina cunninghamiana subsp. cunninghamiana</i>	River Oak
<i>Conium maculatum</i>	Hemlock
<i>Eucalyptus amplifolia</i>	Cabbage Gum
<i>Eucalyptus botryoides</i>	Bangalay
<i>Themeda australis</i>	Kangaroo Grass
EXOTIC SPECIES	
<i>Celtis sp.</i>	Hackberry
<i>Lycium ferocissimum</i>	African Boxthorn
<i>Acetosa sagittata</i>	Rambling Dock
<i>Araujia sericiflora</i>	Moth Vine
<i>Cardiospermum grandiflorum</i>	Balloon Vine
<i>Conium maculatum</i>	Hemlock
<i>Lantana camara</i>	Common Lantana
<i>Ligustrum lucidum</i>	Broad-leaf Privet
<i>Ligustrum sinense</i>	Small-leaved Privet
<i>Anagallis arvensis</i>	Scarlet Pimpernel
<i>Arundo donax</i>	Giant Reed
<i>Bidens pilosa</i>	Cobbler's Pegs
<i>Brassica sp.</i>	Cabbages
<i>Conyza sp.</i>	A fleabane
<i>Cynodon dactylon</i>	Couch
<i>Ehrharta erecta</i>	Panic Veldt Grass
<i>Fumaria capreolata</i>	Climbing Fumitory
<i>Gamochaeta coarctata</i>	
<i>Hypochaeris radicata</i>	Catsear
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Petrorhagia dubia</i>	
<i>Plantago lanceolatus</i>	Lamb's Tongues
<i>Platanus sp.</i>	Plane Trees

Table 6.3 **Stage 7 flora baseline**

Scientific name	Common name
<i>Ricinus communis</i>	Castor Oil Plant
<i>Senecio madagascariensis</i>	Madagascan Fireweed
<i>Sisymbrium officinale</i>	Hedge Mustard
<i>Solanum mauritianum</i>	Wild Tobacco Bush
<i>Solanum nigrum</i>	Blackberry Nightshade
<i>Tradescantia fluminensis</i>	Wandering Jew
<i>Verbena bonariensis</i>	Purple Top

The vegetation in the Stage 7 area is highly disturbed, comprising a sparse native mid-story and a largely exotic ground layer of grasses and herbs (EMM 2019). Canopy species are present in the Stage 7 area but are isolated and few. Pockets of canopy species are generally made up of exotic species such as Broad-leaf Privet (*Ligustrum lucidum*), Hackberry (*Celtis sp.*) and Plane Tree (*Platanus sp.*). The native mid-story species are found in pockets within the site and are dominated by Parramatta wattle (*Acacia parramattensis*).

Direct seeding and infill planting will target the re-establishment of the species listed in Table 5.1.

6.2.3 VMP works

The vegetation management in the Stage 6 and 7 areas as part of the vegetation management plan is described below. Weed control and rehabilitation works have generally commenced as part of ongoing quarry operations. The specific weed control works described below will commence following approval of this plan (see Section 6.4.3), with revegetation works commencing once adequate weed control has been achieved and suitable moisture conditions prevail ie planting would be planned to occur typically in the forecast wetter months – November through to March.

i Fencing and flagging

The Stage 6 and 7 areas are currently fenced to exclude animals from the operations and rehabilitation areas. These fences will be regularly inspected and maintained. The fences will also be inspected if stock animals enter the Stage 6 or 7 areas.

Flagging will be erected to exclude people, vehicles and machinery from the management zones (Figure 6.1 and Figure 6.2). Signs will be installed every 130 m along the flagging indicating that it surrounds a vegetation management zone.

ii Vegetation establishment measures

The following vegetation establishment measures will be applied, within Management Zones 6.1, 6.2, 6.3, 7.1 and 7.2 (see Figure 6.1 and Figure 6.2):

- Additional ground disturbance will be minimised to prevent erosion and to discourage weeds.
- Weed control measures will be implemented. It is anticipated that several rounds of weed treatment will be needed prior to the native species in-fill planting.

- In areas of existing native vegetation, in-fill planting of native plant species will be undertaken to increase species diversity and to shade out weed species. Planting density will vary depending on the species' growth types. Trees will be planted at a rate of 1 individual per 9 m², and mid-story/ground cover species at a rate of 1 individual per m². Plants that die will be replaced.
- In areas of exotic grass, seeding or in-fill planting of native plant species will be undertaken. Planting density will vary depending on the species' growth types. Trees will be planted at a rate of 1 individual per 9 m², and mid-story/ground cover species at a rate of 1 individual per m². Plants that die will be replaced.
- For plantings, a mineral based non-water-soluble fertiliser tablet inoculated with mycorrhizae and beneficial soil bacteria, such as Troforte plant tablets, will be added to each hole to ensure maximum survival of native plant species.
- Tree guards will be to protect the planted individuals from pests and wind.

Further details for each management zone are provided below.

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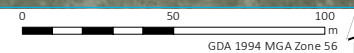


- KEY**
- Rail line
 - Main road
 - Named watercourse
 - ▨ Proposed vegetation monitoring plot
- Stage 6 zone
- MZ6.1
 - MZ6.2
 - MZ6.3

Fencing and vegetation monitoring plots – Stage 6 area

Menangle Sand and Soil Quarry
Biodiversity and Rehabilitation Management Plan
Figure 6.1

Source: EMM (2022); Metromap (2022); DFSI (2017)





- KEY**
- Rail line
 - Main road
 - Named watercourse
 - ▨ Vegetation monitoring plot
- Stage 7 zone**
- MZ7.1
 - MZ7.2
 - MZ7.3

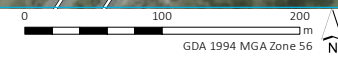
Fencing and vegetation monitoring plots – Stage 7 area

Menangle Sand and Soil Quarry
Biodiversity and Rehabilitation Management Plan
Figure 6.2



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Source: EMM (2022); Metromap (2022); DFSI (2017)



iii Specific measures – Stage 6 area

a Management Zone 6.1

Management Zone 6.1 is well covered by a native canopy. The native mid- and ground-cover species diversity is low, with weed species prevalent in these vegetation layers.

Management Zone 6.1 has already undergone initial rehabilitation that has targeted the establishment of canopy, mid-story, and vine species. Rehabilitation works will focus on the control of herbaceous weeds and infill planting, with additional native species, to increase plant diversity.

The following weed control will be used in this zone:

- non-herbicide treatment:
 - hand weeding (effective against grasses and herbaceous/non-woody weeds such as Cobbler’s Pegs (*Bidens pilosa*));
 - slashing (effective against grasses and herbaceous/non-woody weeds such as Kikuyu (*Pennisetum clandestinum*)); and
 - chainsaw (effective against exotic canopy species such as Privet (*Ligustrum spp.*));
- direct herbicide treatment:
 - cutting and painting (effective against woody weeds such as Lantana (*Lantana camara*));
 - scraping and painting (effective against woody weeds such as Cestrum (*Cestrum parqui*));
 - wick wiping (effective against woody weeds such as Lantana (*Lantana camara*)); and
 - drilling and filling (effective against exotic canopy species such as Privet (*Ligustrum spp.*));
- herbicide spraying:
 - spot spraying (effective against grasses and herbaceous/non-woody weeds such as Cobbler’s Pegs (*Bidens pilosa*)).

Due to the good condition of the native vegetation on site, it is expected that rehabilitation will require minimal herbicide use. There will be no high-volume spraying due to the proximity of the zone to the Nepean River.

b Management Zone 6.2

Management Zone 6.2 is located on the riverbank between MZ6.1 and the Nepean River. It is characterised by sparse native canopy cover, with overall low native species diversity and cover. The riverbank is north-facing and exposed to direct sun. Rehabilitation works will focus on the control of herbaceous weeds and infill planting, with additional native species, to increase plant diversity.

As this zone is located on the riverbank, weed control will be a combination of mechanical and direct herbicide application. Herbicide spraying will not be used, to prevent spray drift and minimise the amount of herbicide used near a waterway.

The following weed control will be used in this zone:

- non-herbicide treatment:

- hand weeding;
- slashing; and
- chainsaw (effective against exotic canopy species such as Privet (*Ligustrum spp.*));
- direct herbicide treatment:
 - cutting and painting;
 - scraping and painting;
 - wick wiping; and
 - drilling and filling.

c Management Zone 6.3

Management Zone 6.3 is located between the two parts of MZ6.1 and has some gully erosion. It is well covered by a native canopy, with the presence of mid- and ground-cover species low.

There is an active gully head within the drainage line in MZ6.3 and rehabilitation works in this zone will include stabilising the soil to prevent further erosion and establishing native plant diversity in the mid- and ground-cover layers. Native plant diversity will be returned by planting suitable species listed in Table 5.1. The gully will be stabilised by the application of rip rap. Works will only be undertaken in a period of low rainfall.

The area will then be seeded with cover crop and ground cover species.

Weed control in this management zone will prioritise non-herbicide treatment as the zone drains into the Nepean River. If herbicide use is necessary, it will be limited to direct application methods (ie cutting and painting, scraping and painting, filling and drilling) with no spraying, as per Management Zone 6.1. Ground disturbance will be minimised to prevent erosion and discourage weeds.

iv Specific measures – Stage 7 area

a Management Zone 7.1

Management Zone 7.1 consists of flat land above the riverbank, and the riverbank slope. It has a densely weedy ground layer with isolated native shrubs and trees, and thickets of mid-story weeds such as Giant Reed (*Arundo donax*) are also present. In version 1 of this management plan it was proposed that short-term, rehabilitation works will be undertaken on the two easterly sections of this zone. This has now been modified to consolidate the rehabilitation areas (Figure 6.2) to allow vegetation management works to start during quarry operations and to minimise edge effects and increase the area undergoing rehabilitation for biodiversity purposes. These works will commence following approval of this BRMP.

Rehabilitation of this zone will commence with the installation of sediment controls such as mulch bunds or silt fences downstream of potential erosion areas. The western extraction areas of Stage 7 will be backfilled with any weed contaminated topsoil buried at least 1 m deep during backfilling. Due to the proximity to the Nepean River, these works will only be undertaken in a period of low rainfall erosivity as identified in the SWMP (EMM 2021). The disturbed areas will be reshaped to resemble the pre-extraction contours with no slopes steeper than 1:5, unless the pre-extraction slopes are steeper.

Soils will be tested. Ameliorants will be applied if the soil testing results indicate that the soils are nutrient-deficient or erosion-prone. Ameliorants will be incorporated via contour scarification. The disturbed area will then be

protected from erosion and seed invasion by revegetating with cover crops with greater than 24 of the River-flat Eucalypt Forest EEC species listed in Table 5.1 and the methods described in Section 7.2.6 of the SWMP.

Watering will not be required as a non-water-soluble mineral based biologically activated fertiliser will be used. Biologically activated fertilisers rapidly establish beneficial soil bacteria and arbuscular mycorrhizal fungi further binding the soil with glomalin (soil carbon cement) and increasing soil aggregation (Hendrickson et.al 2008) without the risk of nutrient loss to groundwater and surface associated with water soluble chemical fertilisers.

Regular inspections and weed control via wick wiping and the use of brush cutters will need to be undertaken to ensure that aggressive grass species such Kikuyu in the grassed areas adjacent to this management zone do not invade and outcompete the seeded native species.

Additional seeding or tube stock planting will be undertaken if the rehabilitation works fail to meet the objectives, performance indicators and completion criteria detailed in Appendix 6 of the Consent (provided in Appendix G of this BRMP).

Sediment control measures will be removed once the vegetation ground cover is equal to or exceeds 70%.

b Management Zone 7.2

Management Zone 7.2 is located on the riverbank adjacent to the Nepean River. It is characterised by sparse native canopy cover, with overall low native species diversity and cover. The riverbank is north-facing and exposed to direct sun. It is heavily dominated by Kikuyu Grass and therefore rehabilitation will focus on weed control and tube stock planting of River-flat Eucalypt EEC species listed in Table 5.1. In version 1 of this management plan short-term rehabilitation works were proposed to only be undertaken on the two easterly sections of this zone. This has now been extended for the bulk of the riverbank to improve connectivity in this area (Figure 6.2). These works have commenced and will continue following approval of this BRMP.

Additional attention to weed management will be required in this zone until the adjacent areas are rehabilitated at the completion of processing activities. Weed management will be limited to mechanical slashing with a brush-cutter or wick wiping with a hand-held wick wiper due to the proximity of the Nepean River, the steep riverbank and uneven ground. Kikuyu Grass is highly aggressive and other grass seeds will be present in the topsoil. As a result, it is expected that several weed treatments will be required before tube stock planting can commence.

Initial plantings will focus on the establishment of canopy and mid-storey species listed in Table 5.1 to shade-out the weed species. Planting of understory species will be able to be commenced once a canopy has established and the weed species have been controlled to an acceptable level.

c Management Zone 7.3

The western portion of Management Zone 7.3 is a steep-sided eroded gully. It contains a canopy cover that is sparse in sections, a densely weedy mid-story layer, and has ground cover dominated by exotic species. Some of the mature trees are covered by Balloon Vine (*Cardiospermum grandiflorum*). This species has the capacity to collapse canopy through the thick curtains of heavy stems it forms. On the high ground either side of the gully, the vegetation is dominated by exotic canopy species such as Broad-leaf Privet (*Ligustrum lucidum*), Hackberry (*Celtis sp.*), and Plane Tree (*Platanus sp.*). These trees vary in size from well-established mature trees to juvenile stage trees.

The eastern portion of MZ7.3 is an area of River-flat Eucalypt Forest adjacent to the Hume Highway.

This management zone is outside of works required as a condition of consent, and therefore works will focus on controlling weeds, to minimise spread of weed propagules to other areas managed for biodiversity values.

In the western portion of MZ7.3, weed control will be a combination of mechanical and direct herbicide application (as opposed to spraying), to prevent spray drift and to minimise the amount of herbicide used near a waterway.

This will include mechanical slashing using brush cutters and chainsaws (as appropriate) to fell larger weed plants such as Privet and wick wiping using a hand-held wick wiper.

A combination of cutting and painting (using chainsaw or handsaw) and drilling and filling will be used to remove the weed trees on the high ground either side of the gully.

6.3 Connectivity

Current vegetation within Management Zone 6.1–6.3 (in the Stage 6 area) provides connectivity along the river downstream of the Main Southern Railway (see Figure 6.1). This will be enhanced by the rehabilitation works described in Section 6.2.3iii. Trees have also been planted along the southern side of the Stage 6 area.

There are scattered trees along the riverbank in the Stage 7 area, native vegetation on the western and eastern boundaries of the Stage 7 area, and trees have been planted on the bund on the southern side of the processing area (see Figure 6.2). The rehabilitation works within Management Zones 7.1 and 7.2 described in Section 6.2.3iv will be started upon approval of this BRMP and will improve connectivity along the river during quarry operations.

The rehabilitation works within Management Zone 7.3 described in Section 6.2.3iv will also improve connectivity along the river.

6.4 Final rehabilitation following cessation of operations (Domains 1 and 2)

6.4.1 Infrastructure areas (Domain 1)

Infrastructure areas (Domain 1) will be rehabilitated as following the completion of quarry and processing operations.

1. Quarry infrastructure will be decommissioned:
 - Services such as power and water will be isolated and removed.
 - Equipment associated with screening of materials and the weighbridge will be moved to another Benedict operation or sold.
 - The office, workshop, associated footings, foundations and car parks will be removed – it is expected that the main office, ablutions, and a workshop will remain until the bulk of the rehabilitation works have been completed.
 - All the scrap steel and waste from the laydown area will be removed from site.
 - A phase 1 contaminated site investigation would be undertaken to identify any potential areas that require further investigation and/or remediation.
2. The final quarry landform will be established:
 - Soil from the noise/visual bund will be used to infill any water storages and sediment sumps including Water Management Dam 01, 02a and 02b in Domain 2 (see below).
 - The entire screening and stockpiling area will be re-shaped with final contours resembling the natural pre-disturbance contours.

- Grazing areas (Figure 3.2) will have a minimum soil depth of 100 mm. This soil depth would allow LSC class of 2 if the site soils had less erosive texture that is, a greater percentage of clay (non-dispersive) to bind the soil.

3. Vegetation will be established:

- Soil testing will be undertaken for erosion and agronomic parameters. Ameliorants will be applied if the soil testing results indicate that the soils are nutrient-deficient or erosion-prone. Ameliorants will be incorporated via contour scarification.
- Areas will be seeded using pasture and cover crop species via drill or broadcast seeding.

An access road will be retained to allow access for rehabilitation monitoring and maintenance. The culverts in drainage lines will remain.

6.4.2 Previously extracted areas (Domain 2)

The areas of the previously extracted Stage 6 and 7 areas (Domain 2) that have not been rehabilitated (Water Management Dams 01, 02a and 02b) will be rehabilitation as described in Section 6.4.1.

6.4.3 Stage 6 and 7 area vegetation management schedule

The short-term (initial actions over 1–2 years), medium (prior to quarry closure) and long-term (following quarry closure) vegetation management measures in the Stage 6 and 7 areas are presented in Table 6.4.

The annual monitoring schedule is presented in Table 7.3.

Table 6.4 Stage 6 and 7 vegetation management schedule

Area ¹	Year																				
Measure ²	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Stage 6 area (MZ6.1, MZ6.2 and MZ6.3)																					
Weed removal	s																				
Infill planting/planting maintenance		s	Continue until completion criteria (see Appendix G) are met																		
Weed control		m	m	m	m	Continue until completion criteria (see Appendix G) are met															
Stage 7 area																					
Rehabilitation areas (MZ7.1 and MZ7.2)																					
Landforming of final extraction area	s																				
Installation of erosion/sediment controls (eastern sections)	s																				
Seeding	s																				
Infill planting/planting maintenance		m	m	m	m	m	m	m	m	m	m	m	m	m							
Weed control		m	m	m	m	m	m	m	m	m	m	m	m	m							
Vegetation requiring management (MZ7.3)																					
Weed removal (western portion)	s																				
Weed control (eastern and western portion)		m	m	m	m	Continue as required to minimise weeds spreading to MZ7.1 and MZ7.2															

1. See Table 2.3.
 2. s: short-term; m: medium term; l: long-term.

7 Stage 8 area rehabilitation and restoration

Biodiversity works will be undertaken in Domain 3 (NRBZ and lower riverbank area), Domain 5 (extraction area), Domain 5 (restoration area) and Domain 6 (weed control areas) as described below.

The extraction area will be progressively cleared and rehabilitated. Similarly, restoration works will be progressive, with restoration of Restoration Stage 1 being undertaken in parallel with the extraction of Substages 8A–8C as described in the *Biodiversity Offset Strategy* (Appendix B).

7.1 Nepean River Buffer Zone and lower riverbank (Domain 3)

The NRBZ and lower riverbank area (Domain 3) has scattered native tree cover, primarily consisting of Southern Blue Gum and River Oak (*Casuarina cunninghamiana*) with some large to very large trees. There is extensive understorey and ground weed cover, including dense thickets of Lantana and Privet.

7.1.1 Area demarcation

The NRBZ and lower riverbank area are generally in the 'Exclusion Areas' (see Section 4.3.4).

The locations of Protected Trees within the NRBZ have been surveyed and each tree has been clearly numbered (see Appendix A). The landward edge of the NRBZ, including the 10 m horizontal setback from each Protected Tree, will be pegged and flagged in accordance with Figure A.1 in Appendix A prior to the start of extraction in the substage. Each peg will be flagged so that it is clearly visible to the excavator operator within the extraction area.

The excavator operator will ensure that extraction does not encroach within the flagged NRBZ.

7.1.2 Weed control

Due to the proximity to the Nepean River, weed control methods will focus on minimising soil disturbance, and re-establishing native plant cover via seeding and tube stock planting of River-flat Eucalypt EEC species listed in Table 5.1.

The following weed-control methods will be implemented in the lower riverbank area by the Rehabilitation Officer (in priority order):

1. mechanical removal by hand – slashing/cutting so that roots are retained (including chainsaw use which is effective against exotic canopy species such as Privet (*Ligustrum spp.*); and
2. herbicide – selective/targeted application (eg using a wick or cut and paint application).

These methods will minimise soil disturbance on the lower riverbank while generally leaving existing roots in situ. Spray application of herbicide will not be used in this zone.

7.1.3 Seeding and planting

Weed control will be followed by the application of native seeds and/or tube-stock planting, as required to introduce species which have not established from seed using the species listed in Table 5.1.

7.1.4 Erosion and sediment control

As soil disturbance will be minimal and ground cover will be maintained, no additional erosion and sediment control measures are anticipated be required in this Domain. The flood event TARP is provided in Section 4.3.4 that considers the potential impacts of floods on bank stability.

7.1.5 Habitat enhancement

The fauna habitat measures described in Section 7.5 will be implemented in the NRBZ and lower riverbank area (Domain 3).

7.2 Extraction area (Domain 4)

The Stage 8 extraction area (Domain 4) will be progressively cleared, stripped, quarried and rehabilitated in a southerly direction. The extraction area has been split into a series of substages (Figure 1.3) that are approximately 1 ha. Each substage will take approximately 1 year to extract. The rehabilitation rate will generally be the same as the clearing, stripping and extraction rate such that the maximum active extraction area does not exceed 0.33 ha at any given time in accordance with Consent Condition B72(b).

