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# Muswellbrook Coal Mine

# Continuation Project

# Surface Water Assessment

Report Number 630.11575

27 April 2016

Muswellbrook Coal Company

Muscle Creek Road

Muswellbrook

NSW 2333

Revision 1

# Muswellbrook Coal Mine

# Continuation Project

# Surface Water Assessment

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## DOCUMENT CONTROL

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## TABLES



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# 1 INTRODUCTION

## 1.1 Background

Muswellbrook coal mine (MCM) is an open cut coal mine operated by Muswellbrook Coal Company Limited (MCC). MCM is located on Muscle Creek Road, 3 kilometres (km) north-east of the township of Muswellbrook, in the Muswellbrook local government area (LGA) in New South Wales (NSW) as shown on **Figure 1**.

MCC has a long history of mining in the Muswellbrook area, with underground operations commencing at MCM in 1907. Underground operations ceased in the late 1990s however; open cut mining continues. MCC has approval from Muswellbrook Shire Council (MSC) to mine within the No. 1 Open Cut Extension Area (Open Cut 1) (DA 205/2002, as modified), with operations approved to be complete by 2020.

Additional coal resources have been identified to the north of Open Cut 1, between Open Cut 1 and Open Cut 2. While this area is within the development consent boundary, a modification to the existing development consent is required to modify the conceptual mine plan to allow mining of the additional resources, as well as extending the approved mine life and modifying the conceptual final landform (the modification) as shown on **Figure 2**.

The modification would maximise the recovery of coal resources within ML 1562, ML 1304 and CCL 713 and would enable the recovery of approximately 4.2 million tonnes (Mt) of additional coal resources.

In summary the modification involves:

- Extension of open cut mining operations in Open Cut 1;
- Extension of mine life, with operations to cease by the end of 2025;
- Changes to the conceptual final landform within the modification area; and
- Overburden emplacement in both Open Cut 1 and Open Cut 2, such as to achieve the conceptual final landform.

As the modification involves mining within a previously disturbed area, there would be no direct impact to undisturbed land. No changes are proposed to the maximum production rate of 2 Mtpa, mining methods, coal processing, blasting methods, water management, waste management and handling, coal transport, access to site, hazardous substances and dangerous goods management or environmental management.

The modification is being assessed under Section 96(2) of the *Environmental Planning and Assessment Act* (EP&A Act). EMM Consulting was commissioned by MCC to prepare a Statement of Environmental Effects (SEE) to accompany a Development Application (DA) for the modification. SLR Consulting Australia Pty Ltd (SLR) was subsequently engaged to prepare a Surface Water Assessment (SWA) to support the DA.

## 1.2 Surrounding Land Use

Land uses surrounding MCM include agricultural activities, light industrial land uses and residential areas. Agricultural activities are located on properties surrounding MCM and primarily include grazing of beef cattle. Light industrial land uses include Muswellbrook Quarry to the north-west, St Helliers correctional centre to the north-west and Muswellbrook waste management facility to the south. Muswellbrook township is to the south-west, with other notable rural-residential areas along Sandy Creek Road to the north, Woodlands Ridge Estate to the south and along Muscle Creek Road.

Other significant features surrounding MCM include the Main Northern Rail Line and the New England Highway, which run to the west through Muswellbrook township and to the south towards Singleton. Numerous other mining operations and power-generating facilities exist between Muswellbrook and Singleton.

## 1.3 Operations

Mining currently targets the Greta Coal Measures and is progressing to the north as an extension of Open Cut 1. Historical (decommissioned) operations include:

- No 1 Underground;
- St Helliers Colliery;
- No 2 Underground; and
- Common Open Cut.

Active extraction has ceased in all areas except for Open Cut 1. While the other areas are not actively mined, they remain important from a water management perspective.

The current mining is undertaken on a truck and excavator basis with raw coal stockpiled adjacent the Coal Processing Plant (CPP) for processing and overburden backfilled into Open Cut 1 behind active extraction. In this manner, the open cut pit is progressing to the north and emplacement activity is following behind the open cut pit. Raw coal is processed in the CPP before being trucked to the Ravensworth Rail Terminal for transport to the Port of Newcastle for export.

## 1.4 Overview of the Modification

Mining is currently targeting up to six coal seams in the Greta Coal Measures. The modification involves a continuation of the current mining in Open Cut 1 to the north. Historical overburden in this area is expected to be up to 40m deep in places (through to a generally undisturbed rock strata). Subsequently, when progressing through this area, the existing overburden will be battered back to a lower grade than the underlying strata for stability purposes. This will redistribute the catchment area between Open Cut 1, Open Cut 2 and Dams 1 and 2.

A number of options have been considered for managing overburden generated by the modification with the preferred option involving dumping of waste rock into both Open Cut 1 and Open Cut 2. This will require up to 23.5 million bank cubic metres (Mbcm) of bulk shaping to achieve maximum final landform slopes of 14 degrees in both final open cut pits (MCC, 2016).

The proposed mining and overburden emplacement activity remains wholly within the current approved development consent boundary and, from a surface water management perspective, there are no significant changes to the currently approved management of water resources.

No increase in water demand is expected as part of the modification and all changes occurring as part of the modification will be contained with the catchments of Dams 1 and 2, Open Cut 1 and Open Cut 2. The only notable changes from a surface water perspective include slight alterations to the catchment area of Open Cut 1, Open Cut 2 and Dams 1 and 2 and relocation of the existing raw water supply tanks which are located on top of the overburden emplacement between Open Cut 1 and Open Cut 2.

## 1.5 Surface Water Assessment Scope of Works

This SWA focussed on:

- Assessment of potential soil and water impacts associated with the modification;
- Assessment of soil and water impacts associated with the ongoing operation of MCM; and

- Development of appropriate measures to mitigate potential impacts associated with the modification and ongoing operation of MCM.

The SWA scope of works included:

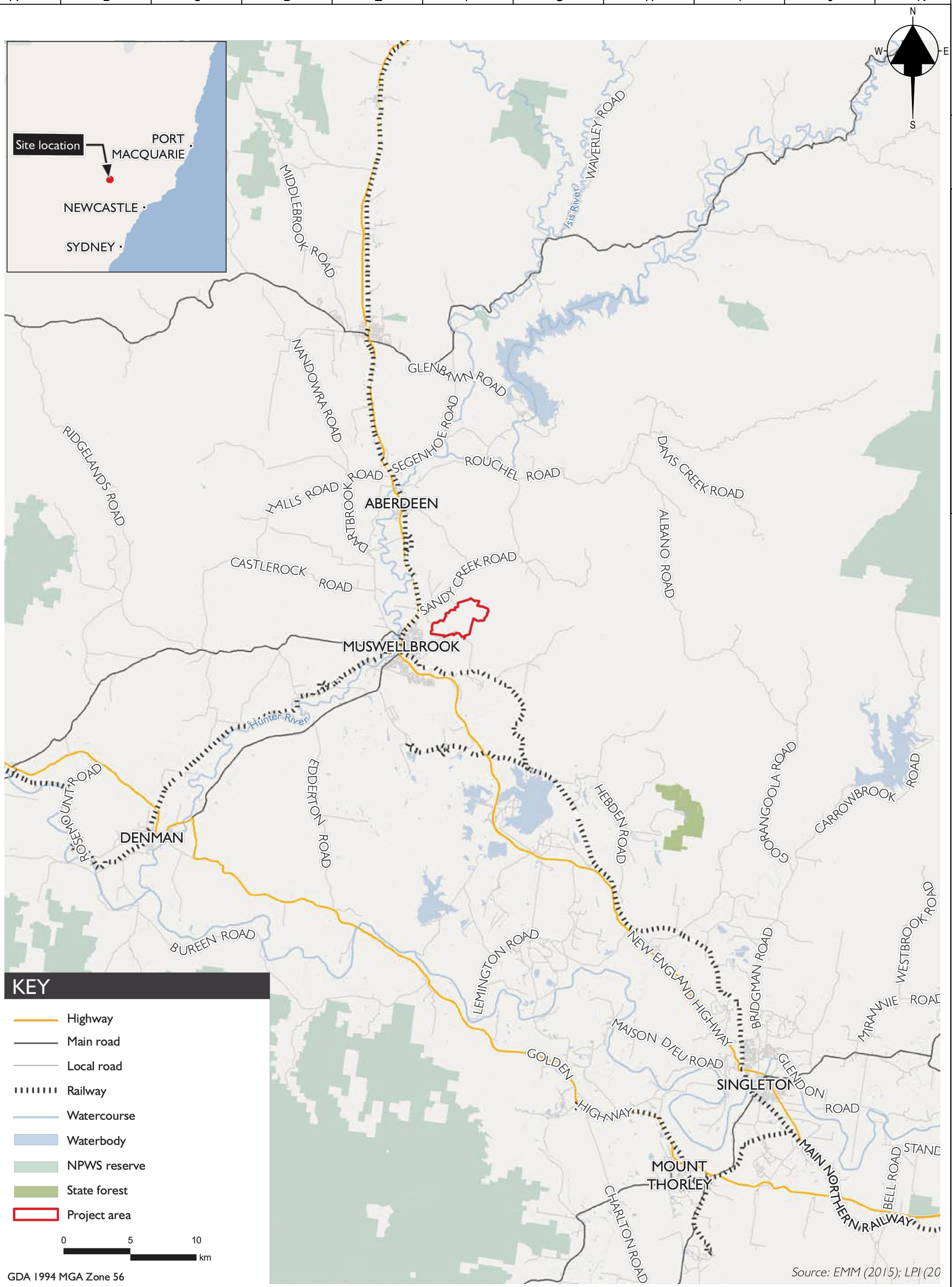
- A site visit;
- Literature review of relevant legislation, policies, guidelines and other relevant documentation;
- Identification of the key issues, relevant assessment criteria and constraints relating to surface water;
- Details on the existing environment (surface hydrology, catchment characteristics, receiving water quality and quantity);
- The proposed mitigation measures, including details on the design criteria used, to minimise or negate the impact the proposed modification may have on the existing environment;
- An overview of the proposed surface water management system including required size of surface water structures for pollution control purposes;
- Consideration of the ability of surface waters to enter external water systems;
- Recommendations for ongoing surface water monitoring; and
- An assessment of the impacts of the proposed modification on surface water flows within the local area and the surrounding watercourses.

