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Site Water Management Plan

Hard Rock Quarry, Karuah, NSW

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Hunter Quarries Pty Ltd
PO Box 51
Thornton NSW 2322

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Site Water Management Plan

Hard Rock Quarry, Karuah, NSW

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Site Water Management Plan – Hard Rock Quarry, Karuah, NSW

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1.0 INTRODUCTION

Hunter Quarries Pty Limited (Hunter Quarries) has operated a hard rock quarry at Karuah (Karuah Quarry) since 2002. In October 2004, Hunter Quarries applied to the Department of Infrastructure, Planning and Natural Resources (DIPNR) for approval to expand the quarry into adjoining land (the Stage 2 area) to allow the extraction of further hard rock resources.

Development Consent was granted by the Minister for Infrastructure, Planning and Natural Resources on the 3 June 2005 (ref. DA 265-10-2004), with the approved development including:

- Implementing the remainder of the approved Stage 1 quarry operation;
- Extending the quarry operations into the Stage 2 area;
- Upgrading and using existing infrastructure on site;
- Rehabilitating the site by re-contouring and revegetating exposed surfaces; and
- Producing up to 500,000 tonnes of product a year over the next 22 years.

The Development Consent DA 265-10-2004 contains requirements relating to water management and erosion and sediment control. Consent Condition 26 of Schedule 3, requires the preparation of a Site Water Management Plan (SWMP). This document was prepared in accordance with the requirements of the Development Consent and approved by the Department of Planning (DoP), now the Department of Planning and Environment (DP&E) in July 2006.

This document was reviewed and revised in August 2008. The review allowed the SWMP to incorporate changes in surface water management on site as a result of variations to the original mining plan presented in the 2004 EIS.

This document was reviewed and updated in January 2012 as part the review of Karuah Quarries Environmental Management Strategy and associated Environmental Management Plans. This document along with other site management plans, were updated in June 2014 as per the planned regular review. All management plans were again updated in December 2014/January 2015 following the Independent Environmental Audit.

1.1 Updates to SWMP

1.1.1 Updates following Audit

Following the completion of the Independent Environmental Audit in 2014 (MCW Environmental), HQPL sent the audit report to DP&E and responded to the recommended actions from the auditor. The recommendations relating to water management and where they addressed (letter sent to DP&E on 9 October 2014) are summarised in **Table 1**.

Table 1: Recommendations from the 2014 Independent Environmental Audit – Water Management

Recommendation from Audit	Section/Comment
Consent Requirements	
Schedule 3 Condition 26 of Development Consent That the drainage lines and catchments outside of the catchment for Sediment Dam 2 directed to SB1-SB4 are inspected by a suitable expert and controls judged to be effective for the flows and water quality reporting to these locations. That monitoring as required of the SWMP is completed consistently and comprehensively (see Section 6 for further discussion). That flows directed from the western end of the production level bench are either treated effectively or directed to the Sediment Dam 2.	HQPL have prepared an updated surface water management figure. There are still upgrades being completed to the northern section of the water management system at the quarry.
Schedule 3 Condition 26 of Development Consent That Hunter Quarries install a gauge to monitor and record the water levels in the dam. That a level alarm is provided for the gauge to warn of high levels. That a means by which to measure the volume of discharge flows from the site is installed. That a systemised approach is applied to managing the risk of dam levels rising and overtopping, that a number of people on site are aware of.	The water level gauge is currently installed. Daily inspections to be continued. In the event of discharge the volume of water discharging from the discharge point is to be calculated, with water testing completed.
General Requirements	
That the program be more specific for water monitoring as to how data will be obtained and recorded; who will be responsible for the monitoring and how will data be analysed and for what purpose.	Section 8.2
That visual monitoring is conducted of drainage lines that are not directed to the Sediment Dam 2 to assess erosion and confirm drainage lines are clean or are directed to the Sediment Basin.	Section 7.2.1
That the Plan include monitoring of water quality around the site entry on a regular basis during and after rain events to ensure erosion and sediment controls are effective.	Section 8.2
That Hunter Quarries ensure all monitoring as per the Monitoring Plan is conducted and adequately recorded to demonstrate compliance with the Monitoring Plan.	Section 8.2
That the water monitoring section within the Environmental Monitoring Plan be expanded to included regular (suggested quarterly) inspection of the integrity of drainage lines and structures that are outside of the Sediment Dam No. 2 drainage lines.	The Environmental Monitoring Program was updated. This SWMP has also been updated.
That further investigations are completed to assess the cause of the dieback below the western end of the production bench. Address any findings of such investigations.	Annual dieback monitoring locations were established in 2014. The results of this monitoring will be recorded in the AEMR. Next dieback monitoring is scheduled for November 2015.
That surfaces in the vicinity of the weighbridge and site access be stabilised to minimise dirt tracking on roads and turbid water generation.	Sections of the weighbridge area are to be spread with gravel.
That more permanent controls are considered in place of sediment fences. Alternatives to sediment fences include: the use of mulch; and stabilisation of road and swale surfaces. Additional controls, where installed should be reflected in the SWMP.	Sediment fences were updated in 2014. There are no current plans to install mulch in this area. Sediment fences

Recommendation from Audit	Section/Comment
	will be reviewed regularly and if required more permanent controls will be installed.

1.1.2 Updates following comments from DP&E

In the letter from the DP&E dated 14 March 2016 there were some recommended updates to the EMS and other management plans.

The letter stated '*that references to NSW Office of Water (NOW) should be replaced with DPI Water'*. This has been completed.

2.0 SCOPE AND OBJECTIVES

The primary purpose of this SWMP is to satisfy the conditions of Development Consent, EPL and the requirements of the *Protection of the Environment Operations Act 1997.* Specifically, Schedule 3 Conditions 26, 27 & 28 of DA 265-10-2004 requires the development of a Site Water Management Plan, erosion and sediment control and surface water monitoring which includes:

- A Site Water Balance (**Section 6.0**);
- An Erosion and Sediment Control Plan (**Section 7.0**); and
- A Surface Water Monitoring (**Section 8.0**).

2.1 Guidelines

In NSW, the most relevant and comprehensive guidelines for the design of stormwater and erosion and sediment controls are contained in the 'Blue Book' (Managing Urban Stormwater: Soils and Construction Vol. 1, 4th edition and Vol. 2E Mines and Quarries (Landcom, 2004 and DECC, 2008)). Many of the prescriptive guidelines are not specifically relevant to this site; however the principles of surface water control have been adopted.

2.2 Legislative Requirements

The *Protection of the Environment Operations Act* (*POEO Act*) is relevant to the Project as it contains requirements relating to the prevention of the pollution of waters. In this regard the discharge of water from the Project Site will need to be controlled to an agreed standard to reduce the potential for pollution of the receiving waters. Karuah Hard rock quarry has an existing Environment Protection Licence (EPL) under the *POEO Act* for the discharge of 'dirty' water from site. Details of this Licence are presented in **Section 8.1**.

