ARCADIS Design & Consultancy for natural and built assets

DUNMORE HARD ROCK QUARRY PROJECT

Water Management Plan

29 NOVEMBER 2016

Incorporating Hyder

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BORAL

Hard Rock Quarry Project

Water Management Plan

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1 INTRODUCTION

1.1 Background

The Dunmore Hard Rock Quarry, owned and operated by Boral Resources (NSW) Pty Ltd, is located at Tabbita Road Dunmore, approximately 12 kilometres north-west of Kiama in the Shellharbour Local Government Area. The quarry produces hard rock which is crushed to produce coarse aggregates and road construction materials, and fines that are used as manufactured sand or bedding material, and to produce NusoilTM, a soil additive and conditioner to assist in increasing agricultural yields.

Development Consent (DA 470-11-2003), issued 19 November 2004 by the Minister for Infrastructure and Planning, allows Boral to produce up to 2.5 million tonnes of hard rock a year (Mtpa), and transport it offsite by road and rail to local and regional markets.

Since consent was issued in November 2004, there have been seven approved modifications (with conditions), as detailed below:

1. Modification 1 - December 2005
2. Modification 2 - June 2006
3. Modification 3 - May 2008
4. Modifications 4 and 5 - November 2008
5. Modification 6 - Increased extraction area and road haulage, February 2014
6. Modification 7 - October 2015.

Consent requires the preparation and implementation of a number of management plans to guide the environmental management of the development throughout its operational life.

In accordance with Condition of Approval (CoA) 4(32) and 4(44), a Water Management Plan was prepared by Evans and Peck for Boral in 2008 (2008 WMP) and an earlier Site Water Management Plan was prepared by Matrix Consulting in 2005. This WMP consolidates and supercedes these previous plans.

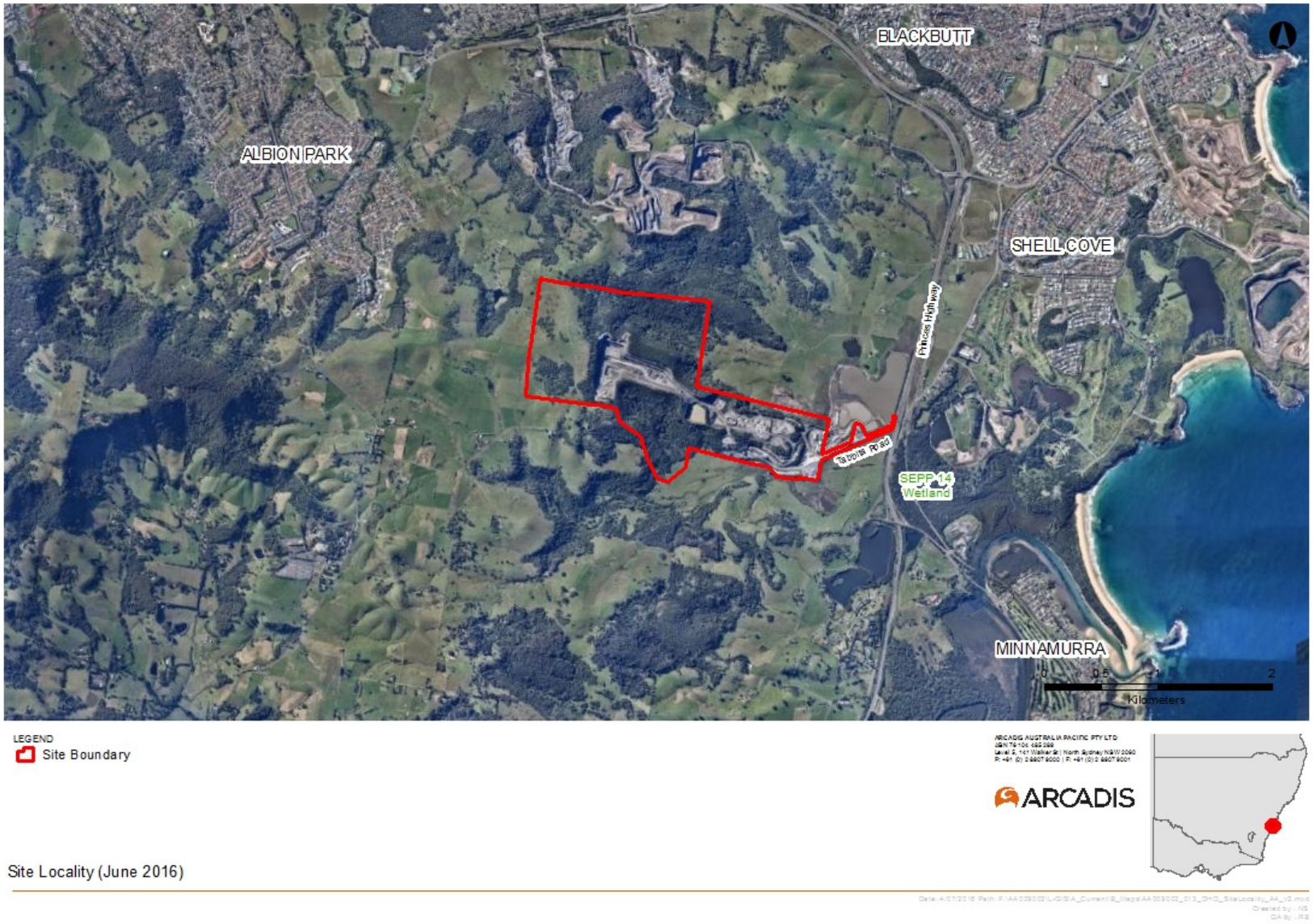

Figure 1-1 Site Locality

1.2 Project Description

Dunmore Hard Rock Quarry (the site) covers approximately 248 hectares and is surrounded by private property and Boral owned property, predominantly agricultural grazing land and tracts of remnant native vegetation, to the south, north and west (Figure 1-1). Dunmore Soil and Sand Quarry adjoins the site to the east.

Dunmore Hard Rock Quarry produces hard rock from Bumbo Latite Member, a fine-grained intermediate volcanic rock similar to basalt, which is crushed to produce coarse aggregates, road construction materials and fines. Extraction occurs from three discrete areas: Original Dunmore Quarry, Croome Farm Pit and Rail Infrastructure Corporation (RIC) land. These areas are described in further detail in Section 3.1.

The extraction method involves drilling and blasting to produce broken rock, that is transported to the primary crusher feed bin. The primary-crushed rock is further reduced in size in a series of crushers, before being conveyed to the tertiary screen house where the crushed rock is sized according to product specifications. The sized products are then stockpiled within the various stockpile areas on site, until they are transported by road and rail to local and regional markets. A detailed description of Dunmore Quarry's operations is provided by *Environmental Impact Statement for the proposed Dunmore Quarry Production Increase* (R. W. Corkery & Co., 2003).

1.3 Objectives of this WMP

The purpose of this WMP is to provide a single operational document that clearly identifies key management issues, management objectives and actions to be implemented in accordance with development consent requirements, the proposed schedule for implementation as well as the monitoring and review of commitments included in this WMP.

This WMP addresses (CoA) 4(32) and 4(44) which require the preparation of a WMP including:

- A water balance (CoA 4(41A))
- An erosion and sediment control plan (ESCP) (CoA 4(42))
- A surface water monitoring program (SWMP) (CoA 4(43))
- A groundwater monitoring program (GWMP) (CoA 4(44))
- An integrated water management strategy (IWMS) (CoA 4(45)).

This document incorporates the above mentioned plans, updates and streamlines the previous WMPs and includes a set of clear and concise maps and diagrams showing the locations of management areas. Further detail regarding the CoAs is provided in Section 2.3.

1.4 Document structure

The structure of this WMP is outlined in Table 1.

Table 1-1 Structure of this WMP

Section	Content
1	Provides an overview of the project and the purpose and scope of this plan.

Section	Content
2	Details the statutory requirements for the plan as outlined in the CoAs issued by the NSW Department of Planning and Infrastructure and other legislative requirements.
3	Describes the existing environment of the site including surface water and groundwater characteristics.
4	Outlines Integrated Water Management Strategy (IWMS)
5	Presents the site water balance
6	Describes the management plans and actions to be undertaken to effectively manage surface and ground water on the site including the WMP, ESCP, SWMP and GWMP.
7	Outlines the monitoring, reporting and review requirements pertaining to surface and ground water management within the site
8	Specifies the environmental induction training to delivered to all staff and subcontractors involved in the project
9	Outlines the requirements pertaining to contingency planning, including emergency incident reporting and management
10	Lists the references used in the preparation of this plan

2 RELEVANT LEGISLATION, GUIDELINES AND PLANS

2.1 Legislation

Key environmental legislation that relates to this WMP include:

- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Environmental Planning and Assessment Regulation 2000* (EPA Reg)
- *Water Act 1912* (Water Act)
- *Water Management Act 2000* (WMA 2000)
- *Protection of the Environment Operations Act 1997* (POEO Act).

This legislation was taken into account during the preparation of the Environmental Impact Statement (EIS) that supported the application for development consent (R. W. Corkery & Co., 2003). Requirements stemming from this legislation have been incorporated into the CoAs, which are addressed throughout this WMP.

2.2 Guidelines

The following guidelines are relevant to the WMP and have been referenced where appropriate throughout this document:

- Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004a)
- Managing Urban Stormwater: Soils and Construction Volume 2E – Mines and Quarries (Department of Environment and Climate Change NSW 2008).

2.3 Conditions of Approval

Table 2-1 lists the CoAs relevant to water management on the site and identifies where the conditions have been addressed in this document.

Table 2-1 Conditions of Approval relevant to the Water Management Plan

CoA#	Aspect	Condition	Where addressed in this document
Surface and groundwater			
4(28)	Pollution of Waters	Except as may be expressly provided by an Environment Protection Licence, the Applicant shall comply with section 120 of the Protection of the Environment Operations Act 1997 during the carrying out of the development.	Section 6
4(29)	Water Discharge Limit	Except as may be expressly provided by an Environmental Protection Licence, the Applicant shall ensure that the discharges from any licenced discharge point/s comply with the limit in Table 12:	Section 6

CoA#	Aspect	Condition	Where addressed in this document
		<table><tr><th>Pollutant</th><th>Units of Measure</th><th>100 Percentile Concentration Lim</th></tr><tr><td>TSS</td><td>mg/L</td><td>50</td></tr><tr><td>pH</td><td>pH</td><td>6.5 – 8.5</td></tr></table> *Table 12: Water Discharge Pollution Limits*	
4(30)	Site Water Balance	Each year, the Applicant shall: (a) review the site water balance for the development against the predictions in the EIS; (b) re-calculate the site water balance for the development; and (c) report the results of this review in the Annual Review.	Section 5*
4(31)	Storm Water Management System	The Applicant shall ensure that the storm water management system for the development is designed, constructed and operated to capture and treat polluted waters from storm event(s) of up to and including the 5-day, 95th percentile rainfall event.	Section 0 and 6.1
4(32)	Storm Water Management System	The Applicant shall ensure that the basins in the storm water management system are managed in accordance with the operating principles within the revised Water Management Plan prepared by Evans and Peck, dated April 2008, or any subsequent Water Management Plan approved by the Secretary, to maintain the required storm water storage volume.	Section 3.2.4.5 and 6.1
4(33)	Offline Dam	By 18 May 2008, or as otherwise agreed to by the Secretary, the Applicant shall: (a) modify the existing dam at the site to create a dam with a capacity of at least 61.4ML offline from Rocklow Creek; (b) ensure the discharge and overflow points of the dam do not cause erosion at the point of discharge/overflow; (c) rehabilitate and stabilize the banks of the dam; (d) construct a baffle and macrophyte zone downstream of the dam; and (e) ensure the integrity of the dam would not be compromised by any flooding in Rocklow Creek; to the satisfaction of the EPA and the Secretary.	Section 0 and 6.1
4(34)	Offline Dam	Prior to carrying out any of these works, the Applicant shall prepare, and subsequently implement, a Dam Upgrade Plan in consultation with the EPA, and to the satisfaction of the Secretary. This plan must include: (a) the detailed design and specifications of the proposed works, which have been certified by a practicing registered engineer;	Section 6.1

CoA#	Aspect	Condition	Where addressed in this document
		(b) an erosion and sediment control plan for the proposed works, that is consistent with the requirements in the Department of Housing's Managing Urban Stormwater: Soils and Construction manual; (c) a vegetation and rehabilitation plan, setting out how the banks of the dam would be rehabilitated and stabilized, and the baffle and macrophyte zone would be constructed; (d) an acid sulfate soil management plan that is consistent with the NSW Acid Sulfate Soil manual; (e) a construction program for the proposed works; and (f) a program setting out how the modified dam and associated revegetation works would be maintained during the life of the development.	
4(35)	Offline Dam	Within 1 month of completing the construction works in the Dam Upgrade Plan, the Applicant shall submit an as-executed report, certified by a practicing registered engineer, to the satisfaction of the EPA and Secretary.	Section 6.1
4(36)	Flocculant Management	The Applicant shall not use a flocculant, other than alum or ferric chloride, without the written approval of the EPA.	Section 6.1*
4(37)	Flocculant Management	Prior to carrying out any of the construction works required in condition 33 above, the Applicant shall prepare, and subsequently implement, a Flocculant Management Plan for the development to the satisfaction of the EPA. This plan must: (a) describe the proposed dosing system, including procedures for dosing in different operating conditions procedures, and procedures to ensure excess flocculant dosing is prevented; and (b) describe how the performance of this system would be monitored over time.	Section 6.1*
4(38)	Other Water Management Works	Within 18 months of the date of this consent, the Applicant shall carry out the following works: (a) Workshop and Fuel Storage Area • desilt drains and culverts upstream of the workshop to limit flooding; • construct a first flush collection basin to capture and store the first 13mm of run-off from the external service bays before it is treated by the oil/water separator; and • bund and roof the drum storage area;	Section 6.1*

CoA#	Aspect	Condition	Where addressed in this document
		(b) Magazine Area • reinstate drain through access road to magazines to direct stormwater flows to the main drain; (c) deleted to the satisfaction of EPA and the Secretary.	
4(39)	Bunding	Impervious bunds must be constructed around all fuel, oil and chemical storage areas and the bund volume must be large enough to contain 110 per cent of the volume held in the largest container. The bund must be designed and installed in accordance with the requirements of the EPA Environment Protection Manual Technical Bulletin Bunding and Spill Management.	Section 6.1
4(40)	Monitoring	The Applicant shall: (a) measure: • the volume of water discharged from the site via licenced discharge points; • water use on the site; • water transfers across the site; • dam and water structure storage levels; (b) monitor the quality of the surface water: • discharged from the licence discharge point/s of the development; • upstream and downstream of the development; (c) monitor flows in Rocklow Creek; and (d) monitor regional groundwater levels and quality; to the satisfaction of the EPA and the Secretary.	Section 6.3
4(41)	Management	Within 12 months of the date of this consent, the Applicant shall prepare, and subsequently implement, a Site Water Management Plan for the development, in consultation with the DPI - Water, and to the satisfaction of the Secretary. This plan must include: (a) the predicted site water balance; (b) an Erosion and Sediment Control Plan; (c) a Surface Water Monitoring Program (d) a Ground Water Monitoring Program; and (e) an Integrated Water Management Strategy.	Section 5, 6.2, 6.3 and 6.4/ Appendix H
4(42)	Management	The Erosion and Sediment Control Plan shall:	Section 6.2

CoA#	Aspect	Condition	Where addressed in this document
		(a) be consistent with the requirements of the Department of Housing's Managing Urban Stormwater: Soils and Construction manual; (b) identify activities that could cause soil erosion and generate sediment; (c) describe measures to minimize soil erosion and the potential for the transport of sediment to downstream waters; (d) describe the location, function, and capacity of erosion and sediment control structures; and (e) describe what measures would be implemented to maintain the structures over time.	
4(43)	Management	The Surface Water Monitoring Program shall include: (a) detailed baseline data on surface water flows and quality in Rocklow Creek; (b) surface water impact assessment criteria; (c) a program to monitor surface water flows and quality in Rocklow Creek; (d) a program to monitor bank and bed stability in Rocklow Creek; and (e) a program to monitor the effectiveness of the Erosion and Sediment Control Plan.	Section 6.3
4(44)	Management	The Ground Water Monitoring Program shall include: (a) detailed baseline data on ground water levels and quality, based on statistical analysis; (b) ground water impact assessment criteria; and (c) a program to monitor regional ground water levels and quality.	Section 6.4/ Appendix H
4(45)	Management	The Integrated Water Management Strategy shall: (a) explore a range of options for a sustainable resource alternative for water supply to the site; (b) identification of all possible and available sources of water; (c) consistency with Government Water Reform initiatives and policies; (d) quality of water to meet usage requirements including any possible effects on product; (e) costs of supply; (f) health and environmental impacts; (g) legislative requirements;	Section 4

CoA#	Aspect	Condition	Where addressed in this document
		(h) assessment of the feasibility, benefits and costs of options; (i) a process to identify and evaluate preferred options for implementation; and (j) the identification of a timetable for implementation of the selected options.	

* Boral is in the process of submitting an administrative modification to amend the following CoA's (relevant to the WMP):

- CoA 4(30) - The EIS water balance is no longer valid. The proposed modification is discussed in further detail in Section 5.
- CoA 4(36) and 4(37) - Delete flocculant management requirement condition as flocculants no longer used.
- CoA 4(38) - Delete condition as actions have been completed and were reported back to the EPA (Annual Return) and Secretary (Annual Review).

This plan will be updated following the resolution of these matters.

2.4 Licences and permits

2.4.1 Environment Protection Licence No. 77

The Environment Protection Authority (EPA) issues environment protection licences (EPLs) to the owners or operators of various industrial premises under the *Protection of the Environment Operations Act 1997* (POEO Act). Licence conditions relate to pollution prevention and monitoring, and cleaner production through recycling and reuse and the implementation of best practice. All licence holders must:

- Comply with the conditions of their licence
- Prepare pollution incident response management plans
- Publish and/or make pollution monitoring data available.

EPL 77 applies to the site and relevant conditions are included throughout this WMP. The EPL itself is provided in Appendix C.

2.4.2 Water Extraction Licence

Dunmore Quarry holds a surface water extraction licence (WAL25152) under *Water Management Act 2000* to extract 227ML per annum of surface water from the "Illawarra Rivers Water Source", "Minnamurra River Management Zone" (i.e. Rocklow Creek). A copy of the licence details is attached at Appendix D. This licence was converted from what was previously a licence (10SL050221) held under the *Water Act 1912*. Details of the conversion are contained in Appendix E.

The *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* (Water Sharing Plan) is currently in force and applies conditions for extraction of water under a water access licences within the Illawarra Rivers Water Source. Any extraction from Rocklow Creek will need to comply with the rules of the Water Sharing Plan.

2.4.3 **Water Supply Works approval**

Water Supply Works approval number 10WA103611 applies to the site. The approval came into effect on 1/07/2011 and expires on 30/06/2024. The approval is for a 100mm centrifugal pump (Work 1) and a bywash dam (Work 2) in the Illawarra Rivers Water Source. Schedule 3 of the approval applies a number of statutory conditions including conditions relating to record keeping (via log books or meters fitted with data loggers) and notifications of breach of the conditions (among others). The approval is included in Appendix F.

2.4.4 **Harvestable Rights**

The Department of Primary Industries document *Dams in NSW: Do you need a licence?* (2016) outlines the circumstances in which licences are not required for dams. In relation to harvestable rights, the document states:

> "*The following dams should not be included when you are calculating the capacity of dams allowed on your property under a harvestable right: (..) Dams for the capture, containment and recirculation of drainage and/or effluent that conform to best management practice or are required by regulation to prevent the contamination of a water source. The harvestable right is not intended to be contrary to initiatives to prevent pollution of water sources. Many landholders are required to install dams to capture contaminated water or to collect and re-use irrigation tailwater* (DPI, 2016).

As outlined in the 2008 WMP, the dams on site all fill a specific environmental purpose, in that the water being stored is re-used for dust suppression of roads, stockpiles and in the plant crushing process. The operating rules for these dams were outlined in the 2008 WMP and have been incorporated as conditions under the sites Development Consent (DA 470-11-2003) via modifications made in November 2008.

2.5 Alignment with other Plans relevant to the Project

This document supercedes the Water Management Plan (Evans and Peck, 2008) and the Site Water Management Plan (Matrix consulting, 2005). Where relevant, the information from these two plans has been used to compile this plan.

A number of other management plans apply to the site including a Flora and Fauna Management Plan (FFMP) and a Rehabilitation Management Plan (RMP). The management actions in this plan complement those outlined in the FFMP and RMP, and should be considered holistically.

3 EXISTING ENVIRONMENT

3.1 Site description

The site covers approximately 248 hectares and includes the existing extraction footprint, processing plant, stockpiles of sized products, a workshop and maintenance area, the rail siding and product loading area, administration buildings, carpark and weighbridge (Figure 3-1).

The site also contains a concrete batching plant, which operates under a separate development consent granted by Shellharbour City Council on 4 December 1997. The site is accessed from the Princes Highway via Tabbita Road, a road used solely for access to the quarry (Corkery & Co 2003). The extraction footprint is surrounded by remnants of native vegetation, separated by expanses of cleared and disturbed grassland.

Historically, extraction has occurred in an area known as Original Dunmore Quarry. Extraction operations are currently centred on the Croome Farm Pit and Rail Infrastructure Corporation (RIC) Slot extraction areas (Figure 3-1).

3.1.1 **Original Dunmore Quarry**

Extraction from the original Dunmore Quarry, located on Boral-owned land, commenced in 1921. The original quarry contains approximately 2.5 million m^3 of breccia- agglomerate above approximately 12 Mt of latite in the lower flow. Extraction involves the progressive removal of a breccia-agglomerate (likely to be suitable for production of road pavement materials) and the eventual recovery of high quality latite from the lower flow. There is no limit on the extraction rate from the original quarry.

The existing extraction floor in the original Dunmore Quarry slopes gradually to the east. Elevations of the floor vary from 30mAHD to 60mAHD and there are localised faces where some of the agglomerate has been extracted. The outer faces of the original Dunmore Quarry have been retained to assist in screening exposed extraction faces and stockpiled by-products on the quarry floor (R. W. Corkery & Co., 2003).

3.1.2 **Croome Farm Pit**

The western area, referred to as Croome Farm Pit extraction area, is owned by Boral. Extraction commenced in this area in 2000, and approximately 12Mt remains in the Croome Farm Pit extraction area. The resource within the Croome Farm Pit extraction area is calculated to the current approved depth of extraction of 107mAHD.

Extraction within Croome Farm Pit will continue to target the upper and middle latite flows. The design of the approved extraction area provides for the creation of three benches in the upper and middle flows in the Croome Farm Pit extraction area. Development Consent No. 168/1994 (am 1) allows an extraction rate of 750 000tpa (R. W. Corkery & Co., 2003).

3.1.3 **Rail Infrastructure Corporation (RIC) Slot**

The central extraction area referred to as Rail Infrastructure Corporation (RIC) Slot extraction area located on land leased to Boral for which a production royalty is applied to any material extracted from this area. Extraction within this area commenced in 1986 with the intent to provide an internal low-level access to the Croome Farm Pit extraction area. Extraction within RIC Slot will continue to target the upper and middle latite flows, with approximately 5 Mt remaining

in the RIC Slot extraction area. Development Consent No. 161/1986 allows an extraction rate of 450 000tpa.

The extraction floor levels within the RIC Slot extraction area rise gradually in a westerly direction at about 3% to 4% to meet the horizontal floor (and bench) levels in the Croome Farm Pit extraction area. The extraction faces in the RIC Slot extraction area are typically 15 to 17m high.

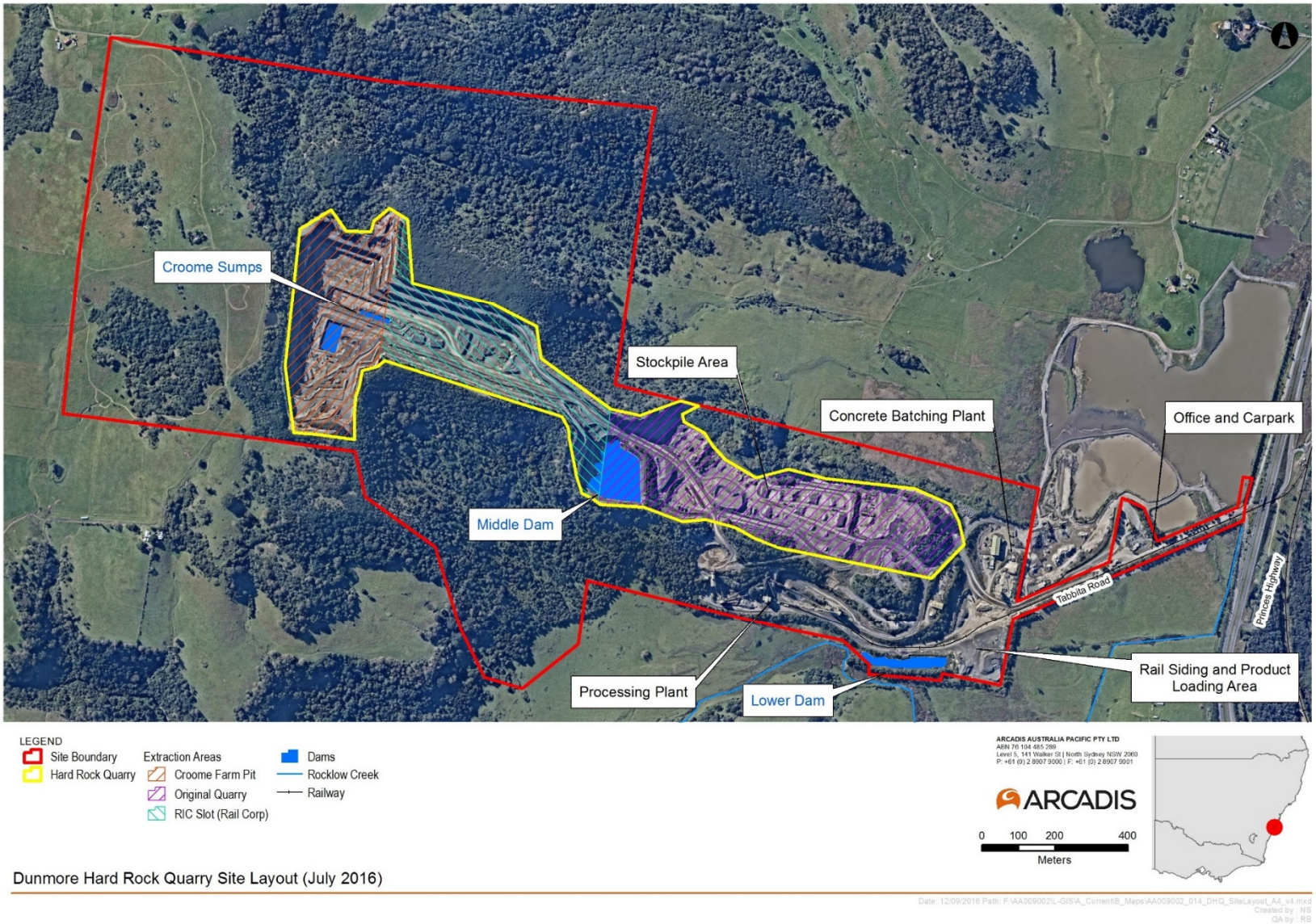

Figure 3-1 Site Layout

3.1.4 **Land use**

The site is characterised by existing quarrying activities. Forested areas and agricultural grazing surround the site to the north, west and south. The Dunmore Sand and Soil property lies to the east of the site and shares the Tabbita Road access point. A wetland listed under *State Environmental Planning Policy No 14 – Coastal Wetlands* (SEPP 14) (Coastal Wetland No 374a) is located downstream, on the eastern side of the Princes Highway.