7.2.1 Area demarcation

The eastern side of the extraction area is defined by the western boundary of the NRBZ (see Section 7.1.1). The other boundaries have been pegged and flagged based on the areas defined in Appendix 1 of the Consent.

7.2.2 Weed management

The following weed-control methods will be implemented in the extraction area by the Rehabilitation Officer (in priority order):

1. mechanical removal – all vegetation will be removed;
2. soil removal and burial – weed infested topsoil will be removed and buried in a completed section of the extraction area;
3. following completion of extraction and final land-forming in an area, the area will be rapidly, and progressively, rehabilitated with sterile cover crop species and native plants (see Section 7.2.9);
4. herbicide – selective/targeted application (eg using a wick application) in the rehabilitation area of any emerging weeds, including those carried into the area by flood water; and
5. burning (primarily to assist native vegetation community establishment) – once the rehabilitated vegetation has reached a suitable level of maturity.

7.2.3 Vegetation clearing

Pre-clearing inspections and clearing will be undertaken as described in Section 5.2.1.

7.2.4 Topsoil removal

Topsoil will be stripped to a depth of approximately 0.2–0.3 m. Given that the topsoil in the Stage 8 area contains the seedbank for the noxious weeds infesting the area, this weed-infested material will be placed in the bottom of

the preceding extraction area, following resource extraction, and will be covered by material returned as part of creating the final landform.

Soil will be managed as described in Section 5.2.2.

7.2.5 Resource extraction

The sand and soil resource in the Stage 8 area will be extracted using an excavator and off-road haul truck. It will only be extracted to within 1 m above the water table. The excavator will load the haul truck, which will then transport the sand and soil to the processing area.

7.2.6 Final landform

Weedy topsoil and weedy vegetated materials from the advancing quarry will be immediately placed in the floor of the completed extraction area. The completed extraction area will be backfilled to approximately 64 m AHD with scalps, course rejects and soil. The Stage 8A–8C final landform is shown in Appendix C of the Flood Management Plan.

7.2.7 Erosion and sediment control

During extraction, the batter between the NRBZ and the extraction area will have a maximum slope of 1(v):1(h) however this will be reduced to 1(v):5(h) within 12 hours if flooding is predicted as described in the Flood Management Plan. This batter will be reformed to a maximum of 1(v):5(h) as part of rehabilitation works.

The landward batter of the extraction area will have a maximum gradient of 1(v):1(h) where soil and sand are present or steeper where bedrock is encountered.

The erosion and sediment control methods described in Section 5.4.1 will be implemented.

7.2.8 Habitat enhancement

Following completion of the final landform (see Appendix C of the Flood Management Plan), woody debris and habitat materials will be placed generally parallel to the contours in a manner that resembles the natural topography, as described in Section 7.5.2.

7.2.9 Revegetation

Soils will be tested, ameliorants applied as required and incorporated via contour scarification. The disturbed area will then be protected from erosion and seed invasion by revegetating with cover crops with greater than 24 of the River-flat Eucalypt Forest EEC species listed in Table 5.1 and other methods as required (see Section 7.2.6 of the SWMP (EMM 2021a)).

Following construction of the final landform, the area will be immediately planted with grasses to stabilise the surface. Native vegetation will then be established through planting and seeding.

7.2.10 Vegetation management

There will be ongoing active management of the rehabilitated extraction area, including weed control.

The rehabilitation areas will be monitored and contingency measures implemented when required as described in Sections 8.2 and 8.4.

7.3 Restoration area (Domain 5)

The restoration areas have been identified for ecological restoration to allow a high-quality vegetation community to be re-established and to compensate for the temporary loss of ecological values within the extraction/rehabilitation area. Following the removal of the previous approval to quarry the Stage 3 area but approval to quarry the Stage 8 area, the restoration areas will provide biodiversity offsets for the additional Stage 8 area to be cleared.

The restoration area (Domain 5) has native tree cover, primarily consisting of Southern Blue Gum. Some small trees or shrubs present at low density including Bracelet Honey-myrtle (*Melaleuca armillaris*), Coast Myall (*Acacia binervia*), Sandpaper Fig (*Ficus coronata*), Tree Violet (*Melicytus dentatus*), White Cedar (*Melia azedarach*), and Willow Bottlebrush (*Callistemon salignus*).

7.3.1 Area demarcation

The extent of the restoration areas will be pegged based on the areas defined in Appendix 1 of the Consent. Fences will be erected to exclude people, stock animals, vehicles and machinery from the restoration area (Figure 7.1). The fence will be stock proof, made of timber, concrete or metal posts, with 5 wire strands. High tension wire will be avoided due to its tendency to break during a fire. Signs will be installed every 130 m along the fence indicating that the fence surrounds a vegetation management zone.

7.3.2 Weed control

The area is heavily degraded by weeds. In particular, the groundcover is weed dominated. Weed species observed in the area are listed in Table 7.1.

Table 7.1 Exotic observed species in the restoration area (Domain 5)

Common Name	Scientific Name
Canopy	
Hackberry	<i>Celtis</i> sp.
Osage Orange	<i>Maclura pomifera</i>
Black Locust	<i>Robinia pseudoacacia</i> (?)
Understorey	
African Boxthorn	<i>Lycium ferocissimum</i>
Balloon Vine	<i>Cardiospermum grandiflorum</i>
Broad-leaf Privet	<i>Ligustrum lucidum</i>
Green Cestrum	<i>Cestrum parqui</i>
Lantana	<i>Lantana camara</i>
Moth Vine	<i>Araujia sericiflora</i>
Prickly Pear	<i>Opuntia stricta</i>
Rambling Dock	<i>Acetosa sagittata</i>
Small-leaved Privet	<i>Ligustrum sinense</i>
Trailing Lantana	<i>Lantana montevidensis</i>

Table 7.1 Exotic observed species in the restoration area (Domain 5)

Common Name	Scientific Name
Groundlayer	
African Lovegrass	<i>Eragrostis curvula</i>
Blackberry Nightshade	<i>Solanum nigrum</i>
Cape Ivy	<i>Delairea odorata</i>
Catsear	<i>Hypochaeris radicata</i>
Climbing Fumitory	<i>Fumaria capreolata</i>
Clustered Clover	<i>Trifolium glomeratum</i>
Cobbler's Pegs	<i>Bidens pilosa</i>
Couch	<i>Cynodon dactylon</i>
Fat Hen	<i>Chenopodium album</i>
Fleabane	<i>Conyza</i> sp.
Four-leaved Allseed	<i>Polycarpon tetraphyllum</i>
Hedge mustard	<i>Sisymbrium officinale</i>
Hemlock	<i>Conium maculatum</i>
Kikuyu	<i>Pennisetum clandestinum</i>
Lamb's Tongues	<i>Plantago lanceolatus</i>
Madagascan Fireweed	<i>Senecio madagascariensis</i>
Paddy's Lucerne	<i>Sida rhombifolia</i>
Panic Veldt Grass	<i>Ehrharta erecta</i>
Prickly Sowthistle	<i>Sonchus asper</i>
Purple Top	<i>Verbena bonariensis</i>
Spear Thistle	<i>Cirsium vulgare</i>
Stinking Roger	<i>Tagetes minuta</i>
Wandering Jew	<i>Tradescantia fluminensis</i>
Wild Tobacco Bush	<i>Solanum mauritianum</i>
-	<i>Gamochoeta coarctata</i>
-	<i>Petrorhagia dubia</i>

The following weed-control methods will be implemented in the restoration area by the Rehabilitation Officer (in priority order):

1. mechanical removal – slashing/cutting or pulling depending on the weed type; and
2. soil removal and burial – scalping of topsoil to a depth of 0.2–0.3 m and burial of weed infested soil.
3. herbicide – selective/targeted applications (eg using a wick application) on re-emerging weed; and

4. burning (primarily to assist native vegetation community establishment).

Prior to the completion of extraction in the first 0.33 ha of the Substage 8A area, weedy topsoil removed from the restoration area will be stockpiled within the cleared extraction area.

7.3.3 Seeding and planting

Weed control will be followed by the application of native seeds and/or tube-stock planting, as required to introduce species which have not established from seed using the species listed in Table 5.1.

No termite mounds have been identified within the Stage 8 area. Should any termite mounds be identified within the restoration area (Domain 5), they will be left undisturbed.

7.3.4 Vegetation management

There will be ongoing active management of the restoration area, including weed control.

The rehabilitation areas will be monitored and contingency measures implemented when required as described in Sections 8.2 and 8.4.

7.4 Weed control areas (Domain 6)

Weed control areas (Domain 6) will be managed for weed control only, with no planting and other vegetation management. The weeds present in this area are like those within the restoration areas (Domain 5) (Table 7.1).

The following weed-control methods will be implemented in the Weed Control area by the Rehabilitation Officer (in priority order):

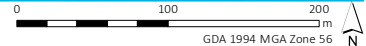
1. mechanical removal – slashing/cutting so that roots are retained; and
2. herbicide – selective/targeted application (eg cutting and painting, scraping and painting and using a wick application).
3. herbicide – spot spraying.



Source: EMM (2022); Metromap (2022); DFSI (2017)

KEY

- Main road
 - Watercourse/drainage line
 - Track
 - Proposed fencing
 - Proposed access gate
 - ▨ Proposed vegetation monitoring plot
-
- Stage 8 zone
 - MZ8.1
 - MZ8.2
 - MZ8.3
 - MZ8.4



Fencing and vegetation monitoring plots – Substages 8A-8C area

Menangle Sand and Soil Quarry
Biodiversity and Rehabilitation Management Plan
Figure 7.1



\\emmsvr1\EMM\Jobs\2019\190166 - Menangle Quarry LEC\GIS\02 - Maps_VMP\WIP\008 - Stage8\FencingPlots_20220224_05.mxd 24/02/2022

7.5 Fauna habitat enhancement measures

Fauna habitat enhancement measures will be implemented in the NRBZ and lower riverbank area (Domain 3) and the restoration area (Domain 5). The pest control measures described in Section 5.6 will also enhance the fauna habitat.

7.5.1 Nest-boxes/tree-hollows

Consent Condition B76 requires that at least 106 nest boxes or tree hollows are placed or created within the restoration area within 12 months of commencing quarrying operations in the Stage 8 Area. These will be placed across the NRBZ and lower riverbank area (Domain 3) and the restoration area (Domain 5), not limited to the restoration area for Substages 8A–8C.

Nest boxes will be constructed of hardwood as nest boxes made of softwood have poor longevity. When received, the quality of each nest box will be checked.

Nest boxes suitable for a range of species will be installed as detailed in Table 7.2. Each nest box will be given a unique identification number (as per Table 7.2) that will be etched on to the bottom of the box (so that it can be seen from ground level).

Table 7.2 Nest box target-fauna types

Nest box type	Number to be installed	Identification numbers to be used	Location in the tree to be installed
Double chamber microbat	40	B1–B40	Approximately 4 m from ground level on trunk of a tree.
Brushtail/ringtail possum, front entry	30	LP101–LP130	Lower canopy approximately 4–6 m from ground level.
Sugar/squirrel, rear entry	30	SP201–SP230	Lower canopy approximately 4–6 m from ground level.
Large owl	6	O301–O306	In the tree canopy, on trunk or branch with relatively clear space to allow owls space for flight.

The nest boxes will be installed in a portion of the tree suitable for the target species (Table 7.2).

Multiple nest boxes may be installed on the one host tree but not more than three nest boxes of the same type will be installed on the one host tree.

The GPS location of each installed nest box will be recorded, along with the type of nest box, identification number, notes on the tree species, diameter at breast height, and notes on the location within the tree where the nest box was installed.

When pre-clearance surveys are conducted for extraction areas (see Section 5.2.1), any healthy animals that do not self-relocate, will be relocated to an area close to a nest box.

The nest boxes will be checked annually and following significant weather events by the Rehabilitation Officer to ensure that they are present and remain suitable for use by the target species and the status of the nest boxes will be reported in the nest-box and woody debris report (see Sections 8.4.3 and 8.4.4).

7.5.2 Woody debris

Following resource extraction, the final landform will be progressively formed, erosion and sediment measures installed, and then woody debris and habitat materials (eg smaller branches and leave material) will be placed on the new land surface. Similarly, woody debris and habitat materials will be placed in the restoration area following the removal of the weed-infested topsoil. The placement of the debris in these areas will generally occur as soon as the land surface is prepared to meet the woody debris placement requirements.

Logs and woody debris salvaged from the extraction area will be placed within the extraction area (Domain 4) and the restoration area (Domain 5) as follows:

- logs and woody debris at least 10 cm in diameter and greater than 0.5 m in length will be placed on the contour, such that there is at least a total of 400 m of this woody debris per hectare in all rehabilitated areas; and
- large woody debris at least 50 cm in diameter and greater than 0.5 m in length, such that there is at least a total of 100 m of this large woody debris per hectare in all rehabilitated areas.

The woody debris will be placed so as to slow overland flow during floods. Debris will be pushed into the soil via track rolling to help anchor them in soil to help them withstand erosive forces from flood flows and to minimise the concentration of flow under the woody debris. The increased surface roughness from the woody debris and seeded and planted vegetation will create a boundary layer of lower velocity during floods events that will help protect the rehabilitated areas from flood related erosion identified in Section 3.3.

A post-placement woody debris survey will be undertaken to confirm that the required length of woody debris has been installed. The results will be reported in the nest-box and woody debris report (see Section 8.4.4).

Woody debris will be added to an area if the post-placement survey (see Section 8.4.4) shows that the requirements have not been met.

7.6 Stage 8 area rehabilitation and restoration schedule

The short-term, medium and long-term rehabilitation and restoration measures in the Stage 8 area are presented in Table 7.3.

The annual monitoring schedule is presented in Table 8.5.

Table 7.3 Stage 8 rehabilitation and restoration schedule

Area	Year																			
Measure ¹	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Extraction area (MZ8.1)																				
Substage 8A																				
Woody debris placement	s	s																		
Vegetation establishment	s	s																		
Infill planting/planting maintenance			s																	
Planting maintenance and weed control			s	m	m	m	m	m	m	m	m	m	m	m						
Pest and erosion control	m	m	m	m	m	m	m	m	m	m	m	m	m	m						
Substage 8B																				
Woody debris placement		s	s																	
Vegetation establishment		s	s																	
Infill planting/planting maintenance				s																
Planting maintenance and weed control				s	m	m	m	m	m	m	m	m	m	m						
Pest and erosion control	m	m	m	m	m	m	m	m	m	m	m	m	m	m						
Substage 8C																				
Woody debris placement			s	s																
Vegetation establishment			s	s																
Infill planting/planting maintenance					s															
Planting maintenance and weed control					s	m	m	m	m	m	m	m	m	m						
Pest and erosion control	m	m	m	m	m	m	m	m	m	m	m	m	m	m						
NRBZ and lower riverbank (MZ8.2)																				
Weed control	s	m	m	m	m	m	m	m	m	m	m	m	m	m						
Restoration Area 1 (MZ8.3)																				

Table 7.3 Stage 8 rehabilitation and restoration schedule

Area	Year																			
Measure ¹	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Weed removal (inc. topsoil weed seedbank)	s																			
Vegetation establishment	s	s																		
Infill planting/planting maintenance			s																	
Planting maintenance and weed control			s	m	m	m	m	m	m	m	m	m	m	m						
Pest control	m	m	m	m	m	m	m	m	m	m	m	m	m	m						
Erosion control	m	m	m	m	m	m	m	m	m	m	m	m	m	m						
Weed control area (MZ8.4)																				
Weed control	s	m	m	m	m	m	m	m	m	m	m	m	m	m						
Fencing																				
Fence installation	s																			
Fencing maintenance		m	m	m	m	m	m	m	m	m	m	m	m	m						
Nest boxes																				
Nest box installation	s																			
Nest box maintenance		m	m	m	m	m	m	m	m	m	m	m	m	m						

1. s: short-term; m: medium term; l: long-term.

8 Performance indicators and completion criteria

8.1 Biodiversity covenant

It is proposed that positive covenant(s) under section 88E of the NSW *Conveyancing Act 1919* will be established for the biodiversity offset/restoration areas. The positive covenant will be in place prior to commencement of quarrying operations in Stage 8 or within another timeframe agreed by the Planning Secretary (as per Consent Condition B67). If a covenant(s) is not used, other suitable arrangements for the long-term protection of the restoration area will be agreed with the Planning Secretary.

It is proposed that the positive covenant will:

- Stipulate that the restoration area (Domain 5) and all rehabilitated substages of the extraction area (Domain 4) will be managed in accordance with the measures set out in this document.
- Establish a trust with sufficient funds to provide for the ongoing management of the restoration area in accordance with the measures set out in this BRMP. The value of the trust will be calculated in accordance with the total fund deposit requirements for a biodiversity stewardship site, in accordance with BC Act.

The trust may include sufficient funds to provide for the ongoing management of the rehabilitated substages in accordance with the measures set out in this BRMP as an alternative to the Rehabilitation Bond (see Section 8.2).

This version of the BRMP applies to Substages 8A–8C. Therefore, whilst the covenant may either be implemented across only extraction Substages 8A–8C, or, if implemented across all extraction and restoration areas the amount put into the trust fund is to be reflective of the works required across extraction Substages 8A–8C and the associated restoration substages.

If a positive covenant is established, then under Consent Condition B88, the Planning Secretary may waive the requirement for all or part of the Rehabilitation Bond required under Consent conditions B83 to B87.

Menangle Sand and Soil will consult with DPE regarding the proposed approach to the long-term protection of the restoration area and rehabilitated substages, culminating in a request to the Planning Secretary for approval of the proposed approach.

8.2 Rehabilitation bond

Unless the costs of rehabilitation are incorporated into the positive covenant (see Section 8.1), a rehabilitation bond for the Stage 8 Area will be lodged with the DPE within 6 months of the approval this BRMP. The sum of the bond will be an amount agreed by the Planning Secretary and determined by:

- calculating the cost of rehabilitating all disturbed areas of the site at third party rates (other than land acquisition costs), taking into account the likely surface disturbance over the next 3 years of quarrying operations; and
- employing a suitably qualified, independent and experienced person to verify the calculated costs.

The calculation of the Rehabilitation Bond will be submitted to the Department for approval at least 2 months prior to the lodgement of the bond.

If lodged (see above), the Rehabilitation Bond will be reviewed and if required, an updated bond lodged with the Department within 3 months following:

- any update or revision to this BRMP;
- the completion of an Independent Environmental Audit in which recommendations relating to the implementation of the BRMP have been made; or
- in response to a request by the Planning Secretary.

The bond will be released when rehabilitation is completed generally in accordance with the relevant completion criteria, to the satisfaction of the Planning Secretary. All, or part of, the bond may be called in and arrangements made for the completion of the relevant works if rehabilitation is not completed generally in accordance with the relevant completion criteria and, if in the opinion of the Planning Secretary, the works are unlikely to be carried out by the company.

8.3 Rehabilitation performance indicators and completion criteria

Performance indicators will be used to monitor the rehabilitation progress towards the completion criteria that will be used as the basis for assessing when rehabilitation and restoration is complete.

The proposed post-quarrying land uses are: biodiversity (Stage 8 area and some of the Stage 6 and 7 areas), grazing (some of the Stage 6 and 7 areas) and access tracks for management and maintenance (see Section 3.3).

The rehabilitation performance indicators and completion criteria to achieve a post-closure biodiversity land use are described below. At quarry closure, the areas of Stage 6 and Stage 7 which have not been managed as native vegetation during quarry operations (see Chapter 6), will be rehabilitated post-quarrying to a grazing land use. Rehabilitation performance indicators and completion criteria for grazing land will be provided in an update to this BRMP at least 3 years prior to the anticipated closure of the quarry.

The performance indicators and completion criteria for the biodiversity land uses were developed during the Consent application process, with consideration of rehabilitation practices and success in similar project environments; the current and desired condition of the River-flat Eucalypt Forest EEC; and biodiversity assessment monitoring (BAM) measures or equivalent. Biodiversity performance indicators and completion criteria are detailed in Appendix 6 and Appendix 7 of the Consent (provided in Appendix G and Appendix H of this BRMP respectively).

The biodiversity and rehabilitation measures consist of:

- a set of objectives;
- performance indicators;
- rehabilitation criteria; and
- methods to gather evidence whether the indicators/criteria have been met.

Generally, rehabilitation and restoration monitoring compare rehabilitation and restoration areas with undisturbed analogue (reference) areas. The absence of suitable good condition River-flat Eucalypt Forest EEC analogue sites close to the quarry means that determining the rehabilitation and restoration success will be based on the criteria in Appendices 6 and 7 of the Consent for River-flat Eucalypt Forest EEC plant community attributes.

8.3.1 Landform establishment, stability and growth medium

Performance indicators and completion criteria that address the following outcomes are presented in Table 8.1 and Table 8.2:

- restoration of a safe and stable landform that is non-polluting; and
- reinstate soil profiles and function and create landforms that are compatible with surrounding topography and that permit the proposed final land-use.