## 1.6 Planning Context

The following relevant legislation, policies and guidelines were considered as part of this SWA:

- *Water Management Act 2000* (WMA) and *Water Act 1912*;
- *Water Sharing Plan for the Hunter Regulated River Water Source 2003*;
- Draft Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources, 2016
- *Protection of the Environment Operations Act 1997* (POEO Act);
- Managing Urban Stormwater: Soils & Construction, NSW Government, 2004;
- *Muswellbrook Local Environmental Plan 2009*;
- National Water Quality Management Strategy, Department of Environment, Australian Government, 1992; and
- NSW State Rivers and Estuaries Policy, NSW Government 1993.

These are discussed further in **Section 2**.

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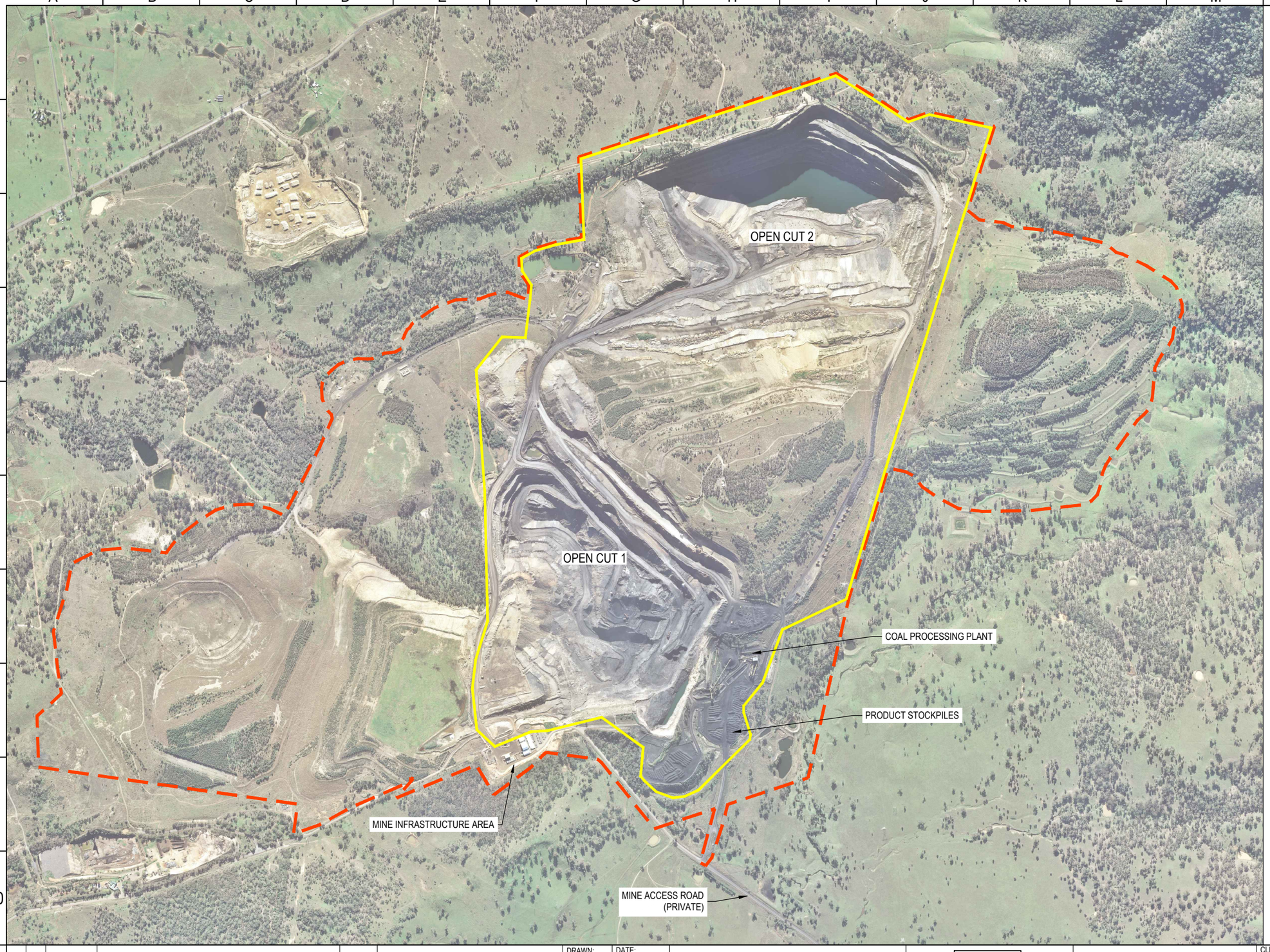


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## LEGEND

- MODIFICATION AREA
- DEVELOPMENT CONSENT BOUNDARY

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# 2 RELEVANT LEGISLATION, POLICY, GUIDELINES AND LICENCES

## 2.1 Legislation

### 2.1.1 Protection of the Environment Operations Act 1997

The POEO Act is the key piece of environmental legislation administered and enforced by the NSW Environment Protection Authority (EPA). The POEO Act enables the Government to set out explicit protection of the environment policies and adopt more innovative approaches to reducing pollution.

MCC holds an Environment Protection Licence (EPL) under the POEO Act however; no discharge limits apply with respect to surface waters (refer to **Section 2.3**).

### 2.1.2 Water Management Act 2000 and Water Act 1912

The *Water Act 1912* and WMA contain provisions for the licensing of water capture and use. MCM is located within an area covered by the *Water Sharing Plan for the Hunter Regulated River Water Source 2003*. Therefore volumetric licensing applies. MCC holds four licences to extract ground water under Part 5 of the Water Act 1912. The access licence volumes are shown in **Table 1**.

**Table 1 MCC Water Access Licenses**

| Licence Number | Pertaining To: | Extraction Entitlement (ML/year Limit) |
|---|---|---|
| 20BL169014 | Borehole RDH529 | 1000 |
| 20BL169037 | Open Cut 1 | 2000 |
| 20BL169038 | Open Cut 2 | |
| 20BL170473 | Borehole RDH607 | 3000 |

Under the WMA, landholders in NSW are permitted to collect a portion of the rainfall runoff on their property and store it in dams (up to a certain size). This rainfall harvesting right is typically 10% of the total rainfall runoff for the property and is known as the Maximum Harvestable Right Dam Capacity (MHRDC). Where dams exceed this capacity or a certain size, they must be licensed.

Exclusions to this licensing requirement exist for dams used to control pollution or effluent. All dams at MCM are used for pollution control purposes (control of mine water and dirty water [refer **Section 4.1**]) and as such, are exempt from MHRDC licensing requirements at the current time. Following rehabilitation, consideration must be given to the applicability of the MHRDC for the property.

### 2.1.3 Hunter Regulated River Water Sharing Plan

The Water Sharing Plan includes rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading in the plan area.

As a means of achieving the objectives of the Water Sharing Plan, total daily extraction limits are in place to protect the water held under access licences for the purpose of providing water to the environment and protecting flow in local watercourses. Extraction limits and environmental flow protection rules are used to protect, preserve, maintain and enhance the region's water.

Planned environmental water provisions are in place to achieve this and relate to water that is committed by management plans for fundamental ecosystem health or other specified environmental purposes, and that cannot to the extent committed, be taken or used for any other purpose. Adaptive environmental water conditions may be imposed on whole or part of an access licence as another way to ensure the environmental water supply is protected.

Surface water runoff from the wider mine site currently drains to either of the open cut pits or operational dams located around MCM. Surface water runoff is not discharged but rather, is pumped between dams for use within the operations. Operational water is extracted from the groundwater bores and from the various surface water dams around the mine.

## 2.2 Policies and Guidelines

The following relevant policies and guidelines were considered as part of this SWA:

- Managing Urban Stormwater: Soils & Construction Volume 1 4th edition, Landcom, 2004;
- Managing Urban Stormwater: Soils and Construction Volume 2E, Mines and Quarries, Department of Environment and Climate Change [DECC], 2008;
- NSW Water Quality and River Flow Objectives, NSW Office of Environment and Heritage, 2006;
- National Water Quality Management Strategy, Australian Department of Environment, 1992;
- NSW State Rivers and Estuaries Policy, NSW Water Resources Council, 1993;
- State Water Management Outcomes Plan, NSW Department of Primary Industries Office of Water (DPI Water);
- Guidelines for Controlled Activities – Riparian Corridors;
- NSW Aquifer Interference Policy, DPI Water, 2012;
- NSW Groundwater Dependent Ecosystems Policy, NSW Department of Land and Water Conservation, 2001; and
- POEO Hunter River Salinity Trading Scheme Regulation, NSW EPA, 2002.

### 2.2.1 Managing Urban Stormwater: Soils and Construction

In NSW, the most relevant and comprehensive guidelines for the design of stormwater controls at mine sites are contained within the Landcom document, 'Managing Urban Stormwater: Soils and Construction' – Volume 1, 4th edition (Landcom, 2004) and Managing Urban Stormwater: Soils & Construction – Volume 2E, Mines and Quarries (DECC, 2008). These publications, along with other volumes, are commonly referred to as "the Blue Book".

The Blue Book is utilised as guidance for broader industries and contains prescriptive guidelines for what should be included in an Erosion and Sediment Control Plan (ESCP) and a Soil and Site Water Management Plan.

The principles of surface water and sediment control have been adopted when assessing the performance and suitability of the onsite water storages and surface water management controls.

### 2.2.2 NSW Water Quality and River Flow Objectives

The NSW Water Quality Objectives (WQOs) and River Flow Objectives (RFOs) are the agreed environmental values and long-term goals for NSW's surface waters. They set out:

- The community's values and uses for our rivers, creeks, estuaries and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water); and
- A range of water quality indicators to help assess whether the current condition of waterways supports those values and uses.

Water Quality Objectives (WQOs) have been agreed for fresh and estuarine surface waters and marine waters. The WQOs are consistent with the agreed national framework for assessing water quality set out in the ANZECC (2000) guidelines. The WQOs provide environmental values for NSW waters and the ANZECC 2000 Guidelines provide the technical guidance to assess the water quality needed to protect those values.