3.1.5 **Topography**

The site is located on rolling hills along the lower slopes of the Illawarra escarpment. The northern and southern extraction boundaries align with the crests of steep slopes (R. W. Corkery & Co., 2003). The site lies between 10m and 164m AHD, with the lowest part of the site at the eastern boundary near the office and weighbridges, and the heights part surrounding the western extraction areas (R. W. Corkery & Co., 2003).

3.2 Surface Water

This section describes the surface water characteristics of the site. The information in this section is sourced from the Environmental Impact Statement for the Proposed Dunmore Quarry Production Increase (R.W. Corkery and Co. 2003), the Water Management Plan (Evans and Peck, 2008), the Site Water Management Plan (Matrix Consulting, 2005) the Boral Quarry - Environmental Monitoring Program (Boral, 2014a) and the Boral Quarry - Environmental Management Strategy (Boral, 2014b).

3.2.1 **Catchment overview**

The Minnamurra River and Rocklow Creek (a major tributary of the Minnamurra River) are the main drainage features in the vicinity of the site with the waters from these drainages ultimately flowing into the Tasman Sea at Minnamurra Point approximately 1.5km to the east of Dunmore (R.W. Corkery and Co., 2003). Both the Minnamurra River catchment (120km^2) and the Rocklow Creek catchment (21km^2) originate in the Illawarra Range to the west of the site (R.W. Corkery and Co., 2003). Figure 1-1 shows the location of the site with respect to both the Minnamurra River and Rocklow Creek.

The headwaters of Rocklow Creek lie approximately 3km west of the Project Site. The creek flows generally in an easterly direction. The tidal influence from the Minnamurra River normally extends upstream into Rocklow Creek to a point immediately east of the Illawarra Railway Line (R.W. Corkery and Co., 2003). During a king tide event, saline water can reach the section of Rocklow Creek immediately west of the Princes Highway (i.e. remains outside the project site).

No volumetric flow data is currently available for Rocklow Creek however Boral is investigating the installation of a flow gauge upstream of the site. Should this be installed, flow data would be incorporated into future versions of this WMP.

3.2.2 **Wetlands**

Coastal Wetland No 374a, listed under State Environmental Planning Policy (SEPP) No 14 – Coastal Wetlands, is located south-east of the site, to the east of the Princes Highway. A small local wetland is located closer to the site, downstream of Lower Dam on Rocklow Creek (see Figure 1-1). The measures in this plan have been designed to minimise potential water quality impacts to these wetland environments.

3.2.3 **Quality**

Boral has undertaken a long-term water quality monitoring program at Dunmore Quarry since 1999. Water samples have been take from locations on Rocklow Creek upstream, adjacent to and downstream of the Lower Dam, and also in the Lower Dam itself. The surface water quality results reported below relate to the monitoring locations shown on Figure 6-1. Values shown in orange

indicate where particular water quality parameters were outside (above or below) the ANZECC Guideline trigger values[1] and results shown in red indicate where results were outside of the EPL criteria[2] (where applicable).

3.2.3.1 Rocklow Creek (upstream)

Table 3-1 provides average water quality values from the monitoring location 500m upstream of the licenced discharge point to Rocklow Creek (site GS1), between 1999 and 2007. The results indicate that average pH was within the ANZECC Guidelines. Turbidity during this period was low and the average turbidity between 1999 and 2003 was below the ANZECC Guidelines. TSS was above the EPL limit which applies to the licenced discharge point for the site.

Table 3-1 Average upstream water quality in Rocklow Creek (GS1) (average water quality 1999-2003 and 2004-2007)

Period	pH	Turbidity (NTU)	TSS (mg/L)
1999-2003	6.9	1.5	3.4
2004-2007	6.8	6.5	4.7
ANZECC Guideline	6.5-8	6-50	-
EPL Limit	6.5-8.5	-	50

Source: 2008 WMP (Evans and Peck, 2008)

Table 3-2 and Table 3-3 provide average water quality values from the same location (GS1) from approximately 11 sampling events between September 2010 and June 2016 (detailed surface water quality results for this period are provided in Appendix G). Conductivity and pH results were within the ANZECC Guideline/EPL limits. Records for turbidity, dissolved oxygen and TSS were outside these limits.

Table 3-2 Average upstream water quality in Rocklow Creek (GS1) (September 2010 to June 2016) – Field Parameters

Location / Reference value	pH	Turbidity (NTU)	Conductivity (uS/cm)	Salinity (PSS)	DO (mg/L)	DO (%)	ORP* (mV)
Rocklow Creek (500m upstream/GS1)	7	116	256	0.11	6.33	63	322
ANZECC Guideline	6.5-8	6-50	200-300[3]	-	-	85-110	-
EPL Limit	6.5-8.5	-	-	-	-	-	-

* Oxidation Reduction Potential (Redox)

[1] Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems (lowland rivers), Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Volume 1 (ANZECC/ARMCANZ 2000).
[2] Exceedance of the EPL criteria only constitutes a breach of the EPL at the licenced discharge point (EPL#6/GS2).
[3] A range of 125-2200 µS/cm is cited in the default trigger values for south-east Australia for slightly disturbed ecosystems (lowland rivers) however NSW coastal rivers are typically in the range 200–300 µS/cm (ANZECC/ARMCANZ, 2000).

Table 3-3 Average upstream water quality in Rocklow Creek (GS1) (September 2010 to June 2016) – Laboratory Testing

Location/ Reference value	pH	Turbidity (NTU)	Conductivity (uS/cm)	TSS (mg/L)	Oil & Grease (mg/L)
Rocklow Creek (500m upstream/GS1)	6.7	74	268	130.3	1.7
ANZECC Guideline	6.5-8	6-50	200-300	-	-
EPL Limit	6.5-8.5	-	-	50	-

3.2.3.2 Operational water quality (on-site)

Surface water quality is monitored on a monthly basis within the Lower Dam (monitoring site EPL#8 / GS4). The average results from monitoring in this location for the period 2009/10-2014/15 are presented in Table 3-4 and Table 3-5 (detailed surface water quality results for this period are provided in Appendix G). Turbidity, dissolved oxygen and conductivity are frequently outside the ANZECC guidelines and TSS is outside the EPL limit (however this does not constitute a breach of the EPL as the limit applies to the licenced discharge point EPL#6/GS2).

Table 3-4 Average operational surface water quality in Lower Dam (EPL#8/GS4) (2009/10 to 2014/15) – Field Parameters

Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	Salinity (PSS)	DO (mg/L)	DO (%)	ORP (mV)
2009-2010 Average	7.6	36	4392	2.60	8.40	90	296
2010-2011 Average	7.2	131	640	0.31	6.71	74	323
2011-2012 Average	7.6	145	521	0.25	6.57	69	317
2012-2013 Average	7.7	331	642	220.88	7.31	78	128
2013-2014 Average	7.6	215	604	84.98	6.38	68	255
2014-2015 Average	7.9	430	480	0.23	7.07	67	254
ANZECC Guideline	6.5-8	6-50	200-300	-	-	85-110	-
EPL Limit	6.5-8.5	-	-	-	-	-	-

Table 3-5 Average operational surface water quality in Lower Dam (EPL#8/GS4) (2009/10 to 2014/15) – Laboratory Parameters

Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	TSS (mg/L)	Oil & Grease (mg/L)
2009-2010 Average	7.9	23	4201	18	<1
2010-2011 Average	7.6	95	601	38	1.83

Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	TSS (mg/L)	Oil & Grease (mg/L)
2011-2012 Average	7.9	102	522	44	1.20
2012-2013 Average	8.2	164	623	81	<1
2013-2014 Average	8.4	183	609	87	0.72
2014-2015 Average	8.2	223	480	119	0.93
ANZECC Guideline	6.5-8	6-50	200-300	-	-
EPL Limit	6.5-8.5	-	-	50	-

3.2.3.3 Operational water quality (controlled discharge)

The licenced discharge point for the site is EPL#6/GS2. There have been no controlled discharges from the site via EPL#6 since July 2009[4].

3.2.3.4 Operational water quality (uncontrolled discharge)

The EPL also requires monitoring of uncontrolled overflows from the Lower Dam (at EPL#7) and the Middle Dam (at EPL#10). There have been no uncontrolled discharges from the Middle Dam (EPL#10) since July 2009[4].

The average results from monitoring of uncontrolled overflows from the Lower Dam (EPL#7) from 2010/11-2014/15 are included in Table 3-6 and Table 3-7. No uncontrolled discharges occurred from the Lower Dam in the 2009-10 or 2013-2014 period.

Results for turbidity, dissolved oxygen and conductivity were frequently outside the ANZECC Guidelines and TSS is outside the EPL limit (however this does not constitute a breach of the EPL as the limit applies to the licenced discharge point EPL#6/GS2 for which there have been no controlled discharges since July 2009). Detailed surface water quality results for this period are provided in Appendix G.

Table 3-6 Average operational surface water quality in uncontrolled overflows from the Lower Dam (EPL#7) (2010/11 to 2014/15) – Field Parameters

Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	Salinity (PSS)	DO (mg/L)	DO (%)	ORP (mV)
2009-2010 Average	No uncontrolled overflows						
2010-2011 Average	7.1	115	373	0.18	4.70	50	339
2011-2012 Average	7.7	312	447	0.24	5.88	65	287
2012-2013 Average	8.0	679	324	181	7.36	80	39
2013-2014 Average	No uncontrolled overflows						
2014-2015 Average	7.7	1225	338	0.16	7.31	78	319

[4] Limit of data provided (July 2009).

Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	Salinity (PSS)	DO (mg/L)	DO (%)	ORP (mV)
ANZECC Guideline	6.5-8	6-50	200-300	-	-	85-110	-
EPL Limit	6.5-8.5	-	-	-	-	-	-

Table 3-7 Average operational surface water quality in uncontrolled overflows from the Lower Dam (EPL#7) (2010/11 to 2014/15) – Laboratory Parameters

Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	TSS (mg/L)	Oil & Grease (mg/L)
2009-2010 Average	No uncontrolled overflows				
2010-2011 Average	7.1	148	382	61	2.2
2011-2012 Average	7.6	650	357	354	<1
2012-2013 Average	8.2	453	325	159	<1
2013-2014 Average	No uncontrolled overflows				
2014-2015 Average	8.2	493	331	305	0.9
ANZECC Guideline	6.5-8	6-50	200-300	-	-
EPL Limit	6.5-8.5	-	-	50	-

3.2.3.5 Rocklow Creek (downstream)

The EPL also requires monitoring of flows downstream of the site in Rocklow Creek (EPL#9/GS3). The average results from monitoring downstream on Rocklow Creek from 2010/11-2014/15 are included in Table 3-8 and Table 3-9Table 3-6.

Results for dissolved oxygen were frequently outside the ANZECC Guidelines however turbidity was generally within the Guidelines and TSS did not exceed the EPL limit. Detailed surface water quality results for this period are provided in Appendix G.

Table 3-8 Average operational surface water quality in Rocklow Creek (EPL#9/GS3) (2010/11 to 2016) – Field Parameters

Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	Salinity (PSS)	DO (mg/L)	DO (%)	ORP
2010-2011 Average	6.82	48	275	0.13	3.96	41	342
2011-2012 Average	6.74	170	226	0.10	5.89	68	372
2014-2015 Average	7.24	38	243	0.11	6.29	58	290
ANZECC Guideline	6.5-8	6-50	200-300	-	-	85-110	-
EPL Limit	6.5-8.5	-	-	-	-	-	-

Table 3-9 Average operational surface water quality in Rocklow Creek (EPL#9/GS3) (2010/11 to 2016) – Laboratory Parameters

Date	pH	Turbidity (NTU)	Conductivity (uS/cm)	TSS (mg/L)	Oil & Grease (mg/L)
2010-2011 Average	6.50	16	292	25	<1
2011-2012 Average	6.20	30	165	14	<1
2014-2015 Average	67.20	22	255	19	<2
ANZECC Guideline	6.5-8	6-50	200-300	-	-
EPL Limit	6.5-8.5	-	-	50	-

While the monitoring results above indicate reduced water quality against a number of parameters in the Lower Dam (including pH, TSS, turbidity and DO), the downstream results show that these parameters have generally either returned to levels in close proximity to the upstream water quality results and/or are within ANZECC Guideline or EPL limits[5].

3.2.4 **Existing Site Drainage**

Drainage within the site is essentially subdivided into clean runoff from outside the extraction areas and potentially sediment-laden runoff from within the extraction and infrastructure areas. Figure 3-2 shows the clean and dirty (i.e. sediment-laden) flows and the water management structures within the site.

The catchment area for potentially sediment laden runoff for the site is defined by the area of disturbance, bund walls and topographic watershed lines. All dirty runoff from site components such as the product stockpile areas, workshop and maintenance area, processing area as well as the extraction area flows into one of three dams: the Croome Sumps, Middle Dam and Lower Dam. A bio-filtration swale is located down gradient of the Lower Dam to aid water quality management when discharging from the Lower Dam. An overview of these dams and the bio-filtration swale is provided below with further detail provided in Section 6. All clean runoff from the site flows into the tributaries of Rocklow Creek which is predominantly dry for most of the year (R.W. Corkery and Co., 2003).

3.2.4.1 Croome Sumps

Runoff within the Croome Farm Pit and part of the Rail Infrastructure Corporation (RIC) land extraction area accumulates at the lowest points within the extraction floor, referred to herein as the Croome Sumps. The capacity of the Croome Sumps are 40ML with an additional allowance of 5-10ML for accumulation of sediment in the dam base (Evans and Peck, 2008). This water either seeps into the groundwater or is used for dust suppression. After major storm events, accumulated water is pumped out and flows to the Middle Dam via an open channel. Uncontrolled overflows, should they occur, would also be directed to the Middle Dam via the open channel.

3.2.4.2 Middle Dam

Runoff from the RIC extraction area flows overland into the Middle Dam. This dam provides for settlement of sediments and collection of water for use in dust suppression. The capacity of the Middle Dam is 120ML with an additional allowance of 12ML for accumulation of sediment in the dam base

[5] The above information is based on averages from a range of sampling events. Boral's Annual Returns and Annual Environmental Monitoring Reports should be consulted for detailed analysis of individual water quality sampling results against EPL criteria.

(Evans and Peck, 2008b). Water can be pumped and transferred via pipe from Middle Dam to Lower Dam (and vice versa) to control water levels in the dams, aid in preventing uncontrolled overflows and manage volumes in the dams for use in dust suppression. Uncontrolled overflows would discharge into Rocklow Creek (see Figure 3-2).

3.2.4.3 Lower Dam

Runoff from the Original Dunmore Quarry area flows overland into the Lower Dam. This dam provides for settlement of sediments and collection of water for use in dust suppression. The capacity of the Lower Dam is approximately 28ML, with a maximum depth of approximately 4.5 m and a top water level of approximately 3 m AHD (Evans and Peck, 2008). The Lower Dam has been separated (i.e. taken offline) from Rocklow Creek and is the point of controlled discharge for the Quarry. Water can be pumped and transferred via pipe from Lower Dam to Middle Dam (and vice versa) to control water levels in the dams, aid in preventing uncontrolled overflows and manage volumes in the dams for use in dust suppression. Uncontrolled overflows would discharge into the bio-filtration swale and then into Rocklow Creek (see Figure 3-2).

3.2.4.4 Bio-filtration Swale

A bio-filtration swale has been established downgradient of the Lower Dam. The swale runs from the east end of the dam back around the embankment and along the southern edge of the dam before connecting to Rocklow Creek. Water discharged from the Lower Dam will travel through this swale at a maximum rate of 7 ML/day (Evans and Peck, 2008).

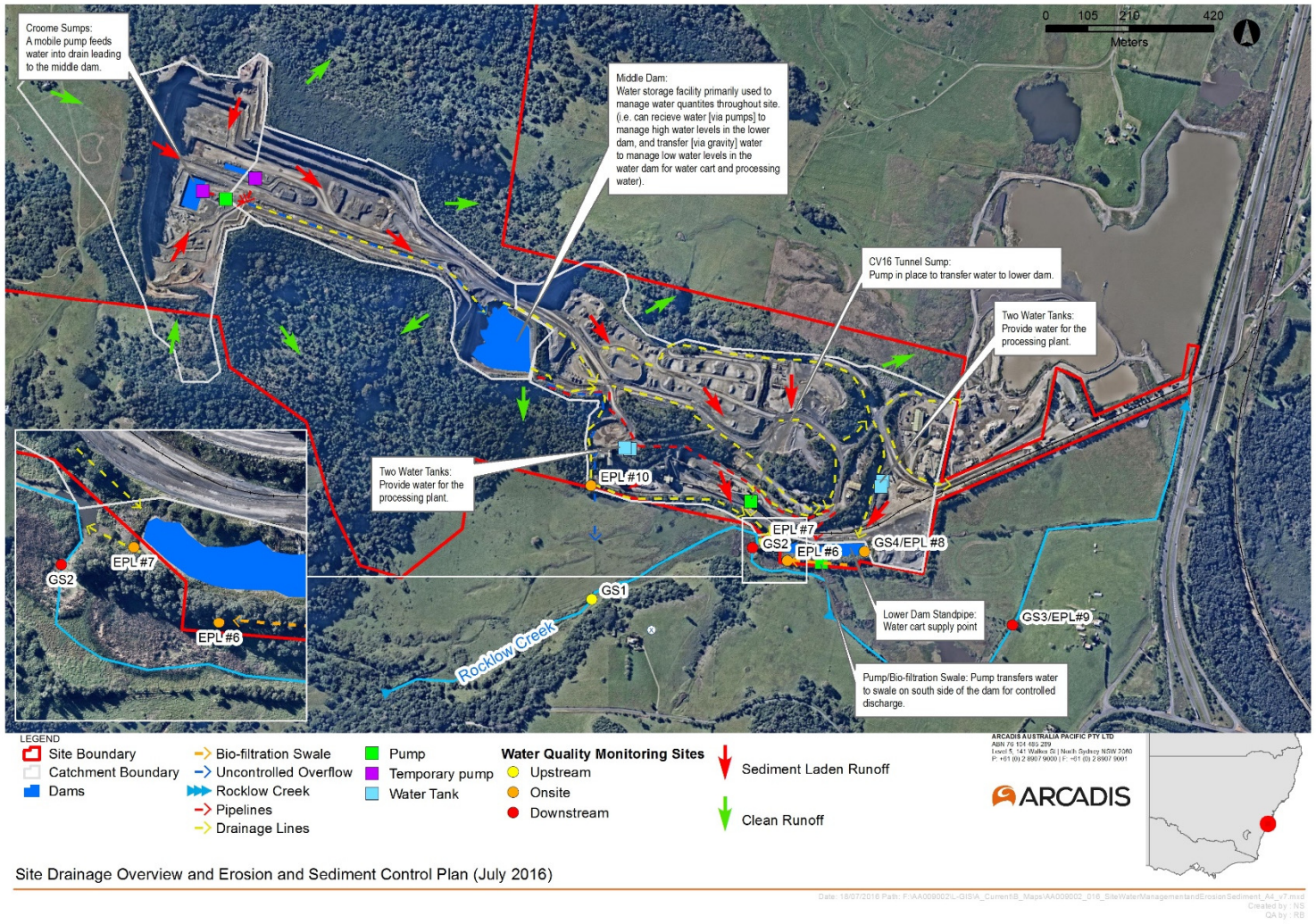

Figure 3-2 Site Drainage Overview and Erosion and Sediment Control Plan

3.2.4.5 Operating principles

The 2008 WMP (Evans and Peck, 2008) established the following operating principles for the on-site water storages. As required by CoA 4(32), the site will be operated to comply with these principles. The primary intention of these principles is to: maintain storage volumes to capture and treat polluted waters from storm events up to and including the 5-day, 95th percentile rainfall event; minimise overflows; and maximise internal water supply requirements to avoid need for external supplies. These operating principles are shown diagrammatically on Figure 5-1 and have been summarised in Table 3-10 with reference to the principle number in brackets. Two additional operating conditions have been incorporated (item #13 and #14) to cater for extraction of water from the Lower Dam into water carts for dust suppression. These have been developed based on the existing operating principles and should be tested/modelled during future updates to the water balance (see Section 5).

1. No water will be pumped to the Croome Sumps from any other water storage.
2. Water will be pumped from the Croome Sumps to the Middle Dam at a rate of 0.225 ML per day if the Middle Dam is below 65% full. This will occur until the Croome Sumps are empty;
3. Water in the Lower Dam will be pumped to the Middle Dam when the Middle Dam is less than 65% full, at a maximum rate of 10 ML/day;
4. The minimum volume that will be transferred by pump from the Lower Dam to the Middle Dam is 3 ML/day. No transfer will take place unless at least 3 ML is available in the Lower Dam (i.e. it is about 10% full);
5. If the Middle Dam is over 65% full, no water will be pumped into it. Water will be left in the Lower Dam for 24 hours, then discharged via controlled discharge to the bio-filtration swale at a maximum rate of 7 ML/day;
6. Controlled discharge to the bio-filtration swale from the Lower Dam can take place on a day when runoff or pump-in occurs, but the volume to be discharged will be limited to the volume present in the Lower Dam at the end of the previous day (up to a maximum rate of 7 ML/day – see guideline 5), to ensure the discharged volume has spent 24 hours in the Dam;
7. The Lower Dam will be capable of pumping water to the Middle Dam, and to the bio-filtration swale for controlled discharge, on the same day (given the guidelines already mentioned above);
8. If the Middle Dam has received pumped runoff from the Lower Dam on any given day, it will not discharge back to the Lower Dam on the same day;
9. The Middle Dam will discharge to the Lower Dam if the volume in the Middle Dam is above 30% capacity (subject to guidelines 8 & 10), at a maximum rate of 4 ML/day;
10. The Middle Dam will not pump to the Lower Dam if the Lower Dam volume is in excess of 30% capacity;
11. When the volume in the Middle Dam drops below 5% capacity, no water will be removed from it for dust suppression of haul roads. Water will continue to be taken for plant use and dust suppression of stockpiles;
12. When the water level in the Middle Dam does drop below this 5% capacity, dust suppression chemicals will be used on haul roads, and water from the Rocklow Creek tidal zone will be added to the dams (in accordance with any applicable water licence (including WAL25152)) and used for dust suppression on stockpiles and use in the Plant.
13. Pumping from the Lower Dam into water carts for dust suppression will only occur when the Lower Dam has at least 3ML available (i.e. it is about 10% full) (as per guideline #4).
14. When the volume in the Lower Dam drops below 5% capacity, no water will be removed from it for dust suppression of haul roads. Water will continue to be taken for plant use and dust suppression of stockpiles.

*Table 3-10 Summary of dam operating principles**

Operating principles	Lower Dam	Middle Dam	Croome Sumps
Pumping in	Not permitted from the Middle Dam if the Middle Dam has received pumped runoff from the Lower Dam on any given day (#8). Permitted from the Middle Dam: - if the volume in the Middle Dam is above 30% capacity (#9) - at a maximum rate of 4 ML/day (#9) - only when the Lower Dam is less than 30% full (#10).	Not permitted when Middle Dam is above 65% full (#5). Permitted from Croome Sumps: - Only when Middle dam is below 65% full (#2) - At 0.225 ML/day (#2) - This will occur until Croome Sumps are empty (#2). Permitted from the Lower Dam: - Only when Middle Dam is below 65% full (#3) - Only when the Lower Dam has at least 3 ML available (i.e. is about 10% full) (#4) - At a minimum volume of 3 ML/day (#4) - At a maximum rate of 10 ML/day (#3).	Not permitted (#1).

Operating principles	Lower Dam	Middle Dam	Croome Sumps
Pumping out	Permitted to the Middle Dam: - Only when the Lower Dam has at least 3 ML available (i.e. is about 10% full) (#4) - Only when the Middle Dam is below 65% full (#3) - At a minimum volume of 3 ML/day (#4) - At a maximum rate of 10 ML/day (#3). Permitted to bio-filtration swale: - After water has spent 24hours in the Lower Dam (#5) and - At a maximum rate of 7 ML/day (#5). - However, on a day when runoff or pump-in occurs, the volume to be discharged will be limited to the volume present in the Lower Dam at the end of the previous day (at a maximum rate of 7 ML/day (#6). Permitted to the Middle Dam and the bio-filtration swale on the same day (given the guidelines already mentioned above) (#7). Permitted for dust suppression only when the Lower Dam has at least 3ML available (i.e. is about 10% full) (#13). Not permitted for dust suppression on haul roads when the volume in the Lower Dam drops below 5% (water will continue to be taken for plant use and dust suppression of stockpiles) (#14).	Not permitted to the Lower Dam if the Middle Dam has received pumped runoff from the Lower Dam on any given day (#8). Permitted to the Lower Dam: - if the volume in the Middle Dam is above 30% capacity (#9) - at a maximum rate of 4 ML/day (#9) - only when the Lower Dam is less than 30% full (#10). Not permitted for dust suppression on haul roads when the volume in the Middle Dam drops below 5% (water will continue to be taken for plant use and dust suppression of stockpiles) (#11).	Permitted to Middle Dam: - Only when Middle dam is below 65% full (#2) - At 0.225 ML/day (#2) - This will occur until Croome Sumps are empty (#2).

* Black text is used where the operating principles apply to only one of the dams. Coloured text is used to indicate where the operating principles apply to pumping between two dams.

3.3 Groundwater

The EIS that supported increased production at the site (R.W. Corkery & Co., 2003) provided limited information about the groundwater of the region. The EIS noted that "Boreholes drilled during the various evaluation phases for quarry design and development did not encounter any significant groundwater inflows at the extraction depths proposed" (R.W. Corkery & Co., 2003). The EIS went on to state that this finding was "consistent with experiences to date and correlates with the observed low porosity levels of the resource material" (R.W. Corkery & Co., 2003). Within the Croome Farm Pit extraction area, topography controlled mounding of the groundwater was noted as being evident however with only minor inflows occurring (R.W. Corkery & Co, 2003).

The EIS noted that there were no discernible impacts on the groundwater beneath the site as a result of the operations at the time of writing, apart from some minor inflows into the extraction area (R.W. Corkery & Co., 2003). There is currently no groundwater monitoring program in place for the quarry. However, EMM Consulting (EMM) recently prepared a Groundwater Monitoring Report to support an application for expansion of the quarry to the west (EMM, 2015). While this WMP does not cover the area proposed as part of the expansion, the EMM report has been used to provide information regarding the groundwater characteristics of the area. The EMM report is based on investigations at three monitoring locations to the west and south-west of the site (i.e. generally up-gradient) and are therefore likely to be generally representative of groundwater quality in the area (see Figure 3-3).

