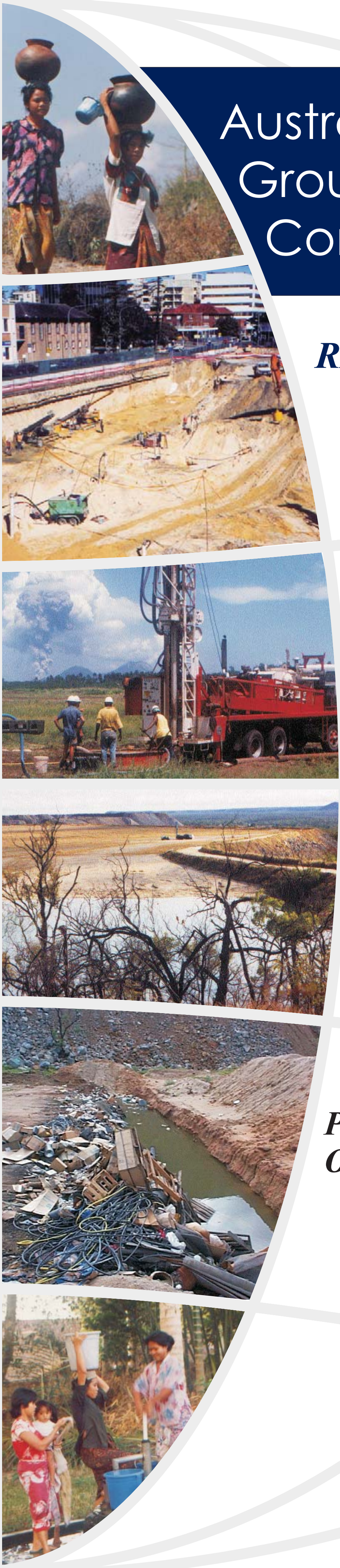


Australasian Groundwater & Environmental Consultants Pty Ltd

REPORT on

ELIMATTA PROJECT

GROUNDWATER ASSESSMENT

prepared for
NORTHERN ENERGY CORPORATION

Project No. G1438/A
October 2012

AGE

ABN:64 080 238 642

Australasian
Groundwater & Environmental
Consultants Pty Ltd

REPORT on

ELIMATTA PROJECT
GROUNDWATER ASSESSMENT

prepared for
NORTHERN ENERGY CORPORATION

Project No. G1438/A
October 2012

Level 2 / 15 Mallon Street
Bowen Hills Qld 4006
Ph (+617) 3257 2055
Fax (+617) 3257 2088
Email: brisbane@ageconsultants.com.au
Web: www.ageconsultants.com.au

A.B.N 64 080 238 642

TABLE OF CONTENTS

Page No.

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

Page No.

List of Tables

List of Appendices

JST:ae (Elimatta)
Project No. G1438/A
October 2012

REPORT ON
ELIMATTA PROJECT
GROUNDWATER ASSESSMENT

1 INTRODUCTION

Taroom Coal Proprietary Limited (Taroom Coal), a wholly owned subsidiary of Northern Energy Corporation (NEC), is the proponent of the proposed Elimatta Project. The Project site is situated within the Western Downs Regional Council area, approximately 35 kilometres (km) west of the Wandoan township and 380km north-west of Brisbane in south-east Queensland (Figure 1).

Taroom Coal proposes open-cut pit mining for thermal coal at up to 8 million tonnes a year (Mt/y) from a new mining lease (ML50254). This report has been prepared as part of the Project Environmental Impact Statement (EIS) and addresses the potential impact of the Project on groundwater resources. The report describes the existing hydrogeological regime of the area and assesses of the potential impact of the Project on this regime. Potential risks and constraints are identified and, where necessary, mitigation strategies developed.

Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) prepared this report at the request of AustralAsian Resource Consultants (AARC) on behalf of their client Taroom Coal.

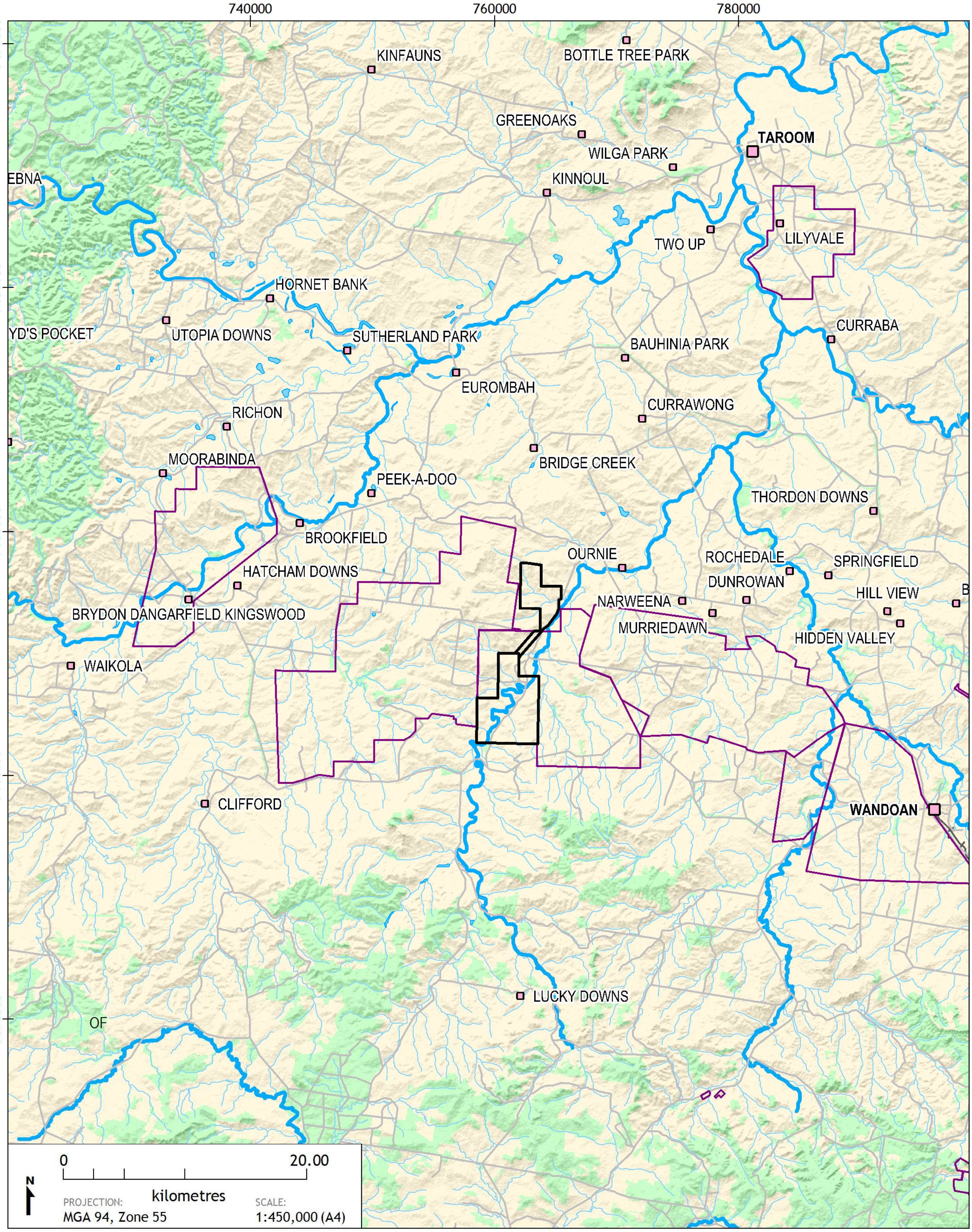
2 PROJECT OVERVIEW

Taroom Coal proposes to mine thermal coal using open-cut methods at up to 8Mt/year run-of-mine (ROM) coal to produce 5Mt/year of product coal for export. Mining and processing would be undertaken on a proposed new mining lease, ML50254 and another mining lease that would be made over land subject to an existing exploration permit EPC1171. The mine would operate for more than 25 years.

Major elements of the Project would include:

- open-cut mining over approximately 2,500 hectares;
- construction and operation of a coal handling and preparation plant (CHPP) and associated mine infrastructure over approximately 100 hectares;
- transportation of ROM coal from the pit to the CHPP via haul trucks on a dedicated haul road within the Elimatta lease;
- development of a rail line (approximately 36km in length) to connect the Elimatta Project to the Surat Basin Rail, north of Wandoan; and
- rail loading at the Project site and transportation of product coal to the Port of Gladstone.

Water supply sources for mining and processing activities for the proposal could include water from local coal seam gas extraction projects and incidental groundwater seepage into the open cut pit. A 12-megawatt power supply connection would be required for the Project.



LEGEND:

- Project Leases
- Mining Lease Application
- Homestead
- Road
- Rail
- Lakes
- River / Major Creek
- Watercourse
- Native Vegetation

Elimatta Project
Groundwater Assessment (G1438A)

Locality

AGE Groundwater & Environmental

DATE: 24/10/2012

FIGURE No: 1

3 TERMS OF REFERENCE AND METHODOLOGY

3.1 Project Terms of Reference

The scope of work for the groundwater impact assessment was the Terms of Reference (TOR) for the Project provided by the Queensland Department of Environment and Resource Management (DERM). The sections of the TOR describing the groundwater assessment are reproduced below:

Section 4.5 Water
Section 4.5.1 Description of environmental values

This section describes the existing environment for water resources that may be affected by the proposal in the context of environmental values, as defined or considered in such documents as the Environmental Protection Act 1994, Environmental Protection (Water) Policy 2009 (EPP(Water)), the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC and ARMCANZ, 2000), the Queensland Water Quality Guidelines (2009) and the DERM guideline: Establishing Draft Environmental Values and Water Quality Objectives.

Additional legislation that should be considered includes the Water Act 2000, the Water Resource (Fitzroy Basin) Plan 1999 and the Water Resource (Great Artesian Basin) Plan 2006 and their associated resource operation plans. The definition of waters in the EPP(Water) includes the bed and banks of waters, so this section should address benthic sediments as well as the water column.

Section 4.5.1.2 Groundwater

The EIS should review the quality, quantity and significance of groundwater in the proposal area, together with groundwater use in neighbouring areas. The review should include a survey of existing groundwater supply facilities (bores, wells, or excavations) to the extent of any environmental harm. The information to be gathered for analysis is to include:

- *location*
- *pumping parameters*
- *depth of supply aquifers*
- *draw down and recharge at normal pumping rates*
- *seasonal variations (if records exist) of groundwater levels.*

A monitoring program, including a network of observation points that would satisfactorily monitor groundwater resources both before and after commencement of operations, should be developed and described in the EIS. Describe the design of the monitoring network and the frequency (schedule) of monitoring groundwater bores. This section of the EIS should address the nature and hydrology of the aquifers and provide a description of the:

- *geology/stratigraphy – such as alluvium, volcanic, metamorphic*
- *aquifer type – such as confined, unconfined, karst or perched*
- *depth to, and thickness of, the aquifers*
- *the significance of the resource at a local and regional scale*
- *depth to water level and seasonal changes in levels*
- *groundwater flow directions (defined from water level contours)*
- *groundwater yield*
- *interaction with surface water*
- *possible sources of recharge*
- *vulnerability to pollution.*

The data obtained from the groundwater survey should be sufficient to enable specification of the major ionic species, pH, electrical conductivity, total dissolved solids and any potentially toxic or harmful substances.

Describe the environmental values of the underground waters of the affected area in terms of:

- *values identified in the Environmental Protection (Water) Policy 2009*
- *sustainability, including both quality and quantity*
- *physical integrity, fluvial processes and morphology of groundwater resources.*

Section 4.5.2 Potential impacts and mitigation measures
Section 4.5.2.2 Groundwater

The EIS should include an assessment of the potential environmental harm caused by the proposal to local groundwater resources. The impact assessment should define the extent of the area where groundwater resources are likely to be affected by the proposed operations. It should assess the significance of the proposal to groundwater depletion or recharge, and propose management options available to monitor and mitigate these effects. The response of the groundwater resource to the progression and eventual cessation of the proposal should be described. An assessment should be undertaken of the impact of the proposal on the local ground water regime caused by the altered porosity and permeability of any land disturbance. An assessment of the potential to contaminate groundwater resources and measures to prevent, mitigate and remediate such contamination should be discussed.

3.2 Methodology

The methodology adopted for the study to address the requirements of the TOR was to:

- review various groundwater, geotechnical and environmental reports from the Project area or surrounding mines in order to develop an appreciation of the hydrogeological setting of the area;
- review exploration geology and mining data provided by Taroom Coal;
- review hydrogeological data held on the DERM Groundwater Database for existing water bores;
- analyse available data and conceptualise the groundwater regime of the Project and surrounding areas;
- develop a numerical model and undertake predictive modelling of the impact of the proposed mine extension during mine operations and post closure;
- assess the groundwater impacts and develop feasible mitigation and measures and management strategies if potential adverse impacts are identified;
- identify environmental issues, risks and risk management strategies for the mine plan; and
- develop a groundwater monitoring plan.

4 LEGISLATION / POLICY

The following sections briefly summarize Queensland Government Legislation and Policy that will apply to the Project with respect to groundwater.

4.1 Environmental Protection (Water) Policy 2009

The Environmental Protection (Water) Policy 2009 (EPP Water) provides a framework to protect and/or enhance the suitability of Queensland waters for various beneficial uses. This policy guides the setting of indicators that will protect the environmental values of any resource.

Indicators for environmental values are those quantitative properties of the water, such as physical and chemical parameters, that can be measured. The Australian Water Quality Guidelines (ANZECC, 2000) prescribe the quantitative properties that protect specific environmental values.

4.2 Water Act 2000

The purpose of the Water Act 2000 is to advance sustainable management and efficient use of water and other resources by establishing a system for planning, allocation and use of water. To achieve this, the Act provides for:

- the sustainable management of water and other resources;
- a regulatory framework for providing water and sewerage services;
- the establishment and operation of water authorities; and
- other purposes.

Several permits are likely to be required for the Project under the Act including the taking of, and interfering with groundwater.4.2.1 Water Resources (Great Artesian Basin) Plan 2006

The objective of the Plan is to provide a framework for the allocation and sustainable management of water resources of the Great Artesian Basin (GAB). There are 25 management areas of which the Project is located in the Surat North Area (Area No. 20). The boundaries of the management areas have been defined based on local factors including hydrological, geological, water demand and recharge and discharge characteristics.

The general outcomes of the Plan are for sustainable management of the groundwater resources within the Plan area and seek to achieve a balance of outcomes between:

- protecting the flow of water to springs and baseflow to water courses that support significant cultural and environmental values;
- providing for the continued use of all water entitlements and other authorizations to take or interfere with water;
- reserving water in storage in the aquifer for future generations;
- ensuring a reliable supply of water from the Plan area;
- making water available for new users.

Unallocated water in the GAB is held as a ‘General’ or ‘State Reserve’. Schedule 5 of the Plan indicates that there is 200ML/annum of water available from the General Reserve for the Surat East Management Area.

The total volumetric limit for water licences for the whole of the State from the State Reserve is 10,000ML/annum. Unallocated water from the State Reserve may be granted for:

- a project of State or Regional significance;
- to a local government for town water supply purposes.

4.2.1 The Great Artesian Basin Resource Operations Plan 2006

The GAB Resource Operations Plan (ROP) provides the proposed arrangements for implementing the Water Resource (Great Artesian Basin) Plan 2006 and gives the broad rules for allocating and managing water in the GAB.

4.2.2 Declared Sub-Artesian Areas

In Queensland, a number of sub-artesian areas have been declared under the Water Act 2000, most of which have been declared under the Water Regulation 2002, which is subordinate legislation to the Act. The Project is located in the GAB Sub-artesian Area. Any development works located within a declared sub-artesian area:

- require a water entitlement, water permit or seasonal water assignment notice is required to take or interfere with sub-artesian water, other than for a purpose mentioned in Schedule 11 (column 2) of Water Regulation 2002;
- are assessable developments under the Sustainable Planning Act 2009 for taking sub-artesian water other than solely for a purpose mentioned in Schedule 11 (column 3) of the Water Regulation 2002.

Schedule 11 states that a water entitlement is not required in the GAB Sub-artesian Area for domestic purposes or for stock watering intersecting sub-artesian aquifers that are not connected to artesian aquifers.

4.2.3 Water Resources Plan and Regulations

The Project area falls in the Fitzroy Catchment Water Resource Plan (WRP). Under Schedule 3 of the WRP, the Project falls within the Carnarvon Groundwater Management Area.

Section 32 (2) of the WRP states of that *"until an amendment to the resource operations plan to deal with the water mentioned in subsection (2) is approved, an application made under the Act for or about a water licence will not be accepted if granting the application would increase the amount of water that may be taken from the water mentioned in subsection (2).*

5 PHYSICAL SETTING

5.1 Location and Access

The Project site is situated within the Western Downs Regional Council area approximately 380km north-west of Brisbane in South-East Queensland (Figure 1). EPC650 is approximately 35km west of the Wandoan and 55km south of Taroom, on the Southern-Central Highlands of Queensland. These townships are accessed via Leichhardt Highway. Access to the EPC is via tarred and graded, dirt shire roads. The EPC is bisected by the graded, dirt-surfaced Bundi-Ryalls Road.

5.2 Topography and Drainage

Topographically, EPC650 consists of low, rolling hills, some with rubbly Jurassic sandstone outcrops down to flat land with deeply incised creeks. Horse Creek is the largest watercourse, effectively bisecting the EPC 650, draining from SSW to the NNE.

The Project is located within the Fitzroy River Basin. Horse Creek forms the dominant waterway of the Project flowing north-east into Juandah Creek which flows into the Dawson River. The Dawson River continues to flow north-east joining with the Fitzroy River, which eventually drains into Keppel Bay, south of Rockhampton.

The flow of ephemeral waterways within, and surrounding the Project, is restricted to heavy rainfall events, which typically occur between November and February. Due to their ephemeral nature, the use of watercourses within the vicinity of the Project is generally limited to stock watering, when water is available. Figure 2 shows the bed of Horse Creek in the 2009 winter dry season.

Figure 2: Bed of Horse Creek - September 2009

Figures 1 and Figure 5 show the topographic and drainage features of the Project area.

5.3 Land Use

Low intensity cattle grazing is the dominant land use and associated infrastructure on the site includes cattle yards, windmills, dams and water storage tanks. The area is largely open woodland interspersed with small patches of Brigalow woodland.

5.4 Climate

The Project area is semi-arid with warm, dry winters and hot, humid summers. Rainfall can be significant in any month, although it is more prevalent in the summer months, with the majority falling between November and March. The average rainfall recorded at Bureau of Meteorology (BOM) Station 035014 located at the Wandoan Post Office 35km east of the Project area is 633mm/year. The average evapotranspiration rate for the Project area is significantly higher at about 1550mm/year.

In order to place recent rainfall years into a historical context, the Cumulative Rainfall Departure (CRD), was calculated. The CRD is a summation of the monthly departure of rainfall from the long-term average monthly rainfall, as shown in Figure 3.

The CRD for the period 1955 to present shows that rainfall declined from 2000 to 2007, with recent years being generally above average.

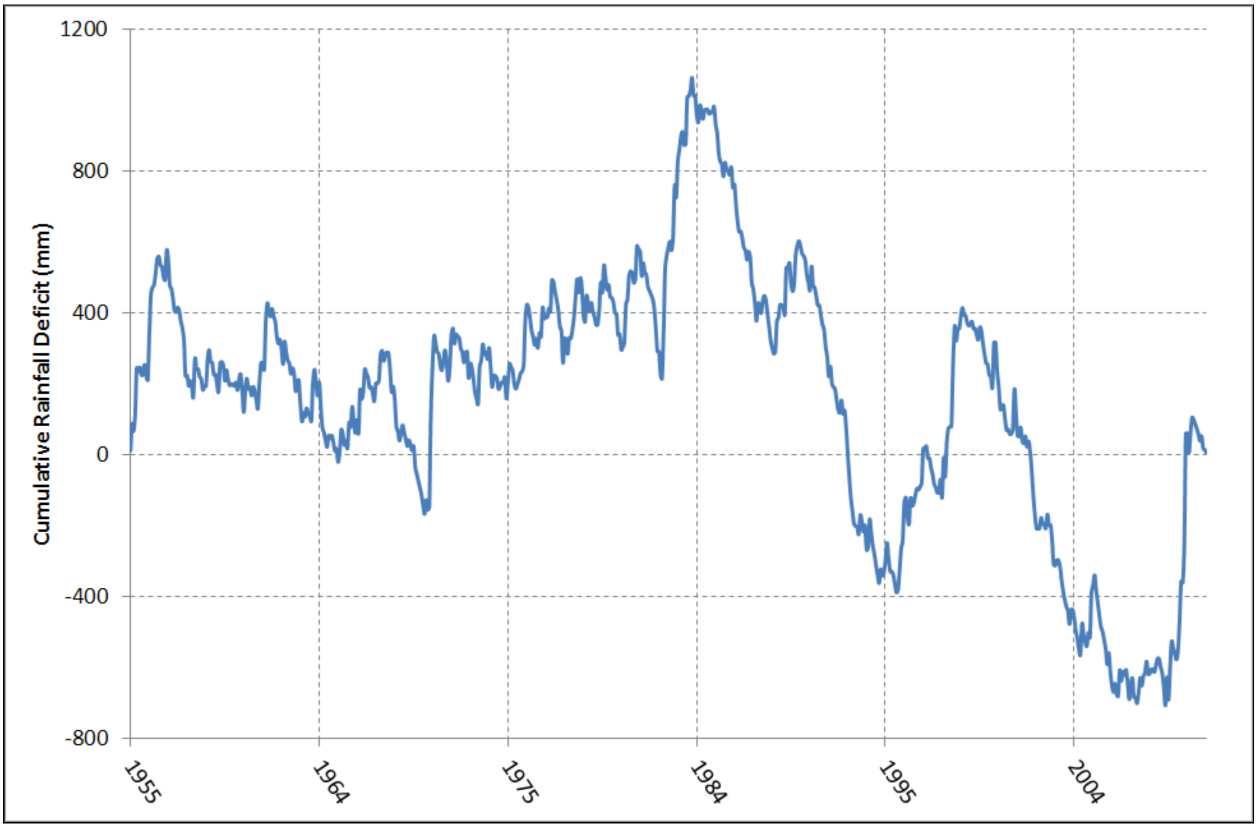


Figure 3: Cumulative Rainfall Deficit – Wandoan Post Office (Station 035014)

5.5 Wetlands and Springs

The mapping of wetlands by DERM[1] indicates the potential presence of wetlands in the Project area. Figure 4 shows the wetlands overlying satellite imagery.

The DERM mapping based on satellite imagery indicates the presence of a riverine wetland (in blue) along Horse Creek and a palustrine vegetated swamp system (shown in red) to the north of

[1] Queensland Wetlands Map 1:100,000 scale Wandoan Sheet 8845

EPC650. Figure 4 shows the area of the palustrine wetland appears to be largely dry in the 2004 satellite imagery.

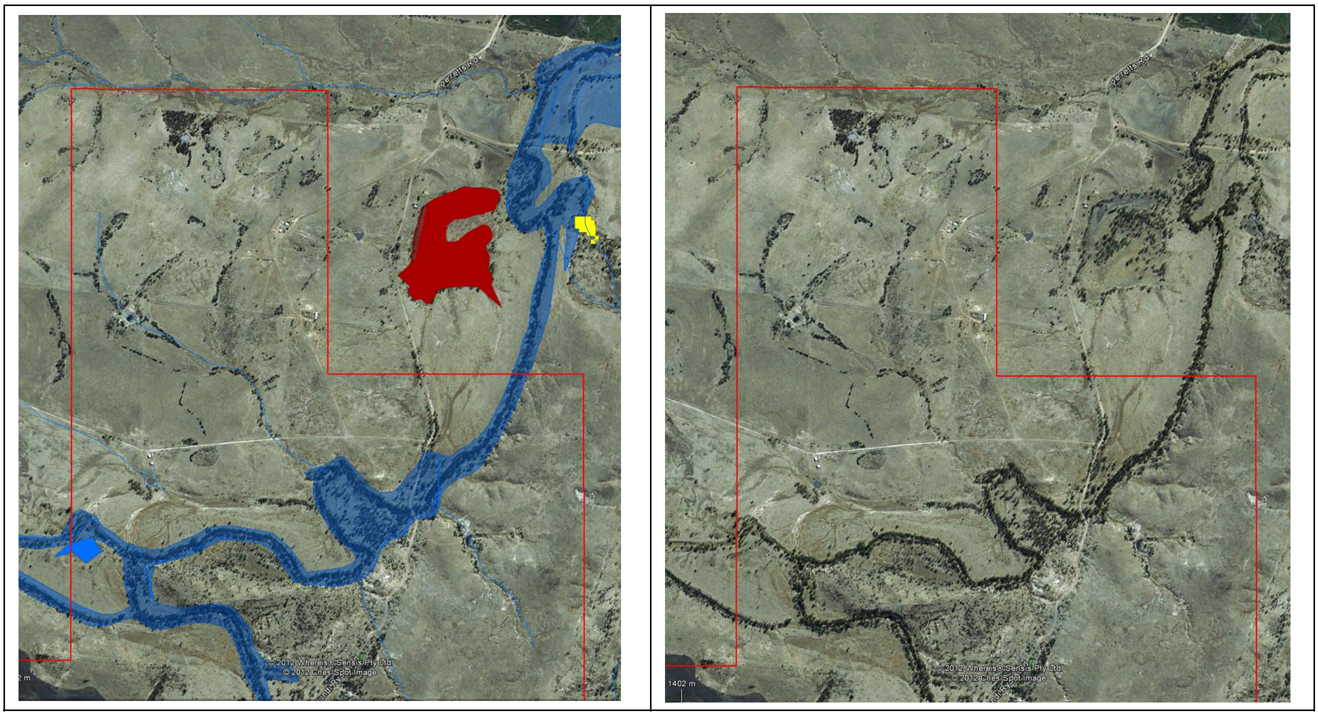


Figure 4: Mapped Wetlands - Northern EPC 650 Area (Google Earth Imagery 5/6/2004) Left Image with mapped wetlands overlay, right image with no overlay

6 GEOLOGICAL SETTING

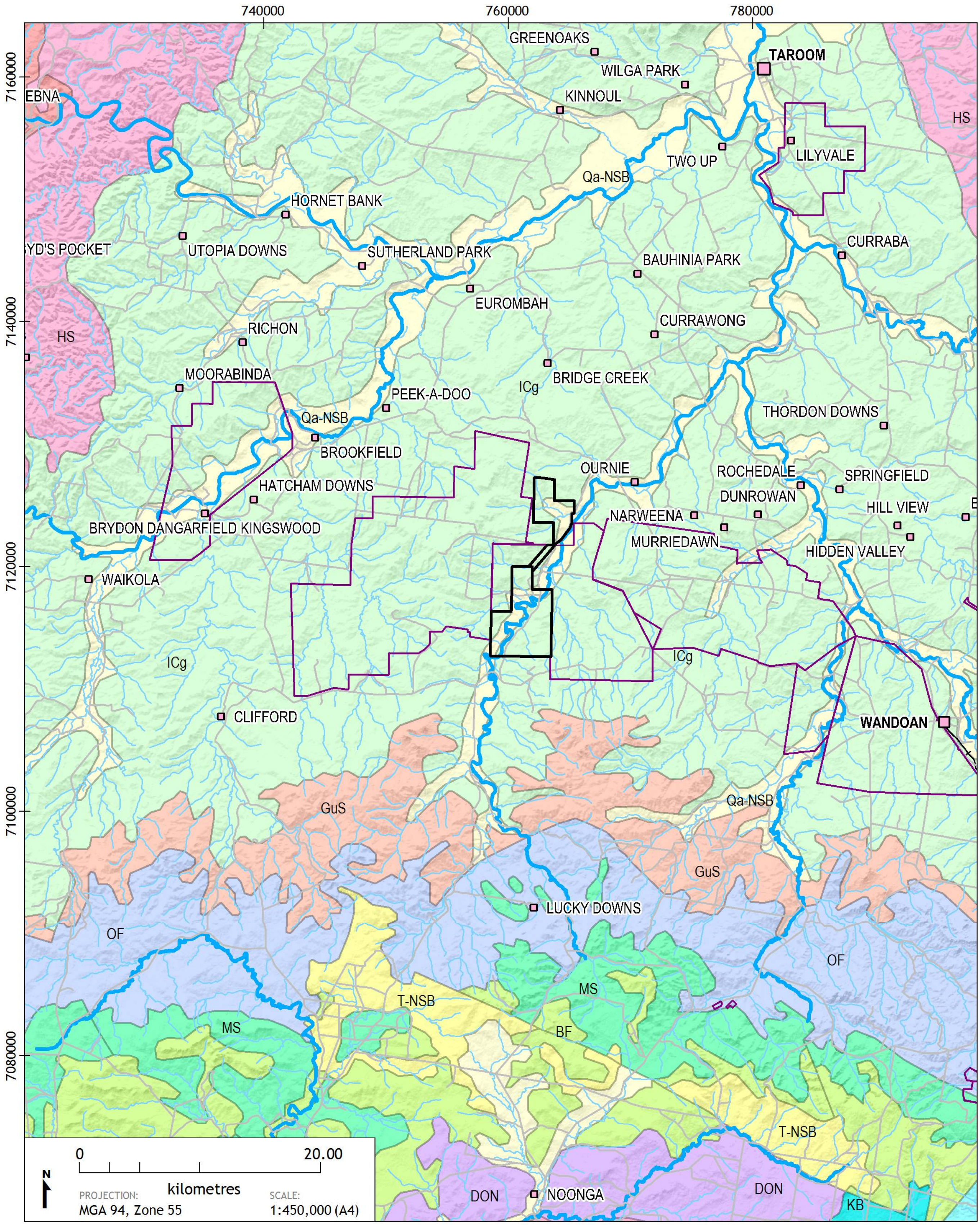
6.1 Stratigraphy

The Project area is on the eastern edge of the Surat Basin and is underlain by over 1000m of shallow-dipping sediments. The Surat Basin is a structural subdivision of the GAB, the regional hydrogeology of which has been described by Habermehl (1980 and 1996)[2].[3]

Figure 5 shows the geology of the area. Table 1 presents a general stratigraphic profile for the region.

[2] Habermehl, MA, (1980), *"The Great Artesian Basin, Australia".* BMR Journal of Australian Geology & Geophysics, 5, 9-38.

[3] Habermehl, MA, (1996). *"Groundwater movement and hydrochemistry of the Great Artesian Basin, Australia". In Mesozoic Geology of the Eastern Australia Plate Conference, Brisbane, Sept 1996.* Geol. Soc. Aus., Extended Abstracts 43, 228-236.



LEGEND:

- Project Leases
- Mining Lease Application
- Homestead
- Road
- Rail
- River / Major Creek
- Watercourse

Surat Basin Surface Geology

- Qa-NSB
- T-NSB
- BF - Bungil Formation
- Don - Doncaster Member
- GuS - Gubberamunda Sandstone
- ICg - Injune Creek Group
- HS - Hutton Sandstone
- Kb - Kumbarilla beds
- MS - Mooga Sandstone
- OF - Orallo Formation
- SoF - Southlands Formation

Elimatta Project
Groundwater Assessment (G1438A)

Surface Geology

DATE: 24/10/2012

FIGURE No: 5

Table 1: SURAT BASIN STRATIGRAPHY

Age			Northern Surat Formation (Jones & Patrick 1981)[4]	Description	AQUIFER
LATE JURASSIC			**Gubberamunda Sandstone**	Fine to coarse and pebbly, poorly sorted, friable, cross-bedded, quartzose to sub-labile sandstone. Minor interbedded siltstone and mudstone. Environment of deposition upper fluvial.	Can be a good aquifer - present to south of Project area, but not on-site
MIDDLE TO LATE JURASSIC	INJUNE CREEK GROUP		**Westbourne Formation** (Swarbrick, Gray & Exon, 1973)	Finely interbedded lithic sandstone, mudstone and coal in lower part (Norwood Mudstone Member). Interbedded siltstone and lithic sandstone in upper part. Lacustrine deposition grading to point bar at top.	Aquiclude
MIDDLE TO LATE JURASSIC	INJUNE CREEK GROUP		**Springbok Sandstone**	Litho-feldspathic sandstone, medium to coarse, porous and friable, some calcareous cemented beds, minor siltstone, mudstone and coal seams. Lower part through cross-stratified with authigenic matrix. Upper part poorly cemented.	Not detected in Project area
MIDDLE JURASSIC	INJUNE CREEK GROUP	WALLOON SUB-GROUP	**Juandah Coal Measures (to be mined by Project)**	Lithic, labile sandstone, interbedded with siltstone. Mudstone and coal, with coal deposition more frequent towards top. Argillaceous component of sandstone is mainly authigenic.	Poor Aquifer (coal seams)
MIDDLE JURASSIC	INJUNE CREEK GROUP	WALLOON SUB-GROUP	**Tangalooma Sandstone**	Lithic, labile sandstone, medium grained with an argillaceous matrix. Numerous intra-formational conglomerate beds. Sedimentary structures suggest channel deposits grading to point bar deposition.	Poor Aquifer (coal seams)
MIDDLE JURASSIC	INJUNE CREEK GROUP	WALLOON SUB-GROUP	**Taroom Coal Measures**	Sub-labile, medium grained sandstone grading upwards to interbedded sandstone, siltstone, mudstone and coal.	Poor Aquifer (coal seams)
MIDDLE JURASSIC	EUROMBAH FORMATION		**Eurombah Formation** (Swarbrick, Gray & Exon, 1973)	Lithic to sub-labile, poorly sorted, medium grained sandstone with argillaceous matrix. Minor siltstone and mudstone in basal section, more argillaceous towards the top.	Poor Aquifer (coal seams)
EARLY JURASSIC			**Hutton Sandstone**	Interbedded labile to quartzose sandstone, siltstone, mudstone and intra-formational conglomerate.	Major Aquifer
EARLY JURASSIC			**Evergreen Formation**	Siltstone, mudstone or shale, carbonaceous in part, lithic to quartzose sandstone, minor oolitic ironstone and coal.	Aquiclude
EARLY JURASSIC			**Precipice Sandstone**	Quartzose sandstone and pebbly sandstone, some lithic sub-labile sandstone, siltstone.	Major Aquifer

Notes; i) Table developed and modified from JBMS (06/2003), QGC (2003), Leblang (1987)

ii) [shaded box] significant aquifer in Project area

The oldest formation is the Precipice Sandstone of Early Jurassic age, which has been deposited directly on the basement rocks that consist of meta-volcanics. The Precipice Sandstone occurs at a depth of about 825m beneath the Project area.

The Precipice Sandstone is overlain by the Late Jurassic Evergreen Formation which is a predominantly non-marine unit of interbedded quartzose to lithic sandstones and siltstones, in part carbonaceous, and carbonaceous shales. The Evergreen Formation is overlain by the Early to

[4] Jones, G.D. & Patrick, R.B., *(1981), "Stratigraphy and Coal Exploration Geology of the North-eastern Surat Basin; Coal Geology"* - Journal of the Coal Geology Group of the Geol. Soc. of Aust. – Surat-Moreton Basin Symposium Vol. 1 Pt. 4.

Mid-Jurassic Hutton Sandstone. The top of the Hutton Sandstone is about 400m bellow surface at the Project area and consists of quartzose to slightly lithic sandstones and shales, some friable and porous, with interbeds of conglomerate, siltstone and mudstone.

The cycle of deposition marked by the Hutton Sandstone terminated in the Middle Jurassic with deposition of the dominantly argillaceous Walloon Coal Measures. The coal measures subcrop in the northern area of the Project. The coal measures which dip gently to the south, south-east away from the subcrop area consist mainly of laminated and thinly bedded, carbonaceous shale, mudstone, siltstone and claystone and banded coal seams.

The Walloon Coal Measures are overlain by a series of barren sandstones that occur to the south of the Project area including the Gubberamunda Sandstone.

Thin quaternary sedimentary deposits occur in a narrow alignment adjacent to Horse Creek, the major water course of the region.

6.2 Aquifers

Within this stratigraphic sequence there are three main groundwater systems relevant to the assessment of hydrogeological impacts, as follows;

- GAB aquifers;
- Coal seam aquifers; and
- Unconsolidated alluvial sediments.

The GAB is a multi-layered sequence of water bearing aquifers, separated by impervious rock units. The main aquifers within the GAB in the Project area are the Precipice Sandstone and the Hutton Sandstone. The Walloon Coal Measures are part of the GAB sequence within the Surat Basin.

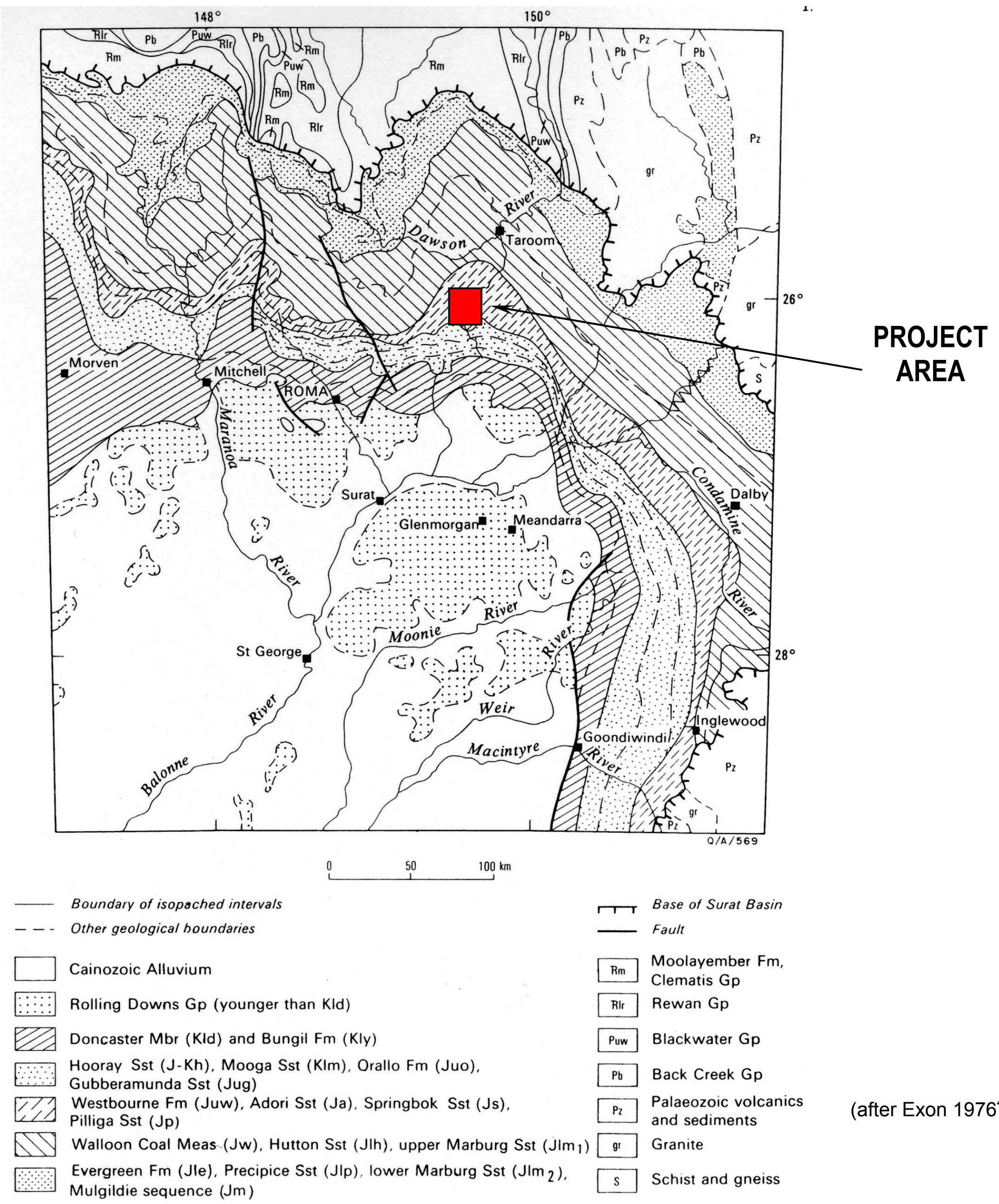
The Precipice Sandstone forms a significant aquifer of the GAB; providing high yields of good quality water. In the Project area it occurs at a depth of about 825m. It is a confined aquifer, that is, it is separated and hydraulically isolated from the overlying formations, and the potential impact from mining, by substantial thicknesses of fine grained, essentially impermeable sedimentary rocks. These include the Evergreen Formation, mudstone and siltstone units within the Hutton Sandstone and lower sections of the Walloon Coal Measures.

The Hutton Sandstone is also a major confined aquifer system which provides reasonable to high yields and good quality water. In the Project area it occurs at a depth of about 400m; however, it is also hydraulically isolated from overlying aquifers and the potential for impact from the proposed mine sites by large thicknesses of intervening mudstones and siltstones.

The Walloon Coal Measures form a moderate to poor aquifer system. The main water bearing strata are the coal seams with individual seams being confined by overlying siltstone and mudstone beds. As discussed they sub-crop to the north and become deeper to the south-west.

The Gubberamunda Sandstone can form a productive aquifer. It outcrops about 5km to the south of the Project in a long east-west trending ridge line and is not present in the proposed mining area. It provides supplies of low salinity water for both stock and domestic purposes.

Figure 6 shows the distribution and subcrop of these aquifers of the GAB in relation to the Project area.



(after Exon 1976[4])

Figure 6: Solid Geology (without alluvial cover) of Subcrop/Recharge Areas of Aquifers

Based on a review of the aquifer systems in the Project area, that is, the area of the sites proposed for open cut mining, it is concluded that:

- given the depth of the Precipice Sandstone and Hutton Sandstone aquifers beneath the Project area, and that they are hydraulically isolated from the Walloon Coal Measures by large thicknesses of impermeable strata, and that the subcrop/recharge area for these aquifer is well distant from the Project area, they will not be impacted by mining. They are therefore not considered further.

- the aquifers that may be impacted by mining, are those associated with the coal seams of the Walloon Coal Measure aquifers, and the alluvial aquifers of Horse Creek. These aquifers are discussed in greater detail in the following sections.

6.3 Walloon Coal Measures Stratigraphy and Lithology

The Middle Jurassic Walloon Coal Measures, which are part of the Injune Creek Group, are developed throughout the Surat Basin, ranging in thickness up to more than 700m. They comprise very-fine to medium grained, labile, argillaceous sandstone, siltstone, mudstone and coal with minor calcareous sandstone, impure limestone and ironstone (Swarbrick, 1973). In the north-east Surat Basin, the formation was raised by Jones and Patrick (1981) to subgroup status and, in stratigraphic order, was divided into Taroom Coal Measures, Tangalooma Sandstone and Juandah Coal Measures (refer Table 1).

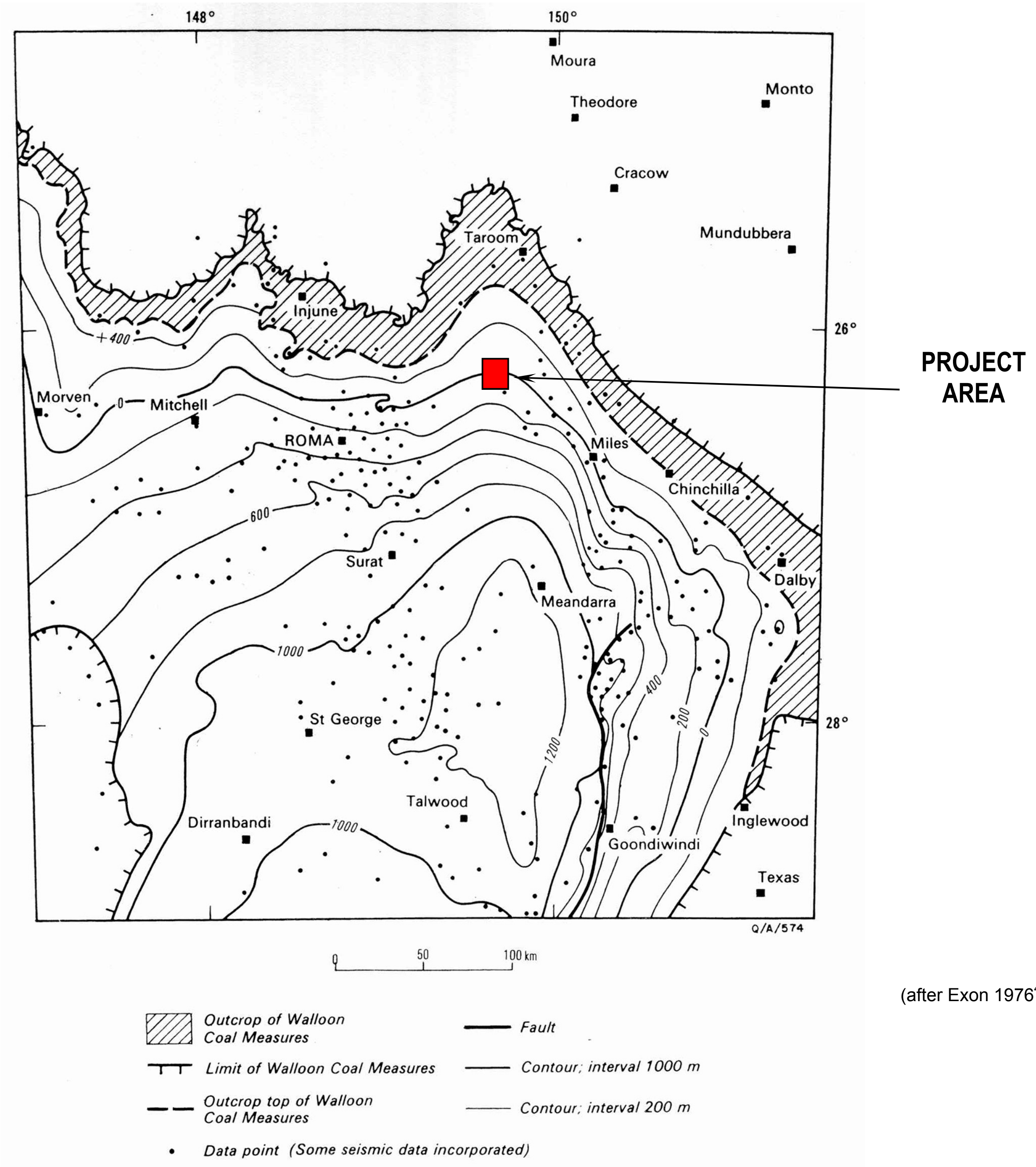
Figure 7 shows the distribution and subcrop of the Walloon Coal Measures.

The Upper Coal Horizon of the Walloon Coal Measures, known as the Juandah Coal Measures, is subdivided into five coal seams or seam intervals. In descending stratigraphic order these are the Kogan, Macalister, Wambo, Iona and Argyle Seams.

Figure 9 shows the general stratigraphy of the Walloon Coal Measures. The outcrop of these formations is shown in Figure 8.

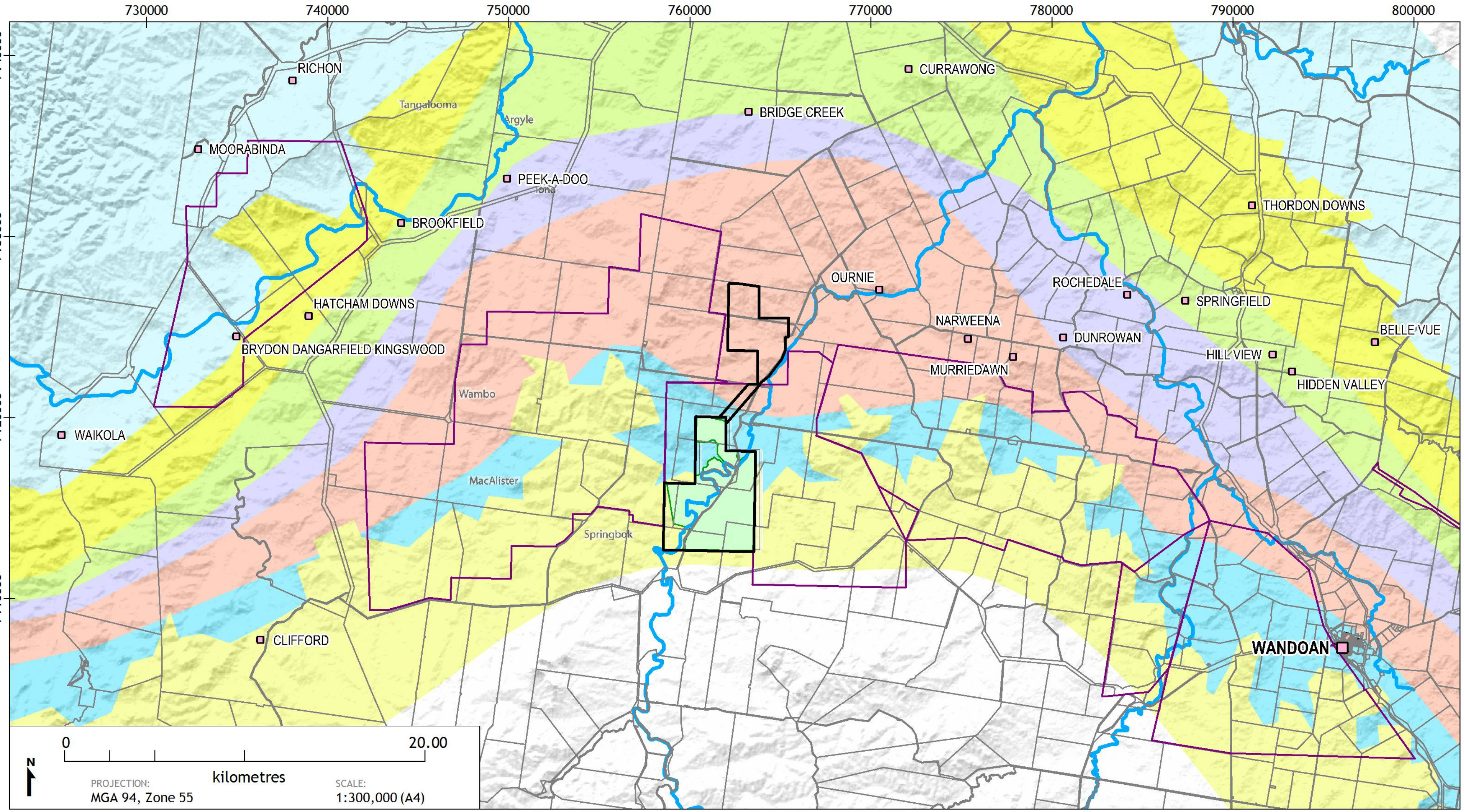
These five coal seams or seam intervals (Kogan, Macalister, Wambo, Iona and Argyle Seams) occur within EPC 650 but the nomenclature has not been used for the Project. Within the Project area, the Juandah Coal Measures are divided into five seam groups named UG, Y, A, B and C in increasing depth below natural surface. Seam and ply nomenclature is summarised in Figure 10. The seams are thought to correlate with outside the lease as follows (pers comm Alban Hanelsy NEC geologist):

- Kogan - UG
- Macalister Upper - Y, A
- Macalister Lower - B
- Nangram - BC
- Wambo / Iona C
- Argyle - LG



(after Exon 1976[4])

Figure 7: Structure Contours Top of Walloon Coal Measures



LEGEND:

- Project Leases
- Mining Lease Application
- Mine Outline
- Cadastre
- Homestead
- Major Creeks

AGE GROUNDWATER & ENVIRONMENTAL

Elimatta Project
Groundwater Assessment (G1438A)

Walloon Coal Measures Outcrop

DATE:
24/10/2012

FIGURE No:
8

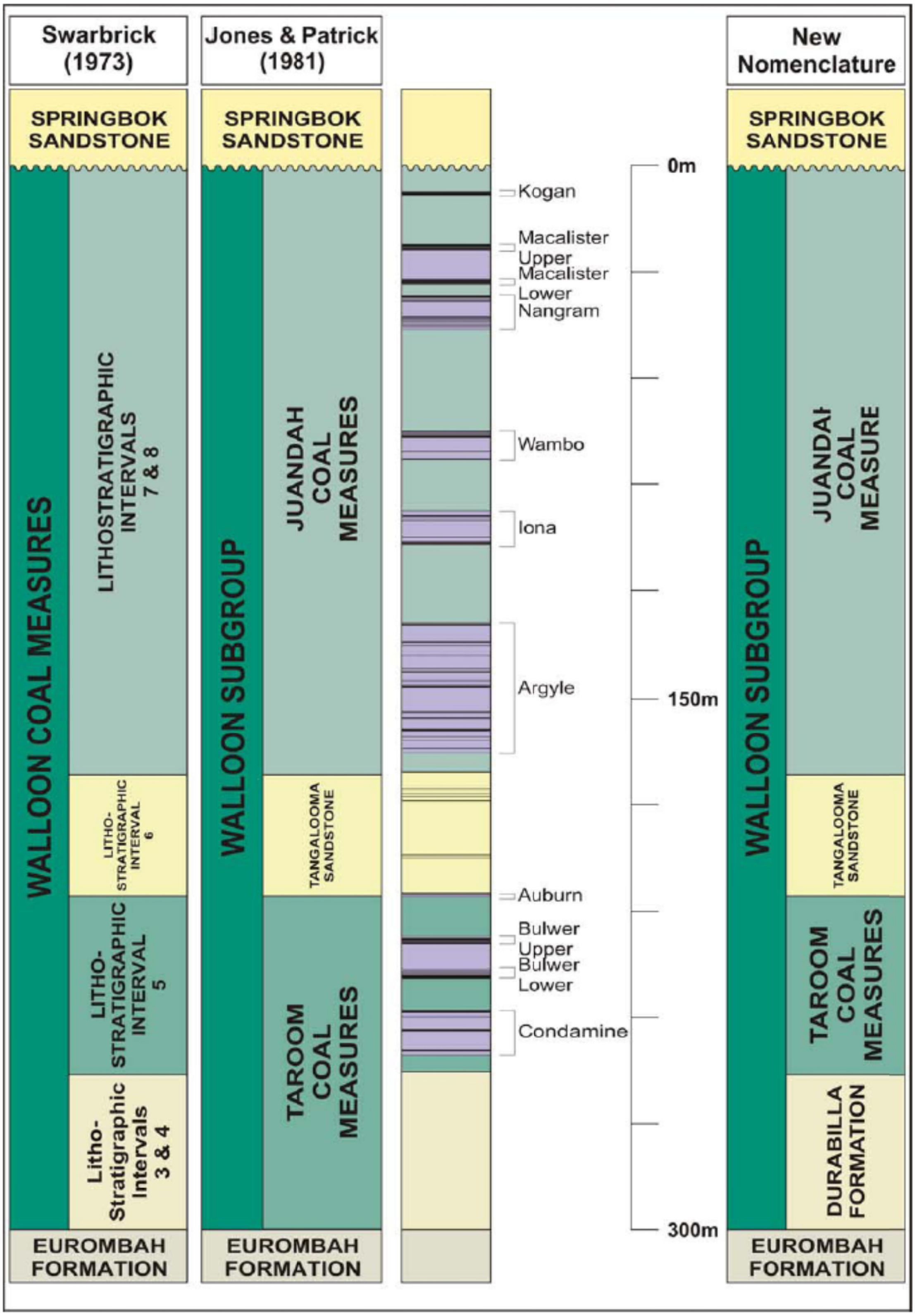


Figure 9: Stratigraphy of the Walloon Coal Measures[5]

[5] Scott et al (2004). Revised geology and coal seam gas characteristics of the Walloon Coal Measures – Surat Basin Queensland, in Eastern Australasian Basins Symposium II, Petroleum Exploration Society of Australia Special Publication 345-355.

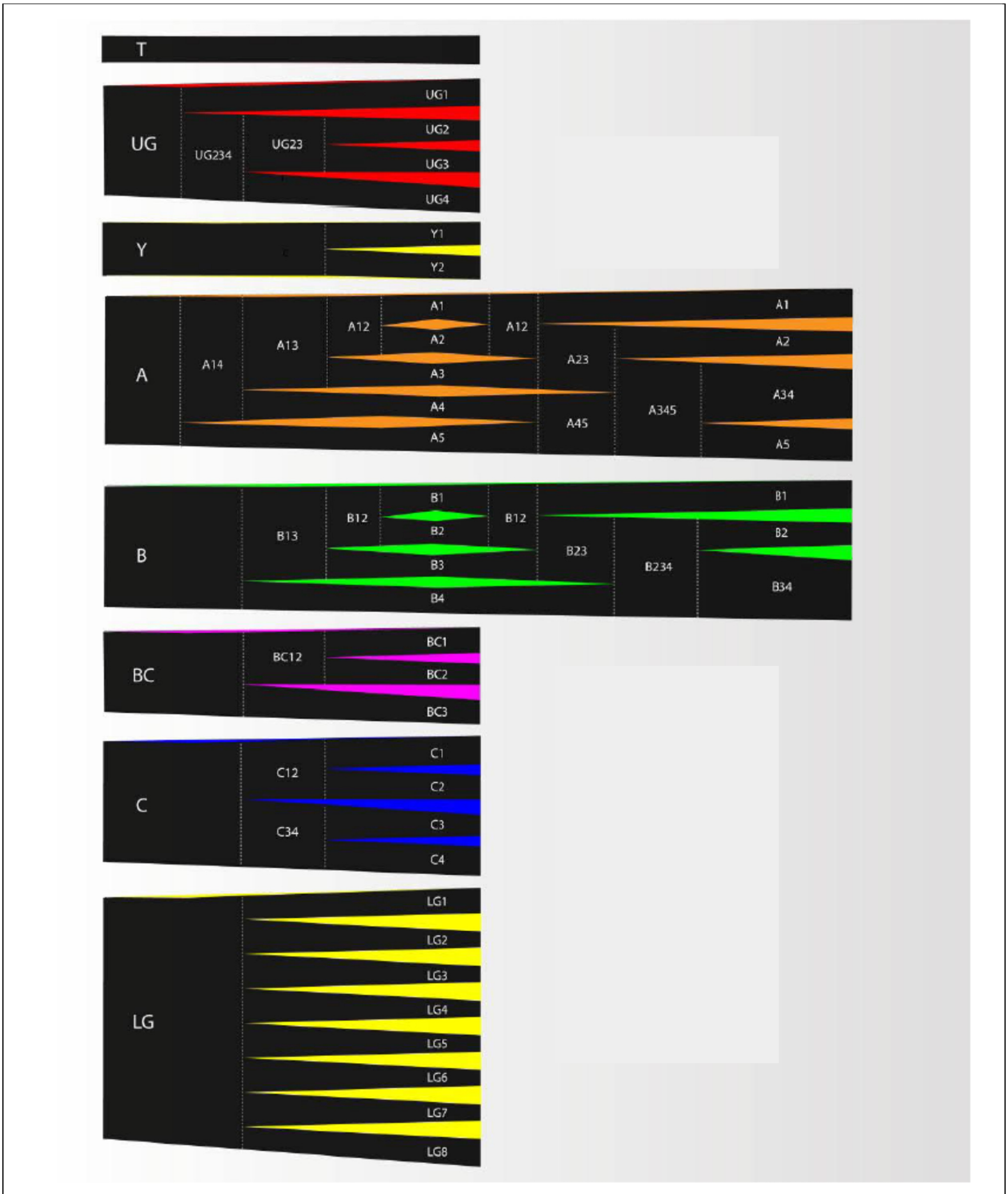


Figure 10: Seam and Ply Nomenclature – EPC650

Typically the overburden above the A Seam averages about 40m in thickness and varies between 20m and 60m. Also present in the overburden are two smaller upper seams, the UG and the Y Seams. The typical depth of overburden above the UG Seam is 15m to 20m, the interburden down to the Y Seam is 7m to 8m, and the typical interburden to the A Seam is 7m to 8m.

The coal seams are separated by interburden units comprising variably interbedded to massive sandstone, siltstone and carbonaceous mudstone. Stratigraphic bedding within the Juandah Coal Measures is sub-horizontal to gently dipping at less than 3^{o}.

Insite Geology (2009)[6] described the five main groups of rock types within the overburden, coal seams, interburden and floor, as follows:

- SANDSTONE, quartzo-feldspathic and lithic, fine to coarse grained, pale grey to grey;
- SILTSTONE, variably sandy, dark grey;
- SANDSTONE/SILTSTONE, variably interbedded to interlaminated, fine to medium grained sandstone, grey/dark grey;
- CARBONACEOUS MUDSTONE, with thin lenses of stony coal, dark brown/black;
- COAL, dull with bright bands, black.

A number of approximately NW-SE trending faults have been identified within the Project area. The fault appears to have throws of around 10m to 30m.

7 GROUNDWATER REGIME

The impacts of mining on the hydrogeological regime of the Project area was undertaken using numerical groundwater flow modelling. The first stage of the numerical modelling is understanding the hydrogeological regime of the area upon which the numerical model is based. This section of the report discusses the conceptualisation and the data used to develop the conceptual model.

As discussed above, there are potentially three aquifer systems in the Project area being:

- Sedimentary aquifers of the GAB;
- Coal seam aquifers of the Juandah Coal Measures;
- Unconsolidated alluvial sediments.

In terms of the hydrogeological impact assessment, the primary focus is considered to be the coal seam aquifers. At the scale of mining, the GAB aquifers are considered to be of sufficient depth not to be impacted and are not addressed further in this report.

7.1 Field Investigation

A field investigation was undertaken as part of the coal resource exploration drilling program to gather additional hydrogeological information within EPC650. The hydrogeological investigation program included:

- construction of 18 groundwater monitoring bores (piezometers) within different lithological units;
- measurement of the hydraulic conductivity of key stratigraphic units using falling/rising head tests;
- measurement of groundwater levels in the new piezometers;

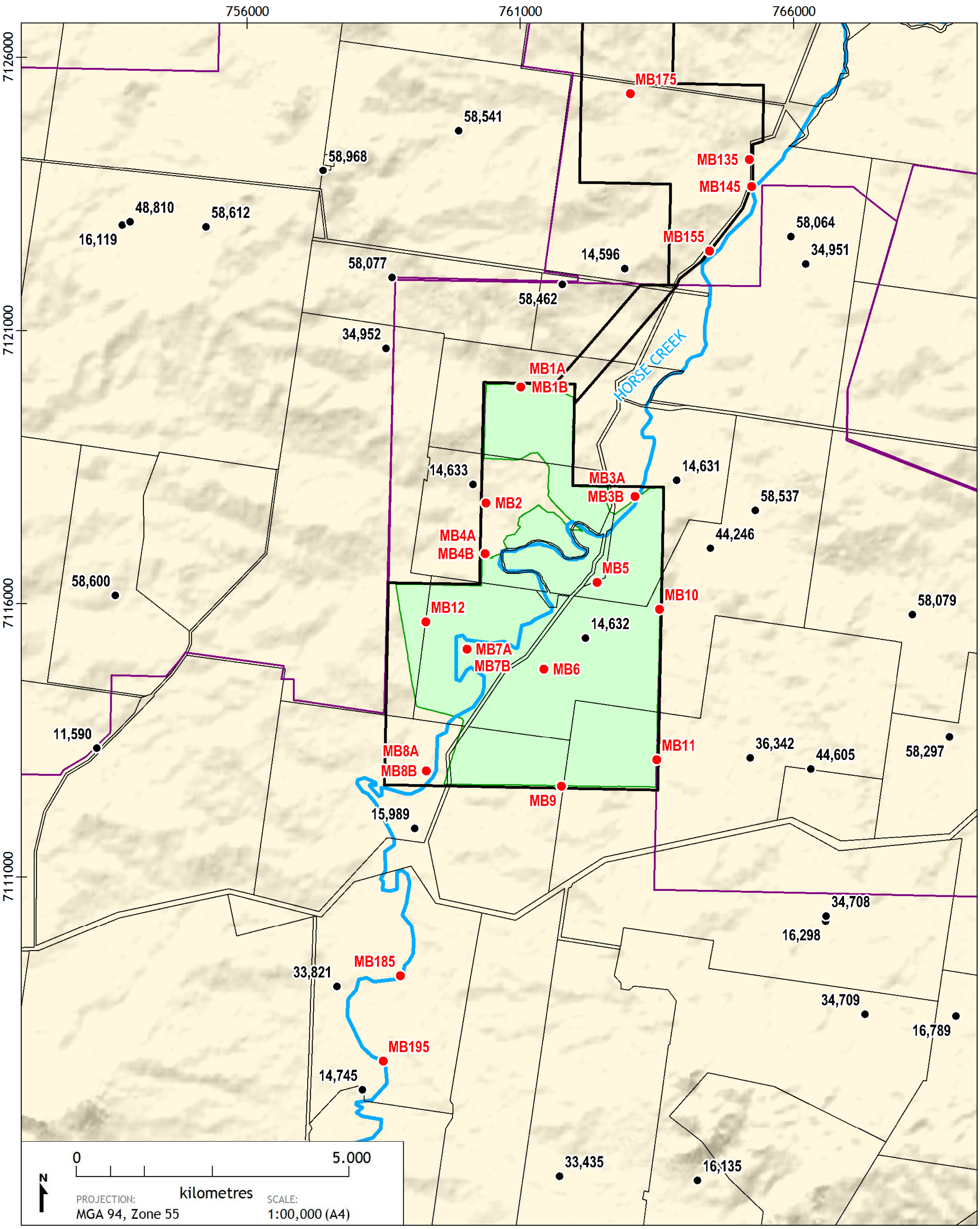
[6] Insite Geology, (2009), *"Elimatta Coal Project Southern Queensland Report on Assessment of Geotechnical Conditions for Northern Energy Corporation Limited",* February 2009.

- collection of groundwater samples for water quality analysis from the new piezometers;
- a census of private bores surrounding the proposed mining operation.

Drilling and installation of the groundwater monitoring network was undertaken in separate campaigns in September 2009 and May 2011. A total of 24 piezometers were constructed as part of the hydrogeological investigation. The sites were selected to provide good spatial coverage over the area to be mined as shown in Figure 11.

Pioneer Drilling installed the monitoring bores under the supervision of Streamline Hydro. The boreholes were cased with Class 18, 80mm diameter, lead free, uPVC casing. Machine slotted uPVC screens were placed at the base of the hole with blank PVC casing completing the hole to the surface. A clean, well-rounded gravel filter pack was placed by gravity around the screens and a bentonite seal installed above the gravel pack. A cement/bentonite grout plug was used to seal the hole to the surface. Lockable steel covers were placed at each site. After construction, the monitoring bores were developed using the airlift method, until all drilling foam was removed and clear sediment free water was being produced.

Table 2 summarises the construction of the monitoring bores, with more detailed borehole logs included in Appendix 2.



LEGEND:

- Registered Bore
- Monitoring Bore
- Project Leases
- Mining Lease Application
- Mine Outline
- Cadastre
- Major Creek

Elimatta Project
Groundwater Assessment (G1438A)

Monitoring and Registered Bores

DATE: 24/10/2012

FIGURE No: 11

Table 2: MONITORING BORE DETAILS

Bore ID	Date Completed	Lithology / Aquifer Monitored	Coordinates (MGA94 Z55)		Surface Elevation	Top of Casing Elevation	Casing Depth	Gravel Pack		Screen Zone		Airlift Yield[3]
			Easting (m)	Northing (m)	(m AHD)	(m AHD)	(m bGL)	Top (m bGL)	Bottom (m bGL)	Top (m bGL)	Bottom (m bGL)	(L/s)
MB1A	06-Sep-09	Walloon Coal Measures	760997	7120002	244.420	244.986	28.0	12.5	29.0	14.0	28.0	0.05
MB1B	06-Sep-09	Alluvium	761001	7120001	244.340	245.150	6.0	2.5	7.0	3.0	6.0	-
MB2	05-Sep-09	Walloon Coal Measures	760367	7117880	240.370	241.108	27.0	16.0	27.0	17.0	27.0	0.10
MB3A	05-Sep-09	Walloon Coal Measures	763091	7117998	236.190	236.788	17.0	10.5	23.0	12.0	17.0	0.13
MB3B	05-Sep-09	Horse Creek Alluvium	763093	7118002	236.210	236.891	10.5	5.5	10.5	6.5	10.5	-
MB4A	15-Sep-09	Walloon Coal Measures	760348	7116954	239.790	240.442	24.0	18.0	24.0	19.0	24.0	0.18
MB4B	15-Sep-09	Horse Creek Alluvium	760351	7116954	239.730	240.474	7.5	3.5	8.0	4.5	7.5	-
MB5	15-Sep-09	Walloon Coal Measures	762400	7116429	256.980	257.585	57.0	34.0	57.0	35.0	57.0	0.85
MB6	12-Sep-09	Walloon Coal Measures	761432	7114842	247.380	248.178	52.0	9.0	60.0	10.0	52.0	0.63
MB7A	08-Sep-09	Walloon Coal Measures	760017	7115207	245.290	245.829	54.0	33.0	54.0	34.0	54.0	0.60
MB7B	08-Sep-09	Horse Creek Alluvium	760020	7115206	245.280	246.061	7.5	3.5	11.0	4.5	7.5	-
MB8A	11-Sep-09	Walloon Coal Measures	759277	7112983	248.530	249.174	68.0	23.0	68.0	24.0	68.0	0.37
MB8B	11-Sep-09	Horse Creek Alluvium	759278	7112979	248.520	249.193	7.0	4.0	8.0	5.0	7.0	-
MB9	12-Sep-09	Walloon Coal Measures	761753	7112704	270.070	270.810	82.0	49.0	82.0	50.0	82.0	0.58
MB10	15-Sep-09	Walloon Coal Measures	763543	7115939	251.100	251.797	69.0	15.5	70.0	18.0	69.0	0.34
MB11	12-Sep-09	Walloon Coal Measures	763493	7113179	266.230	266.776	67.0	51.0	69.0	52.0	67.0	0.42
MB12	08-Sep-09	Walloon Coal Measures	759272	7115706	259.820	260.469	61.0	42.0	66.0	43.0	61.0	0.04
MB13[5]	19-May-11	Alluvium	765191	7124165	TBA	TBA	7.5	5.0	7.5	6.0	7.5	nm
MB14[5]	13-May-11	Horse Creek Alluvium	765229	7123665	TBA	TBA	14.0	7.0	14.0	8.0	14.0	nm
MB15[5]	11-May-11	Horse Creek Alluvium	764461	7122489	TBA	TBA	8.2	5.0	8.2	5.2	8.2	nm
MB16[5]	07-May-11	Horse Creek Alluvium	756901	7102939	TBA	TBA	6.0	2.5	6.0	3.0	6.0	nm
MB17[5]	20-May-11	Alluvium	763008	7125369	TBA	TBA	5.0	3.5	5.5	4.0	5.0	nm
MB18[5]	27-Oct-11	Horse Creek Alluvium	758802	7109229	TBA	TBA	7.0	3.0	10.0	4.0	7.0	nm
MB19[5]	27-Oct-11	Horse Creek Alluvium	758487	7107668	TBA	TBA	6.8	3.3	6.8	3.8	6.8	nm

In the short-term, the monitoring bores were designed to provide water quality information and water level data for numerical modelling. In the long-term, the bores provide locations for monitoring the impact of the operations on groundwater levels and quality during mining. Most of the bores are within the proposed mining footprint and will therefore be removed during mining; however, prior to this, each bore will provide information on the magnitude of the zone of influence as it propagates out from the highwall.

