Metromix Pty Ltd
ABN: 39 002 886 839

Teralba Quarry Extensions

Surface Water Assessment

Prepared by

BMT WBM Pty Ltd

November 2011

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Volume 1, Part 3

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Surface Water Assessment

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EXECUTIVE SUMMARY

BMT WBM has been engaged by R.W. Corkery & Co. Pty Ltd, on behalf of Metromix Pty Ltd, to prepare the Surface Water component of the Environmental Assessment for the proposed Teralba Quarry Extensions.

The Surface Water Assessment for the proposed Teralba Quarry Extensions covers the:

- existing Southern Extraction Area;
- existing Mid Pit Extraction Area;
- proposed Southern Extension; and
- proposed Northern Extension.

The extraction sequence for the proposed Teralba Quarry Extensions would involve ongoing extraction within the Mid Pit Extraction Area followed by the Southern Extension (Western Area to 20m AHD), Northern Extension and final Southern Extension over a total period of 30 years.

This assessment outlines:

- the existing environment and management of the Teralba Quarry;
- an assessment of the potential environmental impacts of the proposed Teralba Quarry Extensions; and
- mitigation measures proposed to manage or offset any potential environmental impacts.

Both site clearing and proposed extraction operations have the potential to impact surface water quantity and quality, mainly by altering runoff volumes and increasing erosion and sedimentation. Potential activities likely to impact surface water as a result of the proposed extensions include:

- vegetation clearing, topsoil and subsoil removal, and overburden removal during site clearing works; and
- conglomerate extraction, hauling, processing and stockpiling, hydrocarbon management and waste management.

Potential surface water impacts of the proposed extensions include:

- erosion and sedimentation of the downstream environment resulting from site clearing activities;
- increased ground infiltration on site resulting from site clearing and the collection and storage of runoff; and
- changes in runoff volumes discharging to the sediment dams.

The potential surface water impacts of the proposed extensions can be mitigated by:

- updating the current Site Water Management Plan (GHD, 2007) to take into account the proposed Northern and Southern Extensions;
- ensuring any off-site discharge is monitored and reported in accordance with an environmental protection licence;
- establishing a regular monitoring program to review all erosion and sediment control mitigation measures;

- conducting initial site clearing in accordance with the Blue Book (Landcom, 2004) guidelines for erosion and sediment control;
- constructing and maintaining temporary diversion drains/bunds around the perimeters of the extraction areas; and
- providing sufficient storage during all stages of works to prevent discharge off-site of sediment-laden water in accordance with the Blue Book (Landcom, 2004) guidelines for sediment retention dams.

The following supporting appendices have also been provided.

1. Historical Off-site Discharge
2. Surface Water Monitoring Program
3. Chemical Inventories
4. Erosion and Sediment Control Standard Drawings

1. INTRODUCTION

Metromix Pty Ltd ("Metromix") operates a conglomerate quarry located approximately 1.5 kilometres west from Five Islands at the mouth of Cockle Creek. The current quarrying operations are contained within the existing Southern Extraction Area and existing Mid Pit Extraction Area. Two other enterprises occupy land leased by Metromix south of Rhondda Road, namely, Downer EDI (operating an asphalt plant) and Civilake (part of Lake Macquarie City Council operating a pugmill (roadbase blending plant)).

Metromix intends to extend its extraction operations to the south of the existing Southern Extraction Area and also to the north of the existing Mid Pit Extraction Area located north of Rhondda Road. R.W. Corkery & Co. is preparing an Environmental Assessment for the proposed extensions. BMT WBM has been engaged by R.W. Corkery & Co on behalf of Metromix to undertake the surface water assessment of the proposed Teralba Quarry Extensions.

1.1 LOCALITY

Teralba Quarry is located off Rhondda Rd in the northwestern area of Lake Macquarie, approximately 800 m west of the suburb of Teralba. The Project Site and property boundary are shown in **Figure 1-1**.

The Project Site is located within the Cockle Creek catchment and larger Lake Macquarie catchment area. The Project Site falls under the Central Coast catchment of the Hunter-Central Rivers Catchment Management Authority.

The Project Site encompasses the freehold land incorporating the full area of the existing Teralba Quarry extraction and processing operations, the proposed southern and northern extensions and a section of Rhondda Road. The Project Site covers an area of approximately 130ha and is located entirely within a 244ha area of freehold land that Metromix leases from the landowner, Mr A.C. Fowkes.

1.2 PROJECT DESCRIPTION

The Project Site incorporates four extraction areas. The first area, referred to as the "existing Southern Extraction Area," encompasses all approved extraction and processing operations south of Rhondda Road. The second area is referred to as the "existing Mid Pit Extraction Area" which is located north of Rhondda Road and is currently part of ongoing quarry operations. The two areas not yet approved and the subject of the project application is referred to as the "proposed Southern Extension" and the "proposed Northern Extension". The extraction sequences of the proposed extensions are provided as **Figure 1-2**, **Figure 1-3** and **Figure 1-4**.

It is noted that it is likely the asphalt plant will continue to operate in its current manner throughout the life of quarry extensions. There is, however, no certainty that the Civilake Pugmill would operate throughout this period. In the event the Civilake Pugmill is removed from site, Metromix proposes to install a pugmill within the eastern stockpile area in the area where roadbase products would be produced and stockpiled. At no time would there be two pugmills operational on site.

Figure 1-1
LOCALITY PLAN

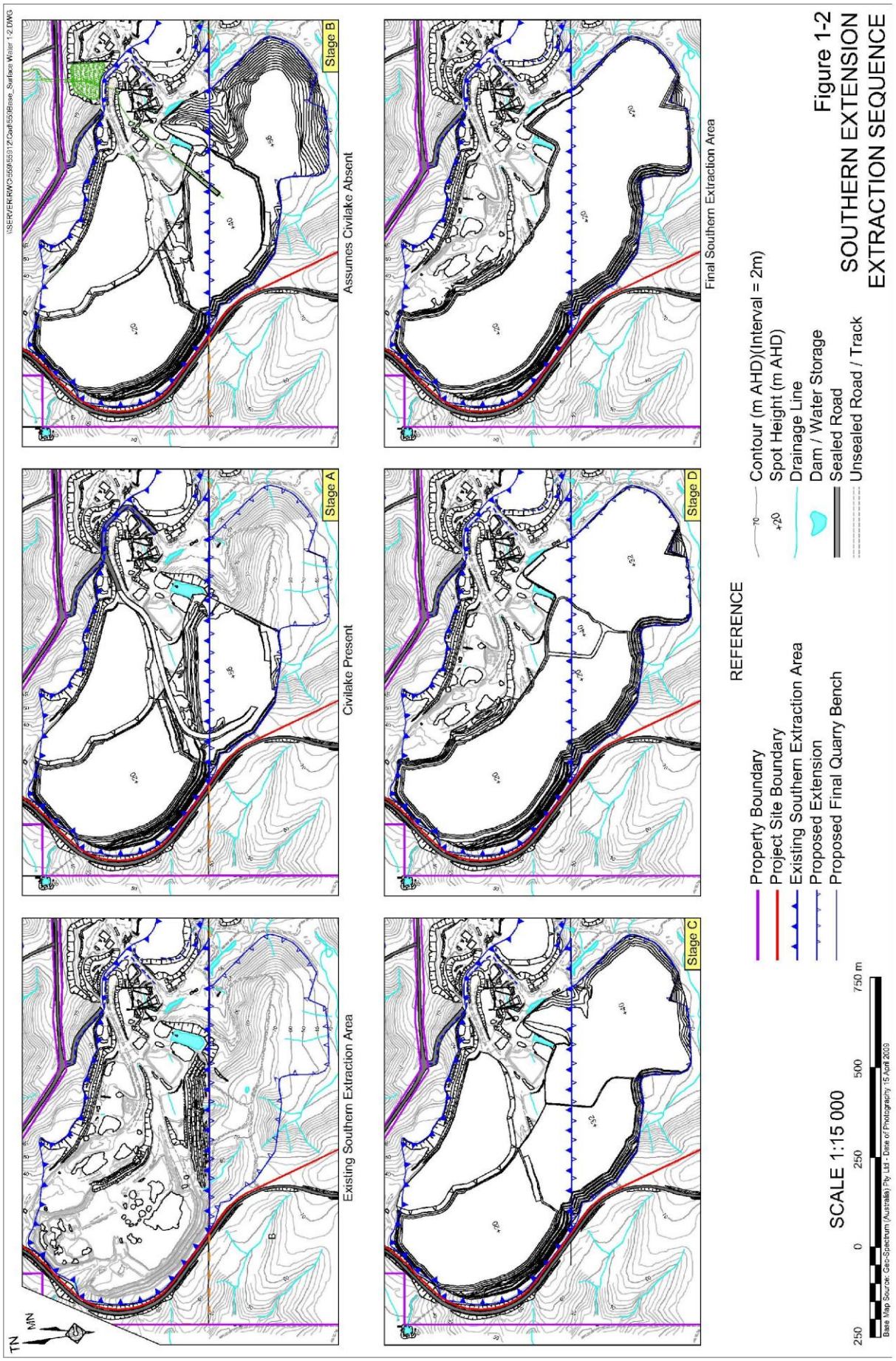


Figure 1-2
SOUTHERN EXTENSION
EXTRACTION SEQUENCE

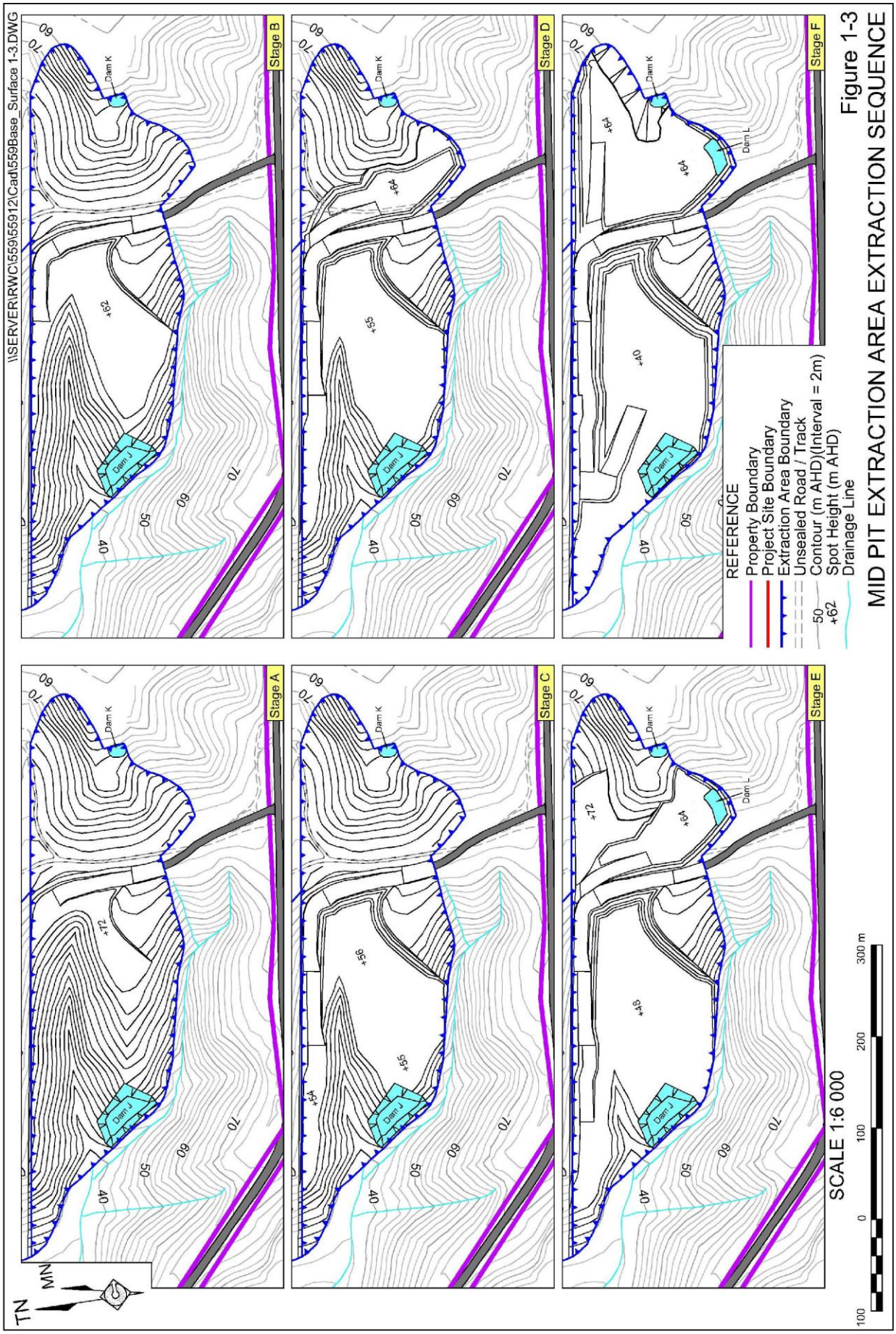


Figure 1-3
MID PIT EXTRACTION AREA EXTRACTION SEQUENCE

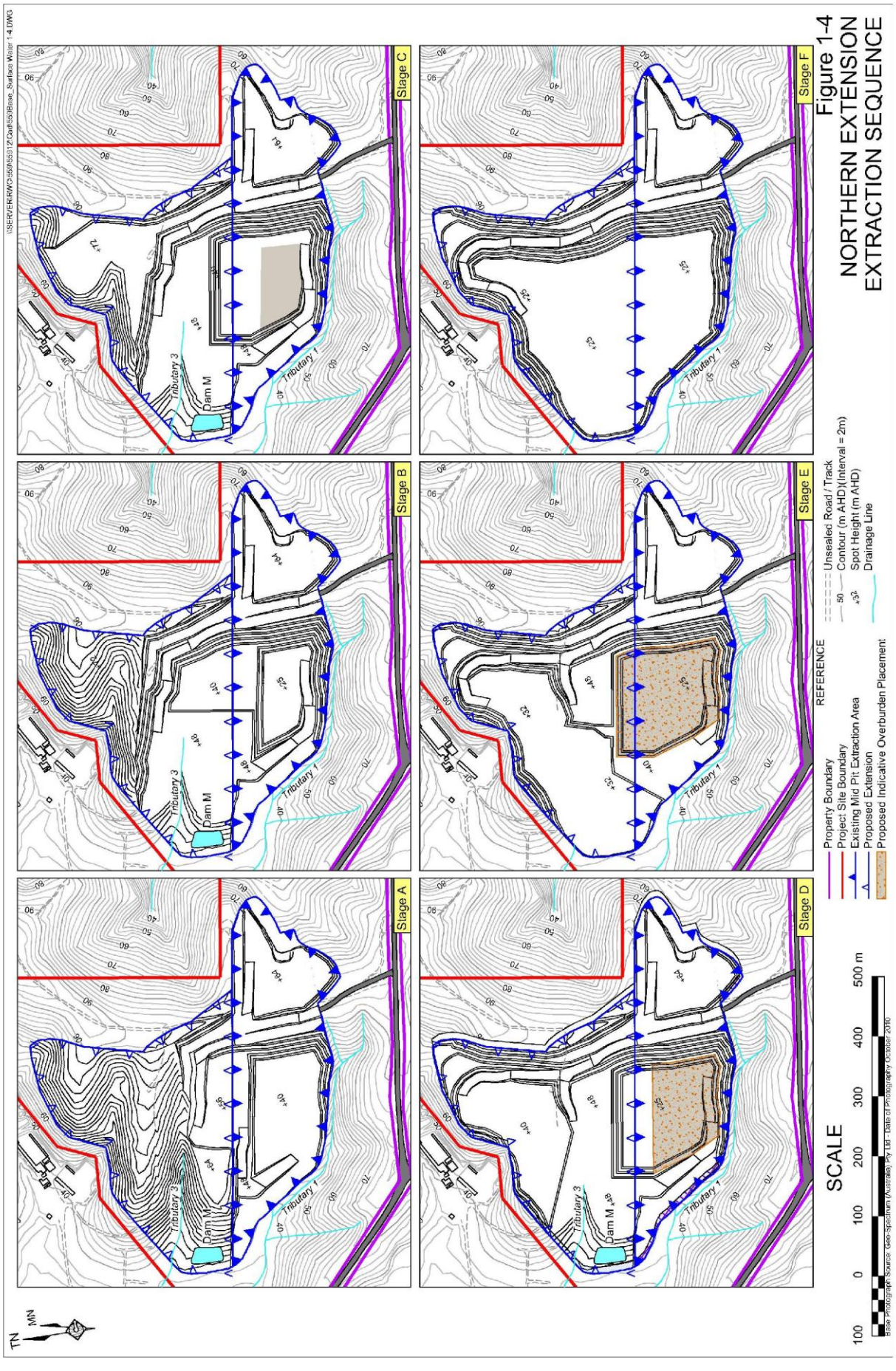


Figure 1-4
NORTHERN EXTENSION
EXTRACTION SEQUENCE
Stage A
Stage B
Stage C
Stage D
Stage E
Stage F
Tributary 1
Tributary 3
Dam M
REFERENCE
Property Boundary
Project Site Boundary
Existing Mid Pit Extraction Area
Proposed Extension
Proposed Indicative Overburden Placement
Unsealed Road / Track
Contour (m AHD)(Interval = 2m)
Spot Height (m AHD)
Drainage Line
SCALE
100 0 100 200 300 400 500 m
TN MN

1.3 OBJECTIVES

The objective of this report is to provide the surface water component of the Environmental Assessment for the proposed Teralba Quarry Extensions. The surface water assessment covers the:

- existing Southern Extraction Area;
- existing Mid Pit Extraction Area;
- proposed Southern Extension; and
- proposed Northern Extension.

Report Format

Section 1: Introduction

Section 2: Existing Environment

Section 3: Site Water Management

Section 4: Surface Water Management

Section 5: Potential Impacts & Mitigation Measures

Section 6: Summary

Section 7: References

Appendices 1 - 4

1.4 COVERAGE OF DIRECTOR-GENERAL'S AND OTHER REQUIREMENTS

Table 1-1 presents a consolidated list of the requirements for the Environmental Assessment relating to surface water that were provided to Metromix by the Director-General of the Department of Planning and other relevant government agencies and where each issue is addressed in this report.

Table 1-1
Coverage of Director-General's and Other Requirements

Page 1 of 4

Government Agency	Relevant Paraphrased Requirement	Section
Department of Planning	The Environmental Assessment of the project must include:	
	• detailed modelling and assessment of potential impacts on:	5
	– the quality and quantity of existing surface water and groundwater resources;	Appendix 1
	– affected licensed water users and basic landholder rights;	1
	– the riparian, ecological, geomorphological and hydrological values of watercourses: and	2
	– impacts to agricultural lands,	2
	• a detailed description of measures to mitigate surface water and groundwater impacts.	5

Table 1-1 (Cont'd)
Coverage of Director-General's and Other Requirements

Government Agency	Relevant Paraphrased Requirement	Section
NSW Office of Water	The Environmental Assessment is required to demonstrate the following:	
	• Adequate and secure water supply is available for the life of the project. Confirmation that water supplies for the ongoing operation of the quarry are sourced from an appropriately authorized and reliable supply.	4
	• Identification of site water supply demands in terms of both volume and timing (including water sources – groundwater and surface water) for the extension and ongoing operations.	4
	• Existing and proposed water licensing requirements are in accordance with the Water Act 1912, Water Management Act 2000 and Water Sharing Plan for the Hunter Unregulated and Alluvial Water Source.	1
	• An assessment of the impact of quarry operations on adjacent licensed water users, basic landholder rights, and groundwater-dependent ecosystems. This is to meet the requirements of the NSW State Groundwater Policy Framework Document (1997) in addition to the Water Act 1912 and Water Management Act 2000.	1
	• An assessment of watercourses that may be impacted and selection of appropriate techniques and mitigation measures to minimise impact. Design and construction of works within 40m of water courses are to be in accordance with "NOW Guidelines for Controlled Activities (August 2010)	4
	• Adequate mitigating and monitoring requirements to address any predicted potential surface and groundwater impacts.	5 & Appendix 2
	• The assessment is required to take into account the requirements of the following legislation (administered by NOW), as applicable:	
	– Water Act 1912	1
	– Water Management Act 2000 (WMA)	1
	– If the proposal is within a gazetted WSP area the assessment is required to demonstrate consistency with the rules of the WSP.	1
	• The assessment is required to take into account the following NSW Government policies, as applicable:	
	– NSW Groundwater Policy Framework Document (1997)	See Groundwater Assessment
	– NSW Groundwater Quantity Management Policy (1998)	
	– NSW Groundwater Quality Protection Policy (1998)	
	– NSW State Groundwater Dependent Ecosystem Policy (2002)	
	– NSW Wetlands Management Policy (2010)	NA
	– Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)	Appendix 1 & 2
	– Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting (2000)	Appendix 1 & 2
	– Guidelines for the Assessment and Management of Groundwater Contamination (2007)	See Groundwater Assessment

Table 1-1 (Cont'd)
Coverage of Director-General's and Other Requirements

Government Agency	Relevant Paraphrased Requirement	Section
NSW Office of Water (Cont'd)	• Guidelines for Groundwater Protection in Australia	See Groundwater Assessment
	• NOW's assessment of the proposal is required to take into account the requirements of relevant water-related legislation and guidelines. The guidelines recommended the following minimum Core Riparian Zone (CRZ) widths.	NA
	• CRZ of 10 meters (on both sides) for any first order watercourse where there is a defined channel where water flows intermittently.	NA
	• CRZ of 20 meters (on both sides) for any permanently flowing first order watercourse, or any second order watercourse where there is a defined channel where water flows permanently or intermittently.	
	• CRZ of 20-40 meters (on both sides) for any third order or greater watercourse where there is a defined channel where water flows intermittently or permanently. Includes estuaries, wetlands and any parts of rivers influenced by tidal waters.	
	• The assessment is required to consider the impact of the proposal on the watercourses and associated riparian vegetation within the site and to provide the following	
	• Identify the sources of surface water	2
	• Details of stream order (using the Strahler System)	NA
	• Details of any proposed surface water extraction, including	
	• Purpose, location and construction details of all dams, diversions, cuttings, levees and expected annual extractions volumes.	3 & 4
	– Description of any proposed development or diversion works including all construction, clearing, draining, excavation and filling and an evaluation of the methods of such works.	NA
	– Description of all potential environmental impacts of any proposed development in terms of vegetation, sediment movement, water quality and hydraulic regime.	5
	– Description of the design features and measures to be incorporated into any proposed development to guard against long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns and the identification of riparian buffers.	3 & 5
	– Details of the impact on water quality and remedial measures proposed to address any possible adverse effects.	5
	– Any stormwater management plan for the site must ensure that the development does not significantly alter environmental flows and inundation patterns in the watercourse	NA

Table 1-1 (Cont'd)
Coverage of Director-Generals and Other Requirements

Government Agency	Relevant Paraphrased Requirement	Section
NSW Office of Water (Cont'd)	• If the proposal includes existing or proposed water management structures, the assessment should provide information on the following.	
	– Date of construction (for existing structures)	NA
	– Details of the legal status/approval for existing structures	1
	– Details of any proposal to change the purpose of existing structures.	NA
	– Details if any remedial work is required to maintain the integrity of the existing structures.	NA
	– Clarification if the structures are on a watercourse.	2
	– Details of the purpose, location and design specifications for the structures.	4
	– Size and storage capacity of the structures.	3
	– Calculation of the maximum harvestable right dam capacity (MHRDC) for the site.	1
	– Details if the structures are affected by flood flows.	NA
	– Details of the proposal for shared use, rights and entitlement of the structures.	NA
	– Details if the proposed development/subdivision has the potential to bisect the structures.	NA

1.5 WATER LICENCING

Both the extraction of water and collection of rainfall runoff are regulated under the Water Management Act 2000 by the NSW Office of Water (NOW). Discharge of concentrated flows off site is regulated by the NSW Office of Environment and Heritage (OEH).

1.5.1 Storage Dams

Pursuant to section 53 of the *Water Management Act* 2000, an occupier of a landholding is entitled to construct stormwater harvesting dams and use the captured water within the property without the need for any access licence, water supply work approval or water use approval - provided the dams have a combined capacity within the maximum harvestable rights dam capacity (MHRDC) calculated according to the formulae nominated by the NOW and any relevant harvestable rights order.

As the existing and proposed sediment dams are for pollution control they are considered to be exempt as 'special dams' i.e. with the exception of Dam B. The proposed silt cells would not be considered as stormwater harvesting dams as they would be for the storage and reuse of process waste water and will not collect stormwater runoff. Similarly, the existing Dam G would not be considered as a stormwater harvesting dam as it acts as a holding dam for water sourced from the Mine Adit Dam and the silt cells prior to use in the processing plant.

The MHRDC is calculated and applied according to each parcel of land. The land leased by Metromix comprises Lot 1 DP 224037 (approximately 156.10ha) and Lot 2 DP 224037 (approximately 87.57ha). Lot 1 encompasses the existing Southern and Mid Pit Extraction Areas, proposed Northern Extension, and existing on-site Dams G and H. Lot 2 DP 224037 encompasses the proposed Southern Extension and existing on-site Dams B to F.

Based on the location of the Project Site, as shown in **Figure 1-5**, the MHRDC is calculated in megalitres as the land area in hectares multiplied by the harvestable right multiplier value of 0.10, giving the Project Site a MHRDC of 15.61ML for Lot 1 DP 224037 and 8.757ML for Lot 2 DP 224037. The combined MHRDC for this project site is 24.37ML. The current on-site storage volumes are provided in Section 3.