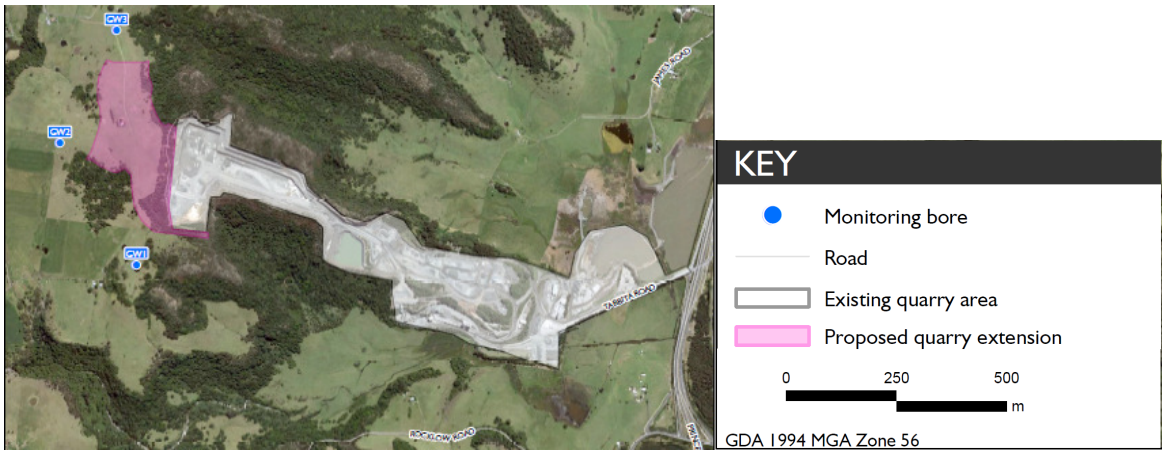

Figure 3-3 Groundwater monitoring bore locations (adapted from EMM, 2015)

In addition, the Dunmore Sand and Soil (DSS) site is located immediately downgradient (east) of the Dunmore Quarry. The Environmental Management Plan for the DSS site (DSS EMP) (R. W. Corkery & Co., 2006) provides groundwater information and this has been included below where relevant. While the DSS EMP presents groundwater quality downgradient of the quarry site. However, due to potential impacts from the DSS site and other land uses in the area, the influence of the quarry on downstream groundwater quality cannot be directly interpreted from this data.

Both the EMM report and the DSS EMP present groundwater information collected post operation of the quarry and therefore are not necessarily indicative of pre-extraction groundwater quality.

3.3.1 Groundwater Flow, Discharge and Levels

Groundwater at the site flows in a south-easterly direction and is influence by topography and the dip of the strata (Cohen, 2006 cited in EMM, 2015). There is no history of dewatering at the quarry and the EMM study found there was no obvious groundwater ingress to the pit and the rock face was dry (EMM, 2015). Discharge is likely to be at locations downgradient, including: springs, spring fed dams, break of slope, and the quarry pit (EMM, 2015).

The groundwater investigations at the three bores investigated for the proposed mine expansion found:

- a low groundwater hydraulic conductivity (the bulk or average hydraulic conductivity is 5.5x10-7 m/day) and

- the groundwater response to rainfall recharge is varied (one bore showed no response to rainfall recharge while there were minor but immediate responses the other two bores) (EMM, 2015).

3.3.2 **Groundwater Quality**

Up-gradient

Groundwater quality monitoring results from the EMM investigation (generally up-gradient) are reported below in Table 3-11 and the commentary below. The results represent average values from the three monitoring locations and from five collection events (first in September 2014 after the initial bore construction and four subsequent quarterly sampling events). Full results are available in the EMM 2015 report.

Table 3-11 Average groundwater quality for field parameters (reported in EMM 2015 for sites generally up-gradient from the quarry site)

Parameter	Water Quality Guidelines*	Minimum	Maximum	Average
EC (µS/cm)	125-2,200	649	3,970	1,699
pH	6.5-8	6.6	8.3	7.7
Dissolved oxygen (mg/L)	-	0.7	20.7	10.4
Redox (mV)	-	-259.7	+235	_10.4

Notes: µS/cm = microseimens per centimetre, mV = milivolts, mg/L = milligrams per litre. Water Quality Guidelines, South-East Australia, low land rivers, ANZECC/ARMCANZ 2000.

Groundwater at these monitoring locations is considered to be fresh to brackish, is neutral to slightly alkaline with low dissolved oxygen levels (typical of groundwater bodies with low recharge) (EMM, 2015). A range of redox conditions was observed however were neither predominantly oxidising nor reducing at any location (EMM, 2015).

Major cations and anions were also investigated. EMM reported that: “overall dissolved metal results were low (…). The exception was dissolved arsenic and zinc measurements, which were often above the Water Quality Guideline limits. However the guideline limits for arsenic and zinc are considered to be low (0.013 mg/L and 0.008 mg/L respectively)” (EMM, 2015).

EMM reported that “Nutrient results were frequently above the laboratory LOR [levels of reporting], and ammonia, nitrate and total phosphorous results were above the applicable Water Quality Guideline criterion” (EMM, 2015). In addition, “Nutrient results fluctuated and were not consistently higher or lower at any location. Elevated nutrient levels are typically indicative of long standing farming practices in the area” (EMM, 2015).

Downgradient

Results from the groundwater assessment for the DSS site (generally downgradient) found the water quality in the aquifer is consistent with the natural environment in this area (R. W. Corkery & Co., 2006). Freshwater is predominantly found beneath the majority of the DSS site with slightly brackish water present beneath the southern the DSS site (R. W. Corkery & Co., 2006).

Groundwater across the DSS site was found to have a pH in the neutral range 6.5 to 7.4 (R. W. Corkery & Co., 2006). The neutral nature of groundwater is likely to be attributable to the large amount of calcium carbonate (CaCO3) dispersed throughout the aquifer sediments as shell fragments (R. W. Corkery & Co., 2006). The Ca2+ and HCO3- (in addition to Mg2+ and SO42-) within the groundwater will act to buffer any organic acids present in the system (R. W. Corkery & Co., 2006).

4 INTEGRATED WATER MANAGEMENT STRATEGY

This section addresses the requirements for an IWMS as outline in CoA 4(45). The information in this section is largely sourced from the 2005 Site Water Management Plan (2005 SWMP) (Matrix Consulting, 2005) and has been supplemented with updates from the 2008 WMP (Evans and Peck, 2008).

The 2005 SWMP presented a detailed investigation into a range of options for a sustainable resource alternative for water supply to the site. The investigation was based on a predicted dry year water deficit of 117ML. Options investigated included:

- Mains water supply
- Stormwater run-off
- Use of treated sewerage effluent
- Extraction from Rocklow Creek
- Extraction of groundwater.

Rocklow Creek was identified as the preferred option, with extraction of groundwater from Dunmore Sand & Soils (DSS) second, and use of treated effluent third (Matrix Consulting, 2005).

The 2008 WMP identified that dust suppression chemicals would be used when water supply in the Middle Dam fell below 5%. The use of dust suppression chemicals was predicted to reduce the water deficit for essential uses[6] to less than 1ML in the 1 in 10 dry year (Evans and Peck, 2008).

Evans and Peck reconsidered the available and preferred alternative water supply options, noting that the small volume of water required would likely exclude previously preferred options (such as DSS groundwater use / treated effluent) due to the infrastructure/cost/complexity involved in those options (2008).

Evans and Peck's assessment concluded that extraction from Rocklow Creek under the existing water access licence is the preferred option for external water supply however, should that option not be available, the next preferred option would be to extract water from the tidal zone of Rocklow Creek (Evans and Peck, 2008). The 2008 WMP noted that extraction from the tidal zone is permitted without a licence and could be implemented with minimal infrastructure and costs.

Since completion of the 2008 WMP, the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* (Water Sharing Plan) has come into force. The Water Sharing Plan applies conditions for extraction of water under water access licences within the Illawarra Rivers Water Source. Any extraction from Rocklow Creek will need to comply with the rules of the Water Sharing Plan, particularly with regard to extraction upstream of the tidal zone.

[6] Essential uses are plant use and dust suppression for product stockpiles (both of which rely on water of a particular quality and therefore can't be substituted with some of the alternatives available [e.g. treated sewage effluent/tidal water etc).

5 WATER BALANCE

CoA 4(41a) requires the preparation of a site water balance while CoA 4(30) requires review and update of the water balance. Boral is currently developing a request to modify CoA 4(30). CoA 4(30) currently states:

"Each year, the Applicant shall:

(a) Review the site water balance for the development against the predictions in the EIS;

(b) Re-calculate the site water balance for the development; and

(c) Report the results of this review in the Annual Review".

The water balance in the EIS is no longer valid. An updated water balance was provided in the 2008 WMP.

The modification will propose that CoA 4(30) be altered to state:

"Each year the Applicant shall provide information on:

(a) Water demand, rainfall and inflow;

(b) Evaporative losses and dust suppression; and

(c) Dam storage levels and implications of outsourcing demand."

This section therefore focuses on summarising the results from the most recent water balance documented in the 2008 WMP. Detailed assumptions used in the modelling exercise are documented in the 2008 WMP and are not repeated here. Following resolution of the proposed modification to CoA 4(30), this plan would be updated to address the new condition.

5.1 Water Balance Results from the 2008 WMP

Table 5-1 and Figure 5-1 present the results of the water balance modelling undertaken by Evans and Peck in 2008. The water balance took into consideration the increase in production to 2.5Mt/pa (proposed at the time of writing the 2008 WMP and now being implemented). The water balance assumed the following water demands:

- Plant dust suppression (sourced from dam) 93 kL/day
- Plant dust suppression (mains back-up) 50-55 kL/day
- Water cart (sourced from dam) 450 kL/day.

The modelling process included testing numerous combinations of pumping trigger levels and rates to determine the optimum operating procedures to minimise overflows while also achieving a high level of self-sufficiency for water use for on-site purposes (Evans and Peck, 2008). The modelling showed that a balance needs to be established between maintaining sufficient available capacity ("air space") to capture subsequent large runoff events and ensuring sufficient water storage to meet on-site demand.

An important outcome of the modelling process was the establishment of the operating principles for the on-site dams. These operating principles are provided in Section 3.2.4.5.

Table 5-1 Annual Water Balance Results (ML) (Evans and Peck, 2008)

	Total Runoff	Controlled Discharge	Overflow	Overflow Events	Water Demand	Water Supply	Demand Met %
Minimum	205	41	0	0	222	148	53
10th %tile	336	139	0	0	238	171	63
Median	459	250	26	1	254	198	80

	Total Runoff	Controlled Discharge	Overflow	Overflow Events	Water Demand	Water Supply	Demand Met %
Average	560	310	56	1.5	254	199	79
90th %tile	916	617	142	4	271	228	91
Maximum	1,035	763	349	4	286	251	97

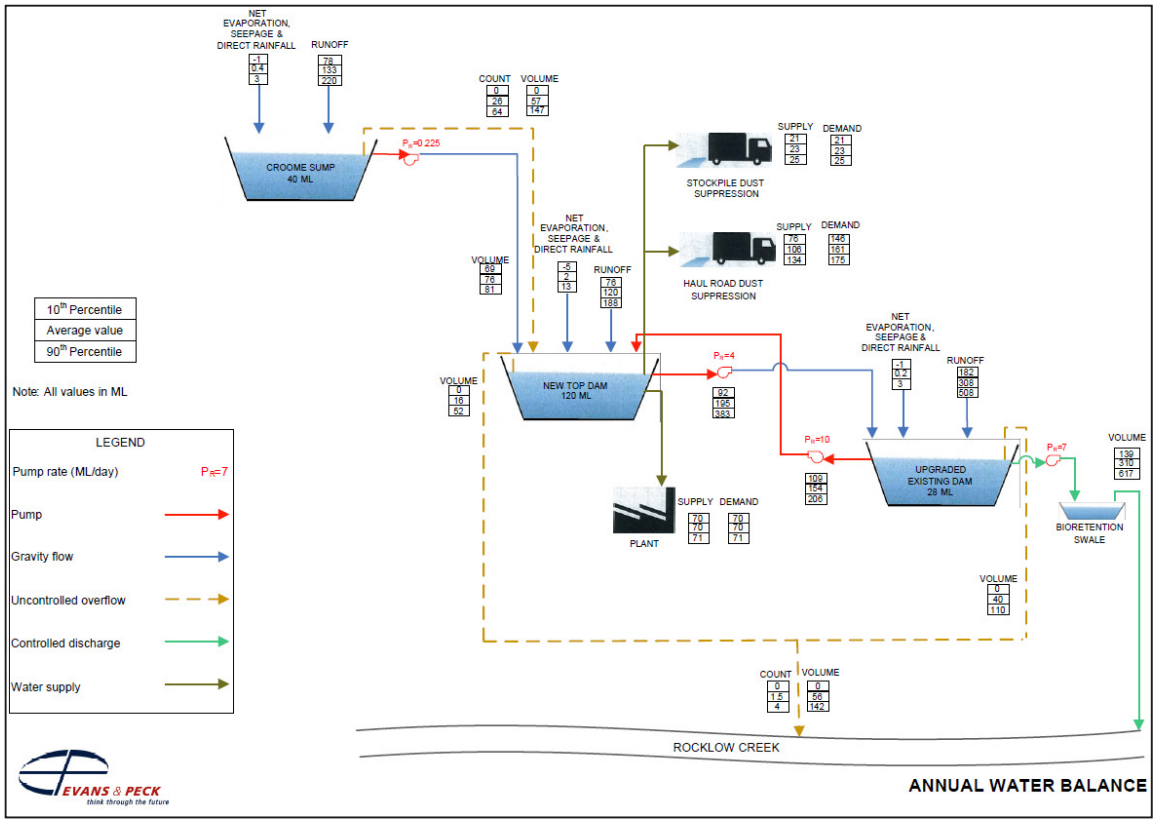

Figure 5-1 Annual Water Balance (Evans and Peck, 2008)

Table 5-1 shows that the overall water supply meets 79% of demand on average and 63% of demand in a 10th percentile year. However it is important to note that water supply for essential uses[7] (stockpile dust suppression and plant use) is 99% on average, and 99.5% in a 10th percentile year. This is because when the New Top Dam drops below 5% full, water is no longer withdrawn for haul road dust suppression, with dust suppression chemicals being used instead (Evans and Peck, 2008).

[7] Stockpile dust suppression and plant use are considered essential water uses because they rely on water quality that can not necessarily be met by other supply mechanisms (such as sourcing potentially saline water from the tidal reaches of Rocklow Creek) and dust from these sources cannot be chemically controlled due to alterations to product quality.

6 MANAGEMENT PLANS AND ACTIONS

This section includes the WMP as well as the ESCP and SWMP. The GWMP is included in Appendix H. These plans address the requirements of CoAs 4(41), 4(42), 4(43) and 4(44) and incorporate a summary of the relevant management actions.

6.1 Water Management Plan

The operation of the Dunmore HRQ has the potential to impact on the quality and quantity of water within and downstream of the site. A range of management actions have been established to manage the potential impacts and these are summarised in Table 6-1. The table includes a “Timing/Status” column which will be updated when actions have been completed, with evidence of completion provided in an Appendix in updated versions of this report.

The measures in Table 6-1 are complemented by the ESCP in Section 6.2, the SWMP in Section 6.3 and the GWMP in Appendix H.

Table 6-1 Water Management Plan Actions

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing/Status	Responsibility	Source
WMP01	Prior to a controlled release of water from the site, undertake water quality monitoring to ensure the water is compliant with the limits in CoA 4(29) and EPL 77 (i.e. pH 6.5-8.5 and TSS maximum 50mg/L).	Whole of site	Ongoing	Boral Site manager or delegate	CoA 4(29), EPL 77
WMP02	Mange water within the site to comply with the water quality objectives identified in Section 6.3.2. These objectives apply to the three dams (Upper, Middle and Lower).	Whole of site	Ongoing	Boral Site manager or delegate	CoA 3(24) EMP p2- 28
WMP03	Update this plan following resolution of the proposed modification to CoA 4(30) to address the new condition. (CoA 4(30) currently requires review and update of the water balance provided in the EIS for the site. The EIS water balance is no longer valid and Boral is seeking to update the CoAs to amend this condition). Update the site water balance to address the proposed Croome Farm Pit expansion.	Whole of site	Annually	Boral Site manager or delegate	CoA 4(30)
WMP04	Operate the stormwater management system, including maintaining the required storage volumes, to capture and treat polluted waters from storm event(s) of up to and including the 5-day, 95th percentile rainfall event.	Whole of site	Ongoing	Boral Site manager or delegate	CoA 4(31)
WMP06	Mange the Upper, Middle and Lower Dams in accordance with the operating principles outlined in Section 3.2.4.5 to maintain the required storm water storage volume. To enable monitoring of compliance with the operating principles, and to establish improved baseline data for use in future water balance updates:	Whole of site	Ongoing	Boral Site manager or delegate	CoA 4(32)

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing/Status	Responsibility	Source
	- Install meters on all pumping locations (including to water carts) - Install and maintain real-time water level loggers on the Lower Dam and Middle Dam. Prior to installation of water meters, maintain log books to record details of water cart extractions for dust suppression.				
WMP07	Provide a letter report to the Secretary (DPE) confirming that the following conditions have been met. Append this report to this WMP and update the status column. "(a) modify the existing dam at the site to create a dam with a capacity of at least 61.4ML offline from Rocklow Creek (b) ensure the discharge and overflow points of the Lower Dam do not cause erosion at the point of discharge/overflow (c) rehabilitate and stabilize the banks of the Lower Dam. (d) construct a baffle and macrophyte zone downstream of the Lower Dam (e) ensure the integrity of the Lower Dam would not be compromised by any flooding in Rocklow Creek". (Note: the Lower Dam has a built capacity 28 ML (not 61.4 ML) however the whole site has capacity of approximately 188 ML. Boral intends to explain this when writing to the Department to close this condition).	Lower Dam	2016	Boral Site manager or delegate	CoA 4(33)
WMP08	Append evidence to this WMP of having met, or been granted a modification to, CoAs 4(34) to 4(38), and update status column with a reference to the relevant appendix. (These CoAs relate to the construction of Lower Dam [completed in 2009], flocculant management [which is not proposed on this site] and other	Whole of site	2016	Boral Site manager or delegate	CoAs 4(34) to 4(38)

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing/Status	Responsibility	Source
	water management works that were to be completed within 18 months of the consent).				
WMP09	Construct and/or inspect and maintain impervious bunds around all fuel, oil and chemical storage areas with a volume large enough to contain 110 per cent of the volume held in the largest container. The bund must be designed and installed in accordance with the requirements of the EPA Environment Protection Manual Technical Bulletin Bunding and Spill Management. Include guidance on proper hydrocarbon use and management practices in toolbox meetings.	Whole of site	Monthly	Boral Site manager or delegate	CoA 4(39)
WMP10	Maintain and operate an on-site weather station, at a location approved by the EPA. The weather station should continuously record rainfall, in mm/hr with a 1 hour averaging period. The sampling method should comply with AM-4 as per the *Approved Methods for the Sampling and Analysis of Air Pollutants* (NSW-EPA, 2001).	Whole of site	Ongoing	Boral Site manager or delegate	EPL 77 (P1.4), CoA 4(27)
WMP11	Implement the SWMP, ESCP and GWMP outlined in Sections 6.2, 6.3 and Appendix H.	Whole of site	Ongoing	Boral Site manager or delegate	CoA 4(42), 4(43), 4(44)
WMP12	Enter all ESCP and surface water quality monitoring results into a spreadsheet in a format that allows immediate comparison of results against surface water discharge pollution limits, water quality objectives and previous monitoring results. Review all surface water quality monitoring results.	Whole of site	Ongoing	Boral Site manager or delegate	N/A
WMP13	Include the following information in the Annual Review and EPL Annual Returns: • The results of monitoring	Whole of site	Ongoing	Boral Site manager or delegate	EPL 77 & CoAs

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing/Status	Responsibility	Source
	• Details of the review for each sub-plan • Amendments to the sub-plans • Details of the measures undertaken/proposed to address any identified issues.				
WMP14	Include the following information when reporting on this plan: • The results of all environmental monitoring and inspections • Analysis and discussion of the results against the relevant criteria, past performance/trends and environmental conditions at time of monitoring • Any community/stakeholder complaints or non-conformances with licences/criteria, including any responses provided or actions undertaken in response to the complaint or non-conformance (note EPL77 includes requirements for recording of pollution complaints and should be referred to in the event of a complaint) • Adequacy of site-specific environmental safeguards and management measures.	Whole of site	Ongoing	Boral Site manager or delegate	N/A
WMP15	All records required to be kept by EPL 77 must be: • In a legible form, or in a form that can readily be reduced to a legible form • Kept for at least 4 years after the monitoring or event to which they relate took place • Produced in a legible form to any authorised officer of the EPA who asks to see them. The following records must be kept in respect of any samples required to be collected for the purposes of EPL 77	Whole of site	Ongoing	Boral Site manager or delegate	EPL 77

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing/Status	Responsibility	Source
	• The date(s) on which the sample was taken • The time(s) at which the sample was collected • The point at which the sample was taken • The name of the person who collected the sample.				
WMP16	Deliver environmental induction training to all staff and subcontractors and have them sign an induction sheet confirming they have understood their responsibilities. Maintain a copy of the signing sheet on site along with appropriate records. Training and induction should include, but not be limited to: • Raising awareness of on-site environmental management issues • Raising awareness of potential sources or erosion and sedimentation and the potential harm to downstream water quality and SEPP 14 wetlands • Explaining the types and importance of erosion and sediment control measures to be installed, maintained and monitored on site • Detailed procedures for appropriate application of dust suppression chemicals.	Whole of site	Ongoing	Boral Site manager or delegate	N/A
WMP17	Maintain a lessons learnt register and include any outcomes from incidents. These will feed into the inductions, toolbox meetings and pre-start meetings as necessary and appropriate.	Whole of site	Ongoing	Boral	N/A
WMP18	Review and if necessary update this plan including the components of each sub-plan (ESCP, SWMP and GWMP).	Whole of site	Annually (or more regularly as required)	Boral Site manager or delegate	CoA 5(4)

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing/Status	Responsibility	Source
WMP19	• Investigate installation of a flow gauge upstream of the site on Rocklow Creek. • If found appropriate, install flow gauge. • If found inappropriate, request removal of flow monitoring conditions from EPL and CoAs.	Rocklow Creek (upstream)	• 2016 • 2016 • 2016-2017	Boral / Site manager or delegate	N/A
WMP20	• Compliance with CoA 4(33) will be addressed in development consent modification 9, whereby the condition will be amended to reflect the actual capacity of the dam.	Existing dam	As required	Boral / Site manager or delegate	CoA 4(33)

6.2 Erosion and Sediment Control Plan

The ESCP has been developed to manage potential erosion and sedimentation risks and improve the quality of water both within the site and flowing from it. The ESCP addresses the requirements of CoA 4(34b), 4(41b) and 4(42). The CoAs require the ESCP to:

a) be consistent with the requirements of the Department of Housing's *Managing Urban Stormwater: Soils and Construction* manual
b) identify activities that could cause soil erosion and generate sediment
c) describe measures to minimize soil erosion and the potential for the transport of sediment to downstream waters
d) describe the location, function, and capacity of erosion and sediment control structures
e) describe what measures would be implemented to maintain the structures over time.

This ESCP has been designed in accordance with Managing Urban Stormwater: Soils and Construction Volume1 and Volume 2B – Mines and Quarries.

Activities that could cause soil erosion and generate sediment

The primary activities that could cause erosion and generate sediment include:

- vegetation clearing
- quarrying and soil disturbance
- truck movements
- wind and water erosion of exposed surfaces and stockpiles
- materials processing.

Measures to minimize soil erosion and the potential for the transport of sediment to downstream waters / location, function, and capacity of erosion and sediment control structures

A number of permanent measures have already been put in place to minimise erosion and sedimentation (see Figure 3-2) and these include:

- The majority of clean water is directed away from the site to ensure mixing of clean and dirty water is minimised. This is primarily achieved through the natural topography of the site draining away from the excavation areas. (At the western end of the site there is a small area that drains towards the site. Flows from this area enter the Croome Farm Pit extraction area and flow to the Upper Dam).
- Minimisation of disturbed areas to reduce the potential for erosion.
- Establishment of the site so that the large majority of runoff is captured in one of three dams (the Croome Sumps, the Middle Dam and the Lower Dam) to allow settlement of sediment prior to release of water from the site.
- The north eastern area of the site has been established to drain to either the Dunmore Sand and Soil (DSS) site or to the site access road (Tabbita Road). The water that flows to DSS enters the fines pond (where settlement occurs) then the freshwater pond, before being released to Rocklow Creek. The water that flows to Tabbita Road flows through drainage swales prior to discharge into Rocklow Creek. There are currently no check dams on this drainage swale and Boral intends to divert it into the DSS fines pond. This action has been incorporated into the management actions in Table 6-2.

- Establishment of runoff channels directing water to these dams have been protected from erosion with rock-check dams.
- The Lower Dam has been brought offline from Rocklow Creek.
- A bio-filtration swale has been constructed adjacent to Lower Dam to allow stormwater to be discharged to Rocklow Creek so as water quality standards for TSS are met without the use of flocculants.
- Establishment of a wheelwash for trucks entering and leaving the site (with both rattle grid and water jets).

These measures will be maintained and the following ongoing operational measures will also be / continue to be implemented:

- Check that existing temporary drainage channels and sediment control measures meet the recommended minimum design criteria outlined in *Managing Urban Stormwater: Soils and Construction Volume 2B – Mines and Quarries* (in particular, Table 6.1 of this guideline).
- Dust suppression on haul roads and stockpile areas
- Use of wheelwash for trucks leaving site
- Use of street-sweeper on sealed entrance roads
- Careful stripping and storage of topsoil for use in site stabilisation and/or revegetation (as described in the Rehabilitation Management Plan). Disturbed lands will be rehabilitated as quickly as possible.

Measures to maintain the structures over time

Every month and following heavy rainfall events the drainage and stormwater infrastructure (including the bio-filtration swale) will be inspected. Inspections will include the following checks: dam water levels, pump/transfer meters, all channels and diversion structures, all sumps, pipes and culverts, all dam spillways and flow entry points to Rocklow Creek, the bio-filtration swale and flow meter at the controlled discharge point. Erosion and sediment controls will be repaired, reinstated and maintained to ensure they continue to function properly.

All erosion and sediment controls will also be checked on following any exceedance of the water quality criteria and objectives outlines in Section 6.3.1 and 6.3.2.

Additionally, sediment levels in the dams will be monitored and maintained. An additional volume allowance has been made in the Middle Dam (12 ML) and the Croome Sumps (5-10 ML) to allow for the build-up of sediment over time. When/if clean out is required, Boral propose to use a suction dredging process that will avoid the need to have vehicular access inside the dams.

The Lower Dam is likely to be cleaned out every 6 to 12 months, depending on the rate of sediment build up. While the system of pumped transfers will allow dams to be emptied, where possible any essential maintenance or cleaning of dams will take place during extended dry periods when the dams are empty. Sediment removed from the dams will be dried and stored on site.

A copy of *The hip pocket handbook* (Landcom, 2004b) (a small field guide for the use of contractors and others responsible for the construction and maintenance of erosion and sediment controls) will be made available to site representatives responsible for the monitoring and maintenance of erosion and sediment controls.

The above measures have been summarised in Table 6-2. In addition, an erosion and sediment control checklist has been developed as a practical tool

to guide monitoring and maintenance of the erosion control measures and is included in Appendix A.

