



Surface Water Assessment

Bombo Quarry Modification

Prepared for Boral Resources (NSW) Pty Ltd
May 2019





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Surface Water Assessment

Bombo Quarry Modification

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Executive Summary

Bombo Quarry (the quarry) is a hard rock quarry owned and operated by Boral Resources (NSW) Pty Ltd (Boral). It is located on Panama Street, Bombo in the Kiama local government area (LGA), approximately 5 km north-west of Kiama and 128 km south of Sydney. The quarry operates under a development consent (DA 10.1971.97.2) originally granted by Kiama Municipal Council (Council or KMC) in September 1971 (DA 10.1971.97.1). The site is licensed for extraction, processing and storage of up to 500,000 tonnes per annum in accordance with environment protection licence (EPL) 313.

The quarry is non-operational with extraction activities having been suspended since 2014. The development consent requires the quarry to be rehabilitated at the completion of quarrying activities, including returning overburden and unused product stockpiles into the quarry void. Boral is seeking to modify the current quarry consent to allow for importation of clean fill material comprising Virgin Excavated Natural Material (VENM) and/or Excavated Natural Material (ENM) from external sources via rail/road for use in rehabilitation of the quarry void.

This surface water assessment (SWA) has been prepared by EMM Consulting Pty Ltd (EMM) on behalf of Boral to assess potential surface water impacts associated with the proposed modification including consideration of impacts to existing watercourses and the downstream receiving environment. The SWA supports a Statement of Environmental Effects which will accompany an application to modify the development consent.

The existing surface water environment and quarry drainage system was determined primarily through desktop assessment and review of available information. This was complemented by site inspection, including ground-truthing of the existing quarry drainage system which was undertaken in December 2018. Both the NSW Department of Industry – Lands and Water Division (DoI-Water) and Council hold watercourse mapping that covers the quarry and surrounds. A key outcome of the ground-truthing exercise was to determine that all open channel reaches within the quarry have been relocated and/or heavily modified by historic quarrying activities, forming part of the quarry's water management system, and no longer occur as shown in either DoI-Water/Council watercourse mapping. Accordingly, controlled activity approval under the provisions of the NSW *Water Management Act 2000* is not considered required for further works within the quarry as part of its ongoing rehabilitation.

The main risks to water quality will occur as a result of an increase in the volume and extent of fill material required to achieve the desired final landform within the quarry; reinstatement of the rail spur; operation of delivery stockpile areas; and transport of fill material within the quarry. These activities are likely to increase ground disturbance and exposure of soils with potential erosion and mobilisation of sediment into receiving watercourses. Contamination of surface water as a result of accidental spillage of materials such as fuel, lubricants, herbicides and other chemicals used to support rehabilitation activities could also adversely impact water quality.

Design and staging of rehabilitation works will need to consider appropriate measures to manage scouring and erosion along drainage lines through the quarry in order to prevent erosion of compacted fill and transport of sediment downstream. Proposed key management measures to minimise the potential for adverse water quality impacts include implementation of erosion and sediment control measures in accordance with Landcom (2004 and 2008); progressive revegetation or stabilisation of disturbed areas to minimise exposed soils; stabilisation of drainage lines; and implementation of procedures for hazardous material storage and spill management.

The proposed modification will continue to monitor and discharge stored stormwater in a controlled manner to Bombo Beach in accordance with the EPL. Therefore, the ongoing management of stormwater during the rehabilitation process would mitigate any potential for adverse flooding impacts downstream. The proposed modification is also considered unlikely to result in any significant cumulative impact to surface water resources.

Further consideration of surface water management will be required as part of future planning and design exercises for the whole redevelopment of the area, including the Sydney Trains quarry site, beyond the current rehabilitation phase of the quarry.

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1 Introduction

Bombo Quarry (the quarry) is a hard rock quarry owned and operated by Boral Resources (NSW) Pty Ltd (Boral). It is located on Panama Street, Bombo in the Kiama local government area (LGA), approximately 5 km north-west of Kiama and 128 km south of Sydney (see Figure 1.1).

The quarry is accessed from the western end of Panama Street, via Hutchinson Street or Riverside Drive and the Princes Highway. It has an area of approximately 45 ha and is made up of nine lots, the legal description and size of each are detailed in Table 1.1 and illustrated on Figure 1.1.