Table 8.1 Landform establishment, stability and growth medium performance indicators and completion criteria

Objective	Completion criteria	Progressive rehabilitation	Performance indicator	Monitoring methods	Performance guidance	Corrective actions
Final landform is established and stable in Stage 6 and 7 areas	<p>The final landform is suitable for the final land uses and generally compatible with surrounding topography.</p> <p>No reduction in flood storage capacity, compared with pre-development conditions.</p> <p>Final landform incorporates geomorphological features to allow for the free draining discharge of clean water.</p> <p>Minimal sediment-laden run-off into the Nepean River.</p>	<p>The final landform has been established in the Stage 6 area.</p> <p>The final riverbank landform in the Stage 7 area (MZ7.2, see Figure 2.3) will be completed in 2022.</p> <p>The final landform in the remainder of the Stage 7 area will be completed following the completion of operations.</p>	<p>Extraction area: minimum 1:50 slope towards swale at base of riverside batter.</p> <p>Structures in place to capture any sediment-laden runoff prior to entering the Nepean River.</p>	Weekly visual inspections.	The existing erosion and sediment control measures are maintained (see SWMP).	Additional earthworks to form a final landform that meets the completion criteria.
Final landform is consistent with the Consent in the Stage 8 extraction area	<p>The final landform is suitable for the final land uses and generally compatible with surrounding topography.</p> <p>No reduction in flood storage capacity, compared with pre-development conditions.</p> <p>Final landform incorporates geomorphological features to allow for the free draining discharge of clean water.</p> <p>Minimal sediment-laden run-off into the Nepean River.</p>	<p>Weedy topsoil and weedy vegetated materials from the advancing quarry will be immediately placed in the floor of the completed extraction area to build up the final landform.</p> <p>The completed extraction area will be backfilled to approximately 64 m AHD with scalps, course rejects and soil.</p> <p>The slopes of the final landform will be constructed to meet the performance indicators.</p>	<p>Slope angles consistent with the Consent and the SWMP:</p> <ul style="list-style-type: none"> riverside batter: 1:5; extraction area: minimum 1:50 slope towards swale at base of riverside batter; and landward batter: maximum of 1:1, except where the batter is formed by the natural sandstone rock escarpment, which may be vertical in places. 	Landform completion survey to be completed prior to commencing extraction in a new phase.	<p>The Stage 8A–8C final landform is shown in Appendix C.</p> <p>Quarrying operations will not progress from one Phase of the quarry (see Table 1.1) to the next Phase if the final landform has not been established in the completed substages (ie excluding the Substage containing the active extraction area).</p>	Additional earthworks to form a final landform that meets the completion criteria.

Table 8.1 Landform establishment, stability and growth medium performance indicators and completion criteria

Objective	Completion criteria	Progressive rehabilitation	Performance indicator	Monitoring methods	Performance guidance	Corrective actions
Landform is stable in the Stage 8 extraction and restoration areas	Areas of active erosion are minimised.	Install erosion and sediment control measures as required (see Table 5.5).	No areas of active erosion as determined by: <ul style="list-style-type: none"> • no drills/gullies; • no sheet erosion present; and • no tunnel erosion present. 	Inspections of drainage, erosion and sediment control measures: <ul style="list-style-type: none"> • weekly during normal operations hours; • daily during periods of rainfall; and • within 12 hours of the cessation of a rainfall event (greater than 10 mm) causing runoff to occur on, or from, the quarry. <p>The following will be recorded</p> <ul style="list-style-type: none"> • active erosion; • number of rills/gullies; • cross-sectional area of rills/gullies; • presence/absence of sheet erosion; and • presence/absence of tunnel erosion. 	The landform and stability completion criteria in each completed extraction area should be progressively met prior to the re-establishment of vegetation to minimise disturbance to re-established vegetation.	Install additional erosion and sediment control measures with consideration of the maturity of re-established vegetation.
Soils in the biodiversity areas are capable of supporting River Flat Eucalypt Forest in the Stage 6 area, Stage 7 area and Stage 8 area (extraction and restoration)	Soils are a suitable growth medium for the establishment and growth of River Flat Eucalypt Forest (EHN526).	Apply woody debris and habitat materials (eg branches and leaves from cleared native vegetation).	Upper and lower range performance indicators to be determined during first round of monitoring based on measurements in comparable soil types supporting HN526.	Soil analysis at each vegetation plot once following establishment of the final landform: <ul style="list-style-type: none"> • pH; • electrical conductivity; • cation exchange capacity; • exchangeable sodium percentage; • organic matter; 	Soil testing frequency and analyses will need to be progressively refined based on the soil testing results and re-vegetation success.	Additional soil testing if vegetation establishment or growth is poor (see Table 8.2). Apply ameliorants if the soil testing results indicate that the soils are nutrient-deficient or erosion-prone. Ameliorants will be incorporated via contour scarification.

Table 8.1 Landform establishment, stability and growth medium performance indicators and completion criteria

Objective	Completion criteria	Progressive rehabilitation	Performance indicator	Monitoring methods	Performance guidance	Corrective actions
				<ul style="list-style-type: none"> • phosphorus and nitrate; and • magnesium and aluminium. 		

8.3.2 Biodiversity restoration and rehabilitation

Biodiversity objectives, performance indicators and completion criteria are provided in Appendix 6 of the Consent for the Stage 6 and Stage 7 areas (provided in Appendix G of this BRMP). These have been applied to the previously extracted areas (Domain 2).

Biodiversity objectives, performance indicators and completion criteria for the Stage 8 area are provided in Appendix 7 of the Consent (provided in Appendix H of this BRMP). These have been applied to the NRBZ and lower riverbank (Domain 3), extraction areas (Domain 4) and restoration area (Domain 5).

The rehabilitation indicators/criteria (from Consent Appendix 6) that are applicable to biodiversity post-quarrying land uses in Domains 2–5 are provided in Table 8.2. The corrective actions if the performance indicators are not met are provided in Table 8.2.

Appendices 6 and 7 of the Consent provides the following note regarding the tables:

Achieving biometric vegetation type (BVT) HN526 and/or plant community type (PCT) in the NSW Bionet Vegetation Information System (PCT835), can be used as a suitable surrogate for the EEC. BVT benchmarks are more specific (to vegetation type level, usually with lower and upper thresholds), whereas PCT benchmarks are to a broader vegetation class level (which is a grouping of similar vegetation types). For this reason, BVT benchmarks have generally been utilised in this table as being the best available.

The Completion Criteria column refers to the desired end goal, with the Performance Guidance column providing broad guidance on how the completion criteria should be interpreted in terms of producing future performance criteria within the Vegetation Management Plan, which is yet to be prepared. It is noted that the completion criteria and performance indicators provided below will need to be resolved with more specific performance criteria relevant to different areas of the site. For example, the Amended restoration area will contain a tree overstorey and thus the performance standard should be higher compared to the Amended extraction area where some time will be required for the tree overstorey cover to become established.

It is also noted that stochastic events such as flood or fire might affect the achievement of performance standards and criteria, and whilst the intent will still be to achieve restoration and rehabilitation of the River-flat Eucalypt Forest EEC in the long-term, such events will need to be taken into account on a case by case basis for specific performance standards.

The progressive rehabilitation performance measures in Table 8.2 include performance indicators for revegetation to maintain soil stability and the establishment and growth of River-flat Eucalypt Forest. Completion criteria that will be used to determine if sustainable high-quality River-flat Eucalypt Forest has been achieved are also provided in Table 8.2.

Table 8.2 Biodiversity rehabilitation and restoration – objectives, completion criteria, performance indicators and corrective actions

Objective ¹	Completion criteria	Progressive rehabilitation	Performance indicator	Monitoring methods	Performance guidance	Corrective actions
Vegetation established to stabilise soils in Stage 8 area substages that have been completed.	No completion criteria as this is a progressive objective to ensure that vegetation establishment works have occurred on completed substages before moving to a new extraction phase.	Vegetation established in the substages where extraction has been completed, prior to commencing extraction in substage in the next Phase. For example, vegetation has been established in the whole of the Substage 8A area (Phase 1) prior to extraction commencing in Substage 8C (Phase 2). Substage seeded or planted with native species from HN526 at one per square metre or greater. Or Planted with an initial cover crop prior to suitable seasonal conditions for native species seeding/planting.	Native species from HN526 at one per square metre or greater. Or Initial cover crop with 70% cover.	Annual 20 x 20 m floristic sampling plot undertaken in the completed substage area (see Section 8.4.1).	The progressive rehabilitation criteria should be met prior to commencing extraction in the next Phase.	Infilling seeding/planting in the completed substage area prior to extraction in the next Phase.

Table 8.2 Biodiversity rehabilitation and restoration – objectives, completion criteria, performance indicators and corrective actions

Objective ¹	Completion criteria	Progressive rehabilitation	Performance indicator	Monitoring methods	Performance guidance	Corrective actions
The vegetation composition in biodiversity areas ² is recognisable as River-flat Eucalypt Forest EEC.	Presence of a suitable number or proportion of species listed in Threatened Endangered Community (TEC) Final Determination. This is considered to be ≥24 species (see Table 5.1), across all monitoring plots, that are aligned with the species list in the Final Determination.	Native plant species are characteristic of River-flat Eucalypt Forest EEC as described in the Final Determination. <i>HN526 benchmark for native plant species richness is ≥24 species.</i> <i>It is noted that Eucalyptus botryoides x saligna is not listed in the River-flat Eucalypt Forest EEC Final Determination, but is to count as one species towards the benchmark value.</i>	Area seeded or planted ≥24 species (see Table 5.1) from HN526 benchmark.	Annual 20 x 20 m floristic sampling plot undertaken in each management zone (see Section 8.4.1).	The completion criteria should be met early (ie 5 years post-establishment), otherwise it is unlikely to be met in the long-term.	Plant additional species for any that are not growing adequately or that have died. This should be done as soon as possible (ie 2 years post-establishment).
The vegetation structure is recognisable as, or is trending towards, the target Biometric Vegetation Type (BVT) HN526, which provides a suitable surrogate for River-flat Eucalypt Forest EEC.	Total foliage cover of species allocated to Tree (TG) growth form is trending towards the benchmark range of 27.5–32.5. Total foliage cover of species allocated to Shrub (SG) growth form is trending towards the benchmark range of 21–31.	Increasing cover and abundance of plants characteristic of HN526.	Cover and abundance of plant growth forms are characteristic of, or are trending towards, the target BVT benchmarks, which are provided in the completion criteria.	Annual use of BAM where all flora species present in a 20 x 20 m plot are recorded, with foliage cover and abundance of each species (see Section 8.4.1).	Foliage cover of Tree (TG) growth form is trending towards target value. Foliage cover of Shrub (SG) growth form is trending towards target value.	If target value is not being met, increase species cover and abundance as early as possible (ie 2 years post-establishment). This will be achieved by planting or hydro-mulching depending upon conditions.

Table 8.2 Biodiversity rehabilitation and restoration – objectives, completion criteria, performance indicators and corrective actions

Objective ¹	Completion criteria	Progressive rehabilitation	Performance indicator	Monitoring methods	Performance guidance	Corrective actions
	Total foliage cover of species allocated to Grass and Grasslike (GG) growth form is trending towards the benchmark range of 24.45–30.45.				Foliage cover of Grass and Grass-like (GG) growth form is trending towards target value.	
	Total foliage cover of species allocated to Forb (FG) growth form is trending towards the benchmark range of 24.45–30.45.				Foliage cover of Forb (FG) growth form is trending towards target value.	
Levels of ecosystem function have been established that demonstrate that the vegetation is self-sustaining or is trending towards self-sustainability.	The cover and species richness of the groundcover, including grasses and forbs, is within the benchmark ranges.	Plant reproduction and regeneration.	The cover and species richness of the groundcover is stable or increasing. Evidence of plant reproduction and regeneration is present.	Annual monitoring of the ongoing persistence/increase of ground cover species (see Section 8.4.1).	An initial decline in species richness and cover may occur, however a stabilisation in observed cover and richness should be observed by 5 to 10 years post-establishment.	If a stabilisation in observed cover and richness is not observed by 5 to 7 years post-establishment, new species will need to be added by planting or hydro-mulching depending upon conditions.

Table 8.2 Biodiversity rehabilitation and restoration – objectives, completion criteria, performance indicators and corrective actions

Objective ¹	Completion criteria	Progressive rehabilitation	Performance indicator	Monitoring methods	Performance guidance	Corrective actions
	Second generation individuals of shrubs and trees are present.		Evidence of second generation individuals.	Annual observations of the presence of second-generation canopy species is evident within the rehabilitation domain (ie not limited to the plot, but present within rehabilitation of the same target community and age) (see Section 8.4.1).	The presence of second-generation trees and shrubs may not be evident for many years post-establishment. However, observations should start three years following the initial rehabilitation works.	No corrective actions required.
	Cover of ‘high threat exotic’ (HTE) and ‘priority weeds’ is no more than 2%.		Minimal weeds present and trend towards less weeds.	Annual data collected in accordance with BAM. Sum foliage cover of species identified as ‘high threat exotic’ under the BAM and ‘priority weeds’ as identified by the Local Land Services (LLS) in the relevant strategic weed management plan for the region (see Section 8.4.2).	Cover of HTE and priority weed species are declining towards target value. Given the very high weed loads it is expected that it will take some time for weed growth to be brought under control and will require ongoing maintenance.	The effectiveness of weed control will be assessed in the yearly progress reports. The reporter will suggest new weed control methods if necessary based on the current cover of HTE and priority weeds so that remediation works are progressing towards the target value.
	Litter cover is within the benchmark range. There is no biometric benchmark, and thus the BAM benchmark of 40 for PCT835 is adopted.		Woody debris has been applied in accordance with Consent condition B78.	Annual data collected in accordance with BAM via five 1 m ² subplots within the 20 m ² floristic plot (see Section 8.4.4).	Litter cover is increasing towards target value.	If litter cover is not increasing after 5–10 years post-establishment, additional canopy species will need to be planted.

1. The performance or completion criteria in this table do not apply to MZ7.3 or MZ8.4. These are additional areas to those required by the Consent and have been recommended to facilitate management within other management zones by reducing the spread of weed propagules.
2. Biodiversity areas: MZ7.1, MZ7.2, MZ8.1, MZ8.2 and MZ8.3.

The performance indicators will be refined and confirmed in subsequent updates this BRMP as the quarry progresses towards closure.

The areas that have been established with native vegetation will continue to be managed until the completion criteria have been met.

8.3.3 Progression into subsequent phases

The active extraction area will progress from north to south with the completed extraction areas being progressively rehabilitated. Extraction in each Phase will take between one and two years to complete before moving to the next Phase.

Quarrying operations will not progress from one Phase of the quarry (see Table 1.1) to the next Phase unless:

- the final landform has been created in the completed substages (ie excluding the Substage containing the active extraction area) (see Table 8.1); and
- vegetation has been established in the completed substages, or works have been undertaken to re-establish failed revegetation (see Table 8.2).

8.4 Rehabilitation and restoration monitoring

The progressive rehabilitation and restoration works require the establishment of River-flat Eucalypt Forest EEC community. The rehabilitation and biodiversity restoration monitoring is designed to measure rehabilitation and biodiversity trends and to identify when intervention is required.

Annual monitoring will consist of:

1. landform establishment and stability assessment (see Table 8.1);
2. growth medium development assessment (see Table 8.1);
3. floristic monitoring (see Section 8.4.1);
4. weed monitoring (see Section 8.4.2); and
5. nest-box and woody debris (see Sections 8.4.3 and 8.4.4).

A Rehabilitation and Restoration Site Annual Progress Report will be prepared that reports on each of these programs (see Section 8.6).

8.4.1 Floristic monitoring

Biodiversity restoration and rehabilitation outcomes will be monitored annually via the establishment of permanent 20 m by 20 m floristic plots quadrats in the restoration and rehabilitation areas to monitor:

- native species diversity;
- tree, shrub, grass, and forb diversity and abundance for both native and exotic species;
- litter cover within five 1 m² subplots within each 20 m by 20 m floristic plot;
- photographic monitoring points; and

- regeneration of overstorey species.

The monitoring methods for each of these aspects are described below.

The locations of the permanent plots are shown in Figure 6.1 (Stage 6), Figure 6.2 (Stage 7), and Figure 7.1 (Substages 8A–8C).

i Floristic plots

Permanent floristic plots will be marked using star pickets. A star picket will be installed on the middle of the eastern and western sides of 20 m by 20 m floristic plot (ie two star pickets). Star pickets will be 1.35-m long, driven approximately 0.15 m into the ground. Star pickets have three pieces of steel, with one side that is slightly longer. This longer side will be installed so that it points to the other star picket. A high visibility cap will be placed on top of each star picket.

Floristic plots would be conducted annually in accordance with the *Biodiversity Assessment Method (BAM)* (DPIE 2020) methods with the application of variations as listed in Table 8.3.

The information recorded for each floristic plot is described in Table 8.3. The plots will be recorded on a specifically-prepared in hardcopy or electronic form.

Table 8.3 Floristic plots – variations from the standard BAM method

Floristic plots	BAM method components that are modified/not required	Relevant completion criteria (see Table 8.2)	Comments
Basic site information	<ul style="list-style-type: none"> • Project name • Site name • PCT confidence • EEC confidence • Physiography and site features 	-	<ul style="list-style-type: none"> • PCT type and class to be based on site vegetation mapping. • Start and end photos will be taken in landscape mode. • High resolution photographs to be saved electronically. • Start and end photographs are to be taken from the middle of the eastern and western sides of the 20 m x 20 m plot. They must be taken consistently each year (Section 8.4.1ii). One litter subplot is to be located in the centre of the 20 m plot, and four litter subplots located 5m from two of the sides of the 20 m plot.

Table 8.3 Floristic plots – variations from the standard BAM method

Floristic plots	BAM method components that are modified/not required	Relevant completion criteria (see Table 8.2)	Comments
<p>The diagram shows a square plot with a side length of 20m. The top and bottom edges are labeled '20m'. The left and right edges are each divided into two 10m segments, with the right edge labeled '10m' on both sides. Two red dots on the left and right edges are labeled 'Star picket'. Inside the plot, five blue dots are arranged in a pentagonal pattern, labeled 'Litter subplots (5)'.</p>			
Flora species, cover & abundance	Don't record abundance.	Presence of a suitable number or proportion of species (≥ 24).	Record floristic species and cover for all species within the 20 m x 20 m plot, for both native and exotic species.
		Total foliage cover.	Calculate TG, SG and GG growth form cover scores from plot data.
		Cover and species richness of the groundcover is within the benchmark ranges	Determine if the cover and species richness of the groundcover, including grasses and forbs, is stable or increasing, and is within the benchmark ranges.
Tree regeneration	Score whether tree species are present or absent within each size class.	-	Score presence or absence within size classes diameter at breast height <5 cm, 5–9 cm, 10–19 cm, 20–29 cm, 30–49 cm, 50–79 cm and 80+ cm.
BAM attribute (20 x 50 m plot)	Not required.	-	-
BAM attribute (1 x 1 m plot)	Amended so that 1 x 1 m subplots are located within	Litter cover is within the	Litter subplots are located as identified under the basic site information.

Table 8.3 Floristic plots – variations from the standard BAM method

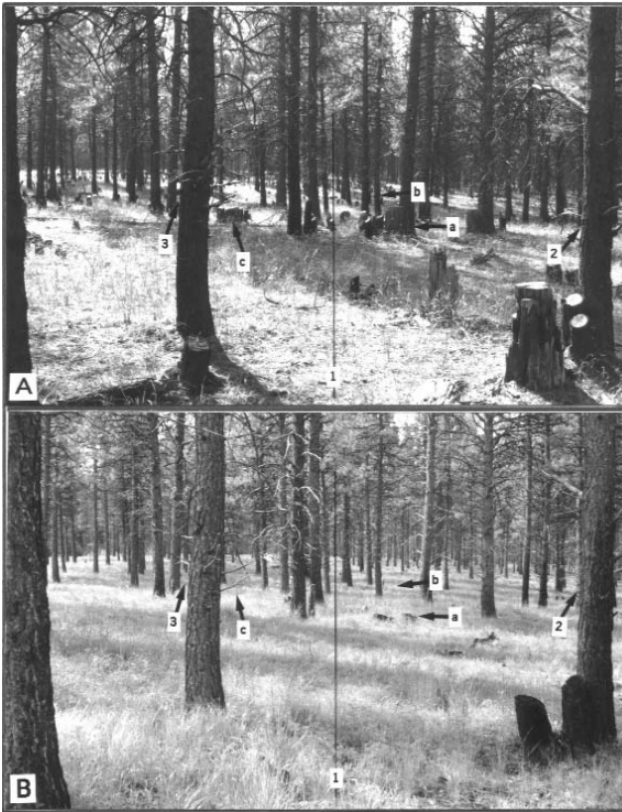
Floristic plots	BAM method components that are modified/not required	Relevant completion criteria (see Table 8.2)	Comments
	the 20 m floristic plot.	benchmark range.	
Evidence of plant reproduction and regeneration is present	Not part of BAM method.	Second generation individuals of shrubs and trees are present.	Record observations of second-generation plant individuals (ie seedlings or young plants) growing in rehabilitation or restoration areas, three years after initial rehabilitation works.

ii Photographic monitoring

Photographic monitoring points will be located at the two star pickets at each floristic plot (ie each floristic plot will have two photo monitoring points).