The *Water Act 1912* and *Water Management Act 2000* contain provisions for the licensing of water capture and use. If any dams are proposed as part of the water management, consideration must be given to whether the dams need to be licensed. If the dams are not within the harvestable right of the property, or are not specifically exempt dams, it is likely that they would need to be licensed. At this stage it is not proposed that any clean water dams will be built and therefore it is anticipated that no licences will need to be obtained.

Whilst a controlled activity approval under the *Water Management Act 2000* is typically not required for mining activities, the general standards used by the DPI Water in implementing the *Water Management Act 2000* still need to be adhered to. In this regard, any guidelines referred to by the DPI Water and the feedback provided by departmental officers would be considered.

2.2.1 Development Consent Conditions

The relevant conditions of Development Consent DA 265-10-2004 and the section(s) in this document where they are addressed are contained in **Table 2**.

Table 2 – Relevant Conditions of Development Consent

Condition Number	Condition Requirement	Section
Schedule 3 Condition 26	*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 DEC, and to the satisfaction of the Director-General. The plan shall detail how the site water management on site will be integrated with existing surface water management and erosion and sediment control systems and address surface water management and erosion and sediment control at both the construction and operation phases of the development. This plan must include:* *a) an Erosion and Sediment Control Plan;* *b) a Surface Water Monitoring Program; and* *c) a site water balance.*	Section 7.0 Section 8.2 Section 6.0
Schedule 3 Condition 27	*The Erosion and Sediment Control Plan must:* *a) be consistent with 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 what measures would be implemented to minimise soil erosion and off-site sediment transport from the following locations:* • *the active quarry face and pit;* • *product and topsoil stockpile sites;* • *haul roads;* • *workshop areas;* • *rehabilitation areas; and* • *all other exposed and disturbed surfaces within the site.* *d) describe the location and function of erosion and sediment control structures and their capacity to contain runoff in relation to above average rainfall events;* *e) describe what measures would be implemented to maintain the structures over time;* *f) describe how the effectiveness of the Erosion and Sediment Control Plan will be measured and monitored.*	Whole document Section 4.2.1 Section 7 Section 7 and Plans in Appendix 1 Section 7.2 Sections 8.2 & 9.0
Schedule 3 Condition 28	*The Applicant Shall:* *a) measure:* • *the volume of water discharged from the site via licensed discharge points;* • *water use on the site;* • *water transfers across the site; and* • *dam and water structure storage levels.* *b) regularly monitor the quality of the surface water discharged from the licensed discharge points on the site;* *to the satisfaction of the DEC and the Director-General.*	Section 8
Schedule 3 Condition 25	*The Applicant shall only discharge water from the development in accordance with the provisions of a DEC Environment Protection license*	Section 8.1

In accordance with condition 27 of DA 265-10-2004, this SWMP has been prepared to be consistent with the requirements of the Department of Housing's *Managing Urban Stormwater: Soils and Construction Manual* (DoH, 2004 – 'Blue Book') and Volume 2E of the Blue Book (Mines and Quarries - 2008). All erosion and sediment control structures described in this plan have been constructed or

erected in accordance with the recommendations identified in the relevant standard drawing and construction notes of the 'Blue Book'.

2.2.2 Environment Protection Licence

Karuah Quarry operates under EPL 11569, issued under Section 55 of the *Protection of the Environment Operations Act 1997*. This licence contains conditions relating to water management at the quarry. In particular, the licence allows for one discharge point, specifying quality limits associated with the discharge point, as well as monitoring requirements. Details of these requirements are discussed in **Section 8.1**.

3.0 SURFACE WATER MANAGEMENT PRINCIPLES

The principal objective of surface water management for the quarry is to ensure that there is no uncontrolled discharge of water from the site and that the water quality leaving the site meets the appropriate quality standards. This objective is intrinsic to erosion and sedimentation designs and controls for the quarry. As such, the following specific objectives of this SWMP have been established:

- Conducting best practice land clearing procedures for all proposed disturbance areas;
- Separating *undisturbed* runoff from *disturbed* runoff where possible to minimise and isolate the amount of disturbed or “dirty water” runoff;
- Directing sediment-laden runoff into designated sediment control dams;
- Diverting clean runoff from areas upstream of the operation into natural depressions and creeks;
- Constructing the haul road and working pit face with effective surface drainage thereby reducing roadside erosion and sedimentation;
- Allowing sediments to settle in sediment control dams so that the water can be re-used for on-site dust depression, thereby maintaining dam capacities for subsequent rainfall events;
- Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments; and
- Implementing an effective revegetation and maintenance program for the site.

This document relates to water management and erosion and sediment control on the land that operates a hard rock quarry at Karuah (ref. DA 265-10-2004). This land includes Lot 21 DP 1024341, Lot 11 DP 1024564 and part of Lot 12 DP 1024564. Quarrying activities undertaken on Lot 21 and Lot 11, which are owned by Hunter Quarries, and a Conservation Offset area has been established on a southern portion of Lot 12. The land is shown in **Figure 1**.

Figure 1 – Location of the Site

4.0 POTENTIAL IMPACTS AND KEY ISSUES

The following section outlines the potential impacts of the quarry operation, including the continuation of the Stage 2 quarrying, on the surface water environment and groundwater in the area.

4.1 Catchment changes in the course of development

Due to site location and topography, areas of potential impeded drainage are insignificant. There are no permanent or ephemeral streams within the vicinity of the quarry site. As such, approval for a controlled activity under the *Water Management Act 2000 (NSW)* is not required.

The diversionary works undertaken to separate the *clean* and *dirty* water systems (see **Section 5.2**) are small in nature and will not intercept any significant drainage lines. As such it is not expected that a licence under the *Water Management Act 2000 (NSW)* is required for these works. The disturbance limit of the quarry had been reached.

4.2 Water pollution

The following section discusses the potential sources of water pollution at the site and appropriate control measures to mitigate potential off site environmental impacts.

4.2.1 Sources of sediment

Runoff from disturbed areas of the site will be the primary source of sediment. The disturbed areas that will generate sediment laden runoff include:

- Ground disturbed ahead of material excavation (e.g. topsoil stripping areas);
- Active quarry working face and pit area;
- Associated haul road infrastructure;
- Product stockpile areas;
- Overburden and topsoil stockpile areas;
- Workshop areas; and
- Rehabilitated areas.

Runoff from these areas will be collected in catch drains and directed to Sediment Dam 2. The principle elements of the Drainage and Sediment and Erosion Control Plan are attached as **Appendix 1** - *Karuah Quarry Drainage and Sediment Control Plan: Disturbance*.

The following control measures are employed at the existing quarry in order to ensure an appropriate level of protection to surface water on and around the quarry site, and these will continue to be used in the Stage 1 and 2 area;

- Source separation in order to separate water of differing quality (clean water diversions);
- In-pit sump with de-watering capabilities;
- Use of sediment control fencing; and
- Collection and containment of quarry water for dust suppression.

These control measures are described further below in **sections 5.2 and 7.1**.

4.2.2 Hydrocarbons

Wherever significant volumes of hydrocarbons are being stored and used, the potential for accidental spillage is high. HQPL have undertaken a number of control measures to ensure that hydrocarbon spillages and off site environmental impacts are avoided.