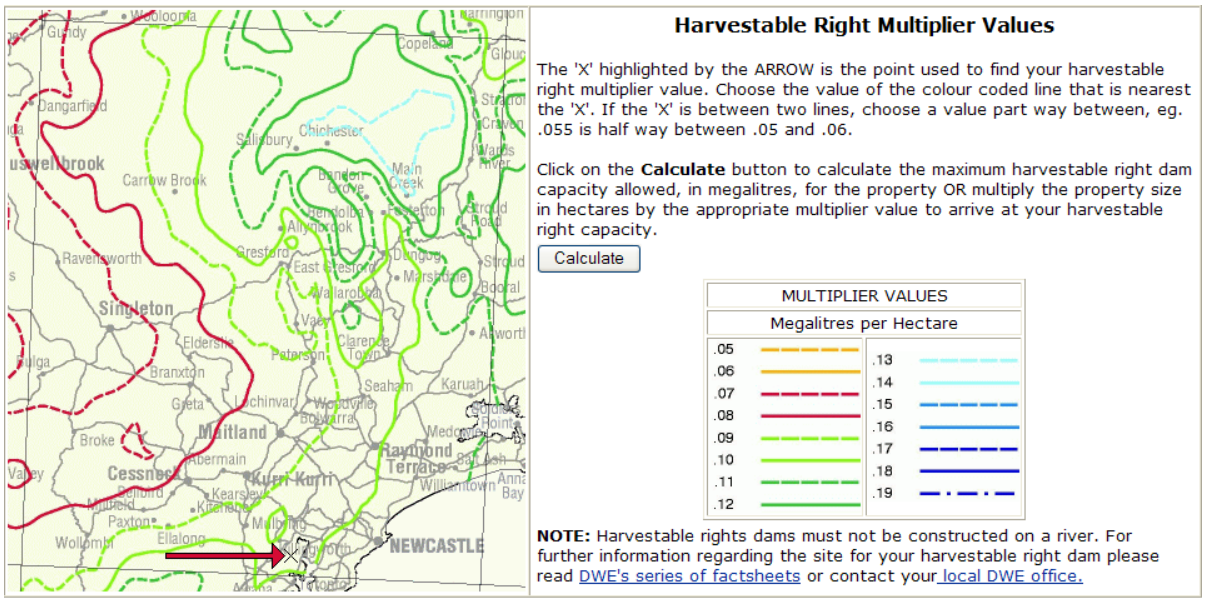


Figure 1-5 Harvestable Right Multiplier

1.5.2 Extraction

Extraction from a water source is governed according to water sharing plans where a water sharing plan exists. Water sharing plans set the rules for sharing and trading water between water users and the environment in accordance with the Water Management Act 2000. With the exception of basic landholder rights (such as the MHRDC discussed in Section 1.5.1), all other water extraction must be authorised under a water access licence.

Presently, the Mine Adit Dam receives groundwater from the mine adit as well as surface water overflow from the final sediment dam, Dam B. Metromix proposes to construct a diversion drain to convey the Dam B overflow directly to the downstream unnamed watercourse, bypassing the Mine Adit Dam. The construction of the diversion drain may require a Controlled Activity Approval under the *Water Management Act 2000*.

Following the diversion of the Dam B overflow, the Mine Adit Dam will solely contain groundwater, the extraction of which would need to be licensed under Section 112 of the *Water Act 1912*.

In the event Metromix intends to extract any water from Sediment Dams B to F, it would not be necessary to obtain a licence until the volume of water recoverable under the maximum harvestable rights dam capacity is exceeded. Metromix is not intending to use substantial quantities of water from these dams and will monitor use and obtain a licence if required.

1.5.3 Environment Protection Licences

The volume of water overflowing from the Mine Adit Dam and flowing off site at the triple point discharge / data logger is currently monitored by Coal & Allied Industries Limited in accordance with its EPA Licence 3139, as discussed further in **Appendix 1**. It is recommended that the discharge point remain under the current licence.

It is recommended that all existing and proposed locations where concentrated flow may discharge off site be identified on Metromix's Environment Protection Licence 536 as they become operational. Existing locations would include the existing Mid Pit Extraction Area. Future locations associated with the proposed Northern Extension and also the proposed diversion drain for overflow from Dam B should be added to the licence as they are constructed.

2. EXISTING ENVIRONMENT

2.1 OVERVIEW

Teralba Quarry is located within the Cockle Creek catchment and larger Lake Macquarie catchment area as shown in **Figure 2-1**. The Project Site falls under the Central Coast catchment of the Hunter-Central Rivers Catchment Management Authority.

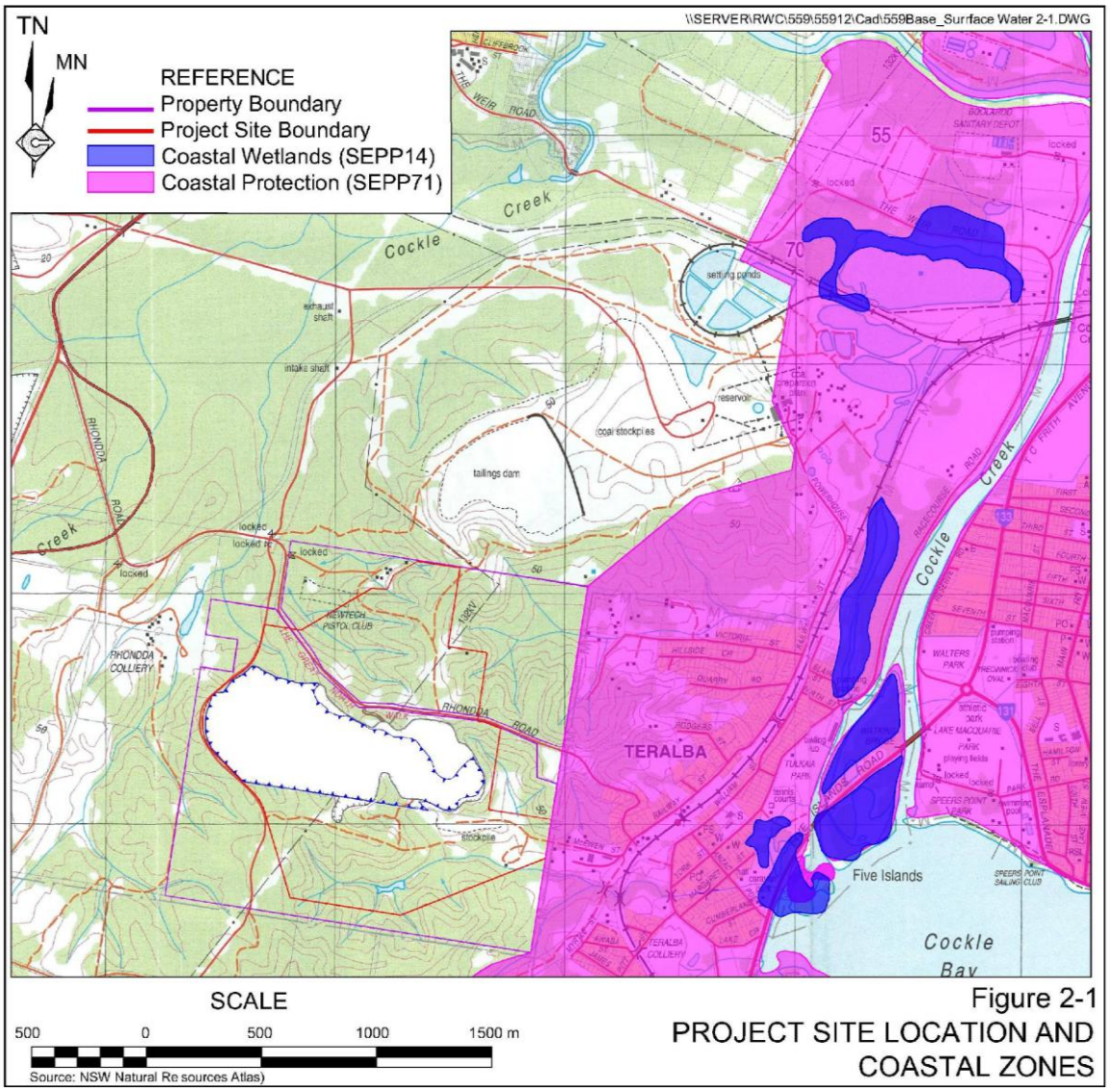


Figure 2-1
PROJECT SITE LOCATION AND COASTAL ZONES

The Project Site includes the current quarry operations, comprising the existing Southern Extraction Area, Mid Pit Extraction Area, the processing plant and related facilities, Downer EDI (asphalt plant) and Civilake pugmill, undisturbed bushland and power transmission line easements.

Surface water runoff occurs as a result of substantial rainfall events and overflow from the processing plant. Rainfall runoff occurs from disturbed areas including the extraction areas, sealed and unsealed haul roads and stockpiles as well as undisturbed and cleared bushland areas of the Project Site. A significant proportion of rainfall and surface water runoff across the Project Site infiltrates due to the highly permeable ground surface.

Located within the Teralba Conglomerate, the entire Project Site has been undermined which results in runoff and rainfall percolating from the surface to the coal mine workings below. Infiltration through the conglomerate is assisted by subsidence and surface cracking throughout the Project Site, as shown in **Plate 2-1**.

Plate 2-1 Surface Cracking

Surface runoff from the existing Southern Extraction Area and surrounding catchment either infiltrates through the floor of the extraction area or flows eastwards via a series of formalised drainage paths including open table drains, pipes, culverts, weirs and sediment dams (see Section 3). Ultimately, during/following substantial rainfall periods, surface runoff reaches the Mine Adit Dam and mixes with water flowing from the mine adit before flowing off site.

The existing Mid Pit Extraction Area and proposed Northern Extension drain to Cockle Creek in a westerly or easterly direction. Work has commenced in the Mid Pit Extraction Area as discussed further in Section 4.4.

2.2 DOWNSTREAM ENVIRONMENT

Overflow from the Mine Adit Dam flows eastward via an irregular vegetated drainage line and a concrete open channel referred to as Murph's Drain as shown in **Figure 2-2**. This creek and drain would have been ephemeral prior to coal mining activities. However, since the cessation of coal mining, the flow in this creek and drain has almost been permanent.

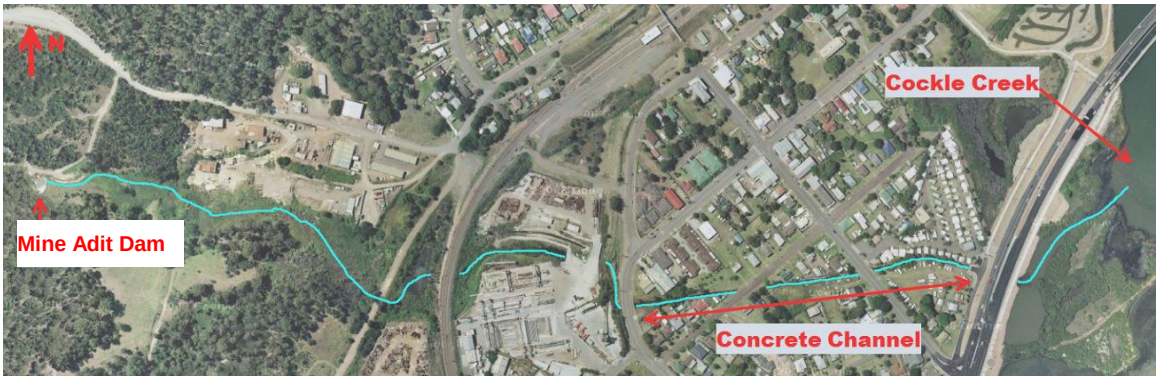


Figure 2-2 Downstream Drainage Line

Immediately downstream of the Mine Adit Dam, the drainage line is overgrown with reeds and other vegetation which continues through to a large pond formed by the railway embankment. Downstream of the railway line, flow discharges to a constructed concrete open channel. It is unknown whether any of the industrial business along Murph's Drain source water from or discharge to the drain. The existing downstream environment is illustrated in **Plates 2-2a** to **2-2d.**

Murph's drain discharges to Lake Macquarie at the mouth of Cockle Creek near the Teralba Lakeside Caravan Park. It is worth noting that downstream of the Project Site is within the SEPP71 Coastal Protection zone with a SEPP14 Coastal Wetland located at the mouth of Cockle Creek as illustrated in **Figure 2-1.**

(a) Immediately downstream of the Mine Adit Dam

(b) Railway Line Embankment Pond

(c) Constructed concrete open channel

(d) Drain discharge to Cockle Creek

Plates 2-2 Environment Downstream from the Mine Adit Dam

2.3 CATCHMENT AREAS

The Project Site incorporates seven sub-catchment areas as summarised in **Table 2-1** and illustrated in **Figure 2-3**. Sub-catchment areas A, B and C cover the existing Southern Extraction Area. Sub-catchment D located south of the existing Southern Extraction Area is largely undisturbed bushland draining into sub-catchment A via an ephemeral creek. Sub-catchments E, F and G are located north of the existing Southern Extraction Area and are largely undisturbed bushland draining off site to Cockle Creek via ephemeral creeks, with the exception of the commenced works in the Mid Pit Extraction Area. The surface water characteristics of each sub-catchment area (including main flow paths and discharge points) are described in the following sections.

Table 2-1
Project Site Sub-catchment Areas

ID*	Location	Description	Approximate Area (ha)
A	Eastern side of existing Southern Extraction Area and Proposed Southern Extension.	Metromix Office, Downer EDI Asphalt Plant, sediment dams, flooded mine adit and undisturbed bushland • Runoff draining east off site and infiltrated	48.0
B	Western side of existing Southern Extraction Area	Existing Southern Extraction Area Quarry • Runoff infiltrated	26.9
C	Northern border of existing Southern Extraction Area	Civilake pugmill and undisturbed bushland • Runoff draining west off site	8.8
D	South of existing Southern Extraction Area. Proposed Southern Extension.	Undisturbed bushland and electricity easement • Runoff draining north-east into Sub-catchment A and infiltrated	47.0
E	North of Rhondda Road. Mid Pit Extraction Area.	Undisturbed bushland and electricity easement • Runoff draining west off site	22.9
F	Northern extent of Project Site. Proposed Northern Extension.	Gun Club and undisturbed bushland • Runoff draining west off site	12.9
G	North-east extent of Project Site. Mid Pit Extraction Area.	Undisturbed bushland and electricity easement • Runoff draining east off site	20.4

* See **Figure 2-3**

2.3.1 Sub-catchment A (Metromix Office)

Sub-catchment A is the largest of the Project Site and encompasses the eastern side of the existing Southern Extraction Area to the eastern boundary of the Project Site, as shown in **Figure 2-3**. Sub-catchment A also contains a portion of the proposed Southern Extension. Features of the sub-catchment area include:

- Metromix office;
- processing plant;
- undisturbed bushland;
- weighbridge;
- asphalt plant;
- sediment dams; and.
- stockpiles;
- haul roads;
- workshop.

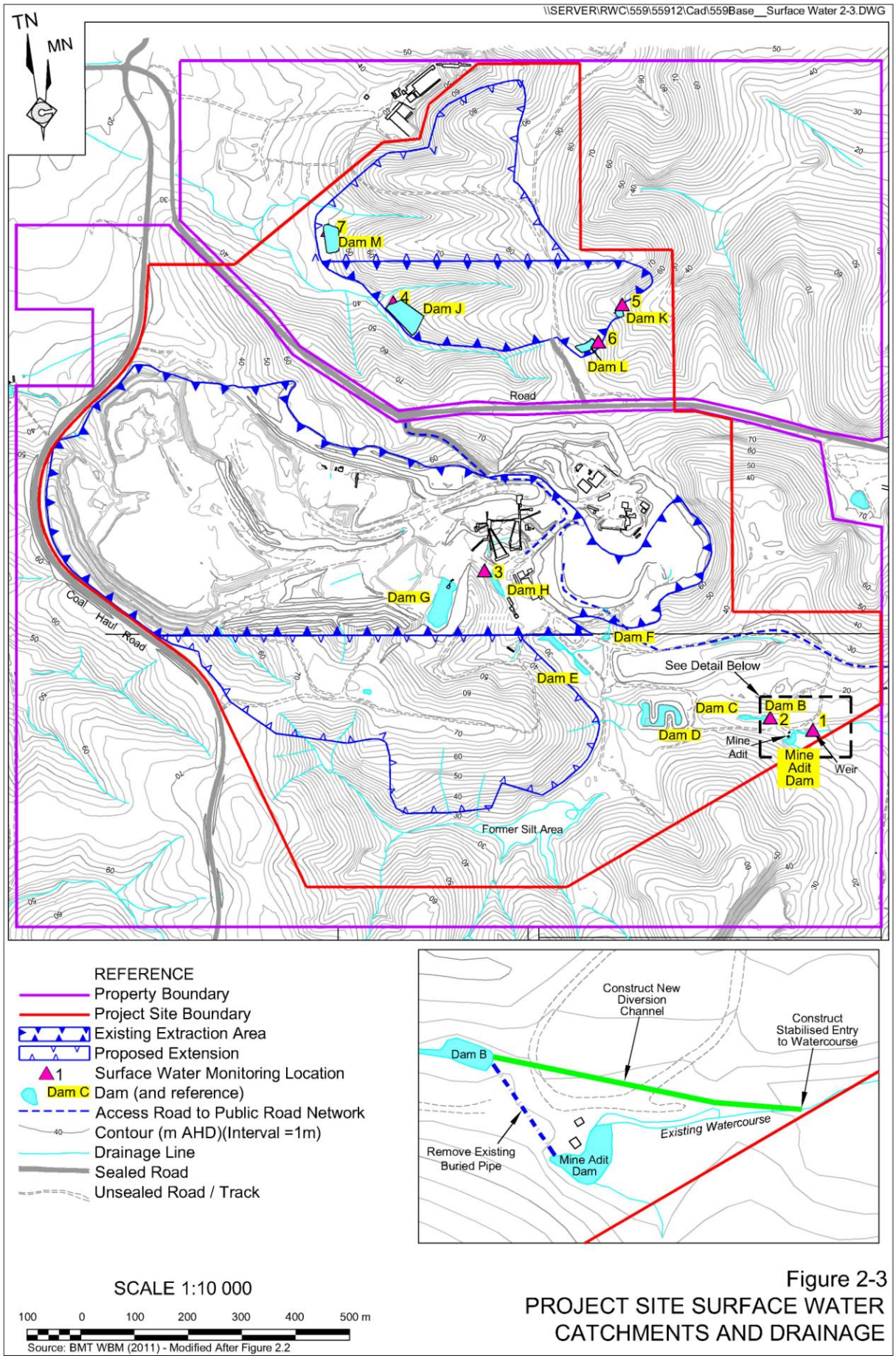


Figure 2-3
PROJECT SITE SURFACE WATER CATCHMENTS AND DRAINAGE

A series of sediment dams (B to F and H) are present in the south of the sub-catchment as discussed further in Section 4.1. It is essential to recognise that many of these dams, particularly Dam D, are known to leak substantially, hence discussions and calculations for their capacities, etc. are invariably highly conservative.

Runoff from this sub-catchment is collected and drained to Dam B through a series of formalised drainage paths. At present, excess flow from Dam B discharges via a pipe to the Mine Adit Dam. Excess flow from the Mine Adit Dam discharges off site to an unnamed creek, which in turn flows into a concrete drain, referred to as Murph's Drain, draining to the mouth of Cockle Creek as discussed in Section 2.2.

Internal haul roads within this catchment are primarily unsealed, apart from the Downer EDI Asphalt Plant, with minimal formalised drainage systems present.

The location of significant surface water flow paths within Sub-catchment A are shown in **Figure 2-4**. Formalised flow paths include open table drains, pipes, culverts, weirs and sediment dams. Some unformed flow paths have resulted from limited drainage in some areas leading to scouring and erosion from concentrated flows. Further details of surface water runoff within the existing Southern Extraction Area are described in Section 4.1.

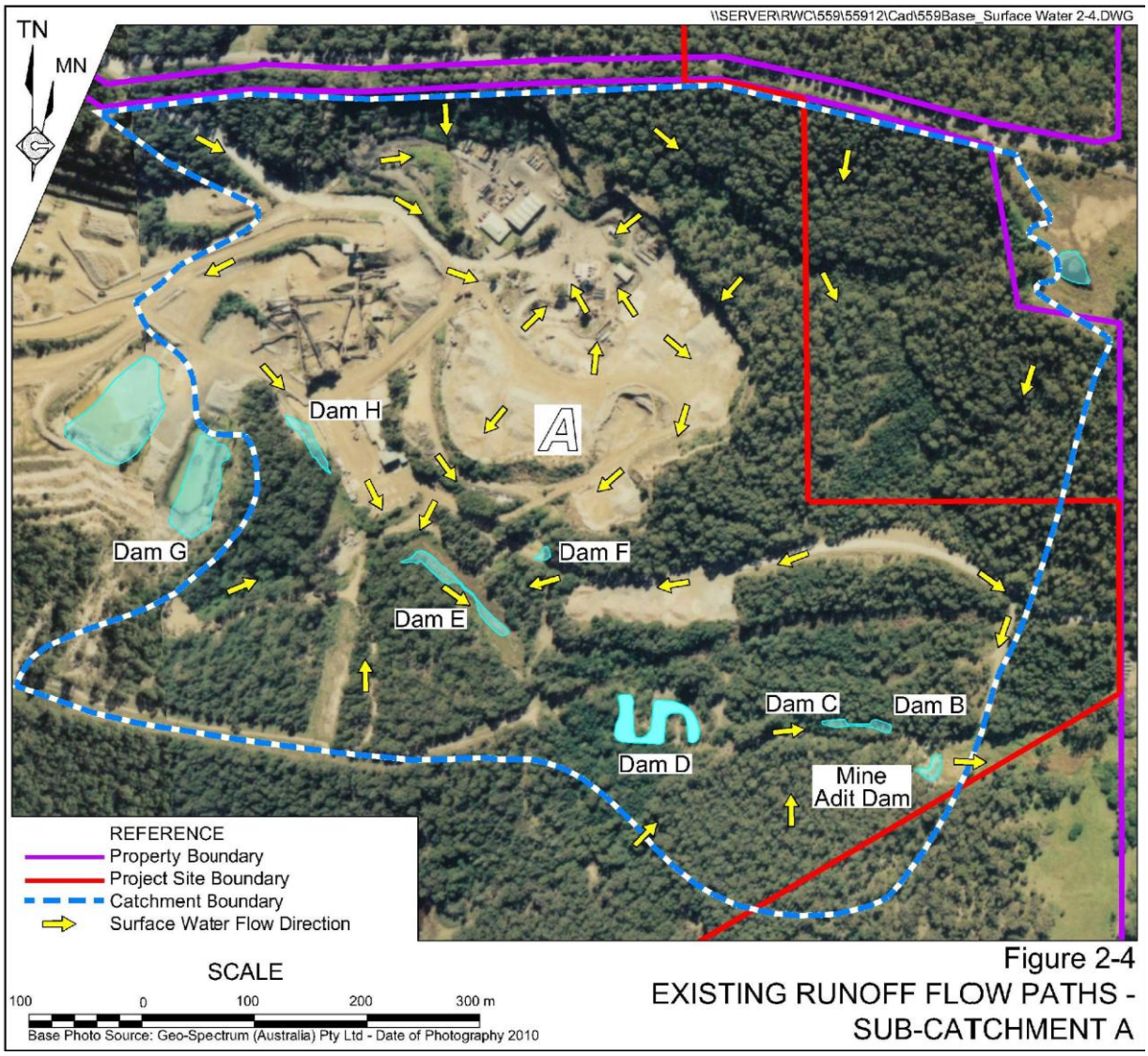
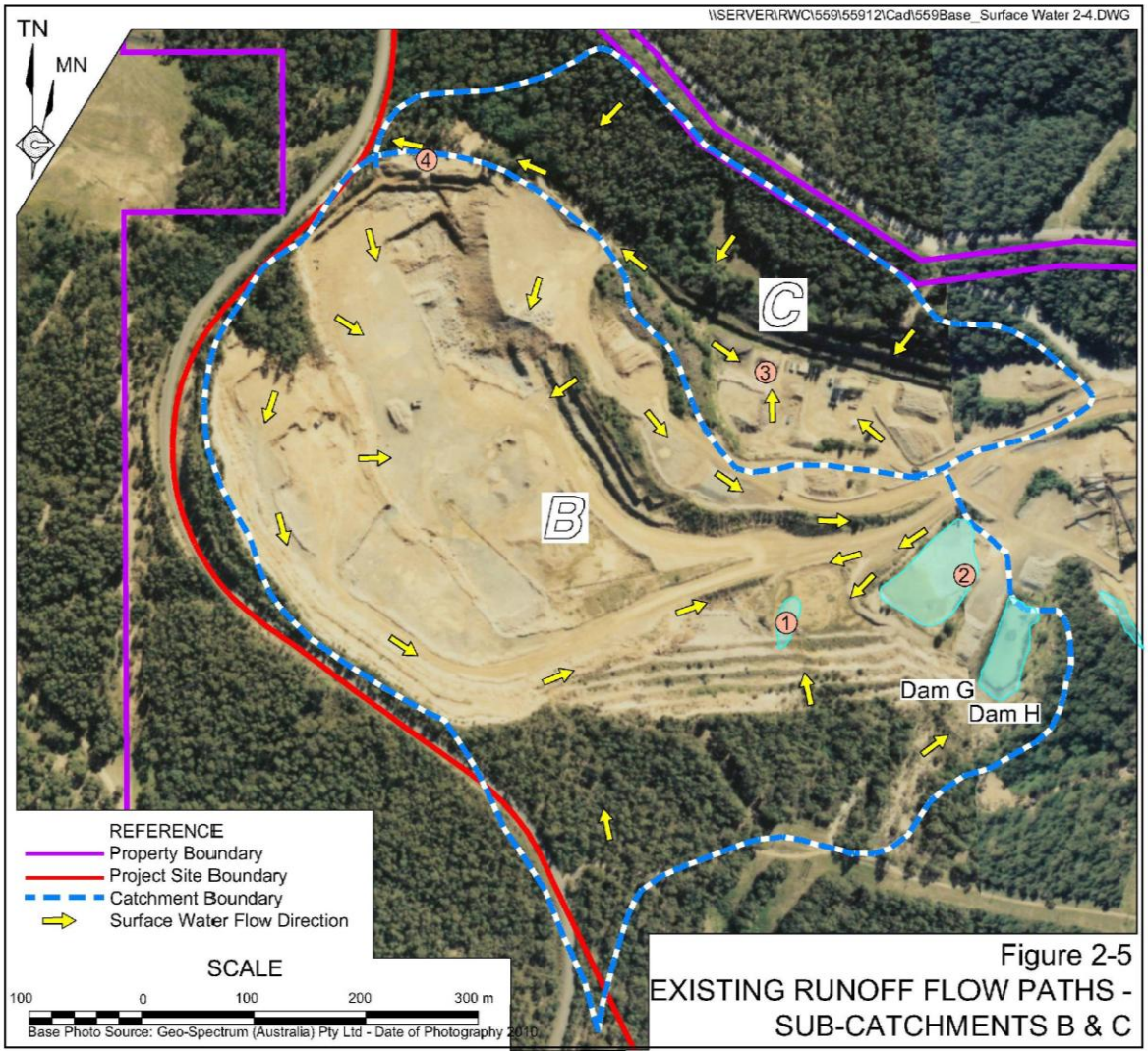


Figure 2-4
EXISTING RUNOFF FLOW PATHS - SUB-CATCHMENT A

2.3.2 Sub-catchment B (Existing Quarry Operations)

Sub-catchment B encompasses the current main conglomerate extraction area of the existing Southern Extraction Area along with a small area of undisturbed bushland to the south, approximately 10% of the sub-catchment area, as shown in **Figure 2-5**. The conglomerate extraction area features haul roads, a detention dam, old extraction pits and holding dam.



