METROMIX PTY LIMITED

Teralba Quarry

Water Management Plan

September 2020

Approved by

the Secretary's nominee, Megan Dawson,

on 2 October 2018

Document Control

Document Title	Water Management Plan			
Document Number	559/65			
Document Owner	Metromix Pty Ltd			
Revision	**Issue Date**	**Originator**	**Reviewed**	**Approved**
Original (Draft 1)	9 August 2013	S. Cadman	F. Robinson	W Sanderson
Revision 1 (Final Draft)	19 August 2013		W Sanderson	W Sanderson
Revision 2	27 June 2014		W. Sanderson	W. Sanderson
Revision 3	30 September 2016	N. Warren	W. Sanderson	W. Sanderson
Revision 4	19 June 2018		W. Sanderson	W. Sanderson
Revision 5	21 September 2020	N. Warren	M. Yunusa	M. Yunusa
Next Review Due	Within 3 months of the submission of an: (a) annual review under Schedule 5 Condition 4; (b) incident report under Schedule 5 Condition 7; (c) audit report under Schedule 5 Condition 9:and (d) any modifications to the Project Approval, Note: Metromix will review, and if necessary, also revise the strategies, plans, and programs prepared in accordance with the Project Approval that are referred to in this Strategy.			

This Copyright is included for the protection of this document

CONTENTS

Page

CONTENTS

Page

COMMONLY USED ACRONYMS

AHD	Australian Height Datum
AS	Australian Standard
ANZECC	Australia and New Zealand Guidelines for Fresh and Marine Waters, 2000
DPE	Department of Planning and Environment
DoI Water	Department of Industry Water (DoI Water)
ENM	Excavated Natural Materials
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPL	Environment Protection Licence
KL	Kilolitre, 1 x 10^3 litres
mg	Milligram, 1 x 10^{-3} grams
MHRDC	Maximum Harvestable Rights Dam Capacity
ML	Megalitre, 1 x 10^6 litres.
MUS	*The Blue Book - Managing Urban Stormwater (MUS): Soils and Construction (Landcom)*
NATA	National Association of Testing Authorities
PA	Project Approval
POEO Act	Protection of the Environment Operations Act 1997
PRF	Primary Raw Feed
SEPP	State Environment Planning Policy
SHE	Safety Heath and Environment
SWMS	Safe Work Method Statement
t	tonnes
VENM	Virgin Excavated Natural Materials
yr	Year

This page has intentionally been left blank

1 INTRODUCTION

This *Water Management Plan* (the Plan) has been prepared by Metromix Pty Ltd (Metromix) for the Teralba Quarry (the Quarry). The Quarry is located west of the suburb of Teralba, beyond the western shores of Lake Macquarie (**Figure 1.1**). The Plan has been prepared in satisfaction of Schedule 3 *Conditions 22 to 26* of Project Approval (PA) 10_0183 MOD 1[1] (approved on 22 February 2013). A modification to PA 10_0183 was approved on 16 April 2018.

A summary of the condition is presented below together with the location within this document where each individual requirement is addressed.

Condition 3(26): Water Management Plan

The Proponent must prepare and implement a *Water Management Plan* for the project to the satisfaction of the Secretary. This plan must be prepared in consultation with Council (*City of Lake Macquarie*), and Department of Industry Water (DoI Water) by suitably qualified and experienced person/s whose appointment has been approved by the Secretary, and be submitted to the Secretary for approval within 6 months of the date of this approval and prior to any extraction activities within the Northern Extension area.

In addition to the standard requirements for management plans (see *Condition 5(3)*), this plan must include a:

a) Site Water Balance that:

- includes details of:
  - sources and security of water supply, including contingency planning (Section 7.3.1);
  - water use on site (Section 7.3.2);
  - water management on site (Section 7.3);
  - reporting procedures, including comparisons of the site water balance each calendar year (Sections 9.5 and 9.7); and
- describes the measures that will be implemented to minimise clean water use on site (Sections 7.3.1 to 7.3.4).

[1] All Schedules in Project Approval MP 10_0183 MOD 1 are referred to as *PA Condition* ...

Figure 1.1
LOCALITY PLAN

b) Surface Water Management Plan, that includes:

- detailed baseline data on surface water flows and quality in the watercourses that could be affected by the project (Section 7.1.3);
- a detailed description of the surface water management system on site, including the:
  - clean water diversion systems (Section 8);
  - erosion and sediment controls (Section 8); and
  - water storages (Section 7.1.2).
- design objectives and performance criteria for proposed:
  - erosion and sediment control structures (Section 8);
  - water storages (Section 8); and
  - control of water pollution from rehabilitated areas of the site (Section 8).
- performance criteria, including trigger levels for investigating any potentially adverse impacts, for surface water quality of local watercourses and Lake Macquarie (Section 9.2);
- a program to monitor:
  - the effectiveness of the water management system (Section 9);
  - surface water flows and quality in local watercourses and Lake Macquarie (Section 9.3); and
  - ecosystem health of local watercourses and Lake Macquarie (Section 9).
- a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the project (Section 11); and
- a detailed review the dirty water management system to:
  - determine whether the capacity, integrity, retention time and management of the system are sufficient to ensure that water discharged from the site meets the performance criteria and propose any upgrades necessary to meet these criteria (Section 8); and
  - assess appropriate options to improve storage and retention times in accordance with *The Blue Book - Managing Urban Stormwater (MUS): Soils and Construction (Landcom)* (Section 8).

c) Groundwater Management Plan, that includes:

- detailed baseline data on groundwater yield and quality in the area, that could be affected by the project (Sections 7.2.1 to 7.2.3);
- groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts (Section 9.2);
- a program to monitor:
  - surface water inflows into the groundwater system beneath the site (Section 9);
  - the impacts of the project on:
    - the local coal seam aquifer (Section 9);
    - any groundwater bores on privately-owned land that could be affected by the project (Section 9);
    - groundwater dependent ecosystems (no groundwater dependent ecosystems were identified on site in the Specialist Consultant Studies Compendium for the Teralba Quarry Extensions, June 2012. Part 2 – Groundwater Assessment); and
  - seepage/leachate from water storages or backfilled voids (including historical coal workings) on site (Section 9).
- a plan to respond to any exceedances of the groundwater assessment criteria (Section 11).

The individual requirements of *Condition 5(3)* and where they are addressed in this document are outlined as follows.

The Proponent shall ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include:

(a) detailed baseline data (Section 7.1);

(b) a description of:

- the relevant statutory requirements (including any relevant approval, licence or lease conditions) (Section 4);
- any relevant limits or performance measures/criteria (Section 9.2); and
- the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures (Section 9.2);

(c) a description of the measures that will be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria (Section 7.3);

(d) a program to monitor and report on the:

- impacts and environmental performance of the project (Section 9); and
- effectiveness of any management measures (see (c) above) (Section 10 and Section 13);

(e) a contingency plan to manage any unpredicted impacts and their consequences (Section 11);

(f) a program to investigate and implement ways to improve the environmental performance of the project over time (Section 15);

(g) a protocol for managing and reporting any:

- incidents (Section 11);
- complaints (Section 12);
- non-compliances with statutory requirements (Section 13); and
- exceedances of the impact assessment criteria and/or performance criteria (Section 13); and

(h) a protocol for periodic review of the plan (Section 13).

Note: The Secretary *may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.*

The Plan addresses the following elements.

- The activities approved under PA 10_0183 MOD 1.
- The consultation undertaken during preparation of this Plan.
- The legal and other requirements associated with management of water quality from the Quarry.
- The objectives and key performance outcomes for this Plan and the Quarry.
- Roles and responsibilities in implementing this Plan.
- Competence training and awareness for Metromix's personnel and contractors.
- Corrective and preventative actions that will be implemented should exceedance(s) of the relevant criteria be identified.
- Complaints handling and response procedures that will be implemented.
- Incident reporting procedures.
- Publication of monitoring information.

- Plan review.

The above elements reflect each of the specific issues outlined in *Condition 5(3)*, where relevant.

The approved Quarry and the water assessments of the approved extension are fully described in the following documents.

- Environmental Assessment for the Teralba Quarry Extensions, November 2011.
- Specialist Consultant Studies Compendium for the Teralba Quarry Extensions, June 2012. Part 2 – Groundwater Assessment.
- Specialist Consultant Studies Compendium for the Teralba Quarry Extensions, June 2012. Part 3 – Surface Water Assessment.
- Specialist Consultant Studies Compendium for the Teralba Quarry Extensions, June 2012. Part 9 – Soil and Land Capability Impact Assessment.

A brief description of the approved activities within the Quarry is provided in Section 2.

It needs to be acknowledged that water management within the Teralba Quarry is substantially different from a conventional greenfield site or a quarry during its early stages of development. The Quarry has been in existence for more than 50 years with Metromix operating it for the past 30 years. During that time, the Quarry has been developed and is now sufficiently advanced that it can be operated with all runoff being directed inwards to the extraction voids that are clearly substantial and able to contain all runoff. Furthermore, because of the permeable characteristics of the conglomerate, the presence of coal mining beneath the quarry in the past and on the surface, runoff characteristics are far from conventional. Numerous subsidence cracks and the presence of chitter material substantially reduces runoff.

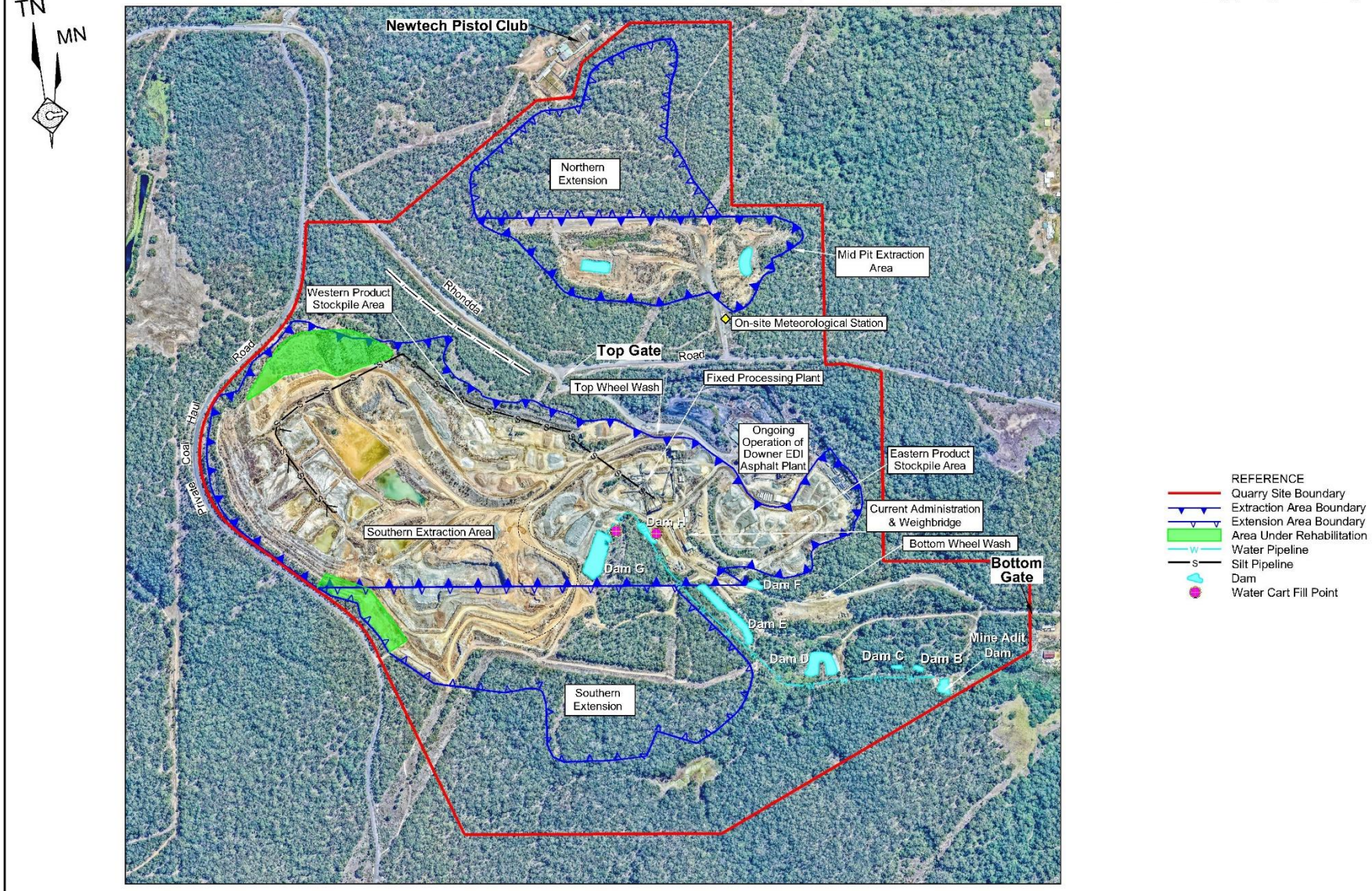
2 APPROVED ACTIVITIES

The approved activities within the Quarry comprise the full range of activities undertaken prior to 22 February 2013 and the extension of extraction operations to the north and south of the previously approved extraction areas. The approved activities on site comprise the following, the locations of which are displayed on **Figure 2.1**.

- Conglomerate extraction (blasting and excavation).
  - Southern Extraction Area.
  - Mid Pit Extraction Area.
  - Southern Extension.
  - Northern Extension.
- Processing Operations (size reduction, screening and blending).
  - Existing processing plant and pugmill.
- On-site Load and Haul Operations.
  - Off-road trucks on the on-site road network.
  - Conveying primary-crushed rock from the Southern and Northern Extensions to the processing plant (including conveyor beneath Rhondda Road).
- Off-site transportation of products.
- Vehicle/equipment maintenance and ancillary activities and stores.
- Administration and product despatch.
- Progressive rehabilitation and maintenance.

The sequence of extraction throughout the life of the Quarry will be consistent with the staging of vegetation clearing and therefore retirement of biodiversity credits specified in Conditions 3(54) to 3(56) of PA 10_0183 MOD 1.

Y:\Jobs 531 to 1000\559\Post April 2004\Reports\55954_Annual Review 2017\CAD\559BaseMGA56.dwg_1.2 Approved Quarry Layout-19.07.2018-10:12 AM



SCALE 1:12 000 (A4)

200 0 200 400 600 m

Base Photo Source: Nearmap - 28 February 2018

Figure 2
QUARRY SITE LAYOUT

The relevant limitations upon the approved activities nominated in conditions within Project Approval 10_0183 MOD 1 are as follows.

- "The Proponent shall not carry out quarrying operations below 20 AHD in the Southern Extension and 24m AHD in the Mid Pit Extraction Area and Northern Extension" (*Condition 2(6)*).
- "The Proponent shall not extract more than 1.2 million tonnes of extractive materials from the site in any calendar year" (*Condition 2(7)*).

The approved quarry life is until 31 December 2038 (*Condition 2(5)*) and the approved hours of operation are set out in **Table 2.1** (*Condition 3(6)*).

Table 2.1: Approved Hours of Operation

Day	**Receipt of Concrete, VENM or ENM**	**Loading and Despatch of Quarry Trucks**	**Extraction and Processing Operations**
Monday to Friday	7:00am to 5:00pm	4:00am Monday to midnight Friday	7:00am to 7:00pm
Saturday	7:00am to 2:00pm	midnight Friday to 6:00pm Saturday	7:00am to 2:00pm
Sundays and Public Holidays	None	None	None
Note: Maintenance activities may occur at any time provided they are inaudible at privately-owned residences.			

3 CONSULTATION

3.1 GOVERNMENT AGENCY CONSULTATION

Condition 3(26) requires this plan to be prepared in consultation with Lake Macquarie City Council and DPI Water. Consultation undertaken during 2014 and involved the submission of a draft version of this plan to both the Department of Planning and Environment (DPE), Lake Macquarie City Council (Council) and DoI Water for review. Council and the DPE provided comments on the document. Whilst no comments were provided by DoI Water, Metromix clarified all outstanding issues regarding the licencing for the quarry's operation. Given that the changes to this document, made as a result of a review in August 2018, are minor in nature, further consultation with DoI Water and Council was not deemed necessary. This was confirmed in correspondence from DPE dated 18 July 2018.

Metromix has continued to consult with the Environment Protection Authority (EPA) regarding the locations and requirements for water monitoring specified within EPL 536. This included completion of a final assessment report for the Pollution Reduction Program (PRP) associated with the Mine Adit Dam and Dam B, which were monitored for additional pollutants over a period of 38 months. More detail on the results of the PRP are provided in Section 7.1.3. The EPA does not provide feedback on environmental management plans where the EPA is not required to approve the plans, however, the proposed monitoring program (Section 9) is consistent with the monitoring requirements of EPL 536, as varied by the EPA on 5 April 2018.

4 LEGAL AND OTHER REQUIREMENTS

4.1 PROJECT APPROVAL PA 10_0183 MOD 1 CONDITIONS

This Plan has been prepared to outline how Metromix proposes to satisfy the requirements of *Conditions 3(22)* to *3(26)* of PA 10_0183 MOD 1 relating to water management.

3(22) Water Supply

"The Proponent must ensure it has sufficient water during all stages of the project, and if necessary, adjust the scale of quarrying operations on site to match its available supply."

3(23) Surface Water Discharges

"The Proponent must ensure that all surface water discharges from the site comply with the discharge limits in any EPL which regulates water discharges from the site, or with section 120 of the POEO Act."

3(24) On-Site Sewage Management

"The Proponent must manage on-site sewage to the satisfaction of Council and the EPA".

3(25) Storage of Chemicals & Petroleum Products

The Proponent must ensure that all chemicals and/or petroleum products on site are held in appropriately bunded areas with impervious flooring and sufficient capacity to contain 110% of the largest container stored within the bund, and in accordance with Australian Standard AS1940-2004,The Storage and Handling of Flammable and Combustible Liquids. The flooring and bund(s) must be designed in accordance with:

- the requirements of relevant Australian Standards; and
- DECC's Storing and Handling Liquids: Environmental Protection – Participants Manual.

3(26) Water Management Plan

See Section 1 for conditional requirements.

Schedule 5 of PA 10_0183 MOD 1 describes general environmental management, reporting and auditing conditions. The following conditions are relevant to the management of water within the Quarry.

5(3) Management Plan Requirements

See Section 1 for conditional requirements.

5(5) Revision of Strategies, Plans & Programs

Within 3 months of the submission of an:

- annual review under *Condition 5(4*);
- incident report under *Condition 5(7);*
- audit report under *Condition 5(9);* and
- any modifications to the Project Approval,

Metromix shall review, and if necessary revise, the strategies, plans, and programs required under this approval to the satisfaction of the Secretary.