The Hunter River is classified as a Major Regulated Waterway along the majority of its length and in some areas (including Muswellbrook), as a Waterway Affected by Urban Development. The WQOs set by OEH for the Hunter River include protection of the following values:

- Aquatic ecosystems;
- Visual amenity;
- Secondary recreation;
- Primary contact recreation;
- Livestock water supply;
- Irrigation water supply;
- Homestead water supply;
- Drinking water at point of supply - disinfection only;
- Drinking water at point of supply - clarification and disinfection;
- Drinking water at point of supply – groundwater; and
- Aquatic foods – cooked.

Meeting water quality trigger levels suitable for local aquatic ecosystems is generally the basis for protecting other environmental values of water resources, which are the uses people have for water (OEH, 2006).

The ecosystem trigger levels for the Hunter Regulated River Water Source (lowland river) (OEH, 2006) are outlined below. A detailed description of the water quality objectives and trigger levels for other environmental values is provided in OEH (2006).

**Table 2 Hunter River WQOs (OEH, 2006)**

| Parameter | Numerical criteria (trigger value) |
|---|---|
| Total phosphorus | 25 µg/L |
| Total nitrogen | 350 µg/L |
| Chlorophyll-a | 5 µg/L |
| Turbidity | 6 to 50 NTU |
| Electrical Conductivity (EC) | 125 - 2200 |
| Dissolved oxygen | 85 to 110% |
| pH | 6.5 to 8.5 |
| Temperature | As detailed in ANZECC 2000 guidelines, Table 3.3.1 |
| Chemical contaminants or toxicants | As detailed in ANZECC 2000 guidelines, Chapter 3.4 and Table 3.4.1 |

As the Hunter River is a Major Regulated River, no RFOs were recommended by OEH for the Hunter River and instead, the greater Hunter Water Sharing Plan applies.

### 2.2.3 National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS) provides a national approach to improving water quality in Australia's waterways. Development has progressed since 1992, with the Australian Government working in cooperation with state and territory governments to produce the Strategy. The Strategy incorporates a number of key guidelines concerning management and monitoring of water including the following:

- Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000); and

- Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ, 2000).

Direction for the application of the guidelines is provided in the following document:

- Using the ANZECC Guidelines and Water Quality Objectives in NSW (DEC, 2006).

These guidelines provide an agreed framework to assess water quality in terms of whether the water is suitable for a range of environmental values (including human uses).

The ANZECC (2000) guidelines for protection of downstream ecosystems have been considered in assessing the potential water quality impacts to the Hunter River and its tributaries.

### 2.2.4 NSW State Rivers and Estuaries Policy

The NSW State Rivers and Estuaries Policy, originally published in 1993, contains State-wide objectives for the protection and enhancement of watercourses. Though the institutional arrangements and legislation have changed since then, the overarching objectives remain valid. The overall objectives of the policy are "to manage the rivers and estuaries of NSW in ways which slow, halt or reverse the overall rate of degradation in their systems, ensure the long-term sustainability of their essential biophysical functions, and maintain the beneficial use of these resources" (NSW Water Resources Council, 1993).

The proposed stormwater management associated with the modification should be consistent with the policy objectives. This assessment demonstrates there is no expected degradation of the Hunter River as a result of the modification.

### 2.2.5 State Water Management Outcomes Plan (WM Act)

The WM Act includes the State Water Management Outcomes Plan, a statutory document which sets the overarching policy, targets and strategic outcomes of the WM Act. This document expired in 2007, however, the content of the document remains an important reference with regard to water management objectives for proposed developments.

### 2.2.6 Guidelines for Controlled Activities – Riparian Corridors (WM Act)

The WM Act includes guidelines for Controlled Activities – Riparian Corridors which outline the required buffer zones required to be maintained between watercourses and proposed developments including any Core Riparian Zones, a Vegetated Buffer and an Asset Protection Zone. The required size of these buffer zones depends upon the conservation significance of the stream, with larger buffer zones required for more significant streams.

Riparian vegetation has not been identified within or adjacent to the Modification Area and as such, no impact will occur to riparian vegetation.

### 2.2.7 NSW Aquifer Interference Policy (WM Act)

The NSW Aquifer Interference Policy was released in September 2012. It sets out the requirements for assessing the impacts of aquifer interference activities on water resources. It explains the role and requirements of the Minister administering the WMA in the water licensing and assessment processes for aquifer interference activities under the WMA and other relevant legislative frameworks.

The NSW Aquifer Interference Policy is discussed further in the Groundwater Impact Assessment Report (SLR, 2016).

### 2.2.8 NSW Groundwater Dependent Ecosystems Policy

The NSW Groundwater Dependent Ecosystem Policy was created in 2002. This policy explains the various types of groundwater dependent ecosystems (GDEs) found in NSW and promotes the management of these systems during planning processes. Five principles provide guidance on how to protect and manage these natural systems using a range of documented tools. The WMA provides the legislative framework for implementing the policy.

### 2.2.9 Hunter River Salinity Trading Scheme Regulation

The NSW Government's Hunter River Salinity Trading Scheme (HRSTS) provides a framework for managing discharge of saline mine waters to the Hunter River via licensed discharge points. The scheme uses continuous real time monitoring data of environmental conditions and river flow conditions to permit and schedule discharges (under salinity credit) to ensure Electrical Conductivity (EC) targets in the Hunter River are not exceeded. MCM does not discharge to surface water and, as such, the HRSTS is not directly applicable.

## 2.3 Environment Protection Licence

MCC holds an EPL (EPL 656) for coal works and mining for coal. No concentration or volumetric limits apply for EPL 656 in relation to discharge to surface waters. In the absence of any specific discharge criteria or limits, the overarching criteria of the POEO Act applies (as stated in EPL 656):

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

# 3 EXISTING SOIL AND WATER ENVIRONMENT

## 3.1 Regional Hydrology

MCM is located in the Upper Hunter Valley region in the catchment of the Hunter River, which is located approximately 3km to the west of MCM. At its nearest point the river has an average flow rate of 200 ML/day. The Hunter River catchment is shown in **Figure 3** and covers an area of approximately 21,367km$^2$.

There are two important catchments within the vicinity of MCM including Sandy Creek and Muscle Creek which are both ephemeral tributaries of the Hunter River. Both watercourses flow in a westerly direction and join the Hunter River in the immediate vicinity of Muswellbrook township. No flow gauging data is available for these watercourses. Local watercourses of significance are shown in **Figure 4**.

## 3.2 Regional Climate

The regional climate is characterised by hot summers and mild winters, typical of temperate conditions. Rainfall is heaviest during the summer months with the majority of rainfall occurring as high intensity storms or cold fronts moving through from the southwest. The area is characterised by low average rates of runoff and infiltration, and high rates of evaporation. Long term average rainfall is reported at 620mm at the nearest Australian Bureau of Meteorology (BoM) monitoring station located at Lower Hill Street in Muswellbrook (Site No. 061053).

Long term temperature and rainfall data are summarised in **Table 3** as sourced from the combined Site Water Management Plan and Surface and Groundwater Monitoring Plan (MCC, 2015a), herein referred to as the Site Water Management Plan. Evaporation data was not available at this station. The nearest available evaporation data was sourced from the Soil Conservation Service Laboratory, located 27km away at Scone (MCC, 2015a).

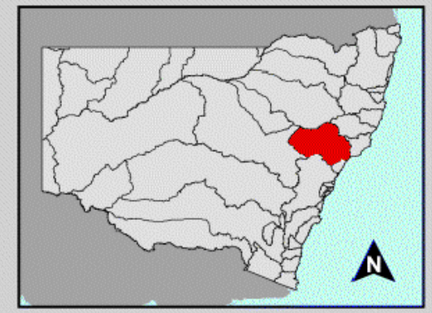
**Table 3 Climate Statistics**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Average | Annual Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Max ($^0$C) | 28.5 | 28.6 | 27.6 | 24.9 | 19.8 | 17.8 | 17.4 | 19.1 | 20 | 25.3 | 25.9 | 29.1 | **23.6** | **-** |
| Mean Min ($^0$C) | 16.1 | 16.7 | 14.1 | 9.7 | 6.5 | 4.5 | 1.8 | 4.2 | 5.8 | 9.9 | 12.2 | 14.9 | **9.6** | **-** |
| Mean Rainfall (mm) | 69.3 | 66.5 | 52.6 | 3.4 | 41.1 | 50.9 | 44.1 | 39.2 | 40.9 | 48.7 | 55.0 | 67.3 | **-** | **619.6** |
| Mean Daily Evap (mm) | 7.1 | 6.2 | 4.9 | 3.5 | 2.2 | 1.6 | 1.8 | 2.7 | 3.9 | 5.1 | 6.1 | 7.1 | **-** | **1606** |

*Source: MCC Site Water Management Plan, 2015.*

Average evaporation rates are higher than average rainfall rates for all months, suggesting that a soil moisture deficit occurs throughout the year.