Generally, the catchment is relatively flat with steep rock faces surrounding the extraction area. The extraction area experiences minimal compaction due to the extraction process.

Surface runoff within this sub-catchment flows to numerous low points where short-term ponding and infiltration occurs. It is understood that in the past holes have been drilled into void space to allow for direct infiltration, however this is no longer current practice. The majority of surface water is expected to infiltrate in all but the most extreme rainfall events due to the highly permeable ground surface. The surface water flow paths are illustrated in **Figure 2-5**.

A small amount of runoff from the haul road is directed south towards a detention dam (location 1) and an old extraction pit (location 2). A small amount of runoff from the surrounding rock escarpment drains into Dam G. Dam G is a holding dam for water pumped from the Mine Adit Dam for site water use such as raw feed washing, dust control and the Civilake pugmill as outlined in Section 3.

2.3.3 Sub-catchment C (Civilake Pugmill)

Sub-catchment Area C is located along the northern boundary of the existing Southern Extraction Area. The sub-catchment encompasses the Civilake pugmill in the south-east and undisturbed bushland, as shown in **Figure 2-5**. The pugmill produces road base from crushed conglomerate, concrete and water sourced from Dam G as outlined in Section 3.

In the vicinity of the pugmill, surface runoff from the internal haul road, stockpiles and steep rocky escarpment to the north drains to a storage dam (location 3) for infiltration/evaporation.

Surface runoff from the undisturbed bushland is diverted around the existing Southern Extraction Area to the west and off site via a gully. The southern side of the gully comprises overburden from the quarry (location 4). The implications of exposed overburden in close proximity to a watercourse that discharges off site are discussed further in Section 5.

2.3.4 Sub-catchment D (Southern Extent)

Sub-catchment D is located to the south of the existing Southern Extraction Area and includes approximately one half of the proposed Southern Extension area, as shown in **Figure 2-6**. The sub-catchment is predominantly undisturbed bushland with a cleared power transmission line easement orientated north-northeast/south-southwest.

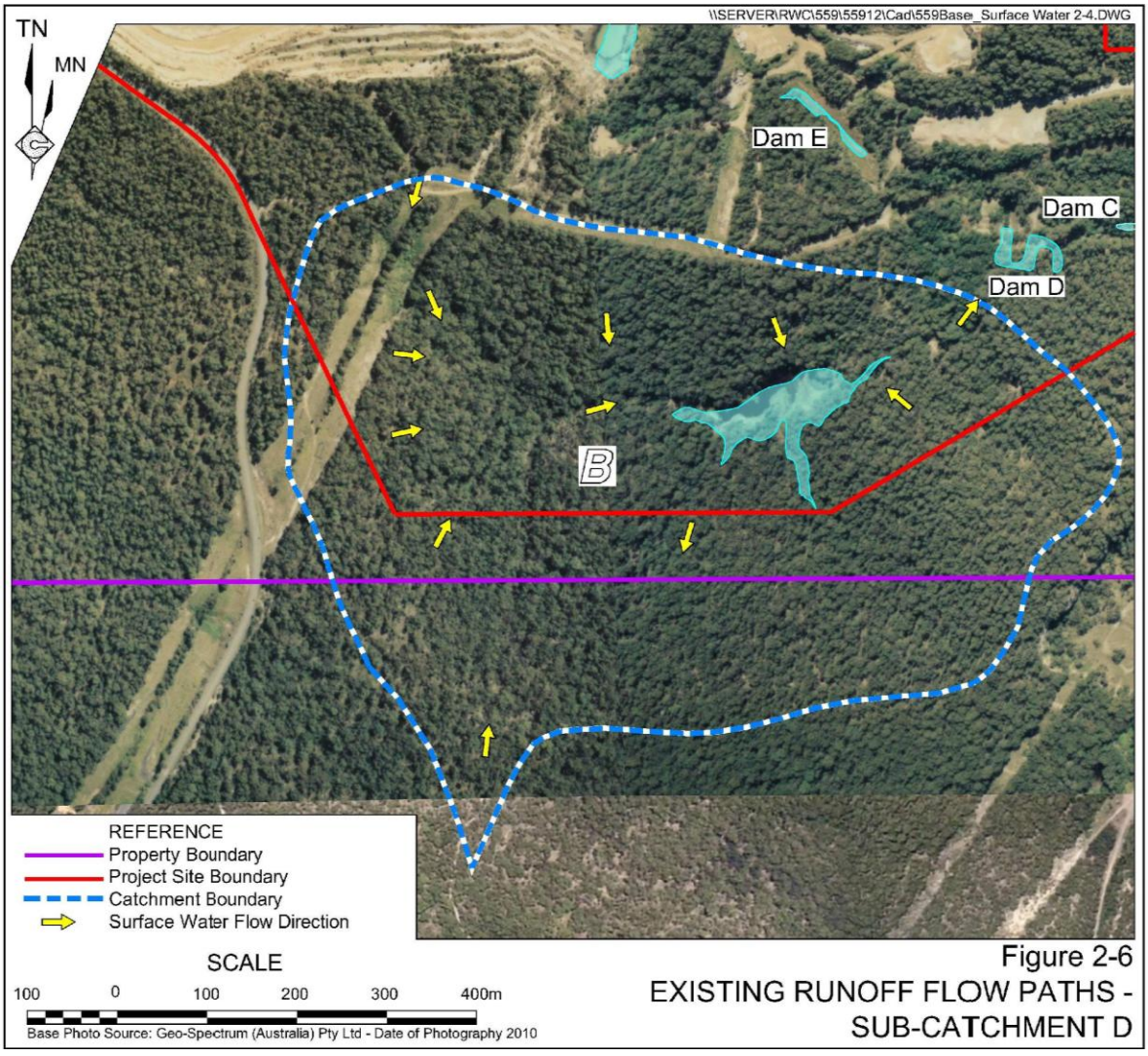


Figure 2-6
EXISTING RUNOFF FLOW PATHS - SUB-CATCHMENT D

Surface runoff within this sub-catchment collects in an ephemeral creek draining north-east towards Dam D located in Sub-catchment A. The location of significant surface runoff flow paths within Sub-catchment D are shown in **Figure 2-6.** The confluence of these tributaries has been modified by the construction of Dam D and past practices of coal chitter placement, etc. It is likely that collection and infiltration of runoff from this catchment would occur prior to runoff discharging into Dam D.

2.3.5 Sub-catchment E (Mid Pit Extraction)

Sub-catchment E is located north of Rhondda Rd. This sub-catchment area contains the majority of the existing Mid Pit Extraction Area and approximately one half of the proposed Northern Extension, as shown in **Figure 2-7**. The catchment is predominantly undisturbed bushland but also contains an asphalt road (Rhondda Rd) along the southern boundary, a cleared power transmission line easement and an unsealed access track along the eastern ridge. As works have now commenced within the Mid Pit Extraction Area, some bushland has been cleared. Stockpiles, sediment dams and a truck wash are also present as discussed further in Section 4.4.

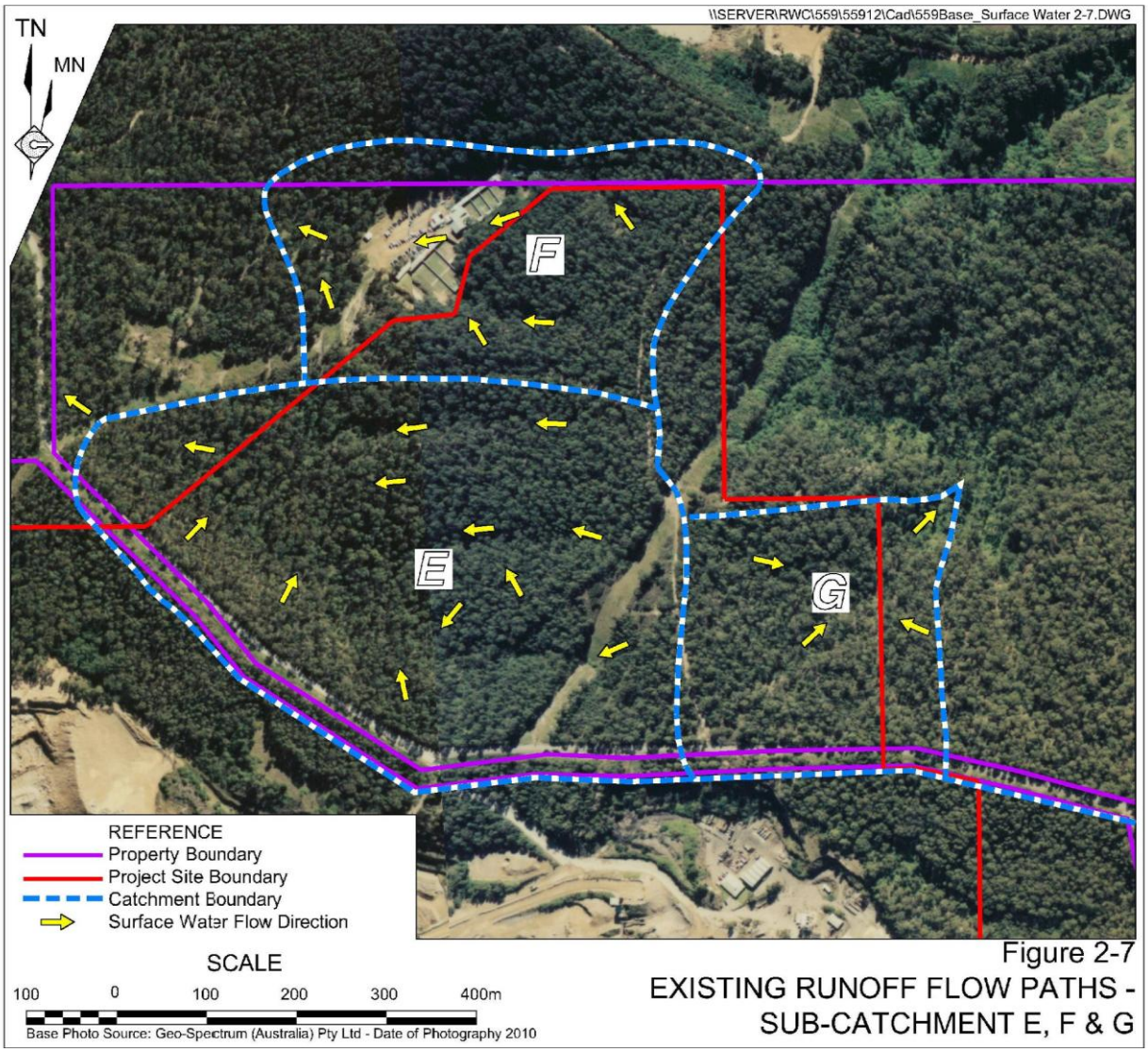


Figure 2-7
EXISTING RUNOFF FLOW PATHS - SUB-CATCHMENT E, F & G

The land within Sub-catchment E falls from the eastern ridge and Rhondda Rd to several gullies. Surface runoff within this sub-catchment collects in these gullies, forming ephemeral watercourses which merge and drain off site to the west. The gullies do not display any substantive bed and bank development reflecting the limited flow conveyed in the gullies. The surface water flow paths are outlined in **Figure 2-7**.

2.3.6 Sub-catchment F (Northern Extent)

Sub-catchment F is located at the northern extent of the Project Site and contains approximately one half of the proposed Northern Extension, as shown in **Figure 2-7**. The sub-catchment is predominantly undisturbed bushland and also includes the area used by the Newtech Pistol Club.

Surface runoff within this sub-catchment drains to the west as sheet flow. The main surface water flow paths are shown in **Figure 2-7**.

2.3.7 Sub-catchment G (Northeastern Extent)

Sub-catchment G is located in the northeastern section of the Project Site and contains the eastern side of the existing Mid Pit Extraction Area, as shown in **Figure 2-7**. The catchment is predominantly undisturbed bushland but also contains a cleared power transmission line easement and an unsealed access track along the western ridge.

Surface runoff within this sub-catchment collects in several gullies forming ephemeral watercourses which merge and drain off site to the east. The gullies do not display any substantive bed and bank development reflecting the limited flow conveyed in the gullies. The surface water flow paths are outlined in **Figure 2-7**.

3. SITE WATER MANAGEMENT

3.1 OVERVIEW

The following sections outline the current and proposed site water management. The overall site water management of the existing Southern Extraction Area is illustrated below in **Figure 3-1**. Details of the current on-site storages as provided by Metromix are listed in **Table 3-1**.

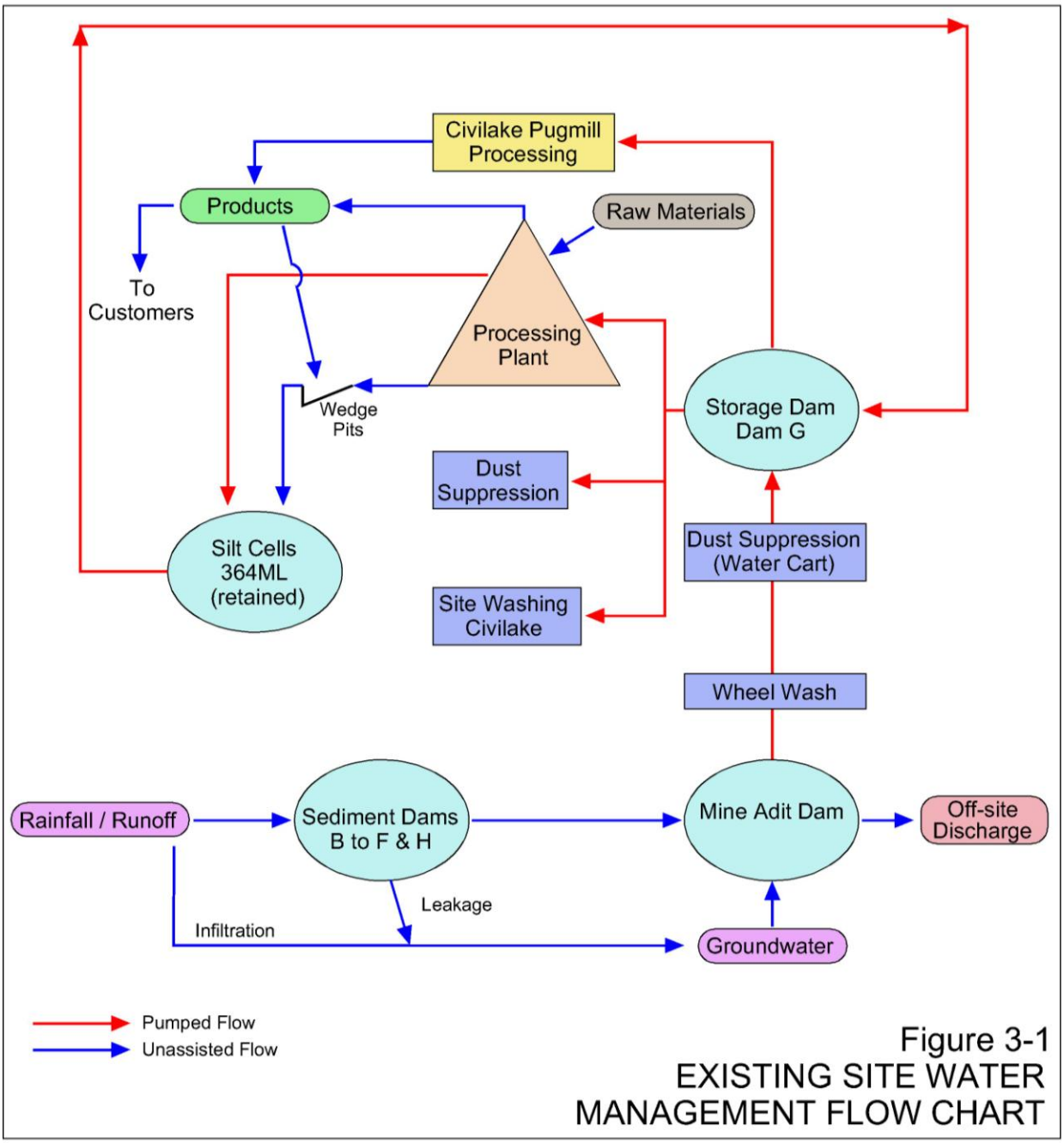


Figure 3-1
EXISTING SITE WATER MANAGEMENT FLOW CHART

Table 3-1
On-site Storage Details

Storage	Description	Volume (m^3)	Surface Area (m^2)
the Mine Adit Dam	Flooded Mine Adit	1 200	400
Dam B	Final Sediment Dam	300	200
Dam C	Vegetated Sediment Dam	300	200
Dam D	Vegetated Sediment Dam	14 500	3 625
Dam E	Reed Bed Sediment Dam	9 000	3 000
Dam F	Stockpile Sediment Dam	700	230
Dam G	Lined Process Water Storage Dam	10 800	2 700
Dam H	Initial Sediment Dam	4 300	1 440

3.2 WATER SUPPLY

Metromix sources potable water directly from the local water mains. Non-potable water is currently sourced from the Mine Adit Dam, a dam located at the exit from a discussed flooded mine adit shown in **Plate 3-1,** which receives predominantly groundwater via the mine adit and small quantities of surface water from the train of sediment dams. The minor surface water flows that are currently entering the Mine Adit Dam would soon be diverted around the Mine Adit Dam. Metromix will continue to source its non-potable water requirements from the Mine Adit Dam in addition to the process water silt dams to be constructed in late 2011 as outlined in Sections 3.4 to 3.5.

Metromix proposes to construct a diversion drain to convey the Dam B overflow directly to the downstream unnamed tributary of Cockle Creek, bypassing the Mine Adit Dam. With the construction of this diversion drain the Mine Adit Dam will be supplied solely by groundwater.

Water continues to be pumped from the Mine Adit Dam to Dam G located near the processing plant. Dam G acts as a storage dam prior to pumping water to the various quarry water use activities, shown in **Plate 3-2**.

Plate 3-1 Mine Adit Dam Pumping Station

Plate 3-2 Dam G

Metromix has indicated that the Mine Adit Dam is a reliable water source, producing sufficient quantities of water for their operations. Coal & Allied Industries Limited has provided daily flow records for the weir downstream of the Mine Adit Dam for the period of July 2000 – November 2008. During this period, there were only five separate periods during which no flow was recorded for seven or more consecutive days.

Metromix has recognised that improving current water use may also assist in managing potential water shortages in the future. From late 2011, Metromix will direct all process waste water to a series of silt cells located in the existing Southern Extraction area. These silt cells will be used to settle suspended solids prior to pumping the treated water to Dam G for re-use on site. The water re-use will reduce the water demand from the Mine Adit Dam.

3.3 SITE WATER USAGE

Metromix requires non-potable water primarily for washing the extracted raw feed as well as dust control and wheel washes. In addition, the Civilake pugmill also requires a smaller volume of non-potable water to add moisture to its products. Potable water from the local water mains is used on site by Metromix for amenities, drinking water and washing of equipment and road trucks. Potable water is also supplied to the asphalt plant for similar purposes. The proposed volumes of water used on site as estimated by Metromix are provided in **Table 3-2**.

Table 3-2
Proposed Site Water Demands

Supply	Water Uses	Proposed Estimated Volume (ML/yr)
POTABLE WATER		
Metromix	Amenities, drinking water, equipment and truck washing	5.7
Downer EDI Asphalt Plant	As above	2.8
Civilake Pugmill	Nil supplied by Metromix	-
Potable Water Total		8.5
NON - POTABLE WATER		
Metromix	Raw Feed Washing Dust Suppression Wheel wash	1 243 20 24
Downer EDI Asphalt Plant	nil	-
Civilake Pugmill	Processing Site Washing	4 1
Non-Potable Water Total		1 292

The ongoing use/requirement for non-potable water would reflect the annual quantity of extracted conglomerate that is washed and screened in processing plant.

Metromix estimates the water usage for processing would average approximately 1 243ML/yr. Due to the increase in exposed surface area, Metromix anticipates the dust suppression water demand would increase to 20ML/yr. With additional truck washing stations proposed, Metromix expects the wheel wash water demand to increase to 24ML/yr. Overall, based on the volumes listed in **Table 3-2**, the use of non-potable water would be approximately 1 292ML per year of which Metromix estimate approximately 70% would be recycled water through the on-site silt cells.

3.4 WASTE WATER MANAGEMENT

Waste water from site amenities is collected in a single septic tank on site. The non-potable and potable water used by Metromix and the Civilake pugmill for dust suppression, wheel, vehicle and equipment washing all drains to the sediment dams on site as overland flow. The non-potable water used by the pugmill remains in the products produced and no waste water is produced.

The waste water or slurry produced within the processing plant, containing approximately 9% solids, is collected in two collection tanks, as shown in **Plate 3-3**, from which it is currently pumped directly into the voids in the Great Northern Coal Seam directly beneath the extraction area. Metromix will cease this practice from late 2011 and direct all waste water or slurry to a series of silt cells constructed on the southern side of the existing Southern Extraction Area. The small proportion of the water which is not captured by the collection tanks, any overflow, and rainfall runoff around the processing plant would continue to drain to a small collection dam, as shown in **Plate 3-3**. The collected water would be pumped to Dam G for re-use through the plant.

Plate 3-3 Process Waste Water Collection Tanks and Dam

3.5 PROCESS WATER MANAGEMENT

Metromix proposes to recirculate as much water as possible throughout the ongoing operations of the processing plant, i.e. through recovering as much of the water as possible from the waste water or slurry pumped to the silt cells.

Either two or three silt cells would be in use at any one time with the supernatant (surface) water within each cell flowing to the next such that the water pumped from the final cell back to Dam G would be almost free of suspended solids. Metromix anticipates that approximately 70% of the waste water or slurry would be recovered from the silt cells.

Make-up water for processing would continue to be sourced from the Mine Adit Dam at the exit from the flooded mine adit by a single 98L/s pump operating on water level sensors at the Mine Adit Dam and the lined storage dam, Dam G. When the Metromix wet processing is underway, water from Dam G would be transferred to the processing plant by a 140L/s pump with waste water or slurry pumped to the silt cells at a rate of 111L/s. The pugmill would continue to source water from Dam G using a separate smaller pump and pipeline.

3.6 SPILL CONTAINMENT

The site contains a bunded fuel bay incorporating one 15 800L and one 27 400L diesel fuel tank. 20L and 205L oil drums are also stored in a neighbouring bunded shed. The bunded areas are shown in **Plate 3.4**. Both bunded areas lie adjacent to Dam H. A spill containment kit is present on site in the nearby workshop. Metromix would prepare a spill management plan.

Metromix and Downer EDI Asphalt Plant has been provided as **Appendix 3**.

Plate 3-4 Bunded Fuel Bay and Oil Drums Shed

3.7 EROSION AND SEDIMENT CONTROL

The main erosion and sediment control measures on site are sediment dams as discussed in **Section 4**. The sediment dams are regularly inspected. Dam H is regularly cleaned out whilst sections of Dam E are cleaned out every 2 or 3 years. Metromix representatives have observed that many of the sediment dams on site are in fact "leaky". The dams are often comparatively dry after only a few weeks of substantial rainfall (Bill Sanderson, pers comm). The Company has undertaken a great deal of treatment to limit the leakage from the water storage dam (Dam G). An important consequence of the leaky nature of the ground surface and sediment dams within the Project Site is that surface runoff into and from Dam B is a comparatively rare occurrence as it only occurs following substantial rainfall events, according to Metromix.

As vegetated areas are cleared, vegetation is pushed to the down-slope side of the cleared area and temporarily stockpiled acting as a sediment barrier. Reliance is placed upon collection and diversion drains on the edges of internal haul roads.

Given rainfall and runoff infiltrates quickly on site, Metromix has not found it necessary to install sediment fences, diversion drains and turbidity barriers within or surrounding the active extraction areas.

As no regular water quality monitoring is undertaken on site, the effectiveness of the on-site erosion and sediment control works cannot be assessed. The proposed surface water monitoring program is provided as **Appendix 2**. The quality of the site discharge from the Mine Adit Dam is currently monitored by Coal & Allied Industries Limited in accordance with its Environment Protection Licence as discussed in **Appendix 1**. It is noted that this quality has periodically been a combination of the mine adit discharge and sediment dam discharge although this practice will soon cease as the diversion drain is constructed from Dam B to the nearby creek system.

BMT WBM representatives have inspected the sediment dams over a number of site visits since 2004. Observed changes in turbidity, algae growth and vegetation growth have been evident. The observed changes over time in the final downstream sediment dam (Dam B) are illustrated in **Plate 3-5**. The total rainfall in the preceding 7 days recorded at the Bureau of Metrology Lake Macquarie (Cooranbong) weather station has also been provided.