A bulk fuel storage facility consisting of a double lined tank is in use at the quarry. The storage facility has been installed in accordance with the requirements of the NSW Office of Environment and Heritage (NSW OEH) and the Great Lakes Council. In addition, all hydrocarbons are stored and handled in accordance with the NSW *Dangerous Goods Act*, AS1940 (*Storage and Handling of Flammable and Combustible Liquids*) and other relevant Australian Standards to minimise the risk of any spills.

Servicing of mobile equipment is undertaken by contractors or site personnel who complete all service work on site. Waste oil is removed from site at the completion of the equipment service. Where major works are required the plant and equipment will be taken off site to an appropriate workshop facility.

The bunded washdown/maintenance area next to the workshop includes a dangerous goods container and a covered bunded area, complete with oil sump to capture potential hydrocarbons during routine maintenance of mobile and fixed plant equipment. The collected waste oil is removed from site by a licensed waste contractor.

4.2.3 Sewerage and bath houses

A bathhouse facility and lunch room has been installed at the quarry and consists of showers and toilet facilities. A bio-cycle system has been installed and inspected by the Great Lakes Council to manage sewerage effluent from the bathhouse. The treated effluent from the bio-cycle system disposes the effluent via an onsite irrigation system. The effluent disposal conforms to the EPA's draft "*Environmental Guideline for the Utilisation of Treated Effluent by Irrigation*", 1995.

4.2.4 Other chemicals

A dangerous goods container is already in use for the storage and delivery of all chemicals required for the Stage 2 area. It should be noted that only a limited amount of chemicals are required for operations.

Safety Data Sheets (SDS) are kept in the site safety system for all chemicals used on the site. SDS' contain information on the environmental impacts of the use of certain chemicals and include detail on emergency response, clean up and disposal should the unlikely event of a spill occur.

Chemicals are stored and handled onsite in accordance with the NSW *Dangerous Goods Act,* AS1940 (*Storage and Handling of Flammable and Combustible Liquids*) and other relevant Australian Standards to minimise the risk of any spills.

4.2.5 Explosives

Explosives used in blasting will be brought to the site on an "as needs basis" by the contractor responsible for drill and blast activities. As such, there is no requirement for the storage of these products on site. The drill and blast contractor will store and handle the explosive materials in accordance with the relevant Australian Standards, and the requirements of the NSW Department of Trade and Investment, Regional Infrastructure and Services – Resources and Energy (DTIRIS-RE).

4.3 Topography, drainage and receiving waters

The quarry area is located on the mid/upper slope on the south western side of a hill system that rises to a height of 150 metres (AHD). The Stage 2 Area extends uphill from the stockpile area to approximately 140m (AHD).

The site is located within a catchment that drains towards the south west and into Yalimbah Creek and designated SEPP 14 Wetlands. A small portion of the site currently drains towards the north/north west (estimated gradient of 10-15%).

The SEPP 14 Wetland (No. 777) on Yalimbah Creek is located approximately 620 metres to the south west of the quarry. Water discharged from the site would flow under the Pacific Highway into these wetlands. Water quality controls have been implemented to ensure that the quarry does not impact on the wetland area. These controls are discussed in **section 8.1**.

4.4 Interception of groundwater aquifers

As identified in the 2004 EIS, no groundwaters will be intercepted by the operations of Stage 2. To date, no groundwaters have been intercepted during exploration drilling, blast drilling and operational excavation.

4.5 Acid sulphate soils

There were no potential acid sulphate soils identified in the 2004 EIS. The existing quarry and the Stage 2 Area are above RL60 (AHD) and are free draining; therefore there is no potential for acid sulphate soil or flooding (2004 EIS).

The low lying wetland area south of the Pacific Highway has been identified as a potential acid sulphate soils zone. This area is associated with the Yalimbah Creek and is separate from the quarry operation.

5.0 SITE WATER MANAGEMENT

5.1 Surface Water Management

5.1.1 Dirty Water Management

The total catchment area of the dirty water system is estimated to be around 23ha. The system is primarily treated through Sediment Dam 2. A small amount of clean and dirty water (from Stage 1 Area) is collected in Sediment Basin 4, which drains to Sediment Dam 2 via a gravity fed pipeline. There previously were three additional temporary small sediment basins (SB 1, 2 and 3), but these have since filled with sediment and have become part of the drainage system.

Surface water collected within the Stage 2 Quarry Area now drains to an in-pit sump located within the north-west area of the extraction pit. The floors of the workings will generally be graded at 0.5 – 1% towards the sump. When required, water will be pumped through a pipeline from within the sump to a location where it can freely drain to Sediment Dam 2. This will ensure that the floor areas are kept dry and will enable a quick return to production following rainfall.

The in-pit de-watering sump will also provide an opportunity for water supply close to the pit workings. This will minimise turnaround times for water carts and enhance the dust control strategy for the site.

The amended plan, Figure 1, in **Appendix 1** shows the general location of the in-pit de-watering sump and approximate location of the pipeline.

In addition, the existing Sediment Dam 2 will continue to treat dirty water runoff from the southern areas of the quarry footprint, access roads and haul road. Roads within the southern section of the product stockpile area will be re-graded to convey runoff to the table drain which runs along the western side of the haul road and reports to Sediment Dam 2. This will maximise the catchment area reporting to Sediment Dam 2 which has substantial capacity.

Sediment Dam 2 has been designed according to the guidelines provided in the ‘Blue Book’ as detailed in **Section 7.1.5**.

5.1.2 Clean Water Management

The current active quarry area located in the Stage 2 Area involves quarrying to the top of a ridge; therefore there is minimal catchment above the site. This limits the likelihood of *clean water* from the undisturbed areas flowing into the ‘dirty’ site water management system. Clean water diversion drains or bunding has been used on the north eastern and south eastern section of the Stage 2 Area to minimise any cleanwater running into the site.

A small amount of clean water from the west of the Stage 1 Area follows a natural drainage line, with this water being captured by Sediment Basin 4, which is then directed to Sediment Dam 2 by a gravity fed pipeline. Any discharges would therefore occur through LDP001.

5.1.3 Site Water Transfers / Discharges

LDP 001 is located on the southern side of Sediment Dam 2. To date, no water has been discharged at this location. As discussed in **Section 7.1.5** below, the capacity of the existing sediment dam is sufficient by Blue Book standards to ensure that water is adequately treated prior to any discharge.

Discharge volume from the discharge pipe can be recorded by HQPL.

6.0 SITE WATER BALANCE

The following section outlines a water balance for the quarry, including the continuing operation of the Stage 2 development.

6.1 Assumptions

The following assumptions were used in forecasting the water balance for the proposed development:

- The disturbance footprint for the end of mine life has been estimated to be consistent with the mine plans made in the original EIS (Co- Resources Pty Ltd; Figures 5 - 12) for the Stage 2 development;
- No Allowance was made for runoff from 'undisturbed' areas as this will be directed away from the site and as such will not be managed as part of the 'closed loop' water management system;
- The runoff reporting to Sediment Dam 2 and the in-pit sump is the only source of water used on site for processing and dust suppression;
- Evaporation was constant for each year of the project proposal. The average annual evaporation for Williamtown was used; and
- The "Production Plant" water usage is predicted to remain constant for each year of the project proposal.