Table 1.1 Legal description and size of lot

Lot	Area (ha)	Land owner
Lot 7 DP1121098	24.35	Boral
Lot 1 DP553706	8.447	Boral
Lot 4 DP553706	1.282	Boral
Lot 52 DP1012601	0.8691	Boral
Lot 53 DP1012601	4.05	Boral
Lot 54 DP1012601	0.4817	Boral
Lot 5 DP1135747	5.299	Boral
Lot 100 DP1121118	0.2306	Boral
Lot 101 DP1121118	0.1740	Boral
Cuba Street Enclosure Permit 39340	0.6905	Crown Lands (Enclosure Permit 39340 held by Boral)
Panama Street	n/a	Council
Jamaica Street	n/a	Crown Lands

Boral operates Bombo Quarry in accordance with a development consent (DA 10.1971.97.2) originally granted by Kiama Municipal Council (Council or KMC) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) in September 1971 (DA 10.1971.97.1). The consent allows for 24-hour quarry production and dispatch of material via both road and rail at unlimited quantities. The site is currently licensed for extraction, processing and storage of up to 500,000 tonnes per annum (tpa) in accordance with environment protection licence (EPL) 313 granted by the NSW Environment Protection Authority (EPA) under the NSW *Protection of the Environment Operations Act 1997* (POEO Act). Boral also has a development consent (DA 4/86) to operate a concrete batching plant (CBP) within the quarry.

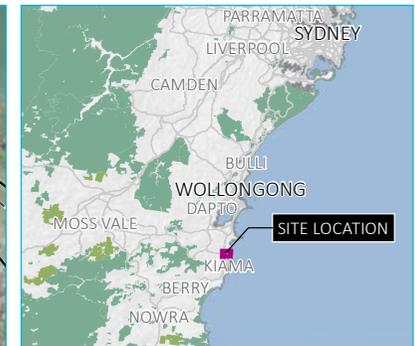
Quarry operations were suspended in 2014 due to Boral's operations being strategically focused at its Dunmore Quarry, approximately 5 km north of Bombo. Since that time, the quarry has been inactive but managed in accordance with the development consent and EPL conditions.

The development consent requires the quarry be rehabilitated at the completion of quarrying activities, including returning overburden and unused product stockpiles into the quarry void. Boral proposes to modify the current consent to facilitate importation of clean fill comprising Virgin Excavated Natural Material (VENM) and/or Excavated Natural Material (ENM) from external sources via rail and road for use in rehabilitation of the quarry void. To achieve

Boral's rehabilitation and strategic land use objectives for future development of the quarry, an estimated 4.5 million m³ of supplementary material is required to fill the void.

This surface water assessment (SWA) has been prepared by EMM Consulting Pty Ltd (EMM) on behalf of Boral to assess potential surface water impacts associated with the proposed modification including consideration of impacts to existing watercourses and the downstream receiving environment. It has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, including consideration of the need for a controlled activity approval for works on waterfront land under the provisions of the NSW *Water Management Act 2000* (WM Act). The SWA supports a Statement of Environmental Effects (SEE) which will accompany an application to modify the development consent.

The SWA has been prepared in consultation with relevant government agencies including Council and the Natural Resources Access Regulator (NRAR) which is an independent water regulator within the NSW Department of Industry – Lands and Water Division (DoI-Water).



- KEY**
- Site boundary
 - Site cadastre
 - Pit sump
 - Bombo rail siding (existing)
 - Bombo rail siding (to be reinstated)
 - Main southern railway line
 - Main road
 - Local road
 - Vehicular track
 - Watercourse / drainage line
 - Waterbody

Local setting

Bombo quarry modification
Surface water assessment
Figure 1.1

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Source: EMM (2019); DFSI (2017); GA (2015)



2 Approved/historic operations

2.1 Approved operations

The current development consent (as modified) places no restrictions on quarrying operations, including no restrictions or limits on road traffic, rail movements or other operational aspects. However, the quarry is currently licensed under EPL 313 to extract, process or store up to 500,000 tpa, of extractive material again without limitation on road or rail dispatch.

The development consent is also subject to several conditions. Specific conditions of note in consideration of the proposed modification include:

- specification of batter slopes at completion of quarry operations; and
- requirement to utilise all stockpiled overburden in rehabilitation of the quarry site at completion of quarry operations.

EPL 313 also places limits on discharges to waters downstream of the quarry. Specifically, Boral is required to *“maintain and operate pollution control structures and treatment works as specified in the Water Pollution Control Plan submitted for this premises. See plan number F003-01-032 REV 0.”*

2.2 Historic operations

The quarry is currently non-operational with extraction activities having been suspended since 2014.

Historic records of operations at the quarry indicate that peak production approximated the current EPL extraction limit of 500,000 tpa. Whilst the current consent includes approval for the operation of rail loading facilities, portions of the spur line rail track into the site were removed some years ago. Boral intends to reinstate the rail spur line at the quarry as allowed for under the existing consent, which would then be utilised for material receipt as part of proposed future rehabilitation activities (refer Section 4.2).

The existing development consent places no conditions or limitation on surface water drainage, and surface water drainage systems within and extending downstream of the quarry through the adjacent Sydney Trains site have been extensively modified over time to suit quarrying operations. In summary, all drainage lines within the site boundary have been subject to modification. Existing surface water management including a description of existing drainage systems are described in Section 3.