Monitoring photographs will be taken as follows. Facing the transect, the camera will be held so that the bottom of the star picket aligns with the bottom of the photo, and the top of the star picket aligns with the midline of the photo. This will require walking a 2-m distance from the star picket and angling the camera down. When the first photographs are taken, the exact locations of the star pickets will be recorded for subsequent use. The transect should be completely vertical in the photo. Vegetation immediately in front of the camera (ie within 0.20 m of the camera) can be moved to improve visibility. Examples of photographic monitoring points are provided in Figure 8.1.

The photographs taken during the first monitoring event will be printed and stored to assist with taking consistent photos in subsequent monitoring events.



Source: USDA (2002).

Figure 8.1 Examples of successful photographic monitoring points

Trees on the left and right side of Figure 8.1 show the boundary of the photograph. Features numbered 1, 2 and 3 are only visible when the photography is at the exact right distance, angle, and height. This requires printing off the initial monitoring point photo so that detail comparison can be made in the field. Note that trees marked a, b and c have clearly been removed, demonstrating that this method allows for effective comparison between photo points.

8.4.2 Weed mapping

The Rehabilitation Officer will map weeds within the rehabilitation and restoration areas as part of annual planning to create a strong focus on prevention, detection, and early intervention of weed infestation, as per the *Australian Weeds Strategy 2017–2027* (Invasive Plants and Animals Committee 2016).

Lantana and Privet are the primary target weeds within the Stage 8 area. These weeds will be mapped annually within the areas covered by this BRMP. Weed mapping will collect areal or point data, depending on the size of the weed infestation. The weed mapping methodology is set out in Table 8.4. Areas where the total weed cover comprises at least 10% of the area are considered to be ‘weed infested’. Hence, the entire quarry area could currently (April 2021) be mapped as a single weed unit. The weed mapping method is summarised in Table 8.4.

A ‘novel weed’ species is defined here as any exotic species not recorded in previous surveys of the area (previously recorded exotic species are listed in Table 4.1). Novel weed species will only be mapped if they are deemed to be serious weed invasions by the Rehabilitation Officer, in which case the species will be included in the annual weed mapping program.

Table 8.4 Weed mapping method

Details	Polygon records	Point records																				
Where	Selected locations within the restoration and rehabilitation areas in the Stage 6, 7 and 8 areas.																					
How to survey	Walk back and forth across the survey site at a spacing of 20 m, effectively creating parallel transects. The transects may need to be varied if weed density prevents access – these areas will be mapped. Use GPS to record tracks and to monitor that areas are not being missed.																					
When to use	For infestations of Lantana, Privet, or a novel weed species covering at least 25 m ²	For infestations of Lantana, Privet or a novel weed species covering 1 m ² to 25 m ² .																				
How to record	Walk the boundary of the infestation if possible. Otherwise, estimate the boundary, and choose 'estimated' from the Mapping Accuracy field.	Record the point from as close to the centre of the infestation as possible. Then estimate the amount of area covered by the weed infestation (0 to 25 m ²). Any signs of feral animals are to be recorded (sign and associated species).																				
When	Annual																					
Triggers for adaptive management	<ul style="list-style-type: none"> Total weed cover areas not decreasing by the amount specific in the progress goal. Novel weed species recorded. 																					
Annual weed report	<p>The annual weed report will provide:</p> <ul style="list-style-type: none"> A figure identifying all areas and point records of Lantana. A figure identifying all areas and point records of Privet. A separate figure identifying all areas and point records for each novel weed species (if required). A table identifying the total size of Lantana, Privet and any novel weed species populations each year, what percentage the population of each species has declined by, and whether this meets the annual review goals, for example: <table border="1" style="margin-left: 40px;"> <thead> <tr> <th></th> <th>Last year (area (ha))</th> <th>This year (area (ha))</th> <th>% change</th> <th>Requirement met? (y/n)</th> </tr> </thead> <tbody> <tr> <td>Lantana</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Privet</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>[List any novel weed species]</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Trigger for adaptive management is if area does not decrease according to the requirements.</p>			Last year (area (ha))	This year (area (ha))	% change	Requirement met? (y/n)	Lantana					Privet					[List any novel weed species]				
	Last year (area (ha))	This year (area (ha))	% change	Requirement met? (y/n)																		
Lantana																						
Privet																						
[List any novel weed species]																						
Evaluation and review	A review of the weed management program, including climatic factors, will be undertaken if annual goals are not met. This review will consider weed monitoring or control methods need to be revised.																					

The weed mapping will provide a yearly record of Lantana and Privet infestations in the restoration and rehabilitation areas. Data, such as other weed species present, will be recorded opportunistically. However, this additional data will not be reported in the annual progress goals except where a novel weed species are monitored.

In addition, floristic monitoring of permanent plots (see Section 8.4.1) will record weed species and allow trends for weeds other than Lantana and Privet to be determined and inform the need for additional weed control.

8.4.3 Nest-box monitoring

The nest boxes will be checked following significant weather events by the Rehabilitation Officer to ensure that they are present and remain suitable for use by the target species.

Once per year, a representative sample of nest boxes will be visually monitored from the ground for recent signs of habitation (eg animal sightings). If recent habitation is not evident, a hand-held pole mounted camera and/or remote monitoring cameras will be used to inspect inside the nest box. The performance indicator for nest boxes is 95% or more of the nest boxes should be functional.

Boxes occupied by beehives or ant nests; boxes missing lids, sides or floors; and boxes that are no longer mounted on trees will be treated as non-functional. To remediate non-functional nest boxes insects should be cleared out (including moving boxes if necessary). Broken, damaged or missing boxes will be replaced. Non-functional nest boxes should be replaced within 6 months of identification.

A nest-box and woody debris report, detailing the nest box monitoring results, will be included in the Rehabilitation and Restoration Site Annual Progress Report (see Section 8.8.2).

8.4.4 Post-placement woody debris survey

The length of woody debris (with diameters of 0.1–0.5 m and >0.5 m) placed within each rehabilitation area will be determined by the Rehabilitation Officer as part of a post-placement woody debris survey will be undertaken once the placement of the required length of woody debris is believed to have been completed.

The length of woody debris within a 20 m by 20 m plot will be quantified in accordance with the recognised method detailed in *Biodiversity Assessment Method 2020 Operation Manual Stage 1* (DPIE 2020). The assessment will be conducted by measuring the length of all placed woody logs and other coarse woody debris in the plot. The measured plot will then be visually compared with the amount of woody debris in the whole of the rehabilitation area to ensure that the length of woody debris within the rehabilitation area meets the requirements of Consent Condition B78. Photographs of debris density will be taken of the plot and the wider rehabilitation areas. If the length of woody debris in a rehabilitated substage does not meet the requirements specified in Consent Condition B78, additional woody debris will be placed in the area so that the requirements are met. The woody debris will be sourced from trees cleared ahead of the active extraction area.

A nest-box and woody debris report, detailing the results of the progressive post-placement woody debris surveys, will be included in the Rehabilitation and Restoration Site Annual Progress Report (see Section 8.8.2).

8.5 Frequency of monitoring

Rehabilitation and biodiversity monitoring will be undertaken annually during operations until completion criteria have been met. The rehabilitation and restoration monitoring schedule is provided in Table 8.5. This table will be revised when the BRMP is revised to address extraction in Substages 8D and beyond.

The monitoring program schedule may be updated based on the rate of progression of the quarry from one substage to the next. For example, monitoring of rehabilitation in Stage 8C will not be started in Year 4 if excavation (and hence vegetation clearing) is in Stage 8C delayed and does not occur in Year 3.

In addition to the formal rehabilitation monitoring program, the quarry's full-time Rehabilitation Officer will frequently inspect all of the areas addressed by this BRMP.

Table 8.5 Annual rehabilitation and restoration monitoring summary and schedule

Stage	Area (ha)	Number of plots	Year											
			1	2	3	4	5	6	7	8	9	10	10+	
Floristic monitoring														
6	2.13	Rehabilitation	2	2	-	2	Continue monitoring until completion criteria are met							
7	4.95	Rehabilitation following quarry closure												
8A	0.93	Extraction/rehabilitation	1	1	1	1	1	Continue monitoring until completion criteria are met						
8B	0.93	-	Extraction/rehabilitation	1	1	1	1	1	Continue monitoring until completion criteria are met					
8C	0.69	-	-	Extraction/rehabilitation	1	1	1	1	1	Continue monitoring until completion criteria are met				
Restoration area 1 ¹	2.73	Restoration works	3	3	3	3	3	Continue monitoring until completion criteria are met						
8D–8M ²	~1 each	-	-	-	Extraction/rehabilitation	Schedule to be determined ²								
Restoration area 2–7 ^{1,2}	12.09	-	-	Restoration works	Schedule to be determined ²									
Landform establishment, stability and growth medium development	0.93–2.82	✓	✓	✓	✓	✓	✓	Continue monitoring until growth medium development and stability criteria have been met.						

Table 8.5 Annual rehabilitation and restoration monitoring summary and schedule

Stage	Area (ha)	Number of plots											
Weeds	Varying	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nest box/woody debris	14.82 ³	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	-	0	6	7	6	8	6	2 + TBD⁴	1 + TBD⁴	TBD⁴	TBD⁴	TBD⁴	TBD⁴

1. See Table B.2 and Figure B.1 in the *Biodiversity Offset Strategy* (Appendix B).
2. To be addressed in revised BRMP addressing Substages 8D and beyond.
3. And any nest-boxes placed in the NRBZ.
4. Plus Substages 8D–8M and Restoration areas 2–7 monitoring – to be determined (TBD).

8.6 Observations and inspections

The quarry employs 16 people. Employees will be required to report incidental observations relevant to the successful implementation of this BRMP in the Environmental Incident and Action Register (see Section 8.3.4 of the *Environmental Management System*).

Three quarry employees will regularly work in the Stage 8 area, the excavator operator, the haul truck driver and the Rehabilitation Officer. These employees will be highly familiar with the Stage 8 area and will report incidental observations relevant to the successful implementation of this BRMP in the Environmental Incident and Action Register.

The Rehabilitation Officer will undertake weekly inspections including:

- evidence that extraction has occurred outside of the pegged and flagged extraction area;
- evidence of unauthorised access to property (eg damaged fencing, litter, vandalism);
- evidence of pests;
- any new/unrecorded erosion or sedimentation;
- weed regeneration/re-introduction to areas where weed control has been applied;
- rehabilitation trials progress; and
- germination, health and vigour of vegetation under management.

8.7 Corrective actions

The formal monitoring described in Section 8 of this BRMP will assess the success of rehabilitation against performance indicators and eventually completion criteria. This will be supplemented at shorter timescales by observations and weekly inspections. The findings will guide the management of rehabilitation and restoration maintenance works, identifying successful methods, identifying opportunities for improvements and where corrective actions are required. Corrective actions are identified in the rehabilitation and restoration trigger action and response plan provided in Table 8.6.

A specific flood event trigger, action and response plan is provided in Section 5.4.3.

Table 8.6 Rehabilitation and restoration TARP

Trigger	Action required	Timing	Follow-up actions
Controlling threats			
Livestock incursions, or evidence thereof (trampling, grazing, scats) Undesirable access to the property by people, or evidence thereof (litter, vandalism).	Ongoing incidental observations.	Ongoing	Repair damage; inspect and repair fence-lines. Reseed, replant tube stock as required.
Increased feral sightings within Stage 8 area.	Ongoing incidental observations.	Ongoing	Baiting and trapping programs, if there is an increasing trend in feral animal sightings.
Bushfire within Stage 8 area.	Bushfire hazards are managed. Control uncontrolled burns on site as soon as possible.	Incident based	If a fire occurs: <ul style="list-style-type: none"> investigate cause of burn and if any preventative measures can be taken; review erosion and sediment control measures in the burn area; observe recovery of vegetation; and undertake additional seeding/in-fill planting as required.
Active rill, gully or tunnel erosion occurring.	Drainage, erosion and sediment control inspections (see SWMP Chapter 8).	Weekly inspections (see SWMP Section 8.2)	Ameliorate to stop erosion as per methods in the SWMP.
Habitat enhancement			
Nest boxes are missing or are not suitable for use by the target species (see BRMP Table 7.2).	Install 106 nest boxes (see Section 7.5.1). Inspect and maintain nest boxes.	Install nest boxes prior to extraction in the Stage 8 area. Check nest boxes following significant weather events. Annual monitoring (see Section 8.4.3).	Repair damaged nest boxes. Install the deficit number of nest boxes.

Table 8.6 Rehabilitation and restoration TARP

Trigger	Action required	Timing	Follow-up actions
<p>Woody debris is not installed in accordance with Consent Condition B78:</p> <ul style="list-style-type: none"> at least 400 m/ha of woody debris (ie. logs > 10 cm diameter, >0.5 m long); and at least 100 m/ha of large woody debris (ie. logs >50cm diameter, >0.5 m long). 	<p>Woody debris will be placed over the ground in rehabilitation areas and pressed in or tracked-rolled to ensure intimate contact with soil to minimise the potential for erosion under the woody debris (see Section 7.5.2).</p>	<p>A post-placement woody debris survey will be undertaken in the completed extraction area once the placement of the required length of woody debris is believed to have been completed (see Section 8.4.4).</p>	<p>Install the deficit amount of woody debris.</p>
Landform establishment, stability and growth medium performance			
See Table 8.1			
Biodiversity rehabilitation and restoration			
See Table 8.2			

8.8 Reporting

Data management and reporting requirements are described below.

8.8.1 Records

Monitoring data will be collected and stored electronically as far as possible. Electronic forms will be prepared to record the monitoring data as described above.

Some data (photographic monitoring points) will be collected with a digital camera. Each photo will be labelled and stored in a secure location.

Recorded information will include:

- the data and location/s of management actions;
- whether the relevant management action has been met or not;
- the name of the person who carried out the action; and
- details about the management action performed.

All information/data will be kept in a legible form. All information/data (including photographs) will be kept for at least 10 years after the event to which they relate took place, unless specified otherwise.

Menangle Sand and Soil will produce any records required to be kept by the Consent conditions to the Minister, the Minister's Representative, or any Authorised Officer on request by the Minister, the Minister's Representative or an Authorised Officer.

8.8.2 Rehabilitation and Restoration Site Annual Progress Report

A Rehabilitation and Restoration Site Annual Progress Report will be prepared that consists of the following:

1. landform establishment and stability assessment (see Table 8.1);
2. growth medium development assessment (see Table 8.1);
3. floristic monitoring report (see Section 8.4.1);
4. weed monitoring report (see Section 8.4.2); and
5. nest-box and woody debris report (see Sections 8.4.3 and 8.4.4).

Each of these reports will summarise:

- the measures taken in the preceding 12 months;
- monitoring results;
- progress against the detailed performance and completion criteria;
- report on the effectiveness of the measures;

- any annual trends based on previous annual reports;
- any progressive improvements that could be implemented to improve biodiversity outcomes; and
- the measures that will be taken in the next 12 months, including any required additional or remedial actions.

8.8.3 Annual Review report (including evaluation and improvements)

A summary of the Rehabilitation and Restoration Site Annual Progress Report will be provided in the Annual Review.

Menangle Sand and Soil will complete and submit an Annual Review report to DPE for by the end of March each year (see Section 7.2 of the *Menangle Sand and Soil Quarry Environmental Management Strategy*). The rehabilitation and restoration activities, monitoring results and progress towards achieving the completion criteria will be reported in the Annual Review.

8.9 Independent audits

As described in Section 6.3 of the Menangle Sand and Soil *Environmental Management System*, the quarry will be subject to internal audits and external audits. An independent environmental audit will be conducted within one year of the commencement of quarrying operations in the Stage 8 Area and every three years thereafter, unless the Planning Secretary directs otherwise. These audits will assess the implementation of this BRMP and the reporting in the Annual Review.

Annually, an ecologist will audit the monitoring described in this BRMP, either as part of the annual floristic monitoring program or as a separate activity. This will consist of auditing the results of monitoring of:

- landform establishment and stability assessment;
- growth medium development;
- weeds; and
- nest-box and woody debris.

8.10 Document review

This BRMP will be subject to ongoing review and continual improvement as described in Chapter 9 of the Environmental Management Strategy. It will be updated to the Planning Secretary's satisfaction prior to the commencement of quarry operations in Substage 8D (Phase 3).

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Appendix A

Native Vegetation Identification Report: Substages 8A–8C

A.1 Introduction

Under Consent Condition A10, the applicant is required to prepare a Native Vegetation Identification Report.

The purpose of the report is to identify the extent of the Nepean River Buffer Zone to be applied during Quarrying Operations in the Stage 8 Area. This report applies to quarry Substages 8A–8C.

The Nepean River Buffer Zone is minimum horizontal setback of 10 m extending landward from the 64 m AHD contour on the western side of the Nepean River, which will not be subject to extraction. It also includes further setback where required, based on the presence of native trees with a diameter at breast height (DBH) of greater than or equal to 0.1 m (referred to as ‘Protected Trees’) within this zone. Where Protected Trees are present, a setback of 7.5 m from the outside of the native tree trunk is applied, unless a variation is sought supported by a report from a consulting arborist.

This report has been prepared by Dr Steven Ward, an ecologist whose appointment has been endorsed by the Planning Secretary (as required under Consent Condition A10b(i)).

A.2 Method

John M. Daly & Associates Pty Ltd (JMD), surveyors, located the 64 m AHD contour on the western side of the Nepean River for extraction Substages 8A–8C, and the minimum horizontal setback of 10 m extending landward from the 64 m AHD contour. They also located native trees present within the minimum horizontal setback area with a DBH of greater than or equal to 0.1 m.

Subsequently, ecologists Dr Steven Ward and Ryl Parker undertook survey on 21 December 2020 to locate native trees identified on the JMD draft survey plan dated 8 December 2020, within the minimum horizontal setback with a DBH ≥ 0.1 m. Once located, trees were marked by spray-paint and flagging tape, recorded the species and DBH, and a photograph was taken. The live native trees within the minimum horizontal setback were identified as Protected Trees.

Trees identified by the surveyors which were identified as exotic, and not required to be retained, were marked by the ecologists with spray-paint as “Ex” (to denote that they are exotic).

JMD were provided with the list of Protected Trees. This list was used to identify the required 7.5-m setback from the outside edge of the tree trunk of each Protected Tree. No variation to the setback is sought for any identified Protected Trees within Substages 8A–8C (Phases 1–2).

The data files required under Consent condition A10(b) and associated final landform plans will be submitted to the Planning Secretary for Phases 1–2 following approval of this BRMP.

This Native Vegetation Identification Report will be updated for Phases 3 and beyond, prior to commencing any vegetation clearing or quarrying operations in the relevant phase.

A.3 Results

A total of 20 native Protected Trees were recorded within the minimum horizontal setback (Table A.1). An additional four stags (dead trees) or stumps were identified. These have not been denoted as Protected Trees as they are dead. In addition, four trees were identified by the ecologists as being exotic species. The GPS coordinates of each protected tree are presented in Table A.2.

Figure A.1 presents the mapped setback and all Protected Trees.

Table A.1 Protected trees

Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
1	<i>Casuarina cunninghamiana</i>	81	Yes	Tree appeared to be distorted at the base	
2	<i>Casuarina cunninghamiana</i>	79	Yes	-	
3	<i>Melaleuca armillaris</i>	19	Yes	-	See photograph for tree #2 (to left rear of photo).

Table A.1 Protected trees

Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
4	<i>Casuarina cunninghamiana</i>	59	Yes	-	
5	<i>Casuarina cunninghamiana</i>	57	Yes	-	

Table A.1 **Protected trees**

Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
6	<i>Eucalyptus saligna x botryoides</i>	61.5	Yes	-	
7	Stag (<i>Eucalyptus saligna x botryoides</i>)	47	No	Not a protected tree as it is dead (a stag)	

Table A.1 Protected trees


Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
8	<i>Eucalyptus saligna x botryoides</i>	91	Yes	First of two trees right next to each other (trunks touching)	
9	<i>Eucalyptus saligna x botryoides</i>	110	Yes	Second of two trees right next to each other (trunks touching). DBH was only estimated as could not reach around the tree due to thick material pressing against the tree trunk.	See photograph for tree #8.

Table A.1 Protected trees



Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
10	<i>Eucalyptus saligna x botryoides</i>	94	Yes	-	
11	<i>Eucalyptus saligna x botryoides</i>	100	Yes	DBH is an estimate only due to thick cover of lantana around the tree trunk.	
12	Stag (<i>Eucalyptus saligna x botryoides</i>)	70	No	Not a protected tree as it is dead (a stag). DBH is an estimate only due to thick cover of lantana around the tree trunk.	Photograph not taken (accidentally omitted)

Table A.1 **Protected trees**

Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
13	<i>Eucalyptus saligna x botryoides</i>	110	Yes	-	
14	<i>Eucalyptus saligna x botryoides</i>	113	Yes	-	

Table A.1 **Protected trees**



Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
15	Stump	51	No	Not a protected tree as it is dead. Stump approximately 4 m in height.	
16	<i>Eucalyptus saligna x botryoides</i>	95	Yes	-	
17	<i>Eucalyptus saligna x botryoides</i>	98	Yes	-	Photograph not taken (accidentally omitted)

Table A.1 Protected trees



Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
18	<i>Eucalyptus saligna x botryoides</i>	79	Yes	-	
19	<i>Eucalyptus saligna x botryoides</i>	97	Yes	-	
20	<i>Eucalyptus saligna x botryoides</i>	102	Yes	-	See photograph for tree #19.