# Hunter River Catchment



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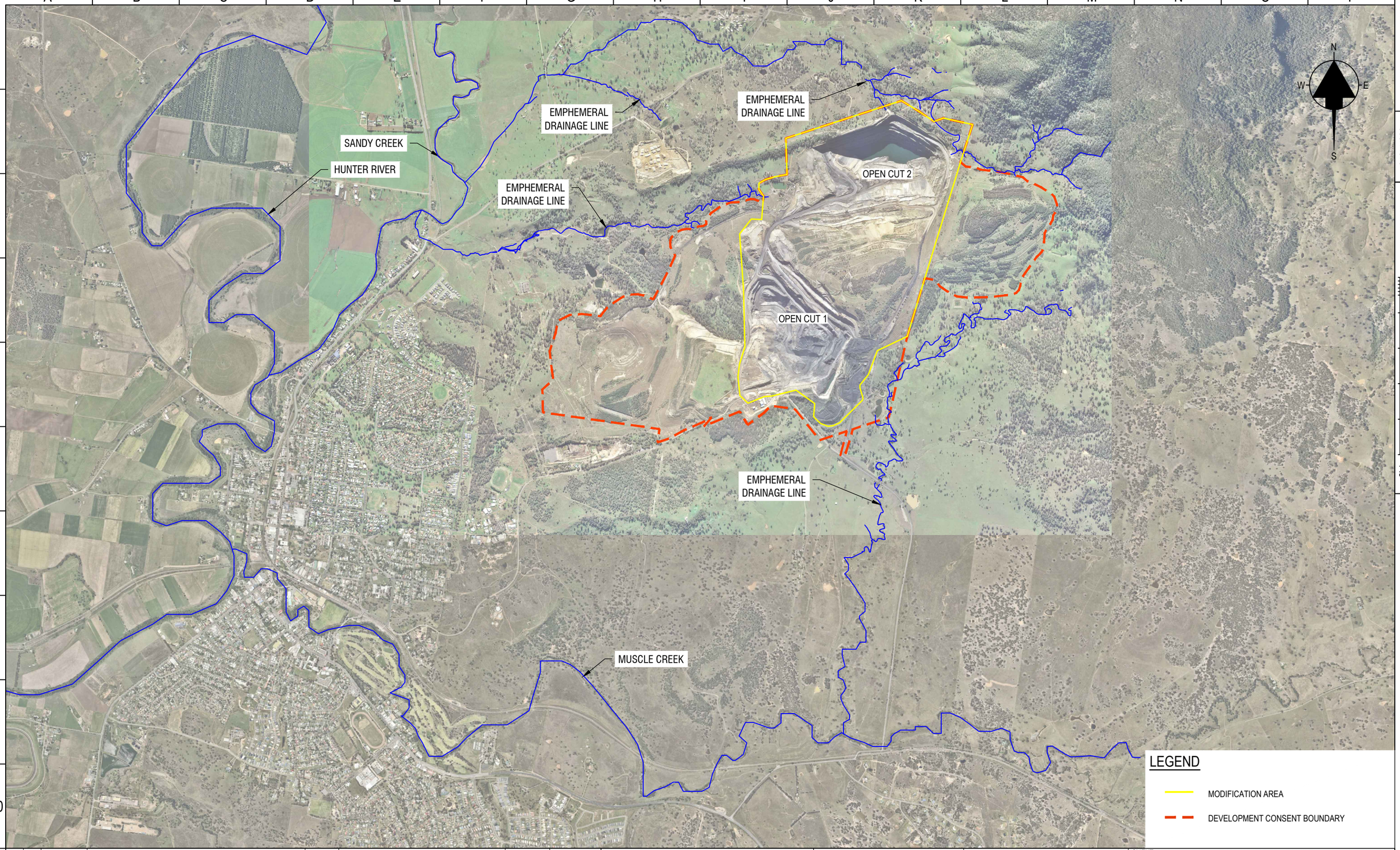


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## 3.3 Local Landform and Topography

The topography within the vicinity of MCM is dominated by the elevated terrain to the east including Bells Mountain with a maximum elevation of 690m AHD, and the Skellatar Ridge to the south (maximum elevation of 333m AHD) (MCC, 2015a).

Natural ground elevations at MCM range between 230m and 260m AHD, while the rehabilitated overburden emplacement areas extend up to 340m AHD. There is an overall fall in topography in a westerly direction toward the Hunter River, where the elevation on the flood plain adjacent to the river lies at around 150m AHD.

## 3.4 Local Hydrology

The Skellatar Ridge, situated immediately to the south of MCM forms the south-west to north-east trending boundary between the catchments of Sandy Creek and Muscle Creek. Runoff from the northern side of Skellatar Ridge flows in a north-west direction to Sandy Creek which flows westerly to the Hunter River. Incident rainfall on the south side of Skellatar Ridge flows to Muscle Creek in the south and subsequently to the Hunter River in Muswellbrook.

MCM is broadly characterised by two distinctly separate catchment types as follows:

- Rehabilitated areas – Historic overburden emplacement or disturbance areas which have undergone rehabilitation; and
- Operational areas – Areas currently utilised for operational activity or undergoing rehabilitation. Runoff associated with these catchment types includes both mine water and dirty water depending upon the use of the area (refer to **Section 4.1**).
- Major surface water dams around MCM are shown in **Figure 5**.

### 3.4.1 Rehabilitation Areas

The rehabilitated land is generally characterised by a good surface cover (i.e. grasses and shrubs which minimises the potential for soil creep and assists in sediment capture across the rehabilitation areas.

### 3.4.2 Operational Areas

The operational areas are generally highly disturbed comprising of haul roads, product stockpiles, overburden emplacement and general disturbance areas. Dirty water and mine water (refer to Section **4.1**) are broadly treated as a single water resource with this runoff draining directly into the open cut pits or the various dams around the mine.

The operational areas of MCM are delineated into the major catchment areas as detailed in **Table 4** and as shown on **Figure 6**.

**Table 4 Operational Catchment Areas at MCM**

| Catchment | Total Catchment Area (Ha) |
|---|---|
| Dam 1 & Dam 2 combined catchment; | 85.8 |
| Final Settling Ponds catchment; | 47.9 |
| Open Cut 1 catchment; | 116.6 |
| Open Cut 2 catchment; | 91.3 |

Surface runoff from the operational areas collects in the base of Open Cut 1, Open Cut 2, Dams 1 and 2 or the Final Settling Ponds and is pumped around MCM to be used for operational activity.

There are a number of additional catchment areas associated with MCM however; these comprise of rehabilitation areas which drain to respective sediment dams and are not considered to have an impact on the modification. These dams are covered by the existing Erosion and Sediment Control Plan (ESCP) and Site Water Management Plan.

## 3.5 Land Capability and Soil Classification

The NSW Department of Primary Industries – Agriculture has a system of classification of lands according to five classes of agricultural suitability. The MCM Land Management Plan (MCM, 2015f) describes soils around MCM as being largely of Class 4 – *land suitable for grazing but not cultivation*. Constraints include slope, soil structure, rockiness and a degree of existing erosion.

The Land Management Plan (MCM, 2015f) describes a refined pattern over the mining area. The Class V lands are those where the Yellow Duplex soils are formed in situ from the sedimentary sequence of the Greta Coal Measures with generally a good cover of native grasses.

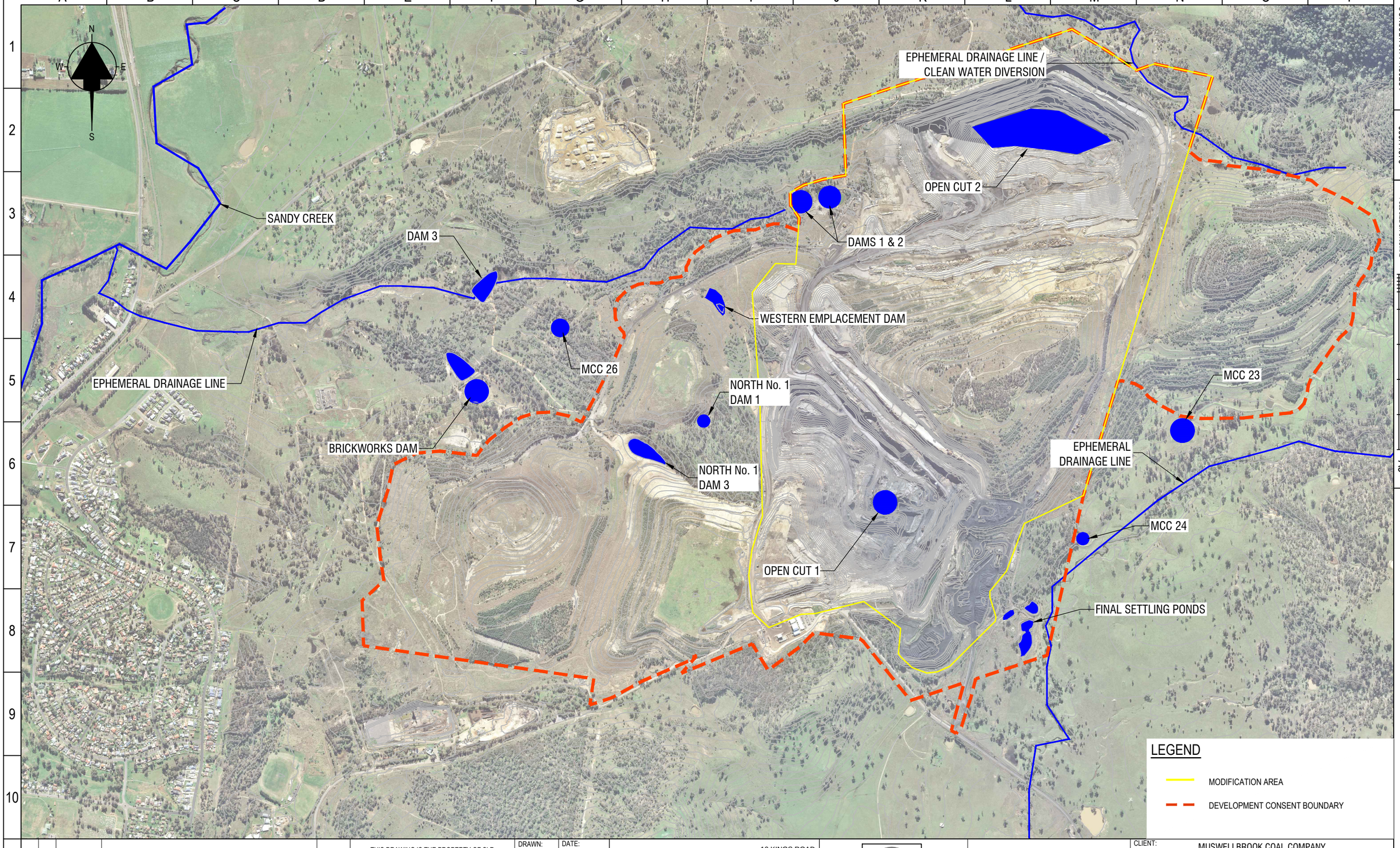
Steeper side slopes and the drainage lines have been grouped as Class VI Land. These areas have poorer cover and active sheet and gully erosion, necessitating only judicious grazing. Class IV Lands are those with moderate slope. There is good ground cover and occasional rocky outcrop making these areas suitable for grazing without constraints other than satisfactory management.