Under the provisions of the development consent, and consistent with advice received from Council in 2003, the southern portion of the main pit was partly filled during 2003-2004 with VENM sourced from the adjacent Kiama Bypass road project that was under construction during that period. To date no other filling works have been undertaken as part of rehabilitation.

2.3 Environmental management and monitoring

Historic operations at the quarry have incorporated environmental management procedures and processes designed to ensure compliance with the development consent and all relevant government legislation and requirements.

Consistent with the requirements of EPL 313, Boral implemented the following at the quarry during historic quarrying operations:

- operation of all pollution control structures and treatment works as specified in a Water Pollution Control Plan (ref: F003-01-032 REV 0) that was developed for the site; and
- environmental monitoring and reporting as required by the EPL, including preparation of Annual Returns for the EPA.

Boral continues to satisfy the management, monitoring and reporting requirements of the EPL and legislative requirements as relevant for the current 'care and maintenance' status of the site.

Consistent with the requirements of the POEO Act, a *Pollution Incident Response Management Plan* (PIRMP) (Boral 2018) was prepared for the quarry in 2012 and has been updated numerous times since to reflect changes in operational and other details over time. The purpose of the document is to provide direction on how to report, manage and communicate incidents to all staff. The document was last revised in August 2018 and reflects the current 'care and maintenance' status of the quarry.

In consultation with the EPA and Council, a dewatering plan was prepared for the site in response to the accumulation of stormwater in the quarry void that necessitated dewatering to maintain safe water levels. Dewatering was undertaken during the period March 2018 to August 2018 in accordance with the plan, which incorporated discharge of accumulated water via a suction pump and temporary poly pipe to the established drainage system through the quarry, which incorporates a series of open channels/culverts and underground pipe sections and discharges to the ocean at Bombo Beach (refer Section 3.2 for details). Discharge water was subject to the water quality discharge conditions of EPL 313 and water quality monitoring was undertaken for the duration of dewatering.

Review of available water quality data from the dewatering period March 2018 to August 2018 is provided in Section 3.4. Discharged water was generally compliant with EPL licence conditions with some minor exceedances noted for selected parameters.

No dewatering is currently being undertaken at the quarry.

3 Existing surface water management

3.1 Overview

The local hydrologic context for the quarry is shown on Figure 3.1, which should be referred to when reading this section of the SWA. Key features presented include:

- site boundary and key features of the quarry including pit sump;
- base mapping including recent aerial imagery, ground surface contours based on available LiDAR;
- existing drainage systems (ground-truthed as part of this present investigation) that serve the quarry and downstream areas extending to Bombo Beach;
- extent of catchment areas that contribute runoff to the quarry and its existing drainage system; and
- water monitoring locations where recent water quality data is available.

The regional topography falls generally from west to east towards Bombo Beach, draining across the beach and into the ocean via an unnamed watercourse. The quarry and neighbouring Sydney Trains site have been extensively modified since quarrying began. Each site has effectively formed its own subcatchment, and these subcatchments are shown on Figure 3.1. An additional subcatchment is shown on the figure to illustrate the total catchment contributing to the unnamed watercourse at its piped crossing of the Princes Highway.

The quarry consists primarily of a single catchment defined by the pit and a small area to the south-west of the pit. The pit captures all direct rainfall which collects in the pit sump. This water overflows or is pumped from the sump to a drainage system, which runs partially through an underground piped network and partially through reaches of open channel discharging ultimately to Bombo Beach. A second catchment drained by a first order watercourse (per DoI-Water mapping) feeds into the site drainage system a short distance downstream of the pit sump.

3.2 Existing drainage systems and watercourses

Both DoI-Water and Council have available watercourse mapping which covers the quarry and surrounds. This is presented in Figure 3.2. However, on review it was noted that:

- inconsistencies exist between the DoI-Water and Council mapping; and
- both DoI-Water and Council watercourse mapping do not accurately reflect current site conditions, given the extraction and supporting activities and associated extensive modifications to watercourses that have occurred over time.

Council has mapped several watercourses across the quarry site, all of which are identified as Category 3 on the relevant Council Riparian Land and Watercourses Map (refer Figure 3.2a). Under the Kiama Local Environmental Plan 2011 (LEP) this potentially applies controls to proposed activities within a riparian corridor extending 10 m from top of bank for mapped Category 3 watercourses. However, the mapped watercourses clearly pre-date development of the quarry and appear to give limited or no consideration of the extensive topographic changes that have occurred to facilitate quarrying and related activities.

DoI-Water mapping (refer Figure 3.2b) shows first and second order streams within the quarry, with corresponding riparian corridor widths extending 10 m and 20 m, respectively, from top of bank. This mapping appears to

recognise the presence of the main quarry pit but gives no consideration to drainage modifications that have occurred beyond the pit.

A site inspection was conducted on 12 December 2018 to ground-truth the location and arrangement of existing drainage elements within the quarry and extending downstream to the Princes Highway. The outcomes of the site inspection and confirmed current drainage system, including photographs for key representative locations, are shown in Figure 3.3.