6.2 Inputs

6.2.1 Rainfall and Runoff

The water balance considers rainfall and runoff generated by low (annual 10th percentile), average (annual 50th percentile) and high (annual 90th percentile) rainfall years for Williamtown. Rainfall data is provided by the Bureau of Meteorology (station number 61078). Rainfall is as follows.

- Annual 10th percentile (dry year): 787.8mm
- Annual 50th percentile (average year): 1087.9mm
- Annual 90th percentile (wet year): 1497.8mm

Rainfall is reasonably well distributed throughout the year, although there is a peak in summer and early autumn, with the lowest rainfall months being in winter and spring.

To determine the annual average runoff generated that reports to either Sediment Dam 2 or the in-pit sump, the Karuah Hard Rock Quarry has been divided into three catchments. These catchments are as follows.

1. Extraction Pit Area;
2. Stockpile areas;
3. Other Disturbed Areas within Dirty Water Catchment (haul roads, workshop etc)

The following key assumptions have been made in estimating the runoff from these catchment areas and in developing the water balance.

i. A runoff coefficient of 0.4 has been applied to the Extraction Pit area given that it is bare and slightly compacted. It is also assumed that there is runoff lost to groundwater based on past observations.

ii. A runoff coefficient of 0.4 has been applied to the stockpile areas given that there is bare and slightly compacted areas with very limited storage capacity within the stockpiles.

iii. A runoff coefficient of 0.25 has been applied to the other disturbed areas within the dirty water catchment. A lower coefficient has been applied to this area to reflect the areas of rehabilitation

and existing bushland. A higher coefficient than a natural catchment has been chosen due to the catchment area having haul roads and other compacted areas.

A summary of the estimated current annual runoff generated at Karuah during average, wet and dry years based on the above assumptions is given in **Table 3**.

Table 3– Current estimated annual runoff captured within Sediment Dam 2 and the In-pit sump during average, dry and wet rainfall years

			CAPTURED RUNOFF (ML)		
Catchment	**Current Area (ha)**	**Runoff Coefficient**	**Average Year**	**Dry Year**	**Wet Year**
Extraction Pit	4	0.4	17	12.3	23.4
Stockpile Areas	4	0.4	17	12.3	23.4
Other Disturbed Areas	3	0.25	8.2	5.9	11.2
TOTAL			42.1	30.5	58.0

6.2.2 Groundwater Seepage

As discussed in **Section 4.4** of this report, to date there has been no groundwater intercepted during exploration drilling, blast drilling or operational excavation. It was therefore assumed that there would be no groundwater seepage into the excavation pit and was not included in the water balance.

6.3 Outputs

6.3.1 Evaporation

The annual water loss due to evaporation from Sediment Dam 2 and the In-pit sump is estimated at 7.6ML/yr. The assumptions used in calculation this evaporation loss are as follows;

1. Average annual pan evaporation is estimated to be 1715.5mm/yr. This has been derived from data obtained by the Bureau of Meteorology station 61078 at Williamtown;
2. The average annual pan evaporation has been multiplied by a factor of 0.7 to account for the 'pan' evaporation and the fact that the sediment dam and in-pit sump are not always full; and
3. The combined surface area of Sediment Dam 2 and the in-pit sump has been estimated at approximately 0.65ha.

6.3.2 Dust Suppression

The current dust suppression water usage at Karuah Quarry is around 5 ML/year based on water flow meter data.

6.3.3 Production Plant

Based on recent data from the sites flow meter reading, it is estimated that 25 ML/yr is used for plant processing.

6.4 Water Balance Results

The site water balance is summarised in the **Table 4** below. It has been calculated based on the end of mine life disturbance footprint (current footprint) that ultimately reports to Sediment Dam 2.

Table 4 - Water Balance for the Continued Operations of Stage 2

Disturbance Area (ha)	Total Demand	Total Make (ML/Year)	Net surplus (ML/Year)
Average Rainfall Year (Based on Bureau of Meteorology data for Williamtown)			
14.1 (end mine life)	33	56	24
Dry Year (10% Chance)			
14.1 (end mine life)	33	41	8
Wet Year (10% Chance)			
14.1 (end mine life)	33	78	45

Sediment Dam 2 will provide a suitable water storage capacity so that water is available to support the operational requirements during those years where the rainfall is less than average.

A similar analysis was undertaken for a *10% chance dry & wet year* scenario. As would be expected, during an extended dry period the site may be required to import a small amount of water based on the current disturbance footprint that reports to Sediment Dam 2 or the in-pit sump. Conversely, during a wet year the water from the site would be directed through a series of sediment control structures (see **Section 7.1** below) and retained in Sediment Dam 2. During extended wet periods and in the unlikely event that the capacity of Sediment Dam 2 is reached, water can be discharged from the licensed discharge point at the Dam. However it is noted that no discharge has occurred to date from Sediment Dam 2 and, should discharge be necessary, processes are in place to ensure that the water quality leaving the site is acceptable (see **section 8.2** below).

7.0 EROSION AND SEDIMENT CONTROL PLAN

7.1 Mitigation and management issues

7.1.1 Internal Clearing Permit

Land disturbance will be minimised by clearing the smallest practical area of land for the shortest possible times. This will be achieved by requiring that an internal site clearance permit be issued by the Quarry Manager prior to the commencement of any clearing. It should be noted that Hunter Quarries reached the disturbance limit for the quarry in 2008.

7.1.2 Clean Water Diversion Works

Diversion banks will be utilised where possible to ensure clean water originating from un-disturbed catchments are not mixed with 'dirty' water from within the quarry footprint as detailed in **Section 5.2.2** above.

7.1.3 Quarry Haul Roads

The quarry haul road has been constructed to ensure surface drainage is optimised and the road surface stabilised, thereby reducing roadside erosion and sedimentation. Cross-fall drainage techniques such as crowning, in-fall and outfall drainage have been implemented for the entire length of the haul road.

Crowning is generally implemented on the steeper sections of the haul road. Outfall drainage has been constructed where the road traverses small fill batter areas and in-fall drainage will occur where the road traverses larger fill batter areas.

The upper section of the haul road near the workshop region, along with the roads within the southern section of the product stockpile area has been in place to ensure water travels into Sediment Dam 2.

Where runoff from the haul road cannot be directed into Sediment Dam 2, a series of mitre drains have been constructed to take water from the shoulders or table drains of the haul road to safe disposal areas. The runoff will be split at regular intervals to keep the volume of water in each mitre drain to a minimum. This will be achieved by spacing the drains as close together as practicable. The spacing will not exceed fifty (50) metres and the drains will be spaced closer together where gradient increases. Sediment fencing or sand bags will control the sediment at the end of the mitre drains.

7.1.4 Product and Topsoil Stockpiles

Stripped topsoil material will be placed directly onto the disturbed areas and spread immediately if excavation sequences, equipment scheduling and weather conditions permit. However, if longer term stockpiling (i.e. greater than 6 months) is required, a maximum stockpile depth of three (3) metres will be maintained to preserve viability and reduce soil deterioration.