6.2.1 **ESCP Management Actions**

Table 6-2 ESCP Management Actions

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing	Responsibility	Source
ESCP01	• Undertake site monitoring to ensure clean water is directed away from the site to ensure mixing of clean and dirty water does not occur. • Vegetate external surfaces of bunds to avoid sediment runoff.	Whole site	Monthly	Boral Site manager or delegate	
ESCP02	• Minimise the amount of disturbed areas to reduce the potential for erosion.	Whole site	Ongoing	Boral Site manager or delegate	
ESCP03	• Establish and maintain the site so that all runoff is captured in one of three dams (the Croome Sumps, the Middle Dam and the Lower Dam) to allow settlement of sediment prior to release of water from the site. Any releases should be meet EPL requirements for the site.	Whole site	Ongoing	Boral Site manager or delegate	
ESCP04	• Check that existing temporary drainage channels and sediment control measures meet the recommended minimum design criteria outlined in *Managing Urban Stormwater: Soils and Construction Volume 2B – Mines and Quarries* (in particular, Table 6.1 of that guideline). • Undertake inspections of the runoff channels directing water to these dams have been protected from erosion with rock-check dams.	Whole site	Ongoing	Site manager or delegate	

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing	Responsibility	Source
ESCP05	• Maintain the Lower Dam offline from Rocklow Creek.	Lower Dam	Ongoing	Boral Site manager or delegate	
ESCP06	• Ensure all vehicles pass through the wheelwash facility prior to leaving the premises.	Wheelwash	Ongoing	Boral Site manager or delegate	
ESCP07	• Carry out regular dust suppression activities on haul roads and stockpile areas.	Whole site	As required based on climatic conditions	Boral Site manager or delegate	
ESCP08	• Monitor the condition of sealed entrance roads and undertake street sweeping when there are visible signs of sediment transfer and deposition.	Sealed entrance roads	Weekly	Boral Site manager or delegate	
ESCP09	• Carefully manage stripping and storage of topsoil for use in site stabilisation and/or revegetation (as described in the Rehabilitation Management Plan). • Rehabilitated disturbed lands as quickly as possible.	Whole site	Ongoing	Boral Site manager or delegate	
ESCP10	Inspect the drainage and stormwater infrastructure including: • the bio-filtration swale • dam water levels • pump/transfer meters • all channels and diversion structures	Whole site	Monthly and following heavy rainfall events	Boral Site manager or delegate	

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing	Responsibility	Source
	• all sumps, pipes and culverts • all dam spillways and • flow entry points to Rocklow Creek • the bio-filtration swale and • flow meter at the controlled discharge point. Repair, reinstate and maintain these measures to ensure they continue to function properly.				
ESCP11	• Check all erosion and sediment controls following any exceedance of the water quality criteria and objectives outlines in Section 6.3.1 and 6.3.2.	Whole site	Following any exceedance of the water quality criteria and objectives	Boral Site manager or delegate	
ESCP12	• Monitor sediment levels in the dams. • When/if clean-out is required, do so using a suction dredging process that avoids the need to have vehicular access inside the dams. • Preferably clean out dams during extended dry periods. • Dry and store sediment removed from the dams on site. • Use dried sediment as fill material throughout operations where appropriate (safety bunds etc).	Dams	When sediment storage areas are full	Boral Site manager or delegate	
ESCP13	• Provide a copy of *The hip pocket handbook* (Landcom, 2004b) to site representatives responsible for the monitoring and maintenance of erosion and sediment controls.	N/A	Ongoing	Boral Site manager or delegate	

Management Action Ref Id	Environmental Management Measure	Location (where appropriate)	Timing	Responsibility	Source
ESCP14	Undertake monitoring to ensure: • The discharge and overflow points of the Lower Dam do not cause erosion at the point of discharge/overflow. • The banks of the Lower Dam are stable, vegetated and can reliably withstand any flooding in Rocklow Creek • The macrophyte zone in the bio-filtration swale is operating effectively (e.g. check signs of plant death, overfilling with sediment etc).	Lower Dam and bio-filtration swale	Monthly	Boral Site manager or delegate	Related to CoA 4(33)
ESCP15	• Install sediment fences, where required, to assist in reducing the suspended sediment level of surface water flows.	Whole site	Ongoing	Boral Site manager or delegate	
ESCP16	• Undertake erosion and sediment control monitoring using the checklist at Appendix A.	Whole site	Monthly	Boral Site manager or delegate	N/A
ESCP17	• Record details of inspections and maintenance works in the relevant section of each Annual Review.	Whole site	At time of inspection and compiled annually	Boral Site manager or delegate	
ESCP18	• Divert the drainage swale along Tabbita Road into the DSS site so that all runoff from the north eastern area of the quarry site is treated through the DSS fines and freshwater ponds.	North eastern area of the site	As soon as possible (ideally in 2016)	Boral Site manager or delegate	

6.3 Surface Water Monitoring Program

This section outlines the surface water monitoring requirements and addresses the requirements of CoA 4(43) and EPL 77. The monitoring program has been designed to provide ongoing records of the surface water quality on the site, and to provide a feedback mechanism to assess the effectiveness of the WMP and ESCP.

The consolidated SWMP is provided in the SWMP Actions Table in Section 6.3.7.

A Standard Procedure for Surface Water Sampling is available in Appendix B.

6.3.1 Water Discharge Limits

Water discharged from the site is not to exceed the water discharge limits stipulated in CoA 4(29) and/or EPL 77 which are included below in Table 6-3 and Appendix C.

Table 6-3 Water Discharge Limits

Pollutant	Unit of Measure	100th Percentile Concentration Limit	Source of requirement	Location
Total Suspended Solids	mg/L	50	CoA 4(29) and EPL 77	EPL#6
pH	pH	6.5 to 8.5	CoA 4(29)	EPL #6

6.3.2 Water Quality Monitoring Parameters and Objectives

EPL 77 requires monitoring of a number of parameters including pH, TSS, conductivity, flow, oil, grease and turbidity. A number of other parameters will be monitored to provide baseline data on the water quality. As outlined above, discharge limits are only set for TSS and pH. The objectives in Table 6-4 have been adopted for the remaining parameters.

Table 6-4 Water Quality Monitoring Parameters and Objectives

Parameter	Unit of Measure	Water Quality Objectives
pH	pH	6.5 – 8.5
TSS	Mg/L	50
Conductivity*	µS/cm	200-300**
Flow	Kilolitres per day	NA - volumetric
Oil and grease	Visible	No visible oil and grease
Turbidity	NTU	6 - 50**

Parameter	Unit of Measure	Water Quality Objectives
Total Dissolved Solids	(mg/L)	No prescribed goal
Total Nitrogen	(mg/L)	0.5**
Total Phosphorus	(mg/L)	0.05**
Arsenic	(ug/L)	1**
Cadmium	(ug/L)	0.06**
Nickel	(ug/L)	11**
Zinc	(ug/L)	2.4**
Lead	(ug/L)	1**

* A range of 125-2200 µS/cm is cited in the default trigger values for south-east Australia for slightly disturbed ecosystems (lowland rivers) however NSW coastal rivers are typically in the range 200–300 µS/cm (ANZECC/ARMCANZ, 2000).

** Objectives as per ANZECC Water Quality Guideline limits for Aquatic Ecosystems Lowland Rivers.

6.3.3 **Monitoring Locations**

The surface water monitoring locations applicable to the site are shown on Figure 6-1 and described in Table 6-5.

Figure 6-1 Surface Water Monitoring Locations

Table 6-5 Description of EPL surface water monitoring locations

EPL #	Ref #	Location	EPL Description		
EPL Ref #	Site Ref #	General location description	Type of monitoring point	Type of discharge point	EPL Location Description*
N/A	GS1	Rocklow Creek (500m upstream of the Lower Dam)			
N/A	GS2	Rocklow Creek (downstream of licensed discharge point (EPL #6))			
EPL#6	N/A	Discharge from the bio-filtration swale to Rocklow Creek	Discharge to waters and discharge quality monitoring	Discharge to waters and discharge quality monitoring	Discharge from the bio-filtration swale (adjacent to Lower Dam) to Rocklow Creek
EPL#7	N/A	Uncontrolled discharge from Lower Dam to Rocklow Creek	Discharge to waters and discharge quality monitoring	Discharge to waters and discharge quality monitoring	Uncontrolled discharge from Lower Dam to Rocklow Creek
EPL#8	GS4	Lower Dam	Effluent quality monitoring	-	At the discharge point end of the Lower Dam (eastern end)
EPL#9	GS3	Rocklow Creek (downstream)	Discharge to waters and stormwater quality monitoring	-	Rocklow Creek at the boundary between Boral Quarry and Creagan Property
EPL#10	N/A	Uncontrolled discharge from Middle Dam to Rocklow Creek	Discharge to waters and discharge quality monitoring	Discharge to waters and discharge quality monitoring	Uncontrolled discharge from Middle Dam to Rocklow Creek

* References in the EPL to the “upgraded existing stormwater treatment dam” are taken to refer to the Lower Dam. References in the EPL to the “top stormwater treatment dam” are taken to refer to the “Croome Sumps”.

6.3.4 **Monitoring Frequency**

The frequency of water quality monitoring is provided in detail in Section 6.3.7. In general, water quality monitoring is to be undertaken:

- Monthly
- Daily during discharge
- Continuously for flow monitoring records.

6.3.5 **Exceedance Protocol**

If an exceedance of the water discharge limits or objectives is identified, the following protocol will be followed.

Step 1: Confirmation of Exceedance

Where relevant, the test will be repeated on site and/or the analysing laboratory will be contacted to ensure no error has been made in testing, storing, analysing or recording the sample or results. Re-analysis will be ordered in the case of laboratory error.

Step 2: Determining causes

Results from location #G1 (in Rocklow Creek upstream of quarry operations) will be compared to the results obtained immediately downstream of the relevant discharge point to help establish if the quarry operation is contributing to the change in water quality or if background levels are the contributing factor and help in determining the appropriate corrective action. If the quarry is likely to have contributed to the exceedance, an inspection of the site should be undertaken to identify locations where water management controls may need to be improved. These should be documented in a report (see Step 4).

Step 3: Notification of Exceedance

Regardless of the cause, if the exceedance relates to criteria from the EPL or CoAs (i.e. TSS and pH), the exceedance will be reported to the EPA and relevant agencies, with a written report submitted within seven days. The report will include and follow the general requirements for a written report as outlined in the EPL 77.

Step 4: Corrective Action

A report should be prepared to outline corrective actions to prevent a recurrence and bring the operation back into compliance. For exceedances of EPL and CoA criteria, the outcomes from actions resulting from the written report will also be forwarded to the EPA.

6.3.6 **Reporting**

Boral's Environmental and Community Advisor will be responsible for reviewing all surface water quality monitoring results. The results will be entered into a spreadsheet in a format that allows immediate comparison of results against surface water discharge pollution limits, water quality objectives and previous monitoring results.

A summary of all monitoring results will be included in the:

- Annual Review and
- EPL Annual Returns.

The records of any monitoring required under EPL77 must be:

- in a legible form, or in a form that can readily be reduced to a legible form;
- kept for at least 4 years after the monitoring or event to which they relate took place; and

- produced in a legible form to any authorised officer of the EPA who asks to see them.

The following records must be kept in respect of any samples required to be collected for the purposes of this licence:

- the date(s) on which the sample was taken;
- the time(s) at which the sample was collected;
- the point at which the sample was taken; and
- the name of the person who collected the sample.

6.3.7 **Surface Water Monitoring Program - Actions**

The primary intention of the SWMP is to determine whether surface water at the site complies with the relevant discharge pollution limits and water quality objectives. Monitoring of the upstream location will help to understand the background water quality and any potential influence of site activities on water quality. Monitoring of on-site water use and transfers will help establish records with which to update the water balance and correlate water quality monitoring results.

Table 6-6 Surface Water Monitoring Program – Actions

Location*	Parameter to be Analysed	Criteria** or Objective	Frequency of Monitoring	Sampling Method
GS#1 GS#2	• Flow (KL/day)	No prescribed goal (background reference only)	Continuously at GS1*** Daily during discharge at GS2	In situ
	• pH • Total Suspended Solids (mg/L) • Turbidity (NTU) • Oil and Grease (mg/L)	No prescribed goal (background reference only)	Monthly and daily during discharge	Grab sample
	• Total Dissolved Solids (mg/L) • Total Nitrogen (mg/L) • Total Phosphorus (mg/L) • Arsenic (ug/L) • Cadmium (ug/L) • Nickel (ug/L) • Lead (ug/L) • Zinc (ug/L)	No prescribed goal (background reference only)	Every 6 months	Laboratory
EPL #6	• pH	6.5 – 8.5	Daily during discharge	In situ
	• Conductivity (uS/cm)	200 – 300	Daily during discharge	In situ

Location*	Parameter to be Analysed	Criteria** or Objective	Frequency of Monitoring	Sampling Method
	• Flow (KL/day)	No prescribed goal (background reference only)	Continuously during discharge	In situ
	• Oil and Grease (Visible)	None visible	Daily during discharge	Inspection
	• Total Suspended Solids (mg/L)	50	Daily during discharge	Grab sample
	• Turbidity (NTU)	6 - 50	Daily during discharge	In situ
	• Total Dissolved Solids (mg/L)	No prescribed goal (for comparison against baseline data collected in Rocklow Creek)	During controlled discharge	Laboratory
	• Total Nitrogen (mg/L)			
	• Total Phosphorus (mg/L)			
	• Arsenic (ug/L)			
	• Cadmium (ug/L)			
	• Nickel (ug/L)			
	• Lead (ug/L)			
	• Zinc (ug/L)			
EPL ID # 7	• pH	6.5 – 8.5	Daily during discharge	In situ
	• Conductivity (uS/cm)	200 – 300	Daily during discharge	In situ
	• Flow (KL/day)	-	Daily during discharge	In situ.
	• Oil and Grease (Visible)	None visible	Daily during discharge	Inspection
	• Total Suspended Solids (mg/L)	50	Daily during discharge	Grab sample

Location*	Parameter to be Analysed	Criteria** or Objective	Frequency of Monitoring	Sampling Method
	• Turbidity (NTU)	6 - 50	Daily during discharge	In situ
EPL ID # 8/GS4	• pH	6.5 – 8.5	Monthly	In situ
	• Conductivity (uS/cm)	200 – 300	Monthly	In situ
	• Oil and Grease (Visible)	None visible	Monthly	Inspection
	• Total Suspended Solids (mg/L)	50	Monthly	Grab sample
	• Turbidity (NTU)	6-50	Monthly	In situ
	• Total Dissolved Solids (mg/L) • Total Nitrogen (mg/L) • Total Phosphorus (mg/L) • Arsenic (ug/L) • Cadmium (ug/L) • Nickel (ug/L) • Lead (ug/L) • Zinc (ug/L)	No prescribed goal (for comparison against baseline data collected in Rocklow Creek and to inform suitability to undertake controlled discharges)	Every 6 months	Laboratory
EPL ID # 9/GS3[8]	• Flow	No prescribed goal (background reference only)	During discharge	In situ
	• pH • Total Suspended Solids (mg/L)	No prescribed goal (background reference only)	Monthly and daily during discharge	Grab sample

[8] Note that the EPL does not specify any monitoring requirements for this location. Monitoring requirements outlined in this table are based on Boral's existing monitoring program.

Location*	Parameter to be Analysed	Criteria** or Objective	Frequency of Monitoring	Sampling Method
	• Turbidity (NTU) • Oil and Grease (mg/L)			
	• Total Dissolved Solids (mg/L) • Total Nitrogen (mg/L) • Total Phosphorus (mg/L) • Arsenic (ug/L) • Cadmium (ug/L) • Nickel (ug/L) • Lead (ug/L) • Zinc (ug/L)	No prescribed goal (background reference only)	Every 6 months	Laboratory
EPL ID # 10	• pH	6.5 – 8.5	Daily during discharge	In situ
	• Conductivity (uS/cm)	200 – 300	Daily during discharge	In situ
	• Oil and Grease (Visible)	None visible	Daily during discharge	Inspection
	• Total Suspended Solids (mg/L)	50	Daily during discharge	Grab sample
	• Turbidity (NTU)	6-50	Daily during discharge	In situ
Weather station	• Rainfall and evaporation	Establish records with which to update the water balance and correlate water quality monitoring results	Ongoing	Weather station
Upper, Middle and Lower Dams	• Water use on the site (ML) • Water transfers across the site (ML)	Establish records with which to update the water balance.	Continuous / ongoing	Meters attached to all standpipes, pumps and transfer systems.

Location*	Parameter to be Analysed	Criteria** or Objective	Frequency of Monitoring	Sampling Method
	• Dam and water structure storage levels.			Logbooks to be maintained by water cart operators. Automated dam level monitoring equipment.
Exceedance protocol	If an exceedance of the water discharge limits or objectives is identified, Boral will implement the protocol outlined in Section 6.3.5 (i.e. confirm the exceedance, determine the causes, notify the EPA and relevant agencies, identify and implement corrective action).			

* See Figure 6-1.

. ** Only the criteria for pH and TSS are nominated by the EPL and/or CoAs. Other objectives are nominal and have been adopted as per ANZECC Water Quality Guideline limits for Aquatic Ecosystems Lowland Rivers. *** Not yet established. Boral to investigate installation of a stream gauge (see Table 6-1).

6.4 Groundwater Monitoring Program

CoA 4(40d) requires monitoring of regional groundwater levels and quality and CoA 4(44) requires a Groundwater Monitoring Program. These conditions are addressed in the Groundwater Monitoring Program prepared by EMM in 2016 and included in Appendix H.

7 REPORTING AND REVIEW

7.1 Reporting

Reporting on the implementation of this Plan would include the following:

- The results of all environmental monitoring and inspections
- Analysis and discussion of the results against the relevant criteria, past performance/trends and environmental conditions at time of monitoring
- Any community/stakeholder complaints or non-conformances with licences/criteria, including any responses provided or actions undertaken in response to the complaint or non-conformance (note EPL77 includes requirements for recording of pollution complaints and should be referred to in the event of a complaint)
- Adequacy of site-specific environmental safeguards and management measures
- Any remediation actions or changes to management and mitigation measures.

7.2 Plan review

Each year Boral will:

- Review and update this WMP including the components of each sub-plan (ESCP, SWMP and GWMP)
- Report the results of this review in the Annual Review, including:
  - The results of monitoring
  - Details of the review for each sub-plan
  - Amendments to the sub-plans
  - Details of the measures undertaken/proposed to address any identified issues.

7.3 Record keeping

All records required to be kept by EPL 77 must be:

- In a legible form, or in a form that can readily be reduced to a legible form
- Kept for at least 4 years after the monitoring or event to which they relate took place
- Produced in a legible form to any authorised officer of the EPA who asks to see them.

The following records must be kept in respect of any samples required to be collected for the purposes of EPL 77

- The date(s) on which the sample was taken
- The time(s) at which the sample was collected
- The point at which the sample was taken
- The name of the person who collected the sample.

8 TRAINING

8.1 Environmental induction

Environmental induction training will be delivered to all staff and subcontractors involved in the Project. This will be delivered by the relevant Boral personnel (e.g. Environment Manager). This will include a component on this WMP and the associated controls and mitigation measures that will be implemented for the Project. All personnel will be required to sign an induction sheet, a copy of which will be maintained on site and appropriate records maintained.

Appropriate training and induction should include, but not be limited to:

- Raising awareness of on-site environmental management issues
- Raising awareness of potential sources or erosion and sedimentation and the potential harm to downstream water quality and SEPP 14 wetlands
- Explaining the types and importance of erosion and sediment control measures to be installed, maintained and monitored on site
- Detailed procedures for appropriate application of dust suppression chemicals.

8.2 Site-specific environmental training

Where identified by the Environment Manager, additional site-specific training may be developed and implemented by the Project manager, delivered to relevant personnel/contractors as required regarding sensitive environmental issues. Specific training may include:

- Training in the use and location of spill kits
- Management, and environmental incident response training.

8.3 Lessons learnt register

A lessons learnt register will be maintained by the Environment Manager and will include any outcomes from incidents. These will feed into the inductions, toolbox meetings and pre-start meetings as necessary and appropriate.

9 CONTINGENCY PLANNING

9.1 Emergency incident plan

The *Dunmore Quarry - Pollution Incident Response Management Plan* (PIRMP) (dated 28 August 2013) applies to the site and will be followed in the instance of a pollution incident. The purpose of the PIRMP is to:

- Minimise and control the risk of a pollution incident at Dunmore Quarry by identifying key risks and planned actions to minimise and manage those risks.
- Detail the training requirements for the plan, identifying persons responsible for implementing it, and ensuring that the plan is regularly tested for accuracy, currency and suitability.
- Provide direction to the staff at Dunmore Quarry in responding to pollution incidents.
- Ensure timely communication about a pollution incident is provided to staff at the premises, the EPA, other relevant authorities specified in the POEO Act (including Shellharbour City Council, NSW Ministry of Health, Work Cover NSW, and Fire and Rescue NSW) and persons outside the operations who may be affected by the impacts of a pollution incident.

Management of other (i.e. non-pollution related) emergencies would be managed in line with the Dunmore Quarry - Emergency Response Plan.

9.2 Other Reporting Requirements

In addition to the above, there is a requirement to notify the DPE and any other relevant agencies under Condition 10 of Schedule 5 of any pollution incident. For all other incidents, Boral is to notify DPE and any other relevant agencies as soon as practicable. A detailed report must be provided to DPE within seven days of the incident.

10 REFERENCES

ANZECC/ARMCANZ (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 1*, Australian and New Zealand Environment and Conservation

Council and Agriculture and Resource Management Council of Australia and New Zealand.

Boral (2014a) *Boral Quarry - Environmental Monitoring Program*, NSW, Australia.

Boral (2014b) *Boral Quarry - Environmental Management Strategy*, NSW, Australia.

Department of Environment and Climate Change NSW (2008) *Managing Urban Stormwater: Soils and Construction Volume 2E – Mines and Quarries*, DECC, NSW, Australia.

Department of Primary Industries (2016) *Dams in NSW: Do you need a licence?*, DPI, NSW, Australia.

EMM (2015) *Annual groundwater monitoring report: Dunmore Quarry*, 18 November 2015, NSW, Australia.

Evans and Peck (2008) *Dunmore Quarry Water Management: Draft Water Management Plan*, 24 April 2008, NSW, Australia.

Evans and Peck (2008B) *Boral Dunmore Quarry - Dam Upgrade works, volume of middle dam* embankment, email dated 19 November 2008.

Landcom (2004) *Managing Urban Stormwater: Soils and Construction*, NSW, Australia.

Landcom (2004b) *The hip pocket handbook,* NSW, Australia.

Matrix Consulting (2005) *Site Water Management Plan*, November 2005, NSW Australia.

R. W. Corkery & Co (2006) *Dunmore Quarry Environmental Management Plan,* NSW, Australia.

R.W. Corkery & Co (2003) *Environmental Impact Statement for the proposed Dunmore Quarry Production Increase*, NSW, Australia.

APPENDICES

Appendix A

Erosion and Sediment Control Checklist

Date				
Start Time		Finish Time		
Conducted By				
Inspections to be Completed	Compliance with Water Management Plan? (Yes/No/N/A)	Comments/Corrective Actions Required	Action by/Date	Date Completed
Is there any evidence of erosion onsite (e.g. gullies, landslips, rill erosion, sheet erosion, subsidence, stream bank instability) associated with project activities?				
Have upstream/downstream flow entry/exit points been inspected for signs of erosion? Has scour protection been installed if required?				
Are there any other areas around the site that require installation of erosion and sediment controls? (Check through flow chart, Appendix F, *Blue Book Volume 2E: Mines and Quarries)*.				
Is there evidence of erosion on the site access road or road side drainage networks?				
Are sediment fences and other erosion controls installed where required and working within				

Date				
capacity? Does sediment need to be actively removed from these areas?				
Is there evidence of increased turbidity downstream of the site (attributable to project activities)?				
Is there any evidence of erosion or contamination around the materials processing area?				
Are erosion and sediment control inspections being undertaken monthly and after high rainfall events				
Are external surfaces of bunds vegetated?				
Do water quality monitoring results indicate that the erosion and sediment controls are suitable for meeting the water quality objectives/criteria?				
Are there any additional measures that could be implemented to minimise erosion and sedimentation?				

Appendix B

Standard Procedure for Surface Water Sampling

Surface Water Quality Monitoring

Boral Resources (NSW) Pty Limited
ABN: 51 000 756 507

Standard Procedure

for the

Monitoring of Surface Waters

July 2011

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1.0 Scope

This document outlines the procedures to be followed when performing surface water monitoring for Boral Quarries. The document outlines the appropriate method to perform water sampling, correct equipment use and calibration method, scheduled monitoring requirements and other considerations to be noted.

2.0 Monitoring Schedule & Sites

The specific Environmental Monitoring requirements for each quarry can be found in **Appendix A-1**. Further information is also available in the individual Environmental Monitoring Plans, Environment Protection Licences, Development Consents and Australian Standards.

3.0 Water Sampling

3.1 Important considerations before sampling

The collection of water samples should take place before field parameters are taken in order to avoid possible contamination introduced to the sample sites by the field instrument. When collecting water samples it is essential to avoid possible external sources of contaminants that may influence the results obtained for example the introduction of sediment from soft banks when sampling, sunscreen or insect repellent from hands (use gloves) or incorrect preparation of sample bottles and equipment (Ref AS/NZS 5667.1:1998 Section 4).

It is essential to comply with Site OHS obligations and undertake sampling in a safe and efficient manner. Any hazards or incidents are to be reported to the Quarry Manager or supervisor in accordance with Boral policy.

3.2 Sampling Procedure

The following outlines the sampling procedure to obtain water samples for laboratory analysis (AS/NZS 5667.1:1998 Section 7, Boral Materials Technical Services Surface Water Sampling Procedure):

- Rinse unpreserved plastic bottle and lid with the water that is to be sampled a total of 3 times making sure waste water is disposed of in a way that will not contaminant the site (eg downstream of sample site or on bank where there is no chance of rinse-water re-entering water body).

- Submerge sample bottle into waterbody trying to avoid the introduction of any surface film, sediment or plant matter. If the water body is less than 0.5m deep aim to sample at approximately half the depth of the waterbody or if the site is greater than 0.5m deep take a sample within the top 20-30cm of the waters surface. Samples should be representative of the site.

- Fill plastic bottle to brim (ie no headspace in bottle) and secure lid.

- When using sample bottles with a preservative (eg acid) do not rinse bottles and only fill to neck of bottle to avoid the loss of any preservative. Take care when using acid preserved bottles not to introduce contaminants to the sample site and to avoid contact with skin (use gloves). Unpreserved bottles should be sampled before preserved bottles to avoid contamination of samples.

- Ensure all bottles are labelled appropriately with details including Quarry name, sampling site name/ID, name of person who collected the sample and the date and time of sampling (**Figure 1**).

- Store samples in a chilled esky while in field and refrigerate upon return to laboratory.

- Arrange for samples to be transported to the Baulkham Hills Laboratory for analysis ASAP and ensure samples are transported in a chilled esky.

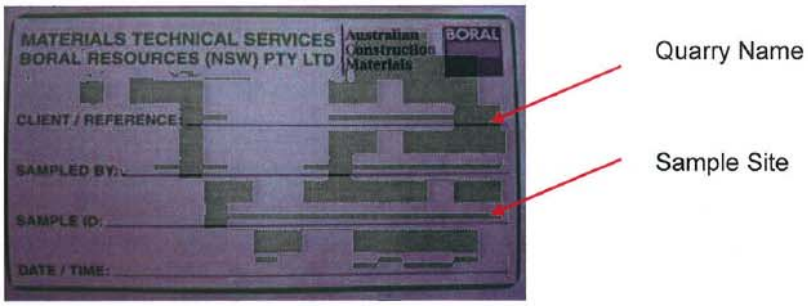


Figure 1: Example of sample label.

3.3 Bottle Selection

The type of bottle used to collect samples is dependant upon what analytes/parameters are required. The following is a list (Table 1) of what each bottle is to be used for (ASNZS 5667.1:1998 Section 7). Further information for parameters other than those listed below as well as sample preservation lifetime can be found in Table 1 of AS/NZS 5667.1:1998.