The key findings of this investigation were as follows:

- the existing drainage system was observed to be generally consistent with arrangements set out in the dewatering plan, which were installed to facilitate dewatering of the pit over the period March to August 2018 (refer Section 2.3 for details); and
- all existing open channel reaches within the site boundary have been relocated and/or heavily modified by historic quarrying activities, forming part of the quarry's water management system, and no longer occur as shown in either DoI-Water/Council watercourse mapping.

Accordingly, controlled activity approval under the provisions of the WM Act is not considered to be required for further works within the quarry as part of its ongoing rehabilitation.

3.3 Flooding

No known assessment of flooding conditions has been undertaken for the quarry nor the downstream drainage system extending to Bombo Beach.

3.4 Existing water quality

There are no known historical issues associated with poor water quality within the quarry, or resulting from discharges from the quarry.

Available data to assist in characterisation of existing water quality within and downstream of the quarry is limited to monitoring that was undertaken by Boral throughout the recent dewatering phase March to August 2018. Water quality monitoring was undertaken at three locations as shown on Figure 3.1, and include within the quarry pit [Point 1], at the licensed discharge point immediately downstream of the site boundary at the Licensed Discharge Point (LDP) [Point 2], and at Bombo Beach [Point 3].

A summary of the available water quality data is provided in Appendix A.

Results indicate that water stored in the pit and released downstream was generally of good quality for a disturbed catchment, with low turbidity and salinity and neutral pH. Temperature at all locations showed a clear seasonal dependence as would be expected.

Discharged water as monitored at the LDP (Point 2) was generally compliant with the water quality discharge parameters set out in the dewatering plan, with a small number of exceedances observed as follows:

- two minor exceedances in pH occurred at the LDP. These exceedances were marginal;
- between 15 June 2018, and 14 August 2018 three consecutive temperature exceedances were recorded at the LDP. These occurred during winter and are therefore reasonably assumed to be due to colder ambient temperature; and

- limits on dissolved oxygen (DO) at the LDP exceeded discharge parameters three times during the dewatering phase. These exceedances were marginal.

Whilst a higher number of exceedances were detected at the pit upstream of the LDP (Point 1), these were generally not detected downstream at either the LDP or the Bombo Beach discharge point (Point 3), which indicates that existing water management systems and practices are effective in managing water quality.



- KEY**
- Site boundary
 - Pit sump
 - Water monitoring location
 - Catchment boundary
 - ▶ Open channel
 - Piped drainage
 - Bombo rail siding (existing)
 - Bombo rail siding (to be reinstated)
 - Main southern railway line
 - Main road
 - Local road
 - Watercourse/drainage line (DFS1, 2017)
 - Contour (5 m interval)

Local hydrologic context

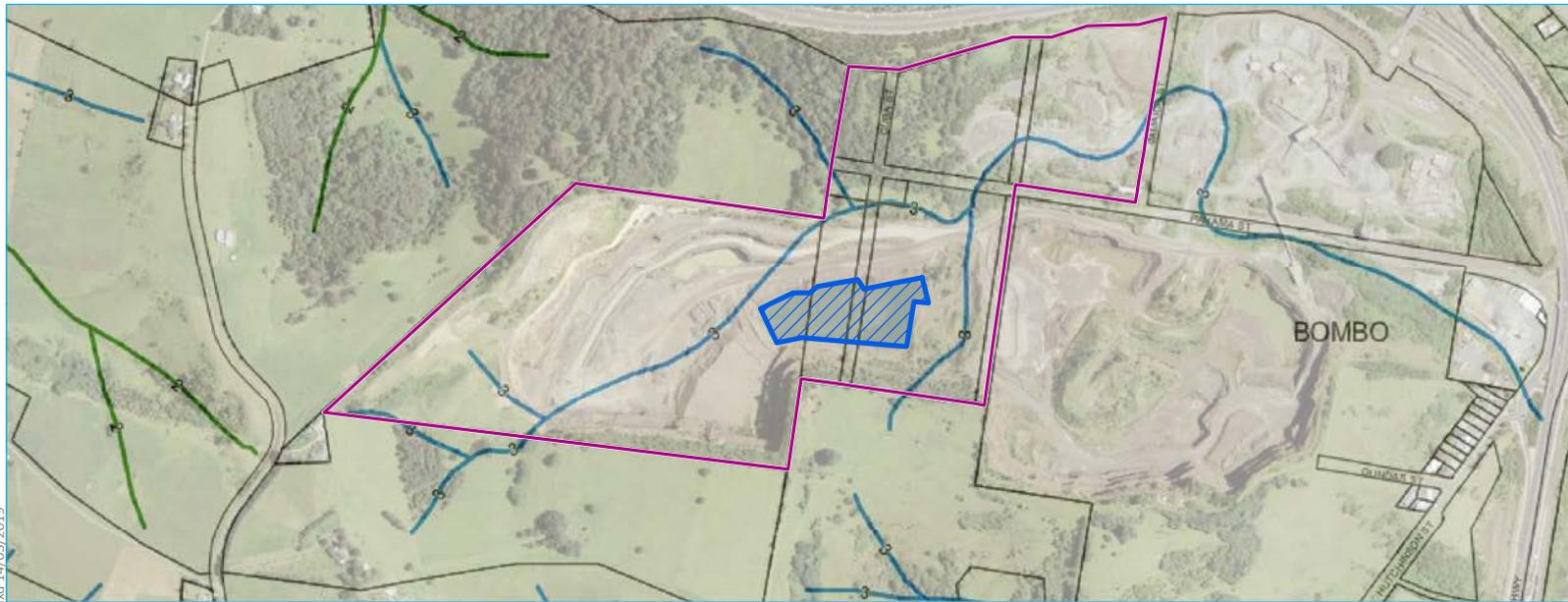
Bombo quarry modification
Surface water assessment
Figure 3.1