5(11) Access to Information

The approved management plan and any monitoring required under PA 10_0183 MOD 1 will be made publicly available on the Metromix website.

4.2 STATEMENT OF COMMITMENTS

Table 4.1 presents the relevant water-related commitments from the Statement of Commitments incorporated within this Plan. These and other control measures and the personnel responsible are incorporated in Section 7 of this Plan.

Table 4.1: Water-related Commitments

Commitment		Timing
	Groundwater	
6.1	Securely store all hydrocarbon products within designated and bunded areas.	Ongoing
6.2	Refuel and maintain all earthmoving equipment within designated areas.	Ongoing
6.3	Prepare a Groundwater Management Plan, including trigger levels for actions.	Ongoing
6.4	Prepare a Spill Management Plan to address potentially significant hydrocarbon spills.	Ongoing
6.5	Develop and implement a monitoring program as part of the Soil and Water Management Plan.	Within 6 months of the receipt of Project Approval.
6.6	Monitor water quality at the Mine Adit Dam for pH levels, electrical conductivity, suspended solids, and oil and grease.	Monthly (subject to review).
6.7	Record flows/discharges from the Mine Adit Dam as well as quarry water usage.	Continuous.
6.8	Review monitoring results to identify trends which may indicate impacts and allow mitigation measures to be implemented, if required.	Annually.
6.9	Ensure all monitoring data is incorporated into each Annual Environment Management Report for the Teralba Quarry.	Annually.

Table 4.1: Water-related Commitments

Commitment		Timing
Surface Water		
7.1	Conduct site clearing activities in accordance with the Blue Book (Landcom, 2004) guidelines for erosion and sediment control.	Ongoing.
7.2	Establish a regular monitoring program to review the effectiveness of all erosion and sediment control mitigation measures.	Prior to commencement of clearing works.
7.3	Incorporate an update of the current Water Management Plan (GHD, 2007) into the Soil and Water Management Plan to take into account the proposed Southern and Northern Extensions.	Within 6 months of date of Project Approval.
7.4	Ensuring any off-site discharge is monitored and reported in accordance with Environment Protection Licence 536.	As Required.
7.5	Provide 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.	Ongoing.
7.6	Inspect all sediment dams and maintain as necessary (keep records).	Monthly of following rainfall exceeding 10mm in 2 days.
7.7	Remove accumulated sediment from sediment dams when storage capacity reduced by 25% - document activity in maintenance records.	Following routine inspection.
7.8	Securely store all hydrocarbon products within designated and bunded areas.	Ongoing.
7.9	Refuel all earthmoving equipment within designated areas (with spill control).	Ongoing.
7.10	Construct a drain from Dam B directly to the nearby watercourse to divert surface flows away from the Mine Adit Dam.	Within 3 months of Project Approval or following advice from DPI Water whichever occurs sooner.

4.3 ENVIRONMENT PROTECTION LICENCE 536

Table 4.2 presents the relevant water-related requirements from the updated amended EPL 536.

Table 4.2: Water-related EPL 536 Requirements

Condition Number	Condition
P1.3	Monitor surface water at monitoring points 4, 5, 6, 7 in accordance with the 'Type of Monitoring Point and at the locations specified in the 'Location Description' column.
L1.1	Compliance with the POEO Act
L2.4	Concentration Limits applicable to monitoring points(1) 4, 5, 6, 7 include Oil and Grease - 10mg/L pH - 6.5 to 8.5 Total suspended solids less than 50 mg/L (at discharge points)
L2.5	Discharges from EPL Points 6 and 7 are only permitted when the quantity and duration of the rainfall event exceeds a 1 in 50 year Annual Rainfall Intensity (ARI).
L3.1	The volume/mass of liquids discharged to water at EPL Point 5 must not exceed 2ML per day or 113 ML per year.

Table 4.2: Water-related EPL 536 Requirements

Condition Number	Condition
M2.3	Monitoring at monitoring Point 4 monthly during discharge period for pH, total suspended solids, conductivity and oil and grease. Monitoring at monitoring Point 5 within 12 hours of commencing any discharge for pH, conductivity, oil and grease and total suspended solids Monitoring at monitoring Points 6 and 7 within 8 hours of commencement of discharge and weekly thereafter during discharge period for pH, conductivity, oil and grease and total suspended solids.
M7.1	Flowmeters must be installed at EPL Point 4 and EPL Point 5 to record the volume/mass of liquids discharged to water on a daily basis. The flowmeter should also record the annual volume/mass of liquids discharged to water from EPL Point 5.
R1.1	Any monitoring is to be included in an Annual Return.
R3	A written report may be required where any pollution event has occurred.
R4.1	The licensee must report any exceedance for water quality limits to the EPA as soon as practicable after the exceedance becomes known.

Between September 2013 and April 2018 Metromix sampled and assessed water discharged at EPL Pont 4 and EPL Point 5 for a range of pollutants in accordance with the Pollution Reduction Program specified in *Condition U1.1, Condition U1.2* and *Condition U1.3* of EPL 536. The PRP has now ceased and a report presenting the results received between September 2013 and September 2017 is provided in **Appendix 2** and summarised in Section 7.1.3.

5 OBJECTIVES AND OUTCOMES

Table 5.1 presents the objectives and key performance outcomes relating to water for this Plan and the Quarry.

Table 5.1: Water Objectives and Key Performance Outcomes

Objectives	Key Performance Outcomes
(a) To ensure compliance with all relevant Project Approval and Environment Protection Licence criteria and reasonable community expectations.	(i) Compliance is achieved with all relevant criteria nominated in the Project Approval 10_0183 MOD 1 and EPL 536 and reasonable community expectations.
(b) To implement appropriate water management and mitigation measures during all stages of the Quarry.	(ii) All identified water management and mitigation measures are implemented to the extent required.
(c) To implement an appropriate monitoring program to establish compliance or otherwise with relevant criteria during all stages of the Quarry.	(iii) All identified monitoring is undertaken in accordance with the relevant procedures and at the relevant intervals.
(d) To implement an appropriate complaints handling and response protocol.	(iv) Complaints (if any) are handled and responded to in an appropriate and timely manner.
(e) To implement continual improvement for investigating, implementing and reporting on reasonable and feasible measures to reduce air quality emissions.	(v) An appropriate continual improvement program has been implemented.
(f) To implement an appropriate incident reporting program, if required.	(vi) Incidents (if any) are reported in an appropriate and timely manner.

6 PERSONNEL MANAGEMENT

6.1 ROLES AND RESPONSIBILITY

Table 6.1 presents the roles and responsibilities of the Quarry personnel for the implementation of this Plan.

Table 6.1: Roles and Responsibilities for Management of Water

ROLES	RESPONSIBILITIES
Risk Manager	• Ensure compliance with the Water Management Plan. • Ensure adequate resources are available to implement the Water Management Plan. • Ensure suitably trained personnel are available to implement the responsibilities of the Quarry Manager during any time of the Quarry Manager's absence from site.
Quarry Manager	• Ensure the implementation of the Water Management Plan. • Ensure that all required monitoring is undertaken and data collected in accordance with the requirements of EPL 536 conditions and Project Approval 10_0183 MOD 1. • Ensure water quality monitoring results are regularly reviewed/evaluated. • Relocate or postpone relevant activities in the event of adverse weather conditions, where practical. • Provide primary contact for complaints and supply follow-up information to any complainant. • Initiate investigations of complaints as received from the public or government agency. • Prepare a report to government agencies or neighbours following a notifiable pollution incident (see Section 13). • Ensure employees are competent through training and awareness programs. • Coordinate the review of the *Water Management Plan* (see Section 15). • Ensure all erosion and sediment control measures are in place and are regularly monitored and maintained/(cleaned out). • Following storm events, monitor sediment dam capacities, test for suspended solids content and assess requirement for discharge from Dam B (or other sediment dams as required). • Ensure that all controls nominated in the Erosion and Sediment Control Plan (**Appendix 1**) are implemented within the nominated time frame.
Quarry Supervisors	• The operation of a water truck to supress dust (and maintain records of use) • The operation of mist sprays/dust suppression on conveyors and transfer points to suppress dust.
All personnel	• Comply with all relevant Water Control Measures

6.2 COMPETENCE TRAINING AND AWARENESS

All Metromix personnel and contractors and their employees will undergo site specific training incorporating water management awareness as part of the Quarry's Safety, Health and Environmental (SHE) program. The training will involve the following.

- use of truck wheel washes;
- preventing and cleaning up spills; and
- hydrocarbon storage.

Relevant personnel to be trained in water sample monitoring and inspection of water control measures and dams.

7 SITE WATER MANAGEMENT

7.1.1 Surface Water Setting

7.1.2 Quarry Surface Water Catchments

The Quarry Site including existing areas and approved extensions, is divided into seven sub-catchment areas, summarised in **Table 7.1** and displayed on **Figure 7.1**

Table 7.1: Quarry Site Sub-catchment Areas

	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	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 Quarry Site. Proposed Northern Extension.	Gun Club and undisturbed bushland Runoff draining west off site.	12.9
G	North-east extent of Quarry Site. Mid Pit Extraction Area.	Undisturbed bushland and electricity easement. Runoff draining east off site.	20.4

Sub-catchment areas A, B and C cover the existing Southern Extraction Area. Sub-catchment D is located south of the existing Southern Extraction Area and 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 area already disturbed within the Mid Pit Extraction Area.

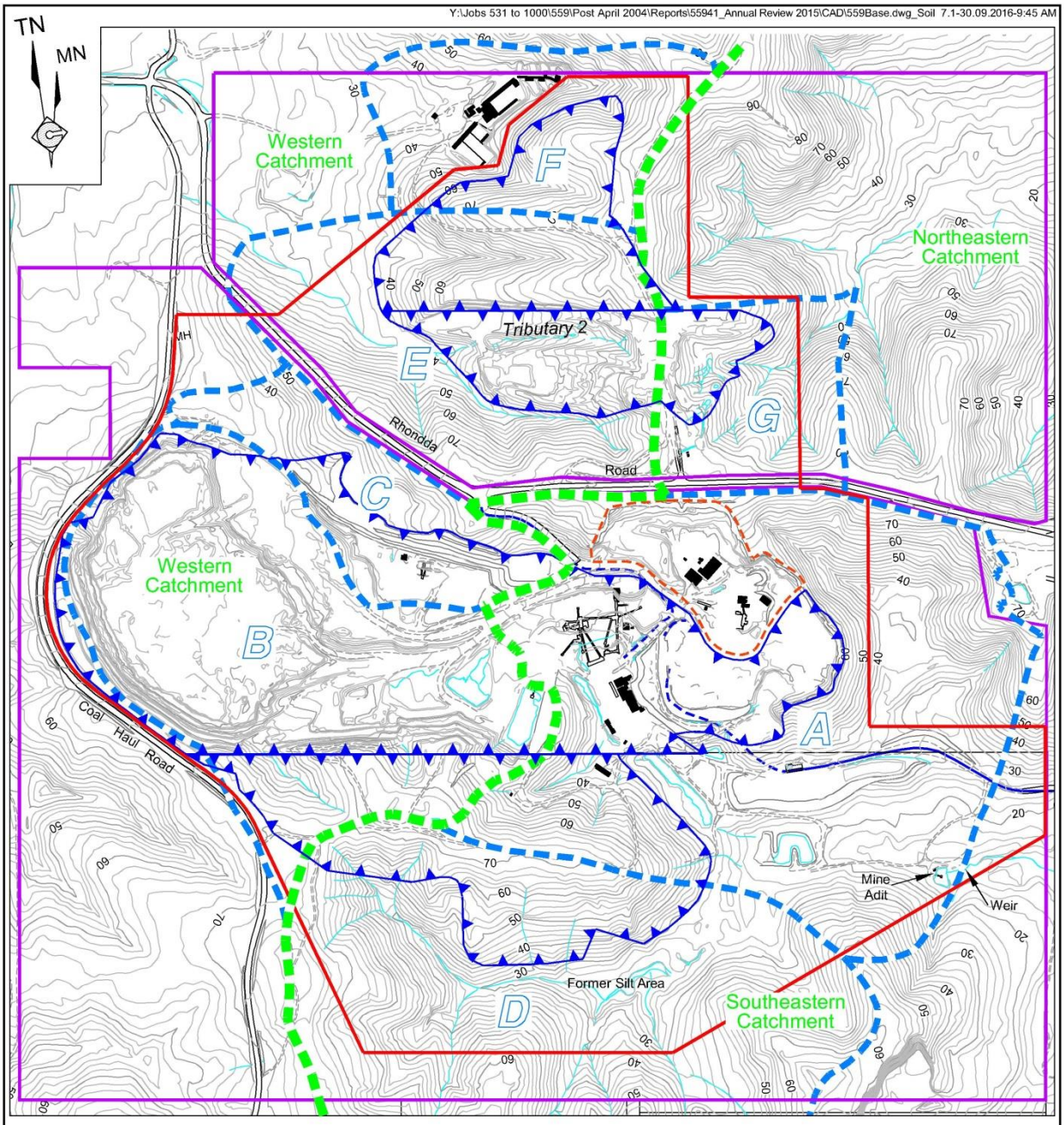


Figure 7.1
QUARRY SITE SURFACE WATER CATCHMENTS AND DRAINAGE

Details of each of the surface water catchments are presented as follows.

Sub-Catchment A *(Eastern side of the existing Southern Extraction Area to the eastern border of the Quarry Site)*

Surface runoff within Sub-catchment A flows to Dam B via a series of formalised drainage paths and sediment dams which aim to reduce suspended solids concentration and encourage infiltration. The dams, particularly Dam D are all known to leak a considerable quantity of water as Metromix personnel regularly observe substantial decrease in water levels in a matter of days within the dams.

The processing plant sources its water from the nearby Dam G. Water draining from the processing plant flows to a small collection dam, and then a wedge pit. The collected water is then 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

Sub-Catchment 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 and an old extraction pit. 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.

Sub-Catchment C *(along the northern boundary of the existing Southern Extraction Area)*

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

Surface water runoff from the remainder of the sub-catchment area, being undisturbed bushland, is diverted around the northern side of the existing Southern Extraction Area to the west and off site via a natural gully. The southern side of the natural gully abuts stockpiled overburden.

It is understood that during large rainfall events, the majority of surface water infiltrates the conglomerate/ground surface within this catchment with only small quantities of runoff actually flowing off site.

Sub-Catchment D

This catchment drains runoff from the southern side of the Quarry Site and the property south of the Quarry Site. The bulk of the catchment is vegetated although a section of the catchment contains a small area of silt placed in this catchment early in the Quarry's operational life. It is also understood that the outflow from this catchment lies above an area backfilled with coarse coal chitter which remains highly porous and limits overland flow from entering Dam D.

Sub-Catchment E

Runoff from within this catchment is either retained within the western side of the Mid Pit Extraction Area (in Dam J) or flows westward off site unaffected by any quarry-related activities. A considerable proportion of this sub-catchment will be progressively captured during the extraction activities north of Rhondda Road.

Sub-Catchment F

This catchment is located near the northern side of the Quarry Site immediately to the east of the Newtech Pistol Club. The bulk of the catchment is currently vegetated with some tracks traversing the catchment. Runoff from the catchment is directed into two drainage lines that flow westward through the club area.

Sub-Catchment G

Runoff from this catchment is either retained within the eastern side of the Mid Pit Extraction Area (in Dams K and L) or flows eastward off site unaffected by any quarry-related activity.

7.1.3 Surface Water Collection and Storage

Surface water runoff within the Quarry Site occurs as a result of rainfall events and overflow from the processing plant. Rainfall runoff occurs from disturbed areas including the extraction areas, sealed and unsealed haul roads and stockpile areas as well as undisturbed and cleared bushland areas of the Quarry. A significant proportion of rainfall and surface water runoff across the Quarry infiltrates due to the highly permeable ground surface (as a result of incipient permeability and subsidence cracks attributable to coal mining beneath the Quarry and the conglomerate weathering profile).

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.

Historically, following substantial rainfall periods, surface runoff within the area south of Rhondda Road was directed to the Mine Adit Dam and, mixed with groundwater flowing from the mine adit before flowing off site. This practice has now ceased and the surface runoff is now directed via a series of sediment dams before flowing off site. The locations of the dams listed in **Table 7.2** are presented in **Figure 7.2**.

Table 7.2: Site Storage/Sediment Dams

Dam	Plate	Description	Volume (ML)	Surface Area (m^2)
Mine Adit Dam	7.1	Flooded Mine Adit	1.2	400
Dam B	7.2	Final Sediment Dam	0.3	200
Dam C	7.3	Sediment Dam	0.3	200
Dam D	7.4	Vegetated Sediment Dam	35	9 900
Dam E	7.5	Reed Bed Sediment Dam	9.0	3 000
Dam F	7.6	Stockpile Sediment Dam	0.7	230
Dam G	7.7	Lined Process Water Storage Dam	10.8	2 700
Dam H	7.8	Initial Sediment Dam	4.3	1 440
Dam J	7.9	Sediment Dam – western Mid Pit	36[2]	6 300
Dam K	7.10	Sediment Dam – eastern Mid Pit	2.6	4 500
Dam L		Sediment Dam/Wheel Wash Runoff	0.5	300
Dam M[1]		Sediment Dam – Northern Extension	18	4 200

1. Not yet constructed
2. Includes the capacity of the adjacent Pit Sump

The minimum volume/capacity of each sediment dam comprises the sum of the settling zone volume and sediment storage volume (BMT WBM Pty Ltd).