7.2 Water Levels

Table 3 summarises groundwater level measurements from the four baseline monitoring events between October 2009 and July 2011. The locations of the bores are shown on Figure 11.

Table 3: SUMMARY OF WATER LEVEL MEASUREMENTS

Bore ID	Aquifer	Oct-09	Nov-09	Jan-10	Jul-11	Oct-09	Nov-09	Jan-10	Jul-11
MB1A	Walloon Coal Measures	10.89	10.91	10.88	10.71	234.096	234.076	234.106	234.276
MB1B	Alluvium	3.58	3.79	2.84	2.03	241.570	241.360	242.310	243.120
MB2	Walloon Coal Measures	7.70	7.69	7.65		233.408	233.418	233.458	
MB3A	Walloon Coal Measures	9.65	9.70	9.58	6.93	227.138	227.088	227.208	229.858
MB3B	Horse Creek Alluvium	9.99	10.03	9.93	6.98	226.901	226.861	226.961	229.911
MB4A	Walloon Coal Measures	8.31	8.32	8.23	6.1	232.132	232.122	232.212	234.342
MB4B	Horse Creek Alluvium	7.86	7.89	7.84	4.44	232.614	232.584	232.634	236.034
MB5	Walloon Coal Measures	24.94	24.87	24.76		232.645	232.715	232.825	
MB6	Walloon Coal Measures	12.07	12.62	12.71		236.108	235.558	235.468	
MB7A	Walloon Coal Measures	10.31	10.26	10.26	10.01	235.519	235.569	235.569	235.819
MB7B	Horse Creek Alluvium	Dry	Dry	Dry	5.01	-	-	-	241.051
MB8A	Walloon Coal Measures	8.55	8.46	8.49	8.47	240.624	240.714	240.684	240.704
MB8B	Horse Creek Alluvium	Dry	Dry	Dry	5.93	-	-	-	243.263
MB9	Walloon Coal Measures	30.65				240.160			
MB10	Walloon Coal Measures	19.68	19.50	19.53		232.117	232.297	232.267	
MB11	Walloon Coal Measures	19.40	19.30	19.33		247.376	247.476	247.446	
MB12	Walloon Coal Measures	25.69	25.65	25.51		234.779	234.819	234.959	
MB13	Alluvium				Dry				-
MB14	Horse Creek Alluvium				7.65				-
MB15	Horse Creek Alluvium				8.11				-
MB16	Horse Creek Alluvium				1.25				-
MB17	Alluvium				3.06				-
MB18	Horse Creek Alluvium								
MB19	Horse Creek Alluvium								

The groundwater levels generally indicate the potentiometric surface is a subdued reflection of the surface topography with groundwater flow from south to north. Along the alignment of Horse Creek, groundwater levels in the coal measures fall from about 240m AHD to 223m AHD, a gentle gradient of 13m over 6.3km (1m in 484m). The water levels show the groundwater flow is controlled by the topography and surface drainages which is to the north, not the dip of the coal seams which is generally to the south.

Paired bores are present at several sites constructed in the alluvium and coal measures. Several of these sites indicate the water head in the alluvium is higher than in the coal measures, indicating that the Horse Creek alluvium likely recharges the underlying coal measures during periods of sustained rainfall.

7.3 Aquifer Properties

Falling head permeability tests were conducted in each of the monitoring bores. The tests evaluated the hydraulic conductivity of aquifer material surrounding the bore screen. The data were analysed by the Hvorslev Method (1951). Table 4 summaries the results of the analyses.

Table 4: SUMMARY OF FALLING / RISING HEAD ANALYSES					
Bore	**SWL (mbGL)**	**Coal Thickness**	**Test Method**	**Test Type**	**Hydraulic Conductivity (m/day)**
MB1A	10.32	3.52	Pneumatic	Falling Head	0.07
				Rising Head	0.07
MB1B	2.76	3.53	Solid slug	Falling Head	0.22
				Rising Head	0.27
MB2	6.99	2.43	Pneumatic	Falling Head	0.45
				Rising Head	0.28
MB3A	9.13	4.08	Solid slug	Falling Head	0.60
				Rising Head	0.65
MB3B	9.30	3.63	Solid slug	Falling Head	1.32
				Rising Head	1.35
MB4A	7.67	2.14	Pneumatic	Falling Head	0.55
				Rising Head	0.55
MB5	24.38	7.44	Pneumatic	Rising Head	1.25
				Rising Head	1.31
MB6	11.69	7.39	Solid slug	Falling Head	0.08
				Rising Head	0.08
MB8A	7.87	6.43	Pneumatic	Rising Head	0.15
				Rising Head	0.10
MB9	29.93	3.28	Pneumatic	Rising Head	1.09
				Rising Head	1.11
MB10	18.40	6.99	Solid slug	Falling Head	0.23
				Falling Head	0.22
				Rising Head	0.22
MB11	18.90	1.44	Pneumatic	Rising Head	1.24
				Rising Head	1.38
MB12	25.10	5	Pneumatic	Rising Head	0.05

The slug test data suggests that the coal seam has a permeability of around 0.05m/day to 1.4m/day which is relatively permeable for coal.

This is in contrast to data presented in regional modelling studies undertaken for coal seam gas projects. USQ (2010)[7] summarised these modelling studies that adopted hydraulic conductivity values for the Macalister coal seam of between 0.0025 to 0.014m/day, and up to 1.38m/day.

7.4 Recharge

Groundwater recharge to coal seam aquifers is derived from two sources:

[7] University of Southern Queensland, (2011), *"Preliminary Assessment of Cumulative Drawdown Impacts in the Surat Basin Associated with the Coal Seam Gas Industry Investigation of Parameters and Features for a Regional Model of Surat Basin Coal Seam Gas Developments"*, March 2011.

- infiltration of incident rainfall; and
- via intersection of the coal seam outcrops or shallow overburden with surface water sources.

The actual volume of rainfall that recharges is a function of rainfall intensity, evaporation rates, topography and the permeability of the surficial soils. Limited data is available on the annual recharge volume of the shallow alluvial aquifers or sandstone beds of the GAB. Kellett et al (2003)[8] used the chloride mass balance method to estimate recharge to the recharge beds of the GAB. The estimated recharge rate to the Gubberamunda Sandstone to the south of the Project was calculated at between 0.5mm/year and 5mm/year.

Due to the relatively low annual rainfall, high evaporation rates (approximately three times rainfall) and low permeability overburden, recharge at the site is considered to be very low and probably fractions of a millimetre per year. DERM (2011)[9] scaled recharge in the Fitzroy Basin in a range from one being low, to five for high. The Wandoan area is ranked as a one, indicating a low recharge rate.

8 GROUNDWATER USE, QUALITY AND ENVIRONMENTAL VALUE

8.1 Groundwater Use

The Project area is located in the GAB Sub-artesian Area, therefore authorisation from the Department of Environment and Resource Management (DERM) is required to abstract water. All water bores constructed within Queensland should be registered with DERM, on a central bore database. A search of the DERM bore database identified 26 registered bores within a 5km zone around EPC650, of which five have been abandoned and destroyed, and two were never installed.

Figure 11 shows the location of the registered bores. Table 5 summarises registered bores within a 5km zone around EPC650.

The majority of the bores are screened between about 100m and 200m depth, and are therefore likely to be within the Walloon Coal Measures. Two deep bores are screened between 603m to 627m and 1086m to 1188m in deeper GAB aquifers underlying the Walloon Coal Measures.

Table 5: REGISTERED BORES WITH 5KM ZONE AROUND EPC650

Bore RN	Date	Property Name	Easting	Northing	Status	Screen Zone		Distance from EPC650
						top	bot	
11590	1948	Kywong	753250	7113396	Existing	88.4	101.2	5.26
14596	1960	Caenby	762910	7122166	Existing			2.45
14631	1961	Wattle Retreat	763861	7118297	Destroyed			0.34
14632	1961	Elimatta	762190	7115406	Existing			within lease
14633	1961	Wattle Retreat	760132	7118218	Destroyed			0.14
15989	1964	Bundi	759061	7111927	Destroyed	85	167	0.76

[8] Kellett, et al, (2003), *"Groundwater Recharge in the Great Artesian Basin Intake Beds"*, Queensland, Bureau and Rural Sciences and Queensland Department of Natural Resources and Mines.

[9] Raymond, M. A. A. and V. H. McNeil, (2011), *"Regional Chemistry of the Fitzroy Basin Groundwater"* Brisbane: Department of Environment and Resource Management, Queensland Government.

Table 5: REGISTERED BORES WITH 5KM ZONE AROUND EPC650								
Bore RN	Date	Property Name	Easting	Northing	Status	Screen Zone		Distance from EPC650
						top	bot	
16119	1965	Wallangra	753714	7122964	Existing	240	254	7.12
16298	1965	Loch Lomond	766590	7110235	Destroyed	75	115.2	3.81
33821	1970	Bundi	757641	7109030	Existing	106	182	3.79
34708	1970	Loch Lomond	766592	7110327	Existing	142	160	3.81
34709	1970	Mt Organ	767306	7108527	Existing	187.1	201.2	5.5
34951	1970	Caenby	766223	7122253	Destroyed	85.3	120.4	4.97
34952	-	In	758540	7120713	Never drilled			1.88
36342	-	Bethany	765205	7113220	Never drilled	304.7	305	1.68
44246	1973	Elimatta	764476	7117053	Existing	18.3	19.8	0.88
44605	1973	Bethany	766313	7113012	Existing	88	117	2.81
48810	1974	Wallangra	753854	7123022	Existing	182	190	7.2
58064	1982	Caenby	765955	7122751	Existing	88	95	5.36
58077	1982	In	758649	7122005	Existing	77	340	2.56
58079	1982	Yabba	768179	7115838	Existing	42	60	4.62
58462	1991	Caenby	761763	7121881	Existing	603	627	1.9
58537	1993	Elimatta	765297	7117745	Existing	112	124	1.7
58541	1993		759871	7124690	Existing			4.64
58600	1994		753583	7116192	Existing	140	270	5
58612	1994	Wallangra	755244	7122934	Existing	182	218	5.97
58968	2004	Eurombah	757387	7123967	Existing	1086	1188	4.85

8.2 Deep Bore Census

To date NEC, along with other mining companies in the area, have not yet undertaken groundwater monitoring of the Hutton Sandstone or Precipice Sandstone aquifers. The Hutton and Precipice Sandstone aquifers are both aquifers in the GAB. These deep aquifers provide the main source of water for the area including the Wandoan Town Bores and other community bores (Juandah, Bimbadeen and Grosmont Bores). The pastoral landowners and the grazing industry throughout the district maintains a high level of dependence on these deep aquifers, which are therefore of high environmental value.

Streamline Hydro Pty Ltd (Streamline Hydro) completed a groundwater bore census on behalf of NEC in 2012. The boundaries of the bore census area were determined after comparing the NEC proposed mining leases with the maximum extent of modelled groundwater drawdown resulting from mining operations (refer Figure 12 and Section 14).

The DERM groundwater database indicated that twenty six registered bores are located within the nominated NEC bore census area. Streamline Hydro contacted landowners within the bore census area to establish whether they were willing to participate in the bore census and allow NEC to record hydrogeological information on their properties. Several landowners stated that there are no bores on their property or that they were not willing to participate in the bore census. Of the twenty six bores registered in the DERM groundwater database, Streamline Hydro were able to identify twenty bores during interviews with landowners. These included bores that were not registered in the DERM groundwater database, bores that were decommissioned or abandoned, and several bores outside the boundaries of the originally nominated census area.

The details of the bore census are presented in Appendix 3.

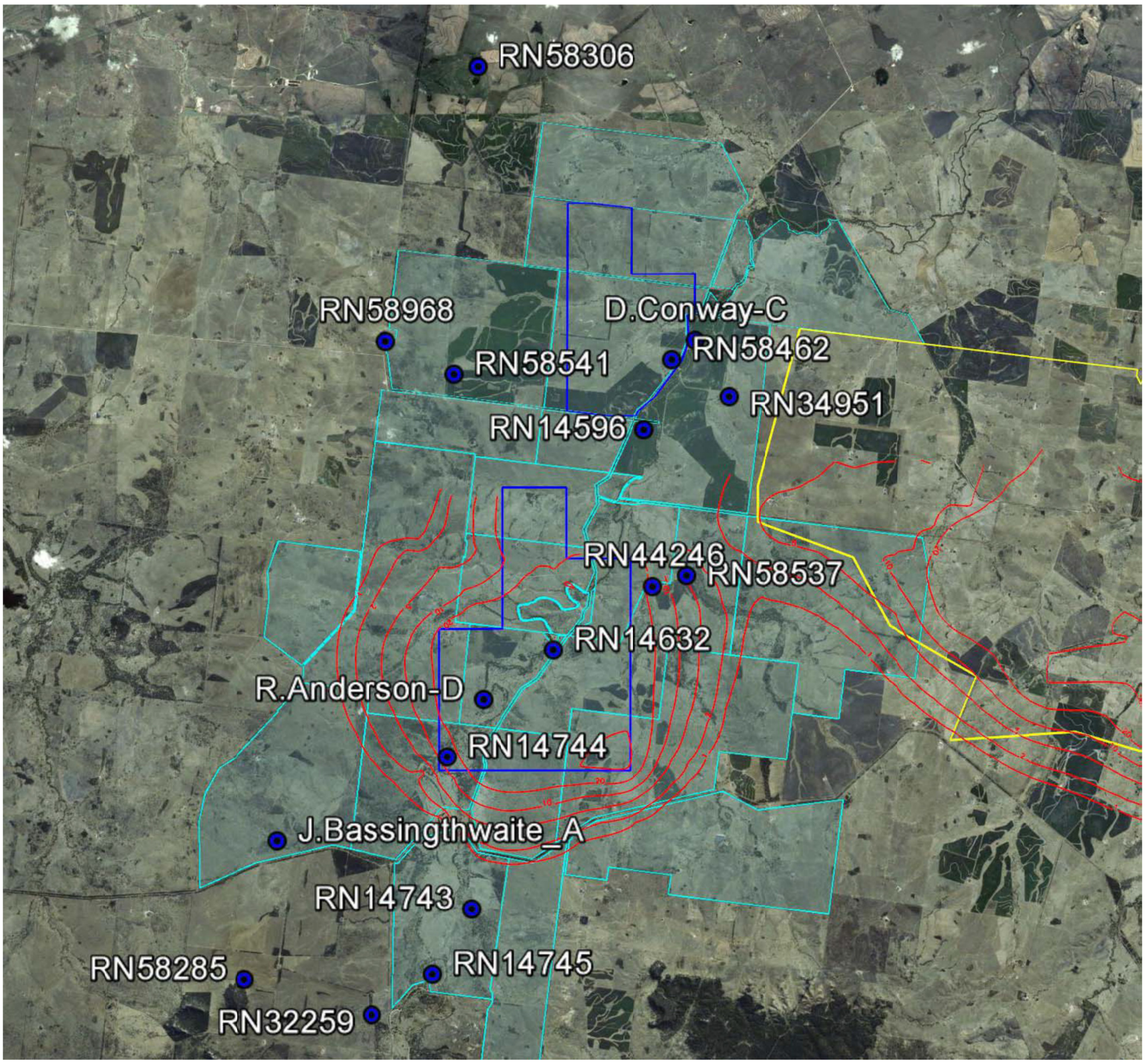


Figure 12: Location of Bores Assessed during the Bore Census

Figure 12 shows the results of the bore census. Bores located in the census that are not registered in the DERM groundwater database have been identified using the relevant landholder's name. The properties contacted during the bore census are shown in blue and the Xstrata Mining Lease application is shown in yellow. AGE modelled groundwater drawdown contours are shown in red around MLA50254.

9 GROUNDWATER CHEMISTRY AND QUALITY

9.1 Baseline Monitoring Program

Four monitoring events were conducted after installation of the monitoring bores in:

- October 2009
- November 2009
- January 2010
- July 2011

Water samples were collected from up to 21 bores located throughout the Project area (refer Figure 11). Nine of the bores are screened in the Horse Creek alluvium, with the remaining 12 across coal horizons within the Walloon Coal Measures.

A total of 39 samples were collected from bores screened across the coal measures and 18 from bores screened across alluvium. Furthermore, 16 duplicate samples were collected for quality assurance purposes.

Laboratory samples were collected by purging bores of a minimum three bore volumes by using a bailer or submersible pump until field parameters had stabilised. Streamline Hydro submitted the water samples to ALS Environmental Laboratories (ALS) for analysis. For approximately every 10 samples collected; an unmarked intra-lab duplicate sample was collected and sent to ALS, and an unmarked inter-lab duplicate sample sent to Amdel Laboratories. Both laboratories are National Association of Testing Authorities (NATA) accredited.

Streamline Hydro measured pH, temperature, electrical conductivity, dissolved oxygen and oxidation-reduction potential in the field using a portable water quality meter. Australian Laboratory Services analysed the baseline samples for:

- pH, EC and Total Dissolved Solids (TDS)
- Major anions (CO_3, HCO_3, Cl, SO_4)
- Major cations (Ca, Mg, Na, K)
- Trace elements - (Al, Sb, As, Be, Ba, Cd, Cr, Cu, Ni, Pb, Zn, Li, Mn, Mo, Se, Ag, U, V, B, Fe)
- Nutrients – nitrite, nitrate, TKN, TN.

Appendix 1 summarises the results of the laboratory testing.

9.2 Salinity

Salinity is a key constraint to water management and groundwater use. Salinity can be categorised by the TDS concentrations. A number of systems exist for categorising water quality, but the following salinity ranges have been found to be the most suitable for Australian conditions based on experience:

Salinity	TDS (mg/L)
Fresh	0 to 500
Slightly brackish	500 to 1,000

Brackish	1,000 to 3,000
Moderately saline	3,000 to 7,000
Saline	7,000 to 14,000
Highly saline	14,000 to 35,000
Brine	>35,000

Figure 13 presents the available TDS data categorised according to this system.

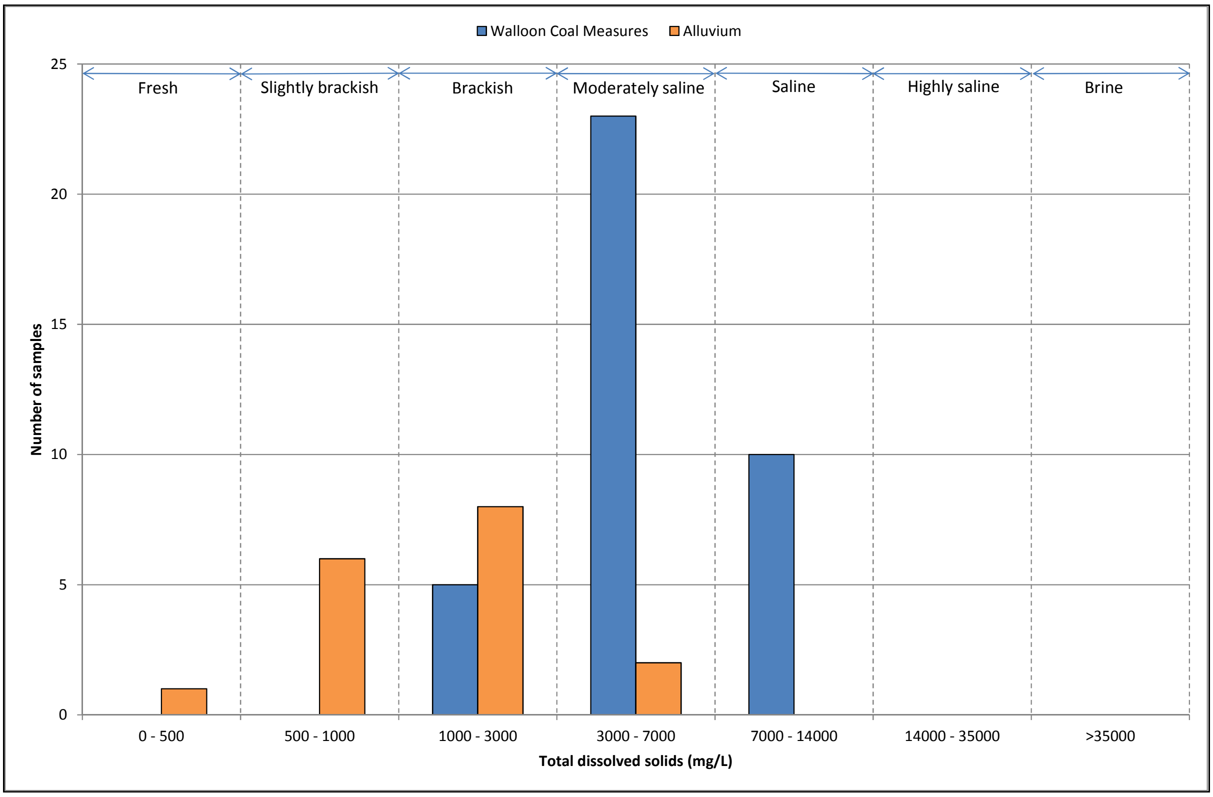


Figure 13: TDS Histogram

Figure 13 shows the groundwater quality varies across the Project area from fresh to saline. Salinity is generally lower within the alluvial deposits than within the Walloon Coal Measures which is are typically saline in nature.

The higher salinity in the Walloon Coal Measures when compared to the alluvium is most likely a result of lower recharge rates to the coal measures that concentrate the rainfall recharge, and greater groundwater residence times increasing water/rock interaction and mineral dissolution.

9.3 Water Types

Figure 14 shows the major ions plotted on a piper diagram. The piper diagram shows that groundwater within the Walloon Coal Measures can be classified as sodium-chloride type water. The composition of groundwater within the alluvial deposits is more variable; sodium is the dominant cation; however, the dominant anion ranges from bicarbonate to chloride to no-dominant type.

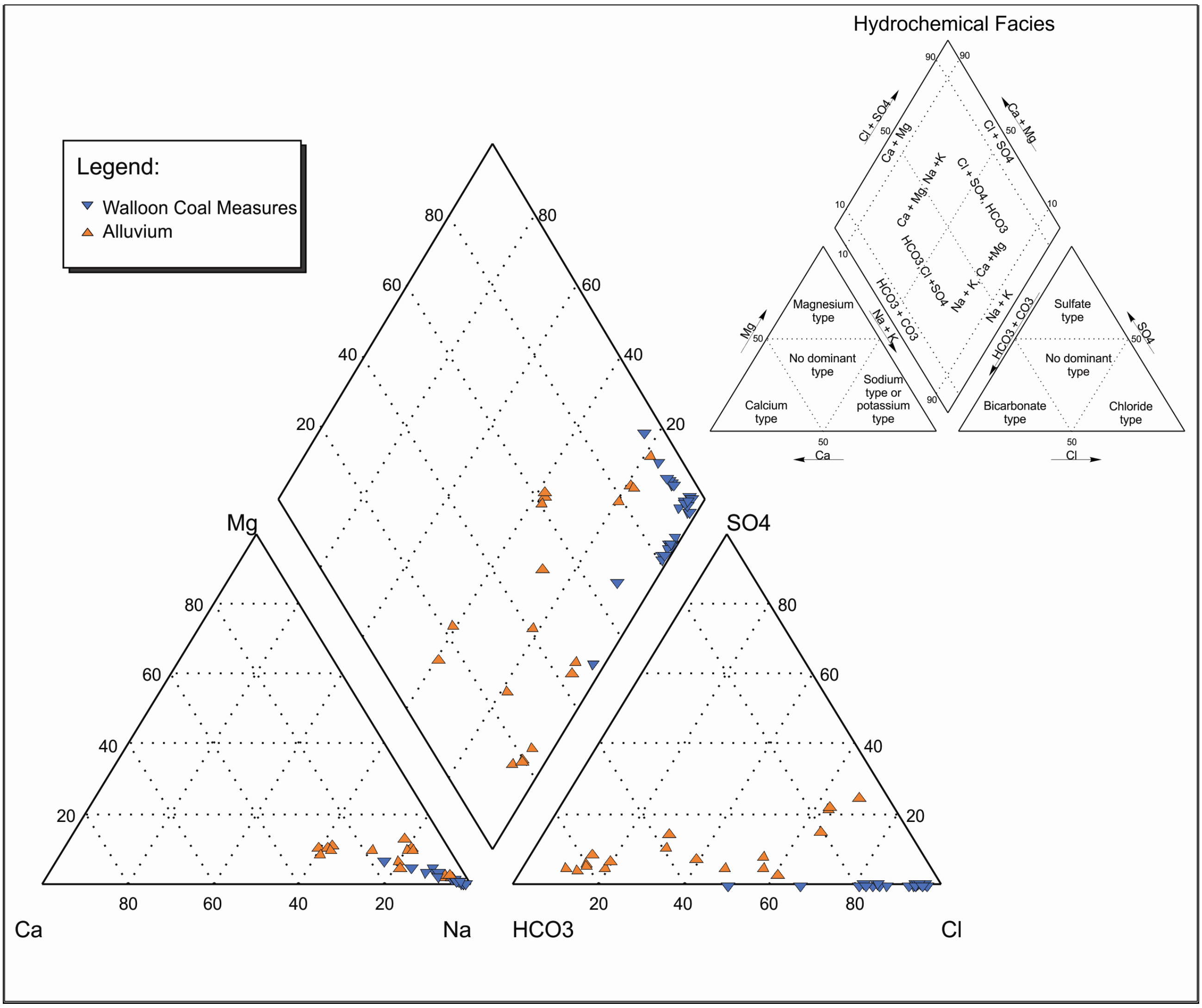


Figure 14: Piper Diagram

Figure 15 shows a scatter plot of pH versus TDS. Figure 15uses field pH as laboratory holding times for pH breached for all lab samples. Figure 15 shows that pH ranges between 6.6 and 8.4 for all samples. TDS show a high variability and ranges between 418mg/L to 13,400mg/L. TDS are higher for those bores screened across the Walloon Coal Measures. In general, pH and TDS show a reasonable correlation within the Walloon Coal Measures whereby TDS concentrations increase with decreasing pH and vice versa.

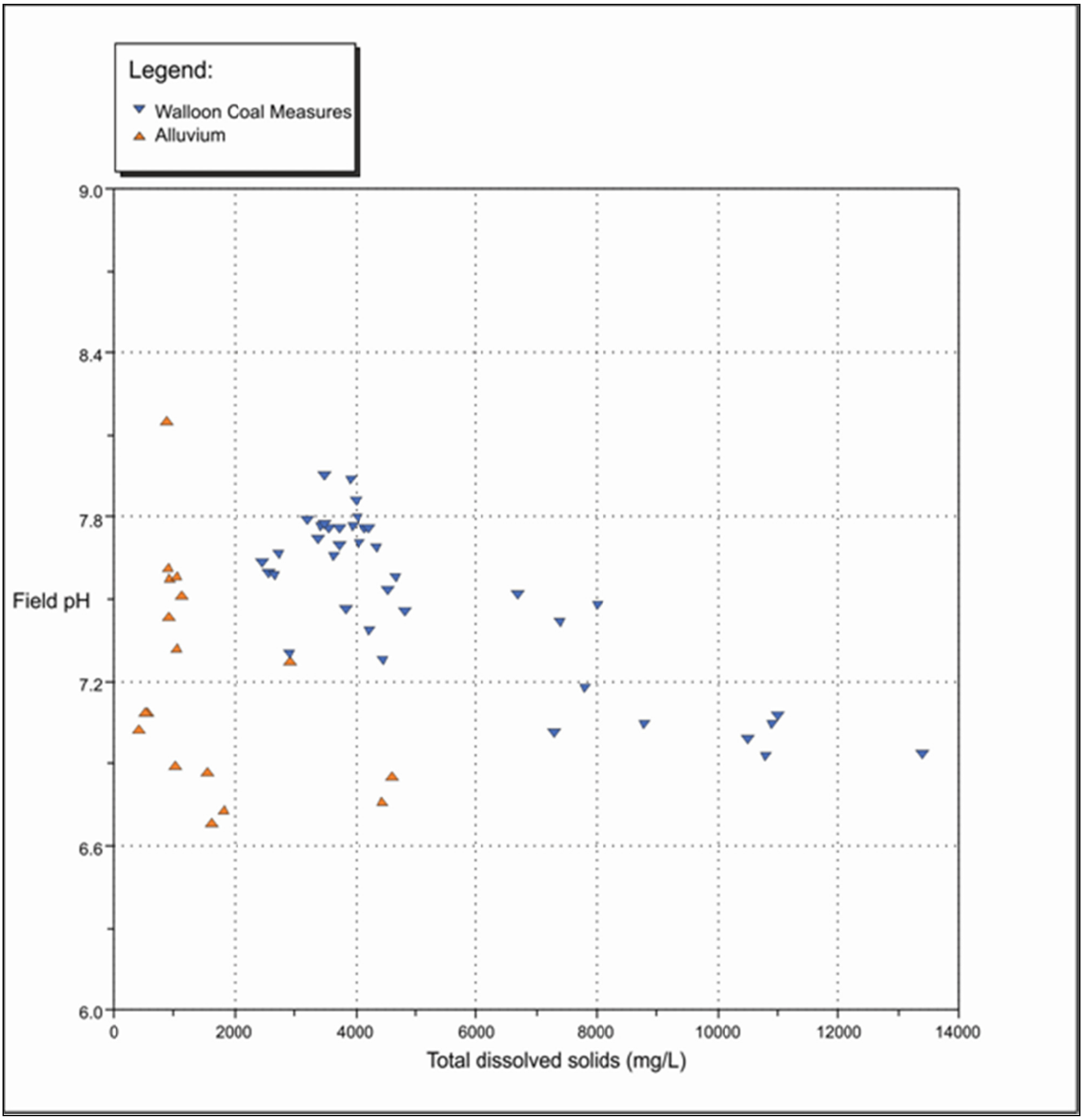


Figure 15: pH versus TDS Scatter Plot

Figure 16 presents the ranges in major ion concentrations in a box and whisker format. Figure 16 shows that the Walloon Coal Measures are characterised by lower sulphate, and higher chloride and sodium concentrations than the alluvium.

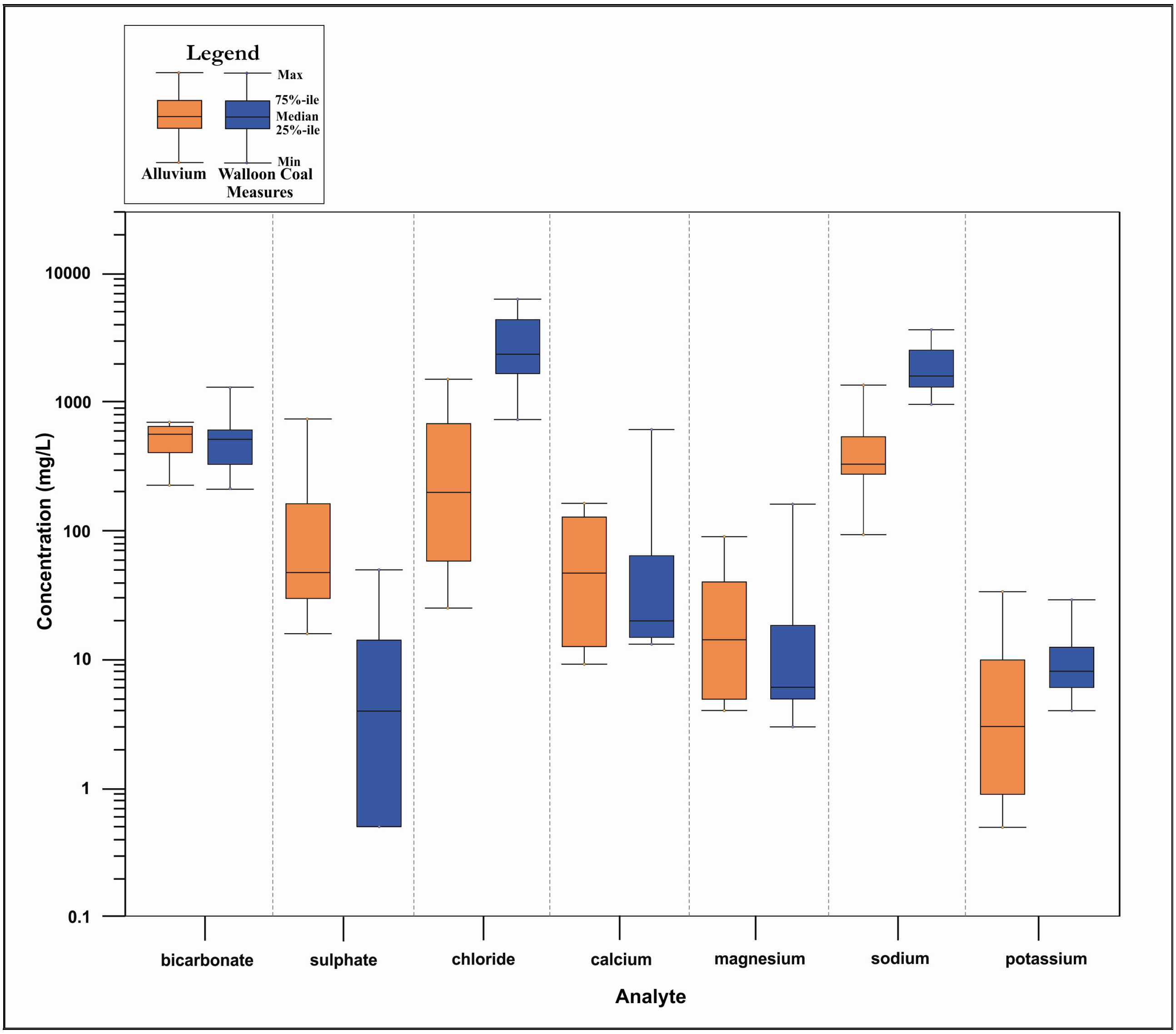


Figure 16: Box and Whisker Plot

9.4 Agricultural and Ecosystem Usage

Appendix 1 compares the groundwater quality data to the ANZECC (2000)[10] guidelines for the quality of stock water and freshwater ecosystems. Table 6 summarises parameters that exceeded the triggers for stock water recommended by ANZECC (2000).

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

Table 6: STOCK WATER TRIGGER EXCEEENCES	
TDS	ANZECC triggers for TDS were exceeded in 11 of the 12 bores screened within the coal measures (exception being MB10), and bore MB4B screened across alluvium. High TDS can cause loss of production and a decline in animal health. The tolerance to salinity varies for each livestock type. The TDS concentrations in the bores generally exceed guidelines for poultry and dairy cattle but most bores remain suitable for watering of horses, pigs, sheep and beef cattle.
Total Aluminium	Concentrations of total aluminium exceeded the triggers in bore MB8A screened across the coal measures, and in bores MB1B and MB8B screened across alluvium. Concentrations of aluminium above the guideline can reduce stock growth and metabolism.
Dissolved Selenium	Dissolved concentrations of selenium exceeded the triggers in bore MB15 screened across alluvium.

The suitability of groundwater for human consumption, the water quality results were compared to the NHMRC (2011) [11] guidelines.

The aesthetic guideline for TDS recommended by NHMRC (2011) was exceeded in all bores screened in the coal measures and in 6 of the 9 bores screened across alluvium meaning the groundwater is too saline for human consumption.

Typically the groundwater within the Walloon Coal Measures and alluvium is suitable for horses, pigs, sheep and beef cattle. However, in some instances the salinity of the water could cause a loss of production. The water is generally unsuitable for watering of poultry and dairy cattle. Groundwater is unsuitable for human consumption.

10 ENVIRONMENTAL VALUE OF GROUNDWATER

DERM (2011)[12] state that "*where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters.*"

10.1 Aquatic and Groundwater Dependent Ecosystems

No permanent surface water bodies reliant on groundwater flows are known to be present within EPC 650.

[11] NHMRC, NRMMC, (2011). *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.

[12] Environmental Protection (Water) Policy, 2009*, "Dawson River Sub-basin Environmental Values and Water Quality Objectives Basin"*, No. 130 (part), including all waters of the Dawson River Sub-basin except the Callide Creek Catchment, September 2011

All the creeks including Horse Creek are flashy ephemeral systems that flow with surface water following rainfall events, and are not fed by a permanent discharge from underlying aquifers. Some subsurface flow of groundwater downstream through the Horse Creek alluvium is expected to occur, but this does not express at the surface.

The groundwater quality is generally brackish to saline and is unlikely that any vegetation is dependent on this groundwater.

The wetland identified through remote sensing by DERM to the north of EPC 650 does not appear to hold permanent water, and maybe a surface depression that collects surface water runoff. The flora and fauna study undertaken for the EIS also reached this conclusion and reported that "t*his community exists within a drainage depression that connects with Horse Creek during high flow events. The topography of the area results in overland flow pooling on the surface rather than flowing directly into Horse Creek, creating a seasonal wetland during periods of sufficient rainfall. The temporary nature of the standing water and the topography of the site suggest the wetland is fed by surface water sources only. No natural springs are known from or were observed in the area."*

10.2 Recreational Use

This category of environmental value is no relevant to the groundwater regime of the area.

10.3 Drinking Water

The groundwater is rarely suitable for human consumption, and there is no known reliance on groundwater for drinking water in the area.

10.4 Agricultural Use

The groundwater is generally suitable for stock and this is the most common use of groundwater in the region surrounding the Project.

10.5 Industrial Use

There are no industrial users of groundwater within the Project area.

The primary environmental value of the groundwater from the coal measures within the Project area is therefore for agricultural use only.

11 PREVIOUS RELATED STUDIES

11.1 Wandoan Project

The Wandoan Coal Project involves open-cut coal mining on three mining leases (MLA 50229, MLA 50230 and MLA 50231) immediately west of Wandoan township. Mining is expected to be limited to a depth of 60m. The MLAs make up approximately 32,000 hectares with production expected to be around 32Mtpa.

Quaternary sediments occur along the major creeks within the mining leases. The Quaternary sediments, where present, are underlain by the Juandah Coal Measures which are comprised predominantly of sandstone with interbedded coal, siltstones and mudstones. The Juandah Coal Measures contain the target coal seams of the operation.

Groundwater occurs predominantly within the coal seams of the Juandah Coal Measures. The hydraulic transmissivity of the coal seams is low with calculated values typically < $8m^2$/day. The deeper coal seams (>50m) are generally more transmissive than shallower seams. The vertical hydraulic connection between the different water-bearing zones in the coal is considered to be low with the interbedded sandstones, siltstones and mudstones acting as semi-confining/confining layers separating the water-bearing zones. The water quality of the coal seams is generally saline and limited to non-intensive stock use only.

The Quaternary alluvium acts as an unconfined aquifer that is directly responsive to rainfall and creek flows. The hydraulic connection between the alluvium and underlying Juandah Coal Measures is poorly understood.

Impacts to groundwater from the mining operation are expected in the Quaternary sediments and Juandah Coal Measures and include the following:

- Lowering of groundwater levels;
- Changes in the groundwater flow pattern;
- Reduction in aquifer yield; and
- Reduced water quality.

It appears a groundwater model has not been used to quantify the impacts of the Wandoan Project. Groundwater impacts are expected to extend beyond the bounds of the Wandoan mining leases, although the lateral extent of the impacts appears to not have been estimated.

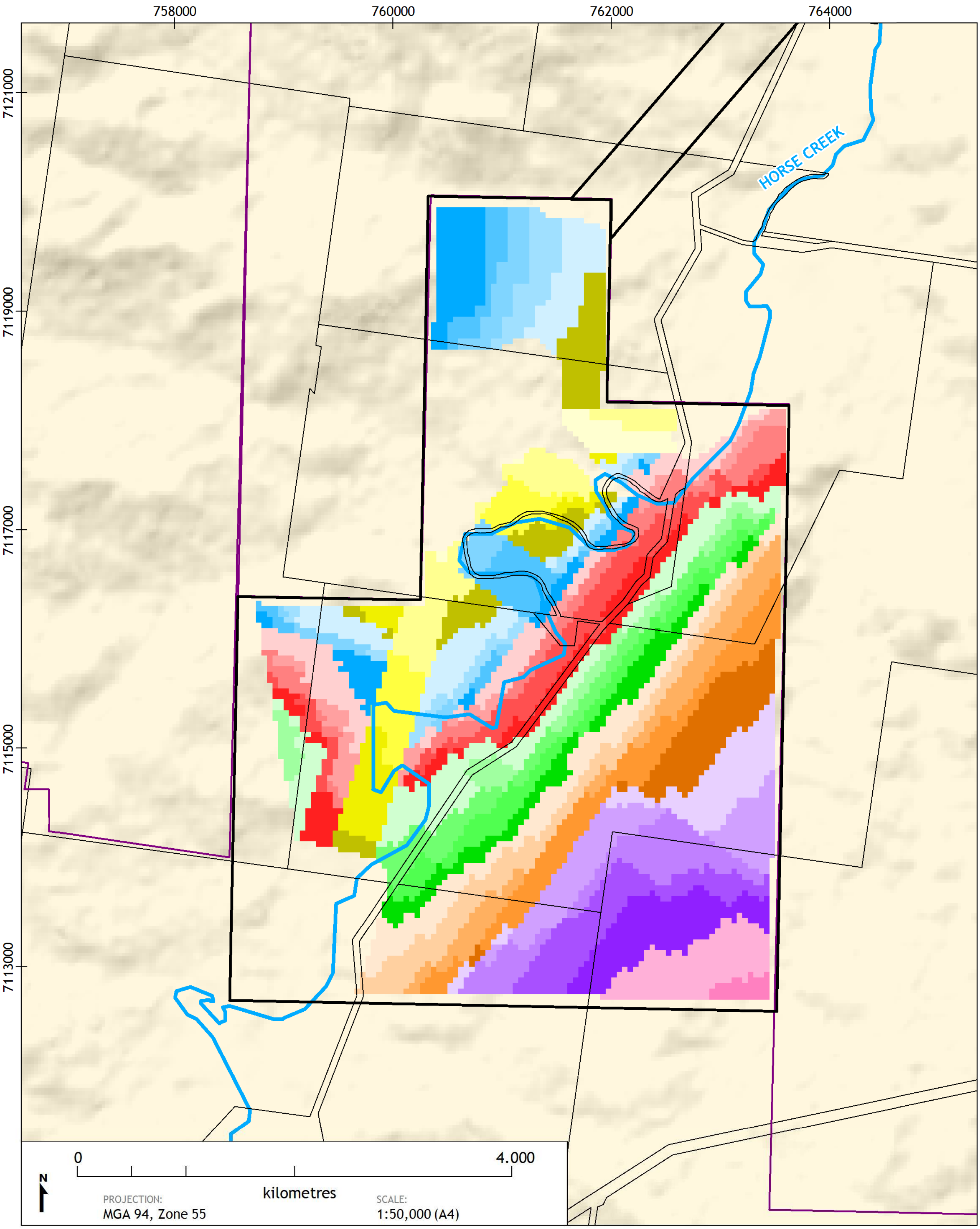
The potential for impacts are not expected to be transferred into the underlying GAB aquifers given the significant depth of separation (>400m) and presence of impermeable strata between the mined seams of the Juandah Coal Measures and the GAB aquifers.

12 PROPOSED MINE PLAN

The Project configuration of seams favours shovel/excavator and truck mining methods. Spoil will initially be placed out of pit beside the first excavation and thereafter backfilled to the mining void. The Project plan proposes two open pit areas which are separated by a fault zone within the deposit.

The water supply requirement for the mining and processing activities, including water required for dust suppression and domestic use, is estimated to be 2,500 Megalitres per annum. The potential for using coal seam gas extraction water as the primary supply is currently under investigation. A significant coal seam gas extraction industry is being developed over areas to the west and south of the Elimatta Project. The supply of treated coal seam gas water from Sunwater is expected to be a viable source for the Project. Approval of water transport infrastructure, outside of the proposed MLs, will be undertaken separately to the Project EIS.

Groundwater use from the Project site will only be incidental where abstraction is required for pit dewatering. No harvesting of groundwater specifically for use in the mine will be undertaken.



LEGEND:

- Project Leases
- Mining Lease Application
- Cadastre
- Major Creek

Mining Sequence

Year 1	Year 9	Year 17	Year 25
Year 2	Year 10	Year 18	Year 26
Year 3	Year 11	Year 19	Year 27
Year 4	Year 12	Year 20	Year 28
Year 5	Year 13	Year 21	Year 29
Year 6	Year 14	Year 22	Year 30
Year 7	Year 15	Year 23	Year 31
Year 8	Year 16	Year 24	Year 32

Elimatta Project
Groundwater Assessment (G1438A)

Mining Sequence

AGE GROUNDWATER & ENVIRONMENTAL

DATE: 24/10/2012

FIGURE No: 17

13 CONCEPTUAL MODEL

A conceptual model describes the processes by which a groundwater system operates given the available data, and represents the natural system in a simplified way. It includes all essential features of the system as described in Section 7, to an appropriate level of detail.

Extensive information on the natural system is typically required to develop an equivalent and simplified conceptual groundwater model representative of the system. Formulation of the conceptual model often highlights gaps in data or deficiencies in understanding of the groundwater system.

The main aquifer intersected by mining are the coal seams of the Walloon Coal Measures. The alluvium associated with Horse Creek is not widespread, and forms only a thin, patchy and partially saturated aquifer.

Recharge of the shallow alluvium occurs from direct rainfall infiltration to the alluvium and through the bed of Horse Creek after rainfall. Recharge to the coal measures is very low, and occurs where the coal seams sub-crop beneath creeks and from direct rainfall infiltration where the seams are exposed at the surface.

Groundwater pressure and hydraulic conductivity control flow directions in the aquifers, which is a subdued reflection of the topography in the shallow strata. Groundwater flows from the areas of elevated topography in the head waters of Horse Creek towards the north. As there is no permanent baseflow in Horse Creek, the groundwater flow is through the gravels in the bed of the creeks downstream, and removed by evaporation and evapotranspiration. The lack of significant aquifer discharge via baseflow in the creeks, as well as the brackish to saline nature of the groundwater due to high evaporation rates, suggests the volume of groundwater recharge entering the aquifers is very low. This is typical for semi-arid areas in Queensland where the evaporation rate is significantly higher than rainfall and thus minimise deep drainage of groundwater. Significant recharge of the groundwater system only occurs after prolonged rainfall events that can saturate the soil and subsoil profile and allow deep drainage of rainfall to occur.

Where the groundwater levels in the creek gravels are close to or above the ground surface level in pools in the creeks, direct evaporation can remove groundwater from the system. Deep rooted remnants of the native vegetation along the creek lines are also expected to contribute to evapotranspiration of water from the creek alluvium. Some discharge from the Permian aquifers could also occur via upward seepage along minor faults and fractures.

14 NUMERICAL MODEL

14.1 Objectives

Numerical modelling was used to predict the impact of the Project on the groundwater regime. The objectives of the predictive modelling were to:

- assess the groundwater inflow to the open cut pits over time;
- simulate and predict the extent and degree of drawdown due to mining within each geological unit;
- identify potential risks to groundwater resources from mining operations;
- assess the potential for mine dewatering to impact on groundwater discharges, groundwater users and groundwater dependent ecosystems; and
- assess the risks to groundwater resources after closure of mining operations.

14.1 Model Development and Calibration

14.2.1 Model Code

Numerical simulation of groundwater flows in the aquifers was undertaken using the MODFLOW SURFACT code (referred to as SURFACT for the remainder of the report). A commercial derivative of the standard MODFLOW code, SURFACT is distributed by Hydrogeologic Inc and has some distinct advantages over standard MODFLOW; advantages that are critical for the simulation of groundwater flow at the Elimatta site.

The MODFLOW code (on which SURFACT is based) is the most widely used code for groundwater modelling and is presently considered an industry standard. Use of the SURFACT modelling package is becoming increasingly widespread, particularly in mining applications where groundwater dewatering and recovery are simulated.

First and foremost, SURFACT is capable of simulating variably saturated conditions. This is critical for the requirements of the proposed Elimatta Mine where coal seams will be progressively dewatered with time until the end of mining when seams will be essentially unsaturated. Then active dewatering will cease, and groundwater recovery will rewet the seams. SURFACT is also supplied with more robust numerical solution schemes to handle the more complex numerical problem resulting from the unsaturated flow formulation. Added to the more robust numerical solution schemes is an adaptive time-stepping function that aides the progression of the solution past difficult and complex numerical situations such as oscillations.

The MODFLOW pre- and post- processor PMWIN (Chaing and Kinzelbach, 1996) was used to generate some of the input files for the SURFACT model, such is the similarity between it and the standard MODFLOW. Where files differ to allow for the additional capabilities of SURFACT, these changes were undertaken through manual editing of the model files.

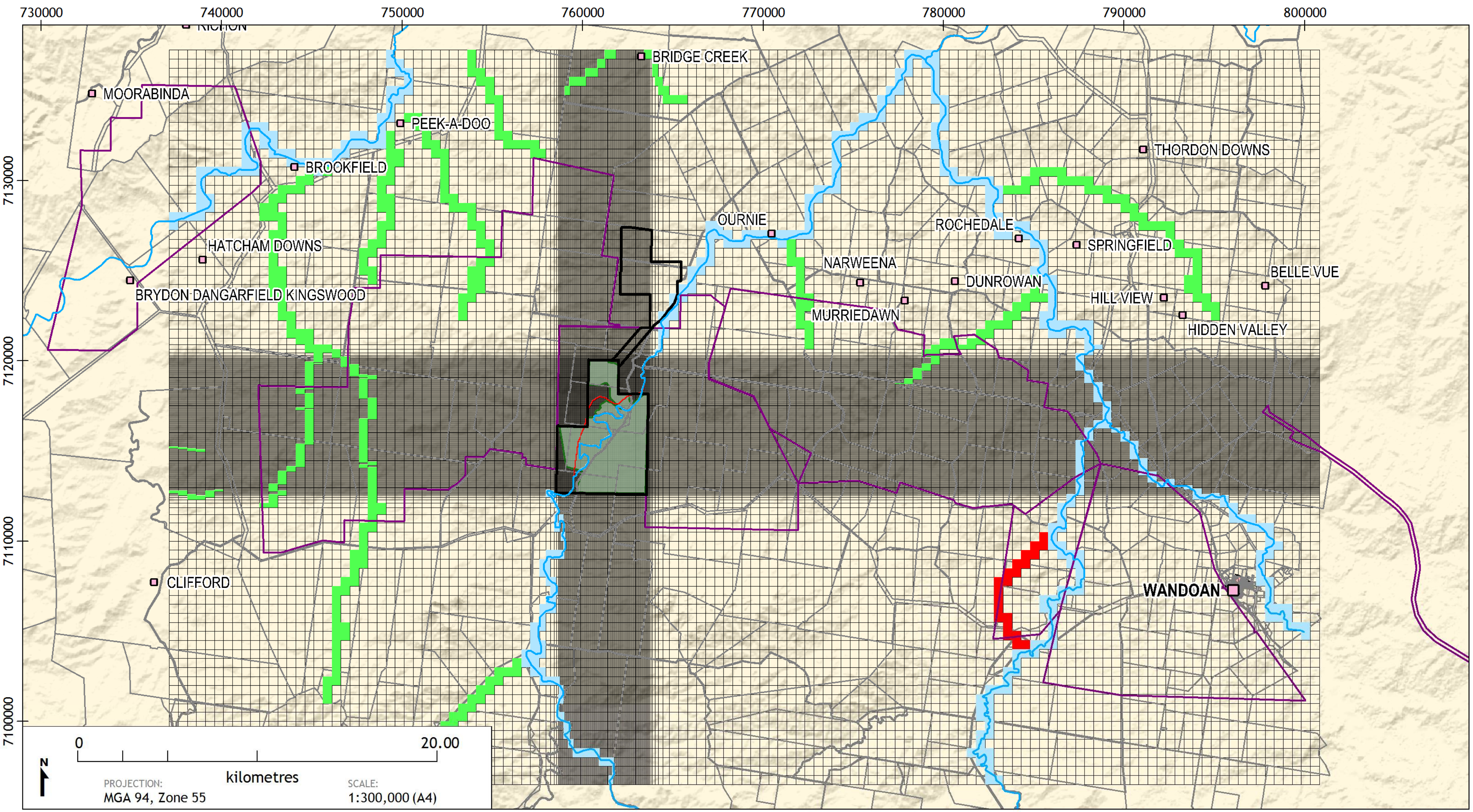
14.2.2 Model Grid

The model domain is 63.7km along the east-west border and 40.7km along the north-south border, extending over an area of 2,595.775 km^2. The north-west corner of the grid is located at 737,100 mE and 7,137,250 mN (MGA94 Z55).

The model area covers the Project area and extends eastwards to cover the proposed Wandoan open cut mine. A relatively large model was constructed to include the proposed Wandoan Mine and make it possible to model the cumulative influence of both Projects.

In the horizontal plane, a rectangular grid of 225 rows and 225 columns covered the area of interest (refer Figure 18). The physical orientation of the grid is north-south. The grid cell size is variable (Table 7), smaller cells cover the mining lease in order to facilitate better head and drawdown calculations in the area of interest, areas further away are covered by larger cells. The maximum size of the cells is 500×500m, the size of the grid cells covering the mining lease is 50 × 50m.

In order to prevent the numerical convergence instabilities, the grid construction followed two basic rules: (1) the step-up ratio of the dimensions of any two adjacent cells will not exceed a factor of 1.5, and (2) the ratio of the minimum to the maximum dimension of the grid row or column should not exceed 1:10. The *telescopic* grid minimises the total number of model cells while enabling the use of smaller cells in the area of interest within the mining area.



LEGEND:

- Project Leases
- Mining Lease Application
- Mine Outline
- Model Grid
- 1st Order Stream
- 2nd Order Stream
- Diverted Stream
- Homestead
- Cadastre
- Major Creek

Elimatta Project
Groundwater Assessment (G1438A)

Model Grid and Model Watercourses

DATE:
24/10/2012

FIGURE No:
18

Table 7: NUMERICAL MODEL GRID							
Columns				Rows			
Easting	Column Width	Column Count	Block Distance	Northing	Row Width	Row Count	Block Distance
737100	500	41	20500	7137250	500	32	16000
757600	360	1	1100	7121250	360	1	1100
757960	260	1		7120890	260	1	
758220	185	1		7120630	185	1	
758405	130	1		7120445	130	1	
758535	95	1		7120315	95	1	
758630	70	1		7120220	70	1	
758700	50	100	5000	7120150	50	151	7550
763700				7112600			
763770	70	1	1100	7112530	70	1	1100
763865	95	1		7112435	95	1	
763995	130	1		7112305	130	1	
764180	185	1		7112120	185	1	
764440	260	1		7111860	260	1	
764800	360	1		7111500	360	1	
800800	500	72	36000	7096500	500	30	15000
∑		225	63700	∑		225	40750

14.2.3 Model Layers

Publicly available digital elevation data (STRM data) with a 90m x 90m grid spacing was used to represent the ground surface of the wider model area. The SRTM dataset was complemented by higher resolution elevation data covering the Elimatta Mine and immediate vicinity provided by NEC.

The surfaces of individual coal seams and plys have been mapped in detail within EPC 650 as part of the feasibility studies for the Project. Outside EPC 650, the data is much less detailed. NEC geologists interpolated the coal seam surfaces outside the EPC 650 to provide input to the groundwater model. Due to the large number of coal seam plys, and the need to represent this data in the groundwater model, it was decided to merge all the individual plys into four logical groups or "super seams" with the seam thickness combined for each. For each seam group, the combined thickness was represented at the base of the seam group. Table 6 shows the coal seam groups represented in each model layer. Figure 19and Figure 20show the layering represented in the groundwater model.

Table 8: NUMERICAL MODEL LAYERS		
	Model Layer	Layer Thickness
1	UG Overburden	*variable*
2	UG Seam	~ 1.5m
3	Y Interburden	~ 9.5m
4	Y Seam	~ 1.5m
5	A Interburden	~ 7.0m

Table 8: NUMERICAL MODEL LAYERS		
	Model Layer	Layer Thickness
6	A Seam	~ 2.4m
7	B Interburden	~ 8.0m
8	B Seam	~ 2.5m
9	C Overburden	~ 26.9m
10	C Seam	~ 1.6m
11	Wambo + Nangram	~ 115.0m
12	Iona	~ 170.0m

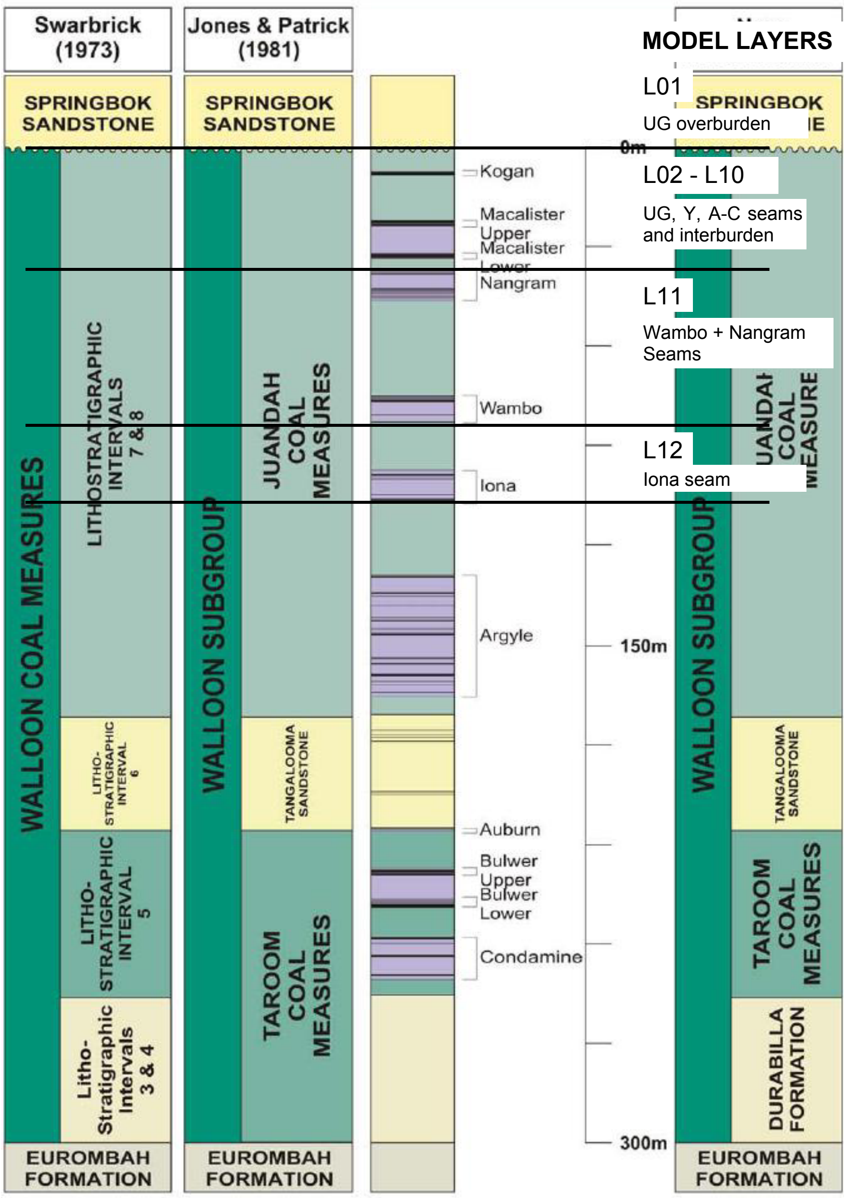


Figure 19: Model Layering of Groundwater Model

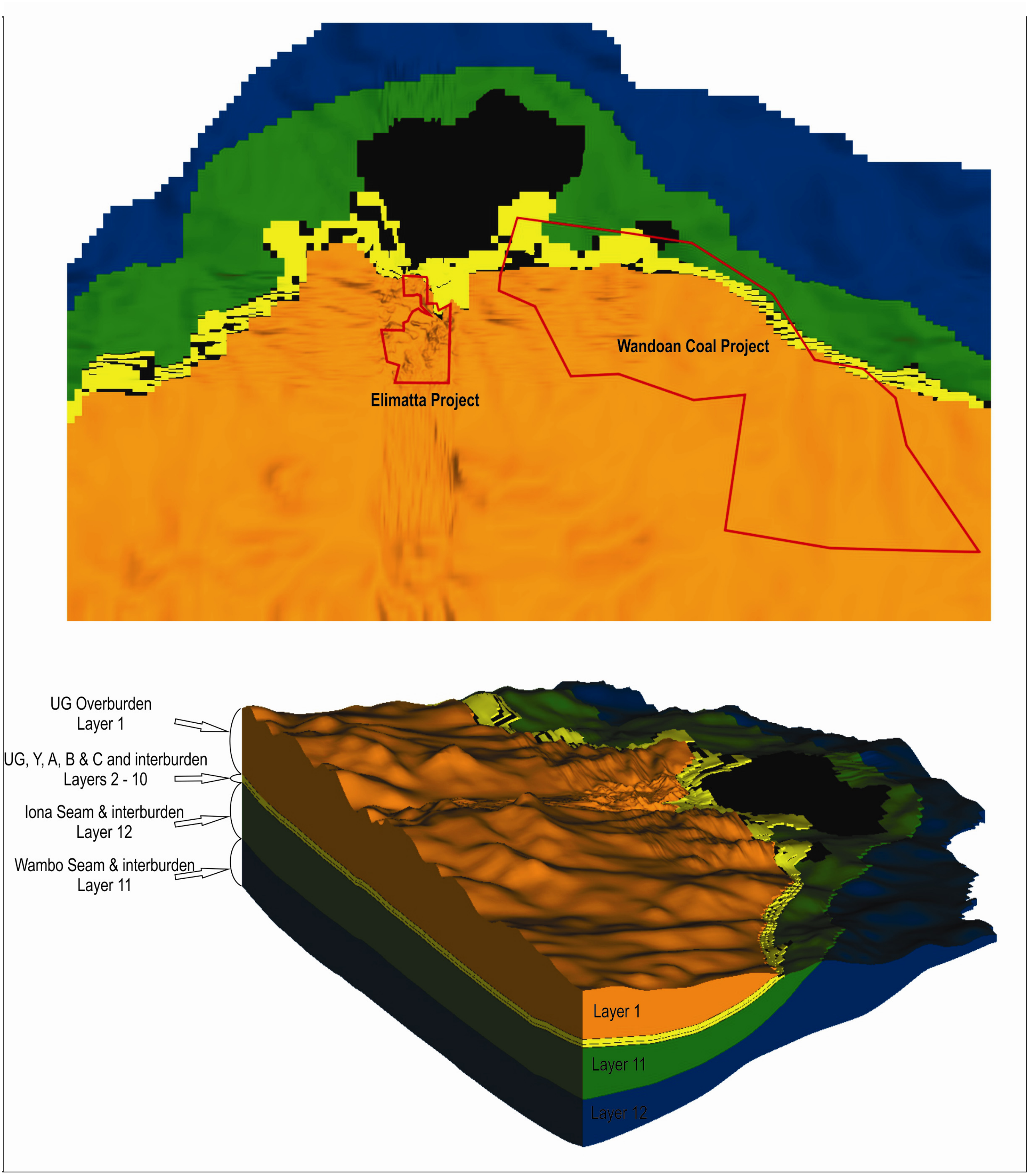


Figure 20: Groundwater Model – Plan and 3D views

14.2.4 Boundary Conditions

The model simulates the water entering or leaving the model domain through the actions of boundary conditions. The specific boundary flows and represented in the model are discussed below.

No Flow Boundaries
A "no flow" boundary does not allow any exchange of water between the model domain and the surrounding areas. The number of active cells is variable for every layer (see Table 7), because inactive cells which act as no-flow boundary conditions are used to represent outcropping geological layers.

Discharge
The model simulated groundwater discharge to the major surface drainages using the SURFACT "River" package. The bed levels of the creeks were estimated by subtracting between 5m and 10m from the topographic surface. The river heads were set to the river bed levels so that the resulting flux was only out of the model and did not allow leakage from the stream into the aquifer. River diversions proposed for both Elimatta and Wandoan Mines were introduced into the model at the beginning of simulated mining activities. Table 9 summaries the set-up of the river cells.

Table 9: RIVER CELLS

River Cell Type	River Bed Depth (below topographic surface) [m]	Water Depth [m]	Thickness of River Bed [m]	Vertical Conductivity of River Bed [m/d]
1st order cells (blue)	10	0	0.5	1.6
2nd order cells (green)	5	0	0.5	1.0
diverted streams (red)	5	0	0.5	0.1

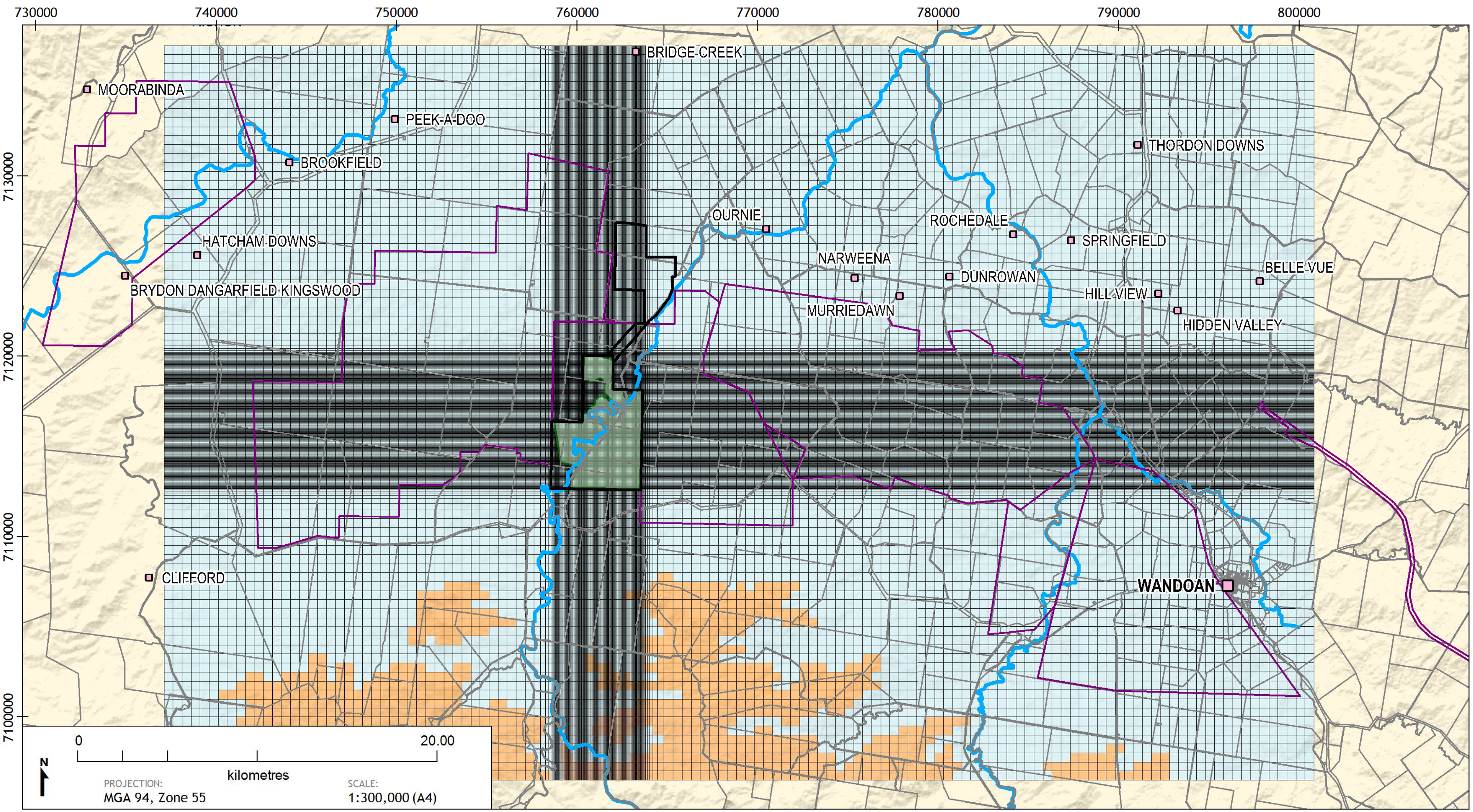
Figure 18 shows the cells with river cells.

Recharge
The model distributed recharge across Layer 1 according to geology. Two distinct recharge zones were specified representing the Walloon Coal Measures (zone 0) and the Gubberamunda Sandstone outcrop area (zone 1). The percentage of incident rainfall that infiltrates as deep-drainage was calibrated for each recharge zone using a long-term average annual rainfall of 653.8mm/year. Table 10 summarises the calibrated rates of recharge for each zone.