Source: EMM (2019); DFS1 (2017); GA (2011); ELVISDEM (2018)



Figure 3.2a: Kiama Council LEP watercourse mapping



- KEY
- Site boundary
 - Pit sump
 - Stream order (DPI, 2013)
 - 1
 - 2
 - 3

Figure 3.2b: DPI watercourse mapping



Existing watercourse mapping

Bombo quarry modification
Surface water assessment
Figure 3.2

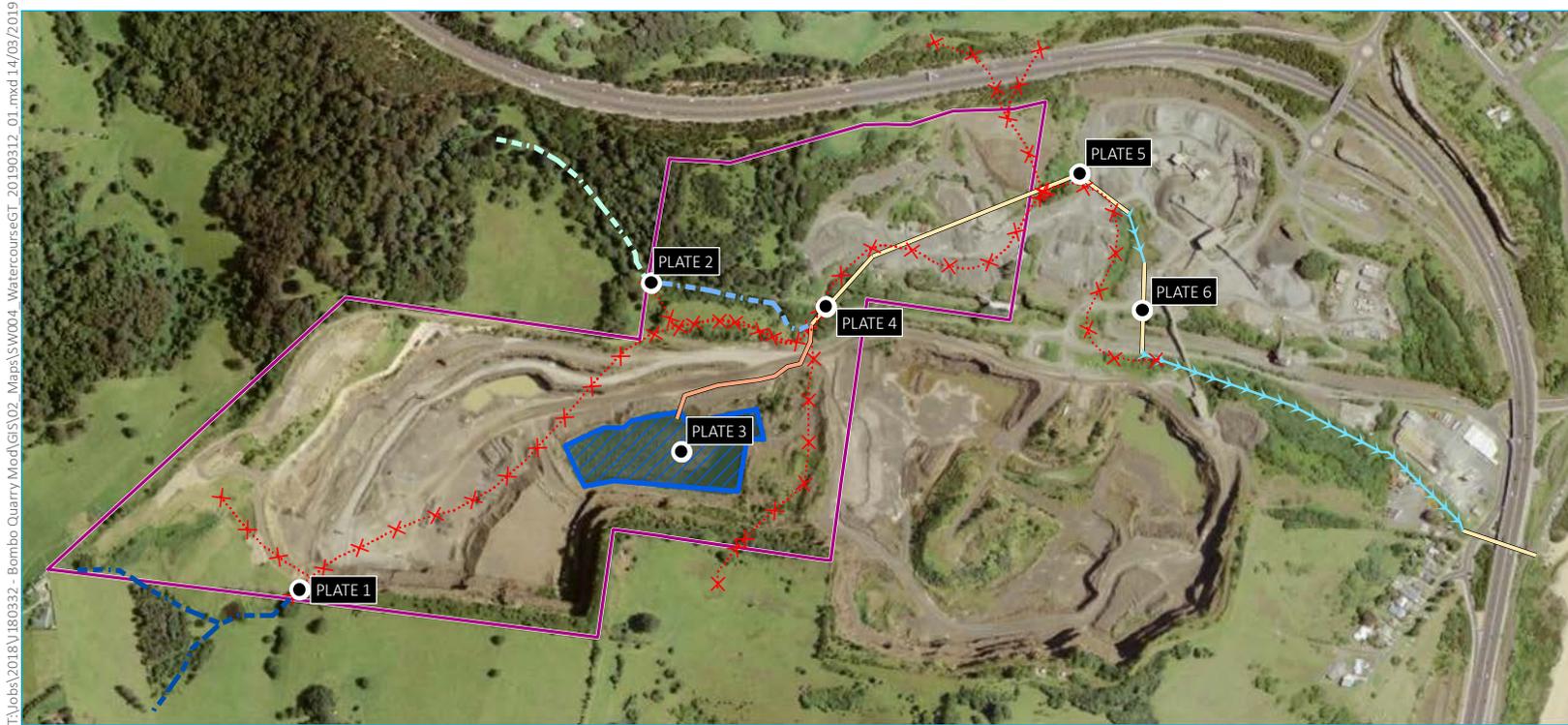
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Source: EMM (2018); DFSI (2017); GA (2015); DPI (2013)