26/11/2008
(rainfall data not available)

19/10/2010
(3.8 mm rainfall in preceding 7 days)

02/05/2011
(48 mm rainfall in preceding 7 days)

31/08/2011
(0.6 mm rainfall in preceding 7 days)

Plate 3-5 Final Sediment Dam (Dam B) Observations

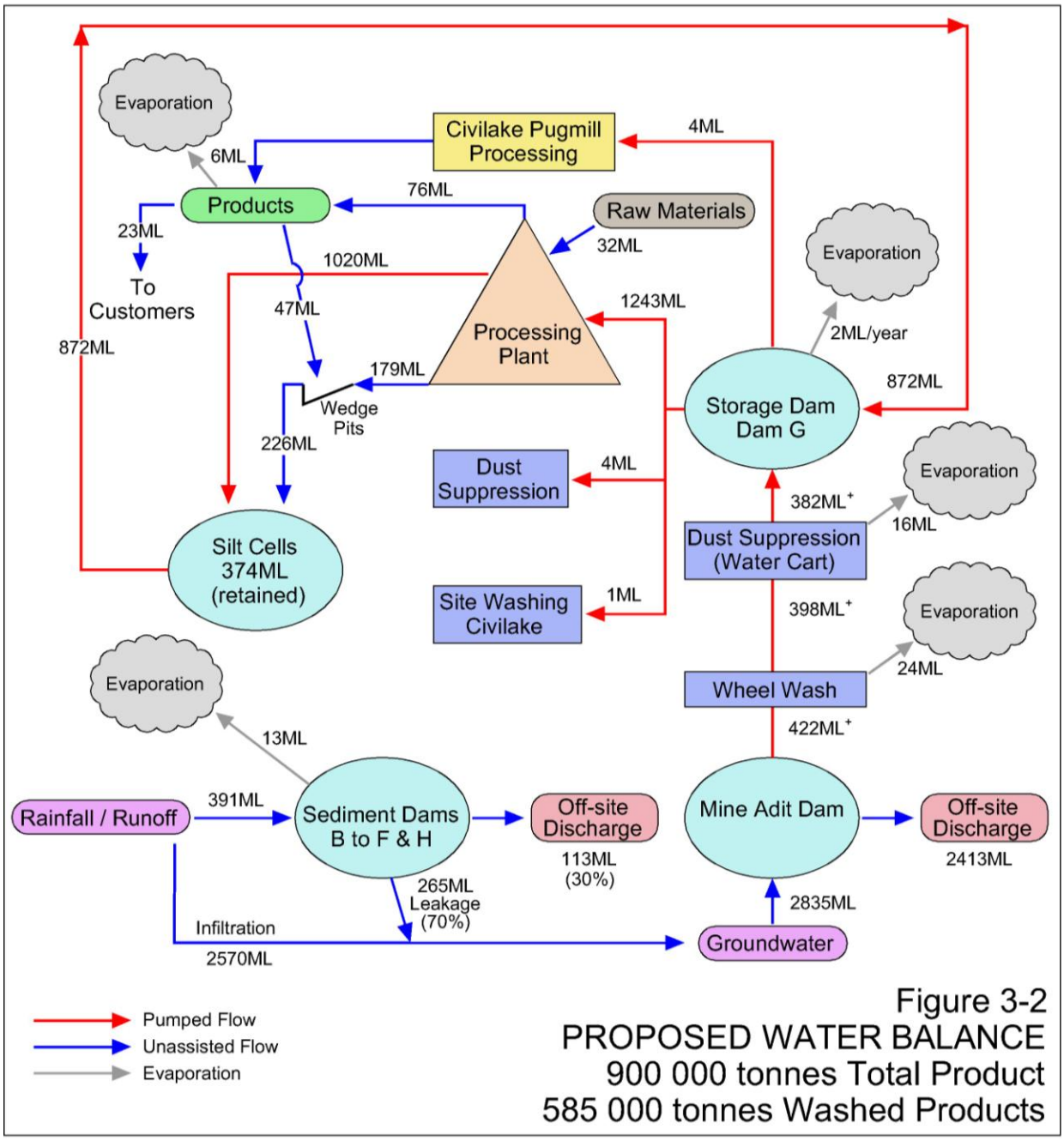
The key erosion and sediment control near the main entrance to Teralba Quarry from Rhondda Road is the sealing of the road and roadside drainage. This is particularly effective given the steep nature of the entrance road. Works commenced within the Mid Pit Extraction Area in October 2010 with access achieved by a second access point off Rhondda Road. A truck wash has been installed at the access point where waste water is collected in two staged sediment dams before discharging off site. The waste water volumes generated by the truck wash along with the sizing of the sediment dams are comparatively minor and there will be emphasis upon recycling.

Erosion and sediment controls are further discussed in Section 5.4. Recommended minimum design criteria along with preliminary volume calculations for sedimentation dams have also been provided.

The historical off-site discharge from the Mine Adit Dam is discussed further in **Appendix 1**. The historical water quality and quantity has been reviewed in light of the existing Environment Protection Licence 3139 (currently held by Coal & Allied Industries Limited).

3.8 PROPOSED SITE WATER BALANCE

The site water balance for the proposed quarry operations (for the proposed quarry extensions) is presented in **Figure 3-2**. Annual site water flows for the processing plant as estimated by Metromix are summarised in **Table 3-3**.



It is important to recognise that a significant proportion of the water used in processing (68%) would be re-circulated through the silt cells.

Table 3-3
Proposed Extension - Water Balance Flows

Water Use	Flow Rate ML/yr	Notes
Processing Plant **- Inflows** **Raw Material Moisture Content**	32	Assuming an average raw material extraction of 952 650t/yr, 65% wet processed (637 650t/yr) at 5% moisture by weight. (Note: 952 650t derived from 65% of 900 000t x 1.09 = 637 650t 35% of 900 000t = 315 000t)
Process Water Demand	1 243	Water demand estimated at 2kL/t (for 637 650t) minus product moisture content (32ML).
Process waste water (slurry)	1020	Estimated at 80% of water used in plant i.e. 0.8 x 1 275ML.
- Outflows **Final Product Moisture Content**	76	Water in products placed in stockpile = 13%, i.e. 585 000t x 0.13 = 76ML
Moisture in products to customers	23	Estimate based on 4% moisture in 585 000t of products = 585 000t x 0.04 = 23ML
Seepage from stockpiled products	47	Estimate based on moisture in products to stockpiles (76ML) less moisture in products to customers (23ML) less estimated evaporation (6ML) = 47ML
Incidental losses	179	Losses around processing plant = 1 275ML less moisture in products to stockpiles (76ML) and less processing waste water 1 020ML = 179ML.
Other Site Water Demands **Dust Suppression** **Wheel Washes**	 20 24	Estimates based on current uses by Metromix
Water retained in silts	374	Assumed to be 30% of the waste water or slurry produced in the washing process (1 020ML) and inflow from the wedge pit (226ML)
Silt Dam Recovery	872	Assumed to be 70% of the waste water or slurry produced in the washing process (1 020ML) and inflow from wedge pit (226ML)
Evaporation **Dam G** **Sediment Dams** **Products**	 2 13 6	Estimate for dams based on the surface area, annual average daily evaporation for the Williamtown RAAF weather station (no. 061078) and applying an adjustment factor for water bodies of 0.75. Estimates of water evaporated from products based on estimated 8% loss (based on site observations of runoff to the wedge pits).

3.8.1 Stormwater Flows

The volume of stormwater runoff from the combined existing Southern Extraction Area and proposed Southern Extension which may ultimately drain to the existing series of sediment dams has been estimated. Annual rainfall runoff was estimated using the daily rainfall data recorded on site by Metromix since 01/01/1997. Rainfall runoff was estimated on a daily time step using the USDA Urban Hydrology for Small Watersheds TR-55 model, relying on the 'curve number' method. The model was selected as there was insufficient data available for the calibration of a first-order rainfall runoff model.

Rainfall runoff over each sub-catchment area was estimated by defining a curve number based on the hydrologic soil group present, cover, treatment and hydrological conditions. According to the soil and land capability assessment completed by GSS Environmental, the most common soil landscape present in the site is Gateshead. Based on the Blue Book (Landcom, 2004) this landscape is soil hydrologic ground C. Consequently, the curve numbers applied were 91 for cleared areas/bare soil and 70 for undisturbed bush areas. Using the curve number method, the volumetric runoff coefficient varies according to rainfall depth.

The average annual runoff was estimated to be 391ML/yr from the combined existing Southern Extraction Area and proposed Southern Extension. This is a conservative estimate of the rainfall runoff generated by the catchment area and does not account for additional water inputs from site water use or losses due to evaporation or seepage from the sediment dams.

As Metromix do not observe runoff discharging from Dam B, the final downstream sediment dam, they consider the above to be an overestimate.

4. EXISTING SURFACE WATER MANAGEMENT

This section reviews the existing surface water management practices across the Project Site principally to provide an appreciation of the controls that have been used to date to effectively manage sediment-laden water on site. Where appropriate, these practices would continue to be adopted throughout the ongoing operation of the quarry – see Section 5. The current surface water management practices have been implemented in accordance with the Company's 2007 Site Water Management Plan (GHD, 2007).

Surface water runoff over the existing Southern Extraction Area results from substantial rainfall events as well as overflow from the processing operations. Surface water runoff is currently managed by infiltration, evaporation and a series of sediment dams. It remains an important attribute of the Project Site that a significant proportion of surface water runoff across the Project Site infiltrates due to the highly permeable and fractured ground surface.

As described in Section 2.1, the existing Southern Extraction Area is located within Sub-catchments A, B and C with the existing Mid Pit Extraction Area is located largely within Sub-catchments E and G. The following sections outline the current surface water management for each of these sub-catchment areas.

4.1 SUB-CATCHMENT A

Sub-catchment A covers the eastern side of the existing Southern Extraction Area to the eastern border of the Project Site, as shown in **Figure 2-4**. Sub-catchment A also covers approximately one half of the proposed Southern Extraction Area. The sub-catchment area includes the processing plant, Downer EDI Asphalt Plant, Metromix office and weighbridge, stockpiles, haul roads, undisturbed bushland and sediment dams. Surface water runoff within Sub-catchment A currently results from process water overflow within and around the processing plant as well as substantial rainfall events.

Surface runoff within this sub-catchment flows to Dam B via a series of formalised drainage paths and sediment dams as shown in **Plate 4-1** to **Plate 4-4**. The series of sediment dams aim to reduce suspended solids concentration and encourage infiltration. The dams, particularly Dam B are all known to leak a considerable quantity of water as Metromix personnel regularly observe substantial drops in water levels in a matter of days from the dams.

Plate 4-1 Dam H – Initial Sediment Dam

Plate 4-2 Dam D – A Leaky Sediment Dam

Plate 4-3 Dam E – Vegetated Dam

Plate 4-4 Dam B – Final Sediment Dam

During and/or following periods of substantial rainfall, excess flow from Dam B drains via a pipe to the Mine Adit Dam, a dam located at the exit from a discussed flooded mine adit. Excess flow from the Mine Adit Dam drains off site to an unnamed creek draining to Cockle Creek.

Metromix proposes to construct a diversion drain to convey the Dam B overflow directly to the downstream unnamed watercourse, bypassing the Mine Adit Dam.

Discharge off site from the Mine Adit Dam is monitored monthly by Coal & Allied Industries Limited (the owners of Rhondda Colliery) in accordance with its Environment Protection Licence 3139 as discussed in **Appendix 1**.

The processing plant sources its water from the nearby Dam G. Water draining from the processing plant flows to a small collection dam, as shown in **Plate 4.5** and then to a sediment dam (Dam H) via a concrete pipe. In late 2011, Metromix proposes to block the concrete pipe to Dam H and construct a wedge pit at the small collection dam. The collected water would then be pumped to the silt cells to settle suspended solids and then for re-use on site via pumping to Dam G.

From Dam H, water currently flows in an easterly direction through subsequent vegetated detention dams, Dams E, D, C and B via culverts, weirs and risers.

The asphalt plant lies in a depression, being surrounded by steep batters from previous extraction activities. Surface water runoff from the asphalt plant area, which includes undisturbed bushland to the north and the adjacent haul road to the south, is collected in a central silt trap. Water discharges from the silt trap via a pipeline and asphalt lined drain to the collection dam at the processing plant.

Surface water runoff from the eastern stockpile area drains southwards via a chute to Dam F. Excess flow from Dam F drains south to Dam E as sheet flow. Dam D also receives surface runoff from Sub-catchment D via an ephemeral creek.

Plate 4-5 Collection Dam adjacent to the Processing Plant

4.2 SUB-CATCHMENT B

Sub-catchment Area B encompasses the current active extraction area within the Southern Extraction Area and features haul roads, a detention dam, an old extraction pit and the principal water storage dam (Dam G).

Surface water runoff within this sub-catchment flows to numerous low points, where ponding and infiltration occurs. The majority of surface water infiltrates through the floor of the extraction area in all but the most extreme rainfall events due to the highly permeable and fractured ground surface.

A small amount of runoff from the haul road is directed southwards towards a detention dam (location 1) and an old extraction pit (location 2) as shown in **Figure 2-4**. A small amount of runoff from the surrounding rock escarpment drains directly into Dam G.

It is understood that the low points within the sub-catchment enable sufficient ponding to accommodate storage of large rainfall events although, in reality, the ponding does not persist for long as it soon infiltrates through the floor of the extraction area.

4.3 SUB-CATCHMENT C

Sub-catchment Area C is located along the northern boundary of the existing Southern Extraction Area, encompassing the Civilake pugmill as shown in **Figure 2-5**. The pugmill utilises water sourced from Dam G.

In the vicinity of the pugmill, surface runoff from the internal haul road, stockpiles and steep rocky escarpment to the north drains to a storage dam (location 3) for infiltration/evaporation.

Surface water runoff from the remainder of the sub-catchment area, being undisturbed bushland, is diverted around the existing Southern Extraction Area to the west and off site via a gully. The southern side of the gully comprises stockpiled overburden from the quarry. The controls needed to manage the exposed overburden in close proximity to a watercourse that discharges off site are discussed further in Section 5.

It is understood that during large rainfall events, the majority of surface water runoff discharges off site via the gully.

4.4 SUB-CATCHMENTS E & G

Works commenced within the existing Mid Pit Extraction Area in October 2010. A truck wash has been installed at the exit of the area where waste water is collected in two staged sediment dams before discharging off site as shown in **Plate 4-6**.

Bushland areas have been cleared with vegetation pushed to the down-slope side of the cleared area and temporarily stockpiled to act as a sediment barrier.

Stockpiles are also present in the area.

Plate 4-6 Truck Wash Sediment Dams – North of Rhondda Road

5. POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

5.1 OVERVIEW

Both site clearing and general quarry operations have the potential to impact surface water quantity and quality by altering flow regimes and increasing erosion and sedimentation.

Activities potentially influencing surface water impacts include:

- vegetation clearing;
- topsoil and subsoil removal; and
- overburden removal.

Quarry operations potentially influencing surface water impacts include:

- conglomerate extraction;
- hauling extracted raw feed;
- processing and stockpiling;
- hydrocarbon management; and
- overburden and waste management.

The anticipated impacts on surface water during the remainder of existing quarry operations (existing Southern and Mid Pit Extraction Area) and the proposed Northern and Southern Extensions are described in more detail in the following sub-sections along with a description of the mitigation measures proposed to manage these impacts.

The existing and proposed quarry operations have the potential to adversely impact the immediate downstream environments and ultimately Lake Macquarie due to the following changes in the discharge surface water quality and flow regime.

- Increasing the suspended solids concentration resulting in reduced water quality and sediment deposition in waterways. These adverse impacts may be further exacerbated by the reduced runoff off site outlined below. Sediments may be mobilised on site as a result of the activities and quarry operations outlined above. Metromix currently utilise a train of sediment dams to collect, detain and treat runoff prior to the off-site discharge point as outlined in Section 4. The immediate downstream environment from the Mine Adit Dam is heavily vegetated with a large ponding area which is expected to further improve the surface water quality before discharging to Lake Macquarie. This approach is to continue for the proposed extensions. Soils and stockpiles around the site should be managed in accordance with the Blue Book (Landcom, 2004) guidelines for erosion and sediment control.
- Discharging pollutants such as hydrocarbons to the waterways. Metromix currently stores fuel and oil drums in bunded areas and a spill containment kit is present on site as outlined in Section 3.6. This approach should continue for the proposed extensions. In addition, Metromix will prepare a spill management plan.

- Reduced runoff off site. The quarry operations collect and store rainfall runoff in the extraction pits and sediment dams for pollution control which ultimately encourages evaporation and infiltration reducing runoff to the downstream environment. The ongoing operations will further expand the footprint of the operations and therefore further reduce runoff to the downstream environment. As only ephemeral creeks are present in the Mid Pit Extraction Area and proposed Northern Extension (located along a ridge line) the impact on the downstream environment is not expected to be significant. A reduction in surface water runoff to the Mine Adit Dam is expected as a result of the diversion of runoff from Dam B. However, as discharge from the Mine Adit Dam will be predominately groundwater, the impact to the immediate downstream environment is not expected to be significant.

The effectiveness of these approaches to manage impacts of the quarry operations will be measured by the proposed surface water monitoring program outlined in **Appendix 2**. With the adoption of appropriate controls and safeguards, the quarry operations are not expected to have a significant impact on Lake Macquarie as a whole or upon the wetland environment at the Murph's drain outlet to Cockle Creek.

5.2 EXISTING OPERATIONS

5.2.1 Southern Extraction Area

The ongoing extraction activities within the existing Southern Extraction Area would continue to increase infiltration rates across Sub-catchment B as the conglomerate rock is removed. However, infiltration volumes are not expected to significantly increase as the majority of runoff is currently detained and infiltrated within the sub-catchment area.

5.2.2 Mid Pit Extraction Area

The ongoing extraction activities within the existing Mid Pit Extraction Area have the potential to increase infiltration rates as more permeable conglomerate rock is exposed and runoff is largely detained on site. As a result, the volume of rainfall runoff draining off site from Sub-catchments E and F would be reduced.

The ongoing removal of vegetation would reduce evapotranspiration and the removal of topsoil, subsoil and overburden would reduce the soil moisture storage capacity. An increase in deep infiltration is expected as the rainfall runoff is contained within the operational area and is allowed to infiltrate through the floor of the extraction area. Increased runoff volumes are expected from compacted areas, however, such areas would be minimal.

The ongoing removal of vegetation from the Mid Pit Extraction Area would expose soils to potential erosion during rainfall events. If left unmitigated, there is the potential for overburden material to be eroded and deposited in the downstream water bodies draining off site. To address the potential for elevated sediment loads in rainfall runoff resulting from site clearing, all clearing would be conducted and monitored in accordance with the Blue Book (Landcom, 2004) guidelines for erosion and sediment control.

During all stages of extraction within the Mid Pit Extraction Area, sufficient storage should be available to prevent discharge off site of sediment-laden water in accordance with the Blue Book (Landcom, 2004) guidelines. Sediment dams should be managed and monitored to ensure they do not become overloaded with sediment. Recommended minimum design criteria along with preliminary volume calculations for sedimentation dams and internal storages are provided in Section 5.4.

All erosion and sediment control mitigation measures would be monitored and reviewed as part of a regular site monitoring program.

5.2.3 Civilake Pugmill Area

Runoff from the Civilake pugmill area is collected in a small storage dam for infiltration/evaporation. The edge of the overburden storage area, located near the Civilake pugmill (location 4 in **Figure 2-7**), is exposed and forms part of a gully. This gully is responsible for diverting runoff off site from the undisturbed bushland of Sub-catchment C. The exposed overburden has the potential to contribute to the sediment load discharging off site.

Where possible, runoff from the sub-catchment should be directed towards the processing plant or the Southern Extraction Area – to avoid flowing off site via the Sub-catchment C diversion gully.

5.2.4 Downer EDI Asphalt Plant

As discussed in **Section 4.1**, runoff from the asphalt plant is collected in a silt trap prior to draining to the processing plant. It is important that the floating booms are regularly replaced to prevent hydrocarbons from exiting the site via surface water flows. Overflow from the silt trap eventually discharges into Dam H, which historically requires cleaning out 1 or 2 times per year.

5.3 PROPOSED EXTENSIONS

5.3.1 General

The removal of vegetation would reduce evapotranspiration and the removal of topsoil, subsoil and overburden would reduce the soil moisture storage capacity. An increase in deep infiltration is expected on uncompacted areas as rainfall runoff is largely contained within operational areas. Increased runoff volumes are expected from compacted areas, however, such areas would be minimal.

The initial removal of vegetation would expose soils to potential erosion during rainfall events. If left unmitigated, there is the potential for overburden material to be eroded and deposited in the downstream water bodies draining off site. To address the potential for elevated sediment loads in rainfall runoff resulting from site clearing, all clearing should be conducted and monitored in accordance with the Blue Book (Landcom, 2004) guidelines for erosion and sediment control.

During all stages, sufficient storage should be available within the Project Site to prevent discharge off site of sediment-laden water in accordance with the Blue Book (Landcom, 2004) guidelines. Storages are to be managed and monitored to ensure they do not become overloaded with sediment. Recommended minimum design criteria along with preliminary volume calculations for sediment dams and internal storages are provided in Section 5.4. Standard erosion and sediment control drawings are provided in **Appendix 4**.

As runoff is largely detained on site, the increased surface area of the proposed extensions would increase the volume of groundwater infiltration. As a result, the volume of rainfall runoff draining off site from sub-catchments A, C, D, E and F will be reduced.

The current Site Water Management Plan (GHD, 2007) would be updated to take into account the proposed Northern and Southern Extensions following the approval of the quarry extensions.

All erosion and sediment control mitigation measures should be monitored and reviewed as part of a regular site monitoring program.

5.3.2 Southern Extension

The Southern Extension will increase the volume of ground infiltration. The surface area of the existing Southern Extraction Area will increase as the current ridge between Sub-catchment A and Sub-catchment D is extracted. As a result, the volume of rainfall runoff draining to the Sub-catchment A sediment dams will be reduced.

Surface water runoff within the proposed Southern Extension would be detained and infiltrated through the conglomerate in a manner similar to the existing Southern Extraction Area. During all stages of the Southern Extension, sufficient storage will be available within the quarry area to prevent discharge off site of sediment-laden water in accordance with the Blue Book (Landcom, 2004) guidelines for sediment dams. Sediment dams are to be managed and monitored to ensure they do not become overloaded with sediment.

5.3.3 Northern Extension

Several small catchment areas of undisturbed bushland drain towards the proposed Northern Extraction Area. Runoff from these catchments should be collected and diverted around the extraction areas by temporary diversions drains/bunds in accordance with the Blue Book (Landcom, 2004) guidelines for erosion and sediment control. Temporary diversion drains/bunds should incorporate energy dissipation and erosion protection measures.

5.4 RECOMMENDED EROSION AND SEDIMENT CONTROLS

5.4.1 Overview

Erosion and sediment control measures are to be designed, constructed and managed in accordance with the ‘Blue Book’ – Managing Urban Stormwater Volume 1 (Landcom, 2004) and Volume 2E Mines and Quarries (DECC, 2008). The recommended minimum design criteria for temporary erosion and sediment control measures are provided in **Table 5-1**. Standard erosion and sediment control drawings have also been provided in **Appendix 4**.

Table 5-1
Recommended Minimum Design Criteria

Temporary Erosion and Sediment Control Measure	Minimum Design Criteria
Duration of disturbance	> 3 yrs
Sensitivity of receiving environment	Standard
Temporary drainage (erosion) controls[1]	
• designed to have a non-erosive capacity to convey	20 yrs ARI
Temporary sediment control measures[2]	
• designed to have a non-erosive capacity to convey	20 yrs ARI
Type C Sediment Dam	
• designed to achieve water quality for flows up to:	1 yr ARI
• embankment and spillway designed to be structurally sound in: [3]	50 yrs ARI
Type F or D Sediment Dam	
• designed to achieve required water quality for storms up to nominated five-day duration percentile event:	90th
• embankment and spillway design to be structurally sound in: [3]	50 yrs ARI
Maximum overflow frequency for internal storages	2 spills/year

[1] e.g. diversions banks, perimeter banks, catch drains, level spreaders, check dams, batter drains and chutes.
[2] e.g. sediment fences, stacked rock sediment traps etc. on small catchments where used as a 'last line of defence' (i.e. without a down-slope sediment dam).
[3] Indicative only. The risk of dam failure is to be considered in determining the spillway design flow.

5.4.2 Sediment Dam Design

The design of sediment dams is based on the sediment type (C, D or F) of the soils present in the disturbed catchment area. The soil landscapes within the Project Site and surrounding land has been mapped at 1:100 000 scale by Matthei (1995) as follows.

- The area to the north, west and south are mapped as Gateshead with Stockrington variant to the east and northeast.
- Killingworth soils are located to the south.
- Warners Bay to the northeast.
- Doyalson to the northwest.

According to the Blue Book, the sediment type varies for these soil landscapes - and as such the sediment dams should be designed to meet the most stringent criterion applicable, in this case Type D.

The sediment dam volume is taken to be the sum of the settling zone and sediment storage zone. Where a sediment dam is also to be used as storage for on-site reuse, the total volume is to equal the sum of the settling zone, sediment storage zone and the capacity required for water reuse. Consideration must also be given to additional runoff generated by on-site water use - such as processing and wheel washes.

5.4.3 Preliminary Sediment Dam Volumes

Preliminary sediment dam volumes have been estimated based on the Blue Book approach for Type D soils and the minimum design criteria outlined in **Table 5-1**. Sediment dam volumes have been estimated for the following sub-catchment areas, which differ to those outlined in Section 2, as they are bound by the disturbed catchment areas and not the project boundaries:

Existing Sub-catchments:

- Southern Extraction Pit (Sub-catchment B)
- Southern Sediment Dams (Sub-catchments A and D)
- Mid Pit Extraction Area (portions of Sub-catchments E and G, limited to the Extraction Area)

Proposed Sub-catchments:

- Southern Extraction Pit
- Southern Sediment Dams
- Northern Extension Area

The settling zone volume has been designed to contain the 5 day, 90th percentile rainfall depth of 51.8mm (Newcastle). The settling zone volume has been estimated based on the following.

- Soil hydrologic group C based on GSS Environmental stating Gateshead as the most common soil landscape present across the Project Site.
- Volumetric runoff coefficient (C_v) of 0.18-0.59 estimated according to USDA curve number method, based on the design rainfall depth and soil hydrologic group. The C_v varied according to the catchment areas and curve number. Based on this soil hydrologic group, the curve numbers applied were 91 for cleared areas/bare soil including the Southern, Mid Pit and Northern extraction pit sub-catchments. A curve number of 70 has been applied to undisturbed bush areas, giving the southern sediment dams sub-catchment a curve number of 74.1.

The sediment storage zone volume has been estimated as the two months soil loss calculated with RUSLE (Revised Universal Soil Loss Equation), based on the following.