Bottle Type	Parameters
Plastic/ Unpreserved 	• pH • Conductivity/Salinity • Nutrients • TSS/TDS/Turbidity
Plastic/ Preserved	• Metals • Cations/Anions
Glass/ Unpreserved 	• Oil And Grease

Table 1: Sample bottle type and parameters tested.

3.4 Sample storage and transport

It is important for samples to be kept below 4°C at all times. Use an esky and ice bricks (available from site laboratory) in the field to keep water samples chilled and upon return place samples into the appropriate refrigerator. When samples are to be sent to the laboratory it is necessary to send them in a chilled esky and to pack the esky in a way that will avoid contamination of samples or any breakages that may

occur in transit. An appropriately filled out COC form should accompany the sent samples (AS/NZS 5667.1:1998 Sections 10-11).

3.5 COC use

A COC document should be filled out for each sampling run undertaken. The COC should include the following details:

- Quarry Name
- Site Name/s
- Date Sampled
- Time Sampled
- Name of Sampler/s
- Analytes required
- Date samples sent
- Name of person sending samples

The completed COC should accompany the samples being sent away (can be via email) and a record kept on site for future reference. Where samples are sent to the Baulkham Hills Laboratory a completed COC should be emailed to the following contacts:

- Justin Dowse (first contact for water sample enquiries) justin.dowse@boral.com.au
- Mike Formosa michael.formosa@boral.com.au
- Muans Abdulnebe muans.abdulnebe@boral.com.au
- Frank Grima frank.grima@boral.com.au

An example of the COC documentation for Quarry sites can be found in the Appendices.

3.5 Sample Tracking & Handling Lab Results

In order to keep track of samples it is important to keep a record of when samples were collected, when they were sent to the lab and when the lab report was received. To help record these details use an Environmental Tracking spreadsheet (or equivalent alternative method). Once a lab report is received check the results against the relevant assessment criteria to ensure results are compliant and file the report in the appropriate folder onsite. If a non-compliance is detected inform the relevant site personnel and Environment Manager.

4.0 Field Parameter Multi-probe Instrument Use, Calibration & Maintenance

The Hydrolab Quanta Multi-probe field water quality instrument is used to determine in-situ water quality using the following parameters:

- Temperature (°C)
- pH
- ORP (Redox) (mV)
- Dissolved Oxygen (mg/L)
- Conductivity (mS/cm)
- Salinity (PSS)
- Turbidity (NTU)

4.1 Equipment Use

The Hydrolab Quanta probe must be stored in the appropriate storage cup in a pH 4 solution filled to the designated level as depicted on the storage cup. To use the instrument the storage cup must be removed and the shield installed in its place. The probe can then be placed in the sampling site. Aim to set the probe into the water body at the same depth as the laboratory samples were collected and turn the handheld unit on. Wait until the readings remain consistent and record the values into a field worksheet (See Section 4.3). Once completed shutdown the handheld unit by holding the power button for 5 seconds. Remove the protection shield from the probe and replace the storage cup between each sampling site. If the pH solution is spilt in field fill the cup with tap water if available or sample water and replace the solution once you return to the laboratory with the pH4 solution. *NEVER store the probe in distilled water as this will have a detrimental impact on the instrument.*

4.2 Calibration & Maintenance

It is essential that the instrument is kept well calibrated. Calibration allows for the accuracy and reliability of the probe to be determined by comparing the results obtained by the probe against known standards and correcting the probe if there are any discrepancies. This process is required in order to have confidence in the results obtained in the field. Refer to the manufacturers instructions when undertaking calibration and make a record of the calibration in the Calibration Log for future reference (see Appendix).

4.3 Field Observations

Field parameters obtained should be recorded legibly on the appropriate field sheet ensuring all details are filled in correctly to maintain complete records. Field sheets for each quarry are available in the appropriate Appendices.

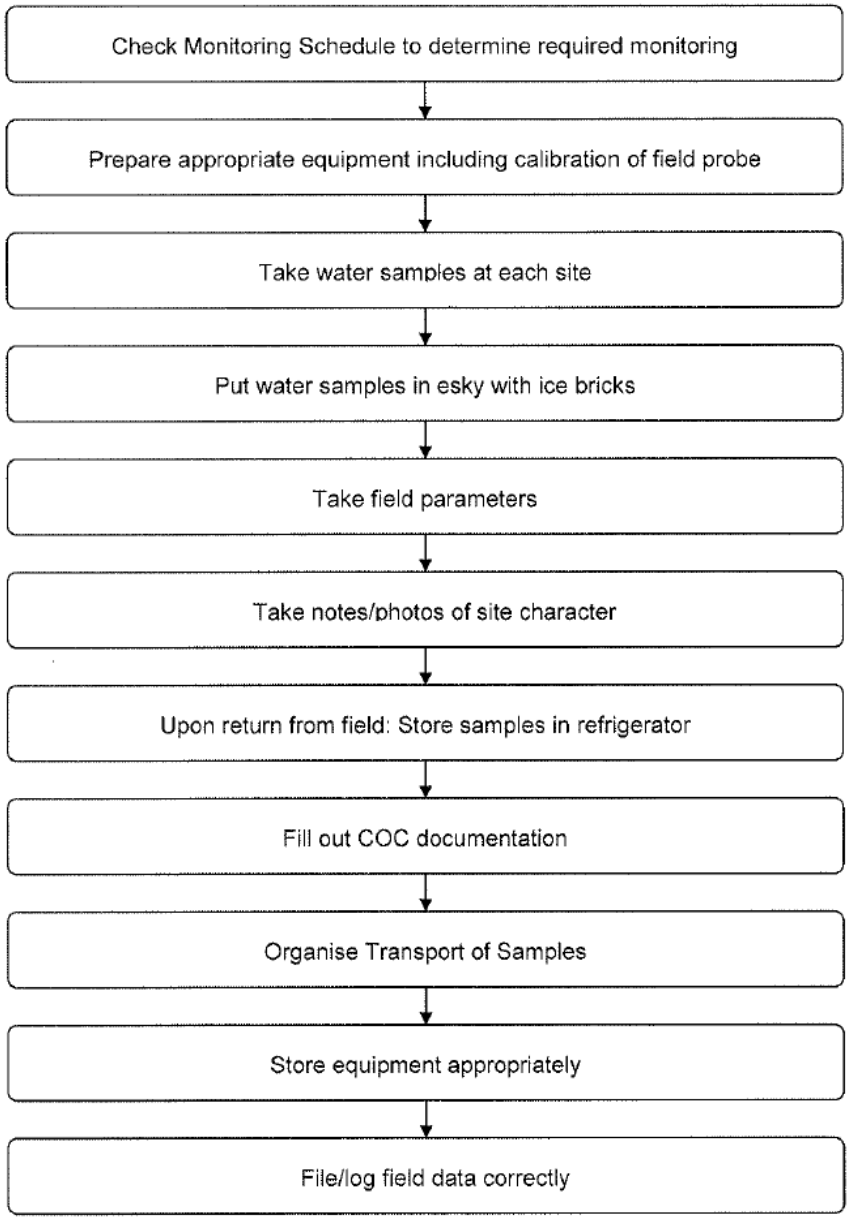
When inspecting water quality it is important to take notes on the character of the site identifying any factors that may influence or impact on water quality. Such details that should be recorded for each site include water clarity (is there any notable sediment plumes or is the water highly turbid), water colour, water odour, bank and bed stability (is there any noticeable signs of erosion), flow conditions and weather. The appropriate field sheets have space to record such details and it is important that these factors are noted and photographs taken so as to explain any discrepancies in water quality that may occur (AS/NZS 5667.1:1998 Section 10).

5.0 Monitoring Quick Checklist

Before undertaking field work ensure that you have the following items with you:

- ☑ Sample Bottles (Enough to cover all sites inspected plus spares)
- ☑ Permanent Marker for labelling samples
- ☑ Esky & Ice bricks for chilling samples
- ☑ Relevant Field Worksheet/s
- ☑ Pen for worksheet
- ☑ Clipboard
- ☑ Map of Sites
- ☑ Camera
- ☑ Field Multi-probe Instrument (fully calibrated before use).
- ☑ Any keys needed to access sites
- ☑ Relevant PPE for site access eg hardhat, hiviz, sunscreen, first aid kits

The following flow chart summarises the main activities to undertake when sampling surface waters:



6.0 References

AS/NZS 5667.1:1998: Water Quality-Sampling, Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.

Boral Materials Technical Services, Environmental Water Sampling Training Manual

Appendix C

Environmental Protection Licence 77

Environment Protection Licence

Licence - 77

Licence Details	
Number:	77
Anniversary Date:	31-August

Licensee
BORAL RESOURCES (NSW) PTY LTD
PO BOX 42
WENTWORTHVILLE NSW 2145

Premises
BORAL DUNMORE QUARRY
PRINCES HIGHWAY
DUNMORE NSW 2529

Scheduled Activity
Crushing, Grinding or Separating
Extractive Activities

Fee Based Activity	Scale
Crushing, grinding or separating	> 500000-2000000 T processed
Land-based extractive activity	> 500000-2000000 T extracted, processed or stored

Region
Metropolitan - Illawarra
Level 3, NSW Govt Offices, 84 Crown Street WOLLONGONG NSW 2500
Phone: (02) 4224 4100
Fax: (02) 4224 4110
PO Box 513 WOLLONGONG EAST
NSW 2520

Environment Protection Licence

Licence - 77

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Environment Protection Licence

Information about this licence

Dictionary

A definition of terms used in the licence can be found in the dictionary at the end of this licence.

Responsibilities of licensee

Separate to the requirements of this licence, general obligations of licensees are set out in the Protection of the Environment Operations Act 1997 ("the Act") and the Regulations made under the Act. These include obligations to:

- ensure persons associated with you comply with this licence, as set out in section 64 of the Act;
- control the pollution of waters and the pollution of air (see for example sections 120 - 132 of the Act); and
- report incidents causing or threatening material environmental harm to the environment, as set out in Part 5.7 of the Act.

Variation of licence conditions

The licence holder can apply to vary the conditions of this licence. An application form for this purpose is available from the EPA.

The EPA may also vary the conditions of the licence at any time by written notice without an application being made.

Where a licence has been granted in relation to development which was assessed under the Environmental Planning and Assessment Act 1979 in accordance with the procedures applying to integrated development, the EPA may not impose conditions which are inconsistent with the development consent conditions until the licence is first reviewed under Part 3.6 of the Act.

Duration of licence

This licence will remain in force until the licence is surrendered by the licence holder or until it is suspended or revoked by the EPA or the Minister. A licence may only be surrendered with the written approval of the EPA.

Licence review

The Act requires that the EPA review your licence at least every 5 years after the issue of the licence, as set out in Part 3.6 and Schedule 5 of the Act. You will receive advance notice of the licence review.

Fees and annual return to be sent to the EPA

For each licence fee period you must pay:

- an administrative fee; and
- a load-based fee (if applicable).

The EPA publication “A Guide to Licensing” contains information about how to calculate your licence fees. The licence requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints), be submitted to the EPA. The Annual Return must be submitted within 60 days after the end of each reporting period. See condition R1 regarding the Annual Return reporting requirements.

Usually the licence fee period is the same as the reporting period.

Transfer of licence

The licence holder can apply to transfer the licence to another person. An application form for this purpose is available from the EPA.

Public register and access to monitoring data

Part 9.5 of the Act requires the EPA to keep a public register of details and decisions of the EPA in relation to, for example:

- licence applications;
- licence conditions and variations;
- statements of compliance;
- load based licensing information; and
- load reduction agreements.

Under s320 of the Act application can be made to the EPA for access to monitoring data which has been submitted to the EPA by licensees.

This licence is issued to:

BORAL RESOURCES (NSW) PTY LTD
PO BOX 42
WENTWORTHVILLE NSW 2145

subject to the conditions which follow.

Environment Protection Licence

Licence - 77

1 Administrative Conditions

A1 What the licence authorises and regulates

A1.1 This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation.

Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.

Scheduled Activity	Fee Based Activity	Scale
Crushing, Grinding or Separating	Crushing, grinding or separating	> 500000 - 2000000 T processed
Extractive Activities	Land-based extractive activity	> 500000 - 2000000 T extracted, processed or stored

A2 Premises or plant to which this licence applies

A2.1 The licence applies to the following premises:

Premises Details
BORAL DUNMORE QUARRY
PRINCES HIGHWAY
DUNMORE
NSW 2529
LOT 1 DP 213575, LOT 1 DP 224597, LOT 2 DP 224597, LOT 4 DP 227046, LOT 4 DP 571406, LOT 6 DP 1001931, LOT 1 DP 1002951, PART LOT 3 DP 1030504, LOT 4 DP 1030504
EXCLUDING BATCH PLANT LAND SHOWN ON PLAN 6673 - SEE DEC FILE280279A15

A3 Information supplied to the EPA

A3.1 Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.

In this condition the reference to "the licence application" includes a reference to:
a) the applications for any licences (including former pollution control approvals) which this licence replaces under the Protection of the Environment Operations (Savings and Transitional) Regulation 1998; and
b) the licence information form provided by the licensee to the EPA to assist the EPA in connection with the issuing of this licence.

A3.2 Further to condition A4.1, the works and activities must be carried out in accordance with:

a) Correspondence entitled “Application to vary Environment Protection Licence No.77”, dated 20 June 2006, record number WOF14132.
b) Correspondence entitled “Response to Variation” emailed to DECC on 27 September 2006, including map “Boral Dunmore Quarry EPL 77 – Monitoring Location”, record number DOC06/51716.
c) Correspondence entitled “Dunmore Quarry – Revised Biodiversity Offset for Quarry Extension” prepared for Department of Planning and copied to the EPA, dated 22 September 2008.
d) “Boral Resources (NSW) Pty Ltd, Dunmore Quarry Water Management, Draft Water Management Plan” dated 28 April 2008, prepared by Evans and Peck.

2 Discharges to Air and Water and Applications to Land

P1 Location of monitoring/discharge points and areas

P1.1 The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point.

Air

EPA identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1	Air Emissions Monitoring - Dust Deposition		Dust deposition gauge located at Croome Farm north and labelled "1" on map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".
2	Air Emissions Monitoring - Dust Deposition		Dust deposition gauge located at Croome Farm south and labelled "2" on map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".
3	Air Emissions Monitoring - Dust Deposition		Dust deposition gauge located on the south-eastern side of quarry and labelled "3" on map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".
4	Air Emissions Monitoring - Dust Deposition		Dust deposition gauge located on the north-east side of quarry and labelled "4" on map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".
5	Air emissions monitoring - high volume air sampler or equivalent		High volume air sampler or equivalent located on the southern side of the quarry and labelled "5" on the map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".

P1.2 The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.

P1.3 The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
6	Discharge to waters and discharge quality monitoring	Discharge to waters and discharge quality monitoring	Discharge from the bio-filtration swale to Rocklow Creek labelled as "6" on map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".
7	Discharge to waters and discharge quality monitoring	Discharge to waters and discharge quality monitoring	Uncontrolled discharge from upgraded existing stormwater treatment dam to Rocklow Creek labelled as "7" on map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".
8	Effluent quality monitoring		At the discharge point end of the upgraded existing stormwater treatment dam labelled as "8" on map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".
9	Discharge to waters and stormwater quality monitoring		Rocklow Creek at the boundary between Boral Quarry and Creagan Property
10	Discharge to waters and discharge quality monitoring	Discharge to waters and discharge quality monitoring	Uncontrolled discharge from top stormwater treatment dam to Rocklow Creek labelled as "10" on map titled "Boral Dunmore Quarry EPL 77 - Momitoring Locations".

P1.4 The following point(s) in the table are identified in this licence for the purpose of the monitoring of weather parameters at the point.

EPA Identification Number	Type of Monitoring Point	Description of Location
11	Weather Analysis	Weather station located on the southern side of the quarry and labelled "11" on the map titled "Boral Dunmore Quarry EPL 77 - Monitoring Locations".

3 Limit Conditions

L1 Pollution of waters

L1.1 Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

L2 Concentration limits

L2.1 For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the

concentration limits specified for that pollutant in the table.

L2.2 Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.

L2.3 To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.

L2.4 Water and/or Land Concentration Limits

POINT 6

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Total suspended solids	milligrams per litre				50

L3 Noise limits

L3.1 Noise from the premises must not exceed the limits in the following table when measured at the nominated receiver locations. Note that the noise limits represent the noise contribution from the premises.

L3.2 Noise Limits for the Dunmore Quarry Operations - LAeq(15 minute)

Receiver Locations (See Note)	Day dB(A)	Evening dB(A)	Night dB(A)	Shoulder dB(A)
Location A McParland Residence	35	35	35	35
Location K Stocker Residence	49	44	38	47
Location O Dunmore Lakes	49	44	38	47
Location J Cregan Residence	Negotiated Agreement in Place	Negotiated Agreement in Place	Negotiated Agreement in Place	Negotiated Agreement in Place

L3.3 Noise Limits for the Dunmore Quarry Operations LA1 - (1 minute)

Receiver Locations (See Note)	Night dB(A)	Shoulder dB(A)

Location A McParland Residence	45	45
Location K Stocker Residence	48	55
Location O Dunmore Lakes	48	55
Location J Cregan Residence	Negotiated Agreement in Place	Negotiated Agreement in Place

Note: 1. Receiver locations nominated in Appendix A Figure A2 of the report prepared by Richard Heggie Associates Report NO 605/03 Titled Part 1: *Noise Assessment – Dunmore Quarry Production Increase.*

2. The above table may be varied in the instance that negotiated agreements are entered into by the licensee and affected residents or if existing arrangements become void.

3. In conditions L3.2 and L3.3:
- "Day" refers to 07.00 am to 06.00 pm Monday to Saturday and 08:00 am to 06:00 pm Sundays and public holidays.
- "Evening" refers to 06.00 pm to 10.00 pm.
- "Night" refers to 10.00 pm to 06.00 am Monday to Saturday and 10:00 pm to 08:00 am Sundays and public holidays.
- "Shoulder" refers to 06.00 am to 07.00 am Monday to Saturday.

L3.4 Noise from the premises is to be measured at 1m from the dwelling façade to determine compliance with the LA1(1minute) noise limits.

L3.5 The noise emission limits identified above apply under meteorological conditions of:
a) Wind speed up to 3m/s at 10 metres above ground level; or
b) Temperature inversion conditions of up to 3oC/100m and wind speed up to 2m/s at 10 metres above the ground.

L4 Blasting

L4.1 The overpressure level from blasting operations at the premises must not exceed 120dB (Lin Peak) at any time. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L4.2 The overpressure level from blasting operations at the premises must not exceed 115dB (Lin Peak) for more than five per cent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L4.3 Ground vibration peak particle velocity from the blasting operations at the premises must not exceed 10mm/sec at any time. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L4.4 Ground vibration peak particle velocity from the blasting operations at the premises must not exceed 5mm/sec for more than five per cent of the total number of blasts over each reporting period. Error margins associated with any monitoring equipment used to measure this are not to be taken into account in determining whether or not the limit has been exceeded.

L4.5 BLASTING TIMES AND FREQUENCY

Blasting operations on the premises may only take place:
a) between 9.00am and 5.00pm Monday to Saturday inclusive;
b) are limited to 2 blasts each day; and
c) at such other times as may be approved by the EPA.

L5 Hours of operation

L5.1 All work at the premises must be conducted between the following hours:

Activity	Days of the Week	Time
Extraction and Processing	Monday to Saturday	6:00am to 10:00pm
Product Transfer to Stockpiles	Monday to Saturday	6:00am to Midnight
Distribution of Product (Sales)	Monday to Saturday	24 hours
Distribution of Product (Sales)	Sunday	Limited - See Condition L5.2
Maintenance	Monday to Sunday	24 hours

L5.2 EXEMPTION FOR DISTRIBUTION OF PRODUCT FROM THE PREMISES (SALES) ON SUNDAYS

Distribution of product from the premises (Sales) on Sunday by road are to be no more than 15 Sundays in any one licensing year between the hours of 8-00am – 6-00pm unless prior approval is obtained from the EPA. This restriction does not apply to sales by rail, which are allowed 24 hours.

A logbook must be kept in the office building for the purpose of identifying Sundays when sales have occurred. An entry must be made in that log book on any Sunday when sales activities occur (excluding sales activities that consist of rail loading alone).

Note: Sales includes transfer of product to road and rail vehicles from stockpiles and subsequent haulage off-site. It does not include transfer of product from the processing plant to the product stockpile areas.

L6 Other limit conditions

L6.1 The licensee must not extract and/or process greater than 2 million tonnes of extractive material per year.

Note: The licensee, through Development Consent 470-11-2003, has approval to produce or transport up to 2.5 million tonnes per annum of extractive material. The licensee has advised the EPA by letter dated 20 June 2006 (refer A4.2) that they do not plan to extract and/or process and/or transport in excess of 2 million tonnes per annum of extractive material for a number of years and has requested they be placed in the 500,000-2,000,000 tonne per annum licence fee scale. This condition therefore adds a production limit of 2 million tonnes per annum.

L6.2 OVERSIZED MATERIAL

L6.3 Oversized raw feed material must not be processed during the shoulder period, being 6-00am –

7-00am.

Note: For the purpose of this condition oversized raw feed material is defined as where more than 50% of the shot is over 900mm in diameter.

Note: In consultation with the proponent the EPA will review at the EPL review stage the necessity to amend or continue the restriction in processing oversized raw feed material based on the findings of any submitted noise monitoring reports.

4 Operating Conditions

O1 Activities must be carried out in a competent manner

O1.1 Licensed activities must be carried out in a competent manner.
This includes:
a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

O2 Maintenance of plant and equipment

O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity:
a) must be maintained in a proper and efficient condition; and
b) must be operated in a proper and efficient manner.

O3 Dust

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

O4 Processes and management

O4.1 WATER POLLUTION CONTROL

O4.2 The storm water management system is to be managed and operated in accordance with the operating principles of the revised Water Management Plan prepared by Evans and Peck, dated April 2008.

O4.3 The stormwater management system must be maintained at its design capacity. In this regard the licensee must inspect the drainage system and associated stormwater infrastructure every three months and following heavy rainfall and arrange for routine maintenance as required. Inspection sheets certifying this work has been completed and detailing actions arising from the inspections must be kept in accordance with the requirements of this licence.

O4.4 Any proposal for a change of flocculant other than those specified in the report titled Dunmore Quarry - Response to Water Management Issues, prepared by Environmental Resources Management Australia and dated February 2004, requires EPA approval and may require an appropriate eco-toxicological risk assessment to the satisfaction of the EPA. The flocculants nominated in the abovementioned report were aluminium sulphate and ferric chloride.

O4.5 Impervious bunds must be constructed around all fuel, oil and chemical storage areas and the bund volume must be large enough to contain 110 per cent of the volume held in the largest container.

O5 Waste management

O5.1 All liquid and non liquid wastes resulting from activities and processes at the premises must be assessed, classified and managed in accordance with the EPA's Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes (1999), or any other EPA document superseding this guideline.

5 Monitoring and Recording Conditions

M1 Monitoring records

M1.1 The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.

M1.2 All records required to be kept by this licence must be:
a) in a legible form, or in a form that can readily be reduced to a legible form;
b) kept for at least 4 years after the monitoring or event to which they relate took place; and
c) produced in a legible form to any authorised officer of the EPA who asks to see them.

M1.3 The following records must be kept in respect of any samples required to be collected for the purposes of this licence:
a) the date(s) on which the sample was taken;
b) the time(s) at which the sample was collected;
c) the point at which the sample was taken; and
d) the name of the person who collected the sample.

M2 Requirement to monitor concentration of pollutants discharged

M2.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

M2.2 Air Monitoring Requirements

POINT 1

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Pollutant	Units of measure	Frequency	Sampling Method
Ash	grams per square metre per month	Monthly	AM-19
Insoluble solids	grams per square metre per month	Monthly	AM-19
Soluble matter	grams per square metre per month	Monthly	AM-19
Total Solid Particles	grams per square metre per month	Monthly	AM-19

POINT 2

Pollutant	Units of measure	Frequency	Sampling Method
Ash	grams per square metre per month	Monthly	AM-19
Insoluble solids	grams per square metre per month	Monthly	AM-19
Soluble matter	grams per square metre per month	Monthly	AM-19
Total Solid Particles	grams per square metre per month	Monthly	AM-19

POINT 3

Pollutant	Units of measure	Frequency	Sampling Method
Ash	grams per square metre per month	Monthly	AM-19
Insoluble solids	grams per square metre per month	Monthly	AM-19
Soluble matter	grams per square metre per month	Monthly	AM-19
Total Solid Particles	grams per square metre per month	Monthly	AM-19

POINT 4

Pollutant	Units of measure	Frequency	Sampling Method
Ash	grams per square metre per month	Monthly	AM-19
Insoluble solids	grams per square metre per month	Monthly	AM-19
Soluble matter	grams per square metre per month	Monthly	AM-19
Total Solid Particles	grams per square metre per month	Monthly	AM-19

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POINT 5

Pollutant	Units of measure	Frequency	Sampling Method
PM10	micrograms per cubic metre	Every 6 days	AM-18

M2.3 Water and/ or Land Monitoring Requirements

POINT 6

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	microsiemens per centimetre	Daily during any discharge	In situ
Flow	kilolitres per day	Continuous during discharge	Special Method 1
Oil and Grease	Visible	Daily during any discharge	Inspection
pH	pH	Daily during any discharge	In situ
Total suspended solids	milligrams per litre	Daily during any discharge	Grab sample
Turbidity	nephelometric turbidity units	Daily during any discharge	In situ

POINT 7

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	microsiemens per centimetre	Daily during any discharge	In situ
Oil and Grease	Visible	Daily during any discharge	Inspection
pH	pH	Daily during any discharge	In situ
Total suspended solids	milligrams per litre	Daily during any discharge	Grab sample
Turbidity	nephelometric turbidity units	Daily during any discharge	In situ

POINT 8

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	microsiemens per centimetre	Monthly	In situ
Oil and Grease	Visible	Monthly	Inspection
pH	pH	Monthly	In situ
Total suspended solids	milligrams per litre	Monthly	Grab sample

Turbidity	nephelometric turbidity units	Monthly	In situ

POINT 10

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	microsiemens per centimetre	Daily during any discharge	In situ
Oil and Grease	Visible	Daily during any discharge	Inspection
pH	pH	Daily during any discharge	In situ
Total suspended solids	milligrams per litre	Daily during any discharge	Grab sample
Turbidity	nephelometric turbidity units	Daily during any discharge	In situ

M2.4 For the purposes of the table(s) above Special Method 1 means measurement of flow at the controlled discharge from the upgraded existing stormwater treatment dam to the bio-filtration swale.

M3 Testing methods - concentration limits

M3.1 Monitoring for the concentration of a pollutant emitted to the air required to be conducted by this licence must be done in accordance with:
a) any methodology which is required by or under the Act to be used for the testing of the concentration of the pollutant; or
b) if no such requirement is imposed by or under the Act, any methodology which a condition of this licence requires to be used for that testing; or
c) if no such requirement is imposed by or under the Act or by a condition of this licence, any methodology approved in writing by the EPA for the purposes of that testing prior to the testing taking place.

Note: The *Protection of the Environment Operations (Clean Air) Regulation 2010* requires testing for certain purposes to be conducted in accordance with test methods contained in the publication "Approved Methods for the Sampling and Analysis of Air Pollutants in NSW".

M3.2 Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.