Table 10: CALIBRATED RECHARGE RATES

Recharge Zone	Surface Geological Unit	Calibrated Recharge Factor (%)	Calibrated Recharge Rate (mm/yr)
Zone 0	Walloon Coal Measures	2.00×10^{-3}	0.00131
Zone 1	Gubberamunda Sandstone	0.165	1.08116

Figure 21 shows the rainfall recharge zones.



LEGEND:

- Project Leases
- Mining Lease Application
- Mine Outline
- Cadastre
- Homestead
- Major Creeks
- Model Grid

Recharge Zones

- Zone 0
- Zone 1

Elimatta Project
Groundwater Assessment (G1438A)

Model Grid and Recharge Zones

DATE:
24/10/2012

FIGURE No:
21

14.2.5 Hydraulic Parameters

Table 11 shows the calibrated hydraulic parameter values.

Table 11: HYDRAULIC PARAMETERS

Layer	Sequence	Hydraulic Conductivity K_h (m/day)	Vertical Hydraulic Conductivity K_v (m/day)	Specific Yield (Sy)	Specific Storage (Ss)
1	Overburden	4.926×10^{-3}	1.626×10^{-4}	5×10^{-2}	5×10^{-4}
	Gubberamunda Ssn	4.508×10^{-4}	8.285×10^{-6}	5×10^{-2}	5×10^{-4}
2	UG Seam	3.762×10^{-2}	2.018×10^{-3}	5×10^{-2}	5×10^{-4}
3	Y interburden	1.516×10^{-3}	8.168×10^{-5}	5×10^{-2}	5×10^{-4}
4	Y Seam	3.762×10^{-2}	5.617×10^{-4}	5×10^{-2}	5×10^{-4}
5	A interburden	1.516×10^{-3}	1.347×10^{-4}	5×10^{-2}	5×10^{-4}
6	A Seam	3.762×10^{-2}	3.634×10^{-3}	5×10^{-2}	5×10^{-4}
7	B interburden	1.516×10^{-3}	9.761×10^{-5}	5×10^{-2}	5×10^{-4}
8	B Seam	3.762×10^{-2}	3.634×10^{-3}	5×10^{-2}	5×10^{-4}
9	C interburden	1.516×10^{-3}	1.402×10^{-4}	5×10^{-2}	5×10^{-4}
10	C Seam	3.762×10^{-2}	3.587×10^{-3}	5×10^{-2}	5×10^{-4}
11	Wambo + Nangram	2.011×10^{-3}	1.918×10^{-4}	5×10^{-2}	5×10^{-4}
12	Iona	1.010×10^{-2}	9.635×10^{-4}	5×10^{-2}	5×10^{-4}
--	spoil	5.000×10^{-1}	1.000×10^{-1}	1×10^{-2}	1×10^{-2}
--	Tailings	1.000×10^{-6}	1.000×10^{-6}	1×10^{-4}	1×10^{-4}

14.2.6 Calibration Targets

The targets for the steady state calibration of the model were baseline steady state groundwater levels. Water levels data from the Elimatta monitoring bores and DERM water bore database were used to estimate steady state water levels. The target heads in the monitoring bores were applied in all model layers.

14.2.7 Calibration Results

During calibration, the recharge rate varied until the best match between predicted and field measured water levels occurred. A summary of the bores used in the calibration process, the measured and model predicted water levels, and the difference between levels is presented in Appendix 2. Figure 22 compares the observed and simulated groundwater levels in the model area.

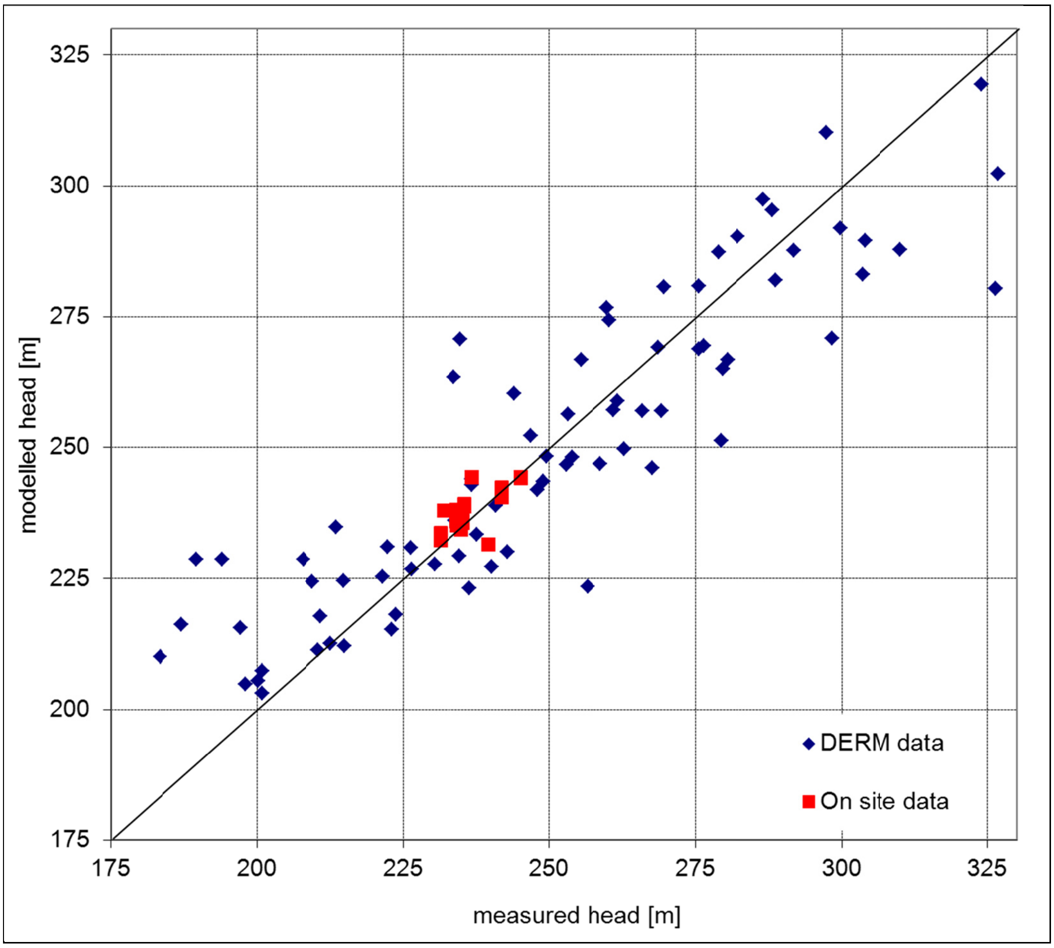


Figure 22: Scatter Diagram: Modelled versus Observed Groundwater Levels

Figure 22 indicates that visually the model achieved a good correlation between observed and simulated heads. An objective method to evaluate the calibration of the model is to examine the statistical parameters associated with the calibration. One such method is by measurement of the residual between the modelled and observed (measured) water levels. A root mean square (RMS) expressed as:

$$RMS = \left[1 / n \sum (h_o - h_m)_i^2\right]^{0.5}$$

where:	n	=	number of measurements
	h_o	=	observed water level
	h_m	=	simulated water level

is considered to be the best measure of error, if measurements and errors are normally distributed. However, the observation data is not normally distributed and results in a RMS error of 10.9. The scaled RMS was calculated in order to account for the high degree of spread within the data; the scaled RMS for the modelled and observed water levels was 7.6%. Scaled RMS was calculated by dividing the RMS by the range of observed values, as shown below:

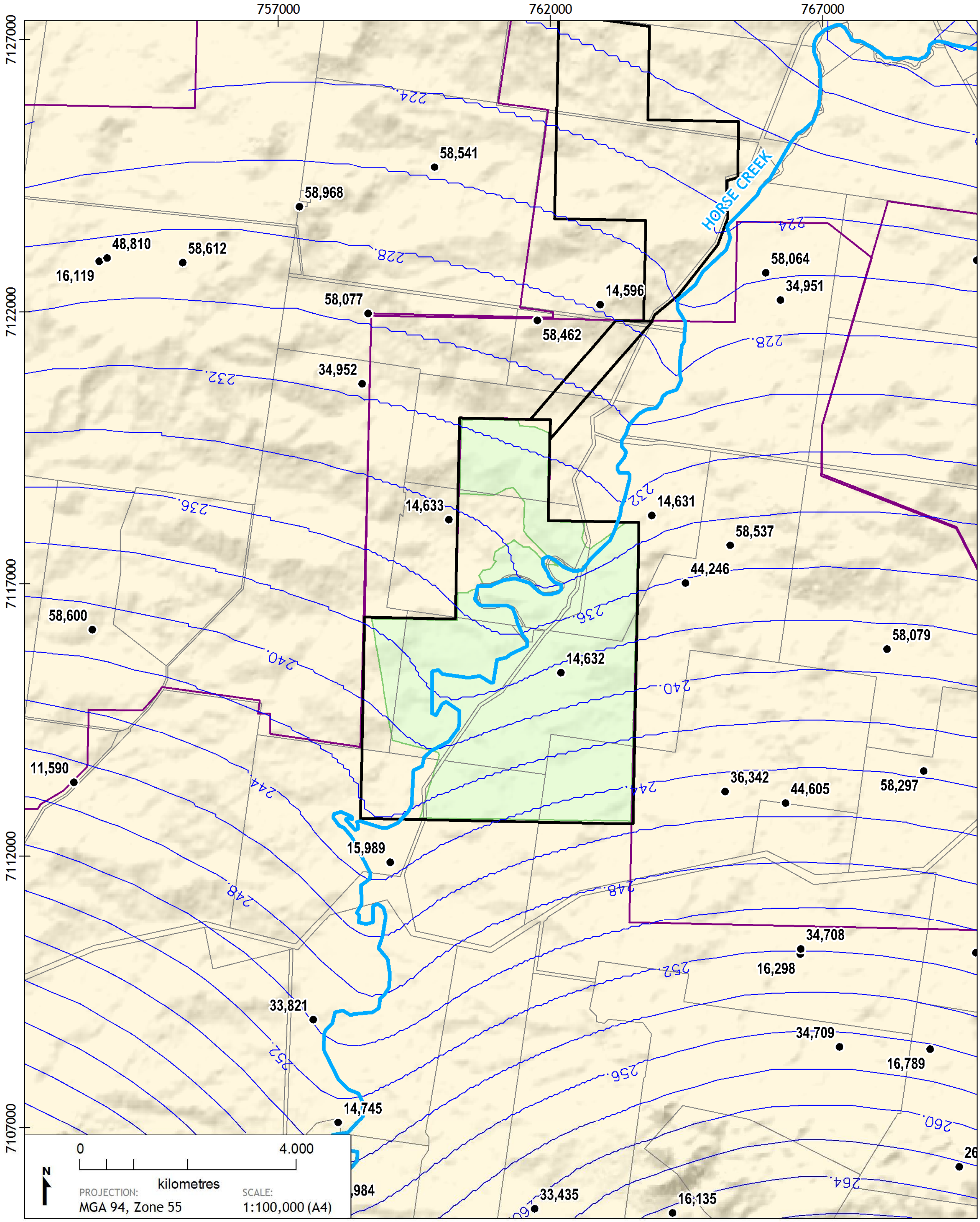
$$RMS_{scaled} = \left[RMS / (\max h_o - \min h_o)\right]\left[\frac{1}{100}\right]$$

The largest contributor to the model RMS is the DERM registered bores as shown in the scatterplot. These bores were included to provide calibration targets at the extents of the model outside the mining areas; however, the data from these bores may be less reliable as:

- the data covered a long time span;
- the majority available groundwater levels recorded for these bores were taken during drilling and/or development and may not be representative water levels;
- ground elevations had to be estimated from regional elevation data to calculate the groundwater level elevations; and
- it is uncertain how the bores were constructed and the aquifers that are being measured.

The majority of the Project monitoring bores are being monitored routinely, and have been surveyed to AHD so a better estimate of the steady state water level could be obtained.

Figure 23 shows the steady-state groundwater levels for the coal seam in Layer 10.



LEGEND:

- Registered Bore
- Groundwater Level Contour (m)
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creek

Elimatta Project
Groundwater Assessment (G1438A)

Groundwater Level Steady State
Layer 10 - Elimatta only

AGE GROUNDWATER & ENVIRONMENTAL

DATE: 24/10/2012

FIGURE No: **23**

14 PREDICTIVE SIMULATIONS AND IMPACTS

15.1 Approach

The steady state model was converted to transient flow conditions to predict:

- the zone of depressurization in the aquifers induced by dewatering of the coal seams; and
- the magnitude of the groundwater seepage to the open cut and underground mines.

SURFACT does not allow for changing of the hydraulic parameters with time, which is necessary to represent the development of the spoil backfill during the mining progress. To represent these changes in hydraulic properties, the model was run in time stages of one year, and the hydraulic parameters at the start of each run adjusted to reflect the progress of spoil backfill and/or deposition of tailings. The final water level conditions from the previous time stage run were the initial conditions for the subsequent run. The first time stage run commenced with the groundwater levels from the steady-state calibrated model to represent pre-mining groundwater levels.

The model represented the development of the spoil piles by changing the horizontal and vertical hydraulic conductivity and specific storage/specific yield in all model layers from the coal seam to the surface.

As rainfall and evaporation cannot be forecast accurately for any period of time, long-term average annual precipitation and evaporation rates have been converted to daily rates and applied as constant fluxes throughout the predictive simulations.

Recharge was applied to the newly developed spoil areas at 10% of the average annual rainfall and reflects the increased coarse fraction of sediments expected to occur in the spoil dumps.

SURFACT simulated mine dewatering with the drain (DRN) package. This requires the setting of a drain level and a conductance term. Groundwater levels in the model are compared to the reference elevation in each cell and when the groundwater level is above the reference level water is removed from the model domain at a rate determined by the head difference and the conductance. The drain cells for the open cut mining were set at the floor level of the B Seam in the Southern Pits (floor of Layer 8) and the C Seam in the Northern Pit (floor of Layer 10). A drain conductance rate of 100m^2/day is used to facilitate free drainage conditions from the strata and ensure the groundwater level was lowered to the reference level, hence dewatering the seam.

The mine advancement was based on an annual mine sequence plan provided by NEC.

Within each year, the area mined is assigned as a drain cell until mining is completed when the cell adopts hydraulic parameters for spoil material. This means that in the open-cut pits, the drain cells remain in place for the duration of one year before adopting spoil parameters.

The model ran for a period of 34 years and included the proposed mining at the adjacent Wandoan Project. The 34-year time span was subdivided into 34 stress periods. At the end of each stress period, the model was stopped and the last predicted groundwater levels for the simulation were used as starting points for the next simulation stage. At this point in time changes in formation hydraulic parameters resulting from the extraction of overburden and placement of spoil were applied. These changes can only occur during the change between one stage and the next, that is, at every year of simulation.

A FORTRAN computer program was written to undertake the “stop-start” nature of the staged simulation. This program defines the active cell drains on an annual basis and applies pre-defined rules for the changes in aquifer parameters and finally the generation and simulation of the various staged runs.

Groundwater recovery was simulated post mining for a period of 750 years after the mining was completed.

15.2 Simulation of Final Void Spaces

Inclusion of final void spaces in the recovery phase of the model predictions was achieved by adjusting hydraulic parameters for model cells lying in the designed void areas to simulate the open space. To achieve this, the following adjustments were made to simulate open space conditions:

- Horizontal and vertical hydraulic conductivities were set at 1,000m/day in the appropriate cells;
- Specific yield and storage coefficients were set to 1 in these cells;
- Recharge to these cells was increased to reflect direct capture of incident rainfall and include a volume likely to runoff from the local terrain; and
- Evaporation from the void was simulated using the MODFLOW-SURFACT evapotranspiration package and adopting an acceptable factor of pan-evaporation and an evaporation surface set to the elevation of the void surface.

These adjustments were made whilst the cells were completely unsaturated.

The cumulative impacts of the Wandoan Mine were assessed by running two scenarios, the first with the both Elimatta and Wandoan mining, and the second with only Elimatta.

15.3 Inflow to Mined Areas

SURFACT predicts groundwater heads and cell by cell flows and reports these for each specified model output time, in this case on a three monthly basis. One of the key flows reported in the model budget is the amount of water removed from the model domain through the drain boundary condition. This boundary condition represents the dewatering of the coal seams and overlaying aquifers in the model, and predicts the inflows to the open cut and underground mining areas.

Figure 24 presents the predicted inflow to the Project from all aquifer sources intersected in the proposed open-cut and underground mines.

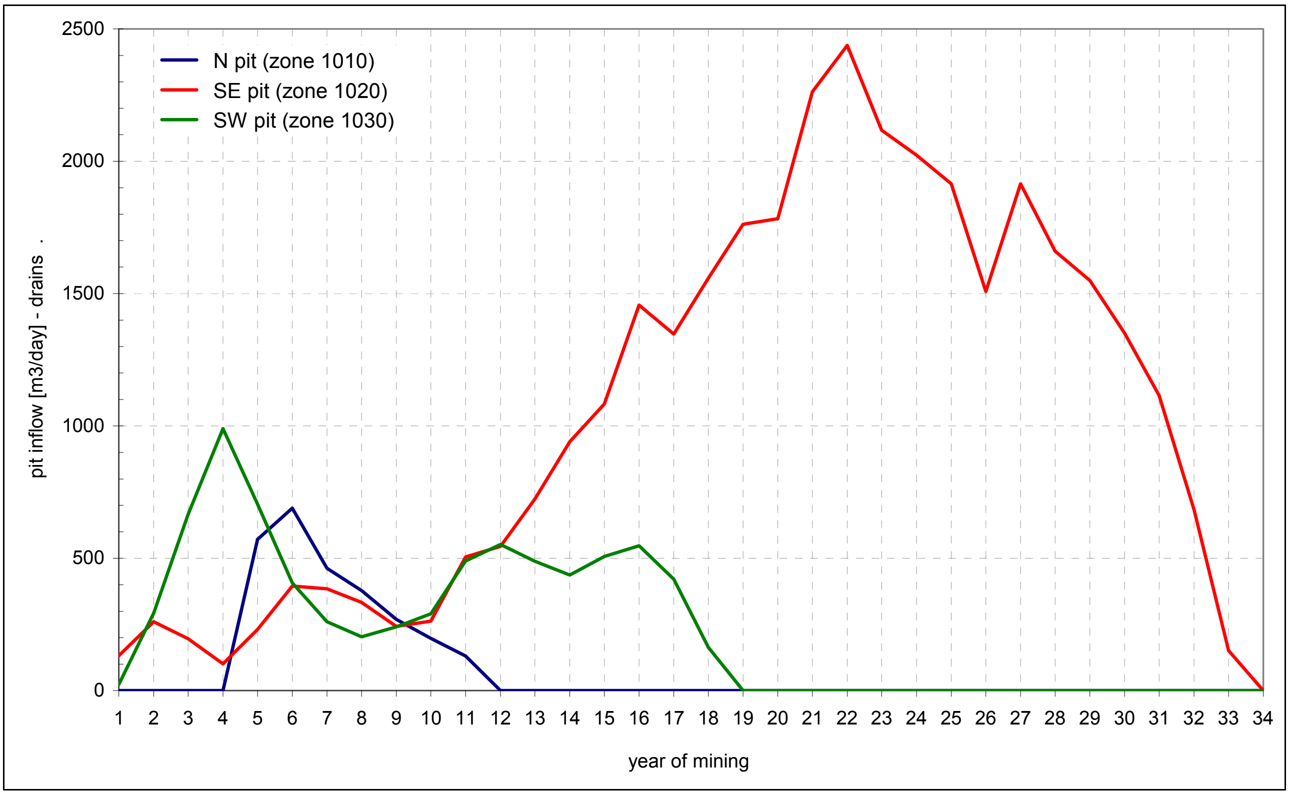


Figure 24: Predicted Inflow from Coal Seams

Groundwater inflow to the mining operations will occur directly from the mined coal seams. Simulated volumes are generally less than 1ML/day for the smaller northern and western pits. The model simulated higher inflows up to 2.5ML/day for the much larger south-eastern open cut. The actual volume of water pumped from the mine may be less than the volumes predicted by the model because:

- the model simulates a continuous aquifer system and does not include the minor faults and variability in hydraulic conductivity in the area – the impact of these features would be to lower the simulated seepage rate;
- the expected lag time required for spoil emplacements to wet up and allow rainfall recharge to migrate through into the pit was not simulated which means seepage from the spoil may be over predicted; and
- the aggregation of the numerous coal seams into four seams at the base of a layer within the groundwater model increased the thickness of coal within the saturated zone, and the hydraulic gradient between the open pit and the aquifers, which is expected to have the effect of increasing the simulated seepage rates.

Figure 25 shows the inflow rate corrected for evaporation losses.

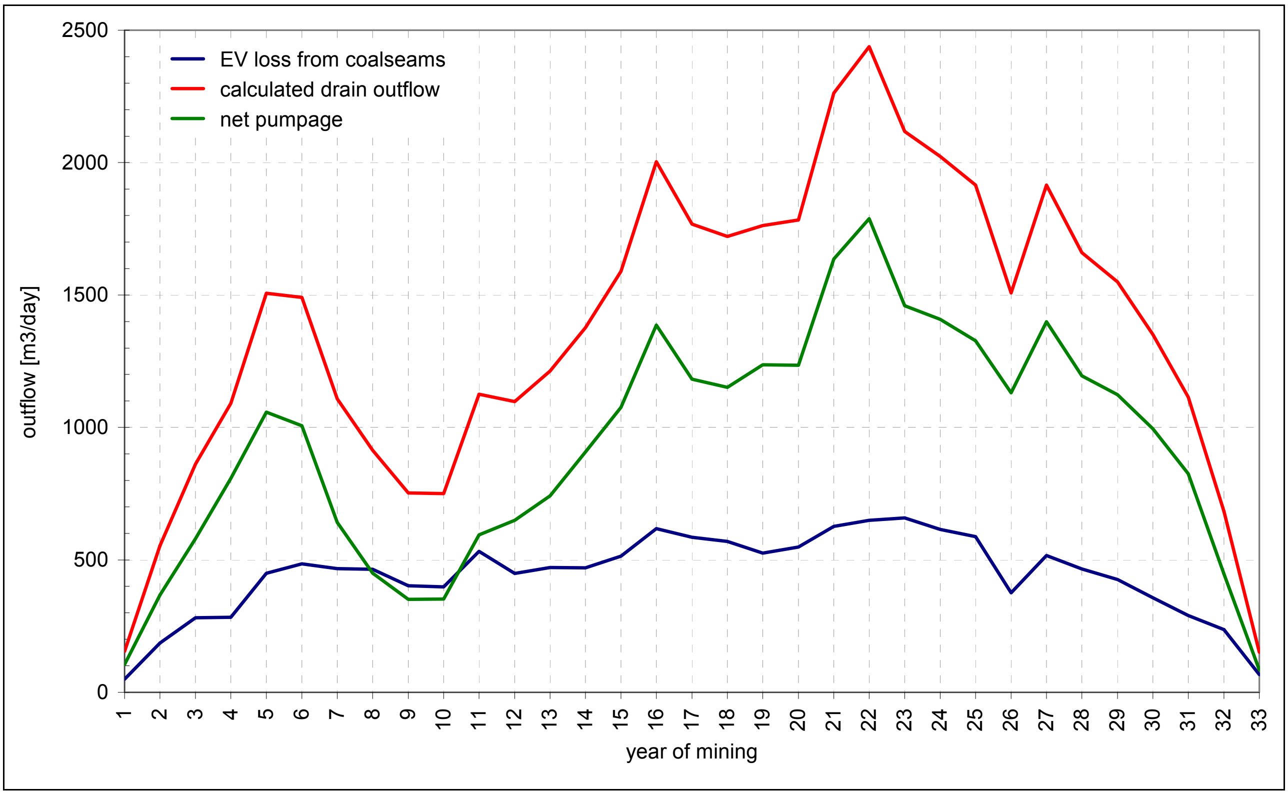


Figure 25: Simulated Pit Inflows Corrected for Evaporation Losses

15.4 Drawdown in Groundwater Levels

Figure 26 presents the groundwater levels in Layer 10 at the end of mining, and shows the zone of depressurisation around open cut pits.

Two model scenarios were run to assess the cumulative impact of the adjacent Wandoan Project mining at the same time as the Elimatta Project. The first scenario was run with the Elimatta Project only mining. The second scenario included both the Elimatta and Wandoan Projects mining simultaneously. The results are shown in:

- Figure 27 shows the drawdown in the C Seam (Layer 10) for Elimatta only;
- Figure 28 shows the drawdown in Layer 12, which represents the coal measures underlying the floor of the pit for Elimatta only;
- Figure 29 shows the drawdown in the C Seam (Layer 10) for Elimatta and Wandoan;

Figure 27 shows the zone of depressurisation generally extends less than 1km from the edge of the open cut pit in the coal seam layer. The exception is along the alignment and down-stream of Horse Creek where depressurisation is slightly more extensive.

Figure 28 shows there is essentially no detectable drawdown in the coal measures underlying the pit floor.

Figure 29 shows the cumulative impact of mining at Elimatta and Wandoan. The modelling indicates the zone of depressurisation generated by the mining projects do not interact after 34 yours of mining. Therefore, there is no cumulative impact at this stage.

- Figure 30 shows the drawdown in the C Seam (Layer 10), 750 years post mining for mining at Elimatta only;
- Figure 31 shows the drawdown in Layer 12, 750 years post mining for mining at Elimatta only;
- Figure 32 shows the drawdown in the C Seam (Layer 10) 750 years post mining for mining at both Elimatta and Wandoan.

Figures 30 and 31 indicate that the zone of depressurisation continues to expand post mining as groundwater flows back into and refills the pits and spoil. The continued growth of the zone of depressurisation is also related to the very low rainfall recharge rate calibrated for the coal measures that means the volume of water entering the groundwater regime is very low. The zone of depressurisation also develops further in the coal measures underlying the pit to a similar magnitude to that in overlying layers.

Figure 32 shows the zones of depressurisation generated by both the Elimatta and Wandoan Projects join up and create a narrow zone to the north-east where a cumulative impact is evident post mining.

It is important to note the model simulates a continuous aquifer system and does not include the minor faults and variability in hydraulic conductivity in the area. The impact of these features would be to reduce the zone of depressurisation simulated by the model.

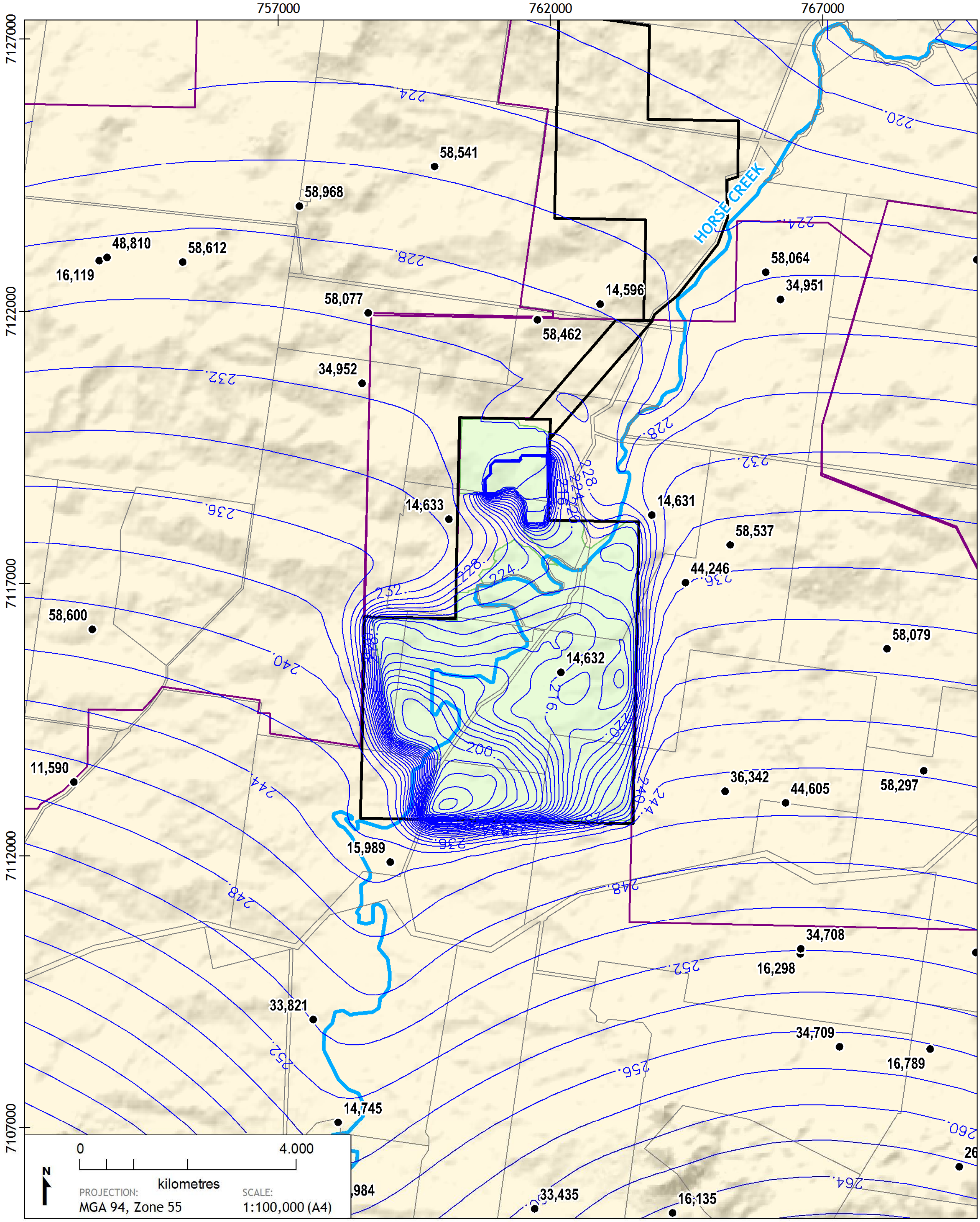
During the mining phase of the Project, there is only two known registered bores within the zone of depressurisation. Bore RN14632 will be removed by mining. Bore RN14631 is predicted to record a reduction of about 4m in the groundwater level at the end of mining.

Post mining, up to 10 registered bores are predicted to record a decline in groundwater levels due to the continued growth of the zone of depressurisation in the model. However as noted previously, the zone of depressurisation is unlikely to expand to the extent predicted by the model due to the presence of minor faults and variability in the coal seam hydraulic conductivity.

15.5 Void Recovery

The model simulated recovery of the groundwater system for 750 years post mining. The simulation utilised the predicted groundwater levels and aquifer hydraulic properties at the end of the mining period. The drain cells used to simulate dewatering from the coal seam and overburden were removed, allowing the groundwater levels in the seam and the overlying aquifers to recover. The model also replicated the geometry of the final voids to simulate the recovery of groundwater levels over time, and the formation of the void lakes.

Figure 33 to Figure 35 shows the model predicted water levels in the lakes that will form in voids remaining post mining.



LEGEND:

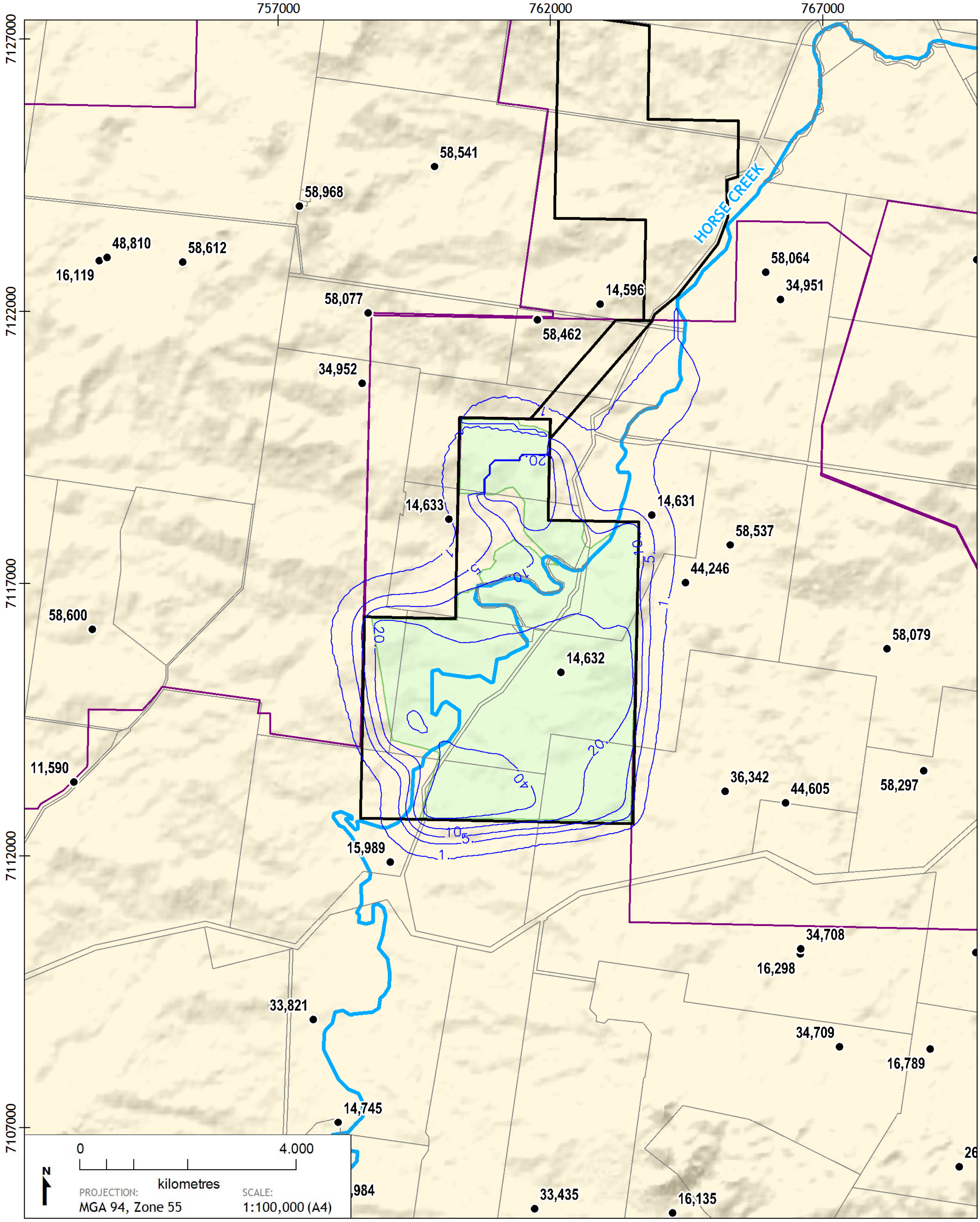
- Registered Bore
- Groundwater Level Contour (m)
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

Elimatta Project
Groundwater Assessment (G1438A)

Groundwater Level End Of Mining
Layer 10 - Elimatta only

DATE: 24/10/2012

FIGURE No: **26**



LEGEND:

- Registered Bore
- Drawdown Contour (m)
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

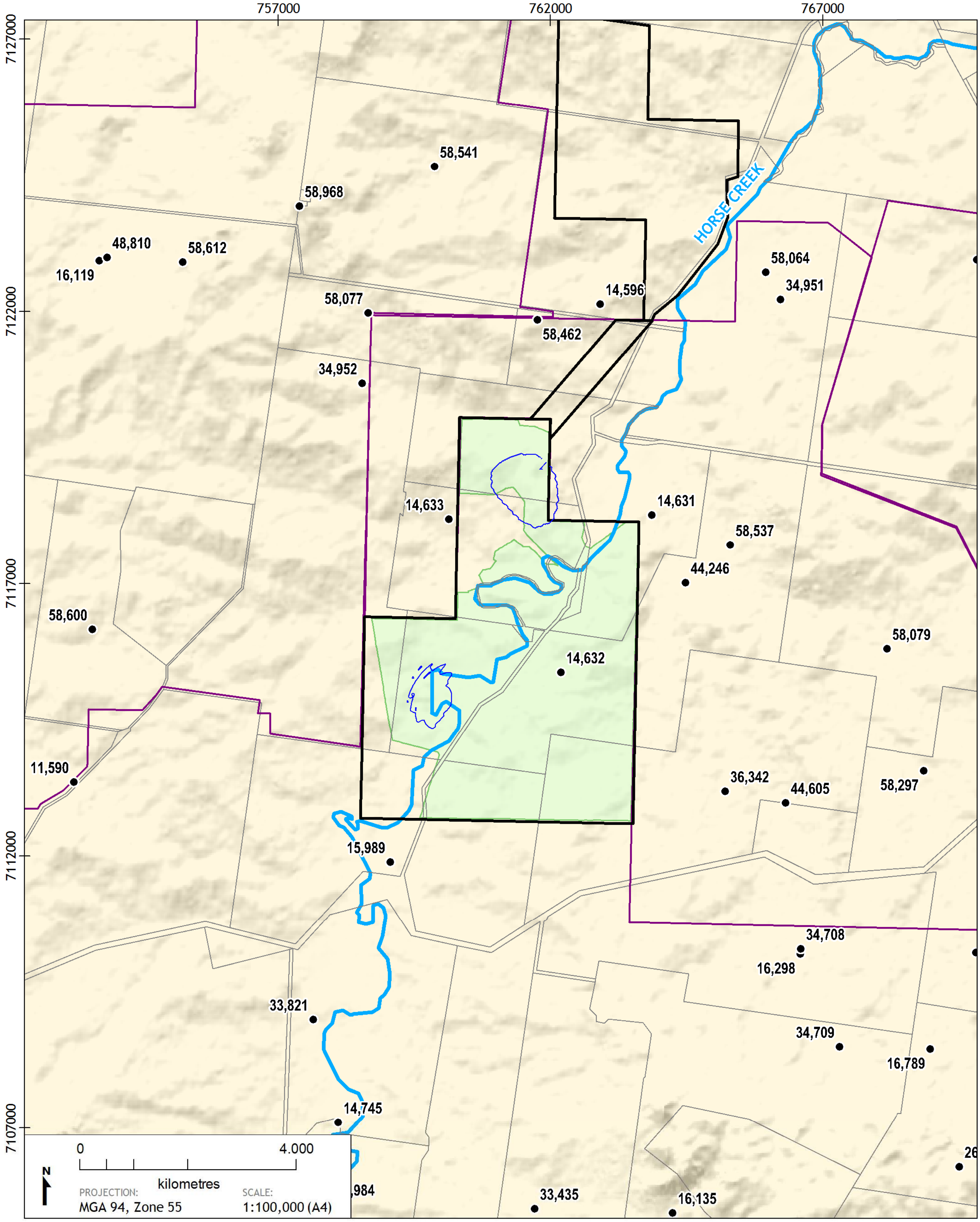
Elimatta Project
Groundwater Assessment (G1438A)

Drawdown End Of Mining Layer 10 - Elimatta only

AGE GROUNDWATER & ENVIRONMENTAL

DATE: 24/10/2012

FIGURE No: 27



LEGEND:

- Registered Bore
- Drawdown Contour (m)
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

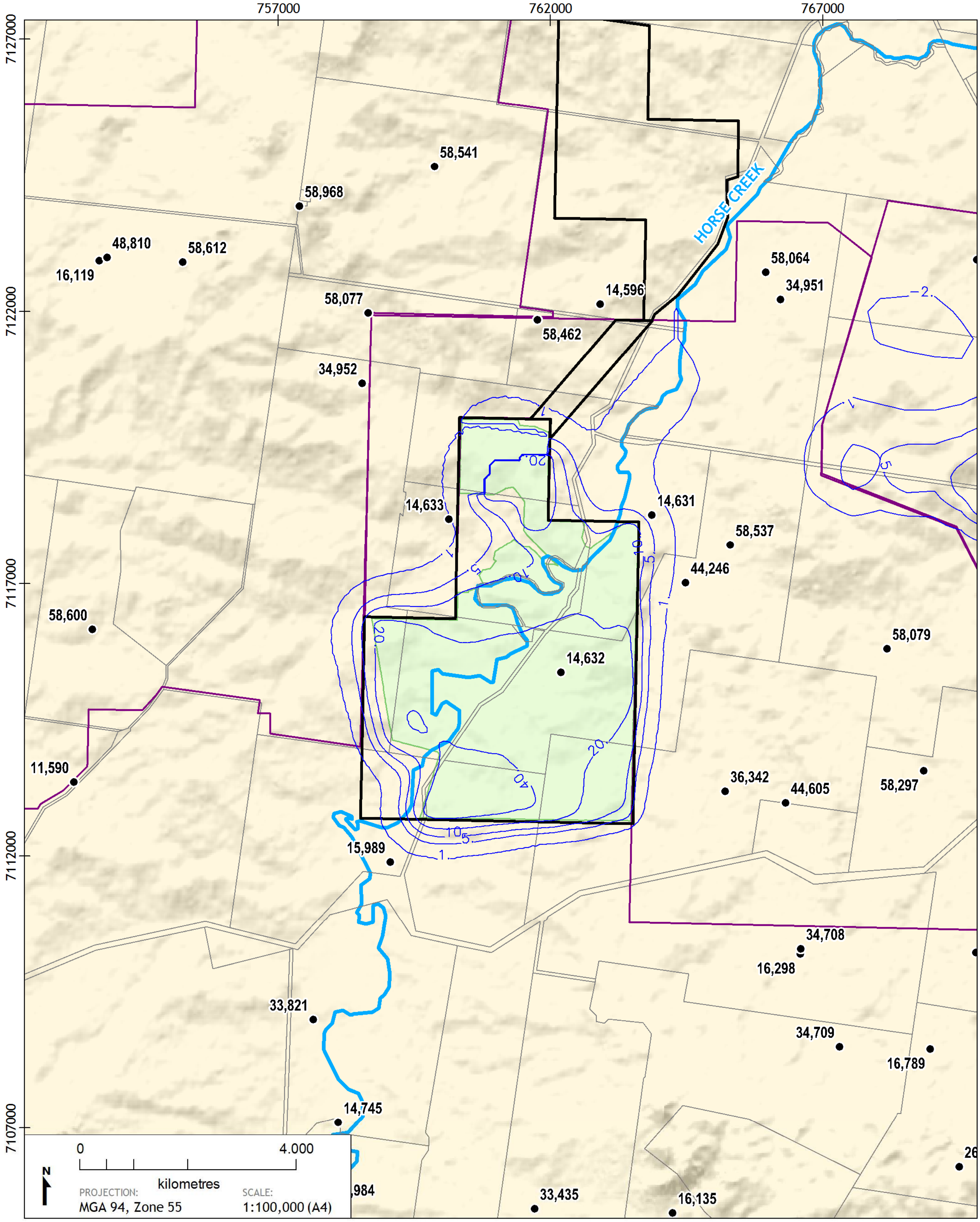
Elimatta Project
Groundwater Assessment (G1438A)

Drawdown End Of Mining
Layer 12 - Elimatta only

AGE GROUNDWATER & ENVIRONMENTAL

DATE: 24/10/2012

FIGURE No: **28**



LEGEND:

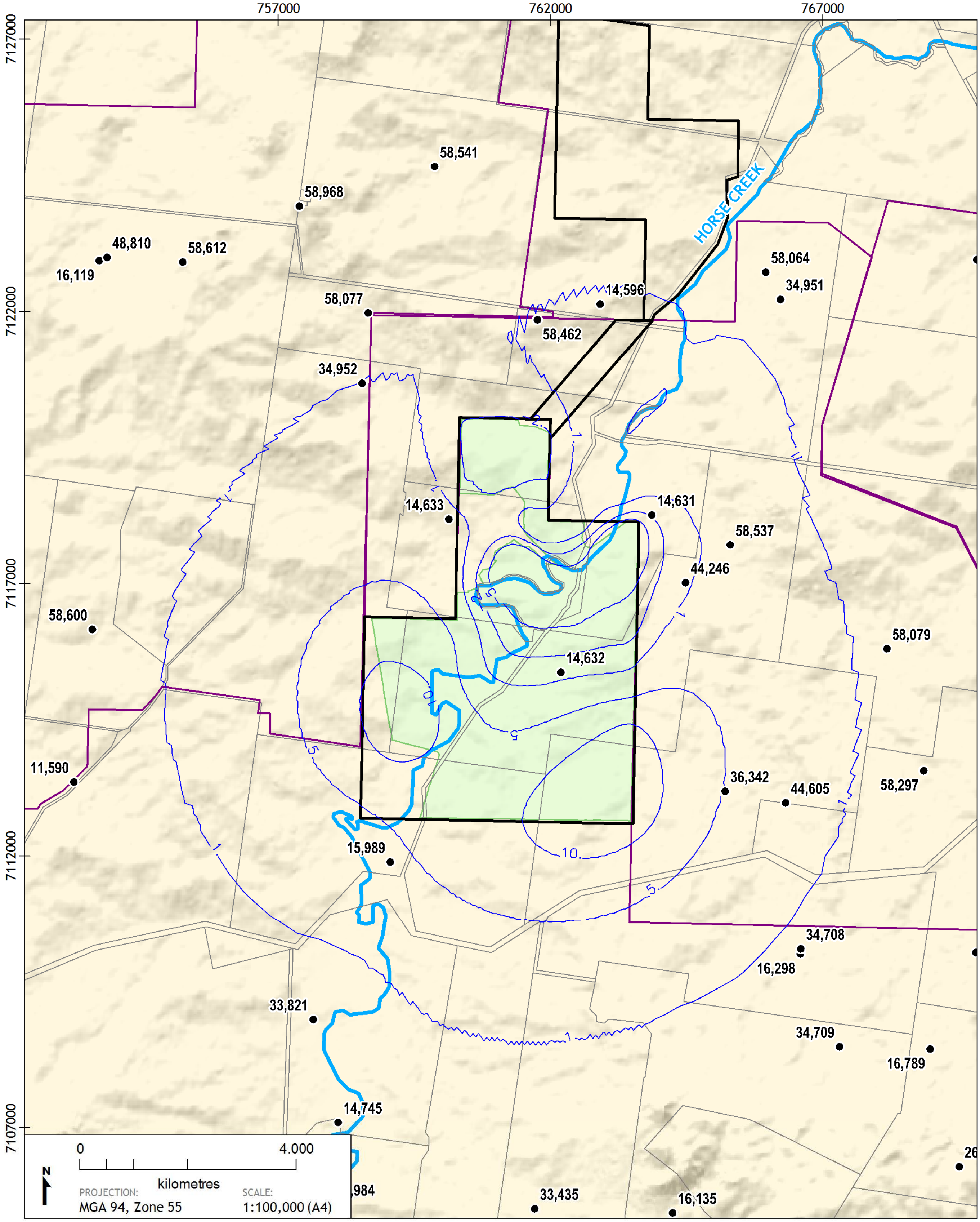
- Registered Bore
- Drawdown Contour (m)
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

Elimatta Project
Groundwater Assessment (G1438A)

Drawdown End Of Mining
Layer 10 - Elimatta + Wandoan

DATE: 24/10/2012

FIGURE No: 29



LEGEND:

- Registered Bore
- Drawdown Contour (m)
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

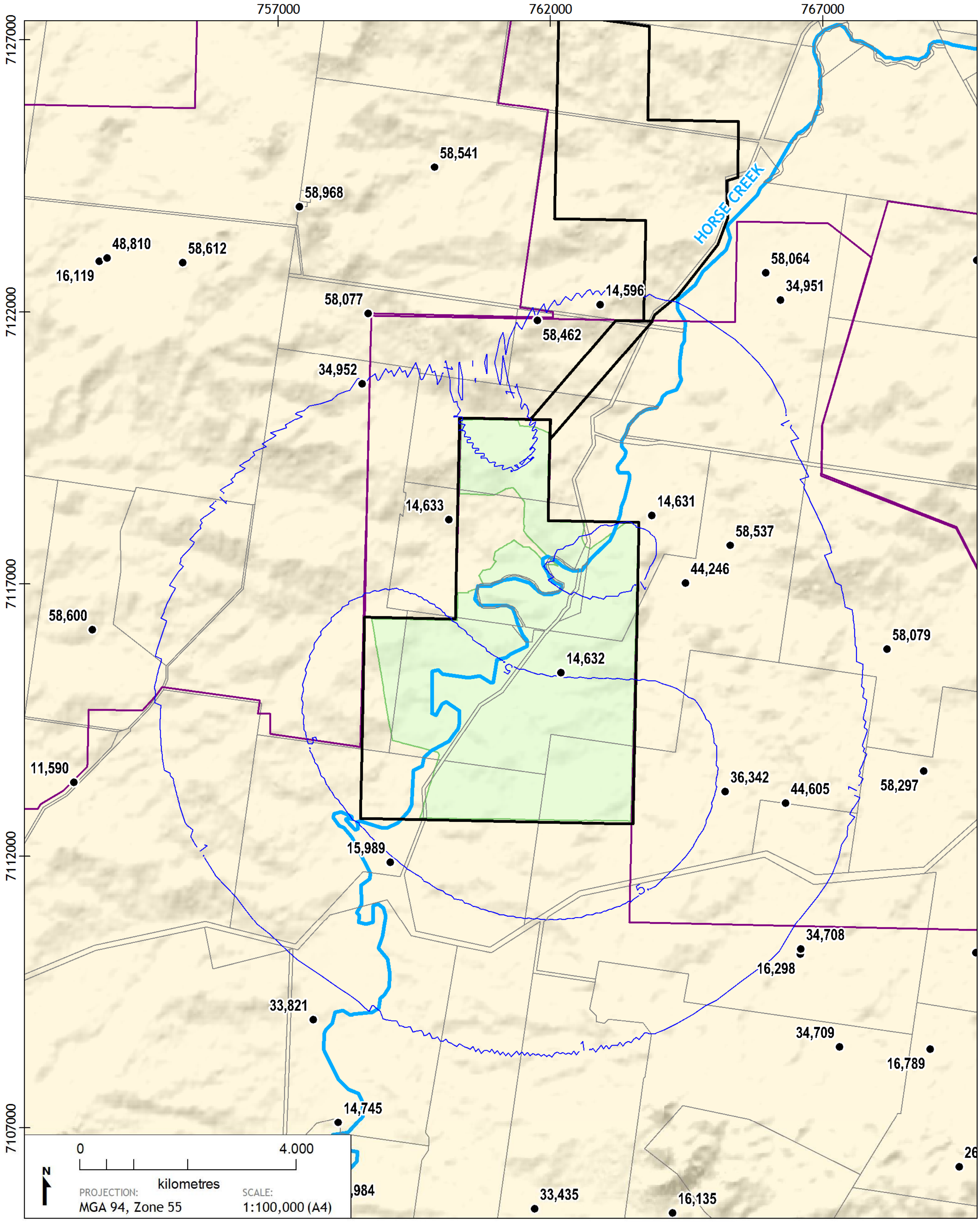
Elimatta Project
Groundwater Assessment (G1438A)

Drawdown End Of Recovery
Layer 10 - Elimatta only

AGE
GROUNDWATER & ENVIRONMENTAL

DATE:
24/10/2012

FIGURE No:
30



LEGEND:

- Registered Bore
- Drawdown Contour (m)
- Cadastre
- Major Creeks
- Project Leases
- Mine Outline
- Mining Lease Application

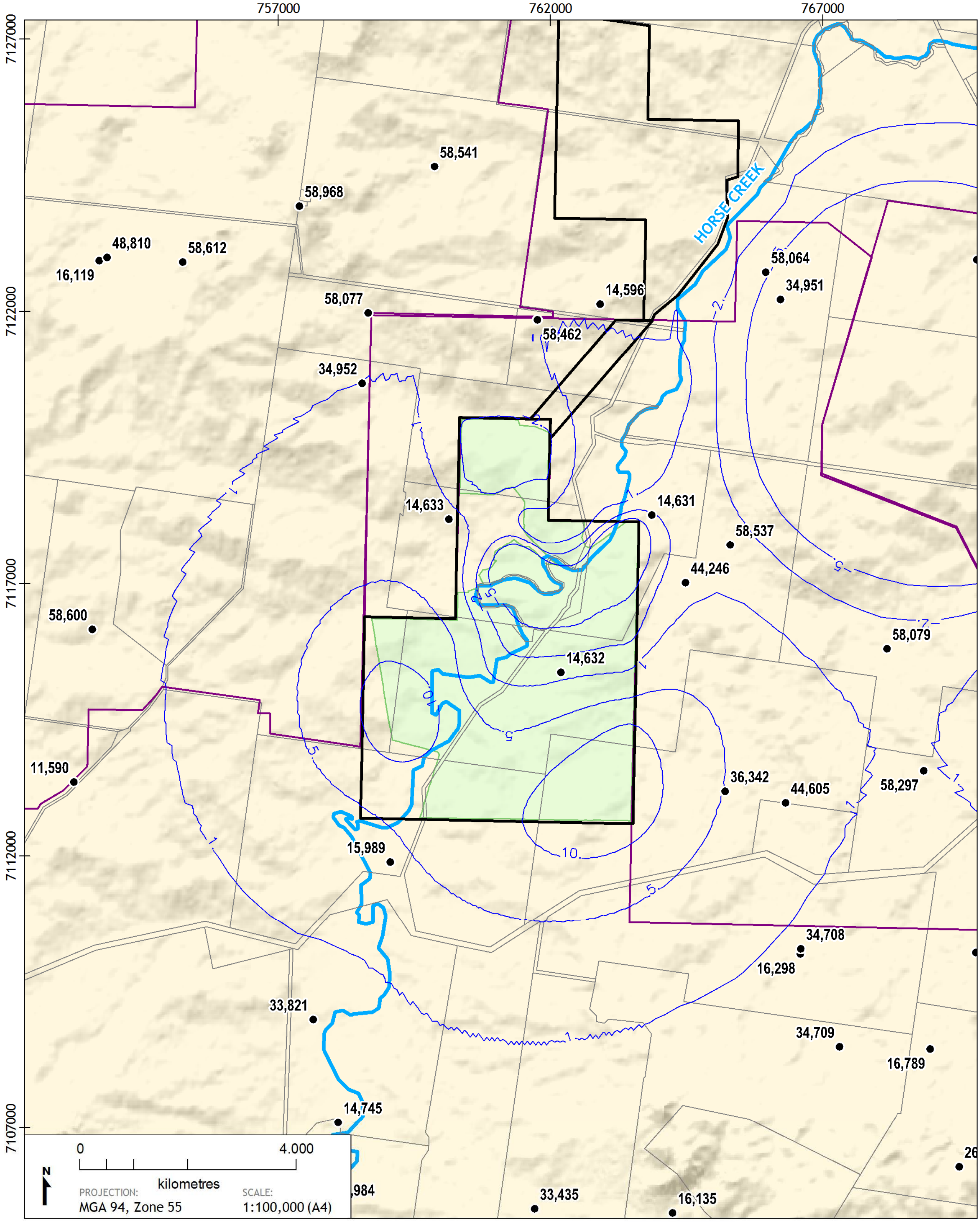
Elimatta Project
Groundwater Assessment (G1438A)

Drawdown End Of Recovery
Layer 12 - Elimatta only

AGE GROUNDWATER & ENVIRONMENTAL

DATE: 24/10/2012

FIGURE No: **31**



LEGEND:

- Registered Bore
- Drawdown Contour (m)
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

Elimatta Project
Groundwater Assessment (G1438A)

Drawdown End Of Recovery
Layer 10 - Elimatta + Wandoan

DATE: 24/10/2012

FIGURE No: 32

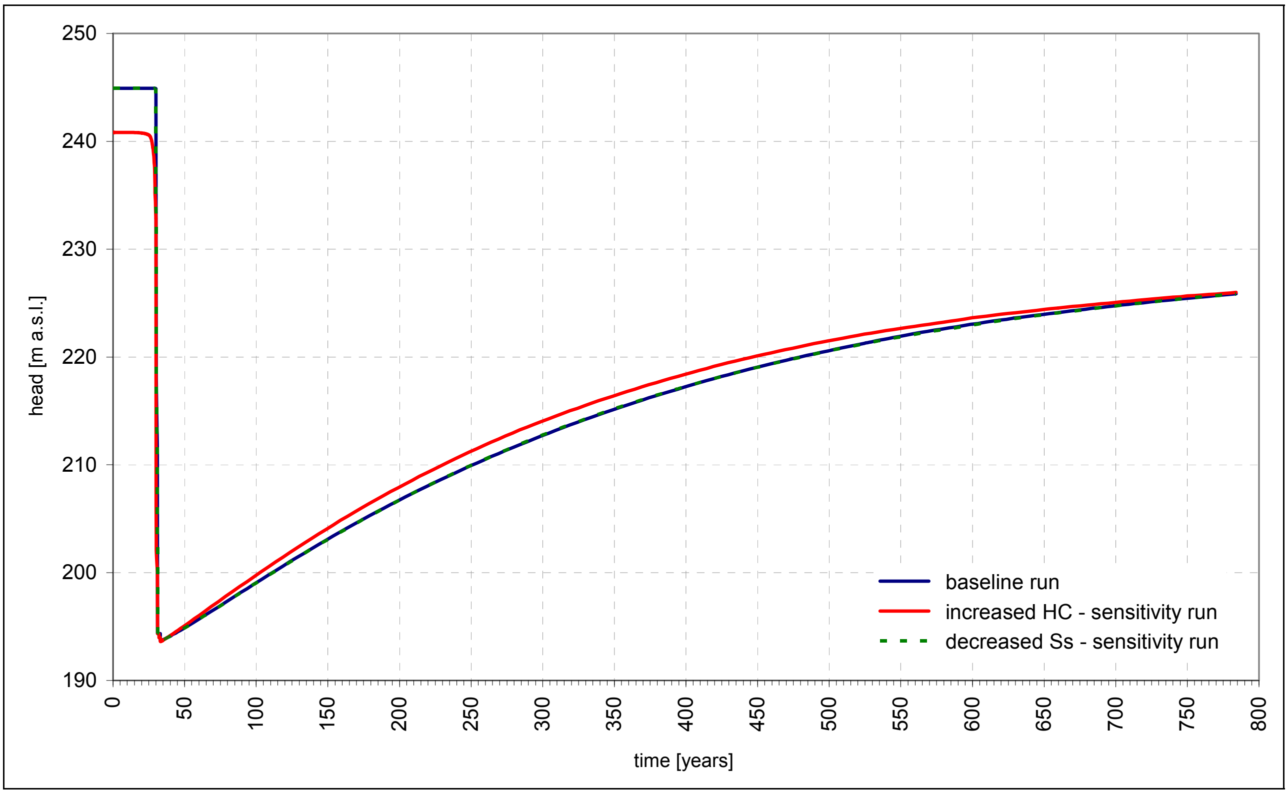


Figure 33: Predicted Water Levels in Final Voids (SE Pit - Void)

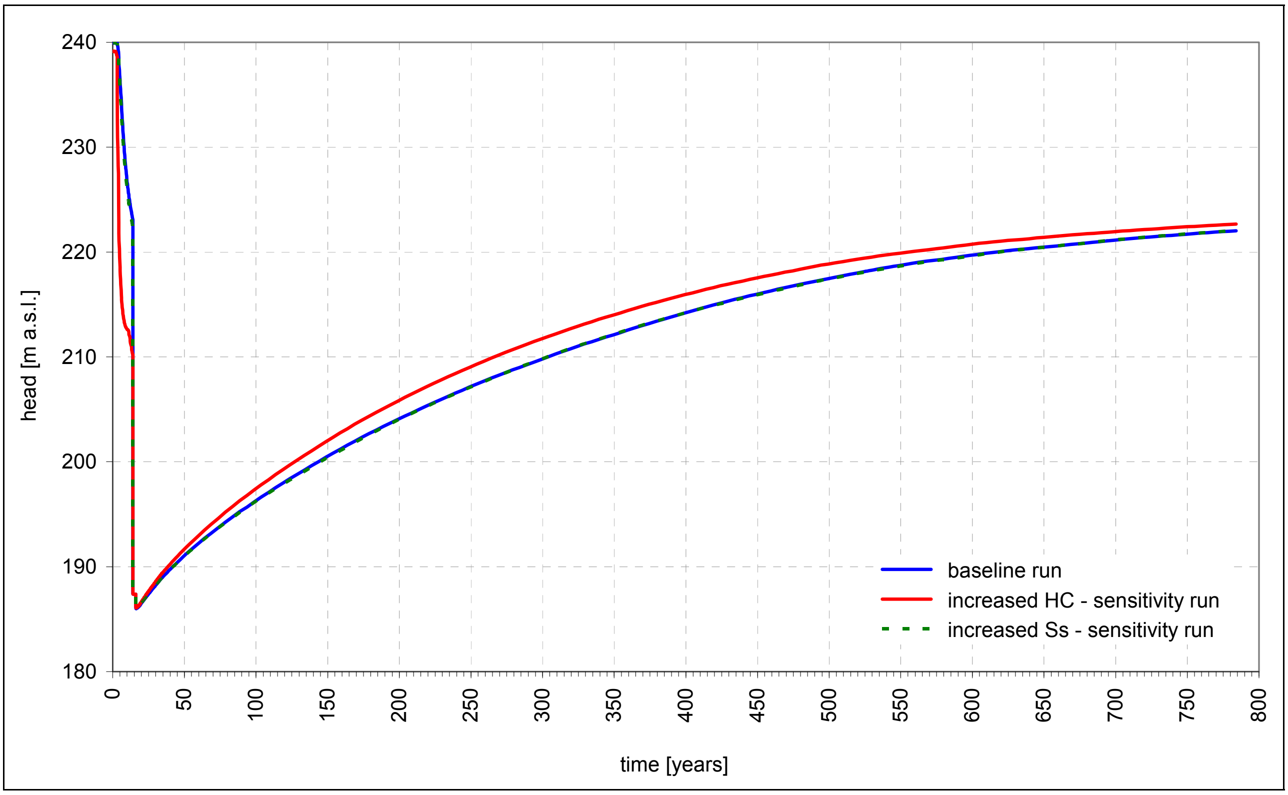


Figure 34 : Predicted Water Levels in Final Voids (SW Pit - Void)

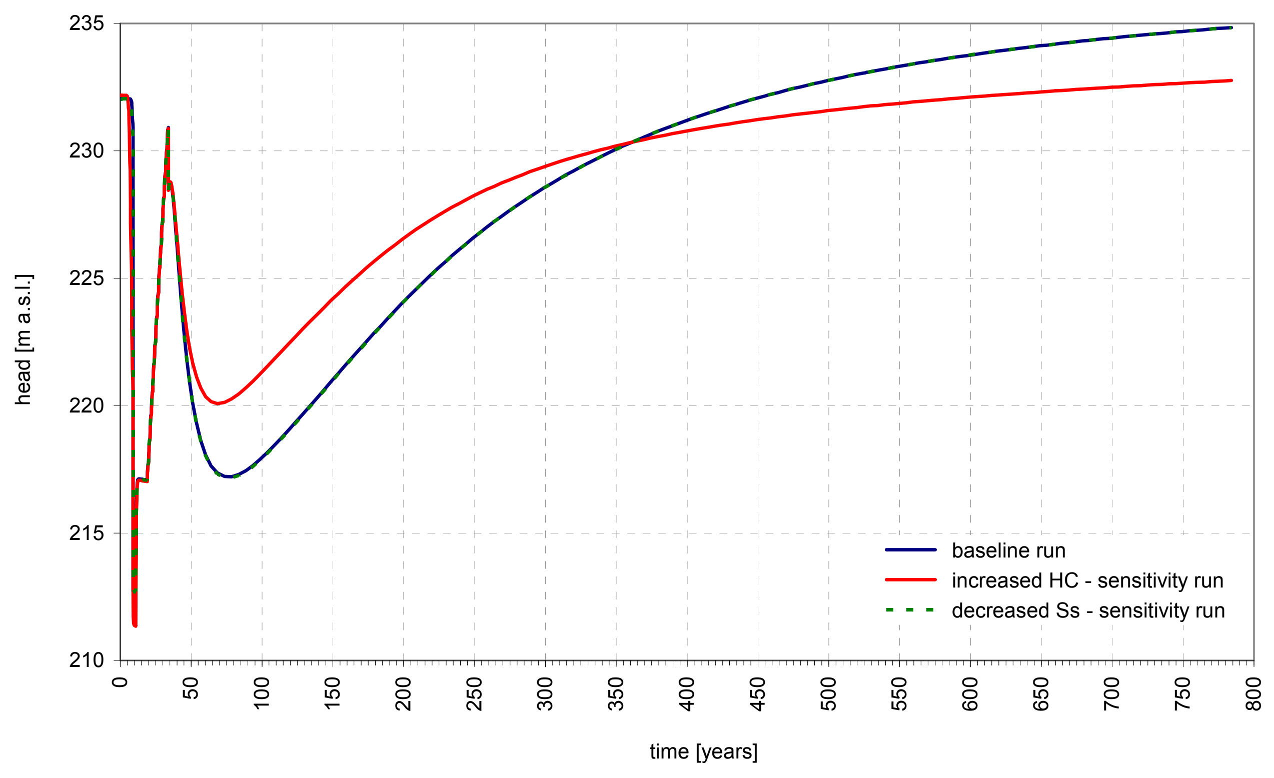


Figure 35 : Predicted Water Levels in Tailings Deposition Area (N Pit)

Figure 36 to Figure 38 show the pre and post mining water levels along three section lines (refer Figure 39).