- KEY**
- Site boundary
 - ▣ Pit sump
 - Water management system based on observations
 - Indicative rainfall-dependent watercourse (LEP)
 - Indicative modified watercourse (EMM)
 - Indicative watercourse (LEP & DPI)
 - ✗ Watercourse does not exist
 - Piped drainage
 - Remnant reaches of open channel
 - Temporary dewatering pipe
 - Plate



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Source: EMM (2018); DFSI (2017); GA (2015)

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m
GDA 1994 MGA Zone 56



Outcomes of watercourse ground-truthing exercise

Bombo quarry modification
Surface water assessment
Figure 3.3



4 Proposed modification

4.1 Overview

The proposed modification seeks to:

- allow for the importation of fill material to be used for rehabilitation; and
- amend approved rehabilitated batter slopes.

4.2 Importation of fill material

The proposed modification seeks to facilitate importation of VENM/ENM for use in the rehabilitation of the quarry void, to supplement existing stockpiled overburden. It is estimated that 4.5 million m³ of supplementary material is required to fill the void to achieve a final landform that satisfies Boral's rehabilitation objectives and supports the key aims and objectives of numerous state and local strategic land use and development plans, including the Illawarra Shoalhaven Regional Plan (NSW Department of Planning and Environment 2015), the Kiama Regional Economic Development Strategy (KMC 2018), Kiama Economic Development Strategy (KMC 2014) and the Kiama Urban Strategy (KMC 2011).

The timing for importation of fill is estimated to be 5 to 8 years, depending on fill availability.

It is proposed to deliver fill material to the site via road and/or rail.

4.2.1 Road delivery

Fill material may be transported to the site via road from either the north or south via Panama Street. Trucks would be unloaded to dedicated onsite material stockpiles for subsequent transfer to the quarry pit or direct to the pit for spreading and compaction.

4.2.2 Rail delivery

For rail delivery Boral intends to reinstate the existing rail spur within the quarry. Trains, made up of either spoil filled containers or wagons, will access the site via the existing rail spur line and be unloaded using one or more of the following methods:

- transfer to void via mobile conveyor;
- transfer to void via haul truck; or
- container emptied at void.

Container and/or wagon unloading, crushing and stockpiling would be undertaken within dedicated onsite material handling areas prior to spoil transfer into the quarry void for placement.

4.2.3 Fill placement

For all options above, the fill material is proposed to be spread and compacted to meet relevant geotechnical requirements. A water cart will also be used for moisture conditioning and to minimise dust impacts, with water sourced from the quarry void where feasible, or else from water imported to site.

4.3 Finished batter slopes and final landform

The proposed modification also seeks to amend approved rehabilitated batter slopes. Currently, batter slopes are limited to a fixed range (1:1) by the development consent. Boral seeks to modify this to allow the final batter slope specification to be determined in consultation with a suitably qualified and experienced geotechnical engineer to ensure that the batters are left in a stable and serviceable condition.

Boral is seeking to adopt flexible consent conditions to allow the final rehabilitated landform and associated batters to be adjusted in response to the availability of suitable fill material during rehabilitation, which will be driven by spoil-generating market conditions.

5 Assessment of surface water impacts

5.1 Overview

An initial review identified the following potential sources of impact to surface water resources arising directly from the proposed modification:

- disturbance of remnant watercourses, potentially triggering the need for controlled activity approval under the WM Act;
- water quality; and
- flooding.

The following sections provide a brief appreciation of each issue and assessment of impacts. Where necessary, additional mitigation and management measures have also been identified.

5.2 Impacts to watercourses and need for controlled activity approval

As described in Section 3.2, all existing open channel reaches within the site boundary have been relocated and/or heavily modified by historic quarrying activities and form part of the quarry's water management system, and no longer occur as shown by current DoI-Water/Council watercourse mapping.

On this basis, a controlled activity approval is not a relevant consideration for the proposed modification.

Design and staging of rehabilitation works will need to consider appropriate measures to manage scouring and erosion along drainage lines through the quarry in order to prevent erosion of compacted fill and transport of sediment downstream. Further details of proposed erosion and sediment control measures and stabilisation methods are provided in Section 5.3.

Design of ultimate watercourse treatments and associated riparian corridors will need to be considered as part of future planning for longer term surface water management for redevelopment of the area, beyond rehabilitation of the quarry.