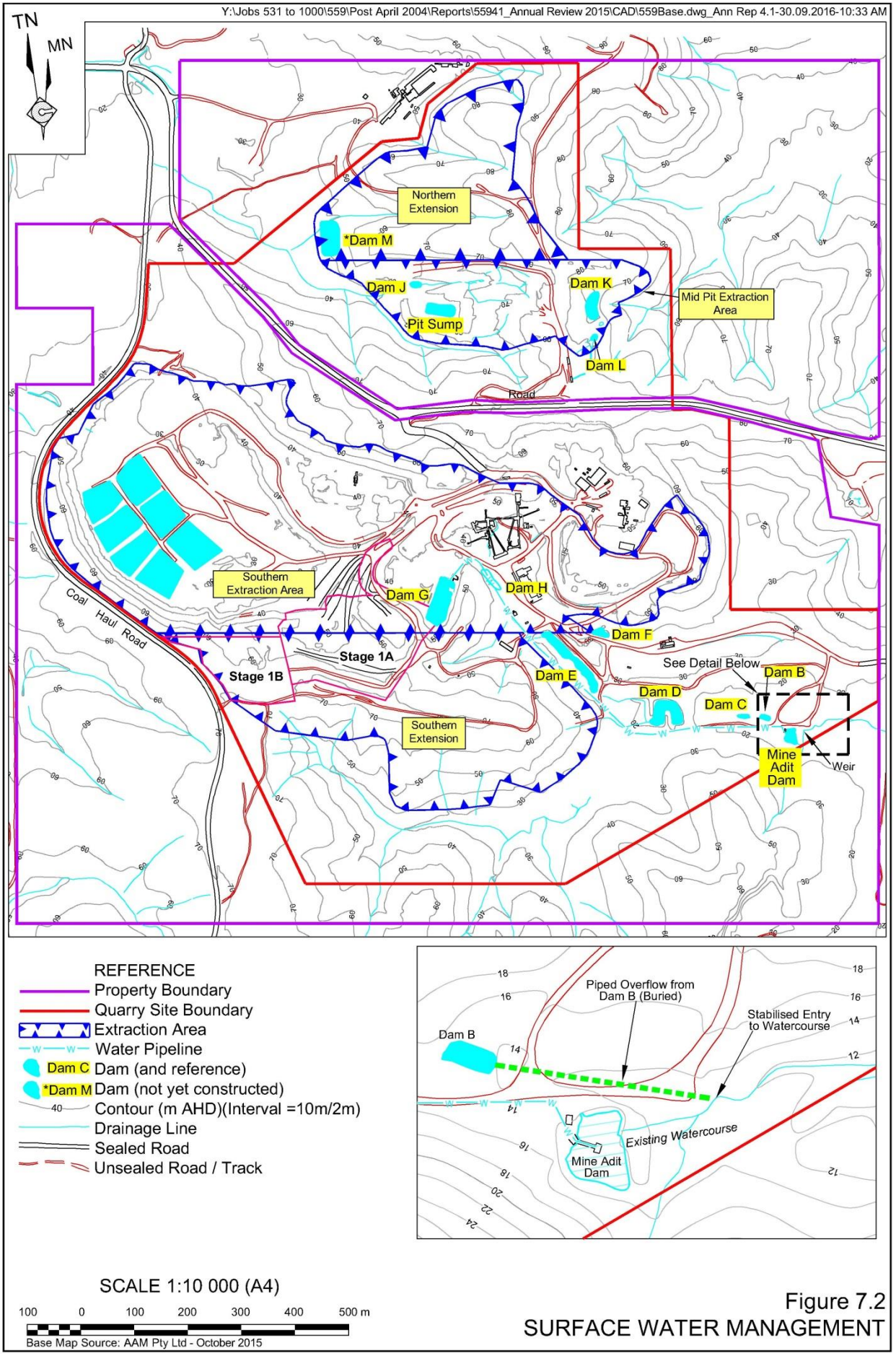


Figure 7.2
SURFACE WATER MANAGEMENT

Plate 7.1 Mine Adit Dam

Plate 7.2 Dam B

Plate 7.3 Dam C

Plate 7.4 Dam D

Plate 7.5 Dam E

Plate 7.6 Dam F

Plate 7.7 Dam G

Plate 7.8 Dam H

Plate 7.9 Dam J

Plate 7.10 Dam K

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 (GSSE, 2011).
- 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.

Metromix has constructed the sediment dams/storage dams based on the calculations undertaken by BMT WBM (2011) and its on-site experience with an emphasis upon over-design of the key dams on site. For example, Dam D has been enlarged to a volume of approximately 35ML. Similarly, Dam J when combined with the Pit Sump within the Mid Pit Extraction Area has a capacity of 36ML.

All dams have spillways designed for at least 50 year average return interval.

A description of each dam, its function and relevant features are set out as follows.

Mine Adit Dam (Plate 7.1)

This dam is located on the northern side of an historic and flooded mine adit that was originally associated with the Oceanic Coal's Westside Colliery (Teralba and Northern Extended Collieries) and Coal and Allied's Northern Colliery (formerly known as Rhondda Colliery) that targeted the Fassifern Seam and Great Northern Coal Seam. The Westside Colliery is in fact connected underground with

other nearby mines such as Rhondda Colliery, the owners of which (Coal and Allied) held an EPL 3139 that required the monitoring of the discharge from the Mine Adit Dam until early 2013.

The Mine Adit Dam was constructed at the outflow of the mine adit and continuously discharges water from the underground voids (groundwater) to the at-surface Mine Adit Dam that flows eastwards for a distance of approximately 40m along an unnamed watercourse to the eastern boundary of the Teralba Quarry and then towards Lake Macquarie. Groundwater from the underground coal workings is referred to as “surface water” once reaching the Mine Adit Dam. The water in the Mine Adit Dam is either pumped to Dam G for Metromix’s use or allowed to flow off site. Metromix has modified this dam through adding an upgraded overflow with geotextile/gabion material and a 4x pipe discharge. Metromix records the overflow continuously from this dam.

During extreme rainfall events in April 2015 and January 2016 this dam overflowed to Dam B with the water eventually discharged from Dam B via the outlet pipe and drainage channel.

Dam B (Plate 7.2)

This dam is the final sediment dam in the sequence of sediment dams on the southern side of Rhondda Road and is the overflow point from the Quarry’s surface water management system. The dam largely receives runoff from Dam C and the upstream catchments and a small local catchment to the north of the dam. This dam is shallow and invariably contains comparatively sediment free water. Water discharged from this dam flows into the unnamed drainage channel via an outlet pipe, effectively mixing with the water overflowing from the Mine Adit Dam before flowing eastwards approximately 2km until its confluence with Lake Macquarie.

Dam C (Plate 7.3)

This dam lies immediately upstream from Dam B and is similar in size to Dam B with a short connecting channel between both dams. This dam is also shallow and invariably contains comparatively sediment free water.

Dam D (Plate 7.4)

This dam is the major water storage dam controlling runoff from the southern side of Rhondda Road. The dam has recently been enlarged to provide a capacity in excess of 25ML. The enlargement is likely to substantially reduce the frequency of overflows from this dam and the overall catchment. The dam operates with a riser and incorporates a height staff for the identification of the trigger level for the discharge of excess water above the trigger level.

Dam E (Plate 7.5)

This dam is an elongated dam containing considerable reeds designed as a filter bed to reduce sediment load prior to water entering Dam D. The reeds within this dam are periodically partially removed (section by section) to retain the reeds as much as possible.

Dam F (Plate 7.6)

This dam collects runoff from the product stockpile area north of the bottom road and overflows to Dam D via a pipe beneath the bottom road. This dam is regularly cleaned out, as required.

Dam G (Plate 7.7)

This dam is excavated within the Southern Extraction Area and is lined and provides the main on site water storage for water pumped from the Mine Adit Dam and returned from the silt cells and wedge pit.

Dam H (Plate 7.8)

This is the first dam immediately downslope from the processing plant which collects sediment-laden runoff from the plant area.

Dam J (Plate 7.9)

This dam is effectively excavated within the western side of the Mid Pit Extraction Area and contains runoff from the entire disturbed western section of the Mid Pit Extraction Area. Dam J would overflow directly to an adjacent Pit Sump, effectively increasing the capacity of this dam.

Dam K (Plate 7.10)

This dam is constructed at the eastern and lowest point of the Mid Pit Extraction Area and collects runoff from this catchment and overflow from the Dam L.

Dam L (Plate 7.10)

This dam collects runoff from its immediate surrounds and overflow from the small dam previously used for the storage of runoff from the Mid Pit Wheel Wash facility.

Dam M

This dam is yet to be constructed.

The existing Mid Pit Extraction Area and Northern Extension drain to Cockle Creek in a westerly or easterly direction via a series of ephemeral streams. Sediment dams to intercept off-site flow (for sediment removal) have been constructed, or will be constructed, as required.

Overflow from the Mine Adit Dam and Dam B flows eastward via an irregular vegetated drainage line and a concrete open channel referred to as “Murph’s Drain”. This creek and drain were ephemeral prior to coal mining activities. However, since the cessation of coal mining, the flow in this creek and drain has almost been permanent due to discharge form the Mine Adit Dam.

The drainage line immediately downstream of the Mine Adit Dam is overgrown with reeds and other vegetation which continues through to a large pond formed by the railway embankment. It is unknown whether any of the industrial enterprises along Murph’s Drain source water from or discharge to the drain.

Murph’s drain discharges to Lake Macquarie at the mouth of Cockle Creek near the Teralba Lakeside Caravan Park.

7.1.4 Surface Water Flow Within the Quarry

Flow meters have been installed to measure water discharging from the or from Dam B (i.e. at EPL Points 4 and 5) and to record water pumped from the Mine Adit Dam to Dam G and represents groundwater intercepted from the Mine Adit. Water drawn into the Water Cart is also recorded on a monthly basis.

Table 7.3 presents a summary of water flow recorded at these locations between 2015 and 2017.

Table 7.3: Annual Recorded Surface Water Flows

Location	Water Destination	2015 (ML/annum)	2016 (ML/annum)	2017 (ML/annum)
Mine Adit Dam	Discharge to unnamed watercourse	1332	1044	336
Dam B	Discharge to unnamed watercourse	105.1*	39.2	2.9
Mine Adit Dam***	Dam G	780.8	1 233	1 198
Dam G or other water source	Water Cart	24.7	18.7	22.6
*Includes approximately 47ML that overflowed from the Mine Adit Dam into Dam B during April 2015 storm event. ** Licenced water use under Water Access and Entitlement Licence No’s: 20PT911863D and 20AL217067D Respectively.				
Source: Metromix				

7.1.5 Surface Water Quality

Surface water discharge from the Quarry Site was historically monitored on a monthly basis downstream of the Mine Adit Dam from September 1998. Discharge from the Mine Adit Dam was largely groundwater sourced from mined voids from the Rhondda Colliery (see Section 7.2.1), since the majority of surface water runoff was retained and infiltrated on site.

The historical approximate daily discharge recorded immediately downstream of the Mine Adit Dam, over the period July 2000 to December 2008, averaged 4.5ML/d.

Briefly, historical pH values were within the range of 6.5-8.5 (the discharge guideline criteria for the site), for all monitoring events with the exception of August 2002 which recorded a pH of 8.6.

Historical suspended solids concentrations range from 1mg/L to 150mg/L, The suspended solids concentration exceeded 50mg/L, (the discharge guideline criteria for the site), during 11 monitoring events since 1998.

Historical electrical conductivity values range from 2300µS/cm to 12,300µS/cm and a declining trend was 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 resulted in a decrease in electrical conductivity of the groundwater discharging from the Mine Adit Dam. Records of electrical conductivity monitored between September 2013 and August 2016 at the Mine Adit Dam ranged between 1460 µS/cm and 2480 µS/cm

Electrical conductivity was found to be very similar for both the Mine Adit Dam and downstream, in the samples historically analysed (by Rhondda Colliery) from the watercourse near the caravan park. This is contrasted with lower Cockle Creek (tidal, reflecting Lake Macquarie values) with an average salinity of approximately 29000µS/cm and a maximum value of approximately 44000µS/cm.

Other monitored water quality parameters are presented in **Table 7.4**.

Metromix present all surface water monitoring results in each *Annual Review*.

Table 7.4: Water Quality – Mine Adit Dam

Analyte	No of samples	Guidelines [a]	Concentrations		
			Mean	Min	Max
pH [b]	274[1]	6.5 to 8.5	7.1	6.2	8.6
Conductivity (µS/cm)	152[2]	N/A	6 541	471	13 600
Dissolved Organic Carbon (mg/L as C)	122[3]	N/A	3.7	0.5	32
Ammonia (mg/L as N)	260[1]	1.43	0.23	0.0025	4.02
TKN Filtered (mg/L as N)[c]	149[2]	N/A	0.85	0.02	3.4
Nitrates (mg/L as N)	275[1]	3.4	0.25	0.0025	10.9
Suspended Solids (mg/L) [b]	271[1]	50 [b]	21.4	0.5	248
Chloride (mg/L)	244[1]	No GL	1 800	86	5 200
Sulfate (mg/L)	123[3]	No GL	509	48	1 200
Total Phosphorus (mg/L as P)	272[1]	0.01	0.078	0.003	0.71
Zinc (mg/L)	123[3]	0.015	0.023	0.01	1.0
Selenium (µg/L)	123[3]	0.011	0.51	0.25	7
Arsenic (µg/L)	123[3]	0.094	1.31	0.05	8.6
Boron (mg/L)	123[3]	0.68	0.45	0.07	1
Bromide (mg/L)	123[3]	No GL	6.59	0.1	50
Fluoride (mg/L)	120[2]	No GL	0.4	0.2	1.2

Source: Rhondda Colliery Monitoring Records. a ANZECC 2000 Freshwater Guideline for 90% protection.

b EPL3139. c Total Kjeldahl Nitrogen. N/A = Not Applicable.

Sampling Duration: 1 ~ Approximately 20 years. 2 ~ Approximately 10 years. 3 ~ Approximately 7 years.

Between September 2013 and August 2016 Metromix sampled and assessed water discharged at EPL Pont 4 and EPL Point 5 for a range of pollutants in accordance with the Pollution Reduction Program specified in *Condition U1.1, Condition U1.2* and *Condition U1.3* of EPL 536. A summary of the results for EPL Point 5 is presented in **Table 7.5** provide an indication of water quality recorded at EPL Point 5 over the previous approximately 3 years.

Table 7.5: Water Quality – Dam B

Analyte	No of samples	Guidelines	Median	Min	Max
pH	19	6.5 to 8.5	7.73	7.25	8.06
Conductivity	19	125 - 2200	1120	834	1910
Total Suspended Solids	19	<50	10	6	25
Oil & Grease	12	5	<5	<5	<5
Aluminium	19	0.055	0.02	0.01	0.96
Ammonia as N	11	0.02	0.02	0.01	0.03
Antimony	18	ID	0.002	0.001	0.002
Arsenic	19	0.013	0.002	0.001	2
Barium	19	NA	0.026	0.017	0.035
Beryllium	19	ID	<0.001	<0.001	<0.001
Boron	19	0.37	0.09	0.06	0.18
Cadmium	19	0.0002	0.0001	0.0001	0.0001
Calcium	12	NA	31	21	42
Chromium	19	0.001	<0.001	<0.001	<0.001
Cobalt	19	ID	0.009	0.009	0.009
Copper	19	0.0014	0.001	0.001	0.002
Iron	19	ID	0.09	0.06	1.06
Lead	19	0.0034	<0.001	<0.001	<0.001
Lithium	19	NA	0.0135	0.011	0.028
Magnesium	18	NA	32	23	49
Manganese	19	1.9	0.0915	0.008	1.67
Mercury	18	0.0006	<0.0001	<0.0001	<0.0001
Molybdenum	19	ID	0.002	0.001	0.009
Nickel	18	0.011	0.0035	0.002	0.006
Phosphorous as P	2	0.025	<0.01	<0.01	<0.01
Potassium	12	NA	6.5	5	11
Selenium	18	0.011	<0.01	<0.01	<0.01
Silicon as SiO_2	17	NA	12.1	6.5	20.4
Silver	18	0.00005	<0.001	<0.001	<0.001
Sulfur as S	15	NA	47	34	71
Tin	18	ID	0.02	0.02	0.02
Titanium	18	NA	<0.01	<0.01	<0.01
Vanadium	18	ID	0.01	0.007	0.013
Zinc	13	0.008	0.006	0.005	0.011

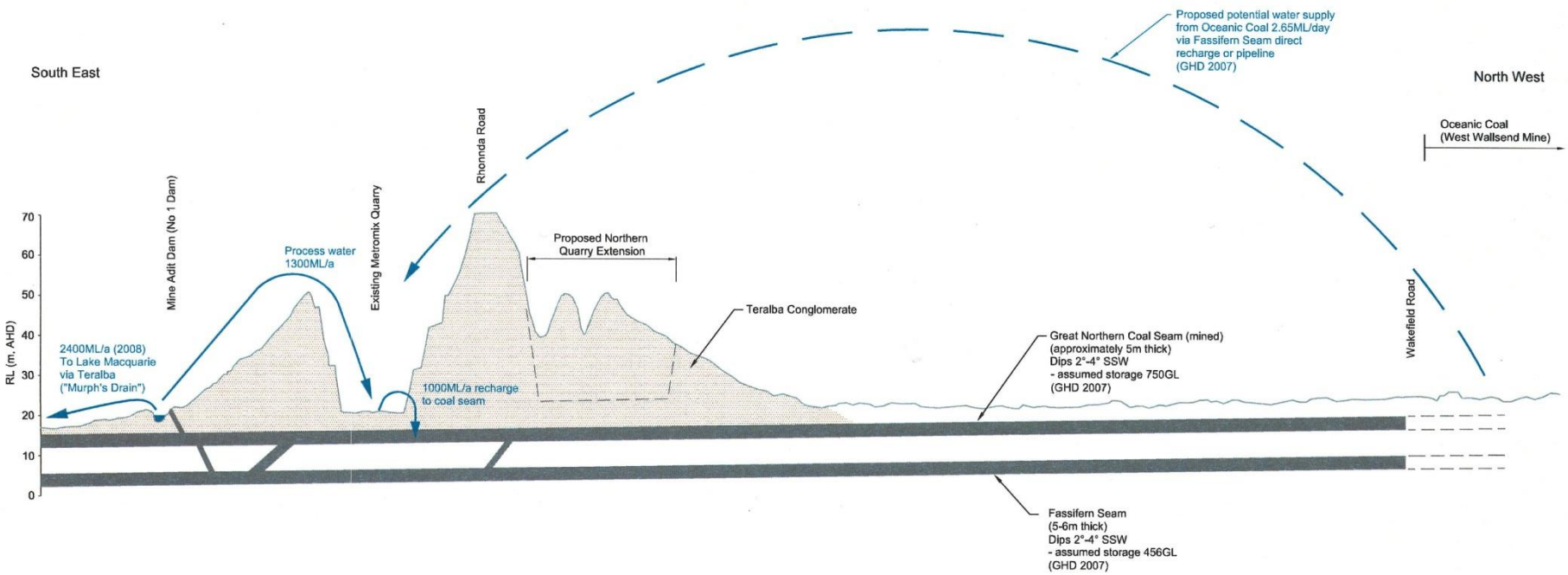
7.2 GROUNDWATER SETTING

7.2.1 Geology and Hydrogeology

The Site is underlain by the Newcastle Coal Measures. The nearest aquifer beneath the extraction areas is the mined Great Northern Coal Seam (GNCS) which lies below the existing floor of the Quarry (approximately at 20m AHD) and occurs at a similar level in the area of the proposed quarry extension. The GNCS dips at approximately 2º to 4º to the south-southeast.