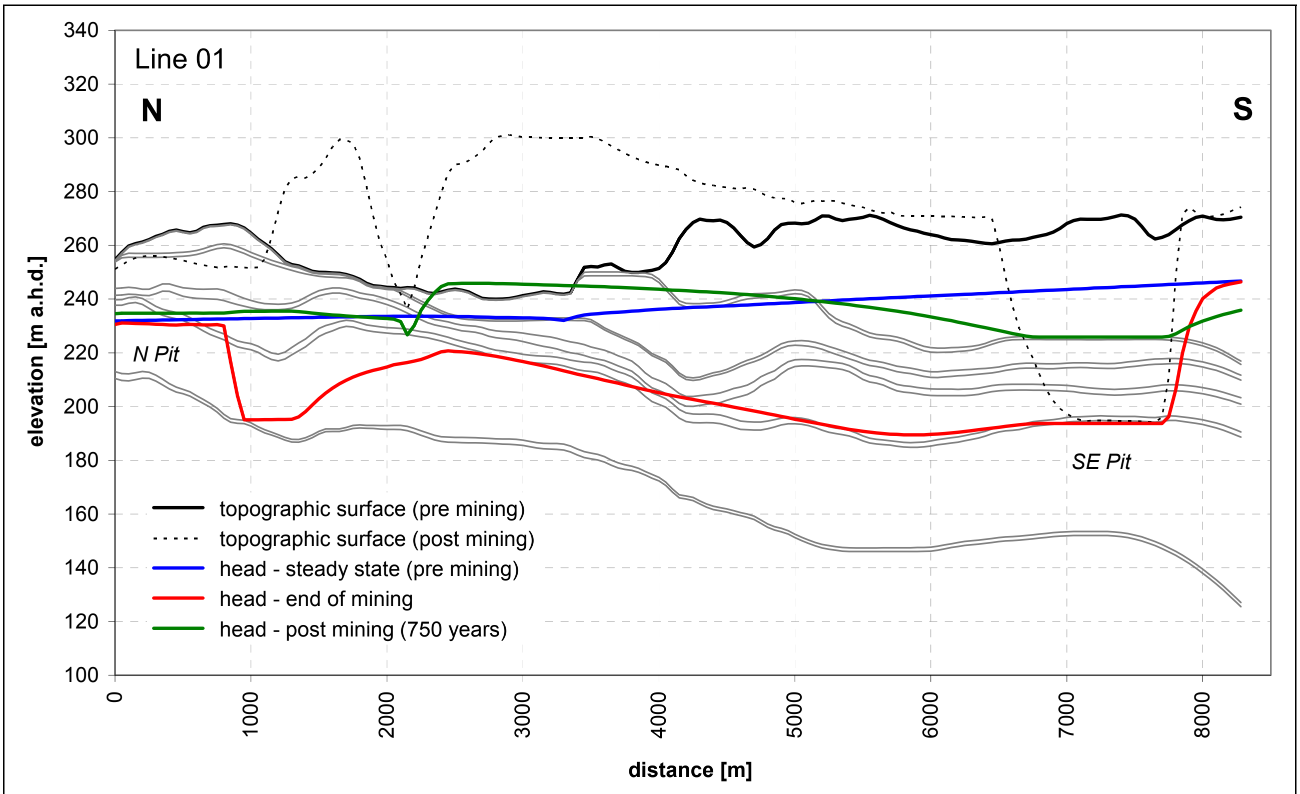


Figure 36: Cross Section Line 1

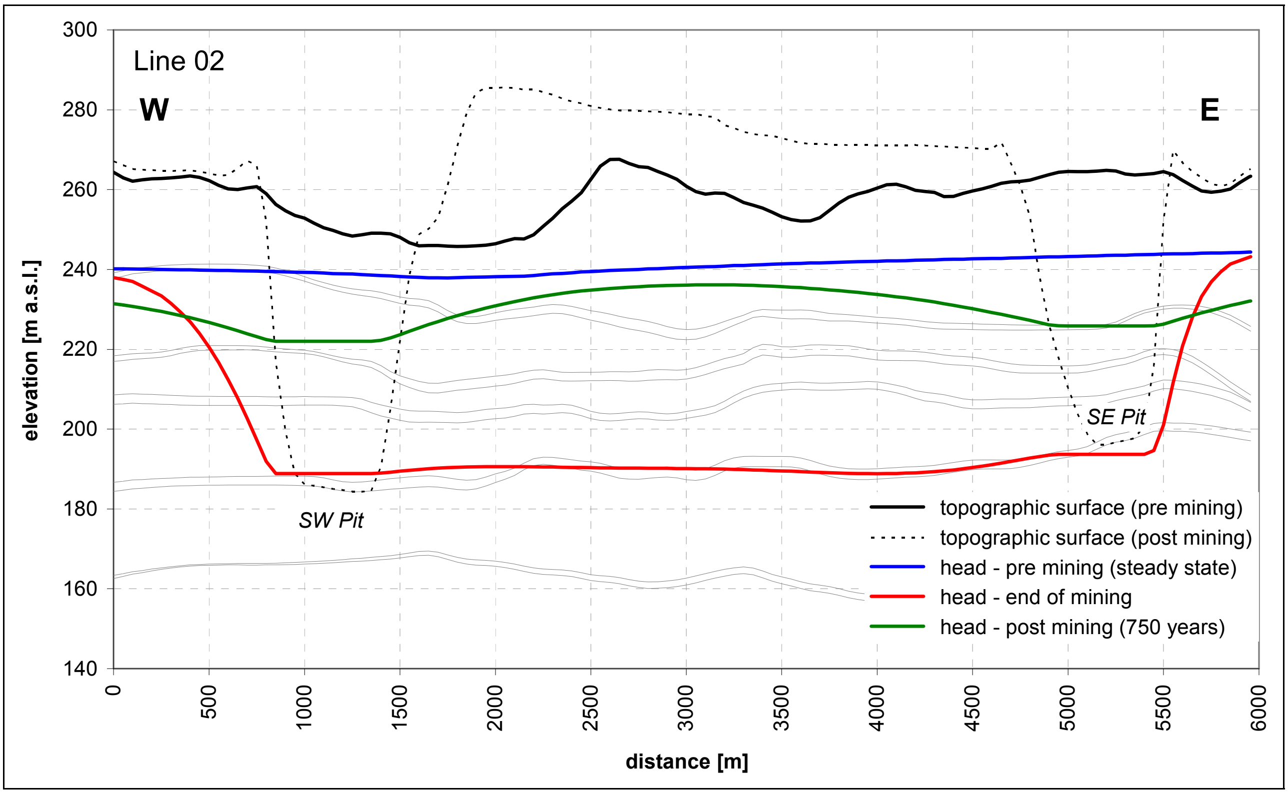


Figure 37: Cross Section Line 2

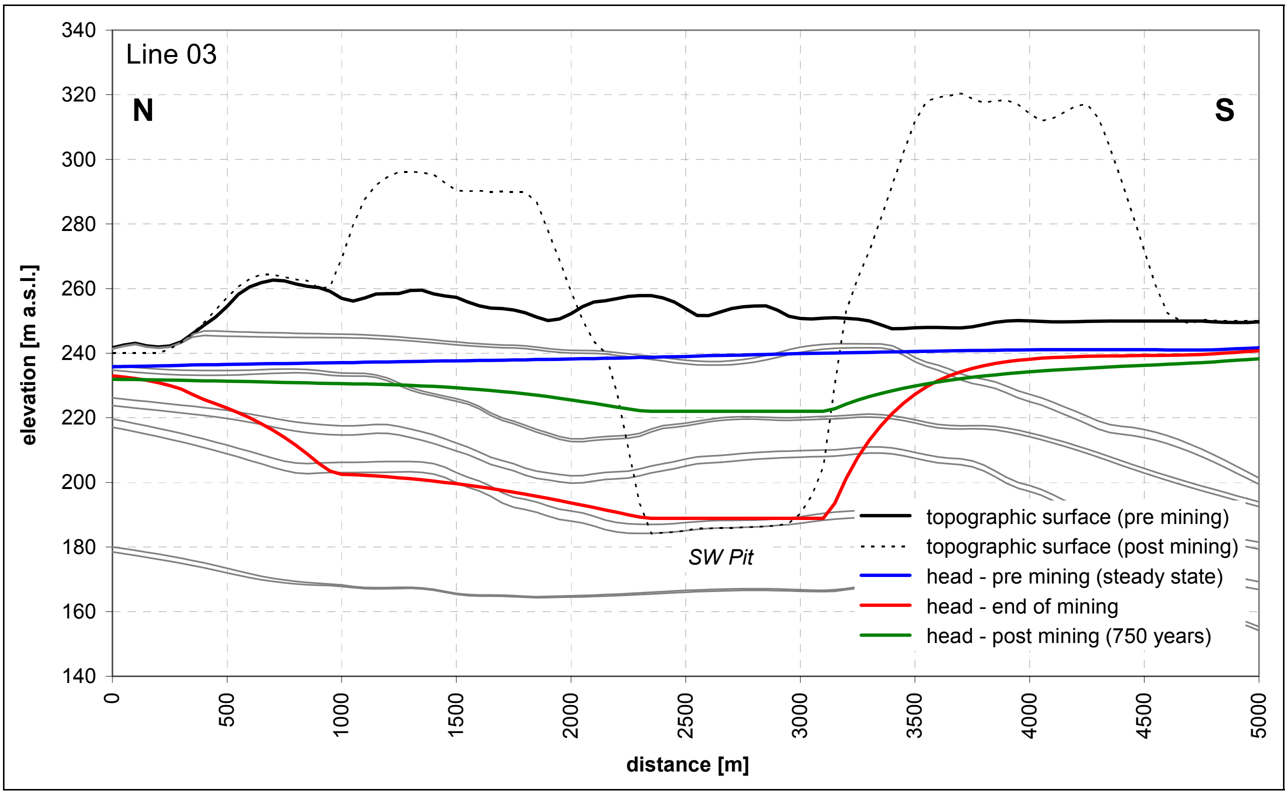
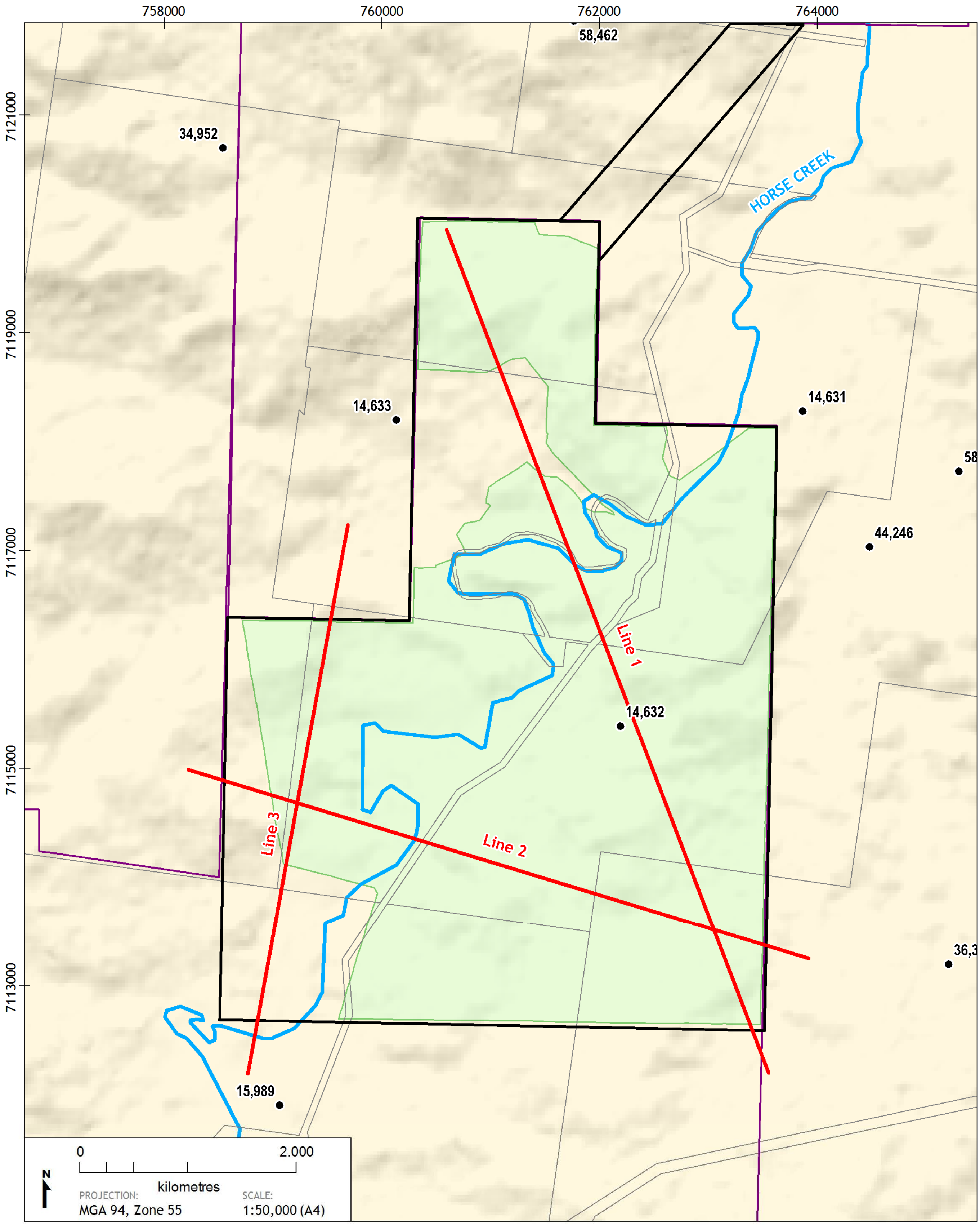


Figure 38: Cross Section Line 3



LEGEND:

- Registered Bore
- Cross Sections
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

Elimatta Project
Groundwater Assessment (G1438A)

Location of Cross-Sections

DATE: 24/10/2012

FIGURE No: 39

15.6 Creek Baseflow

The model assumed an increase in the rainfall recharge rate will occur in the area of backfilled spoils post mining. The modelling indicates this will result in the potential for water from the spoils to flow back into Horse Creek. Figure 40 shows the change in baseflow to Horse Creek.

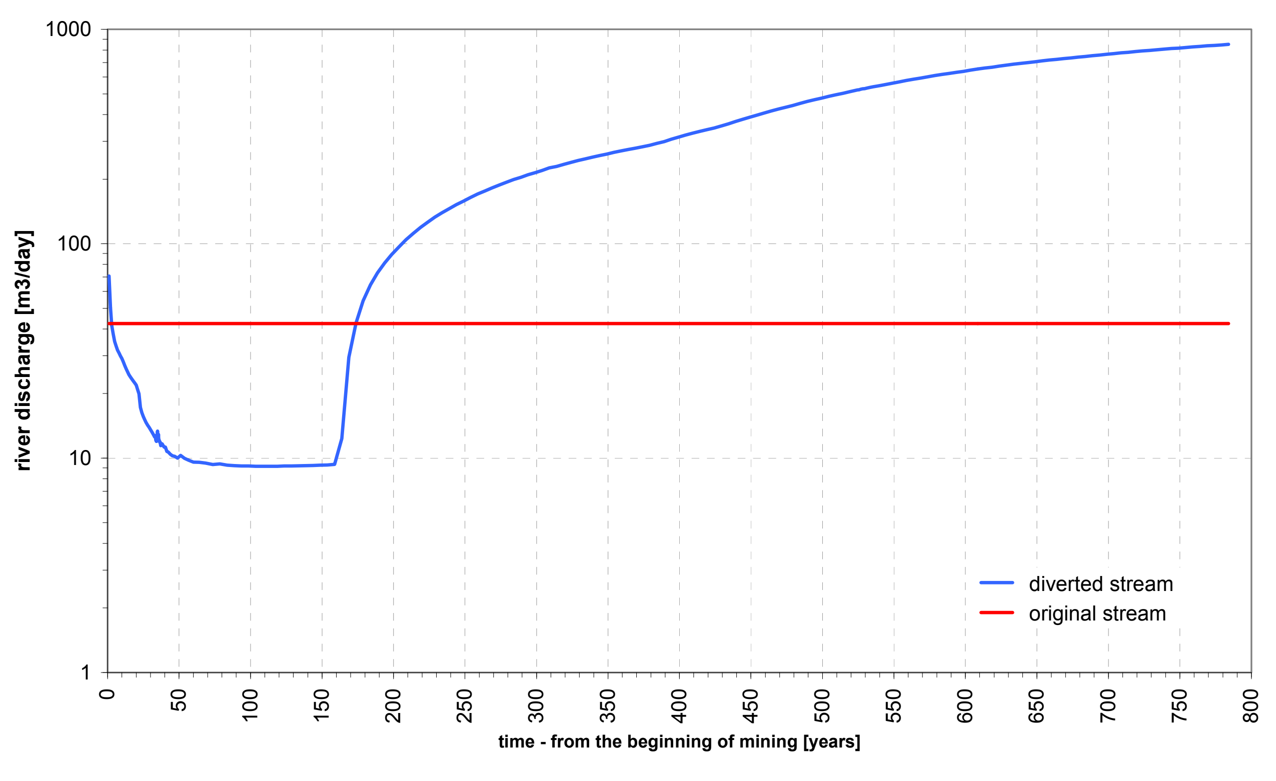


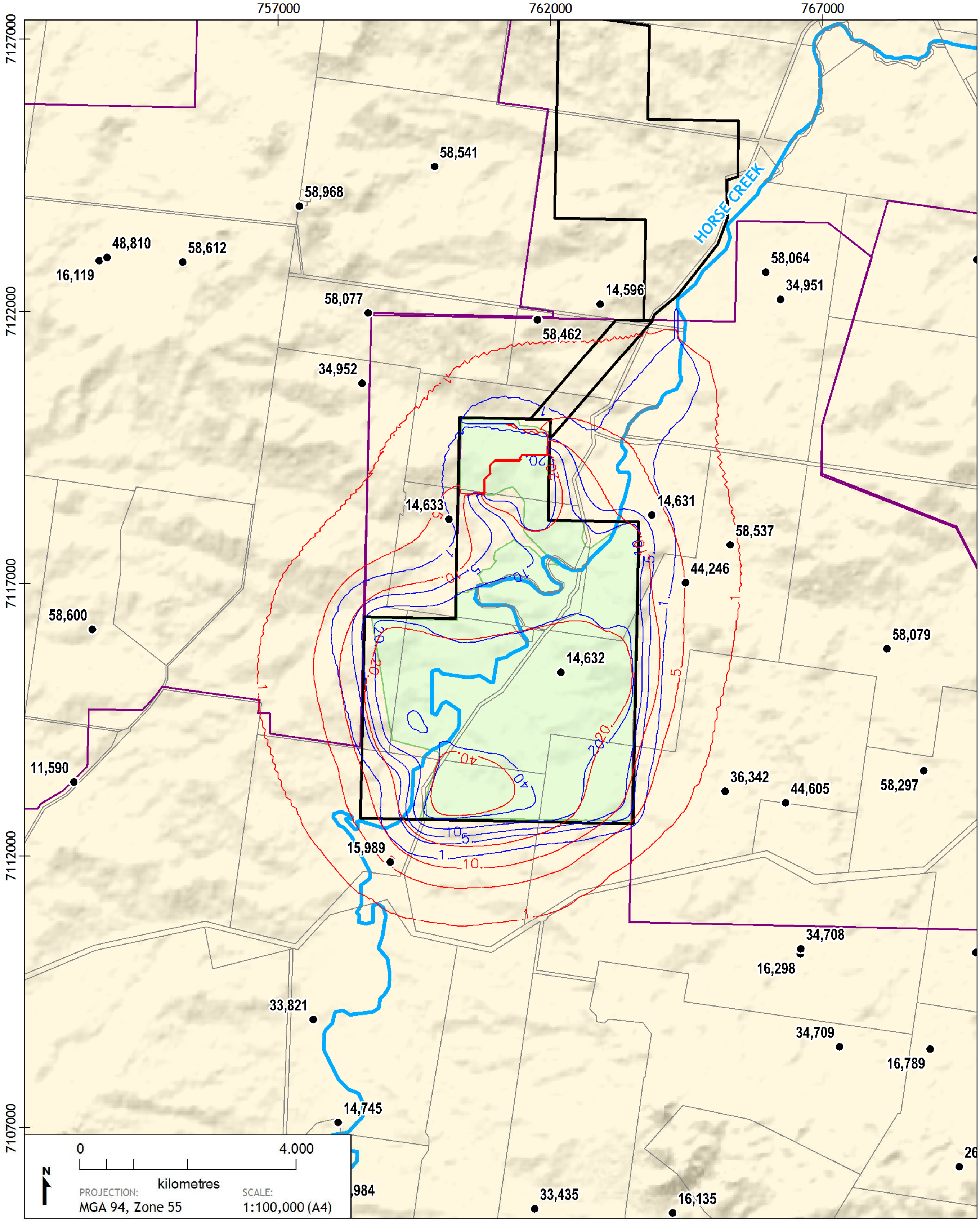
Figure 40: Horse Creek Baseflow

15.7 Sensitivity Analysis

The model uses the available data; however, some of the parameters are based on expected aquifer properties where data is limited. The model was re-run to assess the sensitivity of the model to variability in the aquifer parameters. The sensitivity analysis examined the impact of varying hydraulic conductivity and specific storage, on the predicted magnitude of inflow and drawdown.

For the sensitivity analysis the horizontal hydraulic conductivity adopted in the model for the coal seam was increased by an order of magnitude. Figure 41 shows the impact of the change on the zone of depressurisation. The specific storage was separately reduced by an order of magnitude. Figure 42 shows the resultant change in the zone of depressurisation.

Figure 43 shows the changes in the simulated seepage rate due to the changes in hydraulic conductivity and specific storage.



LEGEND:

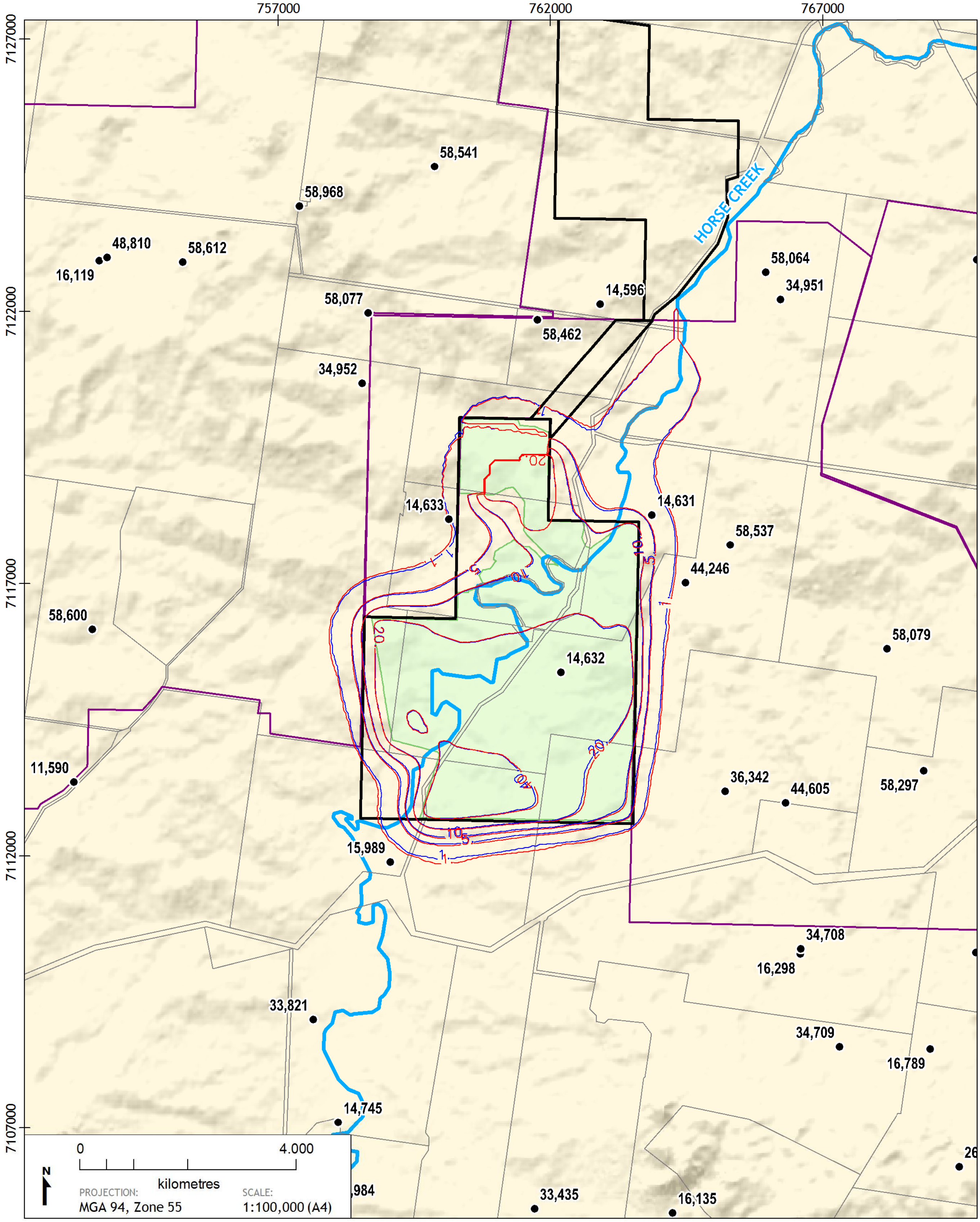
- Registered Bore
- Drawdown Contour (m) - Base Case
- Drawdown Contour (m) - Coal Seam Hydraulic Conductivity 10x higher
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

Elimatta Project
Groundwater Assessment (G1438A)

Drawdown End Of Mining
Layer 10 - Elimatta only - K * 10

DATE: 24/10/2012

FIGURE No: **41**



LEGEND:

- Registered Bore
- Drawdown Contour (m) - Base Case
- Drawdown Contour (m) - Coal Seam Specific Storage 10x lower
- Project Leases
- Mine Outline
- Mining Lease Application
- Cadastre
- Major Creeks

Elimatta Project
Groundwater Assessment (G1438A)

Drawdown End Of Mining
Layer 10 - Elimatta only - SS ÷ 10

DATE: 24/10/2012

FIGURE No: **42**

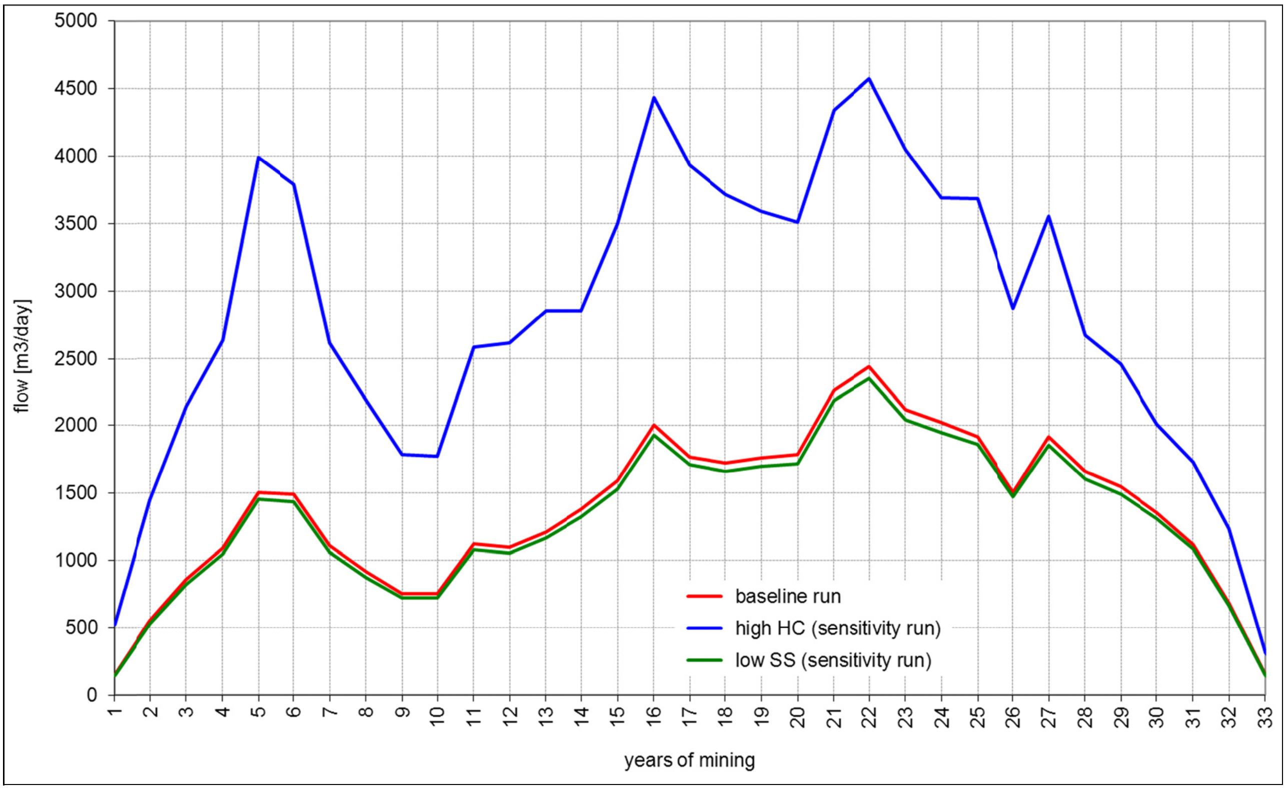


Figure 43: Sensitivity Analysis Inflows

15.8 Surat West Rail Alignment

The proposed Surat West Link (SWL) rail alignment connects Elimatta Mine with the Surat Basin Railway (SBR). The alignment connects with the SBR on the eastern side of Nathan Road and runs approximately 36km to the west. The railway consists of a single track with a proposed passing loop adjacent to the junction with the SBR. Potential mainline grading will enable the positioning of two additional passing loops without modification to the main line. The rail alignment crosses a number of large creeks and six public crossings.

The topography of the rail alignment is undulating, particularly on the western side of Juandah Creek. Construction of the alignment will involve a number of cuttings through areas of slope greater than 1.25%. These areas are displayed in the longitudinal section (Figure 45). These earthworks possess the potential for groundwater seepage if the cuttings intercept the saturated zone.

The rail alignment intersects two geological units along its length, the Injune Creek Group and Quaternary Alluvium associated with the creeks (Figure 46). The former consists of calcareous lithic sandstone, siltstone, mudstone, coal and conglomerate of mid-late Jurassic in age, whilst the latter contains alluvium of older flood plains, sand, gravel and soil. The Injune Creek Group consists of two sub groups, the Walloon Coal Measures and the Westbourne Formation. The Walloon Coal Measures form a moderate to poor groundwater system. The main water bearing strata are the coal seams with individual coal seams confined by overlying siltstone and mudstone beds which dip gently to the south, south-east away from the subcrop area. Overlying the Walloon Coal Measures is the Westbourne Formation consisting of finely interbedded lithic sandstone, mudstone and coal. This formation acts as an aquiclude confining the Walloon Coal Measures.

Due to shallow nature of the rail cuttings (deepest 13.2m), any groundwater encountered is unlikely to be sourced from the Injune Creek Group. Groundwater is more likely to be encountered within the shallow, unconfined alluvial sediments associated with the creeks.

Hydrogeological data available for the impact assessment of the rail corridor comes from two sources; monitoring bores constructed in the alluvium, and the calibrated steady state heads calculated from the numerical groundwater flow model. The location of the monitoring bores are restricted to the exploration lease and can only provide relevant data for the final loading loop section of the rail alignment, therefore the steady state heads from the numerical groundwater model has been used to assess the impact of the rail alignment on the groundwater regime.

The location of the rail alignment cuttings (Figure 46) and the topographic profile in the longitudinal section (Figure 45) show that the deepest cuttings occur at the highest elevations, particularly from meterage 22500 – 23500 where 13.2m of excavation is proposed. However, this cutting occurs at a peak of elevation 295.8mAHD, some 60m above the predicted water table elevation. The two potential passing loops (meterage 12000-15000 and 30500-32500) also require significant excavations; these are located within the Horse Creek Alluvium.

Groundwater contours show the depth to water along the path of the rail alignment (Figure 46). As would be expected, the shallowest groundwater occurs in close proximity to the alluvial sediments associated with the creeks. The rail cuttings located at higher elevations are in areas where the depth to groundwater is relatively deep. Data from the steady state model indicates that at no point along the length of the rail alignment do the rail cuttings intersect the water table (Figure 44).

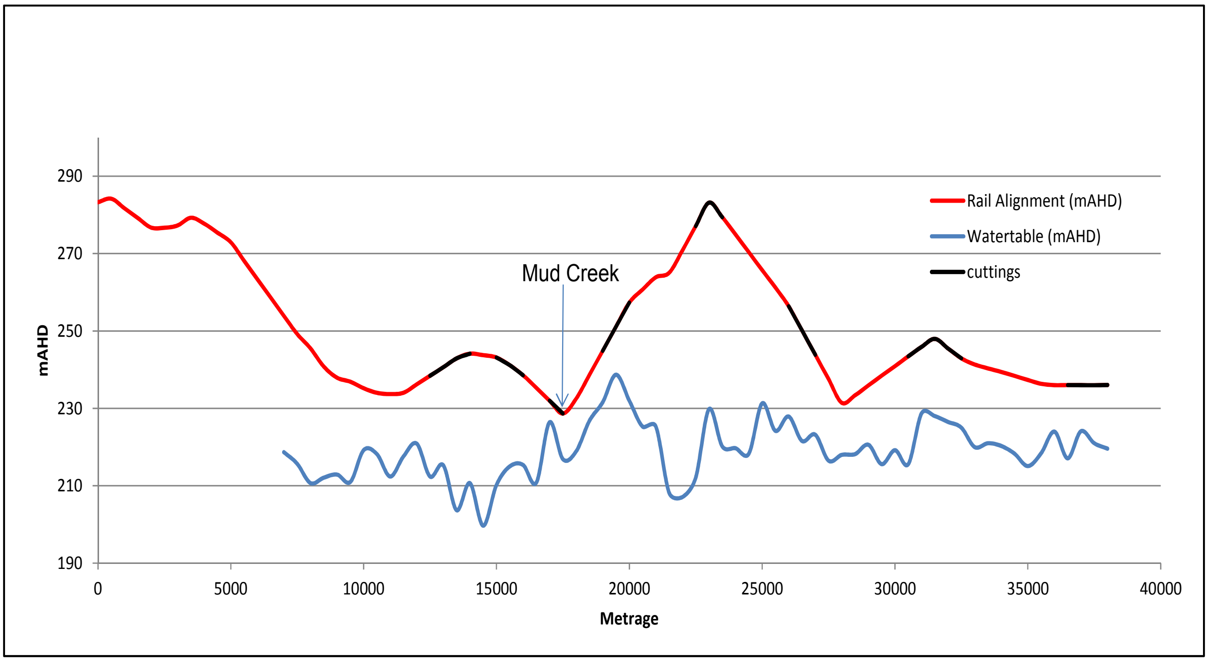


Figure 44: Elevations of Rail Alignment and Water Table (mAHD)

It is unlikely that groundwater seepage will occur in the rail alignment cuttings. The cutting at meterage 17000, ~500m east of Mud Creek is located in an area of lower elevation and relatively shallow depth to groundwater. At the deepest section of the cut, the depth to groundwater is predicted to be 5.6m. At this location, the cutting is still expected to be above the saturated zone and it is unlikely that the groundwater level in the alluvium at Mud Creek could rise by greater than

5m. In the unlikely event that heavy sustained rainfall rapidly recharges the aquifer at this cutting, any excess groundwater will discharge into Mud Creek. There are no DERM registered bores near the cutting and therefore dipped water levels are unavailable.

The balloon loop at the western-most point of the rail alignment is situated in the Horse Creek Alluvium, close to Horse Creek. A number of Elimatta groundwater monitoring bores (MB17, MB14 and MB13) are located within 1km of the proposed cutting with the most recent available reading dated July 2011 (Table 3). The closest monitoring bore to the cutting is MB13 (500m to the south-east) which was effectively dry within the screened depth of 6 - 7.5mbGL. This observation is consistent with the steady state groundwater heads where the predicted depth to water is 11m. The rail alignment at the balloon loop is unlikely to impact the existing groundwater regime.

In summary the proposed cuttings for the SWL rail alignment are unlikely to intersect the water table at any point and are highly unlikely to be at risk from groundwater seepage. As the cuttings traverse areas of high topography, any water will naturally drain along the surface towards the creeks or percolate to the water table aquifer. Whilst no bore data is available for the majority of the rail alignment, the steady state heads provided from the numerical groundwater model provide a reliable depth to water and are supported by monitoring bore data from within the Elimatta mining lease.

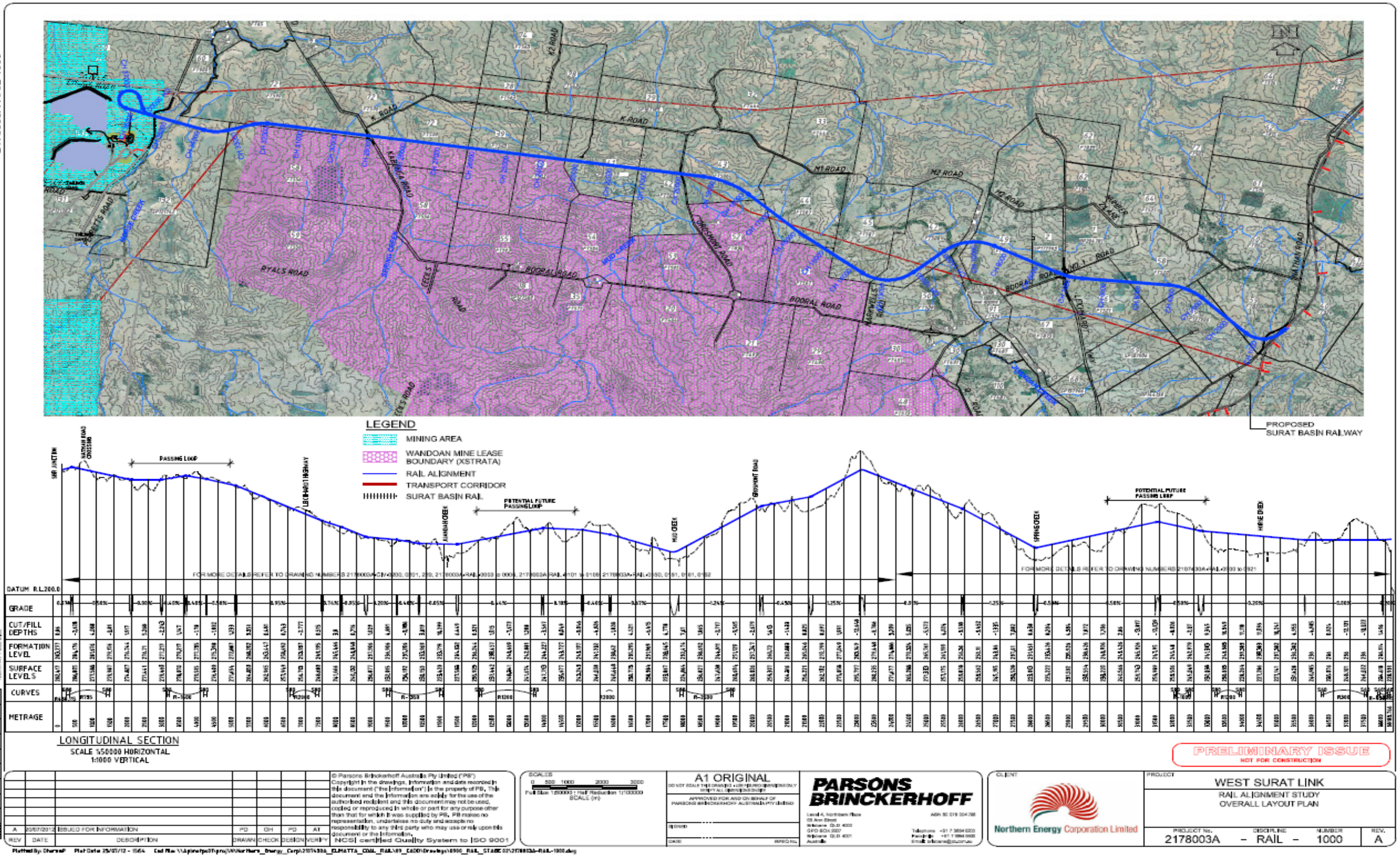
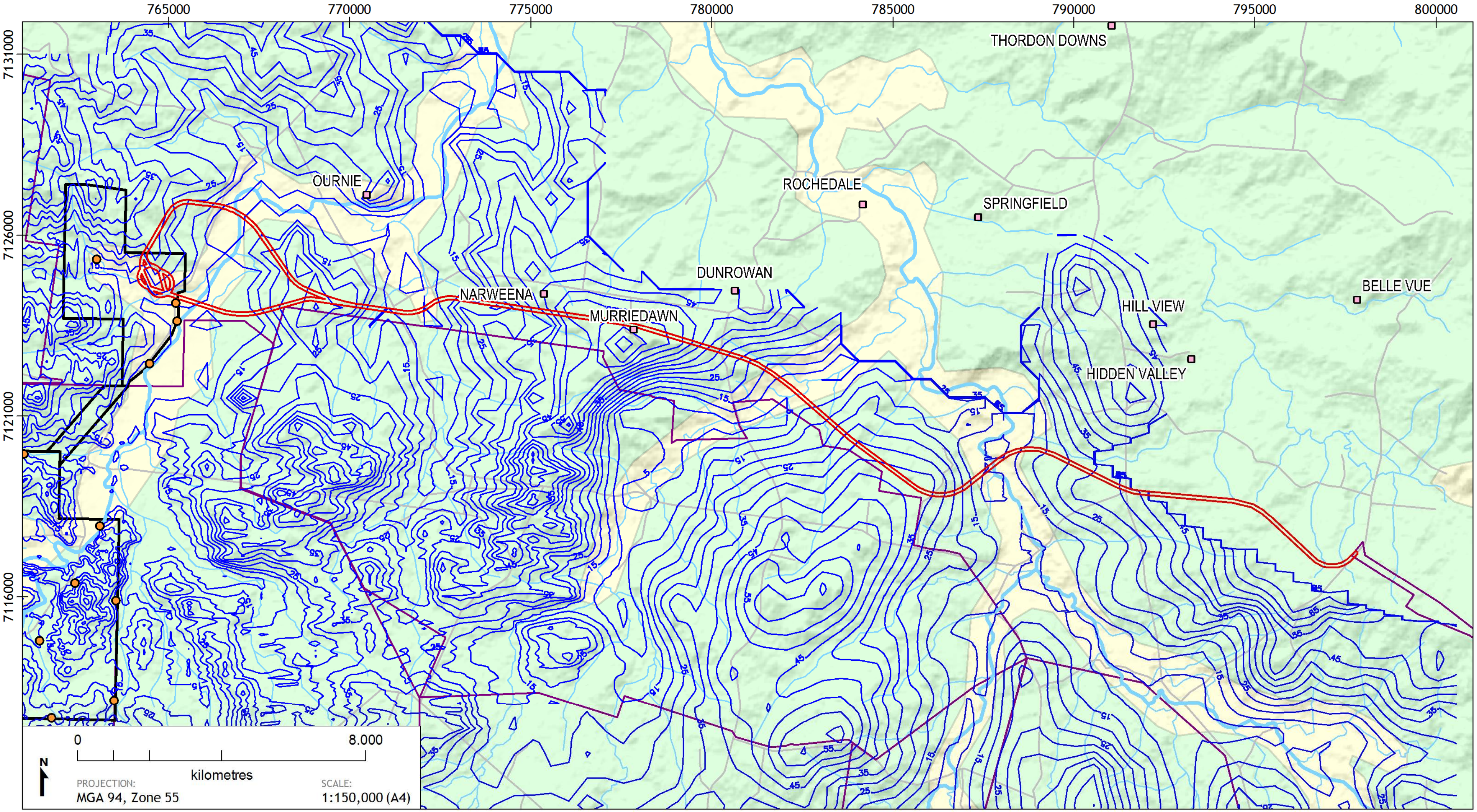


Figure 45: Reference Alignment Diagram



LEGEND:

Surat West Link Rail Alignment

Depth to Water (5m Contour)

Elimatta Monitoring Bores

Project Leases

Mining Lease Application

Major Creeks

Watercourse

Homestead

Road

Surat Basin Surface Geology

Qa-NSB

ICg - Injune Creek Group

Elimatta Project
Groundwater Assessment (G1438A)

Rail Alignment Groundwater Assessment

DATE:
24/10/2012

FIGURE No:
46

16 WATER QUALITY IMPACTS

Environmental Geochemistry International Pty Ltd (2011)[13] assessed the geochemistry of the overburden and reject material from the coal handling and preparation plant. From the results of this work it was concluded by EGI that:

- *Results indicate that overburden/interburden and floor materials represented by the samples tested are unlikely to be acid producing or release significant salinity or metals/metalloids, and will not require special handling for ARD or neutral drainage control.*
- *….19 sample solids were subjected to water extraction at a solids:liquor ratio of 1:2. ….The samples produced circum-neutral to slightly alkaline pH extracts. EC values were generally non saline (<0.4 dS/m), with 5 samples slightly saline (0.4 to 0.8 dS/m) and one sample moderately saline (>0.8 dS/m).*
- *Initial results for laboratory generated tailings and rejects also indicate materials represented by these samples are unlikely to be acid forming or produce significant salinity.*

It is important to note that the system used by EGI to classify the quality of the leachate was different to that presented in this report (Section 0). Under the system used in this report the majority of the leachate water samples would be considered fresh water with TDS <500 mg/L. Given the findings of the geochemical assessment of the overburden and potential reject materials, it is considered unlikely that leachate generated from these materials will adversely impact regional groundwater quality.

17 GROUNDWATER MONITORING PLAN

It is recommended that ongoing monitoring continue to determine comprehensive baseline conditions and to monitor impacts through the life of the Project. Six monthly monitoring of groundwater levels and quality should continue at the existing monitoring bores for the life of the Project. Table 12 shows the recommended monitoring bores.

Table 12: MONITORING BORES

Bore ID	Lithology / Aquifer Monitored	Co-ordinates (MGA94 Z55)	
		Easting (m)	Northing (m)
MB1A	Walloon Coal Measures	760997	7120002
MB1B	Alluvium	761001	7120001
MB2	Walloon Coal Measures	760367	7117880
MB3A	Walloon Coal Measures	763091	7117998
MB3B	Horse Creek Alluvium	763093	7118002
MB4A	Walloon Coal Measures	760348	7116954
MB4B	Horse Creek Alluvium	760351	7116954
MB5	Walloon Coal Measures	762400	7116429
MB6	Walloon Coal Measures	761432	7114842
MB7A	Walloon Coal Measures	760017	7115207

[13] Environmental Geochemistry International Pty Ltd, (2012), *"Geochemical Assessment of the Elimatta Coal Project"*, January 2012, Draft.

Table 12: MONITORING BORES			
Bore ID	Lithology / Aquifer Monitored	Co-ordinates (MGA94 Z55)	
		Easting (m)	Northing (m)
MB7B	Horse Creek Alluvium	760020	7115206
MB8A	Walloon Coal Measures	759277	7112983
MB8B	Horse Creek Alluvium	759278	7112979
MB9	Walloon Coal Measures	761753	7112704
MB10	Walloon Coal Measures	763543	7115939
MB11	Walloon Coal Measures	763493	7113179
MB12	Walloon Coal Measures	759272	7115706
MB13[1]	Alluvium	765191	7124165
MB14[1]	Horse Creek Alluvium	765229	7123665
MB15[1]	Horse Creek Alluvium	764461	7122489
MB16[1]	Horse Creek Alluvium	756901	7102939
MB17[1]	Alluvium	763008	7125369
MB18[1]	Horse Creek Alluvium	758802	7109229
MB19[1]	Horse Creek Alluvium	758487	7107668

Note 1: Coordinates determined using hand held GPS – surveyed coordinates pending

The six monthly analytical water quality suite should include:

- pH, EC, TDS
- Major cations – calcium, magnesium, sodium, potassium
- Major anions – chloride, sulphate, carbonate, bicarbonate
- Major and minor trace elements – (Al, Sb, As, Be, Ba, Cd, Cr, Cu, Co, Ni, Pb, Zn, Li, Mn, Mo, Se, Ag, U, V, B, Fe)
- Nutrients – nitrite, nitrate, TKN, TN.
- Total Petroleum Hydrocarbons

Seepage rates in the open cut pit should be monitored during mining. If significant divergence is observed between the measured and model predicted inflows, revising the model and specifically re-calibration of the model parameters against the measured inflow data should be undertaken.

18 DEEP BORE MONITORING PLAN

The locations of deep bores identified during the census are shown in Figure 47 and the bore construction details are summarised in Table 13.

Whilst none of the deep bores (i.e. bores screened in the Hutton or Precipice Sandstone aquifers) were identified to be within the groundwater drawdown modelled by AGE, it is recommended to include three of the four identified deep bores in a deep bore monitoring program as follows:

- RN58968
- RN58285
- RN58306

It is concluded that the three nominated bores are likely to provide suitable background groundwater monitoring data for NEC for the following reasons:

- They are the closest 'deep' bores around MLA 50254.
- Nominated bores included bores that are screened exclusively over the Precipice Sandstone aquifers.
- Two of the nominated bores (RN5825 and RN58968) are community/share bores.
- The nominated bores are all currently in regular use, so useful bore yield information may be obtained during the monitoring program.
- Bore RN58462 is not recommended for inclusion in the monitoring program because (a) it is currently non-operational and (b) the bore head works are in poor condition with groundwater free-flowing at surface.
- Owners of the three nominated bores have each indicated that they are willing to participate in the proposed monitoring program.

Table 13: DEEP BORES IDENTIFIED DURING BORE CENSUS

Bore ID	Total Bore Depth (m)	Screened Interval (m)	Aquifer(s) over Screened Interval (m)	Data Source
RN58968	1,206	1,086 – 1,188	Precipice 1,062 – 1,194	DEHP GWDB/Bore Construction Log
RN58462	642	603 – 627	Eurombah 608 – 620	DEHP GWDB
RN58285	1,310	1,202 – 1,298	Precipice 1,250 – 1302	Bore Construction Log
RN58306	823	454 – 823	Birkhead 453 - 474 Eurombah 513 – 599 Hutton 693 – 818	DEHP GWDB

Investigative bore condition assessments (e.g. down-hole camera inspections, bond logging, etc) are not recommended at this stage for the following reasons:

- Head works of the three nominated bores appear to be in good condition;
- The nominated bores are operated daily; and
- Bores nominated for monitoring are equipped with electric line shaft pumps. A crane is required to remove these pumps, resulting in disruption to water supply for a period of days.

It is recommended that pressure transducers and flow meters are installed in each of the three nominated deep bores. Logging intervals should be set to record hourly for both pressure transducers and water flow meters, as well as total cumulative flow for the water flow meters. It is recommended that groundwater level and bore pumping rate data be downloaded quarterly.

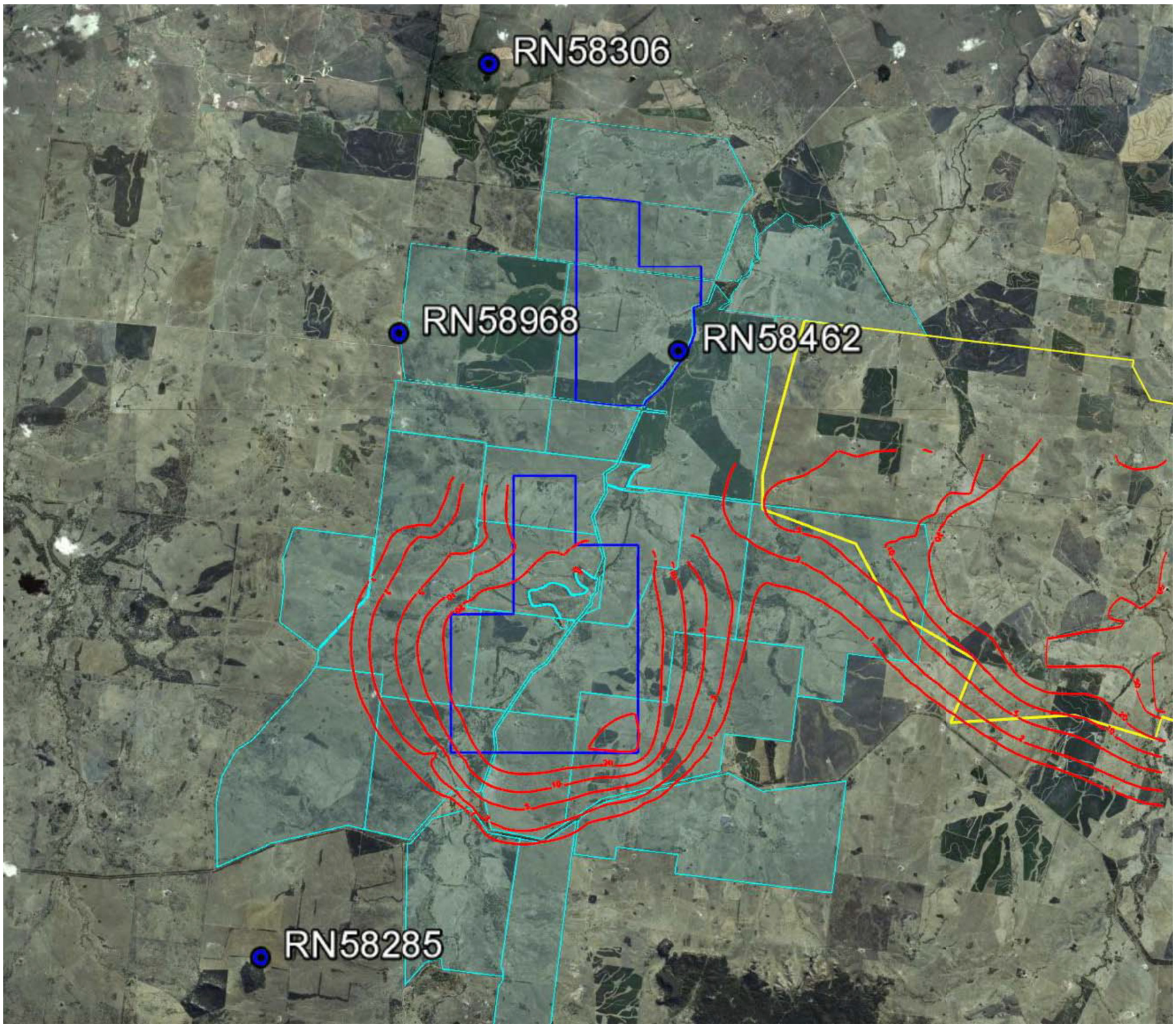


Figure 47: Location of 'deep' bores (>500m total depth) identified during the bore census

It is recommended that a brief letter report summarising the deep bore monitoring data is provided every six months following the receipt of laboratory analytical results, with a more comprehensive report provided every 12 months.

The deep bore monitoring program should commence as soon as practicable to establish baseline deep aquifer conditions prior to mining commences at Elimatta.

AUSTRALASIAN GROUNDWATER AND ENVIRONMENTAL CONSULTANTS PTY LTD

PAVEL DVORACECK
Groundwater Modeller

JAMES S. TOMLIN
Principal Hydrogeologist / Director

LIMITATIONS OF REPORT

Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) has prepared this report for the use of Northern Energy Corporation in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 1 June 2012 and subsequent revised costs emailed on 30 September 2010.

The methodology adopted and sources of information used by AGE are outlined in this report. AGE has made no independent verification of this information beyond the agreed scope of works and AGE assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to AGE was false.

This study was undertaken between 25 May 2012 and 31 October 2012 and is based on the conditions encountered and the information available at the time of preparation of the report. AGE disclaims responsibility for any changes that may occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. It may not contain sufficient information for the purposes of other parties or other users. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing and other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. Where borehole logs are provided they indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of the site, as constrained by the project budget limitations. The behaviour of groundwater is complex. Our conclusions are based upon the analytical data presented in this report and our experience.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, AGE must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge, information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

Appendix 1

WATER QUALITY DATA

Analytes	Units	LOR	MB1A				MB2			MB3A				ANZECC 2000	ADWG (2011)	
Aquifer	-	-	Walloon Coal Measures				Walloon Coal Measures			Walloon Coal Measures				Livestock Drinking	Aesthetic	Health
Date Sampled	-	-	10/10/2009	25/11/2009	21/01/2010	08/07/2011	10/10/2009	25/11/2009	21/01/2010	07/10/2009	26/11/2009	20/01/2010	09/07/2011			
Physical Properties																
Field pH Value	pH Unit	0.01	7.05	6.99	7.08	6.93	7.48	7.42	7.18	7.79	7.78	7.77	7.3	-	6.5 - 8.5	-
Electrical Conductivity @ 25°C	µS/cm	1	18600	17100	18100	17700	14500	13000	14000	6490	6620	6260	5030	-	-	-
Total Dissolved Solids @180°C	mg/L	5	**10900**	**10500**	**11000**	**10800**	**8010**	**7390**	**7800**	**3210**	**3480**	**3430**	2910	3000-13000*	600	-
Alkalinity																
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Bicarbonate Alkalinity as CaCO3	mg/L	1	655	611	643	601	275	249	264	559	573	495	914	-	-	-
Total Alkalinity as CaCO3	mg/L	1	655	611	643	601	275	249	264	559	573	495	914	-	-	-
Major Ions																
Calcium	mg/L	1	218	222	205	210	72	58	62	18	16	16	64	1000	-	-
Chloride	mg/L	1	6070	5860	6190	5930	4700	4330	4730	1720	1870	1710	1090	-	250	-
Magnesium	mg/L	1	97	83	84	83	23	19	20	4	3	3	16	-	-	-
Potassium	mg/L	1	27	29	24	25	16	16	13	6	5	5	7	-	-	-
Sodium	mg/L	1	3400	3740	3740	3480	2880	2910	2830	1440	1510	1300	1050	-	180	-
Sulfate	mg/L	1	32	44	29	49	50	7	2	3	<1	5	4	1000	250	500
Disolved Metals																
Aluminium	mg/L	0.01	0.01	<0.01	0.07	<0.01	0.03	<0.01	<0.01	0.02	0.01	0.01	<0.01	5	-	-
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Arsenic	mg/L	0.001	<0.001	<0.001	0.001	<0.001	0.002	0.001	0.003	<0.001	0.002	<0.001	<0.001	0.5	-	-
Barium	mg/L	0.001	7.05	6.66	6.25	6.55	2.6	2.54	2.68	0.642	0.621	0.523	1.45	-	-	-
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Boron	mg/L	0.05	0.22	0.21	0.16	0.16	0.19	0.16	0.13	0.21	0.21	0.14	0.23	5	-	-
Cadmium	mg/L	0.0001	0.0006	0.0002	<0.0001	<0.0001	0.0014	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.01	-	-
Chromium	mg/L	0.001	0.003	0.004	<0.001	0.001	0.003	0.003	<0.001	0.001	0.009	<0.001	<0.001	1	-	-
Copper	mg/L	0.001	0.059	0.032	0.078	0.002	0.026	0.073	0.007	0.001	0.007	0.015	<0.001	0.5	-	-
Iron	mg/L	0.05	0.75	0.78	0.49	1.33	0.11	0.06	0.16	<0.05	0.13	<0.05	0.73	-	-	-
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.006	0.002	<0.001	<0.001	0.001	0.002	0.001	0.1	-	-
Lithium	mg/L	0.001	0.322	0.333	0.234	0.266	0.141	0.161	0.137	0.093	0.092	0.062	0.084	-	-	-
Manganese	mg/L	0.001	0.045	0.043	0.03	0.041	0.083	0.046	0.028	0.01	0.011	0.009	0.131	-	-	-
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.013	0.006	0.002	<0.001	<0.001	0.001	0.002	0.15	-	-
Nickel	mg/L	0.001	0.013	0.03	0.005	<0.001	0.008	0.006	0.002	<0.001	0.003	0.006	0.004	1	-	-
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	-	-
Silver	mg/L	0.001	0.002	0.005	<0.001	<0.001	0.003	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.2	-	-
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-
Zinc	mg/L	0.005	0.044	0.045	0.012	0.006	0.028	0.034	0.012	0.008	0.006	0.013	<0.005	20	-	-
Total Metals																
Aluminium	mg/L	0.01	-	-	-	0.02	-	-	-	-	-	-	0.02	5	0.2	-
Antimony	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	<0.001	-	-	0.003
Arsenic	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	<0.001	0.5	-	0.01
Barium	mg/L	0.001	-	-	-	6.35	-	-	-	-	-	-	1.52	-	-	2
Beryllium	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	<0.001	-	-	0.06
Boron	mg/L	0.05	-	-	-	0.15	-	-	-	-	-	-	0.22	5	-	4
Cadmium	mg/L	0.0001	-	-	-	<0.0001	-	-	-	-	-	-	<0.0001	0.01	-	0.002
Chromium	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	0.005	1	-	0.05
Copper	mg/L	0.001	-	-	-	0.002	-	-	-	-	-	-	0.002	0.5	1	2
Iron	mg/L	0.05	-	-	-	2.27	-	-	-	-	-	-	1.11	-	0.3	-
Lead	mg/L	0.001	-	-	-	0.005	-	-	-	-	-	-	0.026	0.1	-	0.01
Lithium	mg/L	0.001	-	-	-	0.306	-	-	-	-	-	-	0.098	-	-	-
Manganese	mg/L	0.001	-	-	-	0.044	-	-	-	-	-	-	0.166	-	0.1	0.5
Mercury	mg/L	0.0001	-	-	-	<0.0001	-	-	-	-	-	-	<0.0001	0.002	-	0.001
Molybdenum	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	0.002	0.15	-	0.05
Nickel	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	0.009	1	-	0.02
Selenium	mg/L	0.01	-	-	-	<0.01	-	-	-	-	-	-	<0.01	0.02	-	0.01
Silver	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	<0.001	-	-	0.1
Uranium	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	<0.001	0.2	-	0.017
Vanadium	mg/L	0.01	-	-	-	<0.01	-	-	-	-	-	-	<0.01	-	-	-
Zinc	mg/L	0.005	-	-	-	0.008	-	-	-	-	-	-	0.017	20	3	-
Nutrients																
Nitrite + Nitrate as N	mg/L	0.01	0.09	0.04	<0.01	0.09	0.08	0.04	0.06	0.04	<0.01	0.04	0.06	30-400^	-	3-50#
Total Kjeldahl Nitrogen as N	mg/L	0.1	2.2	1.8	2.7	2.4	1.6	1.4	2	0.7	0.5	1	0.8	-	-	-
Total Nitrogen as N	mg/L	0.1	2.3	1.8	2.7	2.5	1.7	1.4	2.1	0.8	0.5	1	0.9	-	-	-
Total Phosphorus as P	mg/L	0.01	0.02	<0.01	0.47	0.02	0.04	<0.01	0.21	0.06	0.01	0.05	<0.01	-	-	-

Transgressed Australian Drinking Water Guidelines (2011) aesthetic guideline value.
Exceeds Australian Drinking Water Guidelines (2011) health guideline value.
1000 Exceeds ANZECC (2000) livestock drinking water guideline value.
1000 Laboratory holding time breached.
* Guideline Value depends on type of livestock.
^ ANZECC (2000) livestock guideline is 30 mg/L for nitrite and 400 mg/L for nitrate.
# ADWG (2011) heath guideline is 3 mg/L for nitrite and 50 mg/L for nitrate.

Analytes	Units	LOR	MB4A				MB5			MB6			ANZECC 2000	ADWG (2011)	
Aquifer	-	-	Walloon Coal Measures				Walloon Coal Measures			Walloon Coal Measures			Livestock Drinking	Aesthetic	Health
Date Sampled	-	-	10/10/2009	25/11/2009	21/01/2010	09/07/2011	14/10/2009	26/11/2009	22/01/2010	09/10/2009	26/11/2009	20/01/2010			
Physical Properties															
Field pH Value	pH Unit	0.01	7.46	7.39	7.28	7.59	7.76	7.71	7.58	6.94	7.02	7.05	-	6.5 - 8.5	-
Electrical Conductivity @ 25°C	µS/cm	1	7360	8310	8920	5100	8890	7900	7300	18100	12000	14100	-	-	-
Total Dissolved Solids @180°C	mg/L	5	**4830**	**4240**	**4460**	2660	**4220**	**4060**	**4670**	**13400**	**7290**	**8790**	3000-13000*	600	-
Alkalinity															
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Bicarbonate Alkalinity as CaCO3	mg/L	1	285	301	281	205	399	418	405	555	503	523	-	-	-
Total Alkalinity as CaCO3	mg/L	1	285	301	281	205	399	418	405	555	503	523	-	-	-
Major Ions															
Calcium	mg/L	1	49	45	44	33	20	19	19	602	224	333	1000	-	-
Chloride	mg/L	1	2810	3060	3090	1480	2670	2420	2090	6310	4580	4940	-	250	-
Magnesium	mg/L	1	18	16	14	9	7	6	6	159	61	84	-	-	-
Potassium	mg/L	1	15	13	11	11	8	6	6	16	11	11	-	-	-
Sodium	mg/L	1	1740	1860	2010	1010	1700	1820	1600	3160	2640	2800	-	180	-
Sulfate	mg/L	1	20	17	20	2	<1	<1	<1	25	10	14	1000	250	500
Disolved Metals															
Aluminium	mg/L	0.01	0.02	0.02	0.02	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5	-	-
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Arsenic	mg/L	0.001	0.001	0.002	<0.001	0.001	0.002	0.002	0.002	<0.001	<0.001	0.001	0.5	-	-
Barium	mg/L	0.001	1.54	1.47	1.36	1.04	1.08	1.14	1.06	6.65	4.32	4.64	-	-	-
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Boron	mg/L	0.05	0.23	0.23	0.16	0.11	0.2	0.21	0.15	0.28	0.27	0.2	5	-	-
Cadmium	mg/L	0.0001	0.0002	0.003	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	-	-
Chromium	mg/L	0.001	0.003	0.008	<0.001	0.001	0.002	0.006	<0.001	0.002	0.01	<0.001	1	-	-
Copper	mg/L	0.001	0.004	0.024	0.003	<0.001	0.002	0.002	0.002	0.003	0.003	0.001	0.5	-	-
Iron	mg/L	0.05	0.09	0.32	0.21	0.42	<0.05	0.17	0.1	1.94	3	2.98	-	-	-
Lead	mg/L	0.001	0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	-
Lithium	mg/L	0.001	0.149	0.159	0.115	0.084	0.104	0.111	0.085	0.302	0.23	0.183	-	-	-
Manganese	mg/L	0.001	0.08	0.088	0.063	0.106	0.021	0.014	0.011	0.503	0.262	0.306	-	-	-
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-
Molybdenum	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.15	-	-
Nickel	mg/L	0.001	0.009	0.006	0.002	0.002	0.002	<0.001	<0.001	<0.001	0.004	<0.001	1	-	-
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	-	-
Silver	mg/L	0.001	0.001	0.003	<0.001	<0.001	<0.001	0.001	<0.001	0.001	0.002	<0.001	-	-	-
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.2	-	-
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-
Zinc	mg/L	0.005	0.027	0.014	0.005	0.006	0.011	0.006	0.005	0.008	0.006	0.008	20	-	-
Total Metals															
Aluminium	mg/L	0.01	-	-	-	0.43	-	-	-	-	-	-	5	0.2	-
Antimony	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	-	-	0.003
Arsenic	mg/L	0.001	-	-	-	0.003	-	-	-	-	-	-	0.5	-	0.01
Barium	mg/L	0.001	-	-	-	0.935	-	-	-	-	-	-	-	-	2
Beryllium	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	-	-	0.06
Boron	mg/L	0.05	-	-	-	0.09	-	-	-	-	-	-	5	-	4
Cadmium	mg/L	0.0001	-	-	-	<0.0001	-	-	-	-	-	-	0.01	-	0.002
Chromium	mg/L	0.001	-	-	-	0.007	-	-	-	-	-	-	1	-	0.05
Copper	mg/L	0.001	-	-	-	0.007	-	-	-	-	-	-	0.5	1	2
Iron	mg/L	0.05	-	-	-	1.6	-	-	-	-	-	-	-	0.3	-
Lead	mg/L	0.001	-	-	-	0.016	-	-	-	-	-	-	0.1	-	0.01
Lithium	mg/L	0.001	-	-	-	0.086	-	-	-	-	-	-	-	-	-
Manganese	mg/L	0.001	-	-	-	0.14	-	-	-	-	-	-	-	0.1	0.5
Mercury	mg/L	0.0001	-	-	-	<0.0001	-	-	-	-	-	-	0.002	-	0.001
Molybdenum	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	0.15	-	0.05
Nickel	mg/L	0.001	-	-	-	0.007	-	-	-	-	-	-	1	-	0.02
Selenium	mg/L	0.01	-	-	-	<0.01	-	-	-	-	-	-	0.02	-	0.01
Silver	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	-	-	0.1
Uranium	mg/L	0.001	-	-	-	<0.001	-	-	-	-	-	-	0.2	-	0.017
Vanadium	mg/L	0.01	-	-	-	<0.01	-	-	-	-	-	-	-	-	-
Zinc	mg/L	0.005	-	-	-	0.268	-	-	-	-	-	-	20	3	-
Nutrients															
Nitrite + Nitrate as N	mg/L	0.01	0.07	0.04	<0.01	0.22	0.07	0.01	<0.01	0.37	0.02	0.02	30-400^	-	3-50#
Total Kjeldahl Nitrogen as N	mg/L	0.1	1.2	0.9	1.4	1.2	0.9	0.8	1.1	1.2	0.9	1.7	-	-	-
Total Nitrogen as N	mg/L	0.1	1.3	0.9	1.4	1.4	1	0.8	1.1	1.6	1	1.8	-	-	-
Total Phosphorus as P	mg/L	0.01	<0.01	<0.01	0.11	0.16	0.04	0.02	0.02	<0.01	<0.01	0.22	-	-	-

(green)	Transgressed Australian Drinking Water Guidelines (2011) aesthetic guideline value.
(red)	Exceeds Australian Drinking Water Guidelines (2011) health guideline value.
1000	Exceeds ANZECC (2000) livestock drinking water guideline value.
1000	Laboratory holding time breached.
*	Guideline Value depends on type of livestock.
^	ANZECC (2000) livestock guideline is 30 mg/L for nitrite and 400 mg/L for nitrate.
#	ADWG (2011) heath guideline is 3 mg/L for nitrite and 50 mg/L for nitrate.

Analytes	Units	LOR	MB7A				MB8A				MB9	ANZECC 2000	ADWG (2011)	
Aquifer	-	-	Walloon Coal Measures				Walloon Coal Measures				Walloon CM	Livestock Drinking	Aesthetic	Health
Date Sampled	-	-	08/10/2009	27/11/2009	20/01/2010	10/03/2011	11/10/2009	28/11/2009	24/01/2010	10/03/2011	16-Oct-09			
Physical Properties														
Field pH Value	pH Unit	0.01	7.8	7.77	7.86	7.94	7.76	7.72	7.7	7.96	7.52	-	6.5 - 8.5	-
Electrical Conductivity @ 25°C	µS/cm	1	7330	7370	7820	7610	6970	6520	5900	6890	12700	-	-	-
Total Dissolved Solids @180°C	mg/L	5	**4040**	**3960**	**4010**	**3920**	**3730**	**3380**	**3730**	**3490**	**6690**	3000-13000*	600	-
Alkalinity														
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Carbonate Alkalinity as CaCO3	mg/L	1	11	<1	<1	10	<1	<1	<1	15	<1	-	-	-
Bicarbonate Alkalinity as CaCO3	mg/L	1	504	537	525	495	635	665	641	513	335	-	-	-
Total Alkalinity as CaCO3	mg/L	1	514	537	525	505	635	665	641	528	335	-	-	-
Major Ions														
Calcium	mg/L	1	18	16	16	17	18	14	14	19	67	1000	-	-
Chloride	mg/L	1	2030	2150	2510	1940	1680	1820	1580	1740	4360	-	250	-
Magnesium	mg/L	1	5	5	5	5	6	4	4	4	16	-	-	-
Potassium	mg/L	1	7	6	6	8	9	5	5	7	14	-	-	-
Sodium	mg/L	1	1600	1650	1740	1600	1400	1500	1410	1470	2600	-	180	-
Sulfate	mg/L	1	2	<1	<1	<1	15	4	2	6	11	1000	250	500
Disolved Metals														
Aluminium	mg/L	0.01	0.01	<0.01	0.03	0.01	0.03	0.02	0.05	0.08	0.01	5	-	-
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Arsenic	mg/L	0.001	<0.001	0.002	<0.001	<0.001	0.005	0.002	0.004	0.003	<0.001	0.5	-	-
Barium	mg/L	0.001	0.941	1.38	0.832	0.945	0.312	0.436	0.391	0.51	1.79	-	-	-
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Boron	mg/L	0.05	0.22	0.19	0.16	0.16	0.21	0.21	0.16	0.16	0.24	5	-	-
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0003	<0.0001	0.0002	<0.0001	0.0001	0.01	-	-
Chromium	mg/L	0.001	0.002	0.005	<0.001	<0.005	0.004	0.009	<0.001	<0.001	0.003	1	-	-
Copper	mg/L	0.001	0.001	0.002	<0.001	<0.001	0.003	0.001	<0.001	<0.001	0.004	0.5	-	-
Iron	mg/L	0.05	0.12	0.14	0.07	0.1	0.09	0.08	0.05	0.18	0.1	-	-	-
Lead	mg/L	0.001	<0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001	<0.001	0.071	0.1	-	-
Lithium	mg/L	0.001	0.11	0.146	0.084	0.096	0.065	0.091	0.072	0.083	0.182	-	-	-
Manganese	mg/L	0.001	0.005	0.013	0.004	0.005	0.057	0.027	0.036	0.057	0.045	-	-	-
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-
Molybdenum	mg/L	0.001	<0.001	0.002	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.004	0.15	-	-
Nickel	mg/L	0.001	0.002	0.002	<0.001	0.001	0.004	0.001	0.001	<0.001	0.007	1	-	-
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	-	-
Silver	mg/L	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	-	-	-
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	0.2	-	-
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-
Zinc	mg/L	0.005	0.007	0.005	<0.005	0.008	0.029	0.011	0.006	0.008	0.025	20	-	-
Total Metals														
Aluminium	mg/L	0.01	-	-	-	0.16	-	-	-	**14.9**	-	5	0.2	-
Antimony	mg/L	0.001	-	-	-	0.001	-	-	-	<0.001	-	-	-	0.003
Arsenic	mg/L	0.001	-	-	-	<0.001	-	-	-	0.005	-	0.5	-	0.01
Barium	mg/L	0.001	-	-	-	0.993	-	-	-	1.53	-	-	-	2
Beryllium	mg/L	0.001	-	-	-	<0.001	-	-	-	0.003	-	-	-	0.06
Boron	mg/L	0.05	-	-	-	0.16	-	-	-	0.17	-	5	-	4
Cadmium	mg/L	0.0001	-	-	-	<0.0001	-	-	-	0.0004	-	0.01	-	0.002
Chromium	mg/L	0.001	-	-	-	0.005	-	-	-	0.016	-	1	-	0.05
Copper	mg/L	0.001	-	-	-	0.004	-	-	-	0.02	-	0.5	1	2
Iron	mg/L	0.05	-	-	-	0.49	-	-	-	15.4	-	-	0.3	-
Lead	mg/L	0.001	-	-	-	0.096	-	-	-	0.057	-	0.1	-	0.01
Lithium	mg/L	0.001	-	-	-	0.111	-	-	-	0.103	-	-	-	-
Manganese	mg/L	0.001	-	-	-	0.009	-	-	-	0.34	-	-	0.1	0.5
Mercury	mg/L	0.0001	-	-	-	<0.0001	-	-	-	<0.0001	-	0.002	-	0.001
Molybdenum	mg/L	0.001	-	-	-	<0.001	-	-	-	<0.001	-	0.15	-	0.05
Nickel	mg/L	0.001	-	-	-	0.004	-	-	-	0.042	-	1	-	0.02
Selenium	mg/L	0.01	-	-	-	<0.01	-	-	-	<0.01	-	0.02	-	0.01
Silver	mg/L	0.001	-	-	-	<0.001	-	-	-	<0.001	-	-	-	0.1
Uranium	mg/L	0.001	-	-	-	<0.001	-	-	-	0.004	-	0.2	-	0.017
Vanadium	mg/L	0.01	-	-	-	<0.01	-	-	-	0.03	-	-	-	-
Zinc	mg/L	0.005	-	-	-	0.026	-	-	-	0.107	-	20	3	-
Nutrients														
Nitrite + Nitrate as N	mg/L	0.01	0.05	<0.01	0.04	0.04	0.18	0.08	0.01	0.08	0.31	30-400^	-	3-50#
Total Kjeldahl Nitrogen as N	mg/L	0.1	0.8	0.2	1.4	1.1	1.5	0.7	0.9	1.1	1.4	-	-	-
Total Nitrogen as N	mg/L	0.1	0.9	0.2	1.4	1.1	1.7	0.8	0.9	1.2	1.7	-	-	-
Total Phosphorus as P	mg/L	0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.09	0.07	0.17	<0.01	-	-	-

(green shading)	Transgressed Australian Drinking Water Guidelines (2011) aesthetic guideline value.
(pink shading)	Exceeds Australian Drinking Water Guidelines (2011) health guideline value.
1000	Exceeds ANZECC (2000) livestock drinking water guideline value.
1000 (red)	Laboratory holding time breached.
*	Guideline Value depends on type of livestock.
^	ANZECC (2000) livestock guideline is 30 mg/L for nitrite and 400 mg/L for nitrate.
#	ADWG (2011) heath guideline is 3 mg/L for nitrite and 50 mg/L for nitrate.