- Soil Erodibility (K-Factor) of 0.05 based on Blue Book V2E in the absence of site specific soil data.
- 2 year, 6 hour ARI Rainfall Event Depth of 11.1mm based on the location, calculated according to Australian Rainfall and Runoff (Inst. of Eng. Aus., 2001).
- Rainfall Erosivity (R-Factor) of 2672 based on the above, calculated according to the Blue Book V1.
- Slope Gradient of 10% and slope length of 80m assumed in the absence of site specific data.
- Slope length/gradient (LS Factor) of 2.81 based on the above, calculated according to the Blue Book V1.

The sediment dam volume is taken to be the sum of the settling zone and sediment storage zone. Preliminary estimates of sediment dam volumes for each extraction area are provided in **Table 5-2**.

Table 5-2
Preliminary Sediment Dam Volumes

Sub-catchment	Disturbed Catchment Area (ha)	Total Catchment Area (ha)	Sediment Dam Volume (ML)
EXISTING SUB-CATCHMENTS			
Southern Extraction Pit	26.85	26.85	9.92
Southern Sediment Dams	15.70	95.21	9.88
Mid Pit Extraction Area	7.42	7.42	2.74
PROPOSED SUB-CATCHMENTS			
Southern Extraction Pit	43.27	43.27	15.99
Southern Sediment Dams	15.70	80.50	8.51
Northern Extension	9.10	9.10	3.36

5.5 MITIGATION MEASURES SUMMARY

The potential surface water impacts of the proposed Northern and Southern Extensions can be mitigated by:

- updating the current Site Water Management Plan (GHD, 2007) to take into account the proposed Northern and Southern Extensions;
- ensuring any off-site discharge is monitored and reported in accordance with an Environment Protection Licence;
- establishing a regular monitoring program to review all erosion and sediment control mitigation measures;
- conducting initial site clearing in accordance with the Blue Book (Landcom, 2004) guidelines for erosion and sediment control;
- constructing and maintaining temporary diversion drains/bunds around the perimeters of the extraction areas; and
- providing sufficient storage during all stages of works to prevent discharge off site of sediment-laden water in accordance with the Blue Book (Landcom, 2004) guidelines for sediment retention dams.

6. SUMMARY

Both site clearing and general quarry operations have the potential to impact surface water quantity and quality mainly by altering runoff volumes and increasing erosion and sedimentation. Potential activities of concern regarding surface water include:

- vegetation clearing, topsoil and subsoil removal, and overburden removal during site clearing works; and
- conglomerate extraction, hauling, processing and stockpiling, hydrocarbon management and waste management during quarry operations.

Potential surface water impacts of the proposed Northern and Southern Extensions include:

- erosion and sedimentation of the downstream environment resulting from site clear activities;
- increased ground infiltration on site resulting from site clearing and the collection and storage of runoff; and
- change in runoff volume discharging to the sediment dams.

The potential surface water impacts of the proposed Northern and Southern Extensions can be mitigated by:

- updating the current Site Water Management Plan (GHD, 2007) to take into account the proposed Northern and Southern Extensions;
- ensuring any off-site discharge is monitored and reported in accordance with an environmental protection licence;
- establishing a regular monitoring program to review all erosion and sediment control mitigation measures;
- conducting initial site clearing in accordance with the Blue Book (Landcom, 2004) guidelines for erosion and sediment control;
- constructing and maintaining temporary diversion drains/bunds around the perimeters of the extraction areas; and
- providing sufficient storage during all stages of works to prevent discharge off site of sediment-laden water in accordance with the Blue Book (Landcom, 2004) guidelines for sediment retention dams.

7. REFERENCES

ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000* Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)

AWACS (1995) *Lake Macquarie Estuary Process Study (AWACS Report 94/25)* prepared for Lake Macquarie Council, Australian Water and Coastal Studies Pty Ltd, Manly Vale, NSW Australia, November 1995

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

GHD Pty Ltd (2007) *Teralba Quarry Water Management Plan*, August 2007

Institution of Engineers Australia (2001) *Australian Rainfall & Runoff – a guide to flood estimation*, volume 1 (revised), Institution of Engineers Australia, Barton, ACT

Landcom (2004) *Managing Urban Stormwater: Soils and Construction*, Volume 1, 4th Edition, NSW Government, Sydney, March 2004

Matthei L.E. (1995) *Soil landscapes of the Newcastle 1:100 000 Sheet*, Department of Land and Water Conservation, Sydney.

Appendices

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Appendix 1 Historical Off-site Discharge

Appendix 2 Surface Water Monitoring Program

Appendix 3 Chemical Inventories

Appendix 4 Standard Drawings

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Appendix 1

Historical Off-site Discharge

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Introduction

Surface runoff within the existing Southern Extraction Area is retained and infiltrated on site in a series of sediment dams as described in **Section 4.1**. Excess runoff occurs occasionally and discharges to the Mine Adit Dam, a dam located at the exit from a disused flooded mine adit, from the former Northern Extended Colliery. Excess flow from the Mine Adit Dam discharges off site to an unnamed tributary of Cockle Creek. This tributary is concrete lined through Teralba and is referred to as Murph's Drain.

Discharge from the Metromix site is currently monitored by Coal & Allied Industries Limited at the triple point discharge/data logger downstream of the Mine Adit Dam in accordance with Environment Protection Licence 3139.

The following provides relevant background information and details the requirements of Environment Protection Licence 3139. The historical water quality monitoring results from 1998 to 2011 are also compared against the limits on Environment Protection Licence 3139 and the ANZECC 2000 water quality guidelines.

Background

Discharge from the Metromix site is currently monitored at the triple point discharge/data logger downstream of the Mine Adit Dam. Water quality monitoring has been conducted since September 1998 on a monthly basis in accordance with EPL 3139 as outlined in the following sections.

Discharge from the Mine Adit Dam is largely groundwater since the majority of surface water runoff is retained and infiltrated on site, as described in **Section 4.1**. The local groundwater was influenced over time by the direct discharge of water into the Great Northern Coal Seam (GNCS) at Rhondda Colliery.

Prior to 2007, both salt water, from the tidally influenced Cockle Creek, and waste water has been discharged into a burning coal seam located in Rhondda Colliery immediately west of Teralba Quarry. Waste water included what was generated from the Metromix processing plant as well as from the Edgeworth Waste water Treatment Plant. Discharge of waste water from the Edgeworth Waste water Treatment Plant ceased in 2002.

The Rhondda Colliery coal seam fire was extinguished in late 2006, from which time the discharge of salt water and waste water from the adit ceased.

Since 2006, the waste water or slurry from the Metromix processing plant has been directly injected in the GNCS via a borehole within the floor of the existing Southern Extraction Area. This practice of waste water injection to the coal seam is soon to cease with waste water alternatively being stored and re-used from silt cells on site.

EPA Licencing

Discharge from the Metromix site is currently monitored at the triple point discharge/data logger immediately downstream of the Mine Adit Dam. The discharge limits from the Mine Adit Dam are outlined in Environment Protection Licence 3139 which is currently held by Coal & Allied Industries Limited - the owners of Rhondda Colliery. EPL 3139 specifies a discharge limit of 25ML/d. The concentration limits and monitoring requirements are provided in **Table A1-1** and **Table A1-2**. Water quality monitoring is required on a monthly basis.

Table A1-1
EPL 3139 Surface Water Discharge Concentration Limits

Pollutant	Units of Measure	50 percentile concentration limit	90 percentile concentration limit	3DGM concentration limit	100 percentile Concentration Limit
pH	pH				6.5-8.5
Total suspended solids	milligrams per litre				50

Table A1-2
EPL 3139 Surface Water Discharge Monitoring Requirements

Pollutant	Units of measure	Frequency	Sampling Method
Conductivity	microsiemens per centimetre	Once a month (min. of 4 weeks)	Representative sample
Nitrogen (ammonia)	milligrams per litre	Once a month (min. of 4 weeks)	Representative sample
Phosphorus (total)	milligrams per litre	Once a month (min. of 4 weeks)	Representative sample
Total suspended solids	milligrams per litre	Once a month (min. of 4 weeks)	Representative sample
pH	pH	Once a month (min. of 4 weeks)	Representative sample

HISTORICAL WATER QUALITY DATA

Volume

The historical approximate daily discharge recorded at the triple point discharge/data logger immediately downstream of the Mine Adit Dam from July 2000 to July 2011 is illustrated in **Figure A1-1a** and **Figure A1-1b**. The daily discharge over the historic period from July 2000 to December 2008 has averaged 4.5ML/d. The daily discharge has remained under the Licence limit of 25ML/d, with the exception of three days in June 2007 when the maximum discharge of 42.8ML/d was recorded. The exceedances in June 2007 followed an extreme rainfall event (300mm recorded on 11/06/2007) and subsequent rainfall totalling of over 400mm in the two weeks prior to the discharges.

pH

Historical pH values have been within the Licence range of 6.5-8.5 for all monitoring events with the exception of August 2002 which recorded a pH of 8.6. Historical pH values are illustrated in **Figure A1-2a** and **Figure A1-2b**.

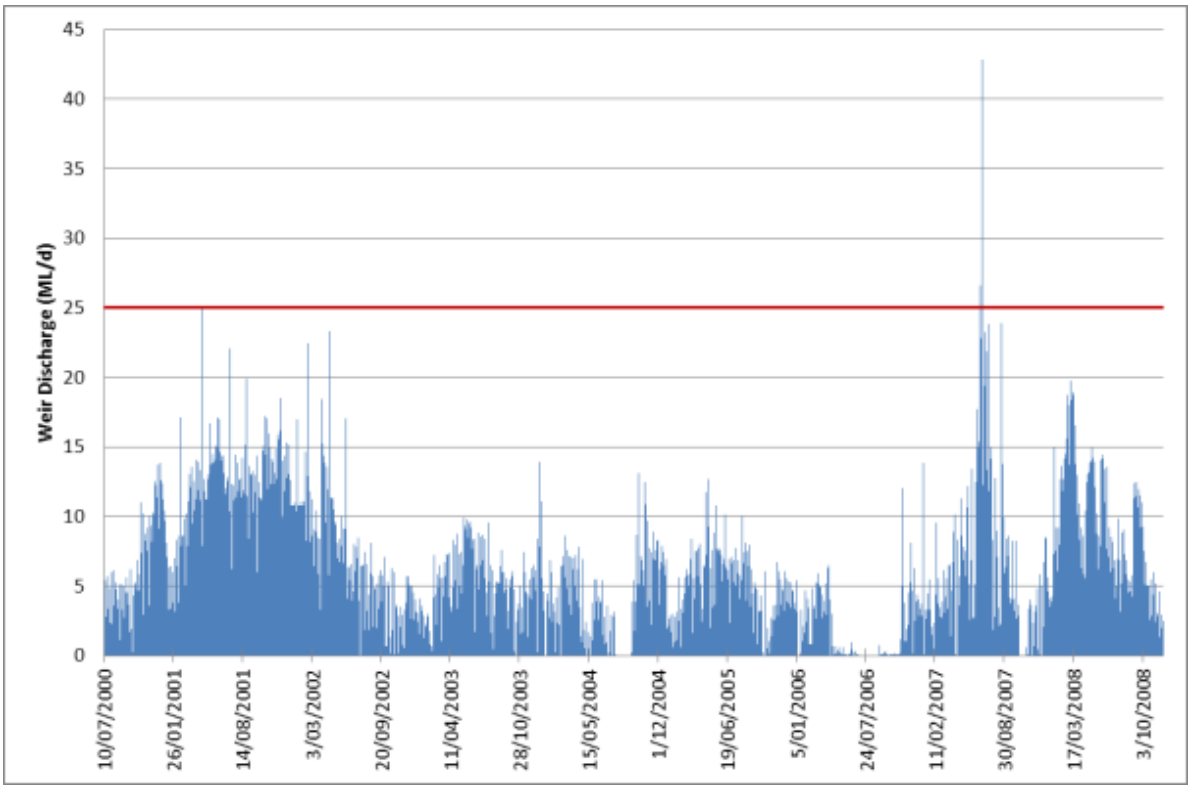

Figure A1-1a Historical V-Notch Weir Discharge (2000-2008)

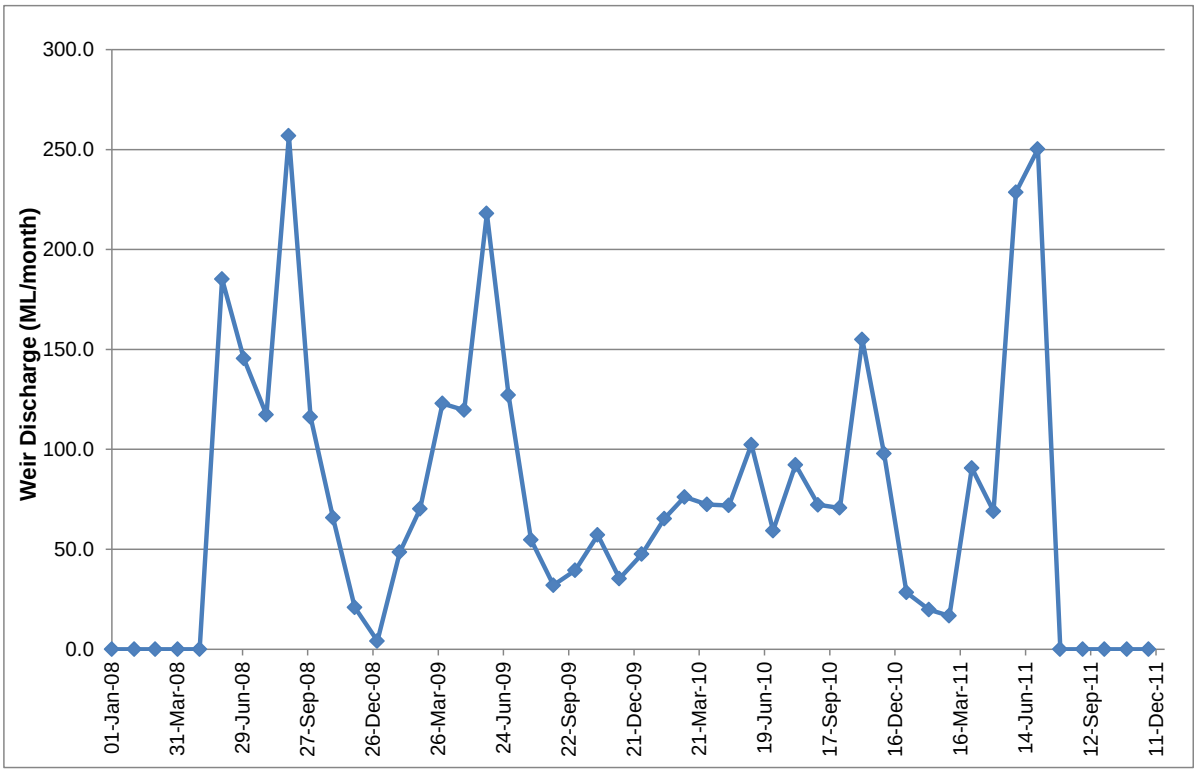

Figure A1-1b Historical V-Notch Weir Discharge (2008-2011)

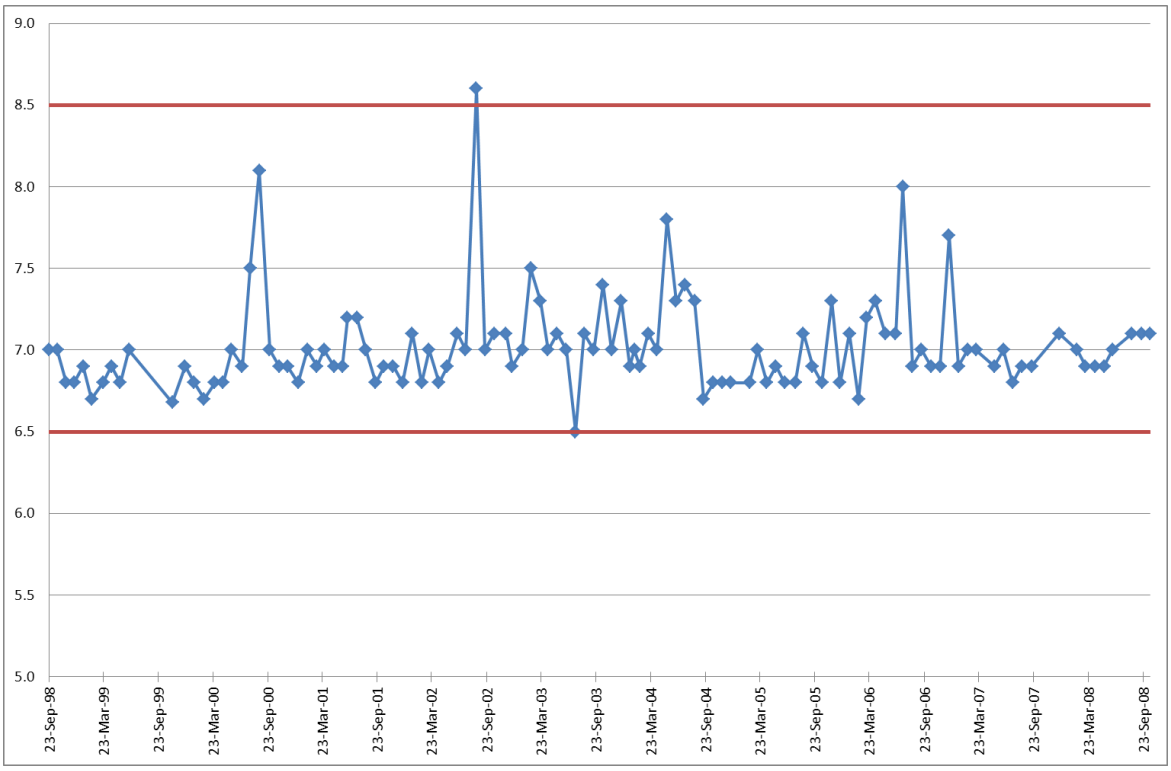

Figure A1-2a Historical pH (1998-2008)

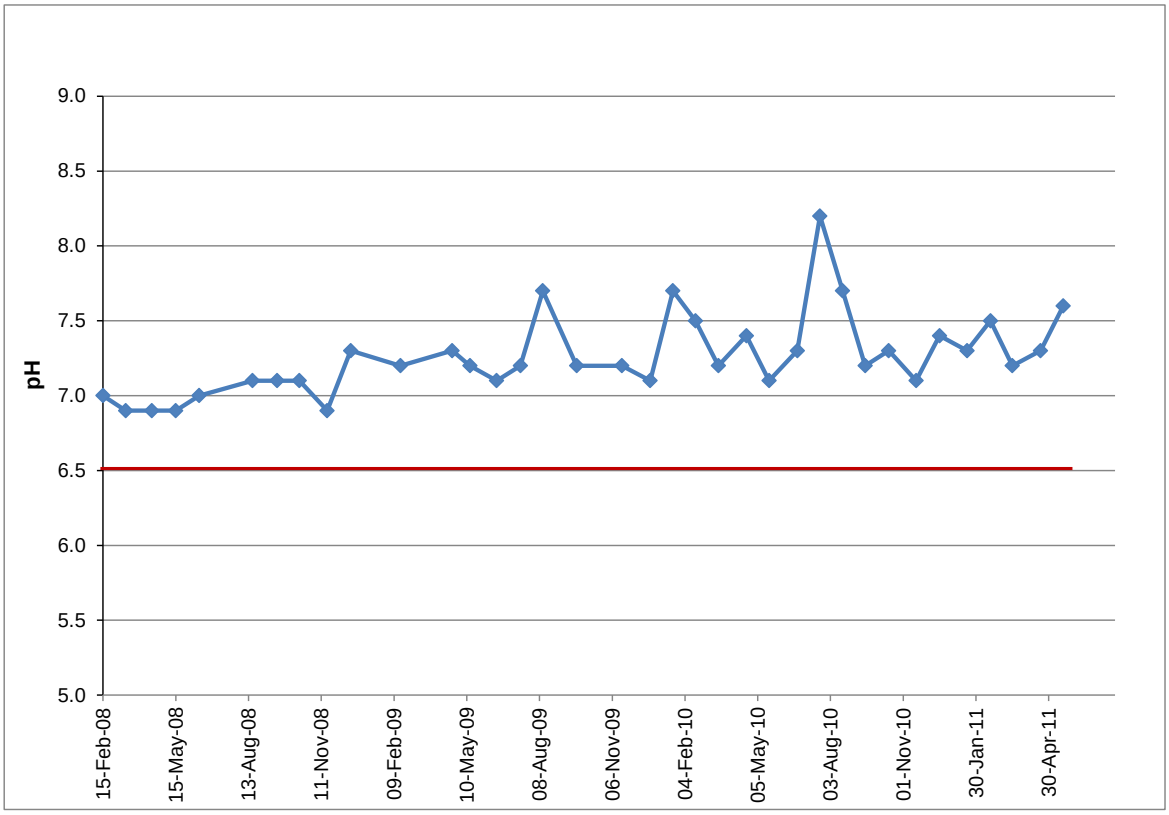

Figure A1-2b Historical pH (2008-2011)

Suspended Solids

Historical suspended solids concentrations range from 1mg/L to 150mg/L, as illustrated in **Figure A1-3**. The suspended solids concentration has exceeded the Licence limit of 50mg/L during 11 monitoring events. Seven of these exceedances have occurred following 2006, i.e. since waste water from the processing plant has been retained on site and pumped into the voids in the GNCS. Higher suspended solids concentrations may be due to higher groundwater concentrations of suspended solids or excess runoff from the Metromix site sediment dams.

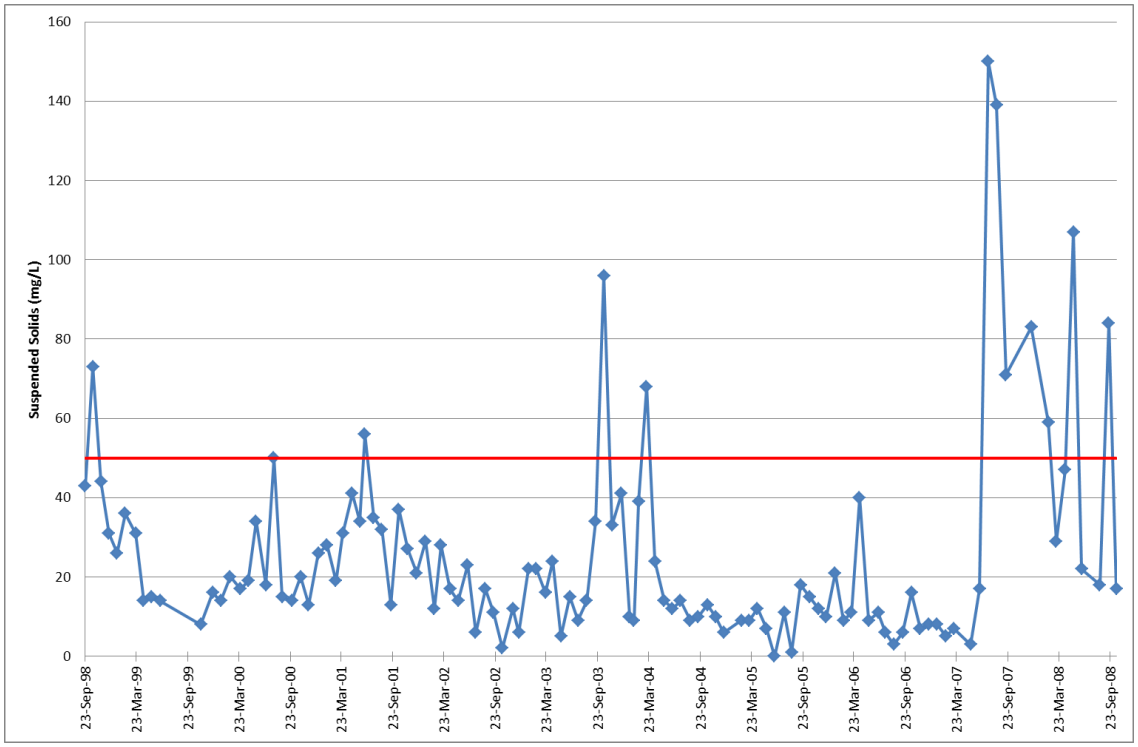

Figure A1-3 Historical Suspended Solids Concentration

Electrical conductivity

Historical electrical conductivity values range from 2300µS/cm to 12,300µS/cm as illustrated in **Figure A1-4a** and **Figure A1-4b**. A declining trend in electrical conductivity is evident following 2006 from which time salt water and waste water was no longer discharged into a coal seam in Rhondda Colliery. It is likely that the discontinued discharge of saline water into the Rhondda Colliery coal seam has resulted in a decrease in electrical conductivity of the groundwater discharging from the Mine Adit Dam.

Ammonia

Historical ammonia concentrations range from below the level of reporting (0.02mg/L) to 1.24mg/L, as illustrated in **Figure A1-5a** and **Figure A1-5b**. Historical spikes in ammonia concentration may be related to the discharge of waste water into the Rhondda Colliery coal seam, increasing local groundwater concentrations of ammonia.

Historical ammonia concentrations have remained below the ANZECC 2000 95% protection of aquatic ecosystems trigger value for fresh water.