The primary aquifer in the region is contained within the strata and voids of the GNCS. Aquifers are present at greater depths and include the underlying Fassifern Coal Seam (FCS) (also extensively mined beneath the site). **Figure 7.3** provides a schematic groundwater section displaying the position of the GNCS and FCS with respect to the Teralba Quarry and **Figure 7.4** displays the various coal mines around Teralba Quarry at which the GNCS and/or FCS were mined. Groundwater flows beneath the site from northern to south-south-eastern corner. Groundwater in the GNCS is partially intercepted within a mine adit located in the south-east where the potential head of the groundwater intersects the surface topography. Here it is collected in a dam (the Mine Adit Dam) before discharging into an open channel and eventually to Lake Macquarie via a concrete channel through the suburb of Teralba.

\\SERVER\RWC\559\55912\Cad\559Base_Soil 7.3.DWG



Source: RCA Australia - Figure 4

Figure 7.3
SCHEMATIC GROUNDWATER SECTION

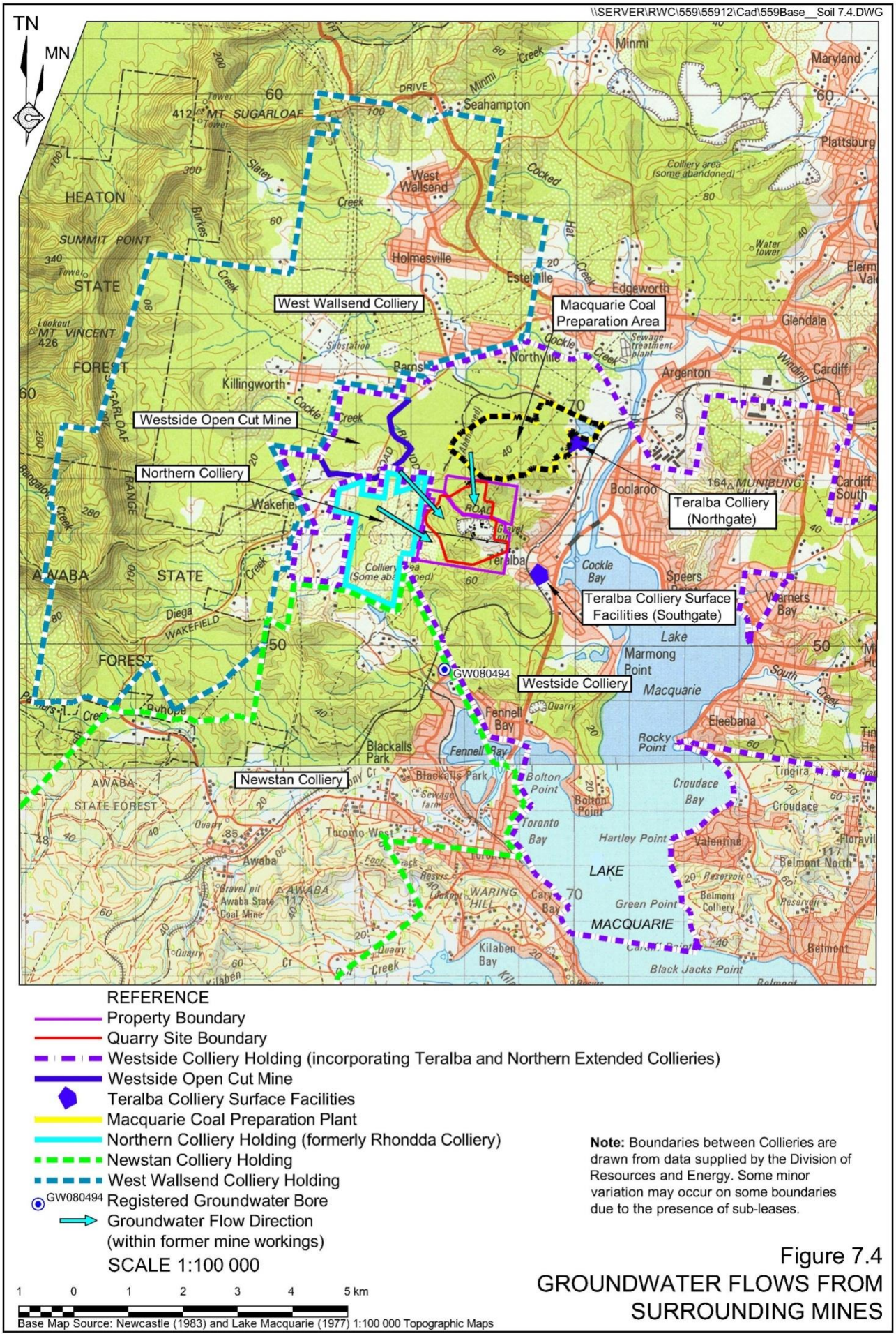


Figure 7.4
GROUNDWATER FLOWS FROM SURROUNDING MINES

Significant “human-induced” recharge to this aquifer has occurred in the past at the adjacent (to the west), Rhondda Colliery. Large quantities of water from Cockle Creek, waste water treatment works and Teralba Quarry process water were pumped into the aquifer to quench an underground coal seam fire. This operation has been successful and this artificial recharge has now ceased.

Operations at Quarry require water for processing and this water is sourced, under licence, from the Mine Adit Dam.

Previously, used process water was recharged back into the aquifer via a subsidence void located on the quarry floor. This discharge point was up-gradient of the Mine Adit Dam and the quarry effectively recirculated groundwater from the aquifer. This practice has ceased with the introduction of silt cells to contain the silts produced in the processing plant.

This creek and drain downstream from the Mine Adit Dam will 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.

Interpreted groundwater flow from surrounding mines is presented in **Figure 7.4** and a conceptual section through the Quarry is presented in **Figure 7.3**.

7.2.2 Neighbouring Groundwater Users

A groundwater database search was conducted and the nearest bore that is located down-gradient is stock/domestic well GW080494 in Fassifern Road, Fassifern, approximately 2.6km to the south. It is considered unlikely that quarry activities will impact this bore.

Other neighbouring potential groundwater users include the surrounding coal mines (see **Figure 7.4**).

- The now-closed Rhondda Colliery (owned by Coal & Allied Industries Limited), immediately to the west of Teralba Quarry. From approximately 1994 until 2008, fines-containing water (post process waste water from the processing plant) was pumped from Teralba Quarry (among other sources) to assist in extinguishing an underground coal seam fire, and in later years used to fill land on the Rhondda site (GHD 2007). The water pumped into the mine was effectively recycled by down-gradient flow through the coal seam. Rhondda Colliery had a licenced discharge point on the south-east corner of the Metromix site (Mine Adit Dam, EPL 3139 – now upgraded and transferred to Metromix, EPL536).
- The now-closed West Wallsend Mine (owned by Oceanic Coal Mines (Glencore)) located approximately 3km to the northwest was dewatering mine workings at approximately 2.6 ML/day with water discharged into Cockle Creek via a licensed discharge point (EPL1360).

- Centennial Coal Newstan mine - 2.5km to the southwest. Newstan is on care and maintenance and has in the past dewatered approximately 6 to 7 ML/day from the GNCS and Fassifern from workings. Water was discharged to LT Creek at Fassifern (with some water use in mine).

The neighbouring coal mining operations are not directly down-hydraulic gradient of the quarry and they are net groundwater producers rather than groundwater users (i.e., groundwater flows from the coal seam aquifers into mine voids).

7.2.3 Groundwater Quality

The summary of water quality presented in **Table 7.3** would also represent groundwater quality as the results present generally monthly sampling undertaken from the Mine Adit Dam from 1989 to 2013 which flows from the coal seam aquifer.

7.3 SITE WATER MANAGEMENT PRACTICES

7.3.1 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 disused, flooded mine adit, which receives groundwater, via the mine adit. This extraction is licensed by DoI Water. Metromix has a current licence, to extract groundwater for Dewatering and "Industrial – Sand and Gravel" use managed by DoI Water (Licence No. 20BL173206). The licence allows for a maximum extraction of 1 407ML per year and states (among other things), that the volume of water extracted must be measured and recorded for inclusion in an annual return to DoI Water.

Metromix will continue to source its non-potable water requirements from the Mine Adit Dam in addition to the silt cells (construction started in late 2011). Water is 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.

The right to use stormwater collected in site storage dams (harvestable rights) is governed by Section 53 of the *Water Management Act 2000*. This is evaluated using the maximum harvestable rights dam capacity (MHRDC) calculation for each land parcel which is formula-based (depending on area), and any other rights orders from DoI Water. The combined MHRDC for the Quarry Site has been calculated at 24.37ML (ref: Section 1.5.1, BMT-WBM, (2011)).

The consideration of a contingency for the non-potable water supply used on site is not necessary given the considerable experience of Metromix on site over 30 years and its knowledge regarding flow rates from the Mine Adit Dam under a wide range of circumstances.

7.3.2 Site Water Usage

Table 7.6 presents details of site water usage.

Table 7.6: Site Water Usage

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
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	-
Pugmill	Processing Site Washing	4 1
Non-Potable Water Total		1 292

Metromix requires non-potable water primarily for washing the extracted raw feed as well as dust control and wheel washes. In addition, the on-site 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 for the bottom wheel wash. Potable water is also supplied to the asphalt plant for similar purposes.

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

Metromix estimates the water usage for processing will average approximately 1 243ML/yr. Due to the increase in exposed surface area, Metromix estimates the dust suppression water demand will increase to 20ML/yr. With the additional wheel washes on site, Metromix estimates the wheel wash water demand to increase to 24ML/yr. Overall, based on the volumes listed in **Table 7.6**, the use of non-potable water will be approximately 1 292ML per year of which Metromix estimate approximately 70% will be recycled water through the on-site silt cells.

7.3.3 Waste Water Management

Waste water from site amenities is collected in a single septic tank on site. The non-potable and potable water used on site 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 6% solids, is collected in two collection tanks, from which it is directed to a series of silt cells constructed on the western 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 will continue to drain to the wedge pit, and the collected water will be pumped to Dam G for re-use through the plant.

7.3.4 Process Water Management

Metromix recirculates 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.

Ultimately, either two or three silt cells will 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 will be almost free of suspended solids. Metromix recognises that the amount of water recovered from the silt cells will gradually increase throughout the life of the Quarry. Metromix estimates that approximately 70% of its waste requirement will be recovered from the silt cells.

Make-up water for processing will 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 pumped to the lined storage dam, Dam G.

When processing is underway, water from Dam G is transferred to the processing plant by a 140L/s pump with water recovered from the silt cells at a rate of 111L/s.

The pugmill will continue to source water directly from Dam G using a separate smaller pump and pipeline.

7.3.5 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. Both bunded areas lie adjacent to Dam H. A spill containment kit is present on site in the nearby workshop.

1 000L containers for oil are stored in the bunded oil shed beside the workshop service area. Waste oil remains contained in the waste oil facility beside Dam H. Metromix currently has a spill management Safe Working Method Statement (SWMS).

7.3.6 Surface Water Discharges

The practices adopted by Metromix to manage water on site and its discharge off site include the following.

- All groundwater and surface water that reports to the Mine Adit Dam is either pumped to Dam G for use on site or is allowed to flow towards Lake Macquarie. During extreme rainfall events in April 2015 and January 2016 the Mine Adit Dam overflowed to Dam B with the water eventually discharged from Dam B via the outlet pipe and drainage channel. The overflow from the Mine Adit Dam is in effect the water in excess of Metromix's requirements. The rate of overflow from the Mine Adit Dam is recorded.

- Discharges from the sediment dam network on the southern side of Rhondda Road are undertaken in the following manner. The key dam controlling water quality is Dam D, a dam with a capacity of approximately 35ML. This dam incorporates a perforated riser that enables water to be drawn from the upper 5m of the dam's storage zone, i.e. following the manual opening of a valve on the outlet pipe from the dam.

  Metromix has established a trigger level for this dam at approximately 20m AHD (and 2m below the spillway level) above which the outlet valve is opened manually provided the quality of the water is acceptable, i.e. if TSS values are less than 50mg/L and no visible oil and grease. The water discharges via the outlet pipe flows via a rock-lined channel towards Dams C and B before flowing into the nearby watercourse via a pipe from Dam B (**Figure 7.2** (Detail)). Metromix has established that the quality of water entering the nearby watercourse is comparable in quality to the water released from Dam D, i.e. its flow through Dams C and B does not cause its quality to deteriorate.

- Runoff from the eastern side of the Mid Pit Extraction Area flows into Dam K and has a trigger level set at 70m AHD or 1.5m below the spillway level of 71.5m AHD.

- It is noteworthy that both Dams D and K exhibit considerable leakage (to underground workings, subsidence cracks, etc.) following storm events such that overflows via the spillway have not occurred to date.

- Runoff from the western side of the Mid Pit Extraction Area flows into Dam J or the floor of the extraction area. Dam J and the adjacent Pit Sump have been excavated to create a capacity of approximately 36ML which will result in no runoff from the western side of the Mid Pit Extraction Area overflowing from the area – given the capacity of Dam J and the Pit Sump are substantially greater than that required in accordance with the Blue Book.

- Whilst Metromix's experience to date has established that acceptable water quality can be achieved prior to discharge form Dams D and K, the Company is developing a flocculation strategy in the event that total suspended solids concentrations exceed 50mg/L and it is necessary to discharge water from either dam. The flocculation (if required) and draw-down of the water level in Dam D would be undertaken within five

days of the rainfall event that causes the water level to rise above the trigger level. Metromix intends to use a non-ionic powder flocculant at a rate of approximately 2.5L/ML.

7.4 SITE WATER BALANCE

The site water balance was prepared as part of the Environmental Assessment for the Teralba Quarry Extensions project[1] and is based on projected product processing volumes and using existing estimates of water requirements. **Table 7.7** presents a summary of inputs/outputs.

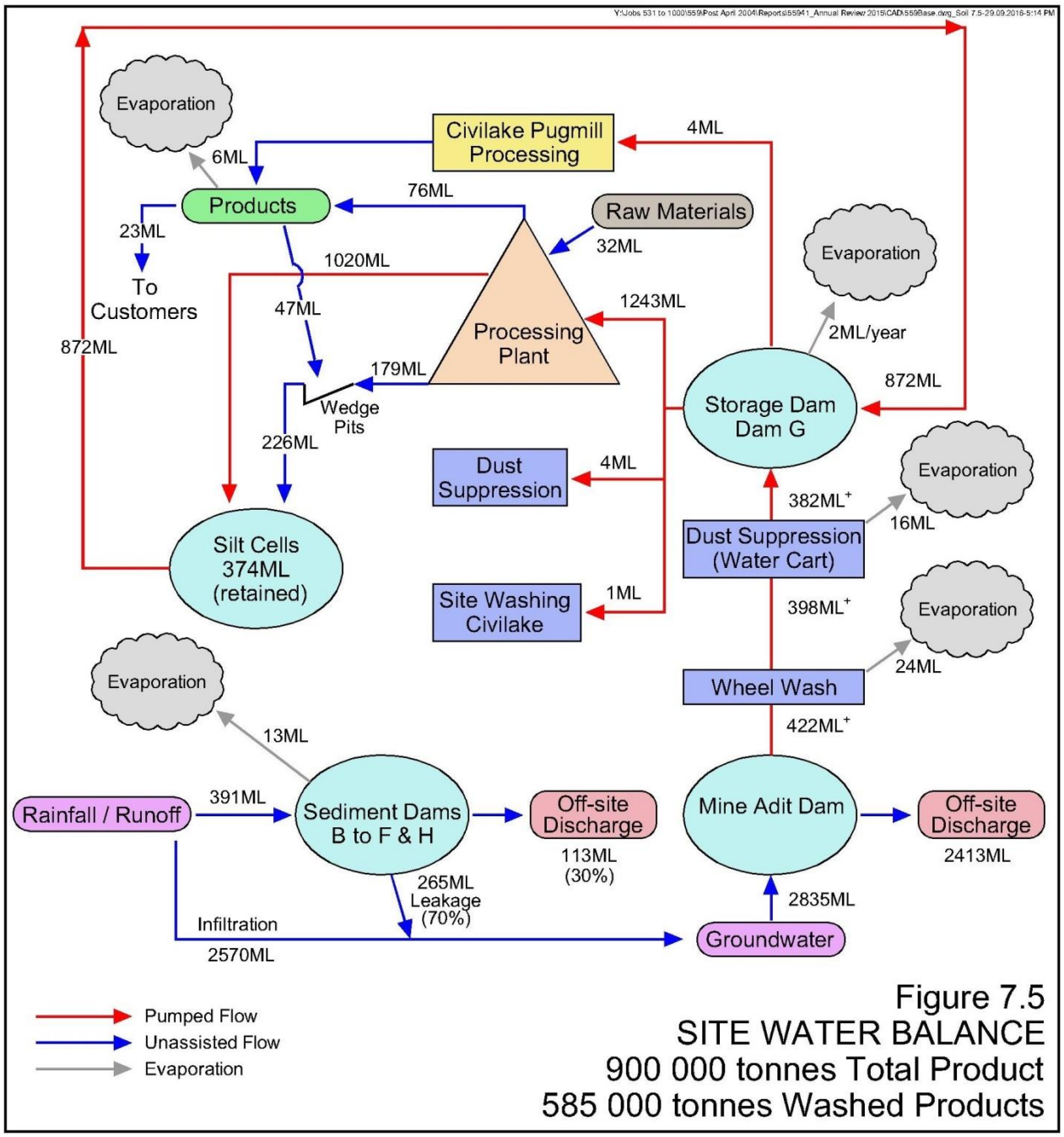
Table 7.7: Site Water Inputs and Demands

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).

NB The volumes/flows presented above are from the Surface Water Assessment (i.e. no additional calculations have been undertaken nor are required).

The water balance is shown graphically in **Figure 7.5**.

[1]Specialist Consultant Studies Compendium for the Teralba Quarry Extensions, June 2012. Part 3 – Surface Water Assessment –BMT-WBM Pty Ltd (2011)



This site water balance has been prepared in satisfaction of *PA Condition 3(26)* of PA 10_0183 MOD 1 (approved on 22 February 2013).

It is noted that **Figure 7.5** incorporates the location of eight flow meters that Metromix has already installed or is soon to install to record the volumes of water transferred/used on site. Metromix records monthly flow rates which will be collected annually and evaluated in terms of the predicted water balance. The results of the flow measurements and an updated water balance for each year of operation will be reported in each *Annual Review*.

8 EROSION AND SEDIMENT CONTROL PLAN

Interaction of operations across the Quarry Site and stormwater will result in potential erosion of exposed soils in the cleared areas, including stockpiled soils, and the generation of sediment-laden waters which may discharge off-site, impacting surface waters beyond the Quarry Site.