The Land and Soil Capability (LSC) of the existing overburden emplacement between Open cut 1 and Open Cut 2 was assessed in accordance with the land and soil capability assessment scheme (OEH 2012). The process comprises comparison of the soils and landscape characteristics determined during soil surveys against eight limitation/hazard criteria (water erosion, wind erosion, soil structural decline, soil acidification, salinity, waterlogging, shallow soils and rockiness and mass movement) to allocate land to classes based on limitations or hazards. There are eight classes which range from extremely high capability land (Class 1) to extremely low capability land (Class 8).

The survey sites were determined to be LSC Class 6 (low capability land), which is most suited for grazing, forestry and conservation (EMM, 2016).

## 3.6 Acid Sulphate Soils

MCM is located some 150km from the coastline and as such, Acid Sulphate Soils (ASS) are highly unlikely to be encountered at the site. This was confirmed by reviewing OEH's ASS maps (OEH, 2013) which show no ASS in the vicinity of MCM. Acid mine drainage has not been identified as an issue at MCM with pH of waters within the mine water management system exhibiting relatively neutral pH levels.

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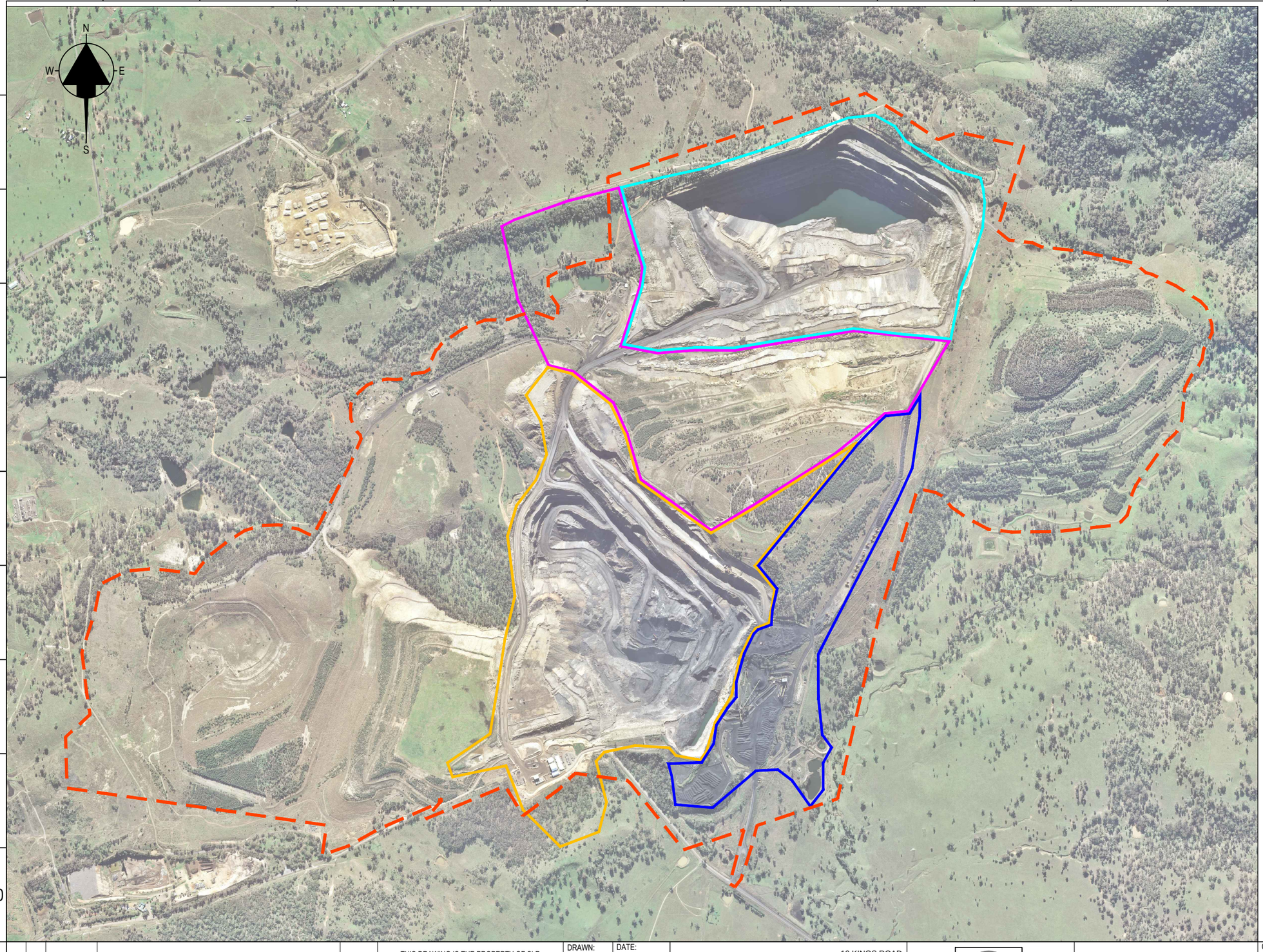


## LEGEND

- DAMS 1 AND 2 CATCHMENT BOUNDARY
- FINAL SETTLING PONDS CATCHMENT BOUNDARY
- VOID 1 CATCHMENT BOUNDARY
- VOID 2 CATCHMENT BOUNDARY
- DEVELOPMENT CONSENT BOUNDARY

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## 3.7 Surface Water and Groundwater Interaction

Groundwater is extracted from licensed bores (as detailed in **Table 1**) and pumped to Dams 1 and 2 for temporary storage before being pumped around MCM to supply operational activities. Groundwater is discussed further in the Groundwater Impact Assessment Report (SLR, 2016).

No impact to Groundwater Dependent Ecosystems (GDEs) is expected. This is discussed further in the Groundwater Impact Assessment Report (SLR, 2016).

## 3.8 Regional Water Quality

The Hunter River is an important water resource for industry, agriculture, mining, ecological, environmental and social purposes. Water quality within the Hunter River is impacted upon by a wide variety of activities within the greater catchment including mining. Water quality varies along the length of the river however; the river is known to have slightly elevated salinity (EC) and Total Suspended Solids (TSS) depending upon flow volumes (OEH, 2006)

## 3.9 Local Water Quality Monitoring

Water quality monitoring is undertaken on a regular basis in Muscle Creek and major water storages on site. The current monitoring locations are presented in **Table 5** and are shown in **Figure 7**.

**Table 5 Local Surface Water Monitoring Locations**

| Site Reference | Description of Structure | Frequency |
|---|---|---|
| Dam 1 / 2 | Dam1 overflows to Dam 2 | Monthly & Annually |
| Open Cut 1 | In Pit Catchment | Monthly & Annually |
| Open Cut 2 | In Pit Catchment | Monthly & Annually |
| MCC7 | Muscle Creek upstream | Monthly & Annually |
| MCC8 | Muscle creek downstream | Monthly & Annually |
| MCC9 | Brickworks Dam 1 | Monthly & Annually |
| MCC12 | Final Settling Pond | Monthly & Annually |
| MCC23 | East Emplacement Dam South | Quarterly & Annually |
| MCC24 | East Haul Road Dam | Quarterly & Annually |
| MCC25 | East Emplacement Dam North | Quarterly & Annually |
| MCC26 | Blues Crusher Dam | Quarterly & Annually |
| MCC27 | Dam 3 | Quarterly & Annually |
| Monthly and Quarterly analysis focusses on pH, TSS and EC. Quarterly analysis is undertaken in June, September and December each year. | | |
| Annual (comprehensive analysis) focusses on pH, TSS, EC, Hardness, Ca, Mg, Na, K, Sulfate, Chloride, Fluoride, Carbonate, Bicarbonate, Nitrate, Oil and Grease, Ammonia, Dissolved Fe, Total Fe, Mn, As, Ba, B, Cd, Cr, Cu, Ni, Pb, Zn, Hg, Se, TPH, PAH<br>Annual analysis is undertaken in March each year. | | |

A summary of the monitoring results for pH, TSS and EC for the period 2006 – 2015 for on-site water management storages is presented in **Table 6**. Monitoring results for offsite monitoring locations in adjacent ephemeral watercourses for the period 2006 - 2015 are provided in **Table 7**. Those results which exceed the relevant trigger value criteria are highlighted in bold. An explanation of the results is provided further below.

**Table 6 Key Surface Water Quality Monitoring Results (2006 – 2015) for on Site Storages**

| | | Dam 1/2 | MCC12 Final Settling Pond | Open Cut 2 | Open Cut 1 |
|---|---|---|---|---|---|
| **pH** | **Average** | 7.7 | 8.1 | 7.8 | 7.8 |
| | **Min** | 6.6 | 6.4 | 6.7 | 7.3 |
| | **Max** | 8.2 | 9.4 | 8.2 | 8.0 |
| **EC** | **Average** | 5,497 | 7,723 | 5,488 | 5,038 |
| | **Min** | 2,020 | 2170 | 3,550 | 3,320 |
| | **Max** | 11,000 | 14,400 | 6,750 | 6,220 |
| **TSS** | **Average** | 15 | 19 | 18 | 41 |
| | **Min** | 1 | 2 | 2 | 5 |
| | **Max** | 375 | 105 | 337 | 478 |

**Table 7 Key Surface Water Quality Monitoring Results (2006 – 2015) For Offsite Locations**

| | | Trigger Value | MCC07 Muscle Creek - Upstream | MCC08 Muscle Creek - Downstream |
|---|---|---|---|---|
| **pH** | **Average** | -- | 7.8 | 7.9 |
| | **Min** | 6.5 | 7.3 | 7.4 |
| | **Max** | 8.5 | 8.1 | 8.1 |
| **EC** | **Average** | -- | **2,606** | **3,133** |
| | **Min** | 125 | 297 | 459 |
| | **Max** | 2,200 | **9,130** | **9,120** |
| **TSS** | **Average** | -- | 13 | 11 |
| | **Min** | 6* | 1 | 4 |
| | **Max** | 50* | 48 | **50** |

**TSS trigger values are for turbidity. While similar, the upper limit is consistent with the broadly accepted upper value limit for TSS as described in Managing Urban Stormwater (the Blue Book)..*