Analytes	Units	LOR	MB10			MB11			MB12			ANZECC 2000	ADWG (2011)	
Aquifer	-	-	Walloon Coal Measures			Walloon Coal Measures			Walloon Coal Measures			Livestock Drinking	Aesthetic	Health
Date Sampled	-	-	13/10/2009	29/11/2009	22/01/2010	15/10/2009	29/11/2009	23/01/2010	12/10/2009	27/11/2009	23/01/2010			
Physical Properties														
Field pH Value	pH Unit	0.01	7.64	7.67	7.6	7.76	7.66	7.47	7.76	7.69	7.54	-	6.5 - 8.5	-
Electrical Conductivity @ 25°C	µS/cm	1	3690	4200	4120	6950	6570	5930	9470	8850	7950	-	-	-
Total Dissolved Solids @180°C	mg/L	5	2460	2730	2570	**3550**	**3640**	**3830**	**4160**	**4350**	**4540**	3000-13000*	600	-
Alkalinity														
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	18	<1	<1	<1	<1	<1	<1	-	-	-
Bicarbonate Alkalinity as CaCO3	mg/L	1	1280	1340	1260	515	545	528	331	347	333	-	-	-
Total Alkalinity as CaCO3	mg/L	1	1280	1340	1280	515	545	528	331	347	333	-	-	-
Major Ions														
Calcium	mg/L	1	16	15	17	17	15	15	28	28	29	1000	-	-
Chloride	mg/L	1	750	803	769	1710	1860	1590	2960	3320	3090	-	250	-
Magnesium	mg/L	1	6	6	6	6	3	3	6	6	6	-	-	-
Potassium	mg/L	1	4	5	4	8	5	5	9	8	7	-	-	-
Sodium	mg/L	1	968	1080	1020	1400	1480	1280	1860	2220	1950	-	180	-
Sulfate	mg/L	1	2	<1	<1	7	1	<1	8	4	3	1000	250	500
Disolved Metals														
Aluminium	mg/L	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.07	5	-	-
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	0.002	0.001	0.001	0.001	0.002	<0.001	0.5	-	-
Barium	mg/L	0.001	0.645	0.682	0.643	0.313	0.541	0.496	1.26	0.951	1.25	-	-	-
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Boron	mg/L	0.05	0.31	0.31	0.25	0.25	0.24	0.18	0.18	0.22	0.14	5	-	-
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	0.0003	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	-	-
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	0.003	0.001	<0.001	1	-	-
Copper	mg/L	0.001	<0.001	0.002	0.001	0.002	0.002	<0.001	0.003	<0.001	<0.001	0.5	-	-
Iron	mg/L	0.05	0.11	<0.05	<0.05	0.08	0.05	0.08	0.09	0.07	0.07	-	-	-
Lead	mg/L	0.001	0.002	0.009	0.002	0.006	0.003	0.001	0.036	<0.001	<0.001	0.1	-	-
Lithium	mg/L	0.001	0.09	0.103	0.08	0.078	0.098	0.07	0.123	0.12	0.11	-	-	-
Manganese	mg/L	0.001	0.01	0.006	0.005	0.05	0.016	0.014	0.022	0.004	0.012	-	-	-
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.012	<0.001	0.001	0.15	-	-
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	0.005	<0.001	<0.001	1	-	-
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	-	-
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	-	-	-
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.2	-	-
Vanadium	mg/L	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-
Zinc	mg/L	0.005	0.008	0.008	0.006	0.011	0.006	<0.005	0.015	0.008	0.005	20	-	-
Total Metals														
Aluminium	mg/L	0.01	-	-	-	-	-	-	-	-	-	5	0.2	-
Antimony	mg/L	0.001	-	-	-	-	-	-	-	-	-	-	-	0.003
Arsenic	mg/L	0.001	-	-	-	-	-	-	-	-	-	0.5	-	0.01
Barium	mg/L	0.001	-	-	-	-	-	-	-	-	-	-	-	2
Beryllium	mg/L	0.001	-	-	-	-	-	-	-	-	-	-	-	0.06
Boron	mg/L	0.05	-	-	-	-	-	-	-	-	-	5	-	4
Cadmium	mg/L	0.0001	-	-	-	-	-	-	-	-	-	0.01	-	0.002
Chromium	mg/L	0.001	-	-	-	-	-	-	-	-	-	1	-	0.05
Copper	mg/L	0.001	-	-	-	-	-	-	-	-	-	0.5	1	2
Iron	mg/L	0.05	-	-	-	-	-	-	-	-	-	-	0.3	-
Lead	mg/L	0.001	-	-	-	-	-	-	-	-	-	0.1	-	0.01
Lithium	mg/L	0.001	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	mg/L	0.001	-	-	-	-	-	-	-	-	-	-	0.1	0.5
Mercury	mg/L	0.0001	-	-	-	-	-	-	-	-	-	0.002	-	0.001
Molybdenum	mg/L	0.001	-	-	-	-	-	-	-	-	-	0.15	-	0.05
Nickel	mg/L	0.001	-	-	-	-	-	-	-	-	-	1	-	0.02
Selenium	mg/L	0.01	-	-	-	-	-	-	-	-	-	0.02	-	0.01
Silver	mg/L	0.001	-	-	-	-	-	-	-	-	-	-	-	0.1
Uranium	mg/L	0.001	-	-	-	-	-	-	-	-	-	0.2	-	0.017
Vanadium	mg/L	0.01	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	mg/L	0.005	-	-	-	-	-	-	-	-	-	20	3	-
Nutrients														
Nitrite + Nitrate as N	mg/L	0.01	0.04	<0.01	<0.01	0.06	<0.01	0.01	0.04	0.03	0.04	30-400^	-	3-50#
Total Kjeldahl Nitrogen as N	mg/L	0.1	0.5	0.1	0.4	0.9	0.6	1.5	0.9	0.9	1.4	-	-	-
Total Nitrogen as N	mg/L	0.1	0.5	0.1	0.4	1	0.6	1.5	0.9	0.9	1.4	-	-	-
Total Phosphorus as P	mg/L	0.01	<0.01	0.02	<0.01	<0.01	0.03	0.06	<0.01	<0.01	0.04	-	-	-

(green)	Transgressed Australian Drinking Water Guidelines (2011) aesthetic guideline value.
(pink)	Exceeds Australian Drinking Water Guidelines (2011) health guideline value.
1000	Exceeds ANZECC (2000) livestock drinking water guideline value.
1000	Laboratory holding time breached.
*	Guideline Value depends on type of livestock.
^	ANZECC (2000) livestock guideline is 30 mg/L for nitrite and 400 mg/L for nitrate.
#	ADWG (2011) heath guideline is 3 mg/L for nitrite and 50 mg/L for nitrate.

Analytes	Units	LOR	MB7B	MB8B	MB14	MB15	MB16	MB17	ANZECC 2000	ADWG (2011)	
									Livestock Drinking	Aesthetic	Health
Aquifer	-	-	Horse Creek Alluvium	Horse Creek Alluvium	Horse Creek Alluvium	Horse Creek Alluvium	Horse Creek Alluvium	Alluvium			
Date Sampled	-	-	10/03/2011	10/03/2011	08/07/2011	08/07/2011	05/07/2011	07/07/2011			
Physical Properties											
Field pH Value	pH Unit	0.01	7.08	7.08	7.51	7.27	7.02	7.32	-	6.5 - 8.5	-
Electrical Conductivity @ 25°C	µS/cm	1	877	840	1740	4850	689	1700	-	-	-
Total Dissolved Solids @180°C	mg/L	5	552	521	1130	2920	418	1040	3000-13000*	600	-
Alkalinity											
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	-	-	-
Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	-	-	-
Bicarbonate Alkalinity as CaCO3	mg/L	1	341	387	525	574	278	573	-	-	-
Total Alkalinity as CaCO3	mg/L	1	341	387	525	574	278	573	-	-	-
Major Ions											
Calcium	mg/L	1	24	52	17	128	42	30	1000	-	-
Chloride	mg/L	1	52	26	222	1040	30	171	-	250	-
Magnesium	mg/L	1	5	9	5	40	9	28	-	-	-
Potassium	mg/L	1	10	10	1	4	4	1	-	-	-
Sodium	mg/L	1	158	117	365	872	94	308	-	180	-
Sulfate	mg/L	1	24	17	57	333	24	82	1000	250	500
Disolved Metals											
Aluminium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5	0.2	-
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	0.003
Arsenic	mg/L	0.001	0.003	<0.001	0.003	0.003	0.001	0.002	0.5	-	0.01
Barium	mg/L	0.001	0.164	0.157	0.034	0.086	0.056	0.059	-	-	2
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	0.06
Boron	mg/L	0.05	0.16	0.13	<0.05	0.17	0.06	0.06	5	-	4
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	-	0.002
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1	-	0.05
Copper	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.5	1	2
Iron	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	-	0.3	-
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.1	-	0.01
Lithium	mg/L	0.001	0.003	0.016	0.011	0.048	0.011	0.019	-	-	-
Manganese	mg/L	0.001	<0.001	<0.001	0.002	0.102	0.1	0.971	-	0.1	0.5
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	0.001
Molybdenum	mg/L	0.001	<0.001	0.001	0.007	0.004	0.002	0.003	0.15	-	0.05
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1	-	0.02
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	**0.02**	<0.01	<0.01	0.02	-	0.01
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	0.1
Uranium	mg/L	0.001	0.002	0.003	0.005	0.016	0.002	0.004	0.2	-	0.017
Vanadium	mg/L	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-
Zinc	mg/L	0.005	<0.005	0.005	<0.005	0.006	0.007	<0.005	20	3	-
Total Metals											
Aluminium	mg/L	0.01	0.14	**8.91**	0.02	1.47	0.02	0.04	5	-	-
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Arsenic	mg/L	0.001	0.002	0.001	0.002	0.003	0.001	0.002	0.5	-	-
Barium	mg/L	0.001	0.161	0.225	0.037	0.095	0.059	0.064	-	-	-
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Boron	mg/L	0.05	0.17	0.13	<0.05	0.16	0.05	0.05	5	-	-
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01	-	-
Chromium	mg/L	0.001	<0.001	0.006	<0.001	0.002	<0.001	<0.001	1	-	-
Copper	mg/L	0.001	<0.001	0.005	0.001	0.004	<0.001	0.001	0.5	-	-
Iron	mg/L	0.05	0.16	2.53	<0.05	1.68	<0.05	0.18	-	-	-
Lead	mg/L	0.001	0.019	0.063	<0.001	0.003	<0.001	<0.001	0.1	-	-
Lithium	mg/L	0.001	0.004	0.018	0.012	0.052	0.011	0.02	-	-	-
Manganese	mg/L	0.001	0.004	0.221	0.032	0.135	0.103	1.04	-	-	-
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-
Molybdenum	mg/L	0.001	<0.001	<0.001	0.007	0.002	<0.001	0.003	0.15	-	-
Nickel	mg/L	0.001	<0.001	0.009	0.001	0.002	<0.001	0.001	1	-	-
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	0.02	-	-
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Uranium	mg/L	0.001	0.002	0.004	0.005	0.016	0.002	0.004	0.2	-	-
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-
Zinc	mg/L	0.005	0.011	0.028	<0.005	0.047	<0.005	<0.005	20	-	-
Nutrients											
Nitrite + Nitrate as N	mg/L	0.01	0.06	0.17	1.11	1.92	0.03	0.06	30-400^	-	3
Total Kjeldahl Nitrogen as N	mg/L	0.1	0.1	0.2	3	0.3	0.3	0.4	-	-	-
Total Nitrogen as N	mg/L	0.1	0.2	0.4	4.1	2.2	0.3	0.5	-	-	-
Total Phosphorus as P	mg/L	0.01	0.51	0.11	0.32	0.21	0.11	<0.01	-	-	-

(green shading)	Transgressed Australian Drinking Water Guidelines (2011) aesthetic guideline value.
(pink shading)	Exceeds Australian Drinking Water Guidelines (2011) health guideline value.
1000	Exceeds ANZECC (2000) livestock drinking water guideline value.
1000 (red)	Laboratory holding time breached.
*	Guideline Value depends on type of livestock.
^	ANZECC (2000) livestock guideline is 30 mg/L for nitrite and 400 mg/L for nitrate.
#	ADWG (2011) heath guideline is 3 mg/L for nitrite and 50 mg/L for nitrate.

Analytes	Units	LOR	MB1B				MB3B				MB4B				ANZECC 2000	ADWG (2011)	
Aquifer	-	-	Alluvium				Horse Creek Alluvium				Horse Creek Alluvium				Livestock Drinking	Aesthetic	Health
Date Sampled	-	-	09/10/2009	25/11/2009	21/01/2010	08/07/2011	07/10/2009	26/11/2009	20/01/2010	09/07/2011	09/10/2009	25/11/2009	21/01/2010	09/07/2011			
Physical Properties																	
Field pH Value	pH Unit	0.01	8.15	7.61	7.58	7.57	6.68	6.73	6.87	6.89	6.98	6.76	6.85	7.43	-	6.5 - 8.5	-
Electrical Conductivity @ 25°C	µS/cm	1	1370	1340	1540	1350	2630	2760	2650	1730	6340	6820	7230	1370	-	-	-
Total Dissolved Solids @180°C	mg/L	5	875	900	1040	925	1610	1820	1540	1020	-	**4450**	**4610**	908	3000-13000*	600	-
Alkalinity																	
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Carbonate Alkalinity as CaCO3	mg/L	1	<1	20	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-
Bicarbonate Alkalinity as CaCO3	mg/L	1	626	577	697	610	660	701	580	458	229	663	674	415	-	-	-
Total Alkalinity as CaCO3	mg/L	1	626	597	697	610	660	701	580	458	229	663	674	415	-	-	-
Major Ions																	
Calcium	mg/L	1	11	10	11	14	160	168	147	62	104	127	136	9	1000	-	-
Chloride	mg/L	1	64	60	101	55	557	584	555	261	1370	1610	1590	125	-	250	-
Magnesium	mg/L	1	4	4	4	5	42	38	33	21	82	91	88	5	-	-	-
Potassium	mg/L	1	<1	<1	<1	<1	3	3	2	2	35	28	24	7	-	-	-
Sodium	mg/L	1	327	325	356	314	427	435	366	284	1150	1390	1310	288	-	180	-
Sulfate	mg/L	1	38	31	36	24	114	73	38	36	669	763	747	86	1000	250	500
Disolved Metals																	
Aluminium	mg/L	0.01	0.01	<0.01	0.06	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	5	-	-
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	-	-	-
Arsenic	mg/L	0.001	0.004	0.004	0.004	0.004	0.001	0.001	0.001	<0.001	0.004	0.01	0.005	0.008	0.5	-	-
Barium	mg/L	0.001	0.027	0.025	0.028	0.034	0.238	0.168	0.143	0.109	0.196	0.148	0.087	0.024	-	-	-
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Boron	mg/L	0.05	0.2	0.18	0.12	0.07	0.15	0.14	0.1	0.14	0.35	0.35	0.25	0.13	5	-	-
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0015	<0.0001	<0.0001	<0.0001	0.0004	<0.0001	<0.0001	<0.0001	0.01	-	-
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.011	<0.001	<0.001	0.002	0.009	<0.001	<0.001	1	-	-
Copper	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	0.002	0.004	0.001	<0.001	0.002	0.5	-	-
Iron	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.56	<0.05	<0.05	0.24	3.17	0.68	<0.05	-	-	-
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.012	<0.001	<0.001	<0.001	0.1	-	-
Lithium	mg/L	0.001	0.006	0.004	0.006	0.009	0.042	0.043	0.029	0.028	0.04	0.047	0.034	0.014	-	-	-
Manganese	mg/L	0.001	0.04	0.007	0.032	<0.001	1.18	1.03	0.236	0.004	1.87	2.03	0.867	0.013	-	-	-
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	-	-
Molybdenum	mg/L	0.001	0.004	0.004	0.004	0.002	0.003	0.002	0.001	0.001	0.003	0.001	0.002	0.002	0.15	-	-
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.004	<0.001	<0.001	0.029	0.011	0.013	0.004	1	-	-
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	-	-
Silver	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	-	-	-
Uranium	mg/L	0.001	0.004	0.003	0.003	0.002	0.008	0.007	0.006	0.004	0.005	0.004	0.006	0.001	0.2	-	-
Vanadium	mg/L	0.01	0.02	0.03	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	-	-	-
Zinc	mg/L	0.005	0.006	<0.005	0.005	0.013	0.018	0.016	0.012	0.005	0.046	0.01	0.008	0.012	20	-	-
Total Metals																	
Aluminium	mg/L	0.01	-	-	-	**14.3**	-	-	-	0.56	-	-	-	0.57	5	0.2	-
Antimony	mg/L	0.001	-	-	-	<0.001	-	-	-	<0.001	-	-	-	<0.001	-	-	0.003
Arsenic	mg/L	0.001	-	-	-	0.004	-	-	-	0.002	-	-	-	0.007	0.5	-	0.01
Barium	mg/L	0.001	-	-	-	0.348	-	-	-	0.105	-	-	-	0.033	-	-	2
Beryllium	mg/L	0.001	-	-	-	0.002	-	-	-	<0.001	-	-	-	<0.001	-	-	0.06
Boron	mg/L	0.05	-	-	-	<0.05	-	-	-	0.11	-	-	-	0.11	5	-	4
Cadmium	mg/L	0.0001	-	-	-	0.0002	-	-	-	<0.0001	-	-	-	<0.0001	0.01	-	0.002
Chromium	mg/L	0.001	-	-	-	0.007	-	-	-	0.002	-	-	-	0.003	1	-	0.05
Copper	mg/L	0.001	-	-	-	0.021	-	-	-	0.003	-	-	-	0.007	0.5	1	2
Iron	mg/L	0.05	-	-	-	10.5	-	-	-	0.69	-	-	-	0.79	-	0.3	-
Lead	mg/L	0.001	-	-	-	0.026	-	-	-	0.016	-	-	-	0.018	0.1	-	0.01
Lithium	mg/L	0.001	-	-	-	0.021	-	-	-	0.029	-	-	-	0.016	-	-	-
Manganese	mg/L	0.001	-	-	-	0.669	-	-	-	0.107	-	-	-	0.109	-	0.1	0.5
Mercury	mg/L	0.0001	<0.0001	-	-	<0.0001	-	-	-	<0.0001	-	-	-	<0.0001	0.002	-	0.001
Molybdenum	mg/L	0.001	-	-	-	<0.001	-	-	-	<0.001	-	-	-	<0.001	0.15	-	0.05
Nickel	mg/L	0.001	-	-	-	0.014	-	-	-	0.003	-	-	-	0.01	1	-	0.02
Selenium	mg/L	0.01	-	-	-	<0.01	-	-	-	<0.01	-	-	-	<0.01	0.02	-	0.01
Silver	mg/L	0.001	-	-	-	<0.001	-	-	-	<0.001	-	-	-	<0.001	-	-	0.1
Uranium	mg/L	0.001	-	-	-	0.002	-	-	-	0.004	-	-	-	0.001	0.2	-	0.017
Vanadium	mg/L	0.01	-	-	-	0.04	-	-	-	<0.01	-	-	-	0.02	-	-	-
Zinc	mg/L	0.005	-	-	-	0.085	-	-	-	0.037	-	-	-	0.014	20	3	-
Nutrients																	
Nitrite + Nitrate as N	mg/L	0.01	2.73	0.18	<0.01	0.14	0.15	0.06	0.2	0.69	0.18	0.06	0.14	0.07	30-400^	-	3
Total Kjeldahl Nitrogen as N	mg/L	0.1	0.3	0.2	0.2	0.5	0.4	0.2	0.5	0.3	0.9	<0.1	0.5	0.3	-	-	-
Total Nitrogen as N	mg/L	0.1	3.1	0.3	0.2	0.6	0.6	0.3	0.7	1	1	<0.1	0.6	0.4	-	-	-
Total Phosphorus as P	mg/L	0.01	0.05	0.09	0.15	0.05	0.05	0.03	<0.01	0.08	0.02	0.16	0.04	0.75	-	-	-

(green)	Transgressed Australian Drinking Water Guidelines (2011) aesthetic guideline value.
(pink)	Exceeds Australian Drinking Water Guidelines (2011) health guideline value.
1000	Exceeds ANZECC (2000) livestock drinking water guideline value.
1000	Laboratory holding time breached.
*	Guideline Value depends on type of livestock.
^	ANZECC (2000) livestock guideline is 30 mg/L for nitrite and 400 mg/L for nitrate.
#	ADWG (2011) heath guideline is 3 mg/L for nitrite and 50 mg/L for nitrate.

Appendix 2

SIMULATED AND MEASURED GROUNDWATER LEVELS

Table A2.1: OBSERVED AND MODELLED HEADS – DERM BORES					
RN / Bore ID	Easting	Northing	Observed Head (mAHD)	Modelled Head (mAHD)	Head Difference
16511	757277	7134349	223.11	215.19	7.92
58005	778387	7130161	200.80	203.06	-2.26
18197	778951	7129164	198.01	204.78	-6.77
11714	751011	7128589	223.84	218.16	5.68
14889	767668	7127551	210.93	217.79	-6.86
14618	756263	7126671	256.62	223.53	33.09
15765	786111	7125437	200.08	205.42	-5.34
15780	776854	7124835	187.19	216.20	-29.01
15781	781086	7124837	210.41	211.39	-0.98
15857	786529	7124195	200.88	207.30	-6.42
16119	753714	7122964	189.61	228.61	-39.00
48810	753854	7123022	194.11	228.61	-34.50
58612	755244	7122934	207.96	228.74	-20.78
58064	765955	7122751	221.51	225.35	-3.84
17753	769829	7122980	214.84	224.58	-9.74
15838	770384	7122937	209.49	224.37	-14.88
15831	781592	7122455	197.11	215.54	-18.43
15836	787079	7122613	183.41	209.97	-26.56
14649	747989	7121872	230.46	227.70	2.76
15854	776103	7122202	236.38	223.12	13.26
43380	772057	7121733	226.41	226.84	-0.43
17800	785695	7121719	214.96	212.09	2.87
17799	786377	7121057	212.66	212.52	0.14
16191	774489	7118263	222.38	231.11	-8.73
58537	765297	7117745	213.61	234.91	-21.30
16080	776979	7117564	242.89	230.15	12.74
44246	764476	7117053	233.89	236.06	-2.17
58079	768179	7115838	240.89	238.98	1.91
15761	777189	7115681	237.67	233.42	4.25
48803	737484	7114955	267.66	246.11	21.55
16040	773889	7114857	233.53	237.71	-4.18
14744	758294	7113740	247.91	241.96	5.95
58297	768857	7113606	248.98	243.58	5.40
11590	753250	7113396	252.87	246.74	6.13
15828	783805	7112859	240.25	227.31	12.94
14533	750446	7112188	279.44	251.20	28.24
15989	759061	7111927	236.76	244.06	-7.30
15989	759061	7111927	236.76	242.91	-6.15
34929	770047	7112012	258.79	246.78	12.01
15855	783315	7112069	234.66	229.30	5.36
34708	766592	7110327	246.89	252.24	-5.35
14743	758565	7109882	249.48	248.31	1.17
33821	757641	7109030	253.93	248.09	5.84
34718	773331	7109479	262.80	249.71	13.09
34709	767306	7108527	253.27	256.29	-3.02
16789	768973	7108492	260.98	257.05	3.93

Table A2.1: OBSERVED AND MODELLED HEADS – DERM BORES					
RN / Bore ID	**Easting**	**Northing**	**Observed Head (mAHD)**	**Modelled Head (mAHD)**	**Head Difference**
16939	747568	7107070	255.49	266.80	-11.31
36143	739505	7106913	276.47	269.37	7.10
16942	749776	7106258	275.58	268.84	6.74
16945	749040	7105533	234.83	270.68	-35.85
32259	756299	7105823	266.01	257.04	8.97
32259	756299	7105823	269.21	257.04	12.17
33435	761713	7105561	244.08	260.23	-16.15
16135	764241	7105479	268.58	269.16	-0.58
48965	765930	7105167	326.84	302.24	24.60
12763	795570	7105451	226.39	230.83	-4.44
16944	747248	7104859	260.25	274.30	-14.05
16941	749420	7103647	259.81	276.75	-16.94
16946	745604	7103166	303.56	283.04	20.52
16943	746552	7103302	269.56	280.66	-11.10
37479	763605	7102905	298.38	270.85	27.53
43660	739979	7102440	275.59	280.74	-5.15
35842	763565	7100904	326.37	280.33	46.04
16102	753137	7100434	282.29	290.26	-7.97
58009	775800	7100064	280.56	266.69	13.87
58009	775800	7100064	279.61	265.03	14.58
58609	778002	7100356	261.70	258.80	2.90
15967	760184	7099956	233.69	263.49	-29.80
48806	765903	7099748	297.39	310.16	-12.77
30553	763805	7099052	288.78	281.98	6.80
14893	756988	7098511	278.93	287.30	-8.37
44699	770463	7098606	286.65	297.32	-10.67
15759	739901	7098254	291.82	287.62	4.20
12464	742123	7098243	288.17	295.41	-7.24
43686	737664	7097897	310.12	287.73	22.39
17947	743783	7097904	299.84	291.90	7.94
36486	753766	7097096	323.98	319.28	4.70
37343	740706	7096730	303.99	289.57	14.42

Table A2.2: OBSERVED AND MODELLED HEADS – MONITORING BORES						
Bore ID	**Easting**	**Northing**	**Model Layer**	**Representative Head**	**Modelled Head (steady state)**	**Head Difference**
MB10	763542.5	7115938.9	2	232.00	238.00	-6.00
			3		238.00	-6.00
			4		238.00	-6.00
			5		238.00	-6.00
			6		238.00	-6.00
			7		238.00	-6.00
			8		238.00	-6.00
			11		238.04	-6.04

Table A2.2: OBSERVED AND MODELLED HEADS – MONITORING BORES						
Bore ID	Easting	Northing	Model Layer	Representative Head	Modelled Head (steady state)	Head Difference
MB11	763492.8	7113178.7	2	245.18	244.33	0.85
			3		244.32	0.86
			4		244.31	0.87
			5		244.31	0.87
			6		244.31	0.87
			7		244.30	0.88
			8		244.29	0.89
			11		244.21	0.97
MB12	759272.3	7115705.7	2	234.15	237.86	-3.71
			4		237.89	-3.74
			4		237.89	-3.74
			5		237.90	-3.75
			6		237.91	-3.76
			7		237.92	-3.77
			8		237.93	-3.78
			11		238.18	-4.03
MB1A	760997.4	7120001.6	3	239.62	231.53	8.09
			3		231.53	8.09
			4		231.53	8.09
			5		231.53	8.09
			6		231.53	8.09
			7		231.53	8.09
			8		231.53	8.09
			12		231.49	8.13
MB2	760367.3	7117880.0	3	235.00	234.43	0.57
			3		234.43	0.57
			4		234.43	0.57
			5		234.43	0.57
			6		234.44	0.56
			7		234.44	0.56
			8		234.44	0.56
			12		234.63	0.37
MB3A	763091.5	7117997.6	3	231.47	232.34	-0.87
			4		232.39	-0.92
			5		232.41	-0.94
			6		232.42	-0.95
			7		232.46	-0.99
			8		232.50	-1.03
			12		233.81	-2.34
MB4A	760348.3	7116954.4	3	234.19	235.15	-0.96
			3		235.15	-0.96
			4		235.15	-0.96
			5		235.15	-0.96
			6		235.15	-0.96
			7		235.16	-0.97
			8		235.17	-0.98
			12		235.89	-1.70

Table A2.2: OBSERVED AND MODELLED HEADS – MONITORING BORES						
Bore ID	**Easting**	**Northing**	**Model Layer**	**Representative Head**	**Modelled Head (steady state)**	**Head Difference**
MB5	762400.2	7116428.9	2	234.05	236.08	-2.03
			3		235.98	-1.93
			4		235.91	-1.86
			5		235.89	-1.84
			6		235.88	-1.83
			7		235.88	-1.83
			8		235.88	-1.83
			11		236.24	-2.19
MB6	761431.8	7114841.7	2	235.57	238.86	-3.29
			3		238.86	-3.29
			4		238.86	-3.29
			5		238.86	-3.29
			6		238.86	-3.29
			7		238.88	-3.31
			8		238.90	-3.33
			11		239.30	-3.73
MB7A	760017.0	7115206.8	2	235.19	235.63	-0.44
			3		236.23	-1.04
			4		236.84	-1.65
			5		236.94	-1.75
			6		237.03	-1.84
			7		237.09	-1.90
			8		237.14	-1.95
			11		238.19	-3.00
MB8A	759277.0	7112982.7	2	241.89	240.60	1.29
			3		240.87	1.02
			4		241.13	0.76
			5		241.22	0.67
			6		241.30	0.59
			7		241.41	0.48
			8		241.51	0.38
			11		242.41	-0.52
MB9	761753.2	7112703.5	2	236.76	244.37	-7.61
			3		244.37	-7.61
			4		244.36	-7.60
			5		244.36	-7.60
			6		244.36	-7.60
			7		244.35	-7.59
			8		244.35	-7.59
			11		244.35	-7.59

Australasian Groundwater
and Environmental Consultants Pty Ltd
Level 2 / 15 Mallon Street
Bowen Hills, QLD 4006 Australia

ABN 64 080 238 642
T. +61 7 3257 2055
F. +61 7 3257 2088
brisbane@ageconsultants.com.au
www.ageconsultants.com.au

JST/ae (G1438A.Elimatta)
14 November 2013

**RE: ELIMATTA COAL PROJECT
RESPONSE TO GOVERNMENT SUBMISSIONS**

1 INTRODUCTION

AustralAsian Resource Consultants Pty Ltd (AARC) is coordinating the environmental approvals process for the Elimatta Coal Project on behalf of New Hope Group. Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) prepared the technical report for the groundwater impact assessment. AARC has now requested AGE respond to submissions from the State Government on the groundwater impact assessment report, which is a component of the Environmental Impact Statement.

2 SCOPE OF WORK

The objective of the assessment was to respond to the Government submissions below.

- *The report needs to clearly identify the groundwater flow directions for all the aquifers in the area, both locally and regionally, any impacts of geological structures in the area. Refer also to groundwater-related comments provided elsewhere in this attachment.*

Regional scale studies in the Surat Basin have generally reported that groundwater flow occurs from the recharge areas (that outcrop in an arc from Warwick to Roma) to the south, south-west and west (QWC 2012). The exception to this, is the northern portion of the Surat Basin that is in Fitzroy River catchment and north the Great Dividing Range. In the Wandoan region (north of the Great Dividing Range), available data indicates groundwater generally flows towards the north, north-east. Hodgkinson *et al*. (2009) noted that topography controls hydraulic gradients in shallow systems with groundwater flow from recharge areas towards the south, south-west and west, but with a minor northern flow component in some aquifers. Water level measurements in the monitoring bore network installed in the Walloon Coal Measures for the Elimatta Project confirm this northerly groundwater flow direction. Asia Pacific LNG (2012) assessed flow directions in the deeper underlying Hutton Sandstone and reported a northerly flow direction (refer Figure 2.1 below) in the region north of the Great Dividing Range.

Head Office
Level 2 / 15 Mallon Street,
Bowen Hills, QLD 4006, Australia
T. +61 7 3257 2055
F. +61 7 3257 2088
brisbane@ageconsultants.com.au

Newcastle Office
Harbour Pier, Shop 8, 21 Merewether Street,
Newcastle, NSW 2300, Australia
T. +61 2 4926 2811
F. +61 2 4926 2611
newcastle@ageconsultants.com.au

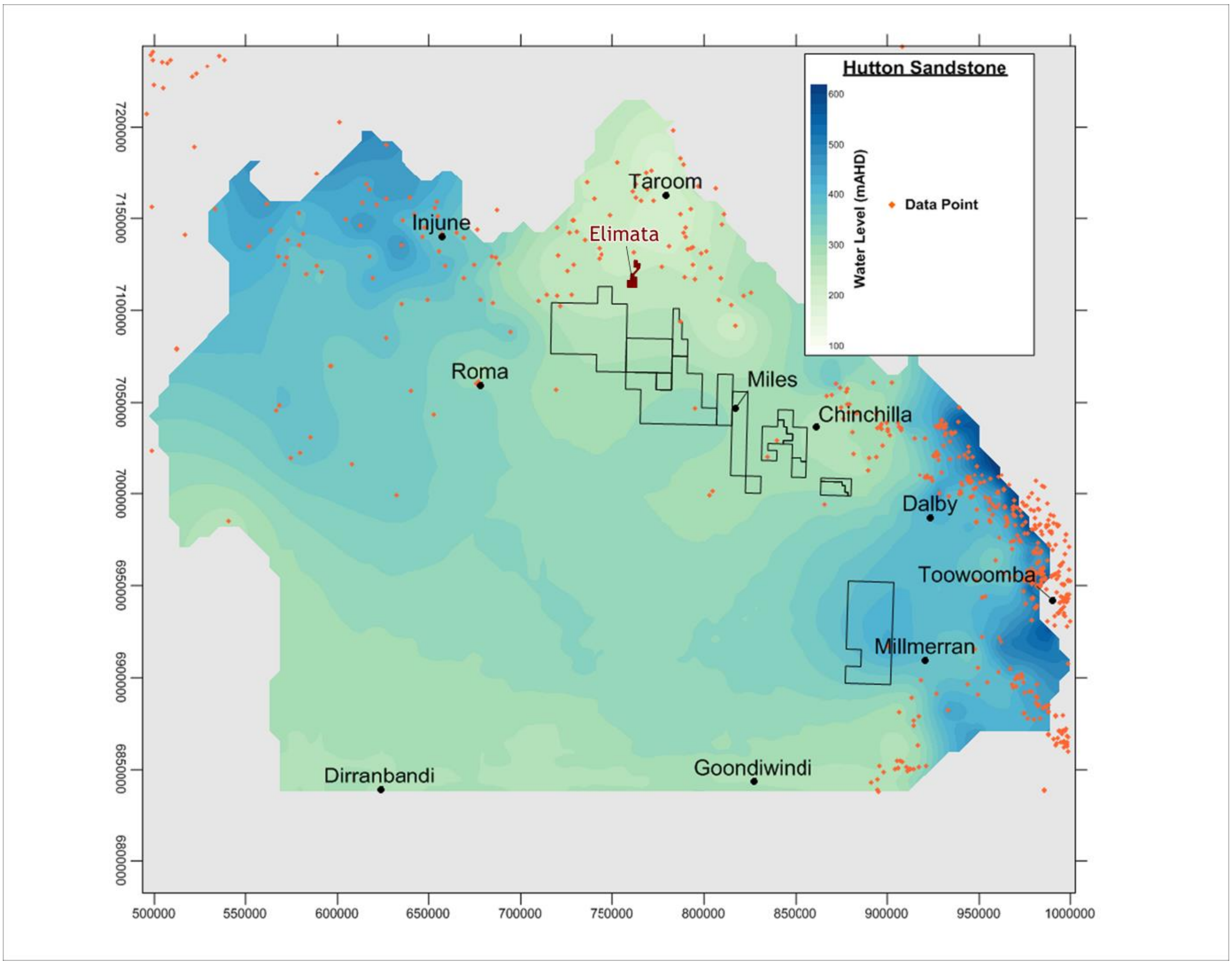


Figure 2.1: Groundwater levels in the Hutton Sandstone (from Australia Pacific LNG (2012)

- *The EIS indicates that, groundwater levels indicate topographic control, rather than conductivity variability or faulting as controls on aquifer flow behaviour. It is suggested that this inconsistency be clarified in the EIS, including further details on fault style (reverse), fault mineralisation or evidence of current stress regimes that would make the faulting or conductivity variability appear more likely to impair conductivity. Further clarification is also sought to validate the model used in the EIS in relation to the predicted extent of depressurization.*

In greenfield areas undisturbed by significant extraction of groundwater, such as in the Elimatta region, the influence of structures such as faults, or changes in hydraulic conductivity on groundwater levels is commonly not detectable in groundwater levels. The effect of structures on water levels in greenfield sites is typically a small scale influence that cannot be detected with widely spaced drilling and monitoring bores installed for an EIS. At the scale of the investigation, topography has the most obvious influence on the groundwater levels and flow directions. It is only when mining commences and depressurisation of the coal seams and overlying strata occurs, that the influence of structure or hydraulic conductivity variability may become apparent. Faults can act as barriers to groundwater flow, or serve to enhance flow along the fault plane, but these local scale effects cannot be observed from widely spaced groundwater monitoring networks or drilling programs.

Insite Geology (2009) assessed the geotechnical conditions at the Elimatta Project. The geotechnical study identified five main faults interpreted from various exploration programmes at Elimatta. All faults were inferred to be sub-vertical normal faults with the distance of throw from 1 m to 35 m as shown in Figure 2.2 below.

The faults generally trend down-dip, and will be gradually removed by mining. During the mining process, the faults will be exposed in the highwall and are likely to drain and depressurise along the fault plane. Features of such fault zones include the undamaged rock, the damaged (fractured) zone and the core (gouge) zone. The hydraulic properties of these zones will control the magnitude of the drainage and depressurisation. The water pressures and the cross sectional area of the fractured material around the fault plane control the volume and rate of water transferred through the fault. The cross sectional area of a fault plane is typically much less than the cross sectional area of other strata exposed by mining (including the coal seams). This implies then that faults typically only contribute in a minor way to the depressurisation and drainage induced by mining.

The groundwater model developed for the EIS will be reviewed after ten years of mining to determine if the predicted zone of depressurisation and impacts are accurate. Review and recalibration of the groundwater model will be undertaken as required by the conditions of the Project's Water Licence issued under the *Water Act 2000*.

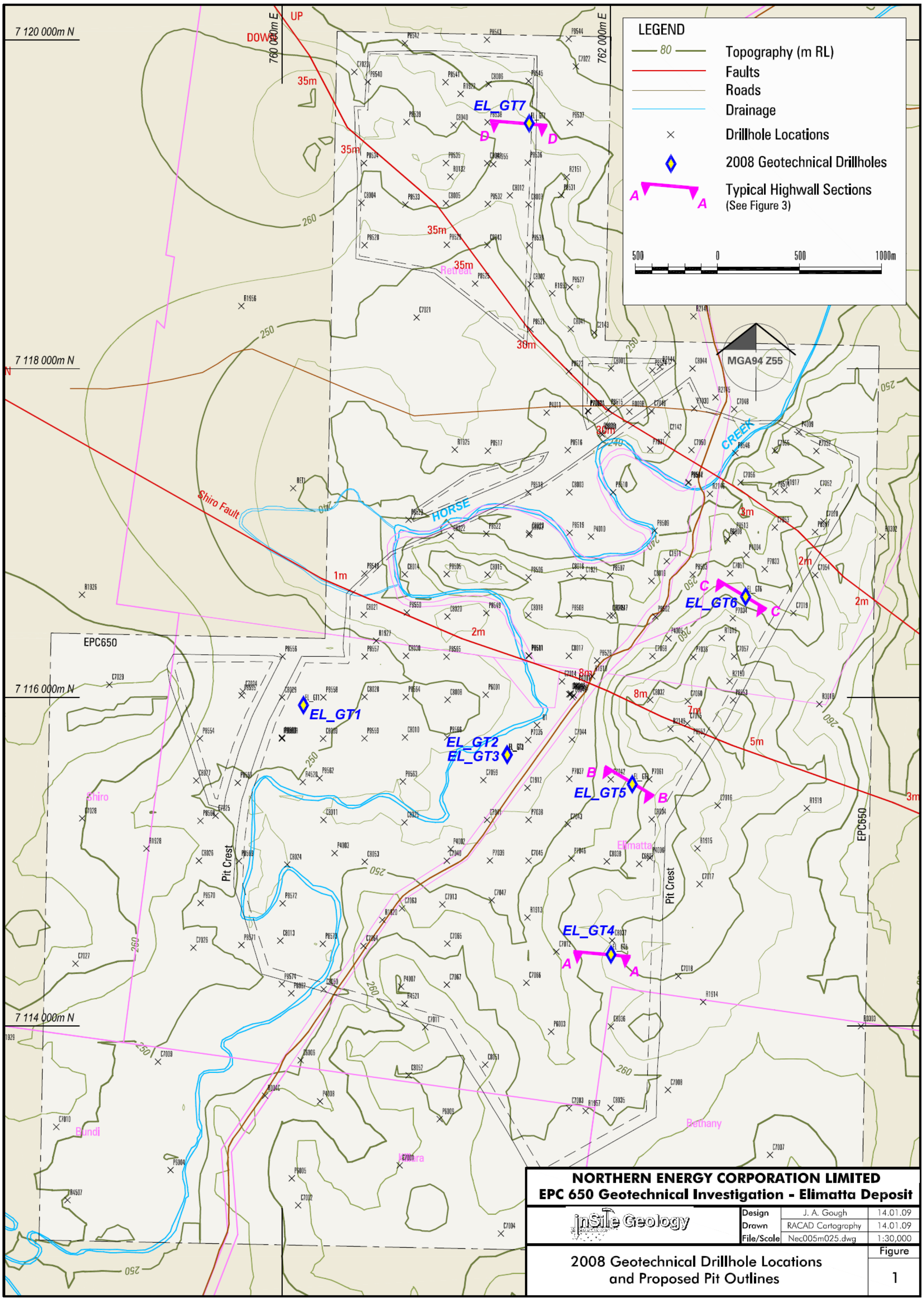


Figure 2.2: Faults and fault throw (from Insite Geology 2008)

- *The EIS is suggested to identify the regional groundwater resources that may be impacted by the Project. If the Juandah Coal Measures (JCM) is to be listed as a separate aquifer to the Great Artesian Basin (GAB), please specify the Juandah Coal Measures and the GAB differently.*

The GAB is not a geologic basin, but a hydrogeological basin comprising various parts of other geologic basins. Within the project area, the GAB includes the Surat Basin and the upper sedimentary sequences of the Bowen Basin. The main aquifer systems in the GAB in the Project area are the Gubberamunda Sandstone, Springbok Sandstone, Hutton Sandstone and Precipice Sandstone. Mining is only predicted to impact on groundwater levels in the Juandah Coal Measures, the upper unit within the Walloon Coal Measures Subgroup. Mining will not impact upon groundwater levels and the availability of water in the aquifers of the GAB. The Gubberamunda Sandstone is remote from the site, and the Hutton and Precipice Sandstones are located at significant depth below the proposed mining sequence. While the Springbok Sandstone is shown on geological maps as being present in the project area, exploration drilling within the lease did not detect an upper sandstone unit that could be classified as an aquifer.

3 REFERENCES

- Australia Pacific LNG, (2012), *“Upstream Phase 1 Reedy Creek Aquifer Injection Trial Management Plan Environmental Authority No PEN101718810 Q-4255-10-MP-001”.*
- Queensland Water Commission, (2012), *“Underground Water Impact Report for the Surat Cumulative Management Area”,* 18 July 2012.
- Hodgkinson J., Preda M., Hortle A., McKillop M. & Foster L., (2009), *“The Potential Impact of Carbon Dioxide Injection on Freshwater Aquifers: The Surat and Eromanga Basins in Queensland”,* Department of Employment, Economic Development and Innovation, Brisbane.
- Insite Geology, (2009), “*Elimatta Coal Project Southern Queensland, Report on Assessment of Geotechnical Conditions for Northern Energy Corporation Limited”,* February 2009.

Please contact me if you have any queries, or if any clarification is required.

Yours faithfully,

JAMES S. TOMLIN
Principal Hydrogeologist
Australasian Groundwater and Environmental Consultants Pty Ltd

Australasian Groundwater
and Environmental Consultants Pty Ltd
Level 2 / 15 Mallon Street
Bowen Hills, QLD 4006 Australia

ABN 64 080 238 642
T. +61 7 3257 2055
F. +61 7 3257 2088
brisbane@ageconsultants.com.au
www.ageconsultants.com.au

JST:tp
Project: *G1438B*
Date: *19 November 2015*

New Hope Group
Via email

Attention: *Peter Isles*

Dear Peter,

RE: Additional Groundwater Modelling – Elimatta Coal Project

1 Introduction

The New Hope Group (New Hope) proposes to develop the Elimatta Coal Project, which is approximately 35 kilometres (km) west of Wandoan and 380 km north-west of Brisbane.

New Hope submitted an Environmental Impact Statement (EIS) for the Elimatta Project to the Queensland Government in 2012. The EIS included a groundwater study prepared by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE). The groundwater study provided estimates of groundwater inflow to the mining area over the Project life. It is understood the Queensland Government has indicated to New Hope they will allocate groundwater from the state reserve to account for groundwater intercepted by the project. The volume of water allocated is proposed based on predictions presented for the project in the 2012 EIS.

JBT Consulting (JBT) requested on behalf of their client, New Hope, that AGE undertake further groundwater modelling for the Elimatta project and further assess the volume of groundwater intercepted to better inform the groundwater volumes that require licensing. This letter summarises the results of the additional modelling.

2 Summary of previous works

The Elimatta Project proposes to use open-cut mining methods to extract coal from the Walloon Coal Measures. Three mining areas are proposed, comprising two smaller northern and western pits, and a larger eastern pit. The Project proposes to target the Walloon Coal Measures, an upper unit in the Surat Basin sequence. The coal seams within the Walloon Coal Measures form a moderate to poor aquifer system and are confined by less permeable siltstone and mudstones. The seams sub-crop in the northern part of the lease and become deeper to the south. Quaternary alluvium is not widespread and only occurs along Horse Creek, forming a thin, patchy and partially saturated aquifer.

The 2012 groundwater study for the EIS report included a numerical groundwater flow model to simulate the impacts of mining on the hydrogeological regime. The numerical model represented the groundwater regime in an area centred on the Elimatta Project and extending some 64 km east-west and 41 km north-south. The model had 12 layers including all the main coal seams in the Project area.

The model was developed using the MODFLOW SUFACT software. The model represented the gradual development of spoil backfill during the mining using a 'stop start' approach. The model was run in time stages of one year, and the hydraulic parameters at the start of each run adjusted to reflect the progress of spoil backfill and / or deposition of tailings. The final water level conditions from the previous run were the initial conditions for the subsequent run. The run commenced with the groundwater levels from the steady-state calibrated model to represent pre-mining groundwater levels.

The open pit mining area in the model was represented using the drain boundary condition. Long-term average annual precipitation and evaporation rates were used throughout the predictive simulations. Recharge was applied to the newly developed spoil areas at 10 % of the average annual rainfall.

The two main objectives of the modelling were to estimate the zone of depressurization in the aquifers induced by dewatering of the coal seams; and the magnitude of the groundwater seepage to the open cut mining areas. The model predicted seepage volumes were generally less than 1 ML/day for the smaller northern and western pits and up to 2.5 ML/day for the much larger south-eastern open cut.

3 Objectives and scope of work

A third party review of the 2012 modelling undertaken by JBT concluded that the rainfall recharge to the spoils in the model is likely to be influencing the predicted volume of seepage reporting to the open cut mining area. Because the rainfall recharge rate through the spoils was higher than pre-mining, and was not sourced from the groundwater it was considered this proportion of the predicted mine inflow should not require a water license. JBT also commented that depressurisation of the Walloon Coal Measures from the adjacent Woleebee coal seam gas field operated by Queensland Gas Company (QGC) has the potential to reduce the rate of groundwater seepage into the proposed Elimatta mine. This would further reduce the volume of water that requires licencing from the state reserve.

The objective of the further modelling was to represent the influence of the spoil recharge and the adjacent Woleebee Gas Field in the model and estimate the volume of water required from the state reserve. The scope of work to achieve this objective included rerunning the model, and:

- determining the proportion of groundwater flow from the Walloon Coal measures in the mine highwall, and the spoils that form the open cut put low wall; and
- representing the drawdown in groundwater levels created by the Woleebee Gas Field.

Sections below outline the methodology for the additional modelling and the results.

4 Additional modelling

4.1 Contribution from spoils

As discussed, the predicted inflows to the open cut pit presented in the EIS represented the combined total of rainfall seepage through the spoil plus seepage from the Walloon Coal Measures through the highwall and pit floor. To determine the proportion of mine inflow that occurs from low wall seepage though spoil the model was rerun. A zone budget program was used to process the model output files and calculate the volumes of water from the spoil. To do this the model was divided into three separate zones; active open cut areas, undisturbed Walloon Coal measures and emplaced spoil within the pits. The size of each zone varied depending on the stage of mining. The zone budget program produced the flow between the zones over time. Figure 4-1 shows the annual total volume of inflow to the mining pits and the amount from the spoils.

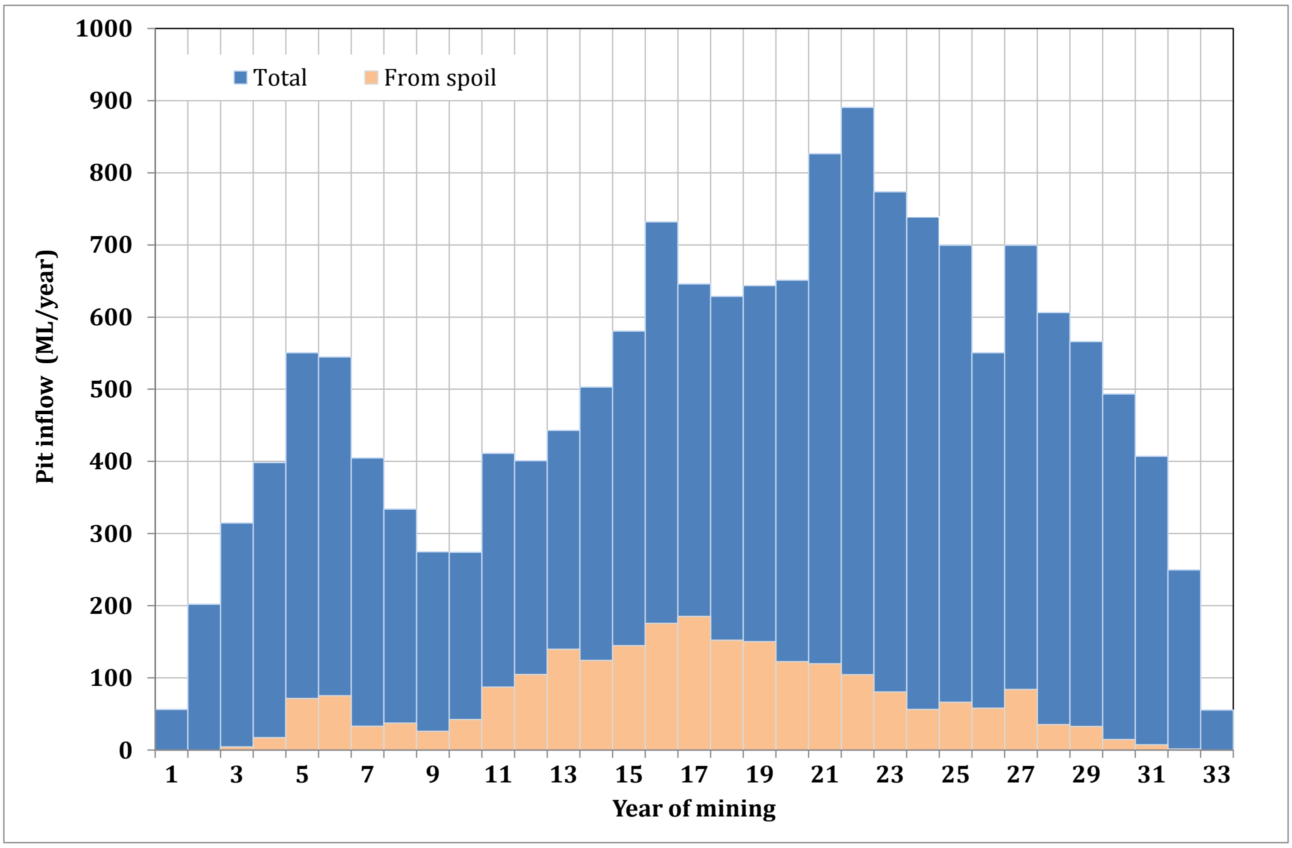


Figure 4-1 Simulated annual pit inflows

The amount of inflow to the mine is a function of the location / depth of mining and the area of Walloon Coal measures exposed in the highwall at any time. The mine inflow gradually increases and peaks when the highwall within the eastern pit is at its most extensive, then reduces as the highwall face contracts as the mine moves into the south-eastern corner of the lease. The coal seams also rise in the south-eastern corner of the lease meaning the mine moves up-dip in the last 10 years of mine life. These factors combine resulting in gradually reducing inflow to the active mining area over time. Spoil inflow also reduces when the mine moves past the south-western corner of the mine lease which is the lowest point in the proposed pit. Mining in this area creates a low point in the pit flow that is covered with spoils and becomes the focus for drainage through spoils.

Table 4.1 presents the annual volumes of groundwater reporting to the mining area from the low wall and the highwall. The total volume of groundwater predicted to be intercepted by mining averages 502 ML/year, reducing to 427 ML/year when the spoil inflow is removed.

Table 4.1 Predicted seepage to pits – contribution of spoil to total seepage

Year of mining	Total mine flow (ML/year)	Volume from spoil (low wall) (ML/year)	Volume from highwall (ML/year)	Year of mining	Total mine flow (ML/year)	Volume from spoil (low wall) (ML/year)	Volume from highwall (ML/year)
1	56.4	0.0	46.4	**18**	628.8	152.4	472.3
2	202.1	0.0	201.7	**19**	643.5	150.3	490.8
3	314.7	4.5	309.3	**20**	651.3	122.6	527.1
4	398.5	17.2	380.0	**21**	826.4	119.5	705.2
5	550.4	71.6	477.2	**22**	890.5	104.4	782.7
6	544.6	75.4	466.7	**23**	773.5	80.4	687.1
7	404.7	33.2	368.6	**24**	739.0	56.4	675.7
8	334.1	37.3	294.5	**25**	699.4	66.4	628.6
9	274.8	26.1	245.8	**26**	550.6	58.1	490.6
10	274.1	42.3	225.3	**27**	699.5	84.2	613.2
11	411.1	87.1	321.4	**28**	606.4	35.3	567.6
12	400.9	104.7	294.8	**29**	566.1	32.7	530.8
13	443.0	139.7	302.6	**30**	493.5	14.6	478.4
14	503.0	124.3	375.0	**31**	407.2	7.3	396.0
15	580.6	144.7	431.5	**32**	249.7	1.6	239.4
16	731.9	175.5	551.9	**33**	55.3	0.0	54.8
17	645.8	185.3	456.2				

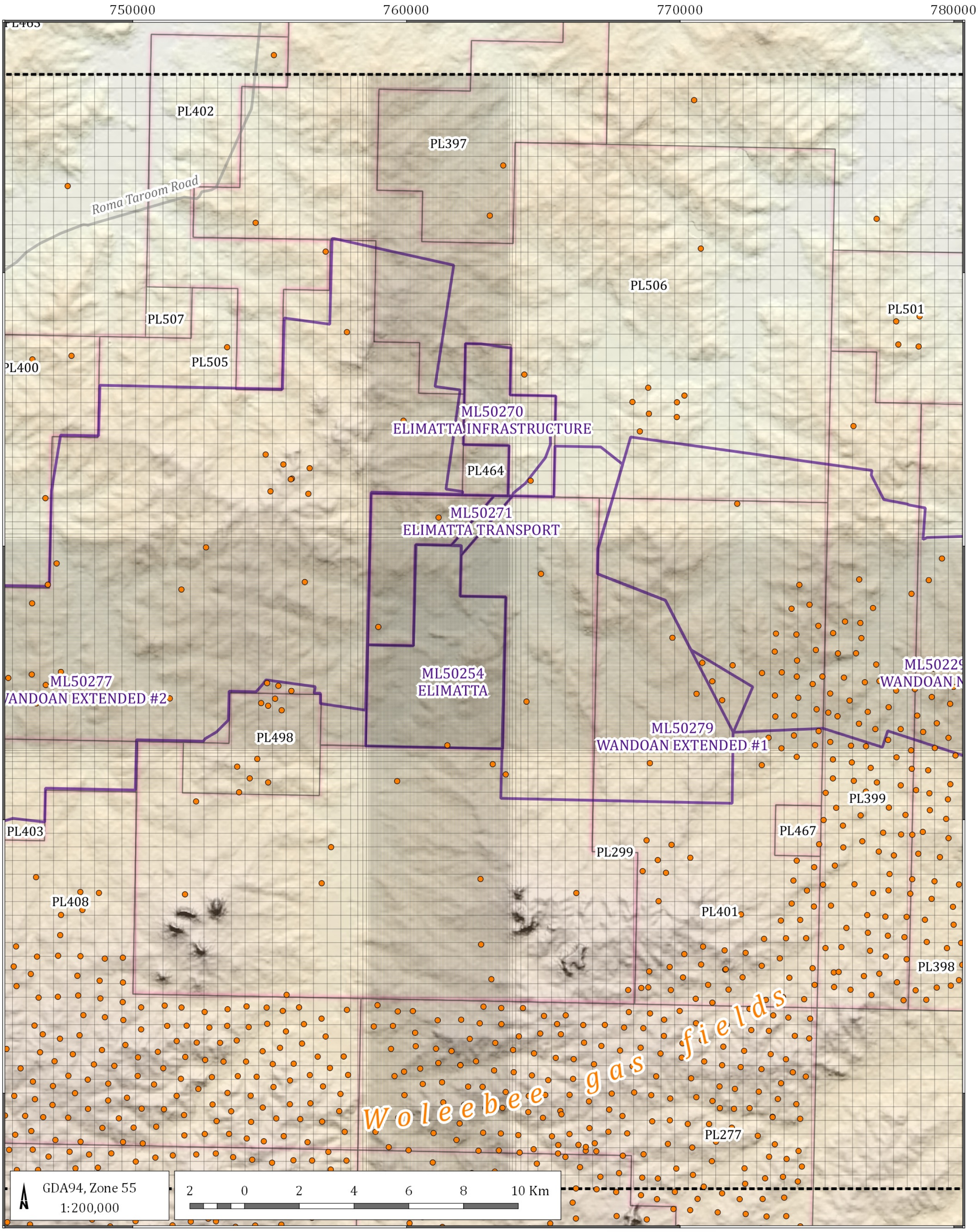
4.2 Impact of Woleebee gas field

QGC's Woleebee coal seam gas field is located approximately 20 km to the south of the project site. Figure 4-2 shows the location of the gas field and Elimatta project area. This gas field forms part of the QCLNG Project. It comprises several tenement blocks where coal seam gas is produced. The Elimatta Project is located within the "Cumulative Impact Area" where multiple CSG tenements occur. In the Cumulative Impact Area the state government develops numerical models to simulate the cumulative impact of multiple coal seam gas projects. These models predict reduced groundwater levels in Walloon Coal Measures to the south of Elimatta Project site caused by the groundwater extraction for CSG operations.

The impact from the gas field was not included in the EIS report as at the time, the coal seam gas project was not approved and advanced. Therefore the predicted pit inflows in the EIS report did not take into account the potential impact from the groundwater extraction from the Woleebee gas field.

The Office of Groundwater Impact Assessment undertakes the Cumulative impact modelling every three years. The most recent groundwater model in the public domain was released by the state government in 2012 (OGIA 2012). OGIAs 2014 annual report indicates that a revised regional groundwater flow model is being developed and due to be released in December 2015.

The drawdown predicted by the 2012 OGIA model was examined and used to represent pumping and drawdown from the gas field Woleebee gas. A constant head boundary condition was applied across the southern boundary of the Elimatta model where the gas field occurs. The constant head boundary condition was used to lower the hydraulic head to level predicted by OGIA due to groundwater / gas extraction from the wells. The average groundwater drawdown predicted by the OGIA model at the southern boundary of the Elimatta model was approximately 85 m. The heads at the southern boundary of the model were therefore fixed at 85 m below the starting level and remained unchanged for the 33 years of mining at Elimatta.



LEGEND

- Model grid extent
- Model grid
- Mining lease
- Petroleum lease
- Gas well
- Major road

Elimatta (G1438B)

Elimatta project and Woleebee gas fields

DATE 4/9/2015

FIGURE No: **4-2**

Figure 4-3 shows the predicted annual pit inflows from the updated model. The values shown on the figure are the volumes from the highwall only and exclude seepage from the spoil. The black line on the figure shows the annual volumes from the original model. The figure shows a significant reduction in groundwater flow to the mine pit due to the depressurisation created by the Woleebee gas field.

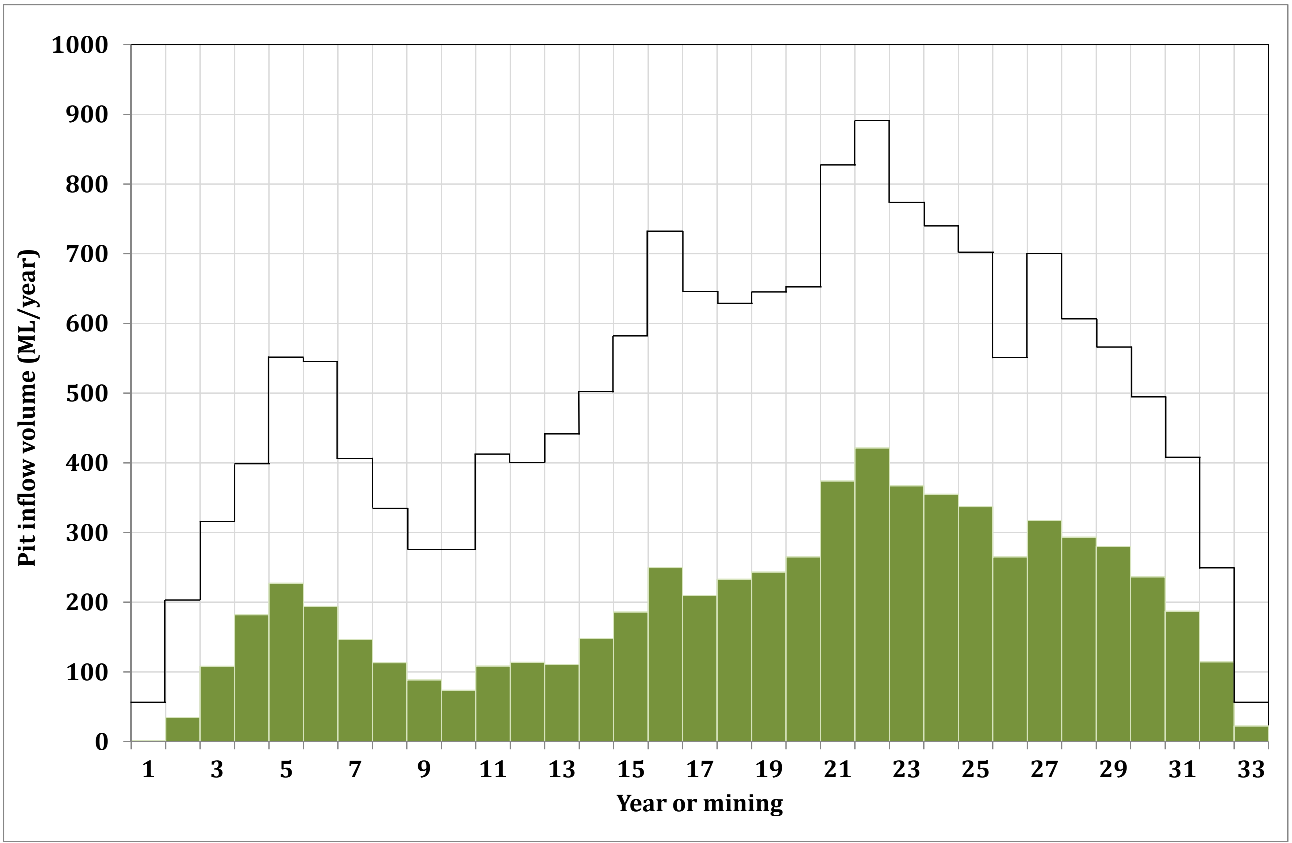


Figure 4-3 Simulated annual pit inflows- corrected for spoil contribution

Table 4.2 presents the predicted flow to the pit from the updated model and the reduction in volumes compared with the 2012 EIS report. The values in the table show that the gas field reduces the flows to the mine by up to half, averaging 206 ML/year over the mine life.

Table 4.2 Predicted seepage to pits - model included Woleebee gas field impact

Year of mining	updated inflows (ML/year)	Reduction (%)	Year of mining	updated inflows (ML/year	Reduction (%)
1	1.6	3%	**18**	232.9	37%
2	34.5	17%	**19**	243.3	38%
3	108.1	34%	**20**	265.0	41%
4	181.9	46%	**21**	373.9	45%
5	227.2	41%	**22**	421.2	47%
6	194.0	36%	**23**	367.0	47%
7	146.4	36%	**24**	354.8	48%
8	113.3	34%	**25**	337.2	48%

Year of mining	updated inflows (ML/year)	Reduction (%)	Year of mining	updated inflows (ML/year	Reduction (%)
9	88.5	32%	**26**	264.9	48%
10	73.7	27%	**27**	317.2	45%
11	108.4	26%	**28**	293.2	48%
12	114.0	28%	**29**	280.0	49%
13	110.6	25%	**30**	236.4	48%
14	147.9	29%	**31**	187.1	46%
15	186.0	32%	**32**	114.5	46%
16	249.6	34%	**33**	22.5	41%
17	209.9	33%			

5 Summary and conclusions

The predicted inflows reported in the EIS were the total volume of groundwater intercepted and also included rainfall seepage through the spoil low wall reporting to the mining area. This water is not sourced from the groundwater systems.

QGC's Woleebee gas field is located to the south on Elimatta project area. The latest prediction (OGIA 2012) showed the gas field would lower the groundwater level by 85 m at the south boundary of the model. When drawdown is represented in the Elimatta model the inflows to the mining area reduce by an average of 40% over the mine life.

Figure 5-1 shows the cumulative 'water take' in the EIS report, and the 'water take' after accounting for the spoil water and Woleebee Gas field. The figure shows graphically that the 'water take' is more than 50% lower than the total groundwater volume reported in the EIS. The average 'water take' of 206 ML/year is considered an appropriate allocation from the state reserve.