It is noted that given the significant volumes of the extraction areas and highly permeable ground surface, overflow off site from runoff collected in extraction pits south of Rhondda Road is extremely unlikely. A similar situation will develop for the extraction area north of Rhondda Road once extraction resumes in that area.

In order to mitigate against off-site surface water quality impacts, Metromix will continue to undertake extraction operations in conjunction with procedures designed to minimise the potential for erosion and instigate measures to control and treat sediment-laden waters prior to discharge as per the Blue Book, “Managing Urban Stormwater Volume 1 (Landcom, 2004) and Volume 2E “Mines and Quarries” (DECC, 2008).

Details of these measures are presented in **Appendix 1** (Erosion and Sediment Control Plan).

9 WATER MONITORING PROGRAM

9.1 INTRODUCTION

This surface water monitoring program has been prepared in satisfaction of *Condition 3(26)* of PA 10_0183 MOD 1 and provides a description of:

- the surface water monitoring requirements of PA 10_0183 MOD 1 and EPL 536;
- locations which will be monitored;
- the program/timing applicable to each monitoring point;
- monitoring parameters; and
- site surface water criteria.

It is noted that the water monitoring program relates principally to surface water although monitoring of water in the Mine Adit Dam effectively relates to groundwater. Given the nature of surface water inflows into the groundwater (within the former underground coal mines), it is not practical nor of any substantive value to monitor such inflows. Similarly, the effects of the quarry operations on the groundwater resources beneath the Quarry Site (i.e. the local aquifer) are unable to be meaningfully monitored. It is recognised that the ongoing monitoring of water quality and the volumes of water pumped and overflowing from the Mine Adit Dam is sufficient (with surface water data) to understand the impacts of Metromix's operations on the groundwater beneath the Quarry Site.

9.2 SURFACE WATER ASSESSMENT CRITERIA

Table 9.1 lists the surface water quality criteria for the Quarry, i.e. relevant to the nominated locations.

Table 9.1: Metromix Quarry Monitoring Criteria

Pollutant	Concentration Limit	Location
pH	6.5 to 8.5	From water flowing off-site (monitoring Points 4, 5, 6 and 7)
Total suspended solids	50 mg/L	From water flowing off-site (monitoring Points 4, 5, 6 and 7)
Oil and Grease	10 mg/L	From water flowing off-site (monitoring Points 4, 5, 6 and 7)
Conductivity	No Limit	From water flowing off-site (monitoring Points 4, 5, 6 and 7)

A trigger level for Electrical Conductivity (EC) of 8500µS/cm has been proposed and would be used to initiate an investigation to the cause of the elevated levels to ensure that no potential adverse impacts would occur on local downstream watercourses and ultimately Lake Macquarie. Although it is noted that Lake Macquarie is a saline environment.

9.3 SURFACE WATER MONITORING LOCATIONS AND FREQUENCY

Metromix will monitor surface water quality at the locations nominated on **Table 9.2** (see **Figure 9.1**) and at the frequency nominated on **Table 9.3**.

Table 9.2: Environment Protection Licence Monitoring Points

EPA ID No.	Type of Monitoring Point	Type of Discharge Point	Location
4	Discharge to Waters: Water Quality Monitoring	Discharge to Waters: Water Quality Monitoring	Mine Adit Dam
5	Discharge to Waters: Water Quality Monitoring	Discharge to Waters: Water Quality Monitoring	Discharge to off-site from Dam B
6	Wet Weather Discharge to Waters: Water Quality Monitoring	Wet Weather Discharge to Waters: Water Quality Monitoring	North-western boundary of site into Creek
7	Wet Weather Discharge to Waters: Water Quality Monitoring	Wet Weather Discharge to Waters: Water Quality Monitoring	North-eastern boundary of site into Creek

Table 9.3: Surface Water Monitoring Requirements

EPA ID No.	Frequency	Monitoring for:	Method
4	Monthly	pH, Total suspended solids, Oil and Grease and Conductivity	Grab sample
5	Within 12 hours of commencing any discharge	pH, Total suspended solids, Conductivity, Oil and Grease	Grab sample
6 and 7	Within 8 hours of discharge and weekly during discharge	pH, conductivity, Total suspended solids, Oil and Grease	Grab sample
4 and 5	Continuous (during discharge for monitoring point 5 – Dam B)	Flow	Flow meter/continuous logger

Opportunistic samples will also be taken periodically from the other site dams during significant rainfall events. These samples will be analysed for the same parameters as above (TSS, EC and pH).

9.4 WATER SAMPLING PROCEDURES

9.4.1 Water Sample Collection

Grab samples of water will be collected at the nominated locations, stored and despatched to a NATA registered laboratory in accordance with the procedures included in Metromix's Safe Work Methods Statement.

9.4.2 Visual Assessment of Total Suspended Solids

As a management tool, Metromix adopts a practical method for visually assessing total suspended solids (TSS) through the adoption of the following procedure.

- Collect duplicate samples, one of which is retained by Metromix.
- One sample is submitted to the laboratory and the second sample (referred to as the "Reference Sample") (from the same location and at the same time), is retained in a sealed, clear, transparent glass bottle, appropriately labelled with date, time and location.

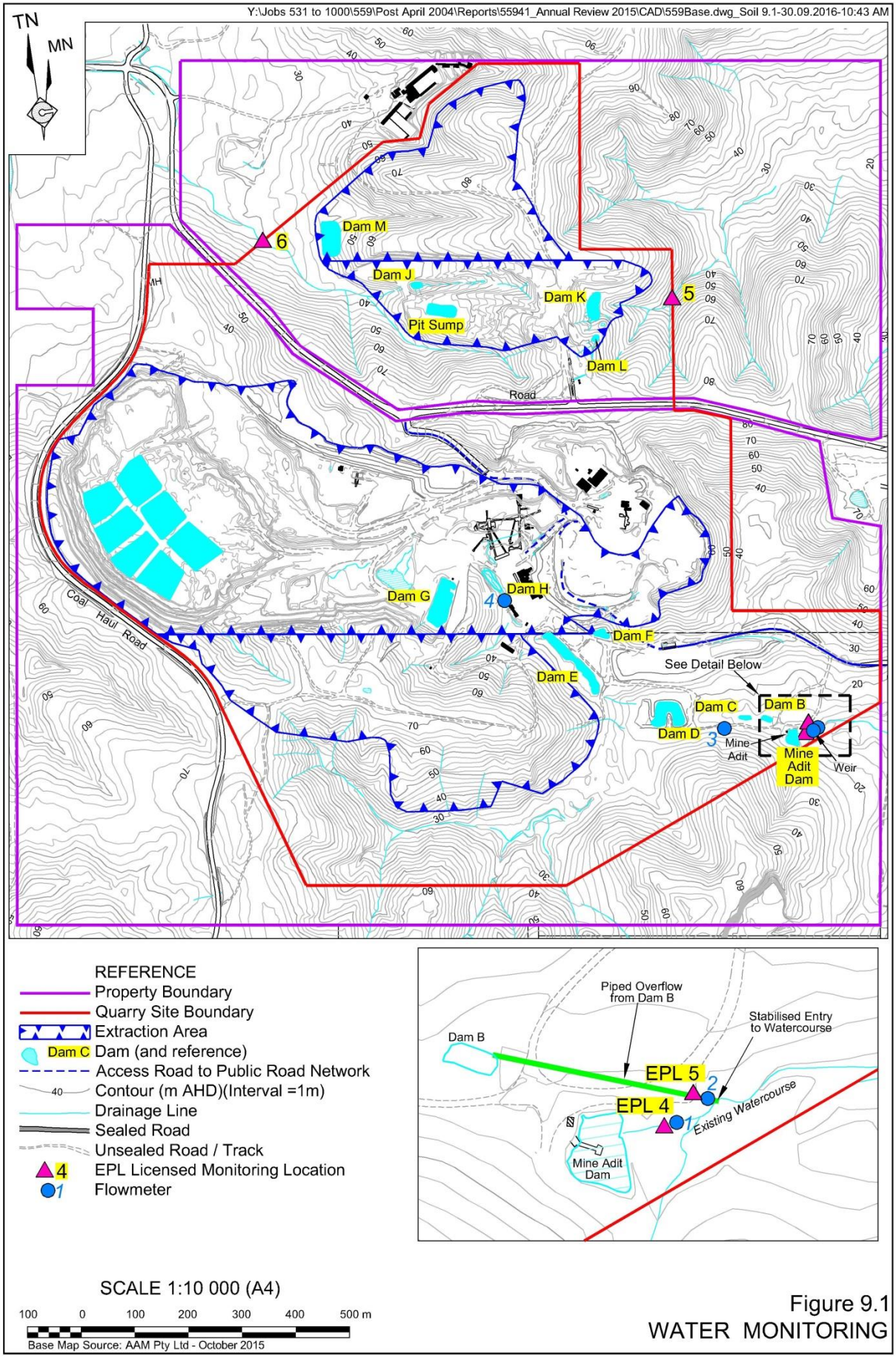


Figure 9.1
WATER MONITORING

- When the results of the TSS analysis are received, the results in milligrams per litre (mg/L) will be recorded on the retained sample bottle in indelible ink (or other permanent fashion).
- All reference bottles are retained in a secure, accessible location as a “library” providing a visual guide to the appearance of waters which may pass or fail the criteria for off-site discharge (50 mg/L).

It is noted that samples collected as above are only relevant for a specific sediment dam. For example, a collection of suspended solids samples from Dam B may not necessarily resemble samples showing the same concentrations in Dam D.

It is noted that the visual assessment of total suspended solids (TSS) is a practical method to establish if TSS values are well below the 50mg/L criteria for discharge. Reliance is placed upon laboratory analyses when it is assessed that the concentration of TSS is close to or above the criteria.

9.5 SURFACE WATER FLOW MONITORING

Metromix has installed (or is in the process of installing) continuous flow meters to monitor water pumped (or discharges) at the following locations (as illustrated on **Figure 9.1**).

FM1 Water Leaving the Mine Adit Dam (flowing towards Lake Macquarie)

FM2 Discharge off site from Dam B

FM3 Mine Adit Dam to Dam G

FM4 Water into Water Cart

FM5 Wedge Pits to Dam G

FM6 Dam G to Processing plant

FM7 Dam G to Pugmill

FM8 Processing Plant to Silt Cells

Records of flow for the installed meters (FM1, FM2, FM3 and FM4) are kept (see **Table 7.3**) and used for required volume reporting and also to provide feedback for long term water management and refining of the site water balance. The remaining flow meters will be installed once Metromix is able to secure a reliable power supply to these locations.

9.6 REVIEW OF MONITORING RESULTS

Following receipt of water quality monitoring results, Metromix will review the data against the criteria listed in **Table 9.1**. In the event that one or more criteria are exceeded, Metromix will immediately undertake an investigation of the suspected incident, potentially resampling the discharge waters;

If confirmed, then Metromix will undertake an assessment of causes and recommend a corrective action plan to re-establish or introduce additional appropriate controls as necessary. Where environmental harm is suspected, Metromix will inform the NSW EPA in accordance with *Condition R2* of EPL 536. A written report detailing the incident will be provided to the EPA, if required.

9.7 REPORTING

As part of the requirements of the EPL 536, all surface water and groundwater monitoring data collected will be reported in summary form as part of the Annual Return to NSW EPA. This will include flow monitoring (from the installed water flow meters), water quality data, relating to required monitoring and sediment control assessment (total suspended solids concentrations).

Specific incidents that are causing or threaten to cause material harm to the environment (for example, where there are discharges from the Quarry Site which are not in compliance with the discharge criteria) will be reported verbally at the earliest opportunity to the EPA and Secretary of the Department of Planning and Environment (DPE). Following the identification of any incident, Metromix and its employees will enact the Emergency Plan and Pollution Incident Response Management Plan (PIRMP), as required.

A written report presenting details of any incident that causes material harm to the environment, any monitoring data, actions taken and proposed actions to prevent a re-occurrence will also be prepared and submitted to the EPA within 7 days of the incident in accordance with the provisions of *Condition R4.1* of EPL 536.

For any other incidents that are reportable and that have not caused or threatened harm, both the EPA and Secretary of the DPE would be notified in writing within 7 days of the incident.

This approach would satisfy the requirements of *Condition 5(7)* of PA 10_0183 MOD 1 and Metromix's Pollution Incident Response Management Plan. Finally, this information would be recorded in the *Annual Review* for the Quarry.

10 EVALUATION OF COMPLIANCE

The tabulated data will include an assessment of the monitoring results against the criteria identified within Section 9.2. The tabulated data will be reviewed by the Quarry Manager and a copy included within each *Annual Review*.

11 CORRECTIVE AND PREVENTATIVE ACTIONS

In the event that the monitoring results exceed the criteria identified in *Condition 3(26)* of PA 10_0183 MOD 1, or EPL 536, the Quarry Manager or Quarry Supervisor will initiate the following responses.

- Undertake an investigation of the suspected incident, potentially resampling the waters.
- If confirmed, undertake an assessment of causes and recommend a corrective action plan to re-establish or introduce additional appropriate controls as necessary (see Section 11).
- Where environmental harm is suspected, inform, DPE, the EPA and Council in accordance with EPL 536.

In the event that water quality monitoring identifies an exceedance of the water quality criteria identified in *Condition 3(26)* of PA 10_0183 MOD 1, the exceedance will be investigated to determine the likely cause. The investigation will seek to determine the following.

- Whether a “quick fix” solution is applicable.
- Establish of the root cause(s) of the problem.
- Establish the appropriate methods to eliminate the root cause(s).
- Establish the steps followed or to be followed to ensure that what is prescribed to fix the problem is in fact doing so.

Where possible, the source of water causing the exceedance will be identified and actions will be formulated to contain the subject water in the subject dam. Alternatively, the water will be pumped to a dam or active extraction area for containment until it either achieves an acceptable quality or seeps into the underground workings beneath the Quarry Site – as it has for the past 50 years. The most likely location where this circumstance will arise is for water discharging from Dam B. In the event the water quality is unacceptable, the water will be treated or pumped from Dam B to Dam G or across the floor of the southern extraction area, thereby preventing the flow or discharge from EPL Point 5. It is noted the actions formulated and their timeframe for implementation will be dependent on the location of the exceedance and nature of the exceedance.

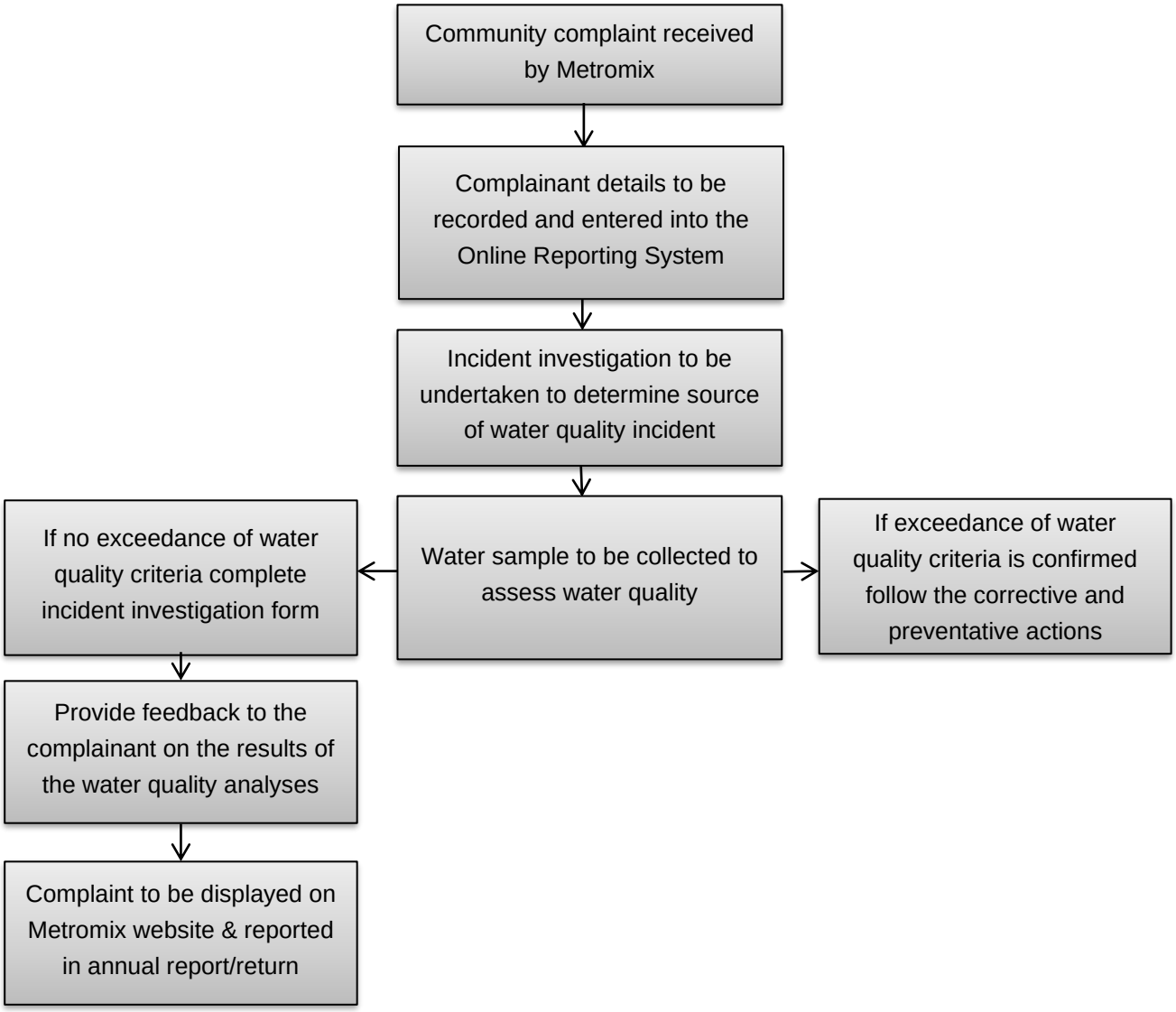
DPE and EPA will be notified by Metromix as soon as practicable after the incident and a report will be prepared and submitted to the DPE and EPA within 7 days of the exceedance in accordance with *PA Condition 5(7*) of PA 10_0183 MOD 1.

12 COMPLAINTS HANDLING AND RESPONSE

Metromix will advertise the community inquires/complaints line 02 4950 6640 as a minimum in the local phone directory and may also consider advertising the number through local media or on newsletters.

Metromix will respond to any registered community inquiries or complaints received by this number as described in the Rapid Online Reporting System.

The flowchart below shows the process that Metromix will follow in the event a complaint is received relating to water quality.