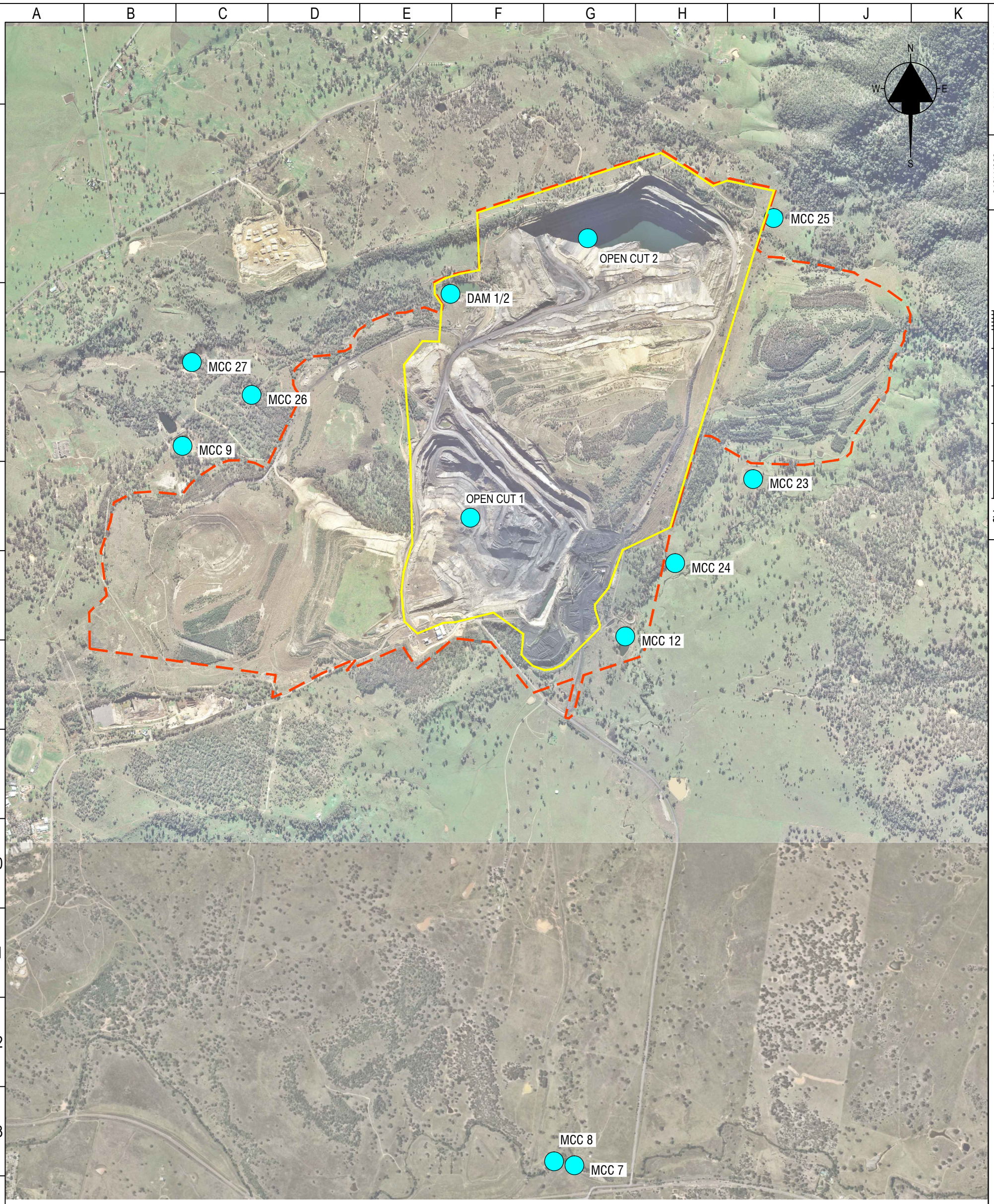
** Trigger values are based on information presented in the NSW WQOs, (OEH 2006) and the ANZECC (2000) Guidelines.*

The results of on-site water storage testing indicate that mine waters are characterised by a relatively neutral pH, a generally low TSS and medium - high EC levels. The pH within the Final Settling Ponds is somewhat higher than other dams at MCM.

Offsite water quality monitoring indicates that the water in Muscle Creek varies according to rainfall with higher EC in drier conditions and lower EC in wet conditions. The pH is slightly alkaline and broadly speaking, historical monitoring results indicate the water quality is highly dependent upon incident rainfall and the ephemeral nature of the watercourses, rather than impacts associated with MCM.

## 3.10 Flooding

A flood assessment was undertaken for MCM as part of the 2010 Statement of Environmental Effects (SEE) for the Area C modification area (Hanson Bailey, 2010). The assessment showed that the proposed and existing mining area were well outside the alluvial floodplain and the 100 year flood limit of the Hunter River.




LEGEND

- MODIFICATION AREA
- DEVELOPMENT CONSENT BOUNDARY
- SURFACE WATER MONITORING LOCATION

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# 4 EXISTING SOIL AND WATER MANAGEMENT

## 4.1 Water Classifications

Water management at MCM is based on the water classification detailed in **Table 8**, as taken from the Site Water Management Plan (MCC, 2015a).

**Table 8 Water Management Classifications and Preferred Management Method**

| Water Classification | Source | Preferred Management Method |
|---|---|---|
| Clean Water | Clean water runoff is that runoff produced from undisturbed, clean catchments or catchments which have been fully rehabilitated to a level suitable for release of surface runoff to the environment. | Diverted around disturbed areas and released to the environment. |
| Dirty Water | Surface water runoff produced from disturbed catchment areas where runoff is expected to exhibit a high TSS or turbidity and sediment loading but is not typically impacted by EC. | Directed to pollution control dams (sediment dams) and pumped back into MCM Water Management System. |
| Mine Water | Runoff produced from areas impacted by coal resources (i.e. haul roads, CPP, mine open cut pits) which is typically characterized by an elevated EC. | Contained within MCM open cut pits; or<br>Contained in the mine water dams (Dams 1 and 2 and the Final Settling Ponds) and reused within the operations. |
| Potable Water | MSC supply pipeline | N/A potable water is sourced from MSC via pipeline. |
| Sewage wastewater | Amenities within the MIA and CPP areas | Trucked offsite for disposal by a third party contractor. |

*SOURCE: Site Water Management Plan (MCC, 2015a)*

## 4.2 Mine/Dirty Water Management

The broader water management system at MCM involves separation and appropriate treatment of the different water classifications as detailed in **Table 8** above.

As shown in **Figure 6**, MCM is characterised by four major catchment areas with respect to the proposed modification including:

- The area surrounding the CPP, coal stockpiles, and the eastern haul road all drains to the Final Settling Ponds;
- The MIA, Open Cut 1 and rehabilitation areas immediately surrounding the Open Cut 1 all drain back into Open Cut 1;
- The majority of the overburden emplacement area between Open Cut 1 and Open Cut 2 drains to Dams 1 and 2; and
- Open Cut 2 and the areas immediately surrounding Open Cut 2 drain into Open Cut 2.

Pumping infrastructure is located on key dams around MCM to allow transfer of water around MCM for operational purposes. No discharge to surface water occurs at MCM.

## 4.3 Erosion and Sediment Controls

MCM has an approved, site wide Erosion and Sediment Control Plan (ESCP) which applies to all operations and activity undertaken by MCC. The ESCP contains major provisions for the installation of erosion and sediment controls, if required, prior to disturbance of any land including:

- The restriction of the extent of disturbance to the minimum that is practical and in accordance with the MOP;
- The progressive rehabilitation of disturbed land and the construction of drainage controls to improve the stability of rehabilitated land;
- The protection of natural drainage lines and watercourses by the construction of erosion control devices such as diversion banks and channels and sediment retention dams as necessary;
- The restriction of access to rehabilitated areas;
- Management of erosion and sediment control of affected surface watercourses/water bodies, including drainage lines within or adjacent to the development consent boundary; and
- Regular inspection of dams to monitor their efficiency and any required maintenance.

## 4.4 Chemical and Hydrocarbon Management

All oils, lubricants, fuels and chemicals are stored within bunded storage facilities at the workshop, stores, CPP and blasting facilities. Activities undertaken on site to minimise hydrocarbon contamination include:

- Above ground fuel storage tanks are self-bunded to contain any spillage which may occur;
- Waste oil from the workshop is stored in a bunded waste oil tank and is removed as required; and
- Runoff from the hardstand wash-down bay passes through a three-staged silt trap and an oil/water separator. The collected silt is routinely cleaned out and disposed of in a suitable manner. Any runoff from around the MIA drains back into Open Cut 1.

## 4.5 Dam Water Level Management

Both the Final Settling Dams (10 ML capacity) and Dams 1 and 2 (50 ML combined capacity), which are the major out of pit mine water dams, have pumping infrastructure installed to allow the transfer of water around site for operational and environmental purposes. These dams are maintained at a level which provides for sufficient storage for future rainfall events. Water used for operational and environmental purposes is also sourced from other dams.

In the unlikely event that Dam 1 and 2 were to overflow, water would enter the adjacent ephemeral drainage line and would report into Dam 3 further downstream. Downstream from Dam 3, the ephemeral drainage line continues to the west and joins Sandy Creek immediately west of the junction between Sandy Creek and the New England Highway.

In the unlikely event that the Final Settling Ponds were to overflow, water would report to an ephemeral drainage line immediately to the east. The ephemeral drainage line joins Muscle Creek some 1.5km to the south. By monitoring the water level within these dams and adjusting accordingly (through the use of existing pumping infrastructure), MCC will maintain a water level within these dams which minimises the risk of overflow.

# 5 REVIEW OF WATER DEMAND, SUPPLY AND REUSE

## 5.1 Site Water Balance Model

MCC periodically (annually) update a water balance model for the site which was most recently revised for the 2015 Annual Environmental Management Plan (AEMR). The results of the annual water balance are detailed in the AEMR.

## 5.2 Water Supply

### 5.2.1 Operational Water

Operational water is sourced from the groundwater bores and is pumped to Dams 1 and 2 where it mixes with surface water runoff from the local catchment of the dams. Water is then pumped around MCM for environmental and operational purposes. Operational water is also sourced from Dam 3 and the Final Settling Ponds.