Where a stockpile is not wholly contained within the "closed loop" dirty water management system, sediment control measures such as hay-bales and silt fences will be used to control any silt that may be leaving the area. Stockpiles will be positioned so as to avoid impediment of natural localised drainage lines and minimise the likelihood of water ponding.

Revegetation is required on the western side of the product stockpile. Until this becomes established, 'dirty' water runoff from this batter will be managed by the implementation of temporary sediment control structures such as silt fencing, hay bales and sand bags around the toe of the batter. There are minimal available topsoil storage areas at site. It should be noted, with the extraction limit reached, there will be no more additional stockpiles.

7.1.5 Sediment Control

Runoff from the extraction pit, southern product stockpile area, majority of the haul road and areas surrounding the recent rehabilitation area report to Sediment Dam 2. The maximum contributing dirty water catchment to this dam is approximately seventeen (17) ha as the quarry footprint has reached its approval limit. Sediment Dam 2 will be responsible for optimising the retention of sediment carried in stormwater runoff before water is discharged into the natural drainage system. A by-wash has also been constructed in the sediment dam.

In the original SWMP, a conservative design capacity for sediment control on the site was adopted for Sediment Dam 2 (Total disturbance area of the overall quarry footprintx 0.5ML) which has been derived from guidelines provided in the 'Blue Book'. The required capacity of Sediment Dam 2 is now 7.5ML using the same conservative guideline. It has been calculated according to the revised total catchment area of Sediment Dam 2 at the end of mine life and anticipated volume of generated runoff. The volume of Sediment Dam 2 has been estimated at 20ML which provides a significant buffer.

Sediment Basin 4 captures a small amount of runoff from the Stage 1 and 2 Area, with this water directed to Sediment Dam 2 by a gravity fed pipeline. There previously were three additional temporary small sediment basins (SB 1, 2 and 3), but these have since filled with sediment and have become part of the drainage system.

7.1.6 Additional Sediment & Erosion Controls

Additional works including, but not limited to, sediment filter fencing, straw bale sediment filters and revegetation will be employed. Temporary sediment controls will be constructed to intercept sediment laden runoff prior to discharge into the natural drainage system.

Sediment filter fencing has been installed adjacent to the road into the front entrance to manage erosion and sediment from trucks leaving site.

Where required straw bale sediment filters will be used during the construction of drainage and road works. Their use will be limited however, to situations where erosion and sediment control is required for a short period (i.e. maximum of three (3) months).

The sediment control techniques used during this project will generally include, but not be limited to, the following:

- Strategically placing silt fencing, straw bales or similar;
- Removing accidental spills of soil or other materials on access roadways or gutters before each days work is complete; and
- Minimising on-site vehicle activity during wet weather or when the site is muddy.

All temporary sediment controls, including sediment filter fencing and straw bale sediment filters, are to be constructed in accordance with the detail included in **Appendix 2** of this Management Plan.

7.2 Maintenance of Sediment & Erosion Controls

7.2.1 General

The Quarry Manager will conduct an inspection of all water management controls as part of environmental inspections completed every two months, in accordance with the site Environmental Management Strategy (Updated SLR Consulting December 2014). This inspection is to ensure that all the water management controls outlined in **Sections 5.2 and 7.**1 are functioning as designed and required. The Quarry Manager will also ensure that any contractor's onsite are operating within the environmental controls as required for their activities. These inspections will cover drainage lines,

sediment fencing and the sediment dams. Event based inspections will be completed when greater than 20mm of rainfall has been recorded. The Quarry Manager also completes a daily operational inspection of the area.

Where significant erosion is observed to be occurring on a regular basis, additional controls would be constructed generally in accordance with the “Blue Book”.

7.2.2 Roads

The haul roads will be visually inspected to ensure that the appropriate mitigation measures are functioning to convey the surface flows from the road and work areas without causing erosion to the road or work areas on the adjacent land. Where significant erosion is observed to be occurring on a regular basis, additional controls would be constructed such as additional mitre drains, scour protection of road drainage, and re-grading of the road surface. Haul roads are regularly inspected as this is a safety requirement of the site.

7.2.3 Dams and Diversion Works

The pipeline from the in-pit sump will be inspected to ensure that there are no leaks or blockages to flow. Any signs of erosion at the points of discharge would be noted and remedial works undertaken as required. Where significant erosion is observed additional erosion controls would be constructed such as new rock scour protection at the discharge locations.

7.2.4 Sediment Controls

Site drainage and sediment control structures will be inspected regularly after runoff events to check for scouring of diversion drains and sedimentation of sediment traps (e.g. silt fences & hay bales) and sediment dams. Sediment control structures will be de-silted when the design capacity of the structure has been reduced by 30% (or as necessary). All scouring of drains will be stabilised as soon as possible.

Regular visual checks will be made of the sediment dams to ensure that there is no noticeable increased periods of discoloration or excessive sediment build up in the dams, and that dams are in a stable condition. Sediment Dam 2 has been conservatively designed to significantly exceed ‘Blue Book’ requirements and ensure a discharge does not occur. In the unlikely event a discharge should occur, the drainage line downstream of the overflow weir will be inspected for scouring and repaired and stabilised as required.

In addition, regular visual checks of sediment control structures, including all silt fences and dams, will be made as part of the monthly internal environmental inspection undertaken by the quarry manager (or nominated representative), as described in the EMS.

8.0 SURFACE WATER MONITORING PROGRAM

8.1 Surface Water Impact Assessment Criteria

Surface water impact assessment criteria applying to discharges from the licensed discharge point (outlet of Sediment Dam 2) at Karuah Hard Rock Quarry are prescribed in L2.4 EPL 11569. The concentration of a pollutant discharged must not exceed these concentration limits in **Table 5** below.

Table 5: Impact Assessment Criteria from EPL 11569

Pollutant	Units of Measure	100 percentile Concentration Limit/Range
pH	pH	6.5 – 8.5
Total Suspended Solids	mg/L	50

All water quality results from water discharged will be compared to the assessment criteria detailed in **Table 5** to ensure levels are within the specified EPL limits and will be reported in the AEMR.

There is a requirement in the EPL to monitor the concentration of the pollutants specified in **Table 5** during a discharge at licensed discharge point 1. The monitoring must be undertaken using the sampling method, units of measure and sample at the frequency specified in **Table 6**.

Table 6 – EPL Monitoring Requirements at Licensed Discharge Point 1

Pollutant	Units of Measure	Frequency	Sampling Method
Nitrogen (total)	mg/L	Daily during any discharge	Gab Sample
Phosphorous (total)	mg/L	Daily during any discharge	Gab Sample
Total Suspended Solids	mg/L	Daily during any discharge	Gab Sample
pH	pH	Daily during any discharge	Gab Sample

The monitoring records must be kept by Hunter Quarries based on conditions laid out in section 5 of the EPL.

8.2 Monitoring Program

A summary of three (3) key parameters for samples collected since the commencement of operations (until 2014) are detailed below in **Table 7**.