Table A.1 **Protected trees**

Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
21	<i>Eucalyptus saligna x botryoides</i>	99	Yes	-	
22	Stump	73	No	Not a protected tree as it is dead. Stump approximately 4 m in height.	

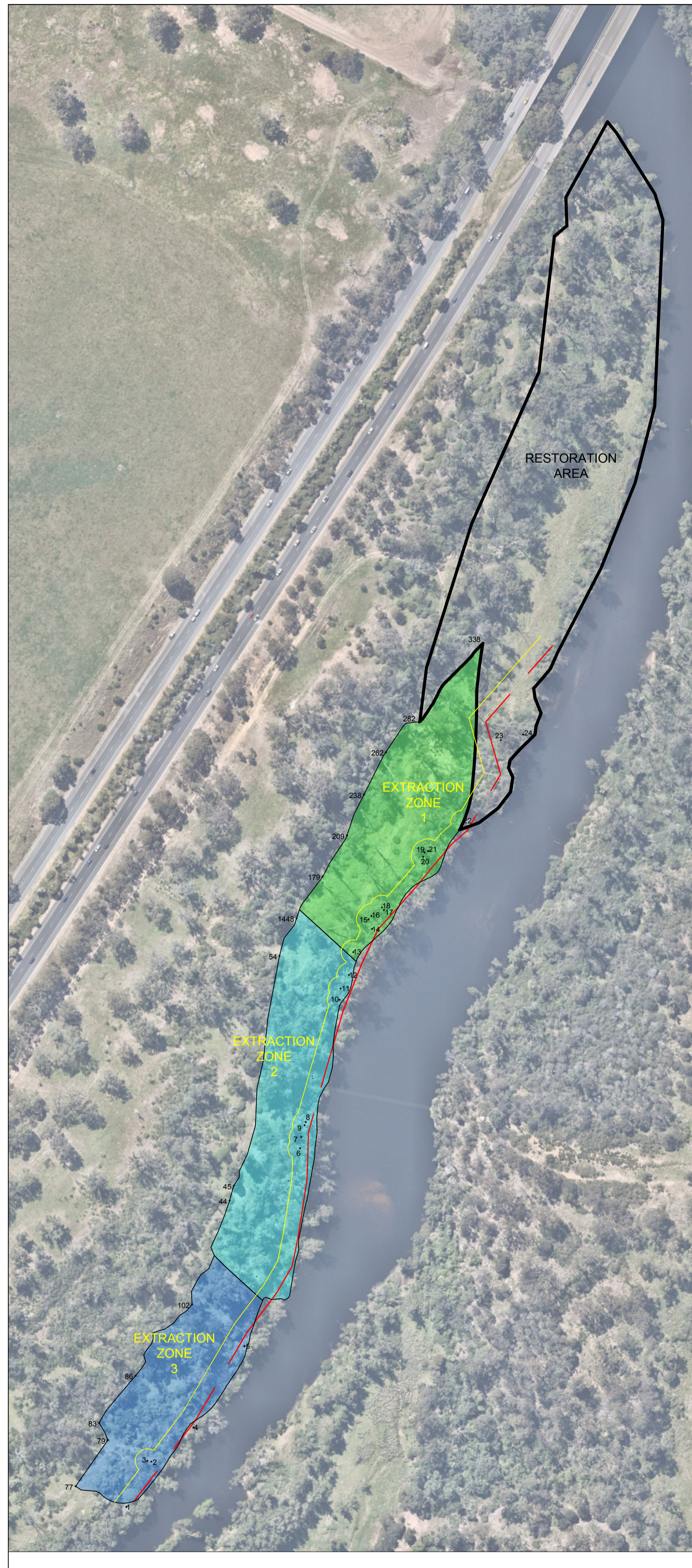
Table A.1 Protected trees

Tree No.	Species	DBH (cm)	Protected Tree	Comments	Photograph
23	<i>Eucalyptus saligna x botryoides</i>	130	Yes	-	
24	<i>Casuarina cunninghamiana</i>	75	Yes	-	Photograph not taken (accidentally omitted)

Table A.2 **Menangle Quarry – tree coordinates**

Tree	Easting	Northing
1*	292735	6221235
2	292752	6221265
3	292749	6221266
4*	292780	6221288
5	292813	6221341
6	292850	6221472
7	292851	6221479
8	292854	6221489
9	292853	6221487
10	292876	6221570
11	292877	6221577
12	292882	6221586
13	292885	6221601
14	292897	6221616
16	292897	6221625
17	292905	6221629
18	292904	6221631
19	292932	6221667
19	292895	6221623
20	292931	6221664
21	292934	6221668
22	292957	6221687
23*	292982	6221741
24*	292997	6221745

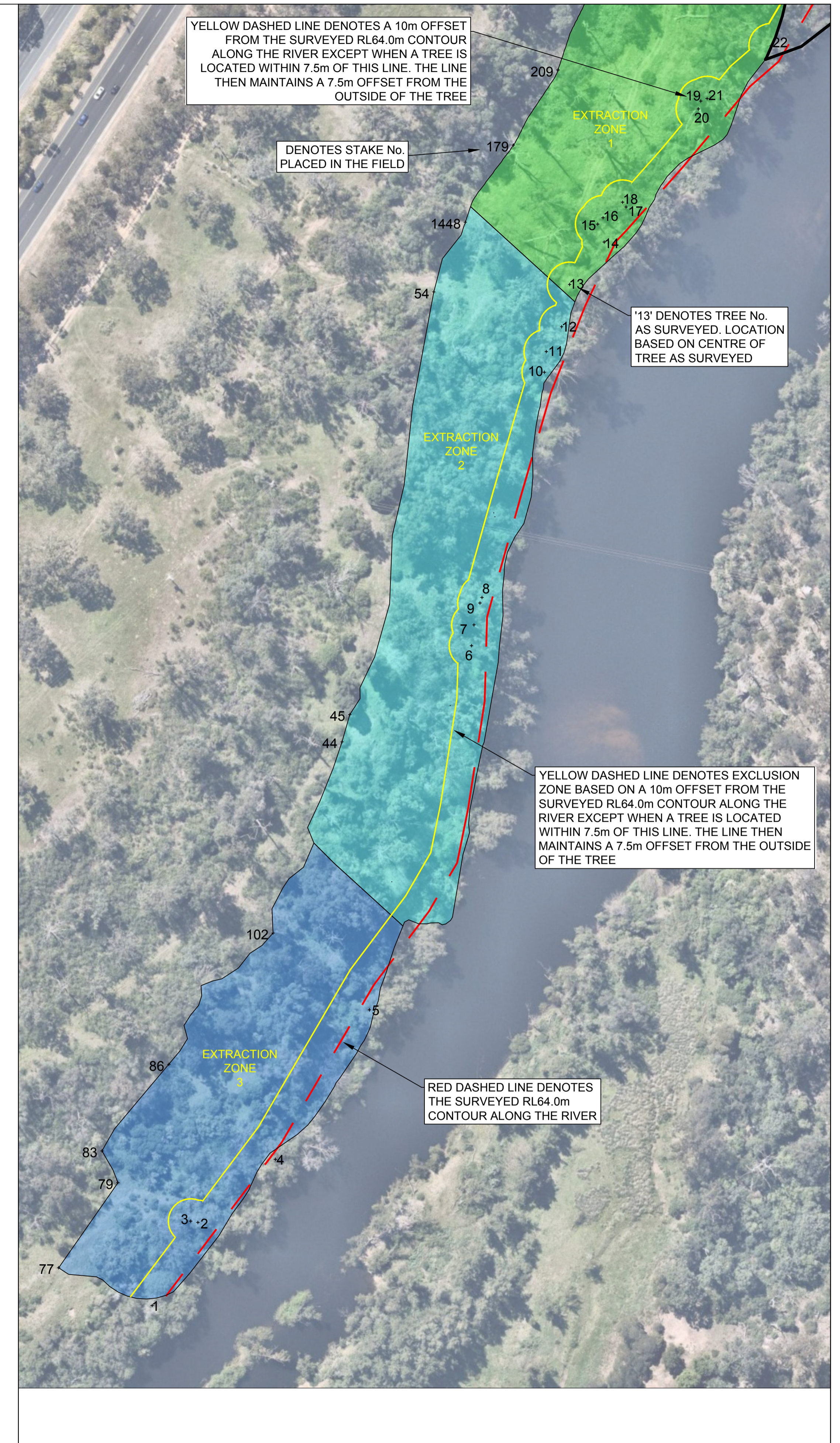
* Tree outside NRBZ.



OVERALL PLAN
1:2000



NORTHERN AREA
1:1000



SOUTHERN AREA
1:1000

MENANGLE - SKETCH OF SETOUT WORKS COMPLETED BY JMD

CLIENT: BENEDICT INDUSTRIES
DATE: 13-01-2021
ISSUE: E

Appendix B

Biodiversity Offset Strategy – Substages 8A–8C

B.1 Biodiversity offset strategy – overview

The following broad actions are proposed as the biodiversity offsets for vegetation clearing associated with extraction in the Stage 8 area, as per the Consent conditions:

- removal of approval to quarry in the Stage 3 area (5.68 ha);
- Stage 6 vegetated area additional management (1.22 ha);
- Stage 7 vegetated area additional management (3.44 ha); and
- Stage 8 management of amended restoration area (14.85 ha of River-flat Eucalypt Forest).

The areas subject to ecological management measures under this BRMP are summarised in Table B.1.

Calculations of clearing in the Stage 8 extraction area in the *Supplementary Biodiversity Assessment* (EMM 2019) conservatively assumed that the Nepean River Buffer Zone would be cleared as the extent of this area had not been accurately surveyed. The detailed survey of the Nepean River Buffer Zone provided in the *Native Vegetation Report Survey* (Appendix A of this BRMP) identified that the Nepean River Buffer Zone in Sub-stages 8A–8C will be 1.38 ha. As a result, area to be cleared with the extraction area will be 1.29 ha less than previously assessed.

In addition, there will be an overall increase in the area to be subject to positive ecological management by 2.46 ha (Table B.1) due to the increased Stage 6, Stage 7 and additional area within the Nepean River Buffer Zone.

Offsets are not proposed for linear infrastructure with Substages 8A–8C as it is proposed to utilise current tracks within the site.

If the Restoration Area does not meet the listing criteria of the targeted communities or the completion criteria in Appendix 7 of the Consent (provided in Appendix H of this BRMP), within the timeframes established in this BRMP, then Menangle Sand and Soil will retire the relevant deficient biodiversity credits in accordance with the Biodiversity Offsets Scheme of the BC Act, to the satisfaction of the Biodiversity Conservation Trust.

Table B.1 Summary of biodiversity outcomes and changes

Region	Management Zones	Amount as originally assessed under the Supplementary Biodiversity Report (EMM 2019) (ha)	Proposed under the BRMP (ha)	Change in area (ha)	Reason for changes
Impact Area					
Extraction area (Domain 4)	MZ8.1	13.22 (total area) 11.00 (River-flat Eucalypt Forest vegetation)	12.56 (total area) 10.36 (River-flat Eucalypt Forest vegetation)	Decrease of 1.38 ha (total area) Decrease of 0.64 ha in River-flat Eucalypt Forest vegetation cleared	Decrease due to Nepean River buffer zone reducing area that can be extracted. Noting that the Nepean River Buffer Zone has not yet been surveyed for future Substage 8D–8M.
Positive Ecological Management Areas					
Surrender of Stage 3 consent	-	5.68	5.68	0	-
Stage 6 vegetated area (Domain 2)	MZ6.1 – MZ6.3	1.22	2.13	Increase of 0.91 ha	Increase in area subject to positive management.
Stage 7 vegetated area (Domain 2)	MZ7.1 – MZ7.2	3.44	4.95	Increase of 1.51 ha	Increase in area subject to positive management.
Nepean River Buffer zone / Lower riverbank (Domain 3)	MZ8.2	0.68	0.96	Increase of 0.28 ha	Increase of Nepean River Buffer Zone due to survey.
<i>Total</i>				<i>Increase in total area managed for positive ecological outcomes of 2.70 ha</i>	
Biodiversity Offset (Restoration) Management Areas					
Stage 8 restoration area (Domain 5 and track within restoration area substages 3 and 6 proposed to be rehabilitated)	MZ8.3	14.85	14.82	Decrease of 0.03 ha	Changes due to boundary adjusted to follow cadastre boundary adjacent to Hume Motorway bridge, plus more detailed mapping of access tracks.
Summary of outcomes	Decrease in area of River-flat Eucalypt Forest to be cleared of 0.64 ha. Increase in total area managed for positive ecological outcomes of 2.70 ha. Slight decrease of 0.03 ha of biodiversity offset area, which is more than offset by the much larger decrease in River-flat Eucalypt Forest clearing, and increase in the total area managed for positive ecological outcomes.			Increases in areas proposed for management within Stage 6, Stage 7 and Stage 8 Nepean River Buffer zone	

B.1.1 Staging of offsets

As the extraction works are proposed to be undertaken in a staged manner, it is proposed to undertake staged restoration works. This is required due to the extremely high weed loads, with stripped weedy topsoil progressively placed at the base of extraction area. Areas where extraction has been completed that are available for weedy topsoil disposal will become available progressively.

The location of proposed extraction area and restoration area substages are shown in Figure B.1. The correlation between proposed extraction area and restoration area substages is provided in Table B.2. The progressive percentage of restoration area will remain similar to the progressive percentage of area cleared, with the total proportion of restoration undertaken generally in excess of the total percentage of loss of River-flat Eucalypt Forest as extraction substages progress.

The relative proportion of the total amount of restoration offset associated with Restoration Stages 1–3 will be in excess of the proportional removal of River-flat Eucalypt Forest. The progression of Restoration Stages 4–6 may lag the progression of clearing. However, the amount of clearing will be updated once the Nepean River Buffer zone is surveyed and accurately quantified for Substages 8D–8M. Thus, the staging of offsets beyond Stage 1 (for Substages 8A–8C) should be considered to be indicative, and subject to revision as quarrying progresses and this BRMP and biodiversity offset strategy are revised.

In addition to the management of the restoration areas, the following additional positive ecological works will be undertaken on the following timeframes:

- removal of approval to quarry in the Stage 3 area (5.68 ha) – completed;
- Stage 6 vegetated area additional management (2.13 ha) – commence immediately when the BRMP is approved; and
- Stage 7 vegetated area additional management (4.95 ha) – commence immediately when the BRMP is approved.

Table B.2 Proposed restoration staging in relation to extraction substages

Restoration Stage	Restoration area (ha)	Percentage of restoration undertaken	Total percentage of restoration undertaken	Associated extraction substages	Extraction area of RFEF removed (ha) as assessed during MOD1 determination (EMM 2019a)	Revised extraction area of RFEF removed (ha)	Percentage loss of RFEF from that extraction substage group	Total percentage loss of RFEF undertaken	Difference between progressive total percentage of restoration and extraction
1	2.73	18.6%	18.6%	8A–8C	0.73	1.70	16.4%	16.4%	2.2%
2	3.67	25.0%	43.6%	8D–8F	1.3	2.03	19.6%	36.0%	7.6%
3	2.96	19.6%	63.2%	8G–8H	1.03	1.85	17.8%	53.8%	9.4%
4	0.90	6.1%	69.3%	8I–8J	0.97	1.86	17.9%	71.7%	-2.4%
5	1.08	7.3%	76.6%	8K	1.07	1.07	10.3%	82.0%	-5.4%
6	1.36	9.2%	85.8%	8L	0.96	0.96	9.2%	91.3%	-5.5%
7	2.12	14.3%	100.0%	8M	0.91	0.91	8.7%	100.0%	0.1%
<i>Total</i>	<i>14.82</i>	<i>100.0%</i>			<i>11</i>	<i>10.36</i>	<i>100.0%</i>		

REEF: River-flat Eucalypt Forest.

B.1.2 Positive covenant

It is proposed that positive covenant(s) under section 88E of the NSW *Conveyancing Act 1919* will be established for the biodiversity offset/restoration areas. The positive covenant will be in place prior to commencement of quarrying operations in Stage 8 or within another timeframe agreed by the Planning Secretary (as per Consent Condition B67). If a covenant(s) is not used, other suitable arrangements for the long-term protection of the restoration area will be agreed with the Planning Secretary.

It is proposed that the positive covenant will:

- Stipulate that the restoration area (Domain 5) and all rehabilitated substages of the extraction area (Domain 4) will be managed in accordance with the measures set out in this document.
- Establish a trust with sufficient funds to provide for the ongoing management of the restoration area in accordance with the measures set out in this BRMP. The value of the trust will be calculated in accordance with the total fund deposit requirements for a biodiversity stewardship site, in accordance with BC Act.

The trust may include sufficient funds to provide for the ongoing management of the rehabilitated substages in accordance with the measures set out in this BRMP as an alternative to the Rehabilitation Bond (see Consent conditions B83 to B87).

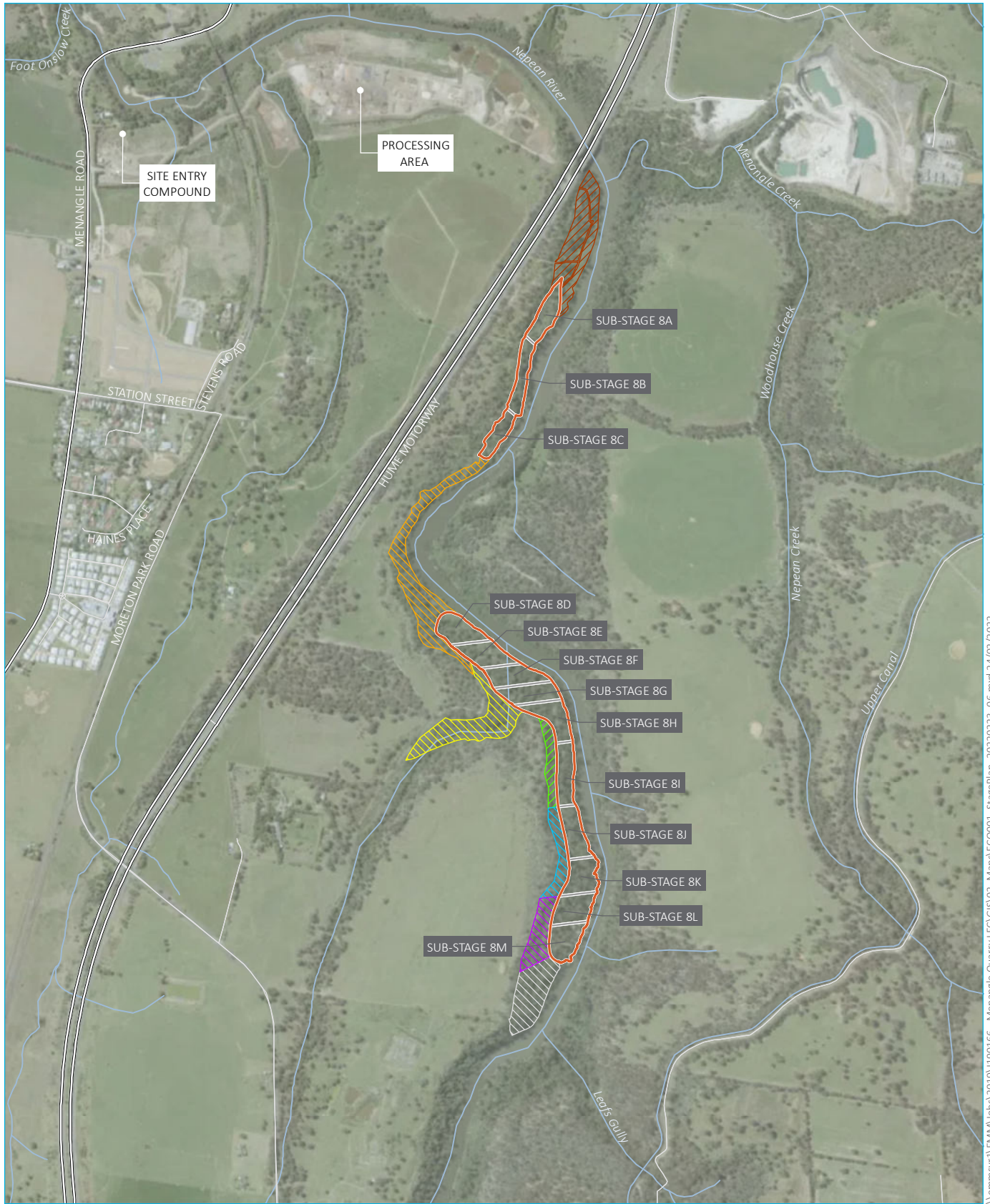
This version of the BRMP applies to substages 8A–8C. Therefore, whilst the covenant may either be implemented across only extraction substages 8A–8C, or, if implemented across all extraction and restoration areas the amount put into the trust fund is to be reflective of the works required across extraction substages 8A–8C and the associated restoration substages.

If a positive covenant is established, then under Consent Condition B88, the Planning Secretary may waive the requirement for all or part of the Rehabilitation Bond required under Consent conditions B83 to B87.

Menangle Sand and Soil will consult with DPIE regarding the proposed approach to the long-term protection of the restoration area and rehabilitated substages, culminating in a request to the Planning Secretary for approval of the proposed approach.