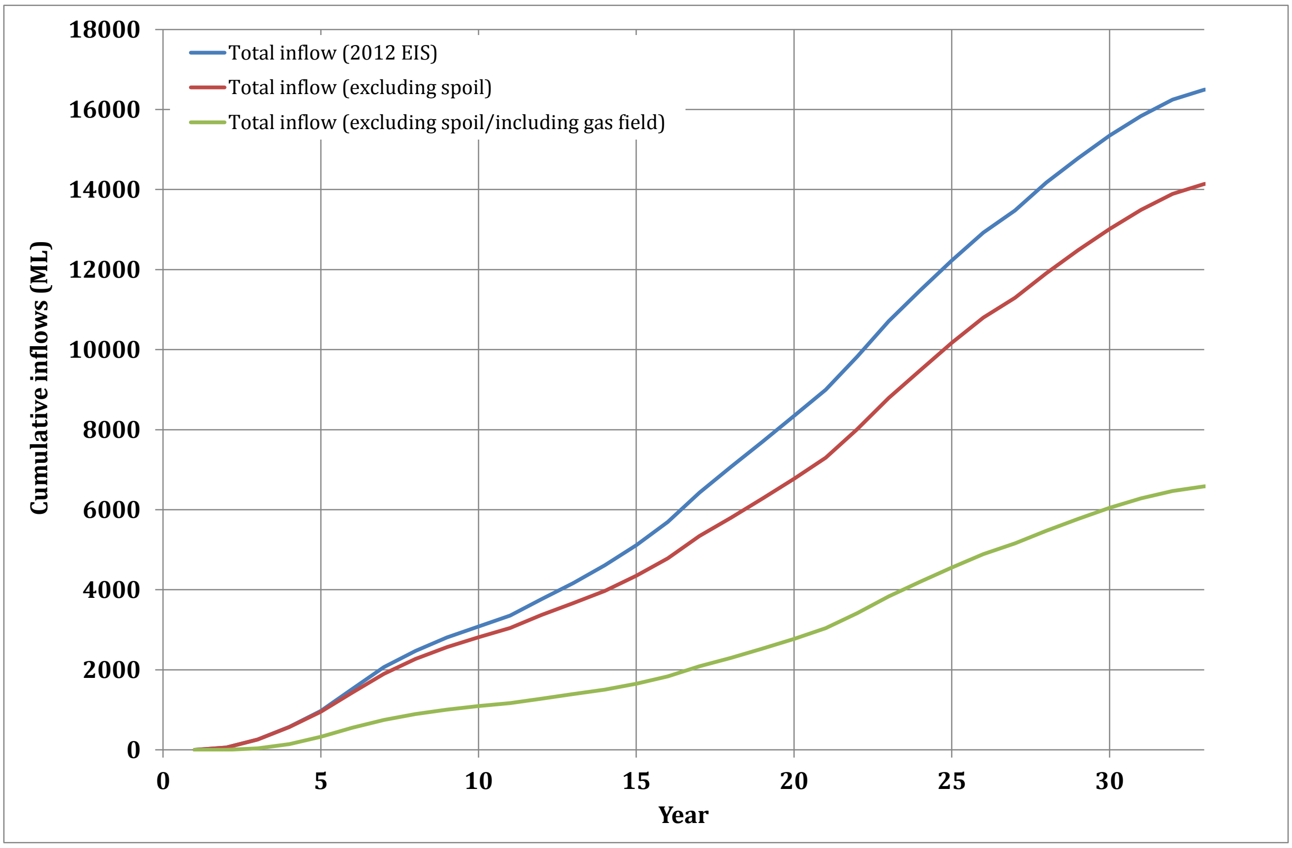


Figure 5-1 Cumulative groundwater take

6 References

Office of Groundwater Impact Assessment (OGIA), 2012. "*Surat Underground Water Impact Report*".

Prepared By:

ENVIRONMENTAL GEOCHEMISTRY INTERNATIONAL PTY LTD

81A College Street, Balmain, NSW 2041 Australia
Telephone: (61-2) 9810 8100 Facsimile: (61-2) 9810 5542
Email: egi@geochemistry.com.au
ACN 003 793 486 ABN 12 003 793 486

For:

NORTHERN ENERGY CORPORATION LIMITED

GPO Box 5283
Brisbane QLD 4001

March 2012

Document No. 5103/995

Geochemical Assessment of the Elimatta Coal Project

Contents

List of Tables (after text)

List of Figures (after text)

List of Appendices (after text)

Executive Summary

Environmental Geochemistry International Pty Ltd (EGi) were commissioned by Northern Energy Corporation Limited (NEC) to carry out a geochemical assessment of the Elimatta Coal Project, located approximately 35km west of Wandoan in Southern Queensland. The objectives of this work were to:

- assess the acid rock drainage (ARD), salinity and elemental solubility (including neutral mine drainage, NMD) potential of the proposed mine materials;
- identify any geochemical issues; and
- provide recommendations for materials management and any follow up test work required.

A comprehensive sampling programme of 7 diamond holes, C10_01, C10_03, C10_04, C10_05, C10_07, C10_08 and C10_10 was carried out to represent the proposed mine overburden and interburden stratigraphy across the pit area. Geochemical test work focused on holes C10_01, C10_08 and C10_10, with holes C10_03, C10_04, C10_05 and C10_07 used as infill to confirm the continuity of geochemical trends identified. A total of 554 overburden/interburden and floor samples were tested.

Testing was also carried out on laboratory prepared samples from washability testing to represent coarse rejects, fine rejects and product coal. A total of 81 samples were tested.

Results indicate that overburden/interburden, floor, washery waste and coal materials represented by the samples tested are unlikely to be acid producing or release significant salinity or metals/metalloids, and will not require special handling (such as mine material segregation, selective placement and engineered covers) for ARD or neutral drainage control.

Initial sodicity testing indicates that some overburden/interburden materials are likely to be sodic and dispersive. Materials with sodic/dispersion potential should be treated (with gypsum or lime) if exposed on dump surfaces or used in engineered structures.

It is recommended a programme of routine sampling and testing of washery wastes, overburden/interburden and floor materials be carried out during operations to confirm the low salinity, neutral mine drainage and ARD risks indicated by testing to date. Leach column testing of these materials could also be considered to better evaluate neutral mine drainage chemistry. Routine site water quality monitoring programmes should include pH, EC, acidity/alkalinity, SO_4, Al, As, Co, Cu, Fe, Mn, Ni and Zn to monitor for effects of pyrite oxidation and acid and neutral mine drainage.

The distribution and extent of sodic/dispersive materials should be investigated further.

1.0 Introduction

Environmental Geochemistry International Pty Ltd (EGi) were commissioned by Northern Energy Corporation Limited (NEC) to carry out a geochemical assessment of the Elimatta Coal Project, located approximately 35km west of Wandoan in Southern Queensland. The objectives of this work were to:

- assess the acid rock drainage (ARD), salinity and elemental solubility (including neutral mine drainage, NMD) potential of the proposed mine materials;
- identify any geochemical issues; and
- provide recommendations for materials management and any follow up test work required.

It is understood that this report will contribute to an Environmental Impact Statement (EIS). The scope of work comprised the following:

- an initial scoping phase involving liaison with relevant project personnel, compilation of background project data, and a site visit in July 2011 to examine representative core through the proposed mine stratigraphic sequence;
- preparation of an overburden and interburden sampling programme in conjunction with site geologists to represent the mine stratigraphy and expected geochemical variation of overburden;
- review and selection of appropriate washery waste materials for geochemical testing in consultation with relevant project personnel;
- collection of samples and arrangement of sample preparation by site personnel with advice from EGi;
- laboratory testing of samples; and
- assessment of results and reporting.

2.0 Background

The Elimatta deposit is a multi-seamed low ash, high volatile thermal coal resource within the Surat Basin coal province. The proposed mine would be developed as an open cut using conventional truck and excavator techniques to produce up to 8.0 Mt of ROM coal per annum (pa), with a mine life in excess of 25 years. A coal wash plant would be required, and it is planned that the resulting coarse rejects would be placed in the open pit with overburden, and the fine rejects (tailings) would be placed in 2 to 3 dedicated storage facilities. Initial development spoils will be placed out of pit, with in pit dumping carried out as soon as practical.

The target coal seams occur within the Juandah Coal Measures, a freshwater succession of late Middle Jurassic aged sandstones, siltstones, mudstones and coal, deposited under fluvial, lacustrine and paludal conditions.

Thicker coal seams are more common towards the top of the formation. The Juandah Coal Measures are part of the Walloon Sub Group, which is in turn part of the Injune Creek Group. In the project area the Juandah Coal Measures are overlain by a variable thickness of poorly consolidated Cainozoic cover, and depth of weathering varies from 5m to 24m (average 11.5m). The main target seam groups are (from youngest to oldest) UG, Y, A, B, BC and C (Figure 1), which include a variety of individual plys that split and coalesce. Four main pit areas are planned with a maximum pit depth of around 80m. These pits will generally extend to the base of the B4 seam, except for the northern pit which will continue to the C5/C8 seam. The final pit floor would therefore mainly comprise the base of B4, and C5/C8 in the northern pit.

Core from drill holes C10_1, C10_10 and EL_GT4 was examined during a project site visit in July 2011 to check for evidence of pyrite and neutralising carbonate occurrence, and obtain a better understanding of the continuity and variation of the major rock types through the planned mine stratigraphic sequence.

Pyrite was rarely observed in the core. Where present it occurred as isolated millimetre sized spheroids (Plate 1) or as thin veneers on bedding surfaces associated with carbonaceous partings and particularly with leaf fossils (Plate 2).

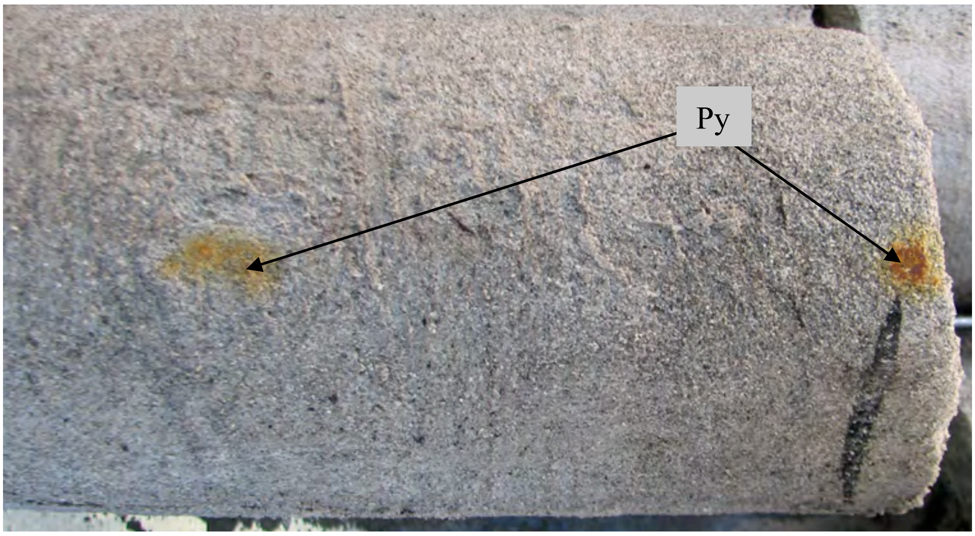


Plate 1: Partly oxidised isolated pyrite spheroids 1-2mm diameter in sandstone. Hole C10_10 at 20.0m.

Plate 2: Minor pyrite coatings associated with leaf fossils. Hole C10_1 at 26.7m.

During inspection of the core, 10% HCl was applied to the core intermittently to provide an indication of the presence of reactive carbonate such as calcite and dolomite. Vigorous fizzing typical of calcitic/dolomitic carbonate was commonly observed throughout the overburden/interburden, occurring as matrix in sandstone units (Plate 3), associated with sideritic bands (Plate 4) and in discrete carbonate rich zones (Plates 5).

Plate 3: Sandstone with reactive carbonate in matrix. Hole C10_10 at 22.40m.

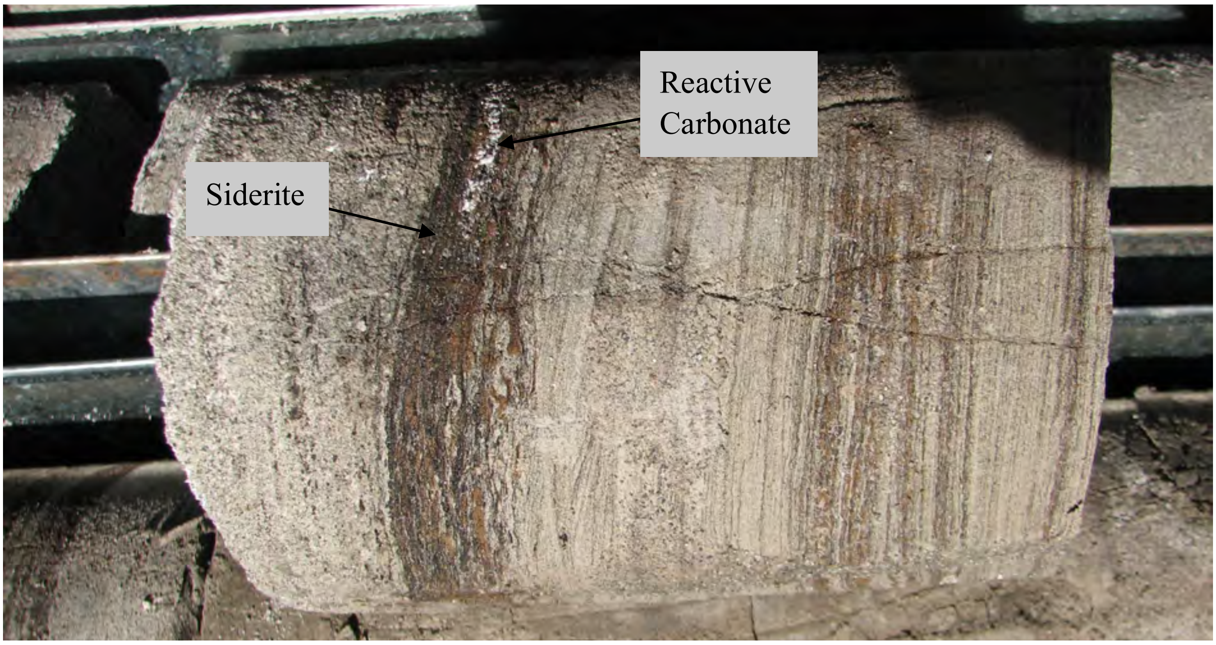


Plate 4: Siderite banding with associated reactive carbonate. Hole C10_10 at 19.40m.

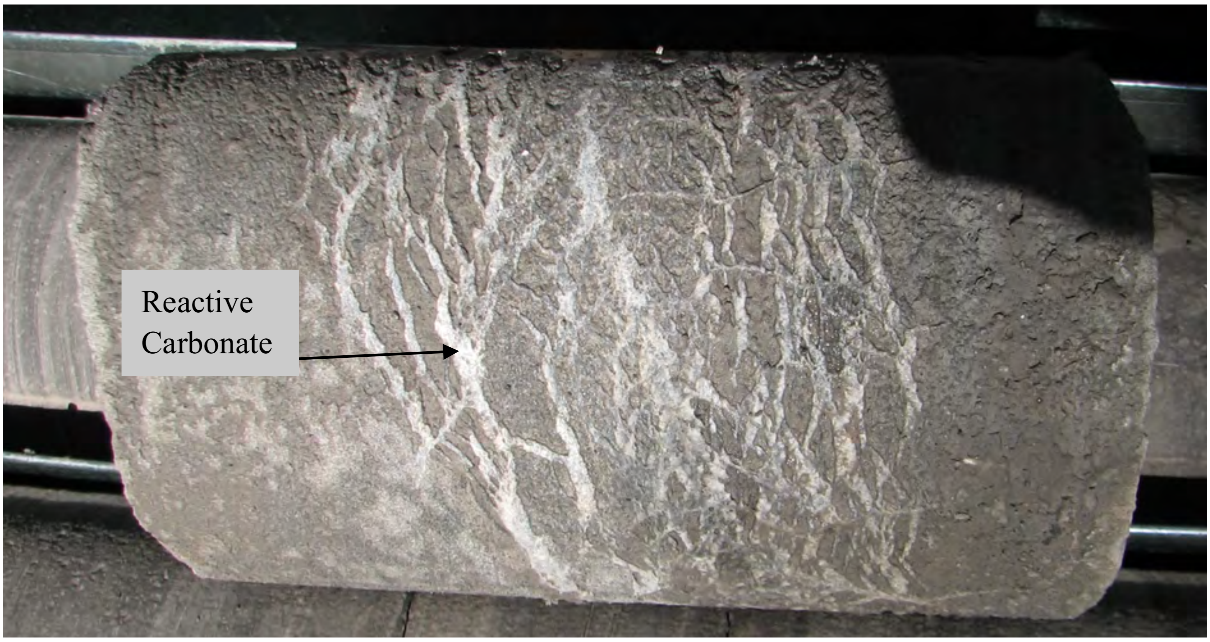


Plate 5: Carbonate rich zone. Hole C10_1 at 64.15m.

The rarely observed pyrite and common occurrence of reactive carbonate observed in the core indicates most of the overburden/interburden is likely to have a low ARD potential.

3.0 Sample Collection and Preparation

A comprehensive sampling programme of 7 diamond holes, C10_01, C10_03, C10_04, C10_05, C10_07, C10_08 and C10_10 was carried out to represent the proposed mine overburden and interburden stratigraphy across the pit area. Geochemical test work focused on holes C10_01, C10_08 and C10_10, with holes C10_03, C10_04, C10_05 and C10_07 used as infill to confirm the continuity of geochemical trends identified. Hole collar locations are shown in Figure 2.

The distribution and abundance of pyrite in coal bearing sedimentary sequences are largely controlled by the original depositional environment, with influences such as seawater incursions and presence of organic matter key to pyrite formation. As a result of these controls, pyrite is usually preferentially distributed in particular lithologies (such as carbonaceous mudstones) and stratigraphic horizons. Coal sequences usually have high lithological variation in the vertical sense, but tend show lateral continuity, and hence sampling for ARD needs to take this into account by obtaining detailed continuous samples in individual holes spaced at wide intervals. The overall aim was to screen the entire mine stratigraphy for acid potential, identify horizons of concern and look for correlations between holes that indicate continuity, and rely on geological correlation to help predict the distribution of potentially acid forming (PAF) and non-acid forming (NAF) rock types. This approach results in better representation of mine materials in coal deposits than purely lithological based sampling.

All holes were sampled continuously except where there were missing intervals or coal intervals removed for coal quality testing. Sample intervals were selected by NEC geologists in conjunction with EGi to match geological boundaries, with intervals ranging from less than 0.5m to 5m. All samples were collected by site personnel.

Sample preparation of core was arranged by NEC geologists with advice from EGi, and was carried out by Coal and Seam Gas Services (CSG) in Queensland, which involved drying (as required), crushing to a nominal -4mm, splitting, pulverising a 300g to 500g split to -212µm, and dispatch of 300g to 500g of -212µm pulverised samples and -4mm crushed samples to EGi.

Splits of pulverised samples previously collected for coal quality investigations representing seam roof, seam floor, seam partings and uneconomical seams were also provided by NEC to complete the stratigraphic coverage.

A total of 513 overburden/interburden samples were tested.

In addition to overburden/interburden samples, EGi were also provided with laboratory prepared samples from washability testing to represent coarse rejects, fine rejects and product coal. Samples were selected by A&B Mylec in conjunction with EGi to cover a range of coal feeds and raw S values. A total of 81 samples were tested.

4.0 Methodology

Leco or Leco equivalent total S was carried out on all samples. A smaller sub set was subjected to standard geochemical characterisation as follows:

- pH and electrical conductivity (EC) of deionised water extracts at a ratio of 1 part solid to 2 parts water ($pH_{1:2}$ and $EC_{1:2}$);
- acid neutralising capacity (ANC);
- net acid producing potential (NAPP), calculated from total S and ANC; and
- standard single addition net acid generation (NAG) test.

Further testing was carried out on selected samples to help resolve uncertainties in the above test results, as follows:

- extended boil and calculated NAG testing to account for high organic carbon contents; and
- acid buffering characteristic curve (ABCC) test.

A general description of ARD test methods and calculations used is provided in Appendix A.

In addition, selected samples were assayed for the following to identify any potential elemental concerns and to provide initial elemental solubility data:

- multi-element scans of solids;
- multi-element scans of deionised water extracts for overburden/interburden/floor samples (ratio of 1 part solid to 2 parts water); and
- multi-element scans of deionised water extracts for tailings and rejects samples (ratio of 1 part solid to 5 parts water).

Selected samples were also tested for soluble and exchangeable cations to provide an initial indication of sodicity and dispersion potential.

Water extractions and soluble and exchangeable cations were carried out on -4mm crushed overburden/interburden and floor samples and as received tailings and rejects samples. Pulverised samples were used for all other tests.

Standard multi-acid digest for elemental analysis could not be carried out directly on rejects samples due to the high carbon content, which can cause explosions during digestion. To overcome this issue, the samples were ashed to remove the organic component and ICP-AES and ICP-MS analysis performed on the ash, with concentrations calculated relative to the original sample weight. However, due to the potential loss of some volatile elements during ashing, element specific coal analysis methods were carried out on splits of the original solid to provide a more reliable measure of As, B, F, Hg, Sb and Se as follows:

As, Sb, Se by Eschka hydride ICP-OES
B by Eschka ICP-OES
F by Pyrohydrolysis/ISE
Hg by Leco direct combustion

Total sulphur assays were carried out by CSG and Sydney Environmental and Soil Laboratory (SESL). Multi-element analyses of solids from lower organic carbon samples and ash from high organic carbon samples were carried out by ALS Laboratory Group (Brisbane). Coal specific elemental analyses of solids for high organic carbon samples were carried out by ALS Laboratory Group (Maitland). Multi-element analyses of water extracts were carried out by ALS Laboratory Group (Sydney). Analyses of NAG solutions were carried out by Levay & Co. Environmental Services (Adelaide). Soluble and exchangeable cations testing was carried out by SESL. All other analyses were carried out by EGi.

5.0 Overburden/Interburden Results

Acid forming characteristics of overburden/interburden samples from holes C10_01, C10_08 and C10_10 are presented in Table 1, comprising pH and EC of water extracts, total S, maximum potential acidity (MPA), ANC, NAPP, ANC/MPA ratio and single addition NAG. Infill holes C10_03, C10_04, C10_05 and C10_07 were analysed for total S only and results are shown in Table 2.

5.1 pH and EC

The $pH_{1:2}$ and $EC_{1:2}$ results were determined by equilibrating the sample in deionised water for approximately 16 hours, at a solid to water ratio of 1:2 (w/w). This gives an indication of the inherent acidity and salinity of the waste material when initially exposed in a waste emplacement area.

The $pH_{1:2}$ values ranged from 5.5 to 9.9.

$EC_{1:2}$ values ranged from 0.07 to 0.87 dS/m with most samples (85%) falling within the non-saline range with an EC of less than 0.4 dS/m, and the rest falling within the slightly saline range (0.4 to 0.8 dS/m) apart from sample 2400 with an EC of 0.87 dS/m, just into the moderately saline range.

Results indicate a general lack of available acidity and salinity in overburden/interburden materials represented by these samples.

5.2 Acid Base (NAPP) Results

Total S ranges from below detection to 0.75%S. The overall total S content of the samples tested is low, with median S values less than 0.03%S, and with most samples (80%) having S values of less than 0.2%S.

ANC ranges up to 198 kg H_2SO_4/t, with a median ANC of 13 kg H_2SO_4.

The NAPP value is an acid-base account calculation using measured total S and ANC values. It represents the balance between the MPA and ANC. A negative NAPP value indicates that the sample may have sufficient ANC to prevent acid generation. Conversely, a positive NAPP value indicates that the material may be acid generating.

Figure 3 is an acid-base account plot of ANC versus total S. The NAPP zero line is shown which defines the NAPP positive and NAPP negative domains, and the line representing an ANC/MPA ratio value of 2 is also plotted. Note that the NAPP = 0 line is equivalent to an ANC/MPA ratio of l. The ANC/MPA ratio is used as an indication of the relative factor of safety within the NAPP negative domain. Usually a ratio of 2 or more signifies a high probability that the material will remain circum-neutral in pH and thereby should not be problematic with respect to ARD.

Results show that 95% of samples are NAPP negative, with 90% also having ANC/MPA ratios of greater than 2, indicating a high factor of safety.

5.3 Single Addition NAG Results

Generally a NAGpH value less than 4.5 indicates a sample may be acid forming. However, samples with high organic carbon contents (such as coal and carbonaceous sedimentary materials) can cause interference with standard NAG tests due to partial oxidation of carbonaceous materials. This can lead to low NAGpH values and high acidities in standard single addition NAG tests unrelated to acid generation from sulphides.

Most samples (70%) had NAGpH values of 4.5 and greater, indicating they are likely to be non acid forming (NAF). Forty seven samples had a NAGpH less than 4.5, but most of these were associated with carbonaceous horizons and coal seams, and results are inconclusive in isolation due to potential organic acid effects.

NAG test results are used in conjunction with NAPP values to classify samples according to acid forming potential. Figure 4 is an ARD classification plot showing NAGpH versus NAPP value. Potentially acid forming (PAF), NAF and uncertain (UC) classification domains are indicated. A sample is classified PAF when it has a positive NAPP and NAGpH < 4.5, and NAF when it has a negative NAPP and NAGpH ≥ 4.5. Samples are classified uncertain when there is an apparent conflict between the NAPP and NAG results, i.e. when the NAPP is positive and NAGpH ≥ 4.5, or when the NAPP is negative and NAGpH < 4.5.

The plot shows that most samples (70%) plot in the NAF domain, with 6 samples plotting in the PAF domain and 41 samples plotting in the lower left uncertain domain.

A total of 103 samples plot in the NAF domain and all have a total S of less 0.3%S.

Six samples plot in the PAF domain, all of which show organic acid effects on the standard NAG test, including a large difference between the $NAG_{(pH4.5)}$ and $NAG_{(pH7.0)}$ values, and

$NAG_{(pH4.5)}$ values that exceed the MPA. Results indicate that the NAG results overestimate the acid potential in these cases. Standard NAG test results affected by organic acids are highlighted in yellow in Table 1. All of these samples represent small intervals of 10cm or less.

Thirty nine of the samples plotting in the bottom left hand uncertain domain also show organic acid effects, and further testing was required to help resolve classification for these samples. The remaining two samples had a total S of 0.10%S or less and marginally acidic NAGpH values of 4.1 to 4.3, which are most likely due to a lack of buffering and the effects of residual hydrogen peroxide in the sample. These two samples are likely to be non-reactive, i.e. no significant acid generation or buffering potential, and are expected to be NAF.

5.4 Extended Boil and Calculated NAG Results

Extended boil and calculated NAG testing was carried out on 5 selected samples to help resolve the uncertainty in ARD classification based on standard NAG test results, as discussed in the previous section. Results are shown in Table 3.

Results show that the NAGpH value increases 2 or more pH units after the extended boiling step, which confirms the effects of organic acids.

Note that the extended boil NAGpH value can be used to confirm samples are PAF, but an extended boil NAGpH value greater than 4.5 does not necessarily mean that samples are NAF, due to some loss of free acid during the extended boiling procedure. To address this issue, a calculated NAG value is determined from assays of anions and cations released to the NAG solution. A calculated NAG value of less than or equal to 0 kg H_2SO_4/t indicates the sample is likely to be NAF, and a value of more than 0 kg H_2SO_4/t indicates the sample may be PAF.

The calculated NAG values for all samples were negative, indicating that all acid generated in the standard NAG test for these samples is organic, and that materials represented by these samples are unlikely to be acid producing under field conditions. NAPP negative samples with NAGpH values less than 4.5 in Table 1 are therefore expected to be NAF.

5.5 Multi-Element Analysis of Solids

Results of multi-element scans of solids from 19 selected samples were compared to the median soil abundance (from Bowen, 1979[1]) to highlight enriched elements. The extent of enrichment is reported as the Geochemical Abundance Index (GAI), which relates the actual concentration with an average or median abundance on a log 2 scale. The GAI is expressed in integer increments where a GAI of 0 indicates the element is present at a concentration similar to, or less than, median soil abundance; and a GAI of 6 indicates approximately a 100-fold enrichment above median soil abundance. As a general rule, a GAI of 3 or greater signifies enrichment that warrants further examination.

---

[1] Bowen, H.J.M. (1979) Environmental Chemistry of the Elements. Academic Press, New York, p 36-37.

Results of multi-element analysis of solids are presented in Table 4, and the corresponding GAI values are presented in Table 5. Results show slight enrichment of Be in many of the samples, but no significant enrichment of metals or metalloids is indicated. Although Be concentrations are slightly enriched relative to soils, they are within normal ranges for sedimentary materials.

5.6 Composition of Water Extracts

The same 19 sample solids were subjected to water extraction at a solids:liquor ratio of 1:2. Results are shown in Table 6. A summary of the results is included, showing 10^{th} percentile, 50^{th} percentile (median) and 90^{th} percentile concentrations.

The samples produced circum-neutral to slightly alkaline pH extracts. EC values were generally non saline (<0.4 dS/m), with 5 samples slightly saline (0.4 to 0.8 dS/m) and one sample moderately saline (>0.8 dS/m).

Most of the circum-neutral to slightly alkaline extracts have elevated Al concentrations and some also have elevated Fe, but both these elements are generally highly insoluble at these pH values. The cause is most likely due to the presence of fine or colloidal particulates in the solution after filtering. Arsenic shows some slight solubility in samples 1375 and 1432. There were no elevated metals or metalloids evident.

Results show that Na and Cl are the dominant cations and anions in solution and indicate metals and metalloids are unlikely to be mobilised to any significant extent from circum-neutral to slightly alkaline leachates.

5.7 Sodicity and Dispersion

Soluble and exchangeable cations testing was carried out on selected overburden/interburden samples to provide a preliminary indication of any sodicity and dispersion issues. Results are presented in Table 7.

Sodic materials tend to form low permeability soil horizons, accelerating erosion and inhibiting plant growth. Sodic soils are also dispersive and should not be used as construction materials since they are prone to tunnelling and collapse. The exchangeable sodium percentage (ESP) is a measure of exchangeable Na as a percentage of the total effective cation exchange capacity (ECEC). The ESP can be used to classify samples according to sodicity as follows:

ESP < 6% - Non-Sodic
ESP 6-15% - Sodic
ESP 15-30% - Strongly Sodic
ESP >30% - Very Strongly Sodic

Five of the samples were classified sodic, with the remaining strongly sodic to very strongly sodic. Over half the samples tested were very strongly sodic.

Results indicate that overburden/interburden materials represented by the samples tested are likely to be sodic and dispersive, and may be subject to surface crusting and high erosion rates if placed in the surface of dumps and exposed directly to rainfall. Materials with sodic/dispersion potential should be treated (with gypsum or lime) if exposed on dump surfaces or used in engineered structures.

More detailed testing would be required to accurately define the distribution and extent of sodic/dispersive materials.

5.8 Sample Classification and Distribution of ARD Rock Types

Results and discussions above were used to classify overburden/interburden samples as NAF, PAF, PAF low capacity (PAF-LC) or UC in Table 1. PAF-LC samples are defined as having an acid capacity of 5 kg H_2SO_4/t or less. All samples with S values of less than or equal to 0.05%S were classified NAF due to the negligible risk of acid formation. Almost all overburden/interburden samples were classified NAF or UC(NAF), with PAF and PAF-LC samples restricted to thin intervals of 0.1m or less and only accounting for less than 0.5% of samples tested.

Results also suggest that a conservative cut off of 0.2%S alone could be used as screening criteria to distinguish NAF and PAF (including PAF-LC) overburden/interburden rock types. These criteria were applied to the total S results for infill holes C10_03, C10_04, C10_05 and C10_07, with samples having total S of 0.2%S or less classified as NAF* and samples with total S greater than 0.2%S classified PAF* in Table 2. Note that coal often contain elevated organic S content (non acid generating) and the S cut off is not valid for these materials. Hence the coal seam samples in Table 2 were not classified using the S criteria.

The proportions of ARD rock types in Table 2 are consistent with those in Table 1, with almost all samples classified NAF*, and PAF* samples accounting for only 0.7% of the total interval tested. Results in Table 1 and 2 did not identify any stratigraphic or lithological controls on ARD or salinity potential.

Results indicate that overburden/interburden and floor materials represented by the samples tested are unlikely to be acid producing or release significant salinity.

6.0 Coal and Rejects Results

Acid forming characteristics of laboratory generated washery tailings, rejects and product coal equivalents are presented in Table 8.

The $pH_{1:2}$ values were circum-neutral, ranging from 6.8 to 8.6. $EC_{1:2}$ values for the tailings and product coal were all non saline at less than 0.4 dS/m. The rejects samples were all slightly saline at between 0.4 to 0.8 dS/m. Results indicate a lack of significant existing acidity and salinity in washery waste and product coal materials represented by these samples.

Total S is low for both tailings and rejects, reaching a maximum of 0.29%S. Product coal samples have a higher (but still relatively low) total S, ranging from 0.26%S to 0.64%S. The tailings samples have low ANC, with all samples less than 20 kg H_2SO_4/t, and most samples less than 10 kg H_2SO_4/t. The rejects generally have moderate to high ANC, with most samples having an ANC greater than 20 kg H_2SO_4/t, to a maximum of 343 kg H_2SO_4/t. The product coal samples have relatively low ANC with a narrow range of 11 to 15 kg H_2SO_4/t.

Figure 5 is an acid base plot for the tailings, rejects and product coal samples, and Figure 6 is the same plot but rescaled to better show ANC values less than 80 kg H_2SO_4/t. All rejects samples are NAPP negative with ANC/MPA ratios greater than 2, indicating a high factor of safety. All except 2 of the tailings samples have NAPP values of 0 kg H_2SO_4/t or less, with around half the samples having ANC/MPA ratios of 2 or more. The product coal samples plot close to the NAPP = 0 kg H_2SO_4/t, with 14 samples plotting in the NAPP negative domain and five samples plotting in the NAPP positive domain.

Most of the single addition NAG results are less than 4.5 but are affected by organic acids, and are likely to overestimate the acid potential of these samples. Eight of the samples have NAGpH values of 4.5 or greater.

Figure 7 is an ARD classification plot for the tailings, rejects and product coal samples. The product coal samples show a tight distribution, with NAPP values close to 0 kg H_2SO_4/t and NAGpH values varying only from 1.9 to 2.1. Five of the product coal samples plot in the PAF domain and the rest plot in the lower left uncertain domain. None of the tailings or rejects samples plot in the PAF domain, 6 plot in the NAF domain, 2 plot in the upper right UC domain, and most plot in the lower left UC domain.

The two samples plotting in the upper right UC domain have low S of 0.06 to 0.22%S and low ANC of 1 kg H_2SO_4/t, and in these cases the NAG test would normally account for all pyritic S in the sample. These samples are expected to be NAF in accordance with the NAG results.

The NAG results for the samples plotting in the lower left UC and PAF domains are affected by organic acids and extended boil and calculated NAG testing was carried out on 13 selected samples to help resolve the uncertainty in ARD classification of these samples. Results are shown in Table 8. The NAGpH value increases 2 or more pH units after the extended boiling step, confirming the effects of organic acids. The calculated NAG values for all samples are negative, indicating that the acid generated in the standard NAG test for these samples is organic, and that materials represented by these samples are unlikely to be acid producing under field conditions. Note that this includes 3 product coal samples that plot in the PAF domain. It is likely that the product coal samples include non acid generating organic S forms, and the NAPP value will tend to overestimate the acid potential for these materials. Product coal samples potting in the PAF domain are expected to be NAF in accordance with calculated NAG results.

An ABCC profile is produced by slow titration of a sample with acid, and provides an indication of the relative reactivity of the ANC measured. The acid buffering of a sample to pH 4 can be used as an estimate of the proportion of readily available ANC. ABCC tests were carried out on 5 selected rejects samples to evaluate the availability of the ANC measured. Results are presented in Figures 8 to 12, with calcite, dolomite, ferroan dolomite and siderite standard curves as reference. Calcite and dolomite readily dissolve in acid and exhibit strongly buffered pH curves in the ABCC test, rapidly dropping once the ANC value is reached. The siderite standard provides very poor acid buffering, exhibiting a very steep pH curve in the ABCC test. Ferroan dolomite is between siderite and dolomite in acid buffering availability.

All samples have ABCC curves that plot close to dolomite and calcite standard trends, indicating reactive ANC. The profile for sample 2583 (Figure 12) indicates that around 50% of the total ANC is readily available, with the remaining likely to be due to siderite effects on the ANC test causing overestimation of the effective ANC. Profiles for the remaining samples indicate that 70% to 100% of the total ANC measured is readily available. Overall, ABCC results suggest that the acid buffering minerals within the rejects tested are generally reactive, and that the ANC would be mainly effective.

Results of multi-element scans and corresponding GAI of 9 selected tailings and rejects sample solids are presented in Table 9. Results show enrichment of Mn in rejects sample 2583, which also has higher Ca and Fe than other samples. This sample had a high ANC of 343 kg H_2SO_4/t, and the elevated Mn is most likely related to Ca-Fe-Mn carbonate. Sample 2586 was also enriched in W, which may be due to contamination from sample preparation equipment and, given the relative insolubility of W, is unlikely to be of any environmental concern. No significant enrichment of metals or metalloids is indicated.

The same 9 tailings and rejects sample solids were subjected to water extraction at a solids:liquor ratio of 1:5. Results are shown in Table 10. A summary of the results is included, showing 10^{th} percentile, 50^{th} percentile (median) and 90^{th} percentile concentrations. The samples produced circum-neutral to slightly alkaline pH extracts and there were no elevated metals or metalloids evident. Na and Cl were the dominant cations and anions in solution.

Results indicate that tailings, rejects and product coal represented by the samples tested are likely to be NAF, with the rejects also likely to have significant excess buffering capacity. Washery waste materials represented by the samples tested were not significantly enriched in elements of environmental concern and water extracts indicate metals and metalloids are unlikely to be mobilised to any significant extent from circum-neutral to slightly alkaline leachates.

7.0 Conclusions and Recommendations

Results indicate that overburden/interburden, floor, washery waste and coal materials represented by the samples tested are unlikely to be acid producing or release significant salinity or metals/metalloids, and will not require special handling (such as mine material segregation, selective placement and engineered covers) for ARD or neutral drainage control.

Initial sodicity testing indicates that some overburden/interburden materials are likely to be sodic and dispersive, and may be subject to surface crusting and high erosion rates if placed in the surface of dumps and exposed directly to rainfall. Materials with sodic/dispersion potential should be treated (with gypsum or lime) if exposed on dump surfaces or used in engineered structures.

It is recommended a programme of routine sampling and testing of washery wastes, overburden/interburden and floor materials be carried out during operations to confirm the low salinity and low risk of neutral mine drainage and ARD indicated by testing to date. Leach column testing of these materials could be considered to better evaluate neutral mine drainage chemistry. Routine site water quality monitoring programmes should include pH, EC, acidity/alkalinity, SO_4, Al, As, Co, Cu, Fe, Mn, Ni and Zn to monitor for indications of any acid and neutral mine drainage and identify the need for additional controls.

The distribution and extent of sodic/dispersive materials should be investigated further.

Table 1: Acid forming characteristics of overburden/interburden samples from holes C10_01, C10_08 and C10_10.

Hole Name	Depth (m)			Lithology	Seam	Weathering	Comments	NEC Sample No	EGi Sample Number	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS					SINGLE ADDITION NAG			ARD Classification
	From	To	Interval									Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	
C10_01	0.00	1.00	1.00	Clay		HW	Open Hole	15501	1532	7.5	0.13	0.02	1	73	-72	119.28	8.8	0	0	NAF
C10_01	1.00	2.00	1.00	Claystone		HW	Open Hole	15502	1533			0.03	1							NAF
C10_01	2.00	3.00	1.00	Claystone		HW	Open Hole	15503	1534	8.2	0.09	0.01	0	12	-12	39.22	7.2	0	0	NAF
C10_01	3.00	4.00	1.00	Claystone		HW	Open Hole	15504	1535			0.02	1							NAF
C10_01	4.00	5.00	1.00	Claystone		HW	Open Hole	15505	1536			0.01	0							NAF
C10_01	5.00	5.40	0.40	Claystone		HW	Open Hole	15506	1537	7.6	0.12	0.02	1	4	-3	6.54	6.9	0	0	NAF
C10_01	5.40	9.80	4.40	Clay		W		63001	1538	7.7	0.15	<0.01	0	7	-7	45.75	6.9	0	0	NAF
C10_01	9.80	10.85	1.05	Claystone		W		63002	1539			<0.01	0							NAF
C10_01	10.85	13.20	2.35	Clay		W		63003	1540			0.03	1							NAF
C10_01	13.20	17.50	4.30	Sandstone		F		63004	1541	8.3	0.09	0.03	1	27	-26	29.41	7.3	0	0	NAF
C10_01	17.50	20.18	2.68	Sandstone		F	Minor Clay	63005	1542			0.04	1							NAF
C10_01	20.18	22.00	1.82	Sandstone		F		63006	1543			0.03	1							NAF
C10_01	22.00	22.90	0.90	Sandstone		F		63007	1544	7.5	0.22	0.05	2	11	-9	7.19	5.8	0	1	NAF
C10_01	22.90	23.00	0.10	Sandstone/Carb Mudstone		F		15507	2455			0.04	1							NAF
C10_01	23.00	24.52	0.09	Coal	A4	F		15508-23				0.32	10							
C10_01	24.52	24.62	0.10	Claystone		F		15524	2456	8.0	0.31	0.09	3	6	-3	2.18	3.1	11	27	UC(NAF)
C10_01	24.62	24.71	0.09	Claystone		F		63008	1545	6.6	0.21	0.09	3	7	-4	2.54	4.1	0.4	3	UC(NAF)
C10_01	24.71	24.81	0.10	Claystone		F		15525	2457	7.5	0.43	0.08	2	5	-3	2.04	4.5	0	5	NAF
C10_01	24.81	24.87	0.06	Coal		F		15526	2458	7.3	0.53	0.50	15	43	-28	2.81	2.1	142	221	UC(NAF)
C10_01	24.87	24.97	0.10	Claystone		F		15527	2459	7.4	0.43	0.23	7	8	-1	1.14	4.5	0	3	UC(NAF)
C10_01	24.97	26.16	1.19	Claystone		F		63009	1546	8.2	0.09	0.06	2	9	-7	4.90	7.1	0	0	NAF
C10_01	26.16	26.93	0.77	Siltstone		F		63010	1547	7.5	0.32	0.02	1	14	-13	22.88	7.1	0	0	NAF
C10_01	26.93	27.03	0.10	Siltstone		F		15528	2460			0.03	1							NAF
C10_01	27.03	27.53	0.50	Coal	A5	F		15529				0.42	13							
C10_01	27.53	27.63	0.10	Siltstone		F		15530	2461	8.5	0.18	0.12	4	9	-5	2.45	2.4	55	91	UC(NAF)
C10_01	27.63	28.85	1.22	Siltstone		F		63011	1548	7.6	0.31	0.03	1	8	-7	8.71	6.6	0	0	NAF
C10_01	28.85	29.80	0.95	Siltstone		F		63012	1549	8.1	0.09	0.03	1	47	-46	51.20	7.9	0	0	NAF
C10_01	29.80	29.90	0.10	Carb Mudstone/Siltstone		F		15531	2462	7.3	0.39	0.12	4	8	-4	2.18	2.4	53	91	UC(NAF)
C10_01	29.90	30.52	0.36	Coal	B1	F		15532-36				0.25	8							
C10_01	30.52	30.62	0.10	Siltstone		F		15561	2463			0.04	1							NAF
C10_01	30.62	31.78	1.16	Siltstone		F		63013	1550	7.6	0.21	0.03	1	10	-9	10.89	7.4	0	0	NAF
C10_01	31.78	31.88	0.10	Siltstone		F		15537	2464			0.01	0							NAF
C10_01	31.88	31.90	0.02	Coal	B2	F		15538	2465	7.6	0.45	0.26	8	35	-27	4.40	2.1	136	203	UC(NAF)
C10_01	31.90	32.07	0.17	Siltstone/Carb Mudstone		F		15539	2466	7.9	0.43	0.01	0	8	-8	26.14	4.6	0	5	NAF
C10_01	32.07	32.10	0.03	Coal		F		15540	2467	8.0	0.20	0.35	11	7	4	0.65	2.0	127	189	PAF-LC
C10_01	32.10	32.29	0.19	Siltstone/Carb Mudstone		F		15541	2468	7.8	0.41	0.06	2	7	-5	3.81	2.9	14	34	UC(NAF)
C10_01	32.29	32.56	0.06	Coal	B3	F		15542-44				0.39	12							
C10_01	32.56	32.66	0.10	Siltstone/Carb Mudstone		F		15545	2469			0.02	1							NAF
C10_01	32.66	32.74	0.08	Siltstone		F		63014	1551	7.9	0.25	0.02	1	7	-6	11.44	6.0	0	1	NAF
C10_01	32.74	32.84	0.10	Siltstone		F		15546	2470			0.01	0							NAF
C10_01	32.84	33.65	0.45	Coal	B4	F		15547-51				0.29	9							
C10_01	33.65	34.01	0.36	Siltstone/Carb Mudstone		F		15552	2471	8.1	0.38	0.06	2	14	-12	7.63	2.7	25	49	UC(NAF)
C10_01	34.01	34.04	0.03	Coal		F		15553	2472	7.3	0.30	0.42	13	12	1	0.93	1.8	169	255	PAF-LC
C10_01	34.04	34.26	0.22	Siltstone		F		15554	2473	7.5	0.24	<0.01	0	13	-13	84.97	5.2	0	3	NAF
C10_01	34.26	34.31	0.05	Coal		F		15555	2474	7.6	0.25	0.44	13	15	-2	1.11	2.1	147	221	UC(NAF)
C10_01	34.31	34.45	0.14	Siltstone		F		15556	2475	7.4	0.26	0.02	1	7	-6	11.44	5.3	0	2	NAF
C10_01	34.45	34.46	0.01	Coal		F		15557	2476	8.4	0.32	0.75	23	14	9	0.61	2.0	117	176	PAF
C10_01	34.46	34.50	0.04	Carb Mudstone		F		15558	2477	7.8	0.43	0.14	4	8	-4	1.87	2.6	44	83	UC(NAF)
C10_01	34.50	34.53	0.03	Coal		F		15559	2478	7.6	0.47	0.50	15	9	6	0.59	1.9	149	226	PAF
C10_01	34.53	34.63	0.10	Carb Mudstone/Siltstone		F		15560	2479	8.7	0.33	0.11	3	15	-12	4.46	2.3	65	104	UC(NAF)
C10_01	34.63	35.46	0.83	Siltstone		F		63015	1552	8.0	0.10	0.02	1	72	-71	117.65	7.8	0	0	NAF
C10_01	35.46	35.56	0.10	Siltstone		F		15562	2480	8.1	0.21	0.01	0	8	-8	26.14	4.5	0	7	NAF
C10_01	35.56	35.60	0.04	Coal		F		15563	2481	8.2	0.43	0.73	22	13	9	0.58	2.0	130	198	PAF
C10_01	35.60	35.70	0.10	Siltstone		F		15564	2482	7.8	0.38	0.01	0	10	-10	32.68	5.4	0	2	NAF
C10_01	35.70	35.99	0.29	Siltstone		F		63016	1553	7.7	0.22	0.01	0	8	-8	26.14	7.5	0	0	NAF
C10_01	35.99	36.09	0.10	Siltstone		F		15565	2483			0.01	0							NAF
C10_01	36.09	36.80	0.04	Coal	BC1	F		15566-72				0.48	15							
C10_01	36.80	36.90	0.10	Siltstone		F		15573	2484			0.01	0							NAF
C10_01	36.90	37.23	0.33	Siltstone		F		63017	1554	7.8	0.23	0.03	1	13	-12	14.16	7.1	0	0	NAF
C10_01	37.23	38.57	1.34	Sandstone		F		63018	1555	7.5	0.25	0.02	1	35	-34	57.19	7.8	0	0	NAF
C10_01	38.57	38.95	0.38	Claystone		F		63019	1556	7.8	0.32	<0.01	0	16	-16	104.58	7.4	0	0	NAF
C10_01	38.95	39.06	0.11	Claystone/Carb Mudstone		F		15574	2485			0.01	0							NAF
C10_01	39.06	39.59	0.42	Coal	BC2	F		15575-77				0.41	13							
C10_01	39.59	39.69	0.10	Siltstone		F		15578	2486			<0.01	0							NAF
C10_01	39.69	40.58	0.89	Siltstone		F	Minor Coal	63020	1557	6.8	0.31	0.03	1	8	-7	8.71	4.5	0	2	NAF
C10_01	40.58	40.68	0.10	Siltstone		F		15579	2487			0.05	2							NAF
C10_01	40.68	40.75	0.07	Coal	BC3	F		15580				0.47	14							
C10_01	40.75	40.85	0.10	Siltstone		F		15581	2488	7.7	0.36	0.06	2	15	-13	8.17	3.9	1	13	UC(NAF)
C10_01	40.85	41.97	1.12	Siltstone/Carb Mudstone		F		63021	1558	6.7	0.38	0.03	1	7	-6	7.63	4.3	0.2	3	NAF
C10_01	41.97	42.07	0.10	Siltstone		F		15582	2489			0.02	1							NAF

Table 1: Acid forming characteristics of overburden/interburden samples from holes C10_01, C10_08 and C10_10.

Hole Name	Depth (m)			Lithology	Seam	Weathering	Comments	NEC Sample No	EGi Sample Number	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS					SINGLE ADDITION NAG			ARD Classification
	From	To	Interval									Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	
C10_01	42.07	42.18	0.11	Coal	BC4	F	Calcite	15583				0.54	17							
C10_01	42.18	42.28	0.10	Siltstone		F		15584	2490			0.03	1							NAF
C10_01	42.28	42.86	0.58	Siltstone/Carb Mudstone		F		63022	1559	6.9	0.36	0.02	1	15	-14	24.51	5.6	0	1	NAF
C10_01	42.86	42.96	0.10	Carb Mudstone		F		15585	2491	8.6	0.34	0.16	5	11	-6	2.25	2.4	65	107	UC(NAF)
C10_01	42.96	43.15	0.09	Coal	BC5	F		15586				0.50	15							
C10_01	43.15	43.98	0.83	Siltstone		F		63023	1560	7.6	0.17	0.02	1	86	-85	140.52	7.6	0	0	NAF
C10_01	43.98	44.08	0.10	Siltstone		F		15588	2493			0.02	1							NAF
C10_01	44.08	44.27	0.19	Coal	BC6	F		15589				0.52	16							
C10_01	44.27	44.37	0.10	Sandstone		F		15590	2494			0.01	0							NAF
C10_01	44.37	44.80	0.43	Sandstone		F		63024	1561	8.2	0.19	0.02	1	9	-8	14.71	6.2	0	1	NAF
C10_01	44.80	46.28	1.48	Siltstone		F		63025	1562			0.02	1							NAF
C10_01	46.28	47.06	0.78	Sandstone		F		63026	1563			0.02	1							NAF
C10_01	47.06	48.35	1.29	Siltstone		F		63027	1564	7.5	0.24	0.02	1	30	-29	49.02	8.3	0	0	NAF
C10_01	48.35	49.98	1.63	Sandstone		F		63028	1565	7.7	0.22	<0.01	0	16	-16	104.58	7.4	0	0	NAF
C10_01	49.98	50.19	0.21	Sandstone		F		15591	2495			0.01	0							NAF
C10_01	50.19	50.60	0.14	Coal	C1	F		15592-96				0.26	8							
C10_01	50.60	50.70	0.10	Claystone		F		15597	2496			<0.01	0							NAF
C10_01	50.70	51.89	1.19	Claystone/Sandstone		F		63029	1566	7.8	0.25	0.01	0	9	-9	29.41	7.1	0	0	NAF
C10_01	51.89	51.99	0.10	Claystone		F		15598	2497			0.02	1							NAF
C10_01	51.99	54.00	0.05	Coal	C2	F		15599-615				0.22	7							
C10_01	54.00	54.10	0.10	Siltstone		F		15616	2498			<0.01	0							NAF
C10_01	54.10	54.27	0.17	Siltstone		F		63030	1567	7.9	0.25	0.01	0	9	-9	29.41	7.3	0	0	NAF
C10_01	54.27	54.37	0.10	Siltstone		F		15617	2499			<0.01	0							NAF
C10_01	54.37	55.82	1.34	Coal	C3	F		15618-20				0.32	10							
C10_01	55.82	55.92	0.10	Claystone		F		15621	2500			<0.01	0							NAF
C10_01	55.92	57.76	1.84	Claystone/Sandstone/Siltstone		F		63031	1568	7.4	0.12	0.03	1	32	-31	34.86	7.9	0	0	NAF
C10_01	57.76	57.86	0.10	Claystone/Clay/Coal		F		15622	2501	9.1	0.20	0.11	3	11	-8	3.27	2.4	56	94	UC(NAF)
C10_01	57.86	58.06	0.20	Coal		F	Minor Calcite	15623	2502	8.7	0.28	0.40	12	36	-24	2.94	2.3	118	180	UC(NAF)
C10_01	58.06	58.16	0.10	Siltstone		F		15624	2503	8.3	0.21	<0.01	0	100	-100	653.59	7.4	0	0	NAF
C10_01	58.16	58.57	0.41	Siltstone		F		63032	1569	7.3	0.14	0.01	0	91	-91	297.39	8.1	0	0	NAF
C10_01	58.57	58.58	0.01	Coal		F		63033	1570	5.5	0.35	0.13	4	10	-6	2.51	2.6	17	28	UC(NAF)
C10_01	58.58	59.47	0.89	Siltstone		F		63034	1571	7.7	0.22	0.01	0	16	-16	52.29	7.5	0	0	NAF
C10_01	59.47	59.57	0.10	Siltstone/Carb Mudstone		F		15625	2504	8.4	0.33	<0.01	0	10	-10	65.36	4.5	0	7	NAF
C10_01	59.57	59.68	0.11	Coal		F		15626	2505	8.1	0.20	0.44	13	23	-10	1.71	2.2	122	185	UC(NAF)
C10_01	59.68	59.78	0.10	Siltstone		F		15627	2506	7.8	0.24	<0.01	0	10	-10	65.36	5.6	0	2	NAF
C10_01	59.78	59.93	0.15	Siltstone		F		63035	1572			0.01	0							NAF
C10_01	59.93	60.03	0.10	Siltstone/Carb Mudstone		F		15628	2507			0.02	1							NAF
C10_01	60.03	60.83	0.13	Coal	C4	F		15629-34				0.09	3							
C10_01	60.83	60.93	0.10	Siltstone		F		15635	2508			<0.01	0							NAF
C10_01	60.93	61.73	0.80	Siltstone		F		63036	1573	7.8	0.22	0.01	0	11	-11	35.95	7.1	0	0	NAF
C10_01	61.73	61.83	0.10	Siltstone		F		15636	2509			<0.01	0							NAF
C10_01	61.83	62.46	0.04	Coal	C5	F		15637-45				0.17	5							
C10_01	62.46	62.56	0.10	Siltstone/Claystone		F		15646	2510			0.01	0							NAF
C10_01	62.56	62.97	0.41	Sandstone		F		63037	1574	7.9	0.11	0.02	1	10	-9	16.34	6.9	0	0	NAF
C10_01	62.97	64.17	1.20	Siltstone/Sandstone		F		63038	1575			0.02	1							NAF
C10_08	0.00	1.00	1.00	Soil		W	Open Hole	62484	1362	7.3	0.07	0.01	0	4	-4	13.07	7.4	0	0	NAF
C10_08	1.00	2.00	1.00	Clay		W	Open Hole	62485	1363	7.4	0.14	0.01	0	4	-4	13.07	7.5	0	0	NAF
C10_08	2.00	3.00	1.00	Clay		P	Open Hole	62486	1364			<0.01	0							NAF
C10_08	3.00	4.00	1.00	Clay		P	Open Hole	62487	1365	7.5	0.11	0.01	0	5	-5	16.34	7.6	0	0	NAF
C10_08	4.00	5.00	1.00	Clay		P	Open Hole	62488	1366			0.01	0							NAF
C10_08	5.00	6.00	1.00	Clay		P	Open Hole	62489	1367			0.01	0							NAF
C10_08	6.00	7.00	1.00	Clay		P	Open Hole	62490	1368	8.1	0.10	0.02	1	32	-31	52.29	8.4	0	0	NAF
C10_08	7.00	8.00	1.00	Clay		P	Open Hole	62491	1369			0.03	1							NAF
C10_08	8.00	9.00	1.00	Sandstone		P	Open Hole, BOW	62492	1370	7.6	0.13	0.04	1	21	-20	17.16	8.1	0	0	NAF
C10_08	9.00	10.00	1.00	Sandstone		F	Open Hole	62493	1371	7.7	0.14	0.06	2	12	-10	6.54	7.3	0	0	NAF
C10_08	10.00	11.00	1.00	Sandstone		F	Open Hole	62494	1372			0.04	1							NAF
C10_08	11.00	12.00	1.00	Sandstone		F	Open Hole	62495	1373	8.2	0.10	0.03	1	9	-8	9.80	7.1	0	0	NAF
C10_08	12.00	13.12	1.12	Siltstone/Sandstone		F		63079	1374			0.05	2							NAF
C10_08	13.12	14.46	1.34	Siltstone		F		63080	1375	7.8	0.09	0.03	1	12	-11	13.07	6.9	0	0	NAF
C10_08	14.46	15.58	1.12	Carb Mudstone		F		63081	1376	7.5	0.19	0.09	3	11	-8	3.99	3.3	21	53	NAF
C10_08	15.58	15.68	0.10	Carb Mudstone		F		62496	2388			<0.01	0							NAF
C10_08	15.68	17.66	0.31	Coal	UG2	F		62497-500+15951-53				0.26	8							
C10_08	17.66	17.76	0.10	Siltstone		F		15954	2389			0.02	1							NAF
C10_08	17.76	18.42	0.66	Siltstone		F	Minor Coal	63082	1377	7.6	0.18	0.04	1	6	-5	4.90	5.0	0	6	NAF
C10_08	18.42	18.52	0.10	Siltstone		F		15955	2390			<0.01	0							NAF
C10_08	18.52	19.14	0.32	Coal	UG3	F		15956-58				0.21	6							
C10_08	19.14	19.24	0.10	Sandstone		F		15959	2391			<0.01	0							NAF
C10_08	19.24	20.70	1.46	Siltstone		F		63083	1378			0.03	1							NAF
C10_08	20.70	21.11	0.41	Carb Mudstone		F		63084	1379	8.3	0.09	0.11	3	10	-7	2.97	3.6	15	46	NAF
C10_08	21.11	22.03	0.92	Siltstone		F		63085	1380			0.02	1							NAF

Table 1: Acid forming characteristics of overburden/interburden samples from holes C10_01, C10_08 and C10_10.

Hole Name	Depth (m) From	To	Interval	Lithology	Seam	Weathering	Comments	NEC Sample No	EGi Sample Number	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS Total %S	MPA	ANC	NAPP	ANC/MPA	SINGLE ADDITION NAG NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	ARD Classification
C10_08	22.03	23.10	1.07	Core Loss																
C10_08	23.10	24.35	1.25	Sandstone/Siltstone		F		63086	1381			0.03	1							NAF
C10_08	24.35	26.99	2.64	Sandstone		F		63087	1382	7.5	0.15	0.02	1	63	-62	102.94	8.5	0	0	NAF
C10_08	26.99	28.59	1.60	Claystone		F		63088	1383	7.4	0.22	0.02	1	15	-14	24.51	7.2	0	0	NAF
C10_08	28.59	29.80	1.21	Claystone/Siltstone		F		63089	1384			0.03	1							NAF
C10_08	29.80	34.37	4.57	Sandstone		F		63090	1385	8.2	0.09	0.03	1	72	-71	78.43	7.7	0	0	NAF
C10_08	34.37	35.16	0.79	Sandstone		F		63091	1386			0.03	1							NAF
C10_08	35.16	35.53	0.37	Siltstone/Carb Mudstone		F		63092	1387	7.3	0.32	0.02	1	11	-10	17.97	7.1	0	0	NAF
C10_08	35.53	35.63	0.10	Siltstone		F		15960	2392			<0.01	0							NAF
C10_08	35.63	36.65	0.29	Coal	Y2	F	Calcite	15961-65				0.40	12							
C10_08	36.65	36.75	0.10	Sandstone		F		15966	2393			<0.01	0							NAF
C10_08	36.75	38.52	1.77	Coal	Y3	F	Minor Calcite & Siderite	15967				0.49	15							
C10_08	38.52	38.62	0.10	Siltstone		F		15968	2394			0.01	0							NAF
C10_08	38.62	38.66	0.04	Siltstone		F		63093	1388			0.03	1							NAF
C10_08	38.66	38.77	0.11	Siltstone		F		15969	2395			<0.01	0							NAF
C10_08	38.77	38.99	0.22	Coal	A2	F		15970				0.26	8							
C10_08	38.99	39.09	0.10	Siltstone		F		15971	2396			<0.01	0							NAF
C10_08	39.09	39.43	0.34	Siltstone		F		63094	1389	7.9	0.08	0.03	1	60	-59	65.36	7.8	0	0	NAF
C10_08	39.43	39.53	0.10	Siltstone		F		15972	2397			<0.01	0							NAF
C10_08	39.53	41.06	0.14	Coal	A3	F		15973-75				0.34	10							
C10_08	41.06	41.16	0.10	Carb Mudstone/Sandstone		F		15976	2398			0.01	0							NAF
C10_08	41.16	41.43	0.27	Sandstone		F		63095	1390			0.04	1							NAF
C10_08	41.43	42.45	1.02	Siltstone		F		63096	1391	8.2	0.15	0.03	1	8	-7	8.71	5.5	0	4	NAF
C10_08	42.45	42.55	0.10	Siltstone		F		15977	2399			<0.01	0							NAF
C10_08	42.55	43.43	0.09	Coal	A4	F		15978-80				0.30	9							
C10_08	43.43	43.53	0.10	Siltstone		F		15981	2400	9.3	0.87	0.01	0	7	-7	22.88	6.0	0	2	NAF
C10_08	43.53	43.80	0.27	Siltstone		F		63097	1392			0.04	1							NAF
C10_08	43.80	43.90	0.10	Siltstone		F		15982	2401	8.4	0.52	0.07	2	4	-2	1.87	3.1	23	46	UC(NAF)
C10_08	43.90	44.04	0.14	Coal	A5	F		15983				0.31	9							
C10_08	44.04	44.14	0.10	Sandstone		F		15984	2402			0.01	0							NAF
C10_08	44.14	45.44	1.30	Sandstone		F		63098	1393	7.4	0.14	0.01	0	28	-28	91.50	7.6	0	0	NAF
C10_08	45.44	46.12	0.68	Siltstone		F		63099	1394			0.03	1							NAF
C10_08	46.12	46.39	0.27	Carb Mudstone		F		63100	1395	8.2	0.28	0.14	4	30	-26	7.00	2.5	87	137	NAF
C10_08	46.39	48.10	1.71	Siltstone		F		63101	1396	8.4	0.12	0.02	1	23	-22	37.58	7.6	0	0	NAF
C10_08	48.10	48.32	0.22	Sandstone		F		63102	1397			0.02	1							NAF
C10_08	48.32	50.17	1.85	Siltstone		F		63103	1398	8.5	0.11	0.03	1	15	-14	16.34	6.9	0	0	NAF
C10_08	50.17	50.96	0.79	Sandstone		F		63104	1399			0.03	1							NAF
C10_08	50.96	51.60	0.64	Siltstone		F		63105	1400			0.03	1							NAF
C10_08	51.60	54.03	2.43	Sandstone		F		63106	1401	8.7	0.11	0.03	1	67	-66	72.98	8.5	0	0	NAF
C10_08	54.03	56.13	2.10	Siltstone		F		63107	1402			0.04	1							NAF
C10_08	56.13	58.76	2.63	Sandstone		F		63108	1403			0.02	1							NAF
C10_08	58.76	60.10	1.34	Sandstone		F		63109	1404			0.03	1							NAF
C10_08	60.10	61.55	1.45	Sandstone		F		63110	1405	8.9	0.11	0.01	0	63	-63	205.88	7.9	0	0	NAF
C10_08	61.55	61.65	0.10	Sandstone		F		15985	2403			0.01	0							NAF
C10_08	61.65	62.43	0.07	Coal	B1	F		15986-92				0.26	8							
C10_08	62.43	62.47	0.04	Siltstone		F		15993	2404			0.05	2							NAF
C10_08	62.47	63.07	0.07	Coal	B2	F		15994-96				0.36	11							
C10_08	63.07	63.17	0.10	Siltstone		F		15997	2405			0.01	0							NAF
C10_08	63.17	63.57	0.40	Siltstone		F		63111	1406	8.2	0.18	0.02	1	12	-11	19.61	6.9	0	0	NAF
C10_08	63.57	65.58	2.01	Sandstone		F	Minor Calcite	63112	1407	7.9	0.26	0.03	1	100	-99	108.93	7.7	0	0	NAF
C10_08	65.58	66.21	0.63	Siltstone		F		63113	1408			0.04	1							NAF
C10_08	66.21	66.31	0.10	Claystone		F		15998	2406	8.7	0.42	0.03	1	9	-8	9.80	3.4	11	32	NAF
C10_08	66.31	66.66	0.07	Coal	B4	F		15999-600+12001-03				0.35	11							
C10_08	66.66	66.76	0.10	Claystone/Carb Mudstone		F		12004	2407	8.9	0.38	0.10	3	28	-25	9.15	2.7	22	41	UC(NAF)
C10_08	66.76	67.46	0.70	Claystone		F		63114	1409	8.4	0.20	0.04	1	14	-13	11.44	6.9	0	0	NAF
C10_08	67.46	69.58	2.12	Siltstone		F		63115	1410	8.5	0.09	0.04	1	31	-30	25.33	8.8	0	0	NAF
C10_08	69.58	69.68	0.10	Siltstone		F		12005	2408	7.8	0.43	0.19	6	17	-11	2.92	4.3	2	28	UC(NAF)
C10_08	69.68	69.76	0.08	Coal	BC1	F		12006				0.23	7							
C10_08	69.76	69.86	0.10	Claystone/Siltstone		F		12007	2409			0.02	1							NAF
C10_08	69.86	71.57	1.71	Siltstone		F		63116	1411	9.4	0.28	0.01	0	17	-17	55.56	9.8	0	0	NAF
C10_08	71.57	71.67	0.10	Siltstone		F		12008	2410			0.01	0							NAF
C10_08	71.67	72.06	0.03	Coal	BC2	F		12009-13				0.19	6							
C10_08	72.06	72.16	0.10	Siltstone		F		12014	2411	7.7	0.61	<0.01	0	8	-8	52.29	4.7	0	5	NAF
C10_08	72.16	73.22	1.06	Siltstone		F	Calcite	63117	1412			0.03	1							NAF
C10_08	73.22	75.24	2.02	Siltstone		F		63118	1413	9.3	0.12	0.04	1	17	-16	13.89	7.5	0	0	NAF
C10_10	0.00	1.00	1.00	Soil		P	Open Hole, BOW	62565	1414	8.8	0.18	0.05	2	39	-37	25.49	7.2	0	0	NAF
C10_10	1.00	2.00	1.00	Sandstone		F	Open Hole	62566	1415	8.2	0.14	0.03	1	12	-11	13.07	8.3	0	0	NAF
C10_10	2.00	3.00	1.00	Sandstone		F	Open Hole	62567	1416			0.02	1							NAF
C10_10	3.00	4.00	1.00	Sandstone		F	Open Hole	62568	1417			0.03	1							NAF
C10_10	4.00	5.00	1.00	Sandstone		F	Open Hole	62569	1418	7.8	0.13	0.02	1	116	-115	189.54	8.7	0	0	NAF

Table 1: Acid forming characteristics of overburden/interburden samples from holes C10_01, C10_08 and C10_10.