5.3 Impacts to water quality

Potential adverse impacts to water quality are associated with the following aspects of the proposed modification:

- placement of an increased volume of fill to achieve the desired final landform;
- import of fill as VENM and/or ENM from offsite to supplement stockpiled overburden;
- reinstatement of rail spur; and
- ongoing management of road/rail delivery stockpile areas and transport of fill material within the quarry.

Table 5.1 provides further description of these activities and associated risks to water quality.

Table 5.1 Summary of potential impacts to water quality

Activity	Description	Risks to water quality
Placement of an increased volume of fill to achieve the desired final landform.	Extents of filling will be increased across the quarry to suit the rehabilitation objectives.	<ul style="list-style-type: none"> Primary risk to water quality is associated with exposure of soils and potential erosion and mobilisation of sediment into receiving watercourses. This could also occur as a result of poor ground cover revegetation or lack of other suitable surface stabilisation.
Import of fill from offsite to supplement stockpiled overburden.	Fill to comprise VENM/ENM, to a maximum of 4.5 million m ³ over anticipated 5 to 8 year period	<ul style="list-style-type: none"> VENM/ENM is suitable for use as engineering fill provided applicable EPA resource recovery order/exemptions are met. Additional risk over and above use of stockpiled overburden is considered negligible.
Reinstatement of rail spur	Rail spur was previously partially dismantled and will require reinstatement.	<ul style="list-style-type: none"> Primary risk to water quality is associated with ground disturbance and exposure of soils and potential erosion and mobilisation of sediment into receiving watercourses. This could also occur as a result of poor ground cover revegetation or lack of other suitable surface stabilisation. Contamination of surface water as a result of accidental spillage of materials such as fuel, lubricants, herbicides and other chemicals used to support construction activities could also adversely impact water quality.
Ongoing management of road/rail delivery stockpile areas and transport of fill material within the quarry.	Existing established delivery / stockpile areas and haul routes with higher throughput due to increased filling.	<ul style="list-style-type: none"> Primary risk to water quality is associated with scouring of stockpiles and material spillage along haul routes with mobilisation of sediment into receiving watercourses. Contamination of surface water as a result of accidental spillage of materials such as fuel, lubricants, herbicides and other chemicals used to support construction activities could also adversely impact water quality.

Potential risks to water quality identified in Table 5.1 are considered minor and manageable provided that appropriate erosion and sediment control (ESC) measures are designed and implemented as part of the rehabilitation phase, and form part of an Environmental Management Plan (EMP) for the quarry. Key principles for ESC and broader water management to address the potential contamination of surface water from operational plant and equipment should include:

- consistency with the approach and guidance of the *Managing Urban Stormwater: Soils & Construction* series, including Volume 1 (Landcom 2004) and Volume 2E: Mines and Quarries (Landcom 2008);
- consideration of staging of fill placement;
- progressive revegetation and/or stabilisation of filled areas to minimise exposed soils to the extent possible, with ongoing monitoring and maintenance as required;
- consideration of appropriate stabilisation techniques along drainage lines; and
- procedures for hazardous material storage and spill management.

The current Water Pollution Control Plan (F003-01-032 REV 0) will also require updating to reflect current site conditions and proposed rehabilitation activities, and should form part of the EMP.

5.4 Impacts to flooding

As part of the void rehabilitation proposal, surface water collected in the void will be re-used for suitable onsite activities such as moisture conditioning and dust suppression. As the infilling occurs and ground levels change, a sump (or retention basin) will be maintained to capture and store excess stormwater.

Stored stormwater will be monitored and continue to be discharged in a controlled manner to Bombo Beach in accordance with the EPL. Therefore, the ongoing management of stormwater during the rehabilitation process would mitigate any potential for adverse flooding impacts downstream.

Flooding conditions and potential impacts on downstream property and infrastructure would be addressed as part of final landform design and future planning for longer term surface water management for redevelopment of the whole locality, including the Sydney Trains site, beyond the rehabilitation phase of the quarry.

5.5 Cumulative impacts

The proposed modification is considered unlikely to result in any significant cumulative impact to surface waters due to the local topography, relatively small contributing catchment area and lack of other known substantial development activities in the area.

6 Summary and conclusion

This SWA has assessed potential surface water impacts associated with the proposed modification. Preliminary review identified the following potential areas of sensitivity:

- watercourses, potentially triggering the need for controlled activity approval under the WM Act;
- water quality; and
- flooding.

Watercourse mapping produced by both DoI-Water and Council is not representative of current site conditions, given the extraction and supporting activities and associated extensive modifications to watercourses that have occurred over time. From review of contemporary aerial imagery and contour data, and supported by recent site inspection, all existing open channel reaches within the quarry site boundary have been relocated and/or heavily modified by historic quarrying activities and are considered to form part of the quarry's water management system, and no longer occur as shown by current DoI-Water/Council watercourse mapping. Accordingly, controlled activity approval under the provisions of the WM Act is not considered to be required for further works within the quarry as part of its ongoing rehabilitation.