Table 7 - Summary of key water quality parameters

Sample Site	Highest Sample Value			Lowest Sample Value			Mean Sample Value		
	pH	EC (uS/cm)	Turbidity (NTU)	pH	EC (uS/cm)	Turbidity (NTU)	pH	EC (uS/cm)	Turbidity (NTU)
Sediment Dam 2	7.26	451	53	6.83	417	38	7.09	430	43

When compared with the ANZECC (2000) *Water Quality Guidelines* for lowland rivers (see **Table 8** below) the water quality data for samples collected from Sediment Dam 2 are consistent with the trigger values for in slightly disturbed ecosystems and as such would be considered as a satisfactory quality for discharge from the site. Notwithstanding this all water has been retained on site for uses as process water and dust suppression.

Table 8 - ANZECC (2000) – Ranges of default triggers for Lowland Rivers

Ecosystem type	pH	EC (uS/cm)	Turbidity
Lowland Rivers	6.5-8.5	125-2200	6-50

The surface water monitoring program is detailed below.

Surface Water Quality will be monitored every six months in Sediment Dam 2, with samples analysed for Total Suspended Solids (TSS), pH and Electrical Conductivity (EC). The collection and review of the water quality data over time will allow a benchmark TSS figure to be set. Where sediment dam water quality exceeds this benchmark, flocculation would be undertaken to assist sediment removal. In addition to the six monthly samples, more regular visual checks would be made to ensure that there is no noticeable increased discoloration or sediment build up in the sediment dams. Water quality sampling would be undertaken where visual impacts were observed.

The depth of the dams will also be reviewed at least once a month to determine if the storage capacity of the dams has been reduced. Where the storage capacity has been reduced by thirty (30) percent or more the dam will be desilted. The Quarry Manager completes a daily inspection of all components of the site. Water samples at Sediment Dam 2 are taken from the edge of the dam, adjacent to the pump. Water quality bottles are sent to a NATA accredited laboratory for testing.

Water Discharge – The water level in Sediment Dam 2 is monitored via an electronic height sensor. The dam has been previously surveyed so that estimated volumes can be calculated.

There is no volume limits specified in the EPL for this licensed discharge point. However it is a requirement of DA 265-10-2004 that the volume of water discharged from the site via a licensed discharge point be measured. The flow of water can be estimated based on the flow through the discharge pipeline.

Opportunistic Grab Samples may also be taken during significant rainfall events. These samples will be analysed for TSS, pH and EC.

Water Use – Water for dust suppression by water cart, and sprays on the crushing facility is sourced from Sediment Dam 2. Water usage will therefore be measured via a flow metre to be installed on the pump in Sediment Dam 2. Flow metre readings will be recorded by the Quarry Manager during the environmental inspection completed every two months.

9.0 REPORTING AND REVIEWING

An assessment of water management and erosion and sediment control on the quarry site will be included within the AEMR to be submitted to the DP&E, OEH and Great Lakes Council annually.

This SWMP will be reviewed at a minimum of every five (5) years to assess its effectiveness. This plan will be reviewed if there is a significant variation to the quarry plan.

Where any changes are recommended as a result of review, the SWMP will be revised to increase its effectiveness. Any major amendments to the SWMP will be undertaken in consultation with the appropriate regulatory authorities, including DP&E, NSW OEH and the Great Lakes Council.

10.0 RESPONSIBILITIES

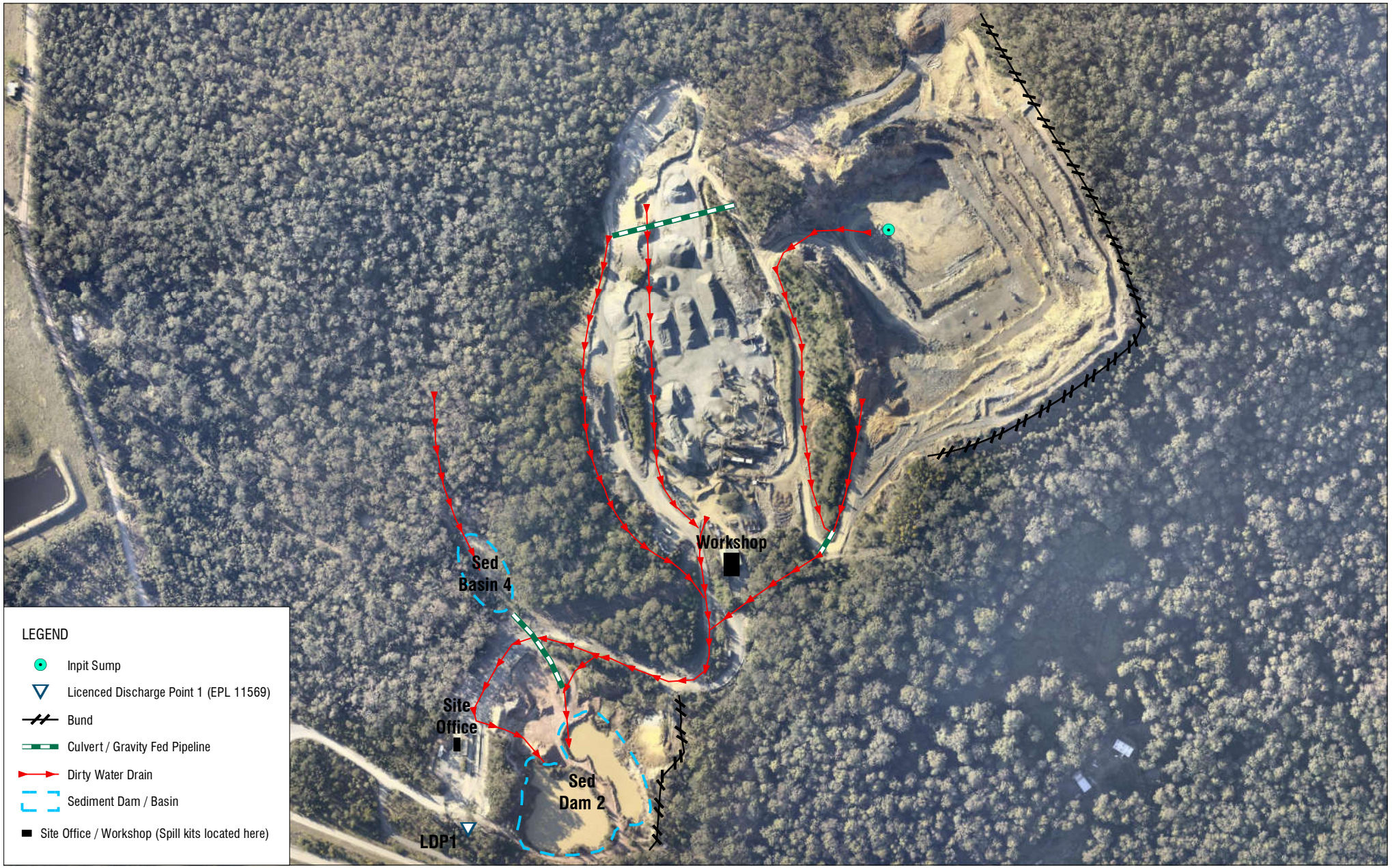
The Quarry Manager (or their nominated representative) is responsible for the implementation of this SWMP. This includes:

- Overall responsibility for environmental compliance with licences and approvals;
- Monitor relevant site environmental performance – compliance, risk assessment and improvement actions;
- Planning for adequate resources to implement the SWMP;
- Implement the inspection schedule for the site; and
- Investigating and reporting of environmental incidents.