B.2 Process for update of the biodiversity offset strategy

As the substage areas will be subject to change, in particular for the Nepean River buffer zone, it is proposed that the Biodiversity Offset Strategy is reviewed within each revised BRMP that is to be completed and approved prior to the extraction in substages 8D and beyond.



Source: EMM (2022); Metromap (2022); DFSI (2017)

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KEY

- | | |
|--|------------------------|
| Stage 8 - extraction/rehabilitation area | Restoration stage area |
| Substage boundary | 1 |
| Main road | 2 |
| Local road | 3 |
| Watercourse/drainage line | 4 |
| | 5 |
| | 6 |
| | 7 |

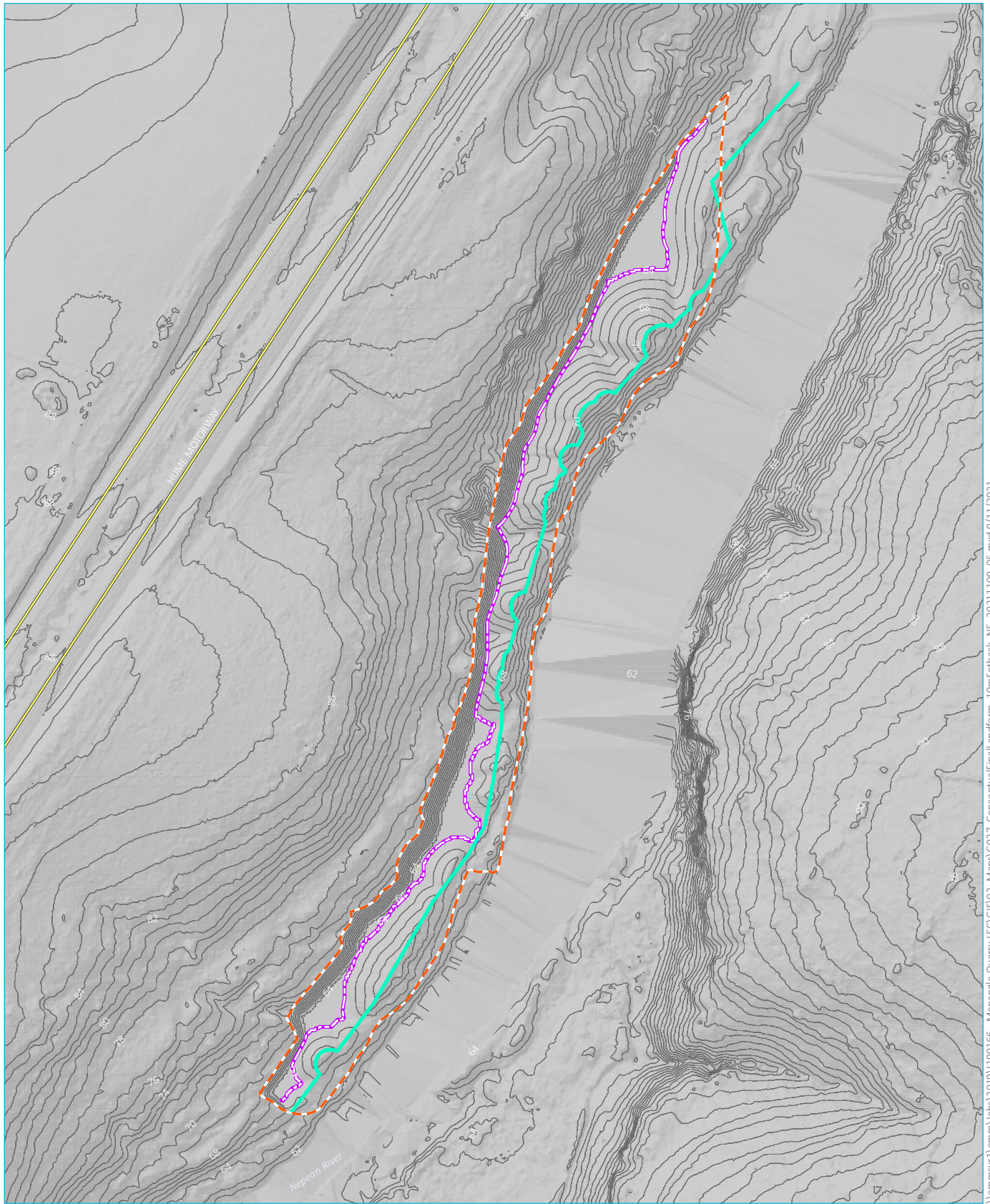
Overall staging and restoration plan

Menangle Sand and Soil Quarry
Biodiversity and Rehabilitation Management Plan
Figure B.1



Appendix C

Final landform



Source: EMM (2020); DFSI (2017); ELVIS (2020)

KEY

- - - Stage 8 - extraction/rehabilitation area
- Inland extent of horizontal setback
- Infiltration swale/toe of riverside 1:5 permanent batter
- Contour (1 m)
- Major road

Final landform
Substage 8A-8C

Menangle Quarry Extension



\\emmsvr1\emms\lobs\2019\190166 - Menangle Quarry LEC\GIS\02_Maps\G02_Conceptual\FinalLandform_10mSetback_NE_20211109_05.mxd 9/11/2021

Appendix D

Agency Consultation

Phil Towler

From: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>
Sent: Thursday, 17 June 2021 4:52 PM
To: Phil Towler
Cc: Joel Herbert
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

CAUTION: This email originated outside of the Organisation.

Hello Phil,

BCD had reviewed the draft BRMP and has no comments apart from the following minor typographical errors:

- Section 6.2.1 Vegetation management plan requirements (on page 54) - Appendix 6 of the Approval is Appendix F of the BRMP (not Appendix E)
- Section 6.2.3 VMP rehabilitation works, iv Specific measures – Stage 7 area, a Management Zone 7.1 (on page 64) - Appendix 6 of the Approval is Appendix F of the BRMP (not Appendix E)
- Section 8.2.1 Biodiversity land (on page 75) - Appendix 7 of the Approval is Appendix G of the BRMP (not Appendix E)
- Section 8.2.1 Biodiversity land, ii Biodiversity restoration and rehabilitation (on page 76) - Appendix 6 of the Approval is Appendix F of the BRMP (not Appendix E)
- Section 8.2.1 Biodiversity land, ii Biodiversity restoration and rehabilitation (on page 76) - Appendix 7 of the Approval is Appendix G of the BRMP (not Appendix F)
- Appendix B, B.1 Biodiversity offset strategy – overview (on page B.2) - Appendix 7 of the Approval is Appendix G of the BRMP (not Appendix F)

Regards

Richard Bonner
Senior Conservation Planning Officer, Greater Sydney Branch

Biodiversity and Conservation Division | Biodiversity, Conservation and Science Directorate | Environment, Energy and Science Group
T 02 9995 6917
12 Darcy Street, 4 Parramatta Square, PARRAMATTA NSW 2150 | Locked Bag 5022
www.dpie.nsw.gov.au



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Industry &
Environment

The Department of Planning, Industry and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

Please note, I work part-time. My usual work days are: Monday, Thursday and Friday.

From: Phil Towler <ptowler@emmconsulting.com.au>
Sent: Friday, 11 June 2021 10:01 AM
To: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>
Cc: Joel Herbert <Joel.Herbert@planning.nsw.gov.au>
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Hi Richard,

Sounds like you are being pulled from pillar to post.

Thanks for having a look at the BRMP. We look forward to your comments.

Best regards

Phil

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>
Sent: Thursday, 10 June 2021 5:20 PM
To: Phil Towler <ptowler@emmconsulting.com.au>
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

CAUTION: This email originated outside of the Organisation.

Apologies for the delay in responding Phil. I was away last week attending a workshop. I should be able to get back to you with any advice within the next couple of days.

Regards

Richard Bonner
Senior Conservation Planning Officer, Greater Sydney Branch

Biodiversity and Conservation Division | Biodiversity, Conservation and Science Directorate | Environment, Energy and Science Group
T 02 9995 6917
12 Darcy Street, 4 Parramatta Square, PARRAMATTA NSW 2150 | Locked Bag 5022
www.dpie.nsw.gov.au



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Environment**

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Please note, I work part-time. My usual work days are: Monday, Thursday and Friday.

From: Phil Towler <ptowler@emmconsulting.com.au>
Sent: Thursday, 10 June 2021 11:19 AM
To: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>
Cc: Susan Harrison <Susan.Harrison@environment.nsw.gov.au>; Joel Herbert <Joel.Herbert@planning.nsw.gov.au>; OEH ROG Greater Sydney Region Planning Unit Mailbox <rog.gsrplanning@environment.nsw.gov.au>
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Hi Richard,

As you will recall, we are seeking BCD's review of the Menangle Quarry Extension Biodiversity and Rehabilitation Management Plan. This plan needs to be prepared in consultation with BCD in accordance with Condition B73(b) of the consent (DA 85/2865).

As well as requiring the BCD comments to update the plan, we need the plan to be completed to allow the conditions regarding agreeing/implementing the measures for the long-term protection of the restoration area (eg establishment of the positive covenant and the trust fund) to be met. It is very likely that these will be the last conditions to be met before quarrying can recommence in accordance with the consent (previous quarrying had to cease by 31 December 2020 in accordance with the consent) – that is updating the plan is on the critical path.

Anything that you can do to expedite the BCD review of the plan would be greatly appreciated.

Best regards

Phil

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Phil Towler

Sent: Thursday, 3 June 2021 12:41 PM

To: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>

Cc: Susan Harrison <Susan.Harrison@environment.nsw.gov.au>; Joel Herbert <Joel.Herbert@planning.nsw.gov.au>

Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Hi Richard,

Are you able to provide an update on when BCD will be providing their comments on the Menangle Quarry Biodiversity and Rehabilitation Management Plan?

Thanks in advance

Phil

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Phil Towler

Sent: Friday, 21 May 2021 3:15 PM

To: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>

Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Richard,

And sorry about the previous cryptic subject line – copy and paste issues!

Regards

Phil

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Phil Towler
Sent: Friday, 21 May 2021 3:13 PM
To: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>
Subject: RE: Good

Good afternoon Richard,

I have resent it.

Could you please let me know if you can download? Otherwise, we can look at another way of getting it across.

Best regards

Phil

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>
Sent: Friday, 21 May 2021 3:01 PM
To: Phil Towler <ptowler@emmconsulting.com.au>
Subject: RE: Good

CAUTION: This email originated outside of the Organisation.

Hello Phil,

Apologies for the delay in responding. Unfortunately the link you provided to the draft BRMP does not work. Can you please provide a new link.

Regards

Richard Bonner

Senior Conservation Planning Officer, Greater Sydney Branch

Biodiversity and Conservation Division | Biodiversity, Conservation and Science Directorate | Environment, Energy and Science Group

T 02 9995 6917

12 Darcy Street, 4 Parramatta Square, PARRAMATTA NSW 2150 | Locked Bag 5022



The Department of Planning, Industry and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

Please note, I work part-time. My usual work days are: Monday, Thursday and Friday.

From: Phil Towler <ptowler@emmconsulting.com.au>
Sent: Thursday, 20 May 2021 1:25 PM
To: OEH ROG Greater Sydney Region Planning Unit Mailbox <rog.gsrplanning@environment.nsw.gov.au>
Cc: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>; Susan Harrison <Susan.Harrison@environment.nsw.gov.au>
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Good afternoon,

I received an out-office-reply to my email below to Susan Harrison.

Could you please forward the email to someone within the Division who could provide a response?

Thanks for your assistance.

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Phil Towler
Sent: Thursday, 20 May 2021 1:07 PM
To: Susan.Harrison@environment.nsw.gov.au
Cc: Richard.Bonner@environment.nsw.gov.au
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Good afternoon Susan,

I'm following up on the email below to confirm that you received it and to check that you could download the draft BRMP using the link.

Could you please let me know if BCD will be reviewing the document, and if so, when we would receive any comments?

Thanks again for your assistance.

Best regards

Phil

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Phil Towler

Sent: Friday, 7 May 2021 1:07 PM

To: Susan.Harrison@environment.nsw.gov.au

Cc: Richard.Bonner@environment.nsw.gov.au; Joel Herbert <Joel.Herbert@planning.nsw.gov.au>; Callum Firth <Callum.Firth@dpie.nsw.gov.au>

Subject: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Good afternoon Susan,

EMM have been engaged by Menangle Sand and Soil to prepare the Biodiversity and Rehabilitation Management Plan (BRMP) for the Menangle Quarry in consultation with BCD.

We previously wrote to you regarding the contents of the BRMP (emails below). Accordingly, the draft BRMP has been prepared to address each of the conditions of Approval (as listed Table 1.3 of the BRMP).

Would BCD like to review the draft BRMP? It too large to email and can be downloaded from:
<https://spaces.hightail.com/receive/INyo5soujD>.

Could you please let me know if BCD will be reviewing the document, and if so, when we would receive any comments?

Of course, please let me know if you have any questions.

Best regards

Phil

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Susan Harrison <Susan.Harrison@environment.nsw.gov.au>

Sent: Thursday, 22 October 2020 4:42 PM

To: Jeremy Slattery <jslattery@emmconsulting.com.au>

Cc: Richard Bonner <Richard.Bonner@environment.nsw.gov.au>

Subject: DA 85/2865 "Menangle Quarry Extension – Modification 1" (MOD1) - Consultation with BCD requirement for preparation of Management Plans

CAUTION: This email originated outside of the Organisation.

Dear Mr Slattery,

I refer to your request for input on the Biodiversity and Rehabilitation Management Plan required by consent condition B73 and advise the Biodiversity Conservation Division of DPIE has no comments.

Regards
Susan

Susan Harrison
Senior Team Leader Planning

Biodiversity Conservation | Department of Planning, Industry and Environment
T 02 9995 6864 | E susan.harrison@environment.nsw.gov.au
<Level 2, 10 Valentine Avenue, Parramatta, NSW 2150
www.dpie.nsw.gov.au



**Planning,
Industry &
Environment**

From: Jeremy Slattery <jslattery@emmconsulting.com.au>
Sent: Wednesday, 14 October 2020 7:38 AM
To: Susan Harrison <Susan.Harrison@environment.nsw.gov.au>
Subject: DA 85/2865 "Menangle Quarry Extension – Modification 1" (MOD1) - Consultation with BCD requirement for preparation of Management Plans

Dear Susan,

Menangle Sand and Soil Pty Ltd operates the Menangle Sand and Soil Quarry (the 'Quarry') at 15 Menangle Road Menangle. A modification to the Quarry's approval has recently been approved. The updated approval requires that the Biodiversity and Rehabilitation Management Plan (BRMP) is prepared in consultation with BCD and Council. This email seeks BCD's input to these plans.

The BRMP consultation letter is attached to this email. We have included an updated project description and the Notice of consent to each letter. This is intended to assist you in your familiarity with the Project.

If you are not the best contact for this Project, could you please forward to the correct person and copy me in, so I have a contact moving forward. Alternatively, if you could point me in the right direction for further correspondence.

Regards

Jeremy

Jeremy Slattery

Associate



T 02 9493 9500

M 0421 827 231

Connect with us

SYDNEY | Ground floor, 20 Chandos Street, St Leonards NSW 2065



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PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

Phil Towler

From: Bianca Klein <Bianca.Klein@wollondilly.nsw.gov.au>
Sent: Tuesday, 25 May 2021 12:10 PM
To: Phil Towler
Cc: Alexandra Stengl
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

CAUTION: This email originated outside of the Organisation.

Hi Phil

Thanks for sharing the report. I do not have further comments, it appears as though all consent conditions listed in Table 1.3 will be addressed.

It would be appreciated if you are able to keep us in the loop regarding progress of the extraction works and future monitoring results of rehabilitated areas.

Kind regards



Bianca Klein

Environmental Services Team Leader

T 0246779610
A P.O. Box 21 Picton, NSW, 2571
E Bianca.Klein@wollondilly.nsw.gov.au
W <http://www.wollondilly.nsw.gov.au>



From: Bianca Klein
Sent: Thursday, 20 May 2021 1:23 PM
To: 'Phil Towler'
Cc: Alexandra Stengl
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Hi Phil

Apologies for the delayed response. Yes, I can confirm that I was able to access the Hightail link to view the document.

I will have a read and provide comments if necessary by early next week. Is that okay?

Kind regards



Bianca Klein
Environmental Services Team Leader

T 0246779610
A P.O. Box 21 Picton, NSW, 2571
E Bianca.Klein@wollondilly.nsw.gov.au
W <http://www.wollondilly.nsw.gov.au>



From: Phil Towler [<mailto:ptowler@emmconsulting.com.au>]
Sent: Thursday, 20 May 2021 1:08 PM
To: Bianca Klein
Cc: Alexandra Stengl
Subject: RE: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Good afternoon Bianca,

I'm following up on the email below to confirm that you received it and to check that you could download the draft BRMP using the link.

Could you please let me know if the Council will be reviewing the document, and if so, when we would receive any comments?

Thanks again for your assistance.

Best regards

Phil

Philip Towler
Associate Director
T 02 9493 9500
M 0409 702 050
www.emmconsulting.com.au

From: Phil Towler
Sent: Friday, 7 May 2021 1:10 PM
To: Bianca.Klein@wollondilly.nsw.gov.au
Cc: Alexandra.Stengl@wollondilly.nsw.gov.au; Joel Herbert <Joel.Herbert@planning.nsw.gov.au>; Callum Firth <Callum.Firth@dpie.nsw.gov.au>
Subject: DA 85/2865 Menangle Quarry Extension – Modification 1 (MOD1) - Draft BRMP

Good afternoon Bianca,

EMM have been engaged by Menangle Sand and Soil to prepare the Biodiversity and Rehabilitation Management Plan (BRMP) for the Menangle Quarry in consultation with WSC and DPIE - Biodiversity Conservation Division.

We previously wrote to you regarding the contents of the BRMP (emails below). Accordingly, the draft BRMP has been prepared to address each of the conditions of Approval (as listed Table 1.3 of the BRMP).

Would WSC like to review the draft BRMP? It too large to email and can be downloaded from:
<https://spaces.hightail.com/receive/INyo5soujD/dXMtMzRhMjA4YzYtNDY2Ni00NzIzLTlmOTQtMTc3Y2JjNDdlNzdk>

Could you please let me know if WSC will be reviewing the document, and if so, when we would receive any comments?

Of course, please let me know if you have any questions.

Best regards

Phil

Philip Towler

Associate Director

T 02 9493 9500

M 0409 702 050

www.emmconsulting.com.au

From: Bianca Klein <Bianca.Klein@wollondilly.nsw.gov.au>
Sent: Monday, 30 November 2020 2:09 PM
To: Jeremy Slattery <jslattery@emmconsulting.com.au>
Cc: Alexandra Stengl <Alexandra.Stengl@wollondilly.nsw.gov.au>
Subject: RE: Follow up on DA 85/2865 "Menangle Quarry Extension – Modification 1" (MOD1) - Consultation

CAUTION: This email originated outside of the Organisation.

Hi Jeremy

Thank you for providing Council with the opportunity to review the relevant documents and management plans.

We are satisfied with the offsetting strategy for impacts to EEC vegetation and threatened species. The proposed management actions are also thorough which is good to see.

We could not find the Aquatic Ecology Assessment of Significance letter on the website and impacts to aquatic ecology are not referred to in the main environmental assessment report. I trust that impacts to aquatic ecology have been adequately assessed and minimised.

Kind regards

Bianca Klein
Environmental Services Team Leader



T 0246779610
A P.O. Box 21 Picton, NSW, 2571
E Bianca.Klein@wollondilly.nsw.gov.au
W <http://www.wollondilly.nsw.gov.au>



From: Jeremy Slattery [<mailto:jslattery@emmconsulting.com.au>]
Sent: Tuesday, 17 November 2020 8:51 AM
To: Alexandra Stengl; Mike Nelson
Cc: Bianca Klein; Corrie Swanepoel
Subject: RE: Follow up on DA 85/2865 "Menangle Quarry Extension – Modification 1" (MOD1) - Consultation

Good morning Alexandra,

Please find the Joint expert report submitted to the LEC.

Did you find the other documents ok?

Please let me know if there are any concerns after reading these reports and any feedback you have for the management plans.


Regards

Jeremy

Jeremy Slattery

Associate



T 02 9493 9500
M 0421 827 231
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From: Jeremy Slattery
Sent: Wednesday, 11 November 2020 9:31 AM
To: Alexandra Stengl <Alexandra.Stengl@wollondilly.nsw.gov.au>; Mike Nelson <Mike.Nelson@wollondilly.nsw.gov.au>
Cc: Bianca Klein <Bianca.Klein@wollondilly.nsw.gov.au>; Corrie Swanepoel <Corrie.Swanepoel@wollondilly.nsw.gov.au>; Mike Nelson <Mike.Nelson@wollondilly.nsw.gov.au>
Subject: RE: Follow up on DA 85/2865 "Menangle Quarry Extension – Modification 1" (MOD1) - Consultation

Hi Alexandra,

Thanks very much for your response. I apologise for not taking your call on Monday, but I had the day off.

The documents addressed in the letter can be found on the DPIE's Major Projects Register at the following site:

http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=8531

Unfortunately the Expert's Joint Report is not. Due to the approval being through the LEC, I have gone back to the client and their legal team to see if this document can be made available. I'll let you know when I have a response.