13 INCIDENT REPORTING

In the event of an exceedance of the nominated water quality criteria or complaint, Metromix personnel are to attempt to locate the source of the exceedance and control the source of the exceedance. If they cannot control the incident, then they are to report the incident to their supervisor/manager.

The incident is to be recorded using the “Rapid Online Reporting System” that is available through the Metromix intranet website. The Manager Quarries and Risk Manager are to be notified as soon as possible to assist in determining corrective actions and the need for and approach to reporting. Section 9.7 sets out Metromix’s procedure for incident reporting.

14 PUBLICATION OF MONITORING INFORMATION

All water quality monitoring reports will be made publicly available on the Metromix website and will be included in the *Annual Review*.

The Quarry Manager will be responsible for publication of all relevant monitoring information.

15 PLAN REVIEW

In accordance with PA *Condition 5(5)*, this *Water Management Plan* will be reviewed and, if required, revised within 3 months of:

- an annual review;
- any incident report relating to water management;
- an independent audit report; or
- any modification to PA 10_0183 MOD 1.

The Quarry Manager will be responsible for the review of this Plan.

Appendix 1

Erosion and Sediment Control Plan

This page has intentionally been left blank



Erosion and Sediment Control Plan
Teralba Quarry
Rhondda Road, Teralba NSW

Prepared for:
Metromix Pty Ltd

Prepared by:
ENVIRON Australia Pty Ltd

Date:
19 August 2013

Project Number:
Project A130331

Prepared by:		**Authorised by:**	
Name:	Steve Cadman	Name:	Fiona Robinson
Title:	Senior Environmental Scientist	Title:	Manager – Hunter Region
Phone:	+ 61 2 4962 5444	Phone:	+ 61 2 4962 5444
Email:	scadman@environcorp.com	Email:	frobinson@environcorp.com
Signature:	Date:	Signature:	Date:

VERSION CONTROL RECORD

Document File Name	**Date Issued**	**Version**	**Author**	**Reviewer**
A130331_ESCP_0	6 Aug 2013	Draft 1	S Cadman	F Robinson
A130331_ESCP_1	19 Aug 2013	Draft 2	S Cadman	F Robinson

Contents

List of Figures

Contents

List of Tables

List of Appendices

1 Introduction

1.1 Background

This Erosion and Sediment Control Plan (ESCP) has been prepared by Environ Australia Pty Ltd (ENVIRON), for Metromix Pty Ltd (Metromix) for the approved extensions to the Teralba quarry at Rhondda Road, Teralba, NSW, located approximately 25 km southwest of Newcastle (see **Figure 1**).

This plan forms part of the overall *Water Management Plan* for the Quarry Site. It is acknowledged that this document focusses on the area south of Rhondda Road and the Mid Pit Extraction Area. Given extraction activities are not programmed to occur in the Northern Extension until about 2025 onwards, little benefit is gained by providing a greater level of detail in that area in this document. Subsequent updates of this document prior to those activities would provide any relevant additional detail.

1.2 Objectives

The objective of this ESCP is to set out strategies to control soil erosion and sediment generation close to the source and thereby minimise the potential for quarry activities to adversely affect downstream water quality.

Specifically, the management objectives of this plan are to:

- minimise the potential for erosion and sedimentation to occur as a direct result of quarry operations;
- limit the potential for operational activities to impact upon off site (downstream) waterways;
- avoid clearing of native vegetation beyond the approved disturbance areas; and
- ensure aquatic habitats downstream are effectively protected from reduced water quality and sediment deposition, specifically within Lake Macquarie.

The management strategies which will be implemented to achieve the above management objectives are to:

- implement stormwater treatment measures to prevent pollution of nearby waters;
- implement erosion and sediment control measures to minimise soil erosion and surface runoff; and
- to limit site disturbance as much as possible to limit the ecological impact footprint of the quarry and to retain native vegetation as an effective barrier to erosion around the margins of the approved extraction areas[2].

It is acknowledged that these objectives are generic, however, Metromix has placed considerable emphasis on its experienced gained over the past 30 years in operating the Quarry and its experience following a range of rainfall events.

1.3 Site Description and Setting

The Quarry Site includes the existing Southern Extraction Area, Mid Pit Extraction Area, the processing plant, pugmill and related facilities, Downer EDI (asphalt plant), the approved Southern and Northern Extensions and undisturbed bushland and power transmission line easements.

[2] It is noted that the bulk of the land surrounding the approved extraction areas will be incorporated within a biodiversity offset area.

Figure 1
SITE LOCATION

Surface water runoff occurs as a result of substantial rainfall events and discharges 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 Quarry Site. A significant proportion of rainfall and surface water runoff across the Quarry Site infiltrates due to the highly permeable ground surface. Furthermore, the entire Quarry Site has been undermined which results in runoff and rainfall percolating from the surface to the coal mine workings below. Infiltration through the conglomerate itself is assisted by subsidence and surface cracking throughout the Quarry Site.

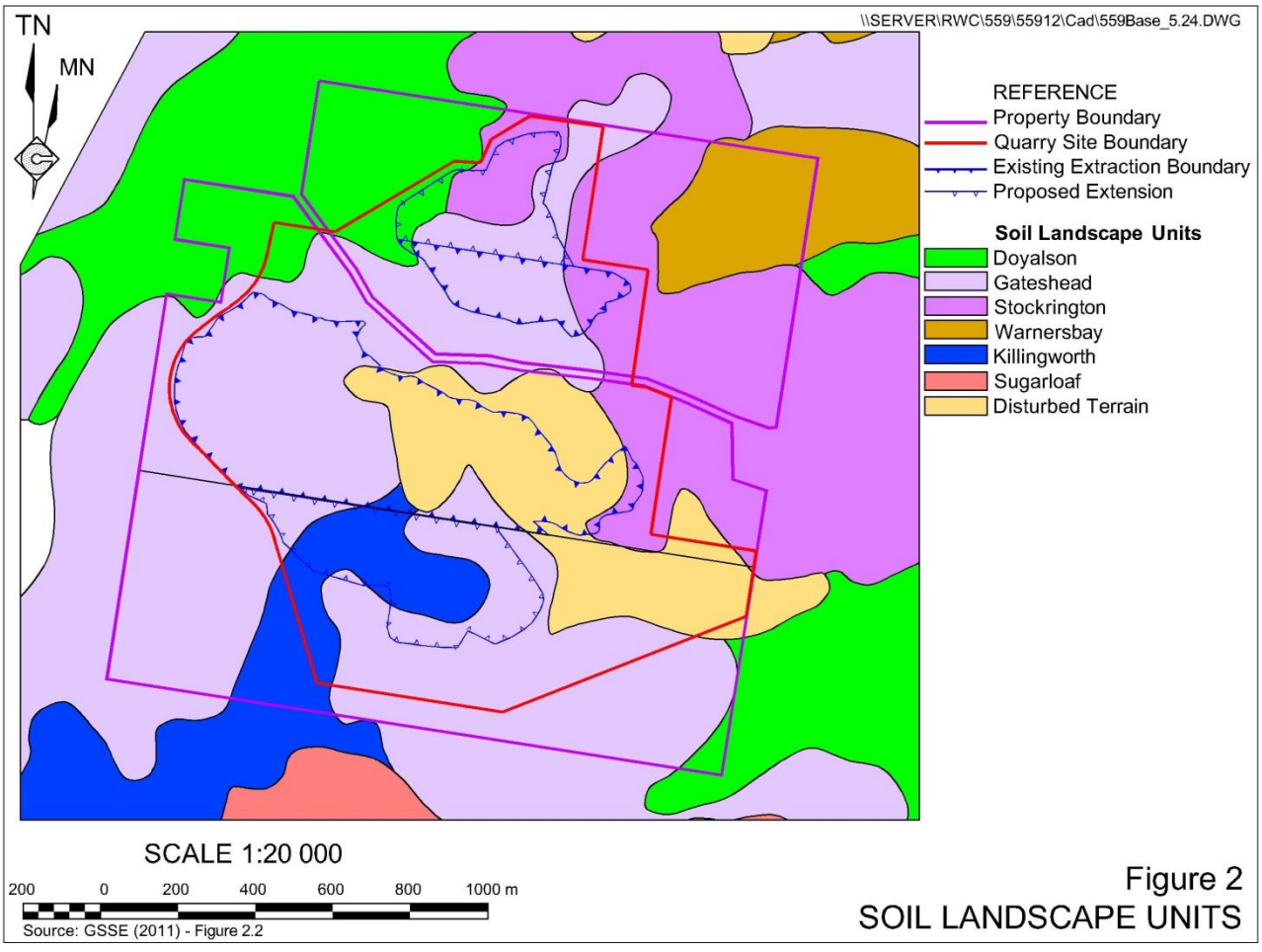
More details of the Quarry Site and setting are presented in the accompanying *Water Management Plan* of which this plan is an Appendix.

1.4 Site Soils

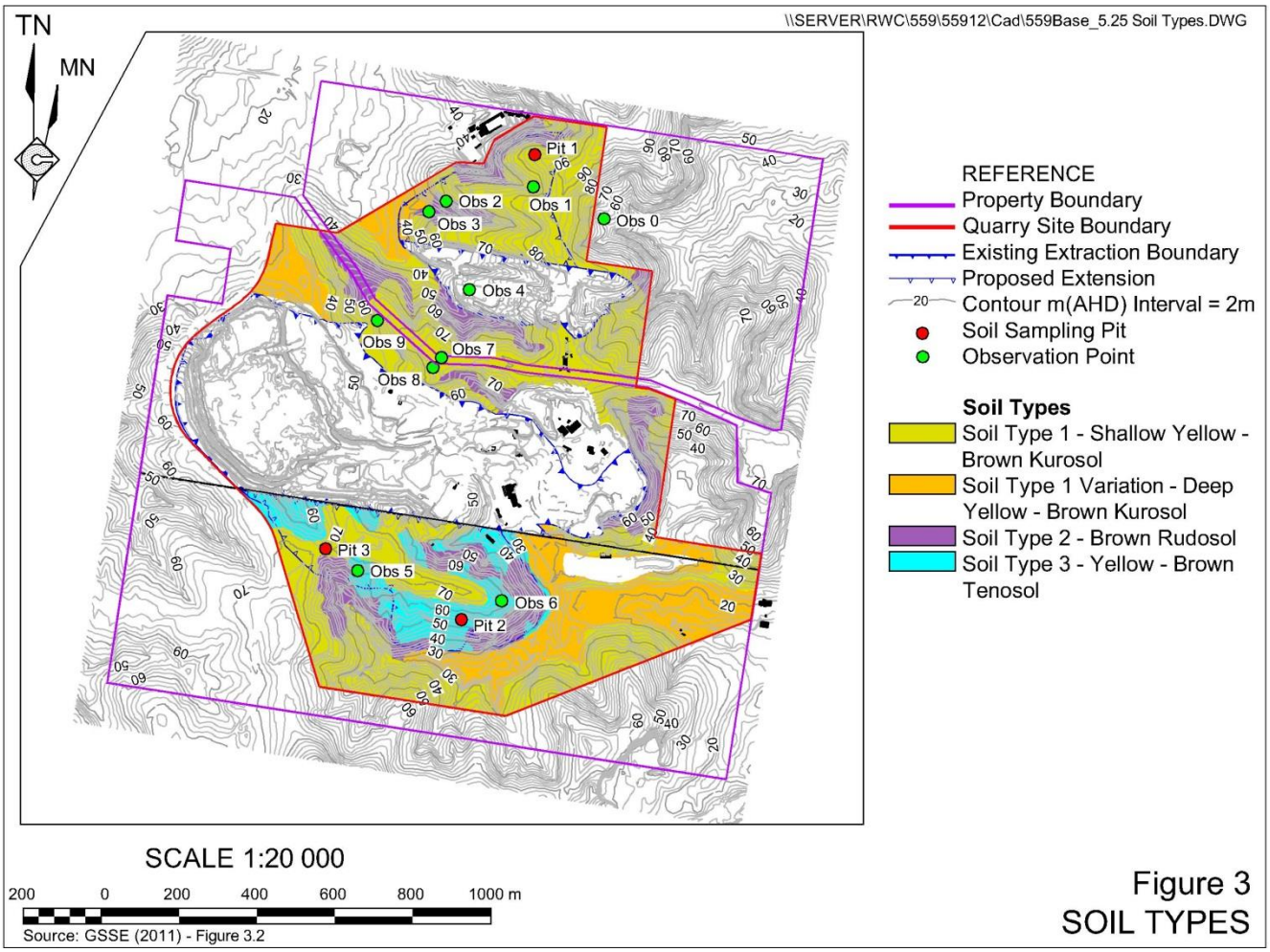
The soil landscape units within the Quarry Site and surrounding land has been mapped at 1:100 000 scale by Matthei (1995) is summarized as follows.

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

Figure 2 displays the soil landscape units with and immediately surrounding the Quarry Site.



GSSE (2011) undertook a field survey to more accurately define the soil resources within the Quarry Site, particularly the Southern and Northern Extension. **Figure 3** displays the three soil types identified, the characteristics of which are outlined as follows.



Soil Type 1: Yellow-Brown Kurosols (shallow)

Soil Type 1 is a Yellow-Brown Kurosol characterised by a clear or abrupt textural B horizon in which the major part of the upper 0.2m of the B2 horizon is strongly acidic. The topsoil has a drainage characteristic of moderate to rapid, while the subsoil drainage is very slow.

These soils cover 55% (48.3ha) of the study area and are associated with moderately inclined slopes as well as level benches and crests. This soil type occurs throughout the study area and is the dominant soil type in the proposed Northern Extension.

The top 0.5m of soil is suitable for stripping and re-use as a topdressing in rehabilitation. The lower layers are generally unsuitable due to heavy clay content and prohibitive stone content. This soil requires significant amelioration prior to its use to increase soil aggregate stability and lime increase soil pH.

Soil Type 1 Variation: Yellow-Brown Kurosols (deep)

A variation of the Yellow-Brown Kurosols (Soil Type 1) occurs within the study area. This variant termed Soil Type 1-Var occurs where a greater amount of topsoil can accumulate, predominately on the lower slopes. The soil is comprised of a higher level of deposited material leading to a deeper soil profile, higher fertility characteristics as compared to Soil Type 1.

This unit covers 16.6ha, is present throughout much of the study area. It forms only a minor portion of the western edge of the proposed Northern Extension and is absent from the proposed Southern Extension. It occurs on slopes that are very gently inclined to moderately inclined (0-18%; 0-10o).

The top 0.7m of soil is suitable for stripping and reuse as a topdressing in rehabilitation. The lower layers are generally unsuitable due to heavy clay content and high acidity. This soil requires some amelioration prior to its use to increase soil aggregate stability and liming to raise soil pH.

Soil Type 2: Brown Rudosols

Soil Type 2 is a Brown Rudosol. This soil type is a shallow soil showing minimal profile development and is dominated by the presence of weathering rock and rock fragments. This skeletal soil is discontinuous throughout the study area and rock outcrops are a common feature. Fertility is generally low due to strong acidity and the absence of organic matter and shallow topsoil.

These soils cover 14.2ha of the study area and occur on steep to very steep slopes, where natural erosion is sufficiently rapid to ensure that only a thin cover of soil is maintained. This soil type occurs in both the proposed Southern and Northern Extensions to a limited extent.

The soil is not suitable for stripping due to its weak textural structure, shallow topsoil and high presence of rock outcrops.

Soil Type 3: Yellow-Brown Tenosol

Soil Type 3 is a Yellow-Brown Tenosol. This soil type shows greater soil profile development than Rudosols, but less development than Kurosols. The soil is weakly structured dark brown silty loam overlying a brown loam overlie a lower horizon dominated by gravels with strong saprolite presence. The soil profile topsoil is slightly dispersive, with the subsoil being moderately to highly dispersive The exchangeable sodium percent was also measured, however, due to the topsoil's very low clay content and associated low cation exchange capacity content, this is not relevant indicator for soil aggregate stability.

Fertility is minimal throughout the poorly developed profile. This soil type has a consistent drainage characteristic of moderate to rapid throughout the profile.

These soils cover 8.5ha of the study area and are found on the mid to lower slopes with moderate to steep slopes. They occur in the southern sections of the study area and extensively within the proposed Southern Extension. This soil type does not occur in the proposed Northern Extension.

The top 0.3m of soil is suitable for stripping and re-use as topdressing material in rehabilitation. This soil is constrained by poor structure, prohibitive subsoil stone content, and high acidity. This soil requires some amelioration prior to its use to increase soil aggregate stability and liming to increase its pH.

According to the Blue Book (Landcom,(2004) "*Managing Urban Stormwater – Soils and Construction Volume1*," March 2004), the sediment type varies for these soil landscapes - and as such the sediment dams shall be designed to meet the most stringent criterion applicable, in this case Type D.

In order to assess the potential erodibility of the soils, a total of 10 soils samples from the three soil test pits (locations shown on **Figure 3**) were submitted to the Soil Conservation Service (Scone) Laboratory and were the subject of the following analyses.

- Particle Size Analysis (PSA).
- Dispersion % (D%) testing.
- Emerson Aggregate Testing (EAT).
- Electrical Conductivity (EC) and pH.

To assess the erosion potential of the soils, the Emerson Aggregate Test (EAT) measures the coherence of soil aggregates when they are immersed in water. Basically, the degree of soil aggregate stability increases from Class 1 through to Class 8. Classes 2 and 3 have a number of subclasses based on the degree of dispersion. Aggregates in Emerson Classes 1 and 2 are generally regarded as being unstable while those in Classes 4 to 8 are considered to be stable.