11.0 REFERENCES

- Asquith and deWitt Pty Ltd (2004) Environmental Impact Statement, *Application for an existing Hard Rock Quarry*
- *DECC 2008 Managing Urban Stormwater – Soils and Construction, Volume 2E: Mines & Quarries*
- Department of Housing (December 2004) *Managing Urban Stormwater: Soils and Construction Manual*.
- SLR Consulting (December 2014), *Environmental Monitoring Plan for Hard Rock Quarry*, Karuah.
- SLR Consulting (December 2014), *Environmental Management Strategy for Hard Rock Quarry*, Karuah.

Appendix 1 – Drainage and Sediment Control Figure



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Project No.:	633.HQP00.003
Date:	12/12/2014
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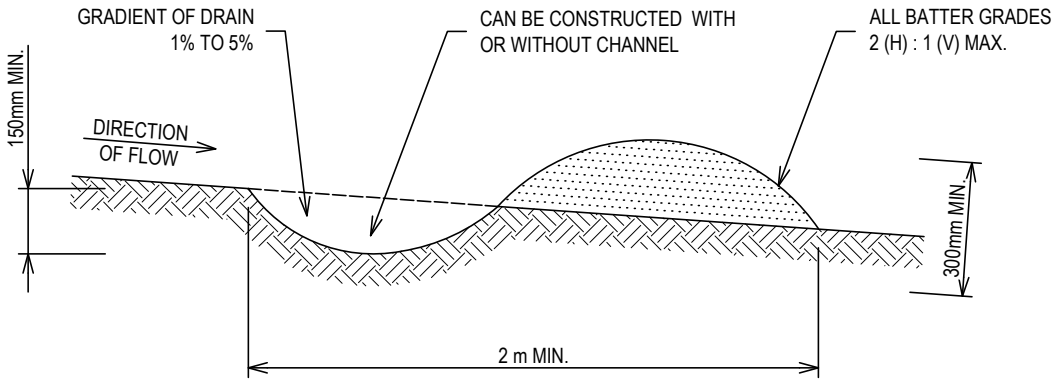
Hunter Quarries Pty Ltd

Environmental Services and Support

Quarry Operations
Water Management

FIGURE 1

Appendix 2 – Construction Guidelines for Blue Book Structures



NOTE: ONLY TO BE USED AS TEMPORARY BANK
WHERE MAXIMUM UPSLOPE LENGTH IS 80m.

CONSTRUCTION NOTES:

1. BUILD WITH GRADIENTS BETWEEN 1% AND 5%.
2. AVOID REMOVING TREES AND SHRUBS IF POSSIBLE - WORK AROUND THEM.
3. ENSURE THE STRUCTURES ARE FREE OF PROJECTIONS OR OTHER IRREGULARITIES THAT COULD IMPEDE WATER FLOW.
4. BUILD THE DRAINS WITH CIRCULAR, PARABOLIC OR TRAPEZOIDAL CROSS SECTIONS, NOT V SHAPED.
5. ENSURE THE BANKS ARE PROPERLY COMPACTED TO PREVENT FAILURE.
6. COMPLETE PERMANENT OR TEMPORARY STABILISATION WITHIN 10 DAYS OF CONSTRUCTION.

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CLIENT: CLIENT
PROJECT: STANDARD DRAWING
DRAWING TITLE: **EARTH BANK (LOW FLOW)**

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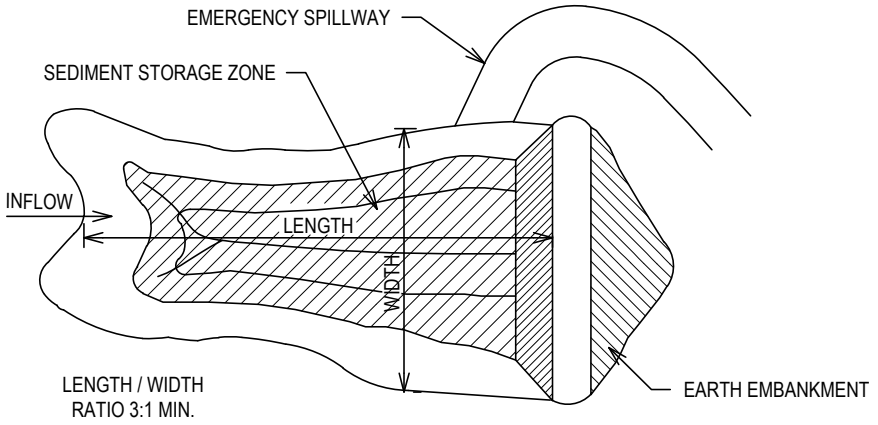
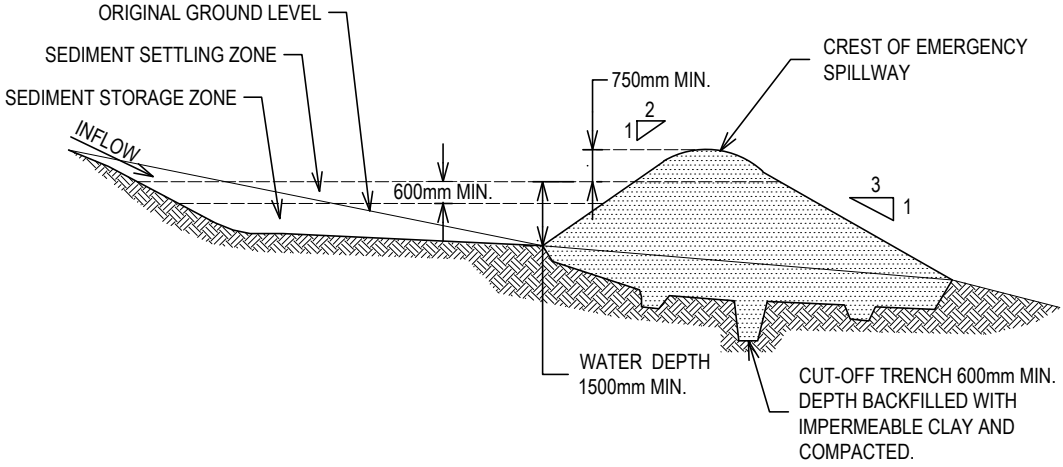


PLAN VIEW



CROSS SECTION

CONSTRUCTION NOTES:

1. REMOVE ALL VEGETATION AND TOPSOIL FROM UNDER THE DAM WALL AND FROM WITHIN THE STORAGE AREA.
2. FORM A CUT OFF TRENCH 500mm DEEP AND 1,200mm WIDE ALONG THE CENTRELINE OF THE EMBANKMENT EXTENDING TO A POINT ON THE GULLY WALL ABOVE THE RISER SILL LEVEL.
3. MAINTAIN THE TRENCH FREE OF WATER AND RECOMPACT THE MATERIALS WITH EQUIPMENT AS SPECIFIED IN THE SWMP TO 95% STANDARD PROCTOR DENSITY
4. SELECT FILL ACCORDING TO THE SWMP THAT IS FREE FROM ROOTS, WOOD STOCK, LARGE STONE OR FOREIGN MATERIAL.
5. PREPARE THE SITE UNDER THE EMBANKMENT BY RIPPING TO AT LEAST 100mm TO HELP BOND THE COMPACTED FILL TO THE EXISTING SUBSTRATE
6. SPREAD THE FILL IN 100mm TO 150mm LAYERS AND COMPACT IT AT OPTIMUM MOISTURE CONTENT FOLLOWING THE SWMP
7. CONSTRUCT THE EMERGENCY SPILLWAY
8. REHABILITATE THE STRUCTURE FOLLOWING THE SWMP.