Please let me know if you would like to organise a teams meeting with our technical specialist.

Regards

Jeremy

Jeremy Slattery

Associate



T 02 9493 9500

M 0421 827 231

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From: Alexandra Stengl <Alexandra.Stengl@wollondilly.nsw.gov.au>

Sent: Monday, 9 November 2020 4:16 PM

To: Jeremy Slattery <jslattery@emmconsulting.com.au>; Mike Nelson <Mike.Nelson@wollondilly.nsw.gov.au>

Cc: Bianca Klein <Bianca.Klein@wollondilly.nsw.gov.au>; Corrie Swanepoel

<Corrie.Swanepoel@wollondilly.nsw.gov.au>; Mike Nelson <Mike.Nelson@wollondilly.nsw.gov.au>

Subject: RE: Follow up on DA 85/2865 "Menangle Quarry Extension – Modification 1" (MOD1) - Consultation

CAUTION: This email originated outside of the Organisation.

Hi Jeremy

Myself and a colleague have reviewed the Biodiversity section of the orders and they seem comprehensive. I am concerned about the presence of EEC along stage 8 of the proposal. It appears you will be undertaking offsetting in accordance with the BOS?

Are we able to see the documents prepared in the letter?

The modification application was initially rejected by DPIE. During the Land and Environment Court (Case number 2018/00342158) appeal, additional assessments were prepared during the appeal process, including:

- Aquatic Ecology Assessment of Significance Letter regarding Sydney Hawk Dragonfly (2 September 2019), prepared by Marine Pollution Research Pty Ltd;
- Amended Extraction Area and Setback Letter (16 August 2019) prepared by EMM Consulting;
- Stage 8 Area Weed Control Strategy Letter (9 September 2019) prepared by EMM Consulting; and
- Supplementary Biodiversity Assessment (16 September 2019), which re-evaluated the Stage 3 and Stage 8 tree value and updated the offset strategy.
- Experts' Joint Report – Ecology Issues (10 July 2020) prepared jointly by Mr Travis Peake (Umwelt) Dr Steven Ward (EMM Consulting Pty Limited) which addressed biodiversity matter issues arising in the proceedings.

Kind regards



Alexandra Stengl
Manager Environmental Outcomes

T 0246779577
A P.O. Box 21 Picton, NSW, 2571
E Alexandra.Stengl@wollondilly.nsw.gov.au
W <http://www.wollondilly.nsw.gov.au>



From: Jeremy Slattery [<mailto:jslattery@emmconsulting.com.au>]
Sent: Monday, 9 November 2020 12:28 PM
To: Alexandra Stengl; Mike Nelson
Subject: Follow up on DA 85/2865 "Menangle Quarry Extension – Modification 1" (MOD1) - Consultation

Hi Alexandra and Mike,

On 13 October I sent emails to Council informing you of our requirement to seek consultation on the development of the biodiversity and traffic management plans for DA 85/2865 "Menangle Quarry Extension – Modification 1" (MOD1) project.

Corrie Swanepoel forwarded these emails to you as the respective managers of Environment and Infrastructure & planning on 20 October.

I am wondering if you have had a chance to look at the email yet and whether Council has any feedback or is interested in meeting via teams to discuss the plans.

We aim to have drafted plans ready for review within the next couple of weeks.

I would appreciate any immediate feedback you can offer now.

Regards

Jeremy

Jeremy Slattery
Associate

T 02 9493 9500
M 0421 827 231



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From: [Phil Towler](#)
To: [Matthew Sprott](#)
Cc: [Alycia Campbell](#)
Subject: Menangle Sand and Soil Quarry (DA85/2865) - management plans
Date: Friday, 26 February 2021 3:46:00 PM
Attachments: [1900166 - Menangle Quarry - PT.pdf](#)
[image.png](#)
[image.png](#)
[image.png](#)

Good afternoon Matthew,

Please find attached a letter summarising of the status of the Menangle Quarry management plans as you requested.

The letter requests minor extensions to the submission dates for the plans that have been reviewed by DPIE. The longer extension requests reflect DPIE's request that we consult further with some of the agencies on these plans and we are awaiting agency comments. The letter also requests an extension for the submission of the Vegetation Management Plan. As noted in the letter, the request is made because we have integrated the Vegetation Management Plan as a chapter within the Biodiversity and Rehabilitation Management Plan so as to better reflect the holistic management of biodiversity at the quarry during operations and closure. The draft BRMP is close to being completed but requires consultation before it is submitted to the Department.

I hope everything is clear in the letter but please let me know if you need anything else.

We will also submit the letter through the portal.

Thanks for your consideration of this matter.

Have a good weekend (almost there).

Phil

Philip Towler

Associate Director



M 0409 702 050

D 02 9493 9500

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26 February 2021

Matthew Sprott
Director Resource Assessments (Coal & Quarries)
Department of Planning, Industry and Environment
via email

Re: Menangle Sand and Soil Quarry (DA85/2865) - management plans

Dear Matthew,

As you are aware, EMM Consulting is assisting Menangle Sand and Soil with the preparation of management plans for the Menangle Sand and Soil Quarry.

This letter outlines the progress of the preparation of these plans and requests an extension to submit the following plans to the Department:

- Draft Vegetation Management Plan to 9/4/21;
- Final Noise Management Plan to 2/3/21;
- Final Air Quality Management Plan to 2/3/21;
- Final Traffic Management Plan (TMP) to 19/3/21; and
- Final Aboriginal Cultural Heritage Management Plan (ACHMP) to 5/3/21.

The status of each management plan and the proposed submission timing is summarised in Table 1.

Table 1 Menangle Sand and Soil management plan status

Document	Condition	Consultation requirement ¹	Status	Submission
Environmental Management Strategy	D1	-	Internal draft complete. Was awaiting finalisation of other management plans to allow completion of monitoring summary. However,	Propose to submit without monitoring summary by 5/3/21.
Native Vegetation Identification Report (NVIR)	A11	-	Appendix to BRMP (see below).	-
Early Works Construction Environmental Management Plan ¹	B1	-	It is not proposed to prepare this plan.	-

Table 1 **Menangle Sand and Soil management plan status**

Document	Condition	Consultation requirement ¹	Status	Submission
Noise Management Plan (NMP)	B7; B7 (b)	EPA	Consultation complete. Draft plan reviewed by DPIE – requested updated plan by 26/2/21. Plan updated to address all comments and undergoing finalisation.	Request extension to submit by 2/3/21
Air Quality Management Plan (AQMP)	B14; B14 (b)	EPA	Consultation complete. Draft plan reviewed by DPIE – requested updated plan by 26/2/21. Plan updated to address all comments and undergoing finalisation.	Request extension to submit by 2/3/21
Flood Management Plan	B32	-	Draft plan undergoing final internal review.	Submit to DPIE by 5/3/21
Soil and Water Management Plan (SWMP)	B36; B36 (b)	EPA DPIE-Water	Consultation initiated. Draft plan undergoing final internal review.	Draft plan to be provided to EPA/DPIE by 5/3/21
Surface Water Management Plan	B36; B36 (c) (ii)	See SWMP	See SWMP	See SWMP
Groundwater Management Plan	B36; B36 (c) (iii)	See SWMP	See SWMP	See SWMP
Ephemeral Creek Management Plan ²	B40	-	To be prepared/approved prior to quarrying operations in Area 8E, 8F or 8G.	In future years.
Traffic Management Plan (TMP)	B55; B55 (b)	TfNSW Wollondilly Shire Council Campbelltown City Council	Consulted with TfNSW during preparation of the TMP and TfNSW reviewed the draft TMP. Wollondilly Shire Council and Campbelltown City Council did not respond to initial consultation requests. Draft plan reviewed by DPIE – requested updated plan by 26/2/21. Requested further consultation with the two Councils. The TMP has been updated to address DPIE comments and has been sent to the Councils requesting their comments.	Submit shortly after receiving/addressing Council comments. Request extension to submit by 19/3/21 (assuming Council comments received by 12/3/21).
Aboriginal Cultural Heritage Management Plan (ACHMP)	B62; B62 (b)	Heritage NSW	Consulted with Heritage NSW and Registered Aboriginal Parties (RAPs) during preparation of the ACHMP. Draft plan reviewed by DPIE – requested updated plan by 1/3/21. Requested further consultation with Heritage NSW. The plan has been updated to address DPIE comments and has been sent to the Heritage NSW. Heritage NSW said that they would	Request extension to submit by 5/3/21 (assuming Heritage NSW comments received by 1/3/21).
Biodiversity and Rehabilitation Management Plan (BRMP)	B73; B73 (b)	BCD Wollondilly Shire Council Campbelltown City Council	Consultation initiated. The BRMP preparation is 90% complete. The draft plan will be sent to BCD and the Councils for review.	Draft plan to be provided to BCD and the Councils by 5/3/21
Biodiversity Offset Strategy ³	B67; B68; B69	See BRMP.	See BRMP.	See BRMP.

Table 1 **Menangle Sand and Soil management plan status**

Document	Condition	Consultation requirement ¹	Status	Submission
Linear infrastructure impact assessment report	B65; B66	-	Not required as it is not proposed to construct any linear infrastructure.	-
Vegetation Management Plan (stages 6 and 7)	B80; B81; B82	-	Forms Chapter 6 of the BRMP as it is seen to be integral to the management of biodiversity during the life of the quarry and needs to form part of the closure considerations for the quarry. The plan is 95% complete but finalisation is pending completion of the other BRMP sections. DPIE previously granted an extension to 26/2/21.	Request extension to submit to DPIE by 27/3/21 to allow time for BCD and the Councils time to review and comment on the BRMP by 9/4/21

1. Excluding consultation with DPIE.

We trust that this information assists, but of course please let me know if there any further information that you require.

Yours sincerely



Philip Towler
Associate Director
ptowler@emmconsulting.com.au



Mr Mark Hutcheson
Operations Planning Support Manager
Benedict Recycling Pty Ltd
11 Narabang Way
Belrose, NSW, 2085

21/05/2021

Dear Mr Hutcheson,

**Menangle Sand and Soil Quarry (DA85/2865)
Extension of Time to Submit Management Plans**

I refer to your request (DA85/2865-PA-13) for an extension of time to submit management plans as required under the conditions of consent for the Menangle Sand and Soil Quarry (DA85/2865).

The Department notes that the Proponent has requested:

- An extension of time for the Environmental Management Strategy (EMS) to be submitted by Tuesday, 1 June 2021; and
- An extension of time for the Vegetation Management Plan (stages 6 and 7) (VMP) to be submitted by Friday, 28 May 2021.

The Department also notes that until all the relevant management plans are approved by the Secretary, the Proponent must not commence quarrying operations in the Stage 8 Area.

Accordingly, the Planning Secretary has granted an extension of time until Tuesday, 1 June 2021 for the submission of the EMS and Friday, 28 May 2021 for the submission of the VMP.

If you wish to discuss the matter further, please contact Callum Firth at callum.firth@dpie.nsw.gov.au.

Yours sincerely

A handwritten signature in black ink, appearing to read 'M Spratt'.

Matthew Spratt
Director
Resource Assessments (Coal & Quarries)

As nominee of the Planning Secretary



Miss Alycia Campbell
Environmental Compliance Manager
Benedict Recycling Pty Ltd
11 Narabang Way
Belrose, NSW, 2085

20/07/2021

Dear Miss Campbell,

**Menangle Sand and Soil Quarry (DA85/2865)
Combination of Management Plans**

I refer to your request (DA85/2865-PA-16) to combine the Vegetation Management Plan (VMP) with the Biodiversity and Rehabilitation Management Plan (BRMP), which was submitted in accordance with condition A30 of Schedule 2 of the consent for the Menangle Sand and Soil Quarry (DA85/2865).

The Department understands that through the combination of the VMP and BRMP, you are attempting to ensure a consistent approach to vegetation management across the development. The Department has carefully reviewed your request and is satisfied that a clear relationship has been demonstrated between these two plans.

Accordingly, the Planning Secretary has approved the combination of the VMP and BRMP.

If you wish to discuss the matter further, please contact Callum Firth at callum.firth@dpie.nsw.gov.au.

Yours sincerely

A handwritten signature in black ink, appearing to read 'M Spratt'.

Matthew Spratt
Director
Resource Assessments
as nominee of the Planning Secretary

Appendix E

Menangle Sand and Soil - Restoration Area Weed Strategy (EMM 2019)

9 September 2019

Luke Walker
Partner
Minter Ellison
Sent via email

Re: NSW Land and Environment Court (2018/342158) Menangle Sand and Soil - Stage 8 area weed control strategy

1 Introduction

This letter outlines the weed management strategy for the Menangle Sand and Soil Quarry Extension Project (the project). It applies to all of the Stage 8 area: the restoration area, the extraction area (including horizontal setback area) and the lower riverbank.

The information in this letter supersedes the information presented in *NSW Land and Environment Court (2018/342158) Menangle Sand and Soil - Restoration Area Weed Strategy*, letter from N. Grant (EMM Consulting Pty Limited) to L. Walker (Minter Ellison) of 16 August 2019.

2 Background

2.1 Stage 8 area

Vegetation in the Stage 8 area will be managed in four zones:

- the extraction area (excluding the horizontal setback area) – all vegetation will be cleared, the sand and soil resource will be extracted and the area will be rehabilitated;
- the horizontal setback area (which is within the extraction area) – all existing trees will be retained;
- the lower riverbank – will be left undisturbed other than the removal of weeds; and
- restoration areas – weeds and the weed soil seedbank will be removed and the area will be managed as a biodiversity offset.

All of these areas currently contain extensive weeds that will need to be managed to prevent weeds infesting the extraction area during rehabilitation and to allow a contiguous high-quality vegetation community to be established in the Stage 8 area. As well as extensive weeds visible above the ground, the soil in these areas contains a weed seedbank that would allow weeds to be quickly re-established if only the parts of the weeds above the surface and some of the roots are removed.

2.2 Weed management options

In general (ie not specific to Menangle Quarry), effective weed control requires a combination of strategies to remove the weeds and to prevent their regrowth. Strategies applied include:

- **Mechanical removal by pulling up the weeds** by hand or machine, attempting to remove as much of the root system as possible.
- **Mechanical removal by slashing/cutting** by hand or machine to remove the part of the weed plant that is above the soil.
- **Herbicide application using broad spraying** through at least two to three seeding cycles, generally including spot spraying of regrowth. The choice of equipment and application method depends on the size of the infestation, type and susceptibility of weed, topography, access, and potential environmental and health hazards. For herbicide treatments to be safe and effective, weather, soil conditions and the timing of the treatment must be considered. Weather conditions must be assessed and monitored during treatments to reduce the risk of drift and off-target damage. If heavy rain follows application, effectiveness can be reduced and contamination of waterways can occur through runoff.
- **Selective/targeted herbicide application** as a secondary mechanism to kill weeds that are not removed using the primary methods employed or that germinate/re-establish.
- **Mulching** by placing a layer of mulch to limit smaller weed growth by excluding light and providing a mechanical barrier.
- **Solarisation** by covering an area of smaller weeds with a plastic sheet to trap heat, increase the soil temperature and kill weeds that are intolerant of increased soil temperatures.
- **Soil removal and burial/stockpiling** by removing of at least the top 0.2–0.3 m of weed infested topsoil and burying it with a cover of at least 0.5 m where seeds will not germinate. Or, by stockpiling the soil (at least 3 m tall stockpiles) for as long as possible (generally greater than 30 months) to reduce the viability of weed seeds. The stockpiles need to be sown with a cover crop to minimise weed growth and propagation from the stockpile surfaces and to provide erosion protection.
- **Tillage** (also called cultivation) which requires slashing the weeds and cross ripping the area to a depth of about 0.5 m. The objective is to turn the soil in a way to damage the weed plants and to bury the weed seedbank, limiting the strike rate. This is widely used in agricultural settings. Repeated tillage is required to control mature well-established weeds.
- **Burning** at the appropriate time (depending on the terrain and access, burning could be substituted with bulldozing or slashing to reduce the bulk of the mature plants). This method relies on certain burning temperatures and durations to be achieved to be effective.
- **Establish other plants** by planting or seeding plants (may be native, endemic, agricultural or horticultural depending on the setting and the land management objectives) with appropriate management to allow them to out-compete returning weeds.

2.3 Proposed weed management

The advantages and disadvantages of applying each of the potential weed management strategies listed above in the Stage 8 areas are summarised in Table 2.1.

Table 2.1 Stage 8 restoration area - weed management strategies

Strategy	Advantages	Disadvantages
Mechanical removal – pulling	Removes the majority of the weed plants. Weed reestablishment is slowed.	Labour/machinery intensive. Requires a combination of different methods based on the size of the weed. Trees/bushes/thickets need to be pulled out mechanically using a tractor or earthmoving equipment. Smaller weeds need to be pulled out by hand. Requires separate destruction of the weeds pulled out (eg burying, burning or transport offsite). Does not remove the weed seedbank in the soil.
Mechanical removal – slashing/cutting	Removes the above-ground portion of the weed plants. Weed reestablishment is slowed. Rapid using mobile plant such as a Positrack fitted with a Tritter attachment.	Weeds more quickly reestablished from plants that have only been partially destroyed. Requires immediate and ongoing secondary treatment such as herbicide application.
Herbicide – broad spraying	Highly effective at weed removal – assuming multiple applications.	The Stage 8 area it is close to the Nepean River and broad/repeated use of herbicides at the site has a high risk of herbicides entering the river directly through drift/runoff or due to infiltration into sandy soils. Relies on other control methods to assist and slow the development of herbicide resistance. Historically, officers of the former Department of Water Resources, in particular Paul Bourne, opposed the broad application of herbicides for weed control at Menangle Sand and Soil Quarry. There is growing community concern with broad herbicide spraying. Repeated broad herbicide spraying (as would be required if the primary mechanism for weed control) has the potential to damage the quarry’s good relations with their neighbours.
Herbicide – selective/targeted application	Can be applied selectively in areas that are difficult to manage using other methods, for example very close to large trees. Greatly reduces the volume of herbicide used. Applied using backpack spray, paintbrush or wick. Can be used with selective application and a rotary wick application. Follow up with herbicide application once new growth emerges. It is more effective than broad spraying of herbicide and there is no spray drift. Herbicide injection into non-native trees can be used for soil stabilisation works. The tree is	Needs to be used in conjunction with other strategies. Labour intensive. Use needs to be limited so as to avoid the disadvantages of broad spraying of herbicides.

	left in situ but allows the current root system remains to assist with soil stabilisation.	
Mulching	Effective removal of small weeds. Minimal herbicide use.	Would not remove the larger weed understorey in the Stage 8 area. Would require large volumes of mulch, with accompanying, high risk of tannin leachate formation.
Solarisation	Effective removal of small weeds in some areas. Minimal herbicide use.	Would not remove the larger weed understorey in the Stage 8 area. Impractical to apply plastic sheeting in the presence of the large trees.
Soil removal and burial	In conjunction with mechanical weed removal, will remove above-ground portion of weed plants, roots in the soil and the weed seedbank in a single campaign. Can be used for herbicide-resistant weed populations. Minimal herbicide use. Deep seed burial prevents weed germination. Pit void available for weed disposal.	Labour/machinery intensive. Requires soils to be physically removed leaving bare ground until a groundcover is established.
Soil removal and stockpiling	In conjunction with mechanical weed removal, will remove above-ground portion of weed plants, roots in the topsoil and the weed seedbank in a single campaign. Can be used for herbicide-resistant weed populations. Minimal herbicide use.	Labour/machinery intensive. Requires soils to be physically removed leaving bare ground until a groundcover is established. A thin layer of seeds in stockpiles can remain viable. Requires open stockpiling areas and signage. Stockpiles above the ground surface more susceptible to erosion in flooding.
Tillage	Minimal herbicide use.	Can create germination by contact with soil moisture and narrow depth of germination. Requires deeper ripping (0.5 m) than soil removal (0.2–0.3 m). Ripping would be difficult in the Stage 8 area due to the presence of large tree roots.
Burning	Effective if correct temperatures are obtained for a sufficient period.	Requires exposure to high temperatures for effectively killing seeds of certain species. Can be time consuming, but successful in windrows. Difficult to manage in small/linear areas surrounded by vegetation that is not to be burnt. Risks of uncontrolled fires in the Stage 8 area due to the large trees that will be retained.
Establish non-weed plants	Establish native vegetation consistent with River Flat Eucalypt Forest.	Labour intensive. Requires management over the life of extraction and beyond. Still requires some patches to be cleared to assist native vegetation establishment.

3 Strategy implementation

The implementation of weed-control methods for each area are outlined below based on the advantages and disadvantages listed in Table 2.1.

3.1 Restoration area

The following weed-control methods are proposed to be used (in priority order) in the restoration area:

1. mechanical removal – slashing/cutting or pulling depending on the weed type;
2. soil removal and burial – topsoil will be removed and buried in a completed section of the pit;
3. rapidly establish non-weed plants;
4. herbicide – selective/targeted applications (eg using a wick application) on re-emerging weed; and
5. burning (primarily to assist native vegetation community establishment).