Hole Name	Depth (m) From	Depth (m) To	Depth (m) Interval	Lithology	Seam	Weathering	Comments	NEC Sample No	EGi Sample Number	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS Total %S	MPA	ANC	NAPP	ANC/MPA	SINGLE ADDITION NAG NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	ARD Classification
C10_10	5.00	6.00	1.00	Sandstone		F	Open Hole	62570	1419			0.02	1							NAF
C10_10	6.00	9.87	3.87	Sandstone		F		63039	1420			0.03	1							NAF
C10_10	9.87	14.87	5.00	Sandstone		F	Siderite	63041	1421			0.03	1							NAF
C10_10	14.87	18.56	3.69	Sandstone		F		63042	1422	8.5	0.09	0.04	1	20	-19	16.34	8.8	0	0	NAF
C10_10	18.56	19.46	0.90	Sandstone/Siltstone		F	Siderite	63043	1423			0.05	2							NAF
C10_10	19.46	23.43	3.97	Sandstone		F	Minor Siderite	63044	1424	8.4	0.24	0.04	1	37	-36	30.23	8.4	0	0	NAF
C10_10	23.43	24.99	1.56	Siltstone		F		63045	1425	9.5	0.21	0.04	1	16	-15	13.07	8.2	0	0	NAF
C10_10	24.99	26.84	1.85	Carb Mudstone		F		63046	1426	8.3	0.19	0.05	2	16	-14	10.46	8.1	0	0	NAF
C10_10	26.84	29.65	2.81	Sandstone		F	Minor Coal	63047	1427			0.05	2							NAF
C10_10	29.65	32.36	2.71	Sandstone		F		63048	1428			0.04	1							NAF
C10_10	32.36	33.25	0.89	Carb Mudstone/Sandstone		F		63049	1429	9.3	0.48	0.10	3	15	-12	4.90	3.5	15	39	NAF
C10_10	33.25	34.54	1.29	Sandstone		F		63050	1430	9.4	0.14	0.06	2	16	-14	8.71	7.2	0	0	NAF
C10_10	34.54	35.53	0.99	Siltstone		F		63051	1431			0.04	1							NAF
C10_10	35.53	36.81	1.28	Carb Mudstone		F		63052	1432	9.5	0.14	0.09	3	13	-10	4.72	3.7	9	34	NAF
C10_10	36.81	36.91	0.10	Carb Mudstone		F		62601	2412	8.3	0.72	0.15	5	11	-6	2.40	2.5	54	90	UC(NAF)
C10_10	36.91	38.27	0.45	Coal	UG1	F		62602-06				0.29	9							
C10_10	38.27	38.37	0.10	Sandstone		F		62607	2413			<0.01	0							NAF
C10_10	38.37	38.47	0.10	Sandstone		F		63053	1433			0.02	1	71	-70	116.01	7.8	0	0	NAF
C10_10	38.47	40.59	2.12	Siltstone		F		63054	1434	9.7	0.39	0.03	1	39	-38	42.48	7.6	0	0	NAF
C10_10	40.59	42.65	2.06	Sandstone		F		63055	1435	9.5	0.30	0.03	1							NAF
C10_10	42.65	44.41	1.76	Siltstone/Sandstone		F		63056	1436			0.04	1	13	-12	10.62	5.9	0	2	NAF
C10_10	44.41	44.51	0.10	Siltstone		F		62608	2414			0.03	1							NAF
C10_10	44.51	44.88	0.19	Coal	UG2	F		62609-11				0.34	10							
C10_10	44.88	44.98	0.10	Siltstone		F		62612	2415			<0.01	0							NAF
C10_10	44.98	45.20	0.22	Siltstone		F	Not Available	N/A												
C10_10	45.20	45.30	0.10	Siltstone		F		62613	2416			<0.01	0							NAF
C10_10	45.30	45.34	0.04	Coal	UG3	F		62614				0.39	12							
C10_10	45.34	45.44	0.10	Carb Mudstone		F		62615	2417	8.2	0.52	0.05	2	143	-141	93.46	6.9	0	0	NAF
C10_10	45.44	45.76	0.32	Siltstone		F	Not Available	N/A												
C10_10	45.76	45.86	0.10	Siltstone		F		62616	2418			<0.01	0							NAF
C10_10	45.86	46.67	0.11	Coal	UG4	F		62617-22				0.21	6							
C10_10	46.67	46.77	0.10	Siltstone		F		62623	2419			<0.01	0							NAF
C10_10	46.77	47.72	0.95	Siltstone		F		63057	1437	9.2	0.12	0.03	1							NAF
C10_10	47.72	47.82	0.10	Siltstone		F		62624	2420	8.4	0.33	0.02	1	15	-14	24.51	4.7	0	4	NAF
C10_10	47.82	47.90	0.08	Coal		F		62625	2421	7.8	0.28	0.38	12	29	-17	2.49	2.3	155	235	UC(NAF)
C10_10	47.90	48.00	0.10	Siltstone		F		62635	2422	7.9	0.28	0.03	1	8	-7	8.71	5.8	0	2	NAF
C10_10	48.00	48.41	0.41	Siltstone		F		63058	1438			0.03	1	8	-7	8.71	6.9	0	0	NAF
C10_10	48.41	48.51	0.10	Siltstone		F		62626	2423	8.0	0.24	0.09	3	7	-4	2.54	3.5	7	21	UC(NAF)
C10_10	48.51	49.18	0.67	Coal	Y1	F		62637				0.37	11							
C10_10	49.18	49.34	0.16	Siltstone		F		62628	2424	8.5	0.25	0.16	5	6	-1	1.23	2.6	49	85	UC(NAF)
C10_10	49.34	50.65	0.76	Coal	Y2	F		62629-30				0.31	9							
C10_10	50.65	50.75	0.10	Siltstone		F		62631	2425			0.03	1							NAF
C10_10	50.75	51.94	1.19	Siltstone		F		63059	1439	9.4	0.35	0.02	1							NAF
C10_10	51.94	52.04	0.10	Siltstone		F		62632	2426	7.8	0.32	0.45	14	5	9	0.36	4.2	1	10	PAF-LC
C10_10	52.04	52.08	0.04	Coal		F		62633	2427	7.8	0.33	<0.01	0	8	-8	52.29	2.0	165	243	NAF
C10_10	52.08	52.18	0.10	Siltstone		F		62634	2428			<0.01	0							NAF
C10_10	52.18	52.91	0.73	Siltstone		F		63060	1440			0.02	1							NAF
C10_10	52.91	54.54	1.63	Sandstone		F		63061	1441	9.6	0.49	0.02	1	25	-24	40.85	7.6	0	0	NAF
C10_10	54.54	55.69	1.15	Siltstone/Carb Mudstone		F		63062	1442	8.5	0.23	0.02	1	9	-8	14.71	5.9	0	4	NAF
C10_10	55.69	55.79	0.10	Siltstone/Carb Mudstone		F		62636	2429			<0.01	0							NAF
C10_10	55.79	56.34	0.55	Coal	Y3	F		62637				0.35	11							
C10_10	56.34	56.44	0.10	Siltstone		F		62638	2430	7.6	0.41	<0.01	0	9	-9	58.82	6.9	0	0	NAF
C10_10	56.44	56.63	0.19	Siltstone		F		63063	1443			0.02	1							NAF
C10_10	56.63	56.74	0.11	Carb Mudstone/Siltstone		F		62639	2431	7.5	0.28	0.09	3	10	-7	3.63	4.0	3	29	UC(NAF)
C10_10	56.74	57.72	0.35	Coal	A1	F		62640-44				0.23	7							
C10_10	57.72	57.87	0.15	Mudstone/Carb Mudstone		F		62645	2432	7.4	0.29	<0.01	0	29	-29	189.54	6.9	0	0	NAF
C10_10	57.87	58.35	0.48	Coal	A2	F		62646				0.24	7							
C10_10	58.35	58.47	0.12	Siltstone/Carb Mudstone		F		62647	2433	7.6	0.36	0.09	3	15	-12	5.45	4.3	1	27	UC(NAF)
C10_10	58.47	58.95	0.48	Siltstone		F		63064	1444	8.4	0.31	0.02	1	7	-6	11.44	5.4	0	5	NAF
C10_10	58.95	59.05	0.10	Siltstone		F		62648	2434			<0.01	0							NAF
C10_10	59.05	60.73	0.27	Coal	A3	F		62649-53				0.32	10							
C10_10	60.73	60.83	0.10	Siltstone		F		62454	2435	8.6	0.41	0.08	2	7	-5	2.86	4.5	0	12	NAF
C10_10	60.83	61.17	0.34	Sandstone/Siltstone		F		63065	1445			0.02	1							NAF
C10_10	61.17	65.00	3.83	Sandstone		F		63066	1446	8.6	0.28	0.02	1	70	-69	114.38	7.9	0	0	NAF
C10_10	65.00	67.50	2.50	Sandstone		F		63067	1447			0.02	1							NAF
C10_10	67.50	71.74	4.24	Sandstone		F		63068	1448			0.03	1							NAF
C10_10	71.74	73.42	1.68	Siltstone		F	Minor CM	63069	1449	9.9	0.38	0.03	1	16	-15	17.43	6.0	0	2	NAF
C10_10	73.42	73.52	0.10	Siltstone		F		62455	2436			0.01	0							NAF
C10_10	73.52	74.02	0.09	Coal	B1	F		62456-62				0.28	9							
C10_10	74.02	74.12	0.10	Siltstone		F		62463	2437	8.3	0.29	<0.01	0	14	-14	91.50	4.7	0	5	NAF

Table 1: Acid forming characteristics of overburden/interburden samples from holes C10_01, C10_08 and C10_10.

Hole Name	Depth (m) From	Depth (m) To	Depth (m) Interval	Lithology	Seam	Weathering	Comments	NEC Sample No	EGi Sample Number	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS Total %S	MPA	ANC	NAPP	ANC/MPA	SINGLE ADDITION NAG NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$	ARD Classification
C10_10	74.12	74.58	0.46	Siltstone		F		63070	1450			0.02	1							NAF
C10_10	74.58	74.68	0.10	Siltstone		F		62464	2438	8.1	0.26	<0.01	0	9	-9	58.82	7.1	0	0	NAF
C10_10	74.68	74.70	0.02	Coal		F		62465	2439	7.3	0.27	0.55	17	18	-1	1.07	2.1	177	281	UC(NAF)
C10_10	74.70	74.80	0.10	Siltstone		F		62466	2440	7.6	0.25	<0.01	0	14	-14	91.50	6.0	0	1	NAF
C10_10	74.80	76.30	1.50	Siltstone		F		63071	1451	8.2	0.12	0.02	1	15	-14	24.51	7.1	0	0	NAF
C10_10	76.30	76.40	0.10	Siltstone		F		62467	2441	7.8	0.29	0.01	0	9	-9	29.41	5.0	0	5	NAF
C10_10	76.40	77.06	0.66	Coal	B2	F		62468				0.39	12							
C10_10	77.06	77.16	0.10	Siltstone		F		62469	2442			<0.01	0							NAF
C10_10	77.16	78.12	0.96	Siltstone		F	Minor Coal	63072	1452	7.9	0.12	0.04	1	9	-8	7.35	4.7	0	9	NAF
C10_10	78.12	78.22	0.10	Carb Mudstone/Siltstone		F		62470	2443			0.05	2							NAF
C10_10	78.22	78.46	0.24	Coal	B3	F		62471				0.42	13							
C10_10	78.46	78.59	0.13	Siltstone		F		62472	2444	7.7	0.31	0.07	2	15	-13	7.00	4.3	1	18	UC(NAF)
C10_10	78.59	78.63	0.04	Coal		F		62473	2445	7.5	0.36	0.54	17	21	-4	1.27	1.9	199	292	UC(NAF)
C10_10	78.63	78.73	0.10	Siltstone		F		62474	2446	7.6	0.31	<0.01	0	198	-198	1294.12	7.2	0	0	NAF
C10_10	78.73	79.10	0.37	Siltstone		F		63073	1453			0.02	1							NAF
C10_10	79.10	79.20	0.10	Siltstone		F		62475	2447	7.5	0.22	0.09	3	6	-3	2.18	3.3	15	38	UC(NAF)
C10_10	79.20	79.25	0.05	Coal		F		62476	2448	7.9	0.25	0.56	17	20	-3	1.17	2.2	113	173	UC(NAF)
C10_10	79.25	79.35	0.10	Siltstone		F		62477	2449	7.8	0.23	<0.01	0	16	-16	104.58	6.9	0	0	NAF
C10_10	79.35	79.85	0.50	Siltstone/Carb Mudstone		F		63074	1454			0.02	1							NAF
C10_10	79.85	79.95	0.10	Carb Mudstone		F		62478	2450	8.6	0.20	0.09	3	10	-7	3.63	3.0	28	56	UC(NAF)
C10_10	79.95	80.18	0.23	Coal	B4	F		62479				0.40	12							
C10_10	80.18	80.28	0.10	Siltstone		F		62480	2451	7.8	0.22	<0.01	0	9	-9	58.82	5.1	0	3	NAF
C10_10	80.28	81.06	0.78	Siltstone		F		63075	1455			0.03	1							NAF
C10_10	81.06	81.16	0.10	Siltstone/Carb Mudstone		F		62481	2452	7.9	0.20	<0.01	0	11	-11	71.90	7.1	0	0	NAF
C10_10	81.16	81.20	0.04	Coal		F		62482	2453	7.1	0.24	0.65	20	30	-10	1.51	1.8	265	373	UC(NAF)
C10_10	81.20	81.30	0.10	Siltstone		F		62483	2454	8.1	0.19	0.05	2	9	-7	5.88	4.6	0	8	NAF
C10_10	81.30	82.00	0.70	Siltstone		F		63076	1456			0.02	1							NAF
C10_10	82.00	84.00	2.00	Siltstone		F		63077	1457			0.02	1							NAF
C10_10	84.00	86.57	2.57	Sandstone		F	Calcite	63078	1458	9.8	0.12	0.02	1	53	-52	86.60	8.5	0	0	NAF

KEY

$pH_{1:2}$ = pH of 1:2 extract

$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)

MPA = Maximum Potential Acidity (kgH_2SO_4/t)

ANC = Acid Neutralising Capacity (kgH_2SO_4/t)

NAPP = Net Acid Producing Potential (kgH_2SO_4/t)

NAGpH = pH of NAG liquor

$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)

$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

NAF = Non-Acid Forming

PAF = Potentially Acid Forming

PAF-LC = PAF Low Capacity

UC = Uncertain Classification

(expected classification in brackets)

Coal seam interval

Missing interval or sample not available

Standard NAG results overestimate acid potential due to organic acid effects

Table 2: Total S results for infill holes C10_03, C10_04, C10_05 and C10_07.

Hole Name	Depth (m)			Lithology	Seam	Weathering	Comments	NEC Sample No	Total %S	ARD Classification Based on Total S% Criteria Only
	From	To	Interval							
C10_03	0.00	1.00	1.00	Sand		H	Open Hole	15716	<0.01	NAF*
C10_03	1.00	2.00	1.00	Sand		H	Open Hole	15718	<0.01	NAF*
C10_03	2.00	3.00	1.00	Sand		H	Open Hole	15719	<0.01	NAF*
C10_03	3.00	4.00	1.00	Sand		H	Open Hole	15720	<0.01	NAF*
C10_03	4.00	5.00	1.00	Sand		H	Open Hole	15721	<0.01	NAF*
C10_03	5.00	6.00	1.00	Sand		H	Open Hole	15722	<0.01	NAF*
C10_03	6.00	7.00	1.00	Sand		H	Open Hole	15723	<0.01	NAF*
C10_03	7.00	8.00	1.00	Sand		H	Open Hole	15724	<0.01	NAF*
C10_03	8.00	9.00	1.00	Sand		P	Open Hole	15725	<0.01	NAF*
C10_03	9.00	10.00	1.00	Sand		P	Open Hole	15726	<0.01	NAF*
C10_03	10.00	11.00	1.00	Sand		P	Open Hole	15727	<0.01	NAF*
C10_03	11.00	11.55	0.55	Sand		P	Open Hole	15728	<0.01	NAF*
C10_03	11.55	14.04	2.49	Sand		P		EL00010	<0.01	NAF*
C10_03	14.04	14.66	0.62	Sand		W		EL00011	<0.01	NAF*
C10_03	14.66	15.27	0.61	Sandstone		W		EL00012	<0.01	NAF*
C10_03	15.27	17.70	2.43	Sandstone		F	Conglomerate	EL00013	0.01	NAF*
C10_03	17.70	20.21	2.51	Sandstone		F		EL00014	<0.01	NAF*
C10_03	20.21	23.00	2.79	Sandstone		F		EL00015	<0.01	NAF*
C10_03	23.00	24.03	1.03	Sandstone		F		EL00016	0.01	NAF*
C10_03	24.03	24.13	0.10	Sandstone		F		15729	0.14	NAF*
C10_03	24.13	24.53	0.40	Coal/Parting	Y3	F		15730-32	0.41	
C10_03	24.53	24.63	0.10	Carb Mudstone		F		15733	0.25	PAF*
C10_03	24.63	24.71	0.08	Carb Mudstone		F		EL00017	0.23	PAF*
C10_03	24.71	24.81	0.10	Carb Mudstone		F		15734	0.27	PAF*
C10_03	24.81	25.13	0.32	Coal	Y4	F		15735	0.40	
C10_03	25.13	25.23	0.10	Carb Mudstone		F		15736	0.04	NAF*
C10_03	25.23	26.27	1.04	Carb Mudstone		F		EL00018	<0.01	NAF*
C10_03	26.27	26.37	0.10	Carb Mudstone		F		15737	0.04	NAF*
C10_03	26.37	26.41	0.04	Coal		F		15738		
C10_03	26.41	26.51	0.10	Carb Mudstone		F		15739	0.02	NAF*
C10_03	26.51	26.81	0.30	Carb Mudstone		F		EL00019	<0.01	NAF*
C10_03	26.81	26.91	0.10	Carb Mudstone		F		15740	0.03	NAF*
C10_03	26.91	28.05	1.14	Coal/Parting	A1	F		15741-53	0.26	
C10_03	28.05	28.08	0.03	Carb Mudstone		F		15754	0.12	NAF*
C10_03	28.08	28.57	0.49	Coal	A2	F		15755-57	0.26	
C10_03	28.57	28.61	0.04	Mudstone		F		15758	0.04	NAF*
C10_03	28.61	29.47	0.86	Coal	A3	F	Minor Calcite	15759-61	0.25	
C10_03	29.47	29.52	0.05	Carb Mudstone		F		15762	0.05	NAF*
C10_03	29.52	30.55	1.03	Coal	A4	F	Minor Calcite	15763	0.28	
C10_03	30.55	30.65	0.10	Mudstone		F		15764	0.02	NAF*
C10_03	30.65	30.87	0.22	Mudstone		F		EL00020	<0.01	NAF*
C10_03	30.87	30.97	0.10	Mudstone		F		15765	0.03	NAF*
C10_03	30.97	31.04	0.07	Coal	A5	F		15766	0.69	
C10_03	31.04	31.14	0.10	Mudstone		F		15767	0.03	NAF*
C10_03	31.14	32.41	1.27	Mudstone		F		EL00021	<0.01	NAF*
C10_03	32.41	32.79	0.38	Carb Mudstone/Claystone		F		EL00022	0.14	NAF*
C10_03	32.79	32.89	0.10	Claystone		F		15768	0.03	NAF*
C10_03	32.89	34.21	1.32	Coal	B1	F		15769-77	0.21	
C10_03	34.21	34.31	0.10	Mudstone		F		15778	0.04	NAF*
C10_03	34.31	34.79	0.48	Mudstone		F		EL00023	<0.01	NAF*
C10_03	34.79	34.89	0.10	Mudstone		F		15779	0.07	NAF*
C10_03	34.89	36.55	1.66	Coal	B2	F		15780-88	0.24	
C10_03	36.55	36.65	0.10	Mudstone		F		15789	0.04	NAF*
C10_03	36.65	37.49	0.84	Mudstone		F		EL00024	<0.01	NAF*
C10_03	37.49	39.97	2.48	Mudstone		F		EL00025	<0.01	NAF*
C10_03	39.97	42.16	2.19	Siltstone		F	Minor Calcite	EL00026	<0.01	NAF*
C10_04	0.00	1.00	1.00	Sand		H	Open Hole	15647	<0.01	NAF*
C10_04	1.00	2.00	1.00	Sand		H	Open Hole	15648	<0.01	NAF*
C10_04	2.00	3.00	1.00	Sand		H	Open Hole	15649	<0.01	NAF*
C10_04	3.00	4.00	1.00	Sand		H	Open Hole	15650	<0.01	NAF*
C10_04	4.00	5.00	1.00	Sand		H	Open Hole	15651	<0.01	NAF*
C10_04	5.00	6.00	1.00	Sand		H	Open Hole	15652	<0.01	NAF*
C10_04	6.00	7.00	1.00	Sand		H	Open Hole	15653	<0.01	NAF*
C10_04	7.00	8.00	1.00	Sand		P	Open Hole	15654	<0.01	NAF*
C10_04	8.00	9.00	1.00	Sand		P	Open Hole	15655	<0.01	NAF*
C10_04	9.00	10.00	1.00	Sand		P	Open Hole	15656	<0.01	NAF*
C10_04	10.00	11.55	1.55					15662	<0.01	NAF*
C10_04	11.55	12.00	0.45	Core Loss						
C10_04	12.00	13.08	1.08	Coal	A2	F		15657-61+63+66	0.40	
C10_04	13.08	13.18	0.10	Mudstone		F		15667	0.06	NAF*

Table 2: Total S results for infill holes C10_03, C10_04, C10_05 and C10_07.

Hole Name	Depth (m)			Lithology	Seam	Weathering	Comments	NEC Sample No	Total %S	ARD Classification Based on Total S% Criteria Only
	From	To	Interval							
C10_04	13.18	14.00	0.82	Mudstone		F		EL00001	<0.01	NAF*
C10_04	14.00	14.35	0.35	Core Loss						
C10_04	14.35	14.91	0.56	Coal	A4	F		15668-74	0.36	
C10_04	14.91	15.01	0.10	Mudstone		F		15675	0.07	NAF*
C10_04	15.01	16.09	1.08	Coal	A5	F		15676-78	0.48	
C10_04	16.09	16.22	0.13	Claystone/Mudstone		F		15679	0.05	NAF*
C10_04	16.22	17.75	1.53	Coal	B1	F		15680-85	0.35	
C10_04	17.75	17.81	0.06	Claystone		F		15686		
C10_04	17.81	17.87	0.06	Coal		F		15687		
C10_04	17.87	18.00	0.13	Claystone		F		15688	0.12	NAF*
C10_04	18.00	18.52	0.52	Claystone		F		EL00002	<0.01	NAF*
C10_04	18.52	18.62	0.10	Claystone		F		15689	0.08	NAF*
C10_04	18.62	19.99	1.37	Coal	B2	F		15690-97	0.30	
C10_04	19.99	20.26	0.27	Claystone/Carb Mudstone		F		15698	0.03	NAF*
C10_04	20.26	20.74	0.48	Coal	B3	F		15702-700	0.18	
C10_04	20.74	20.84	0.10	Siltstone		F		15701	0.05	NAF*
C10_04	20.84	21.25	0.41	Sandstone/Siltstone		F		EL00003	<0.01	NAF*
C10_04	21.25	22.20	0.95	Claystone		F		EL00004	<0.01	NAF*
C10_04	22.20	22.30	0.10	Claystone		F		15703	0.03	NAF*
C10_04	22.30	22.36	0.06	Coal		F		15704		
C10_04	22.36	22.62	0.26	Claystone		F		15705	0.08	NAF*
C10_04	22.62	22.93	0.31	Coal	B4	F		15706	0.35	
C10_04	22.93	23.21	0.28	Siltstone		F		15707	0.07	NAF*
C10_04	23.21	23.28	0.07	Coal		F		15708		
C10_04	23.28	23.39	0.11	Siltstone		F		15709	0.15	NAF*
C10_04	23.39	24.84	1.45	Siltstone/Sandstone		F		EL00005	<0.01	NAF*
C10_04	24.84	24.94	0.10	Sandstone		F		15710	0.06	NAF*
C10_04	24.94	24.97	0.03	Coal		F		15711		
C10_04	24.97	25.17	0.20	Claystone		F		15712	0.02	NAF*
C10_04	25.17	25.24	0.07	Claystone		F		EL00006	<0.01	NAF*
C10_04	25.24	25.34	0.10	Claystone		F		15713	0.04	NAF*
C10_04	25.34	25.42	0.08	Coal		F		15714		
C10_04	25.42	25.52	0.10	Siltstone		F		15715	0.03	NAF*
C10_04	25.52	26.42	0.90	Claystone		F		EL00007	<0.01	NAF*
C10_04	26.42	28.57	2.15	Claystone		F		EL00008	<0.01	NAF*
C10_04	28.57	30.44	1.87	Core Loss						
C10_04	30.44	32.48	2.04	Claystone		F		EL00009	<0.01	NAF*
C10_05	0.00	1.00	1.00	Soil		H	Open Hole	12015	0.01	NAF*
C10_05	1.00	2.00	1.00	Soil		H	Open Hole	12016	<0.01	NAF*
C10_05	2.00	3.00	1.00	Clay		H	Open Hole	12017	<0.01	NAF*
C10_05	3.00	4.00	1.00	Clay		H	Open Hole	12018	<0.01	NAF*
C10_05	4.00	5.00	1.00	Sand		H	Open Hole	12019	<0.01	NAF*
C10_05	5.00	6.00	1.00	Sand		H	Open Hole	12020	<0.01	NAF*
C10_05	6.00	7.00	1.00	Sand		H	Open Hole	12021	<0.01	NAF*
C10_05	7.00	8.00	1.00	Sand		H	Open Hole	12022	<0.01	NAF*
C10_05	8.00	9.00	1.00	Sand		H	Open Hole	12023	<0.01	NAF*
C10_05	9.00	10.00	1.00	Sand		H	Open Hole	12024	<0.01	NAF*
C10_05	10.00	11.00	1.00	Sand		H	Open Hole	12025	<0.01	NAF*
C10_05	11.00	12.00	1.00	Sand		H	Open Hole	12026	<0.01	NAF*
C10_05	12.00	12.34	0.34	Sandstone		P		EL00081	<0.01	NAF*
C10_05	12.34	16.93	4.59	Sandstone		F		EL00082	<0.01	NAF*
C10_05	16.93	20.17	3.24	Sandstone		F		EL00083	<0.01	NAF*
C10_05	20.17	23.73	3.56	Sandstone		F		EL00084	<0.01	NAF*
C10_05	23.73	24.33	0.60	Core Loss						
C10_05	24.33	28.47	4.14	Sandstone		F		EL00085	<0.01	NAF*
C10_05	28.47	29.00	0.53	Core Loss						
C10_05	29.00	30.87	1.87	Sandstone		F		EL00086	<0.01	NAF*
C10_05	30.87	31.62	0.75	Carb Mudstone/Sandstone/Coal		F		EL00087	<0.01	NAF*
C10_05	31.62	31.72	0.10	Carb Mudstone		F		12027		
C10_05	31.72	32.53	0.81	Parting/Coal	Y3	F		12028-30	0.27	
C10_05	32.53	32.63	0.10	Carb Mudstone		F		12031	0.05	NAF*
C10_05	32.63	32.80	0.17	Carb Mudstone		F		EL00088	0.01	NAF*
C10_05	32.80	32.90	0.10	Carb Mudstone		F		12032	0.05	NAF*
C10_05	32.90	32.94	0.04	Coal	Y4	F		12033	0.37	
C10_05	32.94	33.04	0.10	Siltstone		F		12034	0.04	NAF*
C10_05	33.04	34.96	1.92	Siltstone		F		EL00089	<0.01	NAF*
C10_05	34.96	35.06	0.10	Siltstone		F		12035	0.06	NAF*
C10_05	35.06	35.41	0.35	Coal/Parting	A1	F		12036-40	0.33	
C10_05	35.41	35.51	0.10	Tuff		F		12041	0.03	NAF*
C10_05	35.51	36.16	0.65	Siltstone		F		EL00090	<0.01	NAF*

Table 2: Total S results for infill holes C10_03, C10_04, C10_05 and C10_07.

Hole Name	Depth (m)			Lithology	Seam	Weathering	Comments	NEC Sample No	Total %S	ARD Classification Based on Total S% Criteria Only
	From	To	Interval							
C10_05	36.16	36.36	0.20	Siltstone		F		12042	0.07	NAF*
C10_05	36.36	36.53	0.17	Coal	A2	F		12043	0.34	
C10_05	36.53	36.63	0.10	Carb Mudstone		F		12044	0.02	NAF*
C10_05	36.63	36.70	0.07	Claystone		F		EL00091	0.01	NAF*
C10_05	36.70	36.80	0.10	Claystone		F		12045	0.05	NAF*
C10_05	36.80	38.05	1.25	Coal	A3	F		12046-50+ 62651-54	0.38	
C10_05	38.05	38.15	0.10	Siltstone		F		62645	0.07	NAF*
C10_05	38.15	39.78	1.63	Siltstone		F		EL00092	<0.01	NAF*
C10_05	39.78	40.91	1.13	Siltstone		F		EL00093	0.02	NAF*
C10_05	40.91	41.01	0.10	Siltstone		F		62656	0.05	NAF*
C10_05	41.01	41.07	0.06	Coal		F		62657		
C10_05	41.07	41.17	0.10	Siltstone		F		62658	0.07	NAF*
C10_05	41.17	41.23	0.06	Siltstone		F		EL00094	<0.01	NAF*
C10_05	41.23	41.33	0.10	Siltstone		F		62659	0.12	NAF*
C10_05	41.33	42.15	0.82	Coal	A4	F		62660	0.26	
C10_05	42.15	42.25	0.10	Siltstone		F		62661	0.02	NAF*
C10_05	42.25	42.37	0.12	Siltstone		F		EL00095	0.01	NAF*
C10_05	42.37	42.47	0.10	Siltstone		F		62662	0.04	NAF*
C10_05	42.47	42.69	0.22	Coal	A5	F		62663	0.25	
C10_05	42.69	42.79	0.10	Siltstone		F		62664	0.02	NAF*
C10_05	42.79	44.01	1.22	Siltstone/Sandstone		F		EL00096	<0.01	NAF*
C10_05	44.01	45.00	0.99	Core Loss		F				
C10_05	45.00	45.10	0.10	Siltstone		F		62655	0.05	NAF*
C10_05	45.10	45.25	0.15	Coal		F		62666		
C10_05	45.25	45.35	0.10	Siltstone		F		62667	0.02	NAF*
C10_05	45.35	45.72	0.37	Siltstone		F		EL00097	0.01	NAF*
C10_05	45.72	45.82	0.10	Siltstone		F		62668	0.05	NAF*
C10_05	45.82	46.96	1.14	Coal	B1	F		62669-75	0.35	
C10_05	46.96	47.27	0.31	Carb Mudstone		F		62676	0.08	NAF*
C10_05	47.27	49.78	2.51	Coal	B2	F		62677-87	0.25	
C10_05	49.78	49.88	0.10	Carb Mudstone		F		62688	0.03	NAF*
C10_05	49.88	50.64	0.76	Siltstone		F		EL00098	<0.01	NAF*
C10_05	50.64	50.74	0.10	Carb Mudstone/Siltstone		F		62689	0.11	NAF*
C10_05	50.74	50.96	0.22	Coal	B3	F		62690	0.43	
C10_05	50.96	51.06	0.10	Siltstone		F		62691	0.03	NAF*
C10_05	51.06	51.23	0.17	Siltstone		F		EL00099	<0.01	NAF*
C10_05	51.23	51.33	0.10	Siltstone		F		62692	0.03	NAF*
C10_05	51.33	51.38	0.05	Coal	B4	F		62693	0.55	
C10_05	51.38	51.48	0.10	Sandstone		F		62694	0.02	NAF*
C10_05	51.48	52.10	0.62	Siltstone		F		EL00100	<0.01	NAF*
C10_05	52.10	53.03	0.93	Sandstone		F		EL00101	<0.01	NAF*
C10_07	0.00	1.00	1.00	Sand		H	Open Hole	15790	<0.01	NAF*
C10_07	1.00	2.00	1.00	Sand		H	Open Hole	15791	<0.01	NAF*
C10_07	2.00	3.00	1.00	Sand		H	Open Hole	15792	<0.01	NAF*
C10_07	3.00	4.00	1.00	Sand		H	Open Hole	15793	<0.01	NAF*
C10_07	4.00	5.00	1.00	Sand		H	Open Hole	15794	<0.01	NAF*
C10_07	5.00	6.89	1.89	Sandstone		H		EL00027	<0.01	NAF*
C10_07	6.89	7.80	0.91	Sandstone		W		EL00028	<0.01	NAF*
C10_07	7.80	10.52	2.72	Sandstone		P		EL00029	<0.01	NAF*
C10_07	10.52	11.52	1.00	Sandstone		F		EL00030	<0.01	NAF*
C10_07	11.52	11.94	0.42	Claystone		W		EL00031	0.03	NAF*
C10_07	11.94	12.70	0.76	Sandstone		W		EL00032	0.03	NAF*
C10_07	12.70	14.26	1.56	Sandstone		P		EL00033	0.01	NAF*
C10_07	14.26	14.36	0.10	Sandstone		F		15795	0.04	NAF*
C10_07	14.36	14.40	0.04	Coal		F		15796		
C10_07	14.40	14.50	0.10	Carb Mudstone		F		15797	0.15	NAF*
C10_07	14.50	15.02	0.52	Carb Mudstone		F		EL00034	<0.01	NAF*
C10_07	15.02	16.39	1.37	Sandstone/Siltstone		F		EL00035	<0.01	NAF*
C10_07	16.39	17.85	1.46	Carb Mudstone/Claystone		F		EL00036	0.04	NAF*
C10_07	17.85	17.95	0.10	Carb Mudstone		F		15798	0.09	NAF*
C10_07	17.95	18.00	0.05	Coal	T	F		15799		
C10_07	18.00	18.10	0.10	Carb Mudstone		F		15800	0.09	NAF*
C10_07	18.10	18.17	0.07	Mudstone		F		EL00037	<0.01	NAF*
C10_07	18.17	18.27	0.10	Carb Mudstone		F		15801	0.10	NAF*
C10_07	18.27	20.02	1.75	Coal	UG1	F	Minor Calcite	15802-24	0.28	
C10_07	20.02	20.09	0.07	Claystone	UG1	F		15825		
C10_07	20.09	20.11	0.02	Coal	UG1	F		15826		
C10_07	20.11	20.30	0.19	Claystone		F		15827	0.02	NAF*
C10_07	20.30	20.47	0.17	Coal	UG2	F		15828-30	0.28	
C10_07	20.47	20.57	0.10	Claystone		F		15831	0.02	NAF*

Table 2: Total S results for infill holes C10_03, C10_04, C10_05 and C10_07.

Hole Name	Depth (m)			Lithology	Seam	Weathering	Comments	NEC Sample No	Total %S	ARD Classification Based on Total S% Criteria Only
	From	To	Interval							
C10_07	20.57	21.18	0.61	Claystone		F		EL00038	0.01	NAF*
C10_07	21.18	21.28	0.10	Carb Mudstone		F		15832	0.04	NAF*
C10_07	21.28	21.32	0.04	Coal		F		15833		
C10_07	21.32	21.36	0.04	Coal		F		15834	0.08	NAF*
C10_07	21.36	21.41	0.05	Coal		F		15835		
C10_07	21.41	21.51	0.10	Claystone		F		15837		
C10_07	21.51	21.67	0.16	Claystone		F		EL00039	0.01	NAF*
C10_07	21.67	21.77	0.10	Carb Mudstone		F		15838	0.03	NAF*
C10_07	21.77	21.81	0.04	Coal		F		15839		
C10_07	21.81	21.91	0.10	Carb Mudstone		F		15840	0.03	NAF*
C10_07	21.91	22.34	0.43	Carb Mudstone		F		EL00040	0.02	NAF*
C10_07	22.34	24.77	2.43	Mudstone/Sandstone		F		EL00041	<0.01	NAF*
C10_07	24.77	25.41	0.64	Mudstone		F		EL00042	<0.01	NAF*
C10_07	25.41	25.51	0.10	Mudstone	UG3	F		15841	0.04	NAF*
C10_07	25.51	25.69	0.18	Coal	UG3	F	Calcite	15842-44	0.46	
C10_07	25.69	25.79	0.10	Claystone		F		15845	0.11	NAF*
C10_07	25.79	26.14	0.35	Claystone		F		EL00043	<0.01	NAF*
C10_07	26.14	26.24	0.10	Claystone		F		15846	0.02	NAF*
C10_07	26.24	26.37	0.13	Coal	UG4	F		15847-49	0.61	
C10_07	26.37	26.47	0.10	Claystone		F		15850	0.03	NAF*
C10_07	26.47	27.64	1.17	Claystone		F		EL00044	<0.01	NAF*
C10_07	27.64	30.95	3.31	Sandstone		F		EL00045	<0.01	NAF*
C10_07	30.95	31.72	0.77	Coaly Shale		F		EL00046	<0.01	NAF*
C10_07	31.72	31.82	0.10	Coaly Shale		F		15851	0.03	NAF*
C10_07	31.82	32.11	0.29	Coal	Y2	F		15852	0.41	
C10_07	32.11	32.21	0.10	Mudstone		F		15853	0.08	NAF*
C10_07	32.21	33.69	1.48	Mudstone		F		EL00047	<0.01	NAF*
C10_07	33.69	33.79	0.10	Mudstone		F		15854	0.02	NAF*
C10_07	33.79	33.84	0.05	Coal		F		15855		
C10_07	33.84	33.94	0.10	Mudstone		F		15856	0.16	NAF*
C10_07	33.94	34.24	0.30	Mudstone		F		EL00048	<0.01	NAF*
C10_07	34.24	34.34	0.10	Mudstone		F		15857	0.01	NAF*
C10_07	34.34	34.35	0.01	Coal		F		15858		
C10_07	34.35	34.41	0.06	Carb Mudstone		F		15859		
C10_07	34.41	34.52	0.11	Coal		F		15860		
C10_07	34.52	34.62	0.10	Carb Mudstone		F		15861	0.11	NAF*
C10_07	34.62	34.94	0.32	Mudstone		F		EL00049	0.01	NAF*
C10_07	34.94	35.04	0.10	Mudstone		F		15862	0.05	NAF*
C10_07	35.04	35.06	0.02	Coal		F		15863		
C10_07	35.06	35.16	0.10	Sandstone		F		15864	0.02	NAF*
C10_07	35.16	35.69	0.53	Sandstone		F		EL00050	<0.01	NAF*
C10_07	35.69	35.79	0.10	Carb Mudstone		F		15865	0.02	NAF*
C10_07	35.79	36.63	0.84	Coal	Y3	F		15866-70	0.35	
C10_07	36.63	36.73	0.10	Mudstone		F		15871	0.02	NAF*
C10_07	36.73	38.51	1.78	Mudstone		F		EL00051	<0.01	NAF*
C10_07	38.51	38.61	0.10	Mudstone		F		15872	0.03	NAF*
C10_07	38.61	38.70	0.09	Coal		F		15873		
C10_07	38.70	38.80	0.10	Mudstone		F		15874	0.05	NAF*
C10_07	38.80	40.73	1.93	Mudstone		F		EL00052	<0.01	NAF*
C10_07	40.73	40.83	0.10	Mudstone		F		15875	0.04	NAF*
C10_07	40.83	42.12	1.29	Coal	A1	F		15876-84	0.28	
C10_07	42.12	42.18	0.06	Carb Mudstone	A1	F		15885		
C10_07	42.18	42.21	0.03	Coal	A1	F		15886		
C10_07	42.21	42.33	0.12	Carb Mudstone		F		15887	0.05	NAF*
C10_07	42.33	43.34	1.01	Coal	A2	F		15888-96	0.29	
C10_07	43.34	43.44	0.10	Mudstone		F		15897	0.03	NAF*
C10_07	43.44	43.58	0.14	Mudstone		F		EL00053	<0.01	NAF*
C10_07	43.58	43.68	0.10	Mudstone		F		15898	0.03	NAF*
C10_07	43.68	43.73	0.05	Coal		F		15899		
C10_07	43.73	43.83	0.10	Mudstone		F		15900	0.05	NAF*
C10_07	43.83	44.10	0.27	Mudstone		F		EL00054	<0.01	NAF*
C10_07	44.10	44.20	0.10	Mudstone		F		15901	0.02	NAF*
C10_07	44.20	44.74	0.54	Coal	A3	F		15902-04	0.33	
C10_07	44.74	44.75	0.01	Mudstone		F		15905	0.32	PAF*
C10_07	44.75	44.82	0.07	Carb Mudstone		F		15906		
C10_07	44.82	44.86	0.04	Carb Mudstone		F		15907	0.18	NAF*
C10_07	44.86	45.67	0.81	Coal	A4	F		15908-10	0.36	
C10_07	45.67	45.77	0.10	Carb Mudstone		F		15911	0.04	NAF*
C10_07	45.77	46.45	0.68	Mudstone/Carb Mudstone		F		EL00055	<0.01	NAF*
C10_07	46.45	48.53	2.08	Carb Mudstone		F		EL00056	0.02	NAF*

Table 2: Total S results for infill holes C10_03, C10_04, C10_05 and C10_07.

Hole Name	Depth (m)			Lithology	Seam	Weathering	Comments	NEC Sample No	Total %S	ARD Classification Based on Total S% Criteria Only
	From	To	Interval							
C10_07	48.53	49.98	1.45	Carb Mudstone		F		EL00057	<0.01	NAF*
C10_07	49.98	51.69	1.71	Sandstone		F		EL00058	<0.01	NAF*
C10_07	51.69	54.32	2.63	Mudstone		F		EL00059	<0.01	NAF*
C10_07	54.32	55.37	1.05	Sandstone		F		EL00060	<0.01	NAF*
C10_07	55.37	55.47	0.10	Carb Mudstone		F		15912	0.13	NAF*
C10_07	55.47	55.62	0.15	Coal	A5	F		15913-15	0.35	
C10_07	55.62	55.72	0.10	Carb Mudstone		F		15916	0.09	NAF*
C10_07	55.72	55.92	0.20	Carb Mudstone		F		EL00061	0.02	NAF*
C10_07	55.92	56.02	0.10	Carb Mudstone		F		15917	0.07	NAF*
C10_07	56.02	57.21	1.19	Coal	B1	F		15918-24	0.35	
C10_07	57.21	57.31	0.10	Siltstone		F		15925	0.02	NAF*
C10_07	57.31	57.44	0.13	Siltstone		F		EL00013	<0.01	NAF*
C10_07	57.44	57.54	0.10	Carb Mudstone		F		15926	0.04	NAF*
C10_07	57.54	57.60	0.06	Coal		F		15927		
C10_07	57.60	57.70	0.10	Carb Mudstone		F		15928	0.06	NAF*
C10_07	57.70	57.97	0.27	Carb Mudstone		F		EL00063	<0.01	NAF*
C10_07	57.97	58.07	0.10	Carb Mudstone		F		15929	0.17	NAF*
C10_07	58.07	58.14	0.07	Coal	B3	F		15930	0.54	
C10_07	58.14	58.24	0.10	Mudstone		F		15931	0.04	NAF*
C10_07	58.24	59.16	0.92	Mudstone		F		EL00064	<0.01	NAF*
C10_07	59.16	60.52	1.36	Siltstone		F		EL00065	<0.01	NAF*
C10_07	60.52	61.18	0.66	Sandstone		F		EL00066	<0.01	NAF*
C10_07	61.18	61.71	0.53	Shale		F		EL00067	0.45	PAF*
C10_07	61.71	62.41	0.70	Mudstone		F		EL00068	0.03	NAF*
C10_07	62.41	62.51	0.10	Shale		F		15932	0.58	PAF*
C10_07	62.51	62.69	0.18	Coal	B4	F		15933	0.80	
C10_07	62.69	62.79	0.10	Mudstone		F		15934	0.07	NAF*
C10_07	62.79	63.65	0.86	Mudstone		F		EL00069	<0.01	NAF*
C10_07	63.65	64.16	0.51	Coal		F		EL00070	<0.01	NAF*
C10_07	64.16	64.80	0.64	Mudstone		F		EL00071	<0.01	NAF*
C10_07	64.80	67.92	3.12	Sandstone		F		EL00072	<0.01	NAF*
C10_07	67.92	69.20	1.28	Sandstone		F		EL00073	<0.01	NAF*
C10_07	69.20	69.30	0.10	Sandstone		F		15935	0.09	NAF*
C10_07	69.30	69.31	0.01	Coal		F		15936		
C10_07	69.31	69.36	0.05	Carb Mudstone		F		15937		
C10_07	69.36	69.39	0.03	Coal		F		15938		
C10_07	69.39	69.49	0.10	Mudstone		F		15939	0.07	NAF*
C10_07	69.49	70.41	0.92	Mudstone		F		EL00074	<0.01	NAF*
C10_07	70.41	70.51	0.10	Mudstone		F		15940	0.02	NAF*
C10_07	70.51	70.61	0.10	Coal		F		15941		
C10_07	70.61	70.62	0.01	Mudstone		F		15942		
C10_07	70.64	70.74	0.10	Mudstone/Coal		F		15943	0.57	PAF*
C10_07	70.74	71.10	0.36	Mudstone		F		EL00075	<0.01	NAF*
C10_07	71.10	71.30	0.20	Core Loss		F				
C10_07	71.30	73.09	1.79	Mudstone		F		EL00076	<0.01	NAF*
C10_07	73.09	73.19	0.10	Mudstone		F		15945	0.02	NAF*
C10_07	73.19	73.24	0.05	Coal		F		15946		
C10_07	73.24	73.39	0.15	Mudstone		F		15947		
C10_07	73.47	73.57	0.10	Sandstone/Coal		F		15948	0.49	PAF*
C10_07	73.57	73.84	0.27	Sandstone		F		EL00077	<0.01	NAF*
C10_07	73.84	75.68	1.84	Mudstone		F		EL00078	<0.01	NAF*
C10_07	75.68	75.78	0.10	Carb Mudstone		F		16001	0.15	NAF*
C10_07	75.78	75.83	0.05	Coal		F		16002		
C10_07	75.83	75.93	0.10	Carb Mudstone		F		16003	0.12	NAF*
C10_07	75.93	76.60	0.67	Mudstone		F		EL00079	<0.01	NAF*
C10_07	76.60	77.56	0.96	Sandstone		F		EL00080	<0.01	NAF*

KEY

Coal seam interval

Missing interval or sample not available

NAF* = Non-Acid Forming based on S ≤0.2%S

PAF* = Potentially Acid Forming based on S >0.2%S

Table 3: Extended boil and calculated NAG results for selected overburden/interburden samples.

EGi Code	Lithology	ACID-BASE ANALYSIS					STANDARD NAG TEST			Extended Boil NAGpH	Calculated NAG
		Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$		
1376	Carb Mudstone	0.09	3	11	-8	3.99	3.3	21	53	6.1	-14
1379	Carb Mudstone	0.11	3	10	-7	2.97	3.6	15	46	5.8	-13
1395	Carb Mudstone	0.14	4	30	-26	7.00	2.5	87	137	6.2	-26
1429	Carb Mudstone/Sandstone	0.10	3	15	-12	4.90	3.5	15	39	5.9	-26
1432	Carb Mudstone	0.09	3	13	-10	4.72	3.7	9.3	34	7.1	-17

Table 4: Multi-element composition of selected overburden/interburden sample solids (mg/kg except where shown).

Element	Detection Limit	Lithology/Sample Number																		
		Soil	Clay	Clay	Clay	Sandstone	Siltstone	Carb Mudstone	Claystone	Sandstone	Siltstone	Soil	Sandstone	Sandstone	Sandstone	Carb Mudstone	Siltstone	Sandstone	Sandstone	Siltstone
		1362	1363	1365	1369	1370	1375	1376	1383	1385	1410	1414	1415	1417	1421	1432	1434	1435	1441	1449
Ag	0.01	0.06	0.05	0.05	0.07	0.04	0.1	0.11	0.07	0.03	0.08	0.05	0.04	0.06	0.03	0.12	0.06	0.05	0.06	0.09
Al	0.01%	5.64%	5.78%	4.41%	6.67%	7.57%	9.00%	6.57%	6.83%	7.51%	8.79%	7.41%	8.05%	7.31%	8.02%	8.32%	7.73%	7.32%	7.31%	6.92%
As	0.2	3.6	3.6	3.8	7	9	5.2	9.4	2.4	6.9	5.3	8.2	5.5	5.7	3.8	5.5	2.8	4.6	4.7	2.4
Ba	10	420	400	360	440	450	490	340	440	390	430	1230	870	590	380	470	450	380	430	420
Be	0.05	1.36	1.26	1.02	1.22	1.36	1.83	2.46	1.56	1.13	1.45	1.81	1.91	1.57	1.91	2.36	1.52	1.53	1.6	1.69
Bi	0.01	0.15	0.14	0.1	0.06	0.05	0.29	0.44	0.21	0.07	0.27	0.12	0.1	0.1	0.14	0.43	0.3	0.21	0.23	0.28
Ca	0.01%	0.70%	0.58%	0.47%	2.60%	1.34%	0.53%	0.41%	0.30%	2.98%	0.73%	2.46%	1.94%	4.53%	1.99%	0.31%	0.64%	1.29%	0.64%	0.27%
Cd	0.02	0.05	<0.02	0.02	0.08	0.05	0.24	0.18	0.18	0.11	0.18	0.05	0.1	0.08	0.19	0.19	0.19	0.23	0.17	0.19
Ce	0.01	56.1	56.7	44.5	44.3	41	52.6	26.3	39.6	37.4	56.6	53.9	55.6	39.4	67.7	37.1	53.4	48.4	39.5	35.8
Co	0.1	11.5	10.9	7.3	18.6	20.6	11.7	7.4	12.5	20.1	8.9	20.1	16.7	17.5	15.9	8.1	7.5	14.1	9.3	7.9
Cr	1	72	70	92	78	88	43	20	39	42	39	43	39	40	40	23	37	44	31	34
Cs	0.05	3.49	3.55	2.62	1.93	1.67	7.08	2.53	5.41	2.15	6.68	1.68	1.32	1.39	1.45	4.26	7.37	5.24	4.32	5.14
Cu	0.2	16.4	12.9	9.3	11.8	11.3	41.9	36.9	31.4	13	30.8	9	10.1	9.3	10.4	43.8	36	32.4	33.6	36.7
Fe	0.01%	1.75%	1.89%	1.75%	2.14%	1.62%	2.73%	1.22%	2.06%	1.90%	3.05%	1.83%	2.04%	2.06%	4.31%	1.62%	2.12%	1.84%	1.87%	2.30%
Ga	0.05	13.1	12.9	9.76	15.5	18.3	22.8	26	21.1	18.35	21.7	17.75	20.9	19.3	19.15	28.2	23.8	21	23.3	21.5
Ge	0.05	0.12	0.13	0.12	0.13	0.12	0.13	0.06	0.14	0.13	0.12	0.14	0.13	0.13	0.16	0.05	0.17	0.19	0.15	0.14
Hf	0.1	3.4	3.4	2.6	2.6	2.6	3.8	5.3	3.3	2.1	3.6	3.7	4.5	4	5.4	5.3	4.2	3.7	3.4	3.4
Hg	0.005	0.013	0.009	0.009	0.008	0.008	0.044	0.097	0.021	0.026	0.024	0.009	<0.005	0.007	0.012	0.116	0.04	0.031	0.035	0.033
In	0.005	0.039	0.039	0.028	0.041	0.036	0.078	0.103	0.072	0.046	0.076	0.05	0.053	0.055	0.055	0.115	0.082	0.074	0.068	0.067
K	0.01%	1.40%	1.32%	1.23%	1.37%	1.44%	1.77%	0.75%	1.50%	1.20%	1.47%	0.83%	1.27%	1.28%	0.98%	0.99%	1.54%	1.42%	1.53%	1.27%
La	1	26.1	27	21.4	20.3	18.3	24.3	10.8	17.2	16.8	26.7	23.7	24.2	16.4	30.3	15	23.6	21.2	16.8	15.4
Li	0.2	17.6	15.8	13.5	16.9	19.6	28.4	35.7	23.8	20.5	26.8	19.7	16.5	18.1	20.4	39.9	25.2	24.5	24.8	24.3
Mg	0.01%	0.24%	0.23%	0.15%	0.30%	0.31%	0.73%	0.27%	0.56%	0.60%	0.73%	0.45%	0.45%	0.43%	0.90%	0.34%	0.50%	0.40%	0.49%	0.62%
Mn	5	559	310	288	423	176	234	105	206	402	446	383	289	890	1600	125	200	178	169	163
Mo	0.05	1.39	1.07	1.62	1.47	1.52	1.62	1.47	0.99	0.68	1	1.56	1.62	1.69	1.69	1.45	0.98	1.31	1.58	0.96
Na	0.01%	1.08%	1.01%	0.99%	1.83%	2.17%	1.14%	0.48%	1.25%	1.29%	1.14%	2.04%	2.72%	2.65%	2.19%	0.84%	1.13%	1.04%	1.10%	1.23%
Nb	0.1	8.1	7.6	5.6	4	3.7	6.9	8.2	7.5	4.1	8	5.3	5.4	4.9	6	8.5	8.8	7.9	7.2	7.1
Ni	0.2	14.9	10.3	9.8	18.9	21.7	20.5	16.7	12.8	10.5	13.2	12.6	11.5	13	12.6	13.1	11.5	17.1	14.1	13.1
P	10	290	270	180	400	420	510	180	540	440	470	250	520	680	720	260	230	470	630	400
Pb	0.5	18	14.8	11.4	12.6	13.7	21.2	29.4	17.8	12.9	19.4	14.2	14.6	13.1	15.9	28.8	21.6	17.1	19	20.2
Rb	0.1	64.8	64.2	54.5	50.6	48	85.4	20.2	63.6	45.3	79.5	31.8	40.6	36	35.8	37.3	82.4	64.7	57.4	51.6
Re	0.002	0.002	0.003	0.002	0.002	0.005	0.003	<0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.002
S	0.01%	0.01%	0.01%	0.01%	0.03%	0.04%	0.03%	0.09%	0.02%	0.03%	0.04%	0.05%	0.03%	0.03%	0.03%	0.09%	0.03%	0.03%	0.02%	0.03%
Sb	0.05	0.35	0.34	0.33	0.31	0.26	0.38	0.49	0.5	0.35	0.38	0.34	0.25	0.26	0.32	0.45	0.41	0.38	0.38	0.42
Sc	0.1	8.8	8.7	6.1	10.1	10.1	19.4	11.6	13.3	12.7	16.2	10.9	13.6	12.3	13	16.6	15.1	14.8	13.6	12.2
Se	1	1	1	<1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	<1
Sn	0.2	1.5	1.4	1.2	1.1	1.1	2	2.8	2.1	1.3	2.1	1.5	1.6	1.5	1.9	2.9	2.4	2.1	2	2
Sr	0.2	194	169	144.5	348	412	228	169	177	234	296	488	480	469	480	181.5	168	162.5	201	265
Ta	0.05	0.64	0.63	0.43	0.31	0.29	0.55	0.65	0.59	0.32	0.64	0.42	0.42	0.39	0.47	0.65	0.72	0.63	0.57	0.57
Te	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	0.13	0.08	<0.05	0.11	<0.05	<0.05	<0.05	<0.05	0.14	0.11	0.07	0.06	0.1
Th	0.2	9.3	9.8	7	5.8	4.8	8.9	4.8	6.7	5.4	9.6	6.7	7.4	5.9	9.9	6.2	9	7.8	6.7	5.9
Ti	0.005%	0.45%	0.42%	0.33%	0.36%	0.34%	0.49%	0.58%	0.45%	0.36%	0.48%	0.45%	0.48%	0.45%	0.47%	0.63%	0.51%	0.47%	0.45%	0.43%
Tl	0.02	0.42	0.4	0.34	0.39	0.3	0.53	0.44	0.5	0.36	0.55	0.4	0.38	0.36	0.32	0.56	0.6	0.54	0.46	0.5
U	0.10	2	2	1.4	1.3	1.1	2.4	2.8	2.2	1.3	2.3	2	2.1	1.7	2.5	2.5	2.6	2.1	2.3	2.2
V	1	51	49	38	70	64	122	98	95	73	110	73	79	73	84	119	107	108	100	94
W	0.1	1.3	1.8	1.2	3.1	4.9	1.1	1.1	1.4	0.8	1.4	1.7	1.8	1.7	0.8	1.2	1.4	1.3	1.2	1.2
Y	0.1	20.4	21.2	16.4	18.1	16.8	27.2	17.7	15.5	17.1	21.2	25.9	31.4	21.2	31.4	24.1	18.2	19.1	15.7	14.5
Zn	2	72	45	64	70	67	231	207	207	147	355	94	75	86	346	152	116	121	108	185
Zr	0.5	129	124.5	95.9	98.3	95.9	132.5	201	112	71	121.5	138.5	170	152	205	204	142.5	127	116	114

< element at or below analytical detection limit.

Table 5: Geochemical abundance indices (GAI) of selected overburden/interburden sample solids.

Element	Median Soil Abundance*	Lithology/Sample Number																		
		Soil	Clay	Clay	Clay	Sandstone	Siltstone	Carb Mudstone	Claystone	Sandstone	Siltstone	Soil	Sandstone	Sandstone	Sandstone	Carb Mudstone	Siltstone	Sandstone	Sandstone	Siltstone
		1362	1363	1365	1369	1370	1375	1376	1383	1385	1410	1414	1415	1417	1421	1432	1434	1435	1441	1449
Ag	0.05	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
Al	7.1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
As	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ba	500	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Be	0.3	2	1	1	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2
Bi	0.2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
Ca	1.5%	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Cd	0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ce	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Co	8	-	-	-	1	1	-	-	-	1	-	1	-	1	-	-	-	-	-	-
Cr	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cs	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cu	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fe	4.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ga	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ge	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hf	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hg	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
In	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K	1.4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
La	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Li	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mg	0.5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mn	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mo	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Na	0.5%	1	-	-	1	2	1	-	1	1	1	1	2	2	2	-	1	-	1	1
Nb	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ni	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P	800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rb	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Re																				
S	0.07%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sb	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sc	7	-	-	-	-	-	1	-	-	-	1	-	-	-	-	1	1	-	-	-
Se	0.4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sn	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sr	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ta	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Te																				
Th	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ti	0.50%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tl	0.2	-	-	-	-	-	1	1	1	-	1	-	-	-	-	1	1	1	1	1
U	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W	1.5	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Y	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zn	90	-	-	-	-	-	1	1	1	-	1	-	-	-	1	-	-	-	-	-
Zr	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Bowen H.J.M.(1979) Environmental Chemistry of the Elements.

Table 6: Chemical composition of water extracts for selected overburden/interburden samples.

Parameter		Detection Limit	Lithology/Sample Number																			Summary Statistics		
			Soil	Clay	Clay	Clay	Sandstone	Siltstone	Carb Mudstone	Claystone	Sandstone	Siltstone	Soil	Sandstone	Sandstone	Sandstone	Carb Mudstone	Siltstone	Sandstone	Sandstone	Siltstone	10th Percentile	50th Percentile	90th Percentile
			1362	1363	1365	1369	1370	1375	1376	1383	1385	1410	1414	1415	1417	1421	1432	1434	1435	1441	1449			
pH		0.01	7.4	7.4	7.5	8.9	7.8	8.2	7.8	7.9	8.5	8.7	8.5	8.0	9.2	9.5	9.3	9.7	9.6	9.6	9.9	7.4	8.0	8.9
EC	dS/m	0.01	0.085	0.221	0.211	0.561	0.325	0.124	0.221	0.311	0.145	0.209	0.276	0.242	0.531	0.862	0.245	0.411	0.334	0.467	0.384	0.13	0.22	0.49
Alkalinity	mg/l	1	32	37	46	130	99	98	75	148	274	199	95	153	122	283	233	203	251	193	227	39	99	190
Ag	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	<0.001	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005
Al	mg/l	0.01	3.81	17.10	12.90	2.85	1.87	4.72	3.14	3.61	6.74	1.08	0.28	<0.10	0.9	<0.10	4.08	0.5	0.28	2.01	0.26	0.40	3.14	11.67
As	mg/l	0.001	0.003	0.008	0.008	0.011	0.034	0.111	0.083	0.029	0.076	0.081	0.017	<0.010	0.004	0.015	0.238	0.076	0.143	0.082	0.044	<0.004	0.017	0.083
B	mg/l	0.05	0.23	0.34	0.19	0.25	0.22	0.16	0.14	0.35	0.13	0.19	0.1	<0.10	0.1	<0.10	0.2	0.1	0.15	0.13	0.13	0.10	0.19	0.32
Ba	mg/l	0.001	0.255	0.440	0.355	0.261	0.135	0.161	0.055	0.271	0.034	0.011	0.628	0.039	0.128	<0.010	0.077	0.072	0.034	0.081	0.029	0.035	0.161	0.423
Be	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	<0.001	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	0.005
Ca	mg/l	1	2	4	2	1	<1	<1	<1	<1	4	<1	6	3	<1	1	<1	<1	<1	<1	<1	1	1	4
Cd	mg/l	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	mg/l	1	10	45	146	120	58	20	25	28	-	17	113	168	92	97	48	30	36	26	20	17	52	143
Co	mg/l	0.001	0.004	0.002	0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	0.001	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.002	0.005
Cr	mg/l	0.001	0.002	0.010	0.007	0.003	0.003	0.004	<0.005	<0.005	<0.010	<0.010	0.001	<0.010	0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.003	<0.007
Cu	mg/l	0.001	0.019	0.034	0.007	0.009	<0.001	0.002	<0.005	<0.005	<0.010	<0.010	0.007	<0.010	0.002	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	0.002	0.005	0.017
F	mg/l	0.1	0.3	1.2	0.7	1.0	0.8	1.1	1.2	1.5	0.9	1.1	3.4	1.7	0.6	0.2	1.7	1.1	1.6	1.3	1.1	0.6	1.1	1.7
Fe	mg/l	0.05	2.05	10.40	8.24	1.82	0.63	1.07	0.44	0.59	0.78	<0.50	0.07	<0.50	0.31	<0.50	0.7	<0.25	<0.25	<0.25	<0.25	0.3	0.6	7.0
Hg	mg/l	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005	<0.0005	<0.0010	<0.0001	<0.0001	<0.0010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005
K	mg/l	1	2	2	3	2	1	2	1	2	2	1	1	<1	<1	1	<1	1	1	1	1	1	2	2
Mg	mg/l	1	<1	2	1	<1	<1	<1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	1	2
Mn	mg/l	0.001	0.033	0.037	0.046	0.010	0.002	0.002	<0.005	<0.005	<0.010	<0.010	0.006	<0.010	0.002	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	0.002	0.005	0.036
Mo	mg/l	0.001	0.003	0.010	0.006	0.008	0.017	0.147	0.060	0.049	0.021	0.035	0.009	<0.010	0.007	0.1	0.078	0.048	0.087	0.067	0.037	<0.005	0.010	0.058
Na	mg/l	1	19	52	106	130	96	73	57	67	114	104	154	142	123	168	92	79	101	84	78	53	104	139.6
Ni	mg/l	0.001	0.007	0.011	0.004	0.003	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	0.003	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.003	0.007
P	mg/l	1	<1	3	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	mg/l	0.001	<0.001	0.004	0.003	0.001	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	<0.001	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	0.0025	0.005
Sb	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	<0.001	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005
Se	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.06	<0.05	<0.10	<0.10	<0.01	<0.10	<0.01	<0.10	0.07	<0.05	<0.05	<0.05	<0.05	<0.01	0.01	0.05
Si	mg/l	0.1	19	61	43	18	14	21	14	32	-	7	6	514	8	442	70	20	11	12	14	7	18	59
Sn	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	<0.001	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005
SO4	mg/l	1	5	11	7	26	19	20	<10	<10	-	<10	71	29	32	39	<10	<10	<10	<10	<10	5	15	32
Sr	mg/l	0.001	0.021	0.061	0.042	0.037	0.023	0.034	0.024	0.029	0.056	0.028	0.16	0.083	0.028	0.024	0.039	0.023	0.014	0.018	0.011	0.02	0.03	0.08
Th	mg/l	0.001	<0.001	0.006	0.005	0.002	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	<0.001	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.003	0.005
U	mg/l	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	<0.010	<0.010	0.001	<0.010	<0.001	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.001	<0.001	<0.005
Zn	mg/l	0.005	0.137	0.154	0.077	0.021	<0.005	0.021	0.026	0.038	<0.050	<0.050	0.014	<0.050	<0.005	<0.050	0.026	<0.025	<0.025	<0.025	<0.025	0.005	0.025	0.125

< element at or below analytical detection limit.

* Note that Cl, SO4 and Si not analysed for sample 1385 due to insufficient sample available for analysis.

Table 7: Soluble/exchangeable cations of selected overburden/interburden samples.

EGi Sample Code	Hole Name	Depth (m)			Lithology	Weathering	sol Na (meq%)	sol K (meq%)	sol Ca (meq%)	sol Mg (meq%)	ex Na (meq%)	ex K (meq%)	ex Ca (meq%)	ex Mg (meq%)	% ECEC Na (ESP)	% ECEC K	% ECEC Ca	% ECEC Mg	ECEC	Ca/Mg ratio
		From	To	Interval																
1362	1362	0.00	1.00	1.00	Soil	W	0.28	0.08	0.17	0.26	0.60	0.20	6.30	2.10	6.5	2.2	68.5	22.8	9.2	5.00
1363	1363	1.00	2.00	1.00	Clay	W	0.74	0.10	0.27	0.40	1.60	0.20	5.40	1.70	18.0	2.2	60.7	19.1	8.9	5.20
1365	1365	3.00	4.00	1.00	Clay	P	1.41	0.15	0.25	0.50	1.80	0.20	2.70	0.80	32.7	3.6	49.1	14.5	5.5	5.60
1369	1369	7.00	8.00	1.00	Clay	P	3.75	0.10	0.23	0.53	4.80	0.10	32.20	2.30	12.2	0.3	81.7	5.8	39.4	23.10
1370	1370	8.00	9.00	1.00	Sandstone	P	2.66	0.18	0.37	2.06	3.30	0.10	5.00	1.90	32.0	1.0	48.5	18.4	10.3	4.30
1375	1375	13.12	14.46	1.34	Siltstone	F	1.64	0.32	0.27	0.77	3.20	0.30	6.60	2.40	25.6	2.4	52.8	19.2	12.5	4.50
1376	1376	14.46	15.58	1.12	Carb Mudstone	F	1.10	0.05	0.12	0.32	4.60	0.30	8.50	2.70	28.6	1.9	52.8	16.8	16.1	5.20
1383	1383	26.99	28.59	1.60	Claystone	F	3.26	0.71	0.53	3.24	6.40	0.20	3.50	1.20	56.6	1.8	31.0	10.6	11.3	4.80
1385	1385	29.80	34.37	4.57	Sandstone	F	3.41	0.09	0.54	2.22	5.20	0.10	28.90	1.30	14.6	0.3	81.4	3.7	35.5	36.70
1410	1410	67.46	69.58	2.12	Siltstone	F	3.56	0.92	0.39	2.88	9.40	0.30	6.60	1.50	52.8	1.7	37.1	8.4	17.8	7.30
1414	1414	0.00	1.00	1.00	Soil	P	2.98	0.06	0.56	0.92	3.80	0.10	18.70	3.00	14.8	0.4	73.0	11.7	25.6	10.30
1415	1415	1.00	2.00	1.00	Sandstone	F	2.93	0.04	0.87	4.12	4.40	0.00	7.10	2.40	31.7	0.0	51.1	17.3	13.9	4.90
1417	1417	3.00	4.00	1.00	Sandstone	F	3.07	0.09	0.47	1.53	4.70	0.10	25.60	2.20	14.4	0.3	78.5	6.7	32.6	19.20
1421	1421	9.87	14.87	5.00	Sandstone	F	4.59	0.13	0.59	5.83	13.60	0.20	8.20	3.50	53.3	0.8	32.2	13.7	25.5	3.90
1432	1432	35.53	36.81	1.28	Carb Mudstone	F	2.37	0.67	0.18	0.31	9.90	0.30	4.70	1.20	61.5	1.9	29.2	7.5	16.1	6.50
1434	1434	38.47	40.59	2.12	Siltstone	F	3.72	2.63	0.42	3.73	6.20	0.20	7.70	1.00	41.1	1.3	51.0	6.6	15.1	12.60
1435	1435	40.59	42.65	2.06	Sandstone	F	3.09	2.10	0.42	2.58	5.30	0.20	10.50	0.90	31.4	1.2	62.1	5.3	16.9	19.30
1441	1441	52.91	54.54	1.63	Sandstone	F	3.18	0.23	0.38	1.74	8.00	0.30	9.90	1.20	41.2	1.5	51.0	6.2	19.4	13.60
1449	1449	71.74	73.42	1.68	Siltstone	F	3.41	0.47	0.37	2.81	10.40	0.30	4.00	1.60	63.8	1.8	24.5	9.8	16.3	4.10

Table 8: Acid forming characteristics of laboratory generated tailings, rejects and product coal equivalents.

Hole Name	Sample Type	Sample Description	Individual Plys	EGi Sample No	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS					STANDARD NAG TEST			Extended Boil NAGpH	Calculated NAG	ARD Classification
							Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$			
C10_01	Tailings	C10_01 A seam	A4 + A5	2517	8.3	0.16	0.15	5	13	-8	2.83	2.9	24	48			UC(NAF)
C10_01	Tailings	C10_01 C2	C2	2518	8.1	0.15	0.04	1	7	-6	5.72	4.6	0	5			NAF
C10_01	Tailings	C10_01 C3	C3	2519	7.5	0.16	0.10	3	5	-2	1.63	3.0	21	43	6.3	-6	NAF
C10_01	Tailings	C10_01 C4	C4	2520	7.4	0.18	0.05	2	6	-4	3.92	5.4	0	3			NAF
C10_01	Tailings	C10_01 C5	C5	2521	7.6	0.17	0.10	3	19	-16	6.21	6.4	0	2			NAF
C10_03	Tailings	C10_03 A seam	A1 + A3 + A4	2522	7.3	0.14	0.08	2	17	-15	6.94	4.4	2	18			UC(NAF)
C10_03	Tailings	C10_03 B seam	B1_B2	2523	7.5	0.15	0.05	2	2	0	1.31	3.5	8	22			NAF
C10_04	Tailings	C10_04 A seam	A2 + A4 + A5	2524	6.8	0.15	0.20	6	8	-2	1.31	2.7	41	73	5.9	-7	NAF
C10_04	Tailings	C10_04 B seam	B1 + B2 + B3 + B4	2525	7.6	0.13	0.09	3	4	-1	1.45	3.8	7	24	6.9	-10	NAF
C10_05	Tailings	C10_05 A seam	A1 + A3 + A4	2526	7.7	0.24	0.13	4	5	-1	1.26	3.5	12	39			UC(NAF)
C10_05	Tailings	C10_05 B seam	B1_B2	2527	7.9	0.22	0.08	2	7	-5	2.86	3.4	14	36			UC(NAF)
C10_06	Tailings	C10_06 A seam	A1 + A2_A3 + A4 + A5	2528	7.7	0.23	0.07	2	10	-8	4.67	4.0	7	27			UC(NAF)
C10_07	Tailings	C10_07 A seam	A1 + A2 + A3 + A4 + A5	2529	7.5	0.18	0.09	3	7	-4	2.54	3.6	37	64			UC(NAF)
C10_07	Tailings	C10_07 UG Seam	UG1 + UG2 + UG3 + UG4	2530	7.6	0.18	0.07	2	4	-2	1.87	3.4	9	26	6.5	-9	NAF
C10_08	Tailings	C10_08 A seam	A2, A3, A4 + A5	2531	7.9	0.14	0.10	3	12	-9	3.92	3.9	9	29			UC(NAF)
C10_08	Tailings	C10_08 B seam	B1, B2 + B4	2532	7.8	0.15	0.08	2	5	-3	2.04	4.1	2	13			UC(NAF)
C10_08	Tailings	C10_08 UG Seam	UG2 + UG3	2533	7.7	0.18	0.07	2	2	0	1.00	3.5	8	24			UC(NAF)
C10_09	Tailings	C10_09 UG Seam	UG1 + UG4	2534	7.6	0.19	0.06	2	1	1	0.54	4.8	0	6			UC(NAF)
C10_10	Tailings	C10_10 UG Seam	UG1, UG2, UG3 + UG4	2535	7.1	0.20	0.22	7	1	6	0.15	4.6	0	5			UC(NAF)
C10_01	Rejects	C10_01 A seam	A4 + A5	2579	7.6	0.63	0.29	9	120	-111	13.50	3.4	46	108			UC(NAF)
C10_01	Rejects	C10_01 C2	C2	2580	7.9	0.58	0.19	6	14	-9	2.47	2.7	50	104			UC(NAF)
C10_01	Rejects	C10_01 C3	C3	2581	8.0	0.47	0.24	7	19	-12	2.62	2.3	111	172	5.5	-25	NAF
C10_01	Rejects	C10_01 C4	C4	2582	8.3	0.56	0.19	6	102	-97	17.62	3.8	17	62			UC(NAF)
C10_01	Rejects	C10_01 C5	C5	2583	8.6	0.41	0.02	1	343	-342	560.63	7.6	0	0			NAF
C10_03	Rejects	C10_03 A seam	A1 + A3 + A4	2584	8.2	0.52	0.10	3	72	-69	23.60	5.0	0	16			NAF
C10_03	Rejects	C10_03 B seam	B1_B2	2585	8.4	0.67	0.16	5	30	-25	6.13	3.1	35	97			UC(NAF)
C10_04	Rejects	C10_04 A seam	A2 + A4 + A5	2586	7.3	0.48	0.21	6	27	-21	4.27	2.6	66	113	7.6	-23	NAF
C10_04	Rejects	C10_04 B seam	B1 + B2 + B3 + B4	2587	8.0	0.51	0.12	4	67	-63	18.12	3.1	37	75	8.3	-53	NAF
C10_05	Rejects	C10_05 A seam	A1 + A3 + A4	2588	8.3	0.80	0.24	7	104	-97	14.14	4.5	0	36			NAF
C10_05	Rejects	C10_05 B seam	B1_B2	2589	8.1	0.61	0.16	5	33	-28	6.72	2.8	54	127			UC(NAF)
C10_06	Rejects	C10_06 A seam	A1 + A2_A3 + A4 + A5	2590	7.8	0.41	0.12	4	114	-110	30.93	4.0	6	58			UC(NAF)
C10_07	Rejects	C10_07 A seam	A1 + A2 + A3 + A4 + A5	2591	7.9	0.62	0.13	4	45	-41	11.40	2.9	53	101			UC(NAF)
C10_07	Rejects	C10_07 UG Seam	UG1 + UG2 + UG3 + UG4	2592	7.8	0.59	0.12	4	46	-42	12.49	3.0	54	120			UC(NAF)
C10_08	Rejects	C10_08 A seam	A2, A3, A4 + A5	2593	8.1	0.55	0.13	4	56	-52	14.12	3.3	31	91			UC(NAF)

Table 8: Acid forming characteristics of laboratory generated tailings, rejects and product coal equivalents.