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PROJECT: STANDARD DRAWING
DRAWING TITLE: **EARTH BASIN - WET**
(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)

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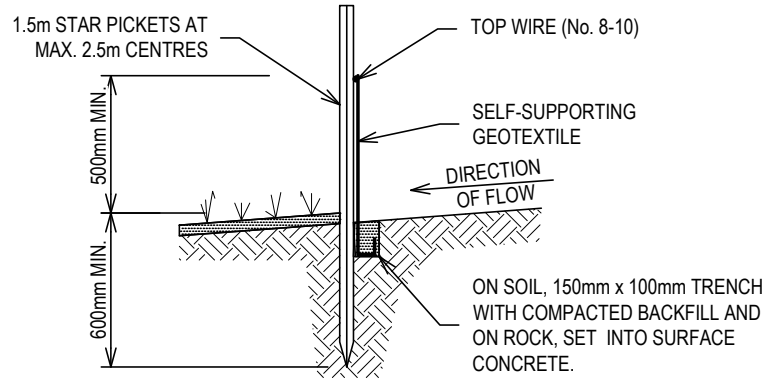

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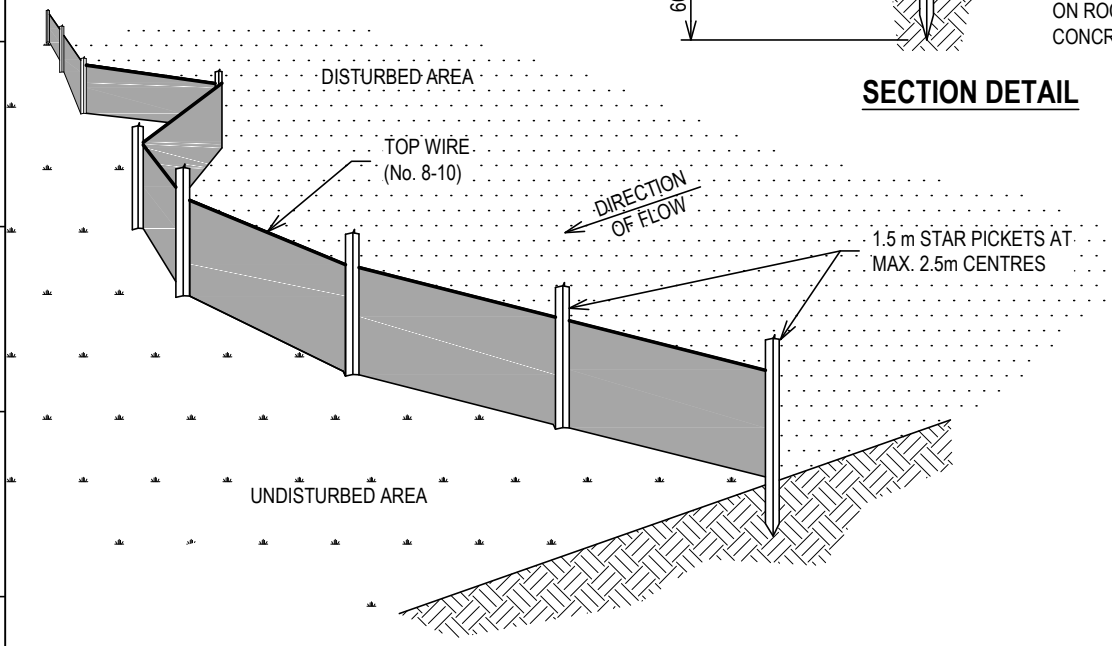

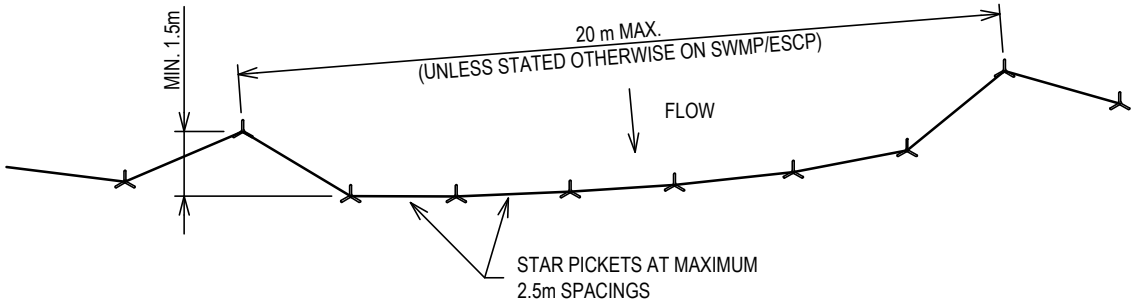

PLAN

CONSTRUCTION NOTES:

1. CONSTRUCT SEDIMENT FENCES AS CLOSE AS POSSIBLE TO BEING PARALLEL TO THE CONTOURS OF THE SITE, BUT WITH SMALL RETURNS AS SHOWN IN THE DRAWING TO LIMIT THE CATCHMENT AREA OF ANY ONE SECTION. THE CATCHMENT AREA SHOULD BE SMALL ENOUGH TO LIMIT WATER FLOW IF CONCENTRATED AT ONE POINT TO 50 LITRES PER SECOND IN THE DESIGN STORM EVENT, USUALLY THE 10 YEAR EVENT.
2. CUT A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED.
3. DRIVE 1.5m LONG STAR PICKETS INTO GROUND AT 2.5 m INTERVALS (MAX.) AT THE DOWNSLOP EDGE OF THE TRENCH. ENSURE ANY STAR PICKETS ARE FITTED WITH SAFETY CAPS.
4. FIX SELF-SUPPORTING GEOTEXTILE TO THE UPSLOPE SIDE OF THE POSTS ENSURING IT GOES TO THE BASE OF THE TRENCH. FIX THE GEOTEXTILE WITH WIRE TIES OR AS RECOMMENDED BY THE MANUFACTURER. ONLY USE GEOTEXTILE SPECIFICALLY PRODUCED FOR SEDIMENT FENCING. THE USE OF SHADE CLOTH FOR THIS PURPOSE IS NOT SATISFACTORY.
5. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
6. BACKFILL THE TRENCH OVER THE BASE OF THE FABRIC AND COMPACT IT THOROUGHLY OVER THE GEOTEXTILE.

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PROJECT: STANDARD DRAWING

DRAWING TITLE: **SEDIMENT FENCE**

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