The main risks to water quality will occur as a result of an increase in the volume and extent of fill material required to achieve the desired final landform within the quarry; reinstatement of the rail spur; operation of delivery stockpile areas; and transport of fill material within the quarry. These activities are likely to increase ground disturbance and exposure of soils with potential erosion and mobilisation of sediment into receiving watercourses. Contamination of surface water as a result of accidental spillage of materials such as fuel, lubricants, herbicides and other chemicals used to support construction activities could also adversely impact water quality.

Design and staging of rehabilitation works will need to consider appropriate measures to manage scouring and erosion along drainage lines through the quarry in order to prevent erosion of compacted fill and transport of sediment downstream.

Proposed key management measures to minimise the potential for adverse water quality impacts include implementation of erosion and sediment control measures in accordance with Landcom (2004 and 2008); progressive revegetation or stabilisation of disturbed areas to minimise exposed soils to the extent possible; stabilisation of drainage lines; and implementation of procedures for hazardous material storage and spill management. The current Water Pollution Control Plan will also require updating to reflect current site conditions and proposed rehabilitation activities.

The proposed modification will continue to monitor and discharge stored stormwater in a controlled manner to Bombo Beach in accordance with the EPL. Therefore, the ongoing management of stormwater during the rehabilitation process would mitigate any potential for adverse flooding impacts downstream. The proposed modification is also considered unlikely to result in any significant cumulative impact to surface water resources.

It is noted that further consideration of surface water management will be required as part of future planning and design exercises for the whole redevelopment of the area, including the Sydney Trains quarry site, beyond the current rehabilitation phase of the quarry.

Abbreviations

DoI-Water	NSW Department of Industry – Lands and Water Division
EMM	EMM Consulting Pty Ltd
EMP	Environmental Management Plan
ENM	excavated natural material
EPA	Environment Protection Authority
EPL	environment protection licence
EP&A Act	NSW <i>Environmental Planning & Assessment Act 1979</i>
ESC	erosion and sediment control
KMC	Kiama Municipal Council
LEP	Kiama Local Environmental Plan 2011
LGA	local government area
NRAR	Natural Resource Access Regulator
PIRMP	Pollution Incident Response Management Plan
SEE	Statement of Environmental Effects
SWA	Surface Water Assessment
tpa	tonnes per annum
VENM	virgin excavated natural material
WM Act	NSW <i>Water Management Act 2000</i>

References

Boral 2018, Pollution Incident Response Management Plan – Bombo Quarry, Revision 6 dated August 2018.

Boral 2017, Bombo Quarry Dewatering Plan, October 2017, Version 6.

Kiama Municipal Council 2018, Kiama Regional Economic Development Strategy.

Kiama Municipal Council 2014, Kiama Economic Development Strategy.

Kiama Municipal Council 2011, Kiama Urban Strategy.

Landcom 2008, Managing Urban Stormwater: Soils & Construction, Volume 2E: Mines and Quarries.

Landcom 2004, Managing Urban Stormwater: Soils & Construction, Volume 1.

NSW Department of Planning and Environment 2015, Illawarra Shoalhaven Regional Plan.



Appendix A

Water quality data



Table A1 Summary of water quality data

Location ¹	Parameter:	Field pH	Lab pH	Temp (°C)	DO (% saturation)	EC (µS/cm)	Turbidity (NTU)	TSS (mg/L)
	Dewatering plan limits:	6.5-9	6.5-9	15-35	90-110	50-50000	0.5-50	40
Bombo Pit [1]	Min	7.82	8.2	12.81	86	508	1.5	5
	Max	9.08	9	25.9	123.8	628	11.5	13
	Total exceedances	7	0	5	8	0	0	0
	Total samples	17	11	18	18	19	19	11
	% exceedances	41%	0%	28%	44%	0%	0%	0%
LDP [2]	Min	8.13	0	12.37	88.2	551	1.5	5
	Max	9.03	8.9	23.99	115.4	696	7.1	13
	Total exceedances	2	1	3	3	0	0	0
	Total samples	19	13	19	20	20	20	12
	% exceedances	11%	8%	16%	15%	0%	0%	0%
Bombo Beach [3]	Min	7.85	8	12.9	84	546	0.5	5
	Max	8.49	8.4	25.01	105.5	696	5.5	20
	Total exceedances	0	0	3	6	0	0	0
	Total samples	18	12	16	19	19	19	12
	% exceedances	0%	0%	19%	32%	0%	0%	0%
All Sites	Min	7.82	0	12.37	84	508	0.5	5
	Max	9.08	9	25.9	123.8	696	11.5	20
	Total exceedances	9	1	11	17	0	0	0
	Total samples	54	36	53	57	58	58	35
	% exceedances	17%	3%	21%	30%	0%	0%	0%

Notes: 1 refer Figure 3.1 for location reference numbers