### 5.2.2 Potable Water

Potable water is supplied to the operations via pipeline from MSC for use in the office/amenities, workshop and CPP.

## 5.3 Water Inputs & Outputs

Typical inputs and outputs to the water balance model are reported in the AEMR annually. The water inputs and outputs reported for the 2015 period, are provided in **Table 9**.

**Table 9 Inputs and Outputs to the Water Balance Model (AEMR, 2015)**

| Source | Volume (ML/yr) |
|---|---|
| **Inputs** | |
| Groundwater Seepage | 0.0 |
| Surface water runoff and Dam Capture | 178.8 |
| Pumping water from the underground workings | 2,041.0 |
| Entrainment in coal | 127.5 |
| Supply of potable water from MSC | 2.7 |
| **Outputs** | |
| Discharge Offsite | 0.0 |
| Dust Suppression – water infusion and sprays | 1,150.3 |
| Dust Suppression – water carts | 351.5 |
| Evaporation from dams | 126.2 |
| Entrainment in coal leaving site | 138.6 |
| Pumped to Council Void | 0.0 |
| Septic pump out | 1.0 |
| **Total Input** | **2,350.0** |
| **Total Output** | **1,767.6** |

The calculated water balance for the 2015 reporting period indicated that MCM operated in water surplus for the reporting period. Surface water balance results for previous reporting periods from 2010 to 2015 are detailed in **Table 10**.

**Table 10 Surface Water Usage Results From Recent AEMRs**

| Period Ending | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|
| **Total Annual Input (ML/year)** | 1034 | 1302 | 2358 | 1847 | 1246 | 2,350 |
| **Total Annual Output (ML/year)** | 1199 | 1360 | 2518 | 1992 | 1492 | 1,767 |
| **Balance (ML/year)** | -165 | -58 | -160 | -145 | -246 | +583 |

The historical water usage results indicate that MCM has operated at a water deficit for all years except for the period ending 2015. The Groundwater Impact Assessment (SLR, 2016) provides additional modelling data for groundwater flows at MCM.

## 5.4 Future Water Balance Model Updates

The modification will not result in any significant changes to the overall water usage rates for MCM. The modified mining area represents a change to the catchment areas of Dams 1 and 2 and Open Cut 1 with a portion of the catchment of Dams 1 and 2 redirected to Open Cut 1 as the open cut progresses to the north. The water balance model will continue to be updated on an annual basis.

## 5.5 Water Supply Contingency

MCM has access to a significant water resource in groundwater via the two existing groundwater extraction bores located immediately to the north of MCM. The scope of the modification does not warrant additional investigation in water supply contingency given the short term nature of the modification, which would only extend mining operations by five years. The Site Water Management Plan contains a contingency plan for investigation of groundwater levels should a groundwater level trigger be activated.

# 6 SOIL AND WATER IMPACT ASSESSMENT

## 6.1 Assessment Focus

It is noted that the activities associated with the modification will be wholly contained within the catchment areas of Open Cut 1, Open Cut 2 and Dams 1 and 2. There will be no disturbance or mining activity associated with the modification beyond the development consent boundary. All other mining activity will continue to be undertaken in accordance with the existing approvals.

## 6.2 Potential Impacts

Potential impacts associated with coal mining in the Upper Hunter Valley which have been given consideration in this assessment may include:

- Changes to surface water volumes and flow patterns/hydrology of downstream watercourses;
- Changes to surface water quality within on site water storages and downstream watercourses;
- Changes to flooding regimes and onsite impacts due to flooding;
- Changes to water demand and reuse for operational water as well as potable water;
- Changes to groundwater flow regimes and quality;
- Adverse impacts to GDEs/IDEs; and
- Generation of potentially contaminated runoff and infiltration to groundwater or entering into downstream waterways.

The key aspects of the modification which have potential to impact upon surface water resources are discussed in the following sections.

## 6.3 Changes to Surface Water Volumes

### 6.3.1 Operational Phase

As Open Cut 1 progresses to the north, a portion of the catchment area reporting to Dams 1 and 2 will be redistributed back into Open Cut 1 while the catchment area of Open Cut 2 is expected to remain relatively unchanged. No additional works, beyond the existing approved mining activity, will occur outside of the catchments of Open Cut 1, Open Cut 2 and Dams 1 and 2.

A reduction in the catchment area of Dams 1 and 2 is anticipated to represent an overall positive impact as it reduces the potential for overflow of Dams 1 and 2. In the event of a significant rainfall event, the open cuts have significant available storage capacity to contain runoff with pumping infrastructure in place to transfer water around MCM as required.

### 6.3.2 Final Landform

Final landform groundwater modelling undertaken for the Groundwater Impact Assessment (SLR, 2016) indicates the modelled standing water levels in each open cut final void will be 192m AHD for Open Cut 1 and 165m AHD in Open Cut 2.

Based on the final landform, the spill levels for each open cut pit are approximately 210m AHD for Open Cut 1 and 200m AHD for Open Cut 2. This provides approximately 18m freeboard in Open Cut 1 and 34m freeboard in Open Cut 2. This equates to an overall freeboard capacity of approximately 5,800 ML in Final Void 1 and 11,000 ML in Final Void 2, which is more than sufficient to hold rainfall from the calculated catchments for the Probable Maximum Precipitation rainfall event.

## 6.4 Changes to Surface Water Quality

No impacts to the quality of offsite surface water resources are anticipated to occur as a result of the Modification. All changes occurring as part of the Modification will be contained within the catchment areas of Open Cut 1, Open Cut 2 and Dams 1 and 2. There is not expected to be any change to surface water runoff quality within these catchment areas.

## 6.5 Regional and Local Flooding

MCM is located above the level of the 100 year ARI flood event for the Hunter River as detailed in **Section 3.10**.

The modification will not involve any changes to externally draining catchments and only represents a change to the internal catchment areas and runoff volumes. As such, the modification will not have any impact on local or regional flooding. Locally within MCM, surface water runoff will continue to be directed to the relevant open cut pits / dams and pumped around MCM as required for operational and environmental purposes.

## 6.6 Operational Water Quality

Operational water is sourced from Dams 1 and 2, Dam 3 and the Final Settling Ponds to supply the operational needs of MCM. Dams 1 and 2 are supplied with water sourced from the groundwater bores and each dam has a local catchment contributing surface runoff.

Water contained within the dams used for water supply is generally characterised by an elevated EC, nominal pH and generally low TSS. No significant change to water quality around the site is expected to occur as a result of the modification.

## 6.7 Potable Water Usage

There are no proposed changes to the staffing structure at MCC or the overall facilities and amenities layout. As such, potable water demand is not anticipated to change. Potable water will continue to be supplied via pipeline from MSC.

## 6.8 Contamination and Chemical Spills

The modification will not create any additional risk of contamination or spills beyond that which is currently approved. Fuels, oils, lubricants and solvents will continue to be stored within bunded areas at the Workshop, CPP and Blasting Facilities.

Wash waters will continue to be treated in the existing triple interceptor before entering the mine water management system.

# 7 MANAGEMENT AND MITIGATION MEASURES

## 7.1 Erosion and Sediment Control

Erosion and sediment control shall continue to be managed in accordance with the currently approved ESCP for MCM, as well as the Blue Book (Managing Urban Stormwater, Soils and Construction, Volume 1, (NSW Government, 2004) and Volume 2E, Mines and Quarries (DECC, 2008)).

It is noted that the Final Settling Ponds have recently (February 2016) been desilted to provide greater capacity for surface runoff and sediment capture.

## 7.2 General Water Management

All changes proposed as part of the modification will occur within the catchments of Open Cut 1, Open Cut 2 and Dams 1 and 2. Surface water will continue to be managed in accordance with the existing Site Water Management Plan. With the exception of relocating the existing raw water supply tanks (and associated pipelines) and redistribution of the catchment areas between Open Cut 1, Open Cut 2 and Dams 1 and 2, no significant changes to the water management system will occur as part of the modification.

## 7.3 Wash Down Water and Hydrocarbon Management

Potentially contaminated water produced in the wash bay will continue to be treated in the three stage silt, oil and water separator. The collected oil and silt will be regularly cleaned out and treated accordingly. No changes to hydrocarbon management will occur as part of the modification.

## 7.4 Operational Water Management

Operational water will continue to be sourced from Dams 1 and 2, Dam 3 and the Final Settling Ponds (among others) for dust suppression, infusion sprays and coal processing. No change to the existing supply arrangement is proposed.

## 7.5 Groundwater Management

Refer to the Groundwater Impact Assessment (SLR, 2016) for details regarding the potential impacts to groundwater and the proposed management measures.

## 7.6 Final Landform Water Management and Rehabilitation

### 7.6.1 Design Principles

Once mining has been completed, the voids will be appropriately shaped to a maximum slope gradient of 14 degrees. Final voids will be managed to make the voids safe for closure and to prevent the likelihood of spontaneous combustion (MCC, 2015e). One highwall will remain, in Open Cut 2, which will be appropriately treated with the installation of a safety fence and/or berms, as well as capping of exposed coal seams.

As discussed in the Rehabilitation and Closure Strategy for the modification (EMM, 2016), there will be limited opportunity for progressive rehabilitation, and hence installation of drainage structures, in the modification area as mining progresses. The majority of rehabilitation in this area will therefore be undertaken at the cessation of coal extraction.

The design of the final landform drainage system will assist in reducing the surface water input into the final void. Where feasible, clean water runoff will continue to be diverted around the voids to minimise catchment area. Land surfaces within the final void catchments and surrounding areas will be topsoiled and rehabilitated with pasture and native vegetation.

Where possible, the final landform will be designed to take advantage of micro-relief to better mimic natural flow patterns and integrate the final landform with the surrounding topography. While an attempt has been made to incorporate the principles of micro-relief into the drainage design in and around the final voids, the volume of overburden material to be emplaced and spatial constraints within the modification area limits the potential for micro-relief and as such, traditional drainage control structures will be required to safely convey runoff over the final landform.