M4 Weather monitoring

M4.1 For each monitoring point specified in the table below, the licensee must monitor (by sampling and obtaining results by analysis) the parameters specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns.

POINT 11

Parameter	Units of Measure	Frequency	Averaging Period	Sampling Method
Rainfall	millimetres	Continuous	1 hour	AM-4
Wind speed @ 10 metres	metres per second	Continuous	15 minute	AM-2 & AM-4
Wind direction @ 10 metres	degrees	Continuous	15 minute	AM-2 & AM-4
Temperature @ 2 metres	degrees celcius	Continuous	15 minute	AM-4
Temperature @ 10 metres	degrees celcius	Continuous	15 Minute	AM-4
Additonal Requirements - Siting				AM-1 & AM-4
Additonal Requirements - Measurement				AM-2 & AM-4

M5 Recording of pollution complaints

M5.1 The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.

M5.2 The record must include details of the following:
a) the date and time of the complaint;
b) the method by which the complaint was made;
c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
d) the nature of the complaint;
e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and
f) if no action was taken by the licensee, the reasons why no action was taken.

M5.3 The record of a complaint must be kept for at least 4 years after the complaint was made.

M5.4 The record must be produced to any authorised officer of the EPA who asks to see them.

M6 Telephone complaints line

M6.1 The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.

M6.2 The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.

M6.3 The preceding two conditions do not apply until 3 months after:
a) the date of the issue of this licence or
b) if this licence is a replacement licence within the meaning of the Protection of the Environment Operations (Savings and Transitional) Regulation 1998, the date on which a copy of the licence was served on the licensee under clause 10 of that regulation.

M7 Blasting

M7.1 To determine compliance with limit conditions relating to blasting:

a) Airblast overpressure and ground vibration levels must be measured and electronically recorded at the McParland Property monitoring station for all production blasts carried out in or on the premises; and
b) Instrumentation used to measure the airblast overpressure and ground vibration levels must meet the requirements of Australian Standard AS 2187.2-2006.

M8 Other monitoring and recording conditions

M8.1 NOISE MONITORING

M8.2 Noise from the premises must be continuously monitored at location K (refer condition titled “Noise Limits”) by use of a real time continuous noise monitoring system. The system shall be capable of, but not necessarily limited to the following:
a) continuous 24 hour seven day per week real time monitoring;
b) linked in real time to Boral Quarry Operations Management;
c) linked to a procedure that outlines corrective/preventative action to ensure compliance with EPL limits.

Detected exceedances of the noise limits must be reported to EPA within 7 days of the detection of the exceedance. The report shall include details of the date and time of the exceedance, the operational cause of the exceedance, the response initiated and the measures proposed to ensure ongoing compliance with the noise limits.

Note: The EPA’s General Terms of Approval for Development Application 470-11-2003 required the licensee to consult with the EPA in the development of an agreed noise monitoring program. As part of these consultations the licensee implemented a noise monitoring system known as “Barn Owl” that was to be deployed for a minimum of 3 months to determine compliance, and may also be used in developing near-field noise level triggers as is required by PRP 15. The EPA suggested that use of the Barn Owl system cover periods when the plant is operating as well as during the Christmas shutdown. The EPA said that use of the Barn Owl over the period when noise levels are likely to be at their worst (ie winter) will also be necessary. It has been agreed that at the conclusion of the monitoring the results will be assessed (along with the results of PRP 15) to determine the necessity for continuation of real time continuous noise monitoring at Location K.

M8.3 Noise from the premises must be measured annually via attended noise surveys at potentially affected residences, including Location K Stocker Residence (as described elsewhere in the licence). The noise monitoring should be conducted during the period when it is known that noise propagation from the premises will be at its worst, that is, generally winter conditions.

6 Reporting Conditions

R1 Annual return documents

R1.1 The licensee must complete and supply to the EPA an Annual Return in the approved form comprising:
a) a Statement of Compliance; and
b) a Monitoring and Complaints Summary.
At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.

R1.2 An Annual Return must be prepared in respect of each reporting period, except as provided below.

Note: The term "reporting period" is defined in the dictionary at the end of this licence. Do not complete the Annual Return until after the end of the reporting period.

R1.3 Where this licence is transferred from the licensee to a new licensee:
a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and
b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.

Note: An application to transfer a licence must be made in the approved form for this purpose.

R1.4 Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on:
a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or
b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.

R1.5 The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').

R1.6 The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.

R1.7 Within the Annual Return, the Statement of Compliance must be certified and the Monitoring and Complaints Summary must be signed by:
a) the licence holder; or
b) by a person approved in writing by the EPA to sign on behalf of the licence holder.

R1.8 A person who has been given written approval to certify a certificate of compliance under a licence issued under the Pollution Control Act 1970 is taken to be approved for the purpose of this condition until the date of first review of this licence.

R1.9 The licensee must supply with the Annual Return a report, which provides:
a) an analysis and interpretation of monitoring results; and
b) actions to correct identified adverse trends.

Note: In consultation with the licensee the EPA will review at the EPL review stage the necessity to expand, reduce, amend or continue any specific aspects of the monitoring program based on the findings of any submitted monitoring reports.

R1.10 REPORTING OF ENVIRONMENTAL MONITORING DATA

R1.11 A noise compliance assessment report, detailing the findings of the noise monitoring required by the monitoring conditions of this licence, must be submitted to EPA yearly as part of the Annual Return. The report shall be prepared by a suitably qualified acoustical consultant. The noise compliance assessment must include, but need not be limited to a comparison of actual noise levels from the premises with the noise limits specified in this licence.

R1.12 A dust deposition report, must be submitted to the EPA yearly as part of the Annual Return. This dust deposition report must contain:
a) A brief summary of the results for all dust deposition monitoring sites.

b) Tabulated monthly data and rolling annual averages for “insoluble solids” and “ash” for each site for the 12 month period covered by the Annual Return. Where the monthly insoluble solid level is greater than 4 g/m2/month an assessment to determine the likely reason for the elevated dust deposition level must be made of:
i) Weather data (including provision of a wind rose showing wind speed and direction for the period of the monitoring);
ii) Ash content of the sample;
iii) Operating conditions such as monthly production or quarry blasts that may have caused the elevated level; and
iv) Other relevant factors.

The findings of the above assessment must be included in the dust deposition report.

Where results are not available the licensee must provide an explanation for the reasons for such non-availability.

c) For each monitoring site, a graphical presentation(s) must be made of dust deposition results since 2002 which includes:
i) The rolling 12 month annual average insoluble solids trendline;
ii) The rolling average insoluble solids trendline since 2002;
iii) The rolling average ash trendline since 2002;
iv) The EPA’s impact assessment criteria for deposited dust; and
v) Annual quarry production rates.

d) Where the rolling average ash trendline shows an upward trend the licensee must provide details of programs and/or works and/or actions that will be put in place to ensure the EPA’s impact assessment criteria for dust is not exceeded.

Note: The EPA's Annual Impact Assessment Criteria for insoluble solids of 4 g/m2/month (12 month rolling average) has been chosen as the standard at which the licensee will do a detailed assessment, if monthly results exceed this figure.

Note: If individual results are also included on the graph it is appropriate to adjust the vertical axis to a lower value, say 6 g/m2/month, so that long term trends can be identified.

Note: This condition is included on the licence as air quality dispersion modelling has predicted an increase in deposited dust with increased quarry production. The EPA's deposited dust impact assessment criteria is expressed in terms of insoluble solids. However due to the nature of the product being quarried any assessment of long-term trends needs to include an assessment of "ash" as dust from the quarrying activities conducted on the premises is mostly inorganic and will predominantly be recorded as "ash".

R1.13 A Fine Particulate (PM10) Report must be submitted to the EPA yearly as part of the Annual Return. This fine particulate report must contain:
a) A brief summary of all the results for PM10 conducted over the licensing year;
b) Graphical presentation of all results for PM10 conducted over the licensing year as well as the annual average and lines representing the impact assessment criteria for PM10 detailed in the publication "Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales";
c) Where levels exceed the impact assessment criteria, an assessment to determine the likely reason for the elevated reading must be undertaken and included in the report. For individual results this may include:
i) Weather data (including an assessment of wind speed and direction for the 24 hours of the test);
ii) Operating conditions such as blasting that may have coincided with the 24 hour monitoring period; and
iii) Other relevant factors.

R1.14 A summary of the monitoring of all blasts undertaken during the licence period must be included in the Annual Return. The summary must include, but may not be limited to, the date, time, ground vibration (mm/sec - peak particle velocity), and airblast overpressure of (dB(Lin Peak)).

R2 Notification of environmental harm

Note: The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act.

R2.1 Notifications must be made by telephoning the Environment Line service on 131 555.

R2.2 The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.

R3 Written report

R3.1 Where an authorised officer of the EPA suspects on reasonable grounds that:
a) where this licence applies to premises, an event has occurred at the premises; or
b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence,
and the event has caused, is causing or is likely to cause material harm to the environment (whether the

harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.

R3.2 The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.

R3.3 The request may require a report which includes any or all of the following information:
a) the cause, time and duration of the event;
b) the type, volume and concentration of every pollutant discharged as a result of the event;
c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event;
d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort;
e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants;
f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
g) any other relevant matters.

R3.4 The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.

R4 Other reporting conditions

R4.1 The results of the monitoring required by Condition M7.1 for each blast that exceeds a ground vibration of 5mm/sec (peak particle velocity) or an airblast overpressure of 115 dB(Lin Peak) must be submitted to the EPA within 7 days of the blast.

R4.2 The written record of results submitted to the EPA must include:
(i) the time and date of each blast;
(ii) the station(s) at which noise was measured;
(iii) the ground vibration for each blast;
(iv) the airblast overpressure for each blast;
(v) evidence that during each 12 month period, a calibration check had been carried out on each blast monitor to ensure accuracy of the reported data; and
(vi) the waveform for the ground vibration and overpressure for the blast.

7 General Conditions

G1 Copy of licence kept at the premises or plant

G1.1 A copy of this licence must be kept at the premises to which the licence applies.

G1.2 The licence must be produced to any authorised officer of the EPA who asks to see it.

G1.3 The licence must be available for inspection by any employee or agent of the licensee working at the premises.

G2 Other general conditions

G2.1 Completed Pollution Studies and Reduction Programs (PRPs)

PRP	Description	Completed Date
PRP 1 - Undertake a noise assessment	Original Title: Undertake a Noise Assessment and Determine Appropriate Project Specific Noise Levels for the Site. Assessment of ambient noise levels within the residential areas surrounding quarry to determine project specific noise levels for site. Noise to be determined in accordance with the Industrial Noise Policy.. Boral to fully disclose environmental impact of noise from quarry	31-January-2002
PRP 2 – Dust Control Work Plan Quarry Roads	Original Title: Prepare a Plan of Works for the Control of Dust from Quarry Roads. Upgrade controls for dust emissions from quarry roads so that when implented quarry roads will not be a source of vehicle generated dust	01-March-2002
PRP 3 – Stormwater Pollution Control Work	Original Title: Prepare a Plan of Works for the Control of Stormwater Pollution from the Quarry. Develop a system of controls that captures all of the contaminated stormwater run off for reuse in dust suppression and/or treatment and discharge to Rocklow Creek.	03-May-2002
PRP 4 – Dust Control Work Plan - High Risk Ops	Original Title: Prepare a Plan of Work for the Control of Dust from the Screenhouse and Bunkers and the Secondary Crusher and Related Transfer Points. Ensure all dust generated within the screenhouse and bunker systems, and the area of the secondary crusher and related transfer points is suppressed.	01-June-2002
PRP 5 – Fixed Water Spray Installation	Original Title: Install Fixed Water Sprays on the roadway between the Site Offices/Weighbridge and the Crushing and Screening Plant Control Room. Installation of sprinkler system to suppress dust from quarry roads. Less dust from quarry road transport into sales area	30-September-2002
PRP 6 – Installation of Dust Controls	Original Title: Install the Following Dust Controls; Clad the Southern Side of the Quarry Product Bunkers; Install Fabric Filter Dust Controls at the tail and head of Conveyor 4 and; Install Fabric Filter Dust Collector at the discharge to Crushers CR6 and CR7. Dust control from screenhouse and other buildings. Prevention of wind and minimise emissions of dust	30-September-2002

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PRP 7 – Air Quality Impact Assessment	Original Title: Undertake Air Quality Impact Assessment in Relation to Proposed Increased Extraction Rates. Air pollution assessment for the increased production proposal. Determine impacts to assist planning decisions	31-March-2004
PRP 8 – Emergency Contingency Management	Original Title: Develop an Emergency Contingency Management Plan. Emergency Contingency Management. Document and implement measures to minimise the environmental impacts of any emergency situations that could arise as a result of the operation of the Dunmore Quarry.	18-May-2005
PRP 9 – Dust Control Effectiveness Program	Original Title: Develop a Dust Control Effectiveness Program. Investigate the effectiveness of dust mitigation controls in relation to the production increase at the premises	01-December-2005
PRP 10 Construct Stormwater Pollution Control Dam	Original Title - Construct and commission stormwater pollution control dam. To capture and treat polluted runoff waters from storm events of less than and including a 1:10 year, 24 hours duration, average recurrence interval	26-June-2009
PRP 11 - Integrated Water Management Program	Original Title: Integrated Water Management Program. To address the external annual water demand for the operation of the premises, which has been estimated at an upper limit of 117 ML/year.	18-November-2005
PRP 12 – Water Control Installation	Original Title: Install Works to achieve better water pollution control. To implement the recommended works detailed in the report titled "Dunmore Quarry - response to water management issues"	13-July-2006
PRP 13 – Install a Rainfall Station	PRP 13 - Install a rainfall station. Install and maintain a rainfall monitoring device which will assist in determining compliance with the conditions of this licence	18-August-2005
PRP 15 - Nearfield Noise Monitoring Investigations	Original Title: Conduct Nearfield Noise Monitoring Investigations. To determine near field trigger levels which would assist in demonstrating compliance and verify the effectiveness of noise mitigation works	18-May-2005
PRP 16 - Fines Stockpile Management Plan	Original Title: Develop a Fines Stockpile Management Plan. Implement measures for the management of the minus 4mm stockpiles with the aim to stabilize the surface of the stockpiles to minimize wind blown dust emissions and to minimize erosion due to stormwater run off	01-March-2005
PRP 17 - Noise Compliance Investigation Program	PRP 17 - Noise Compliance Investigation Program. Identify a range of options to facilitate compliance with the EPL noise limits through physical attenuation measures and/or operational/management processes.	01-July-2006

PRP 18: Clad Secondary Crusher	Original Title: Enclose Secondary Crusher to Reduce Noise. The licensee has advised that cladding the Secondary Crusher will reduce noise at the source by about 12 dBA and this will allow noise limit compliance at the nearest noise receptor.	01-July-2006
PRP 19: Enclose Screen 1 and Fill In gaps	Original Title: Enclose Screen 1 and enclose gaps between the Primary Crusher and the Secondary Crusher. Reduce noise levels so as to comply with licence noise limits.	01-October-2006
PRP 20 Tertiary Screenhouse dust emissions	PRP 20: Improved Dust Controls for the Tertiary Screenhouse. Investigations and then works into reducing dust emissions from the Tertiary Screenhouse. Reduced dust emissions from the premises.	30-June-2010

8 Special Conditions

E1 Biodiversity Conservation Offset

E1.1 The Licensee will conserve, maintain, enhance and ensure long term security of the vegetation offset by a means agreed to by the EPA.

Note: The vegetation offset is detailed in correspondence to the Department of Planning and copied to the EPA, dated 22 September 2008 (refer to A4.2).

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Dictionary

General Dictionary

3DGM [in relation to a concentration limit]	Means the three day geometric mean, which is calculated by multiplying the results of the analysis of three samples collected on consecutive days and then taking the cubed root of that amount. Where one or more of the samples is zero or below the detection limit for the analysis, then 1 or the detection limit respectively should be used in place of those samples
Act	Means the Protection of the Environment Operations Act 1997
activity	Means a scheduled or non-scheduled activity within the meaning of the Protection of the Environment Operations Act 1997
actual load	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
AM	Together with a number, means an ambient air monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
AMG	Australian Map Grid
anniversary date	The anniversary date is the anniversary each year of the date of issue of the licence. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
annual return	Is defined in R1.1
Approved Methods Publication	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
assessable pollutants	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
BOD	Means biochemical oxygen demand
CEM	Together with a number, means a continuous emission monitoring method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.
COD	Means chemical oxygen demand
composite sample	Unless otherwise specifically approved in writing by the EPA, a sample consisting of 24 individual samples collected at hourly intervals and each having an equivalent volume.
cond.	Means conductivity
environment	Has the same meaning as in the Protection of the Environment Operations Act 1997
environment protection legislation	Has the same meaning as in the Protection of the Environment Administration Act 1991
EPA	Means Environment Protection Authority of New South Wales.
fee-based activity classification	Means the numbered short descriptions in Schedule 1 of the Protection of the Environment Operations (General) Regulation 2009.
general solid waste (non-putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997

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flow weighted composite sample	Means a sample whose composites are sized in proportion to the flow at each composites time of collection.
general solid waste (putrescible)	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environmen t Operations Act 1997
grab sample	Means a single sample taken at a point at a single time
hazardous waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
licensee	Means the licence holder describe d at the front of this licence
load calculation protocol	Has the same meaning as in the Protection of the Environment Operations (General) Regulation 2009
local authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
material harm	Has the same meaning as in section 147 Protection of the Environment Operations Act 1997
MBAS	Means methylene blue active substances
Minister	Means the Minister administering the Protection of the Environment Operations Act 1997
mobile plant	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
motor vehicle	Has the same meaning as in the Protection of the Environment Operations Act 1997
O&G	Means oil and grease
percentile [in relation to a concentration limit of a sample]	Means that percentage [eg.50%] of the number of samples taken that must meet the concentration limit specified in the licence for that pollutant over a specified period of time. In this licence, the specified period of time is the Reporting Period unless otherwise stated in this licence.
plant	Includes all plant within the meaning of the Protection of the Environment Operations Act 1997 as well as motor vehicles.
pollution of waters [or water pollution]	Has the same meaning as in the Protection of the Environment Operations Act 1997
premises	Means the premises described in condition A2.1
public authority	Has the same meaning as in the Protection of the Environment Operations Act 1997
regional office	Means the relevant EPA office referred to in the Contacting the EPA document accompanying this licence
reporting period	For the purposes of this licence, the reporting period means the period of 12 months after the issue of the licence, and each subsequent period of 12 mo nths. In the case of a licence continued in force by the Protection of the Environment Operations Act 1997, the date of issue of the licence is the first anniversary of the date of issue or last renewal of the licence following the commencement of the Act.
restricted solid waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
scheduled activity	Means an activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997
special waste	Has the same meaning as in Part 3 of Schedule 1 of the Protection of the Environment Operations Act 1997
TM	Together with a number, means a test method of that number prescribed by the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

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TSP	Means total suspended particles
TSS	Means total suspended solids
Type 1 substance	Means the elements antimony, arsenic, cadmium, lead or mercury or any compound containing one or more of those elements
Type 2 substance	Means the elements beryllium, chromium, cobalt, manganese, nickel, selenium, tin or vanadium or any compound containing one or more of those elements
utilisation area	Means any area shown as a utilisation area on a map submitted with the application for this licence
waste	Has the same meaning as in the Protection of the Environment Operations Act 1997
waste type	Means liquid, restricted solid waste, general solid waste (putrescible), general solid waste (non-putrescible), special waste or hazardous waste

Mr Nigel Sargent

Environment Protection Authority

(By Delegation)

Date of this edition: 14-December-1999

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End Notes

1	Licence varied by notice V/M upgrade, issued on 08-Jul-2000, which came into effect on 08-Jul-2000.
2	Licence transferred through application 140020, approved on 27-Sep-2000, which came into effect on 31-Aug-1999.
3	Licence varied by notice 9418, issued on 09-Mar-2000, which came into effect on 30-Mar-2000.
4	Licence varied by notice 1012272, issued on 19-Oct-2001, which came into effect on 13-Nov-2001.
5	Licence varied by notice 1013531, issued on 14-Dec-2001, which came into effect on 08-Jan-2002.
6	Licence varied by notice 1016381, issued on 12-Aug-2002, which came into effect on 06-Sep-2002.
7	Licence varied by notice 1021119, issued on 11-Oct-2002, which came into effect on 05-Nov-2002.
8	Licence varied by notice 1026479, issued on 08-Jul-2003, which came into effect on 08-Jul-2003.
9	Licence varied by notice 1035077, issued on 17-Nov-2004, which came into effect on 18-Nov-2004.
10	Licence varied by notice 1056152, issued on 15-Feb-2006, which came into effect on 12-Mar-2006.
11	Licence varied by change to DEC Region allocation, issued on 16-Mar-2003, which came into effect on 16-Mar-2003.
12	Licence varied by notice 1057794, issued on 12-Apr-2006, which came into effect on 12-Apr-2006.
13	Licence varied by notice 1061796, issued on 23-Jun-2006, which came into effect on 23-Jun-2006.
14	Licence varied by notice 1065559, issued on 29-Sep-2006, which came into effect on 29-Sep-2006.
15	Licence varied by notice 1073479, issued on 17-May-2007, which came into effect on 17-May-2007.
16	Licence varied by notice 1081122, issued on 16-May-2008, which came into effect on 16-May-2008.
17	Licence varied by notice 1088505, issued on 14-Jul-2008, which came into effect on 14-Jul-2008.
18	Condition A1.3 Not applicable varied by notice issued on <issue date> which came into effect on <effective date>

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19	Licence varied by notice 1102292, issued on 12-Aug-2009, which came into effect on 12-Aug-2009.
20	Licence varied by notice 1106096, issued on 14-Sep-2009, which came into effect on 14-Sep-2009.
21	Licence varied by notice 1502449 issued on 03-Nov-2011
22	Licence varied by notice 1502884 issued on 15-May-2012
23	Licence varied by notice 1506167 issued on 17-May-2012
24	Licence varied by notice 1512744 issued on 27-Mar-2013
25	Licence varied by notice 1518429 issued on 22-Nov-2013

Appendix D

Surface water extraction licence (WAL25152) details under *Water Management Act 2000*

Information about a water licence or approval

Use this tool to search for information about water licences and approvals issued under the *Water Act 1912* or *Water Management Act 2000*.

Select the type of licence or approval and enter the licence or approval number:

- **Water access licence (WAL):** a WAL number starts with the letters 'WAL' followed by several numbers; a WAL also has a reference number that starts with a two digit number, followed by 'AL' and then several numbers.
- **1912 water licence:** a water licence number starts with a two digit number, followed by a two letter code and then several numbers. Note: a PT reference number cannot be entered.
- **Approval:** an approval number starts with a two digit number, followed by a two letter code (WA, UA, CA or FW) and then several numbers.

Search for information about either a:

◉ **Water access licence (WAL) issued under the *Water Management Act 2000***

Water Access Licence (WAL) Number WAL 25152

A WAL number starts with the letters 'WAL' followed by several numbers

Can't find your WAL number? Do you have a reference number? A reference number starts with a two digit number, followed by 'AL' and then several numbers. Use the following tool to find your WAL by entering your reference number. Enter the reference number to find the WAL number.

Notes:

The search results will list the conditions imposed on the water access licence. Any approved water supply work/s nominated on the water access licence are identified by the approval number/s for the work/s.

The information about a water access licence provided in the search results is a summary and may not always be up to date. If you require full and up to date details about a particular water access licence (including current holders, share and extraction component details, encumbrances and notations) you should search the Water Access Licence Register administered by Land and Property Information.

○ Approval issued under the *Water Management Act 2000*

Find out if a *Water Act 1912* licence has been converted

○ Water licence conversion status

Previous Search Print Export

Search Results

Category [Subcategory]	Status	Water Source	Tenure Type	Management Zone	Share Components (units or ML)
Unregulated River	Current	Illawarra Rivers Water Source	Continuing	Minnamurra River Management Zone	227.00

Extraction Times or Rates

Subject to conditions water may be taken at any time or rate

Nominated Work Approval(s)

10WA103611

- Conditions

Plan Conditions

Water sharing plan	Greater Metropolitan Region Unregulated River Water Sources
	Take of water
MW0025-00002	In the Minnamurra River Management Zone of the Illawarra Rivers Water Source, from 1 July 2016, if the flow is less than 3 ML/day at Minnamurra River at the Browns Lane gauge [No. 214010] for a period of 24 or more consecutive hours, then there must be a minimum flow of 3 ML/day at that gauge for at least 24 hours before water can be taken.
MW0112-00001	The maximum water allocation that may be carried over in the account for this access licence from one water year to the next water year is: A. a volume equal to 100 % of the share component of the licence, or B. 1 ML/unit share of the share component of the licence.
MW0036-00002	The volume of water taken in any three (3) consecutive water years from 1 July 2012 must be recorded in the logbook at the end of those three water years. The maximum volume of water permitted to be taken in those years must also be recorded in the logbook.
MW0016-00001	In the Minnamurra River Management Zone of the Illawarra Rivers Water Source, from 1 July 2011 until 30 June 2016, if the flow is less than 1 ML/day at Minnamurra River at the Browns Lane gauge [No. 214010] for a period of 24 or more consecutive hours, then there must be a minimum flow of 1 ML/day at that gauge for at least 24 hours before water can be taken.
MW0605-00001	Water must be taken in compliance with the conditions of the approval for the nominated work on this access licence through which water is to be taken.
MW0050-00001	From 1 July 2011 until 30 June 2016, water must not be taken from the Minnamurra River Management Zone of the Illawarra Rivers Water Source when flows are in the Very Low Flow Class, which means that the flow is 1 ML/day or less at Minnamurra River at the Browns Lane gauge [No. 214010]. This restriction does not apply if water is to be taken from a runoff harvesting dam or an in-river dam pool.
MW0670-00001	Water must only be taken if there is visible flow in the water source at the location where water is to be taken.

This restriction does not apply if water is to be taken:
A. from an off-river pool, an in-river pool, a runoff harvesting dam or an in-river dam pool, or
B. from the following Weirs: Maldon, Douglas Park, Menangle, Camden, Sharpes, Cobbity, Mount Hunter Rivulet, Brownlow Hill, Theresa Park and Wallacia.

MW0080-00005 From 1 July 2016, water must not be taken from the Minnamurra River Management Zone of the Illawarra Rivers Water Source when flows are in the Very Low Flow Class, which means that the flow is 3 ML/day or less at Minnamurra River at the Browns Lane gauge [No. 214010].

This restriction does not apply if water is to be taken from a runoff harvesting dam or an in-river dam pool.

MW0004-00002 From 1 July 2012, the total volume of water taken in any three (3) consecutive water years under this access licence must not exceed a volume which is equal to the lesser of either:
A. the sum of:
i. water in the account from the available water determinations in those 3 consecutive water years, plus
ii. water in the account carried over from the water year prior to those 3 consecutive water years, plus
iii. any net amount of water assigned to or from this account under a water allocation assignment in those 3 consecutive water years, plus
iv. any water re-credited by the Minister to the account in those 3 consecutive water years,

or

B. the sum of:
i. the share component of this licence at the beginning of the first year in those 3 consecutive water years, plus
ii. the share component of this licence at the beginning of the second year in those 3 consecutive water years, plus
iii. the share component of this licence at the beginning of the third year in those 3 consecutive water years, plus
iv. any net amount of water assigned to or from this account under a water allocation assignment in those 3 consecutive water years, plus
v. any water re-credited by the Minister to the account in those 3 consecutive water years.