Hazelton and Murphy [2007] present a summary of the Emerson Aggregate Classes. This is reproduced in **Table 1.**

Table 1: Comparison of Aggregate Dispersibility and Emerson Aggregate Classes*

Aggregate Dispersibility	Emerson Aggregate Classes[#]
Very High	1 and 2[3]
High	2[2]
High to Moderate	2[1]
Moderate	3[4] and 3[3]
Slight	3[2], 3[1] and 5
Negligible / Aggregated	4, 6, 7 and 8
[#] **NOTE** – the subclasses of the Emerson Aggregate Test [EAT] Classes are as follows. [1] slight milkiness immediately adjacent to the aggregate [2] obvious milkiness, less than 50% of the aggregate affected [3] obvious milkiness, more than 50% of the aggregate affected [4] total dispersion, leaving only sand grains [NB – Class 2[4] is equivalent to Class 1]	
* After Hazelton and Murphy [2007]	

The results of the soils analyses undertaken by GSS Environmental (2011) are presented in **Table 2**

Table 2: Soils Laboratory Analyses

Soil Sample	PSA% Clay	PSA% Silt	PSA% Fine Sand	PSA% Coarse Sand	PSA% Gravel	EAT	EC (dS/m)	pH (CaCl2)	pH (CaCl2)	Soil Type[#]
1	4	13	14	18	51	3(1)	0.05	5.6	4.5	C
2	8	13	16	16	47	3(1)	<0.01	5.5	4.3	C
3	43	15	11	14	17	5	0.04	5.2	4.0	F
4	43	11	16	13	17	5	0.05	5.2	4.0	F
5	6	17	19	28	30	3(1)	0.02	5.9	4.9	C
6	8	14	11	23	44	2(1)	0.01	5.4	4.3	C
7	6	6	4	20	64	2(1)	0.01	5.6	4.3	C
8	11	7	11	16	55	3(1)	0.03	5.1	4.0	C
9	12	10	14	20	44	5	0.02	5.0	4.0	C
10	7	13	22	30	28	3(1)	0.02	5.0	4.1	C

Source: GSS (2011) – Table A2.1

[#] Soil type calculated from “Sediment Basin Design Version 6”

PSA – Particle Size Analysis EAT –Emerson Aggregate Test EC – Electrical Conductivity

The results of the soils analysis of the 10 soil samples identified that the majority of soils displayed aggregate dispersibility levels classified as “moderate” with two soil samples being classified as having a “high to moderate” level of dispersibility. The PSA analysis also determined that in the majority of soil samples, gravel was the most present soil material type, which is reflected by the nature of the regional (conglomerate-dominated geology). Based upon this, it has been determined that the potential for soil erosion would be limited, particularly as the majority of rainfall percolates immediately into the soil profiles and into the underlying geology before flow downhill and reaching erosive velocities.

2 Extraction Process

Extraction of the conglomerate involves the following processes.

2.1 Vegetation Clearing

Clearing will typically be completed up to a year in advance of planned extraction with a bulldozer. Where possible, vegetation will be respread on rehabilitation areas or pushed to the down-slope side of the cleared area and temporarily stockpiled for use as a silt barrier, i.e. within the extraction area.

2.2 Topsoil/Overburden Stripping and Stockpiling

Where practical and safe for earthmoving equipment to operate (i.e. not too steep), topsoil will be stripped to a depth of approximately 0.3m to 0.7m (soil types 1 and 3) and the subsoil stripped up to 0.5m and re-spread on areas of progressive rehabilitation.

If rehabilitation areas are not available, topsoil and subsoil will be stockpiled for later use on the floor of the Southern Extraction Area or within the eastern section of the Mid Pit Extraction Area.

Stripping will generally be undertaken along the contour in 20m strips, to minimise exposed areas in the vicinity of the well-defined drainage lines. The key activity undertaken when stripping will be the ongoing approach whereby activities are only undertaken in a small area at any one time so that runoff from the disturbed area is directed back into the existing disturbed area and not off site.

Prior to the removal of the soil close to a drainage line, a silt-stop fence will be installed downslope prior to disturbance and maintained for the duration of the disturbance, i.e. unless drainage can be achieved directly back into the existing disturbed area.

It is noted that for some areas to be stripped of topsoil and subsoil, the soil material removed will be stockpiled either in a temporary area or on the upper surface of a bund wall or similar structure.

In any event, the topsoil will not be stockpiled higher than 2m and the subsoil no higher than approximately 3m. In areas when soil storage is limited, the topsoil will be stored above the subsoil creating a total height of 5m.

2.3 Conglomerate Extraction

Extraction of the conglomerate typically requires smaller blasts and benches (4m to 8m high), than traditional hard rock.

The quantity of rock blasted in a single blast is typically between 10 000 tonnes and 35 000 tonnes. Blasted rock is loaded by an excavator into a haul truck. Generally, up to three active benches operate at a time.

Extraction on the lower levels (above mined coal voids) will be conducted by blasting and collapsing the rock into the underlying (mine) voids and recovering the rock above the mine void level with excavator/haul truck. It is estimated that approximately 35% of the material from the lowermost blasts is lost to the voids.

3 Erosion and Sediment Mitigation

3.1 Introduction

"Dirty" water (sediment-laden water) on site is generated from the following sources.

- Spillage from the crushing/processing area as fines are washed from the quarry product.
- Areas where vegetation has been cleared in preparation for future extraction activities, allowing stormwater runoff to erode surficial soils and transport the entrained sediment downslope.
- Incidental areas where vehicle traffic has degraded vegetation cover resulting in erosion/sedimentation.
- Construction areas (not related to quarrying activities), cleared and trafficked by vehicles and plant.
- Minor transport of soil/sediment on vehicle wheels, etc.

As discussed in the Water Management Plan, surface flow within the areas south of Rhondda Road, (which includes the Southern Extraction Area and Southern Extension), is generally contained with the quarry area and either infiltrates into the underlying conglomerate/mine workings or is captured and contained in a series of sediment dams of which Dam B is the final dam before discharge to the downstream environment.

Water generated in the processing area is largely collected in a temporary storage pit, (wedge pit), and then transferred to Dam G. Following settlement, water is recovered from the silt cells (to Dam G – see **Figure 2**) and re-used in the processing plant.

The following outlines the planned surface water management (in terms of sediment and erosion mitigation), for the planned extensions to the existing works.

3.2 Sequencing of Works

The extraction activities will continue to be undertaken progressively throughout the life of the quarry. Importantly, the extraction activities will involve the incremental advance so that, in most cases, the area being disturbed is shaped that runoff flows into the existing disturbed area.

As extraction will continue to be undertaken progressively, this will allow for progressive adaptation of erosion and sediment control measures and ongoing rehabilitation.

3.3 Sediment and Erosion Control Measures

The sediment and erosion control measures which form the basis of the ESCP are described as follows.

3.3.1 Vegetation Maintenance and Revegetation

Every effort will be made to ensure that groundcover is maintained in areas not utilised for quarry-related operations, with vehicle movements limited to existing tracks. Barrier fencing will be used to delineate vehicle access to and from working areas to minimise damage to adjacent vegetation (not involved in site works). Barrier fencing will be installed at the discretion of the Quarry Manager to delineate no-go zones.

Revegetation will be undertaken progressively as quarry operations progress and extraction is completed in stages. Every effort will be made to ensure establishment of groundcover on sections of the quarry which are no longer in use, with the use of stockpiled topsoil providing a seed bank from which vegetation can regenerate.

3.3.2 Soil Stockpile Maintenance

Soil stockpiles will be maintained in accordance with the New South Wales Department of Housing and Landcom's "Blue Book" *Managing Urban Stormwater – Soils and Construction Volume 1 (2004)* and Volume 2E (Mines and Quarries) DECC (2008). The key features of the soil stockpile management will involve the following.

- Stockpiles will to be located within the Southern Extraction Area or Mid Pit Extraction Area more than 5 m away from existing vegetation, concentrated water flow, roads and hazard areas.
- Stockpiles will generally be constructed on the contour or on flat ground as low, flat elongated mounds.
- All runoff from the stockpiling areas will be contained with the Southern Extraction Area or Mid Pit Extraction Area.
- Long-term rehabilitation plans for the Quarry provide for all topsoil stockpiles to be used for rehabilitation activities.

3.3.3 Structural Controls

The following structural controls will be used on site, if appropriate.

3.3.3.1 Bunding

Bunding will be used around the stockpiling area in order to ensure that runoff is directed away from stockpiles and into sedimentation basins, and that any erosion from stockpiles is contained within the stockpiling area and the sedimentation basins.

3.3.3.2 Sediment Dams

The existing sediment dams are located in the southern area and Mid-Pit area with their storage volume and surface area presented in **Table 3**.

Table 3: Site Storage/Sediment Dams

Dam	Description	Volume (ML)	Surface Area (m^2)
Mine Adit Dam	Flooded Mine Adit	1.2	400
Dam B	Final Sediment Dam	0.3	200
Dam C	Sediment Dam	0.3	200
Dam D	Vegetated Sediment Dam	35.0	9 900
Dam E	Reed Bed Sediment Dam	9.0	3 000
Dam F	Stockpile Sediment Dam	0.7	230
Dam G	Lined Process Water Storage Dam	10.8	2 700
Dam H	Initial Sediment Dam	4.3	1 440
Dam J and Pit Sump	Sediment Dam – western Mid Pit	36.0	6 300
Dam K	Sediment Dam – eastern Mid Pit	2.6	4 500
Dam L	Sediment Dam/Wheel Wash Runoff	0.5	300
Dam M[1]	Sediment Dam – Northern Extension	18.0	4 200
1 Not yet constructed			

The location of the dams is presented in **Figure 4**.

No water will be discharged from the Quarry Site if the total suspended solids (TSS) load is greater than 50mg/L. Flocculation will be required if settling volumes are exceeded after several rain events and the water needs to be discharged. This will be done in accordance with Appendix E of the Blue Book (Landcom 2004).

Runoff from the sediment dams may also be re-used on site for dust suppression purposes on the unsealed internal road network.

Metromix also makes use of floc blocks strategically placed within the drainage lines between Dams H and E, and Dams E and D to assist to reduce sediment loads. The floc block currently used comprises Ovivo EnviroFloc 5001. Metromix will continue to trial flocculant products during normal operations to ensure the most effective flocculants are available for use at those times when flocculation is required.

Sediment Dam Volumes

The following presents calculations based on the New South Wales Department of Housing and Landcom's "Blue Book", "*Managing Urban Stormwater – Soils and Construction Volume 1 (2004).*

The sizing is based on the conservative classification of the site soils as "D/F". Selection of the rainfall depth is based on "Managing Urban Stormwater, Soils and Construction, Volume 2E, Mines and Quarries', which recommends a 90th percentile ARI for areas planned to be disturbed greater than 3 years (Table 6.1, page 31).

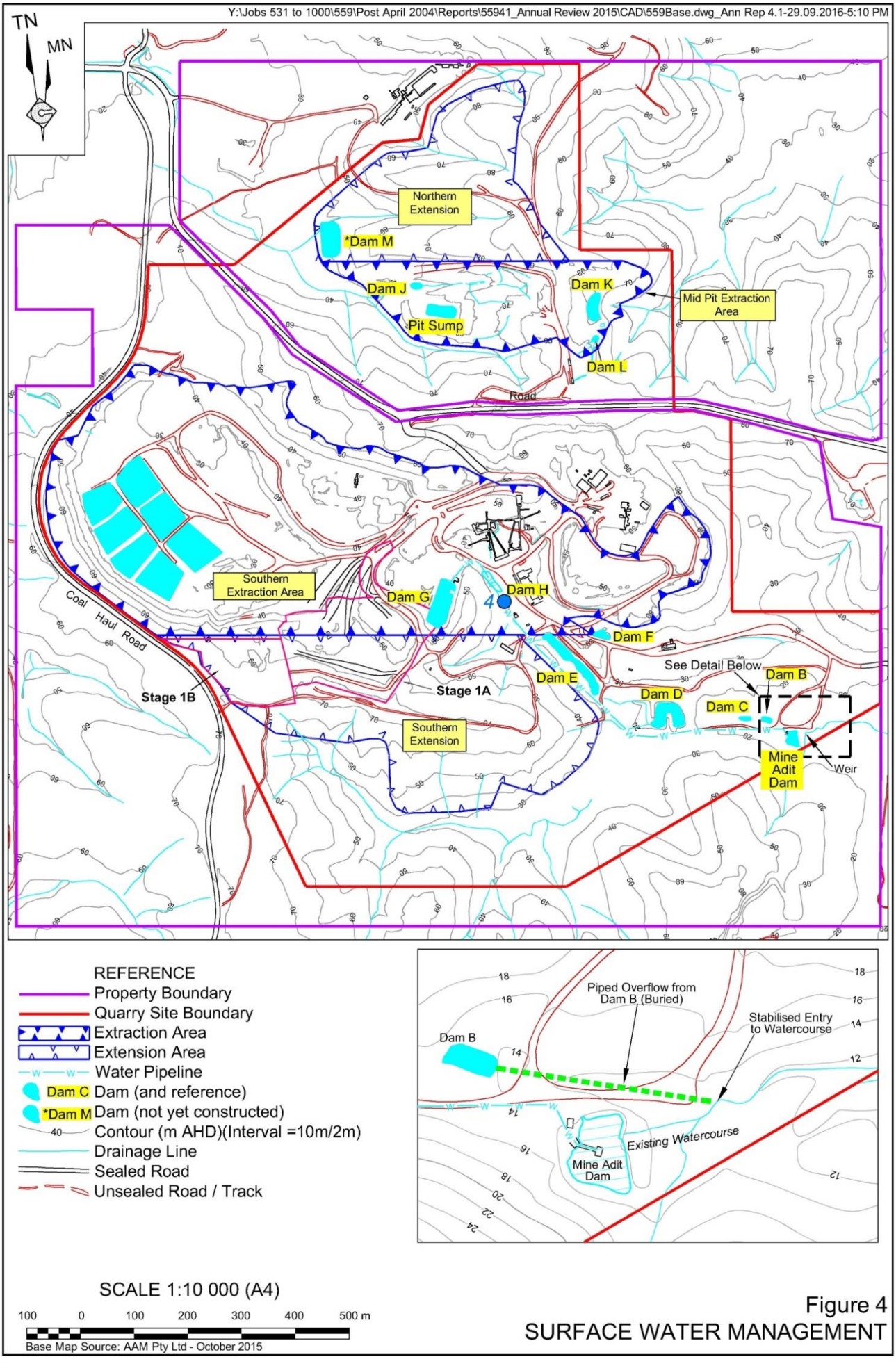


Figure 4
SURFACE WATER MANAGEMENT

The following volume calculations are for a Type D/F Sediment Dam.

Volume of Sediment Basin (V) = volume of settling zone (V1) + sediment storage volume (V2).

Settling Zone Volume (V_1) = 10 x C_V x A x R where

A is disturbed area (ha.)

C_V is Volumetric Runoff Coefficient = 0.7 (as per Section 5.4.3 of the Surface Water Assessment).

R is 5 day rainfall depth (90th%ile) = 51.8mm (Table 6.3a for Newcastle)

10 (unit correction constant to achieve a volume in ML).

V_2 – Sediment Storage Volume is conservatively assumed as 50% of V_1.

Based on the predicted total cleared areas (from Table 5-2 of the Surface Water Assessment[3]), the total storage volumes have been calculated.

Table 4: Predicted Sediment Dam Volume Requirement

Sub-catchment	Disturbed Catchment Area (ha)	Total Catchment Area (ha)	Calculated Sediment Dam Volume (ML)
Southern Extraction Pit	43.27	43.27	23
Southern Sediment Dams	15.70	80.50	8.5
		Total (South of Rhondda Road)	**31.5**
Northern Extension	9.10	9.10	5
Mid Pit Extraction Area	7.42	7.42	4
		Total (North of Rhondda Road)	**9**

NB these are conservative values allowing for total clearance of complete quarried area

Based on the existing sediment dam storage volumes (**Table 3**), current capacities are sufficient to contain the calculated sediment load for all the planned cleared areas.

- Current capacity for Southern Area (Dams B, C, D, E, F and H) is 39.6ML which is well above the predicted sediment dam volume in **Table 4**;
- Current capacity for Northern Area is 14.6ML, with option for upgrade to 38.5ML which is similarly well above the predicted sediment dam volume in **Table 4**.

3.3.4 Monitoring and Maintenance

Metromix will continue to provide for the installation, inspection and maintenance of erosion and sedimentation control measures to ensure their effective implementation. In general, all control measures on site are inspected on a weekly basis and following significant rainfall events (>10mm/24hr). These inspections are recorded.

The monitoring requirements for runoff/sedimentation control are specified in more detail in **Table 5**.

[3] Specialist Consultant Studies Compendium for the Teralba Quarry Extensions, June 2012. Part 3 – Surface Water Assessment – WBM-BMT Pty Ltd 2012

Table 5: Monitoring Requirements for Erosion Control Measures

Issue	Frequency/Timing	Performance Criteria
Visual inspection of structural controls	Weekly and within 24hr after rainfall events >10mm/24hr	Sediment Dam – >70% capacity available(1) Drainage channels – clearly delineated, no adjacent areas subject to erosion Earth banks – structural integrity intact, sediment build-up not inhibiting function Bunding – no gaps or low points through which runoff can flow
Visual inspection of waterways for sedimentation	Weekly and within 24hr after rainfall events >10mm/24hr	No discernible sediment deposition within or downstream of disturbance zone

(1) Sediment Dams will have markers placed to indicate capacity.

4 Erosion and Sediment Control Plan

Based on the mitigation measures outlined in Section 3, the following outlines procedures to enact the ESCP. It needs to be acknowledged that the control of erosion and sediment within the Teralba Quarry is substantially different from a conventional greenfield site or a quarry during its early stages of development. The Quarry has been in existence almost 50 years with Metromix operating it for the past 30 years. During that time, the Quarry has been developed and is now sufficiently advanced that it can be operated with all runoff being directed inwards to the extraction voids that are clearly substantial and able to contain all runoff. Furthermore, because of the permeable characteristics of the conglomerate, the presence of coal mining beneath the quarry in the past and on the surface, runoff characteristics are far from conventional. Numerous subsidence cracks and the presence of chitter material substantially reduces runoff.

The controls to manage surface water (and erosion and sediment-related issues) within the Quarry itself have been constructed and upgraded progressively over the past 30 years. Hence, this section reflects this situation.

4.1 General

This ESCP forms part of the Water Management Plan. All structures installed for sediment and erosion control are already in place on the southern side of Rhondda Road and are planned to remain in place for the life of the Quarry or until they are no longer required. Some additional controls are yet to be installed for the Northern Extension. Sediment and erosion control arrangements will always be reviewed and where appropriate modified over time to reflect changes in operations and/or site conditions at the discretion of the Quarry Manager.

4.2 Staging

Work will proceed along the following general order when activities commence within the Northern Extraction Area.

1. Install erosion and sediment controls required for the establishment and extraction works.
2. Extraction activities will invariably be undertaken from within the extraction void thereby removing the opportunity for sediment-laden runoff to flow off site and the installation of sediment controls beyond the area of disturbance.
3. Monitor and maintain sediment and erosion control measures as extraction activities proceed.
4. Establish the final landform and revegetate completed areas as they are completed.

4.3 Establishment

Prior to the construction of Dam M, the appropriate erosion and sediment control measures will be put in place. These will include one or more of the following.

- Establish sediment fencing along areas where sediment from clearing/construction works could impact on surface water.
- Construct (or augment) sediment dams (as per Section 3.3.3.2).