Hole Name	Sample Type	Sample Description	Individual Plys	EGi Sample No	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS					STANDARD NAG TEST			Extended Boil NAGpH	Calculated NAG	ARD Classification
							Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$			
C10_08	Rejects	C10_08 B seam	B1, B2 + B4	2594	8.3	0.79	0.22	7	49	-42	7.22	3.2	27	99			UC(NAF)
C10_08	Rejects	C10_08 UG Seam	UG2 + UG3	2595	8.0	0.54	0.12	4	67	-63	18.15	3.5	35	108			UC(NAF)
C10_09	Rejects	C10_09 UG Seam	UG1 + UG4	2596	7.9	0.66	0.13	4	30	-26	7.61	3.4	18	76			UC(NAF)
C10_10	Rejects	C10_10 UG Seam	UG1, UG2, UG3 + UG4	2597	8.0	0.71	0.17	5	45	-40	8.69	3.2	41	111			UC(NAF)
C10_01	Product Coal	C10_01 A seam	A4 + A5	2598	8.1	0.09	0.38	12	12	0	1.00	2.1	124	193			
C10_01	Product Coal	C10_01 B seam	B1 + B3 + B4	2599			0.39	12									
C10_01	Product Coal	C10_01 BC1	BC1	2600			0.64	20									
C10_01	Product Coal	C10_01 BC2	BC2	2601			0.41	13									
C10_01	Product Coal	C10_01 C1	C1	2602			0.42	13									
C10_01	Product Coal	C10_01 C2	C2	2603	8.0	0.11	0.44	13	12	2	0.86	2.0	118	185			UC(NAF)
C10_01	Product Coal	C10_01 C3	C3	2604	7.8	0.11	0.39	12	11	1	0.95	2.0	119	185	4.8	-7	UC(NAF)
C10_01	Product Coal	C10_01 C4	C4	2605	7.9	0.09	0.41	13	15	-2	1.19	2.0	148	228			UC(NAF)
C10_01	Product Coal	C10_01 C5	C5	2606	7.8	0.09	0.44	13	11	3	0.80	1.9	212	232			UC(NAF)
C10_02	Product Coal	C10_02 A seam	A1 +A2 +A3	2607			0.34	10									
C10_02	Product Coal	C10_02 A4	A4	2608			0.55	17									
C10_02	Product Coal	C10_02 B1	B1	2609			0.41	13									
C10_02	Product Coal	C10_02 B2	B2	2610			0.35	11									
C10_02	Product Coal	C10_02 B4	B4	2611			0.48	15									
C10_03	Product Coal	C10_03 Y seam	Y3_Y4	2612			0.41	13									
C10_03	Product Coal	C10_03 A seam	A1 + A3 + A4	2613	8.1	0.10	0.31	9	12	-3	1.32	1.9	237	369	5.5	-12	NAF
C10_03	Product Coal	C10_03 B seam	B1_B2	2614	8.3	0.12	0.39	12	12	0	1.00	1.9	176	273			UC(NAF)
C10_04	Product Coal	C10_04 A seam	A2 + A4 + A5	2615	8.0	0.11	0.45	14	11	3	0.79	2.0	101	157	5.4	-13	UC(NAF)
C10_04	Product Coal	C10_04 B seam	B1 + B2 + B3 + B4	2616	7.9	0.08	0.33	10	15	-5	1.46	2.0	151	232	5.0	-23	NAF
C10_05	Product Coal	C10_04 Y3	Y3	2617			0.41	13									
C10_05	Product Coal	C10_05 A seam	A1 + A3 + A4	2618	8.2	0.11	0.42	13	14	-1	1.07	1.9	196	297			UC(NAF)
C10_05	Product Coal	C10_05 B seam	B1_B2	2619	8.1	0.12	0.28	9	13	-4	1.47	1.9	165	264			UC(NAF)
C10_06	Product Coal	C10_06 Y seam	Y3 + Y4	2620			0.37	11									
C10_06	Product Coal	C10_06 A seam	A1 + A2_A3 + A4 + A5	2621	8.3	0.07	0.26	8	12	-4	1.53	2.0	130	207			UC(NAF)
C10_06	Product Coal	C10_06 B seam	B1 + B2 + B3 + B4	2622			0.27	8									
C10_07	Product Coal	C10_07 UG Seam	UG1 + UG2 + UG3 + UG4	2623	8.2	0.07	0.39	12	14	-2	1.17	1.9	160	253	4.8	-5	NAF
C10_07	Product Coal	C10_07 Y seam	Y2 + Y3	2624			0.38	12									
C10_07	Product Coal	C10_07 A seam	A1 + A2 + A3 + A4 + A5	2625	7.9	0.09	0.36	11	15	-4	1.33	1.9	147	226			UC(NAF)
C10_07	Product Coal	C10_07 B1	B1	2626			0.42	13									
C10_08	Product Coal	C10_08 UG Seam	UG2 + UG3	2627	8.0	0.08	0.36	11	14	-3	1.24	2.1	146	226			UC(NAF)
C10_08	Product Coal	C10_08 Y seam	Y2 + Y3	2628			0.30	9									
C10_08	Product Coal	C10_08 A seam	A2, A3, A4 + A5	2629	7.8	0.01	0.33	10	14	-4	1.36	2.0	152	237			UC(NAF)

Table 8: Acid forming characteristics of laboratory generated tailings, rejects and product coal equivalents.

Hole Name	Sample Type	Sample Description	Individual Plys	EGi Sample No	$pH_{1:2}$	$EC_{1:2}$	ACID-BASE ANALYSIS					STANDARD NAG TEST			Extended Boil NAGpH	Calculated NAG	ARD Classification
							Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$			
C10_08	Product Coal	C10_08 B seam	B1, B2 + B4	2630	7.7	0.09	0.53	16	14	2	0.88	2.0	162	257	5.5	-15	UC(NAF)
C10_08	Product Coal	C10_08 BC2	BC2	2631			0.42	13									
C10_09	Product Coal	C10_09 UG seam	UG1 + UG4	2632	7.8	0.10	0.38	12	15	-4	1.31	1.9	184	285			UC(NAF)
C10_09	Product Coal	C10_09 Y seam	Y1 + Y2 + Y3	2633			0.33	10									
C10_09	Product Coal	C10_03 B seam	A2 + A3	2634			0.46	14									
C10_10	Product Coal	C10_10 UG Seam	UG1, UG2, UG3 + UG4	2635	7.9	0.09	0.37	11	11	0	1.00	1.9	267	410			UC(NAF)
C10_10	Product Coal	C10_10 Y Seam	Y1, Y2 + Y3	2636			0.28	9									
C10_10	Product Coal	C10_10 A Seam	A1, A2 + A3	2637			0.29	9									
C10_10	Product Coal	C10_10 B Seam	B1, B2, B3 + B4	2638			0.51	16									
C10_11	Product Coal	C10_11 A4	A4	2639			0.48	15									
C10_11	Product Coal	C10_11 B Seam	B1, B2, B3, B4	2640			0.45	14									

KEY

$pH_{1:2}$ = pH of 1:2 extract
$EC_{1:2}$ = Electrical Conductivity of 1:2 extract (dS/m)
MPA = Maximum Potential Acidity (kgH_2SO_4/t)
ANC = Acid Neutralising Capacity (kgH_2SO_4/t)
NAPP = Net Acid Producing Potential (kgH_2SO_4/t)
NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)
Extended Boil NAGpH = pH of NAG liquor after extended heating
Calculated NAG = The net acid potential based on assay of anions and cations released to the NAG solution (kgH_2SO_4/t)

Standard NAG results overestimate acid potential due to organic acid effects

NAF = Non-Acid Forming
PAF = Potentially Acid Forming
PAF-LC = PAF Low Capacity
UC = Uncertain Classification
(expected classification in brackets)

Table 9: Multi-element composition and geochemical abundance indices (GAI) of selected tailings and rejects sample solids (mg/kg except where shown).

Element	Detection Limit	Material Type/Sample Number									Median Soil Abundance*	Material Type/Sample Number								
		Tailings				Rejects						Tailings				Rejects				
		2519	2524	2525	2530	2581	2583	2586	2587	2592		2519	2524	2525	2530	2581	2583	2586	2587	2592
Ag	0.01	0.11	0.10	0.12	0.08	0.04	0.14	0.27	0.09	0.09	0.05	1	-	1	-	-	1	2	-	-
Al	0.01%	6.40%	4.93%	7.12%	5.79%	2.08%	3.28%	5.08%	3.10%	4.78%	7.1%	-	-	-	-	-	-	-	-	-
As	0.2	1.60	1.60	1.60	1.20	1.70	0.90	1.80	2.20	1.30	6	-	-	-	-	-	-	-	-	-
B	10	20.00	21.00	20.00	23.00	29.00	8.00	20.00	23.00	29.00	20	-	-	-	-	-	-	-	-	-
Ba	10	313	368	351	278	234	208	205	194	235	500	-	-	-	-	-	-	-	-	-
Be	0.05	0.72	1.03	0.90	0.76	1.22	0.91	1.01	1.02	1.20	0.3	1	1	1	1	1	1	1	1	1
Bi	0.01	0.31	0.35	0.34	0.25	0.01	0.15	0.10	0.08	0.09	0.2	-	-	-	-	-	-	-	-	-
Ca	0.01%	0.41%	0.44%	0.52%	0.23%	0.92%	6.12%	0.71%	2.90%	1.47%	1.5%	-	-	-	-	-	1	-	-	-
Cd	0.02	0.28	0.07	0.25	0.15	<0.02	0.04	0.12	0.17	0.13	0.35	-	-	-	-	-	-	-	-	-
Ce	0.01	16.2	26.4	47.1	18.8	15.2	22.9	14.0	12.4	14.4	50	-	-	-	-	-	-	-	-	-
Co	0.1	2.91	3.24	3.66	4.86	6.66	3.91	25.2	5.72	7.67	8	-	-	-	-	-	-	1	-	-
Cr	1	13.8	17.7	18.7	16.2	8.86	9.76	8.07	9.46	9.20	70	-	-	-	-	-	-	-	-	-
Cs	0.05	3.35	8.65	6.62	5.12	2.36	4.00	1.57	1.45	1.09	4	-	1	-	-	-	-	-	-	-
Cu	0.2	44.7	33.5	33.6	31.3	17.0	27.5	35.3	24.9	24.0	30	-	-	-	-	-	-	-	-	-
F	20	240	215	225	205	54	76	110	85	94	200	-	-	-	-	-	-	-	-	-
Fe	0.01%	1.13%	0.91%	1.08%	0.75%	0.63%	16.40%	0.51%	0.42%	0.66%	4.0%	-	-	-	-	-	1	-	-	-
Ga	0.05	19.7	18.3	21.1	21.4	8.03	7.55	16.7	14.4	19.1	20	-	-	-	-	-	-	-	-	-
Ge	0.05	0.08	0.08	0.14	0.12	0.10	0.67	0.07	0.12	0.18	1	-	-	-	-	-	-	-	-	-
Hf	0.01	3.35	2.43	3.58	2.86	1.43	0.91	2.69	2.79	3.12	6	-	-	-	-	-	-	-	-	-
Hg	0.005	0.04	0.03	0.06	0.02	<0.01	<0.01	0.07	0.07	0.02	0.06	-	-	-	-	-	-	-	-	-
In	0.005	0.07	0.05	0.07	0.06	0.02	0.03	0.05	0.05	0.06	1	-	-	-	-	-	-	-	-	-
K	0.01%	0.76%	1.00%	1.00%	0.89%	0.37%	0.46%	0.42%	0.29%	0.32%	1.4%	-	-	-	-	-	-	-	-	-
La	0.5	7.13	11.3	20.3	7.88	6.29	11.2	6.03	4.87	5.67	40	-	-	-	-	-	-	-	-	-
Li	0.2	23.4	20.6	22.1	31.0	7.55	8.98	27.6	17.9	37.7	25	-	-	-	-	-	-	-	-	-
Mg	0.01%	0.42%	0.23%	0.32%	0.19%	0.09%	0.54%	0.12%	0.06%	0.11%	0.5%	-	-	-	-	-	-	-	-	-
Mn	5	72.0	65.5	63.9	46.3	170	9666	67.3	89.9	167.1	1000	-	-	-	-	-	**3**	-	-	-
Mo	0.05	1.32	1.07	1.22	3.62	1.37	0.81	0.93	1.15	1.50	1.2	-	-	-	1	-	-	-	-	-
Na	0.01%	0.33%	0.24%	0.51%	0.20%	0.26%	0.30%	0.23%	0.25%	0.21%	0.5%	-	-	-	-	-	-	-	-	-
Nb	0.1	4.00	6.70	6.31	7.33	2.63	2.02	3.77	3.17	4.60	10	-	-	-	-	-	-	-	-	-
Ni	0.2	7.13	6.11	7.40	9.11	4.66	6.38	6.30	6.76	7.46	50	-	-	-	-	-	-	-	-	-
P	10	73	88	101	85	37	547	75	57	51	800	-	-	-	-	-	-	-	-	-
Pb	0.5	17	15	23	15	8.0	9.3	16	14	13	35	-	-	-	-	-	-	-	-	-
Rb	0.1	21.1	51.7	51.1	33.8	12.0	26.0	13.9	5.01	5.88	150	-	-	-	-	-	-	-	-	-
Re	0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.002	0.002	<0.002	0.002										
S	0.01%	0.10%	0.20%	0.09%	0.07%	0.24%	0.02%	0.21%	0.12%	0.12%	0.07%	-	1	-	-	1	-	1	-	-
Sb	0.05	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2	0.2	0.3	1	-	-	-	-	-	-	-	-	-
Sc	0.1	7.06	6.85	8.81	5.48	4.17	5.08	4.52	3.12	4.96	7	-	-	-	-	-	-	-	-	-
Se	1	0.3	1.3	0.3	0.2	0.4	<0.2	0.6	0.3	0.3	0.4	-	1	-	-	-	-	-	-	-
Sn	0.2	2.76	3.46	3.35	2.47	1.09	0.85	1.88	1.66	1.79	4	-	-	-	-	-	-	-	-	-
Sr	0.2	215	153	186	74	236	208	145	241	152	250	-	-	-	-	-	-	-	-	-
Ta	0.05	0.56	0.60	0.65	0.64	0.19	0.18	0.42	0.37	0.47	2	-	-	-	-	-	-	-	-	-
Te	0.05	0.06	0.10	0.07	0.05	0.03	0.04	0.05	0.05	0.04										
Th	0.2	3.20	4.12	8.26	2.55	2.12	2.73	3.66	2.60	2.25	9	-	-	-	-	-	-	-	-	-
Ti	0.005%	0.29%	0.34%	0.36%	0.37%	0.14%	0.11%	0.27%	0.19%	0.28%	0.50%	-	-	-	-	-	-	-	-	-
Tl	0.02	0.43	0.84	0.61	0.50	0.01	0.16	0.28	0.23	0.31	0.2	1	1	1	1	-	-	-	-	-
U	0.1	1.31	5.37	2.26	1.62	0.54	0.59	1.94	0.76	0.77	2	-	1	-	-	-	-	-	-	-
V	1	49	70	62	49	41	29	37	40	42	90	-	-	-	-	-	-	-	-	-
W	0.1	1.38	1.40	1.40	1.16	1.06	2.54	137	4.68	1.07	1.5	-	-	-	-	-	-	**6**	1	-
Y	0.1	4.58	9.72	12.5	7.10	7.35	16.1	6.84	7.28	9.50	40	-	-	-	-	-	-	-	-	-
Zn	2	81.5	40.5	73.3	17.0	11.4	30.6	119	157	12.8	90	-	-	-	-	-	-	-	-	-
Zr	0.5	63.3	69.6	85.3	71.2	54.3	27.6	70.0	80.6	97.9	400	-	-	-	-	-	-	-	-	-

< element at or below analytical detection limit.

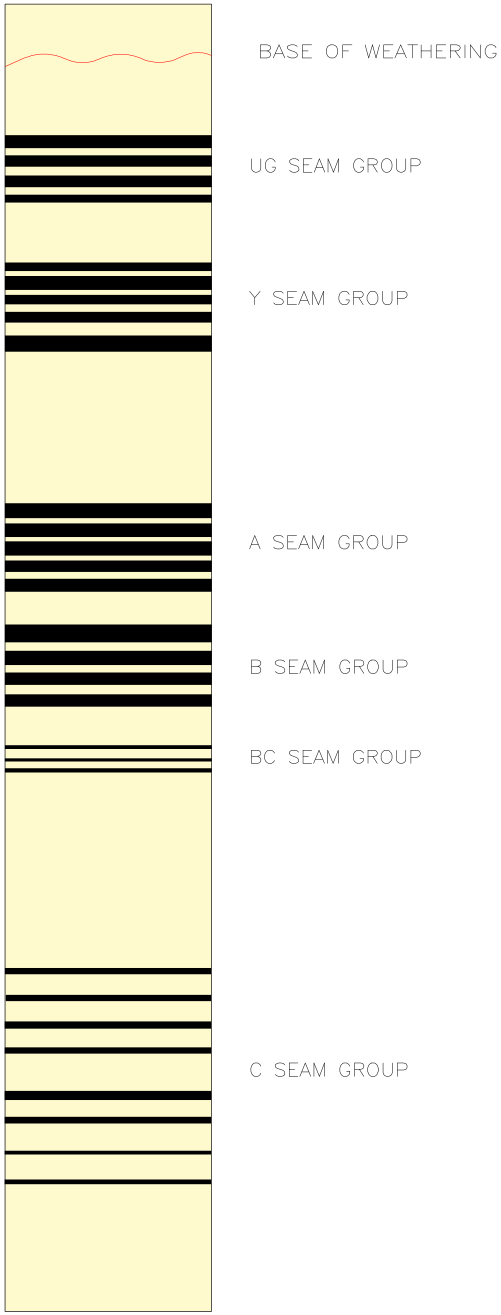
*Bowen H.J.M.(1979) Environmental Chemistry of the Elements.

Table 10: Chemical composition of water extracts (1:5 ratio) for selected tailings and rejects sample solids.

Parameter		Detection Limit	Material Type/Sample Number									Summary Statistics		
			Tailings				Rejects					10th Percentile	50th Percentile	90th Percentile
			2519	2524	2525	2530	2581	2583	2586	2587	2592			
pH		0.01	7.4	7.2	7.8	7.5	8.2	8.9	7.6	8.3	7.9	7.4	7.8	8.4
Alkalinity	mg/l	1	52	39	53	27	200	189	163	173	199	37	163	199
Ag	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Al	mg/l	0.01	<0.01	0.01	<0.01	0.04	0.07	0.22	<0.01	0.05	0.06	<0.01	0.04	0.10
As	mg/l	0.001	<0.001	0.001	0.002	<0.001	0.001	0.001	<0.001	0.007	0.003	<0.001	0.001	0.004
B	mg/l	0.05	0.21	0.13	0.17	0.19	0.25	0.12	0.15	0.16	0.23	0.1	0.2	0.2
Ba	mg/l	0.001	0.760	0.493	0.489	0.213	0.342	0.205	0.600	0.313	0.248	0.2	0.3	0.6
Be	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ca	mg/l	1	11	7	3	<1	3	1	20	3	3	1	3	13
Cd	mg/l	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	mg/l	1	171	36	106	38	23	20	34	29	33	22	34	119
Co	mg/l	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cr	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cu	mg/l	0.001	0.006	0.002	0.004	0.002	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.001	0.004
F	mg/l	0.1	0.6	0.7	1	0.4	0.4	0.6	0.6	0.8	0.6	0.4	0.6	0.8
Fe	mg/l	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hg	mg/l	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.0002	0.0001	<0.0001	<0.0001	<0.0001	0.0001
K	mg/l	1	8	5	4	2	2	3	5	2	3	2	3	6
Mg	mg/l	1	3	2	<1	<1	<1	<1	4	<1	<1	<1	<1	3
Mn	mg/l	0.001	0.034	0.021	0.006	0.003	0.003	0.005	0.031	0.001	0.003	0.003	0.005	0.032
Mo	mg/l	0.001	<0.001	0.003	0.006	0.002	0.007	0.005	0.007	0.009	0.017	0.002	0.006	0.011
Na	mg/l	1	120	44	104	47	98	83	64	90	112	46	90	114
Ni	mg/l	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
P	mg/l	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pb	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sb	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Se	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.02	0.02	<0.01	<0.01	<0.01	0.02
Si	mg/l	0.1	2.3	2.5	1.8	2.5	2.3	2.2	3.1	3.0	4.0	2.1	2.5	3.3
Sn	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
SO4	mg/l	1	29	30	24	16	2	1	8	3	5	2	8	29
Sr	mg/l	0.001	0.49	0.20	0.14	0.02	0.12	0.04	0.55	0.11	0.11	0.04	0.12	0.50
Th	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
U	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zn	mg/l	0.005	0.277	0.028	0.067	0.097	<0.005	<0.005	0.038	<0.005	<0.005	<0.005	0.028	0.133

< element at or below analytical detection limit.

ELIMATTA — TYPICAL STRATIGRAPHIC COLUMN



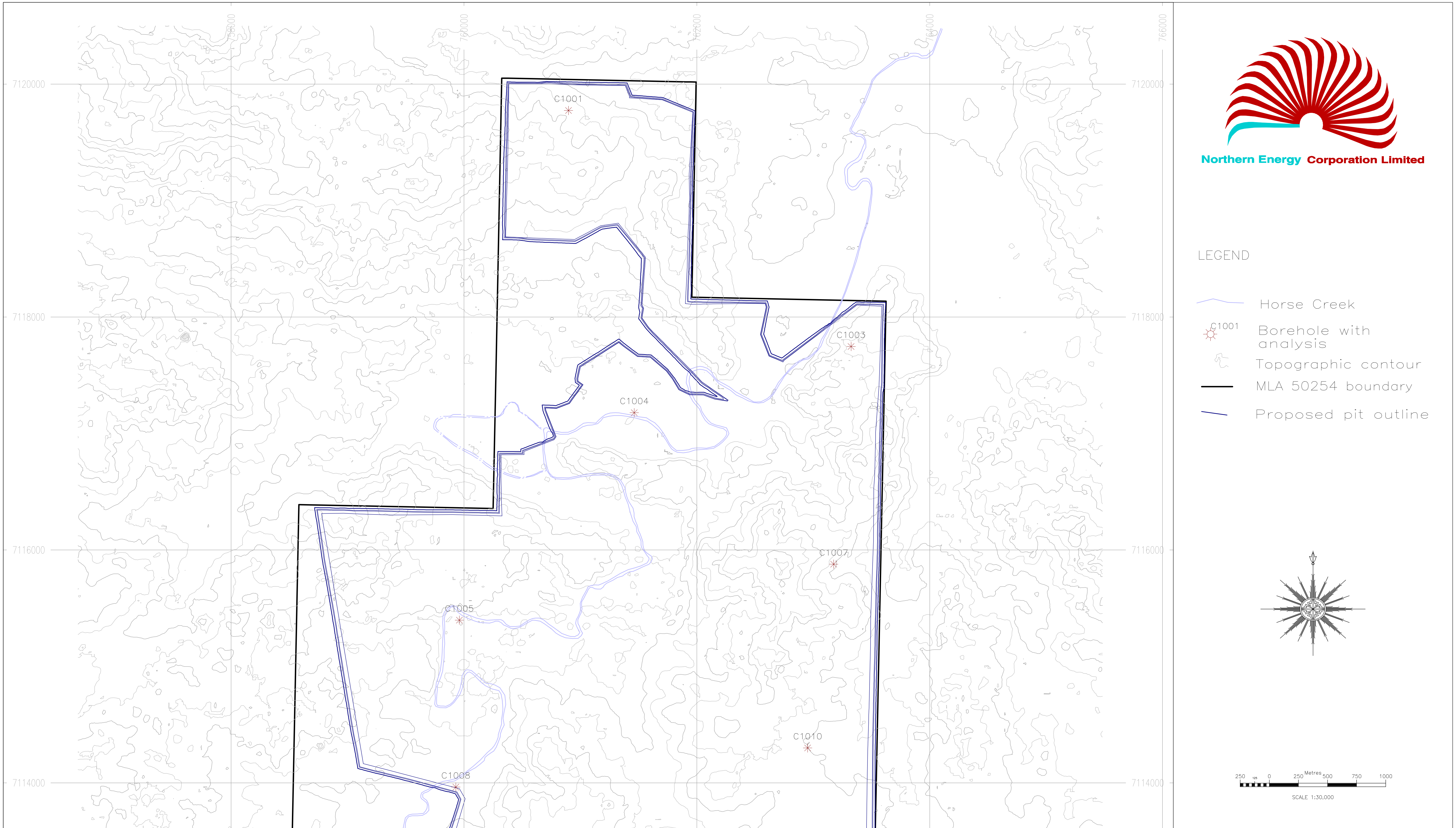
Northern Energy Corporation Limited

NORTHERN ENERGY CORPORATION

ELIMATTA PROJECT

Figure 1: Typical stratigraphic column for the Elimatta Coal Project.

Produced by: M BENSON	Drawing No.:
Date: 16/11/2011	Schema: ELL_1109 · Projection: GDA94 ZN55



NORTHERN ENERGY CORPORATION

ELIMATTA PROJECT

Figure 2: Location of drillholes sampled for geochemical testing.

Produced by: M BENSON	Drawing No.:
Date: 15/11/2011	Schema: ELI_1109 / Projection: GDA94 ZN55

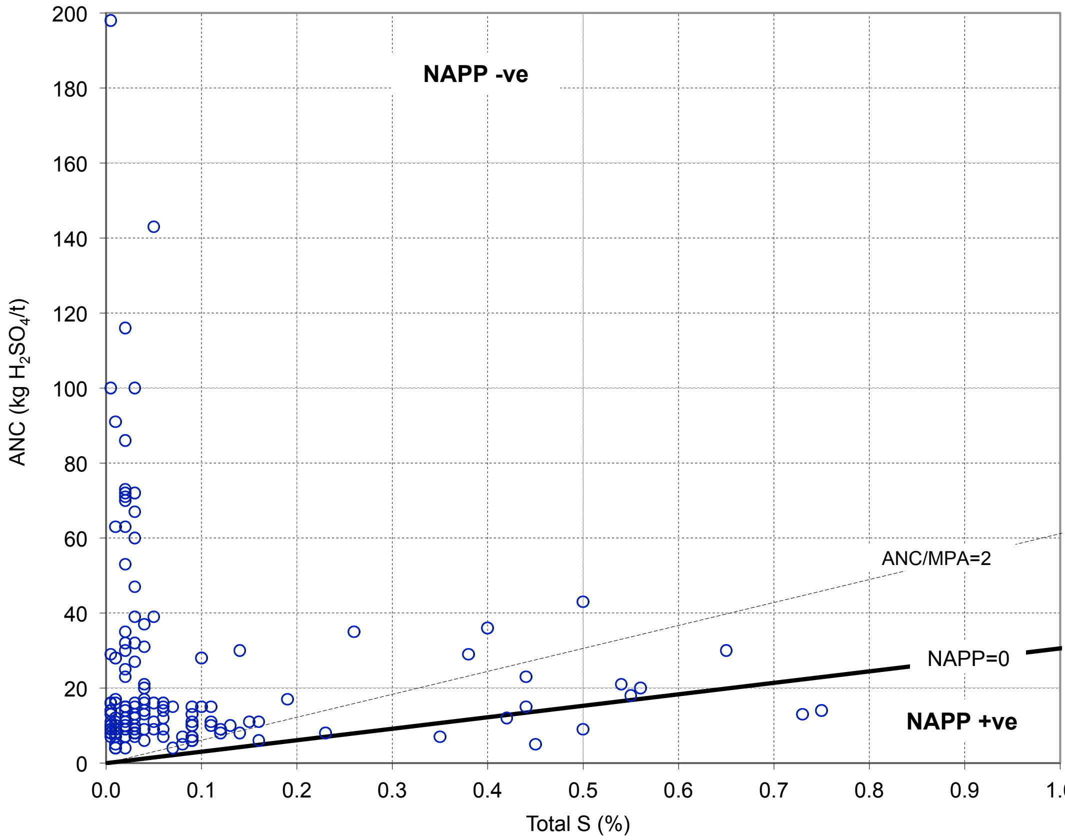


Figure 3: Acid-base account (ABA) plot showing ANC versus total S for overburden/interburden samples.

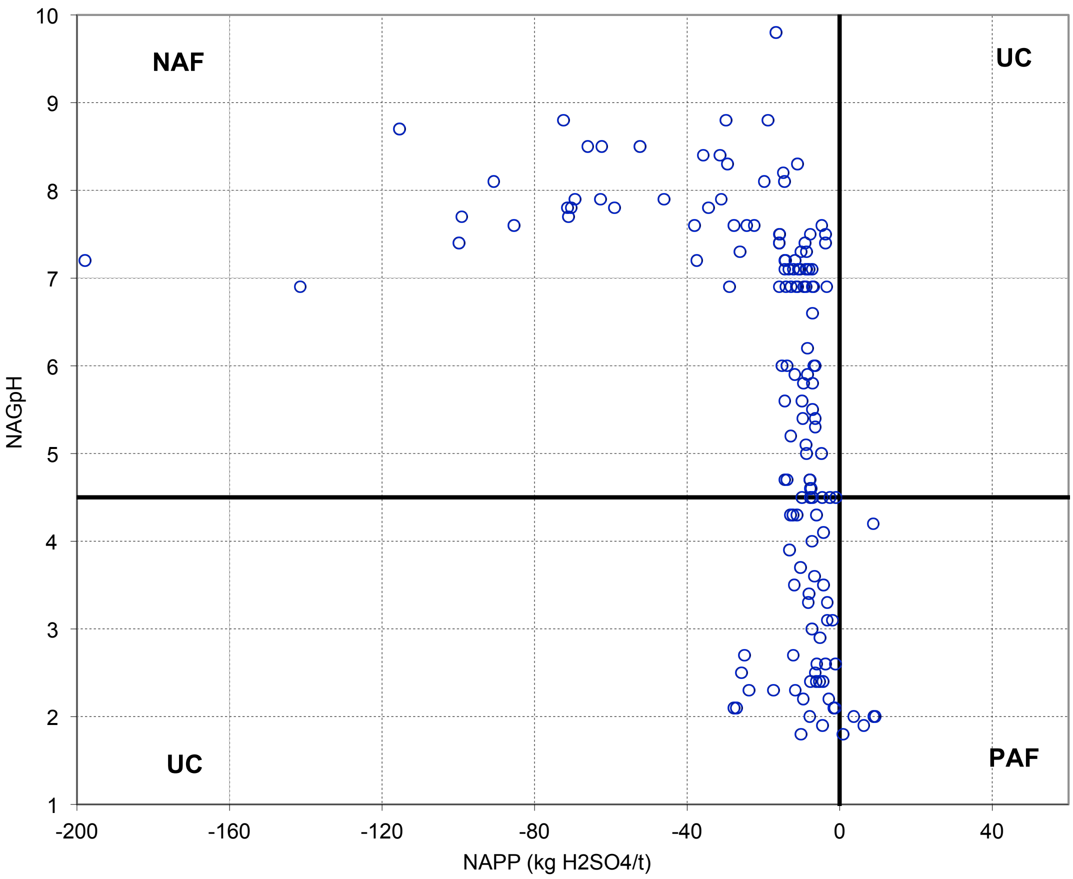


Figure 4: ARD classification plot showing NAGpH versus NAPP for overburden/interburden samples, with ARD classification domains indicated.

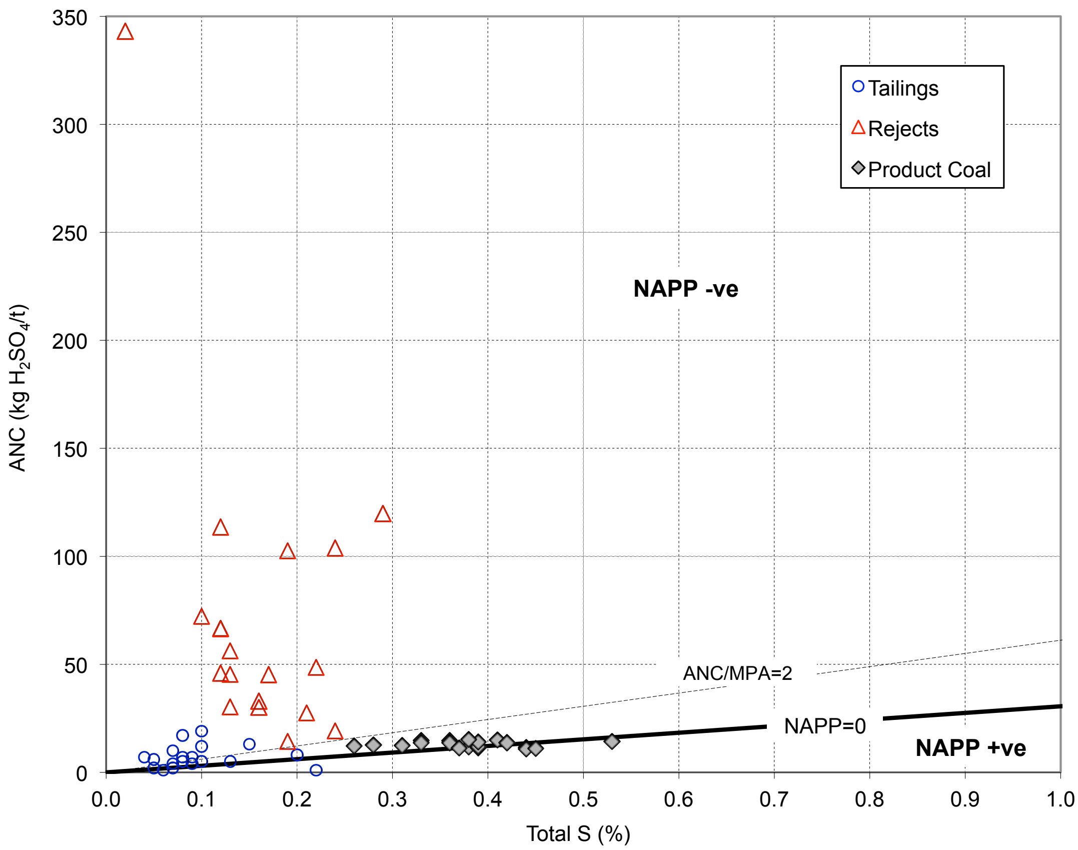


Figure 5: Acid-base account (ABA) plot showing ANC versus total S for tailings, rejects and product coal samples.

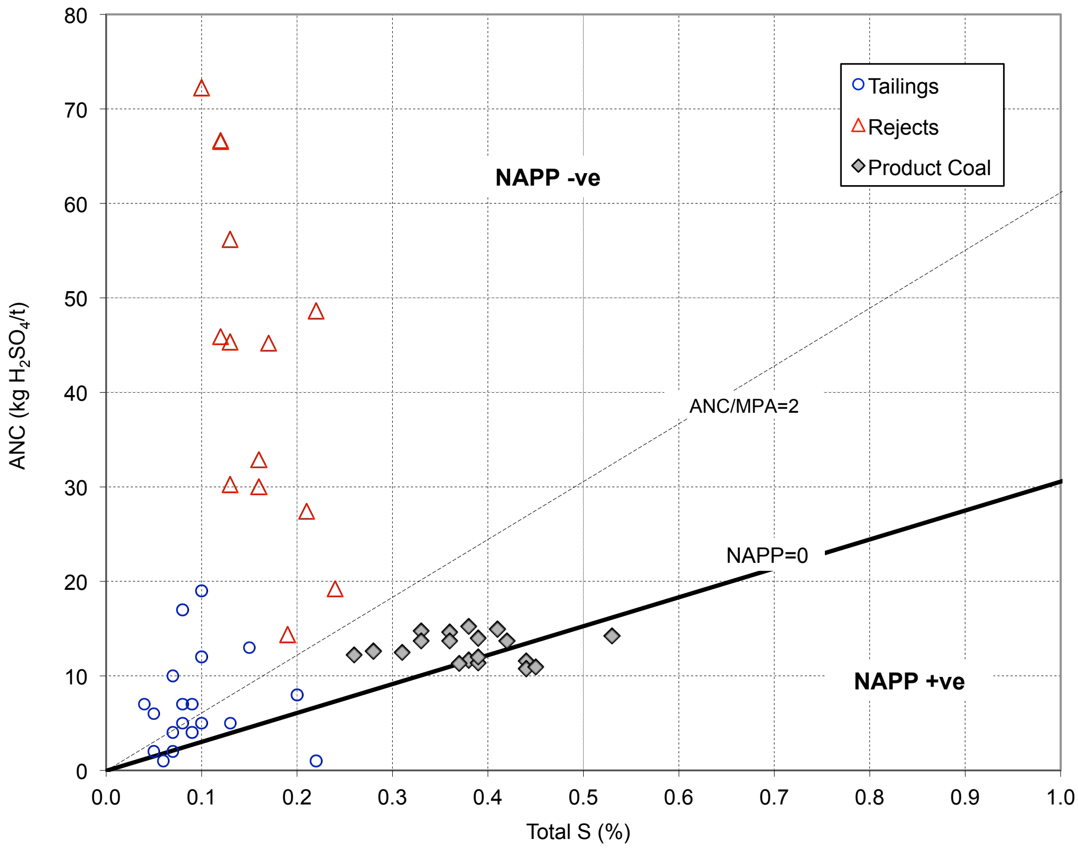


Figure 6: As for Figure 5 but with an expanded ANC axis.

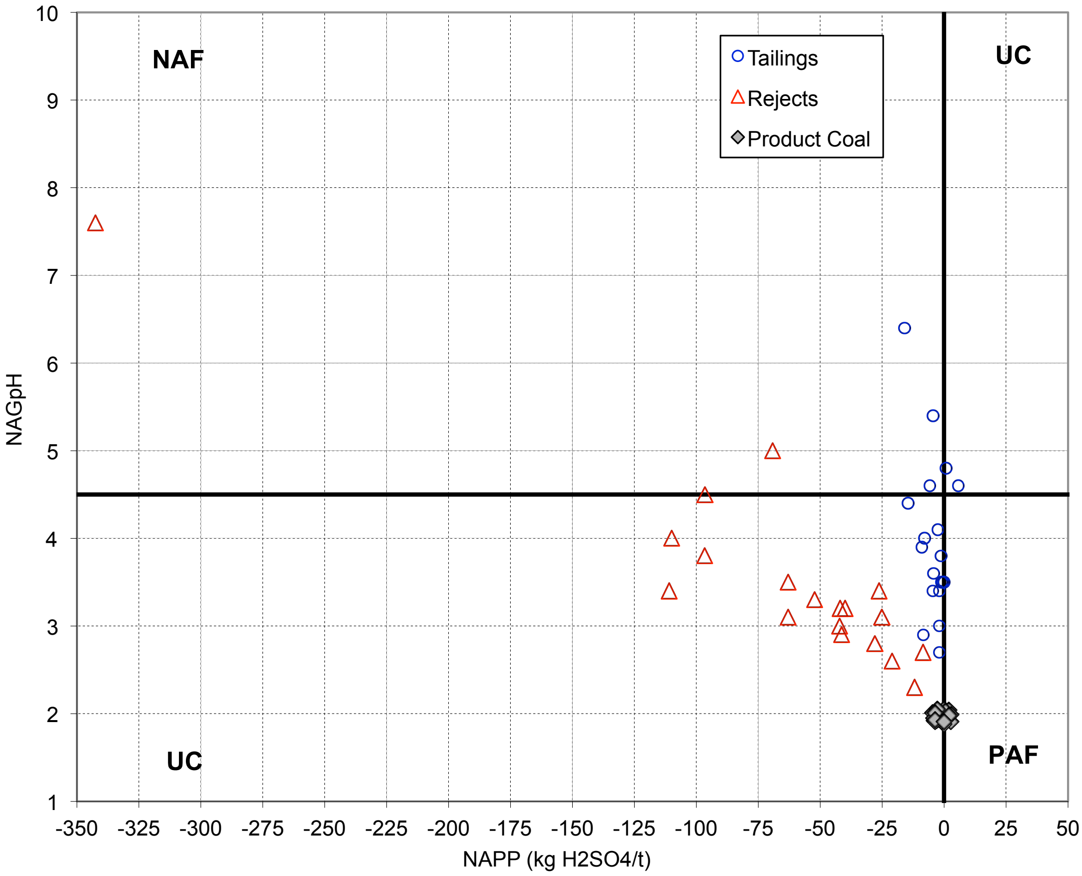


Figure 7: ARD classification plot showing NAGpH versus NAPP for tailings, rejects and product coal samples, with ARD classification domains indicated.

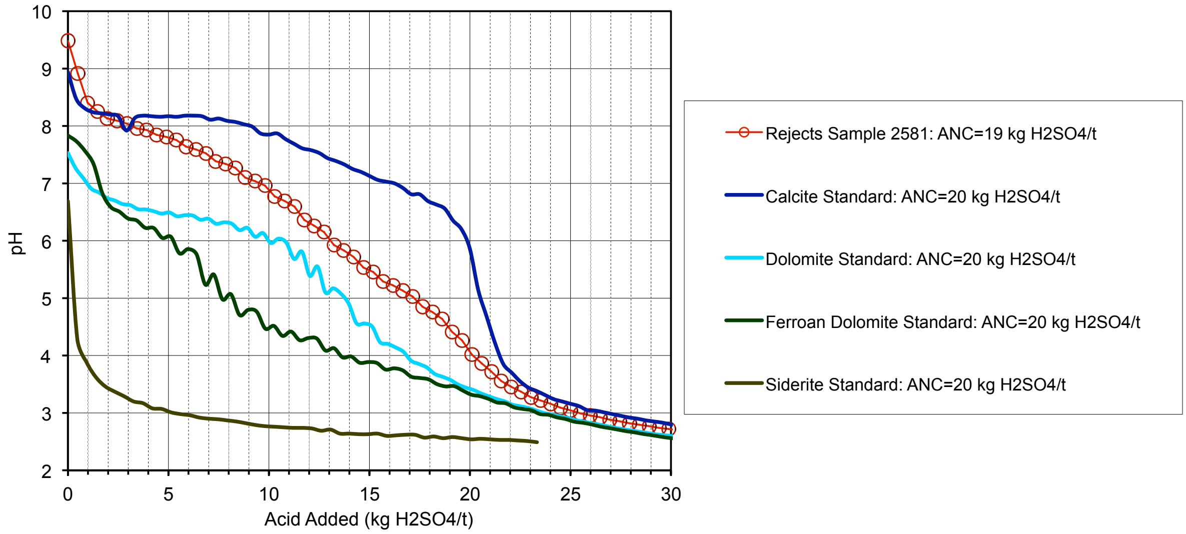


Figure 8: ABCC profile for rejects sample 2581 with an ANC value close to 20 kg H_2SO_4/t. Carbonate standard curves are included for reference.

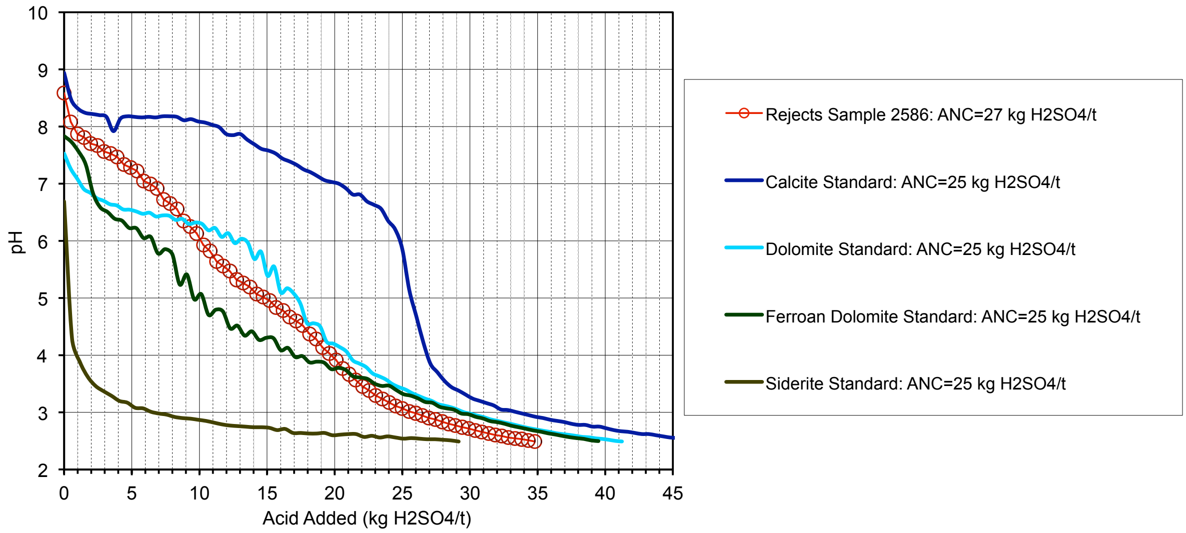


Figure 9: ABCC profile for rejects sample 2586 with an ANC value close to 25 kg H_2SO_4/t. Carbonate standard curves are included for reference.

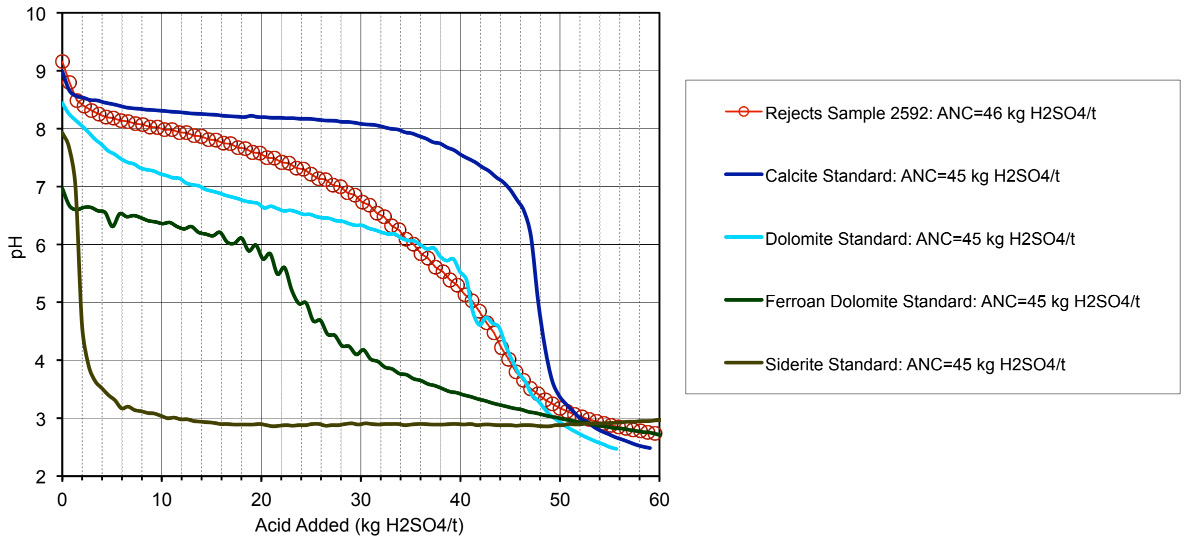


Figure 10: ABCC profile for rejects sample 2592 with an ANC value close to 45 kg H_2SO_4/t. Carbonate standard curves are included for reference.

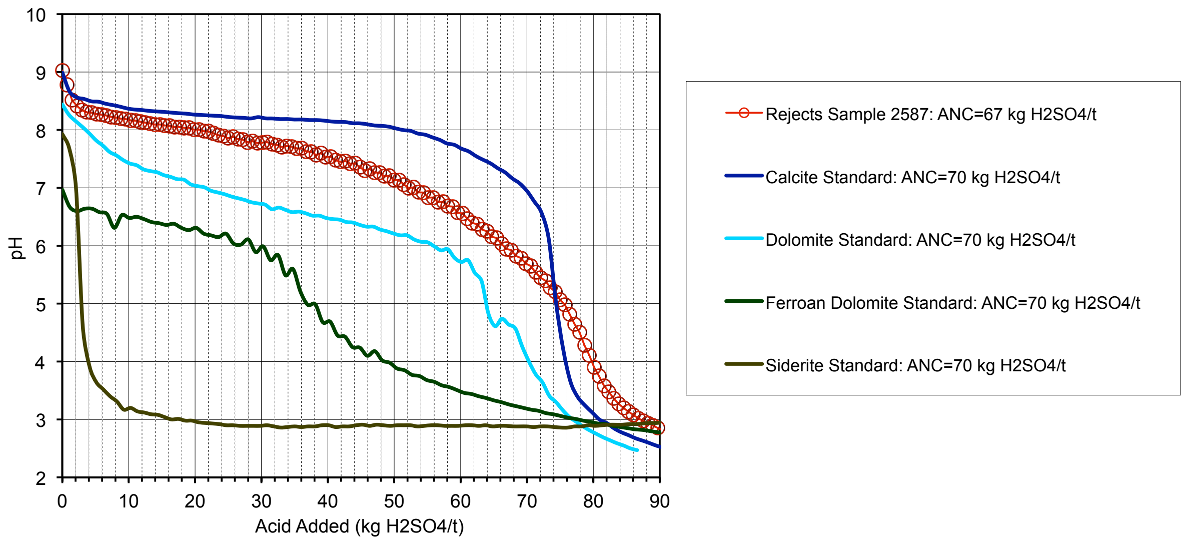


Figure 11: ABCC profile for rejects sample 2587 with an ANC value close to 70 kg H_2SO_4/t. Carbonate standard curves are included for reference.

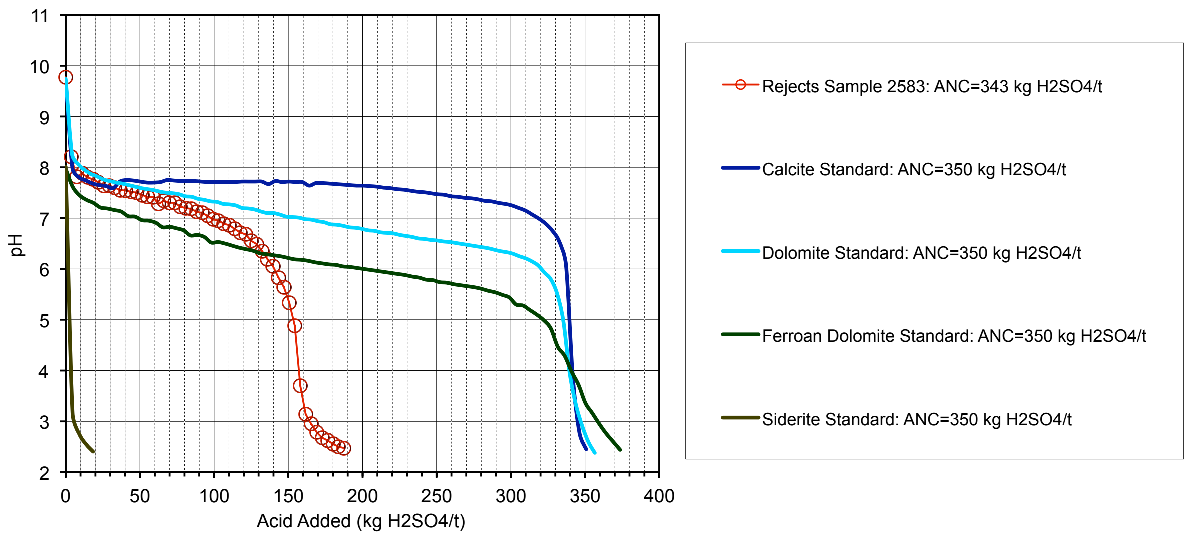


Figure 12: ABCC profile for rejects sample 2583 with an ANC value close to 350 kg H_2SO_4/t. Carbonate standard curves are included for reference.

APPENDIX A

Assessment of Acid Forming Characteristics

Assessment of Acid Forming Characteristics

Introduction

Acid rock drainage (ARD) is produced by the exposure of sulphide minerals such as pyrite to atmospheric oxygen and water. The ability to identify in advance any mine materials that could potentially produce ARD is essential for timely implementation of mine waste management strategies.

A number of procedures have been developed to assess the acid forming characteristics of mine waste materials. The most widely used methods are the Acid-Base Account (ABA) and the Net Acid Generation (NAG) test. These methods are referred to as static procedures because each involves a single measurement in time.

Acid-Base Account

The acid-base account involves static laboratory procedures that evaluate the balance between acid generation processes (oxidation of sulphide minerals) and acid neutralising processes (dissolution of alkaline carbonates, displacement of exchangeable bases, and weathering of silicates).

The values arising from the acid-base account are referred to as the potential acidity and the acid neutralising capacity, respectively. The difference between the potential acidity and the acid neutralising capacity value is referred to as the net acid producing potential (NAPP).

The chemical and theoretical basis of the ABA are discussed below.

Potential Acidity

The potential acidity that can be generated by a sample is calculated from an estimate of the pyrite (FeS_2) content and assumes that the pyrite reacts under oxidising conditions to generate acid according to the following reaction:

$$FeS_2 + 15/4\ O_2 + 7/2\ H_2O \Rightarrow Fe(OH)_3 + 2\ H_2SO_4$$

Based on the above reaction, the potential acidity of a sample containing 1 %S as pyrite would be 30.6 kilograms of H_2SO_4 per tonne of material (i.e. kg H_2SO_4/t). The pyrite content estimate can be based on total S and the potential acidity determined from total S is referred to as the maximum potential acidity (MPA), and is calculated as follows:

$$MPA\ (kg\ H_2SO_4/t) = (Total\ \%S) \times 30.6$$

The use of an MPA calculated from total sulphur is a conservative approach because some sulphur may occur in forms other than pyrite. Sulphate-sulphur, organic sulphur and native sulphur, for example, are non-acid generating sulphur forms. Also, some sulphur may occur as other metal sulphides (e.g. covellite, chalcocite, sphalerite, galena) which yield less acidity than pyrite when oxidised or, in some cases, may be non-acid generating. The total sulphur content is commonly used to assess potential acidity because of the difficulty, costs and uncertainty involved in routinely determining the speciation of sulphur forms within samples, and determining reactive sulphide-sulphur contents. However, if the sulphide mineral forms are known then allowance can be made for non- and lesser acid generating forms to provide a better estimate of the potential acidity.

Acid Neutralising Capacity (ANC)

The acid formed from pyrite oxidation will to some extent react with acid neutralising minerals contained within the sample. This inherent acid buffering is quantified in terms of the ANC.

The ANC is commonly determined by the Modified Sobek method. This method involves the addition of a known amount of standardised hydrochloric acid (HCl) to an accurately weighed sample, allowing the sample time to react (with heating), then back-titrating the mixture with standardised sodium hydroxide (NaOH) to determine the amount of unreacted HCl. The amount of acid consumed by reaction with the sample is then calculated and expressed in the same units as the MPA (kg H_2SO_4/t).

Net Acid Producing Potential (NAPP)

The NAPP is a theoretical calculation commonly used to indicate if a material has potential to produce acidic drainage. It represents the balance between the capacity of a sample to generate acid (MPA) and its capacity to neutralise acid (ANC). The NAPP is also expressed in units of kg H_2SO_4/t and is calculated as follows:

$$\text{NAPP} = \text{MPA} - \text{ANC}$$

If the MPA is less than the ANC then the NAPP is negative, which indicates that the sample may have sufficient ANC to prevent acid generation. Conversely, if the MPA exceeds the ANC then the NAPP is positive, which indicates that the material may be acid generating.

ANC/MPA Ratio

The ANC/MPA ratio is frequently used as a means of assessing the risk of acid generation from mine waste materials. The ANC/MPA ratio is another way of looking at the acid base account. A positive NAPP is equivalent to an ANC/MPA ratio less than 1, and a negative NAPP is equivalent to an ANC/MPA ratio greater than 1. A NAPP of zero is equivalent to an ANC/MPA ratio of 1.

The purpose of the ANC/MPA ratio is to provide an indication of the relative margin of safety (or lack thereof) within a material. Various ANC/MPA values are reported in the literature for indicating safe values for prevention of acid generation. These values typically range from 1 to 3. As a general rule, an ANC/MPA ratio of 2 or more signifies that there is a high probability that the material will remain circum-neutral in pH and thereby should not be problematic with respect to acid rock drainage.

Acid-Base Account Plot

Sulphur and ANC data are often presented graphically in a format similar to that shown in Figure A-1. This figure includes a line indicating the division between NAPP positive samples from NAPP negative samples. Also shown are lines corresponding to ANC/MPA ratios of 2 and 3.

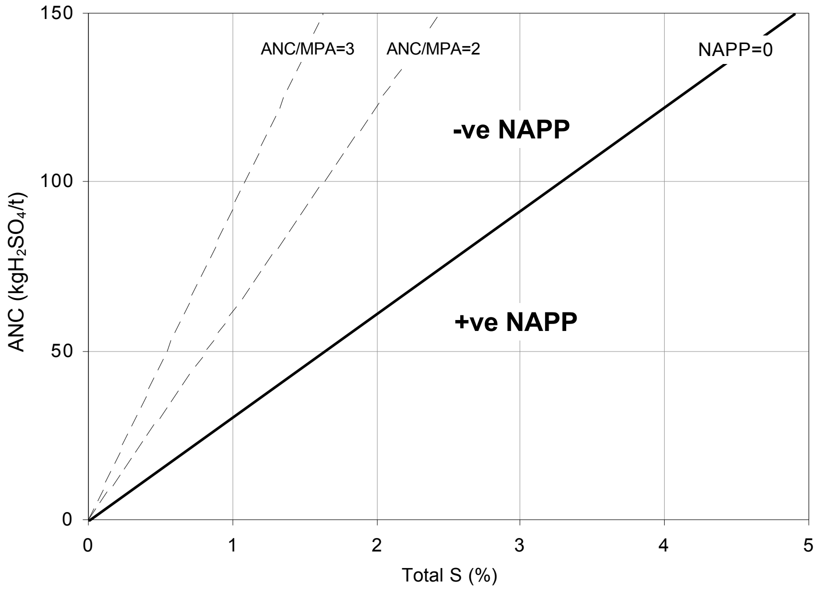


Figure A-1: Acid-base account (ABA) plot

Net Acid Generation (NAG) Test

The NAG test is used in association with the NAPP to classify the acid generating potential of a sample. The NAG test involves reaction of a sample with hydrogen peroxide to rapidly oxidise any sulphide minerals contained within a sample. During the NAG test both acid generation and acid neutralisation reactions can occur simultaneously. The end result represents a direct measurement of the net amount of acid generated by the sample. The final pH is referred to as the NAGpH and the amount of acid produced is commonly referred to as the NAG capacity, and is expressed in the same units as the NAPP (kg H_2SO_4/t).

Several variations of the NAG test have been developed to accommodate the wide geochemical variability of mine waste materials. The four main NAG test procedures currently used by EGi are the single addition NAG test, the sequential NAG test, the kinetic NAG test, and the extended boil and calculated NAG test.

Single Addition NAG Test

The single addition NAG test involves the addition of 250 ml of 15% hydrogen peroxide to 2.5 g of sample. The peroxide is allowed to react with the sample overnight and the following day the sample is gently heated to accelerate the oxidation of any remaining sulphides, then vigorously boiled for several minutes to decompose residual peroxide. When cool, the NAGpH and NAG capacity are measured.

An indication of the form of the acidity is provided by initially titrating the NAG liquor to pH 4.5, then continuing the titration up to pH 7. The titration value at pH 4.5 includes acidity due to free acid (i.e. H_2SO_4) as well as soluble iron and aluminium. The titration value at pH 7 also includes metallic ions that precipitate as hydroxides at between pH 4.5 and 7.

Sequential NAG Test

When testing samples with high sulphide contents it is not uncommon for oxidation to be incomplete in the single addition NAG test. This can sometimes occur when there is catalytic breakdown of the hydrogen peroxide before it has had a chance to oxidise all of the sulphides in a sample. To overcome this limitation, a sequential NAG test is often carried out. This test may also be used to assess the relative geochemical lag of PAF samples with high ANC.

The sequential NAG test is a multi-stage procedure involving a series of single addition NAG tests on the one sample (i.e. 2.5 g of sample is reacted two or more times with 250 ml aliquots of 15% hydrogen peroxide). At the end of each stage, the sample is filtered and the solution is used for measurement of NAGpH and NAG capacity. The NAG test is then repeated on the solid residue. The cycle is repeated until such time that there is no further catalytic decomposition of the peroxide, or when the NAGpH is greater than pH 4.5. The overall NAG capacity of the sample is then determined by summing the individual acid capacities from each stage.

Kinetic NAG Test

The kinetic NAG test is the same as the single addition NAG test except that the temperature and pH of the liquor are recorded. Variations in these parameters during the test provide an indication of the kinetics of sulphide oxidation and acid generation. This, in turn, can provide an insight into the behaviour of the material under field conditions. For example, the pH trend gives an estimate of relative reactivity and may be related to prediction of lag times and oxidation rates similar to those measured in leach columns. Also, sulphidic samples commonly produce a temperature excursion during the NAG test due to the decomposition of the peroxide solution, catalysed by sulphide surfaces and/or oxidation products.

Extended Boil and Calculated NAG Test

Organic acids may be generated in NAG tests due to partial oxidation of carbonaceous materials[1] such as coal washery wastes. This can lead to low NAGpH values and high acidities in standard single addition NAG tests unrelated to acid generation from sulphides. Organic acid effects can therefore result in misleading NAG values and misclassification of the acid forming potential of a sample.

The extended boil and calculated NAG tests can be used to account for the relative proportions of pyrite derived acidity and organic acidity in a given NAG solution, thus providing a more reliable measure of the acid forming potential of a sample. The procedure involves two steps to differentiating pyritic acid from organic derived acid:

Extended Boil NAG	decompose the organic acids and hence remove the influence of non-pyritic acidity on the NAG solution.
Calculated NAG	calculate the net acid potential based on the balance of cations and anions in the NAG solution, which will not be affected by organic acid.

The extended boiling test is carried out on the filtered liquor of a standard NAG test, and involves vigorous boiling of the solution on a hot plate for 3-4 hours. After the boiling step the solution is cooled and the pH measured. An extended boil NAGpH less than 4.5 confirms the sample is potentially acid forming (PAF), but a pH value greater than 4.5 does not necessarily mean that the sample is non acid forming (NAF), due to some loss of free acid during the extended boiling procedure. To address this issue, a split of the same filtered NAG solution is assayed for concentrations of S, Ca, Mg, Na, K and Cl, from which a calculated NAG value is determined[2].

The concentration of dissolved S is used to calculate the amount of acid (as H_2SO_4) generated by the sample and the concentrations of Ca, Mg, Na and K are used to estimate the amount of acid neutralised (as H_2SO_4). The concentration of Cl is used to correct for soluble cations associated with Cl salts, which may be present in the sample and unrelated to acid generating and acid neutralising reactions.

The calculated NAG value is the amount of acid neutralised subtracted from the amount of acid generated. A positive value indicates that the sample has excess acid generation and is likely to be PAF, and a zero or negative value indicates that the sample has excess neutralising capacity and is likely to be NAF.

---

[1] Stewart, W., Miller, S., Thomas, J.E., and Smart R. (2003), 'Evaluation of the Effects of Organic Matter on the Net Acid Generation (NAG) Test', in *Proceedings of the Sixth International Conference on Acid Rock drainage (ICARD), Cairns, 12-18th July 2003*, 211-222.

[2] Environmental Geochemistry International, Levay and Co. and ACeSSS, 2008. *ACARP Project C15034: Development of ARD Assessment for Coal Process Wastes*, EGi Document No. 3207/817, July 2008.

Sample Classification

The acid forming potential of a sample is classified on the basis of the acid-base and NAG test results into one of the following categories:

- Barren;
- Non-acid forming (NAF);
- Potentially acid forming (PAF); and
- Uncertain (UC).

Barren

A sample classified as barren essentially has no acid generating capacity and no acid buffering capacity. This category is most likely to apply to highly weathered materials. In essence, it represents an 'inert' material with respect to acid generation. The criteria used to classify a sample as barren may vary between sites, but for hard rock mines it generally applies to materials with a total sulphur content ≤ 0.1 %S and an ANC ≤ 5 kg H_2SO_4/t.

Non-acid forming (NAF)

A sample classified as NAF may, or may not, have a significant sulphur content but the availability of ANC within the sample is more than adequate to neutralise all the acid that theoretically could be produced by any contained sulphide minerals. As such, material classified as NAF is considered unlikely to be a source of acidic drainage. A sample is usually defined as NAF when it has a negative NAPP and the final NAG pH ≥ 4.5.

Potentially acid forming (PAF)

A sample classified as PAF always has a significant sulphur content, the acid generating potential of which exceeds the inherent acid neutralising capacity of the material. This means there is a high risk that such a material, even if pH circum-neutral when freshly mined or processed, could oxidise and generate acidic drainage if exposed to atmospheric conditions. A sample is usually defined as PAF when it has a positive NAPP and a final NAGpH < 4.5.

Uncertain (UC)

An uncertain classification is used when there is an apparent conflict between the NAPP and NAG results (i.e. when the NAPP is positive and NAGpH > 4.5, or when the NAPP is negative and NAGpH ≤ 4.5). Uncertain samples are generally given a tentative classification that is shown in brackets e.g. UC(NAF).

Figure A-2 shows the format of the classification plot that is typically used for presentation of NAPP and NAG data. Marked on this plot are the quadrats representing the NAF, PAF and UC classifications.

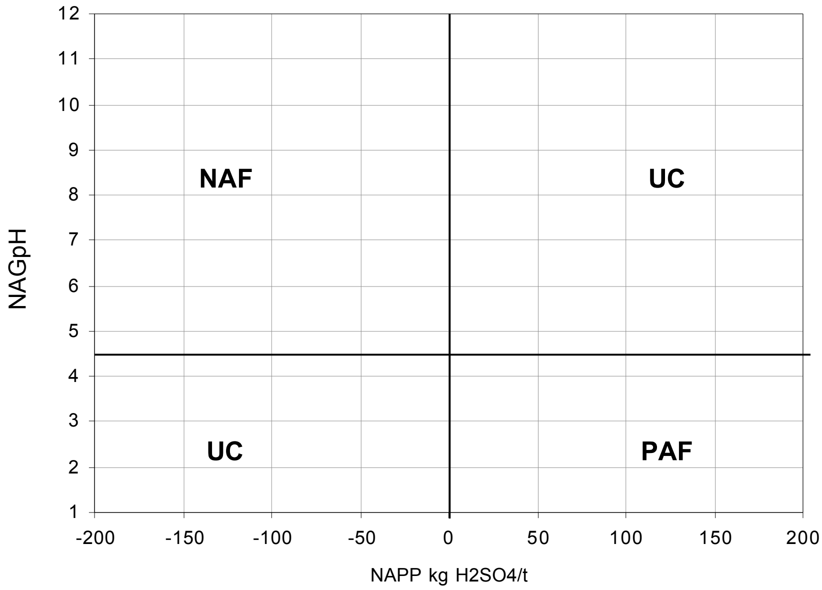


Figure A-2 ARD classification plot

Other Methods

Other test procedures may be used to define the acid forming characteristics of a sample.

pH and Electrical Conductivity

The pH and electrical conductivity (EC) of a sample is determined by equilibrating the sample in deionised water for a minimum of 12 hours (or overnight), typically at a solid to water ratio of 1:2 (w/w). This gives an indication of the inherent acidity and salinity of the waste material when initially exposed in a waste emplacement area.

Acid Buffering Characteristic Curve (ABCC) Test

The ABCC test involves slow titration of a sample with acid while continuously monitoring pH. These data provides an indication of the portion of ANC within a sample that is readily available for acid neutralisation.