Monitoring and recording

MW2337-00001 The following information must be recorded in the logbook for each period of time that water is taken:
A. date, volume of water, start and end time when water was taken as well as the pump capacity per unit of time, and
B. the access licence number under which the water is taken, and
C. the approval number under which the water is taken, and
D. the volume of water taken for domestic consumption and/or stock watering.

MW2339-00001 A logbook must be kept, unless the work is metered and fitted with a data logger. The logbook must be produced for inspection when requested by DPI Water.

Reporting

MW0051-00002 Once the licence holder becomes aware of a breach of any condition on this access licence, the licence holder must notify the Minister as soon as practicable. The Minister must be notified by:
A. email: water.enquiries@dpi.nsw.gov.au,
or
B. telephone: 1800 353 104. Any notification by telephone must also be confirmed in writing within seven (7) business days of the telephone call.

Other Conditions

NIL

Disclaimer: The NSW Office of Water does not warrant the data is current nor does it warrant that the data or the data capturing processes are free from corruption or error.

Privacy: The information provided is limited to meet the requirements of section 57 of the *Privacy and Personal Information Act 1998*.

Exporting and printing: Search results show a maximum of 50 rows per page. Search results can only be printed page by page.

More information: Should you require further information or technical assistance, please submit your request to water.enquiries@dpi.nsw.gov.au or contact 1800 353 104.

Appendix E

Details of the conversion of previous water access licence (10SL050221) under the *Water Act 1912*

Information about a water licence or approval

Use this tool to search for information about water licences and approvals issued under the *Water Act 1912* or *Water Management Act 2000*.

Select the type of licence or approval and enter the licence or approval number:

- **Water access licence (WAL):** a WAL number starts with the letters 'WAL' followed by several numbers; a WAL also has a reference number that starts with a two digit number, followed by 'AL' and then several numbers.
- **1912 water licence:** a water licence number starts with a two digit number, followed by a two letter code and then several numbers. Note: a PT reference number cannot be entered.
- **Approval:** an approval number starts with a two digit number, followed by a two letter code (WA, UA, CA or FW) and then several numbers.

Search for information about either a:

- ○ Water access licence (WAL) issued under the *Water Management Act 2000*
- ○ Approval issued under the *Water Management Act 2000*

Find out if a *Water Act 1912* licence has been converted

- ◉ **Water licence conversion status**

Water Licence Number 10 ▼ SL ▼ 050221

Notes:

Water Act 1912 licences and authorities are being converted to water access licences and approvals under the *Water Management Act 2000* as water sharing plans commence (see licence conversion).

If a *Water Act 1912* licence has been converted, the search results will display the water access licences and approvals that have been created. Water access licences are registered in the Water Access Licence Register administered by Land and Property Information. Those water access licences that do not display a WAL number in the search results are still to have their licence details confirmed and completed.

Due to privacy laws very little information on *Water Act 1912* licence and authorities can be made freely available. Full information for a particular licence or authority can be obtained if required for conveyancing by applying to the DPI Water. See legal searches for water related interests.

« Previous Search Print Export

Search Results

Access licenses created for '10SL050221'

WAL No.	Water Source	Status
25152	Illawarra Rivers Water Source	Current

Approvals created for '10SL050221'

Approval No.	Water Source	Status

10WA103611	Illawarra Rivers Water Source	Current

Land to which the converted entitlement previously related.

Lot/DP	Description
Lot 3, DP 1030504	Work Location
Lot 3, DP 1030504	Land Benefited

Disclaimer: The NSW Office of Water does not warrant the data is current nor does it warrant that the data or the data capturing processes are free from corruption or error.

Privacy: The information provided is limited to meet the requirements of section 57 of the *Privacy and Personal Information Act 1998*.

Exporting and printing: Search results show a maximum of 50 rows per page. Search results can only be printed page by page.

More information: Should you require further information or technical assistance, please submit your request to water.enquiries@dpi.nsw.gov.au or contact 1800 353 104.

Appendix F

Water Supply Works approval number 10WA103611.

Department of Primary Industries
Office of Water

Statement of Approval

Water Management Act 2000

Approval details

Approval number	10WA103611
Status	CURRENT*
Approval kind	Water Supply Works
Water sharing plan	GREATER METROPOLITAN REGION UNREGULATED RIVER WATER SOURCES
Date of effect	01/Jul/2011
Expiry date	30/Jun/2024
Approval holder(s)	Schedule 1
Water supply works	Schedule 2
Conditions	Schedule 3

Contact for service of documents

Name	Boral Resources (N S W) Pty Ltd
Address	B C M PURCHASING HUB P O BOX 42 WENTWORTHVILLE NSW 2145

* **Note: An approval has effect for such period as is specified in the approval, or if the period is extended under section 105, that extended period. If an application for extension of an approval is lodged before the approval expires, the term of the expiring approval is extended until either the date of the final decision on the application, or a date fixed by the Minister for the approval, whichever is the later date. An approval which has expired can be the subject of an application to extend it but it needs to be accompanied by a statutory declaration of the reasons for the delay in making the application. If the Minister accepts these reasons the term of the approval is taken to have been extended, and the application may be dealt with, as if the application had been made before the approval expired.**

  It is an offence under the Water Management Act 2000 to breach a term or condition of the approval or to construct and use works to which the approval does not relate. It is also an offence to use works the subject of an approval if the approval has expired, been surrendered or cancelled.

Schedule 1 - Approval holders

The holders of this approval are:

Approval holder(s)	ACN (if applicable)
Boral Resources (N S W) Pty Ltd	756 507

Important notice - change of landholder or contact

Please advise the Office in the event of any of the following, as soon as practicable:

- If there is a change in the ownership or occupation of the land benefited by this approval (see Schedule 2). Under the Water Management Act 2000, an approval is typically held by the owner or lawful occupier of the benefited land. Consequently, a change in occupation may cause a change in your legal obligations as an approval holder.*
- If there is a change to the contact person. You will be required to lodge a written statement signed by all the holders.*
- If there is a change to the mailing address for the nominated contact person. This should be done by the contact person in writing.

** An updated Statement of Approval will be issued free of charge*

Schedule 2 - Water supply works

Part A: Authorised water supply works

Subject to the conditions of this approval, in relation to each numbered work in the table, the holders of this approval are authorised to construct and use a water supply work of the type shown at the location specified:

Work 1

Specified work	100MM CENTRIFUGAL PUMP
Specified location	3//1030504 Whole Lot
Water management zone (if applicable)	MINNAMURRA RIVER MANAGEMENT ZONE
Water source	ILLAWARRA RIVERS WATER SOURCE
Water sharing plan	GREATER METROPOLITAN REGION UNREGULATED RIVER WATER SOURCES

Work 2

Specified work	BYWASH DAM
Specified location	3//1030504 Whole Lot
Water management zone (if applicable)	MINNAMURRA RIVER MANAGEMENT ZONE
Water source	ILLAWARRA RIVERS WATER SOURCE
Water sharing plan	GREATER METROPOLITAN REGION UNREGULATED RIVER WATER SOURCES

Schedule 3 - Conditions

The approval is subject to the following conditions:

Part A: Statutory conditions

Water sharing plan

GREATER METROPOLITAN REGION UNREGULATED RIVER WATER SOURCES

Condition 1

A LOGBOOK MUST BE KEPT AND MAINTAINED AT THE AUTHORISED WORK SITE OR ON THE PROPERTY FOR EACH WATER SUPPLY WORK AUTHORISED BY THIS APPROVAL, UNLESS THE WORK IS METERED AND FITTED WITH A DATA LOGGER.

A LOGBOOK IS A DOCUMENT, ELECTRONIC OR HARD COPY, THAT RECORDS SPECIFIC REQUIRED INFORMATION.

A METERED WATER SUPPLY WORK IS A WATER SUPPLY WORK FITTED WITH A DATA LOGGER AND A METER THAT COMPLIES WITH AUSTRALIAN STANDARD AS 4747: METERS FOR NON-URBAN WATER SUPPLY.

Condition 2

THE PURPOSE OR PURPOSES FOR WHICH WATER IS TAKEN, AS WELL AS DETAILS OF THE TYPE OF CROP, AREA CROPPED, AND DATES OF PLANTING AND HARVESTING, MUST BE RECORDED IN THE LOGBOOK EACH TIME WATER IS TAKEN.

Condition 3

WHERE A WATER METER IS INSTALLED ON A WATER SUPPLY WORK AUTHORISED BY THIS APPROVAL, THE METER READING MUST BE RECORDED IN THE LOGBOOK BEFORE TAKING WATER. THIS READING MUST BE RECORDED EVERY TIME WATER IS TO BE TAKEN.

A WATER METER IS A DEVICE THAT MEASURES THE VOLUME OF WATER THAT IS EXTRACTED OVER A KNOWN PERIOD OF TIME. EXAMPLES OF A WATER METER MAY INCLUDE A MECHANICAL METER, ELECTROMAGNETIC METER, CHANNEL METER WITH MOBILE PHONE, OR AN AUTHORISED METER EQUIVALENT.

Condition 4

ONCE THE APPROVAL HOLDER BECOMES AWARE OF A BREACH OF ANY CONDITION ON THIS APPROVAL, THE APPROVAL HOLDER MUST NOTIFY THE MINISTER AS SOON AS PRACTICABLE. THE MINISTER MUST BE NOTIFIED BY:

A. EMAIL: INFORMATION0WATER.NSW.GOV.AU,

OR

B. TELEPHONE: 1800 353 104. ANY NOTIFICATION BY TELEPHONE MUST ALSO BE CONFIRMED IN WRITING WITHIN SEVEN (7) BUSINESS DAYS OF THE TELEPHONE CALL.

Condition 5

WHEN A WATER SUPPLY WORK AUTHORISED BY THIS APPROVAL IS TO BE ABANDONED OR REPLACED, THE APPROVAL HOLDER MUST CONTACT THE NSW OFFICE OF WATER IN WRITING TO VERIFY WHETHER THE WORK MUST BE DECOMMISSIONED.

THE WORK IS TO BE DECOMMISSIONED, UNLESS THE APPROVAL HOLDER RECEIVES NOTICE FROM THE MINISTER NOT TO DO SO.

WITHIN SIXTY (60) DAYS OF DECOMMISSIONING, THE APPROVAL HOLDER MUST NOTIFY THE NSW OFFICE OF WATER IN WRITING THAT THE WORK HAS BEEN DECOMMISSIONED.

Condition 6

A LOGBOOK MUST BE KEPT, UNLESS THE WORK IS METERED AND FITTED WITH A DATA LOGGER. THE LOGBOOK MUST BE PRODUCED FOR INSPECTION WHEN REQUESTED BY NSW OFFICE OF WATER.

A LOGBOOK IS A DOCUMENT, ELECTRONIC OR HARD COPY, THAT RECORDS SPECIFIC REQUIRED INFORMATION.

Condition 7

THE FOLLOWING INFORMATION MUST BE RECORDED IN THE LOGBOOK FOR EACH PERIOD OF TIME THAT WATER IS TAKEN:

A. DATE, VOLUME OF WATER, START AND END TIME WHEN WATER WAS TAKEN AS WELL AS THE PUMP CAPACITY PER UNIT OF TIME, AND

B. THE ACCESS LICENCE NUMBER UNDER WHICH THE WATER IS TAKEN, AND

C. THE APPROVAL NUMBER UNDER WHICH THE WATER IS TAKEN, AND

D. THE VOLUME OF WATER TAKEN FOR DOMESTIC CONSUMPTION AND/OR STOCK WATERING.

A LOGBOOK IS A DOCUMENT, ELECTRONIC OR HARD COPY, THAT RECORDS SPECIFIC REQUIRED INFORMATION.

Condition 8

THE COMPLETED LOGBOOK MUST BE RETAINED FOR FIVE (5) YEARS FROM THE LAST DATE RECORDED IN THE LOGBOOK.

Condition 9

ANY WATER SUPPLY WORK AUTHORISED BY THIS APPROVAL MUST TAKE WATER IN COMPLIANCE WITH THE CONDITIONS OF THE ACCESS LICENCE UNDER WHICH WATER IS BEING TAKEN.

Part B: Other Conditions

Works and Use Conditions

Condition 10 THE HOLDER OF THE APPROVAL MUST NOT CONSTRUCT OR INSTALL WORKS USED FOR CONVEYING, DISTRIBUTING OR STORING WATER TAKEN BY MEANS OF THE APPROVED WORK THAT OBSTRUCT THE REASONABLE PASSAGE OF FLOODWATERS INTO OR FROM A RIVER.

Condition 11 THE HOLDER OF THE APPROVAL MUST NOT CONSTRUCT OR INSTALL WORKS USED FOR CONVEYING, DISTRIBUTING OR STORING WATER TAKEN BY MEANS OF THE APPROVED WORK THAT OBSTRUCT THE REASONABLE PASSAGE OF FLOODWATERS OTHER THAN THAT WATER TO BE IMPOUNDED OR OBSTRUCTED.

Condition 12 WHERE ANY INTERNAL COMBUSTION POWERED WORK IS USED FOR THE PURPOSE OF DIVERTING WATER AUTHORISED UNDER THIS LICENCE, THE POWER UNIT AND ANY ASSOCIATED FUEL STORAGE SHALL BE LOCATED OUTSIDE ANY WATERCOURSE OR DRAINAGE DEPRESSION AND A BUNDING WALL OF HAY BALES OR OTHER APPROVED MATERIAL SHALL BE INSTALLED AROUND THE PUMPING PLANT TO AVOID CONTAMINATION OF ANY RIVER OR LAKE THROUGH SPILLS OR LEAKS OF OILS, FUELS OR GREASES.

Condition 13 THE APPROVAL HOLDER MUST ENSURE THAT ANY PUMPING AND ANCILLARY EQUIPMENT AND THE PUMP AUTHORISED SITES MUST, AT ALL TIMES, BE PROPERLY SECURED AND/ OR SEALED SO AS TO PREVENT ANY LEAKAGE OF PETROLEUM BASED PRODUCTS AND/ OR NOXIOUS MATERIAL FROM ENTERING ANY RIVER OR LAKE.

Condition 14 THE EXISTING PROFILE OF THE CHANNEL AND BANK OF ANY WATERCOURSE OR DRAINAGE DEPRESSION MUST NOT BE DISTURBED ANY MORE THAN IS NECESSARY IN ORDER TO SITE AND MAINTAIN THE AUTHORISED DIVERSION WORK. ANY AREA THAT IS DISTURBED WHEN CARRYING OUT SUCH WORK SHALL BE STABILISED AND MAINTAINED BY GRASS COVER, STONE PITCHING OR ANY OTHER APPROVED MATERIAL AS DIRECTED AND TO THIS DEPARTMENT'S SATISFACTION SO AS TO PREVENT THE OCCURRENCE OF EROSION.

Condition 15 ANY DRAINAGE CHANNELS OR CROSS BANKS ASSOCIATED WITH THE AUTHORISED DIVERSION WORK OR ACCESS ROADS, TO OR FROM THAT WORK, SHALL HAVE INSTALLED AND MAINTAINED A BUNDING WALL OF HAY BALES OR OTHER APPROVED MATERIAL, TO PREVENT SILTATION DUE TO THE AUTHORISED DIVERSION WORK OR ACCESS ROADS FROM REACHING ANY RIVER OR LAKE.

Condition 16 THE LEVEL OF THE CREST OF THE BYWASH OF THE DAM SHALL BE FIXED AT NOT HIGHER THAN 0.35 METRES BELOW THE LEVEL OF A BENCH MARK ESTABLISHED ON A FENCE POST ON THE LEFT BANK OF THE WATERCOURSE NEAR THE WORK AND PARTICULARS OF WHICH ARE RETAINED IN THE OFFICE OF NSW OFFICE OF WATER.

Condition 17 THE LOCATION OF THE DAM(S) AS SHOWN ON A PLAN RETAINED IN THE OFFICE OF NSW OFFICE OF WATER SHALL NOT BE ALTERED.

Condition 18 THE HOLDER OF THE APPROVAL MUST CONSTRUCT AND MAINTAIN THE APPROVED WORK IN A SAFE AND PROPER MANNER THAT WILL MINIMISE THE POSSIBILITY OF DAMAGE BEING OCCASIONED BY IT, OR RESULTING FROM IT TO ANY PUBLIC OR PRIVATE INTEREST.

Note: The words in this approval have the same meaning as in the WMA

END OF STATEMENT

Appendix G

Detailed surface water quality results

Dunmore Quarry Surface Water Monitoring
EPL ID # 6: Controlled Discharge to Bio-retention Swale

			Field Parameters								Laboratory Testing														
	Date	Time	Temperature oC	pH	Conductivity uS/cm	Salinity PSS	DO mg/L	%	ORP mV	Turbidity NTU	pH	TSS mg/L	Turbidity NTU	Conductivity uS/cm	Oil & Grease mg/L	TDS mg/L	Total N mg/L	Total P mg/L	Arsenic mg/L	Cadmium mg/L	Nikel mg/L	Lead mg/L	Zinc mg/L	TKN mg/L	Comments
2009-2010																									
	Jul-09	30/07/09																							No Discharge to bio-retention swale
	Aug-09	31/08/09																							No Discharge to bio-retention swale
	Sep-09	30/09/09																							No Discharge to bio-retention swale
	Oct-09	30/10/09																							No Discharge to bio-retention swale
	Nov-09	30/11/09																							No Discharge to bio-retention swale
	Dec-09	05/01/10																							No Discharge to bio-retention swale
	Jan-10	05/02/10																							No Discharge to bio-retention swale
	Jan-00																								
	Jan-00																								
	Jan-00																								
	Jan-00																								
	Jan-00																								
	2009-2010 Average																								

Dunmore Quarry Surface Water Monitoring
EPL ID # 7: Uncontrolled Discharge from upgraded existing dam

			Field Parameters									Laboratory Testing														
		Date	Time	Temperature	Conductivity	DO	pH	Salinity	DO	ORP	Turbidity	pH	TSS	Turbidity	Conductivity	Oil & Grease	TDS	Total N	Total P	Arsenic	Cadmium	Nikel	Lead	Zinc	TKN	Comments
				oC	uS/cm	mg/L		PSS	%	mV	NTU		mg/L	NTU	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
2009-2010	Jul-09	30/07/09																								No Uncontrolled discharge from upgraded dam
	Aug-09	31/08/09																								No Uncontrolled discharge from upgraded dam
	Sep-09	30/09/09																								No Uncontrolled discharge from upgraded dam
	Oct-09	30/10/09																								No Uncontrolled discharge from upgraded dam
	Nov-09	30/11/09																								No Uncontrolled discharge from upgraded dam
	Dec-09	05/01/10																								No Uncontrolled discharge from upgraded dam
	Jan-10	5/02/2010																								No Uncontrolled discharge from upgraded dam
2010-2011	Sep-10	15/09/10	14:58	17.33	302	4.52	6.31	0.14	42.1	375	54	6.7	25.6	31	377	<1										
	Dec-10	01/12/10		19.52	338	3.24	6.99	0.16	34.9	368	17	6.4	10.2	9.1	326	<1										
	Dec-10	02/12/10	14:00	22.67	478	6.35	8.09	0.23	72.9	274	273	7.6	20.9	200	461	<1										
	Mar-11	20/03/11	16:30	y probe locked in office (Sunday Sampling								7.6	48.8	260	431	2.4										Rocklow Creek flooded and backing into dam.
	Mar-11	22/03/11										7.3	198.8	240	315	1.9										Flash flooding in region 21 March 2011. Rocklow very high and entering quarry. See photos
	2010-2011 Average			19.84	373	4.70	7.1	0.18	50	339	116	7.1	61	148	382	2.2										
2011-2012		22/07/11		17.92	392	6.01	7.51	0.21	70	282	443	7.6	354	650	357	<1										
		1/03/2012	Site evacuation																							
		02/03/12		21.59	501	5.75	7.58	0.26	59	291	181															
	2011-2012 Average			19.76	447	5.88	7.5	0.24	65	287	312	7.6	354	650	357	<1										
2012-2013		30/08/2012																								No Uncontrolled discharge from upgraded dam
		25/06/2013	15:35	12.9			8.09	169	87	30	896	8.1	168	490	307	<1										
		26/06/2013	12:45	13.9	255	7.02	7.86	156	73	16	864	8.4	214	660	290	<1										
		27/06/2013	15:09	16.5	393	7.69	7.96	219	80	72	277	8.0	94	210	379	<1										
	2012-2013 Average			14.43	324	7.36	8.0	181.33	80	39	679	8.2	159	453	325	<1										
2014-2015		19/08/2014	9:50	13.56	365	5.94	7.46	0.17	57	328	1988	8.1	257	380	389	0.6										
		27/08/2014	12:15	14.2	330	5.60	7.2	0.17	52	374	455	8.3	249	360	358	1										
		21/04/2015	12:10	16.13	318	9.12	8.33	0.15	111	279	1762	8.3	406	850	290	0.9										
		22/04/2015	Site evacuation																							
		27/08/2015	10:40	18.00		8.58	7.82	0.13	91	293	695	8.2	308	380	286	1.1										
	2014-2015 Average			15.47	338	7.31	7.7	0.16	78	319	1225	8.2	305	493	331	0.9										Lower Dam was not discharging on Saturday Morning, however Rocklow creek was in flow. Due to large rain it was assumed discharge occurred on Sunday when Rocklow creek rises and enters into Lower Dam, which in turn filled up. Sampling and photos were taken first thing Monday morning. Significant flow in Rocklow Creek was observed upstream and downstream.

25/08/2015 to collect samples due to flooding
26/08/2015 ble to colelct samples due to flooding