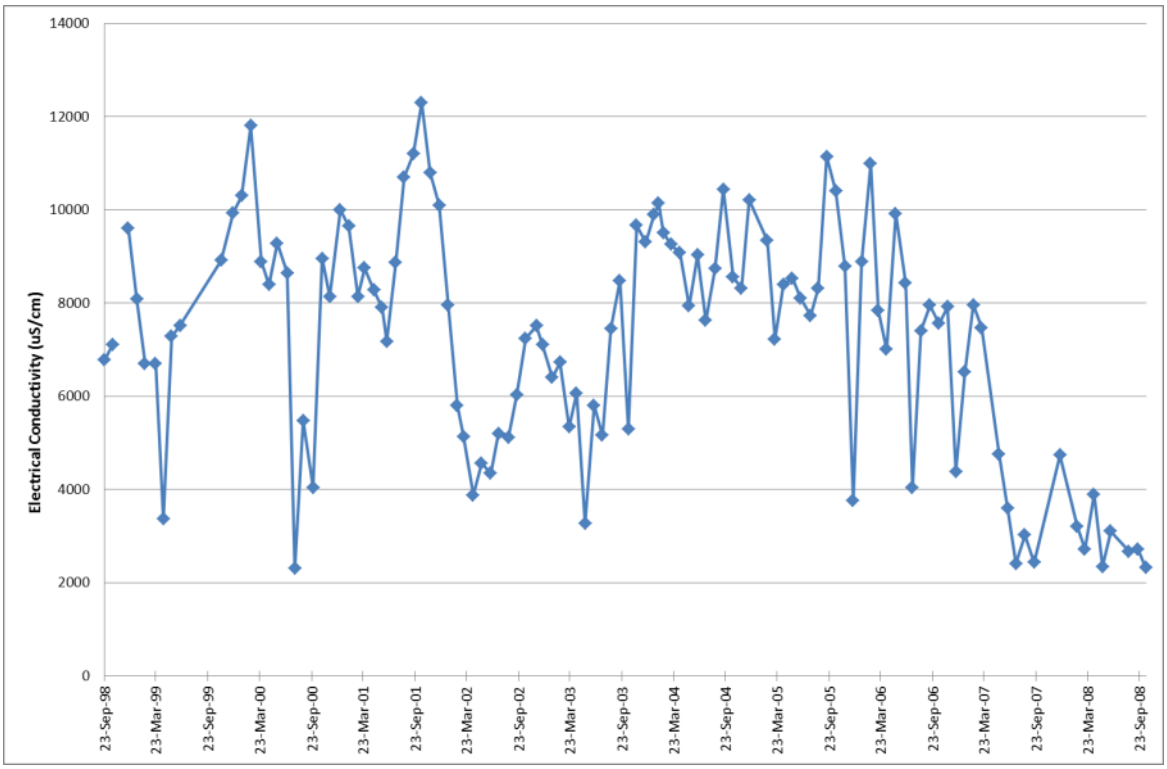

Figure A1-4a Historical Electrical Conductivity (1998-2008)

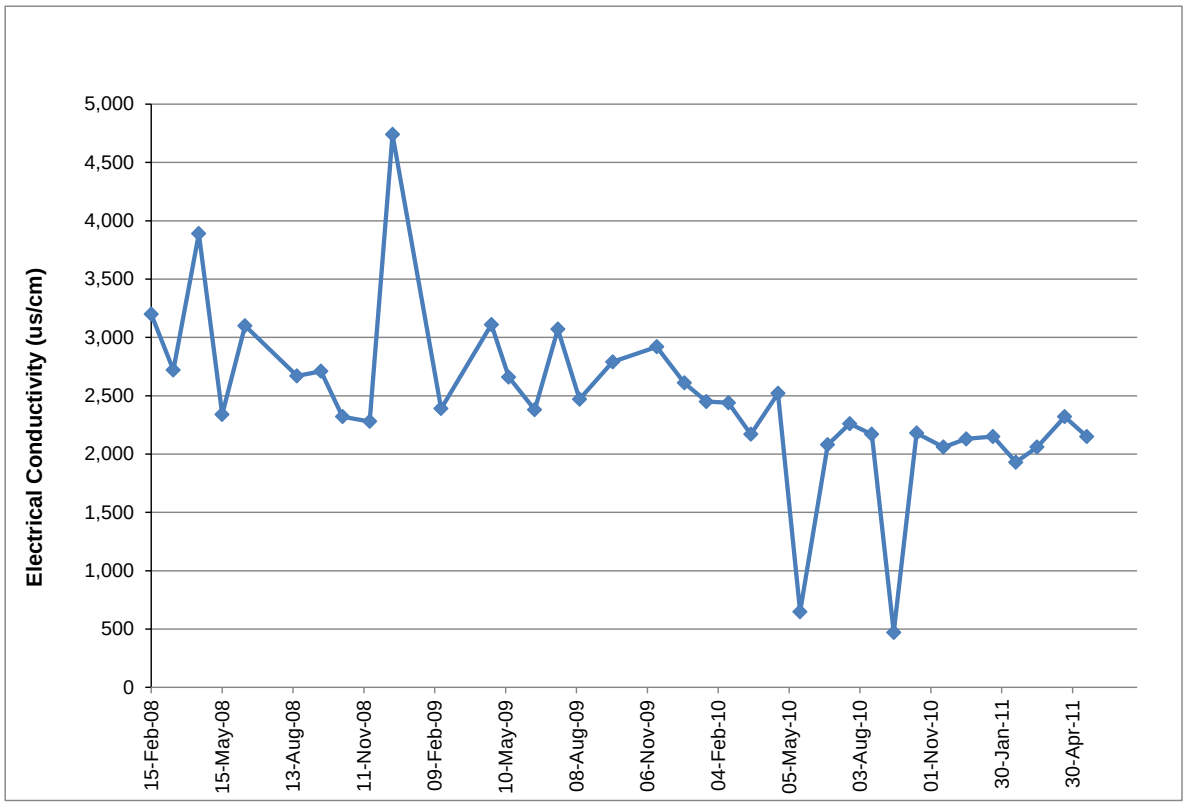

Figure A1-4b Historical Electrical Conductivity (2008-2011)

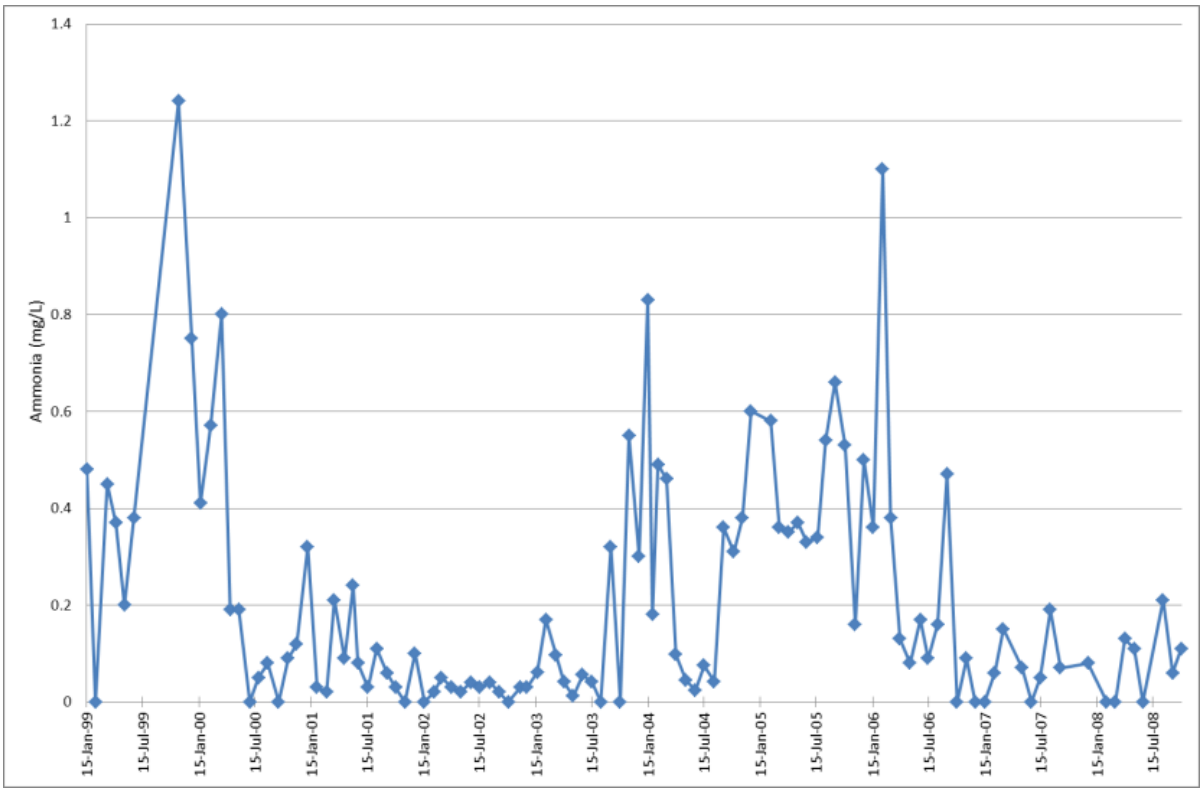

Figure A1-5a Historical Ammonia Concentrations (1999-2008)

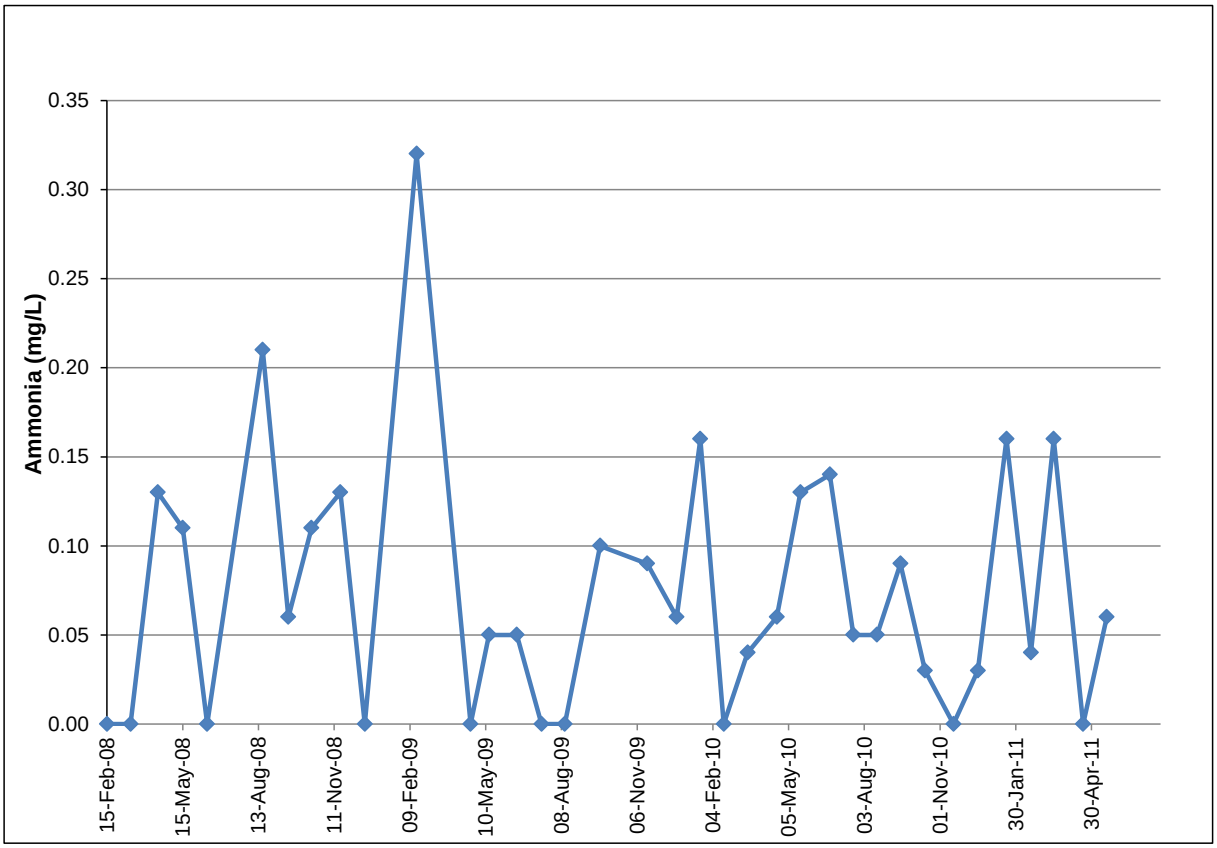

Figure A1-5b Historical Ammonia Concentrations (2008-2011)

Phosphorus

Historical total phosphorus concentrations range from below the level of reporting (0.10mg/L) to 0.37mg/L as illustrated in **Figure A1-6a** and **Figure A1-6b**. Historical total phosphorus concentrations were frequently above the 0.025mg/L ANZECC 2000 chemical stressor trigger value for lowland, east flowing coastal rivers in NSW. The historical average total phosphorous concentration is 0.044mg/L.

Based on the historical average total phosphorous concentration and discharge (see above), the total phosphorous load is estimated to be 73 kilograms per year. Considering the phosphorus load of Cockle Creek has been estimated at 23 tonnes per year (AWACS 1995), 73kg represents roughly 0.3%.

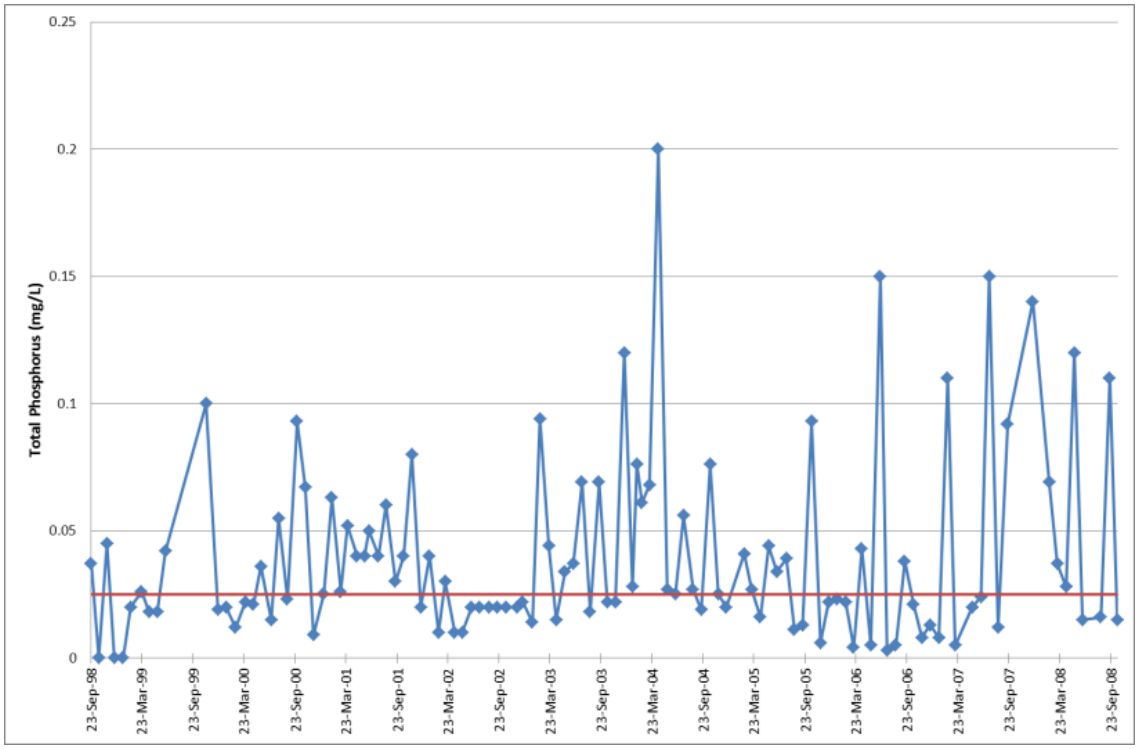

Figure A1-6a Historical Total Phosphorus Concentrations (1998-2008)

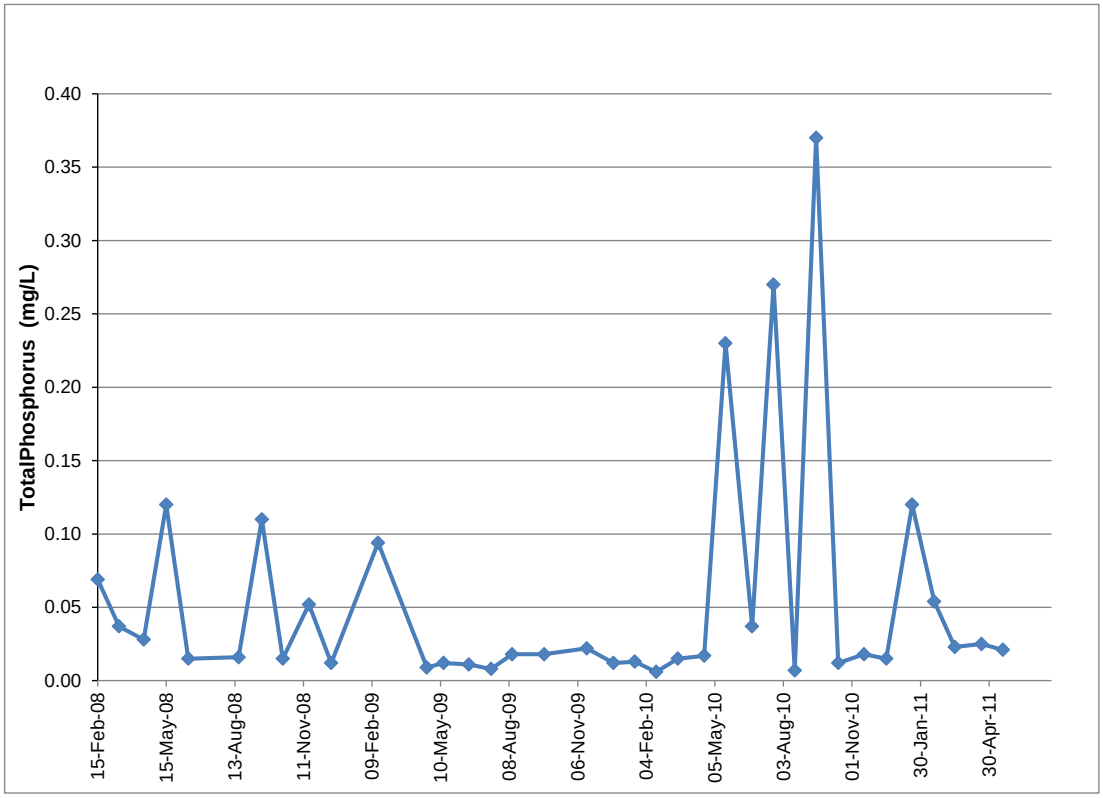

Figure A1-6b Historical Total Phosphorus Concentrations (2008-2011)

Nitrogen

Total nitrogen is equal to the sum of Total Kjeldahl Nitrogen (TKN), nitrates and nitrites. Historical monitoring has included TKN and total nitrates. Total nitrites has not been analysed in historical monitoring and is assumed to be negligible in the calculation of total nitrogen.

Historical total nitrogen concentrations range from below the level of reporting (0.55mg/L) to 3.67mg/L as illustrated in **Figure A1-7**. Historical total nitrogen concentrations are frequently above the 0.35mg/L ANZECC 2000 chemical stressor trigger value for lowland, east flowing coastal rivers in NSW. The historical average total nitrogen concentration is 0.99mg/L with a decreasing trend evident since 2005. The decreasing trend may be related to the discontinued discharge of waste water and salt water into the Rhondda Colliery coal seam resulting in a decrease in the total nitrogen concentration of the groundwater discharging from the Mine Adit Dam.

Based on the historical average total nitrogen concentration and discharge (see above) the annual total nitrogen load is estimated to be 1.62 tonnes per year. Considering the nitrogen load of Cockle Creek has been estimated at 360 tonnes per year (AWACS 1995), 1.62 tonnes represents roughly 0.45%.

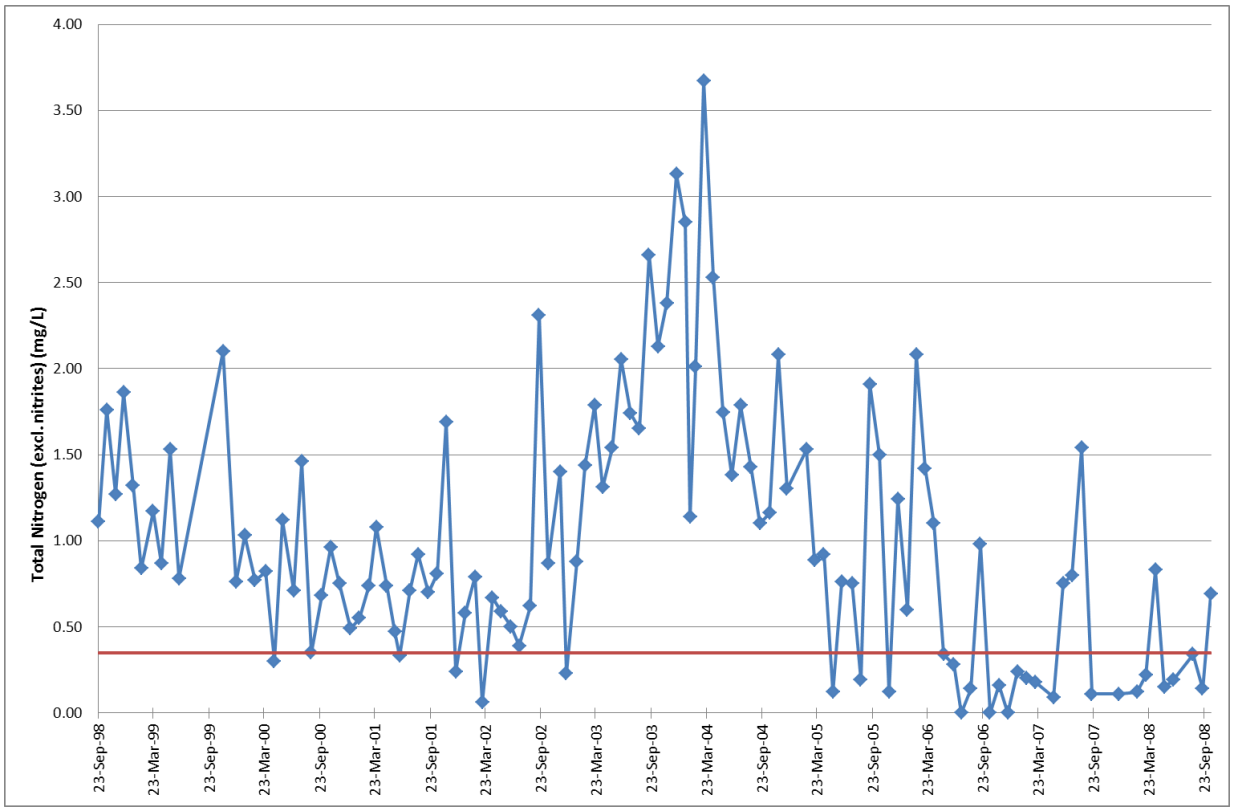

Figure A1-7 Historical Total Nitrogen Concentrations (excl. Nitrites)

Appendix 2

Surface Water Monitoring Program

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Introduction

A comprehensive surface water monitoring program is required for the project approval of the proposed Teralba Quarry Extensions. The main objective of the new surface water monitoring program is to verify that the management of the site complies with the project approval requirements and applicable conditions within EPL 536. The results of the water quality monitoring may be used to estimate the amount of sediment, nutrients and pollutants that are being discharged from the site.

The new surface water monitoring program will commence following the receipt of project approval to the final rehabilitation of the site. The surface water monitoring program will need to be reviewed and updated on an annual basis to meet the program objectives and ensure only meaningful data is being collected.

Background

Surface runoff within the existing Southern Extraction Area is largely collected, retained and infiltrated on site in the extraction pit floor and a series of sediment dams draining to Dam B. Excess runoff from Dam B discharges to the Mine Adit Dam, a dam located at the exit from a disused flooded mine adit, from the former Northern Extended Colliery. Overflow flow from the Mine Adit Dam discharges off site to an unnamed tributary of Cockle Creek.

Discharge from the Metromix site is presently monitored at a triple point discharge/data logger immediately downstream of the Mine Adit Dam. Coal & Allied Industries Limited (the owners of Rhondda Colliery) monitor a flow gauge and conduct water quality sampling at the discharge point in accordance with Environment Protection Licence 3139.

Proposed development

Surface runoff within the existing Southern Extraction Area and proposed Southern Extension is to be collected, retained and infiltrated on site through the extraction floor and the existing series of sediment dams draining to Dam B. Metromix proposes to construct a diversion drain to convey the Dam B overflow directly to the downstream unnamed tributary of Cockle Creek, bypassing the Mine Adit Dam.

Surface water will continue to discharge off site from the Mine Adit Dam as groundwater discharges from the flooded mine adit.

Surface runoff within the existing Mid Pit Extraction Area and proposed Northern Extension is to be collected, retained and infiltrated on site in sediment dams located in the extraction floor. Given the significant volumes of the extraction areas and highly permeable ground surface, overflow off site from runoff collected in extraction pits is unlikely. Hence discharge from the Mine Adit Dam and Dam B will be the only formal surface water discharge points from the Teralba Quarry for the life of the proposed Teralba Quarry Extensions.

Monitoring requirements

The monitoring requirements are outlined in the following sections and summarised in **Table A2-2**.

Locations

Surface water monitoring will be required at any location where a concentrated source of potentially contaminated surface runoff exits the Teralba Quarry. Surface water sampling locations are illustrated in **Figure A2-1**.