- Install diversion drains/bund to minimize clean stormwater flowing across cleared/areas.
- Install, (where required), table drains to ensure dirty water (sediment laden water) is directed to the sediment dams.
- Soil Stripping
  - Strip soils when moist (avoid dry or wet conditions).
  - Identify suitable locations for stockpiles;
  - All soil stockpiles (unless very short term), will be stabilized using appropriate slopes (<1V:3H as a minimum) and vegetated.

Standard sediment control drawings are presented in **Appendix A**.

4.4 Quarry Operational Phase

Undertake inspection, monitoring and maintenance of all erosion/sediment controls, including dams, sediment fences and drains/diversion bunds as per **Table 5**. All sediment dams will continue to be inspected on a weekly basis or following any rainfall of >10min in 24 hours.

4.5 Water Use/Distribution

Water for use on site will continue to be extracted from Dam G which is sourced from the Mine Adit Dam, the wedge pits at the processing plant.

The groundwater extraction licence limits the take-off from the Mine Adit Dam to 1407 ML per annum. All water pumped from the dam will be metred and records kept of the pumped volumes (as per flow meters detailed in Section 9.5 of the Water Management Plan).

4.6 Sediment Dams

Sediment dams have been designed to have a volume sufficient to settle fines and have two components to their volume:

- a settling volume; and
- a sediment storage volume.

A marker will be installed in each dam to indicate when the design sediment storage capacity is reached. When the sediment reaches this level the dam will need to be cleaned out with sediment transferred to silt cells.

4.7 Off-Site Discharge from Sediment Dams

Metromix's regime for the discharge of water from the sediment dams is presented in Section 7.3.6 in the Water Management Plan.

4.8 Barrier Fencing

Barrier fencing (which can be temporary fencing constructed from star pickets and tape/wire or sediment fencing mesh), will be used to delineate vehicle access to and from working areas to minimise damage to adjacent vegetation (not involved in site works).

Barrier fencing will be installed at the discretion of the Quarry Manager to delineate no-go zones.

5 Conclusion

This plan outlines effective erosion and sediment controls for the Teralba Quarry albeit that the Quarry has been established for in excess of 50 years and incorporates a range of structures that adequately manage/minimise sediment-laden water.

Implementation of the listed controls, along with ongoing monitoring and maintenance, will ensure that Metromix continues to effectively manage erosion and sediment control at the Teralba Quarry throughout the remaining quarry life.

6 References

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

GSSE (2011) "*Teralba Quarry Extensions Soil and Land Capability Assessment*". Part 9 of the Specialist Consultant Studies Compendium. Prepared by GSS Environmental on behalf of Metromix Pty Ltd

Landcom, (2004) "*Managing Urban Stormwater – Soils and Construction Volume1*," March 2004

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

7 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to Metromix dated March 2013 and in accordance with our understanding and interpretation of current regulatory standards.

A representative program of sampling and laboratory analyses was undertaken as part of this investigation, based on past and present known uses of the site. While every care has been taken, concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. We cannot therefore preclude the presence of materials that may be hazardous.

Site conditions may change over time. This report is based on conditions encountered at the site at the time of the report and ENVIRON disclaims responsibility for any changes that may have occurred after this time.

The conclusions presented in this report represent ENVIRON's professional judgment based on information made available during the course of this assignment and are true and correct to the best of ENVIRON's knowledge as at the date of the assessment.

ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to ENVIRON was itself complete and accurate.

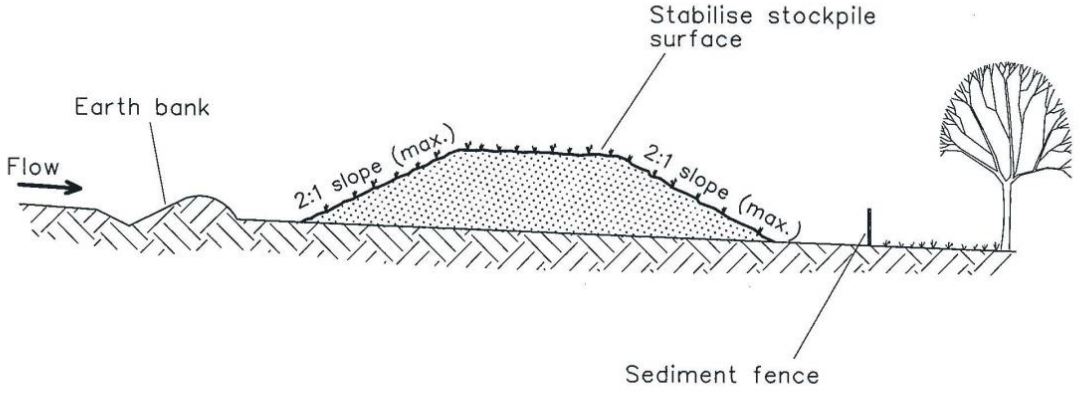
This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

7.1 User Reliance

This report has been prepared exclusively for Metromix and may not be relied upon by any other person or entity without ENVIRON's express written permission.

Appendix A

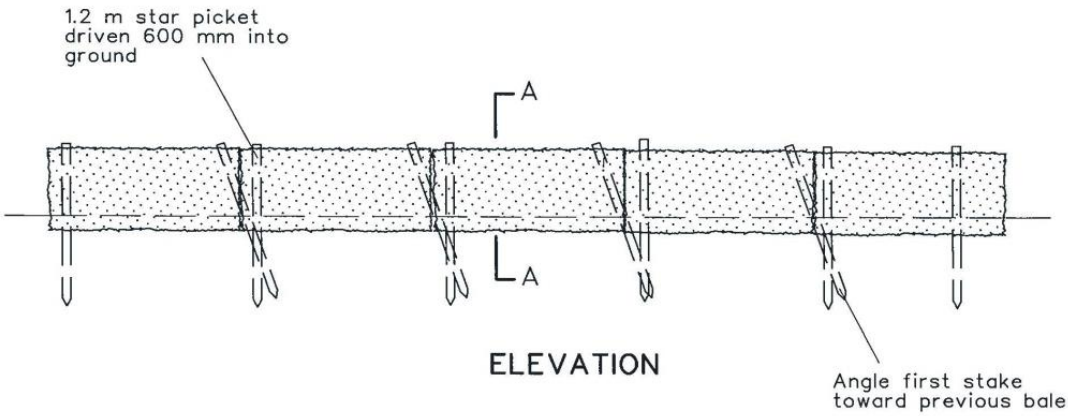
Standard Sediment Control Drawings

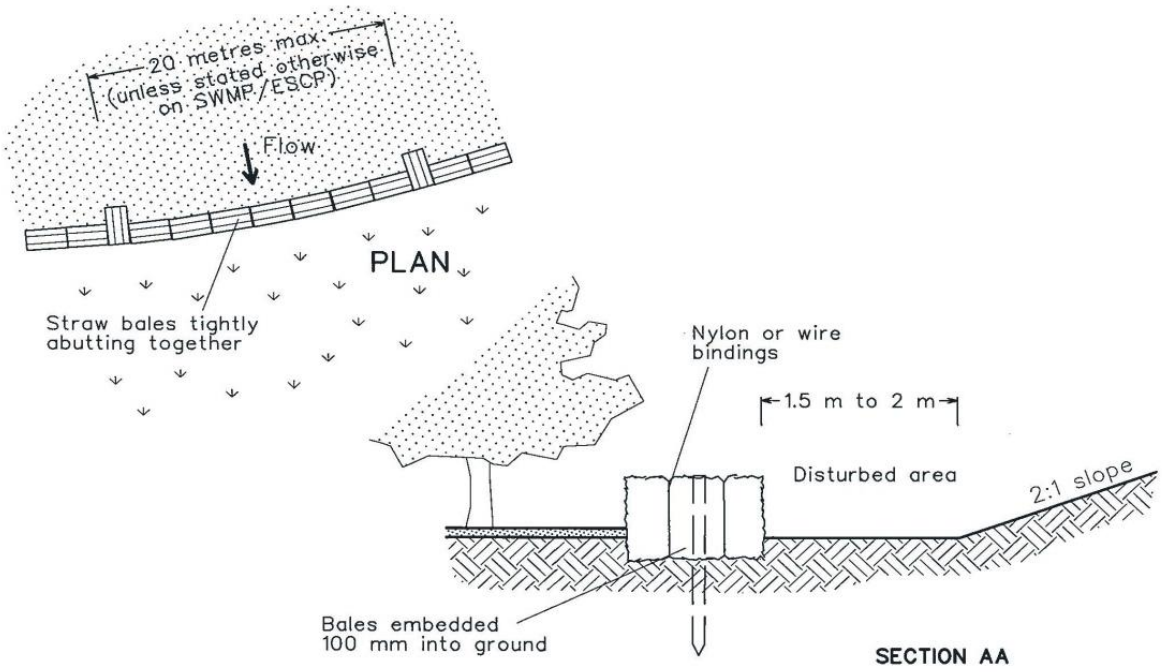


Construction Notes

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

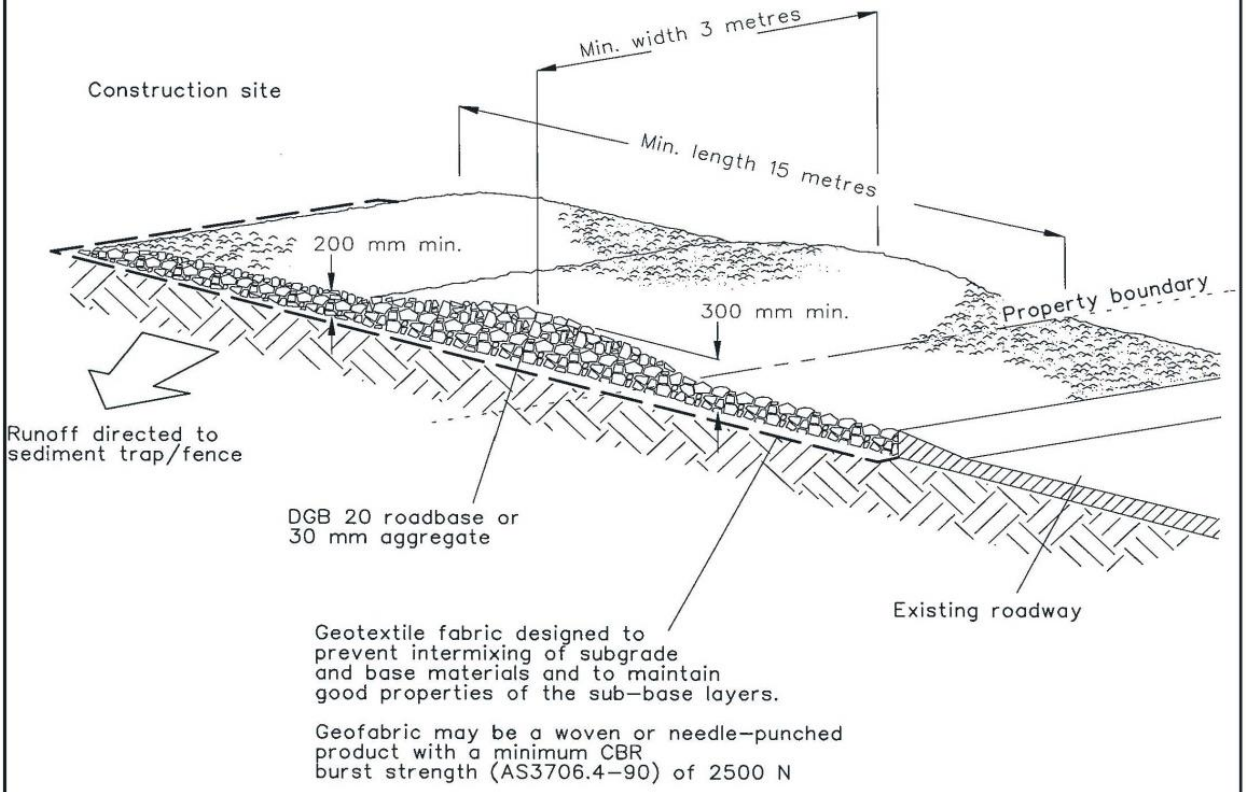




Construction Notes

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.

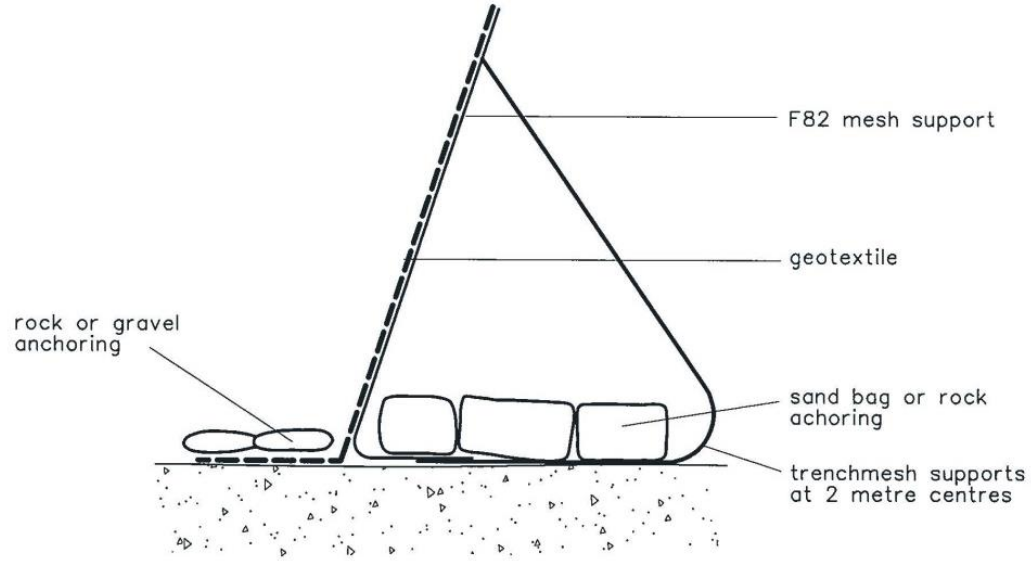
STRAW BALE FILTER — SD 6-7



Construction Notes

1. Strip the topsoil, level the site and compact the subgrade.
2. Cover the area with needle-punched geotextile.
3. Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
4. Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
5. Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

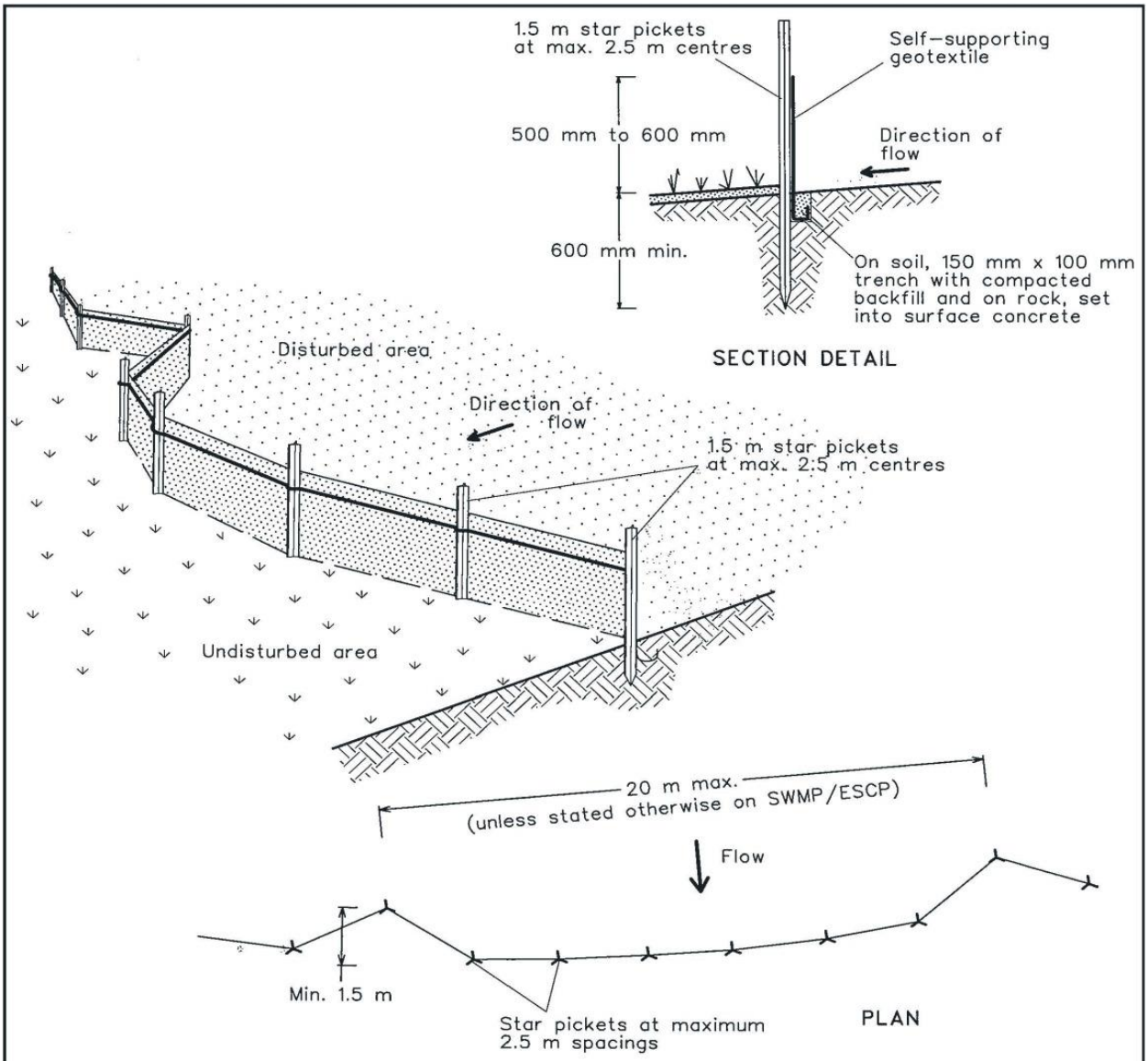
STABILISED SITE ACCESS — SD 6-14



Construction Notes

1. Install this type of sediment fence when use of support posts is not desirable or not possible. Such conditions might apply, for example, where approval is granted from the appropriate authorities to place these fences in highly sensitive estuarine areas.
2. Use bent trench mesh to support the F82 welded mesh facing as shown on the drawing above. Attach the geotextile to the welded mesh facing using UV resistant cable ties.
3. Stabilise the whole structure with sandbag or rock anchoring over the trench mesh and the leading edge of the geotextile. The anchoring should be sufficiently large to ensure stability of the structure in the design storm event, usually the 10 year event.

ALTERNATIVE SEDIMENT FENCE — SD 6-9



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

Appendix 2

Environment Protection Licence 536 Final Assessment Report for the Pollution Reduction Program

This page has intentionally been left blank