These methods require more expertise, labour and effort compared to the broad application of herbicides. It is proposed to employ a full-time rehabilitation specialist at the site to ensure the effective implementation of this strategy. The proposed strategy will be more expensive than a strategy based on the broad application of herbicides but will provide better environmental outcomes within the Stage 8 area and outside of the area (in particular in the Nepean River).

4 Lower riverbank

The following weed-control methods are proposed to be used (in priority order) in the lower riverbank area:

1. mechanical removal – slashing/cutting so that roots are retained; and
2. herbicide – selective/targeted application (eg using a wick application).

These methods will minimise soil disturbance on the lower riverbank while generally leaving existing roots in situ.

5 Extraction area

5.1 Cleared areas, including graded horizontal setback area

The following weed-control methods are proposed to be used (in priority order) in the extraction area, including in the graded horizontal setback area, which will become rehabilitation areas:

1. mechanical removal – all vegetation will be removed;
2. soil removal and burial – topsoil will be removed and buried in a completed section of the pit;
3. following completion of extraction and final land-forming in an area, the area will be rapidly, and progressively, rehabilitated with native plants;
4. herbicide – selective/targeted application (eg using a wick application) in the rehabilitation area of any emerging weeds, including those carried into the area by flood water; and
5. burning (primarily to assist native vegetation community establishment) – once the rehabilitated vegetation has reached a suitable level of maturity.

The full-time rehabilitation specialist will direct rehabilitation activities in this area with a focus on the rapid re-establishment of a native vegetation community and preventing the re-establishment of weeds, including from seeds carried into the Stage 8 area by flooding.

5.2 Ungraded horizontal setback area

The same weed-control methods are proposed to be used (in priority order) in ungraded horizontal setback areas as on the lower riverbank:

1. mechanical removal – slashing/cutting so that roots are retained; and
2. herbicide – selective/targeted application (eg using a wick application).

As for the lower riverbank, these methods will minimise soil disturbance in ungraded horizontal setback areas.

6 Weed control program overview

An overview of the weed control program is provided in Table 6.1. These methods will be selectively applied based on the types of weeds in different parts of the Stage 8 area. These weed control strategies will be detailed in the Vegetation Management Plan that will be prepared for the Stage 8 area prior to the commence of extraction. This plan will be provided to DPIE and Wollondilly Shire Council.

Table 6.1 Weed control program

Strategy	Activity	Frequency
Mechanical removal – slashing/cutting or pulling	<p>Initial mechanical removal where slopes are flat and away from the riverbank.</p> <p>Large weeds such as lantana in the northern and southern parts of the restoration area may be initially removed by slashing/cutting or using mobile plant such as a Tritter machine on a positrack¹.</p> <p>Very large weeds, such as the extensive stands of large-leafed privet and African olive in the central part of the restoration area, will be knocked over and removed using an excavator.</p> <p>The cut stump application of herbicide will be used on steep slopes, the lower riverbank and ungraded parts of the horizontal setback area. Very large privet trees (some over 40 m tall) in the southern parts of the restoration area that are on steep areas adjacent to the minor tributary will be removed progressively and/or cut, drilled and injected with herbicide in areas where complete removal in one event may compromise soil stability.</p> <p>Controls will be implemented for the protection of the large native trees in the restoration, horizontal setback and lower riverbank areas during weed removal:</p> <ul style="list-style-type: none">• large native trees will be surveyed and marked;• an appropriate exclusion zone will be delineated around each large native tree; and• large weeds in the exclusion zone would be removed in sections by a chainsaw or drilled and injected with herbicide and left in-situ. <p>Mechanically removed weeds will be loaded into a haul truck by the excavator or a loader for transport to the pit.</p> <p>Everywhere else, including the areas infested with lantana, will be slashed followed by herbicide application as required (eg wick application) with intensive revegetation.</p>	<p>Progressive.</p> <p>Once in each part of the restoration area.</p>

¹ See <https://www.youtube.com/watch?v=xJxIK-vUrs>

Table 6.1 Weed control program

Strategy	Activity	Frequency
Soil removal and burial	<ul style="list-style-type: none"> • Weed infested soil will be stripped progressively from the restoration area using an excavator so that it can be accurately removed close to existing trees. The soil will be loaded into a haul truck by the excavator or a loader for transport to the pit. • Topsoil will be removed to a depth of 0.3 m (not 0.6–1.0 m as previously proposed). • Mechanically removed weeds and the stripped weed-infested soil from the extraction and restoration areas will be buried in the base of the pit and covered with at least 0.5 m of soil and scalps to kill the weeds and prevent germination of the weed seeds. • Soil will not be stripped from the lower riverbank or the ungraded horizontal setback area. 	<p>Progressive.</p> <p>Once in each part of the restoration area and extraction area (other than in the ungraded setback area).</p>
Establish native plants	<ul style="list-style-type: none"> • A wire fence will be installed along the boundary between the extraction areas and the restoration areas. • Stock will be excluded from the extraction, restoration and lower riverbank areas. • Native seeds consistent with River Flat Eucalypt Forest will be broadcast in the restoration area as soon as the soil weed seedbank has been removed. If strike rates are low, then alternative methods, eg tubestock plantings, will be implemented. • Native seeds consistent with River Flat Eucalypt Forest will be broadcast in the rehabilitation area once the final landform has been completed. If strike rates are low, then alternative methods, eg tubestock plantings, will be implemented. • There will be ongoing intensive inspections for weeds over the life of the project. • Soil ameliorants may be used where required to improve native plant growth. <p>A full-time rehabilitation specialist will be employed by the quarry.</p>	<p>Progressive.</p> <p>Starting as soon as soil is removed in the restoration area.</p> <p>Starting as soon extraction is complete and the final landform is created.</p> <p>Ongoing.</p>
Herbicide – selective/targeted application	<ul style="list-style-type: none"> • Targeted-spot application herbicide by hand if required for weeds in areas where the roots of the weed need to be initially retained for stability or where minor regrowth occurs. 	<p>Ongoing as required.</p>
Burning	<ul style="list-style-type: none"> • Controlled ecological burns to assist the reestablishment of the native vegetation community. 	<p>Approximately every 10 years where vegetation is suitably mature.</p>

7 Inspection and reporting

There will be annual inspections by an appropriately qualified ecologist on the condition of the Stage 8 areas. The findings and actions undertaken during the year will be reported to the Department of Planning, Industry and Environment (DPIE), and to Wollondilly Shire Council.

8 Summary

A weed control strategy that initially mechanically removes weeds in the restoration area and buries them at a depth where they cannot regenerate, in combination with ongoing weed control measures is the best weed control program for the restoration area. While this method is labour intensive and therefore more

costly, it will allow large trees to be retained, provide immediate environmental improvements and will form the best environment for an understorey of native plants to be established. This will be accomplished without broad spraying of herbicides close to the Nepean River and associated risks to water quality, aquatic ecology. It will avoid a potential community backlash from the broad spraying of herbicides, particularly in light of recent media attention and litigation regarding the use of Roundup (Glyphosphate). However, given the Department's concerns regarding the soil removal in the restoration areas it is proposed that it is removed to a maximum a depth of 0.3 m, not 0.6–1.0 m as previously proposed.

The weed control strategy for the lower riverbank and the horizontal setback area is designed to minimise soil disturbance while generally leaving existing roots in situ.

Progressive rehabilitation activities in the completed extraction areas will focus on the rapid re-establishment of a native vegetation community and preventing the re-establishment of weeds.

The vegetation management plan will describe the weed control across the Stage 8 area and will be implemented by a full-time rehabilitation specialist employed by Menangle Sand and Soil.

Yours sincerely



Dr Nardia Grant
Associate Rehabilitation and Closure

Dr Grant has a Bachelor of Natural Resources and PhD from the University of New England. She is a specialist in compliance management, rehabilitation and research. She has in-depth experience in mine site rehabilitation and closure, including rehabilitation strategy development, cover design and review. Prior to joining EMM, she has been an environmental advisor at Peabody Energy Australia and Alcoa World Alumina Australia and a Research Officer-Hydrologist for the Western Australian Department of Agriculture and Food. She has conducted rehabilitation research for a range of organisations.

Appendix F

Annual Report Template

F.1 Annual report template

Please fill out the report below annually, including all attachments mentioned in the report.

Menangle Rehabilitation and Restoration Site Annual Progress Report									
Basic site information									
Reporting Year	1-20	Year	2020 - 2040	Stage	6, 7, 8	Reporter		Version	1
Records of management actions undertaken									
Management actions	Item reference number	Required completion year	Anticipated / actual completion year	Action completed (Yes/No)	Description of actions undertaken (including where undertaken, any variations and the reasons for variation)	Visual observations, recommendations and other comments (including reasons for non-completion)			
1. Controlling threats	1.1 Unrestricted access to property								
	1.2 Invasive pests and predators								
	1.3 Fire								
	1.4 Erosion								
2. Physical conditions	2.1 Soil pH								
	2.2 Plant available nutrients								
	2.3 Organic carbon								
3. Species composition	3.1 Native trees								

	3.2 Native shrubs					
	3.3 Native grasses (or grasslike)					
	3.4 Native forbs					
	3.5 Exotic					
	3.6 Species diversity					
4. Ecosystem function	4.1 Disturbance					
	4.2 Litter amount					
	4.3 Nest boxes					
	4.4 Habitat additions					
Incident or event that has adverse effect on biodiversity values on biodiversity stewardship site						
Incident or event including adverse impacts				Action taken and proposed recommended actions		
Records to submit with this report						
<input type="checkbox"/>	Attachment A: Photo-point monitoring report (.doc / .pdf format) (see template below).					
<input type="checkbox"/>	Attachment B: Weed monitoring report (.doc / .pdf format) (see guide below)					
<input type="checkbox"/>	Attachment C: Excel file (.xlsx format) containing all survey data collected to-date					

<input type="checkbox"/>	Attachment D: Excel file (.xlsx format) containing all survey data collected to-date
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<input type="checkbox"/>	Attachment E: Maps/spatial files containing all spatial data produced to-date
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Signature and certification	
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I hereby declare that the information supplied in this report is accurate and complies with the reporting requirements under Section 8.6 of the Biodiversity Monitoring and Rehabilitation Plan requirements.

Signed

Signed

Date

Date

ATTACHMENT A: Photo-point monitoring report template

Last year		This year	
Site			
Photo-point no.			
Comments about how to take the photo consistently each time, improvements, problems, etc.:			
Last year		This year	
Site			
Photo-point no.			
Comments about how to take the photo consistently each time, improvements, problems, etc.:			

Appendix G

Additional Stage 6 and 7 Biodiversity and Rehabilitation Requirements (DA85/2865 Appendix 6, Table 5)

~~Appendix 6~~ **Additional Stage 6 and 7 Biodiversity and Rehabilitation Requirements**

Table 5: Additional Biodiversity Objectives and Performance and Completion Criteria for Stage 6 and 7 Vegetated Areas

Rehabilitation Objective	Performance Indicator	Completion Criteria	Example Justification/validation methods	Performance Guidance
Composition Objective				
The vegetation composition of Stages 6 and 7 are recognisable as River-flat Eucalypt Forest EEC.	Native plant species are characteristic of River-flat Eucalypt Forest EEC as described in the Final Determination. <i>HN526 benchmark for native plant species richness is ≥24 species.</i> <i>It is noted that Eucalyptus botryoides x saligna is not listed in the River-flat Eucalypt Forest EEC Final Determination, but is to count as one species towards the benchmark value.</i>	Presence of a suitable number or proportion of species listed in the Final Determination. This is considered to be ≥24 species, across all monitoring plots, that are aligned with the species list in the Final Determination.	Use of standard 20 x 20 m floristic sampling plot(s) where all flora species present are recorded.	This criterion should be met early (i.e. at 5 years post-establishment), otherwise it is unlikely to be met in the long-term.
Structure Objectives				
The vegetation structure of Stages 6 and 7 are recognisable as, or is trending towards, the target BVT HN526, which provides a suitable surrogate for River-flat Eucalypt Forest EEC	Cover and abundance of plant growth forms are characteristic of, or are trending towards, the target BVT benchmarks, which are provided in the completion criteria.	Total foliage cover of species allocated to Tree (TG) growth form is trending towards the benchmark range of 27.5– 32.5	Use of BAM where all flora species present in a 20 x 20 m plot are recorded, with foliage cover and abundance of each species.	Foliage cover of Tree (TG) growth form is trending towards target value.
		Total foliage cover of species allocated to Shrub (SG) growth form is trending towards the benchmark range of 21-31		Foliage cover of Shrub (SG) growth form is trending towards target value.

Rehabilitation Objective	Performance Indicator	Completion Criteria	Example Justification/validation methods	Performance Guidance
		Total foliage cover of species allocated to Grass and Grass-like (GG) growth form is trending towards the benchmark range of 24.45-30.45		Foliage cover of Grass and Grass-like (GG) growth form is trending towards target value.
		Total foliage cover of species allocated to Forb (FG) growth form is trending towards the benchmark range of 24.45-30.45		Foliage cover of Forb (FG) growth form is trending towards target value.
Function Objectives				
Levels of ecosystem function have been established that demonstrate that Stages 6 and 7 are self-sustainable, or is trending towards self-sustainability	Evidence of plant reproduction and regeneration is present	The cover and species richness of the groundcover, including grasses and forbs, is stable or increasing, and is within the benchmark ranges	The ongoing persistence of groundcover species, which are relatively short lived and for which recruitment is not straightforward to measure, is regarded as evidence of reproduction and regeneration of these species	An initial decline in species richness and cover may occur, however a stabilisation in observed cover and richness should be observed by 5 to 10 years post-establishment.
		Second generation individuals of shrubs and trees are present	Presence of second-generation canopy species is evident within the rehabilitation domain (i.e. not limited to the plot, but present within rehabilitation of the same target community and age).	No performance guidance. The presence of second-generation trees and shrubs may not be evident for many years post-establishment.

Rehabilitation Objective	Performance Indicator	Completion Criteria	Example Justification/validation methods	Performance Guidance
	Cover of exotic species is low	Cover of 'high threat exotic' (HTE) and 'priority weeds' is no more than 2%.	Data collected in accordance with BAM. Sum foliage cover of species identified as 'high threat exotic' under the BAM and 'priority weeds' as identified by the Local Land Services (LLS) in the relevant strategic weed management plan for the region.	Cover of HTE and priority weed species are declining towards target value. Given the very high weed loads it is expected that it will take some time for weed growth to be brought under control and will require ongoing maintenance.
	Indicators of nutrient cycling are suitable for sustaining the target plant community type	Litter cover is within the benchmark range. There is no biometric benchmark, and thus the BAM benchmark of 40 for PCT835 is adopted	Data collected in accordance with BAM via five 1 m ² subplots within the 20 m ² floristic plot	Litter cover is increasing towards target value.
<p>Notes:</p> <p><i>Achieving biometric vegetation type (BVT) HN526 and/or plant community type (PCT) in the NSW Bionet Vegetation Information System (PCT835), can be used as a suitable surrogate for the EEC. BVT benchmarks are more specific (to vegetation type level, usually with lower and upper thresholds), whereas PCT benchmarks are to a broader vegetation class level (which is a grouping of similar vegetation types). For this reason, BVT benchmarks have generally been utilised in this table as being the best available.</i></p> <p><i>The Completion Criteria column refers to the desired end goal, with the Performance Guidance column providing broad guidance on how the completion criteria should be interpreted in terms of producing future performance criteria in relevant Vegetation Management Plan(s). It is noted that the completion criteria and performance indicators in Table 5 will need to be resolved with more specific performance criteria relevant to different areas of the site.</i></p> <p><i>It is also noted that stochastic events such as flood or fire might affect the achievement of performance standards and criteria, and whilst the intent will still be to achieve restoration and rehabilitation of the River-flat Eucalypt Forest EEC in the long-term, such events will need to be taken into account on a case by case basis for specific performance standards.</i></p>				

Appendix H

Stage 8 Biodiversity and Rehabilitation (DA85/2865 Appendix 7, Table 6)

~~Appendix 7~~ **Stage 8 Operations Biodiversity and Rehabilitation**

Table 6: Biodiversity Objectives and Performance and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Example Justification/validation methods	Performance Guidance
Composition Objective				
The vegetation composition of the Restoration Area and rehabilitated substages are recognisable as River-flat Eucalypt Forest EEC.	Native plant species are characteristic of River-flat Eucalypt Forest EEC as described in the Final Determination. <i>HN526 benchmark for native plant species richness is ≥24 species.</i> <i>It is noted that Eucalyptus botryoides x saligna is not listed in the River-flat Eucalypt Forest EEC Final Determination, but is to count as one species towards the benchmark value.</i>	Presence of a suitable number or proportion of species listed in the Final Determination. This is considered to be ≥24 species, across all monitoring plots, that are aligned with the species list in the Final Determination.	Use of standard 20 x 20 m floristic sampling plot(s) where all flora species present are recorded.	This criterion should be met early (i.e. at 5 years post-establishment), otherwise it is unlikely to be met in the long-term.
Structure Objectives				
The vegetation structure of the Restoration Area and rehabilitated substages are recognisable as, or is trending towards, the target BVT HN526, which provides a suitable surrogate for River-flat Eucalypt Forest EEC	Cover and abundance of plant growth forms are characteristic of, or are trending towards, the target BVT benchmarks, which are provided in the completion criteria.	Total foliage cover of species allocated to Tree (TG) growth form is trending towards the benchmark range of 27.5– 32.5	Use of BAM where all flora species present in a 20 x 20 m plot are recorded, with foliage cover and abundance of each species.	Foliage cover of Tree (TG) growth form is trending towards target value.
		Total foliage cover of species allocated to Shrub (SG) growth form is trending towards the benchmark range of 21-31		Foliage cover of Shrub (SG) growth form is trending towards target value.

Rehabilitation Objective	Performance Indicator	Completion Criteria	Example Justification/validation methods	Performance Guidance
		Total foliage cover of species allocated to Grass and Grass-like (GG) growth form is trending towards the benchmark range of 24.45 - 30.45		Foliage cover of Grass and Grass-like (GG) growth form is trending towards target value.
		Total foliage cover of species allocated to Forb (FG) growth form is trending towards the benchmark range of 24.45 - 30.45		Foliage cover of Forb (FG) growth form is trending towards target value.
Function Objectives				
Levels of ecosystem function have been established that demonstrate the Restoration Area and rehabilitated substages are self-sustainable, or is trending towards self-sustainability	Evidence of plant reproduction and regeneration is present	The cover and species richness of the groundcover, including grasses and forbs, is stable or increasing, and is within the benchmark ranges	The ongoing persistence of groundcover species, which are relatively short lived and for which recruitment is not straightforward to measure, is regarded as evidence of reproduction and regeneration of these species	An initial decline in species richness and cover may occur, however a stabilisation in observed cover and richness should be observed by 5 to 10 years post-establishment.
		Second generation individuals of shrubs and trees are present	Presence of second-generation canopy species is evident within the rehabilitation domain (i.e. not limited to the plot, but present within rehabilitation of the same target community and age).	No performance guidance. The presence of second-generation trees and shrubs may not be evident for many years post-establishment.

Rehabilitation Objective	Performance Indicator	Completion Criteria	Example Justification/validation methods	Performance Guidance
	Cover of exotic species is low	Cover of 'high threat exotic' (HTE) and 'priority weeds' is no more than 2%.	Data collected in accordance with BAM. Sum foliage cover of species identified as 'high threat exotic' under the BAM and 'priority weeds' as identified by the Local Land Services (LLS) in the relevant strategic weed management plan for the region.	Cover of HTE and priority weed species are declining towards target value. Given the very high weed loads it is expected that it will take some time for weed growth to be brought under control and will require ongoing maintenance.
	Indicators of nutrient cycling are suitable for sustaining the target plant community type	Litter cover is within the benchmark range. There is no biometric benchmark, and thus the BAM benchmark of 40 for PCT835 is adopted	Data collected in accordance with BAM via five 1 m ² subplots within the 20 m ² floristic plot	Litter cover is increasing towards target value.
<p>Notes:</p> <p><i>Achieving biometric vegetation type (BVT) HN526 and/or plant community type (PCT) in the NSW Bionet Vegetation Information System (PCT835), can be used as a suitable surrogate for the EEC. BVT benchmarks are more specific (to vegetation type level, usually with lower and upper thresholds), whereas PCT benchmarks are to a broader vegetation class level (which is a grouping of similar vegetation types). For this reason, BVT benchmarks have generally been utilised in this table as being the best available.</i></p> <p><i>The Completion Criteria column refers to the desired end goal, with the Performance Guidance column providing broad guidance on how the completion criteria should be interpreted in terms of producing future performance criteria within the Biodiversity and Rehabilitation Management Plan required under condition B73 of Schedule 2 of this consent. It is noted that the completion criteria and performance indicators in Table 6 will need to be resolved with more specific performance criteria relevant to different areas of the site. For example, the Amended restoration area will contain a tree overstorey and thus the performance standard should be higher compared to the Amended extraction area where some time will be required for the tree overstorey cover to become established. Refined performance criteria are to be included in the Biodiversity and Rehabilitation Management Plan.</i></p> <p><i>It is also noted that stochastic events such as flood or fire might affect the achievement of performance standards and criteria, and whilst the intent will still be to achieve restoration and rehabilitation of the River-flat Eucalypt Forest EEC in the long-term, such events will need to be taken into account on a case by case basis for specific performance standards.</i></p>				