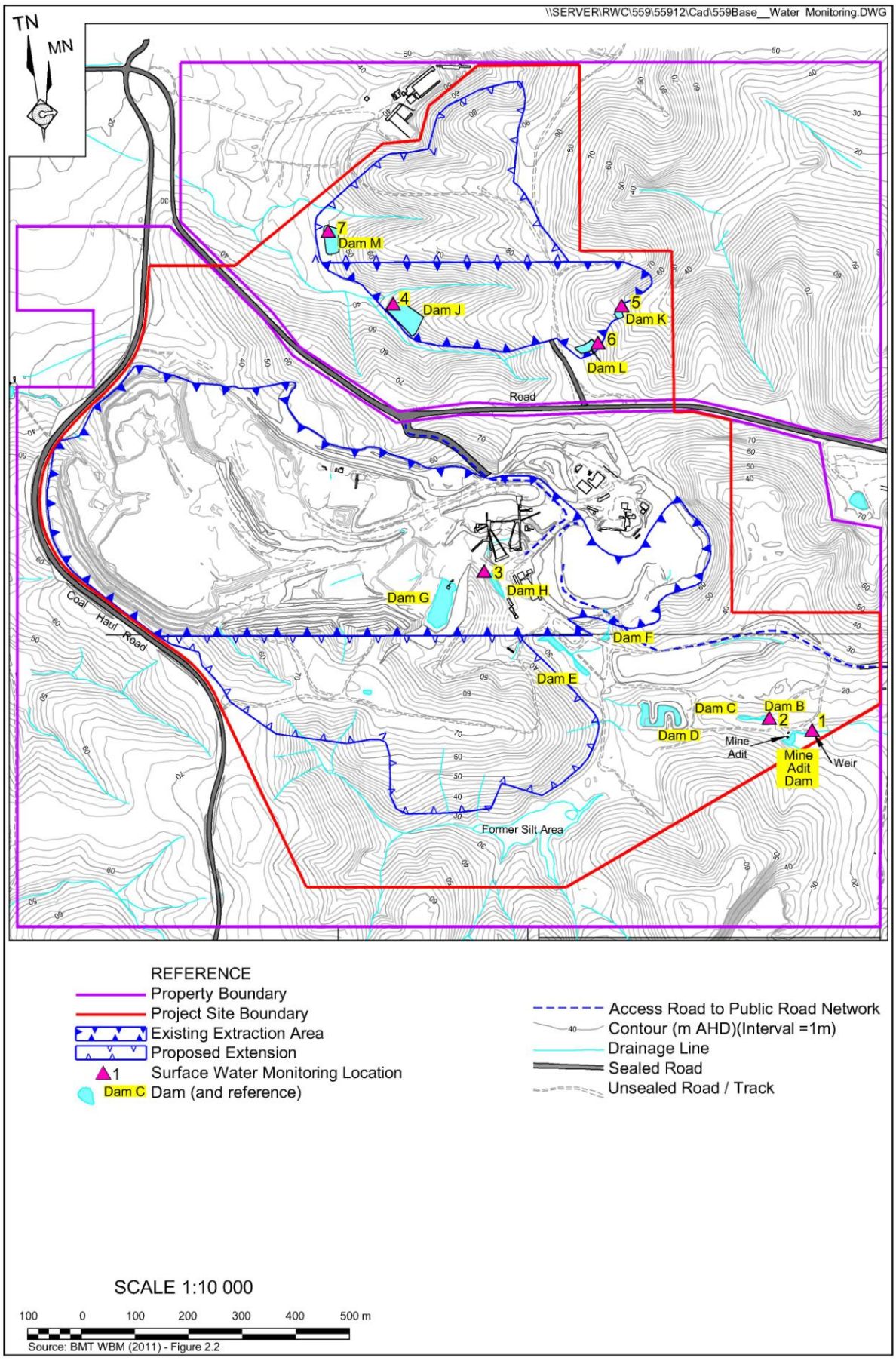

Figure A2-1 Surface Water Sampling Locations

The existing monitoring point (*Sampling Location 1*), located at the triple point discharge/data logger immediately downstream of the Mine Adit Dam will continue to be monitored by Coal & Allied Industries Limited whilst ever EPL 3139 is in existence. In the event EPL 3139 is relinquished, throughout the life of the proposed quarry extensions, Metromix would take over monitoring both flow volumes and water quality, albeit with a reduced number of analytes and frequency.

Monitoring will also be conducted at surface water storages, which may overflow off site during or following large rainfall events. This includes the proposed storages in the existing Mid Pit Extraction Area and proposed Northern Extension (*Sampling Locations 4 and 5*).

In addition, for assessing water treatment performance of the series of sediment dams, monitoring will also be conducted upstream at Dam H (*Sampling Location 3*) and downstream at Dam B (*Sampling Location 2*).

Frequency

Scheduled monitoring to be undertaken by Metromix will initially be conducted on a monthly basis at all sampling locations. In addition, wet weather and overflow monitoring will also be conducted. It is recognised that, based upon Metromix's experience, some of the sampling locations may be dry.

Wet weather monitoring will be conducted in the event that the 2-day site rainfall depth exceeds 100mm. The wet weather trigger event has been based on a review of the historical site rainfall data from 1997-2010, and consideration of the significant porosity of the site and storage available. Wet weather monitoring will be conducted at all sampling locations.

Overflow monitoring will be conducted in the event that the existing Mid Pit Extraction Area or proposed Northern Extension sediment dams (*Sampling Locations 4 and 5*) overflow off site. Sampling at these locations will occur daily during an overflow event.

Parameters

Field Measurements and Observations

During the scheduled monthly, wet weather and overflow monitoring events, the following observations will be recorded at all sampling locations:

- Water Colour
- Turbidity
- Odour
- Surface film/LNAPL present
- Approximate water depth
- Stagnant/flowing

In addition, field measurements will be taken during the scheduled monthly monitoring. The following field measurements will be taken prior to sampling using appropriately calibrated field equipment:

- pH
- Temperature
- Electrical Conductivity

Laboratory Analysis

The representative grab samples collected will be analysed by a NATA registered laboratory for the water quality indicators listed in **Table A2-1**. The need to continue analysing the range of analytes listed in **Table A2-1** will be reviewed annually. In addition, total hydrocarbons will also be analysed at any location where three consecutive exceedances of the oil and grease criterion occur (i.e. 10mg/L).

Table A2-1
Limits and Guidelines for Sampling Analytes

PARAMETER	Existing Rhondda Colliery EPL (3139) LIMIT	GUIDELINE
pH	6.5-8.5	6.5-8.5 [1]
Total Suspended Solids	50 mg/L	
Electrical Conductivity	-	125-2,200 µS/cm [1]
Nitrogen (ammonia)	-	2.18 mg/L [2]
Phosphorus (total)	-	25 µg/L [3]
Nitrogen (total)	-	350 µg/L [3]
Oil and Grease	-	10 mg/L [4]

[1] ANZECC - Lowland river
[2] ANZECC - Freshwater trigger value at pH 7
[3] ANZECC - NSW lowland, east flowing coastal river
[4] NOW - suggested licence limit

Table A2-2
Monitoring Requirements

Sampling Location No.	Latitude/ Longitude	Description	Frequency	Field Measurements	Sampling Method
1*	-32'57"50.69 151'35"44.58	Immediately downstream of the Mine Adit Dam	Continuous	Discharge	-
			Monthly	pH, Temp, EC	AS 5667.1
			Wet Weather	-	
2@	-32'57"49.72 151'35"42.72	Dam B	Continuous	Discharge	-
			Monthly	pH, Temp, EC	AS 5667.1
			Wet Weather	-	
3@	-32'57"38.15 151'35"24.38	Upstream at Dam H	Monthly	pH, Temp, EC	AS 5667.1
			Wet Weather	-	
4@	-32'57"22.56 151'35"21.76	Mid Pit Extraction Area Sediment Dam	Monthly	pH, Temp, EC	AS 5667.1
			Wet Weather	-	
			Overflow	-	
5@	-32'57"16.92 151'35"16.08	Proposed Northern Extraction Area Sediment Dam	Monthly	pH, Temp, EC	AS 5667.1
			Wet Weather	-	
			Overflow	-	

* Responsibility of Coal & Allied Industries Limited @ Responsibility of Metromix

Reporting

The results of the surface water quality monitoring are to be included in each Annual Environmental Management Report produced for the quarry.

Monitoring data will be primarily compared against the limits in the relevant Environment Protection Licence. Monitoring data will be analysed to assess the variation and apparent trends of the parameters being monitored on both a spatial and temporal scale. Monitoring data would also be compared with historical monitoring data and ANZECC guidelines where appropriate.

Review

The surface water monitoring program will be reviewed and updated on an annual basis. The program requirements should be reassessed in light of the data generated to date to ensure only meaningful data is being collected. The review will include an assessment of the effectiveness of the site management measures in meeting the programs objectives.

Related Documents

- EPL 3139 - http://www.environment.nsw.gov.au/prpoeo/licences/L3139.pdf
- AS 5667 Water quality - Sampling

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Appendix 3

Chemical Inventories

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Hazardous Substance Register - Teralba Quarry							
Substance Name	Supplier	Hazardous Substance	Main Storage Area	Poison Schedule	Quantity	Maximum Stock	Comments
Automotive Deisel Fuel	Caltex Australia	Yes	Diesel Storage Tanks	S5	43200 Litres	50,000 litres	C2 Combustible liquid
Delo Extended Life Coolant Antifreeze/Coolant	Caltex Australia	Yes	Oil Storage Area	S6	205	205	
Delo HDD SAE 50 Diesel Engine Oil	Caltex Australia	No	Oil Storage Shed 205 L Drum	n/a		1230	Combustible Liquid
Liplex EP2 (grease)	Caltex Australia	No	Oil Storage Shed 205 L Drum	n/a		500 litres	Combustible Liquid
Liquefied Petroleum Gas	Caltex Australia	No	Flammable Goods Cabinet	not scheduled		1x9k bottles	C2.1 Flammable Gas
Meropa 68 (Oil)	Caltex Australia	No	Oil Storage Shed 205 L Drum	n/a		820	Combustible Liquid
Meropa 220 (Oil)	Caltex Australia	No	Oil Storage Shed 205L Drum	n/a		410	
Rando HD 32	Caltex Australia	No	Oil Storage Shed	not scheduled		615	
Textran TDH Premium	Caltex Australia	No	Oil Storage Shed	not scheduled		410	
Torque Fluid 454 (transmission fluid)	Caltex Australia	No	Oil Storage Shed	not scheduled		410	
Inox-mx3	Merino Pty Ltd	No	Workshop Storage	n/a		20 litres	
Deb Pure Lotion Soap	Merino Pty Ltd	No	Workshop Storage			20 litres	
Dy-Mark line marking paint yellow	Merino Pty Ltd	Yes	Flammable Goods Cabinet	S6		24 cans	C2.1 Highly flammable
Silver Grade Anti-Seize Lubricant	Merino Pty Ltd	Yes	Workshop Storage	n/a		1 carton	Use specified PPE
Galmet Cold Galvanising Aerosol	Merino Pty Ltd	Yes	Flammable Goods Cabinet	n/a	2 kg		
Molybond GOG/1 Lubricant	Merino Pty Ltd	No	Workshop Storage	n/a		2 x 20 kg	

Hazardous Substance Register - Teralba Quarry

Substance Name	Supplier	Hazardous Substance	Dangerous Goods Class & Packing Group (PG)	Main Storage Area	Poison Schedule	Quantity	Maximum Stock	Comments
Acetylene Gas Cylinders	BOC	Yes	DG class 2.1 UN1001	Acelylene Storage Cage, Workshop	n/a		8 cylinders	Highly Flammable Gas
Oxygen Gas Cylinders	BOC	Yes	DG class 2.2 & 5.1 UN1072	Oxygen Storage Cage	n/a		10 cylinders	Oxidising Gas, can present extreme fire hazards
Superfoam	Merino	Yes	Class 3, UN1993, PGIII	Workshop Storage Area	n/a		20 L Drum	
Anfo	Orica Explosives	Yes	1.1D explosive UN 0082	Not stored onsite Brought on site by contractors	None Allocated			Contractor brings onsite
Amex	Orica Explosives	Yes	1.1D explosive UN 0082	Explosive Magazine No 1	None Allocated	4 tonne	4 tonne	Explosion Risk, use restricted to authorised personnel
Electric Detonators	Orica Explosives	No	1.1B explosive UN 0030	Explosive Magazine No 2	n/a	80 units	150 units	Explosion Risk, use restricted to authorised personnel
Excel Connectadet Detonators	Orica Explosives	No	1.1B explosive UN 0360	Explosive Magazine No 2	n/a	800 units	2000 units	Explosion Risk, use restricted to authorised personnel
Exel Lead In Line	Orica Explosives	No	1.1B explosive UN 0360	Explosive Magazine No 2	n/a	600 units	1000 units	Explosion Risk, use restricted to authorised personnel
Powergel buster	Orica Explosives	No	1.1B explosive UN 0241	Explosive Magazine No 1	n/a	300kg	500kg	Explosion Risk, use restricted to authorised personnel
Megapoxy HICB- Part A	Sandvik	Yes	n/a	Workshop Storage Area	S5		4 units	Used only by trained Sandvik staff, refer to Sandvik JSA
Megapoxy HICB- Part B	Sandvik	Yes	n/a	Workshop Storage Area	S5		4 units	Used only by trained Sandvik staff, refer to Sandvik JSA
Ansulate 6% ICAO-B	Wormald	No	n/a	Supression Systems	n/a		6 units	

DownerEDi Works

NRDFM266 – MSDS Register

Review Date	06/05/2011	Reviewed By	B. Scott

This Register is to be kept in the front of the MSDS Document Folder.

Storage Location	Product Name	Dangerous Goods Class	Quantity (maximum)	Manufacturer (and supplier if known)	Hazardous according to Worksafe?
Truck Slip	Asphaltrent	NA	1000ltr	Nynas	No
Lab	Barrier Cream	NA	75g	Deb	No
Bitumen Tank 11	Bitumen C170	9	40,000ltr	Mobil	No
Bitumen Tank 1	Bitumen C320	9	30,000ltr	Mobil	No
Bitumen Tank 2	Bitumen C320	9	30,000ltr	BP	No
Bitumen Tank 12	Bitumen C170	9	40,000ltr	Shell	No
Bitumen Tank 8	Bitumen C170	9	30,000ltr	Shell	No
Bitumen Tank 9	Bitumen C170	9	65,000ltr	Shell	No
Butane Tank (Behind Lab) LPG6	Butane	2.1	75,000ltr	Origin	No
LPG Tank (Outside Plant) LPG9	LPG	2.1	7500ltr	Orgin	No
LPG Tank near Tanks 11 & 12 LPG13	LPG	2.1	7,500ltr	Origin	No
Diesel Tank TK3	Diesel	C1	12,000	Mobil	Yes
Lab	Dishwashing Liquid	NA	2L	Steric Trading Pty Ltd	No
Emulsion Tank (Beside Storage Shed)	CRS Emulsion	NA	20,000ltr	SAMI	Environmentally Hazardous
Plant/Workshop	Grease 28	NA	Negligible	Mobil	No
Plant/Workshop	Grease SHC 460	NA	Negligible	Mobil	No

Plant/Workshop	Grease 681	NA	Negligible	Mobil	No
Tank (Behind Workshop)	Kerosene	3		Mobil	Yes
	Product Name	**Dangerous Goods Class**	**Quantity (maximum)**	**Manufacturer (and supplier if known)**	**Hazardous according to Worksafe?**
Lime Tank (Behind Plant)	Hydrated Lime	NA	10.00T	Unimin	Yes(NOHSC)
Additive Bulk Storage – Tank4	Redicote N422	Class 9	10,000ltr	Akzo Nobel	Yes
Drum Store Compound – Back of Laboratory	Ethanol	3	600ltr	CSR	No
Lab/Coring Trailer	Pavefix	N/A	Negligible	SAMI	No
Yard (Outside Lab)/Big Shed	Crumb Rubber	NA	40T	Sims Tyrecycle	No
Lab/Office/Field	Sunscreen	3.1	NA	Hamilton Pharmaceutical	No
Lab/Plant/Workshop	Suprega Plus (Hand Wash)	NA	NA	Deb	No
Drum Store Compound – Back of Laboratory	Toluene	3	600ltr	Precision Products	Yes
	Vaseline	NA	NA	Unilever	No
Lab/Workshop	WD-40	2.1	NA	(Blackwoods)	Yes
Bulk Storage – TK5	Kerosene	3	34,000ltr	Swift	Yes
Bulk Storage – TK6	Precoat	3	26,000ltr	Emoleum (SAMI)	Yes
	Mobil Delvac MX 15W-40(Engine Oil)	NA	Negligible	Mobil	No
	Exxon System Cleaner	NA	Negligible	Mobil	Yes

Appendix 4

Standard Drawings

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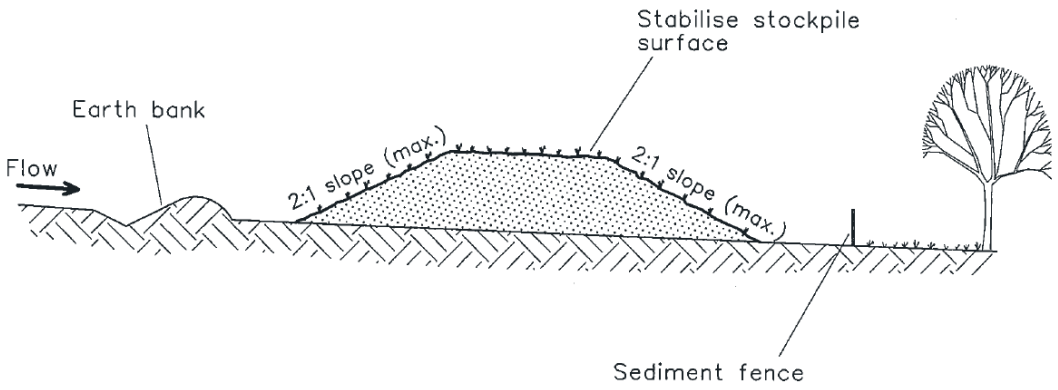
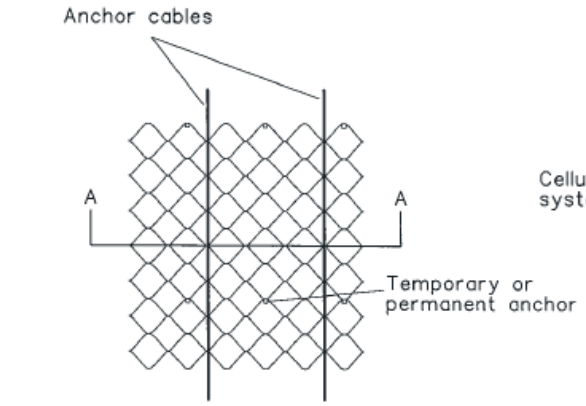
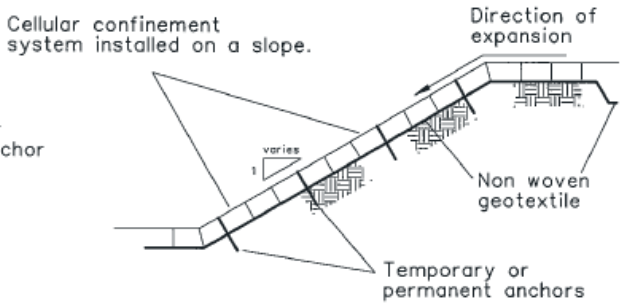


Construction Notes

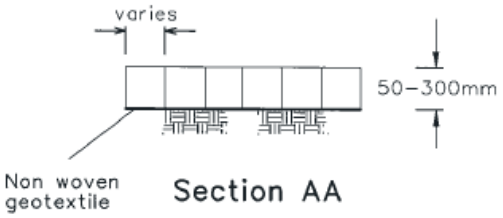
1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

STOCKPILES **SD 4-1**

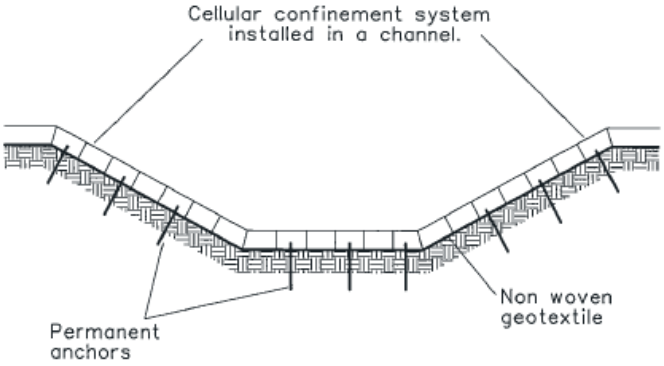




Slope Protection System



Section AA

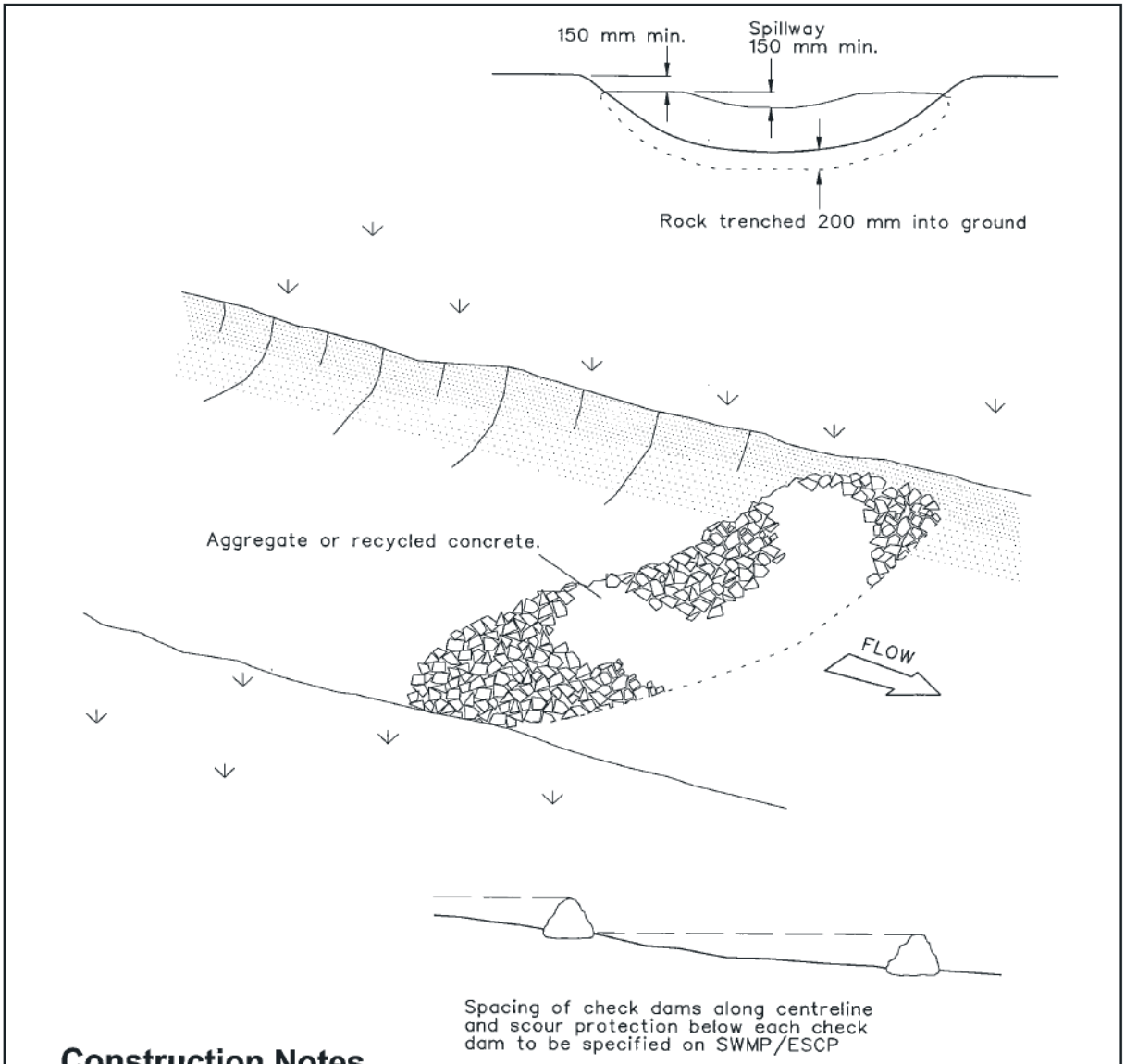


Channel Protection System

Construction Notes

1. Undertake design only with the help of a suitably qualified geotechnical engineer.
2. Anchor systems on steep slopes to prevent sliding or movement under gravitational forces. This might include the use of high tensile, low creep cables made of polyester (not polypropylene), rope or steel wire.
3. Place thick, non woven geotextiles under the cellular confinement system to allow for lateral drainage.
4. Fill the cells with soil, rock or concrete depending on the application.