Based on the principles of the Blue Book (Landcom, 2004), disturbed landforms require benching (in the form of contour drains) and drop structures to safely convey runoff and reduce the potential for erosion (rilling and gullying) to develop. Based on previous experience in final landform design, due to the slope and length of the batters in the final landform, a series of contour banks and drop structures will be essential within the final voids and on surrounding surfaces to safely convey runoff over the land surface and into the relevant water management dams.

### 7.6.2 Final Landform Drainage

The final landform will have maximum slope gradients of up to 14 degrees within the final shaped voids with slope lengths of between 200 – 700m from the void crest to the base of the void. It is noted that the lower portion of the voids will fill with water over time (as discussed in **Section 6.3**) and, as such, the slope lengths will be reduced to a maximum length of approximately 600m.

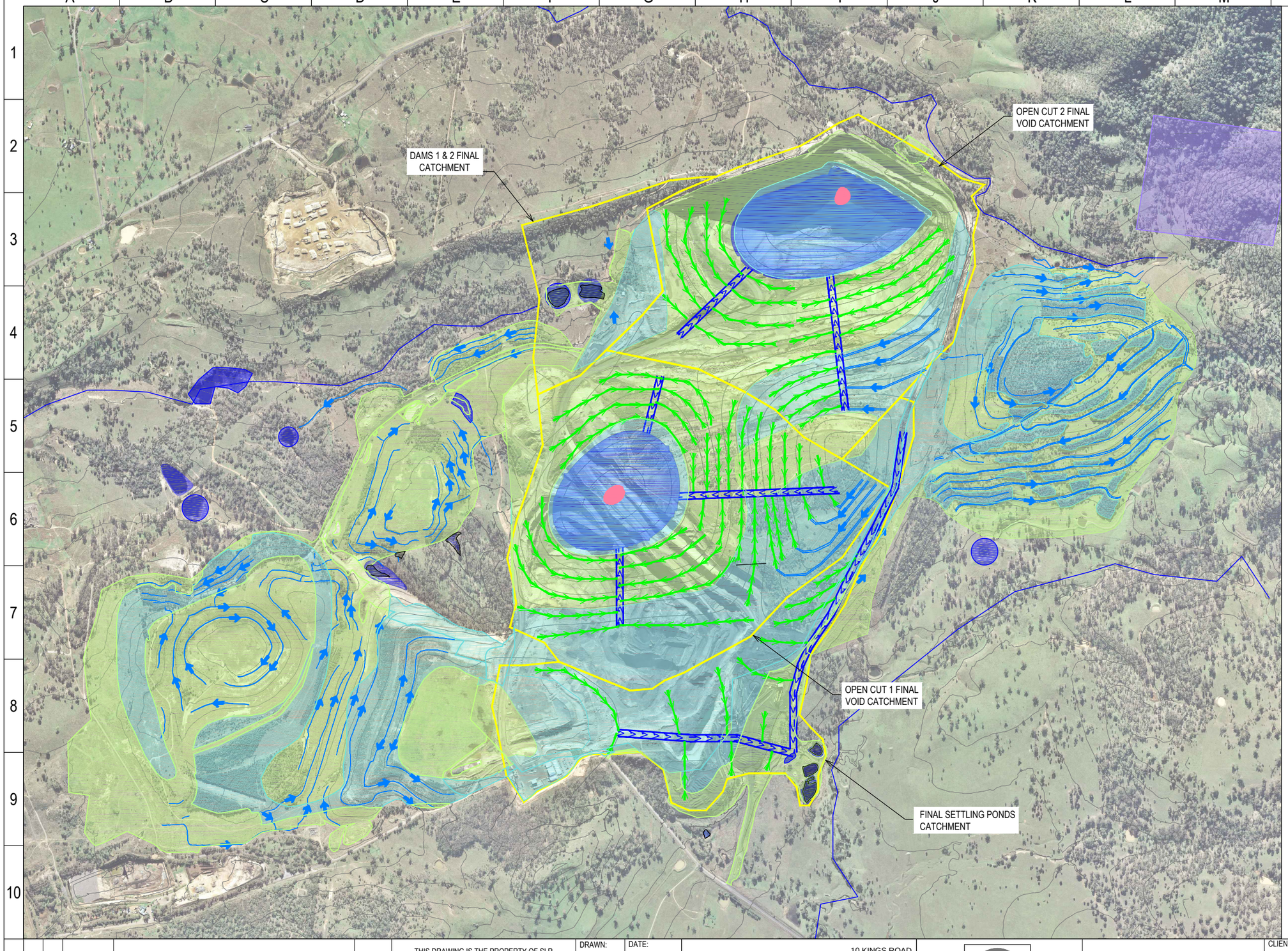
Based on the principles of the Blue Book, benching (contour banks) would be required at a spacing of 60 – 100m (depending upon the slope gradient) within the voids to safely convey runoff down the slopes. Subsequently, drop structures will also be required to convey concentrated flow captured by these contour banks into the base of the final voids. Without such drainage control structures, it is expected that rilling and gullying would occur on the landform which would destabilise the soils and reduce the overall effectiveness of rehabilitation.

A conceptual final landform drainage design is provided in **Figure 8**. The conceptual drainage design is indicative only and will require further assessment in the detailed closure plan to be prepared for MCM prior to cessation of coal extraction activities. It is noted that the number, location and size of the proposed drainage control structures may change slightly following a detailed assessment however; the overall principles of safe and stable water management structures shall be maintained.

Existing rehabilitation areas utilise traditional water management structures including a series of contour banks, rock rip rap drop structures and sediment dams to manage surface water runoff. Where these areas appear stable, the existing water management structures shall be maintained and incorporated into the final landform design. Surface water shall continue to be managed in accordance with the relevant environmental management plans.

Once successful rehabilitation has been achieved, the various sediment dams at MCM will no longer be considered as pollution control dams under the WMA and consideration will need to be given to the MHRDC. Where the capacity of the dams exceeds 10% of the harvestable rights of the contributing catchment, additional works may be required to reduce the capacity of dams to provide environmental flows and meet the requirements of the MHRDC or divert water away from these dams. Alternatively, the dams may require licensing.

The conceptual final landform surface water drainage design is provided in **Figure 8**. This design incorporates existing water management structures along with the proposed drainage control structures.

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## LEGEND

- CATCHMENT AREA
- DAMS
- EXISTING CONTOUR DRAINS
- FINAL LANDFORM CONTOURS (10m INTERVALS)
- PROPOSED CONTOUR DRAINS
- PROPOSED DROP STRUCTURES
- REHABILITATION AREA - PASTURES
- REHABILITATION AREA - TREES
- REHABILITATION AREA - BIODIVERSITY OFFSET
- FINAL VOID

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| REVISIONS | | | |
|---|---|---|---|
| C | 26.04.2016 | REVISED FINAL LANDFORM | MS |
| B | 26.04.2016 | FINAL | MS |
| A | 22.04.2016 | FINAL DRAFT | MS |
| | DATE | DESCRIPTION | |



Responsible Principal Signature | Date

| | | | |
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| DRAWN: | LF | DATE: | 22.04.2016 |
| DESIGN: | BL | DATE: | 22.04.2016 |
| DRG. CHECK: | | DATE: | |
| DES. CHECK: | | DATE: | |

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A3 | DO NOT SCALE THIS DRAWING | IF IN DOUBT ASK

CLIENT: MUSWELLBROOK COAL COMPANY

PROJECT: CONTINUATION PROJECT

DRAWING TITLE: **FINAL LANDFORM DRAINAGE**

DRAWING NUMBER: FIGURE 8

ISSUE: C

H:\Projects-SLR\630-SrvNTL\630-NTL\630.11575 MCC Continuation SW & GW Assessment\06 SLR Data\01 Drawings\630.11575 - FIGURE 8 (REV B).dwg

# 8 MONITORING AND REPORTING

No changes are proposed to the surface water monitoring program nominated in the existing Site Water Management Plan and as such, water quality and flow volume monitoring will continue to be undertaken in accordance with the currently approved Site Water Management Plan.

Monitoring will be carried out to confirm that the water management system is effective. The following monitoring program includes the requirements for the Site Water Management Plan. All monitoring equipment will be maintained and calibrated as required.

## 8.1 Flow Monitoring

Flow monitoring is an integral part of monitoring the site water requirements and allows the calculation of water balances. The following monitoring will allow the assessment of water make and usage and will facilitate the planning for new water storages. Flow meters installed on the following pipelines will continue to be monitored:

- Pipeline from Open Cut 2 to Dam 1;
- Pipeline from Borehole Pump 1 and Borehole Pump 2 to Dam 2;
- Pipeline from Dam 2 to CPP;
- Pipeline that supplies water for dust suppression; and
- Pipeline from Final Settling Ponds to CPP.

Each flow meter is read and recorded on a regular basis. The water levels in Dam 2, Open Cut 1 and the Final Settling Ponds will be recorded on a regular basis. The levels will be recorded by survey RL or appropriate measuring boards.

## 8.2 Reporting

Results of water quality monitoring and water flow monitoring will continue to be reported in the AEMR on an annual basis in accordance with the currently approved Site Water Management Plan.

# 9 CONCLUSIONS AND RECOMMENDATIONS

The modification involves a continuation of existing mining activity to the north, into an area previously disturbed by historic mining activity. All changes associated with the modification will be wholly contained within the catchments of Open Cut 1, Open Cut 2 and Dams 1 and 2. No changes to the currently approved water management system are proposed with the exception of minor alterations to the catchment areas of Open Cut 1, Open Cut 2 and Dams 1 and 2.

No additional disturbance is proposed beyond the current approved development consent boundary and all other activities will continue to be undertaken in accordance with the existing approvals. The key parts of the modification which have the potential to impact upon the surrounding environment remain consistent with those potential impacts relating to the existing approved mining activity including:

- Management of water levels within Dams 1 and 2;
- Management of water levels within the Final Settling Ponds; and
- Storage and use of lubricants, oil and chemicals.

All currently approved management plans will continue to be utilised and maintained throughout the continuation of mining with the existing water monitoring points remaining in use. The environmental management, mitigation and monitoring programs identified in the Site Water Management Plan will continue to be implemented. No impacts to local surface water resources are expected to occur as part of the modification.

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