Dunmore Quarry Surface Water Monitoring
EPL ID # 8: Upgraded Existing Dam

		Date	Time	Field Parameters: Temperature oC	Conductivity uS/cm	DO mg/L	pH	Salinity PSS	DO %	ORP mV	Turbidity NTU	Laboratory Testing: pH	TSS mg/L	Turbidity NTU	Conductivity uS/cm	Oil & Grease mg/L	TDS mg/L
Background Averages	2004-2005											7.9	18	21		<1	
	2005-2006											8.1	7	3		<1	
	2006-2007											7.2	67	84	1093		
	2007-2008											7.5	40	62	664	<1	257
	2008-2009			20.39	737		7.6	371.4 (ppm)				7.6	14	38	693	<1	391
2009-2010	Jul-09	30/07/2009	14:30	14.12	690	8.21	8.0	0.33	89	331	36	7.8	7	21	674	<1	
	Aug-09	31/08/2009	13:30	15.86	808	10.44	8.0	0.40	102	304	66	7.9	31	38	806	<1	
	Sep-09	30/09/2009	13:30	20.79	25100	10.88	7.8	15.19	109	289	16	8.1	24	17	23000	<1	
	Oct-09	30/10/2009	14:30	24.98	7390	13.34	8.8	4.07	164	264	48	8.5	33	28	7440	<1	
	Nov-09	30/11/2009	15:10	24.64	5520	6.00	7.8		73	257	10	8.1	5	5	5760	<1	
	Dec-09	5/01/2010	13:30	26.50	4060	6.71	7.2	2.15	84	193	29	7.8	15	16	3830	<1	2332
	Jan-10	5/02/2010	15:40	27.09	2390	7.58	7.3	1.23	77	335	46	7.7	13	24	2320	<1	
	Feb-10	5/03/2010	13:00	23.35	1356	4.14	6.9		49	371	39	7.6	14	23	1321	<1	
	Mar-10	31/03/2010	12:50	24.16	1980	5.97	7.7	0.99	70	254	54	7.6	52	50	1980	<1	
	Apr-10	29/04/2010	16:25	19.84	1373	11.96	7.1	0.68	103	308	29	7.9	11	18	1354	<1	
	May-10	31/05/2010	15:30	16.24	1096	6.96	7.7	0.50	72	312	22	7.7	7	19	967	<1	
	Jun-10	9/07/2010	15:40	14.48	946	8.60	7.2	0.46	84	328	35	8.0	6	21	957	<1	550
	2009-2010 Average			21.00	4382	8.40	7.6	2.60	90	296	36	7.9	18	23	4201	<1	1441
2010-2011	Jul-10	30/07/2010	15:30	13.80	841	6.90	7.0	0.41	67	361	52	7.7	14	40	851	<1	485
	Aug-10	31/08/2010	14:30	14.53	802	9.55	6.8	0.39	95	385	49	7.8	16	25	803	<1	
	Sep-10	15/09/2010	14:00	15.75	557	5.60	6.7	0.28	57	365	220	7.3	17	100	597	<1	
	Sep-10	30/09/2010	14:00	17.87	724	9.23	7.0	0.35	95	307	34	8.0	10	10	712	<1	
	Oct-10	29/10/2010	15:00	20.98	715	6.43	7.5	0.35	71	274	51	7.7	11	27	701	<1	
	Nov-10	30/11/2010	13:00	21.37	619	8.46	7.8	0.30	95	293	151	7.5	40	55	591	<1	
		1/12/2010		20.30	564	6.30	7.6	0.27	69	336	380	7.8	85	24	543	<1	
	Dec-09	2/12/2010	14:30	22.56	491	5.01	7.7	0.24	61	281	277	7.6	73	250	481	<1	
		22/12/2010	14:30	23.92	654	6.90	7.7	0.32	83	280	72	7.5	10	40	630	<1	
	Jan-10	2/02/2011	13:00	28.75	694	4.84	6.7	0.34	63	293	62	7.6	13	36	646	<1	399
		3/03/2011		22.87	718	5.50	7.0	0.35	65	316	85	7.8	21	55	675	<1	
	Feb-10	20/03/2011	16:00	No Field Parameters: Quality probe locked in office (Sunday Sampling)								7.6	61	280	437	3.8	
	Mar-11	22/03/2011		unsafe access to water to place quality probe								7.2	107	320	309	1.4	
	Apr-11	11/04/2011		14.35	498	5.97	7.0	0.23	82	302	95	7.8	12	70	629	<1	
		4/05/2011		15.62	551	7.15	7.3	0.26	81	281	183	7.2	75	160	485	1.1	
	Jun-11	8/06/2011		13.08	528	7.35	5.7	0.25	79	462	157	7.0	57	35	515	1	
	Jun-10	30/06/2011	16:00	14.19	643	5.45	8.0	0.31	61	303	101	8.0	33	90	608	<1	362
	2010-2011 Average			18.66	640	6.71	7.2	0.31	74	323	131	7.6	38	95	601	1.83	415
2011-2012	Jul-11	22/07/2011		15.15	401	5.91	7.7	0.20	65	271	400	7.5	184	370	364	<1	
	Aug-11	31/08/2011		16.71	565	5.81	7.9	0.27	63	321	200	7.6	80	130	558	<1	
	Sep-11	5/10/2011	15:30	18.29	608	5.72	8.2	0.29	68	291	61	7.9	12	55	587	<1	
	Oct-11	31/10/2011	13:25	19.23	515	6.21	7.5	0.25	66	320	122	7.9	27	110	594	<1	
	Nov-01	5/12/2011	15:40	19.81	525	6.55	7.8	0.22	73	328	81	8.0	27	60	507	<1	
	Dec-11	10/01/2012	15:40	18.71	587	5.59	7.4	0.31	62	304	47	7.7	23	23	605	<1	352
	Jan-12	30/01/2012	15:50	19.15	478	4.98	8.5	0.21	54	271	71	8.6	15	65	454	<1	
	Feb-12	1/03/2012		Site evacuation													
		2/03/2012		20.58	459	5.87	7.5	0.24	55	298.00	197						
	Mar-12	5/04/2012	15:00	22.59	550	6.49	8.0	0.27	73	287	133	7.8	33	75	532	<1	
	Apr-12	24/04/2012	14:15	20.00	479	6.24	7.3	0.23	68	342	198	7.9	31	85	481	<1	
	May-12	28/05/2012	11:45	14.14	558	8.72	6.7	0.27	86	346	135	8.0	30	55	549	1.2	
	Jun-12	29/06/2012	14:55	12.14	522	10.74	6.2	0.25	97	429.00	94	8.1	20	90	508	<1	
	2011-2012 Average			18.04	521	6.57	7.6	0.25	69	317	145	7.9	44	102	522	1.20	352
2012-2013	Jul-12	1/08/2012	10:00	13.27	571	7.91	6.3	0.26	74	399	107	8.0	16	27	533	<1	
	Aug-12	30/08/2012										8.2	69	90	620	<1	
	Sep-12	26/09/2012	11:40	19.10	700	9.10	6.6	0.34	98	342	124	8.4	55	75	687	<1	
	Oct-12	7/10/2012	11:40	18.69	825	6.87	6.5	0.41	72	292	139	8.2	62	80	886	<1	
		12/10/2012	11:55	13.82	621	9.31	7.2	0.28	89	511		8.6	33	55	656	<1	
	Oct-12	13/10/2012	13:50	18.43	534	8.92	7.1	0.26	94	283	104	8.6	33	65	560	<1	
	Oct-12	26/10/2012	11:30	20.20	593	5.30	8.2	331ppm	57	79	156	8.4	71	85	620	<1	
	Nov-12	28/11/2012	14:15	23.10	1154	6.33	8.4	650ppm	73	-21	98	8.2	31	34	1082	<1	
	Dec-12	19/12/2012	14:51	26.20	1274	7.50	8.5	723.00	93	15	213	8.1	265	190	1447	<1	
	Dec-12	25/12/2012	6:34	25.00	1159	5.43	8.1		71	242	148	7.9	78	85	1280	<1	
	Jan-13	27/01/2013	10:50	25.70	1434	5.81	8.1		79	184	150	8.4	61	120	1148	<1	
	Jan-13	29/01/2013	13:40	22.10	374	7.19	7.0	202.00	84	98	1090	8.2	314	950	402	<1	
	Jan-13	30/01/2013	15:30	22.90	431	6.99	8.5	213.00	80	51	60	7.9	101	250	464	<1	
	Feb-13	25/02/2013	12:50	25.10	475	5.97	7.5	262.00	71	54	342	7.9	58	230	490	<1	
		27/02/2013	15:25	26.60	497	5.76	8.0	276.00	68	-17	190	8.1	330	130	327	<1	
		1/03/2013	14:24	20.30	470	6.42	7.1	252.00	65	42	235	8.2	12	230	460	<1	
	Feb-13	2/03/2013	10:30	20.10	465	6.33	7.7	256.00	61	64	184	8.2	32	140	459	<1	
	Mar-13	27/03/2013	14:45	25.70	641	6.10	8.0	416.00	76	63	63	8.3	20	45	620	<1	
	Apr-13	3/04/2013	11:30	21.40	624	6.78	8.5	411.00	77	88	334	8.2	93	21	549	<1	
	May-13	29/04/2013	12:05	21.10	536	6.76	8.2	349.00	72	-19	80	8.3	19	50	512	<1	
		24/05/2013	16:20	14.30	524	10.43	7.3	292.00	95	96	169	8.4	24	95	486	<1	
	Jun-13	29/05/2013	16:30	15.90	520	9.30	7.6	276.00	93	22	86	8.3	19	60	510	<1	
		24/06/2013		12.70	321	7.97	7.9	186.00	73	177	1705	8.4	109	55	369	<1	
	Jul-13	25/06/2013	15:45	12.70			8.1	163.00	94	38	735	8.3	67	530	295	<1	
	Aug-13	26/06/2013	12:50	13.60	271	8.55	7.9	150.00	73	30	1003	8.4	69	420	298	<1	
		27/06/2013	14:56	14.00	384	8.33	7.8	210.00	77	80	421	8.2	45	160	431	<1	
	2012-2013 Average			19.68	642	7.31	7.7	220.88	76	128	336	8.2	81	164	623	<1	-
2013-2014	Jul-13	1/07/2013	14:15	15.30	455	7.28	8.2	255.00	76	-34	117	8.0	27	75	419	<1	
	01/08/13	1/08/2013	15:05	10.60	447	8.10	7.8	291.00	88	100	3	8.3	19	100	436	<1	
	03/09/13	3/09/2013	8:30	16.70	617	7.50	8.7	402.00	80	-18	0	8.6	24	95	556	<1	
	15/09/13	15/09/2013	8:30	15.40	527	8.37	8.2	296.00	92	80	119	8.6	10	90	507	<1	
		3/10/2013	8:04	21.50	507	7.02	8.0	281.00	85	74	214	8.3	45	150	533	<1	
	06/11/13	6/11/2013		21.43	897	7.90	8.1	0.46	89	381	142	8.5	44	65	1039	0.7	
	11/11/13	11/11/2013	11:30	21.15	1079	7.49		0.53	93	385	128	8.5	55	85	1037	1.1	
	17/11/13	17/11/2013	15:20	20.81	827	6.45	6.9	0.40	77	408	106	8.4	34	60	750	<0.1	
		12/12/2013		22.19	840	8.17		0.41	95	415	66	8.1	54	75	495	0.8	
		26/12/2013		no access to waterprobe over LWE shutdown								8.4	122	180	818	0.7	
		8/01/2014	14:00	26.98	546	*	7.9	0.26	*	299	123	8.6	57	90	577	0.5	394
		13/02/2014	15:00	23.52	114	6.64	7.7	0.56	66	278	111	8.5	30	60	975	<0.1	
		1/03/2014	13:30	22.00	968	6.57	6.8	0.48	79	328	659	8.5	144	180	892	<0.1	
		25/03/2014	11:40	19.76	385	5.56	8.0	0.18	53	273	20	8.5	419	800	359	0.3	
		26/03/2014	12:36	21.07	369	4.33	7.8	0.18	46	287	865	8.4	220	590	344	0.9	
		27/03/2014	13:10	21.05	384	4.35	7.7	0.18	50	293	802	8.2	184	500	343	0.5	
		4/04/2014	10:39	22.31	562	1.82	7.6	0.27	18	238		8.2	74	160	456	0.7	
		5/05/2014	11:20	15.64	663	5.86	7.2	0.32	59	401	97	8.4	54	60	509	1.1	
		3/06/2014	10:45	15.78	680	5.06	6.0	0.33	51	399	85	8.4	45	55	527	0.6	
	2013-2014 Average			19.62	604	6.38	7.6	84.98	68	255	215	8.4	87	183	609	0.72	394
2014-2015		2/07/2014	8:55	10.40	664	7.48	6.6	0.32	67	341	39	8.0	30	28	619	0.6	
		4/08/2014	11:05	11.38	947	6.86	7.5	0.46	82	337	28	8.6	25	28	986	1.3	
		18/08/2014	8:00	13.54	469	5.92	7.8	0.22	67	327	171	8.3	213	200	494	0.8	
		19/08/2014	9:30	13.64	369	5.91	7.3	0.17	57	345	832	8.2	242	340	398	0.7	
		26/08/2014	11:30	14.60	419	5.09	6.8	0.20	59	344	1989	8.3	181	450	398	0.7	
		27/08/2014	12:10	14.04	347	5.38	7.1	0.16	61	381	448	8.3	262	380	366	1.1	
		8/09/2014	10:48	14.44	426	5.96	7.9	0.20	67	282	218	8.1	146	190	436	0.3	
		2/10/2014	14:05	20.43	556	4.83	8.4	0.27	62	248	91	8.1	33	45	547	1.1	
		15/10/2014	7:55	15.82	421	5.37	8.0	0.20	58	366	511	8.2	207	130	429	0.8	
		30/10/2014	11:30	21.97	481	5.82	7.9	0.23	67	38	44	8.1	16	27	493	1.4	
		2/12/2014	11:45	24.45	452	6.41	8.7	0.22	73	-26	429	8.4	118	310	459	1	
		2/12/2014	11:45	24.45	452	6.41	8.7	0.22	73	-26	429	8.5	128	300	453	1	
		22/12/2014	15:10	26.90	491	6.64	7.4	0.24	80	241	61	8.0	23	41	495	1	
		11/01/2015	10:25	24.17	439	4.96	7.3	0.21	60	174	236	8.0	81	170	445	1	
		21/01/2015	14:10	29.04	466	6.09	8.3	0.23	73	242	177	8.4	61	140	478	0.7	
		4/02/2015	14:00	23.73	449	6.30	8.6	0.22	79	179	79	8.0	23	41	495	1	297
		5/02/2015	9:30	22.10	448	5.54	8.2	0.22	68	274	101	8.3	40	80	451	0.6	
		4/03/2015	15:00	25.95	571	6.01	8.5	0.25	76	283	64	8.3	38	60	512	0.7	
		21/04/2015	12:15	15.98	323	9.28	8.4	0.15	99	274	1391	8.2	340	800	328	1.1	
		21/04/2015	12:15	15.98	323	9.28	8.4	0.15	99	274	1391	8.2	348	800	326	0.8	
		22/04/2015		Site evacuation													
		24/04/2015	9:50	16.61		6.94	7.9	0.16	79	308	420	8.1	79	140	385	1.1	
		12/05/2015	12:15	14.91	499	14.51	8.5	0.24	103	345	90	8.3	62	75	510	0.8	
		10/06/2015	14:15	13.30	538	15.54	8.3	0.26	102	299	72	8.3	32	40	526	1.8	330
	2014-2015 Average			18.60	480	7.07	7.9	0.23	67	254	439	8.2	119	223	489	0.93	314
		6/07/2015	15:40	11.72	489	97.70	8.1	0.23	10	340	76	8.0	39	50	489	0.8	
		4/08/2015	11:46	11.49	468	9.36	8.3	0.22	85	251	114	8.3	45	70	484	1.5	
		27/08/2015	10:50	14.90		7.74	7.2	0.13	74	291	871	8.2	266	390	275	1.2	
	Monthly	1/09/2015	16:04	15.20	378	8.34	7.9	0.18	80	226	255	8.1	103	190	387	1.1	
	Monthly	1/10/2015	12:40	19.45	434	13.52	8.5	0.21	113	211	123	8.6	66	90	415	0.8	
	Monthly	12/11/2015	11:30	22.38	441	9.03	6.6	0.21	103	232	65	8.6	33	45	411	0.9	
	Monthly	2/12/2015	10:55	24.1	477	7.47	8.7	0.23	86	207	101	8.2	42	55	452	0.9	
	Monthly	5/01/2016	12:45	22.5	475	6.2	8.0	0.23	68	222	220	7.9	71	130	430	0.7	
	Monthly	4/02/2016		23.5	420	8.3	8.6	0.2	89	397	159	8.2	83	130	358	0.9	
	Monthly	10/03/2016	1455	23.9	444	7	7.6	0.22	87	276	94	8.3	36	45	403	0.5	
	Monthly	4/04/2016	1055	21.0	362	6.6	6.8	0.2	77	234	398	8.2	217	340	329	0.3	
	Monthly	30/04/2016	828	20	480	9.10	8.2	0.2	103	244	103	8.3	48	65	321	0.5	
	2015-2016* Average			19.14	443	15.86	7.9	0.21	79	261	214	8.2	87	133	396	0.84	-

* note 2015-2016 average reported to April 2016 only

Monthly
>20mm
25/08/2015 170mm of rain unable to collect samples due to flooding
26/08/2015 50+mm of extra rain unable to colelct samples due to flooding.

Dunmore Quarry Surface Water Monitoring
EPL ID # 10: Uncontrolled Discharge from Upper Dam

				Field Parameters								Laboratory Testing														
		Date	Time	Temperature	pH	Conductivity	Salinity	DO		ORP	Turbidity	pH	TSS	Turbidity	Conductivity	Oil & Grease	TDS	Total N	Total P	Arsenic	Cadmium	Nikel	Lead	Zinc	TKN	Comments
				oC		uS/cm	PSS	mg/L	%	mV	NTU		mg/L	NTU	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
2009-2010	Jul-09	30/07/09																								No Uncontrolled discharge from Upper Dam
	Aug-09	31/08/09																								No Uncontrolled discharge from Upper Dam
	Sep-09	30/09/09																								No Uncontrolled discharge from Upper Dam
	Oct-09	30/10/09																								No Uncontrolled discharge from Upper Dam
	Nov-09	30/11/09																								No Uncontrolled discharge from Upper Dam
	Dec-09	05/01/10																								No Uncontrolled discharge from Upper Dam
	Jan-10	05/02/10																								No Uncontrolled discharge from Upper Dam
	Jan-00																									
	Jan-00																									
	Jan-00																									
	Jan-00																									
	Jan-00																									
2009-2010 Average																										
2012-2013	Jul-12																									
	Aug-12	30/08/12																								No Uncontrolled discharge from Upper Dam
	Sep-12																									
	Oct-12																									
	Nov-12																									
	Dec-12																									
	Jan-13																									
	Feb-13																									
	Mar-13																									
	Apr-13																									
	May-13																									
	Jun-13																									

Dunmore Quarry Surface Water Monitoring
Upstream of Dam in Rocklow Creek

				Field Parameters								Laboratory Testing					
		Date	Time	Temperature oC	Conductivity uS/cm	DO mg/L	pH	Salinity PSS	DO %	ORP mV	Turbidity NTU	pH	TSS mg/L	Turbidity NTU	Conductivity uS/cm	Oil & Grease mg/L	Comments
2010-2011	Sep-10	15/09/10	15:15	17.86	264	6.1	6.18	0.13	64	370	115	6.6	9.4	16	269	<1	No Uncontrolled discharge from Upper Dam
	Dec-10	01/12/10		19.79	173	5.96	6.87	0.08	64.6	326	75	6.5	25.8	240	185	<1	No Uncontrolled discharge from Upper Dam
	Dec-10	02/12/10	15:00	24.62	366	2.98	6.8	0.18	35.5	324	84.6	6.1	120.0	36	375	<1	No Uncontrolled discharge from Upper Dam
	Mar-11	20/03/11															No Uncontrolled discharge from Upper Dam
	Mar-11	22/03/11										6.4	258.0	60	412	2.2	No Uncontrolled discharge from Upper Dam
2011-2012		22/07/11		16.29	295	6.19	6.33	0.13	72.3	381	59.9	5.8	40.8	65	254	<1	
		1/03/2012		Site evacuation													
		02/03/12	9:30	20.13	359		6.67				62.7						
		25/03/14	10:55	19.7	207	4.7	7.65	0.1	51.3	325	26.3	6.9	11.0	26	185	1.3	
2014-2015		19/08/14	12:00	13.56	235	6.1	7.23	0.11	58.1	295	11.1	7.0	148.0	65	231	1.9	
		27/08/2014	14:00	15.03	216	5.63	7.22	0.10	55.50	300.00	11.30	7.1	6.7	15	218	1.7	
		21/04/15	13:20	15.13	264	8.5	7.17	0.13	61	319	25.4	7.3	18.0	20	373	1.4	
		22/04/15		Site evacuation													
		27/08/15	11:40	14.9		8.6	7.06	0.08	85	311	705	7.0	665.0	200	177	1.8	
		06/06/16	8:50	14.9	183	8.5	7.3	0.09	86.5	269	102						
	Average			17	256	6.33	7.0	0.11	63.38	322	116.21	6.7	130.3	74	268	1.7	

25/08/2015 170mm of rain unable to collect samples due to flooding
26/08/2015 50+mm of extra rain unable to colelct samples due to flooding.

Dunmore Quarry Surface Water Monitoring
Downstream of Dam in Rocklow Creek

			Field Parameters							Laboratory Testing					
		Date	Conductivity	DO	pH	Salinity	DO	ORP	Turbidity	pH	TSS	Turbidity	Conductivity	Oil & Grease	Comments
			uS/cm	mg/L		PSS	%	mV	NTU		mg/L	NTU	uS/cm	mg/L	
2010-2011	Sep-10	15/09/10	286	4.5	6.18	0.14	44.8	389	77.8	6.5	14.4	22	296	<1	No Uncontrolled discharge from Upper Dam
	Dec-10	01/12/10	324	4.47	7.49	0.16	47.4	335	45.2	6.5	53.2	22	320	<1	No Uncontrolled discharge from Upper Dam
	Dec-10	02/12/10	214	2.9	6.79	0.1	31.8	303	20.1	6.5	11.8	12	207	<1	No Uncontrolled discharge from Upper Dam
	Mar-11	20/03/11													No Uncontrolled discharge from Upper Dam
	Mar-11	22/03/11								6.5	19.6	7.7	343	<1	No Uncontrolled discharge from Upper Dam
	2010-2011 Average		275	3.96	6.82	0.13	41	342	48	6.50	25	16	292	<1	
2011-2012		22/07/11	201	5.89	6.51	0.1	68.2	372	287	6.2	13.6	30	165	<1	
		1/03/2012													
		02/03/12	251		6.97				53.2						
		25/03/14													
	2011-2012 Average		226	5.89	6.74	0.10	68	372	170	6.20	14	30	165	#DIV/0!	
2014-2015		19/08/14	276	5.08	7.07	0.13	50.2	300	18.8	6.9	18	13	272	2	
		27/08/2014	212.0	5.6	7.18	0.10	51.4	268.0	37.5		19.0				
		21/04/15	240	8.2	7.46	0.11	71.2	302	59.1	7.5	20	31	237	<1	
		22/04/15													
	2014-2015 Average		243	6.29	7.24	0.11	58	290	38	7.20	19	22	255	2	
	06/06/16		150	6.50	7.4	0.1	61	277	33						

Appendix H

Groundwater Monitoring Program

Groundwater monitoring program for Dunmore Hard Rock Quarry

Prepared for Boral Dunmore Quarry | 18 November 2016

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Groundwater monitoring program for Dunmore Hard Rock Quarry

Final

Report J14050RP1 | Prepared for Boral Dunmore Quarry | 18 November 2016

Prepared by	**Carolina Sardella**	Approved by	**Liz Webb**
Position	Senior Hydrogeologist	Position	Associate Director - Principal Hydrogeologist and Groundwater Leader
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Date	18/11/2016	Date	18/11/2016

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1 Introduction

EMM Consulting Pty Limited (EMM) is pleased to present the groundwater monitoring program (GMP) for the Dunmore Hard Rock Quarry (the quarry). This GMP ensures compliance with condition 44 of the quarry's current approval, which states:

> 44. The Ground Water Monitoring Program shall include:
>
> a) detailed baseline data on ground water levels and quality, based on statistical analysis;
>
> b) ground water impact assessment criteria; and
>
> c) a program to monitor regional ground water levels and quality.

2 Conceptual groundwater model

2.1 Geology

The project area is situated in the south-eastern corner of the Permo-Triassic Sydney Basin. The Sydney Basin predominantly comprises Permian and Triassic aged sedimentary rocks. In the vicinity of the quarry the Triassic and Late Permian sedimentary rocks have been eroded and early Permian Gerringong Volcanics of the Shoalhaven Group dominate (*Geology of the Wollongong, Kiama and Robertson 1:50,000 Sheet,* Department of Mines 1974).

Volcanic activity in the area has produced a series of flat lying lava flows interspersed with volcaniclastic sandstone members and breccias. The thickness of each successive flow decreases in extent from the volcanic origin, assumed to be off the current coastline to the south (Cohen 2006). At the quarry all geological units exhibit a gentle dip in an easterly direction at approximately 2-3° (Evans and Peck 2006; MMJ 2013).

The Bumbo Latite, one of the nine latite members of the Gerringong Volcanics facies, is the areas greatest and most persistent lava flow, and is the predominant geological unit at the quarry. The Latite has a maximum thickness of 150 m. Latite is a term used to describe the type of basalts along the south coast of NSW, they are also referred to as trachybasalts (Cohen 2006).

The Bumbo Latite Member overlies the Kiama Sandstone Member at the quarry. Further east is Quaternary Alluvium associated with the floodplain areas of the Minnamurra River and its tributaries. This alluvium comprises unconsolidated to loosely consolidated gravels, sands, silts and clays.

2.2 Hydrogeology

The regional groundwater system flows south-east, governed the dip of the strata and topography (Cohen 2006). Recharge to the regional groundwater system (the Kiama Sandstone) is via infiltration from overlying sedimentary units to the west of the project area (Cohen 2006). Regional groundwater in the Kiama Sandstone discharges to the Pacific Ocean (Cohen 2006).

Local groundwater flow systems (horizontal scale of less than 5 km) are present within the Bumbo Latite along the elevated ridgeline (Walker et al 2003). These systems are isolated and have limited connection to the regional flow system. The Bumbo Latite is tight with a low primary and low secondary porosity (Cohen 2006) restricting groundwater flow. The local groundwater systems are recharged by rainfall with infiltration higher in areas where the Bumbo Latite outcrops on the ridgelines and hilltops of the landscape (ie areas with limited soil profile).

Groundwater flow is minimal and predominantly occurs along fractures and contacts between volcanic rock and the underlying sandstone (MMJ 2013).

The Quaternary alluvial sediments associated with the surface water courses form unconfined groundwater systems of varying storage. These systems are recharge by leakage from surface water courses during wet periods. The alluvial systems are depleted during dry periods and are not recharged by underlying porous and fractured rocks (Cohen 2006).

Groundwater at the quarry is fresh to brackish with an average EC of 1,756 µS/cm. The groundwater is neutral to slightly alkaline with an average pH of 7.7. The groundwater is classified as calcium carbonate dominant and typical of groundwater found in igneous rocks.

2.3 Conceptual Hydrogeological model

2.3.1 Groundwater flow

Groundwater within the Bumbo Latite flows from the areas of high relief towards the valleys and low lying plains where it discharges to the alluvium and surface watercourses. The bulk rock mass has a low primary permeability with groundwater flow primarily through fractures and across the contacts between the latite flows and breccia.

In the vicinity of the quarry, groundwater flow is generally towards the south-east discharging to Rocklow Creek and the Minnamurra estuary system. To the north of the quarry the landscape give way to steep valleys that shed surface water and provide limited potential for groundwater recharge.

The deep groundwater systems within the Kiama Sandstone and Berry formation typically flow sub-horizontally towards the east and coincident with the dip of the strata.

2.3.2 Recharge and discharge

The groundwater system is recharged by rainfall and the surface watercourses. The steep relief increases runoff with a smaller percentage of rainfall infiltration in this steeper terrain.

Groundwater from the shallow latite is largely thought to discharge to the Minumurra River and Rocklow Creek, which form the main drainage systems in the vicinity of the quarry.

2.3.3 Groundwater-surface water connectivity

The surface watercourses are hydraulically disconnected from the underlying fractured rock groundwater systems in the elevated parts of the landscape. The surface water systems are ephemeral in nature with the upper reaches drying out during periods of low rainfall. This ephemeral nature indicates minimal the surface water courses are not connected to the groundwater systems.

The surface water systems to the east of the quarry (Illawarra River, Minnamurra River and Rocklow Creek) are connected to shallow, marginal groundwater systems within surficial alluvial systems. Direct rainfall and surface runoff recharges these shallow systems during wet periods which rapidly deplete during the drier periods providing an important source of baseflow for the surface watercourses.

Although the shallow latite flows through to the alluvial in the east, the volume of this flux is likely to be insignificant in comparison to the recharge from the overlying rivers.

3 Groundwater monitoring network

3.1 Monitoring network design

The objectives of the groundwater monitoring network are to gather baseline data in the groundwater systems that the quarry intersection or potentially impacts upon. Based on the conceptual hydrogeological model for the quarry the latite is the main groundwater system to be monitored, with an option to monitor the alluvium immediately downgradient of the quarry. Due to the minimal, if any, flux between the latite and the sandstone, there is no obvious need to monitor the underlying sandstone.

The monitoring network consists of a total of six bores, three deep up hydraulic gradient bores and three shallow down hydraulic gradient bores.

The three deep monitoring bores were completed within the bumbo latite in July 2014, with one bore screened across the latite and the top of the underlying sandstone. These bores are located up hydraulic gradient from current quarrying activities (Figure 3.1).

The three shallow monitoring bores, were installed as part of the Dunmore Sand and Soil operation, and are down hydraulic gradient from current quarrying activities.

Details of the monitoring bores are listed in Table 3.1.

Table 3.1 Groundwater monitoring bores details

Monitoring bore	Total depth (m bgl)	Total depth (m AHD)	Screened interval (m bgl)	Screened interval (m AHD)	Lithology	Formation
GW1	78.0	70.0	72.0 – 78.0	76.0 – 70.0	Latite / sandstone	Bumbo Latite and Kiama Sandstone
GW2	86.0	51.5	79.0 – 85.0	51.5 – 57.5	Latite	Bumbo Latite
GW3	80.0	51.5	68.0 – 80.0	51.5 – 63.5	Latite / breccia	Bumbo Latite and Breccia
BH-A	tbc	tbc	tbc	tbc	Tbc	tbc
DG-31	tbc	tbc	tbc	tbc	Tbc	tbc
DG-59	tbc	tbc	tbc	tbc	Tbc	tbc

Notes: m bgl = meters below ground level, m AHD = meters Australian Height Datum.
tbc = information to be confirmed.

EMM

Groundwater monitoring bores

Dunmore Quarry

Groundwater Monitoring Program

Figure 1

4 Groundwater monitoring program

4.1 Groundwater quality

Groundwater quality sampling will be undertaken at a six-monthly frequency at all monitoring bores as detailed in Table 4.1.

Table 4.1 Water quality monitoring program

Monitoring bores	Monitoring events	Monitored by
GW1, GW2, GW3	December 2016 and June 2017	EMM
BH-A, DG-31, DG-59	December 2016 and June 2017	Environmental Earth Sciences NSW

Note: tbc = information to be confirmed.

Water quality samples collected from the monitoring network will be analysed for the suite of parameters listed in Table 4.2.

Table 4.2 Water quality suite of analysis

Grouping	Parameters	
Physicochemical parameters (field)	Electrical conductivity	Temperature
	pH	Total dissolved solids
	Dissolved oxygen	Oxidation reduction potential
Major ions	Calcium	Chloride
	Magnesium	Total alkalinity
	Sodium	Sulphate
	Potassium	Silica[1]
Dissolved metals	Aluminium[1]	Iron
	Arsenic[1]	Manganese[1]
	Cadmium[1]	Nickel[1]
	Chromium[1]	Zinc[1]
	Copper[1]	
Nutrients	Ammonia	Total nitrogen
	Nitrate	Total phosphorus
	Nitrite	

Notes: 1. Not analysed in the shallow monitoring bores (BH-A, DG-31 and DG-59).

4.2 Groundwater levels

Following completion of the deep monitoring bores (GW1-3) in July 2014, pressure transducers (dataloggers) were installed in the water column and programmed to record a groundwater level every six hours. A datalogger was installed in monitoring bore BH-A in October 2013 and was programmed to record a groundwater level every hour.

Dataloggers will be installed in monitoring bores DG-31 and DG-59 in December 2016 to record a groundwater level every six hours.

To verify the level recorded by the dataloggers, manual measurements will be recorded during the six-monthly monitoring events (December 2016 and June 2017) using an electronic dip meter.

5 Reporting and review

An annual report will be issued in July 2017, including analysis and interpretation of groundwater quality and groundwater level data collected since monitoring began at all monitoring bores, with emphasis on the data obtained during the last 12 months.

The annual report will also include a review of the monitoring network design and provide recommendations for ongoing monitoring, and also assess the adequecy of the monitoring network design, and whether additional monitoring bores are required.

References

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