CELLULAR CONFINEMENT SYSTEMS **SD 5-3**

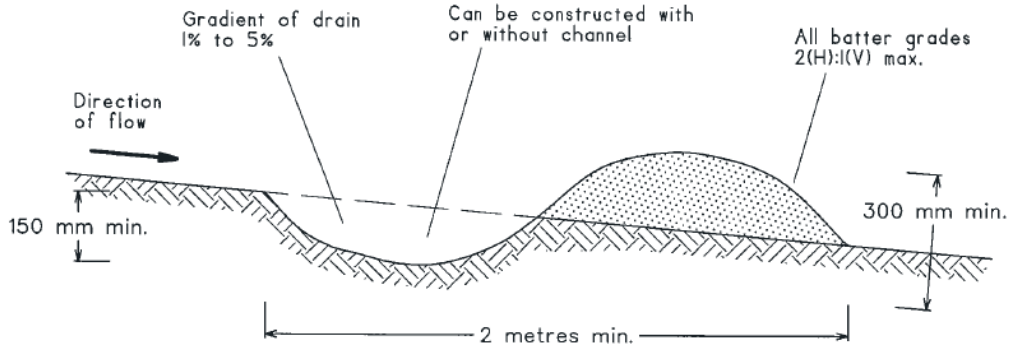


Construction Notes

1. Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.
2. Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.
3. Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.
4. Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

ROCK CHECK DAM

SD 5-4

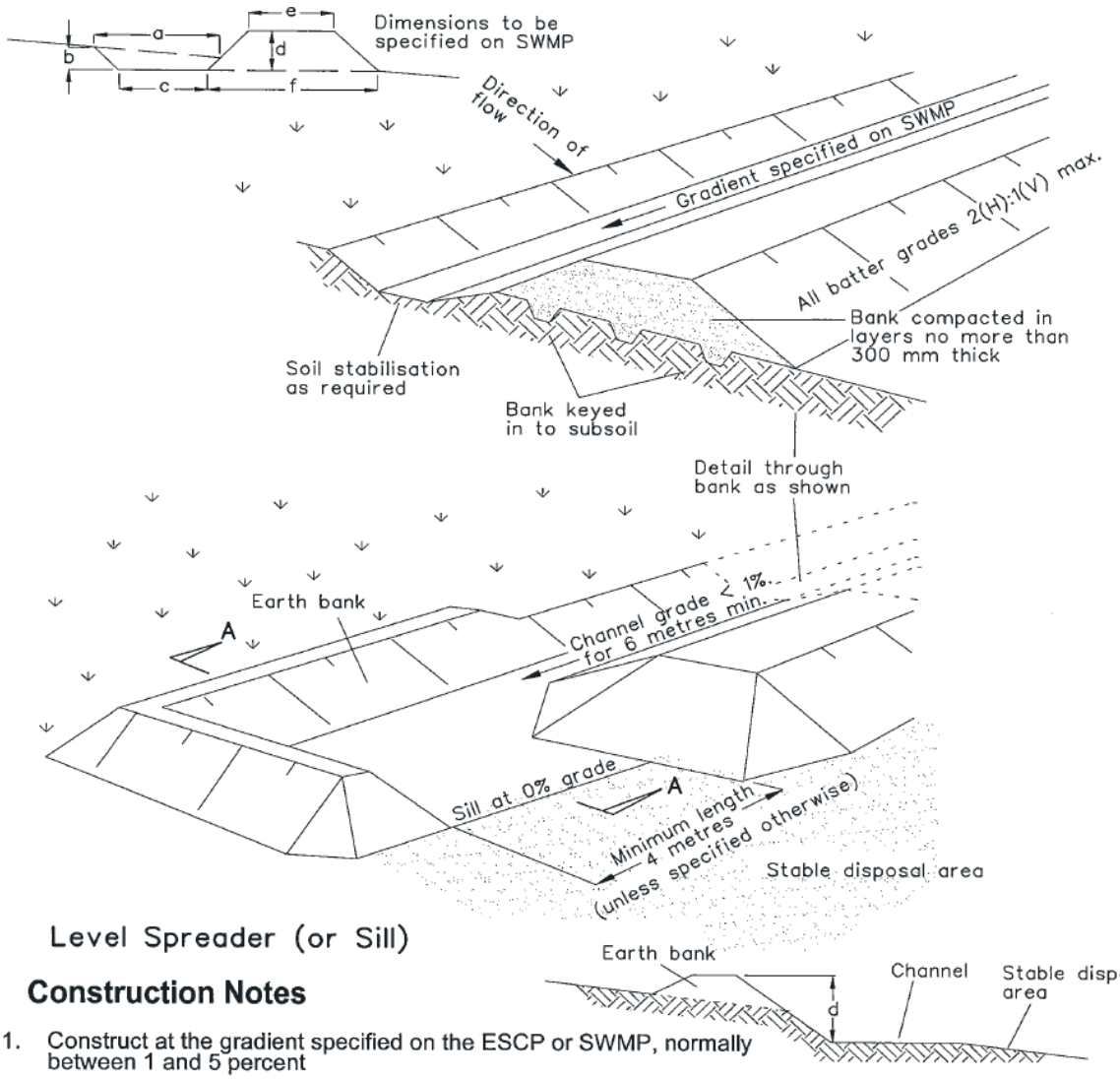


NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

Construction Notes

1. Build with gradients between 1 percent and 5 percent.
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.

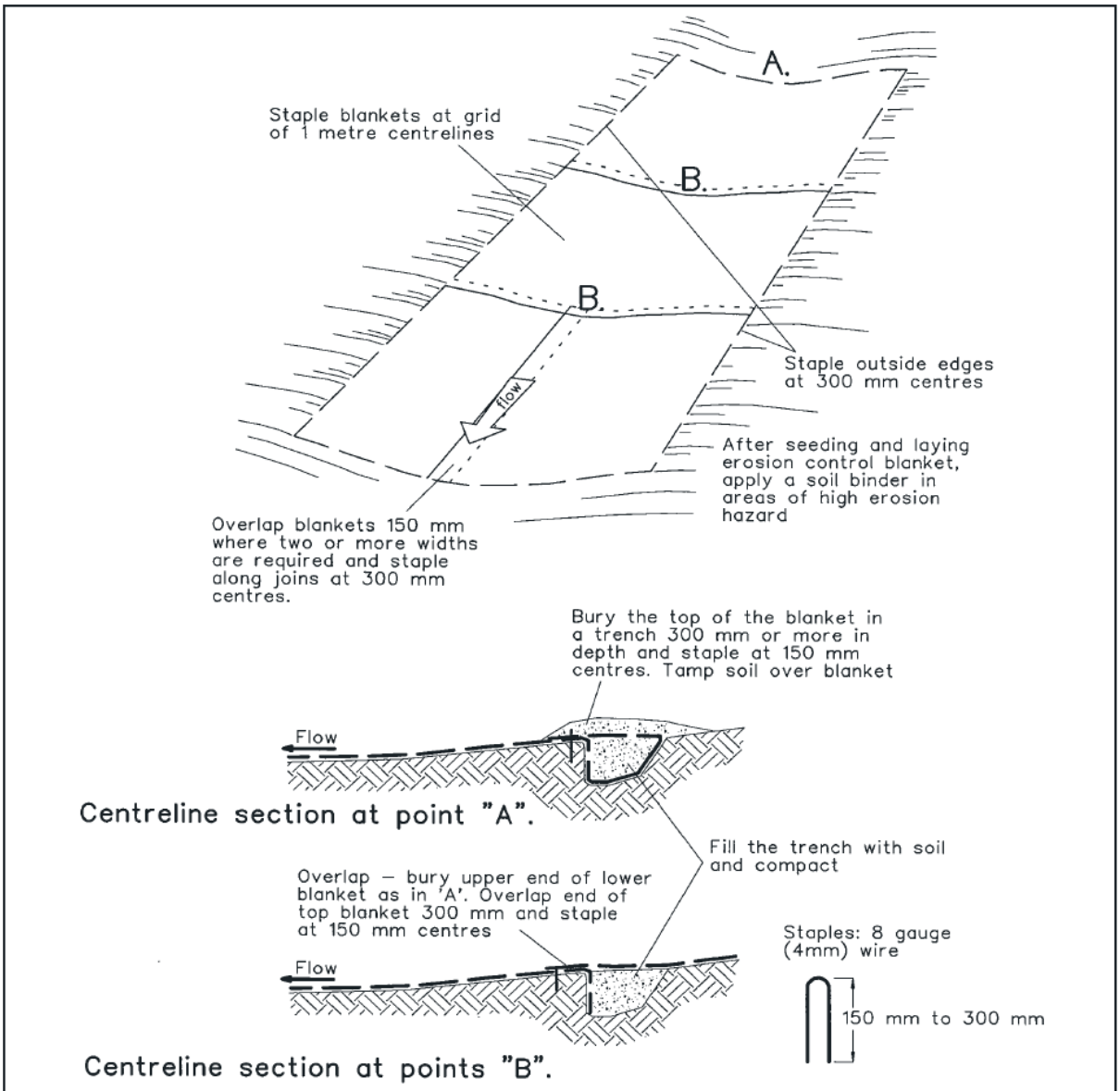
EARTH BANK (LOW FLOW) **SD 5-5**



Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
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, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

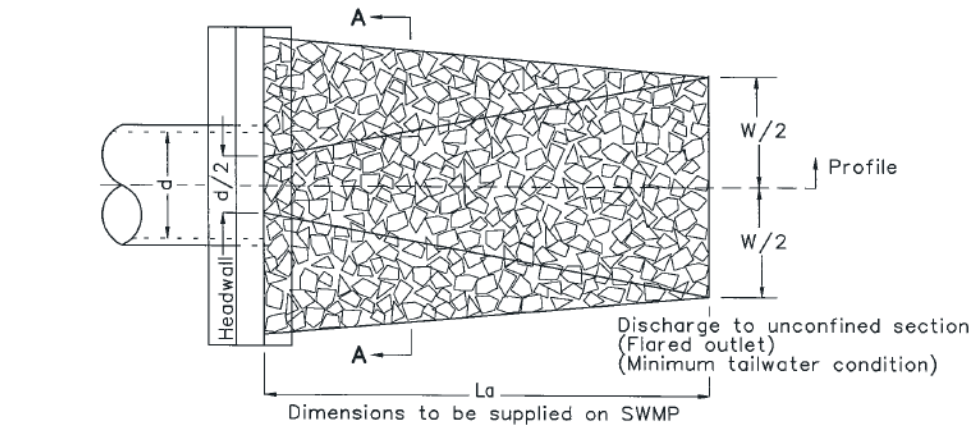
EARTH BANK (HIGH FLOWS) **SD 5-6**



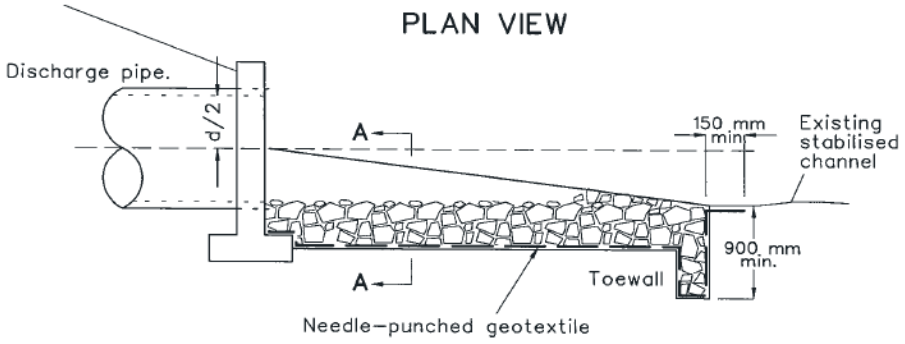
Construction Notes

1. Remove any rocks, clods, sticks or grass from the surface before laying matting
2. Ensure that topsoil is at least 75 mm deep.
3. Complete fertilising and seeding before laying the matting.
4. Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
5. Lay the fabric in "shingle-fashion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
6. Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually in the 10-year ARI time of concentration storm event.
7. Divert water from the structure until vegetation is stabilised properly.

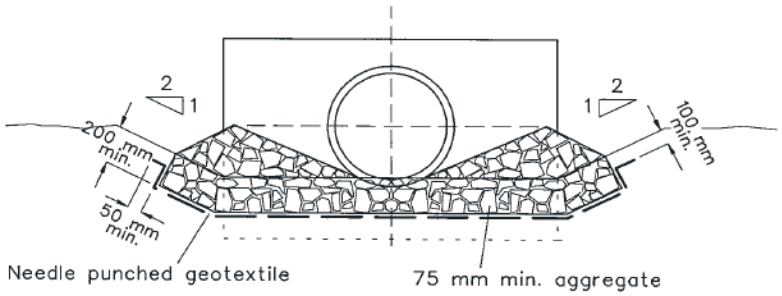
RECP : CONCENTRATED FLOW **SD 5-7**



PLAN VIEW



PLAN VIEW

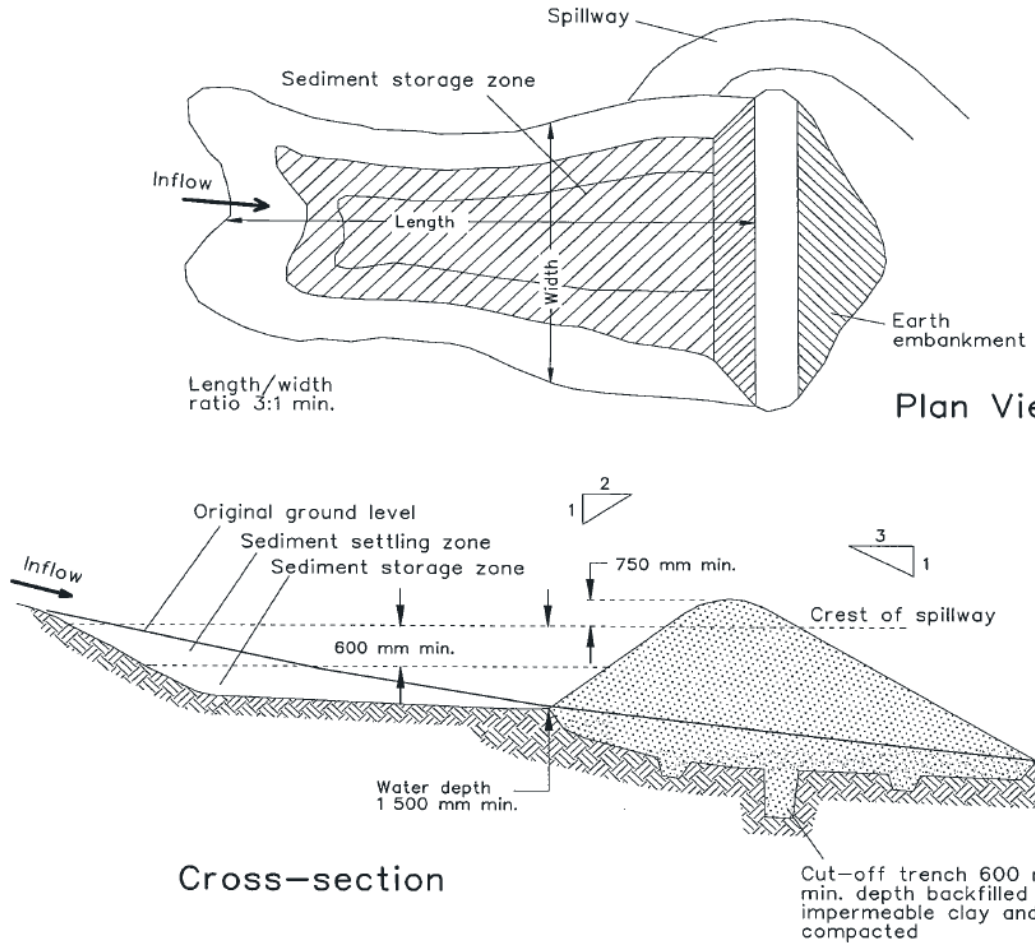


CROSS SECTION AA

Construction Notes

1. Compact the subgrade fill to the density of the surrounding undisturbed material.
2. Prepare a smooth, even foundation for the structure that will ensure that the needle-punched geotextile does not sustain serious damage when covered with rock.
3. Should any minor damage to the geotextile occur, repair it before spreading any aggregate. For repairs, patch one piece of fabric over the damage, making sure that all joints and patches overlap more than 300 mm.
4. Lay rock following the drawing, according to Table 5.2 of Landcom (2004) and with a minimum diameter of 75 mm.
5. Ensure that any concrete or riprap used for the energy dissipater or the outlet protection conforms to the grading limits specified on the SWMP.

ENERGY DISSIPATER **SD 5-8**

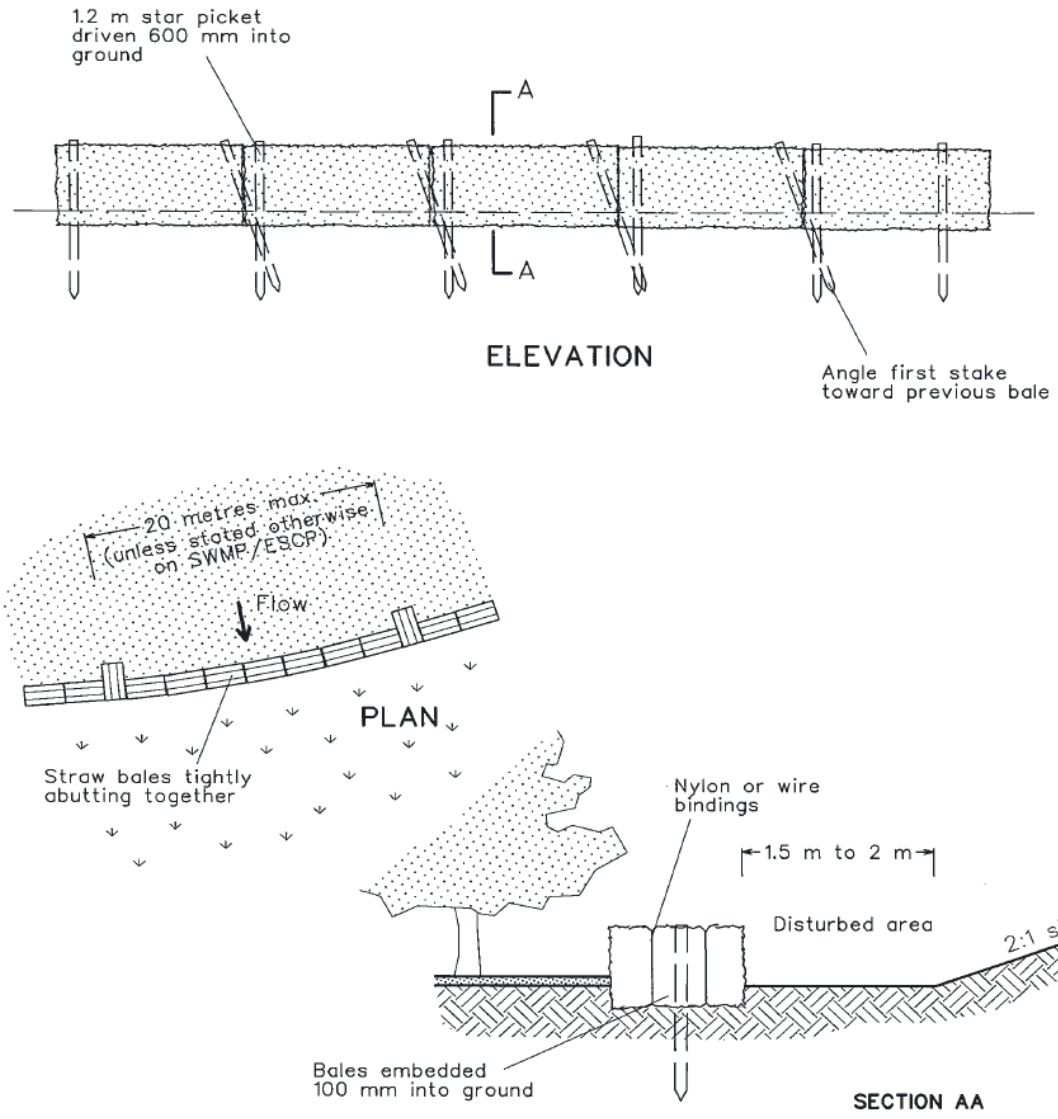


Construction Notes

1. Remove all vegetation and topsoil from under the dam wall and from within the storage area.
2. Construct a cut-off trench 500 mm deep and 1,200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
3. Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
4. Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
5. Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
6. Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
7. Construct the emergency spillway.
8. Rehabilitate the structure following the SWMP.

EARTH BASIN - WET
(APPLIES TO 'TYPE D' AND 'TYPE F' SOILS ONLY)

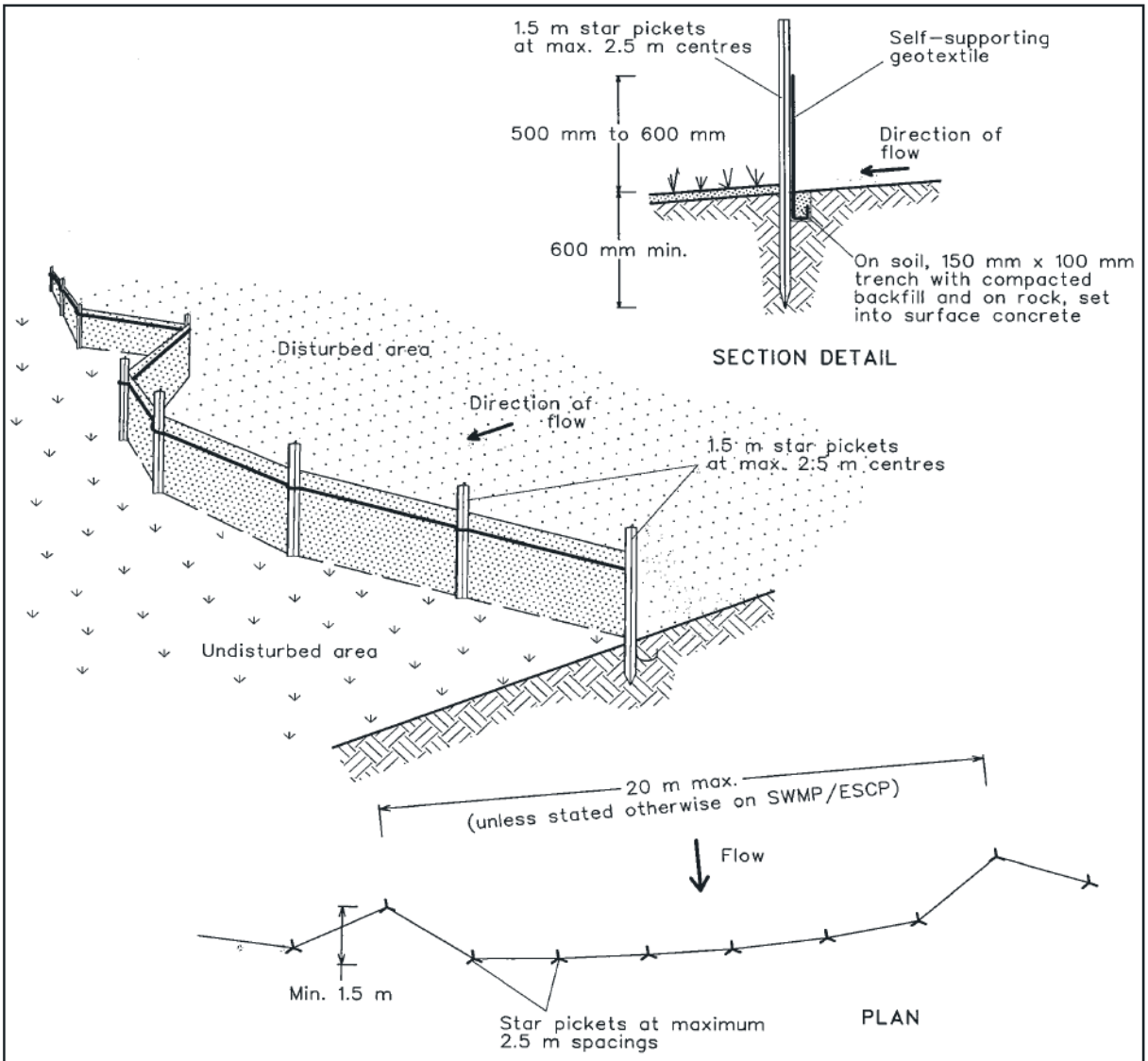
SD 6-4



Construction Notes

1. Construct the straw bale filter as close as possible to being parallel to the contours of the site.
2. Place bales lengthwise in a row with ends tightly abutting. Use straw to fill any gaps between bales. Straws are to be placed parallel to ground.
3. Ensure that the maximum height of the filter is one bale.
4. Embed each bale in the ground 75 mm to 100 mm and anchor with two 1.2 metre star pickets or stakes. Angle the first star picket or stake in each bale towards the previously laid bale. Drive them 600 mm into the ground and, if possible, flush with the top of the bales. Where star pickets are used and they protrude above the bales, ensure they are fitted with safety caps.
5. Where a straw bale filter is constructed downslope from a disturbed batter, ensure the bales are placed 1 to 2 metres downslope from the toe.
6. Establish a maintenance program that ensures the integrity of the bales is retained - they could require replacement each two to four months.

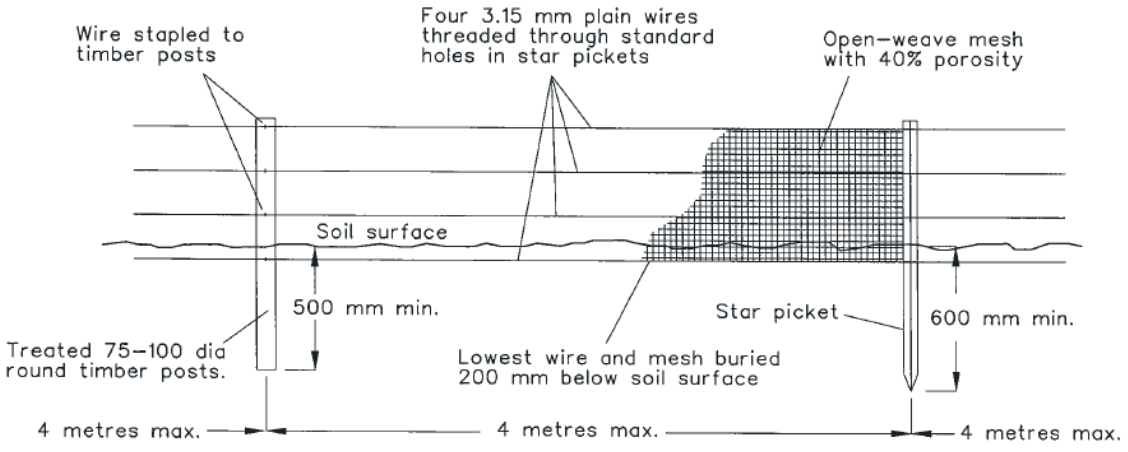
STRAW BALE FILTER **SD 6-7**

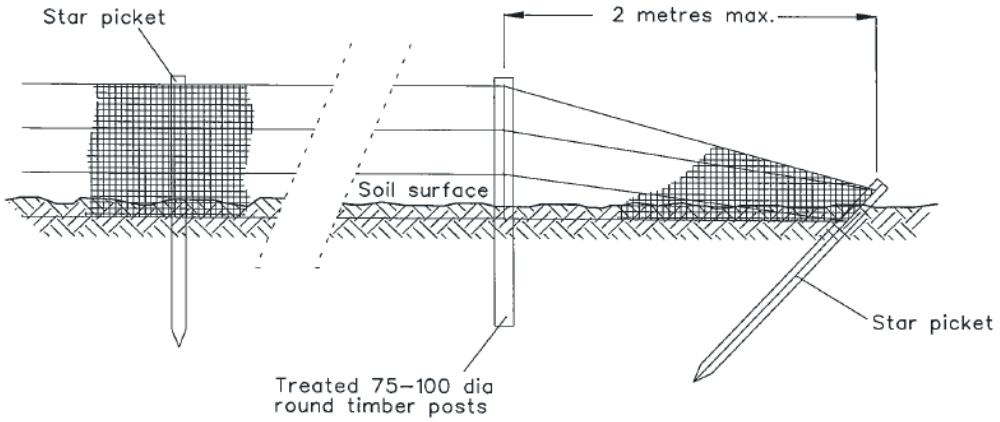


Construction Notes

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 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope 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 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE **SD 6-8**





Construction Notes

1. Install the fence to the height specified in the ESCP/SWMP.
2. Cut a channel 200 mm deep along the fence line.
3. Place wire and light resistant, open-weave polymer mesh with 40 percent porosity on the prevailing wind side of fence.
4. Fasten the mesh to all wires using ring fasteners at 100 mm to 150 mm intervals on top wire and 300 mm intervals on other wires.
5. Use one 75-mm to100-mm diameter treated round timber post every 20 metres.
6. Where star pickets are used, ensure they are fitted with safety caps.

CONTROL OF WIND EROSION **SD 6-15**

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